Draft

BALLONA WETLANDS RESTORATION PROJECT

Environmental Impact Statement/ Environmental Impact Report

State Clearinghouse No. 2012071090

Volume 3

Prepared for
United States Army Corps of Engineers,
Los Angeles District

California Department of Fish and Wildlife,
South Coast Region (Region 5)

September 2017



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APPENDIX A
Scoping Report

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BALLONA WETLANDS RESTORATION PROJECT SCOPING REPORT

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January 2014

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Ballona Wetlands Restoration Project Scoping Report

1.0 Introduction

This report summarizes the public involvement activities implemented during the scoping phase of the environmental review process for the Ballona Wetlands Restoration Project. The California Department of Fish and Wildlife (CDFW)[1] and the U.S. Army Corps of Engineers (USACE) are jointly preparing an Environmental Impact Report/ Environmental Impact Statement (EIR/EIS) for the Ballona Wetlands Restoration Project. Public input on the Ballona Wetlands Restoration Project was sought during the scoping process to help identify alternatives and issues to be addressed in the Draft EIR/EIS.

2.0 Scoping Period Outreach

At the state level, CDFW is the designated lead agency for the EIR because most of the Ballona Wetlands project site is owned by CDFW. At the federal level, USACE is designated lead agency for the EIS because the proposed action requires USACE approval of permits. The Ballona Wetlands Restoration Project will follow the dual track of both CEQA and NEPA as the environmental impacts of the project are assessed.

The basic purposes of CEQA and NEPA are to inform governmental decision makers and the public about the potential, significant environmental effects of proposed activities and identify the ways to mitigate the environmental impacts. The lead agencies are required to analyze the environmental impacts of the project and must also look to the impacts of reasonable alternatives, including a "no project alternative" (under CEQA) and a "no action alternative" (under NEPA).

Each process requires a public notice that a project is being considered—a Notice of Preparation (NOP) under CEQA and a Notice of Intent (NOI) under NEPA. CDFW and USACE released their NOP and NOI for public review in August 2012. Both documents can be viewed on the Ballona Wetlands Restoration Project website (www.ballonarestoration.org) and are available in Attachment A.

The scoping period was originally set at 30 days and scheduled to close on September 10, 2012; however, it was later extended to 60 days and ended on October 23, 2012.

[1] At the time, this agency was known as the California Department of Fish and Game (CDFG).

2.1 Noticing

The NOP was received by the State Clearinghouse and the Los Angeles County Recorder on July 27, 2013. The NOI was published in the Federal Register on July 25, 2012. Copies of the notices are available in Attachment A.

2.2 Advertising

An advertisement announcing the public scoping meeting was placed in *The Argonaut* on August 2, 2012. A copy of the advertisement is available in Attachment B.

2.3 Scoping Meeting

CDFW and USACE held a joint public scoping meeting for both the NOP and NOI on Thursday, August 16, 2012 from 4:00 to 7:00 p.m. The meeting took place at the Fiji Gateway entrance to the Ballona Wetlands at 13720 Fiji Way, Marina del Rey, CA 90292. Various materials were available for public review at the scoping meeting, including handouts, comment cards, and presentation boards on easels. Representatives from CDFW and USACE attended the meeting, as well as staff from the California Coastal Conservancy and the Santa Monica Bay Restoration Commission, who are sponsoring the project, and their consultant team.

2.4 Commenters

A summary of commenters who submitted letters, emails, and comment cards on the NOP and NOI during the scoping period is presented in Table 1. Copies of comments submitted at the public scoping meeting and during the scoping period are available in Attachment C.

Table 1. Summary of Commenters

Date	Agency/ Organization	Commenter	Format
Scoping Comments Received at the Scoping Meeting			
8/16/2012		Eric Andres	Comment card
8/16/2012		Fran Bibian	Comment card
8/16/2012		Fran Bibian	Comment card
8/16/2012		Ellen Brennan	Letter delivered at scoping meeting
8/16/2012		Carolyn Glassman	Comment card
8/16/2012		Carolyn Glassman	Comment card
8/16/2012		Adam Kliszewski	Comment card
8/16/2012		Michael Lutz	Comment card
8/16/2012		Ingrid Moeller	Comment card
8/16/2012		Elizabeth Pollock	Comment card
8/16/2012		Al Sattler	Comment card
8/16/2012		DeAna Vitela-Hayashi	Business card left at scoping meeting
8/16/2012	Grassroots Coalition	Patricia McPherson	Copies of emails and letters left at scoping meeting
8/16/2012	Sierra Club	Joe Young	Letter left at scoping meeting

Date	Agency/ Organization	Commenter	Format
Scoping Comments Received during the Comment Period			
7/31/2012		Janice Hahn	Letter to Jo-Ellen Darcy, U.S. Army
8/2/2012	Native American Heritage Commission	Dave Singleton	Letter to David Lawhead, CDFW
8/2/2012		William Ballough	Email to Daniel Swenson, USACE
8/3/2012		Howard Hackett	Email to Donna McCormick, ICF
8/7/2012		Anita Gutierrez	Email to Donna McCormick, ICF
8/13/2012		Susan Herrschaft	Email to Daniel Swenson, USACE
8/13/2012		Colleen Phillips	Email to Elena Tuttle, SMBRF
8/13/2012	Vista del Mar Neighbors Association of Playa del Rey	Julie Inouye and Dr. Michael Rubottom	Email to Donna McCormick, ICF and Shelley Luce, Santa Monica Bay Restoration Commission
8/14/2012		Cynthia Cannady	Email to Donna McCormick, ICF
8/14/2012		Lisa de Vincent	Email to Donna McCormick, ICF
8/14/2012		Art Lee	Email to Donna McCormick, ICF
8/14/2012		Colleen Phillips	Email to Donna McCormick, ICF
8/14/2012		Karen Thiers	Email to Donna McCormick, ICF
8/14/2012		Ashley Wilson	Email to Donna McCormick, ICF
8/16/2012		Carolyn Anderson	Email to Donna McCormick, ICF
8/16/2012		Christopher McKinnon	Email to Donna McCormick, ICF
8/16/2012		Lucien Plauzoles	Email to Donna McCormick, ICF
8/16/2012	Grassroots Coalition	Patricia McPherson	Email to Donna McCormick, ICF
8/16/2012	Sierra Club	Joe Young	Letter to Daniel Swenson, USACE and David Lawhead, CDFW
8/18/2012		Mary Prismon	Email to Donna McCormick, ICF
8/19/2012		April de Stefano	Email to Donna McCormick, ICF
8/20/2012		Barbara Yang	Email to Donna McCormick, ICF
8/21/2012	California Cultural Resource Preservation Alliance, Inc.	Patricia Martz	Letter to Daniel Swenson, USACE
8/21/2012		Rosie Puntillo	Email to Donna McCormick, ICF
8/24/2012	Department of Conservation	Syndi Pompa	Letter to Donna McCormick, ICF
8/24/2012		Walter Lamb	Email to Donna McCormick, ICF
8/29/2012		Fernanda Braga	Email to Donna McCormick, ICF
8/29/2012		Eddie Chan	Email to Donna McCormick, ICF
8/29/2012		Alana & Michael Getz	Email to Donna McCormick, ICF

Date	Agency/ Organization	Commenter	Format
8/29/2012		Barsam Kasravi	Email to Donna McCormick, ICF
8/29/2012		Julie Thomas Knap	Email to Donna McCormick, ICF
8/29/2012		Tanya & Todd Leeloy	Email to Donna McCormick, ICF
8/29/2012		Kevin Lohman	Email to Donna McCormick, ICF
8/29/2012		Ulrik Knap	Email to Donna McCormick, ICF
9/4/2012		Nikol Lohman	Email to Donna McCormick, ICF
9/4/2012		Liesbeth Maggiotto	Email to Donna McCormick, ICF
9/4/2012		Erin Mays	Email to Donna McCormick, ICF
9/9/2012		Tanya Lindsley	Email to Donna McCormick, ICF
9/10/2012		Ruben Cruz	Email to Daniel Swenson, USACE
9/10/2012	Marina del Rey Convention & Visitors Bureau	Bev Moore	Email to Donna McCormick, ICF
9/21/2012		Liisa Bishop	Email to Donna McCormick, ICF
9/26/2012		Bruce Schelden	Comment Card
9/26/2012		Lew Weinfeld	Email to Donna McCormick, ICF
10/4/2012		Alice Goldstein	Email to Donna McCormick, ICF
10/8/2012		Allen Frankel	Letter to David Lawhead, CDFW and Terri Steward, CDFW
10/13/2012		Hawley Almstedt	Email to Donna McCormick, ICF
10/14/2012		Rosemarie Kornarens	Email to Donna McCormick, ICF
10/15/2012	Los Angeles Audubon	Travis Longcore	Letter to Daniel Swenson, USACE
10/17/2012		Sandra Glass	Email to Donna McCormick, ICF
10/18/2012		Louise Steiner	Letter to Daniel Swenson, USACE
10/29/2012		Louise Steiner	Letter to David Lawhead, CDFW and Terri Steward, CDFW
10/20/2012		Douglas Fay	Email to Daniel Swenson, USACE
10/20/2012		Sue Sass	Email to Charles Piechowski, SMBRF
10/21/2012		Donna Murray	Letter to David Lawhead, CDFW and Terri Steward, CDFW
10/21/2012		Rick Pine	Email to Donna McCormick, ICF
10/22/2012		Stephanie Beckmar	Comment card
10/22/2012		Michele Bigelow	Email to Donna McCormick, ICF
10/22/2012		Joe Cadwallader	Email to Donna McCormick, ICF
10/22/2012		Molly Curtis	Comment card
10/22/2012		Scott Garvey	Email to Donna McCormick, ICF; Daniel Swenson, USACE; and David Lawhead, CDFW
10/22/2012		Lauren Gottlieb	Letter to Daniel Swenson, USACE; David Lawhead, CDFW; and Terri Stewart, CDFW
10/22/2012		Cindy Grant	Comment card

Date	Agency/ Organization	Commenter	Format
10/22/2012		Steffi Jones	Email to Donna McCormick, ICF
10/22/2012		Travis Longcore	Email to Donna McCormick, ICF
10/22/2012		Donna Murray	Email to Donna McCormick, ICF
10/22/2012		Susan Roughen	Comment card
10/22/2012	Friends of Ballona	David Kay	Email to Donna McCormick, ICF and Daniel Swenson, USACE
10/22/2012	Grassroots Coalition	Patricia McPherson	Email to Daniel Swenson, USACE and David Lawhead, CDFW
10/23/2012	U.S. Fish and Wildlife Service	Jonathan Snyder	Email to Daniel Swenson, USACE
10/23/2012		Michele Bigelow	Email to Donna McCormick, ICF
10/23/2012		Bruce Campbell	Email to Donna McCormick, ICF; Daniel Swenson, USACE; and David Lawhead, CDFW
10/23/2012		Natalie Carrere	Email to Donna McCormick, ICF
10/23/2012		Mike Chamness	Email to Donna McCormick, ICF; Daniel Swenson, USACE; and David Lawhead, CDFW
10/23/2012		Joyce Dillard	Email to Daniel Swenson, USACE
10/23/2012		Douglas Fay	Email to David Lawhead, CDFW and Daniel Swenson, USACE
10/23/2012		Margot Griswold	Email to Donna McCormick, ICF; Daniel Swenson, USACE; and David Lawhead, CDFW
10/23/2012		Susan Herrschaft	Email to Donna McCormick, ICF; Daniel Swenson, USACE; and David Lawhead, CDFW
10/23/2012		Mary Knight	Email to David Lawhead, CDFW and Daniel Swenson, USACE
10/23/2012		Jim Lamm	Email to Donna McCormick, ICF
10/23/2012		Keith Linker	Email to Donna McCormick, ICF
10/23/2012		Barbara Lonsdale	Email to Donna McCormick, ICF; Daniel Swenson, USACE; and David Lawhead, CDFW
10/23/2012		Ramona Merryman	Email to Donna McCormick, ICF; Daniel Swenson, USACE; and David Lawhead, CDFW
10/23/2012		Anita Miller	Comment card
10/23/2012		Cliff Moser	Email to Donna McCormick, ICF
10/23/2012		Jack Neff	Email to Donna McCormick, ICF; Daniel Swenson, USACE; and David Lawhead, CDFW
10/23/2012		Leslie Purcell	Email to Donna McCormick, ICF; Daniel Swenson, USACE; and David Lawhead, CDFW
10/23/2012		Kerry Rasmussen	Email to Donna McCormick, ICF
10/23/2012		Gary Stickel	Email to Donna McCormick, ICF; Daniel Swenson, USACE; and David Lawhead, CDFW
10/23/2012		Lola Verdurer Terrell	Email to Donna McCormick, ICF
10/23/2012		John Ulloth	Email to Donna McCormick, ICF; Daniel Swenson, USACE; and David Lawhead, CDFW

Date	Agency/ Organization	Commenter	Format
10/23/2012	Ballona Institute & Wetlands Defense Fund	Marcia Hanscom and Robert Roy van de Hoek	Letter to Daniel Swenson, USACE; David Lawhead, CDFW; and Donna McCormick, ICF
10/23/2012	Ballona Wetlands Land Trust	Walter Lamb	Email to Donna McCormick, ICF; Daniel Swenson, USACE; and David Lawhead, CDFW
10/23/2012	Ballona Ecosystem Education Project	Rex Frankel	Email to Donna McCormick, ICF and Daniel Swenson, USACE
10/23/2012	Ballona Ecosystem Education Project	Rex Frankel	Email to Donna McCormick, ICF and Daniel Swenson, USACE
10/23/2012	Heal the Bay	Katherine Pease	Email to Donna McCormick, ICF
10/23/2012	Sierra Club	Marcia Hanscom	Letter to Daniel Swenson, USACE; David Lawhead, CDFW; and Donna McCormick, ICF
10/23/2012	Southern California Gas Company	Anthony Klecha	Email to Daniel Swenson, USACE
10/23/2012	California Native American Heritage Commission	Dave Singleton	Email to Donna McCormick, ICF
Scoping Comments Received After the Deadline			
10/24/2012		Westley Eftekhar	Email to Donna McCormick, ICF
10/24/2012		Donald Owens	Comment card
10/24/2012	Grassroots Coalition	Patricia McPherson	Email to Daniel Swenson, USACE and David Lawhead, CDFW
10/25/2012		David Jacobs	Email to Donna McCormick, ICF
11/13/2012		Kathy Knight	Email to Daniel Swenson, USACE and David Lawhead, CDFW
11/17/2012		Cliff Moser	Email to Donna McCormick, ICF
11/1/2013	Grassroots Coalition	Patricia McPherson	Letter to Colonel Kimberly Colloton
Scoping Comments Follow Up			
10/25/2012	Native American Heritage Commission	David Singleton	Email to David Lawhead, CDFW

2.5 Comments Received

A summary of comments received during the scoping period is presented in Table 2. This list is sorted by the chapters or sections of the EIR/EIS where the comment topics will be addressed. Copies of comments submitted at the public scoping meeting and during the scoping period are available in Attachment C.

Table 2. Summary of Comments Received during the NOP/NOI Scoping Period

Resource	Comment Summary
General/Overall	• Consider impacts/mitigation for maintenance activities; assign responsibilities for mitigation.
1.0 Introduction	• Identify lead agencies and other agencies/parties involved. • Provide history of Ballona Wetlands (previous tidal influence)/substantiate claim of previous tidal influence/support historic justification.
2.0 Purpose and Need/Goals and Objectives	• How was the goal of estuarine habitat established? • What is the purpose and need? • Discuss objectives related to end-of-pipe pollutions treatment, flood protection, mitigation for other projects (LA Port), and date to which restoration is being targeted. • What is the purpose of relocating Ballona Creek? • Protection of groundwater and groundwater wells. • Address Congressional house document 389 and US Public Law 780. • Presence of non-permitted drains put in by and for Playa Vista. • Need to substantiate the claim that the Reserve has witnessed hydrological degradation. • Ballona is predominantly a seasonal freshwater system that did not perform with a daily ebb and flow of tidal waters.
3.0 Project Description and Alternatives	• Comments requested consideration of various complete alternatives. o Ballona Wetlands Education Project (BEEP) alternative. o Friends of Ballona Wetlands conceptual plan. o "Process oriented historical treatment" alternative. ▪ Focus on heterogeneous brackish to fresh and seasonally variable habitats. ▪ Specifically address recovery of taxa that were historically present and are now special-status. ▪ Replicate processes such as scour. ▪ Maintain beneficial artificial processes such as sediment expulsion and contaminant bypass by flood control channel. ▪ Do not unduly penetrate freshwater and riparian areas with new drainage channels. ▪ Work with existing landscape to mitigate ancillary impacts and undo earth movement; coordinate with necessary infrastructure enhancement and roadwork. ▪ Retain flood tidal channel and levees to expel sediment from system; bypass contaminants during first flush; provide flood protection; use tide gates if needed in response to sea-level rise. ▪ Use multiple gates (multiple inflow, single outflow) and drop to flood channel to provide scour to lateral marsh channels—

Resource	Comment Summary
	minimize velocity and sediment import on incoming tide; allow bypass of first-flush contaminants; general scouring flow by manipulating gates. ▪ Replicate seasonal wetland dynamics through gates or closures. ▪ Use existing raised roadbeds as partitions for habitat management. ▪ Area B • Surround/support existing freshwater wetland with seasonally variable wetlands. • Integrate tidal operation of North Area B with existing flood control channel. • Avoid draining areas with freshwater resources/potential, with tidal/drainage channels. • Manage Area B south of Culver as winter wet seasonal or intermittent freshwater to brackish wetland with reduction of current channels, using freshwater marsh to generate seasonal hydrology (using existing spillway). • Provide greater connection to flood control channel in Area B north of Culver by additional upstream tide gate, designed and operated to generate scour near openings to channel and integrate Ballona Creek tidal function as appropriate; remove roadbeds and oil field structures to facilitate surface flow penetration of spring tides; operate to maximize penetration of high tide and support seasonal perched water; enhance brackish conditions. • Raise Culver to accommodate higher water and protect against sea-level rise and tsunamis, including spans to permit integration and communication between wetland areas. • Use area between Culver and Jefferson as summer-closed habitat with intermittent openings to tides in winter through gate or valve; sustain endangered tidewater gobies; source freshwater from adjacent freshwater marsh; use gate or valve to channel to generate tidal conditions. ▪ Area C • Recover freshwater flow from Ballona channel to generate range of intermittent fresh to brackish environments with flow through to Area A. • Convey Ballona Creek water in low area immediately west of 90 and south of Culver; transport by gates or pumps to Area C north of Culver. • Area C north of Culver—replicate perched/flood deeper water (1 meter) condition in winter for waterfowl; drawdown in spring to provide foraging for least tern; use fill to raise portions of adjacent Culver and Lincoln. • Convey fresh/brackish water outflow to Area A by culvert under raised span on Lincoln to functionally connect Area A and C. ▪ Area A • Gates or connections to Area C, flood control channel, Marina, to interconnect wet landscape. • Brackish water flow from Area C permits variable

Resource	Comment Summary
	salinity/intermittent brackish conditions. • Gates to permit muting tides and scour management. • Varying amounts of upland. • Gates to flood channel and marina permit scour and closure; import water from Area C; allows alternation of tidal and perched brackish conditions. • Perched or muted conditions seasonally permit isolation of muted tide high marsh suitable for clapper rails reproduction in late spring. • Restoration following topography. • Prioritize restoration of lower north and east portions. • Maintain high ground adjacent to levees and around former oil field structures to southwest as upland. o "No bulldozing" alternative. ▪ Small incremental changes. ▪ Small changes to levees to permit more tidal access. ▪ Removal nonnative plants. ▪ Addition of perimeter bike path, viewing platforms, paths. ▪ Preservation of uplands, dunes, salt pan. ▪ Ability to enhance tidal hydrology. ▪ Labor requirements. ▪ Continued degradation. ▪ Loss of social/economic/watershed values/services. ▪ Ability to restore hydrologically functional restoration (recontouring, compaction to meeting engineering/construction standards). ▪ Ability to be constructed with volunteer workers (qualifications, training, safety). ▪ Completion timeline. o "Go slow" alternative. ▪ Slow down restoration. ▪ Gradual, natural restoration, by hand, with small equipment, using students/community groups. ▪ Experimental, over time; using community to grow plants and plant them. o Contiguous habitats. ▪ Raise Culver Boulevard instead of levees. ▪ Relocate flood protection and roadways/utilities to outside edge (or raise out of flood zone on causeways to allow hydrologic continuity). ▪ Raise Culver and Jefferson to allow water and animals to pass under. ▪ Elevate Culver and Lincoln 3–4 meters to remove them from flood/ tsunami hazard. o Lower cost/lower risk alternative. o Acquire rather than restore alternative. ▪ North end of southern remnant of Ballona Lagoon in Playa del Rey. ▪ Railway right-of-way adjacent to southwest edge of western end of 90 Freeway [Toyota dealership land].

Resource	Comment Summary
	▪ Retail garden center between 90 Freeway lanes. ▪ Caltrans right-of-way land not in use. ▪ Dismantle 90 Freeway. o Increased management only alternative. ▪ Remove homeless. ▪ Increase patrols. ▪ Stop dumping. ▪ Clean up. ▪ Bringing in researchers and observers. ▪ Build visitors center. ▪ Remove unauthorized uses (Gordon's lot, defacto alleyway, etc.). o Return to 1800s alternative: ▪ Restoration plan based on site conditions existing before man began altering the land (200 years ago). ▪ Balance of the eco-types: salt marsh, freshwater marsh, upland communities. ▪ Return to the 1800s creeks. ▪ New small channels (20-feet wide) entering Area A through Fisherman's Village site and Area B through Los Angeles city-owned beach parcel (Del Rey Lagoon) going east through box culvert under Argonaut Place, then east into Area B via alley known as Culver Place, daylighting into the wetlands immediately south of the back dune. o Wildlife Friendly Alternative. ▪ Based on detailed, seasonal, unbiased baseline surveys of species and ecosystem. ▪ Protect all rare and imperiled species and habitat. ▪ Acquire more land: nine open spaces on edges of BW that are threatened by development. ▪ Underground utility wires that cross BW. ▪ Community-based restoration to remove nonnative plants using hand tools (no poisons or bulldozers). ▪ Remove dead palms along Culver. ▪ Secure reserve with fences to prevent dog, cat, and human trampling. ▪ Calm traffic and encourage wildlife crossings. ▪ Provide viewing platforms at four city-owned properties abutting BW and walking trail on Cabora Drive, with view areas, scopes, and interpretive signs. ▪ Provide parking collaboratively with business and residential communities. ▪ Restore plants and animals, with nesting platforms for bald eagles and osprey. Reintroduce roadrunner, Los Angeles sunflower, pocket mouse, California quail. ▪ Apply rejuvenation principles. • 21st century, incremental, community involved ecosystem rejuvenation in harmony with natural laws; no industrial-scale habitat conversion, no major bulldozing. • Recognize resiliency of ecosystems; identify areas that require

Resource	Comment Summary
	no more than observation. • Give priority to acquisition/addition of additional unprotected parcels of land over restoration activities to increase habitat enhancing buffer zones, reduce animal road fatalities. • Utilize existing access (bike path, south levee); install walking/biking path around perimeter. • Utilize existing infrastructure (old railway bridge supports, etc.) and sustainable materials to create wildlife, bicycle, and walking linkages that go over or under roads and waterways that divide the refuge. • Underground all power, telephone, and cable lines and remove majority of street lighting. • Give priority to endangered, threatened, and imperiled species. o Reduced scale alternatives ▪ Only add inlets from creek, remove invasive plants. ▪ Do not remove channel; provide trails. ▪ Do not remove trails. ▪ Lesser management of wetlands. ▪ Dig a few small channels to bring water into the wetlands; new small ocean access channels dug from Del Rey Lagoon on south side and through Fisherman's Village on north; trail system and current habitat mix; preserve levees and bike path; small channels from creek near ocean where water is cleaner; use groundwater wells to provide upstream source of water in newly created creeks running through the wetlands. ▪ Less disturbance (retain dunes, salt pans, and brackish salt marsh with native species; retain levees; use tide gates and active management; explicit protection for rare/endangered species present prior to 1880s; has biodiversity as goal). ▪ Less movement of soil in Area A. ▪ Not eliminating of surfaces in Area B. o Increased scale alternatives. ▪ Adding Del Rey Lagoon. ▪ Adding land to project (between access road to 90 and townhomes abutting Area C). ▪ Acquire additional land upstream, construct treatment wetland before discharging into Ballona Creek. ▪ Acquire useful adjacent lands. ▪ Add bike paths: Along 90 Freeway between Culver and Venice Beach; over old railroad bridge on south side of creek, circling around wetlands; connecting bluff paths below LMU through Playa vista to PDR; network through wetlands. ▪ Expand to include watershed cleanup. ▪ Acquire bluff for upland habitat. ▪ Include adjacent water bodies (Marina del Rey harbor, Oxford Lagoon, Del Rey Lagoon, Venice canals, Santa Monica Bay). o No-project alternative. ▪ Continued degradation. ▪ Loss of social/economic/watershed values/services.

Resource	Comment Summary
	• Comments requested specific features be included in alternatives. o Self-sustaining methods. o Replacement of trails on new levees. o Additional bikeways. o Fiji Way access. o Removal of levees and concrete from western end. o Nature reserve with walking and hiking trails. o Tide gates and preservation of freshwater areas. o Path between Playa del Rey and freshwater marsh. o Do not restrict bike routes. o No access to Area C from La Villa Marina, improved fencing/walls, allow wildlife/water movement. o Provide upper salt marsh and upland habitat as refuge for wading birds (light-footed clapper rail) during high tides and to support pollinators of salt marsh plants (salt marsh bird's beak). o Include long-term management plan (inspections to identify maintenance needs, control of unauthorized access to habitats, fence maintenance, trash removal, restoration of habitats if disturbed by unauthorized use). o Access (trails, boardwalks, overlooks). o Limited parking to control amount of access. o More tidal flow into Areas B and C. o Allow marsh areas to treat Ballona Creek water. o Small treatment wetlands along boundaries to treat offsite stormwater runoff. o Maximize potential to sequester carbon dioxide in trees and wetland vegetation. o Protect and create nesting habitat, rookeries, perches. o Shut down SOCALGAS/ Sempra. o More brackish wetland, less saltwater. o Replace Culver with complete street—fewer car lanes, more bike lanes, hiking path, bike service station, observation platform on old railway bridge. o Include comprehensive restoration of natural processes to wetlands, including tidal flow; maintain freshwater circulation; and support healthy ecosystems. o Target greatest need for restoration first. o Incorporate climate change into project planning, changes in temperature, increases in ocean acidity. o Walking trail for south levee, Cabora Drive. • Comments requested information be included in alternative descriptions. o Project as treatment wetland. o Maintenance activities. o Access to publicly owned areas. o Schedule for implementation/describe timing. o Describe/show bike paths. o Provide habitat maps for each alternative, with phasing. o Discuss jurisdiction and oversight in future (who will operate/maintain).

Resource	Comment Summary
	○ Freshwater circulation (what this means in relation to Ballona Creek). ○ Flood control facilities (what property would be protected by levees). ○ Earthmoving estimates for each alternative. ○ Purpose and size of levees. ○ Relationship to Port of LA wetland banking (if any). ○ Provide illustrative plans. ○ Relationship to freshwater marsh. ○ Provide clear plans for specific wildlife benefits such as accommodation of wintering waterfowl or migrating shore birds.
4.1 Geology	• Analyze stability of Playa del Rey Bluffs. • Analyze increased liquefaction potential. • Analyze increase in subsidence. • Use current information. • Analyze earthquakes, liquefaction, tsunami risk. • Evaluate Lincoln Boulevard fault, including impacts related to flooding, aquifer.
4.2 Paleontology	• None.
4.3 Water Resources	• Evidence shows that Ballona would not be self-sustaining. ○ Sites that undergo drastic bulldozing and dredging are not self-sustaining. • Analyze exposure to upstream pollution and mitigation. • Analyze flooding. ○ Address flooding hazards to nearby roadways, Marina del Rey, and other beach-front areas. • Analyze sea level rise. • Analyze impaired waters issue. ○ Consider cleaning up stream before it reaches wetlands. ○ Address issue: Under 303(d), an impaired waterway cannot further pollute another waterway; therefore, Ballona Creek cannot be allowed to flow into the wetlands. Water must be treated to tertiary levels first. ○ Evaluate upstream flood control and contamination control. • Study groundwater hydrology. ○ Analyze impacts to Ballona aquifer, groundwater, groundwater uses, saltwater intrusion. ○ Analyze aquifer dewatering (ongoing at Playa Vista). ○ Analyze Ballona aquifer, potential saltwater intrusion. ○ Evaluate Lincoln Boulevard fault, including impacts related to flooding, aquifer. ○ Evaluate impact of flooding wetlands on aquifer, and subsequently impacts to drinking water. ○ Consequences of groundwater removal. • Analyze impacts related to scour. • Analyze impacts related to trash and contamination. ○ Analyze impacts of trash on ocean if levees removed. • Analyze impacts related to sedimentation. ○ Analyze impacts of sedimentation from relocating levees. ○ Evaluate sediment impacts from contributing areas upstream. ○ Consider consequences of sediment supply and reworking of

Resource	Comment Summary
	sediments; project will likely draw significant sediment into the system; potential increased dredging. • Analyze how surface fresh/salt water will interact. • Analyze existing hydrology/hydrological dynamics of Ballona Creek outflow channel, interaction with bay, 303 waters, jetty, and wetland flows. • Discuss NPDES. o Consider age of pipelines and stormdrains and relation to Ballona (NPDES MS4 permit). • Model first flush runoff to show if concentration would be significant. • Address impacts of sedimentation at mouth (littoral drift or sediment transport from creek); will inlet need periodic dredging; potential impact of maintaining BW as lagoon or ocean estuary. • Analyze saltwater contamination; protection of freshwater resources. • Evaluate impact of levees on water flow. • There is no justified need for any further flood control as the Ballona Channel provides adequate flood control. o Levees are used by the public for recreation and crew teams of multiple universities that have equipment and buildings adjacent to the channel. o Per NOAA documentation, levee removal will invite toxic pollution of Ballona Wetlands. o Science shows that a 6-square-mile area would be required to attempt to cleanse the toxins out of the water and sediment. • Discuss tidal influence, sea-level rise, and tsunamis. • Consider pollution of Southern California Bight (as applicable). • Consider TMDL Storm Means data, including inadequacies in upland watershed. • Consider beneficial impacts of enhanced tidal flow. • Provide metrics for determining improvement in hydrology. • Analyze impacts related to macroalgal blooms. • Determine beneficial impacts to water quality and hydrology. o Evaluate beneficial impacts related to improvement of water quality of Ballona Creek, Marina del Rey harbor. o Demonstrate beneficial and negative impacts of each alternative related to hydrology. • Need to provide freshwater hydrological studies. o Need to quantify the damage done by allowing undisclosed drainage devices in the wetlands.
4.4 Biological Resources	• Analyze impacts to existing wildlife. o Analyze impacts related to levees creating barriers for movement of fish, amphibians, reptiles, and invertebrates. o Analyze impacts on wildlife from large levees. o Analyze impact of flooding wetlands wildlife. o Analyze possible impacts to wildlife from impacts to underground gas storage. o Analyze impacts to wildlife (not just special-status). o Analyze impacts on wildlife from extensive trail network (maintenance, people wandering off trail). o Study wildlife use of adjacent water bodies (Marina del Rey harbor,

Resource	Comment Summary
	Oxford Lagoon, Del Rey Lagoon, Venice Canals, Santa Monica Bay). o Analyze impacts to small mammals. o Analyze impacts to wildlife from construction traffic, air pollution, machinery. o Address road kill impacts. o Analyze impacts to wildlife from construction commuter traffic. o Analyze impacts to birds who favor existing habitat mix. o Analyze beneficial impacts to birds from proposed habitat mixes. • Analyze impacts to species. o Provide information about habitat needs for native special-status species (least tern, rails) or historical seasonal habitats (for tidewater goby, stickleback, reptiles, amphibians [south coast garter snake]). o Analyze impacts to white-tailed kite, western meadowlark, California gnatcatcher, least Bell's vireo, blue-gray gnatcatcher, great blue heron, northern harrier, burrowing owl, great egret, ash-throated flycatcher, yellow-headed blackbird, Bullock's oriole, lazuli bunting, blue grosbeak, hooded oriole, barn owl, great horned owl, and tree swallow. o Analyze impacts to western tiger swallowtail butterfly, monarch butterfly, El Segundo blue butterfly, pygmy blue butterfly, wandering skipper, painted lady butterfly, Acmon blue butterfly, mourning cloak, buckeye butterfly, Mormon metalmark, and red admiral. o Analyze impacts to spiders, moths, mushroom and fungi, lichen, submerged aquatic vegetation, ant/ant-like species, dragonflies and damselflies, and beetles. o Study species over time. o Belding's savannah sparrow impacts. o Analyze impact to ground-nesting bee species. o Analyze impacts to burrowing owls. o Address impacts to blue butterfly, shrike, kites, harriers, great blue heron. o Cumulative impacts of Fisherman's Village, boat storage on egrets and herons. o Address impacts to special-status species and freshwater species. o Consider impacts to dunes at west end and El Segundo blue butterflies. o Analyze construction impacts to burrowing species. o Analyze annual flooding impacts to mid and high marsh species (nesting, burrowing). o Analyze impacts to each special-status species. o Analyze impacts on animals and plants, especially in upland habitats. o Consider impacts from water quality, wildlife diversity, and public recreation and determine how these will affect species (which will gain, which will lose). o Analyze impacts to species from flooding saltpan (i.e., loggerhead shrike). o Analyze impacts to species from speed of restoration in sections. o Analyze impacts to species from adding saltwater marsh. o Analyze impacts to endemic species. o Analyze impacts to California brown pelican and cross-eyed bubo. o Provide qualitative and quantitative assessments of resources (USFWS

Resource	Comment Summary
	species list). o Provide new inventories and species counts. o Evaluate impacts to coastal prairies and upland species, food chain (near, mid, far-term). o Discuss impacts to species during construction. o Discuss how species will be relocated during construction (special-status and non-special-status). o Discuss how rare plants will be relocated. o Provide species impact reports for all species and new species that will be introduced. o Analyze impacts to species from soil elevation. o Analyze impacts to species from changes in water/soil salinity and pH. o Analyze potential reintroduction of: Los Angeles sunflower, saltmarsh bird's beak, Pacific pocket mouse, Ventura marsh milk-vetch, California quail, greater roadrunner, bald eagle (nesting), osprey (nesting), tidewater goby (all alternatives including no-build). o Analyze impacts to least bittern, California brown pelican, redhead, peregrine falcon, white-tailed kite, elegant tern, California least tern, loggerhead shrike, Clark's marsh wren, Belding's savannah sparrow, large-billed savannah sparrow, yellow-headed blackbird, brant, northern harrier, western snowy plover, long-billed curlew, royal tern, burrowing owl, Vaux's swift, willow flycatcher, California Swainson's thrush, yellow warbler, American bittern, white-faced ibis, common moorhen, Pacific golden-plover, red knot, Wilson's phalarope, California quail, black-bellied plover, Bonaparte's gull, American pipit, western meadowlark, blue grosbeak, American white pelican, black skimmer, marbled murrelet, short-eared owl, horned lark, olive-sided flycatcher, bank swallow, yellow-breasted chat, light-footed clapper rail, black tern, bald eagle, fulvous whistling-duck, California black rail, sandhill crane, mountain plover, long-eared owl, Bell's sage sparrow, California gnatcatcher, snowy egret, great egret, black-necked stilt, red-tailed hawk, Cooper's hawk, American kestrel, common yellowthroat, and ash-throated flycatcher. o Analyze impacts to El Segundo blue butterfly. o Analyze impacts to Lewis' evening primrose. o Analyze beneficial impacts related to restoring habitat for endangered and sensitive species in Ballona Wetlands. o Analyze negative impacts to endangered and sensitive species in Ballona Wetlands. • Analyze impacts to existing habitats. o Impacts of berms on habitat. o Analyze impacts to subtidal habitat currently present in flood channel related to elimination of sediment redistribution. o Analyze impacts related to elimination of natural surfaces and drainage, further isolation from marginal upland habitat. o Analyze loss of upland habitat. o Analyze impacts to great blue heron habitat. o Assess direct, indirect, and cumulative impacts to fish and wildlife habitats. o Include detailed maps and tables of habitat types (acreages and

Resource	Comment Summary
	locations). o Provide up-to-date habitat information. o Analyze impacts to habitats from concrete, steel, other unnatural materials. o Analyze beneficial impacts to habitat. • Analyze impacts related to desiccation of marginal riparian habitat. • Analyze impacts to wetlands. • Analyze impacts related to first flush contaminants, facilitating eutrophic conditions and concentrating specific anthropogenic toxins in restoration area, exacerbated by sediment reworking. • Analyze impacts from visitors. o Analyze impacts from human contact (trampling, littering). • Analyze exposure to upstream pollution and mitigation. • Consider National Audubon Society Important Bird Area. • Consider impacts to natural freshwater seep near old cottonwood tree near dunes. • Consider impacts to large salt panne and 1000s of migrating birds that use it. • Consider values of and impacts to current habitats. • Include thorough survey of native plants; consider collecting (as mitigation). • Analyze impacts on migratory birds from change in hydrology. • Analyze impacts to biodiversity. • Analyze impacts to ecosystem integrity. • Analyze impacts to migrating birds/nesting birds; mitigate. • Analyze impacts to feral cats (humane mitigation - trap, spay, release/relocate). • Consider maintenance of dynamic emerging wetlands without intervention (dredging, detention basin cleanup, etc.). • Discuss CDFW permits. • Consider benefits to listed species (including those that would be more likely to occur: Tidewater goby, California least tern). • Consider dynamic nature of estuarine habitat (short-term annual rainfall fluctuations, long-term sea level rise). • Discuss methodology of analysis (thoroughness, timing). • Evaluate impact of maintenance activities. • Evaluate impacts of earthmoving on plants/wildlife; how long to reestablish. • Analyze impacts to seasonal pond soil crusts during restoration or impacts to ecological systems if lost. • Address significance and impacts to Ballona Tule Fog. • Analyze impacts on marsh and inhabitants of year-round tidal openings. • Discuss equilibrium of existing ecosystems. • Discuss relationship to EPA wetlands avoidance criteria. • Demonstrate beneficial and negative impacts of each alternative related to trash removal. • Demonstrate beneficial and negative impacts of each alternative related to invasive species. • Analyze beneficial impacts of enhanced tidal flow.

Resource	Comment Summary
	• Evaluate each alternative for loss of native species and habitat types. • Analyze impacts of fertilizers used in replanting efforts • Analyze impacts to vegetation, ichthyofauna, herpetofauna, mammals, benthic vertebrates, and terrestrial invertebrates. • Analyze impacts from irrigation, if necessary. • Analyze impacts to herbivore species. • Analyze impacts related to macroalgal blooms. • Analyze impacts related to exotic plant invasions.
5.1 Cultural Resources	• Document consultation with NAHC. • Respect confidentiality. • Include human remains mitigation. • Consider preservation over mitigation through excavation. • Discuss importance of site archaeologically and historically, and as sacred site. • Discuss former use of Ballona Wetlands by native peoples. • Include pre-survey, monitoring, and recording to preserve/protect resources. • Analyze impacts to human graves. • Consult with Tongva. • Analyze impacts to cultural, historical, and religious resources.
5.2 Land Use and Socioeconomics	• Analyze consistency with Local Coastal Plan/Coastal Act. • Analyze compatibility of Area C with La Villa Marina neighborhood. • Discuss coastal zone permits. • Fully consider existing SoCalGas infrastructure and need to maintain full-time all-weather access for heavy equipment (Playa del Rey Storage Facility [natural gas storage field] and gas processing plant located immediately adjacent to southern boundary of project; multiple monitoring wells and associated piping located within project). • Analyze future use for gas extraction.
5.3Visual Resources	• Analyze impacts of berms in Area C. • Analyze impacts of levees on views of Santa Monica Bay. • Consider impacts to views of wetlands.
5.4 Transportation	• Analyze impacts to La Villa Marina Street (nonissue if no gateway there). • Analyze traffic impacts (Culver/Playa del Rey area). • Analyze parking Impacts (Gordon's Market lot). • Analyze impacts to pedestrian/ bikes during construction. • Analyze impacts to bike trails. • Analyze impacts to bike trail (length, accessibility). • Analyze construction and operational impacts on La Villa Marina (especially if construction or long-term access to Area C from here). • Analyze impact to creek trail (lengthening, visual access). • Analyze impacts during construction. • Analyze construction traffic in neighborhoods, on Lincoln, Culver, 90, Mindanao Fiji Way, Jefferson. • Analyze impacts related to use of Culver as Tsunami Escape Route.
5.5 Air Quality	• Analyze emissions/increased vehicles (hot spot at Gordon's Market parking lot). • Analyze impacts during construction.

Resource	Comment Summary
5.6 Greenhouse Gases	• None.
5.7 Noise	• Analyze traffic noise (Culver). • Analyze vibration impacts from construction on existing condos.
5.8 Hazards	• Analyze impacts to neighbors health and safety (during construction). • Analyze impacts from SoCalGas ops and oilfield gas migration. • Address procedures and safety measures per DOGGR. • Analyze risk of upset from methane, oil. • Analyze safety impact to La Villa Marina neighborhood (near Area C). • Analyze impacts related to pollution, cleanup, well abandonment, and gas infusion. • Study impacts of earthwork on oilfield gas migration hazards, BTEX and H_2S in oil gases. • Study impacts on leaking gases in gravel zone and effect of tidal action. • Study corrosion impacts of introducing saltwater and facilitating H_2S on SoCalGas wells. • Study potential for more gas migration with tidal inundation. • Analyze nearby GeoTracker sites. • Analyze effects on Playa del Rey natural gas storage reservoir. • Analyze methane gas release due to subsidence. • Analyze impacts from/on SoCalGas and Sempra facilities (leaks, leaching, soils, water). • Analyze dredging (toxic materials). • Analyze impacts related to methane seeps. • Analyze impacts to underground gas storage from flooding wetlands with seawater and construction activities.
5.9 Public Services and Recreation	• Analyze impacts related to access to restoration area for first responders and vector control. • Analyze demonstrate beneficial and negative impacts of each alternative. • Analyze impacts to trails. • Analyze impacts related to eliminating current use of channel by UCLA and LMU crew teams.
5.10 Utilities and Energy Use	• None.
6.1 Environmental Justice	• None.
6.2 Cumulative	• None.
6.3 Growth Inducing	• None.



Attachment A
Notice of Preparation and Notice of Intent

Notice of Completion & Environmental Document Transmittal

Mail to: State Clearinghouse, P.O. Box 3044, Sacramento, CA 95812-3044 (916) 445-0613
For Hand Delivery/Street Address: 1400 Tenth Street, Sacramento, CA 95814

SCH # 2012071090

Project Title: Ballona Wetlands Restoration Project

Lead Agency: California Dept of Fish & Game | Contact Person: David Lawhead
Mailing Address: 3883 Ruffin Road | Phone: 858-627-3997
City: San Diego | Zip: 92123 | County: San Diego

Project Location: County: Los Angeles | City/Nearest Community: Marina del Rey
Cross Streets: Hwy 1 & Fiji Way | Zip Code: 90292
Longitude/Latitude (degrees, minutes and seconds): 33 ° 58 ′ 33.83″ N / 118 ° 26 ′ 20.20″ W Total Acres: 600
Assessor's Parcel No.: | Section: | Twp.: | Range: | Base:
Within 2 Miles: State Hwy #: 1 & 90 | Waterways: Ballona Creek, Santa Monica Bay
Airports: Los Angeles Int'l | Railways: | Schools: Multiple

Document Type:

CEQA: ☒ NOP ☐ Draft EIR | NEPA: ☒ NOI | Other: ☒ Joint Document
☐ Early Cons ☐ Supplement/Subsequent EIR | ☐ EA | ☐ Final Document
☐ Neg Dec (Prior SCH No.) | ☐ Draft EIS | ☐ Other:
☐ Mit Neg Dec Other: | ☐ FONSI

Local Action Type:

☐ General Plan Update ☐ Specific Plan ☐ Rezone ☐ Annexation
☐ General Plan Amendment ☐ Master Plan ☐ Prezone ☐ Redevelopment
☐ General Plan Element ☐ Planned Unit Development ☐ Use Permit ☒ Coastal Permit
☐ Community Plan ☐ Site Plan ☐ Land Division (Subdivision, etc.) ☒ Other: Restoration

Development Type:

☐ Residential: Units | Acres
☐ Office: Sq.ft. | Acres | Employees
☐ Commercial: Sq.ft. | Acres | Employees
☐ Industrial: Sq.ft. | Acres | Employees
☐ Educational:
☐ Recreational:
☐ Water Facilities: Type | MGD

☐ Transportation: Type
☐ Mining: Mineral
☐ Power: Type | MW
☐ Waste Treatment: Type | MGD
☐ Hazardous Waste: Type
☒ Other: 600 acres of wetland restoration

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Project Issues Discussed in Document:

☒ Aesthetic/Visual ☐ Fiscal ☒ Recreation/Parks ☒ Vegetation
☒ Agricultural Land ☒ Flood Plain/Flooding ☒ Schools/Universities ☒ Water Quality
☒ Air Quality ☒ Forest Land/Fire Hazard ☐ Septic Systems ☒ Water Supply/Groundwater
☒ Archeological/Historical ☒ Geologic/Seismic ☒ Sewer Capacity ☒ Wetland/Riparian
☒ Biological Resources ☒ Minerals ☒ Soil Erosion/Compaction/Grading ☒ Growth Inducement
☒ Coastal Zone ☒ Noise ☒ Solid Waste ☒ Land Use
☒ Drainage/Absorption ☒ Population/Housing Balance ☒ Toxic/Hazardous ☒ Cumulative Effects
☒ Economic/Jobs ☒ Public Services/Facilities ☒ Traffic/Circulation ☐ Other:

Present Land Use/Zoning/General Plan Designation:

Project Description: *(please use a separate page if necessary)*
The Ballona Wetlands Ecological Reserve is located in the western portion of the city of Los Angeles (partially within unincorporated Los Angeles County), south of Marina Del Rey and north of Playa Del Rey. The entire project site is held by the State of California, with part owned by CDFG and part owned by SLC. The site is bisected by and includes a channelized span of Ballona Creek, and it is traversed by Culver Boulevard, Jefferson Boulevard, and Lincoln Boulevard. The project entails restoring, enhancing, and creating native coastal wetland and upland habitats in the approximately 600-acre Ecological Reserve. The reserve comprises previously filled and dredged coastal wetland and upland habitat that would be restored by increasing tidal flow throughout the project area, removing invasive species, and planting native vegetation.

Note: The State Clearinghouse will assign identification numbers for all new projects. If a SCH number already exists for a project (e.g. Notice of Preparation or previous draft document) please fill in.

Revised 2010

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REGISTRAR-RECORDER/COUNTY CLERK
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NOTICE OF PREPARATION OF A DRAFT ENVIRONMENTAL IMPACT REPORT

Ballona Wetlands Restoration Project

Introduction

The California Department of Fish & Game (CDFG), the State Coastal Conservancy (Conservancy), and the California State Lands Commission (SLC) are considering a large-scale restoration of the Ballona Wetlands, a State-owned Ecological Reserve located in the western portion of the city and county of Los Angeles. As the primary landowner, project proponent, and permitting agency for the state, CDFG is serving as the lead agency under the California Environmental Quality Act (CEQA). The project will require permits from the U.S. Army Corps of Engineers, Los Angeles District (Corps), who will serve as lead agency under the National Environmental Policy Act (NEPA). The agencies are examining the environmental consequences associated with implementing the project. CDFG is hereby issuing this Notice of Preparation (NOP) that they will be preparing a draft environment impact report (EIR) to satisfy the environmental review requirements of CEQA. The Corps is also issuing a separate Notice of Intent to prepare a draft environment impact statement (EIS) to satisfy the requirements of NEPA. The two documents will be prepared as a joint document (EIS/EIR). This notice solicits input as to the content of environmental review for the project from the public and federal, state, and local agencies relevant to their respective statutory responsibilities.

Project Location

The Ballona Wetlands Ecological Reserve is located in the western portion of the city of Los Angeles (partially within unincorporated Los Angeles County), south of Marina Del Rey and north of Playa Del Rey, as shown in Figure 1. The site is approximately 1.5 miles west of Interstate 405 and approximately 0.25 mile east of Santa Monica Bay. The entire project site is held by the State of California, with part owned by CDFG and part owned by SLC. The site is bisected by and includes a channelized span of Ballona Creek, and it is traversed by Culver Boulevard, Jefferson Boulevard, and Lincoln Boulevard. An aerial photograph of the project site is shown in Figure 2.

Project Summary and Proposed Action

The project entails restoring, enhancing, and creating native coastal wetland and upland habitats in the approximately 600-acre Ecological Reserve. The reserve comprises previously filled and dredged coastal wetland and upland habitat that would be restored by increasing tidal flow throughout the project area, removing invasive species, and planting native vegetation. Figure 3 shows a conceptual design of the proposed restoration. The main components of the project are:

- Habitat restoration of estuarine wetland and upland habitats connected to a realigned Ballona Creek.
- Removal of existing Ballona Creek levees and realignment of Ballona Creak to restore a more meandering channel.
- Construction of new levees to replace the existing Ballona Creek levees and to allow restoration of tidally influenced wetlands while providing flood protection for Culver Boulevard and surrounding areas.
- Installation of water control structures, including culverts with self-regulating tide gates or similar structures, to provide a full range of tides up to an elevation acceptable for flood management and storm drainage, while protecting against some storm events.
- Maintenance of existing levels of flood protection for areas surrounding the Ballona Wetlands site and inclusion of flood hazard management measures into the restored wetlands.

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- Provision of erosion protection as an integral part of the restoration design.
- Modification of infrastructure and utilities as necessary to implement the restoration project.
- Improving public access by realigning existing trails, creating new trails, repairing existing fences, constructing overlook platforms, and providing other visitor-oriented facilities.
- Long-term operations and management activities including inspections, repairs, clean-up, vegetation maintenance, and related activities.

As this project is anticipated to be implemented over the course of several years, the project would include an adaptive management component whereby lessons learned from initial stages would be considered as further work is planned, designed, and implemented, allowing maximum realization of project objectives and minimization of on- and offsite environmental impacts. Additionally, the restoration and flood management approaches to the project will consider the effects of future sea-level rise, per the California Governor's Executive Order S-13-08 and the Conservancy's Climate Change Policy, adopted June 4, 2009.

The primary federal action associated with this project is the issuance by the Corps of permits pursuant to Clean Water Act Section 404 and Section 408. The 404 permit is required for dredge and fill of material within jurisdictional waters of the U.S.; the 408 permit is required for demolition of the concrete-lined flood control channel and realignment of Ballona Creek. The Corps and CDFG also anticipate formally consulting with the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act, with the State Historic Preservation Officer under Section 106 of the National Historic Preservation Act, and with the Native American Heritage Commission regarding this project.

Potential Environmental Effects

The project's effects with respect to the following environmental issue areas will be analyzed and addressed in the EIS/EIR: aesthetics, air quality and greenhouse gas emissions, biological resources, cultural resources, geology and soils, hazards and hazardous materials, hydrology and water quality, land use and planning, noise, public services, recreation, sea-level rise, traffic, and utilities. Additional issues may be identified during the scoping process. The EIS/EIR will consider direct, indirect, and cumulative impacts, and will present a coequal level of detail for impact analysis on a reasonable range of alternatives to the project, including the No Action/No Project Alternative.

Scoping Process

CDFG and the Corps will conduct a public scoping meeting for the EIS/EIR to receive agency and public comment regarding the appropriate scope and preparation of the environmental document. Potential significant issues to be addressed in the EIS/EIR include aesthetics, air quality and greenhouse gas emissions, biological resources, cultural resources, geology and soils, hazards and hazardous materials, hydrology and water quality, land use and planning, noise, public services, recreation, sea-level rise, traffic, and utilities. Additional issues may be identified in during the scoping process. Comments are invited from the public and affected agencies.

A public scoping meeting to receive input on the scope of the EIS/EIR will be conducted on August 16, 2012, beginning at 4:00 pm at the Fiji Gateway entrance to the Ballona Wetlands (13720 Fiji Way, Marina del Rey, CA 90292, across from Fisherman's Village and the Los Angeles County Department of Beaches and Harbors). Participation in the public meeting by federal, state, and local agencies and other interested persons and organizations is encouraged. If you have any questions regarding the meeting, please contact Donna McCormick at (949) 333-6611 (Donna.Mccormick@icfi.com).

Written comments on the scope of environmental review may be submitted at the scoping meeting or sent to the address listed below. Comments will be accepted until September 10, 2012.

Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92816

or by email to:
Donna.McCormick@icfi.com

Additional information on the project and the environmental review process is available on the Ballona Wetlands Restoration website at: www.ballonarestoration.org.

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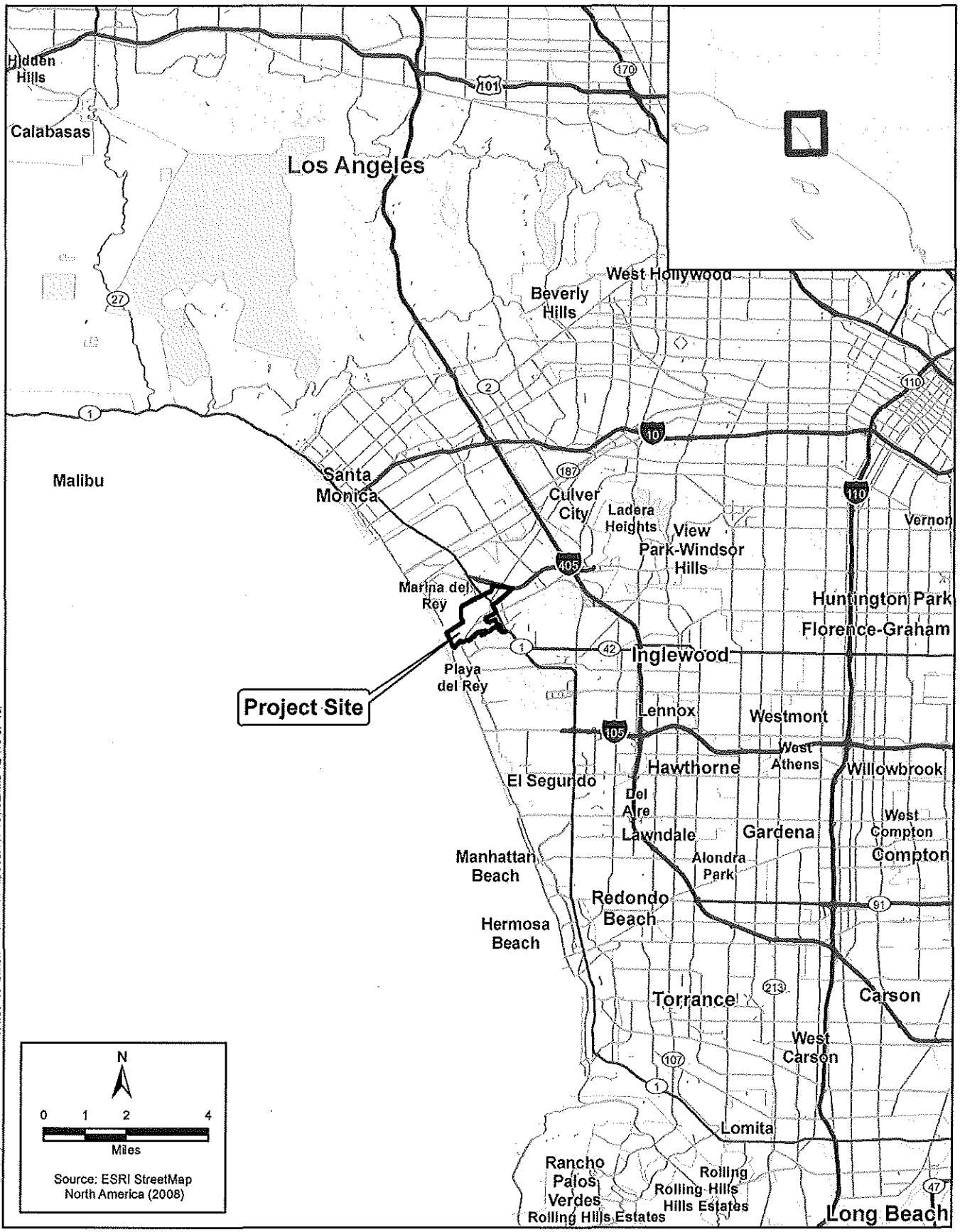

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Figure 1
Regional Location



Source: Digital Globe Imagery, 2008

ICF INTERNATIONAL

Figure 2
Project Site

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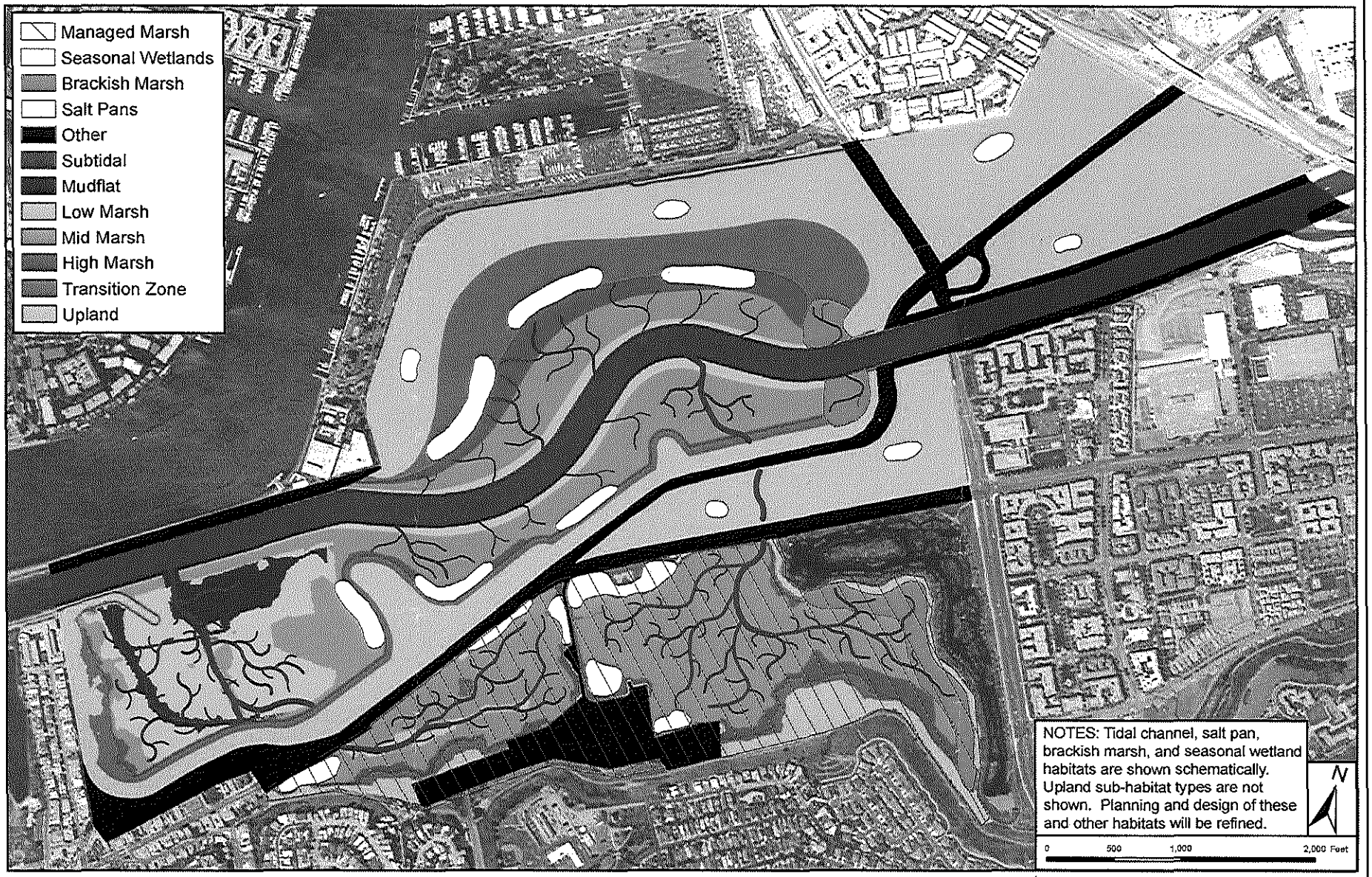

k:\sandiego\projects\coastal conservancy\658 09 ballona wetlands\mapdoc\Fig03 proposed project.ai SS (04-30-12)

Source: ESA PWA

ICF INTERNATIONAL

Figure 3
Proposed Project

12 0046154

NOAA, Rm. 11230, 1315 East-West Highway, Silver Spring, Maryland 20910. Phone: 301–734–1156, Fax: 301–713–1459, Email: *Cynthia.Decker@noaa.gov.*

Dated: July 18, 2012.

Terry Bevels,

Acting Chief Financial Officer/Acting Administrative Officer, Office of Oceanic and Atmospheric Research, National Oceanic and Atmospheric Administration.

[FR Doc. 2012–18034 Filed 7–24–12; 8:45 am]

BILLING CODE 3510–KD–P

DEPARTMENT OF DEFENSE

Office of the Secretary

Department of Defense Wage Committee; Notice of Closed Meetings

AGENCY: Department of Defense (DoD).

ACTION: Notice of closed meetings.

SUMMARY: Pursuant to the provisions of section 10 of Public Law 92–463, the Federal Advisory Committee Act, notice is hereby given that closed meeting of the Department of Defense Wage Committee will be held.

DATES: Tuesday, September 4, 2012, at 10 a.m.

ADDRESSES: 4800 Mark Center Drive, Room 05K25, Alexandria, VA 22350–1100.

FOR FURTHER INFORMATION CONTACT: Additional information concerning the meetings may be obtained by writing to the Chairman, Department of Defense Wage Committee, 4000 Defense Pentagon, Washington, DC 20301–4000.

SUPPLEMENTARY INFORMATION: Under the provisions of section 10(d) of Public Law 92–463, the Department of Defense has determined that the meetings meet the criteria to close meetings to the public because the matters to be considered are related to internal rules and practices of the Department of Defense and the detailed wage data to be considered were obtained from officials of private establishments with a guarantee that the data will be held in confidence.

However, members of the public who may wish to do so are invited to submit material in writing to the chairman concerning matters believed to be deserving of the Committee's attention.

Dated: July 19, 2012.

Aaron Siegel,

Alternate OSD Federal Register Liaison Officer, Department of Defense.

[FR Doc. 2012–18097 Filed 7–24–12; 8:45 am]

BILLING CODE 5001–06–P

DEPARTMENT OF DEFENSE

Office of the Secretary

Department of Defense Wage Committee; Notice of Closed Meetings

AGENCY: Department of Defense (DoD).

ACTION: Notice of closed meetings.

SUMMARY: Pursuant to the provisions of section 10 of Public Law 92–463, the Federal Advisory Committee Act, notice is hereby given that closed meeting of the Department of Defense Wage Committee will be held.

DATES: Tuesday, September 18, 2012, at 10 a.m.

ADDRESSES: 4800 Mark Center Drive, Room 05K25, Alexandria, VA 22350–1100.

FOR FURTHER INFORMATION CONTACT: Additional information concerning the meetings may be obtained by writing to the Chairman, Department of Defense Wage Committee, 4000 Defense Pentagon, Washington, DC 20301–4000.

SUPPLEMENTARY INFORMATION: Under the provisions of section 10(d) of Public Law 92–463, the Department of Defense has determined that the meetings meet the criteria to close meetings to the public because the matters to be considered are related to internal rules and practices of the Department of Defense and the detailed wage data to be considered were obtained from officials of private establishments with a guarantee that the data will be held in confidence.

However, members of the public who may wish to do so are invited to submit material in writing to the chairman concerning matters believed to be deserving of the Committee's attention.

Dated: July 19, 2012.

Aaron Siegel,

Alternate OSD Federal Register Liaison Officer, Department of Defense.

[FR Doc. 2012–18112 Filed 7–24–12; 8:45 am]

BILLING CODE 5001–06–P

DEPARTMENT OF DEFENSE

Department of the Army, Corps of Engineers

Intent To Prepare a Draft Environmental Impact Statement/ Environmental Impact Report for the Proposed Ballona Wetlands Restoration Project at Ballona Creek Within the City and County of Los Angeles, CA

AGENCY: U.S. Army Corps of Engineers, Department of the Army, DoD.

ACTION: Notice of intent.

SUMMARY: The U.S. Army Corps of Engineers (Corps) and the California Department of Fish and Game (CDFG) intend to jointly prepare a Draft Environmental Impact Statement/ Environmental Impact Report (DEIS/ EIR) for the proposed Ballona Wetlands Restoration Project. The proposed project is intended to return the daily ebb and flow of tidal waters, maintain freshwater circulation, and augment the physical and biological functions and services in the project area. Restoring the wetland functions and services would allow native wetland vegetation to be reestablished, providing important habitat for a variety of wildlife species. As a restored site, the Ballona Wetlands would play an important role to provide seasonal habitat for migratory birds. A restored, optimally functioning wetland would also benefit the adjacent marine environment and enhance the quality of tidal waters.

DATES: Submit comments on or before September 10, 2012.

FOR FURTHER INFORMATION CONTACT: Dr. Daniel P. Swenson at (213) 452–3414 (*daniel.p.swenson@usace.army.mil*), U.S. Army Corps of Engineers, Los Angeles District, P.O. Box 532711, Los Angeles, CA 90053–2325.

SUPPLEMENTARY INFORMATION: The Corps intends to prepare a joint EIS/EIR to assess the environmental effects associated with the proposed project. CDFG is the state lead agency for the EIR pursuant to the California Environmental Quality Act (CEQA).

1. Background. The 600-acre Ballona Wetlands Ecological Reserve is located in the western portion of the City of Los Angeles (partially within unincorporated Los Angeles County), south of Marina Del Rey and north of Playa Del Rey. The project site is situated approximately 1.5 miles west of Interstate 405 and approximately ¼-mile east of Santa Monica Bay. The project site is owned by the State of California, and is bisected by and includes a channelized span of Ballona Creek, a component feature of a federal flood risk management project.

2. Project Purpose and Need. A substantial portion of California's historic coastal wetlands have been lost. Restoration of coastal wetlands is needed in order to increase available nursery and foraging habitat for wildlife and to provide recreational and educational opportunities to the public. The Ballona Wetlands ecosystem is one of the last remaining major coastal wetlands in Los Angeles County. It is estimated that historically the wetlands ecosystem spanned more than 2,000

acres in the vicinity of the site. Development occurring over the last century greatly reduced the Ballona wetland area, now estimated at approximately 600 acres. In addition, the wetland habitat and natural hydrological functions in the area have been substantially degraded. The project site provides habitat for a diversity of plant and wildlife species, but most on-site habitat exhibits relatively low physical and biological functions and services.

The proposed project is intended to return the daily ebb and flow of tidal waters, maintain freshwater circulation, and augment the physical and biological functions and services in the project area. Restoring the wetland functions and services would allow native wetland vegetation to be reestablished, providing important habitat for a variety of wildlife species. As a restored site, the Ballona Wetlands would play an important role to provide seasonal habitat for migratory birds. A restored, optimally functioning wetland would also benefit the adjacent marine environment and enhance the quality of tidal waters. The proposed project would provide the community with a valuable educational resource and access to a large wetland area.

The purpose of the project is to restore ecological functions of the site, in part, by enhancing tidal flow.

3. Proposed Action. CDFG is proposing a large-scale restoration of the Ballona Wetlands Ecological Reserve. The proposed project entails restoring, enhancing, and establishing native coastal wetland and upland habitats in the approximately 600-acre Ballona Wetlands Ecological Reserve. The reserve currently supports large expanses of previously filled and dredged coastal wetland and upland habitat that would be restored by increasing tidal flow throughout the project area, removing invasive species, and planting native vegetation.

The main components of the proposed project are:

- Habitat restoration of estuarine wetland and upland habitats connected to a realigned Ballona Creek.
- Removal of existing Ballona Creek levees and realignment of Ballona Creak to restore a more meandering channel.
- Construction of levees along the perimeter of the project area to allow restoration of tidally influenced wetlands in the project area while providing flood risk management for Culver Boulevard and surrounding developed areas.
- Installation of water control structures, including culverts with self-regulating tide gates or similar structures, to provide a full range of tides up to an elevation acceptable for flood risk management and storm drainage, while reducing the risk of damage from storm events.
- Maintenance of existing levels of flood risk management for areas surrounding the Ballona Wetlands site.
- Provision of erosion protection as an integral part of the restoration design.
- Modification of infrastructure and utilities as necessary to implement the restoration project.
- Improving public access by realigning existing trails, creating new trails, repairing existing fences, constructing overlook platforms, and providing other visitor-oriented facilities.
- Long-term operations and management activities including inspections, repairs, clean-up, vegetation maintenance, and related activities.

The proposed project requires a permit under section 404 of the Clean Water Act (CWA) and section 10 of the Rivers and Harbors Act to conduct dredge and fill activities in waters of the United States and for work and (or) structures in or affecting navigable waters of the United States associated with restoring wetlands and associated habitat within the project site. Dredge and fill activities in waters of the United States are proposed to construct new levees, form new tidal channels, modify existing tidal channels, re-contour areas to enhance tidal flow, and to create elevations conducive to establishing wetland habitat. Preliminary conservative estimates indicate the project would result in a balanced total of 1,782,000 cubic yards of excavation and 1,782,000 cubic yards of fill placement, not all of which would affect jurisdictional areas. Based on these preliminary estimates, the volumes and areas of fill are estimated as follows: Permanent discharge of fill within 43.5 acres of non-wetland waters of the U.S. (435,000 cubic yards) and within 65 acres of wetland waters of the U.S. (600,000 cubic yards), as well as temporary discharge of fill within 3.5 acres of non-wetland waters of the U.S. (30,000 cubic yards) and within 0.3 acres of wetland waters of the U.S. (structural fill).

The project will also require a permit from the Corps to the Los Angeles County Department of Public Works, as the non-Federal sponsor of the Los Angeles County Drainage Area (LACDA) project, pursuant to 33 U.S.C. section 408 (408 permit). A section 408 permit is required to alter/modify a completed Corps project. The Ballona Creek levees were constructed by the Corps in the 1930s as part of LACDA. This project proposes to remove levees, construct a larger levee reach around the perimeter of the proposed side, reconfigure the existing concrete-lined Ballona Creek flood-control channel and realign the creek. A permit for modification/alteration of this magnitude would require Corps Headquarters approval.

4. Alternatives Considered. The feasibility of several alternatives is being considered and will be addressed in the DEIS/EIR. The No Federal Action/No Project Alternative, as required by NEPA and CEQA, would maintain the status quo and would include no improvements or discharges of fill material in waters of the United States or work or structures in or affecting navigable waters of the United States. Other alternatives that may be considered include restoring smaller portions of the 600-acre site, alternative designs that would provide differing amounts of various habitats types, and alternative designs for enhancing tidal flow. Additional alternatives may be developed during scoping and will also be considered in the DEIS/EIR.

5. Scoping Process.

a. Affected federal, state and local resource agencies, Native American groups and concerned interest groups/individuals are encouraged to participate in the scoping process. Public participation is critical in defining the scope of analysis in the DEIS/EIR, identifying significant environmental issues in the DEIS/EIR, providing useful information such as published and unpublished data, and knowledge of relevant issues and recommending mitigation measures to offset potential impacts from proposed actions.

b. Potential impacts associated with the proposed project will be fully evaluated. Potential significant issues to be addressed in the DEIS/EIR include aesthetics, air quality and greenhouse gas emissions, biological resources, cultural resources, geology and soils, hazards and hazardous materials, hydrology and water quality, land use and planning, noise, public services, recreation, sea-level rise, traffic, flood control, and utilities. Additional issues may be identified during the scoping process.

c. Individuals and agencies may offer information or data relevant to the environmental or socioeconomic impacts of the proposed project by submitting comments, suggestions, and requests to be placed on the mailing list for announcements to (see **FOR FURTHER INFORMATION CONTACT**) or the following email address: *Daniel.p.swenson@usace.army.mil.*

d. The Corps anticipates formally consulting with the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act, the National Marine Fisheries Service under Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and with the State Historic Preservation Officer under Section 106 of the National Historic Preservation Act. The CDFG, as the project proponent, will need to obtain a CWA section 401 water quality certification or waiver and a consistency certification from the California Coastal Commission in accordance with the Coastal Zone Management Act.

6. Scoping Meeting Date, Time, and Location. A public scoping meeting to receive input on the scope of the DEIS/EIR will be conducted on August 16, 2012, from 4:00–7:00 p.m. at the Fiji Gateway entrance to the Ballona Wetlands (13720 Fiji Way, Marina del Rey, CA 90292, across from Fisherman's Village and Los Angeles County Department of Beaches and Harbors).

7. Availability of the DEIS/EIR. The DEIS/EIR is expected to be published and circulated in late 2012. A public hearing will be held after its publication to field comments on the document.

David J. Castanon,

Chief, Regulatory Division, Corps of Engineers.

[FR Doc. 2012–18166 Filed 7–24–12; 8:45 am]

BILLING CODE 3720–58–P

DEPARTMENT OF DEFENSE

Department of the Army, Corps of Engineers

Intent To Prepare an Environmental Impact Statement for the Proposed Westbrook Project, Corps Permit Application Number SPK–2005–00938

AGENCY: Department of the Army, U.S. Army Corps of Engineers, DOD.

ACTION: Notice of intent.

SUMMARY: The U.S. Army Corps of Engineers, Sacramento District, (Corps) received a Department of the Army permit application from Westpark S.V. 400, LLC (Applicant) to fill approximately 9.6 acres of waters of the United States to construct the proposed Westbrook Project in Placer County, CA, in June 2011. The Corps, as the lead agency responsible for compliance with the National Environmental Policy Act (NEPA), determined that the proposed project may result in significant impacts to the environment, and that the preparation of an Environmental Impact Statement (EIS) is required.

The Applicant proposes to implement a moderate scale, mixed-use, mixed-density master planned community. The Westbrook Project, as proposed, would include a mixture of land uses, including new residential neighborhoods, elementary school, parks and several neighborhood serving retail centers. The Westbrook Project would involve approximately 146 acres of low-density residential, 84 acres of medium-density residential, 28 acres of high-density residential and 43 acres of commercial land uses. Other proposed land uses include a 10-acre elementary school site, approximately 16 acres for three neighborhood parks, and approximately 37 acres of open space for the preservation of natural resources areas.

The proposed project site is approximately 400 acres and contains approximately 13 acres of waters of the United States. The project, as proposed, would result in direct impacts to approximately 9.6 acres of waters of the United States. These acreages do not include indirect impacts from the proposed action or impacts anticipated to result from offsite infrastructure that may be determined to be required as part of the project through the Environmental Impact Statement (EIS) process.

ADDRESSES: To submit comments on this notice or for questions about the proposed action and the Draft EIS, please contact James T. Robb, 1325 J Street, Room 1350, Sacramento, CA 95814. Please refer to Identification Number SPK–2005–00938 in any correspondence.

FOR FURTHER INFORMATION CONTACT: Mr. James T. Robb, (916) 557–7610, email: *DLL-CESPK-RD-EIS-Comments@usace.army.mil.*

SUPPLEMENTARY INFORMATION: Interested parties are invited to submit written comments on the permit application on or before September 3, 2012. Scoping comments should be submitted within the next 45 days, but may be submitted at any time prior to publication of the Draft EIS.

The USACE will evaluate alternatives including the no action alternative, the proposed action alternative, and other on-site and off-site alternatives. The proposed project and the alternatives to its proposed size, design, and location will be developed through the EIS process.

The proposed project would result in direct impacts to approximately 9.6 acres of waters of the United States and would avoid approximately 2.9 acres of these waters of the United States. Waters of the U.S. on-site include two intermittent streams, seasonal wetlands, wetland swales, and vernal pools.

The proposed site for the Westbrook community is in unincorporated Placer County, CA, immediately west of the City of Roseville's existing city limits. The proposed project site is approximately 6 miles west of Interstate 80 and State Route 65, 10 miles northeast of the City of Sacramento, 10 miles east of State Route 99, 5 miles west of downtown Roseville, and 4 miles east of the Sutter County line. The proposed project site is bordered on the west by Fiddyment Road and is approximately 1.2 miles north of Baseline Road. The property to the north was previously authorized for development under permit SPK–2002–00666 (Westpark/Fiddyment Ranch) or is under review in the case of Creekview (SPK–2006–00650). The property to the south, directly adjacent to Baseline Road, is currently under review (Sierra Vista Specific Plan, SPK–2006–01050 and Placer Vineyards, SPK–1999–00737). The proposed project site was once a part of the Sierra Vista Specific Plan area, but the landowners at the time withdrew their application for a Section 404 permit and the area was dropped from analysis under the Sierra Vista EIS in 2008. A new permit application was received for the proposed Westbrook project on June 9, 2011.

The Corps' public involvement program includes several opportunities to provide oral and written comments on the Westbrook project through the EIS drafting process. Affected federal, state, and local agencies, Indian tribes, and other interested private organizations and parties are invited to participate. Significant issues to be analyzed in depth in the EIS include impacts to waters of the United States, including vernal pools and other wetlands; agricultural resources; cultural resources; threatened and endangered species; transportation; air quality; surface water and groundwater; hydrology and water quality; socioeconomic effects; and aesthetics.

The applicant reports that the project area supports suitable habitat for certain federally-listed branchiopods, including the threatened vernal pool fairy shrimp (*Branchinecta lynchi*) and endangered Conservancy fairy shrimp (*Branchinecta conservatio*) and vernal pool tadpole shrimp (*Lepidurus packardi*). The suitable habitat for branchiopods within the project area includes vernal pools and depressional seasonal wetlands (including depressional areas within wetland swales).

The Applicant reports that there are historic properties within the Westbrook



Attachment B
Public Notice for Scoping Meeting

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FICTITIOUS BUSINESS NAME STATEMENT
File No. 2012 127121

The following person is doing business as: Millennium Media and Graphics, 1421 Walgrove Ave., Los Angeles, CA 90066, County of Los Angeles. Articles of Incorporation or Organization Number: AI #ON: Registered owner: Andreas P. Vogel, 1421 Walgrove Ave., Los Angeles, CA 90066. This business is conducted by an Individual. The registrant commenced to transact business under the fictitious business name or names listed above on N/A. I declare that all information in this statement is true and correct. (A registrant who declares as true information which he or she knows to be false is guilty of a crime.) Registrant Signature/Name: Andreas P. Vogel, Owner. This statement was filed with the County Clerk of Los Angeles on June 25, 2012. Argonaut published: July 19, 26, August 2, 9, 2012. NOTICE-In accordance with Subdivision (a) of Section 17920, a Fictitious Name Statement generally expires at the end of five years from the date on which it was filed in the office of the County Clerk, except, as provided in Subdivision (b) of Section 17920, where it expires 40 days after any change in the facts set forth in the statement pursuant to section 17913 other than a change in the residence address of a registered owner. A New Fictitious Business Name Statement must be filed before the expiration. The filing of this statement does not of itself authorize the use in this state of a Fictitious Business Name in violation of the rights of another under Federal, State, or common law (See Section 14411 et seq., Business and Professions Code).

FICTITIOUS BUSINESS NAME STATEMENT
File No. 2012 129391

The following person is doing business as: Studio MD, 4048 Madison Ave., Culver City, CA 90232, County of Los Angeles. Articles of Incorporation or Organization Number: AI #ON: Registered owner: Mauricio Duk, 4048 Madison Ave., Culver City, CA 90232. This business is conducted by an Individual. The registrant commenced to transact business under the fictitious business name or names listed above on 6/15/2012. I declare that all information in this statement is true and correct. (A registrant who declares as true information which he or she knows to be false is guilty of a crime.) Registrant Signature/Name: Mauricio Duk, Principal. This statement was filed with the County Clerk of Los Angeles on June 27, 2012. Argonaut published: July 26, August 2, 9, 16, 2012. NOTICE-In accordance with Subdivision (a) of Section 17920, a Fictitious Name Statement generally expires at the end of five years from the date on which it was filed in the office of the County Clerk, except, as provided in Subdivision (b) of Section 17920, where it expires 40 days after any change in the facts set forth in the statement pursuant to section 17913 other than a change in the residence address of a registered owner. A New Fictitious Business Name Statement must be filed before the expiration. The filing of this statement does not of itself authorize the use in this state of a Fictitious Business Name in violation of the rights of another under Federal, State, or common law (See Section 14411 et seq., Business and Professions Code).

FICTITIOUS BUSINESS NAME STATEMENT
File No. 2012 130970

The following persons are doing business as: Blue Cat Garden Design, 777 Gaviota Ave., Long Beach, CA 90813, County of Los Angeles. Articles of Incorporation or Organization Number: AI #ON: Registered owners: 1. Mary Kingman, 777 Gaviota Ave., Long Beach, CA 90813. 2. Ashley Kingman, 777 Gaviota Ave., Long Beach, CA 90813. This business is conducted by a Husband and Wife. The registrant commenced to transact business under the fictitious business name or names listed above on N/A. I declare that all information in this statement is true and correct. (A registrant who declares as true information which he or she knows to be false is guilty of a crime.) Registrant Signature/Name: Mary Kingman, Owner. This statement was filed with the County Clerk of Los Angeles on June 28, 2012. Argonaut published: July 12, 19, 26, August 2, 2012. NOTICE-In accordance with Subdivision (a) of Section 17920, a Fictitious Name Statement generally expires at the end of five years from the date on which it was filed in the office of the County Clerk, except, as provided in Subdivision (b) of Section 17920, where it expires 40 days after any change in the facts set forth in the statement pursuant to section 17913 other than a change in the residence address of a registered owner. A New Fictitious Business Name Statement must be filed before the expiration. The filing of this statement does not of itself authorize the use in this state of a Fictitious Business Name in violation of the rights of another under Federal, State, or common law (See Section 14411 et seq., Business and Professions Code).

FICTITIOUS BUSINESS NAME STATEMENT
File No. 2012 133827

The following persons are doing business as: Hana Nails, 13700 W. Washington Blvd. # 100, Marina del Rey, CA 90292, County of Los Angeles. Articles of Incorporation or Organization Number: AI #ON: 3221255. Registered owners: Hana Nail Salon, Inc., 13700 W. Washington Blvd. # 100, Marina del Rey, CA 90292. This business is conducted by a Corporation. The registrant commenced to transact business under the fictitious business name or names listed above on 7/28/2009. I declare that all information in this statement is true and correct. (A registrant who declares as true information which he or she knows to be false is guilty of a crime.) Registrant Signature/Name: Hang Wohlstadter, President (Owner) Hana Nail Salon, Inc. This statement was filed with the County Clerk of Los Angeles on July 3, 2012. Argonaut published: July 19, 26, August 2, 9, 2012. NOTICE-In accordance with Subdivision (a) of Section 17920, a Fictitious Name Statement generally expires at the end of five years from the date on which it was filed in the office of the County Clerk, except, as provided in Subdivision (b) of Section 17920, where it expires 40 days after any change in the facts set forth in the statement pursuant to section 17913 other than a change in the residence address of a registered owner. A New Fictitious Business Name Statement must be filed before the expiration. The filing of this statement does not of itself authorize the use in this state of a Fictitious Business Name in violation of the rights of another under Federal, State, or common law (See Section 14411 et seq., Business and Professions Code).

FICTITIOUS BUSINESS NAME STATEMENT
File No. 2012 135623

The following persons are doing business as: The Sandbox, 642 Broadway St., Venice, CA 90291, County of Los Angeles. Articles of Incorporation or Organization Number: AI #ON: Registered owners: 1. Robert Todd Sali, 642 Broadway St., Venice, CA 90291. 2. Birgitte Hellsten, 642 Broadway St., Venice, CA 90291. This business is conducted by Husband and Wife. The registrant commenced to transact business under the fictitious business name or names listed above on N/A. I declare that all information in this statement is true and correct. (A registrant who declares as true information which he or she knows to be false is guilty of a crime.) Registrant Signature/Name: Robert Todd Sali. This statement was filed with the County Clerk of Los Angeles on July 5, 2012. Argonaut published: July 19, 26, August 2, 9, 2012. NOTICE-In accordance with Subdivision (a) of Section 17920, a Fictitious Name Statement generally expires at the end of five years from the date on which it was filed in the office of the County Clerk, except, as provided in Subdivision (b) of Section 17920, where it expires 40 days after any change in the facts set forth in the statement pursuant to section 17913 other than a change in the residence address of a registered owner. A New Fictitious Business Name Statement must be filed before the expiration. The filing of this statement does not of itself authorize the use in this state of a Fictitious Business Name in violation of the rights of another under Federal, State, or common law (See Section 14411 et seq., Business and Professions Code).

PUBLIC NOTICE

NOTICE OF PUBLIC SCOPING MEETING for Ballona Wetlands Restoration Project

The California Department of Fish & Game (CDFG), the State Coastal Conservancy (Conservancy), and the California State Lands Commission (SLC) are considering a large-scale restoration of the Ballona Wetlands. The Ballona Wetlands are a state-owned Ecological Reserve located in the western portion of the city of Los Angeles (partially within unincorporated Los Angeles County), south of Marina Del Rey and north of Playa Del Rey. The site is approximately 1.5 miles west of Interstate 405 and approximately 0.25 mile east of Santa Monica Bay.

The Ballona Wetlands Restoration Project entails restoring, enhancing, and creating native coastal wetland and upland habitats in the approximately 600-acre Ecological Reserve. The reserve comprises previously filled and dredged coastal wetland and upland habitat that would be restored by increasing tidal flow throughout the project area, removing invasive species, and planting native vegetation.

CDFG and the U.S. Army Corps of Engineers (Corps) have initiated the required environmental documentation process and will prepare a joint environmental impact report/environmental impact statement (EIR/EIS) to analyze potential effects the proposed project alternatives may have on the environment. This notice is to inform you of the scheduled public scoping meeting for this project. The scoping meeting will provide you an opportunity to tell the agencies what issues you would like to see addressed in the EIR/EIS. Once the analysis is complete, the Draft EIR/EIS will be released and the public will again have an opportunity to comment.

The scoping meeting will be an open house. You may attend the meeting anytime between 4:00 and 7:00 PM on Thursday, August 16, 2012. You will have the opportunity to provide your comments in writing at the meeting or by dictating your comments to recorders at the meeting. You may also send your comments to the address below any time before September 10, 2012.

SCOPING MEETING

Date & Time: Thursday, August 16, 2012, 4:00-7:00 PM
Location: Fiji Gateway entrance to Ballona Wetlands. 13720 Fiji Way, Marina del Rey, CA 90292
Across from Fisherman's Village & Los Angeles County Dept. of Beaches & Harbors

FOR MORE INFORMATION, CONTACT:	SEND COMMENTS TO:
Donna McCormick, ICF International, (949) 333-6611 Donna.McCormick@icfi.com David Lawhead. California Dept. of Fish & Game, (858) 627-3997 DLawhead@dfg.ca.gov Dr. Daniel P. Swenson, U.S. Army Corps of Engineers, Los Angeles District (213) 452-3414, Daniel.P.Swenson@usace.army.mil	**Ballona Wetlands Restoration Project** C/O Donna McCormick 1 Ada, Suite 100 Irvine, CA 92816 **or by email to:** Donna.McCormick@icfi.com

Additional information on the project and the environmental review process is available on the Ballona Wetlands Restoration website at: www.ballonarestoration.org.



Attachment C
Public Comments

Ballona Wetlands Restoration Project

Advancing ecosystem health. Connecting communities with nature.

Comment Card

Name: ERIC ANDRES

Email: (optional) ANDRESHOUSE@ATT.NET

☒ Add me to the mailing list (please provide email or mailing address):

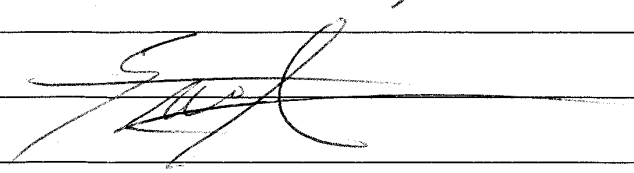
Comments/Issues: (Use additional sheets if necessary)

1) SHOULD BE A PUBLIC HEARING

2) "NO" GATEWAY IN PLAYA DEL REY OFF OF CULVER BLVD

3) GET RESIDENTS FEEDBACK & DISPLAY PUBLIC COMMENTS ON YOUR WEBSITE

4) FOR 3 YEARS PDR RESIDENTS HAVE COMMUNICATED "NO" GATEWAY IN PDR, WHY IS NO ONE LISTENING?



Submit written comments by *October 23, 2012* to:

Mail: Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92618

Email: Donna.McCormick@icfi.com

*****All comments submitted will become part of the Public Record***

Ballona Wetlands Restoration Project

Advancing ecosystem health. Connecting communities with nature.

Comment Card

Name: FRAN BIBIAN

Email: (optional) FRANBIBIAN@SBCGLOBAL.NET

☐ Add me to the mailing list (please provide email or mailing address):

Comments/Issues: (Use additional sheets if necessary)

I WOULD LOVE TO SEE THIS SITE TO BE TURNED INTO A MINI "HEAVEN ON EARTH", A PLACE WITH CLEAN WATER, CLEAN AIR AND CLEAN SOILS. A PLACE WHERE PEOPLE CAN ENJOY A BEAUTIFUL WALK AND NATURE OBSERVATION, A PLACE WHERE WILD LIFE IS SAFE AND PROTECTED. I WOULD LOVE TO HAVE THIS IN A PLACE WITH PERFECT WEATHER! WELL, THIS IS SO CLOSE TO IT.

THE PROCESS OF GETTING THERE SHOULD BE RESPECTFUL AND SENSITIVE TO THE NEEDS AND CONCERNS OF ALL STAKEHOLDERS (LOCAL RESIDENTS, BUSINESSES ... ETC...). IT MAY BE DIFFICULT TO DO, BUT IT IS DOABLE.

GOOD LUCK TO YOU ALL.

Submit written comments by *October 23, 2012* to:

Mail: Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92618

Email: Donna.McCormick@icfi.com

*****All comments submitted will become part of the Public Record***

Ballona Wetlands Restoration Project

Advancing ecosystem health. Connecting communities with nature.

Comment Card

Name: FRAN BIBIAN

Email: (optional) FRANBIBIAN@SBCGLOBAL.NET

☐ Add me to the mailing list (please provide email or mailing address):

Comments/Issues: (Use additional sheets if necessary)

ooops! I Forgot to mention that it would be great to have a place for riding bikes, and would be great to have plenty of trees to keep the trail(s) shaded

Thank you —

Submit written comments by *October 23, 2012* to:

Mail: Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92618

Email: Donna.McCormick@icfi.com

*****All comments submitted will become part of the Public Record***

Army Corp of Engineers
California Department of Fish and Game

August 15, 2012

RE: the Environmental Impact Report for the restoration of the Ballona Wetlands:

Gentlemen:

Please be advised that I oppose the opening of Ballona Creek and the use of the wetlands to sponge up the toxins in the creek.

I also oppose the dredging of the channel.

I support the completion of the study started in 2005 by the Army Corp of Engineers

I support a public hearing to discuss the findings of the Army Corp's completed report

I support the postponement of any Environmental Impact Study until the Army Corp's report is complete and the public has had time to digest it and discuss it in a public hearing.

I support the slow, natural restoration of the wetlands, preserving and enhancing the ecological niche for the native plants and animals and birds that have made it their home for centuries.

Wetlands are the nurseries for the Ocean and their loss is not just geographic, and visual,

I look forward to a public hearing on the restoration of the Ballona wetlands after the Army Corp report is completed and before the EIR is undertaken.

Cordially,

Ellen Brennan

Ellen Brennan
1659 Ocean Front Walk #102
Santa Monica, Ca. 90401
ellenbren@roadrunner.com

Ballona Wetlands Restoration Project

Advancing ecosystem health. Connecting communities with nature.

Comment Card

Name: Carolyn Glassman

Email: (optional) lindsstar@aol.com.

☒ Add me to the mailing list (please provide email or mailing address):

Comments/Issues: (Use additional sheets if necessary)

Area C. East of Lincoln. Homeowner (not renter)
Concerns:
Regulation of car & foot Traffic
Safety = too many (people w/o homes & others) camping in area
= too many " " in State reserve
area who trash it: these include: dogs
dog walkers, bikers = pedal & motor; Vagrants
drugs, disregard of authority, environment
property, ecology. etc.
* Concerned that plans may include opening LaVilla Marina (St.) *
to the wetlands as a parking lot, entrance to tours etc.
(Pls do not let this happen. It will ruin our neighborhood
and our right to enjoyment of our property.) Again safety.
Please make communications between laymen (i.e. neighbors)
and the "powers that be" — too many with many different interests, not
necessarily beneficial — a little more clear. Thank you

Submit written comments by *October 23, 2012* to:

Mail: Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92618

Email: Donna.McCormick@icfi.com

*****All comments submitted will become part of the Public Record***

Ballona Wetlands Restoration Project

Advancing ecosystem health. Connecting communities with nature.

Comment Card

Name: Carolyn Glassman

Email: (optional) lindastar@aol.com

☐ Add me to the mailing list (please provide email or mailing address):

Comments/Issues: (Use additional sheets if necessary)

Area C Concerns (again.)
specifically La Villa Marina =
no break-through to area C
no 30 ft berms on the border
of area C.

Comment rec'd: 2/2 (Correct area reference is "C")

Submit written comments by *October 23, 2012* to:

Mail: Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92618

Email: Donna.McCormick@icfi.com

*****All comments submitted will become part of the Public Record***

From: patricia mc pherson <patriciamcpherson1@verizon.net>
Subject: Fwd: BALLONA WETLANDS Restoration; Public Process Thwarted
Date: August 16, 2012 4:45:18 PM PDT

4 Attachments, 4.5 MB

Begin forwarded message:

From: patricia mc pherson <patriciamcpherson1@verizon.net>
Subject: Fwd: BALLONA WETLANDS Restoration; Public Process Thwarted
Date: August 16, 2012 4:44:05 PM PDT
To: David Lawhead <DLawhead@dfg.ca.gov>, Director <Director@dfg.ca.gov>

Dear Misters Bonham and Lawhead,

As an initial response to the Ballona Wetlands EIR Scoping "Open House" Grassroots Coalition(GC) provides the following information with a request for response from the DFG. GC will provide further specific queries.

In a DLawhead@dfg.ca.gov email Aug. 15,2012 to John Davis--Mr. Lawhead states,
:"3. All comments received , either at the Scoping Meeting or by mail/email, are pooled together so that both Lead Agencies receive all the comments."

To whom is Mr. Lawhead referencing as LEAD AGENCIES?
It is GC's understanding that the Lead Agency is the DFG. Please provide any and all information as to legal status for a second LEAD Agency.

GC supports the RESOLUTION provided by the SIERRA CLUB.
GC believes that the current 'new NOI" process is contradictory to the 2005 JOINT EIS/EIR process that is supposed to be in process.

GC believes that the DFG has failed to perform as previously agreed and been a part of bond money expenditures while failing to comply with the 2005 JOINT EIS/EIR inclusive of the Feasibility Studies.

Why has the DFG failed to work in concert with the public and the Working Groups in an open and transparent process for ALTERNATIVE PLANNING?

Instead the DFG has participated in abrogating its duties of the 2005 JOINT EIS/EIR process and has worked to withhold Science Advisory Committee information to the public. The outcome of the DFG's failure to include the public in
ALL REASONABLE ALTERNATIVES for restoration of Ballona has led
to the singular outcome of "ESTUARINE" CREATION at Ballona and promotion of destruction of important safety levees built by USACE.

This destructive process proposed to reintroduce tidal flow to a freshwater wetland system that was not historically connected to the ocean to the degree the new process implies.

The singular "Alternative" that is illegitimately being forced upon the public also proposed to divert one Impaired Waterway into another. It is illegal to further impair a waterway (delineated wetland portion) into a waterway (seasonal wetland) that is already impaired. (CWA)

GC reserves its right to supply further comments and queries to the DFG regarding DFG's actions that may affect Ballona.

Thank you,
Grassroots Coalition, Patricia McPherson-President

Begin forwarded message:

From: patricia mc pherson <patriciamcpherson1@verizon.net>
Subject: **Fwd: BALLONA WETLANDS Restoration; Public Process Thwarted**
Date: August 16, 2012 7:51:53 AM PDT
To: Scott Valor <svalor@santamonicabay.org>

TO: ALL SANTA MONICA BAY RESTORATION COMMISSION- Commissioners & Alternates ;
ALL BAY WATERSHED COUNCIL
% Scott Valor acting on behalf of SMBRC/BAY WATERSHED COUNCIL
C/O- **Scott Valor is requested to send electronic copy of this message to all parties listed above.**
The parties listed above, in the past, have not received written comments delivered by the public and stakeholders at EITHER the SMBRC Governing Board Meetings and/or Executive Committee Meetings. The website for SMBRC has not posted, as requested, any and all public comments from the meetings. Written public comments delivered at the SMBRC Meetings have also had no response from SMBRC to the public. (One GC query/comment letter had internal SMBRC intercommunication but was only rendered to the public via a Public Record Act request.) The failure by SMBRC to provide any and all public
comments from these meetings to the parties listed above has created a disconnect of information between the public and this
state agency that is contrary to the mission and goals of the this state agency.

RE: SMBRC MEETING AUGUST 16, 2012 - PUBLIC COMMENT Pertaining to the Ballona Wetlands Restoration Process - A Failed Process By SMBRC

FROM: GRASSROOTS COALITION, Patricia McPherson-President

Begin forwarded message:

From: patricia mc pherson <patriciamcpherson1@verizon.net>
Subject: **BALLONA WETLANDS Restoration; Public Process Thwarted**
Date: August 2, 2012 12:37:36 PM PDT
To: sschuchat@scc.ca.gov, dwayman@scc.ca.gov, npeterson@scc.ca.gov, carmen@scc.ca.gov
Cc: john.laird@resources.ca.gov, john@sco.ca.gov, ana.matosantos@dof.ca.gov, billrosendahl@aol.com, bill.lockyer@treasurer.ca.gov, jeanne.h.imamura@usace.army.mil, hamilton.cloud@mail.gov, adolfo_bailon@boxer.senate.gov, michael_davies@feinstein.senate.gov, Kulla Norman <norman.kulla@lacity.org>

To: Coastal Conservancy
Attn. All Governing Board Members and Alternates

From: Grassroots Coalition, Patricia McPherson, President

RE: Complaint and Request re: Support to the J. Davis 3/29/12 REQUEST TO RESCIND APPROVAL FOR STAFF RECOMMENDATION APPROVAL ON 1/19/12 awarding $6,490,00. for: FILE NO. 04-088-
BALLONA WETLANDS RESTORATION ENGINEERING AND TECHNICAL STUDIES
and,
Request for the Coastal Conservancy to stop its interference in the approved and ongoing 2005 Joint EIS/EIR process regarding restoration of the Ballona Wetlands Ecological Preserve.

Respectfully submitted,
Patricia McPherson, Grassroots Coalition

ADDITIONA...ocx (179 KB)

CA CONSER...pdf (1.2 MB)

2 of 4

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
CIVIL WORKS
108 ARMY PENTAGON
WASHINGTON DC 20310-0108

MAY 30 2012

Mr. John Davis
P.O. Box 10152
Marina Del Rey, California 90295

Dear Mr. Davis:

I have been asked to respond on behalf of Secretary of the Army John M. McHugh to your May 11, 2012, correspondence concerning the Marina del Rey Harbor project and the Ballona Creek, California Ecosystem Restoration feasibility study (Ballona Creek study). The Marina del Rey Harbor entrance channel is a Federal navigation project; however the side channels, docks and inner harbor facilities are not a Federal responsibility and are maintained by the Los Angeles County Department of Beaches and Harbors.

The Ballona Creek study is under development by the Los Angeles District of the Army Corps of Engineers (Corps). You asked about the status of the study, the non-federal cost sharing, and the environmental impact statement. The Ballona Creek study is an ongoing feasibility study examining restoration options for coastal wetlands and lagoons. The study and the environmental impact statement have not been finalized, and very limited federal funding is available to continue them. The non-federal sponsor, the Santa Monica Bay Restoration Commission (SMBRC), has provided its share of the study costs through in-kind services, subject to a Corps evaluation and final approval of crediting. Discussions with the SMBRC on the future of the study have been initiated.

If you would like additional details on the Marina del Rey project or the Ballona Creek study, you may wish to contact Mr. Steve Dwyer, Chief, Navigation Branch, Los Angeles District at (213) 452-3385.

Very truly yours,

Jo-Ellen Darcy
Assistant Secretary of the Army
(Civil Works)

3 of 4

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
P.O. BOX 532711
LOS ANGELES, CALIFORNIA 90053-2325

REPLY TO
ATTENTION OF

June 19, 2012

Office of
District Counsel

John Davis
PO Box 10152
Marina Del Rey, CA 90295

RE: Ballona Wetlands

Dear Mr. Davis,

This letter concerns your Freedom of Information Act (FOIA) request dated May 3, 2012. Your request, assigned number FA-12-0109, is enclosed. Please use this reference number in any further correspondence regarding this request.

In your letter, you requested documents related to the Ballona Wetlands, specifically:

1) Any and all documents terminating the Environmental Impact Statement process undertaken by the Corps.

2) Any and all information regarding financial records of the aforesaid process inclusive of all expenditures of money by the Corps and all money received by the Corps for the same purpose from any source whatsoever.

3) Any and all information terminating the local sponsor agreement entered into for the aforesaid purpose between the Corps and the local sponsor, the Santa Monica Bay Restoration Authority.

We have conducted our search and no responsive documents exist due to the following reasons:

1) The Environmental Impact Statement process has not been formally terminated.

2) There have been no expenditures with regard to a formal termination.

3) The local sponsor agreement has not been terminated.

The Program Manager does not anticipate that the EIS process will be terminated in the near future.

4 of 4

Ballona Wetlands Restoration Project

Advancing ecosystem health. Connecting communities with nature.

Comment Card

Name: ADAM KLISZEWSKI

Email: (optional) adamklis@hotmail.com

☐ Add me to the mailing list (please provide email or mailing address): _____

Comments/Issues: (Use additional sheets if necessary)

I AM ~~HEARING~~ READING CONFLICTING INFO ABOUT THE SOUNDNESS OF CURRENT PLANS AND WOULD CERTAINLY SUPPORT AN OPEN PERIOD OF INFORMING THE NEIGHBORS.

I AM MAINLY CONCERNED WITH THE PRESERVATION OF ECOLOGICAL VALUES INHERENT IN THE WETLANDS

Submit written comments by *October 23, 2012* to:

Mail: Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92618

Email: Donna.McCormick@icfi.com

*****All comments submitted will become part of the Public Record***

Ballona Wetlands Restoration Project

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Comment Card

Name: Michael Lutz

Email: (optional) MickeyLutz@gmail.Com

☐ Add me to the mailing list (please provide email or mailing address):

Comments/Issues: (Use additional sheets if necessary)

1) There has been a LACK OF INFORMATION regarding the need for the project. I'm wondering if the desire to restore ecosystem functions is a desire to turn our wetlands into a stormwater management plant. This relates to another concern:

2) That the current plan is to connect the creek to the wetlands. What will be the impact of this sensitive ecosystem receiving polluted waters from the city?

3) I am concerned about the fact that the plan is to remove stable and important aspects of the wetlands. In general, it seems that the plan is to engineer a wetlands, as opposed to working with the natural features of the land. Constant dredging to maintain an open tidal system is a) not consistent with "restoration" and not an expense that tax payers should undertake

Submit written comments by *October 23, 2012* to:

Mail: Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92618

Email: Donna.McCormick@icfi.com

*****All comments submitted will become part of the Public Record***

Ballona Wetlands Restoration Project

Advancing ecosystem health. Connecting communities with nature.

Comment Card

Name: _____

Email: (optional) _____

☐ Add me to the mailing list (please provide email or mailing address): _____

_____

Comments/Issues: (Use additional sheets if necessary) _____

Overall, the rapidity by which this project is being pushed through, the lack of information, the inadequacy of the plan, the lack of a PUBLIC HEARING is Very Concerning to Me.

Submit written comments by *October 23, 2012* to:

Mail: Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92618

Email: Donna.McCormick@icfi.com

*****All comments submitted will become part of the Public Record***

Ballona Wetlands Restoration Project

Advancing ecosystem health. Connecting communities with nature.

Comment Card

Name: Ingrid Mueller

Email: (optional) ingridinvenice@yahoo.com

☐ Add me to the mailing list (please provide email or mailing address):

Comments/Issues: (Use additional sheets if necessary) We NEED:

2 x Public Sit-Down Meetings
@ Convenient Times & locations
that are TRANSPARENT!

Extension is NEEDED for 90 days

Protest Signs:

LEAVE BALLONA ALONE!
TO HELP NATURE

NOT ANOTHER MALIBU LAGOON DISASTER!

NO BULLDOZING OF NATURE
LET FISH + BIRDS + FAUNA BE

Submit written comments by *October 23, 2012* to:

Mail: Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92618

Email: Donna.McCormick@icfi.com

*****All comments submitted will become part of the Public Record***

Ballona Wetlands Restoration Project

Advancing ecosystem health. Connecting communities with nature.

Comment Card

Name: Elizabeth Pollock

Email: (optional) president@delreyhome.org

☐ Add me to the mailing list (please provide email or mailing address):

Comments/Issues: (Use additional sheets if necessary)

I am president of the Del Rey Residents Association. Del Rey is the neighborhood east of Lincoln Blvd. between Jefferson Blvd + Washington Blvd. It is part of the City of Los Angeles.

On August 6, 2012, the MRCA's Ana Petrlic told me that the new Milton Street Park would have no new trees added because the Army Corps of Engineers was concerned that the tree roots might damage the levees. Therefore, I assume that there will be opposition to any proposal to remove the levees.

Also, my family has lived in Venice since the 1890's and I was raised by people who remember the 1938 flood that led to construction of the concrete streets. In 1938, Lincoln Blvd. became impassable. Any restoration project must provide for adequate stormwater management.

Submit written comments by ***October 23, 2012*** to:

Mail: Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92618

Email: Donna.McCormick@icfi.com

All comments submitted will become part of the Public Record

Ballona Wetlands Restoration Project

Advancing ecosystem health. Connecting communities with nature.

Comment Card

Name: Al Sattler

Email: (optional) asattler@icf.org

☒ Add me to the mailing list (please provide email or mailing address):

Comments/Issues: (Use additional sheets if necessary)

Mineral Rights?
Are the mineral rights owned by the State of California?
Or is there any possibility that mineral rights have been retained by an oil company, which could do drilling / fracking without notice?

Plan for sea level rise

Submit written comments by *October 23, 2012* to:

Mail: Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92618

Email: Donna.McCormick@icfi.com

*****All comments submitted will become part of the Public Record***

SIERRA CLUB
FOUNDED 1892
Angeles Chapter
Airport Marina Regional Group
3435 Wilshire Blvd., Ste. 320
Los Angeles, CA 90010

August 16, 2012

U.S. Army Corps of Engineers
Los Angeles District
915 Wilshire Blvd, Suite 1101
Los Angeles, CA 90017
Att:Col. Mark Toy Commander Los Angeles District
Att: Dr. Daniel P. Swenson
1416 9th St., 12th Floor

California Dept. of Fish & Game
1416 9th Street, 12th Floor
Sacramento, CA 95814
Att: Executive Director Charlton H. Bonham

Re: 2012 Notice of Joint EIS/EIR

This letter responds to the Notice of Intent to conduct a joint EIS/EIR pursuant to the National Environmental Policy Act and the California Environmental Protection Act at the Ballona Wetlands Ecological Preserve in the State of California, County of Los Angeles, in 2012.

The Club has resolved to support the joint EIR/EIS process noticed in the Federal Register on September 20, 2005 by the U.S. ACE Los Angeles District and the Santa Monica Bay Restoration Commission, a State Agency, as the local sponsor.

The position of the Club is that the new Notice of Intent placed in the Federal Register on July 25, 2012 contradicts and duplicates the former EIS noticed in 2005.

The Secretary of the Army has stated in writing that the 2005 joint EIS/EIR process is not terminated and is therefore current.

The reasoning of the resolution is as follows:

Another EIS process has been introduced by LA USACE that interferes with and contradicts the current process. The Corp has begun a new process that duplicates and reduces the scope of the 2005 Environmental Process, without first terminating it.

The two processes cannot exist concurrently, because of duplication, and the requirement for the first study to be completed. The first study has been fully funded by the U.S. Congress and the latter process has not.

The second process proposes to change the course of Ballona Creek, and to dredge and fill wetlands, prior to the completion of the first process and before the Corp can report its recommendations back to Congress.

Furthermore, the second process proposes to reintroduce tidal flow to a freshwater wetland system that was not historically connected to the to the ocean to the degree the new process implies.

The National Oceanic and Atmospheric Administration warned against this project, as it would destroy valuable upland habitat.

The U.S. Clean Water Act designates four separate Section 303(d) Impaired Waterways that are present.

- Marina del Rey
- Upper Ballona Creek
- Ballona Creek Estuary
- Ballona Wetlands

The 2012 Notice proposes to divert one Impaired Waterway into another. It is illegal to further impair a waterway that is already impaired.

The resolution reads as follows and represents the Sierra Club official stance on both of the aforesaid environmental processes.

RESOLUTION

Whereas, the Airport Marina Regional Group of the Angeles Chapter Sierra Club has jurisdiction over Marina del Rey,

Whereas, The Club supports National Planning for Environmental Restoration, Recreational Boating, Storm Damage Reduction, and is Supportive of other purposes the Congress of the United States intended for Marina del Rey such as a youth hostel and camping facilities.

Whereas, The U.S. Army Corp of Engineers Environmental Impact Statement process noticed in the Federal Register in 2005 supports the same aforesaid purposes that the Sierra Club supports,

Therefore, be it resolved by the Airport Marina Regional Group, Angeles Chapter of Sierra Club, supports the completion of the 2005 Environmental Review process Noticed in the Federal Register to conduct a review of Marina del Rey: September 20, 2005 (Volume 70, Number 181) [Notices] [Page 55116-55117]

END

The Sierra Club supports a full range of alternatives for the restoration, which is called for in the 2005 Notice for Environmental Impact Statement pursuant to the National Environmental Policy Act. The Sierra Club does not support a limited range of alternatives as proposed by the 2012 Notice for an Environmental Impact Statement.

Sincerely,

Joe Young

Joe Young, Chair
Airport Marina Group
(310) 822-9676

SIERRA CLUB
FOUNDED 1892
Angeles Chapter
Airport Marina Regional Group
3435 Wilshire Blvd., Ste. 320
Los Angeles, CA 90010

August 16, 2012

U.S. Army Corps of Engineers
Los Angeles District
915 Wilshire Blvd, Suite 1101
Los Angeles, CA 90017
Att:Col. Mark Toy Commander Los Angeles District
Att: Dr. Daniel P. Swenson
1416 9th St., 12th Floor

California Dept. of Fish & Game
1416 9th Street, 12th Floor
Sacramento, CA 95814
Att: Executive Director Charlton H. Bonham

Re: 2012 Notice of Joint EIS/EIR

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The Club has resolved to support the joint EIR/EIS process noticed in the Federal Register on September 20, 2005 by the U.S. ACE Los Angeles District and the Santa Monica Bay Restoration Commission, a State Agency, as the local sponsor.

The position of the Club is that the new Notice of Intent placed in the Federal Register on July 25, 2012 contradicts and duplicates the former EIS noticed in 2005.

The Secretary of the Army has stated in writing that the 2005 joint EIS/EIR process is not terminated and is therefore current.

The reasoning of the resolution is as follows:

Another EIS process has been introduced by LA USACE that interferes with and contradicts the current process. The Corp has begun a new process that duplicates and reduces the scope of the 2005 Environmental Process, without first terminating it.

The two processes cannot exist concurrently, because of duplication, and the requirement for the first study to be completed. The first study has been fully funded by the U.S. Congress and the latter process has not.

The second process proposes to change the course of Ballona Creek, and to dredge and fill wetlands, prior to the completion of the first process and before the Corp can report its recommendations back to Congress.

Furthermore, the second process proposes to reintroduce tidal flow to a freshwater wetland system that was not historically connected to the to the ocean to the degree the new process implies.

The National Oceanic and Atmospheric Administration warned against this project, as it would destroy valuable upland habitat.

The U.S. Clean Water Act designates four separate Section 303(d) Impaired Waterways that are present.

- Marina del Rey
- Upper Ballona Creek
- Ballona Creek Estuary
- Ballona Wetlands

The 2012 Notice proposes to divert one Impaired Waterway into another. It is illegal to further impair a waterway that is already impaired.

The resolution reads as follows and represents the Sierra Club official stance on both of the aforesaid environmental processes.

RESOLUTION

Whereas, the Airport Marina Regional Group of the Angeles Chapter Sierra Club has jurisdiction over Marina del Rey,

Whereas, The Club supports National Planning for Environmental Restoration, Recreational Boating, Storm Damage Reduction, and is Supportive of other purposes the Congress of the United States intended for Marina del Rey such as a youth hostel and camping facilities.

Whereas, The U.S. Army Corp of Engineers Environmental Impact Statement process noticed in the Federal Register in 2005 supports the same aforesaid purposes that the Sierra Club supports,

Therefore, be it resolved by the Airport Marina Regional Group, Angeles Chapter of Sierra Club, supports the completion of the 2005 Environmental Review process Noticed in the Federal Register to conduct a review of Marina del Rey: September 20, 2005 (Volume 70, Number 181) [Notices] [Page 55116-55117]

END

The Sierra Club supports a full range of alternatives for the restoration, which is called for in the 2005 Notice for Environmental Impact Statement pursuant to the National Environmental Policy Act. The Sierra Club does not support a limited range of alternatives as proposed by the 2012 Notice for an Environmental Impact Statement.

Sincerely,

Joe Young

Joe Young, Chair
Airport Marina Group
(310) 822-9676

AquaBioEnvironmental**Technologies**



4712 Admiralty Way, #156
Marina del Rey, California
90292 USA

Phone: 310.397.3114
Mobile: 310.418.1754
Fax: 310.862.6708
deana@aquabio.us
www.aquabio.us

DeAna Vitela-Hayashi | Director

JANICE HAHN
36TH DISTRICT, CALIFORNIA

2400 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, DC 20515
(202) 225-8220

Congress of the United States
House of Representatives
Washington, DC 20515–0536

July 31, 2012

The Honorable Jo-Ellen Darcy
Assistant Secretary of the Army (Civil Works)
108 Army Pentagon
Washington, DC 20310-0108

Dear Secretary Darcy,

I write in regards to an issue relating to the proposed Ballona Wetlands restoration project in Los Angeles, California.

It has come to my attention that members of the community are concerned that the announced comment period for scoping the Environmental Impact Statement/Environmental Impact Report will be too short to allow for full comment from the relevant experts and community members. With so much of the comment period falling during peak summer vacation months, the September 10, 2012 deadline might unintentionally diminish the quality of these important assessments.

The community must be able to have trust in the scope of the EIS/EIR so that they can confidently assess the right way to preserve and restore the Ballona Wetlands. As such, I urge you to extend the public comment period on scoping to 90 days, and to convene a public hearing at a time and place convenient for interested community members to make their voices heard.

Sincerely,

Janice Hahn

Janice Hahn
Member of Congress

NATIVE AMERICAN HERITAGE COMMISSION
915 CAPITOL MALL, ROOM 364
SACRAMENTO, CA 95814
(916) 653-6251
Fax (916) 657-5390
Web Site www.nahc.ca.gov
ds_nahc@pacbell.net

August 2, 2012

Mr. David Lawhead, Project Planner
California Department of Fish & Game
3883 Ruffin Road
San Diego, CA 92123

Re: SCH#2012071090 CEQA Notice of Preparation (NOP); draft Environmental Impact Report (DEIR) for the **Ballona Wetlands Restoration Project;** The Ballona Wetlands Ecological Reserve is located in the western portion of the City of Los Angeles (partially within unincorporated Los Angeles County), south of The City of Marina Del Rey and north of Playa Del Rey; approximately 1.5 miles west of Interstate 405 and approximately 0.25 miles east of Santa Monica Bay; Los Angeles County, California.

Dear Mr. Lawhead:

The Native American Heritage Commission (NAHC), the State of California 'Trustee Agency' for the protection and preservation of Native American cultural resources pursuant to California Public Resources Code §21070 and affirmed by the Third Appellate Court in the case of EPIC v. Johnson (1985: 170 Cal App. 3rd 604).

This letter includes state and federal statutes relating to Native American historic properties or resources of religious and cultural significance to American Indian tribes and interested Native American individuals as 'consulting parties' under both state and federal law. State law also addresses the freedom of Native American Religious Expression in Public Resources Code §5097.9. This project is also subject to California Government Code Section 65352.3 *et seq.*

The California Environmental Quality Act (CEQA – CA Public Resources Code 21000-21177, amendments effective 3/18/2010) requires that any project that causes a substantial adverse change in the significance of an historical resource, that includes archaeological resources, is a 'significant effect' requiring the preparation of an Environmental Impact Report (EIR) per the CEQA Guidelines defines a significant impact on the environment as 'a substantial, or potentially substantial, adverse change in any of physical conditions within an area affected by the proposed project, including ...objects of historic or aesthetic significance." In order to comply with this provision, the lead agency is required to assess whether the project will have an adverse impact on these resources within the 'area of potential effect (APE), and if so, to mitigate that effect. The NAHC did conduct a Sacred Lands File search of the project site, therefore 'area of potential effect' or APE, and Native American cultural resources were identified within the APE.

The NAHC "Sacred Sites,' as defined by the Native American Heritage Commission and the California Legislature in California Public Resources Code §§5097.94(a) and 5097.96. Items in

the NAHC Sacred Lands Inventory are confidential and exempt from the Public Records Act pursuant to California Government Code §6254 (r).

Early consultation with Native American tribes in your area is the best way to avoid unanticipated discoveries of cultural resources or burial sites once a project is underway. Culturally affiliated tribes and individuals may have knowledge of the religious and cultural significance of the historic properties in the project area (e.g. APE). We strongly urge that you make contact with the list of Native American Contacts on the attached list of Native American contacts, to see if your proposed project might impact Native American cultural resources and to obtain their recommendations concerning the proposed project. Pursuant to CA Public Resources Code § 5097.95, the NAHC requests cooperation from other public agencies in order that the Native American consulting parties be provided pertinent project information. Consultation with Native American communities is also a matter of environmental justice as defined by California Government Code §65040.12(e). Pursuant to CA Public Resources Code §5097.95, the NAHC requests that pertinent project information be provided consulting tribal parties, including archaeological studies. The NAHC recommends *avoidance* as defined by CEQA Guidelines §15370(a) to pursuing a project that would damage or destroy Native American cultural resources and Section 2183.2 that requires documentation, data recovery of cultural resources.

Furthermore, the NAHC if the proposed project is under the jurisdiction of the statutes and regulations of the National Environmental Policy Act (e.g. NEPA; 42 U.S.C. 4321-43351). Consultation with tribes and interested Native American consulting parties, on the NAHC list, should be conducted in compliance with the requirements of federal NEPA and Section 106 and 4(f) of federal NHPA (16 U.S.C. 470 *et seq*), 36 CFR Part 800.3 (f) (2) & .5, the President's Council on Environmental Quality (CSQ, 42 U.S.C 4371 *et seq.* and NAGPRA (25 U.S.C. 3001-3013) as appropriate. The 1992 *Secretary of the Interiors Standards for the Treatment of Historic Properties* were revised so that they could be applied to all historic resource types included in the National Register of Historic Places and including cultural landscapes. Also, federal Executive Orders Nos. 11593 (preservation of cultural environment), 13175 (coordination & consultation) and 13007 (Sacred Sites) are helpful, supportive guides for Section 106 consultation. The aforementioned Secretary of the Interior's *Standards* include recommendations for all 'lead agencies' to consider the historic context of proposed projects and to "research" the cultural landscape that might include the 'area of potential effect.'

Confidentiality of "historic properties of religious and cultural significance" should also be considered as protected by California Government Code §6254(r) and may also be protected under Section 304 of he NHPA or at the Secretary of the Interior discretion if not eligible for listing on the National Register of Historic Places. The Secretary may also be advised by the federal Indian Religious Freedom Act (cf. 42 U.S.C., 1996) in issuing a decision on whether or not to disclose items of religious and/or cultural significance identified in or near the APEs and possibility threatened by proposed project activity.

Furthermore, Public Resources Code Section 5097.98, California Government Code §27491 and Health & Safety Code Section 7050.5 provide for provisions for inadvertent discovery of human remains mandate the processes to be followed in the event of a discovery of human remains in a project location other than a 'dedicated cemetery'.

To be effective, consultation on specific projects must be the result of an ongoing relationship between Native American tribes and lead agencies, project proponents and their contractors, in the opinion of the NAHC. Regarding tribal consultation, a relationship built

around regular meetings and informal involvement with local tribes will lead to more qualitative consultation tribal input on specific projects.

Finally, when Native American cultural sites and/or Native American burial sites are prevalent within the project site, the NAHC recommends 'avoidance' of the site as referenced by CEQA Guidelines Section 15370(a).

If you have any questions about this response to your request, please do not hesitate to contact me at (916) 653-6251.

Sincerely,

Dave Singleton
Program Analyst

Cc: State Clearinghouse

Attachment: Native American Contact List

Native American Contact
Los Angeles County
August 2, 2012

LA City/County Native American Indian Comm
Ron Andrade, Director
3175 West 6th St, Rm. 403
Los Angeles , CA 90020
randrade@css.lacounty.gov
(213) 351-5324
(213) 386-3995 FAX

Gabrielino Tongva Nation
Sam Dunlap, Chairperson
P.O. Box 86908 Gabrielino Tongva
Los Angeles , CA 90086
samdunlap@earthlink.net

(909) 262-9351 - cell

Ti'At Society/Inter-Tribal Council of Pimu
Cindi M. Alvitre, Chairwoman-Manisar
3094 Mace Avenue, Apt. B Gabrielino
Costa Mesa, , CA 92626
calvitre@yahoo.com
(714) 504-2468 Cell

Gabrielino Tongva Indians of California Tribal Council
Robert F. Dorame, Tribal Chair/Cultural Resources
P.O. Box 490 Gabrielino Tongva
Bellflower , CA 90707
gtongva@verizon.net
562-761-6417 - voice
562-761-6417- fax

Tongva Ancestral Territorial Tribal Nation
John Tommy Rosas, Tribal Admin.
Private Address Gabrielino Tongva
,
tattnlaw@gmail.com
310-570-6567

Gabrielino-Tongva Tribe
Bernie Acuna
1875 Century Pk East #1500 Gabrielino
Los Angeles , CA 90067
(619) 294-6660-work
(310) 428-5690 - cell
(310) 587-0170 - FAX
bacuna1@gabrieinotribe.org

Gabrieleno/Tongva San Gabriel Band of Mission
Anthony Morales, Chairperson
PO Box 693 Gabrielino Tongva
San Gabriel , CA 91778
GTTribalcouncil@aol.com
(626) 286-1632
(626) 286-1758 - Home
(626) 286-1262 -FAX

Gabrielino-Tongva Tribe
Linda Candelaria, Chairwoman
1875 Century Pk East #1500 Gabrielino
Los Angeles , CA 90067
lcandelaria1@gabrielinoTribe.org
626-676-1184- cell
(310) 587-0170 - FAX

This list is current only as of the date of this document.

Distribution of this list does not relieve any person of the statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resources Code and Section 5097.98 of the Public Resources Code.

This list is applicable for contacting local Native Americans with regard to cultural resources for the proposed SCH#2012071090; CEQA Notice of Preparation (NOP); draft Environmental Impact Report (DEIR) for the Ballona Wetlands Restoration Project; located near the City of Marina Del Rey and Santa Monica Bay and part of the Ballona Creek watershed; los Angeles County, California .

Santa Ynez Tribal Elders Council
Freddie Romero, Cultural Preservation Conslnt
P.O. Box 365 Chumash
Santa Ynez , CA 93460
freddyromero1959@yahoo.
805-688-7997, Ext 37

Gabrieleno Band of Mission Indians
Andrew Salas, Chairperson
P.O. Box 393 Gabrielino
Covina , CA 91723
(626) 926-4131
gabrielenoindians@yahoo.
com

This list is current only as of the date of this document.

Distribution of this list does not relieve any person of the statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resources Code and Section 5097.98 of the Public Resources Code.

This list is applicable for contacting local Native Americans with regard to cultural resources for the proposed SCH#2012071090; CEQA Notice of Preparation (NOP); draft Environmental Impact Report (DEIR) for the Ballona Wetlands Restoration Project; located near the City of Marina Del Rey and Santa Monica Bay and part of the Ballona Creek watershed; los Angeles County, California .

Jones, Tanya

Subject: RE: ACE and Del Rey Lagoon (UNCLASSIFIED)

-----Original Message-----
From: Wm. Ballough [mailto:williamb7@Verizon.net]
Sent: Thursday, August 02, 2012 6:02 PM
To: Swenson, Daniel P SPL
Cc: Julie Inouye; beverlyponder@verizon.net; 'Eric Andres'
Subject: ACE and Del Rey Lagoon

I understood that ACES was originally asked to include Del Rey Lagoon in the study, is not to be included. As you know, the corps cut the lagoon off from the creek in connection with its channelization. The local ACE office was very helpful to me in my study of the lagoon's history.

ACE needed use of the north bank of the lagoon to dredge and improve the creek. Because the land beneath its waters were privately owned, it apparently filled the north end in exchange for the right to bring its dredge across it, and to dispose of dredgings. The lagoon was also used during that period for the wholesale dumping of construction debris around its banks.

For the next 20 years the lagoon was used for children boating instruction. However, it silted up and became unusable for boating. With the silting came the unsightly and odiferous algae. The surrounding streets drain into the lagoon. The city has mentioned a possible clean water project to mitigate runoff, but has not addressed the major lagoon street drain at 63rd and Pacific. That drain floods electrical vaults in the street and incidentally, corroded my underground electrical service breakers, and the debris no doubt ended up in the lagoon.

Because of its silted condition the lagoon needs to be dredged, which could be done in connection with the wetland dredging.

Is there a possibility that the lagoon could still be included in the ACE study?

Classification: UNCLASSIFIED
Caveats: NONE

From:	Howard Hackett
To:	McCormick, Donna
Subject:	Ballona wetlands Restoration Project
Date:	Friday, August 03, 2012 4:46:18 PM

Donna McCormick,
Per my input on the restoration project

Ballona Wetlands Restoration Project

C/O Donna McComick

1 Ada, Suite 100
Irvine, CA 92816

Dear Donna McCormick

My name is Howard Hackett. I have been a resident of the area for my whole life. The last decade I have been an active member of the Ballona Creek Watershed Task Force. During this time I have had the opportunity to see all kinds of folks in all kind of actions. I might add, that much that has gone on in this task force has been negative. Although I will not name names from all the negative forces, I will express my opinion that most of this negativity comes from folks that don't have complete knowledge of the goals. The opinions of these diverse groups lead me to believe that "their" convictions lead to self gratification on what the project can do for them, and not the benefit of the whole. "It is my way or it is wrong"

They try so many stupid tricks to make their points, that the goals of any project is lost. We have heard so many stories of killed "cute" creatures crossing streets.

Therefore, all projects are delayed, because of law suits etc, or threatened suits that eat up precious time and energy that we never see any positive results. My one suggestion is to listen to these "extreme" experts only one short time, then get on with the project.

Thank you for listening

Howard Hackett

When I see an adult on a bicycle, I do not despair for the future of the human race!!
H.G. Wells

Jones, Tanya

From: Anita Gutierrez [mailto:agutierrez@planning.lacounty.gov]
Sent: Tuesday, August 07, 2012 5:08 PM
To: McCormick, Donna
Subject: Ballona Wetlands Project

Hi Donna,

Can you please add me to the mailing list to receive information on this project. Thanks so much. Contact information listed below

---

Anita Gutierrez
Special Projects Section
Department of Regional Planning
320 W. Temple Street
Los Angeles, CA 90012
(213) 974-4813

Jones, Tanya

-----Original Message-----
From: Swenson, Daniel P SPL [mailto:Daniel.P.Swenson@usace.army.mil]
Sent: Monday, August 13, 2012 11:31 AM
To: Susan Herrschaft
Cc: McCormick, Donna; Diana Hurlbert
Subject: RE: Ballona DEIS/EIR Information (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Sue,

Other than our public notice mailing list (you can sign up for LA County public notices at our website below), we don't maintain a distribution list for specific projects. I am cc'ing the applicant's agent who can add you to whatever lists they maintain.

sincerely,

Daniel P. Swenson, D.Env.
Chief, LA & San Bernardino Counties Section U.S. Army Corps of Engineers
Attn: Regulatory Division
915 Wilshire Blvd.
Los Angeles, CA 90017

213-452-3414
213-452-4196 fax
http://www.spl.usace.army.mil/Missions/Regulatory.aspx

Assist us in better serving you!
You are invited to complete our customer survey, located at the following link: http://per2.nwp.usace.army.mil/survey.html

Note: If the link is not active, copy and paste it into your internet browser.

-----Original Message-----
From: Susan Herrschaft [mailto:sherrschaft@yahoo.com]
Sent: Monday, August 13, 2012 10:41 AM
To: Swenson, Daniel P SPL
Subject: Ballona DEIS/EIR Information

Hello Daniel,
I understand you are the person to contact to be placed on the mailing list for information regarding the upcoming DEIS/EIR for Ballona. I plan on attending the scoping meeting this week, but wanted to make sure I could receive any additional information that is distributed.

I am a resident of the Villa Marina neighborhood directly adjacent to Ballona Area C. I am looking forward to learning more about the project and offering our perspective.

If you would add my email address to the list, I would greatly appreciate it.

Thank you,
Sue Herrschaft
sherrschaft@yahoo.com

Classification: UNCLASSIFIED
Caveats: NONE

Jones, Tanya

Subject: RE: Ballona " Restoration"-My property continuous with Area B

From: Colleen Phillips [mailto:cpmax82@hotmail.com]
Sent: Monday, August 13, 2012 7:31 PM
To: Elena Tuttle
Subject: Ballona " Restoration"-My property continuous with Area B

Today is Aug 14th and I have just found out about the scoping meeting on the 16th. I have to work that evening and I am amazed that ,at the very least, people who's property is continuous with the project were not informed about the meeting a month ago . This can only be an effort to jam the project through without public input ! I may now have to be the front for a lawsuit ! This time frame is soooooooo outrageous !

Colleen Phillips
8100 Billowvista Drive
Playa Del Rey, Ca

Jones, Tanya

Subject: RE: Ballona Wetlands Restoration Plan DRAFT EIR re-submission letter - Vista del Mar Neighbors Association of Playa del Rey

-----Original Message-----
From: Julie Inouye [mailto:julieinouye@me.com]
Sent: Monday, August 13, 2012 9:04 AM
To: Shelley Luce; McCormick, Donna
Cc: Bill Rosendahl; Michael Bonin; NATE KAPLAN
Subject: Ballona Wetlands Restoration Plan DRAFT EIR re-submission letter - Vista del Mar Neighbors Association of Playa del Rey

Dear Shelley & Donna,

Please find a copy of the scanned pdf letter from the Vista del Mar Neighbors Association of Playa del Rey.
This letter was originally sent to Fish & Games in 2009, when they were requesting input from the community for the BW Restoration.
The letter to Fish and Games is the same letter we would write today, in 2012, so please take this as our letter on record of 8/2012.

We are submitting this same letter to be a part of the preliminary outline of the Draft EIR for the Restoration of the Ballona Wetlands.
Our association is comprised of constituents whose homes and backyards are directly adjacent to the Ballona Wetlands.

Currently, I am the Chair of the Playa del Rey Development Committee, appointed by Councilmember Bill Rosendahl.
Our committee works closely with Councilmember Bill Rosendahl and his staff, in protecting our quality of life and to protect our community from over development.
We strive to mantain the quaint village feel that we all appreciate and moved here for.

We thank you for your hard work in organizing all of the entities involved and we look forward to being an integral part of the Ballona Wetlands Restoration Plan.

Warmest Regards,

Julie Inouye & Dr. Michael Rubottom
Co-founders of the Vista del Mar Neighbors Association (1983 est.)
310/306.1487
310/702.9239
julieinouye@me.com



VISTA DEL MAR NEIGHBORS

COPY

October 20, 2009

Dept. of Fish & Game
4949 Viewridge Avenue
San Diego, CA 92123
Information: (858) 467-4201
FAX: (858) 467-4299
Regional Manager: Ed Pert

RE: GATEWAY OF WETLANDS & parking lot

VDM Neighbors played an important role in the efforts to save the Ballona Wetlands. In fact, many of our neighbors were, and continue to be, members of the Friends of Ballona Wetlands. For this reason, we appreciate all you have done to protect our precious wetlands. We also agree that the parking lot should be upgraded, but we recommend that the primary use should be for the community residents and customers of the local merchants.

Unfortunately, the proposed Gateway use will have a substantial negative effect on our community and our merchants. Traffic is at maximum and parking is at a premium in this area. Increased truck and vehicle traffic will exacerbate this condition. In addition, the outlet on Culver Place to Vista del Mar is one way. Additional traffic will have difficulty turning left on to Vista del Mar, given the Argonaut street intersection and the close proximity to Culver Blvd. There is no traffic light, stop sign or other traffic control to accommodate the additional traffic that will be generated by The Gateway. The impact on our residential community will be significant, including the effect of this additional traffic on public safety, especially children utilizing the nearby public park and baseball field

Ironically, The Gateway will also have a negative effect on the sensitive ecosystem in the Wetlands. Additional vehicle traffic, as well as large busses, and their emissions will increase the "carbon footprint" in the area. Similarly, the residents (another endangered species) will not be benefited by more car and bus traffic, adding both carbon emissions and reducing available public parking for themselves, visitors and customers of the local businesses.

6508 VISTA DEL MAR PLAYA DEL REY CA 90293
310.306.1487 julieinouye@wecahre.org

Under these circumstances, we strongly urge both the Fish and Game and the Coastal Conservancy to reconsider the current use, and to locate The Gateway of the Wetlands on Fiji Way, County of Los Angeles.

We look forward to your reply.

Sincerely,

Julie Inouye and Michael Rubottom M.D.
Founders
Vista del Mar Neighbors Association (est. 1983)

Cc: Assemblyman Ted Lieu
Senator Jenny Oropeza
Councilman Bill Rosendahl

Jones, Tanya

From: cynthia cannady [mailto:cccannady@gmail.com]
Sent: Tuesday, August 14, 2012 1:39 PM
To: McCormick, Donna
Subject: comment

Destroying the Ballona Wetlands would be a terrible mistake. Any politician who supports this kind of destruction will lose my vote and support. We need to do even more to protect our natural world in the LA area. The public trails provide recreation and pleasure to people in central and South LA. How COULD anyone sacrifice nature, citizen enjoyment, our ecosystem and healthy environment for short term objectives? The natural part of Los Angeles is our children's heritage. Don't destroy it.
Cynthia Cannady
2828 Westshire Drive
Los Angeles, Ca. 90068

Jones, Tanya

From: Lisa A de Vincent [divadevincent@me.com]
Sent: Tuesday, August 14, 2012 10:44 PM
To: McCormick, Donna
Subject: Save the Ballona Wetlands

I support keeping pollution and construction out of the Ballona Wetlands. I lived in Huntington Beach when the Coastal Commission let builders put up a neighborhood in the Bolsa Chica Wetlands, that fiasco is still ongoing. We have so few semi-natural places left on the coast of Southern CA, can they just walk away from this and if they need to build and drege can they do it in an area that isn't a wetlands?
Message to the State - We are killing off the last few natural resources that we have once they're gone that's it. That does have an impact on the life cycle even if it doesn't affect you at your desk let the scientists and those that work on that property guide the outcome.

Lisa de Vincent
IWOSC Board Member
Columnist Santa Monica Star
http://www.linkedin.com/in/lisadevincent
writer/copywriter/proofreader
divadevincent@me.com
424-208-3621
Sent from iCloud

Jones, Tanya

From: art lee [mailto:aprilia1@gmx.com]
Sent: Tuesday, August 14, 2012 2:43 PM
To: McCormick, Donna
Subject: Ballona Wetlands

Donna,

I'm sure you have assistants reading your many emails since I'm sure you are very busy.

All I want to say is that I have gone to the wetlands for many years with my family and we have enjoyed it immensely. I understand that it will be bulldozed in guise of "restoration".

Please do not turn it into a urban polluted drainage dump. A wetland is a biodiverse ecosystem that supports a wide variety of animals and species that has been here well before man took it over. We need to keep wild areas wild or we will lose all sense of nature. Please protect it for our future and our childrens.

Sincerely,

Art Lee
A concerned citizen and nature lover.

Jones, Tanya

From: Colleen Phillips [mailto:cpmax82@hotmail.com]
Sent: Tuesday, August 14, 2012 5:09 PM
To: McCormick, Donna
Subject: Ballona Restoration EIR

Dear Ms. McCormick,

Even though my property is continuous with Area B, I just happened to find out about the upcoming scoping meeting On Aug 16 and will not be able to attend because of work obligations and such lack of advance notice . I do have to wonder why ,at the very least , the people who live immediately adjacent to the project were not informed of the meeting ?? Since I can not attend, I would like the EIR to address :

1. How will the existing wildlife and immediate neighbors health and safety be addressed during these years ??
2. Will the project affect the stability of the PDR Bluffs overlooking the project ??
3. How will the new containment walls on either side of Culver Blvd redirect the traffic noise ??
4. What are the potential air quality effects of the project and the impact on local residents breathing this for a period of years ??
5. Can't the existing Ballona Wetlands/Creek be restored without the bulldozers - add more inlet channels from the existing Creek and remove invasive vegetation without killing everything currently there ??

Why wasn't the community surrounding the project given more notice about the meeting ??? I think we both know why ……

Colleen Phillips, PharmD
8100 Billowvista Drive
Playa Del Rey, Ca

Jones, Tanya

From: Karen Thiers [mailto:kthiers@sbcglobal.net]
Sent: Tuesday, August 14, 2012 3:07 PM
To: McCormick, Donna
Subject: I oppose the current proposal for the Ballona Wetlands

There are few things more enjoyable than seeing animals in nature and, with the over-building of the Marina as well as the L.A. area, places where we can observe nature are becoming more scarce every day. This is why it's important to keep the wildlife habitat in the Wetlands as healthy and as undisturbed as possible and to have trails available for people who could not easily make it into the Santa Monica Mountains or other local nature areas.

I regularly commute through that area and over the creek on Culver Boulevard and the amount of junk and oil slick on top of the water is completely disgusting. That has no business contaminating the wetlands where many birds and mammals make their homes and migrating birds stop to rest. Please consider other plans before starting work on the area.

Thank you,

Karen Thiers

Jones, Tanya

From: Ashley Wilson [mailto:wilsonashley_@hotmail.com]
Sent: Tuesday, August 14, 2012 12:55 PM
To: McCormick, Donna
Subject:

Dear Ms. McCormick,

I wanted to put in a comment about how much i object to plans to remove trails from the Ballona Wetland and filter any street drainage into the area. The plan should be to protect the area future not damage it more.

Sincerely,

Ashley Wilson

Jones, Tanya

From: From CGA [mailto:cgabiz@hotmail.com]
Sent: Thursday, August 16, 2012 10:17 PM
To: McCormick, Donna
Subject: re: Ballona Wetlands "restoration"

Ballona is a biodiverse ecosystem and has three natural habitat types: salt marsh, freshwater marsh, and wildflower and sage covered uplands. Under the State "restoration" plan, two of those three natural habitats and their wildlife will be mostly eliminated. I support the Ballona Ecosystem Education Project's (BEEP) alternative plan that protects the three existing wildlife habitats and our trails, allows some re-wetting of appropriate portions of the wetlands, and brings in clean water from the ocean—approximating conditions existing 200 years ago.

Sincerely,

Carolyn Anderson
Los Angeles

cf: http://ballona-news.blogspot.com/2012/08/first-big-public-hearing-on-ballona.html

Jones, Tanya

From: Christopher McKinnon [mailto:chrispm@afewgoodideas.com]
Sent: Thursday, August 16, 2012 3:04 PM
To: McCormick, Donna
Subject: Comments Ballona Wetlands Restoration Project

Ballona Wetlands Restoration Project

Although I laud the restoration of these important wetlands I fear that any use of large mechanical earth moving equipment will do more damage to the plant and animal environment then good. Please employ 100's of union manual laborers and trainees to do this work by hand. If any power equipment is used it should be powered by natural gas or clean diesel.

Thank you,

Christopher McKinnon

Los Angeles, CA 90066

Jones, Tanya

From: Lucien Plauzoles [mailto:plauzoles@me.com]
Sent: Thursday, August 16, 2012 11:09 PM
To: McCormick, Donna
Cc: Ellen Thayer Vahan; Adrian Douglas; Chuck Almdale; Mary Prismon; Lillian Johnson; Liz Galton; Cindy Schotté; Jane Beseda; Chuck Bragg; Jean Garrett
Subject: Ballona restoration "meeting"

Dear Ms. McCormick, I took time off today to attend the "scoping" meeting at the Fiji Way Edison parking lot.
I was very surprised by the lack of solid information available from the agency and consultant teams.
What I noticed was that all personnel present were well trained in conflict avoidance, to the expense of solid information.
Is it because I walked into the parking area at the same time as Marcia Hanscom that I was "dodged" on every question?

I actively participated in the Ballona Watershed task force 7-11 years ago. I was accustomed to rather straight, serious answers.
When I keyed in the linked www.ballonarestoration.org address from Aug. 13th through 16th, I was not able to get ANY information.
Are we feeding Marcia? (...who was standing in the parking lot when I drove in, gathering an audience?)

Please give me some solid links that tell me what has really happened in the past 5 years at the meetings we either could not or declined to attend. What exactly are the alternatives being considered, ...or are they really not even set as alternatives as one of the SMBRC representatives vaguely said? Our only information about alternatives under consideration has been gleaned from Ballona Renaissance's newsletters.

We are active, funding stakeholders in the Ballona restoration process. We are active in making Ballona relevant to the residents of the entire watershed through our educational activities with Friends of Ballona.

If you refer to many of the existing documents on line and in the written record, we, as a group of approximately 1,000 active stakeholders, have a moderate record of careful examination of scientific and political data on most questions. We would like to either sustain or try to oppose Ballona restoration projects. We truly would like to have more information on the state of the Ballona restoration project before it is cast in concrete by a consultant. However, we have no idea of the "state of affairs" from this evening's meeting. It seemed to be an exercise in decision/question avoidance.

I was, this evening, surprised by the "fill in an opinion card" response to any question I might pose, whether it might, in some time, be controversial or not. The information presented was not even sketchy--it was not a 10th of what was presented on your company's/CA F and G's website!

Granted, avoidance of controversy makes decision-making smoother, however, your consultancy as well as any agency owes us more!

Would it be of interest for a representative of your firm to make a short presentation at one of our monthly evening meetings, starting October? We meet at the Ken Edwards Center in Santa Monica on the first Tuesday of each month, (Oct, Nov, Dec, Feb, Mar Apr May)? Please let me know with a few weeks' notice if there is any interest.

Lucien (Lu) Plauzoles, M.S.
Co-chair Conservation

Jones, Tanya

To: McCormick, Donna
Subject: RE: Fwd: BALLONA WETLANDS Restoration; Public Process Thwarted

From: patricia mc pherson<mailto:patriciamcpherson1@verizon.net>
Sent: Thursday, August 16, 2012 07:51
To: Scott Valor<mailto:svalor@santamonicabay.org>
Cc: jd@johnanthonydavis.com<mailto:jd@johnanthonydavis.com> ; Hanscom Marcia<mailto:wetlandact@earthlink.net> ; bill.rosendahl@lacity.org<mailto:bill.rosendahl@lacity.org> ; sschuchat@scc.ca.gov<mailto:sschuchat@scc.ca.gov> ; jeanette@culverevents.com<mailto:jeanette@culverevents.com> ; Roy VanDeHoek<mailto:robertvandehoek@yahoo.com> ; David Warren<mailto:davidw20003@yahoo.com> ; Ferrazzi Paul<mailto:razzip1@ca.rr.com> ; Joe Young<mailto:joengeri@ca.rr.com> ; john.laird@resources.ca.gov<mailto:john.laird@resources.ca.gov> ; bill.lockyer@treasurer.ca.gov<mailto:bill.lockyer@treasurer.ca.gov> ; jeanne.H.Imamura@usace.army.mil<mailto:jeanne.H.Imamura@usace.army.mil>
Subject: Fwd: BALLONA WETLANDS Restoration; Public Process Thwarted

TO: ALL SANTA MONICA BAY RESTORATION COMMISSION- Commissioners & Alternates ;
ALL BAY WATERSHED COUNCIL
% Scott Valor acting on behalf of SMBRC/BAY WATERSHED COUNCIL
C/O- Scott Valor is requested to send electronic copy of this message to all parties listed above.

The parties listed above, in the past, have not received written comments delivered by the public and stakeholders at EITHER the SMBRC Governing Board Meetings and/or Executive Committee Meetings. The website for SMBRC has not posted, as requested, any and all public comments from the meetings. Written public comments delivered at the SMBRC Meetings have also had no response from SMBRC to the public. (One GC query/comment letter had internal SMBRC intercommunication but was only rendered to the public via a Public Record Act request.) The failure by SMBRC to provide any and all public comments from these meetings to the parties listed above has created a disconnect of information between the public and this state agency that is contrary to the mission and goals of the this state agency.

RE: SMBRC MEETING AUGUST 16, 2012 - PUBLIC COMMENT Pertaining to the Ballona Wetlands Restoration Process - A Failed Process By SMBRC

FROM: GRASSROOTS COALITION, Patricia McPherson-President

Begin forwarded message:

From: patricia mc pherson <patriciamcpherson1@verizon.net<mailto:patriciamcpherson1@verizon.net>>
Subject: BALLONA WETLANDS Restoration; Public Process Thwarted
Date: August 2, 2012 12:37:36 PM PDT
To: sschuchat@scc.ca.gov<mailto:sschuchat@scc.ca.gov>, dwayman@scc.ca.gov<mailto:dwayman@scc.ca.gov>, npeterson@scc.ca.gov<mailto:npeterson@scc.ca.gov>, carmen@scc.ca.gov<mailto:carmen@scc.ca.gov>
Cc: john.laird@resources.ca.gov<mailto:john.laird@resources.ca.gov>, john@sco.ca.gov<mailto:john@sco.ca.gov>, ana.matosantos@dof.ca.gov<mailto:ana.matosantos@dof.ca.gov>, billrosendahl@aol.com<mailto:billrosendahl@aol.com>, bill.lockyer@treasurer.ca.gov<mailto:bill.lockyer@treasurer.ca.gov>,

jeanne.h.Imamura@usace.army.mil<mailto:jeanne.h.Imamura@usace.army.mil>,
hamilton.cloud@mail.gov<mailto:hamilton.cloud@mail.gov>,
adolfo_bailon@boxer.senate.gov<mailto:adolfo_bailon@boxer.senate.gov>,
michael_davies@feinstein.senate.gov<mailto:michael_davies@feinstein.senate.gov>, Kulla Norman
<norman.kulla@lacity.org<mailto:norman.kulla@lacity.org>>

To: Coastal Conservancy
Attn. All Governing Board Members and Alternates

From: Grassroots Coalition, Patricia McPherson, President

RE: Complaint and Request re: Support to the J. Davis 3/29/12 REQUEST TO RESCIND APPROVAL FOR STAFF RECOMMENDATION APPROVAL ON 1/19/12 awarding $6,490,00. for: FILE NO. 04-088- BALLONA WETLANDS RESTORATION ENGINEERING AND TECHNICAL STUDIES and, Request for the Coastal Conservancy to stop its interference in the approved and ongoing 2005 Joint EIS/EIR process regarding restoration of the Ballona Wetlands Ecological Preserve.

Respectfully submitted,
Patricia McPherson, Grassroots Coalition

_____

_____

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_____

TO: ALL SANTA MONICA BAY RESTORATION COMMISSION- Commissioners & Alternates ;
ALL BAY WATERSHED COUNCIL
% Scott Valor acting on behalf of SMBRC/BAY WATERSHED COUNCIL
C/O- Scott Valor is requested to send electronic copy of this message to all parties listed above.

The parties listed above, in the past, have not received written comments delivered by the public and stakeholders at EITHER the SMBRC Governing Board Meetings and/or Executive Committee Meetings. The website for SMBRC has not posted, as requested, any and all public comments from the meetings. Written public comments delivered at the SMBRC Meetings have also had no response from SMBRC to the public. (One GC query/comment letter had internal SMBRC intercommunication but was only rendered to the public via a Public Record Act request.) The failure by SMBRC to provide any and all public comments from these meetings to the parties listed above has created a disconnect of information between the public and this state agency that is contrary to the mission and goals of the this state agency.

RE: SMBRC MEETING AUGUST 16, 2012 - PUBLIC COMMENT Pertaining to the Ballona Wetlands Restoration Process - A Failed Process By SMBRC

FROM: GRASSROOTS COALITION, Patricia McPherson-President

Begin forwarded message:

> From: patricia mc pherson <patriciamcpherson1@verizon.net>
> Subject: BALLONA WETLANDS Restoration; Public Process Thwarted
> Date: August 2, 2012 12:37:36 PM PDT
> To: sschuchat@scc.ca.gov, dwayman@scc.ca.gov, npeterson@scc.ca.gov,
> carmen@scc.ca.gov
> Cc: john.laird@resources.ca.gov, john@sco.ca.gov,
> ana.matosantos@dof.ca.gov, billrosendahl@aol.com,
> bill.lockyer@treasurer.ca.gov, jeanne.h.Imamura@usace.army.mil,
> hamilton.cloud@mail.gov, adolfo_bailon@boxer.senate.gov,
> michael_davies@feinstein.senate.gov, Kulla Norman
> <norman.kulla@lacity.org>
>
>
> To: Coastal Conservancy
> Attn. All Governing Board Members and Alternates
>
> From: Grassroots Coalition, Patricia McPherson, President
>
> RE: Complaint and Request re: Support to the J. Davis 3/29/12 REQUEST
> TO RESCIND APPROVAL FOR STAFF RECOMMENDATION APPROVAL ON 1/19/12
> awarding $6,490,00. for: FILE NO. 04-088- BALLONA WETLANDS
> RESTORATION ENGINEERING AND TECHNICAL STUDIES and, Request for the Coastal Conservancy to stop its interference in the approved and ongoing 2005 Joint EIS/EIR process regarding restoration of the Ballona Wetlands Ecological Preserve.
>
> Respectfully submitted,
> Patricia McPherson, Grassroots Coalition
>
>
>
>
>
>
>

FROM: Grassroots Coalition, **August 2, 2012**
Patricia McPherson, President
Patriciamcpherson1@verizon.net

TO:
California Coastal Conservancy
Attn. Executive Director, San Schuchat &
All Governing Board Member and Alternates

CC
John Chiang- CA. State Controller
Matosantos- CA. Dept. of Finance Director
Bill Lockyer- CA. State Treasurer
John Laird- Dept. of Natural Resources
U.S. Army Corps of Engineers Attn. Commander Mark Toy
U.S. Senator Barbara Boxer
U.S. Congress Person Maxine Waters
L.A.Councilman Bill Rosendahl

RE: Complaint- Supporting the 3/29/12 REQUEST TO RESCIND APPROVAL FOR STAFF RECOMMENDATION APPROVAL ON 1/19/12 awarding $6,490,00. for: FILE NO. 04-088-

BALLONA WETLANDS RESTORATION ENGINEERING AND TECHNICAL STUDIES

The following paper from Grassroots Coalition (GC) represents GC's opinion of its findings and data support garnered via the Public Record Act and the Freedom of Information Act.

This document also requests the Coastal Conservancy to stop its illegitimate interference in the approved and ongoing 2005 Joint EIS/EIR process between the Sponsor-- Santa Monica Bay Restoration Commission (SMBRC)/ LA County Flood Control and, the U.S. Army Corps of Engineers.

The Coastal Conservancy, using its control over public bond money, has shut out the public process and taken its influence as a financially powerful board member of the SMBRC and partner of the California Department of Fish & Game (DFG), the lead agency of the publically owned Ballona Wetlands—to fund a process that is contradictory to the 2005 federal process that was requested by Congress.

The Coastal Conservancy is propelling a bait and switch – a NEW Joint EIR/EIS process and a NEW Notice of Intent (NOI) that undermines and attempts to extinguish the current 2005 Joint EIS/EIR APPROVED PROCESS with its attendant safeguards of multiple habitat restoration alternatives.

The Coastal Conservancy is instead, illegitimately propelling a singular outcome that stops restoration of Ballona and protection of its endangered species to instead convert the habitat into a non-historical dredged out estuarine habitat that promotes LA Port expansion and other financial deals.

Background:
In 2004, Ballona Wetlands acreage was purchased via PUBLIC funding for approximately $140 million. **The land is owned by the public** and is currently administered by the California Dept. of Fish and Game (freshwater marsh portion by the State Lands Commission) .

Important, new information contained herein reflects a Coastal Conservancy (CC) Public Record Act (PRA) response consisting of numerous heretofore undisclosed CC documents contained on a CD. The CD was provided after the 1/19/12 CC Governing Board Hearing in Los Angeles, CA. and, after the CC Governing Board's Hearing in Ventura, CA. on 3/29/12.

I.
The Coastal Conservancy PRA CD provides evidence to show that misleading and/or incorrect information was presented in the Staff Recommendation of 1/19/12 (File No. 04-088)

The newly disclosed Coastal Conservancy documents (CD) reveal:

A. potential misuse of public bond money (Prop. 12, PRC 5096.352 (f) and or (b)(1));
B. lack of disclosure, lack of public process and transparency of process regarding the Coastal Conservancy's involvement and; associations with other agencies --federal- US Army Corps of Engineers (USACE) and; state agencies and; a private nonprofit- the Santa Monica Bay Restoration Foundation (Foundation) that pertain to Ballona Wetlands in Los Angeles, CA.
C. Prop. 12 (Number 172 of Dept. of Natural Resources Listing of Prop. 12 bond grants; 3760-30203-0005(2)(B)07) Coastal Conservancy bond grant to The Southern California Coastal Water Research Project (SCWRP) -Ballona Wetlands Restoration. The Coastal Conservancy, contrary to the bond grant language and intention of allowing for a "scientific advisory committee" (SAC) to review and advise regarding **'enhancement'** plans for the restoration goals of Ballona Wetlands; the Coastal Conservancy instead propelled and directed SCCWRP members and other contractors to perform a singular outcome of **'creation' of a full tidal/ estuarine, non-historical , treatment wetland as an end of pipe, experimental solution to the toxic contamination of Ballona Creek.**

The CC Staff Recommendation is a non-historically oriented goal and thus fails to adhere to bond language for "enhancement" of Ballona Wetlands and also fails to adhere to "restoration" as defined by Southern California Wetlands Recovery Project (SCWRP). (See p.3 SCWRP restoration definition) And, contrary to publically stated and written goals of transparency and interchange, the CC and SMBRC precluded the public and Working Group from participating and interfacing with SAC. Thus, the CC and SMBRC, utilizing all public bond dollars have effectively shut the public out of the Ballona Wetland Restoration design process.

Contrary to comments made below in the Staff Recommendation 1/19/12 (File No. 04-088), the conceptual restoration plan was **not** developed in a public process and the public and other parties were **precluded** from participation in all facets of the development of the restoration alternatives

"Cooperation: The conceptual restoration plan was developed in a public process with input from a Science Advisory Committee, an Agency Advisor Committee, and the Ballona Working Group made up of representatives of local nonprofit organizations, agency staff and members of the public. Individual public members also participated in all facets of the development of the restoration alternatives."
(p. 9 of 9 1/19/12 Staff Recommendation; Emphasis added.)

The CD documents reveal that the conceptual restoration plan was developed by the Coastal Conservancy and by the executive director and staff of Santa Monica Bay Restoration Commission- a California state agency.

Note- the SMBRCommission's executive director and most staff are not state personnel . Since 2005, the executive director and staff of the SMBRFoundation (a private 501c3) simultaneously act as SMBRC staff and executive director. IRS records reveal payment to the Foundation's executive director and staff from the Foundation. We have found no contractual authority for such private persons to serve as state officers of a state agency or as staff of a state agency. We are currently requesting an assessment and investigation into these matters of great public concern.

The CD documents reveal that the Coastal Conservancy Staff Recommendation was created:

1. in a void of public/ Working Group input acknowledgement and use.
2. in a vacuum of interchange between the Scientific Advisory Committee and the public/ Working Group and the USACE contractual agreements.
3. while failing to disclose scientific findings to all parties and;
4. while failing to provide process as written by the Coastal Conservancy.
5. without adherence to the 2005, contractual agreement between the United States Army Corps of Engineers (USACE) and the Sponsor (aka the Authority- SMBRC & LA County Flood Control) wherein a Joint EIR/ EIS of Corps certified programs of environmental review would take place and;

6. without CC Governing Board authorization and without public disclosure-- the CC Project Manager created an enterprise consisting of a 'new' Joint EIR/EIS process ostensibly intended to circumvent the 2005 approved process. (JD submission to CC 3/29/12)
7.

Lack of Disclosure Has Led To An Inability To Make Informed Decisions

I.

A. Proposition 12 Funds-The Public's Intent - To Acquire, Protect and Restore Is Not Fulfilled.

The Prop. 12, Public Resource Code (PRC) Section 5096.352 language states, " (f) Twenty-five million dollars ($25,000,000) of the funds shall be allocated to **acquire, protect, and restore** wetlands projects that are a minimum of 400 acres in size in any county with a population greater than 5,000,000. (Emphasis added. The Ballona Wetlands is distinguished as fulfilling this specific criteria.)

Restoration—specifically refers to actions taken to obtain a former state of a natural condition. (Southern California Wetlands Recovery Project (SCWRP)- Science Advisory Panel (SAP)- Glossary of Terms)

Estuarine wetlands- are subtidal and intertidal habitats that are semi-enclosed by land, have access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land (Cowardin et. Al. 1979)SCWRP, SAP Glossary)

. Ballona was not historically continually open and connected to the ocean and large, inundating flows of fresh water occurred infrequently only during major flood events (CD- SAC docs; USGS docs provided to CC by J. Davis; CC's T-sheets).

> **"The project we are recommending is enormous in scale."** CC- MarySmall (JD PRA Response attachment in 3/28/12 CC Hearing-Request)

Contrary to "protecting and restoring" the Ballona habitat, the approval of the Engineering and Technical Studies & SMBRC bond awards will specifically promote a singular outcome— massive destruction of currently functioning habitat that will not 'obtain a former state of a natural condition' but, will instead endeavor upon a non-historically oriented, experimental estuarine treatment wetland project expected to encounter yearly flooding and scouring events. The project is not expected to be self-sustaining but instead expected to promote a perpetual money pit of contracts for monitoring and unknown but expected repairs and fixes- - future landscape changes further transfiguring the flora and fauna. (CD/SAC)

A failure to adhere to grant proposal requirements, as dictated by the State of Ca. Finance Dept. in recent audits, continues

.

NOTE: While the Coastal Conservancy promotes the idea that it provides bond grants to the SMBRC, the Coastal Conservancy has actually never provided any bond money to the SMBRC as per the 2002,

SB 1381 Keuhl bill that established a Treasury Account for the SMBRC. Instead, the Coastal Conservancy provides public bond money grants to the private nonprofit—the SMBRFoundation—typically without a grant proposal having been provided—as is the case in the 1/19/12 grant approval.
Recent audits of the CC by the California Dept. of Finance require that the CC adhere to grant proposal requirements established by the Dept of Finance. However, the CC's failure to adhere continues as is the case in the 1/19/12 grant approval.

The currently clean land (LARWQCB) and functioning habitats—include endangered and rare Southern California native plants and wildlife, which will be destroyed in order to create the end of pipe, treatment wetland for toxic Ballona Creek waters and sediments. (CD-SAC) The full tidal, estuarine goal also appears to discharge political favors for LA Port expansion(s) approvals that need wetland mitigation credit(s) and/or extensive fill material from Ballona.
(See e-mails regarding LA Port - letters of support for the Staff Reccommendation)

Contrary to the 8/13/04 CC MEMO (p.4), the CD –SAC documents reveal wildlife and habitat destruction and dangers, endless and exorbitant financial costs, inability to show sustainability and potential legal quagmires that were not revealed to the public/ Working Group and other parties-- some of whom were asked to sign onto Coastal Conservancy pre-scripted letters of support for the 1/19/12 Staff Recommendation.*

*Contrary to the promised 'transparency' of process; CC and SMBRC staff improperly lobbied for letters of support for the 1/19/12 Staff Recommendation prior to a public notification of an agenda and release of the Staff Report thusly, discriminating against all others by failing to provide the same comment opportunity prior to the issuance of the Staff Report.

The public has a right to know the full extent of issues regarding changes to Ballona. Whatever decisions are rendered, they should not be based upon piecemealed, truncated and biased information as has currently been provided.

PROPOSITION 12 Identification of Funds; Status of Funds
The Staff Recommendation(SR) is unclear which Proposition 12 funds are being requested. Two possible funding sections of Prop. 12 are:
- Proposition 12 bond money discussed in the SR as specifically for Ballona Wetlands is listed under Public Resource Code (PRC) Section 5096.352 (f)). The accounting for these funds was not provided in the Staff Recommendation and remains unknown.
-Other Prop 12 funds include: PRC Section 5096.352(b)(1)—to the Santa Monica Bay Restoration Project/Bay Watershed Council; that account status remains unclear also.
(In 2002, Senate Bill 1381 (Keuhl) transformed the SMBR"Project" into the SMBRCommission. Prop. 12, PRC language utilizes the Bay Watershed Council. The ByLaws of the the Bay Watershed Council (BWC) remained intact which now give rise to

questions regarding the actual existence of the BWC after SB 1381 which may influence the use of the Prop 12 bond funds.)

I.

B. 5-6. The Coastal Conservancy Project Manager and SMBRC Executive Director/ Staff, Have Not Been Forthright With the Public Regarding Disclosure of Process Changes Pertaining to Federal (USACE) Contractual Agreements

U.S. ARMY CORPS OF ENGINEERS

1994, Sept.28 Adopted- "Resolved by the Committee on Public Works and Transportation of the United States House of Representatives, That the Secretary of the Army is requested to review the report of the Chief of Engineers on Playa del Rey Inlet and Basin, Venice, California published as House Document 389, Eighty-third Congress, Second Session, and other pertinent reports, to determine whether modifications of the recommendations contained therein are advisable at the present time, in the interest of navigation, hurricane and storm damage reduction, environmental restoration and other purposes at Marina del Rey Harbor, Los Angeles, California, with consideration given to the disposal of contaminated sediments from the entrance channel required under the existing operation and maintenance program at Marina del Rey Harbor."

In 2005, USACE Noticed and embarked upon an areawide ecological review- an EIS- of the historic Ballona Wetlands area that included the U.S. 83th Congress -- House Document 389 under Public Law 780. Map-Enclosure No. 1 (General Plan of Improvement) reveals the entire Ballona region as part of this action including but not limited to Ballona Lagoon, Del Rey Lagoon and the Sanctuary area , Ballona Creek, Centinela Creek etc. (See language of the USACE Lower Ballona Creek Restoration Reconnaissance Study and; Feasibility Study). This EIS was predicated upon having a local Sponsor as part of the review process and to aid in the outreach to the PUBLIC and the creation of the Joint EIR/EIS process.
SMBRC/LA Flood Control (the Authority) aka the Sponsor-- contractually agreed to the Joint EIR/EIS in 2005.
The contract included having the Sponsor (Authority) provide at least 6 public meetings dedicated to providing time for USACE representatives to discuss the USACE status of the Joint EIR/ EIS process. The follow through for such meetings has not occurred.
(In various earlier approved bond requests for Ballona projects; Project Manager Mary Small eliminates reference to the 2005 contractual agreement for a Joint EIR/EIS which jointly provides for the Ballona Restoration Alternatives (2005 contract between- USACE and SMBRC/LA Flood Control aka Authority) Instead Ms. Small's staff recommendations inform the CC Governing Board that as of 2005 only the Ca. Dept. of Fish & Game, State Lands Commission and SMBRC are part of the oversight of Ballona and alludes that the Conservancy has the restoration alternatives planning duties:

(Ballona Wetland Improved Public Access; File No. 04-088; 7/21/10)
"*In 2005, the Conservancy initiated conceptual planning and feasibility analysis of restoration alternatives*

for the property. This project is being implemented in partnership with the DFG and the State Lands Commission, the two state agency owners of the property and the Santa Monica Bay Restoration Commission. The feasibility analysis was completed in 2008, after a delay due to the bond freeze, and the project partners are now initiating environmental review and detailed engineering of a long-term, phased restoration project. When the restoration planning began, the Conservancy funded the development of an Interim Site Stewardship Plan to address the pressing concerns related to site management. As discussed above, in 2008 the Conservancy provided a grant to MRCA to fund construction of some site improvements and to fund planning, design and preparation of permit applications for additional access improvements. Based on the completed planning work, the MRCA and the project partners determined that it will be more cost effective and logical to pursue implementation of most access improvements as part of the environmental review and permitting for the long-term phased restoration project.
PROJECT FINANCING:
Coastal Conservancy $280,000
MRCA 120,000
SMBRC, US EPA funds 20,000
Total Project Cost $420,000"

This is an omission of pertinent and critical fact given in order to garner public bond money. (See J. Davis 3/28/12 Request to CC Gov. Brd.; USACE/CC minutes of meeting(s) and page 6)
See also File No. 04-088 on page 17.
Additionally, the bond money was approved but accountability for its use has not been forthcoming. And,
No fund award was given to SMBRC from the USEPA as cited above. The Treasury Account set up for the SMBRC under SB1381 was not utilized. Instead, ostensibly the USEPA funds went to the private nonprofit, the Foundation. The Foundation, as a private non-profit 501c3, provides no accountability to the public.

The Coastal Conservancy, had also made promises to the public regarding transparency and public inclusion in the entire process of exploring **all reasonable alternatives for enhancement of Ballona.**

For example in an early Coastal Conservancy MEMO dated 8/13/04 to California Department of Fish & Game (DFG) and the State Lands Commission (SLC), the **GOALS/PRINCIPALS read in part-**

*"**The restoration plan** will be based on the best science, incorporate technical scientific expertise and **will be developed through a transparent planning process that allows stakeholders to provide input and comment on all restoration planning products.** The restoration planning process will develop and analyze a **range of alternatives to implement the following project goals**:*
*-**Restore and enhance a mix of wetland habitats to benefit endangered and threatened species as well as other migratory and resident species**;*
-Provide for wildlife-oriented public access and recreation opportunities; and –
***Implement a technically feasible, cost effective, ecologically beneficial and sustainable restoration**." (Emphasis added.)*

And,

"..restoration will be conducted within the landscape and watershed context, with attention paid ***to adjacent and ecologically related resources."*** Pg. 1

According to CD documents, the Coastal Conservancy's Ballona project manager participated in USACE meetings in the 2004 timeframe citing inclusion of the areawide ecosystem eg. Ballona Lagoon, Del Rey Lagoon, the Sanctuary area, Marina del Rey and others that paralleled the activities of ecosystem review as described by the USACE (Reconnaissance Study; Lower Ballona Creek Restoration Feasiblity Study; 3/28/12 J.Davis submission to CC)

However, in contradiction to the 8/13/04 Memo cited above, the context of the larger historic boundaries of Ballona Wetlands were later arbitrarily dropped, without public notification or discussion. The CC Project Manager discusses no longer including the adjacent and ecologically related resources as part of the Joint EIR/EIS restoration evaluation performed with the USACE:

6/2/10 CC, SMBRC, USACE Ballona Coordination Meeting Minutes:

"*II. b. Mary Small: Have all the PMP sections looked at the same project area? Parts still refer to Ballona Lagoon, Grand Canal, Venice Canals and Oxford Basin, which are no longer in the study area.* (3/28/12 CC hearing; J. Davis Attachment)

And, the Project Manager discusses instead a 'new' process for which there is no ostensible authority and to which the public has not been made aware:

"Mary Small: If the Corps falls too behind, we will work with Corps Regulatory for a permit for their activities (NEPA/CEQA, design, permitting, and Phase 1 construction)" and;

"Mary Small: It was always our understanding that the Corps would use our restoration alternatives. It makes us nervous that this was never in writing."(6/28/10 Ballona Ecosystem Restoration Planning Management Meeting)

It was never the public's understanding that the Corps would be held to Coastal Conservancy and Foundation staff"s restoration alternatives. Legal legitimacy for such behavior is also questionable. And,

"Suggested response

1) *The EIS/EIR process begun in 2005 was for the Army Corps' Lower Ballona Ecosystem Restoration Feasibility Study, that project and the associated environmental review has not been completed and is not moving forward at this time. The EIR/S process for the proposed enhancement project will be separate." 2/7/12*

CC/Mary Small to Ca.Dept. Fish & Game- Rick Mayfield per response to Davis Ballona CEQA process query. (JDavis attachment 3/28/12 Request to CC Board)

Thus, the CC switch in process is 'suggested' to be disclosed to a member of the public after seeking and garnering approval for the 1/19/12 Staff Recommendation.
(3/28/12 CC Hearing, Davis PRA attachment to Request)

This new and unauthorized process discussion continues in the same email, 2/7/12, from Shelley Luce to Mary Small and Rick Mayfield (CDFG):

…." ***The EIR/EIS*** *that* ***we want to start*** *is for a separate project, i.e. the BWER restoration/ enhancement project. ".* (emphasis added.)

The EIR/EIS that they want to start IS NOT on a separate project but instead on the same project but having eliminated the '94/ 2005 Joint EIR/EIS process; scope of review; environmental safeguards and full range of alternatives inherent in '94/ 2005 approved process.
In other words, the CC attempts to have the public and the USACE but out of their way so that the CC can control the project --using the public's dollar--alongside its political allies.

And, while Mary Small provides the appearance that the Request For Proposals is new online--*" the request for services ….went out today"*….
2/8/12 CC email (JDavis PRA response attachment in 3/28/12 Request to CC Board)

The Coastal Conservancy, had already put out an online RFP in 2010 for the work requested for approval in the 1/19/12 Staff Recommendation. Thus, it appears that as of 2010, the outcome was already a done deal behind the public scene.

Changes, such as this were not communicated to the Public/ Working Group and the ongoing status of the relationship with the USACE as per the Joint EIR/EIS was not communicated either. In fact, the USACE- Sect. of the Army was not made aware of the attempt to extinguish the earlier, approved process. Any extinguishing of the approved EIR/EIS process (including House Document 389) would have to abide by the USACE process of removal. The process provides accountability for reasoning as to the ending of the project as well as detailed accounting for money spent and what had occurred throughout the process. This activity has not occurred and the USACE has provided a letter stipulating that the approved process is maintained and that investigation into the matter has started. (USACE-J.Davis communication).

It is also unclear whether USACE/SPONSOR information was communicated to the Science Advisory Committee or other parties. Specific USACE work projects, including response to House Document 389 and work quality/certification needs are not communicated in any of the CD-SAC meeting notes which appears to show that the SAC team (contracted and paid for with public funds) were fulfilling ONLY the arbitrary GOALS as set forth by the CC Project Manager and SMBRC staff. Issues

such as the protection of groundwater (classified as potential drinking water), an issue of House Doc. 389 and current Los Angeles- Best Management Practices (BMPs) are absent in the meeting minutes.

Thus, the CC and SMBRC staff, provided for an atmosphere of further disconnect, lack of transparency and compartmentalization of information sharing.
And,
the public/Working Group was not made aware that the CC considered itself a part of the USACE/SPONSOR contract (which it is not) —so much a part, that Mary Small apparently believed that the CC would provide the alternative(s) for the USACE in the Joint EIR/EIS:

6/28/10 Ecosystem Restoration Planning Management Meeting:
II. C. 2." *Mary Small: It was always our understanding that the Corps would use our restoration alternatives. It makes us nervous that this was was never in writing."..*

This type of very questionable influence was not conveyed publically. According to the USACE, Joint EIR/EIS language, the USACE study would provide for all reasonable alternatives and the process would embrace public disclosure and participation.
The Coastal Conservancy and SMBRC staff have not been forthright with the public regarding status of the Joint EIR/EIS.

I.

B. 1- 3. The CD reveals SAC meetings, reports and concerns not shared with the public/the Working Group and other parties. Conversely, the public/ Working Group comments and concerns are not cross- shared.

Contrary to the 1/19/12 Staff Recommendation, the public, Working Group and others have not been engaged by the Coastal Conservancy as promised and have not been provided with full information from the Science Advisory Committee (SAC) group in order to make informed decisions and provide input throughout the process to date.
Prop. 12 bond money was also provided from the Natural Resources Dept. to the Coastal Conservancy specifically to provide a GRANT to the Southern California Coastal Waters Research Project (SCCWRP)(#172) for creation of a SAC team. Thus, the SAC team was paid with public dollars to perform as an independent scientific advisory panel to provide input and advice regarding historical restoration options. Contrary to the GRANT purposes, the Coastal Conservancy's Ballona Project Manager and SMBRC staff instead told the SAC team what the intended outcome was and that all input was to secure that goal—namely full tidal estuarine and levy removal.
Thus, the Prop. 12 bond money was not utilized as intended.
The Coastal Conservancy and SMBRC staff kept the public and the Working Group out of the SAC loop of information and knowledge thereby thwarting and distancing

any meaningful interchanges and participation as falsely stated in the Staff Recommendation below.

Staff Recommendation excerpt:
"Cooperation: The conceptual restoration plan was developed in a public process with input from a Science Advisory Committee, an Agency Advisor Committee, and the Ballona Working Group made up of representatives of local nonprofit organizations, agency staff and members of the public. Individual public members also participated in all facets of the development of the restoration alternatives."
(p. 9 of 9 Staff Recommendation 1/19/12)

And, contrary to assurances that the public would be notified and included on all SAC meetings, the public was not notified or included.

"*MARY S. all SAC meeting are public, all interested parties will be notified and invited, meetings will be structured with SAC addressing issues first and public comment period at the end."* (CD- 7/20/05 LMU Ballona SAC MTG.)

A 2004 MEMO discusses –
"Ballona Restoration Planning Working Group: Stakeholder Committee and Public Involvement
"*A Ballona Restoration Planning Working Group (brpwg) made up of interested organizations, agencies, and individuals, will meet periodically to obtain project status updates, to provide input, and to support the restoration planning process. These meetings will be open to the public. Subcommittees may be established to address specific issues that may arise during planning."*pg.2

The language above provided for the public involvement at the start of the process that began with 'interim stewardship' meetings, (eg. trash cleanup and education tours) which did occur. As time passed, meetings stopped, informational sharing from agencies and the science team became nonexistent and; the public's comments were not included in the planning process that continued behind closed doors.
-Website topic- SAC meeting minutes- was not accessible to the public. Instead, when clicked – the website told the viewer entry was not allowed.
-SAC meetings, though described as open to the public, were not. The CD documents reveal that the SAC meetings were, in the main, telephonic and not inclusive of the public. Reports and Memos were not shared with the public but utilized internally.

A continued failure to acknowledge the public and Working Group is also documented via the 2012 Science Advisory Meeting that was held days after the Staff Recommendation Approval. The SAC meeting was also a first in years for actually occurring and, that public notice was provided.

The Public/ the Working Group:

- provided strong objections to the proposed Plan, providing written testimony as well as oral testimony.
- listed issues that needed to be addressed properly; asked for responses that thus far have gone unanswered and,
- again requested the area be considered in its totality of ecosystem variety and benefits utilizing the historic system of Ballona.
- reminded the SAC that the area now has more saltwater --deep and mid habitat than historically existed at Ballona due to the Marina del Rey; Ballona Lagoon Marine Preserve; Del Rey Lagoon; Ballona Creek itself and; as well as freshwater due to the newly created catch-basin- aka, the freshwater marsh. (historically= the last couple hundred years)
- SAC numerical analysis of habitat types was in error. Ratios of entire Ballona Wetlands historic habitat applied to be fulfilled in Areas A, B, C alone is a faulty analysis. The SAC- ratio numbers that pertained to former water habitat and land elevations were either incorrect and/or not documented by SAC.
- cited and documented that SAC dredge spoils deposition locations and volumes were incorrect. (USGS Documents and maps provided by John Davis to the Coastal Conservancy)

The CC and SMBRC continue to fail to respond.
Note: The CC continues to fail to respond to queries and comments provided by the public and its so-called "Working Group" members from 1/19/12 and 3/29/12.

FAILURE TO INCLUDE THE WORKING GROUP COMMENTS AND REQUESTS
Despite providing comments, documentation and evidence regarding the topics listed above and others; there is no documentation provided from the Coastal Conservancy on the CD that any of the public/ Working Group communications were included for any meaningful response or use.

The CD documents reveal no inclusion of the public in any decision making for the alternatives.
Public comments provided to SMBRC and the Coastal Conservancy regarding Ballona specific studies such as the Phil Williams & Assoc. report, that did not address or incorrectly addressed issues, such as the migrating oilfield gas and reservoir gas leakage from SOCALGAS had no meaningful response. There is no showing that the CC or SMBRC staff ever shared these concerns with the SAC team, much less did any meaningful, good faith follow up with the public to understand how the gases may impact restoration. The same holds true for issues regarding protection and utilization of the Ballona aquifer groundwater hydrology. Repeated requests from stakeholders to be given ½ hour presentation time to provide information regarding hydrology and groundwater diversion issues, before the SMBRC have been met with silence (The CC is part of the SMBRC) .

I.B.

CONTROL OF MESSAGE AND OUTCOME
The CC and SMBRC Staff :
Allow For No Public/ Working Group Participation In The Planning Process;
Fail to Disclose Science Advisory Committee (SAC) Conference Calls, Memorandums and Reports For Planning of Alternatives;
Feasibility, Cost, Sustainability, Ecosystem Pros and Cons Are Not Disclosed;
And
The CC & SMBRC Staff Arbitrarily Define Project Goal=Estaurine

Staff Recommendation excerpt:
"Cooperation: The conceptual restoration plan was developed in a public process with input from a Science Advisory Committee, an Agency Advisor Committee, and the Ballona Working Group made up of representatives of local nonprofit organizations, agency staff and members of the public. Individual public members also participated in all facets of the development of the restoration alternatives."
(p. 9 of 9 Staff Recommendation 1/19/12)

The 1/19/12 Staff Recommendation excerpt is false. The public/ Working Group was neither privy to the SAC meetings and information created nor included in the planning process to participate in all facets of the development of the restoration alternatives.
The following excerpts from the CD document an internal discussion revealing the CC and SMBRC staff created and controlled the alternative selection:

"Wayne (Wayne Ferren) suggested that biological sustainability be defined as no loss of habitat types & functions, major guilds, and sensitive species over the project site as a whole." July 7, 2008 SAC Conference Call.

And;

"Joy (Joy Zedler) asked how biodiversity is being defined? ***Sean indicated that biodiversity = highest richness of estuarine dependent species****. If this is how we are defining biodiversity, it should be stated clearly in the document.* (emphasis added; Sean Berquist was SMBRC staff and Foundation staff during this timeframe) and,

"*Wayne suggested that we clarify that biodiversity is the sustainable richness of representative interdependent native estuarine habitats along with their associated and expected species biodiversity.* "(CD-June 23, 2008 SAC Conference Call)

The next parargraph, written by the note-taker- cited by CC as being CC or SMBRC staff- <u>states the goal</u>-
"Estuarine biodiversity is the primary objective of the analysis."
(CD- June 23, 2008 SAC Conference Call Memo)

This same Memo also sets forth a GOAL that was not shared with the public/ Working Group.
"The project goal is to create functional estuarine habitat…";
"1. Maximize area of estuarine habitat.";
Opportunities to create regionally significant habitat including vernal pools and…should be pursued but ***not at the expense of restoration of estuarine habitat."***

The public/Working Group was not allowed to participate in the decision making and was not advised as to the differing opinions rendered by the SAC team.

Since this timeframe and without public notification or disclosure the Coastal Conservancy and staff of the Foundation have worked to eliminate the areawide review of ecosystem function and alternative habitat plans—including a public debate regarding the pros and cons of each system -- to instead focus upon a predetermined singular outcome of removal of Ballona Creek levees and dredging of Ballona to 'landscape' and convert the land from its historic natural function to an entirely new, artificial and unnatural function that precludes all habitat function that does not primarily promote the estuarine full tidal premise.

And though asked publically where this 'Plan- Alternative 5 " came from, no response has been forthcoming from either the CC or Foundation staff.

The CD docs however now shed light as to the creation of this "preferred plan". The overtones of financial leverage dominate the first half of the letter and serve to advance a predetermined outcome that is seen fulfilled in the Coastal Conservancy Staff Recommendation—the removal of levees to create the treatment wetlands.

July 10, 2007 SMBRC letter from Shelley Luce to Coastal Conservancy's Ballona Project Manager- Mary Small:

"Dear Mary,
The Santa Monica Bay Restoration Commission, a National Estuary Program of the US EPA, has been pleased to participate in the acquisition and restoration of the Ballona wetlands at all levels over the last several years. We are proud partners in the restoration planning, and currently have one staff member dedicated full time to the planning effort, while I serve on the Ballona Wetlands Science Advisory Committee (SAC). The SMBRC is also an active local partner in the Army Corps of Engineers' Lower Ballona Ecosystem Restoration Feasibility Study and are participating in clean up and restoration plans for Ballona Lagoon, the Grand Canal, Marine del Rey and the Oxford Basin. We have also awarded several millions of dollars of bond monies under our purview to projects designed to improve water quality and habitat in the Ballona Creek watershed. Ballona wetlands restoration is clearly a very high priority of the SMBRC and the EPA.
I have reviewed the restoration design alternatives that are being developed by the consulting team and I am disappointed that they do not fully consider important restoration options, thereby limiting potential habitat, biodiversity and water quality improvements in the wetlands complex. The Ballona SAC requested design alternatives that encompass the "extremes" of restoration planning, i.e. from minimal intervention to maximal structural changes, as well as alternatives in between. The current proposed

alternatives do not provide this and need to be modified, or an additional (fourth) alternative is needed.
SMBRC feels that the restoration design for Ballona wetlands must represent a true restoration of maximum ecological functions and services for the area. Actual restoration work will not begin for months or years, and will be a long term and costly process. The best approach is to include design alternatives that are not limited by current infrastructure or fiscal concerns, since these factors will certainly change over the duration of the restoration process. Similarly, factors such as poor water quality in Ballona Creek will continue to change as Total Maximum Daily Loads and other regulatory measures are implemented. It does not serve us to design the restoration as though it would be undertaken and completed in the very near future, under existing physical or financial constraints.
I would like to request that the design team include at least one design alternative that proposes to
• remove all or part of the levees on one or both sides of Ballona Creek;
• daylight the channel connecting the freshwater marsh to the creek in Area B, and Stingray Creek to Marina del Rey in Area A;
• raise Culver Boulevard to increase flows between the north and south sections of Area B; and
• increase connectivity between Ballona Creek and Areas A and B."

Our staff Wetlands Restoration Manager Sean Bergquist is available to work closely with the consulting team to ensure the revised or new alternatives include features that stakeholders and the SAC members supported. The revised or new alternatives should be presented as one of the group of alternatives for consideration under CEQA and by stakeholders and the SAC.

Given our experience in and commitment to the Ballona wetlands and surrounding interconnected areas, the SMBRC staff, Governing Board and Watershed Council have a great deal to contribute to the restoration process. Please feel free to consult us further during development of the restoration design alternatives and we look forward to continuing our partnership to restore Ballona wetlands.
Sincerely,
Shelley Luce, D.Env.
Executive Director

An e-mail 7/17/07 from SMBRCommission & Foundation executive officer Shelley Luce,
"RE: design alternative for Ballona wetland restoration" and Phil Williams & Associates' (PWA) Jeremy Lowe –
"We've sketched out Alternative 5 as described in Shelley's letter. Is this what you were envisaging?"

Luce: *" Thank you for your response Jeremy. This is a good start for a 5th alternative. Sean and Jessica are adding/changing some details and will forward to you. "*
(presumably-Sean Berquist and Jessica Hall– both Foundation paid staff/ SMBRC staff)

The CD documents also reveal two sets of drawings and plans for the levy removal and levy replacement—by Jessica Hall, a Foundation paid staffer.

Ms. Luce is the Executive Director of the Foundation; no contractual agreements

have been produced by the SMBRCommission or the State Water Board that provide any authority for her to act in capacity of Executive Director of the State Agency-

Santa Monica Bay Restoration Commission which was created under SB 1381 Keuhl as a non regulatory state agency within the State Water Board. There have been no contractual agreements forthcoming by the State Water Board or federal authorities that provide for any SMBRC or federal EPA- National Estuary Program (NEP)- dedicated funding to be handed over to the SMBR Foundation. There is a treasury account that was formed under SB1381 in 2002.

The treasury account has never been used. The attendant oversight and accountability by the State Treasurer has likewise not been utilized.

Ms. Luce has been utilizing both the e-mail address and physical location of the LARWQCB as her work address. The utilization of the addresses has led to common belief that Ms. Luce is a Water Board employee. It is unknown but possible at this time to believe that the utilization of the addresses created a belief that Ms. Luce is LARWQCB personnel, which has in turn, provided Ms. Luce with access to controlling positions on various committees such as IRWMP (Integrated Resource Water Management Program). It would seem that by creating, via continued use of LARWQCB email address and business address, a very public belief that Ms. Luce is a Water Board employee may constitute impersonating a Water Board employee. The following is an e-mail exchange between Ms. Luce and a person with long associations with the Water Board and has acted as a contractor in Ballona restoration matters.

'Travis Longcore travislongcore@laaudubon.org wrote:

Bounced from your waterboards address. Are you no longer a Water Board employee? –

Travis

On Sep 19, 2011, at 2:29 PM, Shelley Luce wrote:

***No, not for many years**. Most of our staff are with our SMBR Foundation. I will check my calendar and get back to you on this meeting, thank you for the invitation.*

Shelley" (emphasis added)

Ms. Luce does not appear to answer directly about herself with regard to the Foundation, or what she means by "our SMBR Foundation". She also does not explain her past personal use of the LARWQCB addresses while not employed and why she suddenly discontinued the practice.

Ms. Luce's resume cites her experience prior to SMBRCommission / Foundation as having been employed by Heal the Bay- the organization that has become institutionalized as part of the SMBRC. Our research indicates Ms. Luce was working in some capacity at LARWQCB during the years 1999-2001- prior to her finishing degrees from UCLA. It appears that her continued use of the Water Board e-mail address after no longer providing service to the California Water Resources Control Board has led/misled many people. (A PRA to LARWQCB is pending for identification of duties.)

Coastal Conservancy- PRA Response to J. Davis

Rare ecosystems of the coastal marsh area are discussed internally by the SAC team with the CC project manager and staff of the Foundation; the information

is not broadcasted for public awareness, inclusion of discussion and decision making as promised.

"Rich noted that the discussion of grasslands should include mention of the historical native grassland prairie ecosystems that previously existed in the area. The rarity of native grasslands should be discussed,,," (CD- 6/28/08 SAC Conference Call)

"Rarity section…complex of prairie and vernal pool…
Wet grasslands formed extensive areas were also palustrine wetlands above highest high tide.." (CD- SAC Call 6/23/08)

"…there is native biodiversity in the non-tidal saline soils. …. At Ballona, these wetlands at Area A, for example, are the only habitat where Alkali Barley (Hordeum depressum) is known to occur in the Ballona Ecosystem. This annual grass was probably the dominant native annual grass in naturally occurring non-tidal saline soils at Ballona." (CD- 11/23/08, Wayne Ferren communication to Mary Small…)

And,
"The region has a shortage of mudflat for shorebirds, high marsh for animals and salt marsh bird's beak, marsh-upland transition for rare shrubs (eg. , box thorn) that are used by animals,…

The region has a shortage of dune habitat and back – dune depressions that support clean-water brackish marsh for aquatic plants and animals.

One could also list maritime scrub, which remains in several places "…
(CD- Joy Zedler (SAC) correspondence)

Thus , without public /Working Group inclusion and input into the formation of the alternatives and later failure to include the public /Working Group comments and concerns regarding the PWA Alternatives that are presented at one public meeting--the CC and Foundation staff continue to work behind publically closed doors to focus upon the 'Preferred Alternative", now known as Alternative 5 presented in the 1/19/12, Staff Recommendation request for funding. Alternative 5 requires massive, non-historic, extraordinary, experimental and knowingly toxic changes to occur on the land masses of Area A and B so that **"biodiversity = highest richness of estuarine dependent species."**

Contrary to the 8/13/04 CC Memo which promised transparency and public inclusion in the alternative planning process which would "restore and enhance" a mix of wetland habitats….and that would implement a technically feasible, cost effective, ecologically beneficial and sustainable restoration.
Instead, <u>the public was shut out of the planning process; and SAC knowledge</u> <u>regarding the **needs and dangers posed by Alternative 5 are not made public:**</u>

"This alternative makes the greatest change to the site, would be the hardest to reverse and consequently has the most risk." (CD- 9/12/08 MEMO from SAC to PMT)

" *..this alternative would* ***require reliance on upstream flood control and pollutant removal****, and could necessitate periodic removal of accumulated pollutants for some portions of the restored wetlands. Furthermore, it is unknown how the flow and sediment yield from the upper watershed would affect the sustainability of the marsh in terms of scour or sediment deposition*." CD, P. 4of 9, 10/15/08 SAC MEMO, emphasis added.

There is no evidence of any such large scale BMP (Best Management Practice) planning or proposals for 'flood control and pollutant removal" occurring upstream on Ballona Creek.

And,

"*Eric suggested that there be a statement up front indicating that this site will not be self-sustainable, but will need to be actively managed in perpetuity. "* (CD- 7/7/08 SAC Conference Call)

Discussion and comments made from key federal agencies were withheld from the public, including but not limited to **NOAA communications regarding concern of toxicity of Ballona Creek upon the remaining wetlands should the levy removal and dredging take place.** (CD- National Oceanic Atmospheric Association email)

Studies that discuss the toxicity of the Ballona Creek waters and sediment to life in the waters and sediment were not released or shared with the public:

"These sediments were toxic to aquatic organisms, potentially from organic compounds in these sediments. Ballona Creek has been identified as a potential source of tidal flows into Areas A, B, and C in each of the proposed restoration alternatives. Therefore, there is concern to tidal marsh areas, resulting in a negative impact to the habitats and biological resources." (CD- Weston –Technical Memorandum 11/26/07; Water Quality Data Gap Investigation Ballona Wetlands Restoration Project- Pohl , P.E., Ph.D.)

And,

" The July 2006 report by Weston also concludes that there are concerns related to water and sediment quality adjacent to the tidal channels. Consequently there is a need to develop a strategy to evaluation the potential ecological risk associated with influent water or sediment quality to the restored wetlands.

The scientific questions regarding sediment and water quality cannot be answered based on the information currently available, and will ultimately depend on the design of the project." (CD- Memorandum 3/8/08; Subject:

APPROACH FOR ADDRESSING SEDIMENT AND WATER QUALITY ISSUES)

And;

"*Eric- Conc(ept) D—is it attempt to move water and sediment into system*

Wayne- breaching levee bringing trash, water pollution and sediment into entire area is problematic.

John Dixon-important to describe these NOT as projects, but a directions.

Ambrose- maybe D is too extreme—this won't happen anyway.

Dixon- do feasible maximum tidal, not D—need to scale back

Jeremy- may need to do that, take out realignment Ballona—include realign on Hydrologic options"
(CD-10/30/06 SAC Conference Call)

Additional -SPECIFICS OF THE STAFF RECOMMENDATION 1/19/12

The 1/19/12 Staff Recommendation misleads the public and the Governing Board as seen on pg. 3 of 9, paragraph 5-

" In order to complete the environmental analysis required under the National Environmental Policy Act and the California Environmental Quality Act ***and to apply for permits*** *to implement the project,* ***detailed technical work must be completed."*** *(Emphasis added.)*

What is not disclosed to the reader, is an entire change of process from the Congressionally approved 2005 Joint EIR/EIS process requirements.

The Staff Recommendation sentence itself is also very misleading. The applications for permits to the USACE for implementation of the Coastal Conservancy "Plan", namely the destruction of the levees and the dredging of Ballona have been in process prior to this Staff Recommendation. The Plan-regarding garnering the USACE permits-including the 408- was already in process. (CD)

The Conservancy in its partnership with SMBRC fails to let the public know that they have been working to end the congressionally approved federal portion of the study which entails a full ecological review of the area between the Westchester Bluffs, the Santa Monica Bay, the Santa Monica mountains to a few miles inland – which would also provide for a full review of ALL REASONABLE ALTERNATIVES for enhancement of the ecosystem. (See minutes of USACE/Sponsor meetings provided in the 3/28/12 Request to Rescind File No.04-088; EIS Lower Ballona Creek Restoration Feasibility Study 2005)

Undisclosed is the take-over of process for Ballona 'restoration' guided by the Coastal Conservancy that may disengage the USACE analysis provided for in the established 2005 Joint EIR/EIS.
Instead, it appears that the Coastal Conservancy along with SMBRC staff seek to simply garner permits from the USACE ostensibly for destruction of habitat on Ballona, in particular Area A and B of Ballona. Specifically, the CC and SMBRC staff seek permits (eg 408) for levee and land destruction and removal. It appears that the extensive dredging and massive bulldozing may provide the necessary fill for the LA Port. Questions from the public regarding the CC/SMBRC/ USACE status have gone unanswered. (CD docs and SMBRC April meeting -submission by GC)

Contrary to discussion in the Staff Recommendation—Area A is vegetated primarily by native plants and native wildlife and, is host to endangered species including but not limited to the Belding's Savannah Sparrow.
Not provided to the public are documents and communications which provide, in part, narrative of 'moving' Belding Savannah Sparrows to areas not planned for dredging. This information is vital for public discussion especially since, destruction of the Belding's habitat may wreak havoc upon the Belding population that utilizes Ballona year round. (CD)

- Pg. 3 of 9 discusses hydrology/hydraulics studies that need to be done. What is not discussed with the reader are the multiple public requests for actual onsite hydrology studies that would include Ballona aquifer and groundwater studies that would provide the knowledge for alternatives inclusive of groundwater use onsite. Ballona has multiple aquifers underlying the site. The aquifers are classified as potential drinking water sources and are part of the West Basin aquifers which intermingle to the south and east. (Poland Report)

- None of the concerns raised in House Document 389 (part of the USACE review) regarding problems associated with further saltwater intrusion have been discussed. The elimination of the USACE EIS as part of the Joint EIR/EIS would hasten the Coastal Conservancy's and SMBRC staff GOALS = Estuarine which in turn would potentially threaten contamination of the underground aquifers as per House Document 389 literature. None of the above has been made a part of any review despite repeated requests from the public for such studies.

- The SOCALGAS operations and oilfield gas migration throughout the Ballona area have also not been discussed despite repeated requests from the public.
- Thus pg 9 of 9 is insufficient and incorrect in its comments regarding the Local Coastal Program and the Coastal Act, including but not limited to the

fact that there is no LCP language that states Ballona requires action as the Staff Recommendation implies as per 31252.

-
- Staff Recommendation- Pg. 8 of 9 Under "Sea level rise vulnerability"
- The Staff fail to alert the reader that the 'broad areas of mid marsh and high marsh" depicted--showing a meandering Ballona Creek mid-way between Area A and B-- will be inundated with yearly flood waters of the contaminated Ballona Creek –potentially killing nesting or burrowing life in the low, mid and high marsh areas. Concerns by the SAC team regarding scouring, trash and contamination were not disclosed in the Staff Report and have not been shared with the public.
- The Staff fail to inform the reader that the Preferred Plan creates a non historic cycling of yearly floods, debris and contamination as part of an end of pipe solution, a treatment wetland device .
- The Staff Recommendation does not disclose the SAC discussion of concerns regarding the creation of a treatment wetland.
- The Staff Recommendation does not alert the reader as to what is achieved with the use of the bond funds via "hydraulics" information. Will the hydraulics information be exclusive to new levy construction?
- The Staff Recommendation does not disclose to the reader, the need for upcreek flood control or contamination control as is discussed by SAC.
-

31400- The Staff Recommendation cites enhancement of future NEW trails.
The Coastal Conservancy has already awarded large grants specifically for the Ballona Bike Trail (File No. 07-058-01) which, currently exists and is heavily utilized by the public. Since, much public funding has already been utilized and will be utilized further for the pathway, why should that same importance of pathway be taken away at Ballona?
Removal of the levies would not only take away a heavily utilized public biking and hiking trail but would also take away the pathway's use as an observatory promenade for viewing the interior of Ballona. The levees provide an important opportunity for viewing without intruding.

The Coastal Conservancy and other agencies have failed to embrace and include the public on this issue as well. Using the public's hard earned money while keeping the public out of the planning process reveals the Coastal Conservancy has not acted in good faith.

Grant Award of $280,000 to Mountains Recreation and Conservation Authority (MRCA) File No. 04-088 from Staff Recommendation 7/21/10.

1. The Mountains Recreation and Conservation Authority governing board refused to approve the use of bond money for the trailhead(s) and other enhancement s at Ballona. The Board agreed with members of the public. Namely, that due to the ongoing **Joint EIR/EIS** process' requirements being

more stringent than a singular EIR; those added requirements had to be fulfilled prior to any further decision making taking place.

Mr. Edmiston, at the meeting, asked did they want him to return the money?-

Ostensibly the bond money had already been approved and given to MRCA. Where did the money go? And;

2. The 1/19/12 Staff Recommendation cites NEW levy demolition and bike trails ,
"*the proposed project could provide a new segment of the Coastal Trail . ……the project is located at the intersection of the California Coastal Trail and the Ballona Creek Trail, and may offer a significant opportunity for the development of improved connections between these trails."* P. 7 of 9 .

- Since the Coastal Conservancy has been intent upon levee removal of Ballona Creek and dredging the land in the near future; <u>why did the Conservancy give bond money to MRCA for trail head construction and enhancements for Area A (in particular)--apparently an area it intends to soon demolish and dredge? These inconsistencies appear to show misuse of public funds; paying for contractors and salaries for projects that lead nowhere.</u>
- <u>Furthermore, it appears that when the CC Project Manager of Ballona desires to garner public bond money; the wetlands (or bike path) are discussed in a decidedly positive depiction as below:</u>

"Despite the degradation of site resources, significant wetland habitat remains within the Ballona Wetlands. Plant species within the project site include wetland indicators such as pickleweed, marsh heather, saltgrass, arrowgrass and glasswort, and a variety of upland and exotic species including brome, iceplant, oxalis, and ryegrass. Bird surveys indicate that the site is used seasonally by a variety of migratory shorebirds, as well as by typical shoreline residents (gulls, terns, and ducks) and typical upland birds including small raptors. Bird species of special interest observed in the project area include nesting pairs of Belding's Savannah sparrow and foraging use by California least terns.
The proposed project will be implemented primarily on the portion of the BWER north of the Ballona Creek channel (Exhibit 2). This area of the reserve currently has very limited public access and suffers from illegal uses. The proposed project seeks to improve the resources on the site, increasing public use while discouraging illegal activities through improvements to fencing and signage." File No. 04-088

This same project manager provides an entirely different depiction in the negative—when public bond money is requested for demolition purposes on the same piece of property. Note also the language of utilizing funds to safeguard the property directly contradicts the 1/19/12 Staff Recommendation of the 6 plus million wherein the Project Manager cites the need to demolish and dredge the same area as a means of eliminating public use by the homeless instead of—the aforementioned request for money to protect the same area. (See also Ms. Small e-mails discussing need to show greater degradation in order to secure the desired outcome. (J. Davis 3/28/12 <u>Request</u> to CC))
It appears that the Ballona habitat is characterized dependent upon financial requests---not on reality or science based requests.

- Despite repeated requests for public follow up with regard to the bond money and that project, (including a request made for information at the recent Ballona Watershed Task Force Meeting) none has been forthcoming from MRCA staff or CC staff.

  "In 2008, the Conservancy authorized funds to the MRCA for planning, final design and implementation of specific public access improvements identified in the Ballona Wetlands Early BALLONA WETLANDS PUBLIC ACCESS IMPROVEMENTS
  Action Plan. MRCA has completed much of that work and as a result of that planning effort, the project partners determined that some of the specific access improvements identified in that plan may need to be re-evaluated and others should be reviewed and permitted as part of the larger wetland restoration project. Rather than pursue the Early Action Plan improvements, the project partners decided that it is a higher priority to develop targeted educational and public access programs in the northern 300 acre portion of the site where there is currently almost no public access. The proposed project would also provide funding for MRCA to continue working on planning public access improvements for inclusion in the ultimate restoration project."

This inconsistency for request/approval and follow-up on bond funds continues to remain unexplained.

And,how does removal of the levees- the lower leg of the "Class 1 bike path" fit with the public's money expended below?:
"In 2000, the Conservancy helped fund a regional plan for creation of a "Park to Playa" river park from Baldwin Hills to Marina Del Rey. The plan envisioned creation of a park along Ballona Creek to link expanded parks at the Baldwin Hills to the beaches and the Coastal Trail. In 2001, the Conservancy helped fund the Ballona Creek and Trail Focused Special Study which identified potential improvements to the creek and trail. Consistent with that study, the Conservancy has also provided funding for construction of a pedestrian bridge in Culver City which increased access to the Ballona Creek Trail. That project has been completed. This project will help to implement the vision of the "Park to Playa" and the Focused Study, developing a multi-benefit, gateway park that will increase access to the trail and enhance the experience of trail users. ***File No. 07-058-01; Project Manager Mary Small***

Conservancy funds for this project are expected to derive from the Conservancy's FY 2002/03 appropriation from Proposition 40."

3. Staff Reccommendation pg. 9 of 9 re: Consistency With Local Coastal Policies fails to provide accurate Local Coastal Plan (LCP)background information.

The Coastal Commission certified the first LUP in 1984, the La Ballona MDR Land Use

Plan.

The Land Use Plan was then changed to reflect two distinctly different Land Use Plans, the La Ballona
Plan and the new and different MDR LUP.

It is questionable as to if the California Coastal Commission certified another Land Use Plan for the Playa Vista Project.

Consistency with the California Coastal Act must be consistent with Chapter 3 of that Act.

The Project will not restore, but will instead convert the land from one historic natural function to an entirely new function that is unnatural.
Lack of saltwater connection is demonstrated in historic maps from the U.S. Geological Survey. (A USGS map was submitted at the public hearing on Jan 19,2012. The CC remains nonresponsive)

Grassroots Coalition respectfully requests a written response to this Additional Complaint and maintains its request for response to the 3/29/12 REQUEST TO RESCIND APPLICATION FOR STAFF RECOMMENDATION APPROVAL ON 1/19/12, to award $6,490,000 Ballona Wetlands Restoration Engineering and Technical Studies. (File 04-088)

The PRA response CD cited herein, is on file with the Coastal Conservancy. Copies of the CD are available upon request and/or are being forwarded.

GC also reserves its right to amend this Complaint and Request with additional information.

Attached is the 3/28/12 Request to Rescind from John Davis to Ca.Coastal Conservancy regarding File No. 04-088

Respectfully,
Patricia McPherson, Grassroots Coalition-President

DEPARTMENT OF THE ARMY

LOS ANGELES DISTRICT, CORPS OF ENGINEERS
P.O. BOX 532711
LOS ANGELES, CALIFORNIA 90053-2325

REPLY TO
ATTENTION OF

June 19, 2012

Office of
District Counsel

John Davis
PO Box 10152
Marina Del Rey, CA 90295

RE: Ballona Wetlands

Dear Mr. Davis,

This letter concerns your Freedom of Information Act (FOIA) request dated May 3, 2012. Your request, assigned number FA-12-0109, is enclosed. Please use this reference number in any further correspondence regarding this request.

In your letter, you requested documents related to the Ballona Wetlands, specifically:

1) Any and all documents terminating the Environmental Impact Statement process undertaken by the Corps.

2) Any and all information regarding financial records of the aforesaid process inclusive of all expenditures of money by the Corps and all money received by the Corps for the same purpose from any source whatsoever.

3) Any and all information terminating the local sponsor agreement entered into for the aforesaid purpose between the Corps and the local sponsor, the Santa Monica Bay Restoration Authority.

We have conducted our search and no responsive documents exist due to the following reasons:

1) The Environmental Impact Statement process has not been formally terminated.

2) There have been no expenditures with regard to a formal termination.

3) The local sponsor agreement has not been terminated.

The Program Manager does not anticipate that the EIS process will be terminated in the near future.

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
CIVIL WORKS
108 ARMY PENTAGON
WASHINGTON DC 20310-0108

MAY 30 2012

Mr. John Davis
P.O. Box 10152
Marina Del Rey, California 90295

Dear Mr. Davis:

I have been asked to respond on behalf of Secretary of the Army John M. McHugh to your May 11, 2012, correspondence concerning the Marina del Rey Harbor project and the Ballona Creek, California Ecosystem Restoration feasibility study (Ballona Creek study). The Marina del Rey Harbor entrance channel is a Federal navigation project; however the side channels, docks and inner harbor facilities are not a Federal responsibility and are maintained by the Los Angeles County Department of Beaches and Harbors.

The Ballona Creek study is under development by the Los Angeles District of the Army Corps of Engineers (Corps). You asked about the status of the study, the non-federal cost sharing, and the environmental impact statement. The Ballona Creek study is an ongoing feasibility study examining restoration options for coastal wetlands and lagoons. The study and the environmental impact statement have not been finalized, and very limited federal funding is available to continue them. The non-federal sponsor, the Santa Monica Bay Restoration Commission (SMBRC), has provided its share of the study costs through in-kind services, subject to a Corps evaluation and final approval of crediting. Discussions with the SMBRC on the future of the study have been initiated.

If you would like additional details on the Marina del Rey project or the Ballona Creek study, you may wish to contact Mr. Steve Dwyer, Chief, Navigation Branch, Los Angeles District at (213) 452-3385.

Very truly yours,

Jo-Ellen Darcy

Jo-Ellen Darcy
Assistant Secretary of the Army
(Civil Works)

California Coastal Conservancy March 28, 2012
Att: All Governing Board Members and Alternates
Re: PUBLIC COMMENT 3/29/12:
Request to Hold Emergency Meeting to Rescind Approval Action on File No. 04-088

Douglas Bosco
Marisa Moret
Ann Nothoff
John Laird
Ana J. Matosantos
Mary Shallenberger
Susan Hancsh
Karen Finn
Bryan Cash
Noreen Evens
Joe Simitan
Anthony Cannella
Bill Mornning
Luis Alejo
Das Williams

CC
John Chiang State Controller
California Department of Finance Director Ana Matosantos
U.S. Army Corp of Engineers Att: Commander Mark Toy
U.S. Senator Barbara Boxer
U.S. Congress Person Maxine Waters

Honorable Chair Bosco, Distinguished Commissioners,

Attachments will be submitted to the Governing Board on March 29, 2012.

I hereby request this public body instruct its Staff to schedule an emergency meeting in accordance with the Bagley Keene Act section 11125.5(b) to rescind its approval of File No. 04-088 on January 19, 2012 for the following reasons;

1. NON-COMPLIANCE DEPARTMENT OF FINANCE ATTACHMENT 1
Final Report—Audit of California State Coastal Conservancy's Propositions 12, 13, 40, 50 Bond Funds

The Department of Finance, Office of State Audits and Evaluations, has completed its audit of the California State Coastal Conservancy's (Conservancy) Propositions 12, 13, 40, and 50 bond funds for the period ending June 30, 2008.

Staff Project Manager Mary Small **failed to require Potential Grantee**, the Santa Monica Bay Restoration Foundation, **to fill out a Grant Application Form** on the Conservancy Website.

Background:

On January 24, 2011 The **California Department of Finance Issued a Final Report – Audit** of the California State Coastal Conservancy. The Report Found that ;

*The Conservancy did not establish formal program guidelines: project awarding criteria; and **grant applications** to document its project merit review process.*
Also, the Conservancy website included limited or incomplete information about ongoing programs and efforts, regional priorities, and funding opportunities.

On October 7, 2010, Executive Director Samuel Schuchat responded to the Audit.

*The **Conservancy website has been updated to included the standardized grant application**, more information about funding opportunities.*

The Conservancy has formally adopted project selection criteria, and a formal, transparent awarding process that follows statute.

*It generally does not institute grant rounds but instead has an **open grant process. Application can be and are made, and these are considered at any time.***

*With respect to the form of **grant applications**, based on discussions with the auditors, we have created a **uniform grant application** that is posted on our website. There is now more information available to the public concerning priorities and how to apply for funding.*

*We have developed a **standard grant application that is now in use**.*

A. Staff Project Manager Mary Small failed to obtain any written documentation to identify the Potential Grantee,no address, no agent name, nor an account to which the grant could be deposited is recorded.

B. Staff Project Manager Mary Small had no paperwork whatsoever from the Potential Grantee prior to January 19, 2012 nor did the Potential Grantee request funding. Staff did not provide public notice that such Grant Funds were available to other qualified entities.

C. Staff Project Manager Mary Small failed to determine if the private business, Santa Monica Bay Restoration Foundation was legally operating out of a State Water Board Office, the Los Angeles Regional Water Quality Control Board. Filings with the California Secretary of State show the private business is operating out of a State Office. There is no legal authority allowing for this.

D. Staff Project Manager Mary Small failed to disclose the fact she was a Director of the Corporation of the Proposed Grantee in 2006 creating an appearance of impropriety.

2. FALSEFICATION OF PUBLIC RECORDS ATTACHMENT 2

Staff falsified a Form SCC 08-08, Work Transmittal.
The Form was initialized by;
Executive Director - Sam Schuchat
Project Manager - Mary Small
Legal - Elena Eger

Staff filled out the form as follows:

*Will this project receive federal or other outside funding? Yes___ No X_*

The January 19, 2012 **Staff Report contradicts on page 6 :**

*"The SMRBF in-kind **funds would come from U.S. EPA funding** provided to the SMRBF for its staff **and from a U.S. EPA Wetland Program Development Grant** received for work at Ballona"*

3. INCOMPLETE PUBLIC RECORDS ATTACHMENT 2

Staff failed to complete Form SCC 08-08, Work Transmittal.
The Form was initialized by;
Executive Director - Sam Schuchat
Project Manager - Mary Small
Legal - Elena Eger

Is the Grantee a Nonprofit Organization Yes___ No__ - NOT CHECKED
If nonprofit: Is the status file complete and current Yes___ No___ - NOT CHECKED
GRANT / CONTRACT AMMENDMENTS REVIEW - BLANK
MAIL OUT APPROVALS - BLANK
APPLICATION - BLANK
GRANT TRANSMITTAL - BLANK
REVIEW OF AGREEMENT - BLANK

4. DISCRIMINATION ATTACHMENT 3

Staff Project Manager Mary Small has improperly lobbied private individuals, private businesses, State and Federal Officials and entities prior to the release of the Staff Report, thusly, discriminating against all others by failing to provide the same comment opportunity prior to the issuance of the Staff Report.

Further Discrimination has taken place because only one Potential Grantee has been selected by Staff Project Manager Mary Small, excluding all others that may have chosen to apply.

Moreover, Discrimination has taken place in that only a select group of Potential contractors was noticed by Staff Project Manager Mary Small, in non-compliance with the California Contract Code, excluding all other qualified firms.

5. PREJUDICE OF PROCESS ATTACHMENT 4

Staff Project Manager Mary Small requested Potential Grantee to help write Staff Report.

Staff Project Manager Mary Small worked with Potential Grantee to engage in media spin to avoid scrutiny.

6. STAFF REPORT EXCLUDED VITAL INFORMATION ATTACHMENT 5

The Staff Report is ambiguous. It describes the Grantee in detail with no supporting documentation whatsoever.

The Staff Report does not establish terms of compliance for the Proposed Grantee nor for entities that will complete the described studies.

The Staff Report does not define that contractors will be hired. Staff Project Manager Mary Small discussed hiring contractors with the Potential Grantee and others before the Staff Report was approved, purposely avoiding the requirement under the Bagley Keene Act for the Governing Board to approve contractors and Notice requirements of the California Contract Code.

Legal Staff Elena Eger encouraged Staff Project Manager Mary Small to complete a grant agreement form because I requested it pursuant to the Public Records Act. The form should have been completed without my request for it.

The Staff Report failed to inform this Board that a Federal Environmental Protection Act Process was initiated by the Army Corp of Engineers Los Angeles in 2005 that governs the Ballona Wetlands.

Staff has failed to inform the Governing Board and Public that the Project Manager, Mary Small, lobbied the Department of Fish and Game to ignore the EIS Notice published in the Federal Register, in favor of a new EIR/EIS process desired by the Project Manager and the Proposed Grantee, without informing and seeking authorization from this Governing Board. This clearly constitutes interference with a legally noticed federal NEPA process. Furthermore Staff Project Manager Mary Small failed to inform this Governing Board that the entire area is governed by U.S. Public Law 780, the Rivers and Harbors Act of 1954, which is the subject of the EIS process currently being conducted by the USACE.

In the Minutes of the Ballona Ecosystem Restoration Planning Management Committee, obtained from the USACE by FOIA Staff Project Manager Mary Small, without the

authorization of this Board, represented to the Army Corp of Engineers on June 28, 2010 that:

Coastal Conservancy is supplying most of the funding toward the in-kind local sponsor efforts.

The Governing Board has not authorized Mary Small to represent the Coastal Conservancy at a meeting of the Army Corp of Engineers and the Local Sponsor (Santa Monica Bay Restoration Authority). The Conservancy is neither a partner nor is there any MOU to with the SMRBA, which is under contract to the USACE. Minutes of other such meetings provide evidence that Mary Small also discussed;

A. Changing the scoping of an Environmental Protection Act process began by the USACE in 2005.

B. Using only the Conservancy's Alternatives.

C. Attempting to gain in kind credits from the USACE.

D. Further documents provided by the USACE provide evidence that the local sponsor, never provided any funding to the USACE whatsoever nor did it provide any in-kind credit.

E. Resumes provided to the Coastal Conservancy by potential contractors for this Project include studies finished and paid for by federal funding stated in the resume(s) as part of the Lower Ballona Creek Feasibility Studies of the Joint EIR/EIS (2005) initiated by the USACE.

7. VIOLATIONS OF CALIFORNIA CONTRACT CODE ATTACHMENT 6

Staff Project Manager Mary Small failed to comply with the California Contract Code Notification and Conflict requirements, Sections 10140-10141 and 10515-10518.

Staff Project Manager Mary Small conducted a Request for Services for Contractors in 2009, and again in 2010 in regard to a Project not noticed to the Public or Governing Board until 2012, both in non-compliance with California Contract Code.

Staff Project Manager Mary Small purports to have initiated another Request for Services in February 2012 with responses due on the 29th of that month outside in non-compliance with the California Contract Code.

8. VIOLATIONS OF BAGLEY KEENE ATTACHMENT 6

Staff failed to obtain permission from the Governing Board to hire contractors to complete studies.

9. QUID PRO QUO INFERED ATTACHMENT 7

The attached e-mails contain an inference of a quid pro quo. The request for a support letter is accompanied by a discussion of bond money provisions. In one email a support letter request exists alongside a discussion to close out another matter, without specificity.

10. INIMIDATION AND HARRASSNMENT OF PUBLIC BY LEGAL STAFF VIOLATING STATE LAW AND AGENCIES PRIVACY POLICY

ATTACHMENT 8

Legal Staff Elena Eger has attempted to intimidate and harass me by copying private business persons on emails to me which disclose my private address, even after I requested the practice cease in writing, in clear contradiction to Information Practices Act (Civil Code section 1798 et seq.) and the Agencies Privacy Policy.

Staff has violated the Conservancy Privacy Policy by the aforesaid action(s).

Privacy Policy

Pursuant to Government Code § 11019.9, all departments and agencies of the State of California shall enact and maintain a permanent privacy policy, in adherence with the Information Practices Act of 1977 (Civil Code § 1798 et seq.), that includes, but is not necessarily limited to, the following principles:

(a) Personally identifiable information may only be obtained through lawful means.

(b) The purposes for which personally identifiable data are collected shall be specified at or prior to the time of collection, and any subsequent use of the data shall be limited to and consistent with the fulfillment of those purposes previously specified.

(c) Personal data may not be disclosed, made available, or otherwise used for a purpose other than those specified, except with the consent of the subject of the data, or as required by law or regulation.

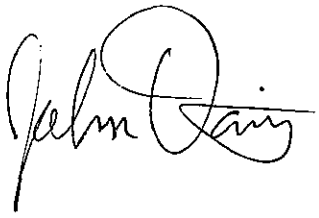
(d) Personal data collected shall be relevant to the purpose for which it is needed.

(e) The general means by which personal data is protected against loss, unauthorized access, use, modification, or disclosure shall be posted, unless the disclosure of those general means would compromise legitimate agency objectives or law enforcement purposes.

Each department shall implement this privacy policy by:

- *Designating which position within the department or agency is responsible for the implementation of and adherence to this privacy policy;*
- *Prominently posting the policy physically in its offices and on its internet website, if any;*
- *Distributing the policy to each of its employees and contractors who have access to personal data;*
- *Complying with the Information Practices Act (Civil Code § 1798 et seq.); the Public Records Act (Government Code § 6250 et seq.); Government Code § 11015.5, and all other laws pertaining to information privacy;*
- *Using appropriate means to successfully implement and adhere to this privacy policy.'*

Sincerely,



John Davis
PO 10152
Marina del Rey Ca. 90295

ATTACHMENT 1

RE: Public Records Request from John Davis

From: Philip Wyels <PWyels@waterboards.ca.gov>(Add as Preferred Sender)
Date: Tue, Feb 21, 2012 2:26 pm
To: <jd@johnanthonydavis.com>

Mr. Davis, I apologize for the delay in responding to your request. I have been unable to locate any records within the possession of the State Water Resources Control Board that are responsive to your requests. The attached two documents may be of interest to you, however, in that they indicate that the Santa Monica Bay Restoration Project's relationship with the Santa Monica Bay Restoration Foundation (Foundation) pre-dated the conversion of the Santa Monica Bay Restoration Project to the Santa Moniea Bay Restoration Commission (Commission). Also, as I explained to you by telephone, the Commission staff is currently undertaking a number of steps to more clearly distinguish the Commission from the Foundation. Unfortunately, some of those steps are taking some time. I will let you know when I receive a timetable for those steps from Commission staff.

Sincerely,
Phil

Philip G. Wyels
Assistant Chief Counsel
State Board Water Quality Unit
State Water Resources Control Board

1001 I Street
P.0. Box 95812-0100
Sacramento, CA 95814

(916) 341-5178 (phone)
(916) 341-5199 (fax)
pwyels@waterboards.ca.gov>>>

From: <jd@johnanthonydavis.com>
To: Philip Wyels <pwyels@waterboards.ca.gov>
CC: Michael Lauffer <MLauffer@waterboards.ca.gov>
Date: 2/21/2012 10:00 AM
Subject: RE: Public Records Request from John Davis

California State Water Board
Att: Phil Wyels
Re: Status Request Public Record Request

Councel Wyels,

The California Public Records Act requires that Agencies subject to the Act reply to request for records
within 10 days after a request is made.

The State Water Resources Board has not complied with the law in this respect in regard to the request for
records made on 2/7/12.

Please advise as to if or when the State Agency will reply.

Thanks,

John Davis

-------- Original Message --------
Subject: Public Records Request from John Davis
From: <jd@johnanthonydavis.com>
Date: Tue, February 07, 2012 3:03 pm
To: "Philip Wyels" <pwyels@waterboards.ca.gov>
Cc: "Elena Eger" <eeger@scc.ca.gov>

California State Water Board
Att: Phil Wyels
Re: Public Record Request

Dear Mr. Wyeles,

This is a request for public records pursuant to the California Public Records Act. Each numbered request is distinct.

1. Please provide any record of any law, regulation, or policy of the State Water Board which allows
a private business to operate out of a State Water Board Office.

2. Please provide any record of any law, regulation,or policy that allows a private business to use a State Water Board Office as a corporate street address of principal office in California, and or as a mailing address of the corporation, and or mailing address of the corporation, and or address of a corporate Chief Executive Officer, and or of a corporate secretary, and or of a corporate financial agent.

3. Please provide any law, and or regulation, and or policy that allows any State Water Board Commission to
designate a private business as its "FISCAL AGENT"

4. Please provide any law, and or regulation, and or policy that allows any State Water Board Commission to designate a private business to receive, manage, and to treat money granted by the U.S. Government to the State of California as revenue of the private business.

Thank you for your continued assistance,

John Davis
PO 10152
Marina del Rey Ca. 90295
310.795.9640

From:	Elena Eger
To:	"jd@johnanthonydavis.com"
Cc:	"Shelley Luce"; "svalor@santamonicabay.org"; "Mary Small"; "Dick Wayman"; "Nadine Peterson"; "Samuel Schuchat"
Subject:	Davis call to Eger of 2-6-12
Date:	Tuesday, February 07, 2012 1:00:00 PM
Attachments:	SWRCB memo2011aug re accusations.pdf SWRCB Ltr to Davis re PRAs.pdf

Dear Mr. Davis:

Pursuant to our phone conversation of yesterday, February 6, 2012, in which you provided a warning to me that the Conservancy should be informed that the Santa Monica Bay Foundation allegedly is appropriating public resources for private gain, attached please find the State Water Resources Control Board's (SWRCB) August 15, 2011 legal memo addressing your contentions and a September 13, 2011 letter to you regarding the same.

As analyzed in the SWRCB memo, especially in #3, pp. 4-5 of that memo, your contentions that the Foundation is improperly utilizing public resources for private use, namely in your assertions yesterday when you identified as improper the fact that the Foundation uses the same mailing address as the SWRCB's Los Angeles office, are specifically addressed. Frances McChesney, Esq., Office of the Chief Counsel for the SWRCB concludes in that memo that the Foundation is not improperly appropriating public resources for its private use.

The Conservancy intends to proceed with its grant to the Foundation approved as Item #5 at its January 19, 2012 meeting.

Sincerely,

Elena Eger
Senior Staff Counsel
California Coastal Conservancy
1330 Broadway, Ste. 1300
Oakland, CA 94612
510-286-4089 tele/voicemail
510-286-0470 fax

[redacted]

State of California

Secretary of State

E-945038

FILED

In the office of the Secretary of State
of the State of California

Feb - 5 2010

This Space For Filing Use Only

STATEMENT OF INFORMATION

(Domestic Nonprofit, Credit Union and Consumer Cooperative Corporations)

Filing Fee $20.00. If amendment, see instructions.

IMPORTANT - READ INSTRUCTIONS BEFORE COMPLETING THIS FORM

N

1. **CORPORATE NAME** (Please do not alter if name is preprinted.)

C1481142
SANTA MONICA BAY RESTORATION FOUNDATION

320 W 4TH ST STE 200
LOS ANGELES CA 90013

DUE DATE:

COMPLETE PRINCIPAL OFFICE ADDRESS (Do not abbreviate the name of the city. Item 2 cannot be a P.O. Box.)

2. STREET ADDRESS OF PRINCIPAL OFFICE IN CALIFORNIA, IF ANY — CITY — STATE — ZIP CODE
320 W 4TH ST STE 200 LOS ANGELES CA 90013

3. MAILING ADDRESS OF THE CORPORATION, IF REQUIRED — CITY — STATE — ZIP CODE
320 W 4TH ST STE 200 LOS ANGELES CA 90013

NAMES AND COMPLETE ADDRESSES OF THE FOLLOWING OFFICERS (The corporation must have these three officers. A comparable title for the specific officer may be added; however, the preprinted titles on this form must not be altered.)

4. CHIEF EXECUTIVE OFFICER/ ADDRESS — CITY — STATE — ZIP CODE
SHELLY LUCE 320 W 4TH ST STE 200 LOS ANGELES, CA 90013

5. SECRETARY/ ADDRESS — CITY — STATE — ZIP CODE
CATHERINE TYRRELL 320 W 4TH ST STE 200 LOS ANGELES CA 90013

6. CHIEF FINANCIAL OFFICER/ ADDRESS — CITY — STATE — ZIP CODE
LAURIE NEWMAN 320 W 4TH ST STE 200 LOS ANGELES CA 90013

AGENT FOR SERVICE OF PROCESS (If the agent is an individual, the agent must reside in California and Item 8 must be completed with a California street address (a P.O. Box address is not acceptable). If the agent is another corporation, the agent must have on file with the California Secretary of State a certificate pursuant to Corporations Code section 1505 and Item 8 must be left blank.)

7. NAME OF AGENT FOR SERVICE OF PROCESS
SHELLEY LUCE

8. STREET ADDRESS OF AGENT FOR SERVICE OF PROCESS IN CALIFORNIA, IF AN INDIVIDUAL — CITY — STATE — ZIP CODE
320 W 4TH ST STE 200 LOS ANGELES, CA 90013

DAVIS-STIRLING COMMON INTEREST DEVELOPMENT ACT (California Civil Code section 1350, et seq.)

9. ☐ Check here if the corporation is an association formed to manage common interest development under the Davis-Stirling Common Interest Development Act and proceed to items 10, 11 and 12.

NOTE: Corporations formed to manage a common interest development must also file a Statement by Common Interest Development Association (Form SI-CID) as required by California Civil Code section 1363.6. Please see instructions on the reverse side of this form.

10. ADDRESS OF BUSINESS OR CORPORATE OFFICE OF THE ASSOCIATION, IF ANY — CITY — STATE — ZIP CODE

11. FRONT STREET AND NEAREST CROSS STREET FOR THE PHYSICAL LOCATION OF THE COMMON INTEREST DEVELOPMENT — 9-DIGIT ZIP CODE
(Complete if the business or corporate office is not on the site of the common interest development.)

12. NAME AND ADDRESS OF ASSOCIATION'S MANAGING AGENT, IF ANY — CITY — STATE — ZIP CODE

13. THE INFORMATION CONTAINED HEREIN IS TRUE AND CORRECT.

02/05/2010	SHELLEY LUCE	EXECUTIVE DIRECTOR	
DATE	TYPE OR PRINT NAME OF PERSON COMPLETING THE FORM	TITLE	SIGNATURE

SI-100 (REV 01/2008) — APPROVED BY SECRETARY OF STATE

Form **990**

Department of the Treasury
Internal Revenue Service

Return of Organization Exempt From Income Tax

Under section 501(c), 527, or 4947(a)(1) of the Internal Revenue Code (except black lung benefit trust or private foundation)

▶ The organization may have to use a copy of this return to satisfy state reporting requirements

OMB No 1545-0047

2006

Open to Public Inspection

A For the 2006 calendar year, or tax year beginning Jul 01, 2006, and ending Jun 30, 2007

B Check if applicable: ☐ Address change ☐ Name change ☐ Initial return ☐ Final return ☐ Amended return ☐ Application pending

Please use IRS label or print or type See Specific Instructions

C Name of organization, number and street, city, town, state, and ZIP code

Santa Monica Bay Restoration Foundation
320 West 4th Street Suite 200
LOS ANGELES CA 90013

D Employer identification number: 33-0420271

E Telephone number: 213-576-6642

F Acctg. method: ☒ Cash ☐ Accrual ☐ Other (specify) ▶

• Section 501(c)(3) organizations and 4947(a)(1) nonexempt charitable trusts must attach a completed Schedule A (Form 990 or 990-EZ).

G Website: ▶ WWW.SANTAMONICABAY.ORG

J Organization type (check only one) ▶ ☒ 501(c)(3) ◀ (insert no) | 4947(a)(1) or | 527

K Check here ▶ ☐ if the organization is not a 509(a)(3) supporting organization and its gross receipts are normally not more than $25,000 A return is not required, but if the organization chooses to file a return, be sure to file a complete return

H and I are not applicable to section 527 organizations

H(a) Is this a group return for affiliates? ☐ Yes ☒ No

H(b) If "Yes," enter number of affiliates ▶

H(c) Are all affiliates included? (If "No," attach a list See instructions) ☐ Yes ☐ No

H(d) Is this a separate return filed by an organization covered by a group ruling? ☐ Yes ☒ No

I Group Exemption Number ▶

M Check ▶ ☐ if the organization is not required to attach Sch B (Form 990, 990-EZ, or 990-PF)

L Gross receipts Add lines 6b, 8b, 9b, and 10b to line 12 ▶ 979,681.

Part I Revenue, Expenses, and Changes in Net Assets or Fund Balances (See the instructions)

Revenue	1 Contributions, gifts, grants, and similar amounts received			
	a Contributions to donor advised funds	1a		
	b Direct public support (not included on line 1a)	1b	342,406.	
	c Indirect public support (not included on line 1a)	1c		
	d Government contributions (grants) (not included on line 1a)	1d	576,050.	
	e Total (add lines 1a through 1d) (cash $ 918,456. noncash $)			1e 918,456.
	2 Program service revenue including government fees and contracts (from Part VII, line 93)			2 18,485.
	3 Membership dues and assessments			3
	4 Interest on savings and temporary cash investments			4 41,773.
	5 Dividends and interest from securities			5 967.
	6 a Gross rents	6a		
	b Less rental expenses	6b		
	c Net rental income or (loss) Subtract line 6b from line 6a			6c
	7 Other investment income (describe ▶)			
	8 a Gross amount from sales of assets other than inventory	(A) Securities 8a	(B) Other	
	b Less cost or other basis & sales expenses	8b		
	c Gain or (loss) (attach schedule)	8c		
	d Net gain or (loss) Combine line 8c, columns (A) and (B)			8d
	9 Special events and activities (attach schedule) If any amount is from gaming, check here ▶ ☐			
	a Gross revenue (not including $ of contributions reported on line 1b)	9a		
	b Less direct expenses other than fundraising expenses	9b		
	c Net income or (loss) from special events Subtract line 9b from line 9a			9c
	10 a Gross sales of inventory, less returns and allowances	10a		
	b Less cost of goods sold	10b		
	c Gross profit or (loss) from sales of inventory (attach schedule) Subtract line 10b from line 10a			10c
	11 Other revenue (from Part VII, line 103)			11
	12 **Total revenue.** Add lines 1e, 2, 3, 4, 5, 6c, 7, 8d, 9c, 10c, and 11			12 979,681.
Expenses	13 Program services (from line 44, column (B))			13 757,878.
	14 Management and general (from line 44, column (C))			14 102,224.
	15 Fundraising (from line 44, column (D))			15 7,373.
	16 Payments to affiliates (attach schedule)			16
	17 **Total expenses.** Add lines 16 and 44, column (A)			17 867,475.
Net Assets	18 Excess or (deficit) for the year Subtract line 17 from line 12			18 112,206.
	19 Net assets or fund balances at beginning of year (from line 73, column (A))			19 872,326.
	20 Other changes in net assets or fund balances (attach explanation)			20
	21 Net assets or fund balances at end of year Combine lines 18, 19, and 20			21 984,532.

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List of Officers, Directors, Trustees and Key Employees

US 990 **990: Page 5, Part V; 990EZ: Page 2 Part IV; 990-PF: Page 6, Part VIII** **2006**

Name and Address	Title/Average Hours Per Week Devoted to Position	Amount Paid	Amount for Employee Benefit Plan	Expense Account and Other Allowances
Rod Spackman 320 W 4th St	President 2			
Randal Orton 320 W 4th St	CFO 2			
Mark Gold 320 W 4th St	Director 1			
Tom Ford 320 W 4th St	Director 1			
Richard Bloom 320 W 4th St	Director 1			
Fran Diamond 320 W 4th St	Director 1			
Marvin Sachse 320 W 4th St	Director 1			
Bob Hoffman 320 W 4th St	Director 1			
S Wisniewski 320 W 4th St	Director 1			
Laurie Newman 320 W 4th St	Director 1			
Mary Small 320 W 4th St	Director 1			
Bryant Chesney 320 W 4th St	Director 1			
Dean Kubani 320 W 4th St	Director 1			
Shelley Luce 320 W 4th St	Executive 40	55,830.		
		55,830.		

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ATTACHMENTS 2

SCC 08-08

WORK TRANSMITTAL

Project Development Approval

Date: 12/13/11 WG Leader: MS Date: 12/13/11

Project Manager: Mary Small Project #: 04-088-01

Project Name: Ballona Wetlands County/City: LA

Grantee/Contractor Name: ESA / Santa Monica Bay Foundation

Is Grantee a Nonprofit Organization? ___ Yes ___ No If Nonprofit: Is status file complete and current? ___ Yes ___ No

Nature of Job Planning / design

RESERVATION OF FUNDS

Will this project receive federal or other "outside" funding? ___ Yes X No. *If Yes, fill out back side of this form (Grant Transmittal - A)*

Will this project receive state / other funding? ___ Yes *(Reimb. -0995)* X No. *If Yes, fill out back side of this form (Grant Transmittal - B)*

Total Amount to be Reserved: $ 6,490,000.00

Prop 84 - Planning? ___ Yes X No

Proposed Budget Item(s):	Fiscal Year (Budget Act)	Amount	Encumb. Expiration Date	Liquid. Date
1. 3760-30203-0005 (2)(B)( )	2000 Chapter: 057/10	$ 6,490,000.00	(6/13	)(6/15)
2. 3760-_____( )( )( )	_____ Chapter: ___	$ _____	(_____	)(_____)
3. 3760-_____( )( )( )	_____ Chapter: ___	$ _____	(_____	)(_____)

Reap. by Chapter: 712/10 *for item* 1. *Reap. by Chapter:* _____ *for item* ___ *Reap. by Chapter:* _____ *for item* ___

Program: enhancement

Project Info entered onto applicable Bond Data Spreadsheet? ___ Y X N Date: N/A

___ Public Access: VRA (Capital Outlay)

___ Habitat Conservation Fund (0262)

___ Support: 001 Fund 0565 only: ___ Yes

IT ___ Consult & Prof. (External) ___ (Inter-Dept.) ___

Repayment Feature? (Loan Receivable) ___ Yes ✓ No

Private Activity ? ___ Yes ___ No ✓ N/A (Tax Reportable to Treasurer's Office)

Expected Date of Board Action: 4/19/12 Project Entered onto SCC Database? ✓ Y ___ N Date: 12/13/11

1. WG Leader: MS Date: 12/13/11

2. Acctg Officer: HT 6.49M Date: 12/13/11

3. Additional WG Leader responsible for management of specific funds (if applicable): _____ Date: _____

4. Legal: EE Date: 12/14/11

5. EO/DEO: SS Date: 12/15/11

STAFF RECOMMENDATION REVIEW (For 1/19/12 Board Meeting)

1. WG Leader: MS Date: 12/13/11

2. Legal : EE Date: 12/14/11

3. EO/DEO : SS Date: 12/15/11

4. *Legal: _____ Date: _____

** At EO/DEO's discretion*

GRANT/CONTRACT AMENDMENTS REVIEW

(CEQA Submitted? ___ Yes ___ No ___ N/A Project Manager _____ Date: _____)

Amount Encumbered: $ _____ Grant/Contract No.: _____

Termination Date: _____ Amendment No.: _____

Disabled Veteran Business Enterprise (DVBE)? ___ Yes ___ No

Small Business Enterprise (SBE)? ___ Yes ___ No

(If Yes, provide OSDS# _____)

20-yr Agreement? ___ Yes ___ No

MAIL OUT APPROVALS

1. Legal: _____ Date: _____

2. Project Manager: _____ Date: _____

3. Proofreader: _____ Date: _____

GRANT TRANSMITTAL

Grant No._____

(for receivable grants)

INTENT TO APPLY

Date: _____

Project Manager: _____

SCC Program: _____

Grant Program Name: _____ Grant Amount: _____

Granting Agency: _____

Project Name: _____ Project Number: _____

SCC required Matching Funds: (if other than in-kind services, please use reverse side of this form to reserve SCC funds)

In - Kind: $ _____ (Copy from reverse side)

Support: $ _____ Fund No.: _____ FY _____

Capital Outlay: $ _____ Fund No.: _____ FY _____

TOTAL: $ _____

Funding Mechanism: Will or will not hit SCC account? _____ Electronic Transfer ? _____

Paid in Arrears ? _____ Cash Advance ? _____

___ *(A) For Federal Grant*

Support (Staff, travel, equipment): $ _____ 3760 - 001- 0890 FY : _____

Capital Outlay: $ _____ 3760 - 301- 0890 FY : _____

Other (Specify) _____ : $ _____ 3760 - _____ FY : _____

TOTAL: $ _____

___ **(B) For State Reimbursable Grant** (Please use reverse side of this form to reserve up-front SCC funds)

Support (Staff, travel, equipment): $ _____ 3760 - 001 - 0565 - F90 FY : _____

Capital Outlay: $ _____ 3760 - 301 - _____ - F90 FY : _____

Other (Specify) _____ : $ _____ 3760 - ____ - ____ - F90 FY : _____

TOTAL: $ _____

Authorization:

Program Manager: _____ Date: _____

Accounting Officer: _____ Date: _____

Grants Manager: _____ Date: _____

APPLICATION *(Provide copy of Application to Grants Manager)*

Legal * _____ Date: _____

**Please inform Grants Manager if signature are missing in the "INTENT TO APPLY" SECTION*

EO/DEO: _____ Date: _____

Date Applied: _____ Expected Date of Grant Award: _____

REVIEW OF AGREEMENT (for receipt of funds)

Board Authorization To Spend The Grant: Date (s): _____

Project Manager: _____ Date: _____

Program Manager: _____ Date: _____

Legal: _____ Date: _____

EO/DEO: _____ Date: _____

Grants Manager: _____ Date: _____ Inform Acct. Date: _____

Amendment #: _____ Legal Reviewed by: _____ Date: _____

ATTACHMENT 3

From: Mary Small
To: sluce@santamonicabay.org; "Barbara Romero"
Subject: FW: hard copy in the mail tomorrow
Date: Friday, January 06, 2012 4:04:00 PM

-----Original Message-----
From: Ruth Galanter [mailto:ruth.galanter@verizon.net]
Sent: Friday, January 06, 2012 3:57 PM
To: Mary Small
Subject: Re: hard copy in the mail tomorrow

I am planning to attend the meeting, and I'm trying to get some more support letters and maybe attendees. You have no idea how much pleasure I would get from foiling your opponents. I can either stand up during the hearing, or if you want, I can instead meet you and the board between the tour and the meeting (since you must be going to feed them someplace) and just chat informally.

Your choice. I'm free at about 11:30 and have a meeting at 3 pm. In between I am at your service.

On Jan 6, 2012, at 3:50 PM, Mary Small wrote:

> Thanks that's a very generous offer. If you have time to attend the
> meeting, that would be great. It starts at 1pm at Baldwin Hills Scenic
> Overlook and this is the first substantive item on the agenda. I will have
> pretty limited time to present, but could acknowledge you and if you were
> willing to speak in public comment on the item that would fantastic.
> Mary
>
> -----Original Message-----
> From: Ruth Galanter [mailto:ruth.galanter@verizon.net]
> Sent: Friday, January 06, 2012 9:52 AM
> To: Mary Small
> Subject: Re: hard copy in the mail tomorrow
>
> I'm available after about 11:30, and you might want to use me as part of a
> board briefing in light of my nearly two decades dealing with the issue.
> That of course is up to you, and I promise not to get huffy if you'd rather
> not.
>
> On Jan 6, 2012, at 9:10 AM, Mary Small wrote:
>
>> Thank you very much, you letter is perfect and I appreciate your quick
>> response. It would be great to have a few supporters at the meeting, I am
>> sure the opponents will attend.
>>
>> We are also going to take the Coastal Conservancy board on a quick tour of
>> the site the morning before the meeting from 10-12. I know you are very
>> busy but it would be great if you wanted to join us for either the tour or
>> to attend the meeting.
>> Mary
>>
>> -----Original Message-----
>> From: Ruth Galanter [mailto:ruth.galanter@verizon.net]
>> Sent: Thursday, January 05, 2012 9:13 PM
>> To: Small Mary
>> Subject: hard copy in the mail tomorrow
>>

>> Hi Mary,
>>
>> I've emailed you my letter and will send the hard copy tomorrow.
>>
>> I've also emailed various people to suggest attending the hearing in case
>> the eco-loonies show up, as I suppose they will.
>>
>> Have a good weekend.
>>
>> Ruth
>>
>>
>>
>
>
>
>

From: Mary Small
To: "Shelley Luce"
Subject: FW: Letter for Coastal Conservancy Board
Date: Tuesday, December 13, 2011 1:21:00 PM

Do you know Ruth?

From: Joan Cardellino [mailto:jcard@scc.ca.gov]
Sent: Tuesday, December 13, 2011 11:57 AM
To: 'Mary Small'
Subject: RE: Letter for Coastal Conservancy Board

It might be worth calling Ruth Galanter to see if she'd speak in support of the project. She has some good credentials. She might know of other supporters to ask too.

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, December 13, 2011 10:38 AM
To: 'Shelley Luce'
Cc: 'Joan Cardellino (Joan Cardellino)'
Subject: RE: Letter for Coastal Conservancy Board

Hi Shelley-
Do you have time to talk about our Jan meeting? I know you have a board meeting this week, so we could also do this via email – or next week, but before next Fri I'd like to work through some ideas:

1) Tour – we'll probably do a tour the morning of the meeting, I think maybe the tour we did with Colonel Toy – view from Cabora Rd and then walk out to boyscout platform
2) Press – do you think we could use this meeting as an opportunity to get either local papers and/or try for LA Times to cover the project? I am worried that once the agenda is out Marcia will use as opportunity to get bad press. Our agenda will be mailed out Jan 6th
3) Public support – who could we have come to support the project at the meeting or with letters? Geraldine is critical (at least her letter) but how about MRCA?, Joe Geever?, Ballona Creek Renaissance?, Friends?, Miguel Luna?, Audubon? HtB? Baykeeper?

Thanks,
Mary

From: Shelley Luce [mailto:sluce@santamonicabay.org]
Sent: Monday, December 12, 2011 3:22 PM
To: Mary Small
Subject: FW: Letter for Coastal Conservancy Board

Hi Mary, Geraldine thought her letter went out already. Have you received? I also invited her to tour the wetlands with us after the meeting.

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission

From:	Mary Small
To:	"Bryant Chesney"
Cc:	"sluce@santamonicabay.org"
Subject:	FW: support letter for Ballona Funding
Date:	Friday, January 06, 2012 9:57:00 AM
Attachments:	Ballona_Wetlands_Engineering and Technical Studies.docx ballona support letter 1.docx ballona support letter 2.docx

Hi Bryant
I was wondering if you would be willing to send a letter of support (samples attached) to the Coastal Conservancy for the Ballona wetlands project. Also attached is the draft staff recommendation. The Conservancy will be considering this authorization in LA on Jan 19th, we will take the board on a quick tour of the site before the meeting. If you have time, it would be great to have you attend either of those events too.

This is the request for all funding to complete the environmental review, 100% engineering, and all of the hydrology/hydraulics modeling that the Army Corps is requiring for its permit to modify the flood control levees. The later analysis is the about half of the cost estimate.

Since the meeting will be in LA, opponents of the project are likely to show up. This approval is pretty critical to moving the project forward. If the Conservancy Board gets frightened away from large scale, ecological restoration then I think we will have very limited options for the future.

Thanks for your consideration and please let me know if you have any questions.
Mary

From: Mary Small
To: "Miguel Luna"
Cc: "Shelley Luce"
Subject: FW: draft support letter for SCC board meeting
Date: Tuesday, January 03, 2012 1:29:00 PM
Attachments: SCC_Ballona_Tech_Support_Ltr.docx

Hi Miguel
Happy New year! Hope you are well.

Is there any chance you would be willing to send a letter of support to the Coastal Conservancy for authorization of funding to continue design of the restoration project? I don't know if Shelley contacted you, but it would be great to get community groups weighing in who support ecological restoration. Our meeting will be in LA, so I expect there will be some opposition.

Please let me know if you have any questions or need more info.
Thanks,
Mary

December 14, 2011

Mr. Doug Bosco, Chairman
State Coastal Conservancy
1330 Broadway, #1300
Oakland, CA 94612
Attn: Mary Small

RE: Proposed Conservancy Authorization for Ballona Wetlands Restoration Engineering and Technical Studies

Dear Chairman Bosco:

I am writing to encourage the Conservancy to authorize funding for the Ballona Wetlands Ecological Reserve Restoration Project planning process. These authorizations would enable the development of technical assessments and engineering design, technical review and agency coordination to support environmental impact analysis and permit applications for the restoration of the Ballona Wetlands Ecological Reserve (BWER).

The Ballona Wetlands Ecological Reserve is 600 acres, surrounded by urban Los Angeles County. The BWER provides valuable and scenic open space in the heart of congested Los Angeles County and offers one of the largest and most promising opportunities for coastal wetland restoration in the region. When restored and opened to the public, the site will allow millions of residents and visitors a rare opportunity to experience a coastal wetland. I support this project because it will help to move the restoration of the Ballona Wetlands Ecological Reserve closer to fruition. Thank you for your consideration of this project.

Sincerely,

From: Mary Small
To: "Shelley Luce"
Subject: RE: draft support letter for SCC board meeting
Date: Tuesday, January 03, 2012 1:27:00 PM

Thanks!
I will talk to Sam about Boxer and Feinstein. Can LA Co DPW send a letter or do you think that is covered by the Supervisors?
Mary

From: Shelley Luce [mailto:sluce@santamonicabay.org]
Sent: Tuesday, January 03, 2012 1:25 PM
To: Mary Small; Diana Hurlbert
Subject: RE: draft support letter for SCC board meeting

Hi Mary,
We are working on:
Knabe
MRT
Friends of BW
So Cal Edison
So Cal Gas
LMU
Waxman
Lieu
Butler
Rosendahl

And Anyone else you want to add to that list. Figured Feinstein and Boxer will be more important later, and that you and Sam are the best ones to approach them.

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission
Pereira Annex MS:8160
1 LMU Drive, Loyola Marymount University
Los Angeles, CA 90045
310-961-4444

www.santamonicabay.org

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, January 03, 2012 1:06 PM
To: Shelley Luce; Diana Hurlbert
Subject: FW: draft support letter for SCC board meeting

Hi
I belatedly just sent this request to DFG and SLC. The only support letter I have is from MRCA, though I know the port is working on one too. Can you let me know who you are working on

getting letters from and if there is anyone else I should follow-up with?
Thanks
Mary

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, January 03, 2012 1:04 PM
To: 'Griggs, Pamela@SLC'; 'Terri Stewart'; 'dlawhead@dfg.ca.gov'; 'Rick Mayfield (rmayfield@dfg.ca.gov)'
Subject: draft support letter for SCC board meeting

Hi
Sorry I didn't send this to you earlier, I meant to send it before the holidays, but forgot. I was wondering if your agencies would send a support letter to Coastal Conservancy for the requested authorization for funds for engineering and final design for Ballona. Our meeting will be in LA so I expect there will be some opposition and it is a huge funding request since we decided to do the EIR and permitting for the whole project.

If you could attend the site tour of Ballona and the meeting (both on Jan 19th) that would be great too.

Please let me know if you have any questions or need more info.
Thanks
Mary

Pereira Annex MS:8160
1 LMU Drive, Loyola Marymount University
Los Angeles, CA 90045
310-961-4444

www.santamonicabay.org

From: Knatz, Geraldine [mailto:knatz@portla.org]
Sent: Sunday, December 11, 2011 1:00 PM
To: Shelley Luce; Zordilla, Eunice
Cc: Tankersley, Eileen
Subject: Re: Letter for Coastal Conservancy Board

The letter was drafted the day after you asked me. Not sure what happened. Eunice- can you check.

Geraldine Knatz
Executive Director
Port of Los Angeles

From: Shelley Luce [mailto:sluce@santamonicabay.org]
Sent: Friday, December 09, 2011 04:26 PM
To: Knatz, Geraldine
Cc: Tankersley, Eileen
Subject: Letter for Coastal Conservancy Board

Dear Geraldine,
When we spoke a month or so ago, I asked if you would provide a letter to Sam Schuchat and his Board regarding your interest in the Ballona Wetlands restoration project. The January meeting of the Conservancy Board will be in Los Angeles and Sam will ask the Board to approve a large sum for continuing the planning and permitting of the restoration project, so your support of the project and interest in providing mitigation funding is important. Do you still intend to provide a letter and can I help with drafting? Also, we will give the Board members a tour of the wetland and briefing on the restoration plan before or after the Board meeting. As soon as we have a date I will send you an invitation and hope that you could come along.

Thank you Geraldine,
Shelley

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission
Pereira Annex MS:8160
1 LMU Drive, Loyola Marymount University
Los Angeles, CA 90045
310-961-4444

www.santamonicabay.org

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Mark Gold, D.Env. | President
Heal the Bay | 1444 9th Street | Santa Monica CA 90401
Tel: 310 451 1500 X123 | Fax: 310 496 1902 | mgold@healthebay.org
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From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, January 03, 2012 2:16 PM
To: Mark Gold
Subject: support letter for SCC board meeting?

Hello Mark,
Happy New Year. I am emailing to see if Heal the Bay would be willing to send a letter of support to the Coastal Conservancy for the recommendation that we authorize $6.5M for the design and engineering of the proposed restoration project? My draft staff report is attached along with a sample letter. I know you have talked to Shelley about the project, but I would be happy to give you an update at any time. Of course I understand if you are not prepared to take a position on this project at this point, but our meeting will be in Culver City, so I expect there will be some opposition.

Please let me know if you have any questions or need more info.
Thanks,
Mary

From:	Shelley Luce
To:	Mary Small; Karina Johnston
Subject:	Fw: Coastal Conservancy funding to complete Ballona Wetlands restoration planning
Date:	Wednesday, January 18, 2012 10:13:14 PM
Attachments:	BCR Support for SCC Ballona Wetlands Funding Authorization.pdf

Jim Lank comes through! Karina or Elena can you please print a copy for me when you get in the office tomorrow? Thank you.

Shelley,

Emails have been flying today, with the end result that BCR is a strong supporter of the requested authorization. See the attached letter. Should we bring copies to give to the board and staff?

As I said before, both Bobbi Gold and I plan to be at the Scenic Overlook for the 1pm meeting start. Bobbi plans to be there for the whole discussion of the agenda item, while I'll stay as long as I can. Both of us plan to sign in to speak on the item. As part of that, I assume it would be appropriate to read the letter, at least in part. If not, let me know.

I hope the tour and meeting both go well. FYI, I'll be leaving soon for another meeting.

Thanks again for your quick response with the helpful cost information.
Jim

Jim Lamm, President
Ballona Creek Renaissance (BCR)...Connecting Creek and Community from the Hills to the Bay
310-839-6896, 310-367-0336 (c), http://facebook.com/ballonacreekrenaissance, www.ballonacreek.org

From: Shelley Luce <sluce@santamonicabay.org>
To: Jim Lamm <jim.lamm@sbcglobal.net>
Sent: Wed, January 11, 2012 11:19:55 AM
Subject: RE: [REPLY] Fw: Coastal Conservancy funding to complete Ballona Wetlands restoration planning

Thank you very much Jim! I hope you had a nice holiday too. It's going to be a great 2012.
Shelley

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission
Pereira Annex MS:8160
1 LMU Drive, Loyola Marymount University
Los Angeles, CA 90045
310-961-4444

www.santamonicabay.org

From: Jim Lamm [mailto:jim.lamm@sbcglobal.net]
Sent: Wednesday, January 11, 2012 10:58 AM
To: Shelley Luce

Subject: Re: [REPLY] Fw: Coastal Conservancy funding to complete Ballona Wetlands restoration planning

Shelley,

Please accept my apologies for this late response. Cathi and I were away on a 2 1/2 week driving trip to the Seattle area for a holiday visit with our kids and grandkids. Then after returning late last Thursday, we've been focused on moving Cathi's 93-year-old mom in with us. I'm just now beginning to turn more of my attention to a backlog of BCR and other matters.

Unfortunately I have an important 3pm meeting at Culver City Hall on the afternoon of the 1pm SCC board meeting at the Scenic Overlook. If I were able to speak on the restoration planning agenda item before about 2:40pm, it could work. Otherwise (or in addition) I might be able to get Bobbi Gold or another knowledgeable BCR board member to represent us.

As for a BCR support letter, I'm pretty sure that would not be a problem. This is on my list of things to bounce off the board prior to our next board meeting.

Here's to a great new year, despite the challenges ahead!
Jim

Jim Lamm, President
Ballona Creek Renaissance (BCR)...Connecting Creek and Community from the Hills to the Bay
310-839-6896, 310-367-0336 (c), http://facebook.com/ballonacreekrenaissance, www.ballonacreek.org

---

From: Shelley Luce <sluce@santamonicabay.org>
To: Jim Lamm <jim.lamm@sbcglobal.net>
Sent: Fri, January 6, 2012 5:32:52 PM
Subject: Coastal Conservancy funding to complete Ballona Wetlands restoration planning

Hello Jim,
I hope you had a lovely Christmas and a happy new year! I did enjoy a nice break.

You may have heard that the Board of the Coastal Conservancy will meet in LA on Jan. 19 and will consider a request from their staff to authorize funding to complete the Ballona Wetlands restoration planning. The request is for about $6.3M and most will go to consultants for additional engineering (through final design), to create a public access master plan, and to do extensive hydraulic modeling as required by Army Corp permitting (the major expense). About $240k will come to SMBRF to fund Diana's position as well as monitoring on the site for the next three years. I don't know if there will be active opposition to this but I am preparing for that nonetheless. Also I see this as a good opportunity to let the SCC board members see the great support that exists in our community for restoration at Ballona.

Please let me know if you are able to support by letter or by attending the meeting. It was posted today on SCC website http://scc.ca.gov/2012/01/06/coastal-conservancy-public-meeting-january-19-2012/
I am attaching the staff report for the item and a couple of example support letters as well. Thank you Jim!
shelley

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission
Pereira Annex MS:8160

Subject: Re: Letter for Coastal Conservancy Board

The letter was drafted the day after you asked me. Not sure what happened. Eunice- can you check.
Geraldine Knatz
Executive Director
Port of Los Angeles

From: Shelley Luce [mailto:sluce@santamonicabay.org]
Sent: Friday, December 09, 2011 04:26 PM
To: Knatz, Geraldine
Cc: Tankersley, Eileen
Subject: Letter for Coastal Conservancy Board

Dear Geraldine,
When we spoke a month or so ago, I asked if you would provide a letter to Sam Schuchat and his Board regarding your interest in the Ballona Wetlands restoration project. The January meeting of the Conservancy Board will be in Los Angeles and Sam will ask the Board to approve a large sum for continuing the planning and permitting of the restoration project, so your support of the project and interest in providing mitigation funding is important. Do you still intend to provide a letter and can I help with drafting? Also, we will give the Board members a tour of the wetland and briefing on the restoration plan before or after the Board meeting. As soon as we have a date I will send you an invitation and hope that you could come along.

Thank you Geraldine,
Shelley

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission
Pereira Annex MS:8160
1 LMU Drive, Loyola Marymount University
Los Angeles, CA 90045
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From: Mary Small
To: "Shelley Luce"; "Diana Hurlbert"
Subject: FW: draft support letter for SCC board meeting
Date: Tuesday, January 03, 2012 1:05:00 PM
Attachments: SCC_Ballona_Tech_Support_Ltr.docx

Hi
I belatedly just sent this request to DFG and SLC. The only support letter I have is from MRCA, though I know the port is working on one too. Can you let me know who you are working on getting letters from and if there is anyone else I should follow-up with?
Thanks
Mary

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, January 03, 2012 1:04 PM
To: 'Griggs, Pamela@SLC'; 'Terri Stewart'; 'dlawhead@dfg.ca.gov'; 'Rick Mayfield (rmayfield@dfg.ca.gov)'
Subject: draft support letter for SCC board meeting

Hi
Sorry I didn't send this to you earlier, I meant to send it before the holidays, but forgot. I was wondering if your agencies would send a support letter to Coastal Conservancy for the requested authorization for funds for engineering and final design for Ballona. Our meeting will be in LA so I expect there will be some opposition and it is a huge funding request since we decided to do the EIR and permitting for the whole project.

If you could attend the site tour of Ballona and the meeting (both on Jan 19th) that would be great too.

Please let me know if you have any questions or need more info.
Thanks
Mary

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Los Angeles, CA 90045
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From: Jim Lamm [jim.lamm@sbcglobal.net]
Sent: Monday, November 14, 2011 8:51 PM
To: Jessica Hall
Cc: Diana Hurlbert; Shelley Luce
Subject: Re: Request for Support Letters - Urban Greening - Cochran Avenue

Jessica,

BCR's letter of support is attached. Here's to a successful project!
Jim

Jim Lamm, President
Ballona Creek Renaissance (BCR)...Connecting Creek and Community from the Hills to the Bay
310-839-6896, 310-367-0336 (c), http://facebook.com/ballonacreekrenaissance, www.ballonacreek.org

---

From: Jessica Hall <jishica@mac.com>
To: Jim Lamm <jim.lamm@ballonacreek.org>; diana hurlbert <dhurlbert@santamonicabay.org>
Cc: shelley <sluce@santamonicabay.org>
Sent: Mon, November 14, 2011 10:44:14 AM
Subject: Request for Support Letters - Urban Greening - Cochran Avenue

Hi Jim and Diana,
I am working on the urban greening grant for SMBRF for Cochran Avenue Gateway project. Jim, I was wondering if BCR would write a letter of support, and Diana, I was wondering if there were other stakeholders in the Ballona community that you have contact info for, that would also provide a letter of support. Any technical experts would be especially appreciated. A draft letter is enclosed.

The grant is due Thursday.

Thanks!
Jessica

From:	Mary Small
To:	"Mark Gold"
Cc:	sluce@santamonicabay.org
Subject:	RE: support letter for SCC board meeting?
Date:	Friday, January 06, 2012 4:23:00 PM

I was just talking to Shelley and we were wondering if you could send a staff person to the meeting even if you don't want to sign a letter? Maybe Meredith or someone on her staff could come to talk about the need to open the site to public access and restore nature in the city?

This authorization doesn't commit to any one project, we still will be going through CEQA and NEPA.

Thanks
Mary

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, January 03, 2012 3:00 PM
To: 'Mark Gold'
Subject: RE: support letter for SCC board meeting?

Thanks, the meeting is the 19th so that's the deadline. Yes, I totally understand.

I was just sending Sarah an email about possible dates I'll be in LA when I'd like to stop in ad talk about OPC, so maybe I'll see you then.

Happy new year (and MLPA implementation)
Mary

From: Mark Gold [mailto:mgold@healthebay.org]
Sent: Tuesday, January 03, 2012 2:39 PM
To: Mary Small
Subject: RE: support letter for SCC board meeting?

Mary – Happy new year to you too. We will definitely take a look at this and think it through. It is a great project and needs to happen. The political baggage that goes with it is no picnic as you know.

When is the deadline?

Mark Gold, D.Env. | President
Heal the Bay | 1444 9th Street | Santa Monica CA 90401
Tel: 310 451 1500 X123 | Fax: 310 496 1902 | mgold@healthebay.org
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From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, January 03, 2012 2:16 PM
To: Mark Gold
Subject: support letter for SCC board meeting?

Hello Mark,
Happy New Year. I am emailing to see if Heal the Bay would be willing to send a letter of support to the Coastal Conservancy for the recommendation that we authorize $6.5M for the design and engineering of the proposed restoration project? My draft staff report is attached along with a sample letter. I know you have talked to Shelley about the project, but I would be happy to give you an update at any time. Of course I understand if you are not prepared to take a position on this project at this point, but our meeting will be in Culver City, so I expect there will be some opposition.

Please let me know if you have any questions or need more info.
Thanks,
Mary

From: Mary Small
To: "Dick Wayman"
Subject: FW: Ballona Wetlands presentation materials at SCC meeting
Date: Friday, January 20, 2012 4:03:00 PM

From: Shelley Luce [mailto:sluce@santamonicabay.org]
Sent: Friday, January 20, 2012 3:12 PM
To: Mary Small; Karina Johnston; Diana Hurlbert
Subject: RE: Ballona Wetlands presentation materials at SCC meeting

Yes Mary - Karina or Diana can you please?
Also wanted to make sure you saw/heard the NPR coverage:
http://www.scpr.org/news/2012/01/20/30859/coastal-conservancy-releases-65-million-ballona-wet/

The MDR patch did a pretty good job covering - except Lisa F's comments which are confusing to me, but I will call her about it - and LATimes is going to run something this weekend, I am told. Fingers crossed.
http://venice.patch.com/articles/coastal-conservancy-approves-6-5-million-for-ballona-wetlands-restoration-plans

Thank you Diana and Karina for helping get this press coverage - the advance work we did made a HUGE difference! Please stay on top of me in the future to make sure we have the same success next time. great job.
shelley

Shelley Luce, D.Env.
Executive Director
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From: Mary Small [msmall@scc.ca.gov]
Sent: Friday, January 20, 2012 2:52 PM
To: Karina Johnston; Diana Hurlbert
Cc: Shelley Luce
Subject: Fwd: Ballona Wetlands presentation materials at SCC meeting

Could one of you email this to him?
Thanks

sent from my phone

Begin forwarded message:

> **From:** Rex Frankel <rexfrankel@yahoo.com>
> **Date:** January 20, 2012 12:46:45 PST
> **To:** Mary Small <msmall@scc.ca.gov>
> **Subject: Re: Ballona Wetlands presentation materials at SCC meeting**
> **Reply-To:** Rex Frankel <rexfrankel@yahoo.com>
>
> Mary,
> thank you for the presentation materials. However, on the Baseline monitoring report page,
> http://santamonicabay.org/smbay/ProgramsProjects/HabitatRestorationProject/BaselineAssessmentReport/tabid/203/Default.aspx
>
> the Chapter 4--Vegetation report does not come up when you click on it. I assume this is where Dr. Luce's conclusion comes from.
>
> If you can, please email that chapter to me.
>
> Thank you, Rex Frankel
>
> ---
>
> **From:** Mary Small <msmall@scc.ca.gov>
> **To:** 'Rex Frankel' <rexfrankel@yahoo.com>
> **Sent:** Friday, January 20, 2012 12:09 PM
> **Subject:** RE: Ballona Wetlands presentation materials at SCC meeting
>
> Hello Rex
> Attached is our slide presentation.
>
> Yes, Dr. Luce was referring to the findings of the baseline assessment. I just went to the project website and clicked on the image of the report cover and was able to download the documents, but if there are specific chapters that you are unable to download, please let us know and we'll get them to you.
>
> Mary
>
> ---
>
> **From:** Rex Frankel [mailto:rexfrankel@yahoo.com]

Sent: Friday, January 20, 2012 10:13 AM
To: msmall@scc.ca.gov
Subject: Ballona Wetlands presentation materials at SCC meeting

Mary,

I am interested in getting a copy of your slide presentation from yesterday's SCC Board meeting. Can you email it to me?

I am also interested in seeing the source documents that were used to make Dr. Luce's point that very little of the site is now functioning habitat.

Are they in the recently released SMBRC's Ballona Wetlands Baseline Assessment Program reports? The SMBRC has a website, ballonarestoration.org, with the Baseline Assessment Program report, unfortunately, most of these documents do not open when clicked upon. They are posted here:
http://santamonicabay.org/smbay/ProgramsProjects/HabitatRestorationProject/BaselineAssessmentReport/tabid/203/Default.aspx

Please call me or email if you can help.

Thanks, Rex Frankel, 310-738-0861

From:	Mary Small
To:	"Joe Geever"
Cc:	"Shelley Luce"; "Diana Hurlbert"
Subject:	Coastal Conservancy Jan 19th Meeting
Date:	Thursday, December 15, 2011 11:25:00 AM
Attachments:	Ballona_Wetlands_Engineering and Technical Studies.docx

Hi Joe

Nice to talk to you this morning, and thanks for agreeing to come to the Coastal Conservancy meeting in Jan. It will be on Jan 19th at the Baldwin Hills Scenic Overlook starting around noon. Ballona funding (draft staff report attached) will be the first major item on the agenda. We are planning to take the Board on a tour of Ballona that morning. The tour and meeting are open to the public and details will be posted on our website by the 6th of Jan.

As I mentioned, we (Shelley and I) would be happy to provide additional information to you &/or your chapters at any point. Since we are finally getting ready to initiate the public environmental review, now would be a good time to get you engaged.

Thanks,
Mary

~~~~~~~~~~~~~~~~

Mary Small
Deputy Executive Officer, Coastal Conservancy
1330 Broadway #1300 Oakland, CA 94612
510-286-4181
~~~~~~~~~~~~~~~~

ATTACHMENT 4

From:	Mary Small
To:	"Shelley Luce"
Cc:	"Joan Cardellino (Joan Cardellino)"; "Diana Hurlbert"
Subject:	RE: Letter for Coastal Conservancy Board
Date:	Tuesday, December 13, 2011 1:11:00 PM

Thanks

Sorry, the plan is to have the tour from roughly 9-11:30 and then start the meeting at noon or 12:30 – something like that. We're afraid that if we do the tour after the meeting none of the board members will come.

I'll call Barbara today to get her ideas and see if they will help with the tour, come to the mtg or send a letter
Mary

From: Shelley Luce [mailto:sluce@santamonicabay.org]
Sent: Tuesday, December 13, 2011 1:08 PM
To: Mary Small
Cc: 'Joan Cardellino (Joan Cardellino)'; Diana Hurlbert
Subject: RE: Letter for Coastal Conservancy Board

Mary, here are some thoughts from me and Diana:

1) Tour – we'll do the tour anytime that works for your members but it seems tight to finish it by 9:15 in order to get them all to Baldwin Hills Overlook for a 10 am meeting. I know we have the Toy meeting the day before so right after the board meeting makes most sense. Could you convince your members to stick around for it?
2) Press – this is troubling. It'll be hard for us to get good press on a $7M expenditure... we can spin this if we get the right people. What if we did a brief presentation on the Monitoring Report before hand? We'll have beautiful hard copies, it's over 400 pages and very impressive and did not cost a lot for the amount of work and info. I think it makes SCC and SMBRC look great. Could we make this the press focus, i.e. with Molly Peterson at least? I'll give her a call for starters.
3) Support – I will talk with Geever, Jim Lamm, Miguel, Lisa Fimiana, Baykeeper, HTB, Nate from Rosendahl's office, Napolitano from Knabe's and Karly from MRT's. I can't say who will show up or do a letter but I will make the asks. I'll also ask Pestrella. Can you talk to MRCA Mary? Also what about the Corps – Rick Liefiled's support would be very meaningful, or Toy's if we can get it. Maybe a letter from Toy with Rick or someone else attending the meeting?

We'll draft a support letter asap and run it by you.
Shelley

Shelley Luce, D.Env.
Executive Director
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From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, December 13, 2011 10:38 AM
To: Shelley Luce
Cc: 'Joan Cardellino (Joan Cardellino)'
Subject: RE: Letter for Coastal Conservancy Board

Hi Shelley-
Do you have time to talk about our Jan meeting? I know you have a board meeting this week, so we could also do this via email – or next week, but before next Fri I'd like to work through some ideas:

1) Tour – we'll probably do a tour the morning of the meeting, I think maybe the tour we did with Colonel Toy – view from Cabora Rd and then walk out to boyscout platform
2) Press – do you think we could use this meeting as an opportunity to get either local papers and/or try for LA Times to cover the project? I am worried that once the agenda is out Marcia will use as opportunity to get bad press. Our agenda will be mailed out Jan 6th
3) Public support – who could we have come to support the project at the meeting or with letters? Geraldine is critical (at least her letter) but how about MRCA?, Joe Geever?, Ballona Creek Renaissance?, Friends?, Miguel Luna?, Audubon? HtB? Baykeeper?

Thanks,
Mary

From: Shelley Luce [mailto:sluce@santamonicabay.org]
Sent: Monday, December 12, 2011 3:22 PM
To: Mary Small
Subject: FW: Letter for Coastal Conservancy Board

Hi Mary, Geraldine thought her letter went out already. Have you received? I also invited her to tour the wetlands with us after the meeting.

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From: Knatz, Geraldine [mailto:knatz@portla.org]
Sent: Sunday, December 11, 2011 1:00 PM
To: Shelley Luce; Zordilla, Eunice
Cc: Tankersley, Eileen

From: Shelley Luce
To: Mary Small
Subject: RE: board presentation
Date: Wednesday, January 11, 2012 6:55:23 PM

Hi Mary,
I think the presentation looks good. I think we should include some comparative data to show the need for restoration – e.g. the seed bank data, the exotic veg data and some of the animal data (birds and herps). I saw what karina sent you and it doesn't help us – we need numbers like "99% invasive plants" and "lowest seed bank of any so cal wetland". we also need her graphs that show huge percent exotic veg. versus tiny percent native veg, etc. along with those photos of invasive plants that you already included.

I also think we should mention the TMDL –or not the TMDL itself, but we can list the impairments listed on the 303d list, note that TMDL implementation would be consistent with the restoration and that we can work with partners on my governing board and other agencies and leverage resources that would go into implementing the TMDL.

I can help with slides – why don't you send me one or two in your formatting and I will make some with the graphs imentioned and see if you like them. Or rather, since you have to finish by tomorrow and I am out of the office all day, we will ask karina to insert some graphs. Okay with you?
Shelley

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Santa Monica Bay Restoration Commission
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From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Wednesday, January 11, 2012 2:49 PM
To: Shelley Luce
Subject:

Hi Shelley
Attached is a draft powerpoint, I want to keep it as simple as we can. There are several extra slides at the end, I just want one picture I can leave up when I walk through the actual requested action, maybe just the bird with its head in the water?

There are two slides about the baseline monitoring program – I think we only need one of them, do you prefer lots of words or just a picture.

I am sending in .pdf because the actual powerpoint is too big. If you want me to ftp the powerpoin so you can edit directly, let me know. I have to finish this by tomorrow night.

Thanks!
Mary

From:	Shelley Luce
To:	Karina Johnston
Cc:	msmall@scc.ca.gov
Subject:	graphs needed for SCC board presentaiton
Date:	Thursday, January 12, 2012 7:57:56 AM

Hi Karina,
Thank you for the bullets you prepped for Mary, they are helpful. The photos are also perfect. What we still need for the presentation are graphics or numbers that will really make our case. Mary needs to complete the presentation today so can you and your team help us prep the following ASAP?

- one map of existing conditions that shows the site today: an aerial photo with transparent overlay of BASIC habitat types - how much is wetland, how much is upland/vacant lot style. goal is to illustrate how little of the site can be said to be funcitoning habitat.

- one simple graph showing predominance of invasive species - the one in the BWER draft TMDL is fine, can you please send that to mary? we need to say "x percent of the site is covered with 99% invasive vegetation" or whatever the actual numbers are. rather than "dominate by invasives" which could mean only 55% covered.

- some species diversity numbers/charts that show how extremely depaupurate poor Ballona is. not just "reduced relative to other wetlands" but "lowest seed bank abundance and diversity of any wetland in southern california" - but i need you to give me the right language so i am not mis-stating anything. please give me those #s or charts or langauge for seed bank, veg, mammals, birds, fish and herps separately and we'll decide which ones to mention in our presentation.

- any other features of the site or results from your surveys that really illustrate to non-scientists how desperate is the need to restore ecological function and habitat at the site.

I am sorry to ask you for all this today, I hope you or one of your team has time. I think you have all this info readily accessible - f there is someihting i've requested that is a big pain check with me and we'll decide if it's really needed. please call my cell or email, i will be out of the office all day but checking my phone compulsively. also please suggest other stuff if you think of it - you know these data better than we do! thank you KJ talk to you later today.
shelley

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From: Mary Small
To: "Karina Johnston"; "Diana Hurlbert"; "Shelley Luce"
Subject: please review these two paragraphs
Date: Tuesday, December 13, 2011 9:09:00 AM

Hi
I'm wrapping up my staff report and I needed to add a little more detail about what SMBRF will do with the grant funds and who you are. Can you please review this and let me know if you have any edits? If you can get it to me today, that'd be great.
Mary

The recommended grant to the SMBRF would provide funds for data collection, technical review and agency coordination to support the proposed restoration project. The SMBRF has implemented a multidisciplinary baseline data collection program using volunteers, students and professional technical experts. The baseline report is the first comprehensive assessment of biological and physical resources at the BWER. It was just published and is available online: http://www.ballonarestoration.org. This grant would allow the SMBRF to conduct additional targeted studies based on the resources identified in the baseline assessment as needed to support the environmental impact analysis of the proposed project. In addition, the SMBRF will continue coordination of the agency review, identification of funding partners, and technical review of work products associated with this project.
The SMBRF is a non-profit organization that was created in 1991 to implement the priorities of the Santa Monica Bay Restoration Plan and to support the work of the Santa Monica Bay Restoration Commission. The SMBRF has a number of initiatives including research, public education, and planning, to support these goals. The SMBRF and the Seaver College of Science and Engineering at Loyola Marymount University (LMU) created the Center for Santa Monica Bay Studies to engage in multidisciplinary research on environmental and social issues affecting Santa Monica Bay and its watershed, and to contribute to policies and actions that improve the environmental condition of the Bay. The partnership with LMU has been very valuable to the data collection efforts, SMBRF has used student volunteers to conduct fieldwork and some faculty have coordinated their own research to support the baseline assessment, resulting in hundreds of hours of field work being donated to the project.

Mary Small
Deputy Executive Officer, Coastal Conservancy
1330 Broadway #1300 Oakland, CA 94612
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ATTACHMENT 5

NORMAN Y. MINETA, Economic Chair

JAMES L. OBERSTAR, Minnesota
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COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION
U.S. HOUSE OF REPRESENTATIVES
WASHINGTON, D.C.

RESOLUTION

Marina del Rey, California
Docket 2455

Resolved by the Committee on Public Works and Transportation of the United States House of Representatives, That the Secretary of the Army is requested to review the report of the Chief of Engineers on Playa del Rey Inlet and Basin, Venice, California, published as House Document 389, Eighty-third Congress, Second Session, and other pertinent reports, to determine whether modifications of the recommendations contained therein are advisable at the present time, in the interest of navigation, hurricane and storm damage reduction, environmental restoration, and other purposes at Marina del Rey Harbor, Los Angeles, California, with consideration given to the disposal of contaminated sediments from the entrance channel required under the existing operation and maintenance program at Marina del Rey Harbor.

Adopted: September 23, 1994

ATTEST: [signature]
NORMAN Y. MINETA, Chair

[Federal Register: September 20, 2005 (Volume 70, Number 181)]
[Notices] [Page 55116-55117] From the Federal Register
Online via GPO Access [wais.access.gpo.gov] [DOCID:fr20se05-36]
[[Page 55116]]

DEPARTMENT OF DEFENSE Department of the Army; Corps of Engineers Notice of Intent To Prepare an Environmental Impact Statement/ Environmental Impact Report for the Ballona Creek Ecosystem Restoration Feasibility Study, Los Angeles County, CA AGENCY: Department of the Army, U.S. Army Corps of Engineers, DoD. ACTION: Notice of intent. --

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SUMMARY: The Los Angeles District intends to prepare an Environmental Impact Statement/Environmental Impact Report (EIS/EIR) to support a cost-shared ecosystem restoration feasibility study with the Santa Monica Bay Restoration Commission. The proposed project study areas has been degraded by encroachment of non-native plants, placement of fill from Marina Del Rey, interruption of the hydrologic regime, trash accumulation, and varied attempts at bank protection along the creek using rock and concrete. Direct benefits of the proposed project include improved habitat and water quality, reductions in waste and trash, and aesthetics. The watershed is an important resource for both recreational uses and for fish, and wildlife and further degradation could jeopardize remaining. The purpose of the feasibility study is to evaluate alternatives for channel modification, habitat restoration (coastal and freshwater wetlands and riparian), recreation, and related purposes along the lower reach of the Ballona Creek. DATES: A public scoping meeting will be held on September 29, 2005 at 6 p.m. ADDRESSES: U.S. Army Corps of Engineers, Los Angeles District, CESPL-PD, P.O. Box 532711, Los Angeles, CA 90053 and Santa Monica Bay Restoration Commission, 320 West 4th Street, Los Angeles, CA 90013. FOR FURTHER INFORMATION CONTACT: Shannon Dellaquila, Project Environmental Manager, at (213) 452-3850 or Malisa Martin, Project Study Manager at (213) 452-3828. SUPPLEMENTARY INFORMATION: 1. Authorization This study was prepared as an interim response to the following authorities provided by Congress under Section 216 of the Flood Control Act of 1970, which states: The Secretary of the Army, acting through the Chief of Engineers, is authorized to review the operation of projects the construction of which has been completed and which were constructed by the Corps of Engineers in the interest of navigation, flood control, water supply, and related purposes, when found advisable due the significantly changed physical or economic conditions, and to report thereon to Congress with recommendations on the advisability of modifying the structures or their operation, and for improving the quality of the environment in the overall public interest; supplemented by House Resolution on Public Works and Transportation dated September 28, 1994 which states: **The Secretary of the Army is requested to review the report of the Chief of Engineers on Playa del Rey Inlet and Basin, Venice, California, published as House Document 389, Eighty-third Congress, Second Session,** and other pertinent reports, to determine whether modifications of the recommendations contained therein are advisable at present time, in the interest of navigation, hurricane and storm damage reduction, environmental restoration, and other purposes at Marina del Rey Harbor, Los Angeles, California, with consideration given to disposal of contaminated sediments from the entrance channel required under the existing operation and maintenance program at Marina del Rey. 2. Background The Ballona Creek Ecosystem

Restoration study area lies within Los Angeles County, CA and includes portions of Marina del Rey, Culver City, Playa del Rey, and the City of Los Angeles. The study area, a component of the greater Ballona Creek Watershed, includes the lower reach of Ballona Creek extending southwest from Cochran Avenue, in Los Angeles, to Pacific Ocean in Marina del Rey. specific features of the Ballona Creek watershed, including existing and historic wetland areas, the Ballona Lagoon, Del Rey Lagoon, Venice Canal, Grand Canal, the Oxford Drain and the Ballona Channel and tributaries, will be addressed in this study. The greater Ballona Creek system drains a watershed of approximately 329 square kilometers (81,300 acres), and is the largest tributary that drains into the Santa Monica Bay. Ballona Creek collects runoff from several partially urbanized canyons on the south slopes of the Santa Monica Mountains as well as from intensely urbanized areas of West Los Angeles, Culver City, Beverly Hills, Hollywood, and parts of Central Los Angeles. The urbanized areas account for 80 percent of the watershed area, and the partially developed foothills and mountains make up the remaining 20 percent. The watershed boundary includes the Santa Monica Mountains on the north, the unincorporated area known as Baldwin Hills, and the City of Inglewood on the south. The Ballona Creek Ecosystem Restoration study footprint's southern boundary is defined by the Westcheste Bluffs, which run southwest from the San Diego (405) Freeway beyond Loyola Marymount University. The western boundary extends from the Pacific Ocean. The eastern boundary begins where Ballona Creek daylights at Cochran Avenue and Venice Boulevard in a section of Los Angeles known as the Mid City. Tributaries of Ballona Creek include Centinela Creek, Sepulveda Canyon Channel, Benedict Canyon Channel, and numerous storm drains. The Ballona Creek watershed ecosystem has been altered by intense land development, encroachment of non-native plants, trash accumulation, and varied attempts at bank protection along the creek using rock and concrete. Although an important function of the Ballona Creek is as a flood control channel, the lower watershed is still an important resource for both recreational uses and for fish and wildlife habitat. Further impairment could jeopardize remaining habitat. This study will evaluate opportunities for habitat restoration (including wetland and riparian habitat), improvements to water quality, trash mitigation, and recreation and related purposes along the lower reach of the Ballona creek. 3. Problems and Needs At least ninety (90) percent of historic coastal wetlands in California have been lost due to filing, dredging, flood control and intensive development. Within the Lower Ballona Creek Watershed, remaining fragmented wetland areas have been degraded due to diminished hydraulic function, poor water quality and introduction of exotic plants and animals. While functioning wetland systems and riparian habitat remain, they are stressed. Channelization of the Ballona Creek and filling of historic wetland and riparian areas have contributed to degradation and loss of habitat due to impeded tidal exchange and circulation. Contaminated stormwater runoff and trash loading has degraded Ballona Creek water quality. Habitat alteration and loss has decreased biodiversity and overall ecological health, threatening the survival of native endangered species such as the California least tern (Sterna antillarum brown), snowy plover (Charadrius alexandrinus), and the Belding's Savannah Sparrow (Sandwichensis beldingi). The current design of the Flood Control channel has resulted in a lack [[Page 55117]] of recreational opportunities and is considered aesthetically challenged. At present there is no integrated approach and partnership amongst stakeholders to resolve lower Ballona Creek in-stream and wetland

degradation issues, which has led to uncoordinated and sometimes redundant and unsuccessful improvement measures. 4. Proposed Action and Alternative The Los Angeles District will investigate and evaluate all reasonable alternatives to address the problems and need stated above. In addition to a without project (No Action) Alternative, both structural and non-structural environmental measures will be investigated. An assessment of the feasibility of removing impervious surfaces from the Ballona Channel will also be evaluated. Proposed restoration measures include: re-grading and removal of fill, remove invasive and non-native plant species, reintroduction of a water source and installation of native plants to restore previously filled coastal wetlands. Other measures to be evaluated include features to improve or restore tidal regime in Oxford Basin, the Grand and Venice canals, and Ballona and Del Rey Lagoons; the potential for in stream wetland development in Centinela, Sepulveda and Ballona Creek; sediment loading in the upper watershed; and related recreation and educational opportunities. 5. Scoping Process The scoping process is on-going, and has involved preliminary coordination with Federal, State, and local agencies and the general public. A public scoping meeting is scheduled for Thursday September 29th from 6-8 p.m. at the Rotunda Room of the Veteran's Memorial Building, 4117 Overland Avenue, Culver City, CA. This information is being published in the local news media, and a notice is being mailed to all parties on the study mailing list to ensure that public will have an opportunity to express opinions and raise any issues relating to the scope of the Feasibility Study and the Environmental Impact Study/Environmental Impact Report. The public as well as Federal, state, and local agencies are encouraged to participate by submitting data, information, and comments identifying relevant environmental and socioeconomic issues to be addressed in the study. Useful information includes other environmental studies, published and unpublished data, alternatives that could be addressed in the analysis, and, potential mitigation measures associated with the proposed action. All comments will be considered in the project development. Concerns may be submitted in writing to the Santa Monica Bay Restoration Commission, or to the Los Angeles District (see ADDRESSES). Comments, suggestions, and request to be placed on the mailing list for announcements should be sp101.usace.army.mil. Availability of the Draft EIS/EIR The Draft EIS/EIR is scheduled to be published and circulated in December 2007, and a public hearing to receive comments on the Draft EIS/EIR will be held after it is published. Dated: September 13, 2005. Alex C. Dornstauder, Colonel, U.S. Army, District Engineer. [FR Doc. 05-18651 Filed 9-19-05; 8:45 am] BILLING CODE 3710-KF-M

From: Shelley Luce
To: Mary Small; "Rick Mayfield"
Cc: "Terri Stewart"
Subject: RE: From John Davis Re Ballona CEQA process
Date: Tuesday, February 07, 2012 1:39:26 PM

Agreed. The doc he references was for a completely different project, a feasibility study in which SMBRC was the local sponsor for the Corps' study. The EIR/EIS that we want to start is for a separate project, i.e. the BWER restoration/enhancement project. As the landowner, DFG will be the lead agency.

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission
Pereira Annex MS:8160
1 LMU Drive, Loyola Marymount University
Los Angeles, CA 90045
310-961-4444

www.santamonicabay.org

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, February 07, 2012 1:30 PM
To: 'Rick Mayfield'; Shelley Luce
Cc: 'Terri Stewart'
Subject: RE: From John Davis Re Ballona CEQA process

Suggested response.
1) The EIS/EIR process begun in 2005 was for the Army Corps' Lower Ballona Ecosystem Restoration Feasibility Study, that project and the associated environmental review has not been completed and is not moving forward at this time. The EIR/S process for the proposed enhancement project will be separate.
2) The CEQA statute where lead agency is defined is Public Resources Code Section 21000.
3) DFG as landowner intends to be the lead agency on the proposed enhancement project that will be analyzed in the EIR/EIS.

From: Rick Mayfield [mailto:rmayfield@dfg.ca.gov]
Sent: Tuesday, February 07, 2012 9:30 AM
To: Mary Small; Shelley Luce
Cc: Terri Stewart
Subject: Fwd: From John Davis Re Ballona CEQA process

Please take a look at the attached from Mr. Davis and let me know if you can provide any further information before I respond.

Thanks,

Rick
>>> <jd@johnanthonydavis.com> 2/6/2012 5:11 PM >>>

Ca DFG
Att: Mr. Mayfield

Hi Mr. Mayfield, attached is the congressional and corp docs we discussed.

The document states an joint EIS/EIR process was begun in 2005 per the request of Congress.

The Santa Monica Bay Restoration Commission is noted as the lead agency for CEQA in the joint EIR/EIS.

It also states that at least one scoping hearing has already occured.

My question is does DFG plan on beginning another EIR process for the same area that is already been started by the SMRBC and Corp. If so, how can there be two lead agencies.

To me, logic indicates the SMRBC should be lead.

Thanks,

John Davis
PO 10152
Marina del Rey Ca. 90045

From:	Mary Small
To:	"Diana Hurlbert"; "David Lawhead (DLawhead@dfg.ca.gov)"; "Eichler, Monica SPL"; "Eric Gillies"; "griggsp@slc.ca.gov"; "Hamamoto, Bruce"; "Patrick Holland (pholland@dpw.lacounty.gov)"; "Rick Mayfield (rmayfield@dfg.ca.gov)"; "Serpa, Phillip J SPL"; "Shelley Luce"; "Strum, Stuart R MVN-Contractor"; "Swenson, Daniel P SPL"; "Terri Grant (tgrant@dpw.lacounty.gov)"; "Youn Sim (ysim@dpw.lacounty.gov)"
Subject:	FW: request for services - ballona wetlands
Date:	Wednesday, February 08, 2012 4:46:00 PM
Attachments:	Ballona Civil Engineering and Geotech.pdf Ballona Hydrology and Engineering.pdf

The request for services for the civil engineering and geotechnical contract and the hydrology and engineering contracts went out today. Feel free to forward to other potential contractors, I sent it to about 60 in our database and we will post it on the web. Proposals are due on Feb 29th.

Mary

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Wednesday, February 08, 2012 4:39 PM
Subject: FW: request for services - ballona wetlands

The California State Coastal Conservancy is requesting proposals for consultant services for two separate contracts related to the proposed enhancement of the Ballona Wetlands Ecological Reserve in Los Angeles County. Services are needed to complete engineering and geotechnical evaluations, hydrology, technical studies, design and related services to support completion of a project level EIR/EIS and preparation and processing of a Section 408 permit through the Army Corp of Engineers. One contract will be for Civil and Geotechnical Engineering and a second contract will be for Hydrology and Engineering Design Analysis.

Mary Small
Deputy Executive Officer, Coastal Conservancy
1330 Broadway #1300 Oakland, CA 94612
510-286-4181

Ballona Ecosystem Restoration Planning Management Meeting
June 28, 2010
3:00-5:00pm

Attendees:

Josephine Axt, USACE	Ed Demesa, USACE	Julian Serafin, USACE
Rene Vermeeren, USACE	Ben Nakayama, USACE	Rhiannon Kucharski, USACE
Diana Hurlbert, SMBRC	Sean Bergquist, SMBRC	Kathy Anderson, USACE
Larry Smith, USACE	Mary Small, Coastal Conservancy (by phone)	

I. Mary Small: Coastal Conservancy is supplying most of the funding toward the in-kind local sponsor efforts.

II. Ed Demesa: Corps Process Overview
   a. We are coming up to our first major milestone (F3)
      i. Baseline and future without project conditions; preliminary alternatives analysis
         1. Describes problems and opportunities, planning objectives
         2. This product will be the basis for future steps
      ii. Next milestone (F4A/F4)
         1. Formulation, evaluation and comparison of alternatives
         2. F4A: SPD requirement, Alternative Formulation Briefing
      iii. (F5) Public Draft Feasibility Report
         1. Headquarters Policy and Public Review
   b. Josephine Axt: New Review Guidance (Estimated at $500,000; IEPR is federally funded)
      i. Agency Technical Review (ATR) - Requires coordination with the planning center of expertise, and coordinates a team of reviewers from another Corps Division
      ii. Model certifications required
      iii. Independent External Peer Review (IEPR)
      iv. Note for budget: call out what IEPR is estimated to cost, and that it does not have to be cost shared
      v. Diana Hurlbert: Under each discipline, there are costs for responding to comments. Are those related to ATR?
         1. Josephine Axt: Yes. There is a formal comment and response system that must be used for ATRs (DrChecks)
   c. Kathy Anderson: Partnership
      i. Communication
         1. Sean Bergquist: Communication has been much better since Rhiannon has taken over as Lead Planner.
         2. Mary Small: Rhiannon has been great in communication.
      ii. Cost share
         1. Sean Bergquist: Our cost share component is 100% in-kind. It is anticipated that most of that work is and will continue to be in the wetlands.
            a. We are finished our F3 equivalent (2006)
            b. We are also finished our alternatives development and analysis (2008)
               i. We want to make sure that all of the products feed in to the Corps process and products.
            c. The Corps and us on not on the same timeline.

2. Mary Small: It was always our understanding that the Corps would use our restoration alternatives. It makes us nervous that this was never in writing. We have done our F4 equivalent.
3. Because of Federal funding starts and stops, the Corps is still in the F3 process, while the sponsor has completed alternatives analysis (F4 equivalent).
4. Diana Hurlbert: We want to make sure you are maximizing our products, and we want to understand what if any deficiencies are found.
5. Josephine Axt: In-kind has to be formally submitted, directly applicable to the project and it must be understood that in-kind increases increase the overall budget increases.
    a. Mary Small: We fear that our in-kind is not properly reflected in the PMP.
    b. Rhiannon Kucharski: This may be the case. We need to go in detail in to this upon receipt of in-kind submissions, quality check them and revisit the PMP.
6. Sean Bergquist: For credit, do we get credit for what we paid or for what it would have cost the Corps to do the same work?
    a. Josephine Axt: The in-kind credit needs to match the estimate for that work in the PMP. Likewise, if the work costs more than estimated, credit will only be given for up to the estimated amount.

iii. Ed Demesa: As the project goes up the chain, we have to be careful for policy issues. When the project is competing nationally, it starts to become a factor. The cost of land acquisition is part of the project costs. We can only credit up to 35% of total project costs.

iv. Mary Small: If the Corps falls too behind, we will work with Corps Regulatory for a permit for their activities (NEPA/CEQA, design, permitting, and Phase 1 construction).
    1. Josephine Axt: If you are going full steam ahead, what is your timeline?
    2. Sean Bergquist: We purchased the property in 2005, and have to do something with the property in the near future. There is no set deadline, but they must show the state that something is being done.
        a. In about 4 years, they would like to be constructing something.
        b. Early phase: Do South portion of Area B, South of Jefferson and below Gas Company (low areas, reconnect tidal flows)
    3. Ed Demesa: The law to partially build a project and receive credit for a larger project applies only to flood control when there is imminent need. Unfortunately, that law does not apply to ecosystem restoration. There is not an authority for us to give credit for it down the line. So, this may be something you want to consider for a WRDA request to change the authorization.

III. Project Status
- a. Corps is working on baseline (F3) right now. Due to H&H delays, the milestone will most likely happen early in FY11.
- b. PMP amendment
    - i. Study area
        1. Will be clearly defined in the PMP amendment (to the satisfaction of all parties).

a. Definition: Ballona Creek from the Pacific Ocean to Cochran, Del Rey Lagoon; and Centinela and Sepulveda Channels from Ballona Creek to where they go underground.

2. Grand canal is out.
3. Sean Bergquist: We have always planned on the daylighted part of Ballona Creek up to Cochran.
4. Coordination needs to go through Diana Hurlbert and Rhiannon Kucharski.

ii. Costs

1. Ed Demesa: For in-kind credit, it is important to let the PDT know what work the sponsor is doing, even if it will not be submitted for in-kind credit.
2. Sean Bergquist: Historical analysis of the watershed is in the works. We are also working with UCLA to do a watershed budget.
3. Sean Bergquist: When things have to be redone, how does the cost share work?
    a. Hydraulic study
        i. Rene Vermeeren: Our H&H models are in DRAFT form and have not yet had the first ATR. They are not ready for use on alternatives.
4. SMBRC Governing Board will have to sign the PMP and FCSA amendments.
5. In construction phase, can the cost of the land/property be used toward sponsor in-kind credit?
    a. Kathy Anderson: Yes, as long as the constructed project uses those lands. The state paid $140 million in 2005 for the property that makes up areas A, B and C.

iii. In-kind submittals

1. Mary Small: Is there really much more additional work that needs to be done to review the submittals? How much is left to be done by the Army Corps depends on the in-kind submittals?
    a. Diana and Rhiannon can work together with each PDT member to work through these. Set up meetings ASAP.
    b. Kathy Anderson: The whole PDT needs to sit down and go through the PMP, in-kind and costs step-by with SMBRC.
2. Mary Small: I am worried about the water quality report in terms of the data being what is needed per the Corps and less worried about the write-up
    a. Confirm with James Chieh that the data is what is needed.

c. Kathy Anderson: Sponsor financial capability?

i. Even in light of cost increases, the sponsor has enough money to fund all of their study activities and even begin phase I construction (Area B).
ii. Corps needs to get details of sponsor plans for "phase I" in Area B and determine if this must be added as a future without project condition or not.

IV. Action items are noted in RED.

Lower Ballona Creek Ecosystem Restoration Study Monthly Coordination Meeting Minutes
April 28, 2010
10-11am

Attendees:

Mary Small, CC	Sean Bergquist, SMBRC	Rhiannon Kucharski, USACE
Kathy Anderson, USACE	James Chieh, USACE	

I. Comments to the DRAFT Corps F3 products and the DRAFT PMP update are due by the next coordination meeting, May 26, 2010.
   a. Comment from Sean related to updated costs/project area: SMBRC considers lower Ballona Creek to be everything from Cochran Avenue to the Ocean.
   b. Sean is concerned about how SMBRC can come up with matching funds and/or in-kind work for a study totaling $6.2 million (the updated estimated study cost total)
      i. Mary: We may not be able to get approval for the cost increases

II. Frank Wu was not able to attend today's meeting. He will contact Mary and Sean independently to discuss his question on the Engineering and Design Section i, Task 3 from the PMP.

III. In-kind submittals
   a. Mary and Sean will try to submit the first set within one week.

IV. Water Quality Analysis
   a. Document forthcoming from SCCWRP (early June)
   b. Document forthcoming from Geosyntech (June)
      i. Delay due to 2 very dry seasons
   c. Some data is already available on the website (Ballonarestoration.org)
      i. Some prior reports from previous years are available
   d. The Corps (James Chieh) will need to translate and analyze the data and put it into the Appendix Report.
      i. Sean will send everything that is currently available to James Chieh, Cc Rhiannon ASAP. This will include the Geosyntech scope of work and cost estimate for water quality data analysis.

V. Other Discussion
   a. There will be a site tour with the Corps, URS and Sean on May 5, 2010.
   b. Kathy: We were able to request $345k for FY11, but need to get amended FCSA executed.
      i. Mary: We need to credit in-kind work before amending the FCSA. We hope this will bring down the overall study cost.

VI. Action items noted in ORANGE.

Ballona Coordination Meeting Minutes
June 2, 2010
10am

Attendees:

Mary Small, Coastal Conservancy	Diana Hurlbert, SMBRC	Heather Schlosser, USACE
Julian Serafin, USACE	Rhiannon Kucharski, USACE	
Ben Nakayama, USACE	Robert Browning, USACE	Robert Grimes, USACE

I. In kind submittals
   a. For In-kind submittals, Mary, Sean and Diana tried to break down the submittals per the PMP, but had a hard time. Please see in-kind spreadsheet submitted last week.
   b. SMBRC and Coastal Conservancy will submit the In Kind Submittal sheets that correspond with each document from the website, along with reference to the document or file they correspond to and a link to that document on the web.

II. PMP updates
   a. Mary Small is concerned that the revised PMP does not reflect the products they have completed, and very concerned about the cost increases.
   b. Mary Small: Have all the PMP sections looked at the same project area? Parts still refer to Ballona Lagoon, Grand Canal, Venice Canals and Oxford Basin, which are no longer in the study area.
      i. All sections should include: Del Rey Lagoon; Areas A, B and C; Ballona Creek from the Ocean to Cochran; and Centinela and Sepulveda Channels from where they daylight to Ballona Creek.
   c. Mary and Diana requested that the Corps add geographic location to the PMP amendment chapter. The scopes of work are confusing because they do not make the study area clear.
   d. Mary: Why have the F3 economics costs gone up?
      i. Ben Nakayama: Economics had to re-run their model due to the revised flood plain hence their cost increase. The potential flooded parcels went from 6000 to 600.
      ii. Sponsor wants to understand why the economics costs for F3 doubled. The model was originally run at a larger scope (6000 parcels) and is now being re-run at a smaller scope (600 parcels). That should not cost double. There should be economies of scale.
      iii. Ben Nakayama: The model had to be completely re-run for the new parcels. This along with added review costs are the reasons behind the cost increase.
   e. Review Guidance has led to approximately $505k in cost increases. $260k of that is for Independent External Peer Review (IEPR), which is NOT cost shared. The other levels of review such as Agency Technical Review (ATR) and model certification ARE cost shared.
      i. Rhiannon will send another copy of the review guidance.
   f. The Coastal Conservancy is worried that there will be no political appetite to support a feasibility study at this cost level.

g. The language in the PMP needs to itemize what the additional costs would go towards.
    i. Rhiannon will send the detailed cost estimates from each PDT member.
h. The Coastal Conservancy believes their GIS work should decrease the revised GIS costs.
    i. This can be investigated further in conjunction with the in-kind review process. USACE will ask Dave Bianco to review the GIS products and scope and cost estimate after the formal in-kind submittal.

III. Coordination

a. Heather Schlosser: It is hard to assure proper coordination when the Corps is trying to complete the baseline F3 this year, while the sponsor is well in to alternatives analysis in the wetlands areas (A, B, C).
    i. Mary and Diana, what do you see as the Corps' role in this feasibility study?
        1. Mary Small: The discussion was that the Corps would focus on the Creek (there aren't state funds for that) and that the wetlands study would go forward separate from the larger feasibility study, but feed in to the project as in-kind credit. The restoration of the wetlands (A, B, C) is being led by SMBRC in conjunction with the State of California.
        2. SMBRC and Coastal Conservancy are both interested in the Creek as well.
            a. Heather Schlosser: Are you willing to cost share the implementation phase of a recommended alternative that includes the Creek and Wetlands?
            b. Mary Small: Our funding strategy for implementing the restoration is the value of the land. However, the Coastal Conservancy's focus is the restoration planning at the wetlands.

IV. Executive Management Meeting

a. Aim to have this in June. SMBRC and Coastal Conservancy will send potential dates and times to Rhiannon Kucharski, who will coordinate with USACE management schedules.

Ballona Telecon Minutes
March 29, 2010

Attendees:

Rhiannon Kucharski, USACE	Kathy Anderson, USACE	Larry Smith, USACE
John Killeen, USACE	James Chieh, USACE	Frank Wu, USACE
Julian Serafin, USACE	Michael Hallisy, USACE	Patrick Singh, USACE
Mary Small, Coastal Conservancy		Sean Berqquist, SMBRC

I. Introductions
II. PMP update
    a. DRAFT SOW Amendment Chapter distributed
    b. Cost estimates
        i. Frank Wu: Coastal Engineering F3 Baseline Conditions
            1. Need to incorporate PWA information in to the appendix
    c. SMBRC Board will have to buy off on the updated PMP and cost estimates
        i. At this Thursday's meeting they are asking the Board to generally support the study
        ii. Cost increase approval will have to come through the Coastal Conservancy's Board
    d. FCSA amendment would come after the PMP update is complete
        i. Have to work with Corps Legal Counsel and SMBRC Legal/Board
    e. Study Area
        i. For F4, the Corps suggests focused study area of A,B & C plus the Creek up to the I-405, and the Centinela Channel and Sepulveda Wash
            1. H&H and Survey and Mapping Sections believe this focused area is best due to cost considerations
            2. Per Frank Wu: Coastal Engineering work has focused on A, B, & C
        ii. Sponsors feel that we need to keep Ballona Creek up to Cochran Boulevard. Otherwise, the map is okay.
    f. Rhiannon and Kathy will set up a meeting between the sponsors and Survey and Mapping (Alan Nichols).[1]
    g. URS and the Corps are in negotiations for the Plan Formulation and Environmental Appendix
III. Corps work Audit
    a. Environmental Resources Branch (ERB)
        i. Review of sponsor work
        ii. Fish survey of creek and channels
        iii. Work with SAC on HEP evaluation
            1. Including scope of work to score A, B & C and the creek between the marsh areas
            2. Mary can re-start the Conservancy agreement with the SAC to possibly fund them.
                a. Larry will send Mary the scope of work he has written.
    b. Cultural Resources
            1. Write-up from PWA, which summarizes a library record search
                a. Corps and Conservancy both feel that the write-up is inadequate

[1] Action Items marked in GREEN.

b. NEPA agency coordination for cultural must be done by a federal agency; it cannot be done by the sponsor or their contractor.
    i. Michael Bever and Bob Stark, with Jones and Stokes and John Killeen need to be in touch with eachother.
2. John Killeen has completed a full record search in the last few months
    a. He is re-writing the F3 input based on the new, more adequate record search.
3. NOTE: Important burials located in the Northwest corner of Area C that have been determined eligible that will need serious consideration for avoidance or mitigation.
4. Also, cultural will have to look at channel as a resource. Where we are pulling out channel, if we decide to, will have to be investigated by cultural.

c. Coastal Engineering
    i. Draft F3 Appendix complete
d. Geotech
    i. Diaz-Yourman contract
    ii. Contract oversite
e. H&H
    i. Baseline Hydrology and Hydraulic Appendices
    ii. Baseline Groundwater Appendix
    iii. Sedimentation will be done during F4 analysis due to funding availability
        1. PWA is looking at sedimentation modeling in their contract with the sponsor. Mary will send their scope of work.
    iv. Water Quality Appendix – We are relying on this product from the sponsor (SCCWRP).
        1. Mary will get us the Appendix as it is available.
f. Socioeconomics
    i. Efforts to date have been on the flood risk management component
        1. Originally the work was going to be done in-house, in L.A.
        2. Original structure inventory and database, site surveys
            a. Subsequent to that work, the H&H floodplain mapping was updated with a fairly significantly reduced floodplain delineation, which demanded that the economics be updated. This update was based on the first revision of the draft Hydraulic Appendix
            b. Update to the economics work will be done through Albuquerque District Economics Section
                i. Finalize F3 analysis
            c. FLO-2D data conversion to HEC format
                i. Will be done through Sacramento District
g. PWA and Jones and Stokes are doing on-going work. Mary will send both scopes of work.

IV. In-kind process (Kathy Anderson)
a. To date there has been no in-kind logged in to the Corps financial system. We need to catch up on that. It should be done yearly.
b. Update in-kind numbers in PMP and in cost summary spreadsheet.
    i. List all in-kind work in a table with associated amount spent on the work, along with a list of work already scoped and contracted to be done. Also, Shelly Luce of SMBRC would need to sign the official submittal.

I. Sponsor needs to keep records of the in-kind and the values in case of an audit.

ii. Mary Small: What is the best way to do that?

iii. Kathy Anderson: We can have a separate meeting to go through the in-kind line by line with Kathy, Rhiannon, Sean and Mary.

iv. Mary Small: Is it what we spend on the product that gets credited or is it what the federal government would have spent to do the same thing?

1. It is up to the PDT to QA/QC the products and agree to the accounting both in amount and content.
2. Coastal Conservancy would feel more comfortable if the in-kind is credited at the value they spent on the product.

V. Coordination

a. Corps requests going forward

i. Each PDT member needs to coordinate with their equivalent on the sponsor's contractor team(s)

1. Rhiannon will send a PDT list to Sean and Mary so that coordination contacts can be filled in next to the corresponding PDT member(s).

b. Sponsor requests

i. Tie up the in-kind process and update more often

c. Our coordination meetings from now on will be the last Wednesday of every month at 10am.

VI. Other Discussion

a. Bike tour with Congresswoman Harman April 9th.

i. Kathy will forward info to Mary and Sean.

DRAFT
ITINERARY FOR
COL R. MARK TOY
MEETING WITH SANTA MONICA BAY RESTORATION COMMISSION AND VISIT TO BALLONA CREEK

26 MAY 2011

TIME/ACTIVITY		TRANSP/REMARKS
THURSDAY – 26 MAY 2011		**UNIFORM: ACUs**
0830	Depart SPL for Loyola-Marymount University (LMU) – 1 LMU	Govt vehicle Driver: Phil Serpa Rick Leifield Josephine Axt
	310-338-2700 PAX: Monica Eichler Stuart Strum Dan Swenson	
0920	Arrive LMU – Santa Monica Bay Restoration Commission Staff Office (SMBRC)	Location: University Hall Room ECC1857 Note: Met by Stuart Strum and Dan Swenson
0930	Executive Management Meeting with SMBRC and California State Coastal Conservancy (CC) Los Angeles County Public Works Dr. Shelley Luce, Executive Director, SMBRB Mary Small, Deputy Executive Officer, Coastal Conservancy Mark Prestrella, Deputy Director	

TIME/ACTIVITY		TRANSP/REMARKS
THURSDAY – 26 MAY (Continued)		
	Agenda: - Introductions - Project Overview – SMBRC/CC o Project goals and regional importance o Planning Process (Science Advisory Committee and Public Meetings) o Proposed Project o Schedule - Partnership with Corps: Discussion (All) o 408 Permit – Outstanding Questions o Status of Feasibility Study o Discussion of Future Coordination	
1100	Depart for Ballona Creek PAX: See above	Govt Vehicle Driver: Phil Serpa
1110	Ballona Creek Site Visit - Overview of the Site - Ballona Channel - Muted Tidal Wetland SMBRC/CC and LAPW Participants: Dr. Luce, Mary Small and Mark Prestrella	
1210	Depart for Ballona Creek for SPL PAX: See above Note: Lunch enroute	Govt Vehicle Driver: Phil Serpa
1330	Arrive SPL	

From:	Mary Small
To:	Diana Hurlbert; sluce@santamonicabay.org
Subject:	talking points ballona - scc board
Date:	Thursday, January 05, 2012 2:08:00 PM
Attachments:	talking points ballona board item.docx

Hi
Shelley, I am hoping that you will share the presentation of this item to the Conservancy board with me. Attached is an outline of what I am thinking we should cover, please take a look and give me your thoughts. My suggestion is that I'd introduce the project and you, you'd cover the need for restoration and the proposed project and then I could go through the details of the proposed action. I am thinking we will have a short (10ish slide) powerpoint with few words but good pictures. I can pull a draft of it together.

Diana, I am hoping you can fill in the highlighted sections in the attached to help me think about how to explain the work that will done if approved, why it's so expensive and why we are going with this approach, as opposed to phasing differently etc.

Thanks,
Mary

Outline for the presentation

(Mary)
Background

- 600 acres owned by the state, DFG and State Lands
- Designated State Ecological Reserve
- Purchased for the purpose of wetland restoration

Project Partners, introduce Shelley

(Shelley)
Need For Restoration, Site Mgt

- Currently no open public access, very restricted
- Site management issues: homeless encampments, trespass, trash, eyesore

Need for restoration, biology

- Very degraded ecological resources – key findings of baseline assessment
- Regional significance – wetland loss around SM Bay and throughout So CA

Proposed project

- Description of grand vision
- Ecological benefits
- Sustainability – adaption to SLR, restoration of ecological processes
- Public access components

Planning process to date 2 slides(?)

- Public and Science Based Process
- Evaluation of broadest possible range of alternatives
- Refinement and assessment of preferred alternative –ideas we rejected, scaling down due to cost considerations, planning for phased implementation

(Mary)
Recommended action:

1) Authorization for a grant of $250 K to SMBRC to fund their ongoing work to advance this restoration project, including continuation of data collection, agency coordination and technical review and oversight.

2) Authorization of $6.25 million to be contracted by SCC through competitive environmental services contracts for specific technical studies that are needed to complete the environmental review and permitting.

Description of the technical work (what will be done and why so expensive)
This authorization would provide funds for several specific scopes of work to support environmental impact review and permitting of the restoration project.

- Soils and Geotechnical assessment – Some soil sampling has been completed onsite, however the main cost for implementation of the project will be soil management. To

reduce construction costs, the project is designed to balance cut and fill onsite. To effectively implement that program, we have to have clear understanding of soil characteristics – which soils can be used to construct levees, which soils should be used to create upland habitat, etc.

- Landscape Architect to design public access improvements. Conceptual designs for public access improvements have been included in the project from the very start. Now that we have a project description for the land-form of the restoration, it will be important to design the public access improvements. One of the major benefits of this project will be to create a new natural area in the urban center of Los Angeles. We intend to design public access amenities
- Civil engineering – design of levees and construction details up to ___% details of proposed work…
- Hydraulics and Hydrology – evaluation of flood risk and uncertainty details of proposed work…

In addition to environmental impact review, this project will need the following permits: Coastal Commission CDP, LA RWQCB permit, and an Army Corps Section 408 permit. Much of the additional technical work that is recommended in this action will be needed to comply with the 408 permit process.

The 408 permit is a permit issued by the Corps to modify an existing flood control project. After Hurricane Katrina, these permit requirements became much stricter and more comprehensive. This permit will have to be approved in DC and will require that the project have ___% design completed. *Explain why so expensive...*

Over the past several months, the project management team has been in conversation with the ACOE and internally discussing the best path forward given the significant costs to complete the design and hydraulic/hydrology studies.

We considered several options of initial projects that would involve installation of tide gates or breaches rather than full levee removal. Tide gate projects were determined to be less desirable because they do not restore full tidal range, are unable to adapt to sea level rise and have higher maintenance costs. We also considered a moving forward only with a smaller Phase 1 project that would restore wetlands north of the channel.

This would reduce the design and technical review costs now, but if we were ever to implement the full restoration project, we would have to go through some of the permit processes again. Our estimate is that the total planning costs would increase by *X-XX* amt in the end.

Of course the actual amount will be determined through contractor selection process and evaluation of proposals, but we have based this recommendation on a comprehensive, conservative but complete estimate to finish all of the pre-project work.

Acknowledge Some Opposition

- Is restoration needed, impacts to existing resources?

Some individuals think that this site is providing important habitat as is. This is a case of shifting baselines, the site does provide some habitat, but is severely degraded. Example - data pt from Karina's work?. To restore estuarine wetlands at Ballona, the land needs to be reconnected to the ocean.

- Can project be done with volunteers and without bulldozers?

The project that we are recommending is enormous in scale. It involves uncovering the wetlands that were buried with the construction of the marina and that have been cut off from the ocean for almost 90 years. We will work to continue working with youth groups and volunteers to implement portions of this restoration.

- Money would be better spend buying small parcels in the neighborhood

Some neighbors to the project have advocated that the restoration of the wetlands is a poor investment and the bond money should be spent to acquire small parcels (each 3-5 acres) rather than to restore the ecological reserve.

Funds are limited to Ballona, consequences if not approved, who will pay for construction?

Conclusion:
Even though this is a major investment and a controversial project, your staff recommends that you approve it. The ecological restoration of the Ballona wetlands is a rare opportunity to bring back coastal wetlands and to develop an urban natural area that will enhance the lives of millions of Californians. To really restore this site we have to implement a big vision and in order to do that we

Questions I will need to be prepared to answer:
Consequences if not approved
Who will pay for construction?
Why not grant all funds to SMBRC?

NOTES

Cost of other wetland restoration projects – engineering and environmental review

South Bay Salt Ponds Initial Planning, EIR and Phase I Design (15,000 acres)	$23 M
Batiquitos Lagoon	$5 M
San Elijo Lagoon	$1.9 M
S San Diego Bay Salt Ponds	$550K

Questions we need to answer:

Why is this so expensive?
    How does it compare to the costs other wetland restoration projects?
Is it needed? Is it a waste of money?
Is this the right alternative?
Will there be more habitat destruction than restoration
Who will implement the project?
Wouldn't we be better off with ngos and volunteers?
What about long term management?

Key Points
Plan developed with extensive scientific review and public input
Plan goals: habitat restoration, sustainability, public access, lower maintenance cost
Funds are specific to Ballona

From: Shelley Luce
To: Mary Small
Cc: Diana Hurlbert
Subject: RE: timelines...
Date: Monday, January 30, 2012 4:44:09 PM

Let's meet downtown at 11 am at Bottega Louie, it's on the corner of 7th and Grand. We can eat or just have coffee for as long as we want there, and then head over. Sound good?

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission
Pereira Annex MS:8160
1 LMU Drive, Loyola Marymount University
Los Angeles, CA 90045
310-961-4444

www.santamonicabay.org

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Monday, January 30, 2012 4:30 PM
To: Shelley Luce
Cc: Diana Hurlbert
Subject: Re: timelines...

Great, let's meet before maybe 11?
Downtown would be easy for me but I could also fly to LAX and meet at LMU, if we do that maybe we could meet a little earlier?

Sam can't make it, this rescehduled time didn't work for him.
Mary

sent from my phone

On Jan 27, 2012, at 12:38, Shelley Luce <sluce@santamonicabay.org> wrote:

> I have kept the whole day open. You can Sam can tell us what works for you - meet earlier downtown or at LMU, anytime after 9:30 is good for me. We can reserve a conf room at water board offices or meet at a coffee shop if we do it downtown.
>
> *Shelley Luce, D.Env.*
> *Executive Director*
> *Santa Monica Bay Restoration Commission*
> *Pereira Annex MS:8160*
> *1 LMU Drive, Loyola Marymount University*
> *Los Angeles, CA 90045*
> *310-216-9827*
> *www.santamonicabay.org*
>
> ---
>
> **From:** Diana Hurlbert
> **Sent:** Friday, January 27, 2012 10:07 AM
> **To:** Mary Small; Shelley Luce
> **Subject:** RE: timelines...

The 1st works for me. As for timeline this is what I am shooting for....

Early Feb for Nick's revised engineering/construction PD
Late Feb/early March for summary NOP/NOI to be circulated
March/April for Habitat/Adaptive Mgmnt Plan
Early May for draft geotech, recreation/Area C, hydraulics, traffic, and 30% engineering/design
Working over summer on & circulating admin draft chapters and finalizing reports, recreation/Area C etc.
Finalizing Public review Draft for circulation in late Sept.

Please keep in mind that we will be creating and circulating draft chapters for review as information is available. All document preparation will be on concurrent paths. Keeping to the timeline depends mostly on how responsive reviewers are to deadlines for comment (ie. a 2 week turn around). The consultants are all aware of these targets and have committed to meeting them.

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Thursday, January 26, 2012 3:24 PM
To: Shelley Luce
Cc: Diana Hurlbert
Subject: Re: timelines...

Hi
Sorry if I misspoke I feel like I have promised dates that we haven't met so many times that I instinctively underestimate when we'll get things done. It would be super valuable to have some key milestones on a schedule that we all are working off of- MRCA asked for that too. I can draft it up nxt week or you guys can send it to me.

I think there may be a role for Sci input going fwd but after I'm not sure I think we should have more SAC mtgs. Do you guys have time on the 1st? I think there are a few things we should touch base on and I could meet before or immediately after our mtg w ACOE.

Thanks
Mary

sent from my phone

On Jan 26, 2012, at 15:47, Shelley Luce <sluce@santamonicabay.org> wrote:

> Hi Mary,
> I wanted to check in on our timelines but I forgot to mention yesterday. I've been shooting for end of Feb. release of the NOP/NOI and public review draft of EIR/EIS in Sept. 2012. In the SAC meeting I thought I heard you say something longer than that – a few months until the NOP comes out. Also in the SAC meeting we kind of indicated there could be more SAC meetings to resolve

things that we were discussing and I didn't think that was part of our plan. I do think we can continue discussion of relevant things with SAC members as we write the draft EIR, and reconvene if necessary. Is that what you were thinking?

Talk to you Monday!
Shelley

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission
Pereira Annex MS:8160
1 LMU Drive, Loyola Marymount University
Los Angeles, CA 90045
310-961-4444

www.santamonicabay.org

From: Mary Small
To: "Shelley Luce"
Subject: LA Co
Date: Tuesday, December 13, 2011 9:14:00 AM

Hi
Do you think there is any chance that we could get a commitment from LA Co to fund the permit process before Jan? Then I could add them as matching funds to my staff report.

Mary

~~~~~~~~~~~~~~~~

Mary Small
Deputy Executive Officer, Coastal Conservancy
1330 Broadway #1300 Oakland, CA 94612
510-286-4181
~~~~~~~~~~~~~~~~

From: Mary Small
To: "Mary Small"; "Shelley Luce"
Cc: "Diana Hurlbert"
Subject: RE: draft agmt SMBRF 2
Date: Monday, February 13, 2012 9:28:00 AM

Hi
Can you let me know if this looks basically ok so I can send it to Mr. Davis?
Thanks
Mary

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, February 07, 2012 2:28 PM
To: 'Shelley Luce'
Cc: 'Diana Hurlbert'
Subject: draft agmt SMBRF 2

Hi Shelley
Attached is a draft of the grant agmt to the SMBRF for the $240K. We'll need to develop a work plan and budget separately.

Can you take a quick review and let me know if it looks ok? Elena has asked me to produce this draft quickly as it seems the best way to respond to our most recent PRA from Mr. Davis.

Thanks
Mary

ATTACHMENT 6

REQUEST FOR SERVICES

Ballona Wetlands Ecological Reserve
Environmental Analysis and Permit Assistance

May 11, 2009

Contract Type: Environmental Professional Services

Scope:
Perform environmental analysis and assist in applying for permits for habitat enhancement and public access improvements at the Ballona Wetlands Ecological Reserve in Los Angeles.

Submittal Deadline: **June 1, 2009**
Proposals should be submitted electronically in adobe acrobat format and must be received at the Conservancy by June 1, 2009.

Contact: Mary Small, California Coastal Conservancy, msmall@scc.ca.gov

From:	Mary Small
To:	"Ivan Medel"
Cc:	"Shelley Luce"; "Karina Johnston"; "Diana Hurlbert"
Subject:	FW: post to web?
Date:	Wednesday, February 08, 2012 4:48:00 PM
Attachments:	Ballona Civil Engineering and Geotech.pdf Ballona Hydrology and Engineering.pdf

Hi Ivan
Could you post the following on the homepage of the Ballona Restoration Project website?

The California State Coastal Conservancy is requesting proposals for consultant services for two separate contracts related to the proposed enhancement of the Ballona Wetlands Ecological Reserve in Los Angeles County. Services are needed to complete engineering and geotechnical evaluations, hydrology, technical studies, design and related services to support completion of a project level EIR/EIS and preparation and processing of a Section 408 permit through the Army Corp of Engineers. One contract will be for Civil and Geotechnical Engineering and a second contract will be for Hydrology and Engineering Design Analysis.

Please unhighlight the text above but insert hyperlinks to the attached docs to the highlighted text to the RFS, does that make sense?

Thanks,
Mary

REQUEST FOR SERVICES

Ballona Wetlands Ecological Reserve
Civil and Geotechnical Engineering and Permit Assistance

February 8, 2010

Contract Type: Civil Engineering and Geotechnical Professional Services

Scope: Provide engineering and geotechnical evaluations, design and related services for the proposed wetland restoration design of the Ballona Wetlands Ecological Reserve in Los Angeles. Technical studies, evaluations, and designs will be of sufficient detail to support completion of a project level EIR/EIS and preparation and processing of a Section 408 permit through the Army Corp of Engineers.

Submittal Deadline: February 29, 2012

Proposals should be submitted electronically in adobe acrobat format and must be received at the Conservancy by February 29, 2012.

Contact: Mary Small, California Coastal Conservancy, msmall@scc.ca.gov

From:	Mary Small
To:	"Diana Hurlbert"; "David Lawhead (DLawhead@dfg.ca.gov)"; "Eichler, Monica SPL"; "Eric Gillies"; "griggsp@slc.ca.gov"; "Hamamoto, Bruce"; "Patrick Holland (pholland@dpw.lacounty.gov)"; "Rick Mayfield (rmayfield@dfg.ca.gov)"; "Serpa, Phillip J SPL"; "Shelley Luce"; "Strum, Stuart R MVN-Contractor"; "Swenson, Daniel P SPL"; "Terri Grant (tgrant@dpw.lacounty.gov)"; "Youn Sim (ysim@dpw.lacounty.gov)"
Subject:	RE: request for services - ballona wetlands
Date:	Thursday, February 09, 2012 5:02:00 PM

Hello all-
Here's some more information about the Coastal Conservancy's contractor selection process. It is a quick process and I am hoping PMT members will assist us so I want to be sure you are aware of the schedule.

I am really hoping the PMT will help in reviewing proposals and that staff from the County and Corp will participate on the selection panel. These contracts are for work to support the County's 408 submittal. Here's the schedule for the review/selection:

- Proposals will be submitted electronically to me on 2/29
- I will post them on a secure site by 3/1 for PMT review
- PMT will select the top 3 or 4 firms we'll interview for each contract by 3/5
- PMT will do a detailed review of the written proposals of the top proposals by 3/13
- Interviews will be in LA on 3/13 – all day

I am assuming the selection panel will be Diana, me, and a representative from the County and the Corps. If anyone else wants to spend March 13th interviewing firms, please let me know.

Mary

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Wednesday, February 08, 2012 4:46 PM
To: 'Diana Hurlbert'; 'David Lawhead (DLawhead@dfg.ca.gov)'; 'Eichler, Monica SPL'; 'Eric Gillies'; 'griggsp@slc.ca.gov'; 'Hamamoto, Bruce'; 'Patrick Holland (pholland@dpw.lacounty.gov)'; 'Rick Mayfield (rmayfield@dfg.ca.gov)'; 'Serpa, Phillip J SPL'; 'Shelley Luce'; 'Strum, Stuart R MVN-Contractor'; 'Swenson, Daniel P SPL'; 'Terri Grant (tgrant@dpw.lacounty.gov)'; 'Youn Sim (ysim@dpw.lacounty.gov)'
Subject: FW: request for services - ballona wetlands

The request for services for the civil engineering and geotechnical contract and the hydrology and engineering contracts went out today. Feel free to forward to other potential contractors, I sent it to about 60 in our database and we will post it on the web. Proposals are due on Feb 29th.

Mary

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Wednesday, February 08, 2012 4:39 PM
Subject: FW: request for services - ballona wetlands

The California State Coastal Conservancy is requesting proposals for consultant services for two separate contracts related to the proposed enhancement of the Ballona Wetlands Ecological

Reserve in Los Angeles County. Services are needed to complete engineering and geotechnical evaluations, hydrology, technical studies, design and related services to support completion of a project level EIR/EIS and preparation and processing of a Section 408 permit through the Army Corp of Engineers. One contract will be for Civil and Geotechnical Engineering and a second contract will be for Hydrology and Engineering Design Analysis.

~~~~~~~~~~~~~~~~

Mary Small
Deputy Executive Officer, Coastal Conservancy
1330 Broadway #1300 Oakland, CA 94612
510-286-4181
~~~~~~~~~~~~~~~~

Subject: RE: PUBLIC RECORDS REQUEST FROM JOHN DAVIS MARCH 27, 2012
From: "Elena Eger" <eeger@scc.ca.gov>(Add as Preferred Sender)
Date: Wed, Mar 28, 2012 8:46 am
To: <jd@johnanthonydavis.com>
Cc: "'Mary Small'" <msmall@scc.ca.gov>, <sschuchat@scc.ca.gov>

Dear Mr. Davis:

The Conservancy does not possess a responsive record to your request, below.

Sincerely,

Elena Eger

Senior Staff Counsel

California Coastal Conservancy

1330 Broadway, Ste. 1300

Oakland, CA 94612

510-286-4089 tele/voicemail

510-286-0470 fax

From: jd@johnanthonydavis.com [mailto:jd@johnanthonydavis.com]
Sent: Tuesday, March 27, 2012 5:55 PM
To: Elena Eger
Cc: 'Mary Small'; sschuchat@scc.ca.gov
Subject: RE: PUBLIC RECORDS REQUEST FROM JOHN DAVIS MARCH 27, 2012

California Coastal Conservancy

Re: Public Records Request

Please provide any statute which exempts the California Coastal Conservancy from the California Contract Code as it relates to the Agency entering into contracts of any type.

Thank you,

John Davis

-------- Original Message --------
Subject: RE: PUBLIC RECORDS REQUEST FROM JOHN DAVIS MARCH 21, 2012
From: "Elena Eger" <eeger@scc.ca.gov>
Date: Tue, March 27, 2012 5:27 pm
To: <jd@johnanthonydavis.com>
Cc: "'Mary Small'" <msmall@scc.ca.gov>, <sschuchat@scc.ca.gov>

Dear Mr. Davis:

Your request below does not constitute a request for a record pursuant to the Public Records Act. Rather, your request is for an analysis of statutory law. I am ethically prohibited from providing counsel to anyone other than my client. Assuming that you are not a lawyer, I am also ethically bound to suggest to you that you obtain your own counsel to advise you on such matters. You may utilize the California State Bar website for referrals to counsel at www.calbar.ca.gov.

Sincerely,

Elena Eger

Senior Staff Counsel

California Coastal Conservancy

1330 Broadway, Ste. 1300

Oakland, CA 94612

510-286-4089 tele/voicemail

510-286-0470 fax

From: jd@johnanthonydavis.com [mailto:jd@johnanthonydavis.com]
Sent: Tuesday, March 27, 2012 1:38 PM
To: Elena Eger
Subject: RE: PUBLIC RECORDS REQUEST FROM JOHN DAVIS MARCH 21, 2012

Hello,

Thank you for the citations. However, neither removes the requirement of the Coastal Conservancy to comply with Public Contract Code Sectoins 10140-10141 nor 10515-10518.

If the Conservancy is exempt from the California Contract Code, please inform me as to what statute or code provides for such an exemption.

John Davis

-------- Original Message --------
Subject: RE: PUBLIC RECORDS REQUEST FROM JOHN DAVIS MARCH 21, 2012
From: "Elena Eger" <eeger@scc.ca.gov>
Date: Tue, March 27, 2012 12:50 pm
To: <jd@johnanthonydavis.com>
Cc: "'Schuchat, Sam'" <sschuchat@scc.ca.gov>, "'Mary Small'" <msmall@scc.ca.gov>, "'Dick Wayman'" <dwayman@scc.ca.gov>, "'Nadine Peterson'" <npeterson@scc.ca.gov>, "'Heather Baugh'" <heather.baugh@resources.ca.gov>, <kimg@resources.ca.gov>

Dear Mr. Davis:

This correspondence contains the Coastal Conservancy's (Conservancy) response to your March 21, 2012 Public Records Act request, below.

The Conservancy does not possess any responsive records to either of your numbered requests. However, we direct you to Government Code Sections 4525 *et seq.* and 14 California Code of Regulations Sections 13870 *et seq.* for our contracting process.

Sincerely,

Elena Eger

Senior Staff Counsel

California Coastal Conservancy

1330 Broadway, Ste. 1300

Oakland, CA 94612

510-286-4089 tele/voicemail

510-286-0470 fax

From: jd@johnanthonydavis.com [mailto:jd@johnanthonydavis.com]
Sent: Wednesday, March 21, 2012 2:11 PM
To: "Samuel Schuchat"; "John Laird"; 'Dick Wayman'; 'Nadine Peterson'; carmenp@scc.ca.gov; kimg@resources.ca.gov
Cc: John Chang
Subject: PUBLIC RECORDS REQUEST FROM JOHN DAVIS MARCH 21, 2012

California Coastal Conservancy

Att: Executive Director Sam Schuchat

California Coastal Conservancy March 21, 2012

To: Governing Board and Management

Douglas Bosco
Marisa Moret
Ann Nothoff
John Laird
Susan Hancsh

Karen Finn

Bryan Cash

Noreen Evens

Joe Simitan

Anthony Cannella

Bill Mornning

Luis Alejo

Das Williams

CC
John Chang State Controller

Att: Executive Director Schuchat, Please Send This Letter to All California Coastal Conservancy Governing Board and Management.

This is a request for public records made pursuant to the California Public Records Act. Each numbered item is a distinct request for public records.

1. Please provide any and all public records that demonstrate compliance with California Public Contract Code Section 10140-10141 in regard to the California Coastal Conservancy approval onf January 19, 2012 of File No. 04-088 which approved money to be disbursed for engineering, hydrologic analyses, geotechnical assessments, and public design.

2. Please provide any and all public records that demonstrate compliance with California Public Contract Code Section 10515-10518 in regard to the California Coastal Conservancy approval on January 19, 2012 of File No. 04-088 which approved money to be disbursed for engineering, hydrologic analyses, geotechnical assessments, and public design.

No such records have been requested or received by me to date.

See Attached Approval for File No. 04-088

Thank you,

John Davis
PO 10152
Marina del Rey Ca. 90295

PUBLIC CONTRACT CODE SECTION 10140-10141

10140. **Public notice of a project shall be given by publication once a week for at least two consecutive weeks or once a week for more than two consecutive weeks if the longer period of advertising is deemed necessary by the department, as follows:** (a) **In a newspaper of general circulation published in the county in which the project is located**, or if located in more than one county, in such a newspaper in a county in which a major portion of the work is to be done. (b) **In a trade paper of general circulation published** in San Francisco for projects located in County Group No. 1, as defined in Section 187 of the Streets and Highways Code, or **in Los Angeles for projects located in County Group No. 2, as defined in said Section 187, devoted primarily to the dissemination of contract and building news among contracting and building materials supply firms. The department may publish the notice to bidders for a project in additional trade papers or newspapers of general circulation that it deems advisable.** 10141. The notice shall state the time and place for the receiving and opening of sealed bids, describing in general terms the work to be done and that the bids will be required for the entire project and for the performance of separate designated parts of the entire project, when the department determines that segregation is advisable.

PUBLIC CONTRACT CODE SECTION 10515-10518

10515. (a) No person, firm, or subsidiary thereof who has been awarded a consulting services contract may submit a bid for, nor be awarded a contract on or after July 1, 2003, for the provision of services, procurement of goods or supplies, or any other related action that is required, suggested, or otherwise deemed appropriate in the end product of the consulting services contract. (b) Subdivision (a) does not apply to either of the following: (1) Any person, firm, or subsidiary thereof who is awarded a subcontract of a consulting services contract that amounts to no more than 10 percent of the total monetary value of the consulting services contract. (2) Consulting services contracts that comply with Article 2.5 (commencing with Section 10510.4). (c) (1) Subdivision (a) does not apply to any person, firm, or subsidiary awarded a consulting services contract by a University of California medical center when the provision of service, procurement of goods or supplies, or any other related action required, suggested, or otherwise deemed appropriate in the end product of the consulting services contract, is necessary to avoid a competitive disadvantage in the hospital industry, improve patient care, protect the privacy of patient information, or avoid significant delay and additional expense. (2) The University of California shall report within 30 days on any exemption granted under paragraph (1) to the Joint Legislative Budget Committee and the Department of Finance. The report shall include a description of the circumstances that warranted the exemption, the effects of the exemption on patient care or patient privacy, and a calculation of the projected costs savings to the institution as a result of the exemption. 10516. No officer or employee of the University of California shall engage in any employment, activity, or enterprise from which the officer or employee receives compensation or in which the officer or employee has a financial interest if that employment, activity, or enterprise is sponsored or funded, or sponsored and funded, by any university department through or by a university contract unless the employment, activity, or enterprise is within the course and scope of the officer's or employee's regular university employment. No officer or employee in the university shall contract on his or her own individual behalf as an independent contractor with any university department to provide services or goods. This section shall not apply to officers or employees of the university with teaching or research responsibilities, nor shall it apply to student employees for payment for additional campus activities or engagements outside of the scope of their primary university employment. 10517. (a) No retired, dismissed, separated, or formerly employed person of the University of California employed with the university or otherwise appointed to serve in the university may enter into a contract in which he or she engaged in any of the negotiations, transactions, planning, arrangements, or any part of the decisionmaking process relevant to the contract while employed in any capacity by any university department. The prohibition of this subdivision shall apply to a person only during the two-year period beginning on the date the person left university employment. (b) For a period of 12 months following the date of his or her retirement, dismissal, or separation from the University of California, no person employed in the university or otherwise appointed to serve in the university may enter into a contract with any university department, if he or she was employed by that department in a policymaking position in the same general subject area as the proposed contract within the 12-month period prior to his or her retirement, dismissal, or separation.

The prohibition of this subdivision shall not apply to a contract requiring the person's services as an expert witness in a civil case or to a contract for the continuation of an attorney's services on a matter he or she was involved with prior to leaving the university. (c) This section does not prohibit the rehire or reappointment of University of California employees after retirement, consistent with university administrative policies, nor does it apply to inventors and authors of intellectual property licensed under technology transfer agreements. 10518. (a) Except as otherwise provided in subdivision (b), each contractor who enters into a contract with a University of California campus for ten thousand dollars ($10,000) or more shall be assigned an identification number by the chancellor of that university campus. Each contractor who has been assigned a number shall list it on each contract the contractor enters into with the university campus, regardless of the amount of the contract. In the case of a corporation or firm, the chancellor's assigned number shall be used exclusively on each contract with that particular chancellor's campus. The assigned number shall remain unchanged regardless of future name changes. (b) If the identification numbers cannot be tracked centrally by the Regents of the University of California, then the regents, and not the chancellors, shall assign the identification numbers.

ATTACHMENT 7

From:	Mary Small
To:	"Barbara Romero"
Cc:	"Melissa Guerrero"; "Diana Hurlbert"; "Shelley Luce"
Subject:	SCC mtg in Jan
Date:	Monday, December 19, 2011 3:30:00 PM
Attachments:	Ballona_Wetlands_Engineering_and_Technical_Studies.docx

Hi Barbara,
Thanks for agreeing to support the recommendation for funding for engineering work at Ballona. Attached is the draft staff report, the project will be heard at our Jan 19th meeting at the Baldwin Hills Scenic Overlook. As you can see it's a pretty big authorization, so we'd love your support. I think we may take the Board on a tour of Ballona that morning and then the meeting will start around 12:30. It would be great to have MRCA join us for either the tour or the meeting.

Thanks also for the message about the early action plan grant. When you have time submit any final billing or just a letter stating that the work is all done and I'll close it out.

Hope you are doing well and have a great holiday.
Mary

From:	Mary Small
To:	"Shelley Luce"; "Scott Valor"
Subject:	FW: support letter for SCC board meeting?
Date:	Wednesday, January 11, 2012 3:53:00 PM

Good news

From: Sarah Sikich [mailto:ssikich@healthebay.org]
Sent: Wednesday, January 11, 2012 3:44 PM
To: Mary Small
Subject: RE: support letter for SCC board meeting?

Hi Mary,

Mark forwarded me your email about the Ballona technical study support letter for the SCC board meeting. We discussed it at our department meeting this week, and will send in a letter. Is an electronic copy fine, or do you need a hard copy? Also, should I just send it to you?

Additionally, Alix Hobbs would like to join our meeting while you are at Heal the Bay to discuss some of our Coastal Conservancy projects and potential future ideas. Is it okay with you if she joins for the second half of the meeting?

Thanks,
Sarah

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, January 03, 2012 3:00 PM
To: Mark Gold
Subject: RE: support letter for SCC board meeting?

Thanks, the meeting is the 19th so that's the deadline. Yes, I totally understand.

I was just sending Sarah an email about possible dates I'll be in LA when I'd like to stop in ad talk about OPC, so maybe I'll see you then.

Happy new year (and MLPA implementation)
Mary

From: Mark Gold [mailto:mgold@healthebay.org]
Sent: Tuesday, January 03, 2012 2:39 PM
To: Mary Small
Subject: RE: support letter for SCC board meeting?

Mary – Happy new year to you too. We will definitely take a look at this and think it through. It is a great project and needs to happen. The political baggage that goes with it is no picnic as you know.

When is the deadline?

ATTACHMENT 8

From: jd@johnanthonydavis.com [mailto:jd@johnanthonydavis.com]
Sent: Wednesday, March 21, 2012 12:34 PM
To: "Samuel Schuchat"; "John Laird"; 'Dick Wayman'; 'Nadine Peterson'; carmenp@scc.ca.gov; kimg@resources.ca.gov
Cc: David Lawhead; John Chang
Subject: To All California Coastal Conservancy Board Members from John Davis

California Coastal Conservancy
Att: Executive Director Sam Schuchat

California Coastal Conservancy March 21, 2012

To: Governing Board and Management
Douglas Bosco
Marisa Moret
Ann Nothoff
John Laird
Susan Hancsh
Karen Finn
Bryan Cash
Noreen Evens
Joe Simitan
Anthony Cannella
Bill Mornning
Luis Alejo
Das Williams

CC
John Chang State Controller

Att: Executive Director Schuchat, Please Send This Letter to All California Coastal Conservancy Governing Board and Management.

Your Staff Attorney, Elena Eger has indicted this State Agency will not answer the fair questions I, as a member of the public asked regarding the procedures of the Conservancy.

Failure to answer such questions is contrary to the role of the State Agency to enjoin the public in the processes.

Please request that Staff respond to the questions I have asked.

Furthermore I have requested that your Staff not copy any Private Business or Individuals on responses to me as I consider it harassment and intimidation by the State Agency.

Should any such private business or individual wish to obtain such email records, such records should ONLY be provide if requests for such records are made pursuant to the Law, the California Public Records Act.

The Information Practices Act (Civil Code section 1798 et seq.) generally prohibits agencies from disclosing an individual☺s personal information to the public.

Thank you,

John Davis
PO 10152
Marina del Rey Ca. 90295

From: jd@johnanthonydavis.com [mailto:jd@johnanthonydavis.com]
Sent: Thursday, February 16, 2012 1:29 PM
To: Elena Eger
Cc: 'Mary Small'; 'Sam Schuchat'; 'Dick Wayman'; 'Shelley Luce'; svalor@santamonicabay.org
Subject: Reply from John Davis RE: Davis' Requests for Information

California Coastal Conservancy
Att: E.Eger
Re: Reply

Dear E. Eger,

The request for public records submitted on 2/14/2012 remains outstanding.

The Commission still needs to reply to this request within 10 days of the submission date. I do expect a reply by 2/24/2012 as
the Public Records Act requires under law.

I also would take issue with your recent email stating that I made a DEMAND of the Commission. This is far from true.

In fact my email stated the INTENDED PURPOSE of the email and made no demands as you stated to me in your email to me.

Prior to that, you inferred in another email that I made statements and or asserted things that I clearly did not.

I corrected you once alreadyin writing, and find I must do so yet again.

Your accuracy in characterizing my telephonic conservations or written documents should not be clouded by your misconceptions
as I do not find it to be professional in your role as a State Attorney.

Regards,

John Davis
PO 10152
Marina del Rey Ca. 90295

****

Subject: Reply from John Davis RE: PUBLIC RECORDS REQUEST FROM JOHN DAVIS
From: <jd@johnanthonydavis.com>(Add as Preferred Sender)
Date: Tue, Feb 14, 2012 2:05 pm
To: "Elena Eger" <eeger@scc.ca.gov>

California Coastal Conservancy
Att: Elana Eger Councel
Re: Reply to your communication

Counsel Eger,

Please pardon my typo in your title.

Also, I still do not understand why a State Agency would share my letter, and personal email
address with a private business, unless requested pursuant to the Public Records Act. I am not
sure what other private businesses you intend to copy on my letters to the State Agency using State facillities.

I do understand that you will continue to provide my emails to this State Agency with private businesses:

" Indeed, we will continue to share communications to you or from you with our other Ballona project partners, irrespective of whether the partner is a public or private organization, when we, at our sole discretion, determine that dissemination to be useful for our project purposes.".

How does the Coastal Conservancy define the term "partner" as used in your statement?

How, at the Coastal Conservancy, is a determination made at its sole discretion whether the dissemination
of my email to the State Agency would be useful for the Conservancy's project purposes?

What entity of the Coastal Conservancy is entitled to make such a determination and under what authority?

These are fair questions given that my letters to you have already been shared with a private business.

Thank you for your continued assistance.

John Davis
PO 10152
Marina del Rey Ca. 90295
-------- Original Message --------
Subject: RE: PUBLIC RECORDS REQUEST FROM JOHN DAVIS

From: "Elena Eger" <eeger@scc.ca.gov>
Date: Tue, February 14, 2012 12:32 pm
To: <jd@johnanthonydavis.com>
Cc: "'Mary Small'" <msmall@scc.ca.gov>, <svalor@santamonicabay.org>, "'Shelley Luce'" <sluce@santamonicabay.org>, "'Dick Wayman'" <dwayman@scc.ca.gov>

Mr. Davis:

This is in partial response to your PRA, below and your request of yesterday at 5:15 p.m. in which you demand that we not share your communications with "any private business" and in which you characterize such communications as "private".
While we will provide you with your requests to the extent possible and in compliance with the PRA, we must clarify to you that communications between you, as a member of the public, and the Conservancy, a public agency, are not considered under the PRA and thus not by the Conservancy to be "private communications", subject to any privilege or exception under the Act. Indeed, we will continue to share communications to you or from you with our other Ballona project partners, irrespective of whether the partner is a public or private organization, when we, at our sole discretion, determine that dissemination to be useful for our project purposes.
I would also like to clarify for you for your future purposes that my title is not "council" but "counsel", that is, I am a lawyer, not a member of a council.
Sincerely,

Elena Eger
Senior Staff Counsel
California Coastal Conservancy
1330 Broadway, Ste. 1300
Oakland, CA 94612
510-286-4089 tele/voicemail
510-286-0470 fax

****

From: jd@johnanthonydavis.com [mailto:jd@johnanthonydavis.com]
Sent: Tuesday, February 14, 2012 10:49 AM
To: Elena Eger
Subject: PUBLIC RECORDS REQUEST FROM JOHN DAVIS

California Coastal Conservancy
Att: Council E. Eger
Re: Public Records Request

This is a public records request made pursuant to the California Public Records Act. Each numbered item is a separate and distinct request for public records. This letter is only intended to for the California Coastal Conservancy and NOT FOR ANY PRIVATE BUSINESS, unless requested by such a business via the California Public Records Act.

1. Provide any and all emails to and received by the California Coastal Conservancy

from the following email address in regard and prior to Item 5 of the Conservancy hearing on January 19, 2012: sluce@santamonicabay.org

2. Provide any and all emails to and received by the California Coastal Conservancy from the following email address in regard and prior to Item 5 of the Conservancy hearing on January 19, 2012: svalor@santamonicabay.org

3. Provide any and all emails to and received by the California Coastal Conservancy from the following email address AFTER the Conservancy hearing on January 19, 2012: sluce@santamonicabay.org

4. Provide any and all emails to and received by the California Coastal Conservancy from the following email address AFTER the Conservancy hearing on January 19, 2012: svalor@santamonicabay.org

6. Provide any and all emails sent by the Conservancy to following email address in regard and prior to Item 5 of the Conservancy hearing on January 19, 2012: sluce@santamonicabay.org

7. Provide any and all emails sent by the Conservancy to following email address in regard and prior to Item 5 of the Conservancy hearing on January 19, 2012: svalor@santamonicabay.org

8. Provide any and all email sent by the California Coastal Conservancy to following email address in AFTER the Conservancy hearing on January 19, 2012: sluce@santamonicabay.org

9. Provide any and all email sent by the California Coastal Conservancy to following email address in AFTER the Conservancy hearing on January 19, 2012: svalor@santamonicabay.org

Thank you for your assistance,

John Davis
PO 10152
Marina del Rey Ca. 90295

-------- Original Message --------
Subject: RE: Reply from John Davis RE: Davis' Requests for Information
From: "Elena Eger" <eeger@scc.ca.gov>
Date: Thu, February 16, 2012 7:48 pm
To: <jd@johnanthonydavis.com>
Cc: "'Mary Small'" <msmall@scc.ca.gov>, "'Sam Schuchat'" <sschuchat@scc.ca.gov>, "'Dick Wayman'" <dwayman@scc.ca.gov>, "'Shelley Luce'" <sluce@santamonicabay.org>, <svalor@santamonicabay.org>

Dear Mr. Davis:

As I stated in my email of yesterday to you, we intend to comply with your records request to us of 2/14. We are working on compiling the records that you have requested. Please clarify whether you wish to receive the emails pertaining to correspondence among Mr. Valor, Ms. Luce and Conservancy staff with respect to the Item #5 on the 1-19-12 agenda only.

Please clarify that you are referring to the Conservancy when you make reference to the "Commission" in your message below.

As to your other allegations contained in your email below, I remind you that, as I said yesterday, we will make no further comment, which, of course, does not mean that we agree or disagree with your interpretations. Again, unless you are requesting a record from us under the Public Records Act, we do not intend to make further explanatory comments to you.

Sincerely,

Elena Eger
Senior Staff Counsel
California Coastal Conservancy
1330 Broadway, Ste. 1300
Oakland, CA 94612
510-286-4089 tele/voicemail
510-286-0470 fax

-------- Original Message --------
Subject: Davis' Requests for Information
From: "Elena Eger" <eeger@scc.ca.gov>
Date: Wed, February 15, 2012 6:45 pm
To: <jd@johnanthonydavis.com>
Cc: "'Mary Small'" <msmall@scc.ca.gov>, "'Sam Schuchat'" <sschuchat@scc.ca.gov>, "'Dick Wayman'" <dwayman@scc.ca.gov>, "'Shelley Luce'" <sluce@santamonicabay.org>, <svalor@santamonicabay.org>

Dear Mr. Davis:

In response to your inquiry below, I am providing you with the link to our website's contents of Item 5, Ballona Restoration Project, approved at the Conservancy's 1-19-12 public meeting unanimously. All my references are to the contents in this link. http://scc.ca.gov/webmaster/ftp/pdf/sccbb/2012/1201/20120119Board05_Ballona_Wetlands.pdf.

I believe in your message below you are referencing Exhibit 4. This record reads at the bottom of the page in the key: "Existing habitat units based on field survey conducted by the California Department of Fish and Game, October – December 2000. Map created by GreenInfo Network October 20, 2011." The Conservancy's logo is next to this statement.

With respect to the remainder of your email to us, below, except for our response to your last statement regarding the Conservancy's

dissemination of your correspondence to and with us, which we responded to in my earlier email to you of yesterday at 11:32 a.m., we wish to direct your attention to the Public Records Act (PRA), which provides the public with the mechanism to request a public record from a public agency. Additionally, we wish to direct your attention to the Ballona Restoration website, linked on our Conservancy website at www.scc.ca.gov , which among other resources, has project documents and provides a calendar of upcoming meetings, if any, where you have the opportunity to seek clarification and information regarding the restoration project.

We have cooperatively provided you with both oral and written clarifications on requests you have made to us for information or on allegations you have made that we or our project partners are violating particular laws or practices or conducting our respective project business improperly. In fact, since the Conservancy unanimously approved Item 5 for Ballona Restoration Planning, on 1-19-12, we responded to every one of your requests for records under the PRA or for explanations or to answer your allegations, which now amount to some 16 written requests to date for both information and records in the 18 business days from our 1-19-12 meeting, except for two requests for information and one request for records, received yesterday. Additionally, you have spoken by phone with six of our staff numerous times each, none of which were records requests but were rather in the nature of your seeking more information or explanation from us. Despite our willingness to provide you with explanations and/or clarifications, we continue to receive more requests for the same information from you, often accompanied by accusations of improper behavior.

In compliance with our obligations under the Public Records Act, we will continue to provide our records to you upon written request for such records. However, we will not be responding to your further requests for non-record information or explanation or to your allegations of improper business practices beyond this request, below. We cannot conduct our regular business in service of the public and continue to respond to your almost-daily and, if daily, often numerous daily requests for non-record information or to answer your allegations. Despite our willingness to provide you with explanations, clarifications and information, our good-faith responses back to you seem to be unsatisfactory to you since you follow-up often with yet another request for the same information. Continuing this "asked and answered" process seems an unproductive use of public resources.

So, with respect to your statement that DFG produced this map, please note that as cited above here, GreenInfo Network produced the map for the Conservancy and its project partners/team's use; DFG is

our restoration partner on this project. We direct you to the Conservancy's website at www.scc.ca.gov, Ballona restoration for identification of our project partners on this project.
With respect to whether DFG provided the Conservancy with permission to put our logo on this proposed restoration design, please note that the Conservancy is a project partner with DFG and that within this partnership, the Conservancy acts as the lead in restoration planning with the full agreement of the other project partners, including the DFG.
Sincerely,

Elena Eger
Senior Staff Counsel
California Coastal Conservancy
1330 Broadway, Ste. 1300
Oakland, CA 94612
510-286-4089 tele/voicemail
510-286-0470 fax

From: jd@johnanthonydavis.com [mailto:jd@johnanthonydavis.com]
Sent: Monday, February 13, 2012 5:15 PM
To: 'Elena Eger'
Cc: 'Nadine Peterson'; 'Sam Schuchat'; 'Dick Wayman'; Mary Small
Subject: RE: Davis call to Eger of 2-6-12

California Coastal Conservancy
Att: Elena Eger Legal Council
CC Mary Small Project Manager
Re: Item 5 January 19th 2012 Meeting

Hello Council Eger,

Mary Small directed me to you to answer a question about the hearing noted above.

The attached map was presented as a projection.

It bears the seal of the State Coastal Conservancy. The small text below the legend is hard to read but it
does reference the California Dpt. of Fish and Game in 2011. The text is not clear. It appears to say Ballona Wetlands units.....summary conducted the California Dpt of Fish and Game .....Map created by .....October 20, 2011.

Could you provide the correct reading of this text?

For what purpose did Fish and Game produce this map?

Did Fish and Game provide specific permission for the Conservancy to place its seal (logo) on this

map for official purposes such as for grant approvals?

I understand the Conservancy is a partner of Fish and Game in the Ballona preserve.

However it is unclear if Fish and Game authorized the use of this map for purposes of another Agency
to consider in its grant process.

Please DO NOT CC ANY PRIVATE BUSINESSES ON MY E-Mail COMMUNICATIONS anymore. This is met
to be a private communication between myself and the State Agency, and not to be shared with any private
business, whatsoever.

Again,

Thank you for your assistance,

John Davis
PO 10152
Marina del Rey Ca. 90045

From:	Mary Small
To:	"Elena Eger"
Cc:	"Scott Valor"
Subject:	FW: State Water Board Legal"s Memo to our Governing Board
Date:	Monday, February 06, 2012 4:47:02 PM
Attachments:	SWRCB memo2011aug re accusations.pdf SWRCB ltr to Davis re PRAs.pdf

Hi Elena

Scott Valor emailed this to you but he had the wrong address.

Mary

From: Scott Valor [mailto:svalor@santamonicabay.org]
Sent: Monday, February 06, 2012 3:42 PM
To: msmall@scc.ca.gov; eeeger@scc.ca.gov
Subject: State Water Board Legal's Memo to our Governing Board

Mary & Elena--

The attached memo to our Governing Board may help with some background. It was not only given to our Governing Board, it is posted on our website, and was forwarded to John Davis and Patricia McPherson, among others. It addresses virtually all of the accusations made against the Foundation and Commission.

Attached also is a direct letter to John Davis from SWRCB legal noting how Foundation staff and contractors legally serve the SMBRC. For example, I am a contractor to the Foundation, but I am authorized to act on behalf of the Commission. He refuses to acknowledge that, which will never change. However, the documents speak for themselves.

One reason he may be contacting you (again) is that SWRCB legal told him that any future PRA queries to the Commission must be directed to me. He simply won't do that so he seeks ways around it. It would be entirely appropriate for you to re-direct any queries relevant to the SMBRC to me.

Call me if/when questions arise.

/s

Scott Valor
Director of Government Affairs
Santa Monica Bay Restoration Commission
310-922-2376

visit us at www.smbrc.ca.gov

SIERRA CLUB
FOUNDED 1892
Angeles Chapter
Airport Marina Regional Group
3435 Wilshire Blvd., Ste. 320
Los Angeles, CA 90010

August 16, 2012

U.S. Army Corps of Engineers
Los Angeles District
915 Wilshire Blvd, Suite 1101
Los Angeles, CA 90017
Att:Col. Mark Toy Commander Los Angeles District
Att: Dr. Daniel P. Swenson
1416 9th St., 12th Floor

California Dept. of Fish & Game
1416 9th Street, 12th Floor
Sacramento, CA 95814
Att: Executive Director Charlton H. Bonham

Re: 2012 Notice of Joint EIS/EIR

This letter responds to the Notice of Intent to conduct a joint EIS/EIR pursuant to the National Environmental Policy Act and the California Environmental Protection Act at the Ballona Wetlands Ecological Preserve in the State of California, County of Los Angeles, in 2012.

The Club has resolved to support the joint EIR/EIS process noticed in the Federal Register on September 20, 2005 by the U.S. ACE Los Angeles District and the Santa Monica Bay Restoration Commission, a State Agency, as the local sponsor.

The position of the Club is that the new Notice of Intent placed in the Federal Register on July 25, 2012 contradicts and duplicates the former EIS noticed in 2005.

The Secretary of the Army has stated in writing that the 2005 joint EIS/EIR process is not terminated and is therefore current.

The reasoning of the resolution is as follows:

Another EIS process has been introduced by LA USACE that interferes with and contradicts the current process. The Corp has begun a new process that duplicates and reduces the scope of the 2005 Environmental Process, without first terminating it.

The two processes cannot exist concurrently, because of duplication, and the requirement for the first study to be completed. The first study has been fully funded by the U.S. Congress and the latter process has not.

The second process proposes to change the course of Ballona Creek, and to dredge and fill wetlands, prior to the completion of the first process and before the Corp can report its recommendations back to Congress.

Furthermore, the second process proposes to reintroduce tidal flow to a freshwater wetland system that was not historically connected to the to the ocean to the degree the new process implies.

The National Oceanic and Atmospheric Administration warned against this project, as it would destroy valuable upland habitat.

The U.S. Clean Water Act designates four separate Section 303(d) Impaired Waterways that are present.

- Marina del Rey
- Upper Ballona Creek
- Ballona Creek Estuary
- Ballona Wetlands

The 2012 Notice proposes to divert one Impaired Waterway into another. It is illegal to further impair a waterway that is already impaired.

The resolution reads as follows and represents the Sierra Club official stance on both of the aforesaid environmental processes.

RESOLUTION

Whereas, the Airport Marina Regional Group of the Angeles Chapter Sierra Club has jurisdiction over Marina del Rey,

Whereas, The Club supports National Planning for Environmental Restoration, Recreational Boating, Storm Damage Reduction, and is Supportive of other purposes the Congress of the United States intended for Marina del Rey such as a youth hostel and camping facilities.

Whereas, The U.S. Army Corp of Engineers Environmental Impact Statement process noticed in the Federal Register in 2005 supports the same aforesaid purposes that the Sierra Club supports,

Therefore, be it resolved by the Airport Marina Regional Group, Angeles Chapter of Sierra Club, supports the completion of the 2005 Environmental Review process Noticed in the Federal Register to conduct a review of Marina del Rey: September 20, 2005 (Volume 70, Number 181) [Notices] [Page 55116-55117]

END

The Sierra Club supports a full range of alternatives for the restoration, which is called for in the 2005 Notice for Environmental Impact Statement pursuant to the National Environmental Policy Act. The Sierra Club does not support a limited range of alternatives as proposed by the 2012 Notice for an Environmental Impact Statement.

Sincerely,

Joe Young

Joe Young, Chair
Airport Marina Group
(310) 822-9676

KATHY KNIGHT, CONSERVATION CHAIR
(310) 450-5961

Jones, Tanya

From: Mary Prismon [mailto:goldcrownking@msn.com]
Sent: Saturday, August 18, 2012 9:06 AM
To: Lucien Plauzoles; McCormick, Donna
Cc: Ellen Vahan; 1and2douglas@wgn.net; Chuck Almdale; Lillian Johnson Almdale; Elizabeth Galton; Cynthia Schotte; Jane Beseda; Charles Bragg,jr; Jean Garrett
Subject: RE: Ballona restoration "meeting"

Lu, As a long time member of SMBAS and its board of directors, I share your frustration for being stone-walled, particularly since you made considerable effort and sacrifice to be there for what should have been an informative and productive meeting. Let's hope fear of controversy is not going to forestall long term, productive outcomes. Perhaps you will be able to communicate more fully with the participants in a less public setting!
Mary

From: plauzoles@me.com
> Subject: Ballona restoration "meeting"
> Date: Thu, 16 Aug 2012 23:08:40 -0700
> CC: ertvahan@aol.com; 1and2douglas@wgn.net; chukar5@att.net; goldcrownking@msn.com; lfjohnson@att.net; egalton@ucla.edu; caniswatch@verizon.net; jane.beseda@gmail.com; braggjr67@verizon.net; jeandrum2001@yahoo.com
> To: donna.mccormick@icfi.com
>
> Dear Ms. McCormick, I took time off today to attend the "scoping" meeting at the Fiji Way Edison parking lot.
> I was very surprised by the lack of solid information available from the agency and consultant teams.
> What I noticed was that all personnel present were well trained in conflict avoidance, to the expense of solid information.
> Is it because I walked into the parking area at the same time as Marcia Hanscom that I was "dodged" on every question?
>
> I actively participated in the Ballona Watershed task force 7-11 years ago. I was accustomed to rather straight, serious answers.
> When I keyed in the linked www.ballonarestoration.org address from Aug. 13th through 16th, I was not able to get ANY information.
> Are we feeding Marcia? (...who was standing in the parking lot when I drove in, gathering an audience?)
>
> Please give me some solid links that tell me what has really happened in the past 5 years at the meetings we either could not or declined to attend. What exactly are the alternatives being considered, ...or are they really not even set as alternatives as one of the SMBRC representatives vaguely said? Our only information about alternatives under consideration has been gleaned from Ballona Renaissance's newsletters.
>
> We are active, funding stakeholders in the Ballona restoration process. We are active in making Ballona relevant to the residents of the entire watershed through our educational activities with Friends of Ballona.
>
> If you refer to many of the existing documents on line and in the written record, we, as a group of approximately 1,000 active stakeholders, have a moderate record of careful examination of scientific and political data on most questions. We would like to either sustain or try to oppose Ballona restoration projects. We truly would like to have more information on the state of the Ballona restoration project before it is cast in concrete by a consultant. However, we have no idea of the "state of affairs" from this evening's meeting. It seemed to be an exercise in decision/question avoidance.
>
> I was, this evening, surprised by the "fill in an opinion card" response to any question I might pose, whether it might, in some time, be controversial or not. The information presented was not even sketchy--it was not a 10th of what was

presented on your company's/CA F and G's website!
>
> Granted, avoidance of controversy makes decision-making smoother, however, your consultancy as well as any agency owes us more!
>
> Would it be of interest for a representative of your firm to make a short presentation at one of our monthly evening meetings, starting October? We meet at the Ken Edwards Center in Santa Monica on the first Tuesday of each month, (Oct, Nov, Dec, Feb, Mar Apr May)? Please let me know with a few weeks' notice if there is any interest.
>
>
> Lucien (Lu) Plauzoles, M.S.
> Co-chair Conservation
> Santa Monica Bay Audubon Society
>
>

Jones, Tanya

From: April De Stefano [mailto:april.destefano@gmail.com]
Sent: Sunday, August 19, 2012 2:37 PM
To: McCormick, Donna
Subject: Ballona Wetlands

Dear Donna McCormick,

As a home owner in the Del Rey neighborhood just northeast of the Ballona wetlands, I am thrilled about efforts to restore and expand the wetlands. I and my neighbors strongly support a plan to restore as much as possible of the wetland to its most natural state, providing much-needed habitat for native flora and fauna.

Sincerely,
April de Stefano

Los Angeles, 90066

Jones, Tanya

From: Barbara Yang [mailto:Barbara.Yang@fox.com]
Sent: Monday, August 20, 2012 8:58 AM
To: McCormick, Donna
Subject: Ballona project

Dear Ms. McCormick,

The Ballona Wetlands are a natural resource that need to be kept that way. I ride my bike down that path to get to the beach and it's one of the most peaceful parts of Los Angeles. The birds that hang out there are awesome and I know for a fact that local school kids go there for field trips (my friend teaches in Manhattan Beach & has taken her students there) to observe the birds and their behavior. To remove those levees to allow trash to just run into the ocean would be an ecological disaster. There is enough pollution in the ocean to allow such a thing to happen. Please leave the Wetlands alone. Enough of this city has been urbanized beyond repair.

Thank you,
Barbara Yang

Jones, Tanya

From: Rosie Puntillo [mailto:rosepuntil@aol.com]
Sent: Tuesday, August 21, 2012 10:11 AM
To: McCormick, Donna
Cc: rexfrankel@yahoo.com
Subject: Ballona wetlands in West L.A. public opinion submission

DONNA.MCCORMICK@icfi.com
Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92816

Dear Ms. McCormick,

I could not attend the meeting last week and I'd like to take this opportunity to share my opinion about Ballona Wetlands in West L.A.

I support saving the trails, keeping pollution out of the wetlands and supporting restoration plans that serve all of the wildlife that is in the Wetlands. I support BEEP's alternative vision plan.

Thank you,
Rose

Rose Puntillo
7924 Clinton St #5
Los Angeles, CA 90048

http://about.me/rationalrosie

Think before you print: save energy, ink and paper. If you must print, please print it double sided.

-----Original Message-----
From: Rex Frankel <rexfrankel@yahoo.com>
To: hiking-196-announce <hiking-196-announce@meetup.com>
Sent: Tue, Aug 14, 2012 12:32 pm
Subject: [hiking-196] Protect our wild trails and wild areas at Ballona wetlands in West L.A.--Speak out on THURSDAY AUGUST 16TH, 4 TO 7 PM, OR WRITE AN EMAILEMAIL

WHAT'S HAPPENING: On this Thursday, August 16th is the first public hearing on the State bureaucracy's plan to massively bulldoze and forever change the Ballona wetlands nature preserve.

You can either attend the meeting or write letters until September 10th.



I have posted a page full of information and photos that give a lot more on this project here: http://ballona-news.blogspot.com/2012/08/first-big-public-hearing-on-ballona.html

A public scoping meeting to receive input on the scope of the DEIS/EIR will be conducted on Thursday August 16, 2012, from 4:00-7:00 p.m. at the Fiji Gateway entrance to the Ballona Wetlands (13720 Fiji Way, Marina del Rey, CA 90292, across from Fisherman's Village and Los Angeles County Department of Beaches and Harbors).

WHAT TO DO:

ON THURSDAY, SUPPORT SAVING OUR TRAILS, KEEPING POLLUTION OUT OF THE WETLANDS, AND "RESTORING" THAT SERVES ALL THE WILDLIFE THAT IS THERE NOW! SUPPORT BEEP'S ALTERNATIVE VISION PLAN!

Comments may also be submitted until September 10, 2012 to DONNA.MCCORMICK@icfi.com.
Or mailed to:
Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92816

THE STATE'S PROPOSAL INCLUDES:

--Removal of most long-used public trails
--Removal of the Ballona Creek levees and the pouring of billions of gallons of polluted street drainage into the Ballona Wetlands
--Permanent discharge of fill (dirt) within 43.5 acres of non-wetland waters of the U.S. (435,000 cubic yards) and within 65 acres of wetland waters of the U.S. (600,000 cubic yards),
--Conversion of a balanced ecosystem featuring three rare and fragile wildlife habitats into nearly entirely an arm of the ocean filled with polluted urban street drainage PLEASE READ MY POST TO SEE OUR ALTERNATIVE PROPOSAL http://ballona-news.blogspot.com/2012/08/first-big-public-hearing-on-ballona.html ---Thanks for your support! Rex Frankel, hike organizer

--
This message was sent by Rex Frankel (rexfrankel@yahoo.com) from The Los Angeles Hiking Group.
To learn more about Rex Frankel, visit his/her member profile

Meetup, PO Box 4668 #37895 New York, New York 10163-4668 | support@meetup.com

cCRPA **California Cultural Resource Preservation Alliance, Inc.**

P.O. Box 54132
Irvine, CA 92619-4132

An alliance of American Indian and scientific communities working for the preservation of archaeological sites and other cultural resources.

August 21, 2012

RECEIVED
AUG 24 2012
B.R.T.
REGULATORY DIVISION
LOS ANGELES OFFICE

Dr. Daniel P. Swenson
U.S. Army Corps of Engineers
Los Angeles District
P.O. Box 532711
Los Angeles, CA 90053-2325

RE: Draft Environmental Impact Statement/Environmental Impact Report for the Proposed Ballona Wetlands Restoration Project at Ballona Creek Within the City and County of Los Angeles, CA.

Dear Dr. Swenson:

The proposed project sounds like it would be good for the environment, but it could be bad for archaeological sites unless serious consideration is give to preservation rather than excavation. As you know the Ballona area is culturally sensitive and many significant archaeological sites have been destroyed by development. Unfortunately, a well-intentioned project to restore a riparian stream resulted in the destruction of a mission period Gabrieleno cemetery.

Archaeological excavations are labor intensive and expensive and preservation almost always results in cost savings. The Waterways Experimental Station published a manual on archaeological site preservation techniques, including site burial and erosion prevention. Rather than have additional archaeological sites destroyed in the process of restoring natural resources, this can be an opportunity to both restore natural resources and protect cultural resources; after all the archaeological sites have been there as long as the wetlands. Please involve archaeologists, Native Americans, and engineers early in the planning process with the goal of preservation, rather than data recovery "mitigation". All this would take is the kind of creative planning that the Corps has been known to undertake in Arizona, Warm Springs Dam, California, and elsewhere.

Sincerely,

Patricia Martz

Patricia Martz, Ph.D.
Professor Emeritus
California State University, Los Angeles

DEPARTMENT OF CONSERVATION

DIVISION OF OIL, GAS AND GEOTHERMAL RESOURCES

5816 Corporate Avenue • Suite 200 • CYPRESS, CALIFORNIA, 90630-4731

PHONE 714 / 816-6847 • **FAX** 714 / 816-6853 • **WEBSITE** conservation.ca.gov

August 24, 2012

Donna McCormick
Ballona Wetlands Restoration Project
1 Ada, Suite 100
Irvine, CA 92816

Dear Ms. McCormick:

NOTICE OF PREPARATION OF A DRAFT ENVIRONMENTAL IMPACT REPORT – SCH# 2012071090

The Department of Conservation's Division of Oil, Gas, and Geothermal Resources (Division), Cypress office, has reviewed the above referenced project. Our comments are as follows:

The proposed project is located within the administrative boundaries of the Playa Del Rey Oil Field. There are approximately 47 plugged and active wells within and/or adjacent to your proposed project. These wells are located on Division map 120 and in Division records.

The Division is mandated by Section 3106 of the Public Resources Code (PRC) to supervise the drilling, operation, maintenance, and plugging and abandonment of wells for the purpose of preventing: (1) damage to life, health, property, and natural resources; (2) damage to underground and surface waters suitable for irrigation or domestic use; (3) loss of oil, gas, or reservoir energy; and (4) damage to oil and gas deposits by infiltrating water and other causes. Furthermore, the PRC vests in the State Oil and Gas Supervisor (Supervisor) the authority to regulate the manner of drilling, operation, maintenance, and abandonment of oil and gas wells so as to conserve, protect, and prevent waste of these resources, while at the same time encouraging operators to apply viable methods for the purpose of increasing the ultimate recovery of oil and gas.

The scope and content of information that is germane to the Division's responsibility are contained in Section 3000 et seq. of the Public Resources Code (PRC), and administrative regulations under Title 14, Division 2, Chapter 4 of the California Code of Regulations.

If any structure is to be located over or in the proximity of a previously plugged and abandoned well, the well may need to be plugged to current Division specifications.

Section 3208.1 of the Public Resources Code (PRC) authorizes the State Oil and Gas Supervisor (Supervisor) to order the reabandonment of any previously plugged and abandoned well when construction of any structure over or in the proximity of the well could result in a hazard.

An operator must have a bond on file with the Division before certain well operations are allowed to begin. The purpose of the bond is to secure the state against all losses, charges, and expenses incurred by it to obtain such compliance by the principal named in the bond. The operator must also designate an agent, residing in the state, to receive and accept service of all orders, notices, and processes of the Supervisor or any court of law.

Written approval from the Supervisor is required prior to changing the physical condition of any well. The operator's notice of intent (notice) to perform any well operation is reviewed on engineering and geological basis. For new wells and the altering of existing wells, approval of the proposal depends primarily on the following: protecting all subsurface hydrocarbons and fresh waters; protection of the environment; using adequate blowout prevention equipment; and utilizing approved drilling and cementing techniques.

The Division must be notified to witness or inspect all operations specified in the approval of any notice. This includes tests and inspections of blowout-prevention equipment, reservoir and freshwater protection measures, and well-plugging operations.

The Division recommends that adequate safety measures be taken by the project manager to prevent people from gaining unauthorized access to oilfield equipment. Safety shut-down devices on wells and other oilfield equipment must be considered when appropriate.

If any plugged and abandoned or unrecorded wells are damaged or uncovered during excavation or grading, remedial plugging operations may be required. If such damage or discovery occurs, the Division's Cypress district office must be contacted to obtain information on the requirements for and approval to perform remedial operations.

Sincerely,

Syndi Pompa

Syndi Pompa
Associate Oil & Gas Engineer - Facilities

CC: State Clearinghouse; P.O. Box 3044, Sacramento, CA 95812-3044
CA Department of Fish and Game; 3883 Ruffin Road; San Diego, CA 92123

Jones, Tanya

From: Walter Lamb [mailto:walter.lamb@earthlink.net]
Sent: Friday, August 24, 2012 3:52 PM
To: McCormick, Donna
Cc: Shelley Luce
Subject: EIS/EIR Public Comment Questions

Hi Donna -

It was nice to meet you last Thursday evening. Because this is the first time going through the EIS/EIR process for so many stakeholders, I thought it would good to ask some questions:

- Since e-mail is one of the ways to send comments, I am assuming that any format is acceptable, but I want to confirm that there is no requirement to use the official comment cards or any particular format. Is that correct?

- How do you categorize and/or tabulate comments? If numerous people make the same, or similar comments, do you aggregate them or treat them each separately? Do you give any priority to comments shared by many people over comments made by only one or two people?

- Is there any priority given to comments made earlier than those made closer to the deadline?

- Are there any length restrictions?

- Can people who have already submitted comments submit additional comments at a later date as long as it before the deadline?

- Will submitters of comments get any kind of confirmation of receipt prior to the deadline to ensure that they can resend comments that were not delivered correctly for any reason?

These are all important questions for our organization as we are interested in broadening public participation in this process so we want to make sure we have a thorough understanding of how messages will be received and processed.

Thank you for your assistance,

Walter Lamb
President
Ballona Wetlands Land Trust
(310) 384-1042

Jones, Tanya

From: Maria Fernanda Braga [mailto:fe_braga@hotmail.com]
Sent: Wednesday, August 29, 2012 11:05 PM
To: McCormick, Donna
Subject: improvements in the Ballona Wetlands

Here is my wish list:

1) A bike path/walkway south of Lincoln from West Jefferson Blvd to Culver Blvd into Playa del Rey.

2) A wider bridge expansion on Lincoln, just south of the Culver Blvd overpass.

3) A bike path/walkway from the bridge (mentioned above) to Fiji Way.

Thanks ;-)

Fernanda

Jones, Tanya

From: Chan, Eddie [Eddie.Chan@activision.com]
Sent: Wednesday, August 29, 2012 11:15 AM
To: McCormick, Donna
Subject: Ballona Wetlands improvements

Hi Donna,

I wanted to chime in my opinion on the Ballona Wetlands improvements. I do think this is a critical need – the current paths are too narrow and dangerous to comfortably reach the beach from Playa Vista. It's particularly an issue given how many young families are in the community and try to routinely go bike riding to the beach. I am in agreement with the 3 areas outlined by some others for improvements. Thank you for your time.

1) A bike path/walkway south of Lincoln from West Jefferson Blvd to Culver Blvd into Playa del Rey.

2) A wider bridge expansion on Lincoln, just south of the Culver Blvd overpass.

3) A bike path/walkway from the bridge (mentioned above) to Fiji Way.

Eddie Chan
Vice President, Finance & Strategy – Americas
Activision Blizzard | 3100 Ocean Park Blvd | Santa Monica, CA 90405
w. 310.496.5261 | c. 917.270.5116

Jones, Tanya

From: Alana Getz [mailto:alanagetz@gmail.com]
Sent: Wednesday, August 29, 2012 01:03 PM
To: McCormick, Donna
Cc: Michael Getz <mgetz@calalum.com>
Subject: support for walking/bike paths near Playa Vista

Hi Donna,

Julie Knap suggested we email you in regard to walking/biking paths near Playa Vista. We could not be more supportive of this idea!

We have lived in Playa Vista for five years and are always concerned when we try to get from Playa Vista to the bike path that leads to the beach/shopping center - it is very sketchy trying to ride along the skinny bike lane on Lincoln over the bridge with the cars whizzing by and now especially that we have a baby, we are extremely hesitant to take her along that stretch. We love to walk and ride our bikes and it would be WONDERFUL to be able to get to the beach and to the shopping center easily and SAFELY without getting in the car.

Thank you so much for your help to make this happen, and if you need any assistance, we'd be on board!

Thanks,

Alana and Michael Getz

Tempo residents, Playa Vista

Jones, Tanya

From: Barsam Kasravi [barsamk@gmail.com]
Sent: Wednesday, August 29, 2012 11:18 AM
To: McCormick, Donna
Subject: Wetlands

I would like to join the conversation to advocate for a wider path and bike path to the Ballona Wetlands on Lincon Blvd. Currently getting to Playa Del Rey under the Lincoln Bridge is very dangerous with kids.

Thanks,
barsam kasravi, md

Jones, Tanya

From: Julie Thomas Knap [mailto:jtknap@gmail.com]
Sent: Wednesday, August 29, 2012 01:05 AM
To: McCormick, Donna
Subject: Ballona Wetlands Improvements

Hi Donna,
I am a Playa Vista resident and would love to see the following user-friendly improvements to the Ballona Wetlands.

1) A bike path/walkway south of Lincoln from West Jefferson Blvd to Culver Blvd into Playa del Rey.

2) A wider bridge expansion on Lincoln, just south of the Culver Blvd overpass.

3) A bike path/walkway from the bridge (mentioned above) to Fiji Way.

Despite our community just being one mile from the beach, we are in many ways landlocked because the pedestrian/bike paths are either non-existent and/or unsafely narrow. If there is anything I can do to help support this cause, please do not hesitate to let me know. I am a member of the Playa Vista Mom's Group (266 Members) and the Friends of Playa Vista School (399 Members).

Thank you,
Julie-

Julie Thomas Knap
Strategic Partnerships & Promotions
jtknap@gmail.com
P: 310-804-0822
F: 310-818-5535

Jones, Tanya

From: Tanya Leeloy [tanya.leeloy@gmail.com]
Sent: Wednesday, August 29, 2012 12:43 PM
To: McCormick, Donna
Subject: Our Playa Vista Community

Hi Donna,
I was told that you could be of assistance regarding improving upon our Playa Vista/Ballona Wetlands area.

We as a community have all been trying to look into who to go to for this so hopefully this is the right place!

Our wish list:

1) A bike path/walkway south of Lincoln from West Jefferson Blvd to Culver Blvd into Playa del Rey.

2) A wider bridge expansion on Lincoln, just south of the Culver Blvd overpass.

3) A bike path/walkway from the bridge (mentioned above) to Fiji Way.

Despite our community just being one mile from the beach, we are in many ways landlocked because the pedestrian/bike paths are either non-existent and/or unsafely narrow.

Thanks so much!
We love our community and have attempted to ride our bike to the beach with our toddler in tow and it just too unsafe.

Warmly,
Tanya & Todd, parents to a 4 year old and one on the way.

Jones, Tanya

From: Lohman, Kevin G. [mailto:KLohman@ReedSmith.com]
Sent: Wednesday, August 29, 2012 11:07 AM
To: McCormick, Donna
Subject: Ballona Wetlands Improvements

Below please find my suggested improvements for the Ballona Wetlands. Thank you for your consideration.

1) A bike path/walkway south of Lincoln from West Jefferson Blvd to Culver Blvd into Playa del Rey.

2) A wider bridge expansion on Lincoln, just south of the Culver Blvd overpass.

3) A bike path/walkway from the bridge (mentioned above) to Fiji Way.

Despite our community just being one mile from the beach, we are in many ways landlocked because the pedestrian/bike paths are either non-existent and/or unsafely narrow.

Kevin G. Lohman
213.457.8040
klohman@reedsmith.com

Reed Smith LLP
355 South Grand Avenue
Suite 2900
Los Angeles, CA 90071
213.457.8040
Fax 213.457.8080

* * *

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* * *

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Disclaimer Version RS.US.20.10.00

Jones, Tanya

From: Ulrik Knap [mailto:huknap@gmail.com]
Sent: Wednesday, August 29, 2012 01:45 AM
To: McCormick, Donna
Subject: Playa vista.

Hi Donna,
I am a Playa Vista resident and would love to see the following user-friendly improvements to the Ballona Wetlands.

1) A bike path/walkway south of Lincoln from West Jefferson Blvd to Culver Blvd into Playa del Rey.

2) A wider bridge expansion on Lincoln, just south of the Culver Blvd overpass.

3) A bike path/walkway from the bridge (mentioned above) to Fiji Way.

Despite our community just being one mile from the beach, we are in many ways landlocked because the pedestrian/bike paths are either non-existent and/or unsafely narrow.

Thank you,
Ulrik Knap
5700 Seawalk Drive, No. 6
Playa Vista, CA 90094

H. Ulrik Knap
+1.310.436.4888

Sent from my iPhone

Jones, Tanya

From: Nikol Lohman [nikkizbaby@aol.com]
Sent: Tuesday, September 04, 2012 7:54 AM
To: McCormick, Donna
Subject: Ballona Wetlands

Dear Donna,

Here is my wish list for improvements on the Ballona Wetlands:

1) A bike path/walkway south of Lincoln from West Jefferson Blvd to Culver Blvd into Playa del Rey.

2) A wider bridge expansion on Lincoln, just south of the Culver Blvd overpass.

3) A bike path/walkway from the bridge (mentioned above) to Fiji Way.

Despite our community just being one mile from the beach, we are in many ways landlocked because the pedestrian/bike paths are either non-existent and/or unsafely narrow.

Thank you,
Nikol Lohman

Jones, Tanya

From: Liesbeth Maggiotto [mailto:liesvdvelde26@yahoo.com]
Sent: Tuesday, September 04, 2012 11:19 PM
To: McCormick, Donna
Subject: Ballona wetlands

Hi Donna,

I live in playa vista with my husband and three kids. I grew up in the Netherlands and LOVE biking, walking and nature. It has been my dream to be able to bike everywhere with my kids however it has been very unsafe to bike out of playa vista to anywhere with my 2,6 and 8 year old. Particular a wider bridge expansion on Lincoln just south of the culver blvd overpass. But also bike paths on Lincoln towards the marina and Jefferson/ culver towards playa del Rey would be much appreciated.

Thank you so much for your attention to this matter!
Liesbeth Maggiotto, MD
Assistant professor in pediatrics

Sent from my iPad

Jones, Tanya

From: Erin Mays [erinmarielmays@gmail.com]
Sent: Tuesday, September 04, 2012 8:49 AM
To: McCormick, Donna
Subject: Improvements to Ballona Wetlands

Hi Donna,

I live in Playa Vista. Here is my wish-list for improvements around the Ballona Wetlands. I know you have heard these before, but I feel they are important enough to repeat.

1) A bike path/walkway south of Lincoln from West Jefferson Blvd to Culver Blvd into Playa del Rey.

2) A wider bridge expansion on Lincoln, just south of the Culver Blvd overpass.

3) A bike path/walkway from the bridge (mentioned above) to Fiji Way.

I really feel that we are so close to the beach, but there is no way to get there besides car/bus. We have bikes, strollers, and other gear that we love riding to the beach or the Marina but it's dangerous and barely accessible, especially with our 10 month old son.

Thank you!

Erin Mays

Jones, Tanya

From: Tanya Lindsley [mailto:marathoner547@gmail.com]
Sent: Sunday, September 09, 2012 7:30 PM
To: McCormick, Donna
Subject: Ballona Wetlands Restoration Project

Putting in my 2 cents - I support BEEP's Alternative Ballona Plan.

Thank you,
Tanya Lindsley
Resident of Mar Vista, A

--

If you're looking for a happy ending and can't find one ... find a new beginning instead.

Jones, Tanya

From: Cruz, Ruben [mailto:RCRUZ@dpw.lacounty.gov]
Sent: Monday, September 10, 2012 5:14 PM
To: Yanez, Jarrett; Swenson, Daniel P SPL
Cc: Ibrahim, Amir
Subject: RE: Ballona Wetlands Restoration- Notice of Intent to Prepare a Draft EIS Comments

September 10, 2012

Dr. Daniel P. Swenson
U.S. Army Corps of Engineers
Los Angeles District
P.O. Box 532711
Los Angeles, CA 90053-2325

Dear Dr. Swenson:

Notice of Intent to Prepare
Draft Environemtnal Impact Statement (EIS) Ballona wetlands restoration

Thank you for the opportunity to review the Notice of Intent to Prepare a Draft EIS for the Ballona Wetlands Restoration project. The project is intended to return the daily ebb and flow of tidal waters, maintain freshwater circulation, and augment the physical and biological functions and services in the project area. The 600-acre Ballona Wetlands Ecological Reserve project area is located in the western portion of the City of Los Angeles, partially within unincorporated Los Angeles County, south of Marina Del Rey and north of Playa Del Rey.

The following comments are for your consideration and relate to the environmental document only:

Hazards - Flood/Water Quality

1. The area of the proposed project contains facilities operated and maintained by the Los Angeles County Flood Control District (LACFCD). We request that future maintenance activities needed for the proposed improvements, such as inspection, repair, clearing vegetation, sediment and debris removal and other maintenance related activities, be included in the CEQA document and all regulatory permits.

2. Los Angeles County Department of Public Works/LACFCD shall not be responsible for any mitigation requirements that may result from impacts associated with LACFCD's future maintenance activities of the improvements.

If you have any questions regarding the flood/water quality comments, please contact Stephen Lipka at (562) 861-0316 or slipka@dpw.lacounty.gov <mailto:slipka@dpw.lacounty.gov> .

If you have any other questions or require additional information, please contact Ruben Cruz at (626) 458-4921 or rcruz@dpw.lacounty.gov <mailto:jwan@dpw.lacounty.gov> .

Ruben Cruz, P.E.
CEQA, CUP, Ordinance Review Unit
Land Development Division
(626) 458-4910
rcruz@dpw.lacounty.gov <mailto:jyanez@dpw.lacounty.gov>

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Classification: UNCLASSIFIED
Caveats: NONE

Jones, Tanya

From: Beverly Moore [mailto:BMoore@visitmarinadelrey.com]
Sent: Monday, September 10, 2012 3:10 PM
To: McCormick, Donna
Subject: Ballona Wetlands Restoration Project

Enclosed please find a letter regarding the Ballona Wetlands Restoration Project from the Marina del Rey Convention & Visitors Bureau.

Bev Moore I Executive Director I Marina del Rey Convention & Visitors Bureau
bmoore@VisitMarinaDelRey.com
310-306-9900 Ext 102
VisitMarinaDelRey.com

Marina del Rey
Coastal Warmth. L.A. Cool

MARINA DEL REY
CONVENTION AND VISITORS BUREAU

4551 Glencoe Ave., #260 Marina del Rey CA 90292
T 310 306 9900 F 310 306 6605 VisitMarinaDelRey.com

September 10, 2012

Ballona Wetlands Restoration Project
c/o Donna McCormick
1 Ada, Suite 100
Irvine, CA 92816

Dear Ms. McCormick:

Thank you for the opportunity to share insights and viewpoints on the restoration of Ballona Wetlands.

As you plan for the wetlands renewal, we hope that you will ensure that free and public access is made available throughout the area. We'd like to especially recommend that public access be created from Fiji Way in Marina del Rey so that residents, students and visitors interested in learning more about wetlands and conservation can more easily visit the wetlands from the Marina side of the wetlands.

Representing the travel and tourism community in Marina del Rey, we treasure this special area and the opportunity we have to restore this great natural asset along our coastline for the protection of the wetlands and the for the enjoyment and education of the public.

Sincerely,

Beverly S Moore

Beverly S Moore
Executive Director

Jones, Tanya

From: Liisa Bishop [mailto:liisa@me.com]
Sent: Friday, September 21, 2012 12:04 AM
To: McCormick, Donna
Subject: Ballona Wetlands

Hello Donna,

I would like to put my name down as also wanting the following improvements to the Ballona Wetlands area:

1) A bike path/walkway south of Lincoln from West Jefferson Blvd to Culver Blvd into Playa del Rey.

2) A wider bridge expansion on Lincoln, just south of the Culver Blvd overpass.

3) A bike path/walkway from the bridge (mentioned above) to Fiji Way.

Despite our community just being one mile from the beach, we are in many ways landlocked because the pedestrian/bike paths are either non-existent and/or unsafely narrow.

Thank you,

Liisa Bishop

Ballona Wetlands Restoration Project

Advancing ecosystem health. Connecting communities with nature.

Comment Card

Name: BRUCE SCHELDEN

Email: (optional)

☐ Add me to the mailing list (please provide email or mailing address):

Comments/Issues: (Use additional sheets if necessary)

I AM IN FAVOR OF A DESIGN OPTION THAT REMOVES THE LEVEES AND THE CONCRETE FROM THE WESTERN END OF BALLONA CREEKS. IT SHOULD PROVIDE FOR SIGNIFICANT TIDAL FLOW IN THE AREAS NOT CONSTRAINED BY PRIVATE PROPERTY.

THIS RESTORATION PLAN WILL REQUIRE BULLDOZERS, NOT SHOVELS.

Submit written comments to:

Mail: Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92816

Email: Donna.McCormick@icfi.com

*****All comments submitted will become part of the Public Record***

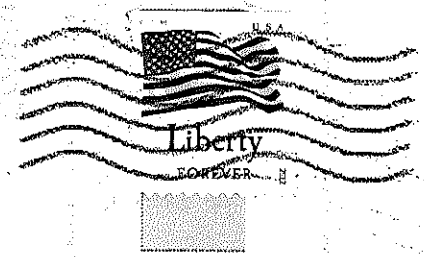
Tape Here
Do Not
Staple

Fold Here



Bruce Scholden
8128 Manitoba St
Playa Del Rey CA 90293

LOS ANGELES CA 900
13 SEP 2012 PM 6 T



Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92816

Jones, Tanya

From: Lewis Weinfeld [mailto:lweinfeld@gmail.com]
Sent: Wednesday, September 26, 2012 2:48 PM
To: McCormick, Donna
Subject: Nature at its best

I would love to have 600 acres of flourishing nature reserve and miles of walking and hiking trails immediately adjacent to Playa Vista, so my family can enjoy the beauty of earth.

--
Lew Weinfeld

Have a great day

Jones, Tanya

-----Original Message-----
From: Alice E Goldstein [mailto:ibrake4roses@aol.com]
Sent: Thursday, October 04, 2012 11:52 AM
To: McCormick, Donna
Subject: Ballona Creek.

Dear Donna,
Thank you so much for all you do in preserving this special place. I walk with my dog there several times a week because the energy is very calming there and you never know what you'll see there as far as birdlife or otherwise.
This has always been a special place for wildlife and I agree it should not be tampered with by the state agencies in their so called "improvement".
If you are counting how many people are opposed to the "improvement", please consider me.
I would also like to volunteer to help out at the wetlands if needed.

Thank you again,
Sincerely,

Alice E. Goldstein
Cel. 310 2669441

Due to a prior commitment I am unable to attend the meeting. I only got the email yesterday pm. from my iPhone

David Lawhead/Terri Steward
California Department of Fish & Game
3883 Ruffin Road
San Diego, CA 92123

Allen Frankel
1466 Paseo De Oro
Pacific Palisades, CA 90272

October 8, 2012

Dear Mr. Lawhead & Mrs. Stewart:

As a Sierra Club member who loves to hike and experience nature, there needs to be a true restoration of the Ballona Wet Lands that retains the natural features over 100 years old and that preserves rare and endangers animals and plants. For this to occur, the land must close and open according to the ocean tide cycles of nature to preserve species that require fresh water. This will save about 300 million dollars per year in silt removal -- very, very expensive operation. This money can be put into constructive wetland conservation.

Again, government and private enterprise can create a win-win-win with ecology.

Appreciate your support.

Most sincerely,

Allen Frankel

Allen Frankel

Jones, Tanya

From: Almstedt, Hawley [mailto:Hawley.Almstedt@lmu.edu]
Sent: Saturday, October 13, 2012 5:32 PM
To: McCormick, Donna
Subject: Wetlands restoration

Hello Donna,

I learned about the upcoming Ballona Wetlands Restoration Project from a neighbor in Playa Vista. As a professor at LMU, I have heard for some time that the wetlands were to be restored and I am excited to hear that things are getting started. As an exercise physiology, a researcher in the health sciences, and a resident of Playa Vista I would like to promote safe ways to be physically active in my immediate community. Is it possible for the wetland restoration to include a walking or bike path that would connect Playa del Rey to the fresh water marsh? I would love for everyone in our community to be able to safely walk or bike to the beach without being in danger from traffic. Improving the health of our citizens includes considering how our community is planned and built. Restoration of the wetlands provides us an opportunity to make improvements that can have vast future benefits for the health of the environment and our bodies. Please let me know how I can help. Thank you.

Hawley C. Almstedt, Ph.D., R.D.
Associate Professor
Department of Health and Human Sciences
Loyola Marymount University
1 LMU Drive MS 8160, North Hall 208 | Los Angeles, CA 90045 | (310) 338-1925 Office | (310) 338-5317 Fax



For more information, visit: http://bellarmine.lmu.edu/thebellarmineforum/

Jones, Tanya

From: rkornarens@verizon.net [mailto:rkornarens@verizon.net]
Sent: Sunday, October 14, 2012 5:33 PM
To: McCormick, Donna
Subject: Ballona Wetlands Restoration Project

Dear Ms. McCormick,

There is a strip of vacant land between the access road to the 90 freeway and a group of townhouses that **abuts Area C**, which you plan to restore-APN 4224-014-013. A map from the County of Los Angeles Assessor's Office shows this parcel as WETLANDS, though it is zoned "RD", Restricted Density Multiple Dwelling Zone.

This land is currently owned Trask Properties that also own a Toyota dealership. They wish to use the area as a parking lot for their overflow of cars. They will need a variance to change the zoning for a parking lot. A permit has not yet been applied for.

Since the only ingress and egress to the propery is on Mindanao Way, the fire department may not grant the variance. The previous owners were denied a variance.

I would like the State of California, that owns Area C to purchase this land and make it part of the Ballona Wetlands Project. I am very happy with your current plans and have no other suggestions.

My only concern is to keep the land its natural state. We have lost enough wetlands already. No, I do not wish to be on your mailing list.

Sincerely,
Rosemarie Kornarens



P.O. Box 931057
Los Angeles, California 90093-1057

October 15, 2012

Dr. Daniel P. Swenson
U.S. Army Corps of Engineers
Los Angeles District
P.O. Box 532711
Los Angeles, CA 90053–2325

Dear Dr. Swenson:

In response to the Notice of Intent to Prepare Environmental Impact Statement/Environmental Impact Report for the Proposed Ballona Wetlands Restoration Project please find attached a letter from the Los Angeles Audubon Society to Dr. Shelley Luce dated May 15, 2012, which contains our comments on the proposed project.

Yours sincerely,

Travis Longcore, Ph.D.
President



P.O. Box 931057
Los Angeles, California 90093-1057

May 15, 2012

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission
Pereira Annex MS:8160
1 LMU Drive, Loyola Marymount University
Los Angeles, CA 90045

Dear Dr. Luce:

Los Angeles Audubon is a California non-profit 501(c)(3) corporation established in 1910. The mission of Los Angeles Audubon is to promote the enjoyment and protection of birds and other wildlife through recreation, education, conservation and restoration. We have over 3,500 members and supporters, most of whom live in Los Angeles. I am sending this letter on behalf of the Board of Directors of Los Angeles Audubon, which approved it unanimously at its April 5, 2012 meeting.

Los Angeles Audubon has a long history of involvement with the Ballona Wetlands. Our members have birded here for over 100 years, since it was known as the Ballona Swamp. In the 1990s, we and our partners developed and now continue to run an elementary school education program in the wetlands that reaches over 2,000 children per year. We have run free, public field trips to the wetlands and surrounding areas for decades and have included this area as part of the Los Angeles Christmas Bird Count for decades as well.

The Ballona Wetlands have been identified as an Important Bird Area by the National Audubon Society on the basis of the resources currently at the site. A portion of the description of the Ballona IBA is as follows:

> Belding's Savannah Sparrow maintains a small but apparently viable population in the salt marsh, among the most northerly in the world.
>
> The area's habitats include coastal (largely-muted) saltmarsh with salt pans (all of which is now owned by the state and has been designated an Ecological Reserve), freshwater marsh (including a new 26-acre constructed freshwater wetland/water treatment lagoon and 25 acre riparian corridor along a re-

constructed tributary connecting to the freshwater marsh), dune remnants, grassland, riparian thickets, and along the south edge, coastal sage and coastal bluff scrub.[1]

Based on the importance of this site, our long history of involvement, our current organizational activities, and the interests of our members, we want to express some concerns about the wetland creation plans that have emerged from the working group that your organization leads on behalf of the State of California.

Our review of the current conceptual plans and phasing documents available at www.ballonarestoration.org prompts the following comments.

1. The plans appear to remove all existing habitat for the State-endangered Belding's Savannah Sparrow. Given the long history of occupancy of the site at these locations by this species, it does not seem wise to remove all existing habitat. Although it is conceivable that the phased implementation of the plan would result in additional pickleweed habitat where the sparrow might move, we have serious concerns about the uncertainties inherent in this approach. What steps in your plan allow for this species to remain on site during construction? What is the phasing and timeframe being considered to accommodate Belding's Savannah Sparrow? We have similar concerns about the particular habitat requirements and distributions of other sensitive bird species and their fate during and after project implementation.

2. The plan proposes removal of existing native habitats that have been restored with thousands of hours of community effort and with significant success. In particular, community members have worked to restore the dune remnant at the western end of the property over many years, and have been rewarded by the recent colonization of the site by endangered El Segundo blue butterflies. The most recent plans for the Ballona project show this site covered by a berm.

3. Other existing natural features that have a long history on the landscape would be removed in the plans. Examples of this include the natural freshwater seep that is marked by an old cottonwood tree near the dunes and the large salt panne that has been present and stable on the site for over 120 years.[2] The salt panne is used by thousands of migrating birds each year and is an essential component of the Ballona wetlands ecosystem. The proposed removal of existing natural features that have been stable on the landscape for generations greatly concerns us.

Any management of the site to enhance biological resource values should recognize that the current habitats at Ballona wetlands do provide significant bird habitat of many kinds and represent one of the few places where the public can observe these species in the Los Angeles

---

[1] National Audubon Society 2012. Important Bird Areas in the U.S. Available at http://www.audubon.org/bird/iba. Accessed 09 March 2012

[2] Dark, S., E. D. Stein, D. Bram, J. Osuna, J. Monteferante, T. Longcore, R. Grossinger, and E. Beller. 2011. Historical ecology of the Ballona Creek watershed. Southern California Coastal Water Research Project. Technical Report #671.

basin. We fear that these values have not been adequately incorporated into the goal of better managing the resources.

We look forward to meeting with you about the proposed wetland creation project and how our concerns might be addressed as the planning process moves forward.

I can be reached at travislongcore@laaudubon.org if you would be able to discuss these concerns with us.

Yours sincerely,

Travis Longcore

Travis Longcore, Ph.D.
President

Jones, Tanya

From: Sandra Glass [mailto:1sanglass@gmail.com]
Sent: Wednesday, October 17, 2012 4:31 PM
To: McCormick, Donna
Subject: Fwd: Ballona Wetlands Restoration Project

Dear Donna,

I am so sorry. I pressed send before I completed my email to you. As I was saying, I live on Playa Vista, behind the old post office; which is presently under construction of 500 Units. I do not know if that is true, but is hearsay. Two months ago, when they started digging and clearing the Post Office area, we have been living with constant jolts and shaking, which starts at 8:00 a.m. for the entire day. At the beginning I thought these were earthquakes; but they weren't. I fear that this additional construction behind us could be a dangerous threat to this community. Just from a layman's opinion, I don't think these condo's could stand this additional construction going on. In fact, with all the methane gas and oil, which the developers tried to secure, I feel we are all in danger, especially, since there is a lot of earth movement, all day long. This can not be a good thing. I'm hoping the city engineers know what they are doing. Anyway, I'm thinking of my course of action. Again, the constant earth movement from this additional construction behind us, could threaten our health or existence. I hope this bit of information, can help you in some ways. And hopefully, someone will look into this. Good Luck with you Quest. Best, Sandra (Please don't publish)

Begin forwarded message:

From: Sandra Glass <1sanglass@gmail.com>
Subject: Ballona Wetlands Restoration Project
Date: October 17, 2012 3:54:03 PM PDT
To: DONNA.MCCORMICK@icfi.com

Dear Donna, I am very sorry about your last case. I have not been following any of the environmental challenges you have faced recently; but I may have just the leverage you need with those officials in command. I am living in Playa Vista, the place you tried so hard to save.

P.S. I just watched the "Big Uneasy" documentary for the 2nd time.

JM

RECEIVED
OCT 23 2012
REGULATORY DIVISION
LOS ANGELES OFFICE

October 18 2012

Dear Mr. Swenson,

I am very involved in the future of our precious Ballona Wetlands.

As I write there are so many animals, repiles & birds that are living and thriving in the wetlands. Many of these animals are nest burrowers so I am very concerned and against the so called "Restoration" using bulldozers and heavy equipment on this fragile land.

There, and there should be, restoration plans that do not destroy habitats in order to rebuild them with "pork" money from Congress etc.

Thank you!

Louise Steiner

My address
1659 Ocean Front
Santa Monica CA 90401

October 19, 2012

Dear David Lawhead and Teresa Stewart,

I am a 36 year resident and lover of our precious Ballona Wetlands.

So few wetlands are left and what is left must be preserved in the most "natural" way possible. The proposed plans for the so called "restoration" seems more to destroy then spend milions of dollas to rebuild. The use of giant bulldozers and heavy equiptment would endanger any burrowing animals or birds habitats etc. The remaining wetlands are teeming with a myiad of animals, mammals, reptiles and birds.

Are there any restoration plans being consided that would avoid massive bulldozing and using less invasive measures?

Opta hearing a lecture of learned individuals. The current plan of erecting huge man-made ~~Berms~~ berms etc seems only protecting the "Playa Vista" community against flooding, with no regard to the existing wildlife and habitat.

There needs to be alternative some + natural restoration plans offered. Will there be?

Thank you,
Louise Stewart

Jones, Tanya

-----Original Message-----
From: Swenson, Daniel P SPL [mailto:Daniel.P.Swenson@usace.army.mil]
Sent: Monday, October 22, 2012 9:40 AM
To: douglaspfay@aol.com
Cc: Diana Hurlbert; DLawhead@dfg.ca.gov
Subject: RE: Proposed Ballona Wetlands Restoration Project questions (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Mr. Fay,

I have responsed to your questions below (see ***).

sincerely,

Daniel P. Swenson, D.Env.
Chief, LA & San Bernardino Counties Section U.S. Army Corps of Engineers
Attn: Regulatory Division
915 Wilshire Blvd.
Los Angeles, CA 90017

213-452-3414
213-452-4196 fax
http://www.spl.usace.army.mil/Missions/Regulatory.aspx

Assist us in better serving you!
You are invited to complete our customer survey, located at the following link: http://per2.nwp.usace.army.mil/survey.html

Note: If the link is not active, copy and paste it into your internet browser.

-----Original Message-----
From: douglaspfay@aol.com [mailto:douglaspfay@aol.com]
Sent: Saturday, October 20, 2012 8:17 PM
To: Swenson, Daniel P SPL; DLawhead@dfg.ca.gov
Subject: Proposed Ballona Wetlands Restoration Project questions

Dear Dr. Swenson & Mr. Lawhead,

It is my understanding that the Comment Period on the proposed BWRP ends October 23, 2012.

At what time of day on October 23, 2012 does the Comment Period close?

***Any comments received at any time on the 23rd would be considered.

Can I send comments to you electronically by email before the deadline?

***Electronic or regular mail submittal is fine.

Will postmarked by October 23, 2012 submissions by postal mail be accepted?

***Yes.

Will all of my questions asked at this time (NOI) be answered and mailed to me prior to the Draft EIS/EIR being prepared?

***Speaking for the federal process, all scoping comments will be included in the draft EIS/EIR; however, there is no requirement to respond to scoping comments directly or to mail any responses to commenters.

Will acknowledgement of my comments and proposed alternatives be mailed to me prior to the Draft EIS/EIR being prepared?

***Not as part of the federal process.

Will a complete list of all letters, comments and questions and your replies be posted and available online prior to the Draft EIS?EIR being prepared?

***Not as part of the federal process.

I'm somewhat familiar with CEQA, but not the NOI process. If you could briefly elaborate on the format of comments on the NOI that is best for you, I would appreciate your reply ASAP by Monday, October 22, as the imposed deadline is near.

***There is no preferred format I am aware of, although in general, I would suggest submitting concise comments focused on the issues of concern and any specific, desired actions or outcomes.

Respectfully submitted,

Douglas Fay
644 Ashland Ave Apt A
Santa Monica, CA 90405
Tele: 310 437-0765
email: douglaspfay@aol.com

Classification: UNCLASSIFIED
Caveats: NONE

Jones, Tanya

To: McCormick, Donna
Subject: RE: Contact form submission from sue sass

From: sue sass [mailto:nobody@santamonicabay.org]
Sent: Saturday, October 20, 2012 11:44 PM
To: Charles Piechowski
Subject: Contact form submission from sue sass

Submission from 'RSVP Piechowski' form:

Name :
sue sass

Email :
ssass60@Yahoo.com

Message :
Unfortunately, there are many birds that are no seen in the Ballona area. Namely, the red-winged black birds, the singing meadowlarks, and the occasional Kingfisher along Culver Boulevard. Additionally, the bullfrogs, and other amphibians that used to be heard croaking along Jefferson Boulevard near Lincoln in the evening, are also missing since the development of Playa Vista started in the 1990\'s... The grasslands & meadows are gone! as well as the natural waters that used to flow from Sepulveda Boulevard/Centinela westward along Jefferson....
After reviewing the survey charts and comments, and being able to recall how much open land has been eliminated due to high density construction in our neighborhoods bordering Slauson, Centinela, Sepulveda, and Jefferson, it\'s no wonder that many species have disappeared that used to inhabit these areas.
I am concerned about the \"restructuring\" of the remaining Ballona Wetlands.
As mentioned many times, this area should be protected from \"good intensions in cement\"... and destroying the natural sands, clay, loam, that provide a natural filtering system and a native habitat.
I do hope that a thorough survey and collection of native plants is conducted before any large scale restoration plans are initiated.

I do not feel that a proper and complete EPA study and accurate survey was conducted prior to allowing the massive Playa Vista to be developed- which has resulted in eliminating much of and altering the Ballona Wetlands habitat areas.

Submit :
Submit

IP address of the submitter:
76.89.158.57

David Lawhead/TeriStewart
California Department of Fish and Game
3883 Ruffin Road
San Diego, CA 92123

Re: NOI Ballona Wetlands Restoration 10/21/2012

I have spent the last 20 years fighting to preserve as much of the wetlands as possible and now I have read the following: Wetlands Explained by William M. Lewis, In Search of Swampland by Ralph W. Tiner, Wetlands by Peter D. Moore, and Wetlands by Max Finalyson and Michael Moser to try to better understand wetlands and to look at the alternatives with a more educated perspective. I have recently begun attending the Santa Monica Bay Commission Meetings, I attended one community event and I attended the scoping venue and I have many unanswered questions.

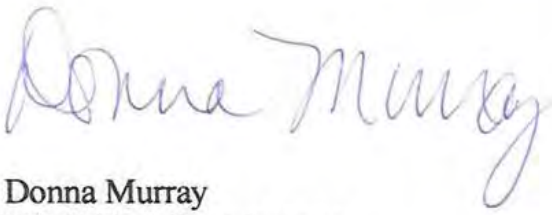
When you refer to "the restoration project" or simply "the project", are you referring to a specific project alternative, or more generically to the process of selecting and then implementing an alternative? Many public statements seem to indicate the former and others seem to indicate that a final decision on which alternative to pursue has not yet been made.
Why must we proceed with the most expensive and most risky solution straight away rather than first seeing what can be achieved with a lower cost and lower risk alternative?
Won't the highly polluted water from the Ballona Creek harm the Ballona Wetlands ecosystem if the levees are breached and that water is allowed to flow directly into the ecosystem?
What plan is in place to clean up the stream before it reaches the wetlands, and what is the timeline for such a plan to be implemented?
Won't this project relieve the state government and local city governments of the pressure to do more to clean the water in the Ballona Creek further upstream?
You have compiled a baseline monitoring report for the current biological diversity of this ecosystem. Have you made any projections as to how different species of animals and plants are likely to affected by the various project alternatives? For instance, there are a number of birds in the baseline report that favor upland habitat, and upland habitat would decline significantly under the favored project alternative. Would not those species therefore be expected to decline if those alternatives are implemented? Are there charts that can help us better understand how each species is expected to fare?
The assessment of the various project alternatives seems entirely based on the goal of increasing estuarine habitat. How was that goal established and how was the benefit of increased estuarine habitat balanced against the loss of upland habitat and other types of habitat?
What will be the increase in distance in the Ballona Creek bike trail (from beginning of the new route to end of the new route) as a result of the proposed rerouting? Will there be portions of the creek that are no longer accessible from the bike trail?
Is is possible that the project will ultimately be funded by mitigation dollars from another development project elsewhere in the area that will have a negative impact on the overall health of the area's ecosystems? In other words, could accepting funds for this project pave the way for other wetlands ecosystems to be compromised?

SMBRC recently received $6.25 million from the California Coastal Commission to conduct additional feasibility studies and to begin the permitting process. Is a detailed breakdown of how those funds will be spent publicly available? Will the studies and permits be exclusively focused on SMBRC's favored alternative? Has any money been set aside to study what could be achieved via any of the other alternatives?
In the unsourced 2006 Goals, Opportunities and Constraints document posted on the project web site, it was acknowledged that "Because the size of the site is limited, it may not be possible to incorporate large enough patches of all historic habitat types to ensure their viability." As such, why hasn't any money been set aside for acquisition of adjacent lands in the Ballona ecosystem?
The web site currently indicates that the restoration project is scheduled to commence in 2012. Does that refer only to the planning and permitting phase, or actual implementation of the plan (i.e. habitat alteration).
In order to make informed decisions, stakeholders should clearly understand the current state of the wetlands and also what specific gains will be realized by a larger scale project that could not also be realized by a smaller scale project. I understand that SMBRC has invested considerable time and effort into establishing baselines with its volunteer monitoring project, but when it comes to pitching the proposed restoration project to the public, I believe that SMBRC's assertions are quite misleading. While I certainly understand the desire to present your preferred approach in the most positive light, I do not believe that this approach is in the public interest.
I do not know which species stand to gain and which stand to lose as a result of the proposed project. I still do not know how different factors such as water quality, wildlife diversity, public recreation and others have been weighted into the decision making criteria. I don't think it is unreasonable to expect this level of information for such an important project impacting an ecosystem that took decades to protect.
If the present levee is removed, the need for berms/levees for flood control seem to cover almost 30% of our very fragile and limited wetlands.A plan that allows a small amount of salt/fresh water could be allowed into Ballona, but without any of the major bulldozing that the Coastal Conservancy wants to do.

From my readings, it is better to reduce pollution with constructed wetlands specifically design for this purpose instead of discharging polluted water directly into a natural wetland. We need to acquire additional land for water treatment – Ballona Creek is too polluted to be directly diverted to the Ballona Wetlands.

Our Ballona Wetlands need to restored/repaired over time. The creek was channelized, then the Marina dredge was dumped, yet we have many working ecosystems presently. We need to move slowly to recover water flow functions, If Ballona is bulldozed we will lose the natural envirnments that have evolved. We need SLOW community engaged restoration with experienced, knowledgeable biologists guiding and observing the process. We need to create and retain a mosaic of as many different habitiats as possible.

Thank you and I hope all of my concerns and those of others will enable a gradual restoration of the Ballona Wetlands.



Donna Murray
8734 Wiley Post Avenue
Los Angeles, CA 90045
310 258-9488
dlmurray47@gmail.com

Jones, Tanya

From: Rick P [mailto:seerixpix@yahoo.com]
Sent: Sunday, October 21, 2012 11:34 PM
To: Walter Lamb
Cc: landtrust@ballona.org; McCormick, Donna
Subject: Re: Final scoping comments

Hello Walter, Donna,

I had planned to provide you with many comments and observations, but life happens and it just never came to fruition. However, after reading your draft I feel very relieved that you pretty much got it all and my comments and observations would mostly have been redundant anyway so first let me commend you all for the outstanding work thus far on the draft.

I don't think I saw the "2012 Preferred Alternative" until tonight and I have to say, it's rather disturbing.

Here's a few things, "comments" if you will, that come to mind when I look at this drawing.

1. Where is the bike path? There is no mention of a bike path in the legend. Are they insane? The bike path goes from downtown LA to Redondo Beach. Do they really plan to stop the bike path at Lincoln or maybe even the Marina freeway? Literally cutting off bike access to the foot bridge at the beach (near Del Rey Lagoon)? It can't be, the public outcry would be of historical proportion.

2. There is a severe lack of explanation and details on the drawing in general, especially if you consider how much research and planning that has been done.

3. What's up with the massive levee that completely surrounds Area A and most of B? That looks crazy, would animals be able to traverse it? Not that they don't risk being road kill on the Culver Bl. if they do it now, but I'm just saying!

4. The plan shows existing and planned trial networks that in some cases are not even possible. One goes right through the Gas Company plant, that'll never happen, and they show old Cabora Road as an existing trail, um, no, not really, it used to be fenced off at Lincoln, I don't think it's intended for public access.

5. The plan shows planned trail networks right through the middle of Area A and loops in Area C north and south. My experience tells me the existing wildlife and migrant birds that visit Ballona are fairly tolerant of pedestrians, based on the fact that they come fairly close to the fence despite the foot and bike traffic on the bike path, but that's not what bothers me about them planning trails for public access, what bothers me is the constant maintenance that will result. At the very least there will be maintenance crews just to keep them clean and accessible, worst case scenario it will become very "Park" like and they will constantly groom the area around the trails so the public can see more than a few feet from the trail. I can see it now, weed whackers and chain saws. Not to mention how many people will wander off the trails. That sort of activity will send sensitive wildlife running for the hills.

6. Managed Marsh for Area B south of Culver? Really? I don't know, it just sounds like too much human intervention all the time. I realize there is an existing gate already at where the creek feeds into the Salt Water Marsh, but I also noticed that only the smallest fish will venture through that gate, so to me all these "managed" gates and marshes translate to "man's intervention" and will prevent nature (wildlife) from doing what it wants to, and many fish that would normally wander up those estuaries to spawn are going to turn around when they see those gates.

As much as my mind is probably just getting rolling with all the things that don't sit right with me regarding this plan, it's 11:30pm and my alarm will ring at 5:15am. I better get some rest for work tomorrow. I will try to put some more thoughts to the keyboard tomorrow night.

Take care and keep up the good work, Rick

Rick Pine
310-902-8993

Dear Wetlands Supporters,

Now is our last, best chance to influence the proposed restoration plan for the Ballona Wetlands. Final scoping comments are due next Tuesday, October 23rd. We've made it easy for you to take part by following a list of steps depending on how much time you have. Doing a little bit is much better than doing nothing at all, so please try to submit something, so that the project team at least knows that you care about this ecosystem that we've worked so hard to preserve.

Submitting Comments (Quick and Easy Option):

1) Go to Jonathan Coffin or Rick Pine's flicker pages and find a wetlands species or two (bird, butterfly, spider, plant or whatever) that really catches your eye.

http://www.flickr.com/photos/stonebird/sets/447673/

http://www.flickr.com/photos/seerixpix/

2) If you have time, do some quick research on that species. What kind of habitat do they favor? What are its food sources? What is its status federally and in California?

3) Take whatever you have learned, or even just the species name itself, and ask that the project team study the impact on that species of the various restoration alternatives being considered. Is the habitat and food sources that this species depends on likely to increase or decrease? What possible ripple effects or unintended consequences could impact this species?

4) Email your comments to Donna McCormick (Donna.McCormick@icfi.com) and please copy us (landtrust@ballona.org)

Ballona Wetlands Restoration Project

Advancing ecosystem health. Connecting communities with nature.

Comment Card

Name: Stephanie Beckman

Email: (optional) beckmans@earthlink.net

☒ Add me to the mailing list (please provide email or mailing address): _____

Comments/Issues: (Use additional sheets if necessary) Please evaluate species level impact for removing levees and adding water to current salt pan (i.e. Lower Ballona Creek). Please evaluate species level impact on speed of restoration in sections. Please evaluate impact of preferred plan to options not chosen. Please evaluate long-term impact of 15-20' foot berms around culver & Jefferson. Please evaluate impact on migratory birds if hydrology is altered at Ballona Wetlands. Please evaluate impact of un-filtered pollution & toxins entering the wetlands from Ballona Creek and mitigation plans. Thank you — Stephanie

Submit written comments by *October 23, 2012* to:

Mail: Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92618

Email: Donna.McCormick@icfi.com

*****All comments submitted will become part of the Public Record***

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J Beckman
8635 FAIRMONT #301
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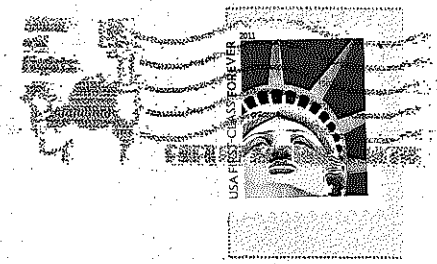

Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92618

Jones, Tanya

From: micheleanna b [mailto:micheleanna@gmail.com]
Sent: Monday, October 22, 2012 7:55 PM
To: McCormick, Donna
Subject: comment re Ballona Wetlands Restoration

To whom it may concern, I would like to submit comments on the plans for restoration of the Balllona Wetlands:

I have lived in Los Angeles nearly all my life, and I have worked to help clean up Santa Monica Bay and to save the Wetlands from development.

I live less than a block from Ballona Creek and walk or ride along the bike path through the Wetlands nearly every day. I also kayak at the mouth of Ballona Creek often. I know the wetlands very well.

In my opinion the plan promoted by SMBRC is far too drastic and indeed destructive. The wetlands have evolved over the years since the creation of the Marina, and they are now a vibrant ecosystem filled with birds both local and migratory. Ballona Creek has fish and turtles and birds, and butterflies and other insects also find refuge in the Wetlands. I see all this every time I go through the wetlands, or walk down to the creek.

The area could use some improvement, of course. But the changes should be small and incremental, not the huge, irreversible, destructive bulldozer plans suggested by SMBRC.

I envision some removal of non-native plants; the addition of a perimeter bike path, and viewing platforms and paths for birds and other nature lovers; and perhaps a SMALL change in the levees to permit more tidal access.

But the existing uplands, dunes, salt pan should be preserved, for the hawks, kites, egrets, ducks, geese, and many other creatures that find a rare respite from the urban landscape there.

Let us not destroy the precious habitat we already have--for the extremely uncertain results of the SMBRC plan.

Thank you,
Michele Bigelow

Jones, Tanya

From: Cadwallader, Joe [mailto:joe.cadwallader@boeing.com]
Sent: Monday, October 22, 2012 10:37 AM
To: McCormick, Donna
Cc: president@villamarinacouncil.com; 'Editor@VillaMarinaCouncil.com'; jewel.johnson@mrca.ca.gov; LINDSSTAR@aol.com; 'Richard Reece'; 'Celinda Jungheim Disaster Planning'; 'Stanleyand Renata Epstein'; naidanjoe@verizon.net
Subject: FW: Ballona Wetlands Restoration Project Comments

Donna:

Corrected your email address, thanks to Carolyn Everhart at MRCA.

Please see below.

Very best regards,

Joe M. Cadwallader
Engineer-Scientist 4
C-17 Avionics Engineering
Boeing Long Beach, CA.
562-826-7488 Cell

-----Original Message-----
From: Joe Cadwallader [mailto:naidanjoe@verizon.net]
Sent: Sunday, October 21, 2012 7:56 PM
To: Donna.McCormick@icfri.com
Cc: president@villamarinacouncil.com; 'Editor@VillaMarinaCouncil.com'; jewel.johnson@mrca.ca.gov; LINDSSTAR@aol.com; 'Richard Reece'; 'Celinda Jungheim Disaster Planning'; 'Stanleyand Renata Epstein'; Cadwallader, Joe
Subject: Ballona Wetlands Restoration Project Comments

October 21, 2012.

Donna:

As the property owner & occupant, and property tax payer of the residential townhouse unit that is closest to Area-C at the far east end of La Villa Marina, with intimate knowledge of the Area-C situation since our occupancy in late 2001, may I offer comments on the proposed Ballona Wetlands Restoration Project as it relates to Area-C in particular. My comments are directed to the concerns we have as local area residents regarding this Project maintaining and not negatively impacting the safety & protection, peace & quiet, and investment value & equity of our neighborhood.

* AREA-C RESTORATION ACTIVITY: We are totally opposed to any Area-C restoration activity being conducted or accomplished via access at the east end of La Villa Marina. The impact to the entire neighborhood would be completely unacceptable. All such restoration access for this Project must be confined to and accomplished from the intersection of Culver Blvd and the Marina Freeway (90).

* AREA-C ACCESS via LA VILLA MARINA: We are absolutely opposed to any future "Public Access" whatsoever to Area-C via the east end of La Villa Marina. Again, the impact to the entire neighborhood would be completely unacceptable on a long-term basis. Over the years, we have been subjected to the problems resulting from homeless squatters illegally accessing Area-C by way of this location, and such is completely unacceptable in any dense residential neighborhood such as ours. We've seen it in action: it does not work.

* AREA-C PUBLIC ACCESS: Because of the past & present issues in Area-C due to homeless squatters, we are absolutely opposed to "Public Access" to the interior of Area-C at all. The "public" must be keep out of Area-C, and the Project should be directed to putting effective means in place - read fencing - that will accomplish this objective. Area-C Viewing locations - such as those previously developed along the south side of Jefferson Blvd.
west of Lincoln Blvd. - would be acceptable and appropriate along Culver Blvd. south of the Marina Freeway, and would bring the "usage" issue of Area-C into conformance with that of the already restored area south of Jefferson & west of Lincoln. Any greater "usage" of Area-C is completely unwarranted and undesirable, and is strongly opposed by this residential community.

* AREA-C FENCING: Denying general public access requires effective fencing of the area, and such an effort would necessarily be a significant component of this Restoration Project. Not only would existing old and dilapidated chain-link fencing need to be replaced with something far more robust, but also aging concrete block fences surrounding the area - many of which in serious states of decay after standing unmaintained since 1965 - would need to be demolished and replaced using a consistent design & construction approach throughout the entire Project. Many of the old concrete block fences are strictly speaking the private property of the specific Villas they bound, virtually none of whom would be in a financial position to pay outright for their replacement. To "do it RIGHT" will necessitate a significant effort of coordination and negotiation with all such Villas, resulting in this issue becoming a significant impact to the Projects total costs and schedule.

* AREA-C WILDLIFE & WATERSHEAD: The effective fencing issue above begs the question of preserving the free access and movement of water and wildlife in this area, which should bea primary objective of the Project.
Diligent Engineering must be applied to the issue to accomplish this objective.

The Restoration Projects careful attention to and consideration of the above issues will assure a successful Project and a supportive neighborhood.

With best regards and wishes for a very successful Area-C Restoration Project,

Mr & Mrs. Joe M. Cadwallader
4812-J La Villa Marina
Marina del Rey, CA. 90292

Ballona Wetlands Restoration Project

Advancing ecosystem health. Connecting communities with nature.

Comment Card

Name: Molly Curtis

Email: (optional) molly[redacted] esq@pacbell.net

[X] Add me to the mailing list (please provide email or mailing address):

Comments/Issues: (Use additional sheets if necessary) Preserve
Dont restrict Bike Access

Preserve great blue heron habitat

Submit written comments by *October 23, 2012* to:

Mail: Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92618

Email: Donna.McCormick@icfi.com

***All comments submitted will become part of the Public Record*

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FOREVER

Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92618

Jones, Tanya

From: Scott Garvey [mailto:scottgarvey02@yahoo.com]
Sent: Monday, October 22, 2012 3:53 PM
To: McCormick, Donna; daniel.p.swenson@usace.army.mil; DLawhead@dfg.ca.gov; jainsworth@coastal.ca.gov; gtimm@coastal.ca.gov; rising.nicky@coastal.ca.gov; cliff.costa@sen.ca.gov; jennifer.zivkovic@sen.ca.gov; elise.swanson@mail.house.gov; clester@coastal.ca.gov; councilmember.rosendahl@lacity.org; kathy.knight@verizon.net
Subject: Comments on State's plan for the Ballona Wetlands Restoration Project

I'm writing in regards to the massively destructive restoration State Plan for the Ballona Wetlands.
I need not remind you that Los Angeles has run out of wetlands, and that this is the last one remaining.

Please see my comments in the attached file.

Respectfully,

Scott Garvey

Scott Garvey

1559 N. Bundy Drive, Los Angeles, CA 90049 Email: scottgarvey02@yahoo.com

October 22, 2012

To: Ms. Donna McCormick, Ballona Wetlands Restoration Project
Mr. Daniel P. Swenson, Chief, Los Angeles section Army Corps of Engineers
Mr. Charles Lester, Executive Director, California Coastal Commission
Mr. John Ainsworth, Sr. Deputy Director, California Coastal Commission, South Coast District Office
Mr. Gary Timm, District Manager, California Coastal Commission, South Coast District Office
Mr. David Lawhead, California Dept. of Fish and Game
Honorable Edmund G. Brown Jr., Governor of California
Honorable Janice Hahn, U.S. representative, 36th Congressional District
Honorable Ted Lieu, CA State Senator, 28th District
Honorable Bill Rosendahl, Councilmember, City of Los Angeles, 11th District
Ms. Kathy Knight, Conservation Chair of the Sierra Club Airport/Marina Group

From: Scott Garvey

Re: Comments on Notice of Preparation of a Draft EIS/EIR for Ballona Wetlands Restoration Project

I'm writing in regards to the massively destructive restoration State Plan for the Ballona Wetlands. I need not remind you that Los Angeles has run out of wetlands, and that this is the last one remaining. I need not remind you that Los Angeles does not have any open space ecosystem on the entire flatlands of Los Angeles County. The formerly huge Ballona Wetlands have been so severely obliterated over the years by mega developments such as Marina Del Rey and Playa Vista. When is enough enough? Once you've completely annihilated the vast ecosystems of Los Angeles to absolutely nothing?

As an Angeleno bike riding and running along the Ballona Creek several times a week for over twenty years I am extremely concerned with the State's proposals and methods for restoration of the small remaining area of Ballona Wetlands.

The following is a list of my concerns in no particular order.

First, can the same animals, birds, plants, and species that live or visit in a saltwater marsh also live in a freshwater marsh, and vice versa? We need further research to the history of the Ballona Wetlands to the legitimacy of the type of marsh that the original habitat supported. This may not even be documented, and any restoration proposal poses a serious threat to the existing native habitat and its native species.

Second, the State plan is obviously not environmentally sound and needs more input and oversight from environmental scientists who understand the science of biodiversity, ecosystem integrity, and the critical ecological impacts to manage the land. Thus, if human use and the restoration process is considered, it will be very minimal to the fragile Ballona Wetlands ecosystems and habitats.

The State's current proposed restoration plans will permanently alter and destroy this fragile ecosystem. As a result of the State's proposal the endemic species and the Ballona Wetlands ecosystems will be unequivocally damaged to an irreversible state, thus leading to its loss forever.

Scott Garvey
1559 N. Bundy Drive, Los Angeles, CA 90049 Email: scottgarvey02@yahoo.com

Third, I do not support the audacity of the State's environmental agencies and their experts opening up this fragile wetlands ecosystem to the public. It is absurd to open this protected area to people because of the likelihood of negative human impact, such as carelessly tromping and littering, and negatively impacting adjacent areas not designated as trails, among other adverse impacts. This proposal to open up the Ballona Wetlands ecosystem to the public is a blatant display of carelessness, disregard, and neglectful environmental assessments used in the State's proposal to restore any type of ecosystem. This makes absolutely no sense and because of this, any other restoration proposed in the State's plan in my opinion lacks credibility and leaves room for major error and concern.

Fourth, Any environmental scientist would be seriously concerned with any type of industrial - scale habitat conversion, involving bulldozing and excavating, removing 1.8 million cubic yards of earth, removing, moving and building levees, and lowering the elevation of the habitat will definitely adversely impact and destroy the current wetlands ecosystems, habitats, and its native species.

"Relocating the levees would come at enormous financial expense and then leave us with an unnatural system that will have a tendency to be filled with sediment and will have the pollution that is currently constrained to the channel discharged into a cookie-cutter abstraction of a fully tidal wetland that destroys existing natural features to create something that was not there prior to our disturbance of the system," stated by Professor Travis Longcore, an associate professor at the UCLA Institute of the Environment and Sustainability.

Fifth, There should be serious concerns by any environmental scientist or agency to the State's proposed restoration plans initiative to bring a polluted Ballona Creek into the Wetlands. Using the Ballona Wetlands as a clean up basin for all the street runoff and garbage from higher areas around Los Angeles is absurd. We don't want that, it is too polluted. Common sense should be to clean up Ballona Creek first before bringing it into the Ballona Wetlands. Preventing all street runoff and people from throwing garbage into Ballona creek or other Los Angeles basin water areas in my opinion is impossible, and thus using Ballona Wetlands as an end of the line basin for any part of Ballona Creek should not even be considered.

Sixth, To conserve rare and endangered species, you have to take into account each one of them on an individual basis. The State's proposal does not even include what species are to be protected, what species are native to the Ballona wetlands ecosystems, and what their proposed methods are to preserve the native plant, animal, and insect species habitat and integrity.

Seventh, and probably most important I also feel that because it is widely known that this area is an important archeological and historical site, as well as even being a registered sacred site comprised of Native American Tongva tribal land, who have been living there for 10,000 years, with sacred artifacts and burial grounds, little to no impact should be our upmost goal. The Playa Vista developers dug up over 1400 of their ancestors' graves. They are the indigenous people of Los Angeles and we need to support what their wishes are. It is time we start respecting their culture and do what is right.

Scott Garvey
1559 N. Bundy Drive, Los Angeles, CA 90049 Email: scottgarvey02@yahoo.com

Eighth, We, the public need to have more time for public comment and review. This should not be limited to only one meeting, this is unfair and unjust. The public needs more time to review, analyze, scrutinize and give input to the State's proposals for restoration of the Ballona Wetlands Ecosystems.

Please strongly consider my concerns. As environmental State agencies representing the integrity of California's limited natural habitats and ecosystems consider the adverse impacts of human use, management, and restoration. Instead, it should be your upmost goal to preserve the integrity and biodiversity of these rare native ecosystems, habitats, and species. As a proclaimed and certified environmental scientist working for the State your motive should not be financial gain. Unfortunately, I have my doubts when it comes to bureaucracy.

Thank you for your consideration. I would appreciate your confirmation of your receipt of this email and your efforts to see that it also gets forwarded to the appropriate parties.

Sincerely,

Scott Garvey

RECEIVED

OCT 25 2012

REGULATORY DIVISION
LOS ANGELES OFFICE

Lauren Gottlieb, MSW
2900 4th St #16
Santa Monica, Calif. 90405

October 22, 2012

Daniel P. Swenson, Chief
Los Angeles Section
Army Corps of Engineers
915 Wilshire Blvd
Los Angeles, CA 90007

David Lawhead
Terri Stewart
Calif. Dept of Fish and Game
3883 Ruffin Road
San Diego, CA 92123

Mr. Swenson, Mr. Lawhead, Ms. Stewart:

I share a vision of Earth with many people, including children, wherein we humans live in a sustainable environment for generations to come.

Micromanagement of crucial ecosystems has become the norm and will not work in the long run. From what I can see so far, the tentative Ballona Wetlands plans are short-sighted. My hope is that federal recognition of this land, which is legally the case, will bring a better future for all concerned. For now, California taxpayers bought the land to save it; this taxpayer would like to see better long-term planning based on science.

As an intelligent, concerned citizen, I have listened to several project scientists and know that the caliber of the studies so far is fairly high. My hope is that Army Corps, and Fish & Game, will be diligent and listen to all of the scientists (without pointing fingers).

As I am aware of many Ballona Wetlands conflicts and hopes, I could comment on several things, but I won't. I will simply point out the following:

Wetlands are the key to life on Earth. Winged Migrations count on intact ecosystems. One rainy year on my commute I remember seeing the Blue Egrets and White Herons in a Ballona Wetlands pond. These big birds are awe-inspiring, and their nesting seasons, according to Audubon scientists, last about eleven months of the year. If any work is done, unless it is limited to that one month per year, they will be gone forever from this area. Bottom line impact.

So my vote, which I am sure is shared by anyone who appreciates Big Birds, is to limit the timing scope of anything done in the Ballona Wetlands to that one safe month once a year. Kind of like Christmas.

Sincerely,

Lauren Gottlieb, MSW

Lauren Gottlieb, MSW

Ballona Wetlands Restoration Project

Advancing ecosystem health. Connecting communities with nature.

Comment Card

Name: CINDY GRANT

Email: (optional) cindy@cindygrant.com

[X] Add me to the mailing list (please provide email or mailing address):

Comments/Issues: (Use additional sheets if necessary) REGARDING THE PROPOSED RESTORATION I AM CONCERNED ABOUT THE FOLLOWING ISSUES:

① POLLUTION CONTROLS

② PROTECTING EXISTING ~~FAUNA~~ FLORA & FAUNA - DOCUMENT & DESCRIBE HOW THIS WOULD BE DONE.

③ COST OF MAINTENANCE OF PREFERRED OPTION - THIS AREA HISTORICALLY WOULD CLOSE OFF ANUALLY AND I WOULD HATE TO SEE AN OPTION THAT HAS TO BE DREDGED ANNUALLY AS SOME SIMILAR RESTORATIONS.

④ LARGE LEVEY ALONG CULVER IN PREFERED ALT. - CAN WE RAISE CULVER INSTEAD? - A LARGE LEVY WOULD BISECT THE ENVIRONMENT & DISRUPT VIEWS.

⑤ PROTECTION OF FERAL CATS - PLEASE ADDRESS HOW HUMANE EFFORTS OF TRAP/SPAY & RELEASE & SOON RELOCATE COULD BE USED - LOCAL ORGS. LIKE CATNIPPERS OR FERAL CAT CARETAKERS COALITION SHOULD BE ENLISTED FOR ASSISTANCE.

⑥ AQUISITION OF ANY USEFUL ADJACENT ~~PROPERTIES~~ LAND.

⑦ I PREFER SLOW RESTORATION SO ANIMALS & INSECTS CAN ADJUST.

Submit written comments by *October 23, 2012* to:

Mail: Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92618

Email: Donna.McCormick@icfi.com

***All comments submitted will become part of the Public Record**

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Audubon

Mr Scott Hutchinson
14971 Sutton St
Sherman Oaks CA 91403



Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92618

Jones, Tanya

From: Steffi Jones [mailto:ibu70@hotmail.com]
Sent: Monday, October 22, 2012 2:30 PM
To: McCormick, Donna
Subject: ballona wetland restoration

Hello,

I am writing because of my concern in regards of the restoration plans of the ballona wetlands.
I am concerned with the impacts on species like the California Brown Pelican or the Cross-eyed Bubo. Will the project team study the impact on these species by restoration alternatives?

Best ,
Steffi

Jones, Tanya

-----Original Message-----
From: longcore@usc.edu [mailto:longcore@usc.edu]
Sent: Monday, October 22, 2012 9:24 PM
To: McCormick, Donna
Cc: David Lawhead; daniel.p.swenson@us.ace.army.mil
Subject: Ballona Wetlands Project Notice of Preparation

Dear Ms. McCormick,

Please see attached comment on the Ballona Wetlands Project Notice of Preparation.

USC Dornsife
Dana and David Dornsife
College of Letters, Arts and Sciences

SPATIAL SCIENCES INSTITUTE
Travis Longcore, Ph.D.
Associate Professor (Research)

October 22, 2012

Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92816

To Whom It May Concern:

Please consider the following comments in preparation of the Draft Environmental Impact Report/Environmental Impact Statement for the Ballona Wetlands Restoration Project. These are my personal comments and do not represent an official position of the University of Southern California or any of my other employers. *The use of letterhead is for identification and contact purposes only.* I am an urban ecologist with a long history of research on ecological restoration (Longcore 2003; Longcore 1999; Longcore et al. 2000) and management of natural ecosystems to support native biodiversity in southern California, with more recent research on the historical conditions of coastal estuaries and riparian systems in the region (Dark et al. 2011; Jacobs et al. 2011; Stein et al. 2010; Stein et al. 2007).

First, the project description should be corrected to describe the project as wetlands "creation" not "restoration." The proposed project in the NOP does not represent "the return of an ecosystem to a close approximation of its condition prior to disturbance," which is a widely accepted definition of "restoration" (National Research Council 1992). The ending conditions depicted in the NOP have not been present in the system for over 2,000 years (Dark et al. 2011; Palacios-Fest et al. 2006) and would be, in fact, out of equilibrium with the hydrogeomorphological forces present in the current day watershed (Jacobs et al. 2011). The site will not be "restored" by introducing permanent tidal flows. Rather, in its historical condition prior to being jettied open to the ocean, the Ballona wetlands were only open to the ocean periodically in response to winter rains. As summarized by Dark et al. (2011):

> Approximately half of the aggregate Ballona Lagoon area consisted of a freshwater and tidally affected saltmarsh and brackish habitats that transitioned into a more alkaline/freshwater system about 1.5 miles (2.4 km) inland. Historical habitat of the Ballona Lagoon coastal complex consisted of substantial amounts of brackish to salt marsh/tidal marsh habitat (29%), followed by salt flat/tidal flat (10%). Open water made up less than 3 percent of the lagoon and one of the more

University of Southern California
3616 Trousdale Parkway, Los Angeles, California 90089-0374 • Tel: 213 740 1310 • Fax: 213 740 9687

> salient features of the complex was a long but narrow strip of open water referred to by some as a "lake" at what we call today Del Rey/Ballona Lagoon (Sheridan 1887). This strip of open water periodically emptied into the ocean at the documented location of seasonal tidal access (figure 22). **We found no evidence that the lagoon remained perennially open, but rather the textual sources indicate that access to the ocean depended on hydraulic forces during any given year** (LAT 1887, Sheridan 1887, Hansen and Jackson 1889, Solano 1893). The migration of the Los Angeles River away from the lagoon transitioned the system into a lower energy system where only on rare occasions was there enough freshwater flow from Ballona Creek to break through the buildup of sediment along the coast. As a result, gradual build up of sediment around the terminus of the previous estuary formed dunes and created this "trapped" lake-like feature. The coastal dunes, which occupied four percent of the Ballona Lagoon coastal complex, played a significant role in the formation of the lake and the limited tidal access (see Jacobs et al. 2011).

Therefore, the creation of a meandering channel for Ballona Creek as described in the NOP would not be a "restoration." The historical system did not have a large main channel. Changing the shape of an unnatural channel does not "restore" it.

Moving the channels will not "restore" the wetlands. To the contrary, it would introduce permanent tidal flow to areas that did not historically have such flows. The EIR/EIS should be accurate in the use of the term "restoration" and not extend it to the creation of novel wetland systems that, because they would not be supported by the existing or proposed hydrology, would require significant maintenance (i.e., dredging) to maintain and would destroy existing biodiversity.

Because the proposed project is not in any way a restoration, but rather represents creation of a distribution of wetland types that is novel in the project location, I request that the alternatives analysis include consideration of an alternative that has the following characteristics:

1. Does not adversely impact features on the landscape that have been stable since the late 1800s. This includes the dune system, various salt pan areas, and existing brackish to saltmarsh habitat currently dominated by native species. That is, all native habitats that roughly correspond with their historical locations are not disturbed. Essentially, "First, do no harm."
2. Does not remove the levees, because these unnatural structures serve the role of the barrier dune that separated the wetland system for the ocean. Their removal unnaturally opens the wetlands area up to permanent tidal flow and would introduce pollution from Ballona

Creek into the wetlands area. The alternative should use tidal gates and active management to create explicitly desired wetland conditions to support rare and endangered species that were historically present in the wetlands system.

3. Has explicit rare or endangered target species that were historically present in the Ballona wetlands complex (prior to the late 1880s) and could recolonize or be reintroduced following restoration. The current project description inexplicably does not list maintenance or restoration of native biodiversity as a goal, so an alternative with biodiversity conservation as a goal should be developed and considered.

I ask that the two attached documents be made part of the record for the EIR/EIS and be considered carefully when weighing the alleged benefits of creating a full-tidal system by removing the levees (see especially the discussion in Jacobs et al. 2011).

I am deeply concerned that the State has proposed a project that is a cookie-cutter abstraction of a generic coastal wetland of a particular type that was not historically present. Pursuing a perennially full tidal design will result in a homogenization of the wetland types found regionally and will be plagued by the same maintenance issues that have been encountered at other projects that artificially open what would naturally be closing estuaries (e.g., Bolsa Chica).

Sincerely,



Travis Longcore, Ph.D.

Literature Cited

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Stein, E. D., S. Dark, T. Longcore, N. Hall, M. Beland, R. Grossinger, J. Casanova, and M. Sutula. 2007. Historical ecology and landscape change of the San Gabriel River and floodplain. SCCWRP Technical Report #499. Southern California Coastal Water Research Project, Costa Mesa, California.

Jones, Tanya

From: Donna Murray [mailto:dlmurray47@gmail.com]
Sent: Monday, October 22, 2012 1:50 PM
To: McCormick, Donna
Subject: Ballona Wetlands Restoration Project

Ballona Wetlands Restoration Project

c/o Donna McCormick

1 Ada, Suite 100

Irvine, CA 92618

Re: NOI Ballona Wetlands Restoration 10/21/2012

I have spent the last 20 years fighting to preserve as much of the wetlands as possible and now I have read the following: Wetlands Explained by William M. Lewis, In Search of Swampland by Ralph W. Tiner, Wetlands by Peter D. Moore, and Wetlands by Max Finalyson and Michael Moser to try to better understand wetlands and to look at the alternatives with a more educated perspective. I have recently begun attending the Santa Monica Bay Commission Meetings, I attended one community event and I attended the scoping venue and I have many unanswered questions.

When you refer to "the restoration project" or simply "the project", are you referring to a specific project alternative, or more generically to the process of selecting and then implementing an alternative? Many public statements seem to indicate the former and others seem to indicate that a final decision on which alternative to pursue has not yet been made.

Why must we proceed with the most expensive and most risky solution straight away rather than first seeing what can be achieved with a lower cost and lower risk alternative?

Won't the highly polluted water from the Ballona Creek harm the Ballona Wetlands ecosystem if the levees are breached and that water is allowed to flow directly into the ecosystem?

What plan is in place to clean up the stream before it reaches the wetlands, and what is the timeline for such a plan to be implemented?

Won't this project relieve the state government and local city governments of the pressure to do more to clean the water in the Ballona Creek further upstream?

You have compiled a baseline monitoring report for the current biological diversity of this ecosystem. Have you made any projections as to how different species of animals and plants are likely to affected by the various project alternatives? For instance, there are a number of birds in the baseline report that favor upland habitat, and upland habitat would decline significantly under the favored project alternative. Would not those species therefore be expected to decline if those alternatives are implemented? Are there charts that can help us better understand how each species is expected to fare?

The assessment of the various project alternatives seems entirely based on the goal of increasing estuarine habitat. How was that goal established and how was the benefit of increased estuarine habitat balanced against the loss of upland habitat and other types of habitat?

What will be the increase in distance in the Ballona Creek bike trail (from beginning of the new route to end of the new route) as a result of the proposed rerouting? Will there be portions of the creek that are no longer accessible from the bike trail?

Is is possible that the project will ultimately be funded by mitigation dollars from another development project elsewhere in the area that will have a negative impact on the overall health of the area's ecosystems? In other words, could accepting funds for this project pave the way for other wetlands ecosystems to be compromised?

SMBRC recently received $6.25 million from the California Coastal Commission to conduct additional feasibility studies and to begin the permitting process. Is a detailed breakdown of how those funds will be spent publicly available? Will the studies and permits be exclusively focused on SMBRC's favored alternative? Has any money been set aside to study what could be achieved via any of the other alternatives?

In the unsourced 2006 Goals, Opportunities and Constraints document posted on the project web site, it was acknowledged that "Because the size of the site is limited, it may not be possible to incorporate large enough patches of all historic habitat types to ensure their viability." As such, why hasn't any money been set aside for acquisition of adjacent lands in the Ballona ecosystem?

The web site currently indicates that the restoration project is scheduled to commence in 2012. Does that refer only to the planning and permitting phase, or actual implementation of the plan (i.e. habitat alteration).

In order to make informed decisions, stakeholders should clearly understand the current state of the wetlands and also what specific gains will be realized by a larger scale project that could not also be realized by a smaller scale project. I understand that SMBRC has invested considerable time and effort into establishing baselines with its volunteer monitoring project, but when it comes to pitching the proposed restoration project to the public, I believe that SMBRC's assertions are quite misleading. While I certainly understand the desire to present your preferred approach in the most positive light, I do not believe that this approach is in the public interest.

I do not know which species stand to gain and which stand to lose as a result of the proposed project. I still do not know how different factors such as water quality, wildlife diversity, public recreation and others have been weighted into the decision making criteria. I don't think it is unreasonable to expect

this level of information for such an important project impacting an ecosystem that took decades to protect.

If the present levee is removed, the need for berms/levees for flood control seem to cover almost 30% of our very fragile and limited wetlands.A plan that allows a small amount of salt/fresh water could be allowed into Ballona, but without any of the major bulldozing that the Coastal Conservancy wants to do.

More concerns and items that need further study and discussion include the following:

Study and describe surface fresh water flows and their interaction with surface salt flows.

Study and describe the pollution, clean up, well abandonment, gas infusion and how all of these will be managed in the course of the project.

Study and describe treatment of 303 waters and how that will be used to enhance the project

Study and describe the dynamic nature of the emerging wetlands environment and how it will be sustained over time with natural processes instead of physical intervention. (dredging, detention basin clean out etc.)

Study and describe existing hydrology and hydrological dynamics of of Ballona Creek outflow channel, both for itself and its interaction with the bay, 303 waters, the jetty, and all wetlands flows.

Study and describe the additional regulatory schemes (FEMA, NPDES, Fish and Game, Coastal Conservancy, Impacted waters, Inundation zone, projected sea rise) and their interaction with the proposed project and alternatives.

This area is a Sacred Site of the Tongva Native Americans, who are the indigenous people of the Los Angeles area. They have been living here for 10,000 years. We need to start acknowledging and respecting their culture more.

Playa Vista is dewatering their gas mitigation system and pumping the water to Hyperion. The aquifer under the wetlands is being depleted rather than replenished. This dewatering of the aquifer should be studied and documented. This water is needed for the wetlands to provide habitat for wildlife including migrating birds.

We need more community meetings with Fish and Game and the Army Corps attending so we can communicate and ask questions of them, prior to expenditure of any more public funds.

The animals and plants need to be studied carefully over a period of time. The government should reach out to local citizens who have studied this ecosystem for a long time and can document a long term history of the area.

Under Section 303(d) of the U.S. Clean Water Act, an impaired waterway cannot further pollute another waterway. Therefore Ballona Creek east and west of Lincoln Blvd. cannot be allowed to flow into the wetlands and pollute them. Other than naturally occurring hydration, no freshwater shall be allowed into the wetlands that has not been treated to tertiary levels.

All of the adjacent bodies of water need to be included into the Ballona Wetlands Study Area (BWSA) including, but not limited to, the Marina Del Rey Harbor, Oxford Lagoon, Del Rey Lagoon, Venice Canals, and Santa Monica Bay. There are still quite a bit of wildlife and sea creatures in the Marina area.

From my readings, it is better to reduce pollution with constructed wetlands specifically design for this purpose instead of discharging polluted water directly into a natural wetland. We need to acquire additional land for water treatment – Ballona Creek is too polluted to be directly diverted to the Ballona Wetlands.

Our Ballona Wetlands need to restored/repaired over time. The creek was channelized, then the Marina dredge was dumped, yet we have many working ecosystems presently. We need to move slowly to recover water flow functions, If Ballona is bulldozed we will lose the natural envirnments that have evolved. We need SLOW community engaged restoration with experienced, knowledgeable biologists guiding and observing the process. We need to create and retain a mosaic of as many different habitiats as possible.

Thank you and I hope all of my concerns and those of others will enable a gradual restoration of the Ballona Wetlands.

Donna Murray

8734 Wiley Post Avenue

Los Angeles, CA 90045

310 258-9488

dlmurray47@gmail.com

Ballona Wetlands Restoration Project

Advancing ecosystem health. Connecting communities with nature.

Comment Card

Name: Susan Roughen

Email: (optional)

☑ Add me to the mailing list (please provide email or mailing address):

sroughen7@yahoo.com

Comments/Issues: (Use additional sheets if necessary)

I am concerned about the harm that may be done to the existing habitat. Has there been an intensive study to evaluate the effect on existing species and native plants? I would like to see the least invasive steps taken in the restoration project.

Submit written comments by *October 23, 2012* to:

Mail: Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92618

Email: Donna.McCormick@icfi.com

*****All comments submitted will become part of the Public Record***

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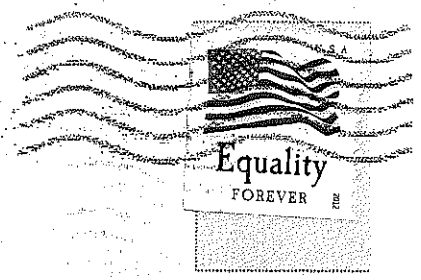

Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92618

Jones, Tanya

From: David.Kay@sce.com [mailto:David.Kay@sce.com]
Sent: Monday, October 22, 2012 3:23 PM
To: daniel.p.swenson@usace.army.mil; McCormick, Donna
Subject: Correction: Comments on NOI: (SC No. 2012071090; Docket No. COE-2012-0014) Ballona Wetlands Restoration Project: Friends of Ballona Wetlands

Please note corrected date on the cover letter.

****

David W. Kay

Manager, Environmental Projects
Southern California Edison Company
1218 South 5th Avenue
Monrovia, CA 91016
626/462-8639

****

----- Forwarded by David Kay/SCE/EIX on 10/22/2012 03:21 PM -----

From: David Kay/SCE/EIX
To: daniel.p.swenson@usace.army.mil, DONNA.MCCORMICK@icfi.com
Date: 10/21/2012 05:48 PM
Subject: Comments on NOI: (SC No. 2012071090; Docket No. COE-2012-0014) Ballona Wetlands Restoration Project: Friends of Ballona Wetlands

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Dear Mr. Swenson and Ms. McCormick,

Friends of Ballona Wetlands are pleased to provide the enclosed comments in response to the Notice of Intent (NOI) to prepare a Environmental Impact Report/Environmental Impact Statement (EIR/S) for the Ballona Wetlands Restoration Project.

Friends of Ballona Wetlands (www.ballonafriends.org) is a non-profit 501(c)(3) membership organization with more than 10,000 individuals participating in our education and restoration programs each year. We represent the single largest group of stakeholders participating in the Coastal Conservancy's Ballona Wetlands Restoration Project. FBW has been dedicated to protecting and restoring the Ballona Wetlands for over 30 years with the help of more than 75,000 volunteers, and was instrumental in protecting the Ballona Wetlands from development through designation of the wetlands as a State Ecological Reserve.

If you have any questions, please feel free to call me at 626/462-8639, or Lisa Fimiani at 310/306-5994

Sincerely,

David Kay

[attachment "FBW Letter Ballona NOI 10-21-12.pdf" deleted by David Kay/SCE/EIX]

Friends of Ballona Wetlands

www.ballonafriends.org

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Dr. David Kay, President
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Tim Rudnick
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October 21, 2012

Ballona Wetlands Restoration Project
c/o Donna McCormick
1 Ada, Suite 100
Irvine, CA 92816

Dr. Daniel P. Swenson
U.S. Army Corps of Engineers, Los Angeles District
P.O. Box 532711
Los Angeles, CA 90053–2325

RE: Friends of Ballona Wetlands – Comments on the Notice of Intent to Prepare a EIR/EIS (SC No. 2012071090; Docket No. COE-2012-0014)

Dear Ms. McCormick and Mr. Swenson:

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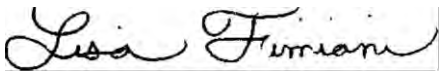
If you have any questions, please feel free to call me at (310) 306-5994.

Sincerely,



Lisa Fimiani

P.O. Box 5159, Playa del Rey, CA 90296
phone: 310.306.5994 email: info@ballonafriends.org

Friends of Ballona Wetlands
Comments on Notice of Intent to Prepare a EIR/S
Ballona Wetlands Restoration Project
October 21, 2012

Friends of Ballona Wetlands (FBW) supports the preparation of an EIR/S for the Ballona Wetlands Restoration Project, and supports a preferred Alternative which includes a comprehensive restoration of most all presently degraded tidelands within the project area. A comprehensive restoration should include a balance of wetland habitats, including subtidal, saltmarsh, mudflat, transitional and upland areas. It must also include elements of well-regulated public access, including ranger patrols, single- and multi-purpose trails, signs and interpretive facilities, rest rooms and trash receptacles. Upland space should be reserved and prepared for a future interpretive center, should one be proposed and funding made available in the future.

The EIR/S should thoroughly analyze the following areas of potential environmental impact from all of the proposed alternatives:

Aesthetics	Agriculture and Forestry	Air Quality
Biological Resources	Cultural Resources	Geology/Soils
Greenhouse Gas Emissions	Hazards and Hazardous Materials	Hydrology/Water Quality
Land Use/Planning	Mineral Resources	Noise
Population/Housing	Public Services	Recreation
Transportation/Traffic	Utilities/Service Systems	Mandatory Findings of Significance

FBW recommends the EIR/S devote extra discussion and analysis of potential impacts to Cultural Resources. While the areas of proposed project ground disturbance below historical land surface elevations were historically wetland habitat (now filled in by dredge spoils and other fills), the former wetlands area was known to support continuous occupation by native peoples for many thousands of years. Great care must be taken during any proposed excavation and grading to pre-survey, monitor and record any cultural resources encountered and, if necessary, modify project design, engineering and construction as deemed necessary to preserve and protect cultural resources of major significance.

FBW also recommends the EIR focus additional analysis of water quality impacts on the potential of any alternatives to cause temporary or permanent accumulation of urban runoff pollutants in the existing or constructed wetland vegetation or soil. Some investigators have recently hypothesized that maintenance of a permanently open tidal inlet may result in impact to existing or constructed wetland habitat as a result of the presence or accumulation of pollutants within urban runoff carried in the Ballona Creek channel. FBW does not believe such impacts are real or significant, and that modeling of known pollutant concentrations and mass loadings in a "first flush" runoff event in the Ballona Creek channel will support our belief. Owing to improvements in urban runoff quality over the past decade, the short duration of a first flush event and the immediate and repeated flushing of wetland habitat by incoming and outgoing tides, we believe modeling will show no significant impact, due to acute or chronic exposure from or accumulation of urban runoff pollutants, to existing or constructed wetland habitat,

sediments, flora or fauna. Data and means to perform such a mass balance analysis combined with tidal dynamics are readily available and should be employed by the project proponents in order to reject or validate this hypothesis.

In addition, the EIR/S should examine potential impacts of sedimentation at the mouth of Ballona Creek (primarily from littoral drift at the ocean side, not sediment transported by the creek itself) and the extent to which this sedimentation may necessitate periodic inlet dredging. Historically the Ballona wetlands were periodically blocked at the tidal inlet end by sand, so the potential impact of maintaining the Ballona Wetlands as a lagoon system versus an open estuary should be analyzed.

The EIR/S should analyze a reasonable range of project alternatives, including a No Project Alternative. The No Project Alternative should thoroughly examine and analyze as a potential impact the continued degradation of the existing wetlands habitat if no restoration is performed, as well as the loss of various social, economic and watershed values and services.

Furthermore, the EIR/S should analyze a so-called "community alternative" which has been proposed by a few individuals publicly opposed to a comprehensive restoration and opposed to use of any mechanized excavation and grading. Since to our knowledge, none of these individuals have yet to produce a coherent project plan or schedule for such a "community alternative", even at a conceptual level sufficient to support CEQA or NEPA analysis, the project proponents should therefore themselves design one such "community alternative" and subject it to EIR/S analysis. This so-called "community alternative", based on repeated verbal and written comments of these individuals in various public forums, would appear to only minimally enhance existing tidal hydrology by hand-constructing tidal channels without the use of mechanized equipment for excavation, grading or material salvage or transport. It would also presumably employ volunteer labor provided by the local community, which should be realistically estimated as part of the analysis.

For a "community alternative", as with the No Project Alternative, the EIR/S should thoroughly examine and analyze the potential impacts of the continued degradation of the existing wetlands habitat if very slow, minimal, non-mechanized restoration is performed, as the "community alternative" would appear to require, including the loss of various social, economic and watershed values and services by such an approach.

The EIR/S should analyze the possible methods by which a hydrologically functional restoration plan could be constructed without large scale mechanized equipment. These methods could include manual laborers with hand tools, wheelbarrows, and the like, and must also analyze how recontoured or constructed wetland areas could be sufficiently compacted to withstand even common non-flood related land erosion or meet any generally accepted engineering and construction standards. The analysis should consider how public volunteer workers would need to be qualified, trained and equipped to work in compliance with all applicable state and federal health and safety requirements, including being physically fit to perform the required labor. Finally, analysis of a "community alternative" should present possible timelines for completion of various stages of vegetation removal and salvage, land excavation, relocation of utilities and infrastructure, grading and contouring, compacting, and revegetation. The public deserves to

know how many years it would take to fully implement a so-called "community alternative." The EIR/S should estimate this level of effort, and the impact of wetlands values and services lost over time by such an approach.

For example, one qualified volunteer hand excavating one-quarter cubic yard of material into a wheelbarrow, manually relocating the material by wheelbarrow, then manually placing and recompacting the material using hand-pushed rollers, could be expected to handle 1.25 cubic yards in one 8-hour workday. Fifty such volunteers could move 62.5 cubic yards per day, or 21,875 cubic yards per 350-day work year. The material required to be excavated, relocated and recompacted for a comprehensive restoration of Ballona is conservatively estimated at 1 million cubic yards (based on other restoration projects of similar area size already performed in California). Therefore, it could take 46 years simply to remove, relocate and recompact the material required for a comprehensive restoration at Ballona. Additional labor would be required to remove, salvage, grow and replant wetland vegetation. Such calculations and estimates for a "community alternative" should be included in the EIR/S.

FBW does not believe this so-called "community alternative" will achieve the primary goals of the project; to restore tidal dynamics and habitat in former wetland areas now deeply buried under dredge spoils. However, this alternative should still be analyzed in the EIR/S in order to withstand any future legal challenge based on a claim that such an alternative was not seriously considered.

The EIR/S should, for all alternatives considered, examine and analyze the potential effects of predicted sea-level rise on the proposed plan, including the proportions of various habitat types expected. For example, the impacts of sea-level rise or flooding on existing dune habitat and species located in the westernmost portion of Area B should be considered for each alternative.

The Ballona Wetlands Ecological Reserve (BWER) is 600 acres, surrounded by urban Los Angeles County. The BWER provides valuable and scenic open space in the heart of congested Los Angeles County and offers one of the largest and most promising opportunities for coastal wetland restoration in the region. When restored and opened to the public, the site will allow millions of residents and visitors a rare opportunity to experience a coastal wetland.

Given the location of the Ballona Wetlands and surrounding open space in an urban environment, the biggest challenge is finding the "right" balance between competing needs for salt marsh, freshwater cleansing marsh, uplands, trails and public use. The FBW's guiding principles are as follows:

1. Restore a wetland ecosystem that functions according to natural estuary flows as much as possible.
2. Respect and enhance existing rich and productive habitats, minimizing disturbances.
3. Maximize the areas available to restore tidal marshes.
4. Minimize disturbance or removal of existing features (such as roads, gas and oil facilities and pipelines, and other expensive infrastructure) when their removal or disturbance would be too expensive, too impractical, or too disruptive.

5. Create opportunities to educate the public about the values of Ballona, teaching them to respect the boundaries of wildlife habitat and enjoy the wetlands without harming them.

With these guiding principles in mind, the FBW overall goals are:

- Restore a dynamic, self-sustaining tidal wetlands ecosystem that results in a net gain in wetlands functions and a net gain in salt marsh acreage and that serves as an estuarine link between Santa Monica Bay and the freshwater tributaries to the Ballona Salt Marsh.
- Maintain flexibility after restoration is complete to allow for adjustments that occur naturally.
- The preferred salt marsh restoration program is a combination of muted tidal where wetlands are currently relatively healthy and functioning (western end south of the channel), and full tidal further inland where it will be least likely to impact existing infrastructure and/or cause flooding. Existing infrastructure forms a divider between these two tidal regimes.
- The new restoration plan is also a unique opportunity to remove at least some existing concrete/rip-rap banks of the Ballona Creek creating a wider and more natural estuarine environment for the Creek.

For non-wetlands open space, the goal is to create additional salt marsh where feasible and to provide improved uplands and prairie grasslands habitat to support a healthy Ballona ecosystem. While restoring uplands vegetation is also important, there is minimal land available for salt marsh restoration and that should be the priority. However existing unique habitat areas, such as the remnant dunes and riparian area at the base of the southern bluffs, should be protected and restored.

- The existing freshwater marsh should be protected, and additional freshwater treatment wetlands be created to protect the salt marsh habitat from upstream urban drainage and pollution and provide a freshwater source for wildlife.
- Public recreational uses, similar to those planned at the Los Angeles State Historic park, most recently known as the Cornfields property near downtown Los Angeles, should be retained at the existing ball fields and in adjacent open space where existing habitat is poor, in order to serve the recreational needs of the children living in surrounding communities, particularly disadvantaged communities.
- Generally, however, emphasis should be on passive recreational uses, such as nature trails or a demonstration garden for native plants, as opposed to more ball fields or active recreation. Such land use should be sensitive to special status species which are known to occur on the site (e.g., southern tarplant) or which may be discovered in surveys.
- Public trails that encourage enjoyment and education regarding Ballona's valuable natural resources and link to existing or planned visitor nodes--- without impacting habitat -- are also important and need to be included. A visitor or interpretive center, conceptually, should also be considered and analyzed as part of the proposed project.

- In order to accomplish the most restoration with limited public dollars, existing constraints should be analyzed and, if possible, accommodated in the restoration design.

Additionally, the following objectives are important for the restoration effort and should be considered:

Biological:

- To create a diverse, integrated salt marsh system that provides habitat for native coastal estuarine fish, invertebrates, and wildlife.
- To create freshwater marsh areas which enhance habitat diversity at Ballona and improve water quality.
- To provide a mix of habitat types for sensitive, rare, and endangered species, and species that are of regional conservation concern.
- To contribute to the health of Santa Monica Bay and its watershed, including the diversity and abundance of fish, invertebrates, wildlife, and habitat linkages.
- To restore as much as possible the native plant diversity that had been present historically in the Ballona Wetlands.
- To allow for a brackish ecotone between the existing freshwater marsh and the to-be-restored salt marsh.
- To create, where feasible, sufficient and adequate native upland buffers that aid in maintaining and/or restoring resources and serving as a biological link to the adjacent wetlands.
- As part of native upland buffers, to enhance and create where possible, native coastal prairie habitat – a habitat that is both extremely rare and historically relevant to the region.

Water Quantity:

- To protect existing communities and facilities from flooding.
- To allow for seasonal freshwater flushing of the saltwater system that considers interannual variability, natural estuarine dynamics, and the ecology of estuarine species.
- To provide sufficient capacity in water control structures to maintain tidal flushing as the new salt marsh plantings mature and consume more space**.**

Water Quality:

- To assure seasonal fluctuations in salinities to promote salt marsh species diversity.
- To minimize pollutant input from urban runoff into the salt marsh and Santa Monica Bay.
- To protect the wetlands system from accidental spills and trash.

Soils and Sedimentation:

- To allow natural accretion of sediment or create elevational contours with the wetland to accommodate sea-level changes.
- To maintain soil moisture and salinity at appropriate levels for the types of salt marsh vegetation desired.
- To remove contaminated or hazardous soils from the site, if present, prior to construction.

Public Access:

- To allow limited, well-regulated but effective public access in order to provide meaningful opportunities for the public to experience Ballona while protecting and preserving sensitive species and habitats.
- To provide cohesive trail connections between the Ballona Discovery Park, freshwater marsh, salt marsh, dunes, Ballona Creek, and the Bluffs.
- Employ safe bicycle and walking trails that do not put pedestrians and cyclists on busy streets.
- Safety on Trails: Call boxes, doggie poop bags, and trash cans should be located periodically on trails. There should be no additional lighting.
- Controlled and sensible: Use perimeters and existing trails when possible. Use vistas and clearly designated trails. Use existing bluffs road (Cabora), possible gas company easement and limited new trails, to link a Visitor Center, Discovery Park, and the Freshwater Marsh to Playa del Rey. Limited trails allowing for on-leash dog walking.
- Use raised look-out towers or platforms for viewing and nature study without disturbing wildlife.
- Educational: Signage should explain the history, value, and scenic beauty of Ballona, encouraging stewardship and limiting negative human impact.

Public Programs:

- To continue on-site education programs to offer valuable education and restoration opportunities to students of all ages, as well as to the general public.
- To allow current volunteer restoration programs to continue in the dunes and in specific permitted areas throughout Ballona.
- To enhance educational opportunities at the Freshwater Marsh.
- To provide cohesive, connected educational opportunities and signage between the Ballona freshwater marsh, salt marsh, dunes, Ballona creek, and bluffs.

Friends of Ballona Wetlands have long advocated its conceptual restoration plan, which is attached, to represent the general comprehensive restoration of Ballona and the physical and biological elements contained within. This plan is not meant as a design, engineering or construction plan; only as a visual representation of the types of habitat that a restoration project should consider, and the locations where FBW believes such habitats could be restored. FBW appreciates the project proponents' consideration of this plan.


EXISTING TRAIL
LEVEE
EXISTING CHANNEL
SEASONAL WETLAND
FRESHWATER MARSH
NATURE TRAIL
PICNIC AREA
FULL TIDAL MARSH
ENHANCED UPLANDS & GRASSLANDS
ENHANCED UPLAND
ISLAND
RECREATION BALL FIELDS
EXISTING TRAIL
DUNES & RIPARIAN AREA
BRIDGE
NEW TIDE GATES
ENHANCED UPLAND
SALT PAN
FULL TIDAL MARSH
FULL TIDAL
SEASONAL WETLAND
MUTED TIDAL MARSH
MUTED TIDAL
FULL TIDAL
BRACKISH
P
BOLO SITE
FRESHWATER MARSHES
GAS CO.
ENHANCED RIPARIAN HABITAT
EXISTING FRESHWATER MARSH
BALLONA DISCOVERY CENTER
BRIDGE OVER LINCOLN BLVD.
BALLONA WETLANDS RESTORATION
CONCEPTUAL PLAN
Prepared by the Friends of Ballona Wetlands
JULY 2007
LEGEND
FULL TIDAL MARSH
MUTED TIDAL MARSH
BRACKISH
FRESH WATER MARSH
SEASONAL WETLAND
ENHANCED UPLANDS & GRASSLANDS
ENHANCED RIPARIAN HABITAT
DUNES HABITAT
TRANSITION BUFFER AREA
PROPOSED TRAILS
EXISTING TRAILS
PUBLIC ACCESS/PARKING
OVERLOOK
TIDE & DRAINAGE GATES
NOT SHOWN
1. Remove concrete floor and rip-rap walls in Ballona Creek to enlarged tidal basin
2. Remove all power lines on Culver Blvd. and Route to underground

Oct. 22, 2012
TO: USACE, Daniel.P.Swenson @ USACE.ARMY.MIL
CDFG David Lawhead

FROM: GRASSROOTS COALITION, Patricia McPherson-President
3749 Greenwood Ave. Los Angeles, CA. 90066
PatriciaMcPherson1@verizon.net

Please extend the Oct. 23rd NOI deadline until a public hearing by the Army Corps and CDFG can be held. This request was made at the August display event, but thus far it has not happened.

RE: SCOPING COMMENTS AND QUERIES FOR THE 2012 NOI; JOINT EIS (CWA PERMITS) AND EIR FOR BALLONA WETLANDS RESTORATION PROJECT

ISSUE # 1:

OILFIELD GAS HAZARDS/ SOCALGAS/PLAYA VISTA/ WILDLIFE AND PUBLIC HAZARDS

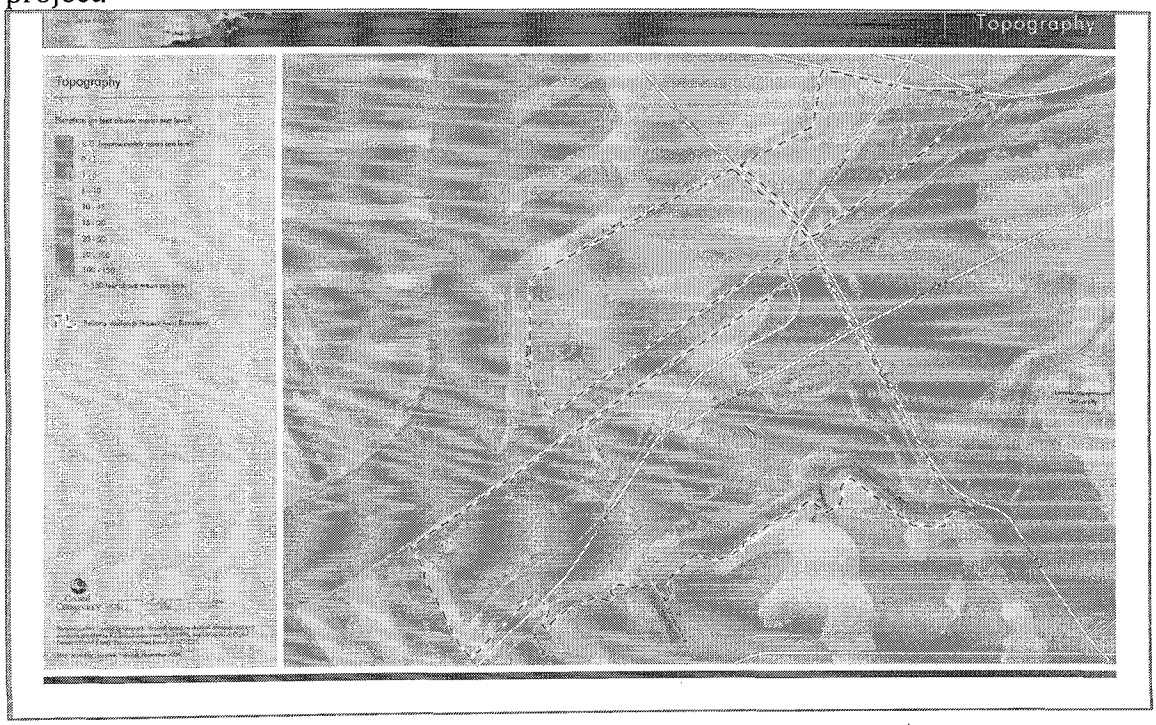
SCOPING – High pressure gas storage operations of the Southern California Gas Company (SOCALGAS) operated within the partially depleted oil fields of Playa del Rey and Venice. New information is available that has not been utilized.

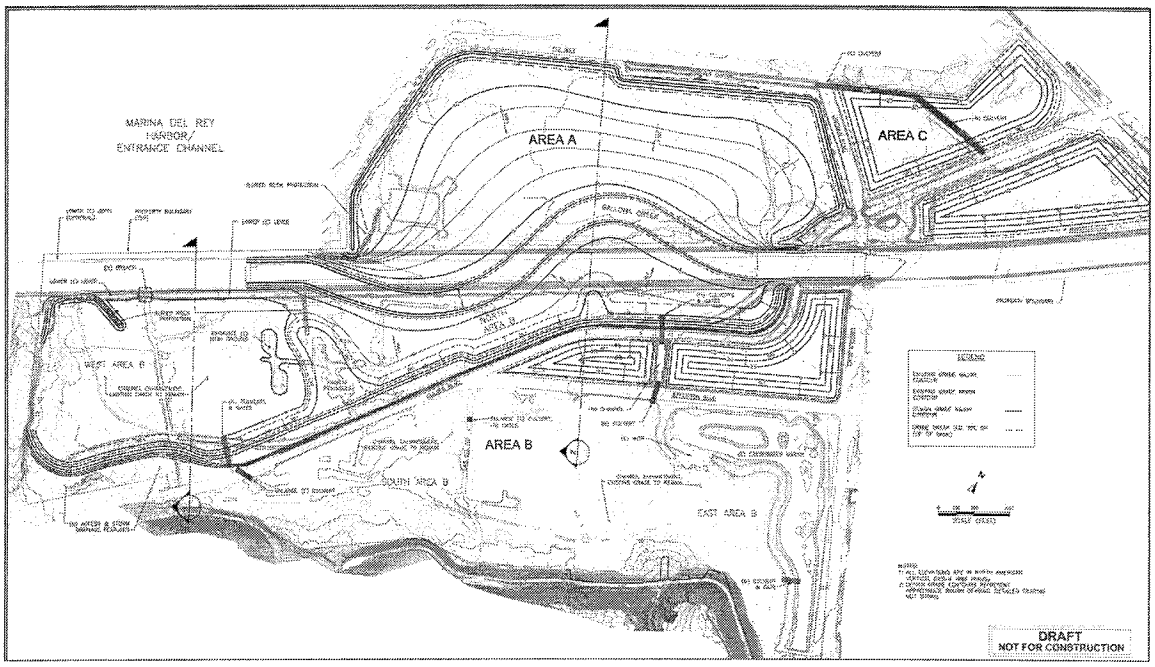
-needs to include studies that evaluate environmental harm from Ballona Channel changes (408 permit) and dredging/ filling of Ballona habitat pertaining to oilfield gas migration hazards and oilfield gas migration hazards that may be enhanced due to the SMBRC/COASTAL CONSERVANCY (CC) "PLAN"
.

Background and overarching scoping needs-
The promised hydrology studies (2005 Joint EIR/EIS—between USACE & the Authority) of Ballona Wetlands have not been done. Instead, the SMBRC/FOUNDATION -director & staff and the California Coastal Conservancy have interfered with and stopped the areawide ecological studies and geotechnical studies of the federal review for restoration potentials in the greater Ballona region in order to promote a singular 'Plan' of destruction and experimental construction upon Ballona Wetlands- Areas A,B,C . This "Plan" excluded groundwater hydrology studies and focused upon hydrolics studies of surface water flows into Ballona Channel .

Conservancy contracted- Psomas Co. contour maps of the "Plan" reveal that it is a flood control plan that only benefits a private development known as Playa Vista (Playa Capital LLC). The Proposition 12 bond funds have illegitimately been spent on private use protections to a development site that was illegally allowed to build in a flood plain. FEMA was not engaged for oversight comments as needed as the EIR process for Playa Vista was thwarted by failure to utilize the Clearinghouse as a gateway for proper notice to all pertinent agencies. (ETINA v City of LA; Playa Capital LLC) This failure by the lead agency- the City of Los Angeles- to include and enforce California Environmental Quality Act (CEQA) protocol of Clearinghouse utilization **PLACES THAT BURDEN NOW UPON USACE AND THE California Dept. of Fish and Game and its state agency partners. FEMA MUST NOW BE ENGAGED** and the issues that pertain to flood protection for Playa Vista must now be reviewed in light of the flood control devices and the preordained 'Plan' of development and construction proposed by SMBRC/Foundation and the California Coastal Conservancy.

The giant berms and levees-approximately 20 feet above current road level as shown in the contour plans – are NOT habitat; are NOT RESTORATION but instead are civil works flood protection devices to benefit Playa Vista.
Furthermore, the 'Plan's' intent to DREDGE Ballona is NOT RESTORATION but instead is simply an experimental attempt at an end of pipe solution to the toxic water and sediment flow down the Ballona Channel. The catch-basin shown in the 'Plan' does NOT enhance or restore Ballona but instead destroys the very habitat that the public has spent over 20 years to protect. The effects of the 'Plan' as a catch-basin and flood control project have not been studied. Current roadways, Marina del Rey and other beach front areas appear to be put in jeopardy from the project.




MARINA DEL REY
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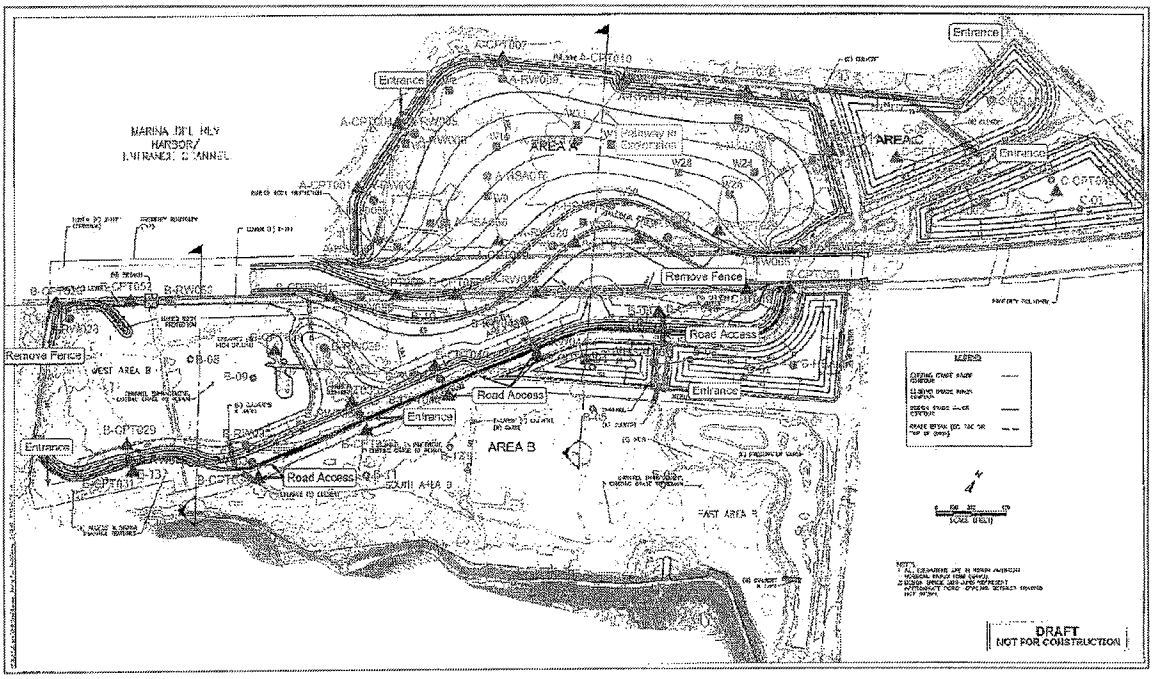
MARINA DEL REY
HARBOR/
ENTRANCE CHANNEL
AREA A
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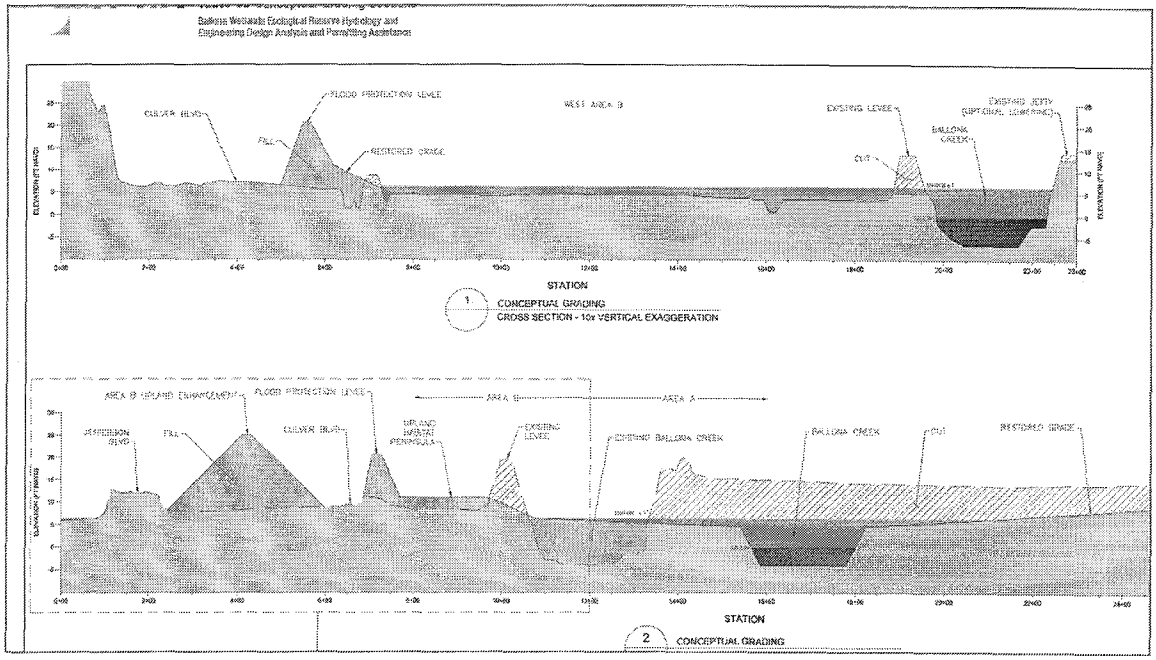

State 'Plan" –note the structural pyramids of berm/ levee and respond to how structures will be 'habitat'? Please include response for nearly vertical levee structures and how is this habitat? Or habitat protection?



View destroyed towards SM Bay AND height of NON-"restoration upland"- aka engineered flood control berm to protect Playa Vista –GC approximate visual

SCOPING:

Issues of safety, failure to utilize the bond funds as approved by the public; failure to work with and include the public's participation in restoration concepts and planning; the legitimacy of process -- promised and paid for by bond dollars v the exclusionary and preordained outcome plan by the SMBRC/Foundation and the Coastal Conservancy must be addressed in the SCOPING AND DRAFT EIS/R.

Response to conflict of interest allegations, illegal use of bond funds, lack of transparency issues raised and failure to perform in good faith toward restoration, acquisition of more of Ballona, and enhancement issues that would protect and utilize the freshwater resources of Ballona onsite must be addressed and raised for public awareness of these and other challenges leveled at the lead agencies and their 'partner' agencies.

SOCALGAS – Playa del Rey operations have not been adequately addressed. Migration of oilfield gas issues have not been addressed.

For example:

"GROUNDWATER MOVEMENT

The movement of local groundwater can greatly influence both the upward and lateral migration of the oilfield gases. For these reasons, a detailed hydrogeological study of the area is necessary. For purposes of environmental assessment, groundwater influences are crucial in the evaluation and interpretation of the experimental data.

For example, many of the environmental studies to evaluate soil contamination are carried out using relatively shallow soil probes that do NOT penetrate below the near surface aquifer zones. Accordingly, before proper experimental interpretations can be given to the gas concentrations, ***the hydrogeological conditions must be well known. A profound example, is where the aquifer conditions are being continually influenced by the nearby tidal forces of the Pacific Ocean.***

Furthermore, each of the oil field gas constituents has a different level of solubility in water."p.3

BTEX chemicals (benzene, toluene, ethylbenzene, p-xylene, o-xylene) and hydrogen sulfide (H2S) are chemicals known to be part of the oilfield gases surfacing in the Ballona Wetlands and Playa Vista. (Exploration Technologies(ETI) / City of Los Angeles 2000-1 gas reports; Still Workin On It – ETI)

And per SOCALGAS-PDR operations:
"...once upward migrating leaking gases, associated with each well, reaches the gravel zone it rapidly spreads out laterally within the highly permeable gravel zone.

The gravel zone extends easterly along the path of the ol Los Angeles Riverbed, and follows the current path of the county flood control channel. In terms of permeability,

this gravel zone provides an excellent conduit for the gas to move easterly, and directly under the Playa Vista *real estate development currently under construction.*

This movement has been facilitated by the tidal action of the ocean, which acts as a "piston" (by analogy to an automobile engine) in providing a periodic, and pulsating, energy source in moving the gas from the location of the leaking wells, easterly under the Playa Vista development. At low tide, oil field gas rapidly moves up the old oil field well bores. At high tide the gas is "pushed" easterly as the rising ocean level influences the pressures within the gravel zone." P. 16 ENVIRONMENTAL AND HEALTH HAZARDS DUE TO METHANE AND OTHER OIL FIELD GAS MOVEMENT THROUGH SOILS Bernard Endres, PhD

Additionally, it is well known that both H2S and salt water have proven corrosive effects upon the casings and sealings of well bores. Numerous wells have been identified by SOCALGAS as having holes due to salt water corrosion in the PDR field. (See attachments of internal SOCALGAS documents citing leakage of SOCALGAS wells)
Example:
SCG-Playa del Rey operations:
"Historical drilling records reveal serious problems with achieving a competent cement seal when the surface casing was being cemented to the surrounding rock formation. This was especially serious for the Townlot Wells that were closer to the Pacific Ocean beach. ***.....Furthermore, saltwater intrusion from the nearby Pacific Ocean is also highly corrosive to the steel surface casing, and is known to cause significant deterioration of the concrete shoe materials."***
CPUC LITIGATION Grassroots Coalition v SOCALGAS/ Bernard Endres PhD consulting expert of record
The Playa del Rey Gas Storage Facility Gas Migration Hazards; And The Duties Imposed To Monitor And Mitigate These Dangerous Conditions Mar. 24,2007
Case 00-05-010; 011;012



The area is just across from Playa Vista on west side of Lincoln Blvd. Note the tire tracks and site vacated after exposing gas and fluids broiling up in closeup provided below. Why wasn't this borehole and effluent contained? This wetland portion filled with pickleweed- a wetland indicatior species- will be destroyed by the State's Plan by filling up to 20' above road level in order to create what? A giant flood control mountain of vertical earth. The public paid for Ballona to be restored and enhanced ---not to use public dollars to provide private protection to Playa Vista. Please respond.

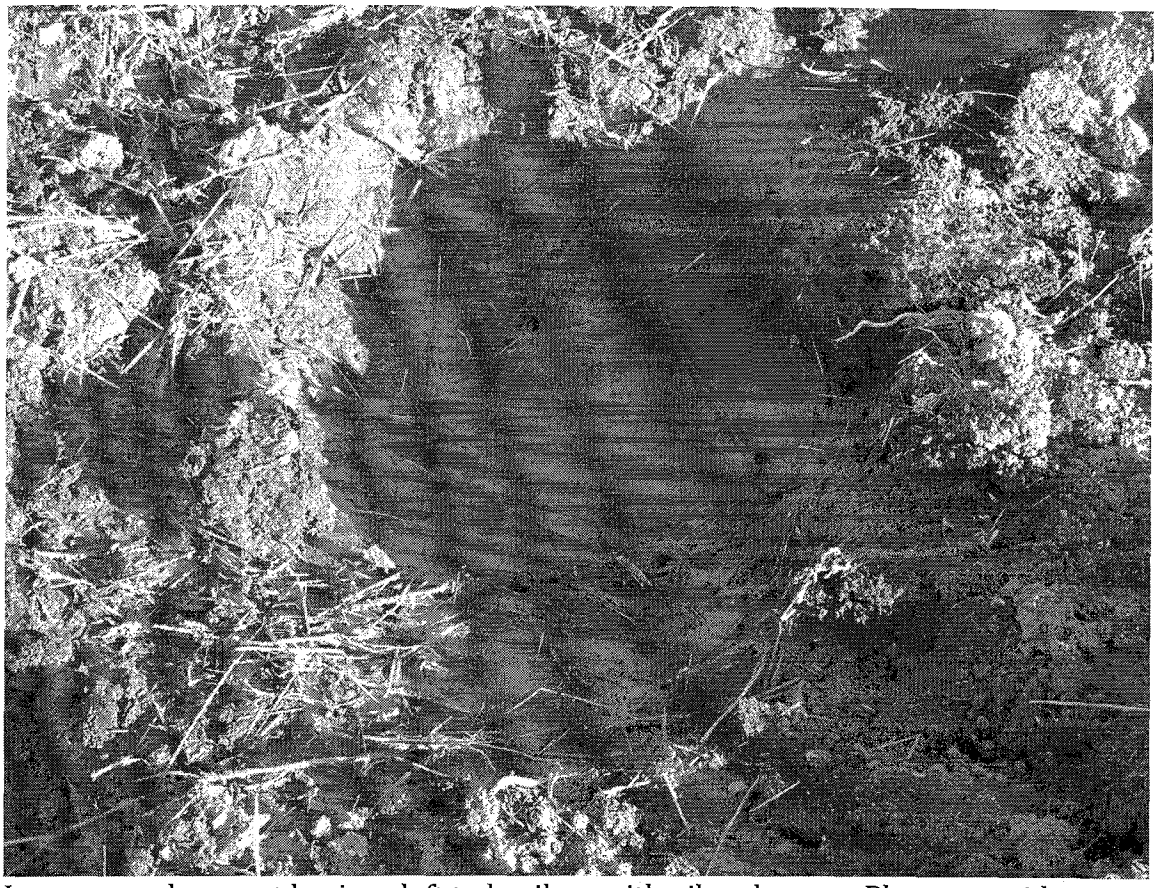

Image reveals recent borings left to broil up with oil and gases. Please provide discussion/ explanation/ testing data of this boring along with the rest of the boring done on Ballona in 2012.

SCOPING- Studies need to include evaluations of how monitoring will occur for gas leakage and contamination, where and what mitigation will need to occur regarding oil/gas wells or other wells acting as conduits for oilfield gas migration.

- **Who will be responsible for enhanced gas migration throughout the area due to the construction of the catch-basin (treatment wetland) and flood control protection to Playa Vista of the berms and levees ?**
- **-What mitigation will take place to prevent enhanced gas movement through the area due to the proposed tidal inundation and flows?**
- **What studies will be done to illuminate the potential gas movement changes?**
- **How and what mitigation measures will offset the enhanced liquefaction potentials caused by gas migration upon the proposed levees, berms and other construction devices of the channel changes and proposed experimental treatment basin?**
- **What liabilities and responsibilities do the state agencies including CDFG ; the Coastal Conservancy (CC); Santa Monica Bay Restoration Commission (SMBRC) and its individual personnel and the USACE have**

for affects upon the infrastructure and the environment for failure to evaluate the gas migration pathways?

- Evaluation needs to take place –
- How will the proposed channel change/ berm and levee construction and dredging and increased tidal flow facilitate the migration of oilfield gases and dangerous accumulation of these gases—especially in light of the current failure to investigate and/or monitor at least one Playa Capitall LLC oilwell- University City Syndicate (freshwater marsh) that is off gassing millions of cubic feet of oilfield gases daily and numerous other SOCALGAS wells that have recently leaked reservoir gases to the surface?(DOGGR 1008 Order & SOCALGAS/ Grassroots Coalition Settlement Agreement gas studies showing 900,000 ppm of oilfield gases surfacing)
- -Since the riparian corridor and the catchbasin (freshwater marsh) are also part of the Ballona ecosystem and directly and/or indirectly affects the region via gas contamination and/or other contamination—what liabilities do the agencies of the EIR/EIS have for failure to include and address the overlapping environmental issues and their mitigation?
- The Playa Vista site- including the riparian corridor and the catch basin (freshwater marsh) need to be included in the EIS/EIR for the issues of gas migration/mitigation ; dewatering-hydrology as the areas directly and indirectly affect the region.
- Playa Vista was built in a flood plain without oversight -via CEQA clearinghouse notification- of FEMA. (ETINA v City of LA/Playa Capital LLC) Scoping now needs to include these issues of buildout in a flood plain and the ramifications of that buildout.
- -

SCOPING- Gas migration evaluations need to be performed throughout the restoration area to update and map current oilfield gas migration patterns. The joint EIR/EIS must include available information pertaining to the oilfield gas migration hazards of Ballona.

-What soil gas and hydrology issues were discovered in 2012 as a result of the boring operations for berm and levee placement ?

- What geotechnical issues regarding the gravel zone and other underlying zones and aquifers were addressed and acknowledged as part of the same boring operations? These issues and scientifically legitimate answers by qualified and UNBIASED scientists must be included as part of the scoping issues.

- It appears that most if not all of the consultants utilized for work studies on Ballona have a lengthy and conflicted history of working for the Playa Vista, Playa Capital LLC; SOCALGAS- SOCALEdison (affiliated with SOCALGAS via gas storage needs and contracts) entities that have vested and monetary interests in Ballona both directly and indirectly.

- Why does the federal government and state agencies allow for such apparent conflict of interest to occur?
-Why aren't companies without such past and current financial ties to the Playa Vista development site and SOCALGAS/Edison being contracted for work on Ballona by the federal government and state agencies??

See- California Public Utilities Commission (CPUC)- Safety Branch Report citing the high likelihood of SOCALGAS reservoir gas leaking to the surface throughout Ballona and Playa Vista. The Nov. 2004 Consumer Protection and Safety Division report cites major concerns for SOCALGAS reservoir gas leakage:

"C. 22 PPM . Helium from a shallow probe sample by John Sepich and Associate. Isotech Laboratory performed an isotopic analysis of a gas sample submitted by Sepich & Associates on 3/25/99. Secich and Associates was working for Playa Vista developers (developers of residential and business properties around the PDR Storage field. The isotopic analysis report indicates the gas sample was collected from Playa Vista Project Area –D. The analysis report also revealed presence of Ethane and 22 PPM Helium in the gas sample. The significance of this isotopic analysis report is the presence Storage Reservoir gas or Native PDR gas signature and the location where the gas sample was collect (Area—D of Playa Vista Project)."

-"My opinion is that the probability of Storage Reservoir gas sample from PDR area containing Ethane and 22 PPM Helium is greater than 50 percent (>50%). Furthermore, the location where the sample was collected should be of major concern. Please see Appendix # C." p.6.

"III. Recommendations

A review of the aforementioned facts and findings suggest the existence of a potential safety hazard." P.9

The report recommends further study and investigation on pages 9-10 that includes but are not limited to :
3-dimensional geologic computer model that provides *"(well records, soil gas investigations, geo-technical borings, geophysical data, environmental borings, site contamination data, groundwater data, etc) to fully integrate and visually display geologic data 9strata and discontinuities) and other subsurface information (gas and groundwater locations) at the storage field."pg. 9*

SCOPING-These studies have not been performed and should be part of the scoping review for the federal and state review of Ballona.

Because of the vested financial interests of Playa Vista (Playa Capital LLC) and SOCALGAS and SOCALEdison (gas storage use of PDR field) ; Grassroots Coalition

believes that only contractors with no conflicted financial ties to these corporate entities should be allowed to perform geotechnical and environmental studies upon the Ballona region in order to perform unbiased studies.

GC is also concerned about the financial and conflicted interests of staff and board members of SMBRFoundation who provide direct and indirect influence upon both the SMBRC and the Coastal Conservancy.

SCOPING- Transparency does not exist in the Ballona restoration process and needs to be included in the scoping issues for the DEIR. Full public disclosure of the financial and economic issues must be addressed and addressed individually for all staff and board members of the private SMBRFoundation—including those that simultaneously hold positions of authority within the SMBRC, the Coastal Conservancy, other state or federal agencies.

Concerns regarding use of bond funds for the 'SMBRProject" which in 2002 became the SMBRCommission. The SMBRFOUNDATION claims in IRS documents that IT IS THE PROJECT. Thus, the SMBRFoundation takes in funding that is cited as being given to the SMBRC.
- Therefore, it is important for public awareness and participation for both the USACE and CDFG to address and make clear to the public---who actually is legally able contractually to receive and spend federal and state funds which are derived from the public.
-Conflict of interest issues must be addressed specifically by the USACE and CDFG that are responsive to specific queries raised by the public—including but not limited to the John Davis March 28, 2012 -REQUEST TO HOLD EMERGENCY MEETING TO RESCIND APPROVAL ACTION ON FILE NO. 04-088 ; the GC Amended Complaint to the Ca. Coastal Conservancy of August 2, 2012. Neither of these documents has had any response from the lead agencies partner—the Ca. Coastal Conservancy. The public has a right to know in order to make informed decisions.

See- 1008 Order -Division of Oil and Gas and Geothermal Resources (DOGGR) 2011
DOGGR 2011 Order for shut down of SOCALGAS gas injection operations pending investigation and control of escaping and surfacing reservoir gases.
The escaping reservoir gases utilized relatively new wells of SOCALGAS/PDR operations.

See- SETTLEMENT AGREEMENT (CPUC litigation Grassroots Coalition v SOCALGAS)

SCOPING -The EIS/EIR should contain information relative to the ongoing status of the SA.
Health and safety issues are critical to restoration of BAllona. SOCALGAS has not abided by the terms of the SA and GC has been working to ensure...

See-
The 2005 EIS/EIR scoping included the potential and likely negative environmental effects of eg.Poland Report issues identified by USACE in the construction of the Marina del Rey marina such as potential negative effects to the groundwater (classified as potential drinking water) due to breeching clay layers from dredging the marina areas. The USACE cited likely salt water intrusion enhancement and needs for protection of freshwater from salt water contamination. The Poland Report cites the connection of the Ballona area to the west basin aquifer.

SCOPING- The 2012 EIS/EIR should include the Poland Report and the USACE 2005 EIS (House Document 389) issues raised regarding concerns of Ballona aquifer / West Basin contamination. For instance:

-what effects will dredging have upon further saltwater contamination in the area.

-how will freshwater resources of the area be protected? The House Document 389 cautioned against breeching a clay layer protecting deeper freshwater zones at Ballona.
Additionally, clay layers can contain secondary collector zones of oilfield gases.
Example- from the Fairfax explosion 1985-Ross-Dress-For-Less.

The pathway of gas migration to the surface included the 3rd Street Fault and an old abandoned well (Chilingar, personal communication). A shallow collector zone (large pocket) of trapped oilfield gas was discovered at a depth of approximately 15 m with pressures of approximately 1.8 kg/cm2 . This collector zone had sufficient porosity and permeability to serve as a temporary trap for the large quantities of upward migrating gases. **A clay layer served as a seal until its threshold pressure was exceeded.** After the explosion, permanent soil gas probes were installed to a depth of approximately 4.6 m in order to perform ongoing monitoring of the upward migrating gases
p 1446. 2012 Migration of Gas from Oil /Gas Fields
J. O. Robertson, G.V.Chilingar, L.F. Khilyuk, B. Endrea

-what mitigation will take place for preservation of the freshwater aquifers and streams?

-Freshwater zones must be protected from the invasion of oilfield gas chemicals; alternative restoration concepts must include options that provide absolute protection from exacerbation of oilfield gas migration contamination.

- SOCALGAS pipelines have not been acknowledged or addressed. Multiple SCG pipelines that surround and pass through Areas A and B have not had any evaluation and must be considered and mitigated and/or removed to prevent

further contamination to the area. (SEE Public Record Act requests to County and Beaches and Harbor)

- **new directional SCG wells that bottom out under Area A are, according to SCG- being used for fluid injection. What potential for direct or indirect harm to the environment exists now? And, what direct or indirect harm may occur to the environment and ecosystem due to potential fracturing of the formation from the fluid injection? What mitigation is proposed and who will maintain liability for harm to the environment?**

SCOPING:

PLAYA VISTA—There are numerous issues of potential for harm and diversion of groundwater that Playa Vista development project poses to the restoration of Ballona.

1. Groundwater diversion- see Groundwater Issues. Playa Vista must dewater the groundwater in order to keep gas evacuation pipes free of clogging from silt and water. The groundwater flow is toward the ocean thus any dewatering is depriving the wetlands from that groundwater and diverting water that would recharge the underlying aquifers.
   -The volumes of groundwater diversion and its potential harm to the wetlands has not been performed and needs to be performed.
   The potential for use onsite of Ballona must be part of any restoration analysis for BAllona.

"What is missing is any review of actual data from the Los Angeles Department of Sanitation. There are no Department of Sanitation documents in the Record which show actual or potential permitted groundwater discharges into the City Sewer System. "

. "Impacts of the project must be measured against the real conditions on the ground." (*Save Our Peninsula Comm. v. Monterey County Bd. of Supervisors* (2001) 87 Cal. App. 4th 99, 121 (citations omitted).) The City cannot simply rely on modeling data provided by Playa Vista, which has a vested interest in downplaying, limiting and minimizing the potential impacts of dewatering. (See *Id.* at 126 (discussing problems with relying solely on applicant generated data).) The City cannot delegate the duty to Playa Vista (or the public) to gather the necessary baseline information. (*Id.* at 122.)

"Petitioners specifically requested the City review its files from the Department of Sanitation in its "Notice of Information Required for Adequate CEQA Review" (5 RR 986.) In addition, a number of comments questioned the lack of actual data from the Department of Sanitation. (See e.g., 2 RR 428; 7 RR 1328; 1357.) In fact, five months before the final decision, Patricia McPherson stated at a public hearing "The Department of Sanitation has 65 - - 65 groundwater dewatering permits for the site

at Playa Vista. You chose five building to look at. You didn't give [the Peer Reviewers] a fair model to begin with." (7 RR 1357:line 24 to 1358: line 3.) The City simply ignored such comment and pretended that the Department of Sanitation did not exist. " page 5 of brief

It is the City's duty, not the public's to do the proper environmental investigation. (*Save Our Peninsula, supra,* 87 Cal. App. 4th at 122; *Sundstrom v. County of Mendocino* (1988) 202 Cal. App. 3d 296, 311.) The City violated the information disclosure provisions of CEQA by not providing records from the Department of Sanitation to the City Council and the public for review.

C. The City Abused Its Discretion By Failing to Inform the Regional Water Quality Control Board of its CEQA Review and Gathering the Appropriate Data.

Informing other governmental agencies that CEQA review is occurring is an incredibly important step in the CEQA process. Section 21080.3 of CEQA states:

> Prior to determining whether a negative declaration or environmental impact report is required for a project, the lead agency shall consult with all responsible agencies and trustee agencies. Prior to that required consultation, the lead agency may informally contact any of those agencies.

(Pub. Res. Code § 21080.3(a).)

Obviously, such consultation will only occur if the responsible or trustee agency that it is informed that it is evaluating a project (or a portion of a project) under CEQA. There is nothing in the record which demonstrates the City informed the Regional Water Quality Control Board (RWQCB) that it was participating in a CEQA process. The failure to inform a lead or trustee agency of the CEQA process is a prejudicial an abuse of discretion. (*Fall River Wild Trout Found. v. County of Shasta* (1999) 70 Cal. App. 4th 482, 492.)

This is not to imply that the RWQCB did not participate in the CLA process. However, the CLA process, according to the City's was not prepared under CEQA. As noted by Attorney Susan Pfann, "There's no requirement of how you about doing [a peer review] or whether or not you have to senditso certain agencies...its simply a study." (2 RR 403.) In this case, the City failed to inform the Regional Water Quality Control Board (RWQCB) of its CEQA process, instead simply requesting the RWQCB simply review Playa Vista's modeling program. Petitioners' specifically objected to the City's failure to notify the RWQCB of the process thereby triggering full CEQA review. (5 RR 943.) By solely requesting a review of the modeling study prepared by CDM, the City prevented the RWQCB from fully participating in a manner

required in a CEQA review process, and violated the information disclosure requirements of CEQA. (Pub. Res. Code 21005.)

The City may argue that its failure to inform the RWQCB that it was participating in a CEQA process was not a prejudicial because the RWQCB did make comments. Perhaps if the City had requested all the relevant data regarding dewater at Playa Vista and Ballona Wetlands possessed by the RWQCB, the City would have an argument. However, there is no evidence in the record that the City requested even basic data, such as NPDES permits or actual metering data, despite the fact that Petitioners specifically requested the City review NPDES permits in its study of significant effects. (5 RR 986.)

D. The City Failed to Gather or Present Data Necessary for Determining Whether Dewatering Activities Were Cumulatively Considerable.

The lack of information from the RWQCB and Department of Sanitation is especially egregious when one considers the lack of analysis of cumulative impacts. A lead agency must determine not only direct and indirect effects of a project are significant, but must also consider whether such impacts are cumulatively significant. (Guidelines section 15064.) As noted in the case law discussing cumulative impacts, "the outcome may appear startling once the nature of the cumulative impact problem has been grasped." (*Kings County Farm Bureau v. City of Hanford* (1990) 221 Cal. App. 3d 692, 721.) The City, by limiting its review solely to the five buildings identified by Playa Vista in its modeling data, failed to consider whether all dewatering activities taken together, may be cumulatively significant.

Phase I of the Playa Vista Development consists of 3,426 residential units, 1.25 million square feet of office and light industrial space, 35,000 acres of retail space and 300 hotel rooms on 246.3 acres of land. ((Environmentalism Through Inspiration and Non-Violent Action, et. al. v. City of Los Angeles, 2005 Cal. App. Unpub. LEXIS 9697, at 3.) ("ETINA v. LA") Despite the massive size, there is no description in the 2007 CLA Report of how many buildings are a part of Playa Vista Phase I, nor how many buildings have dewatering systems. This data should have been easily obtainable from

the Department of Sanitation, which issued industrial water permits for the dewatering systems. (3 RR 502.) Yet, it was not presented to the public.

If one were to search exhaustively through the administrative record, one would find a table described as "Construction and Vesting Status of Playa Vista Phase I" that was apparently submitted by Playa Vista on the date of the hearing. (2 RR 226.) The table identifies 39 Buildings in the "west end of the first phase" (2 RR 226-29.) Of those 39 buildings identified by Playa Vista, 18 of such buildings are identified as having "ground-water dewatering system" Yet, the table fails to identify how much dewatering is occurring at each site. Such information is crucial to knowing whether the dewatering at Playa Vista is cumulatively considerable.

In addition, other dewatering activities independent of buildings must be evaluated to determine whether there is a significant impact. It was incumbent on the City to request dewatering data from the RWQCB, the agency responsible for managing the states' water. Despite petitioners' request that such data be evaluated, there is no indication in the record that the City requested such information from the RWQCB. (3 RR 486.)

Of course, as indicated by the description as "Playa Vista Phase I", there is also Playa Vista Phase II. Despite this well-known fact, there is no analysis in the 2007 CLA report of Phase II. The 2007 CLA report indicates that the peer reviewers solely reviewed reports analyzing the potential impacts installed in Phase I of the Playa Vista development. (3 RR 473.) There is no analysis of the dewatering activities expected in Phase II of the Playa Vista Development.

For a proper analysis of the potential cumulative impacts requires an analysis of all dewatering activities at Playa Vista. This information is available from the RWQCB. But, the City failed to request such information. There is not information in the record which describes NPDES permits of the Playa Vista site or actual discharge volumes into Ballona Wetlands. Without providing the total volume of all dewatering activities, neither the City nor the public can properly evaluate or participate in the public process. "

Pages 6-8
Additional Objections In Opposition To Return To Writ—**ETINA v City of Los Angeles, Playa Capital LLC**

A. Evidence From the Los Angeles Department of Sanitation and the Regional Water Quality Control Board Demonstrates the City and Playa Vista Violated Information Disclosure Requirements of CEQA.

Public Resources Code section 21005 states,

> [N]oncompliance with the information disclosure provisions of this division which precludes relevant information from being presented to the public agency . . . may constitute a prejudicial abuse of discretion.

There a number of ways that an applicant or a lead agency may fail to comply with the information disclosure requirements. (*See e.g. Fall River Wild Trout Found. v. County of Shasta* (1999) 70 Cal. App. 4th 482, 493 (failing to notify DFG); *Cadiz Land Co. v. Rail Cycle* (2000) 83 Cal. App. 4th 74, 95 (failing to identify size of aquifer); *Sierra Club v. State Bd. of Forestry* (1994) 7 Cal. 4th 1215 (failing to study endangered species); *Save Our Peninsula, supra,* 87 Cal. App. 4th at 122 (failing to use actual data).) In fact, many cases which have sought to strike down environmental impact reports have sought to establish, through omission, that there has been non-compliance with the information disclosure requirements of CEQA. (*Association of Irritated Residents v. County of Madera* (2003) 107 Cal. App. 4th 1383, 1391.)

However, suppression of evidence is also a form of non-compliance. Evidence which clearly should be in the record, but has been improperly excluded, should be admissible to demonstrate a violation of Public Resources Code section 21005. Clearly evidence which has been withheld from the public, despite requests from the public for inclusion of such information, cannot be provided by the public. In addition, the public should be able to assume the lead agency will include documents which are required to be part of the administrative record under CEQA, such as documents in its own files on a project. (Pub. Res. Code 21167.6(e)(10).)

Such interpretation is supported by Western States which notes that extra-record evidence should be admissible to demonstrate procedural unfairness and agency misconduct. (*Western States Petroleum Ass'n v. Superior Court* (1995) 9 Cal. 4th 559, 575 n.5 & 579.) In *Western States,* the petroleum association attempted to introduce newly created expert evidence, prepared after the close of the public hearing, to demonstrate that the Air Resources Board failed to consider all relevant factors. The Supreme Court held, "extra-record evidence can never be admitted merely to contradict the evidence the administrative agency relied on in making a

quasi-legislative decision or to raise a question regarding the wisdom of that decision." In contrast, in this case Petitioners seek the court to consider documents which were in the agency's files or trustee agency's files to demonstrate a procedural defect in the City's CLA process.
In this case, there is extra-record evidence from the Department of Sanitation which demonstrates that the level of dewatering is almost five-fold greater than that which was presented in Playa Vista's modeling study. (Notice of Lodgment, Ex. 1.)[1] Brief pgs 9-10

SCOPING:

-The duty of cumulative groundwater dewatering now falls upon the state and federal agencies in the performance of this NEPA/ CEQA process.

- The duty of full disclosure with regard to state and federal agency behavior and process is also required in this NEPA/CEQA process- as cited above in the brief. Thus response to the John Davis and GC Complaints to the COASTAL CONSERVANCY regarding failure of due process, conflict of interest, prejudice ---require full evaluation and response.

" Still all the cases appear to agree that "[a] prejudicial abuse of discretion occurs if the failure to include relevant information precludes informed decisionmaking and

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IV. MOTION TO AUGMENT

A. This Court May Consider Relevant and Improperly Excluded Extra-Record Documents Because Petitioners Have Proven Such Documents Fall Under the Exception Enunciated by the Supreme Court of California.

Respondents contend that this Court may not consider two sets of relevant, extra-record documents: (1) documents from the LA City Department of Sanitation, including a table showing permitted discharges of up to 72,000 gallons per day, and (2) documents from the RWQCB showing permitted discharges of 950,000 gallons per day ("gpd"). (16 CT 3696-3700.) Though extra-record evidence is generally inadmissible, the Supreme Court of California has enunciated an exception to this general rule. "Extra-record evidence is admissible if the proponent shows that the evidence existed before the agency made its decision, but that it was impossible in the exercise of reasonable diligence to present it to the agency before the decision was made." (See *Cadiz Land Co.* v. *Rail Cycle* (2000) 83 Cal. App. 4th 74, 119 quoting *Western States Petroleum Assn. v. Superior Court, supra,* 9 Cal. 4th 559, 576-578.) This exception corresponds with Code of Civil Procedure section 1094.5, subdivision (e), which grants the court discretion to remand the case for reconsideration if the court finds "there is relevant evidence, which, in the exercise of reasonable diligence, could not have been produced at the administrative hearing or which was improperly excluded." (CCP § 1094.5.) Also, arguably, "extra-record evidence may be admissible to show 'agency misconduct.'" (*Id.* at 119 quoting *Western States Petroleum Assn., supra,* 9 Cal. 4th at pp. 575-576, fn. 5.)
The Court may properly consider the extra-record documents at issue

informed public participation, thereby thwarting the statutory goals of the EIR process." (*Id.*; *See also, Save Our Peninsula Comm. v. Monterey County Bd. of Supervisors* (2001) 87 Cal. App. 4th 99, 118; *Sierra Club v. State Bd. of Forestry* (1994) 7 Cal. 4th 1215, 1235.)"The courts have looked not for perfection but for adequacy, completeness, and a good faith effort at full disclosure" (*County of Amador, supra,* 76 Cal. App. 4th at 954.) " Brief p. 3

here because the documents demonstrate the City failed to consider maximum permitted discharges, even though such documents were in existence prior to the City's decision. Maximum permitted discharges are relevant both to an analysis of cumulative impacts, and to an analysis of potential worst-case scenario impacts for methane dewatering. Though Petitioners exercised reasonable diligence in requesting access to and inclusion of these documents, the City failed to comply. (Code Civ. Proc. § 1094.5(e).) This failure to include or consider these documents amounts to suppression of evidence and agency misconduct. Accordingly, the extra-record documents at issue here fall under the narrow exception articulated in *Western States* and Code of Civil Procedure section 1094.5(e). *(Western States Petroleum Assoc.* v. *Superior Court* (1995) 9 Cal. 4th 559, 576-578.)

i. The Record of Proceedings Under Public Resources Code Section 21167.6(a) is Broad and Inclusive.

Pursuant to Public Resources Code Section 21167.6(a), the record of proceedings shall include a broad array of documents "relating to the subject of the action or proceeding." Public Resources Code Section 21167.6(e) is inclusive, providing a list of items that "shall be included," but specifying that the record "is not limited to" those items. The statute "contemplates that the administrative record will include pretty much everything that ever came near a proposed development or to the agency's compliance with CEQA in responding to that development." (*County of Orange v. Superior Court* (2003) 113 Cal. App. 4th 1, 10.)

2. **The 2007 Methane Mitigation AUDIT performed by the City of Los Angeles (City Controller- Laura Chick) needs to be included and analyzed** for determination of the effects of the gas mitigation dewatering. The AUDIT reveals that methane mitigation measures -including the critical 50' deep vent wells (that but for their ability to vent and not clog—the site was considered too dangerous to build (CLA Report)—
Had no mitigation monitoring and no proof that the systems were implanted or implemented in a fashion that they actually work. The Audit also shows that Playa Capital LLC and the City of LA were and are unable to identify where the 50' vent wells are.

3. Department of Sanitation records need to be evaluated for analysis of groundwater dewatering that has direct and indirect impacts upon the restoration of Ballona and current groundwater movement across the Ballona habitat.
   Playa Vista and the City of LA have irresponsibily failed to provide Best Management Practices for the groundwater of Playa Vista and thus upon the sensitive ecological areas of Ballona. Instead, Playa Vista has been improperly and potentially illegally allowed to discharge Ballona groundwater (classified as potential drinking water) into the Sanitary Sewer via WASTEWATER DISCHARGE APPLICATIONS AND SOME PERMITS.

4. **GRAVEL COLLUMNS**:
   No 408 permits were given to Playa Capital LLC for installation of hundreds of gravel collumns along Ballona Channel- the north side of Fountain Park Apts.
   -This 408 permit issue needs to be evaluated for potential illegalities of insertion of the gravel collumns- without permitting as well as evaluated for The known and established actions of the stone collumns to act as cross contamination and groundwater movement features for groundwater and gases.
   -GC supplied pictures to the City of Los Angeles and to the LA County Flood Control that depicted CRACKING along Ballona's south levee- on the north side of Fountain Park Apts. GC herein submits a video- BURNING QUESTIONS- that supplies video of the insertion process of those stone collumns and the apparent outgassing and vibration.
   - What effects do the collumns have upon the integrity of the Ballona levee to the east of Lincoln Blvd.?
   - Did Playa Capital LLC have to secure a 408 permit for insertion of the stone collumns since the collumns align along the fence line of the Ballona levee? And, potentially have the ability to undermine the earth of the levee itself due to the constant rise and fall of tidal action upon the ground waters?

   -The City of Los Angeles and County Flood Control only performed a visual inspection as was discussed during a Building and Safety Commission Hearing during the 2000 -1 timeframe. To GC's knowledge no alert was provided to the Army Corps of Engineers for input into this issue of present concern. The collumns while providing stability from liquefaction for the apartment complex appear to be potentially undermining the integrity of the Ballona levee to the east of Lincoln Blvd.

5. **CDFG HISTORIC LACK OF OVERSIGHT OF KEY HEALTH AND SAFETY ENVIRONMENTAL ISSUES THAT CDFG must address in the 2012 EIS/EIR;**
   Including its role or lack thereof of prudent oversight of health and safety issues.

Example of why clarification is needed- this GC letter to CDFG from 2003:

September 4, 2003

TO: THE CALIFORNIA DEPARTMENT OF FISH & GAME-
Mr. Raisbrook, Regional Manager
San Diego, California ***fx 858 467 4201***

FROM: GRASSROOTS COALITION-
Patricia McPherson

RE: ECOLOGICAL ASSESSMENT OF AREAS B AND D- PLAYA VISTA, 6775 CENTINELA AVENUE, LOS ANGELES, CALIFORNIA &

PHASE 2 EIR- PLAYA VISTA

Dear Mr. Raisbrook,

Grassroots Coalition respectfully requests that the California Department of Fish & Game clarify, in writing, its scope of review and involvement regarding the Playa Vista site.

The EIR for the Playa Vista Phase 2 is now available for review, as I am sure that you are aware. Also, the Los Angeles Regional Water Quality Control Board (LARWQCB) sent Grassroots an Ecological Assessment (EA) of Areas B and D of the Playa Vista site for review. The deadline for comments was mid-August. I have included the LARWQCB letter with its cc list. Grassroots did respond but also notified various Fish & Game personnel, including Brad Henderson- our local CA. Dept. of Fish & Game (DFG) biologist, of the EA. In my comments to the LARWQCB, I noted that DFG had not been given the EA. Apparently, the LARWQCB has now sent the EA to DFG and given the DFG a September 15, 2003 deadline (attached letter).

While Grassroots would appreciate comments from the DFG regarding the EIR and the EA, we believe it is vitally and fundamentally important to clarify, in writing, the DFG role and scope of review at the Playa Vista site. In particular, our concern is that the oilfield gas issues at Playa Vista have not been assessed by any independent state agency.

It is vitally important for the DFG to clarify that it has played no role in the oversight for and/or evaluation of the newly discovered oilfield gas contamination problems of the Playa Vista site as they relate to the biology and ecosystems of the area and/or any other capacity.

The California Environmental Protection Agency- Department of Toxic Substances Control (DTSC) did respond, in writing, to the LARWQCB regarding the City of Los Angeles' / Playa Capital gas study(May 2001), wherein DTSC stated the City study was incomplete and that:
-soil gas studies needed to be performed in native, undisturbed soils (studies performed thus far were done in soils that were predominantly disturbed from construction activities and had other problems noted by DTSC) and that,

- *an ecological risk assessment needed to be performed (LARWQCB does not perform ecological risk assessments);*
- *the DTSC sister agency, the LARWQCB, has not requested or required Playa Capital to fulfill the DTSC recommendations.*

Because the oilfield gases, including benzene, toluene and xylene (BTEX) and oilfield generated hydrogen sulfide (H2S) are not issues within the scope of review for the LARWQCB, and because the LARWQCB has not adhered to the DTSC recommendations, or requested DTSC to step in for oversight of the oilfield issues (of CAL EPA agencies, DTSC has oilfield toxics within their scope of review and expertise), there continues to be no independent state oversight for evaluations of the oilfield issues.

DFG HISTORY

I have requested of the DFG, through numerous DFG personnel, including those in OSPR, of any ability of the DFG to engage in a biological study of the potential negative consequences of the oilfield operation gas migration hazards that we now know exist at the Ballona Wetlands, the site of Playa Vista. Furthermore, the impacts of the construction activities creating enhanced gas migration and H2S production are also issues that potentially affect the ecosystems of Ballona. Thus far, there has been no response from the DFG that it has the ability to engage in any way regarding any of these matters.

In conclusion, if the DFG does not clarify the fact that it has played no role in the oilfield gas issues and apparently cannot engage these issues under its scope of review and study, then any action and/or response the DFG does engage in at the Playa Vista site will leave and, has left a biological gap of oversight that needs to be clarified. ***It would be entirely misleading to the public*** *if the DFG were to continue involvement at the Playa Vista site and not clarify exactly what it does and does not include within its scope of review, with regard to its conclusions and/or recommendations regarding the Playa Vista site.*

Mr. Raisbrook, Grassroots Coalition respectfully requests a written clarification of the DFGs role in oversight of the newly discovered oilfield gases that are migrating to the surface at Playa Vista.

I'm sending along a Public Record Act request for your help in our providing a formal request for the information requested above and also because of our need for a copy of the Habitat Mititgation and Monitoring Plan (HMMP) for Playa Vista.

SCOPING: It is vitally important for CDFG AND OTHER AGENCIES TO MAKE CLEAR TO THE PUBLIC WHAT OVERSIGHT THEY DO AND DON'T HAVE.

ISSUE #2

SUBSIDENCE AND UPLIFT

SCOPING----SUBSIDENCE issues have not been addressed and must be addressed .

State law requires the avoidance of subsidence in coastal areas from oilfield fluid production..

- What are the effects and potential negative impacts due to ongoing subsidence?
- Why has this issue not been address and no monitoring has been done by the state even though it is a policy of this state in coastal areas.

-

"SUBSIDENCE IS CAUSED BY FLUID WITHDRAWAL:

"Fluid withdrawal from a petroleum reservoir or aquifer leads to the inevitable result of causing land subsidence at the surface, and compaction of sands at the reservoir level. The compaction is due to a pressure decrease in the reservoir or aquifer, and causes the overlying formations and the land surface to sink. This deformation leads to fracturing of the geological formations in the surrounding areas, causes movement along existing fault structures, and damages the oil and gas well casings and seals. This gives rise to the upward migration of gas from the petroleum reservoir. The interaction between subsidence and gas migration is illustrated in Exhibit 1.

The geological deformation is greatest at the reservoir level and propagates to the surface as a bowl shaped configuration, as illustrated in Exhibit 2. The maximum subsidence is at the center of the bowl. For a petroleum reservoir, the extent of the subsidence bowl at the surface is approximately twice the areal extent of the reservoir.

....

As a general rule, the amount of subsidence experienced at the surface correlates directly with the volume of fluid production within the reservoir. ...

2. FLUID WITHDRAWAL HAS CAUSED SIGNIFICANT SUBSIDENCE AT PLAYA VISTA, PLAYA DEL REY AND THE MARINA PENINSULA AREAS:

Fluid production of oil and brine water from the Playa del Rey and Venice oil fields caused nearly two feet of surface subsidence between 1927 and 1970. The California

Division of Oil and Gas (DOG) documented this in their Sixtieth Annual Report published in 1974. ..(exhibit 3)

...SOCALGAS has operated an extensive oil field dewatering program with the 'Del Rey Hills Area' and the 'Venice Area' for many years. This has been necessary since the gas storage operations requires continuous pumping of brine water from these areas to prevent invasion of the water into the primary storage zone reservoir.

The average daily production from their dewatering wells is approximately 2,500 barrels of brine water per day. This would equate to over 90,000 barrels per year, or over 27 million barrels of fluid production between 1970 and the present. It is inevitable that this has contributed to the subsidence problem, additional geological fracturing, and additional damage to the oil and gas well casings and seals.

3. CITY OF LOS ANGELES SURVEY DATA HAS CONFIRMED THE EXISTENCE OF A SERIOUS SIBSIDENCE PROBLEM:

I utilized survey data generated by the City of Los Angeles to evaluate the extent of the subsidence problem in the Playa Vista Area (near Jefferson Blvd. and Lincoln Blvd.) in the vicinity of the Playa del Rey oil field. The data utilized is presented in Exhibit 5.

...In summary, these data establish that the Jefferson/Lincoln area subsided .267 feet over a 14-year interval from 1956 to 1970. The Pacific /Lighthouse area, a well known subsidence prone area, subsided .265 feet over a 15-year interval from 1955 to 1970. Accordingly, these data confirm that the subsidence problems caused by oil field production are widespread, and extend to the areas that are under development at Playa Vista. No systematic monitoring of these problems has been undertaken since 1970.

4. THE SUBSIDENCE PROBLEMS IMPACT THE INTEGRITY OF THE OIL AND GAS WELLS THROUGHOUT THE AREA:

Fracturing of the geological formation and damage to the well casings from subsidence will cause upward migration of gas to the surface, exacerbating the near surface soil gas conditions. In the referenced area, over 200 oil wells were drilled and completed prior to the onset of the significant subsidence discussed in this document. Accordingly, subsidence must be recognized as a major contributor to the gas migration problems that have been documented at Playa Vista.

...It is apparent that the gas migration problems at Playa Vista are strongly interrelated with the movement of leaking gas easterly within these gravel zones as a result of being 'swept' by the tidal forces and wave energy within these permeable zones.

5. SURFACE DEFORMATION:

Deformation due to compression and extension at and near the land surface causes fissures in the soil and damages buildings, pipelines, and other structures. In the subject areas, these problems are complicated by the 100% liquefaction prone region that has been identified in the Seismic Hazards Map published by the Division of Mines and Geology, and by the near surface water table.

Regionally water tables will remain at nearly the same elevation after local subsidence lowers the land surface. The effect is to decrease the depth to the water level. If the water table rises (relative to the land surface), higher than the bottom slab of a building, the uplift pressure on the structure will be noticeably increased. This could cause the slab to eventually rupture.

Likewise, the below-slab installation of a gas membrane barrier for gas control purposes could be adversely impacted by these same uplift pressure conditions.....

City of Long Beach....an elaborate water injection program to mitigate the consequences of surface sinking and water incursion in this coastal area. ...

The city of Redondo Beach failed to impose such a requirement on oil field operations conducted under the King Harbor Boat Marina. Approximately two feet of subsidence, which occurred over a period of 20 years of oil production, caused the breakwater rubble barrier, constructed by the U.S. Army Corps of Engineers, to sink. A winter storm in 1988 destroyed the rubble barrier, and the city of Redondo Beach and the U.S. Army Corps of Engineers were held liable for the millions of dollars of damage that resulted to the shoreline structures. They were found to have been negligent for failing to monitor for the subsidence and for their failure to take protective measures to minimize the risk of injury.

It is significant to point out that the level of subsidence measured in the Playa del Rey and Venice coastal areas through 1970 is similar to the subsidence that caused the destruction of the King Harbor at Redondo Beach.
(Society of Petroleum Engineers Paper 83504 Environmental Hazards Posed By The Los Angeles Basin Urban Oilfields: An Historical Perspective Of Lessons Learned- Bernard Endres PhD; George V. Chilingar PhD)

...A systems engineering approach is necessary in evaluating the interactive consequences of subsidence, gas migration and movement of gas through the near surface aquifers from the locations of the leaking wells. This requires a detailed evaluation of the hydrology and the tidal actions that are responsible for moving the gases easterly within the aquifers and under the Playa Vista development."pgs 1-8

Bernard Endres PhD to LOS ANGELES BUILDING AND SAFETY

REGIONAL GROUND SUBSIDENCE AT PLAYA VISTA, PLAYA DEL REY AND THE MARINA PENINSULA, AND RELATED GAS MIGRATION PROBLEMS

(See also SOCALGAS- PDR p.768-9 ; 2012-The Environmental Aspects of Oil and Gas Production Subsidence by J.O. Robertson, G.V. Chilingar; L.F. Khilyuk, and Bernard Endres)

NOTE: The Settlement Agreement (SA) between SCG and Grassroots Coalition (GC) includes INSAR subsidence monitoring . However, SCG has not complied with the SA as it has not provided INSAR subsidence monitoring imagery of a high resolution necessary for expert review of the data. We are still requesting the imagery.

SCOPING-- The EIS/EIR needs to include a systems engineering approach for evaluation of the subsidence issues that are ongoing in the Ballona area.

(SOCALGAS has implemented a water injection program under Area A according to PDR –SOCALGAS officials however, no correlation or explanation has been provided by SOCGALGAS experts.)

-The EIS/R needs to provide thorough evaluations of this issue which overlaps the tidal influences and detriment to the freshwater aquifers that the 'estuarine' PLAN promotes.

-The EIS/R needs to provide ALL REASONABLE ALTERNATIVES of Ballona's restoration which has not been done. The public has been cut out of the process of alternative planning. Thus, the current EIS/R process is a ruse and a process that has fundamentally abused the taxpayers funding of review through bond money intended for a legitimate restoration process providing PUBLIC INCLUSION prior to this end point that has a predetermined outcome by the state agencies engaged.

-The newly adopted City of Los Angeles Methane Ordinance imposes a condition of dewatering in order to prevent the shallow water table---existing throughout the subject area—from invading the perforated pipes and gravel layer. The perforated pipes and gravel layer are required to passively vent the upward migrating oilfield gases from invading buildings and creating an explosion hazard.

If the perforated pipes and gravel layer are invaded by groundwater the gas venting systems become dysfunctional. Thus, dewatering becomes an essential part of implementing the City of LA Methane Ordinance. However, subsidence may result upon pumping the groundwater, necessary to achieve the dewatering, especially because numerous other ongoing decontamination dewatering is ongoing at Playa Vista. **The cumulative dewatering effects have not been addressed at the site since the ordinance was adopted by the City. This imposes a higher duty upon those responsible for protecting public safety.**

7 -

10.0 ENVIRONMENTAL CONCERNS

Cleanup and Land Disposal Sites

Within less than one mile of the Study Area, as shown on Figure 9, twenty-three sites with environmental concerns were identified on GeoTracker (SWRCB, 2010). Of these sites, 12 are leaking underground storage tanks sites (LUSTs), 10 are other clean-up sites, and 1 is a DTSC clean-up site. Sites identified as still active under regulatory oversight include 7 LUSTs, 7 other clean-up sites, the DTSC clean-up site, and the land disposal site. Table 2 provides a summary of the information available from GeoTracker for each site.

The active cleanup sites located up-gradient from the Study Area may pose a risk to the soil and water quality of Ballona Wetland.

Underground Methane Storage Reservoir

The Playa del Ray storage field, a large natural gas storage reservoir that is owned and operated by the Gas Company, is located at depth beneath most of Study Areas A and B, including the southern half of Marina del Rey, most of Playa del Rey, and the terminus of Ballona Creek (see Figure 10). The limits illustrated on Figure 10 include a quarter mile radius measured around the outer limits of the storage field, where the air and ground surface may be effected by fugitive gas or odors released from the natural gas storage reservoir or where subsidence may occur due to changes in pressure from within the reservoir. This radius is termed the area of potential influence by the Gas Company. Formerly an oil field that produced during the 1930s, it was converted to a natural gas storage reservoir when the pressure in the field dropped below optimal levels for oil production. The Playa del Rey storage field is located approximately 6,100 feet below the ground surface in Tertiary-age sandstone, which is capped by approximately 1,500 feet of impermeable shale. Fifty-four active wells and three compressors are used to inject and withdraw methane gas into and from the formation.

On December 20, 2007, a settlement agreement was approved by the California Public Utilities Commission (CPUC) in response to complaint cases against the Gas Company and its operation of the Playa del Rey storage field. This settlement includes an odor program, which involves routine patrols in the area for vagrant odors from the field, natural gas venting, engine and exhaust odor minimization, reduction of fugitive emissions, and the installation and maintenance of a meteorological station. Monitoring of the soil gas, subsidence, gas pressure, withdrawn gas chemistry, and released liquids are also included in the settlement agreement.

The Playa del Rey storage field poses an uncertain risk to Ballona Wetland and the habitat alternatives, with regard to possible release of methane gas and possible ground subsidence related to the operations of the storage reservoir.

SCOPING:

-The issues of thermogenic gas hazards and subsidence concerns raised herein by GC in detail have not been evaluated and need to be.

The CITY OF LOS ANGELES expert- Victor Jones of Exploration Technologies v Inc. current and past data production needs to be included in the SCOPING ASSESSMENTS.
-Still Workin On It must be included as it refers to the actual failures of the experimental gas mitigation systems which give rise to needs of groundwater withdrawal and the effects of that groundwater withdrawal.
--Include Jones' response to SOCALGAS regarding gas sampling and gas migration in the freshwater marsh (catch-basin) via the currently leaking well -University City Syndicate-(this well was last abandoned by Playa Capital LLC. With financing from the City of Los Angeles taxpayers.)

YouTube - Playa Vista Ga#18A265

YouTube - playa vista ga#18A23D

Reference below to University City Syndicate by Victor Jones- ETI
As part of overall review of the URS gas studies assessment for SOCALGAS.
(URS engagement with both Playa Vista and SOCALGAS should be considered a conflict of interest in any work performance of the restoration of BAllona.)

"It is particularly significant to note that this response is associated with an abandoned dry hole that is not a gas storage well, and has never produced oil or gas. The ETI data discussed above was collected in 2001 before the well was re-abandoned by Playa Vista. Following re-abandonment the leakage around this well has significantly increased and today is reported by DOGGER to be vigorously bubbling around the casing and includes additional vents more than 100 feet away from the casing. Actual Youtube videos http://www.youtube.com/watch?v=LR1r9X2VGZo&feature=geosearch and http://www.youtube.com/watch?v=NNA2f3GvUPg&NR=1) show these gas bubbles. An excellent report on this extensive gas leakage from the Syndicate-1 well is discussed in a 12 July 2010 letter report (Geoscience Seep Gas Analysis.pdf) submitted by Lewis Pandolfi.
A similar response to this could be found around any well in the general Playa del Rey area, regardless of whether it is, or was a gas storage well, or an abandoned oil and gas well. ***All old well casings are potential leakage conduits and all of the known wells, whether abandoned or not, should have been included in the planned phase I soil gas survey.*** *This increase in leakage activity is obviously related to the re-abandonment of the well. It can never be assumed that a re-abandonment of any well will always be successful. Follow-up soil gas surveys are the only way to prove that the re-abandonment was successful. " Exploration Technologies Inc., Victor Jones 2011*

Please also respond to the following comments:
The comments raised above (part of a FOIA response from USACE- GeoPentech Report) acknowledges uncertain risks to Ballona and the 'Plan'(s) but thus far the SMBRC/ COASTAL CONSERVANCY AND CDFG and USACE have ignored GC's

concerns and refused to allow GC to provide public presentations at SMBRC meetings or at Ballona watershed meetings--regarding these concerns. Once again, failure to communicate and share with the public , lack of transparency—is the proven objective with the agencies. The Ballona land was acquired with public bond money, the land belongs to the public and the agencies are supposed to be providing stewardship that includes feasibility of alternatives WITH the public. This has not occurred. Thus far, the state is acting as though Ballona is a residential development site owned by the state and that the public must respond TO ONLY WHAT THE STATE TELLS IT TO RESPOND TO AND OTHERWISE BUTT OUT!
This is apparently the state's attitude for its 'supposed' request for the USACE to disengage from the 2005 Joint EIS/R process and stop including the regional Ballona ecological areas and biological values.
According to USACE -FOIA'D documents, the state did not fulfill its contractual agreements. This failure causes the state to also lose the financial support of the federal government that are cited as 65% of restoration costs.



SCOPING:

This is just one example of high volume oilfield gas leaks to the surface—shown here are gas leaks leading to the shut down of the SOCALGAS gas injection operations. (DOGGR 1008 Order)
-The Settlement Agreement and the follow up studies and the GC response to SOCALGAS and the CPUC need to be addressed and analyzed due to the extreme health and safety issues.

SCOPING:

- Needs to include recent DOGGR 1008 Order responsive documents and historic SOCALGAS documents (currently the state has provided only hearsay discussion from SOCALGAS). Some of those documents are included in this submission to alert regarding the oilfield gas migration hazards that SOCALGAS continues to avoid as it fails to abide by the Settlement Agreement between Grassroots Coalition and SOCALGAS.

Example document:
InterOffice (GAS COMPANY) CORRESPONDENCE
*Playa del Rey- Gas Migration_*
"The area where storage gas is currently surfacing is in the flat area. Sound logs suggest gas movement from a depth of about 1000' below sea level. The temperature anomaly in Del Rey 18 is approximately 1100' below sea level."

(Del Rey 18 is located at Fisherman's Village and the 'flats' are the land areas below the bluffs- GC)

"We have also had reports this year of gas containing helium present in the surface casing annulus of 26 wells. "

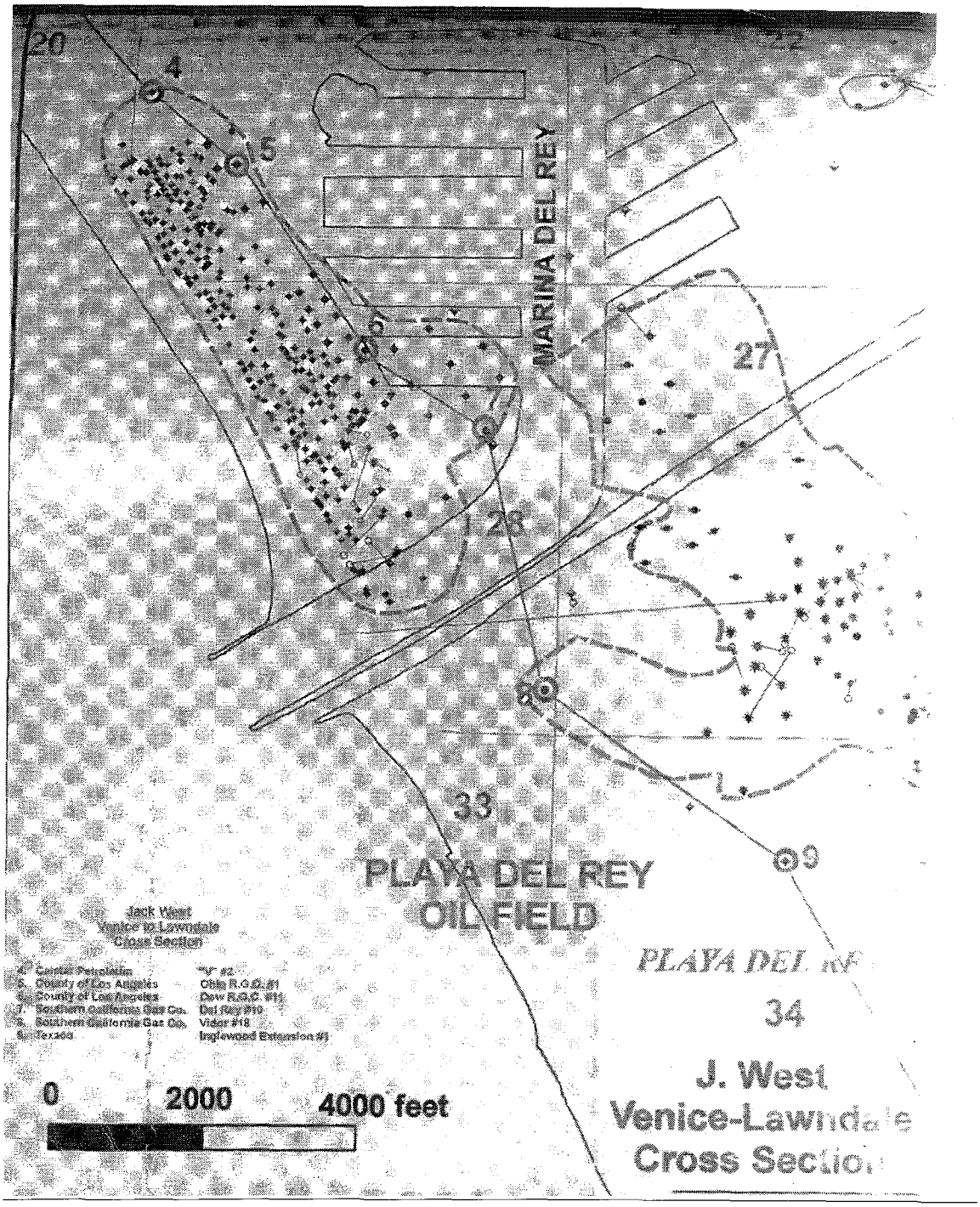
(Helium is often used as a marker for SOCALGAS reservoir gas migration since the gases piped in from Texas, Oklahoma ...contain helium and the PDR field has no historic helium within the oilfield according to the City and DOGGR records. No native gas samples exist of the field from prior to injection of foreign gases. (CPUC discovery queries upon SOCALGAS)

SCOPING:

-Please provide accountability and legal legitimacy for withdrawing from the 2005 Joint EIS/R process.
-Please provide all financial accountability for federal funds already spent. How was the money spent and what was the outcome of the expenditures?

As can be seen in the diagram below, there are numerous active and abandoned wells that must be tested for leakage regularly. Further saltwater intrusion will present not only a potential for casing leakage due to that salt water corrosion but will also pose a more difficult circumstance within which to REPAIR and STOP the leakage and furtherance of at least the GREENHOUSE GASES.

- **Mitigation measures and monitoring of all wells must be part of the scoping of issues needing study and response. What is planned for such study and monitoring of these issues by the state and federal government?**
- **Thus far studies have not occurred. What assurance that these health and safety issues WILL be addressed and mitigation provided?**



ISSUE # 3

HYDROLOGY & DEWATERING

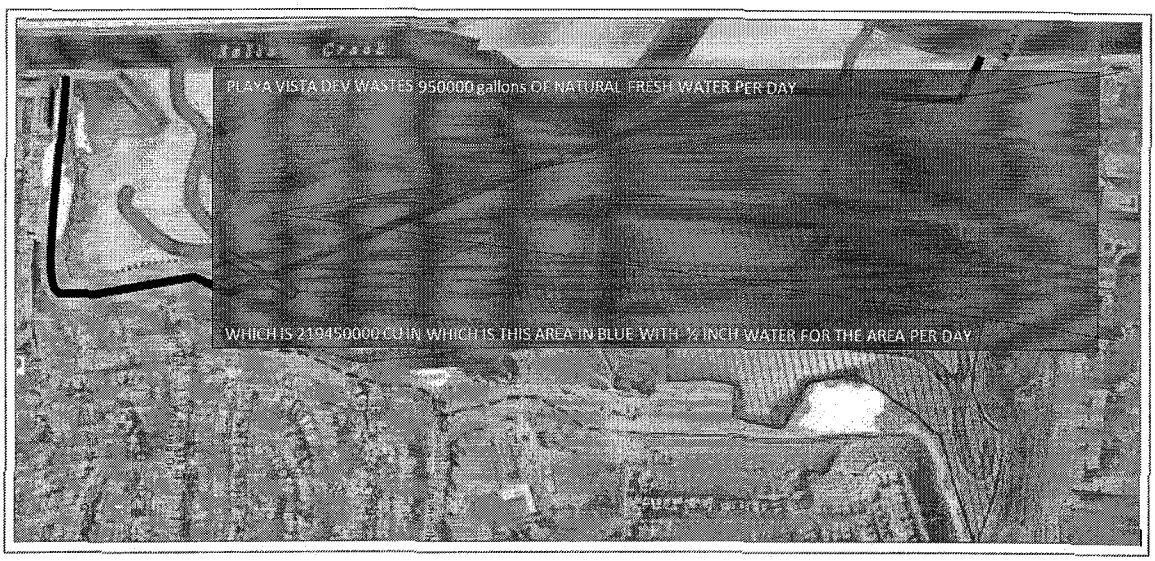
-Why have the state and federal agencies failed to provide the iterative process that was promised to the public for use of public bond money and federal taxpayer funding? Scoping needs to include the history of what has occurred and respond to

why and how the public has not been allowed to cross share information and be part of the planning process for restoration alternative planning of BAllona.

-Address why no hydrology studies of the near surface aquifers and streams have been done during the so-called 'feasibility' phase.
-During the 'feasibility' phase GC and others of the public requested an ACES program study be performed upon Ballona in order to fully understand the hydrology of the area which includes the underlying groundwaters and its surface waters.
-The ACES study needs to be performed.

[PDF]
ACES: Analytical Framework for Coastal and **Estuarine** Study
proceedings.esri.com/library/userconf/proc08/papers/.../pap_2183.pd...

-Why has there been no response from SMBRC/ Coastal Conservancy on this issue of concern and why was this request not provided to USACE AND CDFG?
-Provide hydrology studies that reveal the current levels, locations and sources of groundwater in Ballona.
-How have the groundwater levels changed over the past 20, 50, 100 years? What has caused those changes? And, how can the freshwater resources be restored and utilized for Ballona?
-What studies provide review of protection of the groundwater sources in Ballona ?
- Why has the ACES, sanctioned by the USACE, program for estuary mapping not been employed as requested by the public at Ballona?
-What freshwater resources are available for restoration purposes at Ballona and how can they be utilized?
-How much groundwater of Ballona is being diverted and/or otherwise not being allowed to recharge the area?
-What are the cumulative volumes of groundwater that Playa Vista is diverting from the wetlands and why is this allowed to occur?
-What studies have been done to assure the fresh groundwaters are not negatively impacted by the proposed 'Plan" and how can the "Plan" be implemented when diversion of contaminated and toxic Ballona Channel waters and sediments (as cited in the Weston Report on Coastal Conservancy CD) and further contaminated saltwater intrusion provides for one impaired water way into another. Is this not a violation of the Clean Water Act and Porter-Cologne?



This GC visual aid shows an approximate amount of water permitted by the Dept. of Sanitation- daily to Playa Vista for 'wastewater' dewatering. The removal and throwing away into the sanitary sewer system of this precious groundwater that is classified as 'potential drinking water' should not be allowed. This same volume would/could create a half acre pond at 1 foot deep---in one day.
SCOPING:
- Provide analysis of the actual volumes of groundwater being diverted from Ballona by Playa Vista and provide an analysis of how this water can be utilized onsite for restoration purposes. Especially, in light of the fact that Ballona is historicall dominated by freshwater flows.
-WHY is this water not being utilized onsite and for restoration purposes?
Is it not illegal for Playa Capital LLC to divert this volume of groundwater and throw it into Hyperion sewer treatment plant?
-CDFG's response regarding potential harm has thus far been---they do not know. That answer is unacceptable. Find out.

Documents from LARWQCB showing permitted discharges of 950,000 gallons per day (gpd)(16 CT 3696-3700) and LA City Department of Sanitation, including a table showing permitted discharges of up to 72,000 gpd.
-Why is this water being allowed to be diverted and thrown away and not utilized for groundwater recharge and/or a source of freshwater for BAllona restoration purposes?
-Diagrams included herein, reveal that utilizing the LARWQCB permitted discharge rate of 950,000 gallons per day; this volume of water would provide approximately ½ inch of water across the surface of most of Ballona Wetlands –south of the Ballona Channel. The same volume could provide in one day—a foot of water to a ponded area approximately ½ acre in size. The large volumes described would provide a source of freshwater to Ballona's restoration that would be incredibly valuable.
-Why have these sources of groundwater not been evaluated?

-How is it possible that Playa Vista can divert much needed groundwater away from Ballona? Especially in light of the1993 EIR for Playa Vista requires for any groundwater discharge:
-a preapproved beneficial plan for any such extraction and discharge (EIR Vol. 26 p. 014945)
-tertiary treated groundwater from NPDES provides primary supply of freshwater for the wetland system (EIR Vol. IX- Executive Summary 1-2.
-"ongoing remediation of the known existing groundwater contamination in Area D and utilization of the resulting treated water for the beneficial use of supporting onsite vegetation, would result in a beneficial impact on ground water." P. 12- Exhibit B- Certification of EIR and Adoption of Mitigation and Monitoring and Reporting Program.
And,
"Culverts under Lincoln Boulevard should be of sufficient size to permit wildlife movement between Areas B and D without risk of injury or death from traffic hazards." P. 18. Mitigation and Monitoring Report

The EIR of Playa Vista also requires the
-avoidance of any long term dewatering due to negative environmental consequences
however, no cumulative analysis of groundwater extraction has been done, impacts of that groundwater dewatering have not been done and,
no enforcement of metering requirements has occurred.

-SCOPING:
-The Ballona region requires hydrologic review .

NOP of CDFG cites on page 1:
Project Summary and Proposed Action
The project entails restoring, enhancing, and creating native coastal wetland and upland habitats in the
approximately 600-acre Ecological Reserve. The reserve comprises previously filled and dredged coastal
wetland and upland habitat that would be restored by increasing tidal flow throughout the project area,
removing invasive species, and planting native vegetation. Figure 3 shows a conceptual design of the
proposed restoration. The main components of the project are:
l Habitat restoration of estuarine wetland and upland habitats connected to a realigned Ballona Creek.
l Removal of existing Ballona Creek levees and realignment of Ballona Creak to restore a more meandering channel.
l Construction of new levees to replace the existing Ballona Creek levees and to allow restoration of
tidally influenced wetlands while providing flood protection for Culver Boulevard and surrounding
areas.
l Installation of water control structures, including culverts with self-regulating tide gates or

similar
structures, to provide a full range of tides up to an elevation acceptable for flood management and
storm drainage, while protecting against some storm events.
l Maintenance of existing levels of flood protection for areas surrounding the Ballona Wetlands site and
inclusion of flood hazard management measures into the restored wetlands.

This is description is of a preordained outcome.
The premise of restoring estuarine flow is false advertising. The CDFG already has the T-sheets –the historical studies of Ballona including that done by Travis Longcore PhD. The T-sheets and the Longcore and other scientific studies remove any doubt that Ballona was historically a wetland that utilized freshwater and was not primarily the estuarine environment that is being touted as the PROJECT.
Please review the T. Longcore lecture, entitled "Closure Dynamics of Southern California Estuaries and Implications for Restoration" simply google as it can be found on u-Tube.

-WHY does the CDFG mislead the public and not provide full disclosure?

- Provide the data to show what CDFG utilizes in order to claim restoration of historical functions of Ballona will occur. If not, why not?
- Provide the data to show 'restoration' a restoring of historic tidal influences will be occurring if the 'Plan /Project" is allowed to occur.
- Provide the ratio of current deep and mid-tidal – with tidal flux that already exists at Ballona- including the Marina del Rey, Del Rey lagoon, Ballona Lagoon, and the Ballona Channel itself as compared with the past 100 -200 years.
-

SCOPING:
-Realignment of Ballona's "meandering channel" is also false advertising by CDFG since the Ballona Channel never had to historically carry the high volumes of storm and runoff water that it currently carries. There is no 'restoration' of the historic Ballona Creek, only the forced entry of toxic LA City waters and sediment into what is now habitat for endangered species and rare native plants.
Why does the CDFG fail to provide a historically accurate account of what is proposing upon Ballona?
SCOPING:
-Why has CDFG not provided for Public participation and information sharing in the planning of alternatives for Ballona and instead is promoting a non-historical conversion project that creates a catch-basin end of pipe solution and flood control devices- NOT HABITAT-upland or otherwise—that protects ONLY PLAYA VISTA?

- Since the USACE has stated that it will no longer pursue the 2005 restoration process via the Joint EIS/EIR- and since the USACE is not requesting Ballona Channel changes, please discuss why the CDFG provides a false allusion of need for flood control for Culver Blvd. and what 'other areas'? Or, if CDFG believes there is a

current need to change the Channel for protection to the public from flooding---please list those needs and provide the data support.

SCOPING:
-PLEASE PROVIDE studies that determine ANY PROTECTION TO CULVER BLVD. OR OTHER AREAS ARE NECESSARY if the Ballona Channel is left in its current location.

CDFG provides false and misleading information in the NOP via omission of historical facts.
SCOPING:
_ **Please discuss and provide** any and all data that provides validation of CDFG's claims that the enormous –approximately 20' above road level with sides that must be ENGINEERED TO REMAIN VERTICAL 'upland habitat' is enhancing or restoring Ballona. Provide discussion and data support to show what can survive in the giant berms that are shown on the Psomas contour maps in Area C and south of the BAllona Channel and west of Lincoln Blvd. (Psomas-2012 contour maps)

-GC wishes to see multiple restoration alternatives that do not involve changing the BAllona Channel and that do not involve the massive bulldozing and dredging that is the singular 'Plan' or 'Project' cited in the CDFG NOP and is finalized by Psomas on its 2012 contour map.

- GC wishes to be engaged and provided with multiple alternatives that would embrace freshwater sources for protection and utilization for streams/ponds etc. This alternative has not been explored and needs to be explored, analyzed and presented for public review. Such alternatives would require less money to create and would/ could be self sustaining . Such alternatives would be respectful of the Native American heritage of the site and provide for habitat closely aligned with historic Ballona and its inhabitants—both human and wildlife and flora.

- Why has CDFG not allowed for public participation and sharing of data and information for the public to be engaged in alternative planning??

ISSUE # 4 PROCESS

Background and overarching scoping needs-
The promised hydrology studies (2005 Joint EIR/EIS—between USACE & the Authority) of Ballona Wetlands have not been done. Instead, the SMBRC/FOUNDATION -director & staff and the California Coastal Conservancy have interfered with and stopped the areawide ecological studies and geotechnical studies of the federal review for restoration potentials in the greater Ballona region in order to promote a singular 'Plan' of destruction and experimental construction upon Ballona Wetlands- Areas A,B,C . This "Plan" excluded groundwater hydrology studies and focused upon hydrolics studies of surface water flows into Ballona Channel .

We believe that this 'Plan' is nothing more than a destruction of endangered species and wildlife habitat that is currently functioning well and that the Coastal Conservancy contracted- Psomas Co. contour maps of the "Plan" reveal that it is a flood control plan that only benefits a private development known as Playa Vista (Playa Capital LLC). The Proposition 12 bond funds have illegitimately been spent on private use protections to a development site that was illegally allowed to build in a flood plain. FEMA was not engaged for oversight comments as needed as the EIR process for Playa Vista was thwarted by failure to utilize the Clearinghouse as a gateway for proper notice to all pertinent agencies. (ETINA v City of LA; Playa Capital LLC) This failure by the lead agency- the City of Los Angeles- to include and enforce California Environmental Quality Act (CEQA) protocol of Clearinghouse utilization **PLACES THAT BURDEN NOW UPON USACE AND THE California Dept. of Fish and Game and its state agency partners. FEMA MUST NOW BE ENGAGED** and the issues that pertain to flood protection for Playa Vista must now be reviewed in light of the flood control devices and the preordained 'Plan' of development and construction proposed by SMBRC/Foundation and the California Coastal Conservancy.

The giant berms and levees-approximately 20 feet above current road level as shown in the contour plans – are NOT habitat; are NOT RESTORATION but instead are civil works flood protection devices to benefit Playa Vista.
Furthermore, the 'Plan's' intent to DREDGE Ballona is NOT RESTORATION but instead is simply an experimental attempt at an end of pipe solution to the toxic water and sediment flow down the Ballona Channel. The catch-basin shown in the 'Plan' does NOT enhance or restore Ballona but instead destroys the very habitat that the public has spent over 20 years to protect. The effects of the 'Plan' as a catch-basin and flood control project have not been studied. Current roadways, Marina del Rey and other beach front areas appear to be put in jeopardy from the project.

SCOPING:

Issues of safety, failure to utilize the bond funds as approved by the public; failure to work with and include the public's participation in restoration concepts and planning; the legitimacy of process -- promised and paid for by bond dollars v the exclusionary and preordained outcome plan by the SMBRC/Foundation and the Coastal Conservancy must be addressed in the SCOPING AND DRAFT EIS/R.

Response to conflict of interest allegations, illegal use of bond funds, lack of transparency issues raised and failure to perform in good faith toward restoration, acquisition of more of Ballona, and enhancement issues that would protect and utilize the freshwater resources of Ballona onsite must be addressed and raised for public awareness of these and other challenges leveled at the lead agencies and their 'partner' agencies.

A gross compartmentalism has taken place by the steward agencies in order to create a predetermined outcome – the 'Plan" that excluded the public and its participation.

The current Notice of Preparation by the CDFG provides appearance of –just starting- the process for restoration at Ballona. This is false and CDFG fails again to act in good faith and provide accurate history. Instead, the CDFG while stating verbally at the 'scoping meeting' (which was not a scoping meeting condusive to public awareness and cross sharing of information) that all alternatives are being considered—instead the NOP shows the story of preordained outcome of 'estuarine' environment ONLY AND CHANNEL CHANGES AND DREDGING ONLY.

- **SCOPING NEEDS** to address the NOP and its showing of a preemption of the iterative process as promised and bond funds provided for.
- **SCOPING NEEDS** to address and respond to why CDFG and its partner agencies have NOT abided by public participation in the planning of restoration concepts and are –instead promoting the SINGULAR PLAN of the construction of a flood control basin and flood protection device(es) to protect Playa Vista.

SCOPING NEEDS TO INCLUDE :

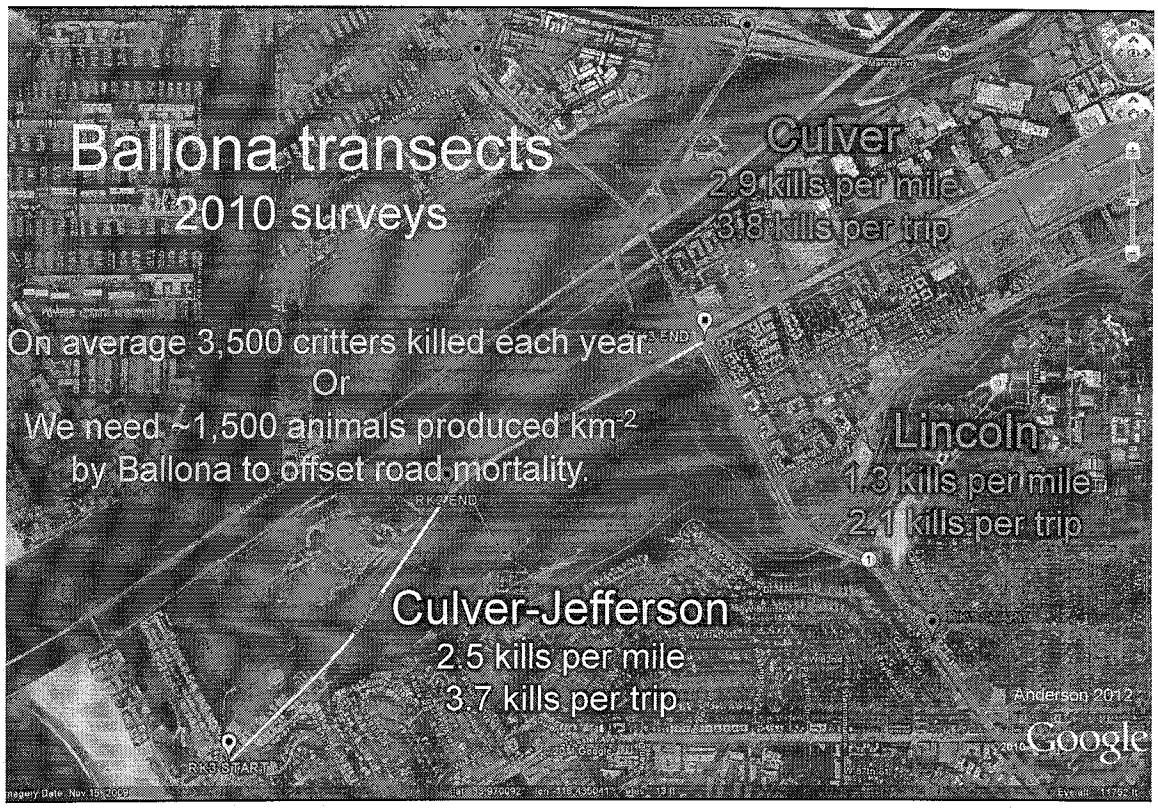
-Response to comments and questions within the Jan. 2012—Bond approval for $6,490,00. by John Davis to California Coastal Conservancy must be addressed.

- The John Davis to Ca. Coastal Conservancy document of March 28, 2012 entitled-
  Request to Hold Emergency Meeting to Rescind Approval Action on File No. 04-088 must be addressed and provided response since the issues pertain directly to the restoration of BAllona and the Coastal Conservancy's; USACE's, SMBRC's/FOUNDATION; CDFG 's in partnership---lack of adherence to stipulated use of public bond money for the publically owned Ballona Wetlands.
- Include response to the Amended Complaint to the Ca. Coastal Commission by Grassroots Coalition, dated August 2, 2012. The three documents ,490,00.are attached to this response.
- The partner agency – Ca . Coastal Conservancy has thus far provided no response whatsoever to these Complaints that have attached data support.
- The Amended Complaint by GC has an attached CD that contains Public Record Act documents from the Coastal Conservancy that provide the data support to the Amended Complaint. The contents of the CD should be part of this record and provided in full to the public for informed decision making. No agency is the 'owner' of Ballona Wetlands but instead the agencies play a role in stewardship of land OWNED BY THE PUBLIC. The public process has been hijacked by these stewards apparently to fulfill private corporate interests. This is not acceptable behavior by our state and federal agencies. Therefore, any attempt to obfuscate the history of Ballona and its 'restoration' path – a path that was to fully include the public to provide alternative planning via informed decision sharing and making—is considered further proof of hostile hijacking of due process.

SCOPING:

Needs to include the history of the "restoration" process of Ballona, including but not limited to the 1995 and 2005 Notice of Intent and the contractual agreements between the USACE and the Authority- SMBRC/County Flood Control. The history must include CDFG's participation in that process and acknowledge for accountability purposes- why that process is not being adhered to at present.

-Acknowledgement of the congressional issues of House Document 389 and any and all Feasibility Reports need to be accounted for as to intent and outcome.
Wildlife Issues:
Credit for Graphic:
Anderson, Sean. 2012. Splatter Spotter: Exploring and Predicting Elevated Vertebrate Road Kill Across the Santa Monic Mountains and Beyond. Chautauqua Lecture. Temescal Canyon Park, Pacific Palisades. August 22.



The EIR process with Playa Vista –mitigation provided for culverts for wildlife movement to prevent roadkill. Playa Vista has not honored this EIR requirement of mitigation and CDFG and the City of Los Angeles refuse to enforce it. Thus, how can the public expect CDFG to promote and protect the wildlife interests in the 2012 EIS/EIR? History reveals itself with our state and federal agencies failing to protect the environment and its wildlife. Corporate interests and money appear to be the driving force behind the state's "Plan" of Ballona destruction and construction into a

flood control project to protect Playa Vista and as an experimental end of pipe solution to the toxic waters and sediments of Ballona Channel. Please address these allegations.

Endangered Species habitat and nesting areas will be destroyed. The Belding Savannah Sparrow –as one example- is a non migratory bird that utilizes both side of the Ballona Channel for nesting and foraging. The intended massive bulldozing /dyking and filling of Ballona will destroy its habitat. See the Coastal Conservancy – Public Record Act requested CD for documents pertaining to wildlife issues.

Vague comments by state agency personnel vaguely recite in emails and minutes of private meetings—that the Beldings will just have to move.
This attitude is excrutiatingly unscientific and it is painful to read such callous rubbish but it does reveal the throw away mentality that the state agents have. Thus far, the taxpayers have not been included in any alterative planning as required and thus far their money has been spent –apparently in its entirety of Prop. 12- for hydraulics studies for their singular end goal of creation of a catch-basin and flood control construction for Playa Vista.

Page 13- Additional Complaint –GC to Coastal Conservancy—August 2 2012
The next parargraph, written by the note-taker- cited by CC as being CC or SMBRC staff- states the goal-
"Estuarine biodiversity is the primary objective of the analysis."
(CD- June 23, 2008 SAC Conference Call Memo)

"The project goal is to create functional estuarine habitat...";
"1. Maximize area of estuarine habitat.";
Opportunities to create regionally significant habitat including vernal pools and...should be pursued but ***not at the expense of restoration of estuarine habitat."****p. 14 Additional GC Complaint to Coastal Conservancy*

The public/Working Group was not allowed to participate in the decision making and was not advised as to the differing opinions rendered by the SAC team.

Pages 16-17 of the Additional Complaint of GC to the Coastal Conservancy:
(the Coastal Conservancy continues to be nonresponsive)

"Rare ecosystems of the coastal marsh area are discussed internally by the SAC team with the CC project manager and staff of the Foundation; the information is not broadcasted for public awareness, inclusion of discussion and decision making as promised.

"Rich noted that the discussion of grasslands should include mention of the historical native grassland prairie ecosystems that previously existed in the area. The rarity of native grasslands should be discussed,,," (CD- 6/28/08 SAC Conference Call)

"Rarity section...complex of prairie and vernal pool...
Wet grasslands formed extensive areas were also palustrine wetlands above highest high tide.." (CD- SAC Call 6/23/08)

"...there is native biodiversity in the non-tidal saline soils. .... At Ballona, these wetlands at Area A, for example, are the only habitat where Alkali Barley (Hordeum depressum) is known to occur in the Ballona Ecosystem. This annual grass was probably the dominant native annual grass in naturally occurring non-tidal saline soils at Ballona." (CD- 11/23/08, Wayne Ferren communication to Mary Small...)

And,
"The region has a shortage of mudflat for shorebirds, high marsh for animals and salt marsh bird's beak, marsh-upland transition for rare shrubs (eg., box thorn) that are used by animals,...

The region has a shortage of dune habitat and back – dune depressions that support clean-water brackish marsh for aquatic plants and animals.

One could also list maritime scrub, which remains in several places "...
(CD- Joy Zedler (SAC) correspondence)

Thus , without public /Working Group inclusion and input into the formation of the alternatives and later failure to include the public /Working Group comments and concerns regarding the PWA Alternatives that are presented at one public meeting--the CC and Foundation staff continue to work behind publically closed doors to focus upon the 'Preferred Alternative", now known as Alternative 5 presented in the 1/19/12, Staff Recommendation request for funding. Alternative 5 requires massive, non-historic, extraordinary, experimental and knowingly toxic changes to occur on the land masses of Area A and B so that **"biodiversity = highest richness of estuarine dependent species."**

And also from the Additional Complaint—GC to Coastal Conservancy-p 17-18:

Contrary to the 8/13/04 CC Memo which promised transparency and public inclusion in the alternative planning process which would "restore and enhance" a mix of wetland habitats....and that would implement a technically feasible, cost effective, ecologically beneficial and sustainable restoration.
Instead, the public was shut out of the planning process; and SAC knowledge regarding the **needs and dangers posed by Alternative 5 are not made public:**
"This alternative makes the greatest change to the site, would be the hardest to reverse and consequently has the most risk." (CD- 9/12/08 MEMO from SAC to PMT)

" ..this alternative would ***require reliance on upstream flood control and pollutant removal****, and could necessitate periodic removal of accumulated pollutants for some portions of the restored wetlands. Furthermore, it is unknown how the flow and*

sediment yield from the upper watershed would affect the sustainability of the marsh in terms of scour or sediment deposition." CD, P. 4of 9, 10/15/08 SAC MEMO, emphasis added.

There is no evidence of any such large scale BMP (Best Management Practice) planning or proposals for 'flood control and pollutant removal" occurring upstream on Ballona Creek.

And,

"Eric suggested that there be a statement up front indicating that this site will not be self-sustainable, but will need to be actively managed in perpetuity. " (CD- 7/7/08 SAC Conference Call)

Discussion and comments made from key federal agencies were withheld from the public, including but not limited to **NOAA communications regarding concern of toxicity of Ballona Creek upon the remaining wetlands should the levy removal and dredging take place.** (CD- National Oceanic Atmospheric Association email)

Studies that discuss the toxicity of the Ballona Creek waters and sediment to life in the waters and sediment were not released or shared with the public:

"These sediments were toxic to aquatic organisms, potentially from organic compounds in these sediments. Ballona Creek has been identified as a potential source of tidal flows into Areas A, B, and C in each of the proposed restoration alternatives. Therefore, there is concern to tidal marsh areas, resulting in a negative impact to the habitats and biological resources." (CD- Weston –Technical Memorandum 11/26/07; Water Quality Data Gap Investigation Ballona Wetlands Restoration Project- Pohl , P.E., Ph.D.)

And,

" The July 2006 report by Weston also concludes that there are concerns related to water and sediment quality adjacent to the tidal channels. Consequently there is a need to develop a strategy to evaluation the potential ecological risk associated with influent water or sediment quality to the restored wetlands.

The scientific questions regarding sediment and water quality cannot be answered based on the information currently available, and will ultimately depend on the design of the project." (CD- Memorandum 3/8/08; Subject:

APPROACH FOR ADDRESSING SEDIMENT AND WATER QUALITY ISSUES)

And;

"Eric- Conc(ept) D—is it attempt to move water and sediment into system

Wayne- breaching levee bringing trash, water pollution and sediment into entire area is problematic.

John Dixon-important to describe these NOT as projects, but a directions.

Ambrose- maybe D is too extreme—this won't happen anyway.

Dixon- do feasible maximum tidal, not D—need to scale back

Jeremy- may need to do that, take out realignment Ballona—include realign on Hydrologic options"
(CD-10/30/06 SAC Conference Call)
Thus, any discussion of any alternative habitat planning for Ballona is suppressed and deep-sixed from any public awareness as the state agents-promote unbeknownst to the public—a singular outcome of the estuarine-"Plan" requiring massive bulldozing and BAllona Channel changes and engineered flood control berms and levees.
GC has concerns regarding members of the private non-profit- the SMBR Foundation –who are also in key decision making positions to promote the 'Plan" that are directors of SMBRC and project planners of the Coastal Conservancy . The SMBRFoundation has past and present strong ties to corporate interests including Playa Capital LLC.

ISSUE- REMEDIATION
SCOPING-

-What and how will the remediation needs of SOCALGAS be analyzed?
ABANDONMENT/DEMOLITION STUDY- Playa del Rey Storage Field- Nov. 22 1993 cites:
"Phase III-Tank Farm Abandonment and Final Clean-Up
...Environmental remediation may require significant disposal of contaminated soil and the importation of clean fill. There is also a potential for the discovery of ground water contamination. This environmentally sensitive area will no doubt provide significant challenges related to keeping our costs within forecasts. There is a potential for very high clean-up costs beyond current estimates because the Ballona Wetlands are immediately adjacent to our facilities."
-What studies are planned and how will the potential mitigation be remediated?
-Groundwater studies need to be included in a restoration of Ballona that pertain to SOCALGAS operations. The high potential of groundwater contamination is acknowledged above in the Jacobson Engineering Report prepared for SOCALGAS.

Please include all the attached documents for review and assessment for the public.
Patricia McPherson, Grassroots Coalition- President

Comments on the Soil Gas Investigations Conducted by SoCalGas

Made In Response to the Grassroots Coalition Settlement Agreement

Southern California Gas conducted a soil gas survey in response to a Settlement Agreement that was reached between SoCalGas and the Grassroots Coalition (GC). The Settlement Agreement can be viewed at http://www.laschools.org/project-status/attach/56.40077/APPENDIXX.pdf). SoCalGas response thus far has been to conduct a phase I soil gas survey between June 10 to 26, 2009, with results, posted on the SoCalGas web site at http://www.socalgas.com/safety/playa-del-rey.shtml. The report http://www.socalgas.com/documents/safety/PDRSoilVaporMonitoringReport.pdf is available and can be viewed on the SoCalGas web site.

In spite of the fact that ETI's soil gas methodologies were specifically requested within Appendix A of the Settlement Agreement, they were not followed by URS during the Phase I investigation. Instead of using the ETI methodology, URS followed the California *"Advisory for Active Soil Gas Investigations, DTSC and RWQCB, dated January 28, 2003.* Although this is the official California methodology, it is not the same as the ETI methodology, and does not obtain the same quality data. The only thing these two methods have in common is they sampled at a depth of 4' feet below surface and URS used similar sample containers having a volume of 125 ml. A review of the data obtained by URS in this phase I soil gas survey easily demonstrates the deficiencies of the California methodology for measuring the concentrations of light methane through butane hydrocarbons in the natural environment. It is very important to note that the California method is not equivalent to the ETI methodology, which was designed specifically for measuring the concentrations of natural hydrocarbon seepages from subsurface petroleum based sources.

As a stated objective, the Settlement Agreement requires SoCalGas to conduct soil gas monitoring surveys designed to find and evaluate any possible leakage of SoCaGas's "storage" and/or "pipeline gas" that might have migrated outside of the boundaries of their approved Playa del Rey (PDR) storage field and to evaluate all of their storage wells for casing leakage of either storage gas and/or and natural gas from any subsurface formation that might be migrating to the surface along any of their well casings, whether active or abandoned.

It is very important to note that this includes the Pico Formation, which is a source of numerous natural gas blowouts. This documentation goes back as far as 1944, when Riegle made a structure map of the shallow Pico Formation and suggested that it might provide a significant source of natural gas. Riegle's structure map was based on numerous Township wells that blew out and six of the main Playa del Rey gas storage wells (Union Del Rey 10, 13, 14, 15, 18 and 19) that had electric logs that could be used for evaluation of the Pico Formation. Although Riegle didn't include the Syndicate 1 on his map, it also blew out when drilled in 1930 and flowed over 5 MMcfd, indicating that the Pico source extends eastward under the Playa Vista development properties. ETI's

investigations at Playa Vista in 1999 - 2000 proved that the Pico Formation was also the source of the gas seepage occurring at Playa Vista.

Appendix A of the Settlement Agreement specifically states that the planned soil vapor surveys should use ETI's soil gas methodologies and references a Camp Dresser & McKee (CDM) report dated November 9, 2000 entitled "Report of Sampling and Analysis of Soil Gas for Methane in Tracts 49104-01-, -03, -05, -06 Playa Vista Area D for the methodology. ETI's methodology "Field and Laboratory Procedures for Soil Vapor Sampling", dated January 5, 2000 was provided by ETI in several reports issued to CDM and to the Los Angeles Department of Building and Safety (LADBS) during the 1999 to 2001 time period when Dr. Victor T. Jones, III from ETI served as the "Methane Peer Reviewer for LADBS. A copy of this document is also available directly from ETI. A review and comparison of the soil gas data obtained by URS with the soil gas data obtained by ETI during the Playa Vista investigations provides a simple way to demonstrate the deficiencies of the California methodology for meeting the objectives stated above. However, before making that comparison, it is important to point out an equally significant error in the SoCalGas/URS work plan.

There is a very important conceptual contradiction between the SoCalGas/URS work plan and the requirements contained within Appendix A of the Settlement Agreement, which states that: "*Under the first phase of the investigation, one hundred and fifty (150) soil probes will be advanced to depths of 4.0' (bg) on a 100' x 100' foot grid over all SoCalGas surface fee or leasehold interest lands*". **It is not possible to use only 150 soil probe samples to conduct a survey on a 100' x 100' grid over all SoCalGas surface fee or leasehold interest lands.** A 100' X 100' gridded survey would require several thousand samples. Obviously SoCalGas has limited the agreement to 150 samples without any regard for the requirement to collect samples on a 100' x 100' grid. With this restriction, using only 150 samples, it is impossible to accomplish the stated objectives, even if the ETI sampling and analysis methodologies had been followed.

A review of soil gas data from ETI's Playa Vista reports demonstrates that collecting soil gas samples on a grid is of a nearly equal significance to employing the correct sampling methodology and in having adequate analytical detection capability. A copy of ETI's CD_6.2Playa Vista report released to Mr. Paul Mount, Chief of the Mineral Resources Division of the California Division of Oil and Gas by Mr. Ray Chan, Chief of the Engineering Bureau at LADBS was released to public record and is available on request. This CD contains numerous reports, data tables, maps and figures that are significant to understanding the deficiencies of the URS phase I soil gas monitoring report and the logic contained within Appendix A of the Settlement Agreement.

It is important to understand that gases migrating through the earth do not follow isotropic nor homogeneous pathways, so that making valid soil gas measurements and maps of soil gas anomalies requires the use of gridded surveys containing many samples and very low analytical (ppbv level) detection capability. Below the vadose zone the methodology must include the measurement of both free and dissolved gases in the underlying aquifers. The planned Phase II surveys cannot be completed within

this area using multi-depth soil vapor stations because the groundwater is too shallow for collection of vapor samples. Phase II must use the groundwater and/or deeper aquifers to collect and measure the free and dissolved gases in the aquifers. The lateral transmissibility of the underlying aquifers significantly aids the movement of dissolved gases, helping in relating the deeper dissolved gases to the shallow soil gases. Comparison of shallow soil vapors with deeper dissolved gases in the underlying aquifers is completely compatible so long as both are correctly collected and analyzed.

The problem with using the California methodology for measuring natural hydrocarbon seepage is not new. A demonstration of ETI's methodology was required back in 1999 when ETI was first hired to evaluate the potential methane problem at Playa Vista. An example from two soil gas surveys conducted by Camp, Dresser & McKee (CDM) over Tract 03 at Playa Vista on 9/21/1999 and 10/07/1999 using the California Geo-Probe methodology are included for comparison with ETI data that was collected in October – November of 1999, after the first two surveys were completed. As shown by this California-versus-ETI-Methodology.pdf poster, the largest methane found by the California method was 970 ppmv at site 07. The second survey conducted 14 days later reported only 55 ppmv when site 07 was resampled. CDM suggested that their data showed there were no appreciable concentrations of methane gas present in the shallow soil gas in this area, and that they had reduced the methane concentration within the soil vapor even further by purging their sampling tools in following the California sampling procedures.

In contrast, the ETI survey conducted after the two California method attempts found methane concentrations that ranged upwards of 59 to 73% (590,400 to 732,000 ppmv). These ETI sites also contained approximately 3000 ppmv of ethane, 30 ppmv of propane, less than 10 ppmv of iso-butane and less than 1 ppmmv of normal-butane. Although these C2+ gases are not large, they are indicative of non-biogenic sources. A comparison with the CDM gases, as shown below, is striking. Site 07 has no ethane or propane, but does have small concentrations of butane, pentane and C6+ (0.049, 0.773, 0.7 ppmv) and even 4 ppmv of C6+ hexanes.

	Monitor well MW-05 ppmv	ETI soil gas ppmv	California Method soil gas ppmv
Methane	804,600.00	732,000.00	970
Ethane	3,028.00	2,973.00	ND(<0.50)
Propane	58.10	33.30	ND(<0.50)
Iso-butane	4.56	8.33	
n-butane	0.92	0.40	TR(0.49)
pentanes	0.00	0.00	TR(0.773)
C6	0.00	0.00	TR(0.7)
C6+	0.00	0.00	4

Monitor well MW-5A (see the Tract 03 report discussed below), which is fairly close to site 07 contains 80.46% methane with 3028 ppmv ethane, 58.1 ppmv propane, 4.56 ppmv iso-butane, 0.92 normal-butane and no C6+ components. Clearly the California method soil gas data is very different from the underlying gases in the aquifer, having very small methane, a complete lack of ethane and propane and measureable butanes and other C6 hydrocarbon gases. This signature suggests the methane is diluted with atmospheric air, and the heavier components are likely contamination from the Geoprobe drill rig tools. The butanes and heavier components could not have come from the aquifer source, so contamination from the drilling tools, coupled with dilution of the soil gas is the only logical explanation.

The objective for conducting these soil gas surveys was to delineate the distribution of the gases contained with the fifty foot deep gravel aquifer that is the underlying source for the soil gas anomalies. Documentation for meeting these objectives is contained in an early report given to Mr. David Hsu, Chief of the Grading Section at LADBS on November 29, 1999. This report, entitled Tract 03 Report confirms that the ETI soil gas method compositionally matches the aquifer gases, whereas the California method does not. Plate 1 and Plate 2 from the Tract 03 report provides maps of the deeper aquifer and surface soil gases, showing the coherence between these two independent data sets. The Tract 03 report demonstrates ETI's methodology for mapping migrating natural gases within all environments, from the surface, down into the underlying aquifers. As illustrated by this report, conducting such investigations correctly, and validating the results requires the measurement of gases in the atmosphere, the near-surface vadose zone and in deeper formations using water wells, and eventually, even to the oil and gas production wells.

ETI's soil gas data also shows the complex distribution of methane anomalies that can only be correctly delineated by sampling on a grid. The Tract 03 report provides a graphical and easily understandable example of the correct approach and methodology used by ETI in the Playa Vista investigations. This approach, which employs both vadose zone soil gases with deeper dissolved gases in the underlying aquifers defines the approach that must be followed in order to conduct meaningful phase I and II surveys. Phase I must be conducted on a grid using ETI's sampling and analysis methodology, with sub-ppmv analysis capability. Due to shallow groundwater in this area, phase II must be conducted using dissolved gas analysis made on groundwater samples obtained from monitor wells that have been placed using soil gas maps from phase I for guidance.

ETI's Playa Vista soil gas data and reports provide the best available guidance for evaluating the 2009 URS phase I soil gas data. In addition to the Tract 03 report, it would be also useful to view Plate 2-RegionalReport and Plate 3-RegionalReport from ETI's "Regional Geochemical Assessment of Methane, BTEX, CO2 and H2S Gas Occurrences" report submitted on July 10, 2001 to the Mineral Resources Division of the California Division of Oil and Gas. Plates 2 and 3 from this regional report contain methane and ethane soil gas data from the entire area of investigation, including some

overlap with the Playa Del Rey field where the more recent 2009 URS phase I report was conducted.

An examination of the URS data tables shows that no ambient (2.5 ppmv), nor sub-ambient methane concentrations were reported in the 2009 URS phase I report. In sharp contrast, the ETI data on the regional Playa Vista methane soil gas map (Plate 2) shows that background methane concentrations are often less than the atmospheric concentration of approximately 2.0 ppmv. All the URS sites have very large methane values, generally ranging from over 15 to 30 ppm, or greater. Such large methane values would mean that all of the sites are impacted by migrated methane, or that the URS methane concentrations are bottom truncated, since they are well above the typical background concentration of shallow soil gas methane. A comparison with Plate 2 from the regional ETI Playa Vista report clearly shows that the area where the URS survey was conducted contains a large number of soil gas sites where methane is at, or below the ambient methane concentration of approximately 2.0 ppm. The very large methane values in the URS report (generally greater than 15 ppmv) suggests that every one of the URS samples have been impacted by methane that could only have come from depth. The concentration of methane in the atmospheric is less than 2 ppmv, so 15 plus ppmv methane anomalies cannot be derived from the atmosphere. These anomalously large methane concentrations in the URS soil gas data suggests migration seepage from depth occurs at nearly every site. That is either true, or their methane data is invalid.

Even more problems with the URS data are obvious when one looks at their ethane and propane data. Detection limits for ethane and propane of 3 and 1.5 ppmv are much too large for mapping the normal range of natural ethane and propane soil gas anomalies. The ethane data on Plate 3 from the regional ETI Playa Vista report provides an example of the expected range for ethane, which is in the sub-ppmv concentrations in this area where the URS samples were collected. Ethane and propane are very significant to the interpretation of deep sourced gases and must be correctly detected and measured in order to meet the stated objectives of detecting deep sourced, petroleum related storage gases. A comparison of the URS data with the ETI soil gas anomalies from Plate 3 shows that ethane background concentrations are nearly always less than 0.100 ppm in the area where the URS data was collected. The larger ethane magnitudes are found only near macro seeps, which generally have a fairly small aerial footprint, where magnitudes increase rapidly from background levels to percent concentrations where the very largest concentrations are found.

This lack of adequate sensitivity is further compounded by URS using two different purge volumes for their Geoprobe samples. Sites 1 to 63 had one purge volume of 365 ml removed, while sites 64 to 150 had three purge volumes of 1095 ml removed before collecting the vapor sample. This increase from one to three purge volumes for the last 86 samples dilutes the final 86 samples with respect to the first 64 samples, further decreasing the concentrations for the smaller magnitude ethane through butanes to values that are obviously below the URS labs detection limits.

The objective for conducting soil gas surveys is to measure the naturally occurring equilibrium established between the soil gas vapors and the subsurface contamination. This equilibrium is in delicate balance (particularly in low-permeability clays) or wet sediments and is easily disturbed. Only the vapor in the sampling tools should be purged. The result in this case is that no background level methane or ethane plus hydrocarbons were found in any sample. A review of ETI's Plates 2 and 3 from the regional Playa Vista report shows the background concentrations that should have been found in, at least a few of the 2009 URS soil gas samples. Clearly, the URS analytical detection limits are far too large for measuring any of the methane, ethane, propane or butanes in the natural environment.

The only useful data obtained by the 2009 URS soil gas survey were the macro level hits at sites 64 near the Del Rey 10 well and sites 137 to 142 near the Stewart, Covington and Riegle production wells. Del Rey 10 has had documented macro level leakage on the pad around the well site for more than 30 years, however, the macro level seepage around the Stewart, Covington and Riegle production wells has not been previously reported and should be a serious concern for SoCalGas. It is interesting to note that URS recommended that this new leakage be further investigated, yet SoCalGas deleted that recommendation from the first draft of the URS report. The need to further investigate this new macro seepage was confirmed nearly two years later on Feb. 24, 2011, when water and storage gas was found to be flowing from the surface casing annulus of the Riegle 1 well, causing SoCalGas to be cited by DOGGER (Formal Order no. 1008). Pressure was reported to be building up in several wells in the vicinity of Riegle 1. No macro level leakage should ever be tolerated without an investigation of the cause.

With the exception of finding two macro seeps, the URS data and report are inadequate and do not meet the minimum Phase I requirements, to say nothing about the fact that the main premise of using a 100' X 100' grid have not been followed or even addressed. As stated in the 2009 URS phase I report, two probes were planned for each gas storage well, and less than two whenever the production wells were close together. This planned URS sample spacing is totally inadequate for finding or defining any seepage found, and obviously is inadequate or determining the size and/or shape of typical soil gas anomalies, on either a regional basis, or particularly around a deep production well where much closer spacing is required.

An example of the seepage associated with an abandoned dry hole, the Syndicate #1, can be viewed on ETI's Plates 2 and 3, on the regional Playa Vista soil gas maps. This abandoned well lies south of Jefferson and west of Lincoln Avenue. Expanded scale illustrations of methane and ethane posted in ppmv have been generated and are included Syndicate-1-well to provide a more detailed view of the seeps located near this well. ETI's soil gas site location numbers are also posted above the site symbol (cross) on the ethane map, and ethane is posted below the symbol. Note that only five samples are above the 10 ppmv methane contour interval, and only 8 samples are above the 0.5 ppmv ethane contour interval. The majority of the soil gas samples, even right next to the well are much lower in concentration, and even more importantly, the

ETI investigators did not observe any macro level seepage (i.e. bubbles) back in 2000 when the Playa Vista surveys were done. This data shows that one soil gas sample placed at random near a well is totally inadequate for determining whether that well is associated with any leakage from depth.

It is particularly significant to note that this response is associated with an abandoned dry hole that is not a gas storage well, and has never produced oil or gas. The ETI data discussed above was collected in 2001 before the well was re-abandoned by Playa Vista. Following re-abandonment the leakage around this well has significantly increased and today is reported by DOGGER to be vigorously bubbling around the casing and includes additional vents more than 100 feet away from the casing. Actual Youtube videos http://www.youtube.com/watch?v=LR1r9X2VGZo&feature=geosearch and http://www.youtube.com/watch?v=NNA2f3GvUPg&NR=1) show these gas bubbles. An excellent report on this extensive gas leakage from the Syndicate-1 well is discussed in a 12 July 2010 letter report (Geoscience Seep Gas Analysis.pdf) submitted by Lewis Pandolfi.

A similar response to this could be found around any well in the general Playa del Rey area, regardless of whether it is, or was a gas storage well, or an abandoned oil and gas well. **All old well casings are potential leakage conduits and all of the known wells, whether abandoned or not, should have been included in the planned phase I soil gas survey.** This increase in leakage activity is obviously related to the re-abandonment of the well. It can never be assumed that a re-abandonment of any well will always be successful. Follow-up soil gas surveys are the only way to prove that the re-abandonment was successful.

The number of soil gas samples has to be set by the grid requirements and cannot be arbitrarily set to only 150 total samples. In addition, the analytical laboratory has to have sub-ambient level methane (1 to 2 ppmv) and ppbv level C2+ detection capability. A valid soil vapor survey often requires additional infill samples placed on an even closer 30' to 50' spacing to validate results. This was done on several subareas at Playa Vista. The problems with the URS data become obvious when compared to the regional ETI soil gas data from the main Playa Vista report that contains actual soil gas data collected by ETI from the same area as the URS report.

In addition, as noted earlier, Phase II cannot be completed using multi-depth soil vapor stations within this particular area because groundwater will be too shallow over most of the area for the collection of soil gas from deeper soil gas probes. Phase II must include the use of dissolved and/or free gases derived from monitor wells that have been installed using the soil gas anomalies as a guide for placement. ETI's Playa Vista investigations provide examples for using this approach, where groundwater samples collected from monitor wells were used to determine the migrated hydrocarbon gases in the subsurface aquifers that are the source of the shallower soil vapor anomalies. The Phase II scope of work should also include the use of stable hydrocarbon isotopes and the measurement of helium on all samples.

Gas samples should also be collected directly from the surface casing, intermediate annulus casing and tubing at all production related wells. All wells should be included in any evaluation, regardless of whether they are producing or abandoned, including even dry holes such as the Syndicate 1, which is now become a problem well that would be very dangerous if located near any buildings. The Troxel-1, Del Rey 10 and several of the other Township wells are as likely to be vertical leakage conduits as the Syndicate-1. They could be leaking as much as the Syndicate-1, but are not obvious because they are not covered by water, which allows the bubbles to be observed. In such cases, only a soil gas survey can determine whether gas leakage is occurring.

Sincerely,
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Environmental Division
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V. T. Jones III

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SUPERIOR COURT OF THE STATE OF CALIFORNIA

COUNTY OF LOS ANGELES, CENTRAL DISTRICT

ENVIRONMENTALISM THROUGH INSPIRATION AND NON VIOLENT ACTION ("ETINA") ET AL. Petitioners, v. CITY OF LOS ANGELES, ET AL. Respondents. PLAYA VISTA CAPITAL, LLC, ET. AL. Real Parties-in-Interest	Case No. BS073182 **PETITIONERS' ETINA AND GRASSROOTS COALITION'S ADDITIONAL OBJECTIONS TO RETURN TO WRIT** Assigned for all purposes to: *Hon. Ann I. Jones* *Department 40* Hearing Date: Sept. 24, 2008 (rescheduled) Hearing Time: 10:00 a.m. Location: Dept. 40

Respectfully submitted,

DATE: August 11, 2008

Todd T. Cardiff, Esq.
Attorney for Petitioner
ETINA and Grassroots Coalition.

ENVIRONMENTALISM THROUGH INSPIRATION AND NON VIOLENT ACTION ("ETINA") and GRASSROOTS COALITION (collectively "Petitioners") submit these additional objections to the City of Los Angeles' ("City") and Playa Vista Capital, et. al. ("Playa Vista" or collectively, "Respondents") Return to Writ. Because there is some confusion as to the meaning and intent of the Court's July 30, 2008 Minute Order denying Petitioners' Motion to Augment the Administrative Record, and Petitioners' subsequent ability to cite to and produce evidence demonstrating a violation of the information disclosure policies of CEQA, the first -part of this brief will address CEQA without citing to extra-record evidence. IN A SEPARATE AND SEVERABLE second part of this brief will discuss the documentary evidence that demonstrates that the City and Playa Vista failed to disclose and apparently suppressed relevant information which precluded informed decisionmaking. Petitioners' will discuss the case law precedent permits the consideration of extra-record evidence to determine whether a violation of information disclosure provisions of CEQA occurred which constitutes a prejudicial abuse of discretion. Such two-part approach will permit the court to consider or exclude the second part of the brief, without affecting the arguments in the first portion of the brief.

PART I

CEQA, at its very heart, is an informational process. One of the basic purposes of CEQA is to "Inform governmental decisionmakers and the public about the potential significant environmental effects of proposed activities." (Guidelines § 15002(a)(1).)[1] One of the goals of an environmental impact report (EIR) is to "demonstrate to an apprehensive citizenry that the agency has in fact analyzed and considered the ecological implications of its action." (*No Oil, supra,* 13 Cal. 3d at 86.) Thus, "[CEQA] must be open to the public, premised upon a full and meaningful disclosure of the scope, purposes, and effect of a consistently described project." (*County of Inyo v. City of L.A.* (1984) 160 Cal. App. 3d 1178, 1185.)

In keeping with the informational nature of CEQA, the Public Resources Code mandates:

> Information relevant to the significant effects of a project, alternatives, and mitigation measures which substantially reduce the effects shall be made available as soon as possible by lead agencies, other public agencies, and

[1] CEQA Guidelines are located at Volume 14 of the California Code of Regulations 15000 et.seq.

interested persons and organizations.

(Pub. Res. Code § 21003.1(b).)

Furthermore, "CEQA protects not only the environment but informed self-government." (*Laurel Heights Improvement Assn. v. Regents of University of California* (1988) 47 Cal. 3d 376, 392 (*Laurel Heights I*) .) "If CEQA is scrupulously followed, the public will know the basis on which its responsible officials either approve or reject environmentally significant action, and the public, being duly informed, can respond accordingly to action with which it disagrees." (*Id.*) Obviously, CEQA cannot accomplish its purpose if either the process for obtaining information or the final document fails to accomplish its informational purpose.

In keeping with the informational purpose of CEQA, the public resources states that non-compliance with the informational disclosure provisions of CEQA may constitute a prejudicial abuse of discretion, regardless of whether non-compliance would have changed the decision approving or denying the project.

> [N]oncompliance with the information disclosure provisions of this division which precludes relevant information from being presented to the public agency, or noncompliance with substantive requirements of this division, may constitute a prejudicial abuse of discretion within the meaning of Sections 21168 and 21168.5, regardless of whether a different outcome would have resulted if the public agency had complied with those provisions.

(Pub. Res. Code § 21005.)

"[a] prejudicial abuse of discretion occurs if the failure to include relevant information precludes informed decisionmaking and informed public participation, thereby thwarting the statutory goals of the EIR process." (*Save Our Peninsula Comm. v. Monterey County Bd. of Supervisors* (2001) 87 Cal. App. 4th 99, 118; *See also, Sierra Club v. State Bd. of Forestry* (1994) 7 Cal. 4th 1215, 1235 (discussing timber harvesting plans).) Because the omission of relevant information is a violation of the procedural requirements of CEQA, a harmless error analysis is inapplicable and a failure to comply is automatically an abuse of discretion. (*County of Amador v. El Dorado County Water Agency* (1999) 76 Cal. App. 4th 931, 946; *State Water Resources Control Bd. Cases* (2006) 136 Cal. App. 4th 674,

723.)

However, not every omission, regardless of how minor, is a per se abuse of discretion. (*Association of Irritated Residents v. County of Madera* (2003) 107 Cal. App. 4th 1383, 1391.)

"The courts have looked not for perfection but for adequacy, completeness, and a good faith effort at full disclosure" (*County of Amador, supra,* 76 Cal. App. 4th at 954.)

As will be discussed below, not only did the City fail to present evidence from the Department of Sanitation, it failed to inform the Regional Water Quality Control Board that it was going through a CEQA process to evaluate the impacts of dewatering activities. This failure to disclose evidence and failure to inform trustee agencies about the CEQA process prevented relevant information from being presented to the decisionmaker, in this case, the City Council. The City Council could not have made an informed decision lacking information about the extent of actual and potential dewatering activities.

B. The City's Failure to Disclose and Analyze Actual Data from the Department of Sanitation Constitutes a Prejudicial Abuse of Discretion.

The City's Chief Legislative Analyst Report process had a very narrow scope. It was limited the scope of the review to solely "the potential for subsidence" and "exacerbation of existing groundwater contamination" caused by groundwater dewatering in connection with methane mitigation systems. (3 RR 472.)[2] Petitioners dispute that this is the proper scope of review. Because the court ordered the City to vacate the methane mitigation measures (not just dewatering system), the City was required to look at all issues regarding such methane systems, not just to subsidence and contamination. Nevertheless, even *assuming arguendo* that the City could narrowly limit its review of the methane mitigation measures to such specific impacts, the City failed to gather all relevant actual data to evaluate the impacts of dewatering. As such, the City abused its discretion. (Pub. Res. Code § 21005.)

The CLA report is very specific on what the "Peer Reviewers" reviewed. The Peer Reviewers examined the modeling study prepared by Playa Vista's consultants, CDM, correspondence between CDM, Los Angeles Department of Building Services and the Regional Water Quality Control Board,

[2] [volume] return record [page number]. Please note that the previous citation at page 4, lines 5-6 of Petitioners' Opposition to Return to Writ incorrectly cited to 3 RR 373. The correct citation is 3 RR 472.

allegedly the original EIR and the public comment. (3 RR 473-78.) What is missing is any review of actual data from the Los Angeles Department of Sanitation. There are no Department of Sanitation documents in the Record which show actual or potential permitted groundwater discharges into the City Sewer System.

Without reviewing existing permits and data from the Department of Sanitation, the agency responsible for accepting water from dewatering activities, there is no possibility that the CLA report complied with CEQA. "Impacts of the project must be measured against the real conditions on the ground." (*Save Our Peninsula Comm. v. Monterey County Bd. of Supervisors* (2001) 87 Cal. App. 4th 99, 121 (citations omitted).) The City cannot simply rely on modeling data provided by Playa Vista, which has a vested interest in downplaying, limiting and minimizing the potential impacts of dewatering. (See *Id.* at 126 (discussing problems with relying solely on applicant generated data).) The City cannot delegate the duty to Playa Vista (or the public) to gather the necessary baseline information. (*Id.* at 122.)

Furthermore, the City cannot claim ignorance of the requirement to consider data from the Department of Sanitation. Afterall, the Peer Review specifically noted that the water was discharged into the sanitary sewer, and also noted that "The water disposal has been installed pursuant to an industrial waste permit issued by the Bureau of Sanitation." In other words, the Peer Reviewer knew of the availability of existing hard data, but failed to review such data.

Petitioners specifically requested the City review its files from the Department of Sanitation in its "Notice of Information Required for Adequate CEQA Review" (5 RR 986.) In addition, a number of comments questioned the lack of actual data from the Department of Sanitation. (See e.g., 2 RR 428; 7 RR 1328; 1357.) In fact, five months before the final decision, Patricia McPherson stated at a public hearing "The Department of Sanitation has 65 - - 65 groundwater dewatering permits for the site at Playa Vista. You chose five building to look at. You didn't give [the Peer Reviewers] a fair model to begin with." (7 RR 1357:line 24 to 1358: line 3.) The City simply ignored such comment and pretended that the Department of Sanitation did not exist.

Respondents will likely argue, as they did in their Opposition to the Motion to Augment, that Petitioners could have obtained such data from the Department of Sanitation and included it in the

record. Any assertion that its Petitioners' duty to review the City's files for the project, obtain the relevant documents, and re-submit such documents back to the City for review, is patently absurd. As discussed in the Guidelines, "The Lead Agency shall not knowingly release a deficient documenting hoping that public comments will correct defects in the documents." (Guidelines § 15020.) It is the City's duty, not the public's to do the proper environmental investigation. (*Save Our Peninsula, supra,* 87 Cal. App. 4th at 122; *Sundstrom v. County of Mendocino* (1988) 202 Cal. App. 3d 296, 311.) The City violated the information disclosure provisions of CEQA by not providing records from the Department of Sanitation to the City Council and the public for review.

C. The City Abused Its Discretion By Failing to Inform the Regional Water Quality Control Board of its CEQA Review and Gathering the Appropriate Data.

Informing other governmental agencies that CEQA review is occurring is an incredibly important step in the CEQA process. Section 21080.3 of CEQA states:

> Prior to determining whether a negative declaration or environmental impact report is required for a project, the lead agency shall consult with all responsible agencies and trustee agencies. Prior to that required consultation, the lead agency may informally contact any of those agencies.

(Pub. Res. Code § 21080.3(a).)

Obviously, such consultation will only occur if the responsible or trustee agency that it is informed that it is evaluating a project (or a portion of a project) under CEQA. There is nothing in the record which demonstrates the City informed the Regional Water Quality Control Board (RWQCB) that it was participating in a CEQA process. The failure to inform a lead or trustee agency of the CEQA process is a prejudicial an abuse of discretion. (*Fall River Wild Trout Found. v. County of Shasta* (1999) 70 Cal. App. 4th 482, 492.)

This is not to imply that the RWQCB did not participate in the CLA process. However, the CLA process, according to the City's was not prepared under CEQA. As noted by Attorney Susan Pfann, "There's no requirement of how you about doing [a peer review] or whether or not you have to senditso certain agencies...its simply a study." (2 RR 403.) In this case, the City failed to inform the Regional Water Quality Control Board (RWQCB) of its CEQA process, instead simply requesting the

RWQCB simply review Playa Vista's modeling program. Petitioners' specifically objected to the City's failure to notify the RWQCB of the process thereby triggering full CEQA review. (5 RR 943.) By solely requesting a review of the modeling study prepared by CDM, the City prevented the RWQCB from fully participating in a manner required in a CEQA review process, and violated the information disclosure requirements of CEQA. (Pub. Res. Code 21005.)

The City may argue that its failure to inform the RWQCB that it was participating in a CEQA process was not a prejudicial because the RWQCB did make comments. Perhaps if the City had requested all the relevant data regarding dewater at Playa Vista and Ballona Wetlands possessed by the RWQCB, the City would have an argument. However, there is no evidence in the record that the City requested even basic data, such as NPDES permits or actual metering data, despite the fact that Petitioners specifically requested the City review NPDES permits in its study of significant effects. (5 RR 986.)

D. The City Failed to Gather or Present Data Necessary for Determining Whether Dewatering Activities Were Cumulatively Considerable.

The lack of information from the RWQCB and Department of Sanitation is especially egregious when one considers the lack of analysis of cumulative impacts. A lead agency must determine not only direct and indirect effects of a project are significant, but must also consider whether such impacts are cumulatively significant. (Guidelines section 15064.) As noted in the case law discussing cumulative impacts, "the outcome may appear startling once the nature of the cumulative impact problem has been grasped." (*Kings County Farm Bureau v. City of Hanford* (1990) 221 Cal. App. 3d 692, 721.) The City, by limiting its review solely to the five buildings identified by Playa Vista in its modeling data, failed to consider whether all dewatering activities taken together, may be cumulatively significant.

Phase I of the Playa Vista Development consists of 3,426 residential units, 1.25 million square feet of office and light industrial space, 35,000 acres of retail space and 300 hotel rooms on 246.3 acres of land. ((Environmentalism Through Inspiration and Non-Violent Action, et. al. v. City of Los Angeles, 2005 Cal. App. Unpub. LEXIS 9697, at 3.) ("ETINA v. LA") Despite the massive size, there is no description in the 2007 CLA Report of how many buildings are a part of Playa Vista Phase I, nor how many buildings have dewatering systems. This data should have been easily obtainable from the

Department of Sanitation, which issued industrial water permits for the dewatering systems. (3 RR 502.) Yet, it was not presented to the public.

If one were to search exhaustively through the administrative record, one would find a table described as "Construction and Vesting Status of Playa Vista Phase I" that was apparently submitted by Playa Vista on the date of the hearing. (2 RR 226.) The table identifies 39 Buildings in the "west end of the first phase" (2 RR 226-29.) Of those 39 buildings identified by Playa Vista, 18 of such buildings are identified as having "ground-water dewatering system" Yet, the table fails to identify how much dewatering is occurring at each site. Such information is crucial to knowing whether the dewatering at Playa Vista is cumulatively considerable.

In addition, other dewatering activities independent of buildings must be evaluated to determine whether there is a significant impact. It was incumbent on the City to request dewatering data from the RWQCB, the agency responsible for managing the states' water. Despite petitioners' request that such data be evaluated, there is no indication in the record that the City requested such information from the RWQCB. (3 RR 486.)

Of course, as indicated by the description as "Playa Vista Phase I", there is also Playa Vista Phase II. Despite this well-known fact, there is no analysis in the 2007 CLA report of Phase II. The 2007 CLA report indicates that the peer reviewers solely reviewed reports analyzing the potential impacts installed in Phase I of the Playa Vista development. (3 RR 473.) There is no analysis of the dewatering activities expected in Phase II of the Playa Vista Development.

For a proper analysis of the potential cumulative impacts requires an analysis of all dewatering activities at Playa Vista. This information is available from the RWQCB. But, the City failed to request such information. There is not information in the record which describes NPDES permits of the Playa Vista site or actual discharge volumes into Ballona Wetlands. Without providing the total volume of all dewatering activities, neither the City nor the public can properly evaluate or participate in the public process.

CONCLUSION

The failure to obtain data concerning actual dewatering data from the Department of Sanitation and the RWQCB constitutes a prejudicial abuse of discretion under CEQA. (Pub. Res. Code § 21005.) The 2007 CLA report fails as an informational document. Such document

PART II

There is a genuine confusion as to the meaning of the Court's ruling on July 30, 2008 denying the Motion to Augment. The Court refused to augment the administrative record with the documents because they were not before the City Council at the time of the final decision. However, the Court also indicated in oral argument that such ruling was without prejudice to Petitioners' ability to bring such arguments under CEQA. What is unclear is whether Petitioners ability to bring such arguments in our additional objections, included the right to refer and cite to the documents excluded from the administrative record to establish non-compliance with the information disclosure requirements of CEQA. (Pub. Res. Code § 21005.) Petitioners were unable to obtain a transcript of the hearing in time to resolve the dispute, and the court was unavailable for clarification of the issue.

It is absolutely clear by reviewing the actual documents that the failure to obtain or provide the documents Petitioners' sought to augment constitutes an omission of relevant material. Because prejudice in not presumed under Public Resources Code section 21005(b), it is important for the court to consider the actual documents to determine whether the failure to include relevant information precludes informed decisionmaking and informed public participation.

The court should consider that CEQA is not intended to be a cat and mouse game, with the lead agency and applicant attempting to avoid evidence which contradicts its predetermined decision to approve the project. CEQA only functions when there is good faith effort at compliance and full disclosure. It is simply to great of a burden to expect the public to divine that the City and applicant are going to refuse to gather the relevant data. It is simply to great of a burden to expect the public to make up for the failure of the City to conduct the proper environmental investigation. The City cannot submit a legally deficient document hoping that the public will cure the deficiencies, or fail to identify the deficiencies. (Guidelines § 15020.)

A. Evidence From the Los Angeles Department of Sanitation and the Regional Water Quality Control Board Demonstrates the City and Playa Vista Violated Information Disclosure Requirements of CEQA.

Public Resources Code section 21005 states,

> [N]oncompliance with the information disclosure provisions of this division which precludes relevant information from being presented to the public agency . . . may constitute a prejudicial abuse of discretion.

There a number of ways that an applicant or a lead agency may fail to comply with the information disclosure requirements. (*See e.g. Fall River Wild Trout Found. v. County of Shasta* (1999) 70 Cal. App. 4th 482, 493 (failing to notify DFG); *Cadiz Land Co. v. Rail Cycle* (2000) 83 Cal. App. 4th 74, 95 (failing to identify size of aquifer); *Sierra Club v. State Bd. of Forestry* (1994) 7 Cal. 4th 1215 (failing to study endangered species); *Save Our Peninsula, supra,* 87 Cal. App. 4th at 122 (failing to use actual data).) In fact, many cases which have sought to strike down environmental impact reports have sought to establish, through omission, that there has been non-compliance with the information disclosure requirements of CEQA. (*Association of Irritated Residents v. County of Madera* (2003) 107 Cal. App. 4th 1383, 1391.)

However, suppression of evidence is also a form of non-compliance. Evidence which clearly should be in the record, but has been improperly excluded, should be admissible to demonstrate a violation of Public Resources Code section 21005. Clearly evidence which has been withheld from the public, despite requests from the public for inclusion of such information, cannot be provided by the public. In addition, the public should be able to assume the lead agency will include documents which are required to be part of the administrative record under CEQA, such as documents in its own files on a project. (Pub. Res. Code 21167.6(e)(10).)

Such interpretation is supported by Western States which notes that extra-record evidence should be admissible to demonstrate procedural unfairness and agency misconduct. (*Western States Petroleum Ass'n v. Superior Court* (1995) 9 Cal. 4th 559, 575 n.5 & 579.) In *Western States,* the petroleum association attempted to introduce newly created expert evidence, prepared after the close of the public hearing, to demonstrate that the Air Resources Board failed to consider all relevant factors. The Supreme Court held, "extra-record evidence can never be admitted merely to contradict the

evidence the administrative agency relied on in making a quasi-legislative decision or to raise a question regarding the wisdom of that decision." In contrast, in this case Petitioners seek the court to consider documents which were in the agency's files or trustee agency's files to demonstrate a procedural defect in the City's CLA process.

In this case, there is extra-record evidence from the Department of Sanitation which demonstrates that the level of dewatering is almost five-fold greater than that which was presented in Playa Vista's modeling study. (Notice of Lodgment, Ex. 1.)[3] Petitioners specifically requested such documents in the CLA process (5 RR 986.) The assertion that the public must independently dig through the City's own files to ensure that a spider maps of phase I and phase II is before the decisionmaker violates CEQA policies which places the duty of environmental investigation squarely on the shoulders of the responsible governmental agency. (Guidelines § 15020; *Sundstrom, supra,* 202 Cal. App. 3d at 311.) Obviously, information about the actual state of dewatering in the City's own files on the Playa Vista would be critical to informed decision-making. Such documents were required to be part of the record under CEQA. (Pub. Res. Code § 21167.6(e)(10).)

Even more egregious is the failure of the City to request and Playa Vista's failure to disclose evidence of NPDES permits in existence at the time of the hearing. Documents from the RWQCB demonstrate that 950,000 gallons a day of dewatering is occurring at the Playa Vista Site. (Exhibit 2.) As evidenced by the 2003 permit number on page 2 of the document, such evidence was available to Playa Vista long before the 2007 CLA Report was adopted.

Respondents may attempt to argue that such dewatering is independent of the methane mitigation system. Such statement would be untrue. As it states in the document, "The area proposed for dewatering under this permit is located at least 800 feet from the areas of known or suspected contamination." If dewatering is not occurring for the purpose of groundwater remediation, then it must be dewatering for the purpose of lowering the groundwater table, and therefore in connection with methane mitigation measures. In addition, the permit requires Playa Vista to maintain a settling tank,

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[3] The documents attached to the Notice of Lodgment have been previously authenticated by Patricia McPherson's declaration filed in conjunction with the Motion to Augment. Plaintiffs Request Judicial Notice of such declaration pursuant to Evidence Code section 452d. Respondents never objected to the authenticity of such documents.

bag filter, activated carbon and Zeolite treatment in case the pumping encounters contamination. In other words, the RWQCB is concerned about expansion of the groundwater contamination...the same potential impact identified by the Court of Appeal. (*Environmentalism Through Inspiration and Non-Violent Action, et. al. v. City of Los Angeles*, 2005 Cal. App. Unpub. LEXIS 9697, at 36.)

The documents from the Department of Sanitation are unquestionably part of the City's file on the Playa Vista project and should have been made available to the City Council and the Public. (Pub. Res. Code section 21167.6(e)(10). The failure to present such evidence to the public and City Council precluded informed decisionmaking and public participation and therefore violated CEQA. (Pub. Res. Code § 21005.) The documents from the RWQCB demonstrate that up to 950,000 gallons a day of dewatering is occurring at the Playa Vista site. Playa Vista, by failing to submit such relevant information to the decisionmaker, violated the information disclosure provisions of CEQA. (Pub. Res. Code 21003.1.) The suppression of such documents cannot be considered a good faith effort at full disclosure. The Return to Writ must be denied.

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3

15 February 2001

CITY OF LOS ANGELES
DEPARTMENT OF BUILDING & SAFETY
201 N. Figueroa, 3rd Floor
Los Angeles, CA 90012

ATTENTION: DANA PREVOST

Re: REGIONAL GROUND SUBSIDENCE AT PLAYA VISTA, PLAYA DEL REY AND THE MARINA PENINSULA, AND RELATED GAS MIGRATION PROBLEMS

Dear Mr. Prevost:

Pursuant to your recent request, I have prepared this letter as a review of issues regarding regional ground subsidence and the related gas migration issues in Playa Vista, Playa del Rey and the Marina Peninsula areas.

1. SUBSIDENCE IS CAUSED BY FLUID WITHDRAWAL:

Fluid withdrawal from a petroleum reservoir or aquifer leads to the inevitable result of causing land subsidence at the surface, and compaction of sands at the reservoir level. The compaction is due to a pressure decrease in the reservoir or aquifer, and causes the overlying formations and the land surface to sink. This deformation leads to fracturing of the geological formations in the surrounding areas, causes movement along existing fault structures, and damages the oil and gas well casings and seals. This gives rise to the upward migration of gas from the petroleum reservoir. The interaction between subsidence and gas migration is illustrated in Exhibit 1.

The geological deformation is greatest at the reservoir level and propagates to the surface as a bowl shaped configuration, as illustrated in Exhibit 2. The maximum subsidence is at the center of the bowl. For a petroleum reservoir, the extent of the subsidence bowl at the surface is approximately twice the areal extent of the reservoir. The cross-sectional distribution of compressive and tensile stresses within the subsiding formation is also illustrated in Exhibit 2.

As a general rule, the amount of subsidence experienced at the surface correlates directly with the volume of fluid production within the reservoir. A convenient representation is to plot cumulative subsidence versus time, and cumulative fluid production versus time in order to characterize this correlation. The survey data and fluid production history of the referenced area supports this correlation.

2. FLUID WITHDRAWAL HAS CAUSED SIGNIFICANT SUBSIDENCE AT PLAYA VISTA, PLAYA DEL REY AND THE MARINA PENINSULA AREAS:

Fluid production of oil and brine water from the Playa del Rey and Venice oil fields caused nearly two feet of surface subsidence between 1927 and 1970. The California Division of Oil and Gas (DOG) documented this in their Sixtieth Annual Report published in 1974. Exhibit 3 presents the iso-contours of subsidence from that report, showing the vertical movement in feet during 1937 to 1970 (viz., Figure 3 from the DOG report). This figure also illustrates the productive limits of the "Del Rey Hills Area," the "Venice Area" and the "Kidson Area."

Exhibit 4 presents the cumulative subsidence in feet for the time period 1927 to 1970 for selected bench marks, along with cumulative oil field production (viz., Figure 4 from the DOG report). These data support the following conclusions:

1. Surface subsidence directly correlates with the fluid production from the oil fields.

2. Surface subsidence directly correlates with the productive limits of the oil fields.

3. The areal extent of the subsidence extends well beyond the productive limits of the oil fields.

4. Subsidence was continuing unabated at the end of the measurement data in 1970.

Although fluid production from these areas has continued to the present time, subsidence monitoring has been ignored. Southern California Gas Company (SOCALGAS) has operated an extensive oil field dewatering program within the "Del Rey Hills Area" and the "Venice Area" for many years. This has been necessary since the gas storage operations requires continuous pumping of brine water from these areas to prevent invasion of the water into the primary storage zone reservoir.

The average daily production from their dewatering wells is approximately 2,500 barrels of brine water per day. This would equate to over 90,000 barrels per year, or over 27 million barrels of fluid production between 1970 and the present. It is inevitable that this has contributed to the subsidence problem, additional geological fracturing, and additional damage to the oil and gas well casings and seals.

3. CITY OF LOS ANGELES SURVEY DATA HAS CONFIRMED THE EXISTENCE OF A SERIOUS SUBSIDENCE PROBLEM:

I utilized survey data generated by the City of Los Angeles to evaluate the extent of the subsidence problem in the Playa Vista Area (near Jefferson Blvd. and Lincoln Blvd.) in the vicinity of the Playa del Rey oil field. The data utilized is presented in Exhibit 5.

The elevation data for a bench mark at Jefferson and Lincoln was as follows ("STD SUR MON, VEN I-4, ON CENTER LINE INTER OF JEFFERSON BLVD AND LINCOLN BLVD. ** GONE 1972 **"):

Exhibit 6 sets forth the location of the oil and gas wells within the Playa del Rey and Venice oil field areas. These areas are all interconnected with a highly permeable gravel zone that was formed by the old Los Angeles Riverbed. This provides a ready conduit for the migration of gas as it leaks up the old and corroded well casings. These wells were drilled prior to the time that significant subsidence had occurred in the oil fields. Accordingly, this subsidence has aggravated the well leakage problems.

SOCALGAS owns all of the mineral rights in this area, and has been the oil field operator for many years. As a consequence, they have the primary responsibility for monitoring for oil field subsidence, but have not done so. Furthermore, they have failed to adequately investigate the integrity of the many old wells in the area, and have failed to perform adequate soil gas studies.

It is apparent that the gas migration problems at Playa Vista are strongly interrelated with the movement of leaking gas easterly within these gravel zones as a result of being "swept" by the tidal forces and wave energy within these permeable zones.

5. SURFACE DEFORMATION:

Deformation due to compression and extension at and near the land surface causes fissures in the soil and damages buildings, pipelines, and other structures. In the subject areas, these problems are complicated by the 100% liquefaction prone region that has been identified in the Seismic Hazards Map published by the Division of Mines and Geology, and by the near surface water table.

Regional water tables will remain at nearly the same elevation after local subsidence lowers the land surface. The effect is to decrease the depth to the water level. If the water table rises (relative to the land surface), higher than the bottom slab of a building, the uplift pressure on the structure will be noticeably increased. This could cause the slab to eventually rupture.

Likewise, the below-slab installation of a gas membrane barrier for gas control purposes could be adversely impacted by these same uplift pressure conditions. Since the gas membrane must perform without failure over the lifetime of the structure (viz., exceeding 70 years), the long-term consequences of the subsidence must be evaluated. As a minimum, this would require ongoing monitoring of the subsidence problem using dedicated bench marks and appropriate surveying techniques.

These survey techniques have been implemented successfully in many oil fields throughout the world. For example, the city of Long Beach requires continuous monitoring for subsidence in the Wilmington Field, and has an elaborate water injection program to mitigate the consequences of surface sinking and water incursion in this coastal area.

The city of Beverly Hills has imposed a contractual obligation upon all oil field operators within the city to monitor for subsidence. This has been ongoing for at least the past 50 years, when it was first imposed upon the Occidental Petroleum operations within the city.

The city of Redondo Beach failed to impose such a requirement on oil field operations conducted under the King Harbor Boat Marina. Approximately two feet of subsidence, which occurred over a period of 20 years of oil production, caused the breakwater rubble barrier, constructed by the U.S. Army Corps of Engineers, to sink. A winter storm in 1988 destroyed the rubble barrier, and the city of Redondo Beach and the U.S. Army Corps of Engineers were held liable for the millions of dollars of damage that resulted to the shoreline structures. They were found to have been negligent for failing to monitor for the subsidence and for their failure to take protective measures to minimize the risk of injury.

It is significant to point out that the level of subsidence measured in the Playa del Rey and Venice coastal areas through 1970 is similar to the subsidence that caused the destruction of the King Harbor at Redondo Beach. However, it is alarming that this profound example of destruction has largely gone ignored as it relates to the Playa Vista development.

The conduct of SOCALGAS in failing to monitor for subsidence over the past 30 years falls well below the standard of care for oil field operators. In addition, their refusal to perform appropriate soil gas surveys in the area has endangered public health and safety.

6. LESSONS LEARNED REGARDING SUBSIDENCE PROBLEMS THAT CAUSED THE COLLAPSE OF THE BALDWIN HILLS DAM:

Another example of oil field related subsidence that deserves careful review is the failure of the Baldwin Hills Dam on December 14, 1963. This facility was designed, constructed and operated by the Department of Water and Power. It was an earthen dam that was constructed over the Inglewood oil field, and used a spray-on membrane barrier similar to the "liquid boot" product. The basic design was flawed because it failed to account for the moving and unstable soil conditions created by the subsiding oil field operated by Chevron.

The reservoir failed so abruptly that there was not enough time to evacuate all of the people located in the area. The foundation of the dam and the membrane barrier lining ruptured and within hours the reservoir was empty. Five persons drowned, 41 homes were destroyed and another 986 homes were severely damaged. The dam purportedly had a monitoring system capable of detecting leakage of water into the area below the membrane barrier.

An investigation conducted after the dam collapse revealed that land subsidence and soil movement had created tears in the membrane barrier, allowing some water to escape and undermine the integrity of the dam's earthen foundation. These studies also revealed that the subsidence was not uniform, and caused differential settling across the diagonal face of the dam. None of this movement was monitored or accounted for in the design of the dam.

These lessons learned are especially significant as they relate to the gas membrane barrier installed at the Fountain Park apartment complex. There has been no showing that this membrane barrier will have the capability to withstand the geological and hydrostatic forces that can be anticipated to exist over the lifetime of the structure.

The problems can be viewed as the reverse of what caused the Baldwin Hills Dam disaster. Gas cannot be allowed to leak upward through the membrane barrier. However, the membrane barrier must survive the forces caused by a combination of movements from earthquake liquefaction, oil field subsidence, multiple piling penetrations, and the upward pressures from a shallow water table.

The pilings and stone columns have already been demonstrated to exacerbate the gas migration problem, placing even greater importance on this problem area.

7. MONITORING REQUIREMENTS:

The following conditions require monitoring and evaluation of their interrelations:

1. Surface vertical and horizontal deformations performed by leveling surveys, to be conducted on an ongoing basis.

2. An evaluation of fluid production being carried out by SOCALGAS, with an identification of well locations and production zones.

3. An evaluation of gas seepage from well locations utilizing soil gas monitoring techniques.

4. An evaluation of the hydrology conditions existing within the gravel aquifers within the vicinity of the oil and gas wells.

5. An evaluation of the dynamic conditions of the water table and other piezometric surfaces, including the influences of tidal action and seasonal variations.

6. An evaluation of the mechanical condition and well leakage information for all of the oil and gas wells located in the Playa del Rey and Venice oil fields.

7. Development of a gas mitigation and earthquake risk assessment plan consistent with the problems identified by this investigation.

The cost burden for these studies should be the responsibity of SOCALGAS. They have responsibility for the safe operation of the Playa del Rey and Venice oil fields by virtue of being the successor in interest to the operations of these fields that first began in the late 1920's. Also, SOCALGAS has derived, and continues to derive, significant economic benefit by the continued operation of these fields as part of their gas storage operations.

It is critical that SOCALGAS be required to disclose all well record information that is within their possession. This is necessary to protect public health and safety, and to facilitate an independent review of the risks posed by their operations. For example, there is overwhelming evidence that SOCALGAS failed to disclose to the DOG, and to the public, important information regarding well leakage problems. Also, they have falsely represented to the city of Los Angeles that there is no vertical gas migration at Playa del Rey.

8. THERE IS A HUGE INCOMPATIBILITY BETWEEN SOCALGAS OPERATIONS AND RESIDENTIAL DEVELOPMENT:

SOCALGAS currently has an application pending before the State of California Public Utilities Commission (PUC) seeking authorization to sell certain residential lots within the Playa del Rey and Marina Peninsula areas. Previously they had sold many residential lots in these areas without obtaining approval from the PUC. The validity of these sales, and possible violations of PUC regulations is currently under review by the PUC.

In many instances, these lot sales have resulted in homes being built directly over old oil and gas wells. SOCALGAS has taken the position that the city of Los Angeles is solely responsible for the permitting and approval procedures regarding this residential development. On the other hand, SOCALGAS has failed to disclose the serious leakage problems they have experienced with these wells. Most of the wells that were proclaimed to have been abandoned to the current standards of the DOG have developed leaks.

There has been a failure to evaluate the long-term consequences of subsidence, well leakage problems and earthquake hazards on these real estate developments. This responsibility has been delegated to the city of Los Angeles by SOCALGAS without adequate disclosure of the public health and safety risks posed by their operations. As a consequence, virtually no mitigation measures have been imposed by the city, and no monitoring procedures have been required.

The SOCALGAS underground gas storage operation in the city of Montebello had to be shut down because of well leakage problems into homes. Some homes had to be torn down to provide access to the leaking wells. In addition, homes built over the wells prevented appropriate monitoring of the gas migration hazards.

Before additional housing construction is allowed in the Playa Vista, Playa del Rey and Marina Peninsula areas a thorough investigation of the hazards to public health and safety must be performed. This is dictated by the City of Los Angeles Building Code which is primarily intended to protect the residents in these areas who have little or no knowledge of the extreme dangers posed by these oil field operations.

9. CONCLUSIONS:

Fluid withdrawal from the Playa del Rey and Venice oil fields has created regional ground subsidence that has impacted, and will continue to impact, real estate developments at Playa Vista, Playa del Rey and the Marina Peninsula areas. Nearly two feet of subsidence occurred between 1927 and 1970. However, there has been no systematic monitoring for subsidence since 1970.

This is an ongoing problem since SOCALGAS continues to produce large volumes of brine water from many wells in the area as part of their underground gas storage operations.

The subsidence has caused fracturing of the geological formation and damage to the well casings causing upward migration of gas to the surface, thereby exacerbating the near surface soil gas problems.

The long-term consequences of the surface deformation will impact the integrity of the gas membrane barriers necessary to protect structures from the migrating gas.

A systems engineering approach is necessary in evaluating the interactive consequences of subsidence, gas migration and movement of gas through the near surface aquifers from the locations of the leaking wells. This requires a detailed evaluation of the hydrology and the tidal actions that are responsible for moving the gases easterly within the aquifers and under the Playa Vista development.

There is an urgent need for SOCALGAS to disclose all of the well record information within their possession in order to facilitate an independent investigation of the public health and safety risks posed by the oil field and gas storage operations.

A monitoring program needs to be initiated that would systematically evaluate the subsidence and gas migration problems on a regional basis in order to properly assess the hazardous conditions.

Sincerely yours,

Bernard Endres

Bernard Endres, Ph.D.

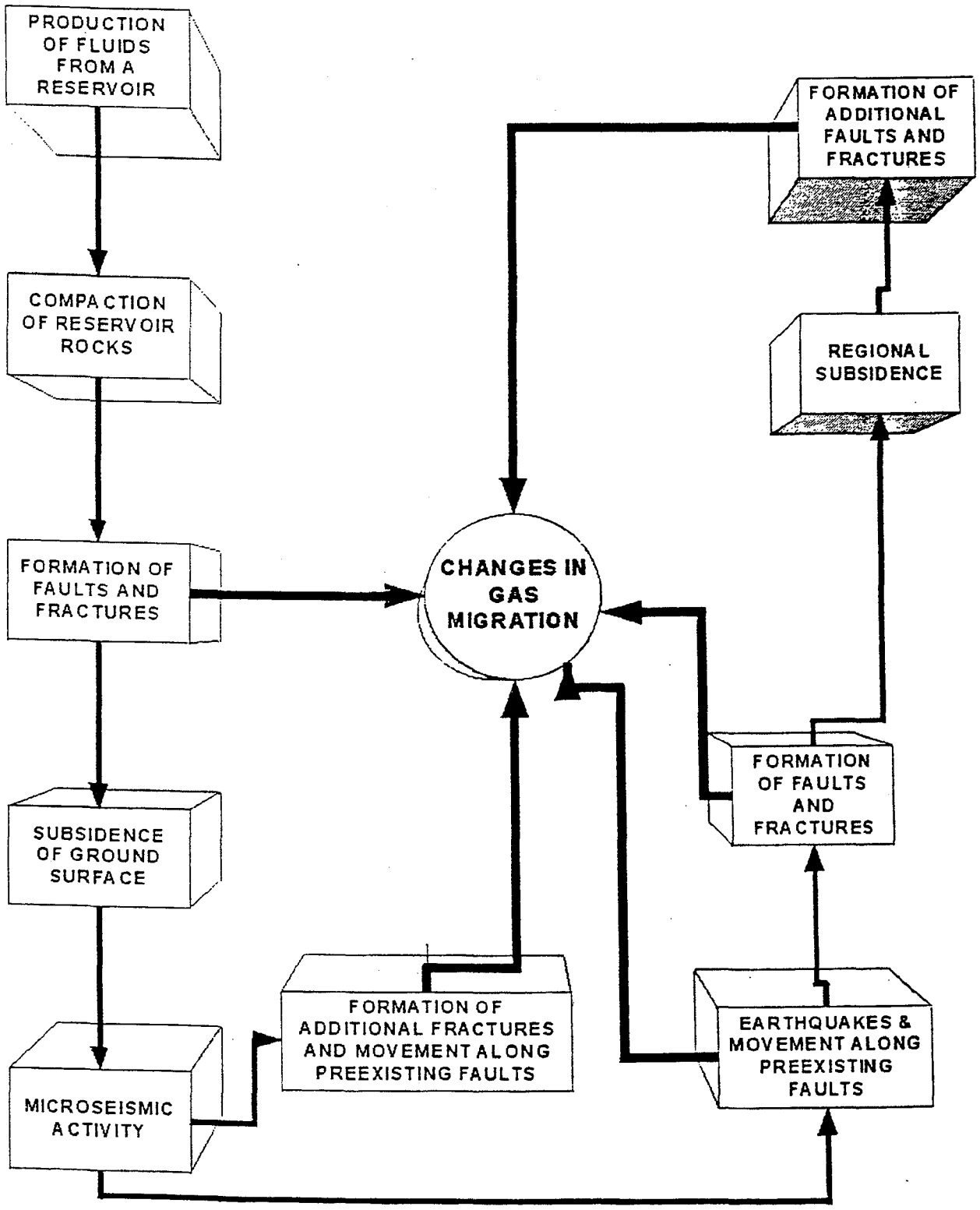
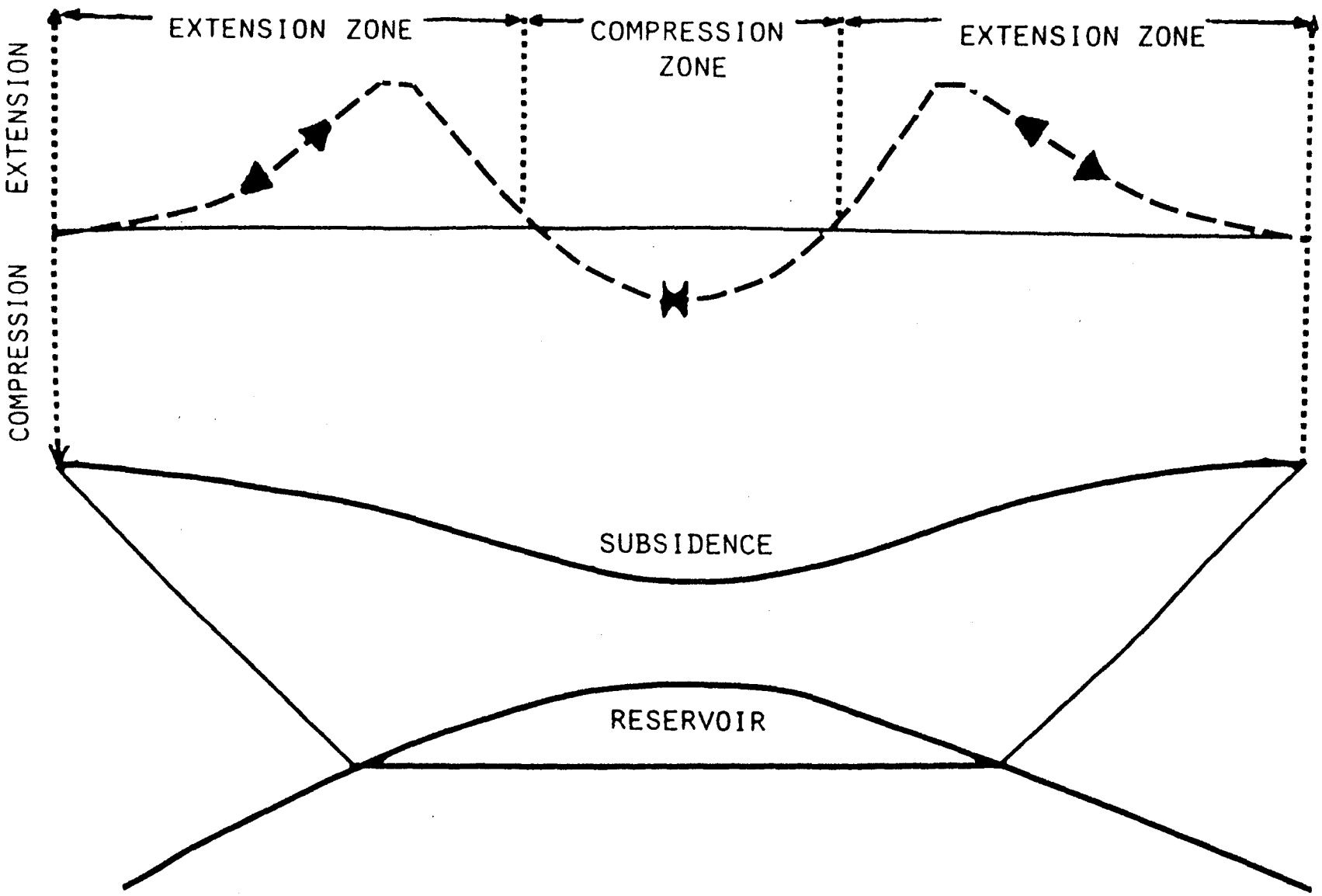
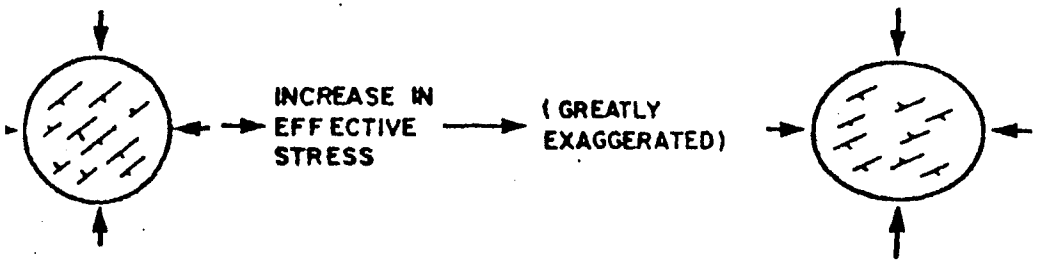


Figure 21-1. Schematic diagram of system relationships among the production of fluids, compaction, subsidence, and seismic activity. (*Modified after Chilingarian et al., 1995, fig. 1, p. 41.)*

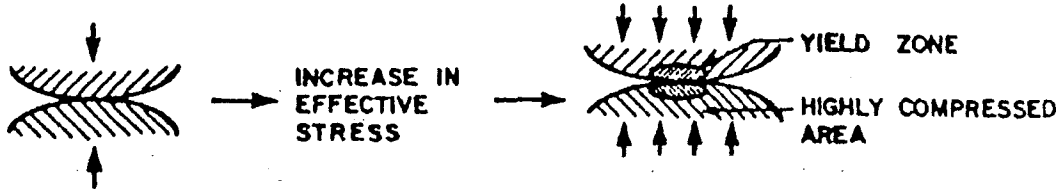


compressive and tensile stress distribution in subsiding formations.

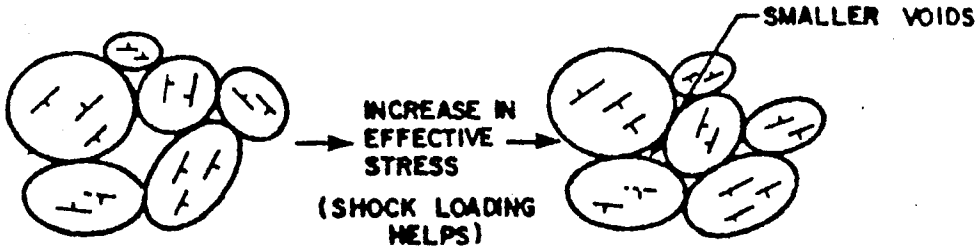
ELASTIC DISTORTION AND COMPRESSION



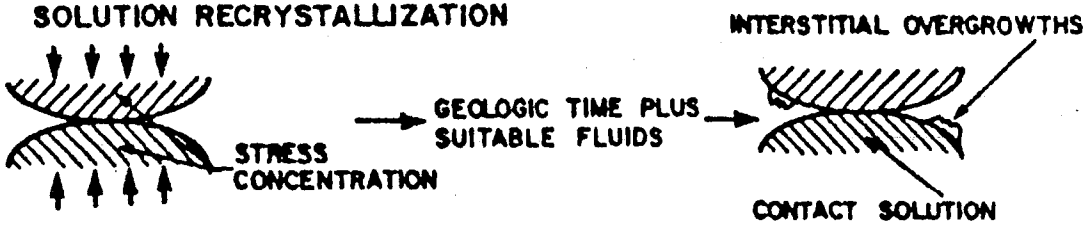
CONTACT POINT COMPRESSION AND YIELD



GRAIN REARRANGEMENT



SOLUTION RECRYSTALLIZATION



Mechanisms of volume decrease

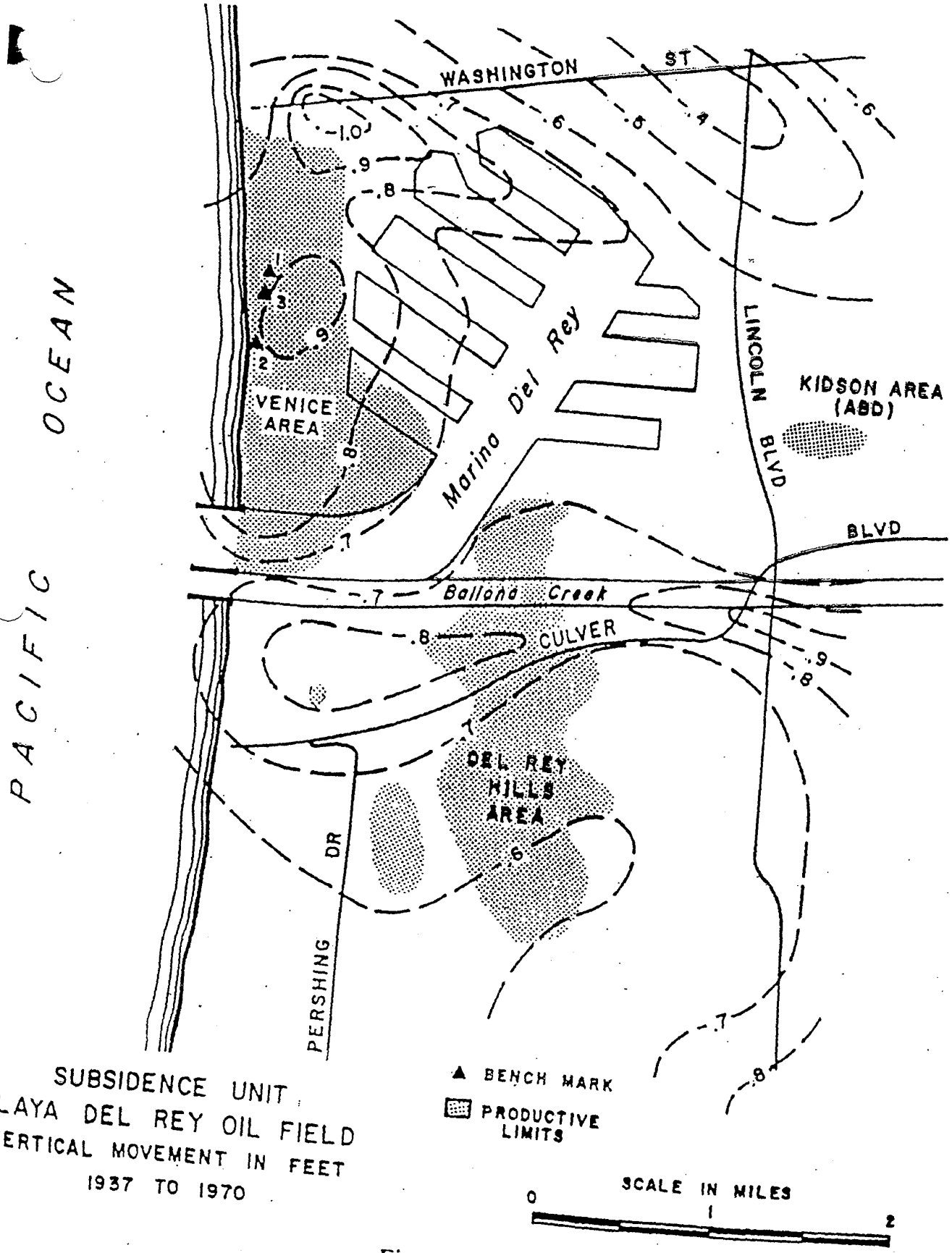

PACIFIC OCEAN
WASHINGTON ST
LINCOLN BLVD
KIDSON AREA (ABD)
VENICE AREA
Marina Del Rey
BLVD
Ballona Creek
CULVER
DEL REY HILLS AREA
PERSHING DR
-1.0
.9
.8
.7
.6
.5
.4
1
2
3
SUBSIDENCE UNIT
PLAYA DEL REY OIL FIELD
VERTICAL MOVEMENT IN FEET
1937 TO 1970
BENCH MARK
PRODUCTIVE LIMITS
SCALE IN MILES
0
1
2

Figure 3

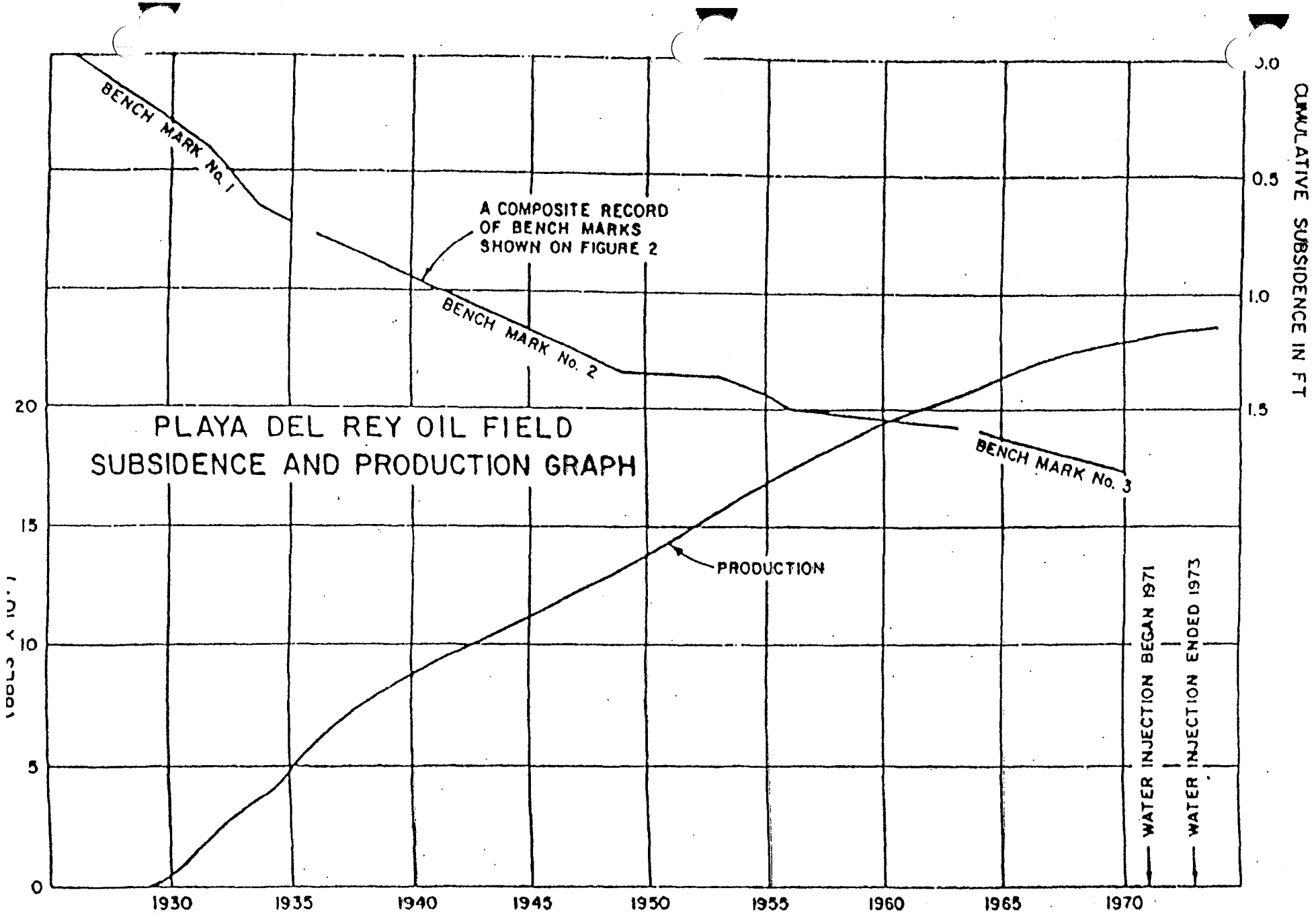

PLAYA DEL REY OIL FIELD
SUBSIDENCE AND PRODUCTION GRAPH
BENCH MARK No. 1
A COMPOSITE RECORD OF BENCH MARKS SHOWN ON FIGURE 2
BENCH MARK No. 2
BENCH MARK No. 3
PRODUCTION
WATER INJECTION BEGAN 1971
WATER INJECTION ENDED 1973
CUMULATIVE SUBSIDENCE IN FT
0.0
0.5
1.0
1.5
0
5
10
15
20
1930
1935
1940
1945
1950
1955
1960
1965
1970

Figure 4

	[illegible] YR	ELEV YR	ELEV YR	ELEV YR	E[illegible] YR	BM N
S[illegible] R MON, SAW J-12, ON CENTER LINE INTERSECTION OF MCLAUGHLIN AVE & WASHINGTON PL	[illegible]366 70 (18.400)	60.414 68P (18.414)	60.526 63S (18.448)			17-108
SPK N CURB MCLAUGHLIN AVE,3FT W/O BCR WASHINGTON PL	61.932 85 (18.877)	61.850 80 (18.852)				17-108
WIRE SPK IN SE CURB HERBERT ST, 6FT NE OF BC CURB RETURN NE OF MCLAUGHLIN AVE	54.101 85 (16.490)	53.989 80 (16.456)	54.140 70 (16.502)	54.187 68P (16.516)	54.299 63S (16.550)	17-108
STD SUR MON, SAW J-12A, ON CENTER LINE MCLAUGHLIN AVENUE, 48.30FT NORTHWEST OF CENTER LINE WASHINGTON BLVD.	44.012 85 (13.415)	43.914 80 (13.385)	44.050 70 (13.426)	44.097 68P (13.441)	44.212 63S (13.476)	17-108
WIRE SPK IN E CURB OF W RDWY CULVER BLVD, 4.8FT S OF N CURB LINE PRODUCED, OF MCLAUGHLIN AV, N END CB	38.966 80 (11.877)	39.097 70 (11.917)	39.143 68P (11.931)	39.257 63S (11.966)		17-109
SPK 2FT E/O E CURB OF WEST BDWY CULVER BLVD, 12FT N/O C/L PROD MCLAUGHLIN AVE, N END CB	39.058 85 (11.905)					17-109
STD SUR MON, VEN K-1, ON CENTERLINE INTER OF CULVER BLVD EAST ROADWAY AND SLAUSON AVENUE,FROM THE EAST.	37.006 70 (11.279)	37.051 68P (11.293)	37.166 63S (11.328)			17-109
LACO FC DISK *STMPD 116-20300,1971* 2FT W/O WEST CURB CULVER BLVD, 9.5FT N/O NORTH ABUT OF FLOOD CONTROL CHANNEL, N END GUARD RAIL, APPROX 150FT S/O SLAUSON AVE EAST	39.278 85 (11.972)	39.180 80 (11.942)				17-109
WIRE SPK IN E CURB CULVER BLVD, 1.6FT S OF BC CURB RETURN S OF STONER AVE	36.037 85 (10.984)	35.938 80 (10.954)	36.072 70 (10.995)	36.116 68P (11.008)	36.232 63S (11.044)	17-109
SPK N CURB INGLEWOOD BLVD, 10FT E/O BCR CULVER BLVD, EAST RDWY	35.026 85 (10.676)	34.924 80 (10.645)				17-109
STD SUR MON, VEN J-1B, ON CENTER LINE INTERSECTION CULVER BLVD E RDWY & INGLEWOOD BLVD	35.090 70 (10.695)	35.134 68P (10.709)	35.247 63S (10.743)			17-109
WIRE SPK IN E CURB CULVER BLVD, 0.6FT S OF BC CURB RETURN S OF FARIAS AVE	30.197 85 (9.204)	30.108 80 (9.177)	30.247 70 (9.219)	30.290 68P (9.232)	30.405 63S (9.267)	17-109
WIRE SPK IN W CURB CULVER BLVD W RDWY, 11.8FT N OF BC CURB RETURN N OF WESTLAWN AVE, S END CB	22.871 85 (6.971)	22.772 80 (6.941)	22.898 70S (6.979)			17-110

(METRIC IN PARENTHESES) P 98

| | | |

	ELEV	YR	ELEV	YR	ELEV	YR	ELEV	YR	E[illegible]	YR	BM N
BRA DISC *STMPD L.A.CO ENGINEER R.E. 7078* IN CONC MON, UNDER COVER, ON APPARENT CTR LINE INTERS OF FIJI WAY & ADMIRALTY WAY, IN THE MARINA COMPLEX	15.440 (4.706)	80	15.622 (4.762)	75	15.518 (4.730)	74S	15.554 (4.741)	74P	15.562 (4.743)	70R	17-115
BOAT SPK IN THE INTER OF FIJI WY & ADMIRALTY WY, 0.7FT E OF BOAT SPK ON C/L EC, STA 17 PLUS 15.00, OF FIRST CURVE IN FIJI WY W OF LINCOLN BLVD ** GONE 1969 **	16.438 (5.010)	63									17-115
BRASS NAIL IN LEAD N CURB FIJI WAY, 1FT W/O BCR W/O ADMIRALTY WAT ** NOTE MILEAGE **	16.440 (5.011)	85									17-115
BRASS DISC *STMPD L.A.CO ENGINEER R.E. 7078* IN CONC MON,UNDER COVER, ON APPARENT CTR LINE 0.14MI W OF ADMIRALTY WAY, OPPOSITE DRVWY ENTRANCE TO FISHERMANS VILLAGE PARKING LOT	13.392 (4.082)	80	13.580 (4.139)	75	13.511 (4.118)	74P	13.519 (4.121)	70R			17-115
SPK 1FT N/O N CURB FIJI WAY, 6FT E/O DRIVE TO FISHERMANS VILLAGE, W END CB 0.14MI W/O ADMIRALTY WAY	14.137 (4.309)	85									17-115
USC&GS BM DISC *STMPD TIDAL NO. 4 1968* IN FIJI WAY 0.7FT N OF NLY CURB LINE, 138FT W OF WLY CURB LINE OF ENTRANCE TO FISHERMANS VILLAGE, W END CB 0.50MI WLY FROM ADMIRALTY WAY 0.64MI W/O ADMIRALTY WAY	12.713 (3.875)	85	12.615 (3.845)	80	12.790 (3.898)	75	12.681 (3.865)	74S	12.710 (3.874)	74P	17-116
USC&GS BM DISC *STMPD TIDAL NO. 3 1967* IN FIJI WAY IN CTR OF CURB RETURN AT S END OF MEDIAN; 53FT S OF CTR LINE DRVWY FOR PIECES OF EIGHT RESTAURANT 42.7FT E OF W CURB FIJI WAY	14.774 (4.503)	85	14.695 (4.479)	80	14.869 (4.532)	75	14.764 (4.500)	74S	14.798 (4.510)	74P	17-116
USC&GS BM DISC *STMPD TIDAL NO. 2 1967* IN FIJI WAY IN CTR OF CURB RETURN N END OF MEDIAN, 28FT S OF CTR LINE OF N DRVWY ENTRANCE TO ADMINISTRATION PARKING LOT, 0.69MI W/O ADMIRALTY WAY	15.226 (4.641)	85	15.131 (4.612)	80	15.310 (4.666)	75	15.198 (4.632)	74S	15.232 (4.643)	74P	17-117
USC&GS DISC * STMPD TIDAL NO. 1 1967 * IN NORTHEAST CORNER OF COAST GUARD BUILDING IN CONCRETE FOUNDATION, 29.5FT WEST OF CENTER FIJI WAY, 17FT SOUTH OF CENTER LINE OF DRIVE WAY, NORTH OF COAST GUARD BUILDING.	14.728 (4.489)	85	14.593 (4.448)	80	14.759 (4.499)	75	14.641 (4.463)	74S	14.657 (4.467)	74P	17-117

(METRIC IN PARENTHESES) P 98

PG 22	ELEV	YR	ELEV	YR	ELEV	YR	ELEV	YR	ELEV	YR	BM
L A CO F C DISK IN TOP OF SW PIER TO OIL DERRICK, 67.5FT W OF CENTER LINE SPEEDWAY AND 37.5FT N OF CENTER LINE PROD 46TH AVE ** GONE 1963 **	16.459 60 (5.017)		16.502 56 (5.030)		16.569 55 (5.050)						17-0
SPK W CURB PACIFIC AV 5FT N/O BCR N/O LIGHTHOUSE ST	13.199 85 (4.023)										17-0
USC & GS DISK MARKED P-767-1945 SET IN S CURB OF BRIDGE 26.7FT E OF CENTER LINE ROADWAY OF PACIFIC AVE, 8FT S OF CENTER LINE PRODUCED, OF LIGHTHOUSE ST., *3.5FT E OF W END OF BRIDGE* ** GONE 1986 **	14.682 70 (4.475)		14.789 63 (4.508)		14.827 60 (4.519)		14.877 56 (4.535)		14.947 55 (4.556)		17-0
STD SUR MON, VEN E-4, AT CENTER LINE INTER OF PACIFIC AVENUE AND LIGHTHOUSE STREET.	12.249 70R (3.733)		12.247 70 (3.733)		12.354 63 (3.765)		12.391 60 (3.777)		12.440 56 (3.792)		17-0
L.A.CFCD STEEL PIN IN LEAD, IN N CURB CULVER BLVD, 20.5FT E OF W BUILDING LINE OF APARTMENT COMPLEX AT #405, 0.09MI WLY FROM NICHOLSON STREET	4.042 85 (1.232)		3.947 80 (1.203)		4.110 75 (1.253)		4.022 74S (1.226)		4.043 74P (1.232)		17-0
BOLT 1FT S/O S CURB CULVER BLVD, 49FT W/O BCR NICHOLSON ST, W END CB	3.973 85 (1.211)		3.868 80 (1.179)								17-0
WIRE SPIKE IN SOUTH CURB CULVER BLVD, 54FT WEST OF CENTER LINE NICHOLSON STREET. ** GONE 1972 **	4.038 70 (1.231)		4.077 68P (1.243)		4.169 63 (1.271)		4.222 60 (1.287)		4.270 56 (1.301)		17-0
STD SUR MON, VEN G-5A, IN CULVER BLVD, 14FT SOUTH OF CENTER STRIPE, ON CENTER LINE P.I., OPPOSITE PP #1277854E, 512.7FT EAST OF CENTER LINE NICHOLSON STREET, 0.37MI WEST OF JEFFERSON BLVD.	3.236 75 (0.986)		3.145 74S (0.959)		3.162 74P (0.964)		3.154 70R (0.961)		3.171 70 (0.967)		17-0
STD SUR MON, VEN H-4, AT CENTER LINE INTER OF CULVER BLVD AND JEFFERSON BLVD.	4.690 75 (1.430)		4.579 74S (1.396)		4.604 74P (1.403)		4.595 70R (1.401)		4.608 70 (1.405)		17-0
PBM DISC STAMPED * 17-02311, 1979 * CTR HEADWALL, 7FT S/O S EDGE PAVEMENT JEFFERSON BLVD, 12FT ELY C/L INTERSECTION CULVER BLVD	5.548 85 (1.691)		5.482 80 (1.671)								17-0

(METRIC IN PARENTHESES) P

(SAT.) JUNE 17, 2000; 5:15 P.M.

PACIFIC AVE

AND LIGHTHOUSE

YR.	ELEVATION
'55	14.947
'56	14.877
'60	14.827
'63	14.789
'70	14.682

14.947

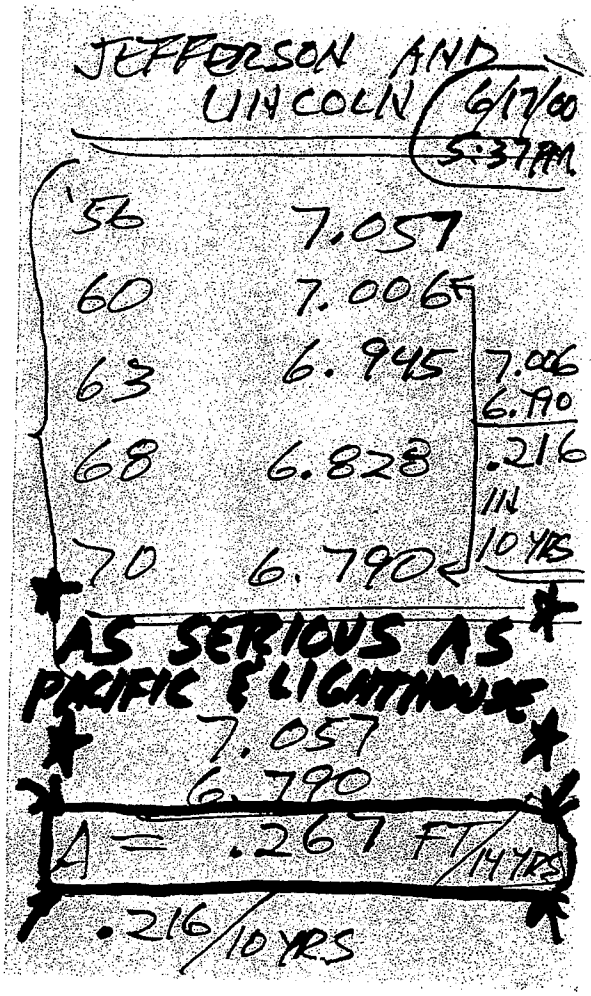
14.682

Δ = .265 FT

(15 YRS.)

	ELEV	YR	ELEV	YR	ELEV	YR	ELEV	YR	ELEV	YR	BM
STD SUR MON, VEN J-5C, AT CENTER LINE INTER OF LINCOLN BLVD AND 83RD STREET.	131.653 75 (40.128)		131.587 74P (40.108)		131.585 70R (40.107)		131.605 70 (40.113)		131.642 68P (40.124)		17-0
SPK 1FT W/O W CURB LINCOLN BLVD, 10FT N/O C/L EC, 400FT N/O 83RD ST, N END CB	94.787 85 (28.891)										17-0
STD SUR MON, VEN J-5B, IN CONC MON ON CENTER LINE P.I. OF LINCOLN BLVD FROM THE SOUTH, 0.22MI NORTH OF CENTER LINE 83RD STREET, 62.3FT NORTH OF A L&T IN EAST CURB ON CENTER LINE TANGENT SOUTH, 65.4FT SOUTHEAST OF L&T IN NORTHEAST CURB * BAR DAMAGED *	80.981 80 (24.683)		81.166 75 (24.739)		81.102 74P (24.720)		81.093 70R (24.717)		81.113 70 (24.723)		17-0
SQ SPIKE IN W CURB LINCOLN BLVD 14.8FT S OF BC TO RDWY NEAR L A CITY LINE 0.55 MILES S OF JEFFERSON BLVD ** GONE 1969 **	51.086 63 (15.571)		51.154 60 (15.592)		51.196 56 (15.605)		51.250 55 (15.621)		51.293 53 (15.634)		17-02
SSM ON CTR LINE LINCOLN BL , 27FT N OF N CURB LINE PROD OF N.O.S SERVICE ROAD TO THE EAST	46.381 85 (14.137)		46.316 80 (14.117)		46.502 75 (14.174)		46.432 74P (14.152)		46.422 70R (14.149)		17-02
SQUARE SPK IN CULVERT HEADWALL, 50FT PLUS OR MINUS W OF C/L LINCOLN BL, 53FT S OF C/L PROD OF ROAD TO HUGHES AIRCRAFT. 0.28MI S OF JEFFERSON BLVD	6.988 85 (2.130)		6.915 80 (2.107)		7.094 75 (2.162)		7.017 74P (2.139)		7.003 70R (2.135)		17-02
STD SUR MON, VEN I-4, ON CENTER LINE INTER OF JEFFERSON BLVD AND LINCOLN BLVD. ** GONE 1972 **	6.790 70 (2.070)		6.828 68P (2.081)		6.945 63 (2.117)		7.006 60 (2.135)		7.057 56 (2.151)		17-02
CITY OF L.A. SURV PBM *STMPD 17-02492 1973* 2FT E OF E CURB LINE OF LINCOLN BLVD, 19.4FT N OF BC CURB RETURN N OF JEFFERSON BLVD, N END CB	11.841 85 (3.609)		11.811 80 (3.600)		12.008 75 (3.660)		11.908 74S (3.630)		11.949 74P (3.642)		17-02
WIRE SPK IN CULVERT HEADWALL, 49.5FT E/O C/L LINCOLN BLVD 45FT S OF CENTER LINE JEFFERSON BLVD ** GONE 1968 **	6.752 63 (2.058)		6.814 60 (2.077)		6.864 56 (2.092)		6.921 55 (2.110)		6.964 53 (2.123)		17-02
LA CO FC DISC MARKED BM-115-228 SET IN HAND RAIL BASE AND ON E SIDE OF HAND RAIL 0.7FT N OF N ABUTMENT OF LINCOLN BLVD BRIDGE OVER BALLONA CREEK 0.26MI NLY FROM JEFFERSON BLVD *CDH BRIDGE #53 118*	19.610 85 (5.977)		19.521 80 (5.950)		19.589 74S (5.971)		19.624 74P (5.981)		19.618 70R (5.980)		17-02
CITY OF L.A. DISC IN W FACE OF MOST NLY COLUMN OF ABANDONED RR BRIDGE OVER LINCOLN BLVD. 4.5FT E OF E CURB, 0.33MI N OF JEFFERSON BLVD *STMPD T 977*	12.864 80 (3.921)		13.054 75 (3.979)		12.939 74S (3.944)		12.972 74P (3.954)		12.967 70R (3.952)		17-02

(METRIC IN PARENTHESES)


JEFFERSON AND LINCOLN
6/17/00
5:37 PM
'56 7.057
60 7.006
63 6.945
68 6.828
70 6.790
7.006
6.790
.216
IN
10 YRS
AS SERIOUS AS PACIFIC & LIGHTHOUSE
7.057
6.790
Δ = .267 FT/14 YRS
.216/10 YRS

PG		ELEV	YR	ELEV	YR	ELEV	YR	ELEV	YR	EL	YR	BM NO
	STD TRAV MON * STMPD VEN H-3 1951 * IN LINCOLN BLVD OF W EDGE CONC PVMT, 25FT N OF C/L OF DRVWY TO PIER 1 IMPORTS. 256FT N/N CURB FIJI WAY.VEN H3 1951	6.570 (2.003)	75	6.457 (1.968)	74S	6.486 (1.977)	74P	6.506 (1.983)	70	6.545 (1.995)	68P	17-025
	SPK S CURB MINDANAO WAY, 0.4FT E/O BCR LINCOLN BL, W END CB	8.553 (2.607)	85	8.455 (2.577)	80							17-025
	STD TRAV MON * STMPD VEN H-3A 1951 * IN LINCOLN BLVD, 1.5FT EAST OF WEST EDGE CONCRETE PAVEMENT, 4FT NORTH OF PP #110719M, 4FT NORTH OF PP #1277914E 0.10MI NORTH OF MINDANAO WAY.	8.644 (2.635)	75	8.527 (2.599)	74S	8.556 (2.608)	74P	8.573 (2.613)	70	8.613 (2.625)	68P	17-025
	CUT SPK IN CULVERT HEADWALL 49FT W OF CENTER LINE LINCOLN BLVD 22FT S OF CENTER LINE PE RY TRACK 1FT S OF N END OF HEADWALL, 0.09MI N OF BALI WAY ** GONE 1975 **	13.119 (3.999)	74P	13.138 (4.004)	70	13.178 (4.017)	68P	13.271 (4.045)	63	13.324 (4.061)	60	17-025
	USC&GS BM DISC *STMPD N 1217 1971* IN W HEADWALL, 1.5FT S OF N END, OF CONCRETE CULVERT, 6.7FT W OF W CURB LINE LINCOLN BLVD, 0.26MI NLY FROM MINDANAO WAY, 33FT N OF NLY RAIL OF OLD S.P. TRAN. CO. TRACK	14.022 (4.274)	85	13.921 (4.243)	80	14.104 (4.299)	75	13.994 (4.265)	74S			17-025
	STD TRAV MON * STMPD VEN G-2B 1951 * IN LINCOLN BLVD. 1.5FT WEST OF EAST EDGE CONCRETE PAVEMENT, IN FRONT OF BRICK BUILDING #4305 12FT NORTH OF POWER P #110709M, 0.12MI NORTH OF P.E RR RIGHT OF WAY.	14.639 (4.462)	74P	14.650 (4.465)	70	14.691 (4.478)	68P	14.784 (4.506)	63	14.826 (4.519)	60	17-026
	SPK W CURB LINCOLN BLVD, 2FT S/O BCR E/O MAXELLA AVE	16.329 (4.977)	85									17-026
	SID SUR MON, VEN G-2C, IN LINCOLN BLVD 5FT WEST OF CENTER LINE, 25.5FT NORTH OF SOUTH PROP LINE PRODUCED OF MAXELLA AVENUE, TO THE WEST.	15.184 (4.628)	80	15.373 (4.686)	75	15.260 (4.651)	74S	15.291 (4.661)	74P	15.301 (4.664)	70	17-026
	USC&GS BM DISC *STMPD V 977 1964* W CURB LINCOLN BLVD, 4.8FT N OF N LINE BLDG #4111, S END OF MOST SLY OF TWO CULVERTS, 0.37MI N OF P.E. RR R/W ** GONE 1973 **	13.969 (4.258)	70	14.010 (4.270)	68P							17-026
	WIRE SPIKE IN W CURB LINCOLN BLVD 0.2 MILES S OF WASHINGTON BLVD N END CULVERT & 47FT N/O POLE #240834M ** GONE 1973 **	13.990 (4.264)	70	14.031 (4.277)	68P	14.120 (4.304)	63	14.157 (4.315)	60	14.210 (4.331)	56	17-026

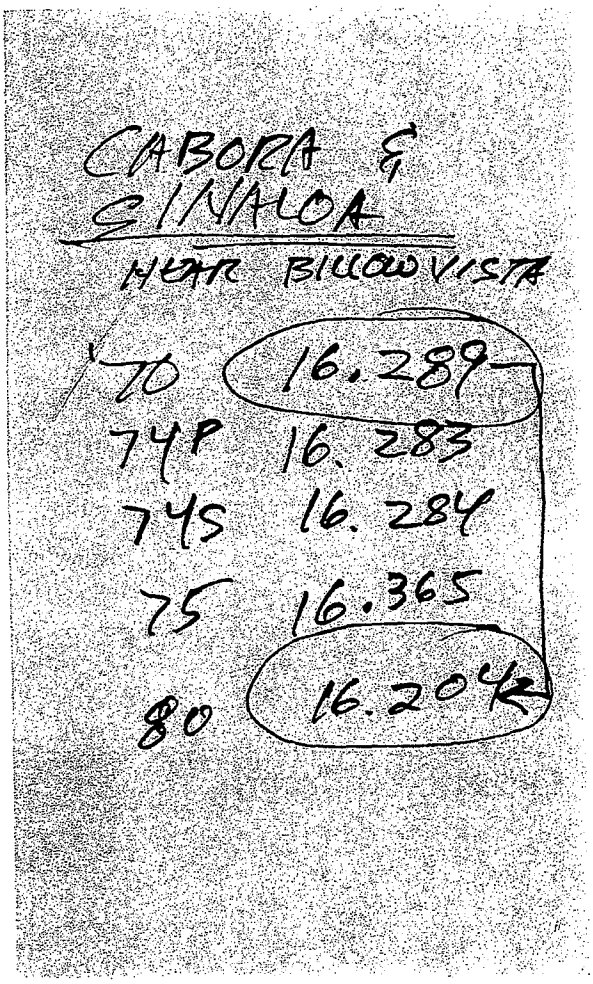
(METRIC IN PARENTHESES) P 98

SPK E END CB ON N'LY SIDE NOS SERVICE ROAD 0.64 W/O BM #27-18400, 244 PLUS 50	81 85 (1 240)					17-1847(
SSM ON C/L P.I. N.O.S AT THE INTERS OF SERVICE RD AND ROAD TO RADAR TOWER ON THE HILL, 146FT E OF E END OF CB, 10.5FT S OF N FLOW LINE OF RD 0.76MI W OF BM 17-18400, STA 234 PLUS 49.33	51.749 80 (15.773)	51.966 75 (15.839)	51.882 74P (15.814)	51.894 70R (15.817)	51.917 70 (15.824)	17-1850(
SPK IN E END CB ON N'LY SIDE NOS SERVICE ROAD 0.82MI W/O BM #17-18400, 234 PLUS 40	53.320 85 (16.252)					17-1850:
SPK IN E END CB ON N'LY SIDE NOS SERVICE ROAD 0.93MI W/O BM #17-18400, 229 PLUS 00	53.100 85 (16.185)					17-1852
SPK IN E END CB ON N'LY SIDE SERVICE ROAD 1.02MI W/O BM #17-18400, 224 PLUS 25	51.306 85 (15.638)					17-1854
COPPER WIRE IN D.H. IN E RIM OF MH IN CTR OF SERVICE RD, 1.09MI W OF BM #17-18400 263FT N OF C/L TANGENT N.O.S. STA 219 PLUS 63.76 * RESET 1975 *	52.372 80 (15.963)	52.476 74P (15.995)	52.478 70R (15.995)	52.495 70 (16.000)		17-1855
SPK IN E END CB ON N'LY SIDE NOS SERVICE ROAD 1.13MI W/O BM #17-18400, 217 PLUS 30	50.541 85 (15.405)					17-1856
SSM IN CTR OF SERVICE RD, 115.1FT W OF SPK IN E END OF CB, 1.19MI W OF BM #17-18400 STA 213 PLUS 71.46	48.756 80 (14.861)	48.944 75 (14.918)	48.865 74P (14.894)	48.863 70R (14.893)	48.882 70 (14.899)	17-1860
2.5IN DISC IN N SIDE AT THE CENTER OF CONC STRUCTURE, INSIDE 5FT WIRE FENCE ENCLOSURE, 350FT S OF SSM OF 1ST ANGLE PT IN CENTINELA AVE, W OF SEPULVEDA BLVD *C/L N.O.S. 313 PLUS 33.30* **FROM THIS POINT PEG UP A WIDE DIRT RD TO THE TOP OF HILL, THEN LEFT TO END OF SPUR**	55.951 75 (17.054)	55.882 74P (17.033)	55.874 70R (17.030)	55.844 70 (17.021)		17-1875
SSM ON C/L N.O.S. @ STA 308 PLUS 88.32, ABOUT 750FT SLY OF FIRST C/L ANGLE PT IN CENTINELA AVE WEST OF SEPULVEDA BLVD, 270FT N OF W END OF 20FT CB AT THE INTERSECTION OF RIGGS PL & KENTWOOD AVE, ON WLY PRODUCTION OF CTR LINE OF CONCRETE WALK AT N SIDE OF ARIZONA CIRCLE, 4FT SW OF SHOULDER OF SLOPE * ABANDONED 1976 *	123.464 74P (37.632)	123.451 70R (37.628)	123.430 70 (37.621)			17-1877

(METRIC IN PARENTHESES) P 989

PG 108	ELEV	YR	ELEV	YR	ELEV	YR	ELEV	YR	ELEV	YR	BM
SQ SPK, 2FT W OF W CURB LINE PRODUCED, OF KENTWOOD AVE, 50FT N OF CTR LINE RIGGS PL, IN W END 20FT CB	120.340 (36.680)	75	120.277 (36.660)	74P	120.261 (36.656)	70R	120.247 (36.651)	70			17-1
WIRE SPK IN E END OF CB, N SIDE OF N.O.S. SERVICE ROAD, ABOUT 800FT WLY OF LINCOLN BLVD	52.234 (15.921)	85	52.159 (15.898)	80	52.344 (15.954)	75	52.270 (15.932)	74P	52.264 (15.930)	70R	17-1
SSM ON C/L TANG. N.O.S. 0.32MI W OF LINCOLN BLVD 4FT N OF N FLOW LINE OF SERVICE RD & 53.3FT W OF 4IN PIPE GATE POST STA 182 PLUS 09.54	51.693 (15.756)	80	51.876 (15.812)	75	51.809 (15.791)	74P	51.800 (15.789)	70R	51.827 (15.797)	70	17-1
SPK IN E END CB ON N'LY SIDE NOS SERVICE ROAD 0.34MI W/O LINCOLN BLVD, 182 PLUS 70	52.195 (15.909)	85									17-1
SPK E END OF CB N SIDE OF SERVICE RD, 0.58MI W OF LINCOLN BLVD	52.956 (16.141)	85	52.877 (16.117)	80	53.057 (16.172)	75	52.994 (16.153)	74P	52.974 (16.146)	70R	17-1
SPK IN E END CB ON N'LY SIDE NOS SERVICE ROAD 0.78MI W/O LINCOLN BLVD, 160 PLUS 40	51.266 (15.626)	85									17-1
SPK IN E END CB ON N'LY SIDE NOS SERVICE ROAD 0.83MI W/O LINCOLN BLVD, 157 PLUS 00	51.703 (15.759)	85									17-1
CHISEL CROSS WLY SIDE INNER RIM N.O.S. MH, NEAR C/L N.O.S. AT APPROX STA 159 PLUS 25, AT CTR OF R&O SERVICE RD, ABOUT 1000FT ELY OF INTER OF CABORA DR & FALMOUTH AVE, ABOUT 600FT WLY OF 8FT GAS CO CHAIN LINK FENCE ACROSS N.O.S. SERVICE ROAD	51.503 (15.698)	80	51.676 (15.751)	75	51.638 (15.739)	74P	51.582 (15.722)	70R	51.607 (15.730)	70	17-1
SPK 1FT W/O W CURB SINALOA RD, 26FT S/O C/L PROD CABORA DRIVE, FRONT OF ELECTROLIER	56.138 (17.111)	85									17-1
COPPER WIRE IN D.H., IN NLY RIM OF N.O.S. MH, ON APPROX C/L N.O.S. ABOUT STA 142 PLUS 00, 9FT NLY OF SLY CURB LINE PROD OF CABORA DR, 15FT WLY OF WLY CURB LINE OF SINALOA RD	16.204 (4.939)	80	16.365 (4.988)	75	16.284 (4.963)	74S	16.283 (4.963)	74P	16.289 (4.965)	70R	17-1
2.5IN BRONZE DISC STAMPED *VEN L.A. CITY SURVEY, N.C.O.S. 32 PLUS 27.00, 1961*, ON C/L N.C.O.S., IN S SIDE OF 5FT DIAMETER CONC MH STRUCTURE, 1250FT N OF IMPERIAL HWY ALONG DIRT RD PASSING E OF CALIF. SAND CO. BLDG, 50FT W OF SAID RD, 215FT E OF P POLE #883845E, THE MOST ELY OF THE SIXTH SET OF POLES COUNTED NLY FROM THE CALIFORNIA SAND COMPANY PLANT ** GONE 1976 **	74.495 (22.706)	74P	74.529 (22.716)	70							17-1

(METRIC IN PARENTHESES) P 9


CABORA &
SINALOA
NEAR BILLOW VISTA
70 16.289
74P 16.283
74S 16.284
75 16.365
80 16.204

	ELEV YR	ELEV YR	ELEV YR	ELEV YR	ELEV YR BM
CITY OF L.A. SURV PBM *STMPD 17-05781 1973* 2FT N OF N CURB LINE JEFFERSON BLVD, 4.8FT E OF BC CURB RETURN E OF GROSVENOR BLVD, W END OF CB	13.415 85 (4.089)	13.323 80 (4.061)	13.514 75 (4.119)	13.433 74S (4.094)	13.444 74P17-0 (4.098)
CITY OF L.A. SURV PBM *STMPD 17-05785 1973* 1FT N OF N CURB LINE JEFFERSON BLVD, 8.3FT W OF BC CURB RETURN W OF WESTLAWN AVE, W END OF CB	14.183 85 (4.323)	14.111 80 (4.301)	14.326 75 (4.367)	14.249 74S (4.343)	14.265 74P17-0 (4.348)
STD SUR MON, VEN K-3, ON CENTER LINE JEFFERSON BLVD, 58.5FT W OF CENTER LINE PE RY TRACK, 0.37 MILES W OF CENTINELLA BLVD **GONE 1973**	14.425 70 (4.397)	14.461 68P (4.408)	14.609 63 (4.453)	14.689 60 (4.477)	14.711 56 17-0 (4.484)
CITY OF L.A. SURV PBM *STMPD 17-05800 1973* 3.9 FT N OF N CURB LINE JEFFERSON BLVD, 20FT E OF E END OF CONCRETE APRON FOR ELY DRIVEWAY TO COLLINS FOODS INTERNATIONAL AT #12731, IN NW CORNER OF CB	13.727 85 (4.184)	13.648 80 (4.160)	13.826 75 (4.214)	13.747 74S (4.190)	13.769 74P17-0 (4.197)
CUT SPK IN CULVERT HEADWALL, 1FT E/O W END, 23FT S OF JEFFERSON BLVD, 165FT W/O C/L INTER P.E.RY & JEFFERSON BLVD, W/O CENTINELLA BLVD **GONE 1972**	14.098 70 (4.282)	14.085 68P (4.293)	14.232 63 (4.338)	14.315 60 (4.363)	14.337 56 17-0 (4.370)
CITY OF L.A. SURV PBM *STMPD 17-05820 1973* 2FT N OF N CURB LINE JEFFERSON BLVD, 5FT E OF BC CURB RETURN E OF MC CONNELL AVE, W END CB	12.385 85 (3.775)	12.310 80 (3.752)	12.506 75 (3.812)	12.423 74S (3.787)	12.453 74P17-05 (3.796)
CITY OF L.A. SURV PBM *STMPD 17-05826 1973* 2.8FT S OF S CURB LINE JEFFERSON BLVD, 27.3FT E OF E CURB LINE PRODUCED, OF BEETHOVEN ST, IN NE CORNER OF CONCRETE FOOTING FOR TRAFFIC SIGNAL CONTROL BOX	13.963 85 (4.256)	13.967 80 (4.257)	14.154 75 (4.314)	14.072 74S (4.289)	14.096 74P17-05 (4.296)
CUT SPK IN CULVERT HEADWALL, 1FT E OF W END, 25.5FT S OF CTR LINE JEFFERSON BLVD, ABOUT 400FT W OF BEETHOVEN ST, 30FT E OF DRIVEWAY TO POWER STATION, 0.22MI W OF MCCONNELL AVE, 0.5MI E OF LINCOLN BLVD **GONE 1972**	9.180 70 (2.798)	9.217 68P (2.809)	9.393 63 (2.863)	9.467 60 (2.886)	9.508 56 17-05 (2.898)
CITY OF L.A. SURV PBM *STMPD 17-05845 1973* 4FT W OF W CURB LINE OF ALLA RD, 10.2FT N OF BC CURB RETURN N OF JEFFERSON BLVD, N END CB	12.287 85 (3.745)	12.208 80 (3.721)	12.388 75 (3.776)	12.290 74S (3.746)	12.317 74P17-05 (3.754)

PG 57	ELEV	YR	ELEV	YR	ELEV	YR	ELEV	YR	ELEV	YR	BI
STD SUR MON, VEN I-4B, ON CENTER LINE JEFFERSON BLVD, 1.05MI WESTERLY FROM CENTINELA AVENUE, 68FT EAST OF PP #310227M. ** GONE 1973 **	7.898 70 (2.407)		7.935 68P (2.419)		8.081 63 (2.463)		8.146 60 (2.483)		8.191 56 (2.497)		17-(
CITY OF L.A. SURV PBM *STMPD 17-05865 1973* 2FT E OF E CURB LINE OF BAY ST, 10.8FT N OF BC CURB RETURN N OF JEFFERSON BLVD, N END CB	12.746 85 (3.885)		12.694 80 (3.869)		12.883 75 (3.927)		12.783 74S (3.896)		12.823 74P (3.908)		17-0
WIRE SPIKE 25.5FT S OF JEFFERSON BLVD 234.5FT E OF CENTER LINE LINCOLN BLVD, 0.5FT E OF W END OF CULVERT HEADWALL ** GONE 1972 **	7.930 70 (2.417)		7.968 68P (2.429)		8.086 63 (2.465)		8.151 60 (2.484)		8.203 56 (2.500)		17-0
WIRE SPIKE IN W CURB CENTINELA AVE 0.8FT N OF BC CURB RET N OF MATTESON AVE ** GONE 1963 **	56.736 60 (17.293)		56.768 56 (17.303)		56.820 55 (17.319)		56.848 53 (17.327)				17-0
WIRE SPIKE IN W CURB CENTINELA AVE 1.2FT S OF BC CURB RET S OF MATTESON AVE	55.905 85 (17.040)		55.823 80 (17.015)		56.036 75 (17.080)		55.974 70 (17.061)		56.021 68P (17.075)		17-0
WIRE SPIKE IN W CURB CENTINELA AVE .5FT N OF BC CURB RETURN NORTH OF BARBARA AVENUE.	54.685 80 (16.668)		54.889 75 (16.730)		54.829 70 (16.712)		54.876 68P (16.726)		54.987 63 (16.760)		17-05
WIRE SPK IN W CURB CENTINELA AVE, 0.5FT N/O BC RET N/O CASWELL AVE	52.664 85 (16.052)		52.592 80 (16.030)		52.796 75 (16.092)		52.738 70 (16.075)		52.785 68P (16.089)		17-05
WIRE SPIKE IN W CURB CENTINELA AVE 0.7FT N OF BC CURB RET N OF MITCHELL AVE	50.650 80 (15.438)		50.844 75 (15.497)		50.817 70 (15.489)		50.864 68P (15.503)		50.967 63 (15.535)		17-05
STD SUR MON, SAW I-12B, ON CENTER LINE INTER OF CENTINELA AVENUE AND MITCHELL AVENUE, FROM THE WEST ** GONE 1960 **	50.717 56 (15.459)		50.764 55 (15.473)								17-05
WIRE SPIKE IN W CURB CENTINELA AVE 0.8FT S OF BC CURB RETURN NORTH OF WASHINGTON PLACE.	49.109 75 (14.968)		49.062 70 (14.954)		49.108 68P (14.968)		49.269 60 (15.017)		49.318 56 (15.032)		17-05
STD SUR MON, VEN I-1A, CENTER LINE CENTINELA AVENUE 13.2FT SOUTH OF CENTER LINE WASHINGTON PLACE, EAST * RESET 1969 *	47.796 56 (14.568)		47.846 55 (14.583)		47.886 53 (14.596)						17-06
WIRE SPK IN S CURB WASHINGTON PL, 21.5FT E OF BC CURB RET E OF CENTINELA AVE, E END CB	48.468 85 (14.773)		48.386 80 (14.748)		48.585 75 (14.809)		48.530 70 (14.792)		48.576 68P (14.806)		17-060

INTER-DEPARTMENTAL CORRESPONDENCE

February 20, 2001

To: Vitaly B. Troyan, P.E.
City Engineer

From: David T. Hsu, Chief of Grading Section
Department of Building and Safety

Subject: REGIONAL GROUND SUBSIDENCE AT PLAYA VISTA, PLAYA DEL REY AND THE MARINA PENINSULA, AND RELATED GAS MIGRATION PROBLEMS, dated February 15, 2001, prepared by Bernard Endres, Ph.D.

REFERENCE: Inter-Departmental Correspondence, dated October 24, 2000, City Engineer

The Department of Building and Safety has received a report concerning subsidence for the Playa Vista area that may affect your conclusions regarding this issue. Please evaluate the attached data with regard to the conclusions of the above referenced letter and inform me of any revisions to your conclusions. Please be aware that an appeal concerning the issue of subsidence at the Playa Vista development has been filed with the Board of Building and Safety Commissioners. Therefore, time is very important with regard to your conclusions.

If you have any questions regarding this information please contact myself at (213)977-6317 or Dana Prevost at (213)97706326.

Attachments: 1) Report dated February 15, 2001, by Bernard Endres Ph.D.

G:/grdocs/grletters/playavista/subsidenceendres

NO RESPONSE

City of Los Angeles
INTER-DEPARTMENTAL CORRESPONDENCE

4

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NO RESPONSE

LOS ANGELES

INTER-DEPARTMENTAL CORRESPONDENCE

Date: May 3, 2000

To: Dana Prevost, David Hsu, Grading Engineering Section
Los Angeles Dept. of Building and Safety

From: Art Kurimoto, Survey Supervisor, Survey Division, Bureau of Engineering
Los Angeles Dept. of Public Works

Subject: **Playa Vista Project Grading Report and Improper Misquotes Regarding Area Subsidence**

It has come to my attention that a report inquiring about methane gas migration leading to ground subsidence in the area of the Playa Vista Development Project has used statements made by me (in a five minute telephone conversation on May 19, 1999) as expert testimony refuting any such ground subsidence during the period of 1975 to 1985. I am alarmed at this, as any statements made by me have been taken out of context.

In my conversation with Mr Steve Kolthoff of Group Delta Consultants, I explained that the City of Los Angeles conducted precise leveling operations citywide on a five year cycle. I explained that I knew of no subsidence studies in the area. However, there are streets such as Jefferson Blvd, Lincoln Blvd and Culver Blvd that have a history of benchmarks that have been remeasured every five years on average since the 1950's as part of a vertical control maintenance program.

In 1985, this citywide leveling program was ended due to lack of funding. This had nothing to do with any subsidence study. I stated that a simple comparison of existing benchmarks along these streets over the years would show vertical ground movement variations in five year increments. I also stated that these records were public information and could be purchased at our Engineering counter for a small reprographics fee.

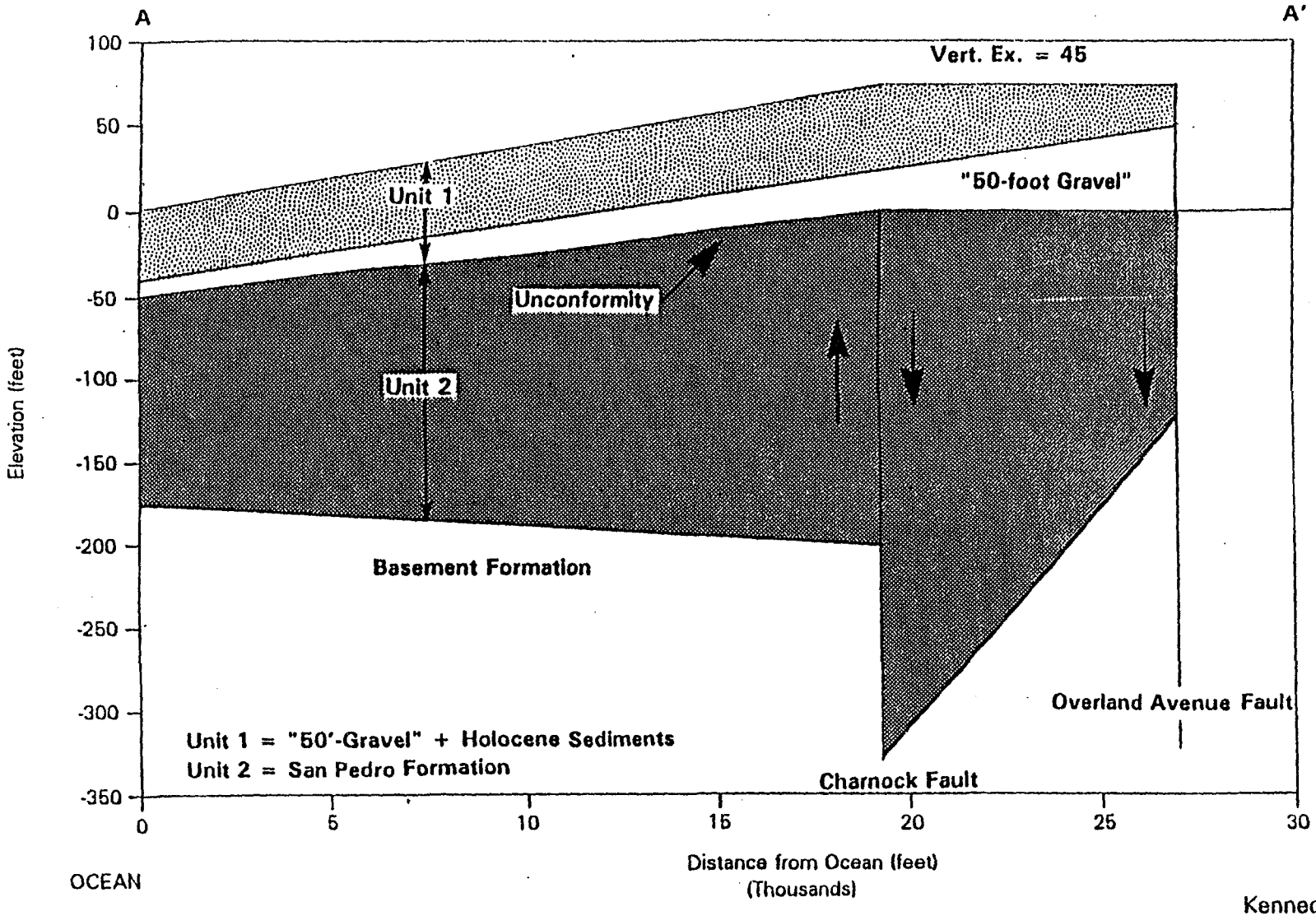
I stated that it was my opinion that there was little or no appreciable ground movement over these recorded benchmarks (which are on the roadway, not in the marshland) and any real comparison would have to be done by Mr. Kolthoff himself.

I do not have any expertise in any matter involving methane gas migration. I do not have any information on any ground subsidence in the project area of the Playa Vista Development. I refute any reference to me as having given expert testimony on any matter regarding ground subsidence at all. Clearly, I have been misquoted during my short conversation with Mr. Kolthoff, and had I known that I would be used as an advisor in a published report, I would have ended the conversation immediately.

Should you have any further questions in this regard, I am available at my office each day.

Phone 310-575-8493
Fax 310-575-8866
E-mail wlasurvey@eng.ci.la.ca.us

Art Kurimoto



Kennedy/Jenks Consultants

Santa Monica Groundwater Management Plan

Idealized Geologic Cross-Section A-A'

K/J 910012
June 1992

Figure 2.3

CA. Public Utilities Safety Report

Complaint Case Facts and Findings
(Playa Del Rey Storage Field)

By

Consumer Protection and Safety Division

August 20, 2002
Revised on November 18, 2004

Table of Contents

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Introduction & Background	1
Discussions of Facts & Findings	2-6
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I. Introduction

This report presents some of the data that Consumer Protection and Safety Division (CPSD) has gathered from the investigation of the Complaint Case (C.00-05-010) proceedings. On May 11, 2000, three residents of Playa Del Rey area filed similar complaints against SoCalGas, C.00-05-010, C.00-05-011 and C.00-05-012, respectively. In addition, Grassroots Coalition and several other residents of Playa del Rey (PDR) and Marina del Rey joined the complaints. Although the complaints were filed separately and individually, they shared a common a concern that SoCalGas is operating its Playa Del Rey gas storage facility unsafely, in a manner hazardous to the health and safety of nearby homeowners. Specifically, the complainants alleged the storage reservoir was leaking, resulting in dangerous toxic pollution from venting and leaking gas, atmospheric contamination, noxious odors, and a leaking abandoned well . Each complainant asked the CPUC to conduct an investigation of the SoCalGas Storage facilities in Playa Del Rey.

SoCalGas filed a motion to dismiss these cases or consolidate the cases. Although the Commission denied the motion to dismiss the cases, but the motion to consolidate was granted and the three complaints were consolidated under Rule 55 of the Commission's Rules of Practice and Procedure. These three cases are now treated as one case under C.00-05-010.

CPSD investigations focused on all the allegations. During the course of these investigations, CPSD conducted laboratory analysis (Isotopic Analysis) of field samples from leaking abandoned well. CPSD also requested and reviewed large volume of data from SoCalGas and Grassroots Coalition. After review of all available data provided to CPSD, the findings were used to determine the merit of the allegations and consequently resolved some of the allegations. The remaining unresolved allegations have been classified into two issues: **(1) Any evidence of PDR storage gas and/ or Thermogenic gas within SoCalGas mineral rights migrating to the surface, (2) Any evidence that the PDR Gas Treatment and/ or PDR Gas Storage facilities are contributing to local**

residents' exposure to carcinogenic toxins. This report focuses on some of the data CPSD has collected, implications of our findings to date, and recommendations for resolving the two remaining allegations.

II. Discussions of Facts and Findings

One must remember that the following facts and findings do not definitively explain or answer the allegations. However, this information, individually or cumulatively, indicate that there might be potential problems that warrant further investigation. The type of investigation or study scope must consider the available data, along with how to integrate that data into a full reservoir study and a Health Risk Assessment (HRA) that provides definitive results that lead to resolution of the two outstanding allegations. It is important to note facts and findings presented below do not indicate any wrong doing on the part of SoCalGas. Instead, they simply reflect the existence of potential hazards compounded by lack of definitive test results or data gaps. The following facts are discussed below:

(a) Evidence of three types of natural gas in PDR
(b) 133 PPM Helium in a natural gas sample from a bar hole near Big Ben well
(c) 22 PPM Helium from a shallow probe by John Sepich & Assoc.,
(d) Greater than 800 PPM Helium from groundwater samples
(e) ETI report indicated Thermogenic gas components detected in shallow subsurface geologic units and H2S detected in soil gas samples
(f) Previous reservoir inventory analysis
(g) 50,000 PPM gas detected at Troxel Well and known migration loss to well
(h) Potential problems with validity of some SoCalGas data.

City docs

A. Three types of natural gas in PDR

There is evidence of surface detection of three types of natural gas in PDR namely: Biogenic gas, Native PDR Thermogenic gas and Storage Reservoir

Thermogenic gas. Biogenic gas is commonly known as Swamp gas. Its chemical and physical characteristics are mostly Methane gas, formed by bacteria action in shallow surface. It has ***no*** Helium, Ethane, Butane or other heavier hydrocarbon. Biogenic gas is non jurisdictional. In contrast, Native PDR Thermogenic gas (native PDR gas) and Storage Reservoir Thermogenic gas (Storage gas)are formed by decomposition of prehistoric fossils under high temperature and pressure in deep and intermediate geological zones. Thermogenic gases have, Methane, Ethane, Helium and other hydrocarbons. Both native themogenic and storage reservoir thermogenic gases have some identical physical and chemical characteristicscontain varying amounts of Helium, Ethane, Methane and other hydrocarbons. Unfortunately, these identical characteristics make it difficult to differentiate Native PDR gas from Storage Reservoir gas. However, experts like Dr. Arehart (Department of Geological Sciences, University of Nevada) have discovered some subtle differences such as the difference in Helium content and the age of the Helium. There are evidence from various gas sample tests and isotopic analysis that show each of these three gases emanating to the ground surface at various locations at one time or another. The presence of Ethane, Methane, Helium and other hydrocarbons are one of the key considerations in determining if a sample is Biogenic or Thermogenic. Once it is determined that a sample is Thermogenic, then the Helium and the concentration present in that sample determines if it's Native PDR gas (1-15 PPM Helium) or Storage Reservoir gas (15-450 PPM Helium). However, commingling of these gases, alteration of physical and chemical properties by some external factors, and filtration of some gas constituents (possibly by groundwater or aquifer) obscure the minor differences and complicates the chemical speciation. *Please see Appendix # A*

B. **133 PPM Helium from bar hole samples near Big Ben Well**

SoCalGas internal office memorandum, dated November 20, 1991 revealed that gas samples collected from bar-holes around Big Ben Well contained 30,000 PPM to 620,000 PPM natural gas and these samples contained 133 PPM to 188 PPM

Helium. A close examination of the memo revealed that three samples were collected on 1/11/91, at bar-holes # 12, 13 & 14. Isotopic analysis of these samples indicated with high probability the signature of Storage Reservoir gas (meaning that the gas migrated from Storage Reservoir). In addition, the memo did not indicate any more sampling at these bar-holes or subsequent remedial action. On 8/23/91 and subsequent dates, samples were collected from bar-hole H instead of bar-holes 12, 13 & 14. The isotopic analyses of the new samples did not reveal the storage gas signature and subsequent discussion on the memo ignored the initial sample data, its significance and if there was any remedial action. *Please see Appendix # B*

C. 22 PPM. Helium from a shallow probe sample by John Sepich and Associate.

Isotech Laboratory performed an isotopic analysis of a gas sample submitted by Sepich & Associates on 3/25/99. Sepich and Associates was working for Playa Vista developers (developers of residential and business properties around the PDR.Storage field. The isotopic analysis report indicates the gas sample was collected from Playa Vista Project Area-D. The analysis report also revealed presence of Ethane and 22 PPM Helium in the gas sample. The significance of this isotopic analysis report is the presence Storage Reservoir gas or Native PDR gas signature and the location where the gas sample was collected (Area – D of Playa Vista Project). My opinion is that the probability of Storage Reservoir gas sample from PDR area containing Ethane and 22 PPM Helium is greater than 50 percent (>50%). Furthermore, the location where the sample was collected should be of major concern. Please see Appendix # C

D. 100 PPM–1000 PPM Helium from groundwater samples collected and analyzed by Exploration Technologies, Inc (ETI)

City of Los Angeles Building and Safety Department retained ETI to conduct test, analyze and provide advice on Playa Vista project. Groundwater samples were collected in 2000 from Playa Vista Project Area, and dissolved

gases were extracted and analyzed by ETI in addition to other scientific sampling and testing. Several groundwater samples revealed presence of high Helium concentrations and methane dissolved in the groundwater. The origin of this Helium in the groundwater is not clear. However, some people have postulated that the groundwater absorbs or strips the Helium from the Storage Reservoir gas or Native PDR gas as it migrates through the aquifer to the ground surface. Hence, Thermogenic gas is detected in soil-gas without Helium. Although, this postulation seems plausible, I have not seen any scientific paper on this absorption theory and the kinetics. *Please see Appendix # D*

E. Dr Victor Jones of ETI detected Thermogenic gas components at the surface and detected H2S in soil gas during his investigation in 2000.

ETI conducted an extensive soil gas investigation in Playa Vista area for the City of Los Angeles in 2000. The isotopic analysis report of the samples collected revealed presence of Methane, Ethane, Helium, H2S, Toluene and other volatile organic compounds (voc). The presence of numerous Thermogenic gas components in the shallow soil gas samples analyzed indicates a deeper source for this gas.

F. Previous Reservoir Inventory Verification Analysis by SCG indicated gas migration loss (8/22/80)

A Reservoir Inventory Verification Analysis conducted by Theodoros Georgakopoulos on August 22, 1980, for SoCalGas indicated gas migration loss. The migration pathways to the Townsite area (separate geologic zone) is unknown. The report estimated storage reservoir gas loss between January 1961 and December 1979 to be 0.10 B.c.f. Subsequent reports estimated the gas loss to have decreased. *Please see Appendix # F*

G. Presence of Methane gas around Troxel Well.

As part of Energy Division (ED) initial preliminary investigation, ED retained MHA, who subcontracted Giroux & Associates to conduct site investigations at the Troxel and Lor Mar well site locations in 2001. These recent studies found very high methane concentrations (greater than 50,000 ppm) at the Troxel site and low methane concentrations (1 to 6 ppm) at the Lor Mar site.

Although high methane levels at Troxel dissipated over time, low methane levels persisted through the end of the 32 days study period. This indicates a possible source of methane at this location. Methane concentrations also fluctuated during the study period, indicating that external factors (atmospheric pressure, tidal influences, gas storage reservoir operations) may be affecting data measurements. However, a soil gas survey study requested by the Commission and conducted by SoCalGas' consultant, TRC concluded that there were no measurable concentrations of volatile or combustible compounds encountered in the soil gas. Also, the study detected presence of Hydrogen Sulfide and the source was unknown. But recent sampling by Energy Division's CEQA team reported measurable concentrations volatile hydrocarbons.

H. Validity of SoCalGas Data.

Data collected by SoCalGas may be flawed. Procedures used by SoCalGas to collect gas samples at the Troxel did not follow standard gas collection and sample handling procedures established by Federal Environmental Protection Agency and other trade associations. A plastic sheet was used to accumulate enough gas to collect samples for analysis. Samples were collected in plastic bottles. Since plastic is permeable to many gases, and may also absorb some hydrocarbon based gases, test results would not fully characterize gas emitted from the well.

Although bar hole testing is acceptable for Department of Oil Gas & Geothermal Resources leak detection requirement, it does not follow standard procedures established

for soil gas investigations. Soil is disturbed and compacted when the bar is driven into the ground. This could interfere with movement of some soil gas. Therefore, low levels of methane may not be detected and concentrations reported may not be valid.

III. Recommendations

A review of the aforementioned facts and findings suggest the existence of a potential safety hazard. Since the available geological data does not definitively support or disprove the existence of safety hazard in and around the storage reservoir, further investigation and study is needed. It is important and recommended that CPSD conduct (1) comprehensive reservoir study and (2) Health Risk Assessment (HRA) (HRA that is not limited to 'for sale lots" and integrate some of the data gathered from the CEQA study). The basis for this recommendation are in response to allegations of hazards to public health and Safety, potential ratepayer liability, lack of definitive results from available data and mandate from General Order 58-A, section 22. We recommend a reservoir study that will include but not limited to:

1) Construction of a 3-dimensional geologic computer model (Earth Vision or equivalent) using existing data (wells records, soil gas investigations, geo-technical borings, geophysical data, environmental borings, site contamination data, groundwater data, etc) to fully integrate and visually display geologic data (strata and discontinuities) and other subsurface information (gas and groundwater locations) at the storage field.

2) Drill a minimum of three shallow well observation wells to describe the stratigraphic conditions (visual and geophysical logging) in geologic deposits above 1000 feet elevation in order to define potential gas storage zones and migration pathways, and to collect gas samples from depths below biogenic sources.

3) Collect and analyze (isotopic and chemical analysis) the gas in geologic deposits from these wells, focusing on depths below

minus 500 feet elevation (below sea level), in order to determine the origin and genesis of the gas.

4) Integrate the results from items 1, 2 and 3 above to develop a logical, defensible subsurface model that explains the surface and subsurface gas detections and the potential pathways for gas to reach the surface environment.

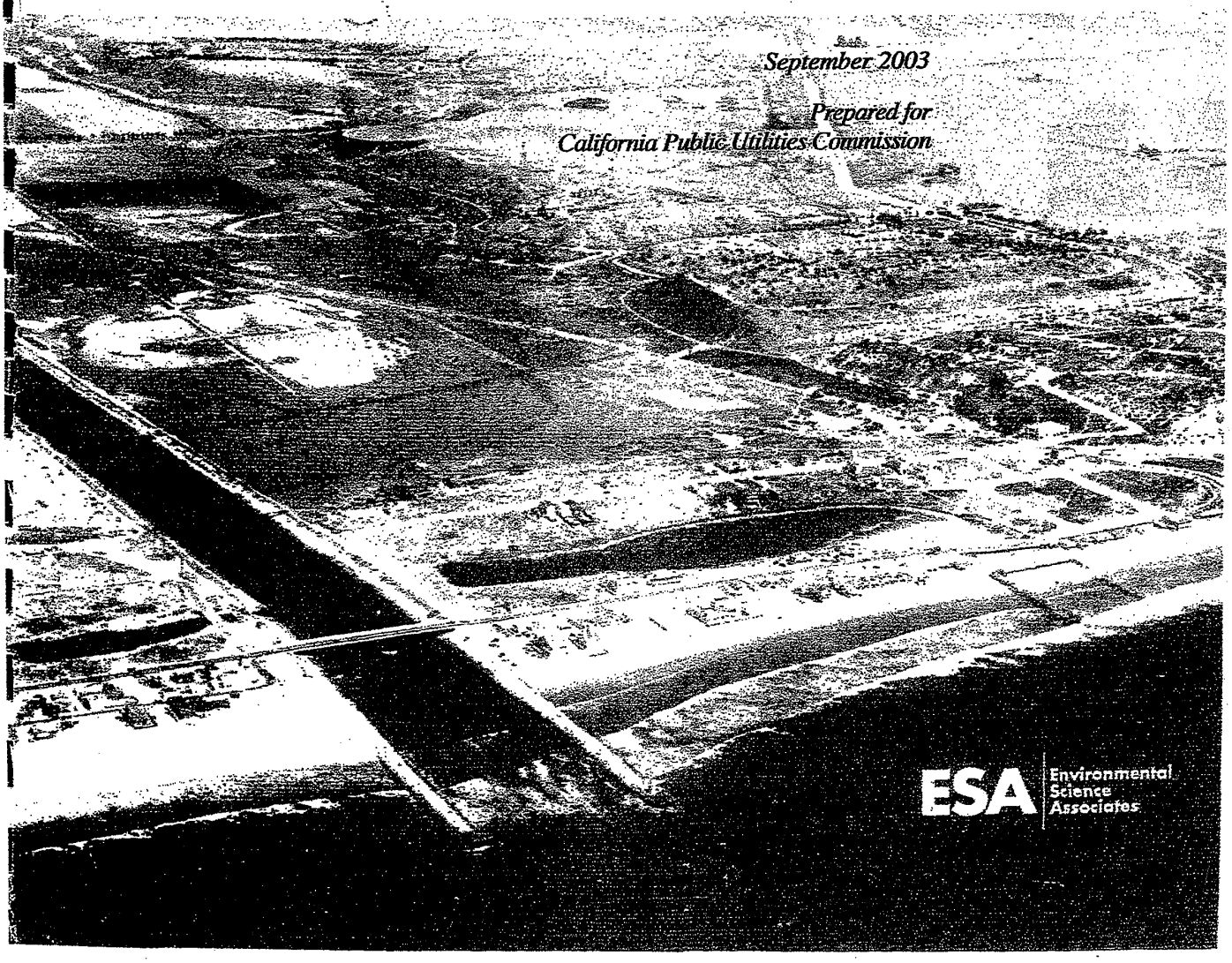
5) Retain an expert to perform Helium Ratio Analysis.

GRASSROOTS COALITION
SAGE COUNCIL

SOUTHERN CALIFORNIA GAS COMPANY'S APPLICATION TO VALUE AND SELL SURPLUS PROPERTY AT PLAYA DEL REY AND MARINA DEL REY

Initial Study

CPUC Application No. 99-05-029



September 2003

Prepared for

California Public Utilities Commission

migration, by either acting as barriers to lateral movement or pathways for vertical migration. Gas movement rates associated with minor faulting would not be significant compared to leaking wells.

The presence of shallow high-pressure gas zones encountered in the Playa Vista area indicates confinement of upward hydrocarbon migration from these intervals. At these locations, shale intervals within the Pico and Repetto Formation form effective cap rock or seals. If natural upward migration pathways were present, such as open fracture systems, gas in these shallow zones would exhibit a normal pressure gradient. High pressure was not released until these zones were penetrated during well drilling operations.

Leaking Wells

Several factors contribute to possible gas migrations through abandoned and active wells such as original drilling, development and completion, operations and redevelopment, and abandonment. Many wells and dry holes were drilled during the exploration and early field development period. Dry or non-commercial wells were abandoned. Common practice by some operators in the 1920s through 1940s was to abandon wells and dry holes by filling them with construction debris or other items, such as telephone poles or railroad ties, prior to covering the surface with soil. These improperly abandoned wells have been unearthed during grading operations for construction sites located over old oil field in several areas of the Los Angeles Basin. Many of these wells and dry holes may not have been plugged to modern standards. Current abandonment requirements have developed since the 1950s to the more stringent standards today. Old dry holes and noncommercial wells have a high potential to provide migrations pathways.

Early in the history of oil and gas development in California and the United States, noncommercial or dry holes were drilled and abandoned without proper documentation and reporting, and some of these abandoned dry holes and wells may not have been recorded by the original drillers or DOGGR. Absence of unknown abandoned holes cannot be determined with certainty. Should they exist, they could serve as migration pathways.

Well construction, redevelopment, and abandonment deficiencies can contribute to gas migration problems. If cement bonds between the casing and surrounding natural formation do not form adequate storage seals, pressurized leakage is possible. Leakage through the annular space between casing and formation can occur under the following circumstances: lack of proper seals, inadequate seal or poor cement bonds with bore walls, channels within cement, deterioration of annular seals over time, and fracturing or cavitation of enclosing walls.

When present, shallow high-pressure gas zones can create problems for cement annular seals. During the well completion process, cement slurry is pumped into the annular space between the hole drilled (rock face) and casing to form a seal. Gas from shallow high-pressure zones can enter cement within the annular space during this process. Gas bubbles within the slurry weakens the cement and can compromise seals around these zones. In turn, poor seals could allow fluid migrations and enhance corrosion of both casing and cement in these areas. If large volumes of gas enter the annular space, vertical channels within the cement seal can also form. Marlow (1989) discusses the mechanisms contributing to compromised integrity of annular cement seals associated with gas zones.

- Based on the data provided, three leaking wells were discovered following detection of soil gas seepage. During routine field monitoring, near surface gas was identified around three wells: Well No. 12-1 (1974), Well No. 24-2 (1975) and Big Ben No. 1 (1991). Leaks in Wells No. 12-1 and 24-2 were repaired, while Big Ben No. 1 was plugged and abandoned in 1991.

- Of the ten wells with documented leaks, three of them are included in the subject project: Well No. 29-1 (1959), Lor Mar No.1 (1981) and Joyce No.1 (1987). Casing leaks in each respective well were repaired. These three wells are on parcels (lots) subject to sale following approval of the proposed project. The Lor Mar No. 1, Joyce No. 1 and Well No. 29-1 were plugged and abandoned in 1992, 1993 and 1994, respectively.

- The ten wells are located between 1/2 mile and 1 mile south to southwest of the Universal City Syndicate Inc. Vidor No. 1. The Vidor No. 1, an old abandoned well, experienced a "blow-out" when shallow gas was encountered during drilling at depths from 1,140 to 1,150 feet. Multiple shallow gas zones were penetrated by this well. At least 4 other wells drilled in the Vidor No. 1 vicinity also penetrated various shallow gas zones at depths ranging from 510 to 3,434 feet.

Leaks in several of the ten wells listed occurred at similar depths to where shallow gas was encountered in old wells experiencing "blow-outs". These old wells were located immediately east and northeast of the subject project. Insufficient data was provided to correlate documented leaks with shallow gas zones.

Gas Responsibility and Rights

SCG owns most, if not all mineral rights in the PDR field and storage zone. As such, SCG is responsible for any gas leaks originating the PDRGSF area of influence and from thermogenic sources. Due to the nature of recent alluvial deposits, the generation of natural biogenic gas at the project site is likely. Biogenic gas in the area is probably related to decomposition of organic material deposited within a lagoon environment. In addition, some biogenic gas could also result from alteration of other hydrocarbons, including thermogenic gas, crude oil, or spilled materials. SCG is not responsible for occurrences of biogenic gas at the project site.

TABLE F-1
SUMMARY OF DETECTED GAS LEAK

Well Name	Problem	Depth (ft bgs)	Year Detected	Well Location
Well No. 29-1	Stage collar leak	723	1959	Between Falmouth Ave. & Calabar Ave., south of intersection with Cabora Dr.
Big Ben No. 1	Casing leak	150	1964	Between 79th St. & Veraqua Dr., northeast Zayenta Dr.
	Surface seepage		1991	
Blackline No. 1	Casing leak	1,064	1969	South of Cabora Dr., west of Veraqua Dr. and Zayenta Dr. intersection
	Casing leak	1,060	1986	
SoCal No. 4	Casing leak	3,216	1971	NW of Cabora Dr., about 1,000 ft. NE of intersection with Falmouth Ave. [a]
SoCal No. 3	Casing leak	3,300	1972	NW of Cabora Dr., about 1,000 ft. NE of intersection with Falmouth Ave.[a]
	Casing leak	3,300	1975	
	Casing leak	2,109	1977	
Well No. 12-1	Surface seepage	481	1974	Southeast of 81st St., north of intersection with 83rd St.
	Casing leak	210	1979	
Well No. 24-2	Surface seepage	191	1975	Northwest of 79th St., west of Zayanta Dr.
Pomoc No. 1	Casing leak	2,815	1975	West of Zayanta Dr., between 79th St and Cabora Dr.
Joyce No. 1	Casing leak	750	1987	Northwest of 82nd St., east of Saran Dr.
Lor Mar No. 1	Casing leak	720	1981	South of 83rd St., east of Saran Dr.

[a] Surface location of directionally drilled well. Bottom hole locations were not made available.

SOURCE: (DOGGR, various dates)

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APPENDIX F

HAZARDS AND HAZARDOUS MATERIALS BACKGROUND INFORMATION

ENVIRONMENTAL SETTING

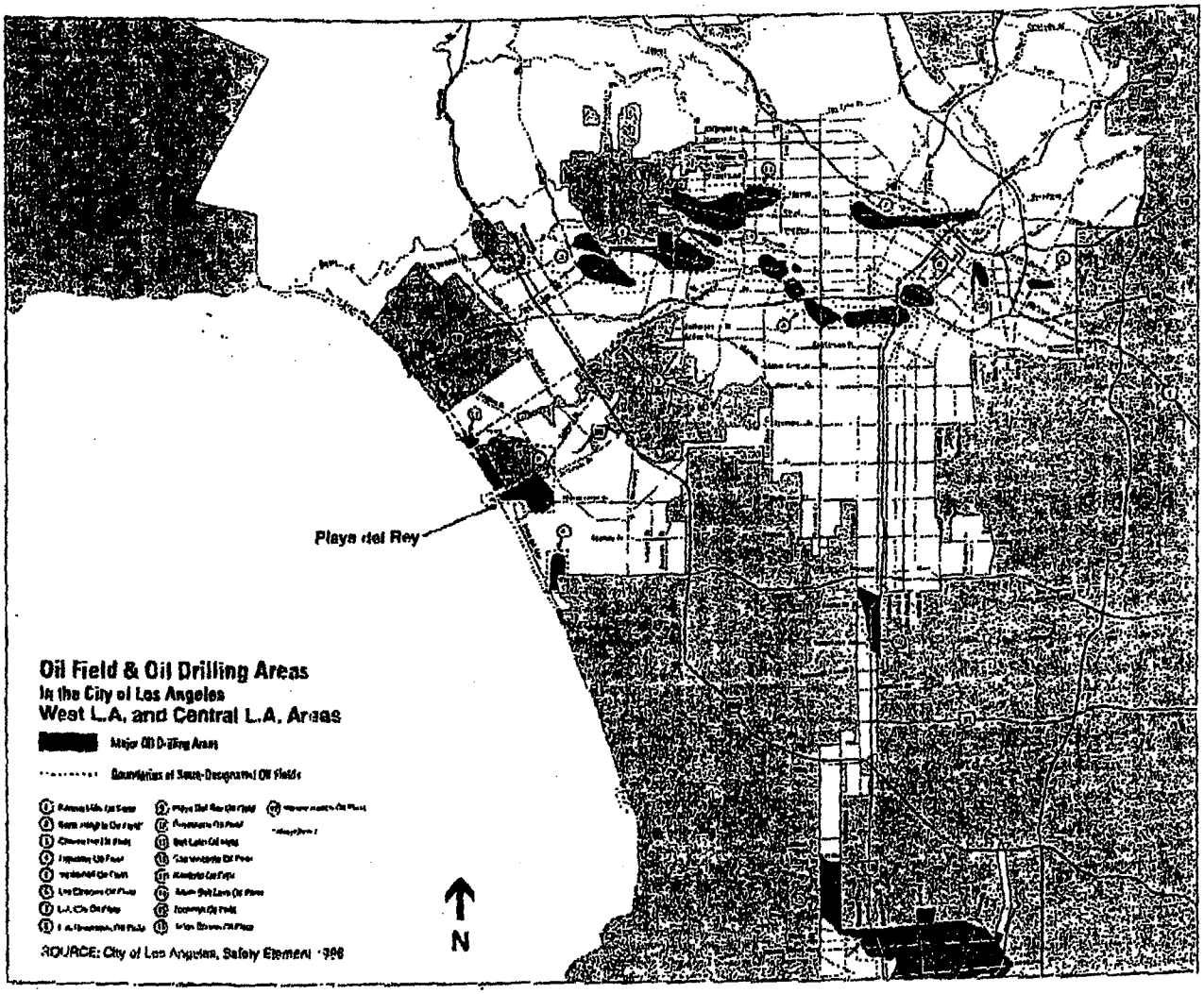
As discussed in Section VII, Geology and Soils, the project area overlies a region of oil fields as shown on Figure F-1. In the early twentieth century oil was extracted from this region and in 1942, the Southern California Gas Company (SCG) converted the depleted Playa del Rey oil field into a natural gas storage reservoir; one of five gas storage facilities operated and maintained by SCG in the Los Angeles region, within a 40 mile radius of the project area. These facilities are capable of meeting all current and anticipated SCG future needs for the Los Angeles region. Therefore, the regional value of gas storage has declined in accordance with increasing available supply of storage and available transmission capacity to serve the regional demands.

There are no designated quarry areas either on the project lots or in the vicinity of the project lots.

REGULATORY SETTING

The current regulatory framework relevant to hazards and human health encompasses process risk related to the use of hazardous materials and management of risks from hazardous materials that have been released to the environment. With respect to chemical hazards, the use, storage, and disposal of hazardous materials and wastes are regulated through a network of overlapping federal, state, and local laws and regulations. Various government agencies are responsible for implementing these laws and enforcing their requirements.

Federal and state laws require planning to ensure that hazardous materials are properly used, stored, and disposed of, and in the event that such materials are accidentally released, to prevent or to reduce injuries to human health, safety, or the environment. Businesses must store hazardous materials appropriately and train employees to manage them safely. Hazardous waste laws impose cradle-to-grave liability, requiring generators of hazardous wastes to handle them in a manner that protects human health and the environment to the extent possible. Both federal and state laws have established programs to identify hazardous waste sites, to require site remediation, and to recover the costs of site remediation from polluters. The following discussion briefly summarizes regulations that must be complied with regardless of ownership of the generating station.



SOURCE: City of Los Angeles, Safety Element 1996

Figure F-1
Oil Fields in the West and Central Los Angeles Areas

FEDERAL

COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT (CERCLA)

Commonly known as Superfund, this federal law defines reportable quantities for spilled materials and the process for investigation and cleanup of contaminated sites The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) also establishes a National Priorities List and outlines a liability and response mechanism for releases of oil and hazardous materials.

SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) OF 1986

This law establishes public reporting of the use of certain chemicals under Title III, also known as the Emergency Planning and Community Right-to-Know Act. In California, some of the provisions of the Superfund Amendments and Reauthorization Act (SARA) Title III are implemented locally by the city or county health department through the Business Plan and hazardous material inventory requirements.

CLEAN WATER ACT (CWA)

The CWA sets up the framework through which permits to discharge waste to surface waters are authorized. The National Pollutant Discharge Elimination System (NPDES) permit typically has conditions specific to the permitted operation and may set limits on acidity (pH), chemical concentrations, oil and grease, dissolved and suspended solids, and temperature of the discharge. The CWA also prohibits the discharge of pollutants to storm water.

OIL POLLUTION ACT OF 1990 (OPA)

The Oil Pollution Act (OPA) regulations supplement existing laws regarding the storage and handling of oil. As defined in OPA, Spill Prevention Countermeasure and Control (SPCC) Plans are required for facilities storing bulk oil. OPA also added requirements for facilities presenting a threat to navigable waters, including preparation of an Facility Response Plan (FRP) that prepares a facility for response to potential worst-case spills. OPA includes employee training requirements related to prevention of, and responses to releases.

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

The Occupational Safety and Health Administration (OSHA) regulations contained in Title 29 and the Cal-OSHA regulations codified in Title 8 contain employee safety provisions that attempt to minimize the hazards for employees in the workplace.

TOXIC SUBSTANCES CONTROL ACT (TSCA)

The Toxic Substances Control Act (TSCA) includes requirements for the storage, use, and disposal of Polychlorinated Biphenyls (PCB)-containing materials.

DEPARTMENT OF TRANSPORTATION (DOT)

Physical hazards, storage field maintenance and operations defined by the Department of Oil Gas and Geothermal Resources (DOGGR) are under the federal jurisdiction of the Department of Transportation (DOT). The DOT regulates the transportation of hazardous materials between states. Both federal and state agencies specify driver training requirements, load labeling procedures, and container specifications. The DOT also indirectly regulates the transportation of natural gas through pipelines according to the Natural Gas Pipeline Safety Act. The Act requirements, including designing pipelines to maximize safety (e.g., installing corrosion protection), routinely inspecting pipelines, preparing for possible emergencies, and reporting injuries and physical damage caused by accident, have been adopted by the California Public Utilities Commission (CPUC).

STATE

Title 22 of the California Code of Regulations defines, categorizes, and lists hazardous materials and wastes. Title 22 defines a hazardous material as:

> "a substance or combination of substances which, because of its quantity, concentration, or physical, chemical or infectious characteristics, may either (1) cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness; or (2) pose a substantial present of potential hazard to human health or environment when improperly treated, stored, transported or disposed of or otherwise managed."

Hazardous wastes are categorized in Title 22 as either hazardous wastes, as defined in the Resource Conservation and Recovery Act (RCRA) or non-RCRA hazardous wastes. Title 22 lists chemical compounds that are presumed to make a material or waste hazardous to the environment.

CALIFORNIA WATER CODE (CWC)

The California Water Code (CWC) includes provisions of the federal CWA and water quality programs specific to California. The CWC requires reporting, investigation, and cleanup of hazardous material releases that could affect waters of the state (including storm waters).

CALIFORNIA ABOVEGROUND PETROLEUM STORAGE ACT

The California Aboveground Petroleum Storage Act, which is implemented by the Regional Water Quality Control Boards (RWQCBs), regulates the storage of petroleum in aboveground storage tanks (ASTs) and requires construction methods and monitoring to prevent petroleum releases.

CALIFORNIA HEALTH AND SAFETY CODE SECTION 25534 (CAH&SC)

Section 25534 of the California Health and Safety Code (CAH&SC) requires businesses that handle amounts of Acutely Hazardous Materials (AHMs) in excess of certain quantities to develop a Risk Management Plan (RMP). The RMP encompasses process hazards, potential consequences of releases, and documentation, auditing, and training relative to the AHMs that are above specified threshold

quantities at the generating station. Regulated AHMs may include aqueous ammonia and sulfuric acid, as well as other acutely hazardous substances.

CALIFORNIA DEPARTMENT OF CONSERVATION, DIVISION OF OIL, GAS AND GEOTHERMAL RESOURCES (DOGGR) AND CPUC

Physical hazards, storage field maintenance and operations within the Playa del Roy gas storage facility are under the jurisdiction of the California Department of Conservation, Division of Oil, Gas and Geothermal Resources (DOGGR) and the California Public Utilities Commission (CPUC). DOGGR regulates the operations and maintenance of natural gas storage fields, and certain aboveground piping is regulated by the CPUC. DOGGR manages oil and gas resources in California and for the Playa del Rey field. The City of Los Angeles has local responsibility and authority through land use permitting and zoning for both oil and gas production and quarry and mining operations. The City also has zoning jurisdiction through special use permits and overlays for oil and gas. Currently, SCG holds use permits and lands are currently zoned for residential (35 of the 36 lots) and commercial (1 of the 36 lots).Playa del Rey Gas Storage Facility (PDRGSF)

The Storage Field is regulated by a number of state and local agencies. The DOGGR has primary jurisdiction over gas storage operations. The storage field operates pursuant to a permit issued by DOGGR, which requires, among many other things, extensive reporting, inspections, and performance reviews. Oil production has been exercised in the Los Angeles area for over seventy years. Gas production has been exercised for over sixty years. Federal and state regulations have been established to manage current and abandoned operations. There are significant numbers of abandoned oil and gas wells throughout the Los Angeles basin. Several of these abandoned wells have buildings constructed over or adjacent to them, and their proximity may be concern for the potential for exposure to hazards if there is gas leakage from abandoned wells. The Playa del Rey Gas Storage Facility (PDRGSF) is the only operating gas storage facility left in the Los Angeles Basin.

A DOGGR Project Approval Letter defines requirements that are specific to the Playa del Rey storage field (1986). Environmental conditions and well safety equipment are inspected regularly. During these inspections, a DOGGR inspector looks for indications of any type of oil or gas leaks from wells, pipelines, pressure vessels, and tanks. They also witness testing of the automatic shut down equipment on each well. Storage project performance reviews take place annually. During these reviews, DOGGR engineers examine SCG records to ensure that all well and reservoir monitoring and leak survey requirements were met.

Storage Tanks

Hazardous materials are typically stored in underground or aboveground storage tanks. Laws and regulations regarding underground storage tanks that are used to store hazardous materials (including petroleum products) require that owners and operators register, install, monitor, and remove their tanks according to established standards and procedures. Releases are to be reported. Owners of above-ground storage tanks containing petroleum products are required to prepare and implement spill prevention and response strategies, and to contribute to the Environmental Protection Trust Fund that is used to respond

to some spills. Proper drainage, dikes, and walls are required in order to prevent accidental discharges from endangering employees, facilities, or the environment.

Well Abandonment Regulations and Policies

DOGGR has adopted regulations[13] for well abandonment to ensure that it is done safely and effectively. These regulations provide well abandonment procedures that prevent future migration of oil or gas from the producing zone and the upper zones, as well as protect groundwater. Furthermore, the DOGGR is charged with ensuring that public safety is not endangered. The DOGGR has the expertise and the authority to require whatever steps are deemed necessary to protect public safety, up to and including requiring SCG to cease operations and/or remove all gas from the field. They have approved SCG operations and monitoring program. As stated above, well abandonment is discussed in more detail within the geology section of this document.

Actually same as S. Salt Lake FALSE

After subsurface abandonment is completed and the surface portions of the well are removed, SCG must test and remove soil that has been contaminated by oil or other well maintenance substances. At the end of abandonment operations, the DOGGR and the Los Angeles Fire Department will complete a final inspection of the well site. After this inspection, the DOGGR will review all of the abandonment records of the operator and will either provide a final abandonment approval or a notice of deficiency that must be corrected.

Regulations Regarding Construction of Buildings Over Abandoned Wells

Future development of the lots would be subject to the requirements of local permitting agencies and would include compliance with all requirements for construction over abandoned wells. The regulatory requirements for building over abandoned wells are discussed in the Geology Section of this document (Section VII).

Other local agencies that have jurisdiction over the PDRGSF facilities or operations include the Los Angeles Fire Department, the South Coast Air Quality Management District, the Los Angeles County Sanitation District, and the Occupational Safety and Health Administration.

GAS MIGRATION

Well Drilling in the Playa del Rey Oil Field and Natural Gas Storage Field

Drilling in the region began as early as 1921 (Davis, 2000b). Early holes drilled and abandoned in the area during 1925 and 1926 were not deep enough to reach the producing zones in the Schist Conglomerate. The discovery well for the Playa del Rey (PDR) oil field was completed in 1929. Primary field development continued through the mid-1930s. By the early 1940s production had reached its economic limit and operators abandoned oil production from the field.

In 1942, as part of the national war effort, the federal government condemned and took possession of approximately 240 acres of the PDR field area to use as a natural gas storage field. This gas storage field

[13] These regulations can be found in California Code of Regulations, Title 14, Chapter 4.

was later transferred to the Reconstruction Finance Corporation in 1945. Then, in 1953, the Reconstruction Finance Corporation declared the field surplus and offered it for sale in 1953. The Southern California Gas Company was the successful bidder and assumed operations in late 1953.

Facilities were completed in 1956, and then gas was injected and stored at depths of about 6,200 feet within the Conglomerate Trap Zone. By July 1958, approximately 27 billion cubic feet (bcf) of cushion gas was stored. Since that time, numerous wells have been utilized for storage and retrieval of the gas. Currently, the storage field is operated through 54 wells directionally drilled from the lowlands and hilltop of PDR. Of these 54 wells, 25 are injection/withdrawal wells used to inject and extract gas, 8 are liquid (primarily water) removal wells, 3 are lateral migration wells to control gas movement, and 18 are observation wells used to monitor pressure and liquid saturation. SCG's facility for the PDRGSF is 0.2 mile north of Manchester Avenue.

Types of Gases

The three types of gas that may exist within the geological and soil units underlying the project area are processed natural gas (or piped gas), biogenic (or swamp) gas, and thermogenic (field) gas. Biogenic gas is primarily methane with carbon dioxide and sulfide gases resulting from decomposition of organic material in former lagoon deposits or other sources. Thermogenic gas is generated at depth, when increased temperatures and pressures alter organic material. It includes a broad range of gas components (methane, propane, butane, ethane, etc.). In contrast, processed natural gas is primarily methane remaining from thermogenic gas after most of the heavier gas components are removed (usually less than 0.1% heavy thermogenic hydrocarbons). These gas types exhibit distinct chemical characteristics, which permits "finger-printing" of gases or differentiation between gas types. In addition to lacking heavier gas components (propane, butane, ethane, etc.), the presence of helium in detectible amounts is a primary fingerprint for natural gas imported from the central US and previously stored in the deep storage zone.

Natural gas can occur in subsurface environments as various phases. Understanding gas phases is important because each phase exhibits specific physical properties, and thus posses different flow characteristics. These phases include free gas, liquefied petroleum gas, and dissolved gas in both water and oil depending on pressures and temperatures. When evaluating the potential for shallow gases reaching the surface, the primary phases of concern are free gas and dissolved gas in groundwater.

Migration Pathways

Studies have detected natural gas at the surface in the PDR area as well as areas overlying other oil fields. Surface gases can originate from biogenic, thermogenic, or storage sources, or a combination of these sources. Gas reaches the surface through various natural, man-made, or combination migration pathways.

WHY ETI?

Both biogenic and thermogenic gas were detected by ETI (2000) during a soil gas survey in the Playa Vista area. Following a second phase of evaluation ETI (2001) concluded "storage gases are not present in any of the methane anomalies observed east of Lincoln Blvd." Routine surface monitoring SCG wells found storage gases were reaching the surface through casing leaks and along the well casings in three

WHY ETI

FALS

wells. Biogenic gas was detected in four abandoned wells in the PDR field area, resulting in re-abandonment of these wells to eliminate the leaks.

Major Pathways

Man-made structures can convey gas to the surface from deep or shallow sources. A list of the most common man-made structures that could serve as vertical conduits include:

- Old abandoned oil and gas wells or dry holes, (abandoned prior to current DOGGR regulations
- Previously undocumented wells and dry holes
- Existing water extraction or injection wells
- Old abandoned water wells
- Monitoring wells
- Recently plugged and abandoned oil and gas wells (abandoned in accordance with current DOGGR regulations)

Gas can also reach the surface through natural geologic features which may facilitate vertical, lateral, or oblique migration. The geologic features most likely to serve as potential pathways include:

- Surficial deposits
- Porous and permeable formations
- Aquifers
- Fracture systems
- Fault planes
- Other geologic features and structures, such as unconformities

The potential gas migration reaching the surface is considered greatest through or along man-made structures. In general, geologic pathways are relatively "tight" in the "shallow" and storage zones. Fractures, faults, and spaces between individual grains are minimized due to the tremendous overburden pressure (the weight of the rock materials). Within the Project area, wells penetrate shallow and deep gas zones at various depths. Once penetrated, a poorly constructed or abandoned well can serve as a conduit for upward migration of natural gas. Such conduits can develop as old wells deteriorate (over the 70 years), even when proper construction and abandonment methods have been applied.

Natural gas of biogenic, thermogenic, and storage sources can travel through a variety of man-made structures to migrate both vertically and laterally through the subsurface. In addition to oil and gas wells, both active and abandoned water wells can serve as vertical conduits, especially in the upper 1,000 feet of geological section. Utility trenches, storm drain systems and sewer lines provide lateral migration pathways, accumulation areas, and near-surface openings for natural gas release.

Natural Pathways

Various studies prepared by SCG, DOGGR, US Geological Survey (USGS), and California Geological Survey (CGS) suggest faults in the PDRGSF area . The USGS and CGS publish maps showing documented faults and reports describing such faults. No through-going active surface faults have been documented by either the USGS or CDMG. None of the information or reports reviewed for this study

present conclusive evidence of active surface faults in the immediate project vicinity. The Compton Blind Thrust Fault passes beneath the project site at much greater depths (>20,000ft), but no related fault is yet known to cut through the storage zone.

The Charnock fault is considered potentially active, and crosses the northeastern edge of the PDRGSF. Smaller, shorter faults and fracture systems are inferred in various units of the storage zone within the PDR field, but are not likely to transmit large volumes of crude oil or natural gas during short time intervals (days, weeks, or months). Naturally occurring subsurface migration of petroleum hydrocarbons typically takes place over extended periods of time, possibly tens or hundreds of thousands of years or more. Natural transmission of hydrocarbons through these systems is known within the oil and gas industry as "micro seeps." Upward migration of oil and gas through micro-seeps allowed hydrocarbon emplacement in shallow zones. Significant natural upward migration from the storage zone is unlikely during the productive life of the PDR field.

The original reservoir pressure in PDR field was 2,750 psi, which is within the range of normal pressure gradient for the storage zone depths (Davis, 2000). Operating pressures (maximum 1,700 psi) are about 38 percent lower than original reservoir pressures. Therefore, significant volumes of storage gas would not be expected to migrate to the surface through natural geologic features.

Past and proposed withdrawal of gas from the storage zone is not expected to cause downward movement of groundwater or other fluids from shallow zones. With decreased reservoir pressures, lithostatic forces (rock overburden pressures) become more dominant, further sealing (through compaction) any open fractures or void spaces in the cap rock. Thus, the potential for fluid or gas migration through geologic pathways either into or out of the storage zone is low.

Shallow gas may migrate through younger earth materials to reach the surface. Both Pleistocene and Holocene sedimentary deposits include many permeable horizons or zones. Both biogenic and thermogenic gas from shallow zones can migrate, both vertically and laterally, through these permeable layers. Gas migration would involve both free-phase and dissolved-phase gases (dissolved in water). In the Playa Vista area immediately northeast of the project site, the contact between the San Pedro Formation and overlying younger alluvium form a contact between geologic units that could affect both lateral and vertical subsurface fluid or gas movement.

Faults affecting the project vicinity are discussed above under Structure and Seismicity. Based on his review of geologic reports and well records for PDR field, Davis (2000b) concludes that there is no evidence for faults cutting through the primary or secondary seals, and there is no evidence of through going fracturing of the seal. In the project area, the northwest-southeast trending Charnock fault (potentially active) is the closest documented fault in the vicinity. It crosses through the area east of the PDRGSF and project site. Although it is possible that undocumented faults could exist and contribute to upward gas migration, rates would not be significant compared to leaking wells.

During well drilling, fractured zones were encountered in some boreholes. The type (open, closed, sealed) and extent of fracturing were not determined from the information available. This fracturing could be related to minor faulting in the immediate vicinity. Minor faults could affect subsurface gas

migration, by either acting as barriers to lateral movement or pathways for vertical migration. Gas movement rates associated with minor faulting would not be significant compared to leaking wells.

The presence of shallow high-pressure gas zones encountered in the Playa Vista area indicates confinement of upward hydrocarbon migration from these intervals. At these locations, shale intervals within the Pico and Repetto Formation form effective cap rock or seals. If natural upward migration pathways were present, such as open fracture systems, gas in these shallow zones would exhibit a normal pressure gradient. High pressure was not released until these zones were penetrated during well drilling operations.

Leaking Wells

Several factors contribute to possible gas migrations through abandoned and active wells such as original drilling, development and completion, operations and redevelopment, and abandonment. Many wells and dry holes were drilled during the exploration and early field development period. Dry or non-commercial wells were abandoned. Common practice by some operators in the 1920s through 1940s was to abandon wells and dry holes by filling them with construction debris or other items, such as telephone poles or railroad ties, prior to covering the surface with soil. These improperly abandoned wells have been unearthed during grading operations for construction sites located over old oil field in several areas of the Los Angeles Basin. Many of these wells and dry holes may not have been plugged to modern standards. Current abandonment requirements have developed since the 1950s to the more stringent standards today. Old dry holes and noncommercial wells have a high potential to provide migrations pathways.

Early in the history of oil and gas development in California and the United States, noncommercial or dry holes were drilled and abandoned without proper documentation and reporting, and some of these abandoned dry holes and wells may not have been recorded by the original drillers or DOGGR. Absence of unknown abandoned holes cannot be determined with certainty. Should they exist, they could serve as migration pathways.

Well construction, redevelopment, and abandonment deficiencies can contribute to gas migration problems. If cement bonds between the casing and surrounding natural formation do not form adequate storage seals, pressurized leakage is possible. Leakage through the annular space between casing and formation can occur under the following circumstances: lack of proper seals, inadequate seal or poor cement bonds with bore walls, channels within cement, deterioration of annular seals over time, and fracturing or cavitation of enclosing walls.

When present, shallow high-pressure gas zones can create problems for cement annular seals. During the well completion process, cement slurry is pumped into the annular space between the hole drilled (rock face) and casing to form a seal. Gas from shallow high-pressure zones can enter cement within the annular space during this process. Gas bubbles within the slurry weakens the cement and can compromise seals around these zones. In turn, poor seals could allow fluid migrations and enhance corrosion of both casing and cement in these areas. If large volumes of gas enter the annular space, vertical channels within the cement seal can also form. Marlow (1989) discusses the mechanisms contributing to compromised integrity of annular cement seals associated with gas zones.

PROPOUAD

REASONS FOR NOT ALLOWING BUILDINGS OVER OLD WELLS

Structural integrity of well components and seals is not permanent. Over extended periods of time, they eventually deteriorate. Both casings and seals are subject to corrosion caused by exposure to chemical attack, high and fluctuating pressures, high temperatures, and earthquakes. Steel casing is susceptible to rusting from saline and sour/sulfurous water produced along with the oil. Hydrogen sulfide of sour water and sour gas can corrode both steel and cement. Differential earth stresses (e.g., local earthquakes) can affect well integrity, even causing casing to collapse. Any deterioration of well integrity can lead to leaks.

Abandoned Wells

During past routine SCG surveys of abandoned wells, SCG determined that three previously abandoned wells on the Marina del Rey Peninsula (not part of the proposed project) would be re-abandoned following detection of leaking natural gas. Well designations and locations for these wells were not provided for this study. Although the origin of detected gas was biogenic and not the storage zone, SCG assumed responsibility and re-abandoned these wells to seal the leaks.

INFO NOT PROVIDED BY SCG.

A leak was recently discovered in a well in the MDR area designated as Block No. 11 (while this well is not part of this proposed sale of property, it is in the vicinity of Cluster 12). This well was abandoned in April 1993 and sold with the surface parcel in 1997. The leak was discovered when DOGGR reviewed and tested the well prior to construction on the site. Preliminary analyses indicate that gas may be biogenic. Based on information available for this review, gas detected in this well is probably not emanating from the PDR storage facility. SCG will assume responsibility and re-abandon this well prior to site construction.

BLOCK 11 CEMC

In the Playa Vista area east of the proposed project site, ETI (2000) conducted a soil gas survey. Several gas anomalies were identified during this survey. Analyses of samples collected indicates a combination of both biogenic and thermogenic gas origins. The presence or absence of storage gas was not confirmed during this study.

An examination of DOGGR maps showing locations of abandoned wells in the gas study area indicates that at least two of these soil gas anomalies correspond with locations of old abandoned wells or dry holes (Universal City Syndicate, Inc. Vidor No. 1 and Cooperative Development Co. Community No. 1). ETI (2000) indicates that a shallow dry hole (A.L. Kitselman, Del Rey No. 1) was also present in an area with surface gas anomalies. These old wells or dry holes may not be abandoned in accordance with current DOGGR regulations. In addition, the two deep abandoned holes penetrated shallow high-pressure gas zones during drilling. As such, they could provide vertical conduits through which thermogenic gas from shallow zones could reach the surface.

Reported Leaking Wells: Southern California Gas

A review of limited Southern California Gas Company records indicates past leaks and surface seepage documented in ten wells located in the Del Rey Hills areas. Following repairs in the ten identified wells, four of these wells experienced recurrences or new leaks. These wells and information on their respective leaks are summarized in Table F-1. Data provided for review was limited; therefore, this list of documented leaks may not be comprehensive.

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ENVIRONMENTAL AND HEALTH HAZARDS DUE TO METHANE AND OTHER OIL FIELD GAS MOVEMENT THROUGH SOILS

By: Bernard Endres, Ph.D.

OVERVIEW:

Methane, and *OTHER* oil field gases, can easily move through cracks in rocks and through pore spaces in soils. The relative ease by which this can take place (viz., the soil's ability to transmit the gas) is measured in terms of *PERMEABILITY*. Accordingly, *POROSITY* and *PERMEABILITY* are important geological parameters regarding the fundamental understanding of gas migration within geological formations.

Furthermore, the underlying oil field characteristics must be understood in order to perform an environmental risk assessment, including health hazards.

GAS POCKETS AND COLLECTOR ZONES:

the rate of gas flux to the surface at any particular location. In addition, the percentage of pore space in the soil ("porosity"), and the "interconnectedness" of the pore spaces ("permeability") will influence the rate of movement of the gases.

Gas flux can be measured experimentally at the surface using a flux chamber. This can be highly variable over the subject area because of the variable geological factors described above.

GROUND WATER MOVEMENT:

The movement of local groundwater can greatly influence both the upward and lateral migration of the oil field gases. For these reasons, a detailed hydrogeological study of the area is necessary. For purposes of environmental assessment, groundwater influences are crucial in the evaluation and interpretation of the experimental data.

For example, many of the environmental studies to evaluate soil contamination are carried out using relatively shallow soil probes that do *NOT* penetrate

below the near surface aquifer zones. Accordingly, before proper experimental interpretations can be given to the gas concentrations, the hydrogeological conditions must be well known. A profound example, is where the aquifer conditions are being continually influenced by the nearby tidal forces of the Pacific Ocean.

Furthermore, each of the oil field gas constituents has a different level of solubility in water. Examples are as follows:

WATER SOLUBILITY OF SELECTED HYDROCARBONS

	WATER SOLUBILITY (AT 25°C)	MOLECULAR WEIGHT
BENZENE	1780 mg/l	78
TOLUENE	500 mg/l	92
P-XYLENE	200 mg/l	106
O-XYLENE	170 mg/l	106
ETHYLBENZENE	150 mg/l	106

The ease and efficiency with which methane and other oil field gases move in the pore spaces of fractures affects how much of the gases can reach the surface. If the gases are able to move easily in the pore spaces, then the gases can travel great vertical, as well as horizontal distances. However, if the migrating gases come in contact with clay or silt, this will impede the gas flow, likely to cause high concentrations of the gases to collect in "pockets" or sometimes called "secondary collector zones."

Also, a water table can impede the upward migration of the gases as a result of the *CAPILLARY* forces. These forces act as the gases attempt to pass through the "pore throat" spaces within the rock and soils.

SPEED OF GAS MOVEMENT:

The method and speed of gas movement through soils (e.g., "gas flux") is controlled by the amount of water present in the pore space. For example, the soil moisture content in the near surface soils can influence

The above chemicals also pose serious health hazards, and must be evaluated for the long-term health risks resulting from their presence in the near surface soil conditions.

Methane gas is the dominant gas that migrates to the surface from the underlying, or adjacent, oil field. However, the methane gas serves as a "carrier" gas for a number of other oil field gases, including Benzene, Toluene, Ethylbenzene and Xylene (viz., the "BTEX" chemicals).

HIGH RISK HEALTH HAZARDS OF THE MIGRATING GASES:

Methane serves as a carrier gas for benzene and toluene, along with other hazardous oil field chemicals. Benzene and toluene are on the so-called Governor's List of Toxic Chemicals, enacted into California Law as Proposition 65 (viz., Health and Safety Code Section 25249.6).

Benzene is a known human carcinogen, which can cause cancer, leukemia, aplastic anemia and birth defects. Toluene is a neurotoxin that can damage the central nervous system, harm the immune system (especially for developing children) and can cause birth defects.

For these reasons, it is very important to evaluate all of the gas constituents within the near surface soil conditions. For example, the detection of high levels of methane gas in the near surface soil conditions, especially in an oil field location, indicates the high probability of finding other oil field chemicals that could be highly dangerous to public health and safety.

THE EXPLOSION HAZARD OF METHANE GAS:

Following the Ross Department Store Explosion, in the Fairfax area of Los Angeles in 1985, the City of Los Angeles adopted changes in the Building Code that required gas migration measures to be incorporated into new building construction undertaken in that area. These measures were also imposed on new

construction being undertaken on the huge Playa Vista real estate development currently underway near Los Angeles International Airport, in the Playa Del Rey and Marina Del Rey areas of the City of Los Angeles.

Although, the Playa Vista development is outside of the area designated in the City of Los Angeles Building Code (viz., applicable only to the Fairfax area, and sitting over the Salt Lake Oil Field), Playa Vista is over and adjacent to the Playa Del Rey and Venice Oil Fields.

Unfortunately, this so-called Methane Ordinance is *HIGHLY FLAWED* since it addresses only the explosion hazard presented by the migrating oil field gases. It does not address the health hazards posed by the presence of the above-identified Proposition 65 chemicals, or the other hazardous conditions to be discussed more fully below.

THE HYDROGEN SULFIDE PROBLEM:

Hydrogen sulfide gas is formed in an oil field setting as a result of the interaction between the upward migration of methane gas and high sulfate

levels within the groundwater. As a result of biogeochemical processes within the anaerobic (viz., absence of oxygen) sulfate-reducing zone of the underlying ground sediments, hydrogen sulfide is formed. This formation occurs as a result of the interaction between methane (viz., the hydrogen "donor"), sulfate-reducing bacteria, and the sulfate radical (viz., SO_4) of the groundwater.

The formation of hydrogen sulfide can be very prolific if the above three conditions are present in the correct chemical balance. For example, the Playa Vista site has been demonstrated experimentally to contain high levels of hydrogen sulfide within the near surface soil conditions. Also, the "new" Belmont school site (located near downtown Los Angeles, and over the City of Los Angeles Oil Field) has demonstrated high levels of hydrogen sulfide, especially at locations also exhibiting high levels of methane gas. The underlying water table at Belmont has been confirmed to contain high levels of sulfide, as also exists at Playa Vista.

These correlations have provided important experimental confirmation of the necessity to evaluate the environmental hazards posed by hydrogen sulfide, in connection with the migration of oil field gases to the surface.

A gas seep location at the north end of the City of Newport Beach (located in Orange County, in Southern California) also exhibits all of the above characteristics. Namely, upward migration of oil field gases (dominated by methane) containing large quantities of hydrogen sulfide when measured in the near surface. However, it appears that the hydrogen sulfide does not originate from the oil field (located laterally over a mile away), but forms closer to the surface where the oil field gas interacts with sulfate reducing bacteria.

HYDROGEN SULFIDE AS A NEUROTOXIN:

Kaye H. Kilburn, M.D., a medical researcher with the University of Southern California Medical School has been the leading researcher in the world regarding the health consequences of hydrogen sulfide on brain

functions. He has published widely on the subject including the text "Chemical Brain Injury," Van Nostrand Reinhold Publisher (1998), and "Evaluating Health Effects From Exposure To Hydrogen Sulfide: Central Nervous System Dysfunction," published in "Environmental Epidemiology Toxicology" (1999) 1, 207-216

His research has demonstrated that levels of hydrogen sulfide exposure as low as one part per million (1 ppm) can cause permanent brain damage.

The levels that are being measured at Playa Vista, the "new" Belmont school site, and at the gas seep in Newport Beach far exceed this level. Accordingly, it is clear that this enormous health hazard has not been adequately assessed.

HYDROGEN SULFIDE CAUSES SEVERE CORROSION:

From an engineering design perspective, hydrogen sulfide is one of the most corrosive agents known to mankind. In the petroleum industry, the Society for Petroleum Engineers (SPE), for example, has declared

that there is no known engineering solution to the corrosion problems caused by hydrogen sulfide. Although mitigation measures are available, these cannot be used where installations were completed many years before the mitigation measures were "invented."

For example, the old oil wells that were drilled in the 1920s and 1930s did not use steel casings or cement seals that were resistant to the corrosive effects of hydrogen sulfide. Many of these wells were abandoned using cement plugs that are now vulnerable to deterioration from corrosion. Furthermore, these wells have demonstrated a long history of leaking oil field gases to the surface as a result of the direct permeable pathways created by the well bores.

Accordingly, an extremely important part of any environmental assessment to be performed within an oil field setting is to evaluate the condition of the wells, and perform an ongoing assessment of soil gas monitoring in the vicinity of <u>each</u> and <u>every</u> well.

This must be ongoing since it must be anticipated that the well casing and cement used to seal the wells will eventually fail because of the ongoing corrosion, and ground movement.

SUBSIDENCE CAN CAUSE WELL SEAL FAILURE:

Another important consideration in the evaluation of the environmental hazards posed by migrating gas from oil and gas fields is the ongoing presence of subsidence caused by fluid production. These factors contribute to the subsidence problem, or vertical ground movement, within an oil field: (1) fluid production of oil; (2) fluid production of brine water (usually far exceeding the oil production); and (3) the reduction of pore pressure within the oil field reservoir as a result of oil, brine water and gas production.

This hazard is often totally ignored, especially relating to the oil and gas well leak integrity. In reality, the subsidence interacts with the corrosion of the steel casings and the cement used to seal the wells from leaks, causing premature seal failure of the wells. This

problem is especially serious where the well completion occurred in the early years of oil field production, and the subsequent subsidence, soil compaction, and earth movement has occurred around the well bore seals.

The most serious problems arise, for example in the Los Angeles basin, where many homes have been constructed directly over the old well bores. If a leak develops, the only way to access the well in an attempt to repair the leak, is to tear the house down. Failure to correct the leak could imperil the entire neighborhood.

In particular, the City of Los Angeles has largely ignored this enormous danger, and has routinely granted building permits that allow construction of homes directly over the old oil and gas wells. There has been enormous pressure and lobbying efforts carried out by the real estate interests in order to facilitate the granting of the building permits. In most instances, no mitigation measures have been imposed upon the builders by the City of Los Angeles.

The most serious consequence of these dangerous building pratices is that no consideration is being given to the health hazards posed by the upward migration of toxic oil field gases, including Proposition 65 chemicals. For example, there have been no real estate disclosures of these health hazards, and real estate developers continue to use "influence peddling" techniques to get their projects routinely approved at City Hall.

UNDERGROUND GAS STORAGE OPERATIONS:

The ultimate example of these environmental hazards that are posed by oil and gas field operations is the Playa Del Rey underground gas storage field operated by Southern California Gas Company ("SOCALGAS"). This gas storage field is operated within the partially depleted oil fields of Playa Del Rey and Venice, located under the residential communities of Playa Del Rey and Marina Del Rey, just north of the Los Angeles International Airport.

These two oil fields saw rapid development when over 300 oil wells were drilled and completed in the 1920s and 1930s. Huge fluid production and pressure decline contributed to nearly two feet (2 ft.) of ground subsidence as a result of cumulative oil, water and gas production through the year 1970. No subsidence measurements have been taken since 1970, although fluid production has continued to the present time.

Large 12,500 horsepower compressors are used to inject natural gas transported into the field by pipeline from other areas of California, Texas, Oklahoma, Wyoming and Canada. The gas is injected into the old oil fields at pressures approaching 1,700 pounds per square inch. Many of the old oil wells in the area have been observed to be leaking gas to the surface.

However, many of the over 300 old oil wells have had homes constructed directly over the wells. This has prevented access to the wells for monitoring, and in performing repairs to control the gas leaks. However, the area is almost entirely underlain by a thick (almost 150 feet deep) gravel layer that allows the leaking wells

to individually go largely undetected for leaks. Namely, once the upward migrating leaking gas, associated with each well, reaches the gravel zone it rapidly spreads out laterally within the highly permeable gravel zone.

The gravel zone extends easterly along the path of the old Los Angeles Riverbed, and follows the current path of the county flood control channel. In terms of permeability, this gravel zone provides an excellent conduit for the gas to move easterly, and directly under the Playa Vista real estate development currently under construction.

This movement has been facilitated by the tidal action of the ocean, which acts as a "piston" (by analogy to an automobile engine) in providing a periodic, and pulsating, energy source in moving the gas from the location of the leaking wells, easterly under the Playa Vista development. At low tide, oil field gas rapidly moves up the old oil field well bores. At high tide the gas is "pushed" easterly as the rising ocean level influences the pressures within the gravel zone.

Oil field gas levels exceeding ninety percent (90%) by volume have been routinely measured in the soil conditions directly under the Playa Vista development. Also, soil probes that have been placed into the gravel zone to allow measurement of gas volumes have recorded flow rates exceeding twenty liters per minute (20 l/min). These flow rates did not significantly diminish over several weeks of ongoing measurements, demonstrating the enormity of the gas migration problem.

Based upon a large body of experimental evidence, it is believed that the near surface oil field gas found at Playa Vista represents the largest known oil field gas seep to be found anywhere in the world. This is especially troubling, since the City of Los Angeles has allowed construction to proceed directly over this gas seep without requiring an investigation of the health hazards, or an investigation of the obviously leaking oil wells that are interconnected with the high pressure underground gas storage operation of SOCALGAS.

In addition to Playa Vista, the City of Los Angeles has allowed many homes, including homes under construction at this time, to be built directly over the old oil wells.

CONCLUSIONS

The purpose of this paper has been to identify the steps that must be taken in order to properly evaluate the environmental and health hazards posed by attempting to construct residential communities over old oil fields and/or underground gas storage operations. Gas migration to the surface along old well bores, and along geological faults, must be considered as an ongoing threat for the lifetime of the project.

Methane gas represents the most prevalent of the oil field gas constituents, and can create a serious explosion hazard, especially if it is to migrate into a confined space of a building or structure. However, methane also serves as a carrier gas for other oil field chemicals including benzene and toluene that are highly dangerous to human health. Benzene is a known

human carcinogen, can cause cancer, leukemia and aplastic anemia, and can cause birth defects. Toluene is a neurotoxin that can cause brain damage, central nervous system disorders and birth defects.

Large quantities of methane gas migrating to the surface can interact with sulfate reducing bacteria giving rise to the ongoing generation of hydrogen sulfide in the near surface environment. Hydrogen sulfide is a neurotoxin, which can cause permanent brain damage at very low levels (e.g., 1 ppm).

In addition, hydrogen sulfide is highly corrosive, having the capability to destroy the integrity of the steel casings and concrete seals of the old oil wells that are the major source of the leaking gases.

It is urgent that proper disclosure be made of these conditions so that the innocent victims of these real estate transactions can take appropriate steps to protect themselves. Furthermore, the oil field operators, and the governmental entities responsible for performing oversight of these operations, must be held

accountable where they have failed to act responsibly regarding these dangerous conditions.

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ENVIRONMENTAL HAZARDS AND MITIGATION MEASURES FOR OIL AND GAS FIELD OPERATIONS LOCATED IN URBAN SETTINGS

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ABSTRACT

This paper presents a methodology for evaluating the environmental hazards posed by gas migration from oil and gas reservoirs, or underground natural gas storage facilities, and into the near-surface environment. Geological faults and improperly completed or abandoned well bores (e.g., due to poor cementing practices) are described as the primary pathways by which the gas can reach the surface. Furthermore, the gas migration problem can be exacerbated by such factors as subsidence, earthquake activity and well corrosion.

Soil gas monitoring, geochemical gas fingerprinting and geological profiling are used in order to identify the magnitude and location of the environmental risks. Shallow and deep soil probes are used in order to characterize the near-surface hydrology, and to identify possible collector zones where gas concentrations can build to dangerous levels.

These techniques have proven to be important in the planning for and design of mitigation systems necessary to protect residential and commercial properties from the migrating gases. For example, some jurisdictions have imposed regulatory controls and design requirements regarding the installation of gas mitigation systems. Also, these methods are important in establishing safe procedures for the operation of oil and gas fields, or underground natural gas storage facilities.

A number of case histories are discussed that have been used by the authors to validate the methodology, and to illustrate the seriousness of the problem. A clear case is made for the need to perform ongoing monitoring for these conditions, especially in an urban setting.

INTRODUCTION

The major paths for vertical migration of gas are formed by natural faults and fractures in the rock formations that overlie the reservoir. Natural lithification processes and tectonic activities formed these breaks or channels. These are illustrated in Figure 1 as subtending zones I, II, and III. However, in many geological settings, these fault zones can be discontinuous, but still allow the gas to literally hopscotch from one fault to another, or to act in conjunction with leaking wellbores in the same manner.

Wellbores of operational, idle or abandoned wells often result in literally pipeline flow of large volumes of gas to the surface. This is an especially serious problem where the well, usually in the annular space between the drill hole and the casing, was not properly sealed with cement. Also, the wellbore may have been hydraulically fractured during the cementing phase of well completion. Vertical fractures may extend for tens of feet from the wellbore depending upon the characteristics of the formation and the injection pressures used for placement of the cement. The cement will fill some of the larger fractures surrounding the casing, but the cement particles cannot enter the smaller fractures away from the wellbore.

SOURCES OF GAS FOR MIGRATION

During the course of oilfield production, fluid is produced from the reservoir causing a drop in pressure. This liberates the gas held in solution, and allows the gas to migrate. The free gas can migrate upward due to differences in the specific weight between the gas and the surrounding fluids (viz., upward buoyancy forces). Figure 1 illustrates the migration of gas from the reservoir to secondary collector zones, and eventually to the surface.

Initially, the gas is trapped below the caprock within the reservoir, forming a free gas zone. However, this free gas can escape through the caprock due to natural fractures in the caprock or man-induced fractures. Man-induced fractures include: wellbores penetrating the caprock during drilling, fracturing pressures occurring during oilfield operations, or by subsidence resulting from production of fluids from the reservoir.

Well completion practices rely upon squeezing cement slurry into the annular space between the drillhole and the steel casing. However, the inevitable movement of the rock formation resulting from the subsidence can destroy the intended sealing joint at the caprock interface. Once through the caprock, the gas can follow faults and fractures, as illustrated by Zone III, in Figure 1. In Zone III, secondary gas traps can often be found where layers of shale or other impervious layers slow down the upward migration of gas and permit it to gather in pockets. Figure 2 is presented to illustrate the interaction between subsidence and gas migration.

In secondary and tertiary recovery operations, water is often injected under high pressure into the reservoir to increase the production of oil. This water displaces the free gas in the reservoir, forcing the gas to migrate under this pressure influence. This free gas is then able to migrate along the paths described above, toward the surface.

The 1985 Fairfax Explosion and Fires

The phenomenon of natural gas migrating to the earth's surface from oil and gas field reservoirs via geological faults, fractures and well bores is a serious environmental problem. An explosion hazard is created if the gas collects in a confined space and reaches a five percent (5%) mixture ratio

with air (viz., the lower explosive limit for natural gas). The Ross Department Store in the Fairfax area of Los Angeles, California exploded on March 24, 1985, seriously injuring 23 people. Fires burned for days through cracks in the sidewalks and parking lots until a vent well was drilled to relieve the pressure build-up. Extensive investigations, including gas fingerprinting, confirmed that the gas had migrated to the surface along faults and poorly maintained well bores. Shallow soil gas probe holes were installed to monitor any future build-up of gas. In 1989 these gas monitoring wells indicated that large volumes of gas were again building up under the site. Fortunately, the area was evacuated immediately. It was discovered that the single vent well, that had been installed to vent the gas, had become plugged with silt at the slotted interval depth of 80 feet.

Other serious gas seeps have occurred in this area over many years. It is also the location of the famous La Brea Tar Pits where gas and oil continually migrate to the surface along the 6th Street Fault. This site has been used by the authors as a large "natural laboratory" to study and research the phenomenon of gas migration discussed in this paper. Over the past 15 years, this research has been expanded to address similar gas migration problems located in many parts of the world. This paper will provide an overview of these findings. References 1 through 5 provide a detailed treatment of these topics, including an analytical formulation of the gas migration mechanisms.

THE 2001 HUTCHINSON, KANSAS EXPLOSION AND FIRES

Research on these topics is continuing at the University of Southern California, including at the graduate student level. This is expected to contribute important new information to the understanding of the geological, geochemistry and hydrogeology principles that control gas migration. The most recent incident that is under investigation is the natural gas explosion that destroyed the downtown area of Hutchinson, Kansas on January 17, 2001. The next day, natural gas exploded under a mobile home park outside of the city, killing two people. Gas and water geysers reached heights of 30 feet. The gas leaks were traced to an underground natural gas storage field located nearly seven miles from the explosion sites. The gas had migrated through geological faults and permeable formations from leaking well bores at the storage site. Investigation has revealed that virtually no monitoring was in place in order to prevent this disaster. Worse yet, the emergency

response teams had no clue as to the cause of the disaster. For example, the fire department was unable to extinguish the flames, illustrating the lack of preparedness for such an event. In the case of the 1985 Fairfax explosion, the fire department had been called, and had responded to gas odors in the area 30 minutes before the explosion. Because of their lack of preparedness, they mistakenly believed it was sewer gas, and returned to the fire station. Shortly thereafter, the alarm was sounded to respond to the explosion and fire that devastated the area that they had just returned from.

ENVIRONMENTAL HEALTH HAZARDS OF CERTAIN OIL FIELD CHEMICALS

Additional concerns regarding the environmental hazards of oil and gas migration in urban areas are the carcinogenic, toxic and neurotoxin constituents that are contained within the oil field gases. These include the so-called BTEX chemicals comprising benzene, toluene, ethylbenzene and xylene. For example, benzene and toluene are contained on the so-called Governor's List of toxic chemicals within the State of California, and require a posting of warning signs to the public under the Proposition 65 environmental laws. Benzene is a known human carcinogen, and can cause blood disorders, including aplastic anemia and leukemia, as well as cancer. Benzene and toluene can cause birth defects. Both chemicals are highly volatile, and can easily transform from the liquid crude oil state into the natural gas state (e.g., associated gas), especially under reservoir pressure conditions.

This also becomes a serious problem in partially depleted oil fields that have been converted to underground natural gas storage operations. The storage gas is pumped into the oil field reservoir under high pressure. Frequently, 60% to 70% of the original crude oil still remains in place. When the storage gas comes in contact with the crude oil, aromatic hydrocarbons are transferred from the crude oil to the natural gas stream, enhancing the presence, particularly, of benzene and toluene. When the storage gas is retrieved to the surface for customer delivery, the gas must be processed through scrubbers and dehydration surface equipment. This provides an opportunity for these chemicals to escape into the atmosphere as fugitive emissions, or intentional releases. As a minimum, vapor recovery systems are necessary to control fugitive emissions. Billions of cubic feet of

storage gas can be withdrawn from inventory over a short period of time, increasing the health hazard risks to the surrounding community.

Furthermore, the natural gases that escape to the surface along well bores, faults and pipeline leaks will contain these health hazard chemicals. Also, workers need to be protected against these hazards, especially from long-term exposure.

HYDROGEN SULFIDE ENVIRONMENTAL HAZARDS

Another serious problem is caused by the hydrogen sulfide formation that can occur when the leaking natural gas stream interfaces with high sulfate levels in the near-surface water table. This can give rise to the perpetual generation of hydrogen sulfide through microbial alteration under anaerobic sulfate to sulfide reducing conditions. Hydrogen sulfide is not only highly corrosive, but is a neurotoxin, that must be considered a health hazard even at levels as low as 1 ppm (Kilburn, 1998; Kilburn, 1999).

The corrosive conditions of hydrogen sulfide on both steel casings and cement are well known (Craig, 1993). However, oil field operators, especially regarding the longevity of well completions and well abandonments, often ignore the long-term consequences of hydrogen sulfide, and other corrosive soil conditions. Namely, the steel casings and cement completion practices can be expected to develop gas leaks to the surface as a result of future aging. Accordingly, it would be ill advised to allow building over abandoned well bores, regardless of how carefully they were abandoned with cement seals and plugs. Also, access to the wells with oilfield drilling rigs would be necessary in order to repair leaks that could develop at any time in the future.

Although this research has been devoted to evaluating the environmental hazards of gas migration, these same topics are important regarding near-surface exploration for oil and gas. In fact, the research methodology – especially soil probe studies – evolved originally from this exploration technology point of view. Namely, near-surface exploration for petroleum is based on the detection and interpretation of a great variety of natural phenomena occurring at or near the land surface or sea floor and attributed, directly or indirectly, to hydrocarbons migrating upward from leaky reservoirs at depth. Development of surface exploration methods began in the early 1930's with chemical analysis of gaseous hydrocarbons in

soil air. It has since expanded to include a wide range of geochemical, geophysical, mineralogic, microbiological and other types of anomalies (Toth, 1996).

MITIGATION SYSTEMS OVERVIEW

Mitigation systems, both passive and active, have been developed in recent years in an attempt to cope with the gas migration hazards discussed in this paper. Many of these remain unproven. For example, the most common procedure is to install a geomembrane or plastic liner under the footprint of the structure being built in order to capture the upward migrating gases. Perforated pipes are installed in a gravel blanket located under the membrane in order to vent the gases that are collecting below the structure. These systems have demonstrated a high failure rate. The membranes can become punctured during installation, and/or develop leaks around the multiple penetrations that must accommodate utility and electrical lines, elevator shafts and pilings used for foundations. Gas detectors, used in conjunction with the membranes, require ongoing maintenance and calibration.

These mitigation systems have typically not been designed to deal with the health hazards of the migrating gas, but only to prevent a catastrophic explosion. This is a serious oversight, since the most dangerous chemical constituents of the leaking gas are heavier than air. For example, benzene, toluene and hydrogen sulfide are all heavier than air, and will tend to concentrate at ground level, and lower elevations, creating an inhalation hazard to those living and working in the area.

In summary, ongoing monitoring for the prevention of explosions and fires is essential, along with monitoring for health hazard conditions. The latter requires, at least, an order of magnitude lower threshold detection limits to protect against an inhalation health hazard.

NATURAL GAS STORAGE FIELDS

It has become common practice to utilize depleted oilfields for the purpose of storing large volumes of natural gas underground. It is more economical to store gas in underground reservoirs than construct large

delivery lines, typically from out-of-state sources, that would be capable of satisfying peak demands. Gas is purchased and delivered to the storage field during non-peak demand periods, and retrieved from the storage field during high demand periods, such as during cold spells.

Underground gas storage facilities utilizing old, depleted oil and gas fields are subject to the same gas migration hazards as discussed above, but are often times more serious. The existing wellbores and well completions were not designed to withstand the high pressures that most gas storage facilities are operated at, nor the cyclical variations in pressure experienced by the seasonal high and low operating pressures. For example, during inventory draw-down the cement seals at the bottom of the casing can fail, causing shoe leaks and other seal damage.

Abandoned wells associated with the prior oil or gas field usage, are difficult, if not impossible to reenter and seal in order to prevent gas leakage. Also, since these wells do not allow direct monitoring, gas seepage can be detected only at the surface. However, the leaking gas can spread out and migrate along fault planes, and/or experience lateral migration within the shallow water table, before ever reaching the surface. This can act to conceal the true dangers of the leaking wells. These problems require the placement of deep soil probes, positioned immediately adjacent to the well bores. Also, gas levels within the near-surface water table require monitoring. Field experience has demonstrated that the near-surface water table can serve as a temporary barrier for the upward migration of gas. Often, the gas will collect below the water tale, and spread out laterally before eventually reaching the surface.

For these reasons, it is important to perform a detailed characterization of the near-surface hydrology, including gas concentrations, free gas volumes and water movement directions. The individual gas constituents (e.g., methane, ethane, propane, etc.) have different solubility levels, and must be accounted for when attempting to characterize the origin of the leaking gases.

Gas fingerprinting studies must account for a number of near-surface gas alterations in order to properly interpret the source of the leaking gas. The primary adjustment factor is to account for the mixing between the native oilfield gas and the gas storage gas during migration using a so-called

mixing line. Also, near-surface mixing with biogenic gas can alter the characterization of the gas.

Underground gas storage facilities are frequently located in urban areas where gas, migrating to the surface can cause serious environmental problems. Examples include the following:

(1) MONTEBELLO GAS STORAGE FIELD, CALIFORNIA

The Montebello Oilfield, located in Southern California, was utilized by a gas company to store large volumes of natural gas in a partially depleted oilfield. Prior to converting the Montebello field to a gas storage facility, many oil wells had been abandoned using standards that were based on 1930's vintage technology. The old oilfield also contains several fault planes that are potential paths for gas migration.

The gas company began storing gas in a portion of the Montebello Oilfield in the early 1960's. By the early 1980's, significant gas seepages were discovered at the surface within a residential housing area. The gas seepages endangered homes, requiring evacuation of families. Some of the homes had to be torn down in order to provide access to leaking wells, that were attempted to be reabandoned. Monitoring of the near-surface water table for gas concentrations was undertaken on an emergency basis. Also, gas was found leaking up under the City Hall front lawn.

Because of the endangerment to the homes, and the huge economic losses suffered by the gas company from the lost gas, this storage facility has been closed.

(2) PLAYA DEL REY GAS STORAGE PROJECT

The Playa del Rey Oilfield was converted into a gas storage field in 1942. Shortly thereafter, storage gas was discovered migrating into the adjoining Venice Oilfield at the reservoir level of approximately 6,000 feet. Gas began migrating when the differential pressure reached approximately 300 psi. The storage field has been operated continuously to the present time, with storage gas pressures reaching approximately 1700 psi. A study, performed by the gas company in 1953, estimated that 25% of the injected gas was migrating to the adjoining Venice Oilfield. The operational procedure is based on capturing as much of the leaking gas as possible, and returning it to the primary storage field on an ongoing basis. This requires

numerous old oil wells to be used as recapture gas wells, in order to return the leaking gas.

Over 200 abandoned oil wells are in the area, which used 1930's era technology for the well completions. High-density housing has been built throughout the area, with many homes constructed directly over the old abandoned wells. Virtually no mitigation measures have been provided to deal with the gas migration hazards.

Recent soil gas studies have revealed gas concentrations as high as 90%, within the near-surface soil conditions. Soil probes and vent wells that have been drilled into the near-surface aquifer have measured gas flow rates as high as 25 to 30 liters per minute. One soil gas measuring expert has characterized the area as having the largest gas seep to be found anywhere in the world.

The City of Los Angeles has only recently begun to require mitigation systems to be installed in new construction, but only in the extremely high gas zones. The lessons learned from the Fairfax gas explosion, and the more recent Hutchinson, Kansas gas explosions have been largely ignored.

CONCLUSIONS

If future disasters are to be averted, careful attention must be given to the monitoring for oilfield gas migration hazards. Furthermore, addressing the health hazards posed by certain chemical constituents such as benzene, toluene and hydrogen sulfide requires much lower detection thresholds to be used for monitoring purposes: within the 1 ppm range. Mitigation systems have not proven to be capable of dealing with these extreme hazards.

The main conclusions to be drawn from this paper can be summarized as follows:

1) The primary force controlling the migration of gas to the surface is the difference between the specific weight of water and that of gas (viz., the buoyancy force).

2) Gas migration occurs along faults, and behind wellbore casings to the surface. The volume of gas migration toward the surface is directly related to the type and width of the path along which it migrates.

3) Gas migration can create surface hazards if the gas is allowed to concentrate in localized collector zones (secondary traps), including the collection in shallow water tables.

4) It is not advisable to build over abandoned wellbores. Over time, the cement and well casing will deteriorate resulting in the creation of paths for gas migration to the surface. The migrating gas is both an explosion hazard, and a health risk, because of the presence of chemicals that can cause cancer, birth defects and central nervous system dysfunction.

5) Underground natural gas storage facilities have demonstrated a long history of gas migration problems. Gas migration hazards are aggravated because of the high reservoir pressures. Experience has shown that these facilities should not be located anywhere close to urban settings. The Hutchinson, Kansas gas explosion demonstrated that the storage gas can migrate many miles (in that case, seven miles to the explosion site).

6) To avoid catastrophic events as described in this paper, a fundamental awareness and understanding of the gas migration hazards and paths of migration would permit taking preventative steps. A detailed risk assessment needs to be performed for existing facilities, including the development of an emergency response plan.

These results have been presented so that individuals, and responsible governmental entities, will begin to take the necessary steps to protect the public health and safety from these dangers.

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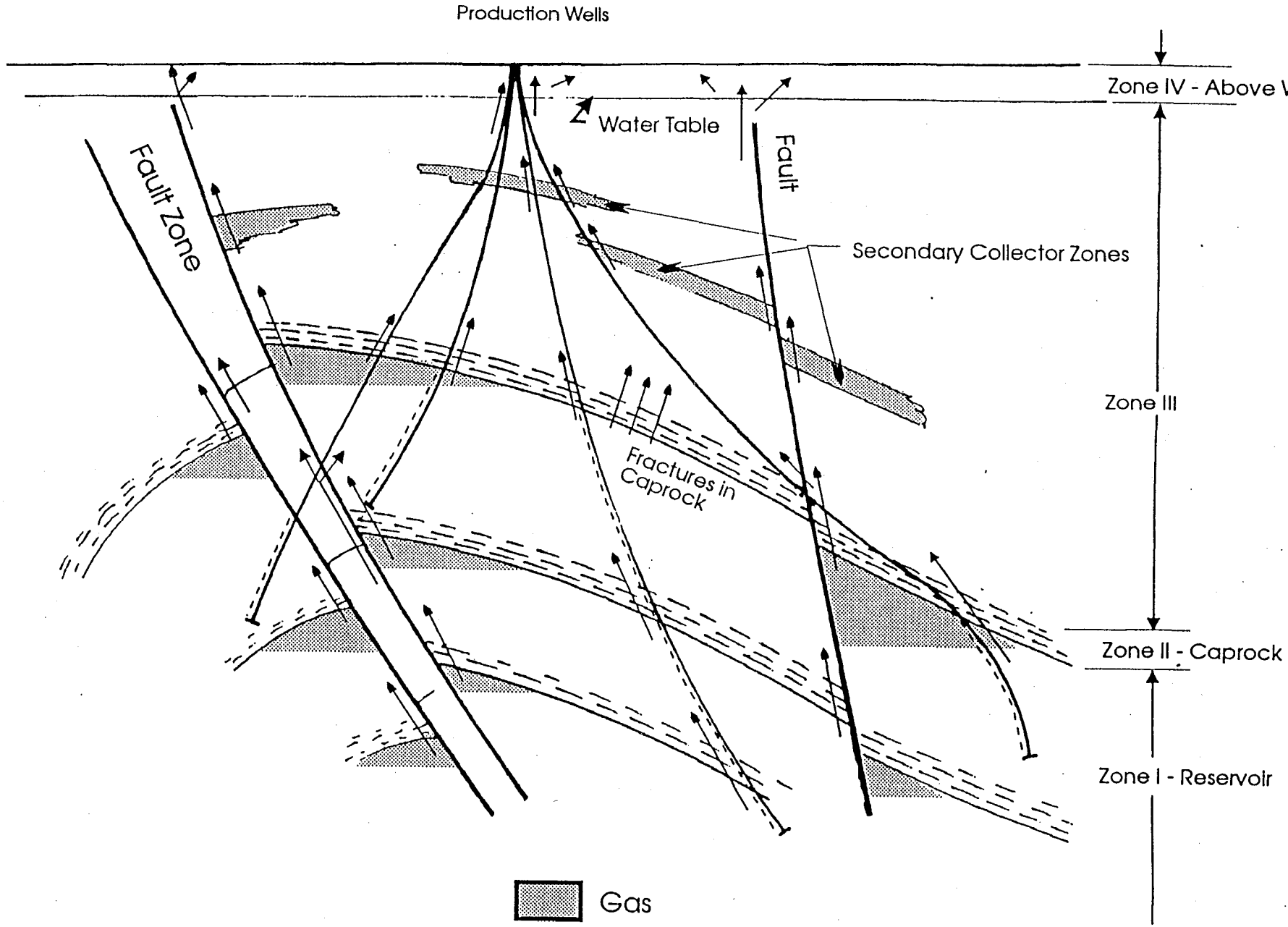


POTENTIAL PATHS OF GAS MIGRATION

FIGURE 1.

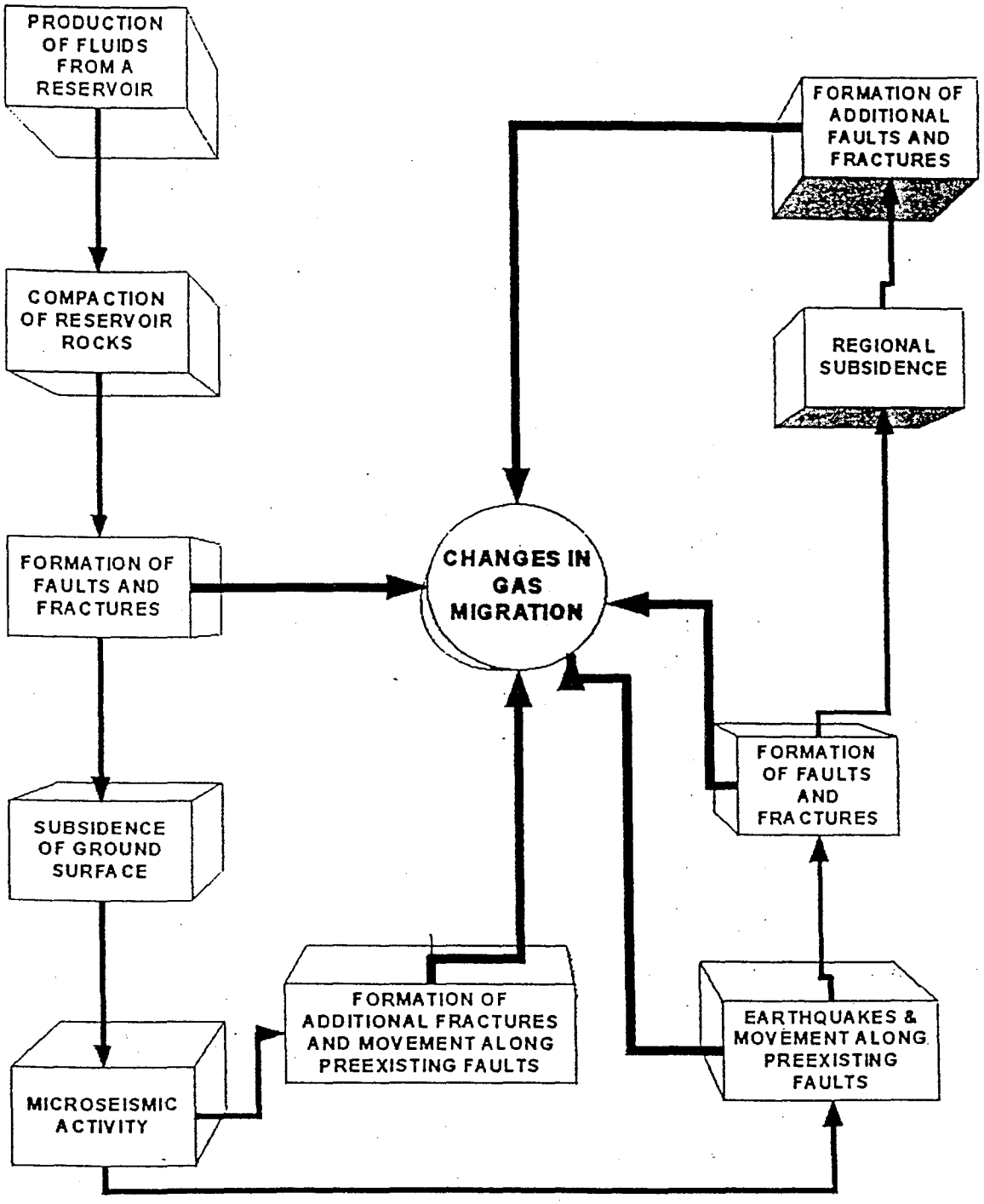
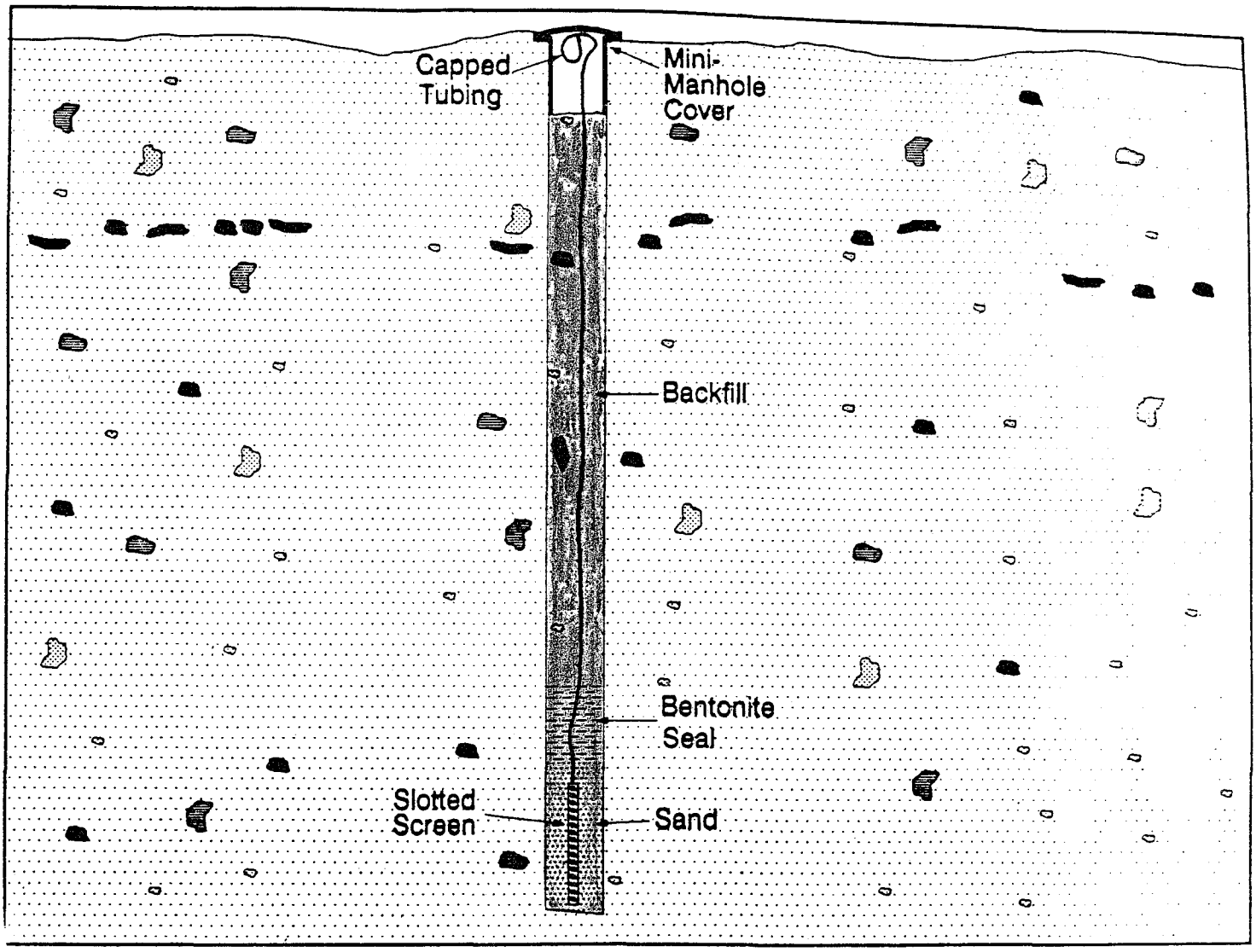


FIGURE 2. Schematic diagram of system relationships among the production of fluids, compaction, subsidence, and seismic activity.



Monitoring probe for determining subsoil gas concentrations.

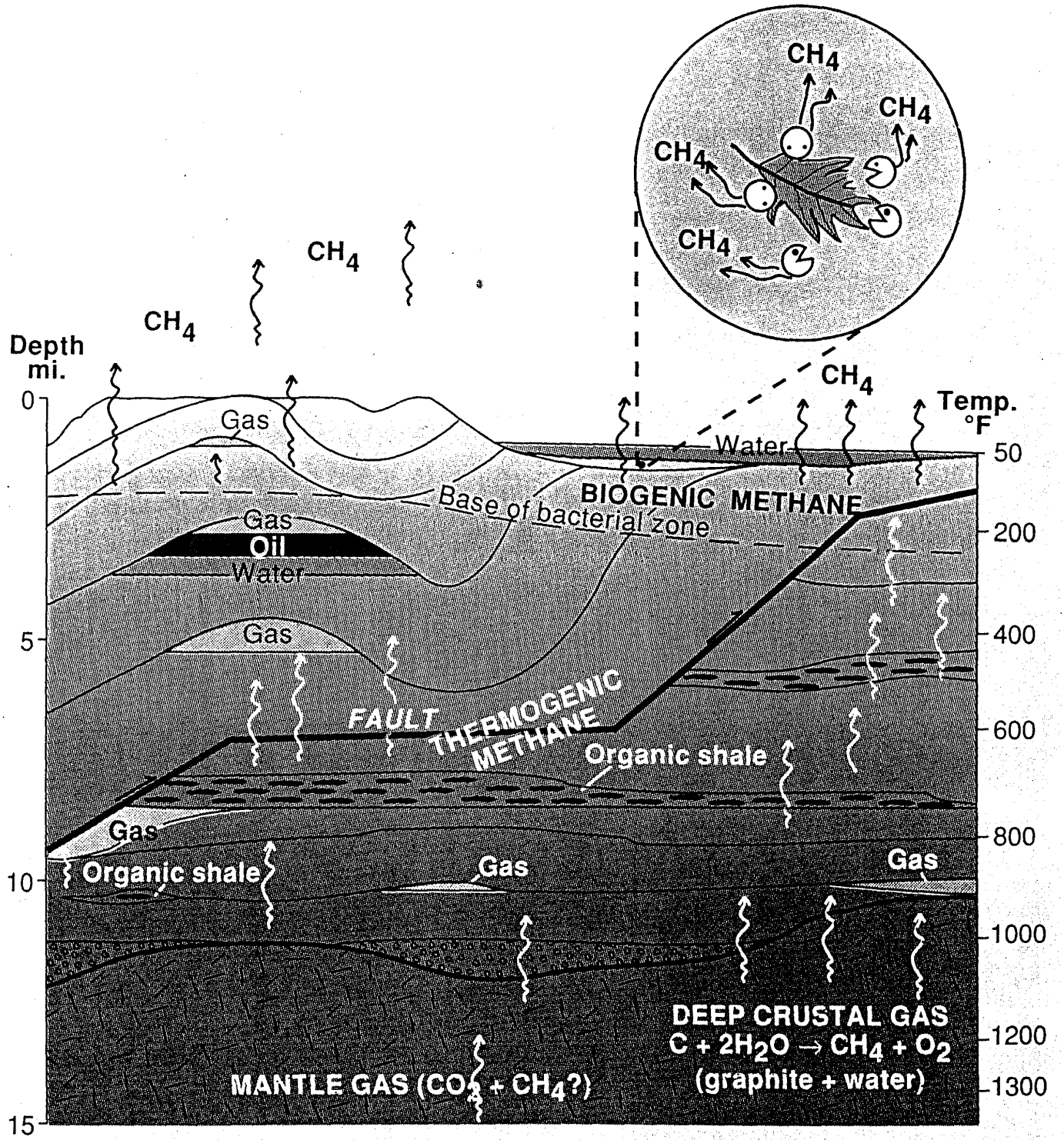
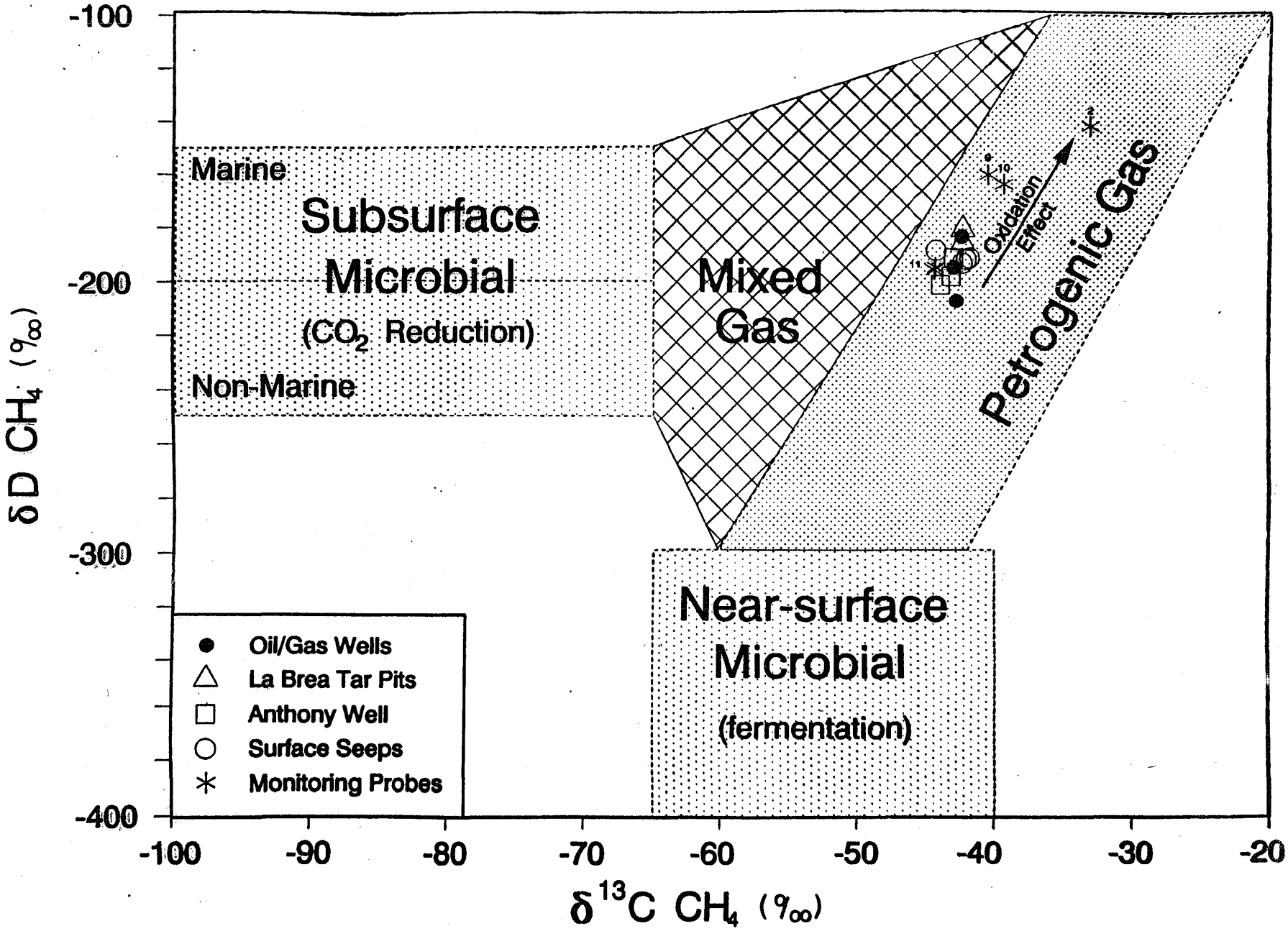

CH4
CH4
CH4
CH4
CH4
CH4
Depth
mi.
0
5
10
15
Gas
Water
BIOGENIC METHANE
Base of bacterial zone
Gas
Oil
Water
Gas
FAULT
THERMOGENIC
METHANE
Organic shale
Gas
Organic shale
Gas
Gas
DEEP CRUSTAL GAS
C + 2H2O → CH4 + O2
(graphite + water)
MANTLE GAS (CO2 + CH4?)
Temp.
°F
50
200
400
600
800
1000
1200
1300

FIGURE 3.


-100
-200
-300
-400
δD CH4 (‰)
Marine
Subsurface
Microbial
(CO2 Reduction)
Non-Marine
Mixed
Gas
Petrogenic Gas
Oxidation
Effect
Near-surface
Microbial
(fermentation)
Oil/Gas Wells
La Brea Tar Pits
Anthony Well
Surface Seeps
Monitoring Probes
-100
-90
-80
-70
-60
-50
-40
-30
-20
δ13C CH4 (‰)

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Rita Boppana, Complainant, vs. Southern California Gas Company, Defendant.	Case 00-05-010 (Filed May 11, 2000)
And Related Matters.	Case 00-05-011 (Filed May 11, 2000) Case 00-05-012 (Filed May 11, 2000)

THE PLAYA DEL REY GAS STORAGE FACILITY GAS MIGRATION HAZARDS; AND THE DUTIES IMPOSED TO MONITOR AND MITIGATE THESE DANGEROUS CONDITIONS

March 24, 2007

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I. EXECUTIVE SUMMARY OF THE PLAYA DEL REY GAS STORAGE FACILITY GAS MIGRATION HAZARDS:

A. FOR MANY YEARS SOCALGAS HAS KNOWN OF THE EXACT MANNER IN WHICH GAS LEAKS INTO THE NEAR-SURFACE SOILS, AQUIFERS AND INTO THE AIR AT PDR:

In an engineering report prepared by Rick Lorio, Associate Petroleum Engineer of Underground Storage for Southern California Gas Company ("SOCALGAS"), the manner in which gas leaks to the surface at Playa Del Rey ("PDR") is described in detail (see Exhibit 1). This engineering analysis report was prepared, and is dated April 25, 1985. Extensive additional engineering reports and measurement data prepared by SOCALGAS reveal that large quantities of gas migrate upward into the surface casings of the old well bores at PDR. These surface casings were initially drilled and cemented to the rock formation at a typical depth of 700 feet below the surface. This is illustrated in the Exhibit 1 Attachments that diagram the well casings, and the paths of gas migration.

Effectively, the surface casings – and the annular volumes that exist between the main casing and the surface casings – serve as collection "containers" for the upward migrating gases, as illustrated in Exhibit 1. SOCALGAS has monitored the gas pressures and the gas composition in these surface casings continuously over many years. These data reveal the central defects existing in the old well bores, in allowing gas to migrate into the near-surface soils and aquifers.

Exhibit 1 identifies these defects, and describes what mitigation measures need to be taken. In summary, these are described in the report as follows (emphasis added):

> Problem:
>
> All wells have some uncemented segments. Few wells have any cement above 2000. Formation sloughing may have filled in some of these wellbores but most remain the most permeable upward path for gas migration.

Solution:

Noise and TDT monitor active wells to find areas of increasing activity. Continually produce shallow zones. Vent to atmosphere all gas coming from surface casing shoe aquifer.

This description is provided in Exhibit 1 under the caption "Uncemented Wellbore Leaks: Type 3." Under the caption "Casing Shoe Leaks: Type 2," the following is described:

Problem:

Casing shoe leaks due to poor, deteriorated cement or to leakage through wso holes in active or abandoned wells.

Solution, Abandoned Wells:

Collect all free gas from overlying zones. Repair work not possible.

In summary, the "Solutions" set forth above by SOCALGAS include:

1. "Continually produce shallow zones."

2. "Collect all free gas from overlying zones."

Under the caption "Abandonment Plug Leaks: Type 4," two types of abandonment are described:

Problem, Type A Abandonment:

Cement plugs inside casing allow some gas to migrate upwards. Because its casing was cut off below the surface string, water will continue to fill casing as gas leaks out. Leak will therefore be sporadic and low rate.

Problem, Type B Abandonment:

Cement plugs inside casing allow some gas to migrate upwards. Because the casing stub is cut off within 100' of surface, the entire surface casing fills with gas. No liquid enters the well. The gas leak unloads fluid from the well and the rate increases with time. Eventually all of the fluid unloads and the leak rate stabilizes at a near constant daily rate.

Problems, Both Type Abandonments:

1. Casing cap, surface casing and casing shoe cement competent. Gas will build up inside-surface casing and force its way into shallow aquifer sand. Gas will surface at a non-leaking well that has the following problems.

2. Casing cap not competent. Gas will surface near well.

3. Surface casing or shoe cement not competent. Gas will spread over large area as it rises to surface lethargically.

Solution, Problem 1:

Direct repair of leaking well not possible because source well is unknown. Other wells where gas appears are continually vented to surface.

Solution, Problem 2:

Unearth well and recap or place collection funnel over it. Rig work not required. Vent all gas to atmosphere.

Solution, Problem 3:

Unearth well, move in rig, attempt to enter and repair old casing. Produce gas through casing into low pressure system. Vent surface annulus to atmosphere.

In summary, the "Problems" and "Solutions" identified under the caption "Abandonment Plug Leaks: Type 4" reveal the true nature of how the abandoned wells at PDR cause the near-surface aquifers to be continually recharged with the leaking gas:

1. "Gas will build up inside surface casing and force its way into shallow aquifer sand."

2. ". . . the [leak] rate increases with time . . . and the leak rate stabilizes at a near constant daily rate."

3. "Gas will spread over large area as it rises to the surface lethargically."

The central issue addressed by SOCALGAS in the above topic is the manner in which "gas will surface at a non-leaking well." This issue was addressed, and corroborated the above finds, in a report prepared by Babson and Sheppard, petroleum engineers, dated July 23, 1985. Their findings included the following (emphasis added):

1. "Leakage of natural gas from underground gas storage reservoirs is not unusual."

2. "The sustained high pressures at which such projects frequently operate tend to develop pockets or channels of gas saturation which are outside the confines of the normal storage reservoir."

3. "The Storage Reservoir is particularly susceptible to occurrences of this nature because of the large number of oil wells drilled into the field's reservoirs prior to initiation of the storage operations." [Exhibit 2 is attached herein to identify the oil wells that were drilled into the PDR Storage Reservoir prior to initiation of the storage operations.]

4. "Each of those wellbores provides a potential channel for the uncontrolled migration of fluid."

5. "Gas could migrate from the storage reservoir through one wellbore to an upper formation, then through a second wellbore to yet higher formation.

6. "Such upward flows could be expected to occur naturally over time even without the presence of the storage operation."

7. "Gas remaining in depleted, abandoned reservoirs will naturally tend to seek a route to a site of lower-pressure – a shallower formation."

8. "It could even be driven toward the available flow channels by the entry of edgewater into the reservoir seeking to replace the depleted hydrocarbon saturation.

9. "The Gas Company's storage project tends to emphasize this potential for upward migration because of the high pressures necessary for its operation."

SOCALGAS has long recognized these problems at PDR, including by way of entering into contractual agreements that purport to allow "storage" of their gas as close to the surface as 500 feet. Namely, quoting from the SOCALGAS report described above:

- "Gas will build up inside surface casing and force its way into shallow aquifer sand."

- "Gas will spread over large area as it rises to surface lethargically."

The corresponding language in contractual legal documents filed with the Los Angeles County Recorders Office by SOCALGAS typically reads as follows:

- FOR A VALUABLE CONSIDERATION, receipt of which is hereby acknowledged, HUGHES TOOL COMPANY, a corporation organized under the laws of the State of Delaware, hereby conveys to SOUTHERN CALIFORNIA GAS COMPANY, a corporation, the exclusive right to use subsurface mineral, oil and/or gas zones for injecting, storing and withdrawing natural gas (whether produced from such or other property) therein and therefrom and for repressuring the same; but with no right to use the surface or to carry on such operation except between a depth of -500 feet to -7000 feet from the surface thereof in the following described property:

- Hughes Tool Company hereby convenants and agrees to prohibit exploration for mineral, oil, gas or other hydrocarbons between depths of -500 feet to -7000 feet from the surface of the above described property.

Clearly, the "exclusive right to use subsurface mineral, oil and/or gas zones for injecting, storing and withdrawing natural gas (whether produced from such or other property) therein and therefrom and for repressuring the same," would be inclusive of the shallower migration zones described in the Babson and Sheppard report quoted above.

Furthermore, the geographic extent of the property [viz., "the following described property:"], as described in the documents recorded with the County Recorder's Office, establish the true boundaries over which SOCALGAS has direct legal responsibility regarding gas leaking to the surface. These boundaries need to be carefully identified regarding the legal issues that are to be addressed regarding this proceeding.

In summary, the legal analysis regarding SOCALGAS responsibilities relating to the leaking gases at PDR must consider the above foundational material critical in this determination. The above factual foundation is essential in establishing the true nature of the legal undertaking of SOCALGAS in operating an underground gas storage field in a partially depleted oilfield under high pressure, where a large number of oil wells were drilled into the field's reservoirs prior to initiation of the storage operation. The controlling legal issues regarding this undertaking will be discussed below.

B. SOCALGAS DEVELOPED PROCEDURES FOR MONITORING AND COLLECTING LEAKING GASES, BUT FAILED TO IMPLEMENT THESE PROCEDURES AT PDR:

In a document prepared by SOCALGAS titled, "Gas Inventory Monitoring, Verification, and Reporting Procedures," (see Exhibit 3), the following procedures are

described for the monitoring and collection of the leaking gases, as detailed in the Rick Lorio report titled, "The Playa Del Rey Monitoring Program," (see Exhibit 1), under the caption Non-Storage Zone Wells, at page 5 of 18, the following is described (emphasis added):

> Non-storage zone wells monitored include both Company wells and wells owned by others in overlying and underlying zones and in other fields within two miles of the storage reservoir boundary, where applicable. These wells are categorized as follows:
>
> i. Pressure observation wells are located in overlying and underlying permeable formations, or adjacent to the storage reservoir but across assumed confining boundaries, such as faults, permeability pinchouts, below the gas-liquid contact or beyond the spill point of the storage zone's confining structure. Although normally static, these wells may have artificial lift mechanisms for removal of gas and fluids.
>
> ii. Gas collection wells are located where known gas migration from the storage zone is intercepted and collected. These wells are normally equipped with operating artificial lift mechanisms so that both liquids and gas can be produced, causing a pressure sink in the reservoir near the wellbore.
>
> iii. In some fields, shallow water observation wells have been drilled into aquifer zones existing in the first permeable sand above the shoe of the surface casing. These wells are closed in at the surface and gas concentrations in the wellbore are measured weekly.

It is important to recognize that Rick Lorio addressed these same issues with the following relevant language (see previous discussion herein) (emphasis added):

- "Gas will build up inside surface casing and force its way into shallow aquifer sand."

Clearly, the monitoring and collection procedures highlighted above are critical in dealing with shoe leaks occurring at the bottom of the surface casing, located at a typical depth of 700 feet, as illustrated in Exhibit 1. Succinctly, these procedures are described as follows (emphasis added):

". . . shallow water observation wells have been drilled into aquifer zones existing in the first permeable sand above the shoe of the surface casing."

At PDR there are permeable sands extending to a depth of at least 500 feet. Accordingly, it is critical that the cement shoes on the active and abandoned wells at PDR be evaluated for integrity using the shallow water observation wells design procedure developed by SOCALGAS. In particular, Rick Lorio of SOCALGAS, in Exhibit 1, warns that if the surface casing or shoe cement is not competent "gas will spread over large area as it rises to surface lethargically."

More importantly, is the high pressure gas that has been extensively measured by third parties in the "50 Foot Gravel," which is a shallow sand and gravel aquifer that overlies the legal boundaries that SOCALGAS claims to have the contractual legal authority to store gas as close to the surface as 500 feet. However, SOCALGAS has consistently denied any legal responsibility over this pressurized gas, and has failed to monitor or collect these gases at PDR in their efforts to shirk their responsibility for the leaking gases.

In a document prepared by the Consumer Protection and Safety Division of the California Public Utilities Commission, dated August 20, 2002 and revised on November 18, 2004 titled, "Complaint Case Facts and Findings (Playa Del Rey Storage Field)" the following facts and findings were set forth:

- Three Types of Natural Gas in PDR:

  "There is evidence of surface detection of three types of natural gas in PDR, namely: Biogenic gas, Native PDR Thermogenic gas and Storage Reservoir Thermogenic gas."

- 133 PPM Helium from Bar-Hole Samples near Big Ben Well:

"SoCalGas internal office memorandum, dated November 20, 1991 revealed that gas samples collected from bar-holes around Big Ben Well contained 30,000 PPM to 620,000 PPM natural gas and these samples contained 133 PPM to 188 PPM Helium. A close examination of the memo reveled that three samples were collected on 1/11/91, at bar-holes #12, 13 & 14. Isotopic analysis of these samples indicated with high probability the signature of Storage Reservoir gas (meaning that the gas migrated from Storage Reservoir). In addition, the memo did not indicate any more sampling at these bar-holes or subsequent remedial action. On 8/23/91 and subsequent dates, samples were collected from bar-hole H instead of bar-holes 12, 13 & 14. The isotopic analyses of the new samples did not reveal the storage gas signature and subsequent discussion on the memo ignored the initial sample data, its significance and if there was any remedial action."

- 22 PPM Helium from a Shallow Probe Sample by John Sepich and Associates:

"Isotech Laboratory performed an isotopic analysis of a gas sample submitted by Sepich & Associates on 3/25/99. Sepich and Associates was working for Playa Vista developers (developers of residential and business properties around the PDR Storage field. The isotopic analysis report indicates the gas sample was collected from Playa Vista Project Area-D. The analysis report also revealed presence of Ethane and 22 PPM Helium in the gas sample. The significance of this isotopic analysis report is the presence Storage Reservoir gas or Native PDR gas signature and the location where the gas sample was collected (Area-D of Playa Vista Project). My opinion is that the probability of Storage Reservoir gas sample from PDR area containing Ethane and 22 PPM Helium is greater than 50 percent (>50%). Furthermore, the location where the sample was collected should be of major concern" (emphasis added).

- 100 PPM-1000 PPM Helium from Groundwater Samples Collected and Analyzed by Exploration Technologies, Inc. (ETI):

"City of Los Angeles Building and Safety Department retained ETI to conduct test, analyze and provide advice on Playa Vista project. Groundwater samples were

collected in 2000 from Playa Vista Project Area, and dissolved gases were extracted and analyzed by ETI in addition to other scientific sampling and testing. Several groundwater samples revealed presence of high Helium concentrations and Methane dissolved in the groundwater. The origin of this Helium in the groundwater is not clear. However, some people have postulated that the groundwater absorbs or strips the Helium from the Storage Reservoir gas or Native PDR gas as it migrates through the aquifer to the ground surface. Hence, Thermogenic gas is detected in soil-gas without Helium. Although this postulation seems plausible, I have not seen any scientific paper on this absorption theory and the kinetics."

- Dr. Victor Jones of ETI detected Thermogenic gas components at the Surface and detected H2S in Soil Gas during his investigation in 2000:

  "ETI conducted an extensive soil gas investigation in Playa Vista area for the City of Los Angeles in 2000. The isotopic analysis report of the samples collected revealed presence of Methane, Ethane, Helium, H2S, Toluene and other volatile organic compounds (voc). The presence of numerous Thermogenic gas components in the shallow soil gas samples analyzed indicates a deeper source for this gas."

- Previous Reservoir Inventory Verification Analysis by SCG indicated gas migration loss (8/22/80):

  "A Reservoir Inventory Verification Analysis conducted by Theodoros Georgakopoulos on August 22, 1980 for SoCalGas indicated gas migration loss. The migration pathways to the Townsite area (separate geologic zone) is unknown. The report estimated storage reservoir gas loss between January 1961 and December 1979 to be 0.10 B.c.f. Subsequent reports estimated the gas loss to have decreased."

- Presence of Methane gas around Troxel Well:

  "As part of Energy Division (ED) initial preliminary investigation, ED retained MHA, who subcontracted Giroux & Associates to conduct site investigations at the Troxel and Lor Mar well site locations in 2001. These recent studies found very high methane concentrations

(greater than 50,000 ppm) at the Troxel site and low methane concentrations (1 to 6 ppm) at the Lor Mar site" (emphasis added).

Investigation reports, including reports prepared on behalf of SOCALGAS, reveal the common occurrence of gas leaking to the surface at the location of the surface casing. Namely, leaking from the annular space, and volume, existing between the surface casing and the primary oilwell casing. This is especially true for the many abandoned wells that were found to be leaking gas to the surface, and required reabandonment. These include wells Troxel, Townsite 2, Block 11 and others. This would reveal the urgent need to carefully evaluate the shoe leak and cement conditions at each of the abandoned wells within the PDR field, using the procedures previously described herein, as developed by SOCALGAS.

Regarding operational wells, SOCALGAS has been monitoring the surface casing volumes for gas pressures, rate of pressure build-up, gas constituents – including Helium, and other leakage conditions for many years. These data are very important regarding identifying the manner in which gas is migrating up the wellbores, and entering the aquifer zones at the shoe leak locations.

The above report by the Consumer Protection and Safety Division of the PUC has not included these important field measurement data gathered by SOCALGAS over many years. It is important to note that these data, including Helium counts, have been used by SOCALGAS to determine the extent of storage gas leakage into the geologically connected permeable reservoirs that surround the PDR "primary" gas storage area.

This migration of storage gas into the surrounding geologically connected reservoirs has been continuously ongoing since the primary storage reservoir pressure was raised above 750 pounds per square inch, beginning in the early 1940's. This storage gas has commingled with

the billions of cubic feet of native gas that has existed within PDR oilfield, before its conversion to an underground storage facility.

For the foregoing reasons, the gas samples that have been collected from the oilwell surface casings, from surface seeps, and from dissolved and free gases in the 50 Foot Gravel zone, contain a mixture of storage gas (including Helium), Native gas, and Carcinogens that are carried to the surface by the upward migrating gases.

It is important to note that the surface casings, and the gas pressure build-up therein are routinely vented to the atmosphere in accordance with the "Solutions" recommended by Rick Lorio, in the report discussed above. Namely these included (emphasis added):

> "Vent to atmosphere all gas coming from surface casing shoe aquifer,"

Accordingly, this intentional venting of gas to the atmosphere – in which the gas has been confirmed to contain carcinogens – is of great concern. Many of these wells are located in close proximity to homes and apartments in the PDR area, and such venting presents a serious health hazard.

C. SOCALGAS HAS CATEGORICALLY DENIED ANY VERTICAL GAS MIGRATION AT PDR, CLAIMING THAT THE FIELD ACTS AS A CLOSED CONTAINER, AND DENIES ANY RESPONSIBILITY FOR THE FOREGOING DESCRIBED CONDITIONS:

The first attempt that SOCALGAS made to deny responsibility was to hire Dr. Kaplan, a geochemist, to evaluate the surface gas seeps for chemical composition. His results in the 1992 and 1993 time period were proclaimed by SOCALGAS, including in the newspapers, to prove that the surface gas seeps at PDR were biogenic gas (commonly described as swamp

gas). These findings were later totally discredited by the soil gas investigations carried out by Exploration Technologies, Inc. (ETI) of Houston, Texas on behalf of the City of Los Angeles.

As summarized above by the Consumer Protection and Safety Division, of the California Public Utilities Commission, the surface seeps were determined to be thermogenic in gas composition, and originating from a deep source (viz., not swamp gas). Furthermore, the so-called John Sepich probe – that extended to a depth of 20 feet, for the first time – revealed significant levels of helium in the seeping gases (viz., 22 ppm helium from his 20-foot deep soil gas probe).

A much more detailed analysis of the seeping gases was performed by Victor Jones of ETI, in which his findings are summarized above in the identified Consumer Protection and Safety Division report. His gas samples were collected using, for the first time, much deeper soil gas probes that extended into the "50 Foot Gravel," with samples collected from depths exceeding 50 feet.

Water samples were also collected from these much deeper sampling depths, and analyzed for the dissolved gas chemical compositions. These samples further confirmed the thermogenic character of the seeping gases, in that they contained methane, ethane, helium, H2S, toluene (a carcinogen) and other volatile organic compounds (VOC's) consisting of propane, butane and xylenes. These gases are especially characteristic of thermogenic oilfield gas. These compositions are also typical of those gases leaking from the abandoned wellheads, that have required reabandonment throughout the PDR field.

Most noteworthy of the deep soil gas samples (viz., below 50 feet) collected by Victor Jones of ETI were the very high helium count levels of between 100 ppm and 1000 ppm, as reported in the Consumer Protection and Safety Division.

A further attempt was made by SOCALGAS to conceal the true dangers of the leaking abandoned wells by claiming that the wellhead leaks were biogenic gas, and not having anything to do with their storage operations. However, the true chemical analysis of the leaking cases contained methane, ethane, propane, butane and other higher order hydrocarbons, entirely consistent with thermogenic gas, that was leaking from a deep source.

Furthermore, senior technical personnel from SOCALGAS have proclaimed before City of Los Angeles hearings on the PDR field, that there is no vertical gas migration out of the field, and the storage reservoir acts as a closed container. It is important to note that the PDR facility operates under a Conditional Use Permit ("CUP") issued by the City of Los Angeles. An important condition of this CUP is as follows:

> "That the underground gas pressure shall be kept sufficiently low so that there will be no escape of gases into the air above the ground."

All of the above described factual issues relate directly to the "Scoping Memo" dated March 7, 2005 which stated the issues that are in controversy regarding the subject adversary proceeding:

> "If the SoCalGas Playa Del Rey gas storage facility is venting or leaking gas or depositing carcinogens into the air or soil to the detriment of the health or safety of the neighboring community" (emphasis added).

The above factual framework is essential in identifying the legal duties imposed upon SOCALGAS as a consequence of undertaking a gas storage operation in the partially depleted oilfield of Playa Del Rey.

D. SOCALGAS HAS THE DUTY TO MONITOR AND PROTECT AGAINST THE GAS MIGRATION HAZARDS AT THE PDR FACILITY BECAUSE THEY UNDERTOOK TO OPERATE A GAS STORAGE FACILITY IN A PARTIALLY DEPLETED OILFIELD, CONTAINING MANY PREVIOUSLY DRILLED WELLS; CREATING A KNOWN DANGEROUS CONDITION:

The controlling principle of law imposed upon SOCALGAS regarding the PDR facility is set forth in Restatement Second of Torts Section 321:

> §321. Duty to Act When Prior Conduct is Found to be Dangerous
>
> (1) If the actor does an act, and subsequently realizes or should realize that it has created an unreasonable risk of causing physical harm to another, he is under a duty to exercise reasonable care to prevent the risk from taking effect.
>
> (2) The rule stated in Subsection (1) applies even though at the time of the act the actor has no reason to believe that it will involve such a risk.

Within the meaning of "actor" regarding the PDR facility would be the "act" of undertaking a gas storage operation in the partially depleted Playa Del Rey oilfield by SOCALGAS.

SOCALGAS subsequently realized, or should have realized, that the many old oilwells drilled into Playa Del Rey oilfield – before they began their operations – would serve as conduits for both storage gas and native oilfield gas to escape and migrate to the surface.

There was a duty imposed to exercise reasonable care to prevent the risk from taking effect. In fact, SOCALGAS developed written policies and procedures (viz., as described above) to monitor and mitigate against the risks created by the upward migration of gases into shallow zones. However, these policies and procedures were not implemented at the PDR

facility. They are believed to have been implemented at other underground gas storage facilities operated by SOCALGAS, at least in part.

Accordingly, the appropriate standard of care to be employed at the PDR facility is established by these written policies and procedures. In summary, these include:

1. Monitoring of both Company wells and wells owned by others in overlying and underlying zones and in other fields within two miles of the storage reservoir boundary.
2. Drill shallow water observation wells into the aquifer zones existing in the permeable sand zones above the shoe of the surface casing.
3. Locate pressure observation wells in overlying and underlying permeable formations, or adjacent to the boundaries, such as faults, permeability pinchouts, below the gas-liquid contact or beyond the spill point of the storage zone's confining structure.
4. Install artificial lift mechanisms for removal of gas and fluids, within the above described offending areas.

For the foregoing reasons, it is essential to establish the legal boundaries of the true extent of the storage reservoir. SOCALGAS claims to have storage rights provided presumably by the relevant documents on file with the Los Angeles County Recorder's Office. These documents need to be carefully identified, primarily to establish the true "legal" boundaries of the PDR facility.

The established boundaries of the PDR facility would then allow determining the monitoring program needed within "two miles of the storage reservoir boundary," as described in paragraph (1) above.

In summary, the PDR facility must conform to an appropriate standard of care, commensurate with the extreme hazards posed by storing billions of cubic feet of flammable and explosive gas under a highly urbanized residential community. This extreme hazard is exacerbated by the hundreds of old oilwells that were drilled into the Playa Del Rey oilfield, many years before the gas storage operations began, thereby severely compromising the rock formations sealing capacity.

Furthermore, it is a well known characteristic of all gas storage fields that the gas leakage losses are directly proportional to the reservoir pressure. The Babson and Sheppard Report, discussed above, identified this hazard in the following way:

> "The Gas Company's storage project tends to emphasize this potential for upward migration because of the high pressures necessary for its operation."

SOCALGAS studies have confirmed that the primary storage area of the PDR field begins to leak when the reservoir is pressurized above 750 pounds per square inch. In contrast, the primary storage reservoir pressure frequently reaches 1700 pounds per square inch, more than double the pressure that precipitates the gas leakage

E. SOCALGAS IS RESPONSIBLE FOR THE LEAKING GAS CONDITIONS AT PLAYA DEL REY BECAUSE THEY EXERCISED EXCLUSIVE CONTROL OVER THE OLD OILWELLS, AND THE DANGEROUS CONDITIONS CREATED BY THEIR DETERIORATED CONDITIONS:

SOCALGAS acquired exclusive control over hundreds of old oilwells that had been drilled, and many of them abandoned, prior to SOCALGAS undertaking gas storage operations

in the PDR field. As previously discussed, the Rick Lorio Report itemized the central defects in these old wells, including:

1. All wells have some uncemented segments. Few wells have any cement above 2000 feet. . . . but most remain the most permeable upward path for gas migration.

2. Casing shoe leaks due to poor deteriorated cement or to leakage through water shut-off holes in active or abandoned wells.

3. Surface casing and surface casing shoe cement (viz., at a typical depth of 700 feet) are not competent. Gas will build up inside surface casing and force its way into shallow aquifer sand.

4. Gas will surface at a non-leaking well, including at wells where the surface casing or shoe cement is not competent. Gas will spread over large area as it rises to surface lethargically.

Surface casing leaks, especially in old abandoned wells, have been documented repeatedly at PDR over many years. The issues raised in paragraph 4, above, are especially important regarding the degree of care and soil gas monitoring necessary to identify which of the old wells are truly leaking. Namely, gas will surface at a non-leaking well. Accordingly, even if the well is reabandoned at the location where the gas is surfacing, this will not cure the leaking well problems.

This problem is especially serious at PDR because of the very extensive sand and gravel permeable zone that was laid down over geologic time by the original river channel flow of the Los Angeles River. This shallow, highly permeable zone, is commonly known as the "50 Foot Gravel." However, other permeable zones exist extending to a depth of approximately 600 feet.

In fact, the surface casing depth requirements (viz., typically 700 feet) are dictated by State of California law, mandating that the surface casing be protective of the fresh water zones

overlying the oilfield. Namely, the very conditions described in the Rick Lorio Report identify violations of State Law:

> "Gas will build up inside surface casing and force its way into shallow aquifer sand."

In short, the sealing integrity of the old surface casings, especially including the cement shoe at a typical depth of 700 feet, is pivotal regarding the operations and maintenance of the PDR field.

Historical drilling records reveal serious problems with achieving a competent cement seal when the surface casing was being cemented to the surrounding rock formation. This was especially serious for the Townlot Wells that were closer to the Pacific Ocean beach. The drill hole would often collapse during the drilling operation, preventing a proper cement squeeze at the shoe location of the surface casing.

Furthermore, saltwater intrusion from the nearby Pacific Ocean is also highly corrosive to the steel surface casing, and is known to cause significant deterioration of the concrete shoe materials.

These wells were drilled in the 1920's and 1930's, as identified herein in Exhibit 2. Certainly, when they were drilled in this early time period, there was no contemplation that the oilfield would ever be used for storing high pressure. The technology for storing natural gas in a partially depleted oilfield had not yet been invented in the 1920's/1930's. Also, the technology for performing well completions and cementing operations were still within their infancy.

The history of the oilwell acquisitions by SOCALGAS at PDR were largely dictated by the large volumes of storage gas that were leaking out of the primary storage area. Once the

storage pressure was raised above 750 pounds per square inch, storage gas began leaking into oilwells operated by Union Oil Company. Initially, Union Oil Company and SOCALGAS entered into an agreement regarding how much SOCALGAS would pay Union Oil Company for the return of the lost gas, plus any additional native gas produced by Union Oil from their wells. Eventually, all right title and interest to these wells were conveyed to SOCALGAS, with legal title conveyed pursuant to documents on file with the Los Angeles County Recorder's Office.

It was also discovered by SOCALGAS that storage gas was leaking into the area known as the Townlot Wells, and migrating as far north as the Troxel well location. For this reason, SOCALGAS acquired all legal interests to these wells, as documented in records on file with the Los Angeles County Recorder's Office.

For the foregoing reasons, SOCALGAS has a direct legal ownership interest in these wells. The mere abandonment of these wells does not extinguish the responsibility of SOCALGAS over the proper monitoring and the maintaining of these wells in a safe condition.

The basic public policy of California is that every person is responsible for an injury, to property or person, caused by his or her lack of ordinary care or skill in the management of his or her property. See Civil Code Section 1714(a), and the numerous Appellate and Supreme Court decisions that have interpreted its application to ownership interests, such as are involved herein.

It is important to recognize that the surface casings of the abandoned wells extend into the surface rights area located above 500 feet. Rick Lorio points out in his report, as discussed above, the gas migration hazards created by this condition:

1. Because the casing stub is cut off within 100 feet of the surface, the entire surface casing fills with gas.

2. The gas leak unloads fluid from the well and the rate increases with time.

3. Eventually all of the fluid unloads and the leak rate stabilizes at a near constant daily rate.

These facts establish that there is an ongoing trespass to the surface property ownership interests, especially since the gas is leaking at a depth of approximately 100 feet. Furthermore, as described by Rick Lorio, the gas will spread over large areas as it rises to the surface lethargically. Accordingly, there are violations of trespass laws on adjoining surface properties as well.

These violations would also constitute nuisance because of the explosive and carcinogenic character of the migrating gases.

The Public Utility Code mandates by statute that all utility property be maintained in a safe condition. Accordingly, the legal ownership of the above-described wells by SOCALGAS imposes an obligation upon them to properly monitor and mitigate the hazards associated with these wells, as described above.

Furthermore, there is a need to provide proper warning to the surface owners regarding the need to take preventative measures to protect themselves and their property from the above-described leaking gases.

II. THE QUESTION BEING SUBMITTED TO THE COMMISSION, WHICH WAS "FRAMED" BY SOCALGAS, MAKES NO LOGICAL OR LEGAL SENSE IN THE CONTEXT OF THE TRUE FACTUAL ISSUES, AS SET FORTH ABOVE:

A. THE LEGAL ARGUMENTS ADVANCED BY SOCALGAS ARE MISPLACED, AND LACK FOUNDATION:

The specific question that has been "framed" by SOCALGAS, and not agreed to in that context by Grassroots Coalition, for submittal to the Commission by briefs is as follows:

"Does SOCALGAS have responsibility for any non? storage and non? pipeline gas that migrates through an area where SOCALGAS owns the mineral rights but does not use SOCALGAS? active or abandoned wells as a conduit to migrate to the surface or from one underground reservoir or zone to another?"

Even if any scientific or legal sense can be made of this convoluted description, it still is objectionable because it lacks foundation regarding the issues relevant to this adversary proceeding.

As previously stated, the "Scoping Memo" identifies the relevant issues as follows:

> "If the SoCalGas Playa Del Rey gas storage facility is venting or leaking gas or depositing carcinogens into the air or soil to the detriment of the health or safety of the neighboring community" (emphasis added).

Section I. of this report has addressed the factual foundation upon which this Scoping Memo addresses. The question posed above, as framed by SOCALGAS, goes far afield of this Scoping Memo by creating its own technical jargon.

First of all, it is not possible to scientifically define the term "non storage gas," and SOCALGAS has made no attempt to define this term. Fundamentally, when the natural gas is injected into the partially depleted PDR oilfield by SOCALGAS under extremely high pressures, this gas commingles with the native oilfield gases existing in the reservoir. Furthermore, these high-pressure conditions cause the commingled gases to migrate into numerous geologically connected oilfield reservoirs that contain even larger quantities of native gases. This multiple commingling constitutes the gases that become available to migrate up the old well bores and faults, as described in the SOCALGAS Rick Lorio report detailed above. This would also be the nature of the venting or leaking gases set forth in the Scoping Memo.

Secondly, even if there were so-called "non storage" and/or "non pipeline" gas migrating through the mineral rights territory of SOCALGAS, this gas would become commingled with the storage gas and the native gases, already commingled in mineral rights territories of SOCALGAS. In short, once the hypothetical gas migration occurred, it would automatically lose whatever unique identity it was presumed to have.

SOCALGAS has failed to give any clue as to how this identity is to be carried out scientifically.

Thirdly, the issue as framed by SOCALGAS, expressly excludes a determination by the Commission of responsibility for gas that migrates and uses SOCALGAS active or abandoned wells. As set forth in Part I. of this report, the central gas migration hazards at the PDR facility are the active or abandoned wells serving as conduits for the commingled gases to reach the surface, and into the near-surface permeable zones, including freshwater aquifers.

Accordingly, any determination of the responsibility issues, as framed by SOCALGAS, would be meaningless within the context of the Scoping Memo.

B. SOCALGAS HAS MISUNDERSTOOD THE STANDARD OF CARE IMPOSED UPON THEIR UNDERGROUND GAS STORAGE OPERATIONS AT THE PDR FACILITY:

The fundamental premise of responsibilities imposed by negligence law, is the duty to act reasonably under the circumstances. This is established by determining the standard of care required. Conduct falling below this standard of care, can be found to be negligent conduct. The appropriate responsibilities, under the instant set of facts, are established by this standard of care.

Accordingly, it is meaningless herein to focus upon the single issue of mineral rights and/or storage. Although these become one aspect of the overall issues, they, in themselves,

misdirect attention away from the central issues identified in the Scoping Memo. The totality of contractual documents, and their specific languages need to be evaluated.

The Conditional Use Permit issued by the City of Los Angeles, and the contractual obligations imposed upon SOCALGAS regarding the prohibition of operating the gas storage facility at pressures that would cause gases to leak into the air, must be considered in establishing SOCALGAS responsibilities.

Various California Administrative Codes prohibit the leakage of gas from surface casings into adjoining permeable aquifers, and must be considered in determining SOCALGAS responsibilities. Violations of the Regulations could be deemed negligence per se under a negligence standard of care legal responsibility analysis.

SOCALGAS has ignored these central issues in their legal analysis. In addition, they have ignored any legal issues related to strict liability. An entire body of law exists related to operating an abnormally dangerous activity, in which responsibility, or legal liability is imposed irrespective of the degree of care that is used in carrying out the operation. Namely, liability can be imposed even if SOCALGAS was able to show that they operated the PDR facility with utmost care.

The test to be used for determining if the PDR facility constitutes an abnormally dangerous activity is set forth in Restatement Second of Torts § 520:

> In determining whether an activity is abnormally dangerous, the following factors are to be considered:
>
> (a) existence of a high degree of risk of some harm to the person, land or chattels of others;
>
> (b) likelihood that the harm that results from it will be great;
>
> (c) inability to eliminate the risk by the exercise of reasonable care;

(d) extent to which the activity is not a matter of common usage;

(e) inappropriateness of the activity to the place where it is carried on; and

(f) extent to which its value to the community is outweighed by its dangerous attributes.

Central to this evaluation are items (d) and (e). Regarding (d), the extent to which the activity of storing gas under high pressure in a partially depleted oilfield, in an urban setting, is certainly an activity that is not a matter of common usage. Regarding (e), the above-described activity is certainly an inappropriate activity to be carried out in a high-density residential location.

Regarding item (c), the "inability to eliminate the risk by the exercise of reasonable care," is pivotal and central to this entire adversary proceeding, SOCALGAS has attempted to frame the legal issues in a context that would require them to make as few changes as possible to their current practices and procedures. The upshot of this nonaction by SOCALGAS to deal with the true gas migration hazards at the PDR facility would be the strong inference that there is an inability to eliminate the risk by the exercise of reasonable care.

In summary, the nonaction by SOCALGAS to deal with these gas migration hazards – during this adversary proceeding – is tantamount to "inviting" a strict liability level of responsibility upon SOCALGAS.

CONCLUSIONS

There is a paramount need for SOCALGAS to set forth the specific policies and procedures that will allow proper monitoring and mitigation of the gas migration hazards at the PDR facility.

These policies and procedures should use as a primary framework the "Gas Inventory Monitoring, Verification, and Reporting Procedures" set forth in Exhibit 3 herein. Particular focus should be upon the shallow monitoring wells, and the gas collection wells detailed above in Section I. of this report.

In addition, these policies and procedures should focus on the surface casing leaks, including shoe leaks, that are enumerated in the SOCALGAS Rick Lorio Report, detailed above in Section I. of this report. This needs to include both active and abandoned wells.

Finally, a determination of responsibility by the Commission of the statement of issues as framed by SOCALGAS (see above) would be of no value in resolving the central issues of this Adversary Proceeding, as articulated in the Scoping Memo, as described above. In addition, to the extent that SOCALGAS is requesting the Commission to make a determination of legal ownership interests, including property rights involving the oil and gas mineral rights and/or storage, these property right determinations are under the jurisdiction of the Superior Court.

DATED: ~~February~~ March 26, 2007

Respectfully submitted,

By: _____

Patricia McPherson
President, Grassroots Coalition

CERTIFICATE OF SERVICE

I hereby certify that I have this day served a copy of the foregoing **SOCALGAS LEGAL RESPONSIBILITIES REGARDING LEAKING AND MIGRATING NATURAL GAS AT THE PLAYA DEL REY GAS STORAGE PROJECT** on all known interested parties of record in C00-05-010, C00-05-011, and C00-05-012 by electronic mail included on the email list on the CPUC web site.

Dated at Los Angeles, California this 23rd day of February, 2007.

Kathy Knight

EXHIBIT 1

THE PLAYA DEL REY

MONITORING PROGRAM

Rick Lorio
Associate Petroleum Engineer
Underground Storage
Southern California Gas Co.
April 25, 1985

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APPENDICES

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Attachment 2 - Playa del Rey Well List

Attachment 3 - Playa del Rey Injection/Withdrawal Schedule

Attachment 4 - Helium Samples on Playa del Rey Pumping Wells

Attachment 5 - Examples of Temperature, Noise, and R/A Tracer Survey Reports.

Attachment 6 - Playa del Rey Well Survey Status Report

Attachment 7 - Examples of Abandoned Well Survey Reports, Leakage Survey Report, and Leak Investigation Report

Attachment 8 - Playa del Rey Annulus Pressure Report

I. Storage Zone Problems

A. Possible source of gas migration to surface

There are at least five different possible sources of gas to the surface at Playa del Rey:

1. Casing leaks due to tubing/drill pipe wear, corrosion, stage collars, squeeze holes or metal failure.

2. Casing shoe leaks in active and abandoned wells.

3. Leaks from lower to upper zones outside the casing through uncemented or poorly cemented well bore in either active or abandoned wells.

4. Abandonment plug leaks inside the casings of abandoned wells.

5. Wellhead seal leaks.

B. Three incidents of shallow casing leaks at Playa del Rey

Since Playa del Rey was converted to gas storage in 1942 for the war effort, there have been three incidents of shallow casing leaks. Two of these leaks had surface shows of gas and oil: 12-1 and 24-2, respectively.

1. In 1964, a casing leak was reported in Big Ben at about 150'. Repaired leak in 6-5/8" casing with Baash Ross casing bowl to 269'. The leak was determined to be at a depth of 269'.

2. On August 9, 1974, a gas leak was reported in the 13-1 block. The well 12-1 was determined to have a casing leak at between 700 and 800 feet. Bar hole surveys around the well and over the pipelines in the area indicated gas was appearing at the surface. The well was killed on August 15, 1974. From this time on, no gas was injected into the 13-1 block.

3. On April 30, 1975 at about 11:00 a.m., oil and gas surfaced on the east side of cellar wall. The well was producing through a leak in 7" casing at an unknown depth. They found corrosion in the

casing from 108' - 157'. Six weeks later well was returned to service. Currently, this well has an Otis subsurface safety valve located at 92'.

II. Overview of Field

A. Introduction

Playa del Rey oil field is about eleven miles west of Los Angeles, between Venice and Playa del Rey. Wildcatting was carried on in the vicinity of Playa del Rey for over eight years before the field was finally discovered. Drilling activities in the vicinity of Playa del Rey date back to May 14, 1921, at which time Del Rey 1 was spudded. This well was drilled to depth of 2785' without encountering any oil or gas showings, and was abandoned because of mechanical problems.

The first well drilled into the storage zone was on August 2, 1929. The Ohio Oil Company spudded the "Recreation Gun Club" 1. This well was drilled to a depth deeper than 6200'. A poorly sorted conglomerate, showing gas and oil, from 6114 to 6199 was discovered. While preparing to run a "water witch" to determine the nature and point of entry of the fluid, the well suddenly came in December 18, 1929, and flowed through the casing at an estimated rate of 2500 barrels of oil and 1,500,000 cubic feet of gas per day with the oil having an API of 21.6°.

On August 4, 1942, the Commission decided that Playa del Rey appeared feasible for Underground Storage from an engineering and economic standpoint. The goverment decided that Union Oil Company of California was to act as the operating contractor for Defense Plants Corporation, and the Southern California Gas Company as the gas utility to store and withdraw gas. From that time, the storage zone has increased from a field deliverability of approximately 10 MMcf/hr to about 25 MMcf/hr. Currently, Southern California Gas Company has 72 active wells in Playa del Rey.

B. Well Lists

There are 72 active wells in this field. These wells are divided into four groups:

1.	Injection/withdrawal wells Storage wells	28
2.	Flowing wells migration Return	2
3.	Pumping wells:	10
	a. Fluid removal b. Pressure relief	
4.	Observation wells	32

These wells comprise the Playa del Rey storage operation.

C. Storage Areas

There are five distinct areas in the Playa del Rey storage field. Each of these areas has distinct operating functions.

1. 13-1 Fault Block
2. 24-1 Fault Block
3. Del Rey Main Area
4. Del Rey Gas Cap
5. Venice Townlot area

13-1 Fault Block

The 13-1 fault block has not been used for injection/withdrawal operations since 1974 when a shallow leak at well 12-1 brought gas to the surface at nearby houses. This block includes wells 12-1, 13-1, Colly 2, Colly 10, Harper, Hisey, Kelly and Merrill. Should this block be determined feasible to return to operations, other factors need to be considered. All of the wells in this block are in a residential area and will require subsurface safety valves with which they are already equipped. These wells have not been operated for some time; and thus the question is whether or not the neighbors will tolerate the increased noise level required to operate these wells.

The 13-1 fault block is geologically connected but not pressure connected. This block is an upthrown fault block, gas can migrate in, but the block holds pressure indicating that gas accumulates.

24-1 Fault Block

This fault block is used in tandem with the main storage area. It has no other purpose other than to remove fluid from this east flank.

Del Rey Main Area

This is the storage zone area. The operating guidelines are to withdraw from low structure wells first and work towards the higher structures. There are twenty-eight injection/withdrawal wells located in this area.

Del Rey Gas Cap

The wells located in this area of the field are primarily used for observation. Two of these wells are also used for gas migration return Del Rey 15 and Del Rey 18.

Venice Townlot Area

The wells in this area have a dual purpose: pressure relief (fluid removal) and gas migration (observation).

Early in the usage of Playa del Rey as a gas storage reservoir, it was discovered that certain oil productive areas, previously considered to be structurally separate deposits were really pressure connected. The areas in question were the Del Rey Gas Cap, Del Rey Hills Area, Del Rey Main Area and the Venice Townlot area. Parts of this reservoir are apparently geologically connected but not pressure connected.

Block 10R, Block 11, Townsite 2, Townsite 3, Townsite 11 and Troxel are located in this part of the field. Troxel, however, is on the other side of a fault block. Helium tests have indicated storage gas production from this area of the field.

III. Monitoring Program

A. Temperature, Noise and Tracer Surveys

All of the wells at Playa del Rey with the exception of tire pumping wells have temperature surveys are run on a quarterly basis. These surveys provide the information needed to determine well leaks. When a well leaks, the expanding gas from the leak cools both the pipe and surrounding formation. On a temperature survey, the leak appears as a cooling anomaly on a temperature survey.

Gas storage technicians run temperature surveys quarterly using company-owned wireline units. If a cooling anomaly appears on the temperature survey, a noise survey is run to verify the leak. If indicated, a radioaoctive tracer survey (R/A) is run which pinpoints the exact location of the leak and provides data necessary to estimate the rate of gas loss. During the 1st five years, only two R/A tracer surveys were run. They were on Big Ben and 12-1. Big Ben had a casing leak at 1065', and well 12-1 had a leak between 168' and 230'.

B. Surface Observation

All active well cellar areas are inspected each month for indications of near surface gas migration by station personnel. Any bubbles are analyzed for hydrocarbon and helium content. The resident reservoir engineer requests the analysis, and reviews and maintains records of the results. If storage gas is forced, the senior petroleum engineer is notified.

Once a month at Playa del Rey, the station personnel survey the four permanent bar holes that are near all active wells with a gas scope or flame ionization unit.

Twice a year, the station surveys the bar holes in the vicinity of abandoned wells with the flame ionization unit to detect any near surface gas migration under the direction of the South Basin Pipeline Superintendent.

Once a year, all storage field pipelines are surveyed using the flame ionization unit to detect any near surface gas migration.

C. Storage Zone

1. Surface pressures in each well are measured and recorded weekly using a calibrated test gauge. The data recorded for each well are:

   Tubing pressure
   Casing pressure
   Annuli pressure
   Safety valve control-line pressure
   Mode of operation

2. A plot of weekly surface casing and innerstring annuli pressures versus time is maintained for each well.

3. Wellhead inspections are performed once a month.

4. Subsurface temperature survey are performed on a quarterly basis.

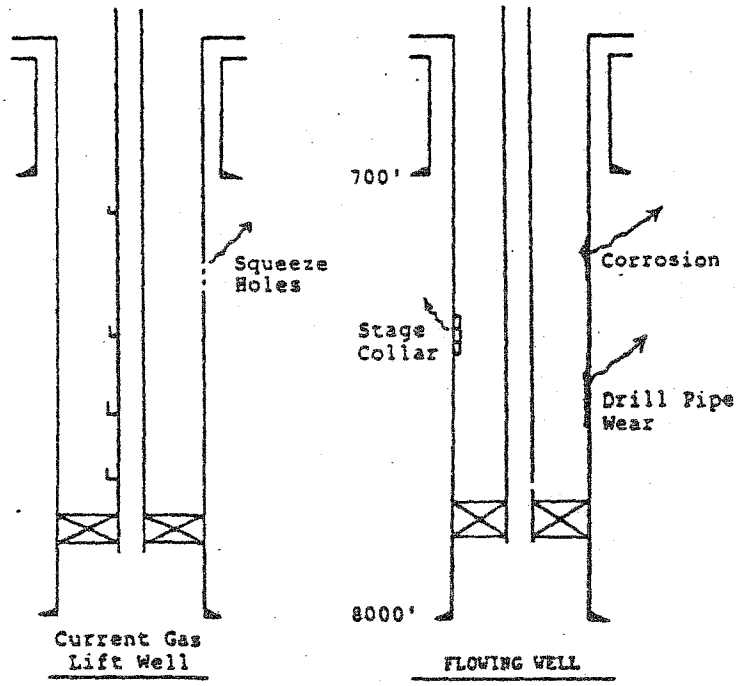
D. Gas Cap Observation Well

Vidor 6 is Playa del Rey's GCOW used to observe gas bubble pressures. This well is not used for injection and is used for withdrawal only for peak load conditions. The surface pressure measurements on the tubing and casing of Vidor 6 is recorded and plotted daily.

RMM:mm
April 25, 1985

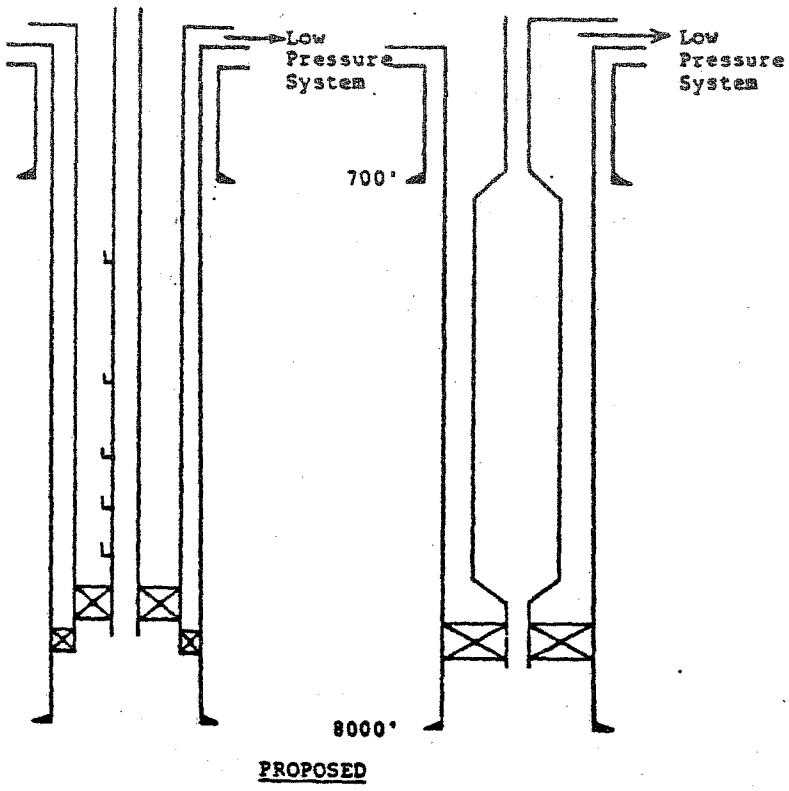
EXHIBIT I

CASING LEAKS: TYPE 1



PROBLEM:

Casing leaks that allow high pressure gas into low pressure, shallow zones.



SOLUTION:

Use innerstrings and/or tubing to confine all high gas pressure. Keep innerstring or tubing annulus pressure lower than that required to force gas into acquifer sand at shoe of surface casing by venting gas to atmosphere or to low pressure system. Withdrawal wells' deliverability can be kept high by using large tubing.

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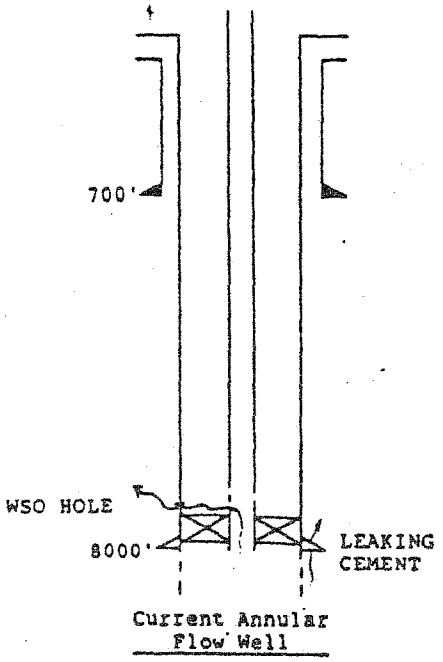
2/9/84

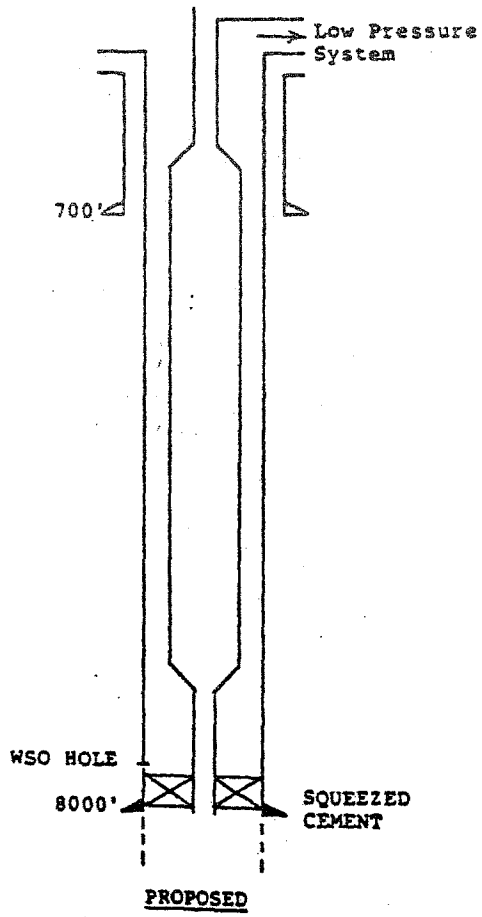
EXHIBIT I
PAGE 1

EXHIBIT I

CASING SHOE LEAKS: TYPE 2



PROBLEM:
Casing shoe leaks due to poor, deteriorated cement or to leakage through WSO holes in active or abandoned wells.



SOLUTION, ACTIVE WELLS:
Squeeze cement into shoe area. Place tubing packer below WSO holes where possible.

ALTERNATE SOLUTION, ACTIVE WELLS:
Do not repair if leak is into 7th zone but no higher. Collect all free gas from the 7th zone by activating more collection wells.

SOLUTION, ABANDONED WELLS:
Collect all free gas from overlying zones. Repair work not possible.

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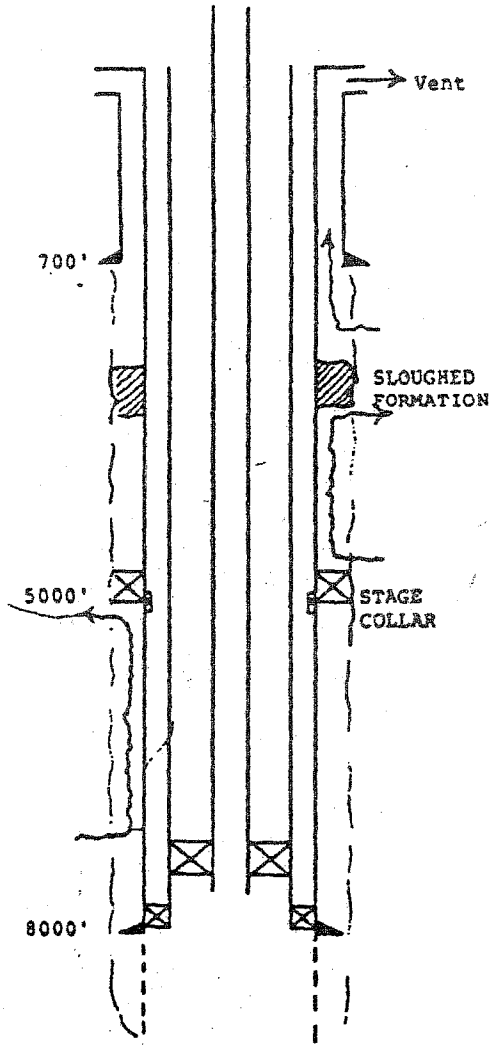
EXHIBIT I

UNCEMENTED WELLBORE LEAKS: TYPE 3



CURRENT AND FUTURE WELL

PROBLEM:
All wells have some uncemented segments. Few wells have any cement above 2000'. Formation sloughing may have filled in some of these wellbores but most remain the most permeable upward path for gas migration.

SOLUTION:
Noise and TDT monitor active wells to find areas of increasing activity. Continually produce shallow zones. Vent to atmosphere all gas coming from surface casing shoe aquifer.

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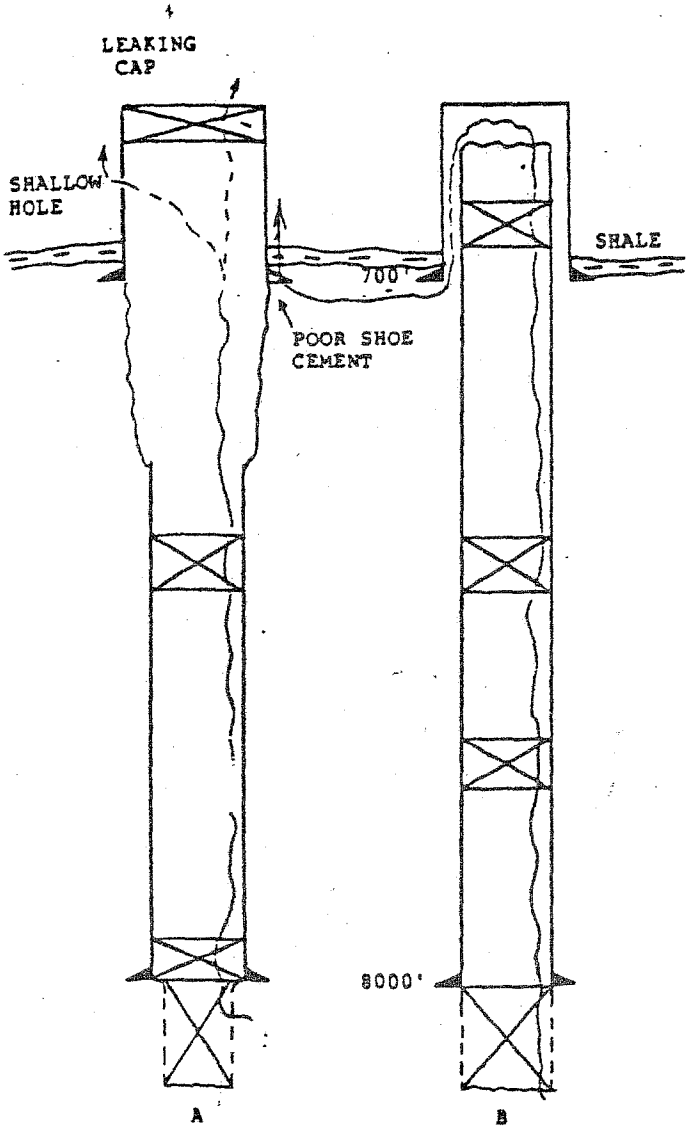
2/9/84

EXHIBIT I

ABANDONMENT PLUG LEAKS: TYPE 4



EXISTING ABANDONED WELL TYPES

PROBLEM, TYPE A ABANDONMENT:
Cement plugs inside casing allow some gas to migrate upwards. Because its casing was cut off below the surface string, water will continue to fill casing as gas leaks out. Leak will therefore be sporadic and low rate.

PROBLEM, TYPE B ABANDONMENT:
Cement plugs inside casing allow some gas to migrate upwards. Because the casing stub is cut off within 100' of surface, the entire surface casing fills with gas. No liquid enters the well. The gas leak unloads fluid from the well and the rate increases with time. Eventually all of the fluid unloads and the leak rate stabilizes at a near constant daily rate.

PROBLEMS, BOTH TYPE ABANDONMENTS:

1. Casing cap, surface casing and casing shoe cement competent. Gas will build up inside surface casing and force its way into shallow aquifer sand. Gas will surface at a non-leaking well that has the following problems.
2. Casing cap not competent. Gas will surface near well.
3. Surface casing or shoe cement not competent. Gas will spread over large area as it rises to surface lethargically.

SOLUTION, PROBLEM 1:
Direct repair of leaking well not possible because source well is unknown. Other wells where gas appears are continually vented to surface.

SOLUTION, PROBLEM 2:
Unearth well and recap or place collection funnel over it. Rig work not required. Vent all gas to atmosphere.

SOLUTION, PROBLEM 3:
Unearth well, move in rig, attempt to enter and repair old casing. Produce gas through casing into low pressure system. Vent surface annulus to atmosphere.

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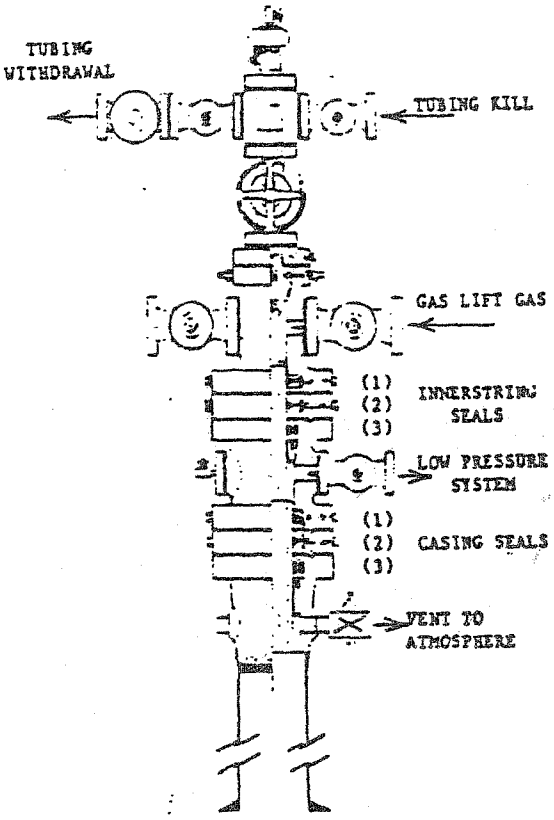
2/9/84

EXHIBIT I

WELLHEAD LEAKS: TYPE 5



CURRENT AND PROPOSED WELLHEAD FOR WELLS WITH INNERSTRINGS

PROBLEM:
Wellhead seal leaks allow high pressure gas to leak into the innerstring, tubing or surface casing annulus. Gas then enters shallow zones at the surface casing shoe or through casing holes.

SOLUTION:
Keep all annular pressures below that required to force gas into shallow zones either by connecting them to low pressure system or venting them to atmosphere. Install new wellheads with triple seals (as illustrated) on wells with obsolete equipment when other well work is performing or when wellhead is leaking badly.

(1) Inject sealant to energize seal in head

(2) Inject sealant to energize seal in sealing flange

(3) Set down weight on slips to energize seal

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2/9/84

EXHIBIT I
Page 5

EXHIBIT 2

CHRONOLOGY OF WELL COMPLETIONS

Operator	*Well No.*	*Date of completion*
Union Oil Co. of California	"King Vidor" 1	May 23, 1931
Union Oil Co. of California	"Del Rey" 4	May 8, 1932
Union Oil Co. of California	"King Vidor" 2	Dec. 4, 1932
Union Oil Co. of California	"King Vidor" 3	May 10, 1933
Union Oil Co. of California	"Del Rey" 5	July 19, 1933
Union Oil Co. of California	"King Vidor" 5	April 17, 1934
Chas. W. Fourl	"Fourl" 1	Nov. 16, 1934
Union Oil Co. of California	"King Vidor" 6	Jan. 24, 1935
Union Oil Co. of California	"King Vidor" 7	Feb. 26, 1935
D. D. Dunlap Oil Co.	"Del Rey" 1	Feb. 26, 1935
McAdams Oil Co.	"Del Rey" 1	Mar. 14, 1935
D. W. Elliott	"Del Rey" 1	Mar. 21, 1935
Union Oil Co. of California	"King Vidor" 8	Mar. 26, 1935
Royalty Service Corp., Ltd.	"Del Rey" 1	Mar. 30, 1935
Pacific Drilling Corp.	"Del Rey" 1	April 20, 1935
Chas. W. Fourl	"Fourl" 3	April 24, 1935
Dunlap Petroleum Co.	1	May 11, 1935
Rite-Lube Oil Co.	"Ray" 1	May 17, 1935
Union Oil Co. of California	"King Vidor" 9	May 19, 1935
Royalty Service Corp., Ltd.	"Pomoc" 1	May 26, 1935
Colly Oil Co.	"Colly" 1	May 31, 1935
Union Oil Co. of California	"King Vidor" 10	June 2, 1935
Red Seal Oil Co., Ltd.	"Big Ben" 1	June 4, 1935
Chas. W. Fourl	"Fourl" 4	June 5, 1935
Coast Petroleum Co.	"Stockburger" 1	June 7, 1935
Thos. Kelly & Laurence C. Kelly	"T. & L." 1	June 13, 1935
Union Oil Co. of California	"Del Rey" 9	June 15, 1935
McAdams Oil Co.	"Del Rey" 2	June 16, 1935
Lor Mar Oil Development Co.	"Lor Mar" 1	June 24, 1935
Colly Oil Co.	"Colly" 2	June 24, 1935
Red Seal Oil Co., Ltd.	"Ben" 2	June 27, 1935
Royalty Service Corp., Ltd.	"Del Rey" 2	July 1, 1935
Embee Oil Co.	"Embee" 1	July 3, 1935
Williams & Harper	"Williams-Harper" 1	July 3, 1935
Royalty Service Corp., Ltd.	"Del Rey" 13-1	July 15, 1935
Union Oil Co. of California	"King Vidor" 11	July 27, 1935
Royalty Service Corp., Ltd.	"Del Rey" 12-1	Aug. 5, 1935
Red Seal Oil Co., Ltd.	"Ben" 3	Aug. 20, 1935
Del Rey Realty Co.	"Herndon Development" 29	Aug. 21, 1935
Union Oil Co. of California	"King Vidor" 12	Sept. 13, 1935
Royalty Service Corp., Ltd.	"Del Rey" 23-1	Sept. 26, 1935
Union Oil Co. of California	"Del Rey" 11	Oct. 18, 1935
Union Oil Co. of California	"King Vidor" 13	Oct. 24, 1935
Birch-Royer Oil Co.	"Hisey-Thrall" 1	Nov. 22, 1935
Otis Hoyt Co.	"Del Rey" 1	Dec. 3, 1935
Union Oil Co. of California	"King Vidor" 14	Jan. 12, 1936
Union Oil Co. of California	"Del Rey" 12	Jan. 27, 1936
G. C. Woodard, Agent	"Milham" 1	Feb. 20, 1936

EXHIBIT 3

APPENDIX A

GAS INVENTORY MONITORING, VERIFICATION, AND REPORTING PROCEDURES

I. GENERAL

Gas Storage Operations require monitoring and inventory verification for safe long-term management of underground gas storage operations. While no single method can be used to precisely monitor and verify the gas inventory in underground storage reservoirs, the three engineering methods in general use are summarized below. Gas volume verification can be obtained only by combining and analyzing available field data. Based on this analysis, gas volume changes or losses are recognized, estimated and reported.

II. DEFINITIONS

When gas storage operations are initiated in an oil or gas reservoir, there is an initial gas content in the reservoir prior to injection. Initial gas content is generally composed of both free gas and solution gas. Additional gas is added to the initial gas content by injection, and the combination comprises the Total Storage Volume. This volume is categorized as follows:

A. Cushion Gas

The base gas is that quantity of gas which must be in the reservoir to maintain the minimum pressure required to exclude fluids from the gas cap and to provide the energy required to deliver the minimum required rate of gas withdrawal at the end of the withdrawal season.

B. Recoverable Cushion Gas

This is defined as the volume of gas that can be economically recovered from the reservoir below the base gas pressure. This volume varies, depending upon economic conditions.

C. Non-Recoverable "Cushion Gas"

This is the volume of gas left in the reservoir after all recoverable gas volumes are removed and is not considered a part of Total Storage Inventory. This gas is capitalized and depreciated over the life of the project.

D. Working Gas

This volume is defined as the gas content which is held in the reservoir between maximum reservoir pressure and the base gas pressure.

E. Effective Working Gas

This volume is defined as the working gas which is withdrawn and re-injected in a complete injection and withdrawal cycle. Ideally, the effective working gas volume is synonymous with the working gas volume. However, limitations by wells, compression facilities, or gas availability may limit effective working gas volume.

F. Total Storage Inventory

This is the sum of all working and recoverable cushion gas volumes.

III. RESPONSIBILITY

The responsibilities for shut-ins, along with analyzing data, verifying gas inventory, and reporting changes or losses are specified in System Instruction 224.0020.

IV. MONITORING

A. Monitoring of the storage reservoir is required to ensure reservoir integrity and field deliverability. The performance review ensures the reservoir functions according to expectations, and integrity tests verify the gas inventory is present and available for delivery. Effective monitoring requires a thorough understanding of the reservoir system. This system is defined as the reservoir rock and wellbores which respond to pressure changes as a result of gas injection and withdrawal. To better understand the system, see System Instruction 224.0035, *Gas Inventory - Summary of Reservoir System.* A successful monitoring program reduces risk of injury, property damage and gas migration.

B. Monitoring of the reservoir system is conducted in both storage and non-storage zone wells and at surface observation points.

1. Storage Zone Wells

a. Performance reviews utilize information collected during individual well and reservoir tests. Back pressure curve shifts, changes in deliverability and field performance are investigated.

b. Tests are conducted on individual wells to prove both well and reservoir integrity.

i. Surface pressures on each well are measured and recorded weekly using a calibrated test gauge. Pressures measured and recorded include tubing pressure, casing pressure, annuli pressures, and, if applicable, safety valve control line pressure. The mode of well operation (injection, withdrawal or shut-in) at the time of pressure measurement is also recorded. Note that the *C.D.O.G.G.R. (California Division Of Oil Gas and Geothermal Resources)* requires a monthly average casing and tubing pressure recorded and submitted as part of the monthly production report.

ii. A plot of the weekly surface casing and the innerstring annuli pressures versus time is maintained or periodically produced for each well. Hardcopy plots are created, marked and filed when an abnormal pressure is

encountered. A pressure is considered abnormal when it may be large enough to force gas into a normally pressured water sand, either at the surface casing shoe or through any other known casing holes or leak-paths.

iii. When abnormally high annular pressures are detected, diagnostic steps are taken to determine the source of pressure build up. This includes tests to eliminate surface valves and downhole tubing as possible sources of leakage. Zero pressure is abnormal in a well that has had a history of annular pressure and is investigated for the possibility of a closed valve.

iv. All wells with continuing zero pressure readings are checked quarterly for closed valves and noted on the pressure plot. Blowdowns are also noted when they occur.

v. Wellhead inspections are performed on a monthly basis. Any leaks from wellhead flanges and valves are reported and corrected.

vi. Subsurface temperature surveys are conducted on each well in according to the following schedule: semi-annually in La Goleta, Montebello, and Playa del Rey storage fields and annually in the Aliso Canyon, and Honor Rancho Storage fields.

vii. Surveys are done in accordance with System Instruction 224.0025, *Standardized Subsurface Temperature and Pressure Surveys*. Wells that have been killed are not exempt from this requirement and must be surveyed according to the schedule. Results of surveys are reported according to Recommended Method 224.001, *Standardized Daily Well Operations Report.*

viii. Additional surveys will be run without regard to this schedule at the first indication of unusual or abnormal well conditions, i.e., anomalous pressure, surface gas emissions or other indications of well problems.

ix. Wireline retrievable tubing obstructions such as tubing plugs, subsurface safety valves, subsurface chokes or tubing stops are removed once each year to perform a temperature survey of the casing shoe and cap rock seal. Ideally, this is done at high reservoir pressure when shoe leaks are most noticeable on temperature surveys.

Under certain conditions it may not be possible or advisable to remove the wireline retrievable obstruction.

x. Subsurface surveys using wireline conductor cable equipment are made to investigate anomalies discovered by temperature surveys.

xi. Conductor cable surveys include temperature surveys, noise logs, spinner surveys, and radioactive tracer surveys.

xii. In the case of well casing leaks above the shoe, radioactive tracer surveys are typically used to verify the location of gas movement through the leak. In the case of shoe or cap rock leaks, these additional surveys are used to verify that a leak exists and as an aid to qualitatively estimate leakage rate.

c. Reservoir integrity tests include:

i. Gas cap observation wells are used to monitor reservoir pressure. If possible one or more wells completed in the gas cap are selected for observation purposes. These wells are not used for injection and are put on withdrawal only for peak load conditions. Surface pressure measurements on the tubing and casing of each gas cap observation well are made and recorded weekly.

ii. A plot of these pressures versus inventory is kept in the office of the Storage Field Engineer and is updated weekly. Anomalous well pressures or behavior are reported to Storage Engineering Staff.

iii. Reservoir shut-ins are generally on a schedule stated in System Instruction 224.0020 or when determined as necessary by the Storage Field Engineer. The

2. Non-storage Zone Wells

a. Non-storage zone wells monitored include both Company wells and wells owned by others in overlying and underlying zones and in other fields within two miles of the storage reservoir boundary, where applicable. These wells are categorized as follows:

i. Pressure observation wells are located in overlying and underlying permeable formations, or adjacent to the storage reservoir but across assumed confining boundaries, such as faults, permeability pinchouts, below the gas-liquid contact or beyond the spill point of the storage zone's confining structure. Although normally static, these wells may have artificial lift mechanisms for removal of gas and fluids.

ii. Gas collection wells are located where known gas migration from the storage zone is intercepted and collected. These wells are normally equipped with operating artificial lift mechanisms so that both liquids and gas can be produced, causing a pressure sink in the reservoir near the wellbore.

iii. In some fields, shallow water observation wells have been drilled into aquifer zones existing in the first permeable sand above the shoe of the surface casing. These wells are closed in at the surface and gas concentrations in the wellbore are measured weekly.

iv. If gas loss is expected, performance reviews of wells operated by other producers in either overlying zones or in adjacent fields may be made by reviewing production reports from these operators.

v. Performance of Company-owned observation and collection wells are also closely monitored. Wellhead inspections and temperature surveys are performed on the pressure observation wells and the gas collection wells.

vi. Pressure observation wells

a. Surface pressures on all tubing and casing strings are measured weekly using a calibrated test gauge.

b. A plot of pressure versus time for each well is kept by the Storage Field Engineer. Bottom-

hole pressure surveys are run as needed on pressure observation wells.

c. If a substantial increase in reservoir pressure is noted or a significant gas buildup occurs, an attempt is made to produce the well. Produced gas is sampled and analyzed for both hydrocarbon and helium content.

vii. Gas collection wells

a. Surface pressures on all casing strings and safety valve control lines are measured weekly using a calibrated test-gauge. The mode of well operation (producing, shut-in) at the time of pressure measurement is also recorded.

b. A plot of pressure vs. time for each surface casing and innerstring annulus is kept by the Storage Field Engineer.

c. Bottom-hole pressure surveys are run on gas collection wells as needed. These surveys follow a shut-in period to allow pressure stabilization after production. If the well is equipped with a standing valve, the valve is pulled prior to the bottom-hole pressure survey and is reinstalled upon completion of the survey.

d. Production schedules are developed by the Storage Field Engineer. The Storage Field Engineer maintains plots of bottomhole pressure versus time and records of produced gas, oil and water.

viii. Shallow water observation wells

a. Shallow water observation wells are closed-in at the surface and gas concentrations in the wellbore measured periodically.

ix. Surface Observations

a. Active well cellar areas are inspected by station personnel each month for indications of near surface gas migration. The Storage Field Engineer requests the analysis if needed and reviews and maintains records of the results.

b. Region personnel survey the location perimeter of four permanent bar holes near all active wells with a gas scope or flame ionization unit. The surveys are performed monthly at Montebello, quarterly at La Goleta, and semi-annually at Aliso Canyon, East Whittier, Honor Rancho and Playa del Rey.

c. The areas in the vicinity of abandoned wells are examined with a flame ionization unit to detect any near surface gas migration under the direction of the Storage Operations Manager. Surveys are performed semi-annually at Montebello, and annually at Aliso Canyon, East Whittier, Honor Rancho, La Goleta and Playa del Rey.

d. Flame ionization surveys to detect any near surface gas migration are performed on all storage field pipelines under the direction of the Storage Operations Manager. These surveys are performed annually at La Goleta, Montebello, and Playa del Rey and every two years at Aliso Canyon, East Whittier and Honor Rancho.

V. BOTTOM-HOLE PRESSURE DETERMINATION

A. Each of the three major methods used to verify gas storage inventory, as explained in Section V, requires the determination of bottom-hole pressures in the field wells. The method used to determine bottom-hole pressure must be consistent from year to year. The most accurate method to determine bottom-hole pressure is to measure the pressure with a pressure bomb. In certain applications the bottom-hole pressure can be calculated from the shut-in wellhead pressure. For wells completed in the gas cap and having full gas columns, the bottom-hole pressure is calculated from the equation:

$$P_{BHP} = P_{WH} \exp\left(\frac{0.01875 \times SG \times D}{Z_{avg} T_{avg}}\right)$$

Where:

P_{BHP} = Bottom-hole pressure, psia.

P_{WH} = Wellhead pressure, psia.

SG = Gas specific gravity.

D = True vertical depth in feet.

T_{avg} = Average wellbore temperature between surface and bottom-hole, degrees Rankin.

Z_{avg} = Average gas compressibility factor from charts, tables or computer programs (dependent on P_{avg}, T_{avg} and gas gravity).

P_{avg} = Average pressure between surface and bottom-hole, psia or

$$P_{avg} = (P_{BHP} + P_{WH})/2$$

NOTE: The above equation could yield incorrect results if the well exhibits abnormally high surface pressure or high fluid levels.

VI. INVENTORY VERIFICATION – SHUT IN

A. Three primary methods for inventory verification of Gas Storage Fields are referenced and summarized below:

1. Calculation of gas content based on volumetric data and average reservoir pressure; Volumetric Determination is explained in Applied Petroleum Reservoir Engineering; by Craft, B. C. and Hawkins, M. F.; Englewood Cliffs, N.J.: Prentice- Hall, 1959.

2. Calculation of effective gas content using the simple gas material balance, hysteresis curve, and P/Z curve methods; Material Balance is explained in Natural Gas Engineering by Ikoku, C. V.; Tulsa, Oklahoma: Penn Well Publishing, 1980.

3. Verification of storage inventory by comparing measured reservoir pressures with calculated pressures obtained using the single cell material balance or reservoir simulation methods; Numerical Simulation or Reservoir Modeling is explained in *Modern Reservoir Engineering —A Simulation Approach* by *Crichlow, H. B.*; Englewood Cliffs, N.J.: Prentice- Hall, 1977 and the *Intercomp Beta II User Manual.*

B. The most common inventory verification method used in mature gas storage projects that are known to have effective geologic closure is the hysteresis curve or P/Z versus inventory plot. Typically, it is adjusted annually for known gas losses and liquid production. Any shift between points plotted at similar pressures following a shut-in is further investigated.

1. Tracking known gas losses and transfers as they occur assist with inventory verification.

2. Recommended Shut-in time durations for effective reservoir stabilization are listed below

   - Aliso Canyon -14 days
   - Honor Rancho -12 days
   - Goleta- 5 days
   - Montebello -12 days

C. Data collected during a shut-in period includes accurate measurements of reservoir pressure on each available well. Bottom-hole pressures can be calculated from surface pressures or measured directly. Gas gravity is determined using gas samples from individual, representative wells.

D. The Storage Field Engineer chooses the type and frequency of data to be collected during shut-ins.

E. Calculation of gas content based on volumetric data and average reservoir pressure from shut-in.

1. Average reservoir pressures used in this calculation are obtained during shut-in periods required for reservoir pressure stabilization. Reservoir pore volumes available for gas storage are calculated from either geologic information, material balances using production and pressure information obtained during primary field production, or in some cases from pressure and production data obtained during gas storage operations. Elements of these calculations are described below:

2. Average reservoir pressures are calculated in an appropriate way for each storage reservoir. To be reliable, the method for each field should stay consistent for all years. Various methods of calculation include the following:

   a. The average reservoir pressure for Honor Rancho, La Goleta, and Playa del Rey are determined by calculating the arithmetic average of the bottom-hole pressure in the gas cap wells. In these fields the pressure of each well is measured or computed at a specified subsea datum approximately at the midpoint of the zone. The datum and reservoir temperature used for these fields are as follows:

      i. Honor Rancho - 8,300 feet subsea, 190°F

      ii. La Goleta - 4,200 feet subsea, 150°F

      iii. Playa del Rey - 6,100 feet subsea, 210°F

iv. Montebello: An average reservoir pressure is obtained. The pressure points for the average reservoir pressure are generated by converting the bottom-hole pressure to a datum at the top of the 8-2 zone using a reservoir temperature of 187°F.

v. A volumetrically weighted average reservoir pressure is used for Aliso Canyon. The pressures in this field is computed at a specified subsea depth approximately at the midpoint of the zone. The datum depth for this field and the reservoir temperature is as follows:

a. Aliso Canyon - 5,400 feet subsea, 180°F

3. Reservoir pore volume calculated from geologic information utilizes data obtained during the drilling and completion of the well such as electric logs or core information to calculate the total pore volume of the reservoir. These calculations are based on the following equations:

a. Gas reservoirs

i. Equation: $V = Ah\phi (1-S_w)$

Where:

V = Reservoir gas pore volume in cubic feet

A = Gas zone area in square feet

h = Average gas zone thickness in feet determined from electric logs or cores

ϕ = Porosity fraction determined from porosity logs or well test analysis

S_w = Water saturation from log, core, or well test analysis

b. Oil reservoirs

i. Equation: $V = Ah\phi(1-S_w) + A_1h_1\phi (1-2_w-s_o)$

Where:

A = Primary gas cap area in square feet

A_1 = Secondary gas cap area in square feet

h_1 = Average secondary gas zone thickness in feet

s_o = Residual oil saturation

ii. In most portions of an oil zone storage reservoir, oil saturation is determined from core analysis or can be considered equivalent to residual oil saturation and can be estimated from the 16" normal resistivity curve using the following relationships.

Equation: Residual oil saturation = $(1-s_{xo})$

$$s_{xo} = \sqrt{\frac{Rmf}{R_{xo}\phi 2}}$$

Where:

R_{xo} = Resistivity of 16" normal or resistivity of flushed zone.

S_{xo} = Water saturation of mud filtrate within the flushed zone.

ϕ = Porosity

Rmf = Resistivity of mud filtrate.

4. Gas Reservoir pore volume calculated using material balance equations:

These calculations utilize production and pressure data in the following equations:

a. Equation for constant volume gas reservoirs using primary production:

$$V = \frac{P_{SC} G_P T}{T_{SC}} \left(\frac{1}{P_i / Z_i - P_f / Z_F} \right)$$

Where water production and influx are assumed negligible and where:

V = Gas pore volume in reservoir cubic feet.

P_{sc} = 14.7 psia

G_p = Gas produced in standard cubic feet.

T = Reservoir temperature in degrees Rankin (°R).

R_{sc} = 520°R

P_i = Initial pressure, psia.

P_f = Final pressure, psia.

Z_i = Initial gas compressibility factor.

Z_f = Final gas compressibility factor.

b. Equation for constant volume gas reservoirs using storage production

$$V = \frac{P_{SC} G_P T}{T_{SP}} \left(\frac{1}{P_1 / Z_1 - P_2 / Z_2} \right)$$

Where water production and influx are assumed negligible

G_p = SCF of gas produced or injected between pressure points P1 and P2.

P_1 and P_2 = The first and second stabilized average reservoir pressures bounding the production or injection period considered.

Z_1 and Z_2 = Gas compressibility factors for P1 and P2.

T = Reservoir temperature in degrees Rankin

5. Oil reservoirs pore volume calculations

a. Equation: The 'Reservoir Gas Pore Volume' is equal to the 'Original Gas Cap Pore Volume' plus the 'Secondary Gas Cap Pore Volume' plus the 'Space created by Water Production'.

Or:

$$V = GB_{gi} = \left(NB_{oi} - \left(N - N_p \right) B_o \right) + W_p B_w$$

Where:

G = Original gas pore volume, standard cubic feet (determined from either geologic data or an appropriate form of the material balance equation).

B_{gi} = Gas formation volume factor in reservoir cubic feet per standard cubic feet at discovery pressure.

N = Initial oil in place in stock tank barrels (determined from either geologic data or an appropriated form of the material balance equation).

N_p = Cumulative oil production in stock tank barrels.

B_{oi} = Oil formation volume factor in reservoir cubic feet per stock tank barrel at discovery pressure.

Bo = Oil formation volume factor at existing pressure in reservoir cubic feet per stock tank barrel.

W_p = Water production in stock tank barrels.

B_w = Water formation volume factor, reservoir cubic feet per stock tank barrel (approximates 5.615).

b. Simplifying assumptions used in the above equation are that no storage gas goes into solution in the oil and that there is no water influx into the storage reservoir. These simplifying assumptions are seldom true. However, the equation can be modified based on a judgment of the volume of gas which may go into solution in the reservoir oil and a judgment of aquifer activity surrounding the storage reservoir. When modified by these judgment factors, the equation provides a method for approximating a limit for the reservoir gas pore volume available for storage operations. An upper limit is established when it is assumed that all the residual oil is resaturated with gas. Generally, only a fraction of the oil becomes saturated and so the calculation has little usage beyond setting limits.

c. The values of G and N are not generally expected to be obtained with an accuracy greater than + 20%. However, this is not a major drawback since the methods are used to establish guidelines and set limits.

6. Calculation of gas content.

a. After the gas pore volume has been calculated, or approximated, by one of the methods indicated above, the gas content at the measured reservoir pressure is determined using the gas law as follows:

PV = ZNRT

Where:

P = Average reservoir pressure, psia

V = Gas pore volume in reservoir cubic feet

T = Temperature of reservoir, (°F + 460) degrees Rankin

Z = Compressibility factor, dependent on P, T, and gas gravity, from charts or tables.

N = pound moles (where one pound mole = 379.41 cubic feet @ 60°F and 14.7 psia).

R = 10.735 universal gas constant for above units.

Solving for gas content;

$$Volume(mscf) = \frac{(0.03533)PV}{ZT}$$

PV = ZNRT

Where:

P = Average reservoir pressure, psia

V = Gas pore volume in reservoir cubic feet

T = Temperature of reservoir, (°F + 460) degrees Rankin

Z = Compressibility factor, dependent on P, T, and gas gravity, from charts or tables.

N = pound moles (where one pound mole = 379.41 cubic feet @ 60°F and 14.7 psia).

R = 10.735 universal gas constant for above units.

Solving for gas content;

$$Volume(mscf) = \frac{(0.03533)PV}{ZT}$$

F. Calculation of effective gas content using the simple gas material balance and hysteresis curve(P/Z curve) methods

1. Pressure changes with rapid gas injection or withdrawal during selected operating periods can show the relationship between effective gas content and the storage inventory. Effective gas content is the gas which, within a given time, causes a measurable pressure response to injection or withdrawal operations. Not all gas in the reservoir yields such a response within the given time interval. The difference between

effective gas content at a given pressure (P_1) and the metered inventory is non-effective gas. Part of this non-effective gas can be due to the lack of pressure equilibrium within the reservoir. Any gas migration out of the storage reservoir also contributes to the non-effective gas. Either one of the two equations, or the graphical solutions presented below are used to calculate the effective gas content.

a. Calculations with negligible water movement are made using the following equation:

$$\text{Effective Gas Content at P1, Q1} = \left(\frac{\Delta Q}{\frac{P_1}{Z_1} - \frac{P_2}{Z_2}} \right) \left(\frac{P_1}{Z_1} \right)$$

Where:

P_1 = Pressure at the first operational point considered.

P_2 = Pressure at the second operational point considered.

Q_1 = Net storage volume at the first operational point considered.

ΔQ = The net change in gas inventory between the two operational points considered.

b. Calculations with significant water movement of a known rate are made using the following equations:

$$Q_1 = \left(\Delta Q - \left(We \times \frac{P_2}{14.7} \times \frac{520}{T_R} \times \frac{1}{Z_R} \right) \right) \frac{\frac{P_1}{Z_1}}{\left(\frac{P_1}{Z_1} - \frac{P_2}{Z_2} \right)}$$

Where terms are defined as above, and where:

We = Water influx in cubic feet.

T_R = Reservoir temperature, degrees Rankin.

Z_R = Z at T_R and P_2.

G. Graphical solutions

1. The hysteresis curve is a plot of reservoir pressure versus storage inventory. This curve utilizes the compressibility factor of non-ideal gas.

It is most effective in a constant volume reservoir since it assumes no water movement into or away from the storage reservoir; and no movement of gas into or out of solution in the reservoir oil. Actually, after sufficient storage history, the hysteresis curve becomes a qualitative tool for inventory verification since with constant operating procedures and a relatively constant storage cycling volume, aquifer movement and movement of gas into and out of solution is relatively constant and effectively drops from the equation.

VII. REPORTING GAS INVENTORY LOSSES

A. Calculated operational losses

1. Gas losses due to compressor, piping system or well blowdowns and wireline surveys are calculated by Storage Field personnel and reported to Measurement monthly. These reports are review by the Storage Field Engineer.

2. Estimates of losses related to workovers and well blowdowns are prepared by the Storage Field Engineer after a well has been killed. These estimated losses are reported monthly to Gas Measurement.

B. Losses from known well and surface facility leaks

1. Some small losses from valves, compressors, field piping, threaded well casing connections and well casing mechanical devices such as cementing stage collars, and some small casing leaks are inherent to Storage Field Operations. These leaks are estimated and reported as follows:

   a. Minor surface facility leakage is surveyed in each storage field periodically. Leakage surveys include wellhead valves and fittings, instrumentation, well piping, field piping, surface production facilities and the compressor station. Surveys are made more frequently if facility modifications are made which might change leakage rates.

   b. During these surveys, measurements are obtained on representative minor atmospheric leaks and then extrapolated to an estimated annual leakage rate for the field.

2. Subsurface leakage from wells is estimated by the Storage Field Engineer and reported to Storage Engineering Staff.

   a. Leakage from well casings is estimated by establishing a leakage rate using the radioactive tracer survey. The number of days of leakage is estimated by using subsurface temperature survey data. Casing shoe or Water Shut-Off (WSO) leakage is estimated by reviewing temperature, noise and radioactive tracer

surveys, pressure draw-down and the overlying wells' gas production during the time of the leak.

b. In cases where leakage rates are not quantifiable, an average rate of 30 Mcf/d may be used. Engineering judgment is then applied and an average daily loss rate selected. The number of days the leak was occurring is determined by taking one-half the difference in the number of days between the last normal and the first abnormal temperature survey.

3. Surface facility leakage and subsurface leakage are quantified annually by the Storage Field Engineer who reports the results to the Storage Engineering Manager and Gas Management.

C. Reservoir losses

1. Reservoir losses are categorized as those associated with Company-operated wells completed in the storage reservoir and general reservoir losses.

a. Losses associated with the Company-operated wells include losses through failures in the cement between the cap rock and well casing. These losses are also known as "shoe leaks," "WSO" leaks and "stage collar" leaks.

b. General reservoir losses include losses through abandoned wells or breakdown of some portion of the trapping mechanism. This type of loss is not directly detected by surveys of Company-operated wells in the storage zone.

c. Quantification of reservoir losses utilizes industry accepted methods of inventory verification.

2. Reservoir losses are quantified annually by the Storage Field Engineer who reports results to the Storage Engineering Manager and Gas Measurement.

■

PC DOCS FCD PROFILE SUMMARY	
Document Number:	**224.070**
Document Title:	Gas Inventory - Monotoring, Verification and Reporting
Document Category:	Recommended Method
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If Merged, Merged to:	
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Current Version Issued:	2/5/1999
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Company:	Southern California Gas Company
Business Unit:	SCG Energy Transportation Services
Business Organization:	Transmission & Storage Operations
Department:	Storage
Department Organization:	Storage Engineering
Organization Team:	None
Contact Person/Writer:	Dan Neville
Referenced Documents:	224.0020; 224.0035; 224.0025; 224.001
Related Documents:	
Part of O&M Plan:	No
Compliance Required by:	
Mandated by:	
CPUC Review Required:	No
Legal Review Required:	No

Author's Brief/Summary of Changes:

This FCD was revised by the Storage Engineer Peer Team. The title of the FCD was changed to Gas Inventory - Monitoring, Verification, and Reporting. It was merged with FCD 224.0045 and FCD 224.020 and changed to a Recommended Method.

Circulation Code	Filing Instructions
TRAN	File numerically in Volume II, behind Underground Storage Tab.

SPE Paper

83504

Environmental Hazards Posed By The Los Angeles Basin Urban Oilfields: An Historical Perspective Of Lessons Learned

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School of Engineering, University of Southern California



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Pacific Section
American Association of Petroleum Geologists

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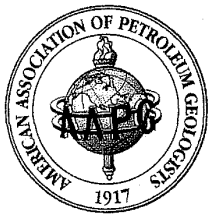

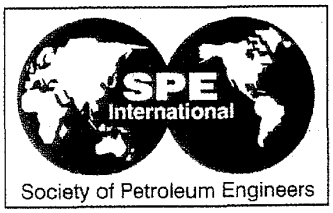

Environmental Hazards Posed By The Los Angeles Basin Urban Oilfields: An Historical Perspective Of Lessons Learned

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Abstract

Urban encroachment into areas historically reserved for oil and gas field operations is an ever-present problem within the Los Angeles basin. The recent frenzy in real estate development has only intensified what can be characterized as a conflict in land usage. Subsurface mineral rights are severed from surface ownership, often resulting in developments being approved without adequate consideration of the underlying oil and gas field consequences. Also, surface operations are frequently co-located within residential areas without consideration of the health and safety consequences of emissions of toxics to air.

This paper presents a review of the environmental, health and safety hazards posed by urban oilfield operations, with an emphasis upon the lessons learned from the "L.A. Basin: Original Urban Oilfield Legend." The Los Angeles basin has provided the authors with one of the largest natural laboratories in the world for studying the consequences of these issues. The results presented are part of a long-term research program based upon the application of geoscience and petroleum engineering principles in obtaining a fundamental understanding of the root causes of the environmental hazards posed. Topics addressed include: (1) vertical migration of gas to the surface along faults and improperly completed or abandoned wellbores (e.g., due to poor cementing practices), (2) subsidence caused by fluid production and declining reservoir pressures, (3) soil and groundwater contamination resulting from historic oil and gas field operations, and (4) air toxics resulting from surface operations.

A number of case histories are discussed that illustrate the seriousness of the problem. A clear case is made for the *urgent* need for closer coordination and education by the petroleum industry of the local government planning departments. These departments have the principal role in determining land use policies, acting as the lead agency in performing environmental site assessments (e.g., under the California Environmental Quality Act), and in establishing mitigation measures for dealing with the long-term environmental hazards. This paper establishes prudent practices on the part of oilfield operators for the monitoring and mitigation of these hazards.

Introduction

The primary purpose of this paper is to systematically review a long history of environmental problems that were created by placing intense urban development in the pathway of areas historically reserved for oil and gas production within the Los Angeles basin. It was during this time that environmental laws were in a state of evolution and the geotechnical impacts of the oilfield operations were not well understood by the land developers. This paper provides a detailed insight into these environmental hazards, along with lessons learned in what mitigation and monitoring methods must be employed in order to prevent repeat disasters. Finally, these findings are related to what must be done to carry out prudent oilfield operations in an urban setting.

Four aspects of environmental hazards posed by oilfield operations within the Los Angeles basin are addressed:

1) Upward migration of oilfield gases into the near surface urban environment, largely along faults and improperly completed or abandoned wellbores.
2) Subsidence caused by fluid withdrawal and declining reservoir pressures.
3) The release of air toxics from surface operations, wellheads and pipelines.
4) Soil and groundwater contamination from fluid production and storage tank leaks.

The environmental impacts are regional in nature and require careful planning by governmental agencies, including land planners, to address the full extent of the environmental impacts. Most cities have no expertise in addressing these oilfield environmental hazards, but are routinely granting building permits for development over and adjacent to oilfield operations. For example, the city is usually designated as the lead agency in performing the environmental reviews mandated by the California Environmental Quality Act (CEQA). However, without adequate knowledge of the oilfield environmental hazards, urban developments are approved without protections taken against the risks.

Gas Migration in Oilfield Settings. The Los Angeles basin has been plagued with numerous oilfield gas seeps that continue to present serious explosion and health risks to the residents. Oilfield gases have a propensity to migrate to the surface along faults and poorly completed and/or abandoned wellbores. Furthermore, the upward migrating gases will accumulate in near surface collector zones, often trapped and concealed within permeable gravel and sand lenses.

The lower explosive limit (LEL) of the oilfield gases (composed primarily of methane) is approximately 5% by volume when mixed with 95% by volume of air. This translates into a serious explosion and fire hazard, especially where the gas is capable of migrating into a confined space such as a room or an electrical vault. In the Los Angeles basin many homes and commercial structures have been constructed directly over old oil wells that have not been properly sealed, and no mitigation measures have been taken to seal out the seeping gases.

The March 24, 1985 Ross Department Store Explosion. The first clear recognition of a very serious problem with oilfield gases migrating to the surface and causing an explosion hazard was the March 24, 1985 incident in the Fairfax area of Los Angeles which demolished the Ross Department Store and injured over 23 people (Cobarrubias, 1985). Escaping oilfield gases burned for days through cracks in the sidewalks and within the parking lot surrounding the store located at 3rd Street and Ogden Drive, directly across the street from the Farmer's Market. Also, large quantities of gas were detected migrating to the surface under the Hancock Park Elementary School located on Fairfax Street near 3rd Street.

Near-surface soil gas studies revealed that the highest concentrations of gases were aligned in an elliptical pattern with the semi-major axis having an exact alignment with the Metropolitan Number 5 Slant Well operated from a nearby drilling island. A review of production records revealed that this well consistently produced the largest gas volumes of any operational well from the underlying Salt Lake Oilfield. Eventually, well records were obtained that revealed that the well casing had developed leaks as a result of corrosion holes located at a depth beginning at approximately 1200 feet, and extending deeper (Endres, 1991; Khilyuk et al., 2000).

Gas pathways to the surface included the 3rd Street Fault (see Figure 1), that surfaced at the Ross Store location, and an old abandoned vertical well identified on the Division of Oil and Gas map for the area as Well Number 99. A vent well drilled into the parking lot of the Ross Store discovered a large pocket (collector zone) of trapped oilfield gas at a depth of approximately fifty (50) feet (see Figure 2). This collector zone had sufficient porosity and permeability to serve as a temporary trapping mechanism for the large quantities of upward migrating gases from the leaking wells to build to pressures of approximately 25 pounds per square inch of pressure. A clay layer served as a trapping mechanism until its threshold pressure was exceeded. Permanent soil gas probes were installed to a depth of approximately fifteen (15) feet in order to perform ongoing monitoring of the upward migrating gases (see Figure 3).

Detailed gas fingerprinting, primarily utilizing isotopic gas characterization, was instrumental in providing 100% scientific proof (see Figure 4) that the explosion and fire was caused by the underlying Salt Lake Oilfield operations (Schoell et al., 1993). Also, further investigation revealed that the gas seeps at the nearby La Brea Tar Pits result from upward migration of oilfield gases from the Salt Lake Oilfield along the 6th Street Fault (Jenden, 1985). The 6th Street Fault slopes downward to the north and intercepts the oilfield reservoir at the location of the Metropolitan Number 5 Production Zone (viz., a very prolific gas zone). Gas fingerprinting has confirmed that the gas seeps at the La Brea Tar Pits match the leaking gases that caused the Ross Department Store explosion (Jenden, 1985).

The City of Los Angeles Methane Ordinance. Following the Fairfax explosion and fires in 1985, the City of Los Angeles adopted a methane ordinance that was incorporated into the City of Los Angeles Building Code, Chapter 15, titled "Methane Seepage District Regulations." The stated purpose is for control of methane intrusion emanating from petroliferous formations. These regulations apply largely to new construction, the boundaries of which are defined in the code, but are coincident with the boundaries of the Salt Lake Oilfield.

Existing commercial structures, including the Hancock Park Elementary School, were required to install gas detectors. These requirements for gas detection in existing buildings, however, were limited to the commercial buildings in the immediate vicinity of the Third Street and Ogden explosion site. Additionally, these commercial establishments were required to share the weekly monitoring expenses associated with the permanent soil gas probes that are depicted in Figure 3. Unfortunately, the Anthony No. 1 gas well (see Figures 2 and 3), that was installed to vent gas from the underlying formation, became plugged in the 1989 time period. Namely, the weekly monitoring of the soil probes failed to provide advanced warning of a near disaster on February 7, 1989.

The Near Disaster of February 7, 1989. On the morning of February 7, 1989, a pedestrian who was walking by the Gilmore Bank building, located on the north side of Third Street and across the street from the 1985 explosion site, observed gas bubbling through the ground in a planter box. The Fire Department was called, which led to the discovery of area wide gas seeps emerging from below the sidewalks and streets, a near repeat of the 1985 incident, but without an explosion.

It was discovered that the Anthony vent well had become silted and plugged at the perforated intervals of the permeable sand zone depicted in Figure 2. This condition was aggravated by the ground water conditions existing at the depth of the vent well.

The response team soon recognized similarities to the 1985 explosion and fires, and the area was immediately cordoned off to prevent ignition and explosion of the gas. In the wake of this near disaster, the City of Los Angeles undertook a second task force study. Unfortunately, even in the presence of overwhelming scientific evidence that the gas accumulations were the direct result of ongoing oil and gas production, and leaking oil wells (see Figure 1), the City of Los Angeles has stood steadfast on the theory that the most

probable source of the methane gas was not an oil well, but rather decomposing organic matter near the surface.

The State Department of Conservation, Division of Oil, Gas, and Geothermal Resources (DOGGR) has also stood steadfast on the proposition that the gas did not originate from the underlying Salt Lake Oilfield, or from leaking wells. Unfortunately, for public safety, this is contradicted by their own well records that clearly demonstrate that the Metropolitan No. 5 well (see Figure 1) had developed serious corrosion leaks within the well casing. These leaks were ongoing, and caused large quantities of oilfield gases to leak into secondary collector zones below both the explosion site and under the Hancock Park Elementary School.

Extensive scientific testing has confirmed that the migrating gases contain methane, ethane, propane, butane and trace elements that could only have an oilfield origin. Accordingly, it is scientifically impossible for these gases to have originated from decomposing organic matter near the surface. Neither the City nor the State has been willing to reconcile their claims with the scientific data substantiated by the top gas fingerprinting experts in the world (Schoell et al., 1993; Jenden, 1985). Figure 4 shows the match between the field production gases and the gas from seeps at the surface.

There is an increased risk of a similar incident occurring somewhere else within our approximately 70 oilfields within the Los Angeles basin. The most important lesson to be learned from the Fairfax explosion is the need to carefully evaluate the integrity of the many old oil wells in the Los Angeles basin that can serve as the primary source and/or the pathways for the oilfield gases to migrate to the surface. The authors have confirmed this enormous hazard by evaluating hundreds of documented well leaks, and identifying the causes of the leaks. Virtually all well leaks can be traced to poor well completion and/or abandonment procedures (e.g., poor cementing practices).

The Well Leakage Problem as an Environmental Hazard. Wells that were drilled and completed many years ago are subject to ongoing corrosion and deterioration of both the steel casings and the cementing operations.

Gas intrusion into cemented wellbores and the resultant leakage to the surface and porous formations below the wellhead have been persistent problems in the oil and gas industry for many years (Marlow, 1989). Pressure and temperature cycling on the cement bonding characteristics, an acute problem in the gas storage industry, can give rise to shoe leaks and loss of bonding in the annular cement. To help quantify the annular leakage problem in gas storage wells, a survey was prepared and sent to the members of the American Gas Associations Pipeline Research and Storage Reservoir Supervisory Committees. The survey attempted to determine the magnitude of the annular leakage problem.

Tests showed that even when the most up-to-date cement types and techniques are used, leakage can and will occur in a significant number of cases (Marlow, 1989 at pp 1147, 1148). For example, in a study of 250 casing jobs over a 15-month period with new compressible cements, 15% of the wells leaked (Watters et al., 1980). Accordingly, the poor cementing and completion practices, typical of the many old wells located in the Los Angeles basin, are giving rise to very serious environmental problems associated with gas leakage to the surface in the annular space, as discussed herein.

Numerous fields have accumulations of hydrogen sulfide that will eventually destroy the integrity of both the steel and cement relied upon to provide protection against gas migration, including abandonments performed to the current standards of the DOGGR. The corrosive conditions of hydrogen sulfide are well known, and have defied engineering solutions (Craig, 1993).

Ongoing seismic activity in the Los Angeles basin is also a major factor in contributing to a well integrity problem. For example, the 1971 Sylmar earthquake was responsible for causing well blowouts in the Fairfax (Salt Lake oilfield) area (Khilyuk, et al., 2000).

Wilshire and Curson Gas Seep. A very serious gas seep at the intersection of Wilshire and Curson (directly across the street, and south of the La Brea Tar Pits) was discovered in 1999. This required the City of Los Angeles to install a vent pipe on the south-west corner of this intersection in order to direct the oilfield gases into the air above the adjoining three story commercial building. The odors from the air toxics emitted from the vent pipe are noticeable throughout the area.

The commercial office building to the immediate east of this seep location was experiencing gas migration through the foundation and into the building. A ventilation system is operated 24 hours per day within the subterranean parking structure of that building in order to mitigate against the risk of an explosion.

Historical records of the area, reviewed by the authors herein, revealed that an old abandoned well had been drilled near the location of the seep. However, the high-density commercial development in the area has prevented finding the well.

South Salt Lake Oilfield Gas Seeps From Gas Injection. In January 2003, serious gas leakage problems were discovered in the South Salt Lake Oilfield, located in a residential area near the Fairfax area (viz., in the vicinity of Allendele and Olympic Boulevard). The oilfield operator had been injecting natural gas into the South Salt Lake Oilfield for approximately two years, under elevated pressures for enhanced oilfield recovery purposes. However, gas began leaking to the surface along abandoned and poorly completed wellbores. In fact, the Division of Oil and Gas records reveal that numerous wells were drilled before official records were maintained. Accordingly, the existence and abandonment status of some of these wells is unknown. High-density urban development, largely of apartment buildings has occurred directly over many of the old wells.

The oilfield is operated through slant wells. The residents of the area had no warning or any indication of the hazards posed by the leaking old wells. The prior history of the Ross Department Store explosion, the numerous gas seeps in the area, and a long-standing problem with oil well leaks should have placed the decision makers on notice of the irresponsible risk taking of injecting gas under high pressure into the formation.

Montebello Underground Gas Storage Operations. The partially depleted Montebello Oilfield was converted into an underground gas storage operation. Natural gas was transported into the field through interstate pipelines and injected under high pressure (exceeding 1500 pounds per square inch) into the 8th Zone located at a reservoir depth of approximately 7,500 feet. However, storage gas was discovered leaking to the surface along old wellbores that had been drilled in the 1930's era. In some instances, homes had to be abandoned and torn down in order to provide access to drilling rigs in an attempt to repair and/or reabandon old wells. Studies revealed that the well cementing operations, the cement plugs used in well abandonment and the integrity of the well casings were not adequate to seal off the high pressure storage gas from migrating along the wellbores to the surface. This facility had to be abandoned because of the gas leaks. However, it will take many years to deplete the gas to pre-storage conditions.

These examples indicate the importance of a systematic examination of how wells leak, and the dangers posed by allowing residential construction to occur directly over old wells. On the other hand, if each well leak is evaluated in isolation of the long history of problems in this area, the true dangers will not be recognized.

Playa Del Rey Underground Gas Storage Operations. The Playa del Rey Oilfield, located in the Marina del Rey area of the Los Angeles basin, was converted to an underground gas storage operation in the 1942 time period, and has been operated in that manner ever since. The Venice Oilfield adjoins the area to the immediate north. The gas storage reservoir has been leaking into the adjoining Venice Oilfield since the early years of operation (Riegle, 1953). There are over 200 old and abandoned wells throughout this area, including wells that had to be specially abandoned in order to accommodate the construction of the Marina del Rey Boat Harbor (see Figure 5). For example, some old wells are located directly below the main channel that connects to the Pacific Ocean. Numerous gas seeps have been observed by the authors of this paper within the boat harbor, and within the Ballona Flood Control Channel that bisects the area and extends eastward along the old Los Angeles Riverbed alignment.

The Los Angeles River was responsible for depositing a massive gravel layer that extends eastward providing a highly permeable zone for leaking oilfield gases to collect and migrate easterly, including under the influence of tidal forces. The gravel zone begins (viz., below surface sediments) at a depth of approximately 50 feet (referred to as the "50 ft. Gravel") and extends to a depth of several hundred feet. This gravel zone is interconnected with many of the old wells in the area, and serves to conceal the identity of wells that are experiencing the worst leakage. However, gas fingerprinting has established that the leaking well gases match the gases seeping to the surface along the flood control channel and into the surrounding residential areas.

This gravel zone has been determined to be saturated with large quantities of oilfield gases, which becomes additionally pressurized during heavy rains as a result of the shallow aquifer being recharged. Surface gas seeps become very pronounced because of this pressurization, and can be observed bubbling through standing water during such rains. Probes placed into the 50 ft. Gravel Zone have measured gas flow rates as high as 20 to 30 liters per minute. Also, drilling rigs have experienced well blowouts as a result of encountering the high-pressure gas zone when penetrating to 50 feet.

These examples, including the Ross Department Store explosion and vent well histories, reveal the importance of understanding the underlying hydrology in the identification of hazardous oilfield gas seeps to the surface (also see Toth, 1996). These studies have confirmed that the water table and the underlying permeable aquifers can act to conceal the true magnitude of the gas migration hazards. Accordingly, soil gas studies must include the magnitude of the free and dissolved oilfield gases contained in the near surface aquifers. This may include multiple zones, requiring the use of deep soil probes determined by first characterizing the underlying hydrology of the site.

A review of well abandonment records for the Playa del Rey and Venice oilfields has revealed very serious leakage problems. Leakage within the annular space between the casing and drill hole, because of poor cementing (see above), is a serious problem. Most of the wells depicted in Figure 5 were drilled in the 1930's, before prudent cementing practices were even used. For example, wells that had been abandoned as recently as 1993 — in order to make way for housing developments — were found to be leaking when excavations were begun for the actual construction. In each case, homes were constructed directly over the old wells after minimal efforts were taken in an attempt to reseal the wells. Because of the small lots and high-density construction, there will be no room for reaccessing the wells using conventional drilling rigs.

Most of the construction in the Playa del Rey and Venice oilfield areas has failed to provide gas detection or other mitigation measures (e.g., as required by the Methane Ordinance) in order to deal with these gas migration hazards. For example, the underground gas storage operations at Playa del Rey continue to inject storage gas under high pressure (approximately 1700 pounds per square inch). Gas storage and inventory studies (Tek, 1987) have shown that leakage is directly proportional to the reservoir pressure maintained for gas storage (see Figure 6). This raises serious questions about the appropriateness of locating gas storage fields in highly populated urban settings, especially where many homes have been built directly over poorly abandoned wells. It is paramount that a fundamental understanding of how wells leak and proper procedures for monitoring are developed. Gas storage pressures are typically selected by the gas storage operator to maximize the storage volume, and to enhance retrievability of the gas when market demands dictate recovery (usually during cold spells when usage suddenly skyrockets). Also, cyclic operations associated with gas injection and withdrawal may create conditions conducive to the formation of leaks.

Hutchinson, Kansas Gas Storage Leaks, Explosions And Fires of January 17-18, 2001. Underground gas storage leaks caused a devastating explosion and fires in the downtown area of Hutchinson, Kansas on January 17, 2001 (Allison, 2001). A sudden release of natural gas burst from the ground under

several stores. Upon ignition windows were blown out, and within minutes two businesses were ablaze. The Fire Department was unable to extinguish the flames because of the ongoing migration of gas into the area.

On the following day, leaking gas migrated into a trailer park on the outskirts of the town, causing a second explosion, and killing two people. The gas leakage was traced to a leaking storage gas well nearly seven miles from the town. The grim reminder is the similar circumstances that gave rise to the Fairfax explosion (viz., directly traceable to the same type of well leakage problem), and the hazards posed by underground gas storage in an urban area. At Playa del Rey, many homes have been constructed directly over old oil wells that directly interconnect with the high-pressure storage gas that is maintained at approximately 1700 pounds per square inch. The conflicting land use of such activities has to be seriously questioned, especially in view of the high risks posed by old and poorly maintained wells, most of which are no longer accessible because of construction.

Santa Fe Springs Oilfield. A study was undertaken by the authors to determine the integrity of operational oil wells in the Santa Fe Springs oilfield. In order to facilitate this review a time period was selected after heavy rains in which the well cellars had partially filled with water. This allowed observation of gas bubbles seeping to the surface along well casings. Results were systematically recorded across the operation of more than 50 wells, some of which were being used for water flooding operations at pressures approaching 1200 pounds per square inch. Approximately 75% of the wells were found to be leaking oilfield gas to the surface.

An important conclusion reached was that water flooding for enhanced oilfield recovery can be a dangerous practice, especially in an urban setting where gas could migrate to the surface creating an explosion hazard. Pressurization of an oilfield by way of water injection or gas injection (see South Salt Lake Oilfield example in this paper) requires careful attention to the integrity of the wells throughout the oilfield, and should not be undertaken until an ongoing soil gas monitoring program has been implemented in the vicinity of each well to detect the potential leakage of oilfield gas to the surface. This is also necessary to determine the need for well repairs and/or well reabandonment.

Belmont School Construction on An Oil Field. The Belmont Learning Center, a proposed high school in downtown Los Angeles, was in the process of being constructed over the Los Angeles City Oil Field before being abandoned. The site chosen was on a 35-acre parcel of land bounded by 1st Street to the south, Temple Street to the north and Beaudry to the east. This location is situated over a shallow oil field that has an outcrop to the surface just north of the building site. Furthermore, major faults criss-cross the area as illustrated in Figure 7 (California Division of Oil and Gas, 1991). The area is also part of the Elysian Park blind thrust fault system that has a generally east-west trend that helps explain the uplifting and tilting of petroliferous formation depicted in Figure 7.

Oil wells in the area continue to produce from shallow oil deposits at a depth no greater than 700 feet. Most of the wells were drilled in the early 1900's, and continue to produce using archaic drilling and production practices. For example, all of the oil field production gases are released to the atmosphere in the residential areas surrounding the well production. This includes four operational wells located on the northwest corner of the school property.

Environmental studies, undertaken only after construction was undertaken, has revealed oilfield gas seepage to the surface over most of the 35 acre parcel, including the area directly under the school buildings. The project was abruptly halted when gas seepage was detected in the main electrical vault room of the project, just before the power was to be energized.

Soil gas studies revealed that explosive levels of methane and other oilfield gases were migrating to the surface, including hydrogen sulfide. Measurements at the well head, and at other seep locations, revealed releases to the air of over 300 parts per million (ppm) of hydrogen sulfide. At depth, hydrogen sulfide was measured at over 3000 ppm. These alarming results were extensively evaluated by the authors herein, and commented on during the many environmental reviews for the project (Endres, 1999; Endres, 2002).

Over 175 million dollars have been spent on the project by the Los Angeles Unified School District. At least 20 million dollars have been spent on environmental site characterization alone. Most of this expenditure has been driven by an attempt to find a solution to the myriad of oilfield problems created by the site selection process. For example, a double passive membrane has been proposed to be installed over the entire 35-acre site.

A recent discovery of surface faulting extending under several of the school buildings has placed a further halt on construction, and may doom the entire project.

This case history clearly identifies the extreme caution needed in evaluating the environmental suitability of sites located over oilfields, especially for school construction. The State of California has passed recent legislation that requires direct participation by the Department of Toxic Substances Control (DTSC) in the future school site selection process in order to avoid a repeat of the Belmont fiasco.

Subsidence Problems Caused By Oilfield Fluid Production. One of the most serious environmental problems caused by oilfield operations within the Los Angeles basin has been subsidence (Chilingarian, et al., 1995 and 1996). Subsidence exists in virtually every oilfield within the Los Angeles basin (Wentworth, et al., 1969). Subsidence is caused by the reduction of pore pressure within the reservoir resulting from fluids production. This influence is propagated to the surface resulting typically in a bowl shaped recession at the surface, centered over the oilfield (see Figure 8). The subsidence can typically extend to an area approximately twice the geometric size of the oilfield itself (Khilyuk, et al. 2001). The enormity of the problem is well known for the Wilmington Oilfield that reached approximately 28 feet before corrective action was taken by implementing a massive and ongoing water injection program. This required legislative action in order to bring about a unitization of the oilfield to allow the water-flooding program to be implemented. It has also become the public policy of this State to arrest subsidence, especially in coastal areas, through the use of water injection.

Minimizing the consequences of subsidence requires implementing a subsidence-monitoring program. The standard in use today in oilfields throughout the world

(Endres, et al. 1991) is the Global Positioning Satellite System (GPS). The disasters of the past can be directly traced to the failure to perform adequate ongoing monitoring for subsidence. Namely, where conventional surveying, and now satellite geodesy, permits determination of vertical and horizontal movements of the land surface above oilfields with great accuracy and at relatively minimal cost.

The Baldwin Hills Reservoir Failure of 1963. On December 14, 1963, at about 11:15 a.m., an unprecedented flow of water was heard in the spillway pipe at Baldwin Hills Dam in the Inglewood Oilfield area of Los Angeles. A short time later water broke violently through the downstream face of the dam causing massive property damage to homes located below the dam and five deaths. The owner, the Los Angeles Department of Water and Power, had operated the dam continuously from July 1951 until its failure on December 14, 1963. Although an ongoing surveillance for leaks within spillways was carried out, no monitoring for oilfield subsidence was undertaken.

The Inglewood Oilfield, discovered in September 1924, lies under the western half of the Baldwin Hills area. It covers about 1200 acres and in 1963 had more than 600 producing wells (see Figure 9). The field adjoins the reservoir site on the south and west, the nearest reported production at the time of the reservoir failure being from three wells within 700 feet of the south rim.

Analysis of failure revealed ground movement that correlated directly with the Inglewood Oilfield fluid production (see Figure 10). The total area of subsidence resembled an elliptical bowl with its center about 0.5 miles west of the reservoir and centered over the oilfield. Subsidence at the reservoir site aggregated about 3 feet, compared to nearly 11 feet at the subsidence bowl. Noteworthy, was the fact that the southwest corner (viz., direction of maximum subsidence) had dropped more than the northeast corner, resulting in differential settlement across the dam of approximately 0.5 foot. Furthermore, a review of survey data from 1934, 1961 and 1963 showed lateral movement in the direction of the subsidence depression.

The Inglewood-Newport Beach active strike-slip fault also bisects the area (see Figure 9), with numerous faults branching off of the main fault in the area. Oilfield drilling records clearly reveal these many branching faults, indicating the enormous potential for differential movement along individual fault blocks. Indeed, a post-accident investigation revealed that differential fault block movement had caused rupturing of the asphaltic membrane used as a water seal over the floor of the dam.

Although fluid extraction and resultant subsidence were the prime contributors to the rupture of the reservoir, there is substantial evidence to indicate that fluid injection to stimulate oil production was also a contributing factor (Hamilton et al., 1971). Increased fluid pressures in the reservoir resulting from secondary recovery from water injection were sufficient to force brine water to the surface along faults. These forces, along with the lubricating influence of the water exacerbated differential movement along individual fault blocks.

Recently, a large housing development was proposed for the Baldwin Hills area, virtually over the above described subsidence area. Large retaining walls (exceptionally high) were contemplated to enhance views (and presumably to add value to the individual lots). These retaining walls would have been extremely vulnerable to this geologically active and subsidence prone area. When the developer became aware of the history of land movement in the area from ongoing oilfield production, the property was willingly sold to the State for use as a public park.

This case history highlights the importance of proper planning and monitoring involving land movement in an area that has been heavily impacted by major faulting, oilfield subsidence, and secondary oilfield recovery.

Redondo Beach, King Harbor Subsidence. During a winter storm in January 1988, waves overtopped the breakwater constructed by the U.S. Army Corps of Engineers in order to protect the Redondo Beach King Harbor Boat Marina and surrounding commercial structures. Enormous damage resulted, including the destruction of the Portofino Inn. King Harbor is located at the northwest end of the Torrance Oil Field, and is directly over the Redondo Beach Oilfield (which is considered an extension of the Torrance Oilfield). The City of Redondo Beach had granted permission for offshore drilling from slant wells located in that city.

Benchmarks used by the U.S. Army Corps of Engineers to construct the breakwater height were based on a U.S. Coast and Geodetic Survey of 1945. These benchmarks were assumed fixed, since the Corps did not suspect subsidence until 1985, when surveys showed the breakwater crests to be as much as 2 to 3 feet above original design elevations. However, nothing was done to protect the harbor, or to warn the commercial establishments prior to the storm of January 1988.

Investigation following the disaster revealed that nearly 2 feet of subsidence had occurred under the breakwater as a result of oil production beginning in 1943, but with accelerated subsidence occurring following the approval of tideland oil production in 1956.

A jury trial in the Torrance Superior Court resulted in a multi-million dollar judgment against the U.S. Army Corps of Engineers and the City of Redondo Beach. Several oil companies involved in the oil production settled prior to the case going to trial.

The main lesson to be learned is that this disaster could have been averted if proper monitoring for subsidence had been undertaken. It is important to note that the judgment was upheld on appeal, in which the Appellate Court found that undertaking oilfield production in such an urban setting constituted an ultra hazardous activity, requiring the utmost standard of care. Virtually every oilfield in the Los Angeles basin has experienced subsidence as a result of fluid production. Accordingly, an appropriate standard of care for all oilfield operators should be to undertake monitoring from the onset of production.

Playa Del Rey/Marina Del Rey Subsidence. Historical measurement data regarding subsidence in the Playa del Rey/Venice oilfield areas reveal almost 2 feet of subsidence between the time that oil production began in the 1920's and through 1970. However, no subsidence monitoring has occurred since 1970, despite the fact that fluid production has continued to the present. The Marina del Rey breakwater is

vulnerable to this subsidence, as is the coastal area from storm flooding.

An additional threat is from oil well damage and movement along fault blocks resulting from subsidence. The most vulnerable are the old wells that were drilled and completed in the 1930's. Any damage to the well seals and/or geological movement along fault blocks present the potential for increased gas migration to the surface. This is especially critical since the oilfields underlying the area are being used to store high-pressure gas transported in from out of state. Figure 11 is presented to illustrate the interaction between gas migration and subsidence resulting from oilfield fluid production (Chilingarian et al., 1995; Gurevich et al., 1993).

Clearly, these oilfield operations constitute ultra hazardous activities, requiring the utmost degree of vigilance in order to protect the high-density urban development in the area. Monitoring for subsidence and gas migration is essential in order to meet this standard of care.

The Release of Air Toxics From Surface Operations, Wellheads And Pipelines. The Federal Environmental Protection Agency (EPA) has determined that the primary hazardous air pollutants (HAP) emitted from oil and natural gas transmission and storage facilities are (see Federal Register, Volume 63, No.25/Feb.6,1998):

1) Benzene
2) Toluene
3) Ethylbenzene
4) Mixed Xylenes
5) n-Hexane

The first four of these chemicals are collectively referred to as the BTEX chemicals. The BTEX chemicals derive their existence from the aromatic component of crude oil. For a further discussion of these hazardous components of crude oil see McMillen et al., (2001). Although crude oil has variable contents of aromatic hydrocarbons, depending upon the origin, the API rating of the crude oil can be a good predictor of the amount of aromatics, and especially benzene, found in the production stream (see Figure 12). Namely, the higher the API rating of the crude oil, the higher the percentage of aromatics contained within the crude oil.

Tissot and Welte (1978) found that 95% of the crude oils produced around the world fell into the distribution pattern shown in Figure 13. As an example, the composition of a 35° API-gravity crude oil was reported by Hunt (1979) to contain the following distribution:

Molecular Type	Weight Percent
Paraffins	25
Naphthenes	50
Aromatics	17
Asphaltenes	8
Total	100

The majority of crude oils have been reported to contain 15 to 40% aromatics. The aromatics are characterized by a double carbon bond, which has been directly linked to the health hazards posed by these chemicals. Benzene, a known human carcinogen, has been linked in the medical literature to leukemia, aplastic anemia, lymphomas and a variety of other cancer related ailments.

The American Petroleum Institute (API), as early as September 1948, issued a report authored by P. Drinker titled "API Toxicology Review: Benzene." This report contained the following statement:

> "Inasmuch as the body develops no tolerance to benzene and there is a wide variation in individual susceptibility, it is generally considered that the only absolutely safe concentration for benzene is zero."

Oil and gas production facilities are required to provide warnings to the public regarding certain hazardous oilfield chemicals, including benzene and toluene, under California Health and Safety Code Section 25249.6 (otherwise known as Proposition 65). An example of such a warning as posted at an oil production facility located in the Los Angeles basin reads as follows:

> DETECTABLE AMOUNTS OF CHEMICALS KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER, BIRTH DEFECTS, OR OTHER REPRODUCTIVE HARM ARE FOUND IN AND AROUND THIS FACILITY.

Most facilities are not required to identify the amount or the specific types of chemicals being released to the atmosphere from their operations. The Federal EPA has identified dehydration equipment as a major source of benzene and toluene air toxics emissions, and has proposed legislation to curtail such emissions, especially in residential areas.

Venting of oilfield gases to the atmosphere must be viewed as a hazardous activity, since the oilfield gases can contain appreciable levels of benzene. Associated oilfield gases and condensates have exhibited the highest levels of benzene. A typical range of benzene in oilfield gases can vary between 30 parts per million (ppm) to over 800 ppm. For this reason, the gas should be carefully tested for its benzene composition before intentional venting of large quantities of gas is undertaken. Also, dehydration vent stack emissions should be carefully monitored.

Prudent oilfield operations dictate that stringent vapor recovery systems be installed to limit VOC emissions to an absolute minimum, especially in populated areas. The BTEX chemicals are highly volatile, and are heavier than air. Accordingly these chemicals will settle to the ground level, and create an inhalation hazard to the surrounding community.

Additional concerns and precautions must be taken in and around sour oilfield operations. Hydrogen sulfide, even in small quantities, can be hazardous to the health. The research conducted at the University of Southern California Medical Facility (Kilburn, 1998; Kilburn, 1999) has established central nervous system damage from the neurotoxin effects of hydrogen sulfide even at levels as low as 1 ppm. This is much lower than the workplace standards that have been considered safe in the past. This also highlights the importance of not relying upon workplace standards regarding air toxics emissions, especially into residential areas and school sites.

This highlights the need to incorporate the full range of potential exposures to human receptors through the multiple sources of toxics emissions. This includes the BTEX and VOC emissions resulting from ground water and/or soil

contamination resulting from the historical oil and gas production facilities.

Safety, health, and environmental considerations need to be made a top priority in the planning and land use planning where urban development coexists with oil and gas field operations. The environmental hazards far exceed earlier expectations.

Conclusions

The history of the Los Angeles basin oilfields has demonstrated the need to exercise a high degree of vigilance regarding the environmental hazards posed by these operations. Land use planning and governmental entity decisions regarding allowing massive real estate development over and adjacent to these operations have largely ignored the health and safety risks posed by these operations. The primary purpose of this paper has been to show the importance of reviewing a long history of environmental problems created by this mixed land usage, and to identify what steps need to be taken to avert future disasters. This includes the necessity of taking the following steps:

1) *Gas Migration Monitoring*: Much closer attention must be given to the need to perform ongoing monitoring for gas migration into the near surface soils in areas heavily impacted by historical oil production, and where there are many old and abandoned wells.
2) *Subsidence Monitoring*: Monitoring for subsidence in oil and gas producing areas is necessary in order to protect against the undermining of foundations, highly sensitive changes in elevation (especially in coastal areas), and to reduce the risk of gas migration hazards.
3) *Air Toxics Monitoring*: The release of air toxics from surface operations, wellheads and pipelines must be carefully monitored in order to be protective of public health, especially from the release of such chemicals as benzene, toluene, ethylbenzene, xylene (viz., the BTEX aromatic hydrocarbons), hydrogen sulfide, and a plethora of other hazardous chemicals that are known to be released from oil and gas field operations. Greater protection is required in the operation of vapor recovery equipment, and in the monitoring of toxic emissions is order to take corrective action.
4) *Soil And Groundwater Monitoring:* Soil and groundwater must be carefully evaluated for petroleum and drilling mud contamination, and appropriate steps must be taken to remediate the soil and water contamination before development is allowed to proceed. This requires an evaluation of the underlying aquifers, which become a ready target for oil and gas migration hazards.
5) *Soil Gas Monitoring*: Soil gas monitoring is an essential step in the evaluation of soil and aquifer contamination by historic oil and gas field operations. It is also necessary to determine what mitigation measures may be necessary to protect against migration of explosive and toxic oil field gases into residential and commercial structures. This will be an ongoing problem in many areas that must employ gas detectors, vent pipes, membrane barriers and ventilation systems in order to protect against the gas migration hazards.
6) *Oil And Gas Well Leaks And Ongoing Monitoring*: Oil and gas wells must be carefully evaluated, and old wells must be reabandoned in order to protect against the risk of oilfield gases migrating up the old wellbores and entering the near surface environment. There has been a long history of this very serious problem, establishing that the prior well abandonment procedures have been woefully inadequate in dealing with this extremely dangerous problem.
7) *Prohibit Building Over Abandoned Wells*: Homes should not be allowed to be constructed over old wellbores and faults. Furthermore, land planning and issuance of building permits should require adequate room to provide access for a drilling rig to reenter old wells, when they begin leaking.

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Figures

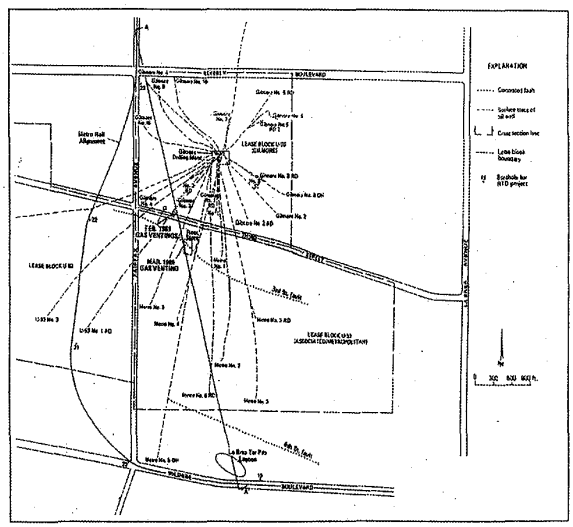


Figure 1. Surface, plan of wells, faults, and gas ventings in the vicinity of Ross Store site (Fairfax and Third St., Los Angeles, California). (Courtesy of Richard Meehan, Palo Alto, California.)

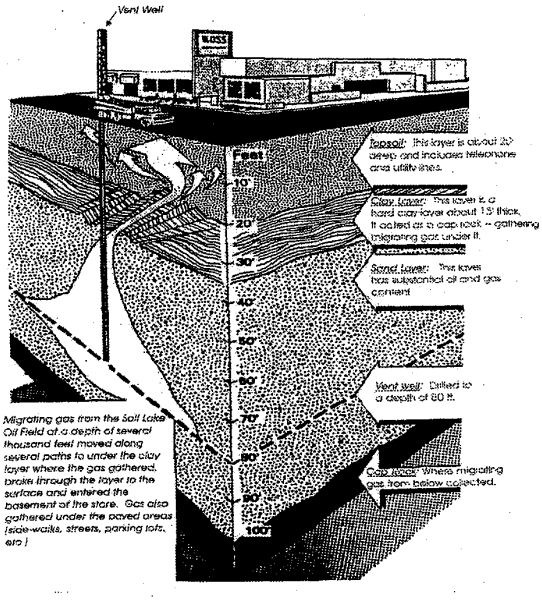


Figure 2. Schematic showing how gas entered the basement of the department store and the surrounding area. (Modified after an article by George Ramos and Ted Thackrey in the Los Angeles Times, 1985; illustration by Michael Hall.)

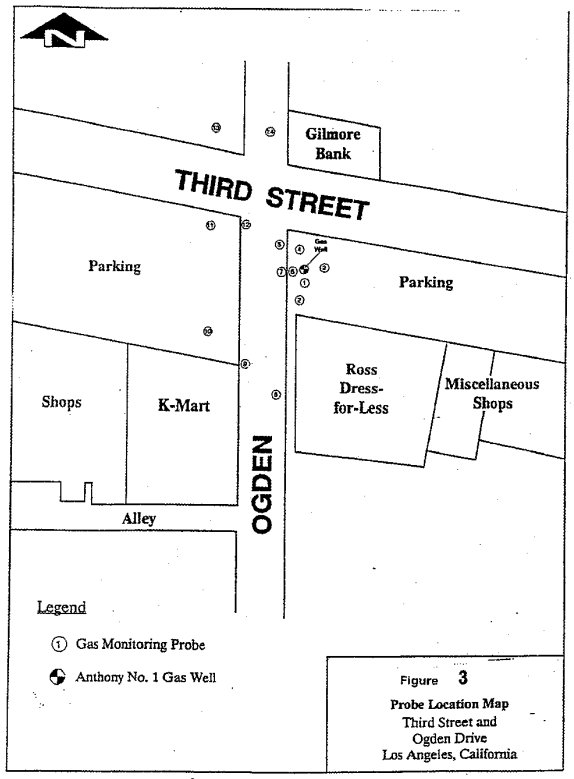


Figure 3. Probe location map; 3rd St. and Ogden Drive, Los Angeles, California. (Courtesy of City of Los Angeles Fire Department.)

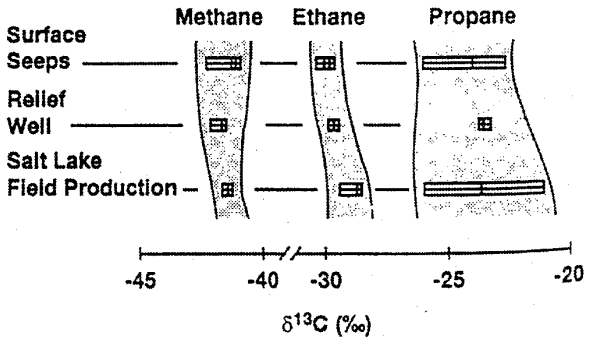


Figure 4. Carbon isotopic fingerprinting of gas leaking from reservoir to the surface. (After Schoell et al., 1993, p. 7, fig. 8.)

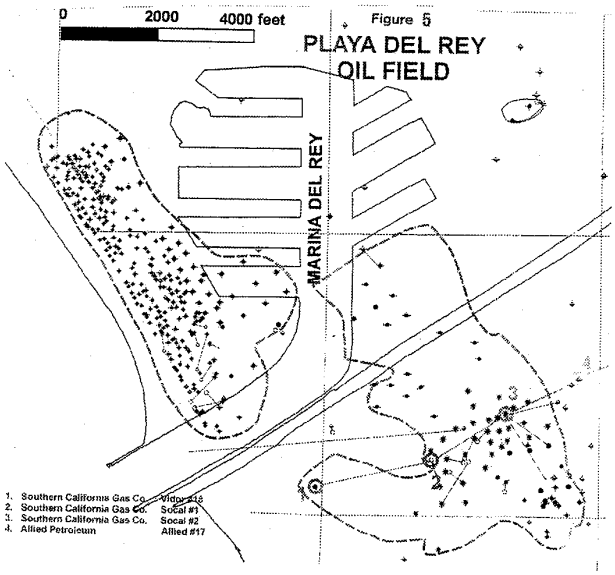


Figure 5. Playa Del Rey Oilfield. (Courtesy of Jack West, Petroleum Geologist, Fullerton, California.)

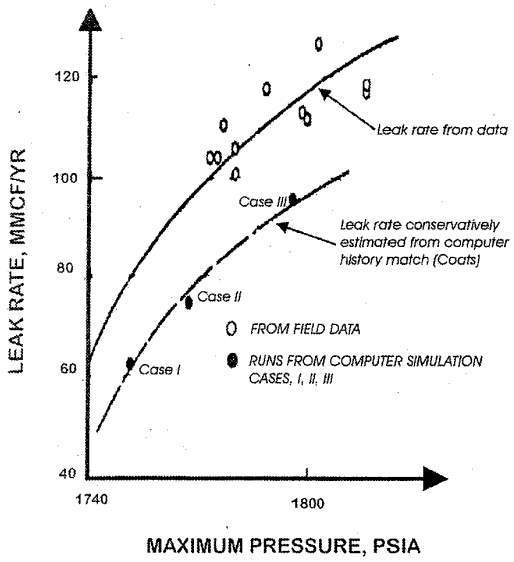


Figure 6. Gas leak rate for various maximum reservoir pressures for Leroy Gas Storage project, Wyoming. (Modified after Tek, 1987, fig. 11-16.)

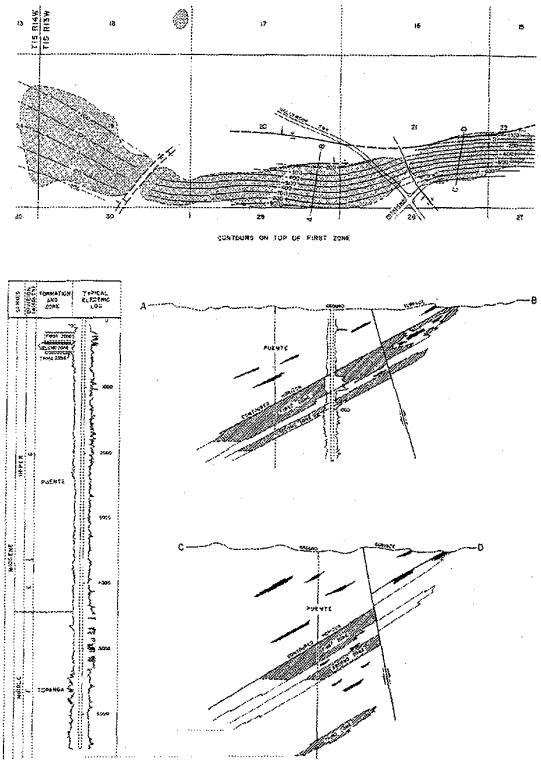


Figure 7. Los Angeles City Oilfield. (After California Division of Oil and Gas.)

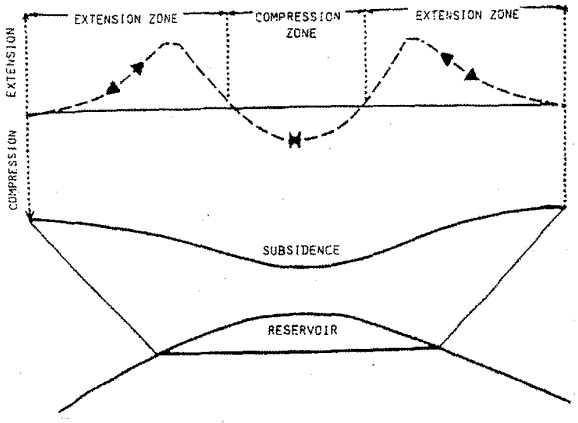


Figure 8. Schematic diagram of compressive and tensile stress distribution in subsiding formations. (Modified after Gurevich and Chilingarian, 1993, fig. 1, p. 244).

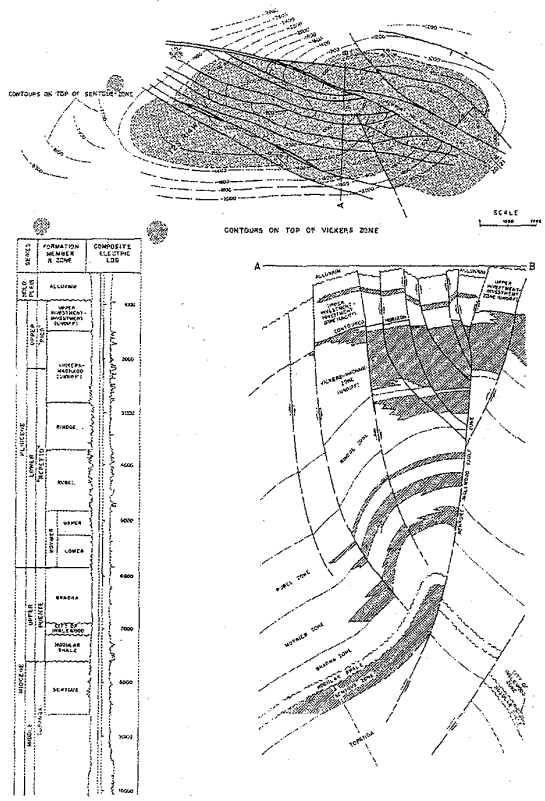


Figure 9. Structural contour map of the Inglewood Oilfield, Los Angeles, California. Contours are on top of the Vickers Zone. (After California Division of Oil and Gas, 1991.)

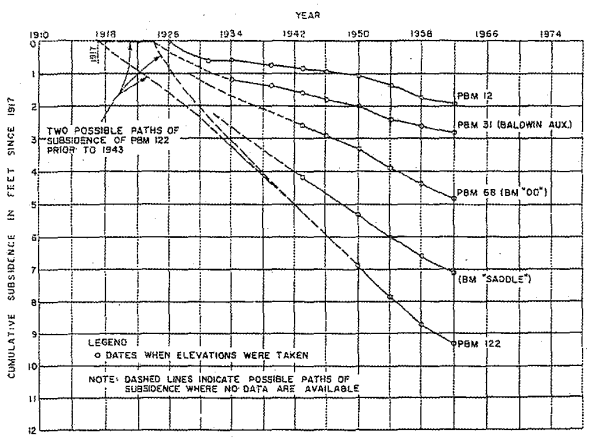


Figure 10. Subsidence of benchmarks, Baldwin Hills Area, Los Angeles, California. (After California Department of Water Resources, Baldwin Hills Reservoir, Apr. 1964).

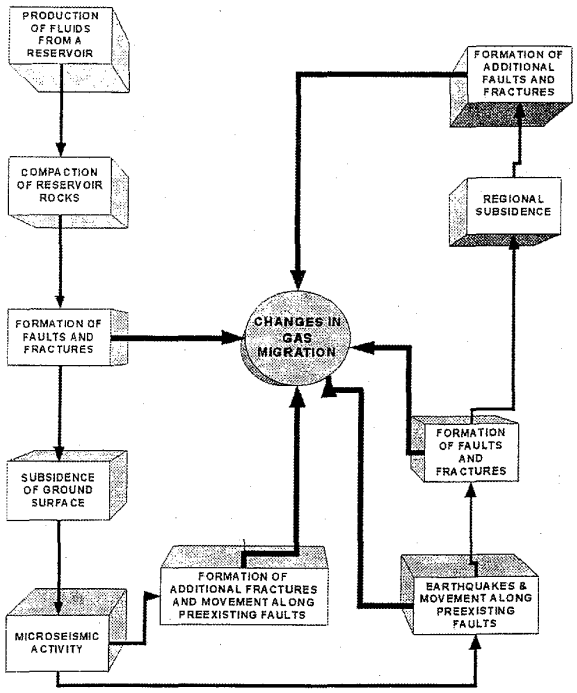


Figure 11. Schematic diagram of system relationships among the production of fluids, compaction, subsidence, and seismic activity. (Modified after Chilingarian et al., 1995, fig. 1, p. 41.)

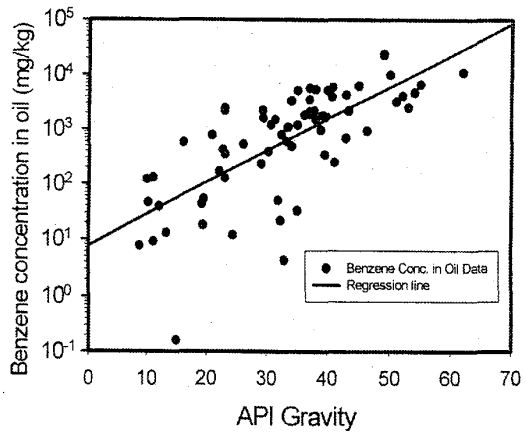


Figure 12. Benzene concentrations versus API gravity for 61 crude oils and 14 condensates (API gravity data were unavailable for 8 crude oils). (After Rixey, 2001.)

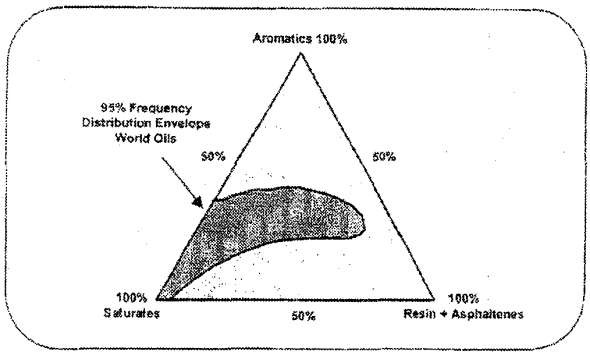


Figure 13. Ternary diagram showing the class composition of crude oils. (After Tissot and Welte, 1978.)

ABANDONMENT/DEMOLITION STUDY

Playa del Rey Storage Facility

Southern Region Transmission

November 22, 1993

5) O&M expenses at playa del rey incurred from 1996 thru 2000 (1994$) for cushion gas recovery phase:
   1996 = $1,500,000
   1997 = $1,000,000
   1998 = $750,000
   1999 = $500,000
   2000 = $500,000

6) Land Sale (1994$) = $16,400,000 ($13,000,000 for land on bluff sold in 1998 and $3,400,000 for other land sold in 2001)
   Adjusting for inflation and net of taxes, total after tax gain = $10,436,000 (nominal $).

7) Recovery of cushion gas and after tax net gain (nominal$) using 41% tax rate:

year	bcf sold	sales price	purchase price	after tax net
1996	1.4	$2.23	$0.25	$1,632,000
1997	1.0	$2.29	$0.25	$1,205,000
1998	0.4	$2.36	$0.25	$498,000
1999	0.3	$2.43	$0.25	$386,000
2000	0.2	$2.51	$0.25	$266,000

costs specific to case 2a - abandon playa del rey and do not replace injection capacity

1) Incremental O&M expenses for injection compressors, starting in 1996 = $269,000/yr (1994$).
2) Incremental fuel expense for injection compressors, starting in 1996 = $648,000/yr (1994$).

costs specific to case 2b - abandon playa del rey and do replace injection capacity

1) Capital cost of replacing injection capacity at Aliso Canyon of $30,000,000 (1994$ excl afudc). Construction period from 1994 - 1995. Inservice in 1996.
2) O&M expense for injection compressors, starting in 1996 = $459,000/yr (1994$).
3) Fuel expense for injection compressors, starting in 1996 = $950,000/yr (1994$).

cc: M.P. Sweeney

The Gas Company™

Interoffice Memo

To: M.A. Forster
From: M.D. Middleton MDM/DHC
Date: November 22, 1993
Subject: Playa del Rey Demolition Estimate

Attached is the Playa del Rey demolition study compiled by Southern Region. This study includes property appraisals and a full assessment of costs associated with decommissioning and abandoning the compressor station, tank farm, and well sites. Also included is a summary of public affairs and political issues involving Playa del Rey.

If you require further information, please contact David Carroll at 578-2623.

DHC/mck
Attachment

cc: D.H. Carroll
Claus Langer

Phase I — Compressor Station Abandonment

Phase I would include decommissioning, abandonment, and removal of all existing compression and injection process equipment. This equipment is located on top of the bluff. Isolation and modification of piping systems would be performed in a manner to allow continued withdrawal operations.

The demolition of all buildings including the general headquarters offices, garage, maintenance buildings, and other surface structures would also be a part of Phase I. The baseball facility would also be razed at this time.

Well abandonments would begin during the first year of Phase I. It is anticipated that approximately 13 wells and wellsites would be completed the first year. Well abandonments would continue in following years with only those wells required for reservoir monitoring and recovery of cushion gas remaining. Completion of all well and wellsite abandonments is expected to require 4 years.

The tank farm would remain in limited service condition to process gas and fluids withdrawn from the reservoir for an estimated four years. Operating and maintenance expenses related to tank farm and withdrawal operations would continue to be incurred during Phase I.

marketing of the property on top of the bluff could begin in the second year of the project.

The cost of Phase I is estimated at $6,399,921 and would be complete at the end of the first year.

Phase II — Storage Field Depletion and Gas Recovery

Phase II involves the continuation of well and wellsite abandonments, storage field gas recovery, and operation of the tank farm.

After the initial withdrawal of gas into Line 1167, the field wil be drawn down to Line 1159 pressure of 150 psi. Further recovery may be achieved by flowing into the local Distribution system at approximately 50 psi. Low flow rates near 500 mcf/day are anticipated and will most likely require compression during the third year to increase gas recovery rates. A skid mounted low pressure compressor package could be leased and installe din the tank farm area. Sound mitigation from this compressor will be a challenge and will require a temporary enclosure.

During Phase II additional wellsite properties will become available for marketing.

Drawdown of the reservoir (gas recovery) has been estimated to require four years.

It is anticipated that 38 wells will be abandoned during Phase II. Five wells will remain for five additional years to monitor field activity and capture minor volume of gas recovered.

The cost of Phase II has been estimated at $8,336,000.

Phase III — Tank Farm Abandonment and Final Clean-up

Phase III involves the demolition and site remediation of the tank farm and lower bluff areas. Phase III would commence after all gas recovery and reservoir management work has been completed. (Demolition of the tank farm will occur during the fourth year.

A significant amount of excavating and backfill work will be required due to the many field lines buried in the tank farm and lower bluff areas.

Environmental remediation may require significant disposal of contaminated soil and the importation of clean fill. There is also a potential for the discovery of ground water contamination. This environmentally sensitive area will no doubt provide significant challenges related to keeping our costs within forecasts. There is a potential for very high clean-up costs beyond current estimates because the Ballona Wetlands are immediately adjacent to our facilities.

The Gas Company may be required by regulatory agencies (the DOG, for example) to continue some type of monitoring activities. This may require that some monitoring wells remain indefinitely and that leakage surveys be conducted.

For the purpose of forecasting costs related to completion of the field decommissioning, it is assumed that all wells will be abandoned.

The tank farm is located on lease property which will not be marketable.

Phase III will require 1 year to complete at an estimated cost of $2,633,589.

Conclusion

The high cost of operating and maintaining the Playa del Rey Storage Field compared against throughput, station load factor, and historical utilization strategy dictates that the continued operation of this facility be assessed based on a value added to our business.

The overall cost to decommission and abandon the Playa del Rey Storage Field has been estimated at $17,369,510. The time necessary to complete the work required is four years.

Gas transmission system enhancements and modifications are necessary to offset the loss of Playa del Rey. These improvements would need to be operational before Playa del Rey could be abandoned. (See Appendix 2.)

The revenue generated from the sale of properties will offset the cost of abandoning Playa del Rey. However, substantial capital investment (23.3 million) will be required elsewhere in the Transmission and Storage System to offset the loss of Playa del Rey. (See Appendix 2.) It is anticipated that these system improvements will be activated with or without the loss of Playa del Rey withdrawal.

It should also be noted that the real estate market is currently very depressed in Playa del Rey and that property values have dropped significantly over the last three years. Existing surplus properties are not selling. Therefore Southern Region recommends that Maguire Thomas Partners be approached regarding their possible interest in acquiring the site. The value of owning additional properties by MTP in the area may be attractive due to the Playa Vista development.

Operating and maintenance costs will be reduced substantially during the first year of the project due to the decommissioning of the compressor facilities.

Assumptions

The following assumptions should be considered when evaluating the feasibility, risk and costs related to the Playa del Rey abandonment:

- There is high potential that environmental costs associated with demolishing and cleanup of the PDR tank farm and related areas could escalate due to adjacent ground water contamination.
- Local Gas Company image may decay if PDR property were sold to Playa Vista developers. Media and environmental group attention is anticipated.
- The need for compliance with air quality regulations would be eliminated ($18,000,000 cost avoidance). These capital dollars could be applied toward system upgrade and improvements.
- System upgrades and improvements identified in System Engineering's report (Appendix 2) will most likely occur whether PDR storage is eliminated or not.
- Annual O&M costs associated with Playa del Rey would be eliminated. (Region O&M $3,694,800, Storage Operations O&M $500,000, fuel cost $230,800).

Cost Estimates

CONTRACT ABANDONMENT AND DEMOLITION COSTS

	Non-Labor
56 Well Abandonments (sub-surface)	5,152,000
56 Wellsite Abandonments (surface)	4,200,000
Wellsite Environmental Cleanup	2,240,000
Compressor Demolition (office, warehouse, etc.)	1,917,650
Tank Farm Demolition	668,714
Little League Field Demolition	21,146
Environmental Investigation & Remediation (tank farm and plant site)	2,000,000
	$16,199,510

COSTS ASSOCIATED WITH ABANDONMENT/DEMOLITION

Preparation and Inspection

	Labor	Non-Labor	Total
Purging (piping, tanks, vessels, etc.)	25,000	30,000	55,000
Liquid Clean-out (piping, tanks, vessels, etc.)	10,000	150,000	160,000
Piping modifications, abandonments, and relocations	75,000	400,000	475,000
Inspection Costs (4-year term)	295,000		295,000
Permit Fees		5,000	5,000
Planning	75,000	25,000	100,000
Purchase Misc. Materials		50,000	50,000
Engineering Haz. Mat. Costs	25,000	5,000	30,000
	505,000	665,000	$1,170,000
TOTAL ABANDONMENT/DEMOLITION COSTS			**$17,369,510**

PROPERTY VALUES

Station Property (see Appendix 6)	10,000 - 13,000,000
Wellsite Parcels (see Appendix 7)	15,600,000
	28,600,000
Wellsite Parcels (cleared and available for sale prior to this report — see Appendix 7)	(12,245,000)
Total	$16,355,000

ANNUAL OPERATING COSTS

Southern Region	3,460,000
Storage Operations	500,000
Fuel Costs	230,800
Total	$4,190,800

Brewer, Leigh S.
Wednesday, April 20, 2005 12:53 PM
Mamsdorfer, Jim
Thompson, John A.; Peterson, John E.
University City Syndicate Inc. Ltd.

Greetings Jim:

Yesterday I got copies of the abandonment work and well log from the DOG for the well, University City. This is one of three wells that Playa Vista re-abandoned for a total of $2.4 MM. This one is that problem well on the southwest corner of Lincoln and Jefferson. Will send you copies of the records and my latest working papers.

Sad story. During the 2001 re-abandonment, they took a kick from 1850'. The records are sketchy regarding the 5" drill pipe 540' - 5860' fish left in May 1934. Only shavings and small pieces were recovered. Maybe you know more about this and can fill me in. At then end of the work, there were gas bubbles at the surface between the existing 14" and the 10 ¾" that they ran, so they dumped 2 sx G cmt and called it good. Would have liked a sample of that gas and the kick at 1850' too! No wonder Rich Baker was unhappy.

Anyway, he is sending me records for the other two wells including their logs. C U tomorrow!

Leigh Brewer
Senior Engineer
562-806-4358
Engineering Analysis Center

CDM
18581 Teller Avenue, Suite 200
Irvine, California 92612
tel: 949 752-5452
fax: 949 752-1307

April 25, 2005

Mr. David Nelson
Vice President
Playa Capital Company, LLC
5510 Lincoln Blvd Suite 100
Playa Vista, California 90094

Subject: Report of Sampling Results for Gas Bubbles Observed in the Freshwater Marsh

Dear Mr. Nelson:

Camp Dresser & McKee Inc. (CDM) has prepared this report to describe its assessment of the gas bubbles observed in the Freshwater Marsh, which is located to the west of the Playa Vista project, near the intersection of Lincoln Boulevard and Jefferson Boulevard. In particular, the purpose of this assessment is to compare the chemical composition of observed gas bubbles with gas from the Southern California Gas Company (Gas Company) Playa Del Rey Storage Field (the "reservoir"), which is located further west of the Freshwater Marsh. Additionally, survey data were reviewed to verify the location of the gas bubbles relative to the University Syndicate Well 1, an exploratory well that was re-abandoned in 2001 to current Division of Oil, Gas, and Geothermal Resources (DOGGR) standards.

Overview

During the course of the past 12 years, investigations have specifically explored the issue of whether gas bubbles migrating to the surface have the same composition as gas stored in the reservoir. Each investigation reached the same conclusion: the gases are of different composition and do not originate from the Gas Company reservoir. Additionally, recent surveying indicates the gas bubbles observed in the Freshwater Marsh are more than 200 feet distant from the location of abandoned University Syndicate Well 1. No gas bubbles have been observed in the area proximate to the abandoned well. A detailed discussion of these findings follows.

Historical Studies

In 1993, Dr. Ian Kaplan, a Ph.D. in Biogeochemistry from USC and Emeritus Professor of Geology and Geochemistry at UCLA, conducted a study that analyzed and compared gas samples from the Ballona Channel and Centinela Channel and from the Gas Company reservoir. The results of the study were presented in the report titled *Comparison of Chemical*

Properties of Gases Collected in Bubbles Emerging from Centinela and Ballona Creeks, dated January 20, 1994. The study, which included the participation of Grassroots Coalition and the Gas Company, concluded that the gas observed bubbling in the Centinela and Ballona channels was not emanating from the reservoir.

More recently, in July 2000, CDM completed sampling and analysis of nine of the Gas Company wells within the Playa Del Rey Storage Field. The results of the sampling were presented in the report titled *Sampling and Analysis of Gas from the Southern California Gas Company Playa Del Rey Storage Field* dated September 5, 2000. The gas composition was compared to soil gas samples collected on site to evaluate if the storage field was the source of gas observed at Playa Vista. The result of the comparison was presented by Dr. Ian Kaplan in the report titled *Comparison of Gas Analyses from Southern California Gas Company Injection and Observation Wells with Soil Gas and Groundwater Gas from 50ft Gravel Aquifer* dated January 29, 2001. The data showed no evidence that gas from the reservoir have migrated into the surface soil at the Playa Vista site. The City of Los Angeles Chief Legislative Analyst (CLA), as part of a broader review of methane issues in this area, in consultation with the City of Los Angeles Bureau of Engineering and Department of Building and Safety and with DOGGR concluded "the Southern California Gas Company Playa Del Rey Gas Storage facility is not the source of methane contamination found at the site." (*City Investigation of Potential Issues of Concern for Community Facilities District No. 4 Playa Vista Development Project*, CLA, dated May 2001).

March 2005 Evaluation

Sampling of Bubbles from Freshwater Marsh

Similar to the bubbles observed in the Centinela and Ballona channels, gas bubbles have been observed at the water surface in the Freshwater Marsh at two locations near the intersection of Lincoln and Jefferson Boulevards (Figure 1). On March 17, 2005, CDM accessed the Freshwater Marsh under the supervision of the Freshwater Marsh manager and attempted to collect bubble samples from each location.

At Bubble No. 1, CDM successfully collected the gas emitted from the bubbles by inverting laboratory-supplied sample bottles completely filled with water over the bubbles. At least a portion of the bottle was underwater at all times. In addition, a plastic funnel was submerged and placed at the opening of the inverted sample bottle to direct the bubbles into the container. The gas from the bubbles then filled the bottle while displacing the water. Once filled, the sample bottle was capped underwater preventing the introduction of atmospheric air. CDM was unable to collect a sample at the southernmost bubble location (Bubble No. 2

on Figure 1) because the bubble flow rate was too intermittent and sporadic to fill the required sample container(s).

A total of seven 1-liter bottles were collected at Bubble No. 1. During sample collection, CDM recorded the approximate flow rate of the gas bubbles into sample bottles. The gas bubbles filled the sample bottles at a rate of approximately 1 liter per minute.

Sampling of Gas Company Wells

Samples were also collected from Gas Company observation wells Vidor 14 and Vidor 17 (Figure 2). These wells were selected as the closest to the occurrence of bubbles in the Freshwater Marsh. The gas samples were taken from the well using a sampling manifold with a pressure gauge (supplied by a Gas Company representative) attached to the well tree. Each sample was collected into two laboratory-supplied 300-cubic centimeter (cc) gas cylinders and two 1-liter Tedlar bags. These samples were also collected in duplicate as a precaution. During sample collection, the pressure readings in Vidor-14 and Vidor-17 were 152 psig and 1,323 psig, respectively. A representative from the Gas Company accompanied CDM during the sampling procedures. The Gas Company representative also collected two Tedlar bag samples for separate laboratory analysis.

Sample Analysis

The seven 1-liter bottles, four gas cylinders, and four Tedlar bags, which included an initial sample and precautionary backup samples, were submitted to two laboratories for off-site analysis. A total of four bottles and two Tedlar bags were submitted to Columbia Analytical Services of Simi Valley, California (Columbia) for benzene, toluene, ethyl benzene, total xylenes (BTEX) and hydrogen sulfide (H_2S) analysis. Three bottles and the gas cylinders were submitted to Isotech Laboratories, Inc. of Champaign, Illinois (Isotech) for molecular and isotopic composition analysis including carbon monoxide, helium, hydrogen, argon, oxygen, nitrogen, carbon dioxide, light hydrocarbons (including methane, ethane, ethane, pentane, propane, iso-butane and n-butane), the Delta 13C of carbon dioxide, methane and ethane and the Delta D of methane. The results of analyses are provided on the laboratory reports attached to this report.

Discussion of the Results

The results of the molecular and isotopic composition analysis are summarized in Table 1. The results for BTEX and H_2S are summarized in Table 2. Data from the Gas Company wells were compared against prior data sets. The sample results (gas composition and isotopic fingerprint) from Vidor 14 and 17 are similar to the data collected from other reservoir

monitoring wells in 2000 suggesting the composition of the gas storage reservoir has remained generally consistent.

Most natural gas accumulations in Southern California contain only trace amounts of helium (i.e., less than 0.001 mol %), whereas the gas imported into the storage reservoir typically contains helium on the order of 0.01 to 0.04 mol %. The two storage facility samples contained helium at concentrations of 0.0234 and 0.0058 mol %. Helium concentrations in the Freshwater Marsh bubble sample were below reporting limits (awaiting reporting limits from the lab), which would suggest that the bubbles represent a local natural source of gas rather than leakage from the reservoir.

The methane isotopic characterization data from the samples is plotted on Figure 3. The data indicate that the Freshwater Marsh bubble sample is distinctly different from the two samples collected from the storage reservoir. Specifically, the signature of the Freshwater Marsh bubble sample suggests a different mechanism of formation (i.e. microbial (biogenic) gas formed by CO_2 reduction) as compared to the two gas storage reservoir samples (i.e., thermogenic gas). The findings are consistent with those previously observed during the 2000 and 2001 studies.

Columbia Analytical indicated that the two storage reservoir samples had significant concentrations of mercaptans and other sulfur-containing markers, whereas the Freshwater Marsh bubble sample did not. Mercaptans are the odorous compounds that gas companies amend natural gas with prior to delivery to the consumers.

In summary, isotopic analysis of gas samples collected in the Freshwater Marsh and from Gas Company observation wells demonstrate the samples are of different composition and that the bubbles observed in the Freshwater Marsh do not originate from the Gas Company reservoir. This finding is consistent with the conclusion reached in the Kaplan 2001 study.

Survey Evaluation

Field Surveying

On April 22, 2005 Psomas, a California licensed surveyor, accessed the Freshwater Marsh under the supervision of the Freshwater Marsh manager, for the purpose of accurately establishing the location of the observed gas bubbles. The survey data collected by Psomas was converted to northing and easting coordinates, and then compared to the coordinates for the abandoned University Syndicate Well 1 that are on file with DOGGR. As depicted on Figure 4, the gas bubbles lie approximately 228.8 feet westerly/southwesterly of the abandoned University Syndicate Well 1.

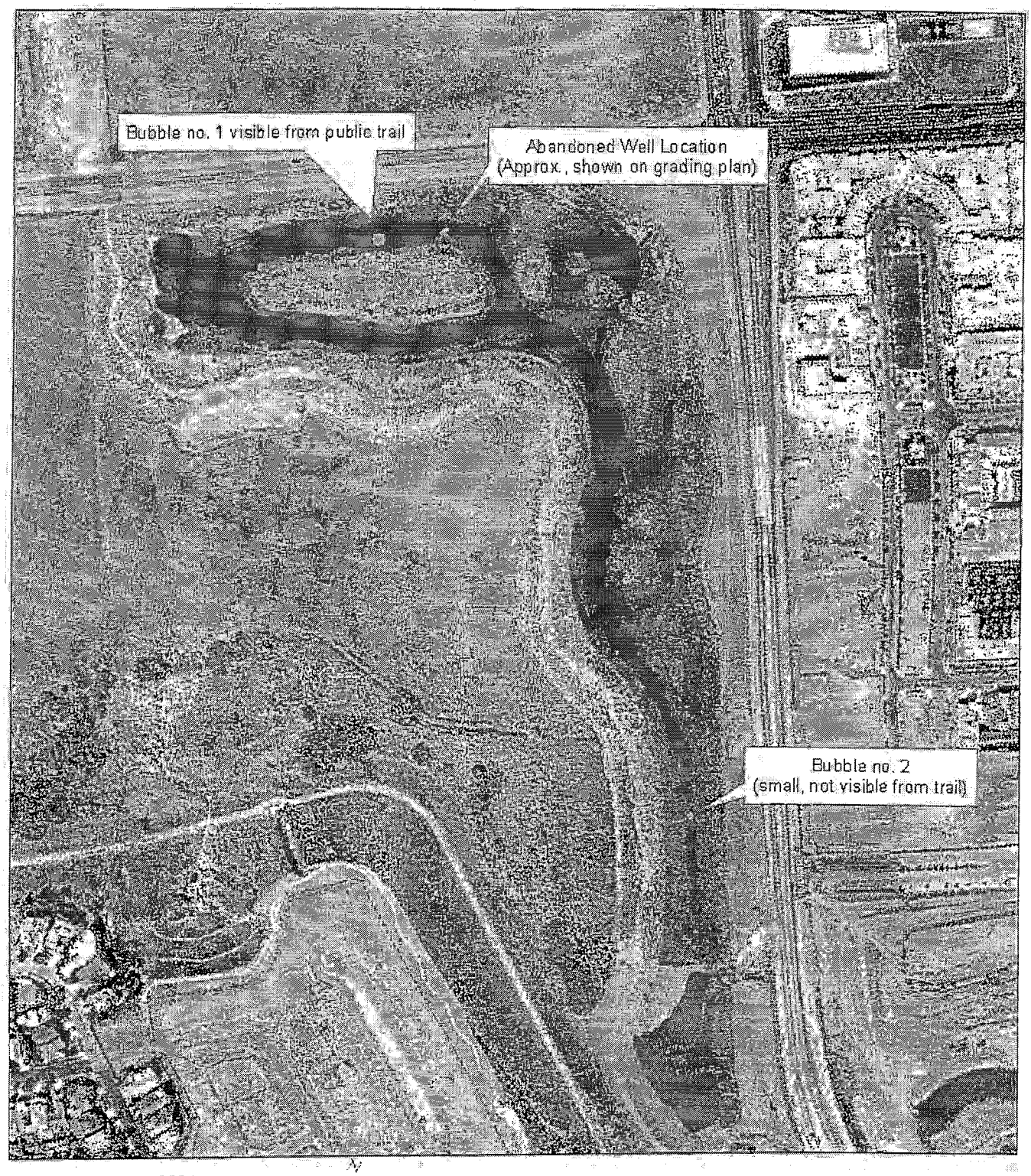
Please do not hesitate to contact Michele Zych at (949) 752-5452 should you have any questions or require further information.

Very truly yours,

Michele Zych
Senior Project Manager
Camp Dresser & McKee Inc.

Attachments

Figure 1
Locations of Bubbles in Freshwater Marsh
Playa Vista



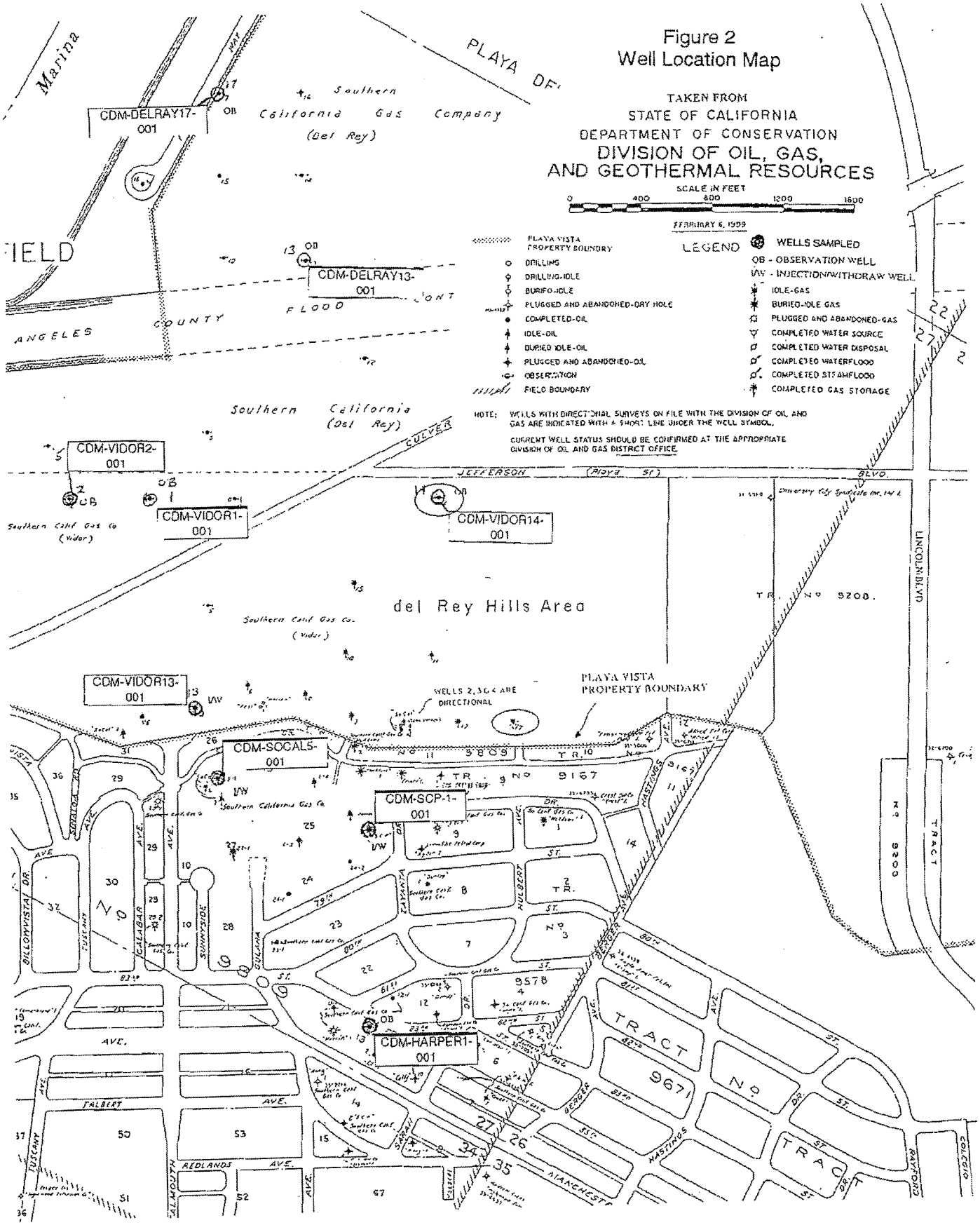


Figure 2
Well Location Map
TAKEN FROM
STATE OF CALIFORNIA
DEPARTMENT OF CONSERVATION
DIVISION OF OIL, GAS,
AND GEOTHERMAL RESOURCES
SCALE IN FEET
0 400 800 1200 1600
FEBRUARY 6, 1999
LEGEND
PLAYA VISTA PROPERTY BOUNDRY
DRILLING
DRILLING-IDLE
BURIED-IDLE
PLUGGED AND ABANDONED-DRY HOLE
COMPLETED-OIL
IDLE-OIL
BURIED IDLE-OIL
PLUGGED AND ABANDONED-OIL
OBSERVATION
FIELD BOUNDARY
WELLS SAMPLED
OB - OBSERVATION WELL
I/W - INJECTION/WITHDRAW WELL
IDLE-GAS
BURIED-IDLE GAS
PLUGGED AND ABANDONED-GAS
COMPLETED WATER SOURCE
COMPLETED WATER DISPOSAL
COMPLETED WATERFLOOD
COMPLETED STEAMFLOOD
COMPLETED GAS STORAGE
NOTE: WELLS WITH DIRECTIONAL SURVEYS ON FILE WITH THE DIVISION OF OIL AND GAS ARE INDICATED WITH A SHORT LINE UNDER THE WELL SYMBOL.
CURRENT WELL STATUS SHOULD BE CONFIRMED AT THE APPROPRIATE DIVISION OF OIL AND GAS DISTRICT OFFICE.
Marina
PLAYA DR.
Southern California Gas Company (Del Rey)
CDM-DELRAY17-001
CDM-DELRAY13-001
FIELD
ANGELES COUNTY FLOOD CONT
Southern California (Del Rey)
CULVER
CDM-VIDOR2-001
CDM-VIDOR1-001
CDM-VIDOR14-001
JEFFERSON (Playa St) BLVD.
Southern Calif Gas Co (Vidor)
del Rey Hills Area
Southern Calif Gas Co. (Vidor)
LINCOLN BLVD
TR. No 9208.
CDM-VIDOR13-001
WELLS 2,3&4 ARE DIRECTIONAL
PLAYA VISTA PROPERTY BOUNDARY
CDM-SOCAL5-001
Southern California Gas Co.
CDM-SCP-1-001
TR. No 9167
TR. No 9809
TRACT No 9671
CDM-HARPER1-001
TALBERT AVE.
REDLANDS AVE.
MANCHESTER
HASTINGS
BERGER
RAYFORD
COLEGIO
BILLOWVISTA DR.
TUSCANY
CALABAR
SUNNYSIDE
GULANA
ZAYANTA
HULBERT
SARAH
ALMOUTH

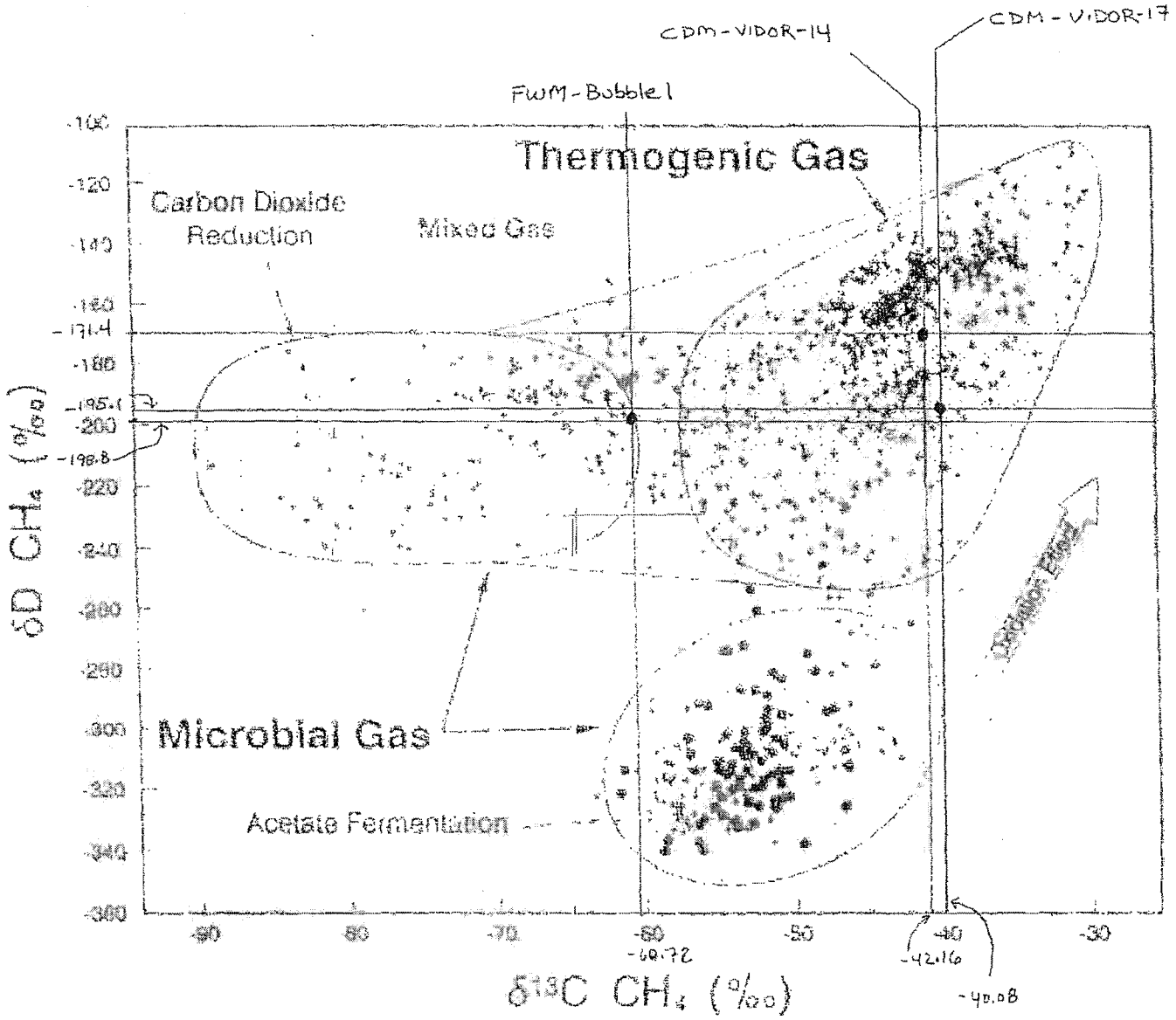


Figure 3- Comparision of isotopic data from samples from Freshwater Marsh and the SoCal Gas Wells

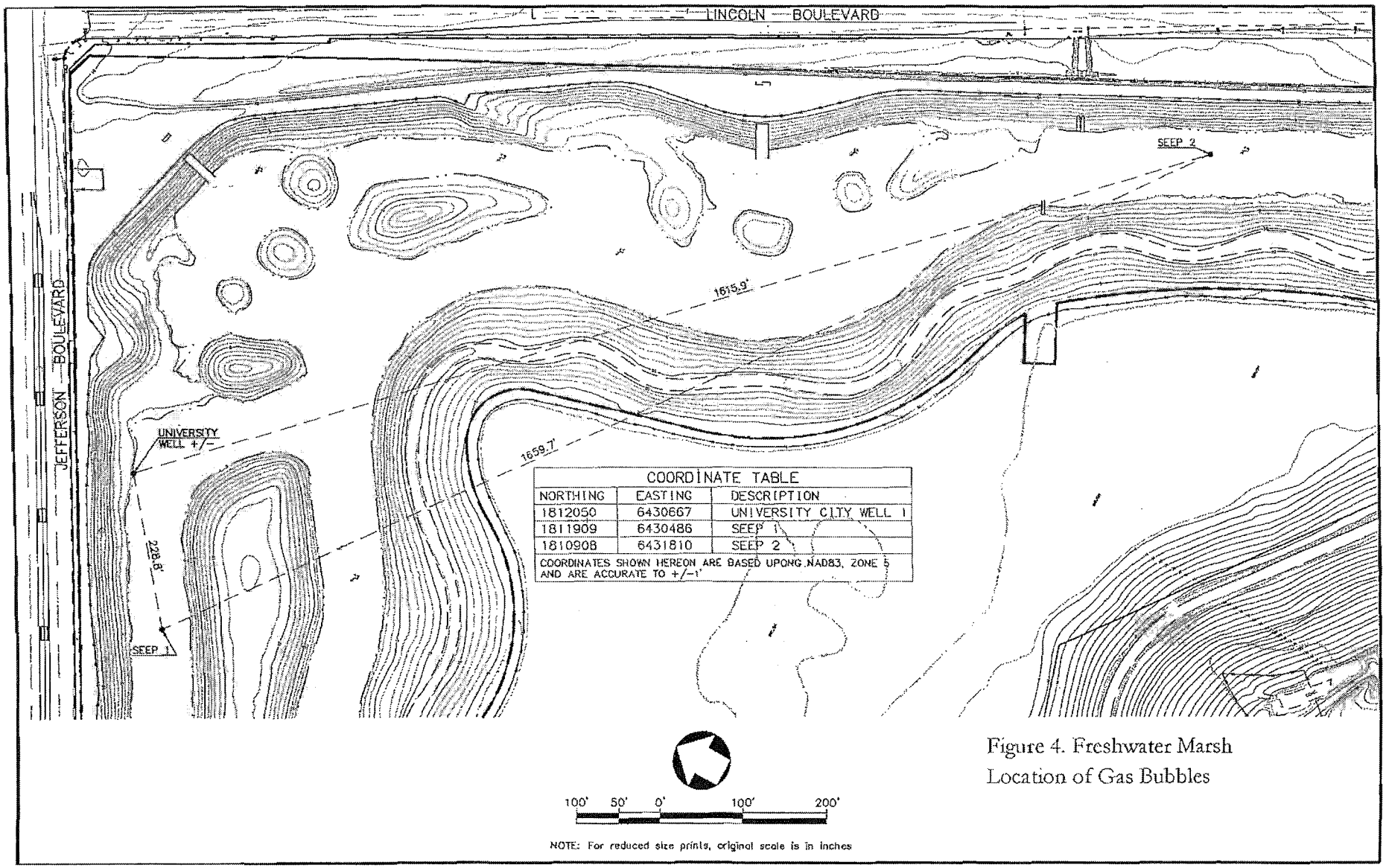


Figure 4. Freshwater Marsh
Location of Gas Bubbles

Table 1
Summary of Analytical Results
Compositional Analysis - Samples from Freshwater Marsh and SoCal Gas Wells
Playa Vista

		Freshwater Marsh	Injection/Withdrawl Wells			Observation Wells								Metering Station
Sample Names		FWM-Bubble 1	CDM-SCP-1-001	CDM-SOCAL5-001	CDM-VIDOR13-001	CDM-VIDOR2-001	CDM-VIDOR14-001	CDM-Vidor-14	CDM-Vidor-17	CDM-DELRAY13-001	CDM-DELRAY17-001	CDM-VIDOR1-001	CDM-HARPER1-001	CDM-METER-001
Sample Date		3/21/2005	07/27/2000	07/27/2000	07/27/2000	07/27/2000	07/27/2000	3/22/2005	3/22/2005	07/27/2000	07/27/2000	07/27/2000	07/27/2000	07/27/2000
Carbon Monoxide	mol %	<0.01	--	--	--	--	--	<0.01	<0.01	--	--	--	--	--
Hydrogen Sulfide	mol %	(see Table 2)	--	--	--	--	--	(see Table 2)	(see Table 2)	--	--	--	--	--
Helium	mol %	<0.0010	0.0120	0.0110	0.0120	0.0013	0.0340	0.0234	0.0058	0.0022	0.0120	0.0082	0.0094	0.0110
Hydrogen	mol %	<0.0010	--	--	--	0.0020	0.0085	0.0148	<0.0010	0.071	--	0.0081	--	0.0015
Argon	mol %	0.0671	0.0066	0.0028	0.0053	--	0.0049	0.0183	0.0056	--	--	--	0.011	0.0037
Oxygen	mol %	0.502	--	--	--	--	--	0.169	<0.004	--	--	--	--	--
Carbon Dioxide	mol %	0.63	1.25	1.31	1.15	15.03	0.58	0.54	0.98	--	3.70	12.75	7.57	1.17
Nitrogen	mol %	3.01	0.65	0.56	0.69	0.17	1.26	2.36	0.42	28.13	0.43	0.40	1.17	0.55
Methane	mol %	95.55	95.62	96.03	95.39	75.40	91.62	90.56	95.22	57.53	89.21	78.14	81.86	96.35
Ethane	mol %	0.24	1.87	1.61	2.10	4.50	4.74	4.67	2.51	6.35	4.17	4.04	4.83	1.58
Ethylene	mol %	<0.002	--	--	--	--	--	<0.002	<0.002	--	--	--	--	--
Propane	mol %	<0.0010	0.34	0.31	0.43	2.63	1.12	1.17	0.56	4.26	1.67	2.39	2.54	0.23
Iso-butane	mol %	<0.0010	0.047	0.042	0.055	0.35	0.10	0.104	0.0843	0.65	0.16	0.38	0.35	0.031
n-Butane	mol %	<0.0010	0.067	0.058	0.075	0.82	0.17	0.163	0.092	1.57	0.31	0.90	0.76	0.034
Iso-pentane	mol %	<0.0010	0.02	0.016	0.02	0.33	0.053	0.0405	0.0269	0.49	0.058	0.31	0.24	0.01
n-Pentane	mol %	<0.0010	0.019	0.014	0.016	0.31	0.059	0.0373	0.0207	0.44	0.05	0.27	0.21	0.0065
Hexanes+	mol %	<0.0010	0.095	0.037	0.057	0.46	0.25	0.127	0.0776	0.49	0.23	0.40	0.45	0.026
Delta 13C in Carbon Dioxide	per mil	-23.05	11.26	12.70	11.17	-10.69	-2.99	-0.83	6.43	n/a	-2.31	-11.32	-3.47	13.26
Delta 13C in Methane	per mil	-60.72	-42.18	-42.69	-42.31	-40.51	-42.37	-42.16	-40.08	-41.97	-41.25	-41.90	-44.88	-42.15
Delta Deterium in Methane	per mil	-198.8	-202.4	-202.3	-202.2	-183.7	-174.2	-171.4	-195.1	-190.9	-184.0	-186.3	-197.1	-204.7
Delta C13 in Ethane	per mil	-19.83	-28.57	-29.20	-28.43	-29.42	-32.66	-32.78	-27.55	-29.40	-29.71	-29.99	-30.80	-27.85

Note:
< = Not detected above laboratory reporting limits shown
-- = Not detected (laboratory reporting limits not provided)
n/a - not available

C:\8103\LMitigation\results\Table 1.xls

Table 2
Summary of Analytical Results
Volatile Organic Compounds and Hydrogen Sulfide - Samples from Freshwater Marsh and SoCal Gas Wells
Playa Vista

		Freshwater Marsh	SoCal Gas Observation Wells	
Sample Names		FWM-Bubble 1	CDM-Vidor-14	CDM-Vidor-17
Sample Date		3/21/2005	3/22/2005	3/22/2005
Benzene	ppbV	ND<0.78	68,000	18,000
Toluene	ppbV	0.92	74,000	16,000
Ethylbenzene	ppbV	1.2	2,700	1,500
m,p-Xylenes	ppbV	3.2	3,700	5,800
o-Xylene	ppbV	1.5	1,100	1,600
Hydrogen Sulfide	ppbV	8.34	ND<5.0	3.34 J

Note:
ND - Not detected above laboratory reporting limits
J - estimated concentration below laboratory reporting limits but above method detection limits.
ppbV - part per billion vapor

Table 3
Summary of Data in Comparison to Risk-Based Concentrations
Samples from Freshwater Marsh and SoCal Gas Wells
Playa Vista

Chemical	Detected Concentration ($\mu g/m^3$)	Risk-Based Concentration ($\mu g/m^3$)
Benzene	ND (RL = 2.5)	60 (chronic) (LA Area Background 1.9 to 2.8)
Toluene	3.5	37,000 (acute) 300 (chronic)
Ethylbenzene	5.3	2,000 (chronic)
Xylenes (m,p + o)	20.5	22,000 (acute) 700 (chronic)
Hydrogen Sulfide	11.6	42 (acute) 10 (chronic)
N-Hexane	ND (RL = 35,243)	7,000 (chronic)

All risk-based concentrations are Reference Exposure Limits (RELs) developed by the Office of Environmental Health Hazard Assessment (OEHHA) (http://www.oehha.ca.gov/risk/ChemicalDB/index.asp) for non-cancer effects, except as noted. Acute RELs are not available for benzene, ethylbenzene or n-hexane. However, acute criteria are always higher than chronic criteria. Thus, if chronic criteria are not exceeded, no acute threats are present.

ISOTECH®
www.isotechlabs.com mail@isotechlabs.com
Isotech Laboratories, Inc. 1308 Parkland Court Champaign, IL 61821-1826 Telephone 217/398-3490 FAX 217/398-3493

April 11, 2005

Michelle Zych
Camp, Dresser & McKee, Inc.
18581 Teller Avenue, Suite 200
Irvine, CA 92612

Dear Michelle:

Enclosed are the analysis reports for the 3 gas samples recently submitted from the Playa Vista project. These samples were assigned to Isotech job number 5963. These are the same data that were emailed to you earlier. If you have any questions, or if there is anything else we can do for you, please do not hesitate to contact us.

We will hold the samples until 04/25/05 in case you should want any additional analyses carried out and will then dispose of the remaining sample material. If you need us to hold the samples longer, please contact us. I have also enclosed an invoice for this work and would appreciate it if you would pass it on to the appropriate office for processing. Thank you for choosing Isotech for your analysis needs, we appreciate your business.

Sincerely,

Steven R. Pelphrey
Laboratory Manager

Enclosure

SRP:cw

Zm050411.doc

ANALYSIS REPORT

Lab #:	80836	Job #:	5963
Sample Name/Number:	FWM-Bubble 1-031705		
Company:	Camp Dresser McKee, Inc.		
Date Sampled:	3/17/2005		
Container:	Bottle		
Field/Site Name:	Playa Vista		
Location:	Playa Del Ray		
Formation/Depth:			
Sampling Point:			
Date Received:	3/21/2005	Date Reported:	3/24/2005

Component	Chemical mol. %	Delta 13C per mil	Delta D per mil	Delta 15N per mil
Carbon Monoxide	nd			
Hydrogen Sulfide	nd			
Helium	nd			
Hydrogen	nd			
Argon	0.0671			
Oxygen	0.502			
Nitrogen	3.01			
Carbon Dioxide	0.63	-23.05		
Methane	95.55	-60.72	-198.8	
Ethane	0.241	-19.83		
Ethylene	nd			
Propane	0.0030			
Iso-butane	nd			
N-butane	nd			
Iso-pentane	nd			
N-pentane	nd			
Hexanes +	nd			

Total BTU/cu.ft. dry @ 60deg F & 14.7psia, calculated: 973
Specific gravity, calculated: 0.577

nd = not detected. na = not analyzed. Isotopic composition of carbon is relative to VPDB. Isotopic composition of hydrogen is relative to VSMOW. Calculations for BTU and specific gravity per ASTM D3588. Chemical compositions are normalized to 100%. Mol. % is approximately equal to vol. %. Chemical analyses based on standards accurate to within 2%.

ISOTECH Laboratories, Inc. 1308 Parkland Ct. Champaign, IL 61821 217/398-3490

ANALYSIS REPORT

Lab #:	80837	Job #:	5963
Sample Name/Number:	CDM-Vidor-17-031705		
Company:	Camp Dresser McKee, Inc.		
Date Sampled:	3/17/2005	Cylinder:	2048
Container:	300 ml stainless		
Field/Site Name:	Playa Vista		
Location:	Playa Del Ray		
Formation/Depth:			
Sampling Point:			
Date Received:	3/21/2005	Date Reported:	3/24/2005

Component	Chemical mol. %	Delta 13C per mil	Delta D per mil	Delta 15N per mil
Carbon Monoxide	nd			
Hydrogen Sulfide	nd			
Helium	0.0058			
Hydrogen	nd			
Argon	0.0056			
Oxygen	nd			
Nitrogen	0.42			
Carbon Dioxide	0.98	6.43		
Methane	95.22	-40.08	-195.1	
Ethane	2.51	-27.55		
Ethylene	nd			
Propane	0.561			
Iso-butane	0.0843			
N-butane	0.0920			
Iso-pentane	0.0269			
N-pentane	0.0207			
Hexanes +	0.0776			

Total BTU/cu.ft. dry @ 60deg F & 14.7psia, calculated: 1036
Specific gravity, calculated: 0.588

nd = not detected. na = not analyzed. Isotopic composition of carbon is relative to VPDB. Isotopic composition of hydrogen is relative to VSMOW. Calculations for BTU and specific gravity per ASTM D3588. Chemical compositions are normalized to 100%. Mol. % is approximately equal to vol. %. Chemical analyses based on standards accurate to within 2%.

ISOTECH Laboratories, Inc. 1308 Parkland Ct. Champaign, IL 61821 217/398-3490

ANALYSIS REPORT

Lab #:	80838	Job #:	5963
Sample Name/Number:	CDM-Vidor-14-031705		
Company:	Camp Dresser McKee, Inc.		
Date Sampled:	3/17/2005	Cylinder:	2058
Container:	300 ml stainless		
Field/Site Name:	Playa Vista		
Location:	Playa Del Ray		
Formation/Depth:			
Sampling Point:			
Date Received:	3/21/2005	Date Reported:	3/24/2005

Component	Chemical mol. %	Delta 13C per mil	Delta D per mil	Delta 15N per mil
Carbon Monoxide	nd			
Hydrogen Sulfide	nd			
Helium	0.0234			
Hydrogen	0.0148			
Argon	0.0183			
Oxygen	0.169			
Nitrogen	2.36			
Carbon Dioxide	0.54	-0.83		
Methane	90.56	-42.16	-171.4	
Ethane	4.67	-32.78		
Ethylene	nd			
Propane	1.17			
Iso-butane	0.104			
N-butane	0.163			
Iso-pentane	0.0405			
N-pentane	0.0373			
Hexanes +	0.127			

Total BTU/cu.ft. dry @ 60deg F & 14.7psia, calculated: 1049
Specific gravity, calculated: 0.612

nd = not detected. na = not analyzed. Isotopic composition of carbon is relative to VPDB. Isotopic composition of hydrogen is relative to VSMOW. Calculations for BTU and specific gravity per ASTM D3588. Chemical compositions are normalized to 100%. Mol. % is approximately equal to vol. %. Chemical analyses based on standards accurate to within 2%.

ISOTECH Laboratories, Inc. 1308 Parkland Ct. Champaign, IL 61821 217/398-3490

2665 Park Center Drive, Suite D Simi Valley, California 93065 (805) 526-7161 ph (805) 526-7270 fax

Columbia Analytical Services INC.
An Employee - Owned Company

LABORATORY REPORT

Client:	CAMP DRESSER & MCKEE, INC.	Date of Report:	03/29/05
Address:	18581 Teller Avenue, Suite 200	Date Received:	03/17/05
	Irvine, CA 92612	CAS Project No:	P2500554
Contact:	Ms. Michele Zych	Purchase Order:	Verbal

Client Project ID: Playa Vista

One (1) 1.0 Liter Plastic Bottle Samples labeled: "FWM-Bubble 1-031705"

Two (2) Tedlar Bag Samples labeled: "CDM-Vidor 17-031705" "CDM-Vidor 14-031705"

The samples were received at the laboratory under chain of custody on March 17, 2005. The client requested and received five day rush results. The samples were received intact. Please refer to the sample acceptance check form for additional information. The results reported herein are applicable only to the condition of the samples at the time that they were received at the laboratory.

Hydrogen Sulfide Analysis

The samples were analyzed for hydrogen sulfide per modified SCAQMD Method 307-91 and ASTM D 5504-01 using a gas chromatograph equipped with a sulfur chemiluminescence detector (SCD).

Reviewed and Approved:

Svetlana Walsh
Analytical Chemist
Air Quality Laboratory

Reviewed and Approved:

Wade Henton
GC-VOA Team Leader
Air Quality Laboratory

COLUMBIA ANALYTICAL SERVICES, INC.

RESULTS OF ANALYSIS

Client: Camp Dresser & McKee, Inc.
Client Project ID: Playa Vista
CAS Project ID: P2500554

Hydrogen Sulfide

Test Code: ASTM D 5504-01
Instrument ID: Agilent 6890A/GC13/SCD
Analyst: Zheng Wang
Sampling Media: Plastic Bottle(s)/Tedlar Bag(s)
Test Notes:

Date(s) Collected: 3/17/05
Date Received: 3/17/05
Date Analyzed: 3/17/05
Volume(s) Analyzed: 1.0 ml(s)

Client Sample ID	CAS Sample ID	Date Analyzed	Time Analyzed	Hydrogen Sulfide Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
FWM-Bubble 1-031705	P2500554-001	3/17/05	15:49	11.6	7.00	8.34	5.00	
CDM-Vidor 17-031705	P2500554-002	3/17/05	15:02	4.65	7.00	3.34	5.00	J
CDM-Vidor 14-031705	P2500554-003	3/17/05	15:26	ND	7.00	ND	5.00	
Method Blank	P050317-MB	3/17/05	09:39	ND	7.00	ND	5.00	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The analyte was positively identified below the laboratory method reporting limit;
the associated numerical value is considered estimated.

Verified By: RG Date: 3/24/05

COLUMBIA ANALYTICAL SERVICES, INC.

RESULTS OF ANALYSIS

Client: Camp Dresser & McKee, Inc.
Client Sample ID: FWM-Bubble 1-031705
Client Project ID: Playa Vista

CAS Project ID: P2500554
CAS Sample ID: P2500554-001

Test Code: Modified EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS8
Analyst: Svetlana Walsh
Sampling Media: 1 Liter Plastic Bottle
Test Notes:

Date Collected: 3/17/05
Date Received: 3/17/05
Date(s) Analyzed: 3/18/05
Volume(s) Analyzed: 0.20 Liter(s)

D.F. = 1.00

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
71-43-2	Benzene	ND	2.5	ND	0.78	
108-88-3	Toluene	3.5	2.5	0.92	0.66	
100-41-4	Ethylbenzene	5.3	2.5	1.2	0.58	
136777-61-2	*m,p* -Xylenes	14	5.0	3.2	1.2	
95-47-6	o-Xylene	6.5	2.5	1.5	0.58	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

Verified By: RG Date: 3/24/05

COLUMBIA ANALYTICAL SERVICES, INC.

RESULTS OF ANALYSIS

Client: **Camp Dresser & McKee, Inc.**
Client Sample ID: **CDM-Vidor 17-031705**
Client Project ID: **Playa Vista**

CAS Project ID: P2500554
CAS Sample ID: P2500554-002

Test Code: Modified EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS8
Analyst: Svetlana Walsh
Sampling Media: Tedlar Bag
Test Notes:

Date Collected: 3/17/05
Date Received: 3/17/05
Date(s) Analyzed: 3/18/05
Volume(s) Analyzed: 0.00050 Liter(s)

D.F. = 1.00

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
71-43-2	Benzene	58,000	1,000	18,000	310	
108-88-3	Toluene	61,000	1,000	16,000	270	
100-41-4	Ethylbenzene	6,300	1,000	1,500	230	
136777-61-2	*m,p* -Xylenes	25,000	2,000	5,800	460	
95-47-6	o-Xylene	6,900	1,000	1,600	230	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

Verified By: RG Date: 3/24/05

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COLUMBIA ANALYTICAL SERVICES, INC.

RESULTS OF ANALYSIS

Client: Camp Dresser & McKee, Inc.
Client Sample ID: CDM-Vidor 17-031705
Client Project ID: Playa Vista

CAS Project ID: P2500554
CAS Sample ID: P2500554-002DUP

Test Code: Modified EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS8
Analyst: Svetlana Walsh
Sampling Media: Tedlar Bag
Test Notes:

Date Collected: 3/17/05
Date Received: 3/17/05
Date(s) Analyzed: 3/18/05
Volume(s) Analyzed: 0.00050 Liter(s)

D.F. = 1.00

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
71-43-2	Benzene	57,000	1,000	18,000	310	
108-88-3	Toluene	59,000	1,000	16,000	270	
100-41-4	Ethylbenzene	5,800	1,000	1,300	230	
136777-61-2	*m,p*-Xylenes	23,000	2,000	5,300	460	
95-47-6	o-Xylene	6,300	1,000	1,400	230	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

Verified By: RG Date: 3/24/05

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COLUMBIA ANALYTICAL SERVICES, INC.

RESULTS OF ANALYSIS

Client: **Camp Dresser & McKee, Inc.**
Client Sample ID: **CDM-Vidor 14-031705**
Client Project ID: **Playa Vista**

CAS Project ID: P2500554
CAS Sample ID: P2500554-003

Test Code: Modified EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS8
Analyst: Svetlana Walsh
Sampling Media: Tedlar Bag
Test Notes:

Date Collected: 3/17/05
Date Received: 3/17/05
Date(s) Analyzed: 3/18/05
Volume(s) Analyzed: 0.00025 Liter(s)

D.F. = 1.00

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
71-43-2	Benzene	220,000	2,000	68,000	630	
108-88-3	Toluene	280,000	2,000	74,000	530	
100-41-4	Ethylbenzene	12,000	2,000	2,700	460	
136777-61-2	*m,p*-Xylenes	16,000	4,000	3,700	920	
95-47-6	o-Xylene	4,800	2,000	1,100	460	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

Verified By: RG Date: 3/24/05

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COLUMBIA ANALYTICAL SERVICES, INC.

RESULTS OF ANALYSIS

Client: Camp Dresser & McKee, Inc.
Client Sample ID: Method Blank
Client Project ID: Playa Vista

CAS Project ID: P2500554
CAS Sample ID: P050318-MB

Test Code: Modified EPA TO-15
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS8
Analyst: Svetlana Walsh
Sampling Media: Tedlar Bag
Test Notes:

Date Collected: NA
Date Received: NA
Date(s) Analyzed: 3/18/05
Volume(s) Analyzed: 1.00 Liter(s)

D.F. = 1.00

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
71-43-2	Benzene	ND	0.50	ND	0.16	
108-88-3	Toluene	ND	0.50	ND	0.13	
100-41-4	Ethylbenzene	ND	0.50	ND	0.12	
136777-61-2	*m,p*-Xylenes	ND	1.0	ND	0.23	
95-47-6	o-Xylene	ND	0.50	ND	0.12	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

Verified By: RC Date: 3/24/05

Columbia Analytical Services, Inc.
Sample Acceptance Check Form

Client: Camp Dresser & McKee, Inc. Work order: P2500554

Project: Playa Vista

Sample(s) received on: 3/17/05 Date opened: 3/17/05 by: SM

Note: This form is used for all samples received by CAS. The use of this form for custody seals is strictly meant to indicate presence/absence and not as an indication of compliance or nonconformity. Thermal preservation and pH will only be evaluated either at the request of the client or as required by the method/SOP.

		Yes	No	N/A
1	Were custody seals on outside of cooler/Box?	☐	☒	☐
	Location of seal(s)? _____ Sealing Lid?	☐	☐	☒
	Were signature and date included?	☐	☐	☒
	Were seals intact?	☐	☐	☒
	Were custody seals on outside of sample container?	☐	☒	☐
	Location of seal(s)? _____ Sealing Lid?	☐	☐	☒
	Were signature and date included?	☐	☐	☒
	Were seals intact?	☐	☐	☒
2	Were sample containers properly marked with client sample ID?	☒	☐	☐
3	Did sample containers arrive in good condition?	☒	☐	☐
4	Were chain-of-custody papers used and filled out?	☒	☐	☐
5	Did sample container labels and/or tags agree with custody papers?	☒	☐	☐
6	Was sample volume received adequate for analysis?	☒	☐	☐
7	Are samples within specified holding times?	☒	☐	☐
8	Was proper temperature (thermal preservation) of cooler at receipt adhered to?	☐	☐	☒
	Cooler Temperature NA °C			
	Blank Temperature NA °C			
9	Is pH (acid) preservation necessary, according to method/SOP or Client specified information?	☐	☒	☐
	Is there a client indication that the submitted samples are pH (acid) preserved?	☐	☐	☒
	Were VOA vials checked for presence/absence of air bubbles?	☐	☐	☒
	Does the client/method/SOP require that the analyst check the sample pH and if necessary alter it?	☐	☐	☒
10	Tubes: Are the tubes capped and intact?	☐	☐	☒
	Do they contain moisture?	☐	☐	☒
11	Badges: Are the badges properly capped and intact?	☐	☐	☒
	Are dual bed badges separated and individually capped and intact?	☐	☐	☒

Lab Sample ID	Required pH	pH (as received, if required)	VOA Headspace (Presence/Absence)	Receipt/Preservation Comments
P2500554-001			NA	
P2500554-001B			NA	
P2500554-001C			NA	
P2500554-001D			NA	
P2500554-002			NA	
P2500554-002B			NA	
P2500554-003			NA	
P2500554-003B			NA	

Explain any discrepancies: (include lab sample ID numbers):

9

Columbia Analytical Services

Air Quality Laboratory
2665 Park Center Drive, Suite D
Simi Valley, California 93065
Phone (805) 526-7161
Fax (805) 526-7270

Chain of Custody Record & Analytical Service Request

Page 1 of 1

Requested Turnaround Time by Close of Business Day (Surcharges) Please Circle:
1 Day (100%) 2 Day (75%) 3 Day (50%) 4 Day (35%) 5 Day (15%) (10 Day Standard)

CAS Project No: 1205005S4

CAS Contact:

Reporting Information (Company Name & Address)
COM, Inc.
18581 Teller Ave., Suite 200
Irvine, CA 92612

Attention: Michelle Zych

Phone: 949-752-5452 Fax: 949-752-1307

Email Address for Result Reporting:

P.O. # / Billing Information:

Project Name: Playa Vista

Project Number:

Sampler (Print & Sign): Scott A. Sanderson Scott A. Sanderson

Analysis Method and/or Analytes

Client Sample ID	Date Collected	Time Collected	Lab Sample No.	Sample Type (Air/Liquid /Solid/Tube)	Canister ID (Bar Code#)	Flow Controller (Bar Code #)	Sample Volume	BTEX	H_2S			Comments e.g. Preservative or specific instructions
FWM-Bubble1-031705	3/17/05	940		Air				✓	✓			4 bottles
~~FWM-Bubble2-031705~~	~~3/17/05~~			Air				✓	✓			4 bottles
COM-Vidor17-031705	3/17/05	1220		Air				✓	✓			2 tedlar bags
~~COM-Delkey18-031705~~	~~3/17/05~~			Air				✓	✓			2 tedlar bags
COM-Vidor14-031705	3/17/05	1140		Air				✓	✓			2 tedlar bag
	11											

Report Tier Levels - please select
Tier I - (default if not specified) _____
Tier II (QC forms) _____
Tier III (QC, Raw Data, Spectra) 10% Surcharge
Other _____

EDD required Yes / No
Type: _____

Project Requirements (MRLs, QAPP

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
Scott A. Sanderson	3/17/05	1230		3/17/05	12:35 PM
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
	3/17/05	1402		3/17/05	2:05
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:

Cooler / Blank Temperature _____ °C

Report to
City of Los Angeles
Department of Building and Safety
201 North Figueroa Street
Los Angeles, CA 90012-2827

on

Playa Vista Development
Playa Vista, California

Comparison of Gas Analyses from Southern California Gas Company Injection and Observation Wells with Soil Gas and Groundwater Gas from 50ft Gravel Aquifer

by

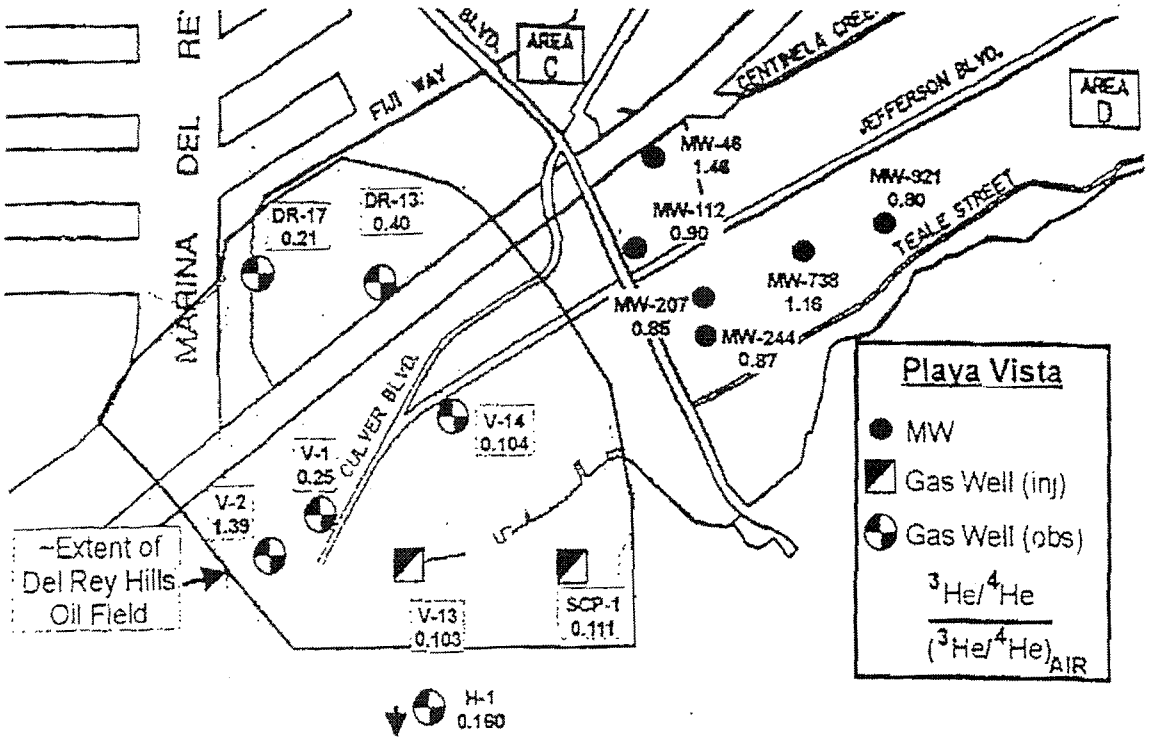
Isaac R. Kaplan
ZymaX forensics, Inc.
16921 Parthenia Street, Suite 201
North Hills, CA 91343

Robert Poreda
Department of Earth and Environmental Sciences
University of Rochester
Rochester, NY 14627

January 29, 2001

Figure 7

A site map of the Playa Vista site showing the locations and helium isotope ratios of the injection (half-filled squares) and observation gas (half-filled circles) wells, and monitoring wells (solid circles).



GR39 ~~TROXEL~~ PDR 1103

INTEROFFICE SOUTHERN CALIFORNIA gas COMPANY CORRESPONDENCE

TO Mrs. Shahed Meskati FROM E. S. Sinclair DATE March 3, 1987

SUBJECT Storage Gas Migration to Well Troxel

Introduction

During parts of December and November 1986, Wells Del Rey 18 and Del Rey 10 were shut-in for several weeks. Del Rey 18 was shut-in because of different maintenance problems while Del Rey 10 was accidentally left shut-in.

Del Rey 15 is generally put on withdrawal as an alternate if Del Rey 18 is expected to be shut-in for more than two days, and concurrently with Del Rey 18 if the field pressure is above 1250 psig.

Del Rey 18 and 15 are gas migration return wells, which collect migration gas to the northwest of the main storage area.

Del Rey 10 is presently used as an observation and also as a migration gas collection well, even though it has a Reda submersible pump presently installed in it. The well is normally shut-in with the casing left open to the Marina low pressure gas collection system.

Common belief is that Troxel is not contiguous to any sections of the storage field. However, it is used to create a pressure sink and to collect gas and liquids in the Marina beach area, fluids which would otherwise probably show up in old abandoned wells which are scattered throughout that area. A recent geological study of the Playa del Rey storage field by Richard L. Hester was not able to clearly deny or agree with the common belief.

Consultants, Stanley and Stolz in 1958 submitted memorandum to the Gas Company which discussed gas migration to the Marina townlot wells. They said the 8-inch line to Del Rey 18 was very effective in reducing the migration gas reaching the townlot wells (which at that time were; Davidson #4, Blocks 10R and 11 and Townsite 2 and 11). However, they discovered that during the winter season when more gas was injected into the main storage area the migration gas to the townlot wells seemed to increase. Stanley and Stolz recommendation, based on the winter observation, was for the Gas Company to aquire complete control of the above mentioned townlot wells.

A consequent memorandum by the consultants was published in 1961 addressing the aquisition of Troxel #1. They stated that with the aquisition of Union Oil Company and Block Oil Company properties the former migration problem is apparently under control. The consultants further stated that although positive helium traces were never evident and faulting might separate Troxel from the Company's holdings, Troxel should not be placed in an unimportant category. They said it would fit nicely into Company operations and would be excellent for observation purposes. Stanley and Stolz later recommended that the Gas Company aquire Troxel #1.

Discussion

During the November/December '86 shut-in of the two gas cap wells and Del Rey 10, significant pressure increase was observed at Del Rey 10 (see graph). Del Rey 10 was accidentally left shut-in and the gas could not be relieved at that well. During this same period a gas sample was taken at Troxel and analyzed for helium. The analysis showed a higher helium content than is usual at this well. Helium analysis on Troxel in November '84 and May '86 showed 15 ppm and 20 ppm respectively, while analysis in December '86 showed 84 ppm.

Gas production at Troxel also doubled during the said two months, November and December of '86 and returned to normal production January '87, after the Del Rey gas cap wells and Del Rey 10 were returned to normal operation. If these increases are due to migrated gas, the Company might be losing money in royalty payments. Furthermore, we might need to take more precaution in preventing high pressure migration gas into this sensitive townlot area.

Conclusion

Although the higher than normal helium concentration and gas production at Troxel during the shut-in of Del Rey 18, 15 and 10 might not be enough evidence to conclusively state that there is gas cap gas migration to Troxel, they certainly are good indications.

Since the Playa del Rey field pressure is usually below 1250 psig., significant variations in migration gas might not be observed until the pressure increases beyond 1250 psig. During November '86 average field pressure was close to 1250 psig. which might be additional reasons for increased helium concentration and gas production in Troxel.

Recommendation

I think monitoring of gas migration to the Townsite area (including Troxel) should be reviewed for effectiveness. The monitoring program should also be structured to detect and determine whether there is continuous migration to Troxel, intermittent migration or any migration at all.

However, for the present time I am recommending the following monitoring and operation procedures, both to monitor and reduce any gas migration to Troxel, the block wells and Townsite wells. In conjunction with present monitoring and operation:

1. Concurrently produce Del Rey 15 and 18 at all field pressures.

Recommendation (cont'd)

2. Investigate Del Rey 19 condition and put on production as soon as possible. Based on Hester Geological Study, Del Rey 19 will be a more useful migration gas return well than Del Rey 15 since it intersects the migration path.

3. Make special efforts to have all Townsite wells, block wells and Troxel on production at all times.

4. Continue to vent the casing at Del Rey 10 in the Marina low pressure system.

5. Compare monthly gas production from all townlot wells with average monthly main storage area pressure.

6. Quarterly, analyse gas sample from Troxel for helium.

7. Analyse gas sample from Troxel for helium as required, if main storage area field pressure increases above 1250 psig. and remains at that pressure more than three days.

8. Prepare quarterly reports on possible gas migration to Troxel.

We will be endeavouring to put the above recommendations into effect one week from the date of this memo, unless you or the copied list have concerns on any of the recommendations. I must also mention that these recommendations will only be in effect as long as they are necessary and prove to enhance understanding of the problem.

EES:dt

cc: J. P. Anand
J. H. Joslin
J. F. Tierney
R. W. Weibel
D. Zuniga

SOUTHERN CALIFORNIA gas COMPANY

INTEROFFICE CORRESPONDENCE

K-1
WELL FILE R.
EACH WELL

TO Memo to File FROM R. D. Phillips DATE Nov. 13, 1989

SUBJECT Playa del Rey

From conversation with Bob Hazel.

- L-1 and F-1 can double deliverability by fixing downhole safety system.

- 27-1 and 29-1 used to be good flowing wells. Bob saw a definite drop in deliverability after an attempt was made to pump condensate into the wells. His theory is that water was in the kill system lines through which the condensate was pumped. The weight of the water and condensate in addition to the pumping pressure caused the tarry substance in the near wellbore region (which was to be loosened by the condensate) to be forced back into the formation. This blocked flow paths resulting in the deliverability loss.

- 29-1 and 29-2 were acidized in the early 80's. Acid caused formation damage.

RDP:hr

56.F

CA. Public Utilities Safety Report

Complaint Case Facts and Findings
(Playa Del Rey Storage Field)

By

Consumer Protection and Safety Division

August 20, 2002
Revised on November 18, 2004

Table of Contents

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Introduction & Background	1
Discussions of Facts & Findings	2-6
Recommendations	7
Appendices	A, - D, F & M

I. Introduction

This report presents some of the data that Consumer Protection and Safety Division (CPSD) has gathered from the investigation of the Complaint Case (C.00-05-010) proceedings. On May 11, 2000, three residents of Playa Del Rey area filed similar complaints against SoCalGas, C.00-05-010, C.00-05-011 and C.00-05-012, respectively. In addition, Grassroots Coalition and several other residents of Playa del Rey (PDR) and Marina del Rey joined the complaints. Although the complaints were filed separately and individually, they shared a common a concern that SoCalGas is operating its Playa Del Rey gas storage facility unsafely, in a manner hazardous to the health and safety of nearby homeowners. Specifically, the complainants alleged the storage reservoir was leaking, resulting in dangerous toxic pollution from venting and leaking gas, atmospheric contamination, noxious odors, and a leaking abandoned well . Each complainant asked the CPUC to conduct an investigation of the SoCalGas Storage facilities in Playa Del Rey.

SoCalGas filed a motion to dismiss these cases or consolidate the cases. Although the Commission denied the motion to dismiss the cases, but the motion to consolidate was granted and the three complaints were consolidated under Rule 55 of the Commission's Rules of Practice and Procedure. These three cases are now treated as one case under C.00-05-010.

CPSD investigations focused on all the allegations. During the course of these investigations, CPSD conducted laboratory analysis (Isotopic Analysis) of field samples from leaking abandoned well. CPSD also requested and reviewed large volume of data from SoCalGas and Grassroots Coalition. After review of all available data provided to CPSD, the findings were used to determine the merit of the allegations and consequently resolved some of the allegations. The remaining unresolved allegations have been classified into two issues: **(1) Any evidence of PDR storage gas and/ or Thermogenic gas within SoCalGas mineral rights migrating to the surface, (2) Any evidence that the PDR Gas Treatment and/ or PDR Gas Storage facilities are contributing to local**

residents' exposure to carcinogenic toxins. This report focuses on some of the data CPSD has collected, implications of our findings to date, and recommendations for resolving the two remaining allegations.

II. Discussions of Facts and Findings

One must remember that the following facts and findings do not definitively explain or answer the allegations. However, this information, individually or cumulatively, indicate that there might be potential problems that warrant further investigation. The type of investigation or study scope must consider the available data, along with how to integrate that data into a full reservoir study and a Health Risk Assessment (HRA) that provides definitive results that lead to resolution of the two outstanding allegations. It is important to note facts and findings presented below do not indicate any wrong doing on the part of SoCalGas. Instead, they simply reflect the existence of potential hazards compounded by lack of definitive test results or data gaps. The following facts are discussed below:

(a) Evidence of three types of natural gas in PDR
(b) 133 PPM Helium in a natural gas sample from a bar hole near Big Ben well
(c) 22 PPM Helium from a shallow probe by John Sepich & Assoc.,
(d) Greater than 800 PPM Helium from groundwater samples
(e) ETI report indicated Thermogenic gas components detected in shallow subsurface geologic units and H2S detected in soil gas samples
(f) Previous reservoir inventory analysis
(g) 50,000 PPM gas detected at Troxel Well and known migration loss to well
(h) Potential problems with validity of some SoCalGas data.

City docs

A. Three types of natural gas in PDR

There is evidence of surface detection of three types of natural gas in PDR namely: Biogenic gas, Native PDR Thermogenic gas and Storage Reservoir

Thermogenic gas. Biogenic gas is commonly known as Swamp gas. Its chemical and physical characteristics are mostly Methane gas, formed by bacteria action in shallow surface. It has ***no*** Helium, Ethane, Butane or other heavier hydrocarbon. Biogenic gas is non jurisdictional. In contrast, Native PDR Thermogenic gas (native PDR gas) and Storage Reservoir Thermogenic gas (Storage gas)are formed by decomposition of prehistoric fossils under high temperature and pressure in deep and intermediate geological zones. Thermogenic gases have, Methane, Ethane, Helium and other hydrocarbons. Both native themogenic and storage reservoir thermogenic gases have some identical physical and chemical characteristicscontain varying amounts of Helium, Ethane, Methane and other hydrocarbons. Unfortunately, these identical characteristics make it difficult to differentiate Native PDR gas from Storage Reservoir gas. However, experts like Dr. Arehart (Department of Geological Sciences, University of Nevada) have discovered some subtle differences such as the difference in Helium content and the age of the Helium. There are evidence from various gas sample tests and isotopic analysis that show each of these three gases emanating to the ground surface at various locations at one time or another. The presence of Ethane, Methane, Helium and other hydrocarbons are one of the key considerations in determining if a sample is Biogenic or Thermogenic. Once it is determined that a sample is Thermogenic, then the Helium and the concentration present in that sample determines if it's Native PDR gas (1-15 PPM Helium) or Storage Reservoir gas (15-450 PPM Helium). However, commingling of these gases, alteration of physical and chemical properties by some external factors, and filtration of some gas constituents (possibly by groundwater or aquifer) obscure the minor differences and complicates the chemical speciation. *Please see Appendix # A*

B. **133 PPM Helium from bar hole samples near Big Ben Well**

SoCalGas internal office memorandum, dated November 20, 1991 revealed that gas samples collected from bar-holes around Big Ben Well contained 30,000 PPM to 620,000 PPM natural gas and these samples contained 133 PPM to 188 PPM

Helium. A close examination of the memo revealed that three samples were collected on 1/11/91, at bar-holes # 12, 13 & 14. Isotopic analysis of these samples indicated with high probability the signature of Storage Reservoir gas (meaning that the gas migrated from Storage Reservoir). In addition, the memo did not indicate any more sampling at these bar-holes or subsequent remedial action. On 8/23/91 and subsequent dates, samples were collected from bar-hole H instead of bar-holes 12, 13 & 14. The isotopic analyses of the new samples did not reveal the storage gas signature and subsequent discussion on the memo ignored the initial sample data, its significance and if there was any remedial action. *Please see Appendix # B*

C. **22 PPM. Helium from a shallow probe sample by John Sepich and Associate.**

Isotech Laboratory performed an isotopic analysis of a gas sample submitted by Sepich & Associates on 3/25/99. Sepich and Associates was working for Playa Vista developers (developers of residential and business properties around the PDR.Storage field. The isotopic analysis report indicates the gas sample was collected from Playa Vista Project Area-D. The analysis report also revealed presence of Ethane and 22 PPM Helium in the gas sample. The significance of this isotopic analysis report is the presence Storage Reservoir gas or Native PDR gas signature and the location where the gas sample was collected (Area – D of Playa Vista Project). My opinion is that the probability of Storage Reservoir gas sample from PDR area containing Ethane and 22 PPM Helium is greater than 50 percent (>50%). Furthermore, the location where the sample was collected should be of major concern. Please see Appendix # C

D. **100 PPM–1000 PPM Helium from groundwater samples collected and analyzed by Exploration Technologies, Inc (ETI)**

City of Los Angeles Building and Safety Department retained ETI to conduct test, analyze and provide advice on Playa Vista project. Groundwater samples were collected in 2000 from Playa Vista Project Area, and dissolved

gases were extracted and analyzed by ETI in addition to other scientific sampling and testing. Several groundwater samples revealed presence of high Helium concentrations and methane dissolved in the groundwater. The origin of this Helium in the groundwater is not clear. However, some people have postulated that the groundwater absorbs or strips the Helium from the Storage Reservoir gas or Native PDR gas as it migrates through the aquifer to the ground surface. Hence, Thermogenic gas is detected in soil-gas without Helium. Although, this postulation seems plausible, I have not seen any scientific paper on this absorption theory and the kinetics. *Please see Appendix # D*

E. Dr Victor Jones of ETI detected Thermogenic gas components at the surface and detected H2S in soil gas during his investigation in 2000.

ETI conducted an extensive soil gas investigation in Playa Vista area for the City of Los Angeles in 2000. The isotopic analysis report of the samples collected revealed presence of Methane, Ethane, Helium, H2S, Toluene and other volatile organic compounds (voc). The presence of numerous Thermogenic gas components in the shallow soil gas samples analyzed indicates a deeper source for this gas.

F. Previous Reservoir Inventory Verification Analysis by SCG indicated gas migration loss (8/22/80)

A Reservoir Inventory Verification Analysis conducted by Theodoros Georgakopoulos on August 22, 1980, for SoCalGas indicated gas migration loss. The migration pathways to the Townsite area (separate geologic zone) is unknown. The report estimated storage reservoir gas loss between January 1961 and December 1979 to be 0.10 B.c.f. Subsequent reports estimated the gas loss to have decreased. *Please see Appendixt # F*

G. Presence of Methane gas around Troxel Well.

As part of Energy Division (ED) initial preliminary investigation, ED retained MHA, who subcontracted Giroux & Associates to conduct site investigations at the Troxel and Lor Mar well site locations in 2001. These recent studies found very high methane concentrations (greater than 50,000 ppm) at the Troxel site and low methane concentrations (1 to 6 ppm) at the Lor Mar site.

Although high methane levels at Troxel dissipated over time, low methane levels persisted through the end of the 32 days study period. This indicates a possible source of methane at this location. Methane concentrations also fluctuated during the study period, indicating that external factors (atmospheric pressure, tidal influences, gas storage reservoir operations) may be affecting data measurements. However, a soil gas survey study requested by the Commission and conducted by SoCalGas' consultant, TRC concluded that there were no measurable concentrations of volatile or combustible compounds encountered in the soil gas. Also, the study detected presence of Hydrogen Sulfide and the source was unknown. But recent sampling by Energy Division's CEQA team reported measurable concentrations volatile hydrocarbons.

H. Validity of SoCalGas Data.

Data collected by SoCalGas may be flawed. Procedures used by SoCalGas to collect gas samples at the Troxel did not follow standard gas collection and sample handling procedures established by Federal Environmental Protection Agency and other trade associations. A plastic sheet was used to accumulate enough gas to collect samples for analysis. Samples were collected in plastic bottles. Since plastic is permeable to many gases, and may also absorb some hydrocarbon based gases, test results would not fully characterize gas emitted from the well.

Although bar hole testing is acceptable for Department of Oil.Gas & Geothermal Resources leak detection requirement, it does not follow standard procedures established

for soil gas investigations. Soil is disturbed and compacted when the bar is driven into the ground. This could interfere with movement of some soil gas. Therefore, low levels of methane may not be detected and concentrations reported may not be valid.

III. Recommendations

A review of the aforementioned facts and findings suggest the existence of a potential safety hazard. Since the available geological data does not definitively support or disprove the existence of safety hazard in and around the storage reservoir, further investigation and study is needed. It is important and recommended that CPSD conduct (1) comprehensive reservoir study and (2) Health Risk Assessment (HRA) (HRA that is not limited to 'for sale lots" and integrate some of the data gathered from the CEQA study). The basis for this recommendation are in response to allegations of hazards to public health and Safety, potential ratepayer liability, lack of definitive results from available data and mandate from General Order 58-A, section 22. We recommend a reservoir study that will include but not limited to:

1) Construction of a 3-dimensional geologic computer model (Earth Vision or equivalent) using existing data (wells records, soil gas investigations, geo-technical borings, geophysical data, environmental borings, site contamination data, groundwater data, etc) to fully integrate and visually display geologic data (strata and discontinuities) and other subsurface information (gas and groundwater locations) at the storage field.

2) Drill a minimum of three shallow well observation wells to describe the stratigraphic conditions (visual and geophysical logging) in geologic deposits above 1000 feet elevation in order to define potential gas storage zones and migration pathways, and to collect gas samples from depths below biogenic sources.

3) Collect and analyze (isotopic and chemical analysis) the gas in geologic deposits from these wells, focusing on depths below

minus 500 feet elevation (below sea level), in order to determine the origin and genesis of the gas.

4) Integrate the results from items 1, 2 and 3 above to develop a logical, defensible subsurface model that explains the surface and subsurface gas detections and the potential pathways for gas to reach the surface environment.

5) Retain an expert to perform Helium Ratio Analysis.

The Gas Company

A Sempra Energy company
Energy Transportation Services

Interoffice Memo

TO: John Thompson
FROM: Leigh Brewer
DATE: May 25, 2001

EAC PROJECT#: TS01-C073
EAC ACCOUNT#: 814 GP

SUBJECT: **Biogenic Gas Found in Barhole V 3 near Mariner's Village in Marina Del Rey**

Objective

To determine the source of the soil gas sample recovered from the barhole, V 3, near Mariner's Village at Marina Del Rey.

Findings and Conclusions

- It appears that the small amount of soil gas (2.1% to 2.8%) recovered from the barhole, V 3, near Mariner's Village, is bacterially degraded biogenic gas and is not from the Playa Del Rey Storage Field as shown by, the lack of heavier hydrocarbons, the lack of helium and the isotope ratios (see Table 1).
- The shallower of the two V 3 gas samples (8' versus 15'), taken on 9/22/00, has both a heavier carbon isotope ratio ($\partial^{13}C$) and a heavier deuterium ratio (∂D) in methane. Since isotope ratios for samples taken from the same barhole, at the same time, should have the same value, bacterial degredation of the soil gas has probably taken place as shown on the table below and on the attached Figure 1.

		Isotope Ratios in Methane	
Location	Sample Date	$\partial^{13}C$	∂D
V 3 - 8' deep	9-22-00	-41.2 °/₀₀	-110 °/₀₀
V 3 -15' deep	9-22-00	-51.4 °/₀₀	-129 °/₀₀
V 3 - surface	4-18-01	-40.5 °/₀₀	-119 °/₀₀
Playa Del Rey Storage gas	11-93 to 10-00	-42.6 °/₀₀	-193 °/₀₀

Mariner Village Sampling

Last September, Sierra Labs under the direction of James Farrow, of Komex, collected two soil gas samples in Marina Del Rey near Mariner's Village. Both were taken from the barhole, V 3, one from 8' and a second from 15' deep. Komex collected a third sample from the surface of V 3 on 4/17/01. The gas concentrations were 2.16%, 2.10% and 2.81% respectively. All three samples had to be aspirated to collect enough volume for analysis. Besides methane, Zymax reported just 10

ppm of ethane in the two 9/00 samples (attached). No helium and only methane was found in the third sample, see attached Table 1.

Also on 4/17, Storage personnel performed a Flame Ionization survey around V 3 and found no combustible gas. In addition, on 4/5/01, Storage personnel checked the Komex barholes V 3 and V 13 (near Del Rey 6, an abandoned well), and found only 200 ppm of gas in V 3.

The Gas Company has tested natural gas in the Playa Del Rey area from gas storage wells, various barholes and several abandoned wells. Usually, the hydrocarbon and helium contents provide sufficient information to identify the gas source. In more difficult situations, isotope ratios in methane can provide further information.

Isotopic Analysis and Soil Gas Degredation

The ∂^{13} C and ∂D in methane can contribute additional clues to source identification. However, bacterial degredation can alter these ratios, making them heavier. Although bacterially altered biogenic (swamp gas) methane may have ∂^{13}C values similar to thermogenic (example: older Storage gas) methane, the ∂D will differ. Degredation is especially likely if the methane concentrations are low (as per a phone conversation on 4/18/01 with Steve Wilkerson of Zymax).

The ∂^{13}C and ∂D ratios are often plotted against each other to help identify sources and degredation issues as discussed in Dennis Coleman's attached paper, "Advances in the Use of Geochemical Fingerprinting for Gas Identification". For the Marina Del Rey area, it appears that the ∂D of fresh, unaltered methane, be it biogenic or thermogenic, has a maximum value of -185°/$_{oo}$, whereas the near surface degraded gas is -150°/$_{oo}$ or more as shown on the attached Figure 1.

On 2/12/98, CDM took several soil gas samples on the nearby Playa Vista property. Their average isotope values of -42.6°/$_{oo}$ for ∂^{13}C and -147°/$_{oo}$ for ∂D, indicate some degredation. The V 3 samples with an average of -44.3°/$_{oo}$ and -119°/$_{oo}$ respectively, indicate even greater degredation.

In contrast, gas sampled from abandoned wells in the Venice and Marina Del Rey area have had a ∂^{13}C has low as -73°/$_{oo}$ (Townsite 3 - 2/26/98). And, the unaltered biogenic gas found in the surface casing of the well, Del Rey 18 open at 750', has a ∂^{13}C of -69°/$_{oo}$ and a ∂D of -218°/$_{oo}$. Storage gas has an average of -42.6°/$_{oo}$ and -193°/$_{oo}$ respectively.

Figure 1 shows how tightly grouped the isotope ratios of Storage gas are. However, the seep samples are spread over a wider area of the graph, owing to degredation issues.

Methods

James Farrow provided the information regarding the 9/22/01 sample results. Komex performed the 4/17/01 V3 sampling and gave a split of the sample to Gas Co. personnel. The 4/17 sample was analyzed by the EAC for helium and hydrocarbon content then sent to Zymax for isotopic analysis. See the attached reports and Coleman's paper for more information.

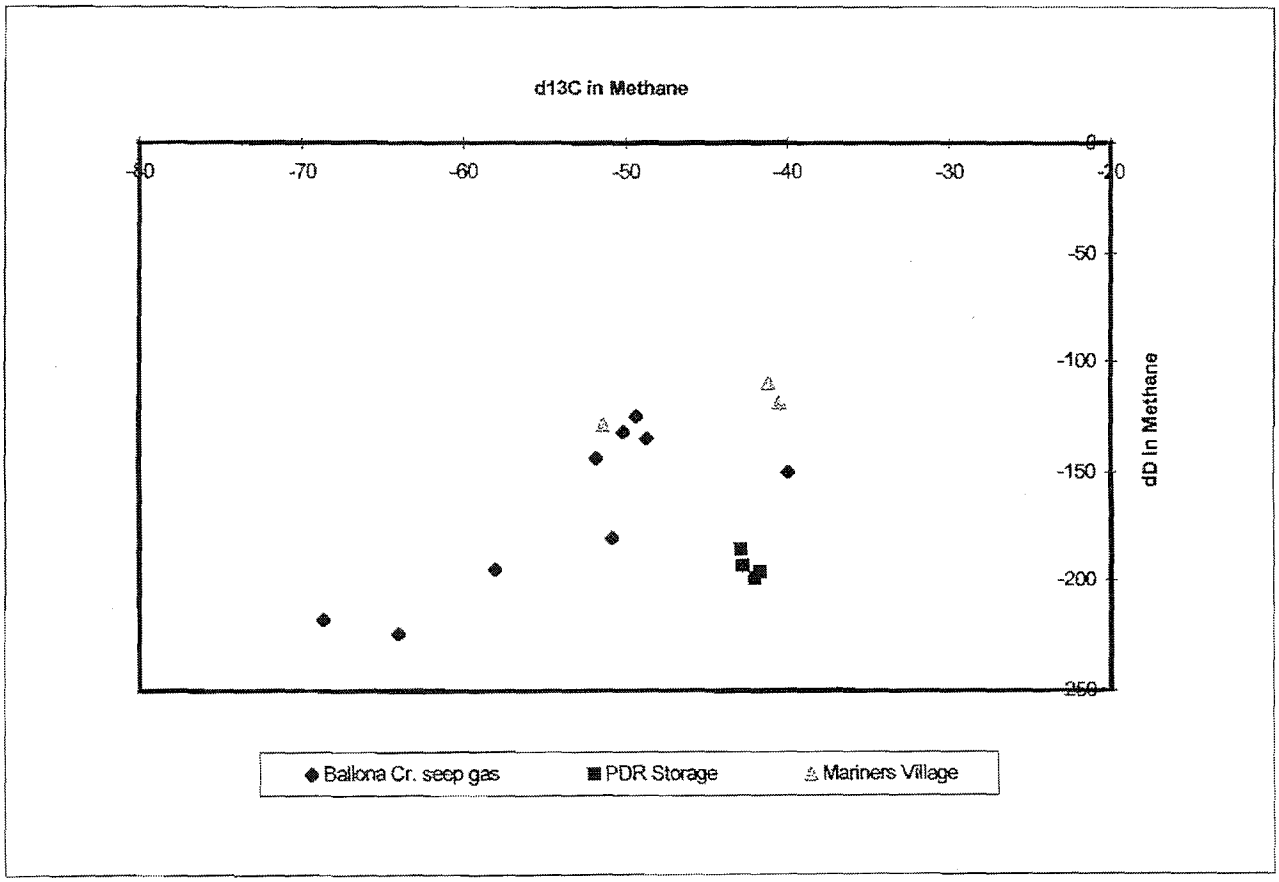
Attachments

cc: Jim Mansdorfer
Joyce Padleschat
Jim Wine
Dan Meltzer
Steve Reed
Bruce Evans

EMSR - Oct 1997

Figure 1 Carbon Isotope Ratio vs. Deuterium Ratio in Methane
Marina Del Rey and Playa Del Rey

			deuterium in methane			
Date	Sample location and depth:	d13C in methane	Ballona Cr. seep gas	PDR Storage	Mariners Village	Who Collected
Nov-93	Centinela Cr Ave.	-50.875	-180			Global Geochemistry
Nov-93	PDR Line 1159	-42.92		-185.5		Global Geochemistry
Apr-96	PDR Line 1167	-42.0		-199		So Cal Gas
Feb-98	Playa Vista: SG 1-3'	-51.86	-144			CDM
Feb-98	Playa Vista: SG 2-5'	-49.41	-125			CDM
Feb-98	Playa Vista: SG 2-9'	-50.17	-132			CDM
Feb-98	PV: SG 2-9':Ground wate	-48.72	-135			CDM
Feb-98	Playa Vista: SG 3-3'	-58.09	-195			CDM
Feb-98	Playa Vista: SG 4-0'	-39.95	-150			CDM
Sep-00	Mariners Village V 3-15'	-51.44			-129	Sierra Labs
Sep-00	Mariners Village V 3-8'	-41.16			-110	Sierra Labs
Oct-00	seep at Block 11	-64.00	-224			So Cal Gas
Oct-00	Fast 1	-42.78		-193		So Cal Gas
Oct-00	SCP 1	-41.72		-196		So Cal Gas
Apr-01	DR 18 sfc csg	-68.65	-218			So Cal Gas
Apr-01	Mariners Village V 3-0'	-40.52			-119	Komex



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5/25/2001

Figure 1 Carbon Isotope Ratio vs. Deuterium Ratio in Methane
Marina Del Rey and Playa Del Rey

			deuterium in methane			
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Feb-98	Playa Vista: SG 3-3'	-58.09	-195			CDM
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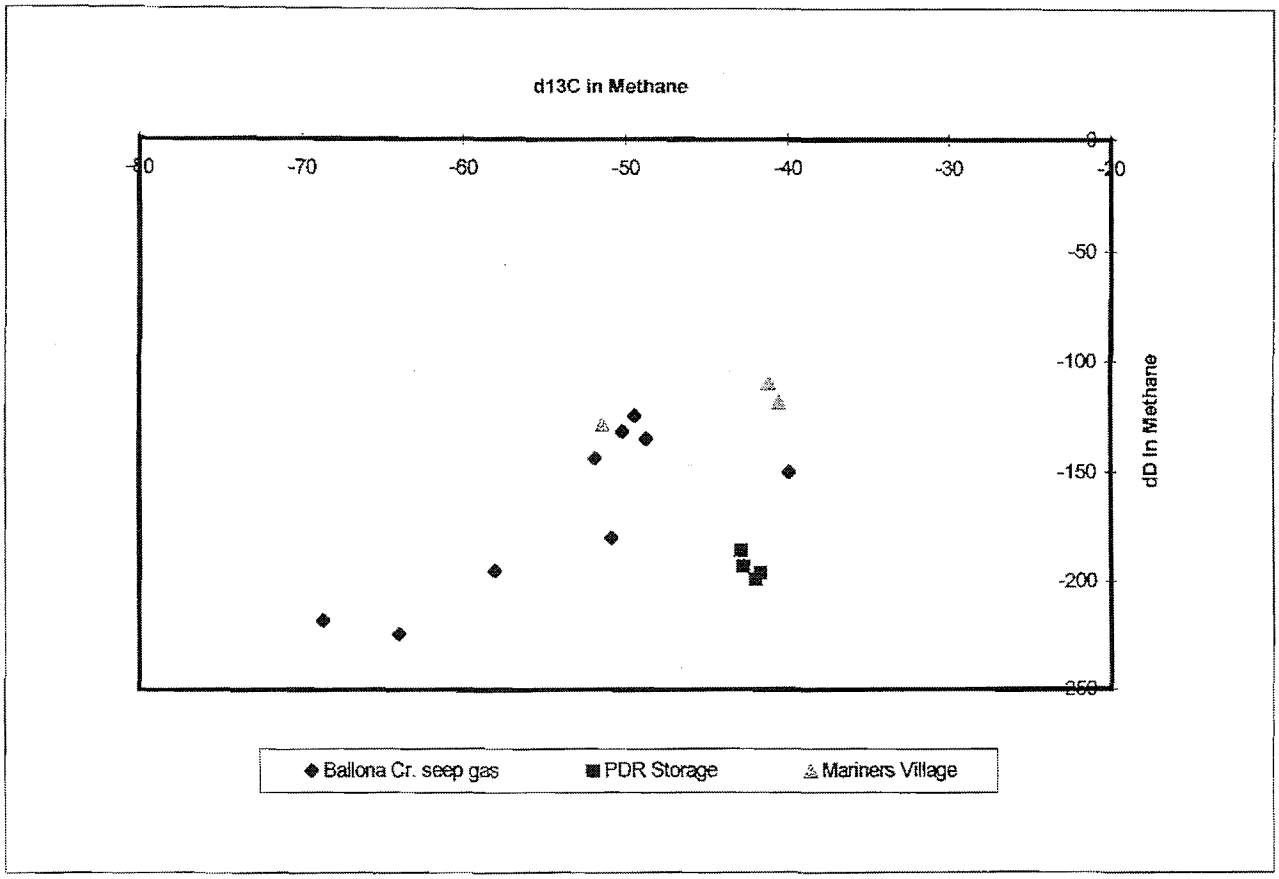
Apr-01	Mariners Village V 3-0'	-40.52			-119	Komex



file: DR18.xls sheet: isotope 05/25/2001

Table 1

Marina Del Rey Soil Gas and Playa Del Rey Storage Gas Analyses

Sample location:	V 3	Del Rey 18	SCP 1	Del Rey 15 & Del Rey 18	Vidor 17	Vidor 12	Vidor 9	Line 1159
Zone:	Barhole in Mariner's Village Surface Gas	Gas from Surface Casing	Storage Shut-in	Storage: "Del Rey Gas Cap"	Storage, flowing (providing lift gas for DR 15 & 18)	Storage, flowing	Storage Shut-in	"Del Rey Gas Cap"
Date Sampled:	4/18/01	4/17/01	10/16/00	2/2/98	2/2/98	3/13/98	3/13/98	11/15/93
			Hydrocarbon Analysis (in mole %)					
Oxygen	air total:	0.285	0.089	0.083	0.055	0.000	0.367	0.64
Nitrogen	94.947	1.715	2.634	0.720	0.787	0.776	2.065	0.42
Carbon Dioxide	2.247	0.062	1.003	1.243	1.219	1.227	1.226	0.98
Methane	2.806	97.894	90.561	94.105	94.675	94.216	92.083	94.80
Ethane			3.901	3.302	2.652	2.932	3.340	3.03
Propane			1.001	0.571	0.435	0.591	0.660	0.68
iso-Butane			0.299	0.0600	0.0640	0.0701	0.0761	0.069
n-Butane			0.289	0.0850	0.0640	0.0959	0.0985	0.110
iso-Pentane			0.0970	0.0270	0.0170	0.0262	0.0251	0.032
n-Pentane			0.0115	0.0240	0.0140	0.0216	0.0202	0.028
C6+ Residuals			0.0975	0.0500	0.0180	0.0438	0.0038	
% Combustibles	2.806	97.894	96.2570	98.224	97.939	97.997	96.307	98.749
Carbon Isotope Ratio	**-40.52**	**-68.65**	**-41.72**	**-42.73**	**-42.76**	**-42.1**	**-43.1**	**-42.9**
Deuterium Isotope Ratio	**-119**	**-218**	**-196**					**-186**
Isotope Ratio Lab**	Zymax	Zymax	Zymax	GGC	GGC	GGC, GS	GS	GGC
Helium (in ppm)	**9**	**ND < 7**	**117**	**144**	**135**	**140**	**150**	**230**

Background helium concentrations at the EAC:

Average of 8 tests performed on 4/23/01 and 13 ppm

HC and helium analyzed by the EAC.

Isotope ratios analyzed by Zymax, Global Geochemistry (GGC), or GeoAnalysis (GS)

May 3, 2001

Isotope ratio data for samples submitted by Southern California Gas Company

Zymax ID	Sample ID	Methane	Methane
		$\delta^{13}C$(‰)	δD(‰)
23609-1	V3	-40.52	-112
STANDARD			
NBS		-29.82	-119
NBS-DUP		-29.78	

23609.wpd h117con115a

Supervisor

Zymax FORENSICS

September 29, 2000

Isotope ratio data for samples submitted by Komex H2O Science, Inc.

Zymax ID	Sample ID	Methane	
		$\delta^{13}C$ (‰)	δD (‰)
21356-1	3-8'	-41.16	-110
21356-2	3-15'	-51.44	-129
STANDARD			
NBS		-29.81	-119
NBS-DUP		-29.79	

21356.wpd corr273

Supervisor

RECEIVED
OCT 03 2000

APR 06 '01 12:05PM KOMEX H2O SCIENCE P.2/5

ZymaX FORENSICS

September 27, 2000

Date received: 9-23-2000
Date analyzed: 9-26-2000

Hydrocarbon concentrations in samples submitted by Komex H2O Science Inc.

Sample ID	Zymax ID	C1	C2*	C2	C3	i-C4	n-C4	i-C5	n-C5
		ppmv							
3-8'	21356-1	21600	<10	14	<10	<10	<10	<10	<10
3-15'	21356-2	21000	<10	14	<10	<10	<10	<10	<10
Detection Limit:		10	10	10	10	10	10	10	10

QA/QC data for C_1-C_5 analysis

Analytes	RF x 10^4	RF_d x 10^4	% D	Acceptance Limit %
C1	0.196	0.188	-4.1	± 10
C2 / C2*	0.381	0.371	-2.6	± 10
C3	0.620	0.576	-7.1	± 10
iC4	0.850	0.830	-2.4	± 10
nC4	0.900	0.900	0.0	± 10
iC5	1.33	1.34	0.8	± 10
nC5	1.35	1.46	8.1	± 10

RF = Mean response factor from 3 point calibration
RF_d = Daily calibration standard response factor
% D = % Difference
Calibration file: c1c5m0174.cal

21356c1c5.wpd

Supervisor

APR 06 '01 12:05PM KOMEX H20 SCIENCE P.3/5

SIERRA LABORATORIES
TEL: 714 • 348 • 9389
FAX: 714 • 348 • 9115
26052 Merit Circle • Suite 105 • Laguna Hills, CA • 92653

CHAIN OF CUSTODY RECORD

Date: 9/22/00 Page 1 of ____

Lab Project No.: ____

Client: Komex H20 Science Inc
Client Address: 5500 Bolsa Ave Suite 105
Huntington Beach CA
92649
Client Tel. No.: 714 379 1153
Client Fax No.: 714 379 1160
Client Proj. Mgr.: James Farrow

Client Proj. Number/Proj. Name:

Turn Around Time Requested:
- [ ] Immediate Attention
- [ ] Rush 24-48 hours
- [ ] Rush 12-48 hours
- [ ] Normal
- [ ] Stability

Analyses Requested

Client Sample No.	Sierra Sample No.	Date/Time	Matrix	Preservatives	Container Type	No. of Containers	[illegible]	[illegible]	EPA [illegible]	EPA [illegible]	Lab Sheet James Farrow								Comments
3-8'		9/22/00 0950	Gas		1L Tedlar	1					X								
3-15'		9/22/00 1010	Gas		1L Tedlar	1					X								

1 Sampler Signature: [signature]
Printed Name: Andrei Zawadzki
Shipped Via:
(Carrier/Waybill No.)

2 Relinquished By: [signature] Date: 9/22/00 Received By: Date:
Company: Komex Time: 16:03 Company: Time:

3 Relinquished By: Date: Received By: H. [signature] Date:
Company: Time: 4:00 Company: CAL OVERNIGHT Time: 4:[illegible]

4 Relinquished By: Date: Received By: Date:

Total Number of Containers Submitted to Laboratory

The delivery of samples and the signatures on this chain of custody form constitutes authorization to perform the analyses specified above under SIERRA's Terms and Conditions, unless otherwise agreed upon in writing between SIERRA and CLIENT.

Total Number of Containers Received by Laboratory

Sample Disposal:
- [ ] Return to Client
- [ ] Lab Disposal
- [ ] Archive ____ mos.
- [ ] Other ____

FOR LABORATORY USE ONLY - Sample Receipt Conditions:
- [ ] Intact
- [ ] Chilled - Temp (°C)

INTEROFFICE CORRESPONDENCE

SOUTHERN CALIFORNIA gas COMPANY

TO Mr. P. S. Magruder, Jr. FROM B. F. Jones DATE August 7, 1975

SUBJECT Playa del Rey - Gas Migration

Action Plan:

Try and pinpoint the source of migrated Playa del Rey stored gas by running sound logs on 14 wells which have temperature anomalies of 3° or more from the normal gradient. Radioactive tracer surveys will be run on wells which show high frequency sound anomalies. The estimated cost of this program is $40,000. In accordance with our discussion, we will accumulate these costs under a miscellaneous work order. We will try and start sound survey work during the week of August 18, 1975. I told Mr. John Brady of our plans this afternoon, and he said we should proceed with the work.

Discussion:

The following summarizes discussions that Jack Hampton, Jeevan Anand and I had July 31, 1975 relating to the Playa del Rey gas migration problem. This discussion resulted in the above plan of action. As you know, we have some very small volumes of stored gas coming to the surface around the cellar of Del Rey 17. We have also had reports this year of gas containing helium present in the surface casing annulus of 26 wells. This information was summarized by John Melton in his letter to me dated February 26, 1975 (attached). A re-survey of surface casing annular gas in May 1975 found gas with traces of helium present in 16 wells. Within the last year, temperature surveys have been made on 53 of the 69 wells. Forty-one of these surveys were made in 1975. Twelve surveys are scheduled to complete this program. Sixteen wells had temperature anomaly varying 3° or more from the normal gradient. A total of six sound logs have been run within the last two years. Three of them were run this year. The only sound log that show a definite hole in the casing was that made on the well Playa del Rey 12-1. Sound logs run in Del Rey 17 and 18 indicated shallow (above 1000') low-cut noises. This is interpreted to represent gas movement outside of the casing. A temperature survey made on Del Rey 18 in June of this year is significantly different than the survey ran in September 1974, suggesting that the well may now be leaking.

The Del Rey wells can generally be grouped as either wells in the flat area or wells in the bluff area. Wells in the flat area are very close to sea level and all except the top 8-10 feet of the casing should be covered by ground water. Wells in the bluff area are those wells where the wellhead is at least 8-10 feet up to 150 feet above sea level. All wells are subject to tidal fluctuation which would

possibly cause a wetting and drying of the casing near sea level. Four wells in the bluff area have developed shallow casing leaks, three of the leaks were near sea level, and probably due to casing corrosion. The first of these three was Big Ben #1 which was repaired in 1964. The second was 12-1 which occurred in August 14, 1974 and the third was 24-2 which occurred April 30, 1975.

The area where storage gas is currently surfacing is in the flat area. Sound logs suggest gas movement from a depth of about 1000' below sea level. The temperature anomaly in Del Rey 18 is approximately 1100' below sea level. It seems reasonable to re-survey this well using a sound log as soon as possible. Next, it would seem prudent to survey with a sound log all wells with a temperature deviation of 3° or more from gradient. Any well which shows a high frequency sound anomaly should have the potential leak evaluated using a radioactive tracer survey.

Cost of running at least 14 sound logs is estimated to be $2,000 per well or $28,000 for the sound log program. If sound anomalies were found on five wells, an additional $10,000 should be allowed for radioactive tracer surveys. $2,000 contingency allowance would bring the estimated total cost of this migration study up to $40,000. It is our opinion that this study should be undertaken this year in order to evaluate the Playa del Rey gas migration problem.

STORAGE GAS IS CURRENTLY SURFACING IN THE FLAT AREA

BFJ:eo
Attachment

cc: Messrs. J. P. Anand
H. C. Carson
J. D. Hampton
A. S. Olson
D. Wood

• GAS MOVEMENT IS FROM 1000 FEET

Also filed in Playa del Rey Misc. Correspondence

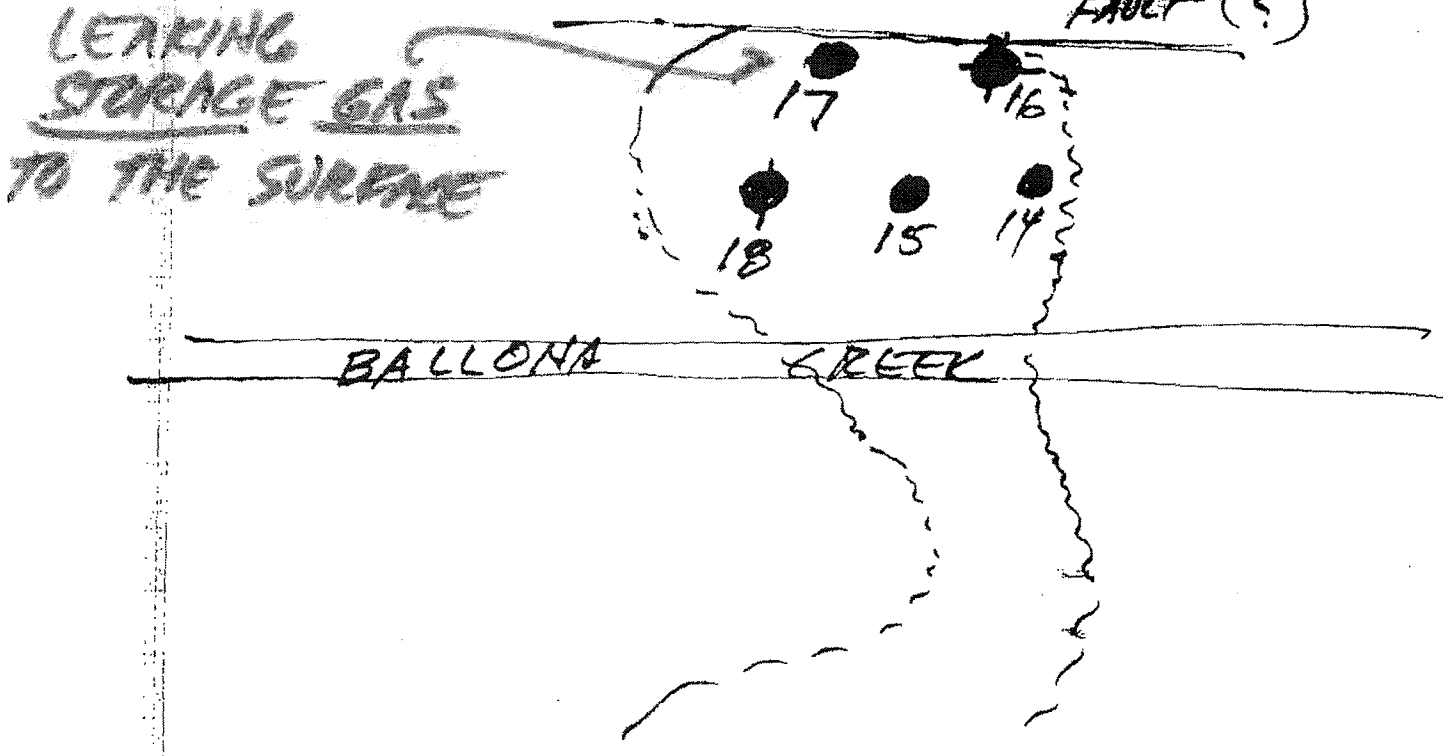
• DEL REY 18 IS FROM APPROXIMATELY 1100' (BASED ON TEMPERATURE ANOMALY)

(1 OF 5)

1975 VINTAGE

NOTE: DEL REY 17
(REPORTING LEAKS TO THE SURFACE IS LOCATED AT FAULT PLANE

NORTH OF BALLONA CREEK



AGENDA FOR ANNUAL REVIEW MEETING WITH
DIVISION OF OIL AND GAS FOR PLAYA DEL REY,
MONTEBELLO AND EAST WHITTIER FIELDS
June 7, 1983

Attending:

E. Brannon, Division of Oil and Gas
C. M. Goldwasser
J. W. Gourley
D. Lande, Division of Oil and Gas
L. L. Langer
P. S. Magruder, Jr.
K. M. Taira
R. E. Wallace

Playa del Rey

Project Performance - No unusual or unpredicted occurrences. Maximum injection pressures range from 1400 psi to 1700 psi wellhead. Discovery pressure was 2750 psi bottom-hole. Plot of annual rate of oil produced vs. cumulative oil attached. Explanation of basic usage of reservoir provided by Mr. Goldwasser.

Conservation - No losses detected. Documentation of monitoring system presented by Mr. Goldwasser.

Pollution Prevention - Status of subsurface safety valve installations: 1. All wells but So. Cal. 1 will be completed this year. 2. Discussion of "Conditions for Operating Critical Wells Without Subsurface Safety Valves" with regard to extension granted for So. Cal 1 - Mr. Gourley. Presentation on Testing of Safety Systems, Water Disposal, and Spill Prevention - Mr. Goldwasser.

Operations - One leak found and repaired at Del Rey 18 and two subsurface safety valves failed at 24-2 and 27-1 and have been replaced. Del Rey 18 was typical of shoe leaks at Playa del Rey in that the storage zone was being dump flooded from above in this well. A W.S.O. was reestablished on the production casing shoe.

Geology and Engineering - Reservoir simulation study in progress. One of new wells to be drilled this year will be cored.

East Whittier

Project Performance - No unusual or unpredicted occurrences. Presentation on normal and summer usage of field by Mr. Wallace.

Conservation - No losses detected. Monitoring program is similar to that used at Playa del Rey and Montebello.

Pollution Prevention - All critical wells protected. No oil production. No waste water disposal problems.

Operations - None for past year.

Geology and Engineering - Discussions under way with Chevron for return of migrating gas.

Montebello

Project Performance - Incidents at Burke Community 3 and Braun 7 will be discussed under Operations. No other unusual or unpredicted occurrences. Plot of annual rate of oil produced vs. cumulative oil attached. Explanation of basic usage of reservoir provided by Mr. Wallace.

Conservation - Documentation of monitoring system presented by Ms. Langer and Mr. Wallace. It is expected that a few wells will require work following this past withdrawal season and every effort is being made for early detection and resolution of these problems.

Pollution Prevention - Status of safety valve installations: All critical wells will be equipped by November of 1985 as per previous correspondence.

Presentation of water disposal and spill prevention methods by Mr. Wallace.

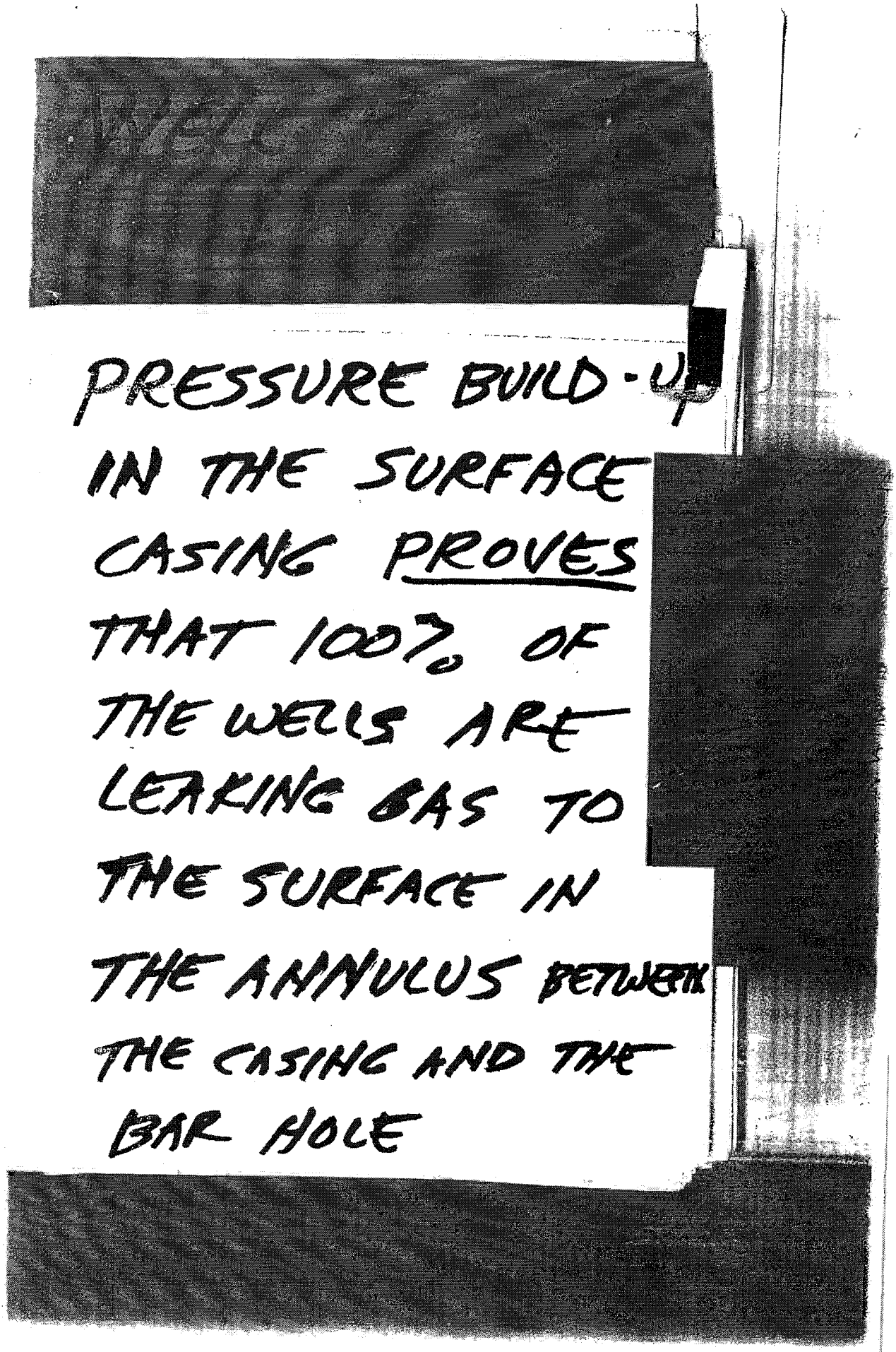
Operations - Two wells converted to cased hole observation wells, Dore 2 and Braun 7 (in progress)

One subsurface safety valve installed (MGS 22-1) and two repaired (Cole 1 and Long 1). valve
control line
One innerstring run to secure casing repair at MGS 2-10. Four Big Tubing Safety Valve installations (MGS 15-28 and Howard & Smith 5, 9, & 10).

Brief description of incident at Burke Community 3 by Mr. Taira.

Geology and Engineering - Nothing new to report.

LLL:pr


PRESSURE BUILD-UP
IN THE SURFACE
CASING PROVES
THAT 100% OF
THE WELLS ARE
LEAKING GAS TO
THE SURFACE IN
THE ANNULUS BETWEEN
THE CASING AND THE
BAR HOLE

(PRESSURE) 1:16PM
1:20PM

VIDOR 9

BARHOLE GAS CONFIRMATION

BARHOLE (BH) IN FRONT OF RAMP

REPORT DATE: 3/11/98

	MOLE %
METHANE	20.8830
ETHANE	.5850
PROPANE	.1190
ISO-BUTANE	.01159
N-BUTANE	.01418
ISO-PENTANE	.00462
N-PENTANE	.0000
C6 PLUS	.00334

HELIUM	160 PPM

ENGINEERING ANALYSIS CENTER

BTU Content of Natural Gas by Gas Composition
(Southern California Gas Company)

PROJECT NO:
REPORTED BY: D.S. Tomlinson
REPORT DATE: 3/11/98
TEST LOCATION: Vidor 9, BH in front of ramp
SAMPLE DATE: 3/9/98

Component	Mole % Xi	(1) HHV	(2) LHV	(3) SG	Xi*HHV Btu/SCF	Xi*LHV Btu/SCF	Xi*SG
METHANE	20.88300	1012.3	911.5	0.5539	211.4	190.3	0.1157
ETHANE	0.58500	1773.7	1622.4	1.0382	10.4	9.5	0.0061
PROPANE	0.11900	2521.9	2320.3	1.5226	3.0	2.8	0.0018
iso-BUTANE	0.01159	3259.4	3007.3	2.0068	0.4	0.3	0.0002
n-BUTANE	0.01418	3269.8	3017.8	2.0068	0.5	0.4	0.0003
iso-PENTANE	0.00462	4010.2	3707.6	2.4910	0.2	0.2	0.0001
n-PENTANE	0.00000	4018.2	3715.5	2.4910	0.0	0.0	0.0000
C6 plus	0.00334	5194.5	4421.3	3.2522	0.2	0.1	0.0001
CARBON DIOXIDE	0.55600	0.0	0	1.5196	0.0	0.0	0.0084
OXYGEN	16.12900	0.0	0	1.1048	0.0	0.0	0.1782
NITROGEN	61.69500	0.0	0	0.9672	0.0	0.0	0.5967
Totals ---->	100.00				226.0	203.7	0.9076

(4) Compressiblity Factor (Z) for mixed gases

Total Non-Hydrocarbons	78.4	Helium 160 ppm
A = (Total SG)(0.0101)	0.00917	
B = (Total Non-HC)(.0070)	0.00549	
Z = 1.00369 - A + B	1.00001	

(5) Adjusted Values (14.73 psia, 60F, Gross, Dry, real volume basis)

HHV	226.0 BTU/real cubic foot
LHV	203.7 BTU/real cubic foot
Specific Gravity	0.9076

FOOTNOTES

(1) Higher Heating Value per ideal cubic foot @ 14.73 psia
Gas Processors Association (GPA) Standard 2145-94
(2) Lower Heating Value per ideal cubic foot @ 14.73 psia
Gas Processors Suppliers Association (GPSA) Vol. II - Sec. 23 - Fig.23-2 (1987)
(3) Specific Gravity
Gas Processors Association (GPA) Standard 2145-94
(4) Empirical formula for compressibility factor
American Gas Association's Transmission Report No. 5.
(5) Values are adjusted to reflect real volumes rather than ideal
volumes by dividing by the compressibility factor.
ex; (BTU/Ideal Gas Volume)/Z where Z=(Real Gas Volume/Ideal Gas Volume)

ENGINEERING ANALYSIS CENTER REPORT

Project No: TS95-C105-21
Reported By: Fred A. Contreras
Report Date: 10/18/95

Request: Monthly Helium Analyses for Wells and Barholes at Playa del Rey.

Requested By: Steve Cardiff **Mail Location:** 9580

Division/Dept. Southern Region /Transmission **Request Date:** 10/18/95

WELL	TYPE	HELIUM CONTENT		REMARKS
		ppm	* Gas %	
So. Cal # 2		78	40	
So. Cal # 4		57	39	
Trap 133		174	70	
Dunlap		119	60	
Fast		24	60	
Harlan		43	60	
DR10 - Casing		< 7	25	
DR10 - BH #1		<7	8	
DR10 - BH # 2		<7	15	
DR10 - BH # 3		124	18	
Vidor 18		12	76	

* (ppm values adjusted to 100% combustibles except where total combustibles are less than 8.0%)

Analyzed By: Fred A. Contreras

Approved By: [signature]

cc: PDR Field Engineer, ML 22GO
Steve Cagle

ENGINEERING ANALYSIS CENTER REPORT

Project No: RC038.04
Reported By: L.S.Brewer
Report Date: 8/4/98

Request: Monthly helium analysis for wells and barholes at Playa del Rey

Requested By: Eugene Covington Mail Location: 9580

Division/Dept. So. Region / Trans. Request Date: 8/3/98

WELL	TYPE	HELIUM * ppm	COMBUSTIBLE GAS %	REMARKS
So Cal 4	casing	39	93	
So Cal 2	casing	ND<7	84	

* (helium ppm values adjusted to 100% combustibles except where total combustibles are less than 8.0%)

Analyzed By: L. Brewer, M.J. Mayeda

Date Sampled: 8/3/98
Date Analyzed: 8/3 to 8/4/98
Approved By:

cc: Leigh Brewer

RUN 1216

TEST & DEVELOPMENT CENTER REPORT

Project No: CR-237

Reported By: JOHNNY LOZANO
Report Date: SEPT. 12, 1990

Request: Monthly Helium Analyses for (7) Pumping Unit Wells at Playa del Rey
ANALYSES FROM (3) ADDITIONAL WELLS INCLUDED AS PER REQUEST

Requested By: J.A. Thompson *Mail Location:* 9580 *Request Date:* 08/17/90

Division/ Work Group: South Basin Transmission-Underground Storage

TEST RESULTS ON SAMPLES TAKEN SEPT 11, 1990

WELL	HELIUM CONTENT OF CASING GAS, PPM	COMMENTS
TROXEL 1	16	WELL NOT PUMPING
TOWNSITE 2	34	WELL PUMPING
TOWNSITE 3	38	WELL NOT PUMPING
TOWNSITE 11	65	WELL PUMPING
BLOCK 10R	31	WELL NOT PUMPING
BLOCK 11	71	WELL PUMPING
VIDOR 18	10	WELL PUMPING
SO CAL 2	54	WELL PUMPING
SO CAL 4	48	WELL NOT PUMPING
DUNLAP 1	423	WELL PUMPING

Tested By: JOHNNY LOZANO

cc: R.A. Skultety, ML 401R

Approved By: Joe Sullivan 9/13/90

MSTRFORM\MF0035

PAGE 1

TEST & DEVELOPMENT CENTER REPORT

Project No: CR-140

Reported By: L. K. McCormack
Report Date: 5/29/90

Request: Analyze cylinder sample sent in for helium content.

Requested By: J. Thompson *Mail Location:* 9580 *Request Date:* 05/23/90

Division/ Work Group: South Basin/Underground Storage

On 5/23/90, the Test Center received a gas sample from Playa del Rey in a stainless cylinder labeled "Troxel Casing." The sample was analyzed for helium content using an in-lab Shimadzu chromatograph. The sample had a helium content of 22 ppm.

Tested By: L. K. McCormack

cc:

Approved By:

September 4, 2003

TO: THE CALIFORNIA DEPARTMENT OF FISH & GAME-
Mr. Raisbrook, Regional Manager
San Diego, California **fx 858 467 4201**

FROM: GRASSROOTS COALITION-
Patricia McPherson
3749 Greenwood Ave.
LA CA 90066 310 397 5779

RE: ECOLOGICAL ASSESSMENT OF AREAS B AND D- PLAYA VISTA, 6775 CENTINELA AVENUE, LOS ANGELES, CALIFORNIA &

PHASE 2 EIR- PLAYA VISTA

Dear Mr. Raisbrook,

Grassroots Coalition respectfully requests that the California Department of Fish & Game clarify, in writing, its scope of review and involvement regarding the Playa Vista site.

The EIR for the Playa Vista Phase 2 is now available for review, as I am sure that you are aware. Also, the Los Angeles Regional Water Quality Control Board (LARWQCB) sent Grassroots an Ecological Assessment (EA) of Areas B and D of the Playa Vista site for review. The deadline for comments was mid-August. I have included the LARWQCB letter with its cc list. Grassroots did respond but also notified various Fish & Game personnel, including Brad Henderson- our local CA. Dept. of Fish & Game (DFG) biologist, of the EA. In my comments to the LARWQCB, I noted that DFG had not been given the EA. Apparently, the LARWQCB has now sent the EA to DFG and given the DFG a September 15, 2003 deadline (attached letter).

While Grassroots would appreciate comments from the DFG regarding the EIR and the EA, we believe it is vitally and fundamentally important to clarify, in writing, the DFG role and scope of review at the Playa Vista site. In particular, our concern is that the oilfield gas issues at Playa Vista have not been assessed by any independent state agency.

It is vitally important for the DFG to clarify that it has played no role in the oversight for and/or evaluation of the newly discovered oilfield gas contamination problems of the Playa Vista site as they relate to the biology and ecosystems of the area and/or any other capacity.

The California Environmental Protection Agency- Department of Toxic Substances Control (DTSC) did respond, in writing, to the LARWQCB regarding the City of Los

Angeles' / Playa Capital gas study(May 2001), wherein DTSC stated the City study was incomplete and that:
-soil gas studies needed to be performed in native, undisturbed soils (studies performed thus far were done in soils that were predominantly disturbed from construction activities and had other problems noted by DTSC) and that,

- an ecological risk assessment needed to be performed (LARWQCB does not perform ecological risk assessments);

the DTSC sister agency, the LARWQCB, has not requested or required Playa Capital to fulfill the DTSC recommendations.

Because the oilfield gases, including benzene, toluene and xylene (BTEX) and oilfield generated hydrogen sulfide (H2S) are not issues within the scope of review for the LARWQCB, and because the LARWQCB has not adhered to the DTSC recommendations, or requested DTSC to step in for oversight of the oilfield issues (of CAL EPA agencies, DTSC has oilfield toxics within their scope of review and expertise) , there continues to be no independent state oversight for evaluations of the oilfield issues.

DFG HISTORY

I have requested of the DFG, through numerous DFG personnel, including those in OSPR, of any ability of the DFG to engage in a biological study of the potential negative consequences of the oilfield operation gas migration hazards that we now know exist at the Ballona Wetlands, the site of Playa Vista. Furthermore, the impacts of the construction activities creating enhanced gas migration and H2S production are also issues that potentially affect the ecosystems of Ballona. Thus far, there has been no response from the DFG that it has the ability to engage in any way regarding any of these matters.

In conclusion, if the DFG does not clarify the fact that it has played no role in the oilfield gas issues and apparently cannot engage these issues under its scope of review and study, then any action and/or response the DFG does engage in at the Playa Vista site will leave and, has left a biological gap of oversight that needs to be clarified. **It would be entirely misleading to the public** if the DFG were to continue involvement at the Playa Vista site and not clarify exactly what it does and does not include within its scope of review, with regard to its conclusions and/or recommendations regarding the Playa Vista site.

Mr. Raisbrook, Grassroots Coalition respectfully requests a written clarification of the DFGs role in oversight of the newly discovered oilfield gases that are migrating to the surface at Playa Vista.

I'm sending along a Public Record Act request for your help in our providing a formal request for the information requested above and also because of our need for a copy of the Habitat Mititgation and Monitoring Plan (HMMP) for Playa Vista.

Sincerely,
Grassroots Coalition, Patricia McPherson (ccDTSC, USEPA)

September 4, 2003

TO: **CALIFORNIA DEPT. OF FISH & GAME,**
Mr. Raisbrook, Regional Manager
San Diego, CA **fx 858 467 4299**

FROM: **GRASSROOTS COALITION,**
Patricia McPherson
3749 Greenwood Ave. LA CA 90066
310 397 5779

RE: **PUBLIC RECORD REQUEST ACT request**

Dear Mr. Raisbrook,

This is a request for records pursuant to the provisions of the California Public Records Act as amended (Cal. Gov. Code /6250, et seq.). I request an opportunity to inspect and make copies of all records prepared, owned, used, or retained by the Ca. Dept. of Fish & Game (DFG) regarding DFG participation in, oversight of the oilfield gas issues, subsidence issues of the Playa Vista site in Los Angeles, Ca. (Playa Vista site address is generally referred to as 6775 Centinela Ave. LA CA.; the site lies on both sides of the cross-roads of Jefferson Blvd. And Lincoln Blvd. In Los Angeles and is the historic site of the Ballona Wetlands)

Please also, provide a copy of the Habitat Mitigation and Monitoring Plan (HMMP) for the Playa Vista site.

This request includes all records regardless of form, including but not limited to letters, memoranda, telephone log entries, visitor log entries, message receipts, notations of conversations, meeting notes, e-mail messages or other records on magnetic media, fax cover sheets, reports, statistics, calendar entries, permits, questionnaires, photographs, audio tape, film, and videotape.

This request reasonably describes identifiable records or information produced therefrom and I believe no express provision of law exists exempting the requested records from disclosure. Should your agency find any portion of any requested record exempt from release, I ask that you carefully consider the public interest served by the full disclosure of all requested records.

The requested records relate to an important issue in which the public has expressed an enormous amount of interest. The Playa Vista development is located in an area of large volumes and pressures of oilfield operations gas that is migrating to the surface (Exploration Technologies Report April 2000). The public interest in these records clearly outweighs all other interests. Therefore, I request that you release non-segrated

copies of each of the requested records otherwise exempt under California Government Code 6254(a).

Should you find any portion of any requested record exempt from release, I ask that you exercise your discretionary authority to release the requested record in its entirety. If you decide against exercising your authority to release non-segregated copies of all requested records, Government Code Section 6257 requires that you release all reasonably segreable portions of the requested records. I reserve my right to challenge the withholding or deletion of any information.

If you decide to withhold any portion of any requested record, I ask that you provide me a list identifying what you have withheld. I also ask that you cite the specific exemption(s) being relied upon to withhold information. In addition, if you deny all or part of this request, Government Code Section 6256.2 requires that you provide the name and title or position of each person responsible for the denial of this request. Should you decide to withhold any information, Government Code Section 6256 requires that you notify me of the reasons for this determination no later than 10 days after receipt of this request. Government Code Section 6256.2 prohibits the use of the 10-day period, or any provisions of the Public Records Act, "to delay access for purposes of inspecting public records."

I also request any records that indicate, suggest or otherwise identify the prior existence of other records related to my request that may have been destroyed or modified. California Government Code Section 14755(a) makes clear that "(n)o record shall be destroyed or otherwise disposed of by any agency of the state" unless (1) the Director of the Department of General Services has determined that "the record has no further administrative, legal or fiscal value," and (@) "the Secretary of State has (also) determined that the record is inappropriate for preservation in the State Archives." The "willful removal" or "destruction" of agency records in violation of these statutory mandates can result in the imposition of criminal sanction. (See Cal. Gov. Code /6200(felony offense for destruction of records by "custodial officer") and Cal. Gov. Code/ 6201 (misdemeanor offense for destruction of records by "noncustodial officers")/)

Please call me at 310 397 5779 if you have any questions or need additional information. Thank you for your assistance and cooperation with this matter.

Sincerely,

Grassroots Coalition, Patricia McPherson

Case No. B213967

COURT OF APPEAL

STATE OF CALIFORNIA

SECOND APPELLATE DISTRICT

DIVISION THREE

ENVIRONMENTALISM THROUGH INSPIRATION AND NON-VIOLENT ACTION (ETINA), ET AL.

Appellants and Petitioners

v.

CITY OF LOS ANGELES, ET AL.

Respondents

PLAYA CAPITAL COMPANY LLC, ET AL.,

Real Parties-in-Interest and Respondents

Los Angeles Superior Court, Case No. BS 073182
Honorable Ann I. Jones

PETITIONERS ETINA, GRASSROOTS COALITION AND DANIEL COHEN'S JOINT REPLY BRIEF

Todd T. Cardiff, Esq. (SBN 221851)
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FAX: (619) 546-5133

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I. INTRODUCTION

If the Court only had five minutes to try this case, Petitioners would urge the Court to ask one question. What is the total amount of dewatering that is occurring from all sources in the Playa Vista area? The City of Los Angeles ("City") cannot answer that question. Real parties-in-interest could probably answer that question, but not from the information in the record. The record is silent on this vital question.

In fact, the record is silent on all rates and volumes of discharges. Yes, the record reveals an estimated groundwater discharge from five buildings of 16,000 gallons per day. But no back-up for that number. The record does not even reveal how the estimates of four of the buildings were calculated. The record does not even disclose whether the remediation dewatering at TS2 and the Fire Safety Training Area exceeds the estimated dewatering at the five buildings in Playa Vista. Take into account all the other dewatering that is going on at Playa Vista, including in Phase II, construction dewatering, and other remediation dewatering, including "toe drain" and "nuisance dewatering" and the Court can see how little information was actually provided to the public.

As will be discussed below, the City's 2007 CLA Report process fails to comply with the procedural or substantive requirements of CEQA. The City claims it was an addendum, but never described it as an addendum, never treated it like an addendum and certainly never considered it with the 1993 EIR as required by law. The Court must overturn the lower court's discharge of the writ and order it to deny the City's return to writ. The City must learn to comply with CEQA.

II. LEGAL FRAMEWORK

The basic purpose of CEQA is to provide the decisionmaker and the public with the environmental analysis necessary to ensure that the agency is fully informed of the environmental consequences of its decision before the project is approved. (Guidelines § 15002[1]; *Citizens of Goleta Valley v. Board of Supervisors* (1990) 52 Cal. 3d 553, 564.) "[T]he ultimate decision of whether to approve a project, be that decision right or wrong, is a nullity if based upon an EIR that does not provide the decision-makers, and the public, with the information about the project that is required by CEQA." (*San Joaquin Raptor/Wildlife Rescue Center v. County of Stanislaus* (1994) 27 Cal. App. 4th 713, 722 (quoting *Santiago County Water Dist. v. County of Orange* (1981) 118 Cal. App. 3d 818, 829).)

Such basic purpose and requirement does not disappear once the project is approved and the EIR is certified. While the EIR is deemed legally adequate after the time for challenging the EIR has passed, all agencies must consider the adequacy of the EIR upon any subsequent discretionary decision for the project. (Pub. Res. Code § 21167.2.) Upon the next discretionary decision, whether lead agency, or a responsible agency, must consider the project and the EIR to determine whether there are any changes to the project, changed circumstances, or new information rendering the prior environmental analysis inadequate to serve its informational purpose. (Pub. Res. Code § 21166.)

This is indisputable from the statutory framework. All levels of government must consider the environmental consequences and the environmental documents prepared for the project. (Guidelines § 15003(f).) For example, if a responsible agency must grant the next discretionary

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[1] CEQA Guidelines are located at Title 14 of the California Code of Regulations section 15000 et. seq..

approval for the project, such agency must consider the EIR or Negative Declaration. (Guidelines § 15096(f).) While the Guidelines specify that a "A subsequent or supplemental EIR can be prepared only as provided in Sections 15162 or 15163," this indicates that the responsible agency must determine whether the EIR is still legally adequate to describe the project and mitigate the impacts. The same process is necessary when the lead agency must grant the next discretionary approval. (Guidelines § 15162(c).) It must consider the prior EIR or negative declaration and consider whether any of the conditions identified in Public Resources section 21166 are present.

This basic theory, unchallenged by the Respondents, guides the Court's review. The first step of the agency is to determine whether there have been any changes to the project, the circumstances or new information that requires changes to the EIR. (Guidelines § 15162.) This must be done by identifying the information not considered in the EIR. (*American Canyon Community United for Responsible Growth v. City of American Canyon* (2006) 145 Cal. App. 4th 1062, 1073-1074.) The second step is to identify whether changes to the EIR are major or minor, and whether the changes or new information causes new significant environmental effects not previously discussed in the EIR or substantially increase the severity of the environmental effects. (Guidelines § 15162(a).) Depending on the level of the changes and severity of the effects, the agency must prepare either a subsequent EIR, a supplemental EIR, an addendum or no further documentation. (Guidelines § 15162(d).)

At the end of the process, assuming that the agency proceeded in a manner required by law, and supported their decision on the level of environmental review, the Court has one more task. The Court must look at the environmental document prepared by the agency and determine whether the EIR as amended, whether by an addendum, by a subsequent EIR or by a

supplemental EIR, or by nothing, adequately serves to inform the public and the decisionmaker of the consequences of its decision. (Guidelines § 15151.)

III. 2007 CLA REPORT

A. THE 2007 CLA REPORT PROCESS WAS DESIGNED TO CREATE THE APPEARANCE OF SUBSTANTIAL EVIDENCE WHILE EXCLUDING CONTRADICTORY DATA OR OPINIONS

Respondents claim that the 2007 CLA Report process went above and beyond the procedural requirements of CEQA. They claim that despite the lack of a requirement for public circulation, they held four public hearings (Resp. Brief at 22, fn. 9), contacted two state agencies (Resp. Brief at 20), and, of course, supplied all the relevant information. (Resp. Brief at 38-40.) However, additional proceedings are not a substitute for compliance with the letter of the law. It does not matter how many hearings are held, or how many state agencies are contacted, if the process omits relevant evidence and fails to produce an adequate document for informed decisionmaking. (Pub. Res. Code § 21003.1 and 21005.)

CEQA is premised upon "an interactive process of assessment of environmental impacts ... which must be genuine. It must be open to the public, premised upon a full and meaningful disclosure. . ." (*County of Inyo v. City of L.A.* (1984) 160 Cal. App. 3d 1178, 1185.) While perhaps the agency could later discount evidence, such as the list of industrial waste discharge permits for Playa Vista Phase I, or explain why the NPDES Permits showing additional dewatering operations are not relevant to their analysis of impacts, failing to provide such information to the public precludes informed public participation and decisionmaking. (*County of Amador v. El Dorado County Water Agency* (1999) 76 Cal. App. 4th 931,

946.) The City cannot hide behind its failure to gather or disclose relevant information to avoid challenges to its alleged substantial evidence. (*See, Sundstrom v. County of Mendocino* (1988) 202 Cal. App. 3d 296, 311 (discussing similar concept concerning a MND).) Substantial evidence must be evaluated in light of the whole record, not just the agency's supporting evidence. The whole record cannot be artificially truncated to support solely the agency's conclusions. (See Pub. Res. Code § 21167.6(e)(10) (record shall include any other written materials relevant to agencies compliance with CEQA or the project).)

As will be discussed below, the 2007 CLA Report was not a valid CEQA process. The procedure used by the City was focused solely on whether estimated dewatering from five buildings created a substantial impact on subsidence and plume migration. The analysis did not compare the 1993 EIR to determine available information or necessary project changes; did not consider the 1993 EIR when approving the project and 2007 CLA Report, and did not properly determine the baseline or cumulative impacts of the project in conjunction with all the other dewatering activities. The process failed to create a document sufficient to adequately inform the public and the decisionmakers of the environmental consequences of the decision.

B. THE COURT IDENTIFIED THE CHANGES NECESSARY TO THE EIR AND DETERMINED THAT SUCH CHANGES COULD RESULT IN NEW SIGNIFICANT EFFECTS REQUIRING A SUPPLEMENTAL OR SUBSEQUENT EIR

Respondents, unable to demonstrate any substantive review of the 1993 EIR in the record, argue that the necessary changes to the EIR were identified by the Court, which is should be sufficient to comply with CEQA. (Resp. Brief at 29.) Undoubtedly, the Court conducted a much more

thorough review of the 1993 EIR in drafting its prior decision than the City has done here. However, if the Court's review of the 1993 EIR is the basis of the City's decision, it certainly cannot change the findings of the Court of Appeal, which would require the preparation of a subsequent or supplemental EIR.

In this case, after reviewing the 1993 EIR, the Court held: "We conclude that the permanent groundwater dewatering contemplated in connection with the methane mitigation measures adopted by the city is a *potentially* substantial project change because it could result in those new or substantially more severe significant impacts." (1 CT 52-53.) CEQA's definition of "significant effect on the environment" is defined as "a substantial, or potentially substantial, adverse change in the environment." (Pub. Res. Code § 21068 (emphasis added).) Thus, because the Court already found that the project change may result in new significant effects the criteria triggering a subsequent of supplement EIR was already met. (Guidelines §§ 15162(a)(1), 15163(a).)

Consistent with the criteria of subsequent environmental review, the Court only provided two options, for the City to prepare a subsequent or supplemental EIR. The Court ordered the City "to vacate its approval of the methane mitigation measures, for the purpose of determining whether a subsequent or a supplemental EIR is required with respect to groundwater dewatering, and proceed accordingly as required by CEQA." (1 CT 62.) The Court could have easily ordered the City to determine whether a subsequent or supplemental EIR or an addendum was necessary, but it did not. (See, *City of San Jose v. Great Oaks Water Co.* (1987) 192 Cal. App. 3d 1005, 1017 (expressly mentioning an addendum as an option).) Thus, the only question for the City was whether the project change was major, requiring a subsequent EIR, or the change was minor, requiring a supplemental EIR.

Admittedly, there was sufficient ambiguity in the order that even the lower court would have preferred some clarification. (2 RT D-17.) Such ambiguity certainly prevented the Petitioners from enforcing the writ, or successfully bringing a contempt action. (2 RT D-36-38.) Nevertheless, considering that Respondents now claim that the Court's review of the EIR in the ETINA I decision was legally sufficient to relieve the City of the duty to conduct its own comparison, then surely the City cannot complain that the Court found substantial evidence of new or substantially more severe significant effects requiring the preparation of a subsequent or supplemental EIR. The Court should deny the return of the writ and order Respondents to determine whether a Subsequent or Supplemental EIR should be prepared, and not prepare an addendum.

C. THE CITY FAILED TO PROCEED IN A MANNER REQUIRED BY LAW BY FAILING TO IDENTIFY THE CHANGES NECESSARY TO CURE THE DEFECTS IN THE 1993 EIR

Respondents claim that nothing in CEQA requires a comparison of the EIR to the addendum. (Resp. Brief at 29.) Such statement side-steps the argument. Assuming arguendo that the City even had the option of choosing to preparing something other than a subsequent or supplemental EIR, the first step to evaluating the level of environmental review is to identify the changes to the project that were not considered in the original environmental review document. (*American Canyon Community United for Responsible Growth v. City of American Canyon* (2006) 145 Cal. App. 4th 1062, 1073-74.) Without providing the decisionmaker with a comparison between the 1993 EIR and the new information about dewatering, the City Council cannot make a meaningful determination of how to comply with CEQA.

Despite claiming that a comparison of the review is not required, Respondents argue that they did, in fact, identify the changes necessary to the EIR. (Resp. Brief at 29.) This was allegedly done by relying on the Court's finding that the 1993 EIR did not discuss methane related dewatering, and repeating such finding in the 2007 CLA Report. (Resp. Brief at 29 citing 3 RR 471.) However, the 2007 CLA Report does not mention the 1993 EIR at all. (3 RR 471.) Respondents simply point to a recitation of the Court's decision in ETINA I, which does not mention the 1993 EIR. (3 RR 471.) The 2007 CLA Report's summary of the Court decision does not constitute review or consideration of the 1993 EIR.

Respondents further claim that comparing the 1993 EIR to the 2007 CLA Report would be a moot act – "there is simply nothing in the EIR against which to compare the 2007 CLA Report" (Resp. Brief at 29.) That is not true. While there may not have been a discussion about "methane related dewatering," the 1993 EIR certainly discussed dewatering, and not just in terms of the Jefferson sewer project. (4 RR 822 at 40.) The EIR warned, "subterranean structures located in areas with a high groundwater table, if any, must be constructed in a way that minimizes the need for long term pumping, especially near the contaminant plume in area D." (4 RR 822 at 40, 4264.) The 1993 EIR states under its cumulative impacts analysis, "Projects within the vicinity of the project site can be expected to impact the local ground water tables by affecting ground water levels should dewatering be required, with potential spreading of contaminants during excavation." (4 RR 822 at 4266; See also 4264 (construction dewatering may lower water table); 4256 (saltwater intrusion.) But, the 1993 EIR concluded that "Excavation below ground water table for subterranean structures is not expected in Area D." (4 RR 822 at 5311.) While the vast quantities of methane leaking at Playa Vista were not discovered until around 1999, and therefore the 1993 EIR could not have analyzed "methane related

dewatering," the concerns about dewatering in general would have been invaluable for the City Council to consider. (5 RR 1024.)[2]

Nothing in the record demonstrates the City reviewed the EIR and identified the changes necessary to the EIR. The simple fact that both construction and permanent groundwater dewatering is occurring at Playa Vista, constitutes a major change to the project. The fact that Avalon, the building closest to the contamination plume, is undergoing significant permanent dewatering, is a major change, if not an outright violation of the mitigation measure requiring building to be designed to minimize the need for long term pumping, especially near the plume. Had the City actually identified the changes in the EIR, the City Council may very well have come to a vastly different conclusion.

In addition, had a comparison been conducted, the City Council might have wondered why the mitigation measures identified in the EIR were not followed. The primary mitigation measures were: first, avoid dewatering; second, if dewatering must occur, identify well locations and discharge rates; and third, create a plan for the beneficial use or discharge of the water. (4 RR 822 at 40.) Respondents argue that the mitigation measures identified only apply to the dewatering for the deep-gravity sewer, and not for other portions of the project. (Resp. Brief at 30-31.) However, the EIR states "before any long-term dewatering is conducted a plan for beneficial use or discharge...must be submitted and approved..." Further, at that time, the only expected long term dewatering was in connection with the deep gravity sewer and the remediation plant. (4 RR 822 at 4274.) In addition, the 1993 EIR explains that the remediation plant would use the remediated

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[2] The concentrations of methane, described by the City's expert, in the Playa Vista is truly frightening. (5 RR 908, 913 (methane bubbling through water), 5 RR 915 (62.9% to 76.16% methane concentrations 4 feet below surface).) In some areas, the methane coming through the ground is described as a macro-seep. (5 RR 913.).

groundwater to supply the freshwater marsh. (4 RR 822 at 4263, 4274.) Such statement contradicts Respondents' assertion that there is no beneficial use available for the groundwater. (Resp. Brief at 6 fn. 3.)

Respondents finally argue that the impacts of dewatering in the EIR were less than significant by the mitigation. (Resp. Brief at 30.) But, the mitigation measures were not implemented. As is evident from the claims of construction dewatering and the fact that at least five buildings in Playa Vista have permanent groundwater dewatering, dewatering has not been minimized. Further, there is no plan for beneficial use or discharge of the pumped water. Pumping groundwater into the sewer does nothing to help the environment, such as the constructed wetlands, and further taxes the City's infrastructure.

Failing to identify the changes in the 1993 EIR deprived the City Council of the ability to make an informed decision and the public the ability to comment on the proposals. The City failed to proceed in a manner required by law. The return to writ must be denied.

D. THERE IS NO EVIDENCE THAT THE CITY COUNCIL MEMBERS CONSIDERED THE 1993 EIR IN CONJUNCTION WITH THE 2007 CLA REPORT

In a related, but separate issue, one of the requirements for approving project changes or the same project despite changed circumstances or new information, is for the City Council to consider the EIR in conjunction with the addendum prior to approving the project. This is expressly stated in CEQA Guidelines, "The decisionmaking body shall consider the addendum with the final EIR or adopted negative declaration prior to making a decision on the project." (Guidelines § 15164.) The purpose of the addendum is to cure the informational deficiencies in the EIR. Because, as the name implies, the addendum "adds" to the EIR, or makes small or minor changes,

it cannot serve its informational purpose by being considered as a separate, independent document. Failing to consider the EIR in conjunction with the addendum constitutes an abuse of discretion. (Code Civ. Proc. § 1094.5.) "Only be requiring the [lead agency] to fully comply with the letter of the law can a subversion of the important public purpose of CEQA be avoided." (*People v. County of Kern* (1974) 39 Cal. App. 3d 830, 842.)

As noted above, it is the decision maker, not agency staff that must consider the addendum with the EIR.[3] Respondents, to their credit, do not contend that the peer reviewers or City Staff's alleged review the 1993 EIR was sufficient to satisfy the requirements of an addendum. (Resp. Brief at 26.) Instead, Respondents contend that the City Council did, in fact, review the 1993 EIR and 1995 MND/Addendum with the 2007 CLA Report. (Id.) Thus, the question for the Court is whether the record reveals the City's Council review.

First, there is nothing in the 2007 CLA Report that describes the project as originally proposed or even mentions the 1993 EIR. The strongest evidence that the City can point to is a listing of the CD ROM containing the 1993 EIR as "Additional Documents Reviewed under the Initial Peer Review Reports." (3 RR 481.)[4]

Respondents claim that no finding is required to state that the City Council considered the 1993 EIR in conjunction with the 2007 CLA Report. The only case which directly addresses the issue states that an express finding is necessary, but found harmless error when it was clear that the decision makers did, in fact, consider the EIR in conjunction with the addendum. (*Save San Francisco Bay Assn. v. San Francisco Bay*

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[3] Despite Respondents assertion, this issue was adequately preserved for appeal. (14 CT 3248.)

[4] The City Council may have only had photo copy of the label of the CD, considering that the original record transmitted to the court contained only photo copies labels of the CD-ROMs.

Conservation etc. Com. (1992) 10 Cal. App. 4th 908, 935.) The *River Valley* case cited by Respondents addresses a different issue, whether findings to support the EIR, and more specifically, whether findings concerning "significant unavoidable affects" must be made again when approving an addendum to the EIR. (*River Valley Preservation Project v. Metropolitan Transit Development Bd.* (1995) 37 Cal. App. 4th 154, 177.) But, there is nothing to suggest in *River Valley* that the lead agency in that case failed to make a finding that it had reviewed the Final EIR. In fact, it is clear that the agency in *River Valley* was closely scrutinizing the EIR. (*Id.*)

Respondents cannot credibly argue that the City Council impliedly considered the EIR with the 2007 CLA Report. Respondents have not identified a single question, comment or anything from any of the City Council Members during the hearings that demonstrates an understanding that they were considering the 1993 EIR in conjunction with the 2007 CLA Report. The assertion that the EIR was somewhere in the administrative record is not an indication that the City Council considered the EIR. (*Kleist v. City of Glendale* (1976) 56 Cal. App. 3d 770, 777.) To accept Respondents' contention that listing the EIR in an index is sufficient would wipe out the mandatory requirement to consider the addendum with the Final EIR. (Guidelines § 15164.)

Furthermore, had the City Council been forced to make even that simple written finding - that it considered the 1993 EIR with the 2007 CLA Report in compliance with Guidelines section 15162 - then, at least the City Council Members would have been alerted to the duty to compare the information in the EIR with the information in the addendum. Such finding would have also alerted the public that the City considered the 2007 CLA Report an addendum, allowing them to respond appropriately. As it was, there was nothing in the 2007 CLA Report that identified itself as an addendum; there was no finding or indication in the 2007 CLA Report that

the City Council should consider the 2007 CLA Report with the 1993 EIR; there was no advice from the City Attorney that the City Council should consider the 1993 EIR in conjunction with the 2007 CLA Report; and there is no indication that the City Council took it upon themselves to consider the 1993 EIR with the 2007 CLA Report. The City failed to follow the procedures required by law, and the City's Return to Writ must be overturned. (Pub. Res. Code § 21168.)

E. THE BASELINE OF THE CDM MODEL IS NOT ACCURATE AND BASELINE CONDITIONS WERE NOT PROPERLY DETERMINED OR DISCLOSED TO THE PUBLIC

Respondents claim that because the City decided to rely on CDM's aquifer model, and such model is allegedly generally accepted by hydrologists, then the Court must accept that such model is valid and unassailable. (Opp. Brief at 14 & 35, citing *Nat'l Parks & Conservation Ass'n v. County of Riverside* (1999) 71 Cal. App. 4th 1341, 1364.) Respondents allege that modeling is accepted and often required under CEQA. (Resp. Brief at 35.) Respondents then go to great lengths discussing the modeling, asserting that CDM utilized industry-standard models developed by U.S. Governmental agencies. (Resp. Brief at 36.)

But, Petitioners are not attacking the use of a model. (Resp. Brief at 36.) Petitioners object to using estimates for determining the data used for the model. A model can only be accurate as the data used to support the model. The issue here is whether the baseline conditions used for the model were accurate and disclosed. (*Save Our Peninsula Committee v. Monterey County Bd. of Supervisors* (2001) 87 Cal. App. 4th 99, 120.)

As noted in the Kostka Treatise section cited by Respondents, "When precise data is not available, an EIR may rely on informed estimates." (Resp. Brief at 35 citing Kostka & Zischke, PRACTICE UNDER THE CAL.

ENVTL. QUALITY ACT (Cont. Ed. Bar 2010) § 11.34.) However, as discussed in *Save our Peninsula*, it is an abuse of discretion to use estimates to describe baseline conditions, in this case actual dewatering, when actual data is available. (*Id.* at 121.) Without an accurate determination of baseline conditions, the impacts cannot be evaluated. (*Id.*)

In this case the amount of dewatering from the four buildings was estimated to be 16,000 gallons per day. This was based on allegedly accurate readings from Avalon, after a 40% reduction, to find a "corrected" discharge of 209 gallons per day, "which was a perfect match to the measured groundwater discharge." (3 RR 530.) Of course, the measurements were not provided in the record. The public cannot determine whether the estimate was a perfect match with a one day flow measurement, actual measurements averaged over a month, or the mean water discharge over a year. Such easily provided data is absent from the record.

Assuming that the measured Avalon groundwater discharge is accurate, there is no indication on how the discharge estimates for the other buildings were derived. No formula is provided in the record. No calculations are provided. There is no way for the public or the decisionmaker to evaluate the basis of the estimates. They are forced to simply accept (or reject) the estimates as accurate.

Furthermore, there is no legitimate reason to estimate the discharges from the other buildings. Like Avalon, the other buildings were complete, with functioning dewatering systems and industrial waste discharge permits and should have installed flow meters. Amazingly, Playa Vista prepared and provided a complex chemical analysis of the groundwater to determine that 40% of the discharge came from irrigation, but could not provide meter readings on all buildings.

The excuse for not using actual discharge volumes is explained by CDM:

> Given the numerous variables, it was not possible to predict the effects of a complex groundwater system by measuring actual flows from the dewatering systems. For these reasons, CDM utilized the calibrated groundwater model to estimate the volume of water generated by the dewatering systems.

(1 RR 21.)

Such explanation makes little sense considering that the rates of discharge were input parameters for the model. The actual dewatering volumes or rates, like the estimated volumes, could have been imputed into the model. Failing to measure the volumes or, more likely, failing to disclose the actual volumes of dewatering places the results of the model in serious question. As noted by the Department of Toxic Substance Control, "the model results would be very sensitive to the changes of certain parameters." (2 RR 210.) Obviously, a change in the amount of dewatering for methane may have an incredible impact on the results of the groundwater model.[5]

Furthermore, had the actual discharge volumes been disclosed, then the discrepancy between the two estimates for the Waterstone building (aka Product 102) would have been resolved. As discussed in Petitioners' Opening Brief, an earlier estimate for the Waterstone building calculated groundwater discharges of 4,815 cu/ft. per day, which "corrected" is five times the "corrected" amount of 605 cu/ft per day estimated for CDM's model. (32 Supp. RR 8541; 3 RR 530.)

Respondents do not dispute the accuracy of this earlier estimate. Instead, they claim that the estimate was for construction dewatering, not methane dewatering. (Resp. Brief at 41.) Unfortunately for Respondents, the record demonstrates that it was an estimate applicable to both

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[5] The Regional Water Quality Control Board's faith, or lack thereof, in CDM's model is demonstrated by the demand for Playa Vista to install a sentinel well. (4 RR 778.)

construction dewatering and methane dewatering. The report states, "A dewatering system will be designed to keep the methane pipes free of water should groundwater rise, and to maintain dry working conditions in the temporary excavation during construction." (32 Supp. RR 8540(emphasis added).) The report also states, "the inverts for the dewatering system pipes are planned for placement at the proposed pad grade, which ranges from El. +0.6 to +1.9" (Id.)[6] The reports estimates a 25 gallons per minute discharge, but recommends a dewatering system capacity of 100 gallon per minute for a two-level basement. (32 Supp. RR 8542.) In addition, the report states, "This does not include any surface water entering the basement though the access ramps from the street or other sources, and the actual dewatering system may have a higher capacity." (Id.) Finally, the report estimates that the groundwater will be lowered nearly 4 feet, which is less than the actual lowering of groundwater as built. (32 Supp. RR 8542; 3 RR 555.)

Most damning to Respondents' "construction dewatering theory" are the engineers' hand-drawn schematics showing the basement with the "methane/dewatering system" along with all the engineers' hand-written calculations. (32 Supp. RR 8694-8696.) Clearly, the engineer intended his estimates to be applicable to the permanent groundwater dewatering system.

The estimate provided by Playa Vista's engineer in 2003 estimated a dewatering rate of 25 gallons per minute, or 36,000 gallons per day. He never contemplated surface water intrusion in his calculation. But, even if his calculations overestimated the actual discharge by 100%, Waterstone's discharge would exceed CDM's estimate of 16,000 gallons per day for all four buildings (16,000 gallons). Further, the earlier estimate for Waterstone was prepared when dewatering was simply an engineering issue, necessary to determine the design of the pumps. Playa Vista's engineer at that time

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[6] The actual elevation of the dewatering pipe at Waterstone is -1.0 MSL. (3 RR 555.)

had no reason to believe that his dewatering calculations would be reviewed by anyone else other than Playa Vista.

The pre-writ report and calculations greatly questions the accuracy and credibility of the modeling input parameters prepared by CDM. At the very least, the incredible discrepancy highlights the necessity of using the actual discharge rates from each of the buildings, instead of using unverifiable estimates. The failure to provide the actual discharge rates and volumes and instead rely on estimates constitutes an abuse of discretion under CEQA.

F. THERE IS NO EVIDENCE IN THE RECORD THAT THE CITY CONDUCTED A CUMULATIVE IMPACTS ANALYSIS OF ALL DEWATERING

Respondents swear that the City accounted for all dewatering at the Playa Vista site. (Resp. Brief at 43.) According to the brief, CDM took into account all past, present, and future dewatering activities at Playa Vista, including: historical groundwater pumping attributed to construction dewatering and ongoing remediation efforts at the site (Resp. Brief at 43); toe drain and nuisance dewatering (Resp. Brief at 44-45); Playa Vista Phase II (Resp. Brief at 47), and even the East Campus, which they erroneously claim, once again, is construction dewatering. (Resp. Brief at 46.) Mentioning such dewatering is not the same as analyzing such dewatering, nor is it the same as analyzing all such dewatering in a cumulative fashion.

Had the City actually prepared a cumulative impacts analysis it would have been easy to identify the answer to the key question. Does the total amount of dewatering occurring at Playa Vista exceed the recharge rate for

the aquifer?[7] However, a thorough review of the record yields no answer to this vital question. At best, the record yields a number of 1.2 inches per year of "recharge" from precipitation and an indecipherable mélange of numbers deep in the technical record discussing boundary inflow conditions. (3 RR 528, 8 RR 1574.) But the record does not yield an answer in any manner that the public can understand, as to whether the total amount of dewatering is slowly draining the aquifer.

The CEQA Guidelines are instructive on the type of cumulative analysis that should be included in an EIR.

> [T]he following elements are necessary to an adequate discussion of cumulative impacts ....either:
>
> (A) A list of past, present and probable future projects producing related or cumulative impacts, including, if necessary, those project outside the control of the agency, or
>
> (B) A summary of projections contained in an adopted local, regional or statewide plan, or related documents, that describes or evaluates conditions contributing to the cumulative effect.

(Guidelines § 15130.)

While such guideline is applicable to an EIR, it is hard to imagine how an analysis of cumulative impacts in any environmental document prepared under CEQA would not start with a list of all the dewatering activities at Playa Vista and the volumes of each of their discharges. At the very least, sufficient information should have been provided demonstrating that the amount of dewatering, when considered in conjunction with past,

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[7] There appears to be some dispute as to whether recharge includes solely rainfall recharge, or it includes boundary conditions, such as underground flows from outside of Playa Vista. Such distinction is irrelevant to Petitioners, interested in determining whether cumulative pumping is lowering groundwater levels, especially for the adjacent state protected Ballona Wetlands.

present and probable future projects, does not exceed the "recharge rate" of the aquifer. This information was not provided and therefore the 2007 CLA Report failed to create an EIR adequate for informed decisionmaking.

In fact, what is clear from the record, and Respondents' brief, is that the 2007 CLA Report was anything but a cumulative impacts analysis. The report and the City distinguished groundwater dewatering from nuisance and toe drain dewatering despite the fact that rain and irrigation recharge the aquifer. (Resp. Brief at 7.) Respondents distinguish construction dewatering and remediation dewatering from methane dewatering. (Resp. Brief at 8.)

G. THE CITY'S FAILURE TO PROVIDE THE PERTINENT DATA, MUCH LESS RAW DATA, PRECLUDED INFORMED PUBLIC PARTICIPATION AND PREVENTED THE PUBLIC FROM VERIFYING THE ACCURACY OF THE GROUNDWATER MODEL

Respondents contend that the CD-ROM data disk provided to Petitioners was not corrupt and that they were not required to provide raw data to support their model. The first issue is an evidentiary issue, and the second issue is a legal issue easily resolved by reviewing the pertinent sections of CEQA and the CEQA Guidelines.

First, Respondents admit that the peer reviewers and the City had trouble reading certain files on the CD-Rom disks provided by Playa Vista. (Resp. Brief at 32.) Thus, Respondents sent a replacement disk to the peer reviewers and the City, ensuring that all the files could be opened. (8 RR 1512.) But, a replacement disk was never provided to the public. In fact, in the various responses to comments, the City claimed it was simply the Petitioners' inability to use the MODFLOW program, not the disk, that was the problem.

Because of Petitioners' inability to read the data, despite attempting to use the MODFLOW program, Petitioners requested that the data be provided in "non-binary format." In other words, provide the input data in a manner that can be tested by third parties. Playa Vista refused.

But, it is not simply the raw data that is missing from the record, it is the relevant data. Had Petitioners been given the input parameters, they could have replicated the model. But, simple, basic information such as the total amount of dewatering at the site, the volumes and rates of discharges at the remediation wells and other important information was not provided in a verifiable format.

A prime example of this lack of basic information can be seen in the analysis of worse case scenario. While CDM explains many of the variables, the assumptions and the changes, the report fails to identify the amount of dewatering that is occurring. (4 RR 782.) Again, there is no way to determine the amount of dewatering occurring at the remediation wells. (Id.) Petitioners are certainly entitled to this kind of "raw data."

Respondents contend that there is "no authority to disclose raw data or permit 'independent verification" of the modeling. However, there is strong statutory authority within CEQA to disclose raw data to permit verification. For example, in discussing the information to be included in an EIR, CEQA states:

> "Environmental impact report" means a detailed statement...provided that information or data which is relevant to such a statement and is a matter of public record or is generally available to the public need not be repeated in its entirety in such statement, but may be specifically cited as the source for conclusions stated therein; and provided further that such information or data shall be briefly described, that its relationship to the environmental impact report shall be indicated, and that the source thereof shall be reasonably available for inspection at a public place or public building.

(Pub. Res. Code § 21061 (emphasis added).)

The Guidelines specify:

> The information contained in an EIR shall include summarized technical data, maps, plot plans, diagrams, and similar relevant information sufficient to permit full assessment of significant environmental impacts by reviewing agencies and members of the public. Placement of highly technical and specialized analysis and data in the body of an EIR should be avoided through inclusion of supporting information and analyses as appendices to the main body of the EIR.

(Guidelines section 15147 (emphasis added).)

While these sections specifically identify data to support conclusions in an EIR, there would not be any reason why any other kind of environmental review would permit the withholding of raw data. (See Pub. Res. Code §§ 21003.1 & 20005.) One of the express purposes of CEQA is, "to demonstrate to an apprehensive citizenry that the agency has, in fact, analyzed and considered the ecological implication of its actions." (Guidelines 15003(d); *No Oil v. Los Angeles* (1974) 13 Cal. 3d 68, 86 (superseded on other grounds by Pub. Res. Code § 21082.2(b)).) Clearly, such policy cannot be accomplished without verifiable data.

The *Blue* case cited by Respondents is inapplicable and distinguishable on numerous grounds. (*Blue v. City of Los Angeles* (2006) 137 Cal. App. 4th 1131, 1135.) First, *Blue* is California Redevelopment Law case, not a CEQA case, and therefore does not have the same express duties to disclose as cited above. (*Id.* at 1134.) Most specifically, CEQA directs that "non-compliance with the information disclosure provisions of this division which precludes relevant information from being presented...may constitute a prejudicial abuse of discretion." (Pub. Res. Code § 21005.) Case law finds that it is a prejudicial abuse of discretion if the omitted information precludes "informed decisionmaking and informed

public participation. (*County of Amador v. El Dorado County Water Agency* (1999) 76 Cal. App. 4th 931, 946.)

Secondly, in *Blue*, the Court notes that the information sought, the "Walker sheets" did not "preclude public participation." (*Blue, supra,* 137 Cal. App. 4th at 1143.) The Court reasoned that actual existing conditions of the dilapidated properties constituted the actual raw data. "By inspecting the project area themselves, plaintiffs could have made their own assessment as to the accuracy of the information regarding conditions in the project area." (*Id.*)

In this case, Petitioners cannot inspect the dewatering rates themselves. Petitioners cannot simply visit Playa Vista, take a picture of a building, and determine the extent of the dewatering of the aquifer. Such information must either come from Playa Vista, or the City. Basic information such as the volume and rate of discharge from the remediation wells used in the model is unavailable. The dewatering rates from the buildings in the "worse case scenario" model is unavailable. In this case, the raw data is required under CEQA, but even stating the unverifiable numbers would have provided Petitioners something to work with. The record demonstrates that the relevant data, whether raw or not, was simply not available.

Failure to provide verifiable raw data is an abuse of discretion. But in this case, relevant data, whether verifiable or not, was not available. The failure to provide the basis of the model constitutes an abuse of discretion and the Court should deny the return to writ.

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H. THE CITY COUNCIL NEVER DETERMINED WHETHER THE 50-FOOT VENT WELLS WOULD BE EFFECTIVE FOR THE LIFE OF THE PROJECT WITHOUT DEWATERING.

The 50-foot vent wells provide an excellent example as to why a supplemental or subsequent EIR must be prepared, and why CEQA findings and CEQA mitigation should be imposed. (Pub. Res. Code § 21081; Guidelines § 15091.) First, as stated in the previous ETINA decision, the parties dispute whether the 50-foot deep vent wells require dewatering. (1 CT 53.) The Court of Appeal specifically found that it did not need to resolve the dispute.

Despite Respondents' attempt to mislead the Court otherwise, the City's peer reviewers did not consider whether the 50-ft vent wells required dewatering. (Resp. Brief at 42.) This is evident from a response to comments by Playa Vista which states, "the 50-foot vent wells were not considered or analyzed by the peer reviewers." (4 RR 833; See also, 3 RR 472 (describing the two tasks of the peer reviewers).) The 2007 CLA Report states in a conclusory manner "some of the commenters at the hearings believed incorrectly that the dewatering system at Playa Vista included "50-foot vent wells". (3 RR 472.) The 2007 CLA report also cites a LA Board of Engineering Report, which apart from the reference, states exactly the same thing as the 2007 CLA report. (6 RR 1277.)

Had the City Council actually considered whether the 50-foot vent wells adequately vented methane without dewatering, the City would be entitled to deference on its factual findings. (Pub. Res. Code § 21168.) But, the process deprived the City Council of the opportunity to consider public comments, discuss the conflict between experts, and impose performance criteria to ensure that the 50-foot vent wells remained unclogged and operational for the life of the project.

This is extremely important. As noted by the City's own experts in 2000, "due to the extremely high concentrations of methane contained in the 50 foot gravel aquifer....we believe the 50-foot aquifer also requires a mitigation system." (28 AR 7479.) The City expert continued,

> If the pump and treat or equivalent methane mitigation system is not effective or if Playa Capital does not install an appropriate methane mitigation system in the 50 foot aquifer, we believe that the development should not proceed. Without the proper mitigation of the methane present, a dangerous situation exists at the site. No further development should be allowed on this site until these mitigation issues are resolved.

(Id.) The test wells were not successful, and many of them clogged. (5 RR 917; 3 RR 572.)

As pointed out by Respondents, there is a report prepared by CDM, Playa Vista's experts, regarding tests conducted on the installed 50 foot vent wells. Such report tested approximately 15 deep vent wells in August of 2005, and again in October of 2005, and found that methane was detected in excess of ambient air background at all of the deep vent wells. (3 RR 570 & 572.) However, as noted by Petitioners, some of the tests appeared to be from other vent wells, because the well identification numbers from August to October did not match. (*Compare* 3 RR 577 *with* 3 RR 596 (listing some different identification numbers "sample id" for the wells tested).) In addition, some wells show dramatic drops in methane concentrations between August and October. For example, well LTW-700-4 recorded 130,000 ppmv of methane in August 2005, and only 18.0 ppmv of methane in October 2005. (*Compare* 3 RR 583 *with* 3 RR 604.)[8] This would seem to

[8] Petitioners recognize that it is somewhat unfair to be citing to new portions of the administrative record on Reply. However, Petitioners did not want to be accused of not providing "an accurate and complete description of the evidence" with regard to the 50-foot vent wells. (Resp. Brief at 42, citing *Defend the Bay v. City of Irvine* (2004) 119 Cal. App. 4th 1261, 1266.)

indicate that the methane concentrations were reducing, which might indicate that the vent wells were slowly being clogged with silt.

And there was certainly the desire to investigate such issues. As complained by one City Councilmember:

> "Look, our number one responsibility is the safety of our constituents . . . I'm confused enough to say I don't understand why a supplemental EIR which might put his issue to bed wasn't done in the last 13 months when we had all the time from last January to do it. Explain again, just from a safety standpoint. That's what I care about is the safety of my people." (2 RR 445.)

In response, City Staff replied, "all I can say to that is because the city attorney advised that under the law there is not a factual basis for the council to require a supplemental EIR." (2 RR 446.)

The details are not particularly important at this point. What is important is that, there are dangerous concentrations of methane in the 50-foot aquifer, a conflict between experts as to whether the 50-foot deep vent wells require dewatering, and a City Council and public that was deprived of the opportunity to consider such issue. These vent wells must effectively vent for the life of the project which could be 80 to 100 years. A conclusory statement that dewatering for the 50-foot vent wells is not required leaves the issue as unresolved as the last time the Court reviewed this case. (1 CT 53.)

I. PETITIONERS EXHAUSTED THEIR ADMINISTRATIVE REMEDIES BECAUSE THE CITY FAILED TO IDENTIFY THE 2007 CLA REPORT AS AN ADDENDUM

Respondents simultaneously claim that the City was not required to identify the 2007 CLA Report as an addendum to the 1993 EIR, and that

Petitioners failed to exhaust their administrative remedies by failing to criticize the City's process of adopting an addendum. (Opp. Brief at 23-24.) The City cannot have it both ways. Clearly, Petitioners could not have complained that the 2007 CLA Report failed to meet the requirements of an addendum if the City never identified that they were considering an addendum to the 1993 EIR.

The purpose of the exhaustion doctrine is to provide an agency an opportunity to respond before those objections are subjected to judicial review. (*Woodward Park Homeowners Assn., Inc. v. City of Fresno* (2007) 150 Cal. App. 4th 683, 712.) If there is not an opportunity to raise objections, then the exhaustion doctrine does not apply. (*Id.* citing Pub. Res. Code § 21177(e).)

In this case, because there was no notice that the 2007 CLA Report was an addendum, there was no opportunity to object that the City was not following the proper procedure for an addendum. In fact, the first time that the City even mentioned that the 2007 CLA Report was an addendum was during the return to writ, 1.5 months after the final hearing. (12 CT 2790 (first claim that the 2007 CLA Report was an addendum).)

Not once during the administrative process did anyone with the City claim that the process was an addendum. (See, 2 RR 396-97 (no discussion at the hearing that the City was adopting an addendum).) There was no notice that the City was taking action pursuant to CEQA Guidelines section 15164. The public notice of the final City Council meeting identified the item as "Communication from the Chief Legislative Analysis relative to compliance with a writ of Mandate...and recommendations that City Council adopt [CEQA] findings on whether a supplemental or subsequent [EIR] is required..." (2 RR 387.)

The City provided three choices to the City Council Members – a Subsequent EIR, Supplemental EIR or neither. (2 RR 354, 356, 400, 436; 8

RR 1505.) In talking about the peer review, the City attorney noted, "There is no requirement of how you go about doing it or whether or not you have to send it to certain agencies or whether or not you have to write up certain findings on the peer review. It's simply a study." (2 RR 403.) The recitation of law in the 2007 CLA Report itself neglects to mention that an addendum is an option. Thus, by the City's own statements the 2007 CLA Report is something completely separate from CEQA. As noted by the City Attorney herself, "it is simply a study." If anything, the City decided to prepare "no further documentation" and abused its discretion in doing so.

Furthermore, it is not necessary to cite to the exact legal inadequacy as long as the agency is fairly apprised of the relevant facts and issues in dispute. (*McPherson v. City of Manhattan Beach* (2000) 78 Cal. App. 4th 1252, 1264.) There were numerous comments from the public objecting to the 2007 CLA Report and the need for a supplemental or subsequent EIR. (See, e.g., 1 RR 42 (Discussing the 1993 EIR.); (1 RR 187 ("The EIR is no longer valid"); (1 RR 190 ("The City cannot "approve" the project until the EIR is complete. The incomplete EIR can only become complete under CEQA compliance.") (1 RR 198) (The CLA Report is improperly narrow and does not review the issues in light of the whole records as CEQA requires.") These comments and many others are specific enough in a non-judicial setting to preserve the issues.

Finally, if there is a requirement that Petitioners make specific objections, then surely, there must be a corresponding requirement for the City to identify specifically what it was allegedly approving. But even when questioned, the City never identified the 2007 CLA Report as an addendum. Five days prior to the final hearing, Grassroots asks, "What action is being taken today? What does 'adoption' mean and entail?" (1 RR 184.) There was no notice that the City was considering an addendum in conjunction

with the 1993 EIR, because the City council never considered the 2007 CLA Report an addendum to the 1993 EIR.

IV. MOTION TO AUGMENT

A. This Court May Consider Relevant and Improperly Excluded Extra-Record Documents Because Petitioners Have Proven Such Documents Fall Under the Exception Enunciated by the Supreme Court of California.

Respondents contend that this Court may not consider two sets of relevant, extra-record documents: (1) documents from the LA City Department of Sanitation, including a table showing permitted discharges of up to 72,000 gallons per day, and (2) documents from the RWQCB showing permitted discharges of 950,000 gallons per day ("gpd"). (16 CT 3696-3700.) Though extra-record evidence is generally inadmissible, the Supreme Court of California has enunciated an exception to this general rule. "Extra-record evidence is admissible if the proponent shows that the evidence existed before the agency made its decision, but that it was impossible in the exercise of reasonable diligence to present it to the agency before the decision was made." (See *Cadiz Land Co.* v. *Rail Cycle* (2000) 83 Cal. App. 4th 74, 119 quoting *Western States Petroleum Assn. v. Superior Court, supra,* 9 Cal. 4th 559, 576-578.) This exception corresponds with Code of Civil Procedure section 1094.5, subdivision (e), which grants the court discretion to remand the case for reconsideration if the court finds "there is relevant evidence, which, in the exercise of reasonable diligence, could not have been produced at the administrative hearing or which was improperly excluded." (CCP § 1094.5.) Also, arguably, "extra-record evidence may be admissible to show 'agency misconduct.'" (*Id.* at 119 quoting *Western States Petroleum Assn., supra,* 9 Cal. 4th at pp. 575-576, fn. 5.)

The Court may properly consider the extra-record documents at issue

here because the documents demonstrate the City failed to consider maximum permitted discharges, even though such documents were in existence prior to the City's decision. Maximum permitted discharges are relevant both to an analysis of cumulative impacts, and to an analysis of potential worst-case scenario impacts for methane dewatering. Though Petitioners exercised reasonable diligence in requesting access to and inclusion of these documents, the City failed to comply. (Code Civ. Proc. § 1094.5(e).) This failure to include or consider these documents amounts to suppression of evidence and agency misconduct. Accordingly, the extra-record documents at issue here fall under the narrow exception articulated in *Western States* and Code of Civil Procedure section 1094.5(e). *(Western States Petroleum Assoc.* v. *Superior Court* (1995) 9 Cal. 4th 559, 576-578.)

i. The Record of Proceedings Under Public Resources Code Section 21167.6(a) is Broad and Inclusive.

Pursuant to Public Resources Code Section 21167.6(a), the record of proceedings shall include a broad array of documents "relating to the subject of the action or proceeding." Public Resources Code Section 21167.6(e) is inclusive, providing a list of items that "shall be included," but specifying that the record "is not limited to" those items. The statute "contemplates that the administrative record will include pretty much everything that ever came near a proposed development or to the agency's compliance with CEQA in responding to that development." (*County of Orange v. Superior Court* (2003) 113 Cal. App. 4th 1, 10.)

Indeed, the statute specifically mandates the inclusion of the following items:

> Any other written materials relevant to the respondent public agency's compliance with this division or to its decision on the merits of the project, including the initial study, any drafts of any environmental document, or portions thereof, that have

> been released for public review, and copies of studies or other documents relied upon in any environmental document prepared for the project and either made available to the public during the public review period or included in the respondent public agency's files on the project, and all internal agency communications, including staff notes and memoranda related to the project or to compliance with this division. (Emphasis added.) (Pub. Res. Code § 21167.6(e)(10).)

Thus, the City must include any written materials relevant to the City's compliance with CEQA, or to its decision on the merits of the project. (Pub. Res. Code § 21167.6(e)(10).) As specified by statute, this includes materials made available to the public during the review period, or included in the City's own files on the project. (Pub. Res. Code § 21167.6(e)(10).) As discussed below, the documents at issue here are directly relevant to the City's compliance with CEQA with respect to the project, and should properly be part of the administrative record, as mandated by Public Resources Code Section 21167.6(e)(10).

ii. The Extra-Record Documents at Issue Here Are Relevant and Important to the Analysis of Cumulative Impacts and to Potential Worst Case Scenario Impacts

Respondents contend that the information contained in the extra-record documents at issue is not relevant. (Resp. Brief at 51.) According to Respondents, the extra-record evidence "merely reflects maximum discharge volumes of numerous water types and is not reflective of probable groundwater discharges from methane system dewatering." (Resp. Brief at 51.) Additionally, Respondents suggest the "technical analyses properly used accepted groundwater modeling techniques with calibration from actual data and did not rely on Bureau of Sanitation maximum permit discharge volumes." (Resp. Brief at 51.) These arguments are without merit, and

directly contradict arguments made earlier in Respondents' brief. Further, the documents speak to the potential cumulative impacts of all dewatering activities on Playa Vista.

Documents reflecting maximum permitted discharges are directly relevant to an assessment of potentially substantial adverse impacts of methane system dewatering. (Pub. Res. Code § 21100.) Though Respondents argue that the Industrial Waste Discharge Permits are not relevant, Respondents' own report expressly notes that the five buildings have permitted discharge flows under the Industrial Waste Discharge Permits of 35,000 gpd. (3 RR 530.) Clearly, Respondent's expert felt the industrial waste discharge permits were sufficiently relevant to discuss.

Respondents claim that the Sanitation permits should not be considered because they incorporate "not only discharges from methane dewatering systems, but also nuisance and toe-drain surface water that has percolated down to the dewatering systems." (Resp. Brief at 39.) However, as noted in Respondents brief, the recharge rate is affected by rain and irrigation.

Respondents similarly argue that the information sheet on the NPDES permits should not be considered because the document "encompasses discharges not associated with methane system dewatering." (Resp. Brief at 40.) In addition, they argue that it is simply construction dewatering. However, NPDES permits establishing a maximum daily flow of 950,000 gpd, from three wells surrounding Playa Vista surely is affecting groundwater levels. (16 CT 3700.) A lead agency must determine not only whether direct and indirect effects of a project are significant, but also whether such impacts are cumulatively significant. (Guidelines §§ 15064(h)(1); 15065(a)(3).)

Respondents argue that the extra-record evidence is improper because it includes "permit information for buildings with contingent (as opposed to

permanent) dewatering systems that are not expected to actually discharge any groundwater." (Resp. Brief, p. 39; 3 RR 514 (emphasis added) .) Respondents make much of this distinction between "permanent" and "contingent" dewatering systems. (Resp. Brief at 6-7; 3 RR 514.) However, the only real distinction is that the contingent systems are "not anticipated to collect groundwater unless the groundwater table rises. (Emphasis added.) (Id.) This, however, is based on Respondents' admittedly moderate estimates. (Resp. Brief at 10-11.)

The true concern with exclusion of these documents is that someone outside of the public process is making decisions on what is relevant and what is not before the public and the decisionmaker has knowledge of the documents. The arguments made by Respondents against their relevance could have been made after such information was disclosed to the public, and the decisionmaker could have weighed the strength of such argument. Excluding such documents from the record prevented the public and the City Council from even considering whether such information was relevant. At the very least, these documents should be accepted in the record for the limited purpose of demonstrating that the cumulative analysis failed to identify all dewatering discharges.

iii. The Extra-Record Documents at Issue Here Were in Existence Prior to the City's Decision and Could Not be Produced at the Administrative Level in the Exercise of Reasonable Diligence.

As discussed above, the extra-record documents at issue here should have been included in the record originally, pursuant to the terms of Public Resources Code Section 21167.6(e)(10). Nonetheless, this Court may consider these documents under the *Western States* exception because: (1) the evidence in question existed *before* the agency made its decision, and (2)

it was not possible in the exercise of reasonable diligence to present this evidence to the agency *before* the decision was made so that it could be considered and included in the administrative record. (*Western States Petroleum Assoc.* v. *Superior Court* (1995) 9 Cal. 4th 559, 578.)

Respondents contend that the extra-record evidence was not before the City Council. (Resp. Brief at 51.) To the contrary, these documents were in existence at the time of the hearing, and in possession of the City and RPI. Petitioners exercised reasonable diligence to obtain documents regarding Industrial Waste Discharge Permits and NPDES permits for buildings at the Playa Vista site. Petitioners submitted two Public Records Act requests, one on September 8, 2006, and one on October 10, 2006. (17 CT 3880-81.) However, Petitioners did not receive a response until May 8, 2007, well after the February 27, 2007 City Council hearing. (Id.) Had Petitioners received timely responses to its Public Records Act requests, such documents would have been submitted to the City for the hearing.

Dewatering information could have easily been provided by the Los Angeles Department of Sanitation, which issues Industrial Waste Discharge Permits. Despite repeated requests for such permits, the information was conspicuously absent from the record. (5 RR 859, 986, 7 RR 1327, 1357-58.) The City failed to disclose Industrial Waste Discharge Permits despite the clear relevance of the information and repeated requests for such information from Petitioners. (5 RR 985-86.) Likewise, the City failed to request from the applicant NPDES permits issued by the RWQCB. (Id.)

Respondents further suggest that Petitioners have an affirmative duty to acquire documents from the City and to submit those documents to the City. (Resp. Brief at 51; 15 CT 3586-87.) This would impose the ludicrous burden on Petitioners to obtain documents already in the City's possession, merely to return those same documents to the City for consideration. This notion shifts the burden of environmental investigation to the public.

Likewise, it was incumbent upon the City to request dewatering data from the RWQCB. Despite Petitioners' request that such data be evaluated, there is no evidence that the City requested NPDES permits or flow meter data from RWQCB. (5 RR 986.) The information is available from the Department of Sanitation and from the RWQCB, but the City failed to request or provide such information.

Without providing the total volume of all dewatering activities, neither the City nor the public can properly evaluate or participate in the public process. The City must "not be allowed to hide behind its own failure to gather relevant data. (*Sundstrom v. County of Mendocino* (1988) 202 Cal. App. 3d 296, 311.) "CEQA places the burden of environmental investigation on government rather than the public." (*Id.)*

iv. The Circumstances Here Warrant Consideration of the Extra-Record Documents Because They Demonstrate Agency Misconduct and Suppression of Evidence in Violation of the Information Disclosure Requirements.

Though the Supreme Court of California addressed a specific exception to the general exclusion of extra-record evidence, the Court did not "foreclose the possibility that extra-record evidence may be admissible . . . under unusual circumstances or for very limited purposes not presented in the case now before us." (*Western States Petroleum Assoc.* v. *Superior Court* (1995) 9 Cal. 4th 559, 578.) As noted in *Cadiz Land*, "extra-record evidence may be admissible to show 'agency misconduct.'" (*Cadiz Land Co.* v. *Rail Cycle* (2000) 83 Cal. App. 4th 74, 119 quoting *Western States Petroleum Assn., supra,* 9 Cal. 4th at pp. 575-576, fn. 5.) However, "extra-record evidence can never be admitted merely to contradict the evidence the administrative agency relied on in making a quasi-legislative decision or to raise a question regarding the wisdom of that decision." (*Id.* at 579.)

Petitioners do not seek this Court's consideration of extra-record evidence merely to contradict the evidence relied on by the City. Rather, Petitioners seek consideration of specific extra-record documents that relevant evidence was suppressed, despite Petitioners' reasonable diligence to have the documents included and considered.

The information disclosure provisions of CEQA provide that "preclud[ing] relevant information from being presented to the public agency, or noncompliance with substantive requirements of this division, may constitute a prejudicial abuse of discretion." (Pub. Res. Code § 21005.) This dovetails with Code of Civil Procedure section 1094.5 subsection (e), discussed above, which permits remand if "there is relevant evidence, which, in the exercise of reasonable diligence, could not have been produced at the administrative hearing or which was improperly excluded." (CCP § 1094.5(e).) Non-compliance with the information disclosure provisions constitutes a prejudicial abuse of discretion, regardless of whether the City would have come to a different conclusion. (Pub. Res. Code § 21005.) The City's failure to timely respond to Petitioners' requests for information violates the information disclosure provisions and Code of Civil Procedure section 1094.5.

The documents at issue here were requested by Petitioners in a timely fashion, well before the City Council hearing. The fact that the City ultimately provided the documents demonstrates that such documents were readily available to the City. (17 CT 003881.) It thus appears that the City's refusal to consider such documents amounts to suppression of evidence that did not support its desired outcome of no further environmental review. This kind of blatant agency misconduct warrants this Court's consideration of the extra-record documents. It would defeat the purposes of Public Resources Code Section 21005 to prohibit Petitioners from submitting documents to the Court demonstrating suppression of evidence. The most effective way for

Petitioners to prove that Respondents have violated the information disclosure provisions is to demonstrate to the Court that such documents exist.

The failure of the City to consider the Industrial Waste Discharge Permits and NPDES permits at issue here denied Petitioners and the public a full and open process. The City failed to disclose all the dewatering activities occurring at Playa Vista, though the data was readily available, making it impossible for the public or the decisionmaker to determine whether the dewatering will have a cumulatively significant impact. In order to effectuate the purposes of CEQA, the extra-record documents here should be permitted to demonstrate suppression of evidence, and to demonstrate the City did not consider the cumulative impacts of all sources of dewatering.

V. REQUEST FOR RECONSIDERATION OF ETINA I

A. THERE IS NO WAIVER ON APPEAL BECAUSE THE TRIAL COURT DID NOT HAVE THE POWER TO REVERSE THE APPELLATE COURT

As a preliminary matter, Respondents assert two procedural arguments. First, they argue in a footnote that Petitioners waived the right to request that the Court reconsider its prior decision by not raising the law of the case doctrine at the trial court level. However, a trial court does not have the power to change an appellate court's decision.

Ordinarily, an appellate court will not review an issue not properly raised at the trial court. (*In re Marriage of Moschetta* (1994) 25 Cal. App. 4th 1218, 1227.) "It is important to remember, however, that the purpose of this general rule is to give the trial court and parties an opportunity to correct an error that *could* be corrected . . . in the trial court." (*Woodward Park*

Homeowners Assn., Inc. v. City of Fresno (2007) 150 Cal. App. 4th 683, 712.) It would be an exercise in futility to argue an issue that cannot be corrected at the trial court level. (Cf. *Automotive Management Group, Inc. v. New Motor Vehicle Bd.* (1993) 20 Cal. App. 4th 1002, 1015 (administrative exhaustion doctrine no applicable in cases of futility.) In this case, the trial court was bound to follow the opinion of the appellate court, and could not reconsider the issue under any circumstance. (*Butler v. Superior Court* (2002) 104 Cal. App. 4th 979, 982.)

In addition, as discussed in *Woodward*, "a noncurable defect of substance where the question is one of law is not an error that falls within the rule." (*Woodward Park Homeowners, supra,* 150 Cal. App. 4th at 712.) In this case, the previous ruling of the Court is one of law - - the applicability of Guidelines § 15162 to the newly discovered existence of large quantities methane at Playa Vista.

Finally, *Woodward* notes that "a matter of public interest" also does not fall under the waiver doctrine. (*Id.*) The *Woodward* court specifically applied the waiver doctrine to CEQA, noting "the baseline issue [under CEQA] we have just discussed falls within both of these exceptions." (*Id.*) *Woodward* specifically held,

> "The question is whether the environmental documents were adequate as a matter of law. This is, of course, a question of law ... Further, the determination of whether the agency has complied with CEQA before approving a major development project in a densely populated area is an issue of public interest."

(*Id.* at 714.)

Likewise, in this case, the issue of whether the City's procedure for analyzing the discovery of methane at Playa Vista complied with the requirements of CEQA is a question of law. Clearly, the issue of approving

massive development bringing a dense population to an area that is releasing explosive gas would be a matter of public interest.

B. REQUEST FOR SUPREME COURT REVIEW OR RECONSIDERATION CANNOT NOT HAVE BEEN EXPECTED WHEN PETITIONERS APPEARED TO RECEIVED THEIR REQUESTED RELIEF IN A SUBSEQUENT OR SUPPLEMENTAL EIR.

The second procedural hurdle that Respondents argue should bar Petitioners' request for the Court to revisit and overturn its previous decision is the fact that Petitioners did not request Supreme Court review or request reconsideration from the appellate court. (Resp. Brief at 55.) This appears to be based on some type of equitable argument. (Id. citing *People v. Scott* (2000) 85 Cal. App. 4th 905.)

People v. Scott is a convoluted criminal case touching on issues of double jeopardy and retrial. (*Id.* at 908.) In the end, the Court found that the Law of the Case doctrine did not apply if new or other evidence was presented by the State on retrial. (*Id.* at 925.) But, such case has nothing to do with whether the failure to request rehearing or seek Supreme Court review creates a procedural bar to seeking to avoid the Law of the Case doctrine based on exceptional circumstances.

Furthermore, it must be remembered that Petitioners prevailed in ETINA I. Petitioners obtained their desired relief, a ruling that the approval of the methane mitigation measures must be vacated. In addition, it appeared to Petitioners that the Court ordered the City of Los Angeles to prepare a Subsequent or Supplemental EIR. While the issue of whether the City had substantial evidence to support its finding that the methane mitigation measures would reduce the impact of methane to a level of insignificance, the Court expressly left unresolved whether the 50' deep vent wells required

dewatering. (1 CT 53, fn. 11.) Considering that the City's own expert noted both that the 50-foot vent wells required a pump and treat system to be operational, and that the 50-foot vents wells were absolutely necessary to build in the area, the question of whether the development could safely constructed was still on the table. (5 RR 899-900, 28 AR 7479.)

Of course, Petitioners could not anticipate that Respondents would only provide lip service to the Court's order to vacate the methane mitigation measures, and would continue to build and inspect methane mitigation systems, including dewatering systems, and issue certificates of occupancy at Playa Vista. (2 CT 381-383.) In addition, Petitioners could not anticipate that the City would refuse to evaluate whether the 50-foot vent wells would sufficiently vent methane from the 50-foot aquifer for the life of the project. (4 RR 833.)

Demanding that Petitioners request rehearing or seek Supreme Court review in a case where they appeared to have obtained their ultimate relief, is demanding too much. Finally, the fact that the Respondents failed to stop or even slow down construction begs the question – what exactly would be inequitable in the Court reviewing its previous decision? Playa Vista, throughout the entire litigation, has proceeded with construction at its own risk and peril. There are no equitable principals that would bar the Court from reconsidering the issues of law, despite the Law of the Case doctrine.

C. THE EXPLOSIVE NATURE OF METHANE AND IMPORTANT CEQA PRINCIPALS ARE EXCEPTIONAL CIRCUMSTANCES JUSTIFYING THE RECONSIDERATION OF ETINA I.

Methane is explosive in concentrations between 5% and 15%. (30 AR 7817.) Clearly, the possibility of people dying in a fiery explosion

constitutes exceptional circumstances. There is no more important role for government than ensuring the health, safety and welfare of its citizens.

The discovery of methane at Playa Vista should have given any rational decisionmaker concerns about the wisdom of building at the site. If anything, this demonstrates the necessity of a thorough environmental review at the earliest stage possible. As noted by the Court of Appeal, "It is all too likely that if such activities proceed pending preparation of an adequate EIR, momentum will build and the project will be approved, no matter how severe the environmental consequences." (*San Joaquin Raptor/Wildlife Rescue Ctr. V. County of Stanislaus* (1994) 27 Cal. App. 4th 713, 741.) Who can deny that, had Playa Vista approached the City in 1993 proposing to build 3,000 plus residential units on the largest methane leak in the Western United States, the City Council would have been hesitant to approve the project.

Respondents argue that the City held six public meetings and received opinions from six outside consultants. (Resp. Brief at 57.) However, the City never considered alternatives such as locating building outside of areas with high methane concentrations. Under CEQA, "the key question and first step in analysis is whether any significant effects of the project would be avoided or substantially lessened by putting the project in another location." (Guidelines § 15126.6(f)(2).) A CEQA-like process is not CEQA. In fact, the primary purpose of the 2001 CLA Report was to evaluate whether methane could be mitigated, not whether it should be mitigated. (See 4 AR 1051-52 (2001 CLA Report stating the five primary questions reviewed).)

Further, CEQA is a doctrine of accountability. "If CEQA is scrupulously followed, the public will know the basis on which its responsible officials either approve or reject environmentally significant action, and the public, being duly informed, can respond accordingly to action with which it disagrees." (*Laurel Heights Improvement Assn. v. Regents of University of California* (1988) 47 Cal. 3d 376, 392.)

Unfortunately, the accountability purpose of CEQA has been sidestepped through-out this entire process. The 1993 City Council, in approving the entire project, did not know about the presence of large quantities of methane. The 2001 City Council was not given the option of changing the project or denying the project, and instead simply "note and filed" a report on methane, and directed the implementation of mitigation measures.

Thus, the 2001 City Council was not tasked with approving mixed use commercial and residential in an area of high levels of methane. They did not consider alternatives, as would be required in a SEIR. Because no SEIR was prepared, the City Council never had the task of considering whether it was wise to build in areas of the highest level of methane.

The 2007 Los Angeles City Council is even more removed and insulated from the decision of building on an incredibly dangerous methane leak. They are tasked with determining whether dewatering associated with the methane mitigation measures is a significant impact, and if so, how to mitigate it. What City Council person is going to deny the approval of a dewatering system, regardless of the impacts, when such dewatering system is critical to the functioning of the methane mitigation systems?

Equipment does break down, necessary inspections are missed, maintenance, which is now the responsibility of numerous third party building owners and Homeowners Associations, is deferred, and the unthinkable can happen. (5 RR 1039; See also, 5 RR 1055 & 1079 noting numerous deficiencies with LA DBS inspection and code enforcement.) There is always a chance that a clogged pipe, an improperly wired detections system, or the unavoidable, but entirely foreseeable earthquake will release large quantities of methane into a building. When the methane level reaches between 5% and 15% concentrations, any ignition source will cause catastrophic injury.

The City and Real Parties-in-Interest are desperate to avoid a Subsequent or Supplemental EIR. An SEIR, like all EIRs, must comply with notice requirements, respond to comments, identify and analysis alternatives and alternative locations, and consider a no project alternative. Importantly, the City Council will have to approve or disapprove a project in area with methane macro-seeps. Should the City Council be willing to permit construction in a high methane area, they may have to explain why they are willing to risk lives in a statement of overriding considerations (Guidelines § 15093.) If the CEQA process works correctly, the public will know the environmental and safety ethics of the City Council members, and may vote accordingly. (*Laurel Heights, supra*, 47 Cal. 3d at 392.) At the very least, when people are asking, "how did this disaster happen?" they can identify the specific elected officials responsible. The CLA process accomplishes none of this. This case constitutes the kind of exceptional circumstances that should elicit the willingness of the Court of Appeal to double check the questions of law in the underlying case, and ensure that they have properly applied CEQA.

D. THE COURT SHOULD BE WILLING TO REVIEW THE QUESTION OF LAW STATED IN ETINA I, AND STATE THE PROPER INTERPRETATION OF CEQA GUIDELINE SECTION 15162

Petitioners challenge the statement, "A new or more severe significant effect does not require the preparation of a subsequent EIR or supplement to an EIR, however, if adopted mitigation measures will reduce the impact to a level of insignificance." (1 CT 42.) The sole question for the Court is simply whether such statement is a correct statement of law. After all, the purpose of the Court of Appeal is to review questions of law.

Admittedly, it is somewhat unusual to request that the Court review its own prior decision. But, it is not uncommon for Courts to overturn their own previous decisions in other case. For example, the Fourth District Court of Appeal noted in one of its CEQA cases,

> We further note our deferential approach taken in *Uhler v. City of Encinitas* (1991) 227 Cal. App. 3d 795 [278 Cal. Rptr. 157], is inconsistent with the standard of review we apply in this case. In *Uhler*, we stated we may not substitute our judgment for that of the agency which certified a negative declaration, mistakenly applying the deferential substantial evidence standard of review. (*Id.* at pp. 802-803.) Accordingly, we candidly admit the *Uhler* standard of review cannot be reconciled with the correct standard of review we adopt in this case, and, as a result, we now abandon the erroneous standard we applied in *Uhler*.

(*Quail Botanical Gardens Foundation, Inc. v. City of Encinitas* (1994) 29 Cal. App. 4th 1597, 1603.) And it is certainly common for other appellate districts to criticize, distinguish and just disagree with other appellate courts. (See e.g., *Pocket Protectors v. City of Sacramento* (2004) 124 Cal. App. 4th 903, 935 criticizing another case.) Surely, overturning an erroneous statement on the standard of review is akin to overturning an incorrect statement of law proffered in the same case. The most important task of the Court of Appeal is to correctly state the law.

In our request, the only relevant task is to determine whether the above challenged statement of law is consistent with CEQA Guidelines section 15162. Respondents give short shrift to the argument simply stating that Petitioners ignore the public policy behind Public Resources Code section 21166, that after the initial review, the public policy shifts in favor of finality over public comment. (Resp. Brief at 59.) Petitioners agree with such general statement of law. However, such public policy is accomplished by not permitting the re-opening of an EIR until the next discretionary

decision, if any, and by requiring substantial evidence to support the conditions requiring a supplemental EIR outlined in Public Resources Code section 21166 and CEQA Guidelines § 15162.

Guidelines section 15162 plainly states that a subsequent EIR is required if "The project will have one of more significant effects not discussed in the previous EIR or negative declaration." (Guidelines § 15162(a)(3)(A).) It is beyond dispute that the discovery of heavy concentrations of an explosive gas is a significant effect. The very fact that methane mitigation measures were required indicates that it was determined to be a significant effect. (Guidelines § 15126.2(a); 15126.4(a)(3).) However, nothing in the Guidelines imposes an additional burden to prove that proposed mitigation cannot mitigate the impacts to a level of insignificance. (Guidelines § 15162.) Such a burden would nullify the informational purpose behind the preparation of a subsequent or supplemental EIR. Indeed, an agency could circumvent additional environmental review in most instances, by drumming up an expert willing to state that such and such mitigation will reduce the significant effect to a level of insignificance.

Respondents complain that Petitioners argument concentrated on the *River Valley* case, and did not address the other cases contained in the court's footnote. (Resp. Brief at 58 citing ETINA I (1 CT 42).) First, the *River Valley* case was the focus of the Court in ETINA I, and the source of the misapplication of law. Secondly, the other case cited by the court, are not particularly instructive on this particular point of law.

The *STOP* case stands for the unremarkable proposition that reducing a project in size does not require the preparation of a subsequent EIR. (*Snarled Traffic Obstructs Progress v. City & County of San Francisco* (1999) 74 Cal. App. 4th 793, 801.) The alleged mitigation measures pointed out by this Court were voluntarily incorporated into the project, and were not

mitigating new significant impacts. As noted in *STOP*, there was no firm commitment at that time to a particular configuration of the project. The revised project proposal would thus not necessarily entail new and negative aesthetic impacts. (*Id.* at 802.)

In the *Benton* case, the County prepared a subsequent mitigated negative declaration to an earlier mitigated negative declaration. (*Benton v. Bd. of Supervisors* (1991) 226 Cal. App. 3d 1467, 1473 & 1483.) *Benton* might suggest that a subsequent mitigated negative declaration might have sufficed, but the Guidelines indicate that such option is only available to cure a previous negative declaration. (See Guidelines § 15162(b)(applying specifically after the adoption of a negative declaration).) Whatever the applicability of *Benton*, there is nothing in *Benton* to suggest that mitigating a new significant impact would relieve an agency of any further CEQA review.

However, the *Longbeach* case did permit the preparation of a mitigated negative declaration after the preparation of an EIR. (*Long Beach Sav. & Loan Ass'n v. Long Beach Redevelopment Agency* (1986) 188 Cal. App. 3d 249, 266.) But, clearly traffic had been studied in the previous EIR, and the issues in *Long Beach* concerned changes in the project and not new information. (*Id.* at 255.) Further, the issue before the Court in ETINA I was whether allegedly mitigating a new significant impact, not studied in the previous EIR, could relieve the agency from all further environmental review. Such concept is simply not supported by the *Longbeach* case, and certainly not supported by the Guidelines as currently written.

The Guidelines require the preparation of a subsequent or supplemental EIR whenever "[n]ew information of substantial importance ... shows any of the following: (A) The project will have one or more significant effects not discussed in the previous EIR or negative declaration." (Guidelines § 15162(a)(3).) The presence of high concentrations of methane

is clearly a significant effect. If there was ever a time for the Court to reconsider its prior ruling, it is now with lives at stake. Without fully evaluating the alternatives and considering the risks and consequences, the City Council should not stake people's lives on the gamble that sump pumps won't break down and large tubes stuck in the mud will not clog. And if they are willing to take such gamble, they should state their reasoning on the record. The Court should require a supplemental or subsequent EIR to evaluate the new discovery of methane.

VI. CONCLUSION

The Return to Writ should be denied with directions to prepare a subsequent EIR or supplemental EIR for both methane and dewatering. An SEIR is absolutely necessary in this case because of the extreme danger methane poses. The public needs the City Council to actually consider alternatives and risks, and if mitigation is actually feasible, to impose a mitigation monitoring program that is actually enforceable and verifiable for the next 100 years.

The 2007 CLA Report, whatever it was, did not comply with procedural requirements of CEQA. It could not have been an addendum because the record shows no comparison or consideration by the decisionmakers of the 1993 EIR. It did not add nor cure the deficiencies in the 1993 EIR. As stated by the City Attorney, "its just a study", nothing more.

Further, the Court should specify that all dewatering in the Playa Vista area must be disclosed, including actual amounts, locations and purpose. In addition, the City of Los Angeles should be ordered to comply with CEQA by considering all new information of substantial importance that has arisen since the 1993 EIR and the 1995 MND/Addendum.

Petitioners respectfully request costs on appeal and to be determined the prevailing party for the purpose of Code of Civil Procedure section 1021.5.

Respectfully Submitted,

DATE:

LAW OFFICE OF TODD T. CARDIFF

_____

Todd T. Cardiff, Esq.

Attorney for Petitioners and Appellants
ETINA, GRASSROOTS COALITION and DANIEL COHEN

FROM: Grassroots Coalition,
Patricia McPherson, President
Patriciamcpherson1@verizon.net

August 2, 2012

TO:
California Coastal Conservancy
Attn. Executive Director, San Schuchat &
All Governing Board Member and Alternates

CC
John Chiang- CA. State Controller
Matosantos- CA. Dept. of Finance Director
Bill Lockyer- CA. State Treasurer
John Laird- Dept. of Natural Resources
U.S. Army Corps of Engineers Attn. Commander Mark Toy
U.S. Senator Barbara Boxer
U.S. Congress Person Maxine Waters
L.A.Councilman Bill Rosendahl

RE: Complaint- Supporting the 3/29/12 REQUEST TO RESCIND APPROVAL FOR STAFF RECOMMENDATION APPROVAL ON 1/19/12 awarding $6,490,00. for: FILE NO. 04-088-

BALLONA WETLANDS RESTORATION ENGINEERING AND TECHNICAL STUDIES

The following paper from Grassroots Coalition (GC) represents GC's opinion of its findings and data support garnered via the Public Record Act and the Freedom of Information Act.

This document also requests the Coastal Conservancy to stop its illegitimate interference in the approved and ongoing 2005 Joint EIS/EIR process between the Sponsor-- Santa Monica Bay Restoration Commission (SMBRC)/ LA County Flood Control and, the U.S. Army Corps of Engineers.

The Coastal Conservancy, using its control over public bond money, has shut out the public process and taken its influence as a financially powerful board member of the SMBRC and partner of the California Department of Fish & Game (DFG), the lead agency of the publically owned Ballona Wetlands—to fund a process that is contradictory to the 2005 federal process that was requested by Congress.

The Coastal Conservancy is propelling a bait and switch – a NEW Joint EIR/EIS process and a NEW Notice of Intent (NOI) that undermines and attempts to extinguish the current 2005 Joint EIS/EIR APPROVED PROCESS with its attendant safeguards of multiple habitat restoration alternatives.

The Coastal Conservancy is instead, illegitimately propelling a singular outcome that stops restoration of Ballona and protection of its endangered species to instead convert the habitat into a non-historical dredged out estuarine habitat that promotes LA Port expansion and other financial deals.

Background:
In 2004, Ballona Wetlands acreage was purchased via PUBLIC funding for approximately $140 million. **The land is owned by the public** and is currently administered by the California Dept. of Fish and Game (freshwater marsh portion by the State Lands Commission) .

Important, new information contained herein reflects a Coastal Conservancy (CC) Public Record Act (PRA) response consisting of numerous heretofore undisclosed CC documents contained on a CD. The CD was provided after the 1/19/12 CC Governing Board Hearing in Los Angeles, CA. and, after the CC Governing Board's Hearing in Ventura, CA. on 3/29/12.

I.
The Coastal Conservancy PRA CD provides evidence to show that misleading and/or incorrect information was presented in the Staff Recommendation of 1/19/12 (File No. 04-088)

The newly disclosed Coastal Conservancy documents (CD) reveal:

A. potential misuse of public bond money (Prop. 12, PRC 5096.352 (f) and or (b)(1));
B. lack of disclosure, lack of public process and transparency of process regarding the Coastal Conservancy's involvement and; associations with other agencies --federal- US Army Corps of Engineers (USACE) and; state agencies and; a private nonprofit- the Santa Monica Bay Restoration Foundation (Foundation) that pertain to Ballona Wetlands in Los Angeles, CA.
C. Prop. 12 (Number 172 of Dept. of Natural Resources Listing of Prop. 12 bond grants; 3760-30203-0005(2)(B)07) Coastal Conservancy bond grant to The Southern California Coastal Water Research Project (SCWRP) -Ballona Wetlands Restoration. The Coastal Conservancy, contrary to the bond grant language and intention of allowing for a "scientific advisory committee" (SAC) to review and advise regarding **'enhancement'** plans for the restoration goals of Ballona Wetlands; the Coastal Conservancy instead propelled and directed SCCWRP members and other contractors to perform a singular outcome of **'creation' of a full tidal/ estuarine, non-historical , treatment wetland as an end of pipe, experimental solution to the toxic contamination of Ballona Creek.**

The CC Staff Recommendation is a non-historically oriented goal and thus fails to adhere to bond language for "enhancement" of Ballona Wetlands and also fails to adhere to "restoration" as defined by Southern California Wetlands Recovery Project (SCWRP). (See p.3 SCWRP restoration definition) And, contrary to publically stated and written goals of transparency and interchange, the CC and SMBRC precluded the public and Working Group from participating and interfacing with SAC. Thus, the CC and SMBRC, utilizing all public bond dollars have effectively shut the public out of the Ballona Wetland Restoration design process.

Contrary to comments made below in the Staff Recommendation 1/19/12 (File No. 04-088), the conceptual restoration plan was **not** developed in a public process and the public and other parties were **precluded** from participation in all facets of the development of the restoration alternatives

"Cooperation: The conceptual restoration plan was developed in a public process with input from a Science Advisory Committee, an Agency Advisor Committee, and the Ballona Working Group made up of representatives of local nonprofit organizations, agency staff and members of the public. Individual public members also participated in all facets of the development of the restoration alternatives."
(p. 9 of 9 1/19/12 Staff Recommendation; Emphasis added.)

The CD documents reveal that the conceptual restoration plan was developed by the Coastal Conservancy and by the executive director and staff of Santa Monica Bay Restoration Commission- a California state agency.

Note- the SMBRCommission's executive director and most staff are not state personnel . Since 2005, the executive director and staff of the SMBRFoundation (a private 501c3) simultaneously act as SMBRC staff and executive director. IRS records reveal payment to the Foundation's executive director and staff from the Foundation. We have found no contractual authority for such private persons to serve as state officers of a state agency or as staff of a state agency. We are currently requesting an assessment and investigation into these matters of great public concern.

The CD documents reveal that the Coastal Conservancy Staff Recommendation was created:

1. in a void of public/ Working Group input acknowledgement and use.
2. in a vacuum of interchange between the Scientific Advisory Committee and the public/ Working Group and the USACE contractual agreements.
3. while failing to disclose scientific findings to all parties and;
4. while failing to provide process as written by the Coastal Conservancy.
5. without adherence to the 2005, contractual agreement between the United States Army Corps of Engineers (USACE) and the Sponsor (aka the Authority- SMBRC & LA County Flood Control) wherein a Joint EIR/ EIS of Corps certified programs of environmental review would take place and;

6. without CC Governing Board authorization and without public disclosure-- the CC Project Manager created an enterprise consisting of a 'new' Joint EIR/EIS process ostensibly intended to circumvent the 2005 approved process. (JD submission to CC 3/29/12)
7.

Lack of Disclosure Has Led To An Inability To Make Informed Decisions

I.

A. Proposition 12 Funds-The Public's Intent - To Acquire, Protect and Restore Is Not Fulfilled.

The Prop. 12, Public Resource Code (PRC) Section 5096.352 language states, " (f) Twenty-five million dollars ($25,000,000) of the funds shall be allocated to **acquire, protect, and restore** wetlands projects that are a minimum of 400 acres in size in any county with a population greater than 5,000,000. (Emphasis added. The Ballona Wetlands is distinguished as fulfilling this specific criteria.)

Restoration—specifically refers to actions taken to obtain a former state of a natural condition. (Southern California Wetlands Recovery Project (SCWRP)- Science Advisory Panel (SAP)- Glossary of Terms)

Estuarine wetlands- are subtidal and intertidal habitats that are semi-enclosed by land, have access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land (Cowardin et. Al. 1979)SCWRP, SAP Glossary)

. Ballona was not historically continually open and connected to the ocean and large, inundating flows of fresh water occurred infrequently only during major flood events (CD- SAC docs; USGS docs provided to CC by J. Davis; CC's T-sheets).

"The project we are recommending is enormous in scale." CC- MarySmall (JD PRA Response attachment in 3/28/12 CC Hearing-Request)

Contrary to "protecting and restoring" the Ballona habitat, the approval of the Engineering and Technical Studies & SMBRC bond awards will specifically promote a singular outcome— massive destruction of currently functioning habitat that will not 'obtain a former state of a natural condition' but, will instead endeavor upon a non-historically oriented, experimental estuarine treatment wetland project expected to encounter yearly flooding and scouring events. The project is not expected to be self-sustaining but instead expected to promote a perpetual money pit of contracts for monitoring and unknown but expected repairs and fixes- - future landscape changes further transfiguring the flora and fauna. (CD/SAC)

A failure to adhere to grant proposal requirements, as dictated by the State of Ca. Finance Dept. in recent audits, continues

.

NOTE: While the Coastal Conservancy promotes the idea that it provides bond grants to the SMBRC, the Coastal Conservancy has actually never provided any bond money to the SMBRC as per the 2002,

SB 1381 Keuhl bill that established a Treasury Account for the SMBRC. Instead, the Coastal Conservancy provides public bond money grants to the private nonprofit—the SMBRFoundation—typically without a grant proposal having been provided—as is the case in the 1/19/12 grant approval.
Recent audits of the CC by the California Dept. of Finance require that the CC adhere to grant proposal requirements established by the Dept of Finance. However, the CC's failure to adhere continues as is the case in the 1/19/12 grant approval.

The currently clean land (LARWQCB) and functioning habitats—include endangered and rare Southern California native plants and wildlife, which will be destroyed in order to create the end of pipe, treatment wetland for toxic Ballona Creek waters and sediments. (CD-SAC) The full tidal, estuarine goal also appears to discharge political favors for LA Port expansion(s) approvals that need wetland mitigation credit(s) and/or extensive fill material from Ballona.
(See e-mails regarding LA Port - letters of support for the Staff Reccommendation)

Contrary to the 8/13/04 CC MEMO (p.4), the CD -SAC documents reveal wildlife and habitat destruction and dangers, endless and exorbitant financial costs, inability to show sustainability and potential legal quagmires that were not revealed to the public/ Working Group and other parties-- some of whom were asked to sign onto Coastal Conservancy pre-scripted letters of support for the 1/19/12 Staff Recommendation.*

*Contrary to the promised 'transparency' of process; CC and SMBRC staff improperly lobbied for letters of support for the 1/19/12 Staff Recommendation prior to a public notification of an agenda and release of the Staff Report thusly, discriminating against all others by failing to provide the same comment opportunity prior to the issuance of the Staff Report.

The public has a right to know the full extent of issues regarding changes to Ballona. Whatever decisions are rendered, they should not be based upon piecemealed, truncated and biased information as has currently been provided.

PROPOSITION 12 Identification of Funds; Status of Funds
The Staff Recommendation(SR) is unclear which Proposition 12 funds are being requested. Two possible funding sections of Prop. 12 are:
- Proposition 12 bond money discussed in the SR as specifically for Ballona Wetlands is listed under Public Resource Code (PRC) Section 5096.352 (f)). The accounting for these funds was not provided in the Staff Recommendation and remains unknown.
-Other Prop 12 funds include: PRC Section 5096.352(b)(1)—to the Santa Monica Bay Restoration Project/Bay Watershed Council; that account status remains unclear also.
(In 2002, Senate Bill 1381 (Keuhl) transformed the SMBR"Project" into the SMBRCommission. Prop. 12, PRC language utilizes the Bay Watershed Council. The ByLaws of the the Bay Watershed Council (BWC) remained intact which now give rise to

questions regarding the actual existence of the BWC after SB 1381 which may influence the use of the Prop 12 bond funds.)

I.

B. 5-6. The Coastal Conservancy Project Manager and SMBRC Executive Director/ Staff, Have Not Been Forthright With the Public Regarding Disclosure of Process Changes Pertaining to Federal (USACE) Contractual Agreements

U.S. ARMY CORPS OF ENGINEERS

1994, Sept.28 Adopted- "Resolved by the Committee on Public Works and Transportation of the United States House of Representatives, That the Secretary of the Army is requested to review the report of the Chief of Engineers on Playa del Rey Inlet and Basin, Venice, California published as House Document 389, Eighty-third Congress, Second Session, and other pertinent reports, to determine whether modifications of the recommendations contained therein are advisable at the present time, in the interest of navigation, hurricane and storm damage reduction, environmental restoration and other purposes at Marina del Rey Harbor, Los Angeles, California, with consideration given to the disposal of contaminated sediments from the entrance channel required under the existing operation and maintenance program at Marina del Rey Harbor."

In 2005, USACE Noticed and embarked upon an areawide ecological review- an EIS- of the historic Ballona Wetlands area that included the U.S. 83th Congress -- House Document 389 under Public Law 780. Map-Enclosure No. 1 (General Plan of Improvement) reveals the entire Ballona region as part of this action including but not limited to Ballona Lagoon, Del Rey Lagoon and the Sanctuary area , Ballona Creek, Centinela Creek etc. (See language of the USACE Lower Ballona Creek Restoration Reconnaissance Study and; Feasibility Study). This EIS was predicated upon having a local Sponsor as part of the review process and to aid in the outreach to the PUBLIC and the creation of the Joint EIR/EIS process.
SMBRC/LA Flood Control (the Authority) aka the Sponsor-- contractually agreed to the Joint EIR/EIS in 2005.
The contract included having the Sponsor (Authority) provide at least 6 public meetings dedicated to providing time for USACE representatives to discuss the USACE status of the Joint EIR/ EIS process. The follow through for such meetings has not occurred.
(In various earlier approved bond requests for Ballona projects; Project Manager Mary Small eliminates reference to the 2005 contractual agreement for a Joint EIR/EIS which jointly provides for the Ballona Restoration Alternatives (2005 contract between- USACE and SMBRC/LA Flood Control aka Authority) Instead Ms. Small's staff recommendations inform the CC Governing Board that as of 2005 only the Ca. Dept. of Fish & Game, State Lands Commission and SMBRC are part of the oversight of Ballona and alludes that the Conservancy has the restoration alternatives planning duties:

(Ballona Wetland Improved Public Access; File No. 04-088; 7/21/10)
"In 2005, the Conservancy initiated conceptual planning and feasibility analysis of restoration alternatives

for the property. This project is being implemented in partnership with the DFG and the State Lands Commission, the two state agency owners of the property and the Santa Monica Bay Restoration Commission. The feasibility analysis was completed in 2008, after a delay due to the bond freeze, and the project partners are now initiating environmental review and detailed engineering of a long-term, phased restoration project. When the restoration planning began, the Conservancy funded the development of an Interim Site Stewardship Plan to address the pressing concerns related to site management. As discussed above, in 2008 the Conservancy provided a grant to MRCA to fund construction of some site improvements and to fund planning, design and preparation of permit applications for additional access improvements. Based on the completed planning work, the MRCA and the project partners determined that it will be more cost effective and logical to pursue implementation of most access improvements as part of the environmental review and permitting for the long-term phased restoration project.
PROJECT FINANCING:
Coastal Conservancy $280,000
MRCA 120,000
SMBRC, US EPA funds 20,000
Total Project Cost $420,000"

This is an omission of pertinent and critical fact given in order to garner public bond money. (See J. Davis 3/28/12 Request to CC Gov. Brd.; USACE/CC minutes of meeting(s) and page 6)
See also File No. 04-088 on page 17.
Additionally, the bond money was approved but accountability for its use has not been forthcoming. And,
No fund award was given to SMBRC from the USEPA as cited above. The Treasury Account set up for the SMBRC under SB1381 was not utilized. Instead, ostensibly the USEPA funds went to the private nonprofit, the Foundation. The Foundation, as a private non-profit 501c3, provides no accountability to the public.

The Coastal Conservancy, had also made promises to the public regarding transparency and public inclusion in the entire process of exploring **all reasonable alternatives for enhancement of Ballona.**

For example in an early Coastal Conservancy MEMO dated 8/13/04 to California Department of Fish & Game (DFG) and the State Lands Commission (SLC), the **GOALS/PRINCIPALS read in part-**

*"**The restoration plan** will be based on the best science, incorporate technical scientific expertise and **will be developed through a transparent planning process that allows stakeholders to provide input and comment on all restoration planning products.** The restoration planning process will develop and analyze a **range of alternatives to implement the following project goals:***
-Restore and enhance a mix of wetland habitats to benefit endangered and threatened species as well as other migratory and resident species;
-Provide for wildlife-oriented public access and recreation opportunities; and –
***Implement a technically feasible, cost effective, ecologically beneficial and sustainable restoration."** (Emphasis added.)*

And,

"..restoration will be conducted within the landscape and watershed context, with attention paid ***to adjacent and ecologically related resources."*** Pg. 1

According to CD documents, the Coastal Conservancy's Ballona project manager participated in USACE meetings in the 2004 timeframe citing inclusion of the areawide ecosystem eg. Ballona Lagoon, Del Rey Lagoon, the Sanctuary area, Marina del Rey and others that paralleled the activities of ecosystem review as described by the USACE (Reconnaissance Study; Lower Ballona Creek Restoration Feasiblity Study; 3/28/12 J.Davis submission to CC)

However, in contradiction to the 8/13/04 Memo cited above, the context of the larger historic boundaries of Ballona Wetlands were later arbitrarily dropped, without public notification or discussion. The CC Project Manager discusses no longer including the adjacent and ecologically related resources as part of the Joint EIR/EIS restoration evaluation performed with the USACE:

6/2/10 CC, SMBRC, USACE Ballona Coordination Meeting Minutes:

"II. b. Mary Small: Have all the PMP sections looked at the same project area? Parts still refer to Ballona Lagoon, Grand Canal, Venice Canals and Oxford Basin, which are no longer in the study area. (3/28/12 CC hearing; J. Davis Attachment)

And, the Project Manager discusses instead a 'new' process for which there is no ostensible authority and to which the public has not been made aware:

"Mary Small: If the Corps falls too behind, we will work with Corps Regulatory for a permit for their activities (NEPA/CEQA, design, permitting, and Phase 1 construction)" and;

"Mary Small: It was always our understanding that the Corps would use our restoration alternatives. It makes us nervous that this was never in writing."(6/28/10 Ballona Ecosystem Restoration Planning Management Meeting)

It was never the public's understanding that the Corps would be held to Coastal Conservancy and Foundation staff"s restoration alternatives. Legal legitimacy for such behavior is also questionable. And,

"Suggested response

1) *The EIS/EIR process begun in 2005 was for the Army Corps' Lower Ballona Ecosystem Restoration Feasibility Study, that project and the associated environmental review has not been completed and is not moving forward at this time. The EIR/S process for the proposed enhancement project will be separate." 2/7/12*

CC/Mary Small to Ca.Dept. Fish & Game- Rick Mayfield per response to Davis Ballona CEQA process query. (JDavis attachment 3/28/12 Request to CC Board)

Thus, the CC switch in process is 'suggested' to be disclosed to a member of the public after seeking and garnering approval for the 1/19/12 Staff Recommendation.
(3/28/12 CC Hearing, Davis PRA attachment to Request)

This new and unauthorized process discussion continues in the same email, 2/7/12, from Shelley Luce to Mary Small and Rick Mayfield (CDFG):

*...." **The EIR/EIS** that **we want to start** is for a separate project, i.e. the BWER restoration/ enhancement project. ".* (emphasis added.)

The EIR/EIS that they want to start IS NOT on a separate project but instead on the same project but having eliminated the '94/ 2005 Joint EIR/EIS process; scope of review; environmental safeguards and full range of alternatives
inherent in '94/ 2005 approved process.
In other words, the CC attempts to have the public and the USACE but out of their way so that the CC can control the project --using the public's dollar--alongside its political allies.

And, while Mary Small provides the appearance that the Request For Proposals is new online--*" the request for services ....went out today"*....
2/8/12 CC email (JDavis PRA response attachment in 3/28/12 Request to CC Board)

The Coastal Conservancy, had already put out an online RFP in 2010 for the work requested for approval in the 1/19/12 Staff Recommendation. Thus, it appears that as of 2010, the outcome was already a done deal behind the public scene.

Changes, such as this were not communicated to the Public/ Working Group and the ongoing status of the relationship with the USACE as per the Joint EIR/EIS was not communicated either. In fact, the USACE- Sect. of the Army was not made aware of the attempt to extinguish the earlier, approved process. Any extinguishing of the approved EIR/EIS process (including House Document 389) would have to abide by the USACE process of removal. The process provides accountability for reasoning as to the ending of the project as well as detailed accounting for money spent and what had occurred throughout the process. This activity has not occurred and the USACE has provided a letter stipulating that the approved process is maintained and that investigation into the matter has started. (USACE-J.Davis communication).

It is also unclear whether USACE/SPONSOR information was communicated to the Science Advisory Committee or other parties. Specific USACE work projects, including response to House Document 389 and work quality/certification needs are not communicated in any of the CD-SAC meeting notes which appears to show that the SAC team (contracted and paid for with public funds) were fulfilling ONLY the arbitrary GOALS as set forth by the CC Project Manager and SMBRC staff. Issues

such as the protection of groundwater (classified as potential drinking water), an issue of House Doc. 389 and current Los Angeles- Best Management Practices (BMPs) are absent in the meeting minutes.

Thus, the CC and SMBRC staff, provided for an atmosphere of further disconnect, lack of transparency and compartmentalization of information sharing.
And,
the public/Working Group was not made aware that the CC considered itself a part of the USACE/SPONSOR contract (which it is not) —so much a part, that Mary Small apparently believed that the CC would provide the alternative(s) for the USACE in the Joint EIR/EIS:

6/28/10 Ecosystem Restoration Planning Management Meeting:
II. C. 2." *Mary Small: It was always our understanding that the Corps would use our restoration alternatives. It makes us nervous that this was was never in writing."..*

This type of very questionable influence was not conveyed publically. According to the USACE, Joint EIR/EIS language, the USACE study would provide for all reasonable alternatives and the process would embrace public disclosure and participation.
The Coastal Conservancy and SMBRC staff have not been forthright with the public regarding status of the Joint EIR/EIS.

I.

B. 1- 3. The CD reveals SAC meetings, reports and concerns not shared with the public/the Working Group and other parties. Conversely, the public/ Working Group comments and concerns are not cross- shared.

Contrary to the 1/19/12 Staff Recommendation, the public, Working Group and others have not been engaged by the Coastal Conservancy as promised and have not been provided with full information from the Science Advisory Committee (SAC) group in order to make informed decisions and provide input throughout the process to date.
Prop. 12 bond money was also provided from the Natural Resources Dept. to the Coastal Conservancy specifically to provide a GRANT to the Southern California Coastal Waters Research Project (SCCWRP)(#172) for creation of a SAC team. Thus, the SAC team was paid with public dollars to perform as an independent scientific advisory panel to provide input and advice regarding historical restoration options. Contrary to the GRANT purposes, the Coastal Conservancy's Ballona Project Manager and SMBRC staff instead told the SAC team what the intended outcome was and that all input was to secure that goal—namely full tidal estuarine and levy removal.
Thus, the Prop. 12 bond money was not utilized as intended.
The Coastal Conservancy and SMBRC staff kept the public and the Working Group out of the SAC loop of information and knowledge thereby thwarting and distancing

any meaningful interchanges and participation as falsely stated in the Staff Recommendation below.

Staff Recommendation excerpt:
"Cooperation: The conceptual restoration plan was developed in a public process with input from a Science Advisory Committee, an Agency Advisor Committee, and the Ballona Working Group made up of representatives of local nonprofit organizations, agency staff and members of the public. Individual public members also participated in all facets of the development of the restoration alternatives."
(p. 9 of 9 Staff Recommendation 1/19/12)

And, contrary to assurances that the public would be notified and included on all SAC meetings, the public was not notified or included.

"MARY S. all SAC meeting are public, all interested parties will be notified and invited, meetings will be structured with SAC addressing issues first and public comment period at the end." (CD- 7/20/05 LMU Ballona SAC MTG.)

A 2004 MEMO discusses –
"Ballona Restoration Planning Working Group: Stakeholder Committee and Public Involvement
*"A Ballona Restoration Planning Working Group (brpwg) made up of interested organizations, agencies, and individuals, will meet periodically to obtain project status updates, to provide input, and to support the restoration planning process. These meetings will be open to the public. Subcommittees may be established to address specific issues that may arise during planning."*pg.2

The language above provided for the public involvement at the start of the process that began with 'interim stewardship' meetings, (eg. trash cleanup and education tours) which did occur. As time passed, meetings stopped, informational sharing from agencies and the science team became nonexistent and; the public's comments were not included in the planning process that continued behind closed doors.
-Website topic- SAC meeting minutes- was not accessible to the public. Instead, when clicked – the website told the viewer entry was not allowed.
-SAC meetings, though described as open to the public, were not. The CD documents reveal that the SAC meetings were, in the main, telephonic and not inclusive of the public. Reports and Memos were not shared with the public but utilized internally.

A continued failure to acknowledge the public and Working Group is also documented via the 2012 Science Advisory Meeting that was held days after the Staff Recommendation Approval. The SAC meeting was also a first in years for actually occurring and, that public notice was provided.

The Public/ the Working Group:

- provided strong objections to the proposed Plan, providing written testimony as well as oral testimony.
- listed issues that needed to be addressed properly; asked for responses that thus far have gone unanswered and,
- again requested the area be considered in its totality of ecosystem variety and benefits utilizing the historic system of Ballona.
- reminded the SAC that the area now has more saltwater --deep and mid habitat than historically existed at Ballona due to the Marina del Rey; Ballona Lagoon Marine Preserve; Del Rey Lagoon; Ballona Creek itself and; as well as freshwater due to the newly created catch-basin- aka, the freshwater marsh. (historically= the last couple hundred years)
- SAC numerical analysis of habitat types was in error. Ratios of entire Ballona Wetlands historic habitat applied to be fulfilled in Areas A, B, C alone is a faulty analysis. The SAC- ratio numbers that pertained to former water habitat and land elevations were either incorrect and/or not documented by SAC.
- cited and documented that SAC dredge spoils deposition locations and volumes were incorrect. (USGS Documents and maps provided by John Davis to the Coastal Conservancy)

The CC and SMBRC continue to fail to respond.
Note: The CC continues to fail to respond to queries and comments provided by the public and its so-called "Working Group" members from 1/19/12 and 3/29/12.

FAILURE TO INCLUDE THE WORKING GROUP COMMENTS AND REQUESTS
Despite providing comments, documentation and evidence regarding the topics listed above and others; there is no documentation provided from the Coastal Conservancy on the CD that any of the public/ Working Group communications were included for any meaningful response or use.

The CD documents reveal no inclusion of the public in any decision making for the alternatives.
Public comments provided to SMBRC and the Coastal Conservancy regarding Ballona specific studies such as the Phil Williams & Assoc. report, that did not address or incorrectly addressed issues, such as the migrating oilfield gas and reservoir gas leakage from SOCALGAS had no meaningful response. There is no showing that the CC or SMBRC staff ever shared these concerns with the SAC team, much less did any meaningful, good faith follow up with the public to understand how the gases may impact restoration. The same holds true for issues regarding protection and utilization of the Ballona aquifer groundwater hydrology. Repeated requests from stakeholders to be given ½ hour presentation time to provide information regarding hydrology and groundwater diversion issues, before the SMBRC have been met with silence (The CC is part of the SMBRC) .

I.B.

CONTROL OF MESSAGE AND OUTCOME
The CC and SMBRC Staff :
Allow For No Public/ Working Group Participation In The Planning Process;
Fail to Disclose Science Advisory Committee (SAC) Conference Calls, Memorandums and Reports For Planning of Alternatives;
Feasibility, Cost, Sustainability, Ecosystem Pros and Cons Are Not Disclosed;
And
The CC & SMBRC Staff Arbitrarily Define Project Goal=Estaurine

Staff Recommendation excerpt:
"Cooperation: The conceptual restoration plan was developed in a public process with input from a Science Advisory Committee, an Agency Advisor Committee, and the Ballona Working Group made up of representatives of local nonprofit organizations, agency staff and members of the public. Individual public members also participated in all facets of the development of the restoration alternatives."
(p. 9 of 9 Staff Recommendation 1/19/12)

The 1/19/12 Staff Recommendation excerpt is false. The public/ Working Group was neither privy to the SAC meetings and information created nor included in the planning process to participate in all facets of the development of the restoration alternatives.
The following excerpts from the CD document an internal discussion revealing the CC and SMBRC staff created and controlled the alternative selection:

"Wayne (Wayne Ferren) suggested that biological sustainability be defined as no loss of habitat types & functions, major guilds, and sensitive species over the project site as a whole." July 7, 2008 SAC Conference Call.

And;

"Joy (Joy Zedler) asked how biodiversity is being defined? ***Sean indicated that biodiversity = highest richness of estuarine dependent species.*** *If this is how we are defining biodiversity, it should be stated clearly in the document.* (emphasis added; Sean Berquist was SMBRC staff and Foundation staff during this timeframe)
and,

"Wayne suggested that we clarify that biodiversity is the sustainable richness of representative interdependent native estuarine habitats along with their associated and expected species biodiversity. "(CD-June 23, 2008 SAC Conference Call)

The next parargraph, written by the note-taker- cited by CC as being CC or SMBRC staff- states the goal-
"Estuarine biodiversity is the primary objective of the analysis."
(CD- June 23, 2008 SAC Conference Call Memo)

This same Memo also sets forth a GOAL that was not shared with the public/ Working Group.
"The project goal is to create functional estuarine habitat...";
"1. Maximize area of estuarine habitat.";
Opportunities to create regionally significant habitat including vernal pools and...should be pursued but ***not at the expense of restoration of estuarine habitat."***

The public/Working Group was not allowed to participate in the decision making and was not advised as to the differing opinions rendered by the SAC team.

Since this timeframe and without public notification or disclosure the Coastal Conservancy and staff of the Foundation have worked to eliminate the areawide review of ecosystem function and alternative habitat plans—including a public debate regarding the pros and cons of each system -- to instead focus upon a predetermined singular outcome of removal of Ballona Creek levees and dredging of Ballona to 'landscape' and convert the land from its historic natural function to an entirely new, artificial and unnatural function that precludes all habitat function that does not primarily promote the estuarine full tidal premise.

And though asked publically where this 'Plan- Alternative 5 " came from, no response has been forthcoming from either the CC or Foundation staff.

The CD docs however now shed light as to the creation of this "preferred plan". The overtones of financial leverage dominate the first half of the letter and serve to advance a predetermined outcome that is seen fulfilled in the Coastal Conservancy Staff Recommendation—the removal of levees to create the treatment wetlands.

July 10, 2007 SMBRC letter from Shelley Luce to Coastal Conservancy's Ballona Project Manager- Mary Small:

"Dear Mary,
The Santa Monica Bay Restoration Commission, a National Estuary Program of the US EPA, has been pleased to participate in the acquisition and restoration of the Ballona wetlands at all levels over the last several years. We are proud partners in the restoration planning, and currently have one staff member dedicated full time to the planning effort, while I serve on the Ballona Wetlands Science Advisory Committee (SAC). The SMBRC is also an active local partner in the Army Corps of Engineers' Lower Ballona Ecosystem Restoration Feasibility Study and are participating in clean up and restoration plans for Ballona Lagoon, the Grand Canal, Marine del Rey and the Oxford Basin. We have also awarded several millions of dollars of bond monies under our purview to projects designed to improve water quality and habitat in the Ballona Creek watershed. Ballona wetlands restoration is clearly a very high priority of the SMBRC and the EPA.
I have reviewed the restoration design alternatives that are being developed by the consulting team and I am disappointed that they do not fully consider important restoration options, thereby limiting potential habitat, biodiversity and water quality improvements in the wetlands complex. The Ballona SAC requested design alternatives that encompass the "extremes" of restoration planning, i.e. from minimal intervention to maximal structural changes, as well as alternatives in between. The current proposed

alternatives do not provide this and need to be modified, or an additional (fourth) alternative is needed.
SMBRC feels that the restoration design for Ballona wetlands must represent a true restoration of maximum ecological functions and services for the area. Actual restoration work will not begin for months or years, and will be a long term and costly process. The best approach is to include design alternatives that are not limited by current infrastructure or fiscal concerns, since these factors will certainly change over the duration of the restoration process. Similarly, factors such as poor water quality in Ballona Creek will continue to change as Total Maximum Daily Loads and other regulatory measures are implemented. It does not serve us to design the restoration as though it would be undertaken and completed in the very near future, under existing physical or financial constraints.
I would like to request that the design team include at least one design alternative that proposes to
• remove all or part of the levees on one or both sides of Ballona Creek;
• daylight the channel connecting the freshwater marsh to the creek in Area B, and Stingray Creek to Marina del Rey in Area A;
• raise Culver Boulevard to increase flows between the north and south sections of Area B; and
• increase connectivity between Ballona Creek and Areas A and B."

Our staff Wetlands Restoration Manager Sean Bergquist is available to work closely with the consulting team to ensure the revised or new alternatives include features that stakeholders and the SAC members supported. The revised or new alternatives should be presented as one of the group of alternatives for consideration under CEQA and by stakeholders and the SAC.

Given our experience in and commitment to the Ballona wetlands and surrounding interconnected areas, the SMBRC staff, Governing Board and Watershed Council have a great deal to contribute to the restoration process. Please feel free to consult us further during development of the restoration design alternatives and we look forward to continuing our partnership to restore Ballona wetlands.
Sincerely,
Shelley Luce, D.Env.
Executive Director

An e-mail 7/17/07 from SMBRCommission & Foundation executive officer Shelley Luce,
"RE: design alternative for Ballona wetland restoration" and Phil Williams & Associates' (PWA) Jeremy Lowe –
"We've sketched out Alternative 5 as described in Shelley's letter. Is this what you were envisaging?"

Luce: *" Thank you for your response Jeremy. This is a good start for a 5th alternative. Sean and Jessica are adding/changing some details and will forward to you. "*
(presumably-Sean Berquist and Jessica Hall– both Foundation paid staff/ SMBRC staff)

The CD documents also reveal two sets of drawings and plans for the levy removal and levy replacement—by Jessica Hall, a Foundation paid staffer.

Ms. Luce is the Executive Director of the Foundation; no contractual agreements

have been produced by the SMBRCommission or the State Water Board that provide any authority for her to act in capacity of Executive Director of the State Agency-

Santa Monica Bay Restoration Commission which was created under SB 1381 Keuhl as a non regulatory state agency within the State Water Board. There have been no contractual agreements forthcoming by the State Water Board or federal authorities that provide for any SMBRC or federal EPA- National Estuary Program (NEP)- dedicated funding to be handed over to the SMBR Foundation. There is a treasury account that was formed under SB1381 in 2002.

The treasury account has never been used. The attendant oversight and accountability by the State Treasurer has likewise not been utilized.

Ms. Luce has been utilizing both the e-mail address and physical location of the LARWQCB as her work address. The utilization of the addresses has led to common belief that Ms. Luce is a Water Board employee. It is unknown but possible at this time to believe that the utilization of the addresses created a belief that Ms. Luce is LARWQCB personnel, which has in turn, provided Ms. Luce with access to controlling positions on various committees such as IRWMP (Integrated Resource Water Management Program). It would seem that by creating, via continued use of LARWQCB email address and business address, a very public belief that Ms. Luce is a Water Board employee may constitute impersonating a Water Board employee. The following is an e-mail exchange between Ms. Luce and a person with long associations with the Water Board and has acted as a contractor in Ballona restoration matters.

'Travis Longcore travislongcore@laaudubon.org wrote:

Bounced from your waterboards address. Are you no longer a Water Board employee? –

Travis

On Sep 19, 2011, at 2:29 PM, Shelley Luce wrote:

No, not for many years. *Most of our staff are with our SMBR Foundation. I will check my calendar and get back to you on this meeting, thank you for the invitation.*

Shelley" (emphasis added)

Ms. Luce does not appear to answer directly about herself with regard to the Foundation, or what she means by "our SMBR Foundation". She also does not explain her past personal use of the LARWQCB addresses while not employed and why she suddenly discontinued the practice.

Ms. Luce's resume cites her experience prior to SMBRCommission / Foundation as having been employed by Heal the Bay- the organization that has become institutionalized as part of the SMBRC. Our research indicates Ms. Luce was working in some capacity at LARWQCB during the years 1999-2001- prior to her finishing degrees from UCLA. It appears that her continued use of the Water Board e-mail address after no longer providing service to the California Water Resources Control Board has led/misled many people. (A PRA to LARWQCB is pending for identification of duties.)

Coastal Conservancy- PRA Response to J. Davis

Rare ecosystems of the coastal marsh area are discussed internally by the SAC team with the CC project manager and staff of the Foundation; the information

is not broadcasted for public awareness, inclusion of discussion and decision making as promised.

"Rich noted that the discussion of grasslands should include mention of the historical native grassland prairie ecosystems that previously existed in the area. The rarity of native grasslands should be discussed,,," (CD- 6/28/08 SAC Conference Call)

"Rarity section...complex of prairie and vernal pool...
Wet grasslands formed extensive areas were also palustrine wetlands above highest high tide.." (CD- SAC Call 6/23/08)

"...there is native biodiversity in the non-tidal saline soils. .... At Ballona, these wetlands at Area A, for example, are the only habitat where Alkali Barley (Hordeum depressum) is known to occur in the Ballona Ecosystem. This annual grass was probably the dominant native annual grass in naturally occurring non-tidal saline soils at Ballona." (CD- 11/23/08, Wayne Ferren communication to Mary Small...)

And,
"The region has a shortage of mudflat for shorebirds, high marsh for animals and salt marsh bird's beak, marsh-upland transition for rare shrubs (eg., box thorn) that are used by animals,...

The region has a shortage of dune habitat and back – dune depressions that support clean-water brackish marsh for aquatic plants and animals.

One could also list maritime scrub, which remains in several places "...
(CD- Joy Zedler (SAC) correspondence)

Thus , without public /Working Group inclusion and input into the formation of the alternatives and later failure to include the public /Working Group comments and concerns regarding the PWA Alternatives that are presented at one public meeting--the CC and Foundation staff continue to work behind publically closed doors to focus upon the 'Preferred Alternative", now known as Alternative 5 presented in the 1/19/12, Staff Recommendation request for funding. Alternative 5 requires massive, non-historic, extraordinary, experimental and knowingly toxic changes to occur on the land masses of Area A and B so that **"biodiversity = highest richness of estuarine dependent species."**

Contrary to the 8/13/04 CC Memo which promised transparency and public inclusion in the alternative planning process which would "restore and enhance" a mix of wetland habitats....and that would implement a technically feasible, cost effective, ecologically beneficial and sustainable restoration.
Instead, <u>the public was shut out of the planning process; and SAC knowledge regarding the **needs and dangers posed by Alternative 5 are not made public:**</u>

"This alternative makes the greatest change to the site, would be the hardest to reverse and consequently has the most risk." (CD- 9/12/08 MEMO from SAC to PMT)

" ..this alternative would ***require reliance on upstream flood control and pollutant removal****, and could necessitate periodic removal of accumulated pollutants for some portions of the restored wetlands. Furthermore, it is unknown how the flow and sediment yield from the upper watershed would affect the sustainability of the marsh in terms of scour or sediment deposition."* CD, P. 4of 9, 10/15/08 SAC MEMO, emphasis added.

There is no evidence of any such large scale BMP (Best Management Practice) planning or proposals for 'flood control and pollutant removal" occurring upstream on Ballona Creek.

And,

"Eric suggested that there be a statement up front indicating that this site will not be self-sustainable, but will need to be actively managed in perpetuity. " (CD- 7/7/08 SAC Conference Call)

Discussion and comments made from key federal agencies were withheld from the public, including but not limited to **NOAA communications regarding concern of toxicity of Ballona Creek upon the remaining wetlands should the levy removal and dredging take place.** (CD- National Oceanic Atmospheric Association email)

Studies that discuss the toxicity of the Ballona Creek waters and sediment to life in the waters and sediment were not released or shared with the public:

"These sediments were toxic to aquatic organisms, potentially from organic compounds in these sediments. Ballona Creek has been identified as a potential source of tidal flows into Areas A, B, and C in each of the proposed restoration alternatives. Therefore, there is concern to tidal marsh areas, resulting in a negative impact to the habitats and biological resources." (CD- Weston –Technical Memorandum 11/26/07; Water Quality Data Gap Investigation Ballona Wetlands Restoration Project- Pohl , P.E., Ph.D.)

And,

" The July 2006 report by Weston also concludes that there are concerns related to water and sediment quality adjacent to the tidal channels. Consequently there is a need to develop a strategy to evaluation the potential ecological risk associated with influent water or sediment quality to the restored wetlands.

The scientific questions regarding sediment and water quality cannot be answered based on the information currently available, and will ultimately depend on the design of the project." (CD- Memorandum 3/8/08; Subject:

APPROACH FOR ADDRESSING SEDIMENT AND WATER QUALITY ISSUES)

And;

"Eric- Conc(ept) D—is it attempt to move water and sediment into system

Wayne- breaching levee bringing trash, water pollution and sediment into entire area is problematic.

John Dixon-important to describe these NOT as projects, but a directions.

Ambrose- maybe D is too extreme—this won't happen anyway.

Dixon- do feasible maximum tidal, not D—need to scale back

Jeremy- may need to do that, take out realignment Ballona—include realign on Hydrologic options"
(CD-10/30/06 SAC Conference Call)

Additional -SPECIFICS OF THE STAFF RECOMMENDATION 1/19/12

The 1/19/12 Staff Recommendation misleads the public and the Governing Board as seen on pg. 3 of 9, paragraph 5-

" In order to complete the environmental analysis required under the National Environmental Policy Act and the California Environmental Quality Act ***and to apply for permits*** *to implement the project,* ***detailed technical work must be completed."*** *(Emphasis added.)*

What is not disclosed to the reader, is an entire change of process from the Congressionally approved 2005 Joint EIR/EIS process requirements.

The Staff Recommendation sentence itself is also very misleading. The applications for permits to the USACE for implementation of the Coastal Conservancy "Plan", namely the destruction of the levees and the dredging of Ballona have been in process prior to this Staff Recommendation. The Plan-regarding garnering the USACE permits-including the 408- was already in process. (CD)

The Conservancy in its partnership with SMBRC fails to let the public know that they have been working to end the congressionally approved federal portion of the study which entails a full ecological review of the area between the Westchester Bluffs, the Santa Monica Bay, the Santa Monica mountains to a few miles inland – which would also provide for a full review of ALL REASONABLE ALTERNATIVES for enhancement of the ecosystem. (See minutes of USACE/Sponsor meetings provided in the 3/28/12 Request to Rescind File No.04-088; EIS Lower Ballona Creek Restoration Feasibility Study 2005)

Undisclosed is the take-over of process for Ballona 'restoration' guided by the Coastal Conservancy that may disengage the USACE analysis provided for in the established 2005 Joint EIR/EIS.
Instead, it appears that the Coastal Conservancy along with SMBRC staff seek to simply garner permits from the USACE ostensibly for destruction of habitat on Ballona, in particular Area A and B of Ballona. Specifically, the CC and SMBRC staff seek permits (eg 408) for levee and land destruction and removal. It appears that the extensive dredging and massive bulldozing may provide the necessary fill for the LA Port. Questions from the public regarding the CC/SMBRC/ USACE status have gone unanswered. (CD docs and SMBRC April meeting -submission by GC)

Contrary to discussion in the Staff Recommendation—Area A is vegetated primarily by native plants and native wildlife and, is host to endangered species including but not limited to the Belding's Savannah Sparrow.
Not provided to the public are documents and communications which provide, in part, narrative of 'moving' Belding Savannah Sparrows to areas not planned for dredging. This information is vital for public discussion especially since, destruction of the Belding's habitat may wreak havoc upon the Belding population that utilizes Ballona year round. (CD)

- Pg. 3 of 9 discusses hydrology/hydraulics studies that need to be done. What is not discussed with the reader are the multiple public requests for actual onsite hydrology studies that would include Ballona aquifer and groundwater studies that would provide the knowledge for alternatives inclusive of groundwater use onsite. Ballona has multiple aquifers underlying the site. The aquifers are classified as potential drinking water sources and are part of the West Basin aquifers which intermingle to the south and east. (Poland Report)

- None of the concerns raised in House Document 389 (part of the USACE review) regarding problems associated with further saltwater intrusion have been discussed. The elimination of the USACE EIS as part of the Joint EIR/EIS would hasten the Coastal Conservancy's and SMBRC staff GOALS = Estuarine which in turn would potentially threaten contamination of the underground aquifers as per House Document 389 literature. None of the above has been made a part of any review despite repeated requests from the public for such studies.

- The SOCALGAS operations and oilfield gas migration throughout the Ballona area have also not been discussed despite repeated requests from the public.
- Thus pg 9 of 9 is insufficient and incorrect in its comments regarding the Local Coastal Program and the Coastal Act, including but not limited to the

fact that there is no LCP language that states Ballona requires action as the Staff Recommendation implies as per 31252.

-
- Staff Recommendation- Pg. 8 of 9 Under "Sea level rise vulnerability"
- The Staff fail to alert the reader that the 'broad areas of mid marsh and high marsh" depicted--showing a meandering Ballona Creek mid-way between Area A and B-- will be inundated with yearly flood waters of the contaminated Ballona Creek –potentially killing nesting or burrowing life in the low, mid and high marsh areas. Concerns by the SAC team regarding scouring, trash and contamination were not disclosed in the Staff Report and have not been shared with the public.
- The Staff fail to inform the reader that the Preferred Plan creates a non historic cycling of yearly floods, debris and contamination as part of an end of pipe solution, a treatment wetland device .
- The Staff Recommendation does not disclose the SAC discussion of concerns regarding the creation of a treatment wetland.
- The Staff Recommendation does not alert the reader as to what is achieved with the use of the bond funds via "hydraulics" information. Will the hydraulics information be exclusive to new levy construction?
- The Staff Recommendation does not disclose to the reader, the need for upcreek flood control or contamination control as is discussed by SAC.
-

31400- The Staff Recommendation cites enhancement of future NEW trails.
The Coastal Conservancy has already awarded large grants specifically for the Ballona Bike Trail (File No. 07-058-01) which, currently exists and is heavily utilized by the public. Since, much public funding has already been utilized and will be utilized further for the pathway, why should that same importance of pathway be taken away at Ballona?
Removal of the levies would not only take away a heavily utilized public biking and hiking trail but would also take away the pathway's use as an observatory promenade for viewing the interior of Ballona. The levees provide an important opportunity for viewing without intruding.

The Coastal Conservancy and other agencies have failed to embrace and include the public on this issue as well. Using the public's hard earned money while keeping the public out of the planning process reveals the Coastal Conservancy has not acted in good faith.

Grant Award of $280,000 to Mountains Recreation and Conservation Authority (MRCA) File No. 04-088 from Staff Recommendation 7/21/10.

1. The Mountains Recreation and Conservation Authority governing board refused to approve the use of bond money for the trailhead(s) and other enhancement s at Ballona. The Board agreed with members of the public. Namely, that due to the ongoing **Joint EIR/EIS** process' requirements being

more stringent than a singular EIR; those added requirements had to be fulfilled prior to any further decision making taking place.

Mr. Edmiston, at the meeting, asked did they want him to return the money?-

Ostensibly the bond money had already been approved and given to MRCA. Where did the money go? And;

2. The 1/19/12 Staff Recommendation cites NEW levy demolition and bike trails ,
"the proposed project could provide a new segment of the Coastal Trail. .....the project is located at the intersection of the California Coastal Trail and the Ballona Creek Trail, and may offer a significant opportunity for the development of improved connections between these trails." P. 7 of 9 .

- Since the Coastal Conservancy has been intent upon levee removal of Ballona Creek and dredging the land in the near future; why did the Conservancy give bond money to MRCA for trail head construction and enhancements for Area A (in particular)--apparently an area it intends to soon demolish and dredge? These inconsistencies appear to show misuse of public funds; paying for contractors and salaries for projects that lead nowhere.
- Furthermore, it appears that when the CC Project Manager of Ballona desires to garner public bond money; the wetlands (or bike path) are discussed in a decidedly positive depiction as below:

"Despite the degradation of site resources, significant wetland habitat remains within the Ballona Wetlands. Plant species within the project site include wetland indicators such as pickleweed, marsh heather, saltgrass, arrowgrass and glasswort, and a variety of upland and exotic species including brome, iceplant, oxalis, and ryegrass. Bird surveys indicate that the site is used seasonally by a variety of migratory shorebirds, as well as by typical shoreline residents (gulls, terns, and ducks) and typical upland birds including small raptors. Bird species of special interest observed in the project area include nesting pairs of Belding's Savannah sparrow and foraging use by California least terns.
The proposed project will be implemented primarily on the portion of the BWER north of the Ballona Creek channel (Exhibit 2). This area of the reserve currently has very limited public access and suffers from illegal uses. The proposed project seeks to improve the resources on the site, increasing public use while discouraging illegal activities through improvements to fencing and signage." File No. 04-088

This same project manager provides an entirely different depiction in the negative—when public bond money is requested for demolition purposes on the same piece of property. Note also the language of utilizing funds to safeguard the property directly contradicts the 1/19/12 Staff Recommendation of the 6 plus million wherein the Project Manager cites the need to demolish and dredge the same area as a means of eliminating public use by the homeless instead of—the aforementioned request for money to protect the same area. (See also Ms. Small e-mails discussing need to show greater degradation in order to secure the desired outcome. (J. Davis 3/28/12 Request to CC))
It appears that the Ballona habitat is characterized dependent upon financial requests---not on reality or science based requests.

- Despite repeated requests for public follow up with regard to the bond money and that project, (including a request made for information at the recent Ballona Watershed Task Force Meeting) none has been forthcoming from MRCA staff or CC staff.

"In 2008, the Conservancy authorized funds to the MRCA for planning, final design and implementation of specific public access improvements identified in the Ballona Wetlands Early BALLONA WETLANDS PUBLIC ACCESS IMPROVEMENTS
Action Plan. MRCA has completed much of that work and as a result of that planning effort, the project partners determined that some of the specific access improvements identified in that plan may need to be re-evaluated and others should be reviewed and permitted as part of the larger wetland restoration project. Rather than pursue the Early Action Plan improvements, the project partners decided that it is a higher priority to develop targeted educational and public access programs in the northern 300 acre portion of the site where there is currently almost no public access. The proposed project would also provide funding for MRCA to continue working on planning public access improvements for inclusion in the ultimate restoration project."

This inconsistency for request/approval and follow-up on bond funds continues to remain unexplained.

And,how does removal of the levees- the lower leg of the "Class 1 bike path" fit with the public's money expended below?:
"In 2000, the Conservancy helped fund a regional plan for creation of a "Park to Playa" river park way from the Baldwin Hills to Marina Del Rey. The plan envisioned creation of a parkway along Ballona Creek to link expanded parks at the Baldwin Hills to the beaches and the Coastal Trail. In 2001, the Conservancy helped fund the Ballona Creek and Trail Focused Special Study which identified potential improvements to the creek and trail. Consistent with that study, the Conservancy has also provided funding for the construction of a pedestrian bridge in Culver City which increased access to the Ballona Creek Trail. That project has been completed. This project will help to implement the vision of the "Park to Playa" and the Focused Study, developing a multi-benefit, gateway park that will increase access to the trail and enhance the experience of trail users. ***File No. 07-058-01; Project Manager Mary Small***

Conservancy funds for this project are expected to derive from the Conservancy's FY 2002/03 appropriation from Proposition 40")

3. Staff Reccommendation pg. 9 of 9 re: Consistency With Local Coastal Policies fails to provide accurate Local Coastal Plan (LCP)background information.

The Coastal Commission certified the first LUP in 1984, the La Ballona MDR Land Use

Plan.

The Land Use Plan was then changed to reflect two distinctly different Land Use Plans, the La Ballona
Plan and the new and different MDR LUP.

It is questionable as to if the California Coastal Commission certified another Land Use Plan for the Playa Vista Project.

Consistency with the California Coastal Act must be consistent with Chapter 3 of that Act.

The Project will not restore, but will instead convert the land from one historic natural function to an entirely new function that is unnatural.
Lack of saltwater connection is demonstrated in historic maps from the U.S. Geological Survey. (A USGS map was submitted at the public hearing on Jan 19,2012. The CC remains nonresponsive)

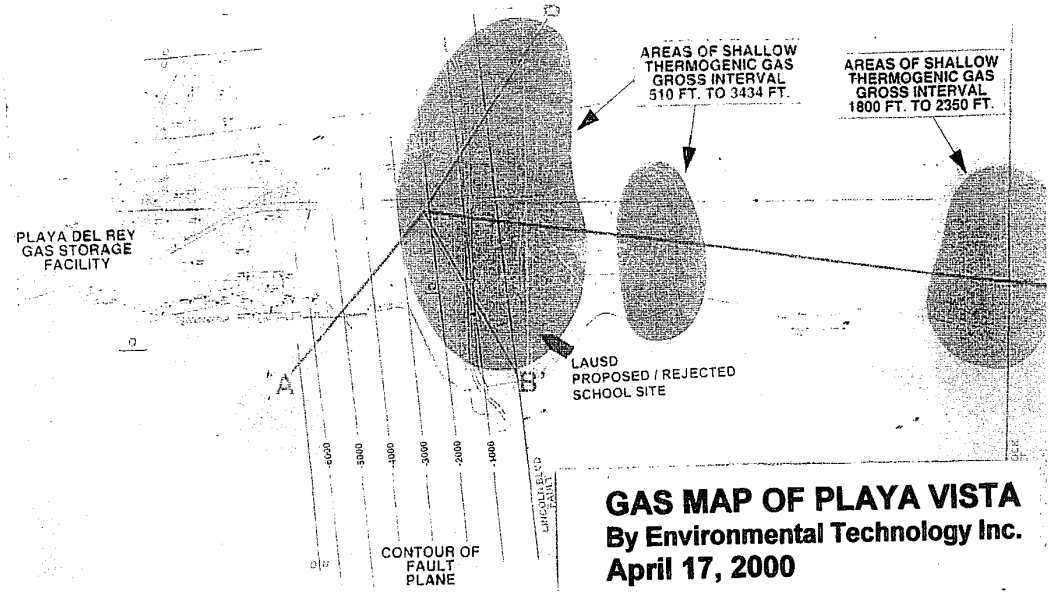
Grassroots Coalition respectfully requests a written response to this Additional Complaint and maintains its request for response to the 3/29/12 REQUEST TO RESCIND APPLICATION FOR STAFF RECOMMENDATION APPROVAL ON 1/19/12, to award $6,490,000 Ballona Wetlands Restoration Engineering and Technical Studies. (File 04-088)

The PRA response CD cited herein, is on file with the Coastal Conservancy. Copies of the CD are available upon request and/or are being forwarded.

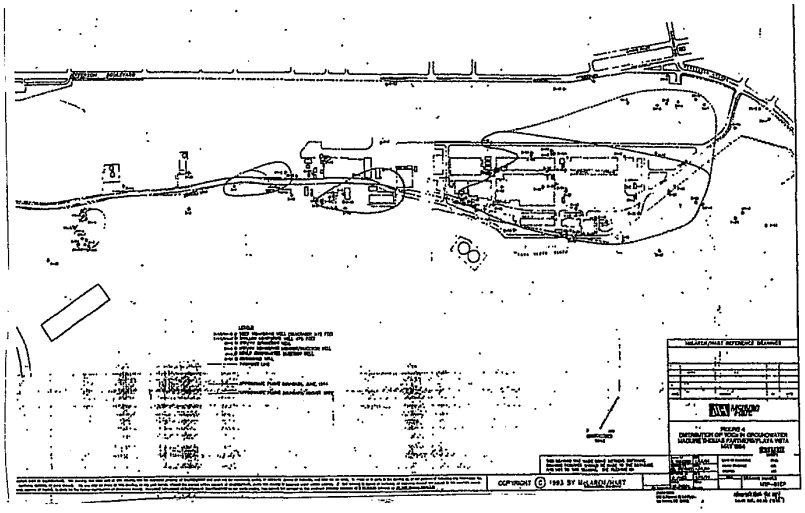
GC also reserves its right to amend this Complaint and Request with additional information.

Attached is the 3/28/12 Request to Rescind from John Davis to Ca.Coastal Conservancy regarding File No. 04-088

Respectfully,
Patricia McPherson, Grassroots Coalition-President

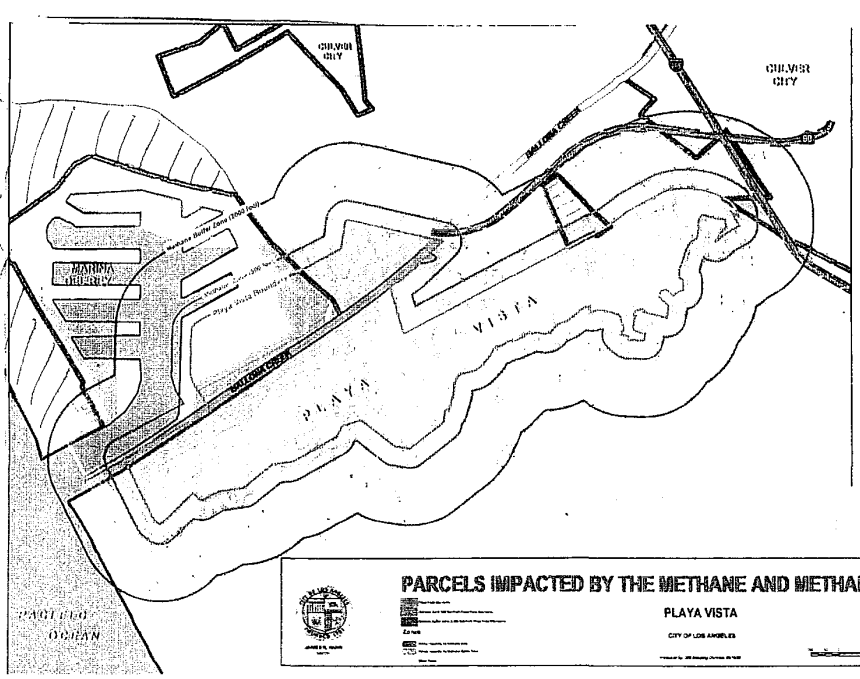


GAS MAP OF PLAYA VISTA
By Environmental Technology Inc.
April 17, 2000



Environmental Impact Report
TOXIC PLUME EXPANSION
1995 Negative Declaration

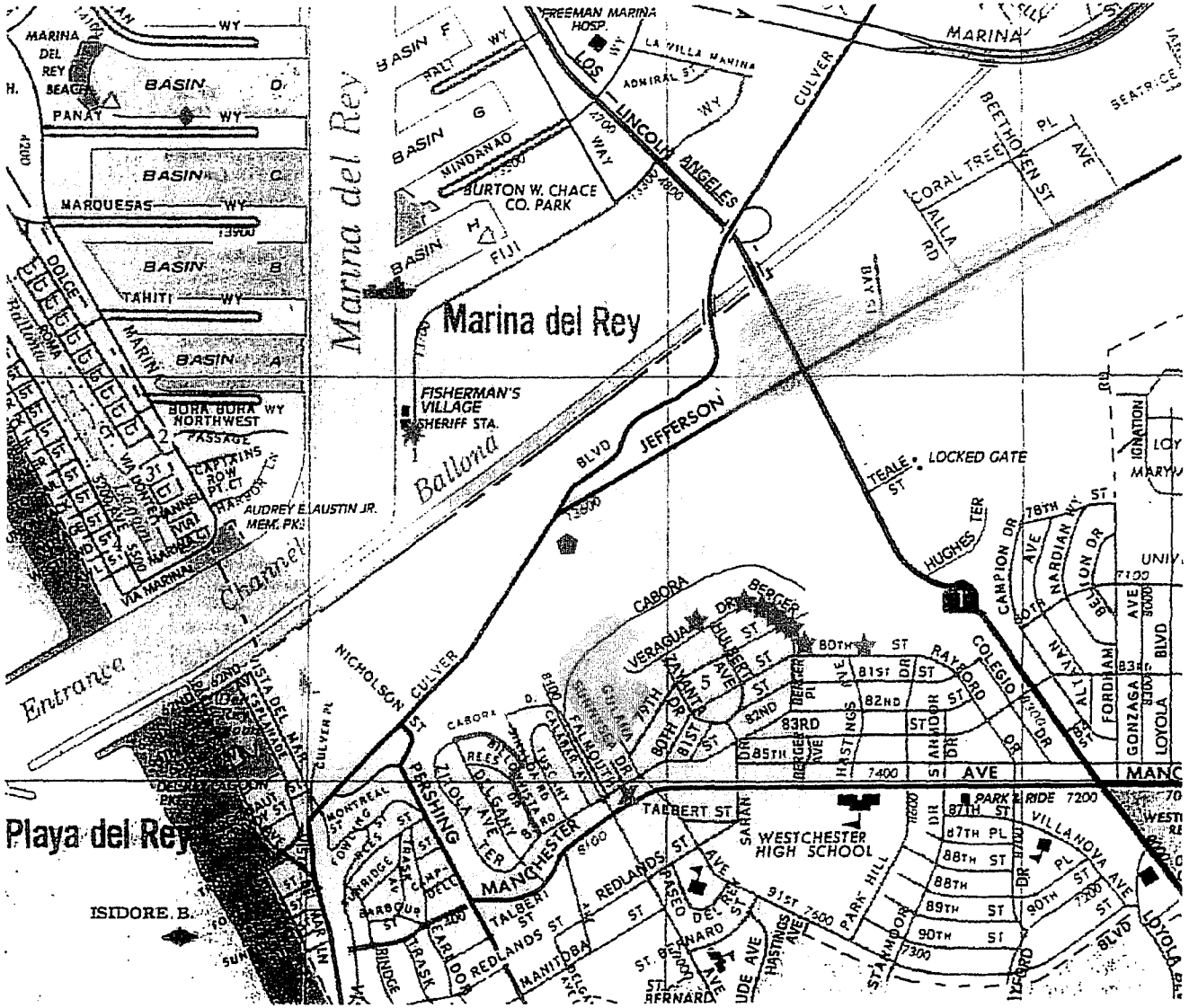
See City Wide Methane Map



PARCELS IMPACTED BY THE METHANE AND METHANE BUFFER ZONES
PLAYA VISTA
CITY OF LOS ANGELES

Source: The California Public Utilities Commission – Safety Branch Investigation

Playa del Rey 851 Application and Complaint Case
Approximate Locations of Facilities and Complaints



SOURCE: Automobile Club of Southern California 1997 and MHA Environmental Consulting, Inc.

Legend

- SCG Facility
- Gas Storage
- Playa Vista

- Odor, health and cancer complaints as a result of emissions from the gas facility
- H_2S cloud exposure, health complaint
- Cancer, health complaints as a result of emissions from a well
- Subsidence complaint
- Odor, respiratory complaints from emissions in the wetlands
- Reported cancer cluster on Billowvista

Problematic wells

1 Playa del Rey 18
2 Townsite 2
3 Townsite 3
4 Block 11
5 Big Ben 1

1000 ft

N

California Coastal Conservancy Public Meeting 1/19/2012
Comments Item 5.

The project must be denied because its primary premise is a fallacy.

This body is not entitled to provide over Six Million dollars to promote a project promoting a primary premise that is not supported by fact but only creative narrative.

The people expect more. We demand supportive facts.

The factually unsupported premise which is not supported by evidence in this Staff Report as stated on page 3 proposes to "restore" an "ecosystem" "by reconnecting the site to the ocean and creek.

Reconnection of the site to the ocean is a demonstrable fallacy.

The truth as supported by factual government surveys is presented by the United States Geological Survey and the State of California Director of Public Works in a map prepared prior to the construction of Marina del Rey, a Federal Project.

The USGS and the State present proof that the ocean did not connect to the site. This is demonstrable fact.

The USGS Beverly Hills Quadrangle Map produced in 1954 demonstrates no connection of the site to the ocean whatsoever, only a creek to ocean connection.

This is simple to determine by looking at the map before you and you may view the original copy, which is here. ATTACHMENT 1

Either Staff is wrong in its narrative unsupported by fact, or the U.S. Geological Survey and State of California Director of Public Works are wrong.

The Staff Report contains no facts to support its contention that the site was connected to the ocean.

The Federal map does provide clear evidence Staff is wrong.

The Staff Report contention is only supported narrative, which under the CEQA Public Resource Code is not to be considered as legal evidence.

The Government Map was clearly based on factual surveys of the land.

The Staff Report premise is FALSE. The site was never connected to the ocean. Only the Lagoon was connected prior to the installation of tide gates when the creek was channelized. The Lagoon is still subject to tidal flows.

Pleases request Staff to respond with facts that demonstrate the State and Federal Government were wrong or deny the permit in absence of this necessary evidence.

The completion of Marina del Rey Harbor allowed for more salt water to into the marshlands that at any prior point in historical times, yet this fact is ignored by Staff.

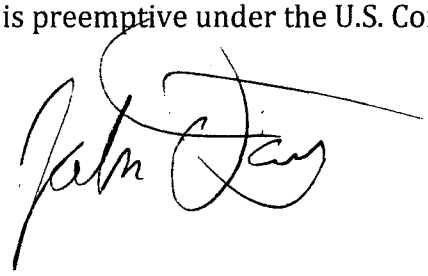
U.S. Public Law 780 Governs the land. ATTACHMENT 2

U.S. House of Representatives Document 389 on page 4 states that some materials will from the harbor construction will be placed to replenish the local beaches. Page 6 describes widening and improving beaches. Page 10 states, "The project is an integral part of the general plan for development of the shoreline of Santa Monica Bay. The General Plan of Improvement is shown as the last page. It to demonstrates no connection of the ocean to the site. ATTACHMENT 3

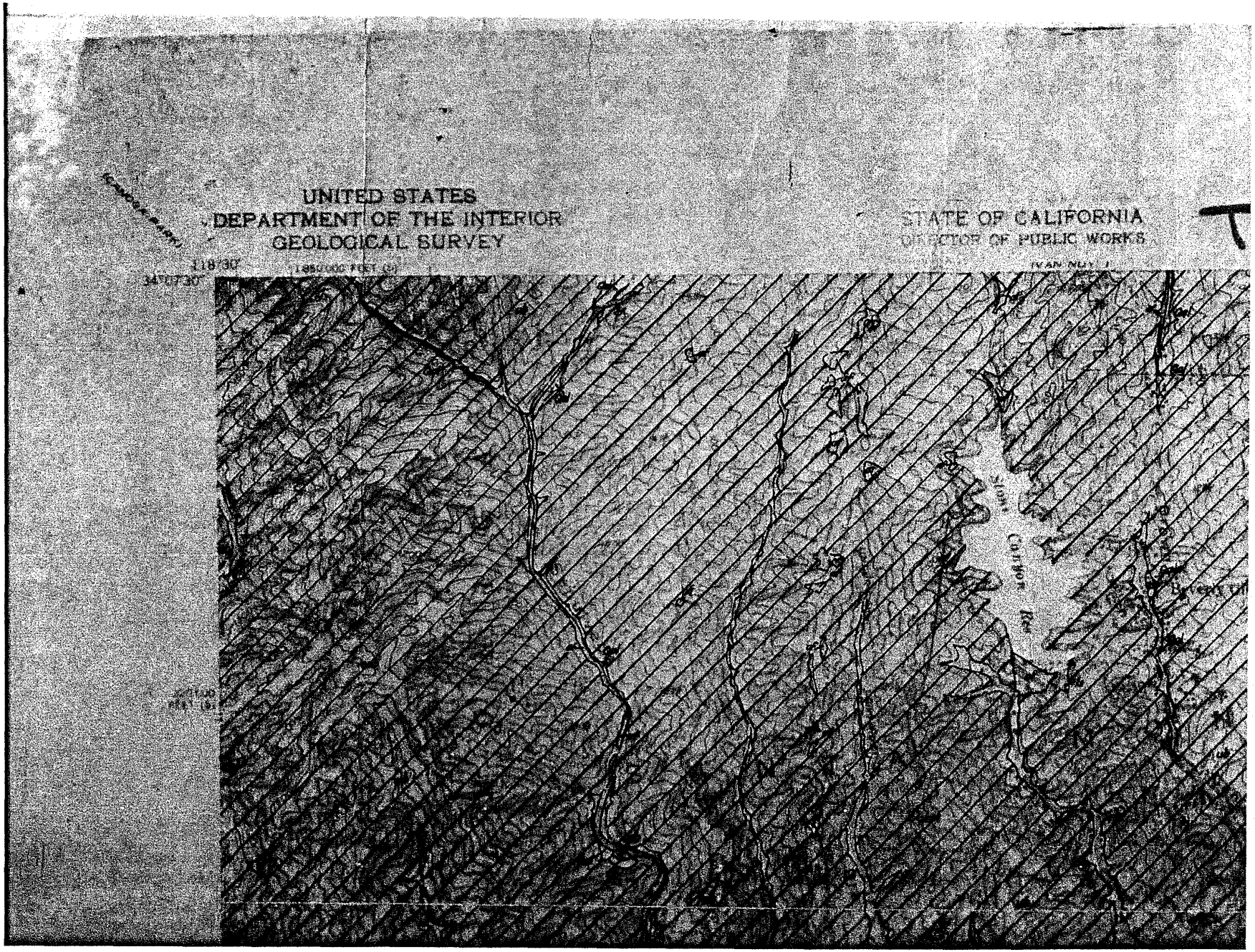
Staff ignores the federal interest entirely and the fact that dredge spoils were placed on local beaches, not only on lowlands.

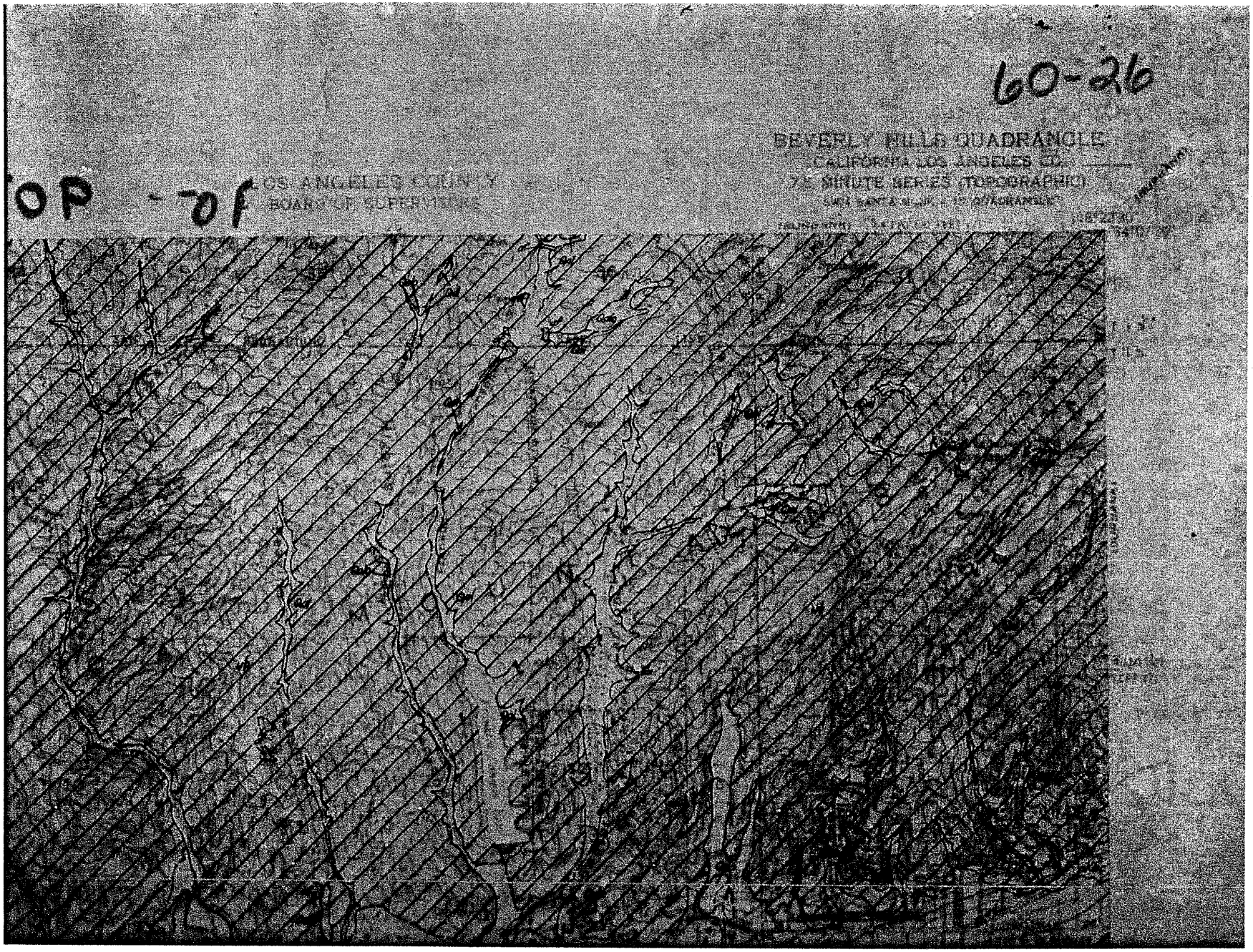
Staff failed to conduct a through investigation backed by fact and has ignored the federal interest in the land which is preemptive under the U.S. Constitution Supremacy Clause.

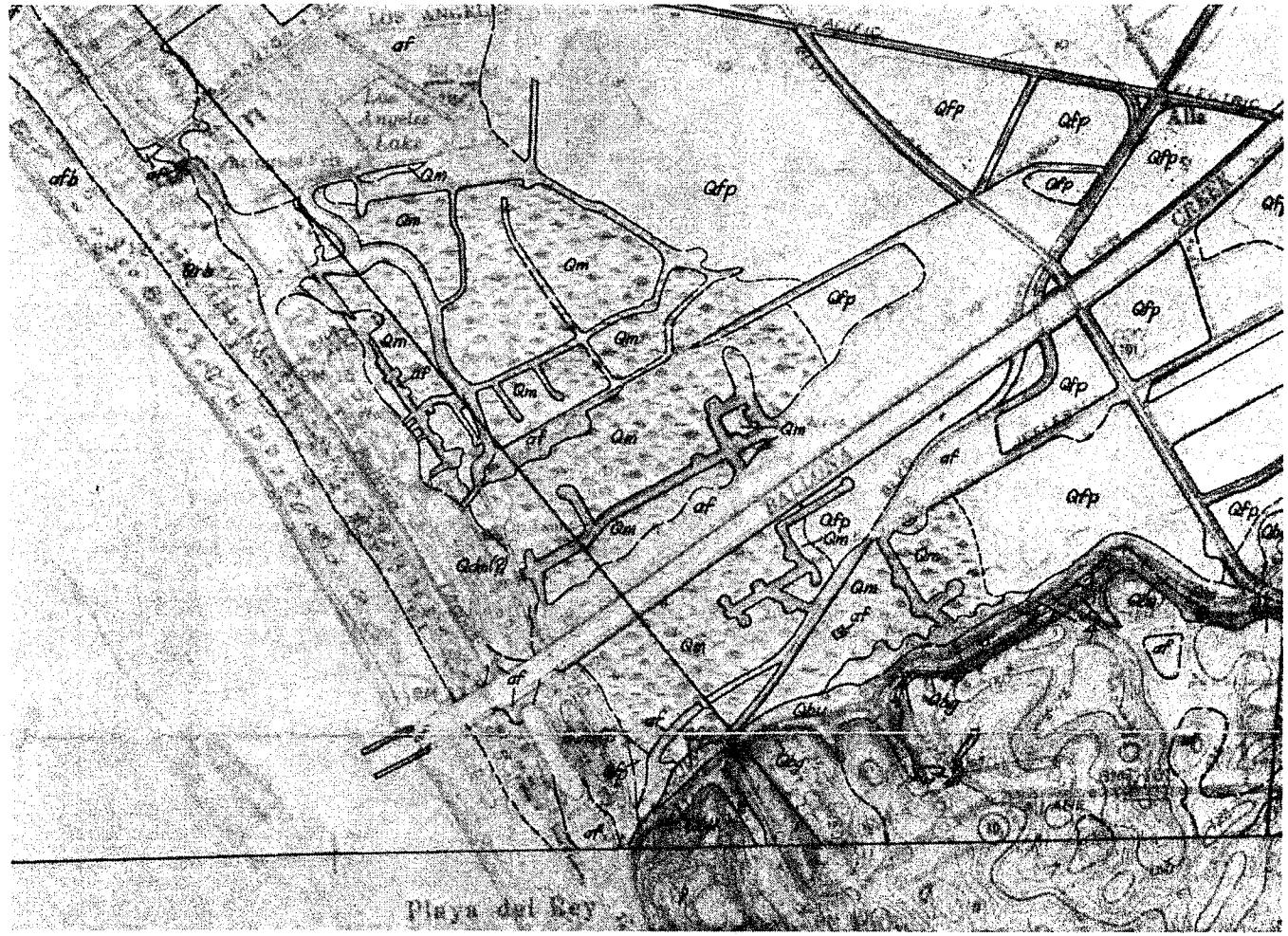
John Davis
PO 10152
Marina del rey Ca. 90295



ATTACHMENT 1


UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
STATE OF CALIFORNIA
DIRECTOR OF PUBLIC WORKS
118°30'
34°07'30"


60-26
BEVERLY HILLS QUADRANGLE
CALIFORNIA-LOS ANGELES CO.
7½ MINUTE SERIES (TOPOGRAPHIC)
OP - 7F
LOS ANGELES COUNTY
BOARD OF SUPERVISORS


af
Qfp
Qm
Playa del Rey

ATTACHMENT 2

Interest on judgments.

SEC. 57. The last sentence of subsection (b) of section 2516 of Title 28, United States Code, is amended by inserting immediately after the word "allowed" where it appears in such sentence the words "for any period", so that such subsection will read as follows:

"(b) Interest on judgments against the United States affirmed by the Supreme Court after review on petition of the United States shall be paid at the rate of four percent per annum from the date of the filing of the transcript of the judgment in the Treasury Department to the date of the mandate of affirmance. Such interest shall not be allowed for any period after the term of the Supreme Court at which the judgment was affirmed.".

Fees.

SEC. 58. Subsection (a) of section 2520 of Title 28, United States Code, is amended by striking out where it appears in such subsection the words "and the hearing of any case before the court, a judge, or a commissioner", so that such subsection will read as follows:

"(a) The Court of Claims shall by rules impose a fee not exceeding $10, for the filing of any petition.".

SEC. 59. (a) Chapter 165 of Title 28, United States Code, is amended by adding at the end thereof a new section to be designated as section 2521 entitled "Subpoenas" and to read as follows:

"§ 2521. Subpoenas

"Subpoenas requiring the attendance of parties or witnesses and subpoenas requiring the production of books, papers, documents or tangible things by any party or witness having custody or control thereof, may be issued for purposes of discovery or for use of the things produced as evidence in accordance with the rules and orders of the court. Such subpoenas shall be issued and served and compliance therewith shall be compelled as provided in the rules and orders of the court.".

(b) The analysis to chapter 165 of Title 28, United States Code, immediately preceding section 2501 of such title, is amended by adding at the end thereof a new item 2521 to read as follows:

"2521. Subpoenas.".

Approved September 3, 1954.

Public Law 780

CHAPTER 1264

September 3, 1954
[H. R. 9859]

AN ACT

Authorizing the construction, repair, and preservation of certain public works on rivers and harbors for navigation, flood control, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

River and Harbor Act of 1954.

TITLE I—RIVERS AND HARBORS

SEC. 101. That the following works of improvement of rivers and harbors and other waterways for navigation, flood control, and other purposes are hereby adopted and authorized to be prosecuted under the direction of the Secretary of the Army and supervision of the Chief of Engineers, in accordance with the plans and subject to the conditions recommended by the Chief of Engineers in the respective reports hereinafter designated: *Provided*, That the provisions of section 1 of the River and Harbor Act approved March 2, 1945 (Public, Numbered 14, Seventy-ninth Congress, first session), shall govern with respect to projects authorized in this title; and the procedures therein set forth with respect to plans, proposals, or reports for works of improvement for navigation or flood control and for irrigation and purposes incidental thereto, shall apply as if herein set forth in full:

59 Stat. 10.

Wisconsin. Cornucopia Harbor, Wisconsin: House Document Numbered 434, Eighty-third Congress, at an estimated cost of $220,000;

Sheboygan Harbor, Wisconsin: House Document Numbered 554, Eighty-second Congress, at an estimated cost of $217,200;

Michigan. Holland Harbor, Michigan: House Document Numbered 282, Eighty-third Congress, at an estimated cost of $574,400: *Provided*, That local interests will contribute 25 per centum of the cost of dredging Section B, but not to exceed $45,500, in addition to the local cooperation required by the project document;

Crooked and Indian Rivers, Michigan: House Document Numbered 142, Eighty-second Congress, at an estimated cost of $225,000:

Saginaw River, Michigan: In accordance with the report of the Chief of Engineers, dated June 7, 1954, at an estimated cost of $4,496,800;

Ohio. Toledo Harbor, Ohio: House Document Numbered 620, Eighty-first Congress, at an estimated cost of $512,000;

Ashtabula Harbor, Ohio: House Document Numbered 486, Eighty-third Congress, at an estimated cost of $4,900,000;

Pennsylvania. Erie Harbor, Pennsylvania: House Document Numbered 345, Eighty-third Congress, at an estimated cost of $174,000;

New York. Black Rock Channel and Tonawanda Harbor, New York: House Document Numbered 423, Eighty-third Congress, at an estimated cost of $270,000;

Little River at Cayuga Island, Niagara Falls, New York: House Document Numbered 246, Eighty-third Congress, at an estimated cost of $36,900;

Oswego Harbor, New York: House Document Numbered 487, Eighty-first Congress, at an estimated cost of $2,459,000;

California. Los Angeles and Long Beach Harbors, California: House Document Numbered 161, Eighty-third Congress, at an estimated cost of $896,500: *Provided*, That the Secretary of the Army is hereby authorized to reimburse local interests for such work as they may have done upon this project prior to July 1, 1953, at actual cost to local interests insofar as the same shall be approved by the Chief of Engineers and found to have been done in accordance with the project hereby adopted: *Provided further*, That such reimbursement shall be subject to appropriations applicable thereto or funds available therefor and shall not take precedence over other pending projects of higher priority for harbor improvement: *And provided further*, That such payments shall not exceed the sum of $500,000;

Playa del Rey Inlet and Harbor, Venice, California: House Document Numbered 389, Eighty-third Congress: *Provided*, That Federal participation in the provision of entrance jetties, entrance channel, interior channel and central basin recommended in the project report and presently estimated to cost $7,738,000 shall not exceed 50 per centum of the cost thereof;

Port Hueneme, California: House Document Numbered 362, Eighty-third Congress, at an estimated cost of $5,437,000;

Richmond Harbor, California: House Document Numbered 395, Eighty-third Congress, at an estimated cost of $2,086,000;

Oregon. Rogue River, Harbor at Gold Beach, Oregon: Senate Document Numbered 83, Eighty-third Congress, at an estimated cost of $3,758,700;

Umpqua Harbor and River, Scholfield River at Reedsport, Oregon: Senate Document Numbered 133, Eighty-first Congress, at an estimated cost of $41,000;

Tillamook Bay and Bar, Oregon: Senate Document Numbered 128, Eighty-third Congress, at an estimated cost of $1,500,000;

ATTACHMENT 3

83D CONGRESS
2d Session
HOUSE OF REPRESENTATIVES
DOCUMENT
No. 389

PLAYA DEL REY INLET AND BASIN, VENICE, CALIF.

Department of Beaches and Harbors
MAY 14 [illegible]

		Act
Director		
Chief Deputy Director		
Deputy Director		
Executive Assistant		
Admin. Services		
Asset Management		
Facilities Projects Office		
Community Services		
Planning		

LETTER

FROM

THE SECRETARY OF THE ARMY

TRANSMITTING

A LETTER FROM THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY, DATED AUGUST 8, 1952, SUBMITTING A REPORT, TOGETHER WITH ACCOMPANYING PAPERS AND AN ILLUSTRATION, ON A PRELIMINARY EXAMINATION AND SURVEY OF HARBOR AT PLAYA DEL REY, CALIF., AND A REVIEW OF REPORTS ON PLAYA DEL REY INLET AND BASIN, VENICE, CALIF., AS AUTHORIZED BY THE RIVER AND HARBOR ACT APPROVED ON AUGUST 26, 1937, AND REQUESTED BY A RESOLUTION OF THE COMMITTEE ON COMMERCE, UNITED STATES SENATE, ADOPTED ON JUNE 2, 1936

MAY 13, 1954.—Referred to the Committee on Public Works and ordered to be printed, with one illustration

DEPARTMENT OF THE ARMY,
Washington 25, D. C., May 11, 1954.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

DEAR MR. SPEAKER: I am transmitting herewith a report dated August 8, 1952, from the Chief of Engineers, Department of the Army, together with accompanying papers and an illustration, on a preliminary examination and survey of Harbor at Playa del Rey, Calif., and a review of reports on Playa del Rey Inlet and Basin, Venice, Calif., with a view to determining whether any improvement of the locality is warranted at the present time, authorized by the River and Harbor Act approved on August 26, 1937, and requested by a resolution of the Committee on Commerce, United States Senate, adopted on June 2, 1936.

47022—54——1

REVIEW BY STATE DIVISION OF WATER RESOURCES OF PROPOSED REPORT OF THE CHIEF OF ENGINEERS, UNITED STATES ARMY, ON PLAYA DEL REY INLET AND BASIN, VENICE, CALIF.

INTRODUCTION

In accordance with the provisions of section 1 of Public Law 14, 79th Congress, the proposed report of the Chief of Engineers, United States Army, on Playa del Rey Inlet and Basin, Venice, Calif., together with the reports of the Board of Engineers for Rivers and Harbors and of the district and division engineers, was transmitted by the Chief of Engineers on March 31, 1952, to Mr. Frank B. Durkee, director of public works, the official designated by Gov. Earl Warren as his representative in such matters. The report was received and referred to the State engineer on April 7, 1952, for review and report thereon. Thereafter, the reports were transmitted by the State engineer to Seth Gordon, director, department of fish and game; Rufus W. Putnam, executive officer of the State lands commission; Newton B. Drury, chief, division of beaches and parks of the department of natural resources; and G. T. McCoy, State highway engineer.

Authority for report

The report was prepared pursuant to a resolution adopted June 2, 1936, which reads as follows:

Resolved by the Committee on Commerce of the United States Senate, That the Board of Engineers for Rivers and Harbors, created under section 3 of the River and Harbor Act approved June 13, 1902, be, and is hereby, requested to review the reports on Playa Del Rey Inlet and Basin, Venice, California, printed in House Document No. 1880, 64th Congress, 2d session, with a view to determining whether any improvement of the locality is warranted at the present time.

Further authorization was contained in Public Law 392, 75th Congress, approved August 26, 1937, which reads in part as follows:

SEC. 4. The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys to be made at the following-named localities, * * * harbor at Playa Del Rey, California * * *.

A review of reports on Playa del Rey Inlet and Basin, Venice, Calif., and preliminary examination of the harbor at Playa del Rey, Calif., dated May 26, 1939, was submitted by the district engineer in accordance with the foregoing authorizations. The district engineer's report was reviewed by the Board of Engineers for Rivers and Harbors, and a report of survey scope was authorized by the Chief of Engineers on April 6, 1944, to determine the advisability and cost of improvement and the local cooperation required.

Recommendations of the Chief of Engineers

The following is quoted from the proposed report of the Chief of Engineers now under review:

After full consideration of the reports secured from the district and division engineers, and after affording local interests full opportunity to be heard, the Board recommends provision of a harbor at Playa del Rey, Calif., to consist of 2 entrance jetties each about 2,300 feet long; an entrance channel 20 feet deep, 600 feet wide, and 1,925 feet long; an interior channel 20 feet deep, 600 feet wide, and 5,600 feet long; a central basin 10 feet deep; and 2 side basins 20 feet deep and 10 side basins 10 feet deep, separated by mole-type piers; the dredged material to be utilized for construction of the piers and for deposition on adjacent lowlands and beaches; all generally in accordance with the plan of the district engineer and the comments herein, and with such modifications thereof as in the discretion

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abandoned due to low production and salt-water intrusion, leaving 111 wells on low production.

Local interests consider that the proposed harbor at Playa del Rey would be an integral unit of an adopted general plan for development of the Santa Monica Bay shoreline. This plan includes widening and improving beaches, providing adequate bath houses, parking areas, picnic facilities, special recreation centers, bathing and wading beaches, fishing piers, youth organization camps, tourist parks with cabin and trailer accommodations, and a bird refuge.

Cost of proposed works

In the report of the district engineer, the total first cost of the project is given as $25,603,000, with a Federal first cost of $9,098,000 and non-Federal first cost of $16,505,000. The total annual carrying charges would be $919,920, and the annual benefits would be $1,529,000. The benefit-cost ratio of the proposed harbor project would be 1.7 to 1.

The Board of Engineers for Rivers and Harbors, in reviewing the report of the district engineer, reevaluated the costs and benefits estimated by the district engineer. In considering both the evaluated and intangible benefits, the Board stated in its report that the Federal interest in the proposed improvement would be served by Federal participation to the extent of providing and maintaining the entrance jetties, entrance channel, interior channel, and central basin shown on the maps accompanying the district engineer's report, all at an estimated first cost of $6,151,000 for construction exclusive of aids to navigation, and $25,000 annually for maintenance, with local interests providing and maintaining all other works including dredging of the side basins at an estimated first cost of $19,427,000.

The Board of Engineers for Rivers and Harbors also reduced the benefits allocated by the district engineer to sport fishing vessels from $280,000 to $47,000, making the total annual benefits $1,296,000. Subsequent to the submission of the report by the district engineer, the United States Coast Guard submitted a revised estimate of $42,000 for first cost of aids to navigation, an increase of $17,000, making a total first cost of the project of $25,620,000. The total annual carrying charges are estimated by the Board to be $933,025, of which $277,555 is Federal, and $655,470 is non-Federal, giving a benefit-cost ratio of 1.4. The recommendation of the Board of Engineers for Rivers and Harbors as to Federal participation is concurred in by the Chief of Engineers.

Local contributions

At its meeting on April 25, 1946, the City Council of Los Angeles adopted a report declaring that the public interest and welfare of the city of Los Angeles and vicinity require the provision of additional small craft facilities by means of construction of a small craft harbor at Playa del Rey, assisting the Federal Government in such undertaking by assuming those obligations required under Federal law in connection [redacted] project.

By resolu[redacted]pted September 28, 1948, and June 7, 1949, the Board of Su[redacted] of the County of Los Angeles declared that the public interest and welfare of the county of Los Angeles and its citizens require that provision be made for additional small craft facilities by means of construction of a small craft harbor at Playa del

B-80

Department of Natural Resources

Newton B. Drury, chief, Division of Beaches and Parks of the Department of Natural Resources, on June 18, 1952, stated that the thoughts expressed in the comments previously submitted to the district engineer on January 6, 1949 still reflect the reaction of the division to the project.

The comments, submitted by Gen. Warren T. Hannum, director of natural resources, on January 6, 1949, are as follows:

(*a*) It is found that plan of development as proposed in the district engineer's report would provide a greatly needed harbor for light craft vessesl, and as a harbor refuge for such craft cruising along the coast.

(*b*) That the proposed harbor development is in general in conformity with the county master plan as approved by the State Park Commission.

(*c*) That there is no State cooperation proposed in the plan, the city of Los Angeles having expressed its desire and willingness to meet the requirements of local cooperation as set forth by the district engineer.

(*d*) That the incidental benefits to the State park system, due to the deposit of sand on the beaches both upcoast and downcoast from the proposed entrance jetties would be very great.

It is recommended therefore, that the report be approved with a favorable comment indicating the advantages to the State park system from the deposit of sand on the Santa Monica beaches.

CONCLUSIONS

The following conclusions are submitted with respect to improvements recommended by the Chief of Engineers in his proposed report on Playa del Rey Inlet and Basin, Venice, Calif., giving consideration to (*a*) need for the project (*b*) engineering feasibility and effectiveness of the proposed works, and (*c*) economic justification for the project:

1. The improvements will provide a desirable addition to small-craft facilities along the southern California coast. The project is an integral part of the general plan for development of the shoreline of Santa Monica Bay.

2. Local interest in and approval of the project have been demonstrated by resolution of the city council of the city of Los Angeles, and by resolution of the Board of Supervisors of the County of Los Angeles, giving assurance that the county will assume those non-Federal contributions and obligations in connection with the project which are required by Federal law.

3. The improvements appear to be of sound and adequate design and feasible of construction and operation.

4. Construction of the proposed harbor will introduce ocean water inland a distance of more than 1 mile, and increase the rate of saline contamination of ground waters of the west coast basin. Except in this respect, the proposed works will not conflict with any beneficial consumptive use, present or future, of water for domestic, municipal, stock water, irrigation, mining, or industrial purposes.

RECOMMENDATIONS

It is recommended that the plan of improvement for the small-craft harbor at Playa del Rey Inlet and Basin, Venice, Calif., as recommended by the Chief of Engineers, be authorized for construction, and that Federal funds be appropriated for the purpose.

SACRAMENTO, CALIF., *June 26, 1952.*

A. D. EDMONSTON,
State Engineer.

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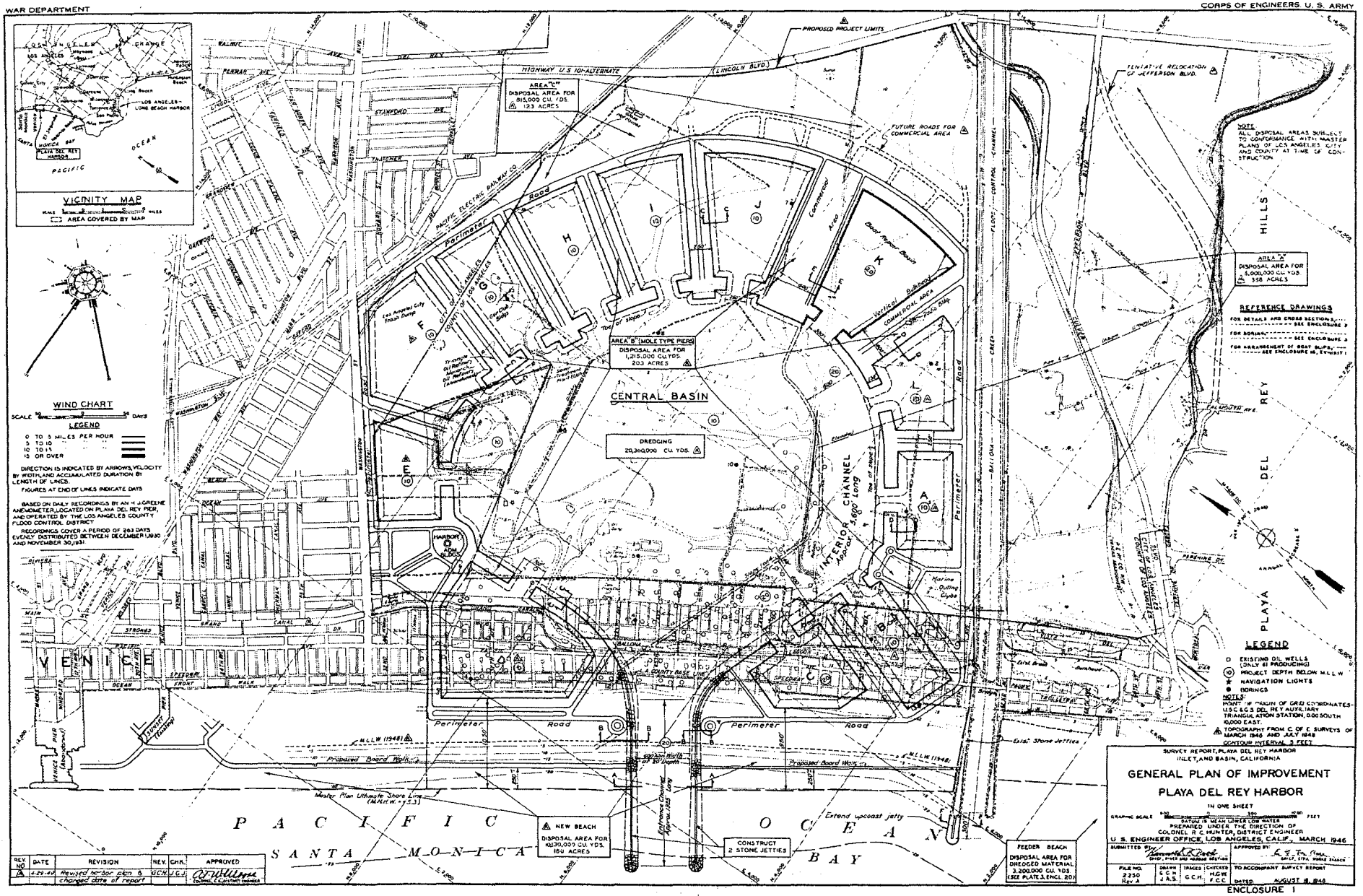
WAR DEPARTMENT
CORPS OF ENGINEERS, U. S. ARMY
VICINITY MAP
AREA COVERED BY MAP
WIND CHART
LEGEND
0 TO 5 MILES PER HOUR
5 TO 10
10 TO 15
15 OR OVER
DIRECTION IS INDICATED BY ARROWS, VELOCITY BY WIDTH, AND ACCUMULATED DURATION BY LENGTH OF LINES.
FIGURES AT END OF LINES INDICATE DAYS
BASED ON DAILY RECORDINGS BY AN H. J. GREENE ANEMOMETER, LOCATED ON PLAYA DEL REY PIER, AND OPERATED BY THE LOS ANGELES COUNTY FLOOD CONTROL DISTRICT
RECORDINGS COVER A PERIOD OF 263 DAYS EVENLY DISTRIBUTED BETWEEN DECEMBER 1930 AND NOVEMBER 30, 1931
PROPOSED PROJECT LIMITS
TENTATIVE RELOCATION OF JEFFERSON BLVD.
HIGHWAY U.S. 101-ALTERNATE (LINCOLN BLVD.)
AREA "C" DISPOSAL AREA FOR 815,000 CU. YDS. 123 ACRES
FUTURE ROADS FOR COMMERCIAL AREA
AREA "B" (MOLE TYPE PIERS) DISPOSAL AREA FOR 1,215,000 CU. YDS. 203 ACRES
CENTRAL BASIN
DREDGING 20,300,000 CU. YDS.
INTERIOR CHANNEL Approx. 5,600' Long
AREA "A" DISPOSAL AREA FOR 2,000,000 CU. YDS. 358 ACRES
NOTE
ALL DISPOSAL AREAS SUBJECT TO CONFORMANCE WITH MASTER PLANS OF LOS ANGELES CITY AND COUNTY AT TIME OF CONSTRUCTION
REFERENCE DRAWINGS
FOR DETAILS AND CROSS SECTIONS ---------- SEE ENCLOSURE 2
FOR BORINGS ---------- SEE ENCLOSURE 3
FOR ARRANGEMENT OF BOAT SLIPS ---------- SEE ENCLOSURE 10, EXHIBIT I
LEGEND
EXISTING OIL WELLS (ONLY 61 PRODUCING)
PROJECT DEPTH BELOW M.L.L.W.
NAVIGATION LIGHTS
BORINGS
NOTES:
POINT OF ORIGIN OF GRID COORDINATES-U.S.C.&G.S. DEL REY AUXILIARY TRIANGULATION STATION, 8,000 SOUTH 10,000 EAST.
TOPOGRAPHY FROM C. OF E. SURVEYS OF MARCH 1946 AND JULY 1948
CONTOUR INTERVAL 5 FEET
SURVEY REPORT, PLAYA DEL REY HARBOR INLET, AND BASIN, CALIFORNIA
GENERAL PLAN OF IMPROVEMENT
PLAYA DEL REY HARBOR
IN ONE SHEET
DATUM IS MEAN LOWER LOW WATER
PREPARED UNDER THE DIRECTION OF COLONEL R. C. HUNTER, DISTRICT ENGINEER
U. S. ENGINEER OFFICE, LOS ANGELES, CALIF., MARCH 1946
SUBMITTED BY
APPROVED BY
FILE NO. 2250 Rev A
DRAWN G.C.M. J.A.S.
TRACED G.C.M.
CHECKED H.G.W. F.C.C.
TO ACCOMPANY SURVEY REPORT
DATED AUGUST 16, 1948
REV. NO. 1
DATE 4-29-49
REVISION Revised harbor plan & changed date of report
REV. CHK. GCM JGJ
APPROVED
NEW BEACH DISPOSAL AREA FOR 10,130,000 CU. YDS. 164 ACRES
CONSTRUCT 2 STONE JETTIES
FEEDER BEACH DISPOSAL AREA FOR DREDGED MATERIAL 3,200,000 CU. YDS. (SEE PLATE 3, ENCL. 20)
Extend upcoast jetty
Existing Concrete Apron, 1,350' Long
Existing Stone Jetties
Proposed Board Walk
Master Plan Ultimate Shore Line (M.H.H.W. +5.3)
Perimeter Road
Pacific Electric Railway Co.
Los Angeles City Intake Pump
County of Los Angeles
Vertical Bulkhead
Commercial Area
Boat Repair Board
Harbor Administration Bldg.
Marine Outfitting Docks
Existing Concrete Apron, 1,350' Long
Proposed Board Walk
Master Plan Ultimate Shore Line (M.H.H.W. +5.3)
PACIFIC OCEAN
SANTA MONICA BAY
VENICE
PLAYA DEL REY
HILLS
ENCLOSURE 1

USACE Los Angeles District

Att: Secretary of the Army John McHugh
Att: Col./Commander/District Engineer Mark Toy
California Department of Fish and Game
Att: Charlton H. Bonham Executive Director Ca DFG
Att: The Honorable Congresswoman Maxine Waters
Att: The Honorable Congresswoman Janice Hahn
Att: The Honorable Congresswoman Barbara Boxer
Att: The Honorable Congresswoman Diane Feinstein
Re: Joint EIS/EIR, Federal Register, July 25, 2012, Ballona Wetlands Project
From John Davis

Commander Toy, Executive Director Bonham,

Pursuant to the U.S. Environmental Protection Policy and the California Environmental Protection Act, I hereby submit the following comments in regard to the scoping process announced in the respective NOI/NOP.

EXECUTIVE SUMMARY

My direct concerns are that the project is inconsistent with The U.S. Rivers and Harbors Act(s), U.S. Public Laws 223, 780, and prior Rivers and Harbors Acts. The U.S. Clean Water Act as it relates to Section 303(d) impaired waterway listings, Section 320 National Esturary Program, National Storm Water Pollution Act, CWA provisions protecting sole source aquifers, U.S. Coastal Zone Management Act of 1972, U.S. Enivornmental Protection Policy, and OMB Circular No. A-16, Coordination of Geographic Information and Related Spatial Data Activities (Draft 6/20/01 edition) which regards the requirement of recordation of Federal Lands by the Bureau of Land Management.

Furthermore, I am concerned about non-compliance with the, California Environmental Quality Act, California Coastal Act, California Water Code, The project threatens the protection of infrastructure and most importantly, human health and safety as it regards geologic hazards, environmental hazards, floods, the rise of sea level, and preservation of potential sources of drinking water from the ground from salt water invasion.

There are land ownership inconsistencies regarding recordation of both local and federal land ownership.

COMMENTS – U.S. PUBLIC LAWS 223 AND 780

After extensive flooding within the County of Los Angeles caused an estimated 40 million dollars in damage, the U.S. Army Corp of Engineers undertook various flood control projects in the County. Pursuant to the U.S. Rivers and Harbors Act at least two completed federal projects authorized under the aforesaid act exist in the newly proposed project site. U.S. Public Law 223 governs that Westerly portion of Ballona Creek which

was excavated and channelized pursuant to the Rivers and Harbors Act of 1941 (HouseDocument 838),(HD838) herafter.

U.S. Public Law 223 reads in part;

"The Chief of Engineers is also authorized in his discretion, to modify the plan for any dam or other work heretofore or hereafter authorized..."

U.S. Public Law 780, the U.S. Rivers and Harbors Act governs adjacent lands to the North and South in accordance with the General Plan of Improvement approved by the U.S. Congress, (House Documents 389), (HD389) hereafter.

(HD389) The letter from the Secretary of the Army Letter to the Speaker of the House of Representatives dated May 11, 1954 states in part:

"The Federal Government completed the Ballona Creek flood-control channel and jetties in 1938. The original random stone jetties at the mouth of the channel were extended by the city of Los Angeles in 1946 and are now about 1.350 feet in length."

Therefore, the Federal Flood Control Channel build in 1938, subsequent improvements made thereto pursuant to U.S. Public Law 223, and the improvement authorized pursuant to U.S. Public Law 780, are all subject to changes described by the proposed project.

Exhibit 1. U.S. Public Law 223, House Document 838

Exhibit 2. U.S. Public Law 780, House Document 389, Deed to U.S.

Exhibit 3. BLM Letter to John Davis, MDR Deed Not Recorded by BLM

Exhibit 4. HD 389 Citations by John Davis

QUESTION 1: UNDER WHAT CONGRESSIONAL AUTHORIZATION IS THE CHIEF OF ENGINEERS PROPOSING CHANGES TO A PROJECT AUTHORIZED AND COMPLETED IN ACCORDANCE TO U.S. PUBLIC LAWS 223 AND 780?

QUESTION 2: DOES THE SECRETARY OF THE ARMY THROUGH THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY, HAVE A VIEW DETERMINING THE PROPOSED IMPROVEMENT OF THE LOCALITY IS WARRENTED AT THE PRESENT TIME, AS AUTHORIZED BY A RESOLUTION OF THE COMMITTEE ON COMMERCE, UNITED STATES SENATE?

QUESTION 2: IS CONGRESSIONAL AUTHORIZATION REQUIRED TO MODIFY THE EXISITING PROJECT(S) BY FILLING, DREDGING,LEVEE DESTRUCTION, LEVEE BUILDING, BASIN BUILDING, AND CHANGING A SURFACE WATER COURSE AUTHORIZED AND COMPLETED IN ACCORDANCE WITH U.S. PUBLIC LAWS 223 AND 780?

QUESTION 3: CAN THE CHIEF OF ENGINEERS LAWFULLY UNDERTAKE A PROJECT THAT CHANGES THE SCOPE AND PURPOSE OF TWO COMPLETED FEDERAL PROJECTS AUTHORIZED IN ACCORDANCE WITH U.S. PUBLIC LAWS 223 AND 780 WITHOUT ANY CONGRESSIONAL AUTHORITY FOR THAT SPECIFIC PURPOSE?

QUESTION 4: IF THE PREVIOUS QUESTION IS YES, TO WHAT EXTENT AND UNDER WHAT EXACT LAWFUL AUTHORITY CAN THE CHIEF OF ENGINEERS MAKE SUCH CHANGES?

QUESTION 5: CAN AND OR COULD THE DISTRICT ENGINEER LAWFULLY CHANGE THE RREQUIRREQUIRMENT FROM "TERMS REASONABLE AND EQUAL, PER (HD389), TO ONLY EQUAL TO ONLY "EQUAL TO ALL", ENABLING THE COUNTY OF LOS ANGELES TO CHARGE COMMERCIAL RATES CONVERTING A FEDERAL PROJECT TO A COMMERCIAL OCEAN GOING LUXURY YACHT HARBOR AND IF SO UNDER WHAT LEGAL AUTHORITY?

QUESTION 6: CAN AND OR COULD THE DISTRICT ENGINEER LAWFULLY CHANGE THE REQUIRMENT SET FORTH IN (HD389) TO PROVIDE "ALL LANDS EASEMENTS AND RIGHTS OF WAY TO THE UNITED STATES FOREVER AND IN PURPUTITY" TO ONLY AN EASMENT OVER THE MAIN CHANNEL, WHICH HAS NOT YET BEEN RECORED BY THE U.S. BUERA OF LAND MANAGEMENT?

QUESTION 7: CAN AND OR COULD THE DISTRICT ENGINEER LAWFULLY CHANGE THE REQUIRMENT SET FORTH IN (HD389) TO PROVIDE A ULTIMATE CAPACITY OF 8,000 SMALL CRAFT IN THE VICINITY OF PLAYA DEL REY AND REDUCE THAT REQUIRMENT TO 4,000 SLIPS OR LESS AND UNDER WHAT AUTHORITY.

QUESTION 8: CAN AND OR COULD THE DISTRICT ENGINEER LAWFULLY CHANGE THE REQUIRMENT SET FORTH IN (HD389) TO PROVE ADIEQUATE PARKING AREAS?

QUESTION 9: QUESTION 6: CAN AND OR COULD THE DISTRICT ENGINEER LAWFULLY CHANGE THE REQUIRMENT SET FORTH IN (HD389) TO CHANGE BOATER RESERVED PARKING TO COMMERCIAL DEVELOPMENT?

QUESTION 10: WHY PERSONELLE OF THE US ACE LOS ANGELES DISTRICT PLAN WITH STAFF OF AGENCIES OF THE STATE OF CLIFORNIA AND OR PRIVATE INDIVIDUALS TO MAKE CHANGES TO U.S. FEDERAL PROJECTS WITHOUT FIRST SEEK THE REQUIRED AUTHORIZATION OF CONGRESS IN REGARD TO U.S. PUBLIC LAW 223 AND 780, AND PRIOR RIVERS AND HARBORS ACTS?

QUESTION 11: COULD THE CALIFORNIA COASTAL ON NOVEMBER 11, 2011 COMMISSION APPROVE MAJOR CHANGES TO REDUCE THE NUMBER OF BOAT SLIPS AND PARKING REQUIRED BY (HD389) WITHOUT FIRST CONSULTING WITH THE USACE LA DISTRICT OR WITHOUT FIRST SEEKING THE CONGRESS OF THE UNITES STATES PURSUANT TO U.S. PUBLIC LAW 780 AND IF SO UNDER WHAT LAWFUL JURDISCTION?

QUESTION 11: COULD THE CALIFORNIA COASTAL CONSERVANCY APPROVE A PLAN TO MAKE MAJOR CHANGES TO COMPLETED FEDERAL PROJECTS WITHOUT FIRST CONSULTING WITH THE USACE LA DISTRICT AND OR SEEKING THE CONGRESS OF THE UNITES STATES PURSUANT TO U.S. PUBLIC LAW 780 AND IF SO UNDER WHAT LAWFUL JURDISCTION?

QUESTION 12: WHY DID THE USACE LOS ANGELES DISTRICT FAIL TO TRANSMIT THE DEED OF LANDS, EASEMENTS, AND RIGHTS OF WAY PURSUANT TO U.S. PUBLIC LAW 780 (HD389) TO THE BLM FOR RECORDATION.

QUESTION 13. WHEN WILL THE USACE LOS ANGELES DISTRICT TRANSMIT THE DEED OF LANDS, EASEMENTS, AND RIGHTS OF WAY PURSUANT TO U.S. PUBLIC LAW 780 (HD389) TO THE BLM FOR RECORDATION.

QUESTION 14: CAN THE PROJECT AT MARINA DEL REY LAWFULLY EXIST AS A FEDERAL PROJECT WITHOUT THE RECORDATION OF THE DEED OF LANDS, EASEMENTS, AND RIGHTS OF WAY PURSUANT TO U.S. PUBLIC LAW 780 (HD389) TO THE BLM AND IF SO UNDER WHAT AUTHORITY.

QUESTION 15: CAN A USACE POLICY TO ONLY REQUIRE LOCAL INTERESTS TO DEED LESS LANDS, EASEMENTS AND RIGHTS OF WAY THAN REQUIRED UNDER U.S. PUBLIC LAW 780 (HD389) AND IF SO HOW CAN A SUCH A POLICY LAWFULLY REPLACE U.S. PUBLIC LAW 780.

Exhibit 5. Request by Congress

On September 28th, 1994 the U.S. Congressional Committee on Public Works and Transportation, U.S. House of Representatives resolved to request the Secretary of the Army review the of the Chief of Engineers on Playa del Rey Inlet and Basin, Venice, California published as House Document 389, Eighty-third, Second Session to determine whether modifications of the recommendations contained therein are advisable at the present time, in the interest of navigation, hurricane and storm damage reduction, environmental restoration, and other purposes at Marina del Rey Harbor, Los Angeles, California with consideration given to the dredging of contaminated sediments.

In 2005 the USACE LA District complied with the request by Noticing a joint EIS/EIR with the Santa Monica Bay Restoration Commissoin under NEPA and CEQA that would in part consider flood prevention improvements and a review of (HD389). In 2012 the Secretary of the Army provide letters indicating that process was ongoing and would not be terminated and the LA District Legal indicated no termination of that process was anticipated.

Later, in 2012, USACE Los Angeles District noticed an NOI withdrawing from the 2005 process. The reason stated is that the SMRBC requested withdrawal from the process.

QUESTION 16: THERE IS NO PUBLIC RECORD OF THE SANTA MONICA BAY RESTORATION COMMISSION REQUESTING WITHDDRAWAL AT THE STATE LEVEL ACCORDING TO RESPONSES MADE UNDER THE PUBLIC RECORDS ACT SO WHAT EXACT REQUEST FROM SMRBC DID THE WITHDRAWAL NOTICE REFER TO AND WHAT PERSON MADE THAT REQUEST ON BEHALF OF SMRBC AND HOW?

QUESTION 17: DID THE USACE DETERMINE THE ENTITY REQUESTING WITHDRAWAL ON BEHALF OF SMRBC HAD THE LAWFUL AUTHORITY OF THE STATE OF CALIFORNIA VESTED IN IT TO REQUEST WITHDRAWAL AND IF SO HOW WERE THE CREDENTIALS OF THAT ENTITY VERIFIED BY USACE?

QUESTION18: THE SANTA MONICA BAY RESTORATION COMMISSION DID NOT PROVIDE ANY MONEY OR IN KIND SERVICES APPROVED BY THE USACE AS THE SPONSOR AGREEMENT REQUIRED SO WHEN WILL THE FINAL ACCOUNTING FOR THE SPONSOR BE COMPLETED?

QUESTION 19: NEPA REQUIRES NOTICE OF CURRENT EIS PROCESS BE NOTICED IN SCOPING, BUT THE 2012 NOTICE FOR THIS PROJECT DID NOT REFER TO THE 2005 PROCESS THAT WAS CURRENT WHEN THE NOI FOR THE CURRENT PROCESS WAS NOTICED, SO WHY DID USACE LA DISTRICT FAIL TO STATE THE 2005 EIS WAS CURRENT IN THE 2012 NOTICE OF EIR/EIS?

There is no public record of the Santa Monica Bay Restoration Commission requesting withdrawal at the State level, according to responses to Public Records Requests so why did the Corp state a withdrawal was requested?

Note, in accordance with the State Bagley Keene Act, only the Governing Board of the SMRBC may take action to request withdrawal from the 2005 process

Exhibit 4. NOI(s) for Joint EIR/EIS 2005, 2012, Withdrawal 2012, Secretary of Army Letters, LA District Letter

COMMENTS U.S. CLEAN WATER ACT

The U.S. Clean Water Act lists more than four distinct 303(d) impaired water bodies present. The current proposal is to dredge and fill the Ballona Creek Esturary, an Esturary of National Significance listed by U.S. EPA in accordance with Section 320 of the USCWA National Esturary Program.

The intent of the NEP is to preserve and protect esturaries.

QUESTION 20: WHY DOES THE PROJECT PROPOSE TO DESTROY A LARGE PARD OF THE MAPPED AND CLASSIFIED ESTURARY BY DREDGING AND FILLINT IT?

There is only one impaired water body that is classified as an esturary by USEPA. The proposed project intends to divert the impaired Ballona Creek Esturary into the impaired Ballona Wetlands, and possibly into the impaired Marina del Rey water body.

QUESTION 21: WHY DOES THE PROPOSED PROJECT CONSIDER DIVERSION OF ONE IMPAIRED WATER BODY INTO OTHER DISTINCTS IMPAIRED WATER BODIES INTRODUCING NEW POLLUTION TO ALREADY IMPAIRED WATER BODIES?

COMMENTS HYDROLOGY

(HD389) cites on page 8 - 9 the following:

"2. Partial analyses of water samples obtained in April 1952 from 2 active water wells located within the perimeter of the proposed harbor show 640 and 486 parts per million chloride, respectively. Water samples from 2 other active wells located within 2,000 feet east of the eastern perimeter contained 216 and284 parts per million respectively.

...The district engineer's quoted conclusion No. 2 is likewise believed to be essentially correct concerning the present situation. Saline contamination of ground water in the Play del Rey area was first noted in wells near the ocean in the 1920s. Coincendent with this increased pumping draft in the west coast basin, accompanied by further lowering of the water table below sea level, the saline intrusion progressively moved inland until by 1945 – 1946 the limit of 500 parts per million of chloride contamination was from 1.5 – 2 miles from the ocean in the Playa del Rey area.

The proposed harbor overliles and important aquifer known as the "50 foot gravel," so named because the average depths of its base is about 50 feed below the ground surface. In the vicinity of the site of the haror the top of this aquifer is 40 to 45 feet below the land surface. A study of the logs of 14 wells located within one-half mile of the perimeter of the harbor site indicates the aggregate thickness of all the relatively impervious material

contained in the sediments overlying the aquifer to vary from 0 to 16 feet. In general, a large percentage of the impermeable material above the 50-foot gavel occurs near the lands surface.

Such dredging will obviously decrease the thickness of the impermeable material lying between the floor of the harbor and the top of the water-bearing zone, thereby decreasit the resistance offered to the percolation of sea water into the aquifer.

From the foregoing observations, it is believed that the quoted conclusion of the district engineer is contrary to what may be expected if the harbor is constructed and that construction of the harbor would aggravate the present conditions of sea-water intrusion and endanger the water quality of wells located near its perimeter in the following ways:

1. *By reducing (though dredging) the thickness of relatively impermeable materials which lie between the surface and the top of the 50-foot gravel aquifer.*
2. *By increasing the landward slope of the water table and consequently the rate of landward slope of the water table and consequently the rate of landward flow of saline water. This slope would be increased as a result of moving the shoreline inland through construction of the harbor.*
3. *By decreasing the lateral distance that sea water must travel to reach producing wells.*

It is believed that if this project is pursued, the ruination of water wells in the immediate vicinity of he harbor should be contemplated. However, the present landward sloping water indicates that the threat of ocean water pollution already exists at these wells.

Exhibit 8. Poland Hydrology Report

The Poland Report indicates three aquifers are present at the project location. The report further indicates sever salt water intrusion into the groundwater. Also, the report shows the deep Siverado aquifer extends into the South Basin and the aquifer is in communication with the Ballona aquifer and the Bellflower aquitard.

The Silverado aquifer is the sole source of drinking water for Los Angele. The State of California designates the Santa Monica Basin as a potential source of drinking water.

QUESTION: WHY DOES THE PROJECT PROPOSE TO ENGAGE A PROCESS THAT WILL ENCOURAGE SALT WATER INTRUSION INTO THE FRESHWATER AQUIFERS THAT WOULD CONTRIBUTE TO THE RUINATION OF POTENTIAL SOURCES OF DRINKING WATER?

COMMENTS –ONLY ONE PROJECT PURSUED

Exhibit 9. Coastal Conservancy Promotes Only One Alternative

Exhibit 10. CA Fish and Game Agrees with Coastal Conservancy Plan

QUESTION 22: WHY DID THE COASTAL CONSERVANCY ONLY CONSIDER ONE PLAN AND WHY DID THE CALIFORNIA DEPARETMENT OF FISH AND GAME ADOPT ONLY ONE PROJECT PROPOSAL AND WHY IS THE PROPOSAL BEING IMPLIMENTED BY PSOMAS ON BEHALF OF THE DEPARTMENT OF FISH AND GAME INCLUDING BORING OF THE LAND THROUGH THE AQUIFERS?

Exhibit 11. CDM Corporation Playa Vista Document

This document shows that the Playa Vista Project is extracting ground water from water wells.

Exhibit 12. LARWQCB NPDES Inspection Reports

NPDES Inspection Reports by the Los Angeles Regional Water Quality Control Board show that the Agency failed on a regular basis to inspect Flow Meters for extraction wells at the Playa Vista Facility. As a result of this failure, unknown quantities of State owned groundwater is being extracted and discharged to the surface.

QUESTION 23: HOW DOES THE CONTINUED EXTRACTION OF UNKNOWN QUANTITES OF GROUNDWATER AFFECT THE RECHARGE OF THE BALLONA WETLANDS WHICH ARE HYDROLOGICALY DOWN GRADIENT FROM THE EXTRACTION SITE?

Exhibit 13. Natural Hazards Present

The proposed project is located in the Venice Quadrangle Seismic Hazard Zone. It is subject to tsunami, seiche, and subsidence. A gas storage facility is located in the subsurface with no approvals from the California Public Utilities Commission and the project area has flooded in recent history.

QUESTION 24: WHAT MEARSUSE WILL THE PROJECT TAKE TO AVOID NATURAL DISASTERS AT THE SITE?

Exhibit 14. AIS GIS System

QUESTION 25: WILL THE PROJECT USE THE ACE GIS SYSTEM IF NOT WHY?

Exhibit 15: NOAA Report On Marina del Rey

Exhibit 16: Report on Biology and History of Project Site

John Davis
PO 10152
Marina del Rey Ca. 90295

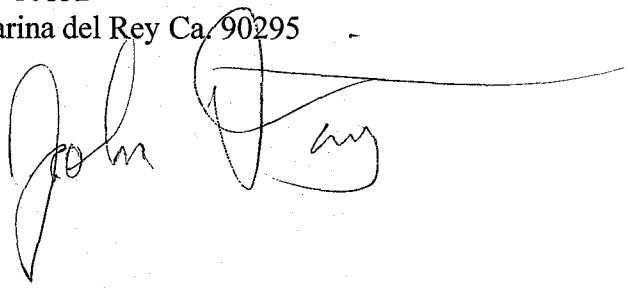

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EXHIBIT 1

[PUBLIC LAW 228—77TH CONGRESS]

[CHAPTER 377—1ST SESSION]

[H. R. 4911]

AN ACT

Authorizing the construction of certain public works on rivers and harbors for flood control, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That hereafter Federal investigations and improvements of rivers and other waterways for flood control and allied purposes shall be under the jurisdiction of and shall be prosecuted by the War Department under the direction of the Secretary of War and supervision of the Chief of Engineers, and Federal investigations of watersheds and measures for run-off and waterflow retardation and soil-erosion prevention on watersheds shall be under the jurisdiction of and shall be prosecuted by the Department of Agriculture under the direction of the Secretary of Agriculture, except as otherwise provided by Act of Congress.

SEC. 2. That section 3 of the Act approved June 22, 1936 (Public, Numbered 738, Seventy-fourth Congress), as amended by section 2 of the Act approved June 28, 1938 (Public, Numbered 761, Seventy-fifth Congress), shall apply to all works authorized in this Act, except that for any channel improvement or channel rectification project provisions (a), (b), and (c) of section 3 of said Act of June 22, 1936, shall apply thereto, and except as otherwise provided by law: *Provided*, That the third proviso of section 1 of the Flood Control Act approved August 28, 1937 (Public, Numbered 406, 75th Congress) and all of section 8 of the Flood Control Act approved August 11, 1939, (Public, Numbered 396, 76th Congress) are hereby repealed: *Provided further*, That the authorization for any flood-control project heretofore or herein adopted requiring local cooperation shall expire five years from the date on which local interests are notified in writing by the War Department of the requirements of local cooperation, unless said interests shall within said time furnish assurances satisfactory to the Secretary of War that the required cooperation will be furnished: *And provided further*, That in any case where the total authorization for a project heretofore or hereafter authorized by Congress is not sufficient to complete plans that may have been made the Chief of Engineers is authorized in his discretion to plan and make expenditures on preparations for the project, such as the purchase of lands, easements, and rights-of-way; readjustments of roads, railroads, and other utilities; removal of towns, cemeteries, and dwellings from reservoir sites; and the construction of foundations. The Chief of Engineers is also authorized in his discretion to modify the plan for any dam or other work heretofore or hereafter authorized so that such dam or work will be smaller than originally planned with a view to completing a

useful improvement within an authorization: *Provided*, That the smaller structure shall be located on the chosen site so that it will be feasible at some future time to enlarge the work in order to permit the full utilization of the site for all purposes of conservation such as flood control, navigation, reclamation, the development of hydroelectric power, and the abatement of pollution.

SEC. 3. That the following works of improvement for the benefit of navigation and the control of destructive floodwaters and other purposes are hereby adopted and authorized in the interest of national security and the stabilization of employment, and shall be prosecuted as speedily as may be consistent with budgetary requirements, under the direction of the Secretary of War and the supervision of the Chief of Engineers in accordance with the plans in the respective reports hereinafter designated and subject to the conditions set forth therein: *Provided*, That penstocks or other similar facilities adapted to possible future use in the development of hydroelectric power shall be installed in any dam herein authorized when approved by the Secretary of War upon the recommendation of the Chief of Engineers and of the Federal Power Commission:

CONNECTICUT RIVER BASIN

In addition to previous authorizations, there is hereby authorized to be appropriated the sum of $6,000,000 for local protection works and $10,000,000 for reservoirs for the prosecution of the comprehensive plan approved in the Act of June 28, 1938, for the Connecticut River Basin, and such comprehensive plan is hereby modified to include the works recommended by the Chief of Engineers in House Document Numbered 653, Seventy-sixth Congress, third session, and House Document Numbered 724, Seventy-sixth Congress, third session, with such further modifications as may be found justifiable in the discretion of the Secretary of War and the Chief of Engineers.

The Secretary of War is authorized to reimburse the city of Hartford, Connecticut, the sum of $252,000 heretofore contributed to the United States by said city for the realignment of the South Meadows section of the flood-protection works in accordance with the plans contained in House Document Numbered 653, Seventy-sixth Congress, third session: *Provided*, That there shall be deducted from the aforementioned sum any reimbursement which may be made to said city pursuant to the provisions of section 1 of the War Department Civil Appropriation Act, 1938, approved July 19, 1937.

THAMES RIVER BASIN

The plan for a system of reservoirs and channel improvements in the Thames River Basin, Connecticut, Rhode Island, and Massachusetts, in accordance with the recommendation of the Chief of Engineers in House Document Numbered 885, Seventy-sixth Congress, third session, is approved, and there is hereby authorized $6,000,000 for initiation and partial accomplishment of the project.

PAWTUXET RIVER BASIN

The project for local flood protection on the North Branch of Pawtuxet River at Clyde, Rhode Island, and for the Pontiac diver-

sion is hereby authorized to be constructed substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 747, Seventy-sixth Congress, third session, at an estimated cost of $1,320,000.

HUDSON RIVER BASIN

The projects adopted by the Act of June 22, 1936, to provide for local flood-protection works in the Hoosic River Basin at North Adams in Massachusetts; at Hoosick Falls, New York, and at Bennington, Vermont, are hereby modified and extended to include the town of Adams, Massachusetts, in accordance with the recommendation of the Chief of Engineers in House Document Numbered 182, Seventy-sixth Congress, first session, and are authorized to be constructed substantially in accordance with said recommendation at an estimated cost of $2,170,000.

LAKE CHAMPLAIN BASIN

The project for local flood protection on the Winooski River at Waterbury, Vermont, is hereby authorized to be constructed substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 656, Seventy-sixth Congress, third session, at an estimated cost of $880,000.

The project adopted by the Act of June 22, 1936, to provide for local flood-protection works on Otter Creek at Rutland, Vermont, is hereby modified in accordance with the recommendation of the Chief of Engineers in Senate Document Numbered 171, Seventy-sixth Congress, third session, and is authorized to be constructed substantially in accordance with said recommendation at an estimated cost of $308,000.

OSWEGO RIVER BASIN

The projects for flood control and other purposes at Canandaigua, Keuka, and Owasco Lakes, and at Hammondsport, Watkins Glen, Montour Falls, Ithaca, and Syracuse, New York, are hereby authorized to be constructed substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 846, Seventy-sixth Congress, third session, at an estimated cost of $3,220,000.

BUFFALO RIVER BASIN

The project for local flood protection on Cayuga Creek at Lancaster, New York, is hereby authorized to be constructed substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 326, Seventy-seventh Congress, first session, at an estimated cost of $575,000.

SUSQUEHANNA RIVER BASIN

The project adopted by the Act of June 22, 1936, to provide for local flood-protection works on the Susquehanna River at Sunbury, Pennsylvania, is hereby modified in accordance with the recommendation of the Chief of Engineers in House Document Numbered 366, Seventy-sixth Congress, first session, and is authorized

to be constructed substantially in accordance with said recommendation at an estimated cost of $1,900,000.

The project for flood control in the Susquehanna River Basin in southern New York and eastern Pennsylvania adopted by the Act of June 22, 1936, is hereby modified to include and authorize the construction of the Stillwater Reservoir on the Lackawanna River, Pennsylvania, for flood control and other purposes in accordance with plans now in the Office of the Chief of Engineers at an estimated cost to the United States of $2,420,000.

DELAWARE RIVER BASIN

The project for local flood protection on Rancocas Creek in the vicinity of Mount Holly, New Jersey, is hereby authorized to be constructed substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 128, Seventy-seventh Congress, first session, at an estimated cost of $300,000.

NEUSE RIVER BASIN

The project for local flood protection on the Neuse River in the vicinity of Goldsboro, North Carolina, is hereby authorized to be constructed substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 327, Seventy-seventh Congress, first session, at an estimated cost of $40,000.

MOBILE RIVER BASIN

The project for local flood protection at Prattville, Alabama, on Autauga Creek, a tributary of the Alabama-Coosa River, is hereby authorized to be constructed substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 657, Seventy-sixth Congress, third session, at an estimated cost of $530,000.

The plan for the Allatoona Reservoir on the Etowah River in the Coosa River Basin, Georgia, for flood control and other purposes in accordance with the recommendation of the Chief of Engineers in House Document Numbered 674, Seventy-sixth Congress, third session, is approved and there is hereby authorized $3,000,000 for initiation and partial accomplishment of the project.

The project for flood control on the Tombigbee River authorized by the Act of June 22, 1936, is hereby modified to provide for additional channel improvements and related works for flood control for the Tombigbee River and tributaries above the mouth of and including the Noxubee River in accordance with plans approved by the Chief of Engineers at an estimated cost of $150,000.

BAYOU TECHE AND VERMILION RIVER

The project for the improvement of Bayou Teche and the Vermilion River, Louisiana, is hereby authorized to be constructed substantially in accordance with the recommendations of the Chief of Engineers in Senate Document Numbered 93, Seventy-seventh Congress, first session, at an estimated cost of $1,390,000.

MERMENTAU RIVER BASIN

The project for the improvement of the Mermentau River in Louisiana for flood control is hereby authorized to be constructed substantially in accordance with the recommendations of the Chief of Engineers in Senate Document Numbered 94, Seventy-seventh Congress, first session, at an estimated cost of $970,000.

COLORADO RIVER BASIN (TEXAS)

The plan for improvement of the Lower Colorado River, Texas, for flood control in accordance with the recommendation of the Chief of Engineers in House Document Numbered 312, Seventy-sixth Congress, first session, is approved and there is hereby authorized $6,500,000 for the construction of the project.

The plan for San Angelo Reservoir for flood control and other purposes on the North Concho River, Texas, and for local flood-protection works at San Angelo, Texas, in accordance with the recommendation of the Chief of Engineers in House Document Numbered 315, Seventy-sixth Congress, first session, is approved and there is hereby authorized $2,000,000 for initiation and partial accomplishment of the project.

The plan for Hords Creek Reservoir and for enlargement of the existing Lake Brownwood Reservoir for flood control and other purposes on Pecan Bayou and its tributaries in Texas, in accordance with the recommendation of the Chief of Engineers in House Document Numbered 370, Seventy-sixth Congress, first session, is approved and there is hereby authorized $1,400,000 for initiation and partial accomplishment of the project, including $460,000 for the Hords Creek Reservoir.

The project for local flood protection on Brady Creek at Brady, Texas, is hereby authorized to be constructed substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 441, Seventy-sixth Congress, first session, at an estimated cost of $825,000.

BRAZOS RIVER BASIN

The plan for Whitney Reservoir on the Brazos River in Texas, for flood control and other purposes in accordance with the recommendation of the Chief of Engineers in House Document Numbered 390, Seventy-sixth Congress, first session, is approved and there is hereby authorized $5,000,000 for the initiation and partial accomplishment of the project.

LOWER MISSISSIPPI RIVER

The project for flood control of the Lower Mississippi River adopted by the Act of May 15, 1928, as amended by the Act of June 15, 1936, as amended by the Acts of August 28, 1937, and June 28, 1938, is hereby modified and, as modified, is hereby authorized and adopted, and the Flood Control Act of June 15, 1936, as amended, is amended as follows:

(a) The existing engineering plan for flood control in the alluvial valley of the Mississippi River is hereby modified so as to provide

for the construction of plan 4 as set forth in the report of the Mississippi River Commission, dated March 7, 1941, to the Chief of Engineers, except that the levees in the Yazoo Basin on the east bank of the Mississippi River south of the Coahoma-Bolivar County line in said plan shall have a three-foot freeboard over the project flood, and all levees shall be constructed with adequate section and foundation to conform to increased levee heights. The Boeuf Floodway in the project adopted by the Act of May 15, 1928, and the Eudora Floodway as well as the Northward Extension and the back protection levee extending from the head of the said Eudora Floodway north to the Arkansas River in the project adopted by the Act of June 15, 1936, as amended, are hereby abandoned, and the provisions of said Acts relating to the prosecution of work on said floodways and extension are hereby repealed.

(b) The project for flood control of the Yazoo River shall be as authorized by the Flood Control Act approved June 15, 1936, as amended by section 2 of the Act approved June 28, 1938, except that the Chief of Engineers may, in his discretion, from time to time, substitute therefor combinations of reservoirs, levees, and channel improvements; and except that the extension of the authorized project and improvements contemplated in plan C of the report of March 7, 1941, of the Mississippi River Commission are authorized, including the extension of the levee on the east bank of the Mississippi River generally along the west bank of the Yazoo River to a connection in the vicinity of Yazoo City with the Yazoo River levee, authorized by the existing project for protection against headwater floods of the Yazoo River system, and the adjustment in the discretion of the Chief of Engineers of the grades of the existing levees in the backwater area on the east bank of Yazoo River below Yazoo City, all at an estimated additional cost of $11,982,000: *Provided*, That the Chief of Engineers shall fix the grade of the extension levees along the Yazoo River, with higher levees in his discretion, so that their construction will give the maximum practical protection without jeopardizing the safety and integrity of the main Mississippi River levees: *And provided further*, That prior to the beginning of construction local authorities shall furnish satisfactory assurances that they will (1) maintain the levees in accordance with the provisions of section 3 of the Act of May 15, 1928, and will (2) not raise the levees in the backwater above the limiting elevations established therefor by the Chief of Engineers.

(c) In the development of the authorized project, the construction of a levee and improvements contemplated in the report of March 7, 1941, of the Mississippi River Commission from the main-line levee on the west bank of the Mississippi River in the vicinity of Shaw, Louisiana, westward and northward to the vicinity of Newlight, Louisiana, for the protection of that part of the Red River backwater known as the Tensas-Cocodrie area at an estimated cost of $6,976,000 is hereby authorized: *Provided*, That the Chief of Engineers shall fix the grade of said levee, with a higher levee in his discretion, so that its construction will give the maximum practical protection without jeopardizing the safety and integrity of the main Mississippi River levees: *And provided further*, That prior to the beginning of construction local authorities shall furnish satisfactory assurances that they will (1) maintain the levee in

accordance with the provisions of section 3 of the Act of May 15, 1928, and will (2) not raise the said levee above the limiting elevations established therefor by the Chief of Engineers: *Provided further*, That subject to the foregoing conditions of local cooperation the Chief of Engineers may in his discretion substitute other levees and appurtenant works for, or make such modifications of, the levees and improvements herein authorized for the protection of the Tensas-Cocodrie area as may be found after further investigation to afford protection to a larger area in the Red River Backwater at a total cost not to exceed $14,000,000 and without jeopardizing the safety and integrity of the main Mississippi River levees and without preventing or jeopardizing the diversions contemplated in the adopted project through the Atchafalaya River and Atchafalaya Basin.

(d) The Chief of Engineers, with approval of the Secretary of War, shall reimburse local authorities for actual expenditures found by the Chief of Engineers to be reasonable, for providing at the request of the United States, in accordance with local legal procedure or custom, rights-of-way and flowage easements required for future setbacks of main-line Mississippi River levees.

(e) The existing engineering plan for flood control of the Saint Francis River is hereby modified so as to permit the substitution for the suspended portions of the original project below Oak Donnick, Arkansas, of the construction of a ditch in Cross County, Arkansas, beginning in the vicinity of the outlet end of the existing Oak Donnick to Saint Francis Bay floodway and terminating in Saint Francis Bay about two miles north of Riverfront, including the construction of a highway bridge at State Highway Numbered 42 made necessary by the ditch construction: *Provided*, That local interests give assurances satisfactory to the Secretary of War that they will (1) provide without cost to the United States all lands, easements, and rights-of-way necessary for the construction; (2) hold and save the United States free from damages due to the construction works; and (3) maintain the works after completion in accordance with regulations prescribed by the Secretary of War.

(f) In the development of the authorized project, the construction of improvements for Bayou Rapides, Boeuf, and Cocodrie, Louisiana, contemplated in the report dated March 24, 1941, of the Special Board of Officers at an estimated cost of $2,600,000 is hereby authorized.

(g) The total authorizations heretofore made for the flood control project of the alluvial valley of the Mississippi River shall not be increased by reason of any provision in this Act, except for the additional amounts necessary for the Yazoo and Red River backwater improvements, and any appropriations heretofore or hereafter made or authorized for said project as herein or heretofore modified may be expended upon any feature of the said project, notwithstanding any restrictions, limitations, or requirements of existing law: *Provided*, That funds hereafter expended for maintenance shall not be considered as reducing present remaining balances of authorizations.

(h) Any officer of the Corps of Engineers who has served or shall serve four years as President of the Mississippi River Commission

and who has been or shall subsequently be retired, shall, from the date of such retirement, receive the rank, pay, and allowances of a retired major general.

The project for flood control on the Homochitto River in Mississippi, authorized by the Act of June 22, 1936 (Public, Numbered 738, Seventy-fourth Congress), and modified by the Act of June 28, 1938 (Public, Numbered 761, Seventy-fifth Congress), is hereby further modified to provide for additional channel improvements and related works for flood control on the Homochitto River and tributaries in accordance with plans approved by the Chief of Engineers, and for the execution of these plans there is hereby authorized $50,000.

RED-OUACHITA RIVER BASIN

The project for local flood protection on the Ouachita River near Calion, Arkansas, is hereby authorized to be constructed substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 427, Seventy-sixth Congress, first session, at an estimated cost of $50,000.

The project for local protection on the Red River in Grant Parish below Colfax, Louisiana, authorized by the Act approved June 28, 1938, is hereby amended to add and authorize the following: Levee enlargement, new levee extension, and the construction of appurtenant drainage structures on the left bank of the Red River opposite Alexandria for the protection of Pineville, Lousiana, and vicinity, at an estimated cost to the United States of $159,100, subject to the provisions of section 3 of the Act approved June 22, 1936.

The project for local flood protection on the Red River in Grant Parish below Colfax, Louisiana, authorized by the Act approved June 28, 1938, is hereby further amended to include and to authorize the following: Levees and appurtenant drainage works on the left bank of the Red River and along Bayous Darrow and Rigolette, the improvement of the channel of Bayou Rigolette, and the separation of the channels of Bayous Darrow and Rigolette in the Aloha-Rigolette area, Grant and Rapides Parish, Louisiana, all at an estimated cost to the United States of $914,500, subject to the provisions of section 3 of the Flood Control Act approved June 22, 1936.

The project for the Bayou Bodcau Reservoir, Louisiana, authorized by the Act of June 22, 1936, as modified by the Acts of June 28, 1938, and June 28, 1939, is hereby further modified to include and to authorize channel improvements below the reservoir on Bayou Bodcau, Red Chute, and Loggy Bayou at an estimated cost of $198,000, subject to the provisions of Section 3 of the Flood Control Act approved June 22, 1936.

The plan for the Narrows Reservoir for flood control and other purposes on the Little Missouri River, Arkansas, and for local flood protection on the main river below Murfreesboro and on the Terre Noire and Ozan Creeks, substantially in accordance with recommendation of the Chief of Engineers in House Document Numbered 837, Seventy-sixth Congress, third session, is approved and there is hereby authorized $3,000,000 for initiation and partial accomplishment of the project.

WHITE RIVER BASIN

In addition to previous authorizations, there is hereby authorized to be appropriated the sum of $24,000,000 for the prosecution of the comprehensive plan approved in the Act of June 28, 1938, for the White River Basin in Missouri and Arkansas, including the projects for flood control and other purposes recommended by the Chief of Engineers in House Document Numbered 917, Seventy-sixth Congress, third session, and the modifications in the Norfork Reservoir project recommended by the Chief of Engineers in House Document Numbered 290, Seventy-seventh Congress, first session.

The projects for local flood protection on the White River, on the east side between Augusta and Clarendon, Arkansas, and at the town of De Valls Bluff, Arkansas, are hereby authorized to be constructed substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 98, Seventy-sixth Congress, first session, at an estimated cost of $2,847,500.

ARKANSAS RIVER BASIN

The general comprehensive plan for flood control and other purposes, approved by the Act of June 28, 1938, for the Arkansas River Basin, is hereby modified to include the reservoirs in the Grand (Neosho) River Basin in Oklahoma and Missouri, and in the Verdigris River Basin in Kansas, in accordance with the recommendations of the Chief of Engineers in House Documents Numbered 107 and 440 of the Seventy-sixth Congress, first session. In addition to previous authorizations, there is hereby authorized to be appropriated the sum of $29,000,000 for the prosecution of said comprehensive plan.

The project for local flood protection on the Salt Fork of the Arkansas River in the vicinity of Cherokee, Oklahoma, is hereby authorized to be constructed substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 480, Seventy-sixth Congress, second session, at an estimated cost of $800,000.

The project for local flood protection along the south bank of the Arkansas River between Little Rock and Pine Bluff, Arkansas, is hereby authorized to be constructed substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 718, Seventy-sixth Congress, third session, at an estimated cost of $641,000, with such modifications as may be advisable in the discretion of the Secretary of War and the Chief of Engineers.

The project for local flood protection along the north bank of the Arkansas River in the Crawford County Levee District, Arkansas, is hereby authorized to be constructed substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 720, Seventy-sixth Congress, third session, at an estimated cost of $284,000.

The project for local flood protection on both sides of the Arkansas River in the immediate vicinity of Tulsa and West Tulsa, Oklahoma, is hereby authorized to be constructed substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 157, Seventy-seventh Congress, first session, at an estimated cost of $513,000.

OHIO RIVER BASIN

In addition to previous authorizations, there is hereby authorized to be appropriated the sum of $45,000,000 for the prosecution of the comprehensive plan approved in the Act of June 28, 1938, for the Ohio River Basin, modified to include the Allegheny Reservoir project in accordance with the recommendation of the Chief of Engineers in House Document Numbered 300, Seventy-sixth Congress, first session.

The project for local flood protection on the Licking River at Salyersville, Kentucky, is hereby authorized to be constructed substantially in accordance with the recommendations of the Chief of Engineers in House Document Numbered 261, Seventy-seventh Congress, first session, at an estimated cost of $174,000.

TENNESSEE RIVER BASIN

The projects for local flood protection on the Tennessee River at Chattanooga, Tennessee, and Rossville, Georgia, are hereby authorized to be constructed substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 479, Seventy-sixth Congress, second session, at an estimated cost of $13,500,000.

UPPER MISSISSIPPI RIVER BASIN

The project adopted by the Act of June 22, 1936, for the Dry Run Reservoir near Decorah, Iowa, is hereby modified to authorize the Chief of Engineers to modify the project so as to provide protection by diversion of floodwaters in accordance with revised plans now on file in his office, at an estimated Federal cost of $460,000.

SEBEWAING RIVER

The project for local flood protection on the Sebewaing River in the vicinity of Sebewaing, Michigan, is hereby authorized to be constructed substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 286, Seventy-sixth Congress, first session, at an estimated cost of $250,000.

MISSOURI RIVER BASIN

In addition to previous authorizations, there is hereby authorized to be appropriated the sum of $7,000,000 for the prosecution of the comprehensive plan approved in the Act of June 28, 1938, for the Missouri River Basin, including the project for the Harlan County Reservoir on the Republican River, Nebraska, recommended by the Chief of Engineers in House Document Numbered 842, Seventy-sixth Congress, third session, and such other supplemental flood-control works on the Republican River as the Secretary of War and the Chief of Engineers may find advisable.

The comprehensive plan for the improvement of Cherry Creek and tributaries, Colorado, for flood control and other purposes in accordance with the recommendations of the Chief of Engineers in House Document Numbered 426, Seventy-sixth Congress, first session, is approved and there is hereby authorized $3,000,000 for the initiation and partial accomplishment of the project.

The project for local flood protection on the Platte River in the vicinity of Schuyler, Nebraska, is hereby authorized to be constructed substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 250, Seventy-sixth Congress, first session, at an estimated cost of $63,000.

The project for local flood protection on the Missouri River and Indian Creek at Council Bluffs, Iowa, is hereby authorized to be constructed substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 577, Seventy-sixth Congress, third session, at an estimated cost of $18,000.

The project for the improvement of Fall River and tributaries, South Dakota, for flood control is hereby authorized to be constructed substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 655, Seventy-sixth Congress, third session, at an estimated cost of $1,050,000.

The project for flood protection in the vicinity of Sioux City, Iowa, and along both banks of the Missouri River between Sioux City and Kansas City for flood control in accordance with the recommendation of the Chief of Engineers in House Document Numbered 821, Seventy-sixth Congress, third session, is approved and there is hereby authorized $1,000,000 for the initiation and partial accomplishment thereof: *Provided*, That such project is hereby modified by eliminating the requirement that the States having a common boundary on the Missouri River shall, as a condition precedent to the initiation of construction along that portion of the river, establish by interstate compact floodway boundary lines and floodway regulations satisfactory to the Secretary of War.

SANTA ANA RIVER BASIN

In addition to previous authorizations, there is hereby authorized to be appropriated the sum of $2,500,000 for the prosecution of the projects approved in the Acts of June 22, 1936, and June 28, 1938, for flood control in the Santa Ana River Basin and for the protection of Orange County in California.

LOS ANGELES-SAN GABRIEL RIVER BASIN AND BALLONA CREEK

The general comprehensive plan for flood control and other purposes in the basins of the Los Angeles and San Gabriel Rivers and Ballona Creek as set forth in House Document Numbered 838, Seventy-sixth Congress, third session, is approved, and in addition to previous authorizations there is hereby authorized $25,000,000 for the partial accomplishment of that plan.

SACRAMENTO-SAN JOAQUIN RIVER BASIN

The projects for the control of floods and other purposes in the Sacramento River, California, adopted by the Acts approved March 1, 1917, May 15, 1928, and August 26, 1937, are hereby modified substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 205, Seventy-seventh Congress, first session, at an estimated cost of $10,500,000, and also modified to provide for channel clearing, rectification, snagging, and

bank protection on the Sacramento River and tributaries in Tehama County, and from Red Bluff southerly, at an additional estimated cost of $150,000.

The project for the Fresno County Stream Group for flood control is hereby authorized to be constructed substantially in accordance with the recommendations of the Chief of Engineers in House Document Numbered 845, Seventy-sixth Congress, third session, at an estimated cost of $510,000.

UMPQUA RIVER BASIN

The project for improvement of the Umpqua River in Oregon for flood control is hereby authorized to be constructed substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 684, Seventy-sixth Congress, third session, at an estimated cost of $176,000.

YAQUINA RIVER BASIN

The project for local flood protection on the Yaquina River in the Mill Four District, Oregon, is hereby authorized to be constructed substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 304, Seventy-seventh Congress, first session, at an estimated cost of $72,000.

WILLAMETTE RIVER BASIN

In addition to previous authorizations, there is hereby authorized to be appropriated the sum of $11,000,000 for the prosecution of the comprehensive plan approved in the Act of June 28, 1938, for the Willamette River Basin in Oregon.

The project for improvement of the Pudding River in Oregon for flood control is hereby authorized to be constructed substantially in accordance with the recommendation of the Chief of Engineers in Senate Document Numbered 185, Seventy-sixth Congress, third session, at an estimated cost of $62,000.

COLUMBIA RIVER BASIN

The project for local flood protection on the Touchet River at Dayton, Washington, is hereby authorized to be constructed substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 662, Seventy-sixth Congress, third session, at an estimated cost of $146,000.

The project for levees, channel enlargement, and channel rectification on Walla Walla River in the vicinity of Milton and Freewater, Oregon, is hereby authorized to be constructed substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 719, Seventy-sixth Congress, third session, and the project for the protection of the city of Walla Walla, Washington, authorized by the Act approved June 28, 1938, is hereby modified in accordance with the recommendations of the Chief of Engineers, in House Document Numbered 719, Seventy-sixth Congress, third session, at an estimated cost of $754,000.

The project for levees on the Cowlitz River, Washington, for local flood protection at Castle Rock, Washington, is hereby author-

ized to be constructed substantially in accordance with the recommendation of the Chief of Engineers in House Document Numbered 721, Seventy-sixth Congress, third session, at an estimated cost of $31,000.

The project for local flood protection on Birch Creek in the vicinity of Pilot Rock, Oregon, is hereby authorized to be constructed substantially in accordance with the recommendation of the Chief of Engineers in Senate Document Numbered 89, Seventy-seventh Congress, first session, at an estimated cost of $34,000.

SEC. 4. The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys for flood control, to be made under the direction of the Chief of Engineers, in drainage areas of the United States and its territorial possessions, which include the following-named localities, and the Secretary of Agriculture is authorized and directed to cause preliminary examinations and surveys for run-off and water-flow retardation and soil-erosion prevention on such drainage areas; the cost thereof to be paid from appropriations heretofore or hereafter made for such purposes: *Provided*, That after the regular or formal reports made on any examination, survey, project, or work under way or proposed are submitted to Congress, no supplemental or additional report or estimate shall be made unless authorized by law except that the Secretary of War may cause a review of any examination or survey to be made and a report thereon submitted to the Congress if such review is required by the national defense or by changed physical or economic conditions: *And provided further*, That the Government shall not be deemed to have entered upon any project for the improvement of any waterway or harbor mentioned in this Act until the project for the proposed work shall have been adopted by law:

Barren River, Kentucky and Tennessee, with special reference to a dam in the vicinity of a site known as Barren No. 2.

Byram River and tributaries, Connecticut.

Blind Brook and tributaries, New York.

Mamaroneck and Sheldrake Rivers and their tributaries, New York.

Bronx River and tributaries, New York.

Hutchinson River and tributaries, New York.

Saw Mill River and tributaries, New York.

Garden Creek, Mathews County, Virginia.

Indian River, Upper Saint Johns River and Marsh, and North Fork, Saint Lucie River, and their tributaries, the Kissimmee River and its tributaries, Florida.

Red River in the vicinity of Shreveport, Louisiana, with a view to determining the advisability of providing bank-protection works.

Polecat Creek, Creek County, Oklahoma.

Walnut Creek, Love and Carter Counties, Oklahoma.

Rio Grande and tributaries, New Mexico.

Mimbres River and tributaries, New Mexico.

Pearl River, Mississippi.

Lake Pontchartrain, Louisiana, from the Orleans-Jefferson Parish line westward and northward to the vicinity of Frenier.

Black River, Catahoula and Concordia Parishes, Louisiana.

Dogy and Clear Creeks, tributaries of the Arkansas River, Oklahoma.

Salt Creek of the Arkansas River and tributaries, Osage County, Oklahoma.

Red River of the North Drainage Basin, Minnesota, South Dakota, and North Dakota.

Inlets and outlets to Lake Hendricks, South Dakota and Minnesota.

North Fork and South Fork of the Shoshone River and their tributaries, Wyoming.

Emery River and tributaries, Tennessee.

Redstone and Dunlap Creeks and tributaries, Pennsylvania.

West Fork River and tributaries, West Virginia, with a view to determining the advisability of constructing a system of multiple-use reservoirs.

Milwaukee River and tributaries, Wisconsin.

Little Calumet River and tributaries, Indiana.

Little Black River and tributaries, Michigan.

Sturgeon and Otter Rivers, and their tributaries, Michigan.

Cuyahoga River and tributaries, Ohio.

Big Sur River and Carmel River, and their tributaries, Monterey County, California.

Laguna Canyon, California.

All streams in San Diego County, California, flowing into the Pacific Ocean.

All streams in San Diego and Imperial Counties, California, flowing into the Salton Sea.

Coyote River and tributaries, California.

San Francisquito Creek, San Mateo and Santa Clara Counties, California.

Alhambra Creek and tributaries, California.

Matadero Creek, Santa Clara County, California.

Novato Creek and its tributaries, Marin County, California.

Petaluma Creek and tributaries, Sonoma County, California.

Guadalupe River and tributaries, California.

Silvies River and tributaries, Oregon.

Columbia River and tributaries, Washington, from the downstream point of Vancouver Lake to upstream point of Bachelor Island.

Salmon Creek, in the vicinity of Juneau, Alaska.

Yaguez, Estero, Portuguez, Bucana, Lapa, Guamani, Chico, Maunabo, Quebrada Arena, and Susua Rivers, and tributaries, Puerto Rico.

Creque Gut and Fair Plain Gut and their tributaries, Island of Saint Croix, and of Turpentine Run, and Crown Mountain water courses and their tributaries, Island of Saint Thomas, Virgin Islands.

SEC. 5. That the Secretary of War is hereby authorized to allot, from any appropriations heretofore or hereafter made for flood control, not to exceed $1,000,000 for any one fiscal year to be expended in rescue work or in the repair or maintenance of any flood-control work threatened or destroyed by flood.

SEC. 6. That the provisions of the following Acts of Congress relating to river and harbor improvements are hereby made applicable to works of flood control heretofore or hereafter authorized: August 8, 1917, section 9 (40 Stat. 267); July 18, 1918, sections 5 and 6 (40 Stat. 911); and August 30, 1935, section 7 (49 Stat. 1048).

SEC. 7. That 25 per centum of all moneys received and deposited in the Treasury of the United States during any fiscal year on account of the leasing of lands acquired by the United States for flood control purposes shall be paid, at the end of such year, by the Secretary of the Treasury to the State in which such property is situated, to be expended as the State legislature may prescribe for the benefit of the public schools and public roads of the county or counties in which such property is situated: *Provided*, That when such property is situated in more than one State or county the distributive share to each from the proceeds of such property shall be proportional to its area therein.

SEC. 8. Section 5 of the Act approved June 28, 1938 (52 Stat. 1215), is amended by striking out the words "in carrying out the purposes of this Act" and inserting in lieu thereof the words "in carrying out the purposes of the Act of June 22, 1936 (49 Stat. 1570), as amended and supplemented"; and by adding at the end of said section the following sentence: "The provisions of this section shall be applicable to any funds heretofore appropriated for the prosecution by the Secretary of Agriculture of works of improvement for measures of run-off and waterflow retardation and soil-erosion prevention upon watersheds."

SEC. 9. That Section 2 of the Flood Control Act of August 28, 1937, as amended is hereby further amended to read as follows:

"That the Secretary of War is hereby authorized to allot not to exceed $500,000 from any appropriations heretofore or hereafter made for any one fiscal year for flood control, for removing accumulated snags and other debris and clearing and straightening channels in navigable streams and tributaries thereof, when in the opinion of the Chief of Engineers such work is advisable in the interest of flood control: *Provided*, That not more than $25,000 shall be allotted for this purpose for any single tributary from the appropriations for any one fiscal year."

SEC. 10. That the sum of $275,000,000 is hereby authorized to be appropriated for carrying out the improvements herein, the sum of $10,000,000 additional is authorized to be appropriated and expended in equal amounts by the Departments of War and Agriculture for carrying out any examinations and surveys provided for in this Act and any other Acts of Congress, to be prosecuted by said departments. There is also hereby authorized to be appropriated for expenditure by the Department of Agriculture in carrying on works of improvement of the character specified in section 7 of the Flood Control Act of June 28, 1938, and which the Department is not otherwise authorized to undertake, such additional sums, not to exceed $5,000,000, as may be necessary for that purpose. All appropriations necessary for operation and maintenance of flood-control works authorized by law to be operated and maintained by the United States are hereby authorized.

Approved, August 18, 1941.

76TH CONGRESS } HOUSE OF REPRESENTATIVES { DOCUMENT
3d Session } { No. 838

LOS ANGELES AND SAN GABRIEL RIVERS AND THEIR TRIBUTARIES, AND BALLONA CREEK, CALIF.

LETTER

FROM

THE SECRETARY OF WAR

TRANSMITTING

A LETTER FROM THE CHIEF OF ENGINEERS, UNITED STATES ARMY, DATED APRIL 11, 1940, SUBMITTING A REPORT, TOGETHER WITH ACCOMPANYING PAPERS AND AN ILLUSTRATION, ON A PRELIMINARY EXAMINATION AND SURVEY OF LOS ANGELES AND SAN GABRIEL RIVERS AND THEIR TRIBUTARIES, AND BALLONA CREEK, CALIF., AUTHORIZED BY THE FLOOD CONTROL ACTS APPROVED JUNE 22, 1936, AND JUNE 28, 1938

JUNE 13, 1940.—Referred to the Committee on Flood Control and ordered to be printed, with an illustration

WAR DEPARTMENT,
Washington, June 11, 1940.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

DEAR MR. SPEAKER: I am transmitting herewith a report dated April 11, 1940, from the Chief of Engineers, United States Army, on preliminary examination and survey of Los Angeles and San Gabriel Rivers and their tributaries, and Ballona Creek, Calif., authorized by the Flood Control Acts approved June 22, 1936, and June 28, 1938, together with accompanying papers and illustration.

Sincerely yours,

HARRY H. WOODRING,
Secretary of War.

238719—40——1

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, April 11, 1940.

Subject: Los Angeles and San Gabriel Rivers and their tributaries, and Ballona Creek, Calif.
To: The Secretary of War.

1. I submit for transmission to Congress my report with accompanying papers and illustration on examinations of Los Angeles River and tributaries, Calif., and San Gabriel River and tributaries, Calif., authorized by the Flood Control Act approved June 22, 1936, and of Ballona Creek, Calif., made under the provisions of the Flood Control Act approved June 28, 1938, which authorized a preliminary examination and survey of streams in Los Angeles and Ventura Counties draining the Santa Monica Mountains, Calif., directly into the Pacific Ocean. Other reports under the latter authority are to be made.

2. The Los Angeles and San Gabriel Rivers and Ballona Creek drain an area of 1,717 square miles in southwestern California. The Los Angeles River is formed by the junction of Calabasas and Bell Creeks near the Los Angeles-Ventura County line, flows southeast 20 miles along the south side of the San Fernando Valley, then turns and flows south for 30 miles and discharges into the Pacific Ocean through a diversion channel in the city of Long Beach. It drains an area of 890 square miles including 137 square miles directly tributary to the Rio Hondo, a cross channel which carries part of the flow of the San Gabriel River to the Los Angeles River. The river traverses the agricultural and residential sections of the San Fernando Valley and the highly developed industrial sections of the city of Los Angeles. The San Gabriel River is formed by the junction of its East and West Forks in the San Gabriel Mountains. After leaving the mountains near the city of Azusa, the river divides into two branches, the branch to the west known as the Rio Hondo flowing southwest to its junction with the Los Angeles River, 12 miles from the ocean, and the branch to the east continuing south as the San Gabriel River to discharge into the Pacific Ocean 6 miles east of Los Angeles River. It drains an area of 698 square miles, exclusive of the area tributary to the Rio Hondo. Below Azusa to Whittier Narrows the river flows through a highly developed agricultural community. Below the Narrows it flows through a relatively well developed area suited to general agriculture except in the lower section which is mostly marsh and overflow land. Ballona Creek drains an area of 129 square miles adjoining the Los Angeles River basin on the west. The main stream is entirely within the coastal plain, but the numerous tributaries head in the mountains and foothills to the north. The upper portion of the Los Angeles and San Gabriel Basins lies within the Santa Susana and San Gabriel Mountains, and topography is rough and broken with the terrain cut by many steeply sloping canyons. Leaving the mountains, streams and washes flow through a foothill and valley area on fairly steep gradients until they enter the relatively flat coastal plain section. The three watersheds under consideration have an estimated population of 2,400,000, of which about 88 percent is urban, including 1,360,000, in the city of Los Angeles. Principal activities in the area are the production and

refining of petroleum, production of motion pictures, manufacturing, and agriculture.

3. Floods are comparatively frequent on the streams under consideration. The winter flood of 1861–62 appears to have been the greatest of historical record, but the magnitude of this or other floods except that of March 1938, is not known. Natural channels in the lower reaches are not stable and tend to change their courses. In 1815 the Los Angeles River changed its course from the general location of its present channel by turning west in the vicinity of what is now downtown Los Angeles, and flowing to the ocean by way of the present Ballona Creek. In 1825 the river returned to its original channel where it has remained except for numerous minor changes in alinement.

4. A total of about 325,000 acres is subject to overflow, 130,000 in the Los Angeles Basin, 140,000 in the San Gabriel Basin, 30,000 along the Rio Hondo, and 25,000 in the Ballona Creek Basin. Not all of this area would be inundated by any one flood, but due to the instability of natural channels and the relative freedom of flood flows to follow various courses over the debris cones and through the alluvial valleys the whole area is threatened. The present value of land and improvements of the entire overflow area is estimated at more than $1,000,000,000, and the number of persons residing therein is approximately 800,000. In the upper Los Angeles Basin the overflow area consists mainly of citrus and olive groves and farm land, and contains many towns and improvements subject to flooding. Large areas in the cities of Burbank and Glendale are exposed to the flood menace and below in the flood plain of the Los Angeles River there are major industrial developments and a large part of the residential and business areas of Los Angeles. The overflow area south of Los Angeles includes the towns of Huntington Park, South Gate, Compton, and a portion of the city of Long Beach, as well as agricultural areas, oil fields, and refineries. The upper portion of the overflow area in the San Gabriel Basin consists principally of citrus groves, but contains no large communities. Below Whittier Narrows the flood plain contains small towns, truck farms, and oil fields, refineries, and tank farms. The towns of Bellflower, Artesia, Norwalk, and a portion of Long Beach are in this area. Along the Rio Hondo and its tributaries, sections of Pasadena, Sierra Madre, Arcadia, Monrovia, San Gabriel, Alhambra, and El Monte are subject to flood damage as well as extensive agricultural areas. Nearly all of the Ballona Creek overflow area is occupied by residential and industrial developments of Los Angeles, Beverly Hills, and Culver City. A small part of the southern portion of the area is in truck farms and contains a number of oil wells. Little information is available as to past flood damages except for the 1938 flood which caused damages estimated at over $40,000,000. There was a large loss of life during this flood and during the 1934 flood.

5. Various local agencies have made extensive improvements in the area under consideration for the alleviation of the flood menace and for water conservation. The Los Angeles County Flood Control District, organized under authority of a State law enacted in 1915, developed comprehensive plans for control of floods in Los Angeles County and constructed extensive improvements, including 12 flood-control dams, 2 flood-control and debris storage basins, one diversion dam, a number of debris basins, many miles of channel improvements,

and several areas as spreading grounds for water conservation. The Flood Control District maintains and operates all such works. The total expenditure from local funds for all work to December 1, 1939, was approximately $57,800,000 for construction and $11,000,000 for maintenance and operation, a total of $68,800,000. The flood-control district contributed $1,600,000 to the cost of diverting the lower Los Angeles River undertaken by the United States at a total cost of $3,000,000 to eliminate silting of Los Angeles and Long Beach Harbors. Since 1935 numerous flood-control improvements have been constructed with Federal relief funds supplemented by contributions by local interests, the total expenditures being about $21,000,000, of which $5,000,000 were contributed. The existing project authorized by the 1936 Flood Control Act as amended by the act approved May 15, 1937, provides for the construction of reservoirs and principal flood channels in Los Angeles and San Gabriel Rivers and Ballona Creek, and tributaries thereof, at an estimated construction cost not to exceed $70,000,000. Provisions of the 1938 Flood Control Act relieve local interests of the expense of lands, easements, and rights-of-way needed for the work, the cost of which is estimated at $12,541,000. Federal expenditures under the existing project to January 1, 1940, have been $37,540,000. The improvements that can be accomplished within the limits of expenditures authorized by the existing project consist of construction of the Hansen and Sepulveda flood-control basins and improvement of a part of the main channel and some tributary channels in the Los Angeles Basin, construction of the Santa Fe flood-control basin and improvement of short sections of channel in the San Gabriel Basin, and a small amount of channel work on Ballona Creek. Local interests state that numerous areas will be left unprotected from floods after completion of the works now authorized, and desire that a comprehensive plan for protection of the areas under consideration by construction of channel improvements, flood-control basins and debris basins be authorized.

6. The district engineer presents a general comprehensive plan for flood protection in the areas under consideration. The plan embodies the work provided for under the existing authorization and desirable extensions thereof. For the Los Angeles Basin the plan provides for the Sepulveda, Hansen, and Lopez flood-control basins, debris basins at the mouths of 17 tributary canyons, improvement of 49.07 miles of main channel and 53.42 miles of tributary channels and reconstruction of 109 bridges. For the San Gabriel Basin the plan provides for the Santa Fe and Whittier Narrows flood-control basins, debris basins at the mouths of 7 tributary canyons, improvement of 35.6 miles of main channel and 69.16 miles of tributary channels, and reconstruction of 142 bridges. For the Rio Hondo Basin the plan provides debris basins at mouths of 7 tributary canyons, improvement of 9.76 miles of main channel and 35.23 miles of tributary channels and reconstruction of 65 bridges. For Ballona Creek Basin the plan provides for debris basins at the mouths of two canyons, improvement of 2.39 miles of main channel and 23.67 miles of tributary channels and reconstruction of 12 bridges. Estimated costs of the general plan by basins follows:

	Existing authorization	Proposed extensions	Total
Los Angeles Basin	$67,283,000	$71,843,000	$139,126,000
San Gabriel Basin	12,103,000	74,125,000	86,228,000
Rio Hondo Basin	1,205,000	21,379,000	22,584,000
Ballona Creek Basin	1,950,000	18,276,000	20,226,000
Total	[1] 82,541,000	185,623,000	268,164,000

[1] Includes $70,000,000 for construction and $12,541,000 for lands and damages.

Annual charges for the general plan, including charges on works under the existing authorization are estimated at $13,537,000. Benefits that would result from construction of the improvements proposed in the general plan, including benefits from works provided under the existing authorization are estimated to average $20,666,000 annually. The district engineer finds the general plan as a whole and its individual elements all to be justified. He believes that in view of the local nature of the additional works proposed that local interests should participate in the expense of the additional improvements to the extent of providing all lands, easements, and rights-of-way, assuming the cost of all highway changes and bridges, holding the United States free from claims for damages except those resulting from faulty operation of the flood-control basins and, in the case of certain of the tributary channel improvements, to contribute 40 percent of the cost of construction. The district engineer recommends modification of the existing project for the Los Angeles and San Gabriel Rivers and Ballona Creek to provide for additional improvements in extension thereof at an estimated increase in first cost to the United States of $131,000,000, with $1,330,000 annually for maintenance and operation, subject to conditions of local cooperation. The division engineer concurs.

7. The Board of Engineers for Rivers and Harbors finds that the general plan proposed by the reporting officers provides a comprehensive outline of the works to be provided under the existing project and of the additional improvements required to afford protection to the areas for which protection now is found advisable. The Board has reviewed estimates of costs and benefits and finds that the estimates of direct flood damages that would be prevented under the plan have been carefully evaluated, and that they represent a fair determination of the direct benefits that would accrue to the project. It notes that these benefits represent nearly 90 percent of the annual charges for the comprehensive project. The Board, on the other hand, questions certain of the indirect and incidental benefits as estimated by the district engineer, and is of the opinion that only a nominal portion of these benefits would accrue to the project. The Board finds, however, that tangible benefits under the comprehensive plan are substantially equal to the annual charges and believes that when account is taken of indirect unevaluated benefits, including the continued economic welfare and development of the region, and of the serious hazard to life which now exists, the existing project works and proposed extensions thereof are well justified. The Board, while noting the large expenditures made by local interests on works useful to the general plan, believes that in view of the local character of the improvement local interests should be required to provide all lands, easements, and

rights-of-way needed for the proposed additional channel improvements, bear the expense of all highway and highway-bridge modifications in connection therewith, hold the United States free from claims for damages resulting from construction thereof and provide without cost police protection for all project works. Under these provisions the estimated costs of the proposed additional improvements would be $163,500,000 to the United States and $22,500,000 to local interests, a total of $186,000,000. The Board believes that the proposed additional improvements are desirable and that they should be constructed in such a manner and sequence as to provide the maximum protection practicable throughout the construction period. It recommends that the plan substantially as outlined in the report of the district engineer be approved as the general comprehensive plan for flood control in Los Angeles and San Gabriel Rivers and Ballona Creek and tributaries thereof, subject to conditions of local cooperation, and that the work thereunder be prosecuted at such rates as may be determined by Congress.

8. After due consideration of these reports I concur in the views of the Board. Floods on Los Angeles and San Gabriel Rivers and Ballona Creek, and on tributaries thereof, inundate extensive areas of highly developed urban and agricultural property and cause large damages. There is also a serious hazard to human life. Extensive improvements for alleviation of flood conditions have been constructed by local interests and by the United States, and some additional work can be accomplished under the existing project. All of this work provides a very substantial degree of protection for certain areas, but there is urgent need that much additional work be undertaken. The general plan proposed by the district and division engineers provides a comprehensive outline of the works to be accomplished under the authorization for the existing project and of the additional improvements required to afford protection to the areas for which protection now is found advisable. The additional works proposed include: First, the construction of the Lopez and Whittier Narrows Flood Control Basins and of certain main stream channels, thereby completing the reservoirs and main channel system already initiated under the authorized project; and, second, improvement of numerous tributary channels and construction of debris basins at mouths of canyons. The work also includes extensive railroad, highway, and bridge changes. I concur with the Board that tangible benefits that would result from construction of the works under the general comprehensive plan are substantially equal to the annual charges and believe that when account is taken of indirect unevaluated benefits, including the continued economic welfare and development of the area, and of the serious hazard to life which now exists, the existing project works and proposed extensions thereof are justified. I also concur with the Board that in view of the essentially local character of the additional improvements now proposed, local interests should participate in the expense of the proposed additional channel improvement works to the extent of providing all lands, easements, and rights-of-way necessary for the construction of the channels, bearing the expense of all highway and bridge modifications needed in connection therewith, hold the United States free from claims for damages resulting from construction thereof, and that they should also be required to provide police protection for all completed flood-control works of the existing project or extensions

thereof. I recommend that the plan, substantially as outlined in the report of the district engineer, be approved as the general comprehensive plan for flood control in Los Angeles and San Gabriel Rivers and Ballona Creek and tributaries thereof, subject to the conditions with respect to the proposed channel improvement works in extension of the existing project, that responsible local interests give assurances satisfactory to the Secretary of War that they will provide without cost to the United States all lands, easements, and rights-of-way necessary for the construction of said channels, bear the expense of all highway and highway bridge modifications needed in connection therewith, hold and save the United States free from claims for damages resulting from the construction thereof, and provide without cost to the United States police protection for all flood-control works of the existing project and extensions thereof; and that the work thereunder be prosecuted at such rates as may be determined by Congress.

J. L. SCHLEY,
Major General, Chief of Engineers.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS

[Second endorsement]

THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
Washington, D. C., March 26, 1940.

TO THE CHIEF OF ENGINEERS, UNITED STATES ARMY.

1. The Board considers that the general plan proposed by the district and division engineer for flood protection in the Los Angeles, San Gabriel, and Ballona Creek Basins provides a comprehensive outline of the works to be provided under the authorization for the existing project and of the additional improvements required to afford protection to the areas for which protection now is found advisable. The additional work proposed includes: First, the construction of the Lopez and Whittier Narrows flood-control basins and of certain main stream channels, thereby completing the reservoir and main channel system already initiated under the authorized project, and second, improvement of numerous tributary channels and construction of debris basins at mouths of canyons. The work also includes extensive railroad, highway, and bridge changes.

2. The Board has examined the plans for the additional work now proposed and has reviewed estimates of costs and benefits. It finds that the estimates of direct flood damages that would be prevented by the works proposed under the general comprehensive plan have been carefully evaluated, and believes that they represent a fair determination of the direct benefits that would accrue to the project. These benefits, estimated to average about $11,700,000 annually, represent nearly 90 percent of the annual charges for the comprehensive project. The Board, on the other hand, questions certain of the indirect and incidental benefits as estimated by the district engineer and is of the opinion that only a nominal portion of these benefits would accrue to the project. The Board finds, however, that tangible benefits that would result from construction of the works under the general comprehensive plan are substantially equal to the

annual charges, and believes that when account is taken of indirect unevaluated benefits, including the continued economic welfare and further development of the area and of the serious hazard to life which now exists, the existing project works and proposed extensions thereof are justified.

3. The Board, while noting the large expenditures already made by local interests on works useful to the general plan, believes that in view of the essentially local character of the improvements, local interests should participate in the expense of the proposed additional channel improvement works to the extent of providing all lands, easements, and rights-of-way necessary for the construction of the channels, bearing the expense of all highway and highway bridge modifications needed in connection therewith, and holding the United States free from claims for damages resulting from construction thereof. Under these provisions the estimated costs of the proposed additional improvements would be $163,500,000 to the United States and $22,500,000 to local interests, a total of $186,000,000. Local interests also should be required to provide, without cost to the United States, police protection for all completed flood-control works of the existing project and extensions thereof.

4. The Board believes that the additional improvements proposed by the district engineer are desirable and that they should be constructed in such a manner and sequence as to provide the maximum protection practicable throughout the construction period. The Board recommends that the plan, substantially as outlined in the report of the district engineer, be approved as the general comprehensive plan for flood control in Los Angeles and San Gabriel Rivers and Ballona Creek and tributaries thereof, subject to the conditions with respect to the proposed channel improvement works in extension of the existing project, that responsible local interests give assurances satisfactory to the Secretary of War that they will provide without cost to the United States all lands, easements, and rights-of-way necessary for the construction of said channels, bear the expense of all highway and highway-bridge modifications needed in connection therewith, hold and save the United States free from claims for damages resulting from the construction thereof, and provide without cost to the United States police protection for all flood-control works of the existing project and extensions thereof; and that the work thereunder be prosecuted at such rates as may be determined by Congress.

For the Board:

THOMAS M. ROBINS,
Brigadier General, Corps of Engineers,
Senior Member.

SURVEY OF LOS ANGELES AND SAN GABRIEL RIVERS AND THEIR TRIBUTARIES, AND BALLONA CREEK, CALIF.

SYLLABUS

The district engineer finds that an extension of the existing project for the control of destructive floods on the Los Angeles and San Gabriel Rivers and Ballona Creek, Calif., is necessary to attain full and satisfactory functioning of the existing project and that such extension is economically justified since the estimated benefits are more than one and one-half times the estimated costs. He sets forth

the items of the existng project that can be completed under existing congressional authorization and proposes extensions thereof to complete a comprehensive or general plan for control of floods in these basins.

The district engineer estimates:

The total cost of the extension of the existing project at $186,000,000, of which the costs to local interests would be $55,000,000.

The annual cost of operation and maintenance of the existing project and the extension thereof at $1,330,000.

The district engineer recommends:

The adoption by the United States of a general plan for flood control, subject to the conditions that local interests—

Provide police protection for all completed flood-control works of the extension of the project and the existing project.

Hold and save the United States free from all claims for damages due to the construction and operation of the extension of the project, except damage claims caused by faulty manual operation of flood-control basins.

Provide, without cost of the United States, all lands, easements, and rights-of-way necessary for the construction of the extension of the project and assume the cost of the relocation of highways and highway bridges required in the extension of the project.

Contribute in advance, and as directed by the Chief of Engineers, United States Army, 40 percent of the construction cost of certain specified items of the general plan.

That the United States pay all other costs and perform all other work entailed in connection with the construction, maintenance, and operation of the existing project and extension thereof.

That all items in the extension of the existing project be executed in accordance with plans to be approved by the Chief of Engineers, United States Army, and in the order directed by him.

That the United States operate and maintain all flood-control works of the existing project and extension thereof under the direction of the Secretary of War and supervision of the Chief of Engineers.

That those items, upon which local contributions of 40 percent of construction costs are required, be constructed only if and when local contributions are made.

That Federal funds be made available in allotments of not less than $20,000,000 per annum.

WAR DEPARTMENT,
UNITED STATES ENGINEER OFFICE,
Los Angeles, Calif., February 5, 1940.

Subject: Survey report, flood control, Los Angeles and San Gabriel Rivers and their tributaries, and Ballona Creek, Calif.

To: The Chief of Engineers, United States Army [through the Division Engineer, South Pacific Division].

AUTHORITY

1. This report is submitted in compliance with an item in section 6 of the Flood Control Act approved June 22, 1936, H. R. 8455, which provides for a preliminary examination and survey for flood control of Los Angeles River and tributaries, Calif., and San Gabriel River and tributaries, Calif.

2. A report on preliminary examination, dated April 23, 1938, was submitted in accordance with the above act and in accordance with an act approved March 6, 1936, H. R. 7147, which latter act provides for a preliminary examination of the Los Angeles and San Gabriel Rivers and their tributaries. The report was reviewed by the Board of Engineers for Rivers and Habors, and pursuant to the recommendation of the Board to the Chief of Engineers a survey was authorized on September 30, 1938. A survey report was submitted to the Chief of Engineers under date of March 15, 1939, in compliance with the foregoing acts, which report was returned by the Chief of Engi-

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neers for revision upon recommendation of the Board of Engineers for Rivers and Harbors.

3. Ballona Creek Basin is considered in this report for the following reasons. Section 5 of the act of June 22, 1936, authorized the construction of reservoirs and principal flood channels on the Los Angeles and San Gabriel Rivers, Calif. This act was amended by an act approved May 15, 1937, S. 1571, which changed the project title to read, "Los Angeles County Drainage Area, Calif.," and changed the text to read, "Construction of reservoirs and principal flood channels in Los Angeles and San Gabriel Rivers and Ballona Creek and tributaries thereof." In view of the inclusion of Ballona Creek in the existing project and since the Flood Control Act of June 28, 1938, authorized report thereon under title "Streams in Los Angeles and Ventura Counties draining the Santa Monica Mountains, Calif., directly into the Pacific Ocean," it is considered more appropriate to include that basin in this survey report. This procedure avoids inclusion of an item of the existing project in a preliminary examination report and preserves the geographical grouping of the existing project streams herein discussed.

PRIOR REPORTS

4. A preliminary examination and survey of Los Angeles and Long Beach Harbors, Calif., and their tributary waters, with a view to the protection of the harbors from silt deposits, called for by the River and Harbor Act of July 25, 1912, was made and published in House Document 462, Sixty-fourth Congress, first session. A further report on this subject, "Reconsideration and Modification of Preliminary Examination and Survey of Los Angeles and Long Beach Harbors, Calif.," authorized by the River and Harbor Act of July 17, 1916, was made and published in House Document 9, Sixty-fourth Congress, second session. The Los Angeles and San Gabriel Rivers and the Rio Hondo were considered in both reports. Based on these reports a project was adopted for the diversion of the Los Angeles River outside of and to the east of Los Angeles and Long Beach Harbors and completed in 1923.

5. A flood-control report dated May 22, 1935, upon an application made under the provisions of the Federal Emergency Relief Appropriation Act of 1935 by the Los Angeles County Flood Control District, was submitted by the district engineer. This report was the basis for the adoption of 14 flood-control projects for unemployment relief.

6. Numerous investigations and surveys of the area for flood control, water supply, and other purposes have been made by the Los Angeles County Flood Control District, by local agencies, and by interested persons. A list of these reports, including a brief description of their contents is presented in enclosure 3.[1]

DESCRIPTION

7. *Location.*—The drainage basins of the Los Angeles and San Gabriel Rivers and Ballona Creek are in southwestern California, principally within Los Angeles County. Small portions extend into the adjacent counties of Ventura, San Bernardino, and Orange. The drainage area, 1,717 square miles, extends southerly from the Santa

[1] Not printed.

Susana and San Gabriel Mountains, Sierra Madre Range, to the Pacific Ocean. The eastern boundary lies in the Puente Hills and the western boundary in the Santa Monica Mountains and Simi Hills.

8. *Climate.*—The climate is subtropical and semiarid. Normal annual maximum, minimum, and average temperatures from the 61-year record of the Los Angeles office of the United States Weather Bureau are 73°, 53°, and 63°, respectively. The average annual precipitation varies from about 10 inches near the coast to about 40 inches near the crest of the mountains. Approximately 80 percent of the annual precipitation falls during the 4-month period from December to March. On an average there are only 38 days a year during which precipitation occurs in a measurable amount. Mean relative humidity at Los Angeles averages 77 percent at 5 a. m. and 61 percent at 5 p. m. The maximum wind movement recorded by the United States Weather Bureau is 38 miles per hour and the average is 6.1 miles per hour.

9. *Topography.*—The upper portion of the area, lying within the Santa Susana and San Gabriel Mountains, is rough and broken, with the terrain cut by many steeply sloping canyons. Between the base of the major mountain range and the northern edge of the coastal plain there are two distinct foothill ranges which traverse the western part of the area in a general east and west direction, roughly paralleling the Sierra Madres. The most northerly of these is made up of the Verdugo Mountains and the San Rafael Hills; the other consists of the Hollywood spur of the Santa Monica Mountains extending into the area from the west. In the eastern part of the area there are two similar ranges, the San Jose Hills and an extension of the Puente Hills. Between the northern edge of the coastal plain and the Pacific Ocean there are several smaller hills, among which are the Baldwin and Dominguez Hills and the Palos Verdes (San Pedro) Hills. Of these, the latter are the most important as they have influenced the shore line along the southern boundary of the area.

10. The major topographic divisions may be classified as follows:

Major topographic divisions, drainage basins of the Los Angeles and San Gabriel Rivers and Ballona Creek

County	Mountain area	Foothill and valley area	Coastal plain area	Total
	(*Square miles*)	(*Square miles*)	(*Square miles*)	(*Square miles*)
Los Angeles	705	447	416	1,568
Orange	0	42	84	126
Ventura	11	0	0	11
San Bernardino	12	0	0	12
Total	728	489	500	1,717

11. Elevations of the drainage areas range from sea level to 10,080 feet at the summit of Mount San Antonio in the northeast. The mountains in the northern limits of the area decrease in elevation to approximately 3,000 feet in the northwest, the general altitude varying between 5,000 and 7,000 feet. The slopes of the mountains from base to summit average about 1,000 feet per mile, and the stream channels consequently are steep, with gradients varying from 8 to 40 percent.

Through the valley areas the land slopes are high, averaging approximately 50 feet per mile. The stream channels and washes have about the same gradients. The coastal plain area is relatively flat, having an average gradient of about 0.2 percent.

12. *Geology and soils.*—Before the Tertiary period the whole region passed through a long process of peneplanation until it became an area of low relief. During the Tertiary period the area was covered to a great depth by marine deposits. The two youngest of the series of marine deposits, the Puente and Fernando formations, are placed in the Miocene and Pliocene periods respectively. During and after deposition of the Puente formations there were earth movements of great magnitude, and the most severe folding of the Puente Hills occurred toward the end of the Pliocene period. However, the main orogenic movement occurred later when the tilted block of the San Gabriel Mountains was thrown up along the San Gabriel Fault; the Puente and Fernando formations were moderately folded by a major uplift along the Whittier Fault, the granitic mass of the Verdugo Mountains being thrown up to the west and the San Jose Hills to the east.

13. The mountain slopes and canyons are composed principally of disintegrated igneous rock which is readily erodible where it is not protected by forest covering. The thin soils of these areas and the lack of rainfall during the greater portion of the year limit vegetation to a sparse growth consisting principally of live oak and chaparral. During the dry months these growths, averaging 4 to 10 feet in height, become subject to fires. After a fire the soil is exposed to erosion, and from 3 to 5 years is required for a regrowth of the brush cover.

14. The valley areas are pervious alluvial deposits of silt, sand, and gravel of great depth, underlain and surrounded by relatively impervious rock, principally crystalline, metamorphic, and igneous. The coastal plain is similar in composition to the valleys, but the deposits are less coarse and are interspersed with fine sand and clay. The soils of the valley and coastal plain areas consist mainly of sandy and clay loams which are usually very fertile. Natural growths are prairie grass, sagebrush, chaparral, oaks, and, along the watercourses, willow trees. Walnuts, citrus fruits, and a wide variety of general farm crops are cultivated in the irrigated areas, and forage crops susceptible to dry farming are grown where water for irrigation is lacking.

15. *Population.*—The present population of the drainage areas of of the Los Angeles and San Gabriel Rivers and Ballona Creek is estimated at 2,400,000, of which about 88 percent is urban and 12 percent rural. Because of the rapid influx of people to southern California since the last general census in 1930, estimates of the present population are considered roughly approximate. There are 44 incorporated cities within the area, with a combined population in 1930 of 1,925,775. The largest is the city of Los Angeles (population, 1,360,000—1939 estimate, Los Angeles chamber of commerce) which has the greatest area of any city in the United States.

16. The general distribution of population is shown on page 2 [1] of enclosure 1. The growth of population in Los Angeles County during the period 1880 to 1938 is indicated by the following tabulation taken from the United States Census, with the exception of 1938, which is an estimate of the Los Angeles Chamber of Commerce.

[1] Not printed.

Population of Los Angeles County

Year:	Population	Year:	Population
1880	33, 381	1920	936, 455
1890	101, 454	1930	2, 208, 492
1900	170, 298	1938	2, 450, 000
1910	504, 131		

17. *Production activities.*—Natural resources consist principally of petroleum, natural gas, and highly productive agricultural land. Of secondary importance are stone, clays, and mineral waters. The mild climate attracts a large number of tourists whose trade is an important source of income.

18. The major productive activities in the area are petroleum production and refining, motion-picture production, airplane production, automobile assembling, miscellaneous manufacturing, and agriculture. The gross return from industrial activity amounted to more than $1,350,000,000 in 1937, and from agricultural production more than $76,000,000 in 1938. Bank debits in the city of Los Angeles were over $9,787,000,000 in 1938, a weekly average of about $188,200,000. The gross assessed valuation for Los Angeles County in 1938 was $3,024,239,435, which represents a true value of about $5,600,000,000. Statistical details for Los Angeles County are given in enclosure 2.[1]

19. *Lines of communication.*—Transcontinental rail facilities are provided by three major lines: The Atchison, Topeka, and Santa Fe Railway, the Southern Pacific Co., and the Union Pacific Railroad. Two electric railways and various bus lines furnish local service. An extensive system of National and State highways and a well-improved secondary-road system permit easy access to all parts of the area. Transcontinental and local truck and bus lines furnish important additions to the transportation facilities.

20. Four major airports and numerous smaller ones provide landing fields for a growing number of private and commercial aircraft. Four transcontinental and two west coast air lines operate from Los Angeles under about 30 daily schedules. Principal highways, railroad lines, and airports are shown on page 3[1] of enclosure 1.

21. The combined harbor of Los Angeles and Long Beach is noted as one of the largest artificial ports in the world. Adequate terminal and transfer facilities are provided for foreign and domestic commerce. For the fiscal year July 1, 1937, to June 30, 1938, the commerce passing through the port amounted to 22,661,126 tons valued at $1,040,855,422.

22. *Streams—general.*—Four major streams and numerous tributaries drain the area. The major streams are the Los Angeles and San Gabriel Rivers, their interconnecting stream the Rio Hondo, and Ballona Creek. The first two have their sources in the high mountains forming the northern boundary of the area; the last two are confined to the foothills and coastal plain. During major storms, large areas in each stream basin, shown on page 2[1] of enclosure 1, are subject to damage from floods.

23. *Los Angeles River.*—The Los Angeles River is formed by the confluence of Calabasas Creek and Bell Creek, which have their sources in the Simi Hills and the Santa Monica Mountains near the

[1] Not printed.

Los Angeles-Ventura County line. The main stream flows southeasterly for about 20 miles along the south side of the San Fernando Valley and thence through the narrows between the Santa Monica Mountains and the San Rafael Hills where it turns south and flows about 30 miles, entering the Pacific Ocean through a diversion channel in the city of Long Beach immediately east of the breakwater of Los Angeles and Long Beach Harbors. The river channel traverses the agricultural and residential sections of San Fernando Valley and the highly developed industrial districts of the city of Los Angeles.

24. The main channel of the Los Angeles River is approximately 50 miles long, and its tributaries have an aggregate length of about 225 miles. The principal tributaries in downstream order are Bell Creek, Calabasas Creek, Brown's Canyon Creek, Aliso Creek, Caballero Creek, Bull Creek, Encino Creek, Pacoima Wash, Tujunga Wash, Studio City Wash, Burbank Wash (west), Burbank Wash (east), Verdugo Wash, Sycamore Wash, Arroyo Seco, Rio Hondo, Compton Creek, and Laguna Dominguez, formerly Nigger Slough. This last name was changed by the Board of Supervisors of Los Angeles County. Since completion of the Los Angeles River diversion channel, Laguna Dominguez has emptied into Los Angeles Harbor.

25. The drainage area of the Los Angeles River excluding the Rio Hondo is 753 square miles, or approximately 44 percent of the area considered in this report. The topographic divisions are as follows:

Major topographic divisions of the Los Angeles River Basin

Topographic division—	*Square miles in Los Angeles County*
Mountain area	[1] 283
Foothill and valley area	285
Coastal plain area	[2] 185
Total	753

[1] Includes 1[illegible] square miles in Ventura County.
[2] Includes Laguna Dominguez, 72 square miles, now excluded by levee of Los Angeles River diversion channel which is located to the east.

26. *San Gabriel River.*—The San Gabriel River is formed by the confluence of its East and West Forks in the San Gabriel Mountains in the northeastern part of the drainage area. The source of the East Fork is at elevation about 10,000 feet and that of the West Fork about 7,000 feet. At the base of the mountains near the city of Azusa the main stream has an elevation of 1,000 feet above sea level. After leaving the mountains the river flows over its alluvial cone in a poorly defined channel. About 3 miles below Azusa the deposit of sand, gravel, and boulders has divided the channel into two branches. The branch to the west is known as the Rio Hondo, tributary to the Los Angeles River. The branch to the east continues as the San Gabriel River in a southerly direction through Whittier Narrows, emptying into the Pacific Ocean through the present outlet channel of Alamitos Bay about 6 miles east of the mouth of the Los Angeles River. Above Whittier Narrows the main stream flows through a highly developed agricultural community. Below the narrows the area is relatively well developed and suited to general agriculture, except for the lower 5 to 8 miles which is mostly marsh and overflow land.

27. The length of the San Gabriel River is approximately 58 miles, including its headwater tributary, East Fork. The principal tributaries, in downstream order, are West Fork, East Fork, Roberts Canyon, Fish Canyon, Walnut Creek, San Jose Creek, Sycamore Canyon, and Coyote Creek.

28. The drainage area of San Gabriel River is 698 square miles, or about 41 percent of the area considered in this report. The topographic divisions are as follows:

Major topographic divisions of the San Gabriel River Basin

Topographic division	Square miles in Los Angeles County	Square miles in Orange County	Total square miles
Mountain area	[1] 270	.....	270
Foothill and valley area	206	42	248
Coastal plain area	96	84	180
Total	572	126	698

[1] Includes 12 square miles in San Bernardino County.

29. *Rio Hondo.*—The Rio Hondo, although a tributary of the Los Angeles River, connects with the San Gabriel River. It receives most of its flow from the latter, but also drains the adjacent area to the north and northwest of its own channel and in time of flood may carry more water than the San Gabriel River.

30. Branching from the San Gabriel River about 3 miles below the canyon mouth, the Rio Hondo flows in a southerly direction for 8 miles, passing through Whittier Narrows about 1 mile west of the present San Gabriel River channel, and thence southwesterly for a distance of 12 miles where it joins the Los Angeles River at a point 12 miles from the ocean. The course of the stream is through areas the development of which is similar to that along the San Gabriel River.

31. The length of the Rio Hondo is approximately 20 miles, and the aggregate length of its tributaries about 60 miles. The principal tributaries in downstream order are Bradbury Canyon wash, Spinks Canyon wash, Sawpit wash, Santa Anita wash, Arcadia wash, Eaton wash, Rubio wash, and Alhambra wash.

32. The normal drainage area of the Rio Hondo is 137 square miles, or about 8 percent of the area considered in this report. The topographic divisions are as follows:

Major topographic divisions of the Rio Hondo Basin

Topographic division:	*Square miles in Los Angeles County*
Mountain area	37
Foothill and valley area	94
Coastal plain area	6
Total	137

33. *Ballona Creek.*—Ballona Creek and its tributaries drain the area on the western edge of the Los Angeles River Basin between the Santa Monica Mountains and the Pacific Ocean. The main stream is entirely within the coastal plain, but the numerous tributaries con-

centrate the run-off from the mountains and foothills to the north. Most of the drainage basin is highly developed urban and suburban area.

34. The length of the main channel of Ballona Creek is approximately 9 miles. Storm drains constructed in this area have replaced and modified to a considerable extent the natural drainage channels of the tributaries. The major improved channels that discharge into Ballona Creek, in downstream order, are Arroyo de los Jardines, La Cienega storm drain, Jefferson and Adams storm drain, Slauson storm drain, Benedict Canyon storm drain, Sawtelle-Westwood storm drain (from Sepulveda Canyon), and Centinela Creek.

35. The total drainage area of Ballona Creek is 129 square miles, or about 7 percent of the area under consideration. The topographic divisions are as follows:

Major topographic divisions of the Ballona Creek Basin

Topographic division:	*Square miles in Los Angeles County*
Mountain area	30
Foothill and valley area	13
Coastal plain area	86
Total	129

36. *Bridges.*—In common with all highly developed districts, the stream channels are spanned by many railroad and highway bridges and utility crossings. Prior to the flood of March 1938, the 4 major stream channels were crossed by 152 bridges, 81 of which were on the Los Angeles River, 33 on the San Gabriel River, 19 on the Rio Hondo, and 19 on Ballona Creek. The map on page 4 [1] of enclosure 1 shows the location of these bridges and indicates their condition after the flood. Damage to bridges by the flood was extensive, amounting to complete demolition in a number of cases.

37. Throughout the area there is a total of about 900 bridges and culverts, including those mentioned above. A complete list of bridges is given in enclosure 4.[1] About half of the bridges are involved in proposed flood-control improvements and are discussed further in enclosures 7 [1] and 8.[1]

EXISTING PROJECT

38. The Flood Control Act approved June 22, 1936 (H. R. 8455), amended by the act approved May 15, 1937 (S. 1571), authorized:

Construction of reservoirs and principal flood channels "in Los Angeles and San Gabriel Rivers and Ballona Creek and tributaries thereof," in accordance with plans to be approved by the Chief of Engineers on recommendation of the Board of Engineers for Rivers and Harbors at an estimated construction cost not to exceed $70,000,000; estimated cost of lands and damages, $5,000,000.

The act of June 22, 1936, provides:

SEC. 3. That hereafter no money appropriated under authority of this Act shall be expended on the construction of any project until States, political subdivisions thereof, or other responsible local agencies have given assurances satisfactory to the Secretary of War that they will (a) provide without cost to the United States all lands, easements, and rights-of-way necessary for the construction of the project, except as otherwise provided herein; (b) hold and save the United States free from damages due to the construction works; (c) maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of War: *Provided*, That the construction of any dam authorized herein may be

[1] Not printed.

undertaken without delay when the dam site has been acquired and the assurances prescribed herein have been furnished, without awaiting the acquisition of the easements and rights-of-way required for the reservoir area: *And provided further*, That whenever expenditures for lands, easements, and rights-of-way by States, political subdivisions thereof, or responsible local agencies for any individual project or useful part thereof shall have exceeded the present estimated construction cost therefor, the local agency concerned may be reimbursed one-half of its excess expenditures over said estimated construction cost: *And provided further*, That when benefits of any project or useful part thereof accrue to lands and property outside of the State in which said project or part thereof is located, the Secretary of War with the consent of the State wherein the same are located may acquire the necessary lands, easements, and rights-of-way for said project or part thereof after he has received from the States, political subdivisions thereof, or responsible local agencies benefited the present estimated cost of said lands, easements, and rights-of-way, less one-half the amount by which the estimated cost of these lands, easements, and rights-of-way exceeds the estimated construction cost corresponding thereto: *And provided further*, That the Secretary of War shall determine the proportion of the present estimated cost of said lands, easements, and rights-of-way that each State, political subdivision thereof, or responsible local agency should contribute in consideration for the benefits to be received by such agencies: *And provided further*, That whenever not less than 75 per centum of the benefits as estimated by the Secretary of War of any project or useful part thereof accrue to lands and property outside of the State in which said project or part thereof is located, provision (c) of this section shall not apply thereto; nothing herein shall impair or abridge the powers now existing in the Department of War with respect to navigable streams: *And provided further*, That nothing herein shall be construed to interfere with the completion of any reservoir or flood control work authorized by the Congress and now under way.

The act of June 22, 1936, was amended by section 2 of the act approved June 28, 1938, reading as follows:

SEC. 2. That section 3 of the Act of June 22, 1936 (Public Numbered 738, Seventy-fourth Congress), as heretofore amended and as herein further modified, shall apply to all flood-control projects, except as otherwise specifically provided by law.

That in case of any dam and reservoir project, or channel improvement or channel rectification project for flood control, herein authorized or heretofore authorized by the Act of June 22, 1936 (Public Numbered 738, Seventh-fourth Congress), as amended, and by the Act of May 15, 1928 (Public Numbered 391, Seventieth Congress), as amended by the Act of June 15, 1936 (Public Numbered 678, Seventy-fourth Congress), as amended, title to all lands, easements, and rights-of-way for such project shall be acquired by the United States or by States, political subdivisions thereof or other responsible local agencies and conveyed to the United States, and provisions (a), (b), and (c) of section 3 of said Act of June 22, 1936, shall not apply thereto. Notwithstanding any restrictions, limitations, or requirement of prior consent provided by any other Act, the Secretary of War is hereby authorized and directed to acquire in the name of the United States title to all lands, easements, and rights-of-way necessary for any dam and reservoir project or channel improvement or channel rectification project for flood control, with funds heretofore or hereafter appropriated or made available for such projects, and States, political subdivisions thereof, or other responsible local agencies, shall be granted and reimbursed, from such funds, sums equivalent to actual expenditures deemed reasonable by the Secretary of War and the Chief of Engineers and made by them in acquiring lands, easements, and rights-of-way for any dam and reservoir project, or any channel improvement or channel rectification project for flood control heretofore or herein authorized: *Provided*, That no reimbursement shall be made for any indirect or speculative damages: *Provided further*, That lands, easements and rights-of-way shall include lands on which dams, reservoirs, channel improvements, and channel rectifications are located; lands or flowage rights in reservoirs and highway, railway, and utility relocation.

The above acts form the basis of the existing Federal flood control project, which will be referred to in this report as the existing project. Portions of the existing project have been completed, some parts are now in various stages of construction, and work on other units has

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not yet been started. The project has now progressed to the state that the following estimate of the items that will be completed under existing authorization may be considered fairly accurate:

Existing project Los Angeles and San Gabriel Rivers and their tributaries and Ballona Creek, Calif., estimated costs

Project item	Construction	Public utilities	Bridges	Lands and rights-of-way	Project subtotals	Basin totals	Percent complete Jan. 1, 1940
	1	2	3	4	5	6	
LOS ANGELES RIVER BASIN							
Hansen Flood Control Basin	$8,500,000	$480,000		$1,400,000	$10,380,000		82
Sepulveda Flood Control Basin	4,000,000	364,000		2,457,000	6,821,000		0
Los Angeles River Channel—Niagara St. to Stewart and Gray Road	41,355,612	1,199,334	$1,783,855	725,706	45,067,507		54
Lond Beach Blvd	34,244				34,244		100
Haines Canyon	520,423	3,110		103,233	626,766		100
Sycamore Canyon	23,546			4,439	27,985		100
Verdugo Wash	588,519	21,989	260,367	216,438	1,087,313		100
Compton Creek	1,892,649	30,403	678,509	239,996	2,841,562		100
Surveys and Engineering	396,206				396,206		
Totals, Los Angeles River Basin	57,311,199	2,098,841	2,725,731	5,146,902	67,282,673	67,282,673	
SAN GABRIEL RIVER BASIN							
Santa Fe Flood Control Basin	8,899,000	50,000		1,068,000	10,017,000		0
San Gabriel River Channel—San Gabriel Canyon to Santa Fe Flood Control Basin	1,720,000	12,000	204,000	150,000	2,086,000		0
Totals, San Gabriel River Basin	10,619,000	62,000	204,000	1,218,000	12,103,000	12,103,000	
RIO HONDO BASIN							
Alhambra Wash	1,017,586	34,902	61,905	91,220	1,205,613		100
Totals, Rio Hondo Basin	1,017,586	34,902	61,905	91,220	1,205,613	1,205,613	
BALLONA CREEK BASIN							
Ballona Creek Channel	752,215	91,165	412,141	394,579	1,650,100		100
Ballona Creek Jetties	300,000				300,000		60
Totals, Ballona Creek Basin	1,052,215	91,165	412,141	394,579	1,950,100	1,950,100	
Totals, existing project	70,000,000	2,286,908	3,403,777	6,850,701		82,541,386	

39. The total Federal cost of the existing project to January 1, 1940, was $37,539,896, of which $11,009,373 was from E. R. A. funds and $26,530,523 was from regular funds. Local contributions reimbursable by the United States amounting to $459,703 bring the Federal costs and audited obligations up to $37,999,599. The $12,385,959 remaining from fiscal year 1940 appropriations will be expended or obligated before the end of the fiscal year. The total estimated cost of the existing project, including the costs of rights-of-way, bridges, and public utilities, is $82,540,000.

EXISTING IMPROVEMENTS

40. *General.*—Various local agencies have made extensive improvements in the area for the alleviation of the flood menace and for water conservation. The accomplishments of these agencies and Federal participation in this work are discussed briefly in the following paragraphs.

41. *Los Angeles County Flood Control District.*—The Los Angeles County flood-control district was organized under authority of the Los Angeles County Flood Control Act, a State law enacted in 1915. The district defined by the above act includes the entire drainage area considered in this report except the small portions lying in Orange, San Bernardino, and Ventura Counties. The State act provides for the preparation of comprehensive plans for flood control and water conservation, for the construction of improvements for such purposes, and for cooperation with other agencies.

42. A comprehensive plan of development was prepared by the flood-control district, and until 1935 all major flood-control and water-conservation projects were constructed in accordance with the plan with the exception of the Los Angeles River diversion channel, which was constructed by the Federal Government in cooperation with the flood control district, at a cost of $1,400,000 to the Federal Government and $1,600,000 to the Flood Control District. This channel was constructed through the city of Long Beach in order to eliminate silting of the Los Angeles and Long Beach Harbors. Upon completion of the construction in 1923, the diversion channel was turned over to the flood-control district for maintenance. Since 1935 the construction of permanent improvements for flood control has been prosecuted largely by Federal agencies under Federal financing. However, the Los Angeles County Flood Control District, after the passage of the Flood Control Act of June 22, 1936, cooperated actively in its function of providing rights-of-way and assuming responsibility for damages and in maintaining those works which it had constructed. Even after the passage of the Flood Control Act of June 28, 1938, it continued to be of great assistance in securing rights-of-way. The flood-control district has been reimbursed under the provision of the act of June 28, 1938, to the amount of $568,697.98 for expenditures made in connection with the existing project subsequent to the passage of the act of June 22, 1936. Further reimbursements, variously estimated from $2,000,000 to $3,000,000, may be made as funds therefor become available.

43. Improvements made solely by the flood-control district include 12 flood-control dams, two flood-control and debris storage basins, one diversion dam, many miles of channel improvements, debris basins, and the development of several areas as spreading grounds for water conservation. The flood-control district maintains and operates all such works. Pertinent data for the dams are given in exhibit 29 of enclosure 6,[1] and their locations are shown on page 1 of enclosure 1. The total expenditure from local funds for all work, including maintenance and operation, to December 1, 1939, was approximately $68,800,000. Of the total local expenditure of $68,800,000, the expenditure for maintenance and operation was about $11,000,000, leaving a total capital investment of $57,800,000. Some parts of the work constructed with this capital investment

[1] Not printed.

may be considered temporary channel improvement made for the immediate alleviation of the flood menace, with the expectation that permanent improvements would be constructed at a later date. The temporary channel work was chiefly 25 miles of pile and wire fence and 70 miles of pipe and wire fence. Data are not available for the exact cost of the temporary channel fencing, but an approximate estimate is $2,400,000. Subtracting the approximate cost of the temporary work from the $57,800,000 total capital investment leaves a balance of $55,400,000, which may be considered to represent the capital investment in permanent work by the Los Angeles County Flood Control District. Although a small part of this investment might be credited to water conservation, by far the greater part represents flood control.

44. *Los Angeles County engineer's office.*—Prior to 1933 this agency spent about $6,800,000 of local funds, almost all of which was spent between 1923 and 1932. From 1933 to 1935 about $680,000 was spent, $270,000 of which was from local funds and $410,000 from the Reconstruction Finance Corporation, the Civil Works Administration and the State Emergency Relief Administration. The State was the major contributor. From October 1935 to January 1940 this agency has expended about $900,000 sponsoring Work Projects Administration construction entailing an expenditure of $10,400,000 of Federal funds. The county engineer's office is therefore accredited with an expenditure of $7,970,000 of local money and $10,810,000 from other sources, a total of $18,780,000. These expenditures do not include sewers and small drains. The improvements were principally storm drains.

45. *City of Los Angeles.*—Prior to 1933 the city had constructed about 522 miles of storm drains within its limits at a cost of about $26,900,000, entirely from local funds. About 85 percent of this work was done between 1923 and 1933. From 1933 to 1935 the city spent about $4,500,000, of which about $600,000 was from local funds and $3,900,000 from the Reconstruction Finance Corporation, the Civil Works Administration, the State Emergency Relief Administration, and the Los Angeles County Relief Administration. The State and county were the major contributors, with a total contribution of about $2,300,000. From October 1935 to January 1940 the city has spent about $1,900,000 in sponsoring Work Projects Administration construction entailing an expenditure of about $20,800,000 of Federal money. The city has therefore expended about $29,400,000 of local money and $24,700,000 from other sources, a total of $54,100,000.

46. *Other cities.*—The cities of Glendale, Pasadena, and Long Beach have records of expenditures for similar work totaling about $2,200,000 from local funds prior to about 1933. The other smaller towns have also expended appreciable sums, records of which are not available at this time. There are also no records available of expenditures for emergency relief work prior to the establishment of the Work Projects Administration in 1935, but, up to January 1940, the smaller cities in this basin have spent about $1,000,000 sponsoring Work Projects Administration construction which has entailed an expenditure of about $4,700,000 of Federal money. The three cities and the smaller towns of the basin are therefore accredited with an expenditure of $3,200,000 of local funds and $4,700,000 of Federal

funds, a total of $7,900,000, and there have been appreciable additional expenditures of which there are no records available.

47. *Federal agencies.*—The Federal Government has participated from time to time in the planning and construction of improvements for flood control in the area, or in improvements partly relating to flood control. Prior to 1935 such participation was in connection with improvements for navigation.

48. In 1935, upon application by local interests, allotments of Federal funds were made under authority of the Emergency Relief Appropriation Act of April 8, 1935, for the construction of flood-control works consisting of storm drains, permanent channel improvements, debris basins, and one combination flood-control dam and debris-storage basin. Further allotments were made under subsequent acts for unemployment relief, and this work was continued by Federal agencies in cooperation with local interests. The principal Federal agencies involved were the War Department and the Work Projects Administration.

49. The following table includes data pertaining to the flood control projects supervised by the War Department in the area considered in this report. A number of these projects were later included in the existing project discussed in paragraphs 38 and 39.

Cost of flood control improvements sponsored by War Department, Corps of Engineers, authorized by the Emergency Relief Act of April 8, 1935, and subsequent emergency relief acts—Federal costs are those prior to existing project

Project and stream	Total Federal cost	Local contributed funds [1]
LOS ANGELES RIVER		
Los Angeles River Channel:		
Section 14-A (Randolph St. to Stewart and Gray Rd.)	$1,257,819.96	$7,041.68
Section 29 (Lankershim to Fletcher)	2,126,747.46	70,606.09
Fletcher to Dayton	82,280.82	
Haines Canyon, channel and debris basin	582,294.24	148,711.52
Dunsmuir Canyon, channel and debris basin	456,728.22	116,628.76
Shields Canyon, channel and debris basin	119,117.68	30,421.88
Eagle-Goss Canyons, channel and debris basin	496,632.86	126,854.99
Snover-Weber Canyons, channel and debris basin	207,429.07	52,961.42
Verdugo Wash, channel (below upper Canada Bridge)	1,783,594.55	1,515,460.04
Sycamore Wash, channel	194,696.05	
Hay and Winery Canyon, channel and debris basin	346,134.71	88,391.06
Compton Creek, channel	949,908.93	528,225.72
Long Beach, northeast drainage system	238,803.82	51,245.23
RIO HONDO		
Eaton Canyon, flood control and debris basin	551,140.50	423,062.31
Rubio Wash, channel	926,048.23	321,887.48
Alhambra Wash, channel	1,076,682.45	374,393.48
BALLONA CREEK		
Ballona Creek, channel	4,161,010.84	1,087,391.10
Arroyo de los Jardines, storm drain	206,872.22	32,993.35
Total	15,763,942.61	4,976,296.08

[1] Does not include cost of rights-of-way. Includes all local contributed funds to Mar. 1, 1939. Of the total, $3,971,955.46 was contributed to the relief projects and $1,004,340.62 was contributed to the existing project.

50. *Summary.*—Approximately $203,000,000 has thus been expended in these basins for protection from floods and storm waters, by means of flood-control works and storm drains, and to a minor extent for water conservation which appears as a small part of the expenditure

of the Los Angeles County Flood Control District. Approximate estimates of the costs to the various agencies are summarized in the following table:

Cost of flood control and storm drain improvements in the basins of Los Angeles and San Gabriel Rivers and Ballona Creek to Jan. 1, 1940

Agency	Amount and source of expenditures			
	Local	Work Projects Administration	Other Federal, State, and county relief agencies	Total
United States Engineer Department:				
Relief projects prior to existing project	.....	.....	.....	$15,800,000
Existing project	.....	.....	.....	37,500,000
Total U. S. Engineer Department	.....	.....	.....	53,300,000
Los Angeles County Flood Control District	$68,800,000	$500,000	.....	69,300,000
City of Los Angeles	29,400,000	20,800,000	$3,900,000	54,100,000
Los Angeles County engineer's office	8,000,000	10,400,000	400,000	18,800,000
Other cities and towns (not complete)	3,200,000	4,700,000	.....	7,900,000
Total	109,400,000	36,400,000	4,300,000	203,400,000

IMPROVEMENTS DESIRED

51. On March 31, 1936, a public hearing was held at Los Angeles to ascertain the extent and character of flood-control improvements desired by local interests. This hearing was attended by about 150 persons, including officials of Federal agencies, the city of Los Angeles, the county of Los Angeles, the Los Angeles County Flood Control District, and various civic organizations, as well as by the general public. Concerning flood control, the hearing disclosed that local interests desire protection from floods in the drainage basins of Los Angeles and San Gabriel Rivers and Ballona Creek by the construction of adequate channel improvements, flood-control basins, and debris basins. They request that, where practicable, water conservation be coordinated with flood control.

52. Local interests believe that numerous areas, some of which are highly developed, will be left unprotected from floods after the completion of the works now authorized. The extent and character of specific measures for flood control were outlined briefly by local interests at the hearing. Local interests' revised general plan includes 54 items which they estimate will cost approximately $237,000,000. These items have been considered in the preparation of the plan of improvement recommended in this report. (See enclosures 7 and 8.)[1]

FACTORS CONSIDERED

53. *Precipitation and run-off.*—Precipitation at Los Angeles has been recorded by the United States Weather Bureau since 1877. Between 1877 and 1917, the records within the area considered in this report were restricted to coastal plain, valley, and foothill stations with the exception of the records at Echo Mountain, Colby Ranch, and Mount Wilson, which have been kept since 1895, 1897, and 1904,

[1] Not printed.

respectively. Since 1917, the number of precipitation stations has increased until records are now regularly maintained at more than 300 stations, of which 125 are in the mountainous areas. Automatic recording rain gages have been installed at 59 stations.

54. An extensive study of rainfall was made by using all available precipitation data from stations within and in the vicinity of the area, and in addition the long-term records for San Diego, Santa Barbara, and Sacramento. Enclosure 6[1] gives the basic rainfall data, the methods of analysis, and estimates of flood flows. The 64-year mean seasonal precipitation for the period 1872 to 1936 was computed for key stations, which are shown on an isohyetal map, exhibit 17, enclosure 6.[1] The mean annual precipitation is approximately 13.5 inches on the coastal plain, 18 inches in the valleys and foothills, and 28 inches in the mountains.

55. The location of the mountainous sections of the drainage basins, with reference to the general direction in which storms advance, has resulted in very high maximum precipitation intensities. A maximum intensity of 1.03 inches per minute has been recorded at Opid's Camp in the San Gabriel Mountains. Recorded daily maxima for the coastal plain, foothill, and mountain areas are, respectively, 5.88 inches (Los Angeles), 8.50 inches (Glendora), and 17.55 inches (Kelly's Camp). The maximum rainfall of 62.9 inches for a calendar year was recorded at Glendora in 1884. The maximum rainfall of 89.33 inches for the water-year occurred at Opid's Camp during the year ending in the summer of 1922.

56. In 1895, the United States Geological Survey began recording run-off from the mountainous area of the San Gabriel River Basin. Additional gaging stations were subsequently installed, and since 1917, discharge records for many mountain streams in the area have been obtained by both the United States Geological Survey and the Los Angeles County Flood Control District. More recent records and single measurements have been obtained at scattered points along the main stream channels in the valleys and coastal plain. The gaging stations are located and listed in enclosure 6.[1]

57. Unfortunately the run-off data obtained from stream gages do not include records of great floods. It was, therefore, necessary to investigate rainfall-run-off relations and develop flood hydrographs by other means, with the available run-off data for guidance. (See enclosure 6.[1])

58. *Flood records.*—A history of floods in southern California has been compiled for the period 1811–1938, inclusive. This record indicates that at least 21 destructive floods have occurred during the 128-year period. A brief history of these floods, including the recent destructive flood of March 1938, is presented in enclosure 5.[1]

59. The magnitude of the respective floods is not known except that of the March 1938 flood. The magnitude of some of the earlier floods has been estimated by local interests from channel profiles, observed high-water marks, and the use of Kutter's formula. (See table, par. 62.) The approximate magnitude of other past floods was estimated from the historical description of the respective floods, rainfall indices when available, and by noting whether the magnitude of a given flood appeared to be greater or less than that of the floods of which the approximate magnitude was known.

[1] Not printed.

60. During the flood of 1815, the Los Angeles River changed its course from the general location of its present channel by turning west in the vicinity of what is now downtown Los Angeles and flowing into the ocean by way of the present Ballona Creek. Ten years later, the flood of 1825 caused the stream to return to its original southerly course. Since then numerous minor changes have occurred in the channel alinement, but in general the stream has held continuously to its present course, even during the great flood of the winter of 1861–62 which appears to have been the greatest of record. This flood caused extensive damage along all streams and their tributaries in the area under consideration.

61. Stream-gaging stations have been maintained for many years by the United States Geological Survey and by the Los Angeles County Flood Control District. During large floods, however, all the main-stream stations have been either destroyed or damaged to an extent that an authentic record of the flood could not be made. All information recorded concerning the magnitudes of the larger floods has been based upon surveys of the stream channels after each flood and upon the river stages as indicated by the location of drift or other high-water marks. Occasionally observations of floating objects were made from which stream velocity was estimated.

62. All available estimates of flood discharges at points along the main channels of three of the major streams in the area are given in the following table:

Flood discharges of the Los Angeles and San Gabriel Rivers and the Rio Hondo

Location	River mile	Drainage area	Crest flow (cubic feet per second)					
			1889	1914	1916	1927	1934	1938
Los Angeles River:		*Sq. mi.*						
Lankershim Blvd. Bridge	36.1	401	.....	[1] 16,780	.....	.....	.....	.....
Dayton Ave	24.0	504	.....	.....	.....	.....	.....	[2] 67,000
Below Main St. Bridge	23.0	500	.....	[1] 31,140	.....	.....	.....	.....
Southern Pacific R. R. bridge	22.6	565	[1] 38,000	.....	.....	.....	.....	.....
Stewart and Gray Rd	13.0	610	.....	.....	.....	.....	[3] 29,400	[2] 63,000
Below mouth of Rio Hondo	12.0	747	.....	.....	.....	.....	[3] 44,000	[2] 75,000
Willow St., Long Beach	3.0	818	.....	.....	.....	[4] 51,200	.....	.....
State St., Long Beach	1.7	818	.....	.....	.....	.....	.....	[3] 99,100
San Gabriel River:								
Near Azusa	38.0	214	.....	.....	[4] 40,000	.....	[3] 18,000	.....
2 miles above mouth of San Gabriel Canyon	37.0	216	.....	[1] 25,260	.....	.....	.....	[3] 56,000
Below mouth of Roberts Canyon	35.0	220	[1] 47,000	[1] 26,680	.....	.....	.....	[3] 43,000
Below Whittier Blvd. Bridge	18.1	450	.....	[1] 16,000	.....	.....	.....	[3] 40,000
Rio Hondo:								
Below Downey Rd	3.5	130	.....	[1] 20,930	.....	.....	.....	[3] 30,000
Stewart and Gray Rd	1.2	137	.....	.....	.....	.....	[5] 16,000	[3] 24,000

[1] Report of the Board of Engineers, flood control, to the Board of Supervisors of Los Angeles County, Calif., submitted July 26, 1915.
[2] Report on engineering aspects, flood of March 1938, U. S. Engineer Office, Los Angeles, Calif., August 1938.
[3] Data from the Los Angeles County Flood Control District.
[4] Bulletin No. 6, San Gabriel Investigations, Department of Public Works, Stat of California, Sept. 30, 1938.
[5] Water Supply Paper No. 766, U. S. Geological Survey, 1934.

63. Floods in Ballona Creek and its tributaries have occurred simultaneously with floods on the Los Angeles River. As has been stated, during the flood of 1815 the Los Angeles River broke through the low divide between the two basins and flowed to the ocean via Ballona Creek. This course was maintained until the flood of 1825

when the Los Angeles River returned to its original channel. Following that period the main channel of Ballona Creek was successively altered by natural erosion, industrial and residential development, and finally by improvement for flood control which was practically completed in 1937. Flood discharges prior to the improvement were not measured, and such estimates as have been made are of little value since they would not indicate the flood crests that may be expected from a given rainfall under present conditions of improved channels. Discharge measurements in the improved channel at Sawtelle Boulevard were obtained during the flood of March 1938, from which a crest flow of 19,200 cubic feet per second was computed.

64. The establishment of gage heights or elevations marking definite flood stages in natural stream channels of the Los Angeles area is extremely difficult. The streams from the mountain areas flow across the alluvial plain in unstable channels, changing their courses frequently in the process of building up the debris cones. In the main channels, flood discharges alter the channel cross sections to such an extent that any relation between stage and discharge which might have been established is soon destroyed.

65. *Flood frequencies.*—Knowledge concerning all the natural factors governing flood occurrences is insufficient to permit accurate predictions of the number of future floods and their corresponding magnitudes. Therefore, the probability of future flood occurrences can be estimated only from a history of past floods, giving due consideration to the possible synchronization of meteorological conditions which would cause floods exceeding those of record. Consequently, for purposes of economic investigation, the probable frequency and relative magnitude of future floods, as given in the following table, are based on the history of past floods.

Estimated frequency of floods in the basins of the Los Angeles and San Gabriel Rivers and Ballona Creek

Character of flood	Number of occurrences in 100 years
Great floods, approaching the probable maximum, covering the entire flood plain in the valleys and extensive areas in the Coastal Plain; causing great damage to property and considerable loss of life	1
Large floods from general storms, inundating all low-lying valley areas and sections of the Coastal Plain adjacent to the stream channels, causing heavy damage and possible loss of life	6
Moderate floods, causing overflow and damage to marginal land along main streams and principal tributaries	10

66. *Extent and character of area subject to floods.*—The probable overflow area is outlined on map 2 [1] of enclosure 1. This area would not be completely flooded by the run-off from any one storm, including the design storm, but because of instability of the natural channels and the relative freedom of flood flows to follow various courses over the debris cones and through the alluvial valleys, the whole area has been and would be damaged one or more times. The total of approximately 325,000 acres within the overflow area is divided among the major stream basins as follows: Los Angeles River Basin, 130,000

[1] Not printed.

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acres; San Gabriel River Basin, 140,000 acres; Rio Hondo Basin 30,000 acres; and Ballona Creek Basin, 25,000 acres. The division of overflow areas among the several basins along their common watersheds is arbitrary, since waters from all the major streams have intermingled during past floods and formed a veritable lake on the Coastal Plain before emptying into the ocean. The present value of land and improvements of the entire overflow area as defined in this report is estimated at more than $1,000,000,000. For various reasons, certain small overflow areas are not included in the total. Enclosure 13 [1] gives estimates of the value of the individual overflow areas.

67. The number of persons residing in the overflow area is estimated at 800,000. No estimate has been made of the number in each of the separate overflow areas of the various basins. A major flood would seriously affect not only those people but everyone within the Los Angeles metropolitan area because of the interruption of industry, power, light, water, and transportation facilities. Due to the large residential areas in the basin being widely separated from the places of business and employment of the inhabitants, the disruption of normal business activity, due to floods which prevent intercommunication, is very serious.

68. In the upper reaches of the Los Angeles River Basin, the overflow area consists mainly of farm land used for growing of citrus fruits, olives, garden truck, and some grain. Many towns in the upper valleys and in the foothills are within the overflow area and subject to extensive damage from debris flows. Large areas in the cities of Burbank and Glendale are exposed to the flood menace, and immediately below, in the flood plain of the Los Angeles River, there are major industrial developments and a large part of the residential and business areas of Los Angeles. The overflow area below Los Angeles includes the towns of Huntington Park, South Gate, Compton, and a portion of the city of Long Beach, as well as agricultural areas, oil fields, and oil refineries. The present value of the overflow area in the Los Angeles River Basin has been estimated at $747,000,000.

69. The upper portion of the overflow area in the San Gabriel River Basin consists principally of highly developed citrus groves. These are representative of extremely valuable agricultural lands and are valued as high as $3,000 an acre. There are several agricultural communities but no large towns in the upper portion of the overflow area. Below Whittier Narrows the area subject to floods includes small towns, truck farms, and petroleum tank farms and refineries. Three highly productive oil fields are affected, the entire extent of one field being within the flood plain. The towns of Bellflower, Artesia, Norwalk, and a portion of the city of Long Beach are in this flood zone. The present value of the overflow area of the San Gabriel River Basin is estimated at $113,000,000.

70. The entire eastern section of the city of Pasadena is subject to flood damage from Eaton and Rubio Washes, tributaries of the Rio Hondo. Other cities and towns affected by floods on the Rio Hondo tributaries are Sierra Madre, Arcadia, Monrovia, San Gabriel, and Alhambra. Outside of the urban and suburban areas, the flood plain of the Rio Hondo is developed into citrus groves and small farms.

[1] Not printed.

The overflow area between the Rio Hondo and the San Gabriel River includes the town of El Monte and several small agricultural communities. Population data for the Rio Hondo flood zone are not available. The present value of the Rio Hondo overflow area is estimated at $85,000,000.

71. Nearly all of the Ballona Creek overflow area is occupied by residental and industrial development. In Los Angeles, Beverly Hills, and Culver City (in Ballona Creek Basin) some of the finest homes in the metropolitan area are affected by recurrent flooding. A small part of the southern portion of the area is occupied by truck farms and by wells of the Baldwin Hills oil field. The present value of the overflow area in Ballona Creek Basin is estimated at $103,000,000.

72. *Damage from past floods.*—Only meager data concerning the extent of the damage from past floods are available. Except for the 1938 flood, these data cover damages in the general area and are not susceptible of apportionment applicable to the separate river basins. The damages from early floods were low due to the undeveloped character of the country at the time of their occurrence. (See par. 16.) Quantitative estimates have been made in only five instances, a brief summary of which follows:

Estimated damage from past floods, basins of the Los Angeles and San Gabriel Rivers and Ballona Creek

Flood year	Authority	Estimated damage (value at time of flood)	Lives lost
1884	Los Angeles Express, Feb. 18, 1884	$1,000,000	(1)
1889	Los Angeles Herald, December 1889	398,700	(1)
1914	J. W. Reagan, chairman, board on flood damage	10,000,000	(1)
1934	Los Angeles County Flood Control District	6,082,300	41
1938	U. S. Engineer Office, Los Angeles:		
	Los Angeles River Basin	25,500,000	43
	Rio Hondo Basin	3,100,000	2
	San Gabriel River Basin	10,500,000	1
	Ballona Creek Basin	1,300,000	3
	Total, 1938	40,400,000	49

[1] None reported.

73. *Damage from future floods.*—Damages from future floods depend on the frequency and severity of flooding and on the existing and future development of the area within the flood plain. The frequency of future floods of various magnitudes has been determined on the basis of past experience and is tabulated in paragraph 65. The damage which most probably would be caused by each flood is estimated on the basis of the present values in the areas involved and the estimated future growth that would occur without flood control. The following table summarizes the probable future damage from all floods within a period of 50 years, which would be prevented by improvements recommended in the general plan. Details of the estimate are given in enclosure 13.[1]

[1] Not printed.

Estimated damage from future floods, basins of the Los Angeles and San Gabriel Rivers and Ballona Creek

[50-year period]

Drainage basin	Estimated damage		Total damage
	Direct	Indirect	
Los Angeles River	$366,074,400	$219,581,200	$585,655,600
San Gabriel River	133,369,000	80,034,000	213,403,000
Rio Hondo	42,187,000	25,321,000	67,508,000
Ballona Creek	44,560,000	26,736,000	71,296,000
Total	586,190,400	351,672,200	937,862,600
Say	586,200,000	351,700,000	938,000,000

74. *Water supply and conservation.*—In nearly all southern California, irrigation is essential to successful agriculture. Since part of the domestic water supply and almost all the water used for irrigation is now obtained by pumping from underground, it is necessary to prevent a lowering of the underground water plane so that pumping will continue to be economical and, near the coast, to prevent intrusion of salt water. In some areas overpumping has lowered the ground water to depths below sea level and as a result salt water intrusion has damaged the underground water supply.

75. About 30 years ago the city of Los Angeles found that the demand for water exceeded the local supply, and in order to permit continued development, constructed the Los Angeles-Owens Valley aqueduct system. Placed in service in 1913, this aqueduct, with an ultimate capacity of 450 cubic feet per second, transports water from Owens Valley at the foot of the Sierra Nevada Mountains in east-central California to Los Angeles, a distance of about 250 miles. Present (1939) estimates by local interests indicate that a quantity double the present supply will be required in the near future for use in the Los Angeles area. To provide for future requirements in this and adjoining areas, the Metropolitan Water District of Southern California is now constructing the Colorado River aqueduct which will have an ultimate capacity of 1,500 cubic feet per second, and which will transport water from the Colorado River, a distance of about 300 miles.

76. Various methods of water conservation have been investigated. Because of the characteristics of the rainfall, the high silt content of the flood flows, and the scarcity of suitable reservoir sites, relatively few water conservation reservoirs have been built. However, the spreading of water over porous soil to cause increased percolation to the underground storage basins has been highly developed. Debris and retarding basins permit percolation of a portion of the flow, and local flood control dams have been operated, when practicable, so that the outflow does not exceed the rate of percolation of the water-spreading grounds. Enclosure concerning water conservation was submitted with preliminary examination report dated April 23, 1938.

77. *Water rights.*—The water supply of various local underground basins is considerably augmented by surface storage facilities and diversions to spreading grounds constructed for that purpose. Modification of run-off and the natural disposal of stream flow by growth and development in the area has further affected the available supplies. Due to inadequacy of the local water supply to meet all the require-

ments of the area, there has been a continual and intense struggle for its use and development. Consequently, the local problem of water rights is very important and must be considered in connection with plans for flood-control improvements.

78. *Water power.*—Typical of all southern California, the dry season in the Los Angeles County area extends over half of each year, and dry cycles lasting for a number of years are not uncommon. The mountain slopes are precipitous, with thin soil and sparse growth, and consequently the run-off is practically completed soon after each flood-producing storm. Reservoir sites of sufficient capacity to provide storage for continuous water-power operation are lacking, and there are only a few water-power plants within the basin operating from local water supplies. The area is now supplied with electricity from municipal, Federal (Boulder Dam), and private plants, the reserves of which appear to be sufficient to supply the needs for a considerable time to come. Therefore, the development of power from local water supplies is considered infeasible.

79. There are several water-power plants in the basin operated by the Los Angeles Bureau of Water and Power with water conveyed by the Los Angeles-Owens Valley aqueduct. Three of these plants are the San Fernando power plant, at the southern terminus of the aqueduct; the River power plant, at Coldwater Avenue on the Los Angeles River near Van Nuys; and the Franklin power plant, located between the upper and lower Franklin Canyon Reservoirs.

80. *Miscellaneous factors.*—The type of flood-control improvements adaptable to the area offers no possibilities for direct coordination with navigation interests except in connection with the Alamitos Bay separation. Indirect benefits will accrue in connection with the proposed improvements at the mouth of the San Gabriel River, through control of silt deposits and the provision of more satisfactory navigation facilities in Alamitos Bay. Only the flood-control benefits in this case are taken into account in the economic analysis of the flood control works given in enclosure 13.[1] The matter of terminal facilities has no connection with flood-control improvements in this area.

81. Concerning section 5 of the River and Harbor Act of August 30, 1935, the desired flood-control improvements will have some effect on beach erosion at the mouths of the streams under consideration. The control of floodwaters in the upland areas will reduce the sand supply from that source and ultimately result in some depletion of the beaches near their estuaries, since the amount of natural beach erosion would probably exceed the sand supplied by the improved streams. A special investigation by the Shore Protection Board does not appear to be necessary at the present time, but it may be found desirable to include the matter in future beach erosion studies. Such study has been requested by local interests.

FIELD WORK

82. Prior to the authorization of this report, considerable information in connection with design studies and construction activities had been collected by this office, as follows:

(*a*) Complete data showing alinement, profiles, and cross sections for the major channel improvements investigated.

[1] Not printed.

(*b*) Special topographic maps of congested sections, aerial photographs of large areas, and complete sets of United States Geological Survey quadrangle maps.

(*c*) Data obtained by the Los Angeles County Flood Control District by extensive field surveys made in connection with flood control studies.

(*d*) Data from the Metropolitan Water District, city engineers of various municipalities in Los Angeles County, the Los Angeles County surveyor, and other local agencies.

83. All the above agencies were generous in their cooperation in making data available to this office.

84. During the progress of the studies and designs made for this report, additional field information was obtained as needed. Field reconnaissance was made to check the location and design of flood-control improvements considered for areas where new residential and industrial developments had rendered previous data obsolete. Supplemental aerial photographs were also obtained where needed detailed information was lacking or where changes had occurred. Field surveys were made at critical points in the alinement or grade of the more important project units.

PLAN OF IMPROVEMENT

85. *General.*—According to testimony originally presented at the public hearing and later substantiated and expanded, local interests desire flood-control improvements to provide protection for all localities now subject to flood damage. Various local interests have presented plans of improvement, partial or complete, in accordance with the extent of the interests involved. All plans submitted have been given careful consideration in the analysis of the general flood problem with a view to developing a general plan that would provide adequate permanent works to operate interdependently in controlling the runoff resulting from a storm of the severity of the estimated design storm. In developing the general plan, complete hydrology studies were made, taking into account all available data. The detailed discussion of the hydrology and the development of the design storm and discharges are presented in enclosure 6.[1] The maximum 24-hour rainfall of the 4-day design storm varies from 3 inches near the coast to 16 inches in mountains and was assumed to occur on the fourth day of the storm. The rainfall for the first 3 days of the 4-day design storm was assumed to be 20, 30, and 50 percent, respectively, of the fourth day's rainfall.

86. The existing project (see par. 38) embraces the major streams in the area under consideration and is the basis of the general plan. To the framework of the existing project have been added items of improvement necessary for the protection of the tributary areas and which have been found by economic analysis to warrant immediate development. Thus the general plan consists of all existing project items and all extensions that are economically justified at this time. Consideration was also given the existing works along the main channels which could be safely included as a part of the general plan.

87. The general plan is shown on page 1 of enclosure 1, and detailed designs for the individual items are presented in enclosures 9[1] and 10.[1] The individual items are described in enclosure 7[1] and detailed cost estimates presented in enclosure 12.[1] A brief description of the general plan by basins with summarized costs is given in the following

[1] Not printed.

paragraphs. The design discharges are shown on exhibit 41 and peak discharges of the flood of March 1938 are indicated on exhibit 5, enclosure 6.[1] The items of the extension of the existing project with their costs are given in table, paragraph 96. The items of the existing project with their costs are given in table, paragraph 38. These two tables give all items of the general plan.

88. *Los Angeles River Basin.*—The items of major importance in the general plan in the drainage basin of the Los Angeles River are the proposed Sepulveda, Lopez, and Hansen flood-control basins. These flood-control basins are located in San Fernando Valley and will minimize the flood menace in the agricultural and residential communities of the Tujunga Wash and lower San Fernando Valley areas, and reduce the probable maximum flood run-off from the valley to the feasible capacity of an improved Los Angeles River main-stream channel to the ocean. The Sepulveda and Hansen flood-control basins are a part of the existing project and are now under construction by the Corps of Engineers.

89. In addition to the three flood-control basins mentioned above, the general plan of improvements on Los Angeles River and tributaries, including works covered in the existing project, consists of debris basins at the mouths of 17 tributary canyons, 49.07 miles of main channel of Los Angeles River, tributary channels having an aggregate length of 53.42 miles, 43 bridges over the main channel of Los Angeles River, and 66 bridges over the tributary channels.

90. *San Gabriel River Basin.*—In the general plan of proposed flood-control improvements in the drainage basin of San Gabriel River, the Santa Fe and Whittier Narrows flood-control basins are the most important. These basins are designed to reduce peak flows of San Gabriel River so as to permit channel improvements to the ocean to be held within economical limits and at the same time provide adequate protection from floods. The Whittier Narrows flood-control basin will reduce the flow in the Rio Hondo Channel so that additional channel work on Rio Hondo will not be necessary. The Santa Fe flood-control basin and the channel from the basin to the mouth of the canyon are included in the existing project.

91. In addition to the above-mentioned flood-control basins, the general plan of improvements on San Gabriel River and its tributaries, including the items covered in the existing project, consists of debris basins at the mouths of 7 tributary canyons, 35.60 miles of main channel of San Gabriel River, tributary channels having an aggregate length of 69.16 miles, 10 bridges over the main channel of San Gabriel River, and 132 bridges over the tributary channels.

92. *Rio Hondo Basin.*—The general plan of improvements recommended for flood control in the Rio Hondo Basin, including Alhambra Wash Channel, an item of the existing project, consists of debris basins at the mouths of 7 tributary canyons, 9.76 miles of main channel, an aggregate length of 35.23 miles of tributary channels, 6 bridges over the main channel, and 59 bridges over the tributary channels.

93. *Ballona Creek Basin.*—Ballona Creek drains a densely populated and highly developed urban area which includes Culver City and the southwestern part of the city of Los Angeles. The lower part of the main stream is but slightly above sea level and has a very low gradient. The tributaries to the north have steeper gradients and drain

[1] Not printed.

the south slope of the Santa Monica Mountains and flow about 5 miles southerly through highly developed residential districts to Ballona Creek.

94. The general plan of flood-control improvements recommended in the drainage basin of Ballona Creek, including Ballona Creek main channel and jetties, items of the existing project, consists of debris basins at two tributary canyon mouths, 2.39 miles of main channel an aggregate length of 23.67 miles of tributary channels, 4 bridges over the main channel, and 8 bridges over the tributary channels.

95. *Summary.*—The type of improvements included in the general plan are summarized in the following table:

General plan of improvement of the Los Angeles and San Gabriel Rivers and their tributaries, and Ballona Creek

Drainage basin	Flood-control basins	Debris basins	Channel, miles		Bridges, number	
			Main stream	Tributary	Main stream	Tributary
Los Angeles River	3	17	49.07	53.42	43	66
San Gabriel River	2	7	35.60	69.16	10	132
Rio Hondo	----------	7	9.76	35.23	6	59
Ballona Creek	----------	2	2.39	23.67	4	8
Total	5	33	96.82	181.48	63	265

96. The estimated cost of the work covered in the general plan, including estimates of the existing project, is given in the following tables:

General plan for flood control (existing project plus extensions), Los Angeles and San Gabriel Rivers and their tributaries, and Ballona Creek, Calif.—Estimated costs

LOS ANGELES RIVER BASIN

Existing project: (See table, par. 38)		$67,282,673
Recommended extension:		
Los Angeles River Channel: Owensmouth Ave. to Niagara St.	$15,926,000	
Los Angeles River Channel: Stewart and Gray Rd. to Pacific Ocean	18,933,000	
Lopez flood-control basin	4,779,000	
Caballero Creek	1,372,750	
Wilson Canyon and Mansfield St. Channel	2,377,700	
Lopez Canyon diversion	301,900	
Pacoima wash channel	2,641,000	
Blue Gum Canyon	106,550	
Tujunga wash channel	7,748,000	
Burbank western system	6,280,000	
Burbank eastern system	7,661,000	
Blanchard Channel	255,700	
Verdugo wash (U. C. Br. to debris basin)	1,092,000	
Dead Horse Canyon and Royal Blvd. Channel	404,000	
Winery Canyon	497,300	
Compton Creek	1,467,000	
Subtotal		71,842,900
Total for Los Angeles River Basin		$139,125,573

General plan for flood control (existing project plus extensions), Los Angeles and San Gabriel Rivers and their tributaries, and Ballona Creek, Calif.—Estimated costs—Continued

SAN GABRIEL RIVER BASIN

Existing project: (See table, par. 38)		$12, 103, 000	
Recommended extension:			
Whittier Narrows flood-control basin	$16, 983, 000		
San Gabriel River Channel: Santa Fe flood-control basin to Whittier Narrows flood-control basin	4, 211, 000		
San Gabriel River Channel: Whittier Narrows flood-control basin to Pacific Ocean	10, 116, 000		
Anaheim Bay Bypass	972, 000		
Jetty extension and Alamitos Bay separation	996, 000		
Walnut Creek system	21, 943, 900		
Walnut Creek Inlet Channel	2, 468, 000		
Marshall Creek	915, 500		
Emerald wash and Liveoak wash	1, 871, 000		
Thompson Creek and San Jose wash	3, 797, 900		
Coyote Creek	9, 851, 000		
Subtotal		74, 125, 300	
Total for San Gabriel River Basin			$86, 228, 300

RIO HONDO BASIN

Existing project: (See table, par. 38)		$1, 205, 613	
Recommended extension:			
Rio Hondo Channel: Santa Fe Ry. to Whittier Narrows flood-control basin	$5, 349, 000		
Sawpit wash	2, 084, 200		
Sierra Madre Villa Channel	498, 900		
Santa Anita wash	4, 321, 000		
Arcadia wash system	4, 717, 500		
Rubio Canyon diversion	946, 000		
Eaton wash	3, 462, 000		
Subtotal		21, 378, 600	
Total for Rio Hondo Basin			22, 584, 213

BALLONA CREEK BASIN

Existing project: (See table, par. 38)		$1, 950, 100	
Recommended extension:			
Higgins and Coldwater Canyon	$4, 418, 000		
Benedict Canyon	4, 680, 000		
Sawtelle-Westwood system	8, 225, 000		
Centinela Creek	953, 500		
Subtotal		18, 276, 500	
Total for Ballona Creek Basin			20, 226, 600
Grand total for general plan			268, 164, 686

Cost summary of the general plan

[By basins]

	Existing project	Recommended extension	Total
Los Angeles River Basin	$67, 282, 673	$71, 842, 900	$139, 125, 573
San Gabriel River Basin	12, 103, 000	74, 125, 300	86, 228, 300
Rio Hondo Basin	1, 205, 613	21, 378, 600	22, 584, 213
Ballona Creek Basin	1, 950, 100	18, 276, 500	20, 226, 600
Total	82, 541, 386	185, 623, 300	268, 164, 686

Estimated cost of construction, utilities, bridges, and rights-of-way included in the general plan

Drainage basin	Construction	Relocation of public utilities	Reconstruction of bridges	Lands, easements, and rights-of-way	Total
Los Angeles River	$114, 482, 499	$5, 135, 941	$10, 978, 231	$8, 528, 902	$139, 125, 573
San Gabriel River	64, 687, 800	1, 409, 800	8, 725, 700	11, 405, 000	86, 228, 300
Rio Hondo	18, 310, 886	179, 702	2, 786, 405	1, 307, 220	22, 584, 213
Ballona Creek	17, 964, 715	630, 765	669, 041	962, 079	20, 226, 600
Total [1]	215, 445, 900	7, 356, 208	23, 159, 377	22, 203, 201	268, 164, 686

[1] For the various units of the general plan, it was found impracticable to give the estimated cost in round figures due to complications arising in the make-up and use of component parts and the difficulty in checking calculations back through a multiplicity of figures.

In the preceding table the costs of construction, relocation of public utilities and bridges, lands, easements, and rights-of-way chargeable to the existing project total approximately $82,540,000. The costs of the extension to the existing project are estimated as follows:

Estimated cost of improvements included in the extension of the existing project, Los Angeles and San Gabriel Rivers and Ballona Creek and their tributaries, after the completion of existing project

Drainage basin	Construction	Relocation of public utilities	Reconstruction of bridges	Lands, easements, and rights-of-way	Total
Los Angeles River	$57, 171, 360	$3, 037, 100	$8, 252, 500	$3, 382, 000	$71, 842, 900
San Gabriel River	54, 068, 800	1, 347, 800	8, 521, 700	10, 187, 000	74, 125, 300
Rio Hondo	17, 203, 300	144, 800	2, 724, 500	1, 216, 000	21, 378, 600
Ballona Creek	16, 912, 500	539, 600	256, 900	567, 500	18, 276, 500
Total	145, 445, 900	5, 069, 300	19, 755, 600	15, 352, 500	185, 623, 300
Say	146, 000, 000	5, 000, 000	20, 000, 000	15, 000, 000	186, 000, 000

[1] Not printed.

97. *Additional improvements considered but not recommended.*—A number of improvements desired by local interests, when investigated in detail, failed to show sufficient justification to warrant their inclusion in the general plan of improvement at this time. Description and details of the items not recommended are given in enclosures 8 [1] and 11,[1] and the estimates of cost and results of economic analyses are included in enclosures 12 [1] and 13,[1] respectively.

[1] Not printed.

BENEFITS FROM IMPROVEMENTS

98. *General.*—Benefits expected to accrue from the improvements described in the general plan for flood control in the drainage basins of the Los Angeles and San Gabriel Rivers and Ballona Creek are divided into two broad classes—tangible benefits and intangible benefits. Tangible benefits are those to which a monetary value can be assigned. In this report they are separated into two parts: (*a*) Benefits from the prevention of flood damage in the probable route of floods during the life of the improvement, and (*b*) benefits from the removal of the flood menace in the alternate route of floods. Intangible benefits are the remaining benefits to which no monetary value is assigned. The estimated annual amounts of the monetary benefits which reasonably may be anticipated from flood control in the drainage basins discussed in this report are given in the following paragraphs. A more detailed analysis appears in enclosure 13.[1]

99. Flood-control benefits in the probable route of floods are confined to the prevention of flood damage, which comprises direct flood damage and indirect flood damage. Direct flood damage is physical damage measured by the cost of repair, replacement and cleaning. Indirect flood damage results from direct damage and is measured by certain nonrecoverable losses. These losses include loss of business income, loss of wages, losses from the interruption of utilities and transportation, the cost of temporary quarters, emergency expenditures for flood warning and relief, and the damage to the community as a whole as reflected by the depreciation in property values. The computation of the direct and indirect flood damage (par. 98 (*a*)), is also divided into two parts. The first part is the estimate of future direct and indirect flood damage on the basis of present values in the overflow area. The second part is the estimate of direct and indirect flood damage based on future growth in the overflow area, without flood control. The sum of these two estimates expressed as average annual amounts is the total benefit which may be expected to accrue in 50 years from the prevention of direct and indirect flood damage.

100. The removal of the flood menace in the alternative routes of floods (par. 98 (*b*)) provides an additional benefit which has been evaluated in this report and which is discussed later in more detail. The remaining benefits that accrue to a community as a whole, after the removal of the flood menace, are considered intangible. This type of benefit includes the prevention of loss of life and personal injury, removal of dangerous health conditions, and other general effects that lower the morale. Intangible benefits are not susceptible of monetary evaulation, and therefore do not appear in the final benefit-cost ratio. However, they represent increased social security, a benefit which should be given considerable weight in the areas considered in this report.

101. Water conservation, which is sometimes included as a benefit in flood-control reports in this area, is not included for reasons discussed in paragraphs 74–76. Although the detention of floodwaters by flood-control basins and debris basins would cause increased percolation to the underground water basins, this would be offset, in some degree, by the reduction in the present large overflow area and by the confinement of flood flows to the narrow improved channels. The

[1] Not printed.

actual increase or decrease in the amount of water conserved, due to flood-control improvements in this area, is difficult to determine.

102. A detailed analysis has been made of each of the improvements in the general plan and of each of the additional improvements considered in detail, but not recommended; the results of these analyses are given in enclosure 13.[1] A description of the method employed and summaries of the results obtained are given in the following paragraphs.

103. *Prevention of flood damage.*—From the history of past floods and a hydrologic analysis of the area, the number and magnitude of floods to be expected in a period of 50 years were estimated. The overflow areas were traced on a contour map and the types of physical flood damage were determined for the various units. From these fundamental data it was practicable to estimate the direct damage from a flood of each magnitude and the total damage from all floods within the economic life of the improvement. As has been stated, the direct damages were estimated in two parts; the first part was based on the damages that would occur to the existing development in the area. It is recognized that, in Los Angeles County, due to the comparatively long-time interval between major floods, there will be a continuing growth in the areas subject to overflow. Consequently, there will be a greater concentration of wealth in these areas when the anticipated floods occur. In the second part, an allowance for damage to this additional wealth was made by estimating the probable increase in wealth that would occur in each area. The amount of damage that would occur to existing and future additional improvements was estimated, using data from the 1938 flood-damage survey as a basis. The 1938 flood data were applied in a manner that allowed for the relative severity of the various floods considered. Reference is made to enclosure 13,[1] for a more detailed development of this analysis. Considering the existing and estimated future developments that would be protected if improvements were made in accordance with the general plan, the estimated direct flood damage that would be prevented in 50 years is estimated at $586,200,000, which amounts to $11,724,000 per annum.

104. The value of indirect damage was estimated from data obtained by a flood damage survey of the Los Angeles area following the 1938 flood, and from a review of the allowance for indirect damages used by other agencies for areas having similar development. Inasmuch as the indirect damages are applicable to the community as a whole, rather than to just the individual area damaged, it was not considered necessary to establish separate ratios of indirect damage to direct damage for various property classifications in the respective flood areas. Based on the above and in order to distribute to the individual projects their proportionate share of the indirect damages sustained by the entire community, an average value of 0.6 was used for all areas as the ratio of indirect to direct damages. The total of indirect damages that would occur during a 50-year period, as assigned to items recommended in the general plan, has been estimated at approximately $351,700,000, or about $7,034,000 per annum.

105. *Incidental benefits.*—In addition to damages to future additional improvements due to normal growth of the flooded area, it is recognized that flood control will permit a higher use of some of the

[1] Not printed.

lands. However, no separate estimate has been made of this incidental benefit for the areas on which direct and indirect flood damages have been estimated.

106. It was seen that, in a majority of the flood areas under consideration, it would be possible for the floods to take other paths than the one considered most probable. Direct and indirect damages, however, were estimated for only one path, but it was recognized that the removal of the flood menace to these alternate paths would be a benefit. It is believed that the removal of the flood menace from these alternate paths will be reflected in a permanent increase in their values, and therefore the annual benefits from this source were estimated at 5 percent of the estimated increase in value. The total benefits from the removal of the menace to these alternate paths by the construction of the items recommended in the general plan have been estimated as $38,165,000, which at 5 percent per annum has an annual value of $1,908,000.

107. *Summary of all benefits.*—The following table is a summary of all the aforesaid benefits expected to accrue from the improvements included in the general plan:

Estimated annual monetary benefits from the general plan for flood control in the Los Angeles and San Gabriel Rivers and their tributaries, and Ballona Creek

Prevention of flood damage (probable overflow area):		
Direct flood damage prevented	$11,724,000	
Indirect flood damage prevented	7,034,000	
		$18,758,000
Incidental benefits (alternate overflow area): Removal of flood menace		1,908,000
Total		20,666,000

ECONOMIC COST OF IMPROVEMENTS

108. Separate economic analyses for the items in the general plan are given in enclosure 13.[1] Since the existing project and the recommended extensions thereof are designed to operate as a single unified plan, the combined economic costs are best presented as totals for the entire general plan, including both the existing project and its extensions. A summary of the economic costs is given in the following table:

Economic cost of improvements in the Los Angeles and San Gabriel Rivers and their tributaries, and Ballona Creek

a. Investment:		
(1) Estimated expenditure for new work of construction:		
Channels, levees, debris basins, and flood-control basins		$215,445,900
Public utilities—relocation and reconstruction		7,356,208
Bridges—reconstruction		23,159,377
(2) Expenditure for lands, easements, and rights-of-way		22,203,201
(3) Total, first cost		268,164,686
(4) Interest during construction, on item *a* (3) for one-half of the estimated construction period, at 3 percent		18,348,821
(5) Total, investment		286,513,507

[1] Not printed.

Economic cost of improvements in the Los Angeles and San Gabriel Rivers and their tributaries, and Ballona Creek—Continued

b. Annual carrying charges:	
(1) Interest, 3½ percent on item *a* (5)	$10,028,151
(2) Amortization of obsolescence and depreciation, in 50 years at 3½ percent (0.0076 × item *a* (5))	2,177,825
(3) Operation and maintenance of structures, items under *a* (1):	
Flood-control structures	1,331,475
Public utilities	(2)
Bridges	(2)
(4) Total, annual carrying charges	13,537,451

[2] Operation and maintenance by present owners and will not exceed present expenditures.

RATIO OF BENEFITS TO COSTS

109. On the basis of the foregoing estimates of cost and the estimated average benefits, the ratio of total benefits to total costs for all the items listed in the general plan is 1.52. The following table gives the benefit-cost ratios of the individual items of the general plan.

Ratios of benefits to economic costs for items of general plan Los Angeles and San Gabriel Rivers and their tributaries, and Ballona Creek

	Economic ratio
Los Angeles River Basin:	
Los Angeles River, Sepulveda and Hansen flood-control basins	1.69
Pacoima wash and Lopez flood-control basin	3.53
Caballero Creek	1.18
Tujunga wash	2.56
Wilson Diversion and Mansfield Channel	2.22
Lopez Canyon	1.62
Haines Canyon	(1)
Blue Gum Canyon	1.49
Burbank Western System	1.20
Burbank Eastern System	2.05
Blanchard Canyon	1.47
Verdugo wash:	
Concord to Upper La Canada	(1)
Upper La Canada to debris basin, inclusive	(2)
Dead Horse Canyon and Royal Blvd	2.25
Sycamore wash inlet	(1)
Winery Canyon	1.17
Compton Creek:	
Los Angeles River to Hooper Ave. storm drain	(1)
Hooper Ave. storm drain to Main St	1.34
Combined items in Los Angeles River Basin	1.77
San Gabriel River Basin:	
San Gabriel River, Santa Fe, and Whittier Narrows flood-control basins	1.10
Walnut Creek system	1.06
Marshall Creek	1.36
Emerald and Live Oak washes	1.30
Thompson Creek and San Jose wash	1.25
Coyote Creek	1.06
Combined items in San Gabriel River Basin	1.10
Rio Hondo Basin:	
Rio Hondo	[3].91
Sawpit wash	1.97

[1] Individual economic analyses have not been prepared for the items completed under the existing project; however, the cost of these items and a proportional share of their contributed benefits are included in the combined analyses of all general plan items for each basin and in the combined analysis of the general plan as a whole.

[2] Verdugo wash extension and debris basin enlargement are items necessary for the proper functioning of the completed Verdugo wash improvement, and although not susceptible of separate analysis, they have been included in the combined analyses.

[3] This section of main channel is an essential part of the improvements in the Rio Hondo and San Gabriel Basins and shows a favorable economic ratio when included with the improvements recommended for the Rio Hondo Basin.

Ratios of benefits to economic costs for items of general plan Los Angeles and San Gabriel Rivers and their tributaries, and Ballona Creek—Continued

	Economic ratio
Rio Hondo Basin—Continued.	
Santa Anita and Sierra Madre washes	1. 40
Arcadia wash system	1. 38
Eaton wash	1. 76
Sierra Madre Villa Channel	1. 40
Rubio diversion	4. 80
Alhambra wash	(1)
Combined items in Rio Hondo Basin, including Rio Hondo Channel from Santa Fe flood-control basin (Flower Ave.) to Whittier Narrows flood-control basin	1. 53
Ballona Creek Basin:	
Ballona Creek Channel and jetties	(1)
Higgins and Coldwater Canyons	1. 26
Benedict Canyon	2. 82
Sawtelle-Westwood system and Sepulveda Canyon	1. 10
Centinela Creek	1. 02
Combined items in Ballona Creek Basin	1. 50
Combined items included in the general plan	1. 52

[1] Individual economic analyses have not been prepared for the items completed under the existing project; however, the cost of these items and a proportional share of their contributed benefits are included in the combined analyses of all general plan items for each basin and in the combined analysis of the general plan as a whole.

110. The ratios of benefits to economic costs, for the items which were considered but which were excluded from the general plan because they were not found economically justified at this time, are given in the following tabulation:

Ratios of benefits to economic costs—items excluded from the general plan on basis of economic analysis—Los Angeles and San Gabriel Rivers and their tributaries

	Economic ratio
Los Angeles River Basin:	
Calabasas Creek, Dry Canyon, and Bell Creek	0. 26
Browns Creek and Santa Susana Creek	. 56
Aliso Creek and Limekiln Creek	. 55
Bull Creek	. 88
Encino Creek	. 81
May Canyon	. 61
East Canyon	. 65
Kagel Canyon	. 15
Cooks Canyon	. 43
Pickens Canyon	. 15
Gould and Paradise Canyons	. 46
Laguna Dominguez (Nigger Slough)—plan A	. 16
San Gabriel River Basin: San Jose Creek, San Jose wash, and North Puente wash	. 26
Rio Hondo Basin: Bradbury and Spinks Canyons	. 87

LOCAL COOPERATION

111. With reference to act, Public, No. 738, Seventy-fourth Congress, approved June 22, 1936, authorizing expenditure of not to exceed $70,000,000 for construction of flood-control improvements in Los Angeles County, Calif., the Board of Supervisors of Los Angeles County has, by appropriate resolution dated December 1, 1937, agreed to furnish all necessary rights-of-way, assume responsibility for all damage claims, and maintain the improvements after completion, all in accordance with the regulations prescribed by the Secretary of War and as required by section 3 of the above act. The Flood Control Act, approved June 28, 1938, and quoted in paragraph 38, modified the requirements as to local cooperation. Under this act, the United

States has assumed the obligations of the acquisition of rights-of-way and the cost of relocating public utilities and bridges, and is reimbursing local interests for expenditures made by them for those items of the existing project. Also the United States assumed responsibility for the maintenance and operation of the completed works of the existing project. The total saving to the local interests, due to the application of the act of June 28, 1938, to the existing project as originally authorized, will amount to approximately $12,540,000, plus the saving in maintenance costs.

112. Although the act of June 28, 1938, rescinded such requirements of the act of June 22, 1936, that pertain to local interests' responsibility for (*a*) rights-of-way, (*b*) damages due to construction, and (*c*) responsibility for operation and maintenance, applicable to all projects adopted by Congress under the 1936 act and amendments thereto, and to all projects adopted under the 1938 act, there appears to be no authority under existing laws that requires the United States to assume such responsibilities and costs pertaining to new projects or in the extension of the existing project, except as may be included in subsequent acts. The district engineer believes that consideration of the preceding items, (*a*), (*b*), and (*c*), for any extension of the existing project should take into consideration the inherent local conditions applicable to each of the separate units that would constitute a part of the extension of the project, and bases his recommendation for required local cooperation upon a study of local conditions, the extent of national benefits as compared to local benefits, and the ability of the local community to pay a part of the costs. In order to give full consideration to the foregoing, the items of the district engineer's comprehensive plan for flood control (general plan) have been divided into three groups, A, B, and C. The items of group A are those comprising the existing project, and the items of groups B and C are those included in the recommended extension of the existing project. Group B includes the items required to complete the improvements on the main streams and parts of tributaries thereof that are necessary for the proper functioning of the general plan, as in the case of lower Burbank-Western and lower Sawtelle-Westwood, and to safeguard life and property where the flood menace is most serious. Group C includes other tributaries whereon the flood menace is not so serious and where the benefits of the improvements are considered to be largely local in character. The grouping of items in the general plan is shown in the following tables:

GENERAL PLAN—FLOOD CONTROL

Los Angeles and San Gabriel Rivers and their tributaries, and Ballona Creek, California

[Cost summary—general plan, groups A, B, and C]

Group	Cost to be borne by United States		Cost to be borne by local interests		Total cost	
Group A, existing project		$82,540,000		0		$82,540,000
Group B, partial extension	$89,780,000		$21,050,000		$110,830,000	
Group C, remaining extension	40,610,000		34,180,000		74,790,000	
Subtotals, group B+group C		130,390,000		$55,230,000		185,620,000
Total		212,930,000		55,230,000		268,160,000

GROUP A (EXISTING PROJECT)

[Entire cost to be borne by the United States]

Item No.	Project item	Construction	Public utilities	Bridges	Lands and rights-of-way	Total	Percent complete Jan. 1, 1940
1	Haines Channel and debris basin	$520,423	$3,110	0	$103,233	$626,766	100
2	Sycamore Wash Channel	23,546	0	0	4,439	27,985	100
3	Verdugo Channel (Concord to Upper Canada Bridge)	588,519	21,989	$260,367	216,438	1,087,313	100
4	Alhambra	1,017,586	34,902	61,905	91,220	1,205,613	100
5	Compton Creek (Los Angeles River to Hooper Ave.)	1,892,649	30,408	678,509	239,996	2,841,562	100
6	Ballona Creek (channel and jetties)	1,052,215	91,165	412,141	394,579	1,950,100	99
7	Hansen flood-control basin	8,500,000	480,000	0	1,400,000	10,380,000	82
8	Sepulveda flood-control basin	4,000,000	[1] 364,000	(1)	2,457,000	6,821,000	0
9	Los Angeles River Channel (Niagara to Stewart and Gray Rd.)	41,355,612	1,199,334	1,786,855	725,796	45,067,597	54
10	Excavation near Long Beach Blvd	34,244	0	0	0	34,244	100
11	Surveys and engineering	396,206	0	0	0	396,206	
12	San Gabriel Channel (Canon to Santa Fe)	1,720,000	12,000	204,000	150,000	2,086,000	0
13	Santa Fe (flood-control basin)	8,899,000	50,000	0	1,068,000	10,017,000	0
	Total	70,000,000	2,286,908	3,403,777	6,850,701	82,541,386	

[1] Cost of two railroad bridges included in utilities.

GROUP B (RECOMMENDED EXTENSION TO EXISTING PROJECT)

[Required for adequate functioning of existing project (see Group C, Extension). Costs to be borne by United States: Construction, public utilities, railroad bridges. Local interests: Highways and highway bridges, lands and rights-of-way]

Item No.	Project item	Costs to United States				Costs to local interests			Total cost
		Construction	Public utilities	Bridges, railroad	Total	Highways and highway bridges	Lands and rights-of-way	Total	
1	Los Angeles River channel—Owensmouth to Niagara and Stewart and Gray Rd. to ocean	$23,465,000	$2,660,000	$1,725,600	$27,850,600	$4,533,400	$2,475,000	$7,008,400	$34,859,000
2	Lopez flood-control basin	4,683,000	0	0	4,683,000	0	96,000	96,000	4,779,000
3	Pacoima wash channel	1,987,000	24,000	0	2,011,000	534,000	96,000	630,000	2,641,000
4	Tujunga wash channel	6,931,000	90,000	259,200	7,280,200	333,800	134,000	467,800	7,748,000
5	Verdugo wash (Upper Canada Bridge to debris basin)	1,078,000	0	0	1,078,000	0	14,000	14,000	1,092,000
6	San Gabriel River channel—Santa Fe flood-control basin to ocean	13,029,000	498,000	506,000	14,033,000	1,013,000	1,249,000	2,262,000	16,295,000
7	Whittier Narrows flood-control basin	8,983,000	500,000	0	9,483,000	0	7,500,000	7,500,000	16,983,000
8	Walnut Creek inlet channel	2,095,000	18,000	90,000	2,203,000	175,000	90,000	265,000	2,468,000
9	Rio Hondo channel	4,284,000	36,000	390,000	4,710,000	522,000	117,000	639,000	5,349,000
10	Lopez diversion channel	274,900	0	0	274,900	0	27,000	27,000	301,900
11	Wilson–Mansfield channel	2,288,300	2,400	0	2,290,700	0	87,000	87,000	2,377,700
12	Eaton channel	2,612,000	29,000	109,000	2,750,000	428,000	284,000	712,000	3,462,000
13	Rubio diversion channel	927,000	0	0	927,000	0	19,000	19,000	946,000
14	Sawpit wash	1,637,200	9,000	100,800	1,747,000	241,200	96,000	337,200	2,084,200
15	Santa Anita wash	3,345,000	24,000	204,000	3,573,000	294,000	454,000	748,000	4,321,000
16	Sawtelle–Westwood (lower)	2,535,000	60,000	0	2,595,000	18,000	20,000	38,000	2,633,000
17	Burbank–Western (lower)	2,050,000	72,000	168,000	2,290,000	140,000	63,000	203,000	2,493,000
	Total	82,204,400	4,022,400	3,552,600	[1]89,779,400	8,232,400	12,821,000	[2]21,053,400	110,832,800

[1] Say, $90,000,000.

[2] Say, $21,000,000.

GROUP C (RECOMMENDED EXTENSION TO EXISTING PROJECT)

[Additional to group B: Items having substantial percentage of local benefits as compared to general flood-control benefits]

Item No.	Project item	Costs to United States				Costs to local interests				Total cost
		60 percent construction	Public utilities	Bridges, railroad	Total	40 percent construction	Highways and highway bridges	Lands and rights-of-way	Total	
1	Compton Creek	$606,000	$34,500	$40.250	$680,750	$104,000	$332.250	$50,000	$786,250	$1,467,000
2	Arcadia system	2,425,920	46,800	111,000	2,583,720	1,617,280	324,500	192,000	2,133,780	4,717,500
3	Sierra Madre Villa	266,940	0	0	266,940	177,960	0	54,000	231,960	498,900
4	Marshall Creek	528,900	0	0	528,900	352,600	0	34,000	386,600	915,500
5	Emerald-Liveoak	910,320	15,600	100,200	1,026,120	606,880	168,000	70,000	844,880	1,871,000
6	Blue Gum	60,330	0	0	60,330	40,220	0	6,000	46,220	106,550
7	Blanchard	138,420	0	0	138,420	92,280	0	25,000	117,280	255,700
8	Winery	273,180	12,000	0	285,180	182,120	0	30,000	212,120	497,300
9	Caballero	792,570	1,800	0	794,370	528,380	0	50,000	578,380	1,372,750
10	Benedict	2,491,500	299,000	0	2,790,500	1,661,000	0	228,500	1,889,500	4,680,000
11	Burbank-Eastern	4,397,400	90,000	140,000	4,627,400	2,931,600	0	102,000	3,033,600	7,661,000
12	Dead Horse-Royal	230,760	2,400	0	233,160	153,840	0	17,000	170,840	404,000
13	Higgins-Coldwater	2,527,800	102,000	0	2,629,800	1,635,200	0	103,000	1,788,200	4,418,000
14	Sawtelle-Westwood (upper unit)	3,166,200	72,000	0	3,238,200	2,110,800	48,000	195,000	2,353,800	5,592,000
15	Thompson Creek-San Jose Wash	1,934,760	19,200	148,890	2,102,760	1,289,840	324,300	81,000	1,695,140	3,797,900
16	Burbank-Western (upper unit)	2,149,800	48,000	0	2,197,800	1,433,200	46,000	110,000	1,589,200	3,787,000
17	Walnut System	10,730,100	225,000	386,400	11,341,500	7,153,400	2,716,000	733,000	10,602,400	21,943,900
18	Centinela	441,000	6,600	0	447,600	294,000	190,900	21,000	505,900	953,500
19	Coyote Creek	3,873,000	72,000	690,000	4,635,000	2,582,000	2,204,000	430,000	5,216,000	9,851,000
	Total	37,944,900	1,046,900	1,616,650	[1]40,608,450	25,296,600	6,353,950	2,531,500	[2]34,182,050	74,790,500

[1] Say, $41,000,000.

[2] Say, $34,000,000.

113. The general plan and the grouping of the items thereof, as given in the table above, were discussed with local interests, principally with regard to local cooperation, and they agreed to provide police protection for all completed improvements in the general plan. In addition, they agreed to assume responsibility for all damage claims arising from flood-control works in extension of the existing project, except such as may be caused by faulty manual operation of the flood-control basins. The question of maintenance and operation was not discussed with local interests, since the act of 1938 has definitely assigned this function to the United States in case of the existing project, and it would be impracticable to have a division of such responsibility in the project as a whole. It is therefore believed that the United States should maintain and operate all flood-control structures of the general plan, in accordance with rules and regulations prescribed by the Secretary of War, under the direction of the Chief of Engineers, in order to assure the proper functioning of the entire project as a whole. This provision has been agreed to by local interests. With reference to acquisition of lands, easements, rights-of-way, and local contribution toward certain parts of the construction costs of the extension of the existing project, it it believed that the procedure should be as follows:

As a measure of local cooperation, local interests should (1) furnish to the United States, without reimbursement for the cost thereof, all lands, easements, flowage rights, and rights-of-way necessary for channel improvement or channel rectification and for debris and flood-control dams and basins; (2) bear the entire cost of relocation of highways and highway bridges; and (3) contribute 40 percent of the cost of the construction of the tributary channels listed in group C in table, paragraph 112.

114. It is believed that the local cooperation specified in the preceding paragraph is reasonable. Local government is organized to provide police protection for all improvements in the area, both public and private.

115. The measures of local cooperation pertaining to the furnishing of rights-of-way and contributions for relocation of bridges, and a proportionate share of the construction cost of certain channels in extension of the existing project, are considered justified, in view of the very large local benefits which will accrue, in addition to the general benefits.

116. The growth in population, business, and industrial production in the Los Angeles metropolitan area and of Los Angeles County has been abnormally large. The cities and towns have extended their boundaries rapidly and the expenditures for roads, streets, bridges, highways, water supplies, and other utilities have been very large. The tax rates in the various incorporated communities and within the different sections of Los Angeles City vary from about $5.80 to $3.90 per hundred dollars assessed valuation. The annual tax rate for flood control on land and improvements within Los Angeles County Flood Control District is 21.88 cents per hundred dollars of assessed valuation. Although major floods in the area are rather infrequent and of short duration, they are of great severity and, due to the steep slopes, high percentage of run-off, and scarcity of vegetation, they carry large quantities of debris and cause great damage, including loss of life. The periods of normal conditions with little or no rainfall

create a false sense of security. Funds for local flood control and storm-water drainage have therefore remained comparatively small, and it is only when severe floods occur with their devastating effects that public interest in the flood problem is aroused. It is therefore believed that local interests can afford to pay a fair proportion of the costs for such work, provided the cost is spread over a period of years. The present income of the Los Angeles County Flood Control District from taxes is about $4,800,000 per annum, 61 percent of which, however, is required for amortization and interest on bonded indebtedness. This income will increase as the valuation of property in the county increases. For the next few years it will also be increased from reimbursements by the United States under the provisions of the act of June 28, 1938, for expenditures in connection with the existing project. These may total about $3,600,000 by the end of the fiscal year 1943. The flood-control works that have been completed have already permitted the safe occupancy and development of areas formerly subject to destructive floods. Further development is certain. Such increases in land, residential, business, and industrial values provide large benefits to local interests as well as to the Nation as a whole.

117. All the items of the project do not have the same economic justification. Certain ones, although of small justification, are more necessary than some others for the proper functioning of the system as a whole. Others, although having small justification at the present time, have large potential justification in the benefits they will provide by preventing damage to future developments. An analysis of each of the items of the general plan leads to the belief that the local flood-control district should bear a portion of the construction cost of certain items, as well as the costs of rights-of-way and relocation of highways and highway bridges.

118. In view of the foregoing, it is believed that the required local cooperation should be as follows:

(*a*) Provide police protection for all completed flood-control works of the existing project and the extension thereof.

(*b*) Hold and save the United States free from all claims for damages due to the construction and operation of the extension of the project, except damage claims caused by faulty manual operation of flood-control basins.

(*c*) Provide, without cost to the United States, all lands, easements, and rights-of-way necessary for the construction of the extension of the project and assume the cost of the relocation of highways and highway bridges required in the extension of the project.

(*d*) Contribute in advance, for any item in group C of the table, paragraph 112, as required by the Chief of Engineers, United States Army, 40 percent of the construction cost of that item.

119. As indicated by appropriate resolution, appended hereto, passed by the Los Angeles County Board of Supervisors, February 6, 1940, the board is willing to undertake to the best of its ability, if required by Congress, the obligations of:

(*a*) Acquiring all lands, easements, or other forms of rights-of-way necessary to the construction of flood control and appurtenant improvements in the extension of the existing project.

(*b*) Relieving the United States Government of all liability for claims for damages arising from the construction of said extension of the existing project,

except for damages such as might be caused by faulty manual operation of flood-control basins and similar structures.

(c) Providing police protection for all completed flood-control works of the extension of the project and the existing project.

(d) Contributing to the cost of construction of certain of the flood-control and appurtenant improvements, which have a substantial percentage of local benefits, as compared to general flood-control benefits.

The cooperation offered at this time is predicated upon the ability of the Los Angeles County Flood Control District to finance its required cooperation. It is believed that if the general plan for flood control is adopted, local cooperation herein recommended will be met without undue financial burden on the communities to be benefited.

SUMMARY AND DISCUSSION

120. The area considered in this report consists of the adjacent drainage basins of Los Angeles River, San Gabriel River, their interconnecting stream, the Rio Hondo, and Ballona Creek, and lies principally in Los Angeles County, Calif. The area, amounting to 1,717 square miles, is composed of mountains, hills, valleys, and a coastal plain. The main streams are relatively short and the slopes in the mountainous section are steep; and, with the short-time rainfall intensities characteristic of southern California, quick run-off and sharp flood peaks result. The action of the high velocity of flood-water on land that is easily eroded causes large quantities of debris to move downstream. The coarser particles are deposited at the mouths of the canyons in fan-shaped cones, and the lighter particles are transported farther and dropped as the carrying power of the water decreases. The resultant accretion diminishes the capacity of the channels, causing the streams to take a new course. In the past, the combination of severe floods with debris flow and unstable channels has caused loss of life and excessive property damage, and is likely to cause still greater damage in the future, unless adequate protection is provided.

121. The total 1939 population in the area considered is estimated at 2,400,000, and it is estimated that 800,000 live in the area subject to overflow. The total true value of property in Los Angeles County was about $5,600,000,000 in 1938, and most of it is concentrated in or near this area. Within the area subject to overflow, the true value of property is estimated at more than $1,000,000,000. To protect this thickly populated and highly developed locality from storm waters and floods, the city and county of Los Angeles have expended about $109,000,000; and many smaller municipalities within the county, as well as various private interests therein, have spent considerable amounts of money. Two Federal agencies, the Work Projects Administration and the War Department, have expended approximately $90,000,000 of a total of about $135,000,000 authorized for expenditure by these agencies, the greater part of such expenditure being for flood control.

122. Although some of the funds included in the preceding amounts were used for local drainage or for water conservation, the greater part was used in an effort to reduce the general flood menace in the entire community. The existing improvements are of great value in reducing flood damage within their respective areas of influence, and the remaining works to be constructed with the balance of the funds

authorized by the Flood Control Act of June 22, 1936, will provide protection for additional areas. Nevertheless, large areas will still remain unprotected from floods, and it is the primary purpose of this report to determine the degree of justification for additional flood-control improvements needed and to set up a general plan of improvement to insure proper functioning of all parts of such general plan.

123. Local interests desire an adequate and unified comprehensive flood-control plan to protect all areas now unprotected. Since the character and value of property in the various parts of the overflow area vary widely, it was found upon preliminary examination that the cost of providing adequate protection for certain parts was in excess of the respective benefits to each area. The plans of improvement presented by local interests were, therefore, analyzed so as to segregate those units which are justified at this time and to include them as parts of a general or comprehensive plan.

124. This study has shown that certain improvements can be combined in such a general plan. The improvements requested by local interests which are not included in the general plan have been given sufficient consideration to show that the cost of protective works exceeds the anticipated benefits. Briefly stated, the general plan includes the construction of three flood-control basins on Los Angeles River and its tributaries, two flood-control basins on the San Gabriel River, numerous debris basins at the canyon mouths of the various tributaries, and extensive channel work on the main streams and certain tributaries of Los Angeles and San Gabriel Rivers, Rio Hondo, and Ballona Creek. The estimated total cost of the extension of the existing project is $186,000,000, of which $146,000,000 is for construction, $5,000,000 for relocation of utilities, $5,200,000 for railroad bridges, $15,300,000 for rights-of-way, and $14,600,000 for relocation of highways and highway bridges. The recommended local cooperation would require that local interests furnish rights-of-way, pay for relocation of highways and highway bridges, and contribute toward the construction cost of certain items, the total contribution being equivalent to about $55,000,000.

125. The annual carrying charges on the estimated cost of the general plan are estimated at about $13,540,000. The annual benefits from the prevention of flood damage and its attendant losses, including the provision of opportunity for higher development in the overflow area, amount to approximately $20,700,000. The ratio of annual benefits that are susceptible of monetary evaluation to annual charges is about 1.52.

126. In this highly developed metropolitan area the intangible benefits to the community as a whole are considerable. The New Year's flood of 1934, although confined to a small area, caused a loss of more than 40 lives, and during the 1938 flood the loss of life was larger. In addition to loss of life, personal injury and sickness follow major floods, the morale of the people suffers severely, and innumerable hardships are inflicted on those unable financially to meet such a catastrophe. Lifetime savings of numerous persons with moderate or low incomes are invested in homes in the overflow area, and it is believed that such financial security as this property affords will be irretrievably lost if the menaced areas remain unprotected from future floods. For these reasons it is believed that the intangible benefits from the additional proposed improvements would be very high, and in combination with

the tangible benefits, indicated by the monetary ratios, would amply justify the construction of the various parts of the recommended general plan.

CONCLUSIONS

127. It is concluded that destructive floods in the basins of Los Angeles and San Gabriel Rivers, Rio Hondo, and Ballona Creek will be only partly controlled after the completion of the existing project; that the existing project and the extension of its improvements, referred to in this report as the general plan, will provide benefits, both local and general, in excess of the estimated cost thereof; that the construction by the United States of the improvements included in the general plan is warranted, subject to conditions of local cooperation discussed in paragraphs 111–119; and that an equitable distribution of the cost of such a modified project would be as follows:

Authorized for construction cost under existing project	$70, 000, 000
Estimated cost of lands, easements, and rights-of-way for work authorized under existing project	12, 540, 000
Cost to the United States of the recommended extension of existing project	131, 000, 000
Cost to local interests of the extension of the existing project as recommended	55, 000, 000
Estimated total cost of general plan, say	268, 000, 000

RECOMMENDATIONS

128. The district engineer recommends:

(*a*) That the existing project, which provides for the construction of reservoirs and principal flood channels in the Los Angeles and San Gabriel Rivers and their tributaries, and Ballona Creek, Calif., at an estimated construction cost not to exceed $70,000,000, and at an estimated cost for lands and damages of $12,540,000, be modified by the inclusion of additional improvements in extension thereof, at an estimated cost of $186,000,000, and at an operation and maintenance cost estimated at $1,330,000 per annum.

(*b*) That local interests be required to cooperate as follows: (1) Provide police protection for all completed flood-control works of the existing project and extension thereof; (2) hold and save the United States free from all claims for damages due to the construction and operation of the extension of the project, except damage claims caused by faulty manual operation of flood-control basins; (3) furnish free of cost to the United States, all lands, easements, flowage rights, and rights-of-way necessary for channel improvement or channel rectification and for debris and flood-control dams and basins required for extension of the existing project; (4) assume the cost of the relocation of highways and highway bridges required in extension of the existing project; and (5) contribute 40 percent of the cost of the construction of the tributary channels listed in group C of table, paragraph 112.

(*c*) That the United States pay all other costs and perform all other work entailed in connection with the construction, maintenance, and operation of the existing project and extension thereof.

(*d*) That all items in the extension of the existing project be executed according to plans to be approved by the Chief of Engineers, United States Army, and in the order directed by him.

(*e*) That the United States operate and maintain all flood-control works of the existing project and extension thereof, under the direction of the Secretary of War and supervision of the Chief of Engineers.

(*f*) That those items, upon which local contributions of 40 percent of construction costs are required, be constructed at such time as the Los Angeles County Flood Control District is able to finance and meet the required local cooperation.

(*g*) That Federal funds be made available in allotments of not less than $20,000,000 per annum.

EDWIN C. KELTON,
Lieutenant Colonel, Corps of Engineers,
District Engineer.

[First endorsement]

OFFICE, DIVISION ENGINEER,
SOUTH PACIFIC DIVISION,
San Francisco, Calif., February 12, 1940.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. *Description.*—The Los Angeles and San Gabriel Rivers, emptying into the ocean at San Pedro Bay, constitute the principal drainage systems of Los Angeles County. Rio Hondo, the largest natural tributary of Los Angeles River, drains a portion of the natural drainage basin of San Gabriel River; and Ballona Creek discharges into the ocean at Santa Monica Bay, the run-off from the southern slope of the easterly portion of the Santa Monica range of mountains. These systems together drain a total of 1,717 square miles, which includes all the industrial, commercial, and residential communities of the Los Angeles County area.

2. The improved area is open to the sea on the southeast, low-lying and generally level for a considerable distance inland from the coast, and then rising gently to the base of a system of hills and mountains enclosing the area in the inland sector. The mountains vary in general altitude from about 3,000 feet in the northwest to between 5,000 and 7,000 feet in the remaining portions, with individual peaks rising to heights up to 10,000 feet. The hills and mountains are generally rugged, with numerous canyons opening directly onto the improved area.

3. The 44 incorporated cities within the area contain about 88 percent of the total population, which was estimated to be 2,450,000 in 1938. The largest city is Los Angeles, with a population of 1,360,000 and bank debits (in 1938) of $9,787,000,000. Industrial activities, principally petroleum production and refining, motion-picture production, airplane production, automobile assembling, and miscellaneous manufacture, yielded a gross return of $1,350,000,000 in 1937. The value of agricultural products was $76,000,000 in 1938. Commerce passing through Los Angeles-Long Beach Harbors for the year ending June 30, 1938, amounted to more than 22,000,000 tons valued at over a billion dollars.

4. *Flood conditions.*—The average annual precipitation varies from about 10 inches near the coast to about 40 inches in the high mountains. Approximately 80 percent of the annual rainfall occurs during the

4-month period from December to March. The maximum recorded daily rainfall for Los Angeles is 5.88 inches, and for the mountain areas is 17.55 inches. Intense winter storms convert the usually dry stream beds into raging torrents, which flow with very high velocities on the steep slopes of the upper channels, eroding bordering areas and flooding wide areas of improved property. Where canyons open onto the sloping foothill area, the floodwaters deposit great quantities of rock, boulders, gravel, and sand upon the adjacent area. This debris deposit often results in complete destruction of the property values, in some cases covering property to a depth greater than the height of homes and other buildings on the land.

5. The rapid expansion within the basin of residential areas during recent past years, together with an ignorance or disregard of the local flood conditions, has resulted in building and making other improvements in areas known to be subject to damage by greater than usual floods. This condition is responsible to some extent for the large amount of damages done by the unusual floods. The overflow area includes 800,000 residents and property valued at over $1,000,000,000. The flood of 1934 resulted in damage estimated by the Los Angeles County Flood Control District as $6,082,300 and caused the loss of 41 lives; the flood of 1938 resulted in damage estimated by the United States engineer office, Los Angeles, as $40,409,127 and caused the loss of 49 lives.

6. *Existing improvements.*—Various agencies of local government have expended large sums for the construction and maintenance of storm drains and works for flood control and water conservation. The Los Angeles County Flood Control District has been the agency responsible for construction of most of the locally financed flood-control improvements, which consist chiefly of 12 flood-storage reservoirs on the upper tributary streams, several debris-retention basins, 1 diversion dam, and many miles of channel improvement. The local expenditures cannot be readily segregated as to purpose, but the total expenditures of local funds for all such purposes is about $112,000,000.

7. Under the conditions of the Emergency Relief Appropriation Act of 1935 the War Department supervised the construction of certain flood-control work consisting of six debris-retention basins, one flood and debris storage basin, and channel improvement work on Los Angeles River and tributaries and on Ballona Creek. Federal funds expended for this work, together, with Federal funds appropriated by Federal relief agencies, such as Works Progress Administration and Civil Works Administration, as direct Federal assistance in constructing the works accomplished by local agencies has totaled about $54,000,000.

8. Upon completion, the existing project for Los Angeles County drainage area, California—flood control will have provided jetties and channel improvement on Ballona Creek, channel improvement on the central section of Los Angeles River with channel improvement and debris retention basins on some of its tributaries, channel improvement of an upper section of San Gabriel River, and three large flood storage reservoirs—two in the foothill area of Los Angeles River and one in the foothill area of San Gabriel River. The items of the existing project are a part of those comprising a comprehensive plan for flood protection of the entire Los Angeles County area, and are the items which generally would be accomplished first, either because of the

condition of the present channels or because of their relation to the comprehensive plan. It is estimated that the total cost of the existing project will be about $82,540,000, the legal limit of expenditures for construction being $70,000,000.

9. The total cost of the works outlined in the preceding paragraphs, upon completion of the existing project, will be about as estimated below:

Funds by local agencies, for water conservation, storm drains, and flood control	$112,000,000
Funds by Federal relief agencies, for storm drains and flood control	54,000,000
Funds by the War Deparment, for flood control under the existing project	82,540,000
Total	248,540,000

10. *Additional improvements.*—At a public hearing conducted by the district engineer, local interests, represented chiefly by the Los Angeles County Flood Control District, requested adequate protection against floods in the Los Angeles County area by means of flood storage basins, debris retention basins, and channel improvements, in general accordance with a comprehensive plan developed by the flood control district, and requested that water conservation be coordinated with flood control to the extent practicable. The district engineer has considered the requests of local interests and has prepared a list of such items included in the comprehensive plan which he believes can be justified at this time. He proposes a plan, in extension of the existing project, which calls for general improvement of Ballona Creek and Los Angeles and San Gabriel Rivers, and many of the tributaries thereto, by means of channel improvement, debris retention basins, and flood storage basins, all as shown on page 1 of enclosure 1 to his report. He estimates the total cost of such items in extension of the existing project which he finds justified at this time at $185,623,300. The existing project and its extension would cost an estimated total of $268,164,686, which represents an annual carrying charge, including operation and maintenance costs of $1,331,000, amounting to $13,537,000.

11. In justification of this estimated cost, the district engineer estimates that the resultant average annual benefits will amount to $20,666,000, giving a ratio of benefits to cost of 1.52. He estimates the costs and benefits for the individual items which can be justified to be as given in the following tabulation:

Item	Cost	Annual cost	Average annual benefit				Ratio
			Damage to existing development	Damage to future improvement	Incidental benefit	Total	
Los Angeles River:							
Channel and Hansen and Sepulveda flood-control basins [1]	$97,558,047	$5,205,091	$6,650,300	$1,300,800	$375,000	$8,826,100	1.69
Lopez flood-control basin and Pacoima wash	7,420,000	349,600	518,400	400,000	316,000	1,234,400	3.53
Caballero Creek	1,372,750	76,770	51,800	22,800	15,800	90,400	1.18
Tujunga wash	7,748,000	371,300	387,100	298,000	265,000	950,600	2.56
Wilson Canyon and Mansfield St. Channel	2,377,700	122,300	159,000	52,500	60,200	271,700	2.22
Lopez Canyon	301,900	20,500	18,100	6,000	9,000	33,100	1.62
Haines Canyon [1]	626,766	(2)	(2)	(2)	(2)	(2)	(2)

See footnotes at end of table.

Item	Cost	Annual cost	Average annual benefit				Ratio
			Damage to existing development	Damage to future improvement	Incidental benefit	Total	
Los Angeles River—Con.							
Blue Gum Canyon	$106,550	$7,200	$9,500	$1,000	$200	$10,700	1.49
Burbank Western System	6,280,000	335,900	236,000	156,000	36,900	428,900	1.20
Burbank Eastern System	7,601,000	352,900	446,000	196,000	81,400	723,400	2.05
Blanchard Canyon	255,700	17,400	20,200	4,500	1,000	25,700	1.47
Verdugo wash	2,179,313	(2)	(2)	(2)	(2)	(2)	(2)
Royal Blvd. and Dead Horse Canyon	404,000	22,700	51,000	0	0	51,000	2.25
Sycamore wash inlet [1]	27,985	(2)	(2)	(2)	(2)	(2)	(2)
Winery Canyon	497,300	29,000	25,000	5,500	3,400	33,900	1.17
Compton Creek to Hooper Ave. [1]	2,841,562	(2)	(2)	(2)	(2)	(2)	(2)
Compton Creek, Hooper to Main St	1,467,000	67,300	28,400	61,400	0	89,800	1.34
Basin total	139,125,573	7,265,243	8,632,800	3,080,000	1,168,200	12,881,000	1.77
San Gabriel River:							
Channel and Santa Fe and Whittier Narrows flood-control basins [1]	45,381,000	2,153,000	1,130,300	1,248,000	0	2,378,300	1.10
Walnut Creek system	24,411,900	1,183,900	710,100	395,600	135,700	1,250,400	1.06
Marshall Creek	915,500	56,800	43,400	23,800	9,900	77,100	1.36
Emerald and Live Oak washes	1,871,000	105,500	72,800	40,000	24,800	137,600	1.30
Thompson Creek and San Jose wash	3,797,900	193,100	65,500	36,000	140,100	241,600	1.25
Coyote Creek	9,851,000	465,500	235,600	258,000	0	493,600	1.06
Basin total	86,228,300	4,157,800	2,266,700	2,001,400	310,500	4,578,600	1.10
Rio Hondo:							
Channel, Santa Fe to Whittier flood-control basins	5,349,000	273,600	107,000	118,000	22,700	247,700	.91
Sawpit wash	2,084,200	120,600	46,400	30,600	160,000	237,000	1.97
Santa Anita and Sierra Madre washes	4,321,000	210,600	154,700	85,200	54,800	294,700	1.40
Arcadia wash system	4,717,500	240,400	170,800	113,000	46,400	330,200	1.38
Eaton wash	3,462,000	168,600	152,300	100,500	42,500	295,300	1.76
Sierra Madre Villa Channel	498,900	35,700	22,000	14,500	13,500	50,000	1.40
Rubio diversion	946,000	56,700	182,000	0	89,600	271,600	4.80
Alhambra wash [1]	1,205,613	(2)	(2)	(2)	(2)	(2)	(2)
Basin total	22,584,213	1,161,643	875,800	474,900	429,500	1,780,200	1.53
Ballona Creek:							
Channel and jetties [1]	1,950,100	(2)	(2)	(2)	(2)	(2)	(2)
Higgins and Coldwater Canyons	4,418,000	202,100	220,600	25,300	0	254,900	1.26
Benedict Canyon	4,680,000	222,400	563,600	62,000	0	625,600	2.82
Sepulveda Canyon and Sawtelle-Westwood system	8,225,000	389,500	383,100	43,400	0	426,500	1.10
Centinela Creek	953,500	46,900	16,500	31,600	0	48,100	1.02
Basin total	20,226,600	952,765	1,207,100	218,800	0	1,425,900	1.50
Total plan	[3] 268,164,686	13,537,451	12,982,400	5,775,100	1,908,200	20,665,700	1.52

[1] Item already included, as a whole or in part, in the existing project.
[2] Completed item of the existing project. Individual economic analysis was not made, but costs and benefits are included in basin totals.
[3] This total cost is made up of the following items:

Item	Existing project	Project extension	Total plan
Flood-control construction	$70,000,000	$145,445,900	$215,445,900
Relocation of utilities	2,286,908	5,069,300	7,356,208
Reconstruction of bridges	3,403,777	19,755,600	23,159,377
Lands and rights-of-way	6,850,701	15,352,500	22,203,201
Total cost	82,541,386	185,623,300	268,164,686

12. *Conclusions and recommendations of the district engineer.*—The district engineer finds that some extension of the existing project is justified and necessary for the proper functioning of the general plan for flood control, and that additional extension is justified by the tangible and intangible benefits which would accrue therefrom. His recommendations are essentially as follows:

(*a*) That the existing project be modified, by the inclusion of additional items in extension thereof, to complete the general plan for flood control as outlined in tabular form in paragraph 11 above, at an additional cost to the United States of $130,390,000 and an increase in the cost for maintenance and operation of the completed works to an estimated total of $1,330,000 per year.

(*b*) That local interests be required to (1) provide police protection for all completed flood-control works of the existing project and extension thereof; (2) hold and save the United States free from all claims for damages due to the construction and operation of the extension of the project, except damage claims based upon faulty manual operation of flood-control basins; (3) furnish, free of cost to the United States, all lands, easements, flowage rights, and rights-of-way necessary for channel improvement or channel rectification and for debris and flood-control dams and basins required for extension of the existing project; (4) assume the cost of the relocation of highways and highway bridges necessitated by extension of the existing project; and (5) contribute 40 percent of the cost of the construction of flood-control improvements on tributary channels, improvement of which is not essential to a proper functioning of the general flood-control plan, and which he considers in paragraph 112 of his report as "group C" improvements; all at an additional cost to local interests of about $55,230,000.

(*c*) That the United States pay all other costs and perform all other work entailed in connection with the construction, maintenance, and operation of the existing project and extension thereof.

(*d*) That all items in the extension of the existing project be executed according to plans to be approved by the Chief of Engineers, United States Army, and in the order directed by him.

(*e*) That the United States operate and maintain all flood-control works of the existing project and extension thereof, under the direction of the Secretary of War and supervision of the Chief of Engineers.

(*f*) That construction of those items upon which local contributions of 40 percent of construction costs are required shall be deferred until such time as the conditions of local cooperation have been complied with.

(*g*) That Federal funds for construction of the extension recommended be made available in allotments of not less than $20,000,000.

13. *Recommendation of the division engineer.*—The division engineer concurs in the conclusions and recommendations of the district engineer.

WARREN T. HANNUM,
Colonel, Corps of Engineers,
Division Engineer.

ENCLOSURES ACCOMPANYING THIS REPORT

(Only p. 1 of enclosure 1 printed)

Enclosure:

1. General maps:
   - Page 1. General plan.
   - Page 2. Distribution of population and areas subject to overflow.
   - Page 3. Principal highways and railroad lines.
   - Page 4. Los Angeles and San Gabriel Rivers, Rio Hondo, and Ballona Creek, location and condition of existing bridges after flood of March 2, 1938.
2. Statistics, Los Angeles County.
3. Tabulation of prior reports.
4. List of bridges.
5. History of past floods.
6. Hydrology in the Los Angeles County drainage area:
   - I. General.
   - II. Los Angeles River drainage system.
   - III. San Gabriel-Rio Hondo drainage system.
   - IV. Ballona Creek and Laguna Dominguez (Nigger Slough)
   - V. Climatology and meterology.
   - VI. Basic data for analysis of hydrology.
   - VII. Factors influencing method of computing design flood.
   - VIII. Computation of design flood by "rational method."
   - IX. Discussion of design and observed data.
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7. Description of the general plan.
8. Description of additional improvements considered but not recommended at this time.
9. General plan, Los Angeles River Basin:
   - Page 1. Index map, Los Angeles River Basin.
   - Pages 2 to 20. Los Angeles River, Owensmouth Avenue to Pacific Ocean.
   - Pages 21 to 23. Hansen flood-control basin.
   - Pages 24 to 28, Sepulveda flood-control basin.
   - Pages 29 to 30. Pacoima wash, Lopez flood-control basin.
   - Page 31. Caballero Creek.
   - Pages 32 to 34. Tujunga wash.
   - Pages 35 to 36. Pacoima wash.
   - Page 37. Wilson Canyon.
   - Pages 38 to 39. Mansfield Street Channel.
   - Page 40. Lopez Canyon.
   - Page 41. Index map, Burbank Western and Eastern Systems.
   - Pages 42 to 46. Burbank Western System.
   - Pages 47 to 48. Burbank Eastern System.
   - Page 49. Blue Gum Canyon.
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   - Page 56. Dead Horse Canyon.
   - Page 57. Winery Canyon.
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10. General plan, San Gabriel River, Rio Hondo, and Ballona Creek Basins:
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- Page 14. Anaheim Bay Bypass.
- Page 15. Alamitos Bay separation.
- Pages 16 to 19. Santa Fe flood-control basin.
- Pages 20 to 25. Whittier Narrows flood-control basin.
- Pages 26 to 28. Little Dalton wash.
- Pages 29 to 33. Big Dalton wash.
- Pages 34 to 36. San Dimas wash.
- Pages 37 to 40. Walnut Creek wash.
- Page 41. Marshall Creek.
- Pages 42 to 43. Emerald wash.

Page 44. Live Oak wash.
Pages 45 to 47. Thompson Creek.
Pages 48 to 50. San Jose wash.
Pages 51 to 55. Coyote Creek.
Pages 56 to 57. North Fork, Coyote Creek.

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Pages 65 to 67. Santa Anita wash.
Page 68. Sierra Madre wash.
Pages 69 to 73. Arcadia wash.
Pages 74 to 79. Eaton wash.
Page 80. Sierra Madre Villa Channel.
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BALLONA CREEK BASIN

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Page 84. Sepulveda Canyon.
Page 85. Sawtelle-Westwood system.
Page 86. Centinela Creek.

11. Additional improvements considered but not recommended:
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LOS ANGELES RIVER BASIN

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SAN GABRIEL RIVER BASIN

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FORMERLY TRIBUTARY TO LOS ANGELES RIVER

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12. Estimates of cost.
13. Economic analysis of flood-control improvements.
Part I. Method employed.
Part II. Application of method and description of overflow areas.
Part III. Detailed analyses of benefits and costs.

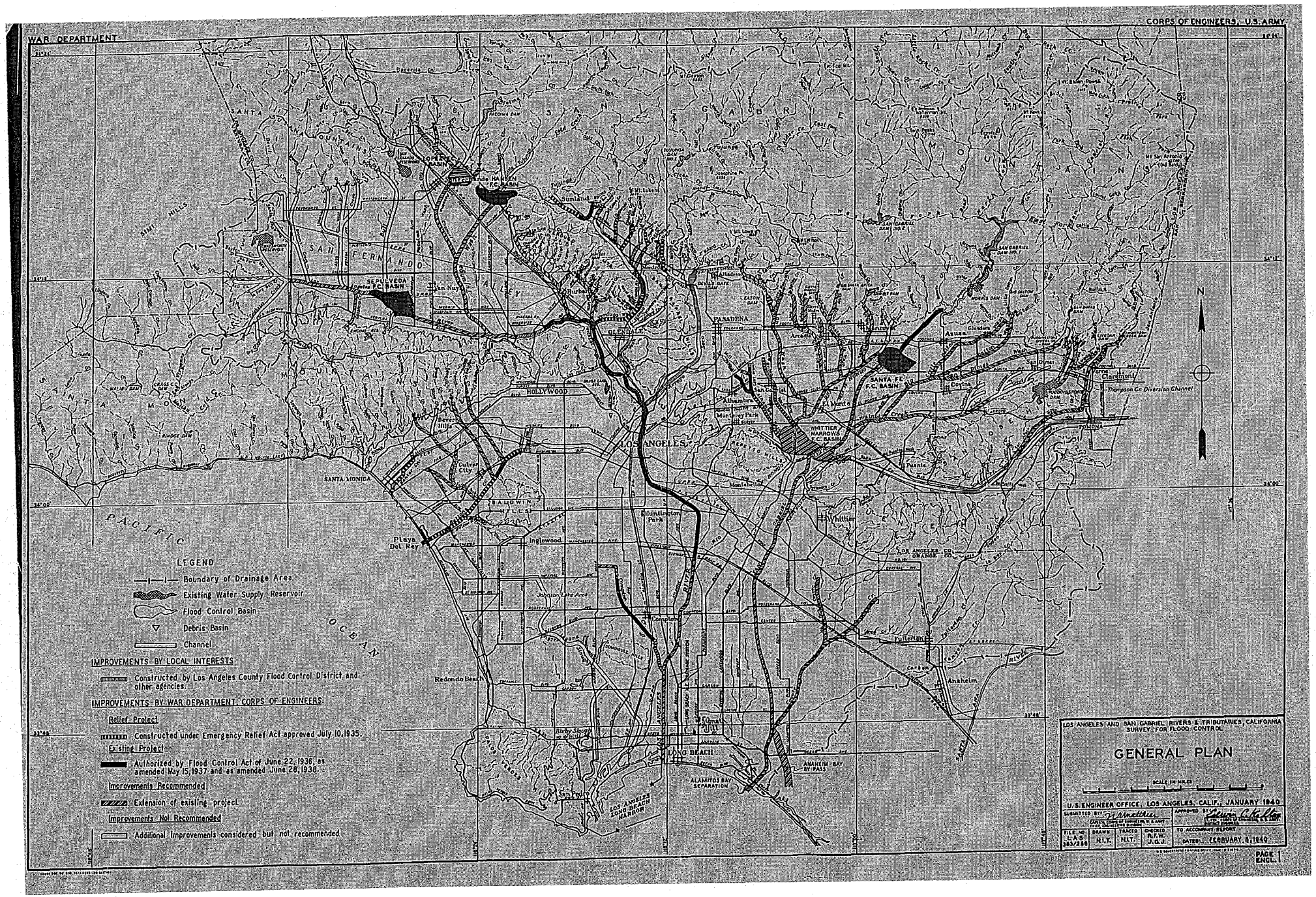
WAR DEPARTMENT
CORPS OF ENGINEERS, U.S. ARMY
LEGEND
Boundary of Drainage Area
Existing Water Supply Reservoir
Flood Control Basin
Debris Basin
Channel
IMPROVEMENTS BY LOCAL INTERESTS
Constructed by Los Angeles County Flood Control District and other agencies.
IMPROVEMENTS BY WAR DEPARTMENT, CORPS OF ENGINEERS
Relief Project
Constructed under Emergency Relief Act approved July 10, 1935.
Existing Project
Authorized by Flood Control Act of June 22, 1936, as amended May 15, 1937 and as amended June 28, 1938.
Improvements Recommended
Extension of existing project.
Improvements Not Recommended
Additional improvements considered but not recommended.
LOS ANGELES AND SAN GABRIEL RIVERS & TRIBUTARIES, CALIFORNIA
SURVEY FOR FLOOD CONTROL
GENERAL PLAN
U.S. ENGINEER OFFICE, LOS ANGELES, CALIF., JANUARY 1940
FEBRUARY 5, 1940
PACIFIC OCEAN
LOS ANGELES
LONG BEACH
PASADENA
GLENDALE
HOLLYWOOD
SANTA MONICA
Inglewood
Compton
Whittier
Anaheim
Pomona
Redondo Beach
Playa Del Rey
Sunland
Burbank
Alhambra
Monterey Park
Montebello
Huntington Park
Fullerton
Azusa
Covina
Claremont
Thompson Cr. Diversion Channel
SANTA FE F.C. BASIN
WHITTIER NARROWS F.C. BASIN
SEPULVEDA F.C. BASIN
HANSEN F.C. BASIN
LOPEZ F.C. BASIN
SAN FERNANDO VALLEY
SANTA SUSANA MOUNTAINS
SIMI HILLS
SANTA MONICA MOUNTAINS
SAN GABRIEL MOUNTAINS
BALDWIN HILLS
PALOS VERDES HILLS
ALAMITOS BAY SEPARATION
ANAHEIM BAY BY-PASS
LOS ANGELES LONG BEACH HARBOR
LOS ANGELES CO.
ORANGE CO.
N

EXHIBIT 2

Interest on judgments.

SEC. 57. The last sentence of subsection (b) of section 2516 of Title 28, United States Code, is amended by inserting immediately after the word "allowed" where it appears in such sentence the words "for any period", so that such subsection will read as follows:

"(b) Interest on judgments against the United States affirmed by the Supreme Court after review on petition of the United States shall be paid at the rate of four percent per annum from the date of the filing of the transcript of the judgment in the Treasury Department to the date of the mandate of affirmance. Such interest shall not be allowed for any period after the term of the Supreme Court at which the judgment was affirmed.".

Fees.

SEC. 58. Subsection (a) of section 2520 of Title 28, United States Code, is amended by striking out where it appears in such subsection the words "and the hearing of any case before the court, a judge, or a commissioner", so that such subsection will read as follows:

"(a) The Court of Claims shall by rules impose a fee not exceeding $10, for the filing of any petition.".

SEC. 59. (a) Chapter 165 of Title 28, United States Code, is amended by adding at the end thereof a new section to be designated as section 2521 entitled "Subpoenas" and to read as follows:

"§ 2521. Subpoenas

"Subpoenas requiring the attendance of parties or witnesses and subpoenas requiring the production of books, papers, documents or tangible things by any party or witness having custody or control thereof, may be issued for purposes of discovery or for use of the things produced as evidence in accordance with the rules and orders of the court. Such subpoenas shall be issued and served and compliance therewith shall be compelled as provided in the rules and orders of the court.".

(b) The analysis to chapter 165 of Title 28, United States Code, immediately preceding section 2501 of such title, is amended by adding at the end thereof a new item 2521 to read as follows:

"2521. Subpoenas.".

Approved September 3, 1954.

Public Law 780

CHAPTER 1264

September 3, 1954
[H. R. 9859]

AN ACT

Authorizing the construction, repair, and preservation of certain public works on rivers and harbors for navigation, flood control, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

River and Harbor Act of 1954.

TITLE I—RIVERS AND HARBORS

SEC. 101. That the following works of improvement of rivers and harbors and other waterways for navigation, flood control, and other purposes are hereby adopted and authorized to be prosecuted under the direction of the Secretary of the Army and supervision of the Chief of Engineers, in accordance with the plans and subject to the conditions recommended by the Chief of Engineers in the respective reports hereinafter designated: *Provided*, That the provisions of section 1 of the River and Harbor Act approved March 2, 1945 (Public, Numbered 14, Seventy-ninth Congress, first session), shall govern with respect to projects authorized in this title; and the procedures therein set forth with respect to plans, proposals, or reports for works of improvement for navigation or flood control and for irrigation and purposes incidental thereto, shall apply as if herein set forth in full:

59 Stat. 10.

Wisconsin.

Cornucopia Harbor, Wisconsin: House Document Numbered 434, Eighty-third Congress, at an estimated cost of $220,000;

Sheboygan Harbor, Wisconsin: House Document Numbered 554, Eighty-second Congress, at an estimated cost of $217,200;

Michigan.

Holland Harbor, Michigan: House Document Numbered 282, Eighty-third Congress, at an estimated cost of $574,400: *Provided*, That local interests will contribute 25 per centum of the cost of dredging Section B, but not to exceed $45,500, in addition to the local cooperation required by the project document;

Crooked and Indian Rivers, Michigan: House Document Numbered 142, Eighty-second Congress, at an estimated cost of $225,000:

Saginaw River, Michigan: In accordance with the report of the Chief of Engineers, dated June 7, 1954, at an estimated cost of $4,496,800;

Ohio.

Toledo Harbor, Ohio: House Document Numbered 620, Eighty-first Congress, at an estimated cost of $512,000;

Ashtabula Harbor, Ohio: House Document Numbered 486, Eighty-third Congress, at an estimated cost of $4,900,000;

Pennsylvania.

Erie Harbor, Pennsylvania: House Document Numbered 345, Eighty-third Congress, at an estimated cost of $174,000;

New York.

Black Rock Channel and Tonawanda Harbor, New York: House Document Numbered 423, Eighty-third Congress, at an estimated cost of $270,000;

Little River at Cayuga Island, Niagara Falls, New York: House Document Numbered 246, Eighty-third Congress, at an estimated cost of $36,900;

Oswego Harbor, New York: House Document Numbered 487, Eighty-first Congress, at an estimated cost of $2,459,000;

California.

Los Angeles and Long Beach Harbors, California: House Document Numbered 161, Eighty-third Congress, at an estimated cost of $896,500: *Provided*, That the Secretary of the Army is hereby authorized to reimburse local interests for such work as they may have done upon this project prior to July 1, 1953, at actual cost to local interests insofar as the same shall be approved by the Chief of Engineers and found to have been done in accordance with the project hereby adopted: *Provided further*, That such reimbursement shall be subject to appropriations applicable thereto or funds available therefor and shall not take precedence over other pending projects of higher priority for harbor improvement: *And provided further*, That such payments shall not exceed the sum of $500,000;

Playa del Rey Inlet and Harbor, Venice, California: House Document Numbered 389, Eighty-third Congress: *Provided*, That Federal participation in the provision of entrance jetties, entrance channel, interior channel and central basin recommended in the project report and presently estimated to cost $7,738,000 shall not exceed 50 per centum of the cost thereof;

Port Hueneme, California: House Document Numbered 362, Eighty-third Congress, at an estimated cost of $5,437,000;

Richmond Harbor, California: House Document Numbered 395, Eighty-third Congress, at an estimated cost of $2,086,000;

Oregon.

Rogue River, Harbor at Gold Beach, Oregon: Senate Document Numbered 83, Eighty-third Congress, at an estimated cost of $3,758,700;

Umpqua Harbor and River, Scholfield River at Reedsport, Oregon: Senate Document Numbered 133, Eighty-first Congress, at an estimated cost of $41,000;

Tillamook Bay and Bar, Oregon: Senate Document Numbered 128, Eighty-third Congress, at an estimated cost of $1,500,000;

Department of Beaches and Harbors

MAY 14 '03

	Info	Act
Director		
Chief ...ty Director		
Deputy Director		
Executive Assistant		
Admin. Services		
Asset Management		
Facilities Property Mtce		
Community Services		
Planning		

83D CONGRESS } HOUSE OF REPRESENTATIVES { DOCUMENT
2d Session } { No. 389

PLAYA DEL REY INLET AND BASIN, VENICE, CALIF.

LETTER

FROM

THE SECRETARY OF THE ARMY

TRANSMITTING

A LETTER FROM THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY, DATED AUGUST 8, 1952, SUBMITTING A REPORT, TOGETHER WITH ACCOMPANYING PAPERS AND AN ILLUSTRATION, ON A PRELIMINARY EXAMINATION AND SURVEY OF HARBOR AT PLAYA DEL REY, CALIF., AND A REVIEW OF REPORTS ON PLAYA DEL REY INLET AND BASIN, VENICE, CALIF., AS AUTHORIZED BY THE RIVER AND HARBOR ACT APPROVED ON AUGUST 26, 1937, AND REQUESTED BY A RESOLUTION OF THE COMMITTEE ON COMMERCE, UNITED STATES SENATE, ADOPTED ON JUNE 2, 1936

MAY 13, 1954.—Referred to the Committee on Public Works and ordered to be printed, with one illustration

DEPARTMENT OF THE ARMY,
Washington 25, D. C., May 11, 1954.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

DEAR MR. SPEAKER: I am transmitting herewith a report dated August 8, 1952, from the Chief of Engineers, Department of the Army, together with accompanying papers and an illustration, on a preliminary examination and survey of Harbor at Playa del Rey, Calif., and a review of reports on Playa del Rey Inlet and Basin, Venice, Calif., with a view to determining whether any improvement of the locality is warranted at the present time, authorized by the River and Harbor Act approved on August 26, 1937, and requested by a resolution of the Committee on Commerce, United States Senate, adopted on June 2, 1936.

47022—54——1

In accordance with section 1 of Public Law 14, 79th Congress, the views of the State of California and the Department of the Interior are set forth in the enclosed communications.

The Bureau of the Budget advises that while there is no objection to submission of the report to Congress, authorization of the improvement recommended therein would not be in accord with the program of the President unless the Federal participation is limited to 50 percent of the cost of the general navigation facilities. The complete views of the Bureau of the Budget are contained in the attached copy of its letter.

Sincerely yours,

ROBERT T. STEVENS,
Secretary of the Army.

COMMENTS OF THE BUREAU OF THE BUDGET

EXECUTIVE OFFICE OF THE PRESIDENT,
BUREAU OF THE BUDGET,
Washington 25, D. C., April 28, 1954.

The honorable the SECRETARY OF THE ARMY.

MY DEAR MR. SECRETARY: Your letter dated March 20, 1953, states that no modifications or revisions need be made from the standpoint of general policy or procedure in the 27 final proposed reports of the Chief of Engineers pending in the Bureau of the Budget on January 20, 1953. One of these is the report on the project at Playa del Rey, Calif. This report had been authorized by the River and Harbor Act approved on August 26, 1937, and requested by a resolution of the Committee on Commerce, United States Senate, adopted on June 2, 1936. Acting Secretary Johnson submitted the report to this office on August 19, 1952.

The Chief of Engineers recommends, subject to certain conditions of local cooperation, the provision of a harbor at Playa del Rey, Calif. First costs to the United States, including aids to navigation, are estimated at $6,193,000 by the Board of Engineers for Rivers and Harbors. First costs to local interests are estimated at $19,427,000. It is noted that the Board's estimate of $25,620,000 for total first costs is based largely on cost estimates made in 1948. On this basis, annual costs are computed to be $933,025. Annual benefits are estimated at $1,296,000. The resulting benefit-cost ratio is 1.4.

The Chief of Engineers considers the proposed Federal participation in the project appropriate "if it is the intent of Congress to provide Federal assistance in the development of recreational boating facilities of the type proposed in this report."

The President in his 1955 budget message stated that, "to the greatest extent possible, the responsibility for resource development, and its cost, should be borne by those who receive the benefits." The benefits from Playa del Rey harbor evidently will be largely local in character. While it is recognized that under the proposed plan local interest will be required to spend large sums for lands,

piers, bulkheads, floats, paving, and other facilities, they would be making no contribution to the cost of the general navigation features of the project. The vessel berthing and shore works are items which traditionally have been furnished by local interests in the case of all navigation improvements to insure effective use of the facilities provided by the Federal Government.

We believe that the Federal share of the costs of all recreational harbors should be limited to not more than 50 percent of the first cost of providing the general navigation facilities. In the case of Playa del Rey the general facilities appear to include the jetties, entrance channel, interior channel, and central basin.

Accordingly, while there would be no objection to submission of the report on Playa del Rey Harbor to Congress, authorization of the improvement recommended therein would not be in accord with the program of the President unless the Federal participation is limited to 50 percent of the cost of the general navigation facilities.

Sincerely yours,

DONALD R. BELCHER, *Assistant Director.*

COMMENTS OF THE STATE OF CALIFORNIA

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS,
Sacramento, June 26, 1952.

Gen. LEWIS A. PICK,
Chief of Engineers,
Department of the Army, Washington, D. C.

DEAR SIR: Your proposed report on a review of reports on and preliminary examination and survey of Playa del Rey Inlet and Basin, Venice, Calif., was received on April 7, 1952, and transmitted on the same date to the division of water resources of this department for review and report thereon.

The report of the division of water resources has been received and is transmitted herewith in accordance with the provisions of Public Law 14, 79th Congress, 1st session.

I concur in the recommendations contained in the report of the division of water resources and it is requested that said report be considered as expressing the views and recommendations of the State of California on your proposed report on a review of reports on and preliminary examination and survey of Playa del Rey Inlet and Basin, Venice, Calif. It is further requested that the report of the division of water resources, dated June 26, 1952, on this subject be transmitted to the President of the United States and to the Congress along with the other material that may be so transmitted.

Very truly yours,

FRANK B. DURKEE,
Director of Public Works.

REVIEW BY STATE DIVISION OF WATER RESOURCES OF PROPOSED REPORT OF THE CHIEF OF ENGINEERS, UNITED STATES ARMY, ON PLAYA DEL REY INLET AND BASIN, VENICE, CALIF.

INTRODUCTION

In accordance with the provisions of section 1 of Public Law 14, 79th Congress, the proposed report of the Chief of Engineers, United States Army, on Playa del Rey Inlet and Basin, Venice, Calif., together with the reports of the Board of Engineers for Rivers and Harbors and of the district and division engineers, was transmitted by the Chief of Engineers on March 31, 1952, to Mr. Frank B. Durkee, director of public works, the official designated by Gov. Earl Warren as his representative in such matters. The report was received and referred to the State engineer on April 7, 1952, for review and report thereon. Thereafter, the reports were transmitted by the State engineer to Seth Gordon, director, department of fish and game; Rufus W. Putnam, executive officer of the State lands commission; Newton B. Drury, chief, division of beaches and parks of the department of natural resources; and G. T. McCoy, State highway engineer.

Authority for report

The report was prepared pursuant to a resolution adopted June 2, 1936, which reads as follows:

Resolved by the Committee on Commerce of the United States Senate, That the Board of Engineers for Rivers and Harbors, created under section 3 of the River and Harbor Act approved June 13, 1902, be, and is hereby, requested to review the reports on Playa Del Rey Inlet and Basin, Venice, California, printed in House Document No. 1880, 64th Congress, 2d session, with a view to determining whether any improvement of the locality is warranted at the present time.

Further authorization was contained in Public Law 392, 75th Congress, approved August 26, 1937, which reads in part as follows:

SEC. 4. The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys to be made at the following-named localities, * * * harbor at Playa Del Rey, California * * *.

A review of reports on Playa del Rey Inlet and Basin, Venice, Calif., and preliminary examination of the harbor at Playa del Rey, Calif., dated May 26, 1939, was submitted by the district engineer in accordance with the foregoing authorizations. The district engineer's report was reviewed by the Board of Engineers for Rivers and Harbors, and a report of survey scope was authorized by the Chief of Engineers on April 6, 1944, to determine the advisability and cost of improvement and the local cooperation required.

Recommendations of the Chief of Engineers

The following is quoted from the proposed report of the Chief of Engineers now under review:

After full consideration of the reports secured from the district and division engineers, and after affording local interests full opportunity to be heard, the Board recommends provision of a harbor at Playa del Rey, Calif., to consist of 2 entrance jetties each about 2,300 feet long; an entrance channel 20 feet deep, 600 feet wide, and 1,925 feet long; an interior channel 20 feet deep, 600 feet wide, and 5,600 feet long; a central basin 10 feet deep; and 2 side basins 20 feet deep and 10 side basins 10 feet deep, separated by mole-type piers; the dredged material to be utilized for construction of the piers and for deposition on adjacent lowlands and beaches; all generally in accordance with the plan of the district engineer and the comments herein, and with such modifications thereof as in the discretion

of the Chief of Engineers may be advisable; at an estimated cost to the United States of $6,151,000 for construction and $25,000 annually for maintenance, subject to the condition that local interests agree to (*a*) provide without cost to the United States all rights-of-way necessary for construction and maintenance of the improvement and furnish suitable spoil-disposal areas for initial work and subsequent maintenance when and as required; (*b*) secure and hold in the public interest lands bordering on the proposed development to a width sufficient for proper functioning of the harbor; (*c*) relocate oil wells and relocate and construct public utilities as required; (*d*) construct a bulkhead around basin K and stone revetment on the side slopes of the remaining basins; (*e*) extend the north jetty at Ballona Creek to a length sufficient to hold the fill to be placed on the beach to the north thereof; (*f*) provide adequate berthing and other facilities for small craft; (*g*) provide adequate parking areas, access roads, and landscaping of the piers; (*h*) establish a public body to regulate the use and development of the harbor facilities which shall be open to all on equal terms; (*i*) dredge or bear the actual cost of dredging the 12 side basins; (*j*) maintain and operate the entire project except aids to navigation, entrance jetties, and project depths in the entrance channel, the interior channel, and in the central basin; and (*k*) hold and save the United States free from damages due to the construction and maintenance of the improvement; and also subject to the condition that adoption of a project as recommended shall not relieve local interests of responsibility for stabilization of beach fill along the shores of Santa Monica Bay with such Federal assistance as may be authorized following completion of the cooperative beach erosion control study now in progress. The local cooperation is estimated to cost $19,427,000.

3. The proposed improvements are designed to meet recreational boating needs and are not significant from the standpoint of commercial navigation. The preponderance of benefits accruing to local interests as compared with general benefits of the type which warrant Federal participation is reflected in the relatively large non-Federal expenditures contemplated as compared with the proposed Federal costs. The proportion of Federal and non-Federal participation recommended by the Board of Engineers for Rivers and Harbors is considered appropriate if it is the intent of Congress to provide Federal assistance in the development of recreational boating facilities of the type proposed in this report. Subject to this, I concur in the views and recommendations of the Board. I further recommend that any authorizing legislation provide that construction shall not be initiated until conditions are such that the work will not interfere with the effort needed to meet existing and prospective emergency requirements.

Description of area

Playa del Rey is located in the central portion of the coast of Santa Monica Bay, about 26 miles upcoast by water from Los Angeles Harbor, and 3 miles downcoast from Santa Monica Harbor. The site proposed for the small craft harbor consists of about 1,200 acres of salt marshlands lying immediately north of the Ballona Creek flood-control channel and south of the Venice district. It is included within the incorporated area of the city of Los Angeles.

In 1903, as part of a real estate development, a series of canals was dredged in the Venice area. Many of these canals have since been filled and utilized for city streets, but the main canal still traverses the proposed harbor site, paralleling the coast and connecting with tide gates in the Ballona Creek channel. There is no navigable connection between the sloughs of the proposed harbor area and the ocean, and the Venice canals are utilized only by rowboats. The Federal Government completed the Ballona Creek flood-control channel and jetties in 1938. This trapezoidal channel is 200 feet wide, with stone paved sides on 1 on 3 slopes. The original random stone jetties at the mouth of the channel were extended by the city of Los Angeles in 1946, and are now about 1,350 feet in length. The harbor site includes a part of the Venice oilfield. Production from this field has declined from a peak exceeding 40,000 barrels per day in the discovery year of 1930 to about 2,300 barrels per day during 1946. About 40 wells have been

abandoned due to low production and salt-water intrusion, leaving 111 wells on low production.

Local interests consider that the proposed harbor at Playa del Rey would be an integral unit of an adopted general plan for development of the Santa Monica Bay shoreline. This plan includes widening and improving beaches, providing adequate bath houses, parking areas, picnic facilities, special recreation centers, bathing and wading beaches, fishing piers, youth organization camps, tourist parks with cabin and trailer accommodations, and a bird refuge.

Cost of proposed works

In the report of the district engineer, the total first cost of the project is given as $25,603,000, with a Federal first cost of $9,098,000 and non-Federal first cost of $16,505,000. The total annual carrying charges would be $919,920, and the annual benefits would be $1,529,000. The benefit-cost ratio of the proposed harbor project would be 1.7 to 1.

The Board of Engineers for Rivers and Harbors, in reviewing the report of the district engineer, reevaluated the costs and benefits estimated by the district engineer. In considering both the evaluated and intangible benefits, the Board stated in its report that the Federal interest in the proposed improvement would be served by Federal participation to the extent of providing and maintaining the entrance jetties, entrance channel, interior channel, and central basin shown on the maps accompanying the district engineer's report, all at an estimated first cost of $6,151,000 for construction exclusive of aids to navigation, and $25,000 annually for maintenance, with local interests providing and maintaining all other works including dredging of the side basins at an estimated first cost of $19,427,000.

The Board of Engineers for Rivers and Harbors also reduced the benefits allocated by the district engineer to sport fishing vessels from $280,000 to $47,000, making the total annual benefits $1,296,000. Subsequent to the submission of the report by the district engineer, the United States Coast Guard submitted a revised estimate of $42,000 for first cost of aids to navigation, an increase of $17,000, making a total first cost of the project of $25,620,000. The total annual carrying charges are estimated by the Board to be $933,025, of which $277,555 is Federal, and $655,470 is non-Federal, giving a benefit-cost ratio of 1.4. The recommendation of the Board of Engineers for Rivers and Harbors as to Federal participation is concurred in by the Chief of Engineers.

Local contributions

At its meeting on April 25, 1946, the City Council of Los Angeles adopted a report declaring that the public interest and welfare of the city of Los Angeles and vicinity require the provision of additional small craft facilities by means of construction of a small craft harbor at Playa del Rey, assisting the Federal Government in such undertaking by assuming those obligations required under Federal law in connection [redacted] project.

By resolu[redacted]pted September 28, 1948, and June 7, 1949, the Board of Su[redacted] of the County of Los Angeles declared that the public interest and welfare of the county of Los Angeles and its citizens require that provision be made for additional small craft facilities by means of construction of a small craft harbor at Playa del

Rey. The Board agreed, insofar as it is authorized by law and the favorable vote of the electorate to do so, to assume the following obligations in connection with the Playa del Rey Harbor project:

(1) Provide without cost to the United States all lands, easements, and rights-of-way for the construction and maintenance of the proposed improvements;

(2) Hold and save the United States free from all claims for damages arising from the construction or operation of the improvement;

(3) Assume the cost of alteration, relocation, or rebuilding of highways and highway bridges, or arrange for the alteration, relocation, or rebuilding of these highways and highway bridges without cost to the United States;

(4) Assume the cost of relocation or reconstruction of utilities or drainage structures;

(5) Contribute in cash or equivalent work, the cost of a steel sheet pile bulkhead and stone revetment required in the side basins;

(6) Provide without cost to the United States all necessary slips and slip facilities and facilities for the repair, service, and supply of small craft on terms reasonable and equal to all;

(7) Secure and hold for public interest lands bordering on the proposed improvement to a depth sufficient for the proper functioning of the harbor;

(8) Furnish assurances satisfactory to the Secretary of War that the area will be improved by the construction of slips, utilities, repair facilities, and other appurtenant works, without cost to the United States and at a rate that will result in complete development of the harbor area within a reasonable time in accordance with plans and time schedules to be approved by the Secretary of War;

(9) Assume the cost of extending the upcoast jetty at Ballona Creek flood-control channel.

(10) Operate and maintain the entire project except aids to navigation, entrance jetties, and project depths in the entrance and interior channels, and in central basin.

According to the report of the Board of Engineers for Rivers and Harbors, local interests were advised of the reduction in financial participation by the Federal Government in the first cost of the project and, at a public hearing held by the Board of Engineers for Rivers and Harbors in the area of the desired improvement, local interests indicated they would endeavor to cooperate in the work of improvement to the extent considered necessary by the Board.

COMMENTS BY STATE AGENCIES

The proposed report of the Chief of Engineers on survey, navigation Playa del Rey Inlet and Basin, Venice, Calif., has been reviewed. As a result of this review and study, the following comments are respectfully submitted:

Division of Water Resources

The following is quoted from the district engineer's report concerning the effect of the construction of the project on saline contamination of the ground waters of the west coast basin:

50. *Saline contamination.*—An investigation was made concerning the effects of the proposed harbor on saline contamination of underground water. This investigation indicated that (1) sea water has already contaminated the ground water

within most of the area that would be occupied by the harbor; (2) further landward progress of this contamination depends primarily on the rate of withdrawal of ground water in the vicinity of the harbor site and on the steepness of the landward gradient produced by this withdrawal; and (3) introduction of sea water by constructing the harbor would not modify existing ground-water conditions.

Available information confirms conclusion No. 1 of the district engineer, as quoted above. Fieldwork in the area disclosed the following information:

1. Three active irrigation wells are situated within the perimeter of the proposed site. An additional 7 active irrigation wells are situated within 3,000 feet of the perimeter of the harbor. A total of 26 active irrigation wells are located within the area investigated, the most distant well being situated about 9,000 feet from the harbor perimeter.

2. Partial analyses of water samples obtained in April 1952 from 2 active water wells located within the perimeter of the proposed harbor show 640 and 486 parts per million chloride, respectively. The chloride content of ocean water is about 18,000 parts per million.

Water samples from 2 other active wells located within 2,000 feet of the perimeter contained 213 and 355 parts per million chloride, respectively. Samples from 2 more wells located 3,700 and 8,400 feet east of the eastern perimeter contained 216 and 284 parts per million chloride, respectively.

3. A rapid crop survey covering the area in the vicinity of the proposed Playa del Rey Harbor project indicates approximately 1,200 acres of truck crops are presently irrigated from wells. Based on an assumed consumptive-use factor of 1.7 acre-feet per acre and an assumed irrigation efficiency of 50 percent, annual consumption is about 2,000 acre-feet and well water production about 4,000 acre-feet per annum.

The district engineer's quoted conclusion No. 2 is likewise believed to be essentially correct concerning the present situation. Saline contamination of ground water in the Playa del Rey area was first noted in wells near the ocean in the 1920's. Coincident with increased pumping draft in the west coast basin, accompanied by further lowering of the water table below sea level, the saline intrusion progressively moved inland until by 1945–46 the limit of 500 parts per million of chloride contamination was from 1½ to 2 miles from the ocean in the Playa del Rey area.

Water level measurements in Ballona Gap in the spring of 1950 indicated the water table to be sloping inland from the coastline with a maximum gradient of about 6 feet per mile.

The proposed harbor overlies an important aquifer known as the "50-foot gravel," so named because the average depth of its base is about 50 feet below ground surface. In the vicinity of the site of the harbor the top of this aquifer is 40 to 45 feet below land surface. A study of the logs of 14 wells located within one-half mile of the perimeter of the harbor site indicates the aggregate thickness of relatively impervious material contained in the sediments overlying the aquifer to vary from 0 to 16 feet. Average aggregate thickness of clay above the aquifer is about 9 feet. In general, a large percentage of the impermeable material above the 50-foot gravel occurs near the land surface.

The General Plan of Improvement (enclosure 1 of the report) indicates dredgings to a depth of 20 feet below sea level, representing excavation to a total depth of roughly 25 feet below the present land

surface. Such dredging will obviously decrease the thickness of impermeable material lying between the floor of the harbor and the top of the water-bearing zone, thereby decreasing the resistance offered to the percolation of sea water into the aquifer.

From the foregoing observations, it is believed that the quoted conclusion No. 3 of the district engineer is contrary to what may be expected if the harbor is constructed, and that construction of the harbor would aggravate the present conditions of sea-water intrusion and endanger the water quality of wells located near its perimeter in the following ways:

1. By reducing (through dredging) the thickness of relatively impermeable materials which lie between the surface and the top of the 50-foot gravel aquifer.

2. By increasing the landward slope of the water table and consequently the rate of landward flow of saline water. This slope would be increased as a result of moving the shoreline inland through construction of the harbor.

3. By decreasing the lateral distance that sea water must travel to reach producing wells.

It is believed that if this project is pursued, the ruination of water wells in the immediate vicinity of the harbor should be contemplated. However, the present landward sloping water table indicates that the threat of ocean water pollution already exists at these wells. Also, lands presently irrigated in the vicinity are rapidly being subdivided, and these subdivisions are being served with domestic water imported from outside sources. For these reasons, and because of the probable increase in property values due to the harbor project, ultimate benefits may offset the possible damage to the limited ground-water supply.

Division of Highways

G. T. McCoy, State highway engineer, by communication dated June 11, 1952, submitted the following:

> State highway routes will not be directly affected by the recommended plan of the harbor improvement. The proposed development plan of the local planning commission includes provisions for access parkway facilities which will cross and connect with U. S. 101, State Route 60. It is understood that such development involving interchanges or alterations affecting the State highway will be undertaken as part of the obligations of the local interests without commitment of the Division of Highways to costs thereof. The Division of Highways' attitude with respect to the project will, we assure you, be cooperative.

State Lands Commission

Col. Rufus W. Putnam, executive officer of the State Lands Commission, submitted the following comments on April 15, 1952:

> The jurisdiction of the tide and submerged lands adjacent to the proposed harbor development is in the city of Los Angeles by legislative grant. No State lands under the jurisdiction of the State Lands Commission are affected by the proposed development.

Department of Fish and Game

Seth Gordon, director, Department of Fish and Game, by communication dated June 6, 1952, submitted the following:

> We do not believe the project would have any harmful effect on the fisheries. However, the benefit figures given for sport-fishing operations (p. 33) are optimistic. Operations at Palya del Rey would draw fishermen away from other landings rather than add new fishermen, it is believed.
> It would affect a small waterfowl marsh.

47022—54——2

Department of Natural Resources

Newton B. Drury, chief, Division of Beaches and Parks of the Department of Natural Resources, on June 18, 1952, stated that the thoughts expressed in the comments previously submitted to the district engineer on January 6, 1949 still reflect the reaction of the division to the project.

The comments, submitted by Gen. Warren T. Hannum, director of natural resources, on January 6, 1949, are as follows:

(*a*) It is found that plan of development as proposed in the district engineer's report would provide a greatly needed harbor for light craft vessesl, and as a harbor refuge for such craft cruising along the coast.

(*b*) That the proposed harbor development is in general in conformity with the county master plan as approved by the State Park Commission.

(*c*) That there is no State cooperation proposed in the plan, the city of Los Angeles having expressed its desire and willingness to meet the requirements of local cooperation as set forth by the district engineer.

(*d*) That the incidental benefits to the State park system, due to the deposit of sand on the beaches both upcoast and downcoast from the proposed entrance jetties would be very great.

It is recommended therefore, that the report be approved with a favorable comment indicating the advantages to the State park system from the deposit of sand on the Santa Monica beaches.

CONCLUSIONS

The following conclusions are submitted with respect to improvements recommended by the Chief of Engineers in his proposed report on Playa del Rey Inlet and Basin, Venice, Calif., giving consideration to (*a*) need for the project (*b*) engineering feasibility and effectiveness of the proposed works, and (*c*) economic justification for the project:

1. The improvements will provide a desirable addition to small-craft facilities along the southern California coast. The project is an integral part of the general plan for development of the shoreline of Santa Monica Bay.

2. Local interest in and approval of the project have been demonstrated by resolution of the city council of the city of Los Angeles, and by resolution of the Board of Supervisors of the County of Los Angeles, giving assurance that the county will assume those non-Federal contributions and obligations in connection with the project which are required by Federal law.

3. The improvements appear to be of sound and adequate design and feasible of construction and operation.

4. Construction of the proposed harbor will introduce ocean water inland a distance of more than 1 mile, and increase the rate of saline contamination of ground waters of the west coast basin. Except in this respect, the proposed works will not conflict with any beneficial consumptive use, present or future, of water for domestic, municipal, stock water, irrigation, mining, or industrial purposes.

RECOMMENDATIONS

It is recommended that the plan of improvement for the small-craft harbor at Playa del Rey Inlet and Basin, Venice, Calif., as recommended by the Chief of Engineers, be authorized for construction, and that Federal funds be appropriated for the purpose.

SACRAMENTO, CALIF., *June 26, 1952.*

A. D. EDMONSTON,
State Engineer.

COMMENTS OF THE DEPARTMENT OF THE INTERIOR

UNITED STATES DEPARTMENT OF THE INTERIOR,
OFFICE OF THE SECRETARY,
Washington 25, D. C., July 25, 1952.

Lt. Gen. LEWIS A. PICK,
Chief of Engineers, Department of the Army,
Washington, D. C.

MY DEAR GENERAL PICK: This is in response to your letter of March 31 transmitting for review by the Department of the Interior copies of your proposed report on the Playa del Rey Inlet and Basin, Calif. Your letter also transmitted copies of the reports of the Board of Engineers for Rivers and Harbors and of the district and division engineers.

Your proposed report recommends that the Federal Government undertake the construction of a harbor at Playa del Rey, Calif., for the use of small boats, subject to deferment of construction until conditions are such that the project would not interfere with existing or prospective emergency requirements on the national economy. The improvement would consist of two entrance jetties, an entrance channel, an interior channel, a central basin, 12 side basins, and a number of piers. The cost to the United States of the improvement would be $6,151,000 for construction, exclusive of aids to navigation, and $25,000 annually for maintenance. The construction cost to local interests for the improvement would total an additional $19,427,000.

The harbor would be built almost wholly for the benefit of pleasure craft owned by private individuals in the Los Angeles area. The benefits from the construction of the harbor are shown to be $1,529,000 annually in the report of the district engineer, of which $805,000 are designated as "general (Federal) benefits" and $724,000 as local (non-Federal) benefits. Those benefits classed as Federal consist of $450,000 for recreational harbor benefit, $75,000 for prevention of boat damage, and $280,000 for increased fish catch. The Board of Engineers for Rivers and Harbors, however, finds the latter figure excessive and reduces it in the Board's report to $47,000. In our view this is the only legitimate Federal benefit from the project. We have serious doubts that prevention of boat damage or recreational harbor benefits to local boatowners can be classed by any stretch of logic as "general Federal benefits."

We note that the proposed report of the Chief of Engineers indicates that the Department of the Army also has serious question as to the soundness of a policy of spending Federal funds on a single-purpose project primarily for the benefit of local pleasure craft owners. Paragraph 3 of this proposed report states that the proportion of Federal and non-Federal participation is considered appropriate "if it is the intent of Congress to provide Federal assistance in the development of recreational boating facilities of the type proposed in this report."

Should the proposed project be constructed in accordance with the plan presented in the report, it can be expected that hundreds of other communities will seek the same type of project with comparable Federal participation. It therefore seems to us important that a policy covering this point with respect to projects of the Corps of Engineers be clearly established. It is suggested that the final draft of the report of the Chief of Engineers contain a suitable recommendation on this matter.

Paragraph 49 of the district engineers report covers the effect of the harbor improvement on wildlife resources. It is noted that the Fish and Wildlife Service of this Department in a letter of April 26, 1946, indicated that no objection will be interposed to construction of the project on account of the elimination of certain wildlife habitat. The district engineer also received a letter from the regional director of the Fish and Wildlife Service dated September 14, 1949, commenting on the project. It is suggested that these letters from a part of the enclosures accompanying the survey report when it is transmitted to the Bureau of the Budget and to the Congress. I endorse the position taken in these communications to the district engineer from the Fish and Wildlife Service.

Opportunity to review and comment on the reports is sincerely appreciated.

Sincerely yours,

MASTIN G. WHITE,
Acting Secretary of the Interior.

REPORT OF THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY

DEPARTMENT OF THE ARMY,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington 25, D. C., August 8, 1952.

Subject: Playa del Rey Inlet and Basin, Venice, Calif.
To: The Secretary of the Army.

1. I submit herewith for transmission to Congress the report of the Board of Engineers for Rivers and Harbors in response to resolution of the Committee on Commerce of the United States Senate, adopted June 2, 1936, requesting the Board to review the reports on Playa del Rey Inlet and Basin. Venice, Calif., printed in House Document No. 1880, 64th Congress, 2d session, with a view to determining whether any improvement of the locality is warranted at the present time. It is also in review of the reports on preliminary examination and survey of harbor at Playa del Rey, Calif., authorized by the River and Harbor Act approved August 26, 1937.

2. After full consideration of the reports secured from the district and division engineers, and after affording local interests full opportunity to be heard, the Board recommends provision of a harbor at Playa del Rey, Calif., to consist of 2 entrance jetties each about 2,300 feet long; an entrance channel 20 feet deep, 600 feet wide, and 1,925 feet long; an interior channel 20 feet deep, 600 feet wide, and 5,600 feet long; a central basin 10 feet deep; and 2 side basins 20 feet deep and 10 side basins 10 feet deep, separated by mole-type piers; the dredged material to be utilized for construction of the piers and for deposition on adjacent lowlands and beaches; all generally in accordance with the plan of the district engineer and the comments herein, and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable; at an estimated cost to the United States of $6,151,000 for construction and $25,000 annually for maintenance, subject to the condition that local interests agree to: (*a*) provide without cost to the United States all rights-of-way necessary for construction and maintenance of the improvement and furnish suitable spoil-disposal areas for initial work and subsequent main-

tenance when and as required; (*b*) secure and hold in the public interest lands bordering on the proposed development to a width sufficient for proper functioning of the harbor; (*c*) relocate oil wells and relocate and construct public utilities as required; (*d*) construct a bulkhead around basin K and stone revetment on the side slopes of the remaining basins; (*e*) extend the north jetty at Ballona Creek to a length sufficient to hold the fill to be placed on the beach to the north thereof; (*f*) provide adequate berthing and other facilities for small craft; (*g*) provide adequate parking areas, access roads, and landscaping of the piers; (*h*) establish a public body to regulate the use and development of the harbor facilities which shall be open to all on equal terms; (*i*) dredge or bear the actual cost of dredging the 12 side basins; (*j*) maintain and operate the entire project except aids to navigation, entrance jetties, and project depths in the entrance channel, the interior channel, and in the central basin; and (*k*) hold and save the United States free from damages due to the construction and maintenance of the improvement; and also subject to the condition that adoption of a project as recommended shall not relieve local interests of responsibility for stabilization of beach fill along the shores of Santa Monica Bay with such Federal assistance as may be authorized following completion of the cooperative beach-erosion-control study now in progress. The local cooperation is estimated to cost $19,427,000.

3. The proposed improvements are designed to meet recreational boating needs and are not significant from the standpoint of commercial navigation. The preponderance of benefits accruing to local interests as compared with general benefits of the type which warrant Federal participation is reflected in the relatively large non-Federal expenditures contemplated as compared with the proposed Federal costs. The proportion of Federal and non-Federal participation recommended by the Board of Engineers for Rivers and Harbors is considered appropriate if it is the intent of Congress to provide Federal assistance in the development of recreational boating facilities of the type proposed in this report. Subject to this, I concur in the views and recommendations of the Board. I further recommend that any authorizing legislation provide that construction shall not be initiated until conditions are such that the work will not interfere with the effort needed to meet existing and prospective emergency requirements.

LEWIS A. PICK,
Lieutenant General, Chief of Engineers.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS

CORPS OF ENGINEERS, UNITED STATES ARMY,
BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
Washington 25, D. C., October 30, 1951.

Subject: Playa del Rey Inlet and Basin, Venice, Calif.
To: The Chief of Engineers, Department of the Army.

1. This report is submitted in response to the following resolution adopted June 2, 1936:

Resolved by the Committee on Commerce of the United States Senate, That the Board of Engineers for Rivers and Harbors, created under section 3 of the River and Harbor Act approved June 13, 1902, be, and is hereby, requested to review the reports on Playa del Rey Inlet and Basin, Venice, Calif., printed in House Document No. 1880, 64th Congress, 2d session, with a view to determining whether any improvement of the locality is warranted at the present time.

It is also in review of the reports on preliminary examination and survey of harbor at Playa del Rey, Calif., authorized by the River and Harbor Act approved August 26, 1937.

2. Playa del Rey is on Santa Monica Bay on the coast of California, 20 miles northwest of Los Angeles Harbor. The proposed harbor site consists largely of salt marsh and lowlands traversed by a number of canals and sloughs with depths varying from 2 to 10 feet below mean lower low water. It is separated from Santa Monica Bay by a narrow beach. There is no navigable outlet from the proposed harbor site to Santa Monica Bay. Ballona Creek flows through an artificial channel along the southerly side of the proposed harbor. A tide gate connecting the interior canals and sloughs with Ballona Creek provides a drainage outlet through Ballona Creek and inlet to Santa Monica Bay. The mean range of tide in Santa Monica Bay is 3.7 feet and the extreme range is 10.5 feet. The Venice district of the city of Los Angeles adjoins the proposed harbor on the north. There is no existing Federal project for improvement for navigation at Playa del Rey. There is, however, an existing Federal flood-control project for Ballona Creek which forms part of a comprehensive approved plan for flood control and other purposes for Los Angeles County drainage area, California. It includes construction of channel improvements along Ballona Creek; 2 stone jetties extending into the ocean for approximately 800 feet; highway and railroad bridges; and a tide gate connecting the proposed harbor site with Ballona Creek. Construction of these improvements was completed in 1940. In 1946 the city of Los Angeles extended the jetties 580 feet in connection with a beach-widening program. In times past, local interests constructed canals in the Venice area, constructed sheet-pile jetties on each side of the Ballona Inlet, and made an unsuccessful attempt to dredge an interior basin.

3. The general tributary area, which includes all of metropolitan Los Angeles, is bounded by a line extending from Oxnard through Bakersfield and Bishop, Calif., to Tonopah and Las Vegas, Nev., and back through Needles and Beaumont to San Clemente, Calif. The immediate tributary area comprises 638 square miles of metropolitan Los Angeles extending from the Pacific Ocean to the San Gabriel Mountains and from San Fernando Valley to El Segundo. The estimated population of this immediate area was 2,307,725 in 1946, including 1,522,702 within the city limits of Los Angeles. Principal activities are petroleum production and refining, motion-picture production, manufacturing, and farming. A part of the proposed harbor would extend over the Del Rey Hills and Venice areas of the Playa del Rey oilfield. There is no water borne freight traffic and no terminal or transfer facility at Playa del Rey. Rowboats are used occasionally on the canals within the proposed harbor site. The region is served by railroads and highways.

4. Local interests request provision by the United States of a harbor for small craft at Playa del Rey as part of a comprehensive plan for park and beach development including recreational boating facilities. Various specific requests were advanced by local interests in connection with the plan of improvement but these evolved during the course of the investigation to substantially the plan presented by the district engineer. Local interests point out the need for adequate facilities for small craft in the Santa Monica Bay area and nearby districts,

the overcrowding in existing harbors, the desirability of separating recreational boating areas from commercial and naval waters, and the favorable economic effect of such an improvement including the benefits to be derived from land reclamation.

5. The district engineer finds there is need for additional harbor facilities for small craft in southern California, particularly in the Santa Monica Bay area. He estimates that, on the basis of the California average of 2.79 boats per 1,000 population, the immediate tributary area would sustain about 6,500 small craft, and on the basis of the Los Angeles average of 1.6 per 1,000 population, the remainder of the tributary area would sustain an additional 960 craft. He points out that the number of craft using the harbor probably would greatly exceed these figures inasmuch as the tributary area contains a high percentage of persons most able to own small craft, and the population is steadily increasing. He concludes that the present and future needs of the tributary area require an improvement with an ultimate capacity of 8,000 craft and estimates that half the ultimate capacity will be reached within 5 years after construction of the improvement. Basing his calculations upon the distribtuion of existing boatowners within the area, he estimates 1,000 would transfer from other harbors, of which 20 would be from Santa Monica Harbor, 400 from Los Angeles Harbor, and 580 from Newport Bay Harbor. He estimates that the remaining 7,000 would be new vessels. Although the improvement is designed for an ultimate capacity of 8,000 craft, the district engineer conservatively bases the estimate of benefits on the 4,000 craft expected to be realized a few years after construction. His cost estimates are based upon construction to provide for the ultimate capacity of 8,000 craft, except that the costs for berthing facilities are based upon construction of the initial 4,000 berths. The cost of the remaining 4,000 berths will be more than offset by the benefits from this additional number of boats. The district engineer considers that the proposed improvement at Playa del Rey is the most suitable for making recreational harbor facilities in Santa Monica Bay available to the largest number of boatowners at the least cost. He states that recovery of petroleum from the existing oilfield could be continued by relocating the wells.

6. The district engineer's plan of improvement provides for construction of an entrance channel 1,925 feet long and an interior channel 5,600 feet long, each 20 feet deep and 600 feet wide, the entrance channel to be protected by 2 jetties, each 2,300 feet long; a central basin 10 feet deep; 2 side basins 20 feet deep and 10 side basins 10 feet deep, separated by mole-type piers; and for certain work to be done by local interests. The dredged material would be used to construct the mole-type piers and to reclaim adjacent lowlands and beaches. The district engineer estimates the total first cost of the proposed plan at $25,603,000, of which the Federal first cost is $9,073,000 for construction and $25,000 for aids to navigation; and the non-Federal first cost is $16,505,000 for lands and rights-of-way including disposal areas, relocation of oil wells, relocation and construction of public utilities, construction of a bulkhead and stone revetments, provision of berthing and other facilities for small craft, development of the area surrounding the harbor for park and recreational purposes, and extension of the north jetty at Ballona Creek. The Federal annual carrying charge is estimated at $395,550, including

$25,000 for annual maintenance of the 2 entrance jetties and of project depths in the entrance and interior channels and in the central basin. The net non-Federal annual carrying charge is estimated at $524,370 after deducting $190,600, returns from slip rentals. The total annual carrying charge is $919,920. The district engineer estimates the average annual benefits from the proposed improvement at $1,529,000, comprising $215,000 from land enhancement due to fill, $16,000 from decreased cost of mosquito control, $280,000 from increased fish catch from sport fishing activities, $75,000 from prevention of storm damage to small craft, $43,000 from decreased automobile travel and decreased boat maintenance resulting from transfer of vessels from distant harbors, and $900,000 from recreational benefits to owners of new vessels. The benefit-cost ratio is 1.7. The district engineer recommends adoption of a project to establish a harbor in accordance with his proposed plan subject to the conditions that local interests give assurances satisfactory to the Secretary of the Army that they will secure and hold in the public interest lands bordering on the proposed development to a width sufficient for proper functioning of the harbor; provide without cost to the United States rights-of-way, including disposal areas; assume the cost of relocating oil wells and the cost of relocating and constructing public utilities; construct a bulkhead around one basin and stone revetment on the side slopes of the remaining basins; extend the north jetty at Ballona Creek; provide adequate berthing and other facilities for small craft; develop the harbor area for park and recreational purposes; establish a public body empowered to regulate the use, growth, and free development of the harbor facilities, open to all on equal and reasonable terms; prepare definite plans and schedules for construction of small craft facilities, subject to approval by the Secretary of the Army; maintain and operate the entire project, except entrance jetties, project depths in the entrance and interior channels and in the central basin, and aids to navigation; and hold and save the United States free from all claims for damages arising from construction or operation of the project. The division engineer concurs.

7. With respect to the effect of the improvement on adjacent shorelines, the district engineer finds that the shores of Santa Monica Bay down coast of the Santa Monica breakwater have been deprived of normal littoral nourishment since construction of the breakwater in 1933, and that the Playa del Rey jetties, 3 miles south of the breakwater, would act as a complete littoral barrier and would benefit the shore to the north. The plan of improvement proposed by the district engineer provides for deposition of 10,130,000 cubic yards of material, dredged from the harbor, on the beaches immediately upcoast of the Playa del Rey jetties and downcoast between Playa del Rey and Ballona Creek jetties, and deposition of 3,200,000 cubic yards of material downcoast of the Ballona Creek jetties. Disposal of the dredged material on the downcoast beaches as proposed would provide adequate nourishment for many years, and thereafter the beaches can be maintained in their advanced position by mechanical bypassing of material, a method now being considered in a cooperative beach erosion control study between the United States and the State of California. The Beach Erosion Board concurs in the conclusions of the district engineer as to the effect of the proposed improvement on the adjacent shorelines. It points out that adoption of the project

as recommended shall not relieve local interests of responsibility for stabilization of beach fill along the shores of Santa Monica Bay with such Federal assistance as may be authorized following completion of the cooperative beach erosion control study now in progress.

8. The Board of Engineers for Rivers and Harbors was not convinced of the advisability of the United States participating in the improvement to the extent recommended by the reporting officers and questioned whether local interests were in agreement as to operational control and sponsorship of the improvement. The Board so notified local interests and they requested a public hearing. At the hearing held by the Board in the area of the desired improvement, local interests indicated they would endeavor to cooperate in the work of improvement to the extent considered necessary by the Board and would agree among themselves in the matter of operational control and sponsorship of the improvement. The commander, 11th Coast Guard District, stated in a communication that a harbor at Playa del Rey would serve as a refuge, would make available a harbor from which Coast Guard patrol and rescue craft could operate, and would tend to relieve the congestion and contribute to general maritime safety in the Los Angeles-Long Beach area. Subsequent to the public hearing, the Hughes Aircraft Co. advised the Board that the proposed improvement would interfere with a contemplated expansion of its facilities and a proposed runway extension. The company was given an opportunity to furnish information in support of its claim but no evidence of importance has been received. The Board also requested the views of the Department of the Air Force and the Civil Aeronautics Administration concerning the claim of the Hughes Co. A communication from the Office, Deputy Chief of Staff, Department of the Air Force, states that the present plans of the Air Force do not contemplate expansion of the Hughes Co. which would result in conflict with the proposed harbor improvement for Playa del Rey, Calif. The Deputy Administrator of Civil Aeronautics, Civil Aeronautics Administration, states in a communication that study by its regional office reveals that no aircraft operation difficulties or conflicts will result by the development and operation of the proposed improvement.

VIEWS AND RECOMMENDATIONS OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS

9. The Board of Engineers for Rivers and Harbors concurs in the views of the reporting officers that a need exists for a harbor with an ultimate capacity of 8,000 small craft in the vicinity of Playa del Rey, Calif. The plan recommended by the district engineer together with work to be performed by local interests will provide a suitable improvement. Total prospective benefits are sufficient to justify the expenditure required. The Board believes that in addition to the evaluated benefits resulting directly from construction of the small-boat harbor, benefits would accrue to local interests from the use of the area as a park facility. It can be expected that the area will be visited and enjoyed by many persons in no way connected with small-boat commerce. Considering both the evaluated and intangible benefits, the Board is of the opinion that the Federal interest in the proposed improvement would be served by Federal participation to

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the extent of providing and maintaining the entrance jetties, entrance channel, interior channel, and central basin shown on the maps accompanying the district engineer's report, all at an estimated first cost of $6,151,000 for construction exclusive of aids to navigation, and $25,000 annually for maintenance, with local interests providing and maintaining all other works including dredging of the side basins at an estimated first cost of $19,427,000. Local interests state they will meet the requirements of local cooperation as indicated by the Board. Benefits from 35 sport fishing vessels are estimated by the district engineer as $280,000, which is $8,000 per vessel. Basing its conclusions on investigations of this type of fishing, the Board finds that a total of $47,000 is more reasonable. The total annual benefits would then amount to $1,296,000. The Board of Engineers for Rivers and Harbors has carefully considered the data presented by the district engineer and Beach Erosion Board with respect to the effect of the improvement on the adjacent shoreline. It is of the opinion—after taking into account the stabilizing effect on the upcoast beaches, the effect of the existing Ballona Creek jetties, and the deposition on adjacent beaches of approximately 13,330,000 cubic yards of material dredged from the harbor, including the deposition of 3,200,000 cubic yards downcoast of the Ballona Creek jetties—that the beneficial effects to the adjacent shoreline would more than offset any adverse effects that would occur. The Board agrees with the Beach Erosion Board that accomplishment of the improvement shall not modify the relative responsibility of local interests and the United States in connection with any work which may be authorized for stabilization of adjacent beaches following completion of the cooperative beach erosion control study now in progress. Subsequent to submission of the report by the district engineer the United States Coast Guard submitted a revised estimate of $42,000 for the first cost of aids to navigation, an increase of $17,000. The total first cost then becomes $25,620,000. With the distribution of costs as proposed by the Board, including the new estimate for aids to navigation, the total annual carrying charge becomes $933,025 of which $277,555 is Federal and $655,470 is non-Federal. The benefit-cost ratio is 1.4.

10. The Board accordingly recommends provision of a harbor at Playa del Rey, Calif., to consist of 2 entrance jetties each about 2,300 feet long; an entrance channel 20 feet deep, 600 feet wide, and 1,925 feet long; an interior channel 20 feet deep, 600 feet wide, and 5,600 feet long; a central basin 10 feet deep; and 2 side basins 20 feet deep and 10 side basins 10 feet deep, separated by mole-type piers; the dredged material to be utilized for construction of the piers and for deposition on adjacent lowlands and beaches; all generally in accordance with the plan of the district engineer and the comments herein, and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable; at an estimated cost to the United States of $6,151,000 for construction and $25,000 annually for maintenance, subject to the condition that local interests agree to: (*a*) provide without cost to the United States all rights-of-way necessary for construction and maintenance of the improvement and furnish suitable spoil-disposal areas for initial work and subsequent maintenance when and as required; (*b*) secure and hold in the public interest lands bordering on the proposed development to a width sufficient for proper functioning of the harbor; (*c*) relocate oil wells and relocate

and construct public utilities as required; (*d*) construct a bulkhead around basin "K" and stc . revetment on the side slopes of the remaining basins; (*e*) extend the north jetty at Ballona Creek to a length sufficient to hold the fill to be placed on the beach to the north thereof; (*f*) provide adequate berthing and other facilities for small craft; (*g*) provide adequate parking areas, access roads, and landscaping of the piers; (*h*) establish a public body to regulate the use and development of the harbor facilities which shall be open to all on equal terms; (*i*) dredge or bear the actual cost of dredging the 12 side basins; (*j*) maintain and operate the entire project except aids to navigation, entrance jetties, and project depths in the entrance channel, the interior channel, and in the central basin; and (*k*) hold and save the United States free from damages due to the construction and maintenance of the improvement; and also subject to the condition that adoption of a project as recommended shall not relieve local interests of responsibility for stabilization of beach fill along the shores of Santa Monica Bay with such Federal assistance as may be authorized following completion of the cooperative beach erosion control study now in progress.

For the Board:

G. J. NOLD,
Major General, Chairman.

REPORT OF THE DISTRICT ENGINEER

SYLLABUS

The district engineer finds that there is need for additional small-craft facilities in Santa Monica Bay. He finds that the provision of such facilities at Playa del Rey is practicable, that the site is the one most suitable for construction of a small craft harbor near the Los Angeles metropolitan area, and that the facilities would be used to capacity.

The district engineer estimates the tangible benefits at $1,529,000 a year and that large intangible benefits would accrue. He estimates the total first cost of the project at $25,603,000 (including $25,000 costs to the United States Coast Guard for aids to navigation), and the annual charges at $919,920. The benefit-charge ratio would be 1.7 to 1.

The district engineer recommends that a project be adopted to establish a harbor for small-craft navigation at Playa del Rey, Calif., to consist of two harbor entrance jetties; an entrance channel 600 feet wide and 20 feet deep; an interior channel 600 feet wide, 5,600 feet long, and 20 feet deep; 2 side basins 20 feet deep in a central basin and 10 side basins 10 feet deep separated by mole-type piers; deposition of dredged material in the mole-type piers, on adjacent lowlands, and along beach frontage; all at an estimated Federal first cost of $9,073,000, exclusive of aids to navigation, and $25,000 annually for maintenance; subject to the condition that local interests shall give assurances satisfactory to the Secretary of the Army that the required cooperation will be furnished, such cooperation to be performed by a competent and duly authorized public body, financially able to accomplish the obligations so assumed and empowered to regulate the use, growth, and free development of the harbor facilities with the understanding that such facilities shall be open to all on equal terms. The required local cooperation would consist of: (1) Securing and holding in the public interest, lands bordering on the proposed development to a width sufficient for proper functioning of the harbor; assuming the cost of all rights-of-way, including disposal areas, the cost of relocating oil wells, and the cost of relocating and constructing public utilities; constructing stone revetments, a vertical bulkhead, and an extension of the upcoast jetty at Ballona Creek flood-control channel; providing adequate facilities for operating, berthing, maintaining, repairing, fueling, and supplying small craft; and for developing the harbor area for park and recreational purposes, all at an estimated non-Federal first cost of $16,505,000; and preparing definite plans and construction schedules for the construction of

small-craft facilities, including development of the mole-type piers, which sha be subject to approval by the Secretary of the Army; (3) maintaining and oper ating the entire project except aids to navigation, entrance jetties, and projec depths in the entrance and interior channels and in the central basin; and (4 holding and saving the United States free from all claims for damages arising fror the construction or operation of the project works.

DEPARTMENT OF THE ARMY,
CORPS OF ENGINEERS,
LOS ANGELES DISTRICT,
Los Angeles, Calif., August 16, 1948.

Subject: Survey of harbor at Playa del Rey, Calif.
Through: Division engineer, South Pacific Division, Oakland, Calif.
To: The Chief of Engineers, Department of the Army.

AUTHORITY

1. This report is submitted pursuant to a resolution adopted June 2 1936, which reads as follows:

Resolved by the Committee on Commerce of the United States Senate, That the Board of Engineers for Rivers and Harbors, created under section 3 of the River and Harbor Act approved June 13, 1902, be, and is hereby, requested to review the reports on Playa Del Rey Inlet and Basin, Venice, Calif., printed in House Document No. 1880, 64th Congress, 2d session, with a view to determining whether any improvement of the locality is warranted at the present time—

and to River and Harbor Act, Public Law 392, 75th Congress, approved August 26, 1937, which reads in part as follows:

SEC. 4. The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys to be made at the following-named localities, * * *:

* * * * * * *

Harbor at Playa Del Rey, Calif.

* * * * * * *

(In accordance with United States Geological Survey maps and with local usage, the harbor under consideration is designated in this report as Playa del Rey.)

2. A review of reports on Playa del Rey Inlet and Basin, Venice, Calif., and preliminary examination of harbor at Playa del Rey, Calif., dated May 26, 1939, submitted by the district engineer in accordance with the resolution and act quoted above, was reviewed by the Board of Engineers for Rivers and Harbors. This report of survey scope was authorized by the Chief of Engineers in letter of April 6, 1944, to determine the advisability and cost of improvement and the local cooperation required.

DESCRIPTION

3. *Charts and maps.*—Playa del Rey inlet and vicinity are shown on United States Coast and Geodetic Survey charts 5101 and 5144; on Venice Quadrangle, United States Geological Survey of 1923; and on maps, enclosures 5 [1] and 6 [1] of this report.

4. *General.*—Playa del Rey is located in the central part of Santa Monica Bay on the coast of southern California, 26 miles by water northwesterly (upcoast) from Los Angeles Harbor, 3 miles southeasterly (downcoast) from Santa Monica Harbor, and about 410 miles southeasterly of San Francisco Bay. The Venice district, a seaside resort annexed to the city of Los Angeles in November 1925, adjoins the proposed harbor area on the north. The business center

[1] Not printed.

of the city of Los Angeles is 15 miles inland to the east. A considerable portion of the area immediately north of Ballona Creek consists of the Venice Slough and canals which drain into the ocean through the outlet of Ballona Creek flood-control channel. This area comprises about 1,513 acres of salt marsh and low farm and residential lands located in the area between the Venice district and the Ballona Creek flood-control channel, and between United States Highway 101 Alternate (Lincoln Boulevard) and the Pacific Ocean. The farm and residential land, except the strip of residential and commercial property adjacent to the beach, is subject to flooding by moderate rainfall. The farmland is along the west side of Highway U. S. 101 Alternate, and the residential property is concentrated along the shoreline and between Washington Street and Venice Boulevard. The salt-marsh area comprises about 1,200 acres.

5. *Depth of water.*—The water depths in the canals and in the connecting sloughs vary from 2 feet to 10 feet below mean lower low water. The elevation of the salt-marsh area averages about 3 feet above mean lower low water.

6. *Tides.*—In Santa Monica Bay the mean tide range is 3.7 feet, the diurnal range is 5.6 feet, and the extreme range is about 10.5 feet.

7. *Exposure and weather.*—Severe ocean winds are rare in the immediate vicinity, as in all southern California coastal waters. Offshore ocean storms of varying intensities occur generally during the period December to March, inclusive, and may cause large ground swells, The ocean front is unprotected except to a small degree by Point San Vicente and by Santa Catalina Island (approximately 30 miles offshore) on the south, and by the trend of the coast and by Point Dume on the northwest. Prevailing winds are principally westerly and southwesterly and seldom attain storm violence, as indicated by the wind rose on map, enclosure 1. During the winter southerly offshore winds occasionally cause destructive wave action.

8. In general, the climate is mild and uniform. A summary of average annual wind and weather conditions and a tabulation showing the number of days each month during 1944 and 1945 that small-craft warnings were posted for the area is given in the following tables.

Average annual meteorological conditions in vicinity of Playa del Rey Harbor, Calif.

Month	Sunshine (percent)	True wind velocity (miles per hour)				Number of days—					
		Average hourly velocity	Prevailing direction	Maximum velocity	Direction of maximum velocity	Clear	Partly cloudy	Cloudy	With precipitation (0.01 inch or more)	Thunderstorms	Dense fog
January	70	6.1	NE	38	NE	15	9	7	6	(1)	1
February	68	6.6	NE	34	NW	13	8	7	6	(1)	2
March	68	6.2	SW	37	SW	13	10	8	6	1	2
April	68	6.0	SW	34	W	12	11	7	4	(1)	2
May	65	5.9	SW	30	W	11	14	6	2	(1)	2
June	70	5.7	SW	28	SW	13	14	3	1	(1)	3
July	78	5.6	SW	21	SW	16	14	1	(1)	(1)	3
August	79	5.5	SW	25	SE	19	11	1	(1)	(1)	3
September	77	5.4	SW	31	S	17	11	2	1	(1)	3
October	76	5.5	SW	28	NE	18	9	4	2	(1)	3
November	79	5.8	NE	35	NE	18	8	4	3	(1)	2
December	73	6.2	NE	35	NE	17	8	6	6	(1)	1
Year	72	5.9	W	-------	-------	182	127	56	37	5	27

[1] Less than 1 day.

Small-craft storm warnings posted

Month	Year— 1944	1945
	Days	*Days*
January	6	3
February	10	6
March	3	6
April	6	5
May	3	0
June	1	0
July	0	0
August	0	0
September	2	1
October	0	2
November	6	6
December	6	8
Total for year	43	37

9. *Navigation.*—There is no navigable connection between the ocean and the Venice canals and connecting sloughs. The ocean outlet is through a steel and concrete tide gate which connects the canals with the Ballona Creek flood-control channel. The canals are occasionally navigated only by small rowboats.

10. The only natural harbor in the southern California area is San Diego Bay, 133 miles to the south. Newport Bay Harbor was created in the tidal outlet of Santa Ana River by diverting the river from the harbor, dredging, and constructing jetties at the harbor entrance. This port is used primarily for recreational craft but has limited facilities for commercial fishing.

11. Los Angeles and Long Beach Harbors are two of the principal Pacific coast commercial harbors. During the war years, 1941–45, many owners of small craft who had been using these harbors were required to find mooring facilities in other harbors. The harbor departments of both Los Angeles and Long Beach are reluctant to assign space to smallcraft and do so only on short-time leases subject to cancellation. The operation of small craft in a commercial and naval harbor is hazardous to the small craft and is a nuisance to the commercial or naval interests.

12. Redondo Beach Harbor has a partially sheltered area of about 20 acres but this area is exposed to southerly storms. Boats anchoring in this harbor are extensively damaged each year.

13. Santa Monica Harbor, which originally comprised 92 acres, is now shoaled to 46 acres. The harbor area is partially protected by an offshore breakwater which was constructed by local interests in 1934. This breakwater has not been maintained and has deteriorated to a considerable extent. About 64 fishing boats and 21 recreational craft are moored within the lee of the breakwater. Because of insufficient mooring space and the poor protection afforded during storms, over 100 small boats are stored on the adjacent Santa Monica pier and several fishing boats anchor outside the breakwater. Boat losses in the harbor have been high in the past years, and marine-insurance agencies are very reluctant to insure boats anchored there. The master plan for shoreline development of Los Angeles County provides for removal of the existing breakwater at Santa Monica Harbor.

14. The numbe
metropolitan area

Number of small

Long Beach	
Los Angeles	
Newport Bay	
Redondo Beach	
Santa Monica	
Alamitos Bay	
Total	

[1] Estimated by Long Beac
[2] Exclusive of about 100 bo

15. *General tribu*
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enclosed by a line
Bishop, Calif., to
Needles and Beau

16. *Immediate tr*
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5.[1] It includes t
Burbank, Culver C
Monrovia, Montere
San Gabriel, San M
and part of the cit
Hollywood, North
comprises 16 perce
the population of th
tax. The populati
mediate tributary a

[3] Not printed.

14. The number of small craft moored at harbors in the Los Angeles metropolitan area are shown in the following table:

Number of small craft in Los Angeles metropolitan area, California (1946)

Harbor	Number of pleasure craft	Number of commercial fishing craft	Total
Long Beach	285	[1] 100	[1] 385
Los Angeles	779	272	1,051
Newport Bay	1,888	600	2,488
Redondo Beach	0	50	50
Santa Monica	21	64	[2] 85
Alamitos Bay	0	0	0
Total	2,973	1,086	4,059

[1] Estimated by Long Beach Harbor Department.
[2] Exclusive of about 100 boats stored on pier and several fish boats moored outside breakwater.

TRIBUTARY AREA

15. *General tributary area.*—The area generally tributary to the proposed harbor at Playa del Rey is shown on enclosure 6.[1] The tributary area includes all of metropolitan Los Angeles and the entire area enclosed by a line extending from Oxnard through Bakersfield and Bishop, Calif., to Tonopah and Las Vegas, Nev., and back through Needles and Beaumont to San Clemente, Calif.

16. *Immediate tributary area.*—The area immediately tributary to Playa del Rey, comprising about 638 square miles, is that part of metropolitan Los Angeles which lies closer to the proposed harbor than to any other existing or proposed harbor. In general, this area extends from the Pacific Ocean to the San Gabriel Mountains, and from the San Fernando Valley to El Segundo, shown as zone 1 on enclosure 5.[1] It includes the cities of Arcadia, Alhambra, Beverly Hills, Burbank, Culver City, El Monte, El Segundo, Glendale, Inglewood, Monrovia, Monterey Park, Pasadena, South Pasadena, San Fernando, San Gabriel, San Marino, Santa Monica, Sierra Madre, and Vernon, and part of the city of Los Angeles with its suburbs of Van Nuys, Hollywood, North Hollywood, and West Los Angeles. This area comprises 16 percent of Los Angeles County, contains 67 percent of the population of the county, and contributes 60 percent of the county tax. The population of cities and unincorporated areas of the immediate tributary area is shown in the following tables:

[1] Not printed.

Population of cities in the immediate tributary area

City	1930 census	Percent gain	1940 census	Percent gain	1946 estimate [1]	Approximate distance from Playa del Rey
						Miles
Arcadia	5,216	74.9	9,122	53.5	14,003	35
Alhambra	29,472	32.1	38,935	10.9	43,174	23
Beverly Hills	17,429	53.9	26,823	5.2	28,217	10
Burbank	16,662	106.1	34,337	80.2	61,859	24
Culver City	5,669	58.3	8,976	51.3	13,580	5
El Monte	3,479	36.4	4,746	33.8	6,349	28
El Segundo	3,503	6.7	3,738	52.8	5,710	3
Glendale	62,736	31.6	82,582	14.0	94,134	20
Inglewood	19,480	54.6	30,114	32.9	40,034	6
Los Angeles	1,195,205	21.5	[2] 1,342,885	13.4	[2] 1,522,702	13
Van Nuys [3]			20,298	32.0	26,784	17
Hollywood [3]			142,262	10.7	157,491	15
North Hollywood [3]			24,449	48.0	36,179	20
West Los Angeles [3]			58,690	27.2	74,649	7
Monrovia	10,809	17.6	12,807	37.5	14,863	37
Monterey Park	6,406	33.2	8,531	20.6	10,291	23
Pasadena	76,086	7.6	81,864	9.7	89,789	25
South Pasadena	13,730	4.6	14,356	10.6	15,880	22
San Fernando	7,567	20.2	9,094	13.6	10,332	30
San Gabriel	7,224	64.3	11,867	25.0	14,828	26
San Marino	3,730	119.2	8,175	29.6	10,598	26
Santa Monica	37,146	44.0	53,500	18.5	63,398	5
Sierra Madre	3,550	29.0	4,581	20.7	5,529	35
Vernon	1,269	−33.0	850	13.0	961	18
Total	1,436,368	25.9	1,8[illegible]61	15.5	2,088,839	

[1] Estimate by Los Angeles County Regional Planning Commission.
[2] Includes the population of only that part of the city of Los Angeles in zone 1.
[3] Included in population figures for Los Angeles.

Population in unincorporated areas in the immediate tributary area

Area	1940 census	Percent gain	1946 estimate [1]	Approximate distance from Playa del Rey
				Miles
Belvedere and East Los Angeles	71,541	12.2	80,289	20
Burbank and Glendale [2]	11,866	26.5	15,007	25
El Monte and San Gabriel [3]	52,565	35.9	71,459	25
Pasadena [4]	32,419	28.4	40,990	28
West Los Angeles	6,361	75.1	11,141	7
Total	174,752	25.2	218,886	
Total for cities	1,807,961	15.5	2,088,839	
Grand total (zone 1)	1,982,713	16.4	2,307,725	

[1] Estimate by Los Angeles County Regional Planning Commission.
[2] Area includes districts of La Crescenta, Verdugo City, Montrose, and La Canada.
[3] Area includes districts of Temple City, Wilmar, Rosemead, Potrero Heights, Garvey, and Duarte.
[4] Area includes districts of Altadena and Lamanda Park.

17. The 1945 assessed valuation of taxable property in the immediate tributary area, as shown on the records of the Los Angeles County assessor, is given in the following table:

Assessed valuation of property in the immediate tributary area

Location	Type of property			Total
	Land	Improvements	Personal	
Arcadia	$4,820,780	$6,725,120	$861,460	$12,407,360
Alhambra	10,579,815	14,271,120	4,105,710	28,956,645
Beverly Hills	25,332,265	27,456,200	5,959,080	58,747,545
Burbank	14,787,325	28,135,030	21,294,340	64,216,695
Culver City	3,671,565	6,536,090	9,930,650	20,138,305
El Monte	1,261,355	1,498,600	286,500	3,046,455
El Segundo	2,476,770	12,286,020	4,109,895	18,872,685
Glendale	28,689,455	31,945,810	5,217,345	65,852,610
Inglewood	8,956,325	12,097,188	1,900,030	22,953,535
Los Angeles (zone 1)	509,057,855	431,732,610	133,171,255	1,073,961,720
Monrovia	2,887,655	3,553,520	1,034,990	7,476,165
Monterey Park	2,065,530	2,266,610	297,840	4,629,980
Pasadena	32,955,175	34,308,160	9,330,755	76,594,090
South Pasadena	4,121,025	4,965,440	708,630	9,795,095
San Fernando	1,926,710	2,019,710	461,590	4,408,010
San Gabriel	3,432,360	5,508,330	665,450	9,606,140
San Marino	6,459,050	9,985,800	1,759,740	18,204,590
Santa Monica	19,860,570	21,445,290	5,638,245	46,944,105
Sierra Madre	1,203,055	1,436,220	231,390	2,870,665
Vernon	9,994,525	15,743,190	31,486,950	57,224,665
Total	694,539,165	673,916,050	238,451,845	1,606,907,060
Unincorporated areas	74,316,165	60,804,135	29,660,555	164,780,855
Grand total	768,855,330	734,720,185	268,112,400	1,771,687,915

18. *Occupations, resources, and industries.*—The principal industries in the area immediately tributary to Playa del Rey are petroleum production and refining; motion picture production; airplane construction; automobile assembly; manufacture of tires and rubber goods, furniture, and apparel; and agriculture. Statistical data are not available for the gross value of manufacturing and agriculture in the immediate tributary area. However, the entire county of Los Angeles contributes toward the support of each small-craft harbor within the metropolitan area, and Playa del Rey would receive its share. The gross output for Los Angeles County in 1939 was in excess of $3,800 million from industry and commerce and $76 million from agriculture. Data subsequent to 1939 were not available because of wartime restrictions.

19. *Transportation.*—The tributary area is served by the Southern Pacific, Union Pacific, Pacific Electric, and the Atchison, Topeka & Santa Fe Railroads, and by 1 foreign and 4 domestic passenger airlines and 6 freight airlines. The harbor site is served by the Pacific Electric Railway and by municipal and Pacific Electric buslines connecting Playa del Rey with the beach cities and with the center of Los Angeles. United States Highway No. 101 Alternate (Lincoln Blvd.) and several secondary highways pass through the proposed harbor area and connect with the network of State, county, and city highways.

20. *Bridges.*—There are no bridges, existing or planned, in the area of the proposed harbor at Playa del Rey. Several bridges crossing the Ballona Creek flood-control channel are planned by local interests as a part of the park development outside the harbor area.

PRIOR REPORTS

21. The only published report concerning harbor improvements in the vicinity of Playa del Rey is listed in the following table:

List of prior reports

Report	Published as—	Recommendation
Preliminary examination of Playa del Rey Inlet and Basin dated Nov. 4, 1916.	H. Doc. No. 1880, 64th Cong., 2d sess.	Improvement not advisable at that time.

OTHER IMPROVEMENTS

22. *Navigation.*—Navigation improvements in the area resulted from early attempts by local interests to create a commercial harbor at Playa del Rey and from the construction of canals as a part of a real estate development. In 1887 the Ballona Harbor Improvement Co. constructed sheet-pile jetties on each side of the inlet and attempted to dredge an interior basin. The dredge was inadequate and the enterprise was abandoned.

23. Beginning in 1903 the Beach Land Co. dredged a series of canals in the Venice area and constructed tide gates in the inlet. After the tide gates were destroyed by storms many of the canals were artificially filled to create city streets in lieu of the canals which had failed to attain popularity.

24. *Flood control.*—The Federal Government completed the Ballona Creek flood-control channel and jetties in 1938. This project was constructed in part under the Emergency Relief Act of 1935 and the remainder under the Flood Control Act approved June 22, 1936. The lower reach of the flood-control channel constitutes the southerly boundary of the proposed harbor area. In this section the channel is trapezoidal, 200 feet wide at the bottom with side slopes of 1 on 3. The side slopes are paved with one-man stone supported by a fill of dumped stone at the toe of paving. The invert is not paved. The jetties at the entrance are random stone, and the voids between the stones above mean lower low water have been filled with concrete to a depth of 3 feet. The jetties as originally constructed were about 775 feet long, measured from mean high-tide line, and are 340 feet from centerline to centerline. The jetties were extended 580 feet in 1946 by the city of Los Angeles. The crest width is 16 feet and the elevation at the crest is 13 feet above mean lower low water. The side slopes are 1 on 1.5. A steel and concrete tide gate was installed to connect the main Venice canal with the flood-control channel. The cost of Ballona Creek Channel (including entrance jetties and tide gate) was about $7 million.

25. *Petroleum production.*—In 1930 an oilfield was discovered in this area and about 151 producing wells have been drilled. The field has been in production continuously since that time. In recent years salt water has encroached in the field and production has been reduced so that about 40 wells have been abandoned, leaving only 111 on low production. The daily production of the entire field is reported to have been 2,300 barrels during 1946, whereas the peak daily production exceeded 40,000 barrels in November 1930. A part of the proposed

harbor area would be over th
or Venice area of the Playa
zone, the lower zone, is pres
older ocean front area, prod
zone and from a relatively sl
acquisition of all oil rights in
sidered, it would be feasible t
production to continue in tho
harbor function. In the inte
it would be more desirable to
from offset wells equipped
abandon the field. Local int
tlement of the oil rights.

26. *Proposed shoreline impr*
a bond issue of $10 million, t
area and the State of Califo
total of $21 million, which wi
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ing plant and outfall sewer.
of the site for the sewage-tr
has excavated 14,100,000 cubi
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This resulted in a general wide
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the Ballona Creek jetties 580
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27. Local interests consider
Rey would be an integral unit
Santa Monica Bay shoreline.
local interests includes the foll
beaches, adequate bathhouse
special recreation centers, salt-
ing pools, fishing piers, youth
cabin and trailer accommodati
the wildlife now inhabiting the
highways along the improved
completed plans for the constr
to facilitate access to the beac
would avoid the congested met
the distance to be traveled and
beach recreation and park are
Playa del Rey from any localit

28. The city of Los Angeles
York City to prepare an econ
purposes on the entire beach
harbor, at a cost of $35,000.

TERMINAL AND

29. There are no terminal o

30. Santa Monica Harbor, 3
at Playa del Rey, has termina
mercial fishing and recreational

harbor area would be over the Del Rey Hills area and the ocean front or Venice area of the Playa del Rey oilfield. Only one productive zone, the lower zone, is present in the Del Rey Hills area. In the older ocean front area, production is obtained both from the lower zone and from a relatively shallow zone, the upper zone. Although acquisition of all oil rights in fee within the proposed harbor was considered, it would be feasible to redrill a part of the wells and to allow production to continue in those wells that would not interfere with the harbor function. In the interest of conservation of mineral resources, it would be more desirable to continue petroleum recovery by redrilling from offset wells equipped with low-height surface pumps than to abandon the field. Local interests do not anticipate difficulty in settlement of the oil rights.

26. *Proposed shoreline improvements.*—The city of Los Angeles voted a bond issue of $10 million, to which other cities in the metropolitan area and the State of California have added $11 million, making a total of $21 million, which will be used for the construction of a complete sewage-treatment plant at Hyperion to replace the present screening plant and outfall sewer. In connection with the preparation of the site for the sewage-treatment plant, the city of Los Angeles has excavated 14,100,000 cubic yards of dune sand, and has deposited it on the beach between Ocean Park and El Segundo (about 5.5 miles). This resulted in a general widening of the beach about 450 feet throughout that distance. The deposit of this material constitutes the initial step in the overall plan for beach improvement. The city extended the Ballona Creek jetties 580 feet seaward to protect the flood-control outlet from the shoaling caused by the new beach fill.

27. Local interests consider that the proposed harbor at Playa del Rey would be an integral unit of the plan for the development of the Santa Monica Bay shoreline. The plan of development proposed by local interests includes the following features: Widened and improved beaches, adequate bathhouses and parking areas, picnic facilities, special recreation centers, salt-water bathing pools and children's wading pools, fishing piers, youth organization camps, tourist parks with cabin and trailer accommodations, and a bird sanctuary to perpetuate the wildlife now inhabiting the area. In addition to scenic and through highways along the improved beach front, local authorities also have completed plans for the construction of a highway and freeway system to facilitate access to the beach areas. The proposed freeway system would avoid the congested metropolitan areas and would shorten both the distance to be traveled and the time required to reach the proposed beach recreation and park area and the proposed harbor facilities at Playa del Rey from any locality within the immediate tributary area.

28. The city of Los Angeles has employed a consulting firm of New York City to prepare an economic analysis and report for financing purposes on the entire beach development, including the proposed harbor, at a cost of $35,000.

TERMINAL AND TRANSFER FACILITIES

29. There are no terminal or transfer facilities at Playa del Rey.

30. Santa Monica Harbor, 3 miles upcoast from the proposed harbor at Playa del Rey, has terminal and transfer facilities for small commercial fishing and recreational craft at the municipal pier. This pier

is partially protected by the Santa Monica breakwater. The breakwater has deteriorated to such an extent that the harbor probably would be abandoned if facilities for small craft are constructed at Playa del Rey. The construction of additional terminal facilities in Santa Monica Bay is impracticable because of the unprotected shoreline.

EXISTING PROJECT

31. There has never been a Federal navigation project at Playa del Rey.

IMPROVEMENTS DESIRED

32. *Public hearings.*—Two public hearings were held in Venice, Calif., by the district engineer to consider the advisability of improving Playa del Rey, one on July 29, 1936, and the other on August 12, 1938, in connection with the preliminary examination report. The hearings were attended by public officials, real estate and other business interests, and representatives of various civic organizations, as well as the general public.

33. *Improvements desired by local interests.*—At the public hearing on August 12, 1938, the Regional Planning Commission of Los Angeles County and local civic organizations requested that a small-craft harbor be provided at Playa del Rey by the United States. The improvements desired by the regional planning commission consisted of (1) extending the jetties of the Ballona Creek flood-control outlet a distance of 800 feet; (2) constructing 2 jetties 1,475 feet in length to provide a second entrance to the interior basin; (3) dredging an interior basin about 1 square mile in area to a depth of 15 feet below mean lower low water, connected by an entrance channel to Ballona Creek flood-control channel; (4) dredging the Ballona Creek entrance and the second entrance to a depth of 15 feet below mean lower low water; (5) constructing secondary roads, miscellaneous drainage structures, and utilities; (6) constructing boat facilities and recreational park improvements; and (7) purchasing rights-of-way and land. The total cost estimated by local interests in 1938 was $9,750,000.

34. *Local interests' justification of the desired project.*—Local interests are unanimous in desiring improvement of Playa del Rey Inlet and Basin for small-craft navigation. They offer the following considerations in support of the navigation improvements.

(*a*) There is need for added mooring space for small craft in Santa Monica Bay, in view of the increasing scarcity of small-craft anchorage areas in Los Angeles Harbor and because of the inconvenience attending the use of that harbor.

(*b*) The desired improvements are required for recreation and small-craft boating by people living in the northern part of Los Angeles County, which includes the heavily-populated Los Angeles city area, as well as Hollywood, Beverly Hills, Culver City, Inglewood, Santa Monica, and other suburban districts.

(*c*) The improvement would be an effective aid in the development of the boatbuilding industry.

(*d*) The improvement would satisfy an increasing need for small-craft facilities, create a widespread economic benefit through an increase in permanent employment and in business, and cause an increase in values of both real estate and other property, thereby increasing the tax base.

(*e*) Indirect benefits would accrue from reclaiming a large swamp area, which would result in an improvement of conditions affecting public health and in the stimulation of development of 5 or 6 square miles of partially developed land. The development of these areas would increase the taxable wealth.

35. Small-craft owners in the Los Angeles metropolitan area state that the proposed harbor at Playa del Rey is required because of unsatisfactory conditions in Los Angeles and Long Beach Harbors, such as overcrowding of available space, decrease in number of berths because of increasing commercial and naval requirements, short-term leases, high maintenance costs, long distances from the ocean, and inadequate automobile parking facilities.

COMMERCE AND VESSEL TRAFFIC

36. *Commerce.*—There is no existing commerce at Playa del Rey Inlet and Lagoon. Future commerce at the proposed harbor would consist of recreational small craft, excurison boats, and commercial sport-fishing boats. Representatives of the city of Los Angeles and of Los Angeles County state that in their opinion the proposed small-craft harbor should be used only by recreational craft and that provision should be made for commercial fishing interests at other ports. No commercial fish canneries would be permitted in the harbor area, and no facilities would be provided for the unloading of fresh fish for transshipment by truck to canneries outside the area.

37. The population of 2,308,000 in the tributary area of Playa del Rey gives an indication that about 6,500 boats would be available for berthing in the harbor. This number is based on the average number of craft in California for each 1,000 population.

38. Inasmuch as the area tributary to Playa del Rey contains a high percentage of persons most able to own small craft, it is expected that the number of 6,500 boats would be considerably exceeded. The records of the Los Angeles County assessor show that there are 2,300 small craft now owned by residents of the immediate tributary area. It is conservatively estimated that within 1 year after completion of the project, 1,000 boats would be transferred from other harbors to Playa del Rey Harbor, and that within 5 years after completion of the project, 3,000 new craft would be constructed, sold to individual owners, and based in the proposed harbor. This figure does not include new boats that would be constructed or purchased by residents outside the immediate tributary area (zone 1). The population of the area outside zone 1, but which logically would be tributary to Playa del Rey rather than to one of the other existing or proposed harbors in the area, exceeds 600,000 persons. This would create an additional potential boat reserve of 960 new craft. To be prepared for future requirements, the proposed harbor would have a capacity of 8,000 craft. It is estimated that 35 of the boats would be commercial sport-fishing vessels carrying charter parties or making regularly scheduled runs.

39. Playa del Rey Harbor would be open to all craft as a port of refuge in case of emergency. Furthermore, the harbor would be used by visiting craft from San Diego Bay, Newport Bay Harbor, Los Angeles and Long Beach Harbors, and Redondo Beach Harbor, and as a port of call for small craft making the longer trips to Santa

Barbara, Monterey, and San Francisco, and for northern small craft cruising in southern waters.

40. *Vessel traffic.* There is no vessel traffic at Playa del Rey other than an occasional rowboat on the Venice canals. Numerous boats cruise in the open sea adjacent to the shore.

DIFFICULTIES ATTENDING NAVIGATION

41. In the vicinity of Playa del Rey, westerly and southwesterly winds prevail most of the year, but there are intermissions of calm during autumn and winter, as indicated by the wind rose on map, enclosure 1. The most severe storms are produced by the occasional southerly winds which occur in winter. The prevailing westerly winds seldom become more than moderate gales.

42. There are no adequately protected areas for small craft in Santa Monica Bay. Partial protection is provided at Redondo Beach, 8 miles to the south, and at Santa Monica, 3 miles to the north, of the site of the proposed harbor at Playa del Rey. At Redondo Beach the harbor formed by the breakwater consists of only about 20 acres of semiprotected area. The breakwater provides protection from westerly storm waves, but craft in its lee are exposed to the southerly storms. During these storms about 10 craft are washed ashore at Redondo Beach each year.

43. At Santa Monica Harbor an area of about 46 acres is partially protected by an offshore breakwater 2,000 feet in length. The breakwater was constructed by the city of Santa Monica in 1934 and has so deteriorated that storm waves break over the structure and create rough water within the harbor area. An average of 50 boats a year break loose from their moorings and are washed ashore. About 20 percent of these boats are a complete loss, as the surf breaks up the beached craft. It is improbable that the breakwater structure will be restored and maintained, mainly because the inadequate facilities and the restricted-water area cannot be remedied owing to site limitations.

44. All small-craft navigation in Santa Monica Bay is endangered by the lack of an adequate harbor of refuge.

SPECIAL SUBJECTS

45. *Shoreline changes.*—Pursuant to section 5 of the River and Harbor Act approved August 30, 1935 (Public Law 409, 79th Cong.), a detailed investigation was made with a view to determining probable effect of the proposed improvement upon the adjacent shoreline. A full report of the investigation is contained in enclosures 19 [1] and 20.[1] Specific studies undertaken included a geological investigation to determine general trends in physiographic development of the coastal area, a determination of wave characteristics, surveys to trace the movement of beach material, investigation of the effect of existing structures, analysis of slopes of artificial fills made on southern California beaches, and an estimation of littoral characteristics in the Santa Monica Bay area.

46. Conclusions reached in the investigation of shore effects are quoted as follows:

[1] Not printed.

(*a*) The shores of Santa Monica Bay downcoast from Santa Monica breakwater have been deprived of normal littoral nourishment since construction of Santa Monica breakwater in 1933.

(*b*) Proposed jetties at Playa del Rey would act as a complete littoral barrier for a considerable period of time and would benefit the shore to the north by preventing further littoral loss from that area. Beach fill made in this area with material dredged from Playa del Rey Harbor would assist in completion of the comprehensive shore development planned by the city of Los Angeles.

(*c*) Between Ballona Creek jetties and proposed Playa del Rey jetties, the shore would stabilize after minor realinement.

(*d*) Downcoast from Ballona Creek, establishment of a feeder beach would be required to provide nourishment for shores to the south, and to prevent depletion of the fill recently completed by the city of Los Angeles. Deposit of 3,200,000 cubic yards along 5,000 feet of shore would be expected to provide adequate supply for a period of about 20 years.

(*e*) Future maintenance of Santa Monica Bay shores between Santa Monica breakwater and Playa del Rey may be accomplished by periodic replenishment of a suitably located feeder beach, or by removal of the breakwater and reestablishment of normal littoral transport at Santa Monica.

(*f*) Shores downcoast from Ballona Creek can be maintained in their advanced position by mechanical bypassing of sand past the proposed harbor entrance or by periodic deposit of sand from inland areas on the feeder beach. The most economic method can best be determined after the plan for maintenance of upcoast beaches has been established.

47. *Field surveys.*—Hydrographic and topographic surveys of the harbor and adjacent shore areas were made in March and April 1945, and during 1948. The surveys included the area from Washington Street to the Playa del Rey Hills and extended from Highway U. S. 101 Alternate (Lincoln Blvd.) seaward to about the 40-foot-depth contour. Shore topography was traced from aerial photographs and existing maps. The character of materials to be dredged was determined from auger borings.

48. *Coordination with other improvements.*—The improvement would not involve flood control, water power, water supply, or other subjects that could be coordinated with the improvement to compensate the United States for expenditures made. The project is an integral part of an overall plan of improvement of the beach areas by municipal and county agencies.

49. *Effect on wildlife.*—Construction of the proposed harbor would eliminate existing marshlands of some wildlife value. However, the Fish and Wildlife Service by letter dated April 26, 1946, state that no objection will be interposed to the construction of the project. Local representatives of the Fish and Wildlife Service state that few game birds occupy the area because of oil pollution which results from the operation of the oil field. Local interests propose to construct a bird refuge about 800 feet wide and 2,500 feet long adjacent to the flood-control channel as a part of the overall park development to provide for the shore birds nesting in the area. Principal among these birds are killdeer, sandpiper, stilt, and tern. In addition there are many other species of birdlife which are not dependent on the area. To

provide for the continuation of this existing birdlife, local interests should construct the bird refuge simultaneously with the construction of the harbor.

50. *Saline contamination.*—An investigation was made concerning the effects of the proposed harbor on saline contamination of underground water. This investigation indicated that (1) sea water has already contaminated the ground water within most of the area that would be occupied by the harbor; (2) further landward progress of this contamination depends primarily on the rate of withdrawal of ground water in the vicinity of the harbor site and on the steepness of the landward gradient produced by this withdrawal; and (3) introduction of sea water by constructing the harbor would not modify existing ground-water conditions.

51. *Harbor lines.*—Harbor lines have not been established in Santa Monica Bay. The plan considered would not adversely affect the future establishment of harbor lines.

52. *Aids to navigation.*—If the proposed harbor is constructed, the district Coast Guard officer, 11th Coast Guard District, recommends the installation of coded lights on the seaward ends of the proposed harbor jetties, the installation of a fog signal on the upcoast jetty, and installation of additional lights at the beginning of the curve on each jetty. Three light buoys would be required to mark the turns in the basin channel. The district Coast Guard officer estimates the total cost of aids to navigation at $25,000.

PLANS OF IMPROVEMENT

53. *Plans considered.*—In determining the best plan of improvement the district engineer gave consideration to the desires of local interests as stated at the public hearings, to the more recent desires of local interests as developed by conferences, to modifications suggested by experienced small-craft operators, and to the requirements of navigation interests in general.

54. The plan originally proposed by local interests included a symmetrically arranged U-shaped harbor which had two entrances and capacity for about 5,200 craft. Local interests now believe that a harbor of that capacity would be inadequate to meet all the demands for anchorage, berthing, and maneuvering, and for adequate servicing and concessionary facilities; therefore, a modified elliptical area approximately 6,500 feet by 6,300 feet was proposed for consideration. The elliptical harbor would have capacity for about 8,000 craft. The two entrances were decided to be undesirable, as a stretch of beach about 2,100 feet long would be rendered inaccessible except by boat. This isolated island would not conform to the general plan of improvement approved by the Los Angeles City Council.

55. Combining the entrance channel with the Ballona Creek flood-control outlet would prove unsatisfactory, from the standpoint of navigation and maintenance of harbor depths. To eliminate both the isolated beach and entrance through the flood-control outlet, local interests proposed a curving entrance adjacent to the flood-control outlet. However, experienced small-craft operators state that a curved entrance is difficult to navigate, especially in foggy or heavy weather. Accordingly, consideration was given to straightening the proposed entrance. This would result in a long and rather wide en-

trance that would require a large area which would not make the most efficient use of the available space. Also, with a southerly side entrance, boats based in the northerly portion of the proposed harbor would be required to travel an excessive distance to reach the ocean. Furthermore, any entrance at the southerly side would subject the southerly shore of the proposed harbor to unfavorable and destructive wave conditions during storms.

56. The plan considered by the district engineer, which comprises a single, short, central entrance, would adequately overcome all the undesirable features of the side entrance.

57. The plans for side basins bordering the main central basin were modified so that the long axes of most side basins would be radial to the central basin. This modification would facilitate berthing small craft in the side basins.

58. All factors affecting the design of the harbor at Playa del Rey were discussed with interested local agencies, and the plan of improvement considered by the district engineer is the plan now desired by all responsible local interests. The plan has been approved by the Los Angeles City Council, the city planning commission, the city engineer, the Los Angeles County Board of Supervisors, the county regional planning commission, and the county engineer.

59. *Recommended plan.*—The plan recommended by the district engineer provides for the following principal features, as shown on enclosure 1.

(*a*) An entrance channel about 1,925 feet long and 600 feet wide, dredged to a depth of 20 feet below mean lower low water.

(*b*) Two random-stone jetties, each 2,300 feet in length.

(*c*) A 300-foot extension to the upcoast jetty at Ballona Creek flood-control channel outlet.

(*d*) A main interior channel 600 feet wide and 5,600 feet long, and two southerly side basins (designated C and K), all dredged to a depth of 20 feet below mean lower low water.

(*e*) A central basin and 10 additional side basins (designated A, B, D, E, F, G, H, I, J, and L), all dredged to a depth of 10 feet below mean lower low water.

(*f*) Disposal of material dredged from the proposed harbor, amounting to about 20,360,000 cubic yards, to construct solid-fill mole-type piers between the side basins, to reclaim lowlands adjacent to the harbor, and to provide about 160 acres of land by widening the beach as permanent beach improvement upcoast from the harbor entrance and to provide a separate feeder beach south of Ballona Creek flood-control channel for nourishment of the downcoast shore.

(*g*) Vertical bulkhead around side basin K, and random-stone revetment on the slopes of the remaining side basins and the central basin.

(*h*) Slips and facilities for berthing, servicing, supplying, and repairing small craft.

(*i*) Roads, parking areas, administration buildings, comfort stations, landscaping, clubhouses, and all other facilities required for a modern recreational small-craft development.

60. Under the general plan, 11 mole-type piers and the entrance abutments would divide the bay into 12 side basins with a capacity for berthing 8,000 small craft at slips. See exhibit 1, enclosure 16,[1]

[1] Not printed.

for a diagrammatic sketch of the arrangement of slips used to determine the capacity of the harbor. Ultimate development of a typical mole arrangement proposed by local interests is shown on enclosure 4,[1] "General plan of harbor," by the Los Angeles City Planning Commission. The pierheads would be reserved for concessions, such as gasoline and oil stations, small stores, cafes, and boat clubs. The pier between basins marked D and E on the general plan, enclosure 1, would be used for harbor administration. The pier on each side of basin K would be reserved for boat-repairing facilities and other commercial purposes. The pier between basins A and B would be used by marine-outing clubs. Parking areas are located wherever space permits. The harbor area is considered as that section encircled by the perimeter road. Justification of all features of design and all items included in the recommended project are contained in enclosure 16.[1]

FIRST COST AND ANNUAL CHARGES

61. *Estimate of first cost.*—The total first cost of the improvements, based on 1948 prices, is estimated at $25,603,000, of which $16,505,000 would be borne by local interests and $9,098,000 by the United States. Details of the estimate are given in enclosure 16 [1] and are summarized in the following table:

Estimate of first cost, Playa del Rey, Calif.

Federal costs:	
Corps of Engineers:	
Dredging entrance channel and interior basins and filling lowlands	$5,090,000
Stone jetties, entrance channel	2,168,680
Subtotal	7,258,680
Engineering and contingencies, 25± percent	1,814,320
Total	9,073,000
U. S. Coast Guard: Aids to navigation	25,000
Total Federal 1st cost	9,098,000
Non-Federal costs:	
Stone jetty extension, Ballona Creek	126,450
Stone revetment, interior basins	388,500
Vertical bulkhead, boat repair basin	1,314,400
Landscaping mole-type piers	25,670
Administration building	150,000
Floats, slips, light and water facilities	860,000
Paving (parking areas)	736,050
Paving (roads)	911,650
Relocation of Venice sewer and constructing mains and laterals	2,150,000
Public utilities, relocation and construction of water and electric lines, and removal of oil pipelines	1,200,000
Subtotal	7,862,720

[1] Not printed.

Estimate of first cost, Playa del Rey, Calif—Continued

Non-Federal costs—Continued		
Engineering and contingencies, 25± percent		$1,965,280
Total non-Federal, except land and rights-of-way		9,828,000
Land and improvements	$4,410,500	
Drilling offset wells and capping existing wells	1,422,000	
Subtotal	5,832,500	
Contingencies, 10± percent	583,300	
Acquisition cost, about 10 percent of land and rights-of-way	441,200	
Subtotal	6,857,000	
Less immediate salvage value of improvements	−180,000	6,677,000
Total non-Federal cost		16,505,000
Total Federal cost		9,098,000
Total first cost of project		25,603,000

62. *Estimate of annual charges.*—In computing the interest charges, it was assumed that the construction would require 3 years. The salvage value of all improvements is assumed to be nominal or negligible at the expiration of the useful life of the project, estimated at 50 years. However, the net salvage value of the land is estimated at $3,352,000. This amount is equal to the total estimated value, immediately after filling and prior to construction of any improvements, of filled lands within the taking area described as areas B and C in enclosure 17.[1] The salvage value of the 160 acres of new beach to be constructed is not assumed to be creditable to this project inasmuch as nourishment of this beach would be provided for under the master plan for beach development by the city and county of Los Angeles, Calif. In computing the non-Federal carrying charges the estimated returns from improvements represent only the net return from slip rentals after deduction of operation and maintenance costs, as shown in the following table. This net return is based on using 50 percent of the estimated total annual return from slip rental for 4,000 boats, as follows:

Boat size	Percent	Number of boats	Estimated annual slip charge	Total
Under 20 feet	43.1	1,724	$56.00	$96,544
20 feet to 35 feet	41.6	1,664	102.00	169,730
36 feet to 50 feet	11.6	464	146.50	67,976
51 feet to 100 feet	2.9	116	253.00	29,350
Over 100 feet	.8	32	550.00	17,600
Total	100.0	4,000		381,200
Estimated operation and maintenance costs				190,600
Estimated direct net returns from improvement				190,600

[1] Not printed.

63. The estimated annual charges for the improvements are given in the following table:

Estimated annual charges for Playa del Rey Harbor, Calif.

(a) Federal investment:	
(1) Corps of Engineers	$9,073,000
(2) U. S. Coast Guard	25,000
(3) Total Federal 1st cost (see estimate of 1st cost)	9,098,000
(4) Interest during ½ of construction period: 3 percent of item (a) (3) for 1.5 years	409,410
(5) Total Federal investment to be justified by benefits and subject to amortization	9,507,410
(b) Federal annual charges:	
(1) Interest at 3 percent of item (a) (5)	285,220
(2) Amortization for 50 years at 3 percent: 0.00887 times item (a) (5)	84,330
(3) Maintenance	[1] 26,000
(4) Total Federal annual charges	395,550
(c) Non-Federal investment:	
(1) Funds to be contributed or cost of improvements to be undertaken by local interests	9,828,000
(2) Value of rights-of-way to be furnished	6,677,000
(3) Total non-Federal 1st cost (see estimate of 1st cost)	16,505,000
(4) Interest during ½ of construction period: 3.5 percent of item (c) (3) for 1.5 years	866,510
(5) Gross non-Federal investment to be justified by benefits	17,371,510
(6) Less net salvage value of land	−3,352,000
(7) Net non-Federal investment subject to amortization	14,019,510
(d) Non-Federal annual charges:	
(1) Interest at 3.5 percent of item (c) (5)	608,000
(2) Amortization for 50 years at 3.5 percent: 0.00763 times item (c) (7)	106,970
(3) Maintenance	[2]
(4) Gross non-Federal annual charges	714,970
(5) Less estimated direct net returns from slip rentals	−190,600
(6) Net non-Federal annual charges	524,370
(e) Total estimated annual charges	919,920

Summary of 1st costs and annual charges

Item	First cost	Interest	Investment	Annual charges	Annual maintenance
Federal	$9,098,000	$409,410	$9,507,410	$395,550	[1] $26,000
Non-Federal	16,505,000	866,510	17,371,510	524,370	[2]
Total	25,603,000	1,275,920	26,878,920	919,920	[1] 26,000

[1] Includes $1,000 maintenance by U. S. Coast Guard.
[2] Estimated $190,600 income from slip rentals to be used for operation and non-Federal maintenance.

ESTIMATES OF AVERAGE ANNUAL BENEFITS

64. *Increased value of filled land.*—In constructing a harbor at Playa del Rey, the Federal Government would dredge approximately 20,360,000 cubic yards of material to provide about 717 acres of water area. The dredged material would be deposited to fill adjacent low-lands and to create additional beach land. Local interests plan to develop the adjacent area as an all-year beach resort and recreation center. The artificial widening of the beach would result in an immediate increase in value of the filled area. The low, undeveloped land between Ballona Creek and the Playa del Rey Hills and the marshland in the harbor area would be reclaimed and would increase in value. In estimating the benefits that would result from filling low lands pursuant to construction of the proposed harbor at Playa del Rey, only those areas that would be filled with material dredged from the harbor have been considered. The estimated increase in value of the areas reclaimed or filled in no way reflects any enhancement in value that would accrue to the land by virtue of its proximity to the proposed harbor.

65. The water area for the proposed harbor would be created by dredging about 717 acres of marsh and low land. An estimated additional 844 acres of land would be filled with the dredged material as listed below:

	Acres
Area A: South of Ballona Creek	358
Area B: Mole-type piers	203
Area C: West of Lincoln Blvd	123
New beach	160
Total	844

The average annual benefits from the increased value of land by reason of filling only are estimated at $215,000. Further details concerning benefits from increased land value are given in enclosure 17.[1]

66. *Mosquito control savings.*—The site of the proposed harbor consists of low, marshy land with inadequate provisions for drainage and, as a result, a large area of water is almost stagnant. The Ballona Creek Mosquito Abatement District spends about $21,000 annually on mosquito control. Approximately 75 percent of these funds would be spent in the area to be improved. The elimination of this problem by the filling of marsh areas or by improvement of drainage would provide an annual benefit of $16,000. In addition to tangible monetary benefits, conditions affecting public health would be improved by the elimination of mosquito breeding areas. (See enclosure 17.[1])

67. *Benefits from navigation.*—The benefits that would accrue to the proposed harbor project from navigation are dependent on the type and number of craft that would use the facility. Based on the records of similar developments in California and on reports from small-craft manufacturers on their backlog of orders for new craft, the anticipated number of boats would exceed 6,500. According to local interests and boat manufacturers, if accommodations were available, 10,000 new craft would be built in the next few years. The proposed harbor at Playa del Rey would have a capacity of 8,000 small craft. However, in computing the recreational benefit that would accrue from navigation, the number of new craft of average

[1] Not printed.

size that would be based in the harbor has been estimated to be only 3,000. The proposed Playa del Rey Harbor would be open to all craft as a port of refuge and as a port of call by many small craft. Additional tangible benefits that would accrue from the navigation features of the proposed project are automobile travel savings, boat maintenance savings, prevention of boat damage, and increased fish catch. Some of the intangible navigation benefits which would accrue from the project are, increase in the recreational activities of the community, creation of additional business opportunities, increase in safety of navigation, and increase in opportunity for boatowners to operate their small craft.

68. *Recreational harbor benefit.*—The monetary benefit from the recreational use of a small-craft harbor is estimated to be the annual income from a capital investment equivalent to the average value of the small-craft fleet at that harbor. On the basis of an average value of $6,000 each, the monetary benefit that would result from the estimated minimum fleet of 3,000 new small craft that would occupy the proposed Playa del Rey Harbor, is estimated at $900,000. (See enclosure 17.[1])

69. *Automobile travel savings.*—Most boatowners living in the area tributary to Playa del Rey (zone 1) are unable to anchor their boats at Santa Monica Harbor and must keep them at Los Angeles Harbor, Long Beach Harbor, Newport Bay Harbor, or at some more distant port because of the lack of proper harbor facilities in Santa Monica Bay. The actual monetary saving of automobile operating costs by the estimated 1,000 boatowners who would transfer their boats from one of the more distant harbors to Playa del Rey Harbor is estimated at $35,000. (See enclosure 17.[1])

70. *Boat maintenance savings.*—The boatowners living in the area tributary to Playa del Rey whose craft are moored in the commercial harbors of Los Angeles or Long Beach would benefit by having a recreational harbor. Provision of such a harbor would result in a saving through decreased maintenance costs to small craft because of their removal from sources of contamination as exists in a commercial harbor. The annual savings in maintenance cost by the estimated 400 boatowners who would transfer their boats from Los Angeles and Long Beach Harbors to Playa del Rey Harbor is estimated at $8,000. (See enclosure 17.[1])

71. *Prevention of boat damage.*—Small craft in Santa Monica Bay are exposed to the sudden and sometimes moderately severe storms that occur annually during the period December to March, inclusive. Records of past storms indicate that about 60 small craft are beached annually by storms because of the lack of a safe anchorage area. The proposed Playa del Rey and Redondo Beach Harbors would replace existing inadequate facilities and offer refuge to all small craft operating in Santa Monica Bay. The total annual benefit from the prevention of this damage to small craft that would be creditable to the proposed Playa del Rey Harbor is estimated at $75,000. (See enclosure 17.[1])

[1] Not printed.

72. *Increased fish catch.*—Fish caught by sport fishermen add to the national wealth to the extent that this fish catch finds its way into the national food supply. From the records of operators of sport-fishing boats, it is estimated that an additional 2,800,000 pounds of fish would be caught each year because of the estimated increased number of sport-fishing boats that would operate from the proposed Playa del Rey Harbor. In addition to trips made by patrons of sport-fishing boats, the estimated increased number of individual boat owners would take an additional fish catch for which no benefit is claimed. The monetary average annual benefit from fish caught by sport fishermen is estimated at $280,000. For additional details of benefits from fish catch. (See enclosure 17.[1])

73. *Intangible benefits.*—Intangible benefits (those not susceptible of monetary evaluation) that would accrue under the plan of improvement considered are large. Benefits would result from increased safety of small-craft navigation in the Santa Monica Bay area by providing a port of refuge for transient craft and a safe port for anchorage of home craft. The pleasure of small-craft operation would be increased by the provision of an adequate facility close to the greatest number of small-craft owners in the Los Angeles metropolitan area and separated from the activities of a large commercial and naval port.

74. Construction of the navigation facility proposed at Playa del Rey Harbor would increase the use of adjacent waters and neighboring ports by small craft because of an additional place to visit, which would increase the pleasure derived from operation of recreational craft. This, in turn, would create new business, additional tax income, and new opportunities for industry in the manufacture, repair, and servicing of additional craft in established harbors. These benefits cannot be evaluated because of the difficulty of determining the proportion of increased use of the established harbors that would be due to the construction of the new facility.

75. Large intangible benefits would also accrue by reason of increased land values in areas adjacent to the proposed harbor, primarily the Venice area and the partially developed area located between Highway U. S. 101 Alternate and Culver City. The proposed harbor constitutes one unit of a large resort and recreation area planned by local interests that would extend from El Segundo to Topanga Canyon on Santa Monica Bay, and a large part of the increased land values would be creditable to that project. The creation of an all-year beach playground would attract visitors from all parts of the country, afford new opportunity for travel, and create an additional economic benefit to the beach communities.

76. *Summary of tangible benefits.*—The average annual tangible benefits that would accrue under the plan considered are summarized in the following table. A detailed analysis of benefits is given in enclosure 17.[1]

[1] Not printed.

Estimated average annual tangible benefits from improvements considered, Playa del Rey, Calif.

Type of benefit	General (Federal)	Local (non-Federal)	Total
Other than navigation:			
Increased value of filled land	0	$215,000	$215,000
Mosquito control savings	0	16,000	16,000
Subtotal	0	231,000	231,000
Navigation:			
Recreational harbor benefit	$450,000	450,000	900,000
Automobile travel savings	0	35,000	35,000
Boat maintenance savings	0	8,000	8,000
Prevention of boat damage	75,000	0	75,000
Increased fish catch	280,000	0	280,000
Subtotal	805,000	493,000	1,298,000
Total	805,000	724,000	1,529,000

COMPARISON OF BENEFITS AND COSTS

77. The total cost of the proposed improvement is estimated at $25,603,000. The total annual carrying charges would be $919,920. The annual benefits would be $1,529,000. The benefit-cost ratio of the proposed harbor project would be 1.7 to 1. In addition to the tangible benefits there would be considerable intangible benefits which, while not susceptible of monetary evaluation, are worthy of consideration.

PROPOSED LOCAL COOPERATION

78. At the public hearings local interests expressed a willingness to cooperate in the cost of the project. The formation of a recreation and harbor district was proposed for the purpose of meeting financial requirements through sale of bonds. One object of the report being prepared by the firm of consulting engineers employed by local interests is to determine the best methods of financing the beach development and harbor projects. The city of Los Angeles and the county of Los Angeles, by resolutions, furnished as enclosure 18,[1] agreed to assume the following obligations: (1) Provide all rights-of-way for construction and maintenance of improvements; (2) hold and save the United States free from all claims for damages resulting from the construction or operation of the improvement; (3) assume the cost of alteration, relocation, or rebuilding of highways and highway bridges, or arrange for the alteration, relocation, or rebuilding of these highways and highway bridges; (4) assume the cost of relocation or reconstruction of utilities or drainage structures; (5) contribute in cash or equivalent work, the cost of constructing a vertical bulkhead, stone revetments in all basins, and extension of the north jetty at Ballona Creek; (6) provide without cost to the United States all necessary slips and facilities for repair, service, maintenance, and supply of small craft; (7) secure and hold for the public interest, lands bordering the proposed development to a width sufficient for proper functioning of the harbor; (8) furnish assurances satisfactory to the Secretary of the Army that the area will be improved in accordance with plans and time schedules to be approved by the Secretary of

[1] Not printed.

the Army; and (9) maintain and operate the entire project except aids to navigation, entrance jetties, project depths in the entrance and interior channels and the central basin, with the understanding that all facilities shall be open to all on equal terms.

ALLOCATION OF COSTS

79. The distribution of costs between Federal and non-Federal interests is based on (1) the distribution of local and general benefits, (2) the ability of local interests to pay, and (3) consideration of the general nature of the work items. Accordingly, of the total first cost of the proposed project estimated at $25,603,000, the United States would provide those items of construction that would benefit navigation in general, comprising the construction of entrance jetties and aids to navigation, and the dredging of channels and basins, all at an estimated Federal first cost of $9,098,000, as itemized in the preceding paragraph, "Estimates of first cost." Local interests would provide the items of local cooperation named in the preceding paragraph, "Proposed local cooperation," all at an estimated non-Federal first cost of $16,505,000, and as itemized in the preceding paragraph, "Estimates of first cost." The United States would maintain the entrance jetties, aids to navigation, and harbor depths in the entrance and interior channels and in the central basin, all at an estimated annual cost of $25,000 for the Corps of Engineers, and $1,000 for the United States Coast Guard. Non-Federal annual maintenance would be paid from operating revenues.

DISCUSSION

80. Local interests base justification for the project on (1) the lack of adequate facilities for small-craft navigation in the Santa Monica Bay area, (2) the desirability of separating small craft and recreational boating from commercial and naval waters, (3) the need for facilities to permit growth of recreational and commercial small-craft operation, (4) requirements for safety of small-craft operation in Santa Monica Bay, and (5) the favorable economic effect that development of small-craft operation and the provision of an adequate small-craft facility would have on the community.

81. The district engineer concurs in general with the statements made by local interests concerning justification of the project. However, in determining the extent of the tributary area, consideration was given to the proposed improvement of the small-craft harbor at Redondo Beach, 8.2 miles downcoast from the proposed harbor at Playa del Rey. The protection afforded by Santa Monica breakwater is inadequate and gives the boatowner a false sense of security. City officials of Santa Monica have stated that the structure will not be maintained. Consideration also was given to the existing harbors at Los Angeles, Long Beach, and Newport Bay. Accordingly, only that portion of the general tributary area that is closer to Playa del Rey than to any other existing or proposed harbor has been considered in determining the need for, or the benefits that would result from, a navigation project at Playa del Rey.

82. Recovery of petroleum from the Venice oilfield could be continued by relocating existing oil wells so as not to interfere with operation of the proposed harbor.

83. Annual tangible benefits from the navigation improvement would be $215,000 from increased value of filled land, $16,000 from cost of mosquito control savings, $900,000 from recreational harbor benefits, $35,000 from automobile travel savings, $8,000 from boat maintenance savings, $75,000 from prevention of boat damage, and $280,000 from increased fish catch, a total of $1,529,000 a year.

84. In addition to the tangible benefits, the proposed navigation project would result in large intangible benefits which have considerable weight in justification of the project. The intangible benefits would include the noncalculable benefits from (1) the increased safety of navigation, (2) the recreational value of an all-year small-craft harbor near the largest concentration of boatowners in the Los Angeles metropolitan area, (3) the promotion of general welfare by the increase in opportunities for employment, and (4) increase in land values in the vicinity of the proposed harbor area that would be partially attributable to the proposed navigation improvement.

85. The estimated total first cost of the proposed navigation project is $25,603,000. Of this amount, $16,505,000 would be borne by local interests. The total annual charges would be $919,920 and the total annual benefits $1,529,000. The benefit-cost ratio is 1.7 to 1.

86. The project considered by the district engineer meets the present desires of local interests. The project has the approval of the city of Los Angeles and Los Angeles County. The harbor project forms one unit of the master plan of the county of Los Angeles for shoreline development. The project is also one unit of the plan of the city of Los Angeles for the development of the shoreline between El Segundo and Topanga Canyon. This plan was approved by the Los Angeles City Council. The overall plan of development proposed by the city of Los Angeles is included as enclosure 11.[1]

87. Departures from the original plans desired by local interests were made by the district engineer to provide better navigation conditions within the proposed harbor and entrance channel, to make more efficient use of the dredged water area, and to reduce the total cost of the proposed improvements.

88. Both the city of Los Angeles and the county of Los Angeles have expressed their desire and willingness to cooperate with the Federal Government by sharing in the cost of the project through fulfilling all items of local cooperation required. Either the city or county of Los Angeles would be able to meet the requirements of local cooperation through direct bond issue or formation of a harbor district. The State of California has adopted a policy of assisting local bodies in meeting items of cooperation for flood control required by the Federal Government, as evidenced by the State Water Resources Act approved July 19, 1945, appropriating $30 million for that purpose. The State also has a policy of cooperating with local public bodies on a matching basis in the acquisition of beaches. It is reasonable to assume that these policies will be extended to include other Federal projects.

89. An investigation of the small-craft harbors in southern California indicates an urgent need for additional facilities. Newport Bay Harbor is the only first-class small-craft harbor in the southern California

[1] Not printed.

area. An integrated recreational marine park and small-craft harbor project at Mission Bay, San Diego, Calif. (120 miles downcoast), was authorized by act approved July 24, 1946. A review of reports on Redondo Beach Harbor is in progress. These harbors would be inadequate to meet the demand for berthing small craft in southern California. Shipbuilding and ship brokerage firms in the Los Angeles area have a backlog of small-craft orders that would increase the number of small craft in southern California coastal waters at the rate of 3,000 boats a year for the next 2 years, provided berths are furnished for these craft. It is reasonable to assume that this trend would continue. Boatbuilders state they are unable to consummate sales of small craft because berthing space is not available. The limited facilities for small craft in Los Angeles and Long Beach Harbors are constantly subject to encroachment by commercial and naval needs.

90. The history of established harbors shows that construction of a new harbor does not result in the transfer of commercial facilities from the existing ports, but tends to increase the facilities in the older established ports in addition to encouraging establishment of new port facilities in a new harbor.

91. A detailed study of the probable effects of the proposed jetties at Playa del Rey upon the adjacent shoreline revealed that between the cities of Santa Monica and Redondo Beach, the shore is now receiving inadequate natural nourishment for maintenance of stable shore alinement. The predominate direction of littoral drift is downcoast throughout this area. The proposed jetties would act as a complete barrier to littoral drift for a considerable period of time and would benefit the shore upcoast therefrom by preventing further littoral loss. From the proposed Playa del Rey Harbor entrance to the existing upcoast Ballona Creek jetty, the shoreline would become stable after minor realinement. Downcoast from Ballona Creek to Redondo breakwater, no natural littoral supply would be available. Nourishment by mechanical means would be necessary to prevent erosion. The most suitable permanent plan for maintaining this area cannot be determined until a plan for maintaining beaches upcoast from Playa del Rey is established. Studies are now in progress with a view to determining the most suitable permanent plan for maintenance of all of the Santa Monica Bay shores. Many interests are involved and considerable time probably will elapse before such a plan is put into effect. In order to insure nourishment of the shore downcoast from Ballona Creek pending a permanent solution to the problem, the proposed plan of improvement includes the establishment of a feeder beach below Ballona Creek by depositing 3,200,000 cubic yards of material that would be dredged from Playa del Rey Harbor. It is estimated that this quantity of material will be adequate to provide normal maintenance in the downcoast area for approximately 10 years.

CONCLUSIONS

92. The district engineer concludes that:

(*a*) There is need for additional small-craft facilities in southern California and, in particular, in Santa Monica Bay.

(*b*) The improvement would be used to capacity within a period of years after its completion.

(*c*) The proposed harbor would not seriously impair the recovery of petroleum from the existing Venice oilfield.

(*d*) The proposed harbor would augment existing harbors, and, while adjustment in small-craft berthing and business would be made, they would not intentionally reduce the use of existing harbors or conflict in any manner with the development of the proposed improvement at Redondo Beach.

(*e*) The proposed harbor jetties would intercept downcoast littoral drift for a considerable period of time. Other improvements in Santa Monica Bay have altered the natural regimen of littoral forces and a comprehensive plan is required to maintain stability of the shoreline. Provision of a feeder beach in accordance with the proposed plan of improvement would prevent harmful effect upon adjacent shorelines by the proposed jetties pending completion of the comprehensive beach-development plan. The harbor would have a stabilizing effect on the upcoast beaches expected to be improved. The general effect of the proposed harbor on the beaches probably would be beneficial.

(*f*) An adequate navigation facility can best be provided by constructing entrance jetties and dredging an entrance channel and interior basins.

(*g*) The plan considered is the best plan for making recreational harbor facilities in Santa Monica Bay available to the largest number of boatowners and potential owners in southern California at the least cost.

(*h*) The project for small-craft navigation is justified.

(*i*) In view of the nature of the work and the distribution of benefits, it would be appropriate for the Federal Government to pay the entire cost of constructing aids to navigation, the entrance jetties, and dredging the channels and basins, all at an estimated total Federal first cost of $9,073,000 for work to be accomplished by the Corps of Engineers.

(*j*) Local interests should pay the cost of extending the upcoast Ballona Creek jetty; constructing a vertical bulkhead; revetting the side slopes of all the basins; providing all slips and other facilities for operating, berthing, maintaining, repairing, servicing, and supplying small craft; constructing all roads, pavements, and parking facilities; providing all rights-of-way, including the cost of relocating existing oil wells, all at an estimated total first cost of $16,505,000.

(*k*) The proposed project would be constructed over a period of 3 years and about $3,073,000 should be made available initially, $3 million the second year, and $3 million the third year.

RECOMMENDATIONS

93. The district engineer recommends that a project be adopted to establish a harbor for small-craft navigation at Playa del Rey, Calif., as follows: construct two harbor entrance jetties; extend the upcoast jetty of Ballona Creek flood-control channel; dredge an entrance and interior channel, an interior central basin, and side basins, and deposit the dredged material in areas to be reclaimed for mole-type piers, in lowlands, and along beach frontage; construct stone revetment and vertical bulkheads; construct adequate harbor facilities for operating,

berthing, maintaining, repairing, servicing, and supplying small craft; relocate and provide utilities and sewage facilities; and relocate existing oil recovery facilities; all at an estimated total first cost of $25,603,000.

94. The district engineer recommends that the United States provide the 2 harbor entrance jetties; an entrance channel 600 feet wide and 20 feet deep; an interior channel 600 feet wide, 5,600 feet long, and 20 feet deep; 2 side basins 20 feet deep and a central basin and 10 side basins 10 feet deep separated by mole-type piers; and deposition of dredged material in the mole-type piers, on adjacent lowlands, and along beach frontage; all at an estimated Federal first cost of $9,073,000, exclusive of aids to navigation, and $25,000 annually for maintenance.

95. The district engineer further recommends that adoption of the project be subject to the conditions that local interests shall give assurances satisfactory to the Secretary of the Army that the required cooperation will be furnished, such cooperation to be performed by a competent and duly authorized public body, financially able to accomplish the obligations so assumed and empowered to regulate the use, growth, and free development of the harbor facilities with the understanding that such facilities shall be open to all on equal terms. The required local cooperation would consist of (1) securing and holding in the public interest lands bordering on the proposed development to a width sufficient for proper functioning of the harbor; assuming the cost of all rights-of-way, including disposal areas, the cost of relocating oil wells, and the cost of relocating and constructing public utilities; constructing stone revetments, a vertical bulkhead, and an extension of the upcoast jetty at Ballona Creek flood-control channel; providing adequate harbor facilities for operating, berthing, maintaining, repairing, servicing, and supplying small craft; and for developing the harbor area for park and recreational purposes, all at an estimated non-Federal first cost of $16,505,000; (2) preparing definite plans and construction schedules for the construction of small-craft facilities, including development of the mole-type piers, which shall be subject to approval by the Secretary of the Army; (3) maintaining and operating the entire project except aids to navigation, entrance jetties, and project depths in the entrance and interior channels and in the central basin; and (4) holding and saving the United States free from all claims for damages arising from the construction or operation of the project works.

A. T. W. MOORE,
Colonel, Corps of Engineers, District Engineer.

[First endorsement]

SOUTH PACIFIC DIVISION,
CORPS OF ENGINEERS,
UNITED STATES ARMY,
OAKLAND ARMY BASE,
Oakland 14, Calif., August 22, 1949.

Subject: Survey of Harbor at Playa del Rey, Calif. (Basic: August 16, 1948.)

To: Chief of Engineers, Department of the Army, Washington 25, D. C.

1. I concur in the conclusions and recommendations of the district engineer.

2. I have reviewed the economics of the report and consider reasonable the district engineer's estimates of total annual benefits amounting to $1,529,000 and total annual charges amounting to $919,920, indicating a favorable benefit-cost ratio of 1.7 to 1.

DWIGHT F. JOHNS,
Colonel, Corps of Engineers, Division Engineer.

LIST OF ENCLOSURES MADE IN CONNECTION WITH THE REPORT OF THE DISTRICT ENGINEER

(Only enclosure 1 printed)

No.	Title
1.	General plan of improvement.
2.	Details and cross sections.
3.	Borings.
4.	General plan by Los Angeles City Planning Commission.
5.	Immediate tributary area.
6.	Tributary area accessible to small-craft harbor development.
7.	Permit-drawing showing proposed beach fill.
8.	Distribution of boatowners.
9.	Sardine and mackerel fishing localities.
10.	Cost tabulation on small-boat navigation.
11.	Proposed development plan, Santa Monica Bay shoreline.
12.	Cost estimate of shoreline development.
13.	Photographs.
14.	Correspondence and data submitted by local interests.
15.	Letters from boatbuilders.
16.	Bases for design and cost estimates.
17.	Benefits from improvements.
18.	Resolutions by local interests.
19.	Geology.
20.	Shoreline effect.

EXHIBIT 3

Print | Close Window

Subject: RE: From John Davis Requesting Assistance in regard to Land Deed to the U.S. from California
From: jd@johnanthonydavis.com
Date: Fri, Sep 07, 2012 6:23 pm
To: "Montgomery, Karen" <k15montg@blm.gov>
Bcc: "patricia pherson" <patriciamcpherson1@verizon.net>, "Daniel Cohen" <daniellcohen1956@gmail.com>

Hello,

Thank you for the well thought out and complete response,

John Davis

> -------- Original Message --------
> Subject: RE: From John Davis Requesting Assistance in regard to Land
> Deed to the U.S. from California
> From: "Montgomery, Karen" <k15montg@blm.gov>
> Date: Fri, September 07, 2012 5:02 pm
> To: "jd@johnanthonydavis.com" <jd@johnanthonydavis.com>
> Cc: "Staszak, Cynthia" <cstaszak@blm.gov>
>
> Upon our investigation, we were able to locate several references addressing land title records and the Bureau of Land Management's (BLM's) responsibility to maintain them, two of which are listed below:
>
> **By federal statute the BLM is required to make a copy of papers affecting the title of land granted by the United States.**
>
> > Whenever any person claiming to be interested in or entitled to land, under any grant or patent from the United States, applies to the Department of the Interior for copies of papers filed and remaining therein, in anywise affecting the title to such land, it shall be the

> duty of the Secretary of the Interior to cause such copies to be made out and authenticated, under his hand and the seal of the Bureau of Land Management, for the person so applying. 43 U.S.C. □ 18, Acts of January 23, 1823 and July 4, 1836

The Office of Management and Budget has designated BLM the lead Federal agency with responsibility for Federal Land Ownership Status.

> Federal land ownership status includes the establishment and maintenance of a system for the storage and dissemination of information describing all title, estate or interest of the federal government in a parcel of real and mineral property. The ownership status system is the portrayal of title for all such federal estates or interests in land. OMB Circular No. A-16, Coordination of Geographic Information and Related Spatial Data Activities (Draft 6/20/01 edition).

The above citations verify BLM's responsibility to maintain the "official records" pertaining to Federal Land Ownership Status. These "Land Status Records" are identified in Historical Indices (HI's) and depicted on Master Title Plats (MTP's). HI's are a chronological listing of all actions that affect the use of title to public land and resources for each township. MTP's are graphic representations of current Federal ownership, agency jurisdiction, and rights reserved to the federal government on private land.

Maintaining these official records is an ongoing process. Although we currently have a backlog of necessary notations, once an official action/request is received, every effort is made to update the official record as soon as possible.

Regarding your specific situation; it is unfortunate a deed executed over fifty years ago has not been noted to the "record". Until the BLM receives a request for notation from a benefitting agency, we are unable to note transactions. We suggest you contact the Army Corps of Engineers concerning the status of the deed in question.

Karen Montgomery – Realty Specialist, CA State Lead
California State Office - BLM
2800 Cottage Way, Suite 1928W
Sacramento, CA 95825
Office 916-978-4647 FAX 916-978-4657

Preservation begins with Conservation

From: jd@johnanthonydavis.com [mailto:jd@johnanthonydavis.com]
Sent: Tuesday, September 04, 2012 11:03 AM
To: Montgomery, Karen
Subject: RE: From John Davis Requesting Assistance in regard to Land Deed to the U.S. from California

Hi,

I am happy to have your assistance. Take all the time you need.

Regards,

John Davis

> -------- Original Message --------
> Subject: RE: From John Davis Requesting Assistance in regard to Land
> Deed to the U.S. from California
> From: "Montgomery, Karen" <k15montg@blm.gov>
> Date: Tue, September 04, 2012 10:43 am
> To: "jd@johnanthonydavis.com"
> <jd@johnanthonydavis.com>

We are working on your questions. We have only had 2 working days, and will need more time.

Karen Montgomery – Realty Specialist, CA State Lead
California State Office - BLM
2800 Cottage Way, Suite 1928W
Sacramento, CA 95825
Office 916-978-4647 FAX 916-978-4657

Preservation begins with Conservation

From: jd@johnanthonydavis.com [mailto:jd@johnanthonydavis.com]
Sent: Tuesday, August 28, 2012 5:56 PM
To: Montgomery, Karen
Subject: RE: From John Davis Requesting Assistance in regard to Land Deed to the U.S. from California

Mrs. Montgomery,

Thank you for responding.

Under what provisions of law, or regulation, or policy, does BLM receive requests for notation from other agencies to note deeds in BLM records?

I understand you are not aware of any law that requires another agency to deliver documents to BLM.

However, there must be some stautory or regulatory authority which authorizes BLM to receive requests for notations into BLM records, delivered by other agencies.

Can you provide that information? If not, can you refer me to an entity at BLM that could provide that information?

Regards,

John Davis

-------- Original Message --------
Subject: RE: From John Davis Requesting Assistance in regard to Land
Deed to the U.S. from California
From: "Montgomery, Karen" <k15montg@blm.gov>
Date: Tue, August 28, 2012 5:21 pm
To: "jd@johnanthonydavis.com" <jd@johnanthonydavis.com>, "Easley, Elizabeth R" <eeasley@blm.gov>
Cc: "Staszak, Cynthia" <cstaszak@blm.gov>

Mr. Davis,

You had 2 questions below...

I checked with our land records sections and we do not have any record of ever receiving a request from another agency to note the easement in question to our records. Until we receive a request, presumably from the Army Corps of Engineers (ACOE), we are unable to make this notation to the record.

We do not know of any law that requires other agencies to deliver documents to the BLM for notation. As the keeper of records we note what is delivered to us. If the ACOE does not deliver the documents to us, we can't make the notation. The ACOE would maintain their own official record.

We suggest that you talk to the ACOE to find out the status of this easement deed. If the ACOE delivers this deed to us with a request for notation we will process their request for notation.

Karen Montgomery – Realty Specialist, CA State Lead
California State Office - BLM
2800 Cottage Way, Suite 1928W
Sacramento, CA 95825

Office 916-978-4647 FAX 916-978-4657

Preservation begins with Conservation

From: jd@johnanthonydavis.com [mailto:jd@johnanthonydavis.com]
Sent: Thursday, August 23, 2012 12:38 PM
To: Easley, Elizabeth R; Montgomery, Karen
Cc: Staszak, Cynthia
Subject: RE: From John Davis Requesting Assistance in regard to Land Deed to the U.S. from California

Hello Mrs. Easley and Mrs. Montgomery,

Thank you in advance for the assistance.

John Davis

> -------- Original Message --------
> Subject: RE: From John Davis Requesting Assistance in regard to Land Deed to the U.S. from California
> From: "Easley, Elizabeth R" <eeasley@blm.gov>
> Date: Tue, August 21, 2012 2:24 pm
> To: "Montgomery, Karen" <k15montg@blm.gov>
> Cc: "jd@johnanthonydavis.com" <jd@johnanthonydavis.com>, "Staszak, Cynthia" <cstaszak@blm.gov>
>
> Hi Karen!
>
> This man called last week regarding Grant Deeds and how they are processed for recordation.
>
> Thank you for addressing his questions?
>
> Liz

From: jd@johnanthonydavis.com [mailto:jd@johnanthonydavis.com]
Sent: Thursday, August 16, 2012 2:40 PM
To: Easley, Elizabeth R
Subject: From John Davis Requesting Assistance in regard to Land Deed to the U.S. from California
Importance: High

U.S. BLM
Att: E. Easley
Re: Deed Required by U.S. Public Law 780

Dear Mrs. Easley,

Attached are the documents I said I would send to you. U.S. Public Law 780 required the deeding
of all lands, easements,and rights of way necessary to complete the federal project.

The Congress approve those lands in the General Plan of Improvement, Enclosure No. 1 to U.S.
Housed Document 389 in accordance with law.

The deed was signed by the County of Los Angeles Board of Supervisors Chairman. However, the cadastrial description on the deed does not comport with the General Plan of Improvement, but only represents an easement over the main channel as mapped by the USACE Los Angeles District for me.

My question is when such land deeds from a State to the United States, does law require that BLM maintain any record of such deeds to the United States from an individual

State?

If so, what laws require BLM to receive such records and from what entity(s)?

Did the BLM receive any records to document that all lands, easements, and rights of way were transferred to the United States regarding U.S. Public Law 780, Project: Inlet at Playa del Rey, pursuant to the Rivers and Harbors Act of 1954 and as approved by the United State Congress in House of Representatives 389?

Thank you for your kind assistance,

John Davis
PO 10152
Marina del Rey Ca. 90295
Ph. 310.795.9640

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EXHIBIT 5

NORMAN Y. MINETA, California
Chair

JAMES L. OBERSTAR, Minnesota
NICK JOE RAHALL II, West Virginia
DOUGLAS APPLEGATE, Ohio
RON DE LUGO, Virgin Islands
ROBERT A. BORSKI, Pennsylvania
TIM VALENTINE, North Carolina
WILLIAM O. LIPINSKI, Illinois
ROBERT E. WISE, JR., West Virginia
JAMES A. TRAFICANT, JR., Ohio
PETER A. DEFAZIO, Oregon
JIMMY HAYES, Louisiana
BOB CLEMENT, Tennessee
JERRY F. COSTELLO, Illinois
MIKE PARKER, Mississippi
DAVID LAUGHLIN, Texas
PETE GEREN, Texas
GEORGE E. SANGMEISTER, Illinois
GLENN POSHARD, Illinois
DICK SWETT, New Hampshire
BUD CRAMER, Alabama
BARBARA-ROSE COLLINS, Michigan
ELEANOR HOLMES NORTON, District of Columbia
LUCIEN E. BLACKWELL, Pennsylvania
JERROLD KADLER, New York
SAM COPPERSMITH, Arizona
LESLIE L. BYRNE, Virginia
MARIA CANTWELL, Washington
PAT DANEY AND DANNER, Missouri
KAREN SHEPHERD, Utah
ROBERT MENENDEZ, New Jersey
JAMES E. CLYBURN, South Carolina
CORRINE BROWN, Florida
NATHAN DEAL, Georgia
JAMES A. BARCIA, Michigan
DAN HAMBURG, California
BOB FILNER, California
WALTER A. TUCKER, California
EDDIE BERNICE JOHNSON, Texas
PETER W. BARCA, Wisconsin

PAUL SCHELLHAMER, Chief of Staff
SAKIE SEPSEIS, Chief Counsel

U.S. House of Representatives

COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION

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WASHINGTON, DC 20515
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VERNON J. EHLERS, Michigan

JACK SCHENDLER, Minority Staff Director

COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION
U.S. HOUSE OF REPRESENTATIVES
WASHINGTON, D.C.

RESOLUTION

Marina del Rey, California
Docket 2455

Resolved by the Committee on Public Works and Transportation of the United States House of Representatives, That the Secretary of the Army is requested to review the report of the Chief of Engineers on Playa del Rey Inlet and Basin, Venice, California, published as House Document 389, Eighty-third Congress, Second Session, and other pertinent reports, to determine whether modifications of the recommendations contained therein are advisable at the present time, in the interest of navigation, hurricane and storm damage reduction, environmental restoration, and other purposes at Marina del Rey Harbor, Los Angeles, California, with consideration given to the disposal of contaminated sediments from the entrance channel required under the existing operation and maintenance program at Marina del Rey Harbor.

Adopted: September 28, 1994

ATTEST: [signature]
NORMAN Y. MINETA, Chair

EXHIBIT 6

[Federal Register: September 20, 2005 (Volume 70, Number 181)]
[Notices] [Page 55116-55117] From the Federal Register
Online via GPO Access [wais.access.gpo.gov] [DOCID:fr20se05-36]
[[Page 55116]]

DEPARTMENT OF DEFENSE Department of the Army; Corps of Engineers Notice of Intent To Prepare an Environmental Impact Statement/ Environmental Impact Report for the Ballona Creek Ecosystem Restoration Feasibility Study, Los Angeles County, CA AGENCY: Department of the Army, U.S. Army Corps of Engineers, DoD. ACTION: Notice of intent. --

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SUMMARY: The Los Angeles District intends to prepare an Environmental Impact Statement/Environmental Impact Report (EIS/EIR) to support a cost-shared ecosystem restoration feasibility study with the Santa Monica Bay Restoration Commission. The proposed project study areas has been degraded by encroachment of non-native plants, placement of fill from Marina Del Rey, interruption of the hydrologic regime, trash accumulation, and varied attempts at bank protection along the creek using rock and concrete. Direct benefits of the proposed project include improved habitat and water quality, reductions in waste and trash, and aesthetics. The watershed is an important resource for both recreational uses and for fish, and wildlife and further degradation could jeopardize remaining. The purpose of the feasibility study is to evaluate alternatives for channel modification, habitat restoration (coastal and freshwater wetlands and riparian), recreation, and related purposes along the lower reach of the Ballona Creek. DATES: A public scoping meeting will be held on September 29, 2005 at 6 p.m. ADDRESSES: U.S. Army Corps of Engineers, Los Angeles District, CESPL-PD, P.O. Box 532711, Los Angeles, CA 90053 and Santa Monica Bay Restoration Commission, 320 West 4th Street, Los Angeles, CA 90013. FOR FURTHER INFORMATION CONTACT: Shannon Dellaquila, Project Environmental Manager, at (213) 452-3850 or Malisa Martin, Project Study Manager at (213) 452-3828. SUPPLEMENTARY INFORMATION: 1. Authorization This study was prepared as an interim response to the following authorities provided by Congress under Section 216 of the Flood Control Act of 1970, which states: The Secretary of the Army, acting through the Chief of Engineers, is authorized to review the operation of projects the construction of which has been completed and which were constructed by the Corps of Engineers in the interest of navigation, flood control, water supply, and related purposes, when found advisable due the significantly changed physical or economic conditions, and to report thereon to Congress with recommendations on the advisability of modifying the structures or their operation, and for improving the quality of the environment in the overall public interest; supplemented by House Resolution on Public Works and Transportation dated September 28, 1994 which states: **The Secretary of the Army is requested to review the report of the Chief of Engineers on Playa del Rey Inlet and Basin, Venice, California, published as House Document 389, Eighty-third Congress, Second Session,** and other pertinent reports, to determine whether modifications of the recommendations contained therein are advisable at present time, in the interest of navigation, hurricane and storm damage reduction, environmental restoration, and other purposes at Marina del Rey Harbor, Los Angeles, California, with consideration given to disposal of contaminated sediments from the entrance channel required under the existing operation and maintenance program at Marina del Rey. 2. Background The Ballona Creek Ecosystem

Restoration study area lies within Los Angeles County, CA and includes portions of Marina del Rey, Culver City, Playa del Rey, and the City of Los Angeles. The study area, a component of the greater Ballona Creek Watershed, includes the lower reach of Ballona Creek extending southwest from Cochran Avenue, in Los Angeles, to Pacific Ocean in Marina del Rey. specific features of the Ballona Creek watershed, including existing and historic wetland areas, the Ballona Lagoon, Del Rey Lagoon, Venice Canal, Grand Canal, the Oxford Drain and the Ballona Channel and tributaries, will be addressed in this study. The greater Ballona Creek system drains a watershed of approximately 329 square kilometers (81,300 acres), and is the largest tributary that drains into the Santa Monica Bay. Ballona Creek collects runoff from several partially urbanized canyons on the south slopes of the Santa Monica Mountains as well as from intensely urbanized areas of West Los Angeles, Culver City, Beverly Hills, Hollywood, and parts of Central Los Angeles. The urbanized areas account for 80 percent of the watershed area, and the partially developed foothills and mountains make up the remaining 20 percent. The watershed boundary includes the Santa Monica Mountains on the north, the unincorporated area known as Baldwin Hills, and the City of Inglewood on the south. The Ballona Creek Ecosystem Restoration study footprint's southern boundary is defined by the Westcheste Bluffs, which run southwest from the San Diego (405) Freeway beyond Loyola Marymount University. The western boundary extends from the Pacific Ocean. The eastern boundary begins where Ballona Creek daylights at Cochran Avenue and Venice Boulevard in a section of Los Angeles known as the Mid City. Tributaries of Ballona Creek include Centinela Creek, Sepulveda Canyon Channel, Benedict Canyon Channel, and numerous storm drains. The Ballona Creek watershed ecosystem has been altered by intense land development, encroachment of non-native plants, trash accumulation, and varied attempts at bank protection along the creek using rock and concrete. Although an important function of the Ballona Creek is as a flood control channel, the lower watershed is still an important resource for both recreational uses and for fish and wildlife habitat. Further impairment could jeopardize remaining habitat. This study will evaluate opportunities for habitat restoration (including wetland and riparian habitat), improvements to water quality, trash mitigation, and recreation and related purposes along the lower reach of the Ballona creek. 3. Problems and Needs At least ninety (90) percent of historic coastal wetlands in California have been lost due to filing, dredging, flood control and intensive development. Within the Lower Ballona Creek Watershed, remaining fragmented wetland areas have been degraded due to diminished hydraulic function, poor water quality and introduction of exotic plants and animals. While functioning wetland systems and riparian habitat remain, they are stressed. Channelization of the Ballona Creek and filling of historic wetland and riparian areas have contributed to degradation and loss of habitat due to impeded tidal exchange and circulation. Contaminated stormwater runoff and trash loading has degraded Ballona Creek water quality. Habitat alteration and loss has decreased biodiversity and overall ecological health, threatening the survival of native endangered species such as the California least tern (Sterna antillarum brown), snowy plover (Charadrius alexandrinus), and the Belding's Savannah Sparrow (Sandwichensis beldingi). The current design of the Flood Control channel has resulted in a lack [[Page 55117]] of recreational opportunities and is considered aesthetically challenged. At present there is no integrated approach and partnership amongst stakeholders to resolve lower Ballona Creek in-stream and wetland

degradation issues, which has led to uncoordinated and sometimes redundant and unsuccessful improvement measures. 4. Proposed Action and Alternative The Los Angeles District will investigate and evaluate all reasonable alternatives to address the problems and need stated above. In addition to a without project (No Action) Alternative, both structural and non-structural environmental measures will be investigated. An assessment of the feasibility of removing impervious surfaces from the Ballona Channel will also be evaluated. Proposed restoration measures include: re-grading and removal of fill, remove invasive and non-native plant species, reintroduction of a water source and installation of native plants to restore previously filled coastal wetlands. Other measures to be evaluated include features to improve or restore tidal regime in Oxford Basin, the Grand and Venice canals, and Ballona and Del Rey Lagoons; the potential for in stream wetland development in Centinela, Sepulveda and Ballona Creek; sediment loading in the upper watershed; and related recreation and educational opportunities. 5. Scoping Process The scoping process is on-going, and has involved preliminary coordination with Federal, State, and local agencies and the general public. A public scoping meeting is scheduled for Thursday September 29th from 6-8 p.m. at the Rotunda Room of the Veteran's Memorial Building, 4117 Overland Avenue, Culver City, CA. This information is being published in the local news media, and a notice is being mailed to all parties on the study mailing list to ensure that public will have an opportunity to express opinions and raise any issues relating to the scope of the Feasibility Study and the Environmental Impact Study/Environmental Impact Report. The public as well as Federal, state, and local agencies are encouraged to participate by submitting data, information, and comments identifying relevant environmental and socioeconomic issues to be addressed in the study. Useful information includes other environmental studies, published and unpublished data, alternatives that could be addressed in the analysis, and, potential mitigation measures associated with the proposed action. All comments will be considered in the project development. Concerns may be submitted in writing to the Santa Monica Bay Restoration Commission, or to the Los Angeles District (see ADDRESSES). Comments, suggestions, and request to be placed on the mailing list for announcements should be sp101.usace.army.mil. Availability of the Draft EIS/EIR The Draft EIS/EIR is scheduled to be published and circulated in December 2007, and a public hearing to receive comments on the Draft EIS/EIR will be held after it is published. Dated: September 13, 2005. Alex C. Dornstauder, Colonel, U.S. Army, District Engineer. [FR Doc. 05-18651 Filed 9-19-05; 8:45 am] BILLING CODE 3710-KF-M

Ballona Creek Eco Restoration 104797

Fiscal Year	FED SHARE ALLOCATION	EXPENDITURE
2005	$ 107,300	$ 98,094
2006	$ 198,000	$ 155,613
2007	$ 450,000	$ 334,062
2008	$ 344,000	$ 319,716
2009	$ 249,000	$ 369,862
2010	$ 565,000	$ 400,983
2011	$ 99,775	$ 179,922
Total	**$ 2,013,075**	**$ 1,858,252**

Ballona Creek Eco Restoration 104797

Fiscal Year	FED SHARE ALLOCATION	EXPENDITURE
2005	$ 107,300	$ 98,094
2006	$ 198,000	$ 155,613
2007	$ 450,000	$ 334,062
2008	$ 344,000	$ 319,716
2009	$ 249,000	$ 369,862
2010	$ 565,000	$ 400,983
2011	$ 99,775	$ 179,922
Total	**$ 2,013,075**	**$ 1,858,252**

CHAPTER 13

ACCOUNTING FOR CIVIL WORKS COST SHARED PROJECTS

13-1. General. The purpose of this chapter is to provide accounting guidance and procedures for applying non-Federal contributions toward the cost of project planning, engineering, design, construction, and operations and maintenance of Civil Works cost shared projects.

a. The Water Resources Development Act of 1986, Public Law 99-662, as amended, (hereinafter "WRDA 86" or "the Act") entered the Corps of Engineers into a new era of project financing through cost sharing with various non-Federal sponsors (public entities). Although the acceptance of funds from private parties is allowed under section 4, Rivers and Harbor Act (38 Stat. 1053; 33 U.S.C. 560) navigation authority, and other authorities, it is HQUSACE policy that funds shall be accepted only from duly appointed public entities. See ER 1165-2-30 for further guidance.

b. WRDA 86 specifies that the cost sharing provisions set forth therein apply to any studies for a water resources project commenced after November 17, 1986, or any water resources project, or any separable element thereof (as defined in the Act), for which a contract for physical construction had not been awarded before November 17, 1986. The Act further provides that, unless otherwise specified, the cost sharing provisions of Title I of the Act shall apply to all projects authorized therein. WRDA 86 further states that prior to initiating work on a project, other than hydropower, a legally binding cooperative agreement must be executed between the Department of the Army and the non-Federal sponsor to document the Government's responsibility and the non-Federal sponsor's responsibility for the project including, but not limited to, paying the non-Federal share of the costs of construction, paying 100 percent of the costs of the operation, maintenance, replacement, and rehabilitation costs, and holding and saving the Government free from damages. Similar requirements are included in the Act regarding planning and engineering of a project authorized by the Act. Model cost sharing agreements for feasibility studies (Feasibility Cost Sharing Agreement (FCSA)), for preconstruction, engineering and design (Design Agreement (DA)), and for construction, operation and maintenance (Project Cooperation Agreement (PCA)) of water resources projects have been approved by HQUSACE and by the Assistant Secretary of the Army (Civil Works) (ASA (CW)) for many of the Corps missions and authorities. The approved model agreements are maintained on the website for Civil Works: http://www.usace.army.mil/civilworks/cecwp/branches/policy_compliance/ccpca.htm

Further guidance regarding cost sharing requirements may be found in ER 1165-2-131, ER 1105-2-100, as well as in other engineering regulations, circulars and pamphlets, and Planning, Policy,

and Project Management Guidance Letters.

c. Many pre-WRDA 1986 projects are still active, and these projects may be subject to different cost-sharing obligations and existing assurance agreements or local cooperation agreements, which contain the contractual agreement of the non-Federal sponsor regarding the project cost-sharing obligations and the method of payment under the specific project authority. Unless these pre-WRDA 86 projects, or a separable element thereof, have been expressly made subject by Congress to the cost-sharing requirements of WRDA 86, as amended, the Government cannot unilaterally alter the contractual obligations of the non-Federal sponsor beyond those obligations set forth in the pre-existing cost sharing agreement executed by the sponsor.

d. Interdisciplinary teams led by the Project Manager are recommended by HQUSACE for development, negotiation and execution of PCAs, FCSAs, DAs, and escrow agreements. It is recommended that the team include a Resource Management (RM) representative. The RM representative must be familiar with the accounting procedures for all agreements and cost sharing procedures of all references in appendix A.

13-2. Policy.

a. General. The Corps of Engineers Financial Management System cost share programming reflects the financial requirements specified in law, regulation, and study or project specific cooperative agreements between the Government and non-Federal sponsors for each cost-share project. For Congressional Add projects with unique cost-sharing allowances during study, design, or construction, the PM will provide RM with copies of the authorizing language supporting the project cost-sharing allowance, with additional support from OC, if requested by RM. When a purchase request is certified, the Federal Government and all non-Federal sponsors must have their respective proportional shares (e.g., Federal cash, sponsor cash, or authorized and approved sponsor credit) available. (See PM Guidance letter No. 11 Revised, SUBJECT: Provisions of Non-federal Cash for Construction of Civil Works Projects and Separable Elements at:
http://www.usace.army.mil/inet/functions/cw/cecwp/branches/policy_compliance/pmg11.htm

Only the Secretary of the Army or the ASA (CW) can waive the non-Federal sponsor's proportionate share requirements. If there is no such waiver and the Government's and/or any non-Federal sponsor's proportionate share (net of any authorized and approved creditable work) is not available when a purchase request is processed, then the purchase request will not be certified. Purchase requests cannot be certified until the Government and each non-Federal sponsor's proportionate share requirements are met.

b. Feasibility Phase. Section 105(a) of WRDA 86 specifies the cost sharing requirements for studies that were initiated after 17 November 1986. Feasibility studies are cost shared 50% Federal and 50% non-Federal and are typically accomplished with General Investigations funding.

As originally enacted in WRDA 86, at least 50% of a non-Federal sponsor's share (25% of the total feasibility phase cost) was required to be in cash. With the passage of WRDA 2000, P.L. 106-541, Section 225, the non-Federal sponsor may now provide 100% of its share in "in-kind service" credit. No credit may be given to the non-Federal sponsor for work performed prior to execution of the FCSA or after completion of the feasibility phase.

(1) The Project Manager assigned to the feasibility study will coordinate actions with the RM representative prior to completion of the negotiations on the FCSA with the non-Federal sponsor. Coordination and accounting mechanisms will be established for: allocating and tracking non-Federal cash contributions, crediting the value of approved in-kind service contributions, and distribution of charges against the Federal and non-Federal sponsor accounts. They will document the effective, departmental overhead and any other rates, and identify increases that could trigger an amendment to the FCSA, or Project Management Plan (PMP).

(2) The Project Manager coordinates a draft FCSA with RM to ensure compliance of the following: procedures for receipt and accounting of non-Federal sponsor cash funds; establishment and handling of escrow accounts, if used; prohibitions pertaining to commingling of funds; the direct charging rule for recording direct labor cost; frequency of charges against the non-Federal sponsor contributed fund accounts; crediting the value of approved in-kind contributions; the F&A reporting products and their interpretation; circumstances precipitating increases in effective and departmental overhead rates; partial reconciliation of the accounts for the non-Federal sponsor and Federal end-of-year budgetary requirements; end of study reconciliation mechanism; and the provision and maintenance of accounting records for inspection and audit by Federal or non-Federal sponsor representatives.

c. Credits for work-in-kind during Feasibility Phase. In-kind services represent study work performed by the non-Federal sponsor during the feasibility phase per Section 105(a) of WRDA 86, as amended, for which credit may be given and counted towards the required non-federal contribution. A PMP is the basis for assigning tasks between the Government and the non-Federal sponsor and for establishing the value for credit for in-kind services. Examples of in-kind services are services, materials, supplies and other in-kind work items other than cash necessary to prepare the feasibility report. The determination of the initial dollar value of in-kind products or services will be based on negotiation of a detailed
Government estimate and a non-Federal sponsor proposal. The value of in-kind services will be stated as fixed fee amounts determined by applying applicable Federal regulations, including

OMB Circular A-87. Acceptance of the product will be as described in the PMP.

d. Preconstruction Engineering and Design (PED) Phase.

(1) Section 105(c) of WRDA 86 specifies that the cost sharing for design of projects will be shared in the same percentages as the project purpose. CECW-AG Memorandum, 3 August 1998, Subject: Model Design Agreement, requires that the Government and the non-Federal sponsor execute a design agreement for all Preconstruction Engineering and Design activities funded by General Investigations, and all engineering and design activities funded by either Construction, General or Operations and Maintenance, General appropriations with certain limited exceptions set forth therein. Since most project purposes have different cost sharing formulas, HQUSACE and ASA (CW) developed the model DA using 75/25 percent cost sharing. To ensure costs of design are ultimately shared in the same percentages as the project purpose, once design is complete total design costs are included in total project costs in the PCA for the project. Any adjustments required ensuring the non-Federal sponsor has contributed the correct percentage of total design costs are accomplished by adjusting the cash requirement from the non-Federal sponsor in the first year of construction. It is important to note that unlike Section 105(a) of WRDA 86, Section 105(c) of WRDA 86 does not authorize or permit any in-kind services to meet a portion of non-Federal sponsor contributions during design.

(2) Section 105(b) of WRDA 86 specifies the cost sharing for projects authorized in WRDA 86 for Planning and Engineering only. Non-Federal sponsors must contribute 50 percent of the cost of planning and engineering during the period of planning and engineering. The costs included herein are all costs necessary to produce a feasibility report. Once the period of planning and engineering is complete, the Government and non-Federal sponsor must execute a DA to cost share the costs of design.

(3) All Other PED. These costs may be incurred under several classes below: All PED costs incurred subsequent to the feasibility study, other than costs incurred during the period of planning and engineering discussed in 2. above, are considered a part of, and included in, the total project cost to be cost shared and included in the PCA. The PED costs are to be treated as a component of the first year construction costs and included in the non-Federal sponsor's first year cash requirements.

(a) Continuing Planning and Engineering. All such costs are subject to cost sharing, if incurred on or after 1 October 1985.

(b) Advance Engineering and Design.

e. Construction. The draft PCA is sent through RM for comment to insure the PCA cost sharing provisions will track and comply with established accounts. Coordination and accounting mechanisms will be established for: allocating and tracking non-Federal sponsor cash contributions, crediting for the value of authorized and approved Lands, Easements, Rights-of-Way, and initial and final Relocations, and Disposal Areas (except for general navigation projects/features), Section 104/215 and other authorized credits to the non-Federal sponsor's cost share; and distribution of charges against Federal and non-Federal sponsor accounts. Project cost estimates reflecting the detailed current schedule and cost share requirements are prepared annually by the project manager/programmer. The project programmer creates and updates the Cost Share Control Record in CEFMS that includes this summarized information annually.

(1) Non-Federal sponsor contributions of Project Cost. The non-Federal sponsor cost sharing and project financing responsibilities must be determined for each project based upon the statutory authority as spelled out in the cost sharing agreement and the project. Except as discussed in the next paragraph, the non-Federal sponsor must provide its share of total project costs during the period of construction. The non-Federal sponsor has flexibility to determine whether to make the total estimated non-Federal share of construction cost available prior to the start of construction or incrementally over the period of construction. The specific policy is generally outlined in ER 1165-2-131 and updated by Policy and Project Management Guidance Letters listed on the Planning and Policy Website.

(2) Authorities Allowing Deferred Payment by the non-Federal sponsor.

(a) For commercial navigation projects, Section 101(a)(1) of WRDA 86 provides that a portion of the non-Federal sponsor's share will be paid during construction. Section 101(a)(2) of WRDA 86 requires an additional 10 percent of the cost of general navigation features to be paid by the non-Federal sponsor over a period not to exceed 30 years at an interest rate determined pursuant to Section 106 of WRDA 86.

(b) In special circumstances (see ER 1165-2-131) where non-Federal sponsors request, non-Federal sponsor financing may be deferred under Sections 101(d) and 103(l) if approved by the Assistant Secretary of the Army (Civil Works) (ASA (CW)). In such an instance, the Government will finance the construction costs from Federal appropriations and the non-Federal sponsor will repay its share over time, plus interest at a stated rate. When this approach is taken, Interest During Construction (IDC) will be assessed, as well as interest during the repayment phase, since the Government is incurring an interest cost in financing the non-Federal share. All interest will be recorded in the Federal project account as miscellaneous receipts funds returned to the U.S. Treasury. Interest methodology is defined in ER 1165-2-131, Appendix I. This methodology will be followed for all projects subject to the provisions of WRDA 86, P.L. 99-662,

but will not be retroactively applied to projects when construction was begun under previous legislative authorities.

f. Flood Control and Coastal Emergencies.

(1) Cost-sharing provisions under natural disaster procedures specified in ER 500-1-1 require that 20 percent of the cost to rehabilitate a non-Federal levee be provided by non-Federal sponsors. This contribution may be cash or in-kind services provided during the period of construction.

(2) In certain circumstances, notably for construction of wells to provide emergency drinking water, any construction of wells by USACE will be paid by the applicant. USACE may construct wells only when commercial or other sources cannot construct them within a reasonable time. The purpose of the well will be for human and livestock consumption only.
Reference ER 500-1-1.

g. Inland Waterways Transportation. Projects authorized under Section 102 of WRDA 86 are to be financed in part through transfer appropriation 96-20X8861 (Inland Waterways Trust Fund). The Inland Waterways Trust Fund will be used to pay 50 percent of total construction cost. The term "construction" as used in Section 102 of WRDA 86 includes planning, designing, engineering, surveying, the acquisition of all lands, easements, and rights-of-way necessary for the project, including lands for disposal of dredged material, and relocations necessary for the project.

h. Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R). The non-Federal cost of OMRR&R of projects shall be in accordance with the statutory authority for the project.

i. Reimbursement For Advance Non-Federal Construction of Authorized Federal Harbors and Inland Harbor Improvement.

(1) Section 204(e) of WRDA 86, as amended, provides authority to reimburse a non-Federal sponsor for construction of an authorized Federal harbor or inland improvement or separable element thereof provided that certain statutory requirements are met.

(2) In accordance with the statutory authority, after project authorization and before initiation of construction of the project or separable element, the Secretary of the Army must approve the plans of construction of the project by the non-Federal interest, the non-Federal interest must execute an agreement to pay the non-Federal share, if any, of the cost of operation

and maintenance of the project, and the Secretary must determine before plan approval that the project or separable element of the project is economically justified and environmentally acceptable. Reimbursement cannot be made until appropriated funds are available and the Secretary has certified that the work has been performed in accordance with applicable permits and approved plans.

j. Lands, Easements, Rights-of-Way, Relocations and Disposal Areas (LERRD).

(1) In addition to cash requirements, the non-Federal sponsors are required, under many project authorities, to provide all lands, easements, rights-of-way, and to perform or assure performance of relocations (see paragraph (3) below) or bear the costs of such work if performed by the Government on behalf of the non-Federal sponsor. Except for commercial navigation projects, non-Federal sponsors also are generally required to provide all dredged or excavated material disposal areas.

For commercial navigation projects, the non-Federal sponsor does not generally provide dredged material disposal areas. They must provide the underlying lands, but the disposal area features will be treated as cost shared general navigation features. However, in order to determine the responsibility for a specific project, the statutory authority for the project must be examined. (See ER 1165-2-131 and chapter 12 of ER 405-1-12.)

(2) The non-Federal sponsor shall receive credit toward its share of total project costs for the fair market value of the lands, easements, and rights-of-way that it provides for the project and for the incidental costs of acquiring such interests. Fair market value, and the credit amount to be afforded shall be determined in accordance with the requirements of the cost-sharing agreement executed by the Government and the non-Federal sponsor.

(3) The general policy for performing and cost sharing of relocations, removal or alteration of highway bridges, railroad bridges, utilities and certain structures has been addressed in a series of policy guidance letters (PGL Nos. 1, 2, 2R 44 and 45). They may be found on the web at:
http://www.usace.army.mil/inet/functions/cw/cecwp/branches/guidance_dev/pgls/pgl101.htm
http://www.usace.army.mil/inet/functions/cw/cecwp/branches/guidance_dev/pgls/pgl02.htm
http://www.usace.army.mil/inet/functions/cw/cecwp/branches/guidance_dev/pgls/pgl02r.htm
http://www.usace.army.mil/inet/functions/cw/cecwp/branches/guidance_dev/pgls/pgl44.htm
http://www.usace.army.mil/inet/functions/cw/cecwp/branches/guidance_dev/pgls/pgl45.htm

Specific project statutory authority may provide a different cost-sharing responsibility.

k. Methods for Providing Non-Federal Funds.

(1) General. For projects involving a single or lump sum contract to be completed in one fiscal year or a project that will be completed in one fiscal year, the non-Federal sponsor shall provide its full cash requirement on or before the scheduled date of issuance of the solicitation of the first construction contract. For projects that will take more than one fiscal year to complete, the non-Federal sponsor may provide its share in periodic payments. The timing of these payments may be on a Federal fiscal year, quarterly, or fiscal year of the non-Federal sponsor basis in accordance with the cost-sharing agreement for the project. The non-Federal sponsor's payment may be made by any of the methods of payment (check, escrow account, letter of credit, or electronic funds transfer) outlined in the cost-sharing agreement executed by the Government and the non-Federal sponsor.

(2) Check.

(3) Escrow Accounts.

(a) Non-Federal sponsors of water resource projects, especially those projects that will be constructed over a period of years, may wish to provide their required contributions in an interest bearing escrow account. The escrow account provides a means for the non-Federal sponsor to earn interest on its funds and ensures that funds are available for use immediately by the Government when needed. Funds are not available for obligation purposes by the Government until withdrawn from the non-Federal sponsor's escrow account and deposited into the U.S. Treasury. Usually, the District Commander or another designated official for deposit will withdraw funds in escrow into the U.S. Treasury in increments as needed. Approval from HQUSACE (CECC-G) is required only when escrow agreements differ from the model escrow agreement. Further discussion is provided in ER 1165-2-30, ER 1165-2-131, ER 37-1-30, in Memorandum, CECC-ZA, 8 October 1997, subject: Escrow Agreements in Support of Agreements Other than Project Cooperation Agreements, as amended by Memorandum, CECW-PG, 28 September 2000, Subject: Revision to Model Escrow Agreement, and references cited therein.

(1) The model escrow agreement found in those ERs has been modified. The revised model is located at the following Internet address:
http://www.usace.army.mil/civilworks/cecwp/branches/policy_compliance/ccpca.htm

(b) Escrow accounts must meet certain criteria. The financial institution must be financially secure. The financial institution that holds the escrow account must hold a national charter (i.e., be a member of the Federal Reserve) or at least be insured by the Federal Deposit

Insurance Corporation (FDIC). In addition, the deposit of funds must be irrevocable. The non-Federal sponsor must not be able to withdraw the funds until the Government has certified that no additional funds will be needed. The funds will not be used for speculative investment. Any investment by the financial institution must be a direct obligation of the Federal Government (e.g., Treasury bills) or obligations of Federal agencies guaranteed by the Federal Government (e.g., certificates issued by the Government National Mortgage Association), or in a money market mutual fund consisting solely of such obligations.

(4) Letter of Credit. The non-Federal sponsor may wish to provide an irrevocable letter of credit for its share of project costs. A letter of credit is similar to an escrow account. With a letter of credit, a financial institution guarantees to the Federal Government that funds are available upon request from the non-Federal sponsor to meet the required cash outlays. HQUSACE (CECC-G) must approve the letter of credit. A suggested example of a letter of credit has been placed on the HQUSACE Civil Works website at:
http://www.usace.army.mil/civilworks/cecwp/branches/policy_compliance/ccpca.htm

(5) Electronic Funds Transfer.

(6) Deferred Payments. Deferred payments by non-Federal sponsors are covered in ER 1165-2-131 and the mechanisms would need to be specifically provided in the project cooperation agreement.

(7) There are occasions when non-Federal sponsors may wish to meet their cost sharing responsibilities at least in part with funds they have received from the Government. As a general rule, non-Federal shares of project cost are to be satisfied through the use of non-Federal funds. Federal funds may not be used to meet the non-Federal sponsor's share of project costs unless the expenditure of such funds is expressly authorized by statute as verified in writing by the granting agency. (See ER 1165-2-131.)

l. Voluntary contributions for recreation and natural resources activities, 33 USC 2325.

(1) Acceptance. USACE is authorized to accept contributions of cash, funds, materials, and services from persons, including governmental entities but excluding the project sponsor in connection with management of recreation and natural resources activities at water resources development projects.

(2) Deposit. Any cash or funds received shall be deposited in the U.S. Treasury into account "Contributions and Advances, Rivers and Harbors, Corps of Engineers (96X8862)" and shall be available until expended.

m. Challenge Partnership Agreements program for the management of recreation and natural resources activities, 33 USC 2328.

(1) General. USACE is authorized to develop and implement a program to share the cost of managing recreation and natural resources activities at water resources development projects.

(2) Cooperative agreements. To implement this program, USACE is authorized to enter into cooperative agreements with non-Federal public and private entities to provide for operation and management of natural resources activities at Civil Works projects.

(3) Contributions. USACE may accept contributions of funds, materials, and services from non-Federal public and private entities for the Challenge Partnership Agreements program. Any funds received shall be deposited in the U.S. Treasury into account "Contributions and Advances, Rivers and Harbors, Corps of Engineers (96X8862)" and shall be available until expended.

13-3. Procedures.

a. Cost Shared Accounting Procedures can be found at:
http://www.usace.army.mil/inet/functions/rm/finance/finance.htm

b. Financial Management System. The Corps of Engineers Financial Management System (CEFMS) user manual at http://rmf31.usace.army.mil/cefmsdoc provides detailed financial system procedures for cost sharing management.

APPENDIX A

Required Publications

P.L. 99-662 (The Water Resources Development Act of 1986)

P.L. 100-676 (The Water Resources Development Act of 1988)

P.L. 106-541 (The Water Resources Development Act of 2000)

38 Stat. 1053; (Rivers and Harbor Act of 1915) 33 U.S.C. 560, Section 4

OMB Circular A-87 (Cost Principles for State and Local Governments)

EFARS (Engineer Federal Acquisition Regulation Supplement)

ER 37-1-30 (Accounting and Reporting)

ER 405-1-12 (Real Estate Handbook)

ER 500-1-1 (Natural Disaster Procedures)

ER 1105-2-100 (Guidance for Conducting Civil Works Planning Studies)

ER 1165-2-30 (Acceptance and Return of Required, Contributed or Advanced Funds for Construction or Operation)

ER 1165-2-120 (Reimbursement for Advance Non-Federal Construction of Federally Authorized Harbor and Inland Harbor Improvements)

ER 1165-2-131 (Project Cooperation Agreements for New Start Construction Projects)

APPENDIX B

Final Accounting Report

13-B-1. The terms of the FCSA, PCA, and Design Agreement require that the Corps must provide the non-Federal sponsor with a final accounting report of total study/project cost. The project manager and the F&A office will prepare the final accounting report. The project manager, RM representative and non-Federal sponsor may develop the final accounting report format during the preliminary negotiations of the FCSA or PCA. It is recommended that a draft report format be presented to the non-Federal sponsor for concurrence. The F&A office must ensure that the final report agrees with the cost recorded in the official accounting records (CEFMS). Commanders and project managers must ensure that responsibilities are clearly assigned, since the report may require a billing or refund to the non-Federal sponsor. An independent review of the final accounting report must be performed prior to billing or returning funds to the sponsor. CEIR reviews the USACE records and DCAA reviews the sponsor records.

13-B-2. The percentage of total project cost which the non-Federal sponsor must provide is normally a joint effort between Project Management, Resource Management, Counsel, and Real Estate and determined based on Federal laws. Under P.L. 99-662, cost sharing requirements for certain project feature/purposes are different from others. The final accounting report must contain clear splits where different project purposes exist. The cost accountant must coordinate with the project manager to determine if different project purposes are involved and hence the applicable cost share percentages have been established prior to start of work.

13-B-3. The terms of the model FCSA require that the final accounting report of study cost be provided to the non-Federal sponsor within 90 days of the study completion. The terms of the FCSA require the following items to be included in the final accounting report:

(1) Government disbursement of Federal Funds.

(2) Cash contributions from the sponsor.

(3) Credits for the negotiated cost of the non-Federal sponsor.

Within 30 days after the final accounting report, the Government shall refund to the sponsor the excess of cash contributions and credits over 50 percent of total study cost, if any, subject to the availability of appropriation funds. Within 30 days after the final accounting report, the non-Federal sponsor shall provide the Government any cash contributions required so that total sponsor's share equals 50 percent of total study cost.

13-B-4. The terms of the PCAs for civil works projects require the Corps, upon completion of construction and resolution of all relevant claims and appeals, to compute total cost of construction and tender to the non-Federal sponsor a final account of the sponsor's share of total project cost. The final accounting report should be provided within 90 days.

a. In the event that the total contributions by the non-Federal sponsor are less than its required share, the sponsor shall, no later than 90 calendar days after receipt of written notice, make cash payment to the Government to meet its required share of project cost.

b. Structural flood control model PCA. See Article VI D for requirements regarding refund of the non-Federal sponsor's contribution.

c. Harbor model PCA.

13-B-5. If interest on deferred payments or during construction applies, it must be computed as earned and reflected in the final accounting report for proper accounting and to preclude allegations that the Corps failed to disclose all cost.

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
P.O. BOX 532711
LOS ANGELES, CALIFORNIA 90053-2325

REPLY TO
ATTENTION OF

June 19, 2012

Office of
District Counsel

John Davis
PO Box 10152
Marina Del Rey, CA 90295

RE: Ballona Wetlands

Dear Mr. Davis,

This letter concerns your Freedom of Information Act (FOIA) request dated May 3, 2012. Your request, assigned number FA-12-0109, is enclosed. Please use this reference number in any further correspondence regarding this request.

In your letter, you requested documents related to the Ballona Wetlands, specifically:

1) Any and all documents terminating the Environmental Impact Statement process undertaken by the Corps.

2) Any and all information regarding financial records of the aforesaid process inclusive of all expenditures of money by the Corps and all money received by the Corps for the same purpose from any source whatsoever.

3) Any and all information terminating the local sponsor agreement entered into for the aforesaid purpose between the Corps and the local sponsor, the Santa Monica Bay Restoration Authority.

We have conducted our search and no responsive documents exist due to the following reasons:

1) The Environmental Impact Statement process has not been formally terminated.

2) There have been no expenditures with regard to a formal termination.

3) The local sponsor agreement has not been terminated.

The Program Manager does not anticipate that the EIS process will be terminated in the near future.

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
CIVIL WORKS
108 ARMY PENTAGON
WASHINGTON DC 20310-0108

MAY 30 2012

Mr. John Davis
P.O. Box 10152
Marina Del Rey, California 90295

Dear Mr. Davis:

I have been asked to respond on behalf of Secretary of the Army John M. McHugh to your May 11, 2012, correspondence concerning the Marina del Rey Harbor project and the Ballona Creek, California Ecosystem Restoration feasibility study (Ballona Creek study). The Marina del Rey Harbor entrance channel is a Federal navigation project; however the side channels, docks and inner harbor facilities are not a Federal responsibility and are maintained by the Los Angeles County Department of Beaches and Harbors.

The Ballona Creek study is under development by the Los Angeles District of the Army Corps of Engineers (Corps). You asked about the status of the study, the non-federal cost sharing, and the environmental impact statement. The Ballona Creek study is an ongoing feasibility study examining restoration options for coastal wetlands and lagoons. The study and the environmental impact statement have not been finalized, and very limited federal funding is available to continue them. The non-federal sponsor, the Santa Monica Bay Restoration Commission (SMBRC), has provided its share of the study costs through in-kind services, subject to a Corps evaluation and final approval of crediting. Discussions with the SMBRC on the future of the study have been initiated.

If you would like additional details on the Marina del Rey project or the Ballona Creek study, you may wish to contact Mr. Steve Dwyer, Chief, Navigation Branch, Los Angeles District at (213) 452-3385.

Very truly yours,

Jo-Ellen Darcy
Assistant Secretary of the Army
(Civil Works)

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
P.O. BOX 532711
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[Federal Register Volume 77, Number 143 (Wednesday, July 25, 2012)] [Notices] [Pages 43575-43577] From the Federal Register Online via the Government Printing Office [www.gpo.gov] [FR Doc No: 2012-18166] ----------

DEPARTMENT OF DEFENSE Department of the Army, Corps of Engineers Intent To Prepare a Draft Environmental Impact Statement/ Environmental Impact Report for the Proposed Ballona Wetlands Restoration Project at Ballona Creek Within the City and County of Los Angeles, CA AGENCY: U.S. Army Corps of Engineers, Department of the Army, DoD. ACTION: Notice of intent. ----------

SUMMARY: The U.S. Army Corps of Engineers (Corps) and the California Department of Fish and Game (CDFG) intend to jointly prepare a Draft Environmental Impact Statement/Environmental Impact Report (DEIS/EIR) for the proposed Ballona Wetlands Restoration Project. The proposed project is intended to return the daily ebb and flow of tidal waters, maintain freshwater circulation, and augment the physical and biological functions and services in the project area. Restoring the wetland functions and services would allow native wetland vegetation to be reestablished, providing important habitat for a variety of wildlife species. As a restored site, the Ballona Wetlands would play an important role to provide seasonal habitat for migratory birds. A restored, optimally functioning wetland would also benefit the adjacent marine environment and enhance the quality of tidal waters. DATES: Submit comments on or before September 10, 2012. FOR FURTHER INFORMATION CONTACT: Dr. Daniel P. Swenson at (213) 452-3414 (daniel.p.swenson@usace.army.mil), U.S. Army Corps of Engineers, Los Angeles District, P.O. Box 532711, Los Angeles, CA 90053-2325. SUPPLEMENTARY INFORMATION: The Corps intends to prepare a joint EIS/EIR to assess the environmental effects associated with the proposed project. CDFG is the state lead agency for the EIR pursuant to the California Environmental Quality Act (CEQA). 1. Background. The 600-acre Ballona Wetlands Ecological Reserve is located in the western portion of the City of Los Angeles (partially within unincorporated Los Angeles County), south of Marina Del Rey and north of Playa Del Rey. The project site is situated approximately 1.5 miles west of Interstate 405 and approximately \1/4\-mile east of Santa Monica Bay. The project site is owned by the State of California, and is bisected by and includes a channelized span of Ballona Creek, a component feature of a federal flood risk management project. 2. Project Purpose and Need. A substantial portion of California's historic coastal wetlands have been lost. Restoration of coastal wetlands is needed in order to increase available nursery and foraging habitat for wildlife and to provide recreational and educational opportunities to the public. The Ballona Wetlands ecosystem is one of the last remaining major coastal wetlands in Los Angeles County. It is estimated that historically the wetlands ecosystem spanned more than 2,000 [[Page 43576]] acres in the vicinity of the site. Development occurring over the last century greatly reduced the Ballona wetland area, now estimated at approximately 600 acres. In addition, the wetland habitat and natural hydrological functions in the area have been substantially degraded. The project site provides habitat for a diversity of plant and wildlife species, but most on-site habitat exhibits relatively low physical and biological functions and services. The proposed project is intended to return the daily ebb and flow of tidal waters, maintain freshwater circulation, and augment the physical and biological functions and services in the project area. Restoring the wetland functions and services would allow native wetland vegetation to be reestablished, providing important habitat

for a variety of wildlife species. As a restored site, the Ballona Wetlands would play an important role to provide seasonal habitat for migratory birds. A restored, optimally functioning wetland would also benefit the adjacent marine environment and enhance the quality of tidal waters. The proposed project would provide the community with a valuable educational resource and access to a large wetland area. The purpose of the project is to restore ecological functions of the site, in part, by enhancing tidal flow. 3. Proposed Action. CDFG is proposing a large-scale restoration of the Ballona Wetlands Ecological Reserve. The proposed project entails restoring, enhancing, and establishing native coastal wetland and upland habitats in the approximately 600-acre Ballona Wetlands Ecological Reserve. The reserve currently supports large expanses of previously filled and dredged coastal wetland and upland habitat that would be restored by increasing tidal flow throughout the project area, removing invasive species, and planting native vegetation. The main components of the proposed project are: Habitat restoration of estuarine wetland and upland habitats connected to a realigned Ballona Creek. Removal of existing Ballona Creek levees and realignment of Ballona Creak to restore a more meandering channel. Construction of levees along the perimeter of the project area to allow restoration of tidally influenced wetlands in the project area while providing flood risk management for Culver Boulevard and surrounding developed areas. Installation of water control structures, including culverts with self-regulating tide gates or similar structures, to provide a full range of tides up to an elevation acceptable for flood risk management and storm drainage, while reducing the risk of damage from storm events. Maintenance of existing levels of flood risk management for areas surrounding the Ballona Wetlands site. Provision of erosion protection as an integral part of the restoration design. Modification of infrastructure and utilities as necessary to implement the restoration project. Improving public access by realigning existing trails, creating new trails, repairing existing fences, constructing overlook platforms, and providing other visitor-oriented facilities. Long-term operations and management activities including inspections, repairs, clean-up, vegetation maintenance, and related activities. The proposed project requires a permit under section 404 of the Clean Water Act (CWA) and section 10 of the Rivers and Harbors Act to conduct dredge and fill activities in waters of the United States and for work and (or) structures in or affecting navigable waters of the United States associated with restoring wetlands and associated habitat within the project site. Dredge and fill activities in waters of the United States are proposed to construct new levees, form new tidal channels, modify existing tidal channels, re-contour areas to enhance tidal flow, and to create elevations conducive to establishing wetland habitat. Preliminary conservative estimates indicate the project would result in a balanced total of 1,782,000 cubic yards of excavation and 1,782,000 cubic yards of fill placement, not all of which would affect jurisdictional areas. Based on these preliminary estimates, the volumes and areas of fill are estimated as follows: Permanent discharge of fill within 43.5 acres of non-wetland waters of the U.S. (435,000 cubic yards) and within 65 acres of wetland waters of the U.S. (600,000 cubic yards), as well as temporary discharge of fill within 3.5 acres of non- wetland waters of the U.S. (30,000 cubic yards) and within 0.3 acres of wetland waters of the U.S. (structural fill). The project will also require a permit from the Corps to the Los Angeles County Department of Public Works, as the non-Federal sponsor of the Los Angeles County

Drainage Area (LACDA) project, pursuant to 33 U.S.C. section 408 (408 permit). A section 408 permit is required to alter/modify a completed Corps project. The Ballona Creek levees were constructed by the Corps in the 1930s as part of LACDA. This project proposes to remove levees, construct a larger levee reach around the perimeter of the proposed side, reconfigure the existing concrete-lined Ballona Creek flood-control channel and realign the creek. A permit for modification/alteration of this magnitude would require Corps Headquarters approval. 4. Alternatives Considered. The feasibility of several alternatives is being considered and will be addressed in the DEIS/EIR. The No Federal Action/No Project Alternative, as required by NEPA and CEQA, would maintain the status quo and would include no improvements or discharges of fill material in waters of the United States or work or structures in or affecting navigable waters of the United States. Other alternatives that may be considered include restoring smaller portions of the 600-acre site, alternative designs that would provide differing amounts of various habitats types, and alternative designs for enhancing tidal flow. Additional alternatives may be developed during scoping and will also be considered in the DEIS/EIR. 5. Scoping Process. a. Affected federal, state and local resource agencies, Native American groups and concerned interest groups/individuals are encouraged to participate in the scoping process. Public participation is critical in defining the scope of analysis in the DEIS/EIR, identifying significant environmental issues in the DEIS/EIR, providing useful information such as published and unpublished data, and knowledge of relevant issues and recommending mitigation measures to offset potential impacts from proposed actions. b. Potential impacts associated with the proposed project will be fully evaluated. Potential significant issues to be addressed in the DEIS/EIR include aesthetics, air quality and greenhouse gas emissions, biological resources, cultural resources, geology and soils, hazards and hazardous materials, hydrology and water quality, land use and planning, noise, public services, recreation, sea-level rise, traffic, flood control, and utilities. Additional issues may be identified during the scoping process. c. Individuals and agencies may offer information or data relevant to the environmental or socioeconomic impacts of the proposed project by submitting comments, suggestions, and requests to be placed on the mailing list for announcements to (see FOR FURTHER INFORMATION CONTACT) or the following email address: Daniel.p.swenson@usace.army.mil. [[Page 43577]] d. The Corps anticipates formally consulting with the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act, the National Marine Fisheries Service under Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and with the State Historic Preservation Officer under Section 106 of the National Historic Preservation Act. The CDFG, as the project proponent, will need to obtain a CWA section 401 water quality certification or waiver and a consistency certification from the California Coastal Commission in accordance with the Coastal Zone Management Act. 6. Scoping Meeting Date, Time, and Location. A public scoping meeting to receive input on the scope of the DEIS/EIR will be conducted on August 16, 2012, from 4:00-7:00 p.m. at the Fiji Gateway entrance to the Ballona Wetlands (13720 Fiji Way, Marina del Rey, CA 90292, across from Fisherman's Village and Los Angeles County Department of Beaches and Harbors). 7. Availability of the DEIS/EIR. The DEIS/EIR is expected to be published and circulated in late 2012. A public hearing will be held after its publication to field comments on the document. David

J. Castanon, Chief, Regulatory Division, Corps of Engineers. [FR Doc. 2012-18166 Filed 7-24-12; 8:45 am] BILLING CODE 3720-58-P

deposit rate will be 5.53 percent; (2) for subject merchandise exported by Golden Dragon but not manufactured by Golden Dragon, the cash deposit rate will be the all others rate (*i.e.*, 26.03 percent); (3) for subject merchandise manufactured by Golden Dragon but exported by any party other than Golden Dragon, the cash deposit rate will be the all others rate. These requirements, when imposed, shall remain in effect until further notice.

Further, effective upon publication of the final results, we intend to instruct CBP that importers may no longer post a bond or other security in lieu of a cash deposit on imports of seamless refined copper pipe and tube from Mexico, manufactured and exported by Golden Dragon. These cash deposit requirements, when imposed, shall remain in effect until further notice.

Notifications to Interested Parties

This notice also serves as a final reminder to importers of their responsibility under 19 CFR 351.402(f)(2) to file a certificate regarding the reimbursement of antidumping duties prior to liquidation of the relevant entries during this POR. Failure to comply with this requirement could result in the Department's presumption that reimbursement of antidumping duties has occurred and the subsequent assessment of doubled antidumping duties.

In accordance with 19 CFR 351.305(a)(3), this notice also serves as a reminder to parties subject to administrative protective order ("APO") of their responsibility concerning the return or destruction of proprietary information disclosed under the APO, which continues to govern business proprietary information in this segment of the proceeding. Timely written notification of the return/destruction of APO materials or conversion to judicial protective order is hereby requested. Failure to comply with the regulations and terms of an APO is a violation subject to sanction.

We are issuing and publishing this new shipper review and notice in accordance with sections 751(a)(1) and 777(i) of the Act.

Dated: September 20, 2012.

Paul Piquado,

Assistant Secretary for Import Administration.

Appendix I—Issues and Decision Memorandum

Comment 1: Date of Sale
Comment 2: Adjustment to U.S. Price
Comment 3: Entitlement to New Shipper Review

[FR Doc. 2012–23686 Filed 9–25–12; 8:45 am]

BILLING CODE 3510–DS–P

CONSUMER PRODUCT SAFETY COMMISSION

[CPSC Docket No. 12–1]

Telephonic Prehearing Conference Cancellation

AGENCY: U.S. Consumer Product Safety Commission.

ACTION: Cancellation of Telephonic prehearing conference.

SUMMARY: Cancellation of Telephonic prehearing conference on September 25, 2012, in the matter of Maxfield and Oberton Holdings, LLC, CPSC Docket 12–1.

FOR FURTHER INFORMATION CONTACT: Katy J.L. Duke, Esq., U.S. Coast Guard ALJ Program, 504/671–2213.

Dated: September 21, 2012.

Todd A. Stevenson,

Secretary.

[FR Doc. 2012–23664 Filed 9–25–12; 8:45 am]

BILLING CODE 6355–01–P

DEPARTMENT OF DEFENSE

Department of the Army, Corps of Engineers

Withdrawal of Intent To Prepare a Draft Environmental Impact Statement/ Environmental Impact Report for the Ballona Creek Ecosystem Restoration Feasibility Study, Los Angeles County, CA

AGENCY: Department of the Army, U.S. Army Corps of Engineers, DoD.

ACTION: Notice of intent.

SUMMARY: The Los Angeles District of the U.S. Army Corps of Engineers (Corps) published a Notice of Intent to Prepare a Draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for the Ballona Creek Ecosystem Restoration Feasibility Study in the **Federal Register** on September 20, 2005 (70 FR 55116). The study's purpose is to evaluate structural and non-structural means of restoring diminished ecosystem functions and services within the lower reach of Ballona Creek including coastal wetlands. Santa Monica Bay Restoration Commission (SMBRC) is the local sponsor for the cost-shared study.

On September 29, 2005, a public scoping meeting was held pursuant to requirements of the National Environmental Policy Act and Engineer Regulations 1105–2–100. Baseline conditions portions of the EIS/EIR have been completed as of January, 2012. On July 17, 2012, the SMBRC requested the Corps terminate the study. Therefore, the Corps is withdrawing the Notice of Intent to Prepare a draft EIS/EIR.

FOR FURTHER INFORMATION CONTACT: Ms. Jodi Clifford, Chief, Environmental Resources Branch. Mailing Address: Ms. Jodi Clifford, Chief, Environmental Resources Branch, Corps of Engineers, Los Angeles District, CESPL–PD–R, 915 Wilshire Boulevard, Los Angeles, CA 90017. Telephone: (213) 452–3840. Email: *Jodi.L.Clifford@usace.army.mil.*

SUPPLEMENTARY INFORMATION: The Corps is no longer pursing restoration within Ballona Creek as a cost-shared study within its Civil Works program. Although SMBRC requested the Corps terminate the feasibility study, SMBRC, acting on behalf of the California Department of Fish and Game, is moving forward with plans for ecosystem restoration within Ballona Creek. SMBRC must obtain permissions from the Corps to proceed with implementation of its restoration proposals. Therefore, the Corps is initiating an EIS pursuant to its authorities under Section 404 of the Clean Water Act, Section 10 of the 1899 Rivers and Harbors Act, and Title 33, U.S. Code, Section 408 for a project to be planned and carried out by SMBRC. To that end, the Corps published a Notice of Intent to Prepare an EIS in the **Federal Register** on July 25, 2012 (77 FR 43575). A scoping meeting was held on August 16, 2012. All technical studies and reports prepared under the Civil Works feasibility study authority will be utilized to the maximum practical extent in support of the EIS/EIR process now underway.

Dated: September 12, 2012.

R. Mark Toy,

Colonel, U.S. Army Commander and District Engineer.

[FR Doc. 2012–23669 Filed 9–25–12; 8:45 am]

BILLING CODE 3720–58–P

DEPARTMENT OF DEFENSE

Corps of Engineers, Department of the Army

Notice of Intent To Prepare a Draft Environmental Impact Statement for a Proposed Aquatic Ecosystem Restoration Project for the Quiver River, MS

AGENCY: Department of Defense, U.S. Army Corps of Engineers, DoD.

SECRETARY OF THE ARMY
WASHINGTON

MAY 17 2012

Mr. John Davis
Post Office Box 10152
Marina del Rey, California 90295

Dear Mr. Davis:

Thank you for your May 11, 2012 communication concerning the status of preparation of an Environmental Impact Statement for the Playa del Rey Inlet and Basin.

I have asked the Assistant Secretary of the Army for Civil Works, who has responsibility in this area, to look into this project and provide you an appropriate update on its status.

Thank you for bringing this matter to my attention and for supporting our Army.

Sincerely,

John M. McHugh

EXHIBIT 7

2010 INTEGRATED REPORT — ALL ASSESSED WATERS

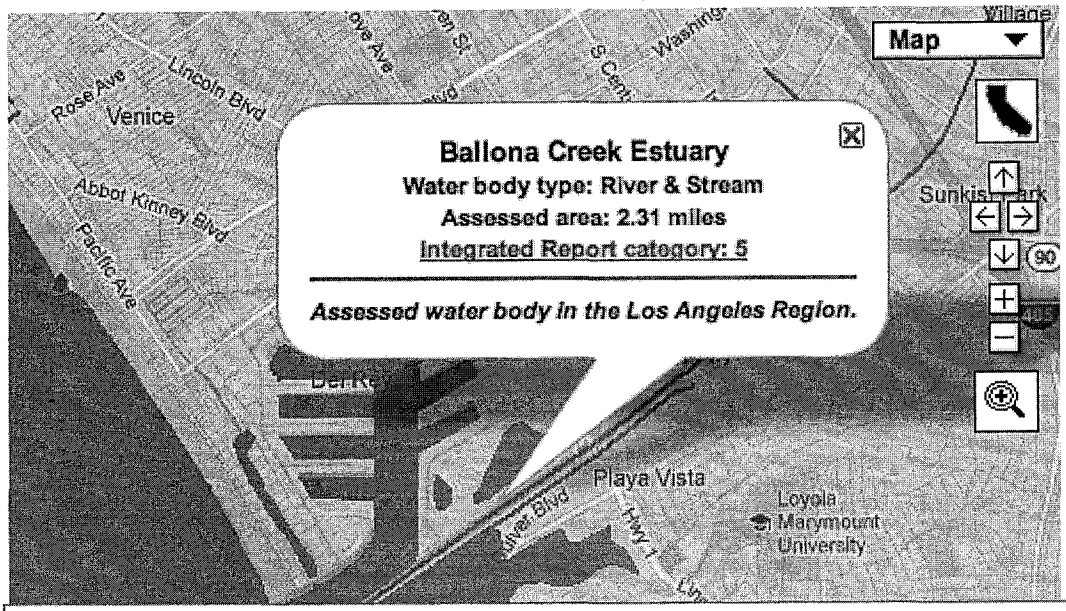
Zoom to county: All
Show county

Zoom to Regional Board: All
Show Regional Board

Map Help

Zoom to water body: *(Filter: All)*

Filter list by: | Reset list



- (•) Show all assessed waters
- ( ) Show only impaired ("303(d)-listed") waters

Show water bodies by pollutant:

Pollutant category: *All*
All

Pollutant: *All*
All

Pollutant assessments for Ballona Creek Estuary

Close

Pollutants	Listing Decision	Detailed Report	Potential Sources	Schedule
	Comments			
Antimony | Arsenic | Benzo(a)pyrene (3,4-Benzopyrene -7-d) | Benzo[a]anthracene | Chromium (total) | Chrysene (C1-C4) | Dibenz[a,h]anthracene | Mercury | Phenanthrene | Pyrene	Do Not List on 303(d) list (TMDL required list)	7584	,	
Cadmium	List on 303(d) list (being addressed by USEPA approved TMDL)	6038	Source Unknown	USEPA TMDL approval: 2005
Chlordane (tissue & sediment)	List on 303(d) list (being addressed by USEPA approved TMDL)	4822	Nonpoint Source, Point Source	USEPA TMDL approval: 2005
Coliform Bacteria	List on 303(d) list (being addressed by USEPA approved TMDL)	6025	Nonpoint Source, Point Source	USEPA TMDL approval: 2007

2010 INTEGRATED REPORT — ALL ASSESSED WATERS

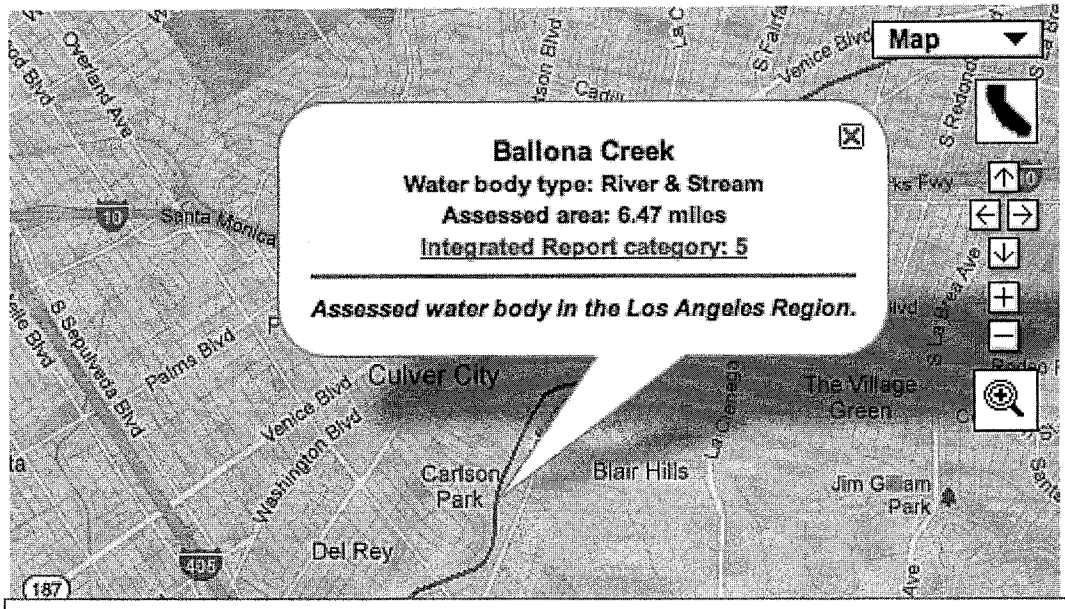
Zoom to county: All
Show county

Zoom to Regional Board: All
Show Regional Board

Map Help

Zoom to water body: *(Filter: All)*

Filter list by: | Reset list



Show all assessed waters
Show only impaired ("303(d)-listed") waters

Show water bodies by pollutant:

Pollutant category: *All*
All

Pollutant: *All*
All

Pollutant assessments for Ballona Creek

Close

Pollutants	Listing Decision	Detailed Report	Potential Sources	Schedule
	Comments			
Ammonia	Do Not List on 303(d) list (TMDL required list)	4468	n/a	
Cadmium (sediment)	Do Not Delist from 303(d) list (TMDL required list)	4880	Nonpoint Source, Point Source	Est. TMDL completion: 2005
	A USEPA-approved TMDL has made a finding of non-impairment for this pollutant.			
ChemA	Delist from 303(d) list (TMDL required list)	4358	n/a	
Chlordane	Delist from 303(d) list (TMDL required list)	4881	n/a	
Coliform Bacteria	List on 303(d) list (being addressed by USEPA approved TMDL)	6024	Nonpoint Source, Point Source	USEPA TMDL approval: 2007

2010 INTEGRATED REPORT — ALL ASSESSED WATERS

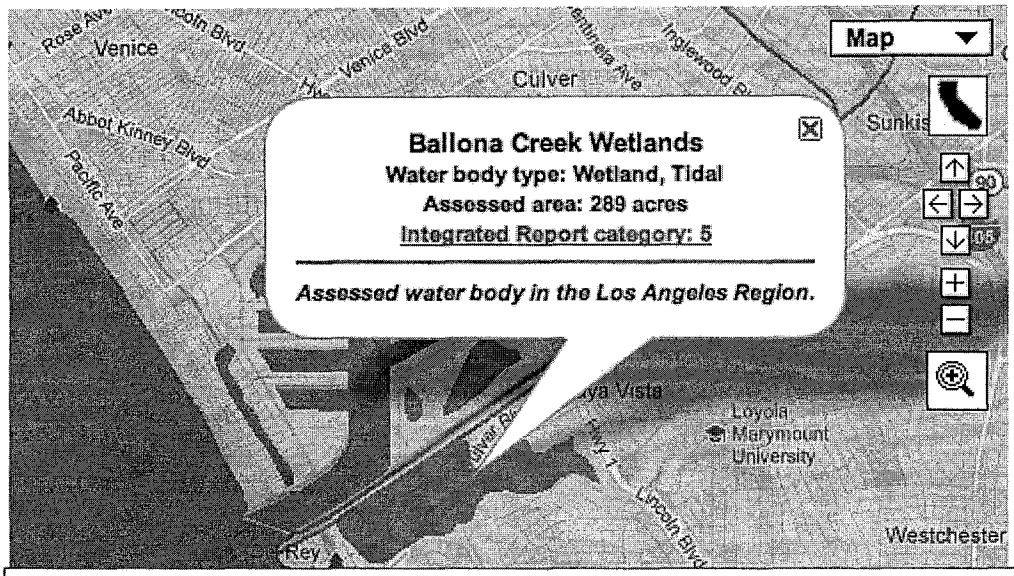
Zoom to county: All
Show county

Zoom to Regional Board: All
Show Regional Board

Map Help

Zoom to water body: *(Filter: All)*

Filter list by: | Reset list



- (•) Show all assessed waters
- ( ) Show only impaired ("303(d)-listed") waters

Show water bodies by pollutant:

Pollutant category: *All*
All

Pollutant: *All*
All

Pollutant assessments for Ballona Creek Wetlands Close

Pollutants	Listing Decision	Detailed Report	Potential Sources	Schedule
	Comments			
Exotic Vegetation	List on 303(d) list (TMDL required list)	7481	Nonpoint Source	Est. TMDL completion: 2019
Habitat alterations	List on 303(d) list (TMDL required list)	7484	Nonpoint Source	Est. TMDL completion: 2019
Hydromodification	List on 303(d) list (TMDL required list)	7487	Nonpoint Source	Est. TMDL completion: 2019
Reduced Tidal Flushing	List on 303(d) list (TMDL required list)	7486	Nonpoint Source	Est. TMDL completion: 2019
Trash	List on 303(d) list (being addressed by USEPA approved TMDL)	6155	Nonpoint Source	USEPA TMDL approval: 2019

2010 INTEGRATED REPORT — ALL ASSESSED WATERS

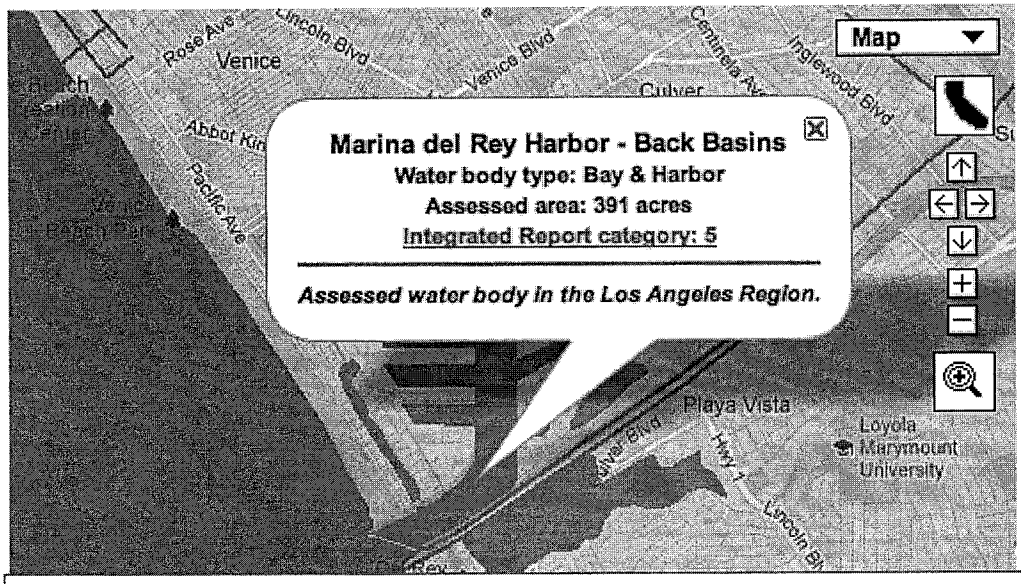
Zoom to county: All
Show county

Zoom to Regional Board: All
Show Regional Board

Map Help

Zoom to water body: *(Filter: All)*

Filter list by: | Reset list



- (•) Show all assessed waters
- ( ) Show only impaired ("303(d)-listed") waters

Show water bodies by pollutant:

Pollutant category: *All*

All

Pollutant: *All*

All

Pollutant assessments for Marina del Rey Harbor - Back Basins Close

Pollutants	Listing Decision	Detailed Report	Potential Sources	Schedule
	Comments			
Chlordane (tissue & sediment)	List on 303(d) list (being addressed by USEPA approved TMDL)	6021	Nonpoint Source	USEPA TMDL approval: 2005
Copper (sediment)	List on 303(d) list (being addressed by USEPA approved TMDL)	6363	Nonpoint Source	USEPA TMDL approval: 2006
DDT (tissue)	Do Not Delist from 303(d) list (TMDL required list)	7328	Nonpoint Source	Est. TMDL completion: 2005
	A USEPA-approved TMDL has made a finding of non-impairment for this pollutant.			
Dieldrin (tissue)	Do Not Delist from 303(d) list (TMDL required list)	6816	Nonpoint Source	Est. TMDL completion: 2005
	A USEPA-approved TMDL has made a finding of non-impairment for this pollutant.			
Fish Consumption Advisory	List on 303(d) list (being addressed by USEPA approved TMDL)	6022	Nonpoint Source	USEPA TMDL approval: 2005

EXHIBIT 8

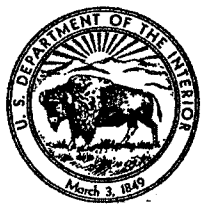
SECTION A-A' ACROSS THE NEWPORT-INGLEWOOD UPLIFT FROM NEWPORT MESA TO LOS ANGELES
SECTION B-B' ACROSS THE NEWPORT-INGLEWOOD UPLIFT FROM NEWPORT MESA TO LOS ANGELES
SECTION C-C' ALONG THE COAST FROM SANTA MONICA TO PALOS VERDES HILLS
SECTION D-D' FROM HUNTINGTON TO THE HILLS
SECTION E-E' THROUGH BALDWIN HILLS
GEOLOGIC SECTIONS OF THE TORRANCE-SANTA MONICA AREA, CALIFORNIA

Geology, Hydrology, and Chemical Character of Ground Waters in the Torrance-Santa Monica Area, California

By J. F. POLAND, A. A. GARRETT, and ALLEN SINNOTT

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1461

Prepared in cooperation with the Los Angeles County Flood Control District, in collaboration with the cities of Inglewood, Redondo Beach, Manhattan Beach, El Segundo, Hawthorne, Culver City, Gardena, Hermosa Beach, and Palos Verdes Estates, and with the West Basin Water Association



UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1959

UNITED STATES DEPARTMENT OF THE INTERIOR

FRED A. SEATON, *Secretary*

GEOLOGICAL SURVEY

Thomas B. Nolan, *Director*

The U. S. Geological Survey Library has cataloged this publication as follows:

Poland, Joseph Fairfield, 1908–

Geology, hydrology, and chemical character of ground waters in the Torrance-Santa Monica area, California, by J. F. Poland, A. A. Garrett, and Allen Sinnnott. Washington, U. S. Govt. Print. Off., 1959.

xi, 425 p. maps (2 col.) diagrs., tables. 25 cm. (U. S. Geological Survey, Water-supply paper 1461)

Part of illustrative matter folded in pocket.

Prepared in cooperation with the Los Angeles County Flood Control District, in collaboration with nine cities and with the West Basin Water Association.

"References cited"; p. 270–273.

1. Water, Underground—California—Torrance-Santa Monica area. 2. Water-supply—California—Torrance-Santa Monica area. I. Title: Torrance-Santa Monica area, California. (Series)

TC801.U2 no. 1461 551.49 G S 58–222

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For sale by the Superintendent of Documents, U. S. Government Printing Office
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GEOLOGY, HYDROLOGY, AND CHEMICAL CHARACTER OF GROUND WATERS IN THE TORRANCE-SANTA MONICA AREA, CALIFORNIA

By J. F. POLAND, A. A. GARRETT, and ALLEN SINNOTT

ABSTRACT

The coastal plain in Los Angeles County, southern California, is divided into two distinct ground-water basins by the Newport-Inglewood uplift. On the northeast or inland side is the main coastal basin; on the southwest, bordering the Pacific Ocean and extending from Long Beach to Santa Monica, is the so-called west basin. The Torrance-Santa Monica area, as identified here, embraces the western part of the coastal plain and spans the entire west basin.

The west basin, which includes about 180 square miles, is an area of expanding population and of rapid industrial growth. Its water supply for domestic, industrial, and irrigation uses is obtained chiefly from wells. In the part of the west basin south of the Ballona escarpment—the Torrance-Inglewood subarea of this report—the draft on ground water has been excessive for many years; and local water levels, which were drawn down to about sea level by 1930, now are as much as 70 feet below sea level. Saline contamination has developed extensively along the coast, and the ground-water supply is threatened with ultimate deterioration if the present draft is maintained.

This investigation, which covers the period from 1943 to 1947, was for the purpose of appraising the geologic conditions controlling the occurrence and circulation of ground water, the replenishment to the west basin, and the extent and sources of saline contamination and methods for its control.

The dominant geologic formations of the area are of Tertiary and Quaternary age. The Tertiary rocks, of Miocene and Pliocene age, are formed almost entirely of marine deposits and consist chiefly of shale, siltstone, and sandstone. Except in their uppermost part, they contain connate saline waters. The lower part of upper division of the Pico formation (the youngest rocks of Pliocene age) has several relatively permeable sand members which collectively average at least 200 feet in thickness. These sand members have not been tapped by water wells; however, they contain essentially fresh water and constitute a reserve supply. It would be expensive to develop this supply because the wells would have to be at least 1,500 feet deep and would require special construction to hold back the sand.

The Quaternary rocks, chiefly of Pleistocene age, contain almost all of the aquifers now tapped by water wells. Deposits of Recent age in the west basin occur only within the Dominguez and Ballona Gaps. The Pleistocene deposits, which underlie most of the Torrance-Santa Monica area, comprise three units which, in downward succession, are: (1) a capping terrace deposit and the Palos Verdes sand, which is composed of sand, silt, and gravel, commonly not more than 30 feet thick and, for the most part, above the water table; (2) the unnamed upper

Pleistocene deposits consisting of silt, clay, sand, and gravel, which are as much as 400 feet thick and are of fluvial and marine origin; and (3) the San Pedro formation (composed of about half sand and gravel and half silt and clay) which is as much as 1,000 feet thick and mostly of marine origin within the west basin. The Silverado water-bearing zone and correlative aquifers in the San Pedro formation yield about 90 percent of the ground water pumped from the west basin. The thickness of this principal aquifer ranges from 50 to 700 feet; its extent within the west basin is about 120 square miles. From pumping tests its permeability has been determined as ranging from 1,000 to 2,000 gallons per day per square foot (gpd per sq ft).

The deposits of Recent age are the latest contributions to the alluvial fans of the Los Angeles and San Gabriel Rivers. They underlie the Downey plain and extend across the west basin as two tongues in Dominguez and Ballona Gaps. The upper division is fine sand and silt, but the lower division is highly permeable coarse sand and gravel, as much as 75 feet thick in Dominguez Gap.

The Newport-Inglewood uplift—a regional anticlinal fold—is ruptured by a series of faults, which form a discontinuous but substantial barrier to underflow from the main coastal basin to the west basin. These faults cut all rocks except those of Recent age.

Three distinct bodies of ground water occur in the area. In downward succession these are: (1) a body of shallow unconfined and semiperched water of inferior quality under natural conditions, which extends to a few tens of feet below the land surface; (2) the principal body of fresh ground water, which occupies almost all the deposits of Recent and Pleistocene age and the upper part of the underlying Pliocene rocks (extending to depths as much as 2,500 feet below land surface in the west basin and 8,000 feet in the main coastal basin), which contains water of good quality; and (3) a body of saline connate water underlying the principal fresh-water body.

The principal body of fresh ground water underlies most of the Torrance-Santa Monica area and occurs beneath the greater part of the west basin. Except near Redondo Beach and north of El Segundo, where a water table exists, the aquifers of the principal water body are confined and separated from each other by substantial thicknesses of relatively impermeable silt or clay.

In the Torrance-Inglewood subarea (the part of the west basin south of the Ballona escarpment), withdrawals of ground water increased from nearly 10,000 acre-feet in 1904 to about 48,000 acre-feet per year in the thirties, and then rose to about 78,000 acre-feet in 1945, because of accelerated demands in the war years. In 1945 about half the withdrawal was used for industrial purposes.

As a result of this increase in draft, water levels noticeably declined in the early twenties and were drawn down to or below sea level throughout the subarea by 1930. A slow, irregular decline continued through 1941, when the decline was accelerated by the increased water demands of the war years. In 1946, local pressure levels in the Silverado water-bearing zone were as much as 70 feet below sea level near the inland boundary of the basin. Because of the impermeable confining beds and disproportionate draft, water levels in the several aquifers have been drawn down unequally. For example, in the Gardena area in 1946, the pressure level in the Silverado water-bearing zone was 50 feet below the semiperched water table, 20 feet below the pressure level of the "200-foot sand" and about 9 feet below that of the "400-foot gravel."

Under the early conditions of ground-water development, replenishment to the west basin occurred (1) by underflow across the Newport-Inglewood uplift, (2) by direct infiltration of rainfall and return water from irrigation on the land surface, (3) by infiltration of local runoff, and (4) by seepage from the channel

of the Los Angeles River to the south and from Ballona Creek and its tributaries to the north. With the drawdown in water levels to and below sea level, water has been added to the basin in substantial quantity by landward encroachment of saline waters from the ocean and from the subsea extensions of the aquifers. Water also has been withdrawn from storage in the water-table reaches by compaction of the water-bearing system in the confined reaches.

The replenishment to the Torrance-Inglewood subarea under native conditions is estimated to have been within the range of 30,000 to 40,000 acre-feet per year. From 1933 to 1941 the draft averaged 48,000 acre-feet per year. It is estimated that about 2,000 acre-feet per year was withdrawn from storage, about 12,000 acre-feet per year was contributed from the subsea extension of the aquifers or from the ocean, and nearly 34,000 acre-feet per year was contributed by net fresh-water replenishment from all sources.

The underflow across the Newport-Inglewood uplift varies with the differential in pressure head across the barrier faults. For the reach from the Baldwin Hills to Long Beach, the average differential is estimated to have decreased from about 40 feet in 1904 to 28 feet in 1941 and to have increased to about 36 feet in 1945 with the accelerated drawdown in the west basin. The underflow into the Torrance-Inglewood subarea in 1945 is estimated as from approximately 15,000 to 20,000 acre-feet, or about 85 percent as much as the underflow during 1904. By 1945 the underflow is believed to have constituted nearly one-half the fresh-water replenishment, and the probable excess of draft over net replenishment was at least 40,000 acre-feet in that year. A major part of this excess draft was replaced by invasion of ocean water.

In the west basin the native waters of good quality in the principal water body range in character from calcium bicarbonate to sodium bicarbonate, and their chloride content ranges from 25 to 90 ppm. For native inferior waters—those in which dissolved solids are in excess of 600 ppm—the chloride content is as great as 500 ppm.

The potential contaminants of the ground water in the west basin are ocean water, oil-field brines, and industrial wastes. The ocean water contains dissolved solids of about 34,000 ppm and chloride content of about 19,000 ppm. The oil-field brines are connate waters from the Tertiary rocks and range in dissolved solids about from 10,000 to 39,000 ppm. The ocean waters are in contact with the subsea extensions of the aquifers; the oil-field and industrial wastes have been discharged at the land surface and in stream channels.

In the twenties and early thirties, in response to the drawdown of the water level in the west basin, certain wells tapping the principal water body along the west coast between Santa Monica and Redondo Beach began to yield saline water. Contamination also developed near the Baldwin Hills and in Dominguez Gap about that time.

In general, the contaminated waters are not simple mixtures of the contaminant and native waters but have been so greatly modified that the nature of the contaminant is very obscure. Such modification is caused chiefly by base exchange—substitution of calcium and magnesium for sodium—and by sulfate reduction.

In the coastal part of Ballona Gap contamination started in the twenties and by 1931 extended beneath nearly 5,100 acres; by 1946 this contamination extended to about 7,300 acres. Inland for about 1.6 miles (near Lincoln Boulevard) the contaminated waters contain more than 500 ppm of chloride. The contaminant at this point is almost wholly ocean water. Contaminated waters extend about 3 miles inland in the Ballona Gap and range in chloride content from 100 to 500 ppm. The source of the contaminant is not definitely known, but the high sulfate content indicates that the shallow unconfined waters are a

principal source. Adjacent to the west and north flanks of the Baldwin Hills, oil-field wastes have contaminated two areas. The contamination on the west flank is increasing but on the north flank it has receded since the thirties.

Along the 11-mile coastal reach, from the Ballona escarpment (Playa del Rey) to the Palos Verdes Hills, salt water has invaded the main water-bearing zones. Contamination was first noted at Hermosa Beach about 1915 and at El Segundo in 1921. By 1931 the coastal area underlain by contaminated waters amounted to almost 5,000 acres, and the greatest inland extent was about 1.3 miles, at El Segundo. By 1946 the contaminated area had increased by about 1,700 acres. In the last 14 years the greatest advance of the front was between El Segundo and Manhattan Beach and was as much as 0.5 mile. In the reach from the Palos Verdes Hills to Hermosa Beach the average rate of advance of the front was about 90 feet per year from 1931 to 1941, and it had increased to about 140 feet per year by 1946. From Hermosa Beach to El Segundo the average rate of advance in the thirties was about 115 feet a year, but it was as much as 300 to 400 feet per year by 1946. The chief source of contamination along the west coast is ocean water. Near El Segundo, part of the early contamination seems to have developed from locally discharged high-sulfate waters.

In Dominguez Gap the Gaspur water-bearing zone, of Recent age, is extensively contaminated in two principal areas. Along the coast and inland, as far as the Pacific Coast Highway (State Street), this zone is highly contaminated with ocean water. Inland from this highway to Carson Street, about 3 miles, the Gaspur zone is contaminated by waste brines from the Long Beach oil field. The Silverado water-bearing zone, which underlies the Gaspur zone but is separated from it by relatively impervious deposits several hundred feet thick, is uncontaminated as of 1947; however, it can become contaminated by downward movement of saline water through abandoned wells unless these wells are properly sealed. The contamination in the Gaspur water-bearing zone is not moving inland; it is moving slowly westward into the upper Pleistocene deposits, and ultimately will reach the Silverado water-bearing zone if the present water-level differentials of as much as 70 feet are maintained.

The continued inland advance of ocean water into the west basin, especially from the west coast, would result in ultimate destruction of the supply of fresh water. The water rights in the Torrance-Inglewood subarea now are being adjudicated because it is recognized that the water supply is being excessively depleted and is being replaced by salt water. In most ground-water basins bordering on the ocean, the most effective long-term program for restraining or driving back saline waters depends upon raising water levels throughout the basin to such a height that fresh-water levels at the saline front will displace salt water seaward. Such raising of water levels ordinarily does not greatly affect replenishment procedures.

However, in the Torrance-Inglewood subarea almost half the current replenishment is derived by underflow across the barrier features. If the restraint of ocean water should be achieved by raising water levels above sea level throughout the basin, and if water levels inland should remain at sea level, underflow across the Newport-Inglewood barrier would cease and half of the replenishment would be lost. Therefore, it seems that the amount of the natural fresh-water yield from the basin will remain substantial only if the salt water can be restrained by local control near the coast and water levels immediately coastward from the barrier can be held low enough to induce continued underflow across the barrier.

Only three physical possibilities seem capable of such local control of saline waters: (1) the construction of artificial subsurface dikes or cut-off walls; (2) the development, by pumping, of a water-level trough coastward from the saline

front; and (3) the maintenance of fresh-water head above sea level at and immediately inland from the saline front. Only the maintenance of fresh-water head is considered to be an economic possibility. The fresh-water head required along the west coast would range from 3 to 13 feet above sea level. It could be attained only by artificial recharge through wells, trenches, or pits.

INTRODUCTION

LOCATION AND GENERAL FEATURES OF THE AREA

The Torrance-Santa Monica area, as identified in this report, embraces the western part of the coastal plain in Los Angeles County, in southern California. Its location is shown by figure 1 and some

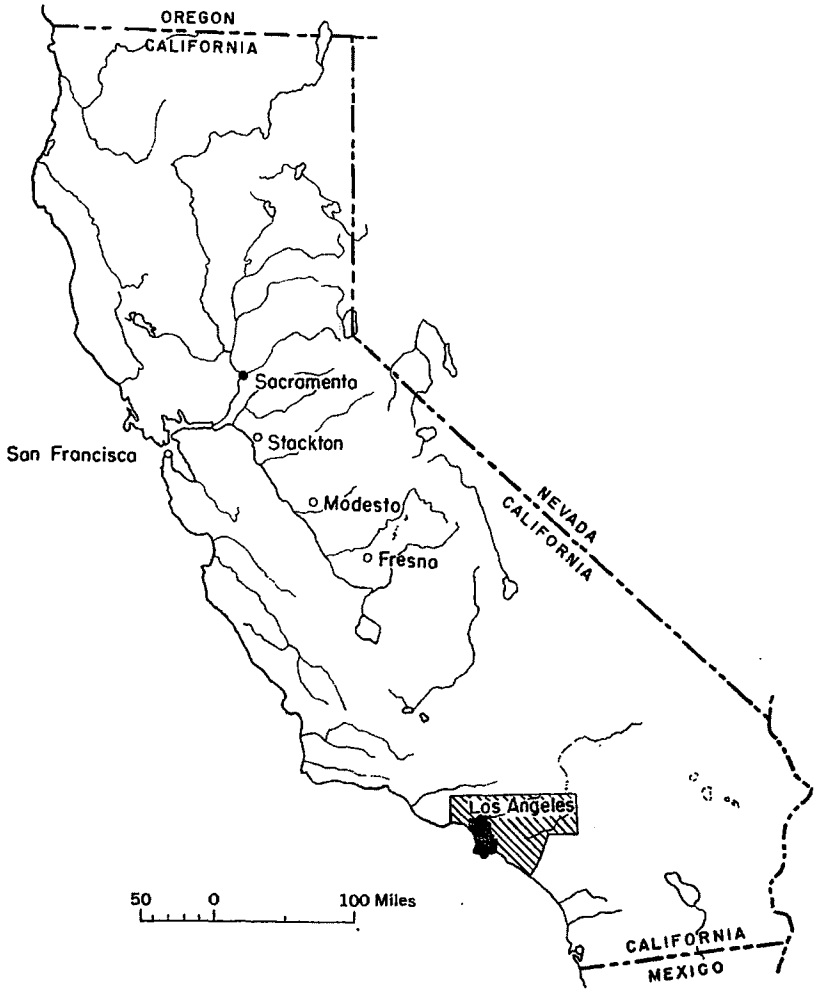

FIGURE 1.—Map of California showing area covered by this report and that covered by plate 1.

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of its general features are shown by plate 1. It is bounded on the north by the Santa Monica Mountains, on the south by the Palos Verdes Hills, and on the west by the Pacific Ocean. It encompasses about 280 square miles, spans the entire west basin of Eckis (1934, p. 198) and extends inland beyond the axis of the Newport-Inglewood uplift. This uplift, which extends about 40 miles southeastward from Beverly Hills to Newport Beach (pl. 1), divides the coastal plain of Los Angeles County into two distinct ground-water basins. On the northeast or inland side is the main or "central" coastal basin, which includes about 500 square miles in Los Angeles and Orange Counties. As of 1948 about one-third of a million acre-feet of ground water is pumped annually to supply municipalities, diversified industries, and extensive agricultural developments from the central basin.

The ground-water basin on the southwest or coastal side of the uplift extends from Santa Monica to Long Beach and is flanked on the southwest by the Palos Verdes Hills and the Pacific Ocean. It was designated the west basin by Eckis, but in recent references by the California Division of Water Resources it has been called the west coast basin. The shorter term by Eckis is used in this report.

The approximate dimensions of the west basin are 25 miles long, 7 miles wide, and 180 square miles in area. It is an area of expanding population and of rapid industrial growth. Two-fifths of the 180 square miles consists of a residential development with a population of at least 300,000. Irrigated farmland covers about one-fifth of the area. The city of Santa Monica is supplied with water from the Metropolitan Water District, but the water supply for domestic, industrial, and irrigation uses is obtained almost entirely from wells. In the part of the west basin south of the Ballona escarpment the draft on ground water has been excessive for many years, and local water levels, which nearly reached sea level by 1930, now (1948) are as low as 70 feet below sea level. As a result, saline contamination has developed in three areas along the coast and the ground-water supply of most of the basin is threatened with ultimate deterioration if the present draft is maintained or increased.

SCOPE OF THE INVESTIGATION AND OF THIS REPORT

Because of the critical ground-water situation in the west basin, in July 1943 an agreement for a cooperative ground-water investigation was made between the U. S. Geological Survey and the Los Angeles County Flood Control District. In addition to its own interest, the District also represented the joint interests of nine cities intimately concerned with the preservation of the ground-water supplies—the cities of Inglewood, Redondo Beach, Manhattan Beach, El Segundo, Hawthorne, Culver City, Gardena, Hermosa Beach, and

Palos Verdes Estates. All these communities obtain water wholly or partly from well fields in the west basin; several of these well fields have been affected or are threatened by saline encroachment—especially the wells that supply Redondo Beach, Hermosa Beach, Manhattan Beach, and El Segundo.

The cooperative investigation of the west basin area was undertaken to appraise: (1) the geologic conditions which control the occurrence and circulation of ground water; (2) the replenishment to the west basin; and (3) the chemical character of the ground water with special reference to saline contamination.

The investigation, which began in October 1943, was under the general direction of O. E. Meinzer, chief geologist. Upon his retirement, A. N. Sayre served in that capacity. Until mid-1946 the project was under the supervision of district geologist A. M. Piper. A. A. Garrett and Allen Sinnott, of the field office at Long Beach, did most of the field operations under the supervision of J. F. Poland, district geologist. Garrett made the partial chemical analyses of well waters. This report is under the combined authorship of Poland, Garrett and Sinnott; the section treating the geology is largely the work of Sinnott and the section on chemical character is chiefly the work of Garrett. The hydrologic interpretations and text were prepared by Poland.

The Geological Survey has made an intensive study of ground-water features in the coastal zone of 240 square miles that extends from Long Beach to Santa Monica, spans all the west basin, and extends inland for about 3 miles beyond the axis of the Newport-Inglewood uplift. The Survey also made a general study of selected ground-water features in a contiguous inland zone of 40 square miles that extends to the western boundary of the Long Beach-Santa Ana area. These two zones comprise the Torrance-Santa Monica area; the boundaries of this area and those of the Long Beach-Santa Ana area are shown on plate 1. It will be noted on plate 1 that the area immediately west of Long Beach (50 square miles comprising Dominguez Gap and vicinity) is common to both areas. Although the ground-water features of Dominguez Gap and vicinity were studied in the earlier investigation, the area lies within the scope of this report and is the area of the most intensive ground-water draft within the west basin.

The Geological Survey has released two reports on its work in the Torrance-Santa Monica area. A progress report (Poland, Garrett, and Sinnott, 1944) was prepared after the first year of work to outline the general ground-water conditions and to indicate the current extent of saline contamination in the critical area from Redondo Beach to El Segundo. In 1946 a factual well index was issued (Sinnott and Garrett, 1946), which for the canvassed extent of the coastal zone pre-

sents brief tabulated descriptions of nearly all of the active or potentially active water wells and of those abandoned wells for which data are available (incorporated in this report as table 26). This index also summarizes the sources and scope of the available well records, chemical analyses of water from wells, measurements of depth to water, and logs of wells. Wells were not canvassed by the Geological Survey in 62 square miles of the Torrance-Santa Monica area; however, a brief tabulated record of pertinent well data was prepared from records supplied by the California Division of Water Resources, the Los Angeles County Flood Control District, the Los Angeles Department of Water and Power, and other agencies (table 27).

The present report gives the findings and conclusions relating to the geology, hydrology, and chemical character of the ground waters in and adjacent to the west basin. Because ground-water conditions are most critical in the part of the west basin that is south of the Ballona Gap, the report treats that area in greater detail. This report was first released to the public in 1948, in duplicated form. Publication has been delayed in part by the decision to wait until the revised topographic sheets of the area became available for the base map. The last of these was supplied in 1953.

From 1940 to 1946 the Geological Survey made an intensive investigation of ground-water conditions within the southern part of the coastal plain—from Dominguez Hill southeast to Newport Beach—with special reference to saline contamination and the effectiveness of the barrier features of the Newport-Inglewood uplift to restrain inland movement of ocean water. The area of study embraced almost all the coastal plain east of Vermont Avenue and was called the Long Beach-Santa Ana area. From that investigation four interpretive reports had been released to the public in duplicated form by 1946.[1] These reports are being published in three water-supply papers (Piper, Garrett, and others, 1953; Poland, Piper, and others, 1956; Poland, 1959). Because the Long Beach-Santa Ana area is adjacent to and, in T. 4 S., R. 13 W., overlaps the Torrance-Santa Monica area, they have many features in common. Thus, in this report, frequent reference is made to matters treated in the reports on the Long Beach-Santa Ana area.

[1] Poland, J. F., Piper, A. M., and others, 1945, Geologic features in the coastal zone of the Long Beach-Santa Ana area, California, with particular respect to ground-water conditions: U. S. Geol. Survey duplicated report, 527 p. Poland, J. F., Sinnott, Allen, and others, 1945, Withdrawals of ground water from the Long Beach-Santa Ana area, California, 1932-41: U. S. Geol. Survey duplicated report, 112 p. Piper, A. M., Garrett, A. A., and others, 1946, Chemical character of native and contaminated ground waters in the Long Beach-Santa Ana area, California: U. S. Geol. Survey duplicated report, 356 p. Poland, J. F., and others, 1946, Hydrology of the Long Beach-Santa Ana area, California, with special reference to the watertightness of the Newport-Inglewood structural zone: U. S. Geol. Survey duplicated report, 198 p.

OTHER INVESTIGATIONS

The first investigation of the ground waters within the western part of the coastal plain was made by Mendenhall (1905a, 1905b) in 1903–4. At that time about 2,500 active wells within the extent of the Torrance-Santa Monica area were visited, and readings were made of depth to water, and of chemical quality as measured by electrical resistance.

From 1904 to 1926 the Geological Survey continued periodic measurements of depth to water on a few selected wells. Of these, 26 were within the Torrance-Santa Monica area, but measurements for all but 3 wells were discontinued prior to 1926. Their records through 1920 have been published by the Geological Survey (Ebert, 1921, p. 13–29).

From the middle twenties to 1941 the Los Angeles Department of Water and Power made periodic measurements of depth to water in many wells within the part of the coastal plain in Los Angeles County. Of these, several hundred were within the Torrance-Santa Monica area. No interpretive reports have been published by that agency as a result of this program but the measurements have been made available for use in the preparation of this report.

Since 1929 the Los Angeles County Flood Control District has been collecting a large mass of basic data, chiefly in the form of water-level measurements, chemical analyses from wells and streams, and well logs. In its series of annual reports, that agency has published semi-annual water-level contour maps and selected hydrographs. Also, it has prepared brief reports or summary statements treating the problems of saline contamination along the coast of Los Angeles County within the west basin. The earliest of these reports is believed to be one prepared by Donald Seal (1931), in which the author pointed out the presence of saline contamination along the coast and the danger of its expansion inland. The saline encroachment was treated more fully by Dockweiler (1932) in a report on the so-called Nigger Slough project for flood control and conservation. The report included a plan for artificial recharge of the ground water by injection through wells. In 1935 the Flood Control District began a study of saline contamination in Ballona Gap, in connection with the construction of the new Ballona Creek flood control channel. The results of the study were issued in several progress reports and summarized in a final report by Koch (1940).

Since the late twenties the California Division of Water Resources has acted as a collecting agency and its Los Angeles office has been a depository for factual information relating to ground-water supplies, especially measurements of depth to water, chemical analyses, and well logs. Some of the measurements and chemical analyses have been made by its own staff but most of the work was done by other

agencies, although the data were assembled by the Division. For many years the Division has been investigating the water supplies available to the ground-water basins of the Los Angeles area and it has issued several factual and interpretive reports relating in part to the west basin area (Gleason, 1932; Scofield, 1933; Eckis, 1934). In 1944 the California Division of Water Resources issued a brief statement on ground-water conditions in the west basin.

Since 1929, the water department of the city of Long Beach has made periodic measurements of depth to water in about a dozen wells in Dominguez Gap. Also in 1932 the water department began making periodic determinations of the chloride content of water samples usually taken once a month from 40 to 50 wells in Dominguez Gap. The measurements and analyses have been continued to date.

In connection with an appraisal of water supply and use of ground water in southern California, the Metropolitan Water District has prepared two reports concerned with ground water conditions in the southern part of the west basin (Vail, 1932; 1942).

After the cooperative investigation in the west basin was started by the Geological Survey, and partly as a result of the findings in the Survey's progress report of 1944, water users in the part of the west basin south of Ballona Gap organized a "West Basin Ground Water Conservation Group" to investigate and report on the problems confronting water producers and users in the area. A Ways and Means Committee of that group, appointed in March 1945, published its findings in September 1945 (Anon., September 1945).

The findings and conclusions of the Ways and Means Committee report led to the organization of the West Basin Water Association late in 1945, a nonprofit organization comprised of many of the water users in the parent group. The Water Association has released a report by Harold Conkling (1946), which appraised the possibilities of the importation of water.

Knowledge concerning the saline encroachment and the increasing overdraft upon the ground-water supplies had been widely disseminated by mid-1945, and in October of that year legal action was brought by three water users in the west basin for the purpose of seeking adjudication of the rights of each producer of ground water in the part of the basin south of Ballona Gap. In July 1946 the California Division of Water Resources was appointed as referee to investigate and report on physical facts pertinent to the action (Gleason, 1946). (See p. 262.)

ACKNOWLEDGMENTS

The U. S. Geological Survey has made extensive use of the data and reports summarized in the preceding section of this report. The

basic data collected by the Los Angeles County Flood Control District, the California Division of Water Resources, and the Los Angeles Department of Water and Power have been of immeasurable value in this investigation. Acknowledgment also is made of valuable data supplied by the cities of El Segundo, Hawthorne, Inglewood, Long Beach, and Manhattan Beach; by the Southern California Water Co., the California Water Service Co., and the Dominguez Water Corp.; by the many industrial plants that produce water from the west basin, especially the Standard Oil Co. at El Segundo for the many chemical analyses and the results of its test-pumping operations on a well tapping the upper division of the Pico formation; and the Union Oil Co. for its cooperation in making a pumping test to determine groundwater conditions in the vicinity of Bixby Slough; also, by many other agencies and individuals that cooperated fully in making their data available.

Substantial contributions on geological data appearing in this report have been made by several oil companies, especially the Standard Oil Co. of California for making available an unpublished map of the surface geology of the Baldwin Hills, by G. B. Moody. With reference to stratigraphic problems, special acknowledgment for microfaunal information is due S. G. Wissler of the Union Oil Co. and M. L. Natland of the Richfield Oil Corp. Sample suites from water wells were obtained through the cooperation of the Roscoe Moss Co. by Paul Karnes and Mr. Bromwell, drillers; and also through the city of Long Beach. Cores from several wells were received from the Kalco Drilling Co. through C. C. Killingsworth; M. R. Peck furnished several logs.

Electric logs of oil wells, supplied through the courtesy of many oil companies, were utilized in correlating the deeper fresh-water zones and in determining the depth to the body of saline connate water that underlies the fresh-water body throughout the area.

NUMBERS APPLIED TO WELLS BY THE GEOLOGICAL SURVEY

In its cooperative programs on the coastal plain and elsewhere in California, the Geological Survey has designated wells by numbers that indicate the respective locations according to rectangular land surveys. For example, for well 3/14–36M3, the first part of the Geological Survey number indicates the township and range (T. 3 S., R. 14 W., San Bernardino base line and meridian), the two digits following the hyphen indicate the section (sec. 36), and the letter indicates the 40-acre subdivision of the section as shown on the accompanying diagram.

D	C	B	A
E	F	G	H
M	L	K	J
N	P	Q	R

Within each 40-acre tract the wells are numbered serially as indicated by the final digit or digits of the number. Thus, well 36M3 is in the NW¼SW¼ sec. 36 and is the third well in that tract to be listed.

In the parts of the area that once were public land, the official Federal land survey is followed. Elsewhere the net is projected, but most of the land has been subdivided according to extensions of the Federal Survey so that the system can be applied readily.

This system of numbers has also been used as a convenient means of locating a feature described in the text. Thus, an area or feature within the NW¼NW¼ sec. 7, T. 3 S., R. 14 W. (projected land lines), may be identified as 3/14–7D.

SUBDIVISIONS OF THE WEST BASIN WITH RESPECT TO GROUND WATER

For purposes of this report, the west basin is divided into two parts. The area extending from the Ballona escarpment (pl. 8) southeast to the Los Angeles River flood-control channel west of Long Beach forms a hydrologic unit that is believed to be essentially unbroken by barrier faults except those which bound the basin. This area, which includes some 135 square miles, or about three-quarters of the west basin, is identified in this report as the Torrance-Inglewood subarea. It is the area of the most intensive regional lowering of water level and, as late as 1945, it yielded more than 80 percent of the water withdrawn from the west basin. Also, this is the area involved in the pending suit for adjudication of water rights.

The area extending from the Ballona escarpment north to the Santa Monica Mountains, and including the Ballona Gap, is traversed by several faults which interrupt hydraulic continuity in the Pleistocene water-bearing deposits and produce conditions of localized groundwater movement. This area, about 45 square miles in extent, is identified in this report as the Culver City subarea.

CLIMATE

The climate of the Torrance-Santa Monica area is mild and is characterized by a wet and a dry season. The average annual rainfall is 12 to 16 inches throughout the area. About 95 percent of the rainfall occurs in the 7 months from October through April, principally from storms originating in the north Pacific area and moving inland from the ocean; at times, however, rain develops from storms moving northwestward from the Caribbean area and across Mexico.

The prevailing winds are from the west and northwest and carry moisture over the land from the Pacific Ocean. These winds quickly lose much of their moisture as they pass eastward across the land. Within the west basin, however, their moisture content is sufficient to substantially reduce the requirements for irrigated crops below those of the interior valleys.

The mean annual temperature at Santa Monica, on the coast, is about 60°F; the temperature ranges from 53° in January to 66° in August. The hottest and driest periods occur when infrequent winds sweep coastward from the interior deserts. Table 1 gives monthly and yearly averages of temperature and precipitation for Long Beach and Santa Monica at opposite ends of the area, and for Los Angeles, at the inland margin. In a recent publication, Gleason (1947, pl. 21) has included a map showing lines of equal precipitation (mean for the 53-year period) for the entire south coastal basin. The distribution and magnitude of average yearly rainfall in the west basin and the increase in rainfall inland to the San Gabriel Mountains are well shown on that map.

TABLE 1.—*Monthly and yearly averages of temperature and precipitation at three climatological stations in or adjacent to the Torrance-Santa Monica area in the period ending 1946*

[From publications of U. S. Weather Bureau]

	Long Beach		Los Angeles		Santa Monica	
	Temperature (°F) 1926–46	Precipitation (inches) 1920–46	Temperature (°F) 1876–1946	Precipitation (inches) 1876–1946	Temperature (°F) 1889–1922	Precipitation (inches) 1884–1922
January	53.7	2.18	54.6	3.10	52.8	3.51
February	55.4	2.90	55.5	3.07	53.1	2.95
March	57.6	1.51	57.5	2.78	55.4	2.85
April	59.9	.88	59.4	1.04	57.8	.52
May	63.1	.31	62.2	.45	60.0	.46
June	65.9	.08	66.4	.08	63.2	.02
July	70.2	----------	70.2	.01	65.9	[1] T.
August	70.6	.04	71.1	.02	66.4	.03
September	68.5	.30	69.0	.17	64.8	.14
October	64.4	.55	65.3	.68	62.0	.61
November	60.2	.71	60.9	1.20	58.3	1.37
December	56.1	2.74	56.6	2.63	54.6	2.32
Annual	62.1	12.20	62.4	15.23	59.5	14.78

[1] T=0.005 inch or less of rain or melted snow.

In another report (Poland, 1959), rainfall records were tabulated for Los Angeles from 1877 to 1945, and for Long Beach from 1921 to 1945; those for Los Angeles were plotted to show cumulative departure from the yearly mean. Because the rainfall at Los Angeles has been observed since 1877 and furnishes much the longest record for any station in the vicinity of the Torrance-Santa Monica area, it is presented again in table 2. Yearly and cumulated departure from the 68-year average from 1877 to 1945 (years ending June 30) also are shown by the table.

TABLE 2.—*Rainfall at Los Angeles, in inches, in the years ending June 30, 1877–1946; also surplus or deficiency (—) with respect to the 68-year average of 1877–1945* [1]

[From publications of U. S. Weather Bureau]

Year	Rainfall	Surplus or deficiency	Cumulated surplus or deficiency	Year	Rainfall	Surplus or deficiency	Cumulated surplus or deficiency
1877–78	21.26	5.73	5.73	1912–13	13.42	−2.11	−1.36
1878–79	11.35	−4.18	1.55	1913–14	23.65	8.12	6.76
1879–80	20.34	4.81	6.36	1914–15	17.05	1.52	8.28
1880–81	13.13	−2.40	3.96	1915–16	19.92	4.39	12.67
1881–82	10.40	−5.13	−1.17	1916–17	15.26	−.27	12.40
1882–83	12.11	−3.42	−4.59	1917–18	13.86	−1.67	10.73
1883–84	38.18	22.65	18.06	1918–19	8.58	−6.95	3.78
1884–85	9.21	−6.32	11.74	1919–20	12.52	−3.01	.77
1885–86	22.31	6.78	18.52	1920–21	13.65	−1.88	−1.11
1886–87	14.05	−1.48	17.04	1921–22	19.66	4.13	3.02
1887–88	13.87	−1.66	15.38	1922–23	9.59	−5.94	−2.92
1888–89	19.28	3.75	19.13	1923–24	6.67	−8.86	−11.78
1889–90	34.84	19.31	38.44	1924–25	7.94	−7.59	−19.37
1890–91	13.36	−2.17	36.27	1925–26	17.56	2.03	−17.34
1891–92	11.85	−3.68	32.59	1926–27	17.76	2.23	−15.11
1892–93	26.28	10.75	43.34	1927–28	9.77	−5.76	−20.87
1893–94	6.73	−8.80	34.54	1928–29	12.66	−2.87	−23.74
1894–95	16.11	.58	35.12	1929–30	11.52	−4.01	−27.75
1895–96	8.51	−7.02	28.10	1930–31	12.53	−3.00	−30.75
1896–97	16.86	1.33	29.43	1931–32	16.95	1.42	−29.33
1897–98	7.06	−8.47	20.96	1932–33	11.88	−3.65	−32.98
1898–99	5.59	−9.94	11.02	1933–34	14.55	−.98	−33.96
1899–1900	7.91	−7.62	3.40	1934–35	21.66	6.13	−27.83
1900–1	16.29	.76	4.16	1935–36	12.07	−3.46	−31.29
1901–2	10.60	−4.95	−.77	1936–37	22.41	6.88	−24.41
1902–3	19.32	3.79	3.02	1937–38	23.43	7.90	−16.51
1903–4	8.72	−6.81	−3.79	1938–39	13.07	−2.46	−18.97
1904–5	19.52	3.99	.20	1939–40	19.21	3.68	−15.29
1905–6	18.65	3.12	3.32	1940–41	32.76	17.23	1.94
1906–7	19.30	3.77	7.09	1941–42	11.18	−4.35	−2.41
1907–8	11.72	−3.81	3.28	1942–43	18.17	2.64	.23
1908–9	19.18	3.65	6.93	1943–44	19.22	3.69	3.92
1909–10	12.63	−2.90	4.03	1944–45	11.59	−3.94	−.02
1910–11	16.18	0.65	4.68				
1911–12	11.60	−3.93	.75	1945–46	11.65	−3.88	−3.90

[1] Average for 68 seasons, to 1945, 15.53 inches.

PHYSIOGRAPHY

GENERAL FEATURES

Most of the major landform features of the coastal plain in Los Angeles and Orange Counties were formed by deformational earth movements during late Pleistocene time. (See table 3 for geologic time classification.) This deformation affected rocks now forming the most important aquifers in the area. Younger aquifers of lesser economic importance were formed by later alluviation in erosional trenches or gaps transecting these deformed older rocks. Thus, a brief discussion of the landforms is pertinent with respect to both the geologic and hydrologic conditions in the area. For a more complete discussion of these landforms, the reader is referred to a previous report in which the physiography of the entire coastal-plain area in Los Angeles and Orange Counties has been treated in detail (Poland, Piper, and others, 1956, p. 11–36, pls. 1–2).

The coastal plain, which includes the Torrance-Santa Monica area in its western part, is in the Angeles section of the Pacific border province (Fenneman, 1931, p. 493). It is bordered by the Pacific Ocean on the west and south and by the Santa Monica Mountains, the Puente Hills, and the Santa Ana Mountains and their foothills on the north and east (pl. 1).

The dominant landform features of the coastal plain are a central lowland plain with six tongues extending to the coast, bordering highlands and their foothills, and a succession of low hills trending northwestward which separate the main lowland plain and a lesser plain to the southwest. The succession of low hills is the land-surface expression of the Newport-Inglewood uplift—the inland margin of the west basin.

The Torrance-Santa Monica area includes the western part of the main lowland plain and two tongues of this plain which extend to the coast across the Newport-Inglewood uplift. Between these two tongues or gaps and coastward from the uplift is a low plain of marine origin, the Torrance plain, which is flanked on the west by a belt of dune sand fringing the coast. To the north and south are bordering highland areas, the Santa Monica Mountains and the Palos Verdes Hills, respectively.

Excepting the bordering highlands, the total relief in the Torrance-Santa Monica area is about 500 feet from a high point of 513 feet above sea level at the summit of the Baldwin Hills to sea level at Ballona Lagoon, 5 miles distant in the northwestern sector of the area.

The location and extent of the landforms within the western part of the coastal plain are generalized on plate 8; details of their form are shown on the Geological Survey topographic maps of the area.

BORDERING HIGHLANDS AND ALLUVIAL APRONS

The highland areas that border the Torrance-Santa Monica area are the eastern part of the Santa Monica Mountains on the north, and the Palos Verdes Hills on the south.

The altitudes of the ridge crests in the eastern part of the Santa Monica Mountains reach a maximum of nearly 1,800 feet about 3 miles north of the project boundary. The highest point in the Palos Verdes Hills is 1,480 feet at San Pedro Hill; below this, 13 wave-cut terraces at altitudes of about 100 to 1,300 feet (Woodring, Bramlette, and Kew, 1946, p. 113–116) represent successive pauses during a long period of uplift, which mostly occurred in late Pleistocene time. The lowest terrace is strongly deformed and rises from about 50 feet above sea level in San Pedro to about 400 feet on the north edge of the hills west of Hawthorne Avenue.

Adjacent to the south flank of the Santa Monica Mountains and westward from the Elysian Hills are two surfaces of alluvial aggradation which have been named the Santa Monica and La Brea plains. These surfaces are considered to be of late Pleistocene age, but they have been extensively modified by the erosion of broad channels in which Recent deposits have been laid down.

These foothill surfaces of aggradation absorb some rainfall and local runoff, and consequently, they contribute to the replenishment of the ground-water supply north of the Baldwin Hills.

NEWPORT-INGLEWOOD BELT OF HILLS AND PLAINS

HILLS

The Newport-Inglewood uplift is expressed topographically as a belt of discontinuous low hills that extend from the Santa Monica Mountains southeastward into Orange County. In the Torrance-Santa Monica area this belt is cut by Ballona and Dominguez Gaps near the northwestern and southeastern boundaries.

The uplift and the related plains are underlain at shallow depth, usually less than 30 feet, by a surface of marine planation which was developed upon deformed lower Pleistocene and Tertiary strata. Initially formed in late Pleistocene time, the surface evidently was a plain of low relief. On it were deposited the upper Pleistocene marine Palos Verdes sand and a thin capping of presumed continental origin, where the thickness ranges from 5 to 20 feet. Thus, the present land-surface forms of the belt offer a fairly accurate picture of the deformation since late Pleistocene time. For example, they reveal certain faults that disrupt the land surface and act as subsurface barriers to water movement across the uplift.

Baldwin Hills is the boldest of the uplifts along the belt, with a relief of about 400 feet above the surface of Ballona Gap, adjacent to

the north and a summit 513 feet above sea level. The Beverly Hills, about 4 miles northwest across Ballona Gap, reach an altitude about 200 feet lower than the Baldwin Hills, and have less relief. The surface of the Baldwin Hills is severely dissected by sharply incised valleys; the Beverly Hills have been moderately dissected.

Extending about 8 miles southeastward from the Baldwin Hills to Dominguez Hill, the Rosecrans Hills consist of an irregular low swell about 3 miles wide. The crestal altitude decreases from about 240 feet east of Inglewood to about 100 feet on the north flank of Dominguez Hill. The swell is of deformational origin and is asymmetric, with a steeper slope on the west which is modified by two fault escarpments. The most pronounced escarpment is about 50 feet high and extends about 2½ miles S. 25° E. from Inglewood. The second escarpment is about 1½ miles long, also trends S. 25° E., and terminates at the north flank of Dominguez Hill.

Dominguez Hill is a simple elliptical dome 3 miles long and about 195 feet above sea level. Like the Rosecrans Hills, it has a flatter slope on the northeast flank and is deformational in origin; however, it is less modified by stream erosion. Its major axis trends N. 60° W., or about 20° west of the general trend of the belt of hills.

RELATED PLAINS

The Ocean Park plain is a comparatively undeformed westward extension of the Beverly Hills; it is immediately south of the Santa Monica plain and north of the coastal part of Ballona Gap. It consists of three subdivisions: (1) a small bench to the east, which is about 190 feet above sea level, (2) an extensive central plain, which slopes gently southward, and (3) a ridge-and-trench area which lies parallel to the coast and is ascribed to upper Pleistocene shoreline features (Hoots, 1931, p. 121).

An extensive counterpart of the Ocean Park plain is the Torrance plain, which stretches from the southwest flank of the Baldwin Hills to Wilmington; its surface is essentially continuous with that of the Rosecrans Hills which flank it on the northeast. This plain is inferred to extend beneath the now inactive dune belt of the El Segundo sand hills along its southwest flank. The Torrance plain is somewhat warped, especially along its inland margin. North of Gardena the warping has formed a shallow depression which has no natural external drainage, and is floored with Recent playa deposits. A more pronounced downwarp occurs at the southwest flank of Dominguez Hill, which is floored with Recent deposits, and represents a northwestward extension of the Downey plain into the Torrance plain.

Under natural conditions the Torrance plain was very poorly drained. Drainage from its northern and central parts was to the

downwarp north of Gardena; drainage from its south-central part was to the downwarp southwest of Dominguez Hill by way of Laguna Dominguez and a small creek trending eastward from Torrance. A small area west of Wilmington drained internally to Bixby Slough. Most of this discontinuous natural drainage has been integrated artificially by the Dominguez Channel, which now receives runoff from 56 square miles upstream from its Carson Street crossing and discharges into the east basin of Los Angeles harbor and thence to San Pedro Bay.

The playa deposits flooring the two natural undrained depressions described above are fine grained and dense. Penetration of rainwater and water from surface runoff through these deposits is slow. On the other hand, water from runoff has collected in these depressions and evaporation has concentrated the total-solids content of the water that has penetrated below land surface. Thus, these downwarps are closely related to the naturally inferior quality of the shallow water in the Gardena area.

GAPS

In the Torrance-Santa Monica area the Newport-Inglewood uplift is transected by two tongues of fluvial deposits which extend from the central lowland (Downey plain) to the coast. These tongues occupy two stream-cut erosional gaps which are known as Ballona and Dominguez Gaps. The streams which formed these gaps maintained their courses during the late Pleistocene deformation along the Newport-Inglewood uplift and thus may be classed as antecedent. Both gaps are flanked by stream-cut bluffs, which have greatest relief across the uplift.

Ballona Gap, which is topographically most prominent between the Beverly Hills and the Baldwin Hills, is 1.2 miles wide at its narrowest point and is about 10 miles long from the east end of the Baldwin Hills to Santa Monica Bay. The lower 6-mile segment is within the west basin. Its trench was cut into the upper Pleistocene marine (Palos Verdes) surface by an ancestral westward-flowing Los Angeles River and is floored by Recent alluvial deposits to a depth of 50 feet near the coast and to about 80 feet northeast of the Baldwin Hills, which are about 9 miles upstream.

The stream-cut bluffs flanking Ballona Gap reach a maximum height of 400 feet at the north face of the Baldwin Hills. Although subsequent deformation has altered the profile of the trench in Ballona Gap, the incising stream evidently reached a level at least 50 feet below present sea level at the coast and as much as 400 feet below the upper Pleistocene marine surface at the axis of greatest deformation along the Newport-Inglewood uplift. It is believed that the present Ballona Gap represents an inland segment of the trenching—that is, the incised

stream was graded to a base level substantially more than 50 feet below present sea level and possibly as much as 2 to 3 miles seaward from the present coast. It is possible that Ballona Gap was trenched at essentially the same time as Bolsa Gap in Orange County, which was graded to a base level about 70 feet below sea level, prior to diversion of the Santa Ana River to Santa Ana Gap (Poland, Piper, and others, 1956, p. 44–46). After the ancestral stream in Ballona Gap had incised its channel about 50 feet below present sea level at the coast, presumably during late Pleistocene recession of the seas, its course was diverted southward into Dominguez Gap and was maintained there during the later stages of the pre-Recent gap-cutting cycle.

Dominguez Gap, which passes between Dominguez Hill and the northwestern extension of Signal Hill, is 1.6 miles wide at its narrowest point and is about 7 miles long. It was trenched mainly by an ancestral San Gabriel River, which had a southward-flowing ancestral Los Angeles River as tributary. The highest of the stream-cut bluffs along the gap is at the east face of Dominguez Hill and is about 100 feet high.

Dominguez Gap was eroded to a depth of 150 feet or more below present sea level at the coast, and to about 250 feet below the late Pleistocene surface at the crest of the uplift. The entrenched valley extended inland across the coastal plain to Whittier Narrows, with a tributary trench reaching from Compton to the Los Angeles Narrows. The Recent epoch of aggradation started with the deposition of gravel and coarse sand to a depth of 50 to 70 feet. Subsequently, deposits of silt and fine sand about 75 feet thick were deposited on top of the permeable basal tongue. Thus the trench was backfilled to a thickness of about 150 feet with deposits of Recent age.

EL SEGUNDO SANDHILLS

A coastal belt of dunes and sandhills about 11 miles long parallels the shoreline from Ballona escarpment to the Palos Verdes Hills, and extends inland from 3 to 6 miles to overlap the Torrance plain. This belt is a conspicuous topographic feature called the El Segundo sandhills. It may be subdivided into two distinct elements. One element is adjacent to the coast and is about half a mile wide. For the most part, it is made up of dunes with crests ranging from 85 to 185 feet above sea level. These dunes are inferred to be of Recent age. The main part of the belt is from 2 to 5 miles wide, and consists of stabilized dunes and parallel ridges and alined hills which have been generally interpreted as ancient offshore bars modified by wind and stream action since their emergence from the ocean.

The coastal bar deposits were probably formed during a high level of the seas immediately before the latest Pleistocene withdrawal which instituted the cycle of gap cutting; hence, they are considered to be of late Pleistocene age. The dunes, on the other hand, although probably formed, in part, during the pre-Recent gap-cutting cycle, presumably were formed chiefly during the drier climatic conditions that inferentially accompanied deposition of the later or upper division of the Recent sediments.

DOWNEY PLAIN

The western part of the extensive central lowland, or Downey plain, forms the inland border of the Torrance-Santa Monica area. It is the surface formed by alluvial aggradation during the post-Pleistocene epoch of rising base level, and is substantially adjusted in grade to the major streams which enter the coastal plain at the several passes through the bordering mountains and foothills. The alluvial deposits in Ballona and Dominguez Gaps thus represent the coastward extensions of this plain.

Within the project area, the Downey plain and its extension through Ballona Gap is underlain chiefly by the alluvial fan of the Los Angeles River; the apex of this fan is in the Los Angeles Narrows at an altitude of 275 feet. The tongue of the plain extending through Dominguez Gap is largely a part of the San Gabriel River fan, whose apex at Whittier Narrows has an altitude of 200 feet.

Near the inland narrows the alluvial material composing the Downey plain is coarser and highly permeable; these segments constitute important intake areas for the recharge of the principal aquifers beneath the Downey plain and the extensions into the west basin.

DRAINAGE

Within the area of investigation the largest stream is the Los Angeles River which passes southward across the Downey plain from the Los Angeles Narrows and discharges into San Pedro Bay through Dominguez Gap. Upstream from the Pacific Coast Highway at Long Beach, it has a drainage area of about 1,060 square miles; almost all the drainage area is inland from the Torrance-Santa Monica area. In 1894 its channel within Dominguez Gap had two distributaries, which branched about 4 miles north of the shore and discharged into the former Wilmington Lagoon (Mendenhall, 1905a, pls. 1 and 4). Within the past two decades, however, the river has been confined in its channel by flood-control levees and now discharges southward directly into San Pedro Bay.

The streams within the coastal plain in Los Angeles County are intermittent; they carry large flows only after heavy winter rains.

Many times in the past flash flows in winter have been too large for the natural channels to carry and have resulted in very destructive floods.

Thirteen major floods were recorded on the Los Angeles and San Gabriel Rivers from 1811 to 1891. For an unknown length of time before 1825, the Los Angeles River flowed westward through Ballona Gap, but during the floods of that year it broke out of its course to drain southward into San Pedro Bay via Dominguez Gap. During the floods of 1862 and 1884, part of the flood waters returned temporarily to Ballona Gap, but since 1884 the Los Angeles River has discharged southward to San Pedro Bay (Troxell and others, 1942, p. 385–391).

The largest flood of the Los Angeles River for which records are available occurred in March 1938. The maximum discharge reached 67,000 cfs at a point a mile upstream from the Main Street bridge in Los Angeles; at Long Beach, where discharge was swelled by the flood waters of the tributary Rio Hondo, a maximum discharge of 99,000 cfs was recorded (Troxell and others, 1942, p. 12 and 246). On the other hand, during the thirties, for as much as 9 months of the year, the recorded flow of the Los Angeles River at Long Beach has been less than 10 cfs; at times in 1929, 1930, and 1934 its channel was dry.

Compton Creek drains an area of some 30 square miles north of Dominguez Hill and east of the Rosecrans Hills. In the middle nineties and for several decades thereafter, it maintained a course southward along the west margin of Dominguez Gap and discharged into San Pedro Bay through the former Wilmington Lagoon. In 1938 part of the upstream channel was paved and the creek was joined to the Los Angeles River about 5.5 miles inland from the coast and about half a mile south of Del Amo Street.

The natural unintegrated drainage pattern within the Torrance plain has been discussed elsewhere (p. 17). Most of the drainage has been integrated artificially by construction of the so-called Dominguez Channel, which discharges into San Pedro Bay.

In the northern part of the area the most important stream is Ballona Creek, whose tributaries drain the northern slopes of the Baldwin Hills, the southern slopes of the Santa Monica Mountains east of Sepulveda Boulevard, and also a large area east and northeast of the Beverly Hills. About 4 miles from the coast, at Sawtelle Boulevard, Ballona Creek has a tributary drainage area of 111 square miles. The creek, which is now paved with concrete except for the 5-mile reach above its mouth, discharges directly into Santa Monica Bay.

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Centinela Creek, its source originally in Centinela Spring in what is now the Centinela Park well field of the city of Inglewood, drains the south flanks of the Baldwin Hills and the area southwest of the Hills. The following quotation from a report by Kew (1923, p. 157) is of interest:

> Before the city of Inglewood obtained its water supply from wells at the Centinela Spring, a stream carrying one hundred and twenty-five inches of water issued from this spring, and flowed down Centinela Creek, forming these channels, which are now nearly obliterated. During wet weather it was even possible to row a boat up to the spring from Playa del Rey.

Centinela Creek flows northwestward into Ballona Gap, turns southwestward and follows a course nearly parallel to and southeast of Ballona Creek, and then discharges into the coastal marshes.

GEOLOGIC FORMATIONS AND THEIR WATER-BEARING CHARACTER

GENERAL FEATURES

In the Torrance-Santa Monica area, a thick section of Tertiary and Quaternary marine and continental sediments has been deposited on a basement complex of pre-Tertiary metamorphic and igneous rocks. The pre-Tertiary rocks, which are essentially non-water-bearing beds, crop out only at the bordering highlands in the northern and southern boundaries of the area, where they have been uplifted by deformational earth movements and exposed by erosion.

The Tertiary rocks are almost entirely of marine origin and range in age from Eocene to Pliocene. They consist of sandstone, siltstone, mudstone, diatomite, and siliceous shale, and are exposed extensively in the Palos Verdes Hills and in the Santa Monica Mountains; they underlie the younger rocks in all the area between these highlands. Within the Torrance-Santa Monica area these Tertiary rocks are penetrated by many oil wells in the several oil fields and by scattered "wildcat" wells. Several of the Tertiary formations are not exposed in the area and are known only from the records of these drilled wells. Except for certain rocks of latest Pliocene age which contain essentially fresh water, the Tertiary rocks contain only saline waters.

The Quaternary rocks contain nearly all the aquifers now tapped by water wells and are chiefly of Pleistocene age; within the west basin deposits of Recent age occur only within the two gaps.

Extensive deposits of coarse gravel and sand of Pleistocene age, amounting to about half the aggregate thickness of the Quaternary rocks, occur beneath nearly the whole project area and are partly exposed on the Baldwin Hills and on the north flank of the Palos Verdes Hills. Within the west basin these coarse deposits are almost entirely of littoral or shallow marine origin. Fine-grained deposits

of sand, silt, sandy clay, and clay, about equal in aggregate thickness to the coarse deposits, commonly overlie them throughout the area. The deposits of finer grain are partly of marine and littoral origin, but to a greater extent are of lagoonal and continental original.

With the exception of the tongues of Recent deposits in the two gaps, the Tertiary and Quaternary rocks have been deformed along the Newport-Inglewood uplift into a succession of anticlines and domes with intervening structural saddles cut by normal and thrust faults arranged en echelon. Flanking this uplift to the southwest and northeast are synclines, where the two systems of rocks attain their greatest thickness. Along the crest of the uplift they are as much as 12,500 feet thick; in the syncline beneath the Torrance plain they are probably as much as 15,000 feet thick; in the syncline to the northeast, beneath the Downey plain, they may exceed 20,000 feet in thickness.

Many of the lithologic and paleontologic data with which the stratigraphic treatment is concerned were obtained from the reports of geologists (Hoots, 1931; Wissler, 1943, p. 210–234; Woodring, 1946) who have carried out detailed investigations in the region; other data were obtained from S. G. Wissler, paleontologist, Union Oil Co.; and from M. L. Natland, paleontologist, Richfield Oil Corp., in connection with stratigraphic correlations and paleontologic information derived from well samples.

The areal distribution of those stratigraphic units which crop out in the area is shown on plate 2. The general subsurface stratigraphic sequence and the structural conditions, based largely on well-log information, are shown on several geologic sections, plates 3–6. A descriptive summary of the rocks in the area, including an appraisal of the water-bearing characteristics of each formation, is presented in table 3. Plate 7 is a stratigraphic correlation chart, showing graphically the relative thicknesses of the formations represented in each of the eight major oil fields in the area (pl. 18). It is in two sections, each trending nearly parallel to the Newport-Inglewood uplift. One is adjacent to the coast and includes a columnar section at the Palos Verdes Hills; the other is alined along the Newport-Inglewood uplift from the Inglewood field in the Baldwin Hills to the Dominguez field at Dominguez Hill. Except for the section concerned with the Baldwin Hills, the data for this chart have been compiled largely from information supplied by S. G. Wissler and are based almost entirely upon micropaleontologic correlations supplemented by electric-log data.

TABLE 3.—*Stratigraphy of the Torrance-Santa Monica area, California*

Geologic age		Formation and symbol on plate 2	Thickness (feet)	Physical character	Ground-water conditions
QUATERNARY	Recent	Alluvial, coastal, and dune deposits (Qal, Qs)	0–175	Beneath the Downey plain and its coastward extensions, Dominguez and Ballona Gaps, unconsolidated silt, gravel, and sand of fluvial origin; coarser materials predominant in lower half of the deposit. Beneath the coastal tidelands, silt and clay of lagoonal and fluvial origin overlying and enclosing tongues of fluvial sand and gravel. Locally along the coast, accretional beach deposits. Beneath the El Segundo sandhills, dune deposits, designated on pl. 2 by symbol (Qs).	Beds of gravel and coarse sand in the lower part of the deposit contain confined water and yield water freely to many wells, especially in tongues extending from Whittier Narrows through Dominguez Gap and from Los Angeles Narrows through Ballona Gap. This water is of good chemical quality inland, but moderately to highly saline from the coast inland about 7 miles in Dominguez Gap and about 6 miles in Ballona Gap. Near the coast, tongues and beds of fine sand, and some of fine gravel, in the upper part of the deposit, contain unconfined semiperched water that is moderately to highly saline.
		Unconformity			
	Pleistocene	Terrace cover and Palos Verdes sand (Qpu); not differentiated on map from unnamed deposits below.	0–50	Reddish-brown sand, silt, and soil, chiefly nonmarine in origin; underlain locally by a deposit of fossiliferous sand and gravel of marine origin, the Palos Verdes sand; together these mantle the hills and mesas of the Newport-Inglewood uplift.	Chiefly above the water table and therefore unsaturated; sufficiently permeable to transmit some water from rainfall to underlying materials.
		Unnamed upper Pleistocene deposits (Qpu); not differentiated on map from Palos Verdes sand and terrace cover above.	0–400(?)	Silt, clay, and some gravel, of fluvial and marine origin; in the central part of the west basin, the lower portion contains an extensive body of sand, with some gravel.	Beds of gravel and sand hold confined and unconfined water and supply small domestic and stock wells and some larger irrigation wells. This water is of good quality within the Torrance-Inglewood subarea, except locally at shallow depth, and along the coast from El Segundo to Redondo Beach, where it is contaminated. This water is of good quality inland from the Newport-Inglewood uplift.
		Local unconformity			
		San Pedro formation, including Timms Point silt and Lomita marl members (Qsp).	0–1,000	Unconsolidated to semiconsolidated gravel, sand, silt, and clay; chiefly marine, beach, and lagoonal deposits within the west basin, but largely of fluvial origin inland from the Newport-Inglewood uplift; the coarser materials more plentiful in the lower two-thirds of the deposit. At some places, silt and clay predominate.	Beds of gravel and coarse sand, most commonly in lower two-thirds of deposit, hold confined water and yield copiously to many wells. This water is of good chemical quality inland from the Newport-Inglewood uplift, also on coastal side of uplift in the west basin, except along and near the coast from Santa Monica to Redondo Beach. This formation is the principal source of water within the west basin.

TERTIARY	Pliocene	Local unconformity			
		Pico formation (Tu) — Upper division	0–1,800	Semiconsolidated sand, silt, clay, and some fine gravel, chiefly of marine origin. Tongues of fluvial(?) sand and fine gravel—the gravel beds north of the Newport-Inglewood uplift and in the upper third of the deposit, the sand layers commonly in the lower two-thirds of the deposit.	Beds of sand and gravel in the upper part of the deposits contain confined water and locally might yield freely to wells. This water is soft and low in dissolved solids, but is dark brown and has a temperature of about 100° F. Beds of fine sand in the lower part of the deposits are fairly permeable but have not been tapped by water wells. This water is essentially fresh although total dissolved solids content may be too high for domestic use and for irrigation.
		Local unconformity			
		Pico formation (Tu) — Middle division	0–1,240	Olive to dark-brown massive claystone and siltstone, fine to coarse gray sand;[1] all of marine origin.	Largely impervious; if water-bearing, the sandy members contain connate waters whose salinity ranges from about half that of ocean water to that of ocean water.
		Local unconformity			
		Pico formation (Tu) — Lower division	0–470	Fine to coarse gray sand, occasionally pebbly, brown sandy siltstone and claystone;[1] all of marine origin.	
		Repetto formation	0–4,080		
	Miocene	Local unconformity			
		Monterey shale, at least in part (Puente formation of Wissler and others) (Tu).	0–4,500	Fine to coarse-grained gray sandstone; sandy micaceous siltstone; bluish-gray to dark-brown platy shale; all of marine origin.	
JURASSIC (?)		Unconformity			
		Franciscan(?) formation		Greenish, grayish, or bluish serpentine, talc, or schist.[1]	Impervious, nonwater-bearing.

[1] After Wissler (1943, p. 210).

In the following paragraphs the formations are discussed in order from youngest to oldest, thereby giving early emphasis to rocks which are of greater importance from a standpoint of ground-water resources. Those rocks of Tertiary age that contain connate saline ground waters are discussed briefly because their waters are a potential source of contamination of the fresh-water body in the younger rocks.

QUATERNARY SYSTEM

RECENT SERIES

DEFINITION AND GENERAL FEATURES

The deposits of Recent age comprise chiefly the youngest unconsolidated materials formed during the present cycle of alluviation by streams, materials associated with shoreline features, including lagoonal, littoral, and dune deposits, also slope-wash and playa deposits of minor extent.

With respect to water-bearing character, the most important deposits of Recent age are those of fluvial origin. They consist of sand, gravel, silt, and clay, and underlie the Downey plain and its tongues, which extend to the coast through the gaps cut in the older rocks (pl. 2). Thus, the top of the Recent deposits is the surface of the Downey plain and its extensions into the several gaps; their base is the former land surface that had been produced by deformation and trenching of the coastal plain in late Pleistocene time.

In Ballona and Dominguez Gaps and inland from the gaps, logs of many wells which have been drilled through the Recent deposits reveal that the relatively fine grained sediments in the upper few tens of feet commonly are underlain by much coarser materials—chiefly coarse sand to cobble gravel, which have been deposited as tongues many miles in length. These important aquifers, which underlie Ballona and Dominguez Gaps, extend inland across the coastal plain; the textural difference between them and the overlying finer grained sediments provides a basis for separation of the Recent alluvial deposits of the area into an upper and a lower division.

Within the coastal plain as a whole, and for almost all the deposits of Recent age except those within Ballona Gap, the report on the geology of the Long Beach-Santa Ana area has treated in considerable detail their physical character, mode of origin, and general water-bearing character (Poland, Piper, and others, 1956, p. 40–52). Accordingly, the treatment in the following paragraphs will summarize the character of these deposits briefly, with emphasis on the two basal aquifers of the lower division which extend across the west basin in Dominguez and Ballona Gaps, and which respectively constitute the Gaspur water-bearing zone and the "50-foot gravel."

UPPER DIVISION

Flood-plain deposits.—Some of the most widely distributed deposits in the upper division of Recent age in the Torrance-Santa Monica area are the alluvial-fan and flood-plain sediments laid down at times of excessive runoff, when the streams overflowed their banks and spread widely over their alluvial fans. These sediments are largely fine sand and silt, with lesser amounts of clay and gravel. The finer sediments have been widely distributed over the coastal flood plains; the sand and gravel have been laid down chiefly on the steeper inland slopes of the alluvial fans and within the larger channels. In the present climatic period, which probably existed throughout the deposition of the upper division of the Recent series, this type of alluviation has been the common pattern. However, because of the increased development of the coastal plain and the construction of engineering works designed to control flood runoff, in recent years the streams have overflowed their banks and deposited sediment over their natural flood plains only during the largest floods.

These deposits of the upper division are distributed beneath all the Downey plain, in the two gaps within the project area, and in local areas tributary to these gaps. Their thickness is as much as 100 feet in the central part of the Downey plain; in Dominguez Gap it ranges from 45 to nearly 80 feet; but in Ballona Gap, where the Recent series as a whole is thinner, the upper division is from 10 to 50 feet thick. In the reach between Dominguez and Ballona Gaps these sediments feather out along the inland flank of the Newport-Inglewood belt of hills. The top of these deposits is the surface of the Downey plain. Within the extent of the lower division of the Recent, the base of the upper division rests almost conformably on the top of these coarser tongues; elsewhere their base is the modified lower Pleistocene land surface.

Minor deposits.—The upper division of the Recent series also contains minor deposits which include slope-wash, playa, lagoonal, beach, and dune deposits. With the exception of the beach deposits, these have relatively little importance from the standpoint of this investigation.

The slope-wash and playa deposits probably do not measure more than a few feet in thickness in any part of the area. The former are mainly weathered rock fragments, fine sand, and silt, developed on hill slopes; the latter have accumulated in undrained depressions in or near the Torrance plain (p. 17), and consist of silt and clay of local origin.

The lagoonal marshes, which were formerly behind the barrier beaches at the mouths of Ballona and Dominguez Gaps, have acted as sedimentation basins for some of the load carried by streams dur-

ing intermittent floods. Thus, they have received contributions of fine sand, silt, and clay, which have become interbedded with the organic debris native to the marshes.

Recent beach deposits form narrow arcuate strips of sand and gravel, which flank Santa Monica and San Pedro Bays, fringe the coastal wavecut sea cliffs and connect across the gaps by barrier beaches. These beach deposits have been the chief source of material supplied to the coastal-dune belt.

With regard to saline contamination from the ocean, these beach deposits are of great interest because: (1) at least locally along the coast, they are believed to extend for several tens of feet below sea level; (2) probably they are in direct contact with the Silverado water-bearing zone in the vicinity of Redondo Beach and with the "50-foot gravel" and the main water-bearing zone of the San Pedro formation at the mouth of Ballona Gap; and (3) they are highly permeable. Thus, under the current conditions of landward hydraulic gradient, these beach deposits probably afford conduits for the movement of ocean water into the coastal margins of the main water-bearing zones within the west basin.

The dune deposits that underlie the El Segundo sandhills are formed almost entirely of fine- to medium-grained sand of uniform texture. They range in thickness from a featheredge to as much as 150 feet. As exposed in an excavation at Hyperion (in 2/15–10), they exhibit several stages of dune formation, with dense cemented layers now buried, which probably represent former land surfaces. These dune deposits mantle an area of about 35 square miles along the southwest flank of the Torrance plain. They are almost entirely above the zone of saturation and thus do not yield water to wells. However, they are relatively permeable and transmit substantial quantities of water from rainfall to the underlying Pleistocene rocks. Where those rocks are impermeable, doubtless a water table occurs within the dune deposits. Also, the denser layers within the dunes may develop perched water bodies of local extent.

LOWER DIVISION

The deposits of the lower division of Recent age do not crop out in the area and consequently are known only from logs of wells and from samples taken during drilling. These indicate that the lower division consists almost entirely of coarse sand and gravel, deposited in tongues. In the Torrance-Santa Monica area, the two principal tongues are the Gaspur water-bearing zone in Dominguez Gap and the "50-foot gravel" in Ballona Gap. Physical connection between these two zones is afforded by the so-called westerly arm of the Gaspur zone, which extends southward from the Los Angeles Narrows

to about a mile east of Compton, where it joins the Gaspur water-bearing zone (pl. 8).

Gaspur water-bearing zone.—The Gaspur water-bearing zone was deposited in early Recent time by an ancestral San Gabriel River, with minor contributions from an ancestral Los Angeles River in the reach coastward from their junction near Compton.

The Gaspur water-bearing zone has been traced for more than 20 miles across the Downey plain from Terminal Island to Whittier Narrows, as shown in an earlier report (Poland, Piper, and others, 1956, pl. 7). Doubtless it extends northward into San Gabriel Valley and southward beneath San Pedro Bay. The maximum width of 4 miles occurs just south of Downey. Within the area covered by this report it is relatively narrow, being about a mile wide at the eastern salient of Dominguez Hill, but increasing somewhat in width to the north and south (pl. 8).

The thickness of the Gaspur zone ranges from 50 to 75 feet. Near the coast, its base has a gradient of about 9 feet per mile, from about 70 feet below sea level 2 miles north of Dominguez Gap to 150 feet below sea level at the coast. The gradient steepens somewhat to the northeast so that, reckoned from Whittier Narrows, where the base of the zone is 100 feet below the land surface and 90 feet above sea level, the average gradient to the coast is about 12 feet per mile.

Typical deposits of the Gaspur zone are indicated by the log of well 4/13–15A11 (table 28). The zone generally is characterized by a lower part consisting of coarse clean gravel from 25 to 50 feet thick, containing cobbles as much as 6 inches in diameter, overlain by an upper part of medium to coarse sand from 20 to 50 feet thick. However, there is considerable lithologic variation and this typical disposition of the gravel and sand is best developed southward from the middle of the Downey plain. Beneath the inland part of the Downey plain both the main Gaspur zone and the westerly arm become coarser and contain more gravel and less sand; neither the gravel nor the sand lie in a characteristic stratigraphic position.

Westerly arm of the Gaspur water-bearing zone.—A tributary branch of the Gaspur water-bearing zone, the deposit of an ancestral Los Angeles River, here called the "westerly arm" of the Gaspur water-bearing zone, has been traced from the Los Angeles Narrows southward and roughly parallel to Alameda Street for about 11 miles to its junction with the main Gaspur zone about a mile east of Compton. The thickness of this westerly arm ranges from 30 to 80 feet; its average width is about 2 miles and its gradient from the south edge of the Los Angeles Narrows to the junction with the Gaspur water-bearing zone is about 20 feet to the mile, although in the 3 miles immediately north of the junction near Compton the gradient is only about 15

feet per mile. At the junction, the Gaspur zone and its westerly arm have a common base 140 feet below the land surface, or 70 feet below sea level. This westerly arm is somewhat coarser in composition than the deposits of the Gaspur zone in Dominguez Gap; it is similar to the gravel found in the main tongue of the Gaspur zone from the middle of the Downey plain to Whittier Narrows. Sand and minor quantities of clay are interspersed irregularly with the gravel in this westerly arm.

"*Fifty-foot gravel.*"—In Ballona Gap, the lower division of the Recent series is represented by a relatively thin and irregular gravel body which was laid down by an ancestral Los Angeles River. In the area of its most characteristic development, between Culver City and the coast, its base ranges from 40 to 80 feet below the land surface, but its average depth is about 50 feet below the surface. For this reason the name "50-foot gravel" has been assigned for the purposes of this report. By means of well logs it has been traced inland beyond the narrows between the Baldwin and the Beverly Hills to its junction with the westerly arm of the Gaspur water-bearing zone, south of the La Brea plain and in the vicinity of Vermont Avenue (pl. 8).

The "50-foot gravel" ranges in thickness from 10 to 40 feet and consists generally of coarse gravel and a subordinate amount of sand. Its average thickness is only about a third as great as that of the Gaspur water-bearing zone in Dominguez Gap.

Logs of wells show that the depth to the base, position, and thickness of the "50-foot gravel" are very irregular. Thus, although the overall seaward gradient of the base of the "50-foot gravel" from northeast of the Baldwin Hills to the coast is about 8 feet per mile, that gradient has been estimated by taking an average altitude of the base from well logs that show substantial variation within short distances. Other well logs show only clay or sandy clay (silt) in the depth range where the gravel would be expected to be present. The discontinuity and irregularity in thickness and position of the "50-foot gravel" suggest that (1) it was deposited on an uneven base which may have contained both channels and terrace remnants, and (2) the backfilling was accomplished by a stream with insufficient transporting power to lay down a broad sheet of gravel across the full width of the gap. Also, during this backfilling stage, the tributary streams that discharged southward to Ballona Gap across the dissected Santa Monica plain may have been building debris cones along the north side of the gap. Those cones would doubtless have contained materials of substantially finer grain than the coarse sediments transported by an ancestral Los Angeles River.

As determined from well logs, west of the Baldwin Hills the transverse profile of the base of the "50-foot gravel" dips southeastward across Ballona Gap. The lowest part of the gravel generally is beneath or south of the present course of Ballona Creek; the altitude of the base at that point is about 40 feet lower than on the northwest side of the gap. This feature suggests that southward tilting of the "50-foot gravel" has occurred. If such is the case, the essentially straight alinement of the Ballona escarpment west of the Baldwin Hills may in part represent a fault scarp that has been modified to some degree by stream erosion. The substantial difference in chemical character of the native waters within the San Pedro formation to the north and south of this escarpment (pl. 19) might be interpreted as supporting this inference. Hydrologic evidence gives no clue in regard to the presence of a ground-water barrier along the escarpment.

WATER-BEARING CHARACTER

Upper division.—Because it is composed chiefly of materials of fine texture and low permeability, the upper division of the Recent is tapped by only a very few small domestic wells. It is sufficiently permeable, however, to absorb a moderate volume of water by infiltration of rain, by percolation from the streams—the Los Angeles River and Compton and Ballona Creeks—and by deep penetration of irrigation water. Most of this water first reaches the unconfined semiperched water body and ultimately is transmitted to the coarse tongues of the lower division—the Gaspur water-bearing zone and the "50-foot gravel."

Gaspur water-bearing zone.—The character of the Gaspur water-bearing zone has been discussed at length in a report by Poland (1959), and will be only briefly summarized here. The Gaspur zone is highly permeable and is tapped by wells throughout its 21-mile reach from Terminal Island to Whittier Narrows. However, for its extent within the west basin—from the coast inland some 6 miles to Del Amo Street—the zone has been contaminated by saline waters and in most of this area its water is unfit for use. Yield data are available for five wells in this coastal area. Their yield ranges from 210 to 1,500 gpm. For four of these wells, the average specific capacity (gallons per minute per foot of drawdown) is 63. Data available from pumping tests suggest that within this reach the permeability of the Gaspur zone ranges from 3,000 to 5,000 gpd per square foot.

"Fifty-foot gravel."—During the early development of ground water in Ballona Gap, the "50-foot gravel" was tapped by several scores of wells for domestic, irrigation, and stock use. Because of the decline in water levels, this water-bearing zone has been dewatered beneath a large part of the gap. Also, its water has become contaminated

within much of its extent coastward from the Inglewood fault. Hence, most of the wells, which currently withdraw water for irrigation or other uses, tap the underlying deposits of the San Pedro formation.

Fragmentary data on yields from wells tapping the "50-foot gravel" indicate that they have ranged from less than 100 to as much as 800 gpm. No information on specific capacity is available. However, because the "50-foot gravel" is only about one-third to one-half as thick as the Gaspur water-bearing zone, the yields indicate that the permeability may be about the same.

PLEISTOCENE SERIES

GENERAL FEATURES

Deposits of Pleistocene age crop out over nearly all of the Newport-Inglewood belt of hills, over the Torrance plain and the Ocean Park plain, and locally on the flanks of the Santa Monica Mountains and the Palos Verdes Hills. They are overlain by alluvial deposits in the gaps and by beach and dune deposits along the coast, and are underlain by Pliocene and older rocks. These Pleistocene deposits are chiefly unconsolidated and consist of interlensing beds of sand, gravel, silt, and clay. In downward succession they include a capping terrace deposit, the Palos Verdes sand, certain unnamed upper Pleistocene deposits, and the San Pedro formation of lower Pleistocene. In the area shown on plate 2 the San Pedro formation is the thickest of the Pleistocene deposits.

Along the coast, the Pleistocene rocks range in thickness from about 100 to 600 feet; in the syncline southwest of Dominguez Hill their thickness is as much as 1,200 feet. Along the crest of the Newport-Inglewood zone their thickness ranges from a feather edge at the Baldwin Hills to 700 feet at the southeast edge of Dominguez Hill. Inland beyond that zone they attain a maximum thickness of about 3,000 feet beneath the central Downey plain and become thinner northward and northeastward toward the inland hills, where they have been faulted, warped upward on anticlinal uplifts, and partly removed by erosion.

TERRACE COVER AND PALOS VERDES SAND

The Newport-Inglewood belt of hills, the Torrance and Ocean Park plains, and parts of the bordering highland areas are capped by a terrace cover of nonfossiliferous red sand and silty sand. In most of the area, this cover ranges from a few feet to about 20 feet in thickness. It owes its characteristic red color to iron oxide derived from the processes of weathering.

In the Palos Verdes Hills, according to Woodring (1946, p. 106), the thickness of the cover toward the rear of one terrace "is as much

as 100 feet, but an exposed thickness greater than 50 feet is exceptional." The deposits there represent "cliff talus rubble, stream fan and channel material, and rill and slope wash," and in places the remains of land mammals have been reported. These deposits, therefore, are definitely continental in origin. Davis (1933, p. 1055–1056, 1058–1061, figs. 5 and 6) describes the origin and physiographic aspects of similar deposits along the Santa Monica Mountains.

At some places, the relatively thin terrace cover over the Newport-Inglewood zone and the Torrance plain may be of flood-plain origin and may have been formed immediately after emergence of the upper Pleistocene marine surface. But elsewhere the true nonmarine cover may be absent, the red zone being merely the upper few feet of the marine Palos Verdes sand, which has been modified by weathering.

Hoots (1931, p. 120–123, 130) describes alluvial deposits of late Pleistocene age which cap the dissected Santa Monica plain. "These deposits range in thickness from a few feet to at least 200 feet" and are composed of dark brown poorly sorted angular rock fragments "embedded in a soft matrix of reddish-brown clay and sand." Locally they "rest directly upon a slight thickness of horizontal fossiliferous marine upper Pleistocene deposits." Thus, although in places they are considerably thicker than the terrace cover, which occurs farther south, these deposits may in large part be stratigraphically equivalent to that cover.

At several exposures along and near the Newport-Inglewood structural zone, the nonmarine terrace cover is underlain by a thin layer of fossiliferous gray sand and gravel. First described under the name "upper San Pedro series" and later called the "Palos Verdes formation," this stratigraphic unit has recently been defined by Woodring (1946, p. 56) as the Palos Verdes sand; he describes its typical characteristics as it occurs in the Palos Verdes Hills as follows:

> The Palos Verdes sand like the older marine terrace deposits, consists of a thin veneer on the terrace platform, which bevels formations ranging in age from lower Pleistocene to Miocene. Also like the older marine terrace deposits, the strata consist generally of coarse-grained sand and gravel but include silty sand and silt. Limestone cobbles are the prevailing constituent of the gravel, granitic and schist pebbles being locally abundant. The thickness of the Palos Verdes generally ranges from a few inches to 15 feet and is usually less than 10 feet. At places it consists of thin lenses, and at other places it is absent.

According to Woodring, faunal evidence indicates that the Palos Verdes sand is of late Pleistocene age. The lowest, and youngest, marine terrace of the Palos Verdes Hills on which it is deposited presumably is a correlative of the upper Pleistocene marine platform that underlies the Torrance plain and the Newport-Inglewood belt of hills at shallow depth, and which prior to deformation was of very low relief.

Outside the Palos Verdes Hills, the Palos Verdes sand or its essential stratigraphic equivalent has been identified at several localities. Among those in or near the Torrance-Santa Monica area, the following are pertinent:

1. About 6 miles west of Long Beach and 200 feet south of the intersection of Sepulveda Boulevard and Vermont Avenue, a thin lens of gray sand containing marine shells is exposed beneath red soil. On the basis of the megafossils, this sand has been identified by Woodring (personal communication, Nov. 23, 1943) as the essential equivalent of the Palos Verdes sand.

2. A trench dug on the northeast side of the Baldwin Hills about 1925, for the Los Angeles Outfall Sewer, exposed a section, which Tieje (1926, p. 502–503) described as 50 feet of massive grayish green very coarse to gravelly quartzose and loosely cemented sands. He called these the "Palos Verdes sands."

3. About 2 miles northeast of Playa del Rey, at the Ballona escarpment, the Palos Verdes sand has been exposed by the widening of Lincoln Boulevard where it begins to decline onto Ballona Gap. Beneath a thin soil cover, reddish-brown sand 10 feet thick is underlain by 10 feet of clay, which in turn is underlain by 15 feet of medium to coarse brown sand. The lower 6 feet of this sand layer contains abundant shell remains. From a study of this fauna, Willett (1937, p. 379–406) has correlated the enclosing sand as the stratigraphic equivalent of the Palos Verdes sand at the Baldwin Hills locality described by Tieje and cited above. About 20 feet of light-brown sand, which is presumed to be part of the San Pedro formation of early Pleistocene age, is exposed beneath this Palos Verdes sand.

4. Just outside the area, about 2 miles northwest of the city of Santa Monica, sands of "upper San Pedro" (Palos Verdes) age are exposed in Potrero Canyon. Woodring, quoted by Hoots (1931, p. 122), believes that these sands "probably correspond to the sands of the Baldwin Hills section described by Tieje as the Palos Verdes sands."

5. The Ocean Park plain and the Beverly Hills are underlain by "soft sand, clay, gravel, and conglomerate," which are considered by Woodring (Hoots, 1931, p. 121), from faunal evidence, probably to represent "upper San Pedro" (Palos Verdes) age. Hoots reports that the only fossils found in the area were from a stream-cut bluff at the north edge of Ballona Gap, where a cut bank on the west side of Overland Avenue and about 200 feet south of the crest of the hill exposes a bed about 10 feet below land surface consisting of dark reddish-brown sandy silt and containing shells. This shell bed is overlain by brown massive silt extending to the land surface. These

upper Pleistocene marine sediments in places underlie the Pleistocene alluvial deposits which form the Santa Monica plain.

Because the main water-bearing zones of the west basin occur at depths usually in excess of 150 feet below the land surface, the shell bed that commonly marks the base of the Palos Verdes sand is not often logged by drillers. A bed containing oyster shells at a depth of 18 feet, a foot of white sand to 19 feet, and a thin "coral" bed—evidently a hard-shell bed—was found in a well about 2 miles north of Torrance, in 3/14–34. It is presumed that these shell beds are at the base of the Palos Verdes sand, and that this formation occurs here to a depth of about 20 feet below the land surface.

For a description of the correlatives of the Palos Verdes sand as it occurs in the adjacent Long Beach-Santa Ana area to the east and southeast, the reader is referred to an earlier report (Poland, Piper, and others, 1956, p. 52–55).

A detailed account of its occurrences in the type locality, including faunal lists, is presented in the report by Woodring, Bramlette, and Kew (1946, p. 56–59) on the Palos Verdes Hills.

Along the Newport-Inglewood uplift, the terrace cover and the Palos Verdes sand are almost entirely above the water table and therefore they are unsaturated. At places beneath the Torrance plain the Palos Verdes sand is below the semiperched water table and is sufficiently permeable to yield water to shallow wells, although this water commonly is of inferior quality. Where these deposits form the land surface, they are sufficiently permeable to absorb some water from rainfall and to transmit it to underlying deposits.

Although the Palos Verdes sand has little importance as an aquifer, it is of critical importance in establishing the amount of deformation of the Pleistocene water-bearing deposits in latest Pleistocene time. Therefore, its known occurrences within the Torrance-Santa Monica area have been described in some detail in the preceding paragraphs.

UNNAMED UPPER PLEISTOCENE DEPOSITS

DEFINITION AND EXTENT

In an earlier report by the Geological Survey (Poland, Piper, and others, 1956, p. 55–57), certain strata of late Pleistocene age found in wells between definite or probable correlatives of the Palos Verdes sand above and the San Pedro formation below have been designated "unnamed upper Pleistocene deposits." These deposits underlie much of the Torrance-Santa Monica area and are described in following paragraphs.

In water well 3/13–32F6, near the intersection of Victoria Street and Avalon Boulevard and low on the west flank of Dominguez

Hill, two zones of marine shells were reported—one in sand 20 to 30 feet below the land surface and the other from 238 to 260 feet. The upper shell zone is inferred to represent the Palos Verdes sand, and the lower one the megafossil zone near the top of the San Pedro formation of lower Pleistocene age; the material between these two shell zones has been assigned to the unnamed upper Pleistocene deposits.

About a mile to the east and near the intersection of Victoria Street and Central Avenue on Dominguez Hill, oil wells are reported by Wissler (1943, p. 212) to pass through: (1) nonmarine yellow and brown sand, sandy clay, and gravel to 175 feet below land surface; (2) lagoonal deposits 40 feet thick; (3) a thin deposit of lignite; and (4) about 300 feet of marine sand and gravel, including a megafossil zone, San Pedro in age, from 215 to 250 feet below land surface. Wissler has concluded that the top 175 feet of nonmarine sediments are of late Pleistocene age, and he assigns the lagoonal deposits and the marine sand and gravel to the San Pedro formation. It is inferred that the nonmarine beds from about 30 to 175 feet below land surface represent the unnamed upper Pleistocene deposits.

Natland examined samples collected during the drilling of well 4/13–22D1, about 3 miles south of Dominguez Hill. He reported that samples taken to a depth of 164 feet were nonfossiliferous and that samples below this depth contained fossils (Natland, M. L., written communication, 1943). From this report and other evidence, it is inferred that the upper 30 feet of deposits are of Recent age; those from 30 to 164 feet are believed to represent the unnamed upper Pleistocene deposits.

By means of peg-model studies, the unnamed upper Pleistocene deposits have been tentatively correlated over most of the southern part of the Torrance-Santa Monica area. These sediments extend at least as far north as the Ballona escarpment and southward to the Palos Verdes Hills. Between these north-south limits they extend from the coast over the crest of the Newport-Inglewood structural zone, and inland beneath the Downey plain. They have not been traced beneath Ballona Gap and to the north, although their stratigraphic equivalent may be present; apparently they are absent beneath the Baldwin Hills.

PHYSICAL CHARACTER AND THICKNESS

The unnamed upper Pleistocene deposits vary considerably in lithology, both vertically and laterally. Nevertheless, the upper half of the deposits is generally fine grained, chiefly silt, clay, and sand. The lower half is chiefly sand, containing some gravel and subordinate amounts of silt and clay. Because of its coarse texture,

this lower stratum is a productive aquifer in much of the Torrance-Inglewood subarea. Its midposition is about 200 feet below the land surface in the area of its most typical occurrence—in the broad syncline extending from Inglewood southeastward through Gardena. Hence, it has been named the "200-foot sand" for purposes of this report.

Although the "200-foot sand" is composed chiefly of sand, logs of wells reveal much variation in its physical character from place to place. Thus, well 3/14–23L1, about a mile north of Gardena and near the synclinal axis, is reported to have cut through 332½ feet of clay, beneath a surface alluvial sand 1½ feet thick, before striking an aquifer in the San Pedro formation. Here the "200-foot sand" apparently is wholly absent. At well 3/14–22A1 (for log, see table 28), also near the axis of the syncline, the "200-foot sand" is represented by an upper sandy zone, a middle clayey zone, and a lower sandy zone. Many well logs indicate that the "200-foot sand" is locally a coarse gravel, as at well 2/14–27J1 (table 28), situated on the crest of the Newport-Inglewood uplift at the north end of the Rosecrans Hills. The "200-foot sand" is also largely gravel beneath an area of about 4 square miles near the coast, at and near the city of El Segundo and the Standard Oil Co. well fields in secs. 12 and 13, T. 3 S., R. 15 W., and beneath about 7 square miles in the vicinity of Gardena near the axis of the syncline.

In general, where it occurs northwest of the Gardena area just referred to, the "200-foot sand" is coarser on the limbs of the syncline than along the axis.

In the southeastern part of the west basin, about southeast of a line from Gardena to Torrance, the "200-foot sand" usually is logged as fine sand and is tapped by very few wells. Thus, in the area in and near Dominguez Gap it has little importance as an aquifer.

In the area between Torrance and the northeast flank of the Palos Verdes Hills, the "200-foot sand" is largely in physical and hydraulic continuity with the thick series of coarse-grained sediments of the underlying San Pedro formation (shown in the cross sections, pl. 3 *B*, *C*). It is difficult or impossible to separate the two units in this area.

Within the part of the Torrance-Inglewood subarea where it is a productive aquifer—that is, between Torrance and Inglewood and from the coast to the crest of the Newport-Inglewood uplift—the "200-foot sand" underlies about 70 square miles.

The "200-foot sand" is tapped by at least 200 highly productive wells in the vicinity of Gardena. Although little information is available on drawdown, estimated yields for wells tapping this

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water-bearing zone range from about 100 to as much as 1,300 gpm. Estimated yields for 22 wells as reported by Mendenhall (1905b, p. 75–80) gave an average yield of 575 gpm. Well 3/14–26E2 is reported to yield 50 gpm with a 3-foot drawdown—a specific capacity of 17 gpm per foot of drawdown.

The thickness of the unnamed upper Pleistocene deposits ranges widely from place to place. Table 4 shows the approximate thickness and depth of both the unnamed upper Pleistocene deposits as a whole and the "200-foot sand" for their occurrence along the synclinal axis from Inglewood southeast to Gardena (pl. 3*B*), and along the west coast from El Segundo to Hermosa Beach (pl. 3*C*).

TABLE 4.—*Range in thickness and depth (in feet) to the base of the unnamed upper Pleistocene deposits in the northern and central parts of the Torrance-Inglewood subarea*

Deposits	Along coast (El Segundo to Hermosa Beach)	Along axis of syncline (Inglewood to Gardena)
Thickness of unnamed upper Pleistocene deposits	60–150	180–280
Depth to base below land surface	140–250	240–310
Altitude of base below sea level	20–80	160–260
Thickness of "200-foot sand"	20–60	65–135

About 5 miles southeast along the synclinal axis from Gardena, at the intersection of Carson and Alameda Streets, the Pleistocene reaches its greatest thickness within the west basin. At this point the base of the unnamed upper Pleistocene deposits is about 350 feet below the land surface, or 325 feet below sea level (pl. 6).

Along the crest of the Newport-Inglewood uplift the unnamed deposits are thickest at Dominguez Hill and in the saddle between Dominguez Hill and the Rosecrans Hills (pl. 3*A*). Here the "200-foot sand" is represented by about 50 to 100 feet of sand and gravel whose base ranges from 100 to 200 feet below the land surface. Farther northwestward along the crest of the Rosecrans Hills, the base of the unnamed deposits is nearer the surface, owing to uplift, and the aggregate thickness averages 50 feet or less. The deposits may have been eroded to a certain extent during or after the uplift of late Pleistocene time, but it is thought that they may never have reached a greater thickness. Beyond the northwest end of the Rosecrans Hills they feather out against the Baldwin Hills uplift.

On the basis of data now available from wells and outcrops, the unnamed upper Pleistocene deposits within the west basin are inferred to be partly marine origin and partly of continental origin. Wissler reported that samples of deposits taken from wells on Domin-

guez Hill were of nonmarine, presumably fluvial origin. In a very few wells southwest of the Newport-Inglewood uplift, fossils have been reported from these deposits (see logs for wells 4/13–15A11 and 4/14–13F1, table 28), but these have been found in the "200-foot sand" or its stratigraphic equivalent.

The upper half of the unnamed deposits in the Torrance-Inglewood subarea is fine grained and is not known to contain any fossils. Accordingly, most of this upper division is inferred to be a flood-plain deposit.

Because the "200-foot sand" is of coarse texture, is widespread in extent, and is relatively uniform in character and thickness over areas as great as several square miles; and also because it contains fossils at a few places, it is inferred to have been deposited in a shallow marine or littoral environment. As already pointed out, the "200-foot sand" is thickest and best developed in the vicinity of Gardena; here it may represent a deltaic deposit laid down beyond a shoreline that fringed the southwest flank of the Newport-Inglewood uplift.

STRATIGRAPHIC RELATIONS

The stratigraphic relations between the unnamed upper Pleistocene deposits and the underlying San Pedro formation are not definitely known. The contact between these two stratigraphic units is nowhere exposed, and well logs are inadequate to supply critical evidence. However, it appears likely that the unnamed deposits are conformable on the San Pedro formation along the synclinal axis; probably they are locally unconformable along the crest of the Newport-Inglewood uplift. Throughout the extent of the 200-foot sand within the Torrance-Inglewood subarea, the base of this sand is presumed to represent the base of the unnamed upper Pleistocene deposits and the top of the San Pedro formation (pls. 3*A*, *B*, *C*, and 5).

The twelve higher terraces of the Palos Verdes Hills are, at least in part, correlatives of the unnamed upper Pleistocene deposits; this fact indicates that locally, if not regionally, deformation was occurring in the interval during which they were being deposited. Possibly this deformation is reflected in the coarse deposits assigned to the lower part of the unnamed deposits.

SAN PEDRO FORMATION

DEFINITION

For the ground-water investigation of the adjacent Long Beach-Santa Ana area, the San Pedro formation of early Pleistocene age has been defined (Poland, Piper, and others, 1956, p. 60–62) as that stratigraphic unit underlying the unnamed upper Pleistocene deposits (just described) and overlying the Pico formation of late Pliocene

age. It has been discriminated for that area partly from outcrops but mostly by data from water and oil wells—drillers' logs, electric logs, samples taken during drilling, and faunal studies. By similar methods of correlation, the San Pedro formation has been traced over most of the Torrance-Santa Monica area.

The San Pedro formation is considered to be essentially correlative with (but much thicker and more heterogeneous) the type San Pedro sand, Timms Point silt, and Lomita marl as defined by Woodring and others (1946, p. 43–53). However, it doubtless includes some younger strata; and it may include some which are older than any exposed in the type section just cited. Owing to the heterogeneous materials of this unit, the nonlithologic designation "San Pedro formation" is preferred to "San Pedro sand." The Timms Point silt and the Lomita marl are treated as the two basal members of the formation.

As here defined, the San Pedro formation embraces all strata of early Pleistocene age. In most of the Torrance-Santa Monica area, the San Pedro formation occurs between the unnamed upper Pleistocene deposits above and the Pico formation below. However, in the northern and southern parts of the area shown on plate 2, major unconformities occur at both its top and its base so that locally it underlies the Palos Verdes sand of late Pleistocene age and rests on rocks as old as upper Miocene (p. 56).

For the stratigraphic units with which the San Pedro formation of this report is correlative—the San Pedro sand, the Timms Point silt, and the Lomita marl of Woodring and others—the type exposures occur low on the east flank of the Palos Verdes Hills in and near San Pedro—the extreme southern part of the area shown on plate 2.

In the type area, the San Pedro sand is made up largely of stratified and crossbedded sand, but it includes some beds of fine gravel, silty sand, and silt. Its component particles are derived chiefly from some distant area of granitic rocks; however, according to Woodring, some of the gravel beds contain pebbles of limestone, siliceous shale, and schist, which are assumed to have been derived locally from the Palos Verdes Hills. In that same area, two local stratigraphic units of early Pleistocene age underlie the San Pedro sand of Woodring; in downward succession they are the Timms Point silt and the Lomita marl. The Timms Point silt of the type area is composed of brownish to yellowish sandy silt and silty sand. Its type outcrop at Timms Point has been described by Clark (1931, p. 25–42). The underlying Lomita marl consists chiefly of marl and calcareous sand.

The type locality of the Lomita marl is near Lomita quarry, about a mile southwest of Lomita. Foraminifera from the Lomita marl at the quarry have been described by Galloway and Wissler (1927).

Woodring ranks the Timms Point silt and Lomita marl as formations. However, because they cannot now be traced as distinct units to the north of the Palos Verdes Hills, for purposes of this report they are treated as the basal members of the San Pedro formation, as was done in the report on the geology of the Long Beach-Santa Ana area.

Woodring reports that in the San Pedro area the greatest exposed thickness of the San Pedro sand is about 175 feet, of the Timms Point silt about 80 feet, and of the Lomita marl about 70 feet. He estimates that these three lower Pleistocene units where concealed in that same area, have a maximum thickness of about 600 feet.

REPRESENTATIVE EXPOSED SECTIONS

For the northeast flank of the Palos Verdes Hills, Woodring (1946, p. 45–53) has described a number of exposed sections of the San Pedro sand, the Timms Point silt, and the Lomita marl. Details will not be repeated here. However, one of the best exposures of the San Pedro sand is about 2,000 feet west of Narbonne Avenue, in 4/14–35E, at the Sidebotham sand pits nos. 1 and 2. Here the Lomita marl is absent, and the San Pedro sand rests directly on the Malaga mudstone member of the Monterey formation. The no. 1 pit exposes about 100 feet of sand and interbedded layers and lenses of gravel dipping gently northward. The sand is gray or reddish-brown and includes thin crossbedded units. Its aspect, as shown in a photograph in the recent report by Woodring and others (1946, pl. 19, p. 58), is typical of that observed in exposures in the Baldwin Hills, described beyond, and at Huntington Beach Mesa in the Long Beach-Santa Ana area. In other pits or ravines farther west, along the north border of the hills, the character of the sand and gravel of the type San Pedro sand does not differ significantly from the exposures just described; the Palos Verdes sand was found unconformably overlying the San Pedro in several of these ravines. As exposed in the several gravel pits along the north edge of the Palos Verdes Hills, the San Pedro sand appears to be highly permeable.

In addition to the exposures of the San Pedro formation just described, the only other known outcrops of this formation within the Torrance-Santa Monica area are in the Baldwin Hills and along the Ballona escarpment.

About 40 feet of the San Pedro formation is exposed in the northern part of the Baldwin Hills, in a sand pit on the east side of Moynier Lane about 250 feet southeast of well 2/14–8C1. The lower part of this section comprises about 25 feet of light-buff massive well-sorted fine granitic sand; this is overlain by about 15 feet of white medium sand, which contains pebbles as large as 1 inch in diameter near the top.

An exposure in another sand pit, about 1,000 feet south of the locality just described but on the west side of Moynier Lane, consists of about 45 feet of silty sand, sand, and gravel. In upward sequence, it comprises: 10 feet of interbedded sand and sandy gravel, with pebbles largely of metamorphic rocks and some granite; 4 feet of coarse loose sand; a 4-inch bed of dark reddish-brown fine sandstone; 6 feet of well-sorted fine loose sand; and at the top of the exposure, 25 feet of massive fine silty sand containing a few layers of scattered pebbles as much as 3 inches in diameter.

In the middle of 2/14–18, at the west border of the Baldwin Hills, about 50 feet of the San Pedro formation is exposed in a gravel pit about 400 feet east of the junction of Overland Avenue and Playa Street. The lower 20 feet of this section consists of light-gray coarse-grained loose crossbedded sand; this is overlain by about 30 feet of light-brown medium- to coarse-grained loose sand with scattered streaks of gravel from 1 to 2 inches thick, which contains pebbles of quartz, metamorphic rocks, and granite as much as 1 inch in diameter. The upper 6 feet of this sand is weathered to a reddish-brown sandy soil.

FAUNAL DATA FROM OUTCROPS AND WELLS

In regard to the San Pedro formation as it occurs within the Torrance-Santa Monica area, faunal studies have been confined to subsurface samples except for the type outcrops in the Palos Verdes Hills, which have been studied by Woodring and his associates (1946, p. 43–53) and by several other investigators. (For references, see Poland, Piper, and others, 1956, p. 64.)

For this report, as in the report on geology of the Long Beach-Santa Ana area the nomenclature and faunal divisions employed by S. G. Wissler (1943) are usually accepted in order to develop the most uniform correlation of Pleistocene and Pliocene strata.

During the drilling of well 4/13–15A11, near the intersection of Alameda and Carson Streets in Dominguez Gap, samples were collected at 10-foot intervals by Paul Karnes of the Roscoe Moss Co. These samples were examined by S. G. Wissler for faunal correlation. From foraminiferal determinations, Wissler (oral communication, January 7, 1947) reported the first good San Pedro fauna at 690 feet below the land surface and suggested from fragmentary data that the top of the San Pedro formation might be as high as 450 feet. On the basis of lithologic correlation, the top is here taken at 415 feet below the land surface, at the base of a bed of sand and gravel 65 feet thick, which is inferred to represent a coarse southeasterly correlative of the "200-foot sand" in the unnamed upper Pleistocene deposits already described. The strata from 415 feet to the total depth of 1,040 feet

are assigned to the San Pedro formation. From logs of nearby wells, it is believed that this part of the San Pedro formation is about 800 feet thick and that its base is about 1,200 feet below land surface (pl. 2).

Core samples from well 3/14–10G2, which was drilled for the city of Inglewood (well 30) about 1 mile northeast of Hawthorne, were made available by the Kalco Drilling Co. and were examined by Wissler and Natland for faunal correlation. Both men were in agreement (Wissler, S. G., oral communication, January 7, 1947; Natland, M. L., oral communication, January 9, 1947) that a fauna essentially equivalent to that associated with the Timms Point silt and the Lomita marl is present from 564 to 825 feet below the land surface at this well. Wissler inferred that the base of the San Pedro formation is just below the deepest core obtained, which was at 825 feet below the surface. The base of the Silverado water-bearing zone is 710 feet below the land surface at this well.

Samples from well 3/14–29D3 (well 11 of the city of Manhattan Beach) were also examined for faunal correlation by Wissler (oral communication). He reported that the base of the San Pedro formation, placed by the Geological Survey at 431 feet below land surface, essentially agrees with the position indicated by the megafossils found in the samples.

Samples were collected at about 10-foot intervals during the drilling of a test well for the Richfield Oil Corp. about 2 miles east of El Segundo (well 3/14–8N3, Richfield Leuzinger No. 1). Wissler examined these samples and placed the base of the San Pedro formation at about 790 feet below the land surface. A megafossil zone, which occurred from 180 to 240 feet below the surface is inferred to mark the top of the San Pedro formation. The base of the Silverado water-bearing zone here is about 440 feet below the land surface; and fine-grained silt and clay containing Timms Point-Lomita fauna extend some 350 feet below the base of the Silverado water-bearing zone.

From paleontologic examination of ditch samples from oil wells drilled near the crest of Dominguez Hill, Wissler concluded that the San Pedro formation was reached from 175 to about 670 feet below land surface (1943, p. 212).

In regard to the Rosecrans Hills, Wissler based his determination on paleontologic evidence from an oil well in 3/13–19A (about half a mile west of the crest of the Newport-Inglewood uplift) Wissler (written communication) assigned the deposits from 210 to 570 feet below land surface to the San Pedro formation.

Additional data on depth and thickness of the San Pedro formation obtained from other oil fields are shown graphically on plate 7 as

diagrammatic columnar sections. In certain fields, particularly in the Potrero oil field, the base of the San Pedro formation is estimated by Wissler to be somewhat lower than is shown by the contacts on the geologic sections (pl. 3*A*, *C*) and by the contours on the geologic map (pl. 2). In such areas, it is probable that the fine-grained deposits underlying the water-bearing zones represent a basal interval containing the Timms Point-Lomita fauna.

Water-bearing deposits that contain a similar faunal assemblage as much as several hundred feet thick have been deposited extensively to the north and northeast of Signal Hill in the Long Beach area (Poland, Piper, and others, 1956, p. 67).

From the evidence just presented, it is apparent that, at least locally within and near the west basin, deposits of impermeable silt and clay underlie the Silverado water-bearing zone and contain a Timms Point-Lomita fauna; therefore these deposits are a basal part of the San Pedro formation. Thus, the contours on the base of the water-bearing zones of Pleistocene age shown on plate 2 do not everywhere represent the base of the San Pedro formation. However, the contours on plate 2 are believed not only to depict with fair accuracy the base of these water-bearing beds of the San Pedro formation but also, for most of the area, to represent generalized structure contours on the base of the deposits of Pleistocene age.

THICKNESS

The thickness of the San Pedro formation varies greatly within the Torrance-Santa Monica area, largely because deformation and erosion have been active since its deposition. The formation has been upturned and beveled by erosion at the outcrop along the north border of the Palos Verdes Hills (pls. 2, and 3*B*, *C*). Along the south flank of the Santa Monica Mountains the San Pedro formation doubtless is also upturned and beveled, but there it is capped by upper Pleistocene and Recent terrace and alluvial deposits and is not exposed at the land surface. In the Baldwin Hills, the San Pedro formation is domed upward and broken by faults and is at or near the surface over more than half the total area of the hills, as shown on plates 2 and 3*A*. The San Pedro is folded into an anticline and faulted over the crest of the Newport-Inglewood uplift southeast of the Baldwin Hills; it does not crop out on the Rosecrans and Dominguez Hills.

The general range in thickness of the San Pedro formation is shown on the several geologic sections. In the west basin it attains a thickness of about 800 feet in the synclinal trough beneath Dominguez Gap, near the intersection of Carson and Alameda Streets. It may have a greater thickness, possibly 900 feet, in the sharp syncline beneath the inner harbor in Wilmington (pl. 2). To the northwest

its greatest thickness is in the synclinal trough extending past Inglewood to Ballona Gap, but it decreases gradually in thickness to about 500 feet at Gardena, to 400 feet west of Inglewood, and to 300 feet beneath Ballona Gap. Thicknesses along the crest of the uplift and along the coast are shown by geologic sections on plate 3*C*. Except within the Baldwin Hills and the Palos Verdes Hills, where the formation has been partly or completely removed by erosion, it is thinnest along the coast near El Segundo (about 100 feet) and along the Newport-Inglewood uplift crest beneath Ballona Gap (about 50 feet, pl. 3*D*).

Inland from the Newport-Inglewood uplift, its greatest thickness is in the synclinal trough that trends northwest through Huntington Park and terminates beneath Ballona Gap at the north flank of the Baldwin Hills (pl. 2). Beneath Huntington Park the thickness of the San Pedro formation may be as much as 1,500 feet (pl. 4); farther southeast toward Orange County and beyond the extent shown on plate 2, it is about 3,000 feet thick.

Contours drawn on plate 2 show the altitude of the base of the water-bearing zones of Pleistocene age. It has already been pointed out (p. 44) that for the treatment in this report the base of the San Pedro formation is assumed to be at the base of these water-bearing zones, although, from faunal evidence, locally the base of the San Pedro is somewhat lower. As shown by these contours, the approximate base of the San Pedro formation is lowest at Wilmington and at the intersection of Carson and Alameda Street about a mile south of Dominguez Hill; at these places it is about 1,200 feet below sea level. Along the crest of the Newport-Inglewood zone it rises to about 400 feet below sea level at Dominguez Hill, less than 100 feet below sea level in the middle of the Rosecrans Hills, and to 400 feet above sea level in the Baldwin Hills, where in places it intersects the land surface.

PHYSICAL CHARACTER AND WATER-BEARING PROPERTIES

General features.—Study of data from well logs shows that the San Pedro formation underlies most of the Torrance-Santa Monica area south of the Santa Monica plain, except where older rocks are exposed on the Baldwin Hills and the Palos Verdes Hills. For much of the area north of Ballona Gap (beneath the Santa Monica plain) the deposits of Pleistocene age cannot be divided on the basis of data now available, and the northward limits of the San Pedro formation are not known.

As shown on the geologic sections (pls. 3–5), along the northern border of the Palos Verdes Hills from Redondo Beach to Wilmington, the San Pedro formation is composed almost entirely of sand and gravel. To the north and east, the formation contains extensive beds

of silt and clay. Within the Torrance-Inglewood subarea, these impermeable beds commonly are in the upper part of the formation and hence overlie and confine the Silverado water-bearing zone. Northward beneath Ballona Gap, west of the Baldwin Hills, the San Pedro formation is mostly sand with some gravel. Locally, however, it includes thick interbeds of silt.

Northeast of the Newport-Inglewood uplift, in the main coastal basin, the San Pedro formation cannot be subdivided into an upper part of clay and silt and a lower part of sand and gravel. Instead, it becomes heterogeneous in character and the water-bearing beds interfinger irregularly with layers of silt and clay.

Along the central part of the synclinal trough, from Inglewood to and beyond Gardena, the silt and clay beds within the San Pedro formation separate the coarser water-bearing deposits into two distinct aquifers (pl. 3*B*). The upper of these two aquifers wedges out along both limbs of this syncline. The lower can be traced beneath nearly all the area from El Segundo and Inglewood southeast to the Palos Verdes Hills and Long Beach. It is the major aquifer within the west basin and has been named the Silverado water-bearing zone. These two water-bearing zones are described in considerable detail in the following paragraphs.

"*Four-hundred-foot gravel.*"—From study of well logs on a peg model, correlated with the position of the water level, a distinct water-bearing zone in the upper part of the San Pedro formation has been located in the synclinal trough southwest of the Newport-Inglewood uplift. This water-bearing zone is well defined from Inglewood southeast to about 3 miles beyond Gardena—a total distance of about 10 miles. Where best developed, it is characteristically composed of gravel or of sand and gravel, and its base is about 400 feet below land surface along the axis of the syncline (pl. 3*B*); accordingly, it has been designated the "400-foot gravel" for purposes of this report. Along the synclinal axis the thickness ranges from 20 to 120 feet. To the west and east of the axis it feathers out against the two limbs of the syncline. The limits of the "400-foot gravel" cannot be precisely defined because well logs suggest that locally it merges with the Silverado water-bearing zone, especially southwest of Gardena. However, the approximate extent of the "400-foot gravel" has been shown on figure 2. As shown there, it is about 10.5 miles long, about 2 miles wide, and underlies approximately 20 square miles. Beyond its southeastern limit as shown on the illustration, and extending along the synclinal trough to Dominguez Gap, a deposit of fine sand of irregular thickness is shown in logs of many wells; this deposit of fine sand possibly represents the stratigraphic extension of the "400-

foot gravel". Doubtless the fine sand has general hydraulic continuity with the "400-foot gravel."

Along the axis of the syncline (pl. 3*B*) the "400-foot gravel" commonly is overlain and underlain by impermeable layers of silt and clay from 50 to 180 feet thick and thus is physically and hydraulically separated from the "200-foot sand" above and the Silverado water-bearing zone beneath.

The "400-foot gravel" does not crop out at the land surface and so is known only from its occurrence as shown by well logs. Representative logs are given in table 28. (See logs for wells 2/14–28L1 3/13–30A2, 3/14–4N2, 10G1, and 22A1.) It is tapped by several wells of the city of Inglewood, and by three wells of the Southern California Water Co. (3/14–10C1, 22A1, and 23L1); also by many privately owned irrigation wells.

The yield is known for only two wells that tap the "400-foot gravel." Well 3/14–10C1 has a reported yield of 500 gpm; tests show that well 3/14–23L1 yielded 600 gpm with a drawdown of 51 feet, giving a specific capacity of about 12 gpm per foot of drawdown. This water-bearing zone is less than 50 feet thick as tapped in these two wells; thus the permeability is inferred to be relatively high, and about the same as that of the underlying Silverado water-bearing zone.

The "400-foot gravel" is entirely a confined aquifer and contains water under artesian pressure. As shown by the hydrograph for well 3/14–23L1 (fig. 5), the water level in this gravel near Gardena in 1945 was only a few feet above the pressure level in the Silverado water-bearing zone beneath. Because under native conditions recharge to the "400-foot gravel" presumably was chiefly through its marginal hydraulic contact with the Silverado water-bearing zone, the current head differential would indicate that the "400-foot gravel" now is receiving little recharge.

Silverado water-bearing zone.—In an earlier report (Poland, Piper, and others, 1956, p. 69) the name "Silverado water-bearing zone" was assigned to the most extensive of the Pleistocene aquifers of the Long Beach-Santa Ana area. The informal term Silverado water-bearing zone is not to be confused with the formal term Silverado formation (of Woodring and Popenoe, 1945) of Paleocene age of the Santa Ana Mountains, Orange County. The Silverado water-bearing zone was named for its typical occurrence in well 4/13–23G2 in Silverado Park within the city of Long Beach; the log is given in table 28. At this well the Silverado water-bearing zone is represented by 478 feet of sand and gravel from 596 to 1,074 feet below land surface. From data on other wells in the vicinity, the base of the Silverado water-bearing zone at this well is considered to be about 1,100 feet below land surface, and the full thickness to be about 500 feet (pl. 2 and fig. 2). The

upper 300 feet of the zone is highly permeable clean sand and gravel; the lower 200 feet is chiefly coarse sand.

The Silverado water-bearing zone underlies most of the Torrance-Inglewood subarea and extends inland about 2 miles beyond the crest of the Newport-Inglewood uplift. Its known extent and thickness within the area treated in this report are shown on figure 2. As delimited on that illustration, it underlies about 140 square miles and also extends southeastward about 6 miles beyond the east margin shown on figure 2, almost to the Orange County line as shown in an earlier report (Poland, Piper, and others, 1956, pl. 8). Its over-all extent within Los Angeles County is about 165 square miles.

Figure 2 shows the known range in the thickness of the Silverado water-bearing zone by means of isopachs (lines showing equal thickness) based on well-log information. Thus it is to be noted that the Silverado zone attains its greatest thickness (about 700 feet) near Bixby Slough in the Wilmington district. In general it is thinnest along the northern border of its known extent—about 100 feet at the coast near El Segundo, and less than 50 feet in Centinela Park in Inglewood. Except for the inordinate thickening in the synclinal foredeep immediately north of the Palos Verdes Hills, the average thickness of the Silverado water-bearing zone is about 200 feet.

The range in physical character of the Silverado zone from gravel to sand and gravel, and in places to sand, is well shown on geologic sections, plates 3*A–C* and 5. Many of the logs included in table 28 are of wells that penetrate the Silverado water-bearing zone. Among those in which the material ascribed to the Silverado is most characteristic are wells 3/13–28A1, 3/14–4N2, 3/14–22A1, 3/15–13R2, and 4/14–13F1. These logs indicate that the water-bearing parts of the zone are predominatly coarse sand and gravel; the maximum pebble diameter averages ½ to 1 inch, and reach a maximum of 2 inches (3/15–13R2, 4/14–13F1) and 4 inches (3/14–4N2). In the Torrance-Inglewood subarea interbedded layers of impervious silt, sandy clay, or clay within the Silverado zone locally reach a few tens of feet in aggregate thickness.

In most of the area between Long Beach and Redondo Beach the Silverado water-bearing zone is essentially a uniform mass of sand and gravel, with almost no interbedded clay or silt layers. It is chiefly gravel in the vicinity of Wilmington but becomes finer westward to Redondo Beach and Hermosa Beach, where it is largely sand. The Silverado zone is the thickest and the most productive water-bearing unit in this southern reach.

In the vicinity of Gardena and Hawthorne, where it is about 200 feet thick, the Silverado zone usually consists of about half sand and half sand and gravel, and contains few layers of silt. At Manhattan

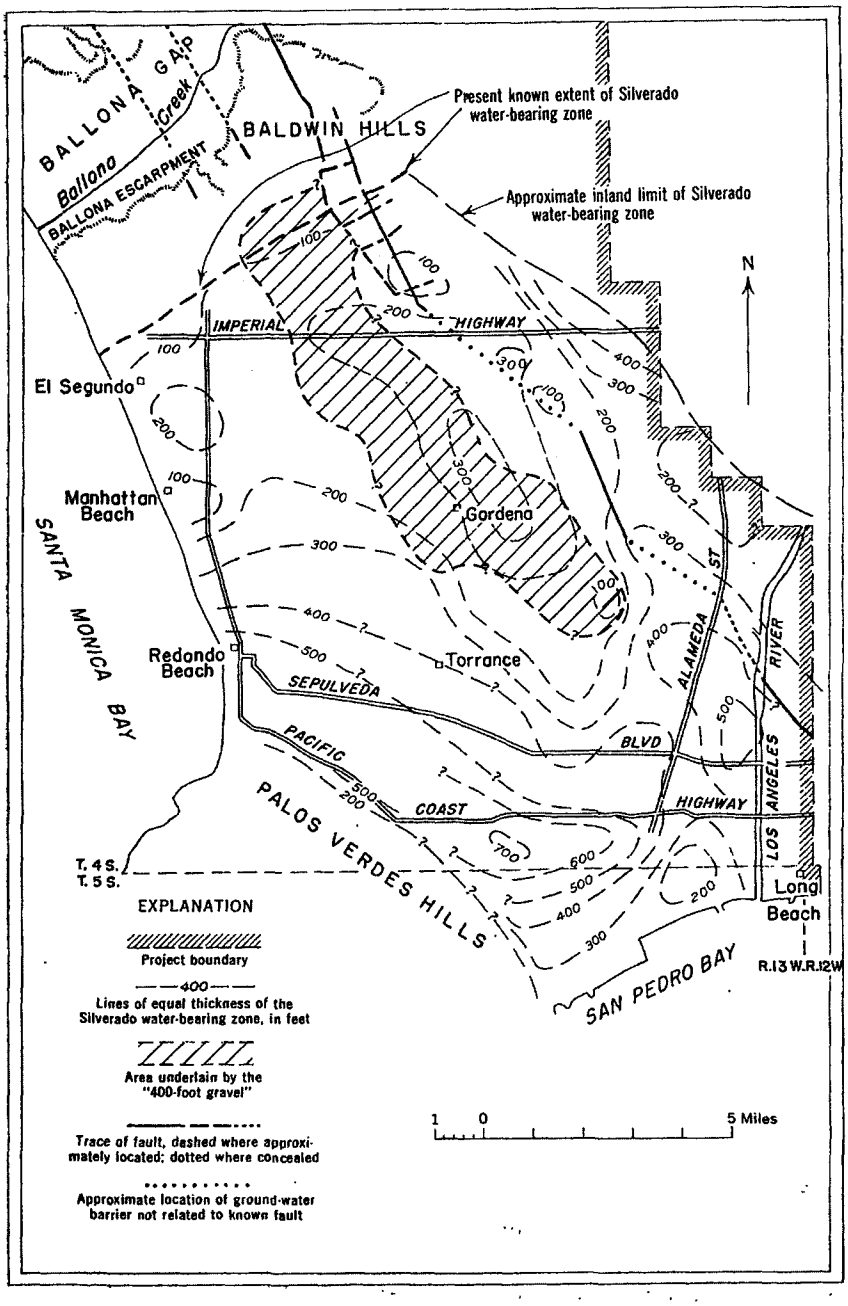

FIGURE 2.—Map showing extent and thickness of the Silverado water-bearing zone within the Torrance–Santa Monica area.

Beach, as tapped by the municipal wells west of Sepulveda Boulevard in 3/15–25A, the Silverado zone is irregular, but in most wells it includes one layer of sand and gravel about 50 feet thick, with a thinner layer below (pl. 4). To the north, near El Segundo, in sec. 13, T. 3 S., R. 15 W., logs of wells show that the Silverado zone is about 230 feet thick and contains from 2 to 4 layers of gravel separated by bodies of silt or clay (pl. 3*C*).

The Silverado water-bearing zone is tapped by many of the wells of the city of Inglewood. It is thickest (230 feet) in well 3/14–10G1 (Inglewood well 28), northeast of Hawthorne. Near the center of Inglewood, at well 2/14–28M1 (Inglewood well 26), it is only 45 feet thick. Within the Inglewood area, however, the zone is almost entirely gravel or sand and gravel and is moderately permeable.

Few water or oil wells have been drilled in the northern part of the Torrance-Inglewood subarea (an area about 5 miles long and 2 miles wide, parallel to and just south of the Ballona escarpment). Logs are not available for this area to show if the Silverado water-bearing zone is stratigraphically and hydraulically continuous with the thick water-bearing zone of the San Pedro formation beneath Ballona Gap. However, because of the general similarity in physical character and common position in the lower part of the San Pedro formation, it is inferred that the water-bearing zone in the San Pedro beneath the gap is correlative to the Silverado zone to the south and that the two zones have hydraulic continuity.[2]

Beneath the coastal 4-mile segment of Ballona Gap, most of the San Pedro formation is composed of permeable sand and gravel (pl. 3*D*). Farther inland, beyond the Inglewood fault at the Sentney plant of the Southern California Water Co., in the NW¼ sec. 5, T. 2 S., R. 14 W., the San Pedro formation contains three distinct aquifers separated by impervious layers of silt or clay (2/14–5D6, table 28); the lower two aquifers probably are stratigraphic equivalents of the Silverado water-bearing zone.

Inland, beyond the crest of the Newport-Inglewood uplift, the Silverado water-bearing zone and the whole San Pedro formation interfinger into more silty and clayey types of beds. This change from coarser to finer sediments involves a transition from shallow-water marine and littoral deposits to nonmarine deposits.

[2] Since the present report was released to the open file (1948), the California Division of Water Resources has completed its investigation (draft of report of referee, 1952). Additional information obtained in the State's investigation confirms the stratigraphic and hydraulic continuity of the Silverado water-bearing zone in the Torrance-Inglewood subarea with the thick water-bearing zone of the San Pedro formation beneath Ballona Gap. Hence, plate 6 of the State's report shows that the Silverado water-bearing zone extends north to and underlies the Ballona Gap.

The Geological Survey has made a laboratory examination of samples collected during the drilling of two deep wells within the west basin. Detailed descriptions of the material in these wells is presented in table 28 (3/14–29D3 and 4/13–15A11). The lithologic character of the material in these wells, which has been ascribed to the Silverado water-bearing zone, may be summarized as follows: Relatively clean fine to coarse gray arkosic sand, which is moderately well sorted, with particles subangular to subrounded; and clean gravel consisting of subrounded to rounded fragments of granitic and metamorphic rocks as much as 2 inches in diameter. A variation from fine sand to coarse gravel is usually represented in beds within the zone; the gravel is predominant in the basal part.

As discussed previously (Poland, Piper, and others, 1956, p. 78–84), the San Pedro formation is thought to have been formed by streams, which carried rock debris from an inland uplifted source across a coastal plain and deposited the material as coastal deltas. These deltas were continuously reworked by strong longshore currents. Throughout much of early San Pedro time, the shoreline maintained a position about 3 miles northeast and nearly parallel to the Newport-Inglewood uplift; that shoreline extended southeastward from the east edge of the Baldwin Hills through what is now the city of Compton. The Silverado zone was deposited seaward from the shoreline, chiefly as beach and shallow marine deposits.

The Silverado water-bearing zone is by far the most important aquifer in the Torrance-Inglewood subarea. In 1945 the Silverado zone was the source of water for essentially all the withdrawals by industries; essentially all the withdrawals by the municipal well fields of Hawthorne, El Segundo, Manhattan Beach, and Torrance, and about one-third of the withdrawal by the well fields of the city of Inglewood within the west basin; nearly all the withdrawals by the larger water companies, and at least half the withdrawals by private irrigators and by the smaller water companies. Of the total withdrawal from the Torrance-Inglewood subarea in 1945—some 78,000 acre-feet—about 68,000 acre-feet, or about 87 percent, was taken from the Silverado water-bearing zone (p. 110).

Wells tapping the Silverado water-bearing zone in the Torrance-Inglewood subarea range in tested capacity from a few hundred to as much as 4,000 gpm. For the area immediately west of Long Beach in T. 4 S., R. 13 W., the yield characteristics have been given in another report (Poland, 1959). Table 5 shows the yield characteristics of 39 wells that draw water solely from the Silverado zone within the Torrance-Santa Monica area (fig. 2).

TABLE 5.—*Yield characteristics of 39 wells tapping the Silverado water-bearing zone in the Torrance-Santa Monica area*

Well	Depth (feet)	Water-yielding zone or zones		Yield characteristics			
		Depth range (feet)	Thickness (feet)	Yield (gallons per minute)	Drawdown (feet)	Specific capacity[1]	Yield factor[2]
2/14-34C1	450	264–362	98	700	70	10	10
3/14-1B2	390	184–282	98	508	16	32	33
1F1	350	165–339	174	1,240	12	103	59
1G1	598	220–290	61	512	21	24	40
9N4	670	300–402	76	1,050	50	21	28
10G1	798	492–711	118	600	17	35	30
13B1	800	273–543	161	675	30	23	14
13J3	620	359–602	129	700	20	35	27
19C1	400	221–268	28	800	50	16	57
21B2	527	310–468	158	433	3	144	91
29D3	520	190–431	112	600	25	24	21
29G1	570	173–350	177	1,800	28	64	36
30A2	525	187–297	110	1,125	55	20	19
30D1	350	225–255	30	905	54	17	56
3/15-12B1	400	185–240	55	680	54	12.6	23
13H2	456	352–425	73	1,000	20	50	69
13J1	400	181–373	123	850	32	27	22
13R2	480	339–460	121	860	13	66	55
13R4	440	366–407	41	560	16	35	85
13R5	504	284–456	56	1,000	34	29	52
13R6	495	275–410	103	900	50	18	17.5
25A3	350	222–295	54	615	36	17	32
4/13-15A11	1,054	765–990	235	2,000	14.5	138	59
21H5	731	440–731	291	1,450	5	290	100
27M3	946	266–800	534	3,000	12	250	47
30G2	695	216–492	276	2,900	28	104	38
31E4	680	230–655	425	4,000	10	400	94
4/13-31P1	900	675–822	147	1,650	28	59	40
33D1	888	669–800	131	2,500	19	131	100
4/14-1H2	596	475–538	45	810	29	28	62
1H3	596	418–547	70	1,375	33	42	60
8C1	518	166–510	344	1,500	13	115	33
17N1	400	206–394	188	640	7	91	48
22D1	404	206–404	198	375	6	63	32
4/14-22D2	390	212–390	178	215	2	108	61
23N2	640	486–640	154	945	13	73	47
35J1	500	180–500	320	1,300	19	68	21
36H1	610	152–610	458	1,340	15	89	19
5/13-6D2	990	735–842	107	1,470	32	46	43
Average	580	----------	160	1,169	25	75	46

[1] Gallons per minute per foot of drawdown.

[2] Yield factor $= \frac{\text{Specific capacity} \times 100}{\text{Thickness of aquifer, in feet}}$.

NOTE.—In tables 5 and 6, specific capacity (relation of drawdown to discharge) is used as the convenient scale for the water-yielding capacity of a well and for the relative transmissibility of the water-bearing zone at the place. In addition, specific capacity has been divided by thickness of water-bearing material yielding water to the well, and the quotient so obtained has been multiplied by 100 for convenience in expression. The result has been termed the "yield factor." The yield factor here is introduced as an approximate relative measure for the permeability of the water-bearing material tapped by a well. Specific capacity and yield factor both involve drawdown, which (as measured in a well) is due to two increments of head loss: (1) that incident to movement of water toward the well through material of a certain average permeability and (2) that incident to entrance of water into the well casing. Thus, both specific capacity and yield factor depend not only on the characteristics of the water-bearing material tapped but also on the number, size, and condition of perforations in the casing and their distribution within the water-bearing zones tapped.

The 39 wells listed in table 5 show averages as follows: Yield 1,169 gpm, drawdown 25 feet, specific capacity 75 gpm per foot of drawdown, and yield factor 46 (specific capacity $\times 100$ divided by the thickness of aquifer, in feet). Within the Torrance-Inglewood subarea, table 5 shows no significant difference in yield factor for wells in the several townships, which indicates that although the thickness of the Silverado zone is more than twice as great between Long Beach and Redondo Beach as in the area north of Gardena, the permeability is essentially the same throughout its known extent in the west basin.

The permeability is a measure of the ability of a material to transmit water. It may be expressed as a field coefficient of permeability, expressed as the number of gallons of water per day that percolates through each mile of the water-bearing bed (measured at right angles to the direction of flow) for each foot of thickness of the bed and for each foot per mile of hydraulic gradient (Wenzel, 1942, p. 7).

Within the west basin the permeability of the Silverado water-bearing zone was determined from a pumping test near Bixby Slough in sec. 31, T. 4 S., R. 13 W. This pumping test was made chiefly to determine whether a barrier to ground-water movement existed between the wells of the Union Oil Co. (wells 4/13–31P1 and 5/13–6D2) and nearby wells at (1) the Lomita plant, city of Los Angeles, in 4/13–31E, and (2) the Palos Verdes Water Co., in 4/14–36H (pl. 2). The conclusions with respect to a hydraulic barrier are described elsewhere (p. 139 and fig. 8). The data also afforded an opportunity to determine transmissibility [3] and permeability.

On September 28, 1946, the pumps at the Lomita plant were idle and had been shut down for several days previously. The wells of the Union Oil Co. had been pumped continuously for several months before the test, and the wells of the Palos Verdes Water Co. had been operated intermittently. During the day, wells 4/13–31P1 and 5/13–6D2 (Union Oil Co.) and well 4/14–36H1 (Palos Verdes Water Co., well 1) were pumped intermittently on an alternating schedule (fig. 8) and water-level measurements were made at about 10-minute intervals from 10:00 a. m. to 9:00 p. m. at wells 4/13–31E4, 4/13–31P1, and 4/14–36H1. The fluctuation of water level in these wells is shown on figure 8. Between 12:10 and 4:10 p. m., the water level in well 31E4 recovered along a uniform curve, as a result of the shutdown of the pumps in the Union Oil Co. wells from noon to 4:00 p. m. From 4:10 to 7:10 p. m., the water level in well 31E4 declined concurrently with pumping of the Union Oil Co. wells. The time-drawdown graph for well 31E4 was utilized to compute transmissibility in ac-

[3] Transmissibility is expressed as the field coefficient of permeability multiplied by the thickness of the saturated part of the aquifer in feet.

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cordance with a procedure described by Cooper and Jacob (1946). The transmissibility was determined by use of the equation

$$T=\frac{263.9Q}{\Delta s}$$

where T is transmissibility in gpd per foot, Q is discharge of the pumped well in gallons per minute, and Δs is the change in drawndown in an observation well over one logarithmic cycle (drawdown plotted against time on semilogarithmic paper, with time on the logarithmic scale). During the test the average joint discharge from the Union Oil Co. wells was about 2,150 gpm and the change in drawdown in well 31E4 was about 0.97 foot during one logarithmic cycle Thus, the indicated transmissibility is about 600,000 gpd per foot. The thickness of the water-bearing deposits tapped at well 31E4 is 425 feet, indicating a permeability of about 1,400 gpd per square foot.

The transmissibility and permeability of the Silverado water-bearing zone in the reach between Wilmington and Torrance were determined from the fluctuation of pressure level in well 4/14–13F1, near Torrance, during the pumping of wells 4/13–30G1 and 4/13–30K1 (city of Los Angeles, Lomita plant wells 6 and 7), 12,000 feet to the southeast, in Wilmington. The hydrograph for well 4/14–13F1 and the draft at the Lomita plant are shown elsewhere on figure 6. A time-drawdown graph was constructed as described for the pumping test of the Union Oil Co. wells near Bixby Slough. The average joint rate of discharge from wells 4/13–30G1 and 4/13–30K1 from April 19 to May 2, 1944, was 4,340 gpm. The change in drawdown in well 4/14–13F1 was about 1.41 feet during one logarithmic cycle. Thus, utilizing the equation for obtaining transmissibility given in the preceding paragraph, the indicated transmissibility is about 813,000 gpd per foot. The average thickness of the Silverado water-bearing zone between the pumped wells and observation well 4/14–13F1 is about 400 feet, indicating a permeability of about 2,000 gpd per square foot. This test is considered to furnish a more accurate and more representative value for the permeability of the Silverado water-bearing zone between Torrance and Long Beach than the test at Bixby Slough, because the latter pumping test was made in an area where physical texture, thickness, and permeability of the Silverado water-bearing zone are believed to change between the pumped wells and the observation well—whereas between Wilmington and Torrance the physical character and thickness are reasonably uniform. Also, the Silverado water-bearing zone wedges out on the flank of the Palos Verdes Hills about 4,000 feet southwest of the Union Oil Co. wells and about 10,000 feet southwest of wells 4/13–30G1 and 4/13–30K1. Thus, for the pumping test at the Union Oil Co. wells, the cone of

pressure relief must have extended rapidly to the non-water-bearing rocks, resulting in distortion during subsequent growth of the cone. On the other hand, the cone surrounding wells 4/13–30G1 and 4/13–30K1 would reach well 4/14–13F1 about as soon as it impinged upon the non-water-bearing rocks and the distortion would have little if any effect on drawdown in well 4/14–13F1, which is about 3.4 miles distant from the south boundary of the basin.

At the Centinela Park well field of the city of Inglewood the permeability of the water-bearing beds of the San Pedro formation—beds essentially correlative to the Silverado water-bearing zone—has been determined from the fluctuation in observation well 2/14–27D1 (city of Inglewood, well 7) during the pumping of well 2/14–22N2 (city of Inglewood, well 9). The hydrograph for well 2/14–27D1 is shown on figure 7. Utilizing the time-drawdown graph and applying the formula of Cooper and Jacob (p. 54), the transmissibility has been estimated at about 55,000 gpd per foot. The saturated thickness of water-bearing beds was about 50 feet at the time of the test. Thus, the permeability here is about 1,100 gpd per square foot.

For the extent of the water-bearing zones of the San Pedro formation in and near the Ballona Gap—zones correlative with the Silverado water-bearing zone in age and physical character—table 6 gives the yield characteristics of eight wells.

TABLE 6.—*Yield characteristics of eight wells tapping the San Pedro formation in the vicinity of Ballona Gap*

Well	Depth (feet)	Water-yielding zone or zones		Yield characteristics			
		Depth range (feet)	Thickness (feet)	Yield (gallons per minute)	Drawdown (feet)	Specific capacity [1]	Yield factor [2]
2/14-4N1	300	118-219	66	1,010	31	33	50
7P2	265	112-187	18	550	75	7.3	41
23H2	827	449-796	136	3,050	40	76	56
2/15-11D2	480	198-340	114	345	24	14	12
11E3	405	196-376	169	1,125	17	66	39
11E5	452	217-430	181	1,155	36	32	18
11F4	380	168-346	176	1,805	32	56	32
34K1	208	91-133	42	355	21	17	40
Average	415		113	1,174	35	38	36

[1] Gallons per minute per foot of drawdown.

[2] Yield factor = $\frac{\text{Specific capacity} \times 100}{\text{Thickness of aquifer, in feet}}$

As shown by this table, the average yield of the 8 wells is 1,174 gpm, almost identical to the average yield for the 39 wells tapping the Silverado water-bearing zone to the south. The yield factor for the 8 wells is 36, as compared to a factor of 46 for the 39 wells of table 5. Thus, it is concluded that the permeability of the water-bearing

beds in the San Pedro in the vicinity of Ballona Gap is somewhat lower than that of the Silverado water-bearing zone, probably about three-quarters as great.

STRATIGRAPHIC RELATIONS

The rocks overlying and underlying the San Pedro formation are separated from it by unconformities. The unnamed upper Pleistocene deposits apparently were laid down after some folding of the San Pedro formation had occurred along the Newport-Inglewood uplift, and are inferred to overlie the San Pedro unconformably at places along this uplift. Subsequent to their deposition, parts of these upper Pleistocene deposits and parts of the San Pedro formation were eroded during the development of the upper Pleistocene marine (Palos Verdes) surface. Therefore, the Palos Verdes sand, which was deposited on this surface, doubtless is locally unconformable on the unnamed upper Pleistocene deposits, and in some places, as at Signal Hill and at the intersection of Lincoln Boulevard and the Ballona escarpment, it rests directly on the San Pedro formation.

The Tertiary rocks underlying the San Pedro formation are reported by Woodring (1946, p. 109, and pl. 1) to be unconformable with it wherever the relations have been clearly exposed in the Palos Verdes Hills area. Here the Pico formation of late Pliocene age is missing and the San Pedro formation rests in part on lower Pliocene and upper Miocene rocks.

Throughout the remainder of the Torrance-Santa Monica area, with the exception of the Baldwin Hills, the contact of the San Pedro formation with the underlying Tertiary rocks is concealed. Unconformities are more likely to be present along the Newport-Inglewood belt than beneath the Torrance or Downey plains. Structural activity along this zone, if it took place during or after the deposition of a group of rocks, could rarely avoid causing a break in the sedimentation and would be registered as an unconformity within that group or between it and the overlying younger deposits. Wissler (oral communication) believes that activity along the Newport-Inglewood belt began in early upper Miocene time, and he infers (Wissler, 1943, p. 231) that there is an unconformity between the Pico and San Pedro formations in the Dominguez and Rosecrans fields.

The Tertiary rocks (upper division of the Pico formation) in the Baldwin Hills area are exposed at several places and are cut by the main Inglewood fault into an eastern and a western block. Driver (1943, p. 308) states that "the Pleistocene is conformably deposited over the Pliocene in the western block, but is unconformable in the eastern block."

During excavation for a storm drain, east of Culver City and one-third of a mile north of the Baldwin Hills, in 1936, Natland [4] found that the Tertiary strata were separated by an unconformity from the overlying sands of the San Pedro formation.

TERTIARY SYSTEM

PLIOCENE SERIES

GENERAL FEATURES

In most of the area shown on plate 2, strata of Tertiary age underlie the Quaternary rocks. They crop out at the surface only in the flanks of the Santa Monica Mountains and in the Baldwin and Palos Verdes Hills. These rocks consist chiefly of marine silt and sand, containing only local lenses of gravel.

The Pliocene series is subdivided on the basis of microfauna into two formations in the Los Angeles basin—the Pico above and the Repetto below. The Pico formation, although absent from the geologic column in the Palos Verdes Hills, is present throughout the remainder of the Torrance-Santa Monica area and so is underlain by the Repetto formation.

The Pico formation has been divided by stratigraphers into upper, middle, and lower divisions on the basis of distinct microfaunal assemblages (Wissler, 1943, p. 212–213). For the purposes of the present investigation, a discussion of the upper division of the Pico formation and its water-bearing characteristics is pertinent, because the relatively permeable sand members in the lower part of the upper division generally contain essentially fresh ground water. In much of the area shown on plate 2, the base of the main fresh ground-water body is approximately at the base of the lowest of these upper Pico sand members (p. 86 and pl. 8).

Because permeable sand beds in the middle and lower divisions of the Pico formation within the project area contain only connate saline water, those divisions will be treated only briefly here; they are discussed in detail in many reports on the petroleum geology of the Los Angeles basin.

PICO FORMATION, UPPER DIVISION

PHYSICAL CHARACTER AND THICKNESS

The upper division of the Pico formation consists of semiconsolidated sand and micaceous silt and clay of marine origin. Locally, beds of fine gravel occur in the upper part of the division, presumably also of marine origin.

The upper division of the Pico formation underlies all the area shown on plate 2 except the south flanks of the Santa Monica Mountains

[4] Natland, M. L., unpublished data from Shell Oil Co., 1936.

and the northern border of the Palos Verdes Hills. The only known exposures of this upper division are in the northern sector of the Baldwin Hills, where they occur as buff siltstone and buff fine silty sand or sandstone with limonitic clayey partings and limonitic concretions. The exposures in these hills are not differentiated on plate 2 from the rocks of lower Pliocene and Miocene age.

Hoots (1931, p. 116) reported that the upper part of the Pliocene section which is exposed about 2 miles outside the west boundary of the area, in Potrero Canyon, "is equivalent to a part of the Pico formation exposed at its type locality in Pico Canyon."

Along the Newport-Inglewood structural zone and in the west basin, the upper few hundred feet of the upper division is composed chiefly of silt and clay. Beneath the Baldwin Hills, according to Wissler (1943, p. 213), most of the entire upper division of the Pico is silt. To the north the character of the upper division of the Pico is not known. However, in almost all of the area south and southeast of the Baldwin Hills, the lower 600 to 1,000 feet of the upper division includes several beds of fine- to medium-grained sand and sandstone and, locally, beds of fine gravel. The geologic sections, plates 3*A* and 4 to 6, show the general disposition of these permeable zones as revealed in a few cored wells and as inferred from electric logs.

These coarser beds commonly range from 25 to as much as 100 feet in thickness, and are separated by beds of massive micaceous siltstone. Thus, about 2.5 miles southeast of Dominguez Hill, well 4/13–17D1 reached the upper division of the Pico from 683 to 1,701 feet below land surface (Poland, Piper, and others, 1956, p. 87, 143). In this well the sand occurs in 10 layers totaling 282 feet—about 28 percent of the thickness. The casing of this well was never perforated, so neither the yield of the deposits nor the chemical character of the water is known.

Well 4/13–12A2 (city of Long Beach, North Long Beach well 6), about a mile northeast of the Newport-Inglewood uplift and a mile east of the Los Angeles River, was drilled to a depth of 1,955 feet, cutting through about half the upper division from 726 feet to the bottom. (See log, table 28.) Within this depth interval, the drillers reported nine water-bearing beds, totaling about 240 feet, or about 20 percent of the top half of the upper division of the Pico, which consist of fine sand and fine gravel with some clay.

Well 3/14–17J1, an oil-test hole about a mile southwest of Hawthorne cut through the entire thickness of the upper division, beginning at about 500 feet below land surface. The electric log indicated fresh-water-bearing sand between 1,110 and 1,320 feet. Three other beds of sand, each about 50 feet thick, were reached in this well between 1,750 and 2,100 feet, but these lower sand members, near the

base of the upper division, are inferred to contain brackish water (pl. 8). A pumping test, made to determine the productivity and the quality of the water in the sand member between 1,110 and 1,320 feet, is described on page 61.

Inland from the Newport-Inglewood uplift, in the area northeast of Dominguez Hill, the deposits of the upper division of the Pico are not tapped by water wells, so far as known. However, electric logs and samples from a few oil-test holes on the Downey plain indicate that this section of the upper division of the Pico formation is almost entirely of marine origin and of the same general character as its west basin equivalent.

Within the area shown on plate 2, the upper division of the Pico formation ranges in thickness from 1,800 feet beneath Dominguez Gap at the southeast end of the Dominguez anticline to feather edges against the uplifts of the Santa Monica Mountains and the Palos Verdes Hills. As shown on plate 7, the thickness is about 1,000 feet at Playa del Rey; 1,300 feet at the El Segundo oil field, and 1,100 feet at the Torrance oil field; about 900 feet at the Inglewood oil field, in the Baldwin Hills; about 1,200 feet southeastward along the Newport-Inglewood uplift at the Rosecrans oil field; 775 feet at the crest of Dominguez Hill, and 1,440 feet at the northwest end of the Long Beach oil field. Inland, beyond the area shown on plate 2, the upper division probably increases in thickness to much more than 2,000 feet beneath the central Downey plain.

STRATIGRAPHIC RELATIONS

At least locally, the upper division of the Pico was deposited on a surface of unconformity. However, throughout much of the Torrance-Santa Monica area, data are insufficient to determine with assurance the stratigraphic relation of the upper division to the underlying older rocks. Furthermore, the relations of this upper division to the overlying Pleistocene rocks are uncertain in many places.

In the Torrance-Wilmington area relations are well established and, according to Wissler (1943, p. 213), the upper division overlaps the middle division of the Pico; in the Long Beach harbor district of the Wilmington oil field it rests directly on the Repetto formation of early Pliocene age. At the north border of the Palos Verdes Hills, where the San Pedro rests locally on the Repetto and on rocks of Miocene age, the upper division of the Pico is absent.

Along the Newport-Inglewood uplift, an unconformity between the upper division of the Pico and the San Pedro formation in the Rosecrans and Dominguez oil fields was inferred by Wissler (1943, p. 212), because of the apparent absence in these fields of the Timms Point fauna, which occurs at the Seal Beach oil field.

Inland beyond the Newport-Inglewood uplift, beneath the Downey plain, it is likely that no unconformity exists and that sedimentation took place almost continuously from late Pliocene into Pleistocene (San Pedro) time.

WATER-BEARING CHARACTER

Within most of the area shown on plate 2, except beneath and north of the Baldwin Hills, the upper division of the Pico formation contains layers of semiconsolidated sand which should yield substantial quantities of essentially fresh water to wells of adequate construction. The productivity of these sand layers in this area can be inferred from pumping tests at two wells and from a laboratory test of permeability of the sand from a third well, as described beyond.

Information derived largely from electric logs of oil wells and prospect holes suggests that, in much of the area covered in this report, the water in these sand members of the upper division of the Pico is either fresh or suitable for certain industrial uses.

The position of the top of the transition zone between fresh and saline ground water has been ascertained from the electric logs of representative oil wells and prospect holes. Contours drawn on the top of the transition zone are presented on plate 8, these contours mark the approximate position of the base of the principal fresh-water body, as defined elsewhere in this report. Although correlation between oil fields in this region is precarious because of the usually pronounced lateral variation in lithology (Wissler, 1943, p. 234), the group of sand members generally prevalent in the lower part of the upper division of the Pico can be traced from one field to another; this general lithologic correlation is supported by studies of the foraminiferal assemblages. A comparison of the position of the top of the transition and of the base of the upper division, as determined by micropaleontologists, shows that they almost coincide in this region. Notable exceptions are at the Potrero oil field, where the top of the transition zone is as much as 400 feet above the base of the upper division of the Pico; and at the west end of the Torrance oil field, in the Redondo Beach area, where the transition to saline water is 300 feet above the base of the upper division. In these two areas, and also locally in the Wilmington oil field, one or more of the lowest sand members ascribed to the upper division contain connate saline ground water.

With respect to specific information on water-bearing characteristics of the upper division of the Pico formation, some data are available as a result of two recent attempts to construct wells that penetrated the fresh-water sands of this formation.

One of these wells, 3/14–17J1, about a mile southwest of Hawthorne, was initially a "wildcat" oil well drilled to a depth of 4,200 feet by the

Loren L. Hillman Co., Inc., and designated "West Hawthorne No. 1." This well was utilized by the Standard Oil Co. of California in 1946 to test the aquifers in the upper division of the Pico formation with respect to quality of the water and productivity of the sands. The electric log indicated a permeable zone containing essentially fresh water from 1,120 to 1,320 feet below the land surface. To test this zone, the hole was plugged off below a depth of 1,294 feet. A double liner with an outer-pipe diameter of 8⅝ inches and an inner-pipe diameter of 7¾ inches, prepacked with gravel between the two pipes, was landed at 1,294 feet and extended into the 11¾-inch casing set at 849 feet. The prepacked liner was perforated from 1,089 to 1,294 feet, opposite the permeable zone.

An initial bailing test was made on this well late in May 1946, at an estimated rate of 25 gpm for about 24 hours. After 20,000 to 30,000 gallons was bailed, the chloride concentration was about 120 ppm. The apparent static level then was about 119 feet below land surface, or about 38 feet below sea level, and the drawdown was about 38 feet after the water became relatively clear.

Subsequently, a pump was installed and a yield test was made by the Standard Oil Co. on August 1–4, 1946. The static level before the test was 111 feet below the land surface, or 30 feet below sea level. The pump bowls were set 400 feet below the land surface. The water yielded during the test contained a large amount of fine sand as well as particles of colloidal size; it was still turbid after standing several days. The maximum yield was at a rate of about 25 gpm; but this yield is not indicative of the productivity of the zone because the liner presumably filled with sand early in the test. At the end of the test, sand filled the casing to 728 feet below the land surface, about 360 feet above the top of the perforations.

In the latter part of August 1946 the sand was removed from the casing and a bailing test was made. The maximum rate of bailing was reported to be about 50 gpm with a drawdown of 50 feet. At the end of the bailing test, when the drawdown was 38 feet, the water level recovered 35 feet in 20 minutes. Large quantities of sand were removed from the well during this bailing test. The company decided that further tests were not warranted and the well was abandoned.

Chemical analyses of water collected during the pumping test and in the final bailing test were made by the Standard Oil Co. (see table 30). The quality of the water is discussed on page 183.

Although the tests made on well 3/14–17J1 were unsuccessful from the standpoint of yield, it is believed that a well constructed to exclude sand, such as a gravel-packed well of 24- to 30-inch diameter with an envelope of fine gravel or coarse sand, probably would yield several times as much water as was obtained during this test. The prepacked

gravel liner utilized for the test was only 8⅝ inches in outside diameter and the gravel screen was less than half an inch thick.

The other type of the two wells tapping the sand members of the upper division of the Pico on which yield-test data are available is a water well drilled by the city of Long Beach in the spring of 1946—well 4/13–12A2 (city of Long Beach, North Long Beach well 6)—about 6 miles north of the business district of Long Beach. Drilled to a total depth of 1,955 feet, the well penetrated about 1,200 feet into the upper division of the Pico—or about 50 percent of the total depth range of the sand zones containing fresh water in the upper division at that locality (see log, table 28). A 26-inch casing was set to a depth of about 360 feet and a 16-inch casing to 1,955 feet; the latter casing was perforated from 1,805 to 1,955 feet. The well flowed 106 gpm. The water was dark brown and had a temperature of 104° to 106°F. Sufficient methane was present to burn continuously when ignited at the open casing.

On October 7, 1947, a yield test was made on this well and the yield was estimated at 400 gpm, with a drawdown of about 60 feet from a static level about 15 feet above land surface, or 53 feet above sea level. Thus the specific capacity was about 7 gpm per foot of drawdown.

Although the content of dissolved solids was moderate (see chemical analysis, table 30), the water was not considered suitable for public supply because of its high temperature and dark color. The cost of treatment to make the water suitable for use was considered too costly, and the well was abandoned.

During the drilling of the well, samples were collected by the city at each change in character of the material, and at 10-foot spacings below 1,470 feet. In the laboratory of the field office of the Geological Survey at Long Beach, permeability tests were made on samples from four of the coarser zones within the depth range of the casing perforations. Coefficients of permeability for these four zones, as determined in the laboratory, are as follows: at 1,890 feet below land surface, fine to coarse sand, some fine gravel, 454 gpd per square foot; 1,900 feet—fine to coarse sand, some silt, little fine gravel, 212 gpd per square foot; 1,910 feet—silty sand and gravel, pebbles as large as ½ inch in diameter, 20 gpd per square foot; 1,940 feet—silty fine to medium sand, 16 gpd per square foot.

Additional information on the permeability of the upper division of the Pico was obtained from well 3/14–8N3 (Richfield Leuzinger well 1), which was drilled by the Richfield Oil Corp. about 2 miles east of El Segundo to test the oil and gas possibilities of the Pico formation. Through the courtesy of this company, a sample of sand from a permeable zone in the upper division of the Pico formation between 1,220 and 1,240 feet below land surface was made available to the Geological

Survey. A laboratory test indicated a permeability of 242 gpd per square foot. A mechanical analysis of this sand gave the composition tabulated below, indicating that the size ranges from fine gravel to very fine sand, but that 34 percent is medium sand.

Mechanical composition (millimeters)	*Percent of dry weight*
Fine gravel (more than 1.00)	2.3
Coarse sand (1.00 to 0.5)	24.6
Medium sand (0.5 to 0.25)	34.0
Fine sand (0.25 to 0.125)	31.1
Very fine sand (0.125 to 0.05)	8.0

Information summarized on preceding pages suggests that the production of water from the upper division of the Pico formation within or near the west basin would require wells of substantial depths, probably as much as 1,500 feet on the average. Also, the sand members of the upper division are fine grained and wells of special construction—with a thick gravel pack or a carefully selected screen—would be required to withdraw water effectively. Such wells would be much more expensive than the water wells now utilized in the area. At some places, especially along and near the crest of the Newport-Inglewood uplift, yields of as much as 1,000 gpm might be obtained locally with a drawdown of not more than 100 feet. Within most of the west basin, however, it is doubtful that yields would exceed a few hundred gallons per minute with such a drawdown.

Although yields from the upper division might be substantial along the Newport-Inglewood uplift, it is concluded that the color of the water probably would be amber to dark brown and thus the water probably would require treatment for domestic use, even though the chemical quality should prove to be satisfactory. This color is presumed to be caused by organic matter in colloidal suspension. It is believed that coloring by organic matter would not be excessive within most of the west basin, but the water might be turbid, similar to the water of well 3/14–17J1, and might require treatment.

The temperature of waters withdrawn from the upper division of the Pico ranged from 90° to 110°F. Therefore, these waters probably would have to be cooled for domestic use although such temperatures might not be objectionable for some industrial uses.

For wells tapping the upper division along the Newport-Inglewood uplift but inland from the west basin boundary, the static level would be above the current water levels in the Pleistocene water-bearing zones, and at places where the altitude of land surface is low, as at well 4/13–12A2, the wells would flow.

Wells tapping the upper division of the Pico formation within the west basin probably would register initial pressure levels ranging from

sea level to possibly as much as 40 feet below sea level. Thus, to yield substantial quantities of water even from wells of special construction, initial pumping levels probably would be about 100 feet or more below sea level. Because replenishment to the water-bearing beds of the upper division in the west basin is inferred to be small or negligible, pressure levels presumably would decline fairly rapidly if large quantities of water were withdrawn from the sands of the upper division.

The water-bearing beds in the upper division of the Pico within the west basin contain a large quantity of water. If the average aggregate thickness of the sand layers containing essentially fresh water is approximately 200 feet, and the area is about 120 square miles, an assumed effective porosity of 25 percent would indicate storage of about 3 to 4 million acre-feet. If replenishment is negligible, as seems likely, only a small part of this quantity could be withdrawn without lowering pumping levels far below sea level. Because exploratory and well-construction costs would be high, the water yielded from the upper division of the Pico would cost substantially more per acre-foot than the ground water now yielded by wells in the west basin. Extensive development of the water in the water-bearing beds of the upper division to abate the current overdraft in the west basin does not offer a permanent solution to the water-supply problems of the basin.

PICO FORMATION, MIDDLE AND LOWER DIVISIONS

The middle and lower divisions of the Pico formation do not crop out within the area shown on plate 2. As determined from cored samples from oil-test holes, they comprise interbedded sandstone, claystone, siltstone, and shale. According to Wissler (1943, p. 214–215), the percentage of sand in the middle Pico averages about 40 percent for the oil fields within the Torrance-Santa Monica area; on the other hand, the lower division of the Pico contains about 60 percent of sand.

Among the oil fields within the area, the combined thickness of the middle and lower divisions ranges from about 400 feet at the Torrance oil field to more than 1,700 feet at the Potrero field (pl. 7), although somewhat greater thicknesses presumably occur in the basin areas between the structurally high oil fields.

In the Torrance-Wilmington area the lower division is overlapped by the middle division, the latter resting with angular discordance on the Repetto formation of early Pliocene age (Wissler, 1943, p. 215). Along the north border of the Palos Verdes Hills, the entire Pico and in many places the Repetto are overlapped by the San Pedro formation of lower Pleistocene age (Woodring and others, 1941, p. 40–41).

Elsewhere within almost all the Torrance–Santa Monica area and south of the Santa Monica Mountains, both the middle and lower divisions of the Pico formation are present and are essentially conformable with each other and with the overlying upper division and the underlying Repetto.

Within the area shown on plate 2, the water in the sand zones of the middle and lower divisions of the Pico formation is believed to be saline. However, inland beneath the Downey plain, electric logs from scattered "wildcat" oil wells indicate that essentially fresh water is contained in the sandier zones of the middle division of the Pico.

OLDER ROCKS OF TERTIARY AGE

Underlying the Pico formation in the Torrance-Santa Monica area are sedimentary rocks of lower Pliocene (Repetto formation) and of Miocene age. Lithologic descriptions of these rocks and their known range in thickness are given in table 3. Their distribution and thickness in the several oil fields of the area are summarized in plate 7. They include most of the oil-producing zones of the Los Angeles basin area and thus have been treated in detail in many reports concerned with the production of the oil resources of this area; however, they do not contain fresh water. The reader who desires information about these older formations is referred to the selected references given in an earlier report (Poland, Piper, and others, 1956, p. 93).

PRE-TERTIARY ROCKS

The pre-Tertiary rocks that crop out within the Torrance-Santa Monica area are generally considered to be of Mesozoic age. All are non-water-bearing and are briefly described here merely to complete the stratigraphic sequence.

As shown on plate 2, the pre-Tertiary rocks crop out only locally along the south border of the Santa Monica Mountains. According to Hoots (1931, p. 88–93), they are represented by the Santa Monica slate of Triassic(?) age, a Jurassic(?) igneous intrusion of granite and granodiorite, and the upper Cretaceous Chico formation consisting of conglomerate, sandstone, and shale. The Chico formation, where it occurs in the area, was not differentiated by Hoots from the Martinez formation of Paleocene age because of a dense covering of brush and unexposed structural complications.

In the Palos Verdes Hills, the pre-Tertiary rocks constitute a metamorphic complex which forms a central core, which crops out only in a limited area on the northern slope of the hills about a mile south of the southern boundary of the area mapped on plate 2. These rocks consist of quartz-sericite, quartz-talc, and quartz-glaucophane schist and altered basic igneous rocks which have been ascribed by

Woodford (1924, p. 62) to a correlative of the Jurassic(?) Franciscan group of the Coast Ranges. However, because there are no unaltered sedimentary rocks among these schist beds, Woodford considered the alternative that they might be older than the Franciscan—a possibility which also has been emphasized by Taliaferro (1943, p. 122–125).

GEOLOGIC STRUCTURE

REGIONAL FEATURES

The thick sequence of sedimentary rocks underlying the coastal plain has been deposited in a broad synclinal depression often referred to as the Los Angeles basin. In the structurally deepest part of the basin, beneath the central part of the Downey plain, the rocks of Tertiary and Quaternary age probably are more than 20,000 feet thick. Along the north and northeast margins of the basin, and locally to the southwest at the Palos Verdes Hills, these rocks have been extensively elevated, folded, faulted, and eroded, to expose a complex of igneous and metamorphic rocks (pl. 1).

The general synclinal structure of the basin is interrupted by the composite faulted anticlinal belt that extends southeastward from the Beverly Hills to Newport Beach—the Newport-Inglewood uplift. In effect, this uplift divides the coastal plain into two synclinal troughs. To the northeast, a broad syncline underlies the Downey plain and extends southeastward from the north flank of the Baldwin Hills through Huntington Park and continues into Orange County. To the southwest, a relatively narrow syncline extends from Santa Monica to Long Beach and forms the structural trough known as the west basin.

The Tertiary and Quaternary rocks dip gently inland and coastward from the crest of the Newport-Inglewood uplift. Along the synclinal axis within the west basin, their thickness ranges from a few thousand to as much as 13,000 feet. Here they overlie a schist basement complex which has been reached by many oil wells (White, 1946; also see Schoellhamer and Woodford, 1951). Southwest beyond the syncline, these rocks are warped over the Torrance-Wilmington anticlinal structure and are flexed sharply upward into the Palos Verdes Hills. Along the north flank of the Palos Verdes Hills, a deep fault is indicated by data from oil-prospect holes, but the Pleistocene rocks at the land surface are not ruptured (Woodring, 1946, p. 110, pls. 1 and 21; Schultz, 1937, fig. 4) except in the local area southeast of Redondo Beach (pl. 2).

Within the Newport-Inglewood uplift and in the two flanking synclines, all rocks older than the alluvial deposits of Recent age are deformed. Also, because the rocks have been deformed recurrently

since Miocene time, the flexure in the Pleistocene rocks is reflected with increasing amplitude in the rocks of Pliocene and late Miocene age. As shown by the contours on the base of the water-bearing zones of Pleistocene age (pl. 2), however, much of the structural deformation has occurred since the time of early San Pedro deposition, chiefly during the so-called mid-Pleistocene revolution, which took place after deposition of the San Pedro formation.

NEWPORT-INGLEWOOD UPLIFT

GENERAL FEATURES

The Newport-Inglewood uplift is a regional anticlinal fold broken by echelon faults, and extending northwestward from the Newport Mesa to the Beverly Hills, a distance of 40 miles. Throughout its extent within Los Angeles County, it is marked at the surface by the common alinement of Signal, Dominguez, Rosecrans, Baldwin, and the Beverly Hills. The continuity of these five hills is broken by two erosional gaps—Dominguez and Ballona Gaps (pl. 8).

Superimposed on this regional anticlinal structure are successive closed anticlines or domes and intervening structural saddles. The domes and, to a lesser degree, the saddles are broken by discontinuous normal and reverse faults arranged in echelon, many of which do not reach the land surface.

According to Wissler, the Newport-Inglewood uplift has been a zone of structural activity since Miocene time. Stratigraphic evidence has been presented that indicates recurrent movement along the zone during later Tertiary and Quaternary time. Recent major earthquakes—the Inglewood earthquake of 1921 and the Long Beach earthquake of 1933—and a minor earthquake in 1941, which damaged several oil wells in the Dominguez oil field, indicate that the zone is still active.

The folds and faults along the Newport-Inglewood uplift at the inland boundary of the west basin form a substantial if discontinuous barrier to water movement from the main (central) coastal basin to the west basin. For example, the crestal position of the impermeable rocks at the base of the water-bearing zones of Pleistocene age determines the depth of the lip below which water cannot pass into the west basin. The depth of this lip in the reach south of the Baldwin Hills has been shown on plate 3*A*. Also, the discontinuous faults along the uplift have produced ground-water barriers that partly restrain the coastward movement of ground water. This restraint has been produced to a small degree by displacement of water-bearing zones but it is chiefly due to cementation, which has developed along the fault planes. Thus, both folds and faults are critical features in an appraisal of the problem of replenishment to the west basin.

FOLDS

Four domal uplifts along the Newport-Inglewood structural zone in the Torrance-Santa Monica area are topographically expressed in order from the southeast by Dominguez, Rosecrans, Baldwin, and the Beverly Hills, respectively. Oil fields have been developed on each of these hills: the Dominguez oil field; the Rosecrans and Potrero fields (near the south and north ends) of the Rosecrans Hills, respectively; the Inglewood field on the Baldwin Hills; and the Beverly Hills field. Consequently, because of the studies incident to the development of each field, much information is available on their subsurface geology.

In general, the land-surface contour of the several domal folds is a moderate replica of the subsurface structure, although the initial land surface on the hills has been modified by erosion.

The structure at Dominguez Hill has been described as follows (Poland, Piper, and others, 1956, p. 96):

> The most regular domal structure underlies Dominguez Hill, whose general outer form reflects the deeper structural pattern in a subdued degree. Thus, whereas the crest of Dominguez Hill is only about 150 feet above the surrounding plains, the structural relief at the base of the Pleistocene is about 400 feet. [See pl. 2.] According to Grinsfelder (1943, p. 318), mapping on successive stratigraphic horizons indicates that the effect of the tectonic forces was progressively greater at increasing depth, and that "mapping on horizons as deep as 4,000 feet reveals an elliptical anticline with a northwest-trending axis, steep flanks on the southwest, with dips of from 15° to 20°." Thus the structural development of this anticline has gone on recurrently through much of Tertiary and Quaternary time.

The Rosecrans Hills comprise an irregular low swell about 3 miles wide and 8 miles long extending from Dominguez Hill northwestward to the Baldwin Hills.

Near the south end of the hills, structure contours at a depth of about 4,000 feet reveal three small domes with a northwest alinement which constitute the Rosecrans oil field (Musser, 1925). Musser has inferred that the three domes are separated by minor faults trending northeastward. At shallow depth the inferred faults apparently are absent, and the attitude of the base of the Pleistocene water-bearing zones, about 200 feet below sea level, assumes a somewhat irregular elliptical shape. The inland and coastward dip of the base of these water-bearing zones is about 2° to 3°.

At the north end of the Rosecrans Hills, the steeper western slope has a nearly straight topographic break parallel with the long dimension of the hills which marks the surface trace of the Potrero fault (see p. 72). This fault passes through the center of the structure on which the Potrero oil field is developed (Willis and Ballantyne, 1943, p. 310)—an elongated dome whose long axis trends about N. 65°

W. The top of the producing zones, at the highest part of the dome, is about 3,000 feet below the land surface. At this depth the dips average 8°, whereas at the base of the Pleistocene water-bearing zones, about 250 feet below the surface (pl. 3*A*), the dips are much gentler—from about 1° to 2°. Impermeable beds underlie these water-bearing zones at a depth of about 50 feet below sea level.

The most pronounced and complex uplift along the Newport-Inglewood structural zone, at the Baldwin Hills, consists of a northwestward-trending dome, whose central crest has been dropped between two fault zones (Driver, 1943, p. 308). Of these two fault zones, the easterly one is known as the Inglewood fault (pl. 2). At the depth of the upper oil zone, about 900 feet below sea level, the crest of the dome underlies the SW¼ sec. 8, T. 2 S., R. 14 W., which is about half a mile west of the topographic summit of the Baldwin Hills. The peripheral outward dips generally are less than 20°, except at the northwest edge of the hills, where the dip is 35° to the west (Driver, 1943, p. 308). The uplift is greatest at the northern part of the hills, where the upper division of the Pico formation crops out at the surface (pls. 2, 3*A*). Within most of the Baldwin Hills area, the base of the permeable beds of Pleistocene age is above sea level; these beds are non-water-bearing.

The Beverly Hills constitute the northernmost of the domal structures which mark the Newport-Inglewood uplift. It is a triangular asymmetric dome underlying the northern part of the hills and is elongated in an east-west direction (Hoots, 1931, p. 132–133 and pl. 34); the closure on this structure trapped the oil produced at the small Beverly Hills oil field in the years following 1908. The oil field is now of little importance as a producer. At the oil zone, 2,500 feet below sea level, the dips on the north flank are from 15° to 20°, and are nearly 45° on the south flank. Along the crest of the Beverly Hills, the base of the water-bearing beds of Pleistocene age is less than 200 feet below land surface and from a few feet to as much as 100 feet above sea level.

FAULTS

In the area shown on plate 2, the Newport-Inglewood structural zone is broken by four known major faults which, in order from the southeast, are the Cherry-Hill, the Avalon-Compton, the Potrero, and the Inglewood faults. As shown on plate 2, these faults are arranged in echelon, and strike, generally, more northward than the trend of the zone as a whole.

CHERRY-HILL FAULT

The Cherry-Hill fault, which has a known extent of about 5 miles from the east side of Dominguez Gap to and beyond the southwest

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flank of Signal Hill, has been discussed in some detail in an earlier report (Poland, Piper, and others, 1956, p. 98). Only the northwestern part of this fault is within the area shown on plate 2.

The Cherry-Hill is a reverse fault, dipping northeast. Land-surface displacement ranges from more than 100 to 40 feet along the southwest flank of Signal Hill, diminishing northwestward. Near the east edge of sec. 24, T. 4 S., R. 13 W., at the east boundary shown on plate 2, the throw or vertical displacement is about 150 feet (Stolz, 1943, p. 321) at a depth of more than 4,000 feet in lower Pliocene rocks. Extension of the fault northwestward across Dominguez Gap (pl. 2) is based upon information obtained during drilling or prospecting for oil, and from an apparent hydraulic discontinuity in the Silverado water-bearing zone (pls. 9–12). The fault probably transects all the deposits of Pleistocene age but does not cut the deposits of Recent age.

FAULTS IN THE DOMINGUEZ HILL AREA

So far as known, no faults are present in the surface or near-surface deposits in the Dominguez Hill area. Grinsfelder (1943, p. 318) states that the effects of faulting become evident below 4,000 feet, presumably in the Repetto formation of early Pliocene age. From subsurface studies, Bravinder (1942, p. 390) reported two sets of faults: (1) high-angle faults striking obliquely across the long axis of the dome and (2) south-dipping lower angle thrust faults striking nearly parallel to the axis. Horizontal movement is evident in the oblique set, and the throw is greatest in the Miocene rocks.

Although faults are not known in the Pleistocene deposits along the crest of Dominguez Hill, water levels in wells tapping those deposits indicate a substantial hydraulic discontinuity across the axis of the Dominguez anticline, because water levels on the southwest are from 20 to 40 feet lower than those on the northeast (pls. 9–12). The position of this ground water barrier is only roughly defined by the water-level data. The inferred barrier may be caused by near-surface effects of the faulting, which is known to have occurred at depth. These near-surface effects may be shear zones characterized either by many minor faults of small displacement, or by systems of tension and compression joints with little or no offset. In either case, it is believed that cementation along openings caused by these structures may have produced the ground-water barrier suggested by the differences in water levels. For a discussion of the mechanism of the formation of such cemented zones, the reader is referred to the report on the Long Beach-Santa Ana area (Poland, Piper, and others, 1956, p. 104 and 123).

AVALON-COMPTON FAULT

The land-surface trace of the Avalon-Compton fault is 2.25 miles long and extends northward from the NW¼ sec. 33, T. 3 S., R. 13 W., on the north flank of Dominguez Hill, to the NW¼ sec. 20, T. 3 S., R. 13 W., 0.1 mile west of the intersection of Rosecrans Avenue and Avalon Boulevard. The fault passes about 500 feet east of the intersection of Avalon Boulevard and Compton Avenue and is designated the Avalon-Compton fault in this report. The fault strikes N. 24° W.; the dip of the fault plane is not known. The trace of this fault has been taken along the topographic discontinuity shown on the Compton topographic sheet and is substantiated by hydrologic data. The average land-surface displacement is about 25 feet, with the dropped block on the southwest side. If this fault is similar to other faults along the Newport-Inglewood uplift, the throw at depth is considerably greater than the vertical displacement at land surface. Well logs are not available, however, to indicate the amount of displacement within the Silverado water-bearing zone, or at greater depth. As shown on plate 12, in November 1945 the water levels northeast of the fault were about at sea level, whereas those across the fault to the southwest were about 30 feet below sea level. This evidence demonstrates the effectiveness of the fault as a ground-water barrier.

FAULTING IN THE CENTRAL PART OF THE ROSECRANS HILLS

The central 4-mile reach of the Rosecrans Hills is beyond the inferred limits of the Avalon-Compton fault to the southeast and the Potrero fault to the northwest (pl. 2). This central reach has a relatively steep southwest flank, locally scarred by stream erosion. No rupture of the land surface can be noted. The Rosecrans oil field, which is about 3 miles in length, underlies the southern half of this central reach. The producing beds of the Rosecrans oil field are broken by a general northwestward-trending main shear zone and by many transverse faults, but none of these are known to pass upward into beds younger than the Repetto formation.

Although there is no geologic evidence of faults transecting the deposits of Pleistocene age, hydraulic continuity in these deposits is substantially impeded along the approximate position of the ground-water barrier shown on plate 2. So far as known, the most extensive measurements of depth to water in wells in the vicinity of this inferred barrier were made between 1930 and 1932. In 1932, one or more nearby wells became inaccessible. Accordingly, measurements of depth to water in 1931 have furnished the control for the position of the barrier as plotted. A straight line drawn to connect the extremities of the Avalon-Compton and the Potrero faults was

found to separate the higher water levels to the northeast from the lower water levels to the southwest. In November 1945, the water-level displacement across this central barrier was about 30 feet (pl. 12). The cause of this barrier is thought to be similar to the one suggested for the Dominguez Hill area; namely, cementation of shear zones, which are believed to be near-surface reflections of major faulting at depth.

POTRERO FAULT AND ASSOCIATED MINOR FAULTS

The trace of the Potrero fault, as shown on plate 2, extends about 4 miles northwestward from the west part of sec. 2, T. 3 S., R. 14 W., to the middle of sec. 16, T. 2 S., R. 14 W., in the eastern part of the Baldwin Hills, and passes through the Centinela Park well field of the city of Inglewood. The fault is marked at the surface by an escarpment about 50 feet high which extends along the west flank of the Rosecrans Hills for about 2.25 miles. At a depth of 3,000 feet, this fault bisects the dome on which the Potrero oil field is developed.

According to Willis and Ballantyne (1943, p. 310), at the Potrero oil field in sec. 34 the Potrero fault is a zone from 100 to 200 feet wide composed of several minor displacements. The general trend of the fault zone is N. 25° W.; the dip is about 82° to the west at depth, but lessens to about 77° at land surface. The throw at a depth of about 3,000 feet is about 270 feet, with the dropped block on the southwest; Willis states that the horizontal component of the displacement is the more important, because the axis of the dome southwest of the fault appears to have been shifted northwestward 1,200 feet relative to the axis northeast of the fault. At the base of the water-bearing zones of Pleistocene age a depth of about 300 feet below land surface, the throw is probably about 100 feet in the north half of 2/14–34 (pl. 2).

However, about a mile to the north in the Centinela Park well field of the city of Inglewood no vertical displacement across the Potrero fault is indicated by well logs. As discussed on page 139, the Potrero fault is a barrier to ground-water movement; therefore, the horizontal component of the displacement in these younger rocks, although presumed to be considerably less than that which is apparent at depth in the oil zones, must at least have been sufficient to produce fracturing and permit cementation. This barrier may be of a mechanical nature, caused by fracturing and pulverizing of the coarser material along the fault plane to form an impervious zone, or it may be a cemented zone similar to that indicated for other localities. Although it is likely that both processes have occurred, cementation is presumed to have caused the principal barrier features.

Between the Potrero fault on the east and the Inglewood fault on the west, in the 3.6-mile reach from Century Boulevard to Slauson Avenue, six transverse faults are shown on plate 2. The four southerly faults have been plotted about in the position indicated by Grant and Sheppard (1939, fig. 8, p. 321), as interpreted by W. S. W. Kew and Graham Moody, reportedly on topographic evidence (Driver, oral communication, January 1947). The two northerly transverse faults, in secs. 21 and 16, T. 2 S., R. 14 W., have been plotted on plate 2 as shown by Graham Moody on an unpublished geologic map of the Baldwin Hills, which was made available through the courtesy of the Standard Oil Co. of California. The three southerly faults are treated here, and the three to the north are discussed later with the Inglewood fault, which they appear to offset.

The most southerly of the inferred transverse faults, near the intersection of Crenshaw and Century Boulevards, is indicated by a land-surface displacement of 10–20 feet, and by a creek channel passing westward along this small topographic offset. No substantiating geologic evidence is known. However, in well 3/14–3A1, a few hundred feet north of this transverse fault and between the Potrero and Inglewood faults, the water level was about 60 feet below sea level in November 1945, which was possibly 20 feet lower than water levels in sec. 3, south of the inferred fault (pl. 12). Thus, a hydrologic discontinuity is indicated and the fault is inferred to be present chiefly on the basis of this hydrologic evidence.

The second inferred transverse fault, near the north edge of sec. 34 (Manchester Avenue) and about 1 mile long, is suggested by a land-surface displacement of about 25 feet, east of the Potrero fault, with the dropped block on the south. However, logs of wells 2/14–27P1 and 34C1, north and south of the fault suggest no displacement at the base of the Silverado water-bearing zone, 220 feet below sea level. Nevertheless, water-level measurements taken in wells 2/14–27P2 and 34C1 in November 1945 were about 60 and 75 feet below sea level, respectively, suggesting a differential in water level across the inferred fault of about 15 feet.

The third inferred fault, which extends westward almost across the center of sec. 27, T. 2 S., R. 14 W., is indicated by a steep northward-facing bluff and a land-surface displacement of about 50 feet, dropped to the north. Logs of water wells indicate a displacement of the water-bearing zones of Pleistocene age, of about 30 to 50 feet in the same direction (pl. 3). Hydrologic data are not available to show whether a hydraulic discontinuity is present across this fault.

INGLEWOOD FAULT AND ASSOCIATED MINOR FAULTS

The Inglewood fault zone, as shown on plate 2, is about 9 miles long and extends northward from the northern part of the Rosecrans Hills, across the Baldwin Hills, and beneath the Recent deposits in Ballona Gap. Topographic evidence and a hydraulic discontinuity indicate that the zone extends northward beyond the Beverly Hills. Its continuity is interrupted by many transverse faults and as shown on plate 2, it has seven distinct segments. Within the Baldwin Hills area, the fault pattern is plotted as shown on an unpublished map by Moody;[5] to simplify the structural detail, however, many minor faults are not shown.

The southern segment of the Inglewood fault extends northwestward for about 2 miles to the center of sec. 28, T. 2 S., R. 14 W. In section 28 it is identical with the Townsite fault of Willis (1943, p. 311–312). In the northern part of the Rosecrans Hills, from a quarter of a mile south to half a mile north of Century Boulevard, a local steepening of the land-surface profile indicates the inferred surface trace of the Inglewood fault, trending about N. 30° W. However, subsurface and hydraulic evidence for this segment of the Inglewood fault is much more definitive. Logs of water wells in the central part of Inglewood indicate a vertical displacement of at least 100 feet at the base of the Pleistocene water-bearing zones, with the dropped block to the southwest (pl. 2). Also, in sec. 34, T. 2 S., R. 14 W., water levels on the northeast side of the fault were about 20 feet lower in November 1945 than levels southwest of the fault (pl. 12).

At the north end of this southern segment, in the SE¼ sec. 28, T. 2 S., R. 14 W., the trace ends abruptly against a transverse fault about a mile long, which strikes N. 60° E. along a former channel of Centinela Creek. The characteristics of this fault are not well known; logs of water wells indicate a displacement of about 50 feet between wells 2/14–28M1 and 28E1 (city of Inglewood, wells 26 and 23), both of which are west of the Inglewood fault. Here the water-bearing beds are dropped to the south. These wells were drilled about 16 years after Kew (1923, p. 157) wrote that "no stratigraphic evidence is present indicating any faulting in this creek." Thus, the displacement suggested by the logs of these wells, although not conclusively demonstrated, constitutes presumed stratigraphic evidence for the existence of this fault. No hydrologic or chemical data are available for confirmation. The trace of the fault has been drawn along the former channel of upper Centinela Creek, according to information supplied by Kew and Moody (Grant and Sheppard,

[5] Moody, G. B., 1935, Surface geology of the Baldwin Hills, Los Angeles County, Calif., Report for Standard Oil Co. of California.

1939, p. 321, fig. 8); but because it is believed to pass north of well 2/14–28M1, the position of its western part has been shifted about 600 feet to the north.

The Inglewood fault, which at the surface is probably horizontally offset slightly to the west by the transverse fault just described, extends 4 miles northward from that fault across the Baldwin Hills. The fault is again horizontally offset, to a small extent, by two other transverse faults in the southern 1.5 miles of this stretch, and trends about N. 10° W. The northern part, about 3.5 miles long, extends over the Baldwin Hills, and trends about N. 25° W.

The fault pattern in the Baldwin Hills area shows that the Inglewood fault is the more easterly of two faults forming a dropped block or graben along the crest of the hills (pl. 2). It is broken along this graben by several echelon faults which trend about N. 20° E. The Inglewood fault is marked here by a westward-facing escarpment with a land-surface vertical displacement or throw of about 275 feet (Driver, 1943, p. 308 and fig. 128). Locally in the NE¼ sec. 17, T. 2 S., R. 14 W., at the top of the producing zones of the Inglewood oil field, the throw is about 1,000 feet down on the west side, so that that zone is about 2,000 feet below the land surface in the graben and 1,000 feet below the surface east of the fault. Surface and subsurface data indicate that the horizontal component of the displacement may be five times as great as the vertical component or throw. The fault dips about 80° west at the surface, and becomes less steep with depth.

About parallel to the Inglewood fault and nearly 1,000 feet to the west, another fault forms the west side of the graben. Like the Inglewood fault, it trends about N. 25° W. and is broken by several echelon faults trending N. 10°–20° E.; it dips about 75° to the east. According to Driver, the throw is about 30 feet at the surface and 100 to 200 feet at a depth of about 2,000 feet. The echelon faults along the graben may have been the result of stresses which caused the large horizontal component of movement along the main Inglewood fault.

Bounding the northeast flank of the Baldwin Hills is an unnamed fault about 2 miles long, trending N. 70° W., which extends northwestward and is offset by the Inglewood fault (Driver, 1943, p. 308). The dip of the fault plane is not known, but it is reported to be a normal fault with the downthrown block on the north. Data on a few wells south of the fault at its northwest end show that water levels at this point have been maintained about 90 feet above sea level; the underground drainage from the hills evidently has been trapped in the acute dihedral angle between this fault and the Inglewood fault.

There is substantial evidence north of the Baldwin Hills that the Inglewood fault extends across Ballona Gap with a trend of about N. 26° W. and is concealed beneath alluvial deposits of Recent age. It has already been indicated that (at the crest of the Baldwin Hills anticline) the Inglewood fault marks the eastern boundary of a graben; the strata at the fault are dropped on its west side. Also, information obtained from a study of well logs in Ballona Gap proves that the water-bearing deposits of Pleistocene age have been dropped on the east side of the fault. Therefore, movement along the Inglewood fault must have been pivotal, with a change from downward displacement on the west in the Baldwin Hills, through a pivot of no displacement, to downward displacement on the east in Ballona Gap. The dip of the fault plane in Ballona Gap is not known.

At the intersection of the Inglewood fault with section *D–D'* (pl. 3*D*), the throw is inferred to be about 200 feet. Apparently no movement has occurred along this fault since the beginning of Recent time because the "50-foot gravel" in Ballona Gap shows no evidence of offset.

Evidence that the Inglewood fault affords an effective barrier to ground-water movement through Ballona Gap is shown by the area of flowing wells that existed inland from the fault in 1904 (Mendenhall, 1905b, pl. 6). More recent water-level data also indicate hydraulic discontinuity. For example, in November 1945 water levels east of the fault in secs. 5 and 6, T. 2 S., R. 14 W., near the Sentney plant of the Southern California Water Co., were as much as 50 to 70 feet below water levels west of the fault (pl. 12).

The trace of the Inglewood fault tentatively has been extended across the eastern part of the Beverly Hills on the basis of an eastward-facing escarpment about 70 feet high, trending N. 25° W., and alined with the fault trace across the Baldwin Hills. If the assumption is correct that this escarpment marks the surface trace of the northward extension of the Inglewood fault, the fact that there is no displacement of Recent beds, and that the strata of late Pleistocene (Palos Verdes) age are displaced, dates the last movement along this fault as occurring in latest Pleistocene time.

The northern limit of the Inglewood fault is not known. However, this shear zone does not extend to the older rocks in the Santa Monica Mountains.

FAULTS IN BALLONA GAP

Two faults in Ballona Gap that are not associated with the Newport-Inglewood uplift, but which have a strong influence on ground-water circulation, are the Overland Avenue and the Charnock faults (pls. 2 and 3*D*). Both faults have been located by well-log and water-

level data. They bound the east and west sides of a dropped block or graben. Both have been shown on the water-level contour maps of the Los Angeles County Flood Control District since 1938 (Baumann and Laverty, 1940, map 9).

The Overland Avenue fault, so named in this report because its inferred trace nearly coincides with Overland Avenue in Culver City, is about 6 miles long and trends N. 30° W. It extends from the southwestern part of the Baldwin Hills northwestward across Ballona Gap, and across the southwest lobe of the Beverly Hills (pl. 2). Logs of wells indicate that where it crosses section *D–D'* (pl. 3*D*) in sec. 12, T. 2 S., R. 15 W., the vertical displacement is about 30 feet, with the dropped block on the west.

The well logs and water-level data indicate the fault extends 1.5 miles northwest of the Beverly Hills lobe over a part of the small alluvial plain, which is tributary on the north to Ballona Gap. Also, hydrologic evidence supported by subsurface data, indicate that the fault extended southeastward across sec. 19, T. 2 S., R. 14 W. Logs of wells 2/14–19C1 and 19C2 on the west side of the fault, and well 2/14–18F2 on the east side, indicate a displacement of several tens of feet at the base of the water-bearing deposits.

Although the attitude of the Overland Avenue fault is shown to be vertical in plate 3*D*, the true direction and magnitude of the dip of the fault plane are not known.

For the past 15 years the water levels on the east side of the Overland Avenue fault have remained 60 to 100 feet above those on the west side; this fact indicates the effectiveness of the fault as a ground-water barrier (pls. 9–12).

The Charnock fault has been so named in this report because it passes immediately west of the Charnock well fields of the city of Santa Monica and the Southern California Water Co., in the NW¼, sec. 11, T. 2 S., R. 15 W. The fault trace trends about N. 35° W. (nearly parallel to the Overland Avenue fault) and extends from the north border of the El Segundo sand hills [6] across Ballona Gap and through the alluvial narrows between the Ocean Park plain and the Beverly Hills. Water levels in wells and well-log data indicate that the north end of the fault trends in a more northerly direction (about N. 5° W.).

The attitude of the Charnock fault is not known; it is shown to be vertical in plate 3*D* (as was done in the case of Overland Avenue and the Inglewood faults). The trace of the fault is concealed beneath deposits of Recent age for almost its full extent on plate 2, but the

[6] The California Division of Water Resources in its investigation for the adjudication concluded from additional information that the Charnock fault extends south to Redondo Beach Boulevard in the vicinity of Gardena and so describe it in their report (1952, p. 93 and pl. 4).

throw is as much as 140 feet at the base of the San Pedro formation, with the dropped block to the east.

Hydraulic discontinuity is apparent across the Charnock fault, as shown by water-level contours on plates 9–12. For example, in November 1945, water levels east of the fault were as much as 50 feet below sea level, and were about 40 feet below those on the west.

The absence of land-surface displacement along the Charnock and Overland Avenue faults suggests that movement along these faults has not taken place during Recent time. The "50-foot gravel" of Ballona Gap is not known to be cut by either of these faults and thus it is believed that they have not produced any barriers to movement of water in this aquifer. As noted earlier in this report, all observable displacement along faults of the Newport-Inglewood structural zone occurred before Recent time, although movement is still taking place at depth.

The marked hydraulic discontinuities across the Charnock and Overland Avenue faults are caused in part by displacement of the water-bearing deposits against impermeable silt and clay beds. However, it is probably true that cementation within the fault zones has been responsible for much of the effectiveness of these ground-water barriers.

GROUND-WATER HYDROLOGY

REGIONAL GROUND-WATER CONDITIONS

The coastal plain in Los Angeles County is divided into two distinct ground-water basins by the Newport-Inglewood uplift, which extends from Beverly Hills southeastward to Signal Hill and beyond into Orange County. To the northeast the main (or central) coastal basin covers about 500 square miles in Los Angeles and Orange Counties and currently (1948) yields about a third of a million acre-feet of ground water annually—about four-fifths of the water pumped from the entire coastal plain. To the southwest of the uplift, the west basin currently (1948) yields about 90,000 acre-feet a year, or about one-fifth of the total pumpage of ground water from the coastal plain.

At least three distinct bodies of ground water occur in these two basins. In downward succession they are: (1) a body of shallow unconfined and semiperched water which occurs in the upper part of the alluvial deposits of Recent age within the several gaps and inland beneath most of the Downey plain, also in the upper Pleistocene deposits beneath the Torrance plain and along the flanks of the uplift; (2) the principal body of fresh ground water, which occurs chiefly in the lower division of the alluvial deposits of Recent age, in nearly all the deposits of Pleistocene age, and in the uppermost part of the

underlying Pliocene rocks; and (3) a body of saline connate water underlying the principal fresh-water body throughout the area.

Within the coastal plain in Los Angeles County, essentially all the water currently withdrawn from wells is pumped from the principal water body. Accordingly, in following paragraphs a brief statement is presented to outline the occurrence and circulation of ground water in this body and to furnish a general background preliminary to the detailed discussion of ground-water occurrence in the west basin treated in following sections of the report.

The sediments in the main coastal basin in Los Angeles County consist chiefly of the coalescing alluvial fans of the Los Angeles River and the San Gabriel River (including the Rio Hondo) systems (pl. 1). The alluvial fans, which were laid down in a synclinal trough, comprise tongues and lenses of sand and gravel, interbedded with silt and clay. The lenses or tongues of gravel and coarse sand are largely the channel deposits of the major streams; the fine sand, silt, and clay are chiefly flood-plain deposits carried to the interstream areas during flood stage. Beneath most of the Downey plain the alluvial deposits are at least 1,000 feet thick, near the axis of the synclinal trough—along a line through Huntington Park and Santa Ana—the deposits are as much as 3,000 feet thick. Most of the alluvium was deposited in early Pleistocene time, thus forming the San Pedro formation.

During most of the Pleistocene epoch, the shore of the alluvial plain in this central reach was nearly parallel to a line between Watts and Los Alamitos. Here the alluvial-fan deposits interfinger with lagoonal deposits of low water-yielding capacity. In effect, these lagoonal deposits produce a partial lithologic barrier to the free coastward movement of the ground water. About a mile or two farther coastward, the lagoonal deposits merge with beach and shallow marine deposits—extensive, thick layers of sand and gravel that constitute the inland margin of the highly productive Silverado water-bearing zone. In the reach from the Baldwin Hills to Signal Hill, the Silverado water-bearing zone extends across the crest of the Newport-Inglewood uplift and southwest to the present coast thus underlying the greater part of the west basin.

Three highly permeable aquifers within the deposits of Recent age that overlie the Pleistocene deposits and locally extend to depths of as much as 100 to 150 feet below land surface are: (1) The Gaspur water-bearing zone, which extends from Whittier Narrows to Terminal Island; (2) the westerly arm of the Gaspur zone, which extends from the Los Angeles River Narrows to a juncture with the main Gaspur water-bearing zone at Compton; and (3) the "50-foot gravel," whose east end is in hydraulic continuity with the westerly arm of the Gaspur water-bearing zone, extends westward through Ballona Gap to the

ocean. (See pl. 8 for extent of these water-bearing zones of Recent age within the Torrance-Santa Monica area.)

These extensively continuous and highly permeable aquifers are not typical alluvial-fan deposits. They are trains of gravel and sand laid down in valleys eroded in the Pleistocene deposits and were deposited contemporaneously with a rise in sea level. They form unbroken ground-water arteries or conduits from the intake areas to the ocean—in fact, they extend inland beyond the intake areas of the coastal plain, and through the passes to the inland valleys. They range in width from 1 to 6 miles; the Gaspur water-bearing zone is at least 20 miles long.

The principal body of ground water is unconfined only within the intake areas, which extend a few miles coastward from the Whittier and Los Angeles Narrows. Most of the recharge to the principal body takes place in these areas of unconfined water, by influent seepage from the major streams, by penetration of rain and irrigation water, and by underflow from the interior basins. Also, since 1938 recharge has taken place by percolation from the spreading basins along the Rio Hondo and the San Gabriel River about 3 miles coastward from Whittier Narrows.

Under native conditions of circulation the ground water moved generally oceanward from the intake areas, but chiefly under confinement. Coastward, beyond the intake areas, beds of silt and clay intervene between the successive water-bearing members and cause hydraulic discontinuity between those members. Such discontinuities generally are slight within the intake areas but they become more extensive toward the Newport-Inglewood uplift. Movement of water is most rapid in the coarsest materials—such as the materials that constitute the Gaspur water-bearing zone of Recent age and the more permeable members of the San Pedro formation. Under the hydraulic gradients from 5 to 10 feet to a mile, which initially prevailed throughout much of the coastal plain, movement is comparatively rapid in coarse deposits. However, the movement, probably is not more than a mile every few years. Although movement is much slower through materials of finer texture, it probably takes place to some extent in all but the finest grained clay. Thus, the fresh water in the principal water body occupies and moves through a succession of water-bearing members that are contained in the vertical range of the alluvial deposits of Recent age and all the deposits of Pleistocene age. To a lesser extent, fresh water may move through the upper part of the Pico formation, but movement through these deposits presumably, is very slow.

The oceanward movement in the principal fresh-water body is greatly impeded along the Newport-Inglewood uplift. There, owing

to substantial barrier features (cemented fault zones), the impedance under native conditions was sufficiently effective to produce a belt of flowing wells (the artesian area of Mendenhall) extending inland to the intake areas and occupying nearly two-thirds of the main coastal basin (Mendenhall, 1905b, pl. 1). The hydrostatic head so developed cause very high pressure in early wells. In the famous Bouton wells 2 miles north of Signal Hill (drilled about 1895), sufficient pressure heads were reached to raise the water level in casings 80 feet above the land surface or about 150 feet above sea level. These high pressures caused substantial leakage from the deeper water-bearing zones by upward movement in fracture-zone conduits adjacent to the master faults. At several places along the uplift, perennial springs occurred at the inland side of the master faults. For example, in Inglewood and immediately inland from the Potrero fault, a spring is reported to have discharged water perennially into the head of Centinela Creek. This spring ceased to flow about 1900. Also, in Long Beach two perennial springs have been described (Brown, 1944, p. 2), both associated with and immediately inland from the faults of the Signal Hill uplift. These springs ceased to flow after pressure levels in the main coastal basin were lowered below land surface by increasing withdrawals.

Under natural conditions of high-water level inland from the uplift, a substantial part of the replenishment to the main coastal basin in Los Angeles County passed across the uplift as underflow into the west basin. This underflow moved coastward in the confined aquifers within the west basin, chiefly in the Silverado water-bearing zone of the Torrance-Inglewood subarea and in aquifers of correlative age to the north, but also in shallower Pleistocene aquifers, and in those of Recent age—the Gaspur water-bearing zone of Dominguez Gap and the "50-foot gravel" of Ballona Gap. In addition to the underflow, recharge from rainfall contributed to the ground-water supply of the west basin.

The Los Angeles River and Ballona Creek did not furnish recharge directly to the west basin under native conditions because they were effluent within its extent and hence functioned as channels for ground-water discharge. Most of the discharge, however, was by direct escape from the aquifers extending beneath the ocean. Such discharge was into Santa Monica Bay along the west coast from Santa Monica to the Palos Verdes Hills, especially southward from Redondo Beach; discharge also occurred into San Pedro Bay at the south end of Dominguez Gap, probably largely from the Gaspur water-bearing zone.

The pressure or piezometric surfaces of all aquifers in the west basin under native conditions were below the land surface everywhere

except (1) near the coast in Ballona Gap, and (2) locally in and near Dominguez Gap, as registered in four wells that were flowing in 1904. In Ballona Gap in 1904 the area of artesian flow as shown by Mendenhall (1905b, pl. 5) extended over about 3 square miles, chiefly in secs. 21, 22, 23, and 27, T. 2 S., R. 15 W. Within this area, almost the entire land surface is less than 10 feet above sea level.

The decline in water level which has occurred in the main coastal basin within the past three decades, has been nearly matched by a similar decline on the coastal side of the uplift (within the west basin); therefore, the local pressure differential has remained almost equal. However, the decline along the crest of the uplift has been many tens of feet; it has dewatered a part of the water-bearing conduits and the over-all escape from the main basin to the west basin has been decreased substantially. Thus, the changes in water level that occur within the main basin are critical in determining the quantity of replenishment that may be contributed to the west basin by underflow across the uplift.

For the main coastal basin and especially for the coastal reach from Dominguez Hill southeast to Newport Beach, the interpretive reports of the Geological Survey on the Long Beach-Santa Ana area have treated in some detail the occurrence and circulation of ground water, the increasing withdrawals, the drawdown of the water level that has developed, the nature and sources of saline contamination, and the character of the Newport-Inglewood uplift as a barrier to water movement. Other sections of this report will treat elements of somewhat similar scope within the west basin.

GROUND WATER IN THE WEST BASIN

SEMIPERCHED WATER BODY

OCCURRENCE

The semiperched and unconfined water body occurs rather widely in the west basin in deposits less than 100 feet below the land surface. It is the first water reached by wells but is utilized only locally. In Dominguez Gap it is contained within the upper 20–50 feet of the Recent deposits in layers of fine sand and silt of low permeability. In Ballona Gap it occurs in deposits of similar age and physical character, but here the semiperched body commonly does not extend more than 20 to 30 feet below the land surface. Beneath the Torrance plain, this body occurs very widely in the uppermost Pleistocene deposits. About in the south-central part of the Torrance plain, where it is tapped by nearly 100 wells, the semiperched body extends to depths of as much as 80–100 feet. Thus, here it is about twice as thick as within the two flanking gaps.

Although this water body has frequently been referred to as perched water in local usage, in reality it is semiperched. According to Meinzer (1923, p. 40–41),

> ground water is said to be *perched* if it is separated from an underlying body of ground water by unsaturated rock [including unconsolidated material]. Perched water belongs to a different zone of saturation from that occupied by the underlying ground water. * * * Ground water may be said to be *semiperched* if it has greater pressure head than an underlying body of ground water, from which it is, however, not separated by any unsaturated rock. Semiperched water belongs to the same zone of saturation as the underlying water, and therefore where it occurs there is only one water table, which may be called a *semiperched water table.* Semiperched water, like perched water, is underlain by a negative confining bed of either permeable or impermeable type. The underlying water has subnormal head.

Nearly everywhere within its extent in the west basin, the static level of the semiperched water body is higher than the pressure head of the underlying body of fresh ground water. Also, it is generally separated from the underlying water by more or less impermeable layers of silt and clay.

The semiperched water body beneath the Torrance plain is replenished principally by infiltration of rain and of runoff temporarily ponded by overflow from Dominguez Channel and by infiltration of irrigation water. Under native conditions in Dominguez Gap the semiperched body discharged to the Los Angeles River. For the last three decades, however, the water table has been at a lower altitude than the channel of the Los Angeles River, and the body is replenished in part by influent seepage from the river. Stream-gaging records are not adequate to define the small quantity of river loss involved but measurements in shallow wells show a ground-water mound beneath the river channel. Also, a study of saline contamination in Dominguez Gap has suggested that since about 1930 the average contribution of saline water from the Los Angeles River passing through the semiperched body to the Gaspur water-bearing zone has been at least 90 acre-feet per year (Piper, Garrett, and others, 1953, p. 190). Thus, it is inferred that the over-all annual recharge to the semiperched body has been substantially more than 90 acre-feet per year. In Ballona Gap under native conditions the ground-water body fed the creek along nearly the full reach of the gap. Within the west basin under the current conditions of depressed water level, the semiperched water doubtless has been and now is replenished in part by seepage from Ballona Creek. Immediately inland from the Inglewood fault, however, even though the pressure head in the underlying San Pedro formation has been drawn down below sea level since the early thirties (pls. 9–12), the semiperched water body is known to

have discharged water to Ballona Creek as late as 1932, from a spring in 2/14–5M (pl. 17, loc. 5).

UTILITY

Almost everywhere within its extent, the semiperched water was greatly inferior in chemical quality to the underlying fresh water under native conditions. Locally in Dominguez Gap, its quality has deteriorated substantially in the past two decades, either from landward movement of ocean water or by addition of industrial wastes and oil-field brines. The changes in chemical quality of the semiperched water in Dominguez Gap have been discussed at length in an earlier report (Piper, Garrett, and others, 1953, p. 173–177); the chemical quality of the semiperched water elsewhere in the west basin is discussed on page 175 of this report.

Because of the general inferior quality of the semiperched water, and because wells of large capacity cannot be obtained, little water is withdrawn from it. In Dominguez and Ballona Gaps, few wells produce water from this body. However, beneath the Torrance plain in the Gardena area, the semiperched water in the uppermost Pleistocene deposits is tapped by about 100 wells which range in depth from 25 to 100 feet. The area of this development is south of Rosecrans Avenue and north of 190th Street, and extends eastward from Hawthorne Avenue about 5 miles to Avalon Boulevard. From information obtained during the well canvass, it is concluded that about half of the wells, or about 50, are used chiefly for irrigation; of the remainder, some are used exclusively for domestic supply but most are used jointly for irrigation and domestic supply. Many of the wells are equipped with windmills. The yield of these wells commonly is only a few gallons per minute, and the irrigated gardens usually do not exceed half an acre in extent. Accordingly, it is estimated that the over-all draft from the 100-odd wells is about 50 acre-feet a year.

DECLINE OF WATER LEVEL

Throughout the known extent of the semiperched water body, its water table has declined 10 to 20 feet since 1904, the time of earliest record. For example, in Dominguez Gap in 1903–4—essentially under native conditions of head—the water table of the semiperched body ranged from 5 to 8 feet below land surface throughout the gap, and coincided closely with the pressure level of the underlying Gaspur water-bearing zone. In 1946 the depth to the water table ranged from 15 to 25 feet; and again it was about coincident with the pressure level in the Gaspur water-bearing zone. Thus, in about 40 years the water table of the semiperched body had declined as much as 10 to 15 feet in Dominguez Gap. Because a coincident decline occurred in the pressure level of the Gaspur water-bearing zone, it is concluded

that there is appreciable hydraulic continuity between the two water bodies. Because the pressure level in the Gaspur zone was drawn down by heavy withdrawals (especially in the twenties and early thirties), water percolated downward from the semiperched body and its level declined accordingly. This conclusion has been substantiated by study of the nature and development of saline contamination within the Dominguez Gap (Piper, Garrett, and others, 1953, p. 167–169).

In the Gardena area in 1904 the semiperched water table ranged from 10 to 25 feet below land surface about 15 to 25 feet above sea level. Since 1929 periodic measurements have been made in a few wells tapping the semiperched body in this area. (See hydrographs for wells 3/14–25E2 and 25K3, fig. 5.) The water table at or near these wells was 22 feet above sea level in 1904 (from Mendenhall); 15 feet in 1929; 12 feet in 1936; and 14 feet in 1945 (high level for each respective year). Thus, this water table has had a net decline of about 8 feet in 40 years. In 1904 the pressure levels in nearby wells tapping the "200-foot sand" and the Silverado water-bearing zone, respectively, were nearly coincident with the semiperched water table, but they have been drawn down progressively until in 1946 they were about 30 and 50 feet below the semiperched water table (fig. 5). Presumably, the 8-foot lowering of the water table in 3/14–25E has occurred in part by slow percolation from the semiperched body to the underlying aquifers. However, this change in storage in the semiperched body has been distributed over many years, and the containing deposits have a low specific yield.[7] Also, some part of the lowering may represent drawdown by withdrawals from the shallow wells of the Gardena area. For these reasons, change in storage in the semiperched body is considered to have been negligible in its relation to problems of replenishment to the principal water body.

PRINCIPAL WATER BODY

OCCURRENCE

EXTENT AND THICKNESS

The principal body of fresh ground water underlies almost all the Torrance-Santa Monica area, and occurs beneath all of the west basin except the crestal part of the Baldwin Hills and certain contaminated areas along the coast. It extends downward from the base of the semiperched water body to the top of the body of saline connate water. This fresh-water body occupies: (1) the lower division of the deposits of Recent age—that is, the Gaspur water-bearing zone

[7] The specific yield of a water-bearing deposit is defined as the ratio of (1) the volume of water which the saturated material will yield by gravity to (2) its own volume. This ratio is stated as a percentage.

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and the "50-foot gravel" where these are uncontaminated; (2) the unnamed upper Pleistocene deposits, in which the principal aquifer is the "200-foot sand"; (3) the San Pedro formation of early Pleistocene age which, in the Torrance-Inglewood subarea, contains (a) an inextensive upper aquifer, the "400-foot gravel", and (b) the underlying thick and very extensive Silverado water-bearing zone; and (4) most of the upper division of the Pico formation of late Pliocene age, except in the Culver City area where the sand members in the upper division of the Pico either are absent or, if present, commonly contain brackish to saline waters.

The depth to the base of the principal fresh-water body has been shown on plate 8. Its over-all thickness is indicated generally by the contours of that map because its top is within a few tens of feet of sea level in almost all of the west basin except along the crest of the Newport-Inglewood uplift and along the flank of the Santa Monica Mountains where its top rises to as much as 200 to 300 feet above sea level.

The upper division of the Pico formation is not tapped by water wells at the present time. Hence, the thickness of the principal water body now utilized is indicated by the contours drawn on the base of the water-bearing deposits of Pleistocene age (pl. 2). In the Torrance-Inglewood subarea, these contours define the base of the Silverado water-bearing zone; in the Culver City subarea, they define the base of the essential correlative of the Silverado water-bearing zone—that is, the main water-bearing zone within the San Pedro formation. As shown by that map, throughout much of the west basin the thickness ranges from 200 to 700 feet but it reaches a maximum of about 1,200 feet near the intersection of Alameda and Carson Streets in Dominguez Gap, at the deepest part of the syncline.

Along the crest of the Newport-Inglewood uplift the thickness of the water-bearing deposits now tapped by wells varies widely. As shown by plate 3*A*, the thickness ranges from a feather edge on the crest of the Baldwin Hills to 700 feet in Dominguez Gap. Specifically, along the line of section *A*–*A'* (pl. 3*A*), these water-bearing deposits are about 330 feet thick in Inglewood, thin to 250 feet at the north end of the Rosecrans Hills, thicken irregularly southeastward to about 600 feet at the south edge of the Rosecrans Hills and beneath the crest of Dominguez Hill, attain a maximum thickness of 700 feet in Dominguez Gap, and thin to about 200 feet beneath Signal Hill.

Along the coast the thickness of the water-bearing deposits tapped by wells is somewhat more uniform although it increases substantially from north to south (pl. 3*C*). These deposits are from 200 to 250 feet thick from Santa Monica to Playa del Rey, thicken to as much as 350 feet at El Segundo, thin to 200 feet at Manhattan Beach, thicken

to 500 feet in the Redondo Beach area, and then thin to a featheredge along the north flank of the Palos Verdes Hills. The thicknesses here cited do not include the deposits of dune and beach sand that blanket the coast from Playa del Rey to the Palos Verdes Hills and extend from a few tens of feet above sea level to altitudes as much as 244 feet.

For the several water-bearing zones within the principal water body, general physical character, water-bearing character, extent, thickness, and depth below land surface have been discussed in the geologic section of this report. The quantity of water withdrawn from them is discussed on pages 99–111.

CONFINED AND WATER-TABLE CONDITIONS

Within most of the west basin, the water-bearing zones within the principal water body are separated by substantial thicknesses of relatively impermeable silt or clay. These features have been shown on the gelologic sections previously introduced. The beds of silt or clay confine the water in the several aquifers and prevent free circulation from one to another. For example, between Hawthorne and Gardena, near the axis of the syncline, along the line of section *B–B'* (pl. 3*B*), the "200-foot sand" is separated from the "400-foot gravel" by 50 to 100 feet of silt or clay; and a similar thickness of silt or clay separates the "400-foot gravel" from the Silverado water-bearing zone beneath.

In the Torrance-Inglewood subarea, the water in the several aquifers is almost wholly confined by impermeable deposits, except to the south of Playa del Rey and near Redondo Beach (pl. 11), where a water table occurs. Near Playa del Rey, the water table is in the main water-bearing zone of the San Pedro formation; the top of this water-bearing zone here rises as high as 30 feet above sea level and the confining beds feather out westward in the vicinity of Lincoln Boulevard. West of Lincoln Boulevard and south nearly to Imperial Highway, the main water-bearing zone is directly overlain by permeable beach and dune deposits. Hydrographs introduced later in this report suggest that rainfall passes through these overlying permeable beds directly into the main water-bearing zone (p. 124).

In the Redondo Beach area, south of 190th Street (boundary between Tps. 3 and 4 S.) and west of the center of the city of Torrance, the confining beds that separate the Silverado water-bearing zone and the "200-foot sand" to the east and north are not present (pl. 5). In this area the permeable deposits of Pleistocene age rise above sea level and a water table occurs in what is inferred to be the Silverado water-bearing zone, although its upper part may represent the westward extension of the "200-foot sand."

In the area south of Sepulveda Boulevard and east of Narbonne Avenue, water-table conditions exist in the "200-foot sand," extend eastward about to Alameda Street and beneath much of the Wilmington area. Here, however, the "200-foot sand" is separated from the Silverado water-bearing zone by relatively impervious deposits and from west to east the water table in the "200-foot sand" stands progressively higher than the pressure surface of the Silverado zone.

Elsewhere within the Torrance-Inglewood subarea, the ground water in the Silverado water-bearing zone is wholly confined and in the "200-foot sand" it usually occurs under confined conditions.

In the Culver City subarea the water in the main water-bearing zone of the San Pedro formation commonly is confined, except locally along the north edge of Ballona Gap from the Charnock fault west to the coast, in the Charnock subbasin north of the Charnock well fields, and from the Overland Avenue fault east at least to and beyond the wells in 2/15–1C (pl. 2).

SOURCE AND MOVEMENT

METHOD OF INVESTIGATION

The source of ground water commonly is indicated by the direction of movement. Water generally moves from areas of recharge to areas of discharge. If the water-bearing deposits are homogeneous, the altitude of water level in a number of wells measured within a short span of time can be utilized to construct a map showing contours on the water table or the piezometric surface. Such a map shows conditions of head from place to place. Movement is at right angles to the contours, which connect points of equal altitude on the water table or the piezometric surface. The rate of movement is proportional to the hydraulic gradient and the permeability of the deposits.

As already discussed, the water-bearing deposits in the west basin do not occur as a homogeneous permeable mass but are stratified in several fairly distinct aquifers which are separated at most places by confining layers. Initially the pressure levels in all the water-bearing zones were at about the same altitude. Through the period of use, and largely because of inequalities in draft and replenishment, differences have developed in the pressure levels of the several aquifers. At some places, the maximum differential in water level in shallow and deep aquifers in 1946 was as much as 70 feet. Thus, in order to draw contours on the piezometric surface or water table for a single aquifer, only levels for wells tapping that aquifer can be utilized. A water-level contour map drawn from levels in random wells tapping more than one aquifer would be misleading and inac-

curate and could not be used to determine direction of movement, or source of water.

Within the west basin, the Silverado water-bearing zone south of the Ballona escarpment and its essential correlative to the north currently yield about 90 percent of the ground-water withdrawal, including nearly all the pumpage for industrial use and about 90 percent of the pumpage for domestic use. Thus, with respect to conditions of replenishment and saline contamination, the changes in the form and position of the piezometric surface in these composite water-bearing zones of the San Pedro formation are critical, and the changes in water level in overlying aquifers are of minor importance.

Water-level contour maps showing conditions in 1903-4 and in March 1933 (pl. 9), in April 1941 (pls. 10, 11), and in November 1945 (pl. 12), have been included in this report. Each of these water-level contour maps has been drawn from water-level altitudes in wells tapping the San Pedro formation—that is, the water-bearing zones most intensively utilized. Within almost all the Torrance-Inglewood subarea, the water levels utilized for the maps were those in wells tapping the Silverado water-bearing zone; in the Culver City subarea the water-level data were from wells tapping the main water-bearing zone of the San Pedro formation, the essential correlative of the Silverado water-bearing zone; and inland from the west basin, water levels were from the deeper wells tapping the Silverado or equivalent water-bearing zones of Pleistocene age.

In preparing the water-level contour maps, measurements of depth to water were utilized from all possible sources. For the maps of 1933 and 1941, measurements were made chiefly by the Los Angeles County Flood Control District and by the Los Angeles Department of Water and Power; for the map of 1945, most of the measurements were made by the Flood Control District and by the Geological Survey. All measurements made by the Geological Survey during the cooperative investigation are being published in the annual reports on water levels and artesian pressure in the United States for the years 1944, 1945, and 1946 (U. S. Geol. Survey). The scope of the measurements is discussed on page 112.

Altitudes of measuring points for most of the observation wells in the Torrance-Santa Monica area have been determined by instrumental leveling. For the area immediately west of Long Beach, in T. 4 S., R. 13 W., altitudes for many of the wells were determined by the Geological Survey in 1941–42 through a third-order level net anchored to bench mark "tidal 8" in the Los Angeles Outer Harbor, and by additional levels with transit and stadia or with alidade and level rod, tied to the third-order net (Meinzer, Wenzel, and others, 1944, p. 87–88). In the remainder of the area, altitudes of measur-

ing points for most of the observation wells have been determined by levels of the Los Angeles Department of Water and Power, and these were utilized wherever available. For a few wells, altitudes of measuring points have not been determined instrumentally; however, these altitudes have been interpolated from topographic maps of the Geological Survey having a 5-foot contour interval.

MOVEMENT IN THE TORRANCE-INGLEWOOD SUBAREA

Conditions in 1903–4.—Water-level contours for 1903–4 are plotted on plate 9 for the southern two-thirds of the project area—essentially the Torrance-Inglewood subarea. These contours were constructed from data obtained by Mendenhall and show substantial modification from his water-level contours (Mendenhall, 1905b, pl. 5). The revision has developed for two reasons: (1) The altitude of land surface at the wells measured during the Mendenhall field canvass has been re-interpolated because of recent Geological Survey topographic maps with a land-surface contour interval of 5 feet; in the Torrance area especially, the topography on the later map (1934 edition) differs considerably from that shown by the survey of 1894, which was published with a land-surface contour interval of 25 feet and was the basis for the well altitudes interpolated by Mendenhall. (2) Insofar as possible, only water levels in wells tapping the Silverado water-bearing zone have been utilized in redrawing the water-level contours, whereas the contours of Mendenhall were generalized from all available water levels, including many levels for wells tapping shallower zones.

The reconstructed water-level contours of 1903–4 show coastward movement of ground water across the Newport-Inglewood uplift and a hydraulic discontinuity from about 40 to 50 feet across the inland boundary of the west basin along the 14-mile reach from the Baldwin Hills to Long Beach. Within the west basin movement was also generally coastward. East of Manhattan Beach the 20-foot contour bulges seaward, indicating a flattening of the hydraulic gradient and a diversion of part of the ground-water flow to the northwest and to the south. This configuration of the pressure surface suggests that the known thinning of the Silverado water-bearing zone near the coast at Manhattan Beach (fig. 2) retarded discharge of ground water to the ocean. However, in the vicinity of Manhattan Beach, the dune topography is rough and hilly; and the locations of the wells shown by Mendenhall can be plotted only approximately on the revised topographic map of the Torrance quadrangle. Hence, the computed altitude of the water surface is subject to possible errors of several feet and the contours based on these altitudes are only approximations and are not suitable for exact interpretations.

From Manhattan Beach northward to Playa del Rey, the movement of ground water was westward; inland from Sepulveda Boulevard the coastward gradient was from 6 to 8 feet per mile. Near the coast, however, the gradient was only about 3 feet per mile.

Southward from Manhattan Beach to the Palos Verdes Hills, the movement was generally westward to the coast; from the Palos Verdes Hills to Long Beach the movement was southward. The coastward gradient in 1903–4, both westward toward Redondo Beach and southward toward San Pedro Bay, was about 4 feet per mile.

Thus, the contours of 1903–4 suggest escape of ground water beneath the ocean offshore from Redondo Beach and beneath San Pedro Bay. Although fresh-water springs were reported in San Pedro Bay, under native conditions, these are believed to have developed by escape of water from the ocean-bottom outcrop of the Gaspur water-bearing zone (Poland, Piper, and others, 1956, p. 50). However, escape from the Silverado water-bearing zone under native conditions by upward movement into San Pedro Bay cannot be substantiated by such direct evidence. The writer has heard reports of former fresh-water springs offshore from Redondo Beach but these have not been verified. If such springs did occur, they must have been fed by discharge from the Silverado zone.

From the geologic relations, it would seem that escape could have occurred with much greater facility in the vicinity of Redondo Beach than beneath San Pedro Bay (pls. 5 and 6). If the permeability of the Silverado water-bearing zone is assumed to be about 1,300 gpd per square foot (about two-thirds as great as in the area east of Torrance, as indicated by comparison of yield factors from table 5), the oceanward discharge in the Redondo Beach area under native conditions can be estimated by use of the equation

$$Q = P_f \times I \times A,$$

where Q is gallons per day; P_f is the field coefficient of permeability defined as the number of gallons of water per day that would be conducted through each mile width of the water-bearing bed for each foot of thickness of the bed and for each foot per mile of hydraulic gradient; I is the hydraulic gradient in feet per mile; and A is the cross-sectional area of the water-bearing material in foot-miles. The average thickness of the Silverado water-bearing zone between Hermosa Beach and the Palos Verdes Hills is about 400 feet and the distance about 3.5 miles; thus the estimated discharge $Q = 1{,}300 \times 4 \times 400 \times 3.5$, or about 7.3 mgd, equivalent to about 11 cfs. The presumed gradient of 4 feet to the mile at Redondo Beach is conservative; coastward from the 10-foot water-level contour, a steeper gradient is

suggested by the altitudes of water level in random wells. Because the local control is poor, however, the regional coastward gradient of about 4 feet per mile was utilized in computing the estimate for seaward escape in the Redondo Beach area as of 1903–4. Thus, the annual discharge to the ocean between Hermosa Beach and the Palos Verdes Hills in 1904 is estimated to have been about 8,000 acre-feet per year.

North from Hermosa Beach to Playa del Rey and along San Pedro Bay the data on gradient near the coast in 1903–4 are fragmentary but a rough estimate of oceanward discharge is given on page 147.

Conditions in 1933.—The withdrawals of ground water from the Torrance-Inglewood subarea increased from an estimated 10,000 acre-feet per year in 1904 to about 50,000 acre-feet per year in the early thirties (p. 99–100). The water-level contours for March 1933 (pl. 9) show the changes in position of the water level and in direction of movement that had developed since 1904 as a result of increasing withdrawals from the west basin and from the main coastal basin to the northeast. These changes can be summarized as follows:

1. Immediately inland from the west basin boundary, in the reach from the Baldwin Hills to Long Beach, the water levels had declined about 40 feet in the 29 years but the direction of movement was still coastward into the west basin. The local gradient had been steepened to a small degree. (See also pl. 4 showing water-level profiles for 1904 and 1930.)
2. The pressure differential across the fault boundary ranged from about 30 feet at Inglewood and Dominguez Gap to about 50 feet in the central part of the Rosecrans Hills.
3. Within the area south of Inglewood the pressure level—and, locally, the water table—was below sea level. Everywhere westward from the axis of the pressure trough, about two-thirds of the Torrance-Inglewood subarea, the direction of movement of the water within the Silverado zone had been reversed and was landward—generally southeastward or eastward toward the area of greatest pressure lowering in Dominguez Gap.

Conditions in 1941 and in 1945.—Plate 11 shows water-level contours for April 1941 and plate 10 indicates the rise or fall in water level that had occurred since March 1933 (pl. 9). The general pattern of the contours is similar to that for March 1933. However, attention is directed to four features:

1. The maximum drawdown of water levels in the 8-year period occurred immediately inland from the west basin boundary, east of Inglewood and within the Rosecrans Hills, and was about 30 feet. This drawdown, indicating local overdraft, was noteworthy because almost everywhere else within the main coastal basin (central basin), except in the Huntington Park area, water levels were higher in 1941 than in 1933.
2. In the west basin, north of 190th Street, nearly all water levels were drawn down, but the maximum decline of 16 feet, which developed between Inglewood and Hawthorne, was only about half as great as the drawdown inland beyond the west basin boundary.

3. South of 190th Street, water levels changed only a few feet between 1933 and 1941. In the Wilmington area, a small net rise resulted from the virtual cessation of pumping at the Wilmington and Lomita well fields of the city of Los Angeles (table 7).

4. The axis of the pressure trough moved inland as much as 3 miles between Hawthorne and Gardena, but it was almost stable from 190th Street into Dominguez Gap. This axis marks the boundary between coastward and landward movement of ground water in the Silverado water-bearing zone.

Largely because of demands caused by industrial expansion during the war years, withdrawal of ground water from the Torrance-Inglewood subarea increased about 50 percent between 1941 and 1945 (table 8). The water-level contours of plate 12 indicate conditions in November 1945, essentially at the end of the period of acceleration in draft induced by the war expansion, in relation to distribution of pumping draft.

The contours represent approximate low-water levels for the year, whereas the contours for 1933 and 1941 represent the high-water levels in those years. As is shown on representative hydrographs introduced later in this report, the yearly fluctuation in the Silverado water-bearing zone within the west basin ranges from about a foot near the coast to as much as 30 feet in areas of heavy pumping near the inland boundary. For example, the center of the depression in the piezometric surface immediately north of Hawthorne was 62 feet below sea level in November 1945, but it was only 38 feet below sea level in March 1945 (pl. 13, well 3/14–4N1). Thus, although the contours for November 1945 indicate a maximum decline of more than 30 feet below the contours for April 1941 (pl. 11), much of this is due to seasonal fluctuations. The contours of November 1945 were drawn to show the lowest water levels for the Silverado water-bearing zone that had occurred in the Torrance-Inglewood subarea to the end of 1945. With respect to saline encroachment from the ocean, the average controlling hydraulic gradient is about halfway between the seasonal high and low levels. However, the maximum rate of landward advance of the saline front occurs at the time of autumn low water. In November 1945, the landward gradient from the coast to the minus 20-foot contour was steepest between El Segundo and Hermosa Beach, as much as 20 feet per mile; in the vicinity of Redondo Beach it was only about a third as steep, from 5 to 6 feet per mile.

The axis of the pressure trough did not move appreciably from 1941 to 1945, even though pressure levels along that axis were drawn down locally as much as 30 feet. In November 1945, the greatest differential pressure across the inland boundary of the west basin was about 60 to 70 feet. Differential pressures of this magnitude occurred east of Inglewood across the southern part of the Potrero fault, also in Dominguez Gap across the Cherry-Hill fault.

MOVEMENT IN THE CULVER CITY SUBAREA

Summary of geologic features.—Ballona Gap, a broad trench cut into the Pleistocene deposits by an ancestral Los Angeles River, is floored by deposits of Recent age to a depth of 40 to 80 feet below land surface. These deposits consist of an upper and a lower division. The upper division consists chiefly of clay, silt, and fine sand; it is from 10 to 40 feet thick and of low permeability. The lower division, the "50-foot gravel," is composed almost wholly of gravel, but locally contains lenses of coarse sand. Its thickness ranges from 10 to 40 feet and its average base is about 50 feet below land surface. The "50-foot gravel" blankets most of the gap (pl. 8) and furnishes a thin but permeable ground-water artery from the main coastal basin to the ocean.

Everywhere within the gap, the "50-foot gravel" is presumed to be underlain by the San Pedro formation. Near the coast, the San Pedro largely consists of sand and gravel; but inland beyond the Inglewood fault more than half the formation is made up of layers of silt and clay, which separate and confine the layers of sand and gravel (pl. 3*D*). Within and adjacent to Ballona Gap, three faults divide the San Pedro formation into distinct blocks which are critical with respect to water circulation and to movement of contaminated waters. These three faults are subparallel and trend about north-northwest. So far as known, they do not transect the deposits of Recent age and presumably do not interrupt hydraulic continuity in the "50-foot gravel." (See p. 76 and 78.)

Of the three faults, the Inglewood fault, the farthest inland, passes across the gap about 6 miles from the coast and forms the inland boundary of the west basin in this area. The Sentney plant of the Southern California Water Co. (in 2/14–5D) is a short distance east of this fault and within the main coastal basin. Logs of wells at this plant show that three distinct aquifers in the San Pedro formation yield water to wells and that the three are separated by impervious strata.

The Overland Avenue fault is about 2 miles coastward from the Inglewood fault. Between these two faults, an upthrown block of the San Pedro formation contains water-bearing beds whose thickness ranges from 50 to 100 feet. The subbasin within this block is termed the crestal subbasin.

The Charnock fault is about 1.2 miles west of the Overland Avenue fault and 3 miles from the coast. Between these two faults the San Pedro formation has been dropped and the main water-bearing zone is as much as 350 feet thick. In subsequent discussion, the subbasin within this block will be referred to as the Charnock subbasin. Coastward from the Charnock fault the San Pedro formation is gently

folded and its water-bearing deposits range from 100 to 250 feet in thickness.

Logs of wells indicate that the "50-foot gravel" and the underlying water-bearing deposits of the San Pedro formation are in direct contact locally within each of the blocks here described, and thus, some hydraulic continuity occurs. The complex structure of the San Pedro formation makes it difficult to trace the extent of hydraulic continuity, except where logs of closely spaced wells are available. However, the hydraulic continuity is known to be most free coastward from the Charnock fault, and is very poor to absent inland from the Overland Avenue fault.

North of Ballona Gap, logs of wells show a general southerly dip of the water-bearing beds of Pleistocene age, but the sand and gravel layers are irregular in thickness and position and cannot be correlated from well to well. Only within the dropped Charnock subbasin (to the north), are the water-bearing deposits thick and extensive. The main water-bearing zone extends continuously at least 2 miles north from the gap, to the vicinity of Pico Boulevard, where its top is about 50 feet above sea level and its thickness about 250 feet.

Circulation of ground water.—The Culver City subarea has been defined as including the part of the west basin north of the Ballona escarpment. The ground-water contour maps of the west basin for the selected times between 1904 and 1945, inclusive, indicate that exchange of ground water between the Culver City subarea and the Torrance-Inglewood subarea—that is, across the Ballona escarpment—has been small. Also, in the Culver City subarea, movement has been controlled very largely by fault barriers, which appear to partition the subarea into three essentially separate subbasins. Within these subbasins, movement has been chiefly in response to concentrations of draft at several heavily pumped well fields (pl. 12).

Water-level contours for the Culver City subarea for 1903–4 were reconstructed from basic data by Mendenhall but it was impracticable to reproduce them on plate 9, because of the complexity of the hydrologic pattern for 1933. However, a brief summary of salient features is presented. These contours indicate that in 1903–4 there was a general southward movement of ground water toward Ballona Gap from the upland area flanking the Santa Monica Mountains. In Ballona Gap the contours were drawn chiefly from water levels in shallow wells tapping the "50-foot gravel" because in 1904 very few wells had been drilled to the San Pedro formation below. Here the movement of water was southwestward and essentially parallel with the slope of the land surface. In Ballona Gap, a short distance west of the Inglewood fault, the water-level contours bulge coastward, indicating that water in the "50-foot gravel" was moving coast-

ward from the main basin into the west basin, over the top of the Inglewood fault. Throughout its 6-mile reach within the west basin Ballona Creek was an effluent stream draining water from the Recent deposits of the gap. The reach of effluent seepage extended inland at least half a mile beyond the Inglewood fault and into the area of artesian flow that still existed in 1904 in the main coastal basin.

The water-level contours for March 1933 (pl. 9), April 1941 (pl. 11), and November 1945 (pl. 12), show general similarity in direction of ground-water movement; and all show substantial change from the water-level contours of 1903–4. This change was brought about by (1) heavy draft from well fields in or adjacent to the two subbasins, and (2) the barrier action of the three major faults, which bound those subbasins.

In the main coastal basin, immediately inland from the Inglewood fault and adjacent to Washington Boulevard, heavy withdrawals from the wells at the Sentney plant of the Southern California Water Co. in sec. 5, T. 2 S., R. 14 W., and from nearby wells of the city of Beverly Hills (Cadillac and Castle plants) had developed a substantial cone of pressure relief by the early thirties. In March 1933, the pressure level at the center of this cone as represented by the hydrograph for well 2/14–5D5 (pl. 14), was about 10 feet above sea level; but by April 1941 it had been drawn down as much as 60 feeet below sea level. By 1945 local draft by the city of Beverly Hills had decreased and the water level in the spring of that year at well 2/14–5D5 had recovered substantially; but it was still 30 feet below sea level. Thus the pressure levels at these well fields have been maintained many tens of feet below sea level continuously for the past decade and water in the aquifers of the San Pedro formation has been moving into this cone of depression from the south, east, and north.

Crestal subbasin.—In the crestal subbasin, between the Inglewood and Overland Avenue faults, the movement of water in the San Pedro formation has been consistently southward from the Beverly Hills through 1945. Within this subbasin pumping draft is largely from wells at the Manning plant of the Southern California Water Co. in 2/15–1C and from well 2/15–12B1 of the Metro-Goldwyn-Mayer Corp. (pl. 2). Total draft from this subbasin is believed not to have exceeded 1,600 acre-feet per year. Under native conditions and continuously through the period of withdrawal, replenishment to the San Pedro formation in the crestal subbasin apparently has been supplied almost entirely by runoff from the south flank of the Santa Monica Mountains and by rainfall from the Santa Monica plain. However, in Ballona Gap north of Washington Boulevard, the water-bearing beds of the San Pedro formation are believed to be in direct contact locally with the overlying "50-foot gravel." Hence, ground

water passing westward across the Inglewood fault in the "50-foot gravel" may contribute some replenishment to the underlying San Pedro beds in the crestal subbasin. Within this subbasin, the position of water level in the "50-foot gravel" is not known, except at well 2/15–1P2 near the western boundary; here the water level in this aquifer has been about 30 feet lower than the pressure level of the San Pedro formation for the past 15 years. (See hydrograph for well 2/15–1P2 on fig. 4; pressure levels for San Pedro formation, pls. 9–12.) Thus, near this well, for many years the pressure differential between the two aquifers would not have permitted downward movement from the "50-foot gravel" to the San Pedro formation—if hydraulic continuity exists at all, movement would have been upward.

Charnock subbasin.—In the Charnock subbasin, during the past two decades at least, pumping has been concentrated at the Charnock plant of the city of Santa Monica (2/15–11C), and at the Charnock plant (2/15–11D, E, F) and the Sepulveda plant (2/15–11J) of the Southern California Water Co. The joint withdrawal from these three plants was 7,352 acre-feet in 1933, reached a maximum of 10,448 acre-feet in 1940, and was 7,258 acre-feet in 1941 and 5,005 acre-feet in 1945. The decrease in withdrawal was caused by the gradual decrease in the rate of pumping at the Charnock plant of the city of Santa Monica following 1940 and the complete cessation of pumping by the city late in 1944.

As a result of the concentrated withdrawal at the Charnock well fields and at the nearby Sepulveda well field, the water level in the San Pedro formation has been depressed several tens of feet below sea level since the late twenties. As shown by the water-level contours for the years 1933, 1941, and 1945 (pls. 9–12), and by other data, movement of ground water throughout the subbasin has been toward this focus of withdrawal for the past two decades. To the north (nearly to Pico Boulevard), water levels have been below sea level consistently since 1933, and the steep southward gradient induced by this draft has been as much as 50 feet to the mile (pl. 11). To the south (to and beyond the Ballona escarpment), water levels have been below sea level consistently since 1933, and the average northward gradient has been as much as 25 feet per mile (pl. 11). Thus, at least since 1933, about two-thirds of the water withdrawn from these well fields has come from the north and about one-third from the south. The water-level contours for the San Pedro formation indicate that very little water enters the Charnock subbasin from the east (across the Overland Avenue fault), or from the west (across the Charnock fault), even though the pressure differentials across the two faults have been as much as 110 feet and 90 feet (pl. 11).

The "50-foot gravel" may conduct some water into the Charnock subbasin, from both the east and the west. As shown by geologic section *D–D'* (pl. 3*D*), the "50-foot gravel" is in contact (at least locally) with the water-bearing beds of the San Pedro formation within the Charnock subbasin, and presumably some downward percolation of water occurs. However, fragmentary records of water levels in shallow wells indicate that in the part of the subbasin north of Ballona Creek, the "50-foot gravel" has been essentially dewatered for the past two decades. Southward from Ballona Creek, the base of the "50-foot gravel" locally is as much as 60 feet below sea level, and this water-bearing zone still must be almost wholly saturated.

Coastal area.—Between the Charnock fault and the coast, the "50-foot gravel" of Ballona Gap and the underlying main water-bearing zone of the San Pedro formation are in contact at many places, as shown by logs of wells. Thus, these water-bearing zones may have fair hydraulic continuity (p. 127). The water-level contours of 1903–4 indicate a general oceanward movement of water through these deposits, with a coastward hydraulic gradient of about 10 feet per mile. North of the gap, the water-level gradient was southward, indicating some replenishment from the Santa Monica upland area.

By the late twenties water levels in this coastal part of Ballona Gap had been drawn down as much as 10 to 30 feet and were from 5 to 15 feet below sea level (see pl. 9 for levels in 1933). The water-level contours of March 1933 indicate some continuing contribution from the north, but the underflow to the gap from beneath the Ocean Park and Santa Monica plains must be small because: (1) the water-bearing deposits are thin, and (2) southward movement is impeded by the ground-water barrier about at the north edge of T. 2 S., which is inferred to be a fault zone. Water levels in the gap had recovered to sea level by 1941, probably in part because of the heavy rainfall of that year but chiefly owing to a general decrease of draft for irrigation and cessation of pumping by the Marine plant of the city of Santa Monica in 2/15–9N; both actions were caused by saline encroachment. However, from the early thirties to date, the water level in this coastal part of the gap has been essentially flat and movement of water apparently has been largely in response to local draft. Except for withdrawals from the Marine plant to which reference has been made, that draft has been moderate and widely distributed. Because water levels were below sea level from the middle twenties through the thirties, sea water has advanced inland beyond Lincoln Boulevard and about half the distance from the coast to the Charnock fault (p. 197).

WITHDRAWAL OF GROUND WATER

HISTORY OF DEVELOPMENT

Development of ground water in the coastal plain began about 1870. As of 1904, Mendenhall (1905a, 1905b, 1905c) canvassed and described about 8,200 wells within the coastal plain, of which about 2,500 were flowing in the spring of 1904. Mendenhall estimated that in 1904, the average discharge of all flowing and pumped wells within the coastal plain was about 250 cfs, equivalent to a yearly withdrawal of about 180,000 acre-feet. He did not evaluate withdrawals from the west basin specifically. However, in 1904 there were 134 wells with pumping plants in the west basin, as compared to 282 wells with pumping plants in the Santa Monica and Redondo quadrangles (Mendenhall, 1905b, pls. 5 and 6). The average annual yield of all pumped and flowing wells in these two quadrangles was estimated as about 30,000 acre-feet. If the estimated yield is distributed in proportion to the number of wells with pumping plants, the withdrawals in 1904 were about 14,000 acre-feet per year for all the west basin, and about 10,000 acre-feet per year from the part of the west basin south of Ballona Gap—the Torrance-Inglewood subarea of this report. Because the lands irrigated by ground water within the Santa Monica and Redondo quadrangles amounted to only 12,250 acres in 1904, Mendenhall's over-all figure of 30,000 acre-feet probably is liberal (about 2.5 acre-feet per acre); thus, the estimate of 14,000 acre-feet just derived for the west basin likewise is also believed to be liberal.

During the quarter century following the canvass by Mendenhall, the rate of withdrawal from the west basin increased several fold, owing to: (1) increased demand for water for irrigation, industrial, and domestic use, (2) lack of surface-water sources, and (3) improvement and widespread use of deep-well turbine pumps. Information is not available to indicate the rate at which the withdrawal increased from 1904 to 1930. However, extensive industrial development commenced in the twenties, and water levels in wells tapping the Silverado water-bearing zone began to decline noticeably in the early to middle twenties. Also, a period of low rainfall began about 1919 (table 2), causing an increase in the use of water for irrigation. Thus, it is inferred that the over-all increase in draft was most rapid after 1919. Furthermore, the figures for electrical energy sold on the "agricultural-rate" schedule in the Redondo and Inglewood operating districts of the Southern California Edison Co. are available for the period beginning in 1923. In comparison with the amount of energy sold in 1932, as a base year (p. 104), the amount of energy sold annually in these two operating districts of the Edison Co. from 1923

through 1930 was higher in all years except 1927. The average use in the 8 years was 112 percent of the use in 1932; the peak was in 1923—about 140 percent of the 1932 base. Although water levels in the west basin declined nominally in the twenties, it is believed that pump efficiencies were improved sufficiently to nearly compensate for the increased lift, and that the amount of electrical energy required to raise an acre-foot of water remained nearly constant. Thus, it is concluded that the draft for irrigation in the Torrance-Inglewood subarea was slightly greater from 1923 through 1930 than in 1932 and following years (table 8). Accordingly, the main increase in irrigation draft must have occurred prior to 1923.

As indicated in table 8, by 1931 the withdrawal from the Torrance-Inglewood subarea was about 53,000 acre-feet per year, which incicates an increase of nearly 400 percent in the 26-year period since 1904. Records of withdrawal by the larger plants since 1931 are reasonably complete, and the withdrawal for irrigation and miscellaneous uses can be approximated with fair accuracy. Methods of evaluating this withdrawal are discussed in following pages, and estimates for the yearly over-all draft from the Torrance-Inglewood subarea beginning in 1931 are summarized in table 8.

PUMPAGE FROM MUNICIPAL WELL FIELDS

In 1945, eight cities operated municipal water systems within the Torrance-Santa Monica area. The well fields of the cities of El Segundo, Hawthorne, Manhattan Beach, Santa Monica, and Torrance are located within the west basin. The city of Santa Monica, however, purchased most of its water supply from the Metropolitan Water District, beginning in 1941, and reportedly discontinued the use of its well fields entirely in 1945. The city of Inglewood operated several well fields within the west basin and one (the Centinela Park well field) that was almost entirely in the main coastal basin. The city of Los Angeles operated its Lomita and Wilmington plants, which were within the west basin, and its Manhattan, 99th Street, and Figueroa Street plants in the main coastal basin. In 1945, the city of Beverly Hills pumped all of its water from well fields outside the west basin, partly from the main coastal basin and partly from the Hollywood basin of Eckis (1934, pl. *E*). In addition to these eight municipal systems, Los Angeles County Water Works Districts 13 and 22 withdrew water from plants wholly within the west basin. The distribution of plants producing more than 200 acre-feet of water for public supply or for industrial use in 1945 is shown on plate 12 (also see table 10).

Pumpage records for all these systems except that of Beverly Hills were collected by the Geological Survey from officials of the water

departments or from the city engineers. In some cases these records were extended to earlier years by utilizing estimates made by other agencies, chiefly the Metropolitan Water District (Vail, 1942, table 2). Records of pumpage by the city of Beverly Hills were obtained through the California Division of Water Resources. Available records of the yearly pumpage by each of the eight cities are given in table 7. In this table each record is carried back as far as available data will permit. Except as noted, records are for the calendar year. Total yearly withdrawals from the municipal and county water works district fields within the Torrance-Inglewood subarea from 1931 through 1945 are summarized in table 8, column 2.

TABLE 7.—*Yearly withdrawal of ground water by municipalities in the Torrance-Santa Monica area*

Year	Acre-feet	Year	Acre-feet	Year	Acre-feet
Beverly Hills, 1929–45					
[For year ending September 30; records obtained from California Division of Water Resources]					
1929	[1] 4,920	1935	5,654	1941	[2] 5,874
1930	[1] 6,900	1936	6,635	1942	[3] 4,977
1931	[1] 6,960	1937	6,778	1943	[2] 4,703
1932	[1] 6,290	1938	6,801	1944	[2] 5,030
1933	[1] 6,480	1939	7,958	1945	[2] 4,824
1934	6,139	1940	7,742		
El Segundo, 1931–45					
1931	[3] 412	1936	726	1941	808
1932	[3] 460	1937	966	1942	1,027
1933	502	1938	942	1943	1,098
1934	697	1939	680	1944	1,269
1935	706	1940	709	1945	1,156
Hawthorne, 1931–45					
[Estimates by Metropolitan Water District through 1941; records from city engineer beginning in 1942]					
1931	410	1936	690	1941	1,120
1932	560	1937	700	1942	1,900
1933	500	1938	800	1943	1,980
1934	550	1939	850	1944	2,302
1935	600	1940	900	1945	1,852
Inglewood, 1923–45					
[Record for years 1923–28 from Los Angles County Flood Control District; for years 1931–36 from Metropolitan Water District; for years 1937–45 from city engineer]					
1923	870	1931	2,170	1939	3,360
1924	2,280	1932	2,560	1940	3,610
1925	1,400	1933	2,440	1941	3,840
1926	1,320	1934	2,650	1942	4,190
1927	2,010	1935	2,350	1943	4,776
1928	2,240	1936	2,670	1944	4,939
1929	----------	1937	2,810	1945	5,297
1930	----------	1938	3,060		

[1] Metered consumption plus 10 percent to cover estimated losses.
[2] Additional water taken from Metropolitan Water District.
[3] Estimate by Metropolitan Water District.

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TABLE 7.—*Yearly withdrawal of ground water by municipalities in the Torrance-Santa Monica area*—Continued

Year	Acre-feet	Year	Acre-feet	Year	Acre-feet
Los Angeles, 1918–45 [Total withdrawal from Lomita and Wilmington pumping plants] [4]					
1919	4,272	1928	7,892	1937	0
1920	4,561	1929	9,774	1938	111
1921	5,285	1930	3,207	1939	48
1922	5,937	1931	8,615	1940	0
1923	7,385	1932	8,073	1941	105
1924	6,950	1933	8,434	1942	92
1925	6,805	1934	8,000	1943	651
1926	7,023	1935	7,211	1944	794
1927	7,312	1936	0	1945	2,058
Manhattan Beach, 1931–45 [Estimates by city engineer, based on rated capacity of booster pumps; rounded off by Geological Survey]					
1931	550	1936	650	1941	1,000
1932	550	1937	700	1942	1,050
1933	600	1938	750	1943	1,300
1934	600	1939	900	1944	1,300
1935	650	1940	950	1945	1,300
Santa Monica, 1931–45					
1931	[5] 2,496	1936	6,790	1941	[6] 4,469
1932	4,288	1937	7,147	1942	238
1933	5,117	1938	7,939	1943	33
1934	5,727	1939	8,525	1944	38
1935	5,812	1940	8,925	1945	19
Torrance, 1931–45					
1931	[7] 800	1936	[7] 1,070	1941	1,178
1932	[7] 800	1937	1,115	1942	1,500
1933	[7] 760	1938	1,350	1943	1,757
1934	[7] 890	1939	1,328	1944	1,786
1935	[7] 875	1940	1,376	1945	1,748

[4] For withdrawal from all well fields of the city of Los Angeles within the coastal plain from 1918 through 1944, see Poland, J. F., Sinnott, Allen, and others (report on withdrawals of ground water from the Long Beach-Santa Ana area), table 4, p. 39.
[5] Pumpage for April through December.
[6] Water supply chiefly from Metropolitan Water District beginning in 1941.
[7] Records from Metropolitan Water District.

WITHDRAWAL FROM THE TORRANCE-INGLEWOOD SUBAREA, 1931–45

METHODS OF EVALUATING WITHDRAWAL

Industrial consumption.—In the southern and central parts of the Torrance-Inglewood subarea, south of El Segundo Boulevard, 20 industrial plants currently obtain their water from wells. The largest use is by petroleum refineries, of which eight are in this area. Most of the records of withdrawal of ground water by each of these industrial plants was obtained from plant representatives. Meter records were available for all plants using large quantities of water. However, estimates that were supplied for several of the smaller plants were based on well performance and hours of operation.

In the central part of the west basin, between El Segundo Boulevard and the Ballona escarpment, there are a number of industrial plants,

but, as far as known, all of these plants purchase their water from municipalities or water companies.

Pumpage by large water companies.—Within the Torrance-Inglewood subarea about 25 private water companies supply water for domestic, irrigation, and industrial uses. Meter records of production are available for several of the larger companies. In connection with its field canvass of wells, the Geological Survey collected meter records from the California Water Service Co., the Dominguez Water Corp., the Palos Verdes Water Co., the Palisades Del Rey Water Co., and the Southern California Water Co. In addition, the pumpage of the Moneta Water Co. has been interpolated from estimates by other agencies in 1931 and 1944. With the exception of the part of the withdrawal by the Dominguez Water Corp. that is sold to industrial plants, total draft by these six companies is given in table 8, column 4.

Pumpage for irrigation and miscellaneous uses.—Withdrawal of ground water by private irrigators and by many small water companies is substantial. However, neither meter records nor estimates are available for most of this use. In its appraisal of withdrawal in the Long Beach-Santa Ana area, the Geological Survey estimated pumpage for agricultural purposes by deriving yearly mean energy factors (energy expended in raising a unit quantity of water) and applying these factors to the quantity of electrical energy expended in pumping from wells. In appraising pumpage for irrigation from the west basin, however, it was found that this method was not readily applicable because: (1) three operating districts of the Southern California Edison Co. extend from the west basin into the main coastal basin, (2) pump-efficiency tests were not sufficiently comprehensive in distribution to define satisfactory yearly energy factors, and (3) many of the smaller water companies are not supplied with energy under the agricultural-rate schedule of the Edison Co.

Because the energy-factor method could not be readily applied, the pumpage for irrigation and for miscellaneous uses in the Torrance-Inglewood subarea was estimated from figures of irrigated acreage, considered together with a plot of electrical energy purchased yearly on the agricultural-rate schedule. Specifically, in 1932 and in 1941, the California Division of Water Resources made crop surveys of the lands in the west basin. Unpublished data in the files of the Division, compiled from these surveys and from maps showing service areas of municipal systems and public utilities, have been utilized by the Geological Survey to estimate the acreage supplied from wells with meter record estimate of pumpage. For the Torrance-Inglewood subarea, it has been estimated from these data that in 1932 an area of about 13,200 acres was so supplied (about 90 percent classified by the Division as irrigated lands and about 10 percent classified as

domestic and industrial areas). Water use on the 13,200 acres in 1932, a year of nearly average rainfall (table 2), is estimated to have been about 13,200 acre-feet, an average use of 1 acre-foot per acre. This figure agrees with estimates made by the Los Angeles County Flood Control District from a field survey in 1931 (Dockweiler, 1932, pl. 11), which indicated that private irrigation and miscellaneous plants in the part of the Torrance-Inglewood subarea west of Vermont Avenue pumped about 9,200 acre-feet in that year. That figure did not include withdrawal from similar plants east of Vermont Avenue, but it is estimated that these plants pumped about 4,000 acre-feet in 1932.

Furthermore, from the crop survey of the California Division of Water Resources made in 1941, it has been estimated that the lands in the Torrance-Inglewood subarea supplied with water from wells for which neither meter records nor estimates are available was about 16,000 acres in that year. About three-quarters of this area—or about the same acreage as in 1932—was classified by the Division as irrigated lands and about one-quarter of the area was classified as domestic and industrial sections. Thus, it is apparent that an increase of about 3,000 acres in lands used for domestic and industrial development supplied with water by noncanvassed withdrawals had occurred since 1932. Data are not available to indicate the rate at which this increase in domestic use took place. Therefore, it is assumed to have been uniform, or about 330 acres per year, and to have required a duty of 1 acre-foot per acre.

To obtain yearly figures for the unmetered irrigation and domestic uses through 1941, it has been assumed that the annual sales of electrical energy under the agricultural-rate classification in the Redondo and Inglewood operating districts of the Southern California Edison Co. furnish an approximate index of water pumped for agricultural use from 1931 through 1941. In that 11-year period the average decline of water level within the Torrance-Inglewood subarea was about 4 feet for the Silverado water-bearing zone, the principal aquifer. The small increase in lift may have been more than offset by improvement in pumping-plant efficiencies. The year 1932, with an estimated withdrawal of 13,200 acre-feet for unmetered agricultural and domestic uses, has been taken as the base year. Thus, for 1931 and the years 1933 through 1941, estimates of withdrawal for unmetered irrigation use in each year have been obtained by multiplying 13,200 by the percentage of electrical energy used in that year in comparison to the 1932 base use. To the figure so obtained has been added the estimated increase in uncanvassed domestic use, prorated as described above. The sum of these two elements has been entered in table 8, column 6.

For the war years 1942–45, agricultural withdrawals decreased substantially but domestic expansion was greatly accelerated, and a considerable part of this increased domestic use of water was met by the smaller water companies. Data are not available to indicate the proportionate changes in area. Therefore, water used for irrigation and for miscellaneous purposes in these 4 years is assumed to have been constant at about 13,000 acre-feet per year.

The estimates entered in table 8 for yearly withdrawals by private irrigators and for miscellaneous use are only approximate. However, these figures constitute less than one-quarter of the total pumpage from the Torrance-Inglewood subarea. Extensive work would have been required to derive a more accurate estimate. In 1948 the California Division of Water Resources began a detailed study of the quantity of ground water drawn from each of the wells or well fields of this subarea, in connection with the pending adjudication of water rights. Accordingly, duplication of work, which the Division must carry out for legal reasons, was not believed to be warranted.

ESTIMATE OF TOTAL PUMPAGE

Table 8 and figure 3 summarize the yearly withdrawal from the Torrance-Inglewood subarea for the 15 years from 1931 through 1945. The estimated over-all draft from this area decreased from 52,600 acre-feet in 1931 to 44,500 acre-feet in 1937, rose to 52,700 acre-feet in 1942, and then increased sharply during the war years to about 78,000 acre-feet in 1945. As shown by the table, most of this expansion was caused by increased industrial demand. Withdrawals for

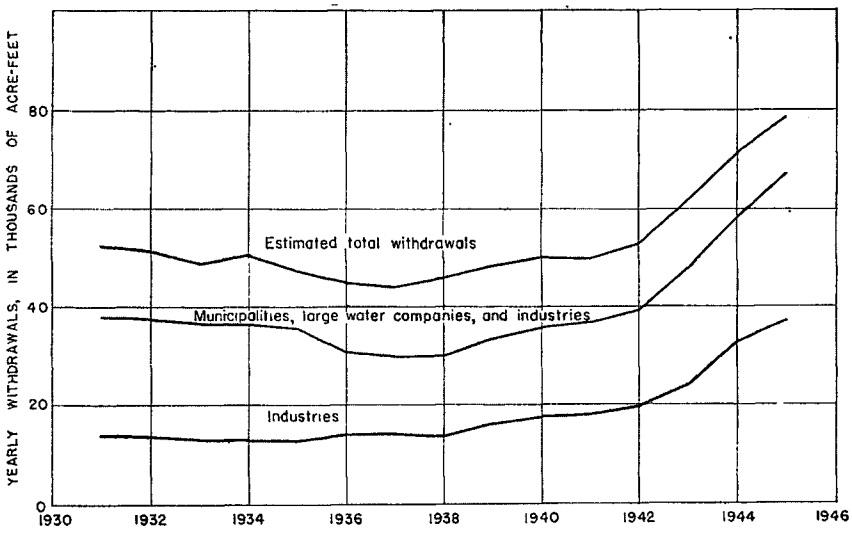

FIGURE 3.—Estimated withdrawals of ground water from the Torrance-Inglewood subarea, 1931–45.

industrial use were nearly constant at 14,000 acre-feet per year from 1931 through 1938, or about 30 percent of the total use; and increased to 19,640 acre-feet in 1942; and to 37,420 acre-feet in 1945, or about 48 percent of the total use. Most of the increase in industrial use of water during the war years was due to the expanded requirements of the oil refineries; in 1945, these refineries accounted for about 88 percent of the industrial demand.

TABLE 8.—*Estimated yearly withdrawal of ground water from the Torrance-Inglewood subarea,*[1] *in acre-feet, 1931–45*

Year	Municipal systems [2]	Industries [3]	Large water companies	Subtotal	Irrigation and miscellaneous	Total [4]
1931	12,720	14,720	11,210	38,650	13,900	52,600
1932	12,460	14,710	10,690	37,860	13,200	51,100
1933	12,900	13,100	10,200	36,200	13,000	49,200
1934	12,830	13,340	10,230	36,400	14,400	50,800
1935	12,030	13,510	10,250	35,790	12,100	47,900
1936	5,300	14,520	10,940	30,760	14,600	45,400
1937	5,580	14,830	9,830	30,240	14,300	44,500
1938	6,250	13,670	10,250	30,170	16,000	46,200
1939	6,020	16,470	11,220	33,710	14,900	48,600
1940	6,670	17,380	11,280	35,330	15,200	50,500
1941	7,010	18,520	11,200	36,730	13,600	50,300
1942	8,660	19,640	11,360	39,660	[5] 13,000	52,700
1943	10,640	24,740	12,770	48,150	[5] 13,000	61,200
1944	12,000	33,680	13,020	58,700	[5] 13,000	71,700
1945	13,220	37,420	14,770	65,410	[5] 13,000	78,400

[1] For purposes of this report, the part of the west basin south of the Ballona escarpment is called the Torrance-Inglewood subarea.
[2] Includes water pumped by County Water Works Districts 13 and 22.
[3] Includes water sold to industrial plants by the Dominguez Water Corp.
[4] Rounded off to three figures.
[5] Flat estimate only.

The municipal systems accounted for nearly 25 percent of the total draft in 1931 and about 17 percent in 1945. The decrease in use by municipal systems from about 12,000 acre-feet in 1935 to 5,300 acre-feet in 1936 was a result of cessation of withdrawal at the Lomita and Wilmington well fields of the city of Los Angeles, these fields had withdrawn about 8,000 acre-feet per year in the early thirties. Since 1936 the yield from these two well fields has been small.

WITHDRAWAL FROM THE CULVER CITY SUBAREA

Withdrawal of ground water from the Culver City subarea (the part of the west basin north of the Ballona escarpment) has not been appraised in detail. The field canvass of wells was carried only from 1 to 2 miles north of Ballona Gap and collection of records of pumpage from privately owned wells was not attempted for any part of the

Culver City subarea. However, the most heavily pumped well fields have been those of the city of Santa Monica and those of the Southern California Water Co. Table 9 gives the draft from the Culver City subarea by these two agencies yearly from 1931 through 1945.

TABLE 9.—*Withdrawal of ground water, in acre-feet, from the Culver City subarea by the city of Santa Monica and by the Southern California Water Co., 1931–45*

[Sum of pumpage from the Marine, Charnock, and Arcadia plants of the city of Santa Monica, and from the Pacific, Charnock, Sepulveda, and Manning plants of the Southern California Water Co.]

Year	Acre-feet	Year	Acre-feet	Year	Acre-feet
1931	7,111	1936	10,461	1941	8,705
1932	8,066	1937	10,956	1942	4,405
1933	8,607	1938	11,773	1943	5,622
1934	9,238	1939	12,567	1944	6,125
1935	9,312	1940	12,933	1945	6,106

In addition to the withdrawal from the principal well fields, shown in table 9, water from private plants was used to irrigate about 3,300 acres of land in 1932 and about 3,000 acres in 1941 (unpublished data from California Division of Water Resources), chiefly along the south edge of Ballona Gap and in secs. 2 and 3, T. 2. S., R. 15 W. (pl. 2). These irrigated areas were supplied almost exclusively from private wells, although possibly as much as 200 acres of this land have been irrigated with water pumped directly from Ballona Creek (C. E. Bollinger, Los Angeles County Flood Control District, oral communication). About two-thirds of the over-all acreage is planted in garden and field crops and one-third is in irrigated grass. The quantity of ground water pumped to irrigate these lands probably is about 4,000 acre-feet a year.

The privately owned wells yielding water for irrigation in the Culver City subarea in 1945 (excluding the area north of the north boundary of T. 2 S.) were distributed as follows: in the coastal area, 30 wells; in the Charnock subbasin, 24 wells; in the crestal subbasin, 2 wells. If the annual well yields are assumed to be proportional to the distribution, the estimated draft for irrigation (4,000 acre-feet) would be about 2,100 acre-feet from the coastal area, 1,700 acre-feet from the Charnock subarea, and 200 acre-feet from the crestal subbasin. Actually, because yields of wells in the Charnock subbasin are larger than those of wells nearer the coast and because slightly more than half of the irrigated acreage is supplied by water pumped from the Charnock subbasin, it is inferred that the division of draft as of 1945 was about 1,800 acre-feet from the coastal area, 2,000 acre-feet from the Charnock subbasin, and 200 acre-feet from the crestal subbasin.

The larger part of the withdrawal from the Charnock subbasin has been for public supply and has been obtained from the Charnock

well field of the city of Santa Monica and the Charnock well field of the Southern California Water Co.; both fields are in the NW¼ sec. 11, T. 2 S., R. 15 W. (pl. 2). The yearly withdrawal records from these two well fields for the 15 years are graphed on plate 14. The Sepulveda plant of the Southern California Water Co. (well 2/15–11J) also is in this subbasin. The over-all draft from the Charnock subbasin from these three well fields, and from the private irrigation wells previously discussed, is estimated to have been approximately 9,000 acre-feet in 1931, 10,000 acre-feet in 1935, 12,500 acre-feet in 1940 (the peak year), and 7,000 acre-feet in 1945.

In the crestal subbasin, perennial draft has been chiefly by: (1) the Manning plant of the Southern California Water Co. from well 2/15–1C, beginning in the middle twenties; (2) the Metro-Goldwyn-Mayer Corp., from wells 2/15–12B1 and 2/14–7P1, beginning in 1932; (3) the LAC Chemical Co., from well 2/14–6H1, beginning in 1942; and (4) the Holy Cross Cemetery from well 2/14–18Q1, and irrigation wells 2/14–18F1 and F2. The over-all draft from this subbasin did not exceed a few hundred acre-feet per year until the middle thirties; it was about 1,100 acre-feet in 1935 and in 1940, and had increased to about 1,600 acre-feet in 1945.

For the Culver City subarea as a whole, it is estimated that the withdrawal in 1931 was about 13,000 acre-feet. Withdrawal increased to about 20,000 acre-feet in 1940, the peak year of pumpage by the city of Santa Monica. In that year withdrawal was approximately two-fifths as large as it was in the Torrance-Inglewood subarea to the south. In 1945, when draft by the city of Santa Monica had ceased, the withdrawal had decreased to about 12,000 acre-feet per year, or only about one-sixth of that in the Torrance-Inglewood subarea. The over-all use of water in the Culver City subarea is many times greater than the ground-water draft. Current importations (1948) consist chiefly of surface water from the Los Angeles municipal supply, the Colorado River and ground water from the Sentney plant of the Southern California Water Co.

WITHDRAWAL INLAND FROM THE WEST BASIN

About 90 square miles of the Torrance-Santa Monica area is inland from the west basin and almost entirely within the main coastal basin. The over-all withdrawal of ground water from the 90 square miles was not evaluated in this investigation.

Except for the area within the city of Beverly Hills, nearly all of the territory north of Imperial Highway is within the city of Los Angeles and is supplied chiefly by water from the Los Angeles municipal system. Most of the Los Angeles municipal supply to the coastal

plain is imported from the Owens Valley or from the San Fernando Valley, but in this inland area the city currently obtains a minor auxiliary supply of ground water from its Manhattan and 99th Street plants. Some of the area north of Imperial Highway is served by the Sentney, South Los Angeles, and Normandie systems of the Southern California Water Co. The distribution and magnitude of draft from the larger well fields for public supply, as of 1945, are shown on plate 12.

Inland from the west basin, the position and slope of the pressure level are critical with respect to the rate of replenishment by underflow across the west basin boundary. Both the position and slope of the pressure level between Slauson and Rosecrans Avenues are believed to be affected to a major extent by the very heavy withdrawal in the Huntington Park area, a short distance to the east of the east boundary of the Torrance-Santa Monica area. However, the position and slope of the pressure level are affected also by the intensity of local withdrawal. Thus, it is of interest to note that the combined withdrawal from the pumping plants of the city of Los Angeles and of the Southern California Water Co., between Slauson and Rosecrans Avenues, was 4,030 acre-feet in 1931, 3,130 acre-feet in 1938, and 6,440 acre-feet in 1945.

DISTRIBUTION OF DRAFT AS OF 1945

By 1945 most of the withdrawal of ground water from the Torrance-Santa Monica area was concentrated at a number of intensively pumped well fields operated almost entirely for public supply or industrial use. To show the nature of this concentration and its effect on the water levels in the Silverado water-bearing zone and in the correlative aquifers within the San Pedro formation beyond the extent of the Silverado, the magnitude of draft at such plants within the coastal zone of the Torrance-Santa Monica area has been indicated on plate 12 by means of circles whose areas are proportional to the draft. The centers of these circles are plotted at the centers of pumping. For closely grouped wells, the circle commonly encompasses the entire well field; for groups of widely scattered wells which supply a single system, such as the South Los Angeles system of the Southern California Water Co., the circle is plotted approximately at the geographic center of pumping. The circles so plotted on plate 12 are numbered and table 10 identifies the agency withdrawing the water; numbers in this table correspond with those of the plate.

As shown on plate 12, the area of most intensive draft in 1945 was between Dominguez Hill and State Street, approximately along Alameda Street.

TABLE 10.—*Agencies withdrawing ground water from the coastal zone of the Torrance-Santa Monica area in 1945 for public supply or industrial use*

[Numbers identify location and magnitude of draft as indicated on plate 12; well fields withdrawing less than 200 acre-feet not listed]

Number on plate 12	Agency	Number on plate 12	Agency
1	City of Beverly Hills.	11	General Chemical Co.
2a	Southern California Water Co.: Sentney plant.	12	City of Manhattan Beach.
2b	Manning plant.	13a	California Water Service Co.
2c	Charnock plant.	13b	California Water Service Co.
2d	Sepulveda plant.	14a	Dominguez Water Corp.: Redondo plant.
2e	Pacific plant.	14b	Main plant.
2½	Metro-Goldwyn-Mayer Corp.	15	General Petroleum Corp.
3a	City of Inglewood: Plants in main basin.	16	Moneta Water Co.
3b	Plants in west basin.	17	City of Torrance.
3c	Plants in west basin.	18	Columbia Steel Co.
4a	City of Los Angeles: Manhattan plant.	19	Quandt pumping plant.
4b	99th Street plant.	20	County Water Works District 13.
5a	Southern California Water Co.: South Los Angeles system.	21	Palos Verdes Water Co.
5b	Normandie system.	22	City of Los Angeles: Lomita plant.
6a	Lennox system.	23	Union Oil Co.
6b	Gardena system.	24	The Texas Co.
6c	Lawndale system.	25a	Shell Oil Co., Inc.: Wilmington plant.
7	City of Hawthorne.	25b	Dominguez plant.
8	Airways Water Co.	26	Richfield Oil Corp.
9	City of El Segundo.	27	Tidewater Associated Oil Co.
10	Standard Oil Co. of California.	28	Johns-Manville Products Corp.
		29	Stauffer Chemical Co.

PRINCIPAL SOURCES OF GROUND WATER

SOURCES IN THE TORRANCE-INGLEWOOD SUBAREA

In the Torrance-Inglewood subarea, the principal sources of the ground water, in order of increasing age, are: (1) the Gaspur water-bearing zone in the deposits of Recent age (in Dominguez Gap); (2) the "200-foot sand" in the unnamed upper Pleistocene deposits; (3) the "400-foot gravel" in the upper part of the San Pedro formation of Pleistocene age; and (4) the Silverado water-bearing zone in the middle and lower parts of the San Pedro formation. In relation to draft, the Silverado water-bearing zone is of primary importance, and the "200-foot sand," the "400-foot gravel," and the Gaspur water-bearing zone are of secondary importance, and probably in the order listed.

In 1945, the Silverado water-bearing zone was the source of water for: (1) all withdrawals by industries, with the exception of one small plant; (2) essentially all withdrawals from the municipal well fields of Hawthorne, El Segundo, Manhattan Beach, and Torrance, and about one-third of the withdrawal from the well fields of the city of Inglewood within the west basin; (3) all withdrawals by County Water Works Districts 13 and 22; (4) all withdrawals by the California Water Service Co., the Dominguez Water Corp., and the Palos Verdes Water Co., and about 90 percent of the withdrawal by the Lennox, Lawndale, and Gardena systems of the Southern California Water Co.; and (5) at least half of the withdrawals by private irrigators and the

smaller water companies. Of the total withdrawal from the Torrance-Inglewood subarea in 1945—approximately 78,000 acre-feet—about 68,000 acre-feet or 87 percent was taken from the Silverado water-bearing zone.

Of the remaining 13 percent—approximately 10,000 acre-feet—about 8 percent was drawn from the "200-foot sand" and associated aquifers in the unnamed upper Pleistocene deposits, about 3 percent from the "400-foot gravel," and about 2 percent from the Gaspur water-bearing zone in Dominguez Gap.

SOURCES IN THE CULVER CITY SUBAREA

In the Culver City subarea the two principal sources of ground water, in order of increasing age, are (1) the "50-foot gravel" in the deposits of Recent age (in Ballona Gap); and (2) the main water-bearing zone of the San Pedro formation of Pleistocene age—believed to be the essential correlative of the Silverado water-bearing zone to the south. The main water-bearing zone of the San Pedro formation underlies all of Ballona Gap within the west basin and, at least in the Charnock subbasin, extends northward nearly 2 miles beyond the north edge of the Gap, or about to Pico Boulevard. No uniform water-bearing zone seems to exist north of Pico Boulevard. As shown by well logs, the aquifers are thin and discontinuous; as might be expected for alluvial deposits laid down by streams transporting debris from the Santa Monica Mountains.

The main water-bearing zone in the San Pedro formation has been the source of supply for: (1) almost all of the water pumped from the three well fields of the city of Santa Monica; (2) all of the withdrawal from the four well fields of the Southern California Water Co.; (3) nearly all of the withdrawal used for irrigation in the area north of Washington Boulevard, south of Pico Boulevard, and east of Centinela Avenue (pl. 2); and probably more than half of the water pumped for irrigation along the south side of the Ballona Gap. Thus, of the total withdrawal in the Culver City subarea in 1945—some 12,000 acre-feet—it is estimated that about 90 percent was drawn from the main water-bearing zone and associated aquifers within the San Pedro formation; most of the remaining 10 percent was drawn from the "50-foot gravel" in the deposits of Recent age in Ballona Gap.

SOURCES INLAND FROM THE WEST BASIN

As explained on page 108, the withdrawal from the 90 square miles of the Torrance-Santa Monica area inland from the west basin was not evaluated as a whole. However, all of the larger pumping plants draw water almost entirely from deposits of Pleistocene age and from aquifers within the San Pedro formation. These same

aquifers supply a substantial part of the replenishment to the west basin across the crest of the Newport-Inglewood uplift.

WATER-LEVEL FLUCTUATIONS

SCOPE AND UTILITY OF THE RECORDS

In 1903–4 Mendenhall made single measurements of depth to water or of artesian pressure head in several thousand wells on the coastal plain. To extend these data, water-level measurements were made in 41 representative wells at irregular intervals during the next two decades by the Geological Survey. Twenty-six of these wells were within the coastal and inland zones of the present investigation. The records through 1920 have been published by the Geological Survey (Ebert, 1921, p. 13–29); records for three wells for the years 1921–26 have been published by the California Division of Water Resources (Gleason, 1932, p. 62, 77, 104).

In connection with its investigation of water resources of the San Gabriel Valley, the Division of Water Rights in the California Department of Public Works, in cooperation with Los Angeles County and the city of Pasadena, measured depths to ground water periodically from 1923 until 1928 (Conkling, 1927, 1929, p. 171–200). This program superseded the earlier program of the Geological Survey but included only a few wells in the Torrance-Santa Monica area, all of which were in the territory east of Main Street—that is, in the vicinity of Compton and of Dominguez Gap.

The program of water-level measurements by the California Division of Water Rights was accompanied or followed by continuing programs of several agencies, which together extended over all the area of the present cooperative investigation. The two principal programs of periodic water-level measurement in the Torrance-Santa Monica area have been that of the Los Angeles Department of Water and Power, beginning in 1923 and terminating in 1941; and that of the Los Angeles County Flood Control District, beginning in 1928 and continuing to date. These programs have been supplemented by those of many other agencies, especially the following: The San Gabriel Valley Protective Association, beginning in 1928; the city of Pasadena, from 1928 to 1933; the city of Long Beach, beginning in 1929; the city of Beverly Hills, beginning in 1930; the Southern California Water Co., beginning about in 1929; and the California Water Service Co., beginning about in 1933. Periodic measurements have also been made by several other municipalities and water companies, by several industrial plants, and by a few individuals.

Nearly all the water-level records by the agencies listed above have been deposited with the Division of Water Resources in the Cali-

fornia Department of Public Works and are available to the public. Representative records from selected observation wells have been published (Gleason, 1932).

Beginning in 1943, single measurements of depth to water were made by the Geological Survey in several scores of wells in connection with the field canvass of water wells in the Torrance-Santa Monica area. Measurements were continued semiannually until December 1945 in about 60 of these wells. Measurements were made at weekly or biweekly intervals from 1944 to November 1946 in 20 other wells. Water-level recorders were also operated on six wells for periods of a month to 2 years. All the periodic water-level measurements made by the Geological Survey have been published in water-supply papers (see p. 89). Table 11 shows the scope of water-level data available from all agencies, including data taken by the Geological Survey for the coastal zone of the Torrance-Santa Monica area.

TABLE 11.—*Scope of water-level records available from wells in the coastal zone of the Torrance-Santa Monica area, as of July 1946*

Type of record	Number of wells measured		
	Active	Discontinued	Total
Nonperiodic and miscellaneous measurements			266
Semiannual measurements	111	140	251
Monthly measurements	125	350	475
Weekly measurements	16	4	20
Water-level recorder operated	4	27	31
Total	256	521	1,043

These records of depth to water in wells are of inestimable value for the interpretation of the past and present hydrologic conditions, and they reveal the changes in pressure level or water table that have developed as a result of increasing draft. Hydrographs plotted from periodic measurements in single wells show the nature of fluctuations and changes in head within the tapped aquifers. Thus, hydrographs for wells tapping separate aquifers at one place reveal the degree or the lack of hydraulic continuity between those aquifers. Water-level contour maps drawn from data for one or more aquifers known to be hydraulically continuous present the water-level conditions at selected times; discontinuities in the water-level contours define basin boundaries or barrier features. Also, the regional changes in water level shown by comparing maps for separate times can be utilized to obtain estimates of change in storage if the specific yield or storage coefficient is known.

Hydrographs for wells in the Torrance-Santa Monica area show several types of fluctuations, related chiefly to recharge and discharge. Specifically these fluctuations are caused by: (1) recharge from streams, (2) recharge by penetration of rainfall, (3) recharge by underflow, (4) discharge by pumping, and (5) tidal oscillations. Typical fluctuations are illustrated and discussed in following pages.

The water-level contour maps previously introduced (pls. 9–12) show four positions of the water level and directions of water movement in the aquifers of principal draft between 1904 and 1945. Hydrographs for 59 selected wells in the Torrance-Santa Monica area are presented on figures 4 and 5 and plates 13 and 14. The locations of the wells are shown on plate 11; the tapped zones are identified on the individual hydrographs and by symbols on plate 11. Pertinent hydrologic data are given in table 12.

FLUCTUATIONS IN THE TORRANCE-INGLEWOOD SUBAREA

Selected hydrographs assembled on figures 4 and 5 and plates 13 and 14, illustrate the rate of change in pressure head in the several aquifers in the Torrance-Inglewood subarea. Most of the hydrographs concern wells that tap the Silverado water-bearing zone, which supplied about 87 percent of the draft in 1945. Other hydrographs are presented, however, to compare pressure heads in overlying aquifers with that in the Silverado water-bearing zone. These paired hydrographs are of particular interest for three reasons: (1) they furnish proof that the aquifers have substantial hydraulic separation; (2) they indicate the effect of and furnish a clue to the magnitude of draft from each of the aquifers; and (3) they show the differentials in pressure head that have been developed between the several aquifers in the period of most intensive use and are of considerable interest in connection with possible downward migration of contamination, either now or in the future, and with the feasibility of artificial recharge.

DIFFERENCE IN HEAD DEVELOPED BETWEEN THE SEVERAL AQUIFERS

VICINITY OF DOMINGUEZ GAP

The Gaspur water-bearing zone of Recent age in Dominguez Gap occurs from about 60 to 140 feet below the land surface and is separated from the underlying Silverado water-bearing zone of Pleistocene age by several hundred feet of silt and fine sand of low permeability (pl. 6). On figure 5*C*, the composite hydrograph for wells 4/13–14K1 and 4/13–14L1 represents the pressure level in the Gaspur water-bearing zone from 1924 through 1946, and the hydrograph for wells 4/13–21H3 and 4/13–23G2 represents the pressure head in the Silverado water-bearing zone for the same period. Data from the Mendenhall well canvass of 1904 indicate that pressure levels in the two

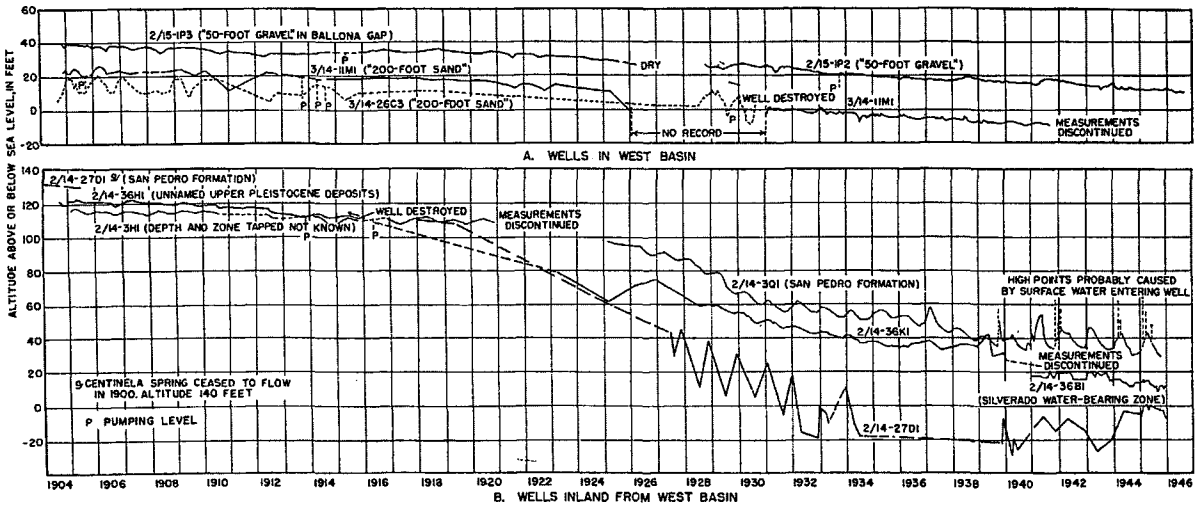

FIGURE 4.—Hydrographs of longest record for wells in and near the west basin.

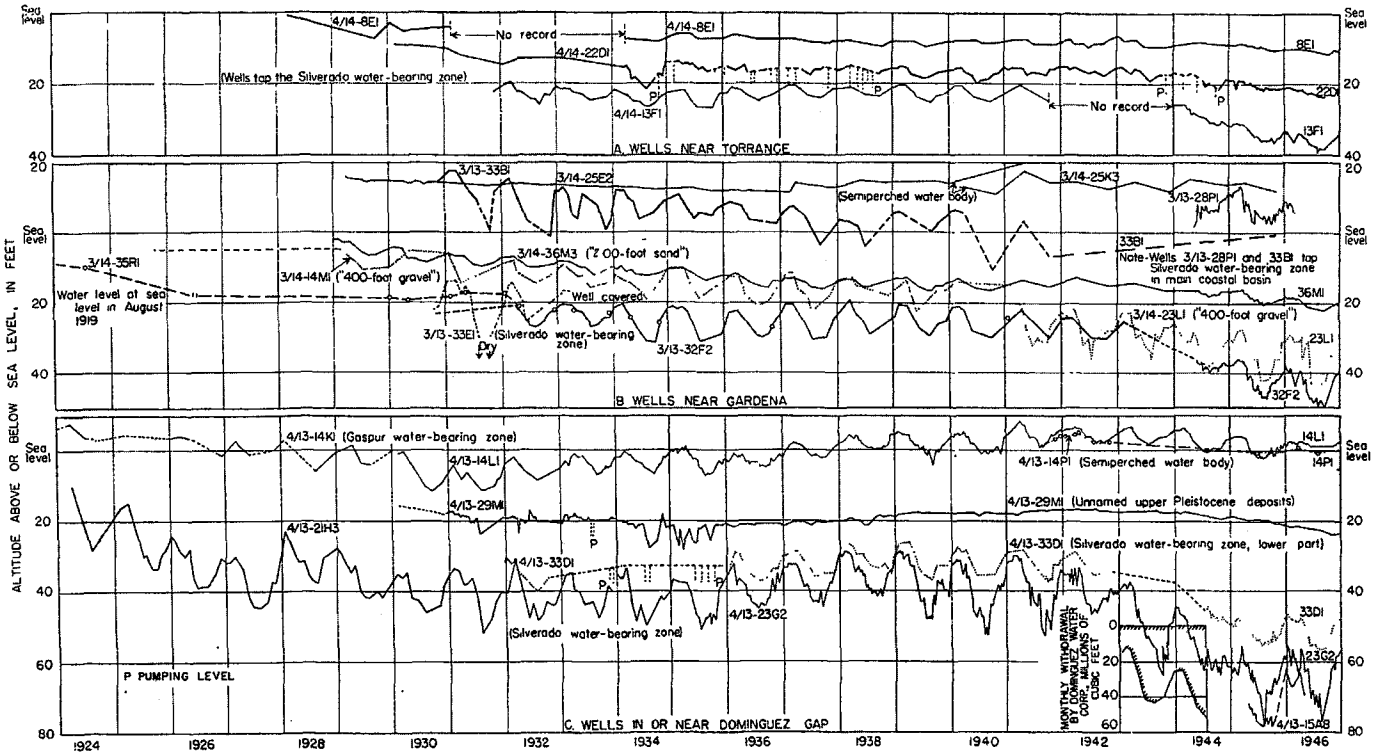

FIGURE 5.—Hydrographs for selected wells in the southern part of the west basin.

TABLE 12.—*Wells in or near the west basin for which hydrographs are plotted on figures 4 and 5 and plates 13 and 14*

Well		Owner's name and well	Water-yielding zone or zones			Agency supplying principal record [3]
USGS	Location [1]		Depth [2] (feet)	Feet below land surface	Stratigraphic correlation	
2/14-3H1		Artesian Land and Water Co.			(?)	USGS
3Q1	2667	City of Los Angeles.	661		San Pedro formation.	LADWP, LACFCD.
		Southern California Water Co.:				
5D5	2626D	Sentney plant, well 5.	266	152–257	do	SCWC
5D9		Sentney plant, well 9.	54	23–54	"50-foot gravel"	SCWC
5F2	2627	Shell Oil Co., Inc.	260		San Pedro formation.	LADWP
7M1	2609A	Mrs. J. D. Machado.	500		do	LADWP
18F1	2619A	Lewis A. Crank	265.8	90–312	do	LADWP, LACFCD
27D1	1352	City of Inglewood, well 7.	300	135–266	do	LACFCD, USGS
27F1, 2, 3	1363	Inglewood Park Cemetery Assn., wells 7, 2, 11.			Silverado zone	LADWP, USGS
32C1	1324	Formerly by Bowler.	190		"200-foot sand"	LADWP, LACFCD
34C1	1364	Inglewood Country Club.	450	264–362	Silverado zone	LADWP
36B1	1404	Southern California Water Co., Manchester Heights plant, well 1.	320		do	SCWC
36H1		Formerly by Mrs. Bedell.	110		Unnamed upper Pleistocene deposits.	USGS
36K1	1404B	Olivita Mutual Water Co.	565		Silverado zone	LADWP
2/15-1P2	2598	Guy Beringhely	80 185		"50-foot gravel"	LACFCD, LADWP
1P3	2597B	Formerly by Borjorquez.	66		do	USGS
		Southern California Water Co.:				
11E3	2578P	Charnock plant, well 1.	405	196–376	San Pedro formation.	SCWC
11F4	2578C	Charnock plant well 4.	380	168–346	do	SCWC
16F1	1240	J. H. Evans	56.0		"50-foot gravel"	LACFCD, LADWP
22B4	1261A	Clarence Michel	207	63–205	San Pedro formation.	LACFD, LADWP
23F1	1271M	Los Angeles County Flood Control District, test hole 1.	24		Semiperched water body.	LACFCD
24C1	1291	Mesmer City Corp., Ltd.	402	170–395	San Pedro formation.	LADWP
34H1	1264C	Formerly by Barnard.	250	130–250	do	LADWP, LACFCD
34K1	1264	Palisades del Rey Water Co., well 1.	208	91–133	do	LADWP, owner.

See footnotes at end of table, p. 119.

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TABLE 12.—*Wells in or near the west basin for which hydrographs are plotted on figures 4 and 5 and plates 13 and 14*—Continued

Well		Owner's name and well	Water-yielding zone or zones			Agency supplying principal record [3]
USGS	Location [1]		Depth [2] (feet)	Feet below land surface	Stratigraphic correlation	
3/13-7N1	1418	Formerly General Petroleum Corp.			Silverado(?) zone	LADWP
8L2	1437G	H. N. Edison, formerly by Mrs. Bushby.	254		Silverado zone	LADWP, USGS
17Q1	1439A	H. Hellmers	341	119–330	do	LADWP
18G2	1418F	Union Oil Co	384.0		do	LADWP, USGS
20C1	1439F	G. L. Douglas	403	183–243	do	LADWP
28P1		Gardena Syndicate.	401.0	284–340	do	USGS
32F2	833A	John Larronde	750		do	LADWP, USGS
33B1	853A	I. W. Hellman Estate.	375		do	LADWP
33E1		Union Oil Co	700	272–480	do	LADWP
3/14-4N1	1346B	Southern California Water Co., Truro plant, well 1.	636	318–636	do	SCWC
11M1	1377	Formerly by Johnson Ranch.	200		"200-foot sand"	USGS, LACFCD
13J2	1409A	Southern California Water Co., Southern plant, well 2.	582	236–556	Silverado zone	SCWC
14M1	1379	O. T. Johnson Ranch, well 5.	440	332–380	"400-foot gravel"	LADWP
		Southern California Water Co.:				
21B1	1349	Rosecrans plant, well 1.	468		Silverado zone	SCWC
23L1	770D	Compton plant, well 1.	397	334–353	"400-foot gravel"	SCWC
25E2	791	Baust	38		Semiperched water body.	LADWP
25K3	802B	A. J. Walter	30		do	LACFCD
26C3	781A	C. G. Pursche, formerly by C. C. Jorgensen.	205		"200-foot sand"	USGS, LADWP
35R1	794	Southern California Edison Co., Ltd., (Torrance substation).	550	470–548	Silverado zone	Owner, LACFCD
36M3	793B	W. H. Seward, formerly by Luckensmeyer.	315 193.0		"200-foot sand"	LADWP, LACFCD, USGS
		City of El Segundo:				
3/15-12L1	1297	Well 1	355	236–355	"200-foot sand" and Silverado zone.	LADWP
12L5	1297G	Well 8	380	207–312	do	Owner.
12L6	1297F	Well 7	350	222–320	do	Do.
		City of Manhattan Beach:				
25A1	701A	Well 3	547	204–280	Silverado zone	LADWP, LACFCD, USGS
25H2	701C	Well 4	395.0	239–265	do	LADWP
4/13-14K1	897	H. E. Dickson			Gaspur zone	JBL, DWR
14L1	887F	do	114.3	86–114	do	LB, LACFCD
14P1		City of Long Beach.	29.5	25–30	Semiperched water body.	USGS
15A8	876E	Dominguez Water Corp., well 5.	980	744–980	Silverado zone	Owner.

See footnotes at end of table, p. 119.

TABLE 12.—*Wells in or near the west basin for which hydrographs are plotted on figures 4 and 5 and plates 13 and 14*—Continued

Well		Owner's name and well	Water-yielding zone or zones			Agency supplying principal record [3]
USGS	Location [1]		Depth [2] (feet)	Feet below land surface	Stratigraphic correlation	
21H3	858B	Richfield Oil Corp., well 3.	800	430–788	Silverado zone	LADWP, owner.
23G2	888H	City of Long Beach, Silverado well 1.	1,074	596–1,066	do	LB
29M1	320	Robert Tracy	68.5		Unnamed upper Pleistocene deposits.	LACFCD
33D1	341D	City of Los Angeles, Wilmington plant, well 14.	888.2	669–800	Silverado zone, lower part.	LADWP, USGS
4/14-8E1	725	California Water Service Co., station 3, well 4.	440.5	140–373	Silverado zone	LADWP, owner, USGS
13F1	797	David E. Crutcher.	697.0	245–660	do	LADWP, USGS
22D1	768	Standard Oil Co., producing and pipeline dept., well 1.	404	206–404	do	LACFCD, USGS

[1] Number assigned by California Division of Water Resources.
[2] Depths below land-surface datum indicated in whole feet are reported; those to a tenth of a foot are measured by Geological Survey.
[3] Names of agencies used in this table are identified as follows: DWR, Division of Water Resources, State of California; JBL, J. B. Lippincott; LACFCD, Los Angeles County Flood Control District; LADWP, Los Angeles Department of Water and Power; LB, city of Long Beach; SCWC, Southern California Water Water Co.; USGS, U. S. Geological Survey.

water-bearing zones were about equal and were about 20 feet above sea level in 4/13–23D. By 1924, levels for both zones had been drawn down but the level of the Silverado water-bearing zone at well 21H3 was about 20 feet below sea level and some 25 feet below the pressure head in the Gaspur zone (fig. 5*C*). The differential increased to about 40 feet by 1930, remained nearly constant to 1941, and increased to about 60 feet by 1946 (high levels for the year for hydrographs 4/13–14L1 and 4/13–23G2). This increasing differential in pressure levels for the two water-bearing zones is indicative of the lack of hydraulic continuity between them. The Gaspur zone here is highly contaminated by oil-field brine, however (p. 258 to 260), and with this pressure differential, which currently is equivalent to some 25 pounds per square inch, the contamination poses a serious threat to the pure water of the Silverado water-bearing zone. Because the two zones are separated by beds of low permeability, contaminated water is more likely to move downward through wells whose casings are either perforated or rusted through in both zones.

The history of changes in the regimen of the Gaspur water-bearing zone both within and inland from the Dominguez Gap have been treated in some detail in another report (Poland, 1959).

For the semiperched water table in Dominguez Gap, the hydrograph of well 4/13–14P1, from 1941 through 1946 (also plotted on fig. 5*C*) shows that the position of the water table in recent years has been essentially equal to that of the pressure level in the Gaspur zone beneath.

Wells 4/13–29M1 and 33D1, in Wilmington and about 3 miles southwest of well 4/13–23G2, tap the unnamed upper Pleistocene deposits and the lower part of the Silverado zone (table 12). Hydrographs for these wells (fig. 5*C*) illustrate the trends and increasing differential between the water levels in these two aquifers at that place since 1931.

In 1904, under essentially native conditions of head, the water level in both aquifers was about 13 feet above sea level. In the upper Pleistocene deposits the water level had been drawn down to about 20 feet below sea level by 1931, was about constant into 1938, recovered to 17 feet below sea level by 1942, and then declined to 22 feet below sea level by 1946. The pressure level for the lower part of the Silverado water-bearing zone (well 33D1) had been drawn down to 31 feet below sea level by 1932, was about constant to 1942, and then was drawn down to 47 feet below sea level by 1946. Thus, the head differential between these two aquifers increased from nothing in 1904 to about 11 feet in 1932, and to 25 feet in 1946 (high level for the year).

At the Wilmington well field of the city of Los Angeles, a 240-foot section of fine sand and silt separates the upper and lower parts of the Silverado water-bearing zone; this section occurs from about 460 to 700 feet below land surface. Water-level measurements for well 4/13–33E6, not plotted on figure 5, indicate that the pressure level in the upper part of the Silverado water-bearing zone was about 21 feet below sea level in 1927, 24 feet in 1930, and 32 feet in 1946 (high levels for the year). Thus, by 1946, the pressure level for the upper part of the Silverado was about 10 feet below that of the unnamed upper Pleistocene deposits and about 15 feet above that of the lower part of the Silverado water-bearing zone (well 33D1).

GARDENA AREA

Four distinct and separate water-bearing zones in the Gardena area are tapped by wells. These zones and their approximate depths below land surface are as follows: (1) The semiperched water body to about 80 feet; (2) the "200-foot sand" in the unnamed upper Pleistocene deposits from 140 to 260 feet; (3) the "400-foot gravel" in the upper part of the San Pedro formation, from 320 to 400 feet; and (4) the Silverado water-bearing zone in the lower part of the San Pedro formation, from 500 to 700 feet (pl. 3*B*).

On figure 5*B*, hydrographs for wells 3/14–25E2 and 25K3 show the position of the water table in the semiperched water body from 1929 through 1945; the hydrograph for well 3/14–36M3 shows the pressure level in the "200-foot sand" from 1929 through 1946; hydrographs for wells 3/14–14M1 and 23L1 show the pressure level in the "400-foot gravel" for the same period; and hydrographs for wells 3/14–35R1 and 3/14–32F2 show the pressure level of the Silverado water-bearing zone from 1924 through 1946.

The record for the "200-foot sand" is extended back to 1904 by the hydrographs for wells 3/14–11M1 and 26C3 (fig. 4*A*). For the "400-foot gravel," although wells 3/14–14M1 and 3/14–23L1 are a mile apart, and although the hydrograph for well 3/14–23L1 indicates a pressure head about 5 feet below that of well 3/14–14M1 early in 1941 when well 3/14–23L1 was completed and placed in service, the two hydrographs are believed to represent the changes in pressure surface during the period of record. In confirmation, well 3/14–10C1, which also taps the "400-foot gravel" is 2.5 miles northwest of well 23L1; in 1945 the pressure level in well 10C1 (not shown on fig. 5) was only about 2 feet above that for well 3/14–23L1 in March and identical with it in December.

For the Silverado water-bearing zone, well 3/13–32F2 is 2.6 miles east of well 3/14–35R1 and only about a mile from the east boundary of the west basin. Nevertheless, from mid-1944 to the end of 1946, frequent measurements (at least biweekly) of depth to water in each of these wells indicated essentially an identical position of water level throughout the yearly range. In fact, the pressure level of these years in well 3/14–35R1 was not plotted on figure 5*B* because the graph would have been confused with that for well 3/13–32F2. For earlier years also, the levels for both can be considered coequal, as is shown by the position of the random measurements in well 35R1 as related to the hydrograph for well 3/13–32F2.

For the four water-bearing zones in the Gardena area, the changes in water levels that have occurred since 1904 can be summarized as follows, utilizing high level for the year if known:

1. In 1904, Mendenhall's data show that the water levels in the several water-bearing zones were about equal but increased slightly in altitude with depth of zone. For example, the water table of the semiperched zone and the pressure surface of the "200-foot sand" were both from about 15 to 25 feet above sea level, but the pressure surface of the Silverado water-bearing zone was from 25 to 30 feet above sea level.

2. By 1920, the water level in the "200-foot sand" had been drawn down to about 10 feet above sea level (well 3/14–26C3, fig. 4*A*) and that of the Silverado water-bearing zone had been drawn down to sea level (measurement by the Southern California Edison Co. in well 3/14–35R1).

3. In 1929, the water table of the semiperched body was 16 feet above sea level; and the pressure surfaces for the "200-foot sand," the "400-foot gravel," and the

Silverado water-bearing zone were respectively 2, 5, and 18 feet below sea level (fig. 5*B*).

4. By 1941, levels in the four zones were respectively 19 feet above sea level (25E2); 14 feet below sea level (36M3); 15 feet below sea level (14M1); and 22 feet below sea level (32F2).

5. As of 1946, levels were respectively 12 feet above sea level (extrapolated), and 18 feet, 29 feet, and 38 feet below sea level. Thus, as of 1946, and with respect to high levels for the year, the pressure level in the Silverado water-bearing zone was 50 feet below the semiperched water table, 20 feet below the pressure level of the "200-foot sand," and about 9 feet below that of the "400-foot gravel."

VICINITY OF INGLEWOOD

In the vicinity of Inglewood, the hydrographs for wells 2/14–32C1 and 3/14–4N1, shown on plate 13, indicate conditions of change in head in the "200-foot sand" (32C1) and in the Silverado water-bearing zone (4N1) from the early thirties through 1945. These wells are about 2 miles apart. Several hundred acre-feet of water is withdrawn each year from well 3/14–4N1, whereas well 2/14–32C1 is used solely as an observation well. Thus, their hydrographs do not furnish an absolute comparison of static water levels at one place. However, they do indicate the increasing differential in head between the two zones in a general way.

In 1904, water levels in both the "200-foot sand" and the Silverado water-bearing zone near the sites of these wells were about 25 feet above sea level. By 1933, the head in the "200-foot sand" was at sea level and that of the Silverado was about 8 feet below sea level. The pressure heads of both aquifers declined continuously from 1933 to 1945; by 1945, the head in the "200-foot sand" at well 2/14–32C1 was about 17 feet below sea level and the head in the Silverado at well 4N1 was about 40 feet below sea level. Thus, the head differential between the two aquifers, which was zero in 1904 increased by 1945 to 23 feet (high for the year) and about 50 feet (low for the year).

FLUCTUATIONS AND CHANGE IN HEAD IN THE SILVERADO WATER-BEARING ZONE

Figure 5 and plate 13 include hydrographs for 20 wells or groups of wells in the Torrance-Inglewood subarea that tap the Silverado water-bearing zone or correlative aquifers in the San Pedro formation. These wells were selected to give a wide and representative geographic distribution (pl. 11).

AREA SOUTH OF REDONDO BEACH BOULEVARD

With regard to the southern part of the area, figure 5 shows hydrographs for two wells in the water-table reach between Torrance and Redondo Beach—for well 4/14–8E1, 0.9 mile from the coast, and well 4/14–22D1, 2.3 miles from the coast; also for eight wells in the confined or pressure area between Torrance and Long Beach wells 4/14–13F1,

3/14–35R1, 3/13–33E1, 3/13–32F2, and 4/13–15A8, 21H3, 23G2, and 33D1. From west to east, these hydrographs show great differences in (1) the character and amplitude of the seasonal fluctuations, and (2) the rate and amount of decline in pressure head.

The seasonal fluctuations have been small in the water-table area west of Torrance and have become progressively greater to the east in the confined or pressure area. For example, in water-table well 4/14–8E1 the seasonal fluctuation has ranged from 1 to 3 feet, and since 1943, when pumping at this well ceased, the fluctuation has been about 1.5 feet per year. The graph from a water-level recorder operated on this well by the Geological Survey showed a daily fluctuation of as much as 0.1 foot, which was correlated with the tidal fluctuation at Los Angeles Outer Harbor. This correlation indicated a tidal efficiency of about 1.4 percent but with an 8-hour lag in registration. Well 4/14–22D1 is 2 miles farther from the coast and only about 200 feet from a pumped well. Even though the hydrograph shows the effect of the nearby pumping, the seasonal range commonly has not exceeded 4 feet.

Within the pressure area, the seasonal fluctuation has ranged from about 5 feet at well 4/14–13F1 in Torrance to as much as 20 to 25 feet at well 4/13–23G2 (city of Long Beach, Silverado well) in Dominguez Gap. Well 4/13–23G2 is an unused observation well a mile from the nearest active well tapping the Silverado water-bearing zone (4/13–22K1, used for irrigation); also 1.2 and 1.7 miles from the well field of the Dominguez Water Corp. (in 4/13–15A), and the Richfield Oil Corp. (in 4/13–21H). Each of these well fields is a locus of heavy draft (pl. 12, plants 14b and 26). The seasonal range shown by the hydrograph for well 4/13–23G2 was only about 13 feet from 1933 to 1938 but has nearly doubled with the accelerated withdrawal during the forties.

Most of the draft in the vicinity of Dominguez Gap is caused by continuous demands of industrial plants; the draft is about as heavy in winter as in summer. Therefore, the hydrograph for well 4/13–23G2 might be expected to show little, if any, seasonal fluctuation. However, the draft by the Dominguez Water Corp., which is the largest single draft of the area, does vary substantially from winter to summer, because part of the withdrawal is for irrigation and domestic use. The monthly draft by this corporation from January 1943 to June 1944, inclusive, has been plotted on figure 5*C* to show its relation to the seasonal fluctuation in pressure level in well 4/13–23G2. The correspondence is reasonably good, although the pressure level of well 4/13–23G2 is affected by other nearby pumping; it is possibly most strongly affected by the intermittent pumping of irrigation well 4/13–22K1.

The decline in the pressure head of the Silverado water-bearing zone in the southern part of the Torrance-Inglewood subarea has ranged from an average of about half a foot per year near Redondo Beach to as much as 2 feet per year in Dominguez Gap. At well 4/14–8E1 (in Redondo Beach), the water table has declined 10 feet from 1928 to 1946—an average yearly rate of 0.55 foot. In Dominguez Gap, some 10 miles to the east, the decline in the pressure head from 1924 to 1946, shown by the composite hydrograph for wells 4/13–21H3–23G2, has been 46 feet, and has occurred very largely in two widely separate periods. From 1924 to 1927 the decline was 20 feet, or about 7 feet per year; and from 1941 into 1946, during the war period, it was 26 feet, or about 5 feet per year.

AREA BETWEEN GARDENA AND THE BALLONA ESCARPMENT

For the central part of the west basin south of the Ballona escarpment, plate 13 shows hydrographs for eight wells or groups of wells which tap the confined reach of the Silverado, as follows: 3/15–12L1, L6, and L5, at El Segundo; 3/15–25H2 and A1 at Manhattan Beach; 3/14–21B1, 3/14–13J2, 3/13–18G2, and 3/13–20C1, all near Rosecrans Avenue; and 3/14–4N1 and 2/14–34C1 near Inglewood. Wells 2/15–34H1 and 34K1, whose hydrographs also are shown, tap the main aquifer of the San Pedro formation (believed correlative with the Silverado water-bearing zone) in the water-table reach near Playa del Rey (pl. 11).

In the confined reach of the Silverado water-bearing zone, near the coast at the municipal well field of El Segundo, hydrographs for wells 3/15–12L1, L6, and L5 suggest a seasonal fluctuation of about 2 feet if pumping effects are disregarded. Three miles inland and south of Hawthorne, the pressure level at well 3/14–21B1 varied about 10 feet per year in the middle thirties and the annual range increased to about 15 feet by the early forties. The joint discharge of wells 21B1 and 21B2 has ranged between 350 and 711 acre-feet per year since 1940. At the east margin of the west basin, the pressure level in well 3/13–18G2 fluctuated about 10 feet per year in 1945 and 1946, but the range in pumped well 3/14–13J2 has been as much as 23 feet (in 1945).

Throughout the central part of the west basin most of the water is pumped for domestic and irrigation use. Thus, the draft is heaviest late in the summer and it is lightest from December to March. The pressure levels in wells fluctuate in direct ratio to draft demands. This general seasonal fluctuation, which is greatest far within the confined reach of the Silverado water-bearing zone and near the centers of heaviest pumping, may be accompanied by a seasonal compression of the aquifer and the confining beds developed by the re-

duction of artesian pressure in the summer, when pumping is most intensive, and expansion of the beds caused by the gradual increase of pressure as water moves into the compressed parts of the formation during winter months. Such an explanation has been suggested by Fiedler (1944, p. 244–245) for similar fluctuation in the Roswell artesian basin. The subject of compressibility of artesian aquifers has been treated in more detail by Meinzer (Meinzer and Hard, 1925, p. 73–95; Meinzer, 1928, p. 263–291).

As in the water-table area near Redondo Beach, the seasonal fluctuations of the water table near Playa del Rey, at wells 2/15–34H1 and 34K1, have been very small—in most years the range in level has not exceeded 0.5 foot. The nearest heavy draft is at El Segundo, about 2.7 miles southeast from these wells as shown by plate 12. The only local withdrawal is from wells 2/15–34A1 and K1 (wells 3 and 1 of the Palisades del Rey Water Co.). In 1945 their joint draft was about 170 acre-feet.

The drawdown of about 1 foot in the water table at well 2/15–34H1, which persisted from February 1935 to April 1937, was induced by a temporary increase in draft from wells of the Palisades del Rey Water Company, as follows: 89 acre-feet in 1933; 87 acre-feet in 1934; 328 acre-feet in 1935; 147 acre-feet in 1936; 102 acre-feet in 1937; and 99 acre-feet in 1938. An active but temporary drilling program in 1935 in the so-called Del Rey Hills segment of the Playa del Rey oil field received most of its water supply from the wells of this company.

The water table in well 2/15–34K1 consistently stood about 2 feet above sea level in the thirties, but from the end of 1940 to the end of 1941 the level rose from 2.6 to 3.8 feet above sea level. Rainfall was very heavy in the water year 1940–41; at Los Angeles it was about 210 percent of the 68-year average (table 2), and the greatest since 1889–90. The unique rise in water level in well 34K1 was caused by recharge from this rainfall. The peak rainfall was in February and March (12.42 and 8.14 inches at Los Angeles); the water-table peak was in November–December, indicating a 9-month lag in maximum rate of recharge at the water table. The water from rainfall here must pass through about 80 feet of dune sand to reach the water table.

The average rate of downward movement of water from rainfall at well 34K1 in 1941 apparently was about 9 feet per month, only about 3 percent as rapid as the rate of 10 feet per day cited by Sopp (1929, p. 2227) for penetration through 150 feet of Recent alluvium near Pasadena, Calif. Possibly the slow rate of movement was caused by the restraining effect of two beds of clay (7 and 9 feet thick) reported in the log for this well to be present within the dune sand. It is not

known why the water table at well 2/15–34H1, 2,900 feet northeast of well 34K1, did not show a similar response, although a rise and decline may have occurred between the May and October measurements of 1941.

As shown by the hydrographs of plate 13, the decline in the pressure head of the Silverado water-bearing zone in the central part of the west basin (between Gardena and the Ballona escarpment) has differed widely from place to place.

Within the confined reach, about 1.2 miles from the ocean at the main well field of El Segundo, water levels were about 3 feet below sea level in the early thirties and about 4 feet below sea level in 1941 (wells 3/15–12L1–12L6); thus, these levels declined about a foot in 10 years. From 1942 through 1946 the decline was 8 feet, or nearly 2 feet per year. Wells at the main well field of Manhattan Beach (3/15–25A1) have shown about the same character and rate of pressure decline.

On the other hand, near the central synclinal axis of the west basin at well 3/14–4N1 (north of Hawthorne) the decline in pressure head was nearly uniform from 1933 to 1940 at about 2 feet per year, and then increased to more than 3 feet per year to 1946; at well 3/14–21B1, south of Hawthorne, the rate of decline was about 1.3 feet per year from 1930 to 1941 and about 3 feet per year from 1941 to 1946.

In the water-table reach near Playa del Rey (wells 2/15–34H1 and K1), water levels were essentialy stable from 1930 through 1944 but declined about 2 feet in 1945–46. Because water levels to the north, east, and south were below sea level as early as 1933 (pl. 9), the water table of the Playa del Rey area must have been maintained at or above sea level since the early thirties by recharge from rainfall. Thus, the recharge from rainfall in this area is shown to have been more than sufficient to supply the draft from the wells of the Palisades del Rey Water Co. However, in 1945 the regional cone of water-level lowering reached wells 34H1 and 34K1 and caused a steady if slow decline. It is interesting to note that the chloride concentration of water from well 34K1 has increased sharply since January 1945 (fig. 15), coincident with the decline in water level.

FLUCTUATIONS IN THE CULVER CITY SUBAREA

As discussed previously, the part of the west basin in and north of Ballona Gap includes three semi-independent subbasins formed by the partitioning effect of the Overland Avenue and Charnock faults. Water levels in the three subbasins have fluctuated in widely differing fashion. The hydrographs of plate 14 bring out some of the most marked differences.

COASTAL AREA

Wells 2/15–16F1 and 2/15–22B4, respectively, tap the "50-foot gravel" and the San Pedro formation in the coastal area west of the Charnock fault. Hydrographs for these wells (pl. 14) indicate that spring water levels in the two aquifers were essentially equal; in the thirties, the pressure head in the San Pedro formation at well 22B4 had a greater seasonal range than did that of the "50-foot gravel" at well 16F1, but this fluctuation was induced by nearby pumping for irrigation.

In 1904, water levels were about 5 feet above sea level near well 16F1 and 8 feet above sea level near well 22B4. By 1930 the levels had been drawn down about 10 feet below sea level at both wells. Records are not available to define when this drawdown developed; but presumably, most of it occurred in the twenties, when pumping for irrigation was most intensive. By 1930, the front of saline contamination had passed inland beyond both wells (pl. 16), and local draft was decreasing.

The hydrographs show a slow and relatively uniform recovery of water level from 1931 to 1941 in well 16F1, and a similar but irregular recovery in well 22B4; this recovery was caused by a decrease in irrigation draft as saline encroachment became more extensive (pl. 16). In the spring of 1941 the levels rose several feet, coincident with cessation of pumping at the Marine plant of the city of Santa Monica (in 2/15–9N); in 1940 this draft had been 944 acre-feet. Also the recovery of water level in 1941 probably was partly due to the increased replenishment during the wet winter of 1940–41. At well 16F1 the recovery continued until 1944, when the level stood a foot above sea level, and the "ground-water hole" of the early thirties had completely disappeared (pls. 9–12).

Well 2/15–23F1, about 4,000 feet east of well 22B4, taps the semiperched water body overlying the "50-foot gravel." The hydrograph (pl. 14) suggests that, the water table of the semiperched body generally stood a few feet above the water level of the underlying aquifers in the late thirties, but has been essentially coincident since 1941.

CHARNOCK SUBBASIN

Very few of the wells in the Charnock subbasin for which water-level records are available tap only the "50-foot gravel." Many small wells which formerly tapped this aquifer have gone dry and have been abandoned, such as well 2/15–1P3 (fig. 4). The hydrograph for this well indicates that the water level in the "50-foot gravel" declined fairly uniformly from 1904 to 1911 and from 1918 to 1926; the hydrograph for well 2/15–1P2 continues the record of the decline to 1946. Both wells are close to the Overland Avenue fault

which, however, does not interrupt hydraulic continuity within the "50-foot gravel." The hydrographs indicate that this aquifer does not have hydraulic continuity with the main aquifer of the San Pedro formation beneath, because the pressure levels of the latter aquifer have followed an entirely different trend. Hydrographs for wells 2/15–11F4 and 2/15–11E3 at the Charnock plant of the Southern California Water Co. and for well 2/15–24C1, about 2 miles southeast, illustrate the fluctuations since 1930 in the San Pedro formation (pl. 14).

In 1904 the water level in 2/15–11C was from 30 to 35 feet above sea level and in 2/15–24C it was about 16 feet above sea level. In 1925 the level at well 2/15–24C1 was 11 feet above sea level, thus indicating a decline in head of only about 5 feet since 1904.

In 1925 the city of Santa Monica completed its first well at the Charnock municipal field in 2/15–11C; about 1927 the Southern California Water Co. began taking water from its Charnock well field in 2/15–11E and 2/15–11F, and the draft became very heavy before 1930. This concentrated withdrawal from the NW¼ sec. 11 has been the controlling factor in the fluctuation of the pressure level in the main aquifer of the San Pedro formation throughout the Charnock subbasin since 1926. The heavy draft at these fields was supplemented by pumping at the Sepulveda plant of the Southern California Water Co. in well 2/15–11J, which also commenced in 1926. Together, these withdrawals produced a cone of perennial drawdown which rapidly extended to the north and south but was terminated abruptly on the west by the Charnock fault barrier, and was limited on the east by the more distant Overland Avenue fault. A water-level contour map of the high level for 1930 (not included in this report) shows that pressure levels at the Charnock well fields then were 20 to 30 feet below sea level; in addition, the map shows that water levels had been drawn down below sea level southward about 2 miles, or to Ballona Creek (see hydrograph for well 24C1), and northward about three-quarters of a mile, or about halfway to Pico Boulevard.

The hydrographs for wells 2/15–11F4 and 11E3 illustrate the great drawdown of water level that occurred at this center of pumping from 1931 to 1940, inclusive. The combined yearly draft from the Charnock well fields by the city of Santa Monica and by the Southern California Water Co., also illustrated on plate 14, increased from 6,070 acre-feet in 1931 to 9,190 acre-feet in 1940. Withdrawal by Santa Monica decreased about one-half in 1941 and was negligible by 1942 (the total draft from the Charnock fields was 2,505 acre-feet at this time). In response to this variation in concentrated draft, the water level in well 11E3 was drawn down to 100 feet below sea level by 1940 but

recovered about 45 feet by 1945 and became temporarily stabilized about 55 feet below sea level. It should be noted that this well is pumped and is in the midst of other pumped wells; hence the level for this well illustrated on plate 14 represents a "recovery" level observed while well 11E3 was idle but while other wells were pumped. Thus, it shows the over-all drawdown at the well field.

Water levels in other wells tapping the San Pedro formation in the Charnock subbasin have fluctuated primarily in response to the draft at the Charnock well fields. For example, well 2/15–24C1 is 2 miles southeast from the Charnock fields and has not been pumped since 1935. Its pressure-level graph is a reduced replica of the hydrographs for wells 11F4 and 11E3 and shows the same downward trend from 1930 (1925) through 1940 and a gentle recovery of about 4 feet from 1941 to 1945, inclusive.

CRESTAL SUBBASIN

The crestal subbasin occupies the narrow upthrown block between the Inglewood fault to the east and the Charnock fault to the west. In the San Pedro formation within this subbasin, movement of water is southward and the pressure levels now stand far above the drawndown levels to the west and east.

Records of water level by Mendenhall in 1904 and periodic measurements beginning in 1930 show that there was no change in the pressure head of the San Pedro formation in the crestal subbasin from 1904 to 1930. For example, measurements made by the Geological Survey in well 2/15–1F1 (Ebert, 1921, well 16) between 1904 and 1910 indicate that its pressure level then was 60 to 62 feet above sea level; it was still about 62 feet above sea level in 1930, as shown by a water-level contour map for the spring of 1930 prepared as a part of the present investigation. Also, about 2 miles to the south in 2/14–7M, the pressure level was 40 feet above sea level in 1904 and in 1930.

The hydrographs for wells 2/14–7M1 and 18F1 (pl. 14) show the change in pressure head that has occurred from 1930 to 1945, nclusive. The seasonal fluctuation has been less than a foot (a icharacteristic of wells in this subbasin). Decline of head began in 1931, was very gentle until 1936, increased in 1937, and then continued until 1945 at a fairly uniform rate—about 1 foot per year in well 7M1 and 2 feet per year in 18F1. Compared with the great range in water levels to the east and west, the change in pressure head in this subbasin has been suprisingly uniform and completely independent—attesting to a lack of hydraulic continuity within the San Pedro formation across the Inglewood and Charnock faults. The fluctuations of water level have been in response to change in draft within the subbasin. Perennial withdrawal has been chiefly by the Southern California Water Co. at its Manning plant in 2/15–1C,

beginning in the middle twenties; and by the Metro-Goldwyn-Mayer Corp. from wells 2/15–12B1 and 2/14–7P1, beginning in 1932. As described earlier (p. 108), the over-all draft did not exceed a few hundred acre-feet per year until the middle thirties; it was about 1,100 acre-feet in 1935 and in 1940, and about 1,600 acre-feet in 1945.

Water levels in wells at the Manning plant of the Southern California Water Co. show a seasonal fluctuation of as much as 10 feet, but their long-term trend has been in agreement with that of the hydrograph for well 2/14–7M1; water levels at the Manning plant are about 25 feet higher than at well 7M1.

Water levels in the "50-foot gravel" in the crestal subbasin have fluctuated in a different manner from those in the San Pedro formation, presumably because the "50-foot gravel" is hydraulically continuous across the barrier faults that are so effective in damming the older aquifer. Hydrographs for wells 2/15–1P2 and 1P3 (fig. 4) show the long-term decline in head in this aquifer. For the past two decades, draft from the "50-foot gravel" within the crestal subbasin has been negligible; hence the decline has been caused largely by decrease of inflow, and by continued outflow.

FLUCTUATIONS INDUCED BY PUMPING

Seasonal fluctuations related to pumping are discernible in most of the hydrographs for wells measured monthly or more frequently. Pumping draft for irrigation and other uses fluctuates not only with the season but also from day to day. Even wells supplying water to satisfy a reasonably constant industrial demand may be subject to momentary and frequent changes in rate of discharge if the system is operated with an automatic control and substantial storage facilities. These fluctuations of the water level in observation wells induced by such changes in the rate of withdrawal can be determined only by taking a continuous record of water level.

In connection with the operation of water-level recorders in wells, the Geological Survey has obtained many examples of these short-term fluctuations. Two records of particular interest are illustrated in figure 6.

Well 4/13–33D1 (city of Los Angeles, Wilmington plant, well 14) in Wilmington taps the lower part of the Silverado water-bearing zone from 669 to 800 feet below the land surface. The wells of the Texas Co. in 4/13–27M, 6,000 feet to the northeast, tap the full thickness of the Silverado water-bearing zone from 400 to 800 feet below the surface. In December 1941 well 4/13–27M4 (owner's well 6) was being pumped continuously at 850 gpm and well 27M3 (owner's well 5) was on automatic control, pumping intermittently at 3,000 gpm. Thus, the over-all discharge was at the base rate of 850

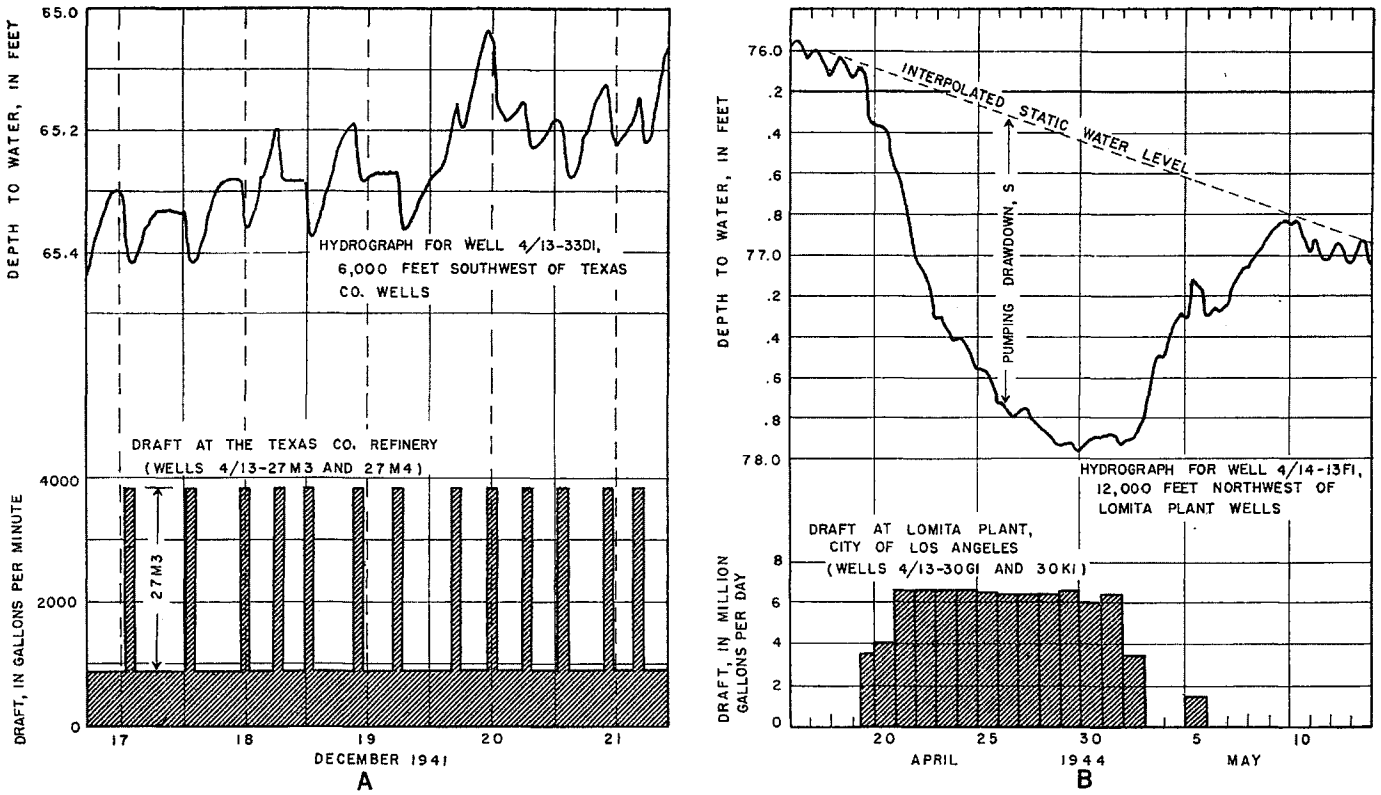

FIGURE 6.—Graphs showing fluctuations of water level in wells 4/13-33D1 and 4/14-13F1 induced by pumping of distant wells.

gpm with intermittent increase to 3,850 gpm (fig. 6). The plot of pressure head in well 4/13–33D1 indicates an immediate response to the pumping of well 27M3. During the time here graphed, the average length of each pumping period for well 27M3 was about 1 hour and the average drawdown in pressure level at well 33D1 induced by this pumping was about 0.08 foot. The drawdown at the pumped well was about 15 feet in 1941. The precise amount of time required for the transmission of the pressure effect through the 6,000-foot distance is not known but the graph indicates registration at well 33D1 within a very few minutes. Before the cause of the fluctuations was identified, the recorder had to be removed from the well and thus an expanded-time graph was not obtained.

Well 4/14–13F1, near Torrance, taps the full thickness of the Silverado water-bearing zone. The fluctuation of pressure head at this well from April 16 to May 13, 1944 is shown on figure 6 together with the combined daily draft from wells 4/13–30G1 and K1 (city of Los Angeles, Lomita plant, wells 6 and 7). The Lomita plant wells, located 12,000 feet southeast from well 4/14–13F1, also tap the Silverado. Their pumps had been idle for about 3 weeks before the beginning of pumping at 9:20 a. m. April 19. In the following 14 days (ending May 2), about 82,620,000 gallons (254 acre-feet) of water was withdrawn from the Silverado water-bearing zone through these wells, at an average discharge rate of 4,340 gpm. The hydrograph for well 13F1 shows that the drawdown of the pressure head caused by this pumping was superimposed on a general declining trend of about 0.04 foot per day. Before, during, and after the operation of the wells at the Lomita plant, the hydrograph for well 4/14–13F1 showed a diurnal fluctuation of about 0.1 foot; its cause is not known. As nearly as can be determined from the recorder graph for well 13F1, the pressure level at this well began to decline about 30 minutes after the pumps were turned on at the Lomita plant, about 2.3 miles distant. Considering the general trend, the drawdown in pressure level induced by the continuous operation of the Lomita plant was 1.1 feet after 4 days and 1.5 feet after 10 days.

Both the rate of response and the magnitude of drawdown at well 4/14–13F1 attest to the complete confinement of the Silverado water-bearing zone between Wilmington and Torrance. If this aquifer were unconfined in that area, it is doubtful if the effect of pumping at a distance of 12,000 feet could be detected from a recorder graph. Certainly a cone of water-table depression of appreciable depth would take many weeks to extend 12,000 feet from the origin.

By plotting on semilogarithmic coordinates the drawdown at well 4/14–13F1 against the time since the pumps at the Lomita plant were started (log scale), the graphical method developed by Cooper and

Jacob (1946, p. 526–534) can be used to determine transmissibility, permeability, and storage coefficient. As discussed on page 54, the transmissibility determined from these data is about 813,000 gpd per foot, and the indicated coefficient of permeability is about 2,000 gpd per square foot. The storage coefficient can be calculated by use of the equation:

$$S=2.25\ T\ t_0/r^2$$

where S is the storage coefficient (volume of water that a unit decline of head releases from storage in a vertical prism of the aquifer of unit cross section), T is the transmissibility, t_0 is the value of time at the drawdown intercept 0, and r is the distance of the observation well from the pumped well. The storage coefficient so derived from the semilogarithmic plot for drawdown in well 4/14–13F1 is 0.0012.

Figures 7 and 8—discussed in detail in the section on barrier features (p. 137 to 141)—also show drawdown fluctuations induced by pumping of nearby wells.

HYDROLOGIC EVIDENCE RELATING TO BOUNDARIES OF THE WEST BASIN

WATER LEVELS ACROSS THE BARRIER FEATURES OF THE NEWPORT-INGLEWOOD UPLIFT

The faults of the Newport-Inglewood uplift produce discontinuities in the pressure surfaces of the aquifers of Pleistocene age. Thus, the location of the fault barriers commonly can best be determined by constructing water-level contour maps and by relating hydraulic discontinuities to geologic or physiographic evidence of faulting. In places where the latter types of evidence are lacking or unknown, the hydraulic discontinuity may furnish the only proof of a fault barrier, and the accuracy of location then depends wholly on the water-level control. The inferred fault barrier passing southeastward along the Rosecrans Hills from the Potrero fault to the Avalon-Compton fault and the similar feature along the crest of Dominguez Hill both have been defined purely from hydrologic data as revealed on plates 9–12, and on hydrographs to be discussed.

The effectiveness of the faults as barriers to water movement can be evaluated in part from the magnitude of the hydraulic discontinuities across them, and by the gradients developed immediately inland and coastward. Both features are shown by the water-level contour maps. The effectiveness can be appraised also from simultaneous water-level fluctuations in two or more wells on opposite sides of such barrier features. In a recent report (Poland, 1959) such an appraisal has been made for the 22-mile reach of the Newport-Inglewood uplift from Dominguez Hill southeast to Newport Mesa.

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From that appraisal and with respect to the reach within Los Angeles County—that is, from Dominguez Hill to the Orange County line near Seal Beach—it has been concluded (Poland, 1959) that:

> In Dominguez Gap there is no barrier to movement through the Gaspur water-bearing zone of Recent age. In the underlying Silverado zone a substantial barrier has been developed but presumably it is not wholly watertight. Along the Signal Hill uplift the barrier features form a reasonably effective barrier to water movement but available evidence suggests that they are not wholly watertight against differential heads of several tens of feet. In Alamitos Gap, no barrier exists within the deposits of Recent age which extend to about 90 feet below land surface. However, the barrier across the underlying San Pedro formation is believed to be essentially watertight.

For the demonstration of the hydrologic evidence from which these conclusions were derived, the reader is referred to that report. In particular, attention is directed to the analysis of hydraulic conditions across the inferred extension of the Cherry-Hill fault in Dominguez Gap, (1) in the semiperched water body, (2) in the Gaspur water-bearing zone, and (3) in the Silverado water-bearing zone (Poland, 1959).

DOMINGUEZ HILL TO THE BALDWIN HILLS

To show hydraulic discontinuities across the 12-mile reach of the Newport-Inglewood uplift from Dominguez Hill northwesterly to the Baldwin Hills, selected data collected or assembled as a part of the present investigation are presented on five pairs or sets of hydrographs, as follows:

1. Across the ground-water barrier on the northwest flank of Dominguez Hill, hydrographs for well 3/13–33B1 (inland side) and well 3/13–33E1 (coastal side). (See fig. 5*B*.)
2. Across the south end of the Avalon-Compton fault, hydrographs for well 3/13–28P1 (inland side) and well 3/13–32F2 (coastal side). (See fig. 5*B*.)
3. Across the north end of the Avalon-Compton fault, hydrographs for well 3/13–17Q1 (inland side) and well 3/13–20C1 (coastal side). (See pl. 13*C*.)
4. Across the ground-water barrier along the central part of the Rosecrans Hills, hydrographs for wells 3/13–8L2 and 7N1 (inland side) and wells 3/13–18G2 and 3/14–13J2 (coastal side). (See pl. 13*C*.)
5. Across the Potrero fault east of the center of Inglewood, hydrographs for wells 2/14–27F1, 2, and 3 (inland side), and well 2/14–34C1 (coastal side). (See pl. 13*D*.)

All these wells tap the Silverado water-bearing zone, therefore the hydrologic data are common to this aquifer. The locations of these wells are shown on plate 11.

On the northwest flank of Dominguez Hill, wells 3/13–33B1 and 3/13–33E1 are about 2,700 feet apart (about 2,300 feet measured normal to the water-level contours). The record for well 3/13–33E1 spans only the years 1931–32. For these years seasonal fluctuation was about the same in both wells, but the pressure head in well 33E1

consistently stood 30 feet lower than that of well 33B1. Thus, the discontinuity shown on plate 9 (March 1933) is known to be an all-year feature. With reference to plate 9, if the approach gradient (inland side) and the escape gradient (coastal side) are projected to the inferred barrier a hydraulic discontinuity of about 25 feet is obtained. Although the measurements at well 33E1 ceased in 1933, the water-level contours of November 1945 (pl. 12) suggest that the actual discontinuity at the barrier had increased in the 12 years to nearly 40 feet.

The hydrographs for wells 3/13–28P1 and 32F2 also span a joint record of about 2 years, from 1944 to 1946. Well 3/13–28P1 is about 700 feet inland from the Avalon-Compton fault, and well 3/13–32F2 is about 4,500 feet coastward. The general character and amplitude of seasonal fluctuation are similar for the two wells. The differential in pressure head, which is about 50 feet, remained about equal throughout the 2 years. Hydrographs for wells 3/13–33B1 and 32F2 furnish a 15-year comparison of the fluctuation in wells which are 6,500 feet apart and on opposite sides of the barrier. They show that the difference between the pressure heads at the two wells has increased from 50 feet in 1931 to 66 feet in 1945.

Wells 3/13–17Q1 and 3/13–20C1, at the northwest end of the Avalon-Compton fault, are only 1,500 feet apart and nearly equidistant from the fault. The hydrographs for these wells, which extend from 1930 to 1945 (pl. 13*C*), show a striking difference in amplitude of seasonal fluctuation; the average for well 17Q1 is about 19 feet and the average for 20C1 is about 6 feet. The greater range in pressure head at well 17Q1 doubtless is caused by more intensive local pumping; however, the pressure effects are not transmitted to well 20C1 because of the fault barrier. The pressure differential at these wells was greatest in the early thirties—about 48 feet in February and 32 feet in August. In 1945 the differential had decreased to about 24 feet for both spring and autumn; this was due almost entirely to decline in head at well 17Q2 (successor to 17Q1 and tapping the same water-bearing beds).

On plate 13*C*, the hydrographs for wells 3/13–8L2 and 7N1 inland from the ground-water barrier along the Rosecrans Hills and those for wells 3/13–18G2 and 3/14–13J2 coastward from the barrier show a striking change during the 17-year period of record. Well 3/14–13J2 is one of the heavily pumped wells in the Gardena system of the Southern California Water Co. Well 3/13–18G2 was pumped by the Union Oil Co. until about 1942. So far as known the two inland wells have not been pumped during the period of record. From 1931 into 1937, the pressure-head differential between wells 3/13–8L2 and 18G2 decreased from 40 feet to 25 feet. In that same period

the head difference between wells 3/13–18G2 and 3/14–13J2 was constant at about 30 feet. From 1937 into 1941, the pressure head in well 3/13–18G2 declined about 30 feet; therefore, in 1941 a pressure differential of 52 feet had developed with respect to well 3/13–8L2. It is inferred that this drawdown of head in well 18G2 was caused by accelerated draft at the Southern plant of the Southern California Water Co. in 3/14–13J. By 1945 the high level for the year in well 18G2 was only about 4 feet above that for 3/14–13J2 and 57 feet below that for well 8L2. The record here discussed is considered to furnish indisputable evidence that well 3/13–18G2 is within the west basin and that it is hydraulically separated from the wells to the northeast by a ground-water barrier.

Hydrographs for wells 2/14–27F1, 2, 3, and 2/14–34C1 compare conditions across the Potrero fault at the north edge of the Rosecrans Hills (pl. 13*D*). Although the hydrograph for well 27F1 is shown here only from 1932, earlier measurements indicate a decline of head from 50 feet above sea level in 1930. The amplitude of seasonal fluctuation in well 27F1 has ranged from 5 to 7 feet; that in well 34C1 has ranged from 10 to 35 feet. From 1930 to 1939 the pressure head at well 27F1 was drawn down 49 feet, and the head in well 34C1 declined only 29 feet. On the other hand, from 1940 to 1945 the head in wells 27F2 and F3 (which tap the Silverado water-bearing zone also) declined only 2 feet, whereas the head in well 34C1 was drawn down 27 feet. This greatly accelerated drawdown of pressure head in well 34C1 is believed to reflect the increase in draft on the small subbasin in section 34 which was caused by the pumping of wells 34F1 and L2 (Hollywood Turf Club) beginning about 1941.

For the several pairs of hydrographs here discussed, the evidence indicates a substantial ground-water barrier at each place. The information gained from an appraisal of replenishment, however, indicates that the barrier features are by no means watertight throughout their extent under the range of differential heads that have prevailed across them in the past (see p. 159 to 161).

BALLONA GAP

Across the Inglewood fault in Ballona Gap, a striking hydraulic discontinuity has developed in the pressure head of the San Pedro formation through drawdown of head east of the fault by the joint draft of the Sentney plant of the Southern California Water Co. and the Castle plant of the city of Beverly Hills. Hydrographs are shown on plate 14 for wells 2/14–5D5 and 5F2 at and near the Sentney plant, respectively, inland from the fault, and for wells 2/14–7M1 and 18F1 in the crestal subbasin coastward from the fault. Although the latter two wells are more than a mile from the Inglewood fault and nearly 2

miles from the Sentney plant, their hydrographs represent fluctuation in the crestal subbasin. The contrast in the seasonal pattern and in the long-term trend needs no verbal emphasis. It is concluded from these graphs and from the shape of the water-level contours on plates 9–12 that between the Baldwin Hills and the Beverly Hills, the Inglewood fault presents an essentially water-tight barrier to movement in the San Padro formation.

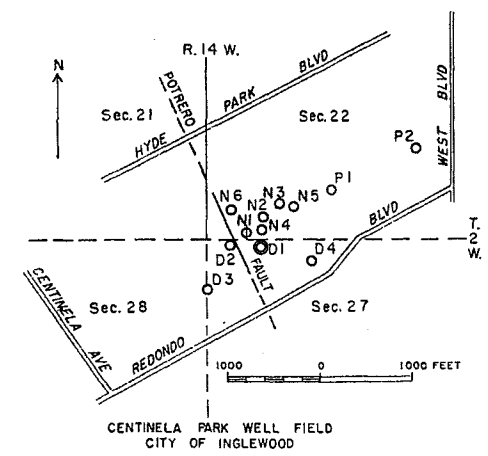
The water level in the "50-foot gravel" inland from the Inglewood fault was about 62 feet above sea level in 1946 (well 2/14–5D9)—about 90 feet above the pressure level in the San Pedro formation beneath (well 5D5). In the crestal subbasin coastward from the fault, the water level in the "50-foot gravel" as of 1946 was known only for well 2/15–1P2 (fig. 4), and was about 12 feet above sea level. Although the suggested gradient from well 5D9 to well 1P2 in 1946 was 25 feet per mile, it is inferred that no hydraulic barrier transects the "50-foot gravel" at the Inglewood fault. It is of interest to note that the gradient between these two places was 25 feet per mile in 1904 also, although the water level was about 30 feet higher at that time.

PUMPING TEST AT INGLEWOOD WELL FIELD

From January 3 to April 30, 1945, the Geological Survey operated a water-level recorder on well 2/14–27D1 (city of Inglewood, well 7), in the Centinela Park well field of the city of Inglewood, and 200 feet east of the Potrero fault. During the early part of the period of operation, it was noted that the water level in this well was drawn down several feet by the pumping of certain nearby wells in the Centinela Park field. With the cooperation of the Inglewood Water Department, a pumping schedule was arranged for the active wells in the Centinela Park field to determine the effectiveness of the Potrero fault as a barrier to water movement. The Inglewood Water Department kept a careful record of the pumping periods for the active wells in the field. The results of this pumping test are shown on figure 7.

As indicated by the plan of wells in the Centinela Park field (fig. 7), 9 of the 11 active wells in the field are east of the Potrero fault (in the main coastal basin) and 2 are west of the fault (in the west basin). All of the wells tap aquifers in the San Pedro formation, which is correlative with the Silverado water-bearing zone.

Figure 7 shows the drawdown in water level at well 27D1 caused by the pumping of well 22N2, 300 feet to the north. At the time, all other well pumps at the field were idle except those for wells 22P1 and 22P2, which were operated continuously through the period of record on the graph (March 5–12). The drawdown induced by pumping of well 22N2 was 3.8 feet after 46 hours of pumping. Obviously there is free hydraulic movement between these wells. As explained on page



WELL			
USGS	CITY OF INGLEWOOD	USGS	CITY OF INGLEWOOD
2/14-22N1	8	2/14-22P1	19
-22N2	9	-22P2	24
-22N3	11	-27D1	7
-22N4	12	-27D2	10
-22N5	13	-27D3	14
-22N6	20	-27D4	17

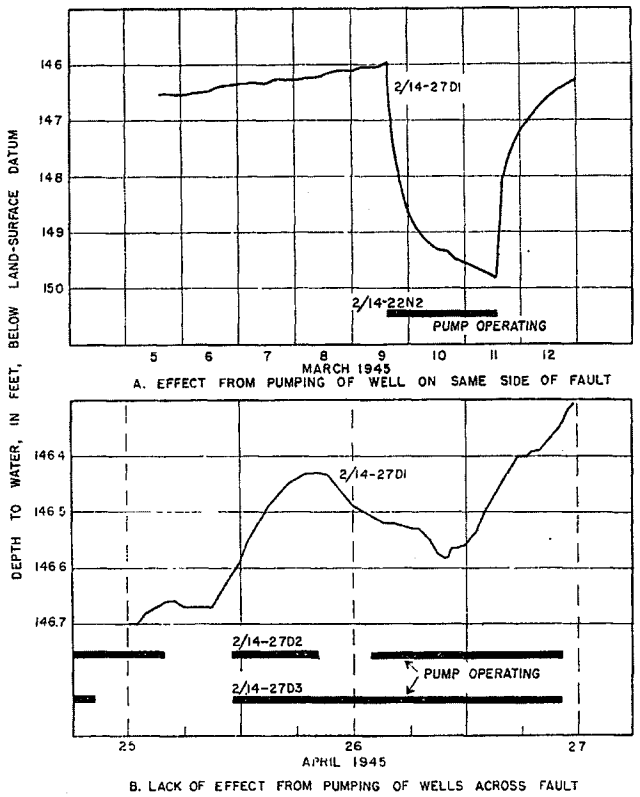


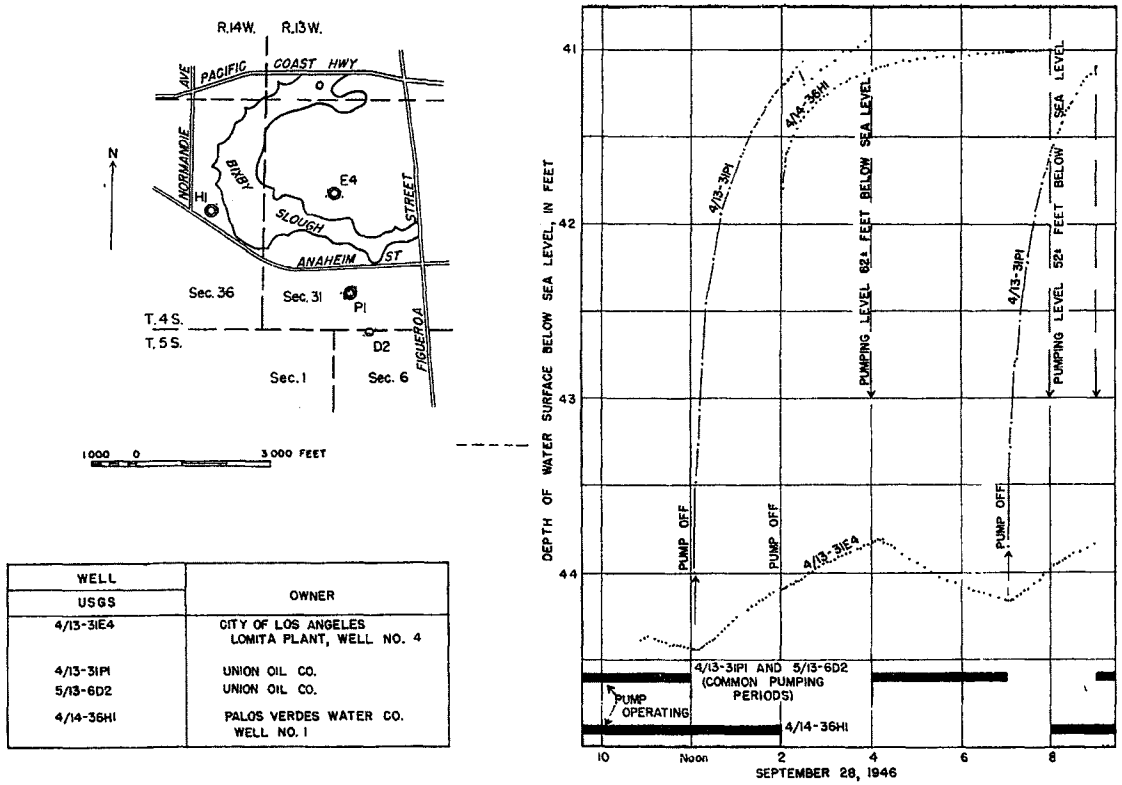
FIGURE 7.—Map of wells, and graphs showing fluctuations of water level in well 2/14-27D1 in Inglewood as related to pumping of nearby wells on opposite sides of Potrero fault.

55, this drawdown of water level in well 27D1 resulting from the pumping of well 22N2 was utilized in computing transmissibility and permeability of the water-bearing beds.

Figures 7 and 8 show the hydrograph for well 27D1 during the intermittent operation of the pumps in wells 27D2 and 27D3 (city of Inglewood, wells 10 and 14); both of these wells are west of the Potrero fault and are 325 and 725 feet, respectively, from well 27D1. For the period here graphed (6 a. m. April 25 to noon, April 27), two of the wells east of the fault 22P1 and 22P2 were operated continuously and all others were idle. Although the hydrograph for well 27D1 indicates drawdown and recovery of the water level in response to pumping, the fluctuations are not related to operation of the pumps in wells 27D2 and 27D3. For example, on April 25 the pumps in these two wells were started at 11:10 and 11:05 p. m., respectively, but the recovering water level in well 27D1 was not affected in the least. Clearly, the Potrero fault is an effective ground-water barrier within the head differentials imposed by this test. The drawdown in well 27D2 at the time of the test is not known. In November 1944 its level was drawn down to 30.7 feet below sea level after pumping for 15 minutes, or about 26 feet below the level in well 27D1. Presumably, the differential of April 25–27 was similar.

PUMPING TEST NEAR WILMINGTON

In September 1946, with the cooperation of the Union Oil Co., the Palos Verdes Water Co., and the Department of Water and Power of the city of Los Angeles, the Geological Survey made a pumping test near Bixby Slough, in Wilmington. This pumping test was made chiefly to determine whether a barrier to ground-water movement existed between the wells of the Union Oil Co. (4/13–31P1 and 5/13–6D2) and nearby wells at (1) the Lomita plant of the city of Los Angeles, in 4/13–31E, and (2) the Palos Verdes Water Co. property, in 4/14–36H. Figure 8 shows the relative locations of the wells, and graphs the results of the pumping test. All of the wells involved in the pumping test tap the Silverado water-bearing zone. Because the wells of the Union Oil Co., beginning with well 5/13–6D1 in 1922, always have yielded water of markedly different chemical quality from that yielded by the wells north of Anaheim Street (fig. 34), it had long been suspected that the Union Oil Co. wells might be separated from the west basin by a hydraulic barrier. For example, from the beginning of 1931 to the end of 1945 about 14,616 acre-feet of water was withdrawn from the Silverado water-bearing zone through the wells of the Union Oil Co. In 1931, the water yielded by well 5/13–6D1 contained about 500 ppm of chloride and 1,200 ppm of dissolved solids; as of 1945, the water from well 5/13–6D2 contained



WELL USGS	OWNER
4/13-31E4	CITY OF LOS ANGELES LOMITA PLANT, WELL NO. 4
4/13-31P1	UNION OIL CO.
5/13-6D2	UNION OIL CO.
4/14-36H1	PALOS VERDES WATER CO. WELL NO. 1

FIGURE 8.—Map of wells, and graph showing results of pumping tests to determine presence or absence of barrier features near Bixby Slough.

about 380 ppm of chloride and about 1,000 ppm of dissolved solids. On the other hand, the water withdrawn from the wells in 4/13–31E north of Anaheim Street, has ranged from 42 to 108 ppm of chloride and from 350 to 500 ppm of dissolved solids.

On September 28, 1946, the pumps at the Lomita plant of the city of Los Angeles were idle and had been shut down for several days. The wells of the Union Oil Co. had been pumped continuously for several months before the test, and the wells of the Palos Verdes Water Co. had been pumped intermittently during previous days. During the day, wells 4/13–31P1 and 5/13–6D2 (Union Oil Co.) and well 4/14–36H1 (Palos Verdes Water Co., well 1) were pumped intermittently on an alternating schedule (fig. 8), and water-level measurements were made by the Geological Survey at about 10-minute intervals from 10:00 a. m. to 9:00 p. m. at wells 4/13–31E4, 4/13–31P1, and 4/14–36H1. The fluctuation of water level in these wells is shown on figure 8. During the periods of pump operation as shown, the average joint discharge from the Union Oil Co. wells was about 2,150 gpm, and the discharge from well 4/14–36H1 was estimated by the operator as 1,230 gpm.

Between 12:10 and 4:10 p. m., the water level in well 31E4 recovered along a uniform curve as a result of the shutdown of the pumps in the Union Oil Co. wells from noon to 4:00 p. m. From 4:10 to 7:10 p. m., the water level in well 31E4 declined concurrently with pumping of the Union Oil Co. wells. There is no hydraulic barrier between the Union Oil Co. wells and well 31E4 at the Lomita plant of the city of Los Angeles. On the other hand, the recovering water levels in wells 31E4 and 31P1 did not show any response to the shutdown of the pump in well 4/14–36H1 (Palos Verdes Water Co., well 1) at 2:00 p. m., nor to the starting of the pump again at 8:00 p. m. Also, the recovering level in well 36H1 was not affected by the starting of the pumps in wells 4/13–31P1 and 5/13–6D2 of the Union Oil Co. at 4:00 p. m. Thus, there appears to be a substantial hydraulic barrier somewhere between well 36H1 on the west and wells 4/13–31E4, 31P1, and 5/13–6D2 on the east. The location and direction of this barrier are not known but it is inferred to be a cemented fault zone, because the Silverado water-bearing zone is known to be continuous, highly permeable, and about 700 feet thick between wells 4/13–31E4 and 4/14–36H1. If this barrier should extend northward from the Palos Verdes Hills into the west basin, it would have some effect on local circulation of ground water; but so far as known, it does not separate any of these wells from the main body of ground water in the west basin.

REPLENISHMENT TO THE WEST BASIN

SOURCES AND GENERAL FEATURES

EARLY CONDITIONS

Under the early conditions of ground-water development, replenishment to the water-bearing deposits of the west basin tapped by wells occurred in four ways. In probable relative order of importance they were as follows:

1. By underflow across the Newport-Inglewood uplift (the inland boundary of the west basin) through the deposits of Recent and of Pleistocene age.
2. By direct infiltration from the land surface of (a) water from rainfall, and (b) return water from irrigation, from cesspools, and by leakage from distribution systems.
3. By infiltration of local runoff water from the hills bordering the west basin, including the Santa Monica Mountains and the Santa Monica plain to the north, the hills of the Newport-Inglewood uplift (especially the Baldwin Hills) to the northeast, and the Palos Verdes Hills to the south.
4. By seepage within the west basin from the channels of the Los Angeles River to the south, and from Ballona Creek and its tributaries to the north.

CONDITIONS DEVELOPED BY WATER-LEVEL DECLINE

OCEAN-WATER REPLENISHMENT

During the period of ground-water use, the draft has become large and levels have been drawn down to sea level and below. As a result, in the twenties ocean water began to invade the water-bearing zones along the coast and became a source of recharge. Because of the accelerated decline of water levels in recent years this condition has become critical.

WATER RELEASED BY COMPACTION

Because of the drawdown of water level, water has been withdrawn from storage in the water-table reach, and some water has been derived by compaction of the aquifers and of the surrounding and enclosing fine-grained, relatively impervious sediments. The latter has been called "water of compaction" by Tolman (1937, p. 142–143, 470–472). The quantity so yielded doubtless has been largest in recent years and in areas of greatest drawdown of the pressure head, such as Dominguez Gap.

In certain other areas in California, large quantities of water have been derived by compaction of sediments resulting from regional drawdown of the pressure level. For example, in the Livermore Valley, Alameda County, Calif., Smith (1934; Tolman, 1937, p. 495–498) has estimated from a careful ground-water inventory that some 15,860 acre-feet of water was supplied by compaction of the alluvial materials during a low-water-level period from 1925 to 1930—an

average rate of about 3,200 acre-feet per year, as compared to an average yearly pumping draft of about 12,500 acre-feet. However, the amount of land-surface subsidence was not known, and the volume of compaction could not be determined.

In the Santa Clara Valley of Santa Clara County, Calif., Tolman and Poland (1940, p. 23–35) found that water of compaction, as measured by subsidence of the land surface and inferred equivalent reduction of pore space, was about 230,000 acre-feet from 1919 into 1937. Subsidence developed over an area of about 200 square miles as a result of an average water-level lowering of 100 feet in the 20 years from 1915 to 1935. The maximum subsidence, about 5.5 feet, was at San Jose. Insofar as water was derived from compaction of silt and clay bodies (aquicludes) within or enclosing the aquifers, it represented a nonreplaceable contribution to the usable ground-water supply.

In the west basin no such substantial subsidence of land surface has occurred as a result of ground-water withdrawal. In the vicinity of Terminal Island, near the crest of the Wilmington oil field, the land surface subsided as much as 7 feet between 1928 and 1947.[9] This subsidence was attributed by Gilluly, Johnson, and Grant (1945, also see Gilluly and Grant, 1949) as due almost wholly to the pressure decline and resulting compaction of the oil-bearing sands of Miocene and lower Pliocene age in the Wilmington oil field (which was caused by the removal of oil and gas beginning about 1937). In a recent report, Harris and Harlow (1947, p. 1197–1218) have concluded that the subsidence resulting from the pressure decline has occurred chiefly in the shale and siltstone associated with the oil sands. The publication of these two conflicting concepts on the mechanics of land subsidence emphasizes the need for careful research to resolve the relatively unexplored question of whether subsidence of the land surface associated with the withdrawal of large quantities of fluid is caused primarily by compaction of the permeable reservoir beds or of the relatively impermeable but porous silt, clay, and shale members which are interbedded with or confine the permeable beds, and which, in effect, are a part of the reservoir system.

A large range in the proportion of compaction of coarse-grained permeable deposits to that of fine-grained, relatively impermeable deposits probably will be found, as more examples of land subsidence associated with withdrawal of fluids or gases are studied in detail. The compressibility of each deposit must be in part a function of the physical character; for the fine-grained deposits the rate of com-

[9] Since the present report was released to the open file (1948), the maximum subsidence in the Wilmington area has increased to 22 feet (1955).

paction will also be a function of permeability which determines the rate at which pressure differentials can be equalized—that is, the rate at which fluid can escape from the fine-grained deposits to the more permeable reservoir rocks and permit compaction of the former.

Also in the vicinity of Terminal Island, a land subsidence of as much as half a foot occurred in 1941, concurrently with the dewatering for construction of the large graving dock at the Naval Operating Base on Terminal Island. A brief description of this dewatering operation, its effect on water levels in nearby wells, and the local subsidence of land surface has been given by Grant (1944, p. 149–154).

As summarized elsewhere (Poland, 1959), this dewatering at Terminal Island was carried out by turbine pumps in 36 gravel-envelope wells which tapped the Gaspur water-bearing zone. The dewatering was started on June 27, 1941, and reached a maximum during August, when the average rate of withdrawal was about 35,000 gpm. Pumping operations ceased on April 4, 1942, after the removal of about 26,000 acre-feet of water from the Gaspur zone in 9 months, or slightly more water than was pumped concurrently from this same zone by all water wells from Terminal Island to Whittier Narrows. The lowering of the piezometric level for the Gaspur water-bearing zone was as great as 35 feet in well 5/13–3L1 (Southern California Edison Co., well 4), and 15 feet in well 4/13–35M1, respectively 0.5 mile and 1.7 miles north of the center of pumping at the graving dock. The maximum recorded subsidence was at bench mark 43, at the southwest corner of the Southern California Edison Co. property and 1,650 feet from the center of the graving dock. Records taken by this company indicate that subsidence of bench mark 43 was 0.495 foot relative to bench mark 18, which is about 3,500 feet from the center of the graving dock. As described by Gilluly and Grant (1949, p. 497), substantial recovery of bench-mark altitudes coincided with recovery of water level in observation wells, during the reduced pumping rates of the latter part of the dewatering operation and immediately after cessation of pumping. The recovery of bench-mark altitudes ranged from 14 to 78 percent, with an average recovery of about 42 percent. From these facts, it was concluded by Gilluly and Grant that one-half or more of this subsidence due to the drawdown of the piezometric level of the Gaspur zone was attributable to mineral-grain rearrangement, and the remainder was due to elastic compression. It is of interest to note that the bench marks that underwent the largest subsidence had the smallest percentage of recovery of altitude.

At the center of the greatest drawdown of the pressure level of the Silverado zone within the west basin—at Carson and Alameda Streets in Dominguez Gap—the subsidence of land surface from about the

end of 1933 to 1944–46 was 0.354 foot, according to first-order leveling by the U. S. Coast and Geodetic Survey.[10]

Three miles to the south, on the right-of-way of the Southern Pacific Railroad, about 0.6 mile northeast of the Anaheim Street crossing, bench mark G 33—67 subsided 1.316 feet between 1914 and 1944–46. Of this subsidence, 0.942 foot has occurred since December 1931, and 0.528 foot since July 1941. This bench mark is within the productive limits of the Wilmington oil field and the greater part of the subsidence is believed to have been caused by the compaction which accompanied the withdrawal of oil and gas from that field.

Although the land surface has subsided several tenths of a foot throughout much of the southern part of the west basin, it is not known how much of this subsidence is due to compaction of sediments accompanying the decline of pressure head in the Silverado water-bearing zone. It may have been partly because of tectonic adjustments and partly because of pressure decline in the saline water sands at much greater depth which are hydraulically connected with the producing oil sands of the Wilmington and other oil fields. Accordingly, a direct estimate of subsidence due to compaction of sediments accompanying the decline of pressure head in the Silverado zone has not been attempted in this investigation. However, the quantity of water made available by such compaction of sediments has been estimated on page 151, by use of the empirical storage coefficient determined from the lowering of pressure head in well 4/14–13F1 due to the pumping of the wells at the Lomita plant of the city of Los Angeles (p. 133).

With fully effective confinement, water is yielded from storage only in proportion to the compaction of the water-bearing system (and expansion of the fluid) in response to pressure drop; therefore, it follows that in such cases the storage coefficient must be a measure of the compressibility of the system, and of the land-surface subsidence that will occur with each foot of sustained drawdown of the regional pressure level. However, in the ground-water basins of southwestern United States the water-bearing deposits consist almost entirely of valley fill (Meinzer, 1923, p. 291–303), and confining beds, although abundant, commonly are not extensive. Thus, with prolonged and substantial withdrawal of water, conditions of fully effective confinement are rarely found, and most of the water commonly is withdrawn from storage in the unconfined reaches of the basins by draining of the pore spaces. Only near the coast, where relatively impermeable beds associated with marine deposition are extensive, and in valleys such

[10] Bench mark D-167—At Dolores, at the southeast corner of the intersection of Alameda and Carson Streets, on the Dominguez Water Corp. property, at the pumping-plant building, in the face of the west wall.

as the San Joaquin, where the deeper water wells partly tap aquifers interbedded with fine-grained lacustrine deposits, would reasonably effective confining systems be found. When considered in relation to time intervals of as much as a few years, and possibly even several tens of years, conditions of fully effective confinement presumably are encountered only in the great artesian basins in which the aquifers have been deposited in interior seas. Probably the Dakota sandstone and the overlying plastic shales form the outstanding example of such a basin (Meinzer and Hard, 1925, p. 73–96; Darton, 1896).

Within the west basin, the area of greatest overdraft and of most serious saline contamination is the Torrance-Inglewood subarea. For these reasons, this subarea now (1948) is involved in a pending adjudication of water rights. Thus, the following appraisals of replenishment concern first the magnitude of replenishment to the Torrance-Inglewood subarea and second the replenishment to the smaller subbasins in the Culver City subarea.

REPLENISHMENT TO THE TORRANCE-INGLEWOOD SUBAREA

MAGNITUDE OF REPLENISHMENT IN 1903–4

The average rate of replenishment to the west basin in 1903–4 is believed to have been nearly equivalent to the natural and artificial discharge of that time. Such discharge occurred almost wholly by underflow to the ocean through the undersea extensions of the aquifers of Pleistocene and Recent age and by withdrawal through wells. The water levels were too far below the land surface to afford appreciable opportunity for evapotranspiration losses.

For the Torrance-Inglewood subarea an estimate of the natural discharge to the ocean in 1903–4 can be made by summing up (1) the discharge from the San Pedro formation (Silverado water-bearing zone and correlative aquifers) along the west coast from Playa del Rey to the Palos Verdes Hills, and along the south coast from the Palos Verdes Hills to the Los Angeles River, and (2) the discharge from the Gaspur water-bearing zone to San Pedro Bay. For the Silverado zone, the cross section along the coast is known with reasonable accuracy (pl. 3*C*), but the hydraulic gradient during 1903–4 at the coast cannot be accurately determined. Although water-level contours for the Silverado zone in 1903–4 have been reconstructed from data of Mendenhall (pl. 9 and p. 90), few of the wells in which water-level measurements were made near San Pedro Bay and from Manhattan Beach northward to Playa del Rey tapped the Silverado zone. The permeability of the Silverado zone was determined from pumping tests near Torrance and near Bixby Slough, but it was not determined along the coast. Yield factors for wells near the west coast compared to yield factors for wells between Long

Beach and Torrance (table 5)—where the permeability has been determined as about 2,000 gpm per square foot (p. 54)—suggest a proportion of about 2 to 3, or a permeability of about 1,300 gpm per square foot for the coastal reach from Palos Verdes Hills to Playa del Rey. The following paragraphs sum up the several increments of natural discharge:

1. For the reach from the Palos Verdes Hills to Hermosa Beach, the discharge to the ocean as of 1903–4 has been estimated as about 11 cfs, or about 8,000 acre-feet a year (p. 92).

2. In the same way and only as an approximation, the discharge to the ocean between Hermosa Beach and Playa del Rey can be estimated. The length of this reach is about 7 miles, the average thickness of the aquifer is about 125 feet (pl. 3*C*), the permeability is estimated as about 1,300 gpd per square foot, and the average hydraulic gradient at the coast in 1903–4 was at least 2 feet per mile. Thus, the discharge of that time (north of Hermosa Beach) is estimated to have been at least 2.3 mgd—about 3.5 cfs or about 2,500 acre-feet per year.

3. In regard to discharge from the Silverado water-bearing zone to San Pedro Bay, electric-log data for oil wells on Terminal Island indicate that the aquifers of the Silverado zone along that reach have an average thickness of about 250 feet. From the Los Angeles River west to the non-water-bearing rocks of the Palos Verdes Hills the width of the escape area is about 4 miles. Thus, the effective cross section is about 1,000 foot-miles. The coefficient of permeability for the Silverado zone in this area is not known, but it is probably somewhat lower than that in the Torrance area, where it was determined to be about 2,000 gpd per square foot (p. 54), and near Bixby Slough where it is about 1,400 gpd per square foot. If the permeability beneath Terminal Island is assumed to be about 1,000 gpd per square foot and if the hydraulic gradient of 1903–4 is taken as 4 feet per mile (p. 91), then the oceanward discharge through the Silverado zone beneath Terminal Island can be calculated at about 4 mgd—about 6.2 cfs or approximately 4,500 acre-feet per year.

4. Underflow to San Pedro Bay from the Gaspur water-bearing zone of Recent age is estimated to have been about 2.8 cfs, or about 2,000 acre-feet per year. These figures are based on the assumption that conditions at the coast were as follows: width of water-bearing zone, 2 miles (pl. 8); thickness, 60 feet—or an area of 120 foot-miles; hydraulic gradient, about 5 feet per mile (Mendenhall, 1905a, pl. 4); and an estimated permeability of 3,000 gpd per square foot (see p. 31).

In summation, the estimated yearly discharge to the ocean in 1903–4 from the aquifers beneath the Torrance-Inglewood subarea was about 21 cfs or 15,000 acre-feet from the Silverado water-bearing zone and was about 2.8 cfs or 2,000 acre-feet from the Gaspur water-bearing zone. Thus, the estimated total subsea escape was about 24 cfs or about 17,000 acre-feet per year. When this figure is added to the artificial discharge by pumping—which has been estimated at about 10,000 acre-feet per year during 1903–4 (p. 99)—the suggested over-all discharge was about 27,000 acre-feet per year, and the replenishment was comparable to that figure.

The rainfall record for Los Angeles (table 2) indicates that the 11 years ending with 1903–4 included only 4 years of normal or slightly above normal rainfall. With respect to the 68-year average rainfall of 15.53 inches, at the end of the year 1892–93 there was a cumulated surplus of 43.34 inches of rainfall. By the end of 1903–4 there was a cumulated deficiency of 3.79 inches, indicating an 11-year deficiency of 47.13 inches. The 3 years beginning with 1897–98 were the driest on record. Thus, runoff to the streams and recharge to the main coastal basin must have been continuously deficient during the 11-year period. Largely because of this deficiency, ground-water levels in the intake area near Whittier declined about 14 feet in this period and those near Anaheim declined about 40 feet (Poland, 1958). Also, the pressure level at the Bouton wells 2.5 miles north of Signal Hill and only 2 miles from the west basin boundary, declined about 80 feet in the same period. The decline of pressure head in the Bouton wells was far more than the average for the main coastal basin in Los Angeles County, however. The decline of artesian pressure along the northeast flank of the Newport-Inglewood uplift between Compton and Manchester Boulevard is known to have averaged about 30 feet from the initial historic level to 1904 (Mendenhall, 1905b, pl. 5).

The recharge to the west basin must have been affected in two ways by this deficiency of rainfall. First, there must have been little if any direct penetration of rainwater from the land surface in this period; certainly there was essentially none except in the 4 wettest years. Second, the replenishment by underflow across the Newport-Inglewood uplift must have diminished substantially in the 11-year period, because the pressure levels on the inland side of the barrier faults fell about 30 feet. Draft from the Torrance-Inglewood subarea was not large at that time and it appears doubtful that pressure levels in that subarea of the west basin could have declined in any such amount. Accordingly, the pressure differential across the barrier faults is inferred to have been greatly reduced by the decline in pressure level in the main basin; thus recharge to the Torrance-Inglewood subarea probably was considerably less in 1903–4 than in the eighties. It is believed that under native conditions of average rainfall the recharge to the Torrance-Inglewood subarea was 30,000 to 40,000 acre-feet per year.

MAGNITUDE OF REPLENISHMENT IN 1933–41

The replenishment to an underground basin may be estimated by measurement or calculation of the rate of inflow (intake methods) or the rate of discharge (discharge methods), or by determining changes in ground-water storage. Methods that have been applied to deter-

mine intake and discharge from ground-water reservoirs have been summarized by Meinzer (1932, p. 99–144).

For the west basin, the direct appraisal of the several elements of replenishment would be very tedious, and estimates of rain-water penetration, irrigation return water, and underflow (subsurface recharge) are subject to substantial error unless the basic data are sufficient to furnish reasonable control over the variable factors in the respective equations. Such is not the case at the present time. However, it is understood by the writer that the California Division of Water Resources, as referee in the pending adjudication of water rights, is planning to make a careful estimate of the several elements responsible for replenishment to the basin (California Division of Water Resources 1952).[11]

ESTIMATE BY RELATING PUMPAGE AND CHANGE IN STORAGE

For the purposes of this investigation, the elements of greatest interest are the over-all replenishment, the sea-water contribution, and the underflow across the Newport-Inglewood uplift. It can be assumed that, for years of average rainfall, the contribution by infiltration of water from rainfall and runoff from the land surface will be nearly constant from year to year. The residential and industrial areas are expanding rapidly and the agricultural area is decreasing, but the joint contribution by return water from irrigation of crops and lawns probably will not change appreciably as agricultural lands become residential districts.

The average gross replenishment can be determined most simply by selecting a period of years in which the cumulated rainfall did not markedly digress from the cumulated average, and in which the position of the water level was about equal at the beginning and the end of the period—that is, a period of little or no storage change. If the pumpage is known (or closely estimated) and if the storage change is estimated by the use of the specific yield and storage coefficients, the replenishment can be calculated. If there is no seaward discharge and no change in storage within the period, the gross replenishment is equal to the pumpage.

For the Torrance-Inglewood subarea of the west basin—the area included in the plaintiff's complaint for adjudication of water rights [12]—a relatively small amount of storage change occurred from the spring high-water level of 1933 to the spring high-water level of 1941 (pls. 9 and 11). Accordingly, this period of 8 years has been

[11] Since this report was released to the open file (1948), the California Division of Water Resources has completed its investigation as referee.

[12] California Water Service Co. and others *v.* City of Compton and others, Action No. 506,806 in the Superior Court for Los Angeles County, Calif., Oct. 1945.

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selected for appraisal of the average replenishment to this area before the accelerated draft and decline of water levels in the war years 1942–45.

The average yearly rainfall at Los Angeles in the years from 1933 into 1941 was greater than normal. However, 1940–41 was the only year of greatly excessive rainfall (table 2). With respect to the average rainfall for the 68 years from 1877–78 through 1944–45, as shown in table 2, the average rainfall in the years 1932–33 through 1939–40 was 1.76 inches above normal, and the cumulated surplus for the 8 years was 14.04 inches. For the 9 years from 1932–33 through 1940–41 the yearly average increased to 3.47 inches above normal, and the cumulated surplus was 31.27 inches. Thus, it might be expected that inclusion of the year 1940–41 would yield a nonrepresentative figure for storage change and replenishment. However, most of the water withdrawn from the Torrance-Inglewood subarea is taken from the Silverado water-bearing zone, which is confined by relatively impermeable beds through most of the area. Therefore, it is doubtful that the rainwater penetration of the winter 1940–41 could have had an appreciable effect on the water levels of the Silverado zone or even on the water levels in the shallower "200-foot sand" by April 1941. Examination of the hydrographs introduced on figures 4 and 5 and plates 13 and 14 substantiates this general conclusion. Therefore, it is considered that the period selected is reasonably representative but that rainwater penetration in the 8 years was slightly above average.

The rise or fall of water level in the Silverado water-bearing zone from March 1933 (pl. 9) to April 1941 (pl. 11) is shown by lines of equal change (long dashes) on plate 10; the rise or fall for the "200-foot sand" in this 8-year period also is shown (short dashes). As discussed on pages 87–88, a water table occurs in the Silverado water-bearing zone only in the Redondo Beach area (pl. 10); another water table occurs in the correlative main water-bearing zone of the San Pedro formation in the vicinity of Playa del Rey. It will be noted from the lines of equal change on plate 10 that: (1) the storage change in the water-table reach of the Silverado zone near Redondo Beach did not exceed 5 feet; and (2) the storage change in the water-table reach of the main water-bearing zone near Playa del Rey did not exceed 6 feet. The maximum change (except for the local fall of 20 feet east of Inglewood between the Potrero and Inglewood faults) in the Torrance-Inglewood subarea, east of Hawthorne in the pressure area, was about 16 feet. Inland beyond the west basin boundary, the maximum fall was in excess of 30 feet.

TABLE 13.—*Estimated storage change in the Torrance-Inglewood subarea, from March 1933 to April 1941, for the Silverado water-bearing zone and correlative aquifers in the San Pedro formation*

Township (S.) and range (W.)	Area (square miles)	Rise (+) or fall (−) (feet)	Change in volume		Storage change (acre-feet of water)
			Square miles × feet	Acre-feet	
Silverado water-bearing zone, water-table area near Redondo Beach					
------	2.91	−1	−2.91	−1,862	--------
------	11.94	−3	−35.82	−22,925	--------
------	.72	−5	−3.60	−2,304	--------
------	1.38	+1	+1.38	+883	--------
------	1.05	+3	+3.15	+2,016	--------
------	.17	+5	+.85	+544	--------
	18.17	--------	−36.95	−23,648	[1] −4,730
Main aquifer, San Pedro formation, water-table area near Playa del Rey					
------	1.42	−1	−1.42	−909	--------
------	1.11	−3	−3.33	−2,131	--------
------	.39	−5	−1.95	−1,248	--------
------	2.00	+1	+2.00	+1,280	--------
	4.92	--------	−4.70	−3,008	[1] −600
Silverado water-bearing zone, confined area					
2/14	7	−11.6	−81	--------	--------
2/15	1	−5	−5	--------	--------
3/13	8	−4.4	−35	--------	--------
3/14	33.5	+8.5	−285	--------	--------
3/15	5	−2.2	−11	--------	--------
4/13	32	+.8	+25	--------	--------
4/14	7.5	0	0	--------	--------
	94	--------	−392	−250,880	[2] −300

[1] Total change in volume (acre-feet) multiplied by 0.20 (specific yield).
[2] Storage coefficient assumed to be 0.0012 throughout the pressure area.

The storage change in the Silverado water-bearing zone was determined in the following manner:

1. The working copy of plate 10, at a scale of 1:48,000 was superimposed over a map sectionized in the manner of plate 2, each main grid unit representing 1 square mile. For the two water-table areas, a grid subdivided in hundredths of a square mile was utilized to determine the part of each section falling between two lines of equal change. For the larger pressure area, the average change of water level in feet was estimated for each square mile. For each territory the area in square miles lying between lines of equal water-level change (0–2, 2–4, and 4–6) was summed up separately. Cumulative areas so obtained were multiplied by the odd-foot value between the two boundary lines (the average change for the area between the 2- and 4-foot lines was assumed to be 3 feet), giving a volume for storage change in square miles × feet. By summing up all such volumetric elements for each area, the total volume change was obtained for that area.

2. The specific yield for the two water-table areas was assumed to be 20 percent (in accordance with estimates made by Eckis from samples collected in the field and tested in the laboratory) (1934, pl. *E*). The storage coefficient of 0.0012—obtained from the drawdown of water level in well 4/14–13F1 due to pumping of the Lomita plant wells (p. 133)—was applied to the main pressure area. Table 13 presents a summary of water-level changes, volumes dewatered or saturated (or of pressure-level change), and water released from storage.

The storage change has been computed for the "200-foot sand" in the same manner. Contours of the water level in this aquifer were not constructed for the beginning and end of the period of appraisal. Instead, the changes in position of the water level in the period for individual wells were plotted on the working copy of plate 10 and the lines of equal change were drawn from these data. Table 14 summarizes the results of the computation. About one-fourth of the pertinent well logs show water-table conditions at current water levels in the upper Pleistocene deposits ("200-foot sand" and other deposits); therefore, the over-all specific yield was assumed to be about 5 percent.

TABLE 14.—*Estimated storage change in the Torrance-Inglewood subarea, from March 1933 to April 1941, for the "200-foot sand" and correlative deposits of upper Pleistocene age*

Area (sq mi)	Rise (+) or fall (−) (feet)	Change in volume		Storage change (acre-feet of water)
		Square miles × feet	Acre-feet	
16.93	−3	−50.79	−32, 505	----------
19.70	−5	−98.50	−63, 040	----------
10.90	−7	−76.30	−48, 830	----------
8.24	−9	−74.16	−47, 460	----------
55.77	----------	−299.75	−191, 835	[1] −9, 600

[1] Total change in volume (acre-feet) multiplied by 0.05 (specific yield).

The estimated storage change within the Silverado zone in the 8-year period (table 13) is 5,600 acre-feet of which 5,300 acre-feet occurred in the water-table areas. The estimated storage change in the unnamed upper Pleistocene deposits (table 14) is 9,600 acre-feet. Thus, the over-all withdrawal from storage in the 8 years is estimated to have been 15,200 acre-feet, or an average rate of about 2,000 acre-feet per year. Changes in storage in the shallow unconfined body and in the 400-foot gravel probably were inconsequential during this period.

The total withdrawal from the Torrance-Inglewood subarea in the 8 years from 1933 through 1940 (table 8) was 383,100 acre-feet; the average rate of withdrawal was about 47,900 acre-feet per year. There was essentially no natural discharge during this period, therefore, the gross replenishment is equal to the withdrawal less the change in

storage—that is, 383,100 less 15,200 or 367,900 acre-feet. Thus, the average yearly gross replenishment is estimated to have been about 46,000 acre-feet.

CONTRIBUTION FROM THE OCEAN

With the extensive drawdown of water levels to and below sea level, saline waters have invaded the Torrance-Inglewood subarea along the full reach from Playa del Rey to the Palos Verdes Hills. Also, along the south shore from the Palos Verdes Hills to the Los Angeles River channel, saline waters probably have moved northward beyond Terminal Island toward centers of pumping. The water in the Silverado zone beneath Terminal Island is inferred to have been of inferior quality under native conditions (Piper, Garrett, and others, 1953, p. 197). To date, these inferior waters have not advanced sufficiently far northward to reach any actively pumped well fields. As shown by the distribution of withdrawals on plate 12, the first major well fields to receive such inferior waters presumably would be that of the Union Oil Co. in Wilmington (pl. 12, no. 23) and that of the Texas Co. (pl. 12, no. 24) at the west edge of Dominguez Gap. Regardless of the quality of the ground water in the Silverado zone beneath Terminal Island, there must have been a substantial contribution of water to the west basin from the subsea reach south of Terminal Island in response to the landward gradients that have existed since the early thirties. This contribution is not being replaced by water of good quality, and probably it is being followed landward by saline waters, either ocean water entering the outcrop of the Silverado zone beneath San Pedro Bay, or connate saline waters contributed from within the subsea ground-water system, or both.

Ocean water advanced inland in the Gaspur water-bearing zone in the thirties (see p. 259, also pl. 16); the extent of that inland advance has been shown in an earlier report (Piper, Garrett, and others, 1953, pl. 17).

The over-all contribution from the ocean or from the seaward extensions of the water-bearing zones of the Torrance-Inglewood subarea from 1933 to 1941 is estimated in following paragraphs.

The extent of encroachment of saline waters for the reach along the west coast from Playa del Rey to the Palos Verdes Hills is shown on plate 16. The contribution from the ocean can be computed if the assumption is made that the rate of advance of the saline front is a direct measure of the rate of landward inflow of salt water to the water-bearing deposits.

From the appraisal of the rates of saline encroachment as suggested by the advance of the saline front from 1931 to 1946 (pl. 16), and with consideration to the effective hydraulic gradients, it is concluded

(p. 251 to 253) that the average yearly rate of advance of the saline front from Playa del Rey to El Segundo from 1931 to 1941 did not exceed 40 feet, from El Segundo to Hermosa Beach it was about 115 feet, and from Hermosa Beach to the Palos Verdes Hills it was about 90 feet. The effective porosity of the Silverado water-bearing zone and correlative water-bearing deposits along this full reach is estimated to be about 20 percent. The product of the cross-sectional area of water-bearing materials, the average yearly advance, and the effective porosity may be considered to be a measure of the contribution seaward from the front.

The cross-sectional area (pl. 3*C*) for the reach from Hermosa Beach to the Palos Verdes Hills is about 3.5 miles long by 400 feet thick. If the average advance of the front (pl. 16) was 90 feet per year through material with an effective porosity of 20 percent, the quantity of water required to fill the block 3.5 miles long by 400 feet thick by 90 feet wide would be about 3,100 acre-feet. In the same way, the yearly displacement for the reach from Hermosa Beach to Playa del Rey is estimated at about 2,500 acre-feet.

By this method, the average annual contribution to the ground water in the area coastward from the saline front in the reach from Playa del Rey to the Palos Verdes Hills for the years from 1931 to 1941 is estimated to be about 5,600 acre-feet.

By another method, the contribution along this reach can be computed as the product of: (1) the cross-sectional area of permeable material; (2) an estimated permeability of 1,300 gpd per square foot (p. 147); and (3) the average hydraulic gradient. For the reach from Hermosa Beach to the Palos Verdes Hills, where the average landward gradient of the thirties was about 3.5 feet per mile, the contribution so computed is 7,100 acre-feet per year. If the contribution in the reach from Hermosa Beach to El Segundo is computed assuming a permeability of 1,300, a cross-sectional area 4.5 miles long and 150 feet thick, and an equivalent hydraulic gradient of 3.5 feet per mile; and if the small contribution from El Segundo to Playa del Rey is estimated from the rate of saline encroachment, as above, the over-all contribution along the west coast is about 10,800 acre-feet per year.

If the quantities derived by these two independent methods are assumed to indicate the general limits of such a contribution along the west coast in the thirties, the suggested mean is about 8,000 acre-feet per year. Most of this contribution must have been ocean water, but it also included water that descended from the land surface to the water table, in the areas coastward from the saline front, south of Hermosa Beach and north of El Segundo. In the thirties, these two areas included about 3,000 acres, and the average annual contribution of water from the land surface in this dune-sand area may have been

as much as 1,000 acre-feet. If these figures are correct, the ocean-water contribution is estimated to be about 7,000 acre-feet per year.

For the south coast facing San Pedro Bay, the landward movement of water in the Silverado water-bearing zone in the thirties can be estimated in the same manner as the coastward discharge of 1903–4 (p. 147). It is inferred that the Silverado zone or correlative deposits crop out on the ocean floor from 8 to 9 miles southwest of Terminal Island.[13] The average depth of the piezometric level at Terminal Island from 1933 to 1941 was about 30 feet below sea level. Thus, the average inland gradient of those years is inferred to have been about 4 feet to the mile—about equal to the coastward gradient of 1903–4. Therefore, the annual contribution of water moving northward in the Silverado zone from beneath San Pedro Bay in the thirties is estimated to have been about 4,500 acre-feet per year.

The landward movement of salt water in the Gaspur water-bearing zone is known to have underrun about 300 acres from 1931 into 1943 (Piper, Garrett, and others, 1953, pl. 17 and p. 178). The thickness of the Gaspur water-bearing zone is about 60 feet and the effective porosity is about 25 percent. The landward encroachment of the thirties thus was approximately 400 acre-feet per year.

In summation, the average yearly contribution of water to the Torrance-Inglewood subarea from 1933 to 1941 from the ocean or from the subsea extensions of the aquifers is estimated to have been about 12,000 acre-feet per year. Thus, within the limitations of the assumptions made here the average net replenishment of fresh water to the Torrance-Inglewood subarea in these years is 46,000 acre-feet less 12,000 acre-feet, or about 34,000 acre-feet per year.

UNDERFLOW ACROSS THE NEWPORT-INGLEWOOD UPLIFT

Under native conditions of high-water level, the quantity of underflow passing across the Newport-Inglewood uplift from the main coastal basin to the Torrance-Inglewood subarea along the crestal reach from Long Beach to the Baldwin Hills varied in accordance with the differential in the water levels across the fault barriers of the uplift as the one variable (the product of permeability and cross section was a constant). At the crest of the uplift the Silverado water-bearing zone and related deposits in the San Pedro formation then were fully saturated. and the upper Pleistocene water-bearing zones were fully saturated, except at the crests of Dominguez Hill and the Rosecrans Hills, and high on the flank of the Baldwin Hills.

In accordance with the drawdown of water level due to increased withdrawal from the main coastal basin, water levels along the crest of the uplift have declined from 100 to 150 feet below the initial levels

[13] U. S. Coast and Geod. Survey hydrologic chart 5143, Los Angeles harbor and vicinity, 1936.

and substantial dewatering of certain aquifers has occurred. For aquifers almost entirely dewatered along the crest of the uplift, the transmissibility of the saturated cross section has become the primary control on the quantity of water passing into the west basin, and the differentials at the barrier features have become secondary. For aquifers wholly dewatered along the crest, no water passes coastward beyond the crest, and the differentials along the barrier features have no meaning.

DEWATERING ALONG THE UPLIFT CREST

Plate 15 has been prepared for the purpose of appraising the magnitude of dewatering of the water-bearing beds along the crest of the Newport-Inglewood uplift from the Baldwin Hills to Long Beach. The position of the water-bearing beds (pl. 15) has been generalized from plate 3*A*, with slight modification between Manchester Avenue and Imperial Highway, in order to follow the land-surface and inferred subsurface crests. Plate 15*B* shows on an expanded scale, the pressure level and the local water table of the Silverado water-bearing zone and correlative aquifers along the alinement of the section for selected times from 1903–4 to 1945. A partial plot of the water levels of the eighties, inferred from data by Mendenhall, also is shown. The water-level profiles for 1904, 1933, 1941, and 1945 are taken from plates 9–12; the profile for 1930 is from a work map not included in the report. Although the water-level profiles are constructed from data for wells tapping the Silverado zone and correlative deposits, these profiles also can be used to appraise the general order of dewatering of the upper Pleistocene deposits. Part of the generalized position of the top of the Silverado zone has been plotted at the expanded scale of plate 15*B* in order to emphasize the extent of dewatering in this principal aquifer.

As shown by the profiles of plate 15, the upper Pleistocene water-bearing deposits (the "200-foot sand" and correlative deposits) have been extensively dewatered along the crest. On the other hand, the Silverado water-bearing zone and lower Pleistocene correlative deposits have been partly dewatered in the 6-mile reach between the Baldwin Hills and El Segundo Boulevard, but no dewatering has occurred in the 8-mile reach from El Segundo Boulevard to Los Cerritos (Long Beach). The extent of dewatering is summarized as follows:

1. The upper Pleistocene water-bearing deposits initially were fully saturated except at the crests of the Dominguez Hill and Rosecrans Hills and high on the south flank of the Baldwin Hills. By 1945 these deposits had been entirely dewatered along all the crestal reach northwest of El Segundo Boulevard, and had been dewatered nearly to sea level along the crestal reach of Dominguez Hill. Thus, in the early forties, the only segments of these deposits still saturated were: the 3-mile reach between El Segundo Boulevard and Artesia Street, along most

of the Avalon-Compton fault; and the 3-mile synclinal reach beneath and adjacent to Dominguez Gap. The water-bearing beds in the reach along the Avalon-Compton fault are only about 60 feet thick but they are highly permeable and are tapped by many wells; thus, these deposits are believed to transmit substantial underflow through the fault barrier. On the other hand, the water-bearing beds beneath Dominguez Gap, which are composed almost entirely of fine sand (pl. 3*A*), as much as 120 feet thick (well 4/13–2J1), are not tapped by many wells because they are not highly permeable, and their transmissibility is less than that of the thinner aquifers northwest of Dominguez Hill.

In terms of cross-sectional area, about 50 percent of the upper Pleistocene water-bearing deposits throughout the area shown on plate 15*A* have been dewatered by the drawdown of water level from native conditions to the levels of 1945. However, the reduction in transmissibility has been much more than 50 percent, because the permeable deposits which occur northwest of well 3/13–17E1 and including those at the Centinela Park well field of the city of Inglewood, have been wholly dewatered. Utilizing the generalized data of plate 15*A*, the calculated cross-sectional area of the initially saturated upper Pleistocene aquifers is 4.4 million square feet and by 1945 the dewatered area totaled 2.1 million square feet.

2. The Silverado water-bearing zone and correlative aquifers in the San Pedro formation of early Pleistocene age initially were fully saturated along all of the crestal reach from Los Cerritos (Long Beach) to the Baldwin Hills. In nearly all of the 8-mile reach southeast of El Segundo Boulevard, the top of the Silverado zone is more than 100 feet below sea level, and beneath Dominguez Gap is as much as 400 feet below sea level. However, between El Segundo Boulevard and the Baldwin Hills, the top of the Silverado zone and correlative deposits is several tens of feet above sea level on a large area. Thus, because of the decline of water level to near sea level, by 1945, extensive dewatering has occurred in the deposits in the 6-mile reach northwest of El Segundo Boulevard.

In terms of cross-sectional area, about 35 percent of the water-bearing beds of the San Pedro formation northwest of El Segundo Boulevard had been dewatered by 1945. Throughout the entire reach, only about 10 percent had been dewatered. However, in the 2-mile reach from near well 2/14–27J1 (city of Inglewood, well 16) southeast to the intersection of Century Boulevard and Western Avenue, the decline of water level by 1945 had dewatered about two-thirds of the thickness and only 30–50 feet of the Silverado zone remained saturated. No well data are available to determine whether the reduction in saturated cross section may have been partly compensated by a steepening of the hydraulic gradient. In any case, a drawdown of water levels to as much as 30 feet below sea level would essentially dewater the Silverado water-bearing zone in this reach and would prevent underflow to the west basin.

From the generalized data of plate 15, the calculated cross-sectional area of the Silverado water-bearing zone and correlative aquifers is 18 million square feet, of which about 12.8 million is south of El Segundo Boulevard and about 5.2 million is north; of the latter, about 2 million square feet had been dewatered by 1945. Thus, the saturated cross-sectional area of the lower Pleistocene aquifers, as compared with that of the upper Pleistocene aquifers, was about four times as great under initial conditions and about seven times as great in 1945.

CHANGE IN DIFFERENTIAL HEAD ACROSS THE BARRIER FEATURES

The average differentials in water level across the barrier features of the uplift between the Baldwin Hills and the southeast edge of

Dominguez Gap can be calculated approximately from water-level contour maps of the Silverado water-bearing zone by estimating average differential heads across measured segments of the barrier features and totaling these differentials, which are weighted in accord with the lengths of the respective segments. In this manner, average differentials in water level have been estimated for 1904, 1933, 1941, and 1945, from the data of plates 9 to 12. Results are summarized in table 15.

TABLE 15.—*Average water-level differentials, in feet, across the barrier features of the Newport-Inglewood uplift between the Baldwin Hills and Long Beach, 1904–45*

Year	Baldwin Hills to El Segundo Boulevard (6 miles)	El Segundo Boulevard to Long Beach (8 miles)	Totaled average from Baldwin Hills to Long Beach (14 miles)
1904	49	33	40
1933 (March)	29	37	34
1941 (April)	22	33	28
1945 (November)	32	40	36

The water-level differentials have been summed up separately for the 6-mile reach northwest of El Segundo Boulevard and the 8-mile reach to the southeast. The former parallels the area of partial dewatering along the crest, and also is the one with the poorer control on water-level differentials, especially across the Potrero fault north of Century Boulevard; here, the amount of drawdown of water level in the several fault blocks between the Potrero and Inglewood faults is irregular and largely unknown.

Although the average differentials presented in table 15 are only approximate and their derivation has required a considerable amount of extrapolation, they suggest with respect to the Silverado water-bearing zone and correlative deposits that:

1. In 1904 the differential in water levels was about 50 percent greater northwest of El Segundo Boulevard than to the southeast.
2. By 1933 the differential northwest of El Segundo Boulevard had decreased about 40 percent and was less than the differential to the southeast, which had increased slightly.
3. The average differential was least in 1941 only 28 feet for the over-all 14-mile reach.
4. If the average head differential between 1933 and 1941 is assumed to be the average of those 2 years, then the head differential northwest of El Segundo Boulevard in that 8-year period (26 feet) was just about half of that in 1904, whereas southeast of El Segundo Boulevard it was slightly higher than in 1904 (35 feet). If the water transmitted across the barrier features is proportional to the differential in head, as seems reasonable, if the permeability of the water-bearing beds is considered uniform along the full reach, and if the effect of de-

watering north of El Segundo Boulevard is ignored, the underflow into the Torrance-Inglewood subarea in the period 1933–41 can be estimated to be about 86 percent as great as in 1904 (product of differential head times cross-sectional area, for each segment).

5. In the same way, the underflow into the Torrance-Inglewood subarea as of 1945 can be estimated to be about the same as in 1904. If the dewatering along the crest north of El Segundo Boulevard is considered wholly effective in proportionately reducing the underflow to the west basin, then, the underflow as of 1945 would have been about 90 percent as great as in 1904, with respect to the Silverado zone and correlative deposits.

Of all water-bearing deposits of Pleistocene age along the reach from the Baldwin Hills to Los Cerritos—that is, the extensively dewatered upper Pleistocene deposits as well as the Silverado zone and correlative deposits of early Pleistocene age—it is estimated that the underflow as of 1945 was about 85 percent as great as in 1904.

METHODS OF ESTIMATING UNDERFLOW

The underflow to the Torrance-Inglewood subarea from the main coastal basin comprises two elements, (1) the underflow in the Gaspur water-bearing zone of Recent age, which passes into the west basin through the throat of Dominguez Gap, and (2) the underflow through all the aquifers of Pleistocene age, of which the Silverado water-bearing zone and correlative aquifiers constitute the principal conduit.

The Gaspur water-bearing zone is not cut by the barrier features of the uplift—specifically, the Cherry-Hill fault (pl. 12)—and thus no differential in water level has been developed. Accordingly, the underflow to the west basin through this aquifer can be estimated as the product of the permeability, the cross-sectional area, and the hydraulic gradient. The permeability has been estimated to be about 3,000 gpd per square foot (p. 31), the cross-sectional area at the throat between Dominguez Hill and Los Cerritos is about 72 foot-miles (width 1.2 miles parallel to the ground-water contours, and thickness about 60 feet), and the hydraulic gradient through the throat has been about 12 feet to the mile in recent years (pl. 11). Thus, the current underflow to the west basin through the Gaspur water-bearing zone is estimated at about 4 cfs, or about 2,900 acre-feet per year.

The quantity of underflow to the Torrance-Inglewood subarea through the deposits of Pleistocene age also could be estimated directly if: (1) the permeability of the water-bearing deposits from place to place along the crest of the uplift had been determined by means of a sufficient number of pumping tests to afford reliable control; (2) the average hydraulic gradient across the crest were known for the particular instants or periods of appraisal; and (3) the amount of withdrawal between the crest of the uplift and the inland boundary of the west basin were known, so it could be subtracted from the underflow passing

the crest. Neither the permeability nor the crestal hydraulic gradient can be evaluated with reasonable accuracy at this time. In the 3-mile reach from the top of Dominguez Hill to the Los Angeles River not a single water well taps the Silverado water-bearing zone immediately inland from the barrier faults. It is here that the greatest differential in pressure level now exists across the barrier features of the uplift. During this investigation an attempt was made, with the cooperation of the Los Angeles County Flood Control District, to utilize certain oil-test holes for obtaining data on the permeability and piezometric level of the Silverado zone within this critical reach; however, the negotiations were unsuccessful.

The importance of obtaining accurate data on the hydraulic gradient can be illustrated by the following example. If the average permeability along the crestal reach is assumed for the moment to be 1,000 gpd per square foot, the quantity of water transmitted across the saturated crestal section of the Silverado zone and correlative deposits in 1945 would have been about 3,400 acre-feet per year for each foot per mile of hydraulic gradient.

The quantity of underflow passing into the Torrance-Inglewood subarea through the Silverado water-bearing zone and correlative deposits could be estimated by another method. The axis of the pressure trough, as shown on plates 9 to 12, marks the boundary between water moving inland and water moving coastward. That axis has migrated inland in recent years because the draft from the Torrance-Inglewood subarea has increased about 50 percent while the underflow has remained roughly constant. The quantity of water withdrawn between the barrier and the axis of the pressure trough—that is, within the area underlain by a coastward gradient—is a measure of the replenishment by underflow. It is impossible to estimate this draft accurately at present. For example, the axis of the pressure trough as of 1945 passed through the main well field of the Dominguez Water Corp. (pl. 12, plant 14b). The proportion of water contributed to this well field from the inland side (coastward hydraulic gradient) and from the coastward side (landward hydraulic gradient) cannot be determined without constructing additional observation wells to indicate the steepness of the coastward gradient as compared to the landward gradient.

However, as plates 9 and 11 suggest, the coastward hydraulic gradient on the inland side of the trough of pressure relief is somewhat steeper than the landward gradient on the oceanward side of the cone. If, for purposes of rough calculation, it is assumed that the coastward hydraulic gradient to such pumping plants along the axis of the pres-

sure trough was twice as great as the inland gradient in 1945, and presuming that the transmissibility of the deposits on the two sides is the same, then the contribution from the inland side would be two-thirds of the total to such well fields. On the basis of this assumption, the underflow from the main coastal basin to the Torrance-Inglewood subarea through the Silverado water-bearing zone as of 1945 is estimated roughly to have been about 12,000 to 16,000 acre-feet per year. If the estimated underflow through the upper Pleistocene deposits and through the Gaspur water-bearing zone is added to this, the total contribution to the Torrance-Inglewood subarea by underflow from the main coastal basin in 1945 is estimated to have been within the range of 15,000 to 20,000 acre-feet.

FACTORS AFFECTING CURRENT AND FUTURE REPLENISHMENT

The net replenishment to the Torrance-Inglewood subarea from 1933 to 1941 has been estimated at about 34,000 acre-feet per year (p. 148–155). Although the withdrawal as of 1945 had increased to some 78,000 acre-feet (table 8), or to about 160 percent of the average yearly draft of the thirties, the net replenishment in 1945 is believed not to have differed greatly from that of the thirties. Because the average differential in the water level across the barrier features is believed to have increased by a few feet from the thirties into 1945 (p. 158), the underflow to the Torrance-Inglewood subarea probably was slightly greater in 1945 than in the thirties. Therefore, because the sum of the other elements of net replenishment is considered to have been about equal in years of average rainfall, the net replenishment of the middle forties presumably has been at least equal to and probably slightly in excess of that of the thirties.

The increase in draft during the war years drew down the water levels substantially in the Torrance-Inglewood subarea and steepened the landward hydraulic gradient along the coastal reaches of the basin. The ocean-water or subsea contribution, which is estimated to have been about 12,000 acre-feet per year in the thirties, is believed to have more than doubled by the end of 1945. Additional drawdown of the water levels in the Torrance-Inglewood subarea would increase the rate of ocean-water contribution in direct proportion to the increase in landward hydraulic gradient along the coastal reach.

If a decrease in draft should occur and water levels in the Torrance-Inglewood subarea should remain about constant for the next few years, and if water levels in the main coastal basin should be drawn down appreciably below the levels of 1945, contributions by underflow from the main coastal basin, which are believed to constitute about

half the current net replenishment to the subarea, would be reduced roughly in proportion to the decrease in average differentials across the barrier. The reduction in underflow probably would be slightly greater than the decrease in differential head because of the effect of additional dewatering along the crest of the uplift. Thus, it is to the interest of water users in the west basin that water levels inland from the barrier be maintained as high as is feasible—in other words, replenishment to the Torrance-Inglewood subarea is affected beneficially by conservation of the water supply and increased replenishment to the groundwater reservoir throughout the coastal plain in Los Angeles County.

REPLENISHMENT TO THE CULVER CITY SUBAREA

Under initial conditions and to date, replenishment to the Culver City subarea has been supplied very largely by infiltration of runoff from the south flank of the Santa Monica Mountains west of the Inglewood fault and from rainwater penetration beneath the Santa Monica plain and within Ballona Gap. Initially, some replenishment doubtless passed coastward across the Inglewood fault from the main coastal basin. Since the middle twenties, however, little if any water has entered the Culver City subarea from the Pleistocene deposits to the east, because water levels in those deposits consistently have stood lower on the inland side of the Inglewood fault than on the coastal side. In the "50-foot gravel," however, a coastward gradient still prevails across the Ingelwood fault and some water presumably passes into the Culver City subarea through this conduit.

In the crestal subbasin (between the Inglewood and Overland Avenue faults) withdrawal now is wholly from the San Pedro formation. The draft did not exceed a few hundred acre-feet per year until the middle thirties, when it increased to about 1,100 acre-feet per year (p. 108). Replenishment to the San Pedro formation is believed to be almost entirely from the north. As shown by the hydrographs for wells 2/14–7M1 and 18F1 (pl. 14), the water level declined at a gentle rate of about 0.6 foot per year in the early thirties, but it had declined at more than double that rate since 1936. The water-level trend in these observation wells must be interpreted with caution, because a general decline of water level in the subbasin would be expected to have occurred in response to drawdown of water levels to the south (escape area), east, and west, as well as to the increased withdrawal in the subbasin itself. Nevertheless, the evidence suggests that the replenishment under present conditions is somewhat less than the draft.

Replenishment to the Charnock subbasin as of 1904 was from: (1) the north by infiltration of rainfall and runoff on the Santa Monica

plain; (2) the east by movement of water from the crestal subbasin, probably largely through the "50-foot gravel," which is not cut by the Overland Avenue fault; and (3) by direct penetration of water from the land surface in the part of the subbasin within Ballona Gap. The concentrated withdrawal from the Charnock and Sepulveda well fields (p. 97 and pl. 12) has developed and maintained a central ground-water depression in which water levels have stood several tens of feet below sea level for the past two decades. Because of this great drawdown of water level, replenishment to the central part of the Charnock subbasin has been derived in part from the south since the late twenties. On the other hand, the general drawdown of water level within the Culver City subarea has largely dewatered the "50-foot gravel," and replenishment from the crestal subbasin to the east probably has about ceased, except for possible contributions across the Overland Avenue fault.

The draft from the Charnock subbasin is estimated to have ranged from 12,500 acre-feet in 1941 to 7,000 acre-feet in 1945. The hydrographs for wells 2/15–11E3 and 24C1 (pl. 14) suggest that in 1945 the replenishment was about equal to the estimated draft of 7,000 acre-feet. The water-level contours of plate 12 suggest that the hydraulic gradient from the north was then about 2½ times as steep as that from the south, and thus—assuming uniform permeability of the water-bearing material—that more than two-thirds of the replenishment was from the north. With respect to replenishment from the south, the water-level contours of plates 9–12 suggest that some of this replenishment moves northward from south of the Ballona escarpment, possibly in part from the crestal subbasin around the south end of the Overland Avenue fault.

The coastal area apparently receives almost all its replenishment from the Santa Monica upland to the north and by direct infiltration of rainwater in Ballona Gap. Through the thirties, when water levels stood below sea level, it also received substantial recharge from the ocean. For the past two decades no replenishment has moved westward across the Charnock fault. In fact, with the great differential in water levels that has existed across the Charnock fault since the late twenties, some water probably has moved inland across the fault.

The draft in the coastal area in the forties is estimated to have been between 2,000 and 3,000 acre-feet per year. The hydrographs for wells 2/15–16F1 and 22B4 (pl. 14) suggest that the replenishment from all sources has been at least equal to this draft in recent years.

CHEMICAL CHARACTER OF NATIVE AND CONTAMINATED GROUND WATERS

GENERAL NATURE OF THE CHEMICAL PROBLEMS

Locally, in the early twenties and more widely in the early thirties, certain wells near the coast from Ballona Gap to and beyond Redondo Beach began to yield saline water, leading ultimately to abandonment of some wells in which the salinity of the water became so great that it could no longer be used.

The districts in the Torrance-Santa Monica area in which the chloride content of some or all of the ground-water bodies exceeded 100 ppm in 1945–46 are shown on plate 16. These districts include several bodies containing water of native inferior quality—specifically, a part of the Wilmington district, a narrow zone extending along the north flank of the Palos Verdes Hills, the Gardena area, an area between Hawthorne and Inglewood, and a narrow strip along the west edge of the Baldwin Hills. They also include areas of inferior water in Dominguez Gap, along the coast from Redondo Beach to El Segundo, and in Ballona Gap, which have developed from progressive contamination during the past two decades; these are identified by diagonal ruling on plate 16.

The approximate extent of saline contamination in 1931–32 is also shown and represented by the boundaries of contaminated waters then containing more than about 100 ppm of chloride. Thus, the spread of contamination in the 14-year period is indicated by the relative position of the two boundaries.

In the Gardena area, the native waters of inferior quality occur within the shallow unconfined water body. In all the other districts underlain by water of more than 100 ppm of chloride, the inferior water is in the principal water body.

In Dominguez Gap, native waters of inferior quality occurring in the shallow unconfined body have become contaminated extensively during the past two decades. However, contamination has developed more widely in certain underlying water-bearing deposits in the principal water body—specifically in the Gaspur water-bearing zone and in the unnamed upper Pleistocene deposits to depths of 150 to 200 feet below land surface. In Dominguez Gap, the extent of contamination as shown on plate 16 relates to conditions in the principal water body and not to those in the shallow unconfined body.

Within the west basin and outside of the districts underlain by inferior waters as indicated on plate 16, a few wells tapping the principal water body yield water containing more than 100 ppm of chloride. Although these are not identified on plate 16, several of the wells are treated in the text beyond.

Because of the increased development of ground water in the west basin and the continuing decline in ground-water levels, local agencies that draw water from the basin or are concerned with the conservation of ground water have become increasingly alarmed by the spread of saline contamination.

Following sections of this report treat this problem of saline contamination by: (1) describing the chemical character and extent of waters of good quality and of inferior quality existing under native conditions; (2) describing the sources of saline contamination insofar as they can be identified; (3) determining the present extent of salt-water encroachment in the several water-bearing zones in the west basin; and (4) evaluating the possibilities for saline contamination to become more extensive in the future.

SCOPE AND SOURCES OF ANALYTICAL DATA

In connection with the canvass of water wells within the coastal plain by Mendenhall (1905a, 1905b) in 1903–4, the approximate dissolved-solids content of the water from about 2,500 wells in the Torrance-Santa Monica area was computed from their electrical conductances. Except for these determinations, only a few analyses are available for the period prior to 1929. The bulk of chemical analyses are for well waters sampled since that time—beginning chiefly in 1931–32, that is, sampling programs of the several active agencies began at about the time that local contamination problems became serious. At the present time, a large amount of analytical data has accumulated; this information includes both comprehensive analyses and those in which only one or two constituents, usually chloride or bicarbonate, have been determined. The scope of these data and the term of record by each contributing agency have been given in an earlier report (Sinnott and Garrett, 1946). In all, about 1,500 comprehensive analyses and about 12,000 field (partial) analyses have been made available for study. The Geological Survey has drawn freely upon this information in compiling the part of this interpretive report that deals with the chemistry of native and contaminated waters in the Torrance-Santa Monica area. From these data, representative analyses have been selected (table 30) to show the character of native waters and the progressive development of contamination in critical areas.

In addition to the large number of analyses, several interpretive reports relating to the problems of saline contamination have been made. Nearly all of these reports have been made by or for the Los Angeles County Flood Control District and chiefly discuss contamina-

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tion in Ballona Gap. Most of these have been cited earlier in this report (p. 9).

Beginning late in 1943 as a part of the field canvass, the Geological Survey sampled 427 water wells in the Torrance-Santa Monica area, subsequently 73 of these were resampled. About 46 wells in critical areas were sampled periodically to determine if any change in salinity was occurring. In addition, a number of wells were sampled repeatedly while pumping. In all, the Geological Survey made 667 field analyses, comprising determinations of electrical conductivity, soap hardness, and chloride. These analyses are presented in table 29. Also, the Geological Survey has made 12 preliminary analyses in which electrical conductivity, soap hardness, calcium, bicarbonate, sulfate, chloride, borate, and iodide were determined; and 21 comprehensive analyses were made. These 33 analyses are included in table 30.

Plate 17 shows the location of wells for which chemical analyses are available from all sources, and indicates by symbol the type of analysis made. This plate also shows the water-quality data of Mendenhall by means of contours which indicate the approximate content of dissolved solids in parts per million. Necessarily, some generalization has been made; however, these contours suggest the approximate quality of the ground water under native conditions. During the survey by Mendenhall the approximate dissolved-solids content of the samples from about 7,500 wells—of which about 2,500 were within the Torrance-Santa Monica area—was computed from determinations of their electrical conductances, corrected to 60°F. The relationship between electrical conductivity and the approximate dissolved-solids content of natural waters within the coastal plain in Los Angeles and Orange Counties has been set forth in a recent report (Piper, Garrett, and others, 1953, p. 10, 11, and pl. 3). This relationship is a simple one and in many cases obviates the need for a gravimetric determination of dissolved solids.

CHARACTER AND DISTRIBUTION OF NATIVE WATERS IN THE DEPOSITS COMMONLY PENETRATED BY WATER WELLS

RANGE IN CHEMICAL CHARACTER OF WATER FROM WELLS

Native waters tapped by wells in the Torrance-Santa Monica area vary widely in quality from excellent to markedly inferior. For purposes of this report, water is considered inferior when its dissolved-solids content is more than about 600 ppm (Piper, Garrett, and others, 1953, p. 50). In general, all the confined waters in that part of the area inland from the Newport-Inglewood uplift are of good to excellent quality and are suitable for all domestic and irrigation purposes

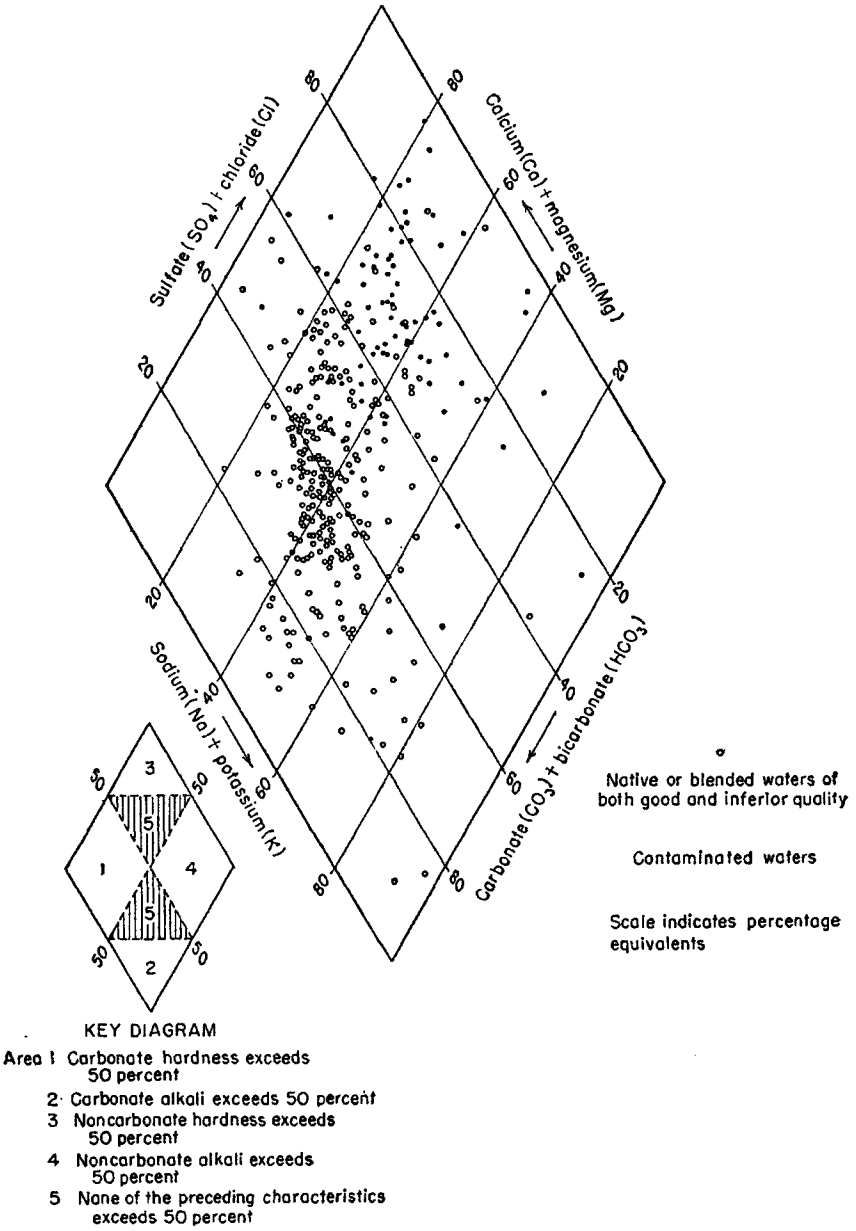
and for industrial use with only moderate treatment. These are chiefly calcium-bicarbonate waters; their chloride content ranges from 20 to 30 ppm and their hardness from 150 to 225 ppm. In this report, terms describing the general chemical character of a water are used in particular senses, as in the following examples: (1) Calcium bicarbonate designates a water in which calcium amounts to 50 percent or more of the bases and bicarbonate to 50 percent or more of the acids, in chemical equivalents; (2) sodium calcium bicarbonate designates a water in which sodium and calcium are first and second, respectively, in order of abundance among the bases but neither amounts to 50 percent of all the bases; and (3) sodium sulfate bicarbonate designates a water in which sulfate and bicarbonate are first and second in order of abundance among the acids, as above.

Coastward from the Newport-Inglewood uplift within the west basin, native waters of good quality range in character from calcium to sodium bicarbonate. Except locally, the chloride in confined waters here ranges about from 30 to 200 ppm, but those containing more than about 100 ppm are considered inferior because their dissolved-solids content is usually in excess of 600 ppm. Locally, the chloride content of certain presumed native confined waters is as high as 400 ppm, although it is possible that some of these have been contaminated in recent years.

Unconfined waters on both sides of the Newport-Inglewood uplift are generally inferior but are poorest in quality on the coastal side. The chloride in these waters is as great as 2,200 ppm and dissolved solids as much as 4,000 ppm.

To show the overall range in chemical character of waters in the Torrance-Santa Monica area, chemical analyses of 375 samples from 338 wells have been plotted on figure 9. This method of plotting well waters has been used earlier to show the chemical character of water from wells in the Long Beach-Santa Ana area. The plotted positions of the analyses on the graph are dependent upon the predominating chemical constituents in the water. Hence, water types can be recognized at once by inspection of the graph. Additional explanation is given on figure 9. This plate presents almost all of the analytical data available to the Geological Survey in graphic form. Included on the graph are analyses of (1) native waters of good quality, (2) native waters of poor quality, (3) native blended waters, and (4) contaminated waters—those native waters that have been modified by the addition of inferior waters from sources exterior to the initial native water body.

The native waters of diverse character can be divided in a general way into several types; each type is more or less characteristic of a



Area 1 Carbonate hardness exceeds 50 percent
2 Carbonate alkali exceeds 50 percent
3 Noncarbonate hardness exceeds 50 percent
4 Noncarbonate alkali exceeds 50 percent
5 None of the preceding characteristics exceeds 50 percent

FIGURE 9.—Chemical character of 375 water samples from 338 wells in the Torrance-Santa Monica area, 1929–46.

stratigraphic range. The zones of water quality associated with certain stratigraphic ranges are discussed later in this section.

ZONES OF WATER QUALITY

In the Long Beach-Santa Ana area, eight distinct vertical ranges of water quality have been discriminated within the deposits tapped by water wells (Piper, Garrett, and others, 1953, p. 17–18). Each of these except the uppermost—that occupied by the body of unconfined water—coincides roughly with a particular stratigraphic zone. In general, the waters of the several ranges as delineated differ from each other in chemical character. The difference in character is striking between certain ranges and between others it is minor. Similarly, in the Torrance-Santa Monica area each zone of water quality coincides in a general way with a particular stratigraphic range. As in the Long Beach-Santa Ana area, differences in character between adjacent ranges may be small, and water of uniform character does not necessarily exist throughout the lateral extent of any one range. However, although the full stratigraphic sequence of the Long Beach-Santa Ana area prevails in the Torrance-Santa Monica area, only six ranges of water quality have been discriminated. Certain of these ranges span stratigraphic intervals identical with those of their counterparts in the Long Beach-Santa Ana area to the east; others span a more inclusive stratigraphic interval.

In both the Long Beach-Santa Ana and the Torrance-Santa Monica areas the uppermost range is that occupied by the semiperched and essentially unconfined water body in the upper part of the alluvial deposits of Recent age in Dominguez and Ballona Gaps and in the topmost part of the upper Pleistocene deposits beneath the Torrance plain. Commonly, the semiperched water body in both the Recent and Pleistocene deposits is separated from the underlying principal water body by a few tens of feet of relatively impermeable layers of silt and clay.

The five ranges in the principal confined ground-water body in the Torrance-Santa Monica area have been assigned numbers identical to those used for comparable ranges in the Long Beach-Santa Ana area In downward succession, these five ranges are as follows:

Range 1.—The lower division of the Recent deposits, which includes the Gaspur water-bearing zone of Dominguez Gap and the "50-foot gravel" of Ballona Gap. In Dominguez Gap the Gaspur water-bearing zone is 40 to 60 feet thick and its base is about 120 feet below land surface. In Ballona Gap, the base of the "50-foot gravel" is about 50 feet below land surface, and its thickness ranges from 10 to 40 feet. Locally the "50-foot gravel" is in hydraulic continuity with underlying permeable Pleistocene deposits. The extent of the

Gaspur water-bearing zone and the "50-foot gravel" is shown on plate 18.

Range 2.—The Long Beach-Santa Ana area, the uppermost Pleistocene deposits beneath the Downey plain, is not differentiated from range 3 in the Torrance-Santa Monica area.

Range 3.—The unnamed upper Pleistocene deposits, including the "200-foot sand" and strata correlative with or in hydraulic continuity with those deposits, ranges in thickness from a feather edge at the Baldwin and Palos Verdes Hills to as much as 300 feet along the synclinal trough within the west basin. The base of this range commonly is from 200 to 300 feet below land surface in the west basin.

Range 4.—In the Long Beach-Santa Ana area—the uppermost part of the San Pedro formation beneath the Downey plain—is not differentiated in the Torrance-Santa Monica area.

Range 5.—The upper part of the San Pedro formation, including the "400-foot gravel" of the area between Gardena and Inglewood, but excluding the Silverado water-bearing zone. In general, this is the stratigraphic equivalent of range 5 of the Long Beach-Santa Ana area. In the west basin, this range is thickest in the synclinal trough (as much as 200 feet); along the crest of the Newport-Inglewood uplift, although this range is present, it is substantially thinner. Along much of the coast from Redondo Beach to Santa Monica the range decreases in thickness to a feather edge or is entirely absent. Along the synclinal trough the base of this range is about 300 feet below land surface in Inglewood, about 400 feet below at Gardena, and as much as 700 feet below in Dominguez Gap, near the intersection of Alameda Boulevard and Carson Street. In Ballona Gap, just inland from the Newport-Inglewood uplift—specifically, in 1/14–32M and 2/14–5D—the San Pedro formation has been divided tentatively into an upper, a middle, and a lower part (fig. 14). However, the separation is intended primarily for local subdivision of the formation on the basis of water-bearing zones and is derived chiefly from examination of logs of wells at the Sentney plant of the Southern California Water Co. Although the upper part of the San Pedro formation here may not be correlative with any part of range 5, as here defined, it has been found most feasible to include the waters yielded from this upper part of the San Pedro formation in that range.

Range 6.—The middle and lower parts of the San Pedro formation, including the Silverado water-bearing zone of the Torrance-Inglewood subarea and the main water-bearing zone in Ballona Gap coastward from the Newport-Inglewood uplift—the essential correlative of the

Silverado zone. Within the west basin the thickness of this range is as much as 600 feet between Wilmington and Redondo Beach, but northward from Gardena the thickness commonly does not exceed 200 feet and in Inglewood it is as little as 50 feet. The depth of its base is shown by the contours of plate 2. In Ballona Gap, just inland from the Newport-Inglewood uplift, the aggregate thickness of the middle and lower parts is probably about 230 feet, and the top of the middle part is about 290 feet below land surface. In the Long Beach-Santa Ana area, range 6 included the lower part of the Silverado water-bearing zone; there the upper part was included in range 5. However, range 6 includes the full vertical extent of the Silverado zone. In other respects, range 6 of the two areas is essentially common.

Range 7.—The upper division of the Pico formation underlies nearly all the west basin. This range contains the deepest fresh waters known to occur in the area, although its waters are brackish locally north of Ballona Gap. Its vertical range has been described on pages 57–59. The depth of its base, where known, is shown on plate 8.

On following pages the waters contained in the six ranges of the Torrance-Santa Monica area are described in detail; on plates 18 and 19 are plotted the wells from which native waters have been selected that are considered representative of the respective ranges tapped. For each of the waters so selected, the dissolved solids content and a "binomial symbol" are shown on the plates 18 and 19. The binomial symbol is written in the form of a decimal fraction. The first term denotes the percentage of hardness-causing constituents among the bases—that is, of calcium and magnesium; the second term denotes the percentage of bicarbonate—and carbonate calculated to bicarbonate—among the acids. For example, the symbol 60.75 would indicate a water in which the calcium and magnesium amount to 60 percent of all the bases, in terms of chemical equivalents, and in which bicarbonate (including carbonate, if present) amounts to 75 percent of all the acids.

The complement of this binomial symbol indicates the percentage amounts of non-hardness-causing constituents or "alkalis" among the bases, and of noncarbonate acids. In the example here given, the complement is 40.25, which indicates 40 percent sodium and potassium [the "percent sodium" of Scofield (1933, p. 22–23)] and 25 percent sulfate and chloride, in chemical equivalents.

The analyses selected as representative for native waters are listed on table 16 and are grouped according to their respective ranges.

TABLE 16.—*Analyses of representative native ground waters*

[See table 30 for description of sources and for analytical data in parts per million]

Well	Dissolved solids (parts per million)	Constituents (percentage equivalents)					
		Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na+K)	Bicarbonate (HCO_3)[1]	Sulfate (SO_4)	Chloride (Cl)[2]
Waters from the unconfined shallow body [Location of sources shown on plate 18]							
3/13-27B1	[3] 954	34.0	24.4	41.6	46.4	22.8	30.8
30P1	[3] 1,125	39.4	26.2	34.4	31.8	16.6	51.6
31H4	[3] 924	48.4	20.8	30.8	27.0	22.6	50.4
3/14-26G2	[3] 3,907	37.2	21.0	41.8	5.4	6.4	88.2
4/13-8L1	[3] 3,609	25.0	28.0	47.0	7.2	46.2	46.6
Minimum	924	25.0	20.8	30.8	5.4	6.4	30.8
Maximum	3,907	48.4	28.0	47.0	46.4	46.2	88.2
Waters from the Gaspur water-bearing zone or "50-foot gravel" in alluvial deposits of Recent age [Location of sources shown on plate 18]							
2/14-5D9	[3] 747	43.6	29.2	[3] 27.2	48.0	28.4	23.6
3/13-36D1	404	52.6	13.6	[3] 33.8	68.6	19.6	11.8
4/13-2P4	[3] 338	52.4	11.4	36.2	62.0	25.6	12.4
15A3	[3] 449	50.2	17.0	32.8	52.8	28.6	18.6
35M3	[3] 318	23.2	15.6	[3] 61.2	66.2	14.4	19.4
Minimum	318	23.2	11.4	27.2	48.0	14.4	11.8
Maximum	747	52.6	29.2	61.2	68.6	28.6	23.6
Waters from unnamed upper Pleistocene deposits including the "200-foot sand" [Location of sources shown on plate 18]							
2/14-29K1	442	46.0	20.8	[3] 33.2	57.0	11.6	31.4
32E1	[3] 496	37.6	24.0	[3] 38.4	59.8	13.8	26.4
3/13-20H1	362	51.4	19.0	29.6	60.0	28.0	12.0
3/14-26J1	[3] 377	44.2	20.4	35.4	54.2	8.6	37.2
4/13-6J1	[3] 308	51.4	14.8	33.8	63.4	24.8	11.8
4/13-19H1	518	46.0	17.0	37.0	39.2	14.8	46.0
19J4	[3] 787	34.2	19.2	46.6	30.4	5.4	64.2
Minimum	308	34.2	14.8	29.6	30.4	5.4	11.8
Maximum	787	51.4	24.0	46.6	63.4	28.0	64.2
Waters from the "400-foot gravel" in upper part of San Pedro formation [Location of sources shown on plate 19]							
3/14-10C1	[3] 347	34.2	17.8	[3] 48.0	69.8	13.6	16.6
15G1	[3] 359	42.0	21.2	[3] 36.8	65.0	19.6	15.4
23L1	[3] 323	46.2	21.0	[3] 32.8	62.0	24.6	13.4
Minimum	323	34.2	17.8	32.8	62.0	13.6	13.4
Maximum	359	46.2	21.2	48.0	69.8	24.6	16.6

[1] Includes carbonate (CO_3) and borate (BO_2), if determined.
[2] Includes fluoride (F) and nitrate (NO_3), if determined.
[3] Calculated.

TABLE 16.—*Analyses of representative native ground waters*—Continued

[See table 30 for description of sources and for analytical data in parts per million]

Well	Dissolved solids (parts per million)	Constituents (percentage equivalents)					
		Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na+K)	Bicarbonate (HCO_3) [1]	Sulfate (SO_4)	Chloride (Cl) [2]
Waters from the Silverado water-bearing zone, or, beyond that zone, from the middle and lower parts of the San Pedro formation							
[Location of sources shown on plate 19]							
2/14-4N1	[3] 350	47.2	20.8	32.0	61.6	27.4	11.0
5C1	[3] 313	34.8	33.6	[3] 31.6	59.4	17.6	23.0
5D6	473	36.6	19.2	[3] 44.2	63.6	20.8	15.6
14C2	[3] 360	49.4	20.6	30.0	61.0	26.8	12.2
19C1	[3] 535	40.8	15.0	[3] 44.2	65.2	12.0	22.8
2/14-22P1	[3] 355	53.8	17.8	[3] 28.4	61.6	26.6	11.8
23H2	[3] 371	49.4	25.6	[3] 25.0	59.4	27.2	13.4
2/15-1C2	[3] 563	47.0	26.8	[3] 26.2	52.0	30.8	17.2
11C6	[3] 483	44.8	31.8	23.4	51.0	31.7	17.3
11D2	[3] 557	49.2	35.2	[3] 15.6	50.6	37.8	11.6
2/15-11E1	[3] 546	45.8	29.6	[3] 24.6	48.0	37.0	15.0
11J1	[3] 476	35.0	19.0	[3] 46.0	60.0	19.8	20.2
14A1	[3] 558	44.0	30.6	25.4	52.0	26.8	21.2
15A4	[3] 631	44.0	21.6	[3] 34.4	44.6	37.2	18.2
15F2	[3] 620	57.8	18.4	[3] 23.8	43.6	39.4	17.0
2/15-15H1	[3] 567	42.8	30.4	26.8	48.0	32.4	19.6
24C1	[3] 567	42.8	32.2	25.0	51.2	38.2	10.6
26B1	[3] 492	26.4	28.2	45.4	65.0	8.6	26.4
34A1	[3] 474	37.8	15.8	[3] 46.4	61.0	7.8	31.2
34H1	[3] 445	33.6	21.8	[3] 44.6	59.4	11.4	29.2
3/13-6G1	[3] 363	46.6	3.2	[3] 50.2	64.0	24.6	11.4
3/14-1G1	[3] 349	51.0	15.6	[3] 33.4	63.4	24.0	12.6
3K2	[3] 335	39.4	20.8	[3] 39.8	72.8	11.2	16.0
4N1	[3] 305	35.6	22.2	[3] 42.2	80.4	3.4	16.2
9N3	[3] 327	33.0	19.4	[3] 47.6	83.0	.2	16.8
3/14-10G1	[3] 425	25.6	15.0	[3] 59.4	86.8	.8	12.4
13J3	[3] 319	49.2	18.4	[3] 32.4	62.4	23.6	14.0
21B2	[3] 319	32.0	14.6	[3] 53.4	84.2	1.2	14.6
30A2	[3] 343	33.8	17.2	[3] 49.0	83.0	----------	17.0
35R1	[3] 251	35.0	19.8	45.2	82.8	1.2	16.0
3/15-1H1	[3] 583	29.2	23.4	47.4	71.2	5.6	23.2
12B1	[3] 484	33.6	18.6	[3] 47.8	75.0	.2	24.8
13R1	[3] 367	36.4	19.6	[3] 44.0	77.4	.0	22.6
24D1	[3] 433	42.2	20.6	[3] 37.2	67.0	2.6	30.4
25A4	[3] 365	39.6	19.0	41.4	57.2	7.0	35.8
4/13-14Q4	[3] 236	27.2	11.4	61.4	66.2	18.2	15.6
15A2	[3] 208	23.8	13.8	62.4	76.6	5.2	18.2
21Q1	[3] 218	16.0	5.0	79.0	82.0	----------	18.0
22E1	221	26.4	11.2	62.4	81.2	1.6	17.2
30K1	[3] 239	17.8	19.4	62.8	85.8	.4	13.8
4/13-31E3	[3] 377	13.0	11.0	76.0	72.4	.0	27.6
31E4	[3] 388	11.2	8.0	[3] 80.8	61.0	10.8	28.2
4/14-1H	[3] 252	43.4	14.2	[3] 42.4	68.6	11.0	20.4
5N2	[3] 303	35.6	24.6	39.8	67.6	4.2	28.2
7J3	[3] 320	35.2	17.6	[3] 47.2	67.6	1.0	31.4
4/14-8C1	[3] 344	33.0	18.8	[3] 48.2	62.6	.8	36.6
8E1	[3] 327	31.6	22.0	46.4	65.8	1.2	33.0
11G2	[3] 267	27.8	20.4	[3] 51.8	87.6	.0	12.4
16L3	[3] 291	18.8	7.4	[3] 73.8	87.4	----------	12.6
17G1	[3] 325	27.2	16.8	56.0	76.4	.0	23.6
4/14-17N1	[3] 427	28.2	20.0	[3] 51.8	68.4	1.8	29.8
23N2	[3] 332	15.2	8.0	[3] 76.8	78.8	.4	20.8
35E2	[3] 547	29.6	6.6	[3] 63.8	63.0	1.0	36.0
36H1	[3] 334	22.0	19.2	[3] 58.8	72.0	.0	28.0
Minimum	208	11.2	3.2	15.6	43.6	.0	10.6
Maximum	631	57.8	35.2	80.8	87.6	39.4	36.6

[1] Includes carbonate (CO_3) and borate (BO_3), if determined.
[2] Includes fluoride (F) and nitrate (NO_3), if determined.
[3] Calculated.

TABLE 16.—*Analyses of representative native ground waters*—Continued

[See table 30 for description of sources and for analytical data in parts per million]

Well	Dissolved solids (parts per million)	Constituents (percentage equivalents)					
		Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na+K)	Bicarbonate (HCO_3) [1]	Sulfate (SO_4)	Chloride (Cl) [2]
Waters from undifferentiated Pleistocene deposits north of Ballona Gap [Location of sources shown on plate 19]							
1/14-19R1	[3] 719	49.8	34.6	[3] 15.6	56 0	21.2	22.8
20M1	[3] 683	20.0	19.0	[3] 61.0	67.0	4.2	28.8
1/15-28B2	[3] 569	49.2	31.6	19.2	53.2	26.4	20.4
32A1	[3] 577	42.0	36.6	21.4	42.2	44.0	13.8
Minimum	569	20.0	19.0	15.6	42.2	4.2	13.8
Maximum	719	49.8	36.6	61.0	67.0	44.0	28.8
Waters from upper division of Pico formation [Location of sources shown on plate 19]							
1/15-25C1	[3] 2,670	40.2	30.2	29.6	13.4	7.4	79.2
2/14-27J1	[3] 1,225	4.2	3.0	92.8	90.2	1.6	8.2
2/15-1C5	[3] 1,698	4.0	6.2	[3] 89.8	38.2	.....	61.8
3/14-17J1	[3] 481	19.4	14.6	[3] 66.0	77.6	6.2	16.2
4/13-12A2	[3] 452	5.2	2.0	[3] 92.8	79.2	1.6	19.2
5/13-3H	[3] 750	7.6	3.4	[3] 89.0	68.0	.8	31.2
Minimum	452	4.0	2.0	29.6	13.4	.0	8.2
Maximum	2,670	40.2	30.2	92.8	90.2	7.4	79.2

[1] Includes carbonate (CO_3) and borate (BO_3), if determined.
[2] Includes fluoride (F) and nitrate (NO_3), if determined.
[3] Calculated.

CHEMICAL CHARACTER OF THE WATERS

UNCONFINED WATERS

In general, the native unconfined waters in the Torrance-Santa Monica area are of poor quality. Only locally are they used for domestic or irrigation purposes. Commonly, the high salinity of the water and the low permeability of the shallow deposits discourage extensive development.

The unconfined waters in Dominguez Gap generally range from 175 to 2,200 ppm in chloride content and from 1,000 to 12,900 ppm in dissolved solids; they are chiefly sodium sulfate to sodium sulfate, chloride waters. Typically, the bicarbonate content is high, ranging from 250 to 1,100 ppm. It is likely that these unconfined waters have been concentrated by evaporation and, locally, by addition of saline waters at land surface, and thus they do not represent native waters. Therefore, no conclusion can be set forth here in regard to the chemical character of these waters under purely native conditions. Probably, however, their chloride content was usually more than 100 ppm.

Near Gardena, about in secs. 24 to 27, T. 3 S., R. 14 W., and in secs. 29 and 30, T. 3 S., R. 13 W. (pl. 16), many domestic wells tapped the unconfined water body in 1903, as shown by the well canvass of that time. As of 1946, the body is tapped by about 100 active wells. The salinity of these unconfined waters is low enough at least locally, to be used for domestic purposes and for irrigation. Their chloride content ranges from 50 to 2,200 ppm but commonly it is from 300 to 500 ppm. An analysis of water from well 3/14–26G2 (table 30) indicates a sodium, calcium chloride water. No other complete analyses of the unconfined water in this area have been made, so far as known, but it is inferred that the proportion of sulfate and bicarbonate in these waters is somewhat lower than in Ballona Gap. On the basis of determinations of electrical conductivity, the dissolved solids are estimated to range from 1,000 to 4,000 ppm.

In Ballona Gap, as of 1903, many domestic and stock wells 10 to 30 feet deep tapped the shallow water body. At that time the dissolved solids in these unconfined waters ranged from 750 to more than 2,000 ppm, but chiefly were about 1,000 ppm; all estimates were based on determinations of electrical conductivity. Locally, however, the dissolved solids of these waters ranged from 1,500 to 2,300 ppm. Presumably, the water quality as determined in 1903 was essentially native. Because of the gradual drawdown of the water levels in Ballona Gap during the twenties and early thirties, many of these shallow wells went dry. Others were abandoned as a result of deterioration in the quality of the water. By the middle thirties none of these early shallow wells were in use. About all that is known concerning the quality of the unconfined water body in recent years has been obtained from 19 shallow wells bored by the Los Angeles County Flood Control District since 1936; almost all these wells were located in the reach between Lincoln and Centinela Boulevards. That agency has made complete analyses of water from two of these wells and partial analyses from five others. The two complete analyses (2/15–23Q1 and 23Q2, table 30) indicate that locally in sec. 23 the shallow unconfined waters are sodium sulfate to sodium, calcium sulfate waters. The partial analyses, which span a more extensive reach, show a chloride content ranging from 170 to 300 ppm. On the other hand, samples taken in 1943–45 from well 2/15–23M2, adjacent to the Ballona Creek channel and 13 feet deep, ranged in chloride content from 2,600 to 11,580 ppm. The channel here is within the reach of tidal water; doubtlessly, this accounts for the very high salinity of water from that well.

The chemical data for the unconfined water in Ballona Gap are so incomplete that its regional chemical character is not known, either under native conditions or in recent years. The complete analyses

from wells 2/15–23Q1 and Q2 (table 30) are probably not of native waters but instead, they concern waters concentrated by evaporation, by the possible addition of saline waters at land surface, or by infiltration of ocean water. However, from knowledge of the native quality of the unconfined body in other areas, it is reasonable to expect that even under native conditions the sulfate content was somewhat high.

Inland from the Newport-Inglewood zone, but proximate to it, little is known in regard to the character of the shallow waters because of the dearth of chemical analyses. One well, 3/13–27B1, in 1932 yielded a sodium, calcium bicarbonate, chloride water. The chloride and dissolved-solids contents of this water were 181 and 954 ppm, respectively. The well is 8 feet deep and taps Recent deposits. The chemical character of the unconfined waters beneath the Downey plain has been discussed in an earlier report (Piper, Garrett, and others, 1953, p. 21, 26, 51).

CONFINED WATERS

WATERS IN RANGE I (GASPUR WATER-BEARING ZONE AND "50-FOOT GRAVEL")

The Gaspur water-bearing zone extends from the coast through Dominguez Gap and inland to Whittier Narrows. Only the coastal 8-mile segment is within the Torrance-Santa Monica area, however (pl. 18). Inland from the Newport-Inglewood uplift the native waters of the Gaspur zone contain about 250 to 350 ppm of dissolved solids and about 175 to 225 ppm of hardness. All are calcium bicarbonate waters. Across the Newport-Inglewood belt and within the west basin, the native waters gain in dissolved solids about 25 to 40 percent, so that concentrations are as much as 450 ppm, largely owing to an increase in sulfate, chloride, sodium, and calcium. This increase may be due to contributions of water from the westerly "arm" of the Gaspur zone. However, at the present time much of the Gaspur zone throughout its extent in the west basin is either incipiently or definitely contaminated either from local sources or from the ocean to the extent that the native character of the water is completely obscured (pl. 16).

The "50-foot gravel" in Ballona Gap contained water ranging from 650 to 750 ppm of dissolved solids in 1903–4; this estimate is based upon determinations of electrical conductance. Locally, however, the dissolved-solids content was at least 850 ppm. Fragmentary data available suggest that ocean-water intrusion had not then occurred. In general, the water in the "50-foot gravel" initially was of substantially better quality than the unconfined water in the overlying shallow deposits.

Comprehensive analyses are not available to show the chemical character of native waters in the Gap—contamination of the "50-foot gravel" had started before extensive sampling of well waters was begun. The available analyses indicate that the dissolved solids have increased to about 1,000 to 1,500 ppm in recent years.

Inland from the Inglewood fault, well 2/14–5D9 (Southern California Water Co., Sentney plant, well 9) taps the full thickness of the "50-foot gravel." That well in 1940 yielded calcium, sodium bicarbonate water containing 747 ppm of dissolved solids. In 1945 it yielded a calcium sulfate, bicarbonate water whose dissolved solids had increased to 958 ppm.

Inland from Ballona Gap, well 2/14–1M1, 80 feet deep, yielded water in 1935 containing 27 ppm of chloride, showing that at least locally the water from the "50-foot gravel" was then as low in chloride as that from deeper aquifers.

WATERS IN RANGE 3 (UNNAMED UPPER PLEISTOCENE DEPOSITS)

Within the west basin the chemical character of waters in the unnamed upper Pleistocene deposits is known almost wholly from analyses of waters from wells tapping the "200-foot sand" or correlative extensions in the Torrance-Inglewood subarea (pl. 18). Beneath the central part of the Torrance plain south of Rosecrans Avenue, under native conditions the "200-foot sand" yielded water in which the dissolved solids ranged about from 300 to 500 ppm and which was of the calcium, sodium bicarbonate type. Analyses made since 1929 (particularly chloride determinations by the Geological Survey for 1944–45) show that the chloride content of these native waters ranges about from 50 to 90 ppm. The upper limit here placed on their chloride content may be too low; water from two wells (3/14–22R2 and 26Q3) in 1943 contained 155 and 121 ppm of chloride, respectively (table 29), and dissolved solids were less than 600 ppm, according to determinations of electrical conductivity. However, data showing these to be native waters are lacking, and the chloride content may have been increased by local contamination. On the other hand, in sec. 26, T. 3 S., R. 14 W., the chloride content of waters taken in 1944–45 from wells tapping the unnamed upper Pleistocene deposits is as low as 22 ppm (table 29, wells 3/14–25N3, 26P1, and 26Q5).

North of Rosecrans Avenue, and especially in the area between Hawthorne and Inglewood, the unnamed upper Pleistocene deposits contain water in which the dissolved solids range about from 500 to 700 ppm and the chloride from 125 to at least 250 ppm. Analyses are not available to define the character of these waters closely, chiefly because wells tapping the unnamed deposits for which an-

alyses are available also tap the underlying San Pedro formation. However, these waters are of native inferior character.

Southeast of Gardena, in sec. 31, T. 3 S., R. 13 W., the unnamed upper Pleistocene deposits now (1948) contain water which probably is contaminated locally. Under native conditions these deposits yielded water ranging in dissolved solids from 400 to 500 ppm (pl. 17). Analyses of water samples collected periodically by the Geological Survey in 1941–42 from wells in sec. 31 suggest that confined water in these unnamed upper Pleistocene deposits may contain somewhat more than 500 ppm of dissolved solids locally; also, they suggest an increase in salinity during that period in certain wells tapping these deposits (Piper, Garrett, and others, 1953, p. 264).

To the south, about in sec. 19, T. 4 S., R. 13 W., the unnamed upper Pleistocene deposits yield water in which the chloride content (based on water samples from 2 wells, each 180 feet deep) is about 25 ppm and the dissolved solids content is about 300 ppm. Here the water from that depth is of excellent quality and is considered free of contamination. However, water from wells not more than 100 feet deep—inferred to tap the upper part of the unnamed deposits—is of poorer quality. In 1941–42 that water ranged from 62 to 409 ppm in chloride content and from 350 to 1,050 ppm in dissolved solids. Waters of both poor and good quality in sec. 19 are believed to be native, however.

WATERS IN RANGE 5 (UPPER PART OF THE SAN PEDRO FORMATION)

In the west basin, the character of waters from range 5 (the upper part of the San Pedro formation) is known only from data of wells tapping the "400-foot gravel" in the synclinal trough beneath the Torrance plain. Analyses are available for four wells in T. 3 S., R. 14 W., and for one well in T. 2 S., R. 14 W., all of which tap only the "400-foot gravel." Of these five analyses, three are for waters considered representative for the "400-foot gravel." These are 3/14–10C1, analysis of August 21, 1945; 3/14–15G1, analysis of 1940; and 3/14–23L1, analysis of December 5, 1940 (table 30 and pl. 19). In these analyses the dissolved solids range from 323 to 359 ppm; from north to south, the ratio of calcium to other bases increases somewhat, with a corresponding decrease in the ratio of bicarbonate to other acid radicals. Also from north to south, chloride decreases from 38 to 28 ppm, and sulfate increases from 42 to 69 ppm. The content of 69 ppm of sulfate at well 23L1—the southernmost of the three—marks that water as being different from the water in the underlying Silverado water-bearing zone, which here contains less than 34 ppm of sulfate. The other two analyses do not conform to the regional character as described. For example, well 3/14–15D1 yields a water

definitely poorer in quality than the type water. In 1930 this well yielded a calcium, sodium chloride water in which the dissolved solids and chloride content were 576 and 198 ppm, respectively. This water has about the same amount of dissolved solids as that known to occur in the overlying unnamed upper Pleistocene deposits west of Hawthorne. Thus, analysis 3/14–15D1 probably represents a blend of waters from the "400-foot gravel" and from the unnamed deposits above.

In Ballona Gap, east of the Inglewood fault, the upper part of the San Pedro formation is tapped by several wells at the Sentney plant of the Southern California Water Co. (wells 2/14–5D5, 5D7, and 5D10); also by several public-supply wells of the city of Beverly Hills (wells 32M3 and 32K1). Chemical analyses are available for these wells. As shown on figure 14 and as discussed on pages 210–212, the character of these waters has varied between wide limits; however, as there explained, this fluctuation presumably does not represent a trend toward contamination but probably results from the blending with inferior native waters that existed in sec. 32. The waters were initially sodium bicarbonate waters; later analyses show a slight trend toward sodium, calcium bicarbonate waters. Chloride ranges generally from 62 to 173 ppm.

WATERS IN RANGE 6 (MIDDLE AND LOWER PARTS OF THE SAN PEDRO FORMATION)

Throughout its known extent in the west basin, except near the coast and locally elsewhere, the Silverado water-bearing zone of the middle and lower parts of the San Pedro formation yields native waters of excellent quality (pl. 19). These range from sodium, calcium bicarbonate to sodium bicarbonate waters.

In the southeastern part of the west basin, in and near Dominguez Gap, wells tapping the Silverado water-bearing zone yield sodium bicarbonate water, in which the dissolved solids range from 210 to 250 ppm, the hardness generally ranges from 70 to 85 ppm, and the chloride content is about 25 ppm. From east to west across Dominguez Gap, the sulfate seems to diminish; at well 4/13–14Q4 the sulfate content is about 35 ppm, and at well 21Q1 it is negligible. In Dominguez Gap most of the waters selected as representative of the Silverado water-bearing zone, as shown on plate 19, are from the upper or central parts of the zone. These waters are similar in hardness content to waters from wells tapping the upper part of the Silverado zone northeast of the Signal Hill uplift, where they range in hardness about from 66 to 91 ppm; those from the lower part of the Silverado zone range in hardness about from 15 to 28 ppm.

Along the northeast flank of Palos Verdes Hills in T. 4 S., R. 14 W., and in the southwest corner of T. 4 S., R. 13 W., the

Silverado water-bearing zone contains waters markedly different from those in the same zone beneath Dominguez Gap.

These markedly different waters are essentially sodium bicarbonate waters in which the bicarbonate is as high as 389 ppm; they differ from typical Silverado waters to the north and to the northeast in that (1) their sodium content is somewhat in excess of 100 ppm and (2) their chloride content commonly ranges from 50 to 75 ppm higher than that of the typical Silverado waters. The chloride is as high as 129 ppm (4/14–35E2) and sulfate commonly is less than 3 ppm. The high chloride content of these waters doubtless is due to blending with connate sodium chloride water occurring locally in the Silverado water-bearing zone beneath the flank of the Palos Verdes Hills (Piper, Garrett, and others, 1953, p. 57–58, and p. 230 analyses for well 5/13–6D1). This connate water is considered native, but since its inclusion with marine sediments it has been modified by the usual processes of base exchange and sulfate reduction, and, in addition, it has been diluted by land-derived waters. Analyses of water from well 5/13–6D1 are typical of this diluted connate water; the chloride and dissolved solids content are about 450 and 1,200 ppm, respectively. To the north, the effect of blending with this connate water does not extend more than about half a mile; wells 4/13–30K1 and 4/14–16L3, each about three-quarters of a mile northeast of the Palos Verdes Hills, yield water containing only 24 ppm of chloride. To the east, water from wells 4/13–31E3 and E4 shows the effect of blending with the connate water, although such blending has not been particularly deleterious; the chloride content of water from both wells in 1932 was less than 70 ppm. To the southeast, the extent of the connate water is not known, but evidence from electric logs of oil wells suggests that it may underlie the eastern part of Terminal Island.

In the west basin northwest of Dominguez Gap and extending about to Inglewood—that is, through the known extent of the Silverado water-bearing zone—the waters are consistently harder and higher in proportion of calcium and magnesium among the bases than those from this zone in Dominguez Gap. For example, the hardness ranges about from 100 to 275 ppm; north of Rosecrans Avenue, it is commonly more than 200 ppm. In these sodium, calcium bicarbonate waters the dissolved solids range about from 250 to 500 ppm but commonly are about 300 to 350 ppm. Across this central part of the west basin, from northeast to southwest—that is, from the crest of the Newport-Inglewood uplift to the coast—certain trends in chemical character are suggested by available data. These trends are as follows:

1. Near, but coastward, from the crest of the Newport-Inglewood uplift, the sulfate in the Silverado waters is at least 30 ppm. Westward, the sulfate di-

minishes rapidly and becomes low or negligible at the axis of the syncline; in general, it remains small or negligible to the coast.

2. Near, but coastward from the crest of the Newport-Inglewood uplift, the chloride content of the Silverado waters is probably not more than 36 ppm. This chloride content is reasonably constant to within about 2 miles of the coast; under native conditions it increased to about 90 ppm at the coast.

Adjacent to the coast, from the Ballona escarpment to and beyond Redondo Beach, native water no longer occurs in the Silverado water-bearing zone; as of 1946 this coastal strip was moderately to intensely contaminated. The chemical features of this contamination, and minor lateral differences in native waters found here initially will be discussed later.

Inland for 2 miles or more from the crest of the Newport-Inglewood uplift, from Dominguez Hill on the south to near Inglewood on the north, wells tapping the Silverado water-bearing zone yield water characteristically different from that in the central part of the west basin. As shown by analyses of water from wells 3/13–6G1, 3/13–8L2, and 3/14–1G1 (table 30), these are predominantly calcium bicarbonate waters; they differ chiefly in chloride and sulfate content from those waters coastward from the Newport-Inglewood uplift. In these waters, chloride is about 26 ppm and sulfate about 75 ppm.

Beyond the known extent of the Silverado zone (pl. 19), waters of excellent quality occur in the middle and lower parts of the San Pedro formation correlative with it. Analyses of water from well 2/14–22P1 at Inglewood, from wells 2/14–4N1 and 5D6, north of the Baldwin Hills, and from well 2/14–14C2, east of the Baldwin Hills, are representative. These wells contain calcium bicarbonate to sodium bicarbonate waters; their range in constituents and character may be determined from table 30, plate 19, and from table 16.

In sec. 5, T. 2 S., R. 14 W., available analyses indicate that water in the lower and middle parts of the San Pedro formation is sodium bicarbonate water and possibly is of somewhat better quality than that from the upper part of the formation (fig. 14).

In the Ballona Gap, about from the Inglewood fault to the coast, native waters in the San Pedro formation range from calcium, sodium bicarbonate to calcium bicarbonate waters. They contain about 40 to 70 ppm of chloride (usually about 60 ppm), nearly 100 ppm, and locally more than 200 ppm of sulfate, and about 480 to 650 ppm of dissolved solids. Thus, compared to waters inland from the Inglewood fault, their content of dissolved solids is higher than in the waters in the middle and lower parts of the San Pedro formation to the east. Also, they differ in character from the waters in the San Pedro formation yielded to wells just south of the Ballona escarpment (pl. 19, also p. 215). Native waters from wells 2/15–11J1 and 23P1

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in Ballona Gap were anomalous in character (as compared to the type waters in the gap) but were roughly similar to the waters south of the escarpment; this fact suggests some blending of the two types of water.

As of 1946, in the coastal part of the gap the waters in both the San Pedro formation and the overlying "50-foot gravel" of Recent age were contaminated; the extent and degree of contamination will be discussed later.

In the area just south of the Ballona escarpment, about in secs. 26 and 34, T. 2 S., R. 15 W., analytical data suggest that the waters under native conditions generally ranged from 80 to 100 ppm of chloride, from 30 to 50 ppm of sulfate (but usually less than 40 ppm) and from 500 to 600 ppm of dissolved solids. They were sodium bicarbonate to sodium, calcium bicarbonate waters and are represented by analyses of water from wells 2/15–26B1, 34A1, 34H1, and 34K1 (table 30: well 26B1, Mar. 29, 1932; well 34A1, Nov. 18, 1929; well 34H1, Jan. 8, 1930). Their chemical character is shown by figure 11, which compares them to representative waters of the San Pedro formation in Ballona Gap. (See also discussion of contamination at Playa del Rey.)

WATERS OF THE UNDIFFERENTIATED PLEISTOCENE DEPOSITS

To the north of Ballona Gap, and particularly beyond the north limit of T. 2 S., water-bearing zones are so discontinuous that a regional stratigraphic correlation has not been made (p. 45). Here, as may be expected, the waters from these several zones range considerably in quality and show striking local differences in character. Nevertheless, the over-all range in character is not markedly greater than that of the waters in the San Pedro formation immediately to the south in Ballona Gap. This also is to be expected because of the presumed hydraulic continuity with those deposits. Analyses of waters from wells 1/14–19R1, 1/14–20M1, 1/15–28B2, and 32A1 are believed to illustrate the range in chemical character of these waters (table 30 and pl. 19).

Typical of water from wells tapping the undifferentiated Pleistocene deposits is a nonsystematic fluctuation of dissolved solids, particularly chloride, in recurrent analyses for any given well over a period of several years. The chloride content in these waters ranges from 40 to 268 ppm and the sulfate content ranges about from 5 to 212 ppm. They range from calcium bicarbonate to sodium bicarbonate waters. Definite evidence of local contamination in these deposits cannot be proved because of the great range in proportion of individual constituents and because of the great range of dissolved solids as a whole. However, definitely inferior waters in these Pleistocene

deposits may be derived through upward movement from the underlying Pliocene rocks.

WATERS IN RANGE 7 (UPPER DIVISION OF PICO FORMATION)

For the Torrance-Santa Monica area, information on the chemical quality of water from the upper division of the Pico formation is obtained from analyses of water from six widely separated wells—1/15–25C1, 2/14–27J1, 2/15–1C5, 3/14–17J1, 4/13–12A2, and 5/13–3H. (See table 30 and pl. 19.) Three of the analyses (3/14–17J1, 4/13–12A2, and 5/13–3H) are from wells in or near the Torrance-Inglewood subarea. In these the dissolved solids range from 452 to 750 ppm, the chloride from 52 to 130 ppm, and the bicarbonate from 413 to 487 ppm. All are sodium bicarbonate waters. For the three the average percent sodium is 83. Thus, these are potable waters, although they are not desirable for irrigation because of their high percent sodium. In well 4/13–12A2 (city of Long Beach, North Long Beach well 6) the water was dark brown and the temperature was about 104°F. Although color and temperature could have been reduced by treatment, the yield of the well was considered too low to make treatment economical and the well was abandoned.

Of the other three analyses, one is from a well in the eastern part of Inglewood (2/14–27J1) and the others are from wells north of Ballona Gap, which are inferred to tap the upper division of the Pico formation or correlative deposits. In these the total solids range from 1,225 to 2,663 ppm, the chloride from 66 to 1,363 ppm, and the bicarbonate from 396 to 1,266 ppm. All these waters are unfit for ordinary uses.

Thus, available analytical data suggest that the waters in the upper division of the Pico formation north of Inglewood are saline and unusable; however, south of Inglewood, locally at least, they are of a quality suitable for some uses, although they may require treatment.

In the descriptions of native waters in the water-bearing zones of the Torrance-Santa Monica area of Recent and Pleistocene age, the silica content of the waters was not discussed because it does not appear to be a distinctive characteristic of any of the several ranges. The silica content of these waters was from 10 to 30 ppm, commonly less than 20 ppm. However, of the analyses of waters from the upper division of the Pico formation, four analyses indicate a considerably higher silica content, ranging from 35 to 59 ppm. Because of this greater concentration in the waters of the upper Pico, silica might be used as a diagnostic constituent in a critical study dealing with blended native waters yielded from wells tapping both the upper division of the Pico formation and the overlying water-bearing zones.

WATERS AT THE CENTINELA PARK WELL FIELD OF THE CITY OF INGLEWOOD

At the Centinela Park well field of the city of Inglewood, wells on opposite sides of the Potrero fault yield water with marked differences in chemical character. Elsewhere along the faults of the uplift, at least south to Dominguez Gap, differences are minor. Hydrologic information shows conclusively that the fault here is a substantial hydraulic barrier. Chemical evidence confirms the existence of that barrier. At this well field, seven wells were sampled in 1944–45 by the Geological Survey. Of the wells so sampled, five were east of (inland from) the Potrero fault and two were west of it. Inland from the fault, the chloride content of the water ranged from 25 to 56 ppm; coastward from the fault but adjacent to it, the chloride content ranged from 121 to 156 ppm. (For type analyses, see wells 2/14–22N3 and 2/14–27D3, table 30.) Inland from the fault, the waters are calcium bicarbonate in character and the dissolved-solids content is about 375 ppm. To the west, across the fault, well 2/14–27D3 also yields calcium bicarbonate water but the dissolved solids content is about 450 ppm. Although not cited here, chemical data from wells about a mile to the southwest, in sec. 28, T. 2 S., R. 14 W., suggest that the increase occurs chiefly in chloride and sulfate, with a proportionate increase in calcium and sodium. Only at well 28E1 (city of Inglewood well 23) is the increase in cations wholly in sodium. However, the character of water from this well probably is anomalous; transverse faulting south of the well may separate it from the others in sec. 28 for which chemical data are available.

At the Centinela field, both the "200-foot sand" and the water-bearing zones in the San Pedro formation are tapped by many of Inglewood's public-supply wells. However, water levels here are now (1948) at or below sea level and the "200-foot sand" is almost wholly dewatered; thus, in recent years the water has been withdrawn almost entirely from the San Pedro formation.

POTENTIAL CONTAMINANTS OF FRESH-WATER BODIES IN THE TORRANCE-SANTA MONICA AREA

Fresh waters in the Torrance-Santa Monica area, which have become contaminated, or which have received an increase in salinity, are a result of a mixture with certain waters, either moderately or excessively high in total solids. These latter waters have their source either outside the fresh-water zones, with migration into those zones after discharge at or near the land surface, or by establishment of favorable gradients through permeable deposits, or both, or inside the fresh-water zones, occupying either a part of a permeable zone stratigraphically equivalent to that containing the fresh water, or a con-

tiguous zone or zones that may be either younger or older than that containing fresh water, but requiring a suitable gradient and hydraulic continuity to advance into the fresh-water zone.

EXTERIOR CONTAMINANTS

Contaminants that initially are outside zones containing fresh water under native conditions and that require hydraulic continuity and a favorable gradient toward those zones in order to mingle with the fresh waters are: (1) ocean water, (2) industrial wastes, and (3) oil-field brines.

OCEAN WATER

As in the Long Beach-Santa Ana area, ocean water is an obvious potential contaminant in the Torrance-Santa Monica area because water-bearing zones, at places along the coast from Santa Monica to the Palos Verdes Hills and beneath San Pedro Bay, crop out on the ocean floor and are inferred to be in hydraulic continuity with the ocean; because certain areas, specifically the coastal parts of Dominguez and Ballona Gaps, have been or are now being overrun by ocean water within the tidal range; and because the water levels near the coast widely have been drawn down below sea level.

In the coastal part of Dominguez Gap, the original tidal flats have been filled in and dikes have been constructed along both the Los Angeles River and Dominguez Channel with the result that inland movement of tidal water is restricted to those water courses; in the Los Angeles River, the extreme inland reach of oceanic water during the highest tides is 0.95 mile or to a point about a quarter of a mile south of Anaheim Street. To the northwest in Ballona Gap, tidal marshes extend inland nearly to Lincoln Boulevard. In the old channel of Ballona Creek, the tidal range was about the same as in the adjacent marsh; in the new channel, completed early in 1938, the inland reach of tidal water is about to Inglewood Boulevard, 1 mile farther inland and about 3 miles from the coast.

To show the chemical character of ocean water, two analyses are given in table 31—a "standard" analysis and an analysis of water from San Pedro Bay. For these representative analyses, ocean water generally ranges from 34,100 to 34,500 ppm in solids, and from 18,400 to 19,000 ppm in chloride. Magnesium is about three times as abundant as calcium; however, in native ground waters, calcium is the more abundant. In ocean water, the bicarbonate content is about 140 ppm; in native ground waters, bicarbonate may be as great as 400 to 500 ppm, but normally it is about 250 to 300 ppm.

INDUSTRIAL WASTES

Wastes discharged as a result of industrial activity become potential contaminants of fresh-water zones in the Torrance-Santa Monica area when (1) they are discharged into natural or artificial water courses that traverse that area, or (2) they are discharged at land surface in sumps and pits and are allowed to evaporate and seep away.

Four water courses traverse the Torrance-Santa Monica area. These are the Los Angeles River, Dominguez Channel, and Compton Creek, which are all in and near the Dominguez Gap, and Ballona Creek, in the Ballona Gap. The conditions of industrial-waste disposal in Dominguez Gap have been discussed at length in an earlier report (Piper, Garrett, and others, 1953, p. 80–83). Wastes discharged to the Los Angeles River inland from Dominguez Gap commonly are sodium chloride or sodium sulfate waters and in most cases are considerably less concentrated than oil-field brines. However, the analyses here cited suggest that in recent years, disposal of wastes into the Los Angeles River inland from Dominguez Gap has been carried on to a lesser degree than formerly.

Within the west basin, the chief point of disposal of waste to the Los Angeles River (in 1946) is just upstream from Wardlow Road. Here are the skimming sumps of the Oil Operators, Inc. From these sumps, oil-field brines have been discharged to the Los Angeles River at a rate that averaged 4.4 cfs from 1928 through 1943. These brines have ranged in chloride content from 9,000 to 16,000 ppm since 1932 and at times of low natural runoff the brines have made up the total flow of the river.

The Dominguez Channel is used for disposal of oil-field brines from the Dominguez and Rosecrans fields and of saline wastes from the several oil refineries in the industrial area west of Long Beach. As shown by analyses of water taken from Dominguez Channel by the Geological Survey in 1942–43, the water of the channel has ranged at least from 145 to 10,000 ppm of chloride throughout its reach southeast of Main Street to Wilmington Avenue. For at least a part of the time, the volume of wastes carried by the Dominguez Channel has been as much or more than that carried by the Los Angeles River.

Inland from the west basin, Compton Creek discharges to the Los Angeles River about 5.5 miles from the coast and 0.3 mile inland from the Cherry-Hill fault. In 1942–43 from analyses by the Geological Survey, the chloride content in the lower reach of Compton Creek ranged from 62 to 132 ppm. Although the indicated concentration is low, the creek carries organic material which makes the water very turbid and foul-smelling. For approximately the same period through which the water samples were taken, the mean flow in the creek was about 10 cfs; the minimum flow was 3 cfs.

Available chemical analyses for Ballona Creek suggest that, at least at times, the creek has received contributions of water of marked salinity. For instance, the highest chloride sample reported (4,354 ppm) was obtained in 1932 from a spring discharging from the northwest bank of Ballona Creek, 700 feet upstream from Higuera Street (in 2/14–5M). A comprehensive analysis was not made, hence the chemical nature of the saline water is not known. Most of the samples collected from the creek have contained only a few hundred parts of chloride. The lowest concentration known was for a sample taken from the creek February 11, 1936 by Dr. Carl Wilson; this sample had a chloride content of 15 ppm. A series of five analyses, two by Dr. Wilson in 1936 and three by the California Division of Water Resources in 1937–38, indicate that the streamflow then ranged in character from a sodium chloride water to a sodium, calcium bicarbonate water. None of the comprehensive analyses suggest additions of oil-field brines during that period; fluctuations in chloride content are accompanied by a corresponding change in sulfate content. If such chloride fluctuation had resulted from addition of oil-field brine, little or no change in sulfate would have occurred. Koch (1940, p. 18) reports that a sample taken in December 1939 from a small creek flowing into Ballona Creek from the Baldwin Hills (sampling point in 2/14–5N, about 100 feet north of Jefferson Boulevard) contained 2,630 ppm of chloride. This creek, according to the report, carries much of the surface runoff of the Inglewood oil field. However, the extent to which the Ballona Creek has been used as a means of disposal for oil-field brines is purely conjectural in the absence of analyses of creek flow showing such discharge.

From the early thirties to 1938, extensive sections of Ballona Creek were paved with concrete. As of 1938, the channel was paved with an impervious lining from Crenshaw Boulevard for about 4 miles downstream to LaSalle Avenue, which is about 0.75 mile upstream from the Overland Avenue fault (pl. 2). From LaSalle Avenue to the coast, about 5 miles, only the sides of the channel are paved (1946). The tidal reach now extends inland about 3.1 miles, or to Inglewood Boulevard. Thus, since 1938, it has been only in the 2-mile reach from LaSalle Avenue to Inglewood Boulevard that the channel bottom has been open to receive influent seepage from the creek discharge. This 2-mile reach spans the Charnock subbasin and the coastward 0.75-mile segment of the crestal subbasin. It is not known whether substantial seepage losses from the creek occur in this reach, but certainly a potential threat of contamination exists at such times as the creek carries water unfit for use. Coastward from Inglewood Boulevard, seepage contributions, if any, are from the saline tidal waters.

OIL-FIELD BRINES

There are eight major oil fields in the Torrance-Santa Monica area—the Inglewood, Potrero, Rosecrans, and Dominguez fields along the Newport-Inglewood uplift and the Playa del Ray, El Segundo, Torrance, and Wilmington fields along the coast (pl. 18).[14] In addition, there are two minor fields—Lawndale and Beverly Hills—from which production is small. In all these fields most of the connate waters raised to the land surface are separated from the oil by settling or by mechanical or chemical dehydration. Analyses of the connate waters for four of these fields are given in table 31.[15] For the several oil fields, methods of brine disposal are described as completely as possible insofar as such information was made available to the Geological Survey.

Yield of oil-field brines.—The total amounts of brines pumped from the several oil fields in the Torrance-Santa Monica area are substantial. Table 17 shows the quantities of these brines discharged by each oil field for the year 1940, from records published by the California Division of Oil and Gas (1940–41, p. 28, 30).

TABLE 17.—*Quantities of water produced from oil fields in the Torrance-Santa Monica area in 1940*

[Data from publications of the California Division of Oil and Gas]

Oil field	Fluid yield (barrels)	
	Annual	Daily average
Beverly Hills	90, 141	247
Inglewood	3, 705, 140	10, 150
Potrero	337, 368	924
Rosecrans	1, 556, 879	4, 265
Dominguez	3, 291, 324	9, 017
Playa del Rey	3, 833, 257	10, 500
El Segundo	1, 179, 636	3, 232
Lawndale	79, 730	218
Torrance	1, 695, 170	4, 644
Wilmington	759, 856	2, 082

The total withdrawal of brines from these 10 fields in the Torrance-Santa Monica area as of 1940 was about 45,000 barrels a day or about 2,200 acre-feet a year, which is about 3 percent as great as the quantity of ground water pumped from the west basin alone in that same year.

Inglewood field.—The Inglewood oil field covers much of the Baldwin Hills north of Inglewood. The discovery well was completed late in 1924, and 150 productive wells had been drilled by September

[14] Two of the fields, Dominguez and Wilmington, are discussed at length by Piper, Garrett and others (1953, p. 70, 78) but those discussions will be briefed here.

[15] For analyses of connate waters from the Dominguez and Wilmington fields, see Piper and others (1953, table 29).

1925. The field has been developed almost entirely by the Kettleman and Inglewood Corp., Standard Oil Co. of California, Tidewater Associated Oil Co., Shell Oil Co., and the Texas Co. As of 1946, at least two companies, the Tidewater Associated Oil Co. and the Standard Oil Co. of California, ran the brines from their producing wells into settling ponds from which the overflow was piped chiefly to the city of Los Angeles Hyperion outfall sewer, which follows the north flank of Baldwin Hills and the south edge of Ballona Gap to the ocean. A part of the Standard Oil Co. waste water reportedly is discharged (1946) to Ballona Creek about half a mile upstream from Lincoln Boulevard, or well within the tidal reach. As of 1946, the Tidewater Associated Oil Co. discharged about 2,650,000 gallons of waste fluid each month. Although none of the brines from the Inglewood field are known to have been discharged to Ballona Creek above tidewater as of 1946, the analysis of the flow of a small stream from the north slope of Baldwin Hills (sampled in 1939 with a chloride content of 2,630 ppm) suggests that at least a diluted connate water was then discharged at land surface

Potrero field.—The Potrero field, east of Inglewood, was discovered in 1927, and by mid-1941 about 26 wells were in production. It is reported that, in the early thirties, the brines either were diverted into unlined ditches and sumps where they drained to the southwest, or they were hauled to a dump in Centinela Creek within the city of Inglewood until a city ordinance was passed to prohibit such practice. As of 1946 most of the production has been from wells of the Basin Oil Co., and waste brines are discharged to the Los Angeles County Sanitation District sewer system.

Rosecrans field.—This field occupies the west-central part of T. 3 S., R. 13 W., about 2 miles west of Compton. The chief operators in the field are the Union Oil Co. and the Barnsdall Oil Co. The Union Oil Co. carries (1946) the oil with its admixed brine from each well to a central dehydrating system. From there, the brine is pumped to a skimming pond near the intersection of Rosecrans Avenue and Main Street. This pond is used by the several companies operating in the field. The effluent from this pond reportedly is piped to a Los Angeles County sewer line. Of the total quantity so disposed, the Union Oil Co. in 1946 reportedly contributed about 57,000 barrels a month.

Dominguez field.—The Dominguez oil field was discovered in 1923 and has been developed largely by the Shell Oil Co. and the Union Oil Co. Since about 1930, at least a part of the waste fluids from the oil wells in this field have been piped to the plant of the Deepwater Chemical Co. for extraction of iodine. This plant is about 0.1 mile north and 1 mile west of the intersection of Wilmington Avenue and

Victoria Street, on the northwest flank of Dominguez Hill. The effluent from the plant is piped (1946) to an outfall on the Dominguez Channel about 0.4 mile northwest of Avalon Boulevard. When the plant is idle, the brines are piped to the Dominguez Channel through the same line.

Other means of disposal of brines formerly were employed by at least one of the operating companies (Piper, Garrett, and others, 1953, p. 70). In 1932, the Shell Oil Co. reportedly released brines into a ravine high on the southwest flank of Dominguez Hill and into the crater of a blown-out oil well near the crest of Dominguez Hill, just west of Wilmington Avenue and about 0.3 mile south of Victoria Street. It is understood that this practice was discontinued late in 1932. The quantity of brine so discharged at the land surface is not known, but if such disposal had been practiced since 1923, several hundred acre-feet of waste brine could have percolated to permeable deposits formerly saturated with fresh water.

Playa del Rey field.—This field is divided into two areas: (1) The ocean front or Venice area, along the coastal front of Ballona Gap, which was discovered in 1929; and (2) the Del Rey Hills area, almost wholly in sec. 27, T. 2 S., R. 15 W., which was discovered in 1931. In the Venice area, the brines from wells operated by the Union, Ohio, and Barnsdall Oil companies are piped to a plant operated by the Dow Chemical Co. for extraction of iodine. As of 1946, about 460,000 gpd was treated. The effluent from the plant is piped to a canal which is open to tidewater a short distance north of the plant. The brine treated by the plant constitutes almost the total water production of the field, although locally small amounts of brine may be discharged at land surface and allowed to drain away. The area occupied by this field is or has been overrun by tidal water of salinity equal to or greater than that of the connate brines.

In the Del Rey Hills part of the field, the brines are collected from the individual wells and then are piped into the city of Los Angeles Hyperion outfall sewer.

El Segundo field.—The El Segundo field, which is just east of the city of El Segundo, was discovered in August 1935 and was completely developed by late 1938. Waste fluids from wells east and southeast of El Segundo are piped (1946) to a main disposal line that crosses Sepulveda Boulevard at El Segundo Boulevard. Waste fluids from active wells in a minor producing area within the city of El Segundo, south of the city's water-treatment plant at Holly Avenue and Maryland Street, are conveyed to this line through a pipe running south on Center Street. The main disposal line runs west along El Segundo Boulevard, thence to the Standard Oil Co. refinery where, presumably, the brine is discharged to the ocean.

Torrance field.—The Torrance field is about 7.5 miles long; it reaches nearly to the Wilmington field on the east and to within about a mile of the coast on the west. The first productive well was completed in 1922, and peak production was reached in 1924. As of mid-1941, most of the production was from the southeastern part of the field.

From investigation of means of brine disposal in this field, it appears that (1946) many of the smaller companies discharge the brines from their wells to small sumps—usually one for each well—from which the brines evaporate or seep away. For the southeastern part of the field, brines from about 300 acres each of the Superior Oil Co. and of the Standard Oil Co. are piped to a skimming pond, about 1,500 feet east of Normandie Avenue and 0.9 mile south of Sepulveda Boulevard. From the pond, the brines are piped to the Los Angeles County sewer farm, which is between Vermont Avenue and Figueroa Street and about 0.8 mile south of Sepulveda Boulevard. In 1946, about 20,000 gpd of waste fluids were discharged to the sewer farm. Previous to about 1940, the fluids were conveyed from the skimming sump to the sewer farm by an open ditch. A large sump, just southwest of the intersection of Hawthorne Avenue and Torrance Boulevard, is reported to be used for disposal of waste fluids from wells of the Del Amo Estate Co.; from this sump, the fluids reportedly are allowed to evaporate or seep away. Disposal methods of waste fluids from the western part of the field are not known.

Thus, in the Torrance field it is possible that at least several hundred acre-feet of saline brines have passed from the land surface into the ground-water bodies, although only in sec. 9, T. 4 S., R. 14 W., are they inferred to have reached deposits tapped by an active water well.

Wilmington field.—The Wilmington oil field is west of the Los Angeles River and extends inland for a distance of about a mile to 3 miles from the Cerritos Channel and the innermost basins of the Los Angeles harbor. The first well of commercial importance was drilled here late in 1936. By the early forties, more than 900 wells were in production. At least three of the principal operators pipe their brines directly to tidewater (1946). However, many operators reportedly discharge brine into sumps or at land surface. Such disposal is of no serious consequence in the eastern two-thirds of the field, because that area now is underlain at shallow depth by contaminated waters which are no longer used. In the western third of the field, however, water wells not more than 75 feet deep yielded water of fair quality in the early forties; hence, in this western area, these brines are a potential contaminant, not only of the shallow water-bearing zones but also of the underlying Silverado water-bearing zone, by passage from the shallow zones through defective

well casings, or by slow downward movement through intervening deposits that are not wholly impermeable.

INTERIOR CONTAMINANTS

The native interior contaminants in the Torrance-Santa Monica area are chiefly those inferior waters that have been described earlier. These include:

1. Unconfined and semiperched waters in the Dominguez and Ballona Gaps and beneath the Torrance plain. Locally in the gaps these contain as much as several thousand ppm of dissolved solids; their concentration probably has been increased both by contamination and by evaporation. Beneath the Torrance plain the dissolved-solids content of the unconfined waters ranges from 1,000 to 4,000 ppm.
2. Waters in the southernmost reach of the Gaspur water-bearing zone in Dominguez Gap. Here, this water-bearing zone has been extensively invaded by exterior contaminants; it, in turn, can contaminate deeper water-bearing zones now containing water of good quality.
3. Native connate or diluted connate water confined in the San Pedro formation adjacent to or underlying the northeast and east flanks of the Palos Verdes Hills. This is sodium chloride water and locally, at least, contains 1,200 ppm of dissolved solids.

Of the three sources, the first and second are the most critical. Wells tapping underlying aquifers must pass through these two, and where the inferior shallow water has a higher head than the deeper water of good quality, downward circulation will occur if well casings are defective. Both in Dominguez Gap and beneath the Torrance plain, water levels in underlying zones are several tens of feet below levels in the inferior water bodies above.

CONTAMINATION OF THE NATIVE FRESH WATERS

GENERAL EXTENT OF WATER-QUALITY DEPRECIATION

As stated earlier, a few wells near the coast began to yield salty water in the late twenties. Subsequently, many of these wells were abandoned because contamination became so intense that the water could no longer be used. On plate 16 are shown the districts in the Torrance-Santa Monica area in which one or more of the groundwater bodies contained more than about 100 ppm of chloride in 1945–46. In certain of the districts, inferior waters existed under native conditions. In the Ballona and Dominguez Gaps, and along the coast from Playa del Rey to the Palos Verdes Hills, however, the extent of waters containing more than 100 ppm of chloride has resulted largely from saline contamination in the last 20 years, primarily from exterior sources. The inland advance of contamination along the coast since 1931–32 is indicated on plate 16 by the change in the position of the line showing 100 ppm of chloride.

MODIFICATIONS IN CHEMICAL CHARACTER OF CONTAMINATED WATERS

For both the Torrance-Santa Monica area and the Long Beach-Santa Ana area, contaminated waters are, almost without exception, not a simple blend of a native and a saline water. Instead, chemical reactions have occurred either concurrently with, or subsequent to, blending with the contaminant to the extent that the nature of the contaminant is completely or substantially disguised. Most commonly, these reactions involve (1) base exchange and (2) sulfate reduction.

1. For many of the contaminated waters in the Torrance-Santa Monica area, successive analyses of water from a given well during its period of active contamination show a definite increase in calcium along with the customary increase in chloride. Hence, these analyses might erroneously be taken as evidence to show blending with a calcium-chloride contaminant. However, no contaminant has been known to exist in the Torrance-Santa Monica area in which calcium predominates as an alkali radical. Therefore, this calcium enrichment, resulting from blending with a contaminant in most cases known to predominate in sodium among the bases, must be due to a modification in the ratios of calcium, magnesium, and sodium to each other. This modification is known as base exchange.

The fact that the base exchange process goes on extensively has become well-established. It can occur because the zeolite and glauconite minerals and certain clay-forming minerals have the property of holding the bases (calcium, magnesium, sodium, and potassium) loosely and in variable proportions. In the presence of a natural water, with whose chemical composition it is not in equilibrium, any of these particular minerals (and possibly some types of organic matter associated with sedimentary deposits) has the property of releasing to the water a part of the base or bases most loosely held and of absorbing from the water an equivalent amount of the base or bases for which it has a stronger bond. This process of exchanging bases goes on until an equilibrium is reached between the proportions of the several bases in the mineral and in the water, or until the exchangeable bases are exhausted in one or the other. With respect to the chemical character of the water, the effect is an increase in one or more bases and an ion-for-ion decrease in one or more of the remaining bases. Thus, if a sediment in equilibrium with a calcium bicarbonate water be subjected to contact with a water in which sodium predominates among the bases, a part of that sodium will be removed and will be replaced by calcium and to a smaller extent by magnesium in an ion-for-ion proportion. Hence, from this base-exchange phenomenon may arise the illusion that a calcium-rich contaminant has invaded the aquifer.

2. In both the Long Beach-Santa Ana area and the Torrance-Santa Monica area, many of the waters known to be contaminated by ocean water contain less sulfate than would result from a simple mixture of native water and the ocean water in the proportions indicated by the total amount of chloride present. This sulfate removal probably is due to the reduction of sulfate to sulfide, either by the action of anaerobic bacteria or by the action of organic material, with the concurrent production of CO_2 in either case, which would increase the bicarbonate content of the water. In brines associated with petroleum, chemical analyses show the sulfate content to be low or zero, doubtless because the hydrocarbons have reacted with the sulfate and have resulted in the formation of hydrogen sulfide; the hydrocarbons in turn are oxidized to form carbon dioxide and water.

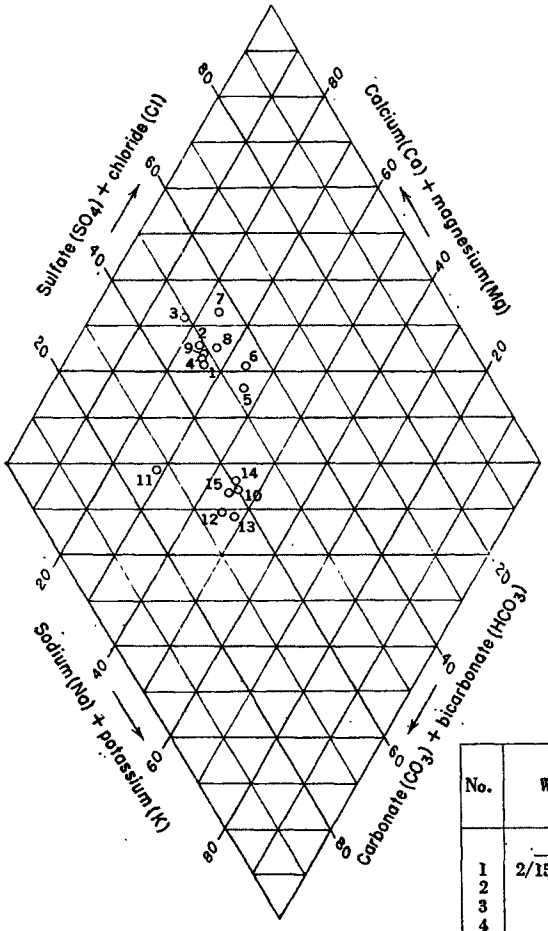
For a more complete discussion of these phenomena and for a bibliography relating thereto, reference should be made to the report on chemical character of waters in the Long Beach-Santa Ana area (Piper, Garrett, and others, 1953, p. 85–91).

CONTAMINATION IN BALLONA GAP

SUMMARY OF NATIVE WATER QUALITY

The geologic conditions in Ballona Gap and the hydraulic relations between the "50-foot gravel" and the underlying San Pedro formation have been summarized on pages 94 to 98. It is inferred that the difference in chemical character between waters yielded from the "50-foot gravel" and from the San Pedro formation was not great under native conditions. Water from wells tapping the "50-foot gravel" ranged about from 650 to 750 ppm of dissolved solids, although local wells presumably tapping the "50-foot gravel" yielded water containing at least 850 ppm of dissolved solids. Data concerning the chemical quality of water from wells tapping the San Pedro formation are fragmentary; the dissolved solids content probably ranged about from 480 to 650 ppm, although locally it was probably nearly as great as in the "50-foot gravel." These data represent the conditions as of 1903–4 and are based on determinations of electrical conductance of water from the wells sampled.

Chemical analyses of samples taken since about 1929 suggest that—at least for the period preceding that of extensive contamination—wells within Ballona Gap, tapping the "50-foot gravel" or underlying zones, yielded water markedly different from that yielded by wells tapping the San Pedro formation just south of the Ballona escarpment. In Ballona Gap, the waters contained from 40 to 70 ppm of chloride (the higher part of the range is confined to the shallower deposits), and nearly 100 to more than 200 ppm of sulfate. South of the Ballona escarpment, particularly in secs. 26 and 34, T. 2 S., R. 14 W., native water contained 80 to about 100 ppm of chloride and usually less than 40 ppm of sulfate. Figure 10 compares the chemical character of native or only incipiently contaminated waters in Ballona Gap to those immediately south of the Ballona escarpment. The principles of the procedure in plotting chemical character of waters on a so-called trilinear diagram have been described by Piper (1945). Also, figure 9 explains the chemical character of waters in the Torrance-Santa Monica area relative to their plotted positions on the diagram. On figure 10 the waters from Ballona Gap and from the area south of the gap plot in two separate fields, chiefly because of the difference in ratio of calcium and magnesium to sodium, and of bicarbonate to sulfate.



No.	Well	Parts per million		
		Dissolved solids	Cl	SO_4
	Waters in Ballona Gap			
1	2/15- 1C2	563	62	150
2	11C6	483	52	134
3	11D2	557	41	182
4	14A1	558	77	131
5	15A2	645	75	185
6	15A4	631	71	197
7	15F2	620	65	204
8	15H1	567	59	151
9	24C1	567	38	184
	Waters south of Ballona Gap			
10	2/15-11 J1	476	62	82
11	23P1	631	96	28
12	26B1	492	87	39
13	34A1	478	94	29
14	34H1	445	86	46
15	34K1	483	100	30

FIGURE 10.—Chemical character of selected native waters in Ballona Gap compared to waters just south of the Ballona escarpment.

However, this distinction in water character is not universal. For example, two wells in the gap, 2/15–11J1 and 23P1, in 1930–31 yielded water somewhat similar to that from wells tapping the San Pedro formation immediately south of the Ballona escarpment. The water in well 2/15–23P1 may represent a blend with a northward-extending lobe of the waters occurring south of the escarpment; it is difficult, however, to see how such a blend could have reached well 11J1 without appearing first in wells 2/15–24C1 and 14A1 (pl. 19). Thus, the chemical evidence here presented suggests that under native conditions, little, if any, water moved from the gap to the deposits south of the escarpment, or vice versa. Although the type native waters selected from secs. 26 and 34, T. 2 S., R. 15 W., are sodium, calcium bicarbonate waters, the analyses of water from wells 2/15–34A1 and 34K1 (table 30) suggest that, at least part of the time, sodium bicarbonate waters were present locally.

On the west flank of Baldwin Hills, well 2/14–18F1 in 1925 yielded water containing 182 ppm of chloride, 143 ppm of sulfate, and 823 ppm of dissolved solids. This water is probably a native blend in which waters from pre-Pleistocene deposits have moved into the San Pedro formation and are tapped by that well. The analysis represents a water similar to, but less concentrated than that from well 5/14–12C1 (table 30), on the east flank of the Palos Verdes Hills; this well is believed to tap pre-Pleistocene deposits in an area presumed to be free of contamination from surface-disposed brines. Analyses of water from well 2/14–18F1 in 1932 and 1945 show definite contamination, in which oil-field brine doubtless has contributed most, although not all, of the observed salinity.

For the shallow unconfined waters in Ballona Gap, too few analyses have been made to gain definite knowledge of their chemical character, either under native conditions or during the development of contamination. However, under native conditions dissolved solids commonly ranged from 800 to 1,000 ppm, but locally they are inferred to have been as high as 5,000 ppm. For water from several wells tapping the unconfined body in secs. 22, 23, and 24, T. 2 S., R. 15 W., the chloride concentration in 1930–32 was about 200 to 400 ppm—not inordinately high for shallow unconfined waters near the coast. However, because the unconfined waters can be expected to differ markedly with local conditions, these analyses are of little value for determining the quality of the unconfined waters elsewhere within the gap. It is concluded that the native unconfined waters at shallow depth in Ballona Gap generally were somewhat inferior and locally were greatly inferior to the waters in the underlying aquifers of the principal water body.

GENERAL FEATURES AND EXTENT OF CONTAMINATION

The study of the history and progress of contamination in Ballona Gap is complex and is rendered difficult for three reasons:

1. Before 1930 only a few comprehensive analyses of Ballona Gap waters were made. Because of this dearth of analyses, some locally native water types in the gap may have been considered in this report as definitely or incipiently contaminated.
2. Only locally in the areas of contamination has the salinity increase been sufficiently great to afford definitive knowledge of the chemical character or the source of the contaminant.
3. The directions in which contaminated waters and contaminants move within the gap are influenced locally by hydrologic barriers which transect the San Pedro formation but do not transect the "50-foot gravel" (p. 94). Therefore, the paths taken by the contaminated waters during the period of development to date (1946) have depended not only upon the hydraulic gradient and the amount of hydraulic connection between the "50-foot gravel" and the underlying water-bearing beds of the San Pedro formation, but they also depend upon the barrier partitions within that formation.

Since 1930 many active wells have been sampled periodically. Consequently, a large number of analyses are available for study for the period 1930–46, and much can be learned regarding the chemical character and contamination of the waters during this period.

Information is not available to indicate the time contamination began in Ballona Gap. As of 1930–32, however, waters containing more than 100 ppm of chloride occurred within the "50-foot gravel" or the underlying water-bearing deposits of the San Pedro formation beneath about 5,100 acres, or about 8 square miles, along the coast and extending inland to the vicinity of Sepulveda Boulevard (pl. 16). In this area, the chloride concentration then ranged from 100 to about 400 ppm, and the dissolved solids commonly ranged from 800 to 2,000 ppm. The extent of contamination between the Charnock and Overland Avenue faults as of 1930–32 is not known because analyses are not available. However, in the middle and late thirties, wells south of Ballona Creek in this block yielded water containing as much as 500 ppm of chloride (wells 2/15–13K2 and K4), and it is inferred that this area was contaminated as early as 1930–32.

At the north edge of the Baldwin Hills, and some 6 miles inland from the coast, chiefly in sec. 5, T. 2 S., R. 14 W., an area of about 250 acres was underlain by contaminated waters in 1930–32. Of six wells for which analytical data are available, the chloride content of five wells was in excess of 500 ppm and was 254 ppm in the sixth. The contamination extended northward beyond well 2/14–5F2 and southward beyond well 2/14–8D1. The greatest concentration was in well 5N1 (5,414 ppm of chloride). Fragmentary analytical data suggest that the waters were not contaminated between the coastal

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and inland areas as of 1930–32, although native water containing more than 100 ppm of chloride existed along the west flank of the Baldwin Hills; this is shown by a chloride concentration of 182 ppm in well 2/14–18F2 in 1925.

As of 1946, nearly all of Ballona Gap coastward from the Overland Avenue fault was underlain by contaminated waters; this coastal area of contamination had extended to some 7,300 acres, or about 11.4 square miles, an increase of about 2,200 acres in 15 years (pl. 16). The movement of the saline front had been generally northward across the gap; coastward from the Charnock fault, it had advanced from 0.4 to 0.9 mile; inland between that fault and the Overland Avenue fault, it probably had advanced about 1 mile in the 15 years. As of 1946, essentially all the area coastward from Lincoln Boulevard was underlain by water with a chloride content greater than 500 ppm.

At the north edge of the Baldwin Hills, in sec. 5, T. 2 S., R. 14 W., the area of contamination probably remained about constant from 1930 into 1946, although its front may have moved northward because of the large withdrawals from the wells of the Southern California Water Co. and the city of Beverly Hills in 2/14–5C and 2/14–5D.

Between the coastal area of contamination and the area north of the Baldwin Hills, a third area of contamination developed on the west flank of the Hills in the thirties and early forties. By 1946, about 200 acres east of the intersection of Overland Avenue and Jefferson Boulevard was underlain by water containing more than 500 ppm of chloride (pl. 16). The focus of this contamination is presumed to be in the vicinity of well 2/14–7K1, because water from this well contained 18,810 ppm of chloride in 1939.

In contrast to the general contamination in the gap, an area about 0.15 mile wide and 0.8 mile long, inland from the Charnock fault and south of Ballona Creek, was still uncontaminated as of 1940—according to analyses of samples from wells 2/15–24C1 and 24F3. So far as known, the main water-bearing zone in this narrow strip then contained less than 60 ppm of chloride; as of 1945, it probably was no more than incipiently contaminated.

CONTAMINATION NEAR THE COAST

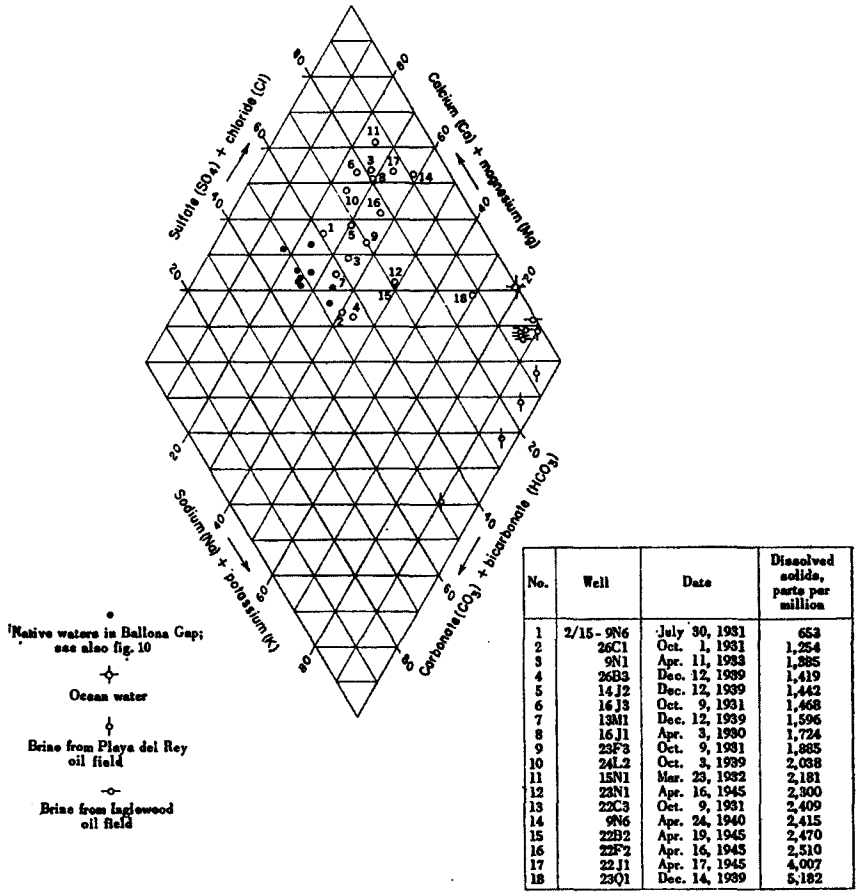
In the coastal area of contamination, saline encroachment presumably began in the twenties and abandonment of wells started about 1930. For example, two wells of the Venice Consumers Water Co. in sec. 16, T. 2 S., R. 15 W., about 1 mile from the ocean, were abandoned in 1930 because of salinity. Abandonment of wells at the Marine plant of the city of Santa Monica in 2/15–9N began about 1933, although at least one or two of the wells were used into 1941. In 1940, well 2/15–9N7 (well 5 of the city of Santa Monica) yielded

water containing over 1,100 ppm of chloride. For the interval from 1930 to 1945, sharp increases in salinity were restricted chiefly to wells within 1.5 to 2 miles of the coast. Records of chloride analyses for selected wells are plotted on plate 20 to show the rate of salinity increase in the coastal area of contamination in Ballona Gap. Analyses were made chiefly by Los Angeles County Flood Control District, California Division of Water Resources, and Los Angeles Department of Water and Power. In general, the chloride increase has been greatest in wells less than about 1.5 miles from the coast. Except for these badly contaminated wells, and some local wells not shown here, the graphs indicate that, for the area as a whole, salinity has not definitely increased since the middle thirties; in fact, many of the well waters have had a slight decrease in salinity in recent years. For this coastal area of contamination, chemical evidence does not suggest any regional quality gradient between the "50-foot gravel" and the San Pedro formation.

The information regarding the zones tapped is too meager to indicate whether any definite relation exists between depth of zone tapped and water quality. Tentatively it may be concluded that, at least for the coastal part of the gap, no uniform vertical gradation in quality exists. Therefore, the two water-bearing zones are not discussed separately in dealing with contamination here, but instead, they are treated as containing a single contaminated water body.

CHEMICAL FEATURES OF CONTAMINATION

In the coastal area of contamination many of the well waters have become grossly contaminated; in 1945, at least one well (2/15–22J1) yielded water in which the dissolved-solids content was more than 4,000 ppm. To show the manner in which chemical character of the contaminated waters has changed with increase in concentration, figure 11 is plotted to show a number of the more highly contaminated waters in order of increasing concentration. Also plotted on the graph are the group of native waters from figure 10. Figure 11 shows that the points representing the contaminated waters scatter to the right and range upward. In terms of character change, departure to the right indicates an increase in the proportion of sulfate or chloride and a similar increase in the proportion of sodium. The shift upward and increased concentration denotes an increase in calcium and magnesium and a proportionate loss of sodium. Inferentially, the increase in alkaline earths at the expense of the sodium might be interpreted to indicate that a high-calcium or high-magnesium contaminant is present in Ballona Gap. However, neither here nor in the Long Beach-Santa Ana area has such a contaminant been found. Therefore, the increase in alkaline earths is presumed to be due to



No.	Well	Date	Dissolved solids, parts per million
1	2/15-9N6	July 30, 1931	653
2	26C1	Oct. 1, 1931	1,254
3	9N1	Apr. 11, 1933	1,285
4	26B3	Dec. 12, 1939	1,419
5	14J2	Dec. 12, 1939	1,442
6	16J3	Oct. 9, 1931	1,468
7	13M1	Dec. 12, 1939	1,596
8	16J1	Apr. 3, 1930	1,724
9	23F3	Oct. 9, 1931	1,885
10	24L2	Oct. 3, 1939	2,038
11	15N1	Mar. 23, 1932	2,181
12	23N1	Apr. 16, 1945	2,300
13	22C3	Oct. 9, 1931	2,409
14	9N6	Apr. 24, 1940	2,415
15	22B2	Apr. 19, 1945	2,470
16	22F2	Apr. 16, 1945	2,510
17	22J1	Apr. 17, 1945	4,007
18	23Q1	Dec. 14, 1939	5,182

FIGURE 11.—Chemical character of native and contaminated waters in the coastal part of Ballona Gap.

base exchange, in which the sodium in the incoming contaminant is replaced nonuniformly by calcium or magnesium, or both. As will be noted on figure 11, the occurrence of base exchange disguises completely any possible gradation in quality toward that of known contaminants. As shown on the illustration it is obvious that, as salinity of the water increases, the path of the plotted points does not head toward the plots for either ocean water or a typical oil-field brine. If the degree to which base exchange has occurred could be determined and a correction made in the position of the plotted points, then a trend toward one or the other of the possible contaminants might actually occur.

Although, as shown by figure 11, no consistent trend in chemical character occurs with increasing concentration, it will be noted from data presented below that from the coast to about 1.5 miles inland,

or about to Lincoln Boulevard, chloride increase is attended by an increase in sulfate in about the proportion to be expected if ocean water were the contaminant. The progress of contamination from Lincoln Boulevard inland to near Sepulveda Boulevard indicates that the sulfate content of the contaminated waters has increased above that which could possibly result from the addition of sulfate carried into the aquifers by ocean water alone. Hence, inferentially, the encroachment of ocean water into Ballona Gap extends about to Lincoln Boulevard, or nearly as far as the 500 ppm chloride contour shown on plate 16.

To show the proportionate amount of sulfate increase in the coastal strip, analyses of contaminated water from three wells have been selected (2/15–9N6, 16J1, and 26C1, all within 1.75 miles of the coast) and are compared to hypothetical mixtures of native waters with ocean water. Table 18 shows these contaminated waters and the corresponding hypothetical mixtures, based on an equality of chloride concentration. As the table shows, only 9N6 contained an excess sulfate content (8 percent) but, because of possible analytical errors in the determination of that constituent, this small excess is not considered to be sufficient to rule out ocean water as the contaminant. On the other hand, analysis 26C1 showed a deficiency of 42 percent in sulfate content. In this case, however, a loss in sulfate is

TABLE 18.—*Contaminated water from wells 2/15–9N6, 16J1, and 26C1, in comparison with hypothetical mixtures of the presumed native water with ocean water*

	Constituents					
	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)
Parts per million:						
Presumed native water of well 2/15-9N3, April 11, 1933	76	26	78	274	151	60
Well 2/15-9N6, contaminated water of Apr. 24, 1940	380	60	465	250	323	1,180
Native water mixed with ocean water	95	100	711	266	299	1,180
Well 2/15-16J1, contaminated water of Apr. 3, 1930	270	105	210	373	231	720
Native water mixed with ocean water	87	70	451	269	238	720
Well 2/15-26C1, contaminated water of Oct. 1, 1931	131	90	225	662	112	373
Native water mixed with ocean water	81	47	255	272	192	373
Equivalents per million:						
Well 2/15-9N6, Apr. 24, 1940	18.97	4.93	20.21	4.10	6.72	33.29
Native waters mixed with ocean water	4.75	8.20	30.92	4.36	6.22	33.29
Well 2/15-16J1, Apr. 3, 1930	13.48	8.64	9.11	6.11	4.81	20.31
Native water mixed with ocean water	4.36	5.72	19.59	4.41	4.95	20.31
Well 2/15-26C1, Oct. 1, 1931	6.54	7.40	9.76	10.85	2.33	10.52
Native water mixed with ocean water	4.06	3.83	11.09	4.46	4.00	10.52
Excess (+) or deficiency (−) of the contaminated waters with respect to native and ocean water mixtures, as follows:						
Water of 2/15-9N6	+14.22	−3.27	−10.71	−.26	+.50	----------
Water of 2/15-16J1	+9.12	+2.92	−10.48	+1.70	−.14	----------
Water of 2/15-26C1	+2.48	+3.67	−1.33	+6.39	−1.67	----------

not diagnostic, because the process of sulfate reduction is common in both native and contaminated waters—it certainly could have occurred here. Referring again to the table, all the contaminated waters are lower in sodium and higher in the sum of calcium and magnesium than the hypothetical mixtures. This discrepancy is due to base exchange in the direction of calcium enrichment and is to be expected. Hence, its occurrence will not, in itself, invalidate the postulation of ocean-water contamination of those well waters whose analyses are examined here.

In contrast, table 19 presents the sulfate content of water from a number of wells inland from the 500 ppm chloride contour, but coastward from Sepulveda Boulevard. The sulfate content of these waters is compared to that which would result from mixtures of native water with ocean water, based on an equality of chloride concentration. As may be seen from the table, all the analyses cited show more sulfate in the contaminated water than could possibly have resulted from an ocean water-native water blend. The excess of sulfate, expressed as the percent of excess over that contained in the hypothetical blend, ranges from 31 to 440 ppm for waters in the confined body. Well 2/15–23Q1, tapping the unconfined body, yielded water in which the percent excess of sulfate with respect to the native confined water is 1,240 ppm. Thus, considering the change in sulfate concentration that has occurred, the shallow water could be causing part of the contamination. Hence, for the coastal part of Ballona Gap, the concentration of sulfate suggests that ocean-water contamination doubtless has occurred inland about to and possibly beyond Lincoln Boulevard. From Lincoln Boulevard to Sepulveda Boulevard, the shallow water in the unconfined body may be the principal contaminant. However, it is likely that the boundary between the ocean-water and high-sulfate-water contamination is very irregular and indefinite.

In an attempt to define the position of this boundary, and to identify the contaminant inland from Lincoln Boulevard, three other chemical characteristics of potential contaminants were considered. These characteristics are (1) bicarbonate content, (2) calcium-magnesium ratio, and (3) borate content. The study of these characteristics failed to provide a better definition of the boundary.

1. The bicarbonate content in ocean water is about 140 ppm; in the shallow unconfined waters of Ballona Gap it commonly is about 500 to 700 ppm but in one locality it is as great as 1,670 ppm; in oil-field brines from the Inglewood field—according to six available analyses—it ranges from 297 to about 2,000 ppm and averages 1,350 ppm. In native waters in Ballona Gap it probably ranged about from 275 to 300 ppm. Therefore, a Ballona Gap native water contaminated by ocean water alone would decrease in bicarbonate, but if the contaminant were either shallow unconfined water, or an oil-field brine, the

TABLE 19.—*Sulfate content of water from selected wells in the coastal part of Ballona Gap in comparison to that resulting from a hypothetical mixture of native water* [1] *and ocean water*

Well	Parts per million			Excess (percent)
	Chloride	Sulfate (actual)	Sulfate (hypothetical)	
2/15-13J3	456	492	208	137
13M1	375	295	192	54
14Q1	259	231	177	31
15N1	604	492	223	121
22B2	222	931	173	438
2/15-22C1	266	835	169	394
22C3	337	674	188	259
23A2	187	532	168	217
23A3	214	449	172	161
23C1	371	483	193	150
2/15-23F3	206	593	170	249
23G1	240	607	175	247
23G2	231	633	174	264
23H1	300	730	183	299
23J2	174	476	166	187
2/15-23M3	250	583	176	231
23Q1	941	2,234	167	1,240
24L2	208	923	171	440

[1] Native water selected is that from well 2/15-9N3, analysis of Apr. 11, 1933.

bicarbonate content of the contaminated water would increase slightly and irregularly. A study of the analyses of contaminated waters throughout the coastal part of Ballona Gap indicates that in such waters a bicarbonate content of 400 to 500 ppm is common and that, with very few exceptions, notably at the Marine plant of the city of Santa Monica, the increase in chloride is attended by an increase in bicarbonate. Well 2/15–9N6, at the Marine plant, yielded water that decreased in bicarbonate from 308 ppm in 1931 to 226 ppm in 1940. Over the same period, the chloride content increased from 81 to 930 ppm. However, here the bicarbonate loss is considerably more than would result from ocean-water contamination alone. In general, the conclusion was reached that, for this coastal area of Ballona Gap, bicarbonate is useless as a criterion for determination of the sources of contaminants.

2. The calcium-magnesium ratio for ocean water, computed from equivalents per million, is 0.19; for oil-field brines from the Inglewood field, it ranges from 0.28 to 1.04 and averages 0.56, according to six available analyses; for shallow, unconfined waters, it appears to be less than 1 (well 2/15–23Q1, 0.57; well 23Q2, 0.73). For presumed native waters in Ballona Gap, the ratio ranges from 1.2 to 2; hence, it would be expected that native waters rendered inferior by blending with any of the known contaminants, would show a decrease in calcium-magnesium ratio concurrent with salinity increase; of course, for only moderate contamination the decrease would be slight. According to computations (not presented here), such a decrease in calcium-magnesium ratio does not occur. Actually, with increase in salinity of randomly selected native waters, a considerable scatter (from 0.9 to 2.5) occurs in the value of the ratio; therefore, such a ratio could be of little value in discriminating the source of a contaminant.

In contrast, waters in Dominguez Gap that were contaminated by ocean water have a much lower calcium-magnesium ratio than waters contaminated by oil-field brines (at least, for chloride concentrations less than 1,000 ppm). There, in water contaminated from the ocean, the ratio averages about 0.6, whereas in

waters primarily contaminated by oil-field brine, the ratio averages about 2.3 (Piper, Garrett, and others, 1953, p. 190). That is, a calcium-magnesium ratio much greater than 0.6 would seem to indicate a contaminant other than ocean water. In regard to those waters in Dominguez Gap, the base-exchange reactions, which usually occur with blending of native waters and saline waters and which cause much irregularity in the proportion of bases, was operative to only a small extent. On the other hand, in Ballona Gap, the great irregularity in calcium-magnesium ratios in contaminated waters doubtless results from base-exchange reactions which prevent the use of that ratio as a diagnostic characteristic.

3. The borate content in ocean water is about 25 ppm. In presumed native waters of Ballona Gap, the borate content commonly ranges from 0.3 to 0.8 ppm, although some of these native waters—particularly those which may represent a blend with waters from the flank of the Santa Monica Mountains—contain as much as 1.4 ppm. Therefore, if a contaminated water with 500 ppm of chloride contains more than about 1.5 to 2 ppm of borate, it is inferred that some saline water other than ocean water has been the cause of such contamination. Little is known concerning the borate content of potential contaminants in Ballona Gap; however, a sample of water from Ballona Creek, collected in 1931, contained 350 ppm of chloride and more than 5 ppm of borate. Although not in Ballona Gap, and cited for example only, a sample of water collected in 1932 from the Los Angeles River just downstream from the sumps of Oil Operators', Inc., contained 14,289 ppm of chloride and 169 ppm of borate. Fragmentary data not presented here suggest that oil-field brines in the Los Angeles basin contain several times as much borate as ocean water (Piper, Garrett, and others, 1953, p. 67 and table 8).

Information on the borate content of contaminated waters in the coastal part of Ballona Gap shows that at least 13 wells have yielded water containing more than about 1.5 ppm of borate (for waters in which the chloride content is not appreciably more than 500 ppm). Of these 13 wells, 8 are in sec. 23, T. 2 S., R. 15 W.; all of the wells are in that part of the coastal reach of Ballona Gap about from Lincoln Boulevard to Centinela Boulevard. For 12 of these wells, the borate content ranges from 1.6 to 3.4 ppm. The additional well, 2/15–23N1, yielded water in 1931 containing 7.6 ppm. Nearly all of these wells are farther inland than the presumed inland extent of ocean-water contamination, as determined on the basis of sulfate content. However, throughout the area in which the 13 foregoing wells are located, other wells, equally saline, contain only slightly larger amounts of borate than is presumed to have occurred in the native waters; many of these wells yield high-sulfate waters. Therefore, it is concluded that the borate content of contaminated waters inland from Lincoln Boulevard is of virtually no value in attempting to delimit the inland extent of ocean-water contamination, because no definite borate-chloride ratio seems to exist.

With respect to possible contamination from Ballona Creek, the available analyses of side inflows and creek water are listed in table 20.

The points where the samples were taken are shown by corresponding numbers on plate 17. The table shows that waters discharged into the creek are of sufficiently great sulfate and chloride content to cause contamination of ground waters within the coastal reach inland from tidewater; that is, providing that the materials beneath and adjacent to the creek are sufficiently permeable to permit appreciable seepage from the creek. Regarding such seepage, the California Division of Water Resources (1933, p. 26) notes that, "Discharge during summer usually penetrates into creek bottom before reaching tidewater." At the time of this observation, August 1931, the flow in the creek was estimated at 3 cfs.

TABLE 20.—*Chloride, bicarbonate, and sulfate content of water samples from Ballona Creek and its tributaries or points of inflow, 1931–40*

[Analyses principally by Los Angeles County Flood Control District]

Number on plate 17	Sampling point	Date sampled	Constituents, parts per million		
			Chloride (Cl)	Bicarbonate (HCO_3)	Sulfate (SO_4)
1	La Cienega storm drain; west half, near West Adams Blvd., 200 feet north of Washington Blvd.	Apr. 20, 1931	86	353	45
		Mar. 1, 1932	304	418	----------
2	La Cienega storm drain, east half	Apr. 20, 1931	160	353	100
		Mar. 1, 1932	241	500	----------
3	Sacatela storm drain, 50 feet upstream from outlet of La Cienega storm drains.	Mar. 1, 1932	227	369	----------
4	Spring at west half of La Cienega storm drain	Mar. 1, 1932	524	622	----------
5	Spring, 700 feet upstream from Higuera St., discharging to Ballona Creek from northwest bank.	Mar. 1, 1932	4,354	806	----------
		Mar. 25, 1932	4,083	778	1,880
6	Storm drain, Moynier Lane, 900 feet south of West Adams Blvd.	Mar. 1, 1932	468	422	----------
7	do	Mar. 1, 1932	262	320	----------
8	Creek flowing from north flank of Baldwin Hills and entering Ballona Creek about at Jefferson Blvd.	Dec. 21, 1939	2,633	363	----------
9	Spring, issuing from cave at north flank of Baldwin Hills, 0.37 mile south of Jefferson Blvd., in Lenawee Ave., extended.	Apr. 29, 1932	311	581	----------
10	Ballona Creek, at Duquesne St. Analyses by California Division of Water Resources.	Aug. 19, 1931	350	360	201
		Aug. 11, 1937	240	361	218
		Oct. 27, 1937	532	394	231
		Feb. 21, 1938	265	508	225
11	Ballona Creek, at Sawtelle Blvd	Dec. 27, 1939	368	----------	----------
		Apr. 25, 1940	489	----------	----------
12	Ballona Creek, at Inglewood Blvd	Dec. 17, 1935	68	----------	----------
		Jan. 30, 1936	185	----------	----------
		Apr. 15, 1936	460	----------	----------
		May 11, 1936	446	----------	----------
		Oct. 14, 1936	383	----------	----------
		Jan. 19, 1937	388	----------	----------
		Mar. 8, 1937	450	----------	----------
		Nov. 27, 1939	441	----------	----------
13	Ballona Creek, at Centinela Blvd	Aug. 24, 1936	629	----------	----------
		Oct. 14, 1936	321	----------	----------
		Jan. 19, 1937	306	----------	----------
		May 10, 1937	287	----------	----------
		Nov. 27, 1939	356	----------	----------
		Dec. 9, 1939	306	----------	----------
14	Ballona Creek, at Lincoln Blvd. Sampling point within tidal reach in creek.	Aug. 24, 1936	7,560	----------	----------
		Jan. 19, 1937	12,600	----------	----------
		Dec. 14, 1939	17,600	----------	----------
	Ballona Creek. Sampling point not known. Analysis by Dr. Carl Wilson.	Jan. 30, 1936	186	160	80
	do	Feb. 11, 1936	15	62	17

As discussed on page 187, the channel of Ballona Creek is paved with an impervious lining inland from La Salle Avenue; however, coastward from this avenue the bottom of the channel is unlined. The analyses (table 20) of creek water suggest that, if seepage has occurred here, the waters so introduced into the ground-water body may have caused a substantial part of the contamination. From La Salle Avenue inland, the ground-water bodies are protected from saline waters flowing within the creek channel. La Salle Avenue is 0.7 mile inland from the fault separating the Charnock and the crestal subbasins; hence, both basins are subject to possible contamination from the creek channel at the present time.

In regard to the sources of contamination in the coastal part of Ballona Gap, it may be concluded that inland at least as far as Lincoln Boulevard and including the abandoned Marine plant of the city of Santa Monica, ocean water has caused most if not all of the contamination. The presence of a landward hydraulic gradient from the early twenties to the late thirties coincides with this conclusion. The conclusion regarding an oceanic source of contamination is in general agreement with that of the Los Angeles County Flood Control District, which was the result of extensive work in Ballona Gap by that agency (Koch, 1940, p. 16).

The Los Angeles County Flood Control District also prepared the first detailed map showing contamination conditions in Ballona Gap. This map (Koch, 1940, pl. 2) shows lines of equal salinity and designates a suggested boundary between sea-water intrusion and oil-field brine pollution.

Inland about from Lincoln Boulevard to Sepulveda Boulevard, water from the shallow, unconfined body tentatively is presumed to be the chief cause of contamination, although near Lincoln Boulevard the contaminant may have been a blend of ocean water and unconfined water. Although confirmatory information is not available, it is likely that Ballona Creek has been an important factor in contaminating the shallow water body, at least as far inland as La Salle Avenue. Nowhere in this coastal part of Ballona Gap has it been possible to identify any contamination from oil-field brines. In part, this may stem from the difficulty of applying any of the criteria that ordinarily may be used in recognition of a blend of oil-field brine with native water.

CONTAMINATION ON THE WEST FLANK OF BALDWIN HILLS

An area of contamination developed on the west flank of the Baldwin Hills in the thirties; by 1946, about 200 acres east of the intersection of Overland Avenue and Jefferson Boulevard was underlain by water containing more than 500 ppm of chloride (pl. 16). Evidence suggesting that the contamination originates in the Baldwin

Hills is afforded by a sample of water (collected in 1939 from well 2/14–7K1), which contained 18,810 ppm of chloride. Referring to table 31, the chloride content of brines from the Inglewood oil field, based on six analyses, ranges from 17,500 to 20,000 ppm. The depth of well 2/14–7K1 is not known, but it is high on the west flank of the Baldwin Hills and presumably taps the San Pedro formation.

The location of well 7K1 is such that contamination by ocean water is physically impossible, because the base of these water-bearing deposits is more than 100 feet above sea level (pl. 2). Hence the well doubtless is contaminated by oil-field brines. It is to be expected that such highly contaminated waters would percolate through the water-bearing deposits and ultimately would contaminate wells in Ballona Gap. Evidence of this fact is provided from two analyses of water from well 2/15–7P2 (table 30). In June 1945 the well yielded water containing 600 ppm of chloride; in February 1946 it yielded water containing 1,100 ppm. During that period the sulfate content increased from 152 to 156 ppm; the comparatively small increase in sulfate is consistent with brine contamination considering the small amount of sulfate present in the brines of the Inglewood field. These two analyses are plotted on figure 12. The analyses are so plotted on this graph that the vertical height of a given constituent represents the amount of that constituent in equivalents per million. The oil-field brine contamination has reached at least as far south as wells 2/14–18F1 and 18F2; to the west it presumably extends into sec. 12, but chemical evidence showing its exact extent is lacking. As shown by plate 2, the permeable sand and gravel of the San Pedro formation crop out extensively to the north, east, and south of well 2/14–7K1, and any brines discharged at the land surface can readily move down the westerly dipping beds to the Overland Avenue fault.

CONTAMINATION ON THE NORTH FLANK OF BALDWIN HILLS

About 300 acres, located chiefly in sec. 5, T. 2 S., R. 14W., was underlain by contaminated waters in 1930–32. The contamination extended northward beyond well 2/14–5F2 and southward into the Baldwin Hills beyond well 8D1. Inferentially, this area became contaminated some years earlier than the coastal area. By 1931 several wells in 2/14–5P yielded water containing from 1,000 to 5,400 ppm of chloride. Because this contamination apparently is due to blending with oil-field brines, as will be explained, the contamination could have started at any time after 1924, which was the year of initial development in the Inglewood oil field. Analyses from three highly contaminated wells in this area are available: analyses 2/14–5N1, March 23, 1932; 2/14–5P1, October 22, 1931; and 2/14–5P3, October 2, 1931. Their chemical character is shown on figure 12. Of the

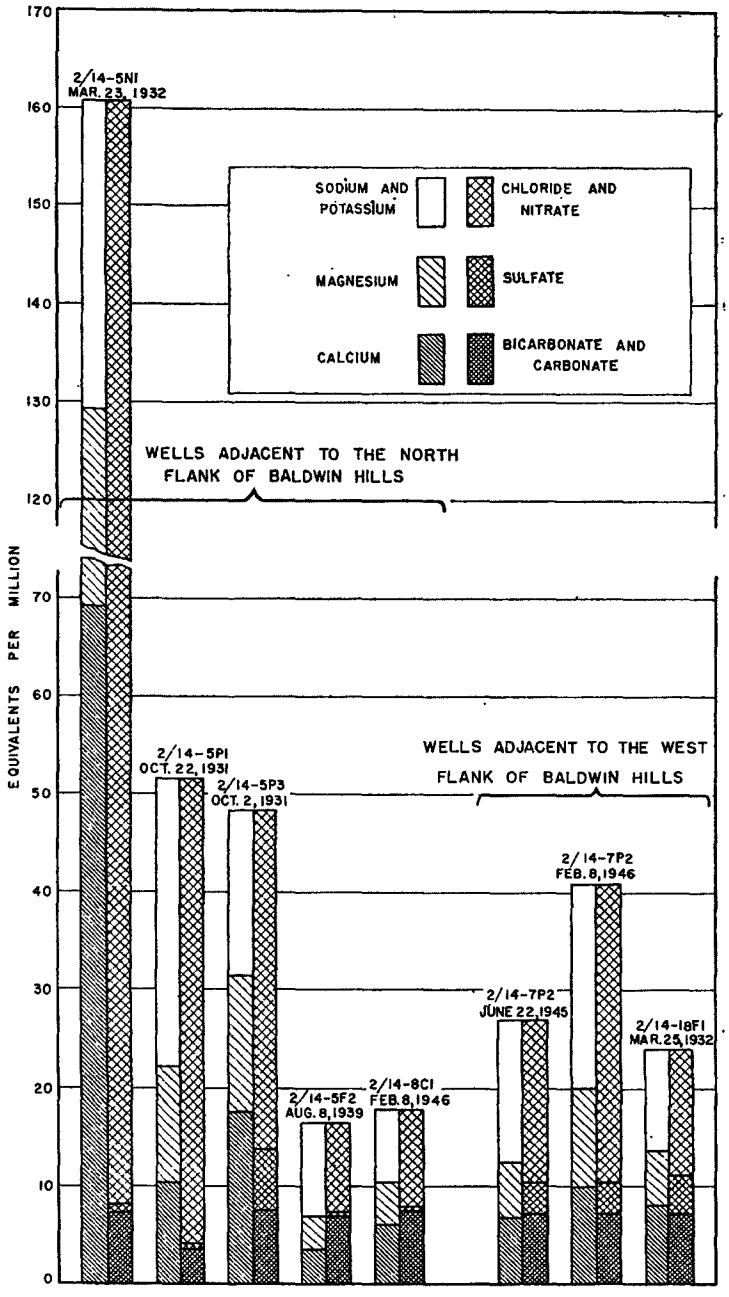


FIGURE 12.—Chemical character of contaminated waters from wells in Ballona Gap adjacent to the west and north flanks of Baldwin Hills.

analyses given, only 5P3 shows an appreciable amount of sulfate; however, in relation to the concentration of dissolved solids, that sulfate content is proportionally far less than in most of the contaminated waters toward the coast. Because the brines from the Inglewood field are low in sulfate—ranging from 13 to 56 ppm (table 31)—the low sulfate in the contaminated waters is a reasonably good indication of the source. Although well 5P1 contained 2.9 ppm and well 5P3 contained 3.5 ppm of borate, this constituent does not assist in isolating the source, because no analyses of borate in Inglewood brines are available.

Although it is possible that the contamination could have originated from Ballona Creek, such an origin is unlikely because of the following three important factors:

1. Because of the position of the contaminated area shown on plate 16 and because of the position of the more highly contaminated wells, a source to the south rather than to the north is the more logical.
2. Existing analyses of water samples from Ballona Creek upstream from the contaminated area fail to show the presence of waters sufficiently saline to cause the observed concentration in the contaminated wells.
3. Contamination from Ballona Creek would have resulted in definite impairment of the waters from one or more of the Sentney plant wells of the Southern California Water Co.

Hence, it is concluded that contamination here has been the result of discharge of oil-field brines from the Inglewood oil field.

Although the wells in 2/14–5P were strongly contaminated by 1931, recurrent chloride determinations from two wells, 2/14–5C1 and 5F2, plotted on figure 13, suggest that the concentration at these wells was not appreciably higher in the early forties than it was in 1931. Well 5C1, 0.2 mile east of the Sentney plant of the Southern California Water Co., taps essentially the same range as well 5D6 (Sentney plant,

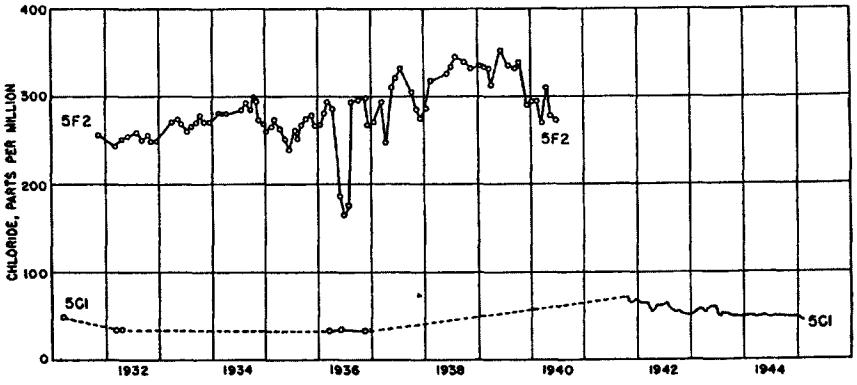


FIGURE 13.—Chloride content of waters from wells 2/14–5C1 and 2/14–5F2. Analyses chiefly by Los Angeles County Flood Control District.

well 6), and is about at the north edge of the contamination. Well 5F2, within the area of contamination, is about 0.2 mile south of 5C1. It is 260 feet deep and taps the upper part of the San Pedro formation. Well 5F2, although of irregular chloride content, showed an increase in salinity into 1939, then it showed a decrease. Well 5C1 may have reached a peak at about the same time as 5F2; chloride determinations on 5C1 from 1941 into 1945 show a decrease in chloride into 1944, then a leveling off at about 50 ppm. Well 5F2 yielded contaminated water containing very little sulfate and is assumed to be contaminated by oil-field brines.

To determine the current status of salinity in the area shown as contaminated in 1930–32 (pl. 16), an electrical-conductivity traverse was made on well 2/14–5P1 in July 1946. This unused well is located about 1,750 feet southeast of Ballona Creek and about 1,500 feet north of the flank of the Baldwin Hills. The measured depth was then 179 feet below land surface. The casing is perforated in gravel, 20 to 32 feet below land surface. As computed from values of specific conductance, the dissolved solids in the water within the casing, from water surface at 13 feet to 88 feet below land surface, ranged from 4,600 to 4,800 ppm. From 89 to 176 feet below land surface, the dissolved solids ranged from 7,400 to 8,000 ppm. In 1931 a sample from the well contained 2,856 ppm of dissolved solids; thus, at least at this one well, the salinity concentration has intensified appreciably during the 15-year period. Well 5N1, 1,000 feet northwest of 5P1, yielded water containing 8,528 ppm of dissolved solids in 1932; this well was not found in 1946, and its salinity at that time could not be determined.

WELLS AT THE SENTNEY PLANT OF THE SOUTHERN CALIFORNIA WATER CO.

In the NW¼ sec. 5, T. 2 S., R. 14 W., analyses of water from the Sentney plant wells of the Southern California Water Co. show that they yield waters with erratic fluctuations in chemical concentration; these analyses strongly suggest a blending of waters of different and distinct types. Although, as of 1946, all the active wells yielded presumably native water, distinct vertical differences in chloride concentration occur; water with the lowest chloride content is yielded from the lowest part of the water-bearing beds. Well 5C1, 0.2 mile east of the Sentney plant and perforated below 277 feet, yielded water containing 44 ppm of chloride in 1945. Well 5D6, perforated below 326 feet, yielded water containing 49 ppm of chloride in 1945. Well 5D4, for which the perforated interval is not known, yielded water containing as much as 219 ppm of chloride in 1936. The records of chloride content of water yielded from seven wells of the Sentney plant have been plotted on figure 14, together with the record of

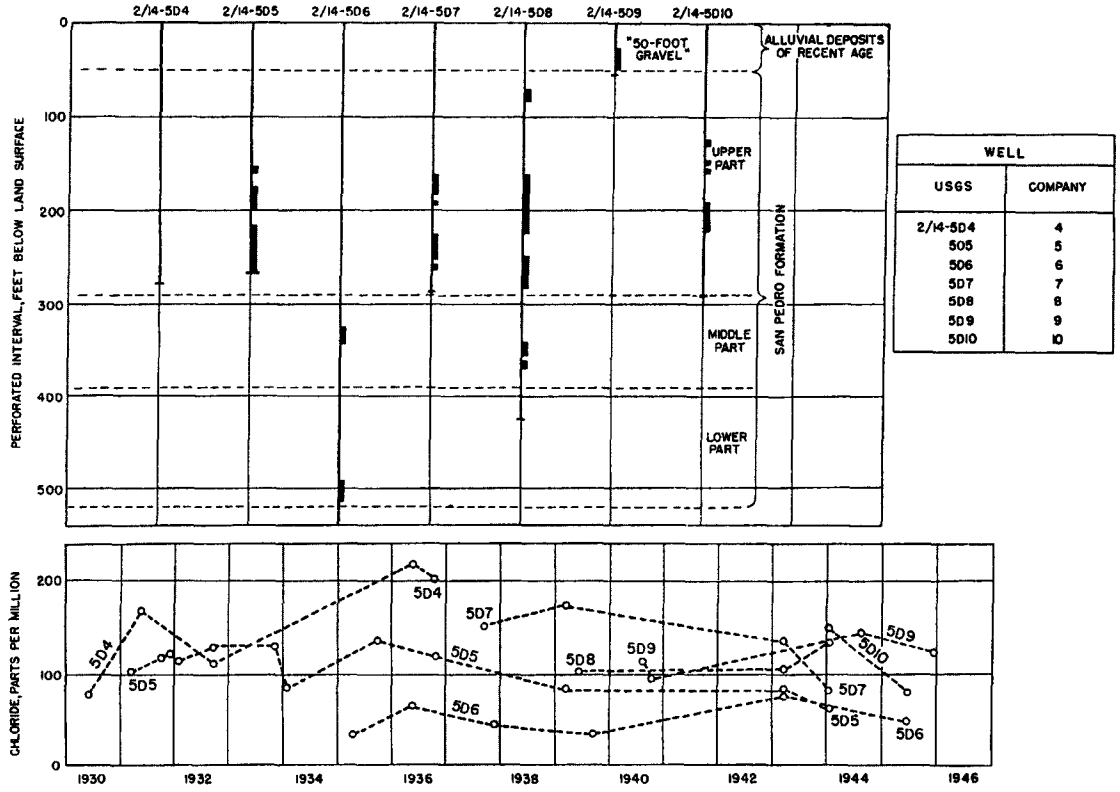


FIGURE 14.—Chloride content of waters and record of perforations for seven wells at the Sentney plant, Southern California Water Co.

perforations for these wells. Three conclusions may be drawn in part from the figure:

1. Well 5D6, which taps the middle and lower parts of the San Pedro formation, yielded water of the best quality, but as of 1943 the quality approached that of water yielded from the upper part of the formation.
2. Essentially no difference in chloride concentration exists between waters in the "50-foot gravel" of Recent age (well 5D9) and in the underlying upper part of the San Pedro formation. However, the former has yielded water definitely higher in sulfate than that from the San Pedro formation. Since 1944 analyses of water from well 5D9 tapping only the "50-foot gravel," have shown an increase in dissolved solids, which has been due chiefly to an increase in calcium and in sulfate.
3. For the respective zones tapped, only a comparatively small range in chloride content exists—as of 1944, from about 65 to 150 ppm. For the span of the records, no definite progressive contamination is indicated, with the possible exception of well 5D4, which has not been pumped since about 1936.

The heaviest production from the Sentney plant is from the upper part of the San Pedro formation—which here includes the main aquifers. Well 5F2, which is 0.4 mile southeast and was definitely contaminated in the thirties, also once yielded water from the upper part of the San Pedro formation. Because a steep cone of pressure relief has been maintained at the Sentney plant for many years (pls. 9–12 and 14) it might be expected that, at least by 1946 wells at the Sentney plant would have become contaminated from the south—that is, from the same source that caused well 5F2 to become saline. The fact that these wells have not yielded definitely contaminated water suggests a hydraulic discontinuity between the Sentney plant and the contaminated water body to the south. However, the hydrographs for wells 5D5 and 5F2 plotted on plate 14, suggest that no hydraulic separation exists. Accordingly, it is concluded that the bulk of the northward-migrating contaminant was withdrawn through wells 5F2, 5C1, and possibly other wells, in the thirties and early forties, and that a small marginal interception was withdrawn through wells 5D4 and 5D7 in the middle thirties (fig. 14).

Under native conditions, inferior waters occurred in sec. 32, T. 1 S., R. 14 W; in 1931 wells 32M1 and M3 yielded water containing 227 and 304 ppm of chloride, respectively. It is believed that these waters have migrated in part to the Sentney plant wells and have caused some of the observed fluctuations in chloride.

From existing analyses of water from the Sentney plant wells, it is inferred that as of 1946 the active wells were not contaminated, and that the recent fluctuations in chloride are not an indication of incipient contamination, but instead, they are a result of blending with inferior waters present to the north and east.

RATE OF ADVANCE OF THE CONTAMINATION FRONT

In Ballona Gap the greatest advance of the contamination front in the last 16 years has been in the Charnock subbasin. From 1930–32 to 1945–46 the front has advanced about 1 mile, and in 1946 it was about 0.6 mile from the Charnock well field of the Southern California Water Co. This advance is estimated at an average rate of about 350 feet per year; the direction of advance is to the northwest and is in response to the hydraulic gradient developed by withdrawals from the Charnock field. If the front continues to advance at the same average rate, it will reach the Charnock field in 8 to 10 years. However, as the front moves closer to the field, it is expected that the rate of movement will be accelerated by the steeper gradient.

As of November 1945 (pl. 12), the hydraulic gradient to the well field from the northwest was about 30 feet per mile; from the southeast, about 15 feet per mile at the saline front. Thus, if the transmissibility of the deposits to the north and to the south is equal, about two-thirds of the supply is derived from the north and one-third from the south. The water now yielded from the Charnock well field contains about 50 ppm of chloride, about 700 ppm of dissolved solids, and 400 ppm of hardness (table 30). The saline waters just south of Ballona Creek in the Charnock subbasin contain as much as 500 ppm of chloride, 2,000 ppm of dissolved solids, and 800 ppm of hardness (table 29). If such saline waters eventually should reach the Charnock plant wells and should be withdrawn with the native waters in a proportion of 1:2, the resulting blend would contain about 200 ppm of chloride, 1,100 ppm of dissolved solids, and 500 ppm of hardness.

In the coastal area, contamination has advanced along about a 3-mile front, chiefly in secs. 14, 15, and 16, T. 2 S., R. 15 W. Part of the advance as shown on plate 16 is conjectural because of the scarcity of wells that could be used to locate the front more precisely. However, for the 16-year period the greatest advance appears to be along the west boundary of sec. 14 and in sec. 15, where it was from 0.7 to 0.9 mile. This represents an average yearly rate of about 260 feet, although for most of the front the rate is probably not more than half so great.

CONTAMINATION FROM PLAYA DEL REY TO REDONDO BEACH

In the coastal reach from Playa del Rey southward to and somewhat beyond Redondo Beach—essentially the 11-mile reach from the Ballona escarpment to the Palos Verdes Hills—salt water has invaded the main water-bearing zone and now extends inland from half a mile to nearly 2 miles (pl. 16). Locally, this contaminated water contains as much as 5,000 ppm of dissolved solids.

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Under the native conditions of coastward ground-water movement it is believed that waters of good or fair quality existed to the coast along essentially all of the reach from Playa del Rey to Redondo Beach. As of 1904, Mendenhall (1905b) canvassed 13 wells from Manhattan Beach to Redondo Beach that were less than 0.7 mile from the coast. Of these, all except three yielded water containing less than 600 ppm of dissolved solids. Only one well, in 3/15–36H (Mendenhall 273, Redondo), yielded water containing more than 1,000 ppm of dissolved solids. North of Manhattan Beach no wells had been drilled near the coast as of 1904—except near Playa del Rey in 2/15–34E (Mendenhall 80 and 81, Redondo), 0.4 mile inland from the coast. There, the main water-bearing zone yielded water containing 710 ppm of dissolved solids as of 1904.

So far as known, contamination within this coastal reach was first noted between 1912 and 1918—in well 4/14–6F1, at Hermosa Beach and 0.6 mile inland from the coast (p. 244). In the reach of greatest current inland advance at El Segundo, contamination was first reported in 1921 in wells of the Standard Oil Co.—in 3/15–13D and 14A (pl. 16). Well 3/15–14A2, about 0.6 mile inland from the coast, yielded water containing 90 ppm of chloride in 1920; this water was considered essentially native to the range tapped. Beginning in 1921, its quality deteriorated rapidly, however (fig. 20).

From 1920 to the early thirties, withdrawal from the Torrance-Inglewood subarea of the west basin increased substantially, largely because of the construction of a number of well fields supplying new industrial plants. As has been shown, water levels were lowered to and below sea level throughout most of the subarea. As a result of this lowering of water level, contamination of wells had occurred along most of the coastal reach from El Segundo to Redondo Beach by 1932.

The inland front of contaminated waters containing more than 100 ppm of chloride as of 1930–32 is shown on plate 16. At that time the greatest inland extent of the contaminated waters was about 1.3 miles at El Segundo; the least extent was not more than half a mile near Century Boulevard and at Hermosa Beach. Along the full 11-mile reach, the area then underlain by contaminated waters was about 5,000 acres, or nearly 8 square miles.

As of 1946, the front of waters containing more than 100 ppm of chloride, as shown on plate 16, ranged from half a mile inland near Century Boulevard to 1.7 miles at El Segundo. At Redondo Beach, the front then was 1.1 miles inland from the coast. From 1932 into 1946, the greatest advance of the saline front occurred between El Segundo and Manhattan Beach and was as much as 0.5 mile. However, the average advance of encroachment between Playa del Rey and Redondo Beach in the 14 years was about 0.3 mile, and the in-

crease in the area underlain by contaminated water was about 1,700 acres.

The withdrawal of water along the coastal reach is largely concentrated at five well fields or local centers of pumping. Analytical data relating to the active wells in these fields have been taken more or less continuously for many years. Thus, the rate of contamination, the chemical character of the contaminated waters, and the source or sources of contamination can be appraised best by analysis of conditions at these several well fields.

WELL FIELD AT PLAYA DEL REY

Just south of the Ballona escarpment in the vicinity of Playa del Rey, water is yielded only from the main water-bearing zone of the San Pedro formation, which here immediately underlies the dune-sand deposits and which, at least locally, is in hydraulic contact with them. At well 2/15–34A2 (Palisades del Rey Water Co. well 4) the main water-bearing zone is about 130 feet thick, and its top is about 30 feet above sea level. The log for this well is considered to be representative and is shown on plate 3*C*.

The Palisades del Rey Water Co. pumps water from two fields. The field in 2/15–34K is about 0.4 mile from the ocean; there two wells have been drilled, of which one (2/15–34K1) is now active. The other field, in 2/15–34A and 2/15–27R, is about 0.9 mile from the ocean and about 0.5 mile from the escarpment; there four wells have been drilled, and one (2/15–34A1) is now active. Of the two fields, that in 2/15–34K is the older; well 2/15–34K1 (Palisades del Rey Water Co. well 1) was drilled in 1924. The first well in field 2/15–34A (2/15–34A1) was drilled about in 1930.

Waters yielded from the two fields were chemically alike and ranged from sodium, calcium bicarbonate to sodium bicarbonate waters, although in the available analyses sodium always made up at least 44 percent of all the bases. In these waters under native conditions, the sulfate content was usually less than 40 ppm. Good series of chloride determinations are available for wells 2/15–34A1 and 34K1 and are plotted on figure 15. As shown in these chloride analyses, both wells became definitely contaminated by 1945, and well 2/15–34A1 was incipiently contaminated in the early thirties. Contamination now is much more serious at well 2/15–34K1, not only because the chloride content is nearly twice that at well 2/15–34A1, but also because the rate of contamination increase is many times greater, as indicated by the slope of the chloride graph.

A striking difference in character change of the two waters is shown by the graph of bicarbonate in water from the two wells (fig. 15). In 1929, both wells yielded water containing over 300 ppm of bicarbonate.

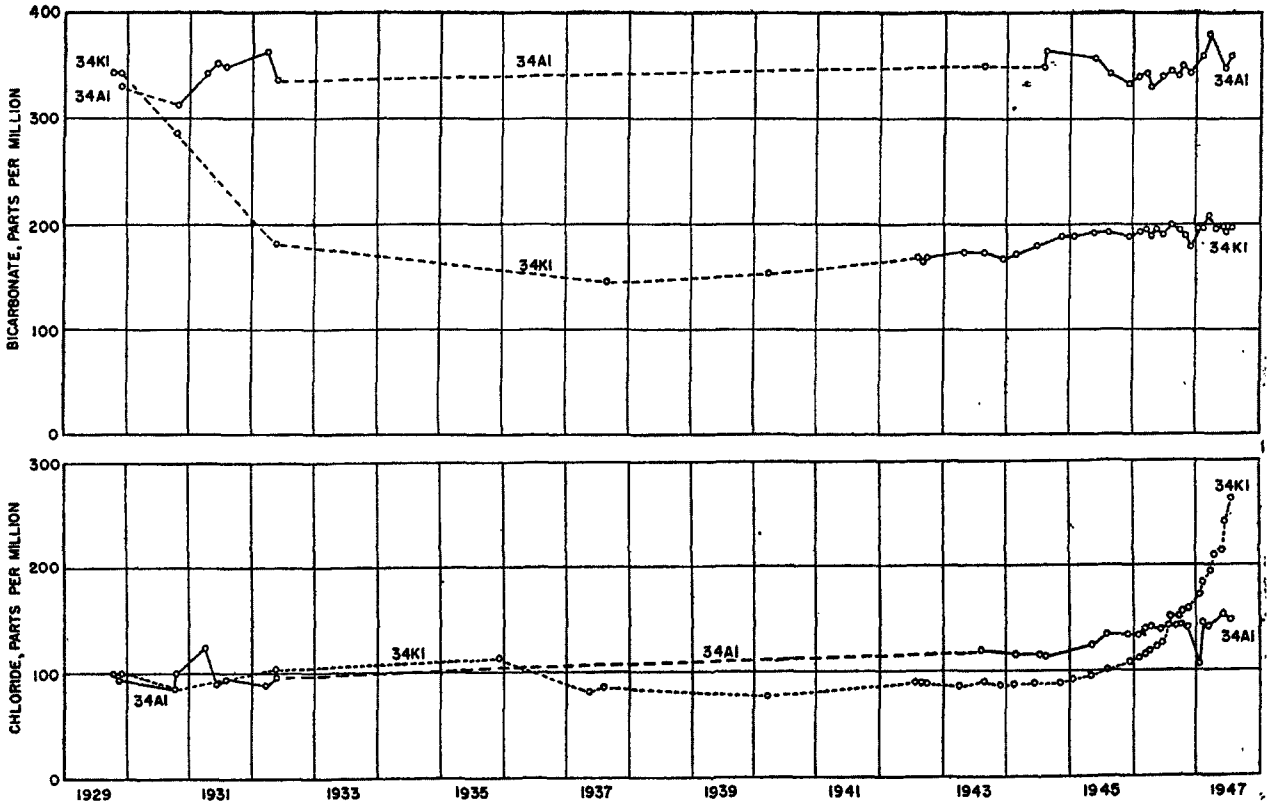


FIGURE 15.—Chloride and bicarbonate content of waters from wells 2/15-34A1 and 34K1 (Palisades del Rey Water Co. wells 3 and 1).

By 1932, the bicarbonate in well 34K1 had decreased to about 150 ppm; well 34A1 remained about the same through the period of record. Since about 1940, well 34K1 has shown an increase in bicarbonate to almost 200 ppm. The loss in bicarbonate in water from this well is accompanied by a loss of bases, chiefly in calcium and to a minor degree in sodium. It is interesting to note that the bulk of the bicarbonate loss in well 34K1 occurred during a period of very slight chloride increase. A possible explanation of the chemical behavior of this well is that the aquifer tapped by the well was being partly recharged by local rainfall on the sand-dune area. The San Pedro formation here is known to be in local hydraulic contact with the sand-dune deposits (p. 125, pl. 13).

Because the chloride increase in water from well 34K1 has become pronounced since 1945, with no corresponding gain in bicarbonate, it is tentatively concluded that the well is now within the area contaminated by ocean water. Furthermore, because the well is now within the area in which a regional inland gradient exists, it is expected that it soon will yield water unfit for use.

WELL FIELD OF THE CITY OF EL SEGUNDO

PERTINENT GEOLOGIC FEATURES

At the well fields of the city of El Segundo in sec. 12, T. 3 S., R. 15 W., two distinct water-bearing zones in the deposits of Pleistocene age are tapped by wells. Recent deposits here consist solely of sand dunes and are non-water-bearing. The upper of the two Pleistocene aquifers is the "200-foot sand" of the unnamed deposits of upper Pleistocene age; here it ranges from 30 to 40 feet in thickness. The lower aquifer is the Silverado water-bearing zone and ranges from 70 to 140 feet in thickness. At the main well field of the city of El Segundo in 3/15–12L, only the upper 30 to 40 feet of the Silverado water-bearing zone is sufficiently coarse to permit perforation of well casings; the lower part, which is as much as 100 feet thick, consists of fine sand and some silt. In the NE¼ sec. 12, the logs of three municipal wells indicate a much more irregular lithology. Here also, the upper 30 to 40 feet of the Silverado water-bearing zone is permeable sand and gravel; however, in two of the three wells a basal gravel is present which is sufficiently permeable to yield water. The Silverado water-bearing zone is separated from the "200-foot sand" in the upper Pleistocene deposits by an impervious clay layer which is 15 to 40 feet thick. Both aquifers here dip gently southward (pl. 3*C*).

SUMMARY OF NATIVE WATER QUALITY

Inland from the coast, toward the axis of the syncline underlying the Torrance plain (pl. 2), it has been possible to distinguish between the quality of the water in the unnamed upper Pleistocene deposits

and that of the water in the Silverado water-bearing zone beneath, because chemical analyses are available for waters from certain wells tapping the upper zone only and from other wells tapping the Silverado zone only. In sec. 12, T. 3 S., R. 15 W., however, all wells tap both zones and thus yield blends of waters from the two aquifers. Necessarily, therefore, a description of native conditions here will be confined to these blended waters. An analysis of water from well 3/15–12L1, sampled March 4, 1930, is selected as representative of the native water throughout the local extent of the tapped water-bearing zones. From this analysis and from others, made before contamination had become more than incipient, it is inferred that these waters ranged about from 390 to 425 ppm in dissolved solids and contained less than 100 ppm—probably from 85 to 92 ppm—of chloride. The early (1929–30) analyses of water from wells of this field, particularly those from well 12L1, show an interesting fluctuation in sulfate content. For example, the analysis of 12L1 for February 13, 1931, shows that sulfate is absent. Other analyses of water from 12L1 for that period show that sulfate ranged from a trace to 35 ppm.

PROGRESS OF WATER-QUALITY DEPRECIATION

Table 21 lists all the wells drilled by the city of El Segundo and gives their status in 1946. Of the ten wells listed, seven were drilled at the main field near the city's water treatment plant at Grand Avenue and Maryland Street; only two wells, 12L5 and 12L7, were active in 1946. Of the other three wells, two are about 0.4 mile northeast of the main plant, and well 12B1, the latest one drilled, is about 0.2 mile north of the first-mentioned wells. All three are now active. Chloride analyses for wells 12L1, 12L3, and 12L6, plotted

TABLE 21.—*History and chloride content of public-supply wells of the city of El Segundo*

Well		Date drilled	Chloride content		Date abandoned	Reason for abandonment
USGS [1]	City of El Segundo		Initial [2] analysis [1]	Latest [3] analysis		
3/15-12L1	1	1920	100	304	1939	Caved in.
12L2	2	1924	98	123	1937	Do.
12L3	3	1930	104	211	1940	Do.
12L4	4	1938	430	430	1938	(4)
12G2	5	1939	113	138	(5)	
12G1	6	1939	128	86	(5)	
12L6	7	1939	157	886	1945	Became saline.
12L5	8	1942	116	245	(5)	
12L7	9	1944	151	219	(5)	
12B1	10	1945	82	86	(5)	

[1] United States Geological Survey.
[2] Earliest analysis available.
[3] Latest analysis available.
[4] Abandoned at time of drilling; water too saline for use.
[5] Active in December 1946.

on figure 16, show the development of contamination at the main field. Because of the fluctuation in chloride content for well 12L1 in 1930–31, it is thought that contamination was then incipient; by 1936 the increase in chloride content was positive. However, only in well 12L6 did salinity increase to a degree that made the water unusable. Wells 12L1 and L3 were abandoned because of mechanical difficulties; doubtless, the salinity of the water yielded by these wells would have increased appreciably above the amounts shown on the graph if pumping had been continued.

The two active wells at the main field as of 1946 (nos. 12L5 and 12L7) both yielded water containing more than 200 ppm of chloride at the end of that year. As shown by the graphs (fig. 16), the chloride content was about stable to mid-1946, and then it increased substantially. It is believed that if these wells are pumped almost continuously, within a relatively short time the chloride will increase at an accelerated rate—similar to the increase shown by the graph for well 12L6 in 1944–45 (fig. 16). Both of these active wells tap the same water-bearing zones that are tapped by wells 12L1, L3, and L6 (which were abandoned earlier). As shown later (p. 224), although both water-bearing zones are about equally contaminated, the upper of the two zones may be slightly more saline. Figure 16 also shows the chloride concentration of waters from wells 12G1 and 12G2. In contrast to chloride graphs for wells at the field in 3/15–12L, the graphs for both wells in 12G show a decrease in salinity (to a greater extent in well G2 than in well G1). Well 12G1 yields more water from a stratigraphically lower part of the Silverado water-bearing zone than any other city well. The monthly combined withdrawal for the two wells also has been plotted on figure 16. It will be noted that the chloride decrease has occurred over a period when withdrawals were nearly constant.

CHEMICAL FEATURES OF CONTAMINATION

As described earlier, at the main field of the city of El Segundo the trend of contamination is toward ever-increasing salinity and resultant abandonment of the wells; however, at the more recently developed field to the northeast in 3/15–12G, the trend since about 1941 is toward a decreasing salinity. In well 12G1 the water has almost returned to its native character. For all the wells of the city of El Segundo, the following description treats the manner in which contamination has occurred and suggests a possible source of this contamination. Although the analyses for any single well do not span the entire period of record, a series has been selected arbitrarily to show progressive increase in chloride content. These analyses have been plotted on a trilinear graph (fig. 17) which shows the salinity trend at the main field. Although some departure from a definite

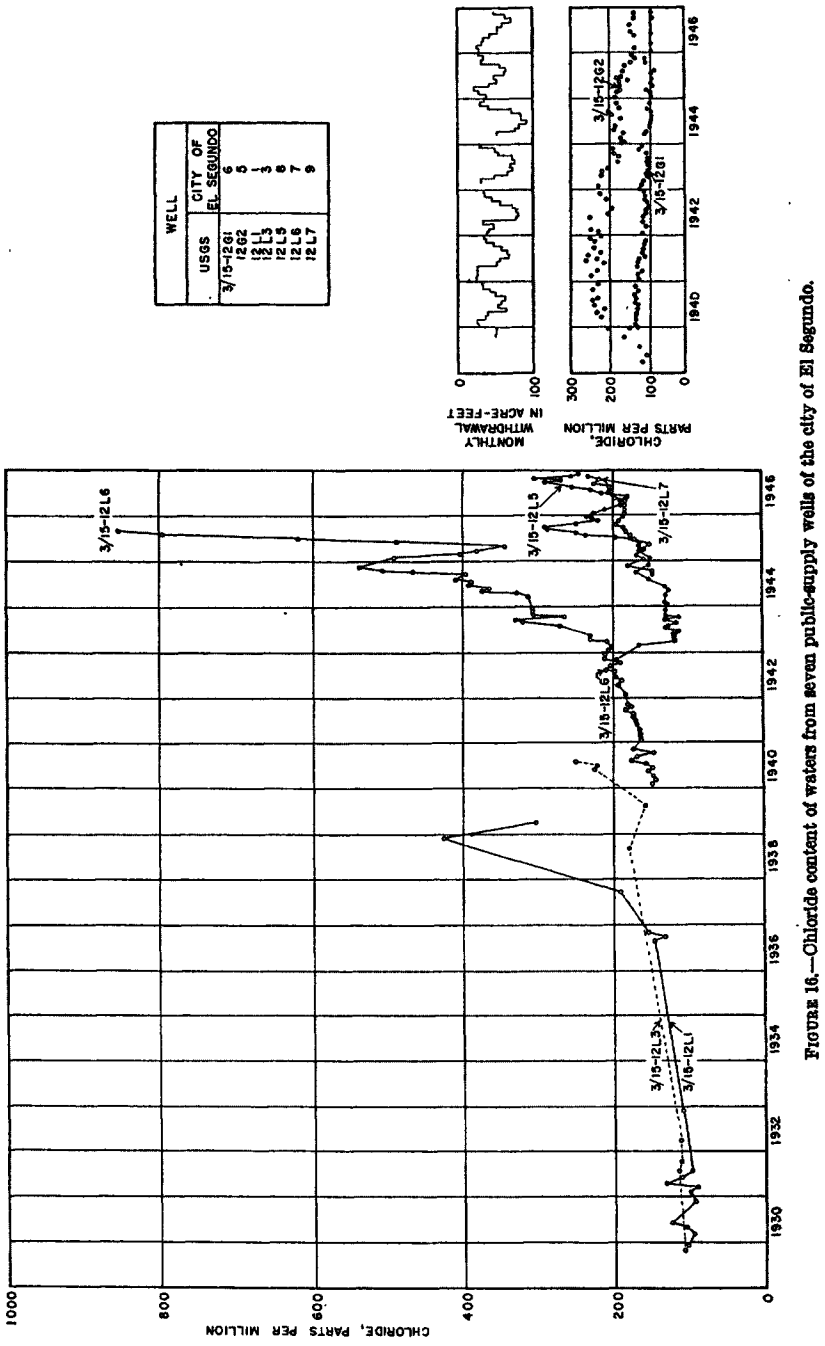
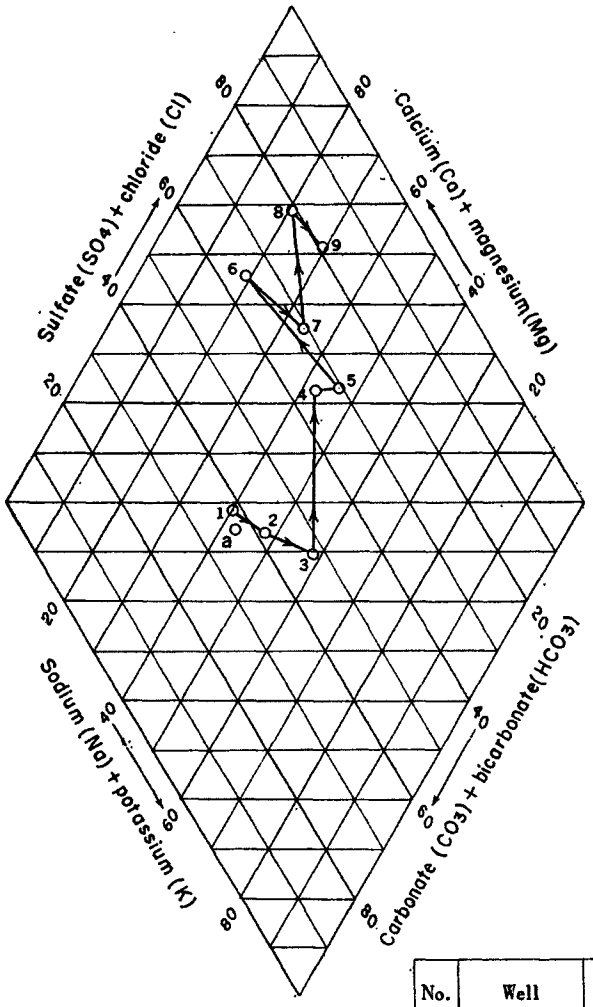


FIGURE 16.—Chloride content of waters from seven public-supply wells of the city of El Segundo.



No.	Well	Date	Chloride, parts per million
a	(3/15-12G1)	Feb. 25, 1945	92
1	12L1	Nov. 25, 1930	92
2	12L2	Sept. 11, 1930	104
3	12L2	Mar. 9, 1931	123
4	12L3	July 24, 1939	157
5	12L6	Jan. 4, 1940	181
6	12L6	Sept. 2, 1942	208
7	12L6	Apr. 24, 1943	220
8	12L6	Feb. 25, 1945	420
9	12L6	Oct. 24, 1944	520

FIGURE 17.—Chemical character of native and progressively contaminated waters at the main well field of the city of El Segundo.

trend occurs, in general, as contamination progresses, the water is enriched chiefly in chloride and in calcium. Inasmuch as no known calcium-chloride contaminant is known to exist locally, it is assumed that the contaminant is a sodium-chloride saline in which base exchange has occurred during blending with the native water.

To determine the source of contamination at this field, use is made of the chloride-bicarbonate ratios of the progressively contaminated waters for which the analyses have been plotted on figure 17. Figure 18 shows these ratios plotted against the chloride content; hypothetical

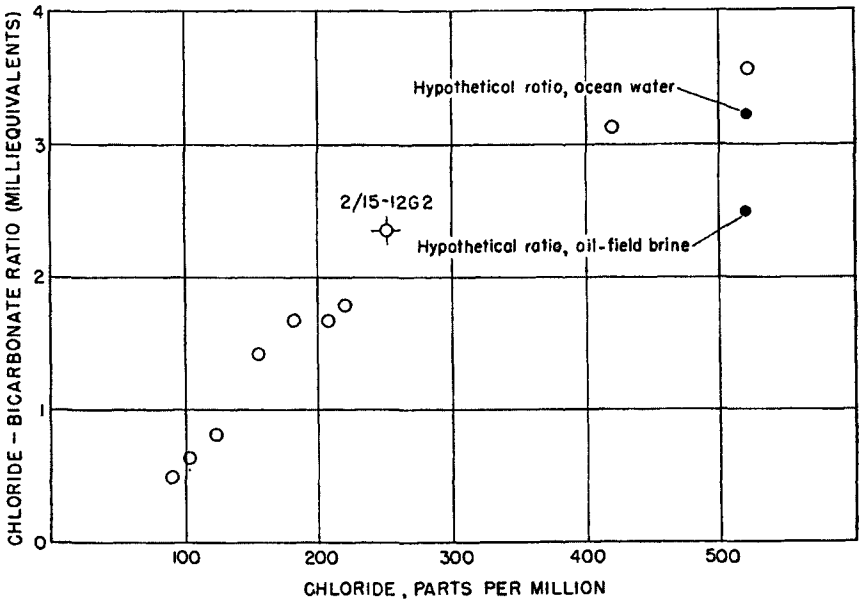


FIGURE 18.—Chloride-bicarbonate ratios of progressively contaminated waters at the main well field of the city of El Segundo.

ratios for a sea-water mixture and an oil-field brine mixture with a native water are plotted also. Sea water is strongly suggested as the source of contamination. That is, for the contaminated water containing 520 ppm of chloride, the Cl–HCO_3 ratio is 3.58; for the ocean-water and brine mixtures with native water, computed to the same chloride concentration, the ratios are 3.21 and 2.49, respectively. The points representing the actual analyses fall on a reasonably well defined curve which approaches the point representing the ocean-water mixtures more closely than that representing the oil-field brine mixture.

The analysis used in computing the hypothetical mixture of brine and native waters was furnished by the Richfield Oil Corp. The water analyzed was from Richfield well El Segundo No. 2 (in 3/14–18G) and was yielded through perforations from 7,243 to 7,319 feet below

the land surface—presumably from rocks of upper Miocene age (pl. 7). The constituents cited below were determined from a sample collected and analyzed by the Richfield Oil Corp. for the Geological Survey; quantities are reported in parts per million (except pH which is reported in percent):

	Parts per million		Parts per million
Silica	81	Chloride	9,390
Iron and aluminum oxides	3	Dissolved solids	24,561
Hydroxyl	0	Suspended solids	207
Carbonate	0	Water soluble organic matter (approx.)	5,300
Bicarbonate	1,946	pH	[1] 7.8
Sulfate	26		

[1] In percent.

Although the trend in chloride-bicarbonate ratios suggests ocean water as the contaminant, the other possible diagnostic constituent, sulfate, is not entirely confirmed by table 22. In the table, the actual sulfate content of the progressively contaminated waters is compared with the sulfate content that would be present if sea water alone had caused the chloride increase. In most of the contaminated waters sulfate is shown to be present in excess; this fact suggests a source of sulfate in addition to that brought in with sea water.

TABLE 22.—*Comparison of actual and hypothetical sulfate content in progressively contaminated waters in the main well field of the city of El Segundo*

Well	Date of sample	Chloride (ppm)	Sulfate (ppm)		Excess (+) or deficiency (−) of sulfate (ppm)
			Actual	Hypothetical [1]	
3/15-12L1	Nov. 25, 1930	92	14		
12L2	Sept. 11, 1930	104	19	14	+5
12L2	Mar. 9, 1931	123	17	18	−1
12L3	July 24, 1939	157	60	23	+37
12L6	Jan. 4, 1940	181	90	26	+64
12L6	Sept. 2, 1942	208	20	30	−10
12L6	Apr. 24, 1943	220	76	32	+44
12L6	Feb. 25, 1945	420	97	60	+37
12L6	Oct. 24, 1944	520	119	74	+45

[1] Computed from a hypothetical mixture of sea water and a native water of 14 ppm sulfate, for which mixture the chloride content is identical to that of the actual contaminated water under comparison.

In regard to contamination at wells 12G1 and 12G2, the salinity increase has not yet become sufficiently intense that the source can be identified. It is inferred that the cause of contamination is the same at the two fields. If such is the case, the chemical character of the contaminated waters would be expected to be the same in both areas. As a check on this inference, the analysis of water from well 12G2 for February 7, 1942, has been selected for comparison. This analysis represents the most saline water of record taken from this well. The chloride-bicarbonate ratio for well 12G2 plotted on figure 18 falls close to the generalized curve. The value of 74 ppm for sulfate

is in excess of that brought in by sea water by about the same amount as in the wells in the main field (in 3/15–12L).

For the main field, the Geological Survey in 1945 conducted a series of pumping tests on well 12L6 in order to determine, if possible, which of the two water-bearing zones tapped would yield water of better quality. Figure 19 shows the electrical-conductivity values

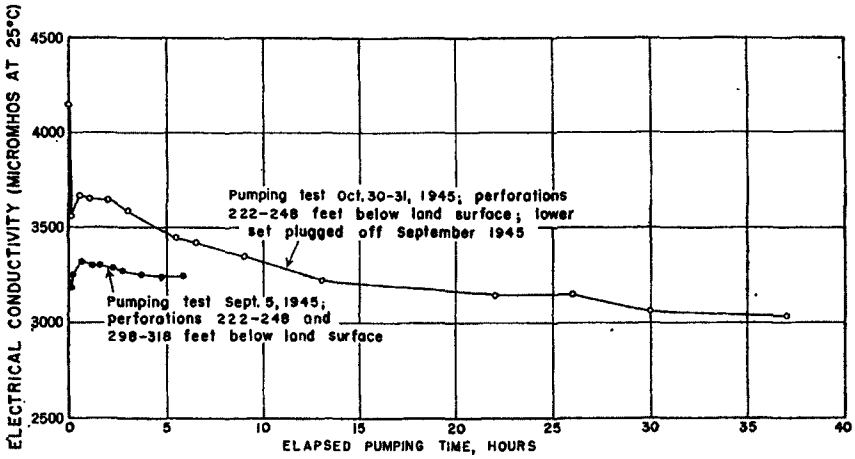


FIGURE 19.—Character of water discharged from well 3/15–12L6 (city of El Segundo, well 7) during pumping tests of September 5 and October 30–31, 1945.

obtained from two separate tests, on September 5 and October 30–31, 1945. During the test on September 5, the well yielded water through perforations from 222 to 248 feet and from 298 to 318 feet below land surface. The lower perforations were then plugged, and during the test of October 30–31 the well yielded water from only the shallower of the two water-bearing zones. The test of September 5 is believed to have been too short for the water from the well to have reached constant quality. During the pumping test of October 30–31 the water yielded initially was poorer but after 13 hours of continuous pumping it was of better quality than that yielded during the short span of the September test. The graphs are not conclusive but the results are included here as a matter of record.

WELL FIELDS OF THE STANDARD OIL CO. AND OF THE GENERAL CHEMICAL CO. AT EL SEGUNDO

The well field of the Standard Oil Co. of California is between El Segundo Boulevard and Rosecrans Avenue and is west of Sepulveda Boulevard, in sec. 13, T. 3 S., R. 15 W. Immediately east of Sepulveda Boulevard, in 3/14–18N, are the wells of the General Chemical Co. These two well fields are treated together here because they tap the same water-bearing zones, and conditions of contamination are common to both.

In this area, wells tap both the "200-foot sand" of upper Pleistocene age and the Silverado water-bearing zone of the San Pedro formation (pl. 3*C*). The "200-foot sand" here is about 20 feet thick, and its top is about 150 feet below the land surface and 50 feet below sea level. Commonly it is separated from the underlying Silverado water-bearing zone by 20–30 feet of impervious silt or clay.

The Silverado water-bearing zone in sec. 13 ranges in over-all thickness from about 150 feet in the northwestern part to about 250 feet in the eastern part (along Sepulveda Boulevard). This thickness includes beds of silt or clay of irregular occurrence. In general, the Silverado zone here spans three more or less distinct parts, which in downward succession are: (1) the principal water-bearing member, which is chiefly sand and gravel and about 100 feet thick; (2) an interbed of silt or clay from 20 to 50 feet thick; and (3) a basal member, which consists of alternating thin layers of sand, gravel, and silt, about 100 feet thick. The bottom of the Silverado zone is about 300 feet below sea level along Sepulveda Boulevard (pl. 2). Logs of wells in 3/15–13D and 14A, about 0.7 mile from the coast, suggest that the basal member grades westward into a layer of nearly uniform silt, and that the thickness of the upper member of the Silverado zone decreases to about 70 feet; the character of the zone here is similar to that at the main well field of Manhattan Beach, 2.4 miles southeast.

SUMMARY OF NATIVE WATER QUALITY

In the "200-foot sand," water is inferred to have been somewhat inferior under native conditions. As of 1903–4, a well in the southeast angle of the intersection of Rosecrans Avenue and Sepulveda Boulevard (Redondo, no. 150), which tapped the "200-foot sand," yielded water containing 630 ppm of dissolved solids. This well was about 1.4 miles inland from the ocean. Because of the comparatively poor quality of water in the "200-foot sand" in this area, it has been tapped by few wells. For the well fields here discussed, only three are known to have yielded water from this zone—wells 3/14–18N3 and 18N4 of the General Chemical Co. and well 3/15–13H1 of the Standard Oil Co. All other wells of these two companies tap solely the Silverado water-bearing zone; some tap the upper part, some the basal part, and some tap both.

In the Silverado water-bearing zone, under native conditions, two somewhat distinct water types existed in sec. 13, T. 3 S., R. 15 W. In the western part of sec. 13 and in the northeastern part of sec. 14, the native water was similar to but perhaps of somewhat poorer quality than that at the city of El Segundo main well field. Both waters contained about 400 ppm of dissolved solids, were calcium, sodium bicarbonate waters and contained substantially equal quan-

tities of chloride; however, the waters at the Standard Oil Co. field may have been somewhat higher in bicarbonate, with a corresponding increase in calcium and sodium. In the eastern part of sec. 13, where nearly all the producing wells of the company are now located, the native water was of somewhat better quality than those described above. These native waters ranged from sodium, calcium bicarbonate to sodium bicarbonate in character and contained from 330 to 375 ppm of dissolved solids and from 50 to 60 ppm of chloride. This difference in quality in the two parts of the field is presumed to result from the deeper penetration of wells in the eastern portion of the section; these waters from the deeper part of the range penetrated agree closely in quality with those that have been yielded from the Silverado water-bearing zone to the east. With respect to sulfate content, a slight difference existed in native waters from the two parts of the field. To the west, they contained about 15 ppm; to the east, the content was probably less than 10 ppm in the upper part and was negligible in the lower part of the range penetrated.

HISTORY OF WELL DRILLING AND ABANDONMENT

Since the first two wells of the Standard Oil Co. were placed in operation in 1914, withdrawal of water from the field has been continuous and has increased in quantity until, as of 1945, the 11 active wells yielded 4,780 acre-feet of water. Table 23 lists the 25 wells drilled by the company before 1946 and shows their status as of January 1946 and the chloride content of their water. For the six producing wells abandoned by 1930, the latest analysis indicated chloride in excess of 200 ppm in each; for the five wells abandoned from 1930 to 1946, only one appears to have yielded water containing more than 200 ppm of chloride at the time of abandonment. At least three of the latter group were abandoned because of mechanical difficulties or gradually diminishing yield. Although the various reports seem inconclusive, it appears that company wells 1 to 8 were abandoned because of excessive salinity. By 1922 salinity became apparent in this area, several years earlier than anywhere else along the coast. For the contaminated but still active wells along the east edge of sec. 13, the salinity increase is only slight; generally an increase in dissolved solids of not more than 25 percent has occurred.

CHEMICAL FEATURES OF CONTAMINATION

A study of the analytical data available for the wells in sec. 13, T. 3 S., R. 15 W., and also for those adjacent to the east, has disclosed that the contaminated waters there are of two general types with respect to change in chemical character and time of such change.

TABLE 23.—*History and chloride content of wells at the Standard Oil Co., El Segundo refinery*

Well		Date drilled	Chloride content (parts per million)				Date abandoned
Company	USGS [1]		Initial [2]	Date	Latest	Date	
1	3/15-13D1	1911	102	[3] 1921			1922
2	13D2	1911	188	1921	255	1921	1922
3	14A2	1917	90	1920	950–125	1923	1924
4a	14A1	[4] 1920					1920
4b	13E1	1920	89	1921	2,400	1930	1930
5	13F1	1922	248	1922	664	1929	1929
6	13G1	1923	58	1924	194	1942	1943
7	13G2	1928	118	1928	620	1939	1939
8	13F2	1929	510	1929	505	1929	1929
9	13R1	1930	60	1930	60	1943	1944
10	13A1	1930	92	1930	92	1940	1940
11	13J1	1935	92	1935	202	1945	[5]
12	13H1	1937	86	1937	198	1944	1944
13	13A2	1939	96	1939	224	1944	[5]
14	13H2	1940	102	1940	70	1946	[5]
15	13A3	1941	86	1941	160	1945	[5]
16	13R2	1941	170	1941	104	1946	[5]
17	13R3	1941	86	1941	141	1946	[5]
18	3/14-19C1	1943	121	1943	112	1946	[5]
19	3/15-13R4	1943	72	1943	109	1946	[5]
20	13R5	1944	68	1944	75	1946	[5]
21	13J2	1944	83	1945	92	1946	[5]
22	13R6	1945	70	1945	68	1946	[5]
23	13J3	1945	97	1945	119	1946	[5]
24	13A4	1945	95	1946			[5]

[1] Unites States Geological Survey.
[2] Earliest analysis available.
[3] An analysis is available in which the chloride content is 91 ppm; date of analysis unknown.
[4] Abandoned after construction because of insufficient thickness of water-bearing strata.
[5] Presumed inactive, but status not known definitely.
[6] Presumed active as of Jan. 1, 1946.

1. In several of the earlier wells, notably 3/15–13E1, 13F1, and 14A2, contamination occurred at a comparatively early date and was characterized by a somewhat sudden increase of chloride and sulfate and by an increase in dissolved solids to more than 5,000 ppm.

2. In the wells just west of Sepulveda Boulevard, contamination has occurred to only a slight degree and is characterized by a small increase in chloride, by only a small increase in sulfate, and by a suggested concurrent but irregular decrease in bicarbonate.

These two water types will be described separately and graphs will be presented to show how contamination has occurred in each case.

For the first type, in which sulfate has increased markedly, figure 20 shows the extent to which sulfate and chloride increases are coincident with the advance of contamination. To show that the sulfate content of these waters is more than that which could have been brought in by sea water, figure 21 gives chloride and sulfate analyses plotted graphically for well 13G2, also the hypothetical content of

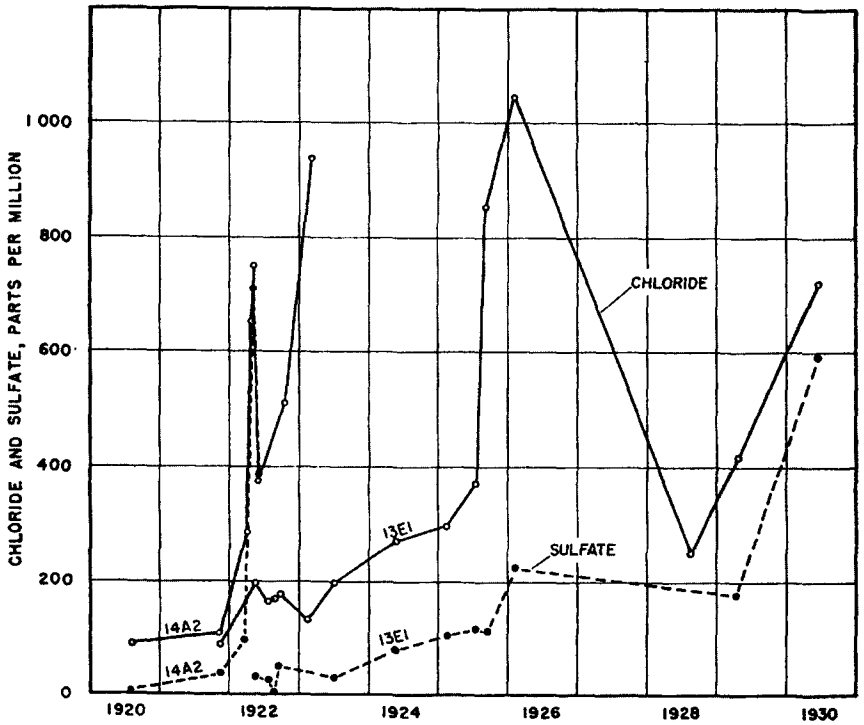


FIGURE 20.—Chloride and sulfate content of progressively contaminated waters from wells 3/15–13E1 and 14A2 (Standard Oil Co. wells 4b and 3).

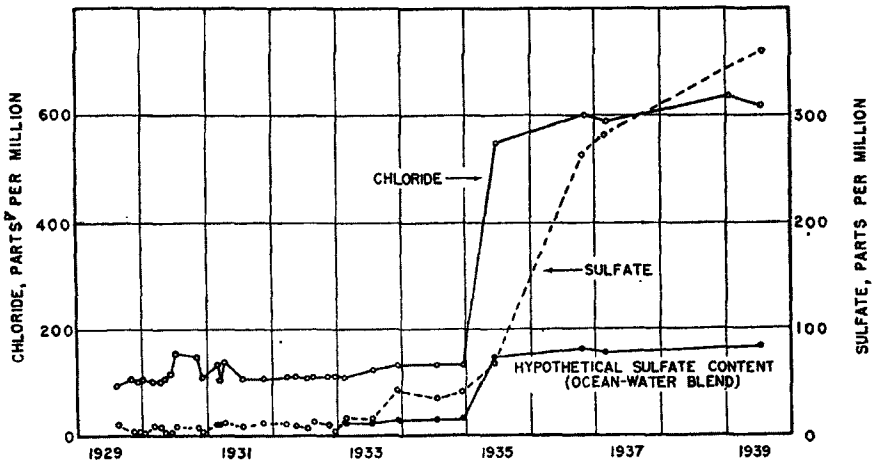


FIGURE 21.—Chloride content and actual and hypothetical sulfate content of progressively contaminated waters from well 3/15–13G2 (Standard Oil Co. well 7).

sulfate in the contaminated water if sea water had been the sole contaminant. The graph for this well shows that sulfate increase began in 1933; definite chloride contamination began in 1935. As of 1939, the increase in sulfate was about five times as great as that which would have been brought in by sea water. Obviously a high-sulfate contaminant must have contributed to the deterioration of the water in these wells.

The Standard Oil Co. conducted pumping tests in 1923, 1929, and 1930, respectively, for three wells that yielded contaminated water at an early date—3/15-14A2, 13F2, and 13E1; a series of water samples was collected from each of the wells until the quality of the effluent became constant. Each well tapped the Silverado water-bearing zone. Figure 22 shows the chloride analyses plotted for the three wells. Presumably, the pump had been idle for several days prior to each test. The following facts are significant:

1. The water yielded initially from each well was highly contaminated, but the water taken in the succeeding samples improved substantially in quality.
2. For each well, the water representative of the Silverado water-bearing zone at the time of the test contained less than 350 ppm of chloride; this water was yielded only after extended pumping—8 hours for well 13E1 and about 160 hours for well 14A2.

Accordingly, it is inferred that the water causing the contamination was coming from a source outside the Silverado zone; and that, while each pump was idle, a relatively small amount of the contaminant moved through the well casing and collected within the Silverado zone immediately outside the well casing. With continued pumping, the supply of concentrated contaminant was exhausted, and the water then yielded indicated the concentration of the regional contaminant in the Silverado zone. If the more concentrated contaminant had been invading the Silverado zone directly, the water quality would have deteriorated or remained about constant during prolonged pumping, because the saline water would have been replenished as rapidly as it was withdrawn. Contamination of this nature has been encountered in Santa Ana Gap and was described in an earlier report (Piper, Garrett, and others, 1953, p. 115–118).

The graph for well 14A2 in 1923 shows a regionally contaminated water containing about 120 ppm of chloride—little more than the native chloride concentration of about 90 ppm. For the three wells, a local source of contamination apparently supplied a small amount of highly saline water; the water yielded after prolonged pumping reflects the regional contamination in the Silverado zone, which contained less than 200 ppm of chloride in the middle twenties and 200 to 400 ppm about 1930. It is inferred that the more concentrated contaminant withdrawn through the wells during the first hours of

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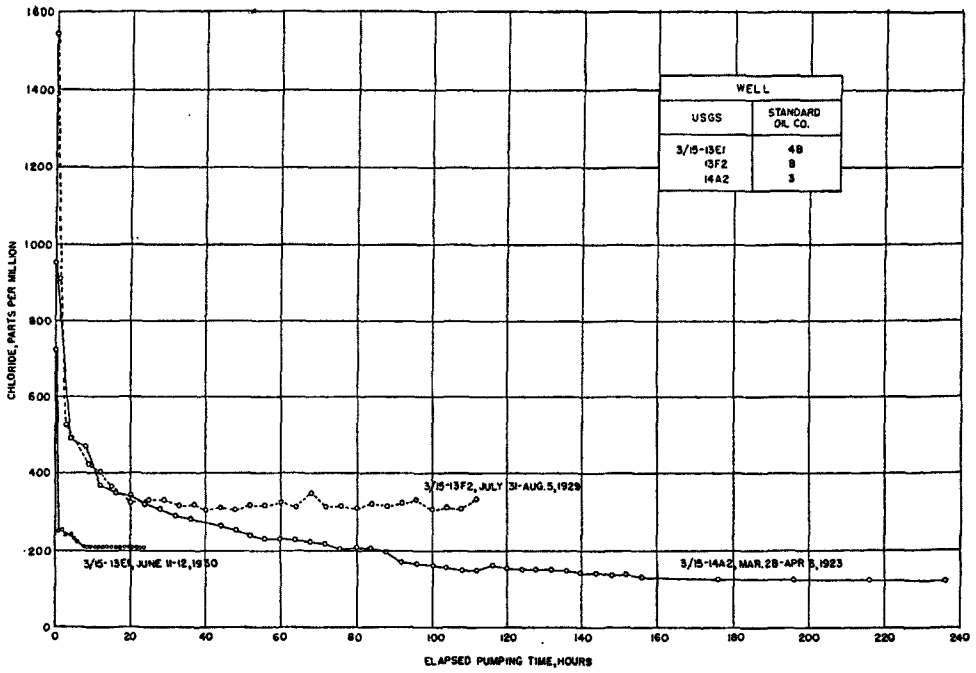


FIGURE 22.—Chloride content of waters from wells 3/15–13E1, 13F2, and 14A2, in relation to duration of pumping.

pumping must have entered the Silverado zone by passing down through the well casings from the overlying "200-foot sand." Because the well casings were not perforated opposite this overlying aquifer, the concentrated contaminant must have entered the casing through leaks.

As a further demonstration of the type of contamination occurring here locally, table 24 compares the contaminated water from well 3/15–13E1 with a hypothetical water formed by a mixture of ocean water and a native water to the same chloride content. The table shows that a large excess of sulfate is present in the contaminated water, also that a large excess of calcium and magnesium is present above that which could be accounted for solely by base exchange following ocean-water contamination. The excess of calcium and magnesium amounts to 14.13 equivalents per million, and is nearly equal to the sulfate excess of 14.26 equivalents per million. Hence, the local contaminant was doubtless a calcium sulfate or calcium, magnesium sulfate water at the time of mixture with the ground water.

TABLE 24.—*Contaminated water from well 3/15–13E1 (Standard Oil Co., well 4b) in comparison with a hypothetical mixture of a presumed native water with ocean water*

	Constituents (ppm)					
	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)
Parts per million:						
Native water, well 3/15–13D1	54	19	62	252	12	91
Contaminated water, well 3/15–13E1; analysis of June 5, 1930	400	260	1,181	230	1,020	2,400
Hypothetical mixture of ocean water with native water	96	172	1,371	238	335	2,400
Equivalents per million:						
Native water, well 3/15–13D1	2.70	1.56	2.69	4.13	0.25	2.57
Contaminated water, well 3/15–13E1; analysis of June 5, 1930	19.96	21.38	51.36	3.77	21.23	67.70
Hypothetical mixture of ocean water with native water	4.79	14.14	59.64	3.90	6.97	67.70
Excess (+) or deficiency (−) of the contaminated water with respect to the hypothetical mixture	+15.17	+7.24	−8.28	−.13	+14.26	----------

For the wells along the eastern boundary of the Standard Oil Co. property, just west of Sepulveda Boulevard, contamination has been far less intensive, and at least three wells—3/15–13H2, J2, and R5—yielded essentially native water as of January 1946. Graphs showing the chloride content of waters from these wells have been presented on figure 23. Wells 3/15–13A1, A2, and A3 all tap essentially the entire thickness of the Silverado water-bearing zone, which here is only about 100 feet thick. The graph for well 13A1 suggests a slight but reasonably consistent increase in chloride from 1931 to 1939; those for

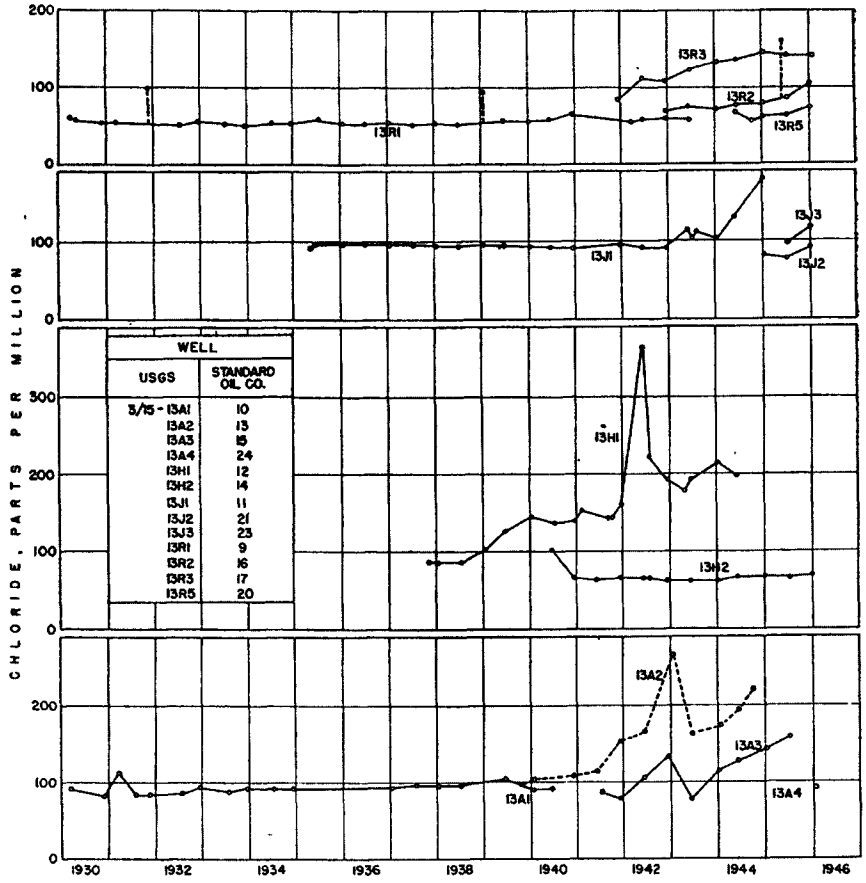


FIGURE 23.—Chloride content of waters from selected wells of the Standard Oil Co. at El Segundo.

wells A2 and A3 indicate a sharp increase in chloride in the early forties. The greatest recorded concentration of chloride for well 13A2—268 ppm—was accompanied by a sulfate content of 66 ppm; this is considerably more than that which could have been brought in with ocean water. For wells 3/15–13H1 and 13H2, the graphs show that definite contamination has occurred at well 13H1, and that well 13H2 yielded essentially native water as of January 1946. Well 13H1 taps the full range of the Silverado zone, and well H2 taps only the basal part. Thus, the contamination here is in the upper part of the Silverado zone.

Of the three wells 3/15–13J1, 13J2, and 13J3, well 13J1 taps the full thickness of the Silverado water-bearing zone, well 13J2 taps the middle part, and well 13J3 taps the middle and lower parts. Well 13J1 became contaminated in 1943, and the other two were incipiently contaminated in January 1946; here, also, the upper part of the Silver-

ado zone is the most saline. Of wells 3/15–13R1, 13R2, 13R3, and 13R5, well 13R1 taps about the middle part of the water-bearing zone, 13R2 taps only the lower part, 13R3 taps the upper part, and 13R5 taps both the middle and lower parts. The water from well 13R3 is the most saline; this fact indicates that here again the water in the upper part of the Silverado zone is markedly of poorer quality than that from the middle and lower parts. Contamination in the upper part of the zone in 13R began in late 1941, and therefore, it is roughly coincident with the onset of contamination adjacent to the north.

To the east, at the property of the General Chemical Co. in 3/14–18N, an analysis of water from well 18N3, in 1930, suggests that here, as to the west, waters contained about 60 ppm of chloride under native conditions. Of the three wells of the General Chemical Co. for which chemical analyses are available, wells 3/14–18N3 (company well 3) and 18N4 (company well 4) tap both the "200-foot sand" in the unnamed upper Pleistocene deposits and the Silverado water-bearing zone beneath. Inferentially, well 18N5 also taps both zones. Because of the low chloride content of water initially yielded from 18N3 (about 60 ppm), that well probably drew most of its water from the Silverado zone and drew a comparatively minor part from the "200-foot sand."

To show the progress of contamination at the well field of the General Chemical Co., chloride determinations on waters from the three wells have been plotted on figure 24. The graph for well 18N3 indicates that contamination here reached a peak in 1940 and since then has decreased markedly; as of January 1946, water from these wells was only very slightly contaminated.

If the graphs of figure 24 are compared with those of figure 23, it will be noted that this contamination peak occurred not only in well 3/14–18N3, but also in wells 3/15–13A2, 13A3, and 13H1, of the Standard Oil Co.; for these latter three wells, however, the peak occurred about in 1942, 2 years later than in well 18N3. This contamination seems to be superimposed on a regional trend toward increasing ground-water salinity which, as of 1945–46, was only moderate. In an attempt to discover whether this superimposed contamination showed a sulfate-chloride pattern similar to that in several of the early wells of the Standard Oil Co. (fig. 21 and p. 231), computations were made to determine, for periods of peak salinity, whether more sulfate had entered the wells than could be accounted for if sea water were the sole contaminant. The data concerning sulfate excess or deficiency for the four wells is given in table 25. The data contained therein indicate that the sulfate content during peak salinity was in excess of that to be expected from an ocean-water blend, and that the sulfate-chloride pattern was essentially

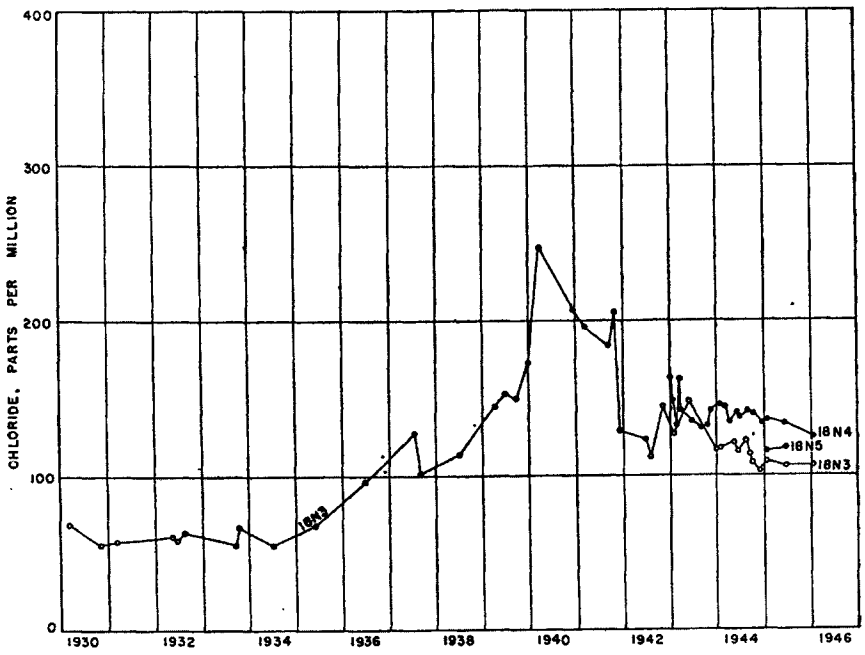


FIGURE 24.—Chloride content of waters from wells 3/14-18N3, 18N4, and 18N5 (General Chemical Co., wells 3, 4, and 5).

similar to that of the earlier contaminant in wells 3/15–13E1 and 14A2, about a mile to the west. For wells 3/15–13A2, A3, and H1 (fig. 23), the chloride peaks of 1942 had essentially disappeared as of mid-1943, and for each well the chloride concentration had returned to the projected normal increase in regional contamination. Furthermore, the abnormal chloride concentration began and ended within a period of 2 years in wells 13A2 and A3 and within one year in well 13H1.

For well 3/14–18N3, the chloride peak of 1940 had essentially disappeared as of 1942. However, as shown by figure 24, the chloride content of waters from the wells of the General Chemical Co. continued to decrease from 1942 into 1946, this fact indicates that the regional contamination front had not yet reached this well field by the end of 1945. Also, as of 1945, the sulfate content of water from the General Chemical Co. wells was only slightly greater than normal; this indicates that the local contaminant has been almost entirely removed or dissipated.

Probably this high-sulfate contaminant is not the cause of the regional contamination, which has progressed much more gradually, and which, for the active wells near Sepulveda Boulevard, has resulted in a maximum concentration only slightly in excess of 200

TABLE 25.—*Sulfate content of contaminated water from certain wells in sec. 18, T. 3 S., R. 14 W., and sec. 13, T. 3 S., R. 15 W., in comparison with hypothetical sulfate content resulting from mixture of a presumed native water with ocean water*

Well	Analysis (parts per million)			Sulfate content resulting from mixture with sea water (parts per million)[1]	Excess (+) or deficiency (−) of the contaminated water with respect to the hypothetical mixture (percent)
	Date	Chloride (Cl)	Sulfate (SO_4)		
3/14-18N3	Apr. 24, 1940	246	43	31	+39
3/15-13A2	Jan. 23, 1943	268	66	34	+94
13A3	Dec. 22, 1942	134	13	15	−13
13H1	June 24, 1942	364	64	48	+33

[1] Based on a native water with presumed chloride and sulfate content of 60 and 5 ppm, respectively.

ppm of chloride—in wells 3/15–13A2. As for the wells of the city of El Segundo, ocean-water intrusion is inferred to have caused the regional contamination, although the change in chemical character of the contaminated waters from the wells near Sepulveda Boulevard has not been great enough to furnish diagnostic proof of such a source.

The source of the high-sulfate contaminant is not known. However, from the occurrence and movement of this contaminant, as described in previous pages, it is inferred that it originated at or near land surface. If waste water containing sulfuric acid were discharged at land surface, it would be neutralized by downward percolation through the soil zone and surface deposits, and it would pick up calcium and, to a lesser degree, magnesium (p. 231).

From land surface to a depth of about 140 feet, the underlying deposits are permeable dune sand or beach deposits, which rest upon the "200-foot sand" of upper Pleistocene age. Well logs indicate that a bed of silt, 10 to 30 feet thick, underlies the "200-foot sand" and separates it from the Silverado zone beneath. Thus, some of the water discharged at land surface doubtless could have seeped through the dune sand to the "200-foot sand" and could then have moved laterally on top of the subjacent silt bed. The lateral movement would have been in the direction of ground-water flow. Downward movement into the Silverado water-bearing zone would occur only where the silt bed was absent, or where it could move through defective well casings.

It is inferred that the high-sulfate contaminant, which has been described in waters from wells 3/15–13E1, 13F2, and 14A2 (p. 227), was derived by downward percolation to the "200-foot sand" and entered these wells through defective or leaky casings. It is inferred further that between the early twenties and the early forties, this high-sulfate contaminant migrated eastward about 1 mile to wells 3/15–13A2 and 13H1 (company wells 13 and 12). In 1935 the con-

taminant reached well 13G2 (fig. 23). Apparently, the "200-foot sand" is not present at well 13G2, and thus, the high-sulfate contaminant must have migrated into the upper part of the Silverado water-bearing zone before reaching this well. Doubtless at some place west of well 13G2 the "200-foot sand" is in direct hydraulic connection with the upper part of the Silverado zone.

Apparently, at the well field of the General Chemical Co. (3/14–18N) the bulk of contamination has entered the casings from the "200-foot sand," and the underlying Silverado water-bearing zone has been comparatively free of contamination. For example, a series of samples taken June 2, 1943, from well 3/14–18N3, during a 24-hour period of operation after a 3-month shutdown, yielded the following quantities of chloride: At start of test, 760 ppm; after pumping 1 hour, 360 ppm; after pumping 24 hours, 148 ppm. Presumably, a relatively small amount of contaminated water migrated downward through the well casing from the "200-foot sand" to the Silverado zone and was soon removed by pumping. (For a parallel example, see discussion of pumping tests of wells 3/15–13E1 and 14A2 (p. 229).)

WELL FIELD OF THE CITY OF MANHATTAN BEACH

Of the 11 public-supply wells of the city of Manhattan Beach, 6 were drilled in a small tract near the intersection of Eighth Street and Sepulveda Boulevard in the NE¼ sec. 25, T. 3. S., R. 15 W. This tract, initially the only well field of the city, is 0.8 mile from the ocean and 1.3 miles south of the large well field of the Standard Oil Co. at El Segundo. With one exception, these six wells tap only the Silverado water-bearing zone, which here ranges in thickness from 30 feet (well 25H1) to 120 feet (well 25A3). That exception, well 3/15–25H1, taps 14 additional feet of coarse sand, 240 feet below the lower assigned limit of the Silverado water-bearing zone. Well 3/15–30D1 (city well 8), which is about 400 feet east of this well field, also taps the Silverado water-bearing zone.

The "200-foot sand" in the unnamed upper Pleistocene deposits was reported to be present in only one well at the main well field—no. 3/15–25H1 (city well 1)—but it was not tapped by that well. About 1 mile east, logs of three additional wells drilled by the city—wells 3/14–30H1, 30A2, and 29D3 (city wells 9, 10, and 11)—show that there the thickness of the Silverado water-bearing zone ranges from 120 feet in well 30H1 (city well 9) to 250 feet in well 29D3 (city well 11); the "200-foot sand" there has been tapped by well 30H1 but the other two wells tap only the Silverado zone.

SUMMARY OF NATIVE WATER QUALITY

Analyses of water from wells in the main field in 1930 indicate that the water in the Silverado water-bearing zone contained from 70 to

80 ppm of chloride and 20 to 35 ppm of sulfate. It is inferred that this water was essentially native. This inferred native water contained about 250 ppm of bicarbonate and 350 ppm of dissolved solids.

The chloride content of waters from six of the municipal wells has been plotted on figure 25. As shown by this figure, the chloride content of water from well 3/15–25A1 (city well 3) ranged from 76 to 120 ppm from 1929 to 1931; however, definite contamination did not develop until 1940 (in well 25H2). As of 1944, all wells in the main field yielded water containing more than 300 ppm of chloride.

By 1946 only wells 25A2 and A3 at the main field were still being utilized; both yielded water containing about 500 ppm of chloride. The three municipal wells near Aviation Boulevard, however, 3/14–29D3, 30A2, and 30H1, as of 1946 yielded native water of excellent quality. (See table 30.)

CHEMICAL FEATURES OF CONTAMINATION

To show the general change in chemical character of the waters at the main well field because of the progress of contamination, selected analyses have been plotted on figure 26. The graph indicates a trend characteristic of contaminated waters along the seaward margin of the coastal plain—that is, toward an increase in chloride, or chloride and sulfate, and with the ratio of sodium to calcium plus magnesium remaining more or less constant; for high-sodium contaminants, such as ocean water and oil-field brines, this approximately constant ratio could be explained only through ionic readjustment by base exchange. The starting point (well 3/14–30D1, analysis of Oct. 20, 1938) represents a water assumed to be essentially native. As revealed by the analytical data (table 30), the drift toward the apex of the graph has resulted almost entirely from an increase in chloride; sulfate has increased very slightly, and bicarbonate has decreased. The slight increase in sulfate renders unlikely the existence of a high-sulfate contaminant here. Thus, the two possible sources of contamination are oil-well brines and ocean water. The sulfate content of the progressively contaminated waters suggests that of the two sources, ocean water has been the source at this field (fig. 27). On this figure both chloride-bicarbonate and chloride-sulfate ratios have been plotted against the chloride content, as determined from all available complete analyses of the contaminated waters. Also plotted on the graph are the points showing, respectively, blends of an essentially native water with ocean water, and with a typical oil-well brine. The illustration shows two pertinent features:

1. The points representing the chloride-bicarbonate ratios of the well waters fall slightly closer to the line indicating the ocean-water blend than to that of the oil-field brine blend. For waters with chloride content of more than 450 ppm,

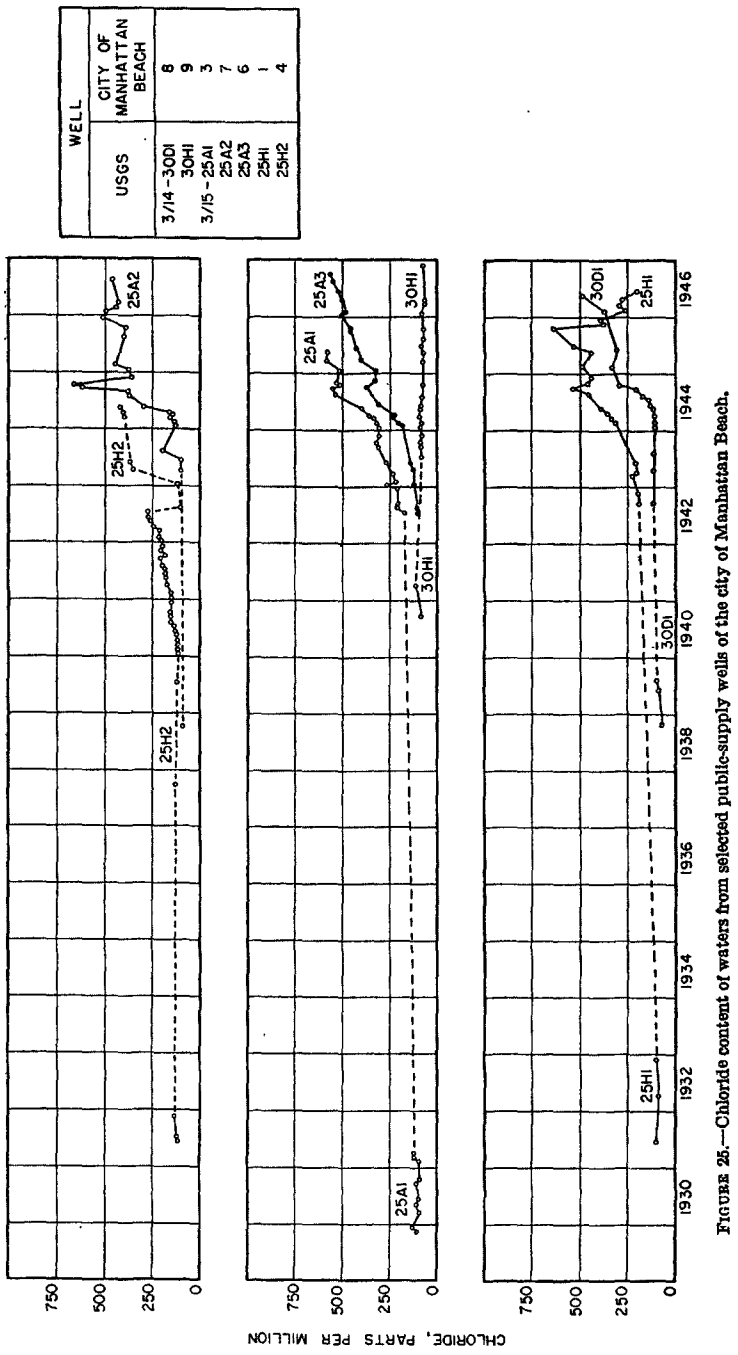
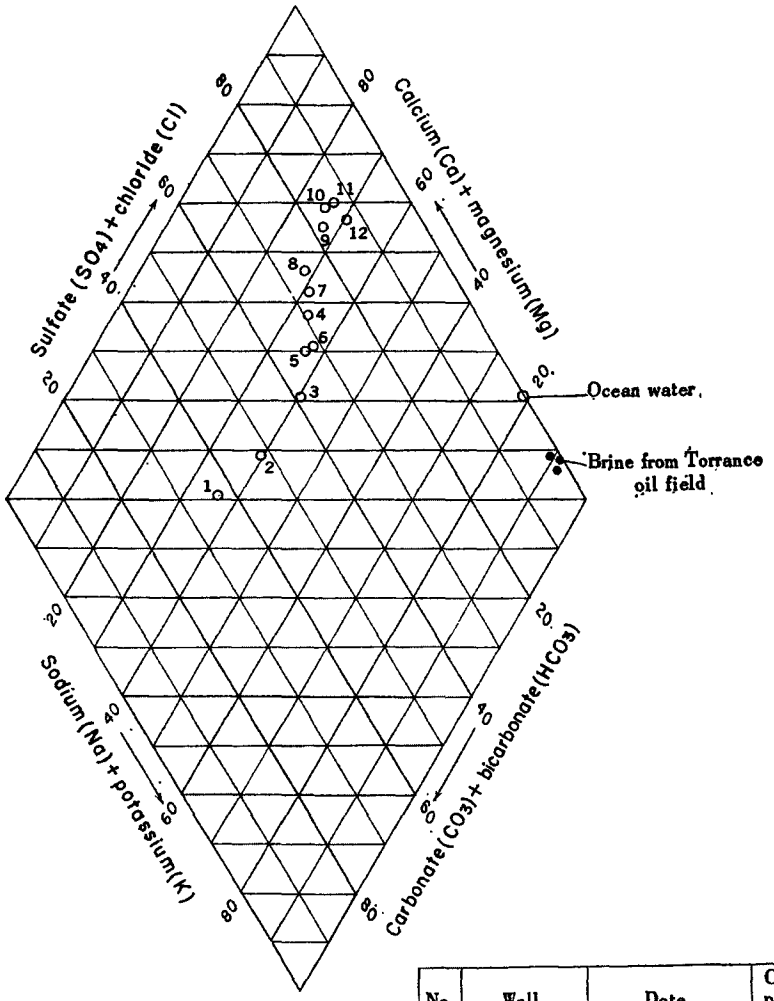


FIGURE 25.—Chloride content of waters from selected public-supply wells of the city of Manhattan Beach.

A-1137



No.	Well	Date	Chloride, parts per million
1	3/14-30D1	Oct. 20, 1938	67
2	30D1	Mar. 31, 1944	111
3	30D1	Aug. 15, 1944	172
4	3/15-25H1	June 11, 1943	203
5	3/14-30D1	Sept. 25, 1944	212
6	30D1	Oct. 24, 1944	226
7	30D1	Oct. 29, 1944	303
8	30D1	Feb. 5, 1946	371
9	3/15-25A1	Aug. 15, 1944	545
10	25A1	Sept. 25, 1944	561
11	3/15-25A2	Sept. 15, 1944	631
12	25A2	Sept. 25, 1944	677

FIGURE 26.—Chemical character of contaminated waters from selected public-supply wells of the city of Manhattan Beach.

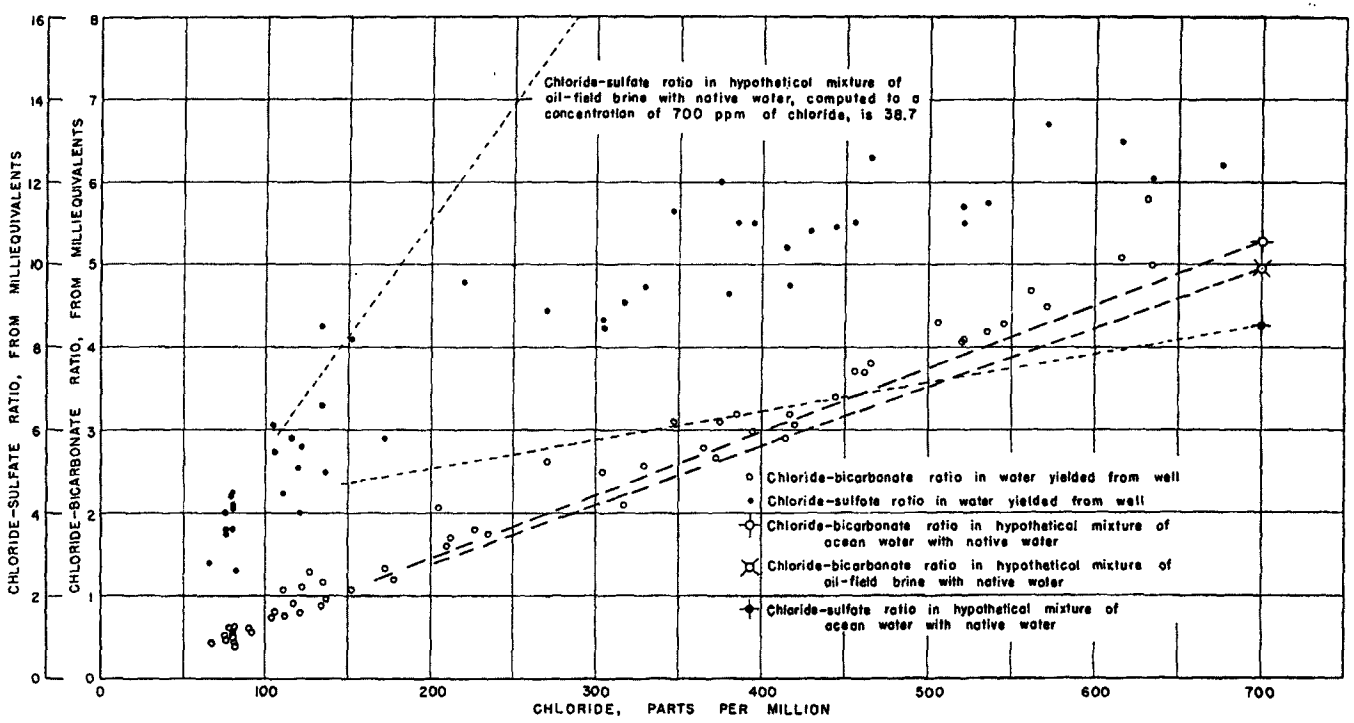


FIGURE 27.—Relationship of chloride, bicarbonate, and sulfate in contaminated waters from public-supply wells of the city of Manhattan Beach.

the digression of the plotted points from the ocean-water blend represents a decrease of bicarbonate amounting to about 7 percent. For the line indicating the oil-field brine blend the loss would have to be about 13 percent. However, this evidence certainly is not diagnostic with respect to selection between the two sources.

2. For values of chloride above 300 ppm the points representing the chloride-sulfate ratios of the well waters are alined much closer to the trend of the line indicating the ocean-water blend than to that of the oil-field brine blend. That is, the contaminated well waters contain much more sulfate than could have been brought in by oil-field brines, but slightly less than the computed amount carried in by ocean water. Of the two features, the chloride-sulfate ratio presents the only definite evidence of ocean-water contamination.

So far as is known from existing analytical data, brines from the western part of the Torrance oil field contain almost as much sulfate as the inferred native water at the main well field of the city of Manhattan Beach. Hence, waters contaminated with such a brine would be expected to show no increase in sulfate with increase in contamination. The analyses of the contaminated waters do show an increase in sulfate; however, this increase is less than that resulting from a simple blend of native water with ocean water, as shown by figure 27. This lack of agreement possibly could be explained to be a result of sulfate reduction if substantiating evidence could be found. However, because of the rapidity with which sulfate reduction may occur and the difficulty of obtaining confirmatory analyses, its occurrence at any given place is necessarily an inferential matter. However, not only does the sulfate content of these waters become greater with increase in contamination, but, as indicated by figure 27, the trend of the chloride-sulfate ratio is about parallel to the hypothetical chloride-sulfate ratio for a simple ocean-water mixture. Thus, it is concluded that ocean water is the contaminant at the Manhattan Beach well field.

VERTICAL RANGE OF CONTAMINATION

As described earlier, all wells at the main field of the city of Manhattan Beach, except well 25H1, yield from a single aquifer—the Silverado water-bearing zone. Well 25H1 taps both the Silverado zone and a 14-foot sand, 240 feet below that zone. In October 1944 and in January 1945, the Geological Survey made conductivity traverses in well 3/15–25H1 to determine: (1) if any range in quality existed between the waters yielded from the two zones; and (2) if any vertical range in quality existed in the water entering the casing through the perforations reported to be 221 to 240 feet below land surface opposite the Silverado zone. The data obtained from those traverses are shown on figure 28, from which the following conclusions have been drawn:

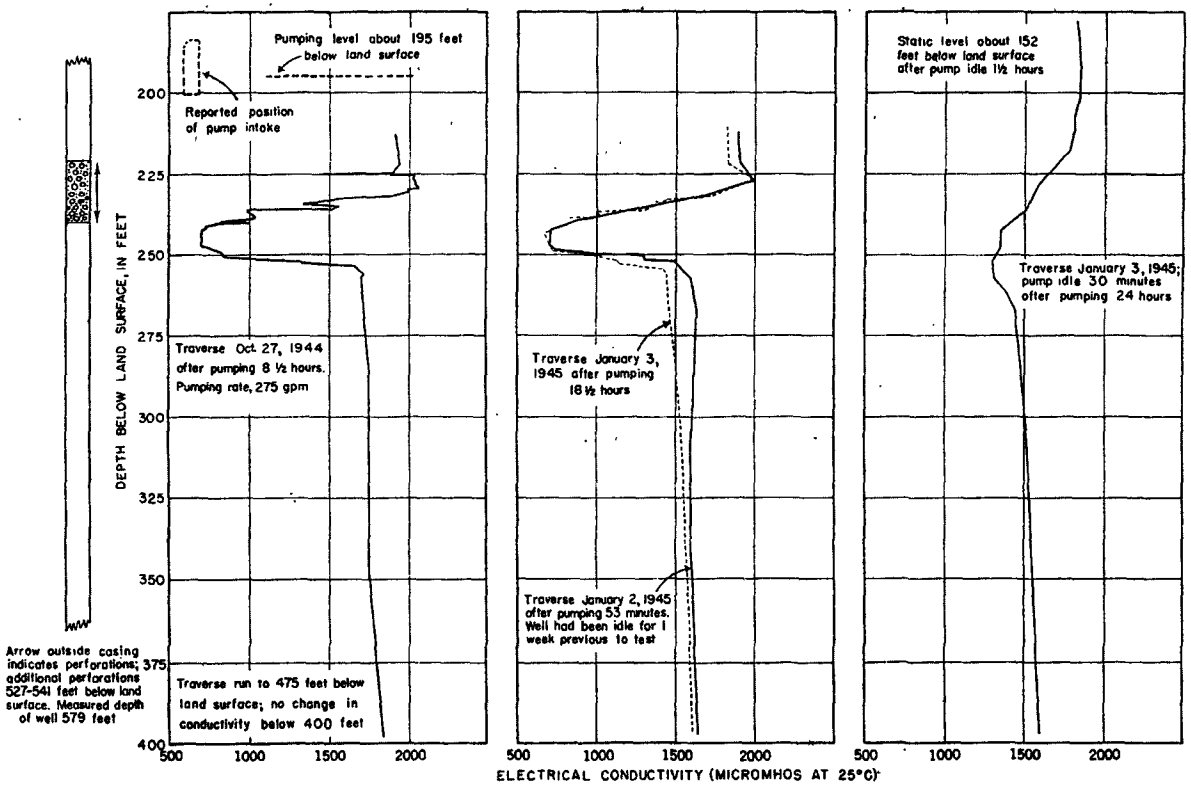


FIGURE 28.—Conductivity traverses in well 3/15-25H1 (city of Manhattan Beach well 1), Oct. 27, 1944, and Jan. 2-3, 1945.

1. The quality of the water from the deeper perforations (527–541 feet) was somewhat better than the water admitted to the pump intake. The amount of water yielded through these perforations was small, probably about 25 gpm.
2. Fresh water entered the well from 248 to 256 feet below land surface; there, the conductivity decreased from about 1,500 to 700 micromhos (dissolved solids about from 900 to 400 ppm). The casing reportedly is not perforated at this depth; thus the water must have entered either through unreported perforations or through a leaking casing.
3. Saline water entered the casing from 230 to 243 feet below land surface. The concentration of this water was indeterminate, but the conductivity was greater than 1,850 (dissolved solids greater than about 1,100 ppm).
4. Under nonpumping conditions, the saline water entering through the perforations 221–240 feet below land surface moved down to displace the fresh water at 248–256 feet and at 527–541 feet. Doubtless this saline fluid not only displaced the water in the casing, but it also invaded these lower water-bearing zones while the pump was idle.

WELLS IN AND NEAR REDONDO BEACH

To the south of 190th Street, near the coast, the Silverado water-bearing zone and the "200-foot sand" cannot be discriminated as separate entities. From here southward to the Palos Verdes Hills, the materials penetrated by wells are permeable throughout nearly their entire thickness (pl. 3*C*). Beneath the dune sand, which extends from land surface about to sea level, the water-bearing material tapped by wells is considered to be within the Silverado water-bearing zone. Wells have penetrated this zone to a depth as great as 400 feet below sea level (well 4/14–17E1 and 5N1). A comparison of drillers' logs of wells in the western part of sec. 8, T. 4 S., R. 14 W., suggests a local division of the Silverado zone into an upper and a lower part, separated by a few tens of feet of clay. Records of water levels in well 4/14–8E1, which taps only the upper part, and in well 8D1, which taps both the upper and lower parts, show little difference in altitude of water level in the two parts from the middle to the late thirties. Since about 1941, however, as shown by measurements at these two wells, the water level in the lower part has been slightly higher than that in the upper. Available chemical analyses suggest some slight difference in quality of water from the two parts; also, even where the separating clayey layer is not present, the deeper water is of appreciably better quality.

SUMMARY OF NATIVE WATER QUALITY

Water of native quality is represented by analyses of water from wells of the California Water Service Co. in sec. 31, T. 3 S., R. 14 W., and from random wells in secs. 5, 8, and 17, T. 4 S., R. 14 W. According to these analyses, the native waters contained 50 to 60 ppm of chloride, and about 300 to 360 ppm of dissolved solids; the sulfate content decreased from north to south. In sec. 31 the sulfate content

of these native waters was about 40 ppm; in sec. 5, from 15 to 12 ppm; in sec. 17, from about 7 ppm to only a trace. The native waters range from sodium, calcium-bicarbonate waters in the northern part of the area to sodium bicarbonate waters in the south. For the central part of the area, the analysis of October 6, 1931 of well 4/14–5N2 (table 30) has been selected to be representative of a native water of good quality. Locally, near the coast, inferior waters existed under native conditions according to early records. For example, by 1908, about half a mile from the coast in 4/14–7J, brackish water containing noticeable quantities of hydrogen sulfide gas was reported at depths of less than 185 feet below land surface. The water below that depth was utilized from about 1905 to 1930 by several public-supply wells of the California Water Service Co. It is reported to have been of good quality until it became contaminated late in the twenties.

PROGRESS OF WATER-QUALITY DEPRECIATION

The earliest known occurrence of water-quality depreciation in the Redondo Beach area is indicated by a series of analyses from well 4/14–6F1, which was drilled in 1912 by the Southern California Edison Co. The chloride content of the water from that well was 79 ppm. By late 1918 the chloride content had increased to 462 ppm. The public-supply wells of the California Water Service Co. in 4/14–7J were abandoned prior to 1931 because of saline contamination. Also, well 4/14–17E1, which was drilled in 1929 and perforated at intervals from 253 to 400 feet below land surface, yielded water containing 404 ppm of chloride in October of that year. Thus, as of 1930, the front of contaminated water extended inland at least 0.8 mile at Redondo Beach.

The general progress of contamination in the Redondo Beach area since 1930 is best shown by the chloride plots for several wells with good analytical records. These have been plotted on figure 29 and include well 4/14–5N2, which, since 1932, has an excellent record of chloride determinations made by the Los Angeles County Flood Control District. Definite contamination in this well began in 1938, and it increased so rapidly that the well was abandoned in 1945. Also plotted on figure 29 are chloride determinations on waters from wells 4/14–8D1 and 8E1, which were badly contaminated when abandoned in 1942 and 1943, respectively; well 8C1, which was incipiently contaminated as of 1946; and well 3/14–31A1, which in mid-1947 still yielded water of excellent quality. The trend of chloride for well 8C1 is anomalous; on the basis of trends shown by the chloride graphs for wells 5N2, 8D1, and 8E1, it would be expected that when the chloride content increased beyond 100 ppm, the slope of the curve would become much steeper and ultimately would result in the abandonment of

EXHIBIT 9

DEPARTMENT OF FINANCE

EDMUND G. BROWN JR., GOVERNOR
915 L STREET ■ SACRAMENTO CA ■ 95814-3706 ■ WWW.DOF.CA.GOV

Transmitted via e-mail

January 24, 2011

Mr. Samuel P. Schuchat, Executive Officer
California State Coastal Conservancy
1330 Broadway, 13th Floor
Oakland, CA 94612-2530

Dear Mr. Schuchat:

Final Report—Audit of California State Coastal Conservancy's Propositions 12, 13, 40, and 50 Bond Funds

The Department of Finance, Office of State Audits and Evaluations, has completed its audit of the California State Coastal Conservancy's (Conservancy) Propositions 12, 13, 40, and 50 bond funds for the period ending June 30, 2008.

The Conservancy's response to the report observations and our evaluation of the response are incorporated into this final report. As requested in the draft report and based on our evaluation of the Conservancy's response, the Conservancy is required to submit a detailed corrective action plan addressing Finding 1. This corrective action plan should be submitted within 60 days from the date of this transmittal.

Please mail your corrective action plan to:

Department of Finance
Office of State Audits and Evaluations
300 Capitol Mall, Suite 801
Sacramento, CA 95814

In accordance with Finance's policy of increased transparency, this report will be placed on our website. Additionally, pursuant to Executive Order S-20-09, please post this report in its entirety to the Reporting Government Transparency website at http://www.transparency.ca.gov/ within five working days of this transmittal.

We appreciate the assistance and cooperation of the Conservancy. If you have any questions regarding this report, please contact Diana Antony, Manager, or Beliz Chappuie, Supervisor, at (916) 322-2985.

Sincerely,

Original signed by:

David Botelho, CPA
Chief, Office of State Audits and Evaluations

Enclosure

cc: On following page

cc: Mr. Neal Fishman, Deputy Executive Officer, California State Coastal Conservancy
Ms. Nadine Hitchcock, Deputy Executive Officer, California State Coastal Conservancy
Ms. Regine Serrano, Chief of Administrative Services, California State Coastal Conservancy
Mr. Patrick Kemp, Assistant Secretary, Natural Resources Agency
Mr. Bryan Cash, Deputy Assistant Secretary, Natural Resources Agency
Ms. Julie Alvis, Deputy Assistant Secretary, Natural Resources Agency

An Audit of Bond Funds

California State Coastal Conservancy
Propositions 12, 13, 40, and 50



Source: California State Coastal Conservancy Website

Prepared By:
Office of State Audits and Evaluations
Department of Finance

093760047

March 2010

MEMBERS OF THE TEAM

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Supervisor

Staff
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Final reports are available on our website at http://www.dof.ca.gov

You can contact our office at:

Department of Finance
Office of State Audits and Evaluations
300 Capitol Mall, Suite 801
Sacramento, CA 95814
(916) 322-2985

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EXECUTIVE SUMMARY

In accordance with the Department of Finance's (Finance) bond oversight responsibilities, we audited the California State Coastal Conservancy's (Conservancy) funding under Propositions 12, 13, 40, and 50 as of June 30, 2008. The audit objectives were to determine whether bond funds were awarded and expended in compliance with applicable legal requirements and established criteria, and to determine if the Conservancy had adequate project monitoring processes in place. We identified the following control and accountability issues requiring corrective action.

- Since 2001 the Conservancy issued approximately $13 million in bond-funded loans without clear authority or adequate controls. Additionally, approximately $2.9 million in loan repayments have been received and deposited in the Conservancy Fund, which is used for general operations and support funding.

- The Conservancy did not establish formal program guidelines; project awarding criteria; and grant applications to document its project merit review process. Also, the Conservancy website included limited or incomplete information about ongoing programs and efforts, regional priorities, and funding opportunities. Subsequent to our audit, the Conservancy made efforts to address some of these issues.

- The Conservancy's fiscal oversight and monitoring of bond funds needs improvement. Specifically, project scopes and budgets lack detail, match contributions are not enforced, grantees are paid for non-budgeted items, and project monitoring is inconsistent and inadequately documented.

- Bond project status is incomplete and does not fully comply with bond reporting requirements. To address this observation, the Conservancy is developing the Coastal Conservancy Project Management Database to track its projects.

The recommendations in this report are intended to assist management in improving operations and accountability for bond funds.

BACKGROUND, SCOPE, AND METHODOLOGY

BACKGROUND

Between March 2000 and November 2002, California voters passed the following four bond measures totaling $10.1 billion:

- Proposition 12—The Safe Neighborhood Parks, Clean Water, Clean Air, and Coastal Protection Bond Act of 2000
- Proposition 13—The Safe Drinking Water, Clean Water, Watershed Protection, and Flood Protection Act
- Proposition 40—The California Clean Water, Clean Air, Safe Neighborhood Parks, and Coastal Protection Act of 2002
- Proposition 50—The Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002

These propositions authorized the sale of bonds to finance a variety of resource programs. Administered by a number of state departments, agencies, boards, and conservancies, the proceeds from these bonds support a broad range of programs that protect, preserve, and improve California's water and air quality, open space, public parks, wildlife habitats, and historical and cultural resources. Bond proceeds are expended directly by the administering departments on various capital outlay projects, and are also disbursed to federal, state, local, and nonprofit entities in the form of grants, contracts, and loans.

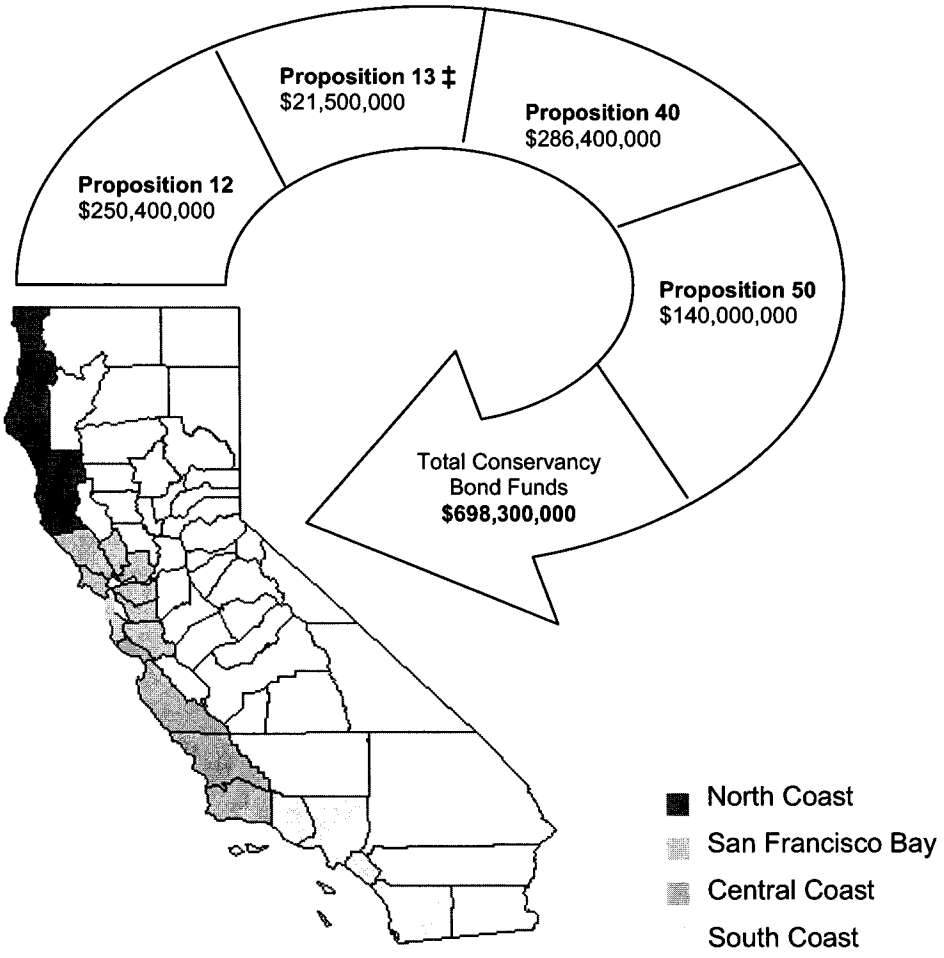
California State Coastal Conservancy

The California State Coastal Conservancy (Conservancy) was established in 1976 through Division 21 of the Public Resources Code. The Conservancy's mission is to act with others to preserve, protect, and restore the resources of the California coast, ocean, and the San Francisco Bay Area. Their vision is of a beautiful, restored, and accessible coastline, ocean and San Francisco Bay Area. The Conservancy Board's seven members are appointed by the Governor and California Legislature. The Legislative Oversight Committee meets with the board and participates in its activities. The committee is made up of three members of the Senate and three members of the Assembly.

The Conservancy staff of 77 consists of executive management, program and project managers, legal, and administrative staff. There are four regional program managers directing a staff of 34 project managers, who are responsible for initiating and developing the projects, selecting the grantee and then managing the projects.

In total, the Conservancy administers over $698.3 million in allocated bond funds over four primary state regions as shown in Figure 1.

Figure 1. Propositions 12, 13, 40, and 50 Funds Allocated to the Conservancy as of June 30, 2008



Source: Propositions 12, 13, 40, and 50 Bond Acts.

Notes:

‡ A specific allocation amount of Proposition 13 Bond funds for the Conservancy was not identified. The Conservancy received Proposition 13 funding through the Department of Water Resources' allocation.

Bond Funded Projects

The Conservancy awarded bond funds to various types of projects as defined in the bond act and Conservancy's enabling legislation. These projects are grouped in the four program areas defined in the Conservancy's strategic plan:

1. Public accessways (to and along the shore)—construction of new facilities, repairs to existing facilities, acquisition of land or offers to dedicate real property, development of the coastal trail, and waterfront development and repair.

2. Resource conservation—land acquisitions, natural resource restoration and enhancement, land use conflict resolution, and watershed restoration.

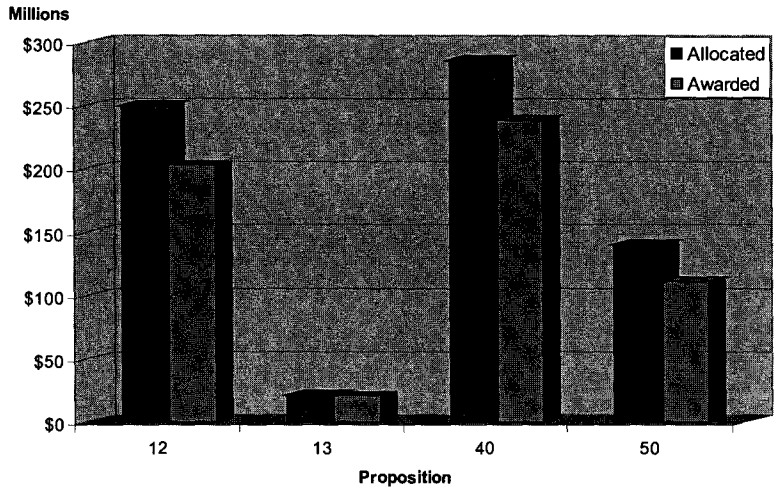
3. San Francisco Bay area conservation—construction of public accessways, natural resource restoration and protection, acquisition of open space and agricultural conservation easements.

4. Ocean program—protection of ocean and coastal resources.

These main program areas are further subdivided into nine sub-programs that correspond to chapters in the enabling legislation and the Ocean Program (see Appendix A).

The Conservancy has awarded $567 million (81 percent) of the $698.3 million allocated from Proposition 12, 13, 40, and 50 as shown in Figure 3.

Figure 3. Bond Funds Allocated* and Awarded as of June 30, 2008



Source: Bond acts and the Conservancy's accounting records.

Notes: *Amounts include statewide costs.

SCOPE

The audit was conducted to determine whether Proposition 12, 13, 40, and 50 bond funds were awarded and expended in compliance with applicable legal requirements and established criteria, and to determine if the Conservancy has adequate project monitoring processes in place. Proposition 84 funds were not included in this audit; however, several programs audited will be receiving Proposition 84 funding. Therefore, because we tested the controls and processes in place for awarding and monitoring under the current programs, the observations and recommendations may be applicable to Proposition 84 programs.

Our review did not include an assessment of the bond authorization, issuance, and sale processes, or an examination of the efficiency or effectiveness of program operations. Further, no assessment was performed on the reasonableness of the land acquisition costs or the conservation value of acquired land or projects completed.

METHODOLOGY

To determine whether bond funds were awarded and expended in compliance with applicable legal requirements and established criteria, and whether the Conservancy had adequate monitoring processes, we performed the following procedures:

- Reviewed applicable bond acts and Conservancy's grant management policies, procedures, including the strategic plan and other legal provisions and regulations.

- Interviewed key personnel responsible for administering bond funds to obtain an understanding of how the Conservancy oversees various project stages: pre-award, award, interim monitoring, closeout, and post-close monitoring.

- Examined a sample of project files to determine if the projects stayed within scope and cost. The sample of projects was selected from two sub-programs; System of Public Accessways and Coastal Resource Enhancement, which represent 52 percent of total bond awards (see Appendix B for list of projects tested).

- Performed nine separate Conservancy grant audits (See Appendix C for list and link to audit reports).

- Identified and assessed the project tracking methods to determine its adequacy for monitoring projects.

- Reviewed a sample of expenditures to verify accuracy of recorded and reported financial information.

- Reviewed the reasonableness of Conservancy's administrative expenditures charged to bond funds.

Multiple discussions were held with the Conservancy throughout our audit fieldwork to discuss and provide specific project review details. Recommendations were developed based on interviews with Conservancy management and key staff directly responsible for administering bond funds and review of documentation made available to us. This audit was conducted during the period December 2008 through April 2009.

Except as noted, this audit was conducted in accordance with *Government Auditing Standards*, issued by the Comptroller General of the United States. In connection with this audit, there are certain disclosures required by *Government Auditing Standards*. Finance is not independent of the audited entity, as both are part of the State of California's Executive Branch. As required by various statutes within the California Government Code, Finance performs certain management and accounting functions. These activities impair independence. However, sufficient safeguards exist for readers of this report to rely on the information contained herein.

The audit identified the following observations requiring corrective action. As noted in the Scope section of this report, although this audit did not include Proposition 84 funding, several programs audited received Proposition 84 funds. Consequently, the following observations and recommendations may also pertain to Proposition 84 programs.

Observation 1: Lack of Accountability Over Bond-Funded Loans

The Conservancy issues bond-funded loans without clear authority or adequate controls. Specifically, the Conservancy's funding agreements include repayment clauses specifying amounts due by a certain date(s); however, the Conservancy classifies these as "grants with repayments" instead of loans. Because loan authority is vested in the legislature (or other rule making body) the Conservancy should cite or obtain legislative authority. In accordance with generally accepted budgetary and accounting principles, we interpret these as loans. The following control weaknesses were noted:

Loan Receivables are Not Recorded
Since 2001 the Conservancy issued approximately $13 million in bond-funded loans without properly recording the outstanding receivables. Although short-term receivables are recorded in the Conservancy Fund (Fund 0565) when the first payment is due, that date in some cases can be as long as 10 years. During that time, the amounts due are manually tracked by contract managers and not recorded in the Conservancy's accounting system.

Based on Conservancy grant audits performed by Finance in March 2010[1], loan repayment terms were inconsistently and inadequately enforced. In two cases, the loan repayments for a $300,000 loan and a $2,000,000 loan were late by over three years and three months, respectively.

The State Administrative Manual (SAM) section 7622 establishes Account No. 2100, Loans and Advances Receivable, as the summary account of long-term loans and advances receivable. The loan accounting entries will depend on the legal authority for the loan, the type of funds involved, and whether the loan will cross fiscal years.

Loan Repayments Recorded as Revenues in Conservancy Fund
Loan repayments are recorded as revenues in Fund 0565 instead of the bond fund of origin. According to the Conservancy, approximately $2.9 million in loan repayments have been received and deposited in Fund 0565. The Conservancy uses Fund 0565 for general operations and support funding.

The Conservancy claims Public Resources Code section 31011 requires it to remit all "funds received" to Fund 565 and establish separate accounts within the fund. However, Government Code section 16303 requires moneys subsequently returned to be credited to the originating appropriation and fund.

[1] See Appendix C for list and link to separately issued grant audit reports.

Therefore, bond loan repayments should be deposited into the bond fund of origin. Additionally, the Conservancy never established separate accounts in Fund 0565 precluding effective identification of bond funds. Because the Conservancy uses Fund 0565 for support-type costs, bond funds are at risk of misuse. For example, during Finance's March 2006 Conservancy bond audit, bond funds were directly charged over $37,000 in ineligible supports costs, including over $10,000 for yoga classes. The Conservancy subsequently repaid the bond funds and moved the costs to Fund 0565.

Proper internal accountability is required to ensure bond funds are separately tracked for future use, reappropriation, or other disposition by the Legislature. Generally accepted budgetary and accounting principles require loan repayments to be deposited into the same fund from which the original loans were made. Without proper recording of loan receivables and repayments, the bond funds are at risk of misappropriation and misuse.

Recommendations:

A. Cite or obtain legislative authority and develop and implement a loan program accordingly.

B. Identify and document all outstanding bond loan receivables. Record bond loans as receivables in the Conservancy's accounting system in accordance with SAM section 7622. Maintain supporting documentation for these amounts.

C. Record bond loan repayments in the bond fund of origin. Discontinue depositing bond loan repayments in Fund 0565. Transfer prior bond loan repayments from Fund 0565 to the bond fund of origin. Maintain supporting documentation for these amounts.

D. Provide a detailed Corrective Action Plan addressing the findings and recommendations within 60 days from the date of this report. The corrective action plan should include milestones and target dates to correct all deficiencies.

Observation 2: Project Awarding Process Needs Improvement

As of June 30, 2008, the Conservancy awarded $567 million in bond funds without established formal program guidelines, specific project awarding criteria, project application forms, or website announcements in place.

The Conservancy does not utilize program specific guidelines and criteria to award bond funds as required by the bond act, the Public Resources Code Division 21, and the Conservancy's enabling legislation. Instead, the Conservancy uses its Strategic Plan as its basis to fund all projects while considering applicable local plans; however, the Strategic Plan is broad and reflects only general requirements applicable to all projects.

General Criteria Used by the Conservancy

- *Promotion of the Conservancy's statutory programs and purposes*
- *Consistency with purposes of the funding source*
- *Public support*
- *Location (must benefit coastal, ocean resources, or the San Francisco Bay region)*
- *Need (desired project or result will not occur without Conservancy participation)*
- *Greater-than-local interest*

Source: Strategic Plan

Additionally, the Conservancy does not have a formal awarding process or a grant applications process to document its project merit review. Without bond-specific program criteria and application review documentation, the merit for selected projects is not transparent.

In awarding projects, the Conservancy works with the Conservancy's partners—public agencies and nongovernmental organizations—to identify potential projects. However, information on the Conservancy website about ongoing programs and efforts, regional priorities, and funding opportunities is limited. Agendas for upcoming Board meetings do not list projects under evaluation and therefore may limit external opportunities for involvement. Additionally, with 34 Conservancy program staff and 4 regional managers performing project reviews, establishing a formalized awarding process is critical to ensure project consistency.

Public Resources Code, Division 21, sections 31205, 31254, and 31303 require "The Conservancy to request the commission, local public agencies, nonprofit organizations, and other public and private groups to assist in the development of *criteria and guidelines for the submission, evaluation, and determination of priority of projects* (coastal restoration, coastal resource enhancement, and urban waterfront restoration). After considering comments received from such sources and ensuring that adequate opportunity for public review and comment has been provided, the *conservancy shall adopt guidelines and criteria for the administration of the coastal program authorized under this chapter.*"

Water Code section 79505.6 (a) (1) states, by March 15, 2004, each state agency disbursing grants or loans pursuant to this division shall develop project solicitation and evaluation guidelines.

Government Code section 13402 states that state agency heads are responsible for the establishment and maintenance of a system or systems of internal accounting and administrative control within their agencies. This responsibility includes documenting the system, communicating system requirements to employees, and assuring that the system is functioning as prescribed and is modified, as appropriate, for changes in conditions.

The Conservancy Strategic Plan states, "The administration, Legislature, academia, interest groups, and the general public need to be informed of programmatic, strategic, and project planning and development, upcoming opportunities for participation, and of the outcomes of these projects and other decisions."

Subsequent to this audit, the Conservancy recently made several efforts to address some of these issues, including grant applications and project selection criteria posted to its website.

Recommendations:

A. Develop program specific guidelines and criteria outlining the submission, evaluation, and project priority process and determinations.

B. Publish the above guidelines and funding opportunities on the Conservancy website.

C. Document merit review activities clearly indicating how projects meet the program's established awarding criteria.

D. Provide related staff training.

Observation 3: Project Matching Funds May Not be Maximized

The Conservancy does not enforce or monitor grantees' required match contributions. For 12 projects reviewed, grant budgets and work plans indicated total available match contributions of over $7.3 million. For example, grant agreements for two of the projects reviewed, California State University at Monterey Bay and City of Pacifica, specifically stated, "Conservancy funds shall not be disbursed until matching funds are committed"; however, the Conservancy never verified the match contribution.

Additionally, although staff project recommendations indicate match contributions, the final grant agreements and work plans do not consistently include the match requirement language. Most state departments require grantees to report match contributions via the reimbursement request forms. This allows the department to monitor and confirm grantee's match contributions. The Conservancy Request for Disbursement form does not require match reporting.

Public Resources Code section 5096.651 requires priority be given to projects with a match contribution. In addition, the Conservancy's 2007 Strategic Plan (see text box above) identified the match need and assumed Conservancy funds would be matched by at least 2 to 1.

Matching Funds Priority

"The Conservancy's recently completed Five-Year Capital Infrastructure Plan for fiscal years 2008-09 to 2012-13 identified a need for approximately two times the dollar amount assumed to be available to the Conservancy. Additionally, like this strategic plan, it also assumes the Conservancy's funds will be matched by at least 2–1."

Source: Conservancy Strategic Plan

Recommendation: Monitor and verify match contributions prior to disbursement. Include a match reporting section in the reimbursement request form and require submission of match documentation.

Observation 4: Project Fiscal Oversight Needs Improvement

The Conservancy lacks adequate project fiscal oversight. Based on a review of 12 projects, the following control weaknesses were noted:

- *Detailed work plans and budgets are not consistently received or documented prior to project commencement.* The Conservancy awards projects based on estimated scope and costs with the condition that detailed work plans and budgets will be submitted and approved prior to commencing project work. However, based on a review of 12 projects, 3 of 12 detailed work plans and 5 of 12 expenditure budgets were missing. Without clearly defined scopes and budgets, the Conservancy's ability to monitor projects and ensure successful completion is at risk.

  State Contracting Manual defines scope as, "The work, service, or product to be performed, rendered, or provided. Clear and concise language must be used to describe the scope."

- *Grantee reimbursements are not consistent with grant budgets.* Based on an audit performed by Finance in 2010 of Sonoma Land Trust, Sears Point Grant, the grantee was reimbursed for $58,862 in overhead costs.

Overhead was not a grant approved budget line item. In addition, the grantee billed and was reimbursed for *budgeted* salary rates instead of *actual* salary cost. Half-way through the contract term, the total markup was $22,775 over actual costs. (See Appendix C for link to grant audit report.)

Grant agreements require grantees to submit a Request for Disbursement form with supporting documentation. However, the Conservancy allows grantees to use their own invoices, which do not always reflect budgeted items. Consequently, the claimed costs are not consistent with the approved budgets.

- *The Conservancy lacks formal monitoring procedures leading to inconsistent reviews and limited documentation.* Project managers are responsible for performing site visits of restoration, enhancement, and public access projects to ensure projects stay within scope and cost; however, there is no guidance defining required site visit intervals, areas to review, or documentation required.

  During the review of the Malibu Lagoon Restoration project, documentation was limited and the project manager was unable to provide adequate justification for the project's eight amendments that modified the scope and increased total funding from $300,000 to $925,259. Additionally, although the file included a detailed budget for the initial award, the subsequent amendments included only lump sum amounts providing little to no justification for the 208 percent funding increase. The project manager was not in charge during the amendment approvals.

- *Post-close monitoring is not performed.* Once a project is closed, the post-monitoring requirement is intended to ensure the project is adequately maintained as specified in the grant agreement. Two of four closed projects reviewed lacked a project monitoring plan. The Conservancy acknowledged post monitoring is not being performed or documented on a consistent basis. The Conservancy relies on grantees, other state agencies, or non-profits in the area to alert them about project issues. Although Conservancy grant agreements include early termination for failure to perform and notification in the case of a change in ownership, these are defensive measures. The Conservancy should be proactive. Other state agencies require long-term management plans with periodic condition reports, including site photos.

- *Project status is inaccurate and incomplete.* A comparison of accounting records with reported project status[2] indicated a difference of over $172 million in project awards. Public Resources Code section 5096.686 and Water Code section 79575 require annual project and expenditure summary reports. According to the Conservancy, the website has not been updated due to limited staffing resources; however, they are in the process of developing the Coastal Project Management Database to track its projects.

Recommendations:

A. Develop a standard application with workplan/budget templates including directions on how to complete it. Define the level of detail needed for different project types to ensure consistency among the program staff.

B. Standardize reimbursement forms to match the approved grant budgets. Include template in program guidelines along with clear definition of eligible costs.

[2] Project status is posted on Natural Resource Agency's "Proposition 40/50 Awards Website".

C. Develop and implement monitoring procedures outlining site visit intervals, areas to review, and project documentation required.

D. Require grantees to submit a maintenance and operation plan at project close-out and require periodic project condition reports.

E. At year-end, reconcile project database information to accounting records to ensure all bond projects are accurately recorded. Complete the Coastal Project Management Database and update the website accordingly.

F. Provide related staff training.

California State Coastal Conservancy's Sub-Programs

Public Resources Code section	Program Name	Program Purpose
31119(a)	Coastal Education	To undertake educational projects for pupils in kindergarten to grade 12, relating to the preservation, protection, enhancement, and maintenance of coastal resources.
31150-31156	Preservation of Agricultural Lands	For the purpose of acquiring fee title, development rights, easements, or other interests in land and undertaking improvements to and development of lands located in the coastal zone in order to prevent loss of agricultural land to other uses and to assemble agricultural lands into parcels of adequate size permitting continued agricultural production. All feasible action will be taken to return to private use or ownership all lands acquired, with appropriate use restrictions.
31160-31165	San Francisco Bay Area Conservancy Program	The Conservancy may undertake projects and award grants to the nine counties of the San Francisco Bay Area that will help achieve the following goals: • To improve public access to, within, and around the bay, coast, ridgetops, and urban open spaces, without having a significant adverse impact on agricultural operations and environmentally sensitive areas and wildlife through completion and operation of regional bay, coast, water, and ridge trail systems, and local trails connecting to population centers and public facilities, and through preservation of related facilities. • To protect, restore, and enhance watersheds, scenic areas, natural habitats, connecting corridors, and other open-space resources of regional importance. • To assist in the implementation of the policies and programs of the California Coastal Act of 1976, the San Francisco Bay Plan, and other adopted plans. • To promote, assist, and enhance projects that provide open space and natural areas that are accessible for recreational and educational purposes.
31200-32215	Coastal Restoration Projects	For the purpose of restoration of areas of the coastal zone that, because of scattered ownerships, poor lot layout, inadequate park and open space, incompatible land uses, or other conditions, are adversely affecting the coastal environment or impeding orderly development. Grants shall be utilized to assemble parcels of land within designated coastal restoration areas, for the redesign of those areas, and installation of public improvements required for those areas.
31220	Integrated Coastal and Marine Resource Protection	To improve and protect coastal and marine water quality and habitats, the Conservancy may undertake coastal watershed, coastal and marine habitat water quality, sediment management, and living marine resources protection and restoration projects. In consultation with the State Water Resources Control Board, the Conservancy will develop projects consistent with Public Resources Code section 30915, which provides approval for projects that restore and protect the water quality and environment of coastal waters, estuaries, bays, and near shore waters.
31251-31270	Coastal Resource Enhancement Projects	For the purpose of enhancement of coastal resources that, because of indiscriminate dredging or filling, improper location of improvements, natural or human-induced events, or incompatible land uses, have suffered loss of natural and scenic values. Assembly of parcels of land is used to improve resource management, relocation of improperly located or designed improvements, and for other corrective measures to enhance the natural and scenic character of the areas.
31300-31316	Urban Waterfront Restoration	To promote the restoration of the state's vital urban waterfronts by developing environmentally sound areas through the creation of parks, open space, visitor serving facilities, and housing for all income levels will promote tourism, public access, and private sector development.
31350-31356	Reservation of Significant Coastal Resource Areas	The Conservancy is vested with the authority to acquire, hold, protect, and use interests in key coastal resource lands to assure coastal resource sites shall be reserved for public.
31400-31410	System of Public Accessways	To implement a system of public accessways by acquiring land or any interest therein, or to develop, operate, or manage lands for public access purposes to and along the coast.
35500-35650	California Ocean Protection Act	To ensure that California maintains healthy, resilient, and productive ocean and coastal ecosystems for the benefit of current and future generations.

List of Projects Reviewed at State Coastal Conservancy

#	Grantee Name	Project Name	Amount	Program	Public Resources Code
1	California State University Monterey Bay Foundation	Santa Barbara Channel Marine Mapping Project	$400,000	Integrated Coastal and Marine Resource Protection	Division 26 Chapter 1
2	Cambria Community Services District	East West Ranch Coastal Trail Improvements	$345,000	System of Public Accessways	Division 21 Chapter 9
3	City of Malibu	Malibu Civic Center Stormwater Improvement Project	$1,000,000	Resource Enhancement	Division 21 Chapter 6
4	City of Pacifica	San Pedro Creek Watershed: Capistrano Bridge Fish Passage Improvements	$545,000	Resource Enhancement	Division 21 Chapter 6
5	County of Humboldt	Humboldt Fish Passage Improvement Program	$594,272	Resource Enhancement	Division 21 Chapter 6
6	County of Santa Barbara	Isla Vista Beach Accessway Improvements (stair reconstruction)	$250,000	System of Public Accessways	Division 21 Chapter 9
7	Gold Ridge Resource Conservation District	Salmon Creek Ranch Implementation	$610,000	Resource Enhancement	Division 21 Chapter 6
8	Mendocino Land Trust	Mendocino Coastal Trail Program, Phase 1	$200,000	System of Public Accessways	Division 21 Chapter 5
9	Peninsula Open Space Trust	Pillar Point Bluff Coastal Trail	$433,550	System of Public Accessways	Division 21 Chapter 9
10	Resource Conservation District of the Santa Monica Mountains	Malibu Lagoon Restoration	$4,316,800	Resource Enhancement	Division 21 Chapter 6
11	Smith River Alliance, Inc.	Mill Creek Implementation Phase I	$1,000,000	Resource Enhancement	Division 21 Chapter 5.5
12	Sonoma Land Trust	Estero Americano Nature Preserve Enhancement	$45,965	Resource Enhancement	Division 21 Chapter 5.5
		Total	**$9,740,587**		

List of State Coastal Conservancy Grant Audits*

#	Grantee Name	Project Name	Amount
1	City of Pacifica	San Pedro Creek Watershed: Capistrano Bridge Fish Passage Improvements	$545,000
2	City of San Clemente	San Clemente Pedestrian Beach Trail	$500,000
3	Sonoma Land Trust	Cedars Area Conservation Plan	$23,000
4	Sonoma Land Trust	Roche Ranch Acquisition	$3,000,000
5	Sonoma Land Trust	Sears Point Restoration Projects Enhancement and Restoration Plans	$1,000,000
6	Sonoma Land Trust	Sonoma Bay Lands Trail Facilities and Site Management	$567,138
7	Monterey Peninsula Regional Park District	Palo Corona Ranch Acquisition	$12,220,0000
8	Santa Clara County Open Space Authority	Blair Ranch Acquisition	$4,340,000
9	City of Pacifica	Mahoney Property Acquisition	$1,100,000
		Total	$23,295,138

* All final grant audit reports posted at http://www.dof.ca.gov/osae/prior_bond_audits/.

Coastal Conservancy

October 7, 2010

Mr. David Botelho, CPA
Chief, Office of State Audits and Evaluations
915 L Street
Sacramento, CA 95814-3706

RE: An Audit of State Bond Fund – California State Coastal Conservancy Propositions 12, 13, 40, and 50

Dear Mr. Botelho:

This is the California State Coastal Conservancy's ("Conservancy's") official response to the above referenced audit report. We found few surprises in the document, having had numerous conversations with your staff during the audit process. We appreciated their openness and professionalism. While we have disagreements about some of the report's conclusions and recommendations, in several areas we are in general agreement and have either begun or completed corrective actions. We respond below to the report as it is organized, with brief overall comments on the four major issues described in the Executive Summary, and with longer discussions for specific issues and recommendations.

Executive Summary Observations

Observation 1: The Conservancy has made loans without proper authority and has deposited returned funds into the Coastal Conservancy Fund instead of the bond fund of origin.

Response to Observation 1: There is specific unambiguous language in Division 21 of the Public Resources Code authorizing the Conservancy to seek repayments of grants (Public Resources Code section 31118). The same legislative bill through which that statute enacted was enacted also amended section 31101 to require that funds received by the Conservancy be deposited in the State Coastal Conservancy Fund (Fund 0565).

Observation 2: The Conservancy does not have formal program guidelines; project awarding criteria; and grant applications. The Conservancy's website has limited or incomplete information about ongoing efforts, regional priorities, and funding opportunities.

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Response to Observation 2: The Conservancy has had project selection guidelines for many years and periodically updates them. In response to the audit, the Conservancy has recently standardized its grant application among its regions. The Conservancy website has been updated to include the standardized grant application, more information about funding opportunities, and additional information about ongoing efforts will be added. In addition, the Conservancy has a Strategic Plan (Plan) that has been posted on its website and guides the development and funding of projects according to the Plans' goals.

Observation 3: Fiscal oversight and monitoring of bond funds needs improvement. Project scopes and budget lack detail, match contributions are not enforced, grantees are paid for non-budgeted items, and project monitoring is inconsistent and inadequately documented.

Response to Observation 3: We disagree that there is an endemic problem with the detailing of project scopes and budgets or paying for non-budgeted items. The audit is vague about the nature of this assertion and any problems that have arisen.

Non-budgeted items: The Conservancy does not pay invoices unless they are consistent with a work program and budget in the corresponding grant-agreement file. This issue identified in this audit appears to arise from a particular project in which a negotiated overhead rate was authorized but was not sufficiently documented in the agreement. This was a rare occurrence and in no way resulted in inappropriate use of funds.

Matching funds: The auditors misunderstood the nature of matching funds. For most projects the Conservancy did not require specific matching amounts, only that the project had sufficient resources for completion. Thus, there were no specific matching requirements to be enforced.

Project monitoring: We are improving post-project monitoring. The Conservancy has developed standardized post-project monitoring requirements that can be tracked and recorded in the Conservancy's project database and will begin staff training to implement its post project monitoring program this fall.

Observation 4: Bond project status is incomplete and does not fully comply with bond reporting requirements.

Response to Observation 4: We have developed a process for project managers to document project status when processing invoices. We are working to complete all required bond reporting.

Detailed Observations and Responses

Observation 1: Lack of Accountability Over Bond-Funded Loans: The Conservancy issues loans without clear authority or adequate controls. The Conservancy classifies its loans as "grants with repayments." These are actually loans made with unclear authority.

Detailed Response: Chapter 1551, Statutes of 1984, in adding Public Resources Code section 31118 to the Conservancy's enabling legislation, clearly authorizes the Conservancy to "seek repayments of funds granted pursuant to this division on terms and conditions as it deems appropriate to carry out the provisions of this division." Conservancy staff worked directly with the author of the bill on this and other provisions it contained. The purpose of this section of law is to authorize the Conservancy to make its grants repayable when warranted. This practice, as carried out by the Conservancy over the years since is clearly authorized, and no additional authorization is needed.

Loan Receivables are Not Recorded: Repayable grants should be considered loans and should be recorded within the Conservancy's accounting system. Loans are currently tracked by contract managers not the accounting department. This has led to some loan repayments becoming overdue.

Detailed response: The payback provisions in some grants do not make them loans requiring that they be recorded as loans receivable. Many of the repayment provisions are conditional. Repayments may be required in some cases if property is sold, or if expected matching funds come through or if there is revenue of some kind associated with the project for which the grant was originally made. There are very few of these repayable grants to begin with. While the current system using the contract manager and project manager to enforce the payback provisions has worked in general, in some cases, for various reasons, public agencies and nonprofit organizations have not been able to repay portions of grants. In order to ensure centralization of the grant-repayment function, we will direct our contracts unit to bill grantees in accordance with the repayment schedule in the grant agreement. Copies of the billing will be provided to the contract manager and to the accounting unit, and follow up will be made if payment is not received within a timely manner.

Loan Repayments Recorded as Revenues in Conservancy Fund: Instead of putting repaid funds into the bond fund of origin the Conservancy has deposited these funds in the Coastal Conservancy Fund. This fund is used for general operations and support. The Conservancy claims that Section 31011 of the Public Resources Code requires it to place repaid funds into the Coastal Conservancy Fund, but Government Code Section 16303 requires that returned funds be credited to the originating appropriation and fund. Because the Conservancy and the Controller have not established separate accounts within the Coastal Conservancy Fund, it is hard to identify what money in that fund should be identified as bond funds. This has led to the improper use of bond funds, most notably $37,000 of support costs, including $10,000 for yoga classes identified in a 2006 audit. These funds had to be returned and other funds used instead.

Detailed response: The Conservancy does not "claim" that Section 31011 of the Public Resources Code requires that it place repaid funds into the Coastal Conservancy Fund. The statute says: "Unless otherwise provided in this division, any funds received by the conservancy pursuant to this division shall be deposited in the State Coastal Conservancy Fund." This section of the Public Resources Code was enacted after the enactment of Government Code Section 16303 and is more specific. Thus, if the two statutes were to conflict, section 31011 would normally prevail.

We strongly disagree that bond funds were misused in that repaid funds were not identified as bond funds. First we disagree that repayments into the Coastal Conservancy Fund should always or perhaps ever be classified as bond funds. But in the unlikely event we are incorrect on this point and repaid funds are classified as bond funds, each of the bond funds that are the subject of this audit allows for their use for state administrative expenses. Additionally, repayments placed in the Coastal Conservancy Fund are subject to appropriation by the Legislature. They cannot be used for administration or any other purpose without the approval of the Governor and Legislature. The practice of putting repayments into the Coastal Conservancy Fund is well known by the Legislature and the Department of Finance and is part of the Conservancy's Long Term Financial Strategy that is updated and discussed by the Conservancy on a yearly basis in a public meeting. Whether repaid funds were returned to a bond appropriation or fund, or to the State Coastal Conservancy Fund, their use for administration was legal and anticipated in the language of the bond acts that generated this money.

The above is true even for the subsidized yoga classes from 2005/06. Rather than dispute that issue at the time it was raised in a previous audit, we decided to switch this expenditure to a non-bond support appropriation. But expenditures for these classes were nothing out of order. They were part of the Conservancy wellness program authorized pursuant to Executive Order W-119-95, which provides in part that core wellness programs, including exercise programs, shall be developed, and that every state department shall dedicate resources to Work Site Health Promotion. Of the $8,360 which paid for these classes, $3,822 was paid by staff contributions, leaving $4,538 as the state's contribution for the $2005/06 fiscal year. It is well documented that exercise provides health benefits, and the cost of yoga to the state is considerably less than other state-recommended options such as subsidies to health club memberships. We consider it inappropriate that the audit brought up this finding from 2006 to justify the position on deposits into the Coastal Conservancy Fund.

Recommendations:

A. Cite or obtain legislative authority and develop and implement a loan program accordingly.

   Response: We have cited what we consider to be unequivocal statutory authority to seek repayments of grant funds.

B. Identify and document all outstanding bond loan receivables. Record bond loans as receivables in the Conservancy's accounting system in accordance with SAM section 7622. Maintain supporting documentation for these amounts.

   Response: We have identified all outstanding bond loan receivables. We believe that we are in compliance with the Conservancy's enabling legislation and applicable Government Codes and SAM sections.

C. Record bond loan repayments in the bond fund of origin. Discontinue depositing bond loan repayments in Fund 0565. Transfer prior bond loan repayments from Fund 0565 to the bond fund of origin. Maintain supporting documentation.

Response: We will continue to follow the law.

D. Provide a corrective action plan.

Response: We will comply with this requirement as detailed above.

Observation 2: Project Awarding Process Needs Improvement: The Conservancy has authorized hundreds of millions of dollars without program guidelines, specific awarding criteria, project application forms, or website announcements in place. The Conservancy does not have a formal awarding process or a grant applications process to document its project merit review. The merit of projects is not transparent. The Conservancy's website does not have sufficient information to tell potential grantees of its priorities and funding opportunities. Projects under development are not included in project agendas. With the high number of Conservancy program staff and managers consistency cannot be ensured without more process for awarding grants. The Conservancy has not followed statutes and its own plans in developing program guidelines.

Detailed response: The Coastal Conservancy has a very successful track record, having funded well over 1,200 projects since its inception. The Conservancy's substantial record of success includes such accomplishments as: helping to protect more than 150,000 acres of wetlands, wildlife habitat, farmland, recreational lands and scenic open space; helping to build over 400 access ways and 100's of miles of trails such as the California Coastal Trail, the San Francisco Bay and Ridge Trails; assisting to complete over 100 urban waterfronts to reclaim properties for recreational use and economic development; and leading the planning and restoration for many complex stakeholder processes including the nationally significant San Francisco Bay Salt Pond Restoration project.

The Conservancy has formally adopted project selection criteria, and a formal, transparent awarding process that follows statute. The Conservancy marries these formal criteria and processes with hands-on involvement with prospective and awarded grantees to encourage innovation and excellence to the extent practicable within each project. The audit suggests problems where they do not exist and are unlikely to arise, and it fails to acknowledge the effectiveness of the processes in place. We assert that this is clearly a case of "if it ain't broke, don't fix it."

The Conservancy long ago formally adopted "Project Selection Criteria" in accordance with the requirements of Division 21, the Conservancy's enabling legislation, and has modified the criteria from time to time, most recently June 4, 2009. The Conservancy uses its project selection criteria, provisions of Division 21, bond-act criteria, Strategic Plan criteria, the occasional Budget Act criteria, and significant public input from stakeholder groups to identify important projects and make funding recommendations.

Conservancy staff is entrepreneurial and geographically arrayed. As directed in Division 21 of the Public Resources Code, the Conservancy works with local and state government officials and nonprofit organizations to develop projects that meet state and regional goals. It generally does not institute grant rounds but instead has an open grant process. Applications can be and are made, and these are considered at any time. There are several advantages to a rolling application process. For example, prospective grantees do not have to prematurely submit an application before a project is adequately developed, and Conservancy staff can provide needed guidance to improve projects before the application is submitted. We believe that this process improves the quality of the applications received and ultimately of the projects that are funded.

These procedures are an efficient process for awarding grants that meets statewide and regional needs. Awards are made at open public hearings. The staff reports are detailed, including the rationale for the project and its priority, how it meets the requirements of the Conservancy's enabling legislation and funding sources, and how it meets both strategic plan goals and project selection guidelines. The public is invited to speak on each project and the Conservancy's board, by public vote, may modify or reject any proposal. This is a very transparent process.

With respect to the form of grant applications, based on discussions with the auditors, we have created a uniform grant application that is posted on our website. There is now more information available to the public concerning priorities and how to apply for funding.

The Conservancy has followed applicable statutes in the development of project selection criteria, the development of a strategic plan and five-year infrastructure plan, and in its compliance with bond act requirements. Proposition 50 requires new guidelines to be developed unless guidelines already exist that are sufficient. Conservancy guidelines predate the passage of this bond act. The bond act's sponsors were aware of the existence of the Conservancy's guidelines and placed the language in the measure in part so that the Conservancy did not have to develop new ones.

Recommendations:

A. Develop program specific guidelines and criteria outlining the submission, evaluation, and project priority process and determination.

   Response: We have updated the Conservancy's website with information helpful to potential grantees and have standardized our grant application. Given existing project selection criteria, the detailed language authorizing each program contained in Division 21 of the Public Resources Code, the specific language contained in various bond acts, and our strategic and infrastructure plans, we do not believe additional work in this area is warranted or an efficient use of scarce dollars or staff resources.

B. Publish the above guidelines and funding opportunities on the Conservancy website.

Response: The website has been and will continue to be upgraded with new information.

C. Document merit review activities clearly indicating how projects meet the program's established awarding criteria.

Response: This is already done in great detail in our staff reports.

D. Provide related staff training.

Response: Conservancy staff is provided periodic training in-house in both formal and informal settings.

Observation 3: Project Matching Funds May Not be Maximized: In some cases it appears that the Conservancy has required matching funds but either grant contracts and work programs and budgets do not include this requirement, and/or requests for reimbursements do not include a way to track matching funds.

Detailed Response: In general Coastal Conservancy grants require that all funds needed to complete a project are in hand before Conservancy funds may be used. The amount of Conservancy funds in proportion to the overall cost of a project is negotiated prior to the project being brought for final approval by the Conservancy's board.

The Conservancy always seeks to ensure that any project it funds has multiple funding sources. The Conservancy funds a greater portion when applicants have limited funds available for high priority projects, but on balance, our project funds are well leveraged. Between 1987 and 2009, Conservancy funds were matched with non-state funding by nearly 2-1. We will continue to leverage funding to the extent practicable.

The staff reports and resolutions brought to the Conservancy describe the various funding sources that will be used to complete a project, but usually do not require a specific match either in cash or in-kind services. The requirement is that the project be completed, and that Conservancy funds do not surpass a specified amount. The audit mistakenly interprets various sections of staff reports which describe expected sources of funding, as required matching funds. They are not requirements unless specific, mandatory language is included in the resolution approving the Conservancy's grant. As a result of the audit we have adopted more standard "matching fund" language for our staff reports to clarify.

Recommendation: Monitor and verify match contributions prior to disbursement. Include a match reporting section in the reimbursement request form and require submission of match documentation.

Response: Conservancy staff works with grantees before projects begin to ensure that funding is available to complete the project and that the cost estimates for each project are accurate. Our chief goal

is to ensure that the project is completed as described. We are less concerned whether or not a grantee provides a set amount of funds as opposed to in-kind services to get the job done, or whether the grantee changes funding sources during the project. Since we generally do not have set matching fund requirements, there is no value added in requiring documentation other than that detailing that the project has been completed as contracted. This is done through an end audit of each project.

Observation 4: Project Fiscal Oversight Needs Improvement: The Conservancy lacks adequate project fiscal oversight. Based on a review of 12 projects, the following control weaknesses were noted:

The Conservancy does not agree with this finding. The Conservancy received audit reports for only seven of the nine projects listed in Appendix C. Of the $17,855,138 audited in those seven reports, the auditors questioned only $78,645 in expenditures. Upon review, those expenditures were found to be appropriate. The specific contract did not reference an agreed upon rate schedule, and the file lacked complete documentation, but we do not agree that this constituted a lack of adequate fiscal oversight. Nonetheless we have ensured that these corrections have been made since we take our fiscal responsibilities very seriously and we are proud that the vast majority of our project audits have found no problems at all.

Detailed Responses

- Detailed work plans and budgets are not consistently received or documented prior to project commencement.

  Response: Invoices are not paid without detailed work plans and budgets being part of a contract file. Initial review of invoices is conducted by our contract staff, who do not forward them to our project and accounting staff if work plans and budgets are missing.

- Grantee reimbursements are not consistent with grant budgets.

  Response: This issue concerns overhead payments made to the Sonoma Land Trust that the auditors claim were not authorized by the contract. However, as we explained to the auditors in a memo, there was an agreement negotiated between our North Coast Program Manager and the Executive Director of the Land Trust that authorized 15% overhead for all contract items. It is worthwhile to note that this agreement was reached within the context of a larger negotiation, initiated by the Conservancy, regarding the billing rates of the Sonoma Land Trust. This negotiation resulted in a substantial rate reduction, nearly 50% for their Executive Officer and other staff. These negotiated rates were also memorialized in an email, but not transferred to a formal agreement or placed in the contract file. We disagree that overhead payments were not authorized.

- The Conservancy lacks formal monitoring procedures, leading to inconsistent reviews and limited documentation.

  Response: We have now established a project-monitoring process that will be documented in our project database. As for the Malibu Lagoon Restoration project, amendments do not lack documentation. These amendments were authorized by the Conservancy's board. The grant agreement amount was increased to fund subsequent phases of a complex project, not to cover cost overruns, and there is a detailed work program for each amendment.

- Post-close monitoring is not performed.

  Response: Post-close monitoring has been accomplished informally during visits of the project managers to their geographic areas. Most of the conservation easement acquisitions that we have funded already have monitoring requirements. We are now implementing a formal monitoring system for other projects.

- Project status is inaccurate and incomplete.

  Response: As noted, we are behind in entering data into the bond database. This is due to lack of staff resources in part due to required furloughs. Additional resources have been assigned to this task.

Recommendations:

A. Develop a standard application with workplan/budget templates including directions on how to complete it. Define the level of detail needed for different project types to ensure consistency among the program staff.

   Response: We have developed a standard grant application that is now in use. We have templates for workplans and budgets and use them where it makes sense. The Conservancy funds many types of projects, and these templates do not work for all projects.

B. Standardize reimbursement forms to match the approved grant budgets. Include templates in program guidelines along with clear definition of eligible costs.

   Response: We have a standard reimbursement form that has been used for years, and we have now made use of that form mandatory for all projects. We have guidelines related to overhead and indirect costs.

C. Develop and implement monitoring procedures outlining site visit intervals, areas to review, and project documentation required.

Response: We have developed procedures to accomplish this. We are in the process of training staff and implementing these procedures.

D. Require grantees to submit a maintenance and operation plan at project close-out and require periodic project condition reports.

Response: Maintenance and operation requirements are included as conditions of grants or as contract terms when warranted. They are not apposite to all types of projects or needed in all cases. The periodic condition of projects will be monitored through the new process.

E. At year-end, reconcile project database information to accounting records to ensure all bond projects are accurately recorded. Complete the Coastal Project Management Database and update the website accordingly.

Response: This is in process.

Thank you for the opportunity to respond to the audit of Conservancy administered State bond funds.

Sincerely,

Original signed by:

Samuel Schuchat
Executive Officer
California Coastal Conservancy

The Conservancy's response to the draft audit report has been reviewed and incorporated into the final report. In evaluating the response, we provide the following comments:

Observation 1

The Conservancy states that grants with repayment provisions are not considered loans and therefore should not be recorded as a receivable. However, irrespective of the type of financial instrument, loan or grant, the transaction should be recorded as a long-term receivable due and payable to the state within the originating fund. Proper accountability is necessary to ensure bond funds are separately tracked for future use and reappropriation.

In addition, based on subsequent consultation with bond counsel at the State Treasurer's Office (STO) and pursuant to the attached September 11, 2008 memorandum, there could be additional reporting requirements and potential tax implications. We strongly recommend the Conservancy consult with the STO and Finance's Fiscal Systems and Consulting Unit (FSCU) to determine specific recording and reporting requirements.

Please provide us a Corrective Action Plan within 60 days of this report including the final resolution based on consultation with the STO and FSCU.

Observation 2

In response to this finding, the Conservancy created a grant application form and posted it on their website. However, we continue to recommend program-specific guidelines and program-specific criteria for the submission, evaluation, and awarding of grants.

Observation 3

The Conservancy has taken steps to address this observation by clarifying definitions and adopting more standard "matching fund" language for its staff reports. In those instances where match is required, the Conservancy should implement procedures to verify and document matching contributions.

Observation 4

Although the Conservancy does not agree with this finding, it has taken corrective actions. In addition, at the time the draft report was issued, two grant audits were still in progress. To date, all grant audits listed in Appendix C have been completed and issued.

State of California State Treasurer's Office

MEMORANDUM

Date: September 11, 2008

To: General Obligation Bond Program Administrators

From: Geoff Palmertree, Manager
Interim Finance Section
Public Finance Division
State Treasurer's Office

Subject: Returned Grant Funds

Departments that administer grant[1] programs funded by general obligation bonds occasionally have grant funds returned by the grantee. This memo is intended to answer frequently asked questions concerning departments' obligations in such situations.

Should the department notify the State Treasurer's Office (STO)? Yes. The Tax Compliance Certificate executed by each department requires the department to immediately notify the STO when grant funds are returned to the department. Returned grant funds are considered unspent bond proceeds, which must be tracked in order for the State to comply with federal tax law requirements.

What information should the department provide to the STO? The following information should be provided to the STO:

- Date the original grant was made
- Amount of the original grant
- The name of the bond act and the number of the bond fund from which the grant was made
- Date and amount of grant funds returned
- Plan for re-granting the funds

What should the department do with the returned grant funds? The returned grant funds should be placed in the bond fund from which the original grant was made and re-granted as soon as possible. If the returned funds can be re-granted and disbursed within 60 days, the STO will not need to track interest earnings on the funds. If the returned funds are not re-granted and disbursed within 60 days, the STO will engage the State's arbitrage rebate consultant to perform the necessary calculations until the funds are re-granted and disbursed. Please notify the STO of the date on which the funds are re-granted and disbursed.

[1] A grant is a transfer of money for a specific purpose, without any obligation or condition to directly or indirectly repay any amount. However, a condition requiring a grant to be returned if the grantee does not meet the requirement of the grant (e.g., a change in use of the project, or if the project is completed under budget) does not prevent the transfer from being a grant.

Immediately notify the STO if for any reason the department will be unable to re-grant the returned funds.

Should the department establish a written policy regarding re-granting of returned grants? Yes. The STO recommends that the department establish a formal written policy providing that all returned grants will be the first dollars disbursed for other eligible grants so long as the necessary appropriation is in place.

What if the returned grant includes some sort of penalty or is otherwise in excess of the original grant amount? Any returned amount in excess of the original grant is not considered bond proceeds and does not need to be tracked for federal tax law purposes. However, a variety of State laws could apply and govern the use of moneys derived from or associated with bond proceeds. These laws could include the bond act itself, laws applicable to a particular program or recipient, and other laws and regulations. The STO recommends that the department consult their legal counsel or the Attorney General's Office in such situations.

What are the record retention requirements for the returned grants? Records relating to a general obligation bond funded grant program, including those related to a returned grant and the subsequent re-granting of the funds, must be retained for 35 years from the date of the original grant. See the July 2, 2008 memo from the STO regarding records retention for additional information.

We hope the above information is helpful. If you have any questions that are not addressed by this memo, please contact Melinda Chan at mchan@treasurer.ca.gov or (916) 653-3445.

COASTAL CONSERVANCY

Staff Recommendation
December 8, 2005

BALLONA WETLANDS ENHANCEMENT PLANNING

File No. 04-088
Project Manager: Mary Small

RECOMMENDED ACTION: Authorization to disburse up to $200,000 to the Santa Monica Bay Restoration Foundation for planning, data collection, and other activities associated with the restoration of the Ballona Wetlands and to implement the Santa Monica Bay Plan, adopted by the Conservancy on August 2, 2001. The project area is in Los Angeles County.

LOCATION: West of Lincoln Boulevard and south of the Marina del Rey along the Ballona Creek Channel in Los Angeles County. A portion of the project is in the City of Los Angeles and a portion is in unincorporated Los Angeles County (Exhibits 1 & 2).

PROGRAM CATEGORY: Coastal Resource Enhancement and Public Access

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EXHIBITS

Exhibit 1: Project Location Map

Exhibit 2: Project Area and Watershed Map

Exhibit 3: Letters of Support

RESOLUTION AND FINDINGS:

Staff recommends that the State Coastal Conservancy adopt the following resolution pursuant to Sections 31251-31270 and 31400 et seq. of the Public Resources Code:

"The State Coastal Conservancy hereby authorizes disbursement of an amount not to exceed two hundred thousand dollars ($200,000) to Santa Monica Bay Restoration Foundation for planning, technical review, data collection and public outreach to support the restoration of the Ballona Wetlands, approved by the Conservancy on December 2, 2004. This authorization is subject to the condition that prior to disbursement of funds, the Conservancy's Executive Officer shall approve the work plan, budget and the contractor for this work."

Staff further recommends that the Conservancy adopt the following findings:

"Based on the accompanying staff report and attached exhibits, the State Coastal Conservancy hereby finds that:

1. The proposed project authorization is consistent with Public Resources Code Sections 31251-31270, regarding the Conservancy's mandate to protect and enhance coastal resources.
2. The proposed project authorization is consistent with Public Resources Code Sections 31400-31409, regarding the Conservancy's mandate to assist in the development of a system of public accessways to and along the coast.
3. The proposed project is consistent with the Project Selection Criteria and Guidelines adopted by the Conservancy on January 24, 2001.
4. The project serves greater than local need.
5. The Santa Monica Bay Restoration Foundation is a nonprofit organization existing under Section 501(c)(3) of the U.S. Internal Revenue Code and which purposes are consistent with Division 21 of the Public Resources Code."

PROJECT SUMMARY:

This authorization would provide funding to advance the efforts of the Santa Monica Bay Restoration Foundation (Foundation) to improve the health of the Santa Monica Bay by helping to restore the former Ballona Wetlands and to implement the Santa Monica Bay Plan. If approved, the Foundation would engage in restoration planning activities, including technical review, collecting data and public outreach. This work would be closely coordinated with and would complement the Conservancy's authorization of December 2, 2004 and other state efforts to restore the 600-acres of the historic Ballona Wetlands owned by the California Department of Fish and Game (DFG) and the State Lands Commission (SLC).

The Santa Monica Bay Restoration Foundation is a non-profit organization that was created in 1991 to implement the priorities of the Santa Monica Bay Restoration Plan and to support the work of the Santa Monica Bay Restoration Commission. The Foundation has a number of on-going initiatives including research, public education, and planning. Restoration of the Ballona Wetlands is a priority activity in Santa Monica Bay Restoration Plan. For the past several years, the Santa Monica Bay Restoration Commission has been actively involved in developing and implementing a watershed management plan for the Ballona Creek Watershed. One of the top priorities of that plan is the restoration of the Ballona Wetlands.

The Ballona Creek watershed is approximately 130 square miles and is the largest watershed draining to Santa Monica Bay. It includes much of the City of Los Angeles as well as the cities of West Hollywood, Beverly Hills and Culver City. Approximately 80% of the watershed is urbanized and it is home to more than 1.5 million people. The Ballona Wetlands are located at the mouth of that watershed and offer one of the largest opportunities to restore coastal wetlands in southern California. The site provides habitat for threatened and endangered species, including the Belding's savannah sparrow and the California brown pelican.

Site Description:

It is estimated that the historic wetland complex at the mouth of Ballona Creek once occupied 2000-acres. Much of that area has been developed. However the State of California now owns

600-acres of the former wetland complex. The Department of Fish and Game owns 540 acres, and that land was purchased with funds provided from the Conservancy to the Wildlife Conservation Board. The State Lands Commission owns 60-acres, including a newly created freshwater marsh and adjacent vacant land..

The project area has been substantially altered during the last century, significantly reducing the quantity and quality of the wetlands. Major human activities that have affected the ecological function of this site include past oil field development, channelization of Ballona Creek, and the construction of the Marina del Rey lagoon, which involved deposition of dredge material onto project area. In addition, several major roadways cross the site and it is surrounded by residential and commercial development.

Despite the degradation of site resources resulting from prior development, significant wetland habitat remains within the Ballona Wetlands. Plant species within the project site include wetland indicators such as pickleweed, marsh heather, saltgrass, arrowgrass and glasswort, and a variety of upland and exotic species including brome, iceplant, oxalis, and ryegrass. Bird surveys indicate that the site is used seasonally by a variety of migratory shorebirds, as well as by typical shoreline residents (gulls, terns, and ducks) and typical upland birds including small raptors. Bird species of special interest observed in the project area include nesting pairs of Belding's Savannah sparrow and foraging use by California least terns.

Project History:

There have been more than twenty years of intense conflict about land use at this site. Several development proposals and regulatory approvals have resulted in litigation, some of which continues today. In 2001, the Trust for Public Land entered into a purchase agreement with Playa Capital Company, the former landowner. Through this purchase agreement, the Department of Fish and Game ultimately took title to 540 acres of the property during the past year. The Conservancy provided $10 million for that acquisition.

The Conservancy has long supported enhancement and public access at the Ballona Wetlands. The first Conservancy project at this site was a 1986 grant to the National Audubon Society for environmental education facility associated with a proposed site restoration. That project was never implemented due to the ongoing conflicts about development at the site. Beginning in the late 1980s, the Conservancy provided funding for planning and implementation of enhancements to the nearby Ballona Lagoon and holds easements for resource enhancement over much of the land bordering the Lagoon.

More recently, the Conservancy has provided funding to the Friends of Ballona Wetlands for dune restoration and invasive plant removal on the southwestern portion of the project area. Last year, the Conservancy approved two grants for projects in the Ballona Creek Watershed that helped implement the Santa Monica Bay Restoration Plan. One of these grants was awarded to the Ballona Wetlands Foundation to develop the Ballona Outdoor Learning and Discovery (BOLD) project. It is a condition of the grant that the BOLD project be developed to be consistent with the larger restoration project.

In December 2004, the Conservancy authorized funds for development of restoration alternatives, feasibility analysis of these alternatives and development of preliminary cost estimates. A consultant team has been hired to develop a conceptual restoration plan. The project is currently collecting data and analyzing existing conditions. Restoration planning for the site will take a minimum of three years. Staff anticipates returning to the Conservancy for authorization to complete this analysis once a preferred alternative has been selected.

PROJECT FINANCING:

Proposition 12, Coastal Conservancy	$200,000
Total Project Cost	**$200,000**

The Conservancy funding would be derived from an appropriation of funds specifically designated for the restoration or acquisition of the Ballona Wetlands in the 2000 park bond, Proposition 12. Public Resources Code Section 5096.352(f) provides that $25 million is available to the Conservancy for this purpose.

CONSISTENCY WITH CONSERVANCY'S ENABLING LEGISLATION:

This project would be undertaken pursuant to Chapter 6 of the Conservancy's enabling legislation, Public Resources Code Sections 31251-31270, Coastal Resource Enhancement Projects. The project would enhance the natural and scenic character of resources within the coastal zone. As discussed below, consistent with Section 31252, the project is consistent with the policies and objectives of Division 20 of the Public Resources Code.

This project would be undertaken pursuant to Chapter 9 of the Conservancy's enabling legislation, Public Resources Code Sections 31251-31270, Coastal Access. If approved, the planning studies would include analysis of opportunities to enhance the California Coastal Trail and create new public access opportunities at this site.

CONSISTENCY WITH CONSERVANCY'S STRATEGIC PLAN GOAL(S) & OBJECTIVE(S):

Consistent with **Goal 5 Objective A** of the Conservancy's Strategic Plan, the proposed project would help the Conservancy to restore and enhance up to 600 acres of coastal wetland and adjacent habitat. When implemented, this project will complete 60% of the total acreage target for Southern California.

Consistent with **Goal 1 Objective C** of the Conservancy's Strategic Plan, the proposed project area could provide a new segment of the Coastal Trail. As discussed above, the project is located at the intersection of the California Coastal Trail and the Ballona Creek Trail, and may offer a significant opportunity for the development of improved connections between these trails.

CONSISTENCY WITH CONSERVANCY'S PROJECT SELECTION CRITERIA & GUIDELINES:

The proposed project is consistent with the Conservancy's Project Selection Criteria and Guidelines adopted January 24, 2001, in the following respects:

Required Criteria

1. **Promotion of the Conservancy's statutory programs and purposes:** See the "Consistency with Conservancy's Enabling Legislation" section above.
2. **Consistency with purposes of the funding source:** See the "Project Financing" section above.
3. **Support of the public:** There is broad public support for developing a restoration plan for this site. The project is supported by the Department of Fish and Game and the State Lands Commission. Letters of support are attached as Exhibit 4.
4. **Location:** The proposed project would be located within the coastal zone of Los Angeles County.
5. **Need:** Conservancy funds are needed to provide resources for the Foundation to provide planning assistance.
6. **Greater-than-local interest:** The proposed project will help advance the largest coastal wetland restoration project in Los Angeles County. The site provides habitat for threatened and endangered species, including the Belding's savannah sparrow and the California brown pelican. The site also provides valuable and scenic open space and public access opportunities in the heart of congested Los Angeles County.

Additional Criteria

7. **Urgency:** More than 98% of the coastal wetlands in the Southern California bight have been destroyed or degraded. This project offers an opportunity to restore and enhance 600 acres of habitat.
8. **Resolution of more than one issue:** Restoration of the Ballona Wetlands will address a number of goals, including: enhancement of wetland and adjacent habitat, creation of compatible public access opportunities, and improvement of coastal water quality.
9. **Readiness:** Restoration planning for the Ballona Wetlands is already underway. If approved, the Foundation will begin work immediately.
10. **Realization of prior Conservancy goals:** "See "Project History" above.
11. **Cooperation:** This authorization will provide resources to improve coordination with the Santa Monica Bay Restoration Commission. The Santa Monica Bay Restoration Commission includes representatives from local government, state government and many stakeholder organizations.

CONSISTENCY WITH LOCAL COASTAL PROGRAM POLICIES:

In the late 1980s, the California Coastal Commission certified two separate Land Use Plans that covered this project area. No Local Coastal Program was ever completed for the Ballona Wetlands area and the two Land Use Plans are now out of date. However the proposed project is consistent with the policies of the Coastal Act. The project goals are consistent with the Coastal Act goals as stated in Section 30001.5, the project will protect, enhance and restore the natural resources of the site and expand public recreational opportunities consistent with conservation of those resources. Specifically, Section 30231 states that coastal wetlands shall be maintained and restored. The project is consistent with Section 30240(a), in that it will help ensure that environmentally sensitive habitat areas are protected against significant disruption of habitat values. As stated in Section 30251, the project will protect the scenic resources and open space of the project site.

CONSISTENCY WITH LOCAL WATERSHED MANAGEMENT PLAN/ STATE WATER QUALITY CONTROL PLAN:

A Watershed Management Plan for the Ballona Creek Watershed was completed by an interagency/stakeholder task force this year. The purpose of the plan is to identify opportunities to improve water quality and restore habitat. The restoration of the Ballona Wetlands is specifically identified as a priority activity in the watershed.

COMPLIANCE WITH CEQA:

Under 14 California Code of Regulations (CCR) Section 15262, feasibility and planning activities are categorically exempt from California Environmental Quality Act (CEQA) review. Similarly, 14 CCR Section 15306 exempts basic data collection, research, and resource evaluation activities which do not result in a serious or major disturbance to an environmental resource. Upon approval, staff will file a Notice of Exemption for the project.

Received at
Calif Coastal Conservancy
public meeting of 1/19/2012.
Ellen Eger
General

California Coastal Conservancy Public Meeting 1/19/2012
Comments Item 5.

The project must be denied because its primary premise is a fallacy.

This body is not entitled to provide over Six Million dollars to promote a project promoting a primary premise that is not supported by fact but only creative narrative.

The people expect more. We demand supportive facts.

The factually unsupported premise which is not supported by evidence in this Staff Report as stated on page 3 proposes to "restore" an "ecosystem" "by reconnecting the site to the ocean and creek.

Reconnection of the site to the ocean is a demonstrable fallacy.

The truth as supported by factual government surveys is presented by the United States Geological Survey and the State of California Director of Public Works in a map prepared prior to the construction of Marina del Rey, a Federal Project.

The USGS and the State present proof that the ocean did not connect to the site. This is demonstrable fact.

The USGS Beverly Hills Quadrangle Map produced in 1954 demonstrates no connection of the site to the ocean whatsoever, only a creek to ocean connection.

This is simple to determine by looking at the map before you and you may view the original copy, which is here. ATTACHMENT 1

Either Staff is wrong in its narrative unsupported by fact, or the U.S. Geological Survey and State of California Director of Public Works are wrong.

The Staff Report contains no facts to support its contention that the site was connected to the ocean.

The Federal map does provide clear evidence Staff is wrong.

The Staff Report contention is only supported narrative, which under the CEQA Public Resource Code is not to be considered as legal evidence.

The Government Map was clearly based on factual surveys of the land.

The Staff Report premise is FALSE. The site was never connected to the ocean. Only the Lagoon was connected prior to the installation of tide gates when the creek was channelized. The Lagoon is still subject to tidal flows.

Pleases request Staff to respond with facts that demonstrate the State and Federal Government were wrong or deny the permit in absence of this necessary evidence.

The completion of Marina del Rey Harbor allowed for more salt water to into the marshlands that at any prior point in historical times, yet this fact is ignored by Staff.

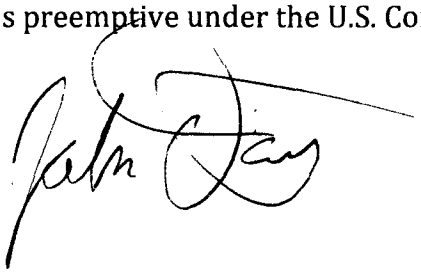
U.S. Public Law 780 Governs the land. ATTACHMENT 2

U.S. House of Representatives Document 389 on page 4 states that some materials will from the harbor construction will be placed to replenish the local beaches. Page 6 describes widening and improving beaches. Page 10 states, "The project is an integral part of the general plan for development of the shoreline of Santa Monica Bay. The General Plan of Improvement is shown as the last page. It to demonstrates no connection of the ocean to the site. ATTACHMENT 3

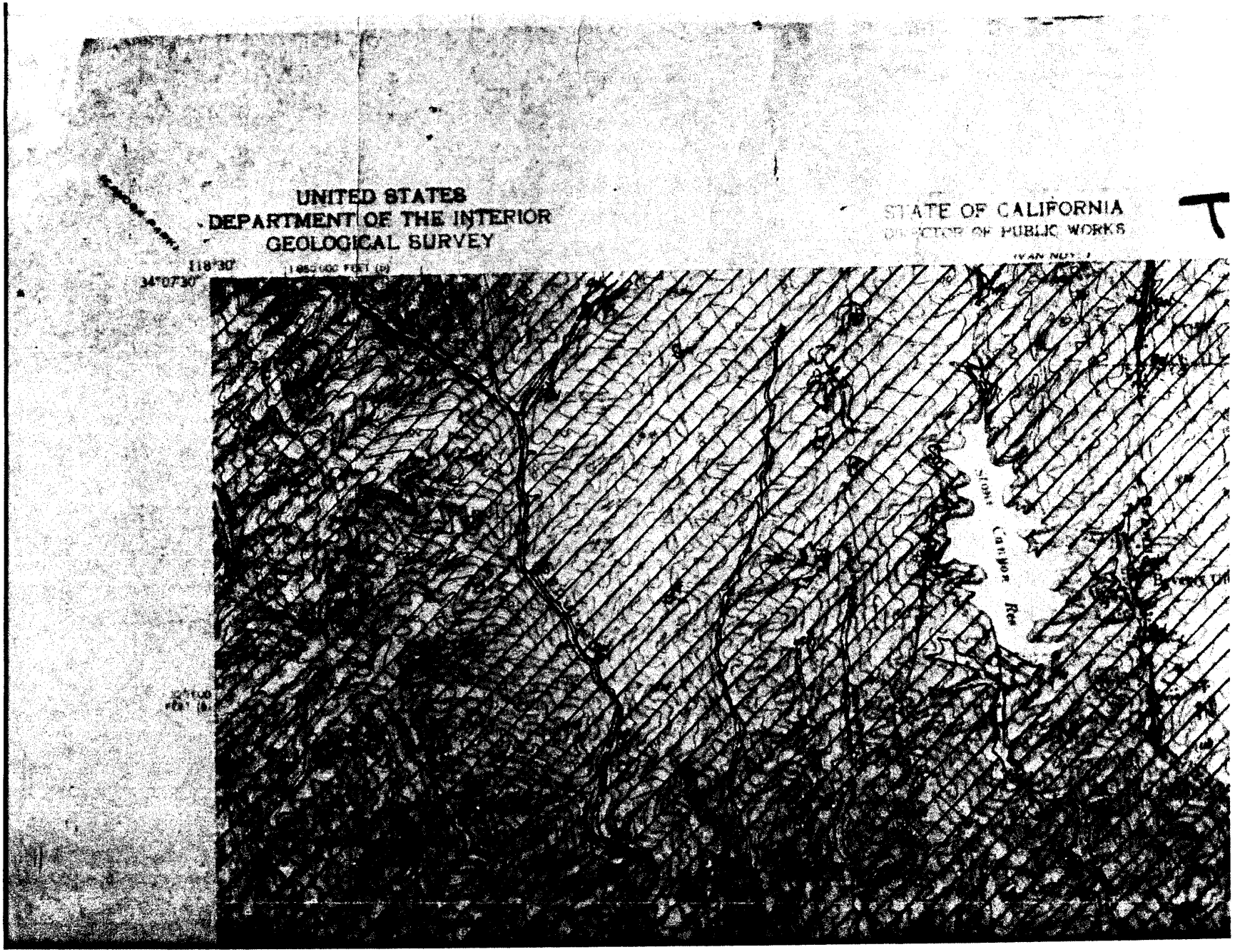
Staff ignores the federal interest entirely and the fact that dredge spoils were placed on local beaches, not only on lowlands.

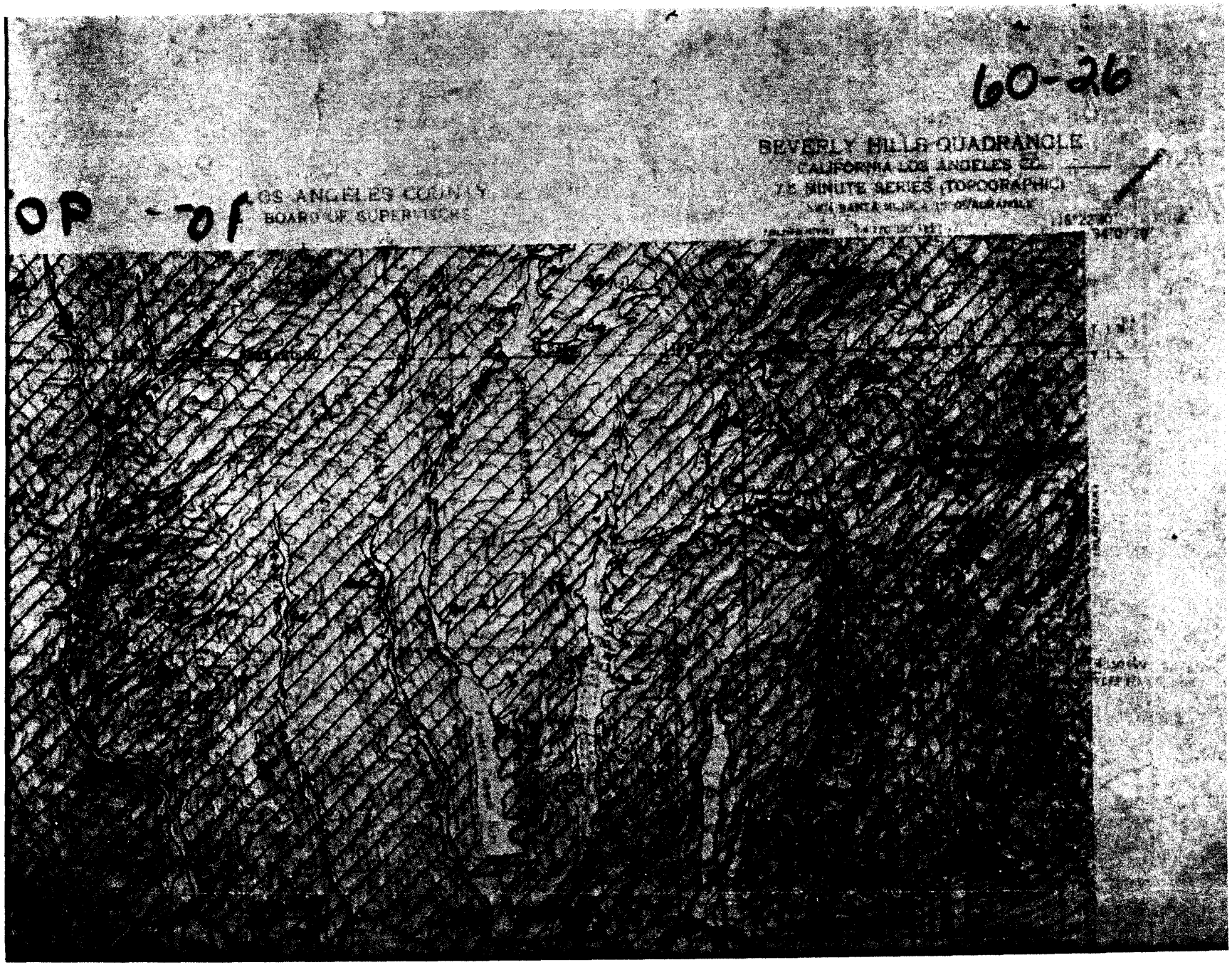
Staff failed to conduct a through investigation backed by fact and has ignored the federal interest in the land which is preemptive under the U.S. Constitution Supremacy Clause.

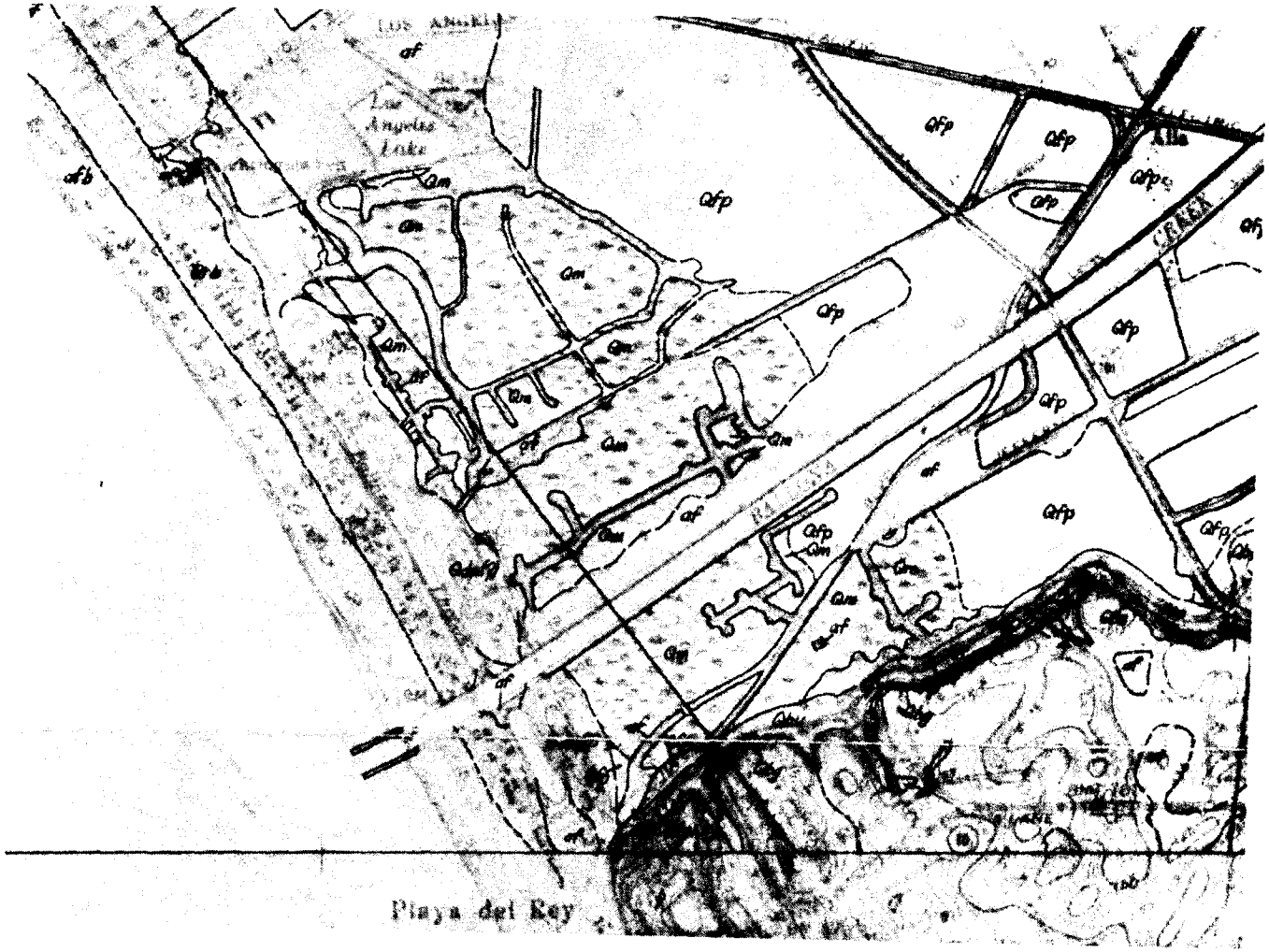
John Davis
PO 10152
Marina del rey Ca. 90295



ATTACHMENT 1


UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
STATE OF CALIFORNIA
DIRECTOR OF PUBLIC WORKS
118°30'
34°07'30"


60-26
BEVERLY HILLS QUADRANGLE
CALIFORNIA-LOS ANGELES CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
LOS ANGELES COUNTY
BOARD OF SUPERVISORS


Los Angeles Lake
Qfp
Qm
af
Playa del Rey

ATTACHMENT 2

Interest on judgments.

SEC. 57. The last sentence of subsection (b) of section 2516 of Title 28, United States Code, is amended by inserting immediately after the word "allowed" where it appears in such sentence the words "for any period", so that such subsection will read as follows:

"(b) Interest on judgments against the United States affirmed by the Supreme Court after review on petition of the United States shall be paid at the rate of four percent per annum from the date of the filing of the transcript of the judgment in the Treasury Department to the date of the mandate of affirmance. Such interest shall not be allowed for any period after the term of the Supreme Court at which the judgment was affirmed.".

Fees.

SEC. 58. Subsection (a) of section 2520 of Title 28, United States Code, is amended by striking out where it appears in such subsection the words "and the hearing of any case before the court, a judge, or a commissioner", so that such subsection will read as follows:

"(a) The Court of Claims shall by rules impose a fee not exceeding $10, for the filing of any petition.".

SEC. 59. (a) Chapter 165 of Title 28, United States Code, is amended by adding at the end thereof a new section to be designated as section 2521 entitled "Subpoenas" and to read as follows:

"§ 2521. Subpoenas

"Subpoenas requiring the attendance of parties or witnesses and subpoenas requiring the production of books, papers, documents or tangible things by any party or witness having custody or control thereof, may be issued for purposes of discovery or for use of the things produced as evidence in accordance with the rules and orders of the court. Such subpoenas shall be issued and served and compliance therewith shall be compelled as provided in the rules and orders of the court.".

(b) The analysis to chapter 165 of Title 28, United States Code, immediately preceding section 2501 of such title, is amended by adding at the end thereof a new item 2521 to read as follows:

"2521. Subpoenas.".

Approved September 3, 1954.

Public Law 780 — CHAPTER 1264

September 3, 1954
[H. R. 9859]

AN ACT

Authorizing the construction, repair, and preservation of certain public works on rivers and harbors for navigation, flood control, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

River and Harbor Act of 1954.

TITLE I—RIVERS AND HARBORS

SEC. 101. That the following works of improvement of rivers and harbors and other waterways for navigation, flood control, and other purposes are hereby adopted and authorized to be prosecuted under the direction of the Secretary of the Army and supervision of the Chief of Engineers, in accordance with the plans and subject to the conditions recommended by the Chief of Engineers in the respective reports hereinafter designated: *Provided*, That the provisions of section 1 of the River and Harbor Act approved March 2, 1945 (Public, Numbered 14, Seventy-ninth Congress, first session), shall govern with respect to projects authorized in this title; and the procedures therein set forth with respect to plans, proposals, or reports for works of improvement for navigation or flood control and for irrigation and purposes incidental thereto, shall apply as if herein set forth in full:

59 Stat. 10.

Wisconsin.

Cornucopia Harbor, Wisconsin: House Document Numbered 434, Eighty-third Congress, at an estimated cost of $220,000;

Sheboygan Harbor, Wisconsin: House Document Numbered 554, Eighty-second Congress, at an estimated cost of $217,200;

Michigan.

Holland Harbor, Michigan: House Document Numbered 282, Eighty-third Congress, at an estimated cost of $574,400: *Provided*, That local interests will contribute 25 per centum of the cost of dredging Section B, but not to exceed $45,500, in addition to the local cooperation required by the project document;

Crooked and Indian Rivers, Michigan: House Document Numbered 142, Eighty-second Congress, at an estimated cost of $225,000:

Saginaw River, Michigan: In accordance with the report of the Chief of Engineers, dated June 7, 1954, at an estimated cost of $4,496,800;

Ohio.

Toledo Harbor, Ohio: House Document Numbered 620, Eighty-first Congress, at an estimated cost of $512,000;

Ashtabula Harbor, Ohio: House Document Numbered 486, Eighty-third Congress, at an estimated cost of $4,900,000;

Pennsylvania.

Erie Harbor, Pennsylvania: House Document Numbered 345, Eighty-third Congress, at an estimated cost of $174,000;

New York.

Black Rock Channel and Tonawanda Harbor, New York: House Document Numbered 423, Eighty-third Congress, at an estimated cost of $270,000;

Little River at Cayuga Island, Niagara Falls, New York: House Document Numbered 246, Eighty-third Congress, at an estimated cost of $36,900;

Oswego Harbor, New York: House Document Numbered 487, Eighty-first Congress, at an estimated cost of $2,459,000;

California.

Los Angeles and Long Beach Harbors, California: House Document Numbered 161, Eighty-third Congress, at an estimated cost of $896,500: *Provided*, That the Secretary of the Army is hereby authorized to reimburse local interests for such work as they may have done upon this project prior to July 1, 1953, at actual cost to local interests insofar as the same shall be approved by the Chief of Engineers and found to have been done in accordance with the project hereby adopted: *Provided further*, That such reimbursement shall be subject to appropriations applicable thereto or funds available therefor and shall not take precedence over other pending projects of higher priority for harbor improvement: *And provided further*, That such payments shall not exceed the sum of $500,000;

Playa del Rey Inlet and Harbor, Venice, California: House Document Numbered 389, Eighty-third Congress: *Provided*, That Federal participation in the provision of entrance jetties, entrance channel, interior channel and central basin recommended in the project report and presently estimated to cost $7,738,000 shall not exceed 50 per centum of the cost thereof;

Port Hueneme, California: House Document Numbered 362, Eighty-third Congress, at an estimated cost of $5,437,000;

Richmond Harbor, California: House Document Numbered 395, Eighty-third Congress, at an estimated cost of $2,086,000;

Oregon.

Rogue River, Harbor at Gold Beach, Oregon: Senate Document Numbered 83, Eighty-third Congress, at an estimated cost of $3,758,700;

Umpqua Harbor and River, Scholfield River at Reedsport, Oregon: Senate Document Numbered 133, Eighty-first Congress, at an estimated cost of $41,000;

Tillamook Bay and Bar, Oregon: Senate Document Numbered 128, Eighty-third Congress, at an estimated cost of $1,500,000;

ATTACHMENT 3

83D CONGRESS
2d Session
HOUSE OF REPRESENTATIVES
DOCUMENT
No. 389

PLAYA DEL REY INLET AND BASIN, VENICE, CALIF.

LETTER

FROM

THE SECRETARY OF THE ARMY

TRANSMITTING

A LETTER FROM THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY, DATED AUGUST 8, 1952, SUBMITTING A REPORT, TOGETHER WITH ACCOMPANYING PAPERS AND AN ILLUSTRATION, ON A PRELIMINARY EXAMINATION AND SURVEY OF HARBOR AT PLAYA DEL REY, CALIF., AND A REVIEW OF REPORTS ON PLAYA DEL REY INLET AND BASIN, VENICE, CALIF., AS AUTHORIZED BY THE RIVER AND HARBOR ACT APPROVED ON AUGUST 26, 1937, AND REQUESTED BY A RESOLUTION OF THE COMMITTEE ON COMMERCE, UNITED STATES SENATE, ADOPTED ON JUNE 2, 1936

Department of Beaches and Harbors
MAY 14
Act
Director
Chief Deputy Director
Deputy Director
Executive Assistant
Admin. Services
Asset Management
Facilities Property Mgt.
Community Services
Planning

MAY 13, 1954.—Referred to the Committee on Public Works and ordered to be printed, with one illustration

DEPARTMENT OF THE ARMY,
Washington 25, D. C., May 11, 1954.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

DEAR MR. SPEAKER: I am transmitting herewith a report dated August 8, 1952, from the Chief of Engineers, Department of the Army, together with accompanying papers and an illustration, on a preliminary examination and survey of Harbor at Playa del Rey, Calif., and a review of reports on Playa del Rey Inlet and Basin, Venice, Calif., with a view to determining whether any improvement of the locality is warranted at the present time, authorized by the River and Harbor Act approved on August 26, 1937, and requested by a resolution of the Committee on Commerce, United States Senate, adopted on June 2, 1936.

47022—54——1

REVIEW BY STATE DIVISION OF WATER RESOURCES OF PROPOSED REPORT OF THE CHIEF OF ENGINEERS, UNITED STATES ARMY, ON PLAYA DEL REY INLET AND BASIN, VENICE, CALIF.

INTRODUCTION

In accordance with the provisions of section 1 of Public Law 14, 79th Congress, the proposed report of the Chief of Engineers, United States Army, on Playa del Rey Inlet and Basin, Venice, Calif., together with the reports of the Board of Engineers for Rivers and Harbors and of the district and division engineers, was transmitted by the Chief of Engineers on March 31, 1952, to Mr. Frank B. Durkee, director of public works, the official designated by Gov. Earl Warren as his representative in such matters. The report was received and referred to the State engineer on April 7, 1952, for review and report thereon. Thereafter, the reports were transmitted by the State engineer to Seth Gordon, director, department of fish and game; Rufus W. Putnam, executive officer of the State lands commission; Newton B. Drury, chief, division of beaches and parks of the department of natural resources; and G. T. McCoy, State highway engineer.

Authority for report

The report was prepared pursuant to a resolution adopted June 2, 1936, which reads as follows:

> *Resolved by the Committee on Commerce of the United States Senate*, That the Board of Engineers for Rivers and Harbors, created under section 3 of the River and Harbor Act approved June 13, 1902, be, and is hereby, requested to review the reports on Playa Del Rey Inlet and Basin, Venice, California, printed in House Document No. 1880, 64th Congress, 2d session, with a view to determining whether any improvement of the locality is warranted at the present time.

Further authorization was contained in Public Law 392, 75th Congress, approved August 26, 1937, which reads in part as follows:

> SEC. 4. The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys to be made at the following-named localities, * * * harbor at Playa Del Rey, California * * *.

A review of reports on Playa del Rey Inlet and Basin, Venice, Calif., and preliminary examination of the harbor at Playa del Rey, Calif., dated May 26, 1939, was submitted by the district engineer in accordance with the foregoing authorizations. The district engineer's report was reviewed by the Board of Engineers for Rivers and Harbors, and a report of survey scope was authorized by the Chief of Engineers on April 6, 1944, to determine the advisability and cost of improvement and the local cooperation required.

Recommendations of the Chief of Engineers

The following is quoted from the proposed report of the Chief of Engineers now under review:

> After full consideration of the reports secured from the district and division engineers, and after affording local interests full opportunity to be heard, the Board recommends provision of a harbor at Playa del Rey, Calif., to consist of 2 entrance jetties each about 2,300 feet long; an entrance channel 20 feet deep, 600 feet wide, and 1,925 feet long; an interior channel 20 feet deep, 600 feet wide, and 5,600 feet long; a central basin 10 feet deep; and 2 side basins 20 feet deep and 10 side basins 10 feet deep, separated by mole-type piers; the dredged material to be utilized for construction of the piers and for deposition on adjacent lowlands and beaches; all generally in accordance with the plan of the district engineer and the comments herein, and with such modifications thereof as in the discretion

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abandoned due to low production and salt-water intrusion, leaving 111 wells on low production.

Local interests consider that the proposed harbor at Playa del Rey would be an integral unit of an adopted general plan for development of the Santa Monica Bay shoreline. This plan includes widening and improving beaches, providing adequate bath houses, parking areas, picnic facilities, special recreation centers, bathing and wading beaches, fishing piers, youth organization camps, tourist parks with cabin and trailer accommodations, and a bird refuge.

Cost of proposed works

In the report of the district engineer, the total first cost of the project is given as $25,603,000, with a Federal first cost of $9,098,000 and non-Federal first cost of $16,505,000. The total annual carrying charges would be $919,920, and the annual benefits would be $1,529,000. The benefit-cost ratio of the proposed harbor project would be 1.7 to 1.

The Board of Engineers for Rivers and Harbors, in reviewing the report of the district engineer, reevaluated the costs and benefits estimated by the district engineer. In considering both the evaluated and intangible benefits, the Board stated in its report that the Federal interest in the proposed improvement would be served by Federal participation to the extent of providing and maintaining the entrance jetties, entrance channel, interior channel, and central basin shown on the maps accompanying the district engineer's report, all at an estimated first cost of $6,151,000 for construction exclusive of aids to navigation, and $25,000 annually for maintenance, with local interests providing and maintaining all other works including dredging of the side basins at an estimated first cost of $19,427,000.

The Board of Engineers for Rivers and Harbors also reduced the benefits allocated by the district engineer to sport fishing vessels from $280,000 to $47,000, making the total annual benefits $1,296,000. Subsequent to the submission of the report by the district engineer, the United States Coast Guard submitted a revised estimate of $42,000 for first cost of aids to navigation, an increase of $17,000, making a total first cost of the project of $25,620,000. The total annual carrying charges are estimated by the Board to be $933,025, of which $277,555 is Federal, and $655,470 is non-Federal, giving a benefit-cost ratio of 1.4. The recommendation of the Board of Engineers for Rivers and Harbors as to Federal participation is concurred in by the Chief of Engineers.

Local contributions

At its meeting on April 25, 1946, the City Council of Los Angeles adopted a report declaring that the public interest and welfare of the city of Los Angeles and vicinity require the provision of additional small craft facilities by means of construction of a small craft harbor at Playa del Rey, assisting the Federal Government in such undertaking by assuming those obligations required under Federal law in connection [redacted]project.

By resolu[redacted]pted September 28, 1948, and June 7, 1949, the Board of Su[redacted] of the County of Los Angeles declared that the public interest and welfare of the county of Los Angeles and its citizens require that provision be made for additional small craft facilities by means of construction of a small craft harbor at Playa del

B-80

Department of Natural Resources

Newton B. Drury, chief, Division of Beaches and Parks of the Department of Natural Resources, on June 18, 1952, stated that the thoughts expressed in the comments previously submitted to the district engineer on January 6, 1949 still reflect the reaction of the division to the project.

The comments, submitted by Gen. Warren T. Hannum, director of natural resources, on January 6, 1949, are as follows:

(*a*) It is found that plan of development as proposed in the district engineer's report would provide a greatly needed harbor for light craft vessel, and as a harbor refuge for such craft cruising along the coast.

(*b*) That the proposed harbor development is in general in conformity with the county master plan as approved by the State Park Commission.

(*c*) That there is no State cooperation proposed in the plan, the city of Los Angeles having expressed its desire and willingness to meet the requirements of local cooperation as set forth by the district engineer.

(*d*) That the incidental benefits to the State park system, due to the deposit of sand on the beaches both upcoast and downcoast from the proposed entrance jetties would be very great.

It is recommended, therefore, that the report be approved with a favorable comment indicating the advantages to the State park system from the deposit of sand on the Santa Monica beaches.

CONCLUSIONS

The following conclusions are submitted with respect to improvements recommended by the Chief of Engineers in his proposed report on Playa del Rey Inlet and Basin, Venice, Calif., giving consideration to (*a*) need for the project (*b*) engineering feasibility and effectiveness of the proposed works, and (*c*) economic justification for the project:

1. The improvements will provide a desirable addition to small-craft facilities along the southern California coast. The project is an integral part of the general plan for development of the shoreline of Santa Monica Bay.

2. Local interest in and approval of the project have been demonstrated by resolution of the city council of the city of Los Angeles, and by resolution of the Board of Supervisors of the County of Los Angeles, giving assurance that the county will assume those non-Federal contributions and obligations in connection with the project which are required by Federal law.

3. The improvements appear to be of sound and adequate design and feasible of construction and operation.

4. Construction of the proposed harbor will introduce ocean water inland a distance of more than 1 mile, and increase the rate of saline contamination of ground waters of the west coast basin. Except in this respect, the proposed works will not conflict with any beneficial consumptive use, present or future, of water for domestic, municipal, stock water, irrigation, mining, or industrial purposes.

RECOMMENDATIONS

It is recommended that the plan of improvement for the small-craft harbor at Playa del Rey Inlet and Basin, Venice, Calif., as recommended by the Chief of Engineers, be authorized for construction, and that Federal funds be appropriated for the purpose.

SACRAMENTO, CALIF., *June 26, 1952.*

A. D. EDMONSTON,
State Engineer.

B-84

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B-80

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(*c*) That there is no State cooperation proposed in the plan, the city of Los Angeles having expressed its desire and willingness to meet the requirements of local cooperation as set forth by the district engineer.

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3. The improvements appear to be of sound and adequate design and feasible of construction and operation.

4. Construction of the proposed harbor will introduce ocean water inland a distance of more than 1 mile, and increase the rate of saline contamination of ground waters of the west coast basin. Except in this respect, the proposed works will not conflict with any beneficial consumptive use, present or future, of water for domestic, municipal, stock water, irrigation, mining, or industrial purposes.

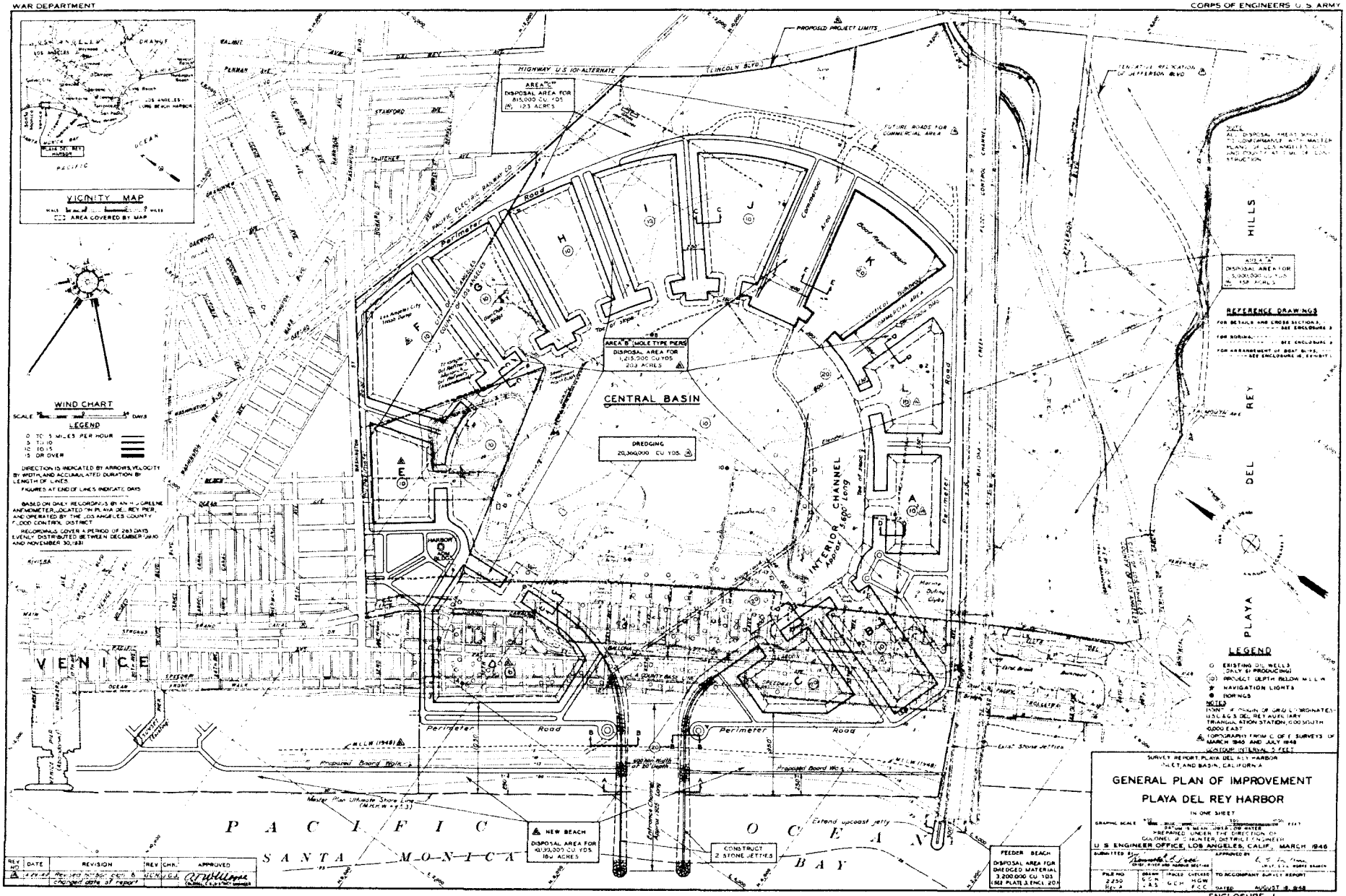
RECOMMENDATIONS

It is recommended that the plan of improvement for the small-craft harbor at Playa del Rey Inlet and Basin, Venice, Calif., as recommended by the Chief of Engineers, be authorized for construction, and that Federal funds be appropriated for the purpose.

SACRAMENTO, CALIF., *June 26, 1952.*

A. D. EDMONSTON,
State Engineer.

B-84


WAR DEPARTMENT
CORPS OF ENGINEERS U. S. ARMY
VICINITY MAP
WIND CHART
LEGEND
0 TO 5 MILES PER HOUR
5 TO 10
10 TO 15
15 OR OVER
DIRECTION IS INDICATED BY ARROWS, VELOCITY BY WIDTH, AND ACCUMULATED DURATION BY LENGTH OF LINES
FIGURES AT END OF LINES INDICATE DAYS
BASED ON ONLY RECORDS OBTAINED FROM A RECORDING ANEMOMETER LOCATED IN PLAYA DEL REY PIER, AND OPERATED BY THE LOS ANGELES COUNTY FLOOD CONTROL DISTRICT
RECORDS COVER A PERIOD OF 283 DAYS EVENLY DISTRIBUTED BETWEEN DECEMBER 1930 AND NOVEMBER 30, 1931
PROPOSED PROJECT LIMITS
HIGHWAY U.S. 101 ALTERNATE (LINCOLN BLVD.)
AREA "C" DISPOSAL AREA FOR 815,000 CU. YDS. (M. 123 ACRES)
FUTURE ROADS FOR COMMERCIAL AREA
AREA "B" (HOLE TYPE PIERS) DISPOSAL AREA FOR 1,215,000 CU. YDS. 203 ACRES
CENTRAL BASIN
DREDGING 20,300,000 CU. YDS.
INTERIOR CHANNEL 5,600' long
Perimeter Road
Proposed Board Walk
Master Plan Ultimate Shore Line (M.H.H.W. +7.3)
NEW BEACH DISPOSAL AREA FOR 10,000,000 CU. YDS. 160 ACRES
CONSTRUCT 2 STONE JETTIES
FEEDER BEACH DISPOSAL AREA FOR DREDGED MATERIAL 3,200,000 CU. YDS. (SEE PLATE 3, ENCL. 20)
REFERENCE DRAWINGS
LEGEND
EXISTING OIL WELLS (ALL BY PRODUCING)
PROJECT DEPTH BELOW M.L.L.W.
NAVIGATION LIGHTS
BORINGS
NOTES
TOPOGRAPHY FROM C. OF E. SURVEYS OF MARCH 1945 AND JULY 1948
CONTOUR INTERVAL 5 FEET
VENICE
PACIFIC OCEAN
SANTA MONICA BAY
PLAYA DEL REY HILLS
GENERAL PLAN OF IMPROVEMENT
PLAYA DEL REY HARBOR
IN ONE SHEET
U. S. ENGINEER OFFICE, LOS ANGELES, CALIF., MARCH 1946
ENCLOSURE 1

California Coastal Conservancy March 28, 2012
Att: All Governing Board Members and Alternates
Re: PUBLIC COMMENT 3/29/12:
Request to Hold Emergency Meeting to Rescind Approval Action on File No. 04-088

Douglas Bosco
Marisa Moret
Ann Nothoff
John Laird
Ana J. Matosantos
Mary Shallenberger
Susan Hancsh
Karen Finn
Bryan Cash
Noreen Evens
Joe Simitan
Anthony Cannella
Bill Mornning
Luis Alejo
Das Williams

CC
John Chang State Controller
California Department of Finance Director Ana Matosantos
U.S. Army Corp of Engineers Att: Commander Mark Toy
U.S. Senator Barbara Boxer
U.S. Congress Person Maxine Waters

Honorable Chair Bosco, Distinguished Commissioners,

Attachments will be submitted to the Governing Board on March 29, 2012.

I hereby request this public body instruct its Staff to schedule an emergency meeting in accordance with the Bagley Keene Act section 11125.5(b) to rescind its approval of File No. 04-088 on January 19, 2012 for the following reasons;

1. NON-COMPLIANCE DEPARTMENT OF FINANCE ATTACHMENT 1

Final Report—Audit of California State Coastal Conservancy's Propositions 12, 13, 40, 50 Bond Funds

The Department of Finance, Office of State Audits and Evaluations, has completed its audit of the California State Coastal Conservancy's (Conservancy) Propositions 12, 13, 40, and 50 bond funds for the period ending June 30, 2008.

Staff Project Manager Mary Small **failed to require Potential Grantee**, the Santa Monica Bay Restoration Foundation, **to fill out a Grant Application Form** on the Conservancy Website.

Background:

2. FALSEFICATION OF PUBLIC RECORDS ATTACHMENT 2

Staff falsified a Form SCC 08-08, Work Transmittal.
The Form was initialized by;
Executive Director - Sam Schuchat
Project Manager - Mary Small
Legal - Elena Eger

Staff filled out the form as follows:

Will this project receive federal or other outside funding? Yes___ No X

The January 19, 2012 **Staff Report contradicts on page 6** :

*"The SMRBF in-kind **funds would come from U.S. EPA funding** provided to the SMRBF for its staff **and from a U.S. EPA Wetland Program Development Grant** received for work at Ballona"*

3. INCOMPLETE PUBLIC RECORDS ATTACHMENT 2

Staff failed to complete Form SCC 08-08, Work Transmittal.
The Form was initialized by;
Executive Director - Sam Schuchat
Project Manager - Mary Small
Legal - Elena Eger

Is the Grantee a Nonprofit Organization Yes___ No__ - NOT CHECKED
If nonprofit: Is the status file complete and current Yes___ No___ - NOT CHECKED
GRANT / CONTRACT AMMENDMENTS REVIEW - BLANK
MAIL OUT APPROVALS - BLANK
APPLICATION - BLANK
GRANT TRANSMITTAL - BLANK
REVIEW OF AGREEMENT - BLANK

4. DISCRIMINATION ATTACHMENT 3

Staff Project Manager Mary Small has improperly lobbied private individuals, private businesses, State and Federal Officials and entities prior to the release of the Staff Report, thusly, discriminating against all others by failing to provide the same comment opportunity prior to the issuance of the Staff Report.

Further Discrimination has taken place because only one Potential Grantee has been selected by Staff Project Manager Mary Small, excluding all others that may have chosen to apply.

authorization of this Board, represented to the Army Corp of Engineers on June 28, 2010 that:

Coastal Conservancy is supplying most of the funding toward the in-kind local sponsor efforts.

The Governing Board has not authorized Mary Small to represent the Coastal Conservancy at a meeting of the Army Corp of Engineers and the Local Sponsor (Santa Monica Bay Restoration Authority). The Conservancy is neither a partner nor is there any MOU to with the SMRBA, which is under contract to the USACE. Minutes of other such meetings provide evidence that Mary Small also discussed;

A. Changing the scoping of an Environmental Protection Act process began by the USACE in 2005.

B. Using only the Conservancy's Alternatives.

C. Attempting to gain in kind credits from the USACE.

D. Further documents provided by the USACE provide evidence that the local sponsor, never provided any funding to the USACE whatsoever nor did it provide any in-kind credit.

E. Resumes provided to the Coastal Conservancy by potential contractors for this Project include studies finished and paid for by federal funding stated in the resume(s) as part of the Lower Ballona Creek Feasibility Studies of the Joint EIR/EIS (2005) initiated by the USACE.

7. VIOLATIONS OF CALIFORNIA CONTRACT CODE ATTACHMENT 6

Staff Project Manager Mary Small failed to comply with the California Contract Code Notification and Conflict requirements, Sections 10140-10141 and 10515-10518.

Staff Project Manager Mary Small conducted a Request for Services for Contractors in 2009, and again in 2010 in regard to a Project not noticed to the Public or Governing Board until 2012, both in non-compliance with California Contract Code.

Staff Project Manager Mary Small purports to have initiated another Request for Services in February 2012 with responses due on the 29th of that month outside in non-compliance with the California Contract Code.

8. VIOLATIONS OF BAGLEY KEENE ATTACHMENT 6

Staff failed to obtain permission from the Governing Board to hire contractors to complete studies.

9. QUID PRO QUO INFERED ATTACHMENT 7

Sincerely,



John Davis
PO 10152
Marina del Rey Ca. 90295

RE: Public Records Request from John Davis

From: Philip Wyels <PWyels@waterboards.ca.gov>(Add as Preferred Sender)
Date: Tue, Feb 21, 2012 2:26 pm
To: <jd@johnanthonydavis.com>

Mr. Davis, I apologize for the delay in responding to your request. I have been unable to locate any records within the possession of the State Water Resources Control Board that are responsive to your requests. The attached two documents may be of interest to you, however, in that they indicate that the Santa Monica Bay Restoration Project's relationship with the Santa Monica Bay Restoration Foundation (Foundation) pre-dated the conversion of the Santa Monica Bay Restoration Project to the Santa Monica Bay Restoration Commission (Commission). Also, as I explained to you by telephone, the Commission staff is currently undertaking a number of steps to more clearly distinguish the Commission from the Foundation. Unfortunately, some of those steps are taking some time. I will let you know when I receive a timetable for those steps from Commission staff.

Sincerely,
Phil

Philip G. Wyels
Assistant Chief Counsel
State Board Water Quality Unit
State Water Resources Control Board

1001 I Street
P.0. Box 95812-0100
Sacramento, CA 95814

(916) 341-5178 (phone)
(916) 341-5199 (fax)
pwyels@waterboards.ca.gov>>>

From: <jd@johnanthonydavis.com>
To: Philip Wyels <pwyels@waterboards.ca.gov>
CC: Michael Lauffer <MLauffer@waterboards.ca.gov>
Date: 2/21/2012 10:00 AM
Subject: RE: Public Records Request from John Davis

California State Water Board
Att: Phil Wyels
Re: Status Request Public Record Request

Councel Wyels,

The California Public Records Act requires that Agencies subject to the Act reply to request for records
within 10 days after a request is made.

The State Water Resources Board has not complied with the law in this respect in regard to the request for
records made on 2/7/12.

From: Elena Eger
To: "jd@johnanthonydavis.com"
Cc: "Shelley Luce"; "svalor@santamonicabay.org"; "Mary Small"; "Dick Wayman"; "Nadine Peterson"; "Samuel Schuchat"
Subject: Davis call to Eger of 2-6-12
Date: Tuesday, February 07, 2012 1:00:00 PM
Attachments: SWRCB memo2011aug re accusations.pdf
SWRCB Ltr to Davis re PRAs.pdf

Dear Mr. Davis:

Pursuant to our phone conversation of yesterday, February 6, 2012, in which you provided a warning to me that the Conservancy should be informed that the Santa Monica Bay Foundation allegedly is appropriating public resources for private gain, attached please find the State Water Resources Control Board's (SWRCB) August 15, 2011 legal memo addressing your contentions and a September 13, 2011 letter to you regarding the same.

As analyzed in the SWRCB memo, especially in #3, pp. 4-5 of that memo, your contentions that the Foundation is improperly utilizing public resources for private use, namely in your assertions yesterday when you identified as improper the fact that the Foundation uses the same mailing address as the SWRCB's Los Angeles office, are specifically addressed. Frances McChesney, Esq., Office of the Chief Counsel for the SWRCB concludes in that memo that the Foundation is not improperly appropriating public resources for its private use.

The Conservancy intends to proceed with its grant to the Foundation approved as Item #5 at its January 19, 2012 meeting.

Sincerely,

Elena Eger
Senior Staff Counsel
California Coastal Conservancy
1330 Broadway, Ste. 1300
Oakland, CA 94612
510-286-4089 tele/voicemail
510-286-0470 fax

Form **990**

Department of the Treasury
Internal Revenue Service

Return of Organization Exempt From Income Tax

Under section 501(c), 527, or 4947(a)(1) of the Internal Revenue Code (except black lung benefit trust or private foundation)

▶ The organization may have to use a copy of this return to satisfy state reporting requirements

OMB No 1545-0047

2006

Open to Public Inspection

A **For the 2006 calendar year, or tax year beginning** Jul 01, 2006, **and ending** Jun 30, 2007

B Check if applicable
- ☐ Address change
- ☐ Name change
- ☐ Initial return
- ☐ Final return
- ☐ Amended return
- ☐ Application pending

Please use IRS label or print or type See Specific Instructions

C Name of organization, number and street, city, town, state, and ZIP code

Santa Monica Bay Restoration Foundation
320 West 4th Street Suite 200
LOS ANGELES CA 90013

D **Employer identification number** 33-0420271

E **Telephone number** 213-576-6642

F **Acctg. method:** ☒ Cash ☐ Accrual ☐ Other (specify) ▶

- **Section 501(c)(3) organizations and 4947(a)(1) nonexempt charitable trusts must attach a completed Schedule A (Form 990 or 990-EZ).**

H and I are not applicable to section 527 organizations

H(a) Is this a group return for affiliates? ☐ Yes ☒ No

H(b) If "Yes," enter number of affiliates ▶

H(c) Are all affiliates included? (If "No," attach a list See instructions.) ☐ Yes ☐ No

H(d) Is this a separate return filed by an organization covered by a group ruling? ☐ Yes ☒ No

G **Website:** ▶ WWW.SANTAMONICABAY.ORG

J **Organization type** (check only one) ▶ ☒ 501(c)(3) ◀ (insert no.) ☐ 4947(a)(1) or ☐ 527

K Check here ▶ ☐ if the organization is not a 509(a)(3) supporting organization **and** its gross receipts are normally **not** more than $25,000 A return is not required, but if the organization chooses to file a return, be sure to file a complete return

I Group Exemption Number ▶

L Gross receipts Add lines 6b, 8b, 9b, and 10b to line 12 ▶ 979,681.

M Check ▶ ☐ if the organization is **not** required to attach Sch B (Form 990, 990-EZ, or 990-PF)

Part I Revenue, Expenses, and Changes in Net Assets or Fund Balances (See the instructions)

Revenue	1 Contributions, gifts, grants, and similar amounts received			
	a Contributions to donor advised funds	1a		
	b Direct public support (not included on line 1a)	1b	342,406.	
	c Indirect public support (not included on line 1a)	1c		
	d Government contributions (grants) (not included on line 1a)	1d	576,050.	
	e **Total** (add lines 1a through 1d) (cash $ 918,456. noncash $)			1e 918,456.
	2 Program service revenue including government fees and contracts (from Part VII, line 93)			2 18,485.
	3 Membership dues and assessments			3
	4 Interest on savings and temporary cash investments			4 41,773.
	5 Dividends and interest from securities			5 967.
	6 a Gross rents	6a		
	b Less rental expenses	6b		
	c Net rental income or (loss) Subtract line 6b from line 6a			6c
	7 Other investment income (describe ▶			
	8 a Gross amount from sales of assets other than inventory	(A) Securities	(B) Other	
		8a		
	b Less cost or other basis & sales expenses	8b		
	c Gain or (loss) (attach schedule)	8c		
	d Net gain or (loss) Combine line 8c, columns (A) and (B)			8d
	9 Special events and activities (attach schedule) If any amount is from **gaming**, check here ▶ ☐			
	a Gross revenue (not including $ of contributions reported on line 1b)	9a		
	b Less direct expenses other than fundraising expenses	9b		
	c Net income or (loss) from special events Subtract line 9b from line 9a			9c
	10 a Gross sales of inventory, less returns and allowances	10a		
	b Less cost of goods sold	10b		
	c Gross profit or (loss) from sales of inventory (attach schedule) Subtract line 10b from line 10a			10c
	11 Other revenue (from Part VII, line 103)			11
	12 **Total revenue.** Add lines 1e, 2, 3, 4, 5, 6c, 7, 8d, 9c, 10c, and 11			12 979,681.
Expenses	13 Program services (from line 44, column (B))			13 757,878.
	14 Management and general (from line 44, column (C))			14 102,224.
	15 Fundraising (from line 44, column (D))			15 7,373.
	16 Payments to affiliates (attach schedule)			16
	17 **Total expenses.** Add lines 16 and 44, column (A)			17 867,475.
Net Assets	18 Excess or (deficit) for the year Subtract line 17 from line 12			18 112,206.
	19 Net assets or fund balances at beginning of year (from line 73, column (A))			19 872,326.
	20 Other changes in net assets or fund balances (attach explanation)			20
	21 Net assets or fund balances at end of year Combine lines 18, 19, and 20			21 984,532.

RECEIVED
FEB 19 2008
861 IRS-OSC
OGDEN, UT

SCANNED MAR 04 2008

For Privacy Act and Paperwork Reduction Act Notice, see the separate instructions. Form **990** (2006)

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ATTACHMENTS 2

GRANT TRANSMITTAL

Grant No._____

(for receivable grants)

INTENT TO APPLY

Date: _____

Project Manager: _____

SCC Program: _____

Grant Program Name: _____ Grant Amount: _____

Granting Agency: _____

Project Name: _____ Project Number: _____

SCC required Matching Funds: (if other than in-kind services, please use reverse side of this form to reserve SCC funds)

In - Kind: $ _____ (Copy from reverse side)

Support: $ _____ Fund No.: _____ FY_____

Capital Outlay: $ _____ Fund No.: _____ FY_____

TOTAL: $ _____

Funding Mechanism: Will or will not hit SCC account? _____ Electronic Transfer ? _____

Paid in Arrears ? _____ Cash Advance ? _____

___ *(A) For Federal Grant*

Support (Staff, travel, equipment): $ _____ 3760 - 001- 0890 FY : _____

Capital Outlay: $ _____ 3760 - 301- 0890 FY : _____

Other (Specify) _____ : $ _____ 3760 - _____ FY : _____

TOTAL: $ _____

___ **(B) For State Reimbursable Grant** (Please use reverse side of this form to reserve up-front SCC funds)

Support (Staff, travel, equipment): $ _____ 3760 - 001 - 0565 - F90 FY : _____

Capital Outlay: $ _____ 3760 - 301 - _____ - F90 FY : _____

Other (Specify) _____ : $ _____ 3760 - ____ - ____ - F90 FY : _____

TOTAL: $ _____

Authorization:

Program Manager: _____ Date: _____

Accounting Officer: _____ Date: _____

Grants Manager: _____ Date: _____

APPLICATION *(Provide copy of Application to Grants Manager)*

Legal * _____ Date: _____

**Please inform Grants Manager if signature are missing in the "INTENT TO APPLY" SECTION*

EO/DEO: _____ Date: _____

Date Applied: _____ Expected Date of Grant Award: _____

REVIEW OF AGREEMENT (for receipt of funds)

Board Authorization To Spend The Grant: Date (s): _____

Project Manager: _____ Date: _____

Program Manager: _____ Date: _____

Legal: _____ Date: _____

EO/DEO: _____ Date: _____

Grants Manager: _____ Date: _____ Inform Acct. Date: _____

Amendment #: _____ Legal Reviewed by: _____ Date: _____

From: Mary Small
To: sluce@santamonicabay.org; "Barbara Romero"
Subject: FW: hard copy in the mail tomorrow
Date: Friday, January 06, 2012 4:04:00 PM

-----Original Message-----
From: Ruth Galanter [mailto:ruth.galanter@verizon.net]
Sent: Friday, January 06, 2012 3:57 PM
To: Mary Small
Subject: Re: hard copy in the mail tomorrow

I am planning to attend the meeting, and I'm trying to get some more support letters and maybe attendees. You have no idea how much pleasure I would get from foiling your opponents. I can either stand up during the hearing, or if you want, I can instead meet you and the board between the tour and the meeting (since you must be going to feed them someplace) and just chat informally.

Your choice. I'm free at about 11:30 and have a meeting at 3 pm. In between I am at your service.

On Jan 6, 2012, at 3:50 PM, Mary Small wrote:

> Thanks that's a very generous offer. If you have time to attend the
> meeting, that would be great. It starts at 1pm at Baldwin Hills Scenic
> Overlook and this is the first substantive item on the agenda. I will have
> pretty limited time to present, but could acknowledge you and if you were
> willing to speak in public comment on the item that would fantastic.
> Mary
>
> -----Original Message-----
> From: Ruth Galanter [mailto:ruth.galanter@verizon.net]
> Sent: Friday, January 06, 2012 9:52 AM
> To: Mary Small
> Subject: Re: hard copy in the mail tomorrow
>
> I'm available after about 11:30, and you might want to use me as part of a
> board briefing in light of my nearly two decades dealing with the issue.
> That of course is up to you, and I promise not to get huffy if you'd rather
> not.
>
> On Jan 6, 2012, at 9:10 AM, Mary Small wrote:
>
>> Thank you very much, you letter is perfect and I appreciate your quick
>> response. It would be great to have a few supporters at the meeting, I am
>> sure the opponents will attend.
>>
>> We are also going to take the Coastal Conservancy board on a quick tour of
>> the site the morning before the meeting from 10-12. I know you are very
>> busy but it would be great if you wanted to join us for either the tour or
>> to attend the meeting.
>> Mary
>>
>> -----Original Message-----
>> From: Ruth Galanter [mailto:ruth.galanter@verizon.net]
>> Sent: Thursday, January 05, 2012 9:13 PM
>> To: Small Mary
>> Subject: hard copy in the mail tomorrow
>>

From: Mary Small
To: "Shelley Luce"
Subject: FW: Letter for Coastal Conservancy Board
Date: Tuesday, December 13, 2011 1:21:00 PM

Do you know Ruth?

From: Joan Cardellino [mailto:jcard@scc.ca.gov]
Sent: Tuesday, December 13, 2011 11:57 AM
To: 'Mary Small'
Subject: RE: Letter for Coastal Conservancy Board

It might be worth calling Ruth Galanter to see if she'd speak in support of the project. She has some good credentials. She might know of other supporters to ask too.

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, December 13, 2011 10:38 AM
To: 'Shelley Luce'
Cc: 'Joan Cardellino (Joan Cardellino)'
Subject: RE: Letter for Coastal Conservancy Board

Hi Shelley-
Do you have time to talk about our Jan meeting? I know you have a board meeting this week, so we could also do this via email – or next week, but before next Fri I'd like to work through some ideas:

1) Tour – we'll probably do a tour the morning of the meeting, I think maybe the tour we did with Colonel Toy – view from Cabora Rd and then walk out to boyscout platform
2) Press – do you think we could use this meeting as an opportunity to get either local papers and/or try for LA Times to cover the project? I am worried that once the agenda is out Marcia will use as opportunity to get bad press. Our agenda will be mailed out Jan 6th
3) Public support – who could we have come to support the project at the meeting or with letters? Geraldine is critical (at least her letter) but how about MRCA?, Joe Geever?, Ballona Creek Renaissance?, Friends?, Miguel Luna?, Audubon? HtB? Baykeeper?

Thanks,
Mary

From: Shelley Luce [mailto:sluce@santamonicabay.org]
Sent: Monday, December 12, 2011 3:22 PM
To: Mary Small
Subject: FW: Letter for Coastal Conservancy Board

Hi Mary, Geraldine thought her letter went out already. Have you received? I also invited her to tour the wetlands with us after the meeting.

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission

From:	Mary Small
To:	"Miguel Luna"
Cc:	"Shelley Luce"
Subject:	FW: draft support letter for SCC board meeting
Date:	Tuesday, January 03, 2012 1:29:00 PM
Attachments:	SCC_Ballona_Tech_Support_Ltr.docx

Hi Miguel
Happy New year! Hope you are well.

Is there any chance you would be willing to send a letter of support to the Coastal Conservancy for authorization of funding to continue design of the restoration project? I don't know if Shelley contacted you, but it would be great to get community groups weighing in who support ecological restoration. Our meeting will be in LA, so I expect there will be some opposition.

Please let me know if you have any questions or need more info.
Thanks,
Mary

From: Mary Small
To: "Shelley Luce"
Subject: RE: draft support letter for SCC board meeting
Date: Tuesday, January 03, 2012 1:27:00 PM

Thanks!
I will talk to Sam about Boxer and Feinstein. Can LA Co DPW send a letter or do you think that is covered by the Supervisors?
Mary

From: Shelley Luce [mailto:sluce@santamonicabay.org]
Sent: Tuesday, January 03, 2012 1:25 PM
To: Mary Small; Diana Hurlbert
Subject: RE: draft support letter for SCC board meeting

Hi Mary,
We are working on:
Knabe
MRT
Friends of BW
So Cal Edison
So Cal Gas
LMU
Waxman
Lieu
Butler
Rosendahl

And Anyone else you want to add to that list. Figured Feinstein and Boxer will be more important later, and that you and Sam are the best ones to approach them.

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission
Pereira Annex MS:8160
1 LMU Drive, Loyola Marymount University
Los Angeles, CA 90045
310-961-4444

www.santamonicabay.org

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, January 03, 2012 1:06 PM
To: Shelley Luce; Diana Hurlbert
Subject: FW: draft support letter for SCC board meeting

Hi
I belatedly just sent this request to DFG and SLC. The only support letter I have is from MRCA, though I know the port is working on one too. Can you let me know who you are working on

Pereira Annex MS:8160
1 LMU Drive, Loyola Marymount University
Los Angeles, CA 90045
310-961-4444

www.santamonicabay.org

From: Knatz, Geraldine [mailto:knatz@portla.org]
Sent: Sunday, December 11, 2011 1:00 PM
To: Shelley Luce; Zordilla, Eunice
Cc: Tankersley, Eileen
Subject: Re: Letter for Coastal Conservancy Board

The letter was drafted the day after you asked me. Not sure what happened. Eunice- can you check.
Geraldine Knatz
Executive Director
Port of Los Angeles

From: Shelley Luce [mailto:sluce@santamonicabay.org]
Sent: Friday, December 09, 2011 04:26 PM
To: Knatz, Geraldine
Cc: Tankersley, Eileen
Subject: Letter for Coastal Conservancy Board

Dear Geraldine,
When we spoke a month or so ago, I asked if you would provide a letter to Sam Schuchat and his Board regarding your interest in the Ballona Wetlands restoration project. The January meeting of the Conservancy Board will be in Los Angeles and Sam will ask the Board to approve a large sum for continuing the planning and permitting of the restoration project, so your support of the project and interest in providing mitigation funding is important. Do you still intend to provide a letter and can I help with drafting? Also, we will give the Board members a tour of the wetland and briefing on the restoration plan before or after the Board meeting. As soon as we have a date I will send you an invitation and hope that you could come along.

Thank you Geraldine,
Shelley

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission
Pereira Annex MS:8160
1 LMU Drive, Loyola Marymount University
Los Angeles, CA 90045
310-961-4444

www.santamonicabay.org

Mark Gold, D.Env. | President
Heal the Bay | 1444 9th Street | Santa Monica CA 90401
Tel: 310 451 1500 X123 | Fax: 310 496 1902 | mgold@healthebay.org
DONATE NOW to protect what you love: make an Aquadoption, shop at our online store or dedicate a Heal the Bay membership or donation.
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From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, January 03, 2012 2:16 PM
To: Mark Gold
Subject: support letter for SCC board meeting?

Hello Mark,
Happy New Year. I am emailing to see if Heal the Bay would be willing to send a letter of support to the Coastal Conservancy for the recommendation that we authorize $6.5M for the design and engineering of the proposed restoration project? My draft staff report is attached along with a sample letter. I know you have talked to Shelley about the project, but I would be happy to give you an update at any time. Of course I understand if you are not prepared to take a position on this project at this point, but our meeting will be in Culver City, so I expect there will be some opposition.

Please let me know if you have any questions or need more info.
Thanks,
Mary

Subject: Re: [REPLY] Fw: Coastal Conservancy funding to complete Ballona Wetlands restoration planning

Shelley,

Please accept my apologies for this late response. Cathi and I were away on a 2 1/2 week driving trip to the Seattle area for a holiday visit with our kids and grandkids. Then after returning late last Thursday, we've been focused on moving Cathi's 93-year-old mom in with us. I'm just now beginning to turn more of my attention to a backlog of BCR and other matters.

Unfortunately I have an important 3pm meeting at Culver City Hall on the afternoon of the 1pm SCC board meeting at the Scenic Overlook. If I were able to speak on the restoration planning agenda item before about 2:40pm, it could work. Otherwise (or in addition) I might be able to get Bobbi Gold or another knowledgeable BCR board member to represent us.

As for a BCR support letter, I'm pretty sure that would not be a problem. This is on my list of things to bounce off the board prior to our next board meeting.

Here's to a great new year, despite the challenges ahead!
Jim

Jim Lamm, President
Ballona Creek Renaissance (BCR)...Connecting Creek and Community from the Hills to the Bay
310-839-6896, 310-367-0336 (c), http://facebook.com/ballonacreekrenaissance, www.ballonacreek.org

---

From: Shelley Luce <sluce@santamonicabay.org>
To: Jim Lamm <jim.lamm@sbcglobal.net>
Sent: Fri, January 6, 2012 5:32:52 PM
Subject: Coastal Conservancy funding to complete Ballona Wetlands restoration planning

Hello Jim,
I hope you had a lovely Christmas and a happy new year! I did enjoy a nice break.

You may have heard that the Board of the Coastal Conservancy will meet in LA on Jan. 19 and will consider a request from their staff to authorize funding to complete the Ballona Wetlands restoration planning. The request is for about $6.3M and most will go to consultants for additional engineering (through final design), to create a public access master plan, and to do extensive hydraulic modeling as required by Army Corp permitting (the major expense). About $240k will come to SMBRF to fund Diana's position as well as monitoring on the site for the next three years. I don't know if there will be active opposition to this but I am preparing for that nonetheless. Also I see this as a good opportunity to let the SCC board members see the great support that exists in our community for restoration at Ballona.

Please let me know if you are able to support by letter or by attending the meeting. It was posted today on SCC website http://scc.ca.gov/2012/01/06/coastal-conservancy-public-meeting-january-19-2012/
I am attaching the staff report for the item and a couple of example support letters as well. Thank you Jim!
shelley

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission
Pereira Annex MS:8160

From: Mary Small
To: "Shelley Luce"; "Diana Hurlbert"
Subject: FW: draft support letter for SCC board meeting
Date: Tuesday, January 03, 2012 1:05:00 PM
Attachments: SCC_Ballona_Tech_Support_Ltr.docx

Hi
I belatedly just sent this request to DFG and SLC. The only support letter I have is from MRCA, though I know the port is working on one too. Can you let me know who you are working on getting letters from and if there is anyone else I should follow-up with?
Thanks
Mary

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, January 03, 2012 1:04 PM
To: 'Griggs, Pamela@SLC'; 'Terri Stewart'; 'dlawhead@dfg.ca.gov'; 'Rick Mayfield (rmayfield@dfg.ca.gov)'
Subject: draft support letter for SCC board meeting

Hi
Sorry I didn't send this to you earlier, I meant to send it before the holidays, but forgot. I was wondering if your agencies would send a support letter to Coastal Conservancy for the requested authorization for funds for engineering and final design for Ballona. Our meeting will be in LA so I expect there will be some opposition and it is a huge funding request since we decided to do the EIR and permitting for the whole project.

If you could attend the site tour of Ballona and the meeting (both on Jan 19th) that would be great too.

Please let me know if you have any questions or need more info.
Thanks
Mary

From: Mary Small
To: "Mark Gold"
Cc: sluce@santamonicabay.org
Subject: RE: support letter for SCC board meeting?
Date: Friday, January 06, 2012 4:23:00 PM

I was just talking to Shelley and we were wondering if you could send a staff person to the meeting even if you don't want to sign a letter? Maybe Meredith or someone on her staff could come to talk about the need to open the site to public access and restore nature in the city?

This authorization doesn't commit to any one project, we still will be going through CEQA and NEPA.

Thanks
Mary

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, January 03, 2012 3:00 PM
To: 'Mark Gold'
Subject: RE: support letter for SCC board meeting?

Thanks, the meeting is the 19th so that's the deadline. Yes, I totally understand.

I was just sending Sarah an email about possible dates I'll be in LA when I'd like to stop in ad talk about OPC, so maybe I'll see you then.

Happy new year (and MLPA implementation)
Mary

From: Mark Gold [mailto:mgold@healthebay.org]
Sent: Tuesday, January 03, 2012 2:39 PM
To: Mary Small
Subject: RE: support letter for SCC board meeting?

Mary – Happy new year to you too. We will definitely take a look at this and think it through. It is a great project and needs to happen. The political baggage that goes with it is no picnic as you know.

When is the deadline?

Mark Gold, D.Env. | President
Heal the Bay | 1444 9th Street | Santa Monica CA 90401
Tel: 310 451 1500 X123 | Fax: 310 496 1902 | mgold@healthebay.org
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From: Mary Small
To: "Dick Wayman"
Subject: FW: Ballona Wetlands presentation materials at SCC meeting
Date: Friday, January 20, 2012 4:03:00 PM

From: Shelley Luce [mailto:sluce@santamonicabay.org]
Sent: Friday, January 20, 2012 3:12 PM
To: Mary Small; Karina Johnston; Diana Hurlbert
Subject: RE: Ballona Wetlands presentation materials at SCC meeting

Yes Mary - Karina or Diana can you please?
Also wanted to make sure you saw/heard the NPR coverage:
http://www.scpr.org/news/2012/01/20/30859/coastal-conservancy-releases-65-million-ballona-wet/

The MDR patch did a pretty good job covering - except Lisa F's comments which are confusing to me, but I will call her about it - and LATimes is going to run something this weekend, I am told. Fingers crossed.
http://venice.patch.com/articles/coastal-conservancy-approves-6-5-million-for-ballona-wetlands-restoration-plans

Thank you Diana and Karina for helping get this press coverage - the advance work we did made a HUGE difference! Please stay on top of me in the future to make sure we have the same success next time. great job.
shelley

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission
Pereira Annex MS:8160
1 LMU Drive, Loyola Marymount University
Los Angeles, CA 90045
310-216-9827
www.santamonicabay.org

From: Mary Small [msmall@scc.ca.gov]
Sent: Friday, January 20, 2012 2:52 PM
To: Karina Johnston; Diana Hurlbert
Cc: Shelley Luce
Subject: Fwd: Ballona Wetlands presentation materials at SCC meeting

Could one of you email this to him?
Thanks

sent from my phone

Begin forwarded message:

> **From:** Rex Frankel <rexfrankel@yahoo.com>
> **Date:** January 20, 2012 12:46:45 PST
> **To:** Mary Small <msmall@scc.ca.gov>
> **Subject: Re: Ballona Wetlands presentation materials at SCC meeting**
> **Reply-To:** Rex Frankel <rexfrankel@yahoo.com>
>
> Mary,
> thank you for the presentation materials. However, on the Baseline monitoring report page,
> http://santamonicabay.org/smbay/ProgramsProjects/HabitatRestorationProject/BaselineAssessmentReport/tabid/203/Default.aspx
>
> the Chapter 4--Vegetation report does not come up when you click on it. I assume this is where Dr. Luce's conclusion comes from.
>
> If you can, please email that chapter to me.
>
> Thank you, Rex Frankel
>
> ---
>
> **From:** Mary Small <msmall@scc.ca.gov>
> **To:** 'Rex Frankel' <rexfrankel@yahoo.com>
> **Sent:** Friday, January 20, 2012 12:09 PM
> **Subject:** RE: Ballona Wetlands presentation materials at SCC meeting
>
> Hello Rex
> Attached is our slide presentation.
>
> Yes, Dr. Luce was referring to the findings of the baseline assessment. I just went to the project website and clicked on the image of the report cover and was able to download the documents, but if there are specific chapters that you are unable to download, please let us know and we'll get them to you.
>
> Mary
>
> ---
>
> **From:** Rex Frankel [mailto:rexfrankel@yahoo.com]

From:	Mary Small
To:	"Joe Geever"
Cc:	"Shelley Luce"; "Diana Hurlbert"
Subject:	Coastal Conservancy Jan 19th Meeting
Date:	Thursday, December 15, 2011 11:25:00 AM
Attachments:	Ballona Wetlands Engineering and Technical Studies.docx

Hi Joe

Nice to talk to you this morning, and thanks for agreeing to come to the Coastal Conservancy meeting in Jan. It will be on Jan 19th at the Baldwin Hills Scenic Overlook starting around noon. Ballona funding (draft staff report attached) will be the first major item on the agenda. We are planning to take the Board on a tour of Ballona that morning. The tour and meeting are open to the public and details will be posted on our website by the 6th of Jan.

As I mentioned, we (Shelley and I) would be happy to provide additional information to you &/or your chapters at any point. Since we are finally getting ready to initiate the public environmental review, now would be a good time to get you engaged.

Thanks,
Mary

~~~~~~~~~~~~~~~~

Mary Small
Deputy Executive Officer, Coastal Conservancy
1330 Broadway #1300 Oakland, CA 94612
510-286-4181
~~~~~~~~~~~~~~~~

From: Mary Small
To: "Shelley Luce"
Cc: "Joan Cardellino (Joan Cardellino)"; "Diana Hurlbert"
Subject: RE: Letter for Coastal Conservancy Board
Date: Tuesday, December 13, 2011 1:11:00 PM

Thanks

Sorry, the plan is to have the tour from roughly 9-11:30 and then start the meeting at noon or 12:30 – something like that. We're afraid that if we do the tour after the meeting none of the board members will come.

I'll call Barbara today to get her ideas and see if they will help with the tour, come to the mtg or send a letter
Mary

From: Shelley Luce [mailto:sluce@santamonicabay.org]
Sent: Tuesday, December 13, 2011 1:08 PM
To: Mary Small
Cc: 'Joan Cardellino (Joan Cardellino)'; Diana Hurlbert
Subject: RE: Letter for Coastal Conservancy Board

Mary, here are some thoughts from me and Diana:

1) Tour – we'll do the tour anytime that works for your members but it seems tight to finish it by 9:15 in order to get them all to Baldwin Hills Overlook for a 10 am meeting. I know we have the Toy meeting the day before so right after the board meeting makes most sense. Could you convince your members to stick around for it?
2) Press – this is troubling. It'll be hard for us to get good press on a $7M expenditure... we can spin this if we get the right people. What if we did a brief presentation on the Monitoring Report before hand? We'll have beautiful hard copies, it's over 400 pages and very impressive and did not cost a lot for the amount of work and info. I think it makes SCC and SMBRC look great. Could we make this the press focus, i.e. with Molly Peterson at least? I'll give her a call for starters.
3) Support – I will talk with Geever, Jim Lamm, Miguel, Lisa Fimiana, Baykeeper, HTB, Nate from Rosendahl's office, Napolitano from Knabe's and Karly from MRT's. I can't say who will show up or do a letter but I will make the asks. I'll also ask Pestrella. Can you talk to MRCA Mary? Also what about the Corps – Rick Liefiled's support would be very meaningful, or Toy's if we can get it. Maybe a letter from Toy with Rick or someone else attending the meeting?

We'll draft a support letter asap and run it by you.
Shelley

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission
Pereira Annex MS:8160

From: Shelley Luce
To: Mary Small
Subject: RE: board presentation
Date: Wednesday, January 11, 2012 6:55:23 PM

Hi Mary,
I think the presentation looks good. I think we should include some comparative data to show the need for restoration – e.g. the seed bank data, the exotic veg data and some of the animal data (birds and herps). I saw what karina sent you and it doesn't help us – we need numbers like "99% invasive plants" and "lowest seed bank of any so cal wetland". we also need her graphs that show huge percent exotic veg. versus tiny percent native veg, etc. along with those photos of invasive plants that you already included.

I also think we should mention the TMDL –or not the TMDL itself, but we can list the impairments listed on the 303d list, note that TMDL implementation would be consistent with the restoration and that we can work with partners on my governing board and other agencies and leverage resources that would go into implementing the TMDL.

I can help with slides – why don't you send me one or two in your formatting and I will make some with the graphs imentioned and see if you like them. Or rather, since you have to finish by tomorrow and I am out of the office all day, we will ask karina to insert some graphs. Okay with you?
Shelley

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission
Pereira Annex MS:8160
1 LMU Drive, Loyola Marymount University
Los Angeles, CA 90045
310-961-4444

www.santamonicabay.org

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Wednesday, January 11, 2012 2:49 PM
To: Shelley Luce
Subject:

Hi Shelley
Attached is a draft powerpoint, I want to keep it as simple as we can. There are several extra slides at the end, I just want one picture I can leave up when I walk through the actual requested action, maybe just the bird with its head in the water?

There are two slides about the baseline monitoring program – I think we only need one of them, do you prefer lots of words or just a picture.

I am sending in .pdf because the actual powerpoint is too big. If you want me to ftp the powerpoin so you can edit directly, let me know. I have to finish this by tomorrow night.

From:	Shelley Luce
To:	Karina Johnston
Cc:	msmall@scc.ca.gov
Subject:	graphs needed for SCC board presentaiton
Date:	Thursday, January 12, 2012 7:57:56 AM

Hi Karina,

Thank you for the bullets you prepped for Mary, they are helpful. The photos are also perfect. What we still need for the presentation are graphics or numbers that will really make our case. Mary needs to complete the presentation today so can you and your team help us prep the following ASAP?

- one map of existing conditions that shows the site today: an aerial photo with transparent overlay of BASIC habitat types - how much is wetland, how much is upland/vacant lot style. goal is to illustrate how little of the site can be said to be funcitoning habitat.

- one simple graph showing predominance of invasive species - the one in the BWER draft TMDL is fine, can you please send that to mary? we need to say "x percent of the site is covered with 99% invasive vegetation" or whatever the actual numbers are. rather than "dominate by invasives" which could mean only 55% covered.

- some species diversity numbers/charts that show how extremely depaupurate poor Ballona is. not just "reduced relative to other wetlands" but "lowest seed bank abundance and diversity of any wetland in southern california" - but i need you to give me the right language so i am not mis-stating anything. please give me those #s or charts or langauge for seed bank, veg, mammals, birds, fish and herps separately and we'll decide which ones to mention in our presentation.

- any other features of the site or results from your surveys that really illustrate to non-scientists how desperate is the need to restore ecological function and habitat at the site.

I am sorry to ask you for all this today, I hope you or one of your team has time. I think you have all this info readily accessible - f there is someihting i've requested that is a big pain check with me and we'll decide if it's really needed. please call my cell or email, i will be out of the office all day but checking my phone compulsively. also please suggest other stuff if you think of it - you know these data better than we do! thank you KJ talk to you later today.
shelley

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ATTACHMENT 5

[Federal Register: September 20, 2005 (Volume 70, Number 181)]
[Notices] [Page 55116-55117] From the Federal Register
Online via GPO Access [wais.access.gpo.gov] [DOCID:fr20se05-36]
[[Page 55116]]

DEPARTMENT OF DEFENSE Department of the Army; Corps of Engineers Notice of Intent To Prepare an Environmental Impact Statement/ Environmental Impact Report for the Ballona Creek Ecosystem Restoration Feasibility Study, Los Angeles County, CA AGENCY: Department of the Army, U.S. Army Corps of Engineers, DoD. ACTION: Notice of intent. --

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SUMMARY: The Los Angeles District intends to prepare an Environmental Impact Statement/Environmental Impact Report (EIS/EIR) to support a cost-shared ecosystem restoration feasibility study with the Santa Monica Bay Restoration Commission. The proposed project study areas has been degraded by encroachment of non-native plants, placement of fill from Marina Del Rey, interruption of the hydrologic regime, trash accumulation, and varied attempts at bank protection along the creek using rock and concrete. Direct benefits of the proposed project include improved habitat and water quality, reductions in waste and trash, and aesthetics. The watershed is an important resource for both recreational uses and for fish, and wildlife and further degradation could jeopardize remaining. The purpose of the feasibility study is to evaluate alternatives for channel modification, habitat restoration (coastal and freshwater wetlands and riparian), recreation, and related purposes along the lower reach of the Ballona Creek. DATES: A public scoping meeting will be held on September 29, 2005 at 6 p.m. ADDRESSES: U.S. Army Corps of Engineers, Los Angeles District, CESPL-PD, P.O. Box 532711, Los Angeles, CA 90053 and Santa Monica Bay Restoration Commission, 320 West 4th Street, Los Angeles, CA 90013. FOR FURTHER INFORMATION CONTACT: Shannon Dellaquila, Project Environmental Manager, at (213) 452-3850 or Malisa Martin, Project Study Manager at (213) 452-3828. SUPPLEMENTARY INFORMATION: 1. Authorization This study was prepared as an interim response to the following authorities provided by Congress under Section 216 of the Flood Control Act of 1970, which states: The Secretary of the Army, acting through the Chief of Engineers, is authorized to review the operation of projects the construction of which has been completed and which were constructed by the Corps of Engineers in the interest of navigation, flood control, water supply, and related purposes, when found advisable due the significantly changed physical or economic conditions, and to report thereon to Congress with recommendations on the advisability of modifying the structures or their operation, and for improving the quality of the environment in the overall public interest; supplemented by House Resolution on Public Works and Transportation dated September 28, 1994 which states: **The Secretary of the Army is requested to review the report of the Chief of Engineers on Playa del Rey Inlet and Basin, Venice, California, published as House Document 389, Eighty-third Congress, Second Session,** and other pertinent reports, to determine whether modifications of the recommendations contained therein are advisable at present time, in the interest of navigation, hurricane and storm damage reduction, environmental restoration, and other purposes at Marina del Rey Harbor, Los Angeles, California, with consideration given to disposal of contaminated sediments from the entrance channel required under the existing operation and maintenance program at Marina del Rey. 2. Background The Ballona Creek Ecosystem

degradation issues, which has led to uncoordinated and sometimes redundant and unsuccessful improvement measures. 4. Proposed Action and Alternative The Los Angeles District will investigate and evaluate all reasonable alternatives to address the problems and need stated above. In addition to a without project (No Action) Alternative, both structural and non-structural environmental measures will be investigated. An assessment of the feasibility of removing impervious surfaces from the Ballona Channel will also be evaluated. Proposed restoration measures include: re-grading and removal of fill, remove invasive and non-native plant species, reintroduction of a water source and installation of native plants to restore previously filled coastal wetlands. Other measures to be evaluated include features to improve or restore tidal regime in Oxford Basin, the Grand and Venice canals, and Ballona and Del Rey Lagoons; the potential for in stream wetland development in Centinela, Sepulveda and Ballona Creek; sediment loading in the upper watershed; and related recreation and educational opportunities. 5. Scoping Process The scoping process is on-going, and has involved preliminary coordination with Federal, State, and local agencies and the general public. A public scoping meeting is scheduled for Thursday September 29th from 6-8 p.m. at the Rotunda Room of the Veteran's Memorial Building, 4117 Overland Avenue, Culver City, CA. This information is being published in the local news media, and a notice is being mailed to all parties on the study mailing list to ensure that public will have an opportunity to express opinions and raise any issues relating to the scope of the Feasibility Study and the Environmental Impact Study/Environmental Impact Report. The public as well as Federal, state, and local agencies are encouraged to participate by submitting data, information, and comments identifying relevant environmental and socioeconomic issues to be addressed in the study. Useful information includes other environmental studies, published and unpublished data, alternatives that could be addressed in the analysis, and, potential mitigation measures associated with the proposed action. All comments will be considered in the project development. Concerns may be submitted in writing to the Santa Monica Bay Restoration Commission, or to the Los Angeles District (see ADDRESSES). Comments, suggestions, and request to be placed on the mailing list for announcements should be sp101.usace.army.mil. Availability of the Draft EIS/EIR The Draft EIS/EIR is scheduled to be published and circulated in December 2007, and a public hearing to receive comments on the Draft EIS/EIR will be held after it is published. Dated: September 13, 2005. Alex C. Dornstauder, Colonel, U.S. Army, District Engineer. [FR Doc. 05-18651 Filed 9-19-05; 8:45 am] BILLING CODE 3710-KF-M

Hi Mr. Mayfield, attached is the congressional and corp docs we discussed.

The document states an joint EIS/EIR process was begun in 2005 per the request of Congress.

The Santa Monica Bay Restoration Commission is noted as the lead agency for CEQA in the joint EIR/EIS.

It also states that at least one scoping hearing has already occured.

My question is does DFG plan on beginning another EIR process for the same area that is already been started by the SMRBC and Corp. If so, how can there be two lead agencies.

To me, logic indicates the SMRBC should be lead.

Thanks,

John Davis
PO 10152
Marina del Rey Ca. 90045

Ballona Ecosystem Restoration Planning Management Meeting
June 28, 2010
3:00-5:00pm

Attendees:

Josephine Axt, USACE	Ed Demesa, USACE	Julian Serafin, USACE
Rene Vermeeren, USACE	Ben Nakayama, USACE	Rhiannon Kucharski, USACE
Diana Hurlbert, SMBRC	Sean Bergquist, SMBRC	Kathy Anderson, USACE
Larry Smith, USACE	Mary Small, Coastal Conservancy (by phone)	

I. Mary Small: Coastal Conservancy is supplying most of the funding toward the in-kind local sponsor efforts.

II. Ed Demesa: Corps Process Overview
   a. We are coming up to our first major milestone (F3)
      i. Baseline and future without project conditions; preliminary alternatives analysis
         1. Describes problems and opportunities, planning objectives
         2. This product will be the basis for future steps
      ii. Next milestone (F4A/F4)
         1. Formulation, evaluation and comparison of alternatives
         2. F4A: SPD requirement, Alternative Formulation Briefing
      iii. (F5) Public Draft Feasibility Report
         1. Headquarters Policy and Public Review
   b. Josephine Axt: New Review Guidance (Estimated at $500,000; IEPR is federally funded)
      i. Agency Technical Review (ATR) - Requires coordination with the planning center of expertise, and coordinates a team of reviewers from another Corps Division
      ii. Model certifications required
      iii. Independent External Peer Review (IEPR)
      iv. Note for budget: call out what IEPR is estimated to cost, and that it does not have to be cost shared
      v. Diana Hurlbert: Under each discipline, there are costs for responding to comments. Are those related to ATR?
         1. Josephine Axt: Yes. There is a formal comment and response system that must be used for ATRs (DrChecks)
   c. Kathy Anderson: Partnership
      i. Communication
         1. Sean Bergquist: Communication has been much better since Rhiannon has taken over as Lead Planner.
         2. Mary Small: Rhiannon has been great in communication.
      ii. Cost share
         1. Sean Bergquist: Our cost share component is 100% in-kind. It is anticipated that most of that work is and will continue to be in the wetlands.
            a. We are finished our F3 equivalent (2006)
            b. We are also finished our alternatives development and analysis (2008)
               i. We want to make sure that all of the products feed in to the Corps process and products.
            c. The Corps and us on not on the same timeline.

a. Definition: Ballona Creek from the Pacific Ocean to Cochran, Del Rey Lagoon; and Centinela and Sepulveda Channels from Ballona Creek to where they go underground.

2. Grand canal is out.
3. Sean Bergquist: We have always planned on the daylighted part of Ballona Creek up to Cochran.
4. Coordination needs to go through Diana Hurlbert and Rhiannon Kucharski.

ii. Costs

1. Ed Demesa: For in-kind credit, it is important to let the PDT know what work the sponsor is doing, even if it will not be submitted for in-kind credit.
2. Sean Bergquist: Historical analysis of the watershed is in the works. We are also working with UCLA to do a watershed budget.
3. Sean Bergquist: When things have to be redone, how does the cost share work?
    a. Hydraulic study
        i. Rene Vermeeren: Our H&H models are in DRAFT form and have not yet had the first ATR. They are not ready for use on alternatives.
4. SMBRC Governing Board will have to sign the PMP and FCSA amendments.
5. In construction phase, can the cost of the land/property be used toward sponsor in-kind credit?
    a. Kathy Anderson: Yes, as long as the constructed project uses those lands. The state paid $140 million in 2005 for the property that makes up areas A, B and C.

iii. In-kind submittals

1. Mary Small: Is there really much more additional work that needs to be done to review the submittals? How much is left to be done by the Army Corps depends on the in-kind submittals?
    a. Diana and Rhiannon can work together with each PDT member to work through these. Set up meetings ASAP.
    b. Kathy Anderson: The whole PDT needs to sit down and go through the PMP, in-kind and costs step-by with SMBRC.
2. Mary Small: I am worried about the water quality report in terms of the data being what is needed per the Corps and less worried about the write-up
    a. Confirm with James Chieh that the data is what is needed.

c. Kathy Anderson: Sponsor financial capability?

i. Even in light of cost increases, the sponsor has enough money to fund all of their study activities and even begin phase I construction (Area B).
ii. Corps needs to get details of sponsor plans for "phase I" in Area B and determine if this must be added as a future without project condition or not.

IV. Action items are noted in RED.

Ballona Coordination Meeting Minutes
June 2, 2010
10am

Attendees:

Mary Small, Coastal Conservancy	Diana Hurlbert, SMBRC	Heather Schlosser, USACE
Julian Serafin, USACE	Rhiannon Kucharski, USACE	
Ben Nakayama, USACE	Robert Browning, USACE	Robert Grimes, USACE

I. In kind submittals
   a. For In-kind submittals, Mary, Sean and Diana tried to break down the submittals per the PMP, but had a hard time. Please see in-kind spreadsheet submitted last week.
   b. SMBRC and Coastal Conservancy will submit the In Kind Submittal sheets that correspond with each document from the website, along with reference to the document or file they correspond to and a link to that document on the web.

II. PMP updates
   a. Mary Small is concerned that the revised PMP does not reflect the products they have completed, and very concerned about the cost increases.
   b. Mary Small: Have all the PMP sections looked at the same project area? Parts still refer to Ballona Lagoon, Grand Canal, Venice Canals and Oxford Basin, which are no longer in the study area.
      i. All sections should include: Del Rey Lagoon; Areas A, B and C; Ballona Creek from the Ocean to Cochran; and Centinela and Sepulveda Channels from where they daylight to Ballona Creek.
   c. Mary and Diana requested that the Corps add geographic location to the PMP amendment chapter. The scopes of work are confusing because they do not make the study area clear.
   d. Mary: Why have the F3 economics costs gone up?
      i. Ben Nakayama: Economics had to re-run their model due to the revised flood plain hence their cost increase. The potential flooded parcels went from 6000 to 600.
      ii. Sponsor wants to understand why the economics costs for F3 doubled. The model was originally run at a larger scope (6000 parcels) and is now being re-run at a smaller scope (600 parcels). That should not cost double. There should be economies of scale.
      iii. Ben Nakayama: The model had to be completely re-run for the new parcels. This along with added review costs are the reasons behind the cost increase.
   e. Review Guidance has led to approximately $505k in cost increases. $260k of that is for Independent External Peer Review (IEPR), which is NOT cost shared. The other levels of review such as Agency Technical Review (ATR) and model certification ARE cost shared.
      i. Rhiannon will send another copy of the review guidance.
   f. The Coastal Conservancy is worried that there will be no political appetite to support a feasibility study at this cost level.

Ballona Telecon Minutes
March 29, 2010

Attendees:

Rhiannon Kucharski, USACE	Kathy Anderson, USACE	Larry Smith, USACE
John Killeen, USACE	James Chieh, USACE	Frank Wu, USACE
Julian Serafin, USACE	Michael Hallisy, USACE	Patrick Singh, USACE
Mary Small, Coastal Conservancy		Sean Berqquist, SMBRC

I. Introductions
II. PMP update
    a. DRAFT SOW Amendment Chapter distributed
    b. Cost estimates
        i. Frank Wu: Coastal Engineering F3 Baseline Conditions
            1. Need to incorporate PWA information in to the appendix
    c. SMBRC Board will have to buy off on the updated PMP and cost estimates
        i. At this Thursday's meeting they are asking the Board to generally support the study
        ii. Cost increase approval will have to come through the Coastal Conservancy's Board
    d. FCSA amendment would come after the PMP update is complete
        i. Have to work with Corps Legal Counsel and SMBRC Legal/Board
    e. Study Area
        i. For F4, the Corps suggests focused study area of A,B & C plus the Creek up to the I-405, and the Centinela Channel and Sepulveda Wash
            1. H&H and Survey and Mapping Sections believe this focused area is best due to cost considerations
            2. Per Frank Wu: Coastal Engineering work has focused on A, B, & C
        ii. Sponsors feel that we need to keep Ballona Creek up to Cochran Boulevard. Otherwise, the map is okay.
    f. Rhiannon and Kathy will set up a meeting between the sponsors and Survey and Mapping (Alan Nichols).[1]
    g. URS and the Corps are in negotiations for the Plan Formulation and Environmental Appendix
III. Corps work Audit
    a. Environmental Resources Branch (ERB)
        i. Review of sponsor work
        ii. Fish survey of creek and channels
        iii. Work with SAC on HEP evaluation
            1. Including scope of work to score A, B & C and the creek between the marsh areas
            2. Mary can re-start the Conservancy agreement with the SAC to possibly fund them.
                a. Larry will send Mary the scope of work he has written.
    b. Cultural Resources
            1. Write-up from PWA, which summarizes a library record search
                a. Corps and Conservancy both feel that the write-up is inadequate

[1] Action items marked in GREEN

1. Sponsor needs to keep records of the in-kind and the values in case of an audit.

ii. Mary Small: What is the best way to do that?

iii. Kathy Anderson: We can have a separate meeting to go through the in-kind line by line with Kathy, Rhiannon, Sean and Mary.

iv. Mary Small: Is it what we spend on the product that gets credited or is it what the federal government would have spent to do the same thing?

1. It is up to the PDT to QA/QC the products and agree to the accounting both in amount and content.
2. Coastal Conservancy would feel more comfortable if the in-kind is credited at the value they spent on the product.

V. Coordination

a. Corps requests going forward

i. Each PDT member needs to coordinate with their equivalent on the sponsor's contractor team(s)

1. Rhiannon will send a PDT list to Sean and Mary so that coordination contacts can be filled in next to the corresponding PDT member(s).

b. Sponsor requests

i. Tie up the in-kind process and update more often

c. Our coordination meetings from now on will be the last Wednesday of every month at 10am.

VI. Other Discussion

a. Bike tour with Congresswoman Harman April 9th.

i. Kathy will forward info to Mary and Sean.

TIME/ACTIVITY		TRANSP/REMARKS
THURSDAY – 26 MAY (Continued)		
	Agenda: - Introductions - Project Overview – SMBRC/CC o Project goals and regional importance o Planning Process (Science Advisory Committee and Public Meetings) o Proposed Project o Schedule - Partnership with Corps: Discussion (All) o 408 Permit – Outstanding Questions o Status of Feasibility Study o Discussion of Future Coordination	
1100	Depart for Ballona Creek PAX: See above	Govt Vehicle Driver: Phil Serpa
1110	Ballona Creek Site Visit - Overview of the Site - Ballona Channel - Muted Tidal Wetland SMBRC/CC and LAPW Participants: Dr. Luce, Mary Small and Mark Prestrella	
1210	Depart for Ballona Creek for SPL PAX: See above Note: Lunch enroute	Govt Vehicle Driver: Phil Serpa
1330	Arrive SPL	

Outline for the presentation

(Mary)
Background

- 600 acres owned by the state, DFG and State Lands
- Designated State Ecological Reserve
- Purchased for the purpose of wetland restoration

Project Partners, introduce Shelley

(Shelley)
Need For Restoration, Site Mgt

- Currently no open public access, very restricted
- Site management issues: homeless encampments, trespass, trash, eyesore

Need for restoration, biology

- Very degraded ecological resources – key findings of baseline assessment
- Regional significance – wetland loss around SM Bay and throughout So CA

Proposed project

- Description of grand vision
- Ecological benefits
- Sustainability – adaption to SLR, restoration of ecological processes
- Public access components

Planning process to date 2 slides(?)

- Public and Science Based Process
- Evaluation of broadest possible range of alternatives
- Refinement and assessment of preferred alternative –ideas we rejected, scaling down due to cost considerations, planning for phased implementation

(Mary)
Recommended action:

1) Authorization for a grant of $250 K to SMBRC to fund their ongoing work to advance this restoration project, including continuation of data collection, agency coordination and technical review and oversight.

2) Authorization of $6.25 million to be contracted by SCC through competitive environmental services contracts for specific technical studies that are needed to complete the environmental review and permitting.

Description of the technical work (what will be done and why so expensive)
This authorization would provide funds for several specific scopes of work to support environmental impact review and permitting of the restoration project.

- Soils and Geotechnical assessment – Some soil sampling has been completed onsite, however the main cost for implementation of the project will be soil management.. To

Some individuals think that this site is providing important habitat as is. This is a case of shifting baselines, the site does provide some habitat, but is severely degraded. Example - data pt from Karina's work?. To restore estuarine wetlands at Ballona, the land needs to be reconnected to the ocean.

- Can project be done with volunteers and without bulldozers?

The project that we are recommending is enormous in scale. It involves uncovering the wetlands that were buried with the construction of the marina and that have been cut off from the ocean for almost 90 years. We will work to continue working with youth groups and volunteers to implement portions of this restoration.

- Money would be better spend buying small parcels in the neighborhood

Some neighbors to the project have advocated that the restoration of the wetlands is a poor investment and the bond money should be spent to acquire small parcels (each 3-5 acres) rather than to restore the ecological reserve.

Funds are limited to Ballona, consequences if not approved, who will pay for construction?

Conclusion:
Even though this is a major investment and a controversial project, your staff recommends that you approve it. The ecological restoration of the Ballona wetlands is a rare opportunity to bring back coastal wetlands and to develop an urban natural area that will enhance the lives of millions of Californians. To really restore this site we have to implement a big vision and in order to do that we

Questions I will need to be prepared to answer:
Consequences if not approved
Who will pay for construction?
Why not grant all funds to SMBRC?

From: Shelley Luce
To: Mary Small
Cc: Diana Hurlbert
Subject: RE: timelines...
Date: Monday, January 30, 2012 4:44:09 PM

Let's meet downtown at 11 am at Bottega Louie, it's on the corner of 7th and Grand. We can eat or just have coffee for as long as we want there, and then head over. Sound good?

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission
Pereira Annex MS:8160
1 LMU Drive, Loyola Marymount University
Los Angeles, CA 90045
310-961-4444

www.santamonicabay.org

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Monday, January 30, 2012 4:30 PM
To: Shelley Luce
Cc: Diana Hurlbert
Subject: Re: timelines...

Great, let's meet before maybe 11?
Downtown would be easy for me but I could also fly to LAX and meet at LMU, if we do that maybe we could meet a little earlier?

Sam can't make it, this rescehduled time didn't work for him.
Mary

sent from my phone

On Jan 27, 2012, at 12:38, Shelley Luce <sluce@santamonicabay.org> wrote:

> I have kept the whole day open. You can Sam can tell us what works for you - meet earlier downtown or at LMU, anytime after 9:30 is good for me. We can reserve a conf room at water board offices or meet at a coffee shop if we do it downtown.
>
> *Shelley Luce, D.Env.*
> *Executive Director*
> *Santa Monica Bay Restoration Commission*
> *Pereira Annex MS:8160*
> *1 LMU Drive, Loyola Marymount University*
> *Los Angeles, CA 90045*
> *310-216-9827*
> *www.santamonicabay.org*
>
> **From:** Diana Hurlbert
> **Sent:** Friday, January 27, 2012 10:07 AM
> **To:** Mary Small; Shelley Luce
> **Subject:** RE: timelines...

things that we were discussing and I didn't think that was part of our plan. I do think we can continue discussion of relevant things with SAC members as we write the draft EIR, and reconvene if necessary. Is that what you were thinking?

Talk to you Monday!
Shelley

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission
Pereira Annex MS:8160
1 LMU Drive, Loyola Marymount University
Los Angeles, CA 90045
310-961-4444

www.santamonicabay.org

From: Mary Small
To: "Mary Small"; "Shelley Luce"
Cc: "Diana Hurlbert"
Subject: RE: draft agmt SMBRF 2
Date: Monday, February 13, 2012 9:28:00 AM

Hi
Can you let me know if this looks basically ok so I can send it to Mr. Davis?
Thanks
Mary

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, February 07, 2012 2:28 PM
To: 'Shelley Luce'
Cc: 'Diana Hurlbert'
Subject: draft agmt SMBRF 2

Hi Shelley
Attached is a draft of the grant agmt to the SMBRF for the $240K. We'll need to develop a work plan and budget separately.

Can you take a quick review and let me know if it looks ok? Elena has asked me to produce this draft quickly as it seems the best way to respond to our most recent PRA from Mr. Davis.

Thanks
Mary

REQUEST FOR SERVICES

Ballona Wetlands Ecological Reserve
Environmental Analysis and Permit Assistance

May 11, 2009

Contract Type: Environmental Professional Services

Scope:
Perform environmental analysis and assist in applying for permits for habitat enhancement and public access improvements at the Ballona Wetlands Ecological Reserve in Los Angeles.

Submittal Deadline: **June 1, 2009**
Proposals should be submitted electronically in adobe acrobat format and must be received at the Conservancy by June 1, 2009.

Contact: Mary Small, California Coastal Conservancy, msmall@scc.ca.gov

REQUEST FOR SERVICES

Ballona Wetlands Ecological Reserve
Civil and Geotechnical Engineering and Permit Assistance

February 8, 2010

Contract Type: Civil Engineering and Geotechnical Professional Services

Scope: Provide engineering and geotechnical evaluations, design and related services for the proposed wetland restoration design of the Ballona Wetlands Ecological Reserve in Los Angeles. Technical studies, evaluations, and designs will be of sufficient detail to support completion of a project level EIR/EIS and preparation and processing of a Section 408 permit through the Army Corp of Engineers.

Submittal Deadline: February 29, 2012

Proposals should be submitted electronically in adobe acrobat format and must be received at the Conservancy by February 29, 2012.

Contact: Mary Small, California Coastal Conservancy, msmall@scc.ca.gov

Reserve in Los Angeles County. Services are needed to complete engineering and geotechnical evaluations, hydrology, technical studies, design and related services to support completion of a project level EIR/EIS and preparation and processing of a Section 408 permit through the Army Corp of Engineers. One contract will be for Civil and Geotechnical Engineering and a second contract will be for Hydrology and Engineering Design Analysis.

~~~~~~~~~~~~~~~~

Mary Small
Deputy Executive Officer, Coastal Conservancy
1330 Broadway #1300 Oakland, CA 94612
510-286-4181
~~~~~~~~~~~~~~~~

California Coastal Conservancy

Re: Public Records Request

Please provide any statute which exempts the California Coastal Conservancy from the California Contract Code as it relates to the Agency entering into contracts of any type.

Thank you,

John Davis

-------- Original Message --------
Subject: RE: PUBLIC RECORDS REQUEST FROM JOHN DAVIS MARCH 21, 2012
From: "Elena Eger" <eeger@scc.ca.gov>
Date: Tue, March 27, 2012 5:27 pm
To: <jd@johnanthonydavis.com>
Cc: "'Mary Small'" <msmall@scc.ca.gov>, <sschuchat@scc.ca.gov>

Dear Mr. Davis:

Your request below does not constitute a request for a record pursuant to the Public Records Act. Rather, your request is for an analysis of statutory law. I am ethically prohibited from providing counsel to anyone other than my client. Assuming that you are not a lawyer, I am also ethically bound to suggest to you that you obtain your own counsel to advise you on such matters. You may utilize the California State Bar website for referrals to counsel at www.calbar.ca.gov.

Sincerely,

Elena Eger

Senior Staff Counsel

Dear Mr. Davis:

This correspondence contains the Coastal Conservancy's (Conservancy) response to your March 21, 2012 Public Records Act request, below.

The Conservancy does not possess any responsive records to either of your numbered requests. However, we direct you to Government Code Sections 4525 *et seq*. and 14 California Code of Regulations Sections 13870 *et seq.* for our contracting process.

Sincerely,

Elena Eger

Senior Staff Counsel

California Coastal Conservancy

1330 Broadway, Ste. 1300

Oakland, CA 94612

510-286-4089 tele/voicemail

510-286-0470 fax

From: jd@johnanthonydavis.com [mailto:jd@johnanthonydavis.com]
Sent: Wednesday, March 21, 2012 2:11 PM
To: "Samuel Schuchat"; "John Laird"; 'Dick Wayman'; 'Nadine Peterson'; carmenp@scc.ca.gov; kimg@resources.ca.gov
Cc: John Chang
Subject: PUBLIC RECORDS REQUEST FROM JOHN DAVIS MARCH 21, 2012

California Coastal Conservancy

Att: Executive Director Sam Schuchat

California Coastal Conservancy March 21, 2012

2. Please provide any and all public records that demonstrate compliance with California Public Contract Code Section 10515-10518 in regard to the California Coastal Conservancy approval on January 19, 2012 of File No. 04-088 which approved money to be disbursed for engineering, hydrologic analyses, geotechnical assessments, and public design.

No such records have been requested or received by me to date.

See Attached Approval for File No. 04-088

Thank you,

John Davis
PO 10152
Marina del Rey Ca. 90295

PUBLIC CONTRACT CODE SECTION 10140-10141

10140. **Public notice of a project shall be given by publication once a week for at least two consecutive weeks or once a week for more than two consecutive weeks if the longer period of advertising is deemed necessary by the department, as follows:** (a) **In a newspaper of general circulation published in the county in which the project is located**, or if located in more than one county, in such a newspaper in a county in which a major portion of the work is to be done. (b) **In a trade paper of general circulation published** in San Francisco for projects located in County Group No. 1, as defined in Section 187 of the Streets and Highways Code, or **in Los Angeles for projects located in County Group No. 2, as defined in said Section 187, devoted primarily to the dissemination of contract and building news among contracting and building materials supply firms. The department may publish the notice to bidders for a project in additional trade papers or newspapers of general circulation that it deems advisable.** 10141. The notice shall state the time and place for the receiving and opening of sealed bids, describing in general terms the work to be done and that the bids will be required for the entire project and for the performance of separate designated parts of the entire project, when the department determines that segregation is advisable.

The prohibition of this subdivision shall not apply to a contract requiring the person's services as an expert witness in a civil case or to a contract for the continuation of an attorney's services on a matter he or she was involved with prior to leaving the university. (c) This section does not prohibit the rehire or reappointment of University of California employees after retirement, consistent with university administrative policies, nor does it apply to inventors and authors of intellectual property licensed under technology transfer agreements. 10518. (a) Except as otherwise provided in subdivision (b), each contractor who enters into a contract with a University of California campus for ten thousand dollars ($10,000) or more shall be assigned an identification number by the chancellor of that university campus. Each contractor who has been assigned a number shall list it on each contract the contractor enters into with the university campus, regardless of the amount of the contract. In the case of a corporation or firm, the chancellor's assigned number shall be used exclusively on each contract with that particular chancellor's campus. The assigned number shall remain unchanged regardless of future name changes. (b) If the identification numbers cannot be tracked centrally by the Regents of the University of California, then the regents, and not the chancellors, shall assign the identification numbers.

From:	Mary Small
To:	"Barbara Romero"
Cc:	"Melissa Guerrero"; "Diana Hurlbert"; "Shelley Luce"
Subject:	SCC mtg in Jan
Date:	Monday, December 19, 2011 3:30:00 PM
Attachments:	Ballona_Wetlands_Engineering and Technical Studies.docx

Hi Barbara,
Thanks for agreeing to support the recommendation for funding for engineering work at Ballona. Attached is the draft staff report, the project will be heard at our Jan 19th meeting at the Baldwin Hills Scenic Overlook. As you can see it's a pretty big authorization, so we'd love your support. I think we may take the Board on a tour of Ballona that morning and then the meeting will start around 12:30. It would be great to have MRCA join us for either the tour or the meeting.

Thanks also for the message about the early action plan grant. When you have time submit any final billing or just a letter stating that the work is all done and I'll close it out.

Hope you are doing well and have a great holiday.
Mary

ATTACHMENT 8

The Information Practices Act (Civil Code section 1798 et seq.) generally prohibits agencies from disclosing an individual◊s personal information to the public.

Thank you,

John Davis
PO 10152
Marina del Rey Ca. 90295

From: jd@johnanthonydavis.com [mailto:jd@johnanthonydavis.com]
Sent: Thursday, February 16, 2012 1:29 PM
To: Elena Eger
Cc: 'Mary Small'; 'Sam Schuchat'; 'Dick Wayman'; 'Shelley Luce'; svalor@santamonicabay.org
Subject: Reply from John Davis RE: Davis' Requests for Information

California Coastal Conservancy
Att: E.Eger
Re: Reply

Dear E. Eger,

The request for public records submitted on 2/14/2012 remains outstanding.

The Commission still needs to reply to this request within 10 days of the submission date. I do expect a reply by 2/24/2012 as
the Public Records Act requires under law.

I also would take issue with your recent email stating that I made a DEMAND of the Commission. This is far from true.

In fact my email stated the INTENDED PURPOSE of the email and made no demands as you stated to me in your email to me.

Prior to that, you inferred in another email that I made statements and or asserted things that I clearly did not.

I corrected you once alreadyin writing, and find I must do so yet again.

Your accuracy in characterizing my telephonic conservations or written documents should not be clouded by your misconceptions
as I do not find it to be professional in your role as a State Attorney.

Regards,

John Davis
PO 10152
Marina del Rey Ca. 90295

From: "Elena Eger" <eeger@scc.ca.gov>
Date: Tue, February 14, 2012 12:32 pm
To: <jd@johnanthonydavis.com>
Cc: "'Mary Small'" <msmall@scc.ca.gov>, <svalor@santamonicabay.org>, "'Shelley Luce'" <sluce@santamonicabay.org>, "'Dick Wayman'" <dwayman@scc.ca.gov>

Mr. Davis:

This is in partial response to your PRA, below and your request of yesterday at 5:15 p.m. in which you demand that we not share your communications with "any private business" and in which you characterize such communications as "private".
While we will provide you with your requests to the extent possible and in compliance with the PRA, we must clarify to you that communications between you, as a member of the public, and the Conservancy, a public agency, are not considered under the PRA and thus not by the Conservancy to be "private communications", subject to any privilege or exception under the Act. Indeed, we will continue to share communications to you or from you with our other Ballona project partners, irrespective of whether the partner is a public or private organization, when we, at our sole discretion, determine that dissemination to be useful for our project purposes.
I would also like to clarify for you for your future purposes that my title is not "council" but "counsel", that is, I am a lawyer, not a member of a council.
Sincerely,

Elena Eger
Senior Staff Counsel
California Coastal Conservancy
1330 Broadway, Ste. 1300
Oakland, CA 94612
510-286-4089 tele/voicemail
510-286-0470 fax

****

From: jd@johnanthonydavis.com [mailto:jd@johnanthonydavis.com]
Sent: Tuesday, February 14, 2012 10:49 AM
To: Elena Eger
Subject: PUBLIC RECORDS REQUEST FROM JOHN DAVIS

California Coastal Conservancy
Att: Council E. Eger
Re: Public Records Request

This is a public records request made pursuant to the California Public Records Act. Each numbered item is a separate and distinct request for public records. This letter is only intended to for the California Coastal Conservancy and NOT FOR ANY PRIVATE BUSINESS, unless requested by such a business via the California Public Records Act.

1. Provide any and all emails to and received by the California Coastal Conservancy

As I stated in my email of yesterday to you, we intend to comply with your records request to us of 2/14. We are working on compiling the records that you have requested. Please clarify whether you wish to receive the emails pertaining to correspondence among Mr. Valor, Ms. Luce and Conservancy staff with respect to the Item #5 on the 1-19-12 agenda only.

Please clarify that you are referring to the Conservancy when you make reference to the "Commission" in your message below.

As to your other allegations contained in your email below, I remind you that, as I said yesterday, we will make no further comment, which, of course, does not mean that we agree or disagree with your interpretations. Again, unless you are requesting a record from us under the Public Records Act, we do not intend to make further explanatory comments to you.

Sincerely,

Elena Eger
Senior Staff Counsel
California Coastal Conservancy
1330 Broadway, Ste. 1300
Oakland, CA 94612
510-286-4089 tele/voicemail
510-286-0470 fax

-------- Original Message --------
Subject: Davis' Requests for Information
From: "Elena Eger" <eeger@scc.ca.gov>
Date: Wed, February 15, 2012 6:45 pm
To: <jd@johnanthonydavis.com>
Cc: "'Mary Small'" <msmall@scc.ca.gov>, "'Sam Schuchat'" <sschuchat@scc.ca.gov>, "'Dick Wayman'" <dwayman@scc.ca.gov>, "'Shelley Luce'" <sluce@santamonicabay.org>, <svalor@santamonicabay.org>

Dear Mr. Davis:

In response to your inquiry below, I am providing you with the link to our website's contents of Item 5, Ballona Restoration Project, approved at the Conservancy's 1-19-12 public meeting unanimously. All my references are to the contents in this link. http://scc.ca.gov/webmaster/ftp/pdf/sccbb/2012/1201/20120119Board05_Ballona_Wetlands.pdf.

I believe in your message below you are referencing Exhibit 4. This record reads at the bottom of the page in the key: "Existing habitat units based on field survey conducted by the California Department of Fish and Game, October – December 2000. Map created by GreenInfo Network October 20, 2011." The Conservancy's logo is next to this statement.

With respect to the remainder of your email to us, below, except for our response to your last statement regarding the Conservancy's

our restoration partner on this project. We direct you to the Conservancy's website at www.scc.ca.gov, Ballona restoration for identification of our project partners on this project.
With respect to whether DFG provided the Conservancy with permission to put our logo on this proposed restoration design, please note that the Conservancy is a project partner with DFG and that within this partnership, the Conservancy acts as the lead in restoration planning with the full agreement of the other project partners, including the DFG.
Sincerely,

Elena Eger
Senior Staff Counsel
California Coastal Conservancy
1330 Broadway, Ste. 1300
Oakland, CA 94612
510-286-4089 tele/voicemail
510-286-0470 fax

From: jd@johnanthonydavis.com [mailto:jd@johnanthonydavis.com]
Sent: Monday, February 13, 2012 5:15 PM
To: 'Elena Eger'
Cc: 'Nadine Peterson'; 'Sam Schuchat'; 'Dick Wayman'; Mary Small
Subject: RE: Davis call to Eger of 2-6-12

California Coastal Conservancy
Att: Elena Eger Legal Council
CC Mary Small Project Manager
Re: Item 5 January 19th 2012 Meeting

Hello Council Eger,

Mary Small directed me to you to answer a question about the hearing noted above.

The attached map was presented as a projection.

It bears the seal of the State Coastal Conservancy. The small text below the legend is hard to read but it
does reference the California Dpt. of Fish and Game in 2011. The text is not clear. It appears to say Ballona Wetlands units.....summary conducted the California Dpt of Fish and Game .....Map created by .....October 20, 2011.

Could you provide the correct reading of this text?

For what purpose did Fish and Game produce this map?

Did Fish and Game provide specific permission for the Conservancy to place its seal (logo) on this

From: Mary Small
To: "Elena Eger"
Cc: "Scott Valor"
Subject: FW: State Water Board Legal"s Memo to our Governing Board
Date: Monday, February 06, 2012 4:47:02 PM
Attachments: SWRCB memo2011aug re accusations.pdf
SWRCB Ltr to Davis re PRAs.pdf

Hi Elena

Scott Valor emailed this to you but he had the wrong address.

Mary

From: Scott Valor [mailto:svalor@santamonicabay.org]
Sent: Monday, February 06, 2012 3:42 PM
To: msmall@scc.ca.gov; eeeger@scc.ca.gov
Subject: State Water Board Legal's Memo to our Governing Board

Mary & Elena--

The attached memo to our Governing Board may help with some background. It was not only given to our Governing Board, it is posted on our website, and was forwarded to John Davis and Patricia McPherson, among others. It addresses virtually all of the accusations made against the Foundation and Commission.

Attached also is a direct letter to John Davis from SWRCB legal noting how Foundation staff and contractors legally serve the SMBRC. For example, I am a contractor to the Foundation, but I am authorized to act on behalf of the Commission. He refuses to acknowledge that, which will never change. However, the documents speak for themselves.

One reason he may be contacting you (again) is that SWRCB legal told him that any future PRA queries to the Commission must be directed to me. He simply won't do that so he seeks ways around it. It would be entirely appropriate for you to re-direct any queries relevant to the SMBRC to me.

Call me if/when questions arise.

/s

Scott Valor
Director of Government Affairs
Santa Monica Bay Restoration Commission
310-922-2376

visit us at www.smbrc.ca.gov

State Lands Commission owns approximately 60 acres, including the Freshwater Marsh and the Expanded Wetlands parcel. The State Coastal Conservancy (SCC) is taking the lead in funding for planning and restoring the property. Together, the three agencies are working with stakeholders, scientific experts and other agencies to develop a plan for restoration of this extraordinary resource. Their goals are to:

- Restore and enhance salt-water influenced wetland habitats to benefit endangered and threatened species, migratory shorebirds, waterfowl, seabirds, and coastal fish and aquatic species. Restoration of seasonal ponds, riparian and freshwater wetlands, and upland habitats will be considered where beneficial to other project goals or biological and habitat diversity;

- Provide for wildlife-dependent public access and recreation opportunities compatible with the habitats, fish, and wildlife conservation;

- Identify and implement a cost-effective, ecologically beneficial, and sustainable (low maintenance) habitat restoration alternative.

Milestone 7.1c: Secure funding source (approximately $50 million, total project cost $100–200 million) sufficient to complete first phase implementation of preferred alternative by 2010.

Implementation Lead: Coastal Conservancy
Implementation Partners: State Parks, SCWRP, NMFS

Role of the SMBRC: Participate



On Fri, Sep 28, 2012 at 2:52 PM, Johntommy Rosas

Bay watershed ecosystem and their preservation and restoration is a high priority of the Bay Restoration Commission. Wetlands are areas of transition between land and water, where soils, plants, and animals are adapted to periods of inundation and saturation. Wetlands are one of the most productive ecosystems in nature, providing essential habitat for a variety of species, including birds, fish, reptiles, invertebrates, and mammals. Wetlands act as natural filters which are able to absorb and remove pollutants from the water. They are also valuable in providing flood protection, groundwater recharge, recreational use, and aesthetic

channelization of Ballona Creek have all reduced what was once a 2,200-acre coastal estuary to less than 200 degraded acres today. Poor tidal exchange, polluted runoff, and invasive plants and animals also impact the wetlands.

In 2004, the State of California took title to 600 acres of the former Ballona Wetlands in Los Angeles. The property is now owned by two state agencies, the Department of Fish and Game (DFG) and the State Lands Commission (CSLC). DFG took title to approximately 540 acres of the former wetlands. DFG also holds title to a section of Ballona Creek. The



k:\san diego\projects\coastal_conservancy\658.09_balboa_wetlands\mapdoc\fig03_proposed_project.ai 55 (04-30-12)

Source: ESA PWA

PSOMAS

Balancing the Natural and Built Environment

PSOMAS WORK PLAN

BALLONA WETLANDS RESTORATION

Prepared for

California State Coastal Conservancy
1330 Broadway, 13th Floor
Oakland, California 94612

Prepared by:

PSOMAS
555 South Flower Street, Suite 4400
Los Angeles, CA 90071
Project Number TCCC0101.00

June 22, 2012

555 South Flower Street
Suite 4400
Los Angeles, CA 90071

Tel 213.223.1400
Fax 213.223.1444
www.Psomas.com

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SECTION I

INTRODUCTION

Project Understanding

Psomas has unmatched technical engineering knowledge of the Ballona Wetlands that spans 25 years. No other firm has been involved or has more engineering knowledge of the wetlands and its surroundings than Psomas. We have extensive knowledge of the infrastructure of the surrounding community as well as The Gas Company facilities throughout the area as a result of our extensive previous work in the community surrounding the Ballona Wetlands. This extensive historical knowledge, has provided us with unique insight and understanding of the opportunities for the restoration plan and the Conservancy's goals for this project.

The State Coastal Conservancy through the PMT team has developed a conceptual plan to restore the Ballona Wetlands ecosystem. It will comprise diverse habitat ranging from sub-tidal through various marshland conditions to upland habitat. The objective of this restoration program is to reintroduce and revive critical wetland habitat and provide a remarkable natural open space for the public benefit. The Ballona Wetlands Restoration Project will enhance the coastal environment for reintroduction of target animal and plant species that left the area because of human development and related loss of the coastal wetland.

The existing Ballona Wetlands have suffered from more than a century of human neglect and abuse that has resulted in a highly degraded habitat area. Much of the area was used for disposal of dredging spoils from construction of Marina Del Rey and the Ballona Creek flood control channel. The Ballona Creek flood control channel was constructed to provide flooding protection for development of lands upstream from the original wetlands; however, the channel also severed the historic natural connection between the freshwater creek and the ocean. As a result, many of the historic ecological functions of the wetlands were lost and no longer support the wide variety of native species that once inhabited the area.

The PMT and their consultant team have studied several alternatives that would allow the reconstruction of a coastal wetland environment and reintroduction of the native species common to these wetlands. While a number of alternatives have been analyzed, a preferred alternative has been developed that involves the removal of segments of the Ballona Creek levees and the reconstruction of a portion of the Ballona Creek channel on an alignment that more closely represents a natural meandering water course. Implementation of this plan will require a technical analysis and review and approval by the County of Los Angeles and U.S. Army Corps of Engineers (USACE) with a Section 408 permit.

More specifically, the preferred project proposes to implement restoration of areas on the north and south sides of the existing Ballona Creek on lands adjacent to Marina Del Rey within Los Angeles County (County) Area A and City of Los Angeles Area B, as well as some restoration in Area C in the City of Los Angeles. This work will generally include:

- Build in flexibility of delivery to address availability of funding. Staged or phased delivery through master planning the construction sequencing.
- The removal of the north and south Ballona Creek levees to allow tidal and stormwater interaction within the Ballona Wetlands Ecological Reserve area.

- Construction of new perimeter levees along the perimeter and strategic alignments within the restoration area to provide the flood protection of existing developed areas when the existing levees are removed.
- Grading to create a restored condition allowing multiple habitat regimes from sub-tidal to upland conditions.
- Execute the proposed construction through a master planned and phased program designed to reduce the environmental impacts as much as possible, balancing earthwork within the Reserve area.
- Assist the PMT in coordinating with and addressing the concerns of the many governmental agencies and other interested parties.

Project Objectives

Consistent with the Conservancy's stated goals, our project team's approach will be driven by the following three primary objectives and secondary objectives for the Civil/Geotechnical team:

Primary Objectives:

- Working with the PMT and Hydrology consultant team, obtain Section 408 approval from the USACE for the levee removal and its supporting analysis.
- Analyze impacts and mitigations for incorporation into the environmental analysis.
- Prepare plans and supporting documents for the grading and infrastructure at the appropriate level for the restoration project.

Secondary Objectives:

- Assist the PMT in obtaining approvals in the most efficient and effective manner. The process to obtain a 408 approval is by design not clearly defined to allow for the many existing conditions in USACE facilities.
- Assist the PMT in addressing the issues and concerns of the community and interested parties. Many groups and agencies are interested in this restoration. They each view it in different terms. Our goal is to provide information and support that is appropriately tailored for public presentation of our technical information in a non-technical manner.
- Ensure that the proposed design elements are sensitive to the environmental goals of the project. The overarching goal of restoring a natural wetland system must be the primary focus in our design.

SECTION II

MANAGEMENT

To meet the objectives of the project as described in Section I, Psomas developed an approach and work plan that identifies the design elements and sequences the work in an efficient and logical manner to allow the Conservancy to realize the restoration potential of this unique site.

Each project team member brings their particular strengths and capabilities that, when combined, cover all aspects of work required to meet the project objectives. The sections of work are identified in the work plan for each of the disciplines responsible for a technical aspect of the project. This section outlines the tasks that each team member will perform and sequencing of performance.

Sequence 1 – Project Initiation

Our first step will be to organize and coordinate our efforts with the project team. This includes preparation of this, more detailed schedule and work plan, developed in conjunction with other project team members and the PMT. The work plan identifies our primary sequences of work with specific tasks with sub-tasks. The schedule will identify Psomas activities and work items being provided by other project team members. Our primary objectives in the project initiation phase are two-fold: understanding the specifics of the work to be delivered and planning that work. We must gain a full understanding of the process we will pursue, the constraints we may encounter, and the steps to address these constraints in order to continue our progress. This understanding extends to the entire Psomas team. An initial full-day workshop start-up meeting will be held with the County agencies as the applicant for the 408 permit. This meeting is intended to provide an orientation for the County staff, and to outline rough expectations that will be refined more fully as the project progresses. A series of meetings and a coordination effort will then be undertaken to refine the procedures and technical criteria to be utilized. Our deliverable will be the final version of this work plan.

Sequence 2 – Data Gathering

During this stage we will gather existing data including topographic survey, record documents for easements, previous geotechnical analyses, utilities, and other constraints that may influence the final design. While the technical sections define specific tasks in more detail, a brief description of the tasks are described below.

- Topographic Survey – The currently available topographic survey is over 10 years old, having been compiled over a period of years from 1998 to 2000. It is also on a different datum than required by the USACE. Through aerial photographic compilation methods, we will prepare an updated topographic survey of existing conditions at 40-scale for areas A, B and C. Prior to undertaking the topographic survey, we will meet with the USACE and the County to discuss the project survey datum. Unless specifically required by an agency, we would use the latest datum adjustment developed for the area by Los Angeles County.

- Boundary and Easements – One of the requirements for any restoration project is the understanding of the legal encumbrances of the property. Using the existing ALTA survey

provided in AutoCAD format by the Coastal Conservancy, we will compile an exhibit showing existing easements, rights of way, lease areas, etc. on the property and their planned disposition. For example, whether an easement is to remain or be vacated, or a new one provided. The boundary will be translated as needed to correspond to the coordinate base used for the new aerial topography, which will be established based on USACE and County requirements.

- Utility Mapping –Utility records already obtained from our previous work on the site (as well as work by another consultant, PWA) will be reviewed, additional records search will be conducted as required, and the known utility lines within and adjacent to Areas A, B, and C will be plotted. Utility type, location, and size will be identified as available.

- Aerial Photography – Along with the topographic survey, a 40-scale color orthographic presentation quality aerial photograph will be prepared that overlays the topographic survey.

- Previous Geotechnical Analyses – Group Delta, will review previous analysis, both historical and recently conducted. All available data will be compiled to help determine the need and location for additional field exploration and site analysis related to soils, seismic, and liquefaction conditions, as well as settlement, structural, and grading requirements.

- Locations of Geotechnical Test – Locations for the additional geotechnical investigation bore holes and test pits that may be required will be identified. A construction stake will be placed at each of the test locations. Approximately 60 locations will be initially required. These locations will be referenced as a data layer on the topographic survey.

- Geotechnical Field Exploration – Upon receiving approval for field exploration, subsurface exploration for a number of borings will be performed ranging from 25 to 70 feet deep along the proposed levees and at appropriate locations of expected improvements. Site clean-up will occur to leave the boring trenching locations in a similar condition as prior to the start of work, with any excess materials removed and disposed of per applicable regulation.

- Geotechnical Analysis – Geotechnical, environmental, and chemical analysis of the sample materials obtained during the field exploration will be conducted.

- Habitat Surveys – If habitat survey information is available, Psomas can work with the appropriate consultant to prepare a data layer that is aligned on the topographic survey.

- Specific Design Survey – Field-surveyed information will be gathered including channel cross sections, top of the levees for end protection implementation, and at existing storm drain culverts and pipes in and adjacent to the property along Culver Boulevard, Jefferson Blvd, Lincoln Boulevard, Fiji Way, and the existing Ballona Creek levees.

- Constraints Map – Using the information and data compiled above, a constraints map will be created for use by all team members. This "Base" map is intended to identify all existing conditions to provide the foundation for future design analysis. An overall map as well as stand-alone map for all three areas will be prepared.

The data gathering components described above have been developed under the assumption that we will have to develop a substantially complete design (at least 70% documents) in order to satisfy Los Angeles County and the USACE requirements. If these agency requirements can be met with a 30% design level of effort, then the topographic survey and related data can be used when the final design documents are prepared.

Due to delays that will occur due to avoidance of sensitive habitats such as nesting seasons, and time to obtain approvals for geotechnical field investigations, the Data Gathering Sequence will overlap with the Preliminary 30% Design Sequence. Final deliverables will include a fully completed design and rectified aerial survey, a fully reviewed constraints map and report, and all geotechnical field exploration.

Sequence 3 – EIR/EIS Support

A great deal of work has already been completed for the EIR/EIS including evaluation of road and levee alignments, investigation of utilities relocation impacts, grading quantities expected, phasing and staging of construction, etc. Psomas will provide additional support as needed to refine or clarify issues identified in the EIR/EIS analysis that relate to the roads, grading, and infrastructure elements of the work. The extent of additional studies and support is not defined at this time and will only be clarified as the EIR/EIS impacts and mitigation measures are refined. These studies will draw upon the already extensive amount of work and analysis that has previously been prepared by the EIR/EIS team. This EIR/EIS Support phase does not have a distinct schedule and may occur throughout the process.

Sequence 4 – Design Services

The design services discussed below are structured to provide various levels of design that may be required for the EIR/EIS and to meet the USACE Section 408 permit requirements as well as requirements from other reviewing agencies. These levels of design can be considered as 30% or preliminary design, 70% design documentation and 100% full construction documents. The level of effort required to obtain the 408 permit is not clear at this time for several reasons as listed below. As the project progresses, the actual requirements to be provided will be more clearly defined.

- The USACE requirements for the 408 approval as described in their own Clarification Guidance Memo are not clearly defined, by design, to allow for the many conditions that exist with USACE Facilities.
- The USACE Western Region has issued few major 408 permits within the memory of their current staff. It is therefore more difficult to determine the level of work that will be required for approval.
- The 408 permit requires approval from USACE Headquarters in Washington D.C. This adds another layer of review and process to the permit.
- Los Angeles County is the public agency responsible for ongoing operation and maintenance of the Ballona Creek flood control channel and levees and will be the applicant for the 408 permit.
- The Department of Fish and Game has a major interest as the landowner and steward of the natural resources on the site that could shape or adjust the construction and sequencing through the process.
- There are many interested parties and stakeholders who will have input into our work which will require adjustments throughout the process.

To address these uncertainties, we have organized the design portion of our work plan into three submittal efforts. This includes a sequenced design process roughly corresponding to 30%, 70%, and 100% complete drawings and supporting documentation. Performing work in these three design stages is intended to provide the project team with a framework for a logical progression through the approval process without the need to commit to more work effort than may be required to meet the project objectives. By providing sufficient scope and budget for design and approval work through 100% documents, the Conservancy can budget for and implement a full documentation of the design should that level of effort be required to meet the Section 408 permit requirements or other project related approvals that may be needed to meet the project objectives.

30% Preliminary Design (Eight Months – by December 2012)

Psomas will manage and be responsible for all services provided by our team. We have listed the disciplines by the team member.

Civil and Survey – Psomas (See Sections III and V)

Geotechnical – Group Delta (See Section IV)

Structural – JCE (See Section VI)

The application to the USACE will initially be submitted with a Preliminary Design Report in the July / August time frame, with the first formal submittal at approximately the 30% design level in the December time frame. This submittal is considered the formal Preliminary submittal. Coordination and review will have occurred up to this formal submittal to gain USACE concurrence with our proposed methodology and proposed construction. The goal of this Preliminary submittal is to provide a total package of our analysis to obtain written USACE concurrence of our proposed construction, and the specific technical requirements for 408 approval.

70% Design Documents (Six Months – January to June 2013)

We anticipate that County and USACE comments to the 30% submittal will help define the direction and responses for our 70% submittal. This 70% level of design effort would involve preparing detailed design calculations and analysis to address the USACE comments. The specific tasks defined for this sequence is outlined in Sections III through VI.

Our intent is that the formal 70% application package to the USACE will provide all the analysis and detail necessary to gain approval for a 408 permit. Coordination and review with the USACE will occur prior to the 70% submittal to clarify and fully understand the intent of all of their 30% comments so that the 70% application package is complete and understandable. This 70% submittal therefore should be considered the formal "Technical" submittal. We expect that the USACE will conduct a detailed technical plan checking process of all of the information provided.

100% Construction Documents (Six Months – June to December 2013)

As in any technical review, additional comments and questions from the USACE are expected. This 100% construction documents phase is expected to include the work efforts necessary to answer their questions and incorporate their comments up to the time a formal 408 permit approval is issued.

Work effort during this 100% stage will include coordination, processing, and updates to address plan check comments to the 70% design documents through the various public agencies for design and permit approval for the construction work. The 70% construction cost estimate will be updated when the plans are at an approval stage. We anticipate that approvals and clearance letters will be required from all appropriate agencies:

SECTION III

SURVEY

The Survey Work Plan is organized into four tasks corresponding to the four primary areas of effort. These tasks are:

- The initial survey establishment.
- The preliminary survey and collection of physical and legal/informational data.
- The production efforts.
- The support related to easements documentation.

The first three areas are in direct support, and a prerequisite of, the design effort. The last area will be provided toward the end of the process after design is approved to the level that easements can be granted to appropriate agencies. These tasks are intended to all be completed during the overall Data Gathering efforts.

I. Initial Survey Establishment Work:

This initial stage of the Survey Work Plan is intended as the detailed planning stage to define the efforts necessary for the rest of the project. There can be some scheduling overlap with the next stages, but this will be limited to field information that will not be adjusted if the datum or coordinate system adjusts. The first priority is to define the horizontal coordinate system and vertical datum to be used for all aspects of the project design. Coordination with the County of Los Angeles and the U.S. Army Corps of Engineers is necessary to obtain concurrence for the selected datum. The limits of topographic work and determination of available data from other sources will also be considered and determined. Coordination with the team will be undertaken to determine the parameters of the field survey data to be collected to satisfy the design team needs. Review of the available legal and ALTA information, record utility and infrastructure, and other available and pertinent documentation.

A. Scope:

1. Meeting with County of Los Angeles
2. Coordination with team and agencies
3. Review available records and information

B. Deliverables in Report Format only:

1. Establish Vertical Datum
2. Establish Horizontal Coordinate System
3. Establish Limits of Aerial Topography and Sections for the Channel
4. Establish locations for specific field collection of data
5. Establish process for integration of all data into base information

II. Preliminary Survey and Collection of Data:

In coordination with access availability due to nesting season constraints, field survey will be conducted to collect the aerial and field determined data necessary for design. The field work will commence immediately upon receiving an access permit from DFG. Some of the field work will ultimately be in or adjacent to

nesting areas. That portion of the field data collection will be postponed until clearance for access is given by project ornithologist after approximately July 31, 2012. This remaining field survey effort in or adjacent to the nesting areas should be conducted and completed within a few weeks of the ornithologist's clearance date and is intended to complete the field data collection efforts without overlap into the next year's breeding season. However, if additional field survey collection is needed in support of progressing design beyond this time frame, and potential into the breeding season for next year, clearance from the project ornithologist will again be obtained. Aerial targets will be located, some of which will double as benchmarks for each project area. We will arrange for the collection of ortho-photographic data by aerial flight for the production of a topographic survey file. Field collection of the cross sections for the Ballona Channel and other upstream channels will be conducted. This will include collection of data for the location and orientation of structures within and adjacent to the Channel. Full sectional data will be collected from the end of the Ballona levees to the west to the start of the fully concrete lined portion of the channel east of Lincoln Boulevard. Channel flow line will be collected east of this point to verify horizontal and vertical alignment with design sections created from as-built plans to the limits identified on "Figure 1 – Initial Input on Survey and Geotech Plan". Cross sections for the tidal channels within Area B will be collected and integrated with sectional information provided separately. Detailed topographic transects will be collected initially in Area A and Area C north of Culver Boulevard followed by the other areas as clearance is given for access. Collection of field survey will also be conducted to determine the bridge underside and cross sectional configuration of the three bridge crossings adjacent to the area – Lincoln Boulevard, Culver Boulevard, and the Pacific Avenue extension. Office survey will be conducted to compile and integrate the data collected. All field collected data will be incorporated into the overall topographic electronic file. Input of the available legal and ALTA information, record utility and infrastructure, and other available and pertinent documentation will be incorporated into the base files for use by the design team. After completion of the dredging operation currently planned for the mouth of the Marina Channel opening, we will incorporate the as-built information into the base files.

A. Sub-Tasks:

1. Set Aerial Targets.
2. Run horizontal and vertical closures for datum integration.
3. Collect existing cross sectional data (500' spacing plus upstream and downstream of bridges) through project limits.
4. Verify as-built channel data upstream and downstream of channel.
5. Collect existing topographic transect data.
6. Collect existing bridge cross sectional data.
7. Collect aerial ortho-photo data.
8. Collect existing structures data.
9. Collect existing public and private utilities record data.
10. Collect record easements and boundary data.
11. Collect habitat areas data.
12. Collect geotechnical testing locations and elevations.
13. Collect Gas Company facilities information.
14. Translate/ rotate Lidar data into our horizontal and vertical datum using project control information provided with Lidar data.
15. Review horizontal and vertical datum with USACE.
16. Collect specific tidal data through Lidar and/ or other appropriate methodology USACE information.
17. Sections generated through field data collection will commence at the end of the Marina del Rey levee to the west, to the bridge at State Route 90.

18. Cross sections for the Ballona channel east of State Route 90, Centinela channel and Sawtelle channel will be created from as-built data and will be verified with a single point at the flow line at each location.
19. At a high tide event and a low tide event, collect tidal elevation readings of water surface elevations on the north and south side of the southerly bank of the Ballona in Area B adjacent to the Los Angeles County tidal gage. Compare and integrate our benchmark with county gage date to verify datum.

B. Deliverables in Report Format:

1. Description of found data
2. Draft utilities cadd file
3. Draft boundary, easements, and constraints cadd file

III. Base Data Production:

After and during the collection of field data, production of the base survey data will be conducted. This will also include setting of field monumentation at various levels of survivability. Design and construction benchmarks will be set with relatively permanent monumentation for future use. While temporary wooden stakes or paint marks will be provided for guidance and control of the geotechnical investigation and miscellaneous data collection needs. The survey data to be provided to the team will include a commercially available area wide photograph at a pixel size of 18" that is sufficient for presentation graphics, an ortho-rectified aerial flight generated photograph of the limits of the aerial topography with a pixel size of 4" or less site specific presentation material, a digital terrain model electronic file, a variety of cadd details and sections describing the specific survey data necessary for design, and hardcopy plots of the data provided. Exhibits are attached for the limits of the aerial topo, verification of upstream cross sections, transects, and geotechnical investigation.

A. Sub-tasks:

1. Produce topographic data.
2. Produce photographic data.
3. Produce survey control.
4. Produce detailed design survey.
5. Produce exhibits detailing survey provided.
6. Produce constraints map.

B. Deliverables in Electronic and/or Report Format:

1. Aerial Photo of the area.
2. Aerial Photo of the project limits.
3. DTM file (autocadd).
4. DEM file (ArcGIS).
5. List and coordinates of Benchmarks/Survey Control.
6. Cadd files and hardcopy of channel cross sections.
7. Cadd files and hardcopy of detailed design survey areas.
8. Cadd file and hardcopy of final utilities.

9. Cadd file and hardcopy of constraints exhibit
10. Cadd file and hardcopy of geotechnical investigation locations.
11. Final report of survey results.
12. After integration of dredge information – update:

    a. DTM.
    b. Channel Cross Sections.

IV. Easements Support:

Once the design has been approved by both L.A. County and the USACE to a level the Project Management Team feels comfortable with, we will prepare legal descriptions and exhibits to identify the appropriate areas necessary for maintenance responsibilities, storm drain structures, and relocated facilities as necessary.

A. Sub-Tasks:

1. Identify and create easements areas.
2. Coordination with team and agencies in review and finalization of easements areas.

B. Deliverables:

1. Legal Descriptions and Exhibits.
2. Plan check revisions.

PSOMAS PROJECT NO 1CCC010100 T100

PROPOSED SOIL BORING LOCATIONS EXHIBIT

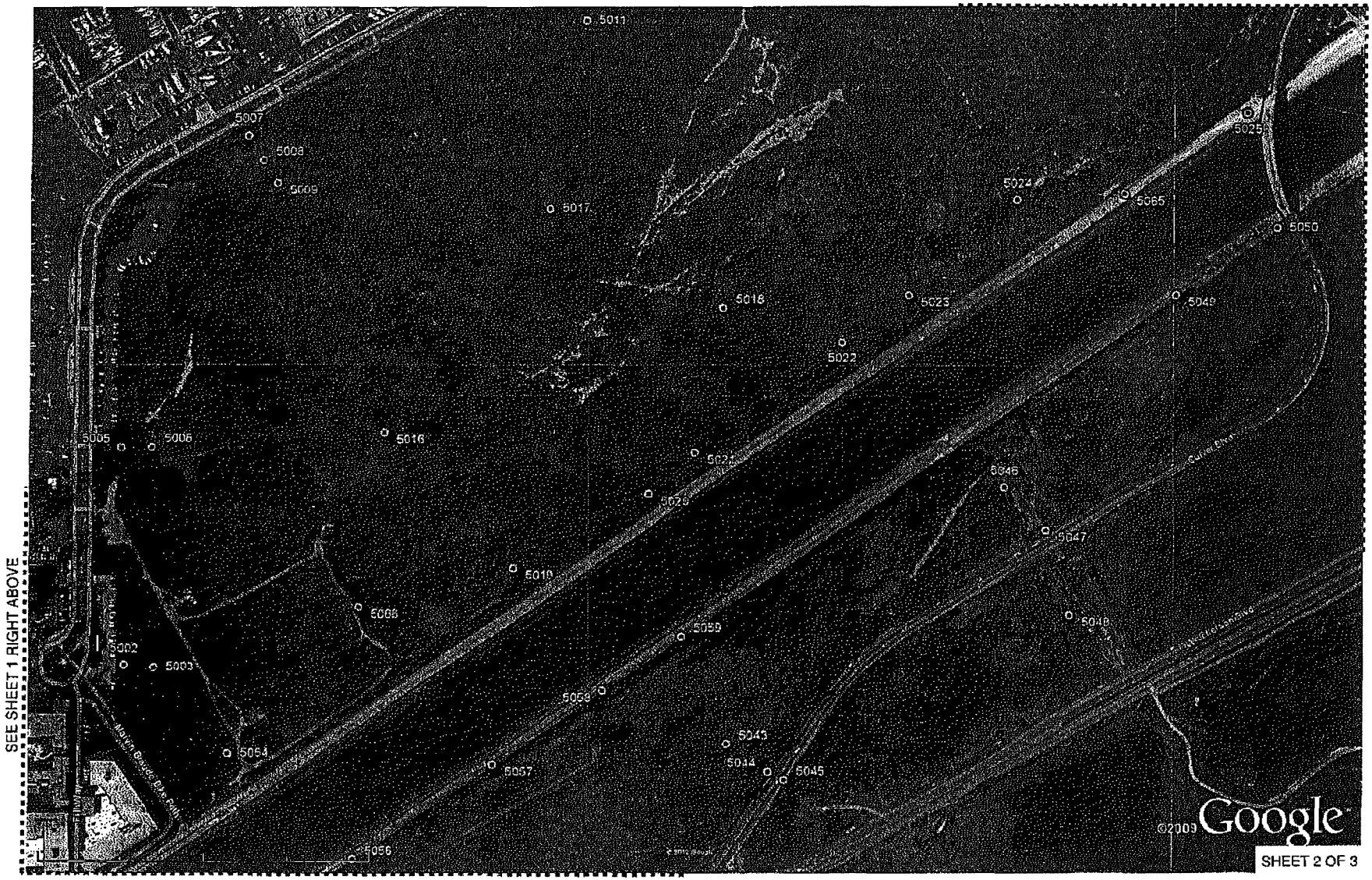
SEE SHEET 2 LEFT BELOW



PSOMAS PROJECT NO 1CCC010100 T100

PROPOSED SOIL BORING LOCATIONS EXHIBIT

SEE SHEET 3 LEFT BELOW



SEE SHEET 1 RIGHT ABOVE

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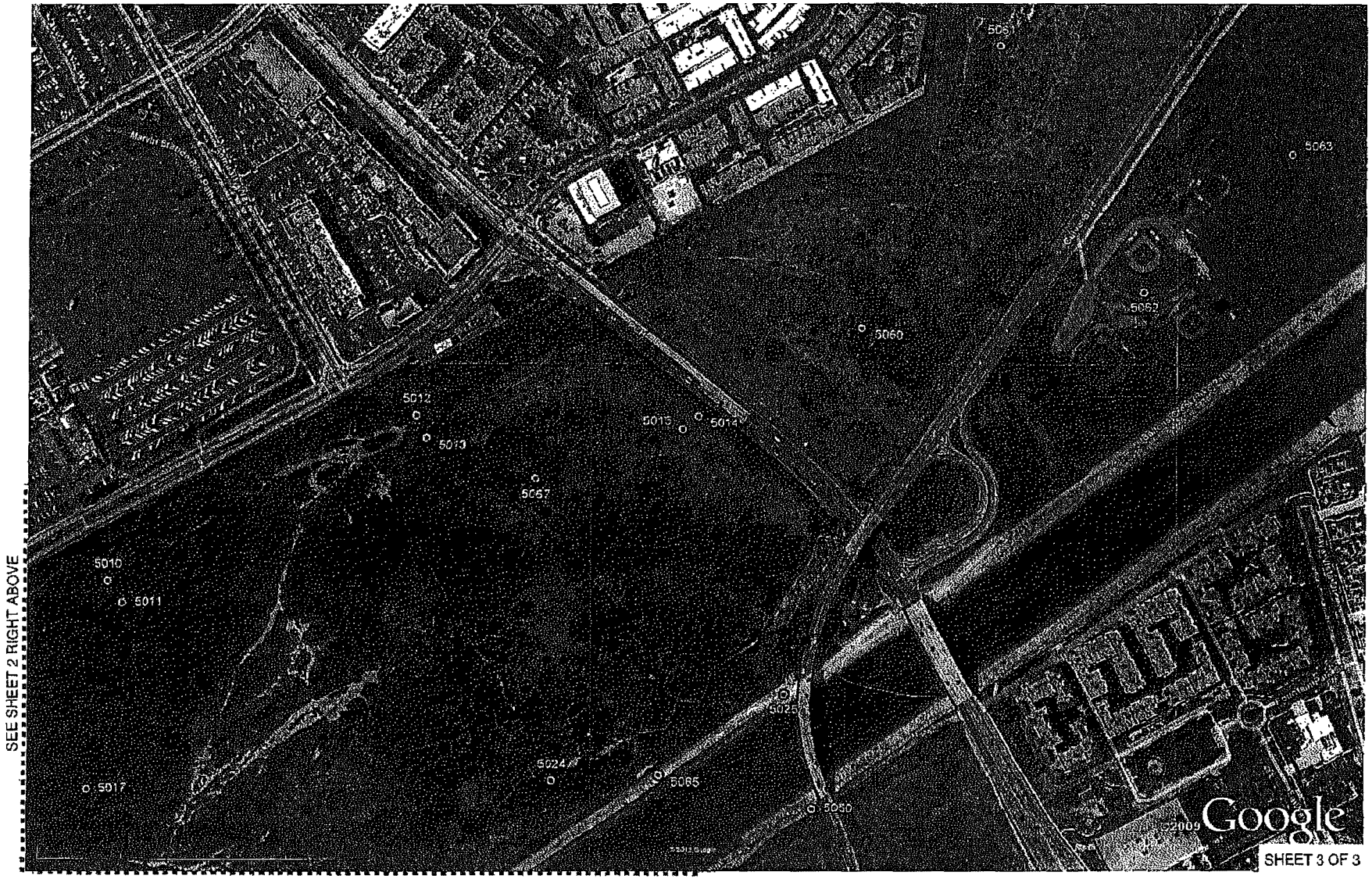
SHEET 2 OF 3

SEE SHEET 1 RIGHT ABOVE

PSOMAS PROJECT NO 1CCC010100 T100

PROPOSED SOIL BORING LOCATIONS EXHIBIT



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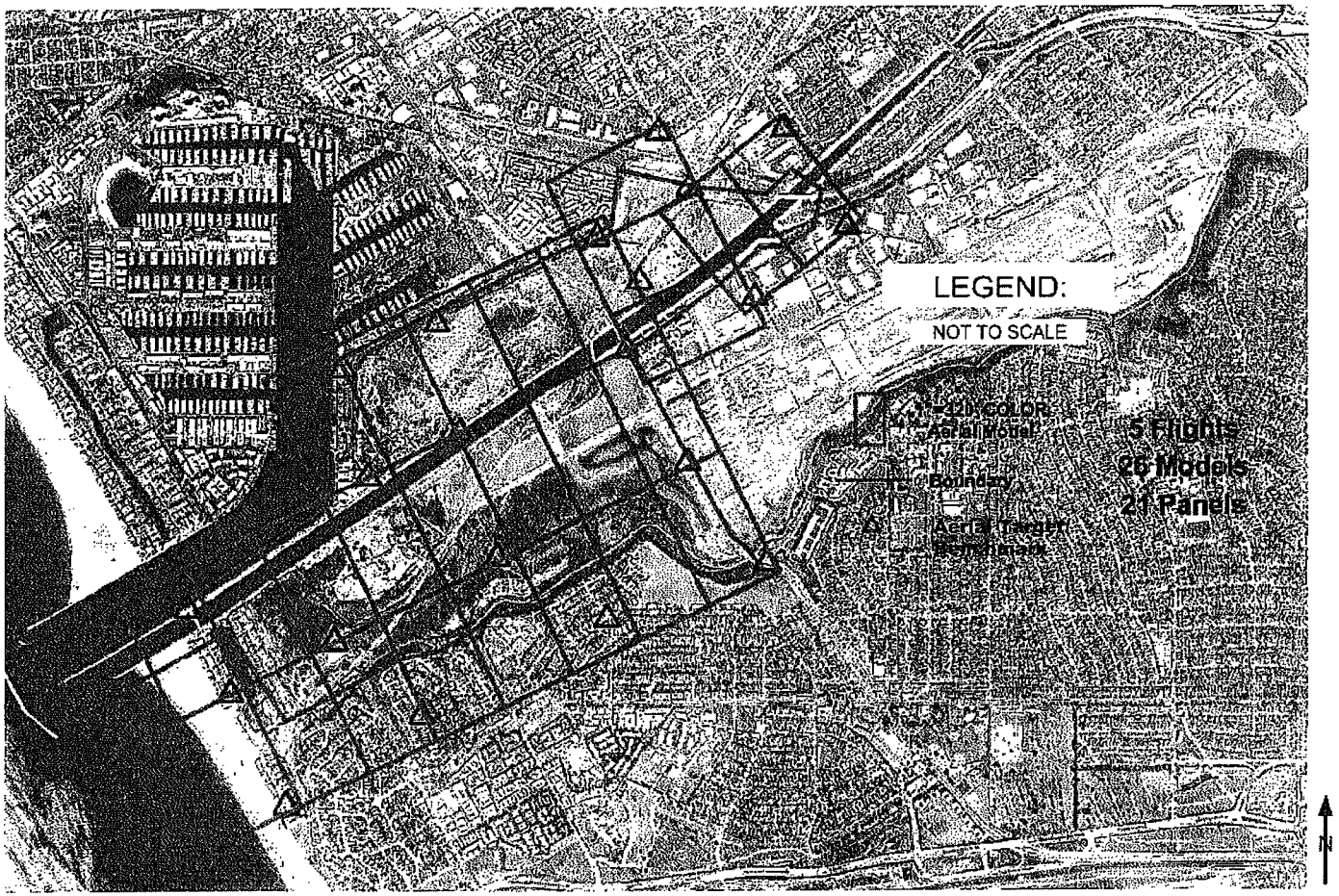
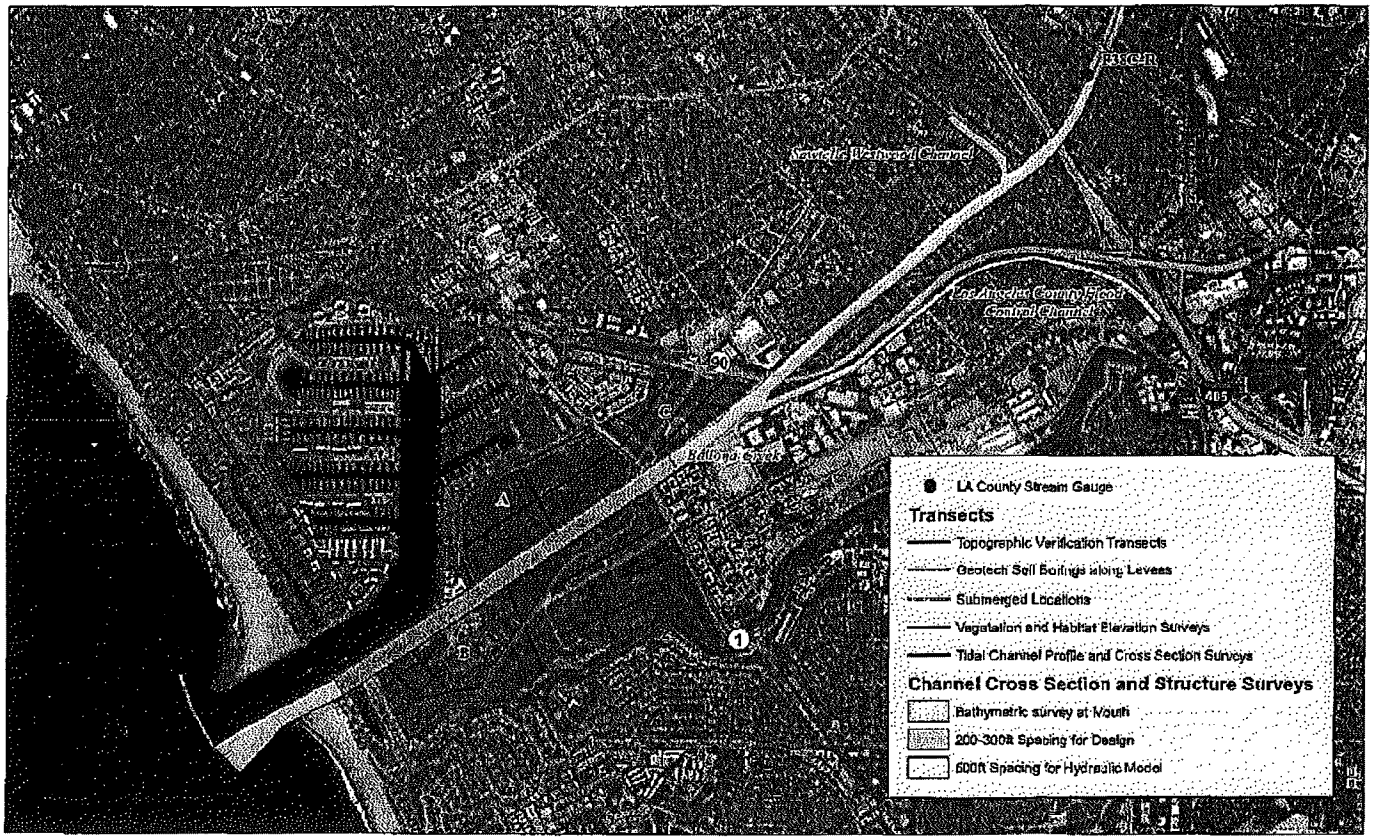


LIMITS OF AERIAL TOPOGRAPHY



Bolsa Wetlands Restoration .

Figure 1

Initial Input on Survey and Geotech Plan

SECTION IV

GEOTECHNICAL

WORK PLAN FOR GEOTECHNICAL INVESTIGATION
BALLONA WETLAND RESTORATION
AREAS A, B, AND C
LOS ANGELES, CALIFORNIA

Prepared for:

CALIFORNIA DEPARTMENT OF FISH AND GAME
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Camarillo, CA 93012

GROUP DELTA CONSULTANTS

Prepared by:

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GDC Project No. LA962
May 4, 2012

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APPENDICES

Appendix A List of Plant Species

GROUP DELTA CONSULTANTS

1.0 INTRODUCTION

Group Delta Consultants, Inc. (GDC) has prepared this work plan for a Geotechnical Investigation for the Ballona Wetland Restoration Project, located in Los Angeles, California.

1.1. Purpose

The purpose of this work plan is to outline and define the procedures for obtaining the necessary access and work permits, performing the field exploration, sample recovery, site cleanup, laboratory testing, geotechnical analyses, and report delivery for the project. A discussion of measures that will be taken to identify and avoid disturbance of the natural habitat, including any mitigation measures, if necessary, is also provided.

1.2. Site Description

The Ballona Wetlands project area consists of over 600 acres and is located in the northwest corner of the Los Angeles Basin, just south of Marina Del Rey. The area is subdivided into 3 portions: Area A, B, and C, as shown in Figure 1. The Ballona Creek Channel runs in an east-west direction through the site. Major streets including Lincoln Boulevard, Culver Boulevard, and Jefferson Boulevard intersect within the project area as well.

Area A is currently fenced off and is undeveloped, and historically in the past had been used as a dumping ground for dredge material. To a lesser extant, dredged material has also been placed in Areas B and C. Area B contains unfilled wetlands with abandoned agricultural fields and freshwater marsh. Area C is mostly undeveloped except for a few sports fields.

1.3. Project Description

The Ballona Wetlands restoration includes the reintroduction and revival of critical wetland habitat, including target animal and plant species, and the creation of a natural open space for the public benefit. The restoration plan will include the following (shown in Figure 1):

Ballona Creek Channel Restoration

- Removal (breaches) of the existing north and south levees in 4 locations, and the lowering and realignment of the channel for the creation of a natural meandering channel.

Area A

- Mass grading, soil excavation and removal, and hauling of previously placed dredged materials.

- Construction of flood protection levees along the north perimeter of the site using the excavated soils.
- Realignment and restoration of the Fiji Channel wetland area

Area B

- Construction of flood protection levees along the north side of Culver Boulevard, and the west portion of the area
- Full restoration of wetlands between the new levees and the realigned Ballona Channel, and managed restoration of the wetlands area located south of the new levees (construction of buried culverts).
- Fill placement in a stockpile area bordered by Culver Boulevard, Jefferson Boulevard, and Lincoln Boulevard.

Area C

- Fill placement in stockpile areas in locations on the north and south sides of Culver Boulevard.

Other Areas

- Construction of a pedestrian and bicycle bridge spanning the Ballona Creek Channel near Culver Boulevard, and an at-grade bicycle roadway along the new levee in Area B.

The implementation of the restoration plan will require a technical analysis and review, and approval by the U.S. Army Corps of Engineers (USACE) along with a Section 408 permit.

2.

WORK PLAN FOR GEOTECHNICAL INVESTIGATION
BALLONA WETLAND RESTORATION
AREAS A, B, AND C
LOS ANGELES, CALIFORNIA

Prepared for:

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The implementation of the restoration plan will require a technical analysis and review, and approval by the U.S. Army Corps of Engineers (USACE) along with a Section 408 permit.

2.0 SCOPE OF WORK

2.1. General

The following subsections outline our scope of work planned for the Geotechnical Investigation of the project. The investigation will collect soil data to be used for the analyses of the various components of the restoration. Our scope of work in this phase of the project includes pre-exploration activities, field work (i.e. drilling and sampling of soil), laboratory testing, geotechnical analyses, and report preparation.

The site investigation activities will be focused in the areas containing the main features of the restoration project, including the proposed perimeter levees, borrow area, stockpile areas, and portions of the existing Ballona Channel to be breached and those portions that will remain. The field work will include the drilling and sampling of soil from approximately 65 small diameter borings (4 to 8 inches) that will be range in depths from 20 to 70 feet. Depending on results of the analyses, additional borings may be considered.

2.2. Pre-Exploration Activities

2.2.1. Access and Permits

Prior to any drilling and sampling activities, permit approval for access and performing the subsurface investigation from the following agencies will be required for all explorations at the site:

- California Department of Fish and Game (CDFG) – Access for survey and to conduct geotechnical investigation permit
- California Coastal Commission (CCC) – exemption letter
- Regional Water Quality Control Board – 401 certification
- United States Army Corps of Engineers (USACE) – nationwide permit, including a Pre-Construction Notification (PCN) and Essential Fish Habitat (EFH) assessment
- Sempra Energy (Southern California Gas Company) – utilities and gas well clearance
- County of Los Angeles Flood Control – Access to conduct investigation permit
- City of Los Angeles – Jefferson and Culver Boulevards right of way permit

GDC has performed a site reconnaissance for selecting the exploratory boring locations and to identify entrance and access routes for review and approval by the appropriate agencies. GDC will contact Underground Service Alert (DigAlert) to perform utility clearance of any other public utilities.

2.2.2. Site Habitat Avoidance Plan

Existing Habitat

Dredged materials from the excavations of Ballona Creek and construction/expansion of Marina Del Rey have historically been placed at the site. As such, much of the site's habitat has been altered relative to the site's native historic habitat. The deposition of the dredged material has altered original elevation contours and has resulted in the development of a variety of plant community types.

Previous investigations have identified plant species present within the project area. A list is included in Appendix A of this document (WRA 2010). Several maps have been prepared showing potential jurisdictional wetland areas for different agencies (United States Army Corps of Engineers, California Coastal Commission, and California Department of Fish and Game), as well as locations of special status plant species in the project area (WRA 2011). These maps were used as guidelines in our selection of

exploration locations and are presented in Figures 3 to 9. Each map shows the proposed boring locations.

Based on previous studies of the site, it is understood that pickleweed salt marsh and salt pan/mudflat areas are to be avoided to the greatest extent possible as exploration sites and in planning access routes to the individual exploration sites. Likewise the coastal scrub is to be carefully traveled on only if necessary. Below is a list of plant species of concern that were previously identified by a prior study (Weston 2009) of Area A:

- Saltpan/mudflats: no vascular plants occur in the salt flats
- Pickleweed salt marsh: *Salicornia virginica, Frankenia salina, Jaumea carnosa, Distichlis spicata, Sueada californica*
- Transition zone: *Atriplex lentiformis breweri* (generally at pickleweed saltmarsh margin, may occur upland as well)
- Riparian scrub: *Baccharis salicifolia, Salix lasiolepis, Salix leavigata*
- *Baccharis scrub: Baccharis pilularis*
- Coastal scrub: *Artemesia californica, Marrubium vulgare, Isomeris aborea, Malosma (Rhus) laurina, Sambucas mexicana, Cucurbita foetidissima, Rhus integrifolia*

A 2011 study also documented breeding areas of the Belding's savannah sparrow within the Ballona Wetlands which are to be avoided during the months of May to July. Site exploration in these areas (Figures 8 and 9) may not be performed during the breeding season.

Habitat Avoidance and Monitoring Measures

Prior to drilling and in support of obtaining the necessary drilling permits, a site reconnaissance and document review were conducted of the vegetation and animal habitats present within the project site, to determine optimal access routes to the exploration locations with minimal disturbance to the natural habitat. The exploration locations will be verified for sufficient space to accommodate the drilling equipment and operation. Plant groups and individual plants of concern will be identified and documented during reconnaissance by a field biologist. An on-site biologist will continually oversee the progress of the sampling program to avoid unnecessary damage to native vegetation. A cultural resource representative will also be present during the sampling program.

Among the criteria for choosing soil sampling/exploration locations is proximity to sensitive vegetation as well as potential to cause disturbance of habitats. Prior to any sampling activities, the exploration locations will be carefully planned and verified to avoid sensitive vegetation to the greatest extent possible. Access routes to and from

each location were mapped for review and approval by the governing agencies. The routes were selected to maximize the usage of the existing access entrances and pathways, and minimize disturbance to the native habitat. Potential exploration sites that cannot be accessed without substantial native plant disturbance will be eliminated, and alternative sites will be chosen. Figure 2A shows a proposed location plan of exploration. The proposed entrance and access routes to the locations are further discussed in Section 2.3.

Figures 3 to 9 show the proposed exploration locations overlain on existing habitat areas. As noted, areas such as the breeding grounds of the Belding's savannah sparrow, primarily in the western portion of Area B, will not commence until after July and will be completed prior to the next May. Areas A and C show less coverage of sensitive habitat and are planned to be drilled first.

During the field exploration, drill rigs and associated support trucks will follow along a single path to minimize any impact to sensitive habitat. Prior to mobilizing, the drill equipment operators will be made familiar with plant species of concern, and the vehicles will be escorted along the pre-scouted route to the exploration locations by the field biologist.

After the field exploration activities are completed, a field team will follow the routes used by the drilling equipment to access the sampling locations to confirm that no sensitive habitat was adversely impacted. Any areas where vehicle traffic resulted in depressions in the soil will be re-graded by hand with shovels. Any tire or tread tracks will be raked to minimize track depressions. Special attention will be given to the salt flat areas and any disruption will be repaired to the satisfaction of the governing agencies. Should any damage to plants occur, it will be recorded in a field logbook and photographed, and a reasonable level of remediation will be performed to restore the site to its original condition.

2.3. Field Exploration

2.3.1. Overview

Approximately 65 boring explorations are proposed (Figure 2A), with drilling depths expected to range from about 20 to 70 feet for each exploration. The proposed borings will supplement previous borings performed at the site (Figure 2B). The borings are generally planned in the following areas of the restoration:

- New Perimeter levees
- Borrow / cut area
- Stockpile areas
- Existing Ballona Channel levees
- Near existing gas wells

The borings will characterize the subsurface conditions in these areas and provide data to complete a range of analyses needed, such as static and seismic stability (temporary and long-term), settlement, deformations, liquefaction, seepage, soil suitability, and seismic hazard. The location, spacing, and depths of the proposed borings were selected based on the analyses necessary for the area of the restoration and recommended criteria from the USACE. For example, for the perimeter levees, the USACE (EM1110-2-569, Design Guidance for Levee Underseepage) recommends:

"An extensive subsurface geotechnical investigation along the levee systems should be conducted and supplemented with geophysical investigation techniques as appropriate. A minimum target level of subsurface explorations should be a series of explorations approximately every 1,000 feet, consisting of an exploration at the riverside toe, at the landside toe, and a deep exploration at the levee crest."

The borings were also positioned to provide information for other features of the restoration, including rock protection areas, pedestrian bridge crossing Ballona Channel, and culverts in Area B. Shallow borings are planned primarily for locations such as the borrow area where the suitability of the excavated material for embankment construction will be analyzed. Deeper borings are planned in areas such as the new perimeter levees, where static and seismic stability will be analyzed.

The explorations will be performed under the technical supervision of GDC's field engineer/geologist. The field engineer/geologist will maintain detailed logs of the drilling activities and soils and groundwater levels encountered. Air monitoring will be performed during the investigation. If evidence of potentially hazardous materials is detected, the exploration will be stopped and project management will immediately be notified for direction.

2.3.2. Access Routes

Entrance to the site and routes to each of the proposed explorations were selected to minimize the distance traveled within the site and to avoid various sensitive areas of the existing habitats. Figures 2 through 9 show the proposed entrance and access routes overlain on various maps of jurisdiction areas, sensitive habitat, and existing wells at the site. These proposed routes may continue to be adjusted based on field conditions and consultation from various habitat experts.

The figures illustrate the intention of the routes to minimize disturbance to the habitat. The following exceptions are noted:

- USACE jurisdictional area (Figure 3) – The proposed route between A-CPT010 and A-CPT012 in Area A and the proposed route to access B-CPT029, B-RW030, and B-CPT031 in Area B traverses through a wetland area. B-RW030 and B-CPT031are also located within a non-wetland waters area.

- CCC jurisdictional area (Figure 4) – In addition to having the same affected areas described for USACE jurisdictional areas, proposed exploration HSA051 is located within a wetland area in Area B. Also, within Area C, the proposed route between C-CPT060 and C-HSA061 may require traversing through a wetland area.
- CDFG jurisdictional area (Figure 5) – Explorations B-RW027, B-RW028, B-RW032, B-RW033, B-CPT034, and B-CPT042 are located within the CDFG jurisdictional area. Also, within Area C, the proposed route between C-CPT060 and C-HSA061 may require traversing through the CDFG jurisdictional area.
- Special status plant species (Figure 6) – B-RW027, B-RW028, B-CPT029, B-CPT052, B-RW053, B-CPT054, C-CPT060, and C-HSA06 are located near special status plant species
- Belding's savannah sparrow breading areas (Figure 8) – The breeding areas are largely within Area B and are particularly dense within the west portion. A-HSA064 in Area A , and B-HSA051 in Area B are also noted to be near breeding locations.

It is also noted that fence removal is proposed in two areas along the existing Ballona Channel. The fence will be repaired after the borings are finished.

- B-RW027 and B-RW028 in Area B. – Access to these locations will be made directly from the existing pathway on the south levee.
- A-RW025 and A-RW026 in Area A – Access to these locations are proposed to be made from Area A onto the bike path on the north levee. If access cannot be made from this location, we propose the explorations be reached by driving the drill rig along the bike path, with access from Pacific Avenue (located west of project site).

2.3.3. Schedule

Borings that do not impact the site habitat will be performed as soon as all the necessary permitting approvals are granted. It is understood that it may take up to two months to receive all the permit approvals. The duration of the boring program is expected to be approximately 2-3 weeks. Borings planned near sensitive areas such as the Belding's savannah sparrow breeding grounds (primarily located in the west portion of Area B) will not begin until after July 2012 and are expected to be completed within approximately 1-2 weeks.

A subsequent phase of exploration will be required if there are changes in the project such as changes in the location of levees or if the results from the current exploration necessitate further testing. It is anticipated any additional exploration occur after the 408 submittal and would be performed in early 2013.

2.3.4. Drill Equipment

The site investigation will be performed by means of truck-mounted rotary wash and hollow stem drilling rigs, and cone penetration testing (CPT) trucks. One to two support trucks (pick up trucks) will accompany each drill rig. The drilling method used in a given area will depend on the information needed for the analyses. Below is a description of the drilling methods (outlined in detail in USACE Engineering Manual 1110-1-1804):

Rotary Wash

The rotary wash method uses typical drilling techniques to advance the hole by removing the soil cuttings with water or bentonite based drill mud. Samples are typically taken at discrete depth intervals of 5 feet. This method is applicable for any type of soil and the standard penetration test (SPT) blow counts obtained in rotary wash borings are not affected by hydrostatic pressure, since water and drilling mud is continuously circulating through this method to stabilize the drill hole and remove cuttings. The diameter of the hole is typically 4 inches. The rotary wash borings will be used in areas such as the levees. The dimensions of a typical rig are about 32 feet (working height) × 32 feet (length) × 8.5 feet (width).

Hollow Stem Auger

Hollow stem augers can be drilled relatively quickly and does not use drilling mud. They will be used in areas where the proposed borings will be shallow and generally above the groundwater table. Samples are typically taken at discrete depth intervals of 5 feet. The diameter of the hole is typically 8 inches. The hollow stem auger borings will be used in locations such as the borrow and stockpile areas. The dimensions of a typical rig are about 27.5 feet (working height) × 25 feet (length) × 8.5 feet (width).

Cone Penetration Test

The CPT involves hydraulically pushing a 3.6-cm (1.4-in.) diameter probe into the earth while performing two measurements, cone resistance and sleeve friction resistance. The probe is normally pushed from a special heavy duty truck but can also be performed from a trailer or drilling rig. As the probe is advanced, electronic instruments measure and record both the tip resistance and the frictional resistance on the sleeve. The tip and frictional resistance are then analyzed, using available correlations, to estimate soil classification, density, strength, and compressibility of the subsurface materials. Unlike soil borings, in which drive samples are typically taken at discrete intervals, the CPT provides a continuous record of soil properties with depth. Hence, the CPT can define the subsurface soil profile with much higher resolution than a soil boring, often detecting thin layers that are easily missed with conventional drilling and sampling. The CPT is a fast method and is ideal for sands, silts, clays, and soft soils. Because there are no soil cuttings, the CPT is ideal for environmentally sensitive areas. CPT explorations will be used throughout the site to characterize the subsurface conditions and collect data for

use in liquefaction analyses, and levee design. The dimensions of a typical CPT rig are about 15 feet (height) × 35 feet (length) × 9.5 feet (width).

2.3.5. Soil Sampling

Soil samples will be obtained for field classification and laboratory testing. Both discrete and composite samples will be taken for geotechnical, chemical, and agronomy testing. The samples will be sealed, labeled, and packaged for transport to the geotechnical, environmental and/or chemical laboratories where they will be tested. During sampling, project archeologist and cultural resource representatives will also be onsite to observe the soils samples taken from the ground.

Geotechnical Sampling

Both relatively undisturbed modified California ring samples and Standard Penetration Test (SPT) drive samples will be taken in the borings at depth intervals of no greater then 5 feet. In addition, representative bulk samples will be taken within the upper 5 feet of select subsurface exploration locations by a shovel and placed into polyethylene bags. The locations of all sampling will be indicated on the boring logs. All samples will be sealed to prevent moisture loss and returned to our laboratory for additional visual examination and laboratory testing.

The SPT sampling will be performed in accordance with ASTM D1586, using a standard 2-inch outside diameter, 1.375-inch inside diameter, split-spoon sampler. The modified California ring sampler will be performed in accordance with ASTM D3550 utilizing a 3-inch O.D. split-barrel sampler lined with 1-inch high brass rings. Both sample types will be driven into the soil using a 140-pound hammer falling a distance of 30 inches. The number of blows required to drive the sampler 18 inches into the soil will be recorded on the boring logs. The hammer of system of each rig will be calibrated and the energy transfer ratio will be provided (ASTM D4633). For preliminary calculations an energy transfer ratio of 75 % will be used.

Chemistry Sampling

In addition to samples obtained for geotechnical testing, GDC will obtain discrete and composite samples for chemical testing, as directed by the project environmental consultant. Environmental samples will be obtained and handled under appropriate protocol and chain of custody.

Agronomy Sampling

Agronomy soil sampling will be performed within the borrow area of Area A. at the following depths: surface, old marsh surface (which will consist of buried organic matter/stems/roots, and one foot below the design depth.

2.3.6. Completion of Borings

Upon completion, all borings will be backfilled with tamped cuttings and/or bentonite/cement slurry. CPTs will be grouted. Drill mud will be placed in approved drums and stored onsite at an approved designated location until testing and disposal can be performed. Drum testing and disposal will be performed by an appointed representative obtained by GDC. Any waste or excess material created during physical investigations of the site will be disposed of by GDC or an appointed representative obtained by GDC. Clean up of the site, including spills and damage, will be performed such that the site is left in a state similar to that prior to the start of work.

As indicated in the site habitat avoidance plan (Section 2.2.2), after all of the sampling activities are completed, a field team will follow the routes used by the drilling equipment to access the sampling locations to confirm that no sensitive habitat was adversely impacted. Any areas where vehicle traffic resulted in depressions in the soil will be re-graded by hand with shovels. Any tire or tread tracks will be raked to minimize track depressions. Special attention will be given to the salt flat areas and any disruption will be repaired to the satisfaction of the governing agencies. Should any damage to plants occur, it will be recorded in a field logbook and photographed, and a reasonable level of remediation will be performed to restore the site to its original condition.

2.4. Laboratory Testing

Laboratory testing will be conducted on the soil samples collected in the field. The purpose of laboratory testing is to determine geotechnical, chemical, and agronomy properties of the encountered soils. Lab testing will be assigned based on the encountered soils and will be conducted according to ASTM standards. Additional testing may be performed on selected samples as necessary.

Geotechnical Testing

GDC presently anticipates the following geotechnical laboratory tests to be performed on representative samples in accordance with current and applicable ASTM standards:

- Moisture Content & Dry Unit Weight
- Testing for shear strength (Direct Shear, Triaxial, Vane, etc.)
- Consolidation
- -200 Sieve Wash
- Expansion Index
- Atterberg Limits
- Grain Size
- Compaction
- Corrosivity (sulfate, chloride, pH, resistivity)
- R-value

Samples that are known to have contaminants will be sent to a certified and approved laboratory that specializes in geotechnical testing of contaminated samples.

Chemistry Testing

In addition to the sampling performed for geotechnical purposes, sampling is planned for environmental testing. Samples designated for chemical testing for contaminants will be taken to an approved chemical or environmental laboratory. Samples for environmental testing will be taken under appropriate protocol and chain of custody. The scope of environmental sampling and evaluation of the chemical test results will be performed by the project environmental consultant.

Agronomy Testing

The testing will be performed as directed and will include pH, salinity, sodium and the five soluble and exchangeable major nutrients, sulfate, boron, USDA texture, organic matter content, micronutrients, and neutralization/ acid generation potential (N/AGP).

2.5. Geotechnical Analyses and Report

To evaluate the geotechnical issues associated with the proposed restoration, GDC will perform the following engineering analyses using the data acquired from the investigation:

- Document review of previous documents, reports, and maps.
- Data evaluation/compilation and analysis of the geotechnical field and laboratory data produced from previous and the current investigation
- Drafting of all boring logs and CPT soundings, including representative cross-sections through the site
- Seismic evaluation including seismic hazard analyses of the major faults impacting the site and deformation analyses of the levee slopes during an earthquake event
- Soil suitability / disposal analysis of the soils to be excavated from Area A to assess its suitability for use in the construction of the proposed levees, including any transportation issues and disposal options
- Levee analyses including stability, seepage, settlement, liquefaction, and deformation for the construction of the perimeter levees in Areas A and B, the effect of the soil excavation near existing and new levees, and the breaches and realignment of the existing Ballona Channel levees
- Ground improvement evaluation for the new levee construction, stockpile areas, and proposed pedestrian / bicycle bridge spanning the Ballona Channel west of Culver Boulevard.

- Stockpile analyses including stability and the effect of settlement from the surcharge of the stockpile on nearby existing roadways (i.e., Culver Boulevard and Jefferson Boulevard), the Ballona Channel, and buried utilities.
- Pedestrian / bicycle bridge analyses, including recommendations for the foundations, and associated grading.
- Mitigation measures for ground improvement (i.e., stone columns, deep dynamic compaction, deep soil mixing), drainage systems, monitoring programs, and excavation and/or replacement of unsuitable materials.
- Additional analyses, if necessary, based on review comments.

Findings and recommendations from the analyses will be summarized in memorandums and reports in support of the 408 permit approval.

3.0 REFERENCES

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Department of the Army, U.S. Army Corps of Engineers, "Engineering and Design, Design and Construction of Levees", EM1110-2-1913, April 30, 2000.

Department of the Army, U.S. Army Corps of Engineers, "Engineering and Design, Geotechnical Investigations", EM1110-1-1804, January 1, 2001.

Department of the Army, U.S. Army Corps of Engineers, "Engineering and Design, Design Guidance for Levee Underseepage", EM1110-2-569, May 1, 2005.

Diaz Yourman and Associates, "Geotechnical Investigation, Ballona Creek Wetlands", June 2, 2010.

State of California – Department of Conservation, Division of Oil, Gas, and Geothermal Resources, Playa Del Rey Map 120.

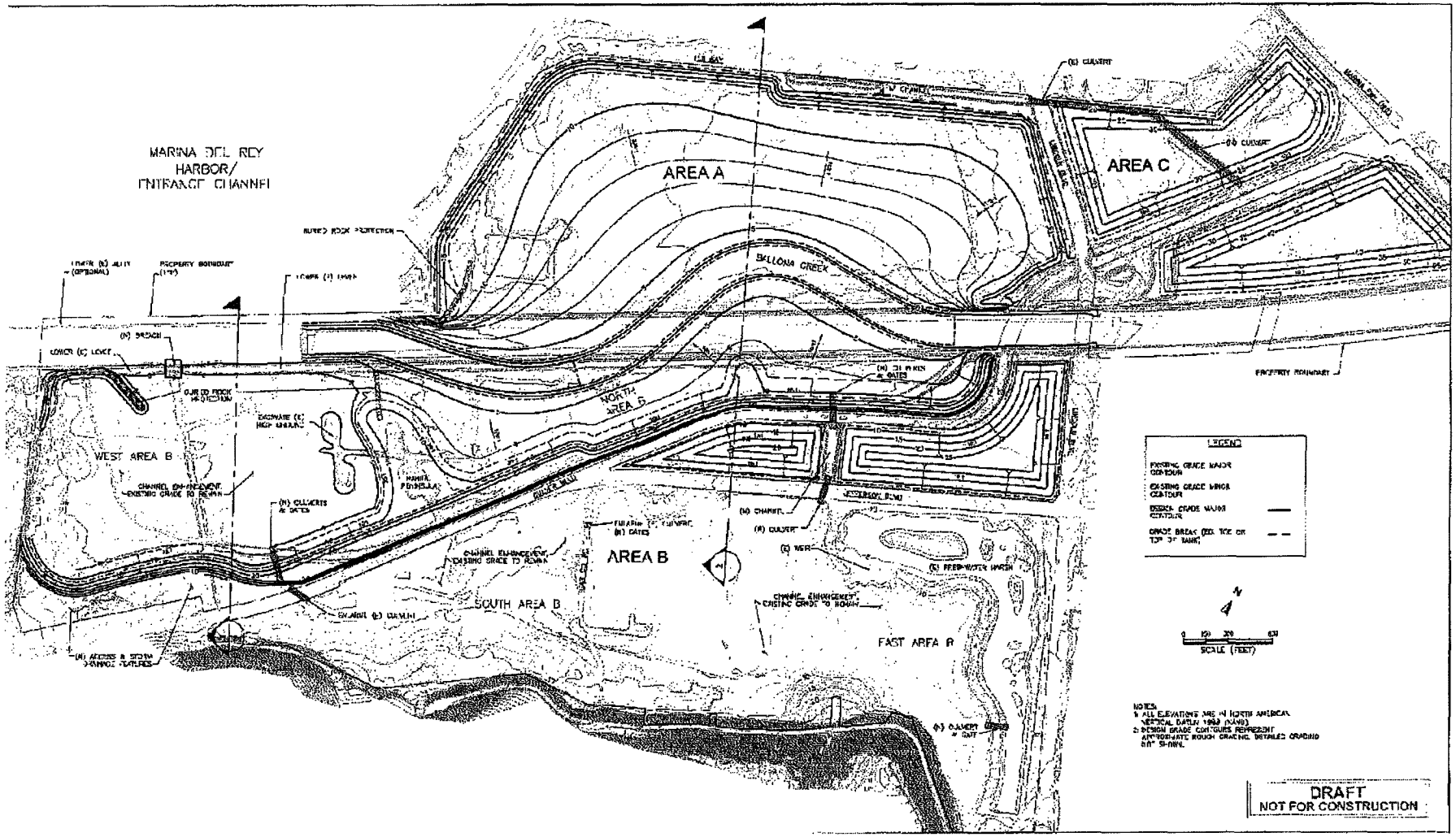
Weston Solutions, "Ballona Wetland Preserve – Area A, Preliminary Geotechnical Investigation and Beneficial Use Assessment, Final Report", April 2009.

WRA Environmental Consultants, "Coast Buckwheat (Eriogonum parviflorum) Habitat Map within the Study Area", July 2010.

WRA Environmental Consultants, "Special Status Plant Species Known Occurrences within the Study Area", April 2011.

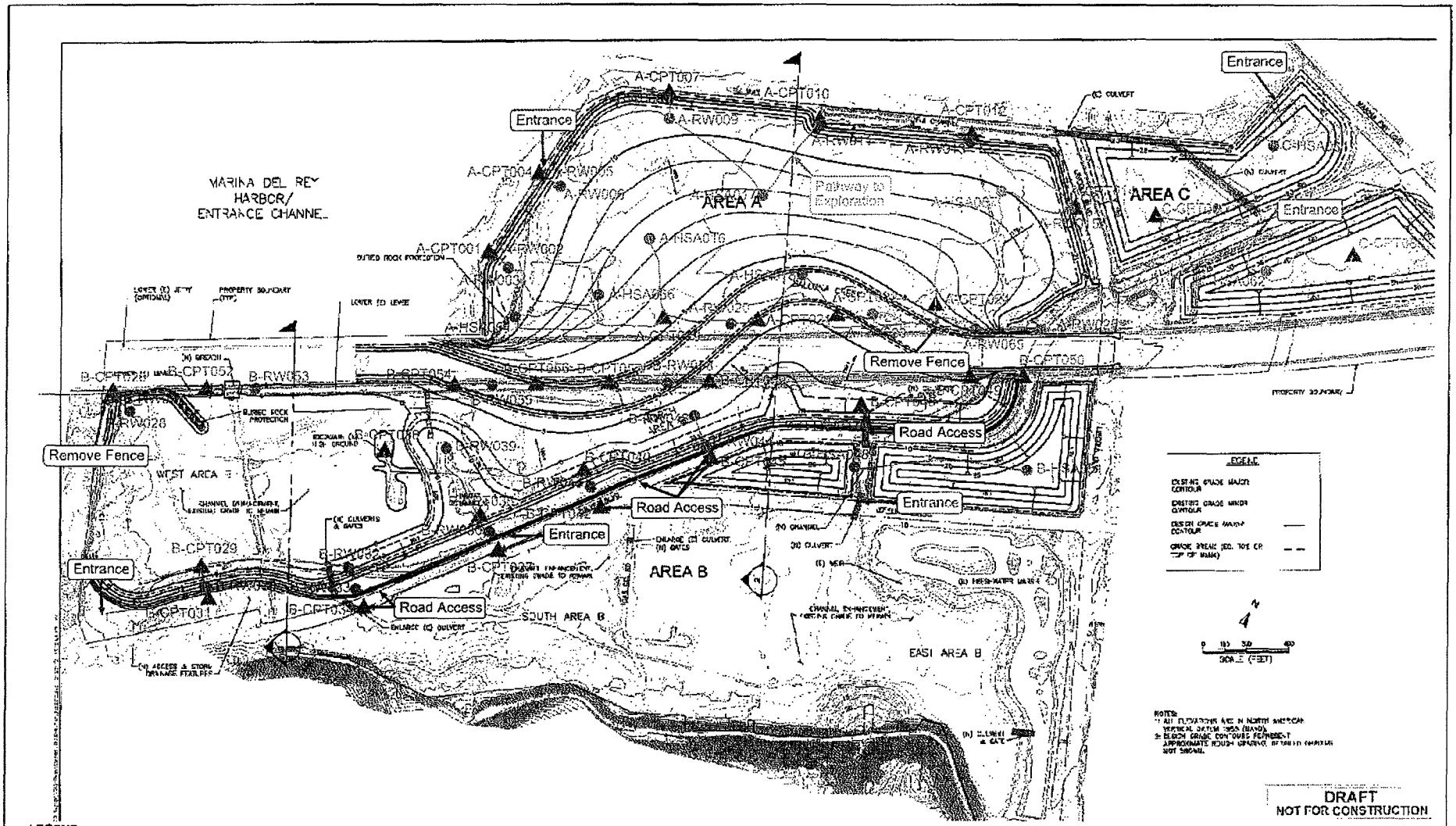
WRA Environmental Consultants, "Ballona Creek Wetlands Ecological Reserve, Preliminary Delineation of Wetlands and Non-Wetland Waters", August 2011.

FIGURES



Reference: Drawings prepared by PWA, titled "Conceptual Grading Plan", dated 2/28/12

DATE: 4/19/12	DRAWN BY: K. Fernandes	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	CONCEPTUAL GRADING PLAN Ballona Wetlands Restoration Los Angeles, CA
REVISION: 5/4/12	APPROVED BY: P. Chiu		PROJECT NUMBER: LA962 SCALE: AS SHOWN SHEET NUMBER: 1
REVISION:			


MARINA DEL REY
HARBOR/
ENTRANCE CHANNEL
AREA A
AREA B
AREA C
WEST AREA B
SOUTH AREA B
EAST AREA B
Pathway to Exploration
Entrance
Entrance
Entrance
Entrance
Entrance
Entrance
Remove Fence
Remove Fence
Road Access
Road Access
Road Access
A-CPT001
A-CPT004
A-CPT007
A-CPT010
A-CPT012
A-RW002
A-RW005
A-RW009
A-HSA006
A-HSA056
B-CPT026
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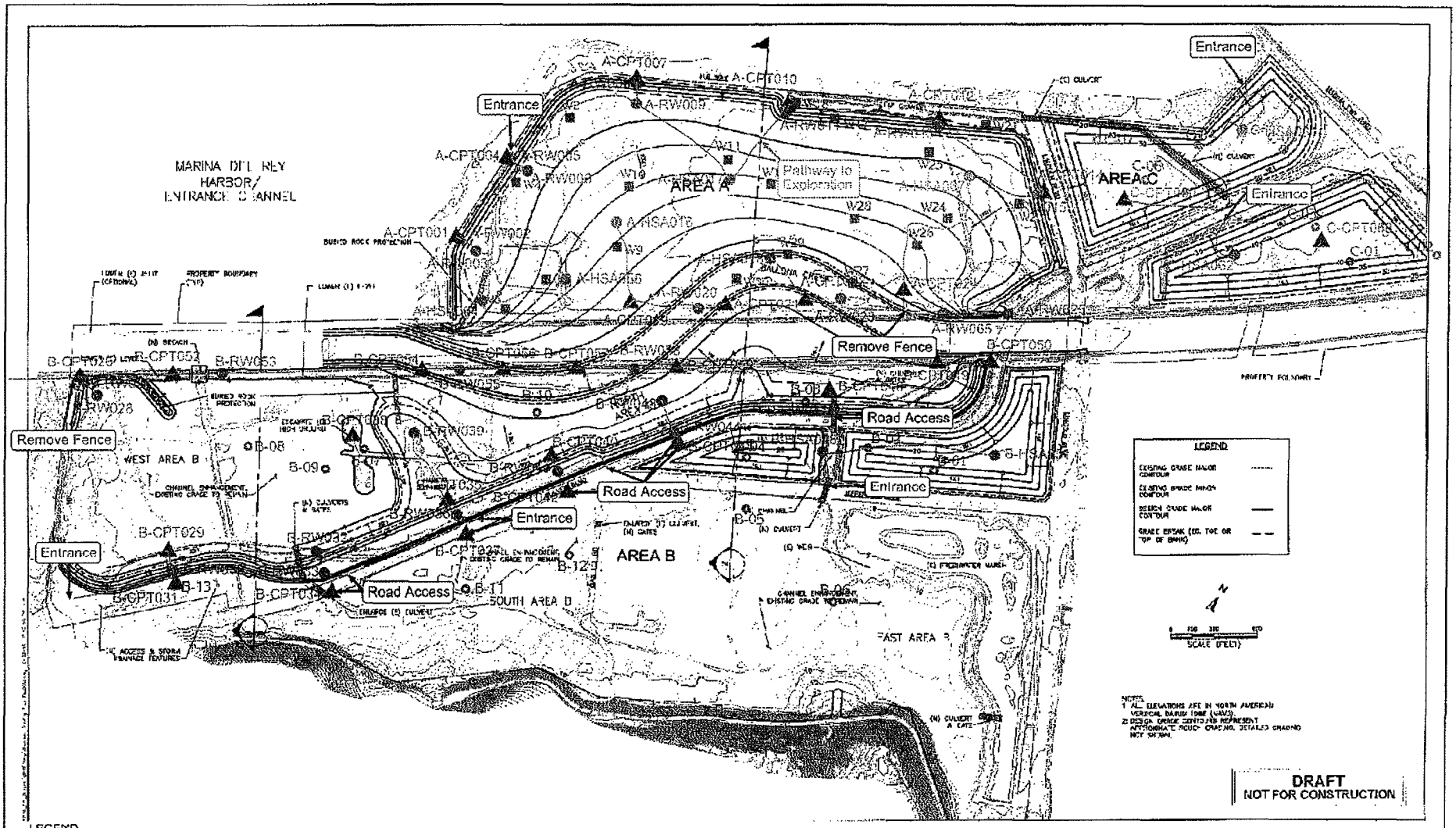
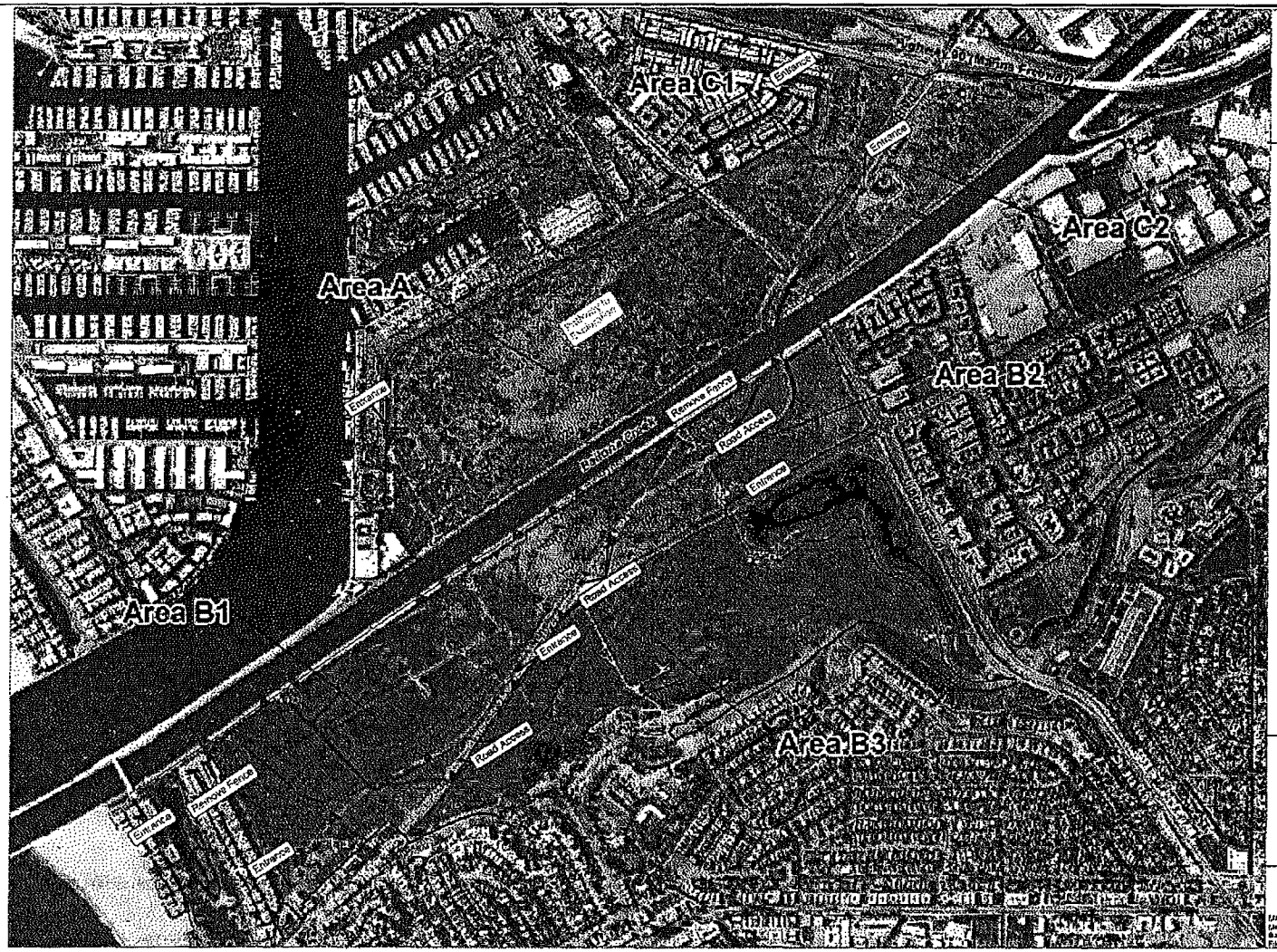


LEGEND

- A-RW002 Proposed Boring (RW/HSA) Location
- A-CPT001 Proposed CPT Location
- B-01, C-01 Existing Boring by Diaz Yourman & Associates
- W1 Existing Sampling Location by Weston Solutions

Reference: Drawings prepared by PWA, titled "Conceptual Grading Plan", dated 2/28/12

DATE: 4/19/12	DRAWN BY: K. Fernandes	GROUP DELTA CONSULTANTS, INC	EXISTING & PROPOSED EXPLORATION LOCATIONS
REVISION: 5/4/12	APPROVED BY: P. Chiu	370 Amapola Ave. Suite 212 Torrance, CA 90501	Ballona Wetlands Restoration Los Angeles, CA
REVISION:			PROJECT NUMBER: LA962 SCALE: AS SHOWN FIGURE NUMBER: 2B



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Ballona Creek Wetlands Ecological Reserve

Marina Del Rey, California

Appendix A. Delineation of United States Army Corps of Engineers Jurisdictional Areas

Legend

Project Area (884.8 acres)
C1 Sample Point
Non-Wetland Waters (83.0 acres)
Wetland (153.2 acres)
Upland Area (568.7 acres)

N
W E
S

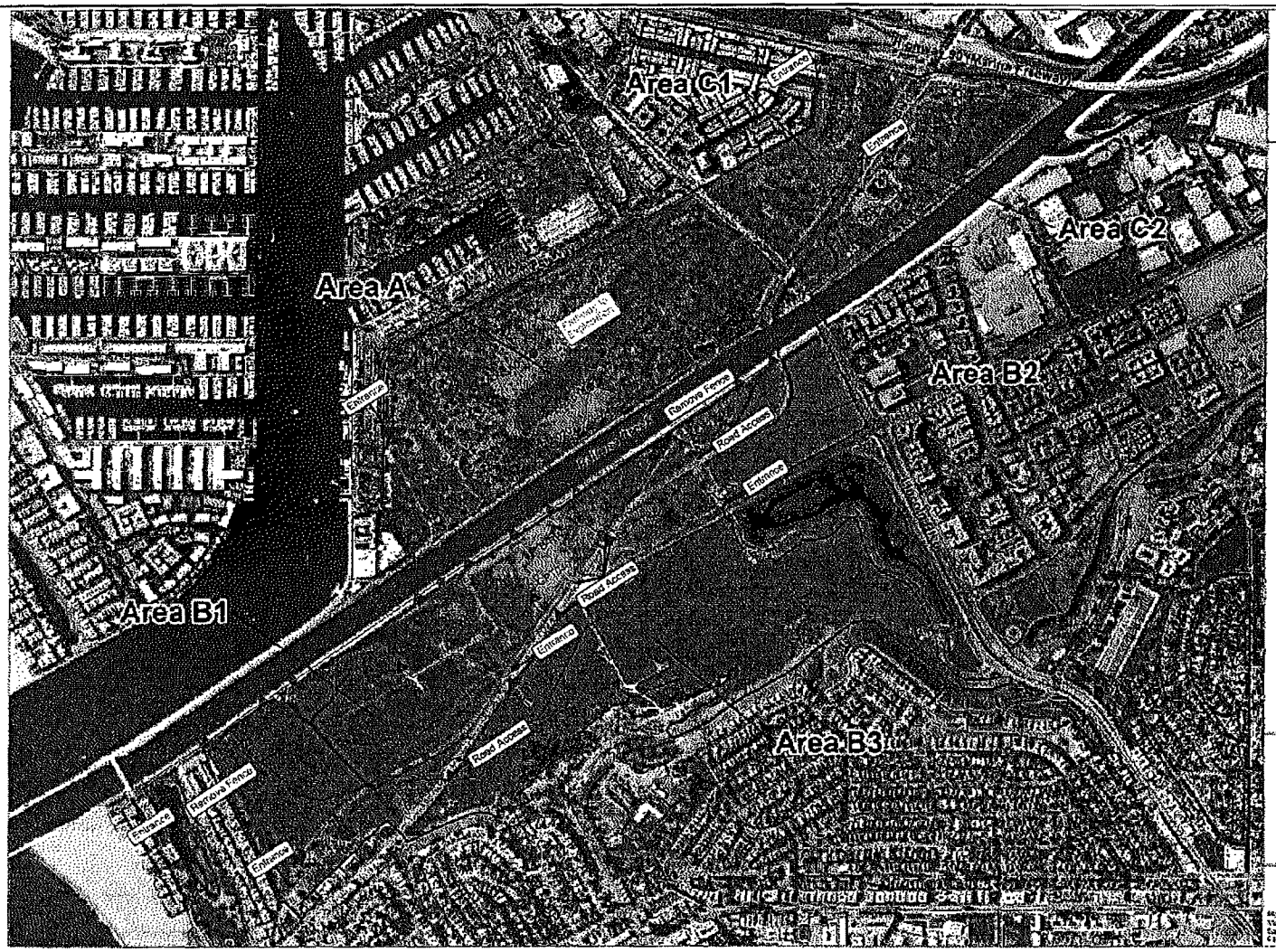
0 400 800 1,600
Feet
1 inch = 400 feet

Map Date: August 2011
Map By: Sweetwater Enterprise
Base Source: source, date
Filename: [illegible]

LEGEND

- ● A-RW002 Proposed Boring (RW/HSA) Location
- ▲ A-CPT001 Proposed CPT Location

DATE: 4/19/12	DRAWN BY: K. Fernandes	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	PROPOSED BORING LOCATIONS USACE JURISCICTION	PROJECT NUMBER: LA962
REVISION: 5/4/12	APPROVED BY: P. Chiu		Ballona Wetlands Restoration Los Angeles, CA	SCALE: AS SHOWN
REVISION:				FIGURE NUMBER: 3


Area A
Area B1
Area B2
Area B3
Area C1
Area C2
Entrance
Road Access
Remove Fence
Remove Fence
Entrance
Entrance
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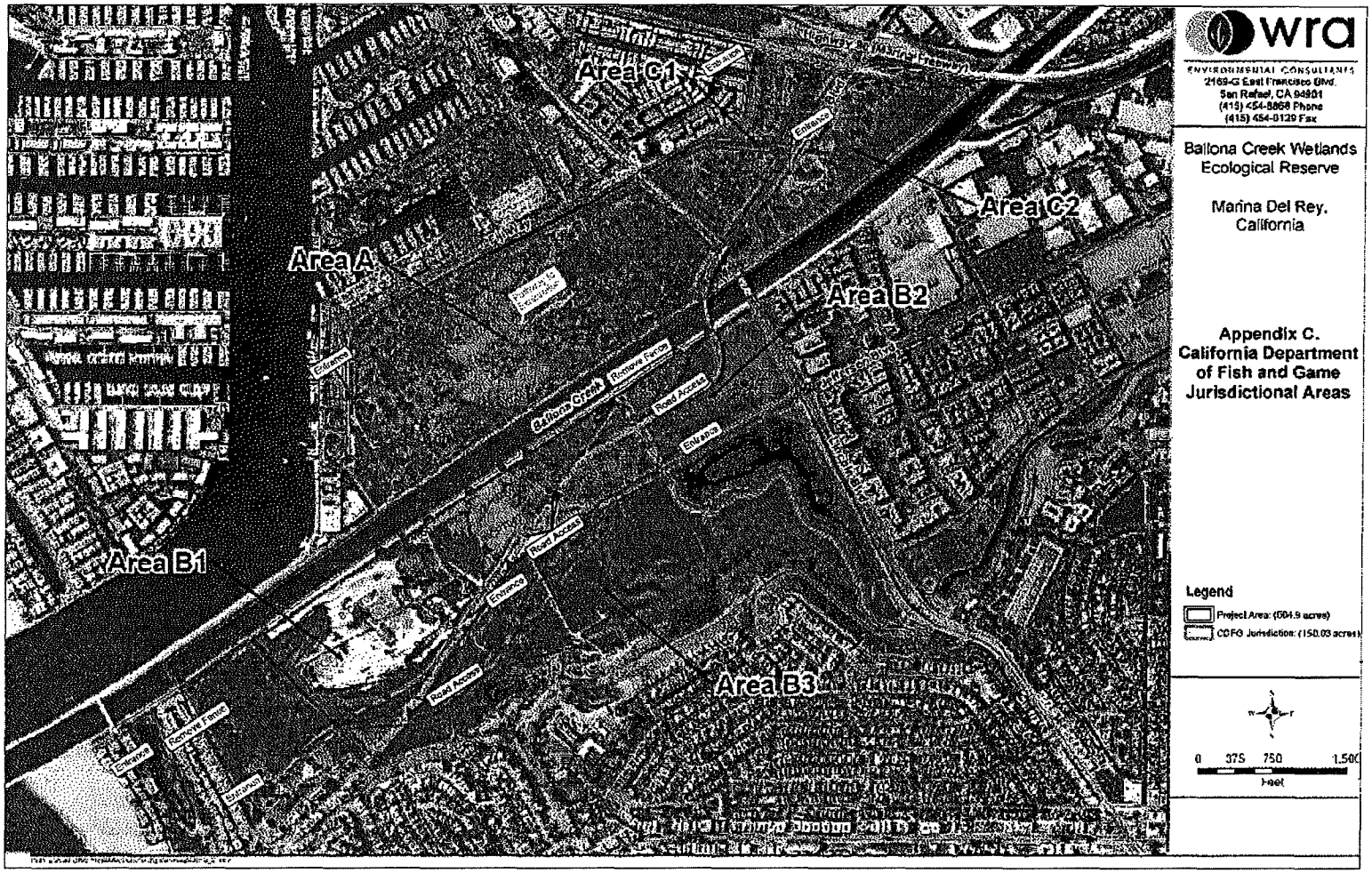
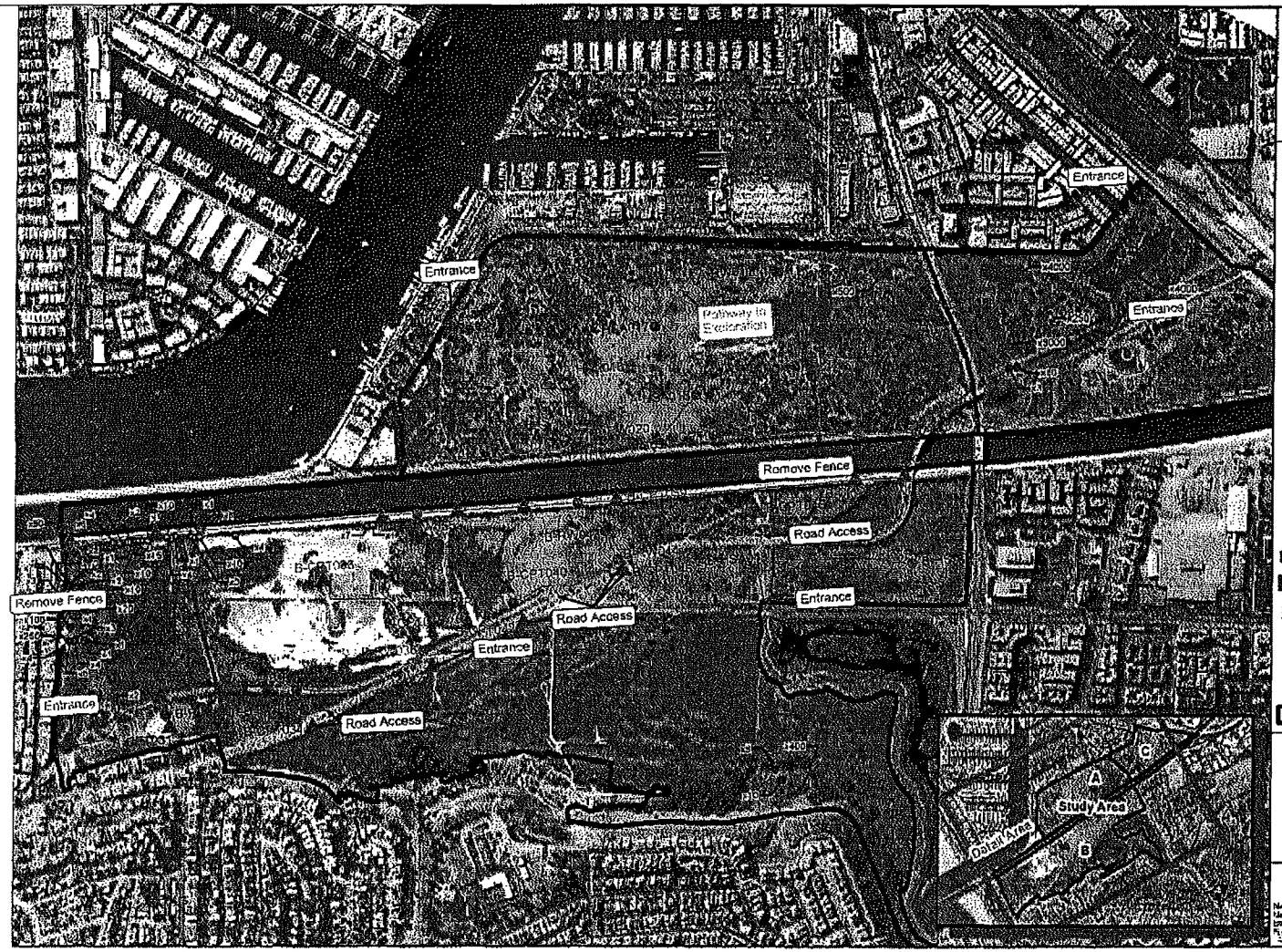


LEGEND

- A-RW002 Proposed Boring (RW/HSA) Location
- A-CPT001 Proposed CPT Location

DATE: 4/19/12	DRAWN BY: K. Fernandes	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	PROPOSED BORING LOCATIONS CDFG JURISCICTION Ballona Wetlands Restoration Los Angeles, CA
REVISION: 5/4/12	APPROVED BY: P. Chiu		PROJECT NUMBER: LA962 SCALE: AS SHOWN FIGURE NUMBER: 5



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Ballona Wetlands

Los Angeles County, CA

Figure 3

Special Status Plant Species Known Occurrences within the Study Area

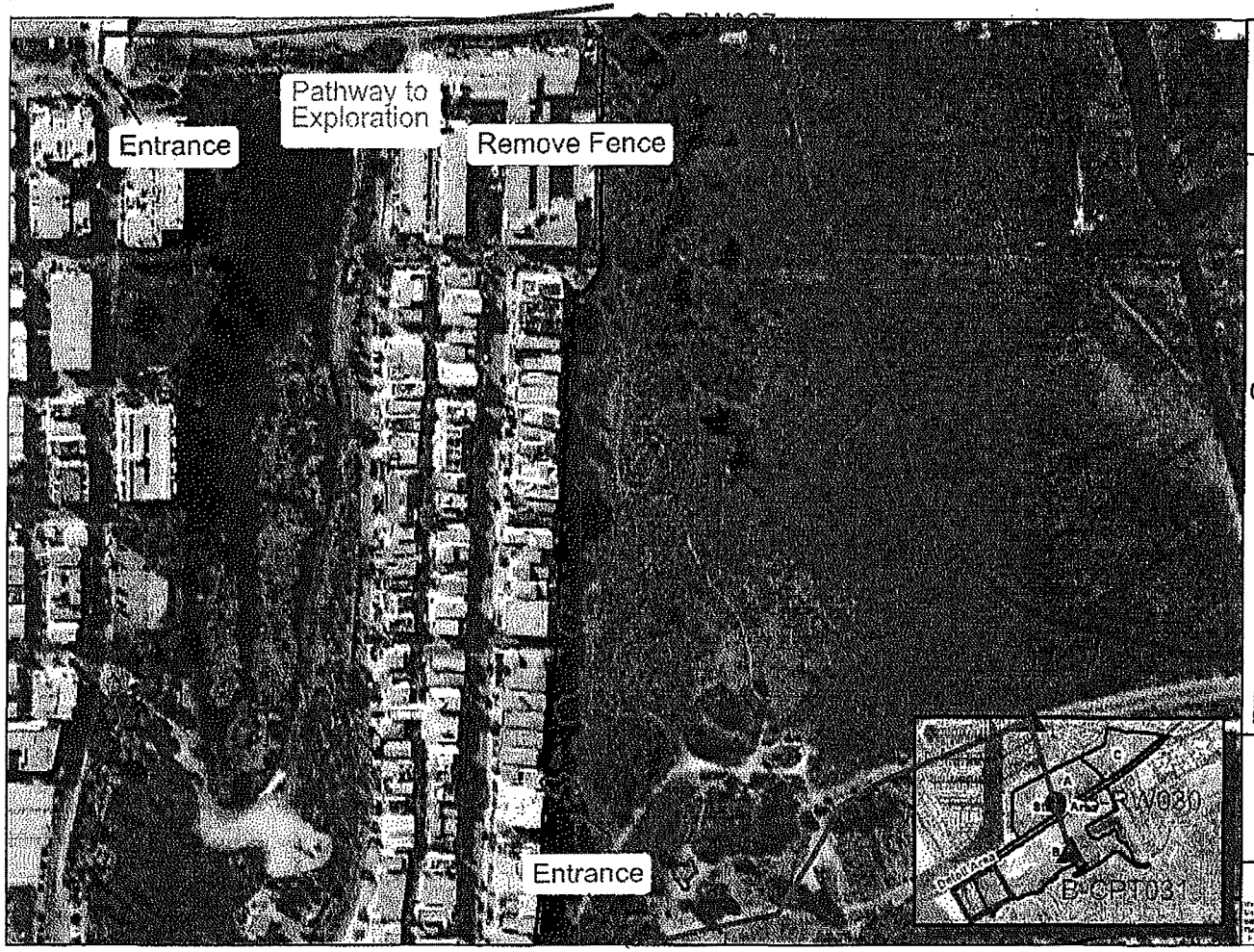
Legend

- *Camissonia lewisii* (x=2,200)
- *Chaenactis glabriuscula* var. *orcuttiana* (x350)
- *Camissonia lewisii* (x=07)
- *Erysimum insulare* ssp. *suffrutescens* (x29)
- *Suaeda taxifolia* (x85)
- Study Area

LEGEND

- A-RW002 Proposed Boring (RW/HSA) Location
- A-CPT001 Proposed CPT Location

DATE: 4/19/12	DRAWN BY: K. Fernandes	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	PROPOSED BORING LOCATIONS SPECIAL STATUS PLANT SPECIES Ballona Wetlands Restoration Los Angeles, CA
REVISION: 5/4/12	APPROVED BY: P. Chiu		PROJECT NUMBER: LA962
REVISION:			SCALE: AS SHOWN
			FIGURE NUMBER: 6



wra
ENVIRONMENTAL CONSULTANTS
2169-G East Francisco Blvd.
San Rafael, CA 94901
(415) 454-8868 Phone
(415) 454-0129 Fax

Ballona Wetlands

Los Angeles County, CA

Figure 4

Coast Buckwheat (*Eriogonum parviflorum*) Habitat Map within the Study Area

LEGEND

- A-RW002 Proposed Boring (RW/HSA) Location
- A-CPT001 Proposed CPT Location

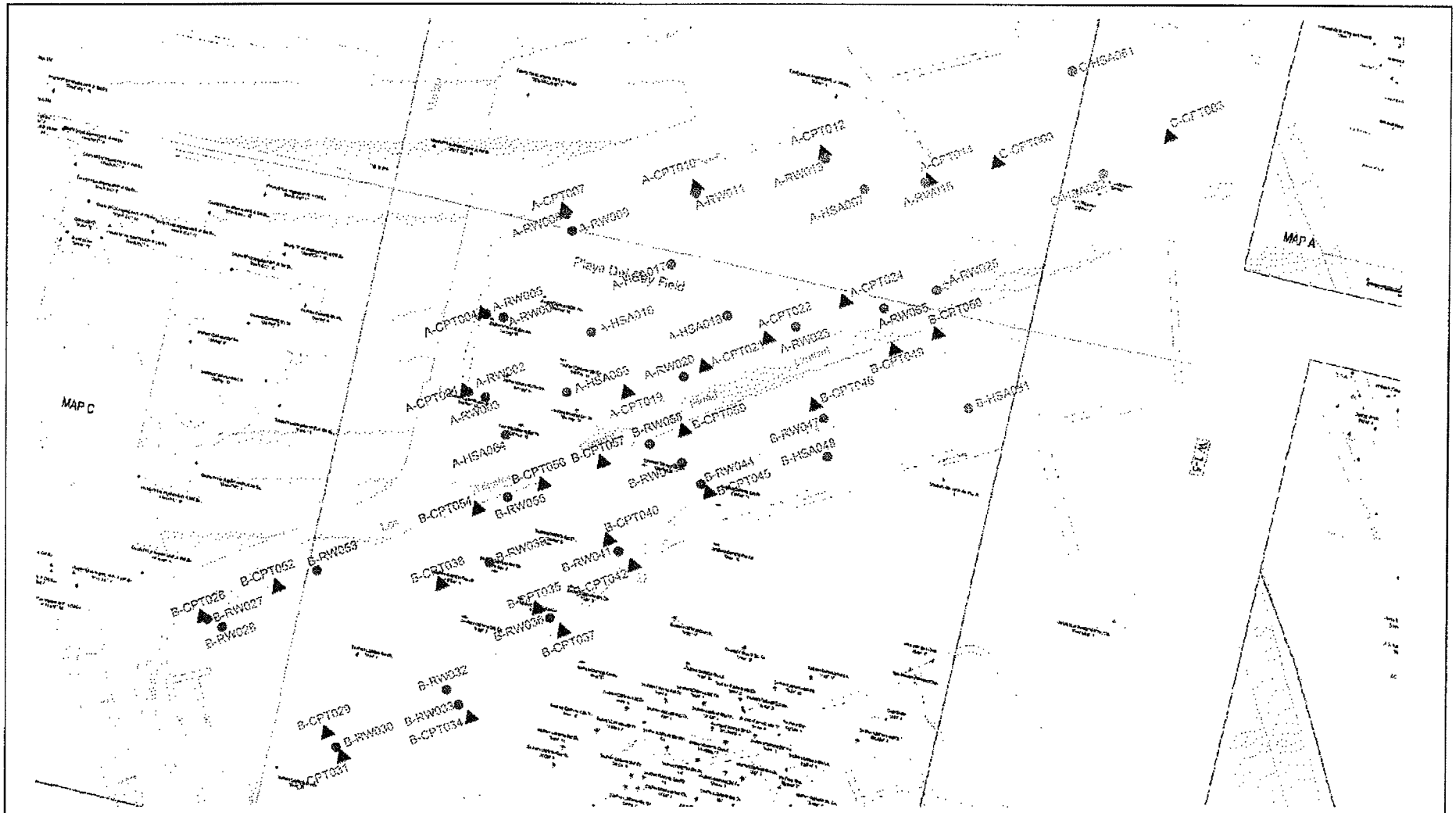
DATE: 4/19/12	DRAWN BY: K. Fernandes	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	PROPOSED BORING LOCATIONS COAST BUCKWHEAT HABITAT Ballona Wetlands Restoration Los Angeles, CA
REVISION: 3/4/12	APPROVED BY: P. Chiu		PROJECT NUMBER: LA962 SCALE: AS SHOWN FIGURE NUMBER: 7
REVISION:			



LEGEND

- A-RW002 Proposed Boring (RW/HSA) Location
- A-CPT001 Proposed CPT Location
- Belding Habitats South of Culver
- Belding's Savannah Sparrow

DATE: 4/19/12	DRAWN BY: K. Fernandes	GROUP DELTA CONSULTANTS, INC	PROPOSED BORING LOCATIONS BELDING HABITAT
REVISION: 5/4/12	APPROVED BY: P. Chiu	370 Amapola Ave. Suite 212 Torrance, CA. 90501	Ballona Wetlands Restoration Los Angeles, CA
REVISION:			PROJECT NUMBER: LA962 SCALE: AS SHOWN FIGURE NUMBER: 8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MAP A
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B-HSA040

APPENDIX A

LIST OF PLANT SPECIES

(Source: WRA report dated August 2011)

Wetland Indicator Status

OBL	Always found in wetlands	>99% frequency
FACW	Usually found in wetlands	67-99%
FAC	Equal in wetland or non-wetlands	34-66%
FACU	Usually found in non-wetlands	1-33%
UPL	Upland/Not listed (upland)	<1%

Family	Scientific Name	Common Name	Wetland Indicator Status
Plant species documented from the Ballona Wetlands[1] Project Site. Species names given according to Hickman (1993) or Jepson Interchange (2010). Old names (Hickman 1993) are given in parentheses, as needed.			
DICOTS			
Aizoaceae	*Aptenia cordifolia*	Baby sun rose	UPL
Aizoaceae	*Carpobrotus chilense*	Sea-fig	UPL
Aizoaceae	*Carpobrotus edulis*	Sour-fig (Hottentot-fig)	UPL
Aizoaceae	*Delosperma litorale*	Seaside delosperma	UPL
Aizoaceae	*Malephora crocea*	Red-flowered iceplant	UPL
Aizoaceae	*Mesembryanthemum crystallinum*	Crystalline iceplant	UPL
Aizoaceae	*Mesembryanthemum nodiflorum*	Slender leaf iceplant	UPL
Aizoaceae	*Sesuvium verrucosum*	Western sea-purslane	FACW
Aizoaceae	*Tetragonia tetragonioides*	New Zealand spinach	UPL
Amaranthaceae	*Amaranthus albus*	White tumbleweed	FACU
Amaranthaceae	*Amaranthus californicus*	Amaranth/Ca. pigweed	FACW
Amaranthaceae	*Amaranthus deflexus*	Pigweed	UPL
Amaranthaceae	*Amaranthus tamariscanus*	Indehiscent pigweed	FACU
Amaryllidaceae	*Narcissus tazetta*	Paper white narcissus	UPL
Anacardiaceae	*Malosma laurina (Rhus laurina)*	Laurel sumac	UPL
Anacardiaceae	*Rhus integrifolia*	Lemonade berry	UPL
Anacardiaceae	*Schinus molle*	Peruvian pepper tree	UPL
Anacardiaceae	*Schinus terebinthifolius*	Brazilian pepper tree	UPL

[1] Species list adapted from 08/18/2006 Ballona Wetlands Floral Compendium

Family	Scientific Name	Common Name	Wetland Indicator Status
Apiaceae	*Apium graveolens*	Celery	FACW
Apiaceae	*Apium leptophyllum*	Marsh parsley	UPL
Apiaceae	*Conium maculatum*	Poison hemlock	FACW
Apiaceae	*Foeniculum vulgare*	Fennel	FACU
Apocynaceae	*Nerium oleander*	oleander	UPL
Araliaceae	*Hedera canariensis*	Algerian ivy	UPL
Asteraceae	*Ambrosia acanthicarpa*	Ragweed/Annual bursage	UPL
Asteraceae	*Ambrosia chamissonis*	Ragweed/Beach bur	UPL
Asteraceae	*Ambrosia psilostachya*	Western ragweed	FAC
Asteraceae	*Artemisia californica*	California sage brush	UPL
Asteraceae	*Artemisia douglasiana*	California/Douglas' mugwort	FACW
Asteraceae	*Artemisia dracunculus*	Dragon sagewort/Tarragon	UPL
Asteraceae	*Symphyotrichum subulatum* var. *ligulatum*	Marsh aster/Slender aster	UPL
Asteraceae	*Baccharis pilularis*	Coyote brush	UPL
Asteraceae	*Baccharis salicifolia*	Mule fat	FACW
Asteraceae	*Brickellia californica*	Brickellbush	FACU
Asteraceae	*Centaurea melitensis*	Tocalote	UPL
Asteraceae	*Centaurea repens*	Russian knapweed	UPL
Asteraceae	*Chaenactis glabriuscula*	Yellow chaenactis	UPL
Asteraceae	*Chamomilla suaveolens*	Pineapple weed	UPL
Asteraceae	*Chondrilla juncea*	Skelton weed	UPL

Family	Scientific Name	Common Name	Wetland Indicator Status
Asteraceae	*Chrysanthemum coronarium*	Garland daisy	UPL
Asteraceae	*Cichorium intybus*	Chicory	UPL
Asteraceae	*Cirsium vulgare*	Bull thistle	UPL
Asteraceae	*Conyza bonariensis*	Flax-leaved horseweed	UPL
Asteraceae	*Conyza canadensis*	Horseweed	FAC
Asteraceae	*Conyza coulteri*	Sticky conyza	FAC
Asteraceae	*Cotula australis*	Cotula	UPL
Asteraceae	*Cotula coronopifolia*	Brass buttons	FACW
Asteraceae	*Encelia californica*	California bush sunflower	UPL
Asteraceae	*Ericameria ericoides (Haplopappus e.)*	Goldenbush/Mock	UPL
Asteraceae	*Ericameria pinifolia (Haplopappus p.)*	Goldenbush	UPL
Asteraceae	*Euryops pectinatus*	Euryops daisy	UPL
Asteraceae	*Euthamia occidentalis (Solidago occidentalis)*	Western goldenrod	OBL
Asteraceae	*Filago sp.*	Filago	UPL
Asteraceae	*Gazania linearis (G. longiscapa)*	African daisy	UPL
Asteraceae	*Gazania scaposa*	African daisy	UPL
Asteraceae	*Gnaphalium bicolor*	Cudweed	UPL
Asteraceae	*Gnaphalium californicum*	California cudweed	UPL
Asteraceae	*Gnaphalium canescens* ssp. *beneolens*	Everlasting cudweed	UPL
Asteraceae	*Gnaphalium ramosissimum*	Pink cudweed	UPL
Asteraceae	*Gnaphalium stramineum (G. chilense)*	Chilean cudweed	FAC

Family	Scientific Name	Common Name	Wetland Indicator Status
Asteraceae	*Grindelia camporum (G. robusta)*	Gum plant	FACU
Asteraceae	*Hedypnois cretica*	Cretan weed	UPL
Asteraceae	*Helianthus annuus*	California sunflower	FAC
Asteraceae	*Deinandra fasciculata (Hemizonia f.)*	Common tarweed	UPL
Asteraceae	*Deinandra paniculata (Hemizonia p.)*	San Diego tarweed	FACU
Asteraceae	*Centromadia parryi australis (Hemizonia p. ssp. a.)*		FAC
Asteraceae	*Heterotheca grandiflora*	Telegraph weed	UPL
Asteraceae	*Heterotheca villosa (Chrysopis v.)*	Hairy goldenaster	UPL
Asteraceae	*Hypochaeris glabra*	Smooth cat's ear	UPL
Asteraceae	*Jaumea carnosa*	Fleshy jaumea	OBL
Asteraceae	*Lactuca eucra*	-	-
Asteraceae	*Lactuca serriola*	Prickly lettuce	FAC
Asteraceae	*Lactuca virosa*	Wild lettuce	UPL
Asteraceae	*Lessingia filaginifolia (Corethrogyne filaginifolia)*		UPL
Asteraceae	*Malacothrix saxatilis*	Cliff aster	UPL
Asteraceae	*Osteospermum fruticosum (Dimorphotheca f.)*	African daisy	UPL
Asteraceae	*Picris echioides*	Bristly ox-tongue	FAC
Asteraceae	*Senecio vulgaris*	Common groundsel	UPL
Asteraceae	*Silybum marianum*	Milk thistle	UPL
Asteraceae	*Solidago californica*	California goldenrod	UPL

Family	Scientific Name	Common Name	Wetland Indicator Status
Asteraceae	*Euthamia occidentalis (Solidago o.)*	Western goldenrod	OBL
Asteraceae	*Sonchus asper* ssp. *asper*	Prickly sow thistle	FAC
Asteraceae	*Sonchus oleraceus*	Common sow thistle	NI
Asteraceae	*Stephanomeria exigua*	Small wire lettuce	UPL
Asteraceae	*Stephanomeria virgata*	Tall stephanomeria	UPL
Asteraceae	*Taraxacum officinale*	Dandelion	FACU
Asteraceae	*Xanthium spinosum*	Spiny cocklebur	FAC
Asteraceae	*Xanthium strumarium*	Rough cocklebur	FAC
Bataceae	*Batis maritima*	Salt wort	OBL
Boraginaceae	*Cryptantha intermedia*	White forget-me-not/popcorn flower	UPL
Boraginaceae	*Heliotropium curassavicum (H. ocellatum)*	Salt heliotrope	UPL
Brassicaceae	*Brassica nigra*	Black mustard	UPL
Brassicaceae	*Brassica rapa*	Field mustard	UPL
Brassicaceae	*Cakile maritima*	Sea-rocket	FACW
Brassicaceae	*Coronopus didymus*	Lesser swine cress	UPL
Brassicaceae	*Erysimum insulare* ssp. *suffrutescens*	Island wallflower	UPL
Brassicaceae	*Guillenia lasiophylla*	California mustard	UPL
Brassicaceae	*Hirschfeldia incana (Brassica geniculata)*	Field mustard	UPL
Brassicaceae	*Lepidium latifolium*	Broad-leaved peppergrass	FACW
Brassicaceae	*Lepidium virginicum* var. *pubescens (L. pubescens)*	Tall peppergrass	FACU

Family	Scientific Name	Common Name	Wetland Indicator Status
Brassicaceae	*Lobularia maritima*	Sweet alyssum	UPL
Brassicaceae	*Raphanus sativus*	Wild radish	UPL
Brassicaceae	*Sinapis alba (Brassica cf. hirta)*	White mustard	UPL
Brassicaceae	*Sisymbrium altissimum*	Tumble-mustard	UPL
Brassicaceae	*Sisymbrium irio*	London rocket	UPL
Cactaceae	*Opuntia ficus-indica*	Indian-fig	UPL
Cactaceae	*Opuntia littoralis*	Coastal prickly pear	UPL
Caprifoliaceae	*Sambucus mexicana*	elderberry	FAC
Caryophyllaceae	*Polycarpon tetraphyllum*	Four-leaved allseed	UPL
Caryophyllaceae	*Spergula arvensis*	Spurry starwort	UPL
Caryophyllaceae	*Silene gallica*	Common catchfly/ windmill pink	UPL
Caryophyllaceae	*Spergularia bocconei*	Boccone's sand-spurrey	UPL
Caryophyllaceae	*Spergularia macrotheca*	Salt marsh sand-spurrey	FAC
Caryophyllaceae	*Spergularia marina*	Hairy sand-spurrey	OBL
Caryophyllaceae	*Spergularia villosa*	Sand-spurrey	UPL
Chenopodiaceae	*Atriplex californica*	California saltbush	FAC
Chenopodiaceae	*Atriplex lentiformis*	Saltbush	FAC
Chenopodiaceae	*Atriplex patula*	Spear oracle	FACW
Chenopodiaceae	*Atriplex rosea*	Tumbling oracle	FACU
Chenopodiaceae	*Atriplex semibaccata*	Australian saltbush	FAC
Chenopodiaceae	*Atriplex triangularis*	Spearscale	FACW

Family	Scientific Name	Common Name	Wetland Indicator Status
Chenopodiaceae	*Bassia hyssopifolia*	Bassia	FAC
Chenopodiaceae	*Beta vulgaris*	Beet	FACU
Chenopodiaceae	*Chenopodium album*	White goosefoot/ Lambs-quarters	FAC
Chenopodiaceae	*Chenopodium ambrosioides*	Mexican tea	FAC
Chenopodiaceae	*Chenopodium berlandieri*	Pitseed goosefoot	UPL
Chenopodiaceae	*Chenopodium botrys*	Jerusalem oak	FACU
Chenopodiaceae	*Chenopodium murale*	Shiny-leaf goosefoot	UPL
Chenopodiaceae	*Chenopodium pumilio*	Glomerate goosefoot	UPL
Chenopodiaceae	*Salicornia bigelovii*	Annual pickleweed	OBL
Chenopodiaceae	*Arthrocnemum subterminale*	Parish's pickleweed	OBL
Chenopodiaceae	*Sarcocornia pacifica (Salicornia virginica)*	Common pickleweed	OBL
Chenopodiaceae	*Salsola tragus*	Russian thistle	FACU
Chenopodiaceae	*Suaeda calceoliformis (S. depressa* var. *erecta)*	Horned sea-blite	FACW
Chenopodiaceae	*Suaeda esteroa*	Sea-blite	UPL
Chenopodiaceae	*Suaeda taxifolia*	Woolly sea-blite	FACW
Convolvulaceae	*Calystegia macrostegia* var. *cyclostegia*	Coast morning glory	UPL
Convolvulaceae	*Convolvulus arvensis*	Bindweed	UPL
Convolvulaceae	*Cressa truxillensis* var. *vallicola*	Alkali weed	FACW
Convolvulaceae	*Dichondra occidentalis**	Western ponysfoot	UPL
Crassulaceae	*Crassula argentea*	Jade plant	UPL

Family	Scientific Name	Common Name	Wetland Indicator Status
Crassulaceae	*Crassula connata*	Pygmy weed	FAC
Cucurbitaceae	*Citrullus lanatus*	Watermelon	UPL
Cucurbitaceae	*Cucurbita foetidissima*	Calibazilla	UPL
Cupressaceae	*Cupressus arizonica* ssp. *arizonica*	cypress	UPL
Cuscutaceae	*Cuscuta californica*	California dodder	UPL
Cuscutaceae	*Cuscuta indecora*	Big-seed alfalfa dodder	UPL
Cuscutaceae	*Cuscuta pentagona (C. campestris)*	Five-angled dodder	UPL
Cuscutaceae	*Cuscuta salina*	Saltmarsh dodder	UPL
Euphorbiaceae	*Chamaesyce albomarginata*	Rattlesnake weed	FACU
Euphorbiaceae	*Chamaesyce maculata*	Spotted spurge	UPL
Euphorbiaceae	*Chamaesyce polycarpa*	Smallseeded sandmat	UPL
Euphorbiaceae	*Chamaesyce serpens*	Matted sandmat	UPL
Euphorbiaceae	*Croton californicus*	California Croton	UPL
Euphorbiaceae	*Euphorbia esula*	Leafy spurge	UPL
Euphorbiaceae	*Euphorbia peplus*	Petty spurge	UPL
Euphorbiaceae	*Ricinus communis*	Castor bean	FACU
Fabaceae	*Acacia longifolia*	Australian wattle	UPL
Fabaceae	*Acacia decurrens*	Green wattle	UPL
Fabaceae	*Acacia neriifolia*	Wattle	UPL
Fabaceae	*Albizia lophantha (A. distachya)*	Albizia	UPL
Fabaceae	*Astragalus trichopodus*	Ocean locoweed	UPL

Family	Scientific Name	Common Name	Wetland Indicator Status
Fabaceae	*Bauhinia variegata*	Orchid tree	UPL
Fabaceae	*Ceratonia siliqua*	Carob	UPL
Fabaceae	*Hoffmannseggia glauca*	Pig nut, Hog-potato	FACU
Fabaceae	*Lotus purshianus*	Spanish clover/Bird's foot trefoil	UPL
Fabaceae	*Lotus scoparius*	Deerweed	UPL
Fabaceae	*Lotus strigosus*	Strigose lotus	UPL
Fabaceae	*Lupinus bicolor*	Miniature lupine	UPL
Fabaceae	*Lupinus chamissonis*	Coastal bush lupine	UPL
Fabaceae	*Lupinus excubitus* ssp. *hallii*	Hall's lupine	UPL
Fabaceae	*Lupinus longifolius*	Longleaf bush lupine	UPL
Fabaceae	*Lupinus succulentus*	Arroyo lupine	UPL
Fabaceae	*Lupinus truncatus*	Lupine	UPL
Fabaceae	*Medicago polymorpha (M. hispida)*	California burclover	UPL
Fabaceae	*Melilotus albus*	White sweetclover	FACU
Fabaceae	*Melilotus indica*	Sourclover	FAC
Fabaceae	*Phaseolus limensis*	Large lima bean	UPL
Fabaceae	*Spartium junceum*	Spanish broom	UPL
Fagaceae	*Quercus agrifolia*	Coast live oak	UPL
Fagaceae	*Quercus x virginica*	Hybrid live oak	UPL
Frankeniaceae	*Frankenia salina*	Alkali heath	FACW
Geraniaceae	*Erodium botrys*	Storksbill/broad-lobed filaree	UPL

Family	Scientific Name	Common Name	Wetland Indicator Status
Geraniaceae	*Erodium cicutarium*	Storksbill	UPL
Geraniaceae	*Pelargonium zonale*	Garden Geranium	UPL
Grossulariaceae	*Ribes malvaceum*	Chaparral currant	UPL
Hamamelidaceae	*Liquidambar styraciflua*	liquidambar	UPL
Hydrophyllaceae	*Phacelia ramosissima* var. *austrolitoralis*	Branching phacelia	UPL
Juglandaceae	*Juglans regia*	English walnut	UPL
Lamiaceae	*Marrubium vulgare*	Horehound	FAC
Lythraceae	*Ammannia sp.*	Red stem	OBL
Lythraceae	*Lythrum hyssopifolium*	Hyssop loosestrife	FACW
Malvaceae	*Malacothamnus fasciculatus*	Bush mallow/Chaparral	UPL
Malvaceae	*Malva nicaeensis*	Bull mallow	UPL
Malvaceae	*Malva parviflora*	Cheeseweed mallow	UPL
Malvaceae	*Malvella leprosa*	Alkali mallow	FAC
Moraceae F	*Ficus carica*	Edible fig	UPL
Moraceae	*Morus alba*	White mulberry	NI
Myoporaceae	*Myoporum laetum*	Lollypop tree	UPL
Myrtaceae	*Eucalyptus camaldulensis*	Red gum	UPL
Myrtaceae	*Eucalyptus globulus*	Blue gum	UPL
Myrtaceae	*Eucalyptus tereticornis*	Forest red gum	UPL
Myrtaceae	*Eucalyptus viminalis*	Manna gum	UPL
Myrtaceae	*Luma apiculata (Eugenia sp.)*	temu	UPL

Family	Scientific Name	Common Name	Wetland Indicator Status
Nyctaginaceae	*Abronia umbellata*	Pink sand verbena	UPL
Oleaceae	*Fraxinus velutina*	Arizona/Velvet	FACW
Oleaceae	*Olea europaea*	Olive	UPL
Onagraceae	*Camissonia bistorta*	California sun cup	UPL
Onagraceae	*Camissonia cheiranthifolia* var. *suffruticosa*	Beach evening	UPL
Onagraceae	*Camissonia lewisii*	Lewis' evening primrose	UPL
Onagraceae	*Camissonia micrantha*	Miniture sun cup	UPL
Onagraceae	*Epilobium ciliatum*	Willow-herb	FACW
Onagraceae	*Oenothera elata* ssp. *hookeri*	Hooter's evening primrose	FACW
Onagraceae	*Oenothera elata* ssp. *hirsutissima*	Hairy evening primrose	FACW
Oxalidaceae	*Oxalis pes-caprae*	Bermuda buttercup	UPL
Papaveraceae	*Eschscholzia californica*	California poppy	UPL
Plantaginaceae	*Plantago lanceolata*	English plantain	FAC
Plantaginaceae	*Plantago major*	Common plantain	FACW
Plumbaginaceae	*Limonium californicum*	Sea lavender	OBL
Polygonaceae	*Eriogonum fasciculatum*	California buckwheat	UPL
Polygonaceae	*Eriogonum gracile*	Slender buckwheat	UPL
Polygonaceae	*Eriogonum parvifolium*	Dune buckwheat	UPL
Polygonaceae	*Polygonum arenastrum*	Common knotweed	FAC
Polygonaceae	*Polygonum lapathifolium*	Willow weed	OBL
Polygonaceae	*Rumex crispus*	Curly dock	FACW

Family	Scientific Name	Common Name	Wetland Indicator Status
Polygonaceae	*Rumex maritimus (Rumex fueginus)*	Golden dock	OBL
Polygonaceae	*Rumex salicifolius*	Willow dock	OBL
Primulaceae	*Anagallis arvensis*	Scarlet pimpernel	FAC
Ranunculaceae	*Clematis sp.*	clematis	UPL
Rosaceae	*Adenostoma fasciculatum*	Chamise	UPL
Rosaceae	*Heteromeles arbutifolia*	Toyon	UPL
Rosaceae	*Prunus persica*	Peach	UPL
Rosaceae	*Pyracantha sp.*	Firethorn	UPL
Rosaceae	*Rosa californica*	California rose	FAC
Rubiaceae	*Galium angustifolium*	Narrowleaf bedstraw	UPL
Salicaceae	*Populus fremontii*	Fremont cottonwood	FACW
Salicaceae	*Salix exigua (S. hindsiana)*	Narrow-leaved willow	OBL
Salicaceae	*Salix gooddingii*	Black willow	OBL
Salicaceae	*Salix laevigata*	Red willow	UPL
Salicaceae	*Salix lasiolepis*	Arroyo willow	FACW
Saururaceae	*Anemopsis californica*	Yerba mansa	OBL
Scrophulariaceae	*Verbascum virgatum*	Wand mullein	UPL
Scrophulariaceae	*Cordylanthus maritimus*	Bird's beak	OBL
Solanaceae	*Datura wrightii (D. meteloides)*	Jimsonweed	UPL
Solanaceae	*Lycium ferocissimum*	African boxthorn	UPL
Solanaceae	*Lycopersicon esculentum*	Tomato	UPL

Family	Scientific Name	Common Name	Wetland Indicator Status
Solanaceae	*Nicotiana glauca*	Tree tobacco	FAC
Solanaceae	*Petunia parviflora*	Wild Petunia	FACW
Solanaceae	*Solanum americanum (S. nodiflorum)*	Small-flowered nightshade	FAC
Solanaceae	*Solanum douglasii*	Douglas's Nightshade	FAC
Solanaceae	*Solanum nigrum*	Black nightshade	FACU
Solanaceae	*Solanum sarrachoides*	Hairy nightshade	UPL
Solanaceae	*Solanum xanti*	Chaparral nightshade	UPL
Tropaeolaceae	*Tropaeolum majus*	Garden nasturtium	UPL
Typhaceae	*Typha domingensis*	Southern Cattail	OBL
Typhaceae	*Typha latifolia*	Broad-leaved Cattail	OBL
Ulmaceae	*Ulmus parvifolia*	Chinese elm	UPL
Urticaceae	*Urtica dioica* ssp. *holosericea (U. holosericea)*	Hoary nettle	FACW
Urticaceae	*Urtica urens*	Dwarf nettle	UPL
Verbenaceae	*Verbena lasiostachys*	Common verbena	FAC
Verbenaceae	*Lantana camara*	Orange-flowered lantana	NI
Zygophyllaceae	*Tribulus terrestris*	Puncture vine	UPL
MONOCOTS			
Alismataceae	*Sagittaria montevidensis* ssp. *calycina*	Arrowhead	OBL
Arecaceae	*Phoenix canariensis*	Canary island date palm	UPL
Arecaceae	*Phoenix dactylifera*	Date palm	UPL
Arecaceae	*Washingtonia robusta*	Slender fan palm	UPL

Family	Scientific Name	Common Name	Wetland Indicator Status
Cyperaceae	*Carex praegracilis*	Clustered field sedge	FACW
Cyperaceae	*Cyperus eragrostis*	Galingale/Tall flat sedge	FACW
Cyperaceae	*Cyperus esculentus*	Yellow nutsedge	FACW
Cyperaceae	*Cyperus involucratus (C. alternifolius)*	Umbrella plant	OBL
Cyperaceae	*Eleocharis macrostachya*	Pale spike rush	OBL
Cyperaceae	*Eleocharis montevidensis*	Dombey's spike rush	FACW
Cyperaceae	*Schoenoplectus americanus (Scirpus a.)*	Olney bulrush	OBL
Cyperaceae	*Schoenoplectus californicus (Scirpus c.)*	California bulrush/Tule	OBL
Cyperaceae	*Bolboschoenus maritimus* ssp. *paludosus (Scirpus m.)*	Prairie burush	OBL
Cyperaceae	*Bolboschoenus robustus (Scirpus r.)*	Saltmarsh bulrush	OBL
Iridaceae	*Chasmanthe aethiopica*	Adams iris	UPL
Iridaceae	*Iris pseudacorus var. alba*	Horticultural iris	OBL
Juncaceae	*Juncus acutus* var. *leopoldii (J. a.* var. *sphaerocarpus)*	Spike-rush	FACW
Juncaceae	*Juncus balticus*	Wire rush	OBL
Juncaceae	*Juncus bufonius* var. *occidentalis (J. sphaerocarpus)*	rush	FACW
Juncaceae	*Juncus mexicanus*	Mexican rush	FACW
Juncaginaceae	*Triglochin maritima* (likely a misidentification of *T. concinnum)*	Arrow grass	OBL
Liliaceae	*Agave americana var. striata*	Giant agave	UPL
Liliaceae	*Agave attenuata*	Foxtail agave	UPL

Family	Scientific Name	Common Name	Wetland Indicator Status
Liliaceae	*Yucca gloriosa*	Spanish dagger	UPL
Liliaceae	*Aloe vera*	Medicinal aloe	UPL
Poaceae	*Agrostis viridis (A. semiverticillata)*	Bentgrass	OBL
Poaceae	*Agrostis stolonifera*	Redtop	FACW
Poaceae	*Arundo donax*	Giant reed grass	FACW
Poaceae	*Avena barbata*	Slender wild oat	UPL
Poaceae	*Avena fatua*	Wild oat	UPL
Poaceae	*Bromus catharticus (B. wildenovii)*	Rescue-grass	UPL
Poaceae	*Bromus diandrus*	Ripgut chess	UPL
Poaceae	*Bromus hordeaceus (B. mollis)*	Soft chess	FACU
Poaceae	*Bromus madritensis* ssp. *rubens*	Foxtail chess	UPL
Poaceae	*Bromus carinatus (B. marginatus)*	California brome	UPL
Poaceae	*Cortaderia selloana*	Pampas grass	UPL
Poaceae	*Cynodon dactylon*	Bermuda grass	FAC
Poaceae	*Digitaria sanguinalis*	Crabgrass	FACU
Poaceae	*Distichlis spicata*	Saltgrass	FACW
Poaceae	*Echinochloa crus-galli*	Barnyard grass	FACW
Poaceae	*Ehrharta erecta*	Upright veldt grass	UPL
Poaceae	*Festuca arundinacea*	Tall fescue	FAC
Poaceae	*Hordeum depressum*	Alkali barley	NI
Poaceae	*Hordeum murinum* ssp. *leporinum*	Wild barley	NI

Family	Scientific Name	Common Name	Wetland Indicator Status
Poaceae	*Hordeum vulgare*	Barley	UPL
Poaceae	*Lamarckia aurea*	Goldentop	UPL
Poaceae	*Leymus condensatus (Elymus c.)*	Giant ryegrass	FACU
Poaceae	*Leymus triticoides*	Alkali ryegrass	FAC
Poaceae	*Leptochloa uninervia*	Mexican sprangle top	FACW
Poaceae	*Lolium multiflorum*	Italian ryegrass	FAC
Poaceae	*Lolium perenne*	Perennial ryegrass	FAC
Poaceae	*Melica imperfecta*	Melic grass	UPL
Poaceae	*Monanthochloe littoralis*	Shoregrass	OBL
Poaceae	*Nassella cernua (Stipa cernua)*	Nodding Needlegrass	UPL
Poaceae	*Parapholis incurva*	Sickle grass	UPL
Poaceae	*Paspalum dilatatum*	Dallis grass	FAC
Poaceae	*Phalaris paradoxa*	Hood canary grass	UPL
Poaceae	*Piptatherum miliaceum (Oryzopsis miliacea)*	Smilo grass	UPL
Poaceae	*Poa annua*	Annual bluegrass	FACW
Poaceae	*Polypogon monspeliensis*	Rabbitsfoot grass	FACW
Poaceae	*Schismus barbatus*	Mediterranean grass	UPL
Poaceae	*Setaria gracilis (S. geniculata)*	Bristlegrass	FAC
Poaceae	*Sorghum halepense*	Johnsongrass	FACU
Poaceae	*Sorghum nutans*	Indian grass	UPL
Poaceae	*Stenotaphrum secundatum*	St. Augustine grass	FAC

Family	Scientific Name	Common Name	Wetland Indicator Status
Poaceae	*Vulpia myuros* var. *myuros (Festuca myuros)*	Fescue	UPL
Poaceae	*Vulpia myuros* var. *hirsuta (Festuca megalura)*	Foxtail fescue	UPL
Poaceae	*Spartina foliosa*	Cordgrass	OBL
Potamogetonaceae	*Ruppia maritima*	Ditch grass	OBL
Typhaceae	*Typha domingensis*	Southern Cattail	OBL
Typhaceae	*Typha latifolia*	Broad-leaved Cattail	OBL

SECTION V

CIVIL

Psomas has an exceptionally long history of working in the area of this restoration project – over 25 years. Psomas will prepare preliminary engineering designs for the following components of the levee breach plan and permit requirements through the duration of the design portion of the project. Civil design elements and support will include the three stages outlines in Section II.

30% Preliminary Design (Eight Months – by December 2012)

The design elements during this Sequence include:

- Preliminary Design Report preparation.
- Overall site plan to be prepared based on the grading schemes developed by PWA/ESA.
- Layout and preliminary design for stabilizing and protecting the ends of the portions of the existing levees to remain.
- Assist PWA/ESA with civil constraints related to the preliminary geometric alignment and stability design for the north levee and maintenance path along Fiji Road and Lincoln Boulevard.
- Preliminary geometric alignment and stability design for the south levee and maintenance path along Culver Boulevard.
- Preliminary geometric alignment and integration of an access/pedestrian/bike path along one or more of the levees.
- Preliminary design and details for protection of the portions of the levee sections that will remain.
- Review of previous studies and refined preliminary design studies and coordination for the ultimate horizontal and vertical alignment of Lincoln Boulevard to assist in determining the location of the perimeter levee in Area A.
- Documentation of the existing gas wells and pipelines that may be impacted by the restoration program.
- Develop exhibits showing the planned construction sequencing for removing the levees and grading the restoration site.
- Provide technical support for maintenance requirements of the infrastructure elements of the design to be incorporated into the operations and maintenance requirements related to the restoration work.
- Prepare preliminary grading plans for Areas B and C that will be used for placement of soil material that is excavated from the Area A and B restoration sites.
- Develop studies and alternatives for transporting excavated soil material from the restoration site to the fill placement areas in Areas B and C.

- Prepare written narrative and exhibits that describe temporary and permanent erosion and sediment transport measures that could be implemented at the restoration site and the fill placement sites.
- Prepare a preliminary hydrology and drainage report in accordance with the City of Los Angeles requirements for the drainage areas associated with Areas B and C.
- Prepare an earthwork analysis of the restoration area grading design and fill disposal areas that identify the earthwork volumes and incorporate shrinkage factors as identified by the geotechnical consultant.
- Preliminary Utility Analysis – Review all utilities affected by the restoration project grading. Priority will be given to those utilities that must be removed or relocated. Those affected agencies will be identified and approached to determine their requirements. A constraints matrix will be populated with the pertinent criteria and actions necessary. If appropriate, applications will be made to initiate their review, but execution of work will not be included in this phase.
- Prepare preliminary plans for a new bike trail to be located on the new north side perimeter levee. These preliminary plans will be prepared using County of Los Angeles requirements.
- If not addressed by a third party development entity, prepare preliminary plans for reconstruction of the existing sports fields located within Area C. The existing sports fields may be removed as part of the overall grading design of the area.
- Constructability Analysis – Conduct a constructability analysis of the preliminary design to determine the options for physical delivery of the project. Review durations and sequencing of work, timing in addressing of constraints, availability and test timing of materials, etc. Options will be reviewed with the team to determine the most appropriate courses of action and acceptable options.
- Prepare an Engineer's Estimate of Probable Construction Costs –This estimate of probable construction costs will be based on the preliminary design documents. At this stage the estimate will be at a level sufficient for overall budgeting purposes with appropriate contingencies. Through later stages, this estimate will be refined as additional information and analysis is available. The estimate will be developed for the Phase 1 project as well as a general estimate for the entire project.
- Preliminary Hydrology and Hydraulic Analysis – Conduct an analysis of the local hydrology within Areas B and C, and then evaluate the capacity of existing and proposed drainage structures and areas.
- Stormwater Pollution Prevention Plan (SWPPP) – In coordination with the Psomas team and other PMT team members, prepare the overall project SWPPP to identify the specific sediment transport impacts due to storm events, and the mitigations necessary during the construction process. This report will be prepared in conjunction with the preparation of the erosion control plans.

- Erosion Control Plans – Prepare an overall erosion control plan and separate erosion control plan details and exhibits to address the construction phases that may be utilized.

Deliverables

1. Project Schedule
2. Overall Project Site Plan
3. Preliminary Levee Removal Plans/Details
4. Preliminary Levee Protection Design and Details
5. Preliminary Grading Plan – Area B and C
6. Preliminary Earthwork Analysis Areas A, B and C
7. Bike Trail Plans
8. Preliminary Gas Well / Pipelines Abandonment Plans (Diana to lead processing)
9. Construction Sequencing Exhibit
10. Project Meetings
11. Assist with Application and Permit Processing
12. Excavated Materials Transportation Study
13. Preliminary Erosion and Sediment Control Plan
14. Preliminary Hydrology and Drainage Report for Area B and C Fill Locations1
15. Preliminary Existing Utility Analysis and Exhibit
16. Constructability Analysis Report
17. Preliminary Engineers Estimate of Probable Construction Costs
18. Design Coordination
19. Permit Application and Processing Support

70% Design Documents (Six Months – January to June 2013)

The design elements during this Sequence include:

- Refine, add detail, and prepare final technical design and details for stabilizing and protecting the ends of the proposed levees and the portions of the levees to remain. This would include identifying

the size, thickness, toe down and extent of riprap or concrete facing protection including backing systems.

- Refine, add detail, and prepare final design, layout and details of the maintenance access road and bike trail on the proposed levees.
- Documentation of coordination with the Gas Company for disposition of their existing wells and pipelines.
- Provide input to other consultants to take advantage of our local knowledge during the preparation of their restoration and final grading plans and details in accordance with County of Los Angeles and City of Los Angeles requirements.
- Refine, add detail to, and prepare final grading plans for the disposal grading in Area B and the fill placement areas in Area C.
- If required, prepare or refine and add detail to the grading plans and layouts for reconstruction of the sports facilities within Area C south of Culver Boulevard.
- Refine, add detail to, and finalize earthwork calculation reports for inclusion with permit application documents submitted to Los Angeles City and County, and the USACE.
- Refine, add detail to, and finalize the SWPPP documentation and Erosion Control plans for grading and construction activity in Area A, B and C in accordance with State requirements as well as the local specific requirements of the City and County of Los Angeles.
- Refine, add detail to, and prepare final hydraulics calculations and reports for drainage devices to be constructed with grading activities in Areas B and C.
- Prepare a Haul Route Application, exhibits and supporting documents for submittal to the City of Los Angeles for transport of earthwork across public streets to the disposal areas in Areas B and C.
- Refine, add detail, and prepare updated final engineers estimate of probable construction costs based on the 70% design documents.
- Refine the 408 application package to the USACE for the70% submittal.
- Prepare a Conditional Use Permit (CUP) application for the County of Los Angeles for export of more than 100,000 cubic yards from a site as required by County codes. The CUP process for LA County may also require approval of the haul route that will be processed through the City of Los Angeles.
- Prepare other applications and submit plans, calculations, reports and other supporting documents for the grading, bridges, and levee modifications to the other applicable agencies for review. This would include the County and City of Los Angeles, Fish and Game, and FEMA.
- Provide coordination services for design work as well as relocation work undertaken by the Gas Company and other utility franchises to remove and relocate facilities which interfere with the planned work.
- Participate in meetings with the PMT and other consultant team members, and other public agencies or local groups as directed.

- Provide peer review of plans, documents and calculations prepared by other consultants. Specifically our focus will be on the grading design and hydrology/hydraulics package that will be reviewed by LA County as part of the grading permit and levee modification process.

Deliverables

1. Detailed Levee Removal Plans and Details
2. Detailed Levee Protection Plans/Details
3. Grading Plans – Areas B and C
4. Detailed Bike Trail Plans
5. Pedestrian/Bike Bridge Plans/Details
6. Final Gas Well/Pipeline Abandonment Exhibit and Coordination
7. Sports Facilities Final Grading Plans
8. Construction Sequencing Plan
9. Haul Route Plan/Permit
10. SWPPP/Local Erosion Control
11. Local Hydrology Report for Storm Drain Culverts
12. Culvert Hydraulics Report
13. Earthwork Calculations
14. Engineers Estimate of Probable Construction Costs

100% Construction Documents (Six Months – June to December 2013)

Work effort during this 100% stage will include coordination, processing, and updates to address plan check comments to the 70% design documents through the various public agencies for design and permit approval for the construction work. The 70% construction cost estimate will be updated when the plans are at an approval stage. We anticipate that approvals and clearance letters will be required from the following agencies:

- County of Los Angeles
- City of Los Angeles
- USACE
- The Gas Company

- Coastal Commission
- Department of Fish & Game
- FEMA
- Other utility providers

Any or all of the services listed during the 70% phase may be refined and adjusted to complete this process. Therefore, we have not relisted these services and tasks in this section. There is one additional service during this phase which is that we will assist the Hydrology Consultant in assembling and preparing the application to FEMA for a Conditional Letter of Map Revision (CLOMR) for adjustment of flood zones. During this time we will also provide updates to the environmental impacts analysis and mitigation measures as appropriate.

Deliverables

1. Detailed Levee Removal Plans and Details
2. Detailed Levee Protection Plans/Details
3. Grading Plans – Areas B and C
4. Detailed Bike Trail Plans
5. Pedestrian/Bike Bridge Plans/Details
6. Structural Report
7. Detailed Geotechnical Report
8. Final Gas Well/Pipeline Abandonment Exhibit and Coordination
9. Sports Facilities Final Grading Plans
10. Construction Sequencing Plan
11. Haul Route Plan/Permit
12. SWPPP/Local Erosion Control
13. Local Hydrology Report for Storm Drain Culverts
14. Culvert Hydraulics Report
15. Earthwork Calculations
16. Engineers Estimate of Probable Construction Costs
17. Supporting Information for CLOMR

SECTION VI

STRUCTURAL

JCE Structural Engineers will be engaged during the preliminary design phase to provide support services related to bridge and structural design. This will include:

30% Preliminary Design (Eight Months – by December 2012)

- Preliminary Bridge Analysis – Prepare options for a pedestrian/bike bridge crossing of the Ballona Creek adjacent to the existing Culver Boulevard Bridge. A number of options may be reviewed initially from both a structural and aesthetic standpoint. This might include free spanning the entire width of the Ballona Creek to multiple piers within the creek bed.
- Initial Constructability Review – The potential options for bridge design will be reviewed including order of magnitude costs, construction impacts, staging requirements, and environmental impacts. After a full understanding of the options, a preferred option will be selected.
- Preliminary Bridge Design – When the preferred option is selected, prepare preliminary structural drawings and supporting structural calculations.
- Structures Design – Structural design drawings and supporting calculations will be prepared for the structural elements associated with the levee and drainage conveyance structures.
- Structural Consultation – Coordinate with the team and review the proposed construction and provide input about the impacts and risks associated with the construction proposed.

Deliverables

1. Project Schedule.
2. Preliminary Structural Analysis.
3. Preliminary Structural Design for all structures.
4. Preliminary Structural Design for levee reinforcement
5. Preliminary Bridge Report.

70% Design Documents (Six Months – January to June 2013)

This will be the completed technical submittal to include structural design. Refinements to the design reports and products from the 30% submittal will be provided to execute this final design and will include:

1. Formal Technical Structural Analysis.

2. Formal Technical Structural Design for all structures.
3. Formal Technical Structural Design for levee reinforcement
4. Formal Technical Bridge Design.

100% Construction Documents (Six Months – June to December 2013)

As in any technical review, additional comments and questions from the USACE are expected. This 100% construction documents phase is expected to include the work efforts necessary to answer their questions and incorporate their comments up to the time a formal 408 permit approval is issued.

1. Final Structural Analysis.
2. Final Structural Design for all structures.
3. Final Structural Design for levee reinforcement
4. Final Bridge Design.

SECTION VII

QA / QC

Quality is one of the cornerstones of our company and a key part of the Psomas culture. Quality is not a product, yet without it, we have nothing to sell. A principal of our quality philosophy is that the job be done right the first time:

"Do it once, do it right"

We wish to fulfill or exceed the expectations and needs of our clients and will do so by providing quality services. As stated in our Key Beliefs, "We believe quality is achieved through teamwork, adherence to firm-wide procedures and the setting of high standards."

Quality assurance at Psomas is a company-wide approach, supported by specific procedures, to ensure delivery of accurate, coordinated, and complete maps, plans, specifications, reports, stakes, and/or other engineering, surveying and planning deliverables in support of the client's requirements identified in the client's contract.

As mentioned above, quality is what we are about at Psomas. The concept and importance of quality is taught to every employee. Guidelines are set out in the Project Manager's Manual, Engineering Design Manual, Survey Procedures Manual, and the Construction Staking Manual (the manuals) for every task in a project. These guidelines are augmented by the project work plan and the project quality assurance plan that identifies and lays out the procedures for specific project tasks. These manuals were written by the leaders of Psomas who have committed to them fully. By following the guidelines we assure our clients that their project will conform to requirements.

Approach

The entire company participates in quality assurance. Quality work is what Psomas must furnish to a client in order to compete successfully for new work. Some of the procedures utilized to help assure that quality work is performed are discussed in this manual. The Psomas commitment to excellence is incorporated in the manuals.

Quality assurance at Psomas includes all activities that are sometimes known in the engineering profession as either quality assurance (primarily strategies) or quality control (primarily detailed procedures for implementing the quality assurance strategies). Quality assurance is a Psomas commitment to the quality of all contract documents and deliverables. It starts with a thorough understanding of the project, organizing a highly qualified project team, and applying skilled planning, surveying and engineering. This approach is consistently presented in the manuals.

As most of the deliverables provided by Psomas are related to constructing something, quality assurance, focuses on project planning, design reviews and checking procedures whose purpose is to assure that Psomas deliverables:

- Are sufficiently clear to be understood, administered, and enforced by all participants exercising only a moderate degree of professional expertise.
- Reflect acceptance and constructability by using local and/or readily available materials and construction methods.
- Will incur virtually no additional costs resulting from design errors and/or omissions.

- Meet the governmental agency's requirements.
- Meet the client's expectations.

Responsibilities

Psomas

Psomas has the responsibility for the accuracy and completeness of the maps, plans, specifications, construction cost estimates, reports, and stakes under its scope of work, and should meet that responsibility through the implementation of the quality assurance plan.

Principal-in-Charge (PIC)

The PIC leader is responsible for ensuring that the project managers and sub-consultants fully understand the scope, contract terms, and work plan. The PIC is responsible for approving Psomas' responsibilities as a consultant, including quality assurance requirements. Mike Crehan of Psomas is the PIC for the Psomas team.

Quality Control Manager (QCM)

The quality control manager is responsible for managing and ensuring proper execution of the quality control plan and procedures established for the project. Ross Barker of Psomas is the QCM for Psomas engineering and the Psomas team. Matt Rowe of Psomas is the QCM for Survey efforts. Mike Reader of Group Delta is the QCM for geotechnical efforts. Juan Carlos Esquivel of JCE is the QCM for structural efforts.

Project Manager

The project manager is responsible for managing the establishment of quality assurance procedures appropriate to the project requirements. A number of project managers are assigned including John Chiappe of Psomas for survey and Tom Swantko for geotechnical. Each sub-consultant will also have a project manager assigned.

Technical Manager – Engineering/Surveying/Planning/Construction (E/S/P/C)

In support of the project manager, the technical manager(s) has the prime responsibility for selecting the design criteria, reviews, and checking procedures that form the detailed components of the quality assurance plan. Andrew Nickerson of Psomas is one of our engineering technical managers.

Project Engineer/Surveyor/Planner (E/S/P)

The project engineer/surveyor/planner assist the project manager and the technical manager(s) in establishing the appropriate design and review criteria, ensure that the review and checking forms are properly used and work to produce designs that are accurate, complete and coordinated.

Project Team

All members of the project staff assist in providing a high quality of work.

Procedures

The Quality Assurance Plan

- Deliverables for the project should be well defined, including their related schedule. These should include such items as design criteria, reports, schematics, contract drawings, specifications, calculations, cost estimates, etc. These deliverables will be listed in the work plan.
- Description of the specific quality assurance procedures to be applied to various elements of the services to include the level of frequency of review required. Include or make references to specific procedures for verifying computer programs, preparing and checking calculations, checking of drawings, drafting standards to be used, and coordination checking. These descriptions will be listed in the work plan.
- Identification of elements of the project, if any, requiring special quality assurance attention or emphasis. Include applicable standards of quality of practice to be met, level of completeness, or extent of detail required. For this project, that will include review of processes for construction phasing/staging, secondary hydraulic impacts to existing facilities, and limitations for environmental impact.
- As outlined in the work plan definition of quality assurance responsibilities and authorities within the project team. List names of key personnel, by discipline, responsible for design as well as for checking, including project organization chart.
- Estimation of the resources required for the quality assurance functions to include specific timing, budgets, and manpower requirements. Include these quality assurance functions in overall project

schedule. Identify deliverables to be reviewed at each stage (i.e. 35 percent, 65 percent, and 100 percent).

- Submittal of plans and computations at the preplanned milestones (i.e. 35 percent, 65 percent and 100 percent levels) should be accompanied by a statement that **Psomas** has been following its quality assurance plan. This may include copies of appropriate lists of deliverables, tables and plan sheet punch lists that show columns for checking, revisions, back checking, and quality control reviews. Documentation of quality control procedures is considered to be a requisite element of each review submittal, as described in the technical manuals.

Technical Review of Plans

Prior to the final submittal, the QCM shall perform an internal quality assurance review with the technical managers E/S/P/C and engineers experienced in the appropriate discipline(s). The purpose of the review is to satisfy the QCM that the plans and special provisions are of quality acceptable to the client **as well as Psomas**. The criteria for acceptance will be products of neat appearance, well organized, technically and grammatically correct, checked, signed and stamped by the drafter, designer, checker and engineer, as appropriate.

Checking Procedure

In keeping with Psomas policy and sound engineering practice, all design analyses, calculations, drawings, specifications, cost estimates, other contract documents, and reports produced by the Company are to be checked prior to submission to clients or agencies. Detailed procedures for the checking of various types of documents are defined in the Psomas Technical Manuals. Staff involved in design are expected to be well versed in these procedures.

The Technical Managers are normally responsible for the quality assurance review, as overseen by the QCM. The reviews are conducted independently of the project c/s/p who prepared the design. A set of check prints will be formalized to document the checking process. If the technical manager is directly involved in the project, the project manager will arranged with another senior e/s/p to perform the review.

Different colors are used to identify the various stages of the checking process.

- Yellow is used to indicate agreement, and all lines, dimensions, and written text are to be yellowed-in if correct.
- Red is used to indicate required corrections and additions.
- Green is used by the project c/s/p to indicate approval of changes, plus additional changes as agreed to by the technical manager.
- Blue is used to indicate that changes to the document original have been made.
- Green is also used to verify that the change to the document original is correct.
- Black is used for non-record comments or instructions.

Check prints are formalized through the addition of a check print stamp. On the stamp, each participant in the checking process signs on the appropriate line, indicating that that stage of the process is completed.

Checklists

Checklists are provided in the Technical Manuals for normal E/S/P/C activities. These checklists should be reviewed by the project manager, technical manager and project engineer/surveyor/planner (e/s/p) prior to beginning the project. This review will determine which checklist items will be included in the design. As each element of the design is completed, the project e/s/p should initial the checklist items that have been completed. The technical manager initials the checklist items as the final review progresses.

QCM and PIC Review of Plans

In addition to the technical manager's quality assurance review, the Quality Control Manager and PIC reviews all deliverables. The purpose of these reviews is not to supplement or replace the technical manager's review, but to add a perspective which is to confirm that the deliverables committed to the client are all included, and that the deliverables meet the level of client expectations that were originally proposed by Psomas.

Additional Requirements

As Psomas is the lead for a multi-disciplinary technical team, when responding to a client on these quality assurance issues, the following will also be a requirement in addition to the above. That Psomas:

- Define the requirements for documentation for the filing of design notes, calculations, drawings, and supporting materials, and for the specific assigned responsibilities in satisfying these requirements.
- Define procedures for resolving differing technical viewpoints.
- Define design change control procedures to be employed.
- Define internal approval procedures.
- Define external communication procedures and protocol.

Reference to Manuals (Available in the Psomas Intranet to all employees):

- **Project Management Manual**

- Quality assurance exists throughout all aspects and phases of project management at Psomas, and thus all parts of the Project Management Manual. The team leader must be satisfied that the project manager clearly understands each new project, including the following:

    - Contractual arrangements
    - Detail scope
    - Standards to be used
    - Tasks/responsibilities
    - Schedules/budget
    - Deliverables

- **Technical Manuals**

Important elements of quality assurance incorporated in the technical manuals include the following:

- Design criteria collection
- Definition of design standards and/or agency manuals to be used
- Design criteria review forms
- Drafting standards to be used (client or Psomas)
- Computer calculation review forms
- Review forms/checklists for:

    - *Technical Managers of E/S/P/C Services*
    - *Project Engineers*
    - *Engineers*
    - *Surveyors*
    - *Draftspersons*

During the project planning and start-up phase, the PIC and QCM will work with the project and technical managers to select the checking and review forms applicable to a particular project. They may add additional review and checking items that are unique for that project. These will be included in the project work plan.

SECTION VIII

SUMMARY

This work plan outlines the sequence of work, specific tasks, and general timeline goals for the efforts the Psomas team will provide. However, we consider it a flexible, living document that will adjust as the project progresses. This must occur as the design considerations and permitting process evolve and additional considerations are discovered and addressed. Flexibility in the scope schedule has been built into the work plan.

As previously stated, our goal at the end of the project is to obtain a USACE Section 408 permit, obtain other jurisdictional permits, and provide a set of documents sufficient to satisfy the further development of the project.

REQUEST FOR DISBURSEMENT

Name of Grantee/Contractor: PSOMAS	Agreement Number: 11-101	Invoice Number: 81966
Address (include zip code): 555 S. Flower Street, Ste. #4400 Los Angeles, CA 90071	**Project Name:BALLONA WETLANDS ECOLOGICAL RESERVE**	
	Billing Period Covered: From: 4/27/2012	To: 5/31/2012

Work Plan Task Number and Name *(insert rows as needed for work plan)*	Task Budget	Costs Incurred this Period	Total Cost to Date	Remaining Balance
Task 1. Project Initiation	$ 52,980.00	$ 12,945.00	$ 34,555.00	$ 18,425.00
Task 2. Data Gathering	$ 483,770.00	$ 135,747.75	$ 141,177.75	$ 342,592.25
Task 3. EIR/EIS Support	$ 100,220.00	$ -	$ -	$ 100,220.00
Task 4. Engineering Design Services				
4.1 30% Preliminary Design	$ 656,735.00	$ -	$ -	$ 656,735.00
4.2 70% Design Submittal	$ 609,840.00	$ -	$ -	$ 609,840.00
4.3 100% Design - Construction Documents	$ 340,260.00	$ -	$ -	$ 340,260.00
	$ -	$ -	$ -	$ -
	$ -		$ -	$ -
				$ -
TOTAL	$ 2,243,805.00	$ 148,692.75	$ 175,732.75	$ 2,068,072.25
LESS Ten (10%) Percent Withhold (if applicable) Not applicable see Progress report		$ -	**Attach all receipts of expenditures , Progress Report & other supporting documents required.**	
TOTAL AMOUNT REQUESTED		$ 148,692.75		

CERTIFICATION OF GRANTEE/CONTRACTOR

I hereby certify that the above costs were incurred in the performance of work required under the agreement and are consistent with the amounts evidenced by supporting documents and expenditures.

Signature	Michael J. Crehan, VP Printed Name and Title	6/27/2012 Date

(FOR STATE COASTAL CONSERVANCY USE ONLY)

AGREEMENT EXPENDITURE APPROVALS

The undersigned certifies that all conditions precedent to disbursement and all other legal prerequisites for this disbursement have been met.

Approval Requested:	Approval Recommended:	Request Approved:
Project Manager	Work Group Leader	Executive Officer

Budget Item:	Project/Program:

GRANTEE/CONTRACTOR DIRECT EXPENDITURE:		
(A) Materials and Equipment	**Reference**	**Amount**
	SUB-TOTAL (A)	$ -
(B) Labor - Description	**Reference**	**Amount**
Psomas Labor Charges		$ 103,022.50
	SUB-TOTAL (B)	$ 103,022.50

(C) SUB-CONTRACTOR'S EXPENDITURE:		
Name	**Reference**	**Amount**
Group Delta Consulting	20901	$42,256.25
Commercial Aerial Images	360	$3,414.00
	SUB-TOTAL (C)	$45,670.25

GRAND TOTAL (A+B+C)*	$148,692.75

NOTE: (1) * Should agree with "Total Costs Incurred This Period" on front page.

BALLONA WETLANDS RESTORATION BILLING BACKUP

Billing Period Ending May 31, 2012
Job No. 1CCC010100

Task 1	PROJECT INITIATION
	Civil:
	The effort during this second billing period (May) continued the project initiation begun last month. From a management standpoint, this included our weekly technical team conference calls, internal team meetings and conference calls, and a site orientation tour with additional Psomas engineering staff. We prepared and submitted two of the work plan sections - the Survey Workplan and the QA/QC Workplan. Our subconsultant Group Delta also prepared and submitted their Geotechnical Workplan. Psomas provided a section to the overall H & H Workplan addressing the local drainage analysis process. And finally related to Workplan efforts, we commenced the overall Psomas Team Workplan. During this billing period, the four deliverables provided were the Survey, Geotechnical, QA/QC, and H&H Workplan sections.
	Geotech:
	During this second billing period (May), Group Delta staff attended meetings and coordinated regarding their geotechnical issues, and continued their research efforts. The deliverable they provided was the Geotechnical Work Plan. Billing was received from Group Delta for these efforts and is included in the payment request. A more detailed description of their efforts is included on their invoice.
	Structural:
	The structural engineer's (JCE) involvement has still not been initiated.
	Survey:
	Survey continued heavily with field and office support for the aerial topography, channel cross sectional data collection and preparation, site specific data collection, the Survey Workplan, and coordination of survey needs for the project. The aerial survey will still require near-term adjustment for incorporation of the transects for eathwork quantity estimates, and channel cross sectional data. This is expected to be completed next month. A third adjustment may be necessary if and when data for the channel dredging is provided. This adjustment should only have a minor effect on the downstream portion of the hydraulics model. This data is not expected for a number of months. Deliverables included two items, the Survey Workplan and the boundary and aerial survey.

BALLONA WETLANDS RESTORATION BILLING BACKUP

Billing Period Ending May 31, 2012
Job No. 1CCC010100

Task 2	DATA GATHERING	
		Civil: The utility data collection was completed. We initiated the local hydrology of the upstream basin analysis which will be utilized for the Psomas local hydrology model for conduit and conveyence sizing, as well as incorporation into the overall hydrology analysis. No deliverables wer required beyond those described in Task 1.
		Geotech: See description above in Task 1
		Structural:
		Survey: Field data continued to be collected. Collection was expanded to include areas within Area A, and along the existing Ballona Creek levees. See the Task 1 description for further detail.

BALLONA WETLANDS RESTORATION BILLING BACKUP

Billing Period Ending May 31, 2012

Job No. 1CCC010100

Task 3	EIR/EIS SUPPORT
	Civil: Minor support related to EIR efforts was provided.
	Geotech:
	Structural:
	Survey:

Task 4	DESIGN SERVICES
	Civil:
	Geotech:
	Structural:
	Survey:

BALLONA WETLANDS RESTORATION BILLING BACKUP
Billing Period Ending May 31, 2012
Job No. 1CCC010100

Task 5	70% DESIGN DOCUMENTS	
	Civil:	
	Geotech:	
	Structural:	
	Survey:	

Task 6	100% CONSTRUCTION DOCUMENTS	
	Civil:	
	Geotech:	
	Structural:	
	Survey:	

BALLONA WETLANDS RESTORATION BILLING BACKUP

Billing Period Ending May 31, 2012
Job No. 1CCC010100

Task 7	ADVISORY SUPPORT SERVICES
	Civil:
	Geotech:
	Structural:
	Survey:

BALLONA WETLANDS RESTORATION

Invoice Task No.	Item	Task Description	Billing Summary Budget	Percent Invoiced	Remaining Budget	Invoiced To Date	Prior Inoviced Amount	Invoice # 81966 Current Invoice Amount
	1	**PROJECT INITIATION**						
200	1.1	PROJECT SCHEDULE / DETAILED WORK PLAN	$12,360	57.4%	$ 5,270.00	$ 7,090.00	$ 977.50	$ 6,112.50
201	1.2	START UP MEETINGS - ENTIRE TEAM	$13,880	85.6%	2,000.00	11,880.00	7,462.50	4,417.50
100	1.3	INITIATE PERMITS FOR FIELD WORK (2)	$11,620	99.3%	85.00	11,535.00	11,535.00	0.00
202	1.4	MEETINGS	$6,420	14.3%	5,500.00	920.00	0.00	920.00
203	1.5	COORDINATION	$8,700	36.0%	5,570.00	3,130.00	1,635.00	1,495.00
		SUBTOTAL	**$52,980**	65.2%	**$18,425.00**	**$34,555.00**	**$ 21,610.00**	**$12,945.00**
	2	**DATA GATHERING**						
107	2.1	TOPOGRAPHIC SURVEY	$40,660	100.0%	20.00	40,640.00	0.00	40,640.00
101	2.2	BOUNDARY / EASEMENTS EXHIBIT FROM ALTA	$5,340	100.0%	2.50	5,337.50	2,205.00	3,132.50
204	2.3	UTILITY MAPPING	$9,200	89.6%	952.50	8,247.50	3,225.00	5,022.50
108	2.4	AERIAL PHOTOGRAPHY	$5,000	99.8%	11.00	4,989.00	0.00	4,989.00
205	2.5	GEOTECH TEST LOCATIONS	$5,440	100.0%	0.00	5,440.00	0.00	5,440.00
102	2.6	HABITAT SURVEY OVERLAYS	$4,660	0.0%	4,660.00	0.00	0.00	0.00
103	2.7	SPECIFIC DESIGN SURVEY	$7,880	99.9%	5.00	7,875.00	0.00	7,875.00
104	2.7a	CHANNEL CROSS SECTIONS (5)	$28,460	68.3%	9,020.00	19,440.00	0.00	19,440.00
105	2.8	CONSTRAINTS MAP	$6,640	0.0%	6,640.00	0.00	0.00	0.00
206	2.9	GEOTECHNICAL FIELD INVESTIGATION	$98,520	37.4%	61,703.75	36,816.25	0.00	36,816.25
207	2.9a	NATIVE AMERICAN MONITOR (6)	$11,110	0.0%	11,110.00	0.00	0.00	0.00
208	2.10	LABORATORY PHYSICAL TESTING	$40,660	0.0%	40,660.00	0.00	0.00	0.00
209	2.11	CHEMICAL TESTING	$30,000	0.0%	30,000.00	0.00	0.00	0.00
210	2.12	PRELIMINARY GEOTECHNICAL ANALYSIS	$56,600	0.0%	56,600.00	0.00	0.00	0.00
211	2.13	STRATEGY AND MASTER PLANNING (3)	$41,440	27.8%	29,907.50	11,532.50	0.00	11,532.50
212	2.14	MEETINGS	$32,640	0.8%	32,370.00	270.00	0.00	270.00
213	2.15	COORDINATION	$59,520	1.0%	58,930.00	590.00	0.00	590.00
		SUBTOTAL	**$483,770**	29.2%	**$342,592**	**$141,178**	**$ 5,430.00**	**$135,747.75**
	3	**EIR / EIS SUPPORT (ONGOING)**						
214	3.1	EXHIBITS - AS NEEDED - BUDGET ALLOCATION	$27,440	0.0%	27,440.00	0.00	0.00	0.00
215	3.2	STUDIES - AS NEEDED - BUDGET ALLOCATION	$45,180	0.0%	45,180.00	0.00	0.00	0.00
		SUBTOTAL	**$72,620**	0.0%	**$72,620**	$ -	$ -	$ -
	4	**DESIGN SERVICES**						
	4.1	**30% PRELIMINARY DESIGN**						
4101	4.1.1	DEVELOP OVERALL SITE PLAN	$7,340	0.0%	7,340.00	0.00	0.00	0.00
4102	4.1.2	LEVEE REMOVAL	$18,315	0.0%	18,315.00	0.00	0.00	0.00
4103	4.1.3	LINCOLN BOULEVARD ULTIMATE ALIGNMENT STUDY	$10,550	0.0%	10,550.00	0.00	0.00	0.00
4104	4.1.4	MAINTENANCE ROAD DESIGN	$9,030	0.0%	9,030.00	0.00	0.00	0.00
4105	4.1.5	SOUTH LEVEE LAYOUT DESIGN	$27,100	0.0%	27,100.00	0.00	0.00	0.00
4106	4.1.6	LEVEE PROTECTION DESIGN	$28,150	0.0%	28,150.00	0.00	0.00	0.00
4107	4.1.7	GAS WELLS AND PIPELINE EXHIBIT	$11,600	0.0%	11,600.00	0.00	0.00	0.00
4108	4.1.8	CONSTRUCTION SEQUENCING EXHIBITS	$15,760	0.0%	15,760.00	0.00	0.00	0.00
4109	4.1.9	O&M TECHNICAL SUPPORT	$16,080	0.0%	16,080.00	0.00	0.00	0.00
4110	4.1.10	LAND OWNERSHIP EXHIBIT FOR LEVEE REMOVAL	$10,800	0.0%	10,800.00	0.00	0.00	0.00
4111	4.1.11	PRELIM GRADING FOR AREA B AND AREA C DISPOSAL	$20,300	0.0%	20,300.00	0.00	0.00	0.00
4112	4.1.12	DIRT TRANSPORT STUDIES AND EXHIBITS	$20,560	0.0%	20,560.00	0.00	0.00	0.00
4113	4.1.13	PRELIMINARY HYDROLOGY AND DRAINAGE FOR AREA C	$11,885	0.0%	11,885.00	0.00	0.00	0.00
4114	4.1.14	PRELIMINARY HYDROLOGY AND DRAINAGE FOR AREA B	$11,885	0.0%	11,885.00	0.00	0.00	0.00
4115	4.1.15	DRAINAGE STRUCTURES DESIGN	$20,590	0.0%	20,590.00	0.00	0.00	0.00
4116	4.1.16	BRIDGE DESIGN STUDY	$32,100	0.0%	32,100.00	0.00	0.00	0.00
4117	4.1.17	EARTHWORK CALCS - AREA A, B AND C	$9,920	0.0%	9,920.00	0.00	0.00	0.00
4118	4.1.18	PRELIM UTILITY ANALYSIS	$16,810	0.0%	16,810.00	0.00	0.00	0.00
4119	4.1.19	PRELIM BIKE TRAIL/MAINT. ROAD PLANS	$13,680	0.0%	13,680.00	0.00	0.00	0.00
4120	4.1.20	CONSTRUCTABILITY ANALYSIS	$17,620	0.0%	17,620.00	0.00	0.00	0.00
4121	4.1.21	ENGINEERS CONST COST ESTIMATE	$15,260	0.0%	15,260.00	0.00	0.00	0.00
4122	4.1.22	PEER REVIEW OF HYDROLOGY CONSULTANT DESIGN	$25,080	0.0%	25,080.00	0.00	0.00	0.00
4123	4.1.23	COMPLETION OF GEOTECHNICAL ANALYSIS	$98,080	0.0%	98,080.00	0.00	0.00	0.00
4124	4.1.24	GEOTECHNICAL REPORT	$44,960	0.0%	44,960.00	0.00	0.00	0.00
4125	4.1.25	STRUCTURES REPORT	$10,320	0.0%	10,320.00	0.00	0.00	0.00
4126	4.1.26	CONSTRUCTION MASTER PLANNING REFINEMENT	$15,200	0.0%	15,200.00	0.00	0.00	0.00
4127	4.1.27	PROJECT MEETINGS	$32,640	0.0%	32,640.00	0.00	0.00	0.00
4128	4.1.28	PROJECT COORDINATION	$59,520	0.0%	59,520.00	0.00	0.00	0.00
4129	4.1.29	APPLICATION AND PERMIT PROCESSING	$25,600	0.0%	25,600.00	0.00	0.00	0.00
		SUBTOTAL	**$656,735**	0.0%	**$656,735**		$ -	$ -

BALLONA WETLANDS RESTORATION

Invoice Task No.	Item	Task Description	Billing Summary Budget	Percent Invoiced	Remaining Budget	Invoiced To Date	Prior Inovoiced Amount	Invoice # 81966 Current Invoice Amount
	4.2	**70% DESIGN DOCUMENTS**						
4201	4.2.1	LEVEE REMOVAL DESIGN	$30,620	0.0%	30,620.00	0.00	0.00	0.00
4202	4.2.2	SOILS ENG STABILITY ANALYSIS COORDINATION	$16,400	0.0%	16,400.00	0.00	0.00	0.00
4203	4.2.3	LEVEE PROTECTION DESIGN / DETAILS	$48,240	0.0%	48,240.00	0.00	0.00	0.00
4204	4.2.4	MAINTENANCE ROAD / BIKE TRAIL DESIGN	$22,030	0.0%	22,030.00	0.00	0.00	0.00
4205	4.2.5	SOUTH LEVEE DESIGN	$42,200	0.0%	42,200.00	0.00	0.00	0.00
4206	4.2.6	GAS CO FACILITIES ABANDONMENT DOCUMENTATION	$26,350	0.0%	26,350.00	0.00	0.00	0.00
4207	4.2.7	LOCAL AGENCY SUPPORT TO HYDROLOGY CONSULTANT FOR GRADING DESIGN	$34,300	0.0%	34,300.00	0.00	0.00	0.00
4208	4.2.8	GRADING PLANS AREA B AND AREA C	$35,900	0.0%	35,900.00	0.00	0.00	0.00
4209	4.2.9	STORM DRAINAGE CULVERT EXTENSIONS / RELOCATIONS - AREA B	$41,080	0.0%	41,080.00	0.00	0.00	0.00
4210	4.2.10	FINAL EARTHWORK CALCS - ALL AREAS	$9,080	0.0%	9,080.00	0.00	0.00	0.00
4211	4.2.11	SWPPP - ALL AREAS	$9,240	0.0%	9,240.00	0.00	0.00	0.00
4212	4.2.12	EROSION CONTROL PLANS - ALL AREAS, WITH PHASING	$20,040	0.0%	20,040.00	0.00	0.00	0.00
4213	4.2.13	CONSTRUCTION MASTER PLANNING COMPLETION	$15,000	0.0%	15,000.00	0.00	0.00	0.00
4214	4.2.14	STAGED / PHASED CONSTRUCTION EXHIBITS	$8,980	0.0%	8,980.00	0.00	0.00	0.00
4215	4.2.15	INTERIM CONDITIONS EXHIBITS	$14,780	0.0%	14,780.00	0.00	0.00	0.00
4216	4.2.16	DRAINAGE HYDRAULIC CALCS - AREA B AND AREA C	$11,120	0.0%	11,120.00	0.00	0.00	0.00
4217	4.2.17	HAUL ROUTE EXHIBITS, APPLICATION AND DOCS	$7,900	0.0%	7,900.00	0.00	0.00	0.00
4218	4.2.18	C.U.P. FOR AREA A DIRT EXPORT - LA COUNTY	$15,400	0.0%	15,400.00	0.00	0.00	0.00
4219	4.2.19	ENGINEERS CONSTRUCTION COST ESTIMATE	$15,440	0.0%	15,440.00	0.00	0.00	0.00
4220	4.2.20	APPLICATIONS AND SUBMITTALS	$16,640	0.0%	16,640.00	0.00	0.00	0.00
4221	4.2.21	RESPOND TO GEOTECHNICAL COMMENTS	$21,740	0.0%	21,740.00	0.00	0.00	0.00
4222	4.2.22	COMPLETE BRIDGE DESIGN	$23,200	0.0%	23,200.00	0.00	0.00	0.00
4223	4.2.23	SUPPORT FOR PUBLIC OUTREACH	$14,400	0.0%	14,400.00	0.00	0.00	0.00
4224	4.2.24	PROJECT MEETINGS AND WORKSHOPS	$32,640	0.0%	32,640.00	0.00	0.00	0.00
4225	4.2.25	PROJECT COORDINATION	$59,520	0.0%	59,520.00	0.00	0.00	0.00
4226	4.2.26	PEER REVIEW OF HYDROLOGY CONSULTANT DOCS	$17,600	0.0%	17,600.00	0.00	0.00	0.00
		SUBTOTAL	**$609,840**	0.0%	**$609,840**	$ -	$ -	$ -
	4.3	**100% CONSTRUCTION DOCUMENTS**						
4301	4.3.1	RESPOND TO LEVEE PROTECTION COMMENTS	$29,800	0.0%	29,800.00	0.00	0.00	0.00
4302	4.3.2	RESPOND TO SOUTH LEVEE DESIGN COMMENTS	$17,500	0.0%	17,500.00	0.00	0.00	0.00
4303	4.3.3	RESPOND TO GRADING PLANS COMMENTS - AREA B / C	$22,200	0.0%	22,200.00	0.00	0.00	0.00
4304	4.3.4	RESPOND TO DRAINAGE CULVERT COMMENTS	$22,300	0.0%	22,300.00	0.00	0.00	0.00
4305	4.3.5	RESPOND TO HYDROLOGY COMMENTS - AREA B / C	$16,800	0.0%	16,800.00	0.00	0.00	0.00
4306	4.3.6	RESPOND TO GEOTECHNICAL COMMENTS	$21,740	0.0%	21,740.00	0.00	0.00	0.00
4307	4.3.7	RESPOND TO BRIDGE COMMENTS	$30,640	0.0%	30,640.00	0.00	0.00	0.00
4308	4.3.8	RESPOND TO SWPPP / EROSION CONTROL COMMENTS	$13,160	0.0%	13,160.00	0.00	0.00	0.00
4309	4.3.9	FINAL EARTHWORK CALCS - ALL AREAS	$9,220	0.0%	9,220.00	0.00	0.00	0.00
4310	4.3.10	RESPOND TO EIR / EIS COMMENTS	$32,800	0.0%	32,800.00	0.00	0.00	0.00
4311	4.3.11	ENGINEERS CONSTRUCTION COST ESTIMATE	$13,520	0.0%	13,520.00	0.00	0.00	0.00
4312	4.3.12	HAUL ROUTE / EXPORT APPROVAL	$7,300	0.0%	7,300.00	0.00	0.00	0.00
4313	4.3.13	C.U.P. APPROVAL	$10,200	0.0%	10,200.00	0.00	0.00	0.00
4314	4.3.14	SUPPORT CLOMR PREP BY HYDROLOGY CONSULTANT	$25,900	0.0%	25,900.00	0.00	0.00	0.00
4315	4.3.15	AGENCY DOCUMENT AND PERMIT PROCESSING	$21,100	0.0%	21,100.00	0.00	0.00	0.00
4316	4.3.16	PROJECT MEETINGS AND WORKSHOPS	$16,320	0.0%	16,320.00	0.00	0.00	0.00
4317	4.3.17	PROJECT COORDINATION	$29,760	0.0%	29,760.00	0.00	0.00	0.00
		SUBTOTAL	**$340,260**	0.0%	**340,260.00**	**0.00**	**0.00**	**0.00**
	5	**ADVISORY SUPPORT SERVICES**	$27,600	0.0%	27,600.00	0.00	0.00	0.00
		Total Labor :	**$2,243,805**	7.8%	**$2,068,072.25**	**$175,732.75**	**$27,040.00**	**$148,692.75**

PSOMAS

Invoice

PO Box 51463, Los Angeles, CA 90051-5763
888.203.3311 fax: 213.223.1444
www.psomas.com

June 27, 2012

Project No: 1CCC010100
Invoice No: 81966

Mary Small
State Coastal Conservancy
1330 Broadway, 13th Floor
Oakland, CA 94612-2530

Total this Invoice: $148,692.75

Ballona Wetlands Ecological Reserve
Contract # 11-101

INITIATED PROJECT
Professional Services from April 27, 2012 to May 31, 2012

Task 00101 2.2 Boundary Easements Exh. from ALTA

Professional Personnel

	Hours	Rate	Amount	
Two Person Survey Party	12.50	245.00	3,062.50	
Project Surveyor	.50	140.00	70.00	
Totals	13.00		3,132.50	
Total Labor				**3,132.50**
		Total this Task		**$3,132.50**

Task 00103 Specific Design Survey Task 2.7

Professional Personnel

	Hours	Rate	Amount	
Two Person Survey Party	28.00	245.00	6,860.00	
Principal	.50	230.00	115.00	
Project Manager	4.50	200.00	900.00	
Totals	33.00		7,875.00	
Total Labor				**7,875.00**
		Total this Task		**$7,875.00**

Task 00104 Channel Cross Sections 5 Task 2.7a

Professional Personnel

	Hours	Rate	Amount
Two Person Survey Party	34.50	245.00	8,452.50
One Person Survey Party	14.00	175.00	2,450.00

Please reference invoice number on payment. Invoices more than 30 days past due will be subject to interest charges.

Principal	7.00	230.00	1,610.00
Project Manager	5.50	200.00	1,100.00
Project Engineer	3.00	155.00	465.00
Project Surveyor	5.50	140.00	770.00
Senior Autocadd Technician	34.00	120.00	4,080.00
Drafter	.50	90.00	45.00
Project Assistant	5.50	85.00	467.50
Totals	109.50		19,440.00
Total Labor			**19,440.00**

Total this Task **$19,440.00**

Task 00107 Topographic Survey Task 2.1

Professional Personnel

	Hours	Rate	Amount
Two Person Survey Party	19.00	245.00	4,655.00
Principal	8.50	230.00	1,955.00
Project Manager	4.00	200.00	800.00
Project Surveyor	94.00	140.00	13,160.00
Drafter	223.00	90.00	20,070.00
Totals	348.50		40,640.00
Total Labor			**40,640.00**

Total this Task **$40,640.00**

Task 00108 Aerial Topography Task 2.4

Professional Personnel

	Hours	Rate	Amount
Drafter	17.50	90.00	1,575.00
Totals	17.50		1,575.00
Total Labor			**1,575.00**

Reimbursable Expenses

Consultants			3,414.00
Total Consultants			**3,414.00** **3,414.00**

Total this Task **$4,989.00**

Task 00200 Proj Schedule/Detailed Work Pln Task 1.1

Professional Personnel

	Hours	Rate	Amount
Principal	25.50	230.00	5,865.00
Project Engineer	.50	155.00	77.50
Project Assistant	2.00	85.00	170.00

Totals	28.00	6,112.50	
Total Labor			**6,112.50**
		Total this Task	**$6,112.50**

Task 00201 Start Up Meetings Entire Team Task 1.2

Professional Personnel

	Hours	Rate	Amount	
Principal	6.50	230.00	1,495.00	
Civil Engineer Designer	18.50	135.00	2,497.50	
Project Assistant	5.00	85.00	425.00	
Totals	30.00		4,417.50	
Total Labor				**4,417.50**
		Total this Task		**$4,417.50**

Task 00202 Meetings Task 1.4

Professional Personnel

	Hours	Rate	Amount	
Principal	4.00	230.00	920.00	
Totals	4.00		920.00	
Total Labor				**920.00**
		Total this Task		**$920.00**

Task 00203 Coordination Task 1.5

Professional Personnel

	Hours	Rate	Amount	
Principal	6.50	230.00	1,495.00	
Totals	6.50		1,495.00	
Total Labor				**1,495.00**
		Total this Task		**$1,495.00**

Task 00204 Utility Mapping Task 2.3

Professional Personnel

	Hours	Rate	Amount	
Senior Project Manager	6.00	210.00	1,260.00	
Project Engineer	16.00	155.00	2,480.00	
Civil Engineer Designer	9.50	135.00	1,282.50	
Totals	31.50		5,022.50	
Total Labor				**5,022.50**

		Total this Task	**$5,022.50**

Task 00205 Geotech Test Locations Task 2.5

Reimbursable Expenses

Consultants		5,440.00	
	Total Consultants	**5,440.00**	**5,440.00**
		Total this Task	**$5,440.00**

Task 00206 Geotech Field Investigation Task 2.9

Reimbursable Expenses

Consultants		36,816.25	
	Total Consultants	**36,816.25**	**36,816.25**
		Total this Task	**$36,816.25**

Task 00211 Strategy and Master Planning 3 Task 2.13

Professional Personnel

	Hours	**Rate**	**Amount**	
Principal	12.00	230.00	2,760.00	
Project Engineer	44.50	155.00	6,897.50	
Civil Engineer Designer	12.00	135.00	1,620.00	
Project Assistant	3.00	85.00	255.00	
Totals	71.50		11,532.50	
Total Labor				**11,532.50**
		Total this Task		**$11,532.50**

Task 00212 Meetings Task 2.14

Professional Personnel

	Hours	**Rate**	**Amount**	
Civil Engineer Designer	2.00	135.00	270.00	
Totals	2.00		270.00	
Total Labor				**270.00**
		Total this Task		**$270.00**

Task 00213 Coordination Task 2.15

Professional Personnel

	Hours	**Rate**	**Amount**
Project Engineer	2.50	155.00	387.50
Civil Engineer Designer	1.50	135.00	202.50

Totals	4.00	590.00	
Total Labor			**590.00**
		Total this Task	**$590.00**
		Total this Invoice	**$148,692.75**

Outstanding Invoices

Number	Date	Balance
81371	5/31/12	27,040.00
Total Outstanding		**27,040.00**
Account Balance Due		**$175,732.75**

Invoice

Michael Crehan
Psomas
555 South Flower Street, Suite 4400
Los Angeles, CA 90071-2416

June 10, 2012
Invoice No: 20901

Project Manager Thomas Swantko

Project LA962A Ballona Wetland Restoration - Engineering

During this period, we prepared a Geotechnical workplan that included locations of 65 explorations for investigation of the subsurface condition throughout the project and outlined our approach to working around protected habitats, describing the type of equipment and tasks to be performed. This included preparation of boring location plans overlaid on maps of protected areas, review of proposed locations by other members of the team and making adjustments as appropriate. Site walks were also performed to review access issues and to become familarized with the site areas. We also participated in weekly team meetings/calls; attended a review meeting with LA County; met with the Gas Company and walked the site with the group. We reviewed requirements of the U.S. Army Corp regarding the investigation and analysis required for leevees, which were used in development of the workplan. We went to Psomas to discuss surveying of boring locations in the field and reviewed archived geotechnical reports of past investigations conducted with the project limits. This previous borings were plotted on a map of the area. We assisted with input to the project description and QC documents, including discussion of construction staging and potential use of a cofferdam.

Professional Services through May 25, 2012

Professional Services

	Hours	Rate	Amount
Project Manager			
Pradel, Daniel	18.50	200.00	3,700.00
Reader, Michael	28.00	200.00	5,600.00
Sr. Project Engineer			
Swantko, Thomas	66.50	175.00	11,637.50
Project Engineer			
Chiu, Peter	103.00	150.00	15,450.00
Cunneen, James	2.50	150.00	375.00
Sr. Autocadd Technician			
Briffa, Nicholas	4.00	120.00	480.00
Latimer, Taylor	5.50	120.00	660.00
Drafter			
Fernandes, Konrad	33.00	85.00	2,805.00
Helma, Ashley	10.00	85.00	850.00
Administrative Assistant			
Beltran, Salvador	9.50	65.00	617.50
Beltran, Salvador	1.25	65.00	81.25

Project	LA962A	Ballona Wetland Restoration - Engineerin		Invoice	20901
	Totals	281.75	42,256.25		
	Total Professional Services				**42,256.25**
			Total Project Invoice Amount		**$42,256.25**

	Current	Prior	Total
Billing Summary	**42,256.25**	**0.00**	**42,256.25**

We appreciate the opportunity to provide our services. Please contact us if you have any questions.

Remit Payment to: Group Delta Consultants, Inc. 32 Mauchly Suite B Irvine, CA 92618

Authorized By: _____

Thomas Swantko

Note:
Efforts & fees as expected.

32 Mauchly, Suite B ▲ Irvine, California 92618-2336 ▲ (949) 450-2100 voice ▲ (949) 450-2108 fax
Torrance (310) 320-5100 ▲ Ontario (909) 605-6500 ▲ San Diego (858) 536-1000 ▲ El Centro (760) 337-2067 ▲ Sacramento (916) 774-7123
www.GroupDelta.com

Commercial Aerial Images, Inc.
1787 Whittier Ave
Costa Mesa, CA 92627

COM195

Invoice

Date	Invoice #
5/8/2012	360

Bill To

PSOMAS
3 Hutton Center Drive, Suite 200
Santa Ana, CA 92707

Commercial Aerial Images, Inc.

Item	Description	Qty	Rate	Amount
RC-30 Mobilization	Job No 1CC010100 T-108 66300 Ron Mocjen Oil Fields, just North of LAX		450.00	450.00T
Airspace Class B			250.00	250.00T
Flight Line Charge		5	40.00	200.00T
Color Exposure	$200 Minimum charge.	31	35.00	1,085.00T
Color Scans		31	30.00	930.00T
Film Annotation	$15.00 Minimum	31	1.00	31.00T
Color Balancing			38.00	38.00T
Color Contact Prints		31	5.95	184.45T
	Sales Tax		7.75%	245.55

MAY 7 2012

RECEIVED

MAY 10 2012

Initial:

	Total	$3,414.00

EXHIBIT 10

California Department of Fish and Game
Att: C. Bonham Executive Director
Att: All California Fish and Game Commissioners
Re: Ballona Wetlands Ecological Preserve
California Contract Code Violation by DFG
California Water Code Violations by DFG

September 14, 2012

Executive Director Bonham,

A Notice of Exemption was filed by this Agency on August 13, 2012 and signed by Agency Staff Person Ed Pert, then transmitted to the California Office of Planning and Research. The Project title is:

GEOTECHNICAL AND BIOLOCICAL DATA COLLECTOIN TO SUPPORT HABITAT RESTORATION AND MANAGEMENT PLANNING ACTIVITIES AT THE BALLONA WETLANDS ECOLOGICAL PRESERVE.

Attachment 1. (DFG NOI)

I hereby notify this agency that it is currently in violation of California Law in regard to the afore said noticed project.

A Contractor acting on behalf of the Agency has been hired in violation of California (Contract Code Notification and Conflict Requirements pursuant to Sections 10140-10141 and 10515-10518). The Contractors name is Psomas. The Contractor was hired by the California Coastal Conservancy.

Attachment 2 (Psomas Proposal to Coastal Conservancy)

The Coastal Conservancy approved the agreement with Psomas on April 20th, 2012.

Attachment 3 (Standard Agreement by Coastal Conservancy)

Psomas submitted a Request for Disbursement to the Coastal Conservancy for the work dated June 27, 2012.

Attachment 4 (Request for Disbursement from Psomas)

CALIFORNIA CONTRACT CODE

The contractor hired by the Coastal Conservancy and currently representing the California Department of Fish and Game was hired by the Conservancy without compliance with California Contract Code Notification and Conflict Requirement pursuant to Sections 10140-10141 and 10515-10518.

In my request submitted to the California Coastal Conservancy on August 23, 2012, pursuant to the California Public Records, Request No. 5 read as follows:

5. ***Provide any and all records*** *that demonstrate that the Agency complied* ***with California Contract Code Notification and Conflict Requirement*** *pursuant to Sections 10140-10141 and 10515-10518 of California Contract Code* ***in regard to Conservancy File Number 04-088, Ballona Wetlands Restoration Engineering and Technical Studies approved by the Governing Board on 1/19/2012 as it relates to contractors hired by the Agency in accordance with that approval.***

Attachment 5 (John Davis PRA to Coastal Conservancy)

The Coastal Conservancy responded that it had no records responsive to this request No. 5. The Agency purported to respond to items 1-4, the Conservancy only responds to request No. 5. as follows:

We do not possess any further responsive records to your August 23, 2012 request.

Sincerely,

Elena Eger
Senior Staff Attorney
California Coastal Conservancy
1330 Broadway, Ste. 1300
Oakland, CA 94612
510-286-4089 tele/voicemail
510-286-0470 fax

Therefore, there is no public record to demonstrate the contractor currently acting on behalf of the DFG has been hired in conformance with the aforesaid requirements of California Contract Code Notification and Conflict Code Sections 10140-10141 and 10515 -10518. For this reason other qualified contractors were not offered the same opportunity to submit a proposals, resulting in discrimination, and the current contractor may be conflicted, as there is no proof to the contrary available as a public record.

My response to the Conservancy transmitted to the Agency on September 13th is attached. It confirms no such records exist.

Attachment 7 (Reply to Coastal Conservancy by John Davis)

STATE WATER CODE

The Contractor representing DFG is currently conducting geotechnical borings in the State Ballona Ecological Preserve.

Attachment 8 (DFG CCC Application)

Attachment 9 (CCC NOE)

Such borings on behalf of DFG will be extracted and will contain Waters of the State of California extracted from the underground as defined by (California Water Code Section 13710). The three aquifers that will be intercepted by such borings are the Bellflower Aquitard, Ballona Aquifer, and Silverado Aquifer. The Silverado aquifer extends South of the Palos Verdes peninsula and is a source of drinking water.

As a consequence of extracting groundwater (Waters of the State) from extracted geotechnical borings, the aforesaid contractor acting on behalf of this Agency is drilling water wells as defined by (California Water Code 13710).

California Water Code Section 13710

"Well" or "water well" *as used in this chapter,* ***means any artificial excavation constructed by any method for the purpose of extracting water from****, or injecting water into,* ***the underground****. This definition shall not include: (a) oil and gas wells, or geothermal wells constructed under the jurisdiction of the Department of Conservation, except those wells converted to use as water wells; or (b) wells used for the purpose of (1) dewatering excavation during construction, or (2) stabilizing hillsides or earth embankments.*

A map produced by the United States Department of the Interior Geological Survey demonstrates the aforesaid aquifers and their depth from MSL.

Attachment 10 (USGS Cross-Sectional Map)

The aforesaid map is contained in GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1464.

Attachment 11 (USGS Water Supply Report)

The Contractor acting on behalf of DFG is therefore, artificially excavating and constructing by method of geotechnical borehole and extraction thereof containing water from the underground is, therefore, constructing a Water Well as defined by the California Water Code.

To drill such a water well, the Contractor must have a State License in accordance with the California Code of Regulations.

C57 - Water Well Drilling Contractor

California Code of Regulations
Title 16, Division 8, Article 3. Classifications

A well drilling contractor installs and repairs water wells and pumps by boring, drilling, excavating, casing, cementing and cleaning to provide a supply of uncontaminated water.

Authority cited: Sections 7008 and 7059, Reference: Sections 7058 and 7059 (Business and Professions Code)

When such a water well is drilled Well Completion Reports DWR-188 must be filed with the California Department of Water Resources according to the Department of Water Resources website @

http://www.water.ca.gov/groundwater/well_info_and_other/well_completion_reports.cfm

Therefore, no public record associated with this project demonstrates the contractor acting on behalf of DFG has a C-57 permit or has filed and or will file any Well Report on behalf of the DFG pursuant to (California Water Code 13710) regarding "geotechnical borings". The contractor was not authorized by DFG to construct a water well and is doing so without formal permission of the Agency. Oversight by the Agency has failed.

In summary, the California Department of Fish and Game cannot prove to the public its aforesaid contractor was hired by the State of California within the requirements of (California Contract Codes 10140-10141 and 10515-10518).

The California Department of Fish and Game cannot prove to the public geotechnical borings portrayed by the aforesaid contractor for DFG **do not** meet the criteria of the definition of water well in accordance with (California Water Code 13710)

CADFG did not engage the aforesaid contractor to drill water wells.

For these reasons, I request the Executive Director of the California Department of Fish and Game, Charles Bonham to cease the aforesaid contractors drilling activities if and until the provisions of California Code are fully addressed by this Agency.

I request that this document be submitted to the California Fish And Game Commission prior to their next meeting.

I finally request that this document a submission for scoping in regard to the Ballona Wetlands Ecological Reserve Project currently being undertaken by this Agency.

Please reply to these concerns in a timely fashion.

Sincerely,

John Davis
PO 10152
Marina del Rey Ca. 90295

ATTACHMENT 1

NOTICE OF EXEMPTION

TO:	**Office of Planning and Research** **1400 Tenth Street, Room 121** **Sacramento, CA 95814** **Tel#: (916) 322-2318** **Fax#: (916) 322-3785**	**FROM:**	**Calif. Dept of Fish and Game-R5** **3883 Ruffin Road** **San Diego, CA 92123** **Tel#: (858) 467-4201** **Fax#: (858) 467-4299**

PROJECT TITLE: **Geotechnical and biological data collection to support habitat restoration and management planning activities at the Ballona Wetlands Ecological Reserve**

PROJECT LOCATION (CITY AND COUNTY): **City and County of Los Angeles, south of Marina del Rey and north of Play del Rey.**

PROJECT DESCRIPTION: The approximately 600-acre Ballona Wetlands Ecological Reserve is the largest remaining tidal wetland area remaining in the Los Angeles area, and restoration and management of this degraded wetland is the focus of this project. To create a restoration plan baseline data collection of multiple resources on-site is necessary. Data collection will include geotechnical soil borings, and biological assessments and sampling. Geotechnical soil borings will be located primarily in areas that are already disturbed, and will be taken during the non-breeding season (August – February) to avoid impact to breeding birds. Borings will be 4-8 inches in diameter and from 20 to 70 feet deep. Boring holes will be filled with tailings or bentonite when completed, and the site restored to pre-drilling conditions. Specific boring locations, and access to those locations for drilling equipment, will be selected in consultation with biologists and archeologists familiar with the property. Biological and archeological monitors will accompany and guide the boring work to ensure that any sensitive biological or cultural resources are avoided to the maximum extent possible. Soil borings are expected to only take 2-3 weeks to complete. Biological sampling will consist of general observation data collection, trap and release of wildlife and fish specimens, vegetation sampling, and other technical studies.

NAME OF PUBLIC AGENCY APPROVING PROJECT: **California Department of Fish and Game-R5**

NAME OF AGENCY CARRYING OUT PROJECT: **California Coastal Conservancy, Santa Monica Bay Restoration Commission, and consultants**

EXEMPT STATUS (CLASS AND GUIDELINES SECTION): **Class 4 (15304) and Class 6 (15306)**

REASONS WHY PROJECT IS EXEMPT:

- **Minor public alterations in the condition of land, water, and/or vegetation which do not involve removal of healthy, mature, scenic trees (Class 4).**
- **Basic data collection, research, experimental management, and resource evaluation activities which do not result in a serious or major disturbance to an environmental resource (Class 6).**

LEAD AGENCY CONTACT PERSON - **David Lawhead, Staff Environmental Scientist**
PHONE: **(858) 627-3997**

Signature: _____ **Date:** 8-13-12
Title: Regional Manager

Date sent to OPR for posting: 8-13-12

ATTACHMENT 2

PSOMAS

PROPOSAL FOR

BALLONA WETLANDS ECOLOGICAL RESERVE CIVIL AND GEOTECHNICAL ENGINEERING AND PERMIT ASSISTANCE

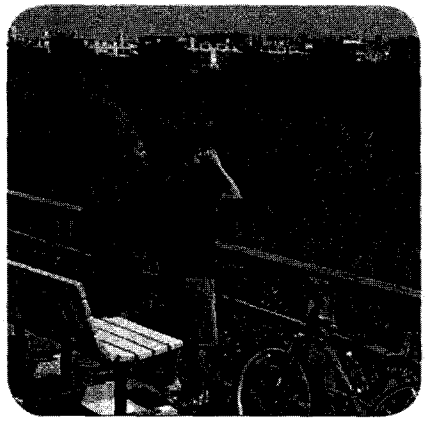




PRESENTED TO

STATE OF CALIFORNIA COASTAL CONSERVANCY

Coastal Conservancy



FEBRUARY 29, 2012

Balancing the Natural and Built Environment

PSOMAS

Balancing the Natural and Built Environment

February 29, 2012

Ms. Mary Small
Deputy Executive Officer
California Coastal Conservancy
1330 Broadway, 13th Floor
Oakland, CA 94612-2530

Email: msmall@scc.ca.gov

Subject: Proposal for Ballona Wetlands Ecological Reserve
Civil and Geotechnical Engineering and Permit Assistance

Dear Ms. Small:

Psomas is pleased to present our proposal to assist the California Coastal Conservancy in restoring the Ballona Wetlands Ecological Reserve to a more natural state. Having been involved in the planning and design of the Ballona Wetlands and its surrounding natural areas starting 25 years ago, we are uniquely qualified and share a passion to continue to assist in restoring and protecting this rare natural resource.

Psomas brings the following benefits to the project.

- **Unmatched technical civil and geotechnical engineering knowledge of the Wetlands and its opportunities and constraints that goes back 25 years.**
  No other firm has been as involved or has more engineering knowledge of the Ballona Wetlands and its surrounding area than Psomas.

- **Long-term successful working relationship with the involved agencies, stakeholders and neighborhoods.**
  These relationships are a result not only of our past work at the Wetlands, but also from Psomas' 65-year history in the Los Angeles region. Over a dozen agencies at the local, state and federal level will be involved, in addition to about a half dozen diverse neighborhoods and stakeholders.

- **Detailed knowledge of adjacent infrastructure and key issues.**
  We have intimate knowledge of local utility facilities and the requirements for abandonment, relocation and/or protection in place. We have conducted a wide variety of engineering and environmental studies in the Reserve area and are therefore familiar with the issues of the watershed area surrounding the wetlands. *In*

555 South Flower Street
Suite 4400
Los Angeles, CA 90071-2416

Tel 213.223.1400
Fax 213.223.1444
www.psomas.com

addition to the engineering and environmental studies, we have also addressed sensitive issues including:

- Evaluating nearby street lighting and landscape compatibility
- Archeology
- Habitat protection
- Hydrology and hydraulics
- Sediment transport
- Salinity modeling and
- Stormwater quality impact issues.

- **Current experience processing a Section 408 permit through the Los Angeles District of the US Army Corps of Engineers (USACE)**
  Psomas is in the final stages of processing a 408 permit through the USACE for the City of Los Angeles on the North Spring Street Historic Bridge widening project. In addition, other members of our team are currently working on projects that involve a 408 permit.

We'd also like to directly address a few issues mentioned in your Request for Services.

- **DVBE Participation — *Two DVBE Firms on Psomas' Team***
  Psomas has included two Disabled Veteran Business Enterprise (DVBE) firms on our team to help bring this project to a successful conclusion. We will ensure they receive as a minimum the percentage of work stated as a goal in Public Contract Code Section 10115.

- **Principal-Level Involvement on the Team — *Four Psomas Principals on Team***
  The four key Psomas staff that will be involved in this project are Principals of the firm. And all of them have worked on projects in the Ballona Wetlands region while employed at Psomas – either directly on the wetlands or adjoining areas such as the Playa Vista Development. One of these Principals, Jacob Lipa, has been providing services on this project and its environs for 25 years – all while working at Psomas. His institutional knowledge of the site will prove invaluable during the course of this project.

We thank you for this opportunity and look forward to continuing to work with you in bringing the restoration of the Ballona Wetlands Ecological Reserve to fruition.

Sincerely,
PSOMAS

Michael J. Crehan, PE
Project Director / Principal

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Appendix – Resumes of Key Personnel

California Coastal Conservancy March 28, 2012
Att: All Governing Board Members and Alternates
Re: PUBLIC COMMENT 3/29/12:
Request to Hold Emergency Meeting to Rescind Approval Action on File No. 04-088

Douglas Bosco
Marisa Moret
Ann Nothoff
John Laird
Ana J. Matosantos
Mary Shallenberger
Susan Hancsh
Karen Finn
Bryan Cash
Noreen Evens
Joe Simitan
Anthony Cannella
Bill Mornning
Luis Alejo
Das Williams

CC
John Chang State Controller
California Department of Finance Director Ana Matosantos
U.S. Army Corp of Engineers Att: Commander Mark Toy
U.S. Senator Barbara Boxer
U.S. Congress Person Maxine Waters

Honorable Chair Bosco, Distinguished Commissioners,

Attachments will be submitted to the Governing Board on March 29, 2012.

I hereby request this public body instruct its Staff to schedule an emergency meeting in accordance with the Bagley Keene Act section 11125.5(b) to rescind its approval of File No. 04-088 on January 19, 2012 for the following reasons;

1. NON-COMPLIANCE DEPARTMENT OF FINANCE ATTACHMENT 1
Final Report—Audit of California State Coastal Conservancy's Propositions 12, 13, 40, 50 Bond Funds

The Department of Finance, Office of State Audits and Evaluations, has completed its audit of the California State Coastal Conservancy's (Conservancy) Propositions 12, 13, 40, and 50 bond funds for the period ending June 30, 2008.

Staff Project Manager Mary Small **failed to require Potential Grantee**, the Santa Monica Bay Restoration Foundation, **to fill out a Grant Application Form** on the Conservancy Website.

Background:

On January 24, 2011 The **California Department of Finance Issued a Final Report – Audit** of the California State Coastal Conservancy. The Report Found that ;

*The Conservancy did not establish formal program guidelines: project awarding criteria; and **grant applications** to document its project merit review process.*
Also, the Conservancy website included limited or incomplete information about ongoing programs and efforts, regional priorities, and funding opportunities.

On October 7, 2010, Executive Director Samuel Schuchat responded to the Audit.

*The **Conservancy website has been updated to included the standardized grant application**, more information about funding opportunities.*

The Conservancy has formally adopted project selection criteria, and a formal, transparent awarding process that follows statute.

*It generally does not institute grant rounds but instead has an **open grant process. Application can be and are made, and these are considered at any time.***

*With respect to the form of **grant applications**, based on discussions with the auditors, we have created a **uniform grant application** that is posted on our website. There is now more information available to the public concerning priorities and how to apply for funding.*

*We have developed a **standard grant application that is now in use**.*

A. Staff Project Manager Mary Small failed to obtain any written documentation to identify the Potential Grantee,no address, no agent name, nor an account to which the grant could be deposited is recorded.

B. Staff Project Manager Mary Small had no paperwork whatsoever from the Potential Grantee prior to January 19, 2012 nor did the Potential Grantee request funding. Staff did not provide public notice that such Grant Funds were available to other qualified entities.

C. Staff Project Manager Mary Small failed to determine if the private business, Santa Monica Bay Restoration Foundation was legally operating out of a State Water Board Office, the Los Angeles Regional Water Quality Control Board. Filings with the California Secretary of State show the private business is operating out of a State Office. There is no legal authority allowing for this.

D. Staff Project Manager Mary Small failed to disclose the fact she was a Director of the Corporation of the Proposed Grantee in 2006 creating an appearance of impropriety.

2. FALSEFICATION OF PUBLIC RECORDS ATTACHMENT 2

Staff falsified a Form SCC 08-08, Work Transmittal.
The Form was initialized by;
Executive Director - Sam Schuchat
Project Manager - Mary Small
Legal - Elena Eger

Staff filled out the form as follows:

*Will this project receive federal or other outside funding? Yes___ No X_*

The January 19, 2012 **Staff Report contradicts on page 6** :

*"The SMRBF in-kind **funds would come from U.S. EPA funding** provided to the SMRBF for its staff **and from a U.S. EPA Wetland Program Development Grant** received for work at Ballona"*

3. INCOMPLETE PUBLIC RECORDS ATTACHMENT 2

Staff failed to complete Form SCC 08-08, Work Transmittal.
The Form was initialized by;
Executive Director - Sam Schuchat
Project Manager - Mary Small
Legal - Elena Eger

Is the Grantee a Nonprofit Organization Yes___ No__ - NOT CHECKED
If nonprofit: Is the status file complete and current Yes___ No___ - NOT CHECKED
GRANT / CONTRACT AMMENDMENTS REVIEW - BLANK
MAIL OUT APPROVALS - BLANK
APPLICATION - BLANK
GRANT TRANSMITTAL - BLANK
REVIEW OF AGREEMENT - BLANK

4. DISCRIMINATION ATTACHMENT 3

Staff Project Manager Mary Small has improperly lobbied private individuals, private businesses, State and Federal Officials and entities prior to the release of the Staff Report, thusly, discriminating against all others by failing to provide the same comment opportunity prior to the issuance of the Staff Report.

Further Discrimination has taken place because only one Potential Grantee has been selected by Staff Project Manager Mary Small, excluding all others that may have chosen to apply.

Moreover, Discrimination has taken place in that only a select group of Potential contractors was noticed by Staff Project Manager Mary Small, in non-compliance with the California Contract Code, excluding all other qualified firms.

5. PREJUDICE OF PROCESS ATTACHMENT 4

Staff Project Manager Mary Small requested Potential Grantee to help write Staff Report.

Staff Project Manager Mary Small worked with Potential Grantee to engage in media spin to avoid scrutiny.

6. STAFF REPORT EXCLUDED VITAL INFORMATION ATTACHMENT 5

The Staff Report is ambiguous. It describes the Grantee in detail with no supporting documentation whatsoever.

The Staff Report does not establish terms of compliance for the Proposed Grantee nor for entities that will complete the described studies.

The Staff Report does not define that contractors will be hired. Staff Project Manager Mary Small discussed hiring contractors with the Potential Grantee and others before the Staff Report was approved, purposely avoiding the requirement under the Bagley Keene Act for the Governing Board to approve contractors and Notice requirements of the California Contract Code.

Legal Staff Elena Eger encouraged Staff Project Manager Mary Small to complete a grant agreement form because I requested it pursuant to the Public Records Act. The form should have been completed without my request for it.

The Staff Report failed to inform this Board that a Federal Environmental Protection Act Process was initiated by the Army Corp of Engineers Los Angeles in 2005 that governs the Ballona Wetlands.

Staff has failed to inform the Governing Board and Public that the Project Manager, Mary Small, lobbied the Department of Fish and Game to ignore the EIS Notice published in the Federal Register, in favor of a new EIR/EIS process desired by the Project Manager and the Proposed Grantee, without informing and seeking authorization from this Governing Board. This clearly constitutes interference with a legally noticed federal NEPA process. Furthermore Staff Project Manager Mary Small failed to inform this Governing Board that the entire area is governed by U.S. Public Law 780, the Rivers and Harbors Act of 1954, which is the subject of the EIS process currently being conducted by the USACE.

In the Minutes of the Ballona Ecosystem Restoration Planning Management Committee, obtained from the USACE by FOIA Staff Project Manager Mary Small, without the

authorization of this Board, represented to the Army Corp of Engineers on June 28, 2010 that:

Coastal Conservancy is supplying most of the funding toward the in-kind local sponsor efforts.

The Governing Board has not authorized Mary Small to represent the Coastal Conservancy at a meeting of the Army Corp of Engineers and the Local Sponsor (Santa Monica Bay Restoration Authority). The Conservancy is neither a partner nor is there any MOU to with the SMRBA, which is under contract to the USACE. Minutes of other such meetings provide evidence that Mary Small also discussed;

A. Changing the scoping of an Environmental Protection Act process began by the USACE in 2005.

B. Using only the Conservancy's Alternatives.

C. Attempting to gain in kind credits from the USACE.

D. Further documents provided by the USACE provide evidence that the local sponsor, never provided any funding to the USACE whatsoever nor did it provide any in-kind credit.

E. Resumes provided to the Coastal Conservancy by potential contractors for this Project include studies finished and paid for by federal funding stated in the resume(s) as part of the Lower Ballona Creek Feasibility Studies of the Joint EIR/EIS (2005) initiated by the USACE.

7. VIOLATIONS OF CALIFORNIA CONTRACT CODE ATTACHMENT 6

Staff Project Manager Mary Small failed to comply with the California Contract Code Notification and Conflict requirements, Sections 10140-10141 and 10515-10518.

Staff Project Manager Mary Small conducted a Request for Services for Contractors in 2009, and again in 2010 in regard to a Project not noticed to the Public or Governing Board until 2012, both in non-compliance with California Contract Code.

Staff Project Manager Mary Small purports to have initiated another Request for Services in February 2012 with responses due on the 29th of that month outside in non-compliance with the California Contract Code.

8. VIOLATIONS OF BAGLEY KEENE ATTACHMENT 6

Staff failed to obtain permission from the Governing Board to hire contractors to complete studies.

9. QUID PRO QUO INFERED ATTACHMENT 7

The attached e-mails contain an inference of a quid pro quo. The request for a support letter is accompanied by a discussion of bond money provisions. In one email a support letter request exists alongside a discussion to close out another matter, without specificity.

10. INIMIDATION AND HARRASSNMENT OF PUBLIC BY LEGAL STAFF VIOLATING STATE LAW AND AGENCIES PRIVACY POLICY
ATTACHMENT 8

Legal Staff Elena Eger has attempted to intimidate and harass me by copying private business persons on emails to me which disclose my private address, even after I requested the practice cease in writing, in clear contradiction to Information Practices Act (Civil Code section 1798 et seq.) and the Agencies Privacy Policy.

Staff has violated the Conservancy Privacy Policy by the aforesaid action(s).

Privacy Policy

Pursuant to Government Code § 11019.9, all departments and agencies of the State of California shall enact and maintain a permanent privacy policy, in adherence with the Information Practices Act of 1977 (Civil Code § 1798 et seq.), that includes, but is not necessarily limited to, the following principles:

(a) Personally identifiable information may only be obtained through lawful means.

(b) The purposes for which personally identifiable data are collected shall be specified at or prior to the time of collection, and any subsequent use of the data shall be limited to and consistent with the fulfillment of those purposes previously specified.

(c) Personal data may not be disclosed, made available, or otherwise used for a purpose other than those specified, except with the consent of the subject of the data, or as required by law or regulation.

(d) Personal data collected shall be relevant to the purpose for which it is needed.

(e) The general means by which personal data is protected against loss, unauthorized access, use, modification, or disclosure shall be posted, unless the disclosure of those general means would compromise legitimate agency objectives or law enforcement purposes.

Each department shall implement this privacy policy by:

- *Designating which position within the department or agency is responsible for the implementation of and adherence to this privacy policy;*
- *Prominently posting the policy physically in its offices and on its internet website, if any;*
- *Distributing the policy to each of its employees and contractors who have access to personal data;*
- *Complying with the Information Practices Act (Civil Code § 1798 et seq.); the Public Records Act (Government Code § 6250 et seq.); Government Code § 11015.5, and all other laws pertaining to information privacy;*
- *Using appropriate means to successfully implement and adhere to this privacy policy.'*

Sincerely,



John Davis
PO 10152
Marina del Rey Ca. 90295

ATTACHMENT 1

RE: Public Records Request from John Davis

From: Philip Wyels <PWyels@waterboards.ca.gov>(Add as Preferred Sender)
Date: Tue, Feb 21, 2012 2:26 pm
To: <jd@johnanthonydavis.com>

Mr. Davis, I apologize for the delay in responding to your request. I have been unable to locate any records within the possession of the State Water Resources Control Board that are responsive to your requests. The attached two documents may be of interest to you, however, in that they indicate that the Santa Monica Bay Restoration Project's relationship with the Santa Monica Bay Restoration Foundation (Foundation) pre-dated the conversion of the Santa Monica Bay Restoration Project to the Santa Monica Bay Restoration Commission (Commission). Also, as I explained to you by telephone, the Commission staff is currently undertaking a number of steps to more clearly distinguish the Commission from the Foundation. Unfortunately, some of those steps are taking some time. I will let you know when I receive a timetable for those steps from Commission staff.

Sincerely,
Phil

Philip G. Wyels
Assistant Chief Counsel
State Board Water Quality Unit
State Water Resources Control Board

1001 I Street
P.O. Box 95812-0100
Sacramento, CA 95814

(916) 341-5178 (phone)
(916) 341-5199 (fax)
pwyels@waterboards.ca.gov>>>

From: <jd@johnanthonydavis.com>
To: Philip Wyels <pwyels@waterboards.ca.gov>
CC: Michael Lauffer <MLauffer@waterboards.ca.gov>
Date: 2/21/2012 10:00 AM
Subject: RE: Public Records Request from John Davis

California State Water Board
Att: Phil Wyels
Re: Status Request Public Record Request

Councel Wyels,

The California Public Records Act requires that Agencies subject to the Act reply to request for records
within 10 days after a request is made.

The State Water Resources Board has not complied with the law in this respect in regard to the request for
records made on 2/7/12.

Please advise as to if or when the State Agency will reply.

Thanks,

John Davis

-------- Original Message --------
Subject: Public Records Request from John Davis
From: <jd@johnanthonydavis.com>
Date: Tue, February 07, 2012 3:03 pm
To: "Philip Wyels" <pwyels@waterboards.ca.gov>
Cc: "Elena Eger" <eeger@scc.ca.gov>

California State Water Board
Att: Phil Wyels
Re: Public Record Request

Dear Mr. Wyeles,

This is a request for public records pursuant to the California Public Records Act. Each numbered request is distinct.

1. Please provide any record of any law, regulation, or policy of the State Water Board which allows
a private business to operate out of a State Water Board Office.

2. Please provide any record of any law, regulation,or policy that allows a private business to use a State Water Board Office as a corporate street address of principal office in California, and or as a mailing address of the corporation, and or mailing address of the corporation, and or address of a corporate Chief Executive Officer, and or of a corporate secretary, and or of a corporate financial agent.

3. Please provide any law, and or regulation, and or policy that allows any State Water Board Commission to
designate a private business as its "FISCAL AGENT"

4. Please provide any law, and or regulation, and or policy that allows any State Water Board Commission to designate a private business to receive, manage, and to treat money granted by the U.S. Government to the State of California as revenue of the private business.

Thank you for your continued assistance,

John Davis
PO 10152
Marina del Rey Ca. 90295
310.795.9640

From:	Elena Eger
To:	"jd@johnanthonydavis.com"
Cc:	"Shelley Luce"; "svaior@santamonicabay.org"; "Mary Small"; "Dick Wayman"; "Nadine Peterson"; "Samuel Schuchat"
Subject:	Davis call to Eger of 2-6-12
Date:	Tuesday, February 07, 2012 1:00:00 PM
Attachments:	SWRCB memo2011aug re accusations.pdf SWRCB Ltr to Davis re PRAs.pdf

Dear Mr. Davis:

Pursuant to our phone conversation of yesterday, February 6, 2012, in which you provided a warning to me that the Conservancy should be informed that the Santa Monica Bay Foundation allegedly is appropriating public resources for private gain, attached please find the State Water Resources Control Board's (SWRCB) August 15, 2011 legal memo addressing your contentions and a September 13, 2011 letter to you regarding the same.

As analyzed in the SWRCB memo, especially in #3, pp. 4-5 of that memo, your contentions that the Foundation is improperly utilizing public resources for private use, namely in your assertions yesterday when you identified as improper the fact that the Foundation uses the same mailing address as the SWRCB's Los Angeles office, are specifically addressed. Frances McChesney, Esq., Office of the Chief Counsel for the SWRCB concludes in that memo that the Foundation is not improperly appropriating public resources for its private use.

The Conservancy intends to proceed with its grant to the Foundation approved as Item #5 at its January 19, 2012 meeting.

Sincerely,

Elena Eger
Senior Staff Counsel
California Coastal Conservancy
1330 Broadway, Ste. 1300
Oakland, CA 94612
510-286-4089 tele/voicemail
510-286-0470 fax

State of California
Secretary of State

E-945038

FILED
In the office of the Secretary of State
of the State of California
Feb - 5 2010
This Space For Filing Use Only

STATEMENT OF INFORMATION
(Domestic Nonprofit, Credit Union and Consumer Cooperative Corporations)
Filing Fee $20.00. If amendment, see instructions.
IMPORTANT - READ INSTRUCTIONS BEFORE COMPLETING THIS FORM

1. **CORPORATE NAME** (Please do not alter if name is preprinted.) **N**

C1481142
SANTA MONICA BAY RESTORATION FOUNDATION

320 W 4TH ST STE 200
LOS ANGELES CA 90013

DUE DATE:

COMPLETE PRINCIPAL OFFICE ADDRESS (Do not abbreviate the name of the city. Item 2 cannot be a P.O. Box.)

2. STREET ADDRESS OF PRINCIPAL OFFICE IN CALIFORNIA, IF ANY — CITY — STATE — ZIP CODE
320 W 4TH ST STE 200 LOS ANGELES CA 90013

3. MAILING ADDRESS OF THE CORPORATION, IF REQUIRED — CITY — STATE — ZIP CODE
320 W 4TH ST STE 200 LOS ANGELES CA 90013

NAMES AND COMPLETE ADDRESSES OF THE FOLLOWING OFFICERS (The corporation must have these three officers. A comparable title for the specific officer may be added; however, the preprinted titles on this form must not be altered.)

4. CHIEF EXECUTIVE OFFICER/ ADDRESS — CITY — STATE — ZIP CODE
SHELLY LUCE 320 W 4TH ST STE 200 LOS ANGELES, CA 90013

5. SECRETARY/ ADDRESS — CITY — STATE — ZIP CODE
CATHERINE TYRRELL 320 W 4TH ST STE 200 LOS ANGELES CA 90013

6. CHIEF FINANCIAL OFFICER/ ADDRESS — CITY — STATE — ZIP CODE
LAURIE NEWMAN 320 W 4TH ST STE 200 LOS ANGELES CA 90013

AGENT FOR SERVICE OF PROCESS (If the agent is an individual, the agent must reside in California and Item 8 must be completed with a California street address (a P.O. Box address is not acceptable). If the agent is another corporation, the agent must have on file with the California Secretary of State a certificate pursuant to Corporations Code section 1505 and Item 8 must be left blank.)

7. NAME OF AGENT FOR SERVICE OF PROCESS
SHELLEY LUCE

8. STREET ADDRESS OF AGENT FOR SERVICE OF PROCESS IN CALIFORNIA, IF AN INDIVIDUAL — CITY — STATE — ZIP CODE
320 W 4TH ST STE 200 LOS ANGELES, CA 90013

DAVIS-STIRLING COMMON INTEREST DEVELOPMENT ACT (California Civil Code section 1350, et seq.)

9. ☐ Check here if the corporation is an association formed to manage common interest development under the Davis-Stirling Common interest Development Act and proceed to items 10, 11 and 12.

NOTE: Corporations formed to manage a common interest development must also file a Statement by Common Interest Development Association (Form SI-CID) as required by California Civil Code section 1363.6. Please see instructions on the reverse side of this form.

10. ADDRESS OF BUSINESS OR CORPORATE OFFICE OF THE ASSOCIATION, IF ANY — CITY — STATE — ZIP CODE

11. FRONT STREET AND NEAREST CROSS STREET FOR THE PHYSICAL LOCATION OF THE COMMON INTEREST DEVELOPMENT — 9-DIGIT ZIP CODE
(Complete if the business or corporate office is not on the site of the common interest development.)

12. NAME AND ADDRESS OF ASSOCIATION'S MANAGING AGENT, IF ANY — CITY — STATE — ZIP CODE

13. THE INFORMATION CONTAINED HEREIN IS TRUE AND CORRECT.

02/05/2010	SHELLEY LUCE	EXECUTIVE DIRECTOR	
DATE	TYPE OR PRINT NAME OF PERSON COMPLETING THE FORM	TITLE	SIGNATURE

SI-100 (REV 01/2008) — APPROVED BY SECRETARY OF STATE

Form **990**

Department of the Treasury
Internal Revenue Service

Return of Organization Exempt From Income Tax

Under section 501(c), 527, or 4947(a)(1) of the Internal Revenue Code (except black lung benefit trust or private foundation)

▶ The organization may have to use a copy of this return to satisfy state reporting requirements

OMB No 1545-0047

2006

Open to Public Inspection

A **For the 2006 calendar year, or tax year beginning** Jul 01, 2006, **and ending** Jun 30, 2007

B Check if applicable: ☐ Address change ☐ Name change ☐ Initial return ☐ Final return ☐ Amended return ☐ Application pending

Please use IRS label or print or type See Specific Instructions

C Name of organization, number and street, city, town, state, and ZIP code

Santa Monica Bay Restoration Foundation
320 West 4th Street Suite 200
LOS ANGELES CA 90013

D **Employer identification number** 33-0420271

E **Telephone number** 213-576-6642

F **Acctg. method:** ☒ Cash ☐ Accrual ☐ Other (specify) ▶

• **Section 501(c)(3) organizations and 4947(a)(1) nonexempt charitable trusts must attach a completed Schedule A (Form 990 or 990-EZ).**

G **Website:** ▶ WWW.SANTAMONICABAY.ORG

H and I are not applicable to section 527 organizations

H(a) Is this a group return for affiliates? ☐ Yes ☒ No

H(b) If "Yes," enter number of affiliates ▶

H(c) Are all affiliates included? (If "No," attach a list See instructions) ☐ Yes ☐ No

H(d) Is this a separate return filed by an organization covered by a group ruling? ☐ Yes ☒ No

J **Organization type** (check only one) ▶ ☒ 501(c)(3) ◀ (insert no) | 4947(a)(1) or | 527

K Check here ▶ ☐ if the organization is not a 509(a)(3) supporting organization **and** its gross receipts are normally **not** more than $25,000 A return is not required, but if the organization chooses to file a return, be sure to file a complete return

I Group Exemption Number ▶

M Check ▶ ☐ if the organization is **not** required to attach Sch B (Form 990, 990-EZ, or 990-PF)

L Gross receipts Add lines 6b, 8b, 9b, and 10b to line 12 ▶ 979,681.

Part I Revenue, Expenses, and Changes in Net Assets or Fund Balances (See the instructions)

Revenue	1 Contributions, gifts, grants, and similar amounts received			
	a Contributions to donor advised funds	1a		
	b Direct public support (not included on line 1a)	1b	342,406.	
	c Indirect public support (not included on line 1a)	1c		
	d Government contributions (grants) (not included on line 1a)	1d	576,050.	
	e **Total** (add lines 1a through 1d) (cash $ 918,456. noncash $)			1e 918,456.
	2 Program service revenue including government fees and contracts (from Part VII, line 93)			2 18,485.
	3 Membership dues and assessments			3
	4 Interest on savings and temporary cash investments			4 41,773.
	5 Dividends and interest from securities			5 967.
	6 a Gross rents	6a		
	b Less rental expenses	6b		
	c Net rental income or (loss) Subtract line 6b from line 6a			6c
	7 Other investment income (describe ▶)			7
	8 a Gross amount from sales of assets other than inventory	(A) Securities	(B) Other	
		8a		
	b Less cost or other basis & sales expenses	8b		
	c Gain or (loss) (attach schedule)	8c		
	d Net gain or (loss) Combine line 8c, columns (A) and (B)			8d
	9 Special events and activities (attach schedule) If any amount is from **gaming**, check here ▶ ☐			
	a Gross revenue (not including $ of contributions reported on line 1b)	9a		
	b Less direct expenses other than fundraising expenses	9b		
	c Net income or (loss) from special events Subtract line 9b from line 9a			9c
	10 a Gross sales of inventory, less returns and allowances	10a		
	b Less cost of goods sold	10b		
	c Gross profit or (loss) from sales of inventory (attach schedule) Subtract line 10b from line 10a			10c
	11 Other revenue (from Part VII, line 103)			11
	12 **Total revenue.** Add lines 1e, 2, 3, 4, 5, 6c, 7, 8d, 9c, 10c, and 11			12 979,681.
Expenses	13 Program services (from line 44, column (B))			13 757,878.
	14 Management and general (from line 44, column (C))			14 102,224.
	15 Fundraising (from line 44, column (D))			15 7,373.
	16 Payments to affiliates (attach schedule)			16
	17 **Total expenses.** Add lines 16 and 44, column (A)			17 867,475.
Net Assets	18 Excess or (deficit) for the year Subtract line 17 from line 12			18 112,206.
	19 Net assets or fund balances at beginning of year (from line 73, column (A))			19 872,326.
	20 Other changes in net assets or fund balances (attach explanation)			20
	21 Net assets or fund balances at end of year Combine lines 18, 19, and 20			21 984,532.

RECEIVED
FEB 19 2008
OGDEN, UT
IRS-OSC
861

SCANNED MAR 04 2008

For Privacy Act and Paperwork Reduction Act Notice, see the separate instructions. Form **990** (2006)

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9 17

List of Officers, Directors, Trustees and Key Employees

US 990 **990: Page 5, Part V; 990EZ: Page 2 Part IV; 990-PF: Page 6, Part VIII** **2006**

Name and Address	Title/Average Hours Per Week Devoted to Position	Amount Paid	Amount for Employee Benefit Plan	Expense Account and Other Allowances
Rod Spackman 320 W 4th St	President 2			
Randal Orton 320 W 4th St	CFO 2			
Mark Gold 320 W 4th St	Director 1			
Tom Ford 320 W 4th St	Director 1			
Richard Bloom 320 W 4th St	Director 1			
Fran Diamond 320 W 4th St	Director 1			
Marvin Sachse 320 W 4th St	Director 1			
Bob Hoffman 320 W 4th St	Director 1			
S Wisniewski 320 W 4th St	Director 1			
Laurie Newman 320 W 4th St	Director 1			
Mary Small 320 W 4th St	Director 1			
Bryant Chesney 320 W 4th St	Director 1			
Dean Kubani 320 W 4th St	Director 1			
Shelley Luce 320 W 4th St	Executive 40	55,830.		
		55,830.		

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ATTACHMENTS 2

SCC 06-08

WORK TRANSMITTAL

Project Development Approval

Date: 12/13/11 WG Leader: MS Date: 12/13/11

Project Manager: Mary Small Project #: 04-088-01

Project Name: Ballona Wetlands County/City: LA

Grantee/Contractor Name: Heal / Santa Monica Bay Foundation

Is Grantee a Nonprofit Organization? ___ Yes ___ No If Nonprofit: Is status file complete and current? ___ Yes ___ No

Nature of Job Planning / design

RESERVATION OF FUNDS

Will this project receive **federal or other "outside" funding?** ___ Yes X No. *If Yes, fill out back side of this form (Grant Transmittal - A)*

Will this project receive **state / other funding?** ___ Yes *(Reimb. -0995)* X No. *If Yes, fill out back side of this form (Grant Transmittal - B)*

Total Amount to be Reserved: $ 6,490,000.00

Prop 84 - Planning? ___ Yes X No

Proposed Budget Item(s):	Fiscal Year (Budget Act)	Amount	Encumb. Liquid. Expiration Date
1. 3760-30203-0005 (2)(B)( )	2000 Chapter: 052/a	$ 6,490,000.00	(6/13)(6/15)
2. 3760-_____ ( )( )( )	_____ Chapter: ___	$ _____	( )( )
3. 3760-_____ ( )( )( )	_____ Chapter: ___	$ _____	( )( )

Reap. by Chapter: 12/10 *for item* 1 *Reap. by Chapter:* _____ *for item* ___ *Reap. by Chapter:* _____ *for item* ___

Program: enhancement

Project Info entered onto applicable Bond Data Spreadsheet? ___ Y X N Date: N/A

___ **Public Access:** VRA (Capital Outlay)

___ **Habitat Conservation Fund** (0262)

___ **Support:** 001 Fund 0565 only: ___ Yes

IT ___ Consult & Prof. (External) ___ (Inter-Dept.) ___

Repayment Feature? (Loan Receivable) ___ Yes ✓ No

Private Activity ? ___ Yes ___ No ✓ N/A (Tax Reportable to Treasurer's Office)

Expected Date of Board Action: 4/19/12 Project Entered onto SCC Database? ✓ Y ___ N Date: 12/13/11

1. WG Leader: MS Date: 12/13/11
2. Acctg Officer: HT 6.49M Date: 12/13/11
3. Additional WG Leader responsible for management of specific funds (if applicable): _____ Date: _____
4. Legal: EE Date: 12/14/11
5. EO/DEO: SS Date: 12/15/11

STAFF RECOMMENDATION REVIEW (For 1/19/12 Board Meeting)

1. WG Leader: MS Date: 12/13/11
2. Legal: EE Date: 12/14/11
3. EO/DEO: SS Date: 12/15/11
4. *Legal: _____ Date: _____

** At EO/DEO's discretion*

GRANT/CONTRACT AMENDMENTS REVIEW

(CEQA Submitted? ___ Yes ___ No ___ N/A Project Manager _____ Date: _____)

Amount Encumbered: $ _____ **Grant/Contract No.:** _____

Termination Date: _____ **Amendment No.:** _____

Disabled Veteran Business Enterprise (DVBE)? _____ Yes _____ No

Small Business Enterprise (SBE)? _____ Yes _____ No

(If Yes, provide OSDS# _____)

20-yr Agreement? _____ Yes _____ No

MAIL OUT APPROVALS

1. Legal: _____ Date: _____
2. Project Manager: _____ Date: _____
3. Proofreader: _____ Date: _____

GRANT TRANSMITTAL

Grant No. _____

(for receivable grants)

INTENT TO APPLY

Date: _____

Project Manager: _____

SCC Program: _____

Grant Program Name: _____ Grant Amount: _____

Granting Agency: _____

Project Name: _____ Project Number: _____

SCC required Matching Funds: (if other than in-kind services, please use reverse side of this form to reserve SCC funds)

In - Kind: $ _____ (Copy from reverse side)

Support: $ _____ Fund No.: _____ FY _____

Capital Outlay: $ _____ Fund No.: _____ FY _____

TOTAL: $ _____

Funding Mechanism: Will or will not hit SCC account? _____ Electronic Transfer ? _____

Paid in Arrears ? _____ Cash Advance ? _____

___ *(A) For Federal Grant*

Support (Staff, travel, equipment): $ _____ 3760 - 001- 0890 FY : _____

Capital Outlay: $ _____ 3760 - 301- 0890 FY : _____

Other (Specify) _____ : $ _____ 3760 - _____ FY : _____

TOTAL: $ _____

___ **(B) For State Reimbursable Grant** (Please use reverse side of this form to reserve up-front SCC funds)

Support (Staff, travel, equipment): $ _____ 3760 - 001 - 0565 - F90 FY : _____

Capital Outlay: $ _____ 3760 - 301 - _____ - F90 FY : _____

Other (Specify) _____ : $ _____ 3760 - _____ - _____ - F90 FY : _____

TOTAL: $ _____

Authorization:

Program Manager: _____ Date: _____

Accounting Officer: _____ Date: _____

Grants Manager: _____ Date: _____

APPLICATION

(Provide copy of Application to Grants Manager)

Legal * _____ Date: _____

**Please inform Grants Manager if signature are missing in the "INTENT TO APPLY" SECTION*

EO/DEO: _____ Date: _____

Date Applied: _____ Expected Date of Grant Award: _____

REVIEW OF AGREEMENT (for receipt of funds)

Board Authorization To Spend The Grant: Date (s): _____

Project Manager: _____ Date: _____

Program Manager: _____ Date: _____

Legal: _____ Date: _____

EO/DEO: _____ Date: _____

Grants Manager: _____ Date: _____ Inform Acct. Date: _____

Amendment #: _____ Legal Reviewed by: _____ Date: _____

ATTACHMENT 3

From: Mary Small
To: sluce@santamonicabay.org; "Barbara Romero"
Subject: FW: hard copy in the mail tomorrow
Date: Friday, January 06, 2012 4:04:00 PM

-----Original Message-----
From: Ruth Galanter [mailto:ruth.galanter@verizon.net]
Sent: Friday, January 06, 2012 3:57 PM
To: Mary Small
Subject: Re: hard copy in the mail tomorrow

I am planning to attend the meeting, and I'm trying to get some more support letters and maybe attendees. You have no idea how much pleasure I would get from foiling your opponents. I can either stand up during the hearing, or if you want, I can instead meet you and the board between the tour and the meeting (since you must be going to feed them someplace) and just chat informally.

Your choice. I'm free at about 11:30 and have a meeting at 3 pm. In between I am at your service.

On Jan 6, 2012, at 3:50 PM, Mary Small wrote:

> Thanks that's a very generous offer. If you have time to attend the
> meeting, that would be great. It starts at 1pm at Baldwin Hills Scenic
> Overlook and this is the first substantive item on the agenda. I will have
> pretty limited time to present, but could acknowledge you and if you were
> willing to speak in public comment on the item that would fantastic.
> Mary
>
> -----Original Message-----
> From: Ruth Galanter [mailto:ruth.galanter@verizon.net]
> Sent: Friday, January 06, 2012 9:52 AM
> To: Mary Small
> Subject: Re: hard copy in the mail tomorrow
>
> I'm available after about 11:30, and you might want to use me as part of a
> board briefing in light of my nearly two decades dealing with the issue.
> That of course is up to you, and I promise not to get huffy if you'd rather
> not.
>
> On Jan 6, 2012, at 9:10 AM, Mary Small wrote:
>
>> Thank you very much, you letter is perfect and I appreciate your quick
>> response. It would be great to have a few supporters at the meeting, I am
>> sure the opponents will attend.
>>
>> We are also going to take the Coastal Conservancy board on a quick tour of
>> the site the morning before the meeting from 10-12. I know you are very
>> busy but it would be great if you wanted to join us for either the tour or
>> to attend the meeting.
>> Mary
>>
>> -----Original Message-----
>> From: Ruth Galanter [mailto:ruth.galanter@verizon.net]
>> Sent: Thursday, January 05, 2012 9:13 PM
>> To: Small Mary
>> Subject: hard copy in the mail tomorrow
>>

>> Hi Mary,
>>
>> I've emailed you my letter and will send the hard copy tomorrow.
>>
>> I've also emailed various people to suggest attending the hearing in case
>> the eco-loonies show up, as I suppose they will.
>>
>> Have a good weekend.
>>
>> Ruth
>>
>>
>>
>
>
>
>

From: Mary Small
To: "Shelley Luce"
Subject: FW: Letter for Coastal Conservancy Board
Date: Tuesday, December 13, 2011 1:21:00 PM

Do you know Ruth?

From: Joan Cardellino [mailto:jcard@scc.ca.gov]
Sent: Tuesday, December 13, 2011 11:57 AM
To: 'Mary Small'
Subject: RE: Letter for Coastal Conservancy Board

It might be worth calling Ruth Galanter to see if she'd speak in support of the project. She has some good credentials. She might know of other supporters to ask too.

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, December 13, 2011 10:38 AM
To: 'Shelley Luce'
Cc: 'Joan Cardellino (Joan Cardellino)'
Subject: RE: Letter for Coastal Conservancy Board

Hi Shelley-
Do you have time to talk about our Jan meeting? I know you have a board meeting this week, so we could also do this via email – or next week, but before next Fri I'd like to work through some ideas:

1) Tour – we'll probably do a tour the morning of the meeting, I think maybe the tour we did with Colonel Toy – view from Cabora Rd and then walk out to boyscout platform
2) Press – do you think we could use this meeting as an opportunity to get either local papers and/or try for LA Times to cover the project? I am worried that once the agenda is out Marcia will use as opportunity to get bad press. Our agenda will be mailed out Jan 6th
3) Public support – who could we have come to support the project at the meeting or with letters? Geraldine is critical (at least her letter) but how about MRCA?, Joe Geever?, Ballona Creek Renaissance?, Friends?, Miguel Luna?, Audubon? HtB? Baykeeper?

Thanks,
Mary

From: Shelley Luce [mailto:sluce@santamonicabay.org]
Sent: Monday, December 12, 2011 3:22 PM
To: Mary Small
Subject: FW: Letter for Coastal Conservancy Board

Hi Mary, Geraldine thought her letter went out already. Have you received? I also invited her to tour the wetlands with us after the meeting.

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission

From:	Mary Small
To:	"Bryant Chesney"
Cc:	"sluce@santamonicabay.org"
Subject:	FW: support letter for Ballona Funding
Date:	Friday, January 06, 2012 9:57:00 AM
Attachments:	Ballona_Wetlands_Engineering and Technical Studies.docx ballona support letter 1.docx ballona support letter 2.docx

Hi Bryant
I was wondering if you would be willing to send a letter of support (samples attached) to the Coastal Conservancy for the Ballona wetlands project. Also attached is the draft staff recommendation. The Conservancy will be considering this authorization in LA on Jan 19th, we will take the board on a quick tour of the site before the meeting. If you have time, it would be great to have you attend either of those events too.

This is the request for all funding to complete the environmental review, 100% engineering, and all of the hydrology/hydraulics modeling that the Army Corps is requiring for its permit to modify the flood control levees. The later analysis is the about half of the cost estimate.

Since the meeting will be in LA, opponents of the project are likely to show up. This approval is pretty critical to moving the project forward. If the Conservancy Board gets frightened away from large scale, ecological restoration then I think we will have very limited options for the future.

Thanks for your consideration and please let me know if you have any questions.
Mary

From:	Mary Small
To:	"Miguel Luna"
Cc:	"Shelley Luce"
Subject:	FW: draft support letter for SCC board meeting
Date:	Tuesday, January 03, 2012 1:29:00 PM
Attachments:	SCC_Ballona_Tech_Support_Ltr.docx

Hi Miguel
Happy New year! Hope you are well.

Is there any chance you would be willing to send a letter of support to the Coastal Conservancy for authorization of funding to continue design of the restoration project? I don't know if Shelley contacted you, but it would be great to get community groups weighing in who support ecological restoration. Our meeting will be in LA, so I expect there will be some opposition.

Please let me know if you have any questions or need more info.
Thanks,
Mary

December 14, 2011

Mr. Doug Bosco, Chairman
State Coastal Conservancy
1330 Broadway, #1300
Oakland, CA 94612
Attn: Mary Small

RE: Proposed Conservancy Authorization for Ballona Wetlands Restoration Engineering and Technical Studies

Dear Chairman Bosco:

I am writing to encourage the Conservancy to authorize funding for the Ballona Wetlands Ecological Reserve Restoration Project planning process. These authorizations would enable the development of technical assessments and engineering design, technical review and agency coordination to support environmental impact analysis and permit applications for the restoration of the Ballona Wetlands Ecological Reserve (BWER).

The Ballona Wetlands Ecological Reserve is 600 acres, surrounded by urban Los Angeles County. The BWER provides valuable and scenic open space in the heart of congested Los Angeles County and offers one of the largest and most promising opportunities for coastal wetland restoration in the region. When restored and opened to the public, the site will allow millions of residents and visitors a rare opportunity to experience a coastal wetland. I support this project because it will help to move the restoration of the Ballona Wetlands Ecological Reserve closer to fruition. Thank you for your consideration of this project.

Sincerely,

From:	Mary Small
To:	"Shelley Luce"
Subject:	RE: draft support letter for SCC board meeting
Date:	Tuesday, January 03, 2012 1:27:00 PM

Thanks!
I will talk to Sam about Boxer and Feinstein. Can LA Co DPW send a letter or do you think that is covered by the Supervisors?
Mary

From: Shelley Luce [mailto:sluce@santamonicabay.org]
Sent: Tuesday, January 03, 2012 1:25 PM
To: Mary Small; Diana Hurlbert
Subject: RE: draft support letter for SCC board meeting

Hi Mary,
We are working on:
Knabe
MRT
Friends of BW
So Cal Edison
So Cal Gas
LMU
Waxman
Lieu
Butler
Rosendahl

And Anyone else you want to add to that list. Figured Feinstein and Boxer will be more important later, and that you and Sam are the best ones to approach them.

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission
Pereira Annex MS:8160
1 LMU Drive, Loyola Marymount University
Los Angeles, CA 90045
310-961-4444

www.santamonicabay.org

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, January 03, 2012 1:06 PM
To: Shelley Luce; Diana Hurlbert
Subject: FW: draft support letter for SCC board meeting

Hi
I belatedly just sent this request to DFG and SLC. The only support letter I have is from MRCA, though I know the port is working on one too. Can you let me know who you are working on

getting letters from and if there is anyone else I should follow-up with?
Thanks
Mary

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, January 03, 2012 1:04 PM
To: 'Griggs, Pamela@SLC'; 'Terri Stewart'; 'dlawhead@dfg.ca.gov'; 'Rick Mayfield (rmayfield@dfg.ca.gov)'
Subject: draft support letter for SCC board meeting

Hi
Sorry I didn't send this to you earlier, I meant to send it before the holidays, but forgot. I was wondering if your agencies would send a support letter to Coastal Conservancy for the requested authorization for funds for engineering and final design for Ballona. Our meeting will be in LA so I expect there will be some opposition and it is a huge funding request since we decided to do the EIR and permitting for the whole project.

If you could attend the site tour of Ballona and the meeting (both on Jan 19th) that would be great too.

Please let me know if you have any questions or need more info.
Thanks
Mary

Pereira Annex MS:8160
1 LMU Drive, Loyola Marymount University
Los Angeles, CA 90045
310-961-4444

www.santamonicabay.org

From: Knatz, Geraldine [mailto:knatz@portla.org]
Sent: Sunday, December 11, 2011 1:00 PM
To: Shelley Luce; Zordilla, Eunice
Cc: Tankersley, Eileen
Subject: Re: Letter for Coastal Conservancy Board

The letter was drafted the day after you asked me. Not sure what happened. Eunice- can you check.
Geraldine Knatz
Executive Director
Port of Los Angeles

From: Shelley Luce [mailto:sluce@santamonicabay.org]
Sent: Friday, December 09, 2011 04:26 PM
To: Knatz, Geraldine
Cc: Tankersley, Eileen
Subject: Letter for Coastal Conservancy Board

Dear Geraldine,
When we spoke a month or so ago, I asked if you would provide a letter to Sam Schuchat and his Board regarding your interest in the Ballona Wetlands restoration project. The January meeting of the Conservancy Board will be in Los Angeles and Sam will ask the Board to approve a large sum for continuing the planning and permitting of the restoration project, so your support of the project and interest in providing mitigation funding is important. Do you still intend to provide a letter and can I help with drafting? Also, we will give the Board members a tour of the wetland and briefing on the restoration plan before or after the Board meeting. As soon as we have a date I will send you an invitation and hope that you could come along.

Thank you Geraldine,
Shelley

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission
Pereira Annex MS:8160
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Los Angeles, CA 90045
310-961-4444

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Mark Gold, D.Env. | President
Heal the Bay | 1444 9th Street | Santa Monica CA 90401
Tel: 310 451 1500 X123 | Fax: 310 496 1902 | mgold@healthebay.org
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From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, January 03, 2012 2:16 PM
To: Mark Gold
Subject: support letter for SCC board meeting?

Hello Mark,
Happy New Year. I am emailing to see if Heal the Bay would be willing to send a letter of support to the Coastal Conservancy for the recommendation that we authorize $6.5M for the design and engineering of the proposed restoration project? My draft staff report is attached along with a sample letter. I know you have talked to Shelley about the project, but I would be happy to give you an update at any time. Of course I understand if you are not prepared to take a position on this project at this point, but our meeting will be in Culver City, so I expect there will be some opposition.

Please let me know if you have any questions or need more info.
Thanks,
Mary

From: Shelley Luce
To: Mary Small; Karina Johnston
Subject: Fw: Coastal Conservancy funding to complete Ballona Wetlands restoration planning
Date: Wednesday, January 18, 2012 10:13:14 PM
Attachments: BCR Support for SCC Ballona Wetlands Funding Authorization.pdf

Jim Lank comes through! Karina or Elena can you please print a copy for me when you get in the office tomorrow? Thank you.

Shelley,

Emails have been flying today, with the end result that BCR is a strong supporter of the requested authorization. See the attached letter. Should we bring copies to give to the board and staff?

As I said before, both Bobbi Gold and I plan to be at the Scenic Overlook for the 1pm meeting start. Bobbi plans to be there for the whole discussion of the agenda item, while I'll stay as long as I can. Both of us plan to sign in to speak on the item. As part of that, I assume it would be appropriate to read the letter, at least in part. If not, let me know.

I hope the tour and meeting both go well. FYI, I'll be leaving soon for another meeting.

Thanks again for your quick response with the helpful cost information.
Jim

Jim Lamm, President
Ballona Creek Renaissance (BCR)...Connecting Creek and Community from the Hills to the Bay
310-839-6896, 310-367-0336 (c), http://facebook.com/ballonacreekrenaissance, www.ballonacreek.org

From: Shelley Luce <sluce@santamonicabay.org>
To: Jim Lamm <jim.lamm@sbcglobal.net>
Sent: Wed, January 11, 2012 11:19:55 AM
Subject: RE: [REPLY] Fw: Coastal Conservancy funding to complete Ballona Wetlands restoration planning

Thank you very much Jim! I hope you had a nice holiday too. It's going to be a great 2012.
Shelley

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission
Pereira Annex MS:8160
1 LMU Drive, Loyola Marymount University
Los Angeles, CA 90045
310-961-4444

www.santamonicabay.org

From: Jim Lamm [mailto:jim.lamm@sbcglobal.net]
Sent: Wednesday, January 11, 2012 10:58 AM
To: Shelley Luce

Subject: Re: [REPLY] Fw: Coastal Conservancy funding to complete Ballona Wetlands restoration planning

Shelley,

Please accept my apologies for this late response. Cathi and I were away on a 2 1/2 week driving trip to the Seattle area for a holiday visit with our kids and grandkids. Then after returning late last Thursday, we've been focused on moving Cathi's 93-year-old mom in with us. I'm just now beginning to turn more of my attention to a backlog of BCR and other matters.

Unfortunately I have an important 3pm meeting at Culver City Hall on the afternoon of the 1pm SCC board meeting at the Scenic Overlook. If I were able to speak on the restoration planning agenda item before about 2:40pm, it could work. Otherwise (or in addition) I might be able to get Bobbi Gold or another knowledgeable BCR board member to represent us.

As for a BCR support letter, I'm pretty sure that would not be a problem. This is on my list of things to bounce off the board prior to our next board meeting.

Here's to a great new year, despite the challenges ahead!
Jim

Jim Lamm, President
Ballona Creek Renaissance (BCR)...Connecting Creek and Community from the Hills to the Bay
310-839-6896, 310-367-0336 (c), http://facebook.com/ballonacreekrenaissance, www.ballonacreek.org

---

From: Shelley Luce <sluce@santamonicabay.org>
To: Jim Lamm <jim.lamm@sbcglobal.net>
Sent: Fri, January 6, 2012 5:32:52 PM
Subject: Coastal Conservancy funding to complete Ballona Wetlands restoration planning

Hello Jim,
I hope you had a lovely Christmas and a happy new year! I did enjoy a nice break.

You may have heard that the Board of the Coastal Conservancy will meet in LA on Jan. 19 and will consider a request from their staff to authorize funding to complete the Ballona Wetlands restoration planning. The request is for about $6.3M and most will go to consultants for additional engineering (through final design), to create a public access master plan, and to do extensive hydraulic modeling as required by Army Corp permitting (the major expense). About $240k will come to SMBRF to fund Diana's position as well as monitoring on the site for the next three years. I don't know if there will be active opposition to this but I am preparing for that nonetheless. Also I see this as a good opportunity to let the SCC board members see the great support that exists in our community for restoration at Ballona.

Please let me know if you are able to support by letter or by attending the meeting. It was posted today on SCC website http://scc.ca.gov/2012/01/06/coastal-conservancy-public-meeting-january-19-2012/
I am attaching the staff report for the item and a couple of example support letters as well. Thank you Jim!
shelley

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission
Pereira Annex MS:8160

Subject: Re: Letter for Coastal Conservancy Board

The letter was drafted the day after you asked me. Not sure what happened. Eunice- can you check.
Geraldine Knatz
Executive Director
Port of Los Angeles

From: Shelley Luce [mailto:sluce@santamonicabay.org]
Sent: Friday, December 09, 2011 04:26 PM
To: Knatz, Geraldine
Cc: Tankersley, Eileen
Subject: Letter for Coastal Conservancy Board

Dear Geraldine,
When we spoke a month or so ago, I asked if you would provide a letter to Sam Schuchat and his Board regarding your interest in the Ballona Wetlands restoration project. The January meeting of the Conservancy Board will be in Los Angeles and Sam will ask the Board to approve a large sum for continuing the planning and permitting of the restoration project, so your support of the project and interest in providing mitigation funding is important. Do you still intend to provide a letter and can I help with drafting? Also, we will give the Board members a tour of the wetland and briefing on the restoration plan before or after the Board meeting. As soon as we have a date I will send you an invitation and hope that you could come along.

Thank you Geraldine,
Shelley

Shelley Luce, D.Env.
Executive Director
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From: Mary Small
To: "Shelley Luce"; "Diana Hurlbert"
Subject: FW: draft support letter for SCC board meeting
Date: Tuesday, January 03, 2012 1:05:00 PM
Attachments: SCC_Ballona Tech Support Ltr.docx

Hi
I belatedly just sent this request to DFG and SLC. The only support letter I have is from MRCA, though I know the port is working on one too. Can you let me know who you are working on getting letters from and if there is anyone else I should follow-up with?
Thanks
Mary

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, January 03, 2012 1:04 PM
To: 'Griggs, Pamela@SLC'; 'Terri Stewart'; 'dlawhead@dfg.ca.gov'; 'Rick Mayfield (rmayfield@dfg.ca.gov)'
Subject: draft support letter for SCC board meeting

Hi
Sorry I didn't send this to you earlier, I meant to send it before the holidays, but forgot. I was wondering if your agencies would send a support letter to Coastal Conservancy for the requested authorization for funds for engineering and final design for Ballona. Our meeting will be in LA so I expect there will be some opposition and it is a huge funding request since we decided to do the EIR and permitting for the whole project.

If you could attend the site tour of Ballona and the meeting (both on Jan 19th) that would be great too.

Please let me know if you have any questions or need more info.
Thanks
Mary

1 LMU Drive, Loyola Marymount University
Los Angeles, CA 90045
310-216-9827
www.santamonicabay.org

From: Jim Lamm [jim.lamm@sbcglobal.net]
Sent: Monday, November 14, 2011 8:51 PM
To: Jessica Hall
Cc: Diana Hurlbert; Shelley Luce
Subject: Re: Request for Support Letters - Urban Greening - Cochran Avenue

Jessica,

BCR's letter of support is attached. Here's to a successful project!
Jim

Jim Lamm, President
Ballona Creek Renaissance (BCR)...Connecting Creek and Community from the Hills to the Bay
310-839-6896, 310-367-0336 (c), http://facebook.com/ballonacreekrenaissance, www.ballonacreek.org

---

From: Jessica Hall <jishica@mac.com>
To: Jim Lamm <jim.lamm@ballonacreek.org>; diana hurlbert <dhurlbert@santamonicabay.org>
Cc: shelley <sluce@santamonicabay.org>
Sent: Mon, November 14, 2011 10:44:14 AM
Subject: Request for Support Letters - Urban Greening - Cochran Avenue

Hi Jim and Diana,
I am working on the urban greening grant for SMBRF for Cochran Avenue Gateway project. Jim, I was wondering if BCR would write a letter of support, and Diana, I was wondering if there were other stakeholders in the Ballona community that you have contact info for, that would also provide a letter of support. Any technical experts would be especially appreciated. A draft letter is enclosed.

The grant is due Thursday.

Thanks!
Jessica

From: Mary Small
To: "Mark Gold"
Cc: sluce@santamonicabay.org
Subject: RE: support letter for SCC board meeting?
Date: Friday, January 06, 2012 4:23:00 PM

I was just talking to Shelley and we were wondering if you could send a staff person to the meeting even if you don't want to sign a letter? Maybe Meredith or someone on her staff could come to talk about the need to open the site to public access and restore nature in the city?

This authorization doesn't commit to any one project, we still will be going through CEQA and NEPA.

Thanks
Mary

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, January 03, 2012 3:00 PM
To: 'Mark Gold'
Subject: RE: support letter for SCC board meeting?

Thanks, the meeting is the 19th so that's the deadline. Yes, I totally understand.

I was just sending Sarah an email about possible dates I'll be in LA when I'd like to stop in ad talk about OPC, so maybe I'll see you then.

Happy new year (and MLPA implementation)
Mary

From: Mark Gold [mailto:mgold@healthebay.org]
Sent: Tuesday, January 03, 2012 2:39 PM
To: Mary Small
Subject: RE: support letter for SCC board meeting?

Mary – Happy new year to you too. We will definitely take a look at this and think it through. It is a great project and needs to happen. The political baggage that goes with it is no picnic as you know.

When is the deadline?

Mark Gold, D.Env. | President
Heal the Bay | 1444 9th Street | Santa Monica CA 90401
Tel: 310 451 1500 X123 | Fax: 310 496 1902 | mgold@healthebay.org
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From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, January 03, 2012 2:16 PM
To: Mark Gold
Subject: support letter for SCC board meeting?

Hello Mark,
Happy New Year. I am emailing to see if Heal the Bay would be willing to send a letter of support to the Coastal Conservancy for the recommendation that we authorize $6.5M for the design and engineering of the proposed restoration project? My draft staff report is attached along with a sample letter. I know you have talked to Shelley about the project, but I would be happy to give you an update at any time. Of course I understand if you are not prepared to take a position on this project at this point, but our meeting will be in Culver City, so I expect there will be some opposition.

Please let me know if you have any questions or need more info.
Thanks,
Mary

From: Mary Small
To: "Dick Wayman"
Subject: FW: Ballona Wetlands presentation materials at SCC meeting
Date: Friday, January 20, 2012 4:03:00 PM

From: Shelley Luce [mailto:sluce@santamonicabay.org]
Sent: Friday, January 20, 2012 3:12 PM
To: Mary Small; Karina Johnston; Diana Hurlbert
Subject: RE: Ballona Wetlands presentation materials at SCC meeting

Yes Mary - Karina or Diana can you please?
Also wanted to make sure you saw/heard the NPR coverage:
http://www.scpr.org/news/2012/01/20/30859/coastal-conservancy-releases-65-million-ballona-wet/

The MDR patch did a pretty good job covering - except Lisa F's comments which are confusing to me, but I will call her about it - and LATimes is going to run something this weekend, I am told. Fingers crossed.
http://venice.patch.com/articles/coastal-conservancy-approves-6-5-million-for-ballona-wetlands-restoration-plans

Thank you Diana and Karina for helping get this press coverage - the advance work we did made a HUGE difference! Please stay on top of me in the future to make sure we have the same success next time. great job.
shelley

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission
Pereira Annex MS:8160
1 LMU Drive, Loyola Marymount University
Los Angeles, CA 90045
310-216-9827
www.santamonicabay.org

From: Mary Small [msmall@scc.ca.gov]
Sent: Friday, January 20, 2012 2:52 PM
To: Karina Johnston; Diana Hurlbert
Cc: Shelley Luce
Subject: Fwd: Ballona Wetlands presentation materials at SCC meeting

Could one of you email this to him?
Thanks

sent from my phone

Begin forwarded message:

> **From:** Rex Frankel <rexfrankel@yahoo.com>
> **Date:** January 20, 2012 12:46:45 PST
> **To:** Mary Small <msmall@scc.ca.gov>
> **Subject: Re: Ballona Wetlands presentation materials at SCC meeting**
> **Reply-To:** Rex Frankel <rexfrankel@yahoo.com>
>
> Mary,
> thank you for the presentation materials. However, on the Baseline monitoring report page,
> http://santamonicabay.org/smbay/ProgramsProjects/HabitatRestorationProject/BaselineAssessmentReport/tabid/203/Default.aspx
>
> the Chapter 4--Vegetation report does not come up when you click on it. I assume this is where Dr. Luce's conclusion comes from.
>
> If you can, please email that chapter to me.
>
> Thank you, Rex Frankel
>
> ---
>
> **From:** Mary Small <msmall@scc.ca.gov>
> **To:** 'Rex Frankel' <rexfrankel@yahoo.com>
> **Sent:** Friday, January 20, 2012 12:09 PM
> **Subject:** RE: Ballona Wetlands presentation materials at SCC meeting
>
> Hello Rex
> Attached is our slide presentation.
>
> Yes, Dr. Luce was referring to the findings of the baseline assessment. I just went to the project website and clicked on the image of the report cover and was able to download the documents, but if there are specific chapters that you are unable to download, please let us know and we'll get them to you.
>
> Mary
>
> ---
>
> **From:** Rex Frankel [mailto:rexfrankel@yahoo.com]

Sent: Friday, January 20, 2012 10:13 AM
To: msmall@scc.ca.gov
Subject: Ballona Wetlands presentation materials at SCC meeting

Mary,

I am interested in getting a copy of your slide presentation from yesterday's SCC Board meeting. Can you email it to me?

I am also interested in seeing the source documents that were used to make Dr. Luce's point that very little of the site is now functioning habitat.

Are they in the recently released SMBRC's Ballona Wetlands Baseline Assessment Program reports? The SMBRC has a website, ballonarestoration.org, with the Baseline Assessment Program report, unfortunately, most of these documents do not open when clicked upon. They are posted here:
http://santamonicabay.org/smbay/ProgramsProjects/HabitatRestorationProject/BaselineAssessmentReport/tabid/203/Default.aspx

Please call me or email if you can help.

Thanks, Rex Frankel, 310-738-0861

From:	Mary Small
To:	"Joe Geever"
Cc:	"Shelley Luce"; "Diana Hurlbert"
Subject:	Coastal Conservancy Jan 19th Meeting
Date:	Thursday, December 15, 2011 11:25:00 AM
Attachments:	Ballona_Wetlands_Engineering and Technical Studies.docx

Hi Joe

Nice to talk to you this morning, and thanks for agreeing to come to the Coastal Conservancy meeting in Jan. It will be on Jan 19th at the Baldwin Hills Scenic Overlook starting around noon. Ballona funding (draft staff report attached) will be the first major item on the agenda. We are planning to take the Board on a tour of Ballona that morning. The tour and meeting are open to the public and details will be posted on our website by the 6th of Jan.

As I mentioned, we (Shelley and I) would be happy to provide additional information to you &/or your chapters at any point. Since we are finally getting ready to initiate the public environmental review, now would be a good time to get you engaged.

Thanks,
Mary

~~~~~~~~~~~~~~~~

Mary Small
Deputy Executive Officer, Coastal Conservancy
1330 Broadway #1300 Oakland, CA 94612
510-286-4181
~~~~~~~~~~~~~~~~

ATTACHMENT 4

From: Mary Small
To: "Shelley Luce"
Cc: "Joan Cardellino (Joan Cardellino)"; "Diana Hurlbert"
Subject: RE: Letter for Coastal Conservancy Board
Date: Tuesday, December 13, 2011 1:11:00 PM

Thanks

Sorry, the plan is to have the tour from roughly 9-11:30 and then start the meeting at noon or 12:30 – something like that. We're afraid that if we do the tour after the meeting none of the board members will come.

I'll call Barbara today to get her ideas and see if they will help with the tour, come to the mtg or send a letter
Mary

From: Shelley Luce [mailto:sluce@santamonicabay.org]
Sent: Tuesday, December 13, 2011 1:08 PM
To: Mary Small
Cc: 'Joan Cardellino (Joan Cardellino)'; Diana Hurlbert
Subject: RE: Letter for Coastal Conservancy Board

Mary, here are some thoughts from me and Diana:

1) Tour – we'll do the tour anytime that works for your members but it seems tight to finish it by 9:15 in order to get them all to Baldwin Hills Overlook for a 10 am meeting. I know we have the Toy meeting the day before so right after the board meeting makes most sense. Could you convince your members to stick around for it?
2) Press – this is troubling. It'll be hard for us to get good press on a $7M expenditure... we can spin this if we get the right people. What if we did a brief presentation on the Monitoring Report before hand? We'll have beautiful hard copies, it's over 400 pages and very impressive and did not cost a lot for the amount of work and info. I think it makes SCC and SMBRC look great. Could we make this the press focus, i.e. with Molly Peterson at least? I'll give her a call for starters.
3) Support – I will talk with Geever, Jim Lamm, Miguel, Lisa Fimiana, Baykeeper, HTB, Nate from Rosendahl's office, Napolitano from Knabe's and Karly from MRT's. I can't say who will show up or do a letter but I will make the asks. I'll also ask Pestrella. Can you talk to MRCA Mary? Also what about the Corps – Rick Liefiled's support would be very meaningful, or Toy's if we can get it. Maybe a letter from Toy with Rick or someone else attending the meeting?

We'll draft a support letter asap and run it by you.
Shelley

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission
Pereira Annex MS:8160

1 LMU Drive, Loyola Marymount University
Los Angeles, CA 90045
310-961-4444

www.santamonicabay.org

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, December 13, 2011 10:38 AM
To: Shelley Luce
Cc: 'Joan Cardellino (Joan Cardellino)'
Subject: RE: Letter for Coastal Conservancy Board

Hi Shelley-
Do you have time to talk about our Jan meeting? I know you have a board meeting this week, so we could also do this via email – or next week, but before next Fri I'd like to work through some ideas:

1) Tour – we'll probably do a tour the morning of the meeting, I think maybe the tour we did with Colonel Toy – view from Cabora Rd and then walk out to boyscout platform
2) Press – do you think we could use this meeting as an opportunity to get either local papers and/or try for LA Times to cover the project? I am worried that once the agenda is out Marcia will use as opportunity to get bad press. Our agenda will be mailed out Jan 6th
3) Public support – who could we have come to support the project at the meeting or with letters? Geraldine is critical (at least her letter) but how about MRCA?, Joe Geever?, Ballona Creek Renaissance?, Friends?, Miguel Luna?, Audubon? HtB? Baykeeper?

Thanks,
Mary

From: Shelley Luce [mailto:sluce@santamonicabay.org]
Sent: Monday, December 12, 2011 3:22 PM
To: Mary Small
Subject: FW: Letter for Coastal Conservancy Board

Hi Mary, Geraldine thought her letter went out already. Have you received? I also invited her to tour the wetlands with us after the meeting.

Shelley Luce, D.Env.
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Los Angeles, CA 90045
310-961-4444

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From: Knatz, Geraldine [mailto:knatz@portla.org]
Sent: Sunday, December 11, 2011 1:00 PM
To: Shelley Luce; Zordilla, Eunice
Cc: Tankersley, Eileen

From: Shelley Luce
To: Mary Small
Subject: RE: board presentation
Date: Wednesday, January 11, 2012 6:55:23 PM

Hi Mary,
I think the presentation looks good. I think we should include some comparative data to show the need for restoration – e.g. the seed bank data, the exotic veg data and some of the animal data (birds and herps). I saw what karina sent you and it doesn't help us – we need numbers like "99% invasive plants" and "lowest seed bank of any so cal wetland". we also need her graphs that show huge percent exotic veg. versus tiny percent native veg, etc. along with those photos of invasive plants that you already included.

I also think we should mention the TMDL –or not the TMDL itself, but we can list the impairments listed on the 303d list, note that TMDL implementation would be consistent with the restoration and that we can work with partners on my governing board and other agencies and leverage resources that would go into implementing the TMDL.

I can help with slides – why don't you send me one or two in your formatting and I will make some with the graphs imentioned and see if you like them. Or rather, since you have to finish by tomorrow and I am out of the office all day, we will ask karina to insert some graphs. Okay with you?
Shelley

Shelley Luce, D.Env.
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From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Wednesday, January 11, 2012 2:49 PM
To: Shelley Luce
Subject:

Hi Shelley
Attached is a draft powerpoint, I want to keep it as simple as we can. There are several extra slides at the end, I just want one picture I can leave up when I walk through the actual requested action, maybe just the bird with its head in the water?

There are two slides about the baseline monitoring program – I think we only need one of them, do you prefer lots of words or just a picture.

I am sending in .pdf because the actual powerpoint is too big. If you want me to ftp the powerpoin so you can edit directly, let me know. I have to finish this by tomorrow night.

Thanks!
Mary

From:	Shelley Luce
To:	Karina Johnston
Cc:	msmall@scc.ca.gov
Subject:	graphs needed for SCC board presentaiton
Date:	Thursday, January 12, 2012 7:57:56 AM

Hi Karina,
Thank you for the bullets you prepped for Mary, they are helpful. The photos are also perfect. What we still need for the presentation are graphics or numbers that will really make our case. Mary needs to complete the presentation today so can you and your team help us prep the following ASAP?

- one map of existing conditions that shows the site today: an aerial photo with transparent overlay of BASIC habitat types - how much is wetland, how much is upland/vacant lot style. goal is to illustrate how little of the site can be said to be funcitoning habitat.

- one simple graph showing predominance of invasive species - the one in the BWER draft TMDL is fine, can you please send that to mary? we need to say "x percent of the site is covered with 99% invasive vegetation" or whatever the actual numbers are. rather than "dominate by invasives" which could mean only 55% covered.

- some species diversity numbers/charts that show how extremely depaupurate poor Ballona is. not just "reduced relative to other wetlands" but "lowest seed bank abundance and diversity of any wetland in southern california" - but i need you to give me the right language so i am not mis-stating anything. please give me those #s or charts or langauge for seed bank, veg, mammals, birds, fish and herps separately and we'll decide which ones to mention in our presentation.

- any other features of the site or results from your surveys that really illustrate to non-scientists how desperate is the need to restore ecological function and habitat at the site.

I am sorry to ask you for all this today, I hope you or one of your team has time. I think you have all this info readily accessible - f there is someihting i've requested that is a big pain check with me and we'll decide if it's really needed. please call my cell or email, i will be out of the office all day but checking my phone compulsively. also please suggest other stuff if you think of it - you know these data better than we do! thank you KJ talk to you later today.
shelley

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From: Mary Small
To: "Karina Johnston"; "Diana Hurlbert"; "Shelley Luce"
Subject: please review these two paragraphs
Date: Tuesday, December 13, 2011 9:09:00 AM

Hi
I'm wrapping up my staff report and I needed to add a little more detail about what SMBRF will do with the grant funds and who you are. Can you please review this and let me know if you have any edits? If you can get it to me today, that'd be great.
Mary

The recommended grant to the SMBRF would provide funds for data collection, technical review and agency coordination to support the proposed restoration project. The SMBRF has implemented a multidisciplinary baseline data collection program using volunteers, students and professional technical experts. The baseline report is the first comprehensive assessment of biological and physical resources at the BWER. It was just published and is available online: http://www.ballonarestoration.org. This grant would allow the SMBRF to conduct additional targeted studies based on the resources identified in the baseline assessment as needed to support the environmental impact analysis of the proposed project. In addition, the SMBRF will continue coordination of the agency review, identification of funding partners, and technical review of work products associated with this project.
The SMBRF is a non-profit organization that was created in 1991 to implement the priorities of the Santa Monica Bay Restoration Plan and to support the work of the Santa Monica Bay Restoration Commission. The SMBRF has a number of initiatives including research, public education, and planning, to support these goals. The SMBRF and the Seaver College of Science and Engineering at Loyola Marymount University (LMU) created the Center for Santa Monica Bay Studies to engage in multidisciplinary research on environmental and social issues affecting Santa Monica Bay and its watershed, and to contribute to policies and actions that improve the environmental condition of the Bay. The partnership with LMU has been very valuable to the data collection efforts, SMBRF has used student volunteers to conduct fieldwork and some faculty have coordinated their own research to support the baseline assessment, resulting in hundreds of hours of field work being donated to the project.

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Mary Small
Deputy Executive Officer, Coastal Conservancy
1330 Broadway #1300 Oakland, CA 94612
510-286-4181
~~~~~~~~~~~~~~~~

ATTACHMENT 5

NORMAN Y. MINETA, California
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NICK JOE RAHALL II, West Virginia
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PETE GEREN, Texas
GEORGE E. SANGMEISTER, Illinois
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PAUL SENSENBRENNER, Chief of Staff
SANTE SEPERIO, Chief Counsel

U.S. House of Representatives

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COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION
U.S. HOUSE OF REPRESENTATIVES
WASHINGTON, D.C.

RESOLUTION

Marina del Rey, California
Docket 2455

Resolved by the Committee on Public Works and Transportation of the United States House of Representatives, That the Secretary of the Army is requested to review the report of the Chief of Engineers on Playa del Rey Inlet and Basin, Venice, California, published as House Document 389, Eighty-third Congress, Second Session, and other pertinent reports, to determine whether modifications of the recommendations contained therein are advisable at the present time, in the interest of navigation, hurricane and storm damage reduction, environmental restoration, and other purposes at Marina del Rey Harbor, Los Angeles, California, with consideration given to the disposal of contaminated sediments from the entrance channel required under the existing operation and maintenance program at Marina del Rey Harbor.

Adopted: September 28, 1994

ATTEST: [signature]
NORMAN Y. MINETA, Chair

[Federal Register: September 20, 2005 (Volume 70, Number 181)]
[Notices] [Page 55116-55117] From the Federal Register
Online via GPO Access [wais.access.gpo.gov] [DOCID:fr20se05-36]
[[Page 55116]]

DEPARTMENT OF DEFENSE Department of the Army; Corps of Engineers Notice of Intent To Prepare an Environmental Impact Statement/ Environmental Impact Report for the Ballona Creek Ecosystem Restoration Feasibility Study, Los Angeles County, CA AGENCY: Department of the Army, U.S. Army Corps of Engineers, DoD. ACTION: Notice of intent. --

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SUMMARY: The Los Angeles District intends to prepare an Environmental Impact Statement/Environmental Impact Report (EIS/EIR) to support a cost-shared ecosystem restoration feasibility study with the Santa Monica Bay Restoration Commission. The proposed project study areas has been degraded by encroachment of non-native plants, placement of fill from Marina Del Rey, interruption of the hydrologic regime, trash accumulation, and varied attempts at bank protection along the creek using rock and concrete. Direct benefits of the proposed project include improved habitat and water quality, reductions in waste and trash, and aesthetics. The watershed is an important resource for both recreational uses and for fish, and wildlife and further degradation could jeopardize remaining. The purpose of the feasibility study is to evaluate alternatives for channel modification, habitat restoration (coastal and freshwater wetlands and riparian), recreation, and related purposes along the lower reach of the Ballona Creek. DATES: A public scoping meeting will be held on September 29, 2005 at 6 p.m. ADDRESSES: U.S. Army Corps of Engineers, Los Angeles District, CESPL-PD, P.O. Box 532711, Los Angeles, CA 90053 and Santa Monica Bay Restoration Commission, 320 West 4th Street, Los Angeles, CA 90013. FOR FURTHER INFORMATION CONTACT: Shannon Dellaquila, Project Environmental Manager, at (213) 452-3850 or Malisa Martin, Project Study Manager at (213) 452-3828. SUPPLEMENTARY INFORMATION: 1. Authorization This study was prepared as an interim response to the following authorities provided by Congress under Section 216 of the Flood Control Act of 1970, which states: The Secretary of the Army, acting through the Chief of Engineers, is authorized to review the operation of projects the construction of which has been completed and which were constructed by the Corps of Engineers in the interest of navigation, flood control, water supply, and related purposes, when found advisable due the significantly changed physical or economic conditions, and to report thereon to Congress with recommendations on the advisability of modifying the structures or their operation, and for improving the quality of the environment in the overall public interest; supplemented by House Resolution on Public Works and Transportation dated September 28, 1994 which states: **The Secretary of the Army is requested to review the report of the Chief of Engineers on Playa del Rey Inlet and Basin, Venice, California, published as House Document 389, Eighty-third Congress, Second Session,** and other pertinent reports, to determine whether modifications of the recommendations contained therein are advisable at present time, in the interest of navigation, hurricane and storm damage reduction, environmental restoration, and other purposes at Marina del Rey Harbor, Los Angeles, California, with consideration given to disposal of contaminated sediments from the entrance channel required under the existing operation and maintenance program at Marina del Rey. 2. Background The Ballona Creek Ecosystem

Restoration study area lies within Los Angeles County, CA and includes portions of Marina del Rey, Culver City, Playa del Rey, and the City of Los Angeles. The study area, a component of the greater Ballona Creek Watershed, includes the lower reach of Ballona Creek extending southwest from Cochran Avenue, in Los Angeles, to Pacific Ocean in Marina del Rey. specific features of the Ballona Creek watershed, including existing and historic wetland areas, the Ballona Lagoon, Del Rey Lagoon, Venice Canal, Grand Canal, the Oxford Drain and the Ballona Channel and tributaries, will be addressed in this study. The greater Ballona Creek system drains a watershed of approximately 329 square kilometers (81,300 acres), and is the largest tributary that drains into the Santa Monica Bay. Ballona Creek collects runoff from several partially urbanized canyons on the south slopes of the Santa Monica Mountains as well as from intensely urbanized areas of West Los Angeles, Culver City, Beverly Hills, Hollywood, and parts of Central Los Angeles. The urbanized areas account for 80 percent of the watershed area, and the partially developed foothills and mountains make up the remaining 20 percent. The watershed boundary includes the Santa Monica Mountains on the north, the unincorporated area known as Baldwin Hills, and the City of Inglewood on the south. The Ballona Creek Ecosystem Restoration study footprint's southern boundary is defined by the Westcheste Bluffs, which run southwest from the San Diego (405) Freeway beyond Loyola Marymount University. The western boundary extends from the Pacific Ocean. The eastern boundary begins where Ballona Creek daylights at Cochran Avenue and Venice Boulevard in a section of Los Angeles known as the Mid City. Tributaries of Ballona Creek include Centinela Creek, Sepulveda Canyon Channel, Benedict Canyon Channel, and numerous storm drains. The Ballona Creek watershed ecosystem has been altered by intense land development, encroachment of non-native plants, trash accumulation, and varied attempts at bank protection along the creek using rock and concrete. Although an important function of the Ballona Creek is as a flood control channel, the lower watershed is still an important resource for both recreational uses and for fish and wildlife habitat. Further impairment could jeopardize remaining habitat. This study will evaluate opportunities for habitat restoration (including wetland and riparian habitat), improvements to water quality, trash mitigation, and recreation and related purposes along the lower reach of the Ballona creek. 3. Problems and Needs At least ninety (90) percent of historic coastal wetlands in California have been lost due to filing, dredging, flood control and intensive development. Within the Lower Ballona Creek Watershed, remaining fragmented wetland areas have been degraded due to diminished hydraulic function, poor water quality and introduction of exotic plants and animals. While functioning wetland systems and riparian habitat remain, they are stressed. Channelization of the Ballona Creek and filling of historic wetland and riparian areas have contributed to degradation and loss of habitat due to impeded tidal exchange and circulation. Contaminated stormwater runoff and trash loading has degraded Ballona Creek water quality. Habitat alteration and loss has decreased biodiversity and overall ecological health, threatening the survival of native endangered species such as the California least tern (Sterna antillarum brown), snowy plover (Charadrius alexandrinus), and the Belding's Savannah Sparrow (Sandwichensis beldingi). The current design of the Flood Control channel has resulted in a lack [[Page 55117]] of recreational opportunities and is considered aesthetically challenged. At present there is no integrated approach and partnership amongst stakeholders to resolve lower Ballona Creek in-stream and wetland

degradation issues, which has led to uncoordinated and sometimes redundant and unsuccessful improvement measures. 4. Proposed Action and Alternative The Los Angeles District will investigate and evaluate all reasonable alternatives to address the problems and need stated above. In addition to a without project (No Action) Alternative, both structural and non-structural environmental measures will be investigated. An assessment of the feasibility of removing impervious surfaces from the Ballona Channel will also be evaluated. Proposed restoration measures include: re-grading and removal of fill, remove invasive and non-native plant species, reintroduction of a water source and installation of native plants to restore previously filled coastal wetlands. Other measures to be evaluated include features to improve or restore tidal regime in Oxford Basin, the Grand and Venice canals, and Ballona and Del Rey Lagoons; the potential for in stream wetland development in Centinela, Sepulveda and Ballona Creek; sediment loading in the upper watershed; and related recreation and educational opportunities. 5. Scoping Process The scoping process is on-going, and has involved preliminary coordination with Federal, State, and local agencies and the general public. A public scoping meeting is scheduled for Thursday September 29th from 6-8 p.m. at the Rotunda Room of the Veteran's Memorial Building, 4117 Overland Avenue, Culver City, CA. This information is being published in the local news media, and a notice is being mailed to all parties on the study mailing list to ensure that public will have an opportunity to express opinions and raise any issues relating to the scope of the Feasibility Study and the Environmental Impact Study/Environmental Impact Report. The public as well as Federal, state, and local agencies are encouraged to participate by submitting data, information, and comments identifying relevant environmental and socioeconomic issues to be addressed in the study. Useful information includes other environmental studies, published and unpublished data, alternatives that could be addressed in the analysis, and, potential mitigation measures associated with the proposed action. All comments will be considered in the project development. Concerns may be submitted in writing to the Santa Monica Bay Restoration Commission, or to the Los Angeles District (see ADDRESSES). Comments, suggestions, and request to be placed on the mailing list for announcements should be sp101.usace.army.mil. Availability of the Draft EIS/EIR The Draft EIS/EIR is scheduled to be published and circulated in December 2007, and a public hearing to receive comments on the Draft EIS/EIR will be held after it is published. Dated: September 13, 2005. Alex C. Dornstauder, Colonel, U.S. Army, District Engineer. [FR Doc. 05-18651 Filed 9-19-05; 8:45 am] BILLING CODE 3710-KF-M

From: Shelley Luce
To: Mary Small; "Rick Mayfield"
Cc: "Terri Stewart"
Subject: RE: From John Davis Re Ballona CEQA process
Date: Tuesday, February 07, 2012 1:39:26 PM

Agreed. The doc he references was for a completely different project, a feasibility study in which SMBRC was the local sponsor for the Corps' study. The EIR/EIS that we want to start is for a separate project, i.e. the BWER restoration/enhancement project. As the landowner, DFG will be the lead agency.

Shelley Luce, D.Env.
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From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, February 07, 2012 1:30 PM
To: 'Rick Mayfield'; Shelley Luce
Cc: 'Terri Stewart'
Subject: RE: From John Davis Re Ballona CEQA process

Suggested response.
1) The EIS/EIR process begun in 2005 was for the Army Corps' Lower Ballona Ecosystem Restoration Feasibility Study, that project and the associated environmental review has not been completed and is not moving forward at this time. The EIR/S process for the proposed enhancement project will be separate.
2) The CEQA statute where lead agency is defined is Public Resources Code Section 21000.
3) DFG as landowner intends to be the lead agency on the proposed enhancement project that will be analyzed in the EIR/EIS.

From: Rick Mayfield [mailto:rmayfield@dfg.ca.gov]
Sent: Tuesday, February 07, 2012 9:30 AM
To: Mary Small; Shelley Luce
Cc: Terri Stewart
Subject: Fwd: From John Davis Re Ballona CEQA process

Please take a look at the attached from Mr. Davis and let me know if you can provide any further information before I respond.

Thanks,

Rick
>>> <jd@johnanthonydavis.com> 2/6/2012 5:11 PM >>>

Ca DFG
Att: Mr. Mayfield

Hi Mr. Mayfield, attached is the congressional and corp docs we discussed.

The document states an joint EIS/EIR process was begun in 2005 per the request of Congress.

The Santa Monica Bay Restoration Commission is noted as the lead agency for CEQA in the joint EIR/EIS.

It also states that at least one scoping hearing has already occured.

My question is does DFG plan on beginning another EIR process for the same area that is already been started by the SMRBC and Corp. If so, how can there be two lead agencies.

To me, logic indicates the SMRBC should be lead.

Thanks,

John Davis
PO 10152
Marina del Rey Ca. 90045

From:	Mary Small
To:	"Diana Hurlbert"; "David Lawhead (DLawhead@dfg.ca.gov)"; "Eichler, Monica SPL"; "Eric Gillies"; "griggsp@slc.ca.gov"; "Hamamoto, Bruce"; "Patrick Holland (pholland@dpw.lacounty.gov)"; "Rick Mayfield (rmayfield@dfg.ca.gov)"; "Serpa, Phillip J SPL"; "Shelley Luce"; "Strum, Stuart R MVN-Contractor"; "Swenson, Daniel P SPL"; "Terri Grant (tgrant@dpw.lacounty.gov)"; "Youn Sim (ysim@dpw.lacounty.gov)"
Subject:	FW: request for services - ballona wetlands
Date:	Wednesday, February 08, 2012 4:46:00 PM
Attachments:	Ballona Civil Engineering and Geotech.pdf Ballona Hydrology and Engineering.pdf

The request for services for the civil engineering and geotechnical contract and the hydrology and engineering contracts went out today. Feel free to forward to other potential contractors, I sent it to about 60 in our database and we will post it on the web. Proposals are due on Feb 29th.

Mary

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Wednesday, February 08, 2012 4:39 PM
Subject: FW: request for services - ballona wetlands

The California State Coastal Conservancy is requesting proposals for consultant services for two separate contracts related to the proposed enhancement of the Ballona Wetlands Ecological Reserve in Los Angeles County. Services are needed to complete engineering and geotechnical evaluations, hydrology, technical studies, design and related services to support completion of a project level EIR/EIS and preparation and processing of a Section 408 permit through the Army Corp of Engineers. One contract will be for Civil and Geotechnical Engineering and a second contract will be for Hydrology and Engineering Design Analysis.

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Mary Small
Deputy Executive Officer, Coastal Conservancy
1330 Broadway #1300 Oakland, CA 94612
510-286-4181
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Ballona Ecosystem Restoration Planning Management Meeting
June 28, 2010
3:00-5:00pm

Attendees:

Josephine Axt, USACE	Ed Demesa, USACE	Julian Serafin, USACE
Rene Vermeeren, USACE	Ben Nakayama, USACE	Rhiannon Kucharski, USACE
Diana Hurlbert, SMBRC	Sean Bergquist, SMBRC	Kathy Anderson, USACE
Larry Smith, USACE	Mary Small, Coastal Conservancy (by phone)	

I. Mary Small: Coastal Conservancy is supplying most of the funding toward the in-kind local sponsor efforts.

II. Ed Demesa: Corps Process Overview
   a. We are coming up to our first major milestone (F3)
      i. Baseline and future without project conditions; preliminary alternatives analysis
         1. Describes problems and opportunities, planning objectives
         2. This product will be the basis for future steps
      ii. Next milestone (F4A/F4)
         1. Formulation, evaluation and comparison of alternatives
         2. F4A: SPD requirement, Alternative Formulation Briefing
      iii. (F5) Public Draft Feasibility Report
         1. Headquarters Policy and Public Review
   b. Josephine Axt: New Review Guidance (Estimated at $500,000; IEPR is federally funded)
      i. Agency Technical Review (ATR) - Requires coordination with the planning center of expertise, and coordinates a team of reviewers from another Corps Division
      ii. Model certifications required
      iii. Independent External Peer Review (IEPR)
      iv. Note for budget: call out what IEPR is estimated to cost, and that it does not have to be cost shared
      v. Diana Hurlbert: Under each discipline, there are costs for responding to comments. Are those related to ATR?
         1. Josephine Axt: Yes. There is a formal comment and response system that must be used for ATRs (DrChecks)
   c. Kathy Anderson: Partnership
      i. Communication
         1. Sean Bergquist: Communication has been much better since Rhiannon has taken over as Lead Planner.
         2. Mary Small: Rhiannon has been great in communication.
      ii. Cost share
         1. Sean Bergquist: Our cost share component is 100% in-kind. It is anticipated that most of that work is and will continue to be in the wetlands.
            a. We are finished our F3 equivalent (2006)
            b. We are also finished our alternatives development and analysis (2008)
               i. We want to make sure that all of the products feed in to the Corps process and products.
            c. The Corps and us on not on the same timeline.

2. Mary Small: It was always our understanding that the Corps would use our restoration alternatives. It makes us nervous that this was never in writing. We have done our F4 equivalent.
3. Because of Federal funding starts and stops, the Corps is still in the F3 process, while the sponsor has completed alternatives analysis (F4 equivalent).
4. Diana Hurlbert: We want to make sure you are maximizing our products, and we want to understand what if any deficiencies are found.
5. Josephine Axt: In-kind has to be formally submitted, directly applicable to the project and it must be understood that in-kind increases increase the overall budget increases.
    a. Mary Small: We fear that our in-kind is not properly reflected in the PMP.
    b. Rhiannon Kucharski: This may be the case. We need to go in detail in to this upon receipt of in-kind submissions, quality check them and revisit the PMP.
6. Sean Bergquist: For credit, do we get credit for what we paid or for what it would have cost the Corps to do the same work?
    a. Josephine Axt: The in-kind credit needs to match the estimate for that work in the PMP. Likewise, if the work costs more than estimated, credit will only be given for up to the estimated amount.

iii. Ed Demesa: As the project goes up the chain, we have to be careful for policy issues. When the project is competing nationally, it starts to become a factor. The cost of land acquisition is part of the project costs. We can only credit up to 35% of total project costs.

iv. Mary Small: If the Corps falls too behind, we will work with Corps Regulatory for a permit for their activities (NEPA/CEQA, design, permitting, and Phase 1 construction).
1. Josephine Axt: If you are going full steam ahead, what is your timeline?
2. Sean Bergquist: We purchased the property in 2005, and have to do something with the property in the near future. There is no set deadline, but they must show the state that something is being done.
    a. In about 4 years, they would like to be constructing something.
    b. Early phase: Do South portion of Area B, South of Jefferson and below Gas Company (low areas, reconnect tidal flows)
3. Ed Demesa: The law to partially build a project and receive credit for a larger project applies only to flood control when there is imminent need. Unfortunately, that law does not apply to ecosystem restoration. There is not an authority for us to give credit for it down the line. So, this may be something you want to consider for a WRDA request to change the authorization.

III. Project Status
a. Corps is working on baseline (F3) right now. Due to H&H delays, the milestone will most likely happen early in FY11.
b. PMP amendment
    i. Study area
        1. Will be clearly defined in the PMP amendment (to the satisfaction of all parties).

a. Definition: Ballona Creek from the Pacific Ocean to Cochran, Del Rey Lagoon; and Centinela and Sepulveda Channels from Ballona Creek to where they go underground.

2. Grand canal is out.
3. Sean Bergquist: We have always planned on the daylighted part of Ballona Creek up to Cochran.
4. Coordination needs to go through Diana Hurlbert and Rhiannon Kucharski.

ii. Costs

1. Ed Demesa: For in-kind credit, it is important to let the PDT know what work the sponsor is doing, even if it will not be submitted for in-kind credit.
2. Sean Bergquist: Historical analysis of the watershed is in the works. We are also working with UCLA to do a watershed budget.
3. Sean Bergquist: When things have to be redone, how does the cost share work?
    a. Hydraulic study
        i. Rene Vermeeren: Our H&H models are in DRAFT form and have not yet had the first ATR. They are not ready for use on alternatives.
4. SMBRC Governing Board will have to sign the PMP and FCSA amendments.
5. In construction phase, can the cost of the land/property be used toward sponsor in-kind credit?
    a. Kathy Anderson: Yes, as long as the constructed project uses those lands. The state paid $140 million in 2005 for the property that makes up areas A, B and C.

iii. In-kind submittals

1. Mary Small: Is there really much more additional work that needs to be done to review the submittals? How much is left to be done by the Army Corps depends on the in-kind submittals?
    a. Diana and Rhiannon can work together with each PDT member to work through these. Set up meetings ASAP.
    b. Kathy Anderson: The whole PDT needs to sit down and go through the PMP, in-kind and costs step-by with SMBRC.
2. Mary Small: I am worried about the water quality report in terms of the data being what is needed per the Corps and less worried about the write-up
    a. Confirm with James Chieh that the data is what is needed.

c. Kathy Anderson: Sponsor financial capability?

i. Even in light of cost increases, the sponsor has enough money to fund all of their study activities and even begin phase I construction (Area B).
ii. Corps needs to get details of sponsor plans for "phase I" in Area B and determine if this must be added as a future without project condition or not.

IV. Action items are noted in RED.

Lower Ballona Creek Ecosystem Restoration Study Monthly Coordination Meeting Minutes
April 28, 2010
10-11am

Attendees:

Mary Small, CC	Sean Bergquist, SMBRC	Rhiannon Kucharski, USACE
Kathy Anderson, USACE	James Chieh, USACE	

I. Comments to the DRAFT Corps F3 products and the DRAFT PMP update are due by the next coordination meeting, May 26, 2010.
   a. Comment from Sean related to updated costs/project area: SMBRC considers lower Ballona Creek to be everything from Cochran Avenue to the Ocean.
   b. Sean is concerned about how SMBRC can come up with matching funds and/or in-kind work for a study totaling $6.2 million (the updated estimated study cost total)
      i. Mary: We may not be able to get approval for the cost increases

II. Frank Wu was not able to attend today's meeting. He will contact Mary and Sean independently to discuss his question on the Engineering and Design Section i, Task 3 from the PMP.

III. In-kind submittals
   a. Mary and Sean will try to submit the first set within one week.

IV. Water Quality Analysis
   a. Document forthcoming from SCCWRP (early June)
   b. Document forthcoming from Geosyntech (June)
      i. Delay due to 2 very dry seasons
   c. Some data is already available on the website (Ballonarestoration.org)
      i. Some prior reports from previous years are available
   d. The Corps (James Chieh) will need to translate and analyze the data and put it into the Appendix Report.
      i. Sean will send everything that is currently available to James Chieh, Cc Rhiannon ASAP. This will include the Geosyntech scope of work and cost estimate for water quality data analysis.

V. Other Discussion
   a. There will be a site tour with the Corps, URS and Sean on May 5, 2010.
   b. Kathy: We were able to request $345k for FY11, but need to get amended FCSA executed.
      i. Mary: We need to credit in-kind work before amending the FCSA. We hope this will bring down the overall study cost.

VI. Action items noted in ORANGE.

Ballona Coordination Meeting Minutes
June 2, 2010
10am

Attendees:

Mary Small, Coastal Conservancy	Diana Hurlbert, SMBRC	Heather Schlosser, USACE
Julian Serafin, USACE	Rhiannon Kucharski, USACE	
Ben Nakayama, USACE	Robert Browning, USACE	Robert Grimes, USACE

I. In kind submittals
   a. For In-kind submittals, Mary, Sean and Diana tried to break down the submittals per the PMP, but had a hard time. Please see in-kind spreadsheet submitted last week.
   b. SMBRC and Coastal Conservancy will submit the In Kind Submittal sheets that correspond with each document from the website, along with reference to the document or file they correspond to and a link to that document on the web.

II. PMP updates
   a. Mary Small is concerned that the revised PMP does not reflect the products they have completed, and very concerned about the cost increases.
   b. Mary Small: Have all the PMP sections looked at the same project area? Parts still refer to Ballona Lagoon, Grand Canal, Venice Canals and Oxford Basin, which are no longer in the study area.
      i. All sections should include: Del Rey Lagoon; Areas A, B and C; Ballona Creek from the Ocean to Cochran; and Centinela and Sepulveda Channels from where they daylight to Ballona Creek.
   c. Mary and Diana requested that the Corps add geographic location to the PMP amendment chapter. The scopes of work are confusing because they do not make the study area clear.
   d. Mary: Why have the F3 economics costs gone up?
      i. Ben Nakayama: Economics had to re-run their model due to the revised flood plain hence their cost increase. The potential flooded parcels went from 6000 to 600.
      ii. Sponsor wants to understand why the economics costs for F3 doubled. The model was originally run at a larger scope (6000 parcels) and is now being re-run at a smaller scope (600 parcels). That should not cost double. There should be economies of scale.
      iii. Ben Nakayama: The model had to be completely re-run for the new parcels. This along with added review costs are the reasons behind the cost increase.
   e. Review Guidance has led to approximately $505k in cost increases. $260k of that is for Independent External Peer Review (IEPR), which is NOT cost shared. The other levels of review such as Agency Technical Review (ATR) and model certification ARE cost shared.
      i. Rhiannon will send another copy of the review guidance.
   f. The Coastal Conservancy is worried that there will be no political appetite to support a feasibility study at this cost level.

g. The language in the PMP needs to itemize what the additional costs would go towards.
    i. Rhiannon will send the detailed cost estimates from each PDT member.
h. The Coastal Conservancy believes their GIS work should decrease the revised GIS costs.
    i. This can be investigated further in conjunction with the in-kind review process. USACE will ask Dave Bianco to review the GIS products and scope and cost estimate after the formal in-kind submittal.

III. Coordination

a. Heather Schlosser: It is hard to assure proper coordination when the Corps is trying to complete the baseline F3 this year, while the sponsor is well in to alternatives analysis in the wetlands areas (A, B, C).
    i. Mary and Diana, what do you see as the Corps' role in this feasibility study?
        1. Mary Small: The discussion was that the Corps would focus on the Creek (there aren't state funds for that) and that the wetlands study would go forward separate from the larger feasibility study, but feed in to the project as in-kind credit. The restoration of the wetlands (A, B, C) is being led by SMBRC in conjunction with the State of California.
        2. SMBRC and Coastal Conservancy are both interested in the Creek as well.
            a. Heather Schlosser: Are you willing to cost share the implementation phase of a recommended alternative that includes the Creek and Wetlands?
            b. Mary Small: Our funding strategy for implementing the restoration is the value of the land. However, the Coastal Conservancy's focus is the restoration planning at the wetlands.

IV. Executive Management Meeting

a. Aim to have this in June. SMBRC and Coastal Conservancy will send potential dates and times to Rhiannon Kucharski, who will coordinate with USACE management schedules.

Ballona Telecon Minutes
March 29, 2010

Attendees:

Rhiannon Kucharski, USACE	Kathy Anderson, USACE	Larry Smith, USACE
John Killeen, USACE	James Chieh, USACE	Frank Wu, USACE
Julian Serafin, USACE	Michael Hallisy, USACE	Patrick Singh, USACE
Mary Small, Coastal Conservancy		Sean Berqquist, SMBRC

I. Introductions
II. PMP update
    a. DRAFT SOW Amendment Chapter distributed
    b. Cost estimates
        i. Frank Wu: Coastal Engineering F3 Baseline Conditions
            1. Need to incorporate PWA information in to the appendix
    c. SMBRC Board will have to buy off on the updated PMP and cost estimates
        i. At this Thursday's meeting they are asking the Board to generally support the study
        ii. Cost increase approval will have to come through the Coastal Conservancy's Board
    d. FCSA amendment would come after the PMP update is complete
        i. Have to work with Corps Legal Counsel and SMBRC Legal/Board
    e. Study Area
        i. For F4, the Corps suggests focused study area of A,B & C plus the Creek up to the I-405, and the Centinela Channel and Sepulveda Wash
            1. H&H and Survey and Mapping Sections believe this focused area is best due to cost considerations
            2. Per Frank Wu: Coastal Engineering work has focused on A, B, & C
        ii. Sponsors feel that we need to keep Ballona Creek up to Cochran Boulevard. Otherwise, the map is okay.
    f. Rhiannon and Kathy will set up a meeting between the sponsors and Survey and Mapping (Alan Nichols).[1]
    g. URS and the Corps are in negotiations for the Plan Formulation and Environmental Appendix
III. Corps work Audit
    a. Environmental Resources Branch (ERB)
        i. Review of sponsor work
        ii. Fish survey of creek and channels
        iii. Work with SAC on HEP evaluation
            1. Including scope of work to score A, B & C and the creek between the marsh areas
            2. Mary can re-start the Conservancy agreement with the SAC to possibly fund them.
                a. Larry will send Mary the scope of work he has written.
    b. Cultural Resources
            1. Write-up from PWA, which summarizes a library record search
                a. Corps and Conservancy both feel that the write-up is inadequate

[1] Action Items marked in GREEN

b. NEPA agency coordination for cultural must be done by a federal agency; it cannot be done by the sponsor or their contractor.
    i. Michael Bever and Bob Stark, with Jones and Stokes and John Killeen need to be in touch with eachother.
2. John Killeen has completed a full record search in the last few months
    a. He is re-writing the F3 input based on the new, more adequate record search.
3. NOTE: Important burials located in the Northwest corner of Area C that have been determined eligible that will need serious consideration for avoidance or mitigation.
4. Also, cultural will have to look at channel as a resource. Where we are pulling out channel, if we decide to, will have to be investigated by cultural.

c. Coastal Engineering
    i. Draft F3 Appendix complete
d. Geotech
    i. Diaz-Yourman contract
    ii. Contract oversite
e. H&H
    i. Baseline Hydrology and Hydraulic Appendices
    ii. Baseline Groundwater Appendix
    iii. Sedimentation will be done during F4 analysis due to funding availability
        1. PWA is looking at sedimentation modeling in their contract with the sponsor. Mary will send their scope of work.
    iv. Water Quality Appendix – We are relying on this product from the sponsor (SCCWRP).
        1. Mary will get us the Appendix as it is available.
f. Socioeconomics
    i. Efforts to date have been on the flood risk management component
        1. Originally the work was going to be done in-house, in L.A.
        2. Original structure inventory and database, site surveys
            a. Subsequent to that work, the H&H floodplain mapping was updated with a fairly significantly reduced floodplain delineation, which demanded that the economics be updated. This update was based on the first revision of the draft Hydraulic Appendix
            b. Update to the economics work will be done through Albuquerque District Economics Section
                i. Finalize F3 analysis
            c. FLO-2D data conversion to HEC format
                i. Will be done through Sacramento District
g. PWA and Jones and Stokes are doing on-going work. Mary will send both scopes of work.

IV. In-kind process (Kathy Anderson)
a. To date there has been no in-kind logged in to the Corps financial system. We need to catch up on that. It should be done yearly.
b. Update in-kind numbers in PMP and in cost summary spreadsheet.
    i. List all in-kind work in a table with associated amount spent on the work, along with a list of work already scoped and contracted to be done. Also, Shelly Luce of SMBRC would need to sign the official submittal.

1. Sponsor needs to keep records of the in-kind and the values in case of an audit.

ii. Mary Small: What is the best way to do that?

iii. Kathy Anderson: We can have a separate meeting to go through the in-kind line by line with Kathy, Rhiannon, Sean and Mary.

iv. Mary Small: Is it what we spend on the product that gets credited or is it what the federal government would have spent to do the same thing?

1. It is up to the PDT to QA/QC the products and agree to the accounting both in amount and content.
2. Coastal Conservancy would feel more comfortable if the in-kind is credited at the value they spent on the product.

V. Coordination

a. Corps requests going forward

i. Each PDT member needs to coordinate with their equivalent on the sponsor's contractor team(s)

1. Rhiannon will send a PDT list to Sean and Mary so that coordination contacts can be filled in next to the corresponding PDT member(s).

b. Sponsor requests

i. Tie up the in-kind process and update more often

c. Our coordination meetings from now on will be the last Wednesday of every month at 10am.

VI. Other Discussion

a. Bike tour with Congresswoman Harman April 9th.

i. Kathy will forward info to Mary and Sean.

DRAFT
ITINERARY FOR
COL R. MARK TOY
MEETING WITH SANTA MONICA BAY RESTORATION COMMISSION AND VISIT TO BALLONA CREEK

26 MAY 2011

TIME/ACTIVITY		TRANSP/REMARKS
THURSDAY – 26 MAY 2011		**UNIFORM: ACUs**
0830	Depart SPL for Loyola-Marymount University (LMU) – 1 LMU 310-338-2700 PAX: Monica Eichler Stuart Strum Dan Swenson	Govt vehicle Driver: Phil Serpa Rick Leifield Josephine Axt
0920	Arrive LMU – Santa Monica Bay Restoration Commission Staff Office (SMBRC)	Location: University Hall Room ECC1857 Note: Met by Stuart Strum and Dan Swenson
0930	Executive Management Meeting with SMBRC and California State Coastal Conservancy (CC) Los Angeles County Public Works Dr. Shelley Luce, Executive Director, SMBRB Mary Small, Deputy Executive Officer, Coastal Conservancy Mark Prestrella, Deputy Director	

TIME/ACTIVITY		TRANSP/REMARKS
THURSDAY – 26 MAY (Continued)		
	Agenda: - Introductions - Project Overview – SMBRC/CC o Project goals and regional importance o Planning Process (Science Advisory Committee and Public Meetings) o Proposed Project o Schedule - Partnership with Corps: Discussion (All) o 408 Permit – Outstanding Questions o Status of Feasibility Study o Discussion of Future Coordination	
1100	Depart for Ballona Creek PAX: See above	Govt Vehicle Driver: Phil Serpa
1110	Ballona Creek Site Visit - Overview of the Site - Ballona Channel - Muted Tidal Wetland SMBRC/CC and LAPW Participants: Dr. Luce, Mary Small and Mark Prestrella	
1210	Depart for Ballona Creek for SPL PAX: See above Note: Lunch enroute	Govt Vehicle Driver: Phil Serpa
1330	Arrive SPL	

From:	Mary Small
To:	Diana Hurlbert; sluce@santamonicabay.org
Subject:	talking points ballona - scc board
Date:	Thursday, January 05, 2012 2:08:00 PM
Attachments:	talking points ballona board item.docx

Hi

Shelley, I am hoping that you will share the presentation of this item to the Conservancy board with me. Attached is an outline of what I am thinking we should cover, please take a look and give me your thoughts. My suggestion is that I'd introduce the project and you, you'd cover the need for restoration and the proposed project and then I could go through the details of the proposed action. I am thinking we will have a short (10ish slide) powerpoint with few words but good pictures. I can pull a draft of it together.

Diana, I am hoping you can fill in the highlighted sections in the attached to help me think about how to explain the work that will done if approved, why it's so expensive and why we are going with this approach, as opposed to phasing differently etc.

Thanks,
Mary

Outline for the presentation

(Mary)
Background

- 600 acres owned by the state, DFG and State Lands
- Designated State Ecological Reserve
- Purchased for the purpose of wetland restoration

Project Partners, introduce Shelley

(Shelley)
Need For Restoration, Site Mgt

- Currently no open public access, very restricted
- Site management issues: homeless encampments, trespass, trash, eyesore

Need for restoration, biology

- Very degraded ecological resources – key findings of baseline assessment
- Regional significance – wetland loss around SM Bay and throughout So CA

Proposed project

- Description of grand vision
- Ecological benefits
- Sustainability – adaption to SLR, restoration of ecological processes
- Public access components

Planning process to date 2 slides(?)

- Public and Science Based Process
- Evaluation of broadest possible range of alternatives
- Refinement and assessment of preferred alternative –ideas we rejected, scaling down due to cost considerations, planning for phased implementation

(Mary)
Recommended action:

1) Authorization for a grant of $250 K to SMBRC to fund their ongoing work to advance this restoration project, including continuation of data collection, agency coordination and technical review and oversight.

2) Authorization of $6.25 million to be contracted by SCC through competitive environmental services contracts for specific technical studies that are needed to complete the environmental review and permitting.

Description of the technical work (what will be done and why so expensive)
This authorization would provide funds for several specific scopes of work to support environmental impact review and permitting of the restoration project.

- Soils and Geotechnical assessment – Some soil sampling has been completed onsite, however the main cost for implementation of the project will be soil management. To

reduce construction costs, the project is designed to balance cut and fill onsite. To effectively implement that program, we have to have clear understanding of soil characteristics – which soils can be used to construct levees, which soils should be used to create upland habitat, etc.

- Landscape Architect to design public access improvements. Conceptual designs for public access improvements have been included in the project from the very start. Now that we have a project description for the land-form of the restoration, it will be important to design the public access improvements. One of the major benefits of this project will be to create a new natural area in the urban center of Los Angeles. We intend to design public access amenities
- Civil engineering – design of levees and construction details up to ___% details of proposed work…
- Hydraulics and Hydrology – evaluation of flood risk and uncertainty details of proposed work…

In addition to environmental impact review, this project will need the following permits: Coastal Commission CDP, LA RWQCB permit, and an Army Corps Section 408 permit. Much of the additional technical work that is recommended in this action will be needed to comply with the 408 permit process.

The 408 permit is a permit issued by the Corps to modify an existing flood control project. After Hurricane Katrina, these permit requirements became much stricter and more comprehensive. This permit will have to be approved in DC and will require that the project have ___% design completed. *Explain why so expensive…*

Over the past several months, the project management team has been in conversation with the ACOE and internally discussing the best path forward given the significant costs to complete the design and hydraulic/hydrology studies.

We considered several options of initial projects that would involve installation of tide gates or breaches rather than full levee removal. Tide gate projects were determined to be less desirable because they do not restore full tidal range, are unable to adapt to sea level rise and have higher maintenance costs. We also considered a moving forward only with a smaller Phase 1 project that would restore wetlands north of the channel.

This would reduce the design and technical review costs now, but if we were ever to implement the full restoration project, we would have to go through some of the permit processes again. Our estimate is that the total planning costs would increase by *X-XX* amt in the end.

Of course the actual amount will be determined through contractor selection process and evaluation of proposals, but we have based this recommendation on a comprehensive, conservative but complete estimate to finish all of the pre-project work.

Acknowledge Some Opposition

- Is restoration needed, impacts to existing resources?

Some individuals think that this site is providing important habitat as is. This is a case of shifting baselines, the site does provide some habitat, but is severely degraded. Example - data pt from Karina's work?. To restore estuarine wetlands at Ballona, the land needs to be reconnected to the ocean.

- Can project be done with volunteers and without bulldozers?

The project that we are recommending is enormous in scale. It involves uncovering the wetlands that were buried with the construction of the marina and that have been cut off from the ocean for almost 90 years. We will work to continue working with youth groups and volunteers to implement portions of this restoration.

- Money would be better spend buying small parcels in the neighborhood

Some neighbors to the project have advocated that the restoration of the wetlands is a poor investment and the bond money should be spent to acquire small parcels (each 3-5 acres) rather than to restore the ecological reserve.

Funds are limited to Ballona, consequences if not approved, who will pay for construction?

Conclusion:
Even though this is a major investment and a controversial project, your staff recommends that you approve it. The ecological restoration of the Ballona wetlands is a rare opportunity to bring back coastal wetlands and to develop an urban natural area that will enhance the lives of millions of Californians. To really restore this site we have to implement a big vision and in order to do that we

Questions I will need to be prepared to answer:
Consequences if not approved
Who will pay for construction?
Why not grant all funds to SMBRC?

NOTES

Cost of other wetland restoration projects – engineering and environmental review

South Bay Salt Ponds Initial Planning, EIR and Phase I Design (15,000 acres)	$23 M
Batiquitos Lagoon	$5 M
San Elijo Lagoon	$1.9 M
S San Diego Bay Salt Ponds	$550K

Questions we need to answer:

Why is this so expensive?
    How does it compare to the costs other wetland restoration projects?
Is it needed? Is it a waste of money?
Is this the right alternative?
Will there be more habitat destruction than restoration
Who will implement the project?
Wouldn't we be better off with ngos and volunteers?
What about long term management?

Key Points
Plan developed with extensive scientific review and public input
Plan goals: habitat restoration, sustainability, public access, lower maintenance cost
Funds are specific to Ballona

From: Shelley Luce
To: Mary Small
Cc: Diana Hurlbert
Subject: RE: timelines...
Date: Monday, January 30, 2012 4:44:09 PM

Let's meet downtown at 11 am at Bottega Louie, it's on the corner of 7th and Grand. We can eat or just have coffee for as long as we want there, and then head over. Sound good?

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission
Pereira Annex MS:8160
1 LMU Drive, Loyola Marymount University
Los Angeles, CA 90045
310-961-4444

www.santamonicabay.org

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Monday, January 30, 2012 4:30 PM
To: Shelley Luce
Cc: Diana Hurlbert
Subject: Re: timelines...

Great, let's meet before maybe 11?
Downtown would be easy for me but I could also fly to LAX and meet at LMU, if we do that maybe we could meet a little earlier?

Sam can't make it, this rescehduled time didn't work for him.
Mary

sent from my phone

On Jan 27, 2012, at 12:38, Shelley Luce <sluce@santamonicabay.org> wrote:

> I have kept the whole day open. You can Sam can tell us what works for you - meet earlier downtown or at LMU, anytime after 9:30 is good for me. We can reserve a conf room at water board offices or meet at a coffee shop if we do it downtown.
>
> *Shelley Luce, D.Env.*
> *Executive Director*
> *Santa Monica Bay Restoration Commission*
> *Pereira Annex MS:8160*
> *1 LMU Drive, Loyola Marymount University*
> *Los Angeles, CA 90045*
> *310-216-9827*
> *www.santamonicabay.org*
>
> ---
>
> **From:** Diana Hurlbert
> **Sent:** Friday, January 27, 2012 10:07 AM
> **To:** Mary Small; Shelley Luce
> **Subject:** RE: timelines...

The 1st works for me. As for timeline this is what I am shooting for....

Early Feb for Nick's revised engineering/construction PD
Late Feb/early March for summary NOP/NOI to be circulated
March/April for Habitat/Adaptive Mgmnt Plan
Early May for draft geotech, recreation/Area C, hydraulics, traffic, and 30% engineering/design
Working over summer on & circulating admin draft chapters and finalizing reports, recreation/Area C etc.
Finalizing Public review Draft for circulation in late Sept.

Please keep in mind that we will be creating and circulating draft chapters for review as information is available. All document preparation will be on concurrent paths. Keeping to the timeline depends mostly on how responsive reviewers are to deadlines for comment (ie. a 2 week turn around). The consultants are all aware of these targets and have committed to meeting them.

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Thursday, January 26, 2012 3:24 PM
To: Shelley Luce
Cc: Diana Hurlbert
Subject: Re: timelines...

Hi
Sorry if I misspoke I feel like I have promised dates that we haven't met so many times that I instinctively underestimate when we'll get things done. It would be super valuable to have some key milestones on a schedule that we all are working off of- MRCA asked for that too. I can draft it up nxt week or you guys can send it to me.

I think there may be a role for Sci input going fwd but after I'm not sure I think we should have more SAC mtgs. Do you guys have time on the 1st? I think there are a few things we should touch base on and I could meet before or immediately after our mtg w ACOE.

Thanks
Mary

sent from my phone

On Jan 26, 2012, at 15:47, Shelley Luce <sluce@santamonicabay.org> wrote:

> Hi Mary,
> I wanted to check in on our timelines but I forgot to mention yesterday. I've been shooting for end of Feb. release of the NOP/NOI and public review draft of EIR/EIS in Sept. 2012. In the SAC meeting I thought I heard you say something longer than that – a few months until the NOP comes out. Also in the SAC meeting we kind of indicated there could be more SAC meetings to resolve

things that we were discussing and I didn't think that was part of our plan. I do think we can continue discussion of relevant things with SAC members as we write the draft EIR, and reconvene if necessary. Is that what you were thinking?

Talk to you Monday!
Shelley

Shelley Luce, D.Env.
Executive Director
Santa Monica Bay Restoration Commission
Pereira Annex MS:8160
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310-961-4444

www.santamonicabay.org

From: Mary Small
To: "Shelley Luce"
Subject: LA Co
Date: Tuesday, December 13, 2011 9:14:00 AM

Hi

Do you think there is any chance that we could get a commitment from LA Co to fund the permit process before Jan? Then I could add them as matching funds to my staff report.

Mary

~~~~~~~~~~~~~~~~

Mary Small
Deputy Executive Officer, Coastal Conservancy
1330 Broadway #1300 Oakland, CA 94612
510-286-4181
~~~~~~~~~~~~~~~~

From: Mary Small
To: "Mary Small"; "Shelley Luce"
Cc: "Diana Hurlbert"
Subject: RE: draft agmt SMBRF 2
Date: Monday, February 13, 2012 9:28:00 AM

Hi
Can you let me know if this looks basically ok so I can send it to Mr. Davis?
Thanks
Mary

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, February 07, 2012 2:28 PM
To: 'Shelley Luce'
Cc: 'Diana Hurlbert'
Subject: draft agmt SMBRF 2

Hi Shelley
Attached is a draft of the grant agmt to the SMBRF for the $240K. We'll need to develop a work plan and budget separately.

Can you take a quick review and let me know if it looks ok? Elena has asked me to produce this draft quickly as it seems the best way to respond to our most recent PRA from Mr. Davis.

Thanks
Mary

ATTACHMENT 6

REQUEST FOR SERVICES

Ballona Wetlands Ecological Reserve
Environmental Analysis and Permit Assistance

May 11, 2009

Contract Type: Environmental Professional Services

Scope:
Perform environmental analysis and assist in applying for permits for habitat enhancement and public access improvements at the Ballona Wetlands Ecological Reserve in Los Angeles.

Submittal Deadline: **June 1, 2009**
Proposals should be submitted electronically in adobe acrobat format and must be received at the Conservancy by June 1, 2009.

Contact: Mary Small, California Coastal Conservancy, msmall@scc.ca.gov

From: Mary Small
To: "Ivan Medel"
Cc: "Shelley Luce"; "Karina Johnston"; "Diana Hurlbert"
Subject: FW: post to web?
Date: Wednesday, February 08, 2012 4:48:00 PM
Attachments: Ballona Civil Engineering and Geotech.pdf
Ballona Hydrology and Engineering.pdf

Hi Ivan
Could you post the following on the homepage of the Ballona Restoration Project website?

The California State Coastal Conservancy is requesting proposals for consultant services for two separate contracts related to the proposed enhancement of the Ballona Wetlands Ecological Reserve in Los Angeles County. Services are needed to complete engineering and geotechnical evaluations, hydrology, technical studies, design and related services to support completion of a project level EIR/EIS and preparation and processing of a Section 408 permit through the Army Corp of Engineers. One contract will be for Civil and Geotechnical Engineering and a second contract will be for Hydrology and Engineering Design Analysis.

Please unhighlight the text above but insert hyperlinks to the attached docs to the highlighted text to the RFS, does that make sense?

Thanks,
Mary

REQUEST FOR SERVICES

Ballona Wetlands Ecological Reserve
Civil and Geotechnical Engineering and Permit Assistance

February 8, 2010

Contract Type: Civil Engineering and Geotechnical Professional Services

Scope: Provide engineering and geotechnical evaluations, design and related services for the proposed wetland restoration design of the Ballona Wetlands Ecological Reserve in Los Angeles. Technical studies, evaluations, and designs will be of sufficient detail to support completion of a project level EIR/EIS and preparation and processing of a Section 408 permit through the Army Corp of Engineers.

Submittal Deadline: February 29, 2012

Proposals should be submitted electronically in adobe acrobat format and must be received at the Conservancy by February 29, 2012.

Contact: Mary Small, California Coastal Conservancy, msmall@scc.ca.gov

From: Mary Small
To: "Diana Hurlbert"; "David Lawhead (DLawhead@dfg.ca.gov)"; "Eichler, Monica SPL"; "Eric Gillies"; "griggsp@slc.ca.gov"; "Hamamoto, Bruce"; "Patrick Holland (pholland@dpw.lacounty.gov)"; "Rick Mayfield (rmayfield@dfg.ca.gov)"; "Serpa, Phillip J SPL"; "Shelley Luce"; "Strum, Stuart R MVN-Contractor"; "Swenson, Daniel P SPL"; "Terri Grant (tgrant@dpw.lacounty.gov)"; "Youn Sim (ysim@dpw.lacounty.gov)"
Subject: RE: request for services - ballona wetlands
Date: Thursday, February 09, 2012 5:02:00 PM

Hello all-
Here's some more information about the Coastal Conservancy's contractor selection process. It is a quick process and I am hoping PMT members will assist us so I want to be sure you are aware of the schedule.

I am really hoping the PMT will help in reviewing proposals and that staff from the County and Corp will participate on the selection panel. These contracts are for work to support the County's 408 submittal. Here's the schedule for the review/selection:

- Proposals will be submitted electronically to me on 2/29
- I will post them on a secure site by 3/1 for PMT review
- PMT will select the top 3 or 4 firms we'll interview for each contract by 3/5
- PMT will do a detailed review of the written proposals of the top proposals by 3/13
- Interviews will be in LA on 3/13 – all day

I am assuming the selection panel will be Diana, me, and a representative from the County and the Corps. If anyone else wants to spend March 13th interviewing firms, please let me know.

Mary

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Wednesday, February 08, 2012 4:46 PM
To: 'Diana Hurlbert'; 'David Lawhead (DLawhead@dfg.ca.gov)'; 'Eichler, Monica SPL'; 'Eric Gillies'; 'griggsp@slc.ca.gov'; 'Hamamoto, Bruce'; 'Patrick Holland (pholland@dpw.lacounty.gov)'; 'Rick Mayfield (rmayfield@dfg.ca.gov)'; 'Serpa, Phillip J SPL'; 'Shelley Luce'; 'Strum, Stuart R MVN-Contractor'; 'Swenson, Daniel P SPL'; 'Terri Grant (tgrant@dpw.lacounty.gov)'; 'Youn Sim (ysim@dpw.lacounty.gov)'
Subject: FW: request for services - ballona wetlands

The request for services for the civil engineering and geotechnical contract and the hydrology and engineering contracts went out today. Feel free to forward to other potential contractors, I sent it to about 60 in our database and we will post it on the web. Proposals are due on Feb 29th.

Mary

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Wednesday, February 08, 2012 4:39 PM
Subject: FW: request for services - ballona wetlands

The California State Coastal Conservancy is requesting proposals for consultant services for two separate contracts related to the proposed enhancement of the Ballona Wetlands Ecological

Reserve in Los Angeles County. Services are needed to complete engineering and geotechnical evaluations, hydrology, technical studies, design and related services to support completion of a project level EIR/EIS and preparation and processing of a Section 408 permit through the Army Corp of Engineers. One contract will be for Civil and Geotechnical Engineering and a second contract will be for Hydrology and Engineering Design Analysis.

Mary Small
Deputy Executive Officer, Coastal Conservancy
1330 Broadway #1300 Oakland, CA 94612
510-286-4181

Subject: RE: PUBLIC RECORDS REQUEST FROM JOHN DAVIS MARCH 27, 2012
From: "Elena Eger" <eeger@scc.ca.gov>(Add as Preferred Sender)
Date: Wed, Mar 28, 2012 8:46 am
To: <jd@johnanthonydavis.com>
Cc: "'Mary Small'" <msmall@scc.ca.gov>, <sschuchat@scc.ca.gov>

Dear Mr. Davis:

The Conservancy does not possess a responsive record to your request, below.

Sincerely,

Elena Eger

Senior Staff Counsel

California Coastal Conservancy

1330 Broadway, Ste. 1300

Oakland, CA 94612

510-286-4089 tele/voicemail

510-286-0470 fax

From: jd@johnanthonydavis.com [mailto:jd@johnanthonydavis.com]
Sent: Tuesday, March 27, 2012 5:55 PM
To: Elena Eger
Cc: 'Mary Small'; sschuchat@scc.ca.gov
Subject: RE: PUBLIC RECORDS REQUEST FROM JOHN DAVIS MARCH 27, 2012

California Coastal Conservancy

Re: Public Records Request

Please provide any statute which exempts the California Coastal Conservancy from the California Contract Code as it relates to the Agency entering into contracts of any type.

Thank you,

John Davis

-------- Original Message --------
Subject: RE: PUBLIC RECORDS REQUEST FROM JOHN DAVIS MARCH 21, 2012
From: "Elena Eger" <eeger@scc.ca.gov>
Date: Tue, March 27, 2012 5:27 pm
To: <jd@johnanthonydavis.com>
Cc: "'Mary Small'" <msmall@scc.ca.gov>, <sschuchat@scc.ca.gov>

Dear Mr. Davis:

Your request below does not constitute a request for a record pursuant to the Public Records Act. Rather, your request is for an analysis of statutory law. I am ethically prohibited from providing counsel to anyone other than my client. Assuming that you are not a lawyer, I am also ethically bound to suggest to you that you obtain your own counsel to advise you on such matters. You may utilize the California State Bar website for referrals to counsel at www.calbar.ca.gov.

Sincerely,

Elena Eger

Senior Staff Counsel

California Coastal Conservancy

1330 Broadway, Ste. 1300

Oakland, CA 94612

510-286-4089 tele/voicemail

510-286-0470 fax

From: jd@johnanthonydavis.com [mailto:jd@johnanthonydavis.com]
Sent: Tuesday, March 27, 2012 1:38 PM
To: Elena Eger
Subject: RE: PUBLIC RECORDS REQUEST FROM JOHN DAVIS MARCH 21, 2012

Hello,

Thank you for the citations. However, neither removes the requirement of the Coastal Conservancy to comply with Public Contract Code Sectoins 10140-10141 nor 10515-10518.

If the Conservancy is exempt from the California Contract Code, please inform me as to what statute or code provides for such an exemption.

John Davis

-------- Original Message --------
Subject: RE: PUBLIC RECORDS REQUEST FROM JOHN DAVIS MARCH 21, 2012
From: "Elena Eger" <eeger@scc.ca.gov>
Date: Tue, March 27, 2012 12:50 pm
To: <jd@johnanthonydavis.com>
Cc: "'Schuchat, Sam'" <sschuchat@scc.ca.gov>, "'Mary Small'" <msmall@scc.ca.gov>, "'Dick Wayman'" <dwayman@scc.ca.gov>, "'Nadine Peterson'" <npeterson@scc.ca.gov>, "'Heather Baugh'" <heather.baugh@resources.ca.gov>, <kimg@resources.ca.gov>

Dear Mr. Davis:

This correspondence contains the Coastal Conservancy's (Conservancy) response to your March 21, 2012 Public Records Act request, below.

The Conservancy does not possess any responsive records to either of your numbered requests. However, we direct you to Government Code Sections 4525 *et seq*. and 14 California Code of Regulations Sections 13870 *et seq.* for our contracting process.

Sincerely,

Elena Eger

Senior Staff Counsel

California Coastal Conservancy

1330 Broadway, Ste. 1300

Oakland, CA 94612

510-286-4089 tele/voicemail

510-286-0470 fax

From: jd@johnanthonydavis.com [mailto:jd@johnanthonydavis.com]
Sent: Wednesday, March 21, 2012 2:11 PM
To: "Samuel Schuchat"; "John Laird"; 'Dick Wayman'; 'Nadine Peterson'; carmenp@scc.ca.gov; kimg@resources.ca.gov
Cc: John Chang
Subject: PUBLIC RECORDS REQUEST FROM JOHN DAVIS MARCH 21, 2012

California Coastal Conservancy

Att: Executive Director Sam Schuchat

California Coastal Conservancy March 21, 2012

To: Governing Board and Management

Douglas Bosco
Marisa Moret
Ann Nothoff
John Laird
Susan Hancsh

Karen Finn

Bryan Cash

Noreen Evens

Joe Simitan

Anthony Cannella

Bill Mornning

Luis Alejo

Das Williams

CC
John Chang State Controller

Att: Executive Director Schuchat, Please Send This Letter to All California Coastal Conservancy Governing Board and Management.

This is a request for public records made pursuant to the California Public Records Act. Each numbered item is a distinct request for public records.

1. Please provide any and all public records that demonstrate compliance with California Public Contract Code Section 10140-10141 in regard to the California Coastal Conservancy approval onf January 19, 2012 of File No. 04-088 which approved money to be disbursed for engineering, hydrologic analyses, geotechnical assessments, and public design.

2. Please provide any and all public records that demonstrate compliance with California Public Contract Code Section 10515-10518 in regard to the California Coastal Conservancy approval on January 19, 2012 of File No. 04-088 which approved money to be disbursed for engineering, hydrologic analyses, geotechnical assessments, and public design.

No such records have been requested or received by me to date.

See Attached Approval for File No. 04-088

Thank you,

John Davis
PO 10152
Marina del Rey Ca. 90295

PUBLIC CONTRACT CODE SECTION 10140-10141

10140. **Public notice of a project shall be given by publication once a week for at least two consecutive weeks or once a week for more than two consecutive weeks if the longer period of advertising is deemed necessary by the department, as follows:** (a) **In a newspaper of general circulation published in the county in which the project is located**, or if located in more than one county, in such a newspaper in a county in which a major portion of the work is to be done. (b) **In a trade paper of general circulation published** in San Francisco for projects located in County Group No. 1, as defined in Section 187 of the Streets and Highways Code, or **in Los Angeles for projects located in County Group No. 2, as defined in said Section 187, devoted primarily to the dissemination of contract and building news among contracting and building materials supply firms. The department may publish the notice to bidders for a project in additional trade papers or newspapers of general circulation that it deems advisable.** 10141. The notice shall state the time and place for the receiving and opening of sealed bids, describing in general terms the work to be done and that the bids will be required for the entire project and for the performance of separate designated parts of the entire project, when the department determines that segregation is advisable.

PUBLIC CONTRACT CODE SECTION 10515-10518

10515. (a) No person, firm, or subsidiary thereof who has been awarded a consulting services contract may submit a bid for, nor be awarded a contract on or after July 1, 2003, for the provision of services, procurement of goods or supplies, or any other related action that is required, suggested, or otherwise deemed appropriate in the end product of the consulting services contract. (b) Subdivision (a) does not apply to either of the following: (1) Any person, firm, or subsidiary thereof who is awarded a subcontract of a consulting services contract that amounts to no more than 10 percent of the total monetary value of the consulting services contract. (2) Consulting services contracts that comply with Article 2.5 (commencing with Section 10510.4). (c) (1) Subdivision (a) does not apply to any person, firm, or subsidiary awarded a consulting services contract by a University of California medical center when the provision of service, procurement of goods or supplies, or any other related action required, suggested, or otherwise deemed appropriate in the end product of the consulting services contract, is necessary to avoid a competitive disadvantage in the hospital industry, improve patient care, protect the privacy of patient information, or avoid significant delay and additional expense. (2) The University of California shall report within 30 days on any exemption granted under paragraph (1) to the Joint Legislative Budget Committee and the Department of Finance. The report shall include a description of the circumstances that warranted the exemption, the effects of the exemption on patient care or patient privacy, and a calculation of the projected costs savings to the institution as a result of the exemption. 10516. No officer or employee of the University of California shall engage in any employment, activity, or enterprise from which the officer or employee receives compensation or in which the officer or employee has a financial interest if that employment, activity, or enterprise is sponsored or funded, or sponsored and funded, by any university department through or by a university contract unless the employment, activity, or enterprise is within the course and scope of the officer's or employee's regular university employment. No officer or employee in the university shall contract on his or her own individual behalf as an independent contractor with any university department to provide services or goods. This section shall not apply to officers or employees of the university with teaching or research responsibilities, nor shall it apply to student employees for payment for additional campus activities or engagements outside of the scope of their primary university employment. 10517. (a) No retired, dismissed, separated, or formerly employed person of the University of California employed with the university or otherwise appointed to serve in the university may enter into a contract in which he or she engaged in any of the negotiations, transactions, planning, arrangements, or any part of the decisionmaking process relevant to the contract while employed in any capacity by any university department. The prohibition of this subdivision shall apply to a person only during the two-year period beginning on the date the person left university employment. (b) For a period of 12 months following the date of his or her retirement, dismissal, or separation from the University of California, no person employed in the university or otherwise appointed to serve in the university may enter into a contract with any university department, if he or she was employed by that department in a policymaking position in the same general subject area as the proposed contract within the 12-month period prior to his or her retirement, dismissal, or separation.

The prohibition of this subdivision shall not apply to a contract requiring the person's services as an expert witness in a civil case or to a contract for the continuation of an attorney's services on a matter he or she was involved with prior to leaving the university. (c) This section does not prohibit the rehire or reappointment of University of California employees after retirement, consistent with university administrative policies, nor does it apply to inventors and authors of intellectual property licensed under technology transfer agreements. 10518. (a) Except as otherwise provided in subdivision (b), each contractor who enters into a contract with a University of California campus for ten thousand dollars ($10,000) or more shall be assigned an identification number by the chancellor of that university campus. Each contractor who has been assigned a number shall list it on each contract the contractor enters into with the university campus, regardless of the amount of the contract. In the case of a corporation or firm, the chancellor's assigned number shall be used exclusively on each contract with that particular chancellor's campus. The assigned number shall remain unchanged regardless of future name changes. (b) If the identification numbers cannot be tracked centrally by the Regents of the University of California, then the regents, and not the chancellors, shall assign the identification numbers.

ATTACHMENT 7

From:	Mary Small
To:	"Barbara Romero"
Cc:	"Melissa Guerrero"; "Diana Hurlbert"; "Shelley Luce"
Subject:	SCC mtg in Jan
Date:	Monday, December 19, 2011 3:30:00 PM
Attachments:	Ballona_Wetlands_Engineering and Technical Studies.docx

Hi Barbara,
Thanks for agreeing to support the recommendation for funding for engineering work at Ballona. Attached is the draft staff report, the project will be heard at our Jan 19th meeting at the Baldwin Hills Scenic Overlook. As you can see it's a pretty big authorization, so we'd love your support. I think we may take the Board on a tour of Ballona that morning and then the meeting will start around 12:30. It would be great to have MRCA join us for either the tour or the meeting.

Thanks also for the message about the early action plan grant. When you have time submit any final billing or just a letter stating that the work is all done and I'll close it out.

Hope you are doing well and have a great holiday.
Mary

From: Mary Small
To: "Shelley Luce"; "Scott Valor"
Subject: FW: support letter for SCC board meeting?
Date: Wednesday, January 11, 2012 3:53:00 PM

Good news

From: Sarah Sikich [mailto:ssikich@healthebay.org]
Sent: Wednesday, January 11, 2012 3:44 PM
To: Mary Small
Subject: RE: support letter for SCC board meeting?

Hi Mary,

Mark forwarded me your email about the Ballona technical study support letter for the SCC board meeting. We discussed it at our department meeting this week, and will send in a letter. Is an electronic copy fine, or do you need a hard copy? Also, should I just send it to you?

Additionally, Alix Hobbs would like to join our meeting while you are at Heal the Bay to discuss some of our Coastal Conservancy projects and potential future ideas. Is it okay with you if she joins for the second half of the meeting?

Thanks,
Sarah

From: Mary Small [mailto:msmall@scc.ca.gov]
Sent: Tuesday, January 03, 2012 3:00 PM
To: Mark Gold
Subject: RE: support letter for SCC board meeting?

Thanks, the meeting is the 19th so that's the deadline. Yes, I totally understand.

I was just sending Sarah an email about possible dates I'll be in LA when I'd like to stop in ad talk about OPC, so maybe I'll see you then.

Happy new year (and MLPA implementation)
Mary

From: Mark Gold [mailto:mgold@healthebay.org]
Sent: Tuesday, January 03, 2012 2:39 PM
To: Mary Small
Subject: RE: support letter for SCC board meeting?

Mary – Happy new year to you too. We will definitely take a look at this and think it through. It is a great project and needs to happen. The political baggage that goes with it is no picnic as you know.

When is the deadline?

ATTACHMENT 8

From: jd@johnanthonydavis.com [mailto:jd@johnanthonydavis.com]
Sent: Wednesday, March 21, 2012 12:34 PM
To: "Samuel Schuchat"; "John Laird"; 'Dick Wayman'; 'Nadine Peterson'; carmenp@scc.ca.gov; kimg@resources.ca.gov
Cc: David Lawhead; John Chang
Subject: To All California Coastal Conservancy Board Members from John Davis

California Coastal Conservancy
Att: Executive Director Sam Schuchat

California Coastal Conservancy March 21, 2012

To: Governing Board and Management
Douglas Bosco
Marisa Moret
Ann Nothoff
John Laird
Susan Hancsh
Karen Finn
Bryan Cash
Noreen Evens
Joe Simitan
Anthony Cannella
Bill Mornning
Luis Alejo
Das Williams

CC
John Chang State Controller

Att: Executive Director Schuchat, Please Send This Letter to All California Coastal Conservancy Governing Board and Management.

Your Staff Attorney, Elena Eger has indicted this State Agency will not answer the fair questions I, as a member of the public asked regarding the procedures of the Conservancy.

Failure to answer such questions is contrary to the role of the State Agency to enjoin the public in the processes.

Please request that Staff respond to the questions I have asked.

Furthermore I have requested that your Staff not copy any Private Business or Individuals on responses to me as I consider it harassment and intimidation by the State Agency.

Should any such private business or individual wish to obtain such email records, such records should ONLY be provide if requests for such records are made pursuant to the Law, the California Public Records Act.

The Information Practices Act (Civil Code section 1798 et seq.) generally prohibits agencies from disclosing an individual◊s personal information to the public.

Thank you,

John Davis
PO 10152
Marina del Rey Ca. 90295

From: jd@johnanthonydavis.com [mailto:jd@johnanthonydavis.com]
Sent: Thursday, February 16, 2012 1:29 PM
To: Elena Eger
Cc: 'Mary Small'; 'Sam Schuchat'; 'Dick Wayman'; 'Shelley Luce'; svalor@santamonicabay.org
Subject: Reply from John Davis RE: Davis' Requests for Information

California Coastal Conservancy
Att: E.Eger
Re: Reply

Dear E. Eger,

The request for public records submitted on 2/14/2012 remains outstanding.

The Commission still needs to reply to this request within 10 days of the submission date. I do expect a reply by 2/24/2012 as
the Public Records Act requires under law.

I also would take issue with your recent email stating that I made a DEMAND of the Commission. This is far from true.

In fact my email stated the INTENDED PURPOSE of the email and made no demands as you stated to me in your email to me.

Prior to that, you inferred in another email that I made statements and or asserted things that I clearly did not.

I corrected you once alreadyin writing, and find I must do so yet again.

Your accuracy in characterizing my telephonic conservations or written documents should not be clouded by your misconceptions
as I do not find it to be professional in your role as a State Attorney.

Regards,

John Davis
PO 10152
Marina del Rey Ca. 90295

****

Subject: Reply from John Davis RE: PUBLIC RECORDS REQUEST FROM JOHN DAVIS
From: <jd@johnanthonydavis.com>(Add as Preferred Sender)
Date: Tue, Feb 14, 2012 2:05 pm
To: "Elena Eger" <eeger@scc.ca.gov>

California Coastal Conservancy
Att: Elana Eger Councel
Re: Reply to your communication

Counsel Eger,

Please pardon my typo in your title.

Also, I still do not understand why a State Agency would share my letter, and personal email
address with a private business, unless requested pursuant to the Public Records Act. I am not
sure what other private businesses you intend to copy on my letters to the State Agency using State facillities.

I do understand that you will continue to provide my emails to this State Agency with private businesses:

" Indeed, we will continue to share communications to you or from you with our other Ballona project partners, irrespective of whether the partner is a public or private organization, when we, at our sole discretion, determine that dissemination to be useful for our project purposes.".

How does the Coastal Conservancy define the term "partner" as used in your statement?

How, at the Coastal Conservancy, is a determination made at its sole discretion whether the dissemination
of my email to the State Agency would be useful for the Conservancy's project purposes?

What entity of the Coastal Conservancy is entitled to make such a determination and under what authority?

These are fair questions given that my letters to you have already been shared with a private business.

Thank you for your continued assistance.

John Davis
PO 10152
Marina del Rey Ca. 90295
-------- Original Message --------
Subject: RE: PUBLIC RECORDS REQUEST FROM JOHN DAVIS

From: "Elena Eger" <eeger@scc.ca.gov>
Date: Tue, February 14, 2012 12:32 pm
To: <jd@johnanthonydavis.com>
Cc: "'Mary Small'" <msmall@scc.ca.gov>, <svalor@santamonicabay.org>, "'Shelley Luce'" <sluce@santamonicabay.org>, "'Dick Wayman'" <dwayman@scc.ca.gov>

Mr. Davis:

This is in partial response to your PRA, below and your request of yesterday at 5:15 p.m. in which you demand that we not share your communications with "any private business" and in which you characterize such communications as "private".
While we will provide you with your requests to the extent possible and in compliance with the PRA, we must clarify to you that communications between you, as a member of the public, and the Conservancy, a public agency, are not considered under the PRA and thus not by the Conservancy to be "private communications", subject to any privilege or exception under the Act. Indeed, we will continue to share communications to you or from you with our other Ballona project partners, irrespective of whether the partner is a public or private organization, when we, at our sole discretion, determine that dissemination to be useful for our project purposes.
I would also like to clarify for you for your future purposes that my title is not "council" but "counsel", that is, I am a lawyer, not a member of a council.
Sincerely,

Elena Eger
Senior Staff Counsel
California Coastal Conservancy
1330 Broadway, Ste. 1300
Oakland, CA 94612
510-286-4089 tele/voicemail
510-286-0470 fax

****

From: jd@johnanthonydavis.com [mailto:jd@johnanthonydavis.com]
Sent: Tuesday, February 14, 2012 10:49 AM
To: Elena Eger
Subject: PUBLIC RECORDS REQUEST FROM JOHN DAVIS

California Coastal Conservancy
Att: Council E. Eger
Re: Public Records Request

This is a public records request made pursuant to the California Public Records Act. Each numbered item is a separate and distinct request for public records. This letter is only intended to for the California Coastal Conservancy and NOT FOR ANY PRIVATE BUSINESS, unless requested by such a business via the California Public Records Act.

1. Provide any and all emails to and received by the California Coastal Conservancy

from the following email address in regard and prior to Item 5 of the Conservancy hearing on January 19, 2012: sluce@santamonicabay.org

2. Provide any and all emails to and received by the California Coastal Conservancy from the following email address in regard and prior to Item 5 of the Conservancy hearing on January 19, 2012: svalor@santamonicabay.org

3. Provide any and all emails to and received by the California Coastal Conservancy from the following email address AFTER the Conservancy hearing on January 19, 2012: sluce@santamonicabay.org

4. Provide any and all emails to and received by the California Coastal Conservancy from the following email address AFTER the Conservancy hearing on January 19, 2012: svalor@santamonicabay.org

6. Provide any and all emails sent by the Conservancy to following email address in regard and prior to Item 5 of the Conservancy hearing on January 19, 2012: sluce@santamonicabay.org

7. Provide any and all emails sent by the Conservancy to following email address in regard and prior to Item 5 of the Conservancy hearing on January 19, 2012: svalor@santamonicabay.org

8. Provide any and all email sent by the California Coastal Conservancy to following email address in AFTER the Conservancy hearing on January 19, 2012: sluce@santamonicabay.org

9. Provide any and all email sent by the California Coastal Conservancy to following email address in AFTER the Conservancy hearing on January 19, 2012: svalor@santamonicabay.org

Thank you for your assistance,

John Davis
PO 10152
Marina del Rey Ca. 90295

-------- Original Message --------
Subject: RE: Reply from John Davis RE: Davis' Requests for Information
From: "Elena Eger" <eeger@scc.ca.gov>
Date: Thu, February 16, 2012 7:48 pm
To: <jd@johnanthonydavis.com>
Cc: "'Mary Small'" <msmall@scc.ca.gov>, "'Sam Schuchat'" <sschuchat@scc.ca.gov>, "'Dick Wayman'" <dwayman@scc.ca.gov>, "'Shelley Luce'" <sluce@santamonicabay.org>, <svalor@santamonicabay.org>

Dear Mr. Davis:

As I stated in my email of yesterday to you, we intend to comply with your records request to us of 2/14. We are working on compiling the records that you have requested. Please clarify whether you wish to receive the emails pertaining to correspondence among Mr. Valor, Ms. Luce and Conservancy staff with respect to the Item #5 on the 1-19-12 agenda only.

Please clarify that you are referring to the Conservancy when you make reference to the "Commission" in your message below.

As to your other allegations contained in your email below, I remind you that, as I said yesterday, we will make no further comment, which, of course, does not mean that we agree or disagree with your interpretations. Again, unless you are requesting a record from us under the Public Records Act, we do not intend to make further explanatory comments to you.

Sincerely,

Elena Eger
Senior Staff Counsel
California Coastal Conservancy
1330 Broadway, Ste. 1300
Oakland, CA 94612
510-286-4089 tele/voicemail
510-286-0470 fax

-------- Original Message --------
Subject: Davis' Requests for Information
From: "Elena Eger" <eeger@scc.ca.gov>
Date: Wed, February 15, 2012 6:45 pm
To: <jd@johnanthonydavis.com>
Cc: "'Mary Small'" <msmall@scc.ca.gov>, "'Sam Schuchat'" <sschuchat@scc.ca.gov>, "'Dick Wayman'" <dwayman@scc.ca.gov>, "'Shelley Luce'" <sluce@santamonicabay.org>, <svalor@santamonicabay.org>

Dear Mr. Davis:

In response to your inquiry below, I am providing you with the link to our website's contents of Item 5, Ballona Restoration Project, approved at the Conservancy's 1-19-12 public meeting unanimously. All my references are to the contents in this link. http://scc.ca.gov/webmaster/ftp/pdf/sccbb/2012/1201/20120119Board05_Ballona_Wetlands.pdf.

I believe in your message below you are referencing Exhibit 4. This record reads at the bottom of the page in the key: "Existing habitat units based on field survey conducted by the California Department of Fish and Game, October – December 2000. Map created by GreenInfo Network October 20, 2011." The Conservancy's logo is next to this statement.

With respect to the remainder of your email to us, below, except for our response to your last statement regarding the Conservancy's

dissemination of your correspondence to and with us, which we responded to in my earlier email to you of yesterday at 11:32 a.m., we wish to direct your attention to the Public Records Act (PRA), which provides the public with the mechanism to request a public record from a public agency. Additionally, we wish to direct your attention to the Ballona Restoration website, linked on our Conservancy website at www.scc.ca.gov , which among other resources, has project documents and provides a calendar of upcoming meetings, if any, where you have the opportunity to seek clarification and information regarding the restoration project.

We have cooperatively provided you with both oral and written clarifications on requests you have made to us for information or on allegations you have made that we or our project partners are violating particular laws or practices or conducting our respective project business improperly. In fact, since the Conservancy unanimously approved Item 5 for Ballona Restoration Planning, on 1-19-12, we responded to every one of your requests for records under the PRA or for explanations or to answer your allegations, which now amount to some 16 written requests to date for both information and records in the 18 business days from our 1-19-12 meeting, except for two requests for information and one request for records, received yesterday. Additionally, you have spoken by phone with six of our staff numerous times each, none of which were records requests but were rather in the nature of your seeking more information or explanation from us. Despite our willingness to provide you with explanations and/or clarifications, we continue to receive more requests for the same information from you, often accompanied by accusations of improper behavior.

In compliance with our obligations under the Public Records Act, we will continue to provide our records to you upon written request for such records. However, we will not be responding to your further requests for non-record information or explanation or to your allegations of improper business practices beyond this request, below. We cannot conduct our regular business in service of the public and continue to respond to your almost-daily and, if daily, often numerous daily requests for non-record information or to answer your allegations. Despite our willingness to provide you with explanations, clarifications and information, our good-faith responses back to you seem to be unsatisfactory to you since you follow-up often with yet another request for the same information. Continuing this "asked and answered" process seems an unproductive use of public resources.

So, with respect to your statement that DFG produced this map, please note that as cited above here, GreenInfo Network produced the map for the Conservancy and its project partners/team's use; DFG is

our restoration partner on this project. We direct you to the Conservancy's website at www.scc.ca.gov, Ballona restoration for identification of our project partners on this project.
With respect to whether DFG provided the Conservancy with permission to put our logo on this proposed restoration design, please note that the Conservancy is a project partner with DFG and that within this partnership, the Conservancy acts as the lead in restoration planning with the full agreement of the other project partners, including the DFG.
Sincerely,

Elena Eger
Senior Staff Counsel
California Coastal Conservancy
1330 Broadway, Ste. 1300
Oakland, CA 94612
510-286-4089 tele/voicemail
510-286-0470 fax

From: jd@johnanthonydavis.com [mailto:jd@johnanthonydavis.com]
Sent: Monday, February 13, 2012 5:15 PM
To: 'Elena Eger'
Cc: 'Nadine Peterson'; 'Sam Schuchat'; 'Dick Wayman'; Mary Small
Subject: RE: Davis call to Eger of 2-6-12

California Coastal Conservancy
Att: Elena Eger Legal Council
CC Mary Small Project Manager
Re: Item 5 January 19th 2012 Meeting

Hello Council Eger,

Mary Small directed me to you to answer a question about the hearing noted above.

The attached map was presented as a projection.

It bears the seal of the State Coastal Conservancy. The small text below the legend is hard to read but it
does reference the California Dpt. of Fish and Game in 2011. The text is not clear. It appears to say Ballona Wetlands units.....summary conducted the California Dpt of Fish and Game .....Map created by .....October 20, 2011.

Could you provide the correct reading of this text?

For what purpose did Fish and Game produce this map?

Did Fish and Game provide specific permission for the Conservancy to place its seal (logo) on this

map for official purposes such as for grant approvals?

I understand the Conservancy is a partner of Fish and Game in the Ballona preserve.

However it is unclear if Fish and Game authorized the use of this map for purposes of another Agency
to consider in its grant process.

Please DO NOT CC ANY PRIVATE BUSINESSES ON MY E-Mail COMMUNICATIONS anymore. This is met
to be a private communication between myself and the State Agency, and not to be shared with any private
business, whatsoever.

Again,

Thank you for your assistance,

John Davis
PO 10152
Marina del Rey Ca. 90045

From:	Mary Small
To:	"Elena Eger"
Cc:	"Scott Valor"
Subject:	FW: State Water Board Legal"s Memo to our Governing Board
Date:	Monday, February 06, 2012 4:47:02 PM
Attachments:	SWRCB memo2011aug re accusations.pdf SWRCB Ltr to Davis re PRAs.pdf

Hi Elena

Scott Valor emailed this to you but he had the wrong address.

Mary

From: Scott Valor [mailto:svalor@santamonicabay.org]
Sent: Monday, February 06, 2012 3:42 PM
To: msmall@scc.ca.gov; eeeger@scc.ca.gov
Subject: State Water Board Legal's Memo to our Governing Board

Mary & Elena--

The attached memo to our Governing Board may help with some background. It was not only given to our Governing Board, it is posted on our website, and was forwarded to John Davis and Patricia McPherson, among others. It addresses virtually all of the accusations made against the Foundation and Commission.

Attached also is a direct letter to John Davis from SWRCB legal noting how Foundation staff and contractors legally serve the SMBRC. For example, I am a contractor to the Foundation, but I am authorized to act on behalf of the Commission. He refuses to acknowledge that, which will never change. However, the documents speak for themselves.

One reason he may be contacting you (again) is that SWRCB legal told him that any future PRA queries to the Commission must be directed to me. He simply won't do that so he seeks ways around it. It would be entirely appropriate for you to re-direct any queries relevant to the SMBRC to me.

Call me if/when questions arise.

/s

Scott Valor
Director of Government Affairs
Santa Monica Bay Restoration Commission
310-922-2376

visit us at www.smbrc.ca.gov

State Lands Commission owns approximately 60 acres, including the Freshwater Marsh and the Expanded Wetlands parcel. The State Coastal Conservancy (SCC) is taking the lead in funding for planning and restoring the property. Together, the three agencies are working with stakeholders, scientific experts and other agencies to develop a plan for restoration of this extraordinary resource. Their goals are to:

- Restore and enhance salt-water influenced wetland habitats to benefit endangered and threatened species, migratory shorebirds, waterfowl, seabirds, and coastal fish and aquatic species. Restoration of seasonal ponds, riparian and freshwater wetlands, and upland habitats will be considered where beneficial to other project goals or biological and habitat diversity;

- Provide for wildlife-dependent public access and recreation opportunities compatible with the habitats, fish, and wildlife conservation;

- Identify and implement a cost-effective, ecologically beneficial, and sustainable (low maintenance) habitat restoration alternative.

Milestone 7.1c: Secure funding source (approximately $50 million, total project cost $100–200 million) sufficient to complete first phase implementation of preferred alternative by 2010.

Implementation Lead: Coastal Conservancy
Implementation Partners: State Parks, SCWRP, NMFS

Role of the SMBRC: Participate

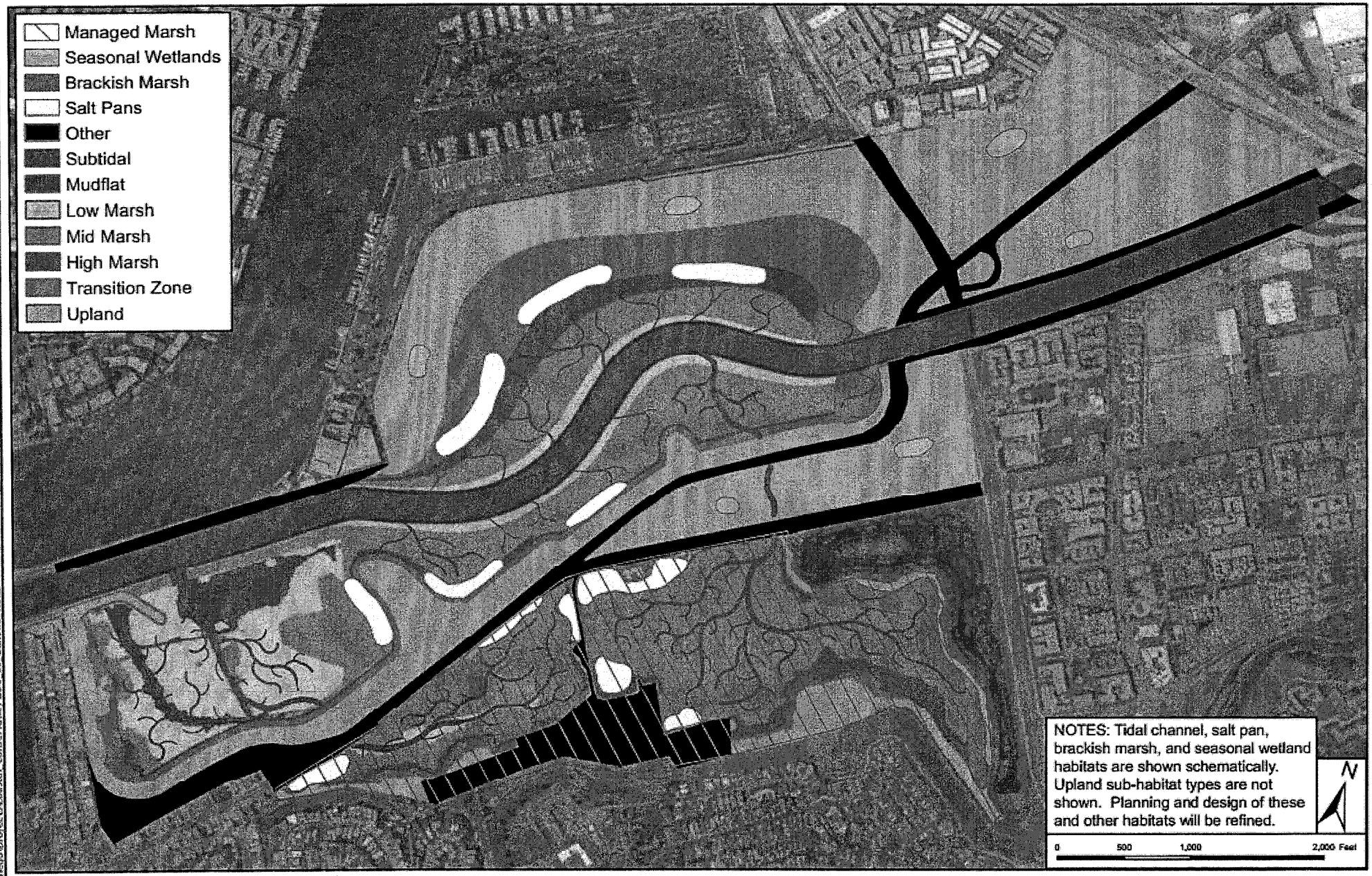


On Fri, Sep 28, 2012 at 2:52 PM, Johntommy Rosas

Bay watershed ecosystem and their preservation and restoration is a high priority of the Bay Restoration Commission. Wetlands are areas of transition between land and water, where soils, plants, and animals are adapted to periods of inundation and saturation. Wetlands are one of the most productive ecosystems in nature, providing essential habitat for a variety of species, including birds, fish, reptiles, invertebrates, and mammals. Wetlands act as natural filters which are able to absorb and remove pollutants from the water. They are also valuable in providing flood protection, groundwater recharge, recreational use, and aesthetic

channelization of Ballona Creek have all reduced what was once a 2,200-acre coastal estuary to less than 200 degraded acres today. Poor tidal exchange, polluted runoff, and invasive plants and animals also impact the wetlands.

In 2004, the State of California took title to 600 acres of the former Ballona Wetlands in Los Angeles. The property is now owned by two state agencies, the Department of Fish and Game (DFG) and the State Lands Commission (CSLC). DFG took title to approximately 540 acres of the former wetlands. DFG also holds title to a section of Ballona Creek. The



Source: ESA PWA

PSOMAS

Balancing the Natural and Built Environment

PSOMAS WORK PLAN

BALLONA WETLANDS RESTORATION

Prepared for

California State Coastal Conservancy
1330 Broadway, 13th Floor
Oakland, California 94612

Prepared by:

PSOMAS
555 South Flower Street, Suite 4400
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Project Number 1CCC0101.00

June 22, 2012

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SECTION I

INTRODUCTION

Project Understanding

Psomas has unmatched technical engineering knowledge of the Ballona Wetlands that spans 25 years. No other firm has been involved or has more engineering knowledge of the wetlands and its surroundings than Psomas. We have extensive knowledge of the infrastructure of the surrounding community as well as The Gas Company facilities throughout the area as a result of our extensive previous work in the community surrounding the Ballona Wetlands. This extensive historical knowledge, has provided us with unique insight and understanding of the opportunities for the restoration plan and the Conservancy's goals for this project.

The State Coastal Conservancy through the PMT team has developed a conceptual plan to restore the Ballona Wetlands ecosystem. It will comprise diverse habitat ranging from sub-tidal through various marshland conditions to upland habitat. The objective of this restoration program is to reintroduce and revive critical wetland habitat and provide a remarkable natural open space for the public benefit. The Ballona Wetlands Restoration Project will enhance the coastal environment for reintroduction of target animal and plant species that left the area because of human development and related loss of the coastal wetland.

The existing Ballona Wetlands have suffered from more than a century of human neglect and abuse that has resulted in a highly degraded habitat area. Much of the area was used for disposal of dredging spoils from construction of Marina Del Rey and the Ballona Creek flood control channel. The Ballona Creek flood control channel was constructed to provide flooding protection for development of lands upstream from the original wetlands; however, the channel also severed the historic natural connection between the freshwater creek and the ocean. As a result, many of the historic ecological functions of the wetlands were lost and no longer support the wide variety of native species that once inhabited the area.

The PMT and their consultant team have studied several alternatives that would allow the reconstruction of a coastal wetland environment and reintroduction of the native species common to these wetlands. While a number of alternatives have been analyzed, a preferred alternative has been developed that involves the removal of segments of the Ballona Creek levees and the reconstruction of a portion of the Ballona Creek channel on an alignment that more closely represents a natural meandering water course. Implementation of this plan will require a technical analysis and review and approval by the County of Los Angeles and U.S. Army Corps of Engineers (USACE) with a Section 408 permit.

More specifically, the preferred project proposes to implement restoration of areas on the north and south sides of the existing Ballona Creek on lands adjacent to Marina Del Rey within Los Angeles County (County) Area A and City of Los Angeles Area B, as well as some restoration in Area C in the City of Los Angeles. This work will generally include:

- Build in flexibility of delivery to address availability of funding. Staged or phased delivery through master planning the construction sequencing.
- The removal of the north and south Ballona Creek levees to allow tidal and stormwater interaction within the Ballona Wetlands Ecological Reserve area.

- Construction of new perimeter levees along the perimeter and strategic alignments within the restoration area to provide the flood protection of existing developed areas when the existing levees are removed.
- Grading to create a restored condition allowing multiple habitat regimes from sub-tidal to upland conditions.
- Execute the proposed construction through a master planned and phased program designed to reduce the environmental impacts as much as possible, balancing earthwork within the Reserve area.
- Assist the PMT in coordinating with and addressing the concerns of the many governmental agencies and other interested parties.

Project Objectives

Consistent with the Conservancy's stated goals, our project team's approach will be driven by the following three primary objectives and secondary objectives for the Civil/Geotechnical team:

Primary Objectives:

- Working with the PMT and Hydrology consultant team, obtain Section 408 approval from the USACE for the levee removal and its supporting analysis.
- Analyze impacts and mitigations for incorporation into the environmental analysis.
- Prepare plans and supporting documents for the grading and infrastructure at the appropriate level for the restoration project.

Secondary Objectives:

- Assist the PMT in obtaining approvals in the most efficient and effective manner. The process to obtain a 408 approval is by design not clearly defined to allow for the many existing conditions in USACE facilities.
- Assist the PMT in addressing the issues and concerns of the community and interested parties. Many groups and agencies are interested in this restoration. They each view it in different terms. Our goal is to provide information and support that is appropriately tailored for public presentation of our technical information in a non-technical manner.
- Ensure that the proposed design elements are sensitive to the environmental goals of the project. The overarching goal of restoring a natural wetland system must be the primary focus in our design.

EXHIBIT 11

Playa Capital Company, LLC

Soil and Groundwater Remediation Plan – Campus Area

June 7, 2002

Prepared for:

Playa Capital Company, LLC
12555 West Jefferson Boulevard, Suite 300
Los Angeles, California 90666

Prepared by:

CDM
18881 Von Karman Avenue, Suite 650
Irvine, California 92612

Project No. 10610-32615-RT.SCM

Signatures

The information contained in this Soil and Groundwater Remediation Plan - Campus Area, dated June 7, 2002 has received appropriate technical review and approval. The conclusions and recommendations presented represent professional judgments and are based upon findings from the investigation identified in the report and the interpretation of such data based on our experience and background. This acknowledgment is made in lieu of all warranties, either expressed or implied.

Reviewed and Approved by:

David C. Chamberlin Senior Vice President	William J. Weaver, R.G., 6738 Project Manager/Geologist
Jay Accashian Project Engineer	John Eisenbeis, Ph.D. Senior Scientist

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List of Acronyms

1,1,1-TCA	1,1,1-Trichloroethane
1,1,2-TCA	1,1,2-Trichloroethane
1,1-DCA	1,1-Dichloroethane
1,1-DCE	1,1-Dichloroethene
1,2-DCA	1,2-Dichloroethane
1,4-DCB	1,4-Dichlorobenzene
ASTM	American Society for Testing and Materials
B&C	Brown and Caldwell
bgs	Below Ground Surface
BTEX	Benzene, Toluene, Ethyl Benzene, and Xylene
CA	Chloroethane
CaCR	California Code of Regulations
Cal/EPA	California Environmental Protection Agency
CAM	California Assessment Manual
CAO	Cleanup and Abatement Order
CC&Rs	Covenants, Conditions, and Restrictions
CDM	Camp Dresser & McKee Inc.
CEM	Conceptual Exposure Model
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cis-1,2-DCE	Cis-1,2-Dichloroethene
CLA	Chief Legislative Analyst
COCs	Chemicals of Concern

COPCs	Chemicals of Potential Concern
DBS	Department of Building and Safety
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
DPE	Dual Phase Extraction
DTSC	Department of Toxic Substances Control
DWR	Department of Water Resources
EAB	Enhanced Anaerobic Bioremediation
EEC	Environmental Engineers and Contractors
ENSR	ENSR Consulting and Engineering
ft bgs	Feet Below Ground Surface
ft^2	Square Feet
ft/day	Feet per Day
GAC	Granular Activated Carbon
Geomatrix	Geomatrix Consultants
gpd/ft	Gallons per Day per Foot
gpm	Gallons per Minute
GSI	Groundwater Services Inc.
H_2S	Hydrogen Sulfide
HA	Hargis & Associates
HASP	Health and Safety Plan
HBRGs	Health-Based Remediation Goals
IESI	Integrated Environmental Services, Inc.
IR	Infrared Spectrometer
LNAPL	Light Non-Aqueous Phase Liquid

LSRTs	Lower Soil Remediation Triggers
MC	Methylene Chloride
MCL	Maximum Contaminant Levels
MCP	Monitoring and Contingency Plan
mg/kg	Milligram per Kilogram
mg/L	Milligrams per Liter
mg/m3	Milligrams per Cubic Meter
µg/(m²/min)	Micrograms per Square Meter per Minute
MNA	Monitored Natural Attenuation
MSL	Mean Sea Level
NCP	National Contingency Plan
NFA	No Further Action
NPDES	National Pollution Discharge Elimination System
O&M	Operation and Maintenance
OEHHA	Office of Environmental Health Hazard Assessment
OM&M	Operation, Maintenance & Monitoring
OSHA	Occupational Health & Safety Administration
PCA	Tetrachloroethane
PCBs	Polychlorinated Biphenyls
PCC	Playa Capital Company, LLC; Playa Phase I Commercial Land Company, LLC; and affiliate companies
PCE	Tetrachloroethene
PID	Photo-Ionization Detector
POTW	Public Owned Treatment Works
PPE	Personal Protective Equipment

ppmv	Parts per Million by Volume
PRGs	Preliminary Remediation Goals
PVC	Polyvinyl Chloride
RA	Remedial Action
RBCA	Risk-Based Corrective Action
RD	Remedial Design
RGs	Remedial Goals
RME	Reasonable Maximum Exposure
ROs	Remedial Objectives
RP	Remediation Plan
RWQCB	Regional Water Quality Control Board
SAs	Source Areas
SCAQMD	South Coast Air Quality Management District
SCM	Site Conceptual Model
SECOR	Secor International Incorporated
SGI1	*Soil and Groundwater Investigation Report, Former Dream Works Project Area, Playa Vista Site*
SGI2	*Soil and Groundwater Investigation Phase 1 Project (Excluding Former Dream Work Project) Report*
SRTs	Soil Remediation Triggers
SVE	Soil Vapor Extraction
SVOCs	Semi-Volatile Organic Compounds
SWMP	Storm Water Management Plan
TCE	Trichloroethene
TDS	Total Dissolved Solids
TPH	Total Petroleum Hydrocarbons

trans-1,2-DCE	Trans-1,2-Dichloroethene
TRPH	Total Recoverable Petroleum Hydrocarbons
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
USRTs	Upper Soil Remediation Triggers
UST	Underground Storage Tanks
UV	Ultraviolet
VC	Vinyl Chloride
VOCs	Volatile Organic Compounds
WTP	Water Treatment Plant
ZOI	Zone of Influence

Section1
Introduction

Playa Capital Company, LLC; Playa Phase 1 Commercial Land Company, LLC; and affiliate companies (collectively "PCC") are developing a large tract of land (Playa Vista) north of Los Angeles International Airport for residential, commercial, community serving, and wildlife habitat uses (herein referred to as the "Site"). As part of this development, residual chemical contamination from past industrial operations and other land-use activities at the site is being investigated and remediated, as necessary. Camp Dresser & McKee Inc. (CDM) has prepared this Soil and Groundwater Remediation Plan (RP) on behalf of PCC to address contaminants of concern in soil and groundwater present within the Campus Area portion of the proposed development, which is planned for commercial land use. This document is submitted in response to Cleanup and Abatement Order No. 98-125 (CAO, attached as Appendix A), issued by the California Regional Water Quality Control Board, Los Angeles Region (RWQCB), in December 1998. The CAO directs PCC to initiate a phased cleanup and abatement program that addresses discharges of contaminants into soil and groundwater from historical land use and former manufacturing operations.

1.1 Purpose and Organization of Report

The purpose of this RP is to develop, evaluate, and select potential remedial alternatives to address soil and groundwater impacted with contaminants of concern in the Campus Area of the Site and to propose remedial actions for soil and groundwater contamination in each source area. The report is organized into ten separate sections. A brief description of each section is provided below:

The remainder of Section 1 provides a summary of the approach to remediation in the Campus Area along with the regulatory context for remedial activities, which is the framework for remediation activities described in this RP.

Section 2, *Site Characteristics*, provides a brief description of the Site history, historical investigations and operations, and regional and Site-specific geology and hydrogeology.

Section 3, *Remedial Objectives and Goals*, provides a discussion of media-specific Remedial Objectives (ROs) and Remedial Goals (RGs) applicable to a list of Chemicals of Potential Concern (COPCs) for the purposes of protecting human health and groundwater quality in the Campus Area. This section also evaluates the list of COPCs to identify specific chemicals of concern (COCs) and source areas.

Section 4, *Known Nature and Extent of Contamination*, provides a brief summary of the nature, extent, and fate and transport of contamination is provided in this section, along with the distribution of COCs in soil and groundwater. Finally, nine source

areas are identified based on a comparison of historical COPC concentrations in soil and groundwater contamination data with RGs described in Section 3.

Section 5, *Identification of Remedial Technologies and Process Options*, covers the first step in the remedial alternative evaluation process, namely the identification of response actions, potential remedial technologies and process options capable of meeting the ROs.

Section 6, *Development of Remedial Alternatives*, develops a series of remedial alternatives from an array of the retained general response actions, remedial technologies, and process options identified in Section 5. A conceptual-level description of each remedial alternative is provided.

Section 7, *Evaluation of Remedial Alternatives*, evaluates each remedial action alternative in relation to the seven evaluation criteria established in the National Contingency Plan (NCP) (40 CFR Part 300.430). Although the Site does not fall under the jurisdiction of the NCP, the seven evaluation criteria were chosen for this section to ensure a complete and comprehensive evaluation of each remedial alternative. The recommended remedial alternative is highlighted at the end of this section.

Section 8, *Proposed Remedial Action*, provides an overview of the proposed remedial actions for soil and groundwater in each source area. The overview is followed by detailed descriptions of the proposed remedial action for the nine source areas. Finally, the section presents a remedial implementation plan that outlines the phases of implementation for the proposed remedial actions to achieve optimal effectiveness.

Section 9, *Monitoring and Contingency Plan*, provides the basis for a Monitoring and Contingency Plan that will be prepared following remedial design activities and prior to remedial action implementation.

Finally, Section 10 provides a reference list of sources used in preparing this document.

1.2 Overview of Approach to Remediation and Mitigation

Investigation and characterization of contamination in the Campus Area at Playa Vista has been the subject of numerous reports prepared during the past nearly twenty years. This section briefly summarizes how those past efforts relate to this RP, and outlines the strategies, methods, and goals of Site cleanup developed in those documents to set the context for the detailed discussion of remediation for soil, groundwater, and soil gas contamination set out in this RP for the Campus Area portion of the Site development.

1.2.1 The Playa Vista Site Development

The Site, located in western Los Angeles, encompasses 1,087 acres of land north of the Los Angeles International Airport and just south of the community of Marina del Rey (Figure 1-1, *Site Location Map*). The Site is divided into four planning areas identified as Areas A, B, C, and D (Figure 1-1).

The Site is being developed in two phases. The Phase 1 Development Area (parts of Area D and the freshwater marsh in Area B) is fully entitled and is under construction. The easterly-most portion of the Phase 1 Development Area, known as the Campus Area, is planned for mixed-use commercial development. As discussed below, this portion of the Phase 1 development includes areas where Hughes Aircraft Company and other industrial operations were once located (Figure 1-2, *Area D Features Map*). Residential development and a limited amount of mixed-use commercial development will also occur at the westerly end of the Phase 1 Development Area (i.e., western portion of Area D).

The Campus Area consists of approximately 114 acres of Area D that were used from the 1940s to the 1990s by the former Hughes Aircraft Company and the former McDonnell Douglas Helicopter Company for the manufacture, research, development and testing of electronics, aircraft, and other equipment[1]. Historically, structures, asphalt pavement, aircraft taxiways, and a runway covered approximately 80 percent of the Campus Area.

The types of chemicals historically used by Hughes Aircraft Company and other industrial operators in the Campus Area included VOCs and semi-volatile organic compounds (SVOCs), petroleum hydrocarbons, metals, pesticides, and polychlorinated biphenyls (PCBs). Based on reviews of industrial records, interviews of former employees, and extensive sampling of the property, it was determined that some of these chemicals were either stored and/or used in the Campus Area in locations of previous industrial activity, such as a former drum storage area, former underground storage tanks, several clarifiers, utility trenches, former degreaser area, sumps and a former storm drain discharge. Investigations of these locations have revealed several areas of environmental concern in the Campus Area, which this RP intends to address.

Additionally, the City of Los Angeles Office of the Chief Legislative Analyst (CLA, 2001), with input from independent consultants and various City departments and State agencies, issued a report in May 2001 that investigated the potential public health and safety impacts, and appropriate mitigations if any, associated with naturally-occurring compounds and other environmental conditions in portions of the Phase 1 Development Area of the Site (see Figure 1-2). The CLA report addressed soil

[1] The Campus Area consists of Tracts 49104-04 and 52092

gas (methane, hydrogen sulfide (H_2S), and benzene, toluene, ethyl benzene, xylene (BTEX)), subsidence, and earthquake fault impacts. Specifically, the study addressed five primary questions, which are presented below along with a summary of the CLA findings:

1. Is the Southern California Gas Company Playa Del Rey Gas Storage Facility located in the adjacent Playa Del Rey area leaking and, therefore, a source of the methane observed at the Site and a risk to workers and future residents?

   The CLA concluded the gas storage facility is not the source of methane observed at the Site; there is no evidence to suggest the storage facility is leaking or improperly maintained; and there is no evidence that the gas storage facility presents a danger to workers or future residents at the Site.

2. Is the extent of the methane observed at the Site fully defined and can it be mitigated?

   The CLA concluded the numerous extensive studies of methane concentrations "yielded a data set that is more than adequate for the assessment of potential methane hazards and for the design of appropriate mitigation measures." Further, the report recommended that a methane mitigation system be implemented to prevent, detect, and monitor the presence of methane for future development (CLA, 2001, Table 2-1). The report noted that mitigation measures would vary depending upon the concentration of methane present.

3. Is there significant subsidence at the Site currently, or will future methane mitigation cause subsidence issues that may undermine the structural integrity of future building structures?

   The CLA concluded that "no significant or clearly defined trend of increased subsidence" was observed in the vicinity of the Site. The report noted that a minimal level of settlement and uplift was observed, however, design measures are adequate to address such occurrences. Further, the report concluded that there is no evidence the proposed methane mitigation measures would result in increased potential for subsidence in the area.

4. Is there an active earthquake fault at the Site that presents an unacceptable risk to workers and future residents?

   The CLA concluded that the geologic and geophysical data do not support the existence of the postulated Lincoln Boulevard fault. In addition, the CLA report also noted that the Division of Geology and Mines was reviewing offshore seismic data to ascertain if observed

anomalies were indicative of offshore faults.[2] Subsequent to the issuance of the CLA report, the City of Los Angeles Planning and Land Use Management Committee issued a statement on behalf of the Division of Geology and Mines that there are several plausible explanations for the anomalies, and "it appears that the anomalies could be associated with depositional features characteristic of stream channels."

5. Is there BTEX and H_2S contamination associated with the methane that presents a health risk to workers and future residents?

   The CLA concluded the potential health risks associated with BTEX and H_2S soil gas emissions are below the benchmarks established by the U.S. Environmental Protection Agency (USEPA), Department of Toxic Substances Control (DTSC), Office of Environmental Health Hazard Assessment (OEHHA) and other regulatory agencies to indicate insignificant risk, and therefore no further investigation or remediation is warranted.

PCC and other developers at the Site will implement appropriate methane mitigation measures at new buildings in the Phase 1 Development Area, including those proposed in the Campus Area in accordance with City of Los Angeles building codes.

1.2.2 The Regulatory Process for the Site

The California Environmental Protection Agency (Cal/EPA) has designated the RWQCB as the lead agency for the Site. A copy of the letter reporting that designation is included in Appendix B.

The RWQCB has provided oversight for remedial activities at the Site since the 1980s, and in 1998 issued a CAO, which directs PCC to address discharges of contaminants into soil and groundwater from past industrial operations at the Site (RWQCB, 1998). Specifically, the CAO defines several requirements: to implement free product recovery, to monitor groundwater on a quarterly basis, and to design and implement appropriate soil and groundwater remediation.

To achieve these goals, PCC conducted a Site-wide soil and groundwater assessment to supplement previous studies and to better define the nature and extent of contamination. PCC submitted to the RWQCB a Soil Remedial Action Plan (SRAP) addressing portions of the Campus Area (CDM, 1999a), later extended to the entire Phase 1 Development Area (PCC, 2000), and a Groundwater Treatment System Evaluation (IESI, 1999a). Both documents recommended additional activities in order to finalize soil and groundwater remediation plans (see Appendix A). Under the oversight of the RWQCB, PCC performed these additional activities for the Campus

[2] These anomalies were observed approximately ½ mile west and ¼ north of the sites.

Area. Using these results, this RP addresses areas of concern within the Campus Area that require further remediation.

1.2.3 General Approach For Addressing Environmental Contamination

PCC has developed both a risk-based and resource-protection approach to the investigation and remediation of contamination for the Site development, based on several important principles:

- PCC will address chemical contamination that presents human health risks at the Site in a conservative fashion. Where uncertainty is present, PCC remediation will base it's decisions in favor of public health protection;
- During remediation, PCC will address potentially complete human exposure pathways (i.e., ways in which exposure may occur as opposed to purely hypothetical exposure pathways) as its first priority. PCC will also implement mitigation measures to prevent or reduce, as appropriate, potential exposures that may occur while remediation is underway;
- PCC will also work to protect resources (e.g., groundwater), even though no direct human exposure to contaminants in this water is likely now or in the foreseeable future[3];
- PCC will employ an approach to Site cleanup that addresses the needs and concerns of all involved regulatory agencies.

PCC's general approach to addressing contaminated areas of the Site is outlined in the flow diagram in Figure 1-3, *Summary of Approach to Remediation for the Phase 1 Site Development.*

In support of this approach, various numerical remediation goals or triggers have been developed in a series of stand-alone documents. Particularly important are the Site-specific health-based remediation goals (HBRGs) and soil remediation triggers (SRTs). The documents in which they have been developed, and the relationship of those documents to other environmental reports for the Site, are shown in Figure 1-4, *Flow of Information Among Playa Vista Environmental Reports.*

1.2.3.1 Health-Based Remediation Goals

Remediation has been completed for most areas of the Site where chemical releases had been identified. However, residual contamination is still present in some areas and this RP evaluates whether further remediation is needed to protect human health. Initially, for purposes of identifying residual contamination that would require

[3] Presently, groundwater at the Site, which is of poor quality due to high TDS, sulfate, and chloride levels unrelated to Site activities, is not used as a source of drinking water. Prospectively, the Covenants, Conditions, and Restrictions (CC&Rs) adopted for the Site will prohibit use of groundwater for such purposes.

remediation, PCC considered comparing contaminant levels with the relevant PRGs developed by the USEPA. (PRGs are non-Site-specific quantitative levels for contaminants expected to be protective of human health). However, USEPA developed these PRGs without consideration of indoor air exposures, which is the primary exposure pathway at the Site. Additionally, EPA's PRGs assume certain site conditions, not all of which exist at the Site.

For these and other reasons, PCC developed its own media-specific HBRGs. HBRGs are concentrations of chemical contaminants in soil, groundwater, and soil gas that will protect the public from unacceptable exposures to these chemicals at the Site. Calculating these concentrations involves, in general terms, deciding how people might be exposed to Site contaminants, and then establishing levels of these contaminants that are sufficiently low to ensure that exposures would not represent threats to human health. The methodology for calculating HBRGs is the subject of considerable Cal/EPA and USEPA guidance. This guidance was followed in developing the HBRGs.

The PCC-developed HBRGs take into account the indoor air exposure pathway and other specific Site conditions (IESI, 2000; 2001a) using standard risk assessment methods, and are designed to assist PCC in identifying contaminated areas and environmental media (soil, groundwater, and soil gas) that would need to be addressed during remediation to ensure the protection of human health. Additional details regarding the development of HBRGs that are applicable to the Campus Area remediation are presented in Section 3.

1.2.3.2 Soil Remediation Triggers

PCC developed SRTs to identify soil contamination requiring remediation to protect shallow groundwater as a resource (IESI, 2001b). SRTs are concentrations of chemical contaminants in soil that will protect shallow groundwater resources at the Site. These values are based on protecting groundwater resources, not on potential human health risk. Calculating these concentrations involves, in general, establishing how leachable COPCs in soil could migrate to groundwater, quantifying this migration, and then determining levels of such COPCs in soil that are sufficiently low to ensure that concentrations of COPCs in groundwater will not exceed acceptable levels.

SRTs were developed for both the upper (USRTs) and lower strata (LSRTs) in the shallow hydrologic zone to address the very different geological conditions of these units. Additional details regarding the development of SRTs that are applicable to the Campus Area remediation are presented in Section 3.

1.2.3.3 Application of HBRGs and SRTs in Campus Area Remediation

In this RP, HBRGs and SRTs are used to identify and prioritize areas in the Campus Area that require remediation. Essentially, they are remediation triggers; these

numerical goals may not be the final cleanup criteria. The RWQCB will determine final cleanup goals.[4]

Identifying areas where remediation is potentially required is based on exceedances of HBRGs, SRTs, and/or protection goals. Appropriate remediation technologies to address these areas are then designed and implemented. This process is discussed in more detail in Section 8.

Specific remedial technologies comprising the recommended remedial action will be implemented within each source area based on a comparison of source area-specific soil and groundwater contamination with appropriate HBRGs, SRTs, and other resource protection goals. The decision process is complex because, in some cases, remediation in one medium (e.g., groundwater) will address contamination in another medium. In such cases, it may not be necessary to apply a full suite of remedial technologies for both soil and groundwater contamination. Where remediation in one medium (e.g., groundwater) will address contamination in another (e.g., soil), the proposed remediation is limited to the most appropriate media and justification for such action is provided.

Remedial efforts for the Campus Area, especially for groundwater, may require relatively long periods of time to complete. In order for development of the Campus Area to proceed concurrently with implementation of the remedial measures identified in this RP, additional mitigation of potential human exposures may be necessary to ensure protection of human health prior to completion of remedial activities. This mitigation will take several forms. During construction, worker health and safety will be addressed through the existing *Construction Safety Standards* that cover the Site. In addition, certain engineered and institutional controls may be implemented as part of construction and development activities. Engineered and institutional controls may include vapor intrusion barriers and certain land use restrictions designed to restrict potential uses and activities within the Campus Area once construction and implementation of all components of the remedial alternative are completed. These mitigation measures would remain in affect as long as necessary.

[4] The process of determining final cleanup levels will consider, as appropriate, a number of factors, including, for example, a comparison of residual contaminant levels to HBRGs, PRGs, SRTs and other resource protection goals; a post-remediation cumulative risk assessment; and the technical feasibility of achieving greater contamination reduction.

Section2
Site Characteristics

This section sets out the current understanding of the known or suspected contaminant source(s), the known lateral extent of impacts to groundwater, soil, and soil gas, and the vertical extent of impacts to groundwater, as compiled from previous investigation reports. This section also discusses the potential fate and transport mechanisms affecting the observed contaminants. Specifically, this section presents the current understanding of contaminant mass; groundwater flow directions and velocities; contaminant phase distribution and partitioning between soil, groundwater, and soil gas; mechanisms of biotic and abiotic contaminant transformation; and the current understanding of the temporal variability of such processes.

The data and information presented in this section are important in identifying remedial options capable of addressing COPCs within the Campus Area. This information is also relevant to the development of ROs discussed in Section 3.

The site-specific information presented in this section includes:

- A description of the Campus Area and historical operations;
- A summary of historical investigations at this location;
- An interpretation of Site geology and hydrogeology with respect to subsurface contaminant transport; and
- A conceptual understanding of the fate and transport of dissolved phase contaminants and natural attenuation mechanisms including advection, dispersion, matrix diffusion, sorption, volatilization, and biotic or abiotic transformation.

2.1 Site Description

This Remediation Plan is limited to areas of concern within the Campus Area of the Site (Figure 2-1, *Project Location Map),* which lies within the eastern region of the Area D planning area.

The Campus Area consists of approximately 114 acres of Area D that were used from the 1940s to the 1990s by the former Hughes Aircraft Company and the former McDonnell Douglas Helicopter Company for the manufacture, research, development and testing of electronics, aircraft, and other equipment.

Historically, aircraft manufacturing, metal plating, machining, painting, ordnance development and manufacturing, aircraft cleaning and maintenance, aircraft testing, and aerospace research were conducted at the Campus Area. During such

operations, structures, asphalt pavement, aircraft taxiways, and a runway covered approximately 80 percent of the Campus Area (McLaren Environmental Engineering, [MEE], 1987a, b).

As part of the historical operations, numerous chemicals were used for industrial activities. MEE indicated the following compounds were stored and handled at the Campus Area: VOCs, SVOCs, total petroleum hydrocarbons (TPH), metals, pesticides, and PCBs (MEE, 1987a).

More recently, mass grading, decommissioning of building structures, and construction of underground utilities and roadways has occurred within the Campus Area. These activities are ongoing and will be carefully coordinated with the remediation activities proposed in this RP.

2.2 Historical Investigations

Investigation and remediation of the Campus Area has been ongoing since 1983. These activities and results are described in numerous reports and documents.[5]

The compounds historically detected in Campus Area soil and groundwater include VOCs, phenol, metals, PCBs, TPH, and pesticides. Light non-aqueous phase liquid (LNAPL) hydrocarbons continue to be encountered west of Building 11, in the form of a hydrocarbon sheen. A summary of groundwater data collected within the Campus Area since the issuance of the CAO in 1998 is attached as Appendix C. A summary table of historical soil investigations conducted within the Campus Area is attached as Appendix D.

Unrelated to past human activities at the Site, naturally-occurring methane, H_2S, and associated naturally-occurring hydrocarbons are also present in the subsurface in many locations throughout the Site. The findings of the *Report of Sampling and Analysis of Soil Gas for Methane within Eastern Portion of Area D at Playa Vista* (CDM, 2001a) indicate that methane concentrations in the Campus Area are among the lowest detected throughout the Site (CLA, 2001).

2.2.1 Distribution of VOCs in Subsurface

The most recent, comprehensive summaries of soil data collected during the historical investigations are provided in reports prepared by CDM and EEC. Findings of these investigations indicated that chlorinated VOCs (primarily 1,1-Dichloroethene [1,1-DCE], 1,1-Dichloroethane [1,1-DCA], cis-1,2-Dichloroethene [cis-1,2-DCE], and Trichloroethene [TCE]) and fuel hydrocarbons were found in a limited number of soil samples. In August and September 1999, CDM conducted a soil and groundwater

[5] Refer to Aqua Science Engineers, Inc. 1996; Brown and Caldwell (B&C), 1998a, 1998b, 1999a, 1999b, CDM, 1999a, 1999b, 1999c, 1999d; 2000a, 2000b; Environmental Engineering & Contracting Services (EEC), 2001a, 2001b, 2001c, 2001d; ENSR Consulting and Engineering, 1997; Geomatrix Consultants, Inc. 2001; Integrated Environmental Services, Inc. (IESI), 1999a, 2000, 2001a, 2001b, 2001c, 2001d, 2001e, 2001f, 2001g; MEE 1987a, 1989a. References for these and other relevant reports are provided in Section 10.

investigation of a portion of the Campus Area. A total of 60 soil borings were advanced and samples collected at depths of approximately 6 and 12 feet below ground surface (ft bgs); six of the borings were advanced to the water table. Results of the investigation were presented in the *Soil and Groundwater Investigation Report, Former Dream Works Project Area, Playa Vista Site (SGI1)* (CDM, 2000a). In December 1999 and January 2000, CDM conducted an additional soil and groundwater investigation in the balance of the Phase I project area, including the remainder of the Campus Area. The investigation included 61 soil borings. The results of the investigation were summarized in the *Soil and Groundwater Investigation Phase 1 Project (Excluding Former Dream Works Project) Report (SGI2)* (CDM, 2000b). Finally, EEC conducted several investigations and soil excavation activities in the Campus Area from March through October, 2001 (EEC, 2001a, 2001b, 2001c, 2001d). The results from these activities are provided in Appendix F.

In accordance with the provisions of the CAO, sampling of groundwater monitoring wells has been performed quarterly since March 1999. Results of the most recent quarterly groundwater sampling, which provide groundwater data from 62 groundwater monitoring wells throughout the Campus Area, were presented in the *First Quarter 2002 Groundwater Monitoring and Progress Report* (CDM, 2002). These data represent the most recent, comprehensive summaries of groundwater data collected in the Campus Area. The chlorinated VOCs that were detected in Campus Area groundwater samples most frequently and at the highest concentrations include the following: Tetrachloroethene (PCE), TCE, 1,1-DCE, 1,1-DCA, cis- and trans-1,2-DCE and Vinyl Chloride (VC).

A VOC groundwater summary concentration map for the Campus Area, summarizing detected chlorinated and non-chlorinated organic compounds from the first quarter 2002 analytical results is provided as Figure 2-2, *First Quarter 2002 Groundwater Sampling VOC Concentration Summary Map.* These data are also provided in Appendix C (Tables C-2 through C-13), along with groundwater monitoring well construction details, analytical testing methods and sample holding times, quality control samples, and other relevant data presented previously in the *First Quarter 2002 Groundwater Monitoring and Progress Report* (CDM, 2002).

Separate VOC groundwater plume contour maps are provided for 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, VC, and 1,1-DCA for each impacted water bearing zone (Bellflower Aquitard and the Ballona Aquifer) in Figure 2-3, *1,1-Dichloroethene Concentration Summary Map - Bellflower Aquitard,* through Figure 2-12, *1,1-Dichloroethane Concentration Summary Map - Ballona Aquifer.* Data for other groundwater contaminants such as PCE, TCE, and methylene chloride (MC) (commonly referred to as dichloromethane) are presented in Figure 2-2 and Appendix C. The interpreted extent of groundwater impacted by PCE, TCE, and MC suggest that the lateral extent of these contaminants is isolated and therefore plume maps have not been provided.

2.2.2 Groundwater Treatment System

In 1994, Secor International Incorporated (SECOR) started operating a groundwater treatment system to remediate chlorinated VOCs. There were 10 extraction wells discharging to the system. Historically, treated groundwater from this system has been discharged to Centinela Channel under National Pollution Discharge Elimination System (NPDES) permit #CAG834001.

In 1999, the RWQCB approved the temporary suspension of active groundwater treatment due to Site development activities (RWQCB, 1999). The groundwater treatment system was taken off-line on June 19, 2000.[6]

During the third quarter 2000, a new and more efficient water treatment system, designed to treat a wider range of contaminants was installed north of Building 2. Since then, the system has been used predominantly to treat dewatering and purge water.[7] Quarterly and annual NPDES reports on discharges of treated dewatering and purge water have been submitted to the RWQCB (IESI, 2001c, 2001d, 2001e, 2001f, 2001f, 2001g, ; IESI, 2002a, and 2002b), and continue to be submitted as such activities are ongoing.

2.3 Geology and Hydrogeology

This section presents regional and Site geology and hydrogeology, as interpreted from previous Site investigations. A generalized cross section of the geology and hydrogeology beneath the Campus Area is shown in Figure 2-13, *Generalized Cross Section.*

2.3.1 Regional Geology

The Site is in the Los Angeles Basin, which is at the juncture of three southern California physiographic provinces: the Transverse Ranges to the north, the Peninsular Ranges to the east and southeast, and the continental borderland to the west (Wright, 1991). The basin is a central alluvial lowland that slopes gently to the south and is bordered by highlands and their foothills. The basin overlies a structural depression where deposition occurred since late Cretaceous time.

The great relief of the present basin floor began forming during the middle-Miocene period, and has since been filled with both marine and continental sediments. The primarily fine-grained marine sediments were deposited during marine transgressions. The primarily coarse-grained continental sediments were deposited during marine regressions. Fine-grained marine deposits typically form aquitards, whereas stream deposits from the surrounding uplifted areas (San Gabriel Mountains, Santa Ana, and Puente Hills) and coarser marine deposits (Yerkes, et. al., 1965) form aquifers.

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[6] A report documenting the decommissioning of the groundwater treatment system was submitted to the RWQCB in December 2000 (SECOR, 2000).

[7] On July 31, 2000, the RWQCB gave written approval to include construction dewatering as an additional influent source for the treatment system (RWQCB, 2000).

The Site is more specifically located in the Ballona Gap, a lowland between the Beverly Hills and the Baldwin Hills that extends to the coast and the southerly adjacent Ballona Bluffs (Poland et al, 1959; Barrows, 1974). The Ballona Gap resulted from erosion by the ancestral and present-day Los Angeles River.

The generalized Los Angeles Basin stratigraphy described below is based on descriptions presented by Yerkes, et. al., 1965; California Department of Water Resources (DWR), 1961; Poland, et. al., 1956; Poland, et. al., 1959; and Blake, 1991. In order of shallow to deeper, the formations generally encountered are:

Recent alluvium. These deposits consist primarily of unconsolidated stream gravel, sand, silt, and clay with some interbedded littoral and estuary or bay sediments near the ocean. The Recent alluvium includes the Bellflower aquiclude and Ballona aquifer.

Lakewood formation. This Pleistocene aged deposit contains primarily shallow marine silt, sand, and gravel. The Lakewood formation is absent beneath the Site.

San Pedro formation. Silt, clay, sand, and gravel comprise this formation. This deposit, dating from the upper Pleistocene, represents the transition from neritic to nonmarine deposition. The San Pedro formation includes the Silverado aquifer.

Pico formation. This marine-derived (bathyal and neritic) formation is composed of poorly consolidated micaceous siltstone and claystone, interbedded with shale and sandstone. The Pico formation is upper Pliocene to upper Pleistocene in age. The upper portion of the Pico formation contains potable groundwater with mid and lower portions of the formation containing saline groundwater (Poland, et. al., 1959).

2.3.2 Regional Hydrogeology

The Site is located within the Santa Monica Basin, a sub-basin of the Los Angeles County Coastal Plain (DWR, 1961).

The aquifers and aquitards in the Los Angeles Basin are formations created during the Recent and Pleistocene Epochs. The Recent and Pleistocene deposits are similar in composition, since their depositional environments were similar. The following summarizes the significant hydrostratigraphic units in the vicinity of the Site (DWR, 1961; Poland, et. al., 1959):

Bellflower Aquiclude/Aquitard The uppermost hydrostratigraphic unit beneath the Site is the Bellflower aquiclude (Recent alluvium), which is a sequence of low permeability continental, marine and wind-blown deposits consisting primarily of clay and silty clay (DWR, 1961). Although this sequence is regionally classified as an aquiclude (DWR, 1961), site-specific data indicate that recharge to the underlying aquifer, although minimal, occurs in this sequence. Therefore, for this RP, the Bellflower aquiclude is considered to be a semi-confining layer and will be referred to as the Bellflower aquitard.

Ballona Aquifer. Below the Bellflower aquitard is the Ballona aquifer (Recent alluvium), which is encountered in the Ballona Gap north of the Ballona Bluffs and merges into the Gage/Gardena aquifer to the southeast. Although the Ballona aquifer is considered Recent in age, at least part of the aquifer may have been deposited in the late Pleistocene. The Ballonaquifer is often times called the "50-foot Gravel" aquifer because it is generally encountered 50 feet below native grade, and primarily consists of stream deposited coarse sand, rounded to sub-rounded gravel, and cobbles (up to 5 inches in diameter) of granitic and metamorphic origin. The Ballona aquifer ranges in thickness from less than 10 feet near the coast to 40 feet near Beverly Hills. The base of the aquifer is approximately 40 to 60 feet below sea level in the vicinity of the Site (DWR, 1961).

Silverado Aquifer. Further below, the Silverado aquifer was deposited during the Pleistocene Epoch (San Pedro formation). The Silverado is composed primarily of marine and non-marine sand and gravel. The Silverado can be up to 500 feet thick in parts of the Los Angeles Basin. Locally, the elevation of the base of the aquifer is estimated to be approximately 200 feet below mean sea level (MSL) (DWR, 1961), although Site-specific data indicate this dimension is somewhat variable.

2.3.3 Site Geology

Site geologic conditions have been determined based on lithologic logs from numerous monitoring wells and soil borings and from published reports of regional and local geology (MEE, 1987a). Monitoring well locations and the locations of transect lines for four geologic cross-sections are shown on Figure 2-14, *Cross -Section Location Map.* The four geologic cross-sections, Figure 2-15, *Geological Cross-Section A-A'* through Figure 2-18, *Cross Section D-D'*, summarize geologic conditions, as recorded during the recent drilling and monitoring well installation performed by CDM (CDM, 2001b). The Site geologic description focuses on the near-surface water-bearing geologic units encountered beneath the Campus Area. These units include the Bellflower aquitard and Ballona aquifer of the recent alluvium, and the Silverado aquifer of the San Pedro formation.

Soil borings show that the shallow soil zone beneath the Campus Area consists of fine- to medium-grained sand. The sand is interpreted to have been derived from water and wind erosion of the sand deposits on the Playa del Rey Bluff, and it varies from 2 to 10 feet in thickness (MEE, 1987a). The sandy soil deposits are thickest at the base of the Playa del Rey Bluff and become thinner to the north. The sand is unconsolidated, loosely compacted, and its permeable nature allows downward percolation of fluids. The shallow sand is shown on the geologic cross-sections (Figure 2-15 through Figure 2-18). Some of the shallow soils also reflect non-native fill materials that originated from the Playa del Rey Bluff (used beneath existing buildings) and clean imported fill for placement under existing or proposed roads. The characteristics of these shallow non-native fill materials are variable.

The Bellflower aquitard (Recent alluvium) underlies the surficial sands throughout the Campus Area. The Bellflower aquitard consists mostly of clay and silty sand layers with smaller lenses of clays, silts, and silty sands throughout. The Bellflower aquitard is depicted as "clay" and "silty sand" on the geologic cross-sections (Figure 2-15 through Figure 2-18) and is approximately 10 to 40 feet thick. The upper half of the Bellflower tends to be dominated by clays, and the lower half tends to be dominated by silty/clayey sands. For the purposes of remedial alternatives evaluation and design, the Bellflower aquitard will be subdivided into two zones: the "upper Bellflower aquitard", which is comprised generally of less permeable soils; and the "lower Bellflower aquitard", which is comprised generally of more permeable soils.

The Ballona aquifer (Recent alluvium) underlies the Bellflower aquitard throughout the Campus Area. The Ballona aquifer consists of mostly well graded to poorly graded sands and gravels, and is approximately 10 to 40 feet thick. The Ballona aquifer is depicted as "sand" on the geologic cross-sections (Figure 2-15 through Figure 2-18). The Silverado aquifer of the San Pedro formation lies unconformably beneath the Ballona aquifer throughout most of the Campus Area.

Regional geological studies by DWR (1961) and Poland, et. al. (1959) identified the presence of a fault underlying a portion of the Central Basin. This fault, named the Charnock fault, was thought to act as a partial barrier to groundwater flow in the Central Basin especially in the deeper aquifers (DWR, 1961). MEE (1987a, b) postulated that the Charnock fault offset some of the deeper formations in the western portion of Area D, including the Silverado aquifer of the San Pedro formation. The MEE (1987a) interpretation is based primarily on a recent geophysical study performed at the Site, using high-resolution seismic surveys and geologic data from local oil wells and Site monitoring wells, found no evidence of the Charnock fault at the Site (Davis and Namson, 2000). The Site seismic survey showed that geologic units used as seismic "reflectors" are continuous across the entire Site to a depth of 4,500 feet (Davis and Namson, 2000). The authors concluded that the Charnock fault may actually bend east of the Site, be deeper than 4,500 feet at the Site, or it may actually truncate north of the Site. The authors found no evidence of faulting at the Site in the past 4 million years (Davis and Namson, 2000).

2.3.4 Site Hydrogeology

As presented in Section 2.3.2, the hydrogeologic units beneath the Site generally consist of, from top to bottom, thin surficial sands (2 to 10 feet thick), the Bellflower aquitard (about 30 feet thick for the sum of the upper and lower Bellflower aquitard), the Ballona aquifer (about 10 to 40 feet thick), and the Silverado aquifer (about 60 feet to 100+ feet thick). The upper and lower Bellflower aquitard are in hydraulic communication with the underlying Ballona aquifer, based on the interpretation of water level data and the presence of Site-originated contaminants in the Ballona aquifer. However, this vertical hydraulic communication is limited by the low transmissivity of the Bellflower aquitard soils, particularly those belonging to the

upper Bellflower aquitard. MEE (1987a) depicts the Ballona and Silverado aquifers in direct hydraulic communication and suggests that they act as a single aquifer.

2.3.4.1 Beneficial Uses of Groundwater

In accordance with the California Porter-Cologne Water Quality Control Act and the federal Clean Water Act, the RWQCB has established a Water Quality Control Plan for the Los Angeles River Basin (the "Basin Plan"). The function of the Basin Plan, which is amended from time to time, is to preserve and enhance water quality, and to protect the beneficial uses of all regional waters including groundwater (RWQCB, 1994).

Existing beneficial uses designated in the Basin Plan for Coastal Watersheds of Los Angeles and Ventura Counties (RWQCB, 1994) include municipal and domestic supply; agricultural supply; industrial process supply; and industrial service supply. The Basin Plan sets forth a number of general objectives for all groundwater, and specific mineral objectives for most basins. Mineral objectives for naturally-occurring chemicals in the Santa Monica Basin include, among others, Total Dissolved Solids (TDS) [1,000 milligrams per liter (mg/L)][8], sulfate (250 mg/L), and chloride (200 mg/L).

The Silverado aquifer is a regionally significant source of drinking water, although groundwater samples collected from Silverado wells in the Campus Area indicate this water-bearing unit is of poor quality for drinking water purposes as a result of naturally-occurring minerals. Analytical data from monitoring wells screened within the Silverado aquifer, indicate high TDS concentrations ranging from 660 to 2,600 mg/L (Appendix C; Table C-10), well above both the Maximum Contaminant Level (MCL) (Secondary) of 500 mg/L, and the recommended level in the Basin Plan (1,000 mg/L) for drinking water. In addition, elevated concentrations of chloride (as high as 770 mg/L) and sulfate (as high as 850 mg/L) have also been detected in Silverado aquifer monitoring wells located within the Campus Area (Table C-10).

Groundwater quality, particularly given the levels of naturally-occurring minerals, is also considered degraded within the lower Bellflower aquitard and Ballona aquifer as a consequence of the site's proximity to brackish or saline water. Monitoring wells screened within these water-bearing units have shown elevated concentrations of TDS (as high as 13,000 mg/L)[9], chloride (as high as 4,400 mg/L), and sulfate (as high as 3,600 mg/L) (Table C-10).

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[8] The RWQCB, as a matter of general policy, also assumes that water with TDS as high as 3,000 mg/L has the potential to be potable (RWQCB, 1994). However, such potability would require treatment of these naturally-occurring solutes to a level at or below 500 mg/L, the state and federal standard for drinking water. Such treatment is very costly, and currently is not a cost-effective technology.

[9] The 13,000 mg/L TDS concentration was observed at perimeter Campus Area monitoring well C-66; typical TDS concentrations in the Campus Area range from approximately 1,000 to 4,000 mg/L (See Appendix C).

The nearest potential public water supply well was located at Venice Polytechnic High School, approximately 1.5 miles north of the Site. The subject well was capped in 1960 and is not active. The next closest public supply wells are located approximately 2.5 miles north of the Site in the City of Santa Monica. The nearest irrigation well is located approximately 1.5 miles southeast of the Site at the Hillside Memorial Park Cemetery (MEE, 1987a). Records indicate that the irrigation well is screened across multiple, deep hydrologic zones ranging in depth from 188 to 590 feet below ground surface (bgs), and therefore not likely to be influenced by the shallow groundwater at the Site.

2.3.4.2 Groundwater Elevations and Flow Directions

Potentiometric contour maps depicting groundwater elevations and flow direction in the Bellflower aquitard and the Ballona and Silverado aquifers (Figure 2-19, *Potentiometric Surface Map for the Bellflower Aquitard* through Figure 2-21, *Potentiometric Surface Map for the Silverado Aquifer*) were last presented in the First Quarter 2002 Groundwater Monitoring and Progress Report (CDM, 2002).

The groundwater elevations in Campus Area wells screened in the Bellflower aquitard ranged between 2.39 feet below MSL (C-72be) and 8.07 feet above MSL (EMS-2) (Figure 2-19). A summary of groundwater elevation data at all monitoring wells in the Campus Area is included in Appendix C (Table C-1). The apparent groundwater flow direction across the Bellflower aquitard is toward the northeast at an apparent gradient of 0.002 ft./ft. (Figure 2-19).

Groundwater contours show a "mound" and a depression in the Campus Area that impact local flow within the Bellflower aquitard. The observed groundwater "mound" (Figure 2-19) may be explained by water leaking from the large catch basin in that area.

The depression is most likely due to Groundwater extraction or dewatering for construction purposes within the Bellflower aquitard occurs near C-72be. These groundwater extraction activities are currently ongoing.

Groundwater elevation levels measured in Ballona aquifer wells ranged between 2.92 (C-72ba) feet below MSL and 4.70 (C-73ba) feet above MSL. The apparent groundwater flow direction for the Ballona aquifer in the Campus Area is toward the northeast at an apparent gradient of 0.0008 ft./ft. (Figure 2-20).

Groundwater elevations for Silverado aquifer wells in the Campus Area (C-30 C-65d, C-87, and C-88) ranged between 2.01 (C-88) and 3.77 (C-30) feet above MSL (Figure 2-21). The groundwater flow direction across the Site within the Silverado aquifer based on the January 2002 data is toward the northeast at an apparent gradient of 0.001 ft./ft. (Figure 2-21).

Table 2-1, *Hydraulic Gradient and Flow Direction to the Shallow Water Bearing Limits Beneath the Campus Area*, summarizes hydraulic gradient and flow direction for the shallow water-bearing units beneath the Campus Area. The gradients and flow directions have been consistent over the past year for all of the aquifers. The only exception is the Bellflower aquitard data from June 2001, which are influenced by construction dewatering activities.

Geologic cross-sections (Figure 2-15 through Figure 2-18) show water level data from January 2002 for a number of the well pairs (i.e., adjacent wells completed in the Bellflower aquitard and Ballona aquifer). Water levels in these well pairs generally indicate only a slight downward vertical gradient from the Bellflower aquitard to the Ballona aquifer.

2.3.4.3 Aquifer Pumping Tests

McLaren Environmental Engineering (1987)

Hargis performed a series of short-term aquifer pumping tests and one 36-day pumping test between 1984 and 1985. The following summarizes the findings of these pumping tests as reported by MEE (MEE, 1987b).

Monitoring wells were pumped for 40- to 410-minute time periods using submersible pumps. Water production varied from 1.7 to 45.3 gallons per minute (gpm). MEE used the Jacob straight-line method to estimate transmissivity from each of the wells tested. This method assumes a homogenous, isotropic, and fully confined aquifer. Transmissivity estimates for each of the wells tested are summarized in Table 2-2, *Hydraulic Conductivity Estimates for Shallow Water Bearing Units.*

The transmissivity estimates ranged from 100 to 32,000 gallons per day per foot (gpd/ft) (13 to 4,278 ft^2), suggesting large differences in the aquifer characteristics within the Campus Area. Monitoring wells C-18, C-19, C-20, C-21, C-23, C-24, C-27, C-28, and C-30, which are screened within both the Bellflower and Ballona units, yielded an average transmissivity estimate of 19,000 gpd/ft, (2,540 ft^2/day) with values ranging from 8,000 to 32,000 gpd/ft. Monitoring wells C-16 and C-17, which are screened in the Bellflower aquitard, yielded an average transmissivity estimate of 3,000 gpd/ft (401 ft^2/day), with values ranging from 100 to 4600 gpd/ft (13 to 615 ft^2/day).

Wells C-29 and C-31 are screened within the Silverado aquifer. Well C-31 is located west of the purported Charnock fault zone, and it has an estimated transmissivity of 10,000 gpd/ft (1,337 ft^2/day). Well C-29 was drilled into the Silverado aquifer east of the purported fault, and it has an estimated transmissivity of 31,000 gpd/ft (4,145 ft^2/day). The Silverado is known to have lateral heterogeneities that could account for the difference between the estimated transmissivities derived from the two short-term pumping tests.

MEE (1987a) performed a 36-day pumping test in the Campus Area using extraction well EW-1 and seven observation wells (C-18, C-36, C-37, C-53, C-54, C-55, and C-56). All but one of the observation wells was screened in both the Bellflower aquitard and the Ballona aquifer. One well, C-53, was screened in the Silverado aquifer. Transmissivities in the observation wells ranged from 18,000 to 34,000 gpd/ft (2,407 to 4,546 ft^2/day), with an average of 29,000 gpd/ft (3,877 ft^2/day).

McLaren/Hart (1991)

McLaren/Hart also performed a pumping test in the Campus Area during February 1991 (McLaren, 1991). Extraction well EW-3 was pumped in a step-wise fashion for a 24-hour period. Pressure readings were recorded in observation wells EW-1, EW-1A, EW-2, EW-4, EW-8 and EW-9 during the test, and inter-well permeabilities were estimated using a curve-matching modeling technique. The pumping test results estimated aquifer permeabilities ranging from 0.481 darcies to 30.05 darcies (McLaren, 1991). CDM converted these permeabilities to hydraulic conductivities using the conversion factor published in Fetter (1980). Converted hydraulic conductivity values range from 1.16 to 72.18 feet per day (ft/day), with an average value of 17.3 ft/day.

The groundwater observation wells used during the test were screened across both the Bellflower aquitard and the Ballona aquifer. Since the Bellflower aquitard is thought to be less permeable because of its finer grained composition, these hydraulic conductivity values may be lower than for only the Ballona aquifer.

2.3.4.4 Groundwater Flow Velocities

Groundwater flow velocities may be estimated using hydraulic conductivity, hydraulic gradient, and effective porosity estimates and applying Darcy's Equation. This equation states that the average linear groundwater flow velocity (i.e., seepage velocity) through a saturated porous medium is given by:

$$Vx = K(dh/dl)/çe$$

Where Vx = average linear groundwater velocity parallel to the groundwater flow direction.

K = hydraulic conductivity

çe = effective porosity

dh/dl = average hydraulic gradient

Table 2-3, *Groundwater Velocities with Shallow Water Bearing Units*, summarizes groundwater velocities using hydraulic gradient and hydraulic conductivities presented in Sections 2.3.4.2 and 2.3.4.3.

2.4 Fate and Transport of Contaminants in Groundwater

Groundwater in the Bellflower aquitard and Ballona aquifer has been sampled periodically since 1984 for priority pollutants including VOCs, SVOCs, metals, pesticides, and PCBs. With respect to the Campus Area, the primary classes of contaminants in groundwater are VOCs and TPH. The VOCs include chlorinated ethenes, namely PCE, TCE, cis-1,2-DCE, trans-1,2-dichloroethene (trans-1,2-DCE), 1,1-dichloroethene (1,1-DCE), and VC. They also include chlorinated ethanes; namely tetrachloroethane (PCA), 1,1,1-trichloroethane (1,1,1-TCA), 1,1,2-trichloroethane (1,1,2-TCA), 1,1-DCA, 1,2-DCA, and chloroethane (CA). TPH consists of refined fuel hydrocarbons, including BTEX.

The fate and transport of these organic chemicals in groundwater is affected by a variety of chemical, physical and biological processes. Some of these processes are destructive and result in contaminant mass removal from the groundwater. Destructive mechanisms include both chemical and biological processes. Others are non-destructive and do not result in a change in contaminant mass or migration ability. Non-destructive mechanisms include sorption, dispersion, matrix diffusion, dilution from recharge, and volatilization. Typically the most important processes contributing to the ultimate fate of groundwater contaminants is biodegradation. The significance of biodegradation is discussed in Section 2.4.4.

The following factors are important in evaluating the fate and transport of the groundwater contaminants within the Campus Area:

- Groundwater flow directions and velocities in the Bellflower aquitard and Ballona aquifer;
- Implementation of remedial programs at source areas; and
- Natural attenuation (including adsorption, biodegradation, matrix diffusion, and dispersion).

Each of these factors is discussed below.

2.4.1 Migration Pathways

In the Campus Area, the majority of the contaminant mass is located adjacent to the source areas in the stratified, lower hydraulic conductivity material of the Bellflower aquitard. The lateral migration of contaminants from the source areas in this unit is generally in a north to northeast direction and is limited by the presence of less permeable soils with a groundwater flow velocity of approximately 0.09 feet per day (Table 2-3). However, plume migration will likely be slower than predicted by the calculated groundwater velocity due to the effects of contaminant adsorption and biotransformation (as much as several times slower, depending on the hydrophobicity and biological fate of the migrating compound).

Downward vertical migration in the Bellflower aquitard is also expected to be limited by the presence of fine-grained layers and hydraulic anisotropies in the aquitard. However, the presence of contaminants in the Ballona aquifer indicates that some contaminants have migrated vertically through the entire aquitard thickness. This is important because groundwater velocities in the Ballona aquifer (and presumably the lower Bellflower aquitard) are higher than in the upper Bellflower aquitard. As such, the Ballona aquifer is the most important medium for lateral migration of groundwater contaminants in the Campus Area.

Once the contaminants have reached the more permeable portions of the Bellflower aquitard (lower Bellflower aquitard) or deeper Ballona aquifer, lateral mobility is greatly enhanced. Much of the organic contaminant mass, however will be adsorbed to naturally-occurring organic material in soils near the source locations.

2.4.2 Implementation of Remedial Programs at Source Areas

Source area remedial activities have already been implemented at numerous locations in the Campus Area (see Section 4). The majority of these actions involved excavation of contaminated soils. These source-specific actions are important because they have removed contaminants that might have otherwise migrated to underlying groundwater.

Remedial actions proposed as part of this document will be designed to remove as much of the remaining contaminant mass from groundwater, unsaturated zone soil, and saturated zone soil, as technically feasible.

2.4.3 Natural Attenuation Processes

Various naturally-occurring processes affect the transport of contaminants in saturated zone soil and groundwater. Most of these mechanisms or processes combine to limit the rate of contaminant migration. However, other processes, such as desorption of adsorbed contaminants and matrix diffusion may prolong the time necessary for groundwater remediation. The following mechanisms also affect the fate and transport of contaminants in the Campus Area groundwater systems:

- Biological transformation (biodegradation);
- Adsorption to and desorption from the aquifer media;
- Matrix diffusion;
- Abiotic degradation;
- Volatilization; and
- Advection and dispersion.

Biological transformation processes, including biodegradation, are summarized below, while the other processes/mechanisms are described briefly in Appendix E.

2.4.4 Biological Transformation

The principal contaminants in groundwater at the Campus Area are chloroethanes (e.g,. 1,1,1-trichloroethane) and chloroethenes (e.g., TCE) and their respective family of metabolic products. Other contaminants are fuel hydrocarbons, including gasoline. Groundwater conditions underlying the Campus Area are conducive to biodegradation of the more oxidized forms of chlorinated VOCs such as source contaminants (e.g., 1,1,1-TCA and TCE). The biological mechanisms for biodegradation of petroleum hydrocarbons and reductive dechlorination of chlorinated ethenes and ethanes are more fully described in Appendix E.

In general terms, the biodegradation of petroleum hydrocarbons such as BTEX and other organic compounds (e.g., naturally-occurring organic materials such as humic substances), serve as the carbon and energy sources (i.e., electron donors) for microorganisms. These carbon and energy sources are biodegraded/biotransformed, thereby driving groundwater reducing conditions to an anaerobic state (dissolved oxygen [DO] < 1.0 mg/L). Furthermore, the metabolism of these compounds can employ chlorinated VOCs as electron acceptors. In the process of acting as electron acceptors, the chlorinated VOCs are reductively dechlorinated (reduced). The sequential reduction of chlorinated VOCs eventually leads to the production of innocuous end-products such as ethene/ethane.

A schematic pathway for the primary contaminants and their degradation products is shown in Figure 2-22, *Biotransformation Pathways*. For TCE, a common source contaminant historically used within the Campus Area, reductive dechlorination could eventually result in the formation of non-toxic ethene and ethane. However, incomplete reductive dechlorination could lead to the accumulation of intermediate toxic products (e.g., VC), although the lower chlorinated contaminants may subsequently degrade to innocuous carbon dioxide through oxidation processes. TCA, an additional source contaminant used historically in the Campus Area, is subject to abiotic transformations under aerobic and anaerobic conditions, and biological transformations under anaerobic conditions. TCA transformations and breakdown products are also summarized in Figure 2-22. The abiotic and biotic pathways are important to the ultimate fate of chloroethanes. In particular, 1,1,1-TCA may be transformed abiotically to form 1,1-DCE that can then undergo reductive dechlorination to form VC, and ultimately over time ethene and ethane. Under anaerobic conditions, 1,1,1-TCA may also be rapidly transformed by biotic processes into 1,1-DCA, which may be further reduced to CA. CA is relatively stable biologically under anaerobic conditions, but is transformed rapidly to ethanol and chloride by an abiotic hydrolysis reaction.

The redox conditions of groundwater in the Campus Area that control the biodegradation are briefly described in Appendix E.

2.4.5 Summary

The high organic content and low permeability of the soils in the upper Bellflower aquitard appear to have prevented the groundwater contaminant plume from significant horizontal migration in this water-bearing unit. As a result, the majority of the contaminant plume remains close to the probable source areas. However, the contaminant plume has moved vertically into the relatively more permeable lower Bellflower aquitard and Ballona aquifer, and subsequently downgradient in these water-bearing units.

The low organic content and relatively high permeability soils of the Ballona aquifer allow relatively faster dispersion of the VOC contaminant plume compared to the Bellflower aquitard. Some biotransformation and biodegradation of VOCs in the Ballona aquifer also occurs. VOCs are attenuated laterally downgradient through various natural attenuation mechanisms in the Ballona aquifer, and do not appear to migrate vertically below the aquifer to the underlying Silverado aquifer to any significant extent. Data collected from monitoring wells screened in the Silverado aquifer indicate the continued absence, or near detection limit concentrations, of contaminants in this water-bearing unit.

Groundwater data obtained for the Campus Area suggest that biodegradation, abiotic degradation, adsorption/desorption, matrix diffusion, and advection/dispersion are the current dominant factors influencing the fate and transport of observed groundwater contaminants. The most significant attenuation mechanism in the lower Bellflower and Ballona aquifers appears to be dispersion through horizontal transport in this aquifer.

Groundwater data indicate that sulfate concentrations (Appendix C), although an order of magnitude less than in the Bellflower aquitard, are substantially above levels known to inhibit reductive dechlorination (e.g., approximately 50 mg/L). In addition, the lack of significant ethene/ethane production in the Ballona aquifer indicates limited dechlorination activity. Data suggest that only limited quantities of VC, and other highly reduced VOCs, are generated as a result of reductive dechlorination processes occurring in the Ballona aquifer. Rather, most of the highly reduced VOCs detected in the Ballona aquifer are a result of the dechlorination processes occurring in the Bellflower aquitard and subsequent vertical migration of VC. Redox conditions, including elevated sulfate concentrations, and low DOC concentrations in the Ballona aquifer groundwater likely limit further reductive dechlorination from occurring once the chlorinated contaminants reach the Ballona aquifer. Such limitations may be overcome through engineered remediation systems.

Section3
Remedial Objectives and Goals

This section identifies media-specific Remedial Objectives (ROs) and Remedial Goals (RGs) for remedial activities within the Campus Area. ROs and RGs have been developed considering the significant human exposure pathways present at the Site, effects on environmental resources and future planned commercial use. To set such ROs and RGs requires identifying, in turn, media of concern, significant human exposure pathways, and COPCs.

3.1 Establishing ROs and RGs

Establishing ROs is an essential step in the process of identifying and evaluating potential remedial action alternatives ("the Alternatives"). ROs are qualitative statements of what remediation is expected to achieve to protect human health and environmental resources.

The ROs then serve as the foundation for setting quantitative RGs to address contamination within the Campus Area. Protection of human health will be addressed through the use of HBRGs, which are quantitative criteria used to guide remediation to address contamination that could reach potential receptors at unacceptable levels. Protection of environmental resources, specifically shallow groundwater, will be addressed through the use of SRTs, which are quantitative criteria used to identify soils that require remediation, so that contaminants do not reach groundwater at unacceptable levels. HBRGs and SRTs are essentially triggers for remediation, but not necessarily the final cleanup levels. Importantly, for many COPCs, the final cleanup levels will end up being more protective than HBRGs and SRTs, to the extent technically feasible.

3.1.1 Media of Concern

ROs are developed for each medium of concern, and are designed to address the types of chemicals found in these media. This RP focuses on soil and groundwater as the critical media of concern. Soil gas is also a potential medium of concern as a result of potential "off-gassing" of volatile contaminants from groundwater and/or soil. However, because the proposed remedial actions for soil and groundwater will address the significant sources of such off-gassing, and certain mitigation measures will address potential exposures during and after remediation, contaminants in soil gas are not addressed directly in this RP as a medium of concern.

3.1.1.1 Soils

For the Campus Area, the focus of remediation is on unsaturated zone soils that extend from ground surface to approximately 15 feet bgs, and on shallow groundwater. Further, as described in the next section (3.1.2), remediation is intended to reduce or eliminate both the migration of vapors from the subsurface to buildings and the migration of COPCs from subsurface soils to groundwater. Preventing the

transport of COPCs away from subsurface sources is, therefore, a critical aspect of evaluating remedial alternatives.

Contaminated soils in the Campus Area are located within the unsaturated portion of the upper Bellflower aquitard as illustrated in Figure 3-1, *Conceptual Model for Transport of COPCs in Soil of Upper Bellflower Aquitard.* As the conceptual model shows, contaminated soil gas occurs as the result of contaminants partitioning across phases including: (1) groundwater to soil vapor, and (2) soil to vadose zone moisture to soil vapor. Once present in soil vapor, some release of contaminants to the atmosphere will occur at the ground surface.

The conceptualized soil layers of the unsaturated upper Bellflower aquitard act as zones of equilibration between phases. Transport of COPCs from groundwater (originating from the capillary fringe) to the surface will be retarded to an extent determined by the adsorption capacity of the soil and varying contaminant concentrations with depth in the soil. Transport of COPCs to the ground surface from vadose zone impacted soil will occur in a similar manner.

3.1.1.2 Groundwater

For groundwater, the focus of remediation is on water-bearing intervals in the Bellflower aquitard, Ballona aquifer, and the Silverado aquifer. As discussed in Sections 2.3 and 2.4, contamination is currently limited to the Bellflower aquitard and Ballona aquifer; all existing data demonstrate the continued absence or near detection limit concentrations of contaminants in the Silverado aquifer.

Accordingly, this RP focuses on contaminants in groundwater that are present within the Bellflower aquitard and Ballona aquifer. Proposed remedial activities factor in the potential for migration of contaminants from the Bellflower aquitard and Ballona aquifer to the underlying Silverado aquifer. Specifically, the proposed remedial activities address the ability to provide continued protection of the underlying Silverado aquifer. This topic is addressed further in Sections 6, 7, and 8.

3.1.2 Potential Exposure Pathways

In order to develop ROs to guide remediation, an understanding of the exposure scenario that applies to a site's circumstances is necessary. Developing an exposure scenario involves identifying the potentially exposed population (e.g., construction workers, occupants, etc.) and all of the ways this population might be exposed to COPCs. To develop an exposure scenario for each potentially affected population, the many potential exposure pathways by which people might be exposed are evaluated to identify those pathways in the Campus Area that could present an actual source of exposure. By definition, exposure pathways—the ways in which a population comes into contact with environmental contamination—must include a source of chemicals, a release and transport mechanism from the source to a population, and a route of exposure (e.g., inhalation, ingestion, dermal contact). IESI identified the exposure pathways for each potentially exposed population at the Site during the development of a conceptual exposure model (CEM) (Figure 3-2, *Conceptual Exposure Model for*

Commercial Development). As explained in that model, certain pathways will not exist in the Campus Area. For example, no residential development is planned for the Campus Area; therefore, residents are not considered a potentially exposed population for this area.

Stated another way, only "complete" exposure pathways are considered in developing ROs. An exposure pathway is deemed "complete" if all elements—source, release and transport, route of exposure, and population—are present. If any element is missing, no exposure will occur. Furthermore, although a pathway is potentially complete, in many instances exposure is expected to be too small to be significant for human health impacts. Relative to the Campus Area, IESI judged several potential exposure pathways as complete as part of its development of HBRGs (IESI, 2000, 2001a). The selection of these pathways as complete has been reviewed and approved by OEHHA. They include:

- Incidental ingestion of surface soil (construction workers);
- Dermal contact with surface soil (construction workers);
- Inhalation of particulate matter suspended in air from surface soil (operations, construction workers);
- Inhalation of vapors migrating from subsurface soil and groundwater to ambient (outdoor) air (operations/office workers, construction workers, and children in day care); and
- Inhalation of vapors migrating from subsurface soil and groundwater to indoor air (operations/office workers and children in day care).

Importantly, direct contact with, or ingestion of, contaminated subsurface soils and groundwater by future occupants, maintenance and repair personnel or children in day care are deemed incomplete pathways. Workers in buildings and children in day care will be separated from subsurface contamination by several feet or more of clean fill, pavement, building foundations, and/or landscaping, once construction is complete. Maintenance and repair personnel who may have to work in subsurface areas will generally be working in clean fill. Where their activities take them into deeper areas, they will be subject to the same health and safety procedures that apply to construction workers. Furthermore, remediation efforts are expected to reach levels appropriate for protection of future workers, day-care children and the groundwater resource. Since these goals are lower than those needed to protect construction workers and others that may excavate into areas of residual contamination, future risks for maintenance/repair workers are not expected to be significant.

Similarly, contact with, or ingestion of, contaminated groundwater is also deemed an incomplete pathway. Shallow groundwater within both the Bellflower aquitard and Ballona aquifer is not currently used on-site for either drinking water or irrigation and

such potential future uses will be prevented by CC&Rs that shall apply to the owners or users of the property. Additionally, the natural mineral content of these waters preclude their use for either drinking water or irrigation without additional treatment. Individual users would find such treatment impracticable, and a supplier of public drinking water would have to assure that the water was treated to meet MCLs. The significance of this determination is thus minimal, meaning only that the groundwater will not occur (discussed in more detail below).

A full discussion of how pathways were selected as complete from among the larger universe of potential exposure pathways can be found in the HBRG Protocol and subsequent Commercial Area HBRG Report and Addendum Report (IESI, 1999b; IESI, 2000; IESI, 2001a).

In consideration of the above potentially complete pathways, priorities for managing possible human health risks associated with current Campus Area contamination and future development therefore should focus on:

- Interrupting potential upward migration of vapors from groundwater or soil to commercial buildings to be constructed above contaminated groundwater or soil;
- Removing contaminant mass, particularly from source areas, so that contaminant concentrations in downgradient areas decrease over time, thereby limiting future contaminant migration and potential human exposure; and
- Preventing unacceptable direct contaminant exposures to workers.

Finally, some park spaces will probably be included within the Campus Area. Planned remediation and subsequent park development are anticipated to address any potential health risks associated with recreational exposures. However, remedial plans will be reviewed, as appropriate, to ensure compliance with future use scenarios for park areas.

3.1.2.1 Exposure Pathways Not Addressed by this Remediation Plan

For the purposes of developing ROs, one potential exposure pathways is not addressed in this RP. As discussed above, a potential exists for construction worker exposure during remediation and development of the Campus Area. However, the Site health and safety procedures, already in place, and certain risk management protocols that apply to the Campus Area development will protect construction workers and maintenance workers against such exposures. Because subsurface contamination within the Campus Area is well characterized, and under extant health and safety procedures, workers will be informed, trained, and equipped to work safely with known and unknown contamination. As such, this RP does not propose additional remediation measures to address the complete exposure pathways associated with construction workers.

3.1.3 Chemicals of Potential Concern (COPCs)

The initial list of COPCs identified for the Site (including the Campus Area and areas extending beyond the Campus Area) by IESI included almost all chemicals detected in the Campus Area, including many that actually present little or no threat to human health (IESI, 2000, IESI, 2001a). The IESI list is presented in Appendix I.

To identify those COPCs pertinent to the Campus Area portion of the Site, CDM reduced IESI's list of COPCs to only those chemicals detected during comprehensive soil and groundwater investigations since March 1999 in the Campus Area. These media-specific COPCs, specific to the Campus Area of the Site, are presented in Table 3-1, *List of Chemicals of Potential Concern for Soil,* and in Table 3-2, *List of Chemicals of Potential Concern for Groundwater.*

3.1.4 Identification of Remedial Objectives

Based on the analysis described above, this section sets out the media-specific ROs developed for Campus Area soil and groundwater. For each media, the ROs are designed to meet the two overall objectives of: (1) protecting human health, and (2) protecting the groundwater resource.

3.1.4.1 Soil Remedial Objectives

Soil ROs for the protection of human health are:

- The selected remedial actions shall reduce soil concentrations of COPCs to levels protective of human health, considering exposure pathways and potential future receptors in the Campus Area;
- The selected remedial actions shall prevent exposure of the public to VOC vapors from soil at concentrations above acceptable levels; and
- At a minimum, the selected remedial actions shall reduce COPC concentrations in source area soils to the HBRG levels specifically developed for contaminants in the Campus Area.

The soil RO for the protection of the groundwater resource is:

- The selected remedial actions will seek to reduce COPCs in source area soils so that the groundwater resource can be protected, to the extent technically feasible (see groundwater resource protection RO below).

3.1.4.2 Groundwater Remedial Objectives

Remedial groundwater actions in the Campus Area will be implemented to assure the primary goal of protecting human health. As discussed above, the most significant risks to human health are associated with exposures to VOCs off-gassing from groundwater. In addition, even though all direct exposure pathways (e.g., ingestion or dermal contact) for contaminants in groundwater are currently incomplete, and are unlikely to be completed in the foreseeable future, the proposed remedial actions will

seek to further reduce COPC concentrations beyond that necessary for the protection of human health, as a means to protect the groundwater resource. As applied in this RP, ROs established for the protection of human health must be achieved by the proposed remedial actions, while the proposed remedial actions will seek to achieve the RO for the protection of the groundwater resource to the extent technically feasible.

Groundwater ROs for the protection of human health are:

- The selected remedial actions shall reduce groundwater concentrations of all Site-originated COPCs to levels protective of human health, considering complete exposure pathways and potential future receptors within the Campus Area;
- The selected remedial actions shall prevent exposure of the public to VOC vapors from groundwater at concentrations above acceptable levels; and
- Specifically, the selected remedial action shall reduce COPC concentrations in groundwater in the Campus Area to the HBRG levels specifically developed for the Campus Area.

The RO intended to protect the groundwater resource, above and beyond that necessary to protect human health, is:

- The remediation will seek to reduce Campus Area COPC concentrations to levels equal to the Maximum Contaminant Levels ("MCLs"), to the extent technically feasible, even though MCLs would apply only if the groundwater were to be supplied as drinking water, a highly unlikely scenario.

3.2 Proposed Remedial Goals

RGs are quantitative expressions of contaminant concentrations that are used in this RP to identify areas where remediation is needed, to provide an initial indication of the amount of reduction of contamination needed, and to guide the selection of remedial actions appropriate to meet the desired reduction. In effect, the RGs used to develop proposed remedial actions in this RP are more like remediation triggers. They are not being proposed at this time as final cleanup levels. Such final levels are more appropriately set, once the necessary remedial actions have been implemented and performance data are available to use in determining those levels.

Like the ROs, this RP uses both a set of RGs developed to protect human health (HBRGs) and a set to protect the groundwater resource (SRTs). The methods used to develop these quantitative RGs, which are fully developed in documents outside this RP, are briefly described below.

3.2.1 Health Based Remediation Goals

HBRGs are calculated concentrations of chemical contaminants in soil, groundwater, and soil gas that will protect the public from unacceptable exposures to these chemicals in the Campus Area. Calculating these concentrations involves, in general, deciding how people might be exposed to Campus Area contaminants, and then establishing levels of these contaminants that are sufficiently low to ensure that exposures would not represent threats to human health.

Development of HBRGs applicable to the Campus Area follows the protocol methods approved in June 1999 by the RWQCB and OEHHA for soil HBRGs. The approved methodology involves several basic steps, including:

1. Identifying and assessing the toxicity of the COPCs;
2. Developing a conceptual exposure model;
3. Calculating unit risk and unit hazard levels; and
4. Integrating the results to calculate HBRGs.

This methodology closely follows guidance developed by Cal/EPA (e.g., 1992) and USEPA (e.g., 1989, 1996, 1997). Key details of that guidance are discussed below. A more complete discussion of the approach used to develop HBRGs is available in several documents, including the HBRG Protocol, the HBRG Report (covering soils), and Addendum to HBRG Report (covering soil gas and groundwater) submitted to the RWQCB by Integrated Environmental Services, Inc. (IESI) (1999b, 2000, 2001a). Set out in the following subsections is a brief summary of the steps used to develop HBRG levels for the Campus Area.

3.2.1.1 Chemicals of Potential Concern for HBRG Development

Typically, chemicals detected in environmental media (soils, groundwater, soil gas) are screened to select a subset of chemicals that would account for all, or nearly all, risk and hazard. For the Campus Area, however, only minimal screening was done to the list of COPCs detected at the Site (see Appendix I). However, because inorganic constituents in groundwater do not partition into soil gas or vapor phases, these chemicals are not considered COPCs for exposure pathways involving exposure to vapors migrating from the subsurface. Rather, soil gas COPCs were selected from those chemicals that may migrate as vapors in the environment and were found in groundwater during recent monitoring. Other than this adjustment, no additional screening of detected chemicals was performed.

3.2.1.2 Conceptual Exposure Model

HBRGs were generated using exposure estimates for all complete pathways considered above. Other pathways included in Figure 3-2 are either incomplete or insignificant. Details of the exposure assessments are found in IESI (2000, 2001a).

All exposure estimates for the development of HBRGs applicable to the Campus Area were based on the concept of reasonable maximum exposure (RME). As defined in Cal/EPA and USEPA guidance, RME is an exposure well above the average but still within the upper range of those possible. Use of the RME approach is conservative, and ensures that even individuals with the greatest exposure are protected.

3.2.1.3 HBRG Calculations

The process of calculating HBRGs for potentially affected populations and complete exposure pathways requires the use of several simple transport models to estimate attenuation factors and exposure algorithms to estimate RME. A convenient means to integrate these calculations is to first calculate cancer risk or noncancer hazard associated with unit concentrations of COPCs. Because the relationship between cancer risk or hazard to COPC concentration is linear, cancer risks and noncancer hazards change proportionally with different levels of COPC concentrations in groundwater or soil gas. For example, if cancer risk for a groundwater concentration of 1 milligram per liter (mg/L) is 1 in one million, cancer risk for a concentration of 2 mg/L is 2 in one million.

3.2.1.3.1 Attenuation Factors

Calculation of cancer risk and noncancer hazard for exposure to COPC vapors in either outdoor or indoor air requires estimating attenuation factors for each COPC for each medium (soil, groundwater, and soil gas). A similar attenuation factor (termed a particle emission factor) is required to estimate air concentrations of particulate matter suspended in air from surface soil. Attenuation factors are ratios of contaminant concentrations in air to those in soil, groundwater, or soil gas. For instance, an attenuation factor for migration of contaminants from groundwater to indoor air of 1×10^{-4} indicates that indoor air concentrations in milligrams per cubic meter (mg/m^3) are predicted to be 10,000 times less than groundwater concentrations in mg/L.

Attenuation factors for migration of vapors to indoor air were calculated using electronic spreadsheet models developed by USEPA and based on the Johnson and Ettinger model for vapor intrusion. Similarly, attenuation factors for migration of vapors from groundwater to outdoor air were calculated using a series of spreadsheet models developed by Groundwater Services Inc. (GSI), which are based on Risk-Based Corrective Action (RBCA) methods defined by American Society for Testing and Materials (ASTM) recommendations. Attenuation factors for release of vapors and particulate matter from soil to outdoor air were estimated using methods employed by USEPA to calculate soil-screening levels often used as PRGs.

Attenuation factors developed using methods described above appear to be reasonable, if not overly conservative, for the Site. Flux chamber analyses performed at the former Test Site 2 area in a residential portion of the Phase 1 Development Area (west of the Campus Area) indicated very low vapor fluxes, less than 0.1 microgram per square meter per minute (µg/(m2/min)). Dr. C.E. Schmidt of Red Bluff, California, performed these analyses in January 2002 under subcontract to CDM. Flux

samples were taken from areas where elevated soil gas VOC concentrations (greater than 1,000 ppbv) were detected at depth and were analyzed for VOCs in accordance with EPA Method No. TO-14. The results of the investigation indicate that the surface emissions are extremely low. For example, using data from sampling location TS2-FLX-17, flux of VC at the soil surface was estimated to be <0.0010 µg/(m2/min) even though VC was present at 2,200 ppbv at 12 feet bgs at nearly co-located SG-5. Although elevated VOC concentrations have been measured at depth beneath the Site, no significant surface emissions from these subsurface source areas have been detected. Low flux rates at the surface are indicative of significant attenuation of vapors in soil gas as they move vertically to the soil surface.

3.2.1.3.2 Target Risks and Hazards

HBRGs are calculated using target cancer risks or hazard indices that are "acceptable" to California and federal regulatory agencies. In essence, a level of risk or hazard that can be accepted at the Site is chosen, and then concentrations of COPCs in soil, groundwater, and soil gas are calculated to ensure this target is not exceeded.

A target cancer risk of 1×10^{-6} (1 in one million) is the most protective standard commonly used in human health risk management decisions. HBRGs for carcinogens are therefore set at levels such that incremental cancer risks for individual COPCs will not be greater than 1 in one million. This low target risk is chosen to account for the potential for receptors to be exposed to more than one carcinogenic COPC. That is, by choosing a low "acceptable" risk for exposure to individual chemicals, additive impacts from exposure to several chemicals present at their HBRG are also kept low. Generally, acceptable risk from exposure to multiple chemicals should not exceed 1×10^{-5}. Using a target risk of 1×10^{-6} therefore is protective even if 10 chemicals are present at their HBRGs. Examination of Site data indicates that few chemicals are likely to present at such concentrations, confirming that the approach used to develop HBRGs will be protective for cumulative effects of multiple chemical exposures.

For noncancer health effects, a target Hazard Index (HI) of 0.2 is selected for use in commercial areas. This target is one-fifth of the standard target of one. This low target is also selected to account for the potential for receptors to be exposed to more than one chemical that might cause noncancer health effects. The approach used is conceptually the same as that described above for addressing exposure to multiple carcinogens. Using a target HI of 0.2 for individual chemicals suggests that up to 5 chemicals could be present at their HBRGs without exceeding an overall HI of 1. Because hazards are added only for chemicals that affect the same target organ(s), cumulative impacts would only be seen if all chemicals present at their HBRGs also had similar toxicity profiles. Thus, a "safety factor" of 5 is appropriate for considering cumulative impacts for noncarcinogens. Finally, many chemicals demonstrate both carcinogenic and noncarcinogenic effects. For these chemicals, HBRGs based on cancer risks are almost always lower than those based on noncancer hazards. This finding reduces the potential for the occurrence of multiple chemicals at HBRGs based on noncarcinogenic effects.

HBRGs are calculated as the ratio of target risk or hazard to the risk or hazard for a unit concentration of chemical in an environmental medium—1 mg/L for groundwater, 1 milligram per kilogram (mg/kg) for soil and 1 milligram per cubic meter (mg/m^3) for soil gas. For example, if the calculated cancer risk for a COPC present in groundwater at a concentration of 1 mg/L is 2×10^{-5}, and the HBRG is to be calculated so that possible exposure will not result in a cancer risk greater than the target risk of 1×10^{-6}, then the HBRG is calculated as 1×10^{-6} divided by 2×10^{-5}, which equals 0.05 mg/L. Unit risks and hazards for these calculations assumed additive cancer risk and noncancer hazard. That is, for each scenario, unit risks and hazards were separately summed for all exposure pathways involving a given environmental medium.

HBRGs for several chemicals that demonstrate both carcinogenic and other toxic properties were calculated for both cancer and noncancer effects. HBRGs adopted are the more stringent (i.e., more public health protective) of these two estimates and typically based on cancer risks.

3.2.1.3.3 "Reality Checks" for HBRGs

HBRGs for soil could exceed saturation limits and those for groundwater could exceed solubility limits. Concentrations that exceed saturation or solubility limits imply that free product is present. Thus, use of HBRGs alone to identify locations where remediation could be required might allow, in such cases, free product to remain in place. Therefore, when an HBRG for a given chemical exceeded saturation or solubility limits, the saturation or solubility limit was substituted for the calculated HBRG.

3.2.1.3.4 Campus Area HBRGs

Table 3-3, *Final Commercial HBRGs for Organic COPCs in Campus Area Soil,* and Table 3-4, *Final Commercial HBRGs for Inorganic COPCs in Campus Area Soil,* present the HBRGs approved by the RWQCB for the list of Campus Area soil COPCs. Proposed Groundwater HBRGs are presented in Table 3-5, *Final Commercial HBRGs for Organic COPCs in Campus Area Groundwater.* The complete list of HBRGs based on the Site-wide COPC list is included in Appendix I.

3.2.2 Soil Remediation Triggers

SRTs are calculated concentrations of chemical contaminants in soil that will protect shallow groundwater resources within the Campus Area. Calculating these concentrations involves, in general, establishing how leachable COPCs in soil could migrate to groundwater, quantifying this migration, and then determining levels of COPCs in soil that are sufficiently low to ensure that concentrations of these chemicals in groundwater will not exceed acceptable levels (IESI, 2001b).

SRTs aim to protect the quality of the groundwater resource, not to address human health risk. However, as shown in the final calculations of SRTs below, the SRTs are all lower than corresponding HBRGs. In part this is due to the fact that exposure pathways for direct contact with, or ingestion of, contaminated soil or groundwater

are not considered complete within the Campus Area. Thus, the soil and groundwater HBRGs are tied primarily to the risk of off-gassing of VOCs from these media. SRTs, on the other hand, are back-calculated to assure that the groundwater quality will not exceed the groundwater protection RO, which seeks to achieve MCLs. Because MCLs are themselves health-based standards, the effect is that SRTs are more conservative than the corresponding HBRGs. Such SRTs will help ensure that residual soil contamination in the Campus Area will not migrate in significant amounts to shallow groundwater beneath source areas, and subsequently, be carried in groundwater to currently un-impacted areas.

The methodology for making the calculations is the subject of considerable Cal/EPA and USEPA guidance, which has been used in developing SRTs for the Campus Area.

Development of SRTs involves several basic steps, including:

1. Identifying COPCs that can leach to groundwater;
2. Identifying soil and hydrogeologic characteristics that are essential to predicting soil to groundwater migration;
3. Developing a conceptual subsurface model;
4. Estimating COPC migration potentials using appropriate models; and
5. Calculating acceptable concentrations in soil using MCLs as target "acceptable" groundwater concentrations.

As with the preceding discussion of HBRG development, the following subsections set out a summary of how the steps in this methodology were used to develop SRTs. A fuller discussion can be found in *Soil Remediation Triggers, Campus Area at Playa Vista* (IESI, 2001b).

3.2.2.1 Chemicals of Potential Concern for SRT Development

IESI developed SRTs for 18 organic chemicals found in source area soils in the Campus Area (IESI, 2001b). The 18 chemicals included, but were not limited to, all organic contaminants detected in groundwater at concentrations greater than their applicable MCLs.

3.2.2.2 Conceptual Exposure Models

IESI used site-specific soil and hydrogeological data obtained during Campus Area characterization activities to define a conceptual model of the subsurface (Figure 3-1).

Data collected from beneath the Campus Area indicate that analysis of migration of COPCs in groundwater can be adequately characterized assuming two basic water-bearing units. As discussed in more detail in Section 2.4.1, first encountered groundwater exists in the upper Bellflower aquitard. This aquitard consists primarily of clays and silts, and is characterized by limited hydraulic flow. Below the upper Bellflower aquitard is the lower Bellflower aquitard, which also consists primarily of

low permeable soils although increased fractions of silty/clayey sands make this water-bearing unit slightly more hydraulically conductive than the upper Bellflower aquitard. Due to the hydraulic properties of the upper Bellflower aquitard, COPCs that migrate away from source areas must first migrate vertically through the upper Bellflower aquitard before they can migrate horizontally away from the source area in the lower Bellflower aquitard (and Ballona aquifer).

3.2.2.3 Determining Migration Potential and Calculating SRTs

Because protection of groundwater in sources areas (protection of upper Bellflower aquitard), and protection of groundwater outside of source areas (protection of lower Bellflower aquitard) involve different migration pathways, two sets of SRTs were developed (IESI, 2001b). Details of the approach and the development of SRTs are available in IESI (2001b). The first set of SRTs, USRTs, are designed to protect the upper Bellflower aquitard; the second, LSRTs, are designed to protect the lower Bellflower aquitard.

SRTs were developed using two transport models in series. First, leaching of COPCs from soil to groundwater was estimated using VLEACH. This model was developed by USEPA and is commonly used to predict vertical (downward) migration of chemicals in the vadose zone to groundwater. The Summers Model used the output from VLEACH to predict concentrations of COPCs in groundwater downgradient from source areas. Together, the two models provide a conservative prediction of COPC concentrations in groundwater directly beneath a source of soil contamination.

To run the models, certain decisions had to be made with respect to the contamination and the nature of the unsaturated zone. Contamination was defined, using Site-specific data, in 1-foot intervals, overlaid on the soil zones described above, from the soil surface to first encountered groundwater (i.e., upper Bellflower aquitard). Downward migration of this contamination is a function of precipitation and infiltration, soil-water partitioning, vaporization and vapor migration, as well as the soil characteristics of the unsaturated zone. These interactions are resolved by the VLEACH model, as discussed by IESI (2001b).

IESI indicated that data collected from soil boring and monitoring well logs could be used to adequately characterize the unsaturated zone for the VLEACH model by assigning three soil layers to this zone. The three layers are denoted as upper, middle, and lower, with the lower layer in communication with the first encountered groundwater. Each soil layer was defined using Site-specific estimates for properties such as dry bulk density, porosity, and moisture content (IESI, 2001b).

The calculated results from running the models are shown in Table 3-6, *Soil Remediation Triggers.* This table presents both USRTs and LSRTs developed under the approach described above. In all instances, USRTs and LSRTs are substantially lower than corresponding HBRGs.

3.3 Chemicals of Concern

Media-specific COCs for the Campus Area, which are those chemicals requiring remedial action to meet the ROs, are identified in this section. The COCs were identified for the Campus Area based on the presence of Site COPCs that have been detected at concentrations exceeding RGs for the protection of human health, or the protection of the groundwater resource. Specifically, results from historical soil investigations that exceed soil HBRGs, LSRTs, and USRTs were identified as COCs. Similarly, the results from all groundwater monitoring investigations that exceed groundwater HBRGs were identified as COCs. As an additional protective measure, groundwater data exceeding California Title 22 MCLs were also identified as COCs. A summary of the COCs identified for Campus Area soil and groundwater, including all RGs (i.e., HBRGs, LSRTs, USRTs, and MCLs) is provided in Table 3-7, *Media-Specific Chemicals of Concern and Remedial Goals*.

For soil, COCs identified based on exceedances of soil HBRGs are: PCE, copper, cadmium; total chromium, and vanadium. Additional COCs for soil based on concentrations that exceed LSRTs include: TCE; cis-1,2-DCE; trans-1,2-DCE; VC; 1,1-DCE; 1,1,1-TCA; 1,1-DCA; 1,2-DCA; MC; benzene; toluene; arsenic; and total chromium. No additional COCs were identified based on soil concentrations that exceed USRTs.

For groundwater, COCs identified based on exceedances of groundwater HBRGs are: 1,1-DCE; VC; and benzene. Additional COCs for groundwater based on concentrations that exceed MCLs include: PCE; TCE; 1,1,1-TCA; 1,1,2-TCA; 1,1-DCA; 1,2-DCA; cis-1,2-DCE; trans-1,2-DCE; 1,4-Dichlorobenzene (1,4-DCB); MC; toluene; ethylbenzene; and xylenes.

Remedial activities discussed later in this document focus on the above COCs, and areas and media where exceedances of RGs occur. COC-based remediation assures both human health and the groundwater resource are protected.

3.4 Application of Remedial Objectives and Goals

To summarize, the quantitative RGs -- HBRGs and SRTs - developed for this RP are used in the sections that follow to identify areas where remediation is needed. This identification will provide an initial indication of the amount of reduction of contamination needed, and guide the selection of remedial actions appropriate to meet the desired reduction. Stated another way, HBRGs are used to identify areas where remedial actions are necessary to address the presence of COCs that pose a potential threat to human health, if unabated, while SRTs are used to identify areas where remedial actions are necessary for the protection of the groundwater resource.

HBRGs and SRTs may not be final cleanup standards, but rather remediation triggers for the Campus Area. Remediation is planned for areas where current concentrations of COCs exceed these numerical criteria, but selection of remedial alternatives considers other factors, including the various means to reduce contaminant mass and

media concentrations to the extent feasible. For example, active remediation (e.g. groundwater extraction, enhanced biodegradation, or other) may be followed by MNA, to further reduce COC concentrations in the subsurface.

Section4
Known Nature and Extent of Contamination

This section presents information on the extent of COCs in soil and groundwater in the Campus Area. Source Areas (SAs) were identified by comparing media-specific data to the RGs presented in Section 3 as well as considering historical Campus Area activities and usage. Data showing COCs that exceeded the RGs (HBRGs and LSRTs) resulted in the identification of nine potential SAs.

4.1 Identification of Source Areas

As presented previously, numerous investigations have been conducted in the Campus Area to identify impacted soils and groundwater. These investigations have been performed by MEE; IESI, B&C, Environmental Engineers and Contractors (EEC), ENSR Consulting and Engineering (ENSR), SECOR, Geomatrix, CDM, and others. A comprehensive list of the primary Campus Area investigation and characterization reports is presented in Section 2.2. In addition, summary tables of groundwater and soils data collected in the Campus Area are presented in Appendices C and D.

From these data, nine SAs were identified based on COC exceedances of HBRGs for soil and groundwater (i.e., protection of human health) or LSRT exceedance for soil (i.e., protection of the groundwater resource). The nine SAs and their general locations are depicted in Figure 4-1, *Source Areas in the Campus Area.* The SA numbers in Figure 4-1 match Site Location I.D.s provided in the summary of historical investigations (Appendix D).

Table 4-1, *Chemicals of Concern Identified by Media for Each Source Area* identifies the nine SAs as well as the COCs for groundwater and soil at each SA that exceed the RGs presented in Section 3. Additionally, groundwater data exceeding California Title 22 MCLs, a criterion of the ROs, were included in Table 4-1 for completeness. Similarly, soil data exceeding soil USRT values that are designed to protect first encountered groundwater to MCLs, are included in Table 4-1. The significance of groundwater data exceeding MCLs and soil data exceeding USRTs are discussed further in Section 8.

At several of these SAs, some historical remediation activities have been conducted to remove impacted soil that posed a potential threat to human health and/or the groundwater resource.

4.2 Summary of Soil and Groundwater Data and Historical Remedial Activities at the Source Areas

A summary of the identified SAs, existing or formerly impacted soil and/or groundwater; and any historical remedial activities, are presented below. For ease of discussion, the following sections summarize historical detections in soil that exceed the HBRGs, LSRTs, and USRTs, and HBRGs for groundwater. Contaminants in groundwater that exceed MCLs are also summarized in Table 4-1.

4.2.1 SA No. 1- Former Underground Storage Tanks (UST) South of Former Building 5

This area included a 1,500-gallon UST that was used to store cutting oils (MEE, 1987a). Soil samples were collected from four soil borings and analyzed for VOCs, TPH, and PCBs (MEE, 1987a). TCE, PCE, benzene and MC were detected above the soil LSRTs and USRTs. PCBs and TPH were also found in soil samples obtained from this location. The UST at this location and an adjacent 500-gallon UST, were initially abandoned in place in 1992 and remained so until nearby Buildings 5 and 6 were decommissioned in 1998. In 1998, the USTs and some soils were removed (B&C, 1999). Four stockpiles samples were collected and analyzed for PCBs, VOCs, TPH, and metals. All analytes were below the remediation criteria. After removal of the USTs, seven borings (GP-53 through G-58, and GP-60) were advanced in November 1998 to depths between 5 and 20 feet bgs to delineate the vertical and lateral extent of impacted soil. Soil samples were collected from the borings at depths between 5 and 20 feet bgs. Several VOCs were observed below the soil LSRTs and USRTs (B&C, 1999).

An additional investigation was performed during the Soil and Groundwater Investigation (SGI1) Report for the Phase 1 project area (CDM, 2000a). Two soil borings (D37 and D38) were advanced to a maximum depth of 13 feet bgs in the vicinity of the former USTs to better delineate the lateral extent of VOC impacted soil. Laboratory reports of these soil samples indicate that chlorinated VOCs were not present above laboratory reporting limits. Groundwater samples collected in this area, however, indicate the presence of VOCs. Groundwater samples collected from monitoring well C-86ba, which is screened from 45 to 55 feet bgs, during the first quarter of 2002 indicate the presence of several VOCs, including 1,1-DCA (690 µg/L), cis-1,2-DCE (110 µg/L), and VC (200 µg/L) (CDM, 2002).

For SA-1, VC exceeded the groundwater HBRGs. PCE, TCE, and benzene exceeded the soil LSRTs (Table 4-1). However, confirmation soil sampling conducted following the excavation and tank removal did not indicate any VOC detection exceeding LTRSs.

4.2.2 SA No. 2- Southwest Corner of Former Building 12

This area consists of a former Plating Shop, two associated former clarifiers, and a former test sump located near the southwest corner of former Building 12. The test sump received waste containing 1,1,1-TCA, acetone, and other solvents as well as cleaning agents from the plating operations. Soil sampling conducted in 1987 (MEE, 1987a) indicated that VOCs were present, extending from the bottom of the sump down to the water table. Trans-1,2-DCE, 1,1-DCE, 1,1-DCA, benzene, MC and TCE were detected in soil samples and concentrations ranged from 0.004 to 7.9 mg/kg. (MEE 1987a). From 1988 to 1989, the former Building 12 clarifiers and sump were removed and the adjacent soil excavated (MEE, 1989). Confirmation sample results did not indicate any VOC concentrations exceeding LSRTs and USRTs. However, additional investigations by ENSR in 1997 and CDM in 1999 detected VOCs in this area. B&C also conducted sampling of the area in 1998 and metals analysis showed cadmium at 21 mg/kg and total chromium at 360 mg/kg (B&C, 1999b).

In December 2000 and January 2001, nine soil samples were collected from six borings. Samples were analyzed for VOCs and the following compounds with concentrations exceeding soil LSRTs and/or USRTs were detected: cis-1,2-DCE (0.86 to 2.25 mg/kg), VC (0.01 mg/kg), 1,1-DCA (0.039 to 0.191 mg/kg), and TCE (0.038 to 1.23 mg/kg), and PCE (0.007 to 0.264 mg/kg).

Groundwater samples collected from monitoring well C-09, which is screened from 25 to 35 feet bgs, during the first quarter of 2002 indicate the presence of several VOCs, including cis-1,2-DCE (14,000 µg/L), VC (13,000 µg/L), 1,1-DCA (3,300 µg/L), and 1,1-DCE (130 µg/L) (CDM, 2002).

For SA-2, VC and 1,1-DCE exceeded the groundwater HBRGs. Cadmium and Total Chromium exceeded the soil HBRGs. 1,1-DCA, cis-1,2-DCE, trans 1,2-DCE, TCE, and MC exceeded soil LSRTs. 1,1-DCE, VC, PCE, and benzene exceeded only soil USRTs. (Table 4-1).

4.2.3 SA No. 3- Central Area of Former Building 12

A former plating shop and circuit board lab were located in the south central region of former Building 12 and were operated from 1961 to 1975. Operations at this location included plating, etching, stripping and degreasing. In 1997 ENSR advanced four borings in the area. Soil samples were analyzed for VOCs, TPH and metals. All analytes were below soil HBRGs and LSRTs (ENSR, 1997).

A total of 48 geoprobe soil samples from 12 borings (GP18 through GP-28; and GP-33) were collected at depths between 5 and 20 feet bgs in 1998 (B&C, 1999b). The maximum VOC concentrations detected in the soil samples were TCE (1.2 mg/kg), 1,1-DCA (0.42 mg/kg), and cis-1,2-DCE (1.8 mg/kg). Total chromium was detected at 890 mg/kg. Five additional soil samples (310 series) were also collected during this investigation and analyzed for metals. Total chromium and copper were detected at 1,700 mg/kg and 2,100 mg/kg respectively.

Groundwater samples collected from monitoring well C-89be, which is screened from 23 to 38 feet bgs, during the first quarter of 2002 indicated the presence of several VOCs, including VC (840 µg/L), cis-1,2-DCE (300 µg/L), and 1,1-DCA (96 µg/L) (CDM, 2002).

For SA-3, VC exceeded groundwater HBRGs. Copper and total chromium exceeded soil HBRGs and cis-1,2-DCE exceeded LSRTs. 1,1-DCA and TCE exceeded soil USRTs (Table 4-1).

4.2.4 SA No. 4– Former Drum Storage Area (near Former Building 34)

The former Drum Storage Area was located south to southwest of former Building 34 and was used for approximately 25 years for the storage of drums containing kerosene, lubricating oils, cutting oils, hydraulic oils, degreasers, solvents and antifreeze (MEE, 1987a). The storage drums were placed on an asphalt-covered area, on five gravel covered spill tarps, and on a leakage collection tray that drained into an underground sump. Soil analyses from 1986 detected elevated concentrations of 1,1,1-TCA (30 mg/kg), 1,1-DCE (340 mg/kg), 1,1,-DCA (121 mg/kg), and PCE (340 mg/kg), as well as lesser concentrations of several other VOCs and fuel components (MEE, 1987a).

VOC-impacted soil within the former Drum Storage Area was excavated in 1988 (MEE, 1989b). A total of 23 confirmation soil samples were collected and analyzed for TPH, VOCs and PCBs. Several VOCs were detected in soils including 1,1-DCE, TCE, PCE, and 1,1,1-TCA. Total TPH concentrations were detected up to 6,100 mg/kg. PCBs were not detected above reporting limits.

An additional investigation was performed during the SGI1 for the Phase 1 project area (CDM, 2000a). Two soil borings (D44 and D45) were advanced to maximum depths of 12 and 6 feet bgs, respectively. The samples were analyzed for VOCs, TPH, MTBE, and metals. Laboratory results for these soil samples indicated that all analytes were below LSRTs or HBRGs.

More recently, a soil investigation was conducted from March 28, 2001 to April 3, 2001 to assess the extent of the remaining VOC-impacted soil (EEC, 2001c - see Appendix F). A total of 63 soil samples were collected from 24 locations at depths ranging from 1 to 13 feet bgs and analyzed for TPH, VOCs and metals. TPH and several VOCs were detected in soils, including 1,1-DCA (0.003 to23 mg/kg), 1,1,1-TCA (0.0031 to 510 mg/kg), 1,1-DCE (0.007 to 14 mg/kg), PCE (0.003 to 130 mg/kg), VC (0.0058 to 0.76 mg/kg) and toluene (0.0054 to 63 mg/kg).

Based on these findings, five areas around the former drum storage area were identified for excavation. In April 2001, potentially impacted soil from 4 feet bgs to approximately 12.5 feet bgs was excavated from each identified area (EEC 2001c -see Appendix F). Following the excavation, confirmation soil samples were collected and analyzed for VOCs. PCE (0.0068 to 15 mg/kg), 1,1-DCE (0.011 to 2 mg/kg), 1,1-DCA

(0.0084 to 2.8 mg/kg), VC (0.0052 to 1.1 mg/kg), and MC (0.022 to 0.94 mg/kg) were detected in soil samples.

Groundwater samples collected from monitoring well C-74be, which is screened from 17 to 32 feet bgs, during the first quarter of 2002 indicated the presence of several VOCs, including 1,1-DCA (6,200 µg/L), VC (270 µg/L), cis-1,2-DCE (21 µg/L), and TCE (14 µg/L), and chloroethane (CET) (2,400 µg/L) (CDM, 2002).

For SA-4, VC exceeded the groundwater HBRGs . PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, 1,1-DCA, 1,1-DCE, 1,2-DCA, VC, 1,1,1-TCA, benzene, and toluene exceeded soil LSRTs (Table 4-1).

4.2.5 SA No. 5- Former UST and Degreaser Pit West of Building 11

During a drilling program in 1983, fuel hydrocarbon free product was observed on groundwater in the vicinity of the USTs located in this area (MEE, 1987a). Since 1987, fuel hydrocarbon free product recovery was subsequently conducted at monitoring wells TB-04, TB-07, TB-11, and TB-12 in the vicinity of Building 11. The results of the fuel hydrocarbon recovery conducted on an approximate monthly basis since March 1999 are provided in Appendix C (Table C-5). Measurable free product has not been observed since April 2000, and only a hydrocarbon sheen has recently been observed in groundwater at these wells (CDM, 2002). First quarter 2002 monitoring data indicated an exceedance of the groundwater HBRG for benzene at monitoring well TB-12 (14,000 µg/L, see groundwater data provided in Appendix C).

Soil samples in this area were collected in 1985 during the drilling of monitoring wells TB-06, TB-07, and TB-08 [Hargis & Associates (HA), 1986]. The samples were analyzed for VOCs and benzene and toluene were detected at 80 mg/kg and 77 mg/kg, respectively. As noted above, leaking UST was subsequently discovered and was taken out of service. Four USTs and associated piping were removed in September of 1996 (AquaScience Engineers, 1996). Confirmatory soil samples were collected from beneath the product piping and from the excavated soil piles and analyzed for TPH and BTEX. The sample results were below LSRTs and USRTs. The excavations were lined with 6-millimeter thick plastic sheeting and backfilled with the excavated soil and clean imported fill sand from an on-Site stockpile.

Soil samples were collected to assess the vertical and lateral extent of contamination at two boring locations southwest of Building 11 near the Degreaser Pit (MEE, 1987a). Soil borings SB-21 and SB-22 were sampled at depths of 0.5, 2.5, 4.5, 9.5, 14.5, and 19.5 feet bgs. VOCs detected in soil included TCA (0.004 to 0.021 mg/kg), TCE (0.002 to 0.13 mg/kg), benzene (0.034 to 1.064 mg/kg), toluene (0.004 to 0.60 mg/kg), MC (0.009 to 0.45 mg/kg), and xylenes (0.68 to0. 862 mg/kg). AquaScience removed soils to a depth of 2 feet bgs in this area in 1996 (AquaScience, 1996).

Groundwater samples collected from monitoring well C-48, which is screened from 35 to 45 feet bgs, during the first quarter of 2002 indicated the presence of benzene at a concentration of 30 µg/L (CDM, 2002). For SA-5, benzene exceeded the groundwater HBRG and also the LSRT for soil. Toluene, benzene, and MC also exceeded LSRTs (see Table 4-1).

4.2.6 SA No. 6–Former Building 35

Former Building 35 was used for painting, metal plating, and heat-treating. A chromate waste sump, neutralization pit, concrete clarifier and a vapor degreaser were located in and outside of the northeastern quadrant of the building. The sump and pit were lined with fiberglass in 1986/1987 (MEE, 1987a) and they were removed when the building was decommissioned in 1998.

In 1986, MEE performed Site assessment work in the vicinity of former Building 35 and collected samples from SB-14 in the chromate sump area. Benzene and arsenic were detected at concentrations of 0.512 and 10.11 mg/kg, respectively. In 1997, ENSR conducted additional sampling (20 soil samples from ten borings). The samples were analyzed for TPH, metals, VOCs, and SVOCs. Several VOCs including PCE (0.001 to 4.1 mg/kg), TCE (0.004 to 1.2 mg/kg), and cis-1,2-DCE (0.002 to 0.13 mg/kg) exceeded LSRTs. (ENSR, 1997). Vanadium detected in one soil sample at a concentration of 120 mg/kg.

An organic waste sump was located outside of the southwest corner of former Building 35. It received waste solvents and paint sludge from paint booths inside the building (MEE, 1987a). In 1986, MEE collected eight soil samples from C-48 located near the sump, and benzene and MC were detected at concentrations of 0.44 and 0.99 mg/kg, respectively (MEE, 1987a). This sump was removed and the area was excavated to 8 ft bgs in 1998 (MEE, 1989a).

In the fourth quarter of 1998, Building 35 was decommissioned and the chromate waste sump and neutralization pit were excavated and removed during demolition activities (B&C, 1999b). The chromate waste sump and neutralization pit cavities were later backfilled with clean soil to grade.

In January 2000, CDM advanced three borings in the vicinity of the northeast quadrant of former Building 35. Soil samples were collected and analyzed for VOCs and metals. Benzene (0.47 to 6.1 mg/kg) and toluene (3.2 to 100 mg/kg) were detected (CDM, 2000b). Metal concentrations did not exceed soil LSRTs and HBRGs. Arsenic concentrations were below soil HBRGs.

In October of 2001, EEC advanced additional soil borings at the location of former Building 35 (EEC, 2001d - see Appendix F). 116 soil samples were analyzed for VOCs, SVOCs, TPH and metals. EEC encountered soil impacted by PCE and TCE at concentrations in excess of LSRTs. The location of the observed impacted soil was at the northwest quadrant of the former Building 35 at a depth of 20 feet and shallower. TPH concentrations were not detected above the laboratory reporting limits. Metal

concentrations did not exceed soil LSRTs. Arsenic concentrations did not exceed soil HBRGs.

A grab sample of groundwater was taken using geoprobe technology at a depth of 35 ft bgs (the first fully saturated zone). The groundwater analytical results for the grab sample did not indicate an exceedance of groundwater HBRGs.

For SA-6, no exceedance of the groundwater HBRGs has recently been observed at this location (CDM, 2002). PCE, TCE, MC, toluene and benzene exceeded LSRTs. Cis-1,2-DCE exceeded USRTs. Based on the recent investigation results conducted by Geomatrix/CDM and EEC, these compounds are listed as COCs (Table 4-1). Vanadium slightly exceeded the soil HBRGs in one isolated location. This isolated exceedance of the HBRGs is not considered significant and vanadium is not listed as a COC. Arsenic exceeded the soil HBRG in only one isolated sample location. Furthermore, the sample result was only slightly higher than one standard deviation of the established background level of 5.2 mg/kg for the Site, indicating that the arsenic is most likely naturally-occurring and not related to previous industrial activities. Therefore, this isolated exceedance of the HBRG is not considered significant and arsenic is not included as a COC for this SA (Table 4-1).

4.2.7 SA No. 7- Storm Drain Discharge Site

Prior to 1954, treated industrial wastewater from several industrial waste clarifiers and neutralization sumps on the north side of the Plant Site was discharged into this area. A shallow drainage ditch directed runoff in a northerly direction adjacent to the parking lot. Soil analyses from 1986 indicated the presence of benzene (0.066 to 0.7 mg/kg), and MC (0.098 to 1.2 mg/kg) (MEE, 1987a).

In December 1988 and January 1989, MEE excavated shallow soil in the vicinity of the storm drain outlet (MEE, 1989a). The excavation was extended laterally at least 5 feet beyond the drainage ditch to a depth of approximately 1-foot bgs. Approximately 100 cubic feet of soil was removed. Confirmation samples analyzed for VOCs (USEPA Methods 8020 and 8010) did not contain detectable concentrations of VOCs. Based on the results of confirmation samples analyzed for TPH (2,000 mg/kg), an additional foot of soil was removed from the area. Analysis of subsequent confirmation samples for TPH did not indicate detectable concentrations of TPH (MEE, 1989a).

In March of 2001, EEC removed the storm drain outlet catch basin. The area was excavated and 13 confirmation samples were collected (EEC, 2001a - see Appendix F). During the excavation of the storm drain outlet catch basin, a leach line was observed and additional confirmation sample was collected to determine the presence of any chemicals. Soil excavation confirmation samples were analyzed for VOCs (USEPA Method 8260B), SVOCs (USEPA Method 8270), TPH (USEPA Method 8015M with carbon chain speciation), California Assessment Manual (CAM) Metals (USEPA Method 6010B), mercury (USEPA Method 245.1A), and chromium VI (USEPA Method 7196A). VOCs did not exceed LSRTs and USRTs. Detected metal

concentrations were below HBRGs. Chromium VI was not detected (EEC, 2001a). TPH was detected at concentrations of 2,907 to 6,399 mg/kg.

Additional soil sampling to confirm the presence or absence of VOCs (previously detected at concentrations greater than LSRTs in the vicinity of well C-49) was conducted in October 2001 (EEC, 2001a). VOCs did not exceed LSRTs and USRTs.

First quarter 2002 groundwater sampling results from the closest monitoring well to this area (C-49), which is screened from 20 to 30 feet bgs, indicated the presence of 1,1-DCA (320 µg/L), cis-1,2-DCE (710 µg/L), 1,4-diclorobenzene (1,4-DCB, 58 µg/L), and VC (14 µg/L), as well as several other VOCs at lesser concentrations (CDM, 2002).

For SA-7, no exceedance of the groundwater HBRGs have recently been observed. Before excavation, MC and benzene concentrations exceeded the soil LSRTs at well C-49 located within SA-7. However, recent investigations conducted by EEC in 2001 did not detect these compounds near locations where previous detections from 1986 sampling were observed. Therefore MC and benzene are not listed as COCs in Table 4-1.

4.2.8 SA No. 8- Sumps, Clarifiers, and Former Vapor Degreaser Northeast Corner of Building 14 to Northeast Corner of Building 15

This source area consists of the Building 14 clarifier system including two concrete clarifiers and sumps that handled cutting oils and solvents from machining operations prior to 1985. In addition, it includes the former above-floor vapor degreaser area , at the northeast corner of Building 15 which was operated until 1994. Soil samples collected adjacent to the clarifier in 1986 indicated that VOCs were present, including benzene (0.042 to 0.2 mg/kg), and TCE (0.31 to 0.42 µg/kg) at location SB-23 (MEE, 1987a). Impacted soils associated with the trenches and clarifiers could not be excavated because this would have impaired the structural integrity of the now designated historic building. More recently, the Building 14 clarifiers and Building 15 trenches were cleaned and inspected (CDM, 2000a). Soil samples collected as part of the SGI1 in August 1999 confirmed the presence of chlorinated VOCs beneath the foundation. Soil concentrations were observed at five feet bgs for TCE (0.320 mg/kg), cis-1,2-DCE (0.043 mg/kg), and PCE (0.046 mg/kg) (CDM, 2000a).

In January 2001, two soil samples were collected from one boring (Geomatrix/CDM) and analyzed for TPH and VOCs. PCE (0.887 mg/kg) and TCE (0.128 mg/kg) exceeded USRTs.

Groundwater samples collected from monitoring well C-78be, which is screened from 17 to 32 feet bgs, during the first quarter of 2002 indicated the presence of several VOCs, including cis-1,2-DCE (800 µg/L), trans-1,2-DCE (99 µg/L), PCE (2.3 µg/L), and VC (100 µg/L) (CDM, 2002).

For SA-8, VC exceeded the groundwater HBRG. 1,2-DCA, cis-1,2-DCE, and benzene exceeded the LSRTs for soils. 1,1-DCE, TCE, PCE, and trans-1,2-DCE exceeded the USRTs (Table 4-1).

4.2.9 SA No. 9 - Existing Clarifier and Former Vapor Degreaser Pit Building 15 Center Bay and Utility Trenches in Building 15 North Bay

A 10,000-gallon concrete clarifier, backfilled degreaser pit, and sump are located in the western part of the Center Bay of Building 15 near Column H-33. The clarifier intercepted system drains from rinse tanks. The vapor degreaser pit was backfilled in the 1960's. The initial investigation of this area, conducted in 1986, showed detects in soil samples for 1,1-DCA (0.08 mg/kg), MC (0.08 mg/kg to 0.6 mg/kg), PCE (0.2 mg/kg to 0.4 mg/kg), and TCE (0.56 mg/kg to 9.2 mg/kg) (MEE, 1987a). Subsequent sampling in the area of the clarifier, degreaser pit, and sump, conducted by ENSR (1997) and Geomatrix/CDM (2000) confirmed the presence of VOCs in soils with detections of cis-1,2-DCE (1.5 mg/kg), PCE (12 mg/kg), and TCE (24 mg/kg). In May 2001, EEC collected 12 soil samples from four borings for additional characterization of this area. The samples were analyzed for VOCs. The sample results did not exceed soil USRTs and LSRTs.

Utility trenches located in the north bay of Building 15 run the length of the building (760 feet) and collected drips of solvents and cutting oils (MEE, 1987a). In 1986, MEE collected 16 soil samples from five borings within the trenches. Various VOCs were detected including benzene (0.073 mg/kg), 1,2-DCA (0.2 mg/kg), trans-1,2-DCE (2.8 mg/kg), and TCE (5 mg/kg) (MEE, 1987a). The trenches were pressure washed in 1994 after operations ceased. In April 1999, CDM collected two soil samples from two borings and analyzed for VOCs, metals, BTEXs, and MTBE. VOCs including TCE (5.4 mg/kg), cis-1,2 -DCE (0.77 mg/kg) and trans 1,2-DCE (0.24 mg/kg) and low concentrations of metals were detected. BTEX and MTBE were not detected above the laboratory reporting limits (CDM, 2000a).

Groundwater samples collected from monitoring well C-77be, which is screened from 15 to 25 feet bgs, during the first quarter of 2002 indicated the presence of several VOCs, including cis-1,2-DCE (900 µg/L) and trans-1,2-DCE (21 µg/L) (CDM, 2002).

For SA-9, no exceedances of the groundwater HBRGs were observed. PCE exceeded soil HBRGs at one location near the clarifier. PCE, TCE, cis-1,2-DCE, and MC, exceeded LSRTs. Trans-1,2-DCE, benzene, 1,1-DCA exceeded USRTs (Table 4-1).

4.3 Summary of Soil Gas Results

During the week of December 18 through 22, 2000, soil gas samples were collected in the vicinity of Buildings 14, 15, 16 and 21 within the Campus Area. A total of 221 soil gas samples were collected from depths of 3 to 5 feet below ground surface. Appendix I, *Soil Gas Results*, presents a description of the methods that were used to collect and analyze the samples, as well as a table of the results.

To summarize the findings, 5 of the 221 sample locations were found to have soil gas concentrations that exceeded the final HBRGs for organic compounds in commercial soil gas (IESI 2001). These HBRGs are shown in Appendix H.

All five of the sample locations with HBRG exceedances were located at the western end of Building 15, the area that has been identified above as SA-9.

Section5
Identification of Remedial Technologies and Process Options

The next step in selecting potential remedial alternatives is to identify technologies and process options that should be considered for the Campus Area.

This section presents remedial technologies and process options that have been identified as capable of meeting ROs in the Campus Area. For groundwater, these were screened remedial technologies and process options on the basis of technical feasibility. The remedial technologies and process options retained following this screening are described and evaluated in more detail in this section. For soils, no screening was done because the list of potentially applicable soil remediation technologies is limited.

5.1 Groundwater Remedial Technologies and Process Options

5.1.1 General Response Actions

The first step, at this point, is to identify general response actions, which are defined as actions that, singly or in combination, will meet the ROs defined in Section 3 or will provide a baseline for comparison with other actions. From this set, a subset of remedial alternatives is developed.

General response actions for the Campus Area include both passive and active measures to mitigate groundwater contamination. Passive measures include those that involve no active engineered technology(ies) for containment or treatment of groundwater, such as monitoring only of contaminant plume migration and/or biodegradation and attenuation, or use restrictions (e.g., land or groundwater). Active measures include the installation of systems that will contain and/or treat contaminated groundwater. The general response actions for the Campus Area are shown in Table 5-1, *General Response Actions for Groundwater.*

The general response actions listed in Table 5-1 provide a basis upon which to identify and then screen remedial technologies. Process options associated with the remedial technology are also identified. Once screened, acceptable technologies and process options are incorporated into remedial action alternatives that satisfy ROs defined in Section 3.

5.1.2 Preliminary Screening of Groundwater Technologies and Process Options

The first step, at this point, is to identify general response actions, which are defined as actions that, singly or in combination, will meet the ROs defined in Section 3 or will provide a baseline for comparison with other actions. From this set, a subset of remedial alternatives is developed.

Each remedial technology may have several process options (e.g., enhanced bioremediation, air sparging, *in situ* chemical oxidation, etc.), which refer to the specific material, equipment, or method used to implement a technology. The identified remedial technologies and process options applicable to groundwater remediation within the Campus Area are presented in Table 5-2, *Initial Screening of Groundwater Remediation Technologies and Process Options*. In the initial screening, process options were evaluated on the basis of technical feasibility, i.e. whether there were compatible with Campus Area characteristics (e.g., physical features) and chemical characteristics of the COCs, and on their overall effectiveness. Process options considered clearly infeasible or not applicable for the Campus Area were eliminated as indicated by shading in Table 5-2. In particular, these groundwater process options were eliminated from further consideration:

- Slurry walls, grout curtains, sheet piles, and reactive gates. Due to the lack of a competent geologic unit to "seat" the base of the barrier (e.g., bedrock or competent clay unit), these technologies would likely not reduce vertical migration of VOCs. In as much as the potential for vertical migration of contaminants from the Ballona aquifer to the Silverado aquifer exists, lateral migration may occur if VOCs migrate vertically into the Ballona or Silverado aquifers;

- Phytoremediation was screened because the root systems of the plants are not expected to extend fully through the Bellflower aquitard, the hydrostratigraphic unit where phytoremediation has a higher probability of mass removal; and

- *Ex situ* membrane treatment technologies. These technologies are not as reliable as other technologies available for VOC removal.

The no-action response was retained as a baseline alternative.

5.1.3 Evaluation of Retained Groundwater Technologies and Process Options

The retained technologies and associated process options surviving the initial screening in Section 5.1.2 were deemed potentially applicable to the Campus Area and evaluated further based on three criteria: effectiveness, implementability, and cost.

The effectiveness analysis focuses on the relative merits of process options, when compared to other processes within the same technology type. The criteria used in the effectiveness evaluation are:

- The ability of the process option to address the estimated volume of contaminated media and to attain ROs;

- Potential environmental and health impacts during implementation of the process option; and

- Reliability of the process option with respect to Campus Area contaminants and conditions.

The implementability evaluation considers the technical and administrative feasibility of the process options. Process options that are clearly ineffective or incompatible with the Campus Area were previously eliminated. This analysis focuses primarily on institutional implementability, including:

- Ability to obtain necessary regulatory permission (i.e., permitting), and
- Availability of appropriate process option services (e.g., vendors, technicians).

At this stage of the evaluation, cost is less significant than either effectiveness or implementability, and therefore plays a limited role in the screening of process options. Each process option is evaluated based on its costs being high, medium, or low relative to other process options in the same technology type.

Process options for groundwater, arranged according to remedial technologies and general response actions, are listed in Table 5-3, *Relative Comparison of Retained Groundwater Technologies and Process Options*. This table summarizes the screening of process options for effectiveness, implementability and cost. Process options clearly infeasible or inappropriate based on the evaluation criteria were eliminated from further consideration, as indicated by shading in the table. The evaluations of each of the remaining remedial actions and process options are described in the following subsections.

5.1.3.1 No Further Action (NFA)

Under this alternative, no remedial action would be undertaken.

Although this option is technically feasible and inexpensive, it is not effective in preventing future contaminant migration or removing the contaminants from the Campus Area. Nonetheless, the evaluation of no further action provides a baseline by which all other alternatives are evaluated.

5.1.3.2 Monitored Natural Attenuation (MNA)

MNA is an *in situ* remediation technology that relies on naturally-occurring processes (including biodegradation, dispersion, matrix diffusion, sorption, volatilization, and chemical degradation) to reduce the concentration, and in some instances, mass of contaminants in groundwater and soils. MNA is recognized by the USEPA and the State of California as a viable method of remediation that can be evaluated and compared to other remediation strategies. This method of groundwater remediation may be used as the sole remediation technology when it: (1) is combined with some degree of source control; (2) is shown to be fully protective of human health and the environment; and (3) meets ROs within a reasonable time frame. An established monitoring program is required to evaluate the effectiveness of MNA. MNA may

also be used in combination with other process options as a concurrent technology, or implemented following the completion of other technologies.

The effectiveness of MNA is dependent on the types of contaminants, and the chemical, physical, and biological characteristics of the soil and groundwater at a particular location. In areas of elevated contaminant concentrations (e.g., source areas), MNA effectiveness as a stand-alone technology is low because it likely would not meet the RO that requires the reduction of groundwater concentrations to levels protective of human health and the groundwater resource in a timely fashion, as compared with other technologies. However, MNA may be more effective if implemented with appropriate risk control measures, or after alternate remedial technologies have resulted in a reduction of contaminant mass. MNA is easily implemented and requires moderate costs over the lifetime of the project. MNA is therefore retained as a remediation technology.

5.1.3.3 Institutional Controls

Institutional controls function to prevent or reduce public contact with contaminated media and have little or no effect on the presence of contaminants. Examples of institutional controls include Site use restrictions (e.g., deed restrictions) and public education. These are discussed below.

Use Restrictions

Use restrictions are an institutional control mechanism in which a governing body regulates the access or use of a site. For the Campus Area, restrictions may be imposed to ensure that the land use is limited to commercial development, unless otherwise allowed by governing regulatory agencies in the future. In addition, institutional controls can be established through legally enforceable prohibitions, such as CC&RS that preclude private withdrawals of groundwater. Institutional restrictions on groundwater use is a typical component of a remedial action, because they prevent public use of untreated groundwater.

However, because use restrictions alone do not meet the RO that requires the sources of contaminants to be reduced or eliminated; their effectiveness is low. Use restrictions may require regulatory permitting and cooperation with state and local agencies, which may be troublesome to obtain, making them moderately implementable. On the other hand, establishing and enforcing such restrictions is only moderately expensive. Thus, use restrictions are retained as a process option, which may apply to a number of remedial technologies.

Public Education

Public education can be used to facilitate protection of human health. This requires educating the public about the potential risks associated with exposure to contaminated groundwater. Water quality information can be disseminated through fact sheets, public meetings, and local news media announcements.

Public education alone does not meet the RO that requires the sources of contaminants to be reduced or eliminated; therefore, the effectiveness is low. Public education via fact sheets and public meetings is easily coordinated and highly implementable. The cost for such actions is typically low to moderate compared to other response actions. Public education is retained as a process option due to the high implementability and low to moderate cost of this option, despite its limited effectiveness.

5.1.3.4 Hydraulic Containment

Of the various forms of hydraulic containment, a general response action, vertical barriers (slurry walls, grout curtains, and sheet piling) were eliminated from further consideration in Section 5.1.2. However, two other types of surface water infiltration reduction are retained and discussed below.

Source Area Capping

Infiltration of surface water into contaminated areas of the Campus Area contributes to contaminants leaching into groundwater as the contaminants are desorbed from soil and transported down into groundwater. Capping source areas will reduce this risk. In addition, some capping will result from development activities such as the placement of concrete, asphalt, building structures, or clay capping material over areas with soil contamination.

Source area capping is considered to be moderately effective because it is possible to meet the RO of reducing groundwater concentrations and contaminant migration; however, it does not reduce the presence of contaminant mass in the source areas. This process option is considered highly implementable because it can be completed as part of the Campus Area development and its costs are low with respect to other response actions. Potential source area capping is therefore retained as a process option.

Storm Water Diversion/Control

Storm water run-on near source areas may pond under conditions of high rainfall and percolate vertically through the soils, creating additional recharge that serves to increase the mobility of contaminants. Storm water diversion or control structures could serve to reduce the volume of water infiltration through source areas and reduce the vertical and lateral migration of VOCs.

Storm water diversion/control is considered to be moderately effective because it is possible to meet the RO of reducing groundwater concentrations by reducing migration of COCs from source areas to groundwater; however, it does not reduce the presence of contaminant mass in the source areas. This process option is considered highly implementable because it can be completed as part of the Campus Area development and its costs are low with respect to other response actions. Storm water diversion/control is therefore retained as a process option.

5.1.3.5 Groundwater Collection/Extraction

The principal means of recovering contaminated groundwater is through altering of the groundwater gradient to enhance and/or control contaminant movement. This response is typically accomplished by artificially influencing an existing gradient via groundwater extraction wells and/or by placing groundwater interceptor drains downgradient of the contaminated area, which options are discussed below.

Groundwater Extraction Wells

Groundwater extraction wells are commonly used as a method to influence groundwater flow and to recover contaminants. Extraction wells are used to contain the migration of a contaminant plume and/or reduce contaminant mass in groundwater. Such wells would be located within and/or downgradient of the source areas. In general, extraction wells are versatile under a variety of environmental conditions and have design and operating flexibility. Extraction wells may be used singly, or in multiples, to sufficiently contain the spread of a groundwater contaminant plume. Multiple wells should be positioned in such a way that their radii of influences overlap, thereby minimizing the potential for downgradient plume migration.

Groundwater extraction wells are considered to be moderately to highly effective because they potentially meet ROs of reducing groundwater contaminant concentrations. Extraction wells are highly implementable, and have relatively moderate capital and maintenance costs, although long-term operation may be expected. Extraction wells are retained as a process option.

Dual Phase Extraction

Dual phase extraction (DPE) is an *in situ* remediation technology that, for the purposes of this RP, is categorized under the groundwater collection/extraction general response action. DPE involves the extraction of groundwater and soil vapor at a common location, and typically consists of a "pipe within a pipe" configuration. Groundwater is extracted from a well screened across the water table using a submersible pump, while soil vapor is extracted by applying a vacuum to the wellhead. The groundwater flow to the DPE well results in removal of dissolved contaminant mass and helps to control or reverse the spread of dissolved contaminants from the source areas. Groundwater extraction also results in a cone of depression exposing additional vadose zone soil from which VOCs can be removed via soil vapor flow. Thus, the soil vapor flow results in remediation of vadose zone and exposed saturated zone soils through volatilization and removal of VOCs in extracted soil gas.

DPE is considered to be moderately to highly effective because it has the potential of meeting all of ROs for the shallow Bellflower aquitard, provided that the lithology of this unit is permeable enough to allow for an effective vapor extraction flow rate. The implementability of DPE is moderate, with the collection and treatment of off-gas

vapors and groundwater requiring treatment and regulatory permits. The cost of DPE is considered moderate. DPE is retained as a process option.

Interceptor Drains

Groundwater can also be removed by the installation of subsurface drains to intercept groundwater as it migrates beneath the Campus Area. Such drains would consist of perforated pipe in trenches backfilled with porous media. Subsurface drains or interceptor trenches may be used as an effective containment remedy.

Interceptor drains would be moderately effective at meeting the ROs to reduce groundwater contaminant concentrations. Considering the depth and spatial distribution of contamination within the Campus Area, interceptor drains have only a low to moderate implementability. This process option is most cost-effective when implemented in conjunction with concurrent soil excavation activities. As such, costs are moderate to high, but may vary depending on whether excavation is concurrent. Interceptor drains are therefore screened from further consideration.

5.1.3.6 Treatment

Treatment technologies include *in situ* and *ex situ* alternatives as described in the sections below.

In Situ Treatment

The three process options surviving the initial screening under *in situ* treatment alternatives are enhanced bioremediation, chemical oxidation, and air sparging.

Enhanced Bioremediation

Enhanced bioremediation is a groundwater technology that involves injection of an electron acceptor, electron donor, microorganisms, and/or nutrients to stimulate or enhance the biodegradation of VOCs. For chlorinated VOCs found within the Campus Area, the enhanced bioremediation technology typically involves induction of reduced groundwater environments. As such, biodegradable organic carbon (electron donor) would be injected in sufficient quantities to sufficiently lower the groundwater-reducing environment and stimulate the rapid, reductive dechlorination of VOCs. It is important to note that some of the chlorinated VOCs detected in the Campus Area (e.g., VC and cis-1,2-DCE), may also be biodegraded under oxidizing groundwater environments. Thus, injection of air into the subsurface or the application of oxygen releasing compounds may also be useful in the Campus Area, although such approaches may be complicated by the already reduced groundwater environment. Inherent challenges that may affect the feasibility of this process option include the ability to adequately deliver amendments to the subsurface; the presence of competing electron acceptors/donors; the presence of a microbial consortia capable of degrading the VOCs; and the possibility of forming additional toxic intermediates, such as VC.

Enhanced bioremediation is considered to be moderately to highly effective because it has the potential of meeting all ROs, provided that adequate delivery of amendments to the subsurface can be achieved. The implementability of enhanced bioremediation is moderate as it will require subsurface injection permits, and the costs are moderate. Enhanced bioremediation is retained as a process option.

Chemical Oxidation

In situ chemical oxidation involves the delivery of chemical oxidants to convert subsurface contaminants to innocuous end products (e.g., water, chloride ions, and carbon dioxide). The most common field application of chemical oxidation is based on Fenton's Reagent addition, whereby hydrogen peroxide is injected with an iron catalyst creating hydroxyl free radicals. These hydroxyl free radicals result in relatively non-specific chemical reactions that destroy organic compounds in the subsurface, including contaminants such as chlorinated solvents found at the Campus Area. Proprietary catalysts may also be used in the injection process to increase the efficiency of reactions; such reactions are referred to as Fenton's-Like Reactions. Permanganate is also a common chemical oxidant used in the application of chemical oxidation. Inherent challenges that may affect the feasibility of this process option include the ability to adequately deliver amendments to the subsurface (i.e., affected by permeability of soils); the presence of highly reduced subsurface conditions and high organic soils or naturally-occurring reduced metals that consume excessive amounts of chemical oxidant; and the potential mobilization of naturally-occurring metals in the subsurface.

Similar to enhanced biodegradation, the effectiveness of *in situ* chemical oxidation is considered to be highly variable, depending on the soil characteristics of the targeted treatment zone. For example, the effectiveness would be low in the native soils of the upper Bellflower aquitard as a result of presumably poor distribution of amendments and highly reduced subsurface conditions. The effectiveness of this process option may be moderate if applied to more permeable water-bearing zones, or in conjunction with infiltration galleries. The implementability of chemical oxidation is moderate as it would require subsurface injection permits, and the costs are moderate. Chemical oxidation is screened from further consideration, primarily due to the presence of highly reduced subsurface conditions that make this process option less desirable as compared with other *in situ* process options (e.g., enhanced bioremediation).

Air Sparging

Air sparging involves the installation of wells in contaminated groundwater areas to inject air into the saturated zone. The induced airflow enhances the volatilization of the VOC contaminants from groundwater into the vadose zone. Once in the vadose zone, the VOCs can be removed via soil vapor extraction (SVE). The application of this technology is highly dependent on the hydraulic conductivity, the zone of influence (ZOI) of the air injection and vapor extraction wells, and the airflow rate sustained through the contaminated zones. Preferential flow paths established for airflow have the potential for limiting the contaminant contact area and limiting the effectiveness of the sparging process. It should be noted that the injection of air may

alter the groundwater reducing environment, thereby limiting any further reductive dechlorination of chlorinated contaminants. However, such introduction of air may lead to an oxidizing environment, thereby creating conditions in which oxidative biodegradation of some chlorinated VOCs (e.g., VC and cis-1,2-DCE) may occur.

Similar to other *in situ* technologies, the effectiveness of air sparging is considered to be highly variable, depending on the soil characteristics of the targeted treatment zone. For example, the low permeable soils characteristic of the Bellflower aquitard are expected to complicate the recovery of volatilized contaminants, thereby limiting the effectiveness of this technology. Furthermore, the addition of air to the saturated zone will interfere with biological, reductive dechlorination processes. For these reasons, air sparging was screened from further consideration, even though it is considered to be low to moderate in implementability and have moderate costs.

Ex situ Treatment

Inherent to all *ex situ* treatment options is that groundwater is removed from the subsurface to the surface for treatment. Groundwater collection/extraction is achieved through the use of either extraction wells or interceptor drains, or a combination of both. A review of the process options focused on determining the appropriate treatment process for the removal of chlorinated organic compounds in groundwater. The required treatment efficiency is dictated by limits on discharge to an on-Site water treatment facility, Public Owned Treatment Works (POTW), storm drain, and/or surface discharge.

Air Stripping

Air stripping towers have been used effectively for removing numerous dissolved VOCs from groundwater waste streams. Contaminated water enters the stripping tower at the top and is evenly distributed across the internal packing media through distributor nozzles or weirs. Clean air is introduced into the bottom of the tower below the packing using a forced air blower, and flows upward through the packing. As the falling contaminated water flows countercurrent to the rising air stream, VOCs are stripped from the water and enter the air stream. Volatilized organics are then discharged to the atmosphere or an off-gas treatment system. The internal packing media acts to increase the total surface area available for mass transfer of the organic contaminants from the liquid to the vapor stream. Treated water falls from the packing into the stripper basin and exits the tower.

The extent of compound removal by air stripping is governed by many factors, including contaminant concentrations in groundwater, temperature of the air and water, the air-to-water ratio, and contaminant physical properties (e.g., Henry's Law constant). Air stripping tower performance may also be influenced by the presence or absence of various inorganic compounds and suspended solids in the groundwater. Groundwater with elevated hardness may result in calcium and magnesium salt deposits in the tower packing media. Elevated iron (concentrations over 5 mg/L) or

manganese concentrations, when oxidized in the air stripper, will result in metal hydroxide precipitation, which can severely foul the packing media and reduce its effectiveness to remove VOCs. In addition, elevated total suspended solids (TSS) concentrations in the groundwater can also result in solids deposition on the tower packing and reduce liquid-to-air mass transfer.

Groundwater within the Campus Area contains moderately high concentrations of iron and suspended solids that may require pretreatment. Pretreatment equipment could include multi-media filters to remove TSS, followed by greensand filters (if necessary) to remove iron. An alternative approach to pretreatment equipment may be the use of proprietary chemical complexing agents that prevent iron from precipitating in the air stripping tower. The need for pretreatment should be explored during the remedial design phase to identify the appropriate combination of pretreatment steps.

The majority of VOCs found within the Campus Area exhibit relatively high Henry's Law constants and, therefore, are expected to be effectively treated with air stripping. For this reason, air stripping is considered highly effective. The implementability of this technology is moderate. The cost of air stripping is moderate relative to other *ex situ* treatment options. Air stripping is retained as a process option.

Ultraviolet Enhanced Chemical Oxidation

The chemical destruction of organic compounds through oxidation is a common practice in many industrial processes. The process involves mixing the influent water with one or more chemical oxidizers, such as ozone and/or hydrogen peroxide, followed by irradiating the water with ultraviolet (UV) radiation. As a result of these reactions, the organic compounds are transformed to less harmful compounds. Advantages of this process are that the contaminants are destroyed rather than being transferred to another media and that it does not generate significant air emissions or other residual waste that will require further treatment. Furthermore, this technology is also applicable to highly soluble contaminants, which are not effectively treated with the carbon adsorption technologies. Potential disadvantages are high operating costs (electrical power and chemical oxidizers) and reduced effectiveness if ozone-demanding or hydroxyl radical-trapping substances occur in the water. In addition, post-treatment using carbon adsorption may be necessary to remove incomplete oxidation byproducts.

UV-enhanced chemical oxidation is a highly effective technology that is applicable for the treatment of all VOCs found in the Campus Area groundwater. This technology is considered low to moderately implementable and does not generate significant air emissions or residual wastes that will require substantial regulatory permitting. Although this process option has high costs relative to other process options, UV-enhanced chemical oxidation is retained as a potential polishing treatment technology.

Biological Treatment

As discussed in the enhanced bioremediation *in situ* treatment process option (Section 5.1.3.6), organic contaminants may be readily biodegraded to innocuous end products under the appropriate environmental conditions. The biological treatment of groundwater often involves the induction of oxidized or reduced groundwater conditions, or a combination of both in series, to achieve the desired removal efficiency. Biological treatment systems may be difficult to maintain relative to other treatment alternatives and require the collection and disposal of sludge materials (i.e., waste products).

Despite moderate effectiveness and implementability, biological treatment is characterized by high operational costs and, therefore, screened from further consideration as a process option.

Activated Carbon Adsorption

One process option for organics removal from both liquid and gaseous phases is activated carbon adsorption. Activated carbon adsorption is most often carried out in a pressurized vessel that contains a bed of granular activated carbon. Contaminated liquid or vapor enters a pressurized vessel and is evenly distributed over the granular activated carbon. As the contaminated stream flows through the activated carbon media, organic compounds are adsorbed onto the micro-porous surfaces of the activated carbon by an electrical attraction. When the porous surfaces of the carbon become saturated with adsorbed organic material, the carbon must be replaced with new or thermally regenerated carbon media. Activated carbon adsorption is a surface attraction phenomenon influenced by several factors including physical properties of the carbon and contaminant compounds, and system characteristics such as dissolved solids concentration, temperature, and pH. Depending on the composition of the waste stream, pretreatment steps such as multi-media filtration or clarification might be necessary to enhance the removal efficiency and life of activated carbon filters. Carbon adsorption is typically used for vapor waste streams when contaminant concentrations are less than 1,000 parts per million by volume (ppmv). Operating life before carbon exhaustion is primarily a function of the flow rate and the concentration of organic compounds in the influent stream.

The majority of VOCs found within the Campus Area exhibit relatively high adsorption capacities, and therefore will be effectively treated with activated carbon. However, the more soluble and volatile compounds such as VC will likely require other treatment technologies to achieve desired removal efficiencies. Furthermore, groundwater within the Campus Area contains several reduced metals (e.g., reduced iron and manganese) that, if not removed or complexed, may oxidize and plug the carbon media.

Overall, activated carbon is considered to be moderately to highly effective. This technology is highly implementable. The costs of carbon adsorption are moderate to high and depend on the frequency of carbon bed exhaustion, which require carbon

replacement or regeneration and disposal of spent carbon and concentrated wastes. Activated carbon adsorption is retained as a process option.

Synthetic Resin Adsorption

VOCs can be adsorbed using various synthetic resins in place of activated carbon. In contrast to activated carbon, which will adsorb a wide variety of chemicals, synthetic resins are designed to selectively adsorb particular chemicals or families of chemicals. In certain applications, this is advantageous because only chemicals of concern are removed. However, this selectivity may also result in synthetic resins being inappropriate or incapable of treating all contaminants in a waste stream, and overly expensive (because additional resins or treatment trains may be needed) for certain treatment applications where a wide variety of chemicals must be removed. Synthetic resin adsorption systems are typically constructed as on-Site regenerative systems because the resins may be regenerated more than 1,000 times without any loss of adsorptive capacity, and because limited infrastructure exists to perform off-Site recycling of the resins, as is the case with activated carbon. Thus, long-term liabilities common with off-Site disposal of carbon will be limited by using a synthetic resin adsorption system. Also, synthetic resins typically have a greater tolerance for high moisture content vapor streams than activated carbon systems.

Synthetic resin adsorption systems are considered to be only moderately effective and implementable, primarily due to the emerging status of this technology. Furthermore, the presence of elevated suspended solids or solids formed by the precipitation of reduced metals such as iron and manganese can foul the bed requiring possible pretreatment measures. Synthetic resin adsorption costs are considered moderate to high as on-Site regenerative systems generally have greater capital costs than typical carbon adsorption systems that employ off-Site regeneration or disposal, although the operating costs may be lower. Due to the emerging status and potentially high costs of this process option relative to other options, synthetic resin adsorption is screened from further consideration.

Thermal Oxidation

Thermal oxidation units destroy VOC vapors through thermal destruction mechanisms. In this process, VOC vapors are preheated, thoroughly mixed, and combusted at high temperatures (e.g., 1,200 to 1,600 ^{o}F), forming carbon dioxide and water. The primary advantage of thermal destruction is that the contaminant is chemically altered so that it is no longer toxic. Thermal oxidation units are most efficiently applied for treating off-gas containing 1,000 to 5,000 ppmv of combustibles. Thermal oxidation systems require auxiliary fuel (e.g., natural gas or propane) when treating low-concentration waste streams.

Thermal oxidation units are characterized by simple operation and high compound destruction efficiencies. However, it is unlikely that VOC concentrations in the vapor stream to be treated will remain high enough to make this a cost-competitive treatment approach. Furthermore, treated vapor streams will likely require scrubbing processes to remove hydrogen chloride, which makes this option more costly than

other alternatives. For these reasons, thermal oxidation is screened from further consideration as a process option.

Catalytic Oxidation

Catalytic oxidation is a process very similar to thermal oxidation; however, a catalyst module is attached to the combustion chamber exhaust. The VOC-laden vapor is directly preheated (electrically, or more frequently with natural gas or propane) to reach a temperature to initiate the catalytic oxidation of the VOCs. Then, the preheated vapor stream is passed through a bed of solid catalysts where the VOCs are rapidly oxidized. VOCs are thermally destroyed at temperatures typically ranging from 600 to 1,000 ^{o}F. Operating the combustion chamber at temperatures lower than required for thermal oxidation units improves fuel economy when treating dilute waste streams. Catalytic oxidation is best applied for treating off-gas containing 100 to 3,000 ppmv of contaminants.

Catalytic oxidation may be a highly effective technology for discrete vapor waste streams; however, it is unlikely that a catalyst capable of addressing all VOCs of concern for the anticipated waste streams is available. Furthermore, treated vapor streams will likely require scrubbing processes to remove hydrogen chloride, which makes this option more costly than other alternatives. For these reasons, catalytic oxidation is screened from further consideration as a process option.

Vapor Condensation

Vapor condensation units may be used when the contaminant concentrations are high and waste stream flow rates are low. Condensation is typically accomplished by refrigeration or with liquid nitrogen. The effectiveness of this technology is determined by the vapor pressure and temperature characteristics of the contaminants present. Because condensation of the contaminants is rarely complete, an additional method of treatment is typically required.

Vapor condensation is considered to be an ineffective treatment technology because long-term waste stream contaminant concentrations are expected to be low and flow rates are expected to be high. For these reasons, vapor condensation is screened from further consideration as a process option.

Oxidant-Impregnated Materials

High-surface-area materials impregnated with chemical oxidants such as permanganate may be used to treat VOC-laden vapor waste streams, especially those with VC. Examples of such materials impregnated with permanganate are zeolite and alumina. The VOC-laden waste streams are passed through canisters containing these materials, resulting in rapid oxidation of the VOC contaminants. The lifespan of a canister depends on both the concentration of VOCs and the flow rate of the waste stream. Once expended, the canisters will require replacement and disposal.

Oxidant-impregnated materials are considered to be moderately effective and implementable, primarily due to the emerging status of this technology. The costs of

this technology are considered moderate to high, depending on the required frequency of canister replacement. Oxidant-impregnated materials are therefore retained as a process option.

5.1.3.7 Disposal

Disposal technologies are subdivided into on-Site and off-Site discharge. Two On-Site discharge options were considered for the Campus Area: surface discharge of treated water, and discharge of treatment system off-gas of to the atmosphere. Similarly, two off-Site discharge options were considered for the Campus Area: discharge of treated water to a storm sewer, and discharge of treated water to a local POTW via a sanitary sewer collection system.

On-Site Disposal

Surface Discharge

This option discharges treated groundwater to a surface feature, such as the Riparian Corridor present at the Site. Effluent limits for surface discharge would be determined based on appropriate NPDES discharge permits. It is anticipated that secondary treatment would likely be required to improve the quality of discharge water. Such steps may require polishing to reduce TDS and sulfate concentrations that are elevated in portions of the Campus Area groundwater.

Surface discharge is considered to be a highly effective disposal alternative. This option is moderately implementable because it will require regulatory permitting. The cost of surface discharge could either be moderate to high relative to other discharge options, with the primary factor based on the degree of treatment required under the NPDES permit. Surface discharge is retained as a process option.

Atmospheric Emission

Many of the treatment technologies presented previously in this section transfer contaminants from the liquid to the gas phase. It is possible that, without treatment, the discharge of these contaminants to the atmosphere will exceed state and federal air quality regulations, thereby requiring that the off-gas be treated prior to discharge to the atmosphere. Off-gas treatment is used to remove the contaminants from a vapor stream (e.g., air stripper off-gas) prior to discharge to the atmosphere. Technologies potentially applicable for treating vapors prior to atmospheric emissions were described in Section 5.1.3.6.

Atmospheric emission is considered to be a highly effective disposal alternative, provided that necessary pretreatment of vapors is performed. This option is moderately implementable, as it will require regulatory permitting. The cost of atmospheric emissions is moderate relative to other alternatives. Atmospheric emission is retained as a process option.

Off-Site Disposal

Storm Sewer Discharge

This option discharges treated groundwater to a storm sewer present within or adjacent to the Campus Area. Discharge of treated groundwater would require an NPDES permit and local public works approval, and a sampling program to meet compliance with discharge permit requirements. As stated in Section 2, groundwater generated from construction activities and groundwater sampling efforts is currently discharged to Centinela Channel under NPDES permit #CAG834001. Groundwater generated from remedial actions may be discharged under the existing permit, provided that the treatment will be sufficient to comply with discharge requirements, and the upper limits of discharge flow are not exceeded. Alternatively, the existing NPDES permit may be modified, and/or additional permits may be requested to meet the demands of treated groundwater discharge generated by implementing remedial actions and future changes to construction dewatering, etc.

Storm sewer discharge is considered to be a highly effective disposal alternative. This option is moderately implementable, as it will require regulatory permitting. The cost of storm sewer discharge is moderate relative to other alternatives. Storm sewer discharge is retained as a process option.

Publicly Owned Treatment Works Discharge

Extracted groundwater may be discharged to a local POTW provided that the necessary permits may be obtained from the facility and regulatory agencies. Also, a piping network to such a facility must exist to handle the desired flows. The nearest POTW to the Campus Area is the Hyperion Treatment Plant, which is operated by the City of Los Angeles. The Hyperion Treatment Plant is located immediately southwest of the Los Angeles Airport. Pretreatment of groundwater would likely be required to meet applicable discharge requirements.

The implementability of this process option is quite variable and would depend largely on the feasibility of alternative discharge options (e.g., NPDES discharge), and the flows for which an industrial user's permit from the City of Los Angeles would be acceptable. For low flow rates (e.g., less than 50,000 gallons per day), the implementability would be considered moderate to high, while higher flow a rates would be considered to have a low implementability. The discharge to a POTW has been retained for further consideration, pending further evaluation of the other discharge flows and alternative process options. This option, if allowed, would be highly effective with moderate to high costs depending on the level of pretreatment required.

5.1.3.8 Summary of Retained Technologies and Process Options for Groundwater

The evaluation of retained technologies and process options is based on criteria including effectiveness, implementability, and cost. Table 5-3 summarizes the technologies and process options that were considered, the relative ranking for the three criteria, and whether the alternative was retained or screened from further

consideration. Each of the retained process options is considered for further evaluation in Section 6 as part of the development and description of remedial action alternatives.

5.2 Remedial Technologies and Process Options for Soil

Typically, an evaluation of remedial technologies and process options is performed to identify the preferred remedial technology, as was done with groundwater in previous sections. However, because a majority of the known contaminants are VOCs, SVE is the most appropriate remedial technology. Excavating soil impacted by non-volatile contaminants, such as metals, is also applicable. In addition, excavation is also applicable for removing historical source area equipment (e.g. clarifiers). Excavation and SVE are remediation technologies with long and proven track records for addressing VOCs in soils. In addition, excavation is a proven technology for addressing non-volatile contaminants such as inorganic compounds.

This section describes the tasks associated with using excavation and/or SVE. Detailed explanations and plans for each source area requiring remediation of soil are presented in Section 8. In addition to the active soils remediation to be accomplished via excavation and/or SVE technologies, infiltration of direct precipitation and runoff will be impeded by a number of features of site development. Development features including buildings, asphalt roadways, and concrete areas all serve to restrict the percolation of water at the ground surface. In this manner, the potential for leaching of limited residual contamination that may remain after active remediation will be further reduced. Because these features of the Campus Area development are not explicit components of the soils or groundwater remediation, they are not quantitatively evaluated herein. Their contribution to the protection of the groundwater resource should be fully acknowledged, however.

5.2.1 Soil Vapor Extraction

SVE removes VOCs from soil without excavation and will be used in situations where excavation of soil is insufficient or not feasible to meet ROs. SVE may be considered for use alone, or in conjunction with, excavation activities. DPE, which was considered in Section 5.1.3.5 and retained for further consideration, combines SVE with groundwater extraction at a single extraction well.

An SVE (and DPE) system typically consists of a blower, a control panel, an air-water separator, a particulate filter, valving, gauges, piping, and a vapor treatment system. The type of vapor treatment system selected is based on the nature and concentrations of the contaminants. Petroleum hydrocarbons can be treated with catalytic or thermal oxidizers or granular activated carbon (GAC) vapor treatment vessels. Chlorinated hydrocarbons may require additional off-gas treatment for hydrochloric acid with oxidizers, or additional treatment for VC, if present, with GAC and oxidant-impregnated material vessels (Section 5.1.3.6). A schematic of a typical DPE extraction system is provided in Figure 5-1, *Schematic of Dual Phase Extraction System.*

An SVE extraction system would be similar to that of a DPE extraction system, although the screened interval would be limited to the unsaturated zone soils and no groundwater extraction or treatment would be occur.

An SVE (and DPE) system requires the installation of extraction wells within or near the zone of contamination. SVE wells would be installed at each appropriate location, along with vadose zone monitoring points to measure the vadose zone area of influence.

SVE (and DPE) is considered to be moderately to highly effective because it has the potential of meeting all ROs for unsaturated portions of the upper Bellflower aquitard, provided that the lithology of this unit is permeable enough to allow for an effective vapor extraction flow rate. The implementability of SVE (and DPE) is moderate, with the collection and treatment of off-gas vapors and groundwater (DPE only) requiring treatment and regulatory permit. The cost of SVE is considered moderate.

The no-action response was retained as a baseline alternative.

Section 6
Development of Remedial Alternative

The purpose of this section is to develop remedial alternatives to address soil and groundwater contamination within the Campus Area. The remedial alternatives for groundwater are formed by using combinations of general response actions, remedial technologies, and process options that survived the screening processes in Section 5. Remedial alternatives for soil include either excavation or SVE, which were the two methods considered appropriate for active remediation of soils within the Campus Area. The description of the remedial alternatives presented in this section provides a conceptual-level understanding of each alternative, sufficient to allow comparison of the alternatives in Section 7. The selected remedial alternative is developed in more detail in Section 8.

6.1 Development of Remedial Alternatives for Groundwater

The retained general response actions, remedial technologies, and process options for groundwater from the screening processes in Section 5, (summarized in Table 5-3) are:

- No Further Action;
- Monitored Natural Attenuation (includes monitoring and evaluating a variety of naturally-occurring physical, chemical, and biological processes);
- Institutional Controls (includes use restrictions (e.g., use and deed restrictions) and public education to limit exposure to potentially impacted media);
- Hydraulic Containment (includes source area capping and stormwater diversion and control measures to limit surface water recharge and contaminant mobility);
- Groundwater Collection/Extraction (includes groundwater extraction wells and/or DPE wells to remove contaminant mass in groundwater and/or soils and control contaminant migration);
- Treatment (in situ treatment via enhanced biodegradation, and ex situ treatment of various wastes using air stripping, UV-enhanced chemical oxidation, activated carbon adsorption, and oxidant-impregnated materials); and
- Disposal (includes on-Site discharge of treated groundwater, and discharge of treatment system off-gas to the atmosphere, as well as off-Site discharge of treated water to a storm sewer, and discharge of groundwater to a local POTW).

These retained remedial technologies and process options were combined to create four remedial alternatives for the Campus Area groundwater:

1. No Further Action;

2. Monitored Natural Attenuation;

3A. Enhanced Biodegradation in Source Areas and Monitored Natural Attenuation Downgradient (Note the term "Downgradient" refers to those portions of the Campus Area that are hydraulically downgradient of the former Plant Site from where the source areas are located); and

3B. Groundwater Extraction in Source Areas and Monitored Natural Attenuation Downgradient

6.2 Description of Alternatives for Groundwater

Process options contained within each alternative are shown in Table 6-1, *Remedial Technologies and Process Options Comprising the Remedial Alternatives*. In some instances, the process options are common to all of the alternatives, while in other cases; the process options are common to only one or two alternatives. The process options included in the alternatives are described in the following sections.

6.2.1 Process Options Common to Each Alternative

6.2.1.1 Use Restrictions

Use restrictions for the Campus Area exist, and are being updated currently to add explicit restrictions on groundwater use. For each alternative presented in this section, these use restrictions will explicitly restrict groundwater use within the Campus Area during and after construction and implementation of all components of the remedial alternative.

Prospectively, PCC anticipates that other deed restrictions, CC&Rs and/or or negative easements may be implemented that would apply to the ownership or use of the property and further restrict potential uses and activities on the Site to prevent potential exposure.

6.2.1.2 Source Area Capping and Stormwater Diversion and Control

As part of the Campus Area development, a reduction in surface water infiltration is expected through various source area capping and storm water diversion and control measures. Capping will be accomplished through the construction of new buildings and infrastructure (e.g., parking structures, sidewalks, and roads). Similarly, construction of storm water drains and surface grading and other storm water management completed as part of the development will limit surface water run-on near source areas. Both measures will reduce surface water infiltration that during conditions of high rainfall otherwise accumulates and percolates through the soils, a circumstance which increases the mobility of contaminants. Thus, these measures

will limit the mobility of contaminants in source area soils and their vertical migration to groundwater.

6.2.2 Alternative 1 - No Further Action (Includes Monitoring)

The no further action alternative provides a baseline for comparison to other alternatives. In this alternative, by definition, no remedial actions are taken to control groundwater contaminant migration from or within the Campus Area, with the exception of capping and stormwater diversion and control measures which will occur as part of the Campus Area development.

6.2.3 Alternative 2 - Monitored Natural Attenuation

MNA is an *in situ* remedial technology that relies on the natural fate and transport, and attenuation, processes to mitigate contaminant concentrations. The effectiveness of the MNA technology is evaluated through groundwater monitoring of contaminant concentrations. Contaminant mass bound to saturated soils and in groundwater is expected to decrease with time under MNA.

A brief evaluation of the fate and transport of contaminants, including natural attenuation processes occurring within the Campus Area, is presented in Sections 2.4 and Appendix E. Because the fate and transport properties, and therefore the attenuation characteristics, of the two main water-bearing units (i.e., Bellflower aquitard and Ballona aquifer) are significantly different, the two units are described separately in the following subsections. Additional remedial actions for groundwater (e.g., groundwater extraction) are not considered under this alternative; however, remedial actions for soils would be addressed, as necessary, through excavation or SVE (Section 6.3).

6.2.3.1 MNA in the Bellflower Aquitard

The primary mechanisms for natural attenuation within the Bellflower aquitard appear to be biodegradation and retardation. MNA would be an effective remedial technology provided that the integrated effects of natural attenuation mechanisms bring about a reduction in contaminant mass and attenuation of COC concentrations below levels of concern. Under this alternative, groundwater data would be collected to document the active processes in contaminant mass reduction/attenuation and to predict the future migration and concentrations of COCs in the groundwater.

As presented in Section 2, both a low flow setting and biotransformation of VOCs have contained the majority of the contaminant plume in close proximity to the source areas in the Bellflower aquitard. The generally high organic content (see data in Appendix C) and low permeability of the soils in this unit appear to have limited the contaminant plume from significant horizontal migration in this unit. However, the contaminant plume has moved vertically into the relatively more permeable Ballona aquifer, and subsequent lateral contaminant movement has occurred in this unit.

After collecting initial data required to predict future contaminant migration or attenuation, a long-term monitoring plan is required for MNA. The long-term monitoring would be used to document and verify the predictive results. Assuming a sufficient number of monitoring wells exist to document the migration and fate of the contaminant plume, Bellflower aquitard monitoring wells located between the Campus Area perimeter and the former Plant Site (e.g., wells C-80be through C-83be) would serve as sentinel wells to document that the limited horizontal contaminant plume in this water-bearing unit does not migrate to the property boundary. Sampling and groundwater analyses under an approved monitoring program would be conducted semi-annually. Because groundwater movement in this unit is expected to be only approximately 10 to 20 feet between sampling events (or approximately 20 to 40 feet/years) based on hydraulic conductivity data from Section 2, and the contaminants would be further retarded by the generally impermeable silty-sand and high organic soils. Monitoring would collect data for VOCs, electron acceptors, metabolic byproducts, and potential electron donating compounds.

6.2.3.2 MNA in the Ballona Aquifer

Groundwater contamination from the Bellflower aquitard has also migrated vertically into the Ballona aquifer, where the primary mechanisms for natural attenuation are significantly different. By contrast, the soluble contaminants are not significantly retarded in the gravel-sand lithology of the Ballona aquifer. The comparatively lower organic carbon content of soils (generally an order of magnitude lower than found in the Bellflower aquitard – Appendix C) helps to explain the decreased retardation in the Ballona aquifer. In addition, preliminary evaluations (Section 2.4 and Appendix E) suggest that only limited biodegradation may be occurring once the contaminants enter the Ballona aquifer. This condition is likely due to the low concentration and rapid biological utilization of dissolved organic carbon (DOC) entering the Ballona aquifer simultaneously with the VOCs, as well as elevated concentrations of sulfate that interfere with reductive dechlorination reactions.

Although contaminants are not significantly retarded in the Ballona aquifer, the relatively low organic content and high permeability soils of the Ballona aquifer allow for rapid dispersion. VOCs are attenuated as the plume migrates downgradient in the Ballona aquifer, and have not migrated vertically below the Ballona aquifer to any significant extent.

Under this alternative, additional information would be collected to assess the level of natural attenuation that is occurring in the Ballona aquifer. The most significant attenuation mechanism in the Ballona aquifer appears to be dispersion through horizontal transport in this aquifer, and to a lesser extent, biodegradation and adsorption.

After establishing the rates of attenuation by the various mechanisms active within the Ballona aquifer, long-term monitoring will collect data to simulate the fate and transport of the contaminant plume and to predict the future extent of contaminants concentrations. Simple analytical models should be sufficient to predict the two-

dimensional transport of the contaminant plume in this semi-confined aquifer. Assuming a sufficient number of monitoring wells exist to document the migration and fate of the contaminant plume, perimeter wells in the Ballona aquifer would serve as sentinel wells. Sampling and groundwater analyses under an approved monitoring program would be conducted semi-annually and would include analyses for VOCs, electron acceptors, metabolic byproducts, and potential electron donating compounds. Groundwater movement in this zone is expected to be approximately 15 to 50 feet between sampling events (or approximately 35 to 100 feet/year), and because of lower retardation factors in this gravel and sand aquifer, higher advective movement of the contaminant plume is expected.

Results from this monitoring would be used to trigger contingency remedial evaluations or actions if elevated concentrations of VOCs than expected migrate into areas of lower VOC concentrations (see Section 9). Under this MNA alternative, if such a trigger threshold were exceeded, the remedial actions described below for Alternatives 3A and B would be implemented.

6.2.4 Alternative 3A – Enhanced Biodegradation in Source Areas and MNA Downgradient

Alternative 3A includes all of the elements of Alternative 2 and adds EAB treatment to the source areas in the Bellflower aquitard and the areas of vertical migration in the Ballona aquifer. EAB is a groundwater remedial technology that requires injecting sufficient biodegradable organic carbon (electron donor) into an aquifer to stimulate the rapid reductive dechlorination of VOCs. By inducing highly reduced groundwater conditions, EAB may improve both the extent and rate of dechlorination reactions. The available data indicate a microbial community exists that is capable of dechlorinating COCs (e.g., TCE and 1,1,1-TCA) to innocuous end products such as ethene and ethane. A key assumption is that the Campus Area groundwater has relatively low levels of competing electron acceptors, such that only a minimal addition of organic compound is necessary to achieve and sustain a highly reduced groundwater environment. Otherwise, EAB may not be cost-effective.

This alternative focuses on the *in situ* reduction of contaminant mass in both aquifers to achieve ROs. EAB within source areas would reduce the contaminant mass in the Bellflower aquitard and consequently, reduce VOC mass migration into the Ballona aquifer. In the Ballona aquifer, EAB would reduce VOC migration downgradient by reducing the mass at locations where it enters from the overlying Bellflower aquitard. Thus, EAB would be implemented only at points where VOC mass migrates vertically into the Ballona aquifer. MNA would be implemented in downgradient areas of the contaminant plume.

The brief evaluation of biogeochemistry parameters presented in Section 2.4 and Appendix E has been used to assess the potential for implementing this alternative. As described for Alternative 2, the hydrogeology and biogeochemistry of the Bellflower aquitard and Ballona aquifer are significantly different and, therefore, the

rate and extent of enhanced reductive dechlorination would be different. Therefore, EAB for each of the two units is described separately in the following subsections.

6.2.4.1 Enhanced Anaerobic Biodegradation in the Source Areas Bellflower Aquitard

This alternative would include injection of a concentrated electron donor solution (e.g., sodium or ethyl lactate) in the generally silty-sand, high-organic content soils within the source areas. The conceptual design assumes a delivery radius of influence of approximately 10 feet using injection wells, or a larger treatment zone through the use of recirculation wells. The actual injection method would be determined during remedial design activities and would be dependent on the source area hydrogeologic conditions within the saturated regions of the upper and lower Bellflower aquitard. Sulfate concentrations in the Bellflower aquitard are generally in excess of 1,000 mg/L (see Appendix C); thus, it is anticipated that optimal treatment would take several months to sufficiently lower this competing electron acceptor to allow more rapid detoxification. Electron donor concentrations from a single injection are expected to persist in the Bellflower aquitard for several months due to low transport potential from the target area. The actual injection frequency and radius of influence would be determined during the remedial design. It is anticipated that enhanced biodegradation of VOCs would be evident within a 6-month period.

Evaluation of the effectiveness of EAB requires monitoring for declining sulfate and VOC concentrations to measure the shift of contaminant mass to the detoxification products, ethene and ethane. The conceptual design includes five new monitoring wells in the Ballona aquifer and five new wells in the Bellflower aquitard to monitor the reduction in contaminant mass, changes in biogeochemistry of the groundwater near the source areas, and distribution of the substrate over the contaminated area. Sampling and groundwater analyses would be conducted quarterly for the first year, then semi-annually until ROs are achieved. These analyses would include VOCs, electron acceptors, metabolic byproducts, and potential electron donating compounds under an approved monitoring program. In addition, MNA sampling would be conducted at monitoring wells in the downgradient plume, but not the source wells, as described under Alternative 2.

6.2.4.2 Enhanced Anaerobic Biodegradation in the Source Area Ballona Aquifer

EAB in the Ballona aquifer targets contaminant concentrations in the gravel/sand below the source areas in the Bellflower aquitard. This alternative includes an array of injection wells screened in the gravel/sand of the Ballona aquifer beneath the source areas, or the use of recirculation wells.

Under the injection array scenario, electron donor solution (e.g., sodium or ethyl lactate) would be injected with water to dilute the electron donor concentration and drive it from each injection point. Current estimated groundwater velocities in the Ballona aquifer range from 0.2 to 0.6 feet/day. Under this flow range, it is assumed that the dispersion and biotransformation of electron donor would require re-injection

of high strength lactate every 120 days. Electron donor solutions would be injected at concentrations not to exceed 2,000 mg/L *in situ*. The injection arrays would be plumbed in series to allow equal distribution of substrate by a pump from a holding tank. Periodic injections would not require a storage tank. The actual injection concentration and timeframe would be determined with data from pump tests performed during the remedial design.

An engineering design test would be required to determine the rate of substrate utilization and dispersion through the aquifer. This test would likely operate for a period of several months. Data collected would include sulfate reduction rate, substrate utilization rate, and production of detoxification products (e.g., ethene and ethane).

Evaluation of EAB for this alternative includes monitoring for declines in sulfate and VOC concentrations with a continual shift of contaminant mass to the detoxification products, ethene and ethane. The conceptual design includes five new downgradient monitoring wells in the Bellflower and five new wells in the Ballona to monitor for the reduction in contaminant mass, changes in biogeochemistry of the groundwater, and distribution of the substrate over the contaminated area. Sampling and groundwater analyses would be conducted quarterly for the first year and semi-annually until ROs are achieved. These analyses would include VOCs, electron acceptors, metabolic byproducts, and potential electron donating compounds under an approved monitoring program. In addition, MNA sampling would be conducted at monitoring wells in the downgradient plume, but not the source wells, as described under Alternative 2.

6.2.4.2 Enhanced Anaerobic Biodegradation in Vadose Zone Soils

Under this alternative, two approaches would be evaluated for remediating those source areas that have vadose zone soils above HBRGs. Preferably, EAB would be implemented in such a way as to target the vadose zone soils. This could be done by injecting the amendments above the targeted soils and allowing infiltration of the amendment to enhance biodegradation of the vadose zone contaminants *in situ*. Alternatively, SVE would be used for vadose zone treatment at these source areas. The selection of the most appropriate approach would be made during the RD.

6.2.5 Alternative 3B – Groundwater Extraction in Source Areas and MNA Downgradient

Alternative 3B consists of the MNA elements described for Alternative 2 together with groundwater extraction in source areas.

Source Area Groundwater Extraction

Groundwater extraction under this alternative is intended to remove VOC mass from groundwater associated with identified source areas. Although the extraction wells would be located primarily for mass removal purposes, they would also be sited to contain contaminant migration as a secondary objective. VOC mass removal has

distinct and quantifiable advantages to enhance VOC plume control by reducing high concentrations of VOCs within the source areas.

The final design for the extraction system would be determined through data collection, modeling, and evaluation efforts during the remedial design. A conceptual approach has been developed for a groundwater extraction and treatment program for this alternative evaluation. The conceptual extraction system consists of three types of extraction wells: one for the upper Bellflower aquitard, one for the lower Bellflower aquitard, and one for the Ballona aquifer. In some instances, DPE would be used to address vadose zone and saturated zone remediation concurrently with groundwater remediation.

Upper Bellflower Aquitard
DPE would be used to extract groundwater from the uppermost water-bearing unit. DPE has the advantage of not only extracting groundwater, but also further removing VOCs from previously saturated soils via volatilization within an induced cone of depression. In addition, if VOCs were present within the vadose zone in the vicinity of the DPE well, they would be removed via the vapor extraction effects of DPE. This remediation of vadose zone soils would protect further contamination from the underlying groundwater. To monitor performance of DPE, new monitoring wells screened in the upper Bellflower aquitard and a limited number of vapor monitoring points would be installed. The number and location of DPE wells, performance monitoring wells, and vapor monitoring points would be determined by the extent of soil contamination above remediation trigger values.

DPE engineering design testing would be required at the time of implementation to collect design data concerning the achievable ZOI at different extraction rates. For the purposes of this RP, it is assumed that a ZOI of 20 feet is achievable at a groundwater extraction rate of approximately 1 gpm and a vapor extraction rate of approximately 50 standard cubic feet per minute (scfm) per DPE well. The assumed drawdown of water table would be approximately 7 feet at the DPE well.

Several design assumptions have been made about the layout and size of the DPE system in order to evaluate the cost of this component of the alternative. The remedial design would revisit these assumptions subsequent to collecting additional groundwater data with considering Campus Area construction plans that would be available during design activities. Conceptually, there would be the option for a central vapor treatment unit housed within the groundwater treatment system or satellite treatment systems depending on technical feasibility, cost, and development needs. Extracted groundwater and vapors would be piped to treatment systems for processing. Blowers would be used for vapor extraction and be capable of inducing a vacuum of approximately 15 inches of mercury at the wellhead.

Lower Bellflower Aquitard
It has been assumed that an extraction rate of 5 gpm is required to achieve a capture zone of approximately 100 feet per well within the lower Bellflower aquitard. Extracted groundwater would be conveyed in pipelines to a new treatment plant (described below). The location of wells and piping would take into account development plans and would be coordinated with the project developer.

Ballona Aquifer
For this unit, it has been assumed that a pumping rate of 25 gpm is needed to produce a groundwater capture zone approximately 1,300 feet in diameter.

Groundwater and Vapor Treatment
As discussed in Section 5.1, extracted groundwater would be discharged either for reuse in the Riparian Corridor, the current, permitted storm sewer discharge into Centinela Creek Channel (east of Centinela Avenue and south of Teale Street), or to a POTW. Additional analysis would be performed during remedial design to select the discharge option and to determine the type of treatment that would be required.

Currently, there is a groundwater treatment plant located to the north of Buildings 1 and 2 in the Campus Area. This plant is treating groundwater that is produced from construction dewatering and groundwater sampling activities. It is assumed, however, that this plant would not be available for use in this alternative. Instead a new treatment plant would be constructed in the Campus Area.

For alternative costing and evaluating purposes, it is assumed that extracted groundwater would be treated, as necessary depending on ultimate disposal requirements, for VOC removal using shallow tray air strippers with vapor treatment by activated carbon adsorption. Because VC is poorly adsorbed on carbon, the activated carbon unit vapor effluent would flow through a second unit containing zeolite coated with potassium permanganate. The permanganate units would remove VC in the vapor phase by chemical oxidation. It should be noted that some contaminants exist in groundwater that may not be effectively treated using air stripping technologies, such as 1,2-DCA and MC. However, these contaminants are only observed in localized areas and occur at low enough concentrations such that air stripping methods on a combined waste stream may be sufficient for treatment. If, however, air stripping is demonstrated to be not adequate, additional treatment may be required to address such contaminants (e.g., wellhead treatment at select locations using oxidative technologies).

For air stripper off-gas, two parallel vapor treatment units would be used. The vapor treatment units would be sized to treat vapors from both the DPE system and off-gassing from the air strippers (if centrally treated). The total vapor flow would be divided into two streams, each processed by activated carbon units in series and a single zeolite/potassium permanganate unit for VC polishing.

6.3 Development of Remedial Alternatives for Soil

As described earlier, the majority of the known contaminants are VOCs and would be addressed using SVE, or DPE, as the preferred remedial technology. However, soil impacted by non-volatile contaminants, such as inorganic compounds (e.g., metals), would be addressed using excavation. Excavation would also be performed, as appropriate, to remove any historical source area equipment (e.g., clarifiers). As noted previously in Section 5.1, the effectiveness of soil remediation will be further enhanced by various "capping" features of the Campus Area development, including buildings, roadways, and selected landscaped areas. Although not an actual component of the remedial measures discussed in this RP, the benefits of impeding the infiltration of precipitation or surface water are an important consideration in the overall protectiveness of the remedies.

Remedial actions for soil impacted with VOCs would be addressed using SVE (or DPE), as appropriate. SVE would be applied to the unsaturated portion of the upper Bellflower aquitard, while DPE would be applied to both the unsaturated and saturated portions of the upper Bellflower aquitard as described in Section 6.2. This remediation of vadose zone soils would be protective of further contamination of the underlying groundwater. To monitor performance of SVE, vapor monitoring points would be installed. If DPE were implemented, then additional monitoring wells screened in the upper Bellflower aquitard may be installed to monitor groundwater, as necessary. The number and location of SVE/DPE wells, vapor monitoring points, and performance monitoring wells would be determined by the extent of soil contamination above LSRT values.

SVE/DPE engineering design testing would be required during remedial design to collect design data concerning the achievable ZOI at different extraction rates. For the purposes of this RP, it is assumed that a ZOI of 20 feet for the SVE system, or vapor portion of the DPE system would be achieved. It is assumed that the vapor extraction rate would be approximately 50 scfm per DPE well.

The remedial design would revisit the above assumptions subsequent to the collection of additional data and with consideration of Campus Area construction plans that would be available during design activities. Conceptually, there would be either a central vapor treatment unit housed within the groundwater treatment system or satellite treatment systems (depending on cost and/or development needs). Extracted vapors (and groundwater) would be piped to treatment system(s) for processing. Blowers would be used for vapor extraction, each capable of inducing a vacuum of approximately 15 inches of mercury at the wellhead. Vapor treatment would be accomplished by the methods described in Section 6.2.5.

Excavation would be performed to address non-volatile contaminants (e.g., metals) or removal of source area equipment, as needed. The proposed areas of excavation would be based on the data obtained from the existing investigations. Additional information regarding the necessary depths and areal extents of excavations would be obtained during the implementation of the proposed remedial actions, which would

be used to supplement and guide the excavation activities, as appropriate (see Section 5.2). Based on field screening and confirmatory soil sampling results, the excavations may be extended laterally and vertically.

Section 7
Evaluation of Remedial Alternatives

This section evaluates remedial alternatives developed in Section 6 with regard to seven evaluation criteria based on similar criteria used for CERCLA remedial actions. Although CERCLA is not applicable to this Site these criteria provide a meaningful approach for evaluating the remedial alternatives developed in Section 6.

The seven criteria for comparing the developed alternatives are:

- Overall protection of human health and the environment;
- Compliance with ROs;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume through treatment;
- Short-term effectiveness;
- Implementability; and
- Cost

The seven evaluation criteria fall into two categories, namely threshold criteria and primary balancing criteria. Threshold criteria are requirements that each alternative must meet to be eligible for selection as the preferred alternative. Threshold criteria include overall protection of human health and the environment and compliance with ROs. Primary balancing criteria are used to weigh relative effectiveness and cost among alternatives. These balancing criteria are long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost.

The application of all of the criteria to the four alternatives are discussed below and the results of this evaluation are summarized in Table 7-1, *Groundwater Remedial Alternatives Seven Criteria Evaluation Matrix.*

- Alternative 1 – No Further Action;
- Alternative 2 – Monitored Natural Attenuation;
- Alternative 3A – Enhanced Biodegradation in Source Areas and Monitored Natural Attenuation Downgradient;
- Alternative 3B – Groundwater Extraction in Source Areas and Monitored Natural Attenuation Downgradient;

7.1 Protection of Human Health and the Environment

This evaluation criterion addresses the ability of each alternative to adequately protect human health and the environment. The assessment of overall protection also draws on the assessments conducted using other evaluation criteria, especially long-term effectiveness and permanence, and short-term effectiveness.

Each alternative is evaluated against this criterion to determine whether specific elements of each alternative eliminate, reduce, or control risks posed by exposure via potential complete exposure pathways.

Evaluation of Alternatives

Alternatives 1 and 2 provide the least protection for human health and the environment. Neither alternative has an active engineered component that provides source reduction nor migration control of contaminated groundwater. However, as long as institutional controls regarding groundwater use are in effect, there would not be an increase in the long-term potential for human exposure through groundwater use. Under these alternatives, groundwater contaminants would potentially be allowed to further migrate vertically and downgradient into the Ballona aquifer. However, Alternative 2 includes groundwater monitoring that would provide early warning of contaminant migration at downgradient monitoring wells. Alternative 2 would also fully quantify and document the reductions of VOC mass as a result of the various physical, chemical and biological processes that are inherent to MNA. Although such documentation may indicate significant mass reduction with time, Alternative 2 would rate lower than Alternatives 3A and 3B on a relative scale because it does not include an active engineered component. An advantage of Alternatives 1 and 2 is that there are no risks associated with treatment residuals, because none are created. The relative overall rating for protection of human health and the environment for Alternative 1 is low, and low to moderate for Alterative 2.

Compared to Alternatives 1 and 2, Alternatives 3A and 3B would provide significant reduction in long-term risks to human health and the environment by removing contaminant mass from the source areas, which will result in long-term decreases in VOC concentrations in downgradient areas. MNA would be applied at downgradient locations to fully quantify and document the reductions of VOC mass at downgradient locations and verify the overall protection of human health and the environment. The relative overall rating for protection of human health and the environment for Alternatives 3A and B is high.

7.2 Compliance with Remedial Objectives

This evaluation criterion addresses whether each alternative would meet ROs for soils or groundwater in the Campus Area. The ROs developed in Section 3 have two primary objectives: (1) protection of human health, and (2) protection of the groundwater resource. Because the ROs established for protection of human healthhave the same objective as the first evaluation criterion, the first and second

criteria are essentially the same. This second threshold criterion, therefore, is only meaningful with respect to the resource protection ROs.

Evaluation of Alternatives

Alternatives 1 and 2 do the least to meet the ROs, because neither alternative has an active component to address source area remediation, and both alternatives would allow potential further migration of contaminants. The relative overall rating for compliance with ROs for Alternatives 1 and 2 is low.

Alternatives 3A and 3B have active components designed to meet ROs in source areas, with MNA applied to the downgradient portions of the Campus Area. The main difference between these alternatives is the technology used to reduce VOC mass at source locations (3A uses enhanced biodegradation and 3B uses groundwater extraction, and DPE if applicable). Under Alternative 3B, groundwater extraction at source locations with a DPE component would be accompanied with removal and treatment of soil vapors, which would provide an immediate and added level of conservatism for meeting ROs. Alternatives 3A and 3B would meet the ROs for protection of human health. The relative overall rating for compliance with ROs for Alternatives 3A and 3B is high.

7.3 Long-Term Effectiveness and Permanence

The evaluation of alternatives under this criterion assesses the results of a remedial alternative in terms of the risk remaining within the Campus Area after ROs are met. The primary focus of this evaluation is the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes.

Untreated waste primarily refers to groundwater contaminants not removed from the aquifer. Treatment residuals would include spent carbon or oxidant-impregnated material canisters, if used for VOC removal. Remaining risk associated with VOC contaminants not removed from the aquifer relates to the effectiveness of each alternative at preventing or reducing contaminant migration and meeting ROs. Also considered in evaluating the performance of each alternative is the relative magnitude of treatment residuals. The actual types and magnitude of the treatment residuals would depend on the type of treatment technology used.

Evaluation of Alternatives

Alternatives 1 and 2 are ranked lowest for this criterion because neither alternative has an active engineered component that provides migration control or VOC mass reduction at source locations. Although natural attenuation processes (e.g., adsorption, dispersion, and biodegradation) would continue to attenuate contaminant concentrations in the Bellflower aquitard, the rates of attenuation are likely too slow to fully prevent vertical migration and influx of contaminants into the Ballona aquifer without some form of active source control. Thus, contaminated groundwater would potentially continue to migrate vertically from the Bellflower

aquitard to the Ballona aquifer in source areas, and horizontally in the Ballona aquifer in downgradient areas. The potential for further downgradient contaminant migration in the Ballona aquifer exists, although this plume may be currently under steady-state conditions as the result of natural attenuation processes. One other factor: Alternatives 1 and 2 would not generate any treatment residuals. Nonetheless, the relative overall rating for long-term effectiveness and permanence for Alternatives 1 and 2 is low.

Alternative 3A employs enhanced biodegradation to provide VOC mass reduction at source locations. While enhanced biodegradation would result in lower mass of VOCs in the source areas, this alternative could potentially result in limited amounts of untreated mass migrating downgradient of the source areas. However, the risk associated with such migration would be minimal because groundwater contaminants do not exceed HBRG values in downgradient portions of the Campus Area. Regardless, MNA would be employed at downgradient locations to document the extent of VOC migration and mass removal. No treatment wastes would be generated under this alternative.

Under Alternative 3B, groundwater extraction at source locations would result in a reduction of VOC mass at source locations. Similar to Alternative 3A, Alternative 3B would employ natural attenuation processes at downgradient locations. Given the current understanding of MNA in the Campus Area, this would result in a limited amount of untreated mass migrating downgradient of the source areas. In either case (Alternative 3A or 3B), MNA would ensure that any untreated mass migration from source areas is being reduced by naturally occurring processes.

Under Alternative 3B, the primary residual waste generated would likely be spent GAC and zeolite/potassium permanganate from treatment of contaminated groundwater and extracted vapors. The spent GAC and zeolite could potentially be reactivated off-Site. The transportation and reactivation of this residual would be conducted in accordance with applicable regulations and would present minimal long-term risks because contaminants adsorbed to the GAC would be destroyed during the reactivation process. The amounts of treatment residuals produced would be proportional to the contaminant mass-loading rate (i.e., function of contaminant concentrations and flow rates).

The relative overall rating for long-term effectiveness and permanence for Alternatives 3A is high, and moderate to high for Alternative 3B. The difference in ratings reflect the absence of residual wastes generated under Alternative 3A as compared to 3B.

7.4 Reduction of Toxicity, Mobility or Volume Through Treatment

This evaluation criterion addresses the preference under CERCLA guidance for selecting remedial actions that employ treatment technologies that permanently and

substantially reduce toxicity, mobility or volume of the hazardous substances as their principal element. This preference is satisfied when treatment is used to reduce the principal threats at a site through destruction of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media.

This evaluation for each remedial alternative focuses on the following factors:

- The treatment processes and the materials to be treated;
- The degree of expected reduction in toxicity, mobility or volume;
- The degree to which treatment is irreversible;
- The type and quantity of treatment residuals that would remain following treatment;
- The amount of material that would be destroyed or treated.

Evaluation of Alternatives

Under Alternatives 1 and 2, standing alone, no active treatment would be employed to reduce the toxicity, mobility, or volume of contaminants, although naturally-occurring processes would continue to meet these objectives to a limited extent. The relative overall rating for long-term effectiveness and permanence for Alternatives 1 and 2 is low.

Enhanced biodegradation would be used to address VOC contamination at source locations under Alternative 3A, while Alternative 3B would employ groundwater extraction to accomplish the same goal. Both alternatives would incorporate MNA for downgradient treatment. If enhanced biodegradation were to perform optimally, biodegradation could potentially remove more contaminant mass than groundwater extraction technologies. If conditions for enhanced biodegradation could not be maintained properly, then groundwater extraction would most likely remove more VOC mass. It is important to note that incomplete biotransformation reactions could potentially increase the toxicity of contaminants (e.g., through accumulation of toxic intermediates such as VC). Complete biotransformation reactions, however, would result in the irreversible destruction of contaminants to innocuous end-products *in situ*, without the production of any residual wastes to dispose of at the surface. For comparison purposes, it has been estimated that enhanced biodegradation and groundwater extraction would result in a similar contaminant mass reduction.

The relative overall rating for this criterion is high for Alternatives 3A and 3B.

7.5 Short-Term Effectiveness

This evaluation criterion addresses the effects of the alternative during the construction and implementation phase until ROs are met. The following factors are addressed for each alternative:

- Protection of workers and the community. This factor examines risk that results from the construction and implementation of the proposed remedial action and the effectiveness and reliability of protective measures;
- Environmental impacts. This factor addresses potential adverse environmental impacts that may result from the construction and implementation of an alternative. This factor also evaluates the reliability of the available mitigation measures to prevent or reduce potential impacts; and
- Time until ROs are achieved. This factor estimates the time period that would be required to meet ROs.

Evaluation of Alternatives

Alternatives 1 and 2 do not have significant proactive measures and therefore score low with respect to short-term effectiveness. Alternative 1 has no construction or implementation phase. Alternative 2 does pose slight risks to the workers during construction of new monitoring wells; however, these risks are easily addressed and are not beyond general construction hazards associated with construction projects, and other remedial alternatives considered in this evaluation. Because of the limited construction activities, no significant environmental impacts are expected from Alternatives 1 or 2. These two alternatives score low for short-term effectiveness.

Under Alternative 3A, enhanced biodegradation would be used to reduce VOC mass at source locations. Enhanced biodegradation of chlorinated VOCs requires an acclimation time to overcome the presence of alternative electron acceptors such as sulfate, and would require preliminary testing to provide a basis for design of this technology given the elevated sulfate concentrations. Therefore, the short-term effectiveness is ranked lower for this alternative than for Alternative 3B, which incorporates groundwater extraction and treatment in source areas. It should be noted that enhanced biodegradation may achieve a greater reduction of VOC mass than obtained by groundwater extraction in the long-term. The relative overall rating for short-term effectiveness is moderate to high for Alternative 3A.

Under Alternative 3B, groundwater extraction in addition to soil vapor extraction (through SVE and/or DPE) would occur at source locations. The immediate removal and treatment of soil vapors, in areas of both soil and groundwater concern, using DPE would likely provide an engineered component with short-term benefits in the vadose zone. While EBG would provide greater long-term benefits, the relative overall rating for short-term effectiveness is high for Alternative 3B largely because of the ability of DPE to remove contaminant mass immediately upon startup.

7.6 Implementability

This evaluation criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. The evaluation of this criterion would consider the following factors:

- Technical Feasibility
  - Construction and Operation - This relates to the technical difficulties and unknowns associated with a technology;
  - Reliability of Technology - This focuses on the likelihood that technical problems associated with implementation would lead to schedule delays or render a selected technology inappropriate or ineffective;
  - Ease of Undertaking Additional Remedial Actions - This includes consideration of potential future additional remedial actions and whether the alternative would interfere or assist in the implementation of additional remedial actions; and
  - Monitoring Considerations - This addresses the ability to monitor the effectiveness of the remedial action and an evaluation of risks of exposure should monitoring be insufficient to detect a system failure.
- Administrative Feasibility
  - Coordination with other agencies, including the need for agreements with parties other than RWQCB for construction and operation of the remedy (e.g., grading permits).
- Availability of Services and Materials
  - Availability of necessary equipment, specialists, and provisions to ensure any necessary additional resources; and
  - Availability of services and materials plus the potential for obtaining competitive bids.

Evaluation of Alternatives

Technical Feasibility: Construction and Operation

The groundwater extraction, treatment, and conveyance technologies included in Alternatives 3B, and the monitoring technologies included in Alternatives 2, 3A, and 3B are widely used. No significant difficulties are expected in construction and operation of these technologies. The enhanced biodegradation components of Alternative 3A would require preliminary *in situ* testing to determine whether conditions can be produced within the formations in a timely fashion to implement

enhanced biodegradation given the elevated concentrations of competing electron acceptors (e.g., sulfate).

Technical Feasibility: Reliability of Technology
The groundwater extraction, treatment, conveyance and monitoring technologies in Alternative 3B are generally known to be proven and reliable. For enhanced bioremediation, if preliminary testing results indicate that the delivery of amendments would be difficult; that the amount of required amendment is high; or that sulfate cannot be removed in a timely fashion, then the feasibility of the approach could be affected.

Technical Feasibility: Ease of Undertaking Additional Remedial Actions
None of the alternatives would interfere with the implementation of future response actions in the Campus Area.

Technical Feasibility: Monitoring Considerations
All alternatives except Alternative 1 include a monitoring program to provide early warning of changes in contaminant concentrations that could require modifications in extraction rates, amendment injection rates, monitoring well locations, or treatment methods to ensure attainment of ROs.

Administrative Feasibility
There are not likely to be any significant administrative feasibility issues associated with implementation of Alternatives 1 or 2, although Alternative 2 would require easily obtainable permits for monitoring well installation. Implementation of Alternatives 3A and 3B would require acquisition of permits including but not limited to the construction of extraction wells, treatment facilities, and conveyance piping. In addition, implementing Alternative 3B would require resolution of administrative issues associated with discharge of treated groundwater to the Riparian Corridor, a storm drain, or a POTW. Alternative 3A would require permits for injecting the amendments required for enhanced biodegradation.

Availability of Services and Materials
Implementation of Alternative 3B would require fabrication of treatment plant equipment and a treatment building. Required services and materials are available, including qualified contractors for construction and operation of the technologies under consideration. Similarly, services and materials necessary to implement enhanced biodegradation are readily available.

The relative overall rating for this criterion is high for Alternative 1 because there are no significant issues that could impact implementability of this alternative. Alternative 2 rates as moderate to high for implementability due to the need to obtain well installation permitting, and the MNA sampling and reporting that is required as part of this alternative. Alternative 3A is ranked low to moderate because it requires preliminary testing of enhanced bioremediation to evaluate the feasibility of this approach, as well as permits for subsurface injection of amendments. Alternative 3B is

assigned a moderate ranking because of the administrative issues associated with construction and disposal permitting.

7.7 Cost

This criterion addresses the total cost of each alternative. This considers likely capital, and Operations and Maintenance (O&M) expenditures. The following cost elements are considered for each alternative:

- Direct capital costs, which include the construction, labor, equipment, land, Site development, and utility service costs;
- Indirect capital costs, which include engineering fees, license and permit costs, startup costs, and contingencies; and
- O&M costs, which include operating labor, maintenance materials and labor, pumping and treatment energy, monitoring, and other post-construction costs necessary for the continuous effective operation of the alternative.

Evaluation of Alternatives

Alternative 1 has no costs.

Alternative 2 capital costs include installation of new monitoring wells in the Ballona aquifer, development of an MNA sampling plan, and performing MNA modeling. O&M costs include: semi-annual sampling, water quality analysis for VOCs, purge water disposal, reporting, and groundwater modeling support.

Alternative 3A capital and O&M costs include all of the costs indicated above for Alternative 2 plus costs for an enhanced biodegradation system in the source areas. The system would include substrate injection points, additional performance monitoring wells, and injection equipment. The number of amendment injections and locations that would be needed would govern the capital and O&M costs. These costs would be best determined by preliminary testing results and performance monitoring results following the first injection.

Capital and O&M costs for Alternative 3B include all of the costs indicated above for Alternative 2 plus costs for a groundwater (and soil vapor) extraction and treatment system in the source areas. Treated water would be discharged to the Riparian Corridor, a storm drain, or a POTW. The system would include DPE extraction wells, lower Bellflower aquitard and Ballona aquifer extraction wells, performance monitoring wells, and a treatment plant which would likely utilize air stripping with GAC treatment of the off-gas and DPE vapor streams.

It is assumed that the source area extraction and DPE wells would operate for three years, at which time the concentrations of all COCs are assumed to have decreased to below HBRGs and mass removal rates have reached asymptotic levels.

To be consistent with the ratings used for other criteria in Table 7-1, this criterion is used as cost effectiveness rather than cost. For example, the alternative with the lowest cost rates as high for cost effectiveness. For this evaluation, Alternative 1 is ranked high (i.e., lowest cost); Alternative 2 is ranked moderate to high; and Alternatives 3A and 3B are ranked low (i.e., highest cost).

7.8 Overall Evaluation of Alternatives

A summary of this evaluation, which highlights differences among alternatives in meeting the seven criteria, is presented in Table 7-1. This table shows that alternatives 3A and 3B had very similar overall ratings. The differences are related primarily to two issues:

- The uncertainty regarding the effectiveness, design parameters, and acclimation times required for EAB implementation weighed against the absence of residual wastes generated at the surface (as compared with groundwater extraction);
- The advantages of EAB implementation in areas where low permeable materials limit the use of groundwater extraction technologies.

It is recognized that EAB in source areas could aid in achieving the ROs. It is necessary, however, to consider the uncertainty associated with this component when selecting the remedial approach. It is proposed that Alternative 3B be implemented as the preferred alternative in such a way as to benefit from supplemental EAB, were appropriate.

Based on the criteria evaluated in this section, Alternative 3B (Groundwater Extraction in Source Areas and Monitored Natural Attenuation Downgradient) is identified as the preferred remedial alternative. Since it is recognized that an EAB component could aid in achieving the ROs, it is proposed that Alternative 3B be implemented as the preferred alternative, with further consideration of the EAB during the early phases of remedial action implementation, as appropriate. This topic is further discussed in the detailed review of the proposed remedial action in the next section.

Section 8
Proposed Remedial Action

This section describes the proposed remedial plans for soil and groundwater contamination. It includes discussion of the approach used to select the appropriate remedial technologies for each SA. This section also describes the use and implementation of institutional controls in conjunction with the recommended remedial actions, finally, the approach for implementing the remedial actions.

8.1 Overview of Proposed Remedial Action

Remedial activities identified in this section address the areas and media where COC exceedances of the RGs (HBRGs, LSRTs, USRTs, and MCLs) occur, thereby assuring that both human health and the groundwater resource are protected. Exceedances of HBRGs and LSRTs will be the thresholds for selecting active remediation systems, while exceedances of USRTs and MCLs will generally be addressed through passive remedial technologies such as MNA.

As determined in the analyses presented in Sections 5, 6 and 7, the recommended active remedial technology for addressing COC-impacted groundwater is groundwater extraction or DPE/SVE at the source areas, with passive remediation (MNA) of the downgradient portion of the plume. Treatment at source areas will generally consist of groundwater extraction or DPE/SVE for the upper Bellflower aquitard, and groundwater extraction in both the lower Bellflower aquitard and Ballona aquifer. MNA will apply downgradient in the Ballona aquifer, which is the primary unit where low concentrations of COCs extend laterally downgradient from the source areas. Once active remedial measures are completed in source areas, residual concentrations of COCs in source areas are expected to be sufficiently low for application of MNA, consistent with achieving the ROs.

For impacted soil at source locations, vapor extraction (SVE or DPE) for volatile COCs will be the preferred active treatment technology. Excavation will be implemented in areas impacted by non-volatile COCs (e.g., metals). Furthermore, future migration of contaminants to groundwater is expected to be minimized as a result of the construction of impervious surfaces as part of the Campus Area development.

8.1.1 Source Area Remedial Technology Selection

A summary of proposed remedial actions for both groundwater and soil contamination is provided in Table 8-1, *Proposed Remedial Action at Source Areas*. Table 8-1 identifies the specific remedial technologies selected for each source area (i.e., DPE, groundwater extraction, SVE, excavation, and MNA), as well as additional data collection activities required to refine the lateral extent of contamination and to optimize the proposed remedial action. The specific application of the preferred alternative for each source area is discussed below. Additional data collection activities are discussed briefly below and are outlined in Section 8.4, *Remedial*

Implementation Plan. A detailed description of additional data collection activities will be provided to the RWQCB prior to implementing the proposed remedial action.

Specific remedial technologies will be implemented within each source area based on a comparison of source area-specific soil and groundwater contamination with the appropriate HBRGs, LSRTs, USRTs, and MCLs.[10] Active remediation of soils is triggered through an exceedance of soil HBRGs or LSRTs, while active remediation of groundwater is triggered through an exceedance of HBRGs. MNA, a passive remedial technology, will be applied in some capacity to all source areas and will be the sole remediation technology for only a limited number of areas. Where the technology applied in one medium (e.g., groundwater) will address contamination in another medium (e.g., soil), the proposed remediation is limited to the most appropriate medium and justification for such action is provided.

The basic decision process is best illustrated by the following subsections which address the question of whether active remediation of soils is triggered (i.e., if soil contamination exceeds HBRGs or LSRTs) in the source areas.

8.1.1.1 Soil Contamination Exceeds HBRGs or LSRTs (i.e., Requires Active Soils Remediation)

If soil concentrations exceed either soil HBRGs or LSRTs (protection of lower Bellflower aquitard groundwater resource), remediation of the source areas will be accomplished using SVE or soil excavation. Furthermore, active groundwater remediation will be initiated where groundwater COCs exceed HBRGs, or where soils concentrations exceed LSRTs and either (1) the distribution of COCs in groundwater indicate a residual source exists in groundwater, or (2) technical evaluation demonstrates that soil remediation alone may not sufficiently reduce groundwater concentrations. The remedial technology(ies) will be selected from several possibilities including DPE and groundwater extraction. The selected technology(ies) will be used along with passive groundwater remediation (i.e., MNA), as appropriate. The basis for determining when the operation of active groundwater remedial technologies may be turned off in favor of passive remedial technologies, such as MNA, is presented in Section 9, *Monitoring and Contingency Plan*.

If active groundwater remediation is not triggered, MNA for groundwater may be applied in conjunction with either SVE or excavation to address the vadose zone soils that exceed HBRGs or LSRTs.

[10] The HBRGs and LSRTs presented in Section 3 are used to identify areas and media where residual contamination is sufficient to warrant remediation, and to guide the implementation of the most appropriate remedial technology(ies). As such, the HBRGs and LSRTs are used as remediation "trigger" criteria. However, as described previously, the HBRGs and SRTs may not be the final cleanup criteria. For example, if remediation efforts continue to be effective at reducing contaminant levels, remedial systems may continue to operate even after chemical concentrations drop below HBRGs and/or SRTs. The RWQCB will determine final cleanup goals as remediation is completed or further remediation becomes technically infeasible.

8.1.1.2 Soil Contamination is Less Than HBRGs or LSRTs (i.e., No Active Soils Remediation)

Where concentrations of COCs in soils do not exceed soil HBRGs or LSRTs, no active remediation of soils is required. In this case, if underlying groundwater is contaminated above HBRGs for groundwater (suggesting an upgradient source), active groundwater remediation will be implemented, along with or followed by MNA, as appropriate.

Where concentrations of COCs in groundwater do not exceed HBRGs for groundwater, groundwater concentrations will be compared to MCLs and soil concentrations to USRTs. If MCLs are exceeded MNA will most likely be implemented. If USRTs (protection of upper Bellflower units) are exceeded and there are no indications of impacts to groundwater, MNA will most likely be implemented.[11] If neither MCLs nor USRTs are exceeded, no remediation is necessary and the source area can move to NFA status.

IESI estimated the amount of contaminant mass removal from soils that could potentially be accomplished by using the application of soil remedial triggers (i.e., remediation of vadose zone soils at concentrations greater than soil HBRGs and LSRTs). IESI's preliminary calculations are based on a simple radial diffusion model and Site-specific data regarding the lateral and vertical dimensions of impacted vadose zone soils. IESI's conclusions suggest that remediation of vadose zone soils to the HBRG and LSRT values would potentially address 80 to 90 percent of the VOC mass in the vadose zone. When one considers the typical over design of remedial systems (e.g., the addition of extra SVE wells to account for "dead zones" along the perimeter of the targeted remediation area), it is reasonable to expect that the "remediated mass" could potentially exceed the upper-bound mass removal calculated by IESI. IESI's preliminary calculation of VOC mass removed from the vadose zone is attached as Appendix G.

8.2 Source Area Specific Remedial Plans

The proposed remedial measures will be accomplished using one or more approaches. Impacted groundwater will be extracted and treated at a central water treatment plant (WTP). Figure 8-1, *Conceptual Layout of Source Area and Downgradient Groundwater Extraction and Treatment System,* provides the conceptual layout of the WTP and related interconnecting pipelines. The WTP will be designed to accommodate groundwater extracted from downgradient wells, if the criterion discussed in Section 8.1.1.2 demonstrates such wells are necessary. Where appropriate, DPE will be implemented to address VOC impacted soil at source locations. Treatment of vapors from DPE wells will occur either at a central treatment system or at strategically located satellite treatment units. Placement of the satellite treatment units will be determined based on a variety of criteria, including cost and development needs. For SA soils impacted by non-volatile contaminants (metals), surgical excavation of the impacted soil will be performed.

[11] MNA will also be used outside SAs identified in this RP where USRTs are exceeded.

A schedule for the remedial measures is proposed in Section 8.5. The following discussion describes remedial measures proposed for each identified source location.

8.2.1 SA No. 1 – Former UST South of Building 5

Figure 8-2, *Conceptual Layout of Remediation of Former UST South of Building 5 (SA-1)*, depicts the conceptual layout of one DPE well and two groundwater extraction wells at SA-1. Figure 8-3, *Conceptual Cross-Section for SA-1*, provides the complementary conceptual cross-section for this source area.

DPE will be implemented to address both groundwater and impacted soil such that the ZOI for vapor extraction will encompass locations where VOCs in the upper Bellflower aquitard soil (including existing fill material) exceed LSRTs.

Groundwater extraction from the lower Bellflower aquitard will be performed near former monitoring well C-64. Groundwater extraction in the Ballona aquifer will be performed approximately 50-feet downgradient from the former location of monitoring well C-64. Additional soil samples will be collected north of monitoring well C-64. Soils that exceed LSRTs will be addressed by implementing additional SVE or DPE. Excavation of soils is not anticipated to be necessary as all COCs in soil are volatile and DPE and/or SVE will likely achieve ROs.

8.2.2 SA No. 2 – Southwest Corner of Building 12

Figure 8-4, *Conceptual Layout for Remediation of Building 12 (SA-2 and SA-3)*, depicts the conceptual layout for multiple DPE wells and groundwater wells at the southwest corner of Building 12 (SA-2). Figure 8-5, *Conceptual Cross-Section for SA-2*, provides the complementary conceptual cross-section for this source area.

Soil impacted by metals above HBRGs (cadmium and total chromium) will be surgically excavated, while DPE and groundwater extraction will target VOC removal. DPE will be implemented such that the ZOI for vapor extraction encompasses locations where VOCs in upper Bellflower aquitard soils exceed LSRTs. Groundwater extraction will be implemented from the lower Bellflower aquitard and Ballona aquifer in the southwest corner of former Building 12, at locations upgradient of the C-76 monitoring wells.

Additional data collection will include obtaining a grab groundwater sample from the Ballona aquifer in the area downgradient of C-76 and upgradient of C-84. The results from the grab sample will be compared to the RGs (Section 3) and used to evaluate the need for additional groundwater extraction in the Ballona aquifer downgradient of C-76.

8.2.3 SA No. 3 – Central Area of Former Building 12

Figure 8-4, *Conceptual Layout for Remediation of Building 12 (SA-2 and SA-3)*, depicts the conceptual layout for DPE and groundwater extraction wells at the central portion of Building 12 (SA-3). Figure 8-6, *Conceptual Cross-Section for SA-3*, provides the complementary conceptual cross-section for this source area.

Surgical excavation of soils will be used to address soil impacted by metals above HBRGs (copper and total chromium), while DPE and groundwater extraction will target VOC removal. DPE will be implemented such that the ZOI for vapor extraction includes locations where VOCs in the upper Bellflower aquitard soils exceed LSRTs. Groundwater extraction will be implemented for the lower Bellflower aquitard at a point located upgradient of monitoring well C-89be.

In addition, a 4-inch diameter monitoring well will be installed downgradient of C-89be and screened in the Ballona aquifer. A grab sample of groundwater will be collected from this monitoring well and the analytical results will be used to evaluate the need for additional groundwater extraction in this area.

8.2.4 SA No. 4 – Former Drum Storage Area (near Building 34)

Figure 8-7, *Conceptual Layout for Remediation of the Former Drum Storage Area (near Building 34)*, depicts the conceptual layout for multiple DPE wells and groundwater extraction wells (one screened in the lower Bellflower and one screened in the Ballona aquifer) at SA-4. Figure 8-8, *Conceptual Cross-Section for SA-4*, provides the complementary conceptual cross-section for this source area.

DPE will be implemented such that the ZOI for vapor extraction encompasses soil in the upper Bellflower aquitard where VOC concentrations exceed LSRTs. LSRT exceedances have been observed in two areas: near monitoring well cluster C-74 (at the bottom and margins of the soil excavation performed in 2001 by EEC), and near former monitoring well C-45. Groundwater extraction in the lower Bellflower aquitard will occur immediately upgradient of monitoring well C-74, and near monitoring well C-45. Groundwater extraction in the Ballona aquifer will occur downgradient of these two locations, at a single location between monitoring well C-74 and monitoring well C-75.

8.2.5 SA No. 5 – Former UST and Degreaser Pit West of Building 11

Figure 8-9, *Conceptual Layout of Remediation for Former UST and Degreaser Pit West of Building 11 (SA-5)*, depicts the conceptual layout for three DPE wells to be located west of Building 11 (SA-5). Figure 8-10, *Conceptual Cross-Section for SA-5*, provides the complementary conceptual cross-section for this source area.

DPE will be implemented such that the ZOI for vapor extraction will address VOCs in the upper Bellflower aquitard soils that exceed LSRTs; where hydrocarbon sheen has been previously observed in monitoring wells (i.e., TB-04, TB-07, TB-11, and TB-12); and where the benzene HBRG for groundwater was exceeded (TB-12).

8.2.6 SA No. 6 – Building 35

Figure 8-11, *Conceptual Layout for Remediation of Building 35 (SA-6)*, depicts the conceptual layout for seven DPE wells to be located within the northeast corner of former Building 35 (SA-6). Figure 8-12, *Conceptual Cross-Section for SA-6*, provides the complementary conceptual cross-section for this source area.

DPE at the northeast corner of the former Building 35 will be implemented such that the ZOI for vapor extraction will address areas in the upper Bellflower aquitard where soil is impacted by VOCs in excess of LSRTs. Additional soil matrix or soil vapor data may be acquired during the DPE pilot testing to ensure that the ZOI of extraction extends to all areas where soil concentrations exceed the LSRTs.

Groundwater extraction from the lower Bellflower aquitard will be implemented at the northeast corner of the former Building 35 (immediately west of the former chromate waste sump and former neutralization pit). An additional lower Bellflower aquitard groundwater extraction well will be installed, if necessary, to capture groundwater contamination under the northeast quadrant of the former Building 35. A 4-inch diameter Ballona aquifer monitoring well will be installed at the extreme northeast corner of the former building to assess conditions in the Ballona aquifer. If analytical results obtained from the monitoring well samples exceed the RGs presented in Section 3, then the 4-inch diameter Ballona aquifer monitoring well will be converted to an extraction well and groundwater extraction will be implemented at this location.

Application of DPE at the former organic sump (southwest corner of former Building 35) has not been proposed because the exceedance of soil LSRTs for the COC at this location (benzene) was observed below groundwater levels. Furthermore, the benzene observed in the soil samples likely did not originate from the organic sump, and is therefore not a likely source location for the COC observed. Groundwater extraction performed downgradient from this location is expected to address impacted groundwater associated with this location.

8.2.7 SA No. 7 – Storm Drain Discharge Site

Figure 8-13, *Storm Drain Discharge Site (SA-7)*, depicts boring sampling data and associated data for the storm drain discharge site. Figure 8-14, *Conceptual Cross-Section for SA-7*, provides the complementary conceptual cross-section for this source area.

Data collected in 1987 by MEE at C-49 indicated exceedances of LSRTs by MC and benzene. More recently, soil borings advanced in 2001 by EEC at three locations in a radial pattern immediately around C-49 did not detect MC or benzene in soil. Therefore, MNA has been selected as the appropriate remediation method for this location. Monitoring well C-49 will be placed on the MNA sampling list.

8.2.8 SA No. 8 – Sumps, Clarifiers, and Former Vapor Degreaser Northeast Corner of Building 14

Figure 8-15, *Conceptual Layout of Remediation for Building 15 (SA-8 and SA-9)*, depicts the conceptual layout for multiple DPE wells to be installed within the area of Building 15 to address SA-8 and SA-9. Figure 8-16, *Conceptual Cross-Section for SA-8*, provides the complementary conceptual cross-section for this source area.

Three DPE wells and one groundwater extraction well screened in the lower Bellflower are proposed for implementation to address source contamination at the northeast corner of Building 14 (SA-8). The DPE wells will be installed such that the ZOI for vapor extraction will encompass locations where VOCs exceed LSRTs in the upper Bellflower aquitard. Notably, LSRTs are exceeded in only two areas: 1) at former soil boring location 4-1 (near monitoring well C-78be), and 2) at monitoring well C-36.

Groundwater extraction will be implemented in the lower Bellflower aquitard downgradient of monitoring well C-78be. A 4-inch diameter monitoring well will be installed in the Ballona aquifer downgradient of C-78be. If analytical data obtained from the groundwater monitoring well samples exceed the criteria presented in Section 3, then the 4-inch diameter monitoring well will be converted to an extraction well.

8.2.9 SA No. 9 – Existing Clarifier and Former Vapor Degreaser Pit Building 15 Center Bay

Figure 8-15, *Conceptual Layout of Remediation for Building 15 (SA-8 and SA-9)*, depicts the conceptual layout for multiple DPE wells to be installed within the area of Building 15 to address SA-8 and SA-9. Figure 8-17, *Conceptual Cross-Section for SA-9*, provides the complementary conceptual cross-section for this source area.

Four, or potentially five, DPE wells (or SVE wells, as appropriate) are proposed to address source area contamination in the center bay of Building 15 (SA-9). The existing clarifier will be removed. Surgical excavation of soils (in the vicinity of former soil boring 226-11) will be performed to remove soil impacted by PCE above soil LSRTs and/or HBRGs to the extent technically feasible, based on access restrictions. If soils exceeding LSRTs cannot be fully removed, DPE will be implemented such that the ZOI for vapor extraction will encompass soil in the upper Bellflower aquitard that exceed LSRTs. The potential implementation of DPE at this location represents the "fifth" DPE well for SA-9. To supplement existing data, soil

and groundwater samples may be collected in the vicinity of floor trenches. Locations where soil concentrations are found to exceed LSRTs will be addressed using DPE.

Groundwater extraction will be implemented in the lower Bellflower aquitard immediately downgradient of former soil boring 226-11. Groundwater extraction from the Ballona aquifer at a single location along the northern, downgradient edge, of Building 15 will also be implemented.

8.3 Downgradient Specific Remedial Plans

As determined in the analyses presented in Sections 5, 6 and 7, the recommended alternative for addressing impacted groundwater includes source area contaminant and MNA for the downgradient portions of the plume. MNA applied to the upper and lower Bellflower aquitard and Ballona aquifer should show a reduction in contaminant mass. As stated previously, the Ballona aquifer is the primary unit where low concentrations of COCs extend laterally downgradient from source areas. As such, implementation of the MNA technology within the downgradient areas of the Campus Area will focus primarily on the Ballona aquifer, although both upper and lower Bellflower aquitard monitoring locations will be included, as needed. The details of the MNA sampling and analyses will be submitted to the RWQCB prior to implementation of the remedial action.

8.4 Remedial Implementation Plan

A detailed remedial design (RD) will be prepared prior to complete implementation of the remedial action (RA). By way of example, flow diagrams of the proposed implementation activities for Alternative 3B are provided in Figure 8-18, *Remedial Design Activities*, and Figure 8-19, *Remedial Action Activities*.

8.4.1 Remedial Design

The RD will include preparation of detailed engineering design documents, including plans, specifications, drawings and schedules for implementing each of the components of the remedy. An outline of the activities and data to be developed as part of the complete RD effort will be discussed with the RWQCB. The preliminary design will describe the conceptual design of the system, specify the additional data required to further refine the remedial concepts, and provide the appropriate level of engineering design specifications, construction schedule, and cost estimates to complete the RD. This phase will also include additional data collection required for final design (e.g., vapor permeability, physical parameters, hydraulic conductivity, etc.).

Groundwater Extraction in Source areas

Implementation of the DPE component of the remedy will install in phases. This approach will facilitate confirmation of design criteria, including extraction rates and ZOI. The conceptual number of DPE wells and their placement have been designed using a ZOI of approximately 20 feet. Initially, one DPE well will be installed at each of the source areas near the apparent center of contaminant mass based on historical

data. A series of tests will be conducted at this well to validate the appropriateness of the technology; obtain design criteria to ensure appropriate placement and adequate coverage of system; estimate initial VOC mass removal rates; and to size required equipment.

Two types of testing will be performed at the initial well, "quick tests" and "extended test(s)". Both of these tests will use portable DPE equipment and treatment systems. The quick tests will be 1-day test (maximum) and is expected to provide information on the permeability of soils surrounding the test well and on the approximate amount of contaminant mass that is in groundwater and vadose zone soils within the treatment zone of the well. A quick test will be performed at each of the source area locations. The quick test results will be used to determine the placement of additional DPE wells, and to make modifications to design specifications, if necessary. The quick test results will also be used to select one representative location for performing an extended DPE test. The extended test(s) will be conducted for a period of up to five days. Results of the extended test will be used to provide design information for the proposed treatment plant.

Monitoring wells will be installed to collect water level data to estimate the ZOI of the DPE wells during operation. Additionally, triple-depth piezometer clusters will be used for water level measurement. Water level monitoring will be conducted using data-loggers set to logarithmic frequency. Static pressures and groundwater elevations will be periodically checked at nearby monitoring wells.

Vapor monitoring probes will be installed into the vadose zone around the DPE wells. These probes will be used to collect subsurface static pressure and respiration gas data to estimate the ZOI of the vapor extraction portion of DPE.

The groundwater extraction systems in the lower Bellflower aquitard and Ballona aquifer source areas are intended to reduce contaminant mass and limit the migration of contaminants to downgradient areas. Contaminant removal and containment efficiency by these extraction systems require placement of wells based on an understanding of the hydraulic properties of the Campus Area. Existing hydraulic data from previously performed pumping tests will be used to complete the design of the source area groundwater extraction system in the lower Bellflower aquitard and in the Ballona aquifer. No additional aquifer tests in the lower Bellflower aquitard are necessary for the RD of the source area extraction systems. The assumed maximum capture zone width of the source area extraction wells designed for this hydrologic zone will be sufficiently large to contain the areas of concern. These assumptions will be verified, or modified as necessary, during the initial period of DPE operation.

To verify the hydraulic pumping characteristics of the Ballona aquifer and finalize the design of the source area extraction systems, a single groundwater extraction well screened in the Ballona aquifer will be installed in the source areas. This well will be used in step testing during RD to evaluate the relationship between groundwater

capture zone and extraction rates. The proposed step test will be completed for a minimum of three different pumping rates.

Regional hydrogeologic data for the Ballona aquifer have ranged from 3.1 $x10^{-3}$ feet per second to 7.7 to 10^{-3} feet per second (DWR, 1961). The need for additional groundwater monitoring wells or piezometers to monitor hydraulic head during the step tests will be evaluated once the location of the extraction well is selected, and based on expected ZOI and the proximity of existing monitoring wells. Existing monitoring wells will be used during the proposed step test, as feasible.

8.4.2 Remedial Action Implementation

The RA implementation phase will include construction of the groundwater treatment plant, remaining source area extraction wells, downgradient extraction wells, and remaining portions of the DPE system.

Groundwater Treatment Plant Construction

The extent of groundwater treatment construction required prior to discharge will be evaluated during RD and will be dependent upon the actual discharge option selected (e.g., reuse in the Riparian Corridor; discharge into Centinela Creek Channel, or to a POTW). It is likely, however, that the selected treatment process would include air-strippers, GAC, and oxidant-impregnated canisters for vapor streams. A conceptual flow diagram for the treatment of extracted groundwater and collected vapor is presented in Figure 8-20, *Groundwater/Vapor Treatment Flow Diagram*. Under this conceptual depiction, the vapor streams would be treated by activated carbon units (in series) and a single zeolite/potassium permanganate unit for VC polishing. The vapor treatment units would be sized to treat vapors from both DPE wells and the air stripping units. The central vapor treatment unit for vapor would consist of two parallel units. At satellite treatment locations specific factors such as anticipated adsorbent bed life may be used to justify a single unit at these locations. The actual treatment requirements and process details will be finalized during RD.

The location of the groundwater treatment plant was selected for this RP by considering several issues, including:

- Minimizing the total length of subsurface piping from the source areas to the treatment system;
- Proximity to treated groundwater discharge location (assumed to be the Riparian Corridor); and
- Minimizing visibility and blending treatment plant in with surrounding features.

The proposed treatment plant location is in the vicinity of former Building 35 and was shown previously in Section 8 (Figure 8-2)

Source area extraction systems will be turned on incrementally as all necessary equipment installation and piping to the treatment plant are complete.

DPE Implementation

The results from the initial DPE well testing will be used to complete the RD for this component of the remedy, including number and location of the remaining DPE wells. The additional DPE wells, equipment and underground piping to the treatment plant will then be installed. DPE system operation will commence in a step-wise fashion when the treatment plant is ready to treat DPE-extracted groundwater and vapors.

Source Area Groundwater Extraction Implementation

Source area groundwater extraction wells in the lower Bellflower aquitard, and those remaining for the Ballona aquifer, will be installed incrementally. Groundwater extraction at these locations will commence in a step-wise fashion when the treatment plant is ready to treat groundwater extracted from these systems, and all necessary piping to the treatment plant is in place.

Performance Monitoring Well Installation

Groundwater monitoring wells will be installed to monitor extraction performance and source removal. These additional monitoring wells will supplement existing monitoring wells and will be used for the performance-monitoring program. The location, aquifer being monitored, groundwater analyses, and sampling frequency will be described in a separate submittal to the RWQCB.

8.5 Summary of Approach for Remedial Actions

The foregoing proposed remedial action plan has been developed through a comprehensive set of steps, starting with identification of ROs and RGs for the Campus Area. Then, a set of remedial technologies and process options were developed that could address the nature and extent of known contamination in the Campus Area, and, in turn refined into a set of four potential remedial alternatives. Using widely-accepted evaluation criteria, a final alternative — 3B Groundwater Extraction in Source Areas and MNA Downgradient — was selected.

This 3B Alternative involves both source area and groundwater remediation. It will also involve active and passive components, as determined by which RGs need to be achieved. At this stage, conceptual layouts of the required remediation have been proposed, but many aspects of the final action will need to be refined during the RD phase. Additionally, as discussed in the next section, the proposed approach will have the flexibility to accommodate new data and other possible contingencies.

Section 9
Monitoring and Contingency Plan

This section establishes the basis for the future development of a Monitoring and Contingency Plan (MCP) for the proposed remedial action, Alternative 3B (Groundwater Extraction in Source Areas and MNA Downgradient). Information presented in this section will be expanded in the MCP document that will be submitted to the RWQCB after the completion of RD activities, and prior to RA implementation.

9.1 Description of Plan

The overall objectives of the MCP will be three-fold:

- Outline the procedures for establishing a database to optimize the performance and efficiency of the RA, and evaluate shut-down criteria for individual components of the RA;
- Ensure that human health and the environment remain protected during the implementation of the selected remedial alternative;
- Provide sufficient performance-monitoring data to adequately evaluate the ability of the remedial alternative to meet the ROs.

To meet these objectives, the MCP will have a groundwater monitoring program to evaluate the effectiveness of the preferred remedial alternative. Proposed groundwater monitoring activities identified in the MCP will be subject to revision based on a periodic evaluation of data collected during the early phases of RA implementation.

This plan will also describe actions to be taken (i.e., contingencies) in the event that the monitoring or other information reveals that additional steps should be undertaken to protect human health or the environment. The contingencies will be activated by "triggers" that are pre-determined action levels or conditions. Finally, the MCP will present the criteria by which the remedial systems will be shutdown.

9.2 Monitoring Program

The monitoring program will be used to monitor performance of the remedial systems in attaining the Campus Area ROs and RGs. The monitoring program component of the MCP will be developed as part of the RD; however, modifications to this program may be appropriate during the early phases of RA implementation based on actual conditions encountered.

The monitoring program data will be used to evaluate changes in the overall extent of the COCs in soils and groundwater in the Campus Area over time. In addition, the groundwater data will be used to:

- Evaluate the mass removal effectiveness of various components of the RA;
- Confirm that the RA is achieving the ROs set for the Campus Area;
- Evaluate the significance of natural attenuation processes throughout the operation of the RA; and
- Evaluate the need to implement contingency measures.

The MCP will include provisions for performance monitoring locations; analytical requirements; field methods; QA/QC guidelines; and reporting requirements.

With respect to monitoring wells, the locations will be selected considering (1) existing monitoring wells (2) the likely location of groundwater extraction wells that will be installed in the RA; and (3) the historical monitoring data results. The MCP will specify the water-bearing unit in which the monitoring wells will be screened, the proposed frequency of sampling, analytical target list, and intended purpose. All proposed monitoring and groundwater extraction wells required by the MCP will be installed during the RA phase.

9.3 Contingency Program

The purpose of any contingency program is to establish a mechanism by which meaningful changes in circumstances will be addressed in the design or operation of the remedial systems. Such a program will be structured around "triggers," the action levels or conditions that require a response, and "contingencies," the responsive actions to a trigger. Here, the point of the MCP contingency program is to allow contingency measures to be implemented where the triggers indicate that additional action is needed to protect human health or the groundwater resource. The contingency program that will be developed and submitted with the MCP will cover the following:

- The conditions that trigger a responsive action (i.e., triggers);
- The means of reviewing analytical data obtained from the monitoring program to determine if triggers are met;
- The contingency action to be taken in a response to a triggering event; and
- The reporting requirements when contingencies are triggered.

9.3.1 Identification of Triggers

The types of information or events that would trigger the implementation of a contingency action may be analytical results, observations conducted during the monitoring program, or events like the drilling of a new supply well. Specific triggers will be developed and submitted with the MCP considering the following factors:

- VOC concentration trends;
- Migration of VOCs in groundwater;
- Potential for impact to water supply wells; and
- Natural attenuation.

9.3.2 Identification of Contingencies

Contingencies are defined as a systematic set of site-specific, pre-determined responses to triggers that may be encountered during the implementation of a selected remediation alternative. Contingencies will be implemented if data, observations or events indicate that additional action is needed to protect human health or the groundwater resource In addition, some contingencies may be implemented to modify the scope of the monitoring program in response to changes in field conditions or groundwater quality, thus increasing the flexibility of the monitoring program based on an ongoing evaluation of the results of the monitoring program. Specific contingency measures will be developed and submitted as part of the Campus Area MCP.

At a minimum, the adequacy of ongoing remedial measures and the need for contingency measures will be considered on an annual basis as part of the groundwater monitoring program. Contingency measures will be implemented if groundwater monitoring indicates that additional action is needed to protect human health or the groundwater resource.

Any contingencies implemented and the corresponding triggers will be described in the data submittal or monitoring report prepared following that monitoring event. The MCP will identify any trigger conditions that would cause immediate agency notification upon discovery of the condition.

9.4 Shut-down Criteria and Post Shut-Down Monitoring

Performance monitoring data collected in accordance with the MCP will be evaluated to determine the effectiveness of individual components of the RA to meet the ROs, and for terminating portions of the remedial system, as appropriate. The primary performance monitoring data for source area systems are extracted contaminant concentrations and contaminant mass removal time trends. The MCP will contain proposed shut-down criteria for approval by the RWQCB. These criteria will be used to determine final cleanup levels as remediation is completed, or when further remediation becomes technically infeasible. As stated previously, HBRGs and SRTs will be used to identify and prioritize areas in the Campus Area that require remediation. However, the eventual cleanup goals are, to a significant extent, technology-based. Thus, the HBRGs and SRTs may not be the final clean up standards for the Campus Area. It is also expected that the RWQCB would also consider MNA data collected and evaluated

throughout the implementation of the RA. Where appropriate as a remedial response, MNA would continue until submittal of a Campus Area Closure Plan.

9.4.1 Shut-Down of Source Area Extraction

Source area extraction of both groundwater and vadose zone vapors (collected through the operation of DPE/SVE) would continue until reaching aquifer and media specific shut-down criteria approved by the RWQCB. The rationale that will guide the development of such criteria, which will be submitted in the MCP, is outlined below for each active component of the proposed remedial action:

Shut-Down Criteria for Groundwater Extraction

Consistent with the ROs, groundwater remediation in the source areas will be undertaken with the dual objectives of protecting human health and the groundwater resource. As such, groundwater extraction from the source area wells will continue, at a minimum, until performance-monitoring results indicate that all COC concentrations are below the RWQCB-approved HBRG values. To address the groundwater resource protection aspect of the ROs, the remediation will further seek to reduce Site COC concentrations to levels equal to MCLs, to the extent technically feasible. As noted previously, MCLs are standards that must be met before water can be supplied as drinking water. This is a highly unlikely scenario, since such water use from the Campus Area groundwater is restricted by CC&Rs and the water has other qualities (taste, color and smell) that make it an unlikely source of drinking water. Nonetheless, the groundwater extraction system will be run until it is no longer technically feasible to achieve MCLs by active remediation. The criteria for determining when this is so will be proposed in the MCP and will be assessed against the performance data that will be collected under the MCP monitoring program. It is also expected that the RWQCB would consider MNA data collected and evaluated throughout the implementation of the RA. Where appropriate as a remedial response that follows active remediation, MNA would continue until submittal of a Campus Area Closure Plan.

Shut-Down Criteria for Vapor Phase Extraction Component of DPE

Operation of the vapor extraction portion of the DPE or SVE remedy would continue until the effluent vapor concentrations and mass removal rates have reached asymptotic conditions. Rebound testing of the vapor extraction well(s) would be performed on a semi-annual basis for two years to verify that asymptotic conditions have been met.

Post Groundwater and Vadose Zone Vapor Extraction

It is expected that post-extraction groundwater monitoring of the upper Bellfower aquitard would continue on a semiannual basis for 2 years after the last DPE well has been shut down. If during the period of monitoring the concentration of a COC were found to rebound above the HBRGs, the affected extraction well would be operated until the conditions described above are met again. After 2 years of monitoring of the source area extraction wells, if no exceedances of HBRGs occur, the extraction wells would be permanently shut down. An evaluation of using MNA to address any

residual contamination would be performed prior to requesting closure of the Campus Area active remediation systems from the RWQCB.

9.5 Reporting Requirements

Following each monitoring event completed in accordance with the MCP, a data submittal or monitoring report, as appropriate, would be prepared and submitted to the RWQCB. The contents and schedule for these reports will be discussed in further detail upon submittal of the detailed scope of work for the groundwater-monitoring program, which will be submitted prior to the implementation of the RA. On an annual basis, an Annual Summary Report will be submitted to the RWQCB that includes data presented in each monitoring report along with an evaluation of remedial system performance.

The Annual Summary Report will include an evaluation of the potential effectiveness of MNA as compared to active groundwater extraction. Once MNA becomes an approved remedial approach to replace the active remedial components, it would continue until submittal of a Campus Area Closure Plan to the RWQCB.
This section establishes the basis for the future development of a Monitoring and Contingency Plan (MCP) for the proposed remedial action, Alternative 3B (Groundwater Extraction in Source Areas and MNA Downgradient). Information presented in this section will be expanded in the MCP document that will be submitted to the RWQCB after the completion of RD activities, and prior to RA implementation.

9.6 Description of Plan

The overall objectives of the MCP will be three-fold:

- Outline the procedures for establishing a database to optimize the performance and efficiency of the RA, and evaluate shut-down criteria for individual components of the RA;
- Ensure that human health and the environment remain protected during the implementation of the selected remedial alternative;
- Provide sufficient performance-monitoring data to adequately evaluate the ability of the remedial alternative to meet the ROs.

To meet these objectives, the MCP will have a groundwater monitoring program to evaluate the effectiveness of the preferred remedial alternative. Proposed groundwater monitoring activities identified in the MCP will be subject to revision based on a periodic evaluation of data collected during the early phases of RA implementation.

This plan will also describe actions to be taken (i.e., contingencies) in the event that the monitoring or other information reveals that additional steps should be undertaken to protect human health or the environment. The contingencies will be activated by "triggers" that are pre-determined action levels or conditions. Finally, the MCP will present the criteria by which the remedial systems will be shutdown.

9.7 Monitoring Program

The monitoring program will be used to monitor performance of the remedial systems in attaining the Campus Area ROs and RGs. The monitoring program component of the MCP will be developed as part of the RD; however, modifications to this program may be appropriate during the early phases of RA implementation based on actual conditions encountered.

The monitoring program data will be used to evaluate changes in the overall extent of the COCs in soils and groundwater in the Campus Area over time. In addition, the groundwater data will be used to:

- Evaluate the mass removal effectiveness of various components of the RA;
- Confirm that the RA is achieving the ROs set for the Campus Area;
- Evaluate the significance of natural attenuation processes throughout the operation of the RA; and
- Evaluate the need to implement contingency measures.

The MCP will include provisions for performance monitoring locations; analytical requirements; field methods; QA/QC guidelines; and reporting requirements.

With respect to monitoring wells, the locations will be selected considering (1) existing monitoring wells (2) the likely location of groundwater extraction wells that will be installed in the RA; and (3) the historical monitoring data results. The MCP will specify the water-bearing unit in which the monitoring wells will be screened, the proposed frequency of sampling, analytical target list, and intended purpose. All proposed monitoring and groundwater extraction wells required by the MCP will be installed during the RA phase.

9.8 Contingency Program

The purpose of any contingency program is to establish a mechanism by which meaningful changes in circumstances will be addressed in the design or operation of the remedial systems. Such a program will be structured around "triggers," the action levels or conditions that require a response, and "contingencies," the responsive actions to a trigger. Here, the point of the MCP contingency program is to allow contingency measures to be implemented where the triggers indicate that additional action is needed to protect human health or the groundwater resource. The contingency program that will be developed and submitted with the MCP will cover the following:

- The conditions that trigger a responsive action (i.e., triggers);
- The means of reviewing analytical data obtained from the monitoring program to determine if triggers are met;

- The contingency action to be taken in a response to a triggering event; and
- The reporting requirements when contingencies are triggered.

9.8.1 Identification of Triggers

The types of information or events that would trigger the implementation of a contingency action may be analytical results, observations conducted during the monitoring program, or events like the drilling of a new supply well. Specific triggers will be developed and submitted with the MCP considering the following factors:

- VOC concentration trends;
- Migration of VOCs in groundwater;
- Potential for impact to water supply wells; and
- Natural attenuation.

9.8.2 Identification of Contingencies

Contingencies are defined as a systematic set of site-specific, pre-determined responses to triggers that may be encountered during the implementation of a selected remediation alternative. Contingencies will be implemented if data, observations or events indicate that additional action is needed to protect human health or the groundwater resource In addition, some contingencies may be implemented to modify the scope of the monitoring program in response to changes in field conditions or groundwater quality, thus increasing the flexibility of the monitoring program based on an ongoing evaluation of the results of the monitoring program. Specific contingency measures will be developed and submitted as part of the Campus Area MCP.

At a minimum, the adequacy of ongoing remedial measures and the need for contingency measures will be considered on an annual basis as part of the groundwater monitoring program. Contingency measures will be implemented if groundwater monitoring indicates that additional action is needed to protect human health or the groundwater resource.

Any contingencies implemented and the corresponding triggers will be described in the data submittal or monitoring report prepared following that monitoring event. The MCP will identify any trigger conditions that would cause immediate agency notification upon discovery of the condition.

9.9 Shut-down Criteria and Post Shut-Down Monitoring

Performance monitoring data collected in accordance with the MCP will be evaluated to determine the effectiveness of individual components of the RA to meet the ROs, and for terminating portions of the remedial system, as appropriate. The primary performance

monitoring data for source area systems are extracted contaminant concentrations and contaminant mass removal time trends. The MCP will contain proposed shut-down criteria for approval by the RWQCB. These criteria will be used to determine final cleanup levels as remediation is completed, or when further remediation becomes technically infeasible. As stated previously, HBRGs and SRTs will be used to identify and prioritize areas in the Campus Area that require remediation. However, the eventual cleanup goals are, to a significant extent, technology-based. Thus, the HBRGs and SRTs may not be the final clean up standards for the Campus Area. It is also expected that the RWQCB would also consider MNA data collected and evaluated throughout the implementation of the RA. Where appropriate as a remedial response, MNA would continue until submittal of a Campus Area Closure Plan.

9.9.1 Shut-Down of Source Area Extraction

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Shut-Down Criteria for Vapor Phase Extraction Component of DPE

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9.10 Reporting Requirements

Following each monitoring event completed in accordance with the MCP, a data submittal or monitoring report, as appropriate, would be prepared and submitted to the RWQCB. The contents and schedule for these reports will be discussed in further detail upon submittal of the detailed scope of work for the groundwater-monitoring program, which will be submitted prior to the implementation of the RA. On an annual basis, an Annual Summary Report will be submitted to the RWQCB that includes data presented in each monitoring report along with an evaluation of remedial system performance.

The Annual Summary Report will include an evaluation of the potential effectiveness of MNA as compared to active groundwater extraction. Once MNA becomes an approved remedial approach to replace the active remedial components, it would continue until submittal of a Campus Area Closure Plan to the RWQCB.

Section 10
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SOURCE: Camp Dresser & McKee Inc., 1999

PLAYA VISTA
SOIL & GROUNDWATER REMEDIATION PLAN - CAMPUS AREA

Site Location Map

CDM

Figure 1-1

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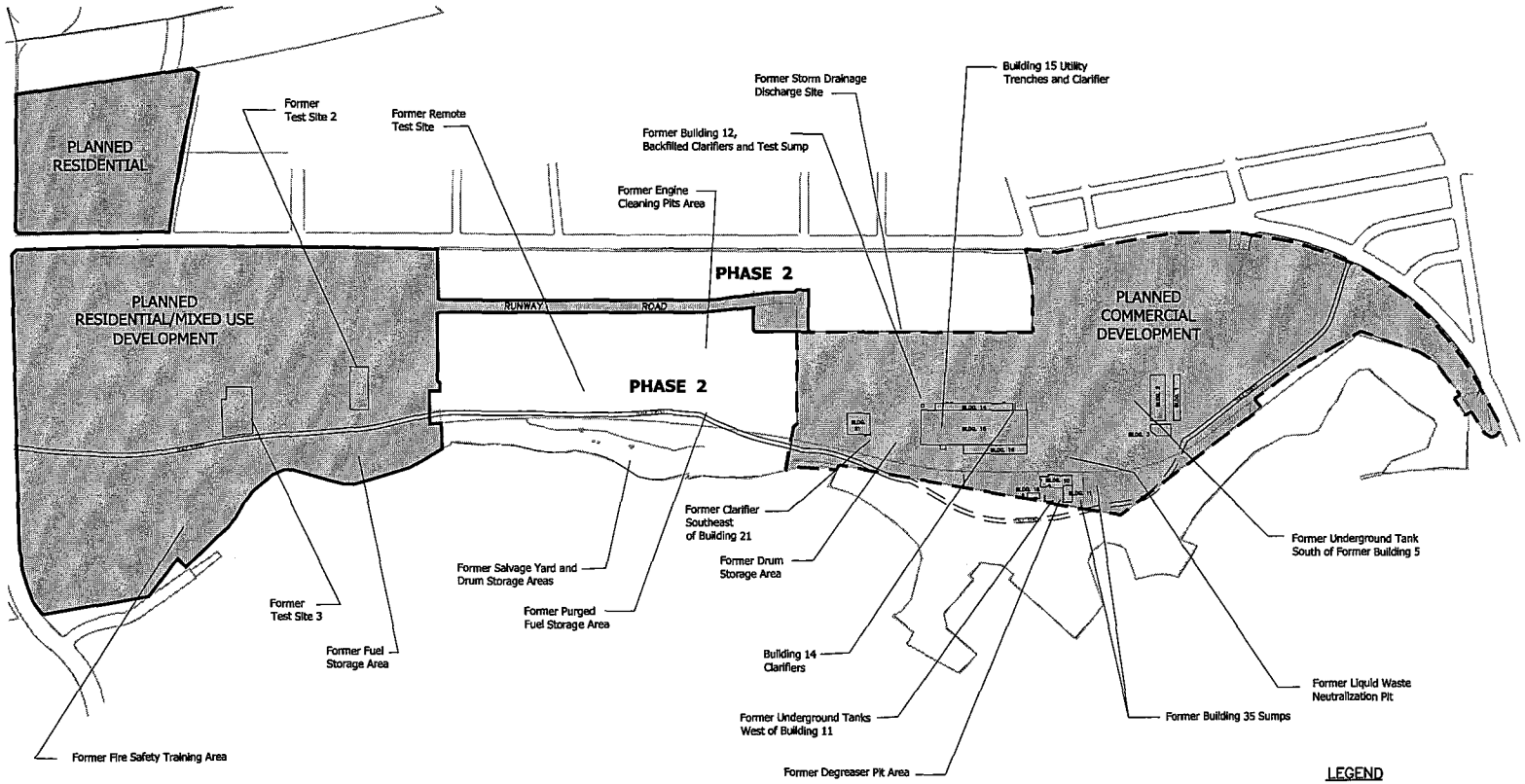

Notes: Only the existing primary building structures and site features are shown. Some of the historic building structures and site features shown have been demolished or no longer exist.

PLAYA VISTA
SOIL & GROUNDWATER REMEDIATION PLAN - CAMPUS AREA

Area D Features Map

Figure 1-2

CDM

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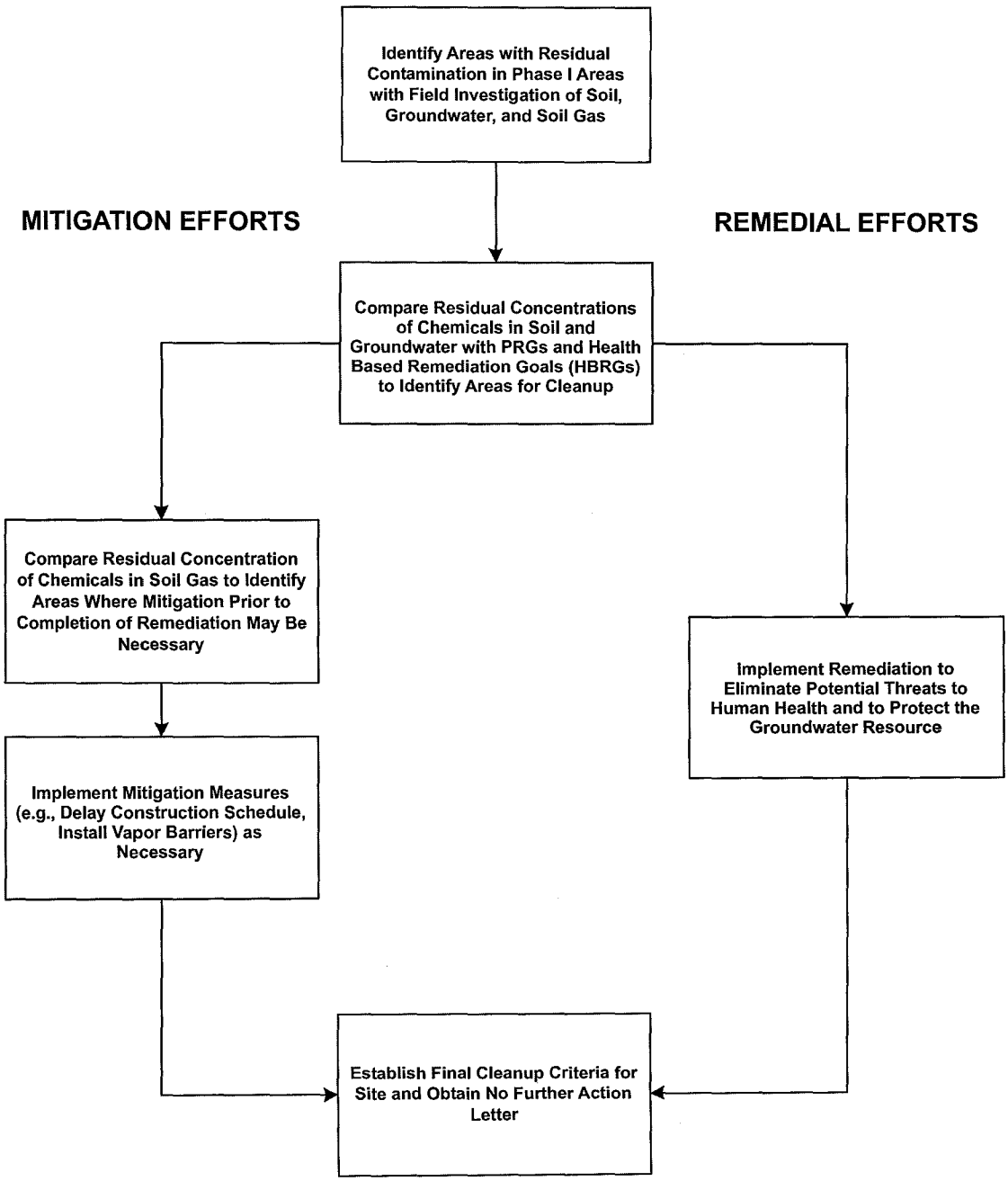

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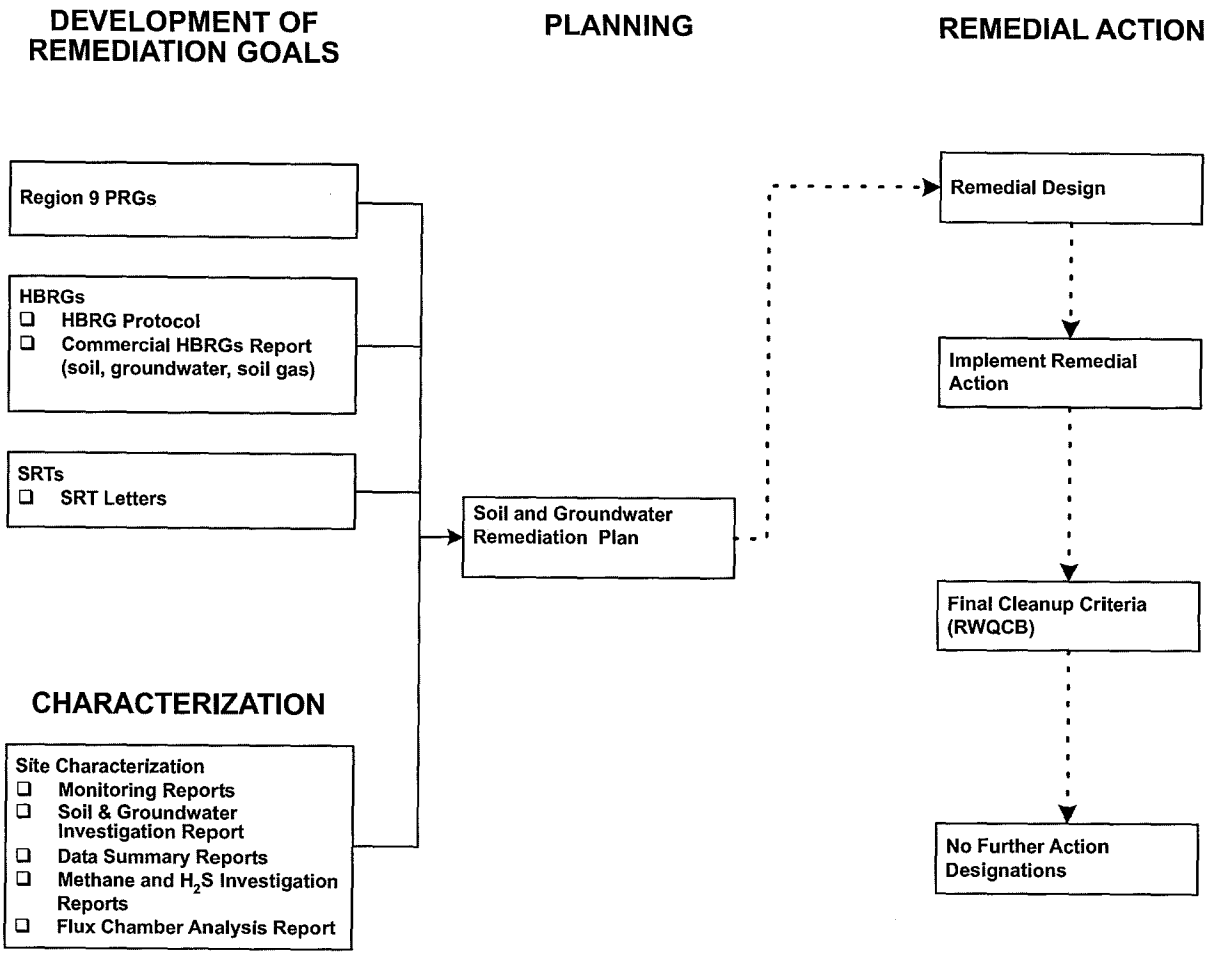
PLAYA VISTA
SOIL & GROUNDWATER REMEDIATION PLAN - CAMPUS AREA

Summary of Approach to Remediation for Phase I Site Development

CDM

Figure 1-3



PLAYA VISTA
SOIL & GROUNDWATER REMEDIATION PLAN - CAMPUS AREA

Flow of Information Among Playa Vista Environmental Reports

CDM

Figure 1-4

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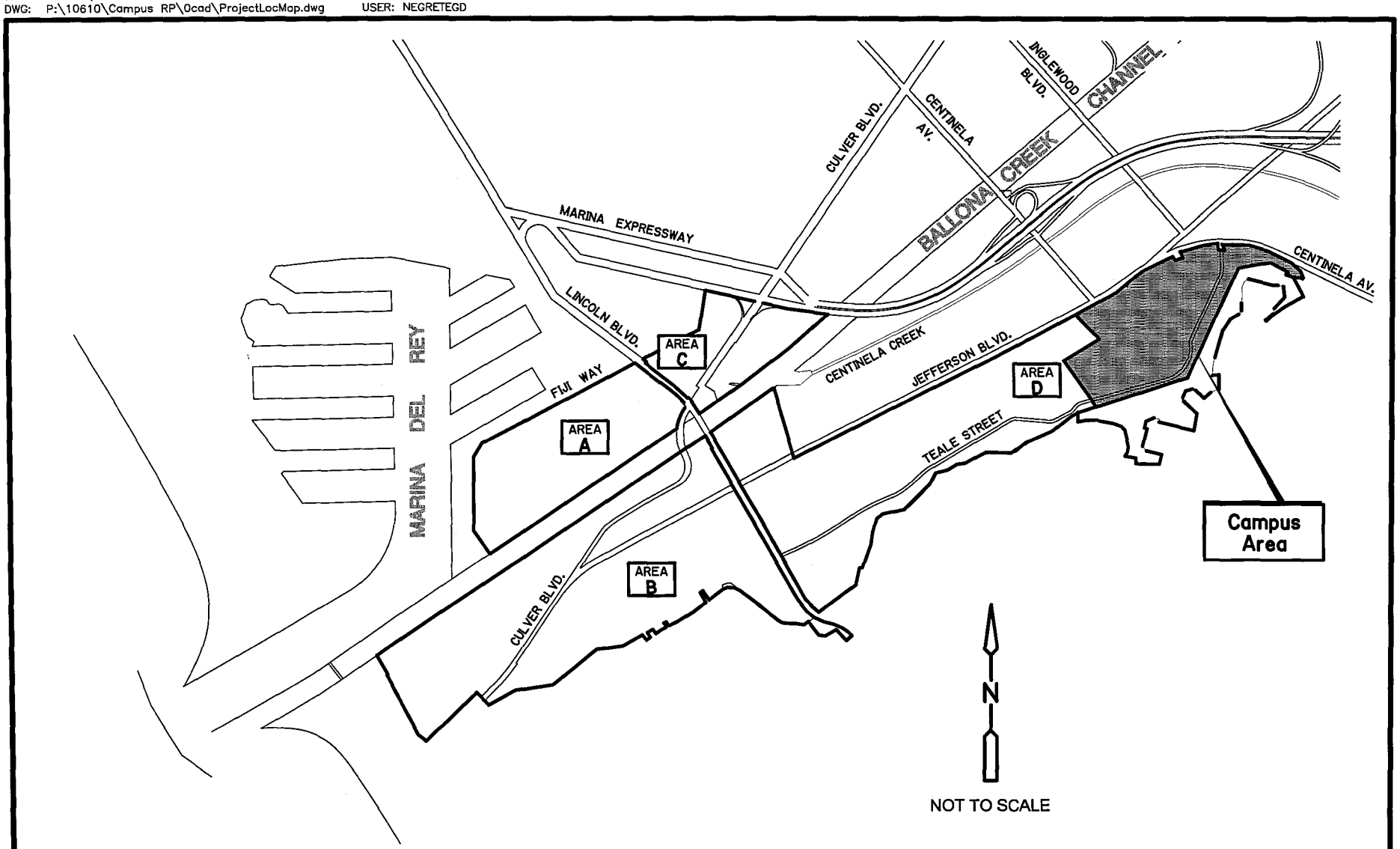

PLAYA VISTA
SOIL & GROUNDWATER REMEDIATION PLAN - CAMPUS AREA

Project Location Map

CDM

Figure 2-1

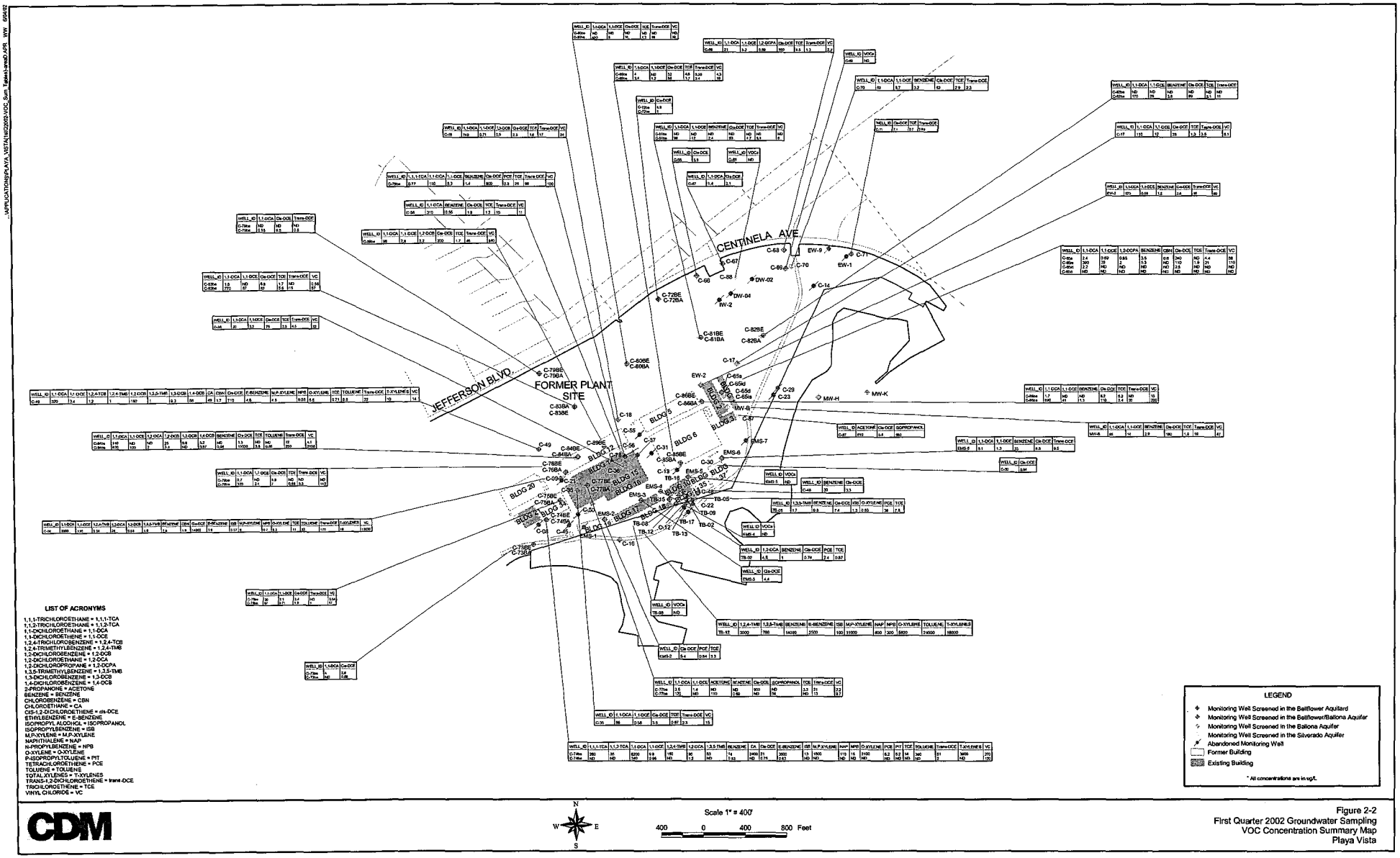

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Figure 2-2
First Quarter 2002 Groundwater Sampling
VOC Concentration Summary Map
Playa Vista

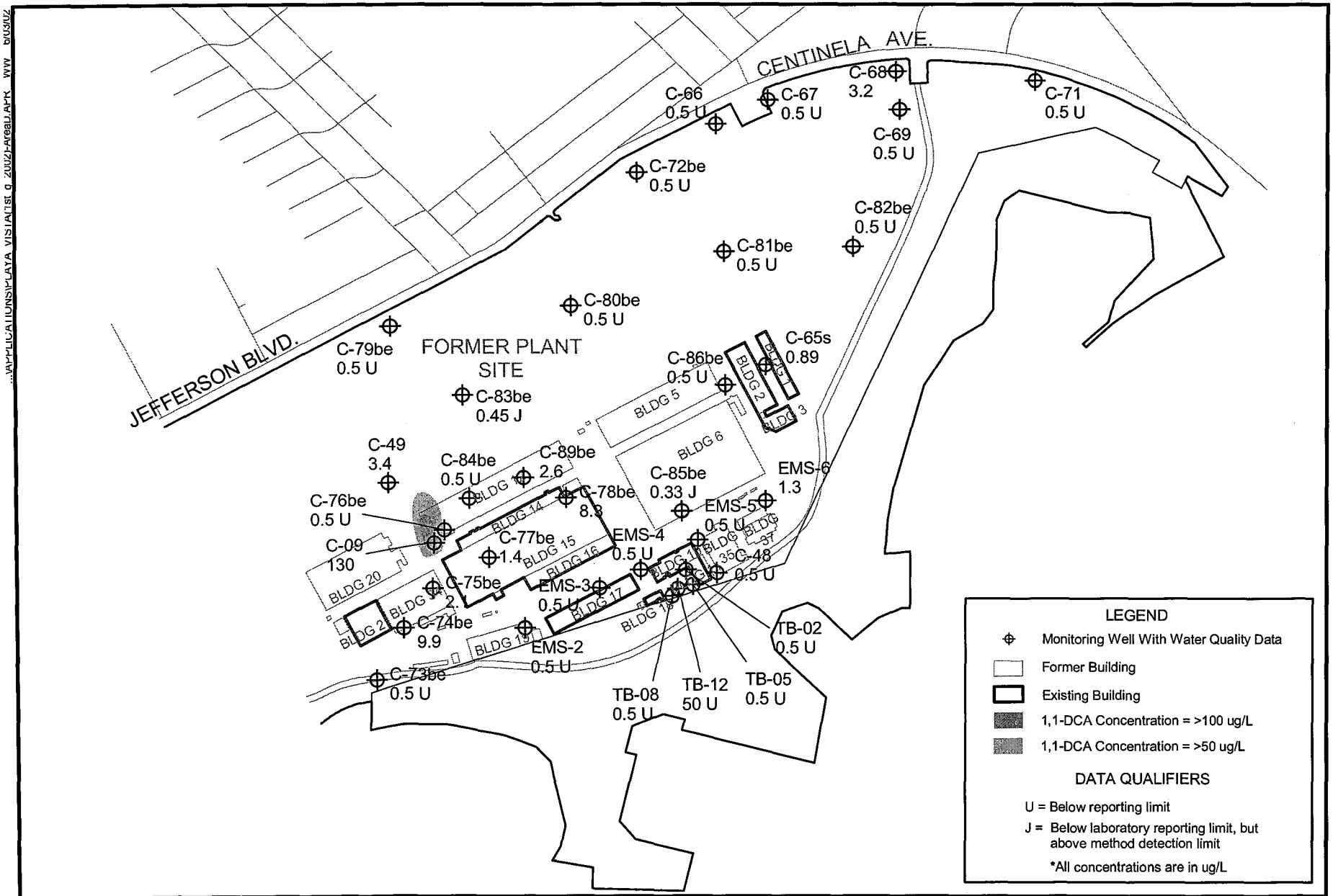
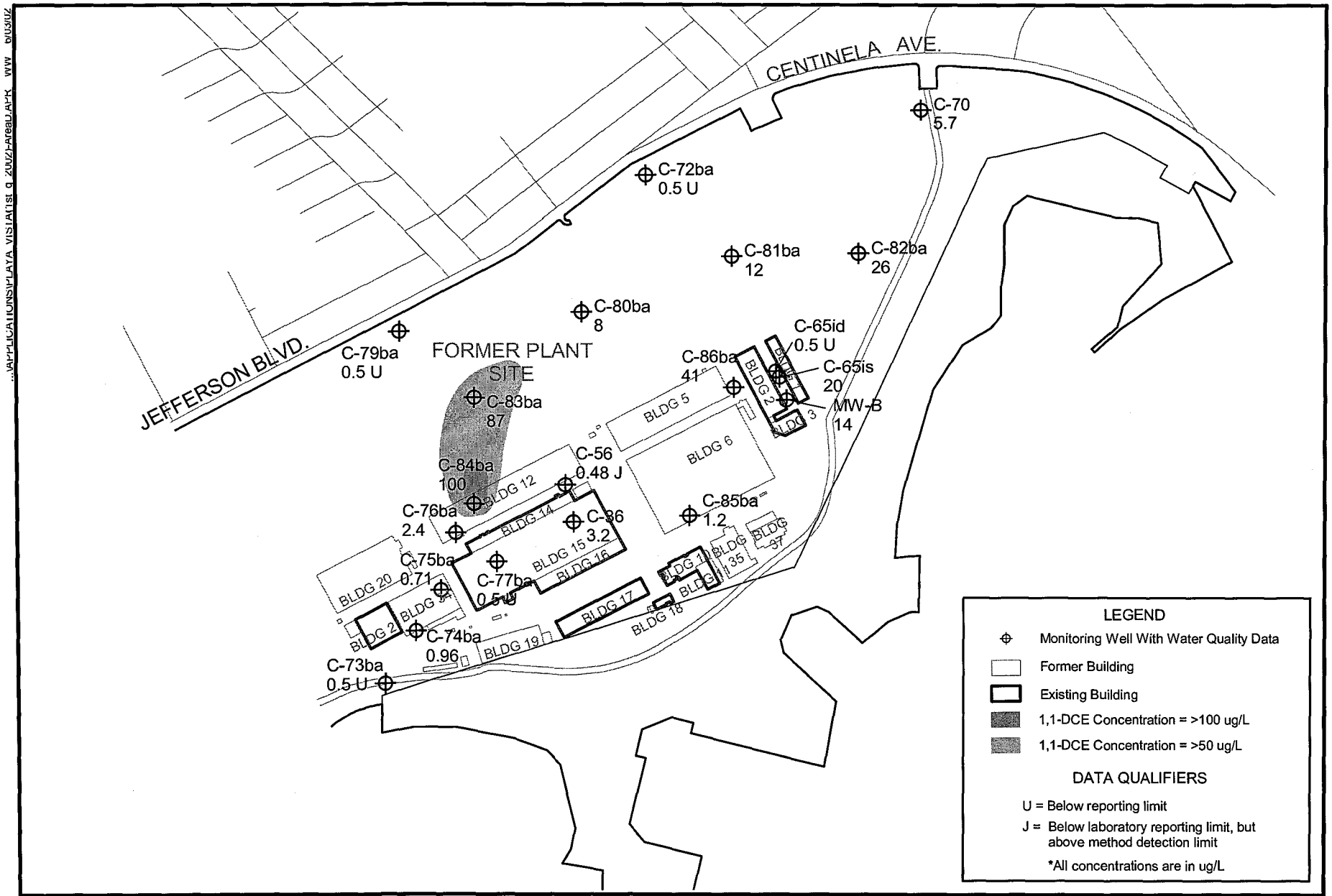


Figure 2-3
First Quarter 2002 Groundwater Sampling
1,1-Dichloroethene Concentration Summary Map - Bellflower Aquitard
Playa Vista



CDM

Figure 2-4
First Quarter 2002 Groundwater Sampling
1,1-Dichloroethene Concentration Summary Map - Ballona Aquifer
Playa Vista

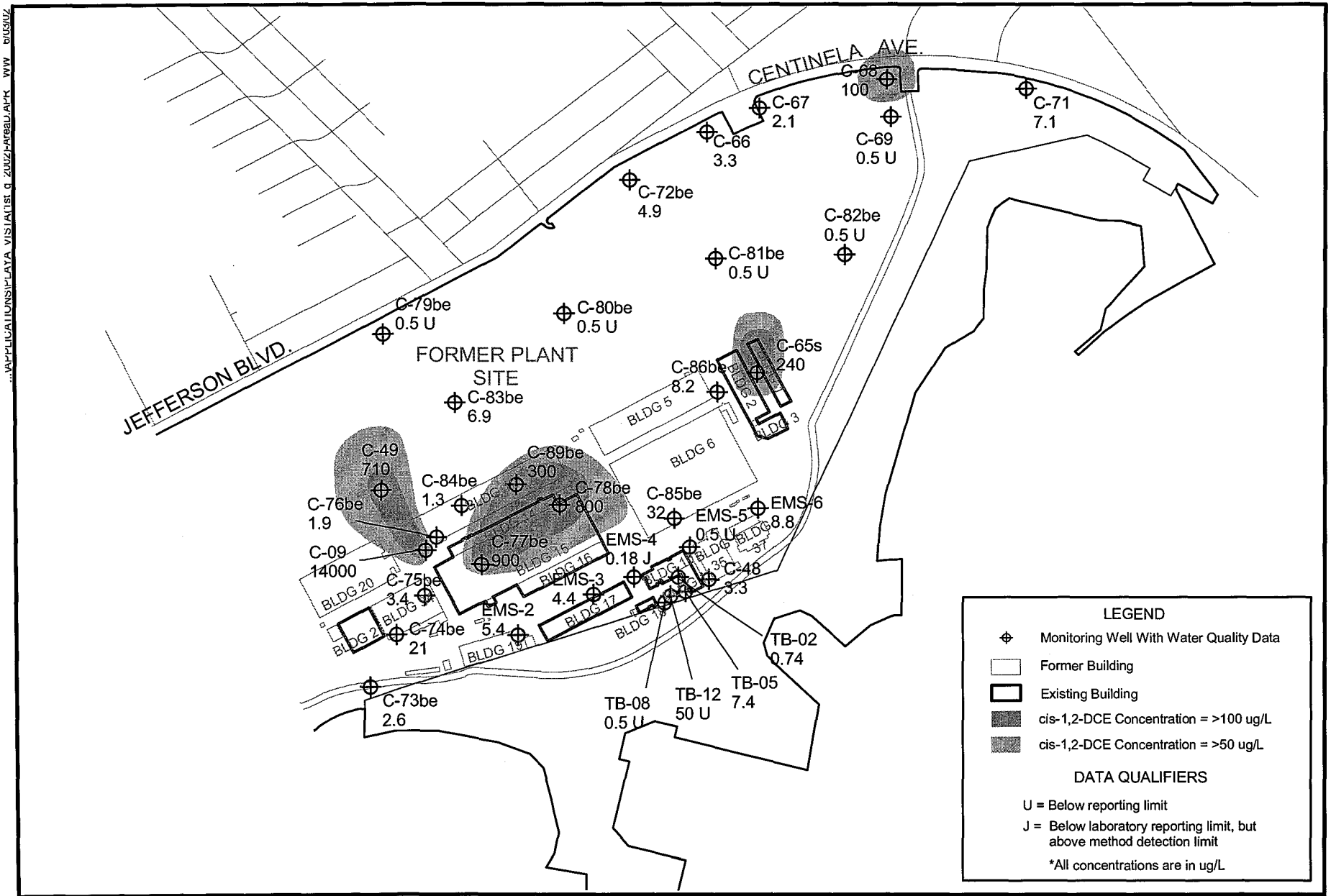


Figure 2-5
First Quarter 2002 Groundwater Sampling
cis-1,2-Dichloroethene Concentration Summary Map - Bellflower Aquitard
Playa Vista

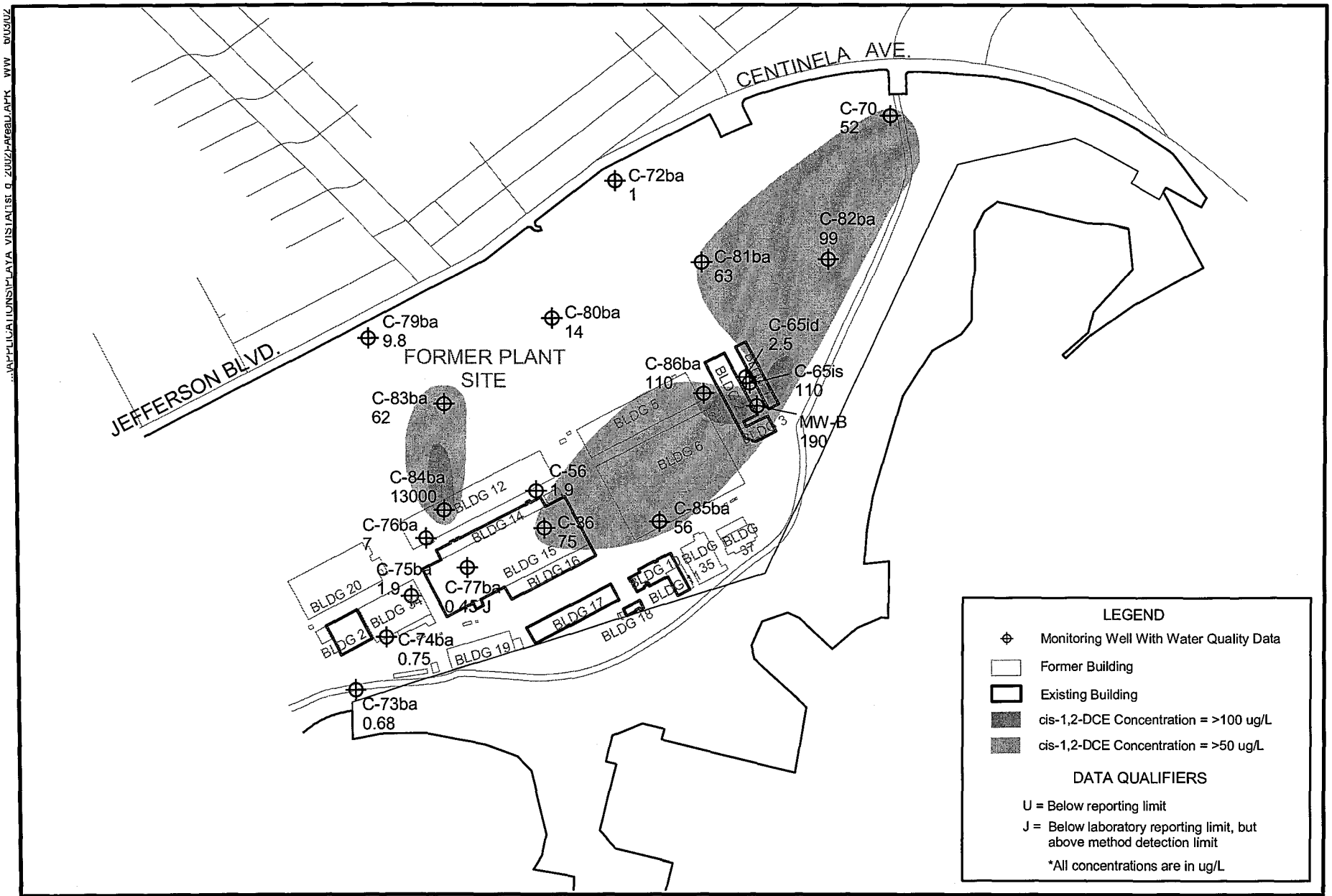


Figure 2-6
First Quarter 2002 Groundwater Sampling
cis-1,2-Dichloroethene Concentration Summary Map - Ballona Aquifer
Playa Vista

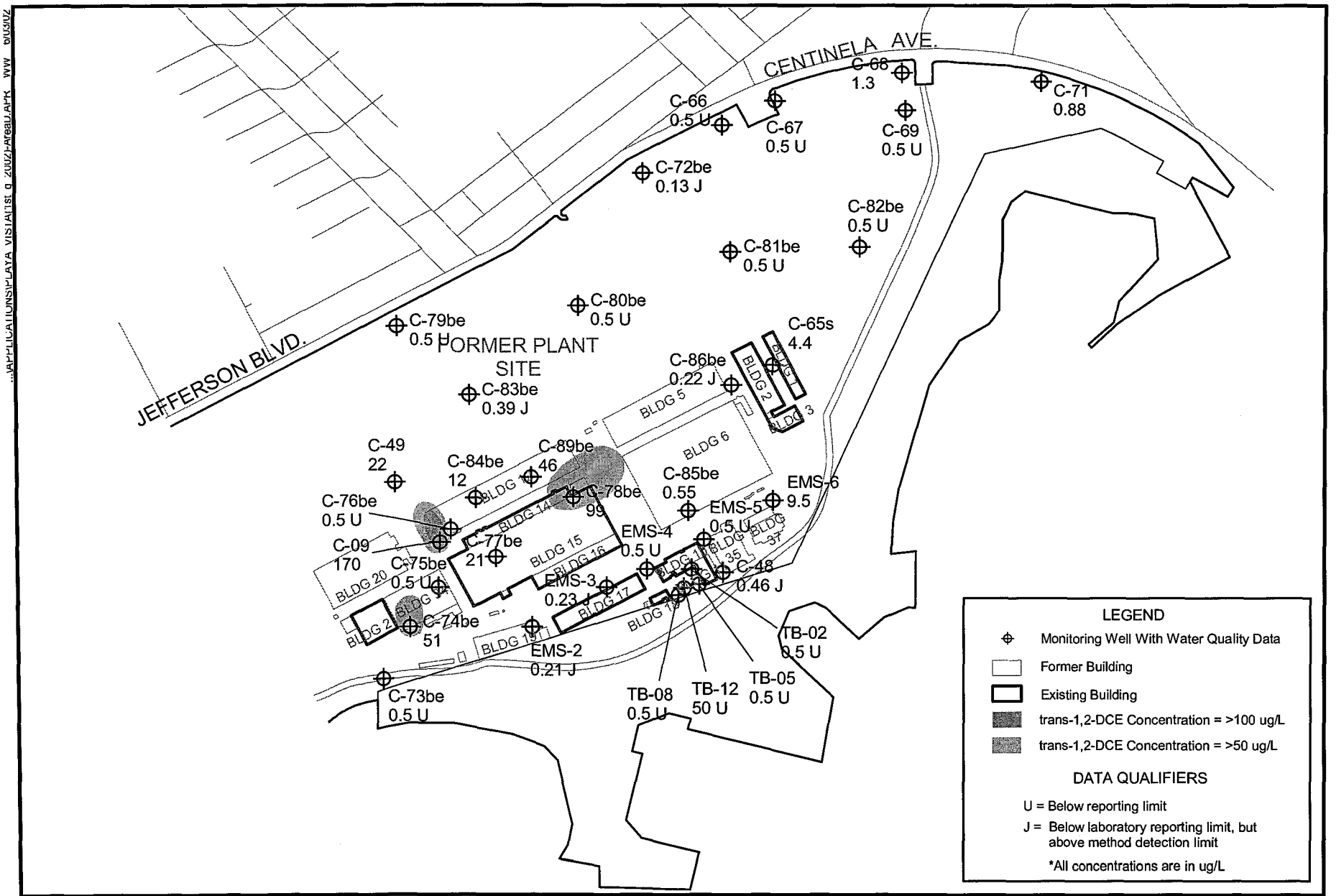


Figure 2-7
First Quarter 2002 Groundwater Sampling
trans-1,2-Dichloroethene Concentration Summary Map - Bellflower Aquitard
Playa Vista

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November 21, 2001

Ms. Rebecca Nevarez
California Regional Water Quality Control Board
Los Angeles Region
320 West 4th Street, Suite 200
Los Angeles, CA 90013

Subject: Former Fire Training Burn Pit Area - Phase 1 Project Area
Additional Soil and Groundwater Characterization Activities
Playa Vista Site, Los Angeles
CDM Project No.: 10610-32621-DATA

Dear Ms. Nevarez:

Camp Dresser & McKee Inc. (CDM) is submitting this letter report for soil and in-situ groundwater sampling conducted at the former Fire Training Burn Pit (FTBP) within the Phase 1 Project Area of the Playa Vista Site (Figure 1). This work was completed at the request of Playa Capital Company, LLC (PCC) in preparation for further development plans in the vicinity of the former FTBP. On January 30, 2001, Integrated Environmental Services, Inc., (Integrated) submitted a work plan to the Los Angeles Regional Water Quality Control Board (LA-RWQCB) to conduct additional groundwater investigation activities at the FTBP area. The work plan was approved by LA-RWQCB on July 27, 2001.

This letter report describes the recent site characterization and sampling activities completed at the former FTBP area, including rationale, technical approach, and results. For ease of presentation, figures and tables related to these most recent activities are included at the end of this letter report in Attachments A and B, respectively.

1.0 BACKGROUND

1.1 Geologic and Hydrogeologic Conditions

Two primary lithologic sequences exist in the shallow subsurface of the former FTBP, including a finer-grained unit of silty sand, silt and clay from ground surface to approximately 15 feet bgs (3 feet below mean seal level [msl]) and a coarser-grained sandy unit (including both poor- and well-graded sands) to an approximate depth of 40 feet bgs (30 feet below msl, the maximum depth investigated). Both lithologic sequences are part of the Bellflower aquitard, the uppermost hydrogeologic unit at the Site. A distinctive clay layer (3 to 10 feet thick) underlies the former FTBP area between depths of approximately 10 to 15 feet bgs (2 feet above msl to 3 feet below msl).

Groundwater is encountered at depths between 4 and 8 feet bgs (average elevation of 6.5 feet above msl measured in May 2001) in the former FTBP area. Groundwater flow for the Bellflower aquitard in this area is generally in a northerly direction at an approximate gradient of 0.004 feet/feet. Groundwater flow is generally perpendicular to and away from the Ballona Bluffs. The groundwater flow direction is depicted on Figure 2.

1.2 Summary of Historical Activities

Based on available documentation, the former FTBP was used between the early 1960s and mid-1980s to train fire fighters to handle chemical and fuel fires. The pit was unlined and surrounded by a one-foot high berm. Based on soil boring analytical results from *Remediation Report, First Phase, West Side Soils* (McLaren Environmental Engineering [MEE], 1987), soils impacted with petroleum hydrocarbons and volatile organic compounds (VOCs) extended vertically to a depth of 19.5 feet below ground surface (bgs) in the center of the bermed area.

The 1987 MEE report recommended that the former FTBP be dewatered, excavated and backfilled. Remediation of the pit began in March 1988. Approximately 1,815 cubic yards of soil were excavated from within the bermed area to a depth of 17 feet bgs. Shallow groundwater was encountered during excavation. Based on the evaluation of 20 confirmation soil samples collected from within the excavation area, with results below the clean-up criteria approved by the LA-RWQCB in June 1987, the excavation was considered complete. The excavation was backfilled with 15 feet of gravel and capped with 2 feet of native soil (MEE, 1988).

Subsequent investigations and monitoring activities were conducted after excavation activities were complete, which are summarized in the following sections. Analytical results from soil and groundwater investigations in the former FTBP are illustrated on the figures included in Attachment C.

1.2.1 Soil and Groundwater Investigation - January and February 2000

Soil and groundwater samples were collected in January and February 2000 as part of the LA-RWQCB approved *Soil and Groundwater Investigation Work Plan (SGIWP II), Phase I Project Area* (CDM, November 1999) to assess the extent of any remaining VOCs and TPH in groundwater and soil. During the investigation, 13 shallow borings (D-65 through D-77) were advanced in the FTBP area and soil samples collected at depths of 6 and 12 feet bgs. Ground surface was 11 to 12 feet above msl and sample depths ranged from 0 to 6 feet above msl. Four cone penetrometer test (CPT) borings were advanced in the vicinity of the former FTBP area to depths ranging from 31 to 44 feet bgs (to elevations of approximately 30 feet below msl). Also, three groundwater monitoring wells (MW-1F, MW-2F and MW-3F) were installed south of the former FTBP. The depths of the wells ranged from 10 to 16 feet bgs (bottom of wells at approximately 3 feet above msl). In-situ groundwater samples were collected at eight locations: samples were collected from borings CPT-1A, CPT-2A, CPT-3, CPT-4A, FTBP-1-24, HP-67, HP-72 and HP-73.

Results of the investigation were presented in the *Soil and Groundwater Investigation Report - Phase I Project* (CDM, May 2000). Soil and groundwater analytical results from historical investigations are illustrated on figures included in Attachment C (Figures C-1 and C-2, respectively). Significant findings are summarized as follows:

- Although chlorinated VOCs were detected in soil samples, concentrations were lower than the concentrations detected in confirmation samples collected in 1987 and lower than the approved 1987 clean-up levels (i.e., less than 1,000 times the corresponding maximum contaminant levels [MCLs]). Non-chlorinated VOCs were not detected in soil samples. TPH was detected in boring D-67; fuel fingerprinting indicated the detection was quantified in the motor oil range.

- Chlorinated VOCs were detected at concentrations greater than laboratory reporting limits in four (HP-67, HP-73, CPT-3 and CPT-4A) of the eight in-situ groundwater samples collected in the vicinity of the former FTBP. The highest concentrations were detected in the sample collected at 12 feet bgs (0 feet msl) in HP-73: cis-1,2-dichloroethene (cis-1,2-DCE) was detected at 760 micrograms per liter (µg/L); 1,1-dichloroethane (1,1-DCA) at 51 µg/L; 1,1-dichloroethene (1,1-DCE) at 26 µg/L, trans-1,2-DCE at 28 µg/L; trichloroethene (TCE) at 8.6 µg/L; and vinyl chloride at 11 µg/L. Tetrachloroethene (PCE) was detected in the sample collected at 12 feet bgs from HP-67 at a concentration of 71 µg/L.

- Chlorinated VOCs were detected in the three newly installed shallow groundwater monitoring wells. The highest concentrations were detected in well MW-3F: TCE (940 µg/L), 1,1-DCE (130 µg/L), 1,1-DCA (100 µg/L), trans-1,2-DCE (110 µg/L), cis-1,2-DCE (1,500 µg/L), PCE (16 µg/L) and vinyl chloride (42 µg/L).

- Non-chlorinated VOCs were detected at concentrations greater than the respective laboratory reporting limits in four of the in-situ groundwater samples and in one of the shallow monitoring well samples. Detections of non-chlorinated VOCs, however, were limited to benzene and toluene. Benzene was detected at concentrations just slightly higher than the reporting limit of 0.50 µg/L in samples collected from HP-72, HP-73, and CPT-4A, and in monitoring well sample MW-3F at a concentration of 1.4 µg/L; toluene was detected in sample CPT-2A at a concentration of 1.2 µg/L.

- TPH concentrations were detected within the shallow in-situ groundwater samples in the former FTBP. Fuel fingerprinting indicated that the TPH consisted of heavier hydrocarbons quantified in crude oil/motor oil range. Lighter hydrocarbons were detected in monitoring well MW-3F at a concentration of 450 µg/L.

Based on the results of this soil and groundwater investigation, subsequent field activities were conducted in April and May 2000 to further assess the extent of VOC and TPH contamination in soil and groundwater in the vicinity of the former FTBP.

1.2.2 Soil and Groundwater Investigation - April and May 2000

On April 7, 2000, CDM submitted an addendum to SGIWP II to implement the additional investigation activities. Field activities were conducted in April and May 2000 and included the advancement of two borings (D-117 and D-118) to depths of 15 feet bgs (to 3 feet below msl), and installation and sampling of three additional groundwater monitoring wells (MW-4F, MW-5F and MW-6F). Soil samples were collected at the above five boreholes. Samples were collected at multiple depths from each borehole up to a maximum depth of approximately 11.5 feet (0.5 feet above msl) and analyzed for VOCs and TPH. Significant findings from this investigation include:

- VOC analyses indicated the presence of chlorinated compounds, primarily TCE and cis-1,2-DCE, in soil samples collected from borings D-117, D-118, MW-4F and MW-6F. The maximum VOC concentrations were detected in these borings at depths of approximately 10 feet bgs (2 feet above msl), which corresponds to the upper portion of the clay layer underlying the former FTBP. Non-chlorinated VOCs (acetone and methyl tert-butyl ether [MTBE]) were only detected in the sample collected from MW-5F at a depth of 9.5 feet bgs (0.5 feet above msl) and at relatively low concentrations. TPH compounds were detected in the shallowest samples (i.e., 3.5 feet bgs, or 7 feet above msl) collected from borings MW-5F and MW-6F at concentrations of 17 and 15 milligrams per kilogram (mg/kg), respectively.

- Chlorinated VOCs, predominantly cis-1,2-DCE, were detected in two (MW-4F and MW-6F) of the newly-installed groundwater monitoring wells. The highest concentrations were reported in well MW-4F. Cis-1,2-DCE, TCE and vinyl chloride were detected in groundwater at concentrations of 110, 1.6 and 11 µg/L, respectively. Non-chlorinated VOCs and TPH compounds were not detected in any of the three wells at concentrations greater than the laboratory reporting limits.

1.2.3 Quarterly Groundwater Monitoring

Six groundwater monitoring wells (EW-6A, MW-1F, MW-2F, MW-3F, MW-F and MW-M) located in the vicinity or down gradient of the former FTBP have been monitored at least twice during quarterly events since quarterly monitoring began in 1999. Of these six wells, two (MW-F and MW-M) are located down gradient of the former excavation and have slotted intervals beginning at depths of at least 30 feet bgs or deeper. Well MW-F has a slotted interval in both the Bellflower aquitard and Ballona aquifer (32.6 to 52.6 feet bgs) and MW-M is slotted within the Ballona aquifer (40 to 60 feet bgs). The other four wells screen the Bellflower aquitard at much shallower depths (bottom of slotted intervals

are 16 feet bgs or shallower). Analytical results from quarterly groundwater monitoring events for wells located in the vicinity of the former FTBP are summarized on tables included in Attachment D.

Low concentrations of chlorinated compounds have been detected in the deep down gradient wells MW-F and MW-M; however, the detections have been limited to cis-1,2-DCE. The maximum cis-1,2-DCE concentrations have been detected in well MW-M. Between March 1999 and May 2001, cis-1,2-DCE concentrations have remained consistently less than 8.1 µg/L. Non-chlorinated VOCs have not historically been detected in either of these two deep wells. TPH compounds have not been detected above laboratory reporting limits in wells MW-F and MW-M.

With respect to the four shallow wells in the vicinity of the former FTBP, the maximum chlorinated VOC concentrations have been detected in well MW-3F, which is located at the southern edge of the former excavated area and screens the Bellflower aquitard between 3 and 10 feet bgs (2 to 9 feet above msl). In May 2001, concentrations of cis-1,2-DCE and TCE were reported at750 and 170 µg/L, respectively. Vinyl chloride has also historically been detected in this well, with the most recent concentration at 9.3 µg/L (CDM, 2001).

The detection of non-chlorinated VOCs at concentrations greater than laboratory reporting limits in the shallower monitoring wells has been limited to benzene in wells EW-6A and MW-3F. The highest benzene concentration was reported in well EW-6A at 3.9 µg/L in January 2001. Non-chlorinated VOCs have not been detected in any of these wells at concentrations greater than laboratory reporting limits since January 2001. TPH has only been detected one time in any of the shallow wells; TPH was detected in well EW-6A at a concentration of 230 µg/L in January 2001.

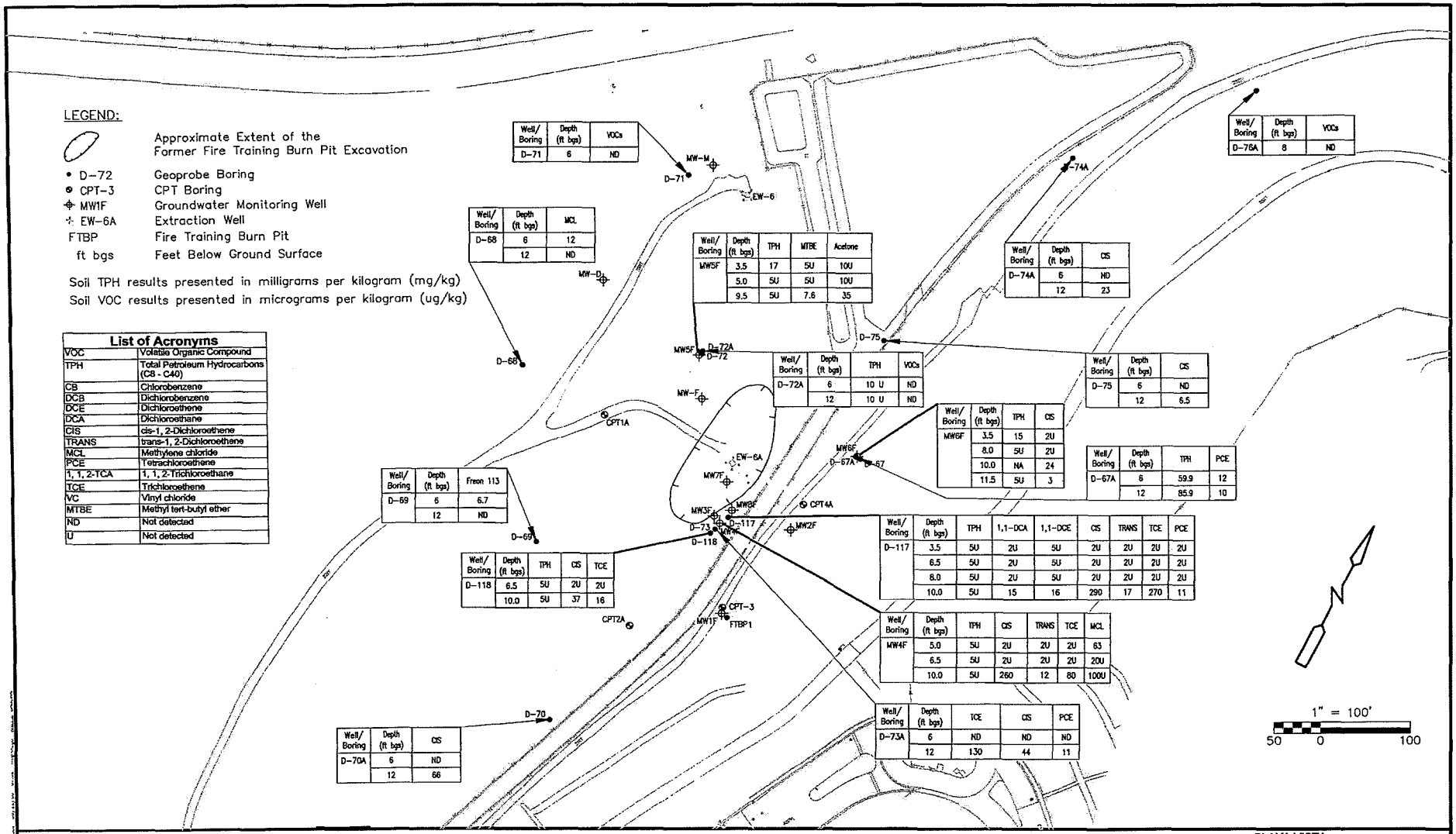
2.0 SCOPE OF WORK

This work was completed at the request of PCC in preparation for further development plans in the vicinity of the former FTBP. The work plan approved by the LA-RWQCB (Integrated, June 29, 2001) included the collection of three in-situ groundwater samples down gradient of the former FTBP excavation. These three samples were to be analyzed for TPH with carbon chain identification to assess TPH contamination down gradient of the former FTBP area. Subsequently the scope of work was expanded to include the following:

- At each of the three originally proposed sample locations, in-situ groundwater samples were collected at two depths to provide data on the vertical distribution of contamination. Target samples depths were determined using current water level data from nearby monitoring wells and historical lithologic information. The uppermost groundwater sample was collected at the first encountered groundwater (within coarser-grained materials); whereas the second sample was collected

ATTACHMENT C

HISTORICAL SOIL AND GROUNDWATER CONCENTRATION FIGURES



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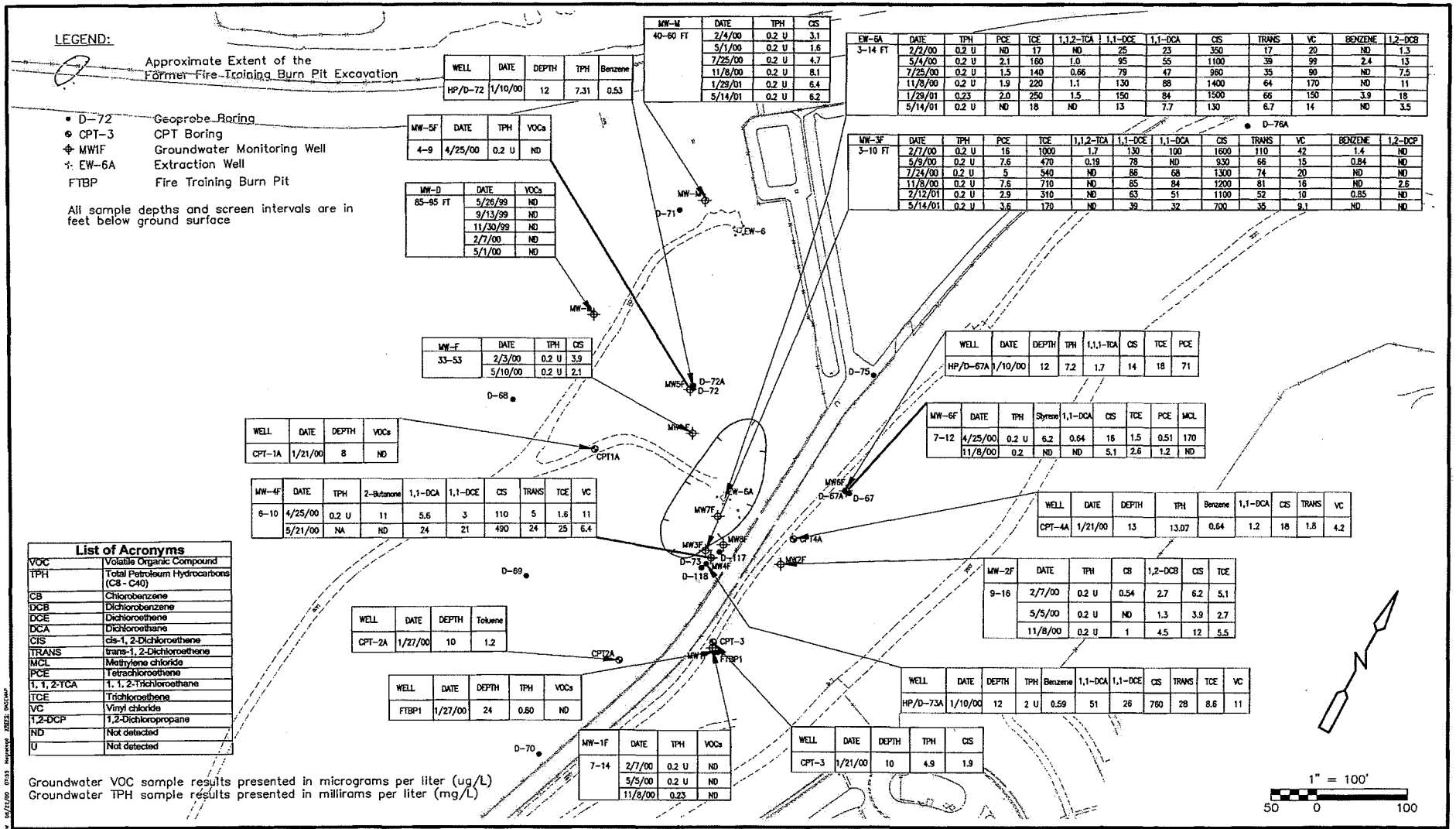
Historical Soil Concentration Map VOCs and TPH

Figure C-1



WELL	DATE	DEPTH	TPH	Benzene
HP/D-72	1/10/00	12	7.31	0.53

MW-M 40-60 FT	DATE	TPH	CIS
	2/4/00	0.2 U	3.1
	5/1/00	0.2 U	1.6
	7/25/00	0.2 U	4.7
	11/8/00	0.2 U	8.1
	1/29/01	0.2 U	6.4
	5/14/01	0.2 U	6.2

EW-6A 3-14 FT	DATE	TPH	PCE	TCE	1,1,2-TCA	1,1-DCE	1,1-DCA	CIS	TRANS	VC	BENZENE	1,2-DCB
	2/2/00	0.2 U	ND	17	ND	25	23	350	17	20	ND	1.3
	5/4/00	0.2 U	2.1	160	1.0	95	55	1100	39	99	2.4	13
	7/25/00	0.2 U	1.5	140	0.66	79	47	960	35	90	ND	7.5
	11/8/00	0.2 U	1.9	220	1.1	130	88	1400	64	170	ND	11
	1/29/01	0.23	2.0	250	1.5	150	84	1500	66	150	3.9	18
	5/14/01	0.2 U	ND	18	ND	13	7.7	130	6.7	14	ND	3.5

MW-5F	DATE	TPH	VOCs
4-9	4/25/00	0.2 U	ND

MW-D 85-95 FT	DATE	VOCs
	5/26/99	ND
	9/13/99	ND
	11/30/99	ND
	2/7/00	ND
	5/1/00	ND

MW-3F 3-10 FT	DATE	TPH	PCE	TCE	1,1,2-TCA	1,1-DCE	1,1-DCA	CIS	TRANS	VC	BENZENE	1,2-DCP
	2/7/00	0.2 U	16	1000	1.7	130	100	1600	110	42	1.4	ND
	5/9/00	0.2 U	7.6	470	0.19	78	ND	930	66	15	0.84	ND
	7/24/00	0.2 U	5	540	ND	86	68	1300	74	20	ND	ND
	11/8/00	0.2 U	7.6	710	ND	85	84	1200	81	16	ND	2.6
	2/12/01	0.2 U	2.9	310	ND	63	51	1100	52	10	0.85	ND
	5/14/01	0.2 U	3.6	170	ND	39	32	700	35	9.1	ND	ND

MW-F 33-53	DATE	TPH	CIS
	2/3/00	0.2 U	3.9
	5/10/00	0.2 U	2.1

WELL	DATE	DEPTH	TPH	1,1,1-TCA	CIS	TCE	PCE
HP/D-67A	1/10/00	12	7.2	1.7	14	18	71

MW-6F	DATE	TPH	Styrene	1,1-DCA	CIS	TCE	PCE	MCL
7-12	4/25/00	0.2 U	6.2	0.64	16	1.5	0.51	170
	11/8/00	0.2	ND	ND	5.1	2.6	1.2	ND

WELL	DATE	DEPTH	VOCs
CPT-1A	1/21/00	8	ND

MW-4F	DATE	TPH	2-Butanone	1,1-DCA	1,1-DCE	CIS	TRANS	TCE	VC
6-10	4/25/00	0.2 U	11	5.6	3	110	5	1.6	11
	5/21/00	NA	ND	24	21	490	24	25	6.4

WELL	DATE	DEPTH	TPH	Benzene	1,1-DCA	CIS	TRANS	VC
CPT-4A	1/21/00	13	13.07	0.64	1.2	18	1.8	4.2

MW-2F	DATE	TPH	CB	1,2-DCB	CIS	TCE
9-16	2/7/00	0.2 U	0.54	2.7	6.2	5.1
	5/5/00	0.2 U	ND	1.3	3.9	2.7
	11/8/00	0.2 U	1	4.5	12	5.5

WELL	DATE	DEPTH	Toluene
CPT-2A	1/27/00	10	1.2

WELL	DATE	DEPTH	TPH	VOCs
FTBP1	1/27/00	24	0.80	ND

WELL	DATE	DEPTH	TPH	Benzene	1,1-DCA	1,1-DCE	CIS	TRANS	TCE	VC
HP/D-73A	1/10/00	12	2 U	0.59	51	26	760	28	8.6	11

MW-1F	DATE	TPH	VOCs
7-14	2/7/00	0.2 U	ND
	5/5/00	0.2 U	ND
	11/8/00	0.23	ND

WELL	DATE	DEPTH	TPH	CIS
CPT-3	1/21/00	10	4.9	1.9

List of Acronyms	
VOC	Volatile Organic Compound
TPH	Total Petroleum Hydrocarbons (C8 - C40)
CB	Chlorobenzene
DCB	Dichlorobenzene
DCE	Dichloroethene
DCA	Dichloroethane
CIS	cis-1, 2-Dichloroethene
TRANS	trans-1, 2-Dichloroethene
MCL	Methylene chloride
PCE	Tetrachloroethene
1, 1, 2-TCA	1, 1, 2-Trichloroethane
TCE	Trichloroethene
VC	Vinyl chloride
1,2-DCP	1,2-Dichloropropane
ND	Not detected
U	Not detected

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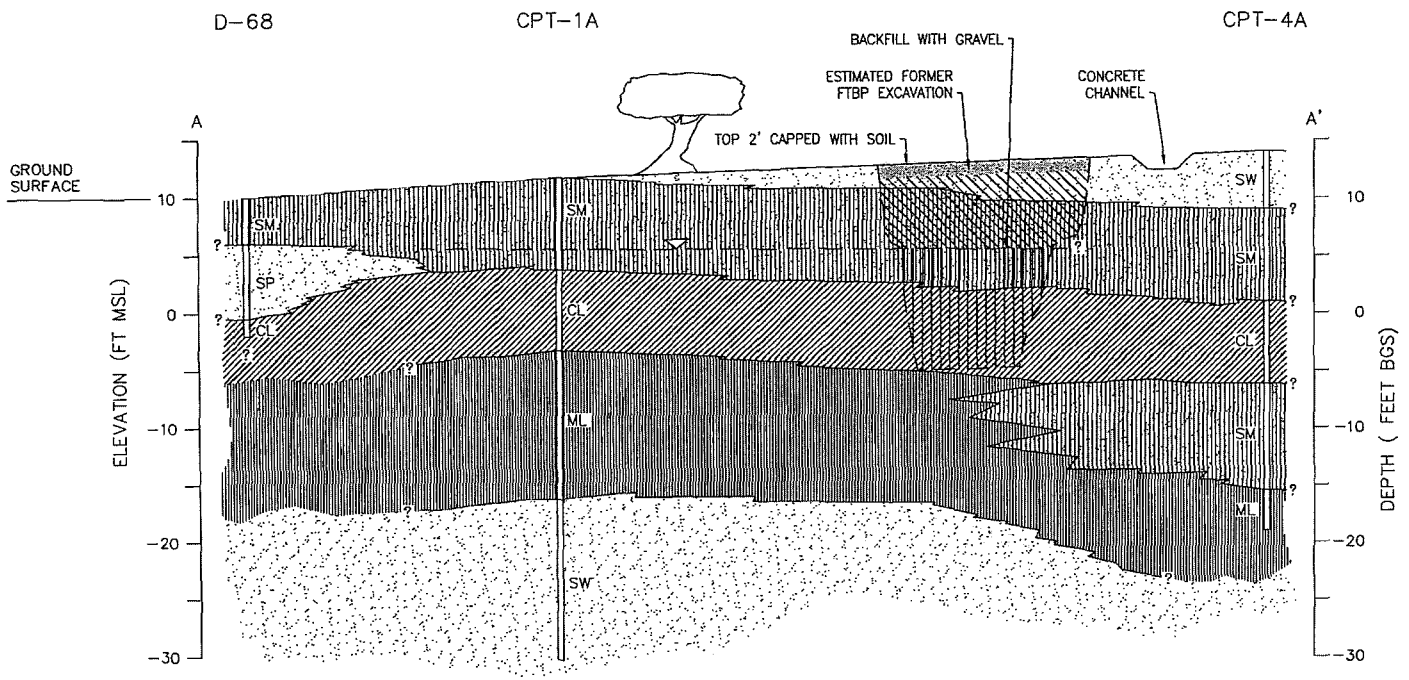
Historical Groundwater Concentration Map VOCs and TPH

Figure C-2



LEGEND

CL	CLAY	
SM	SILTY SAND	
ML	SANDY SILT	
SW/SP	POORLY GRADED SAND WELL GRADED SAND	
	NATURAL FILL	
	GRAVEL FILL	
FTBP	FIRE TRAINING BURN PIT	
		PERFORATED INTERVAL
		GROUNDWATER ELEVATION
		WATER TABLE (February 7, 2000)

HORIZONTAL SCALE
1" = 40'
20 0 40

VERTICAL SCALE
1" = 10'
5 0 10

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Geological Cross-Section A-A'

Figure C-4

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ATTACHMENT D

SUMMARY OF QUARTERLY GROUNDWATER MONITORING RESULTS

Attachment D
Playa Vista- Former Fire Training Burn Pit
Groundwater Analytical Results - Quarterly Sampling
Chlorinated VOCs Analytical Summary

Area/ Well ID	Screened Interval (ft bgs)	Sample Date	Sample Type	PCE	TCE	1,1,1-TCA	1,1,2-TCA	1,1-DCE	1,1-DCA	1,2-DCA	cis-1,2-DCE	trans-1,2-DCE	CFM	MCL	CBN	1,2-DCB	1,3-DCB	1,4-DCB	BDM	CET	CMT	1,2-DCP	1,2,3-TCB	VC
AREA D	Former Fire Training Burn Pit																							
C-01	30 - 40																							
		3/29/1999		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U		0.5 U
		5/25/1999		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U		0.5 U
		9/2/1999		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	0.5 U
		11/29/1999		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
		2/2/2000		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	0.5 U
		5/1/2000		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	0.5 U
EW-6A	3 - 14																							
		9/9/1999		0.6	16	0.5 U	0.5 U	12	12	0.5 U	180	8.6	0.5 U	5 U	0.5 U	0.7	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	2.2
		12/1/1999		0.5 U	8	0.5 U	0.5 U	8.6	10	0.5 U	140	6.9	0.5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	7.2
		12/1/1999	K	0.5 U	8.4	0.54	0.5 U	9.6	11	0.5 U	140	7.9	0.5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	7.6
		2/2/2000		0.5 U	17	0.62	0.5 U	25	23	0.5 U	350	17	0.5 U	2 U	0.5 U	1.3	0.5 U	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	20
		5/4/2000		2.1	160	0.34 J	0.96	95	55	0.31 J	1100	39	0.5 U	2 U	1.2	12	0.41 J	1.5	0.5 U	1 U	1 U	0.5 U	1 U	97
		5/4/2000	K	2	160	0.33 J	1	95	55	0.33 J	1100	39	0.5 U	2 U	1.2	13	0.41 J	1.5	0.5 U	1 U	1 U	0.5 U	1 U	99
		7/25/2000		1.4	130	0.24 J	0.66	71	42	0.29 J	960	32	0.5 U	0.24 JUB	0.74	6.9	0.26 J	0.88	0.5 U	1 U	1 U	0.5 U	1 U	80
		7/25/2000	K	1.5	140	0.24 J	0.64	79	47	0.3 J	930	35	0.5 U	2 U	0.84	7.5	0.29 J	0.96	0.5 U	1 U	1 U	0.5 U	1 U	90
		11/8/2000		1.9	220	0.26 J	1.1	120	81	0.56	1400	59	0.5 U	0.42 JUB	1.4	11	0.44 J	1.3	0.5 U	1 U	1 U	0.5 U	1 U	150
		11/8/2000	K	1.7 J	200	2 U	2 U	130	88	2 U	1400	64	2 U	7.1 JUB	1.5 J	11	0.44 J	1.4 J	2 U	4 U	4 U	2 U	4 U	170
		1/29/2001		2	250	0.22 J	1.5	150	84	0.58	1500	66	0.5 U	0.57 J	1.9	18	0.76	2.3	0.5 U	1 U	1 U	0.5 U	1 U	150
		1/29/2001	K	1.8 J	230	2 U	1.3 J	130	78	2 U	1700	60	2 U	8 U	1.8 J	17	0.6 J	2 U	2 U	4 U	4 U	2 U	4 U	110
		5/14/2001		0.25 J	18	0.5 U	0.5 U	13	7.7	0.5 U	130	6.7	0.5 U	2 U	0.5 U	3.5	0.24 J	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	14
		5/14/2001	K	0.25 J	17	0.5 U	0.5 U	11	6.8	0.5 U	110	5.8	0.5 U	0.24 J	0.5 U	3.2	0.19 J	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	11
MW-1F	7 - 14																							
		2/7/2000		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.24 J	0.5 U	0.5 U	2 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	0.5 U
		5/5/2000		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	0.5 U

Attachment D
Playa Vista- Former Fire Training Burn Pit
Groundwater Analytical Results - Quarterly Sampling
Chlorinated VOCs Analytical Summary

Area/ Well ID	Screened Interval (ft bgs)	Sample Date	Sample Type	PCE	TCE	1,1,1-TCA	1,1,2-TCA	1,1-DCE	1,1-DCA	1,2-DCA	cis-1,2-DCE	trans-1,2-DCE	CFM	MCL	CBN	1,2-DCB	1,3-DCB	1,4-DCB	BDM	CET	CMT	1,2-DCP	1,2,3-TCB	VC
MW-2F	9 - 16																							
		2/7/2000		0.5 U	5.1	0.5 U	0.5 U	0.16 J	0.41 J	0.5 U	6.2	0.3 J	0.5 U	0.28 J	0.54	2.7	0.5 U	0.47 J	0.5 U	1 U	1 U	0.5 U	1 U	0.43 J
		5/5/2000		0.5 U	2.7	0.5 U	0.5 U	0.5 U	0.26 J	0.5 U	3.9	0.45 J	0.5 U	2 U	0.34 J	1.3	0.5 U	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	0.48 J
MW-3F	3 - 10																							
		2/7/2000		16	940	0.5 U	1.7	130	100	0.5 U	1500	110	0.5 U	2 U	0.4 J	0.5 U	0.5 U	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	42
		2/7/2000	K	16	1000	0.5 U	1.7	130	98	0.5 U	1600	110	0.5 U	2 U	.39 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	40
		5/9/2000		7.3	450	0.5 U	0.84	77	60	0.5 U	920	66	0.5 U	2 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	14
		5/9/2000	K	7.6	470	0.5 U	0.91	78	62	0.5 U	930	66	0.5 U	2 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	15
		7/24/2000		5	540	2 U	2 U	86	68	2 U	1300	74	2 U	3.2 JUB	2 U	2 U	2 U	2 U	2 U	4 U	4 U	2 U	1.9 J	20
		11/8/2000		7.6	710	2 U	2 U	85	84	2 U	1100	81	2 U	7.2 JUB	2 U	2 U	2 U	2 U	2 U	4 U	4 U	2 U	4 U	16
		11/8/2000	K	7.2	670	2 U	2 U	84	82	2 U	1200	79	2 U	7.2 JUB	2 U	2 U	2 U	2 U	2 U	4 U	4 U	2.6	4 U	16
		1/29/2001		4.6	510	1 U	1 U	65	58	1 U	1300	58	1 U	4 U	0.2 J	1 U	1 U	1 U	1 U	2 U	2 U	1 U	2 U	9.7
		1/29/2001	K	2.4	310	1 U	1 U	48	53	1 U	1100	48	1 U	4 U	1 U	1 U	1 U	1 U	1 U	2 U	2 U	1 U	2 U	11
		5/14/2001		3.6	170	1 U	1 U	39	32	1 U	700	35	1 U	4 U	1 U	1 U	1 U	1 U	1 U	2 U	2 U	1 U	2 U	9.1
		5/14/2001	K	3.7	170	1 U	1 U	39	32	1 U	750	36	1 U	4 U	1 U	1 U	1 U	1 U	1 U	2 U	2 U	1 U	2 U	9.3
MW-F	33 - 52.6																							
		3/29/1999		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2.8	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	0.5 U
		5/25/1999		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2.3	0.5 U	0.5 U	2.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U		0.5 U
		9/13/1999		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	0.5 U
		11/29/1999		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	3	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
		2/3/2000		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	3.9	0.41 J	0.5 U	2 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	0.5 U
		5/10/2000		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2.1	0.2 J	0.5 U	2 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	0.5 U
MW-M	40 - 60																							
		3/29/1999		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2.5	0.5 U	0.5 U	2.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U		0.5 U
		5/25/1999		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1.7	0.5 U	0.5 U	2.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U		0.5 U
		9/2/1999		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2.2	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	0.5 U

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Area/ Well ID	Screened Interval (ft bgs)	Sample Date	Sample Type	PCE	TCE	1,1,1-TCA	1,1,2-TCA	1,1-DCE	1,1-DCA	1,2-DCA	cis-1,2-DCE	trans-1,2-DCE	CFM	MCL	CBN	1,2-DCB	1,3-DCB	1,4-DCB	BDM	CET	CMT	1,2-DCP	1,2,3-TCB	VC
		11/29/1999		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	4.1	0.5 U	0.5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
		2/4/2000		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	3.1	0.11 J	0.5 U	0.23 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	0.5 U
		5/1/2000		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1.6	0.5 U	0.5 U	2 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	0.5 U
		7/25/2000		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	4.7	0.5 U	0.5 U	2 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	0.5 U
		11/8/2000		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	8.1	0.5 U	0.5 U	2 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	0.5 U
		1/29/2001		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	6.4	0.5 U	0.5 U	2 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	0.5 U
		5/14/2001		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	6.2	0.17 J	0.5 U	2 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	0.5 U

Notes:

VOC = Volatile Organic Compound
PCE = Tetrachloroethene; TCE = Trichloroethene; TCA = Trichloroethane; DCE = Dichloroethene; DCA = Dichloroethane; CFM = Chloroform; MCL = Methylene chloride; CBN = Chlorobenzene; DCB = Dichlorobenzene; BDM = Bromodichloromethane; CET = Chloroethane; CMT = Chloromethane; DCP = Dichloropropane; TCB = Trichlorobenzene; and VC = Vinyl chloride.

Samples analyzed by EPA Method 8260B.
Only analytes detected in one or more samples are listed.
All concentrations are reported in micrograms per liter (µg/L).
U = Not detected at a concentration greater than the reporting limit shown.
UB = Methylene chloride detected less than 5 times the concentration reported in the method blank.
J = Detected at an estimated concentration between method detection and laboratory reporting limits.
If left blank, analyte was either not analyzed or not reported.

Sample Type:
K = Split sample

ATTACHMENT E

WELL CONSTRUCTION PERMIT

EXHIBIT 12

Appt: March 16, 2011 10:00 AM

ENFORCEMENT UNIT
FILE REVIEW FORM

I. TO BE FILLED OUT BY PERSON RECEIVING REQUEST

Request received by: DAI NGUYEN Date: 1/18/11

Person requesting file review: John Davis

Phone number: 310-795-9640

Representing: _____

File(s) to be reviewed: CI-1492

Inspection Reports - Hyperion NPDES Permit R4-2005-0020

Purpose: _____

II. TO BE FILLED OUT BY PERSON SETTING APPOINTMENT

Appointment date: 3/16/11 Time: 10^00

Staff Contact: _____ Staff time expended: _____

Phone: _____

III. TO BE FILLED OUT AFTER FILE REVIEW HAS BEEN COMPLETED

If copies were made, the file(s) shall be returned in the same order and manner in which they were provided to you.

INITIAL IF COPIES MADE: ✓

COPY SERVICE USED: ✓

I CERTIFY THAT I HAVE/WILL NOT REMOVE ANY FILES FROM THE PREMISES, HAVE NOT ABUSED THE FILES, AND HAVE REPLACED THE FILES IN THE ORDER AND MANNER IN WHICH THEY WERE PROVIDED TO ME.

SIGNATURE OF REVIEWER: ✓

March 18, 201

Reviewed by: (1)___ (2)_____ (3)_____

EPA Region IX and California Water Resources Control Board

NPDES Compliance Evaluation Inspection (CEI) Checklist

Name and Location of Facility Inspected	Entry Time/Date	Permit Effective Date
City of Los Angeles, Bureau of Sanitation **Hyperion Wastewater Treatment Plant** **12000 Vista Del Mar Blvd., Playa Del Rey, CA**	**10:10 AM / 05-25-05**	**2-28-94**
NPDES Permit Number **CA0109991** Board Order Number **R4-2005-0020** Major or Minor (circle)	Exit Time/Date **Appx. 12:05 PM / 05-25-05**	Permit Expiration Date **5-14-2010**
Names of On-Site Representative(s), Title(s), Phone, and Fax Number(s) **Steven Fan, Plant Manager, 310-648-5168** **Doug Bohlmann, Shift Supervisor II, 310-648-5680** **Ronald Bell, Operations Supervisor, 310-648-5250** **Susan Chang, Senior Chemist, 310-648-5607, 310-648-5828 (FAX)**		Notified of Inspection? (Y - N) When?
Name and Address of Responsible Official, Title, Phone, and Fax Number **Rita L. Robinson, Director, City of Los Angeles Bureau of Sanitation, 213-473-7999**		Official Contacted? (Y – N)
Inspectors(s) Primary and Back-up **Jose M. Morales, WRCE**		Presented Credentials (Y – N)

Weather Conditions at the Time of the Inspection	Receiving Water Name
overcast, cool	**Santa Monica Bay (Pacific Ocean)**
Were Violations noted during the inspection? (Y – N – Pending Sample Results) NO	Was this a Quality Assurance-Based Inspection? (Y-N) Were bioassay samples taken? (Y-N)

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Reviewed by: (1) (2) (3)

EPA Region IX and California Water Resources Control Board

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PERMIT: OVERALL RATING__S__

1. Current copy of facility NPDES permit available on-site.	S
2. Correct name and mailing address of permittee identified on NPDES permit.	S
3. Facility is as described in permit.	S
4. a. Notification given to RWQCB of process/production modifications, collection system expansions, etc. that impacted quality/quantity of discharge or changes to the facility or increased discharge. b. Permit modification received, if required, prior to changes.	N
5. Recent permit modifications, amendments or compliance orders on file.	N
6. Number of discharge outfalls the same as listed in the permit.	S
7. Name of receiving waters listed correctly in the permit.	S
8. Permit status (i.e., current, expired, or extended)	Extended
9. Permit renewal application submitted to the RWQCB within 180 days of expiration date.	N
10. Other:	
Notes:	

RECORDS/REPORTS OVERALL RATING__S__

1. NPDES records maintained for the time period required (3 years):	Yes
2. a. Spills and bypasses reported and documented as required by the permit. b. Follow-up written documentation given as required by the permit (within 5 days in most cases).	Yes
3. Discharge Monitoring Report (DMR) evaluation: a. The responsible person or designee signs and certifies the DMR. (Yes) b. The facility monitors more frequently than required by the permit. (N) c. All data collected are summarized on the DMR. (Yes) d. Data reported on DMR consistent w/ analytical results. (Yes) e. Coliform concentrations calculated as required by the permit (e.g., median, geometric mean). (Yes) f. Numerical values for minimum detection limits are reported on DMR when laboratory reports "Not Detected" or "0" (for example, MDL= 3, Report: "<3" on DMR). (Yes) g. "Less than values" properly carried through loading calculations. (Yes) h. Flow measurement period used for loading calculations brackets the sampling period. (Yes) i. Influent and effluent loading rates properly calculated, if required. (Yes) j. Number Exceeding (N.E.) properly reported on all DMRs and annual reports. (Yes)	S
4. Reports completed in time frame and frequency as required by the permit (not all reports required for all facilities): a. Discharge Monitoring Reports (Yes) b. Biosolids Monitoring Reports (Yes) c. Biosolids Management Reports (Yes) d. CSO/ I&I Reports (N) e. Compliance Schedule Reports (N) f. Pretreatment Reports (N) g. Other	S

5. Sampling and analytical records (for water and biosolids) include: a. Dates, times, and location of sampling (Yes) b. Names of individuals performing sampling (Yes) c. Analytical methods (Yes) d. Results of analyses (Yes) e. Dates of analyses (Yes) f. Time of analyses, as necessary to verify holding times (Yes) g. Analysts' names or initials (Yes) h. Instantaneous flow at grab sample stations, if required (Yes)	S
6. Plant records include: a. Daily plant operational records or log book (Yes) b. Equipment maintenance records and schedules (Yes) c. CSO/lift station check records or log book (N) d. Records of auxiliary power checks (N) e. Spill Prevention Control and Countermeasure (SPCC) plan (N) f. Pollution Prevention Plan (P3) (Yes) g. Influent and Effluent flow measurement records maintained for the past three years (Yes) h. Other	S
7. All records and reports required by the permit appear to be organized and available for inspection.	S
8. Other:	
Notes:	

FACILITY SITE REVIEW: OVERALL RATING_ S____

1. All treatment units and supporting equipment are in service and mechanically functioning properly.	S
2. Hydraulic and organic loadings are consistent with the fact sheet and plant design criteria. a. Are there signs of overloading to the facility and collection system, including I&I and septage loading?	S
3. Peak flows remain within the established plant capacity. a. If flows have exceeded capacity, has the RWQCB been notified?	N
4. Lift stations are properly monitored, maintained, have a back-up power source and are not subject to chronic spills and/or overflows.	N
5. Odors are adequately controlled, resulting in limited complaints.	S
6. Residual chlorine monitoring is well documented and sampling/monitoring is representative of the discharge. a. If a UV system is used, the dosage intensity, tubes, and alarms are adequate, maintained and documented.	S
7. Housekeeping procedures are adequate to prevent release of pollutants to environment: a. Adequate dikes and secondary containment b. Spill containment and clean-up c. Signs of spillage to soil, groundwater, or surface water d. Storm water and leachate management from storage piles e. Leaking pipes, pumps, etc. f. Drum and chemical storage areas g. Minimization of pollutants entering storm water outfalls h. Other open dumps or debris piles i. Other	S
8. Signs of tank deterioration and/or settlement.	N
9. Safety concerns may interfere with proper operation, maintenance, and/or monitoring.	N
10. Material Safety Data Sheets (MSDS) are available for stored chemicals.	S

FACILITY SITE REVIEW: OVERALL RATING_S___

11. Equipment available for spill cleanup and containment.		N
12. Other:		
Notes:		

EFFLUENT/RECEIVING WATERS: OVERALL RATING_S___

1. Recent DMR history () (outfall number(s) **002**): a. Violations of discharge limits (N) b. Spills/bypasses (N) c. Fish kills or other receiving water impacts (N) d. WET results are in accordance with the permit (N) e. If effluent limit violations have been identified, what actions has the facility taken to eliminate or reduce their reoccurrence?	S
2. DMR spot check conducted for the months of a. Internal lab sheets and contract lab results properly transferred to DMRs b. Monthly average, weekly, maximum, etc. values calculated per the permit and are correct c. Influent and effluent loadings reported d. DMR is accurate and complete for each outfall	N/A
3. Appearance of effluent during inspection: a. The effluent(s) was viewed during the inspection. b. Excessive foam, scum, or sheens present: **None** c. Cloudy and/or color: **Slightly turbid** d. Excessive solids: **None** e. Other:	S
4. Appearance of receiving water(s) during inspection: a. The receiving water(s) was viewed during the inspection b. Distinctly visible foam or sheens on receiving water c. Biosolids accumulation or deposits of solids below discharge point(s) d. Distinctly visible plume from discharge(s) to receiving water e. Discharge creates objectionable odor at or near receiving water f. Other:	N/A
Notes:	

FLOW MEASUREMENT: OVERALL RATING__S___

1. Flow Measurement devices and methods: **Influent Measurement** Primary Device (e.g., Parshall flume, weir, etc.): **Venturi meter (flume)** Secondary Device (e.g., transducer, float, strip gauge, etc.): **Effluent Measurement** Primary Device: **None** Secondary Device: Other method of estimating flow:_____	S
2. Flow measurement devices designed to meet permit requirements ("continuous measured," "continuous record," etc.).	N
3. Flow measurement location is representative of the actual discharge (considering return and bypass lines, etc.).	N
4. Flumes a. Approach channel straight for at least 10 times the maximum head height in flume. b. Flow enters flume evenly distributed across the channel and free of turbulence, boils, or other disturbances. c. The flume is clean and free of debris or deposits. d. All flume dimensions appear accurate, level, and plumb. e. Flume head being measured properly. f. Flume is appropriately sized to measure the existing range of flows. g. No obstructions downstream causing inaccurate flow measurement due to excessive "submergence" in flume. h. Proper flow tables being used.	N
5. Weirs a. Approach channel straight for at least 10 times the maximum head height. b. Flow in the approach channel is evenly distributed and free of turbulence, boils, or other disturbances. c. No solids accumulation in the bottom of the approach channel. d. Weir crest is located at least two times the maximum head height off the floor of the flow channel. e. The weir plate is level, plumb and without distortions. f. Weir is beveled on downstream side if plate is >1/8 inch thick. g. No leakage around the weir plate. h. Measuring point located at least 3 times the maximum head height behind (upstream of) the weir. i. There is free-fall and access for air below the nappe of the weir (i.e., water doesn't cling to the weir plate). j. Weir sized properly to measure the existing range of flows. k. Proper flow tables being used for weir type and size.	N
6. Secondary flow device properly installed and maintained, and operating without interference from foam, turbulence, webs, etc.	N
7. Date of last flow meter calibration: Performed by: **Mike Allen (Instrumentation Supervisor) and/or other staff**	S
8. Calibration checks by plant personnel routinely performed.	S
9. Calibration records (external and internal checks) maintained.	N
10. Other:	

Notes:
Final effluent flow is determined from the venturi meter readings of the influent flow. By approximately October of 2005, a flow meter will be installed at the end of each clarifier for effluent measurement.

SAMPLING (SELF-MONITORING PROGRAM): OVERALL RATING_S___

1. Sampling locations, type, methods, and frequencies conform to the NPDES permit for all required samples (including influent, effluent, biosolids, receiving stream, etc.).	S*
2. Sampling locations and methods provide representative samples. a. Grab samples are collected during peak flow conditions rather than low-stress conditions. b. Composite sampling procedures comply with the permit (time vs. flow weighted).	S111
3. Automatic samplers and other sampling equipment are properly cleaned.	N
4. Samples are preserved using methods listed in 40 CFR, Part 136 (e.g., chilled, acidified, etc.).	N
5. Sample containers are as listed in 40 CFR, Part 136.	N
6. Chain-of-custody is maintained and documented.	S
7. Samples are collected using approved protocols: a. Coliform sample taken directly into sterilized container. b. BOD samples are taken prior to disinfection or reseeded. c. Oil and grease collected directly into a glass container. d. Other:	S
8. Other:	

Notes:

I collected final effluent samples at the Outfall 002 station. The samples were stored in ice-chests prior to submittal to the State Laboratory. Analysis results were in compliance with their respective discharge limitations.

LABORATORY: OVERALL RATING__S___

1. On-site lab is certified? a. List parameters analyzed on-site that are used for DMR reporting: **See MRP No. 1492 (not including parameters listed in item 8 of the following page)** b. List additional parameters analyzed for internal monitoring and process control: **TSS, VSS, DO, nitrite, ammonia, pH, BOD, COD, settleable Solids**	Yes
2. EPA-approved analytical procedures are used in the on-site laboratory	S
3. Adequate equipment and procedures used for on-site analyses: a. BOD and CBOD b. TSS c. pH d. Dissolved Oxygen e. Residual Chlorine f. Temperature g. Other	N
4. On-site laboratory records include: a. Calibration and maintenance of equipment b. Equipment operating instructions and manuals	S
5. Adequate spare parts and supplies for on-site analyses.	N
6. Results of latest external DMR QA study are available and are acceptable. Date of last review: _____	N
7. Satisfactory refrigeration in use.	S
8. Certified contract laboratory being used: Laboratory name: **Fruit Growers Laboratory** Visited (no) Address: **853 Corporation Street, Santa Paula, CA**	

LABORATORY:

OVERALL RATING__S___

Phone: **805-392-2000** Parameters: **Radioactivity**		
9. EPA-approved analytical procedures are identified on contract lab report.		N
10. Holding times being met by on-site and/or contract laboratory.		N
11. Other:		

Notes:

***Dioxin*:**
Severn Trent Laboratories Inc.
880 Riverside Parkway, West Sacramento CA 95605
***Tributyltin*:**
Battelle Incorporated, Duxbury, Massachusetts, performed analyses from January to September 2003.
CRG Marine Laboratory Torrance, California performed the analyses from October to December 2003.

OPERATIONS AND MAINTENANCE:

OVERALL RATING__S___

1. Preliminary treatment units (bar screens, comminuters, grit channels, etc.) properly maintained with wastes properly disposed.	S
2. Adequate oxygen maintained in aerated treatment systems.	S
3. No operational problems caused by hydraulic "short-circuiting" in treatment units.	N
4. Biosolids wasting/return rates adequate to maintain system equilibrium.	S
5. O&M Manuals and supporting information organized and maintained for use: a. Plant O&M Manual b. Equipment manuals c. Plant engineering drawings d. Collection system drawings available or in development e. Maintenance records/costs	S
6. Routine and preventive maintenance items are scheduled and performed on time.	N
7. The amount of maintenance activities and parts in back-log is acceptable.	N
8. Operational problems contributing to plant upset, excessive odors, effluent violations, etc.	S
9. Level of operator certification as required by the permit and staffing level as specified in O&M Manual.	S
10. Auxiliary power available as required by the permit and operates the necessary treatment units.	S
11. Alarm systems for power and equipment failure.	S
12. Treatment control procedures are established for emergencies.	N
13. Hydraulic surges are handled without excessive solids wash-out or bypasses.	N
14. Spare pumps and parts readily available.	N
15. Facility appears to be well operated and maintained.	S
16. Other:	

Notes:

BIOSOLIDS/SOLID WASTE HANDLING AND DISPOSAL: OVERALL RATING_N____

1. Biosolids/solid waste disposal/reuse method (e.g., land application, landfill, etc.):	N
2. Biosolids/solid waste disposal/reuse location(s) (provide name or other identifier for disposal location):	N
3. The above processes are in accordance with the permit.	N
4. Storage at facility: a. Adequately sized for periods of inclement weather b. Controls leachate, runoff, and public access	N
5. Recent analytical results for metals (biosolids) are within permit limits.	N
6. Biosolids land application records include: a. Farm maps and land owner agreements b. Soil nutrient analyses done within the last year for active sites c. Records showing loading rate to each site d. Pathogen/Vector reduction records (pH or temp. logs, etc.)	N

7. Other:		

Notes:

COMPLIANCE SCHEDULES: OVERALL RATING_N____

1. Facility is subject to a compliance schedule in either its permit or in an order.	Yes / No
2. Items in the compliance schedule, which are currently due, have been completed (includes both the permit and orders).	N
3. The permittee has a plan to comply with items in the compliance schedule coming due in the future (includes both the permit and orders).	N
4. Written notification to RWQCB of compliance with scheduled items as required by the permit.	
5. Other:	

Notes:

PRETREATMENT: OVERALL RATING_N____

1. The facility has/participates in an approved pretreatment program. a. POTW has approved pretreatment program? b. Name of POTW running industrial facility's pretreatment program: ____Hyperion Wastewater Treatment Plant	Yes / No Yes / No
2. The latest annual report is available for review.	N
3. Procedures are sufficient to ensure that all required industrial users are subject to POTW pretreatment permits.	N
4. Effluent toxicity has not been identified as a result of WET testing.	N
5. Environmental and/or operational problems caused by: a. Restaurant cooking grease discharged into system b. Commercial discharges (e.g., mobile detailers, carpet cleaners) c. Food processing waste d. Industrial toxics e. Other industrial discharges:_____	N
Notes:	

STORM WATER: OVERALL RATING_S____

1. a. Facility storm water discharges are covered under the facility's individual NPDES permit or the California General Permit for Storm Water Discharges Associated with Industrial Activity (NOI is available). b. If no, should the facility have submitted an NOI for coverage under the California General Permit for Storm Water Discharges Associated with Industrial Activity (NPDES CAS000001).	Yes
2. The facility had a storm water pollution prevention plan (SWPPP) available for on-site review.	S
3. Pollutant sources (materials and practices) are adequately controlled (inside, undercover).	S
4. Appropriate BMPs deployed.	N
5. BMPs are being maintained (e.g., waddles and hay bales are intact).	S
6. Designated outfalls and sampling locations are identified.	S
7. Other:	
Notes: **Staff can access an electronic copy of the SWPPP with an intranet connection. The hard copy is kept at their administration offices in downtown Los Angeles. Housekeeping near stormwater sampling sites appeared satisfactory.**	

Form Last Updated – 3/02/04

CEI Photo Log

Facility Name: Hyperion Wastewater Treatment Plant, CI-1492

Date of Inspection: 05/25/2005

Inspector: Jose M. Morales

Photo #	Description
1	No photos were taken during this inspection.
2	
3	
4	
5	

SUMMARY OF ANALYSIS RESULTS FROM THE SRL BRANCH
HYPERION WWTP, CI-1492
05/25/05

Bottle ID No.	Constituent	Analysis Result	Permit Limit	Violation? (Yes or No)	Percent in Violation
	Grab Samples				
1H	Settleable solids	<.1 ml/L	3 ml/L	No	
1H	pH	6.98	6.0 to 9.0	No	
3H	Oil and grease	< RL	75 mg/L	No	
4H	Residual chlorine	0.58 mg/L	No Limit	No	
5H	**VOC**	<RL	See permit	No	
6H	Cyanide	<RL	8.3 µg/L (PG)	No	

California State Department of Health Services
Division of Drinking Water and Environmental Management—SRL (South)

Analysis Request Form

Name of Sampler: José M. Morales

Phone No: ( ) (213) 620-2273

Sampler employed by: ☐ ODW
R.W.Q.C. Board No: ☒ 4 ☐ 7 ☐ 8

Sample source: Hyperion Waste Water Treatment Plant (CI-1492)

Date collected: 05/25/05 Analysis Task No. _____

Sample Type: ☐ Drinking Water : ☐ Ground water ☐ Surface water
☒ Waste water : Chlorinated ☒ Yes ☐ No
☐ Solid sample : ☐ Soil ☐ Sludge ☐ Sediment
☐ Other _____

Use your own bottle ID number for each bottle.

For Lab Use Log Number	Bottle ID No.	Sampling Point	Time Collected	Type of Analysis Required (Be specific)
05-3125-01	1H	Effluent - Grab	10:45AM	Settleable solids; pH (G2)
X	~~2H~~	~~Effluent - Grab~~	X	~~Coliform (total)/fecal:bottle No. _____~~ (B)
-02	3H	Effluent - Grab	10:45AM	Oil and Grease (O)
-03	4H	Effluent - Grab	10:45AM	Residual Chlorine (R)
-04	5H	Effluent - Grab	10:45AM	Volatile Organics (VC)
05-3125-05	6H	Effluent - Grab	10:45AM	Cyanide (C)

Warning or special instruction on samples:

Seals: ☐ Intact ☐ None ☐ Broken		Date	Time
Samples relinquished by	José M. Morales	05/25/2005	2:40PM
Samples relinquished by			
Received for Lab by	Richard Monzon	5-25-05	2:41PM

(For Lab use only) Total cost for laboratory analyses:

SRLform28-9/22/94

2409554
CI 1492

EPA Region IX and California Water Resources Control Board

NPDES Compliance Evaluation Inspection (CEI) Report

Name and Location of Facility Inspected		Entry Date	Permit Effective Date
City of Los Angeles - Hyperion Treatment Plant 12000 Vista Del Mar Boulevard Playa Del Rey, CA 90293		4/7/2009 **Entry Time** 8:00 AM	4/7/2005
NPDES Permit Number	**Order Number**	☒ **Major** ☐ **Minor**	**Permit Expiration Date**
CA0109991	R4-2005-0020		5/14/2010
Name(s) & Title(s) of On-Site Representative(s)	**Contact Information**		**Notified of Inspection?**
Ron Bell (Shift Supervisor) Jeff Beller (Laboratory Manager II)	Phone: (310) 648-5680 Fax: (310) 648-5612		☒ **Yes** ☐ **No**
Name, Title & Address of Responsible Official	**Contact Information**		**Official Contacted?**
Enrique C. Zaldiv (Director, Bureau of Sanitation) 433 S. Spring Street, 4th Floor Los Angeles, CA 90013	Phone: (213) 978-0261 Fax: (213) 485-2210		☐ **Yes** ☒ **No**
Inspector(s) **Primary:** Danny O'Connell (PG Environmental, LLC) **Other(s):** Bobby Jacobsen, Brenner Perryman (PG Environmental, LLC)			**Presented Credentials?** ☒ **Yes** ☐ **No**
Weather Conditions at the Time of the Inspection: Sunny; no signs of recent precipitation		**Facility Receiving Water Name:** Pacific Ocean within the Santa Monica Bay	

Overview of Areas Evaluated During Inspection

S = Satisfactory, M = Marginal, U = Unsatisfactory, N = Not Evaluated

Permit: S	Flow Measurement: S	Solid Waste Handling & Disposal: S
Records & Reports: S	Self-Monitoring Program: U	Compliance Schedules: N
Facility Site Review: S	Laboratory: S	Pretreatment (POTWs Only): N
Effluent & Receiving Waters: U	Operations & Maintenance: S	Storm Water: N

Prepared By: Brenner Perryman (PG Environmental, LLC) on 4/14/2009

Reviewed By: Craig Chomiak (PG Environmental, LLC) on 4/23/2009

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LOS ANGELES REGION

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CI 1492

EPA Region IX and California Water Resources Control Board

NPDES Compliance Evaluation Inspection (CEI) Report

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NPDES Permit Number	Order Number		Permit Expiration Date
CA0109991	R4-2005-0020	☒ Major ☐ Minor	5/14/2010

Name(s) & Title(s) of On-Site Representative(s)	Contact Information	Notified of Inspection?
Ron Bell (Shift Supervisor) Jeff Beller (Laboratory Manager II)	Phone: (310) 648-5680 Fax: (310) 648-5612	☒ Yes ☐ No

Name, Title & Address of Responsible Official	Contact Information	Official Contacted?
Enrique C. Zaldiv (Director, Bureau of Sanitation) 433 S. Spring Street, 4th Floor Los Angeles, CA 90013	Phone: (213) 978-0261 Fax: (213) 485-2210	☐ Yes ☒ No

Inspector(s)	Presented Credentials?
Primary: Danny O'Connell (PG Environmental, LLC) **Other(s):** Bobby Jacobsen, Brenner Perryman (PG Environmental, LLC)	☒ Yes ☐ No

Weather Conditions at the Time of the Inspection:	Facility Receiving Water Name:
Sunny; no signs of recent precipitation	Pacific Ocean within the Santa Monica Bay

Overview of Areas Evaluated During Inspection

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Records & Reports: S	Self-Monitoring Program: U	Compliance Schedules: N
Facility Site Review: S		Pretreatment (POTWs Only): N
		Storm Water: N

INSPECTION REPORT

A-1650

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Facility Narrative

On April 7, 2009 a USEPA contractor inspected the City of Los Angeles – Hyperion Treatment Plant in Playa Del Rey, CA. Discharges from the facility are regulated by Regional Water Board Order No. R4-2005-0020 (NPDES Permit No. CA0109991). The primary purpose of the inspection was to determine the accuracy and reliability of the Discharger's self-monitoring and reporting program. The primary on-site facility representatives were Ron Bell (Shift Supervisor) and Jeff Beller (Laboratory Manager II). The weather at the time of inspection was sunny with no signs of recent precipitation.

The City of Los Angeles (City or Discharger) owns and operates the Hyperion Treatment Plant (Facility) which discharges disinfected (through Outfall 001) / non-disinfected (through Outfall 002) secondary treated municipal wastewater to the Pacific Ocean within Santa Monica Bay. The Facility is part of a joint outfall system commonly known as the Hyperion Treatment System which consists of the wastewater collection system, the Hyperion Treatment Plant, and three upstream wastewater treatment plants: Donald C. Tillman Water Reclamation Plant (Tillman WRP), Los Angeles-Glendale Water Reclamation Plant (LAGWRP), and Burbank Water Reclamation Plant (Burbank WRP) (owned and operated by the City of Burbank). The Hyperion Treatment System collects, treats, and disposes of sewage from the entire City (except the Wilmington - San Pedro Area, the strip north of San Pedro, and Watts) and from a number of cities and agencies under contractual agreements. Approximately 85% of the sewage and commercial/industrial wastewater comes from the City. The remaining 15% comes from the contract cities, business zones and agencies. There are approximately four million people in the Hyperion Treatment System Service Area.

The Hyperion Treatment System is an interconnected system and includes approximately 6,500 miles of sewer lines located within the City (including trunk sewers in contract cities, business zones and agencies) and additional sewer lines under the control of the contract cities and agencies. The contract cities and agencies operate their respective collection systems that are tributary to the City's main trunk lines. Sludge from the City's two upstream plants is returned to the wastewater collection system and flows to the Facility for treatment. Discharges from Tillman WRP and LAGWRP are regulated by NPDES Permit Numbers CA0056227 and CA0053953, respectively. In addition, sludge generated from the Burbank WRP is also returned to the City of Burbank sewer system for discharge to the Hyperion Treatment System for treatment at the Hyperion Treatment Plant. The influent to the Burbank WRP can be diverted to the Hyperion Treatment System during periods of emergency. The operations of the Burbank WRP are regulated under NPDES Permit No. CA0055531.

The Facility has two ocean outfalls. Outfall 001 is commonly referred to as the "one-mile outfall". It is a 12-foot diameter outfall terminating approximately 5,364 feet west-southwest of the Facility at a depth of approximately 50 feet below the ocean surface. This outfall is permitted for emergency discharge of chlorinated secondary treated effluent during extremely high flows, power failures, and preventive maintenance, such as routine opening and closing the outfall gate valve(s) for exercising and lubrication (occurred twice since the last inspection). However, during intense storms or storms associated with Facility power outages, direct discharge of nondisinfected storm water overflow is also permitted at this outfall. This Order requires the City to notify the Regional Water Board and USEPA in advance of any planned preventive maintenance that results in discharges through Outfall 001 (the Regional Water Board was informed prior to the two scheduled preventive maintenance activities that occurred since the last inspection). Outfall 002 is commonly referred to as the "five-mile outfall". It is a 12- foot diameter outfall terminating approximately 26,525 feet (8.1 km) west-southwest of the Facility at a depth of approximately 187 feet (57 m) below the ocean surface. This outfall is located North of Outfall 001 and ends in a "Y" shaped diffuser consisting of

two 3,840-foot legs. This is the only outfall permitted for the routine discharge of nondisinfected secondary treated effluent.

The Facility has a dry weather average design treatment capacity of 450.0 million gallons per day (mgd) and a wet weather peak hydraulic capacity of approximately 850.0 mgd. The instantaneous influent flow was 311.0 mgd at 10:30 AM.

The Facility also accepts dry weather urban runoff that is diverted from storm drains into the City's collection system from April 1 to October 31. The City plans to extend this diversion operation from the dry summer months to year-round in order to conform to the six-year compliance schedule for bacteria concentration during winter dry weather, contained in the Santa Monica Bay Beach Dry-weather Bacteria TMDL regulation (Resolution No. 02-004 and Resolution No. 2002-022) adopted by the Regional Water Board.

Discharge monitoring reports (DMRs) for Outfall 002 for the months of November and December 2008, and January 2009 were reviewed as a component of this inspection. The review included a comparison of reported monitoring results versus requirements and limitations contained within the permit. The Discharger had three consecutive months of ammonia performance goal exceedances from November 2008 to January 2009. The facility's effluent quality is discussed in the 'Major Findings' and 'Effluent and Receiving Waters' section of this report.

Members from the Discharger's laboratory conduct the self-monitoring activities. Effluent samples for Outfall 002 are collected from a sink off of the discharge line (refer to Photo 4). Sample collection location and methods appeared to provide representative samples. All samples are analyzed at the on-site laboratory.

Major Findings

Effluent and Receiving Waters

1. Regional Water Board Order No. R4-2005-0020, Section I.A.2 of the permit requires the Discharger to "submit a written report to the Regional Board and USEPA on the nature of the exceedance, the results of the investigation as to the cause of the exceedance, and the corrective actions taken or proposed corrective measures with timetable for implementation" if there are three consecutive months of performance goal exceedances. The Discharger had three consecutive months of ammonia exceedances from November 2008 to January 2009. The Discharger's January 2009 monthly monitoring report discusses the nature of the exceedances and the potential cause, but does not discuss corrective actions or associated timetables.

Self-Monitoring Program

1. Regional Water Board Order No. R4-2005-0020, Monitoring and Reporting Program (MRP) 1492 (Attachment T) III.B/C require that "Pollutants shall be analyzed using the analytical methods described in 40 CFR 136". Some of the parameters analyzed from composite samples require a preservation temperature at or below 6 degrees F, as specified by the sample preservation requirements in 40 CFR 136. The Facility did not maintain thermometers installed in the influent and effluent composite samplers (refer to Photos 3 and 5). Therefore, the Discharger cannot demonstrate compliance with the sample preservation requirements specified in 40 CFR Part 136.

PERMIT: **OVERALL RATING: S**

INSPECTED ITEM	EVAL
1. Current copy of facility NPDES permit available on-site.	S
2. Correct name and mailing address of permittee identified on NPDES permit.	S
3. Facility is as described in permit.	S
4. a. Notification given to Regional Water Board of process/production modifications, collection system expansions, etc. that impacted quality/quantity of discharge or changes to the facility or increased discharge. b. Permit modification received, if required, prior to changes.	N N
5. Recent permit modifications, amendments or compliance orders on file.	N
6. Number of discharge outfalls the same as listed in the permit.	S
7. Name of receiving waters listed correctly in the permit.	S
8. Permit status (i.e., Current, Expired, or Extended)	Current
9. Permit renewal application submitted to the Regional Water Board at least 180 days prior to the expiration date.	N
10. Other:	N
Notes: ***This section was rated "satisfactory" because all items reviwed were rated satisfactory.***	

RECORDS/REPORTS: **OVERALL RATING: S**

INSPECTED ITEM	EVAL
1. NPDES records maintained for the time period required (5 years): The following records and reports were requested and observed: - ***Machinery Calibration Logs*** - ***Work Orders*** - ***November 2008, December 2008, and January 2008 DMRs*** - ***Operation and Maintenance Reports (i.e. for the One Mile Outfall)*** - ***2008 Biosolid Annual Report***	Yes
2. a. Did the facility document any spills or bypasses during the period reviewed? b. Spills and bypasses reported and documented as required by the permit (i.e.- as soon as possible, but no later than 24 hours from the time the permittee first became aware of the circumstances). c. Follow-up written documentation given as required by the permit (within 5 days in most cases).	No N N
3. Discharge Monitoring Report (DMR) and/or Self Monitoring Report (SMR) evaluation: a. The responsible person or designee signs and certifies the DMRs/SMRs. b. The facility monitors more frequently than required by the permit. c. All data collected are summarized on the DMRs/SMRs. d. Data reported on DMRs/SMRs is consistent w/ analytical results. e. Coliform concentrations calculated as required by the permit (e.g., median, geometric mean). f. Numerical values for minimum detection limits are reported on DMRs/SMRs when laboratory reports "Not Detected" or "0" (for example, MDL= 3, Report: "<3" on DMR). g. "Less than values" properly carried through loading calculations. h. Flow measurement period used for loading calculations brackets the sampling period. i. Influent and effluent loading rates properly calculated, if required. j. Number Exceeding (N.E.) properly reported on all DMRs and annual reports.	 S Yes S N N S N N N N
4. Reports completed in the time frame and frequency as required by the permit (not all reports required for all facilities): a. Discharge Monitoring Reports/Self-Monitoring Reports b. Biosolids Monitoring Reports c. Biosolids Management Reports d. CSO/ I&I Reports e. Compliance Schedule Reports f. Pretreatment Reports g. Other:	 S N S N N S N
5. Sampling and analytical records (for water and biosolids) include: a. Dates, times, and location of sampling b. Names of individuals performing sampling c. Analytical methods d. Results of analyses e. Dates of analyses f. Time of analyses, as necessary to verify holding times g. Analysts' names or initials h. Instantaneous flow at grab sample stations, if required	 S S S S S S S S

S = Satisfactory, M = Marginal, U = Unsatisfactory, N = Not Evaluated/Not Applicable

RECORDS/REPORTS: **OVERALL RATING: S**

INSPECTED ITEM	EVAL
6. Plant records include:	
a. Daily plant operational records or log book	S
b. Equipment maintenance records and schedules	S
c. CSO/lift station check records or log book	N
d. Records of auxiliary power checks	S
e. Spill Prevention Control and Countermeasure (SPCC) plan	S
f. Pollution Prevention Plan (P3)	N
g. Influent and Effluent flow measurement records maintained for the past three years	S
h. Other:	N
7. All records and reports required by the permit appear to be organized and available for inspection.	S
8. Other:	N

Notes:
This section was rated "satisfactory" because all items reviewed were rated satisfactory.

FACILITY SITE REVIEW: **OVERALL RATING: S**

INSPECTED ITEM	EVAL
1. All treatment units and supporting equipment are in service and mechanically functioning properly. ***The Plant provides full secondary treatment for the wastewaters received. Preliminary and primary wastewater treatment consists of screening, grit removal, and primary sedimentation with coagulation and flocculation. In secondary treatment, the primary effluent is biologically treated in a high purity oxygen activated sludge process comprised of a cryogenic oxygen plant, 9 secondary reactor modules and 36 secondary clarifiers. Each secondary reactor module is designed to handle 50 mgd of flow which results in a total treatment capacity of 450 mgd of primary effluent. After clarification, non-disinfected secondary effluent is discharged into Santa Monica Bay through a five mile submerged outfall pipe. A discharge of up to 325 mgd flows by gravity to the outfall, or is pumped at the Effluent Pumping Plant when flows exceed 325 mgd.*** ***Solid fractions recovered from wastewater treatment processes include grit, primary screenings, primary sludge and skimmings, thickened waste activated sludge, digested sludge screenings and digester cleaning solids. The fine solids (grit, primary screenings, digested sludge screenings, digester cleaning solids) that consist of primarily inorganic materials are hauled away to landfills. The remaining solid fractions (primary sludge, skimmings, and thickened waste activated sludge) are anaerobically digested onsite. The digested solids are screened and dewatered using centrifuges. The biosolids are beneficially reused offsite for land application and composting projects. The digester gas is cleaned and piped to the Los Angeles Department of Water and Power's Scattergood Steam Generating Plant, located immediately adjacent to the plant. The exported digester gas is used as fuel in the generation of electricity. In return, the generating plant provides steam for digester heating. During interruptions in the export of steam from the DWP Scattergood Steam Generation Plant, digester gas can be used as fuel for in-plant boilers that provide steam to heat the anaerobic digesters.***	S
2. Hydraulic and organic loadings are consistent with the fact sheet and plant design criteria. a. Are there signs of overloading to the facility and collection system, including I&I and septage loading?	S S
3. Peak flows remain within the established plant capacity. a. If flows have exceeded capacity, has the Regional Water Board been notified?	S N
4. Lift stations are properly monitored, maintained, have a back-up power source and are not subject to chronic spills and/or overflows.	N
5. Odors are adequately controlled, resulting in limited complaints.	S
6. Residual chlorine monitoring is well documented and sampling/monitoring is representative of the discharge. a. If a UV system is used, the dosage intensity, tubes, and alarms are adequate, maintained and documented.	S N

FACILITY SITE REVIEW: **OVERALL RATING: S**

INSPECTED ITEM	EVAL
7. Housekeeping procedures are adequate to prevent release of pollutants to the environment:	
a. Adequate dikes and secondary containment	S
b. Spill containment and clean-up	S
c. Signs of spillage to soil, groundwater, or surface water	S
d. Storm water and leachate management from storage piles	S
e. Leaking pipes, pumps, etc.	S
f. Drum and chemical storage areas	S
g. Minimization of pollutants entering storm water outfalls	S
h. Other open dumps or debris piles	S
i. Other:	N
8. Signs of tank deterioration and/or settlement.	S
9. Safety concerns are present that may interfere with proper operation, maintenance, and/or monitoring.	S
10. Material Safety Data Sheets (MSDS) are available for stored chemicals.	S
11. Equipment available for spill clean-up and containment.	S
12. Other:	N
Notes: ***This section was rated "satisfactory" because all items reviwed were rated satisfactory.***	

EFFLUENT AND RECEIVING WATERS: **OVERALL RATING: U**

INSPECTED ITEM	EVAL
1. Recent DMR history (last ***3*** months) (outfall number(s) ***002***):	
a. Violations of discharge limits	U
b. Spills/bypasses	S
c. Fish kills or other receiving water impacts	S
d. WET testing results are in accordance with the permit	S
e. If effluent limit violations have been identified, what actions has the facility taken to eliminate or reduce their recurrence?	U
The Facility had three consecutive months of ammonia performance goal exceedances (November 2008, December 2008 and January 2009). The Facility's January 2009 DMR discusses the nature of the exceedances and the potential cause, but does not discuss corrective actions or associated timetables. See 'Major Findings - Effluent and Receiving Waters' for additional information.	
2. DMR spot check conducted for the months of:	
November 2008, December 2008, and January 2009	N
a. Internal lab sheets and contract lab results properly transferred to DMRs	S
b. Monthly average, weekly, maximum, etc., values correctly calculated per the permit	S
c. Influent and effluent loadings reported	S
d. DMR is accurate and complete for each outfall	
3. Appearance of effluent during inspection:	
a. The effluent(s) was viewed during the inspection	Yes
b. Excessive foam, scum, or sheens present	S
c. Cloudy and/or color	S
d. Excessive solids	S
e. Other:	N
4. Appearance of receiving water(s) during inspection:	
a. The receiving water(s) was viewed during the inspection	Yes
b. Distinctly visible foam or sheens on receiving water	S
c. Biosolids accumulation or deposits of solids below discharge point(s)	S
d. Distinctly visible plume from discharge(s) to receiving water	S
e. Discharge creates objectionable odor at or near receiving water(s)	S
f. Other:	N
5. Other:	N

Notes:
This section was rated "unsatisfactory" due to checklist items 1a. and 1e.

FLOW MEASUREMENT: **OVERALL RATING: S**

INSPECTED ITEM	EVAL
1. Flow Measurement devices and methods: **Influent Measurement:** Primary Device: *Parshall flumes* Secondary Device: *N/A* **Effluent Measurement:** Primary Device: *Calculated* Secondary Device: *N/A* Other method of estimating flow: *N/A* ***Effluent flow is calculated by summing the influent flows, then subtracting the flow that is diverted to the West Basin Facility.***	S N S N N
2. Flow measurement devices designed to meet permit requirements ("continuous measured," "continuous record," etc.).	S
3. Flow measurement location is representative of the actual discharge (considering return and bypass lines, etc.).	S
4. Flumes: a. Approach channel straight for at least 10 times the maximum head height in flume b. Flow enters flume evenly distributed across the channel and free of turbulence, boils, or other disturbances c. The flume is clean and free of debris or deposits d. All flume dimensions appear accurate, level, and plumb e. Flume head is being measured properly f. Flume is appropriately sized to measure the existing range of flows g. No obstructions downstream causing inaccurate flow measurement due to excessive "submergence" in flume h. Proper flow tables being used	N N N N N N N N

FLOW MEASUREMENT: **OVERALL RATING: S**

INSPECTED ITEM	EVAL
5. Weirs:	
a. Approach channel straight for at least 10 times the maximum head height	N
b. Flow in the approach channel is evenly distributed and free of turbulence, boils, or other disturbances	N
c. No solids accumulation in the bottom of the approach channel	N
d. Weir crest is located at least two times the maximum head height off the floor of the flow channel	N
e. The weir plate is level, plumb and without distortions	N
f. Weir is beveled on downstream side if plate is >1/8 inch thick	N
g. No leakage around the weir plate	N
h. Measuring point located at least 3 times the maximum head height behind (upstream of) the weir	N
i. There is free-fall and access for air below the nappe of the weir (i.e., water doesn't cling to the weir plate)	N
j. Weir sized properly to measure the existing range of flows	N
k. Proper flow tables being used for weir type and size	N
6. Secondary flow device properly installed and maintained, and operating without interference from foam, turbulence, webs, etc.	S
7. Date of last flow meter calibrations: **Influent**: *3/25/2009* Performed by: *John Fees* **Effluent**: *Calculated* Performed by: *N/A* ***The Facility's effluent is calculated by an equation that sums the influent flows, then subtracts the flow that is sent to the West Basin Facility for recycling.***	S S
8. Calibration checks by plant personnel routinely performed.	S
9. Calibration records (external and internal checks) maintained.	S
10. Other:	N

Notes:
This section was rated "satisfactory" because all items reviwed were rated satisfactory.

SELF-MONITORING PROGRAM: **OVERALL RATING: U**

INSPECTED ITEM	EVAL
1. Sampling locations, type, methods, and frequencies conform to the NPDES permit for all required samples (including influent, effluent, biosolids, receiving stream, etc.). ***See 'Facility Narrative' for a description of self-monitoring activities.***	S
2. Sampling locations and methods provide representative samples. a. Grab samples are collected during peak flow conditions rather than low-stress conditions b. Composite sampling procedures comply with the permit (time vs. flow weighted) c. Other:	 S S N
3. Automatic samplers and other sampling equipment are properly cleaned.	S
4. Samples are preserved using methods listed in 40 CFR, Part 136 (e.g., chilled, acidified). ***Thermometers were not maintained within the refrigerators where influent and effluent composite wastewater samples were collected and stored (refer to Photos 3 and 5). Therefore, sample preservation temperature could not be determined. See 'Major Findings - Self-Monitoring Program' for additional information.***	U
5. Sample containers are as listed in 40 CFR, Part 136.	S
6. Chain-of-custody is maintained and documented.	S
7. Samples are collected using approved protocols: a. Coliform sample taken directly into sterilized container b. BOD samples are taken prior to disinfection or reseeded c. Oil and grease collected directly into a glass container d. Other:	Yes N N N N
8. Other:	N
Notes: ***This section was rated "unsatisfactory" due to checklist item 4.***	

S = Satisfactory, M = Marginal, U = Unsatisfactory, N = Not Evaluated/Not Applicable

LABORATORY: **OVERALL RATING: S**

INSPECTED ITEM	EVAL
1. On-site lab is ELAP-certified? a. List parameters analyzed on-site that are used for DMR reporting: *The Facility performs analysis on-site for all parameters reported on its DMRs.* b. List additional parameters analyzed for internal monitoring and process control: *Dissolved phosphorus and chemical oxygen demand.* ***The on-site laboratory ELAP Certification Number is 1723 and expires on January 31, 2010. The lab was awarded a certificate of environmental accreditation from ELAP in February 2008. Groups of analysis (i.e., metals, organics, etc.) are conducted at several specialized on-site labs.***	Yes
2. EPA-approved analytical procedures are used in the on-site laboratory?	S
3. Adequate equipment and procedures used for on-site analyses: a. BOD and CBOD b. TSS c. pH d. Dissolved Oxygen e. Residual Chlorine f. Temperature g. Other:	 N N S N N S N
4. On-site laboratory records include: a. Laboratory SOPs b. Calibration and maintenance of equipment c. Equipment operating instructions and manuals	 S S S
5. Adequate spare parts and supplies for on-site analyses.	S
6. Results of latest external DMR QA study are available and are acceptable. Date of last report: / /	N
7. Satisfactory refrigeration in use.	S
8. Certified contract laboratory(s) being used: ***All parameters are analyzed on-site.***	N
9. EPA-approved analytical procedures are identified on contract lab report.	N
10. Holding times being met by on-site and/or contract laboratory. a. pH measured in situ or within 15 minutes of sample collection. b. Residual chlorine measured in situ or within 15 minutes of sample collection.	 N N

S = Satisfactory, M = Marginal, U = Unsatisfactory, N = Not Evaluated/Not Applicable

LABORATORY: **OVERALL RATING: S**

INSPECTED ITEM	EVAL
11. Other:	N

Notes:
The lab utilizes the Laboratory Information System (LIMS) to maintain and track data.

This section was rated "satisfactory" because all items reviwed were rated satisfactory.

OPERATIONS AND MAINTENANCE: OVERALL RATING: S

INSPECTED ITEM	EVAL
1. Preliminary treatment units (bar screens, comminuters, grit channels, etc.) properly maintained with wastes properly disposed.	S
2. Adequate oxygen maintained in aerated treatment systems.	S
3. No operational problems caused by hydraulic "short-circuiting" in treatment units.	S
4. Biosolids wasting/return rates adequate to maintain system equilibrium.	S
5. Operation and Maintenance (O&M) Manuals and supporting information organized and maintained for use: a. Plant O&M Manual b. Equipment manuals c. Plant engineering drawings d. Collection system drawings available or in development e. Maintenance records/costs	 N N N N N
6. Routine and preventive maintenance items are scheduled and performed on time. ***On January 13, 2009 and August 20, 2008, the Facility tested the operation of the valving gear to discharge effluent via the 1-mile outfall. The Regional Water Board was notified prior to the events as required by the Facility's permit.***	S
7. The amount of maintenance activities and parts in back-log is acceptable.	S
8. Operational problems contributing to plant upset, excessive odors, effluent violations, etc.	S
9. Level of operator certification as required by the permit and staffing level as specified in O&M Manual.	S
10. Auxiliary power available as required by the permit and operates the necessary treatment units.	S
11. Alarm systems for power and equipment failure.	S
12. Treatment control procedures are established for emergencies.	S
13. Hydraulic surges are handled without excessive solids wash-out or bypasses.	S
14. Spare pumps and parts readily available.	S
15. Facility appears to be well operated and maintained.	S

S = Satisfactory, M = Marginal, U = Unsatisfactory, N = Not Evaluated/Not Applicable

OPERATIONS AND MAINTENANCE: **OVERALL RATING: S**

INSPECTED ITEM	EVAL
16. Other:	N
Notes: ***This section was rated "satisfactory" because all items reviwed were rated satisfactory.***	

BIOSOLIDS/SOLID WASTE HANDLING AND DISPOSAL: **OVERALL RATING: S**

INSPECTED ITEM	EVAL
1. Biosolids/solid waste disposal/reuse method(s) (e.g., land application, landfill, etc.): Compost, landfill, and land application	S
2. Biosolids/solid waste disposal/reuse location(s): The 2008 Biosolids Annual Report states that biosolids were disposed of in the southern and central areas of California.	N
3. The above processes are in accordance with the permit.	N
4. Storage at facility: a. Adequately sized for periods of inclement weather b. Controls leachate, runoff, and public access	 S N
5. Recent analytical results for metals (biosolids) are within permit limits.	N
6. Biosolids land application records include: a. Farm maps and land owner agreements b. Soil nutrient analyses done within the last year for active sites c. Records showing loading rate to each site d. Pathogen/Vector reduction records (pH or temperature logs, etc.)	 N N N N
7. Other:	N
Notes: ***This section was rated "satisfactory" because all items reviwed were rated satisfactory.***	

S = Satisfactory, M = Marginal, U = Unsatisfactory, N = Not Evaluated/Not Applicable

City of Los Angeles – Hyperion Treatment Plant (NPDES No. CA0109991) Photo Log
Inspected by: Danny O'Connell, Bobby Jacobsen, and Brenner Perryman (PG Environmental, LLC)

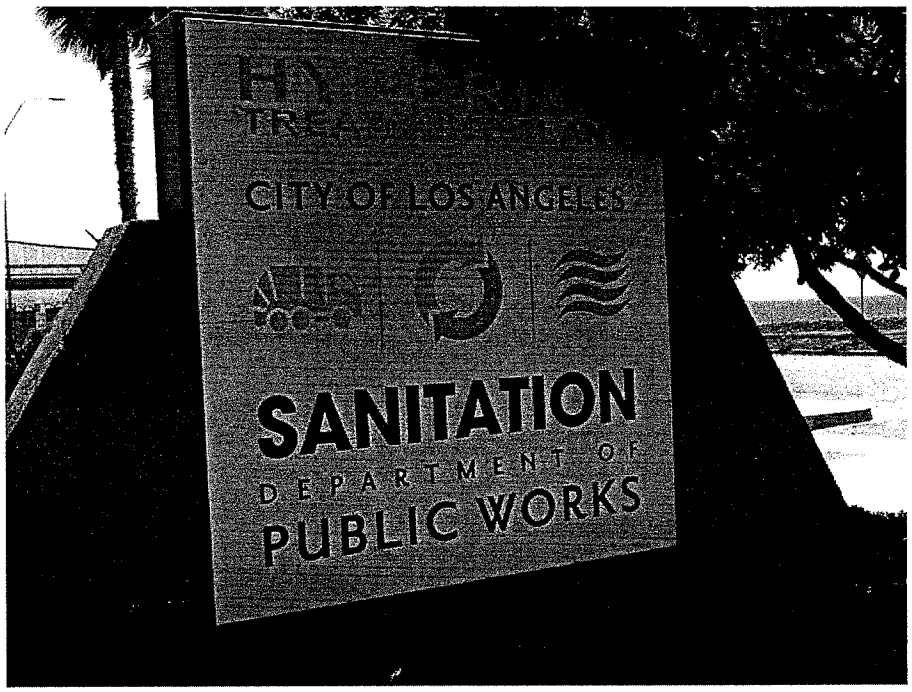


Photo 1: Facility entrance sign

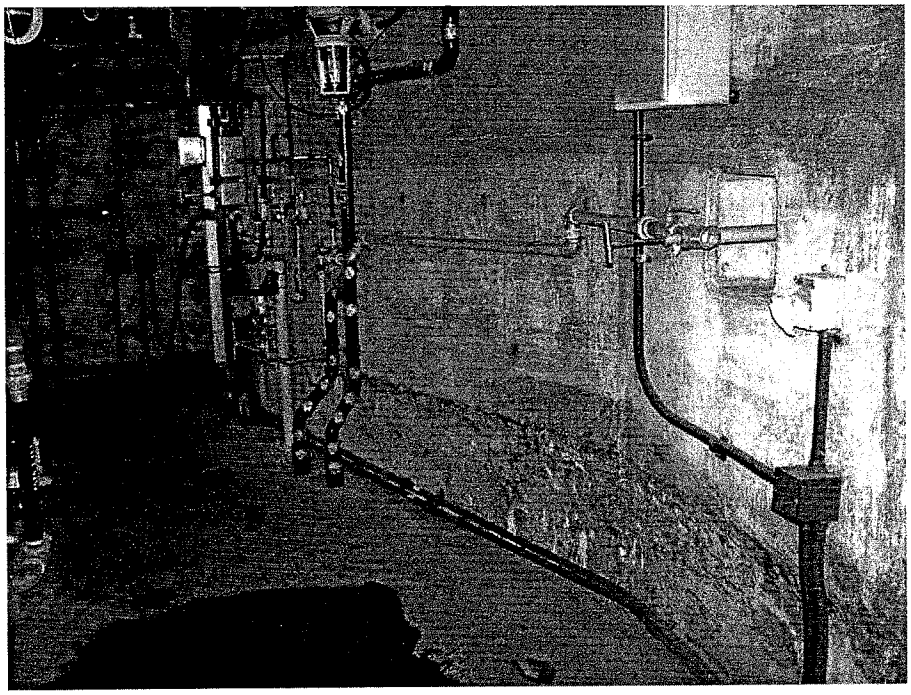


Photo 2: Side of flume measuring the Facility's influent

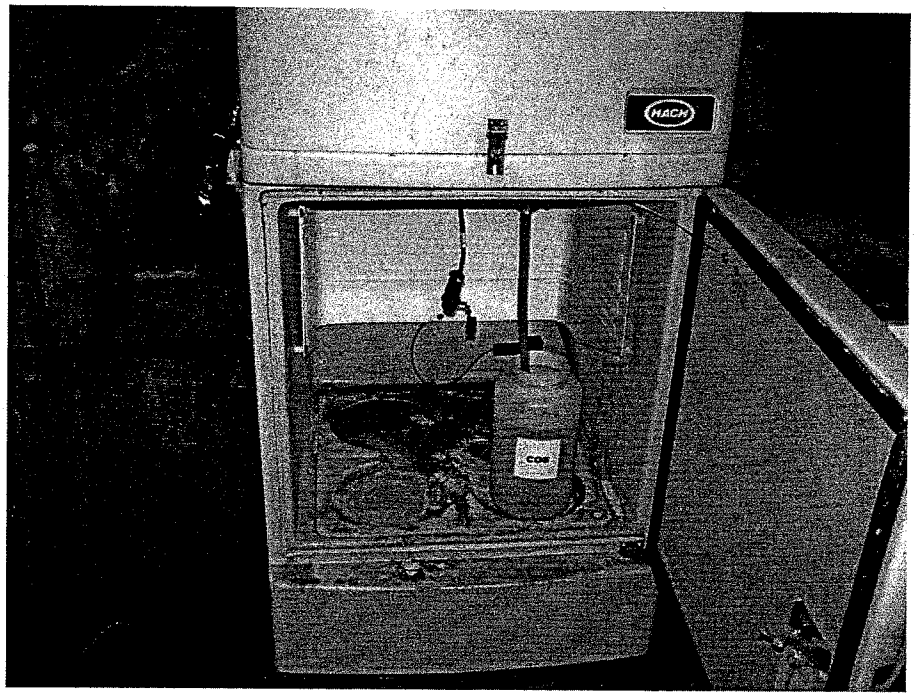


Photo 3: Example of influent composite sample storage without a thermometer

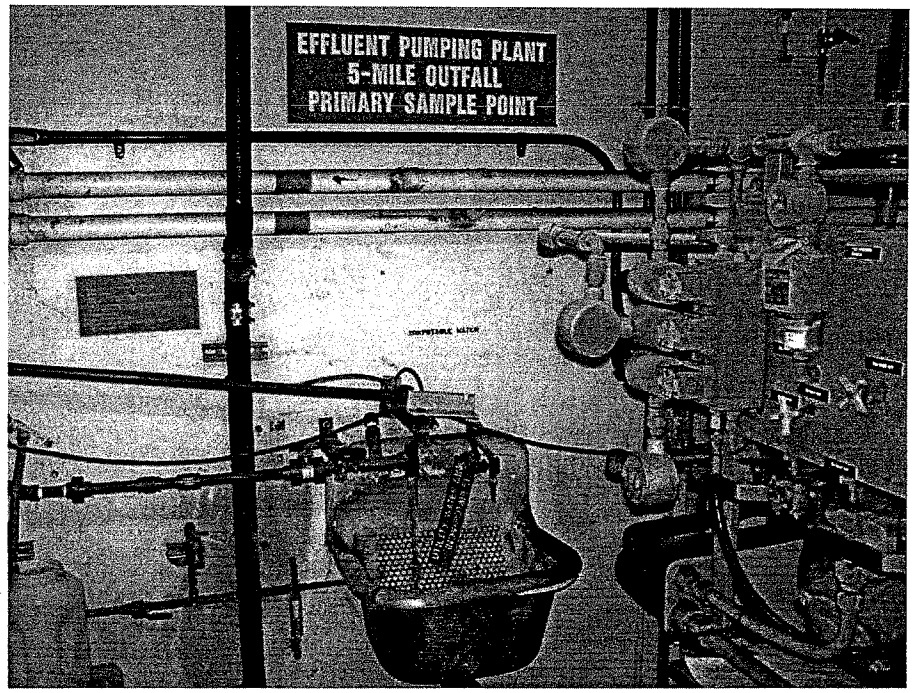


Photo 4: The sink serves as the grab sample location for the effluent through the 5-mile outfall



Photo 5: Sample storage from the 5-mile outfall without a thermometer

ID: 2021614

EPA Region IX and California Water Resources Control Board

NPDES Compliance Evaluation Inspection (CEI) Report

Name and Location of Facility Inspected	**Entry Date**	**Permit Effective Date**
City of Los Angeles - Hyperion Treatment Plant (CI - 1492) 12000 Vista Del Mar Boulevard Playa Del Rey, CA 90293	10/6-7/2009 **Entry Time** 12:00 PM	4/7/2005

NPDES Permit Number	**Order Number**		**Permit Expiration Date**
CA0109991	R4-2005-0020	☒ **Major** ☐ **Minor**	5/14/2010

Name(s) & Title(s) of On-Site Representative(s)	**Contact Information**	**Notified of Inspection?**
Mike Ruiz (Shift Supervisor II) Mahesh Pujari (Senior Chemist)	Phone: (310) 648-5328 Fax: (310) 648-5612	☒ **Yes** ☐ **No**

Name, Title & Address of Responsible Official	**Contact Information**	**Official Contacted?**
Enrique C. Zaldiv (Director, Bureau of Sanitation) 433 S. Spring Street, 4th Floor Los Angeles, CA 90013	Phone: (213) 978-0261 Fax: (213) 485-2210	☐ **Yes** ☒ **No**

Inspector(s)	**Presented Credentials?**
Primary: Danny O'Connell (PG Environmental, LLC) **Other(s):** Robyn Stuber and Jamie Marincola (EPA Region 9)	☒ **Yes** ☐ **No**

Weather Conditions at the Time of the Inspection:	**Facility Receiving Water Name:**
Sunny; no signs of recent precipitation	Pacific Ocean within the Santa Monica Bay

Overview of Areas Evaluated During Inspection

S = Satisfactory, M = Marginal, U = Unsatisfactory, N = Not Evaluated

Permit: S	Flow Measurement: S	Solid Waste Handling & Disposal: S
Records & Reports: S	Self-Monitoring Program: U	Compliance Schedules: N
Facility Site Review: S	Laboratory: S	Pretreatment (POTWs Only): N
Effluent & Receiving Waters: U	Operations & Maintenance: U	Storm Water: N

Prepared By: Danny O'Connell (PG Environmental, LLC) on 10/15/2009

Reviewed By: Craig Chomiak (PG Environmental, LLC) on 10/29/2009

Facility Narrative

On October 6 and 7, 2009 a USEPA contractor inspected the City of Los Angeles – Hyperion Treatment Plant in Playa Del Rey, CA. Discharges from the facility are regulated by Regional Water Board Order No. R4-2005-0020 (NPDES Permit No. CA0109991). The primary purpose of the inspection was to determine the accuracy and reliability of the Discharger's self-monitoring and reporting program. The primary on-site facility representatives were Mike Ruiz (Shift Supervisor II) and Mahesh Pujari (Senior Chemist). The weather at the time of inspection was sunny with no signs of recent precipitation.

The City of Los Angeles (City or Discharger) owns and operates the Hyperion Treatment Plant (Facility). The Facility provides secondary level treatment in a process train which consists of screening, grit removal, primary sedimentation with coagulation and flocculation, activated sludge biological treatment, and secondary clarification. Sludge processing includes anaerobic digestion prior to disposal in a landfill or reuse by land application.

The Facility discharges secondary treated municipal wastewater through two outfalls to the Pacific Ocean within Santa Monica Bay. Outfall 001 discharges disinfected secondary effluent while Outfall 002 discharges nondisinfected secondary effluent, the outfalls are discussed in more detail later in this 'Facility Narrative' section. The City's Hyperion Treatment System, which includes both the sewer system and the Facility, is designed to collect and treat wastewaters generated within the City. The City sewer system services approximately 600 square miles. The system consists of approximately 15 interceptor sewer lines servicing four wastewater treatment plants including the Facility, and three upstream wastewater treatment plants: Donald C. Tillman Water Reclamation Plant (Tillman WRP), Los Angeles-Glendale Water Reclamation Plant (LAGWRP), and Burbank Water Reclamation Plant (Burbank WRP) (owned and operated by the City of Burbank). The Hyperion Treatment System collects, treats, and disposes of sewage from the entire City (except the Wilmington - San Pedro Area, the strip north of San Pedro, and Watts) and from 29 cities and agencies under contractual agreements. Approximately 85% of the sewage and commercial/industrial wastewater comes from the City. The remaining 15% comes from the contract cities, business zones and agencies. There are approximately four million people in the Hyperion Treatment System service area.

The Hyperion Treatment System is an interconnected system which supports approximately 6,500 miles of sewer lines located within the City (including trunk and interceptor sewers in contract cities, business zones and agencies) and additional sewer lines under the control of the contract cities and agencies. The contract cities and agencies operate their respective local collection systems that are tributary to the City's trunk and interceptor lines. Sludge from two of the City's two upstream plants is returned to the wastewater collection system and flows to the Facility for processing. Discharges from Tillman WRP and LAGWRP are regulated by NPDES Permit Numbers CA0056227 and CA0053953, respectively. Sludge generated from the Burbank WRP is discharged to the Hyperion Treatment System's North Outfall Sewer for processing at the Facility. In addition, the influent to the Burbank WRP can be diverted to the Hyperion Treatment System during periods of emergency. The operations of the Burbank WRP are regulated under NPDES Permit No. CA0055531.

As previously stated, the Facility has two ocean outfalls. Outfall 001 is commonly referred to as the "one-mile outfall". It is a 12-foot diameter outfall terminating approximately 5,364 feet west-southwest of the Facility at a depth of approximately 50 feet below the ocean surface. This outfall is permitted for emergency discharge of chlorinated secondary treated effluent during extremely high flows, power failures, and preventive maintenance, such as routine opening and closing (exercising) the outfall gate valve(s) and for lubrication. Regional Water Board Order No. R4-2005-0020

requires the City to notify the Regional Water Board and USEPA in advance of any planned preventive maintenance that results in discharges through Outfall 001. The City provides prior written notice to the Regional Water Board when preventive maintenance has been scheduled, typically once a quarter. Outfall 002 is commonly referred to as the "five-mile outfall". It is a 12-foot diameter outfall terminating approximately 26,525 feet (8.1 km) west-southwest of the Facility at a depth of approximately 187 feet (57 m) below the ocean surface. This outfall is located north of Outfall 001 and ends in a "Y" shaped diffuser consisting of two 3,840-foot legs. This outfall is permitted for routine discharge of non-disinfected secondary treated effluent.

Hyperion also provides the West Basin Municipal Water District (West Basin) with secondary effluent for additional treatment and sale to various clients. West Basin operates a Water Recycling Facility in El Segundo and has a contract to receive up to 70 mgd of secondary effluent from Hyperion Treatment Plant for advanced treatment. The secondary effluent is pumped from the southwest corner of the Plant to the West Basin Facility via a West Basin operated pump station. West Basin Facility provides tertiary treatment and/or advanced treatments such as microfiltration and reverse osmosis (RO) to the Hyperion secondary effluent to produce Title 22 and high purity recycled water. The Title 22 recycled water is used for beneficial irrigation and industrial applications (which included cooling water and boiler feed water). The RO treated recycled water is injected into the West Coast Basin Barrier Project to control seawater intrusion. The waste brine from West Basin Facility is discharged to the ocean through Hyperion's five-mile outfall via a waste brine line from West Basin Facility. Although the waste brine is discharged through Hyperion's outfall, it is regulated under separate waste discharge requirements and NPDES permit.

The Facility has a dry weather average design treatment capacity of 450.0 million gallons per day (mgd) and a wet weather peak hydraulic capacity of approximately 850.0 mgd. The instantaneous influent flow was 349.7 mgd at 11:05 AM on October 7, 2009.

The Facility continues to accept and treat dry weather urban runoff that is diverted from storm drains into the City's collection system from April 1 to October 31. The City plans to extend this diversion operation from the dry summer months to year-round in order to conform to the six-year compliance schedule for bacteria concentration during winter dry weather, contained in the Santa Monica Bay Beach Dry-weather Bacteria TMDL regulation (Resolution No. 02-004 and Resolution No. 2002-022) adopted by the Regional Water Board.

Members from the Discharger's operations and laboratory teams conduct self-monitoring activities. Effluent samples for Outfall 002 are collected from a sink that pulls effluent from the discharge line. Sample collection location and methods appeared to provide representative samples. All samples are analyzed at the on-site laboratory.

Discharge monitoring reports (DMRs) for Outfall 002 for the months of May, June, and July 2009 were reviewed as a component of this inspection. The review included a comparison of reported monitoring results versus requirements and limitations contained within the permit. Permit limit exceedances were identified and are presented in the 'Major Findings – Effluent and Receiving Waters' component of this report.

The Major Findings stated in the previous inspection report have not been corrected. The Discharger continues to exceed and report ammonia performance goals as previously documented; however the Discharger has not provided a corrective action plan or timetable for compliance. In addition, the Discharger's composite samplers still do not have thermometers to document that sample temperatures are at or below 6 degrees F as required by 40 CFR 136.

Major Findings

Effluent and Receiving Waters

1. Regional Water Board Order No. R4-2005-0020, Section I.A.2 requires the Discharger to comply with a Settleable Solids Daily Maximum concentration of 3.0 ml/L. On July 16, 2009 at 1:00 PM the Settleable Solids Daily Maximum concentration was 25.0 ml/L (refer to Exhibit 1).

2. Regional Water Board Order No. R4-2005-0020, Section I.A.2 requires the Discharger to "submit a written report to the Regional Board and USEPA on the nature of the exceedance, the results of the investigation as to the cause of the exceedance, and the corrective actions taken or proposed corrective measures with timetable for implementation" if there are three consecutive months of performance goal exceedances. The Discharger had nine consecutive months of ammonia exceedances from November 2008 to July 2009. The Discharger's July 2009 DMR discusses the nature of the exceedances and the potential cause, but does not discuss corrective actions or associated timetables.

Self-Monitoring Program

1. Regional Water Board Order No. R4-2005-0020, Monitoring and Reporting Program (MRP) 1492 (Attachment T), III.B requires that "Pollutants shall be analyzed using the analytical methods described in 40 CFR 136". Some of the parameters analyzed from composite samples require a preservation temperature at or below 6 degrees C, as specified by the sample preservation requirements in 40 CFR 136. The Facility did not maintain thermometers in the influent and effluent composite samplers. Therefore, based on these findings, the Discharger cannot demonstrate compliance with the sample preservation requirements specified in 40 CFR Part 136.

2. Regional Water Board Order No. R4-2005-0020, Monitoring and Reporting Program (MRP) 1492 (Attachment T), III. C requires that "Proper chain of custody procedures must be followed". Sample chain of custody could be questioned due to the transfer of samples between the operations and laboratory teams. The current operational practice is for influent and effluent samples to be placed by the operations team in an unsecure refrigerator located in the loading dock area of the laboratory/administration building with sample collection data and signed chain of custody. The laboratory team eventually removes the samples, data, and chain of custody from the unsecure refrigerator and delivers them to the on-site laboratory. Therefore, based on these findings, the Discharger cannot demonstrate compliance with valid chain of custody protocols.

Operations and Maintenance

1. Regional Water Board Order No. R4-2005-0020, Standard Provisions (Attachment S), Provision C requires that the "discharger shall, at all times, properly operate and maintain all facilities and systems of treatment". On July 14, 2009 the Facility shut down solids wasting operations to accommodate some scheduled preventive maintenance activities. Those preventive maintenance activities had an unscheduled delay of 16 hours and created a situation in which some solids were washed out of the secondary clarifiers. At 1:00 PM on July 16, 2009 the Facility's effluent exceeded its settleable solids daily maximum concentration limit (25.0 ml/L vs

permitted 3.0 ml/L). Therefore, based on these findings, the Discharger failed to properly operate and maintain all facilities and systems of treatment.

PERMIT: **OVERALL RATING: S**

INSPECTED ITEM	EVAL
1. Current copy of facility NPDES permit available on-site.	S
2. Correct name and mailing address of permittee identified on NPDES permit.	S
3. Facility is as described in permit.	S
4. a. Notification given to Regional Water Board of process/production modifications, collection system expansions, etc. that impacted quality/quantity of discharge or changes to the facility or increased discharge. b. Permit modification received, if required, prior to changes.	N N
5. Recent permit modifications, amendments or compliance orders on file.	N
6. Number of discharge outfalls the same as listed in the permit.	S
7. Name of receiving waters listed correctly in the permit.	S
8. Permit status (i.e., Current, Expired, or Extended)	Current
9. Permit renewal application submitted to the Regional Water Board at least 180 days prior to the expiration date.	N
10. Other:	N
Notes: ***This section was rated "satisfactory" because all items reviewed were rated satisfactory.***	

S = Satisfactory, M = Marginal, U = Unsatisfactory, N = Not Evaluated/Not Applicable

RECORDS/REPORTS: **OVERALL RATING: S**

INSPECTED ITEM	EVAL
1. NPDES records maintained for the time period required (5 years): The following records and reports were requested and observed: ***- Machinery Calibration Logs*** ***- Work Orders*** ***- May 2009, June 2009, and July 2009 DMRs*** ***- Operation and Maintenance Reports (i.e., for the One Mile Outfall)*** ***- 2008 Biosolids Annual Report***	Yes
2. a. Did the facility document any spills or bypasses during the period reviewed? b. Spills and bypasses reported and documented as required by the permit (i.e.- as soon as possible, but no later than 24 hours from the time the permittee first became aware of the circumstances). c. Follow-up written documentation given as required by the permit (within 5 days in most cases).	No N N
3. Discharge Monitoring Report (DMR) and/or Self Monitoring Report (SMR) evaluation: a. The responsible person or designee signs and certifies the DMRs/SMRs. b. The facility monitors more frequently than required by the permit. c. All data collected are summarized on the DMRs/SMRs. d. Data reported on DMRs/SMRs is consistent w/ analytical results. e. Coliform concentrations calculated as required by the permit (e.g., median, geometric mean). f. Numerical values for minimum detection limits are reported on DMRs/SMRs when laboratory reports "Not Detected" or "0" (for example, MDL= 3, Report: "<3" on DMR). g. "Less than values" properly carried through loading calculations. h. Flow measurement period used for loading calculations brackets the sampling period. i. Influent and effluent loading rates properly calculated, if required. j. Number Exceeding (N.E.) properly reported on all DMRs and annual reports.	 S Yes S S S S N N N S
4. Reports completed in the time frame and frequency as required by the permit (not all reports required for all facilities): a. Discharge Monitoring Reports/Self-Monitoring Reports b. Biosolids Monitoring Reports c. Biosolids Management Reports d. CSO/ I&I Reports e. Compliance Schedule Reports f. Pretreatment Reports g. Other:	 S S S N N S N
5. Sampling and analytical records (for water and biosolids) include: a. Dates, times, and location of sampling b. Names of individuals performing sampling c. Analytical methods d. Results of analyses e. Dates of analyses f. Time of analyses, as necessary to verify holding times g. Analysts' names or initials h. Instantaneous flow at grab sample stations, if required	 S S S S S S S S

S = Satisfactory, M = Marginal, U = Unsatisfactory, N = Not Evaluated/Not Applicable

RECORDS/REPORTS: **OVERALL RATING: S**

INSPECTED ITEM	EVAL
6. Plant records include:	
a. Daily plant operational records or log book	S
b. Equipment maintenance records and schedules	S
c. CSO/lift station check records or log book	N
d. Records of auxiliary power checks	S
e. Spill Prevention Control and Countermeasure (SPCC) plan	S
f. Pollution Prevention Plan (P3)	S
g. Influent and Effluent flow measurement records maintained for the past three years	S
h. Other:	S
Wet Weather Preparedness and Operations Plan 2008-2009	
2008-2009 Annual Report for Storm Water Discharges	
Operations & Maintenance Manuals:	
- Biosolids Dewatering Facility - February 2007	
- Gas Compressor Facility - February 2007	
- Gas Handling Flares - June 2003	
- Digester Screening Facility - August 2005	
- Intermediate Pumping Station - March 2002	
- Air Pollution Control - March 2002	
- Preliminary Treatment - May 2006	
- Primary Treatment - March 2006	
- Effluent Pumping Plant - October 2005	
7. All records and reports required by the permit appear to be organized and available for inspection.	S
8. Other:	N

Notes:
This section was rated "satisfactory" because all items reviewed were rated satisfactory.

FACILITY SITE REVIEW: **OVERALL RATING: S**

INSPECTED ITEM	EVAL
1. All treatment units and supporting equipment are in service and mechanically functioning properly. ***The Facility provides full secondary treatment for the wastewaters received. Preliminary and primary wastewater treatment consists of screening, grit removal, and primary sedimentation with coagulation and flocculation. In secondary treatment, the primary effluent is biologically treated in a high purity oxygen activated sludge process comprised of a cryogenic oxygen plant, nine secondary reactor modules and 36 secondary clarifiers. Each secondary reactor module is designed to handle 50 mgd of flow which results in a total treatment capacity of 450 mgd of primary effluent. After clarification, non-disinfected secondary effluent is discharged into Santa Monica Bay through a five mile submerged outfall pipe. A discharge of up to 325 mgd flows by gravity to the outfall, or is pumped at the Effluent Pumping Plant when flows exceed 325 mgd.*** ***The solids management operations were not inspected as a component of this inspection. The Facility hauls grit, primary screenings, skimmings, and other inorganic materials offsite for disposal at landfills. Biosolids are processed on-site by means of anaerobic digestion and beneficially reused for land application and composting.***	S
2. Hydraulic and organic loadings are consistent with the fact sheet and plant design criteria. a. Are there signs of overloading to the facility and collection system, including I&I and septage loading?	S S
3. Peak flows remain within the established plant capacity. a. If flows have exceeded capacity, has the Regional Water Board been notified?	S N
4. Lift stations are properly monitored, maintained, have a back-up power source and are not subject to chronic spills and/or overflows.	N
5. Odors are adequately controlled, resulting in limited complaints.	S
6. Residual chlorine monitoring is well documented and sampling/monitoring is representative of the discharge. a. If a UV system is used, the dosage intensity, tubes, and alarms are adequate, maintained and documented.	S N
7. Housekeeping procedures are adequate to prevent release of pollutants to the environment: a. Adequate dikes and secondary containment b. Spill containment and clean-up c. Signs of spillage to soil, groundwater, or surface water d. Storm water and leachate management from storage piles e. Leaking pipes, pumps, etc. f. Drum and chemical storage areas g. Minimization of pollutants entering storm water outfalls h. Other open dumps or debris piles i. Other:	 S S S S S S S S S N

S = Satisfactory, M = Marginal, U = Unsatisfactory, N = Not Evaluated/Not Applicable

FACILITY SITE REVIEW: **OVERALL RATING: S**

INSPECTED ITEM	EVAL
8. Signs of tank deterioration and/or settlement.	S
9. Safety concerns are present that may interfere with proper operation, maintenance, and/or monitoring.	S
10. Material Safety Data Sheets (MSDS) are available for stored chemicals.	S
11. Equipment available for spill clean-up and containment.	S
12. Other: ***Flow Rates*** ***Facility representatives stated that influent flow rates appear to decreasing. It was explained by the representatives that the decrease is assumed to be associated with water conservation efforts and slow down in the economy.***	S
Notes: ***This section was rated "satisfactory" because all items reviewed were rated satisfactory.***	

S = Satisfactory, M = Marginal, U = Unsatisfactory, N = Not Evaluated/Not Applicable

EFFLUENT AND RECEIVING WATERS: **OVERALL RATING: U**

INSPECTED ITEM	EVAL
1. Recent DMR history (last ***3*** months) (outfall number(s) ***002***):	
a. Violations of discharge limits	U
b. Spills/bypasses	S
c. Fish kills or other receiving water impacts	S
d. WET testing results are in accordance with the permit	S
e. If effluent limit violations have been identified, what actions has the facility taken to eliminate or reduce their recurrence?	U
The Facility had a settleable solids permit exceedance on July 16, 2009 (refer to Exhibit 1). In addition, the Facility has had nine consecutive months of ammonia performance goal exceedances (November 2008 through July 2009). The Facility's July 2009 DMR discusses the nature of the exceedances, the cause of the settleable solids exceedance, and the potential cause, but does not discuss corrective actions or associated timetables for the eliminatation of the ammonia performance goal exceedances. See 'Major Findings - Effluent and Receiving Waters' for additional information.	
2. DMR spot check conducted for the months of: ***May, June, and July 2009***	
a. Internal lab sheets and contract lab results properly transferred to DMRs	N
b. Monthly average, weekly, maximum, etc., values correctly calculated per the permit	S
c. Influent and effluent loadings reported	S
d. DMR is accurate and complete for each outfall	S
3. Appearance of effluent during inspection:	
a. The effluent(s) was viewed during the inspection	Yes
b. Excessive foam, scum, or sheens present	S
c. Cloudy and/or color	S
d. Excessive solids	S
e. Other:	N
Effluent quality observed from secondary clarifier weirs (refer to Photo 2).	
4. Appearance of receiving water(s) during inspection:	
a. The receiving water(s) was viewed during the inspection	Yes
b. Distinctly visible foam or sheens on receiving water	S
c. Biosolids accumulation or deposits of solids below discharge point(s)	S
d. Distinctly visible plume from discharge(s) to receiving water	S
e. Discharge creates objectionable odor at or near receiving water(s)	S
f. Other:	N
The Santa Monica Bay was observed from the Facilities entrance and beach area approximately two miles south of the Facility.	
5. Other:	N

Notes:
This section was rated "unsatisfactory" due to checklist items 1a. and 1e.

S = Satisfactory, M = Marginal, U = Unsatisfactory, N = Not Evaluated/Not Applicable

City of Los Angeles – Hyperion Treatment Plant
(NPDES No. CA0109991) Photo Log
Inspected by: Robyn Stuber and Jamie Marincola (EPA) and
Danny O'Connell (PG Environmental, LLC)

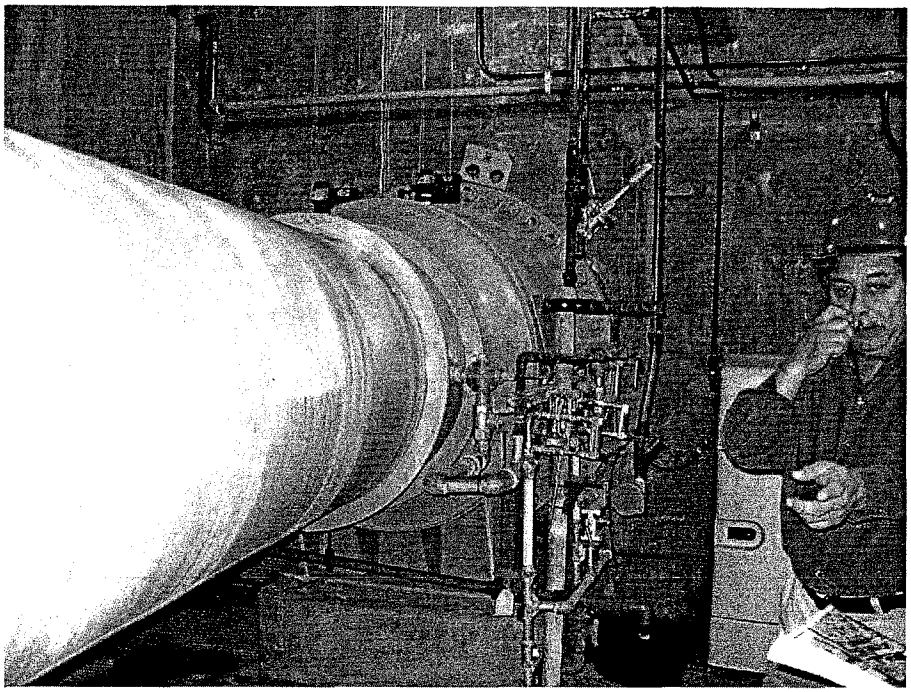


Photo 3: Venturi flow meter measuring the combined flows from the NCOS and COS lines.



Photo 4: Influent composite sample storage without a thermometer.

City of Los Angeles – Hyperion Treatment Plant
(NPDES No. CA0109991) Photo Log
Inspected by: Robyn Stuber and Jamie Marincola (EPA) and
Danny O'Connell (PG Environmental, LLC)

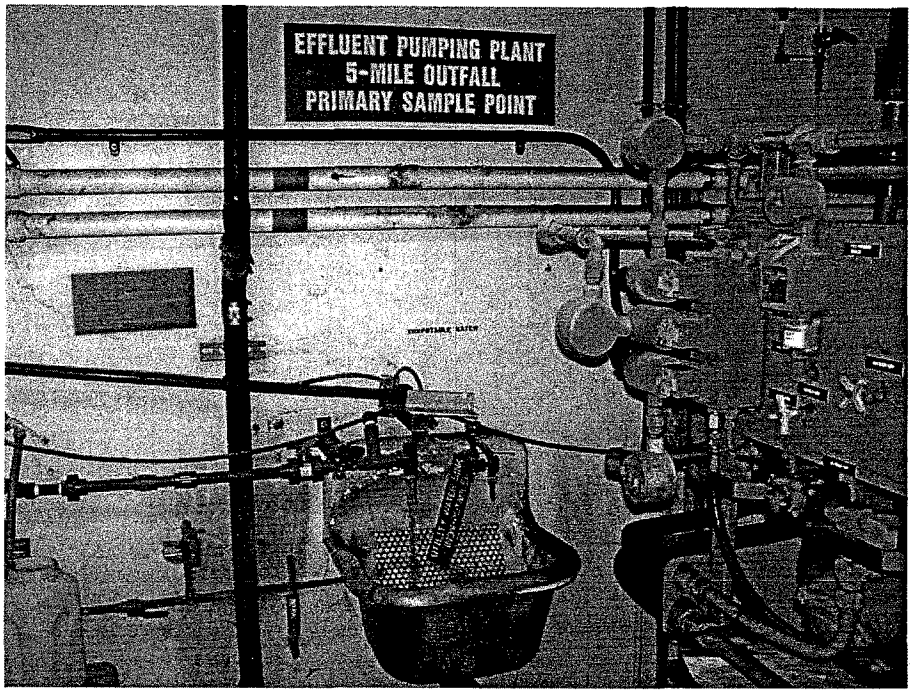


Photo 5: The sink serves as the grab sample location for the effluent through the 5-mile outfall.

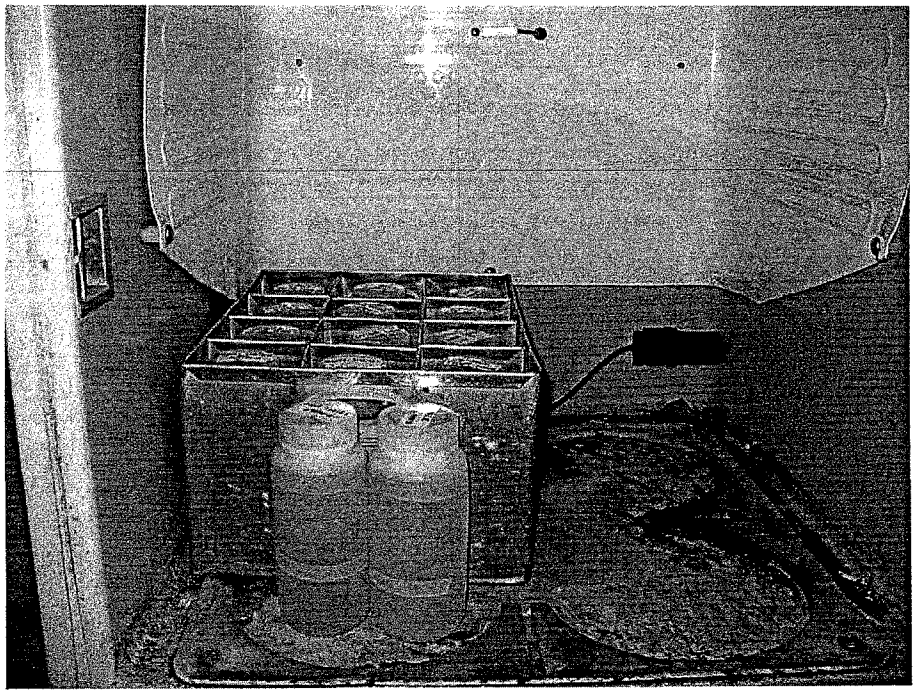
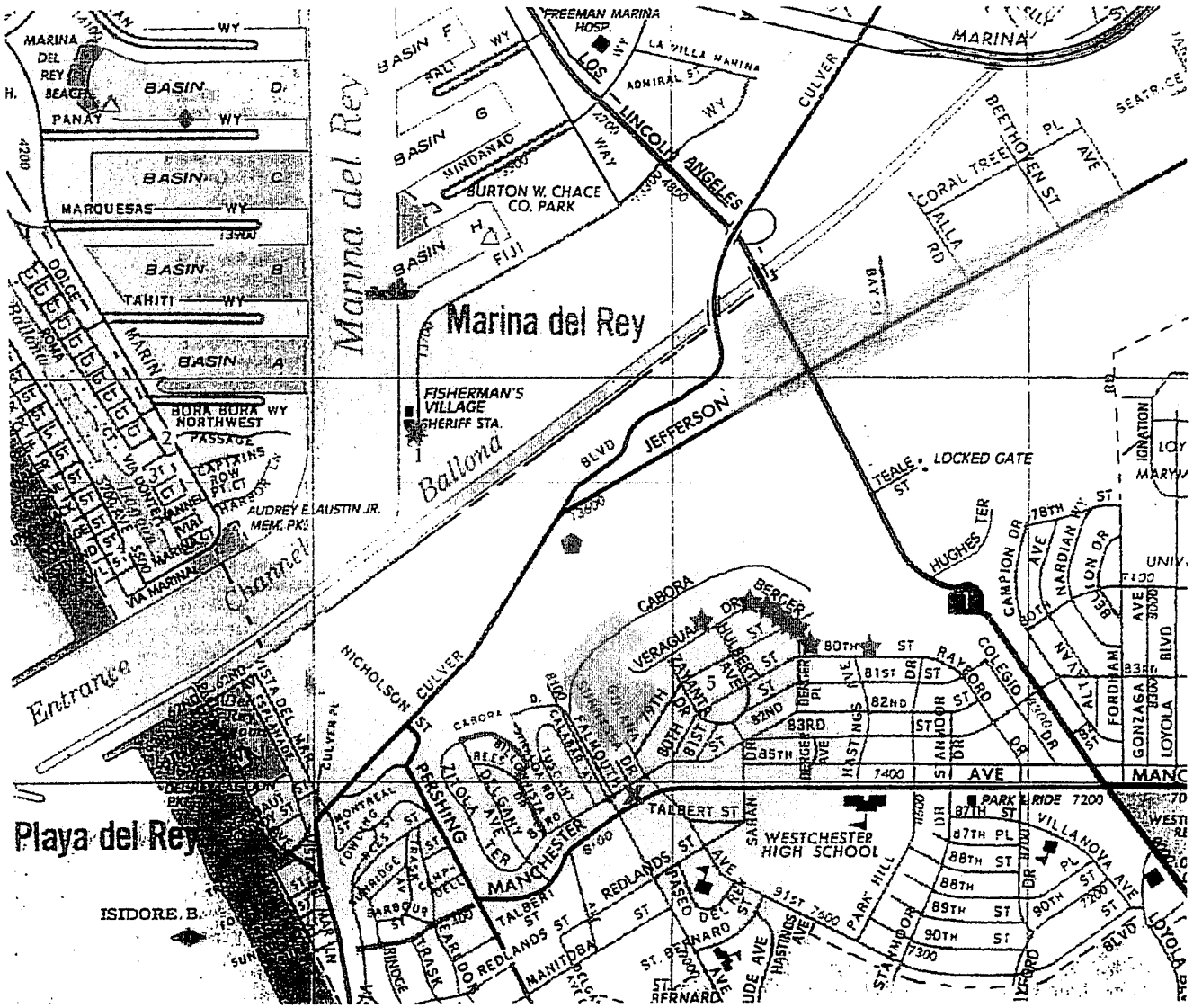


Photo 6: Sample storage from the 5-mile outfall without a thermometer.

EXHIBIT 13

Source: The California Public Utilities Commission – Safety Branch Investigation

Playa del Rey 851 Application and Complaint Case
Approximate Locations of Facilities and Complaints



SOURCE: Automobile Club of Southern California 1997 and MHA Environmental Consulting, Inc.

Legend

- SCG Facility
- Gas Storage
- Playa Vista
- Odor, health and cancer complaints as a result of emissions from the gas facility
- H_2S cloud exposure, health complaint
- Cancer, health complaints as a result of emissions from a well
- Subsidence complaint
- Odor, respiratory complaints from emissions in the wetlands
- Reported cancer cluster on Billowvista

Problematic wells

1. Playa del Rey 18
2. Townsite 2
3. Townsite 3
4. Block 11
5. Big Ben 1

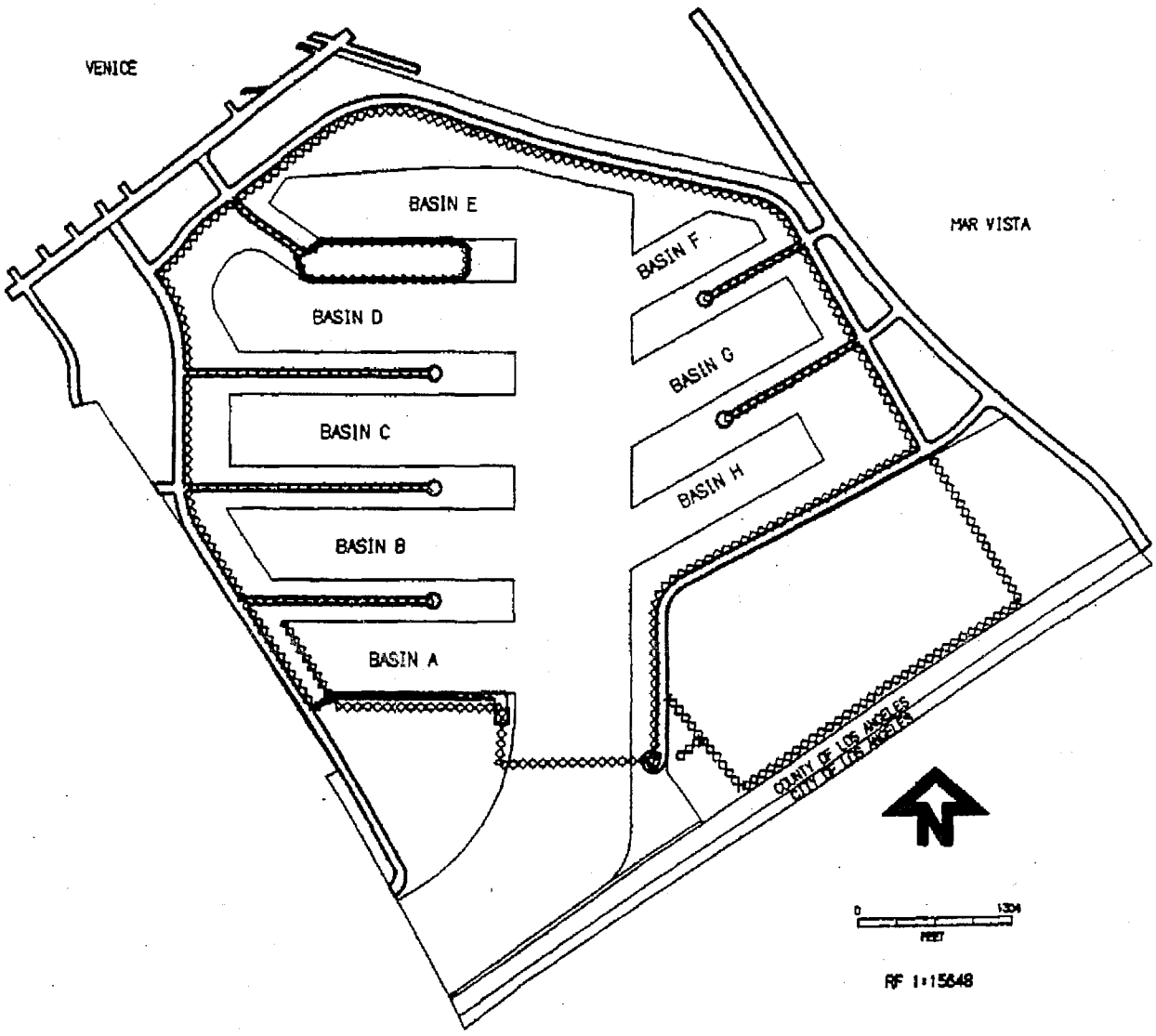
1000 ft

N

GAS UTILITY EASEMENTS

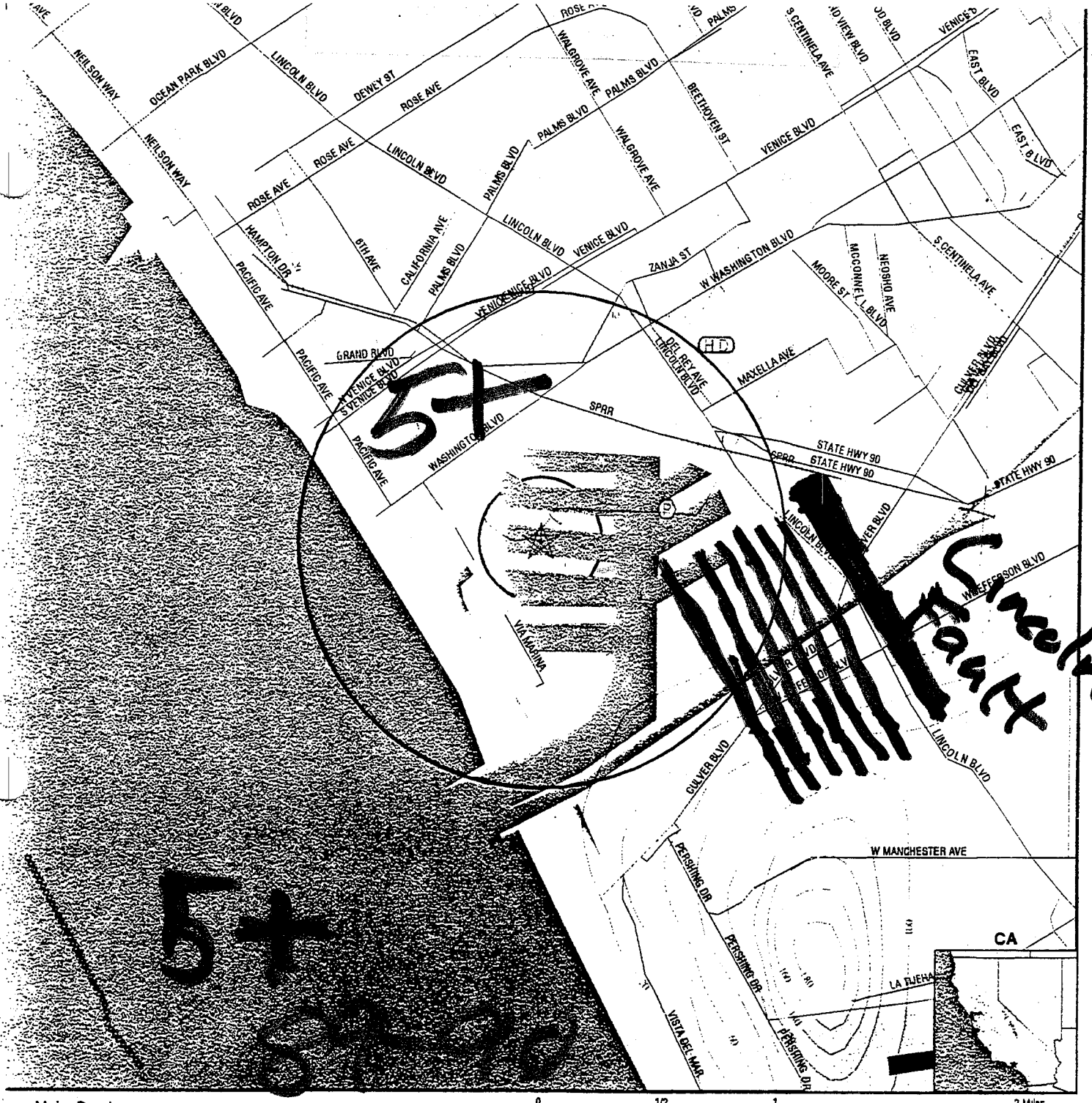
MAP 27

EASEMENT OF SOUTHERN CALIFORNIA GAS COMPANY



MARINA DEL REY

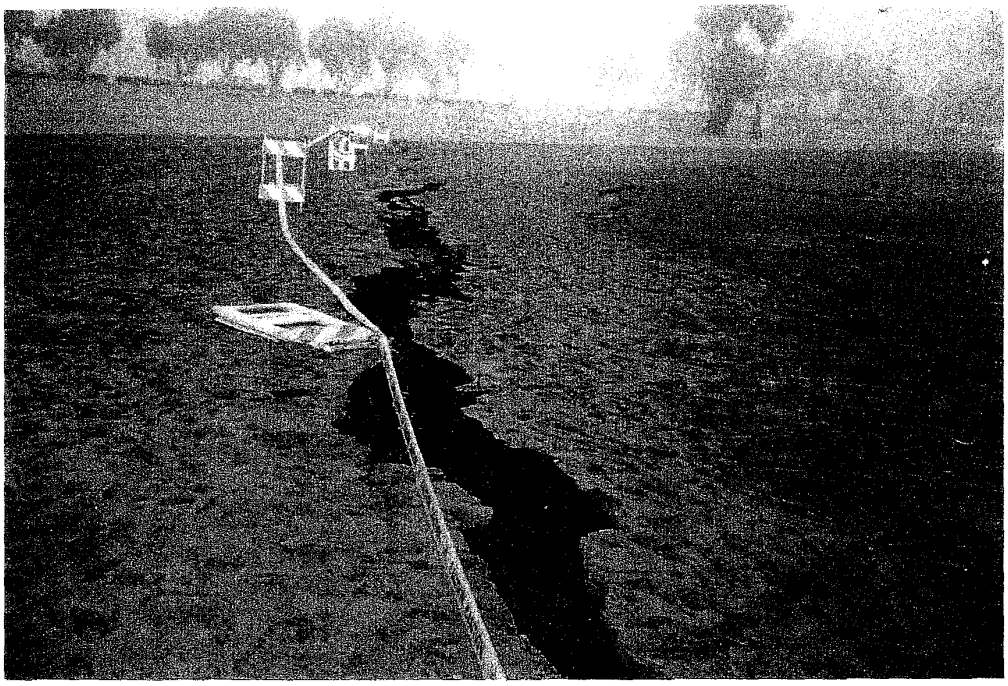
LOCAL COASTAL PROGRAM

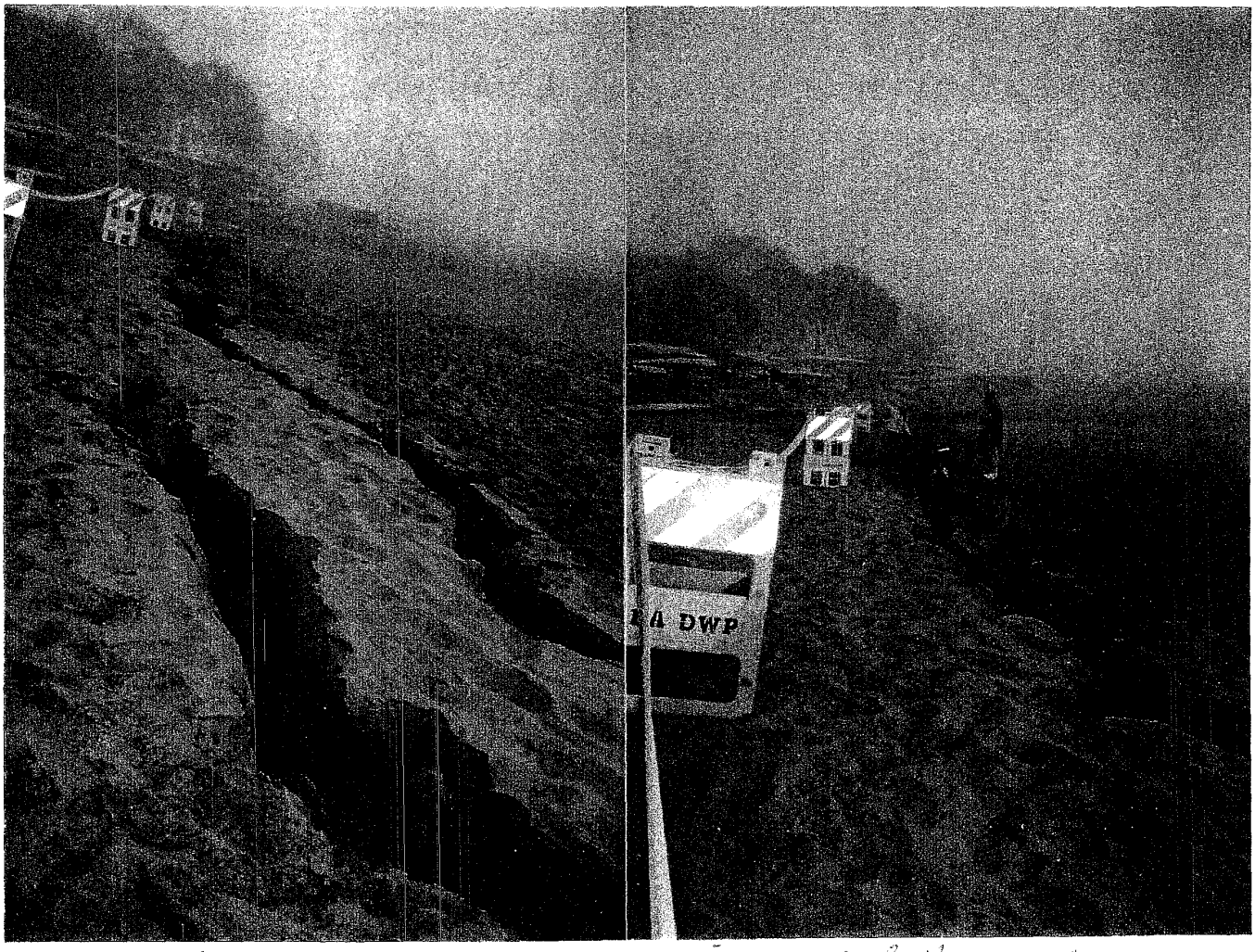


Major Roads
Contour Lines
Waterways
Earthquake Fault Lines
Airports
Earthquake epicenter, Richter 5 or greater
Closest Federal Well in quadrant
Closest State Well in quadrant
Closest Public Water Supply Well

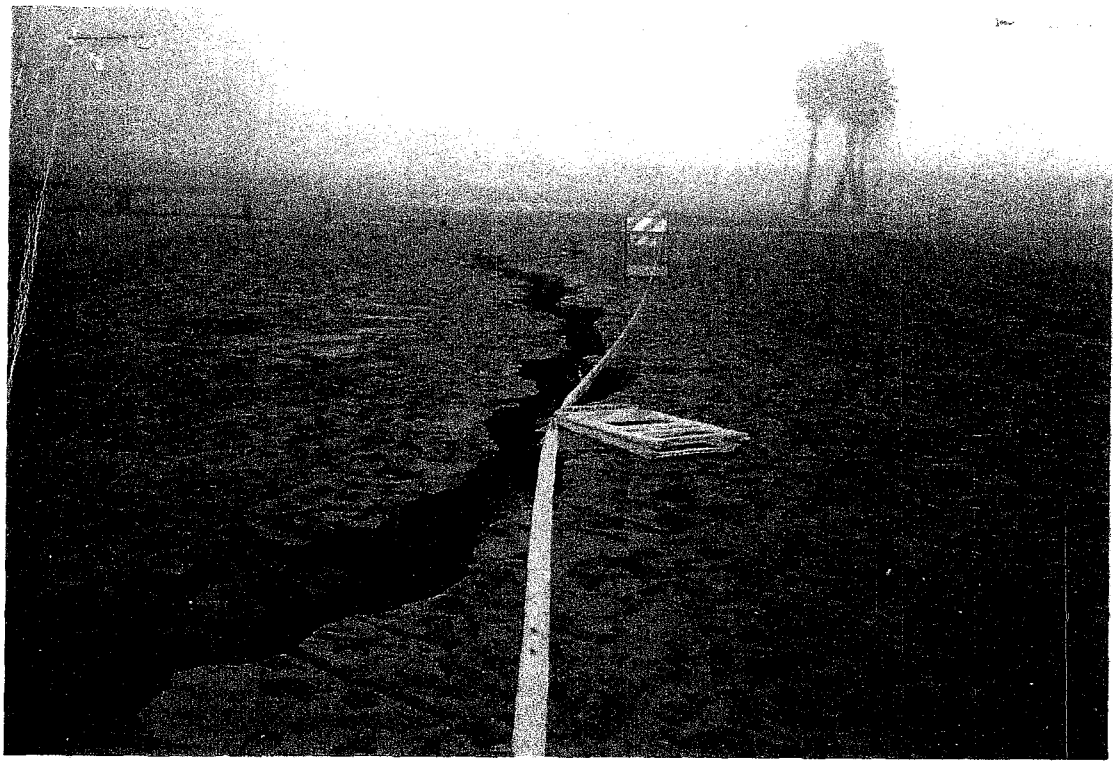
HD Closest Hydrogeological Data

TARGET PROPERTY:	Marina Del Rey	CUSTOMER:	Earth Systems Consultants
ADDRESS:	Via Marina + Panay Way	CONTACT:	Amy McCain
CITY/STATE/ZIP:	Marina Del Rey CA 90292	INQUIRY #:	264237.3s
LAT/LONG:	33.9781 / 118.4540	DATE:	June 16, 1998 6:51 pm



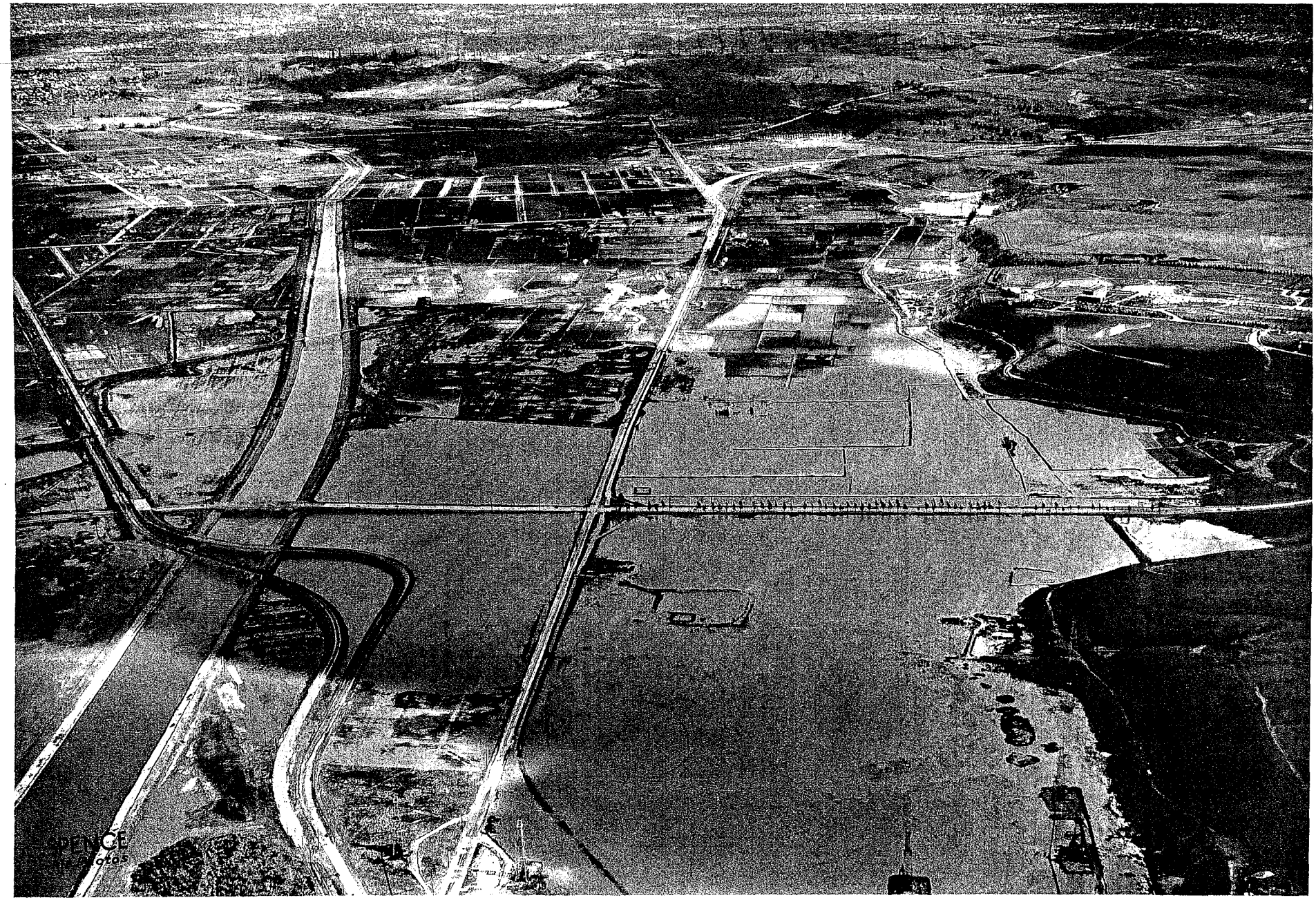


Mother's Beach, Marina Del Rey, CA
Day of Northridge Earthquake
1-17-94





Mother's Beach, Marina Del Rey. Day of Northridge Earthquake 1-17-94



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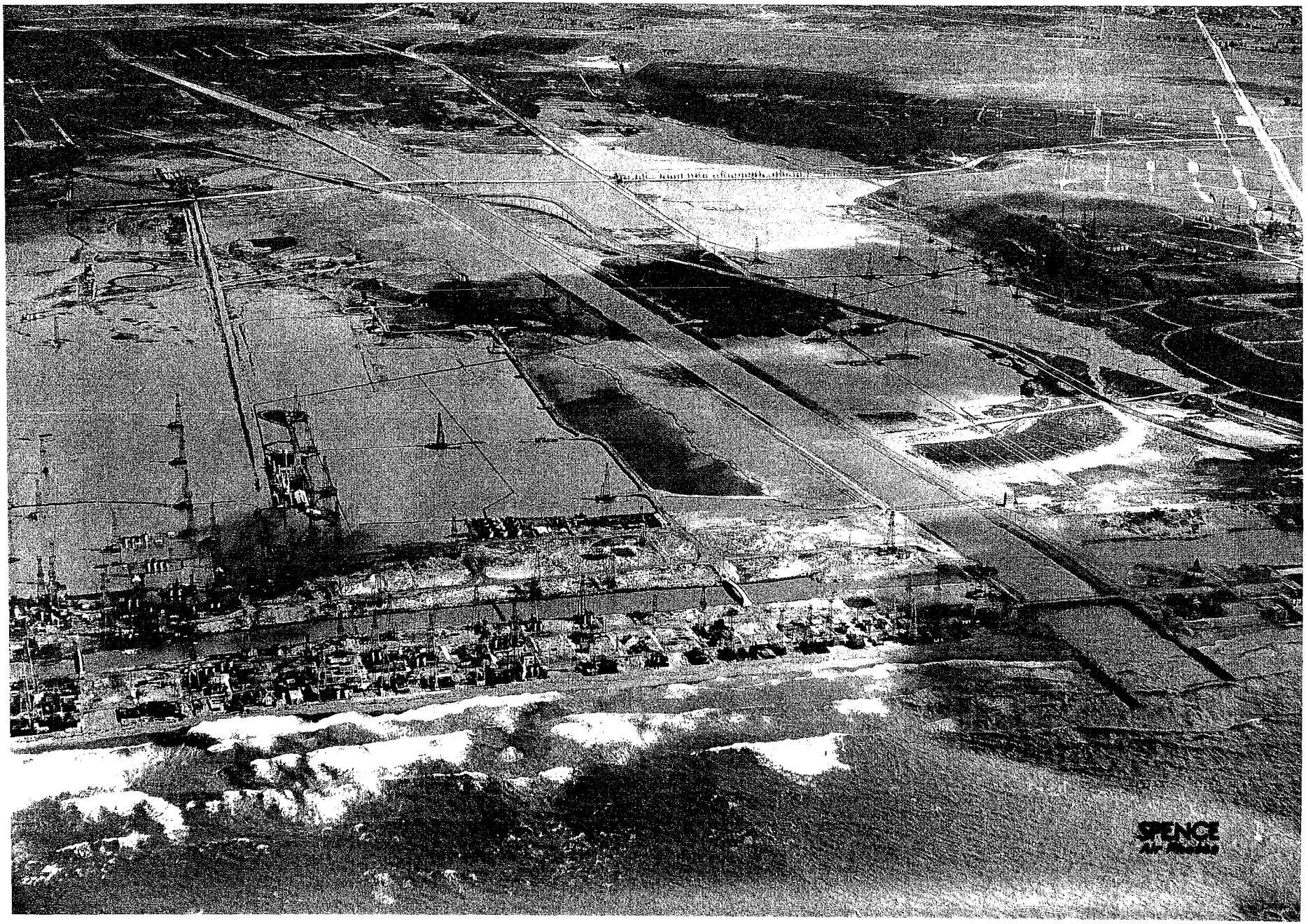

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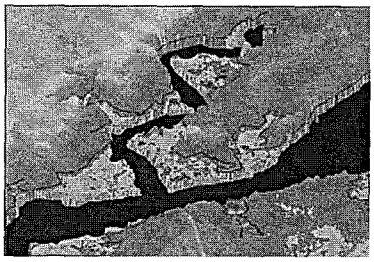
EXHIBIT 14

The Virtual Estuary
New GIS tool for exploration and analysis
By Sandra Fox, St. Johns River Water Management District, and Stephen Bourne, PBS&J

This article as a PDF .

A GIS tool developed by a team of experts is helping scientists more effectively study complex coastal and estuary systems.



In this portion of the estuary displayed in ArcScene, the high tide polygon (red line) and low tide polygon (solid dark blue) along with a digital elevation model (DEM) of the area

Coastal flooding from extreme weather events threatens millions of lives and properties along U.S. coastlines every year. Especially hard hit are areas along the Atlantic Ocean and the Gulf of Mexico where over 60 percent of homes and businesses are within 500 feet of the shoreline. Yet, the ability to explore and study complex coastal environments with accuracy and speed has been limited, if not impossible. Affordable hydrologic models that work well on inland studies simply don't translate to coastal applications. However, more sophisticated supercomputer-based modeling techniques are cost prohibitive.

In a pioneering effort, the St. Johns River Water Management District (SJRWMD) led a team of experts from academia, government, and industry in the development of the Analytical Framework for Coastal and Estuarine Studies (ACES) GIS tool, one of the first comprehensive coastal and estuarine tools. Still under development, ACES is designed to help scientists accurately monitor and manage the health of a complex estuary from within the Arc Hydro hydrologic environment. *[Arc Hydro is a data model template for use with water resources applications that has been developed by Esri in collaboration with key state, national, and international contributors.]*

This tool has been used to support estuarine and coastal studies for the Guana/Tolomato/Matanzas Estuary, also a National Estuary Research Reserve for SJRWMD, as well as water quality studies in the Gulf of Mexico. *[The National Estuarine Research Reserves are "living laboratories" that help researchers better understand coastal communities and find methods for dealing with the challenges these areas face.]*

Cooperative Development

SJRWMD is responsible for regulating water use and protecting wetlands, waterways, and drinking water supplies along Florida's sensitive eastern coastline from Fernandina Beach to Vero Beach. The agency's Surface Water Quality Monitoring (SWQM) has used Arc Hydro to develop specialized hydrologic tools such as an automated pollution load screening model and a drainage area spatial data summary tool.

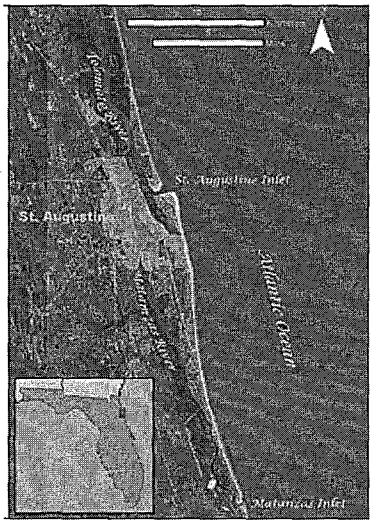
Yet, while greatly beneficial, these hydrologic tools were unable to account for tidal influences, which directly impact water quality in estuarine waters. This limited the agency's ability to accurately manage water quality throughout the region.

SJRWMD put together a technical team to develop ACES that included experts from SJRWMD, University of Florida, The Nature Conservancy, U.S. Geological Survey, and PBS&J, a consulting firm. The agency also put in place an expert review team that would be responsible for evaluating the end product developed by the technical team. The review team included the members from the Center for Research in Water Resources at the University of Texas, Austin; U.S. Army Corps of Engineers' Engineer Research and Development Center; and PBS&J.

The technical team's first task was to establish a master plan for the tool development from proof of concept to production. SJRWMD stipulated that the tool must be applicable to all SJRWMD estuaries and include existing GIS-based tools and enhanced Arc Hydro geodatabases developed by SWQM. Goal-driven brainstorming sessions helped keep the technical team on track throughout the development process. The initial brainstorming sessions and literature review focused on the nature of

an estuary, estuarine hydrodynamics, estuarine classification, existing GIS-based modeling technologies for estuaries, and synthetic modeling of water quality in estuaries.

The team found that the first step in approaching the study of estuaries was the creation of a GIS-based workbench tool that could integrate multiple sources. Water in coastal areas frequently comes from multiple sources. These might include surface water flow, incoming tides, manmade waterways, and even in some cases groundwater. The tool had to allow for the creation of virtual estuaries and estimation of bulk parameters of the estuaries and facilitate development and integration of other models into the same framework.



The St. Augustine Inlet to the Guana/ Tolomato/Matanzas Estuary is a barrier that was accurately characterized with the ACES tool. The Matanzas Inlet is one of Florida's few remaining natural, unmanaged inlets.

Conceptual Controls

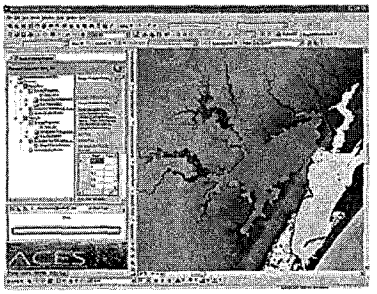
In the initial development phase of the ACES project, the technical team developed an estuary control volume conceptual model that connects features in the estuary physical model with elements contributing to the control volumes such as waters from coastal bases, oceanic constituents, riverines, and intracoastal waterways. Groundwater influence was not considered in this initial application since the influence is likely small as compared to the other elements.

The team relied on a simple multiple linear regression (MLR) tool for evaluating relationships between constituents emanating from drainage areas and the measured values of water quality in the control volume. A more robust estimate of contributing areas may be obtained by using an iterative process that compared predicted and measured values while modifying the drainage area contribution. Throughout the effort, the team communicated extensively regarding various topics ranging from the deceptively simple, such as the definition of an estuary, to the complex and controversial modeling approach.

Coastal Possibilities

The ACES prototype tool is composed of a GIS-based database of spatial and temporal data that describes the environment and an accompanying ArcMap-based toolset. Using ACES, scientists can essentially build a virtual model of the estuary they are interested in using topographic, bathymetric, and tidal datum data.

Within an Arc Hydro model, ACES can be used to determine estuarine bulk parameters (such as total area, high and low tide, volume, depth, and tidal flow) related to the shape of the estuary. With data related to flow rates into and out of the estuary, more complex parameters can be derived, such as residence time (the time water stays within a system) and flushing potential (an estuary's ability to flush a harmful substance).



ACES was used to find the volume of Copano Bay in Texas at several tidal levels to estimate pollutant loadings in the bay. Each colored polygon shows the shoreline for a different water level.

Using this information, the relative importance of tidal versus land-based flow on estuarine hydrodynamics can be assessed. Relationships between estuary water quality and flow rates can also be investigated. Using the ACES regression model capabilities, scientists can find the correlative relationships between the influential factors of upstream riverine drainage, coastal drainage, and estuarine non-point source pollution.

Prototype in Action

An ACES prototype was used to support estuarine and coastal studies for the Guana/ Tolomato/Matanzas Estuary, which is also a National Estuary Research Reserve for SJRWMD. Guana/Tolomato/Matanzas encompasses approximately 73,000 acres of salt marsh and mangrove tidal wetlands, oyster bars, estuarine lagoons, upland habitat, and offshore seas in northeast Florida. Along the northern section of the reserve, the Tolomato and Guana rivers meet the waters of the Atlantic Ocean. The southern section follows the Matanzas River, which extends from Moses Creek south of Pellicer Creek.

The ACES tool was also used to support a water quality study of Copano Bay in south Texas, a project sponsored by the Texas Commission on Environmental Quality. A popular fishing and recreation site, Copano Bay is a large watershed with source waters from Aransas Bay and several rivers. Dr.

Stephanie Johnson, then a doctoral student in the Center for Research in Water Resources at the University of Texas under Dr. David Maidment, wanted to develop an accurate water quality model for the bay. Johnson had already acquired estuary depth measurements, which she converted to volumes to model the processes within the bay.

"To complete this study, I needed basic information, such as the bay volume and symmetry, which I could have calculated by hand using available contour maps, though it would have been a tedious process," said Johnson. Working with the ACES development team, Johnson used the ACES program to automatically develop the necessary estuary volume versus depth curve for use when computing the total maximum daily load of pollutants. "Through the ACES program, I was also able to create highly visual images that I incorporated into my larger water quality model and used to communicate with various nontechnical stakeholders," added Johnson.

In the near future, environmental scientists at SJRWMD will use ACES to explore the estuaries along the northeastern coast of Florida, including the mouth of the St. Johns River, the Indian River Lagoon, and the Nassau and St. Marys rivers. ACES presents a wealth of possibilities for the exploration and analysis of estuaries at universities and within water management districts. This tool will continue to evolve in functionality and application to help coastal experts more easily explore and understand complex coastal environments.

About the Authors

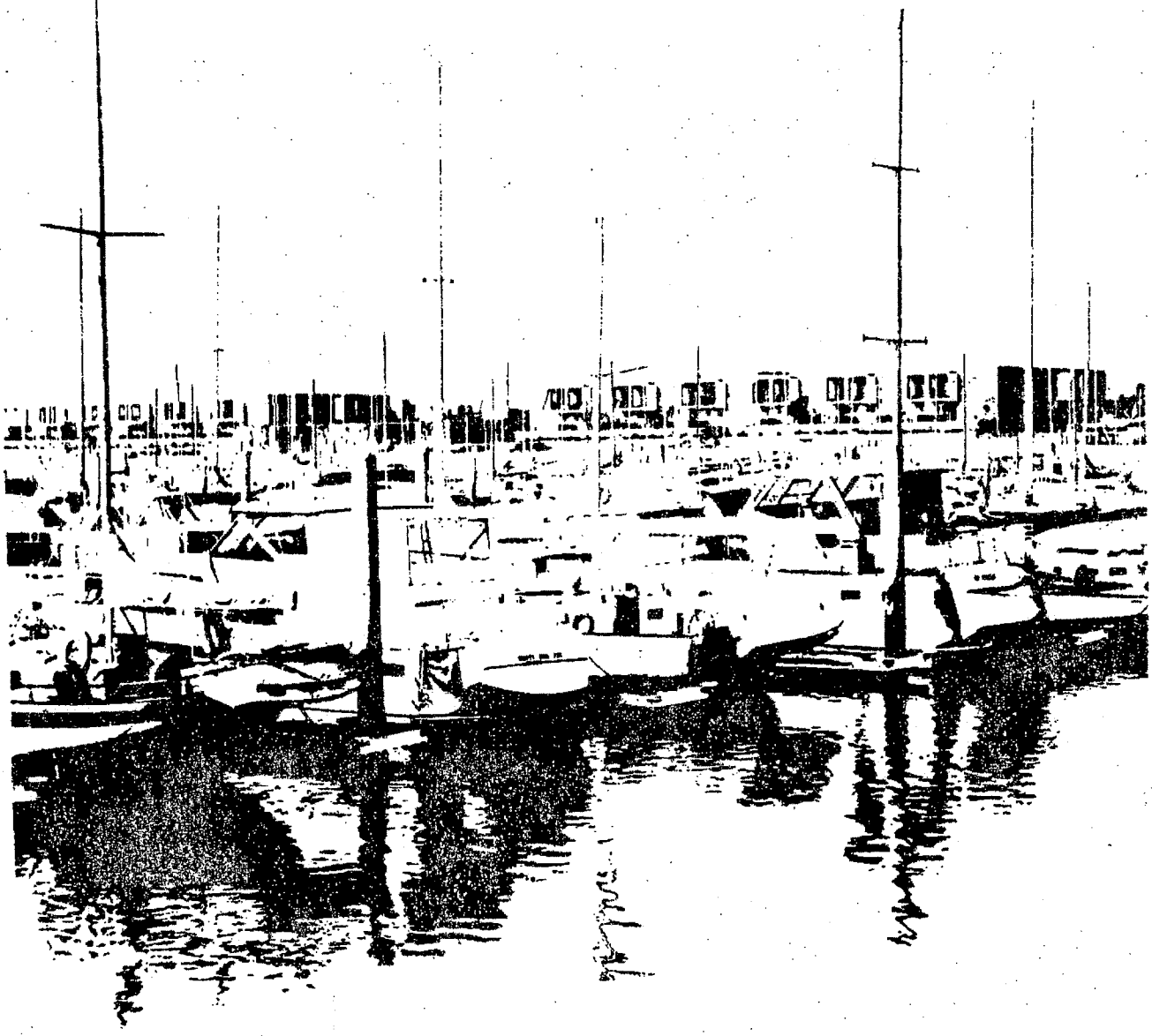
Sandra Fox is an environmental scientist with St. Johns River Water Management District (SJRWMD). She can be reached at SFox@sjrwmd.com.

Stephen Bourne is a project manager with the PBS&J Water Resources Technology group. He can be reached at 404-895-0753 or sfbourne@pbsj.com.

EXHIBIT 15

MARINA DEL REY STUDY

WORKING PAPER 15 THE DEVELOPMENT OF THE MARINA



COASTAL ZONE PLANNING AND MANAGEMENT PROJECT
UNIVERSITY OF SOUTHERN CALIFORNIA SEA GRANT PROGRAM • LOS ANGELES, CALIFORNIA

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THE DEVELOPMENT OF MARINA DEL REY

Marina del Rey Study
Coastal Zone Planning and Management Project
University of Southern California
Sea Grant Program

Prepared by
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Regional Planning
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With the assistance of
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Regional Planning

Cover photograph by Gwen Halvorson

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from the National Sea Grant Program, U.S. Depart-
ment of Commerce, to the University of Southern
California.

Sea Grant Publication No. USC-SG-5-72

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PREFACE

This working paper is one of a series focused on the Marina del Rey being prepared as part of the Coastal Zone Planning and Management Project at the University of Southern California. The overall project has been conducted jointly by the Center for Urban Affairs and the Graduate Program of Urban and Regional Planning under a grant from the U.S. Department of Commerce to the U.S.C. Sea Grant Program. This paper was undertaken to provide an orderly, accurate presentation of the decision process which has led to the Marina's present status.

We believe that the study will be of value to the Los Angeles County Department of Small Craft Harbors in its future Marina development activities. Although the department has been our principal source of information, an outsider's view of past events is sometimes useful. The principal value, however, will accrue to other coastal communities which are considering marina development but do not have the experience which Los Angeles has gained.

Obviously, there are many aspects of the Marina which we have not investigated in depth here. Among these are current activity patterns, developer behavior, environmental conditions, effects on surrounding areas, and the internal governance of the Marina. Furthermore, it has not been our intention to identify individuals who have advocated various

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policies. Other papers in the series will deal with many of these factors.

We would like to thank the following people at the Los Angeles County Department of Small Craft Harbors for their cooperation in providing reference documents and for the time they spent with us in interviews: Victor Adorian, Director; Donald Deise, Assistant Director; James Quinn, Chief of Operations and Development; Leo Bialis, Harbor Controller; and Richard Landon, Property Manager. Ben H. Southland, of Gruen Associates, who represented this consulting firm in their land use planning for the Marina, offered a number of valuable insights concerning its development.

We also recognize the important roles played by Ronald Linsky, Director of Sea Grant Programs at U.S.C.; Jerome Milliman, Director of the Center for Urban Affairs; and Professor Robert Warren in making the initial contacts which allowed us to proceed on this study.

CHAPTER I. INTRODUCTION

The Marina del Rey, on Santa Monica Bay in Los Angeles County, is one of the largest man-made small craft harbors in the world, containing 375 acres of land and 405 acres of water. It is expected to have about 6,000 boats in slips and hundreds more in dry storage. Beyond this, it is a small community in itself with a resident population of 10,000 and a seasonal daytime population of about 30,000. The residential accommodations are supplemented by extensive commercial facilities including a shopping center, office buildings, and many restaurants. Public investment to date has been over $36,000,000 which has been funded by federal and county contributions as well as a revenue bond issue of $13,000,000. Total private investment is expected to reach $160,000,000 or more. Today the project is clearly a financial success for the County, both in terms of internal revenues and increased tax income.

The site of the Marina is totally owned by Los Angeles County but most of the land and some of the water area is leased to private developers. The County Department of Small Craft Harbors, the Small Craft Harbor Commission and the Marina Design Control Board regulate both the form of development and the operations of the lessees.

Obviously, this financially successful project has required extensive and continuous planning effort. The pattern of decisions must be seen as a dynamic process. Plans have been modified considerably over a

long period of time and will continue to change. Each action taken by the County and by developers was a response to possibilities and constraints at a specific point in time, as they were perceived by particular groups. Some comments will be made here concerning the significance of Marina development decisions for its users, the surrounding area, and the community as a whole. However, a more complete critique of the decision process will appear in a later working paper.

Stages of development

The stages of Marina development and planning will be presented in a roughly chronological sequence. The first stage, up to 1956, covers early schemes for use of the Marina site and the planning which led up to a tentative decision for extensive public investment in a small craft harbor there.

During the second stage, 1956-62, detailed economic studies were conducted to estimate the costs and revenues from the Marina. Arrangements for the use of general fund and revenue bonds were established for financing public expenditures. The land needed for Marina development was acquired by the County and construction of the basic form of the Marina was undertaken. In 1960, the first complete land use plan was prepared. Procedures for leasing land and water parcels were defined. Finally, the first lessees built their own structures and began to operate.

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A third stage began in 1962 with a period of great difficulty brought on by storm damage and problems with financing. Up to 1967, every decision concerning the Marina had to be made with the goal of increasing revenues in order to meet debt service requirements. At present, many private structures and their arrangement reflect the market and financing conditions existing during this critical period which made low cost development necessary. More recent projects are of higher quality and higher cost. A revised land use plan was prepared in 1967 which updated the original plan. The new plan took account of experience gained during the intervening period, as well as the rapidly changing market conditions.

Currently the County contracts, when necessary, with economic and land use planning consultants who undertake studies and make recommendations to ensure that the continuing development of the Marina will be effective.

Important Public Issues

The Marina today appears to be a remarkably successful operation. However, from the point of view of public policy, a number of issues should be considered which will be relevant to decision-making concerning other marinas. While we will not attempt to answer these questions in this descriptive paper, they have guided the selection of information to be presented.

The first issue is whether the Marina del Rey site should have been used

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for a small craft harbor or for some other purpose. It can be assumed that local governments today must be constantly searching for revenue producing development. Rarely is a project carefully analyzed to determine whether its overall effect on the community will be the most favorable of all possible uses. Apparently, little consideration was given to uses other than a small craft harbor for this site and the possibilities for alternative uses were discarded long ago. Some other uses which might have been considered are industry, low density residence, a more or less natural estuary and park, and a recreation area like Marineland or even Disneyland. We are not necessarily suggesting that these uses are more suitable for the Marina site, but that a wide range of possibilities should be examined for all coastal zone sites.

Given that a marina has been assigned to the site, it should be considered whether the overall layout and the land use pattern have been handled well. For example, could the surge problem during the 1962-63 period have been avoided by better channel planning? Does the channel and basin arrangement result in acceptable water quality? Is the percent of the site filled as land appropriate? Have internal roads, links to external streets, and parking been well organized? Are high and low rise buildings properly balanced and arranged? Are residential and transient population densities too high or too low?

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Another category of issues concerns the financial and operating arrangements of the Marina. Were the public subsidies from the Federal government and the County general fund appropriate? Were the revenue bond issue and state loan handled well? Have leasing arrangements been fair and in the best interest of the County? Are public services adequate? Are Marina users paying their share of service costs?

Finally we come to the question of who should have the ultimate decision-making responsibility for marinas and other coastal zone development. If, as in the present case, the Department of Small Craft Harbors is given a major role in planning one would expect that water recreation uses, especially pleasure boating facilities, would be given precedence whenever possible. However if an agency with responsibility for all activities in the coastal zone were making decisions, perhaps a different land use scheme would have resulted.

In the remaining chapters of this report, we will turn to the chronolgy of Marina development.

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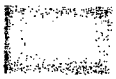
FOOTNOTES

1 Note that boating dominated the early plans, but as time has passed, residential and other "landside" development have been allowed to expand considerably because of the need to pay back the revenue bonds. Apparently boat slips alone would not support the cost of the Marina.



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CHAPTER II. THE PRE-DEVELOPMENT ERA

Natural Topography

Marina del Rey is located at the southern end of an area of beachfront lowlands which extend south from Pacific Palisades to the bluffs of Playa del Rey. Toward the east, the land slopes gradually upward to the Baldwin Hills, four miles inland. Until recently, the Marina area was known as Playa del Rey Inlet. Early in the 1800's the inlet had formed the mouth of the Los Angeles River but later the river rerouted itself so that it now enters the sea at Long Beach.

The concrete lined Ballona Creek Flood Control Channel, just south of the Marina site, was constructed in 1938. After the construction of the flood control channel, the Marina area was described as "1513 acres of salt marsh and low farm and residential lands." Residences were clustered along the shore since the area inland was subject to flooding by even moderate rainfall.[1]

Early Development Schemes

Indians once inhabited the area of the present Marina. There was fresh water from Ballona Creek, hunting and fishing were good, and there were clams in the lagoon. When Southern California came under the jurisdiction of the Spanish, the area was part of a large rancho used for raising cattle. The Rancho la Ballona, named for the town of Bayona in Spain, gave its name to Ballona Creek.

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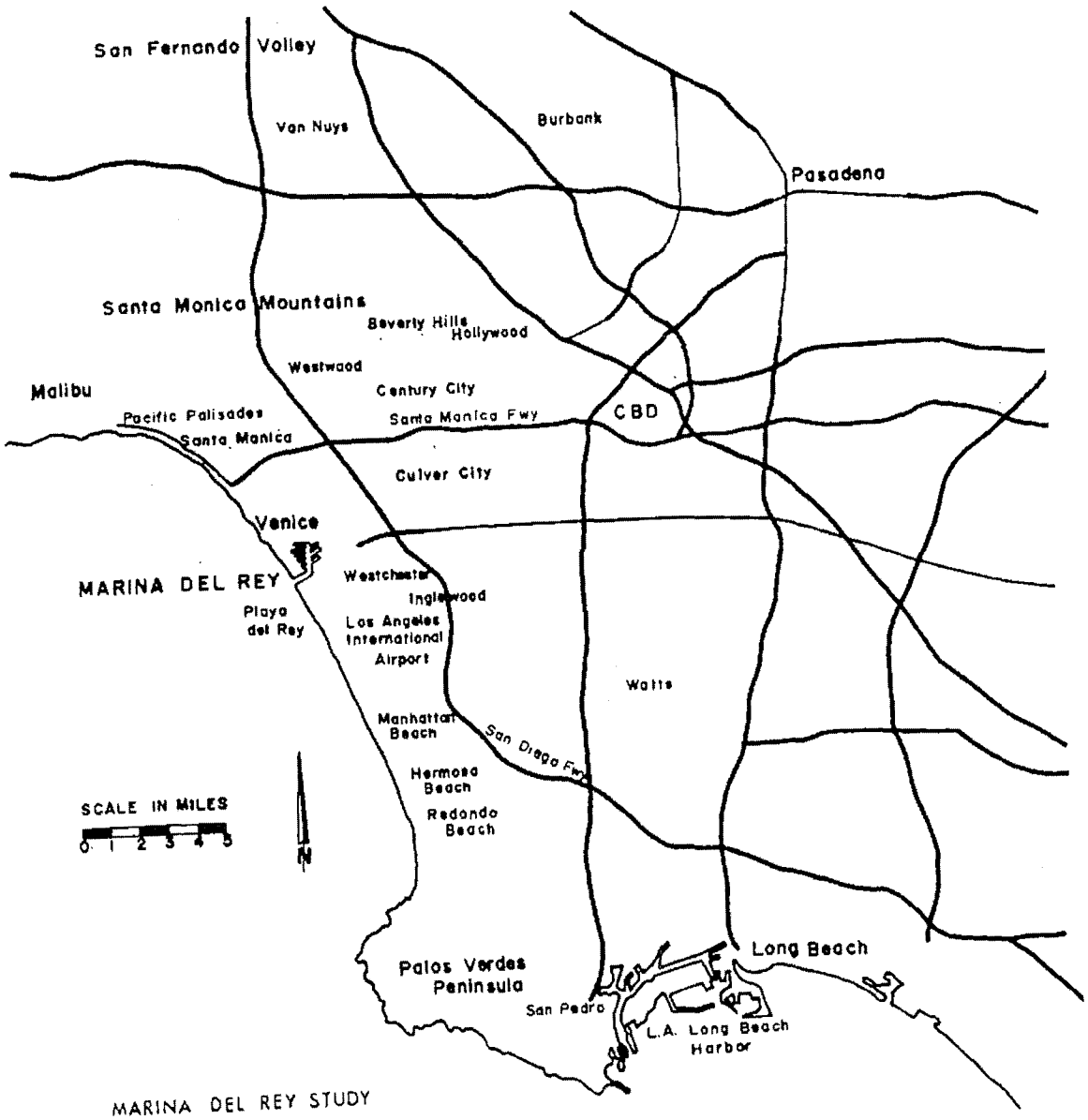
GENERAL LOCATION MAP



MARINA DEL REY STUDY
COASTAL ZONE PLANNING
AND MANAGEMENT PROJECT
UNIVERSITY OF SOUTHERN CALIFORNIA

Source: California State Division of Highways

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Moses Wicks, a real estate speculator began construction of a commercial harbor on the site in 1887. Although only 35, Wicks had been successful in land dealings after his graduation from law school and was able to capitalize $300,000 for the venture. The Santa Fe Railroad built a rail line to service the port and a pile-lined channel was begun. Construction proceeded to the point of creating a basin suitable for small boats before a collapse of the real estate market left the speculators without customers and stopped the construction.[2] The channel quickly deteriorated and the basin filled in until it was no longer naviagble.

In 1892 Abbot Kinney bagan developing the Venice area, complete with canals with the intention of replicating the character of Venice, Italy. This transformed what had been an ownerless beach into a vacation resort. Kinney remained active in the development of Venice throughout his life and was one of the successors to Wicks in encouraging the development of a harbor at Playa del Rey Inlet. His exact role here is not known, but in 1916 he made a statement of support and encouragement of the construction of a harbor in the House Document No. 1880 of the 64th Congress. This document reported the findings of the Corps of Engineers in studying the feasibility of such a commercial harbor.[3] The Corps' preliminary examination determined there was no justification for such a major undertaking. The commerce projected for such a harbor was uncertain since the site of the present area harbor at San Pedro and

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Long Beach was considered far superior. Although it was thought that a small craft harbor might be useful, there was no provision for federal participation in such a project at that time.[4] Abbot Kinney's son, Thornton, tried to encourage the construction of a naval base at Playa del Rey in 1921 but failed to gain recognition for the project.[5]

The Venice canals connected with the sea at Playa del Rey Inlet. After the construction of the Ballona Creek Flood Control Channel, tide gates into the channel became the only opening from the canals to the sea. The marshes drained into the canals and the canals into the channel.

As Venice grew, development crept southward towards Ballona Creek. Houses were built along the beach in the area known as the peninsula, so named because of the salt marshes behind the beach. A bridge over Ballona Creek at Pacific Avenue connected the peninsula with Playa del Rey. In 1930, a profitable oil well was discovered and soon 151 oil wells dotted the peninsula and the western side of the marshlands. The production of these wells decreased from a peak of 40,000 barrels a day in 1930 to 2,300 barrels a day in 1946 and their existence at that time was not seen as a serious obstacle to the construction of the marina.[6]

A proposal for a harbor was again raised in 1937 when Congress approved the Rivers and Harbors Act, Public Law 75-392, which "authorized and directed to cause a preliminary survey to be made ..." at Playa del Rey

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Inlet.[7] Before the Corps of Engineers undertook the study, they requested that a certain amount of information be provided by the community. Accordingly, the Los Angeles County Regional Planning Commission was authorized to provide the information. For the first time, the proposal was for the construction of a recreational harbor, a concept which was made possible by Public Law 72-16 which had defined the term commerce to include "the use of waterways by seasonal passenger craft, yachts, houseboats, fishing boats, motor boats and other similar water craft whether or not operated for hire."

It is not known who inspired the inclusion of Playa del Rey Inlet in the 1937 Law. By this time, however, the perceived local need for recreational facilities, coupled with the unusual suitability of the area for small craft harbor development seems to have created a predisposition for the harbor among many groups.

Basic Marina Plans

The Regional Planning Commission produced a report in 1938 which envisioned a large open body of water (435 acres) surrounded by ten smaller berthing areas created by mole type piers jutting into the central basin. It's estimated cost was $9,750,000. The harbor was to accomodate 5,000 boats and include automobile garages, parking spaces, water and electrical outlets, restrooms, yacht clubs, boat repair

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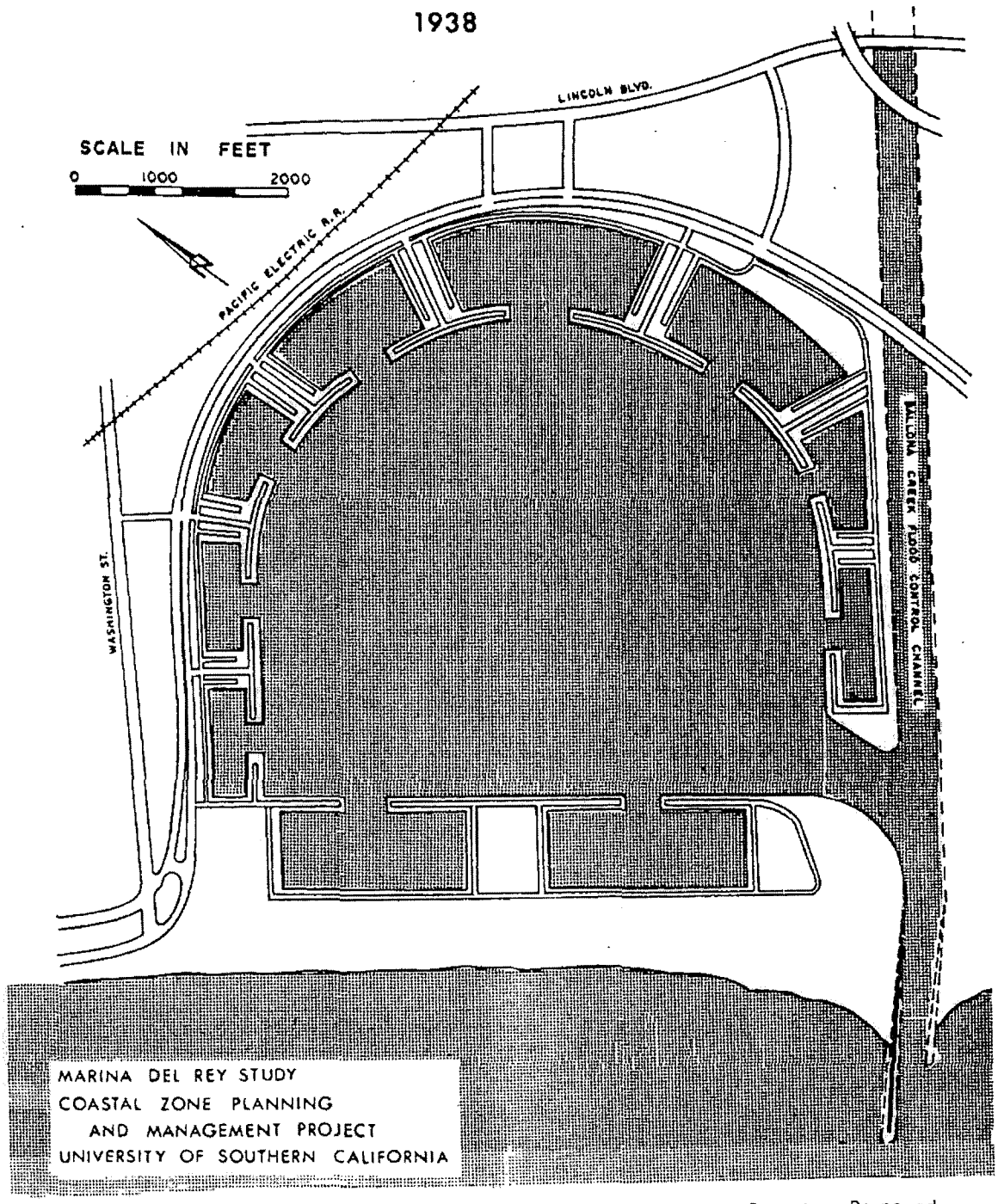
REGIONAL PLANNING COMMISSION PLAN
1938



Adapted from: L.A. County Regional Planning Commission, Report on Proposed Recreation Harbor at Playa del Rey, 1938.

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facilities, sport fishing boats, administration buildings, and possibly civic buildings such as a post office or library.[8] The physical plan was not based on thorough analysis, but was thought to be reasonable in light of the needs of the boating public. The amount of business assumed for the Marina was based on extrapolations from the demand for services at existing harbors. The final report, accompanied by a review of the findings of George F. Nicholson, consulting engineer, was completed in August 1938.[9] At this time, the Corps of Engineers was expected to begin their survey. World War II, however, delayed their action and the survey was not authorized until April 6, 1944.[10]

County plans and Corps of Engineers plans

The early plans for the marina at Playa del Rey Inlet were as speculative as the Marina itself. The plan developed by the Regional Planning Commission in 1938 and updated later as part of the Master Plan of Shoreline Development, was designed to provide needed information for the Corps of Engineers. The Corps wanted to know what kind of harbor the local community wanted. They wanted to know what activities would take place in the Marina and what interests would be served. The Corps of Engineers was unfamiliar with evaluating a recreational harbor proposal since they had been previously involved only in commercial harbor construction. Similarly, the Regional Planning Commission was not accustomed to dealing with the issues peculiar to a recreational harbor. At any rate,

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they were reacting to a particular request for information on a project which could be fit into county plans but which was not yet adopted or thought to be imminent. Their plan drawings show little regard for property lines or city boundaries. The planners seem to have assumed that much more planning would be done before any marina would be built.

The action of the Regional Planning Commission and the pending action by the Corps of Engineers probably increased in people's minds the likelihood of a marina at Playa del Rey Inlet. The Shoreline Planning Association of California urged preliminary studies for such a marina. In response, the City of Los Angeles commissioned a study of the recreational development of the Los Angeles shoreline to be done by a private consultant, Madigan-Hyland.[11] The consultant postulated the future existence of the Marina del Rey to the point of saying that it would probably be open in 1953. Again the planners assumed that someone else would do more detailed plans for the Marina. Madigan-Hyland apparently based its projections on the plan developed by the Corps of Engineers. The Corps had not published its report yet but the general plan which accompanied the Corps' findings had been drawn in 1946, so that it was available to the consultants.

The Corps of Engineers report was finally completed in 1949.[12] The major purpose of this study was to determine whether or not the federal government would participate in the construction of the Marina. For this reason its plans

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were more specific than any others had been. The plans, however, covered only the construction of the waterways and left land use and accompanying facilities out of their considerations. Only as it affected channel design did the Corps indicate the existence of boat repair yards, administration buildings and boating clubs.[13]

The harbor designed by the Corps of Engineers was similar to that envisioned by the Regional Planning Commission. There was to be a large central basin connected to the sea by a single channel. Twelve side basins with a capacity of 8000 boats would be twenty feet deep and be served by a twenty foot deep interior channel from the entrance. The rest of the water area was to be ten feet deep. The deeper areas were to be for boat repair, perhaps to accomodate larger commercial boats which would be harbored elsewhere.

Madigan-Hyland Plan.

The Madigan-Hyland plan for the coastline also was finished in 1949. Since theirs was a study of the entire Los Angeles County coast, Madigan-Hyland described the facilities to be included in the Marina primarily in relation to the entire County's coastal recreational facilities. It is not known if the consultant had been asked to determine what type of facilities should be specifically included in the Marina, or if they merely wished to influence the eventual planners of the Marina to give consideration to regional recreational needs.

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Madigan-Hyland determined the number of parking spaces needed for a marina would be 1.5 spaces for each of 80% of the boat slips plus 1400 parking spaces for the general public. They apparently felt the public should have access to the Marina even if only for sight seeing. They suggested, however, that the way to pay for such public parking would be to collect a fee at the Marina entrance. No one but a boat owner with a pass would get into the Marina without paying.

While Madigan-Hyland probably based their recommendations for land and water use on a plan similar to that shown in the Corps of Engineers Plan of 1949, it is difficult to reconcile the activities and facilities they specify with the areas provided in the plan.

The major emphasis in the report is on the 8,000 small craft to be docked in slips located within bays built around the periphery of the circular harbor. Two additional bays are planned for marine related commercial and recreational use. The support facilities thought to be required for 8,000 craft are described, but no indication is given of the space allocated for these facilities. Two of the bays shown on the plans are adjacent to Washington Street, two to Ballona Creek Flood Control Channel, three back on to the ocean beach, and only four of the remaining five bays have any contiguous land area available for the location of the 11,000 parking spaces, the marine supply stores, restaurants, bars, and retail commercial facilities which are noted as

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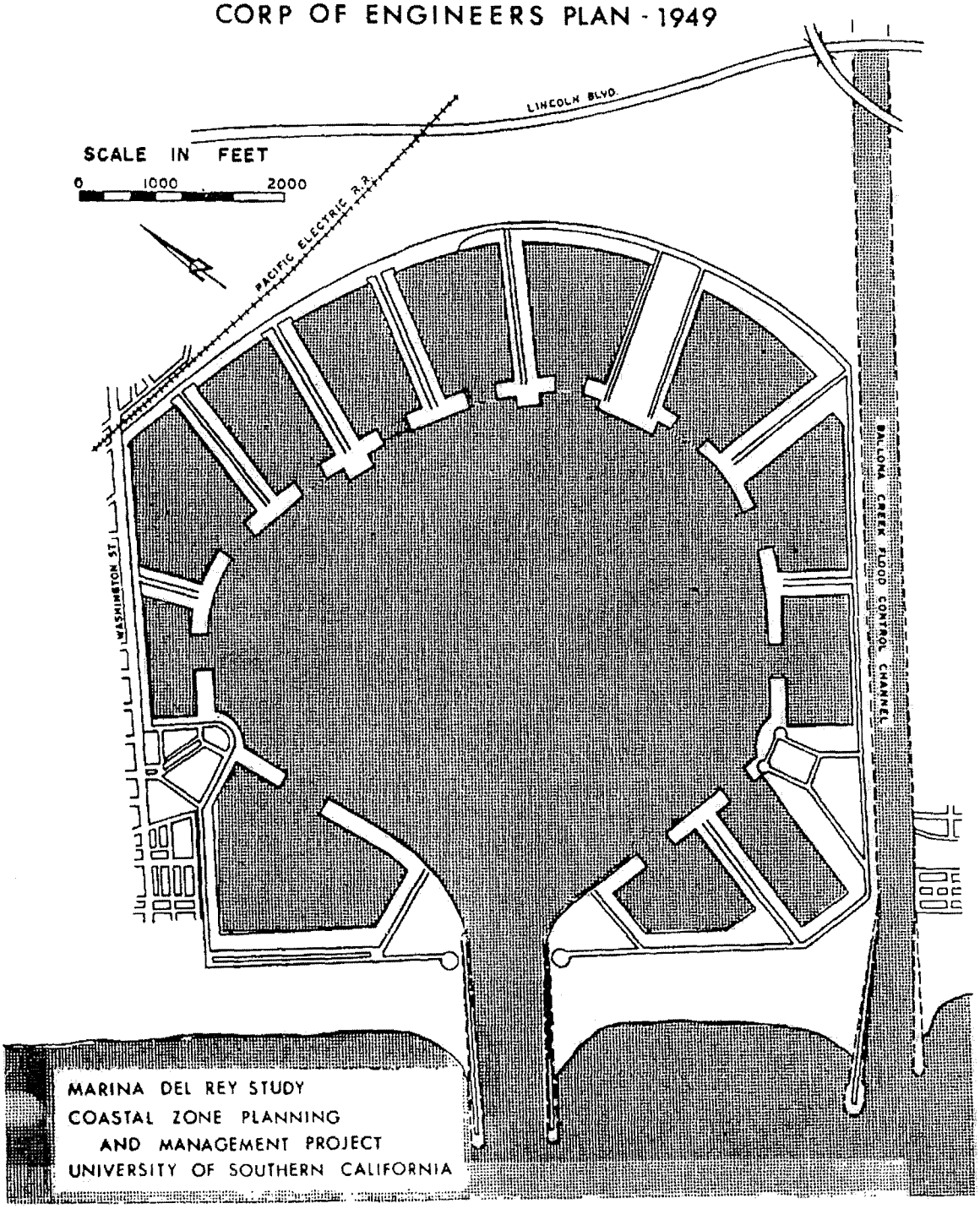
CORP OF ENGINEERS PLAN - 1949



Adapted from: U.S. Engineer Office, "General Plan of Improvement, Playa del Rey Harbor" Los Angeles, 1949.

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necessary. The area which lies between Lincoln Boulevard and the marina's circumferential road is approximately 125 acres and would be inadequate for even a small share of the facilities described.

Four of the thirteen moles shown are large enough to accomodate harbor administration and maintenance operations as well as marine repair yards, but the remaining moles are only large enough to provide for a minimal number of the storage lockers to be rented to boat owners. Space on the moles is not sufficient for the garages recommended for rental to boat owners for their cars and paraphernalia, nor is it possible to find such space within feasible distance from the slips.

Numerous other discrepancies between narrative and plan are apparent, so that it is obvious that Madigan-Hyland's textual report on the Marina, considered by itself or in conjunction with the Corps of Engineers plan for the area, cannot be regarded as a complete land use plan. Again, it must have been assumed that other agencies would complete the planning work necessary before actual construction of the Marina.

While Madigan-Hyland's report had been addressed to County coastal recreational needs, the Corps of Engineers Plan, developed at the same time, concerned only the Marina. The major purpose of the report was to present a benefit-cost analysis to justify the federal government's participation in the Marina's construction. Considering tangible benefits only, they

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estimated that the benefit-cost ratio resulting from the proposed marina development would be 1.4 to 1. Along with this figure it is mentioned that federal participation is further legitimized by a higher percentage of marina costs to be borne by local interests, rather than by the federal government. The amount necessary to construct half of the main navigational features was finally recommended as the federal government share.[14]

In 1954, Congress passed Public Law 83-780 which "adopted and authorized to be prosecuted" the recreational harbor at Playa del Rey Inlet.[15] This decision had been recommended by the Secretary of the Army on the basis of the 1949 report by the Corps of Engineers. The legislation approved federal participation in the project in the event that the local authorities decided to go ahead with it.

Nicholson's Plans

In response to the federal support provided by Public Law 83-780 the Los Angeles County Board of Supervisors hired George F. Nicholson, consulting engineer, to prepare a schematic plan for a marina accompanied by an economic feasibility study. The Nicholson plan was a radical departure from the Corps of Engineers Plan of 1949. The Nicholson Plan eliminated the large central basin which characterized the earlier plans. The basin, it was reported was not required for navigation nor would it

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be appropriate to the area the Marina was planned to occupy, a much smaller area than was previously contemplated. Also, it was thought that the mole design in the Corps of Engineers Plan would constrict the flow of water within the mooring basins.[16] Nicholson's Plan therefore, employed a straight main channel 1,000 feet wide with six side basins each 600 feet wide and one 625 feet wide. The plan was to accomodate 6000 boats in the water with dry storage for 2000. The entrance channel was moved so as to be directly adjacent to, but separate from Ballona Creek. This was done to avoid isolating a stretch of beach between Ballona Creek and the entrance channel. Ballona Creek was kept separate from the channel in order to avoid the difficult task of dismantling the existing jetty and to avoid the debris that the flood control channel carries.[17]

Beaches were planned at the end of four of the mooring basins with substantial parking areas for the public using the beaches.[18] Boat launching and boat repair also figured in the design. It was intended that motels would be located near the beaches on sites leased to private interests. Restaurants, yacht clubs, gas stations (auto and boat) and a large salt water lagoon and beach sand stockpile area completed the plan.

The radically different configuration of Nicholson's first plan for the harbor was decided upon, then, in order to provide: 1) protection against silting, 2) convenient land access, 3) reduced water contamination and 4) lower land acquisition costs.

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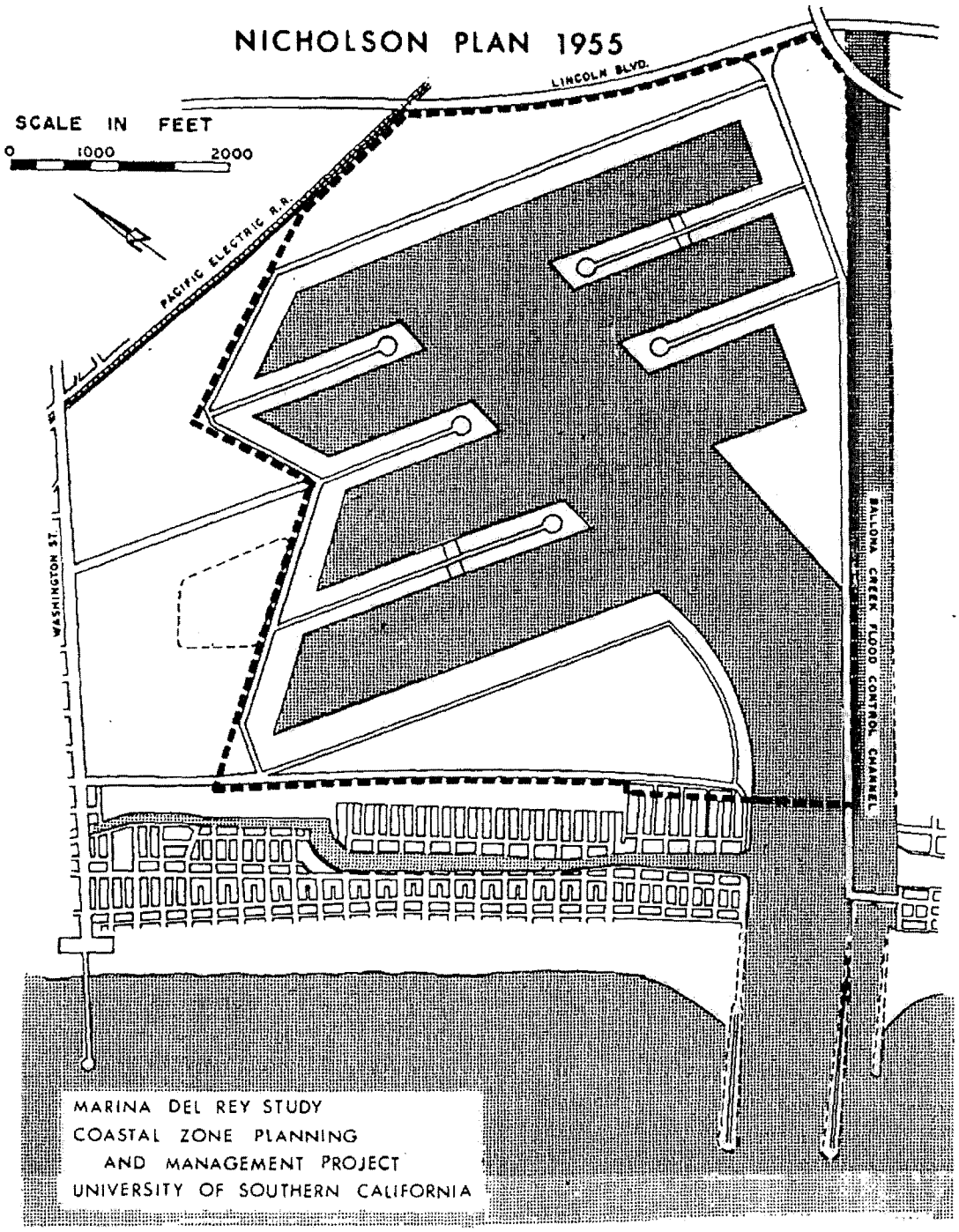

Adapted from: George F. Nicholson, Schematic Plan, Long Beach, Calif. 1955

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This plan was based on the assumption that the County could acquire all the land adjacent to and north of Ballona Creek from the ocean east to Lincoln Boulevard. A triangular parcel of land in the northeast section of the present marina which contained a salt pond was not included. The proposed boundary on the north side of the marina conformed partially to the boundary of the County of Los Angeles. The land with the salt pond, Lake Los Angeles, was within the City of Los Angeles and was used for recreation. Its cost was considered excessive and therefore it was excluded from the project area.[19]

The orientation of the side basins was determined in large part by the Venice Interceptor Sewer which ran directly across the middle of the Marina. It was planned to build the Marina in stages so that the first phase would include dredging the waterways up to the point at which the sewer line crossed the main channel. The sewer line thus ran along what was to become a mole on either side of the main channel.

The change in the basic round form of the Marina to Nicholson's design proposal did more than merely make for more efficient use of land and water area. The new design precluded the use of the Marina by small boats seeking protected waters for recreational boating. This greatly changed the character of the Marina from the traditional recreational harbor, to a berthing harbor whose waters are used only for entrance and exit. The Corps of Engineers commented on this loss of a sailing basin but said that the plan was acceptable

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if cost had to be the governing factor.

This was perhaps the first example in Marina del Rey planning in which a policy decision for the public recreation facility imitated the private market: it is expensive to build a marina, therefore it should be designed only for those who can afford such expense. The change by Nicholson's plan eliminated a large part of the boating public--those who owned small boats which are unsuited for use in the open sea. By making the Marina primarily a berthing harbor, the Plan in effect limited its use to sea-going and therefore larger, more expensive boats.

The change in the character of the Marina is never acknowledged in any Marina plan documents. No consideration is given to the fact that the change would alter the demand for launching facilities, or that it might affect the optimal boat capacity for which the Marina should be planned. Looking back, it is believed that demand for slips for large boats was being expressed then and that small boats could be accomodated at inland lakes.

This is not meant to imply that land and cost construction are not valid, but only to say that within those constraints, certain harbors are possible, other are not. If the harbor is changed, the goals and the client which the harbor is to serve should be re-evaluated in these terms. If the goals and clients change, it should be the result of a conscious

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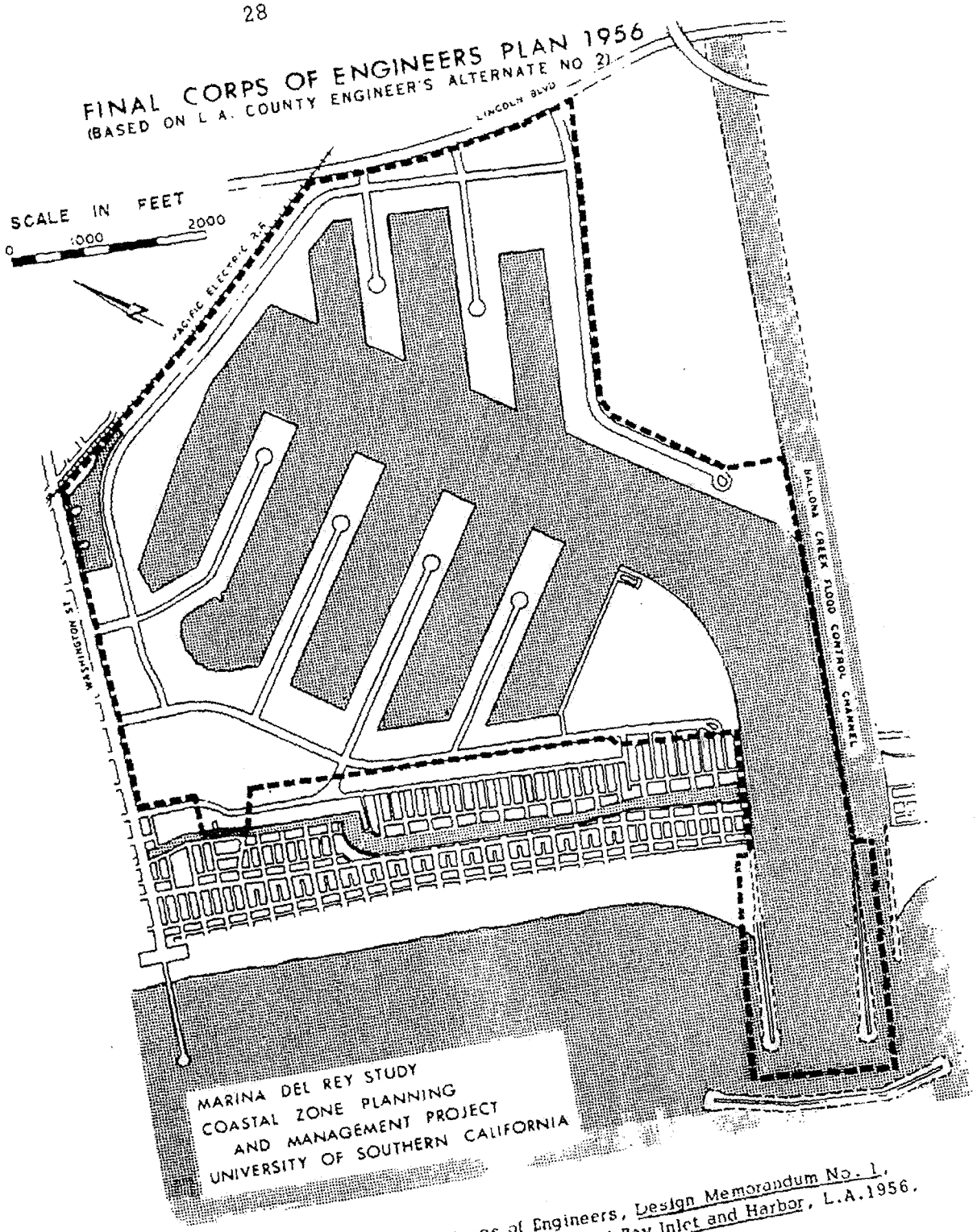

Adapted from: U.S. Army Corps of Engineers, Design Memorandum No. 1, General Design for Playa del Rey Inlet and Harbor, L.A.1956.

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policy decision rather than as an accident of design.

Nicholson submitted his plan to the County Engineers on October 23, 1955. Almost immediately the plan was revised. The Engineer's office made up three alternative plans. Alternate No. 1 was apparently very similar to Nicholson's original; Alternate No. 2 was drawn to appraise the use of additional land in the marina plan, and it conforms closely to the plan of the Marina today; Alternate No. 3 showed only two mooring basins on the east side of the main channel.[20] Nicholson was asked to render an opinion on the alternatives. He stated that he preferred his original scheme as modified by Alternate No. 1, but that Alternate No. 2 "should be given consideration if the additional land in the City of Los Angeles south of Washington Street and the Pacific Railway is added to the site."[21] He did say, however, that Alternate No. 2 would: 1) permit advantage in making street connections with Washington Street, 2) be better for boat races because the main channel is longer, 3) be added protection from southwest storms, and 4) take advantage of the salt water pond on the property on the north side of the marina.

Alternate No. 2 moved the north end of the main channel westward so that there was a sharper turn to the left when entering the marina from the sea. The channel was made wider and the side basins were changed so as to fit better in the new area. More water area was created in

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the larger plan and therefore more cost for dredging was expected. The drawing of the new plan showed no industrial area and little commercial area. Instead, the larger areas on the perimeter of the marina were designated as future residential development.

On February 21, 1956 the Los Angeles County Board of Supervisors adopted Alternare No. 2 as the plan the county intended to use. The projected public and private cost of the Marina were estimated by Nicholson to be $24,351,000 for Nicholson's Plan of 1955 and $26,188,000 for Alternate No. 2.[22,23] The increase in cost was due mainly to the greater water area and the consequently lengthened bulkheads etc. Also the increased capacity caused higher costs allotted to mooring facilities and restrooms.

Alternate No. 2 was then sent to the Corps of Engineers for approval.[24] Simultaneously a revenue bond proposal was prepared for the November 1956 ballot which would give the County the authority to issue bonds to pay for its share of the cost of the marina.

Corps of Engineers: Design Memorandum No. 1.

In 1956, the Corps of Engineers, using the County's Alternate No. 2 produced their Design Memorandum No. 1.[25] This document defined the parts of the project for which the federal government was to be responsible. It set the engineering specifications for the exact outline of the water area, the depth of the water, the type of jetty to be built, etc.

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The Memorandum reviews the discussions of cooperative arrangements between the federal and county governments which appear in House Document 389, 1954; in Public Law 83-780, 1954; and in the supporting text for Alternate No. 2. The document then defines more precisely the particular responsibilities each party would have. It also states that the federal government would pay for fifty percent of the main navigational features i.e. the main channel and entrance jetties.

The Corps of Engineers was in communication with the County government so that the County Board of Supervisors was able to adopt a resolution on October 23, 1956 (before Design Memorandum No. 1 was published in November 1956) which agreed to the terms of participation and the responsibilities which the County would have.[26]

On November 6, 1956, the voters of Los Angeles County passed a proposition allowing the County to issue revenue bonds for the construction of the Marina. The bonds were not issued until 1959, but acquisition of property and actual construction began before that. The date of the start of construction of the entrance jetties was December 1957.[27]

Before much progress on jetty construction had been made, the Corps of Engineers prepared Addendum No. 1 to their General Design Memorandum. The addendum made changes stemming from Corps observations and requests by local interests and consultants.[28] Boat launching

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facilities were moved to the basin closest to the entrance on the east side of the main channel which necessitated making that basin narrower and shorter. The basin originally intended for boat launching was made wider. No reason is given for this change. The entrance channel was made deeper to minimize the wave effect caused by shallower water near the bend in the channel. The northern edge of the water area was moved slightly to make it conform to the city-county boundary line which passed through the Marina. The road system was changed so that better use could be made of the land area in the marina. The section of the perimeter road, which ran along the southern entrance jetty and crossed Ballona Creek at Pacific Avenue was eliminated from the plan.

As construction progressed the City of Los Angeles and the County of Los Angeles cooperated to make all the land within the Marina fall under County jurisdiction. The County adopted a resolution requesting that the area at the north end of the Marina adjacent to Washington Street be put under County jurisdiction while the City passed an ordinance to remove that land from within 29 the boundaries of the city. The ownership of the land was held by the County during this entire process.

Another section adjacent to the Marina remains within the City of Los Angeles. The beachfront property all along the west side of the Marina, known as the Venice "peninsula" is within the City. The portion of the entrance channel which passes through this strip also lies within city boundaries. In this

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area, the city has adopted a special ordinance which allows the County Harbor Patrol to handle law enforcement in the channel.[30]

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FOOTNOTES

1 House Document 389, 83rd Congress, 2nd Session. Playa del Rey Inlet and Basin, Venice, California (May 1954).

2 Department of City Planning, Los Angeles, California, A History of the Venice Area, (Oct. 1969) p. 6.

3 House Document No. 1880, 64th Congress, Preliminary Examination of Playa del Rey Inlet and Basin, Venice, California, (1916).

4 House Document 389, p. 5.

5 A History of the Venice Area, p. 19.

6 House Document 389, p. 26, 27.

7 P.L. 75-392, 75th Congress, 1st Session, (August 1937).

8 Regional Planning Commission, Report on Proposed Recreational Harbor at Playa del Rey, (June 1938).

9 Venice Evening Vanguard, "The Story of a Harbor Told Chronologically," (Venice, Calif.: April 26, 1957).

10 House Document 389, p. 4, 20.

11 Madigan-Hyland, Recreational Development of the Los Angeles Area Shoreline, (New York: 1949), pp. 95-97.

12 House Document 389.

13 Ibid., Plan.

14 House Document 389 p. 6.

15 Public Law 83-780, 83rd Congress (1954).

16 George F. Nicholson, Schematic Plan, Small Boat Harbor Development, Marina del Rey (Long Beach, California: Oct. 1955) p. 2.

17 Ibid., p. 23.

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18 Ibid., p. 4.

19 George F. Nicholson, Letter evaluating Alternate Plan No. 2 (Long Beach: December 12, 1955).

20 Ibid., p. 1.

21 Ibid., p. 2.

22 Nicholson, (Oct. 1955) Schematic Plan, p. 30-32.

23 Nicholson, (Oct. 1955) Alternate Plan No. 2, p. 6.

24 Corps of Engineers, Design Memorandum No. 1, (Los Angeles: November 1956) p. 5.

25 Ibid.

26 Venice Evening Vanguard.

27 Gruen Associates, Marina del Rey: Land Use Study (Los Angeles: March 1967) mimeo 59 pp. Part I, p. 4.

28 Corps of Engineers, Addendum No. 1 to Design Memorandum No. 1 (Los Angeles: January 1957).

29 Los Angeles City Ordinance 11973 (August 7, 1961).

30 Los Angeles City Ordinance 139, 030 (September 19, 1969).

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CHAPTER III. INITIAL DEVELOPMENT (1956-1962)

Economic Studies

Along with the plans for the physical development of the Marina del Rey site, Los Angeles County asked its consultants to determine whether the project would be economically feasible and desirable for the County.[1] The major questions apparently were:

1) Is it suitable for the County to purchase land and carry out the basic public works needed for a marina at this site?
2) If the County can do this, what should its further role be in development and operation of the Marina?
3) What pattern of land and water use would be most desirable for County government and for the community as a whole?
4) Presuming that some of the funds needed for capital investment would be borrowed, how much would be required and what is the most appropriate mechanism for borrowing?

The answers to such questions depend largely on estimates made concerning capital costs, operating costs, revenues, and benefits to the community resulting from the Marina. The "opportunity costs" of benefits foregone from other projects which might have been undertaken in lieu of the Marina and from other possible internal arrangements of the Marina should also be considered.

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The first detailed economic study was conducted by George F. Nicholson, Consulting Engineer, in 1956 for the County Engineer.[2] This study displays two schematic plans, Alternate No. 2, based on a County Engineer's proposal, is much like the form of the Marina as it exists today. Costs, revenues, and benefits were estimated for a thirty year period. Two years later, Coverdale and Colpitts, Consulting Engineers, prepared a report for the Board of Supervisors. They took as given the plan presented as Alternate No. 2 in Nicholson's report and his cost estimates for it.[3] They also introduced some refinements into the long-run financial analysis. In 1959, Coverdale and Colpitts rechecked the principle data and modified some of their estimates. This later report was submitted to Stone and Youngberg, Municipal Financing Consultants in San Francisco.[4]

In 1960, Gruen Associates, Architects, Engineers, and Planners produced land use studies based on updated information concerning costs and revenues, which strongly influenced the County's leasing program.

Analysis Methods.

There are two basic ways of structuring the analysis of the desirability of any public investment. Cost-revenue analysis considers estimates of the dollar expenditures and revenues for a particular governmental unit to see if the project is financially feasible. A governmental unit often feels it can justify certain projects only if they pay for themselves. This was apparently true for Marina del Rey.[5]

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Cost-benefit analysis takes into account all of the gains and losses, intangible as well as tangible, sustained by a defined population group, such as the population of Los Angeles County. Much of the criticism of public projects such as urban renewal, highway construction, etc. results from governmental use of costs and revenues while citizens are looking at costs and benefits.

The Nicholson and Coverdale-Colpitts studies use the cost-revenue framework almost exclusively. There were attempts, in the Nicholson and the Corps of Engineers reports to identify benefits and to compute an annual benefit-cost ratio.[6] These do not appear to be serious studies. No information is provided about the methods for benefit estimation, the list of intangible benefits is obviously incomplete, and intangible costs are not discussed. Furthermore, an increase in tax revenue is listed as the major local benefit--$1,417,810 out of $1,997,886 total local benefits. But most of these taxes are merely a transfer, for County residents, from the private to the public sector. Since such a transfer does not add anything to the community well-being, it cannot be called a benefit to the County. Only taxes from visitors residing outside the County are a benefit even in this limited sense.

Unfortunately, even after it is clear that a project is financially feasible, i.e., that it will more than break even in the long run, government often

continues to make decisions about the project as if profit maximization were the only goal. It would seem more reasonable to set reaching the break-even point as a necessary condition for undertaking some projects. Beyond this point, the criteria should shift to costs and benefits for the community as a whole. The distribution of benefits among population subgoups should also be examined.

Of course we cannot ignore the difficulty of getting some projects to the break-even point. Marina del Rey was such a project. For example, in 1956 it was necessary for the Small Craft Harbor Commission to obtain a loan from the County general fund to meet cost of operations after bond requirements were met. Until 1966 it was not clear that private investors would be able to get financing for their proposed development. Today, however, the project is clearly a financial success.

Development Costs

The overall development costs for a marina depend on the size of the project and the extent to which new waterways, landforms, and structures vary from previously existing conditions. Capital costs can be divided into six categories: planning, site acquisition, basic structures, secondary structures and landscaping, buildings, and interest. The following information about the costs in these categories is taken from the Nicholson and Coverdale-Colpitts reports, the "Marina del Rey Reporter," and the "Marina del Rey Fact Sheet." Some figures are consultants' estimates and

some are actual costs. The latter were used when available since early estimates are likely to be inaccurate.

Planning. This includes all engineering, economic, and land use studies done up to 1959. Actual expenditure: $543,000.[7] The cost of later land use plans are not known.

Site acquisition. Nicholson used the County Engineer's estimate of 1954 which indicated a total land cost of $2,000,000.[8] In 1959, after acquisition, actual land acquisition costs were found to be $9,286,834 with clearance costs an additional $2,433,000.[9] Of this total, the State of California provided a loan of $2,000,000.[10] Los Angeles County paid the remainder out of its general fund. The great discrepency between estimated and actual costs was apparently due to inflation and the growing awareness of the site's potential value between 1954 and the time of purchase in 1958-1960.

Basic structures. The dredging of channels and basins, the construction of jetties, rip-rap, and mole bulkheads were estimated by Nicholson to cost $9,697,000.[11] The actual cost is not available.

A breakwater was added to the project after storms caused extensive damage to boats and slips in the winter of 1962-63. This resulted in an additional cost of $4,200,000.

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The Federal government paid a total of $4,600,000 toward dredging, construction of the main navigational features, and construction of the breakwater.[12]

Secondary structures. The estimate made by Nicholson for roads, walkways, parking areas, the boat launching facility, sewers, utilities and landscaping was $3,361,000.[13] The actual cost is not available. These publicly owned structures were paid for by County government and the revenue bond issue. The perimeter road system was paid for out of County Road funds in the amount of $775,000.

Buildings and slips. Most buildings in the Marina are owned by lessees---apartments, restaurants, stores, etc. as are all privately used boat slips. Public buildings include the administration building, Coast Guard Station and restrooms.

Up to July 1971, $105,000,000 had been invested by private developers. The County expects total private investment to reach $160,000,000 or more when all sites are being used.[14] This is vastly greater than Nicholson's 1956 estimate for private investment which was $11,747,000.[15]

Interest during construction. The Nicholson study did not include any amount for interest due on loans during the period of construction when no revenues are being received. This is properly a capital cost, as the Coverdale and Colpitts study points out.[16] They proposed that five years

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interest be included in the bond issue which is intended to cover capital costs. This amounted to $3,437,500.

Capital cost summary. It is difficult to compare categories within the cost estimates with actual costs since they have not been aggregated in a consistent manner. However we can display the total capital costs, estimated and actual, for the Federal government, the County Road Fund and Los Angeles County.[17]

	Federal	County Road Fund	County	Total
Nicholson (1956 estimate)	2,177,000		12,264,000	14,441,000
Coverdale & Colpitts (1959 estimate)	2,320,000		17,120,000	19,440,000
Dept. of Small Craft Harbors (1971 actual)	4,600,000	775,000	30,875,000*	36,250,000

*These "County costs" include the $13,000,000 in revenue bonds which is really a private investment in the Marina.

Obviously, the actual public costs are greater than early estimates. A large part of this is due to inflation but another part is the result of increased intensity of development beyond early expectations. The cost of private development, as mentioned earlier, may be 15 times as much as originally predicted. A higher investment of private funds requires a higher investment of public funds for support facilities.

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Operating costs. The annual costs to be borne by the County in operating Marina del Rey are a function of the scale and intensity of development, the range of activities occurring there, and the degree of involvement by County agencies.

Coverdale and Colpitts suggested that the Department of Small Craft Harbors limit its role to "...the administration of leases and the collection of rents, supervision of the aquatic activities, and maintenance of utilities, and that with one exception (public parking), the County will not be involved in any operation of facilities producing revenues."[18] Apparently this is the County's policy today. Therefore, public operating costs should be relatively low.

The Nicholson study listed the following annual operating costs for County government.[19]

Maintenance	39,144
Utilities	5,000
Depreciation	56,820
Administration	87,000
	$187,964

Coverdale and Colpitts' report states that the Department of Small Craft Harbors expected to spend the following amounts annually:[20]

Salaries and Wages	285,000
Other Maintenance and Operation Costs	121,000
	$406,000

This is in addition to a sum of $24,000 per year which would be used for new capital improvements.

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Coverdale and Colpitts also suggested that total capital expenditures should be increased to $450,000 to cover the cost of additional ground maintenance and the salaries of traveling auditors who would periodically examine the books of lessees.[21]

Revenues. The Marina was to receive from lessees either a minimum land rent or payment of a percentage of their gross income, which ever was greater.[22] Some direct income from parking lots, etc. would also accrue to the Marina. The County as a whole would receive sales taxes and property taxes on the "possessory interest" of the lessees. Obviously the amount of these revenues will depend on the types of enterprise which have been developed and their financial success.

The Nicholson report provides the estimates shown in the table on the next page for the Marina after all development is complete.[23]

Coverdale and Colpitts used a similar system for categorizing revenues. They did a much more thorough job of explaining how estimates were made. Their estimates for complete development, expected by 1964 are shown in the table on page 46.[24] To reduce risk to the County, Coverdale and Colpitts suggested a minimum annual rental for each lessee to be set at $.06 per s.f. of land regardless of his gross income.[25] This would at least meet the County's annual operating and interest charges.

According to a recent report of the Department of Small Craft Harbors,

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Activity	Units	Gross Income	Rate	County Revenue
Mooring slips	5,400 slips	$1,944,000	25%	$501,000
Boat storage and launching	2,000 boats stored 10,000 launching	120,000	25%	30,000
Marina chandlers		2,700,000	4%	120,000
Restaurants		2,000,000	4%	80,000
Motels	510,000 s.f.		$.15/s.f.	76,500
Boat repair	250,000 s.f.		$.10/s.f.	25,000
Sport fishing	115,000 passengers	400,000	10%	40,000
Industrial and commercial uses	2,500,000 s.f.		$.10/s.f.	250,000
Clubs	64,000 s.f.		$.10/s.f.	64,000
Trailer courts	400,000 s.f.		$.10/s.f.	40,000
Fuel sales	2,520 motor boats	252,000		12,000
Boat sales		2,000,000	3%	60,000
Permits				15,000
Public telephones			9½%	30,000
Parking	2,167 meters		$24/meter	52,000
Total annual county revenue				$1,338,500

Annual Revenue Estimates--Coverdale and Colpitts, 1959

Activity	Units	Gross Income	Rate	County Revenue
Anchorages-slips	6,100 slips	$1,976,400	25%	494,100
Boat storage and launching	3,000 boats stored 72,000 launchings	324,000	25%	81,000
Marine chandlers		1,825,000	6%	109,500
Restaurants	2 independent 4 club 20 snack bars	4,000,000	5%	200,000
Boat repair		2,000,000	6%	120,000
Boat sales	$5,700,000 sales	460,000 (commissions)	20%	92,200
Fuel sales	4,000,000 gallons		$.03/gal.	120,000
Clubs	3,200 members	576,000	15%	86,400
Cabanas	1,000 units	2,700,000	15%	405,000
Cabana-trailers	650 units	592,000	20%	120,000
Parking				304,000
Miscellaneous	39 sport fishing boats 10 stores, etc.			135,000
Total annual county revenues				$2,267,200

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revenues now exceed $3 million annually and are increasing.[26] It is interesting to note that estimates for revenues did not change as much due to the effects of inflation as did the estimates for costs. Some of this stability is due to fixed lease conditions.

Economic justification. For a project such as Marina del Rey to be financially feasible to the County on a cost-revenue basis, the sum of discounted future net revenues must exceed total expenditures.[27] This is roughly equivalent to the basic model used by Coverdale-Colpitts with respect to the bond issue. It shows that the estimated revenues for 15 years will more than repay a bond issue of $12,500,000 and compound interest of 5½% each year on the outstanding bonds.[28] At the same time a reserve fund could be accumulated from excess revenues in the amount of $1,877,000. Using another repayment scheme, if total debt service payments, interest and principle were kept level for thirty years, a reserve fund in excess of $40,000,000 could accumulate.[29] The major differences (1) between pure cost-revenue analysis and the Coverdale and Colpitts approach are the cash-flow problem which became extremely important in this case and (2) the fact that only a limited part of the costs and revenues are considered.

Coverdale and Colpitts point out that their study is based on a conservative estimate of revenues. By 1959 they had revised their revenue estimates upward so that the 15 year scheme showed payment of a $13,000,000 bond

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issue with a $4,479,000 reserve fund accumulation.[30]

Public and Private Roles

In this section, we will bring together information about public and private support of Marina del Rey development.

Federal. The U.S. Army Corps of Engineers paid for 50% of the cost of design and construction of the Marina's general navigational facilities. This includes channel dredging, jetties, and the breakwater. In addition the Corps contributes to the maintenance of these features.

The U.S. Coast Guard installed and maintains aids-to-navigation outside the channels. The Coast Guard also operates a rescue station at the Marina.

State. The State of California has supported the Marina in several ways. The first is through planning done by the Small Craft Harbors Commission and the Division of Small Craft Harbors. In 1962, they commissioned a state-wide master plan for boating facilities, which was completed in 1964.[31] Basically it is a long-range plan for Marinas as "harbors of refuge." The document also includes a survey of present and projected boat ownership and a description of existing facilities. The State also provided a loan of $2,000,000 to the County to pay part of the cost of land acquisition. These funds were provided from the State Lands Act

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Fund, which was essentially General Fund money. The loan was authorized by State Assembly Bill 1784 in 1957. The loan period is 35 years after the first payment with an interest rate of 3 percent on the unpaid balance from the time of the loan. The first payment is expected before July 1972. At least one-half of the Marina's net revenues, after revenue bond requirements are met, must be applied to this loan.

County. The total share of Marina capital costs to be paid by Los Angeles County amounts to $17,875,000.[32] Of this, $15,875,000 apparently came entirely from the County general fund. The $2,000,000 State loan is included in the amount. An additional $13,000,000 was derived from the sale of revenue bonds in 1959. A large part of the general funds were needed to cover the cost of land acquisition and clearance beyond $2,000,000. In addition, some general fund money was loaned to the Marina to meet maintenance and operating expenses when revenues were not sufficient. This amount has since been paid back. Special State legislation and a resolution of bondholders was necessary to allow the latter expenditures.[33]

The construction of the peripheral road system, which cost $775,000 was paid for out of the County Road Fund.

In addition to the capital investments listed above, the County obviously has continuing costs associated with internal operations of the

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Marina such as the provision of public services. The need for improvement of major streets near the Marina is also due in part to traffic generated by it. All such costs, whether paid by the State, County, or City must be considered in estimating the overall effect of Marina development.

The revenue bond principal and interest are to be paid off no later than October, 1999. The loan from the County general fund was to be repaid next in priority after operating and maintenance costs and bond interest payments. Presumably there is no obligation to repay the remaining County investment directly. However the estimated net increase in County taxes due to the development of the Marina may cover past and future general fund contributions by 1999. Property taxes for 1970-71 were $4,100,000 with an additional $330,000 in sales taxes and $55,000 in motel bed taxes.[34]

The revenue bond approach was approved by Los Angeles County in 1956 when two-thirds of the voters accepted a proposition stating: "Shall the Board of Supervisors of the County of Los Angeles be authorized to adopt the revenue bond method of financing small boat harbor improvements and facilities for public convenience in conjunction therewith, as provided by in Chapter 14, Part 2, Division 2, Tittle III of the Governmental Code of the State of California?"[35]

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This allows the County, after the approval of the Board of Supervisors, to sell bonds for the construction of additional marinas. The amount of indebtedness is limited only by bond buyers' willingness to invest, which is in turn dependent on the expected demand for marina facilities, the soundness of the County's proposal, and the interest rate offered.[36] However, the County can be expected to be conservative since it must be concerned with its financial rating.

Bonds for the Marina del Rey were each of $1000 denominations, carrying an interest rate of 5.6 percent. They are to be redeemed according to an increasing schedule beginning with $130,000 in 1965 and ending with $810,000 in 1999.[37]

A number of accounts were established by the Bond Resolution to assure proper financial behavior from year to year. For example, the Bond Interest Reserve Account must contain an amount "...equal to the greater of (a) $250,000 or (b) the aggregate amount of interest due and payable on all bonds at the time outstanding on the next three succeeding interest payment dates."[38] Other accounts are Bond Interest, Bond Redemption, Maintenance and Operation Reserve, Construction, State Payment, County Rental, Replacement, and Improvement accounts. In total, these requirements amounted to about $3,000,000. Funds in these accounts may be invested in general obligation bonds of the United States government.[39]

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The County may not incur additional indebtedness for development of the Marina del Rey except under specified conditions. No part of the Marina may be used by any public or private organization without compensation to the County.[40]

Private. Developers of Marina land and water facilities must obtain private financing for their projects. Some large developers may use their own resources but ordinarily they rely on lending institutions. This means that the projects must be well justified financially.

Each prime lessee obtains the use of a land and/or water parcel by competitive bid, usually for 60 years. His project must meet requirements established by the Director of the County Department of Small Craft Harbors, the County Engineer and the Marina Design Control Board. Minimum rental rates vary with the type of land or water use, but ordinarily the rate is a percent of gross receipts of the lessee. Subleases are allowed with the approval of the Director, and are quite common.[41] All leases contain provisions for periodic renegotiation in order to make adjustments for changing economic conditions.[42]

The Department of Small Craft Harbors regularly audits the accounts of the lessees to see that proper payment is being made to the County. Prices charged by lessees must be approved by the Director as being "...fair and reasonable, based on the following considerations. First,

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that the property...is intended to serve a public use and to provide needed facilities to the public at a fair and reasonable cost; second that Lessee is entitled to fair and reasonable return upon his investment..."[43]

Improvements and personal property of lessees are subject to property taxation, as is possessory interest in leases.[44]

Land Acquisition

It was mentioned earlier that the area north of the Ballona Creek Flood Control Channel was low enough so that it was susceptable to periodic flooding. For this reason much of the land there was devoted to low intensity uses such as agriculture, oil fields, and gun club hunting preserves. In addition there were many large parcels which would simplify acquisition. It is not surprising therefore that this area was often considered for a large, ocean-oriented development. Originally, the proposed small craft harbor was to have been a City and County of Los Angeles project. The Los Angeles City Council adopted a report declaring that in the publics' interest the City and Council required provision of additional small craft facilities. In 1948, the County Board of Supervisors adopted a similar resolution. It was suggested that the County proceed with initial acquisition and development of the pilot phase, within County territory. If this initial work proved successful, then a harbor authority would be created under a joint powers agreement to carry out development of the remainder of the proposed development.

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In 1949, the County began to withold from sale all property within the proposed Marina site which was taken by it because of tax delinquency.[45] It was hoped that the State would purchase the required land and lease it to the County but the State Attorney General ruled that this was not possible. In 1958, the County was able to obtain the $2,000,000 State loan for land acquisition, to augment the County's investment.

On October 23, 1956, the Los Angeles County Board of Supervisors issued a formal order instructing the County Counsel to file condemnation action on all private property rights within the approved site of the proposed Playa del Rey Inlet and Harbor.[46]

Between March 1957 and January 1963 several hundred parcels were purchased by the County. Many of these parcels were on land near the beach which had been subdivided for residential use. The larger parcels were further inland and were often owned by corporations or clubs. The latter comprise most of the total of about 800 acres.

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Land Use Plans, 1960

On May 1, 1960 Gruen Associates submitted A Development Plan for Marina del Rey Small Craft Harbor to Los Angeles County. Some revisions were made on September 15, 1960.[47] The introduction to the development plan states that, "The basic land use plan, the technical details and economic aspects of the Marina del Rey project have already been studied by the Department of Small Craft Harbors, Coverdale and Colpitts, George F. Nicholson and Associates, and the U.S. Corps of Engineers."[48] The Gruen work, therefore, is based on a study and review of previous efforts.[49] Although it is true that the outlines of the Marina, both exterior boundaries and land/water lines, were set at the time that the Gruen development plan was undertaken, and that several important land and water use policies seem to have been agreed upon by the County and previous consultants prior to Gruen's work, it remained for this plan to allocate recommended uses to specific areas; to detail the parcelling of land; to relate activities, facilities, revenue potentials, densities and circulation within the Marina; and finally, to consider the whole in relation to the surrounding area. Thus the Gruen plan is the first comprehensive land use planning effort applied to the Marina, and undoubtedly the major planning influence on its eventual development.

Leasable areas. In considering the Gruen plan, parallels naturally appear between its recommendations and those made in previous studies, referred to above. The parallels must not be drawn too closely with regard to the areas

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allocated for specific uses, since the gross areas assumed by the consultants varied somewhat.

Gross Area in Marina del Rey (square feet)

Nicholson Plan	33,715,440	50
Alternate Plan No. 2	39,988,080	51
Corps of Engineers, Design Memorandum No. 1	35,893,440	52
Gruen Associates	33,976,800	53

In their economic feasibility study, Coverdale and Colpitts did not provide a figure for gross area, but use instead figures for square feet of leasable areas.

Leasable Area in Marina del Rey (square feet)

	Land	Water	Total	
Coverdale and Colpitts	12,908,000	6,106,000	19,014,000	54
Gruen Associates	17,472,723	6,337,766	23,810,489	55

Based on a figure of 35,893,440 square feet, Coverdale and Colpitts estimated approximately 16,969,440 square feet in non-leasable area such as roads, public parking lots, public recreational areas, administration centers, etc. Gruen Associates allowed only 10,166,311 square feet to be non-leasable out of 33,976,800 square feet gross area. A few

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of the reasons that Gruen was able to reduce non-leasable area in comparison with the Coverdale and Colpitts estimate are as follows:

1. The area actually acquired was almost 2,000 square feet less than the 1958 estimate of area to be acquired.
2. Elimination of two of the three public beaches proposed in Alternate No. 2 on which Coverdale and Colpitts' recommendations are based. 56
3. Elimination of three recreational areas proposed in Alternate No. 2. 57
4. Reduction in acreage allotted to administration facilities. 58
5. A more efficient internal circulation plan which is estimated to have eliminated approximately a mile of roads.

A single factor increasing non-leasable area is public parking, for which 1,349,300 square feet is provided in the Gruen Revised Development Plan and only 1,006,000 square feet in Coverdale and Colpitts recommendation.

Thus, working with a gross area smaller by 1,916,000 square feet than the area of Alternate No. 2, Gruen Associates achieved a leasable, or revenue-producing area larger by approximately 4,791,000 square feet than that estimated by Coverdale and Colpitts, based on the Alternate No. 2.

While part of this increase may be attributable in increased efficiency of the site arrangement, a major part must be considered the result of a change in policy regarding the ratio of revenue producing use to non-revenue producing use of Marina acreage. The need to meet development

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and financing charges may have dictated this altered policy, which required the elimination of two public beaches and three recreational areas.

The Gruen land use plan. In general, the Gruen Plan is based on the standard planning policy of separation of uses. The west side of the Marina was planned for boat anchorages and related residential uses, the east side for marine-related and general commercial areas: boat launching facilities, sports fishing, piers and hotels and motels, with marine-related industrial uses located along a section of the southeastern boundary.[59] The plan, with the single exception of the remaining public beach, thus separated the activity patterns of the boat-owning and resident users of the Marina from the more casual boaters, visitors and shoppers.

Protection of slip renters and residents in the Marina from the general public was a matter of concern to several of the consultants. Madigan-Hyland recommended toll gates at Marina entrances, for which renters would have a pass.[60] Coverdale and Colpitts suggested that a curfew on the use of public parking, and thus on nonrenting members of the public in the Marina was "essential (so) that such activities of the public should not interfere with the comfort and convenience of those on leased property, especially those in cabanas and cabana-trailers, and others living on the site."[61] The Gruen approach, that of separating activities

is less rigid than either toll gates or a curfew hour, and is far more sensitive to the implications of publicly owned property.

Specific allocations of use to land and water parcels is shown on the plan, and in the accompanying tables. Some sectors of the Development Plan of more than routine interest to this study will be considered below.

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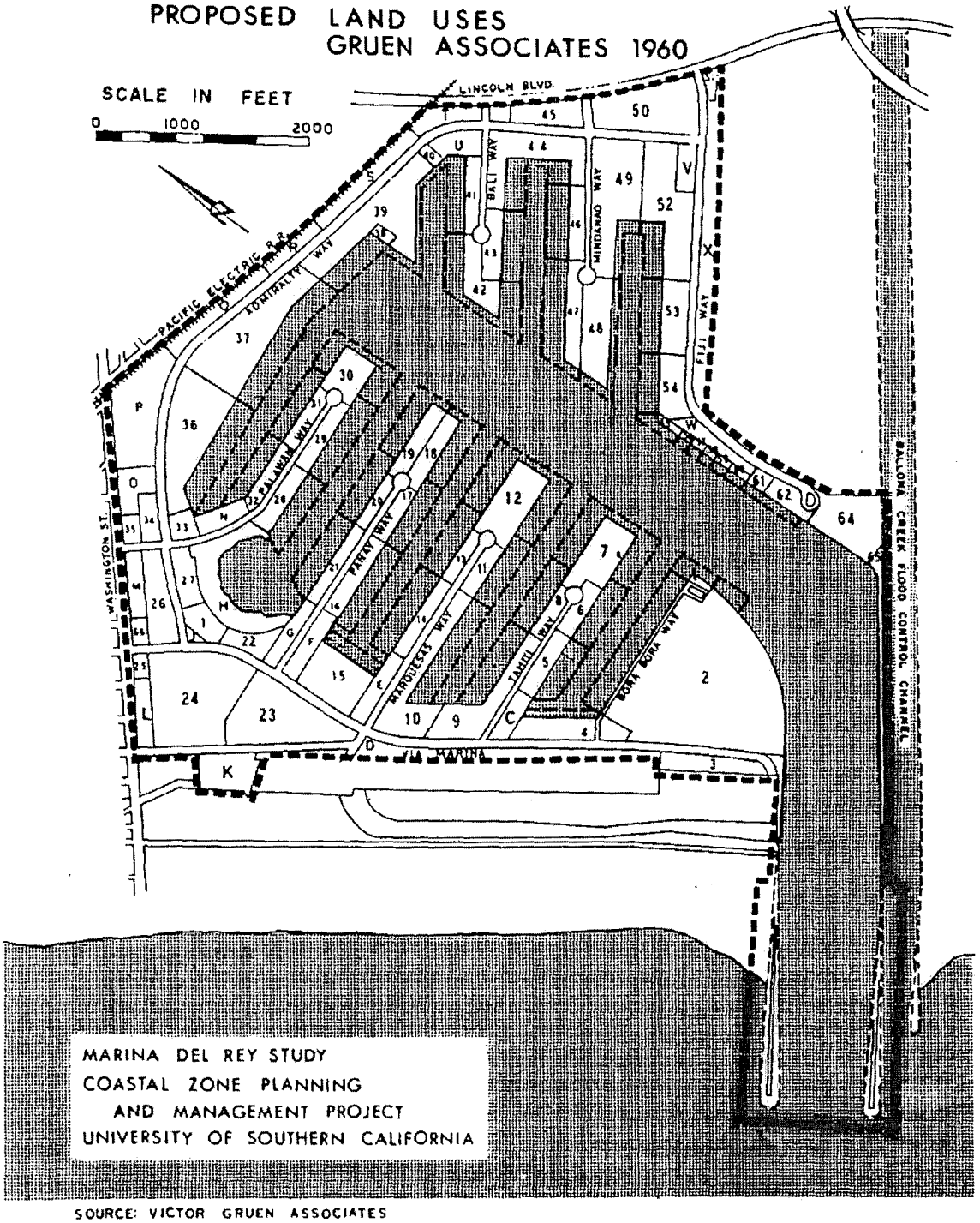

SOURCE: VICTOR GRUEN ASSOCIATES

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Proposed Land Uses - Gruen Associates 1960

Parcel Number	Land Use	Parcel Number	Land Use
1	Fuel Dock-Related Uses	2	Hotel-Motel-Restaurant-Club-Related Use Anchorage-Related Uses
3	Cabanas-Apartments	4	Boatel-Cabanas-Apartments Anchorage-Related Uses
5	Anchorage-Related Uses	6	Anchorage-Related Uses
7	Cabanas-Restaurant-Club Anchorage-Related Uses	8	Anchorage-Related Uses
9	Boatel-Cabanas Anchorage-Related Uses	10	Boatel-Cabanas Anchorage-Related Uses
11	Anchorage-Related Uses	12	Cabanas-Restaurant-Club Anchorage-Related Uses
13	Anchorage-Related Uses	14	Anchorage-Related Uses
15	Boatel-Cabanas Anchorage-Related Uses	16	Anchorage-Related Uses
17	Anchorage-Related Uses	18	Cabanas-Restaurant-Club Anchorage-Related Uses
19	Cabanas-Restaurant-Club Anchorage-Related Uses	20	Anchorage-Related Uses
21	Anchorage-Related Uses	22	Misc. Retail-Concessions
23	Motel-Hotel-Restaurant Trailer-Cabanas if Zoning Permits	24	Hotel-Motel-Restaurant Trailer-Cabanas if Zoning Permits
25	Gasoline Station	26	Hotel-Motel-Restaurant

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Parcel Number	Land Use	Parcel Number	Land Use
27	Cabanas-Coffee Shop-Misc. Retail-Concessions	28	Anchorage-Related Uses
29	Anchorage-Related Uses	30	Cabanas-Restaurant-Club Anchorage-Related Uses
31	Anchorage-Related Uses	32	Anchorage-Related Uses
33	Restaurant	34	Drive-In Restaurant, Etc.
35	Gasoline Station	36	Cabanas-Apartments-Motel Coffee Shop-Anchorage Related Uses
37	Cabanas-Apartments-Motel Coffee Shop-Anchorage Related Uses	"0"	(Add to Parcel 37)
38	Fuel Dock-Related Uses	39	Hotel-Apartment-Restaurant Marina Sales-Related Uses Anchorage-Related Uses
"S"	(Add to Parcel 39)	40	(Reserved for Fire Station)
41	Anchorage-Related Uses	42	Boatel-Cabanas-Restaurant Clubs-Anchorage-Related Uses
43	Anchorage-Related Uses	44	Portable Boats and/or Marine Sales-Related Uses Portable Boats and/or Anchorage
45	Motel-Commercial-Related Uses	46	Anchorage-Related Uses
47	Anchorage-Related Uses	48	Portable Boats (Storage & Launching) Related Uses
49	Portable Boats (Storage & Launching) Related Uses Portable Boats (Trailer Boats)	50	Shopping Center-Office Building

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Parcel Number	Land Use	Parcel Number	Land Use
51	Gasoline Station-Carwash Repairs-etc.	52	Portable Boats (Storage & Launching) Trailer Boats and/or Boat Repair-Anchorage Related Uses
53	Boat Repair-Anchorage Related Uses	54	Boat Repair-Anchorage-Related Uses
55	Fuel Dock-Related Uses	56	Sports Fishing-Related Uses
57	Sports Fishing-Related Uses	58	Sports Fishing-Related Uses
59	Sport Fishing-Related Uses	60	Sport Fishing-Related Uses
61	Restaurant & Guest Docks	62	Administration Building
64	Trailer-Cabanas-Apartments & Related Uses	65	University Boat House
66	Gasoline Station	67	Medical Building
A	Public Parking	B	Park Site
C	Public Parking	D	Buffer Strip
E	Public Parking	F	Public Parking
G	Public Parking	H	Public Beach
I	Public Parking	J	Park Site
K	Experimental Garden & Maintenance	L	Public Parking
M	Public Parking	N	Public Parking
O	Public Parking	P	Drainage Basin
Q	See Parcel "37"	R	Public Parking
S	See Parcel "39"	T	Public Parking
U	Public Parking	V	Public Parking
W	Public Parking	X	Buffer Strip

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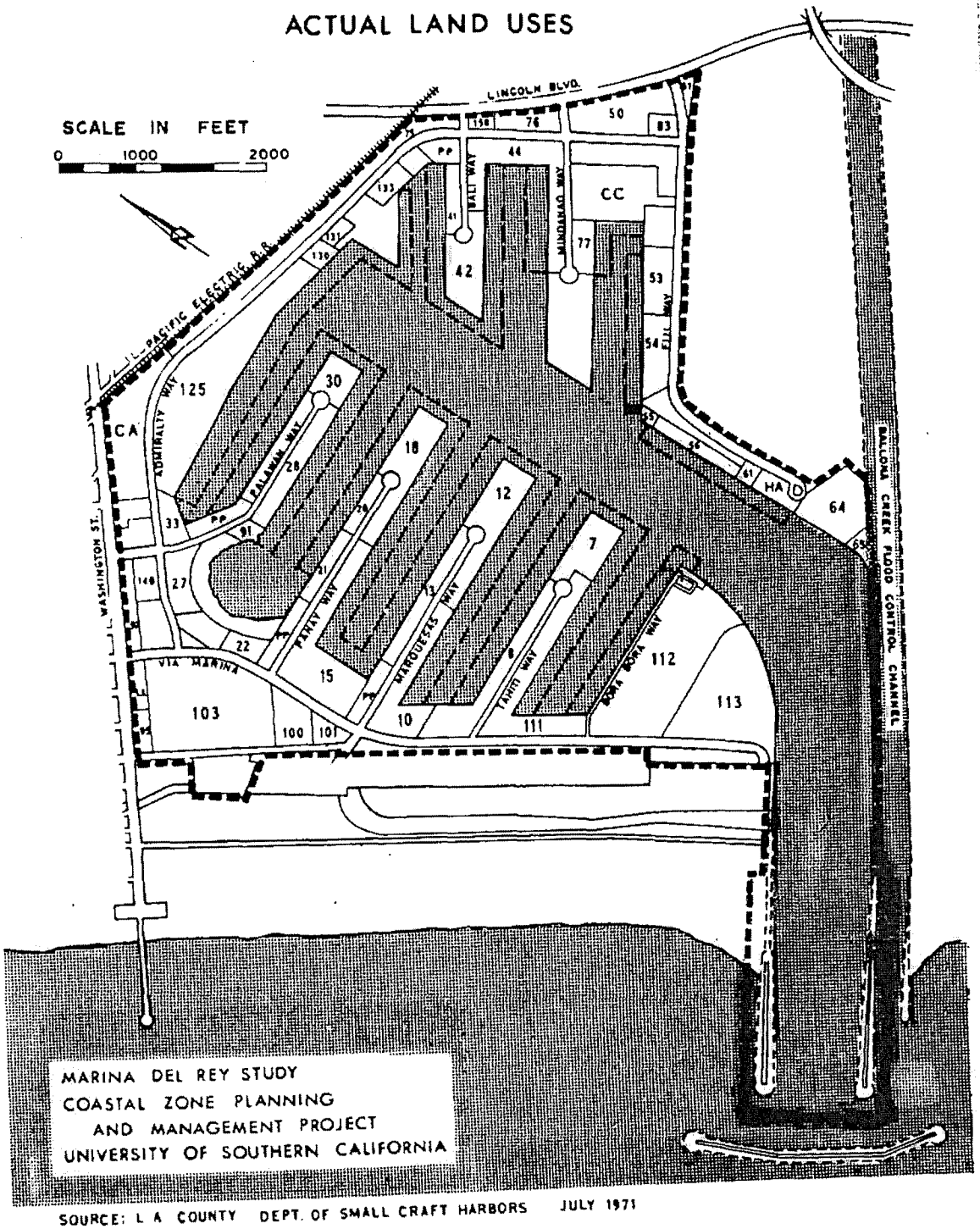
ACTUAL LAND USES



SOURCE: L A COUNTY DEPT. OF SMALL CRAFT HARBORS JULY 1971

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ACTUAL LAND USE 1971

PARCEL NUMBER	LAND USE	PARCEL NUMBER	LAND USE
1	Union Oil Marine Fuel Dock	7	Tahiti Marina
8	Islander Marina	10	Neptune Marina Donkin's Restaurant
12	Deauville Marina Captain's Wharf Restaurant	13	Villa Del Mar Marina
15	Bar Harbor Marina	18	Dolphin Marina Randy Tar Restaurant
20	Trade Winds Marina Pacific Mariners Yacht Club	21	Holiday Del Rey Marina
22	Foghorn Harbor Inn Chuck's Steak House	27	Jamica Bay Inn Kelley's Steak House Marina Area Chamber of Commerce
28	Mariners Bay Slip Rental Venice Yacht Club	30	Del Rey Yacht Club
33	Lobster House Restaurant	41	Del Amo Marine Center
42	Marina Del Rey Hotel Windjammer Restaurant Don the Beachcomber	44	Cyrano's Restaurant Corinthian & Windjammers Yacht Club Santa Monica Yacht Club
50	Marina Shopping Center U.S. Post Office Mr. "D" Restaurant Marina Del Rey Theater	51	Union Oil Service Station
53	Chris Craft Pacific	54	Windward Yacht & Repair
55	Union Oil Marine Fuel Dock	56	Fisherman's Village El Torito Restaurant Port D' Italy Restaurant

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PARCEL NUMBER	LAND USE	PARCEL NUMBER	LAND USE
61	Pieces of Eight Restaurant	64	Villa Venetia Apartments
65	U.C.L.A. Boat House	75	Del Rey Professional Building, Bird Conservation Area
76	Airport-Marina Freeway Building	77	Stor-a-Boat
83	Central Directory East Entrance	91	Sail Boat Rental/Storage
95	Bratskeller Restaurant	97	Shopping Center West
100/101	Del Rey Shores North/South	103	South Bay Club Apartments
111	Marina Point Harbor	112	Pacific Harbor Apartments
113	Mariners Village	125	Marina City Corporation Second Storey Restaurant The Basement Discotheque
130	Charley Brown's Restaurant	131	The Fiasco Restaurant
132	California Yacht Club	133	Surety National Bank The Warehouse Restaurant
140	The Admirality Apartments	150	Marina Federal Savings & Loan
BB	Loyola Boat House	CC	Launching Ramp
LL	Central Directory-North Entrance	PP	Parking
HA	Harbor Administration U.S. Coast Guard	CA	Conservation Area

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Residential uses. Probably the greatest deviation in the Marina as planned from the Marina as developed appears to be in the very large number of permanent residents living in Marina apartments. By the end of 1970 there were 2,223 residential units at the Marina, with 5,095 planned for completion by mid 1972. Yet apartments were not mentioned in any of the consultant work of preliminary planning for the Marina. Rather, "cabanas" were considered feasible.

Alternate No. 2 shows the moles and basins surrounded by areas labelled "future residential development." Indeed Nicholson's criticism of the scheme included the comment that, "There appears to be an overemphasis on residential development and insufficient areas set aside for commercial and recreational development."[62] Yet, in Nicholson's work, only motels and trailers are mentioned as residential units. Presumably the Marina was to be surrounded by a most extensive trailer park.

Coverdale and Colpitts include only cabanas and cabana trailers as residential units. They describe cabana areas as available for "living quarters such as are provided in motels as well as in individual cabanas."[63] Cabana trailer areas are "not in the nature of trailer parks. They are not intended for the itinerant trailer owner. The trailer, once located at the site, must remain there."[64] Coverdale and Colpitts make it clear that the majority of occupants of both areas are expected to be permanent residents: they provide no recommendation for trailer parks.

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Gruen Associates include motel-hotels, boatel-cabanas and trailers in their categories of living accomodations in the Marina, with varying densities and height limitations assigned to them.

Much of the consultants' seeming confusion in defining residential structures, as well as their omission of apartments from approved land uses, stems from legal advice provided to the County to observe caution in locating apartments in the Marina. It was uncertain at that time that apartments would be considered a proper use of public land acquired for a small craft harbor.[65] This made it difficult to obtain title insurance for apartments.

Gruen handled this problem by categorizing residences as boatels or cabanas which are "primarily a home ashore for persons spending as much time afloat as possible."[66] Height regulations for these living accomodations were three stories when located at either end of a mole. The central sections of moles were reserved for anchorages and related use. Structures on parcels located between the western Marina boundary and the peripheral road had no height limitations applied to them. Suggested uses for these parcels were motels, hotels, and cabanas and varying densities were supplied for each of them. All parcels at the north end of the Marina were similarly zoned and unrestricted as to height. Apartments were not mentioned in the May 1, 1960 plan.

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Among the revisions to the original Gruen development plan, submitted in September of 1960, the word "apartment" was added to the suggested uses for six parcels, all except one located in the northern and western areas enjoying unrestricted height zoning. Because of the definitions used, the varied density regulation, and the distribution of height restrictions, no changes were necessitated by the addition of the apartment category. In effect, it had already been provided for.

This initiation of approved locations for apartments began a broadening policy for this use so that, at present, apartments fill most of the parcels in the northern and western sections on both mole and peripheral locations. There are no cabanas, cabana-trailers or house trailer parks in the Marina.

Non-revenue producing areas. In 1960, when the Gruen plan was presented to the County, the most urgent consideration for the Marina was to insure that it produced enough revenue to meet the financial obligations incurred by the bonds. The plan is responsive to this pressure. Gruen Associates have worked toward minimizing non-revenue/productive land and water area in relation to areas planned for uses which would return a profit to the County. 67

It would be poor government policy, however, to exclude the general public entirely from a recreational project acquired and developed in large part with

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public funds. Gruen Associates recognized the problem of establishing a balance between the County's financial responsibility to private investors and its need to satisfy some recreational demands for the general public.

In essence, the Gruen approach to this problem was to require that by efficiency, by good planning practice and by closely administered controls, a minimum area allotted for public use would return a maximum satisfaction of public demand.

Parks and recreation: Of the total 17,472,723 square feet of land in the Marina, Gruen allocated approximately 2.2% for "Parks and Recreation" (Including Beach, Buffers, etc.) as follows:[68]

Parcel	Use	Development Plan (May 1960)[69]	Revised Development Plan (Sept. 1960)[70]
B	Park Site	18,000 sq. ft.	14,725 sq. ft.
D	Buffer Strip	43,000 sq. ft.	14,863 sq. ft.
H	Beach	380,000 sq. ft.	280,604 sq. ft.
J	Park Site	17,200 sq. ft.	18,170 sq. ft.
X	Buffer Strip	59,800 sq. ft.	62,797 sq. ft.
	Total	518,000 sq. ft.	391,159 sq. ft.

A serious effort is given to making this small area an effective increment in the development plan.

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Los Angeles Lake, a salt water lake of approximately 364,000 square feet included in Alternate No. 2 provides the largest area in the Marina for public recreation. Every square foot is planned for use; a sand beach and picnic area, calm water for swimming bordering the beach, and for sailing dinghy-size boats in the wazer between the basin docks and the swimming area make up the facility. Two motels are placed to border the beach. A launch area is provided on the beach for hand-carried small boats. Two of the four public restrooms in the entire Marina are located here. Concessions provide rental boats, sailing instruction and refreshment and the whole is supported by 392,040 square feet of parking area, enough for 1150 cars.

Landscape areas: The importance of creating attractive surroundings in the limited areas open for public use is underscored in the Gruen plan. Public parking lots are to include planting areas. Buffer strips bordering the peripheral road are to be landscaped, as is a small site at the main entrance, where a memorial plaque will provide a theme center. A tiny park located on the main channel will provide a pleasant site for boat watchers. Parcels for private use bordering the peripheral road carry mandatory landscaping provisions. Planted divider strips on public roads, underground utility lines, strict sign controls, architectural and design review of all structures, and the prohibition of any curb parking would work together to provide a pleasant prospect for the visitor wherever he was permitted to travel within the Marina.

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Planting charts and detailed design diagrams for public areas are included in the plan. Recognizing the difficult soil and climate conditions for planting, Gruen proposed an experimental nursery to develop hardy stock for supply to landscaped areas. All of these provisions lie within the control and are the responsibility of the Marina. Gruen emphasizes that proper design and maintenance of public area "will contribute much to the enjoyment of the Marina and act as an incentive to lessees to provide equally pleasant facilities."[71]

Unfortunately, the plans for beautification of public areas remain largely unfulfilled.

Portable boat launching: Unlike other consultants, Gruen Associates did not believe that portable boat launching would be a remunerative use of Marina land. They foresaw that the amount of space on land required to park cars and trailers, and the amount of protected water area required for boat maneuvering and boats waiting for retrieval would be extremely expensive in terms of Marina resources. Nonetheless they recognized that, as with public recreation areas, this demand from the non-renting general public would have to be met to some extent. In the Gruen development plan 1,197,800 square feet was allocated for portable boat facilities.

After submission, the original plan was evaluated by the Department of

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Small Craft Harbors in consultation with Coverdale and Colpitts, economic consultants, as well as Gruen Associates, the authors of the Plan. Replies from more than 200 questionnaires, mailed by the County to prospective lessees for Marina parcels, were examined and considered. The changes made to the original plan were minor, such as the provision for three gas stations rather than two, or revised areas for specific parcels. All of these changes are reviewed in A Development Plan: Revised, submitted by Gruen to the County on September 15, 1960 which, together with the original Plan, constitute the final Master Plan for the Marina.

The provisions for portable boat launching submitted in the original Development Plan met with the criticism that there was more demand for portable boat launching than the plan provided for. Gruen did not accede to the demand but recommended instead that optional use for portable boats be added to the approved uses of two parcels in an adjoining basin. This was done, but the demand for portable boat launching facilities has never been great enough to require more than the facilities originally provided. This is generally attributable to boating conditions at the Marina. Neither the crowded Marina channels nor the often rough open ocean immediately beyond the breakwater provide suitable conditions for sailing boats under 15 feet in length. Fishing in the area is poor and no protected space is allotted for waterskiing.

Conclusions. It is difficult to retain much flexibility in land uses, short of

rebuilding, for a limited area requiring a high intensity of uses such as the Marina. Only two possibilities for flexibility were noted in the Gruen development plan: the first was for portable boat launching facilities, and the second for public parking, which was provided on a generous basis with the comment that any excess could easily be converted to other uses, should the need arise.

The economic necessity which precluded large areas for public use, and required intensive private development of revenue productive areas in the Marina was effectively met by the Gruen plan. It is the achievement of this goal which will make it most difficult to change activities and clients for the Marina when the priorities of needs are seen to change. Rebuilding may take place in private leaseholds at any time. However, increases in public space can be expected only when the Marina's debts are paid, and the demands of the general public can be accorded equal importance with those of private investors.

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FOOTNOTES

1 The earlier Corps of Engineers reports had been oriented toward the concerns of the federal government.

2 George F. Nicholson and Associates, Marina del Rey Economic Study (Long Beach, California: 1956).

3 Coverdale and Colpitts, Report on the Economic Feasibility of a Proposed Marina del Rey Small Craft Harbor at Los Angeles, (New York: 1958).

4 Coverdale and Colpitts, Supplementary Report (New York: 1959).

5 There are public projects which are carried out without regard to the ability to repay costs, e.g. in public schools, hospitals.

6 Nicholson (1956) p. 76.

7 Coverdale and Colpitts (1959) Tabulation 2 (Revised).

8 Nicholson (1956) p. 66.

9 Coverdale and Colpitts (1959) Tabulation 2 (Revised). A discussion of the land acquisition process may be found in the next section of this paper.

10 "Marina del Rey Reporter" (September 1970) p. 3.

11 Nicholson, p. 60-61. Note that all Nicholson's estimates include a percentage for contingencies and engineering design (p.72).

12 "Marina del Rey Reporter" (Sept. 1970) p.3.

13 Nicholson (1956) p. 60-61.

14 "MdR Fact Sheet" (July 1971).

15 Nicholson (1956) pp. 60-61.

16 Coverdale and Colpitts (1958) p. 50.

17 See Nicholson (1956) p. 66; Coverdale and Colpitts (1959) Tabulation 2 (Revised); and "MdR Reporter" (Sept. 1970) p. 3.

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18 Coverdale and Colpitts (1958) pp. 21-22. Currently, this County also operates the portable boat launch facility.

19 Nicholson (1956) p. 57.

20 Coverdale and Colpitts (1958) pp. 48-49.

21 Coverdale and Colpitts (1958) pp. 21-22,

22 The leases are usually for a 60 year period with terms subject to renegotiation after 10 or 21 years and every 10 years thereafter, depending on the amount of lessee investment.

23 Nicholson (1956) pp. 41-50.

24 Coverdale and Colpitts (1958) pp. 26-47 and Exhibit 3; Coverdale and Colpitts (1959) Tabulation 3 (Revised).

25 Coverdale and Colpitts (1958) p. 24.

26 "Marina del Rey Fact Sheet" (July 1971).

27 This criterion is often written as:

$$\sum_{t=0}^{T} \frac{R_t - C_t}{(1+i)^t} > C_o$$

C_o: initial investment
C_t: annual costs, year t
R_t: annual revenues, year t
i: market interest rate
T: last year of planning period

28 Coverdale and Colpitts (1958) p. 53 and Exhibit 5.

29 Ibid., p. 53 and Exhibit 6.

30 Coverdale and Colpitts (1959) Exhibit 5 (Revision No. 2).

31 Leeds, Hill, and Jewitt, California Small Craft Harbors and Facilities Plan (San Francisco: 1964). This study was supported by a "701" planning grant to the State from the U.S. Department of Housing and Urban Development.

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32 "Marina del Rey Reporter" (Sept. 1970) p.3.

33 County of Los Angeles, Department of Small Craft Harbors, "Summary of Experience in Small Craft Harbor Planning and Operation," (1966), p. 5.

34 Los Angeles Times, "Richer, 'Fatter Marina' Marina Seen By Chace in '72," (December 19, 1971).

35 Board of Supervisors, County of Los Angeles. Marina del Rey Revenue Bonds of 1959 (Los Angeles: September 8, 1959; amended September 15 and November 10, 1959) p. 1.

36 Note that revenue bonds normally carry a higher interest rate than general obligation bonds since the former depend on the success of a single project rather than the "full faith and credit" of the County.

37 Ibid., p. 7.

38 Ibid.,p. 8.

39 Ibid., p. 16.

40 Ibid., p. 15

41 Standard lease form for parcels in the Marina del Rey Small Craft Harbor (n.d.).

42 Los Angeles County, Department of Small Craft Harbors, Information for Bidders, Revision (December 1961).

43 "Standard Lease Form," (n.d.) p. 18.

44 Los Angeles County, Department of Small Craft Harbors, Information for Bidders, Revision (December 1961).

45 Venice Evening Vanguard, "Story of a Marina..." (April 26, 1957).

46 Corps of Engineers, (1956) p. 22.

47 Gruen Associates, Planning & Design, A Development Plan for Marina del Rey Small Craft Harbor (Beverly Hills, California: May 1, 1960) and Development Plan, Revised, for Marina del Rey Small Craft Harbor (September 15, 1960).

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48 Gruen Associates (May 1, 1960), p. A.

49 Ibid.

50 Nicholson (1956) p. 78

51 Ibid.

52 Corps of Engineers, Design Memorandum No. 1 (Los Angeles: November 1956) p. 8.

53 Gruen Associates (May 1, 1960) p. L.U.-1.

54 Coverdale and Colpitts (1958) Exhibit 2.

55 Gruen Associates (May 1, 1960) p. L.U.-2.

56 George F. Nicholson, Small Boat Harbor Development, Marina del Rey, Alternate Schematic Plan No. 2 (Long Beach, California: 1955) 6 pp. mimeo.

57 Ibid.

58 Gruen Associates (Sept. 15, 1960) p. 5.

59 Gruen Associates (May 1, 1960) p. L.U.-26.

60 Madigan-Hyland, Recreational Development of the Los Angeles Area Shoreline (1949) p. 95.

61 Coverdale and Colpitts (1958) p. 23.

62 Nicholson, Alternate No. 2 (1955) p. 2.

63 Coverdale and Colpitts (1958) pp. 39-40.

64 Ibid., p. 41.

65 Interview with Mr. Ben H. Southland, Gruen Associates, Nov. 19, 1971.

66 Gruen Associates (May 1, 1960) p. L.U.-23.

67 Ibid., p.L.U.-35.

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68 Ibid., p. L.U. -20.

69 Ibid., pp. L.U. -31-32.

70 Gruen Associates (Sept. 15, 1960) pp. 31-32.

71 Gruen Associates (May 1, 1960) p. L.D.-2.

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CHAPTER IV. LATER DEVELOPMENT (1962-71)

The Critical Period

The County's economic consultants had been optimistic about rapid development of Marina enterprises after the basic and secondary public improvements were complete. Nicholson's schedule indicated full private development almost immediately.[1] Coverdale and Colpitts expected this to occur after three years of operation.[2]

However, private development was limited at first. The Marina was opened to boat traffic in the summer of 1962. The Coverdale and Colpitts prediction, upon which the bond repayment schedule was based, implied that total annual County income would reach $2,000,000 by 1965. Actually, income in the fiscal year 1965-66 was only about $1,000,000. This was not sufficient to meet the minimum operating expenses and debt service requirements.[3] The Marina had to borrow $500,000 over a three year period from the County general fund to meet its obligations. As mentioned earlier, State legislation and a resolution of bondholders was required to do this.[4]

Unfortunately, this situation was not just a matter of slow response to the part of private developers. There had been some fundamental problem which jeopardized the overall success of the Marina project. The most dramatic problem was the "surge" problem which began soon after the Marina opened, but became especially difficult in the winter of 1962-63. Apparently, storms in the Pacific produced high waves which entered

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through the wide entrance channel. Furthermore, the waves were augmented by reflection from the channel walls. The most critical wave action occurred in the side basins nearest the entrance.[5]

Considerable damage was done to boats and slips at this time. Ultimately about $5,600,000 in damage suits were threatened against the County.[6]

In addition, it was reported that:

> Reputable waterfront contractors have refused to accept even temporary responsibility for construction in the interior basins until positive protection of the harbor is in place. Maritime insurance agents are refusing to write hull insurance for boats berthing in the harbor. Property damage insurance recently has increased significantly for Los Angeles County lessees. Manufactures of floating equipment are refusing to guarantee their protection against wave conditions in Marina del Rey.[7]

Still, ultimately, only one settlement for $50,000 and another of unknown amount were paid.[8] These events discouraged potential developers of both water and land oriented enterprises. Fortunately the Corps of Engineers was already considering studies of the Marina using a scale model and wave action machine.[9] These studies were soon complete and recommendations were made. The Corps proposed the construction of a breakwater across the channel entrance and the sealing of the south jetty. This was expected to reduce the maximum wave height within the Marina to two feet.[10] The cost was about $4,600,000, with equal shares paid by Federal and County governments. By 1956, this project was completed and has apparently been successful in eliminating the surge problem.

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Another environmental problem was particularly apparent at that time. Heavy concentrations of "red tide" made up of algae which discolor the water, have an unpleasant odor, and can poison fish and shellfish, appeared all along the coast and affected the Marina area.[11] No cure has been found for this periodic phenomenon although there have been no serious "red tides" recently.

During the "critical period", title companies were being cautious about insuring titles to land leased from the County. The terms of the revenue bond resolution required "active public use" of the Marina by sublessees. This was interpreted to mean that subleases for questionable uses could not be written for periods longer than one year and that the County could require a 25 percent annual turnover in sublessees.

An additional expense for lessees also appeared with a ruling from the Los Angeles County Tax Assessor that the land they had leased, as well as the structures they owned would be subject to property tax. A tax on "possessory interest" in leased land had to be paid by each lessee. This resulted in property taxes said to be about 60% higher than the amounts anticipated at the time leases were signed.[12]

All of these factors combined to put many lessees in financial jeopardy. In May 1962, the Marina del Rey Lessees Association was formed to see what could be done. At this time some lessees were ready to cancel

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their contracts, preferring to take their losses rather than incur greater losses under the undue hardship conditions which they perceived.[13] Later they met with the Los Angeles County Assessment Appeals Board and worked out mutually acceptable arrangements. This led to some reduction of the possessory interest tax based on the time remaining on leases.

By 1967, most Marina problems had been resolved, consumer demand had increased and considerable new development had taken place. Revenues were sufficient to cover current costs, interest on bonds, and to retire bonds according to the required schedule. The period from 1962-67 had been a difficult one. During this time, much of the negotiation with lessees about private development took place and the policies established then continue to affect current decisions.

Land Use Plan 1967

In 1967 Gruen Associates completed a revised Land Use Study.[14] This was a review of Marina development that had taken place, under the original Plan, an evaluation of problems then current, and an examination of alternative planning strategies for the solution of those problems.

When this Land Use Study was begun, the Marina was still in a critical period of economic development. Revenues were not sufficient to cover bond payments as well as operating expenses.

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Income Statement

Fiscal Year 1965-66 [15]

Gross rents	$1,095,851
Small Craft Harbor Expenses	724,068
Net Income	371,783
Bond Payments	$ 728,000
Deficit	356,717

According to the data then available to Gruen, the deficit was expected to drop to $175,000 for the fiscal year 1966-67, and to $100,000 the following year. It was expected that after 1968, loans from the County general fund would no longer be needed to meet the deficit.[16] It is clear, then, that the highest priority in planning for the Marina had still to be given to its potential for revenue production.

Leasing problems. Many of the difficulties which slowed the development of the Marina were discussed in the previous section of this chapter. The result of these difficulties was a period of low return from under-developed County real estate resources which extend for a longer period than had been anticipated.

In 1967, 53 leases for Marina land had been awarded, and 17 parcels still remained unleased and vacant.[17] In terms of development, only 35 parcels were considered to be fully developed: 10 leased parcels were vacant and 12 were only partially developed.[18] The 17 unleased

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parcels were, of course, vacant. The visible effect of 39 empty or underdeveloped parcels on the Marina was to give it a dispersed and under-used appearance discouraging to investors.

County leasing arrangements for Marina properties stipulated three levels of rent which might be paid. The lowest rent was "holding rent" based on 1/3 of the specified square foot rent for a parcel. It was intended for the initial period in which the leased parcel was either undeveloped or under construction. In either case the parcel was incapable of producing a return for the lessee.[19]

"Square foot rent," sometimes called "minimum rent", was to be charged when construction was complete. The facility on the parcel was assumed to be in operation, but not yet successful. Each parcel was assigned a minimum square foot rent for land which varied, according to location and use, from 6 to 30 cents per square foot.[20] It was hoped that minimum rents would cover all costs to the County, including financing costs, for the operation of the Marina.

The normal return to the County was from "percentage rents", based on percentages of gross receipts earned on each successful parcel.[21] The specific percentage to be charged varied according to the type of business in which the lessee was engaged. Originally, the percentages of gross receipts to be charged ranged from 5% to 25%.[22] This schedule was revised in 1961 to range from $1\frac{1}{4}$% to 20%.[23]

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Rents for each developed parcel were to be based on either square foot rents or percentage rents, whichever was greater, thus insuring that the County would cover its costs as soon as a parcel moved beyond the holding rent stage of its operation. Time limits for paying holding rents were specified in leases.[24] Had these time limits on holding rents been strictly enforced, Marina deficits would have been reduced, if not eliminated. General economic conditions, financing difficulties and the threat of lessee withdrawal made it impolitic to insist on these time constraints.

In 1967, 41 parcels in the Marina had been leased.[25] Eleven of the 41 were paying percentage rent, indicating a profitable operation for the County. Ten parcels were paying minimum rent, assumed to be a break-even level of revenue return for the County. Twenty were paying holding rent, which produced a net loss for the County.

Gruen noted that if all unleased parcels were let at minimum rent they would provide additional annual income to the County of only $184,145. This would not cover current deficits. Furthermore, there was no indication that parcels leased in the future would be developed, and thus move from holding to minimum rents, any more quickly than the parcels already leased. At holding rent, all parcels available for lease would bring in only an additional $61,380 per year.[26]

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If, on the other hand, the 20 parcels then paying holding rent were developed to pay minimum rent, additional annual County income would amount to $447,509, a sum more than sufficient to cover annual deficits.

Emphasis, therefore, should be placed on encouraging more rapid completion of improvements on parcels already leased rather than on putting all parcels out for bid. The study recognizes the difficulty to the County of speeding development on leased parcels, since initiation of further construction must lie with the lessee. It was suggested, however, that the County encourage the development of temporary improvements such as public tennis courts or recreational areas on leased parcels. These uses would also provide the appearance of activity. Some income would be obtained by lessees while they awaited favorable financing opportunities for more intensive development. Landscaping, placed so as to be usable on sites destined for future completion, would mature in readiness for final development. This would enhance the appearance of the Marina in the interval. Finally, higher intensity use of parcels already in operation should be encouraged.

The break-through year, in which the Marina achieved an acceptable level of revenue was 1967. So far as is known, neither the temporary uses nor the landscaping improvements were implemented since the problems which suggested them did not continue.

Strategies for the future. Reviewing the analysis of rents, the Gruen study

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recommended against making the unleased parcels available for lease indiscriminately. Pointing out that undeveloped parcels, both leased and unleased, provided an opportunity for flexibility in strategies for revenue maximization, the study recommended that alternate strategies be examined to achieve a goal of optimum balance of land use. "This does not mean that the current land use plan and policies be rejected, but that certain emphases might be changed."[27]

Gruen considered 14 parcels as potential leaseholds and recommended that light of them be withheld from leasing for a time. Four of these parcels were designated as public parking to be converted to other uses as deemed necessary. Four parcels for commercial use should also be withheld. The remaining six, planned for a drive-in restaurant, two gas stations, and anchorages, apartments and related uses were to be leased immediately.

Recommendations for leasing were based partially on location, since key parcels which were empty detracted greatly from the appearance of the Marina. Another consideration was apparently needed. For example gas stations were needed to serve Marina residents and visitors. Proven operational success was also a factor, as in the case of anchorages and apartments.

Recommendations for withholding parcels from leasing were based on

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the need to reevaluate some land uses in the light of experience up to that time. Recommendations of particular interest to this study will be considered below.

Analysis of land use revenues. Examination of rents received by the County from August 1963 through August 1966, as shown on the following charts, indicates that boat slips, restaurants and apartments were the most revenue productive uses to the County. Relating area to revenue, rents received per square foot clearly show restaurants to be the most productive use, returning $.44 in rent per square foot. Boat slips produced $.41 per square foot if land alone is figured, but only $.08 if land and water area is considered. Apartments returned $.105 per square foot. No attempt is made to relate County costs for various uses to the rents received.

The analysis of revenues must be viewed in relation to several factors: gross revenues on which percentage rents are based, the percentages charged for varying uses and the areas of land required to produce the receipts. Thus, for example, restaurants are a highly intensive land use, producing the highest gross receipts in the Marina, $3,445,013 in 1965-66, but returning only $119,931 in rents at 3% of gross receipts. Boat slips, however, which grossed only $1,252,500 during the same period returned $250,495 on the basis of 20% of gross receipts charged as percentage rent. Ideally, costs to the County in terms of differing services required should

28

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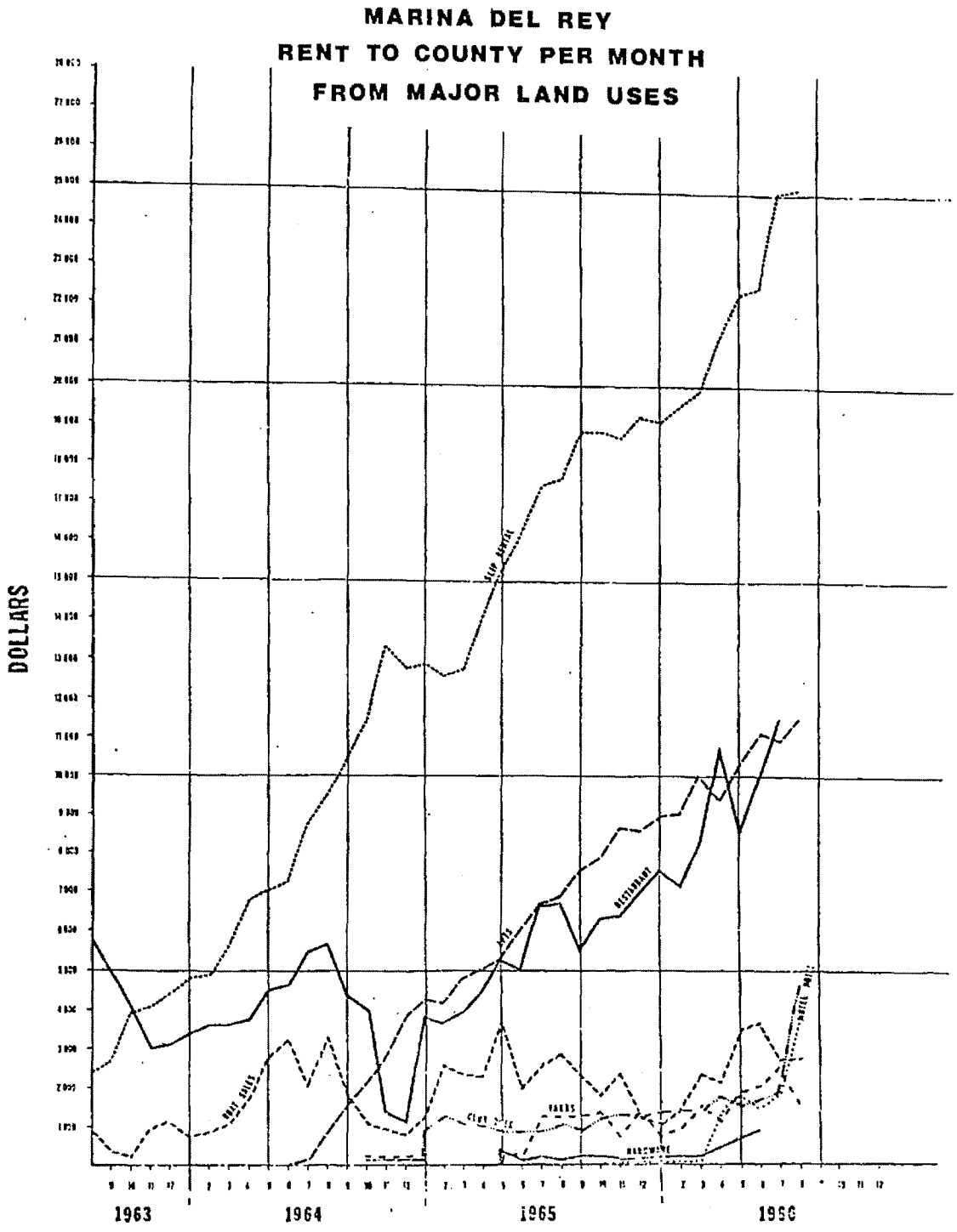

Source: Gruen Associates, Marina del Rey: Land Use Study, Los Angeles (March 1967)

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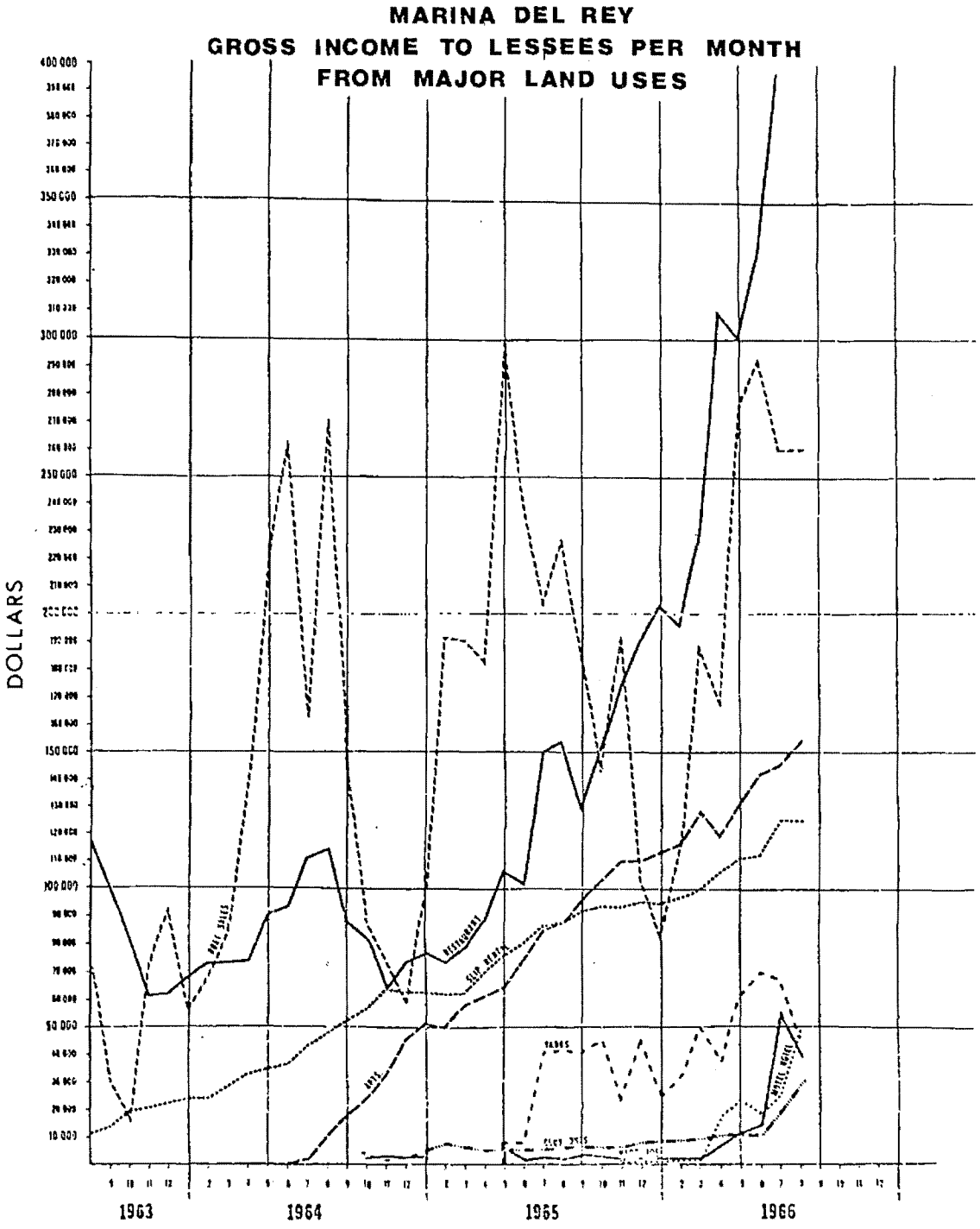

Source: Gruen Associates, Marina del Rey: Land Use Study, Los Angeles (March 1967)

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be figured into the land use revenue analysis to give a true assessment of productivity. The Land Use Study does not provide these figures, but in making recommendations for future planning strategies the study does consider the opportunity costs which would result if balanced and efficient land use were ignored.

The Land Use Study

In general the Land Use Study responds to the financial pressures still prevalent in Marina operations by recommending further development of those land uses which have proved profitable. Anchorages were, of course, the prime purpose for Marina development and were, in addition, a profitable enterprise, producing the largest single source of revenue in 1965-66. The Study recommends that more slips be provided as current occupancy reaches 90%. The following chart shows how occupancy tends to rise to meet newly constructed capacity.

Boat sales, a use related to anchorage, were also a highly successful operation, grossing $2,278,289 in 1965-66, but returning only $27,262 to the County because of the 1¼% rent charged on the gross receipts. Gruen sees the demand for boat sales as being directly related to the number of slips available. This, coupled with the low return, leads to a recommendation that the area available for boat sales be increased only in proportion to anchorages available.

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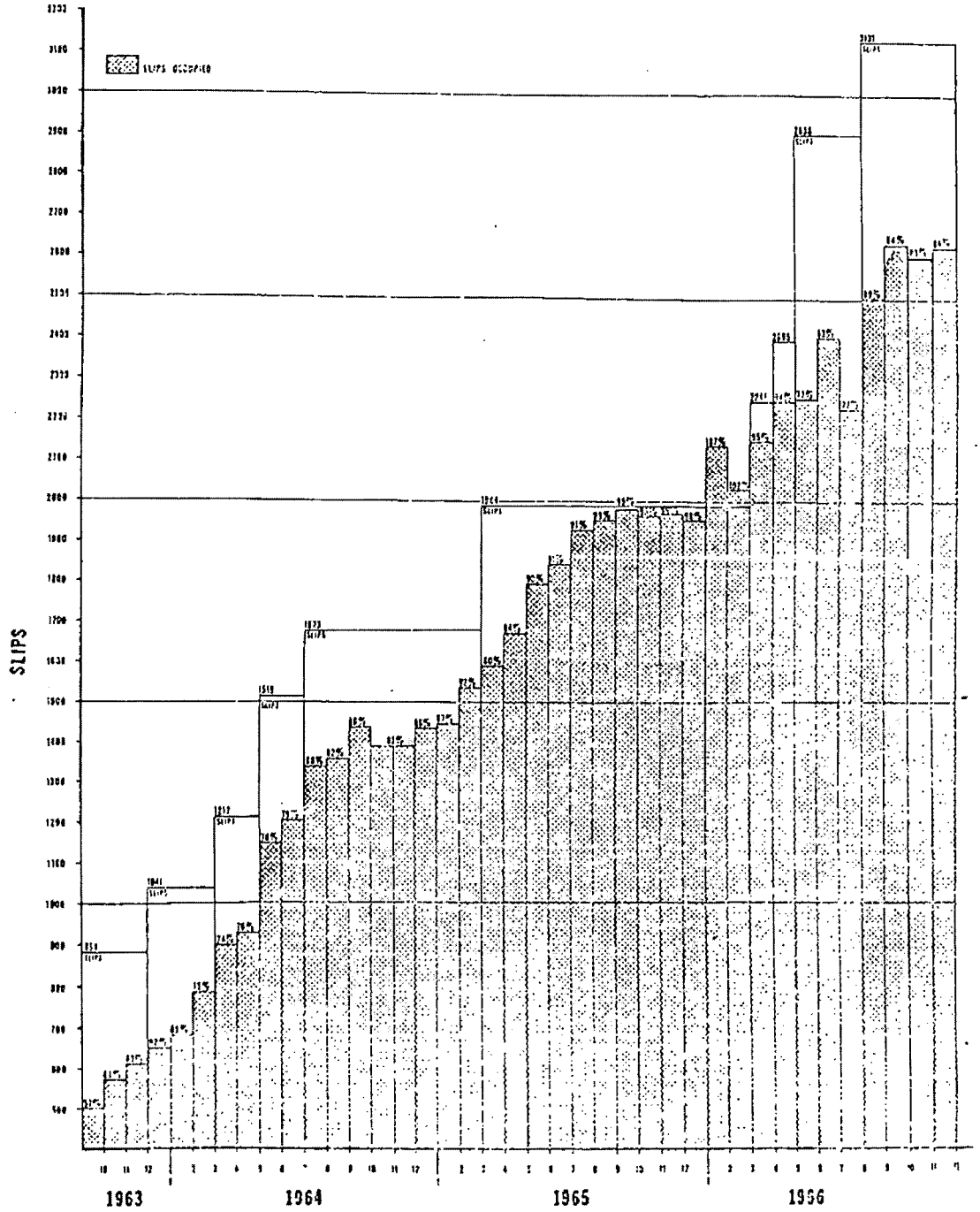
MARINA DEL REY
SLIPS OCCUPANCY



Source: Gruen Associates, Marina del Rey: Land Use Study, Los Angeles (March 1967)

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EXHIBIT 16

HISTORICAL ECOLOGY OF THE

Ballona Creek Watershed



SHAWNA DARK
ERIC D. STEIN
DANIELLE BRAM
DEL OSUNA
JOSEPH MONTEFERRANTE
TRAVIS LONGCORE
ROBIN GROSSINGER
ERIN BELLER

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EXECUTIVE SUMMARY

LOOKING ACROSS THE VAST URBANIZED LANDSCAPE in the Los Angeles Basin, it is almost impossible to imagine the natural landscape prior to human development. The remaining wetlands leave only a few clues about the past wetland complexes in this region. Nevertheless, the past is vital to understanding the foundation of landscape-processes, historical wetland distribution, and human impact that lend to a better understanding of sustainable restoration plans within the constraints of the contemporary landscape.

The primary goal of this project was to identify the characteristics of historical wetland habitat types and describe the historical form of major creeks in the Ballona Creek watershed. Our target time period was 1850-1890, just prior to contemporary impacts but after the migration of the Los Angeles River, which fundamentally altered the hydrology and morphology of the watershed. It is also a time period that is relatively data rich associated with information compiled around the time of statehood. We set forth to answer the following questions:

1. What was the extent (acreage) of persistent riparian, wetland, and associated floodplain habitat in the Ballona waterhshed?
2. What were the predominant types of wetlands in the watershed and what was the spatial distribution of these wetlands within the watershed?
3. What potential resources are available for stakeholders and scientists wanting to pursue further and more detailed research on this watershed?

Conclusions about historical wetland composition, extent, and distribution were based on a "weight of evidence" approach. Over 300 documents were compiled from 84 source institutions and origanized through a metadata catalogue. Data sources were digitized, georeferenced, and organized by subregions within the study area. Spatially referenced datasets were overlaid and augmented by textual citations, photographs and other non-geospatial data. The concordance between multiple data sources allowed us to draw conclusions that supported inferences about historical conditions. We assigned a certainty rating for interpretation, shape/size, and location of each polygon mapped based on the number and quality of corroborating pieces of evidence. Finally, historical herbaria records and bird observations were used to provide insight into the composition of historical plant communities.

EXTENT AND TYPE OF WETLANDS IN THE BALLONA WATERSHED

The Ballona watershed supported a great diversity of wetlands during the mid-late 19th century (FIGURE ES-1). The La Cienega wetlands and the Ballona Lagoon complex accounted for the majority of wetland area in the watershed. Various freshwater ponds, vernal pools, wet meadows, freshwater marshes and numerous springs were found throughout the watershed. We mapped 174 unique wetland polygon features comprising 14,149 acres. The dominant wetland types included alkali meadow (35%), valley freshwater wet meadow (10%), valley freshwater marsh (10%), brackish to salt marsh/tidal marsh (9%), and alkali flats (8%; TABLE ES-1).

HABITAT CLASSIFICATION	NUMBER OF WETLANDS	ACRES	HECTARES
ALKALI FLAT	5	1284	486
ALKALI MEADOW	21	5273	1915
BEACH	2	159	64
DUNE	8	187	76
OPEN WATER*	8	96	39
PERENNIAL FRESHWATER POND	8	110	45
SALT FLAT/TIDAL FLAT	15	423	171
SALT MARSH/TIDAL MARSH	20	1240	498
VALLEY FRESHWATER MARSH	35	1356	547
VERNAL POOL	15	260	105
WET MEADOW	24	3336	1351
WILLOW THICKET	13	425	173
TOTALS	170	14352	5810

*DOES NOT INCLUDE PACIFIC OCEAN

TABLE ES-1:
Summary of wetlands mapped on the Ballona Historical Ecology project.

We mapped 232 miles (373 km) of historical stream channels in the study area. Approximately 80% of the stream channels were intermittent (often discontinuous) washes. Across the valley floor most of the streams sank into porous soils or spread into the major wetland complexes of La Cienega and the Ballona Lagoon. This characteristic likely contributed to a significant amount of subsurface water flow and to the vast wetland complex at La Cienega. The exceptions were Ballona and Centinela Creeks, which were perennial streams lined with willow woodlands. Both streams provided freshwater input to coastal wetlands of Ballona Lagoon.

Freshwater seeps and springs were a characteristic feature of the Ballona Watershed. Although springs were present at a few locations throughout the Ballona Valley, 70% of the 45 mapped springs in the watershed were found in the Santa Monica Mountain foothills. These springs were clustered in the foothills and stopped abruptly at Franklin Canyon. This distribution could be the result of fault displacement or geologic composition. These springs played a notable role in downstream hydrology, where in several locations freshwater wetlands formed at their confluence (particularly in Rodeos de las Aguas near present day Beverly Hills). Many of these springs persist today and are unique remnant features from the historical landscape.

Data Products

In addition to this summary report, we developed several products designed to make the data compiled through this effort more readily available for exploration and use. Once collected, photographs, maps, and textual data were uploaded into an online metadata catalog. The catalog provides a means to organize and query historical documentation by spatial location, wetland descriptions, time period, and source. Bibliographic tables and information about source institutions may also be downloaded from this online database creating a secondary product for stakeholder use. This type of database creates a dynamic tool for the discovery of new information and allows for the creation of different hypothetical questions that can be explored by future researchers. The metadata catalogue, an associated geodatabase with spatially explicit data, raw data tables, and this summary report can be viewed and downloaded from **www.ballonahe.org**.

The contemporary Ballona watershed represents unique opportunities for restoration planning. The information in this report should provide a foundation for understanding the functional relationships of the various wetland complexes, lend support to the development of sustainable restoration plans, and facilitate consideration of natural landscapes into future planning for infrastructure and stormwater management.

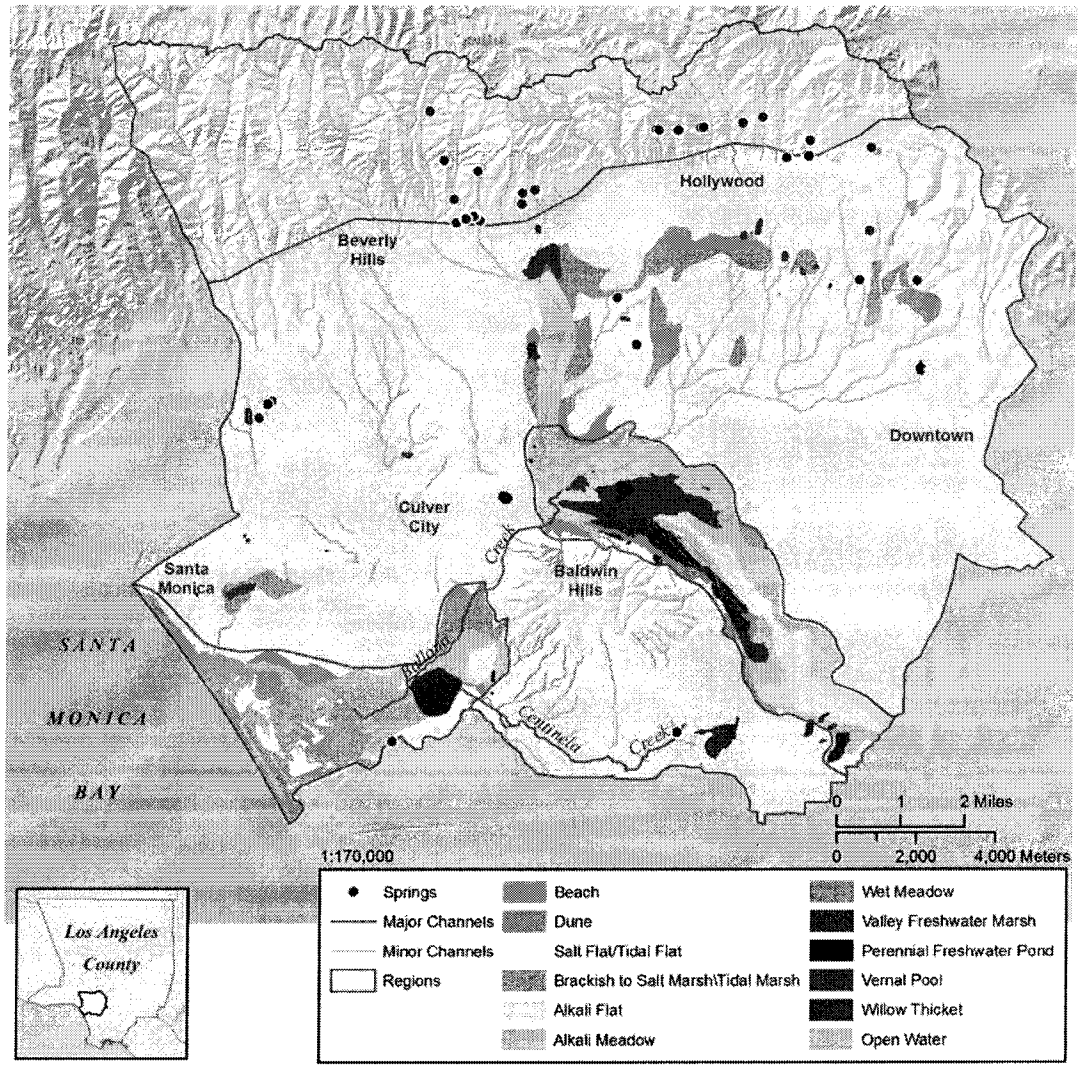


FIGURE ES-1: *Distribution of wetlands and associated features within the Ballona Watershed (1850–1890).*

INTRODUCTION

"Restoring the Ballona Creek watershed is a waste of time and money." Such commonly heard sentiments about highly urbanized watersheds used to be commonplace. Studies in California and other regions have shown that where underlying watershed processes remain intact, restoration options exist, even in highly urbanized settings (Zedler and Leach 1998, Ehrenfeld 2000). Historical ecology provides an understanding of how landscape-scale processes influence wetland extant and distribution under more natural conditions; thus it provides context for restoration planning by providing insight to natural ecosystem functions. (Kentula 1997, Kershner 1997, NRC 2001, White and Fennessy 2005, Kentula 2007).

The on-going planning efforts associated with the Ballona watershed can benefit from the insights of historical ecology. While the Ballona watershed is highly urbanized, it retains remnants of its historical natural resources mainly in the form of coastal wetlands and natural springs. Developing an understanding of potential restoration options in such landscapes depends upon a sound understanding of both contemporary conditions and historical ecological wetland functions. The historical perspective provides an understanding of the relationship between physical settings that support natural wetland functions, the driving forces behind ecosystem degradation and perhaps most importantly, the value of wetland ecosystems that remain intact (Stein et al. 2010). Our goal is to provide this unique perspective of the Ballona Watershed as a valuable tool for understanding not only the past, but for assessing present and future options for management and restoration.

Knowing the historical ecosystem processes associated with the Ballona watershed will provide insight into larger ecosystem processes that governed the greater Los Angeles/San Gabriel river basin. Previous historical ecological research on the San Gabriel River suggests that ecosystem processes were more dynamic and wetlands more diverse than previously expected (Stein et al. 2007). This sheds light on only one component of a larger interconnected system of rivers and wetland complexes, all tied together at some point in time by the Los Angeles River. This report provides information on one additional component of this system, accentuating the importance of historical research on the Los Angeles River to capture a more comprehensive understanding of inter-relatedness and unique qualities of Southern California wetland ecosystems.

PROJECT OBJECTIVES

The primary goal of this project was to identify the characteristics of historical wetland habitat types and describe the historical form of major creeks in the Ballona Creek watershed. To achieve this goal, we created a habitat map and comprehensive dataset describing the extent of creeks and diversity of habitats throughout the watershed. The target time period was prior to significant Euro-American modification (including the Spanish-Mexican ranching era) and just after the natural realignment of the Los Angeles River in 1825 from the Los Angeles Basin to the San Gabriel Valley. Specifically, we used historical ecological research to answer the following questions about the Ballona watershed:

1. What was the extent (acreage) of persistent riparian, wetland, and associated floodplain habitat in the Ballona waterhshed?
2. What were the predominant types of wetlands in the watershed and what was the spatial distribution of these wetlands within the watershed?
3. What potential resources are available for stakeholders and scientists wanting to pursue further and more detailed research on this watershed?

Data Products Available

In answering the above questions, we developed a geodatabase with spatially explicit data. This geodatabase can be used to identify the location and classification of historical habitat types. We also developed a web-portal for visualizing the historical distribution of wetlands relative to the contemporary environment, this executive summary report, and a series of tables that will provide resources to those wanting to pursue more detailed research of specific wetlands or specific time periods not examined for this project. These data sets can be viewed and downloaded from **www.ballonahe.org**. TABLE 1 provides an overview of each data set, including data format, source, and brief description.

Disclaimer

The information provided in this report should be viewed as metadata that supports a detailed understanding of how the GIS data layers for this project were created, interpreted from historical documents, and are best used. In addition, we provide a summary of the historical watershed characteristics. This report has a limited focus on interpreting these data. We did not interpret or analyze landscape change or discuss implications for management. While we documented historical habitat and creek patterns in the watershed, we did not investigate historical ecological dynamics such as how the migration of the Los Angeles River impacted hydrological dynamics of the watershed. The "Next Steps" section of this report (see page 34) provides a comprehensive overview of potential efforts that would provide a better understanding and documentation of historical processes and conditions of the Ballona Creek and adjacent watersheds.

GEOSPATIAL DATA PRODUCTS					
DATA LAYER	AVAILABLE FORMAT	REPRESENTATIONAL GEOMETRY	DATA SOURCES	CLASSIFICATION	DESCRIPTION
WETLAND LAYER	GEODATABASE, KML SHAPEFILE	POLYGON	COMPILED FROM SYNTHESIS OF ALL HISTORICAL DATA	HISTORICAL WETLAND CLASSIFICATIONS, SOURCE, CERTAINTY LEVELS	SEE METHODS SECTION OF THIS DOCUMENT FOR INFORMATION ON THE DERRIVATION OF THIS LAYER
CREEKS AND STREAMS	GEODATABASE, KML SHAPEFILE	LINE	USGS TOPOGRAPHIC MAPS, 1927 AERIAL PHOTOGRAPHY, IRRIGATION MAPS	SEASONALITY, SOURCE, CERTAINTY LEVELS	DATA LAYER REPRESENTS THE DISTRIBUTION OF HISTORICAL STREAMS IN THE STUDY AREA
GLO DATA	GEODATABASE, KML SHAPEFILE	POINT	GENERAL LAND OFFICE SURVEY DATA	ECOLOGICAL FLAGS	FIELD NOTES TRANSCRIBED INTO A GIS
SPECIFIC LOCATION DATA	GEODATABASE, KML SHAPEFILE	POINT	TEXTUAL DATA	NONE	TEXTUAL CITATIONS WITH ENOUGH INFORMATION FOR GEOREFERENCING TO A POINT LOCATION
NON-GEOSPATIAL DATA PRODUCTS					
SOURCE INSTITUTIONS VISITED	EXCEL	NA	NA	NA	LIST OF SOURCE INSTITUTIONS VISITED WITH BRIEF DESCRIPTION OF RELATED COLLECTION
CITATION LIST	EXCEL	NA	SOURCE INSTITUTIONS	ECOLOGICAL FLAG	EACH TEXTUAL CITATION WAS FLAGGED BASED ON REGIONAL LOCATION WITHIN THE WATERSHED, TYPE OF WETLAND, AND BASIC TYPE OF INFORMATION
HISTORICAL BIRD/PLANT SPECIMENS	EXCEL	NA	SOURCE INSTITUTIONS	NA	NA
BIBLIOGRAPHY	EXCEL	NA	SOURCE INSTITUTIONS	NA	LIST OF CITATIONS USED FOR THIS PROJECT

TABLE 1: *Data products created for the Ballona Historical Ecology project can be downloaded from* ***www.ballonahe.org.***

WATERSHED BACKGROUND

Historical accounts of the Ballona watershed suggest a landscape with vast and diverse sources of water. Descriptions of groundwater fed wetlands, springs, creeks, and lagoons were abundant in the early literature (Mesmer 1904, Regan 1917). These descriptions also suggest that before most of the county's hydrology was constrained to concrete channels, the prairie-like lowlands were often flooded from seasonal rainfall contributing to a dynamic and diverse watershed (LAT 1906, Regan 1917, USEO 1939, Schiffman 2005).

Understanding the unique history of this watershed is important as it helps to identify the most appropriate target time period for this project. Prior to 1825, the Los Angeles River flowed through the Ballona watershed and into the Ballona Lagoon. However, beginning in 1825, the Los Angeles region experienced three consecutive years of heavy rains that inundated the lowland (LAT 1906, Reagan 1917). Along with years of unusually high precipitation, the residents during this period frequently mention a series of earthquakes that rocked the Los Angeles area (Regan 1917). While it may not be possible to fully determine the extent of each natural change, it was after *both* of these that the discharge of the Los Angeles River shifted south to San Pedro.

Despite the newly formed southward course of the Los Angeles River, the inland marshes of the Ballona watershed although hydrologically altered, did not dry up. In both the lowlands and the Santa Monica Mountains, fresh water springs flowed in a southwest direction and sustained much of the inland marshland of the Ballona Creek. Because our goal was to identify the historical landscape that is most representative of the contemporary hydrodynamics and it is doubtful the Los Angeles River will ever flow into the Ballona estuary again, we chose the post-Los Angeles River migration period (1850-1890) as our target time period. This was also just prior to significant changes in land use that likely had a dramatic impact on water resources in the region, such as a shift from ranching to agriculture which was quickly followed by urban development (Stein et al. 2007).

The Ballona watershed geology played a major role in shaping its ecological patterns. Major factors controlling this geologic template include the Newport-Inglewood fault, which created the Baldwin Hills and other outcrops, aeolian beach-derived sand deposits, and the Holocene history of various courses of the Los Angeles River. The eastern part of the watershed comprises well-drained soils of the Los Angeles River's broad alluvial fan (FIGURE 1). Where the coarse alluvial fan deposits diminish, giving way to finer grain soils, wetlands occurred. Wetlands formed in the trough aligned with the Baldwin Hills and faulting throughout the watershed. These geologic patterns expressed themselves in habitats found in the 19th century, such as the groundwater fed wetland complex at the base of the Baldwin Hills and the springs in the Santa Monica Mountain foothill regions.

METHODS

The following section provides a broad overview of the analytical process used to map wetlands in the study area and provides guidance the most effective use of the data relative to current restoration and management practices. Land use history was investigated as it related to wetland location, type, and extent. A detailed investigation of the history of land and water use for the Ballona watershed is, however, beyond the scope of this study.

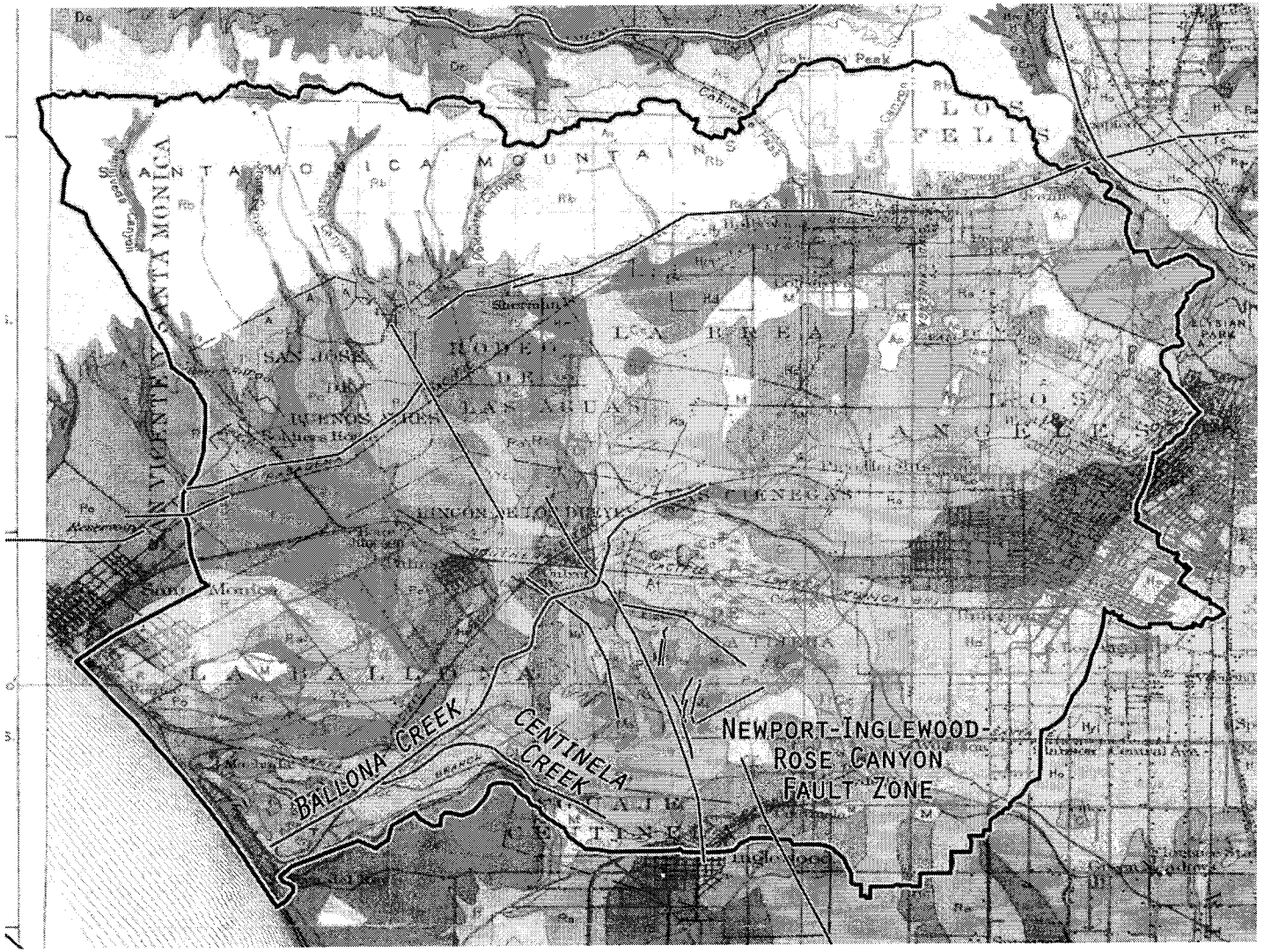


FIGURE 1:
Historical soil map (Nelson et al. 1917) demonstrating the extent of the historical Los Angeles River alluvial fan (dark yellow) within the Ballona watershed.

Our methodology can be divided into a series of phases; data collection/data compilation, synthesis/interpretation, and mapping. Each phase of the project represents a systematic and consistent process that has been developed by the San Francisco Estuary Institute (SFEI) and applied across many historical ecology projects throughout the state of California (e.g., Grossinger et al. 2006, Grossinger et. al. 2007, Stein et al. 2007, Grossinger et al. 2008, Beller et al. 2010, Beller et al. 2011). FIGURE 2 demonstrates the various phases of the project and the primary tasks completed in each phase.

Data Collection and Compilation

Mapping historical wetland features is dependent upon building a body of evidence to support habitat boundaries, classification interpretations, and

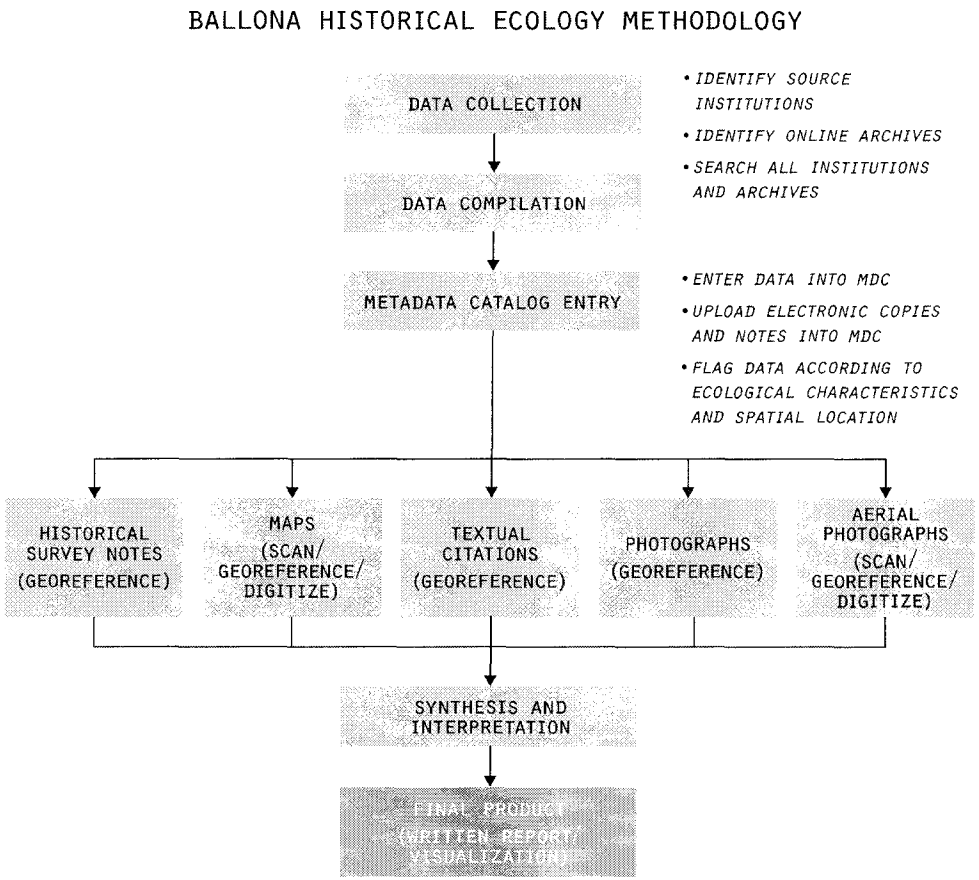


FIGURE 2: *Schematic illustration of research process for historical data acquisition and use in historical ecology. Methodology described in detail in the following sections.*

certainty of the features mapped. For this project, we visited 84 source institutions (50 physical archives and 34 online archives) throughout the state of California, although the majority of institutions are located in Southern California. These institutions included libraries, government agencies, historical societies, map archives, and other institutions housing related historical documents. One of the most notable collections investigated for this project was the Solano Reeves map collection found at the Huntington Library, which provided both early surveyor maps of Los Angeles County and field notes not attainable through other sources.

Over 300 documents were collected. The documents included written accounts, historical photographs (landscape and aerial), and historical maps. Our data collection efforts focused on 19th century sources; a few data sets from the 20th century (e.g. 1927 aerial photography, 1917 soil map) were also collected. The variety of data sets from overlapping time periods allowed for a comprehensive assessment of persistent wetland features and an in-depth interpretation of their classification. We relied on each overlapping dataset to understand the complexity of the ecological pattern and function of the landscape, and our confidence in conclusions about these features was commensurate with the supporting weight of evidence.

Written documents provided detailed insight, supplementing historical map interpretation and allowing for a more comprehensive depiction of the landscape. In some instances, textual data provided significant support for wetland features depicted on a historical map. For example, the following quote identifies the size of a depression and its associated flow regime:

> *"In the Northwest corner of the parcel secondly described in said order of partition, I found a depression cover about sixteen acres, which was filled up by the rains in winter so as to render it unfit for either cultivation or pasture."*
> ***-Solano (1893)***

This information allowed us to verify the size of the mapped feature and classify it as a vernal pool given the additional information about seasonality. Other quotes provided a general overview of the study area:

> *"In the medium part of this southwest course [Ballona Creek] it is bordered on either side by a rich plain of several thousand acres in area, and which, to some extent, it has served in irrigation for a long number of years. The lands irrigated are all within the rancho La Ballona and the waters have for many years been considered as appurtenant thereto."*
> ***-Hall (1888)***

> *"In several depressions or arroyos of the Santa Monica plain, and at the footing of that plain against the Centinela hills, as elsewhere better explained, there are a number of little water sources of the class called cienegas, and which have been referred to in this report, also as cienega springs, and sometimes as artesian springs. A belt of these sources in the ranchos La Brea, Rodeo de los Aguas, and Santa Monica, is found one to three miles out from the mountain's base, and nearly half way down the plain."*
> ***-Hall (1888)***

> *"Coldwater Canyon Creek; Ballona Creek basin; Los Angeles County; an intermittent stream, 3 or 4 miles long, draining a small area in the Santa Monica Mountains, and flowing southward and southeastward into Rodeo de las Aguas Rancho. Near the mouth of its canyon it receives streams draining from Franklin and Higgins canyons."*
> ***-Lee (1912)***

Historical photographs collected from the Los Angeles Public Library and the Huntington Library also provided insight into landscape conditions throughout the watershed. Some of the most useful photographs were those that did not have a principal focus on ecology, but depicted enough of the landscape to provide corroborating data. For example, the photograph in FIGURE 3 depicts recreational boating on Ballona Lake, which gave us insight into not only the size and extent of the dunes surrounding this feature, but also the cultural value of the physical landscape at this site.

A variety of unique historical thematic and reference maps were collected, many of which became the primary source of mapping. Some examples of these include the Hall irrigation maps (1888), a variety of soil maps (1903–1916), and diseño maps of California land grants (circa 1840). The Hall irrigation maps are two maps produced in conjunction with an irrigation report, Irrigation in California by the California State Engineer, William H. Hall in 1888. These two maps focused on water works, developments, and use within Southern California (Hall 1888). The maps provided an accurate depiction of natural hydrological features such as channels and springs (FIGURE 4).

Additionally, ecological features were accurately presented in the Hall irrigation map, allowing us to use the map as a primary source to digitize historical wetlands (FIGURE 5). Primary digitizing sources were those that we used as a primary source to create habitat boundaries (though thse boundaries may bave been further adjusted based on additional subsidiary evidence). Because of the maps' accuracy, composition, and time frame they served as a useful source, particularly in areas with large and diverse wetland complexes.

Similarly, the 1876 T-Sheet (Chase 1876; T-1432B) was another dataset that was key to the completion of this project. T-Sheets were produced between 1851 and 1900 by the United States Coast Survey. These accompanied surveys completed along the Southern California coastline (Grossinger et al, 2011). Specifically, the T-Sheet we utilized for this project included the Ballona Lagoon and immediate wetlands as surveyed in 1876. Produced at an unusually large scale (1:10,000),

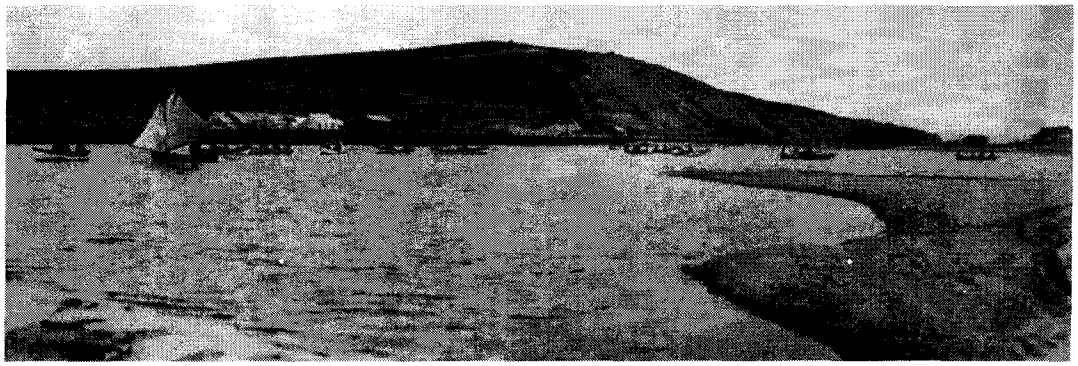


FIGURE 3:
Ballona Lake located at what is now Del Rey/Ballona Lagoon (photo courtesy of the Los Angeles Public Library).

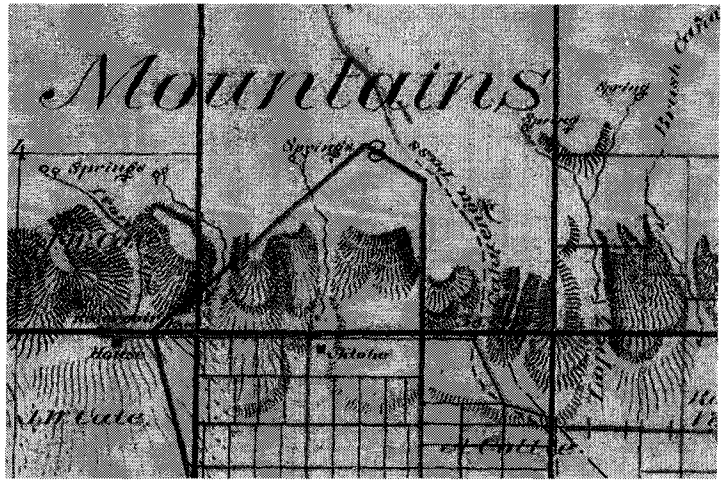


FIGURE 4: *Detail of Hall (1888) irrigation map demonstrating the location of springs in the Santa Monica Mountains.*



FIGURE 5: *Detail of Hall (1888) irrigation map demonstrating the level of detail in describing habitat types in the La Cienega area at the base of present day Baldwin Hills.*

this map provided a level of detail not available on other data sets. It was useful for mapping fine scale features within the estuary, especially when used in conjunction with other data sources (FIGURE 6).

We also obtained detailed ecological information from the General Land Office (GLO) Public Land Survey (PLS) survey notes. Initiated in 1785, the GLO Public Land Survey was carried out by dividing the land into a grid system. Land was divided into 36 mi2 townships and further divided into square mile sections. In California, Mexican land grant boundaries were not modified, though surrounding lands were assimilated into the township-range system. Surveyors ran the boundaries of these land divisions, including those of the Mexican land grants, taking note of distances and notes on the landscape including any significant human made and natural features to establish these boundaries. The GLO survey notes provide an array of detailed historical ecological descriptions that could be spatially referenced. Notes often included information about hydrology, soil types, and vegetation. At times, survey notes were extremely detailed, providing channel morphology descriptions, physical characteristics of trees, including species, height, and diameter, and wetland descriptions (Manies 1997). In the Ballona watershed, GLO surveys were conducted from 1850 to 1895, with the most frequent survey period being around 1870.

Metadata Catalog

Once collected, photographs, maps, and textual data were uploaded into an online metadata catalog. Given the collaborative nature of this project, being able to share data dynamically was important to reduce repetition of effort, to allow for collaborative viewing of data, and to

facilitate regional synthesis and ongoing investigations. The catalog provided the means to organize and query historical documentation by spatial location, wetland descriptions, time period, and source (FIGURE 7). Upon review and entry to the catalog, each source was assigned metadata such as year, author, and keywords pertaining to the item's ecological content. The assigning of metadata within the online catalog system allowed us to query our data sources by using simple to complex parameters in an efficient manner with relative ease. For example, we were able search citations by year or by year, location, author, and citation type (i.e., map, text, or photograph). The metadata catalog also allowed for data to be uploaded to a centralized location via ftp so that team members were able to download and access the data dynamically. Bibliographic tables

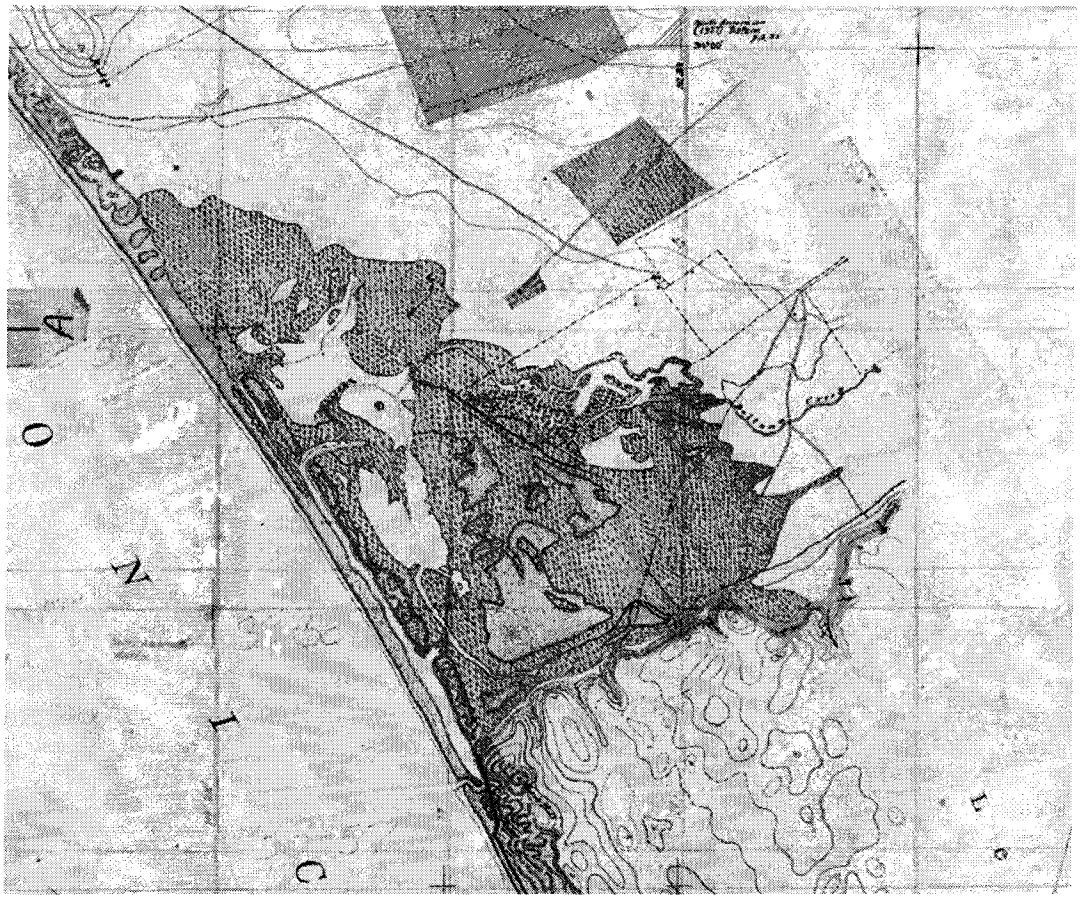


FIGURE 6:
Chase (1876) T-Sheet demonstrating the detail used to map the Ballona Lagoon.

Subset Records by Title:
Subset Records by Reference Type: All
Subset by Primary Source:
Subset by Collector:

	Reference Type	Author	Journal / Publisher	Found (Y/N)	Acquired (Y/N)	Useful (Y/N)	Original Scan Aquired (Y/N)	Title	Year	Primary Source	Call #	Secondary Source	Call #	Tertiary Source	Call #	Geographic Area	Watershed	Scale	Description	Keywords	Collector	File Path	GeoReferenced (Y/N)
Select	Text	Mesmer, L.		Yes	Yes	Yes		Soil Survey of the Los An ...	1904	Google Book Search						Los Angeles County			Soil survey for Los Angel ...	soils, hydric soils	S. Dark	Mesmer_1904_soilsurvey.pdf	
Select	Map	Unknown		Yes	Yes	Yes	Yes	Map Showing Part of the R ...	1887	LA County Department of Public Works	MR022-020					Rancho Rincon de los Buey ...			Plat map scanned by LA Co ...	sycamore, valley floor habitats	S. Dark	MR022-020.pdf	Yes
Select	Map	Mesmer, L.		Yes	Yes	Yes	Yes	Soil Map: Los Angeles She ...	1903	University of Alabama, Department of Geography						Los Angeles County		1:62,500	Great soils map, really g ...	soils, hydric soils, cienegas	S.Dark	UnivAlabama_map_Mesmer_1903.sid	Yes
Select	Text	Salvator, L.		Yes	No	Yes		Los Angeles in the Sunny ...	1929	First-person Narratives of California's Early Years	F869.L8 L94					General Study Area			Very general description ...	Springs, rivers	S. Dark	AmerMem_text_Salvator.doc	
Select	Map	Jonas, C.		Yes	Yes	Yes	Yes	Index map to county surve ...	1950	Library of Congress Map Collections	G1528.L6 R3 1950					LA Basin		1:24000	General index map for sur ...	Surveyor index	S.Dark	LiboCong_Map_1950.zip	Yes
Select	Text	Grinnell, J.		Yes	Yes	Yes		Birds of the Pacific Slop ...	1898	Archive.org	None					Los Angeles County			Birds of LA County. Usefu ...	Birds	S. Dark	GrinnellJ_Archive_1877_birds.pdf	
Select	Map	Solano, A.		Yes	Yes	Yes	Yes	Map of Those Parts of the ...	1868	LA County Department of Public Works	3204					Rancho La Ballona			Plat map scanned by LA Co ...	lagoon	S. Dark	MR003_204_laballona.pdf	Yes

FIGURE 7:
Sample of the online metadata catalog used to store, query, and flag data.

and information about source institutions may also be downloaded from this online database creating a secondary product for stakeholder use. These data products are available at **www.ballonahe.org**. This type of metadata catalog creates a living tool for the discovery of new information and allows for the creation of different questions that can be explored by future researchers.

Data Processing

Certain sources required further processing in the form of spatial reference assignments. Maps were georeferenced, GLO data was transferred to a point layer via linear referencing, and aerial photographs were orthorectified and mosaiced into a single data layer. This allowed us to assimilate a significant portion of our data sources into Geographic Information System (GIS) software for electronic mapping. Some data sources were not spatially referenced. These sources, including photographs and most textual documents, were still organized geographically via their metadata, printed, and compiled manually for use during the interpretation process. Over 150 maps were georeferenced. Textual citations with enough spatial detail were also georeferenced into a point layer. For this point layer, the associated textual description and citation were recorded in the features attribute table. Over 50 of these "specific location" points were digitized.

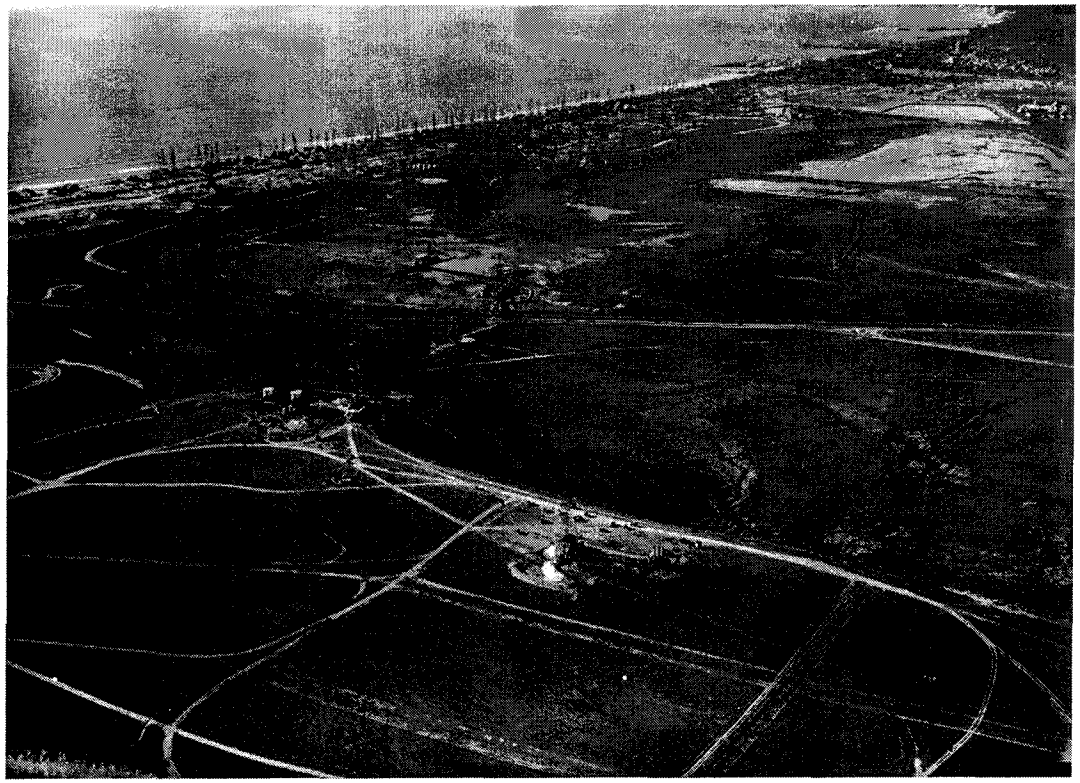
Mapping and Interpretation of Historical Documents

All mapping was completed using a Geographic Information System (GIS). ArcGIS 9.3 (ESRI) software was used to display, manipulate, and compare spatial data sources as well as create our final geospatial dataset. As discussed in the previous sections, data sources that could not be spatially referenced were printed and organized by very general regional spatial locations (as flagged in our metadata catalog). These data sources were reviewed as we mapped each of these regions and often provided valuable nuanced descriptions of wetlands in the study area that maps could not provide, such as details about tree species or plant composition not depicted on a map. Using GIS, data sources were organized and spatially overlayed with each other, which not only allowed us to view features across multiple datasets, but also allowed us to view change over time. Subsequently, this granted us the ability to better establish the shape, location, and identification of persistent wetland features while at the same time considering the variability (or lack thereof) in the physical and relational aspects of those features through different datasets.

The ability to compare the numerous historical data sources allowed us to build a body of evidence and assess the certainty of each persistent landscape feature mapped. Drawing upon methodological approaches used in previous studies in California, we documented each feature using multiple sources from varying years and authors to ensure accurate interpretation (Grossinger 2005, Grossinger et al. 2007). This was possible for many features, although others (notably some ponds and springs) were only documented by one source.

Usually, the most detailed and accurate datasets that fell within our target mapping period were used to map features. These sources included the Hall irrigation maps and historic topographic maps. After initial digitizing, other datasets were reviewed to determine if corroboration between them deemed it necessary to modify a given feature's properties, such as shape, location, attributes, and sometimes, identification.

Datasets that were produced within our target mapping period, 1850 to 1890, were given mapping priority. Datasets that fell outside of this range were used only as interpretation sources for already mapped features. Interpretation sources are those sources that gave us additional evidence in our interpretation but were not used as a mapping source. These datasets were not used as a mapping source because it is likely they depicted the landscape after significant modification by European settlement and could only be used as supporting evidence for persistent features found on earlier maps. Examples of these include the soil survey maps and aerial photographs. Whenever photographs or textual documents supported the interpretation of features their citation was added to the feature's attributes, specifically as an interpretation source. Seldom did photographs provide extreme corroboration, but there were times where photographs were vital. For example, a set of oblique aerial photographs taken over the Ballona Lagoon provided excellent corroborating evidence to the shape of included waterbodies (FIGURE 8).



Another important component of the mapping methodology involved transcribing and spatially referencing the GLO survey notes. A total of 1,913 survey points were produced with just over 900 points solely dedicated to describing natural features mapped by the GLO during their surveys. These data proved invaluable due to both their spatial and descriptive accuracy. GLO points were often used to confirm boundaries of habitat features. In several GLO survey notes surveyors would note when they entered or left an area of a given habitat type. Thus, it was common to find phrases such as "enter swamp" or "leave prairie" within GLO surveys. These points aided in modifing feature boundaries that were initially drawn from primary mapping sources. Ultimately, the GLO data resulted in a more refined physical shape in the wetland areas mapped and supported more detailed intepretation. These surveys were

FIGURE 8:
Oblique aerial photograph of the Ballona Lagoon taken from the current site of Loyola Marymount University (circa 1940, photo courtesy of Loyola Marymount University, Special Collections). Areas with a smooth, lighter signature in the background are either open water or unvegetated areas.

also aligned with known rain and drought cycles to better inform our interpretations.

Streams were mapped primarily from the historical aerial photographs and historical topographic maps (because of their improved spatial accuracy compared to older mapping sources). When available, other data sources were used to provide additional interpretation validation such as the Hall Irrigation Map (1888). All streams that were consistently present across the historical aerials, topographic maps, and irrigation map (Hall 1888) were digitized. However, we prioritized digitizing from the aerials because the spatial referencing was the most accurate. The topographic maps and irrigation maps were in this order of priority where the feature was no longer present on the aerials. The channel network in the watershed was not analyzed extensively due to two factors. First, preedominantly intermittent streams dominated the Ballona watershed; this likely is the result of porous soils, geology, and climatic conditions (Hall 1888). We were only able to identify two major channels that were perennial: Ballona Creek and Centinela Creek. Second, as would be expected, corroborating evidence for the remainder of the intermittent channel network was sparse.

Estimating Confidence in Mapped Polygons

Measuring and quantifying certainty is critical to the final interpretation and usefulness of historical ecology data. Following Grossinger (2005), feature attributes were developed to capture the estimated certainty of a mapped feature's interpretation, size, and location. Each feature was assigned these attributes to provide a concise assessment of how confident we are in its presence and habitat classification, and in its spatial accuracy (Grossinger and Askevold, 2005). Certainty levels were based primarily on the number, type (i.e. GLO versus historical topo) and quality (i.e. degree of detail and/or spatial accuracy) of the data sources (TABLE 2). For example, a feature such as a wet meadow may be supported by numerous and highly detailed independent data sources would be assigned a "high" value for interpretation certainty. On the other hand, a wet meadow referenced in only 1 or 2 more contemporary historical documents may

CERTAINTY LEVEL	INTERPRETATION	SIZE	LOCATION
HIGH "DEFINITE"	FEATURE DEFINITELY PRESENT BEFORE EURO-AMERICAN MODIFICATION	MAPPED FEATURE EXPECTED TO BE 90%–110% OF ACTUAL FEATURE SIZE	EXPECTED MAXIMUM HORIZONTAL DISPLACEMENT <50 METERS
MEDIUM "PROBABLE"	FEATURE PROBABLY PRESENT BEFORE EURO-AMERICAN MODIFICATION	MAPPED FEATURE EXPECTED TO BE 50%–200% OF ACTUAL FEATURE SIZE	EXPECTED MAXIMUM HORIZONTAL DISPLACEMENT <150 METERS
LOW "POSSIBLE"	FEATURE POSSIBLY PRESENT BEFORE EURO-AMERICAN MODIFICATION	MAPPED FEATURE EXPECTED TO BE 25%–400% OF ACTUAL FEATURE SIZE	EXPECTED MAXIMUM HORIZONTAL DISPLACEMENT <500 METERS

TABLE 2:
Certainty levels assigned to historical features on the Ballona Historical Ecology Project (after Grossinger et al. 2007).

receive a lower value. Confidence values were assigned not just on the number of data sources supporting the presence of a particular feature, but also on the quality and time period of the individual data source. For example, the Hall Irrigation map (1888) provided detailed information about wetlands mapped, as such, wetlands mapped from this source were given a consistently higher confidence value for interpretation than a feature found on a few coarse scale maps (such of topographic maps) that had very little detail. Estimation of certainty is critical to the scientific credibility of any study and reinforces why conclusions about historical conditions must be based on corroboration of multiple lines of independent evidence. Ultimately, land managers and other stakeholders can utilize these objective classifications of certainty to guide the decision making process by helping to determine how extensively results are applied to various land management and restoration activities.

Assessment of Historical Plant and Bird Communities

We also collected about the natural history of the study area, concentrating on plants and birds. For plants, all of the digitized herbarium records available from the state clearinghouse (Jepson Interchange) for Los Angeles County were obtained. Because these records contain many spelling errors and the locations are not reported in a standardized manner, they were sorted through (100,382 records) manually to extract those records from the Ballona watershed and to exclude exotic species, leaving 2,342 records of native species. These were updated with current nomenclature, sorted into families, and coded with the standard U.S. Fish and Wildlife Service codes for wetland indicator status. Each record was then assigned to a region within the watershed to develop species lists for each. For birds, we obtained nest and egg set records from the Western Foundation for Vertebrate Zoology for a suite of riparian indicator species: Black Phoebe, Common Yellowthroat, Black-headed Grosbeak, Least (Bell's) Vireo, Yellow Warbler, House Wren, Long-tailed Chat, Little Flycatcher, Western Wood-Pewee, Song Sparrow, Barn Swallow, and Cliff Swallow. Searches were not made for species associated with coastal wetland features. Region and nest condition notes were consolidated from these records as indicators of riparian vegetation.

RESULTS

A diversity of wetlands were mapped in the Ballona watershed during the target time period with four major types of wetlands dominating the watershed; coastal wetlands, the inland La Cienega complex (consisting of groundwater and surface water associated depressional wetlands), seeps and springs, and creeks (FIGURE 9). Particularly unique to this watershed was the continued legacy of the migration of the Los Angeles River and its effect on the nature and distribution of wetlands. During the target period of analysis, Ballona Lagoon was undergoing a transition from a wetland at the terminus of the large Los Angeles River watershed to a system associated with the smaller Ballona Creek watershed. The shift to a smaller watershed likely resulted in a reduction in the magnitude and frequency of high energy scouring flows experienced by the estuary. Historical analysis of the Ballona watershed is also complicated by the relatively early human impact beginning in the mid-19th century which escalated in pace into the early 1900s along this portion of the southern California coast.

A total of 174 unique wetland polygons were mapped comprising 14,149 acres (5,470 ha; TABLE 3). The dominant wetland types across the entire study area included alkali meadow (35%), valley freshwater marsh (10%), brackish to salt marsh/tidal marsh (9%), and alkali flats (8%). The watershed contained a wide diversity of wetlands ranging from vernal pools and alkali flats to wetland meadows and willow thickets (excluding willow-dominant riparian corridors). It is likely that our habitat map did not capture the total complexity of this landscape, due to a lack of documentation in the historical record, or inability to display using a habitat map. For example, textual citations describing features at a finer scale cannot be incorporated into a two-dimensional map, but lend depth to our understanding of habitat diversity. We hope to provide a cautioned insight into the complexity of this ecological system in the following pages.

HABITAT CLASSIFICATION	UNIQUE WETLANDS	ACRES	HECTARES
ALKALI FLAT	5	1284	486
ALKALI MEADOW	21	5273	1915
BEACH	2	159	64
DUNE	8	187	76
OPEN WATER*	8	96	39
PERENNIAL FRESHWATER POND	8	110	45
SALT FLAT/TIDAL FLAT	15	423	171
SALT MARSH/TIDAL MARSH	20	1240	498
VALLEY FRESHWATER MARSH	35	1356	547
VERNAL POOL	15	260	105
WET MEADOW	24	3336	1351
WILLOW THICKET	13	425	173
TOTALS	174	14149	5470

*DOES NOT INCLUDE PACIFIC OCEAN

TABLE 3:
Summary of wetlands mapped on the Ballona Historical Ecology project.

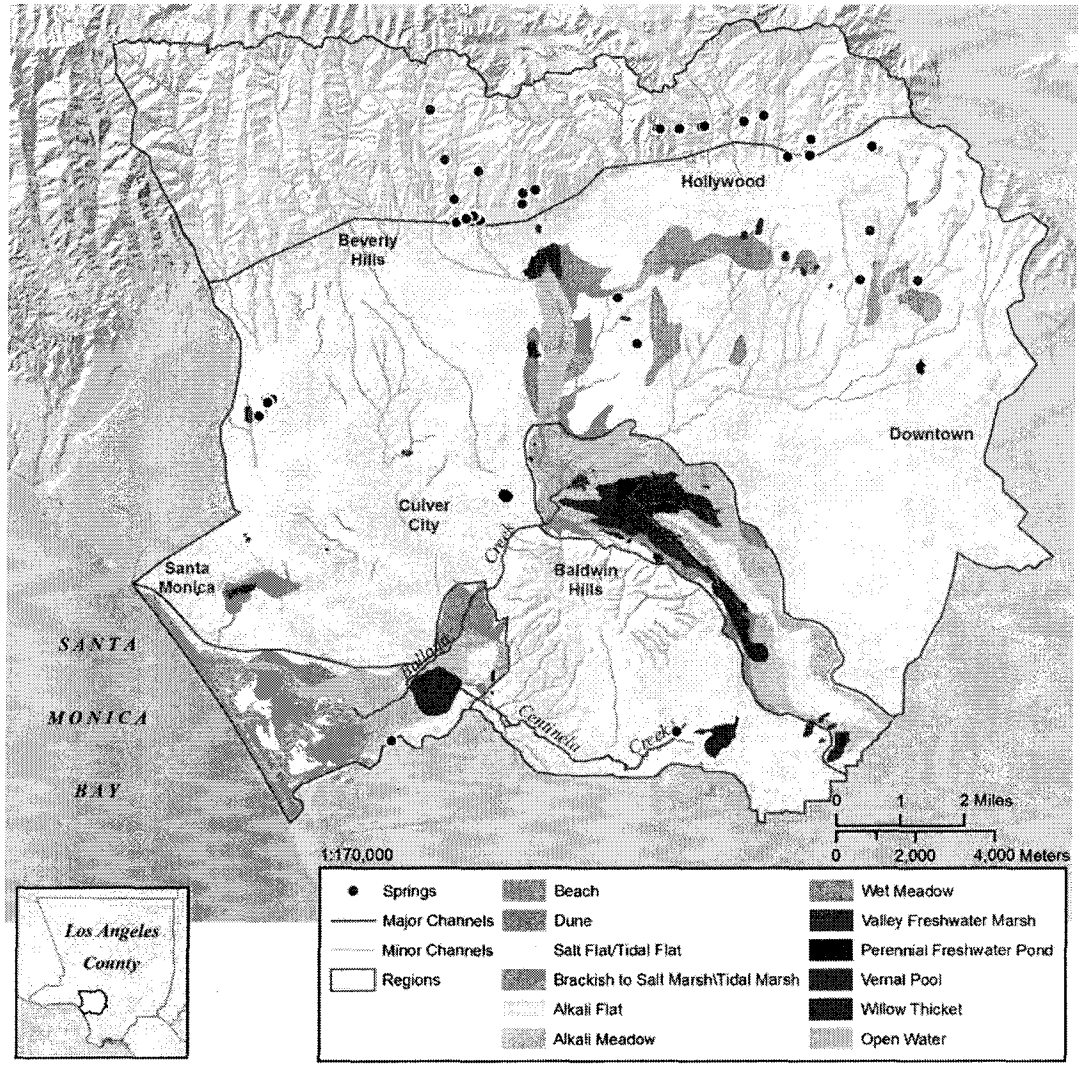


FIGURE 9: *Wetlands mapped for the Ballona Historical Ecology project.*

The historical location and extent of wetlands in the Ballona watershed was extensive compared to their contemporary distribution. Although discrete boundaries of historical wetlands can be challenging to identify in many instances, a few substantial wetland complexes were clearly evident, namely the La Cienega wetlands and the Ballona Lagoon complex. These complexes, in addition to other topographic and ecological factors, were used to organize the Ballona watershed into meaningful units of analysis. The four regions are Ballona Valley, Ballona Lagoon, Santa Monica Mountain Foothills (SAMO), and La Cienega. Key hydrologic features, Ballona and Centinela Creeks were discussed separately (FIGURE 10).

Each of these regions demonstrated a unique profile of wetland types (FIGURE 11). Two significant wetland complexes (La Cienega and Ballona Lagoon) supported the largest extent of wetland habitat in the watershed. Freshwater marsh surrounded by numerous other habitat types (primarily alkali meadows and flats) dominated a broad band of habitat making up the La Cienega complex. Brackish to salt/tidal marsh was the principal component making up the Ballona Lagoon complex, although various other habitat types were present as well. Elsewhere across the valley floor wetland habitat existed but was sparse with the exception of intermittent streams, which were in greater abundance. Various freshwater ponds, vernal pools, wet meadows, and freshwater marshes and numerous springs were found throughout the watershed.

We mapped 232 miles (373 km) of historical stream channels in the study area (FIGURE 10). One characteristic of the channels is their lack of continuity across the watershed, especially in the Ballona Valley region. With the exception of Ballona Creek, virtually every

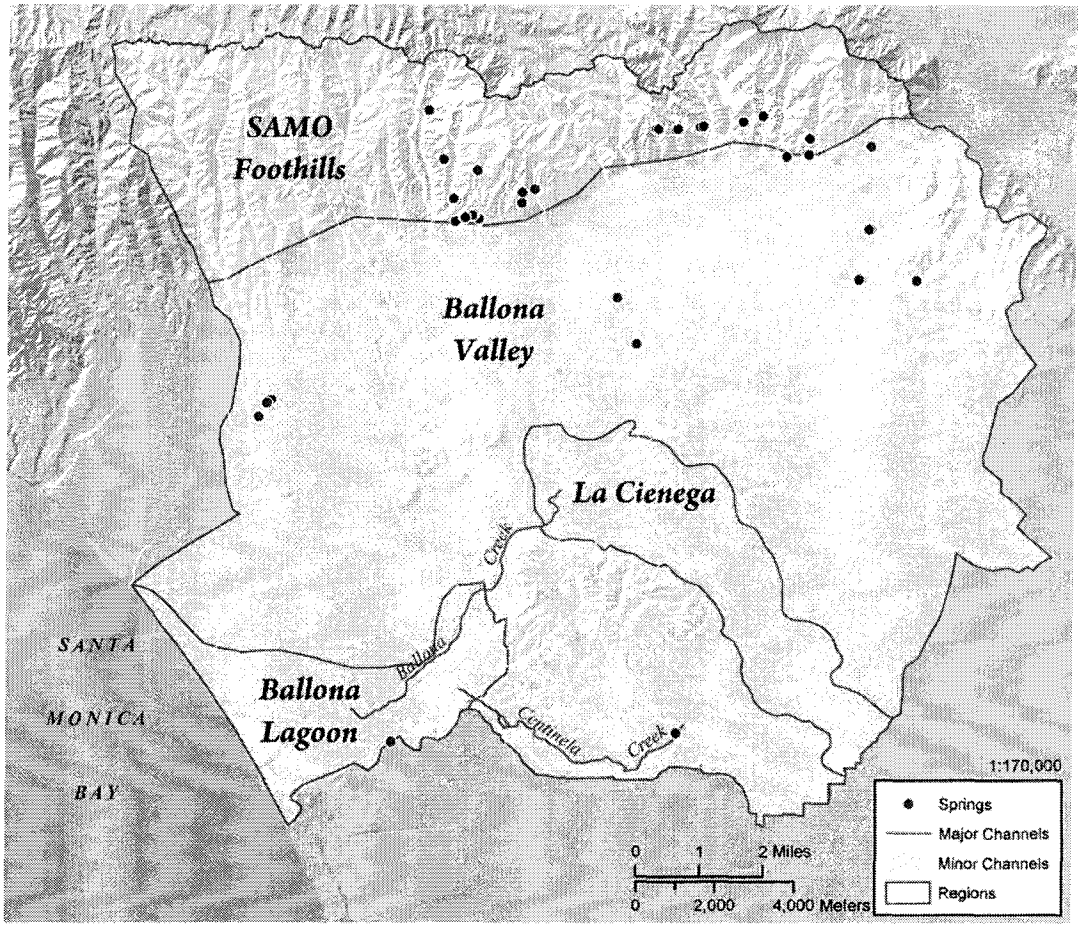


FIGURE 10: *Regions and distribution of springs mapped within the Ballona watershed.*

other channel either sank into porous soils or spread into the major wetland complexes of La Cienega and the Ballona Lagoon. While this characteristic may have contributed to a significant amount of subsurface water flow and consequently to the vast wetland complex at La Cienega, we were unable to discern if this pattern was naturally occurring or the result of land use changes (that may have lowered the water table) during our target time period.

Although springs were present at a few locations throughout the Ballona Valley, 70% of the springs in the Ballona Watershed were found in the Santa Monica Mountain foothills (primarily from Hall 1888; see FIGURE 10). These springs were clustered in the foothills and stopped abruptly at Franklin Canyon. This distribution could be the result of fault displacement or geologic composition.

In the following sections, a landscape profile of wetlands found within each of the regions identified in the study area. The landscape profile includes a review of wetland types, extent, and spatial distribution. In addition, we have included a discussion of stream characteristics within each region.

BALLONA VALLEY

Ballona Valley was the largest region in the study area, comprising the entire valley floor (FIGURE 12). Streams from the surrounding foothill regions drained into the valley floor and in many places disappeared as they flowed across alluvial fans with porous soils. However, in some places spring fed wetlands gave way to wetland and alkali meadows, the dominant wetland types within this region.

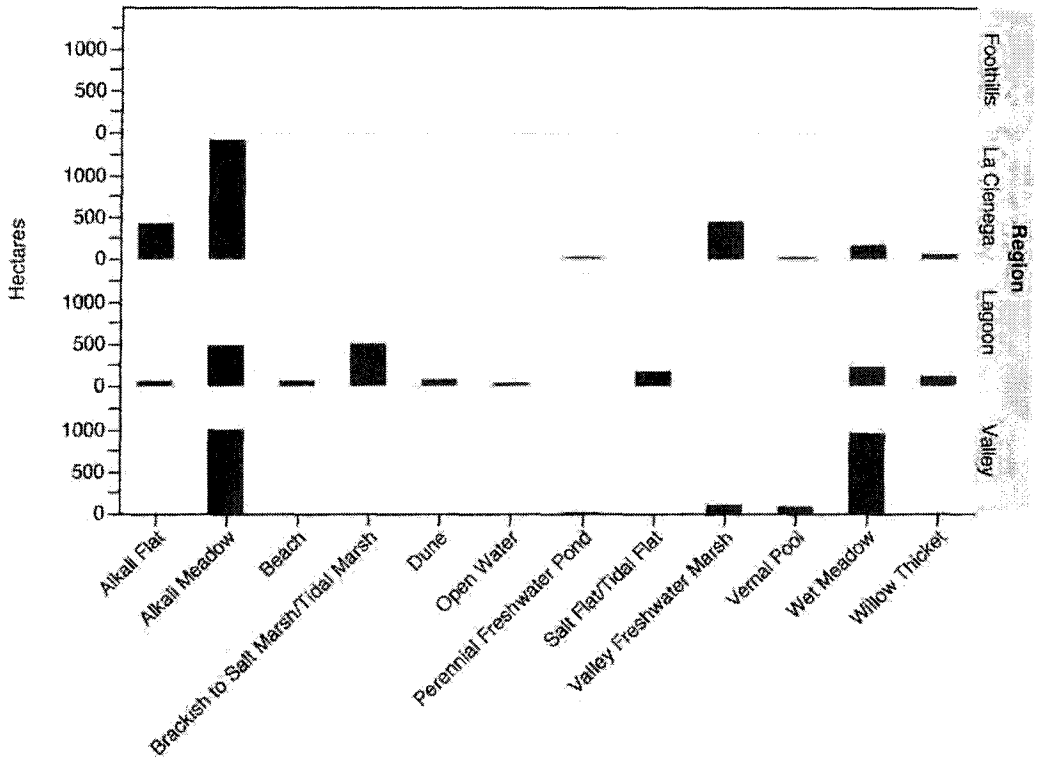


FIGURE 11: *Landscape profile for each region in the Ballona watershed.*

Wetlands

Wetland habitat, excluding streams and associated riparian areas, covered five percent (5,327 acres) of the Ballona Valley region. We mapped five different types of habitat on the valley floor: valley freshwater marsh (242 acres), wet meadow (2,370 acres), alkali meadow (2,479 acres), freshwater ponds (37 acres) and vernal pools (197 acres) (TABLE 4). With just two freshwater ponds and only one lake documented in the historical record, perennial water bodies were scarce throughout the region.

On the other hand, 12 vernal pools, and a significant vernal pool complex were present, probably comparable in flora to vernal pools described for the Los Angeles Coastal Prairie immediately to the south (Mattoni and Longcore 1997). Concentrations existed in both in the southwestern and southeastern portions of the region. One vernal pool located in the southwest portion of the Valley is noteworthy due to its size (16 acres) and an abundance of supporting historical documentation both in narrative and map form (Carson 1883, Solano 1893) (FIGURE 13). This wetland feature is also shown on a Solano Reeves (1893) map which indicates a channel connecting the depression to the Ballona Lagoon.

HABITAT CLASSIFICATION	UNIQUE WETLANDS	ACRES	HECTARES
ALKALI MEADOW	1	2479	1003
PERENNIAL FRESHWATER POND	2	37	15
VALLEY FRESHWATER MARSH	14	242	98
VERNAL POOL	12	197	79
WET MEADOW	14	2370	959
WILLOW THICKET	1	2	1
TOTALS	44	5327	2155

TABLE 4:
Habitat types mapped in the Ballona Valley region of the Ballona Watershed.

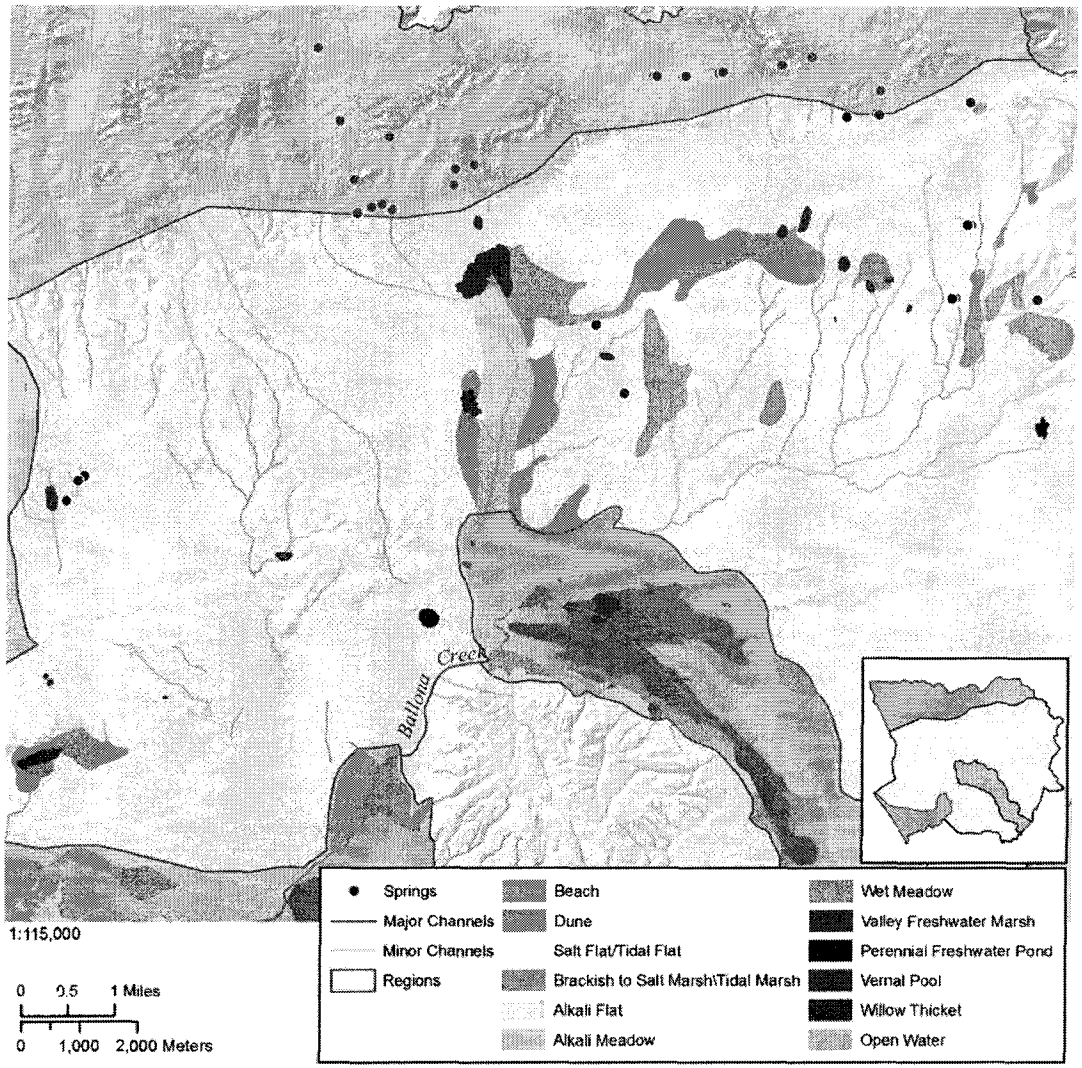


FIGURE 12: *Wetlands of the Ballona Valley region.*

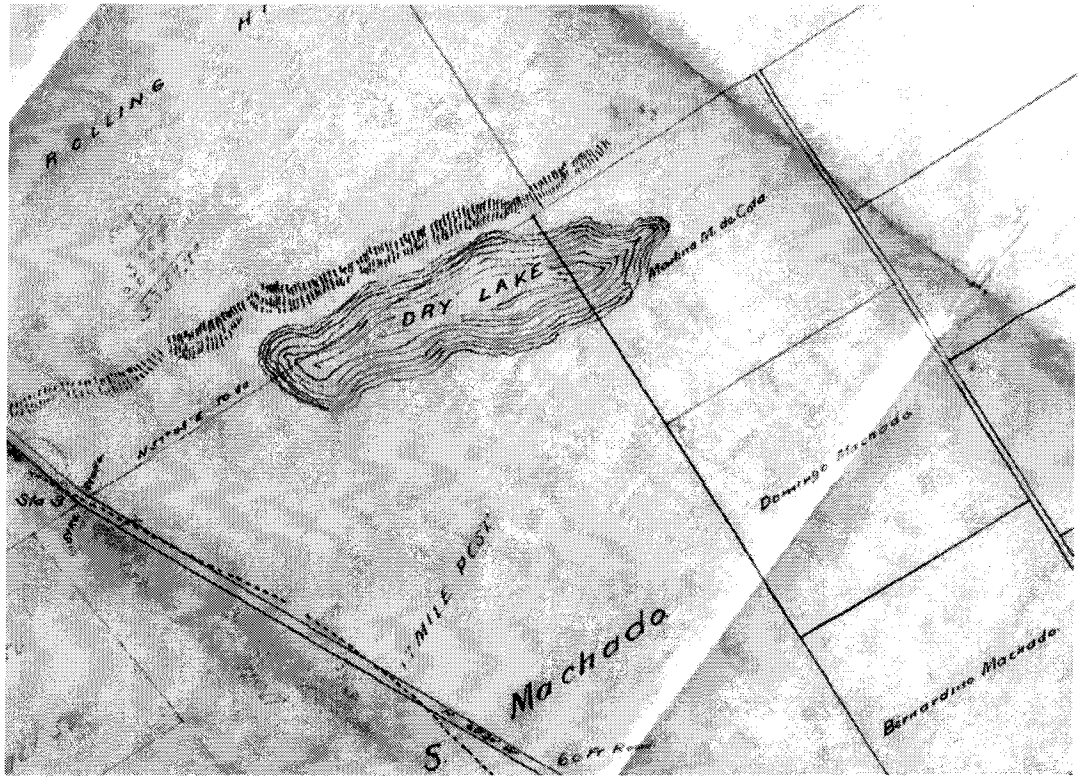


FIGURE 13:
Map (Solano 1893) showing the location of a large vernal pool adjacent to the Ballona Lagoon (Map courtesy of Huntington Library).

The central northern section of the Ballona Valley is also of special interest due to the area referred to as the "Rodeo de Las Aguas" or the "Round-up of the Waters" (Hancock 1949). In this area, streams ran down from the Santa Monica foothills and converged "each rainy season in a broad swamp or cienega" (Benedict 1934, Wilson 1959). This locale marks the northernmost extent of a band of wetland habitat that transitions into the La Cienega system to the south. Valley freshwater



FIGURE 14:
Early diseño map showing the location of a spring and fresh water marsh on Rancho de las Aguas. (Map courtesy of the Bancroft Library).

marsh transitions into wet meadow, which in turn becomes a huge swath of alkali meadow. This area is depicted in detail on historical topographic maps, the Hall irrigation maps, and a diseño of this area (FIGURE 14).

The remaining wetland habitat covering the northeastern sections of the Ballona Valley contained a few pockets of valley freshwater marsh, which, in most cases, were surrounded by wet meadow, the most prevalent habitat type in the area. As Ballona Valley's wet meadows were not clearly and frequently depicted on multiple data sources, polygons were primarily derived from the 1916 soil map offering lower levels of certainty across all categories.

Eleven springs were mapped within the Ballona Valley region. Although most of the springs were not coincident with other wetland features, they were often in close proximity. The absence of a direct physical connection between the springs and other wetlands features

may have been due to the limitations in spatial accuracy of historical data sources, rather than the true locations of the feature themselves. These springs likely played an important role in the early settlement patterns and ranching practices of this region as most settlements were typically located near reliable water sources. FIGURE 15 shows the use of one of these springs for aquaculture (notice a man standing in the background tending to the plants).

Streams

There were approximately 120 miles (193 km) of channels in the Ballona Valley region. Ballona and Centinela creeks are the only two streams consistently identified as perennial in the Ballona Watershed (Hansen 1866, CIU 1874, Hall 1888, Lee 1912, LAT 1914, Mathew 1917). These channels would have been associated with a range of facultative to obligate wetland plant species (as documented in herbaria specimens) but only our channel lines (not polygons) represent the extent of this vegetation. So although riparian and associated stream channel vegetation area is not reported separately, it would have been associated with these linear features, depending on the hydroperiod of the stream. The 1902 topographic map indicates that a few other creeks in the northeast section of Ballona Valley may be perennial, but lack of corroborating evidence limited the interpretation of these creeks' hydrology.

The only intermittent channels that continued out of the SAMO Foothills and down across the valley floor were Brown Canyon and the junction of Franklin and Coldwater Canyons (Giffin 1902, Lee 1912). The northeast section of the region also hosts a fairly continuous network of

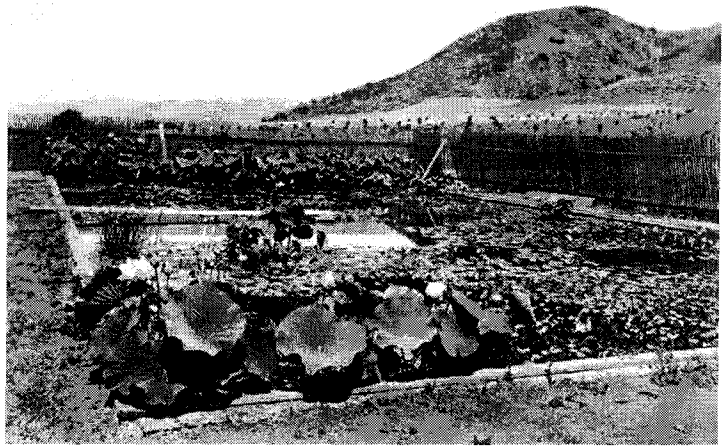


FIGURE 15:
Photograph of a spring being used as a garden in the Ballona Valley (Photo courtesy of the Huntington Library). Note the man standing in the middle of the garden towards the back tending to the plants.

streams that are likely dependent on groundwater presence, as are the springs, valley freshwater marsh, and wet meadow habitat present in that area (FIGURE 16).

Flora and Fauna

The plant species from the Ballona Valley supported the presence of freshwater wetlands, riparian elements, and some scrub (Appendix 1). The bird species confirmed this, but with some difficulty distinguishing between the foothills and the valley from the location data provided in the historical data sets. Obligate wetland plant species included whorled

marsh pennywort (*Hydrocotyle verticillata*), water parsely (*Oenanthe samentosa*), seaside heliotrope (*Heliotropium curassavicum*), chairmaker's bulrush (*Schoenoplectus americanus*), prairie bulrush (*Scirpus maritimus*), marsh milk-vetch (*Astragalus pycnostachyus*), swollen duckweed (*Lemna gibba*), common duckweed (*Lemna minor*), floating primrose willow (*Ludwigia peploides*), curlytop knotweed (*Polygonum lapathifolium*), silver weed cinquefoil (*Potentilla anserine*), yerba mansa (*Anemopsis californica*), and seep monkeyflower (*Mimulus guttatus*) (Appendix 1).

La Cienega

Located at the base of Baldwin Hills, the La Cienega region encompassed approximately 7,012 acres and the complexity of this region was one of the most intriguing aspects of the historical landscape given the contemporary lack of wetlands in this area (FIGURE 17). The historical extent of La Cienaga was large, stretching from present day Hollywood in the north to present day Inglewood in the south; roughly 10 miles in length and up to 3 miles wide in places (Denker 1881). Of the wetlands mapped in this complex, we were highly confident in both interpretation and location certainty. We had less confidence with shape certainty, which reflects the dynamic quality of this complex. In years with high rainfall, this complex was likely large and comprised different types of wetlands (more freshwater ponds and marshes) compared to dry years which probably supported more alkali flats and meadows.

Wetlands

This wetland complex was dominated by alkali meadow (58%), alkali flat (16%), and valley freshwater marsh (16%; TABLE 5). The internal

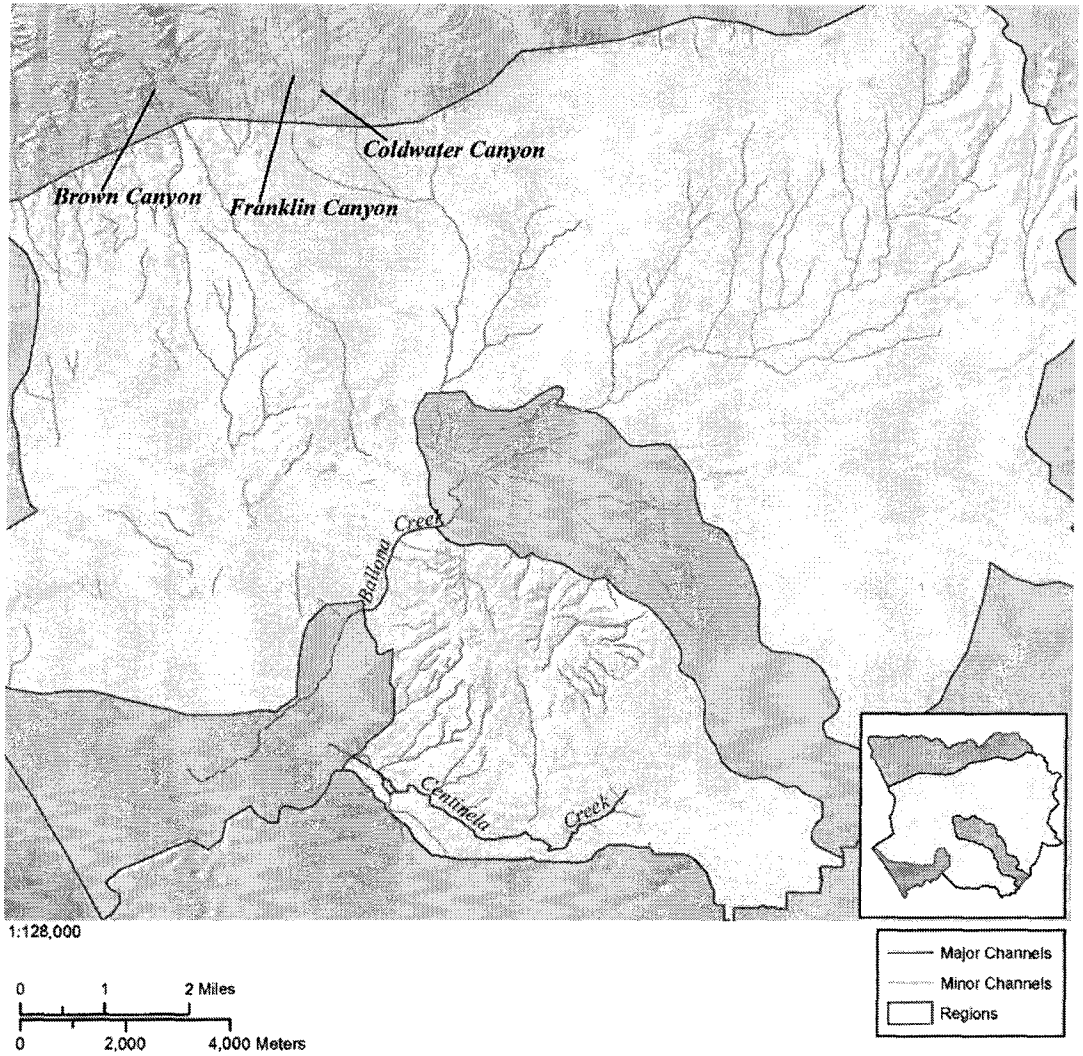


FIGURE 16: *Distribution of creeks and streams in the Ballona Valley region.*

habitat was dominated by valley freshwater marsh and alkali flat, and was surrounded by vast expanses of alkali meadow with wet meadow habitat dotting the periphery of the complex (FIGURE 18, FIGURE 19). The habitat composition also included numerous willow thickets and perennial freshwater ponds (as supported by the Solano Reeves maps). The southwest region of the system is host to a vernal pool complex as indicated by Hansen court dockets (Abila 1859) and consistent with those documented immediately to the south by Mattoni and Longcore (1997).

Streams

Approximately 18 miles (29 km) of streams and sloughs traversed the La Cienega region. We did not designate many permanent channels in this complex because data indicated that it was extremely dynamic; channels appeared to be continually changing location and even disappearing, as the greater wetland complex engulfed them during very wet seasons (Reagan 1915). An absence of any references to channel names in historical sources appears to support this theory.

HABITAT CLASSIFICATION	UNIQUE WETLANDS	ACRES	HECTARES
ALKALI FLAT	4	1137	427
ALKALI MEADOW	17	4085	1434
PERENNIAL FRESHWATER POND	5	68	28
VALLEY FRESHWATER MARSH	21	1114	449
VERNAL POOL	3	63	26
WET MEADOW	5	404	164
WILLOW THICKET	11	141	57
TOTALS	66	7012	2838

TABLE 5:
Habitat types mapped in the La Cienega region of the Ballona Watershed.

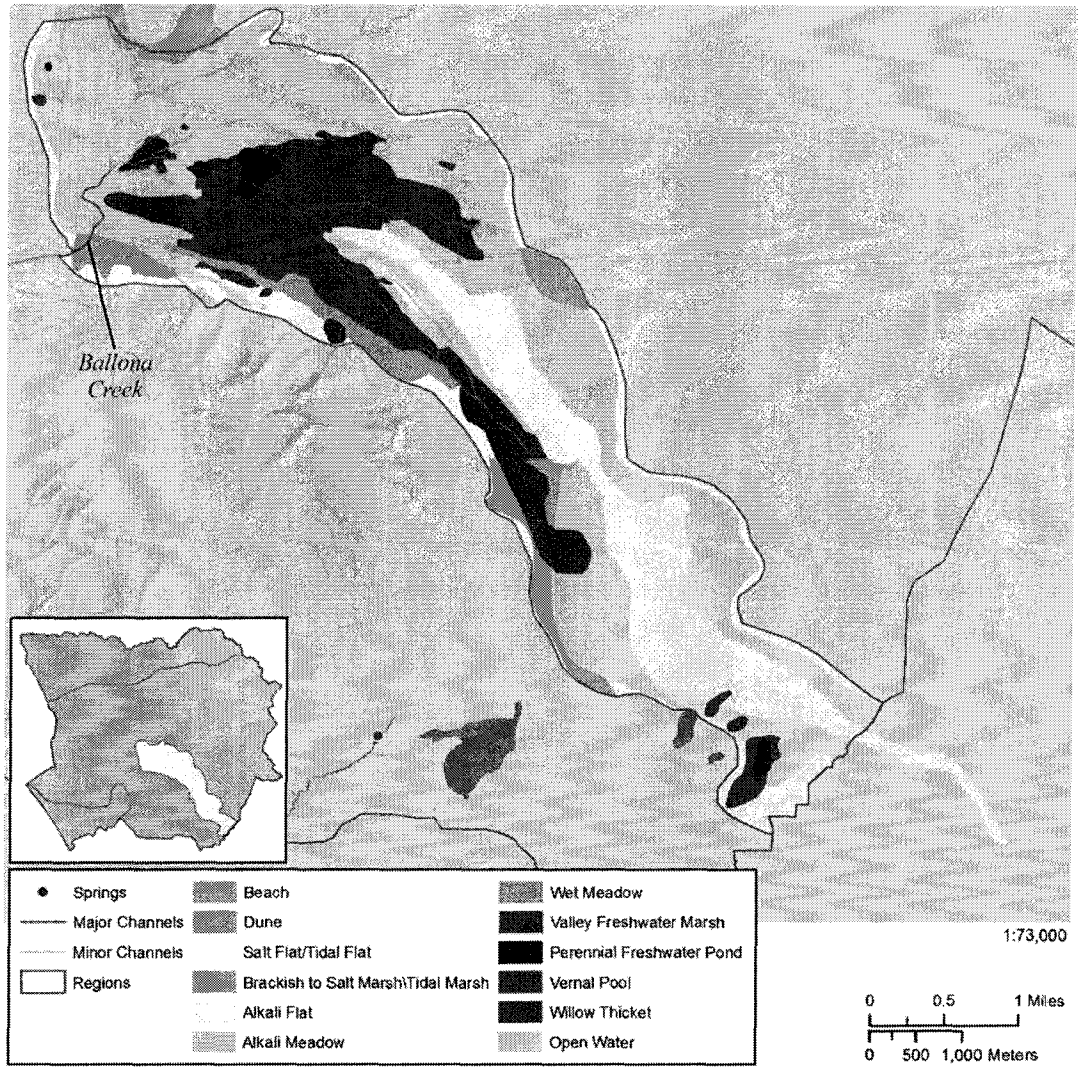


FIGURE 17: *Wetlands mapped within the La Cienega region. This complex extended beyond the watershed boundary.*

Flora and Fauna

Botanical records from La Cienega conclusively document the presence of extensive perennial and ephemeral freshwater wetlands and alkali meadows in this region (Appendix 2). Records indicated that La Cienega supported many types of sedge and rushes, and even rare species like marsh milk-vetch (Astragalus pycnostachyus var. lanosissimus; once thought extinct) and interestingly also Braunton's milk-vetch (Astragalus brauntonii). The language on the herbarium records describes the region mostly as "Cienega," but sometimes also "Cienega swamp," "Culver City marshland," and "marsh at Cienega." Bird nest records from our target species included Black Phoebe ("Under bridge across from Baldwin's sloughs") and Common Yellowthroat ("Tules, in swamp").

Ballona Lagoon

The Ballona Lagoon was a large (4,288 acres) and diverse system. The historical lagoon extended from the base of the bluffs to the south all the way to the intersection of Main St and Abbot Kinney to the north, and as far east as Overland Blvd. Historical narratives, such as Reagan (1917), provide strong support to suggest that the size of the greater wetland system was dynamic and heavily influenced by winter rains: "This area was called Ballona Swamp. In rainy winters Ballona Swamp extended over nearly all the low ground as far back as the present site of Culver City, then called "The Palms," and running over to the Inglewood Mesa, an area about ten miles square." (Chambers 1936).

This area encompassed a tremendous diversity of wetland habitat types, more so than any region within the study area (TABLE 6). This is likely due to the juxtaposition of freshwater and brackish environments

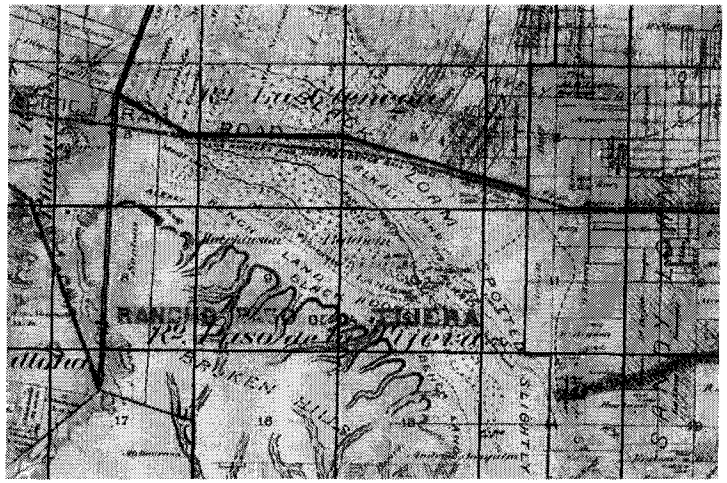


FIGURE 18: *Hall irrigation map (1888), notice the reference to alkali land. [courtesy of California State Archives].*



FIGURE 19: *Alkali lands in the La Cienega wetland complex at the base of Baldwin Hills (photo courtesy of Los Angeles Public Library, date unknown).*

and the complexity of the hydrodynamics of the system. This complexity was likely enhanced by the change in the volume of freshwater input and the assumed frequency of mouth opening associated with the re-alignment of the Los Angeles River. T-sheet analysis by Grossinger et al. (2011) focused specifically on mapping habitats as depicted by the T-sheet and did not include additional sources. As with other historical ecology studies (e.g., Beller et al. 2011), the use of additional historical data sources revealed additional information. For example, our research determined that the use of the term tidal in reference to habitat associated with the lagoon was too limiting. Our data suggests that at most times, this low energy system had only moderate or no tidal influence and was dominated by freshwater inputs from the watershed (see Jacobs et al. 2011). The textual sources indicate complete closure of the system from the ocean through substantial portions of the year, opening only during periods of significant rainfall (LAT 1887; see discussion in Jacobs et al. 2011). Consequently, we broadened our classification from tidal flat to salt flat/tidal flat and from tidal marsh to brackish to salt marsh/tidal marsh. In addition, we were able to map transitional estuarine–upland habitats not mapped on the T-sheet project such as the presence of willow groves and akali flats located at the confluence Centinela Creek and the inland extent of the estuary.

HABITAT CLASSIFICATION	DISTINCT WETLANDS	ACRES	HECTARES
ALKALI FLAT	1	147	59
ALKALI MEADOW	4	1118	481
BEACH	2	159	64
DUNE	8	187	76
OPEN WATER*	8	96	39
PERENNIAL FRESHWATER POND	1	5	2
SALT FLAT/TIDAL FLAT	15	423	171
BRACKISH TO SALT MARSH/TIDAL MARSH	18	1239	498
WET MEADOW	5	562	228
WILLOW THICKET	1	282	115
TOTALS	63	4298	1743

*DOES NOT INCLUDE PACIFIC OCEAN

TABLE 6:
Distribution of habitats associated with the Ballona Lagoon.

Wetlands

The historical mouths of both Ballona and Centinela Creeks emptied into the lagoon complex at different locations (Lee 1912); the Centinela tributary further inland into a large willow thicket, and the Ballona tributary closer to the coast into the brackish to salt/tidal marsh habitat (FIGURE 20). The 1825 migration of the Los Angeles River dramatically reduced flow into the lagoon area and the wetland distribution that developed since that time likely reflected a process of equilibration to this new flow regime. As a consequence, efforts to obtain consistent corroborating evidence for the system were difficult. The documentation that exists, aside from the USCS T-sheet (Chase 1876), often provided conflicting and broad descriptions as to the historical habitat and ecological communities in the complex. Apparent inconsistencies in the historical record may have also resulted from the dynamism inherent in coastal lagoons leading to different physical and biological conditions at different points in time. What is clear is that the system was an expansive marshy area that supported both abundant wildlife, and later on, extensive human activity such as fishing, hunting and boating (Ingersoll 1908, Adler 1969, Wittenberg 1973).

Approximately half of the aggregate Ballona Lagoon area consisted of a freshwater and tidally affected saltmarsh and brackish habitats that transitioned into a more alkaline/freshwater system about 1.5 miles (2.4 km) inland. Historical habitat of the Ballona Lagoon coastal complex consisted of substantial amounts of brackish to salt marsh/tidal marsh habitat (29%), followed by salt flat/tidal flat (10%). Open water made up less than 3 percent of the lagoon and one of the more salient features of the complex was a long but narrow strip of open water referred to by some as a "lake" at what we call today Del Rey/Ballona Lagoon (Sheridan 1887). This strip of open water periodically emptied into the ocean at the documented location of seasonal tidal access (FIGURE 22). We found no evidence that the lagoon remained perennially open, but rather the textual sources indicate that access to the ocean depended on hydraulic forces during any given year (LAT 1887, Sheridan 1887, Hansen and Jackson 1889, Solano 1893). The migration of the Los Angeles River away from the lagoon transitioned the system into a lower energy system where only on rare occasions was there enough freshwater flow from Ballona Creek to break through the buildup of sediment along the coast. As a result, gradual build up of sediment around the terminus of the previous estuary formed dunes and created this "trapped" lake-like feature. The coastal dunes, which occupied four percent of the Ballona Lagoon coastal complex, played a significant role in the formation of the lake and the limited tidal access (see Jacobs et al. 2011).

Inland areas of the Ballona Lagoon were dominated by alkali meadow, with less wet meadow. Water from Centinela Creek also flooded into this area contributing to the formation of an extensive willow thicket which covered approximately 280 acres. Diseno maps

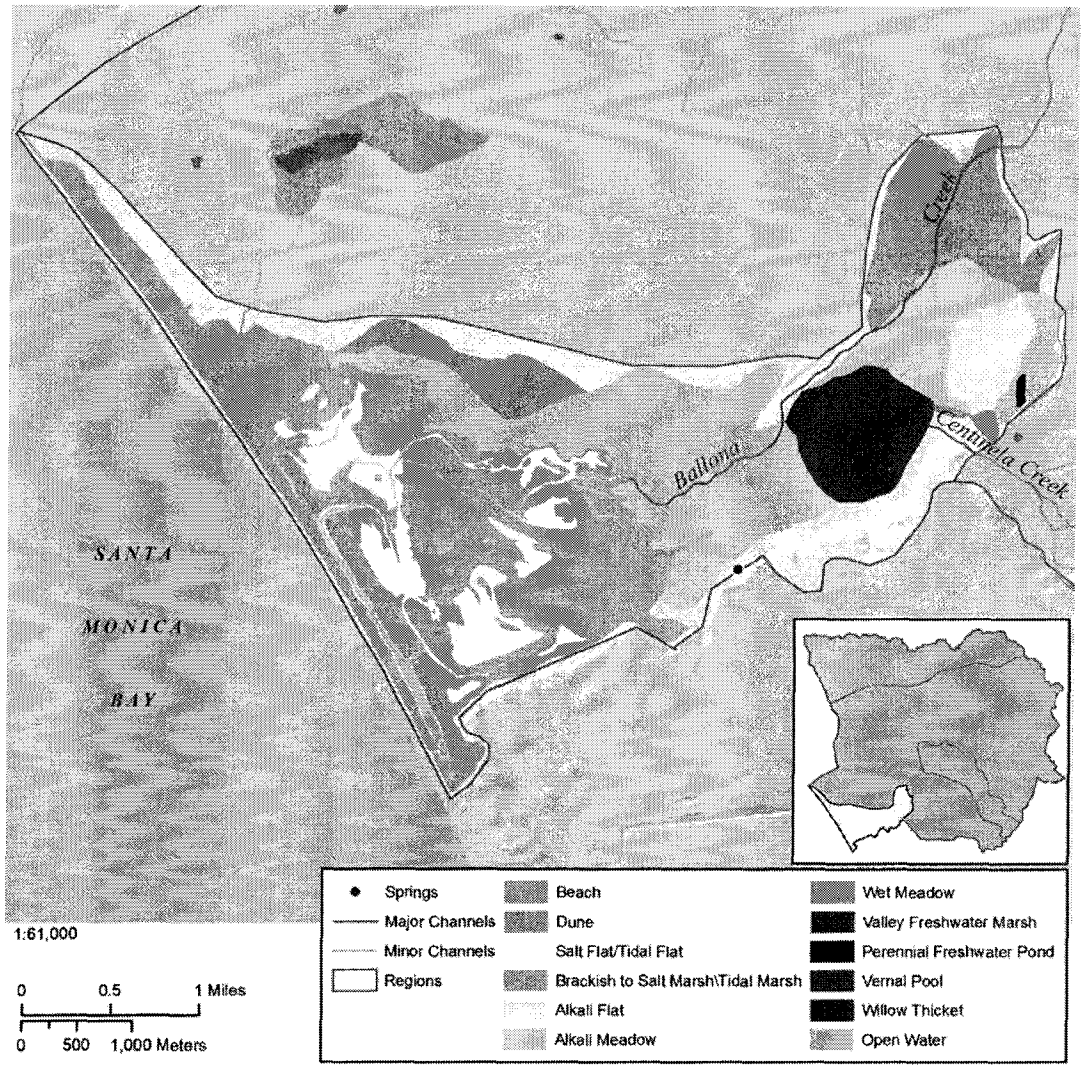


FIGURE 20: *Wetlands mapped in the Ballona Lagoon region of the Ballona Watershed.*



FIGURE 21:
Man boating on Ballona Lake (photo courtesy of Los Angeles Public Library, date unknown). Notice the dunes surrounding the lake.

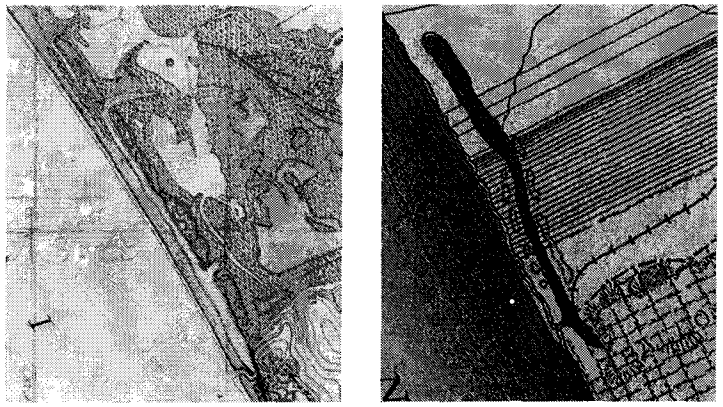


FIGURE 22:
Maps demonstrating the location of Ballona Lagoon (a) Chase T-sheet (1876) and b) Hall irrigation map (1887).

(FIGURE 23) clearly depict a large willow grove or thicket, and ancillary data sources such as the 1894 topographic map and alkali soils map support the delineation and classification of this wetland habitat. Alkali flat comprises 147 acres of the inland lagoon, and a single five-acre freshwater pond sits in a small depression on the southeastern edge of the system.

Streams and Tidal Channels

The coastal region of the Ballona Lagoon contained extensive drainage channel networks as illustrated in the USCS T-sheet (Chase 1876). These channel networks served in part to connect salt flat/tidal flat habitat, and ultimately drain into the long "lake" described previously. Ballona and Centinela creeks were the only substantial freshwater channels to enter the upper lagoon system. Ballona Creek terminated at the head of the tidal portion of the complex. Centinela Creek entered the upper lagoon region just south of Ballona Creek.

Flora

Herbarium records provide a picture of freshwater to brackish and some saltwater wetlands in this region (Appendix 3). Species of perennially open tidal wetlands (e.g., cordgrass) are not found in the older records. Rather, brackish, freshwater, and salt marsh species are represented in the records. All of the dune species are also recorded in this region as these habitats interweave with the wetlands. Of the riparian bird species we surveyed, Song Sparrows are recorded nesting in the tules at the Lagoon. The brids of the lagoon region and the changes in composition over time have been discussed previously by Cooper (2006).

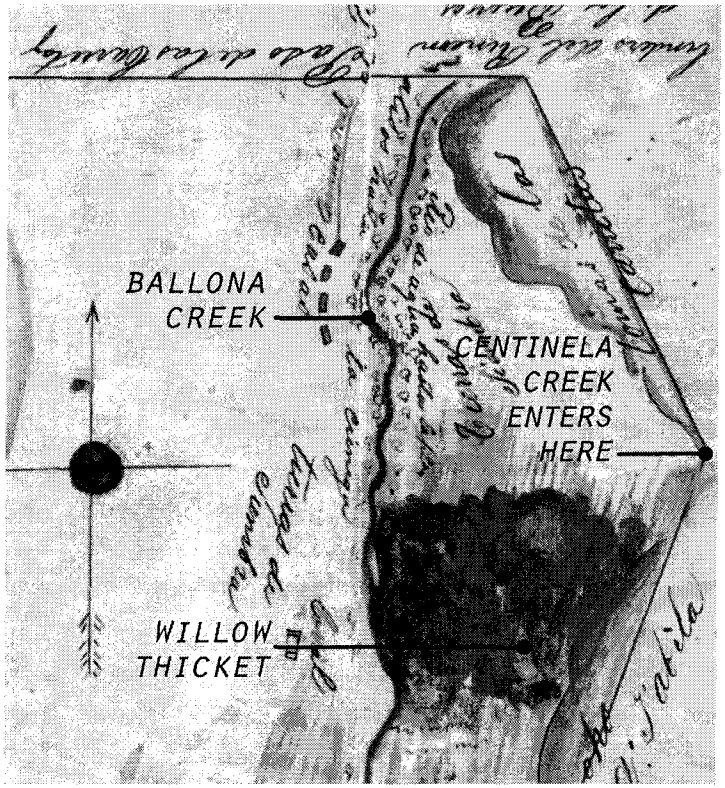


FIGURE 23:
Diseno map (circa 1860) demonstrating the location of a willow thicket at the confluence of Ballona and Centinela Creek (not shown on map). (Map courtesy of the Bancroft Library).

Santa Monica Mountain Foothills

Located in the northern-most section of the Ballona watershed, the Santa Monica Mountain Foothills (SAMO) are composed entirely of steep canyons (FIGURE 24). This region is dominated by approximately 97 miles of intermittent channels and 29 springs. No other wetland habitat type was documented in historical sources. According to one narrative source, "In the winter time, when the rains came the gullies ran full and overflowing from the mountain. That would only last for two or three days and then it would be gone" (Eckhardt, 1966).

One notable geographic trend is the absence of springs along the western section of the foothill region. This could be the result of local trends in geomorphic composition or displacement caused by faulting. These springs played a notable role in downstream hydrology, where in several locations freshwater wetlands formed at their confluence (particularly in Rodeos de las Aguas as discussed in the Ballona Valley regional description above). Many of these springs persist today and are unique remnant features from the historical landscape (FIGURE 25).

Flora and Fauna

The flora of the foothills includes the expected chaparral and coastal sage elements, but also documents the presence and diversity of the riparian habitats associated with perennial and ephemeral streams (Appendix 4). Obligate wetland species included cutlear water-parsnip (*Berula erecta*), saltmarsh baccharis (*Baccharis douglasii*), mosquito fern (*Azolla filiculoides*), California tule (*Scirpus californicus*), basket rush (*Juncus textilis*), rigid hedge nettle (*Stachys ajugoides*), valdiva duckweed (*Lemna valdiviana*), California loosestrife (*Lythrum californicum*), willow dock

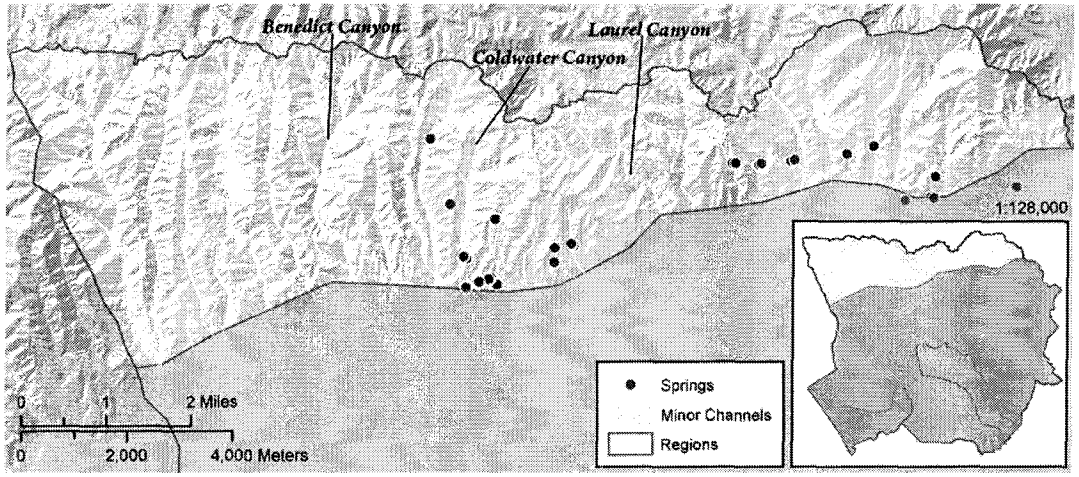


FIGURE 24:
SAMO region showing location of springs and streams.



FIGURE 25:
Bridge over Franklin Canyon, 1890 (photo courtesy of the Seaver Collection at the Natural History Museum).

(*Rumex salicifolius*), sago pondweed (*Stuckenia pectinata*), and seep monkey flower (*Mimulus guttatus*). The nest and egg records showed the breeding presence of a range of riparian-associated bird species, including Black-headed Grosbeak (in willows, "grape vine," and sycamores), the now-endangerd Least Bell's Vireo (in sycamores, willows, and "elder"), Yellow Warbler (in willows), House Wren (in willows), Long-tailed Chat ("blackberry vines in willow thicket," "tangle of briars"), Little flycatcher ("thicket, near stream"), and Western Wood-Pewee (in oaks).

Ballona and Centinela Creeks

Ballona and Centinela creeks were the dominant fluvial features in the Ballona watershed. Both channels played major roles in the formation, development and usage of the surrounding landscape. Likewise, both channels were the primary streams supplying water to the Ballona Lagoon.

Ballona Creek

Although we classified Ballona Creek as a perennial channel (Hall 1888, Giffin 1902, Adler 1969), we were surprised at how relatively little other historical information was available for the most significant channel in the watershed. In retrospect, we realized that this lack of information was related to the relatively short length of the fluvial channel. Contemporary channelized Ballona Creek is a fairly long hydrologic feature, but the historical span was only 5.7 miles (9.2 km) long prior to 1900, when expansive wetlands dominated the adjacent areas. The two ends of Ballona Creek were effectively subsumed by the La Cienega and Ballona Lagoon wetland complexes and the creek provide surface hydrologic linkage between these two larger wetland complexes (FIGURE 26).

Several smaller drainages flowed into the La Cienega wetlands, but none appeared to be continguous with Ballona Creek; therefore, we interpreted the origin of Ballona Creek proper to be at the outflow of the La Cienega complex.

As indicated by textual descriptions such as the one below and various map sources, the Creek's historical terminus was the Ballona wetland complex (Solano 1868, Carson 1883 Adler 1969). The contemporary location of the channel is remarkably similar but now extends substantially farther upstream and downstream than it did historically.

> *"Out from the central springs of the upper belt - on the ranchos La Brea and Rodeo de las Aguas - Ballona creek gathers its upper perennial waters, leads them south against the base of the Centinela hills. Here, reinforced by a little stream from the east, draining the springs of the ranchos La Cienega and Paso de la Tijera, it turns west and southwest, parallel with the hill's footing, into the Ballona flats and the sea five to six miles away" (Hall 1888).*

Where Ballona Creek flowed independently from the surrounding wetlands, narrative accounts support the description of a clear flowing "stream"lined with sycamores, willows and tules, which, on occasion, inundated the surrounding lands during times of flooding (LAT 1906, Robinson 1942, Wittenberg 1973). Tributaries of Ballona Creek originated far to the north (potentially via the Los Angeles River), and throughout the La Cienega wetland complex (LAT 1906). As described by Hall in 1888.

Centinela Creek

Centinela Creek was largely a spring fed channel just over 4.5 miles (7.2

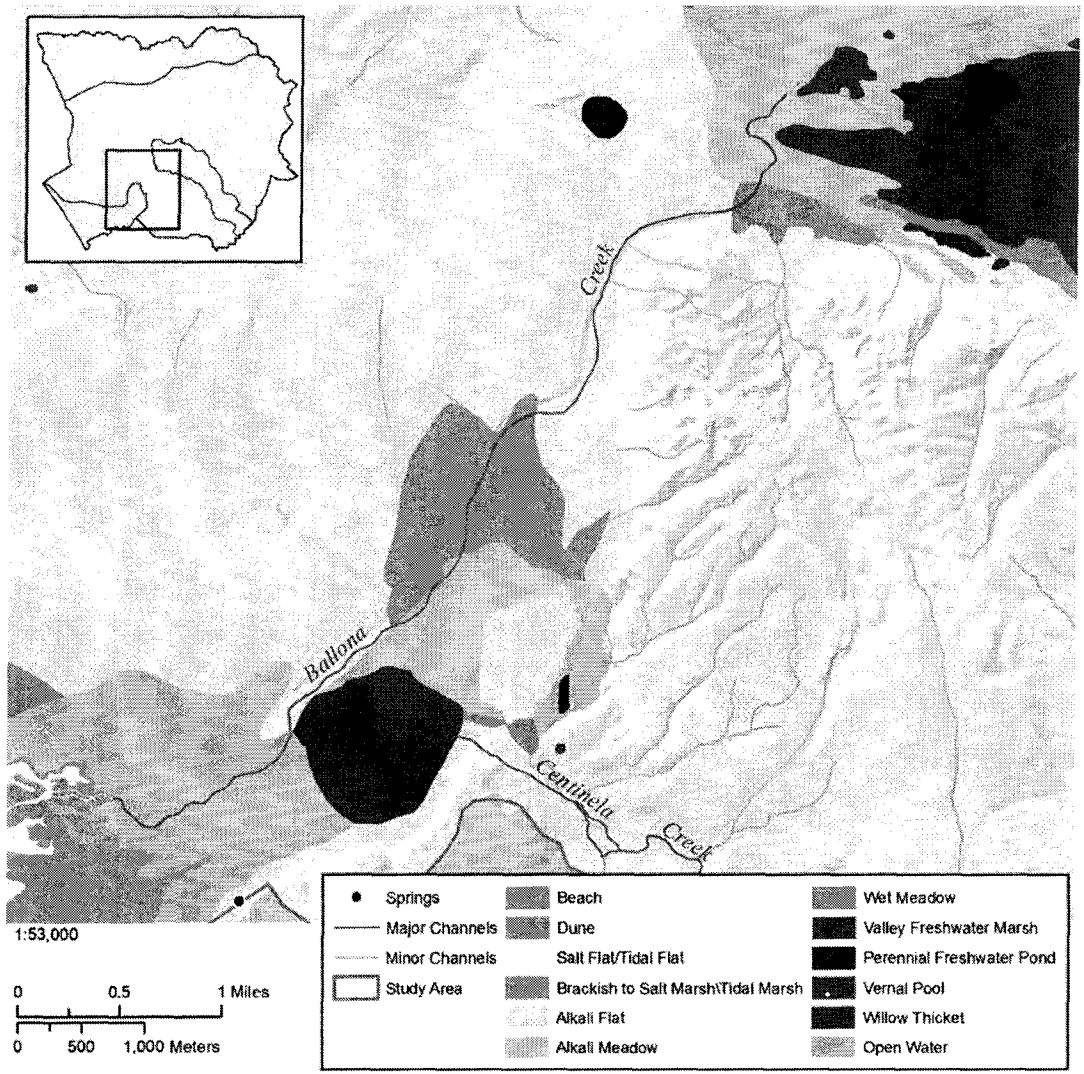


FIGURE 26: *Extent of Ballona Creek.*

km) long, originating at Centinela Springs (FIGURE 27) in the Inglewood area, and draining most of the lands in the surrounding region (Hansen 1867, CIU 1874). As with Ballona Creek, historical documentation was limited, and mainly focuses on the Centinela Springs and surrounding lands of Centinela rather than the Creek itself. Records indicate that the Creek was a perennial stream that provided consistent and ample flow for both domestic and agricultural uses (Hansen 1867, LAT 1873, CIU 1874). The surrounding lands and rich soils of Centinela produced a region ideal for agriculture (LAT 1873, CIU 1874). Several documents described the creek morphology, for example:

> *"The bottom of the Creek from the Spring to St. 16 is from 660 to 1320 feet wide, the banks, from 20 to 30 feet high and steep from station 16 North westerly the bottom widens out and the banks are less abrupt" (Hansen 1867).*



FIGURE 27: *Photograph of Centinela Springs (date unknown, photo courtesy of the Huntington Library).*

Compared to the channelized, short extent of contemporary Centinela Creek, historical Centinela Creek maintained significant sinuosity as it wound its way through the lands of Centinela. Depth and volume of the historical Creek was "over 75 miner's inches of water (3 acre feet/day)" (LAT, 1904). At its terminus, Centinela Creek emptied into the southeastern part of the Ballona Lagoon promoting the formation of a large willow thicket (Lee 1912; FIGURE 28).

Flora and Fuana

The plant records for Ballona Creek are found largely in the Lagoon category for the lower creek, frequently refered to as "Ballona Creek, near Mesmer." Other records are from the relatively short Culver City section between the marshes of the Cienega and the start of the coastal wetland complex. The flora of Centinela Creek was classified with Inglewood because insufficient records speificially identified the creek (Appendix 5). These records also show presence of vernal pools through the presence of spreading navarretia, which is found in vernal pools and alkali grasslands, and is now federally endangered. None of the riparian bird nest records were from this region.

OVERALL CONFIDENCE IN MAPPED POLYGONS

Estimated confidence in the historical analysis was based on three factors; interpretation of data sources, wetland location, and wetland shape. Interpretation of data sources and the shape of wetlands mapped had the highest confidence classifications (FIGURE 29). This is not

CERTAINTY	INTERPRETATION	SHAPE	LOCATION
HIGH	9	3	6
MEDIUM	91	48	75
LOW	0	49	19
TOTALS (%)	100	100	100

FIGURE 29:
Percentage of wetland area mapped in each certainty category.

surprising given the dynamic nature of wetlands in the study area. While a wetland feature may have been persistent on multiple sources it may have been much larger or smaller depending upon the amount of rainfall in any given year.

Certainty estimates based on habitat type were also analyzed. We were the most confident in our interpretation of alkali flats and valley fresh water marsh, both habitat types had certainty classifications of high for 80% of the associated polygons mapped. Salt/tidal flat had the lowest interpretation certainty given the inconsistency of the data sources for the Ballona Lagoon region with regard to tidal influence.

Habitat maps with the greatest confidence in shape and location were; alkali flats, beach, salt/tidal marsh, and salt/tidal flats. Beach, salt/tidal marsh, and salt/tidal flats were all mapped from the detailed USGS T-Sheet (Chase 1876). Given our knowledge of the detail and spatial accuracy of these maps we feel confident in the general location and shape of these features. The location and shape of vernal pools and willow thickets had the lowest confidence classification, with both receiving a classification of low in these categories for about 70% of the polygons mapped. This may reflect the dynamic nature of these habitat types. Vernal pools are heavily influenced by annual precipitation,

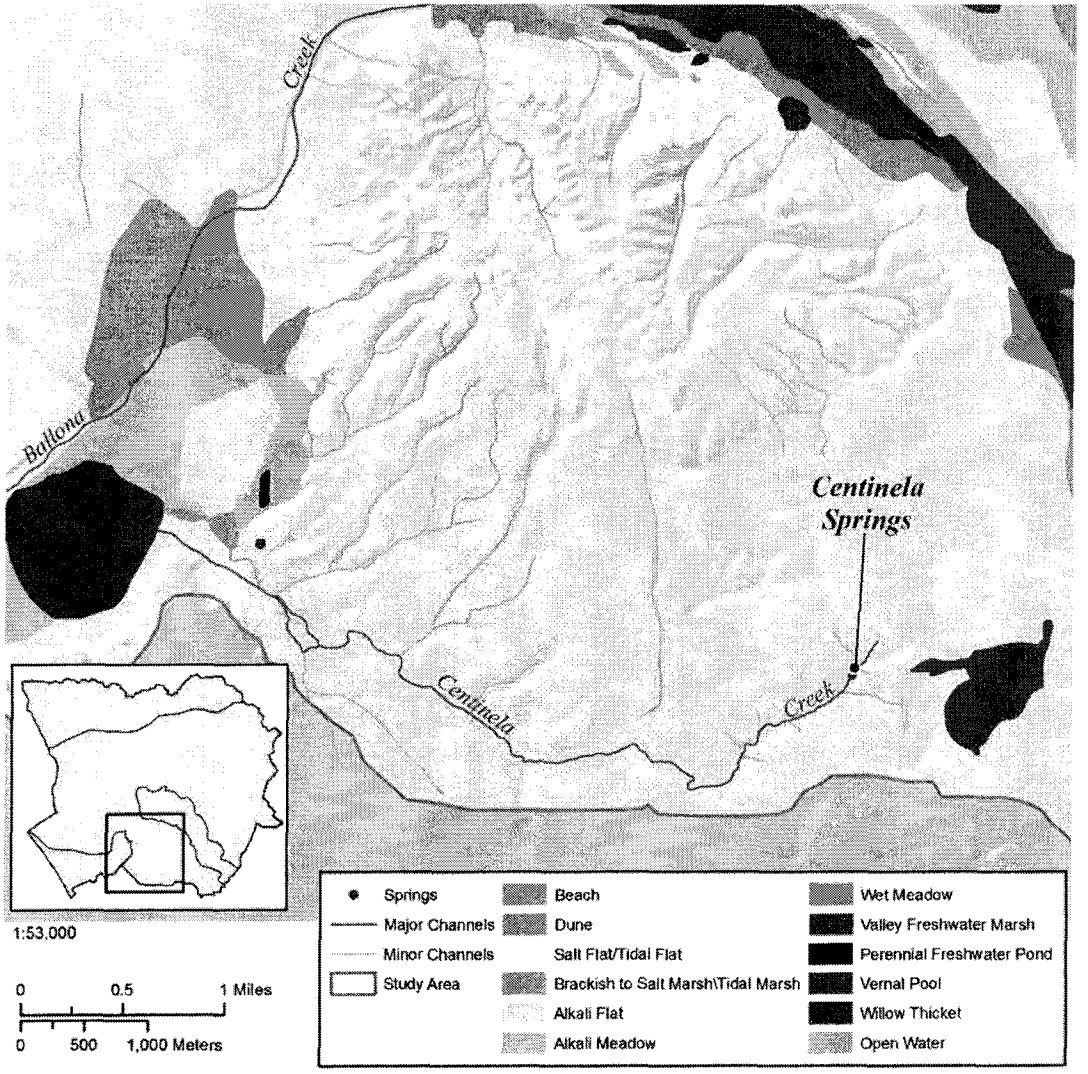


FIGURE 28: *Extent of Centinela Creek.*

therefore during dry years there were likely to be less data sources available documenting their location and shape with consistency. Willow thickets were only found on the early diseno and docket maps, but not present on any other maps from the late 19th century. It may be these thickets were so small they were not identified on more coarse scale maps. Also, it could be they were modified by humans early given their location relative to fresh water and the likely fertile soils they are found on.

SUMMARY

This research outlined above demonstrates the impressive complexity and diversity that was characteristic of southern California's wetland ecosystems. The dynamism of surface waters in combination with broad shallow aquifers supported vast expanses of alkali flats, alkali meadows, wet meadows, and salt/tidal associated wetlands. Vernal pools, freshwater ponds, and willow groves were also evident, contributing to a tremendous diversity of wetland habitats and consequently large amounts of biodiversity that were historically present within the watershed.

The question remains, how do we bridge this knowledge of the historical Ballona watershed to contemporary landscape management plans? The knowledge of reference conditions often creates considerable discussion about what should be restored, how, and where. We consider this discussion to be an extremely valuable process for restoration of wetlands within this watershed. Clearly, it is unrealistic to have the expectation that systems can be restored to their natural hydrodynamics. The vast alkali meadows of the La Cienega region cannot be realistically restored in the contemporary urbanized landscape. Application of the findings of this study is largely dependent on the extent of human modification, the confidence of historical interpretations, and the intended purpose of restoration. We do not believe the results from this study drive toward one specific endpoint, but may support numerous alternatives for a particular project. In fact, the ensuing discussions about restoration and the iterative process by which further understanding is developed are a valuable outcome from this project.

NEXT STEPS

This project provides significant insight into the historical landscape of the Ballona watershed. The development of living tools such as the metadata catalog and Ballona Historical Ecology website will hopefully encourage further historical research of wetland resources in this region. As stated at the beginning of this report, we provide a summary of the historical watershed characteristics. This report has a limited focus on the interpretation of data created. We do not interpret or analyze landscape change or discuss implications for management. Future efforts can build upon the foundation provided by this project through the exploration of key issues such as:

1. An analysis of how the ecosystem functioned over time, including factors that affected local and regional habitats. Broadening the temporal scale to include human impact would create a better understanding of the key drivers influencing changes within this unique landscape.
2. A more detailed analysis of the distribution of specific plant communities.
3. An examination of where the greatest losses occurred, both geographically and in terms of specific habitat types.
4. A linkage between our results and potential restoration options in light of current day landscape constraints.

The datasets and living tools provided on the Ballona Historical Ecology website may serve as valuable resources to initiate research in some of these areas.

A common theme running through some of the unanswered questions in this report is the lack of information about the historical ecology of the Los Angeles River. Attempts to understand the history of the Los Angeles River have been made through a variety of mediums (Gumprecht 1999, Elrick and FOLAR 2007). However, there has been little detailed work focusing on the historical wetland habitats, hydrodynamics and associated impacts of the Los Angeles River on connected systems such as the Ballona Watershed and the San Gabriel River watershed. We believe this report offers an opportunity to understand the value and need of such research, not just within the regional landscape but also to better understand the historical ecology of wetland ecosystems throughout Southern California.

In addition to furthering our understanding of the Los Angeles River, there is also a need to better connect the historical ecological research being performed throughout southern California with contemporary landscapes. For example, creating a cross-walk between contemporary and historical habitat classifications would be immensely helpful for restoration purposes. Likewise, the identification of specific sites that could be restored and the options for restoration given the historical ecology would be immensely helpful.

This project has provided a unique opportunity to collaborate across disciplines and within groups currently involved in historical ecology efforts throughout the state of California. We were able to create living tools such as the metadata catalog and the Ballona Historical Ecology website that allow for a coordinated exchange of information in both data collection efforts and visualization of the study area. These tools set a precedent for future research and lend to further development on future projects.

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Additional information on historical ecology in southern California, can be obtained from **www.csun.edu/~centergs/**. Digital products associated with this project can be obtained at **www.ballonahe.org**.

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APPENDIX 1.
PLANT SPECIES RECORDED IN THE BALLONA VALLEY REGION

FAMILY	SPECIES	COMMON NAME	WETLAND
Apiaceae	*Hydrocotyle verticillata*	whorled marsh pennywort	OBL
Apiaceae	*Oenanthe sarmentosa*	water parsley	OBL
Apiaceae	*Tauschia arguta*	southern umbrellawort	
Asteraceae	*Ambrosia acanthicarpa*	annual bursage	
Asteraceae	*Ambrosia psilostachya*	western ragweed	FAC
Asteraceae	*Ambrosia psilostachya var. californica*	western ragweed	FAC
Asteraceae	*Chrysothamnus nauseosus*		
Asteraceae	*Conyza canadensis*	Canada horseweed	FAC
Asteraceae	*Corethrogyne filaginifolia*	common sandaster	
Asteraceae	*Corethrogyne filaginifolia var. virgata*	common sandaster	
Asteraceae	*Deinandra fasciculata*	common tarweed	
Asteraceae	*Erigeron foliosus*	leafy fleabane	
Asteraceae	*Gnaphalium leucocephalum*	white-headed cudweed	
Asteraceae	*Gnaphalium stramineum*	Small-flowered cudweed	
Asteraceae	*Grindelia camporum*	Great Valley gumweed	
Asteraceae	*Grindelia hirsutula*	hairy gumweed	FACW
Asteraceae	*Helianthus annuus*	common sunflower	FAC
Asteraceae	*Helianthus annuus subsp. lenticularis*	common sunflower	FAC
Asteraceae	*Hemizonia australis*	Asteraceae	
Asteraceae	*Heterotheca grandiflora*	telegraphweed	
Asteraceae	*Isocoma menziesii var. vernonioides*	white-flowered goldenbush	FAC
Asteraceae	*Lasthenia californica*	California goldfields	FACW
Asteraceae	*Lasthenia glabrata subsp. coulteri*	yellowray goldfields	FACW
Asteraceae	*Layia glandulosa*	White tidy-tips	
Asteraceae	*Lepidospartum squamatum*	scalebroom	
Asteraceae	*Malacothrix saxatilis var. tenuifolia*	cliff aster	

Family	Species	Common Name	Wetland
Asteraceae	*Pseudognaphalium leucocephalum*	white headed cudweed	
Asteraceae	*Pseudognaphalium microcephalum*		
Asteraceae	*Senecio californicus*	California Butterweed	
Asteraceae	*Senecio flaccidus var. douglasii*	Douglas' shrubby ragwort	
Asteraceae	*Stephanomeria exigua subsp. coronaria*	milk aster	
Asteraceae	*Uropappus lindleyi*	silver puffs	
Asteraceae	*Xanthium spinosum*	spiny cocklebur	FAC
Boraginaceae	*Amsinckia intermedia*	Eastwood's fiddleneck	
Boraginaceae	*Cryptantha muricata*	prickly cryptantha	
Boraginaceae	*Heliotropium curassavicum var. oculatum*	seaside heliotrope	OBL
Boraginaceae	*Plagiobothrys nothofulvus*	rusty popcornflower	FAC
Brassicaceae	*Erysimum capitatum*	western wallflower	
Brassicaceae	*Lepidium oblongum*	Wayside peppergrass	
Brassicaceae	*Lepidium strictum*	prostrate pepper grass	
Cactaceae	*Opuntia oricola*	chaparral pricklypear	
Caryophyllaceae	*Silene laciniata subsp. major*	Indian pink	
Chenopodiaceae	*Atriplex serenana*	saltscale	FAC
Chenopodiaceae	*Suaeda calceoliformis*	Pursh seepweed	FACW+
Chenopodiaceae	*Suaeda moquinii*	bush seepweed	FAC
Cistaceae	*Helianthemum scoparium var. vulgare*	common sun-rose	
Convolvulaceae	*Calystegia macrostegia subsp. cyclostegia*	south coast morning-glory	
Convolvulaceae	*Cressa truxillensis*	spreading alkaliweed	FACW
Cupressaceae	*Calocedrus decurrens*	incense cedar	
Cuscutaceae	*Cuscuta campestris*	field dodder	
Cyperaceae	*Carex praegracilis*	clustered field sedge	FACW-
Cyperaceae	*Cyperus eragrostis*	tall flatsedge	FACW

Family	Species	Common Name	Wetland
Cyperaceae	*Cyperus esculentus*	Yellow nutgrass	FACW
Cyperaceae	*Schoenoplectus americanus*	chairmaker's bulrush	OBL
Cyperaceae	*Scirpus maritimus*	prairie bulrush	OBL
Euphorbiaceae	*Chamaesyce albomarginata*	rattlesnake weed	
Euphorbiaceae	*Croton californicus*	California croton	
Fabaceae	*Astragalus pycnostachyus var. lanosissimus*	marsh milk-vetch	OBL
Fabaceae	*Astragalus trichopodus var. lonchus*	Santa Barbara milk-vetch	
Fabaceae	*Lathyrus vestitus subsp. laetiflorus*	wild sweetpea	
Fabaceae	*Lotus unifoliolatus*	American bird's foot trefoil	
Fabaceae	*Lupinus excubitus var. hallii*	Hall's bush lupine	
Fabaceae	*Lupinus longifolius*	long leaf bush lupine	
Fabaceae	*Pickeringia montana*	chaparral pea	
Fabaceae	*Trifolium ciliolatum*	foothill clover	
Fabaceae	*Trifolium obtusiflorum*	creek clover	FAC
Grossulariaceae	*Ribes aureum var. gracillimum*	golden currant	FACW
Hydrophyllaceae	*Nemophila menziesii*	baby blue eyes	
Hydrophyllaceae	*Phacelia distans*	common phacelia	
Hydrophyllaceae	*Phacelia minor*	California bluebell	
Iridaceae	*Sisyrinchium bellum*	blue-eyed grass	FAC
Juncaceae	*Juncus ambiguus*	saline toad rush	FACW
Lamiaceae	*Stachys ajugoides var. rigida*	rigid hedge nettle	
Lemnaceae	*Lemna gibba*	swollen duckweed	OBL
Lemnaceae	*Lemna minor*	common duckweed	OBL
Liliaceae	*Bloomeria crocea var. crocea*	common goldenstar	
Loasaceae	*Mentzelia affinis*	yellow blazing star	
Myricaceae	*Morella californica*	Myricaceae	FAC

Family	Species	Common Name	Wetland
Nyctaginaceae	*Abronia umbellata*	purple sand verbena	
Onagraceae	*Camissonia cheiranthifolia subsp. suffruticosa*	beach evening-primrose	
Onagraceae	*Epilobium canum subsp. canum*	California fuchsia	
Onagraceae	*Ludwigia peploides subsp. peploides*	floating primrose willow	OBL
Papaveraceae	*Platystemon californicus*	cream cups	
Papaveraceae	*Romneya coulteri*	Coulter's matilija poppy	RARE
Plantaginaceae	*Plantago erecta*	California plantain	
Platanaceae	*Platanus racemosa*	western sycamore	FACW
Poaceae	*Bromus grandis*	tall brome	
Poaceae	*Elymus condensatus*	giant wild rye	FACU
Poaceae	*Elymus triticoides*	alkali rye	FAC
Poaceae	*Eragrostis pectinacea*	tufted lovegrass	FAC
Poaceae	*Eragrostis pectinacea var. pectinacea*	tufted lovegrass	FAC
Poaceae	*Leptochloa panicea ssp. brachiata*	mucronate sprangeltop	
Poaceae	*Leptochloa uninervia*	Mexican sprangletop	FACW
Poaceae	*Leymus triticoides*	beardless wildrye	FAC
Poaceae	*Nassella cernua*	nodding needlegrass	
Poaceae	*Nassella pulchra*	purple needlegrass	
Poaceae	*Phalaris lemmonii*	Lemmon's canarygrass	FACW-
Poaceae	*Phalaris minor*	littleseed canarygrass	
Polygonaceae	*Polygonum lapathifolium*	curlytop knotweed	OBL
portulacaceae	*Calandrinia ciliata*	red maids	FACU
Primulaceae	*Dodecatheon clevelandii*	padre's shootingstar	
Rosaceae	*Potentilla anserina*	silver weed cinquefoil	OBL
Rosaceae	*Potentilla glandulosa*	Common cinquefoil	FAC
Salicaceae	*Salix lasiolepis*	arroyo willow	FACW

Family	Species	Common Name	Wetland
Saururaceae	*Anemopsis californica*	yerba mansa	OBL
Scrophulariaceae	*Castilleja exserta*	purple owl's clover	
Scrophulariaceae	*Kochia scoparia*	climbing penstemon	
Scrophulariaceae	*Linaria canadensis var. texana*	rough seeded blue toad flax	
Scrophulariaceae	*Mimulus guttatus*	seep monkeyflower	OBL
solanaceae	*Datura wrightii*	Jimson weed	
Ulmaceae	*Celtis laevigata*	western hackberry	
Urticaceae	*Hesperocnide tenella*	western stinging nettle	
Verbenaceae	*Verbena lasiostachys var. lasiostachys*	Common verbena	FAC

APPENDIX 2.
FLORA OF THE LA CIENEGA REGION AS DOCUMENTED IN HERBARIUM SPECIMENS

FAMILY	SPECIES	COMMON NAME	WETLAND
Apiaceae	*Oenanthe sarmentosa*	water parsley	OBL
Asclepiadaceae	*Asclepias fascicularis*	narrow leaf milkweed	FAC
Asteraceae	*Ambrosia acanthicarpa*	annual bursage	
Asteraceae	*Baccharis douglasii*	saltmarsh baccharis	OBL
Asteraceae	*Helianthus nuttallii subsp. parishii*	Los Angeles sunflower	FACW
Asteraceae	*Hemizonia australis*	Asteraceae	
Asteraceae	*Isocoma menziesii var. menziesii*	white-flowered goldenbush	FAC
Asteraceae	*Pluchea odorata*	salt marsh fleabane	
Asteraceae	*Pseudognaphalium stramineum*	Small flowered cudweed	FAC
Asteraceae	*Symphyotrichum defoliatum*	San Bernardino aster	
Asteraceae	*S. lanceolatum var. hesperium [=Aster hesperius]*		
Asteraceae	*Xanthium spinosum*	spiny cocklebur	FAC
Brassicaceae	*Hutchinsia procumbens*	prostrate hutchinsia	FAC
Brassicaceae	*Nasturtium gambelii*	Gambel's yellowcress	OBL
Chenopodiaceae	*Atriplex argentea var. mohavensis*	mohave saltbush	FAC
Chenopodiaceae	*Atriplex serenana var. davidsonii*	saltscale	FAC
Chenopodiaceae	*Atriplex triangularis*	spear leaved saltbrush	
Chenopodiaceae	*Salicornia virginica*	pickleweed	OBL
Chenopodiaceae	*Suaeda moquinii*	bush seepweed	FAC
Cornaceae	*Cornus californica*	Creek Dogwood	FACW
Cornaceae	*Cornus occidentalis*	Creek Dogwood	FACW
Cyperaceae	*Carex barbarae*	Santa Barbara sedge	FACW
Cyperaceae	*Carex praegracilis*	clustered field sedge	FACW
Cyperaceae	*Carex schottii*	Schott's sedge	OBL
Cyperaceae	*Cyperus esculentus*	Yellow nutgrass	FACW
Cyperaceae	*Cyperus niger var. capitatus*	black flatsedge	FACW

Family	Species	Common Name	Wetland
Cyperaceae	*Scirpus californicus*	California tule	OBL
Euphorbiaceae	*Chamaesyce serpens*	creeping spurge	FAC
Euphorbiaceae	*Euphorbia serpens*	creeping spurge	FAC
Fabaceae	*Astragalus brauntonii*	Braunton's milk vetch	
Fabaceae	*Astragalus funereus*	black milk vetch	
Fabaceae	*Astragalus pycnostachyus var. lanosissimus*	marsh milk-vetch	OBL
Fabaceae	*Lotus purshianus var. purshianus*	Spanish clover	
Juncaceae	*Juncus mexicanus*	mexican rush	FACW
Juncaceae	*Juncus phaeocephalus*	brownhead rush	FACW
Lamiaceae	*Stachys albens*	whitestem hedgenettle	OBL
Liliaceae	*Bloomeria crocea var. crocea*	common goldenstar	
Onagraceae	*Epilobium ciliatum*	fringed willowherb	FACW
Onagraceae	*Epilobium ciliatum subsp. ciliatum*	fringed willowherb	FACW
Onagraceae	*Ludwigia peploides subsp. peploides*	floating primrose willow	OBL
Poaceae	*Setaria parviflora*	marsh bristlegrass	
Polygonaceae	*Polygonum punctatum*	Common water smartweed	OBL
Rosaceae	*Potentilla anserina var. grandis*	silver-weed cinquefoil	OBL
Rubiaceae	*Galium trifidum var. pacificum*	Pacific Bedstraw	FACW
Typhaceae	*Sparganium erectum subsp. stoloniferum*	simplestem bur-reed	OBL

APPENDIX 3.
PLANT SPECIES RECORDED AT BALLONA LAGOON FROM HERBARIUM RECORDS

Family	Species	Common Name	Wetland
Aizoaceae	*Sesuvium verrucosum*	western sea-purslane	
Alismataceae	*Sagittaria montevidensis ssp. calycina*	hooded arrowhead	OBL
Amaranthaceae	*Amaranthus blitoides*	mat amaranth	FACW
Anacardiaceae	*Malosma laurina*	laurel sumac	
Anacardiaceae	*Rhus ovata*	sugar bush	
Apiaceae	*Bowlesia incana*	hoary bowlesia	FACW
Apiaceae	*Hydrocotyle verticillata*	whorled marsh pennywort	OBL
Apiaceae	*Oenanthe sarmentosa*	water parsley	OBL
Asclepiadaceae	*Asclepias fascicularis*	narrow leaf milkweed	FAC
Asteraceae	*Amblyopappus pusillus*	dwarf coastweed	FACW
Asteraceae	*Ambrosia acanthicarpa*	annual bursage	
Asteraceae	*Ambrosia chamissonis*	Silver Beachweed	
Asteraceae	*Ambrosia chamissonis var. bipinnatisecta*	Silver Beachweed	
Asteraceae	*Ambrosia psilostachya*	western ragweed	FAC
Asteraceae	*Ambrosia psilostachya var. californica*	western ragweed	FAC
Asteraceae	*Artemisia californica*	California sagebrush	
Asteraceae	*Artemisia douglasiana*	mugwort	FACW
Asteraceae	*Artemisia dracunculus*	herbaceous sagewort	
Asteraceae	*Aster subulatus var. ligulatus*	annual water-aster	
Asteraceae	*Baccharis douglasii*	saltmarsh baccharis	OBL
Asteraceae	*Baccharis pilularis*	coyote brush	
Asteraceae	*Baccharis salicifolia*	mulefat	FACW
Asteraceae	*Bidens laevis*	bur marigold	OBL
Asteraceae	*Centromadia parryi subsp. australis*	Parry's tarweed	FAC
Asteraceae	*Chaenactis glabriuscula*	yellow pincushion	
Asteraceae	*Chaenactis glabriuscula var. glabriuscula*	yellow pincushion	

Family	Species	Common Name	Wetland
Asteraceae	*Chaenactis glabriuscula var. lanosa*	yellow pincushion	
Asteraceae	*Chaenactis glabriuscula var. orcuttiana*	yellow pincushion	
Asteraceae	*Cirsium occidentale var. occidentale*	California thistle	
Asteraceae	*Conyza canadensis*	Canada horseweed	FAC
Asteraceae	*Corethrogyne filaginifolia*	common sandaster	
Asteraceae	*Deinandra fasciculata*	common tarweed	
Asteraceae	*Ericameria ericoides*	California goldenbush	
Asteraceae	*Euthamia occidentalis*	western goldenrod	OBL
Asteraceae	*Filago californica*	California Cottonrose	
Asteraceae	*Gnaphalium bicolor*	bicolored everlasting	
Asteraceae	*Gnaphalium californicum*	California cudweed	
Asteraceae	*Gnaphalium californicum*	California everlasting	
Asteraceae	*Gnaphalium ramosissimum*	pink everlasting	
Asteraceae	*Gnaphalium stramineum*	Everlasting Cudweed	FAC
Asteraceae	*Grindelia camporum*	Great Valley gumweed	
Asteraceae	*Helianthus annuus subsp. lenticularis*	common sunflower	FAC
Asteraceae	*Hemizonia australis*	Asteraceae	
Asteraceae	*Hemizonia fasciculata*	common tarweed	
Asteraceae	*Heterotheca grandiflora*	telegraphweed	
Asteraceae	*Jaumea carnosa*	marsh jaumea	OBL
Asteraceae	*Laennecia coulteri*	Coulter's horseweed	FAC
Asteraceae	*Lasthenia californica*	California goldfields	FACW
Asteraceae	*Lasthenia coronaria*	royal goldfields	
Asteraceae	*Lasthenia glabrata subsp. coulteri*	yellowray goldfields	FACW
Asteraceae	*Lasthenia gracilis*	needle goldfields	
Asteraceae	*Layia platyglossa*	White tidy-tips	

Family	Species	Common Name	Wetland
Asteraceae	*Lessingia filaginifolia*	common sandaster	
Asteraceae	*Logfia filaginoides*	California Cottonrose	
Asteraceae	*Malacothrix saxatilis var. tenuifolia*	cliff aster	
Asteraceae	*Pluchea odorata*	salt marsh fleabane	
Asteraceae	*Pseudognaphalium biolettii*	twocolor cudweed	
Asteraceae	*Pseudognaphalium canescens ssp. beneolens*	Wright's cudweed	
Asteraceae	*Pseudognaphalium microcephalum*		
Asteraceae	*Pseudognaphalium microcephalum*	white headed cudweed	
Asteraceae	*Senecio californicus*	California Butterweed	
Asteraceae	*Stephanomeria diegensis*	San Diego milk aster	
Asteraceae	*Stephanomeria exigua subsp. coronaria*	milk aster	
Asteraceae	*Stephanomeria virgata*	Tall stephanomeria	
Asteraceae	*Symphyotrichum subulatum*	eastern annual saltmarsh aster	FACW
Asteraceae	*Xanthium spinosum*	spiny cocklebur	FAC
Asteraceae	*Xanthium strumarium*	rough cockleburr	FAC
Boraginaceae	*Amsinckia eastwoodiae*	Eastwood's fiddleneck	
Boraginaceae	*Amsinckia intermedia*	Eastwood's fiddleneck	
Boraginaceae	*Amsinckia lycopsoides*	Eastwood's fiddleneck	
Boraginaceae	*Amsinckia spectabilis*	seaside fiddleneck	FACU
Boraginaceae	*Cryptantha clevelandii*	Cleveland's cryptantha	
Boraginaceae	*Cryptantha clevelandii var. florosa*	Cleveland's cryptantha	
Boraginaceae	*Cryptantha intermedia*	Clearwater cryptantha	
Boraginaceae	*Cryptantha leiocarpa*	coast cryptantha	
Boraginaceae	*Cryptantha microstachys*	Tejon cryptantha	
Boraginaceae	*Heliotropium curassavicum*	seaside heliotrope	OBL
Boraginaceae	*Heliotropium curassavicum var. oculatum*	seaside heliotrope	OBL

Family	Species	Common Name	Wetland
Brassicaceae	*Descurainia pinnata subsp. menziesii*	western tansymustard	
Brassicaceae	*Dithyrea californica*	California shieldpod	
Brassicaceae	*Dithyrea maritima*	beach shieldpod	RARE
Brassicaceae	*Erysimum insulare subsp. suffrutescens*	suffrutescent wallflower	
Brassicaceae	*Erysimum suffrutescens*	suffrutescent wallflower	
Brassicaceae	*Guillenia lasiophylla*	California mustard	
Brassicaceae	*Lepidium lasiocarpum*	shaggyfruit pepperweed	
Brassicaceae	*Lepidium nitidum*	shining pepperweed	
Brassicaceae	*Lepidium virginicum*	wild pepper grass	FACW
Brassicaceae	*Lepidium virginicum var. pubescens*	hairy pepperweed	FACW
Brassicaceae	*Rorippa curvisiliqua*	curvepod yellowcress	OBL
Brassicaceae	*Tropidocarpum gracile*	slender tropidocarpum	
Cactaceae	*Opuntia oricola*	chaparral pricklypear	
Capparaceae	*Isomeris arborea*	Coastal bladderpod	
Caryophyllaceae	*Cardionema ramosissimum*	Sand mat	
Caryophyllaceae	*Minuartia douglasii*	Douglas' stitchwort	
Caryophyllaceae	*Polycarpon depressum*	California manyseed	
Caryophyllaceae	*Spergularia macrotheca*	sticky sandspurry	FAC
Caryophyllaceae	*Spergularia marina*	salt marsh sand spurry	OBL
Chenopodiaceae	*Atriplex argentea*	silverscale saltbush	FAC
Chenopodiaceae	*Atriplex argentea var. mohavensis*	mohave saltbush	FAC
Chenopodiaceae	*A. argentea var. mohavensis [=Atriplex expansa]*	mohave saltbush	FAC
Chenopodiaceae	*Atriplex breweri*	quailbush	FAC
Chenopodiaceae	*Atriplex californica*	California saltbush	FAC
Chenopodiaceae	*Atriplex lentiformis*	big saltbush	FAC
Chenopodiaceae	*Atriplex lentiformis subsp. breweri*	quailbush	FAC

Family	Species	Common Name	Wetland
Chenopodiaceae	*Atriplex lentiformis subsp. lentiformis*	big saltbush	FAC
Chenopodiaceae	*Atriplex lentiformis var. breweri*	quailbush	FAC
Chenopodiaceae	*Atriplex leucophylla*	beach saltbush	FAC
Chenopodiaceae	*Atriplex patula subsp. hastata*	fathen saltweed	FACW
Chenopodiaceae	*Atriplex triangularis*	spear leaved saltbrush	
Chenopodiaceae	*Atriplex truncata*	wedgescale	FAC
Chenopodiaceae	*Salicornia europaea*	slender pickleweed	OBL
Chenopodiaceae	*Salicornia subterminalis*	Parish's pickleweed	OBL
Chenopodiaceae	*Salicornia virginica*	pickleweed	OBL
Chenopodiaceae	*Suaeda calceoliformis*	Pursh seepweed	FACW
Chenopodiaceae	*Suaeda taxifolia*	woolly seablite	FACW
Chenopodiaeceae	*Chenopodium berlandieri var. sinuatum*	Berlandier's goosefoot	
Convolvulaceae	*Calystegia macrostegia subsp. intermedia*	south coast morning-glory	
Convolvulaceae	*Calystegia soldanella*	beach morning glory	
Convolvulaceae	*Cressa truxillensis*	spreading alkaliweed	FACW
Crassulaceae	*Crassula connata*	sand pygmyweed	FAC
Crassulaceae	*Crassula connata var. erectoides*	sand pygmyweed	FAC
Crassulaceae	*Dudleya lanceolata*	lanceleaf liveforever	
Cucurbitaceae	*Cucurbita foetidissima*	calabazilla	
Cucurbitaceae	*Marah macrocarpus*	southern wild-cucumber	
Cuscutaceae	*Cuscuta californica*	chaparral dodder	
Cuscutaceae	*Cuscuta campestris*	field dodder	
Cuscutaceae	*Cuscuta salina*	saltmarsh dodder	
Cyperaceae	*Carex praegracilis*	clustered field sedge	FACW
Cyperaceae	*Cyperus eragrostis*	tall flatsedge	FACW
Cyperaceae	*Cyperus esculentus*	Yellow nutgrass	FACW

Family	Species	Common Name	Wetland
Cyperaceae	*Eleocharis macrostachya*	common spikerush	OBL
Cyperaceae	*Eleocharis montevidensis*	sand spikerush	FACW
Cyperaceae	*Eleocharis montevidensis var. montevidensis*	sand spikerush	FACW
Cyperaceae	*Isolepis cernua*	annual tule	OBL
Cyperaceae	*Schoenoplectus americanus*	chairmaker's bulrush	OBL
Cyperaceae	*Scirpus [=Schoenoplectus] californicus*	California tule	OBL
Cyperaceae	*Scirpus californicus*	California tule	OBL
Cyperaceae	*Scirpus maritimus*	prairie bulrush	OBL
Equisetaceae	*Equisetum hyemale subsp. affine*	common scouring rush	FACW
Equisetaceae	*Equisetum telmateia subsp. braunii*	giant horsetail	OBL
Euphorbiaceae	*Chamaesyce albomarginata*	rattlesnake weed	
Euphorbiaceae	*Chamaesyce polycarpa var. polycarpa*	small seeded spurge	
Euphorbiaceae	*Chamaesyce serpens*	creeping spurge	FAC
Euphorbiaceae	*Croton californicus*	California croton	
Euphorbiaceae	*Croton californicus var. californicus*	California croton	
Euphorbiaceae	*Croton californicus var. tenuis*	California croton	
Euphorbiaceae	*Croton setigerus*	dove weed	
Fabaceae	*Astragalus didymocarpus var. didymocarpus*	dwarf white milk vetch	
Fabaceae	*Astragalus pycnostachyus var. lanosissimus*	marsh milk-vetch	OBL
Fabaceae	*Astragalus trichopodus var. lonchus*	Santa Barbara milk-vetch	
Fabaceae	*Hoffmannseggia glauca*	Indian rushpea	FACU
Fabaceae	*Lotus heermannii*	Heermann's lotus	
Fabaceae	*Lotus scoparius*	deerweed	
Fabaceae	*Lotus scoparius var. scoparius*	deerweed	
Fabaceae	*Lotus strigosus*	Hairy Lotus	
Fabaceae	*Lotus strigosus var. strigosus*	Hairy Lotus	

Family	Species	Common Name	Wetland
Fabaceae	*Lotus unifoliolatus*	American bird's foot trefoil	
Fabaceae	*Lupinus bicolor*	miniature lupine	
Fabaceae	*Lupinus bicolor subsp. microphyllus*	miniature lupine	
Fabaceae	*Lupinus chamissonis*	dune bush lupine	
Fabaceae	*Lupinus excubitus*	grape lupine	
Fabaceae	*Lupinus excubitus var. hallii*	Hall's bush lupine	
Fabaceae	*Lupinus longifolius*	long leaf bush lupine	
Fabaceae	*Lupinus succulentus*	succulent lupine	
Fabaceae	*Lupinus truncatus*	truncated lupine	
Fabaceae	*Trifolium willdenovii*	tomcat clover	
Frankeniaceae	*Frankenia salina*	alkali seaheath	FACW
Frankeniaceae	*Frankenia salina*	alkali seaheath	FACW
Frankeniaceae	*Fraxinus latifolia*	alkali seaheath	FACW
Grossulariaceae	*Ribes malvaceum var. viridifolium*	chaparral currant	
Hydrophyllaceae	*Nemophila menziesii*	baby blue eyes	
Hydrophyllaceae	*Phacelia distans*	common phacelia	
Hydrophyllaceae	*Phacelia douglasii*	Douglas' phacelia	
Hydrophyllaceae	*Phacelia ramosissima*	south coast branching phacelia	
Hydrophyllaceae	*Phacelia ramosissima var. austrolitoralis*	south coast branching phacelia	
Hydrophyllaceae	*Phacelia stellaris*	Brand's phacelia	
Hydrophyllaceae	*Phacelia tanacetifolia*	tansy leafed phacelia	
Juncaceae	*Juncus bufonius*	toad rush	FACW
Juncaceae	*Juncus mexicanus*	mexican rush	FACW
Juncaceae	*Juncus textilis*	basket rush	OBL
Lamiaceae	*Lycopus americanus*	American water horehound	OBL
Lamiaceae	*Salvia carduacea*	thistle sage	

Family	Species	Common Name	Wetland
Lamiaceae	*Salvia columbariae*	chia sage	
Lamiaceae	*Stachys ajugoides*	bugle hedgenettle	OBL
Lamiaceae	*Stachys ajugoides var. rigida*	rigid hedge nettle	OBL
Lamiaceae	*Stachys albens*	whitestem hedgenettle	OBL
Lemnaceae	*Lemna minuscula*	least duckweed	OBL
Lemnaceae	*Lemna valdiviana*	valdivia duckweed	OBL
Lennoaceae	*Pholisma arenarium*	Desert pholisma	
Loasaceae	*Mentzelia affinis*	yellow blazing star	
Lythraceae	*Lythrum californicum*	California loostrife	OBL
Malvaceae	*Malacothamnus fasciculatus*	chaparral mallow	
Malvaceae	*Malvella leprosa*	alkali mallow	FAC
Malvaceae	*Malvella leprosa var. hederacea*	alkali mallow	FAC
Nyctaginaceae	*Abronia maritima*	red sand verbena	
Nyctaginaceae	*Abronia umbellata*	purple sand verbena	
Nyctaginaceae	*Abronia umbellata subsp. umbellata*	purple sand verbena	
Nyctaginaceae	*Abronia villosa*	desert sand verbena	
Nyctaginaceae	*Mirabilis laevis var. crassifolia*	California four o'clock	
Oleaceae	*Fraxinus velutina var. coriacea*	velvet ash	FACW
Onagraceae	*Camissonia bistorta*	California sun cup	
Onagraceae	*Camissonia cheiranthifolia subsp. suffruticosa*	beach evening-primrose	
Onagraceae	*Camissonia lewisii*	Lewis' evening primrose	
Onagraceae	*Camissonia micrantha*	miniature suncup	
Onagraceae	*Epilobium ciliatum subsp. ciliatum*	fringed willowherb	FACW
Onagraceae	*Epilobium pygmaeum*	smooth boisduvalia	OBL
Onagraceae	*Ludwigia peploides subsp. peploides*	floating primrose willow	OBL
Onagraceae	*Oenothera elata subsp. hirsutissima*	hairy evening primrose	FACW

Family	Species	Common Name	Wetland
Papaveraceae	*Eschscholzia californica*	California poppy	
Papaveraceae	*Platystemon californicus*	cream cups	
Papaveraceae	*Stylomecon heterophylla*	wind poppy	
Plantaginaceae	*Plantago erecta*	California plantain	
Poaceae	*Agrostis viridis*	green bentgrass	
Poaceae	*Distichlis spicata*	saltgrass	FACW
Poaceae	*Elymus condensatus*	giant wild rye	FACU
Poaceae	*Elymus glaucus*	blue wildrye	FACU
Poaceae	*Elymus triticoides*	alkali rye	FAC
Poaceae	*Hordeum brachyantherum*	meadow barley	FACW
Poaceae	*Hordeum intercedens*	vernal barley	FAC
Poaceae	*Koeleria macrantha*	prairie Junegrass	
Poaceae	*Leptochloa uninervia*	Mexican sprangletop	FACW
Poaceae	*Melica imperfecta*	smallflower melicgrass	
Poaceae	*Nassella pulchra*	purple needlegrass	
Poaceae	*Phalaris minor*	littleseed canarygrass	
Poaceae	*Setaria parviflora*	marsh bristlegrass	
Polemoniaceae	*Gilia clivorum*	purplespot gilia	
Polemoniaceae	*Linanthus parviflorus*	common linanthus	
Polemoniaceae	*Navarretia prostrata*	prostrate pincushionplant	OBL
Polygonaceae	*Eriogonum fasciculatum*	California buckwheat	
Polygonaceae	*Eriogonum gracile*	slender buckwheat	
Polygonaceae	*Eriogonum gracile var. gracile*	slender buckwheat	
Polygonaceae	*Eriogonum parvifolium*	seacliff buckwheat	
Polygonaceae	*Eriogonum parvifolium var. parvifolium*	seacliff buckwheat	
Polygonaceae	*Lastarriaea coriacea*	leather spineflower	

Family	Species	Common Name	Wetland
Polygonaceae	*Mucronea californica*	California spineflower	
Polygonaceae	*Mucronea californica var. suksdorfii*	California spineflower	
Polygonaceae	*Polygonum hydropiperoides*	swamp smartweed	OBL
Polygonaceae	*Polygonum lapathifolium*	curlytop knotweed	OBL
Polygonaceae	*Pterostegia drymarioides*	woodland pterostegia	
Polygonaceae	*Rumex maritimus*	golden dock	FACW
Polygonaceae	*Rumex salicifolius*	willow dock	OBL
Portulacaceae	*Calandrinia ciliata*	red maids	FACU
Portulacaceae	*Calyptridium monandrum*	common pussypaws	
Potamogetonaceae	*Ruppia cirrhosa*	spiral ditchgrass	OBL
Potamogetonaceae	*Ruppia maritima*	widgeongrass	OBL
Ranunculaceae	*Clematis ligusticifolia*	creek clematis	FAC
Ranunculaceae	*Delphinium parryi subsp. maritimum*	seaside larkspur	
Ranunculaceae	*Delphinium parryi subsp. parryi*	San Bernardino larkspur	
Rosaceae	*Potentilla anserina ssp. pacifica*	Pacific potentilla	OBL
Rosaceae	*Potentilla anserina subsp. pacifica*	silver-weed cinquefoil	OBL
Rosaceae	*Potentilla anserina var. grandis*	silver-weed cinquefoil	OBL
Rosaceae	*Potentilla multijuga*	ballona cinquefoil	OBL
Rubiaceae	*Galium angustifolium subsp. angustifolium*	narrowleaf bedstraw	
Salicaceae	*Populus fremontii*	Fremont cottonwood	FACW
Salicaceae	*Salix exigua*	sandbar willow	OBL
Salicaceae	*Salix laevigata*	red willow	
Salicaceae	*Salix lasiolepis*	arroyo willow	FACW
Saururaceae	*Anemopsis californica*	yerba mansa	OBL
Scrophulariaceae	*Antirrhinum coulterianum*	Coulter's snapdragon	
Scrophulariaceae	*Antirrhinum nuttallianum subsp. nuttallianum*	Nuttall's snapdragon	

Family	Species	Common Name	Wetland
Scrophulariaceae	*Castilleja exserta*	purple owl's clover	
Scrophulariaceae	*Collinsia heterophylla*	purple Chinese houses	
Scrophulariaceae	*Cordylanthus maritimus subsp. maritimus*	salt marsh bird's beak	OBL
Scrophulariaceae	*Mimulus guttatus*	seep monkeyflower	OBL
Solanaceae	*Datura wrightii*	Jimson weed	
Solanaceae	*Nicotiana clevelandii*	Cleveland's tobacco	
Solanaceae	*Solanum americanum*	common nightshade	FAC
Solanaceae	*Solanum douglasii*	Douglas' nightshade	FAC
Typhaceae	*Sparganium erectum subsp. stoloniferum*	simplestem bur-reed	OBL
Typhaceae	*Typha domingensis*	narrowleaf cattail	OBL
Typhaceae	*Typha latifolia*	broadleaf cattail	OBL
Urticaceae	*Urtica dioica subsp. holosericea*	giant creek nettle	FACW
Urticaceae	*Urtica urens*	dwarf nettle	
Verbenaceae	*Phyla lanceolata*	lanceleaf fogfruit	
Verbenaceae	*Phyla lanceolata*	lanceleaf fogfruit	FACW
Verbenaceae	*Verbena lasiostachys var. lasiostachys*	Common verbena	FAC
Zosteraceae	*Phyllospadix torreyi*	Torrey's surfgrass	OBL

APPENDIX 4.
FLORA OF THE SANTA MONICA MOUNTAIN REGION AS DOCUMENTED IN HERBARIUM RECORDS

Family	Species	Common Name	Wetland
Amaranthaceae	*Amaranthus blitoides*	mat amaranth	FACW
Amaranthaceae	*Amaranthus powellii*	Powell's amaranth	
Anacardiaceae	*Malosma laurina*	laurel sumac	
Anacardiaceae	*Rhus integrifolia*	lemonade berry	
Anacardiaceae	*Rhus ovata*	sugar bush	
Anacardiaceae	*Rhus trilobata*	skunkbush sumac	NI
Anacardiaceae	*Rhus trilobata var. pilosissima*	skunkbush sumac	NI
Apiaceae	*Apiastrum angustifolium*	wild celery	
Apiaceae	*Berula erecta*	cutleaf water-parsnip	OBL
Apiaceae	*Bowlesia incana*	hoary bowlesia	FACW
Apiaceae	*Daucus pusillus*	Wild carrot	
Apiaceae	*Lomatium lucidum*	shiny biscuitroot	
Apiaceae	*Sanicula arguta*	sharp toothed snakeroot	
Apiaceae	*Sanicula bipinnata*	poison sanicle	
Apiaceae	*Sanicula crassicaulis*	Pacific blacksnakeroot	
Apiaceae	*Tauschia arguta*	southern umbrellawort	
Asteraceae	*Achillea millefolium*	common yarrow	FACU
Asteraceae	*Acourtia microcephala*	sacapellote	
Asteraceae	*Ambrosia acanthicarpa*	annual bursage	
Asteraceae	*Ambrosia chamissonis*	Silver Beachweed	
Asteraceae	*Ambrosia confertiflora*	weak leaved burweed	
Asteraceae	*Ambrosia psilostachya*	western ragweed	FAC
Asteraceae	*Ambrosia psilostachya var. californica*	western ragweed	FAC
Asteraceae	*Artemisia californica*	California sagebrush	
Asteraceae	*Artemisia douglasiana*	mugwort	FACW
Asteraceae	*Artemisia dracunculus*	herbaceous sagewort	

Family	Species	Common Name	Wetland
Asteraceae	*Baccharis douglasii*	saltmarsh baccharis	OBL
Asteraceae	*Baccharis pilularis*	coyote brush	
Asteraceae	*Baccharis salicifolia*	mulefat	FACW-
Asteraceae	*Brickellia californica*	California brickellbush	FACU
Asteraceae	*Brickellia nevinii*	Nevin's brickellia	
Asteraceae	*Centromadia parryi subsp. australis*	Parry's tarweed	FAC
Asteraceae	*Chaenactis artemisiifolia*	artemisia leaved chaenactis	
Asteraceae	*Chaenactis glabriuscula var. glabriuscula*	yellow pincushion	
Asteraceae	*Cirsium occidentale*	California thistle	
Asteraceae	*Cirsium occidentale var. californicum*	California thistle	
Asteraceae	*Cirsium occidentale var. occidentale*	California thistle	
Asteraceae	*Conyza canadensis*	Canada horseweed	FAC
Asteraceae	*Corethrogyne filaginifolia*	common sandaster	
Asteraceae	*Corethrogyne filaginifolia var. virgata*	common sandaster	
Asteraceae	*Deinandra fasciculata*	common tarweed	
Asteraceae	*Dicoria canescens*	desert dicoria	
Asteraceae	*Encelia californica*	California sunflower	
Asteraceae	*Ericameria ericoides*	California goldenbush	
Asteraceae	*Ericameria linearifolia*	narrowleaf goldenbush	
Asteraceae	*Ericameria palmeri var. pachylepis*	broad scaled Palmer's goldenbush	
Asteraceae	*Ericameria parishii*	Parish's goldenbush	
Asteraceae	*Ericameria pinifolia*	pinebush	
Asteraceae	*Erigeron foliosus*	leafy fleabane	
Asteraceae	*Erigeron foliosus var. foliosus*	leafy fleabane	
Asteraceae	*Eriophyllum confertiflorum*	golden-yarrow	
Asteraceae	*Eriophyllum confertiflorum var. confertiflorum*	golden-yarrow	

Family	Species	Common Name	Wetland
Asteraceae	*Filago californica*	California Cottonrose	
Asteraceae	*Gnaphalium bicolor*	bicolored everlasting	
Asteraceae	*Gnaphalium californicum*	California cudweed	
Asteraceae	*Gnaphalium californicum*	California everlasting	
Asteraceae	*Gnaphalium canescens subsp. microcephalum*	white everlasting	
Asteraceae	*Gnaphalium ramosissimum*	pink everlasting	
Asteraceae	*Grindelia camporum*	Great Valley gumweed	
Asteraceae	*Grindelia hirsutula*	hairy gumweed	FACW
Asteraceae	*Gutierrezia californica*	California matchweed	
Asteraceae	*Gutierrezia sarothrae*	Matchweed	
Asteraceae	*Hazardia squarrosa var. grindelioides*	saw toothed goldenbush	
Asteraceae	*Hazardia squarrosa var. squarrosa*	saw toothed goldenbush	
Asteraceae	*Hemizonia fasciculata*	common tarweed	
Asteraceae	*Heterotheca grandiflora*	telegraphweed	
Asteraceae	*Heterotheca sessiliflora ssp. fastigiata*	erect goldenaster	
Asteraceae	*Isocoma menziesii var. vernonioides*	white-flowered goldenbush	FAC
Asteraceae	*Iva hayesiana*	San Diego marsh elder	FACW
Asteraceae	*Laennecia coulteri*	Coulter's horseweed	FAC
Asteraceae	*Lasthenia californica*	California goldfields	FACW
Asteraceae	*Lasthenia gracilis*	needle goldfields	
Asteraceae	*Layia platyglossa*	White tidy-tips	
Asteraceae	*Layia platyglossa subsp. campestris*	White tidy-tips	
Asteraceae	*Lepidospartum squamatum*	scalebroom	
Asteraceae	*Lepidospartum squamatum var. squamatum*	scalebroom	
Asteraceae	*Lessingia filaginifolia*	common sandaster	
Asteraceae	*Madia gracilis*	slender tarweed	

Family	Species	Common Name	Wetland
Asteraceae	*Madia sativa*	coast tarweed	
Asteraceae	*Malacothrix saxatilis var. tenuifolia*	cliff aster	
Asteraceae	*Monolopia lanceolata*	common monolopia	
Asteraceae	*Pluchea sericea*	arroweed	FACW
Asteraceae	*Pseudognaphalium biolettii*	twocolor cudweed	
Asteraceae	*Pseudognaphalium microcephalum*		
Asteraceae	*Pseudognaphalium microcephalum*	white headed cudweed	
Asteraceae	*Pseudognaphalium ramosissimum*	pink cudweed	
Asteraceae	*Pseudognaphalium stramineum*	Small flowered cudweed	FAC
Asteraceae	*Psilocarphus tenellus*	round woolly-marbles	FAC
Asteraceae	*Rafinesquia californica*	California chicory	
Asteraceae	*Senecio californicus*	California Butterweed	
Asteraceae	*Senecio flaccidus*	Douglas' shrubby ragwort	
Asteraceae	*Senecio flaccidus var. douglasii*	Douglas' shrubby ragwort	
Asteraceae	*Solidago californica*	California goldenrod	
Asteraceae	*Solidago velutina subsp. californica*		
Asteraceae	*Stebbinsoseris heterocarpa*	grassland stebbinsoseris	
Asteraceae	*Stephanomeria cichoriacea*	chicory leaved stephanomeria	
Asteraceae	*Stephanomeria diegensis*	San Diego milk aster	
Asteraceae	*Stephanomeria exigua subsp. coronaria*	milk aster	
Asteraceae	*Stephanomeria virgata*	Tall stephanomeria	
Asteraceae	*Stephanomeria virgata subsp. virgata*	Tall stephanomeria	
Asteraceae	*Symphyotrichum defoliatum [=Aster bernardinus]*	San Bernardino aster	RARE
Asteraceae	*Symphyotrichum greatae [=Aster greatae0*	Greata's aster	RARE
Asteraceae	*Venegasia carpesioides*	canyon sunflower	
Asteraceae	*Xanthium spinosum*	spiny cocklebur	FAC

Family	Species	Common Name	Wetland
Asteraceae	*Xanthium strumarium*	rough cockleburr	FAC
Azollaceae	*Azolla filiculoides*	mosquito fern	OBL
Berberidaceae	*Berberis nevinii*	Nevin's barberry	
Boraginaceae	*Amsinckia intermedia*	Eastwood's fiddleneck	
Boraginaceae	*Amsinckia punctata*		
Boraginaceae	*Cryptantha intermedia*	Clearwater cryptantha	
Boraginaceae	*Cryptantha micromeres*	minute flowered cryptantha	
Boraginaceae	*Cryptantha microstachys*	Tejon cryptantha	
Boraginaceae	*Cryptantha muricata*	prickly cryptantha	
Boraginaceae	*Cryptantha muricata var. jonesii*	prickly cryptantha	
Boraginaceae	*Pectocarya penicillata*	sagebrush combseed	
Boraginaceae	*Pedicularis densiflora*	Indian warrior	
Boraginaceae	*Plagiobothrys collinus*	Cooper's popcornflower	
Brassicaceae	*Arabis glabra*	smooth rock cress	
Brassicaceae	*Barbarea orthoceras*	American Wintercress	FACW
Brassicaceae	*Cardamine californica*	California toothwort	UPL*
Brassicaceae	*Caulanthus heterophyllus var. pseudosimulans*	San Diego wild cabbage	
Brassicaceae	*Descurainia pinnata subsp. menziesii*	western tansymustard	
Brassicaceae	*Erysimum capitatum subsp. capitatum*	western wallflower	
Brassicaceae	*Guillenia lasiophylla*	California mustard	
Brassicaceae	*Lepidium virginicum*	wild pepper grass	FACW
Brassicaceae	*Thysanocarpus curvipes*	common fringe-pod	
Brassicaceae	*Thysanocarpus laciniatus*	common lace pod	
Brassicaceae	*Tropidocarpum gracile*	slender tropidocarpum	
Cactaceae	*Opuntia littoralis*	coast prickly pear	
Cactaceae	*Opuntia vaseyi*	Vasey's prickly pear	

Family	Species	Common Name	Wetland
Campanulaceae	*Githopsis diffusa subsp. candida*	San Gabriel bluecup	
Campanulaceae	*Triodanis biflora*	Venus looking glass	
Capparaceae	*Isomeris arborea*	Coastal bladderpod	
Caprifoliaceae	*Lonicera interrupta*	chaparral honeysuckle	
Caprifoliaceae	*Lonicera subspicata var. denudata*	southern honeysuckle	
Caprifoliaceae	*Sambucus nigra ssp. caerulea*	blue elderberry	FAC
Caprifoliaceae	*Symphoricarpos mollis*	creeping snowberry	
Caryophyllaceae	*Polycarpon depressum*	California manyseed	
Caryophyllaceae	*Silene antirrhina*	sleepy silene	
Caryophyllaceae	*Silene laciniata*	Indian pink	
Caryophyllaceae	*Silene laciniata subsp. major*	Indian pink	
Chenopodiaceae	*Atriplex serenana*	saltscale	FAC
Chenopodiaceae	*Chenopodium californicum*	soaproot	
Chenopodiaeceae	*Chenopodium berlandieri*	Berlandier's goosefoot	
Cistaceae	*Helianthemum scoparium*	common sun-rose	
Cistaceae	*Helianthemum scoparium var. scoparium*	common sun-rose	
Cistaceae	*Helianthemum scoparium var. vulgare*	common sun-rose	
Convolvulaceae	*Calystegia macrostegia*	south coast morning-glory	
Convolvulaceae	*Calystegia macrostegia subsp. cyclostegia*	south coast morning-glory	
Convolvulaceae	*Calystegia macrostegia subsp. intermedia*	south coast morning-glory	
Convolvulaceae	*Calystegia purpurata*	Pacific false bindweed	
Convolvulaceae	*Convolvulus simulans*	small flowered morning glory	RARE
Cornaceae	*Cornus occidentalis*	Creek Dogwood	FACW
Crassulaceae	*Crassula connata var. erectoides*	sand pygmyweed	FAC
Crassulaceae	*Dudleya lanceolata*	lanceleaf liveforever	
Crassulaceae	*Dudleya multicaulis*	manystem liveforever	RARE

Family	Species	Common Name	Wetland
Cucurbitaceae	*Marah macrocarpus*	southern wild-cucumber	
Cucurbitaceae	*Marah macrocarpus var. macrocarpus*	southern wild-cucumber	
Cuscutaceae	*Cuscuta californica*	chaparral dodder	
Cuscutaceae	*Cuscuta subinclusa*	canyon dodder	
Cyperaceae	*Carex triquetra*	triangular fruit sedge	
Cyperaceae	*Scirpus californicus*	California tule	OBL
Dennstaedtiaceae	*Pteridium aquilinum*	western brackenfern	FACU
Dennstaedtiaceae	*Pteridium aquilinum var. pubescens*	hairy brackenfern	FACU
Dryopteridaceae	*Athyrium filix-femina var. californicum*	Western Lady Fern	FAC
Dryopteridaceae	*Dryopteris arguta*	California wood fern	
Equisetaceae	*Equisetum hyemale subsp. affine*	common scouring rush	FACW
Equisetaceae	*Equisetum laevigatum*	smooth horsetail	FACW
Ericaceae	*Arctostaphylos glandulosa*	Eastwood manzanita	
Ericaceae	*Arctostaphylos glandulosa subsp. mollis*	Eastwood manzanita	
Euphorbiaceae	*Chamaesyce albomarginata*	rattlesnake weed	
Euphorbiaceae	*Chamaesyce melanadenia*	squaw spurge	
Euphorbiaceae	*Chamaesyce polycarpa*	small seeded spurge	
Euphorbiaceae	*Chamaesyce polycarpa var. polycarpa*	small seeded spurge	
Euphorbiaceae	*Chamaesyce serpens*	creeping spurge	FAC
Euphorbiaceae	*Chamaesyce serpyllifolia*	thyme leafed spurge	
Euphorbiaceae	*Croton californicus*	California croton	
Euphorbiaceae	*Croton setigerus*	dove weed	
Euphorbiaceae	*Euphorbia polycarpa*	small seeded spurge	
Fabaceae	*Amorpha californica*	California false indigo	
Fabaceae	*Amorpha californica var. californica*	California false indigo	
Fabaceae	*Astragalus didymocarpus var. didymocarpus*	dwarf white milk vetch	

Family	Species	Common Name	Wetland
Fabaceae	*Astragalus gambelianus*	Gambel's dwarf milk vetch	
Fabaceae	*Astragalus trichopodus var. phoxus*	Santa Barbara milk-vetch	
Fabaceae	*Cercis occidentalis*	western redbud	
Fabaceae	*Lathyrus vestitus subsp. laetiflorus*	wild sweetpea	
Fabaceae	*Lathyrus vestitus subsp. laevicarpus*	wild sweetpea	
Fabaceae	*Lathyrus vestitus subsp. vestitus*	wild sweetpea	
Fabaceae	*Lathyrus vestitus var. vestitus*	wild sweetpea	
Fabaceae	*Lotus argophyllus var. argophyllus*	southern California silver lotus	
Fabaceae	*Lotus purshianus var. purshianus*	Spanish clover	
Fabaceae	*Lotus salsuginosus*	coastal lotus	
Fabaceae	*Lotus salsuginosus var. salsuginosus*	coastal lotus	
Fabaceae	*Lotus scoparius*	deerweed	
Fabaceae	*Lotus strigosus*	Hairy Lotus	
Fabaceae	*Lotus strigosus var. strigosus*	Hairy Lotus	
Fabaceae	*Lotus wrangelianus*	Calf lotus	
Fabaceae	*Lupinus affinis*	fleshy lupine	
Fabaceae	*Lupinus bicolor*	miniature lupine	
Fabaceae	*Lupinus excubitus*	grape lupine	
Fabaceae	*Lupinus excubitus var. hallii*	Hall's bush lupine	
Fabaceae	*Lupinus formosus*	summer lupine	
Fabaceae	*Lupinus formosus var. formosus*	summer lupine	
Fabaceae	*Lupinus hirsutissimus*	stinging annual lupine	
Fabaceae	*Lupinus latifolius subsp. parishii*	broadleaf lupine	
Fabaceae	*Lupinus lepidus var. sellulus*	dwarf tidy lupine	
Fabaceae	*Lupinus longifolius*	long leaf bush lupine	
Fabaceae	*Lupinus sparsiflorus*	Coulter's lupine	

Family	Species	Common Name	Wetland
Fabaceae	*Lupinus sparsiflorus subsp. sparsiflorus*	Coulter's lupine	
Fabaceae	*Lupinus succulentus*	succulent lupine	
Fabaceae	*Lupinus truncatus*	truncated lupine	
Fabaceae	*Pickeringia montana*	chaparral pea	
Fabaceae	*Rupertia physodes*	California tea	
Fabaceae	*Trifolium albopurpureum*	Indian clover	FACU
Fabaceae	*Trifolium ciliolatum*	foothill clover	
Fabaceae	*Trifolium gracilentum*	pinpoint clover	
Fabaceae	*Vicia americana*	American vetch	FACU
Fabaceae	*Vicia americana var. americana*	American vetch	FACU
Fagaceae	*Quercus agrifolia*	coast live oak	
Fagaceae	*Quercus berberidifolia*	inland scrub oak	
Fagaceae	*Quercus dumosa*	Nuttall's scrub oak	
Fagaceae	*Quercus durata var. gabrielensis*	San Gabriel Mtns. leather oak	
Fagaceae	*Quercus wislizeni var. frutescens*	Chapparal Oak	
Fumariaceae	*Ehrendorferia ochroleuca*	yellow bleeding heart	
Gentianaceae	*Centaurium venustum*	Beautiful centaury	
Geraniaceae	*Geranium carolinianum*	Carolina geranium	
Grossulariaceae	*Ribes aureum var. gracillimum*	golden currant	FACW
Grossulariaceae	*Ribes californicum var. hesperium*	California gooseberry	
Grossulariaceae	*Ribes indecorum*	white-flowering currant	
Grossulariaceae	*Ribes malvaceum*	chaparral currant	
Grossulariaceae	*Ribes malvaceum var. viridifolium*	chaparral currant	
Grossulariaceae	*Ribes speciosum*	fuchsia flowered gooseberry	
Hydrophyllaceae	*Emmenanthe penduliflora*	whisperingbells	
Hydrophyllaceae	*Emmenanthe penduliflora var. penduliflora*	whisperingbells	

Family	Species	Common Name	Wetland
Hydrophyllaceae	*Eriodictyon trichocalyx*	hairy yerba santa	
Hydrophyllaceae	*Eucrypta chrysanthemifolia*	common eucrypta	
Hydrophyllaceae	*Eucrypta chrysanthemifolia var. chrysanthemifolia*	common eucrypta	
Hydrophyllaceae	*Nama stenocarpum*	mud fiddleleaf	FACW
Hydrophyllaceae	*Nemophila menziesii*	baby blue eyes	
Hydrophyllaceae	*Nemophila menziesii var. integrifolia*	baby blue eyes	
Hydrophyllaceae	*Phacelia cicutaria*	caterpillar phacelia	
Hydrophyllaceae	*Phacelia cicutaria var. hispida*	caterpillar phacelia	
Hydrophyllaceae	*Phacelia cicutaria var. hubbyi*	caterpillar phacelia	
Hydrophyllaceae	*Phacelia grandiflora*	giant flowerd phacelia	
Hydrophyllaceae	*Phacelia imbricata subsp. imbricata*	imbricate phacelia	
Hydrophyllaceae	*Phacelia minor*	California bluebell	
Hydrophyllaceae	*Phacelia parryi*	Parry's phacelia	
Hydrophyllaceae	*Phacelia viscida*	sticky phacelia	
Hydrophyllaceae	*Pholistoma auritum*	blue fiestaflower	
Hydrophyllaceae	*Turricula parryi*	common turricula	
Iridaceae	*Sisyrinchium bellum*	blue-eyed grass	FAC
Juglandaceae	*Juglans californica*	Southern California black walnut	FAC
Juglandaceae	*Juglans californica var. californica*	Southern California black walnut	FAC
Juncaceae	*Juncus balticus*	wire rush	FACW
Juncaceae	*Juncus textilis*	basket rush	OBL
Lamiaceae	*Salvia apiana*	white sage	
Lamiaceae	*Salvia columbariae*	chia sage	
Lamiaceae	*Salvia leucophylla*	purple sage	
Lamiaceae	*Salvia mellifera*	black sage	
Lamiaceae	*Salvia spathacea*	hummingbird sage	

Family	Species	Common Name	Wetland
Lamiaceae	*Scutellaria tuberosa*	Danny's skullcap	
Lamiaceae	*Stachys ajugoides var. rigida*	rigid hedge nettle	
Lamiaceae	*Stachys ajugoides var. rigida*	rigid hedge nettle	OBL
Lamiaceae	*Stachys bullata*	California hedgenettle	
Lamiaceae	*Trichostema lanatum*	woolly bluecurls	
Lamiaceae	*Trichostema lanceolatum*	vinegarweed	
Lauraceae	*Umbellularia californica*	California laurel	FAC
Lemnaceae	*Lemna valdiviana*	valdivia duckweed	OBL
Liliaceae	*Allium haematochiton*	redskin onion	
Liliaceae	*Allium peninsulare*	Mexicali onion	
Liliaceae	*Bloomeria crocea*	common goldenstar	
Liliaceae	*Bloomeria crocea var. crocea*	common goldenstar	
Liliaceae	*Brodiaea terrestris subsp. kernensis*	chaparral brodiaea	
Liliaceae	*Calochortus catalinae*	Catalina mariposa lily	
Liliaceae	*Calochortus clavatus var. clavatus*	club haired mariposa	
Liliaceae	*Calochortus plummerae*	Plummer's mariposa lily	
Liliaceae	*Dichelostemma capitatum*	blue dicks	
Liliaceae	*Fritillaria biflora*	chocolate lily	
Liliaceae	*Lilium humboldtii*	Humboldt's lily	
Liliaceae	*Triteleia ixioides subsp. scabra*	prettyface	FAC
Liliaceae	*Triteleia laxa*	Ithuriel's spear	
Liliaceae	*Yucca whipplei subsp. intermedia*	chaparral yucca	
Liliaceae	*Yucca whipplei var. parishii*	chaparral yucca	
Liliaceae	*Zigadenus fremontii*	Fremont's Star Lily	
Loasaceae	*Mentzelia lindleyi*	Lindley's blazing star	
Loasaceae	*Mentzelia micrantha*	chaparral blazing star	

Family	Species	Common Name	Wetland
Lythraceae	*Lythrum californicum*	California loostrife	OBL
Malvaceae	*Malacothamnus fasciculatus*	chaparral mallow	
Malvaceae	*Malacothamnus fasciculatus var. fasciculatus*	chaparral mallow	
Malvaceae	*Malvella leprosa var. hederacea*	alkali mallow	FAC
Nyctaginaceae	*Mirabilis laevis var. crassifolia*	California four o'clock	
Nyctaginaceae	*Mirabilis multiflora var. pubescens*	Colorado four o'clock	
Onagraceae	*Camissonia bistorta*	California sun cup	
Onagraceae	*Camissonia californica*	California suncup	
Onagraceae	*Camissonia hirtella*	Santa Cruz Island suncup	
Onagraceae	*Camissonia ignota*	Jurupa Hills sun cups	
Onagraceae	*Camissonia intermedia*	intermediate suncup	
Onagraceae	*Camissonia micrantha*	miniature suncup	
Onagraceae	*Camissonia robusta*	robust sun cup	
Onagraceae	*Clarkia bottae*	Botta's clarkia	
Onagraceae	*Clarkia cylindrica*	speckled clarkia	
Onagraceae	*Clarkia dudleyana*	Dudley's clarkia	
Onagraceae	*Clarkia epilobioides*	Willow Herb Clarkia	
Onagraceae	*Clarkia purpurea*	purple clarkia	
Onagraceae	*Clarkia unguiculata*	elegant clarkia	
Onagraceae	*Epilobium canum subsp. canum*	California fuchsia	
Onagraceae	*Epilobium ciliatum*	fringed willowherb	FACW
Onagraceae	*Epilobium paniculatum*	autumn willowherb	
Oxalidaceae	*Oxalis albicans subsp. californica*	California woodsorrel	
Paeoniaceae	*Paeonia californica*	California peony	
Papaveraceae	*Dendromecon rigida subsp. rigida*	bush poppy	
Papaveraceae	*Eschscholzia californica*	California poppy	

Family	Species	Common Name	Wetland
Papaveraceae	*Meconella denticulata*	smallflower fairypoppy	
Papaveraceae	*Papaver californicum*	western poppy	
Papaveraceae	*Platystemon californicus*	cream cups	
Plantaginaceae	*Plantago erecta*	California plantain	
Platanaceae	*Platanus racemosa*	western sycamore	FACW
Poaceae	*Vulpia bromoides*		
Poaceae	*Achnatherum coronatum*	giant needlegrass	
Poaceae	*Agrostis pallens*	Bent grass	
Poaceae	*Bothriochloa barbinodis*	Beard grass	
Poaceae	*Bromus arizonicus*	Arizona brome	
Poaceae	*Bromus carinatus*	California brome	
Poaceae	*Elymus condensatus*	giant wild rye	FACU
Poaceae	*Elymus glaucus*	blue wildrye	FACU
Poaceae	*Hordeum brachyantherum*	meadow barley	FACW
Poaceae	*Melica imperfecta*	smallflower melicgrass	
Poaceae	*Muhlenbergia microsperma*	littleseed muhly	
Poaceae	*Nassella lepida*	small flowered needlegrass	
Poaceae	*Poa secunda*	one sided blue grass	FACW
Poaceae	*Setaria parviflora*	marsh bristlegrass	
Poaceae	*Vulpia octoflora*	sixweeks fescue	
Polemoniaceae	*Allophyllum glutinosum*	sticky false gilia	
Polemoniaceae	*Eriastrum sapphirinum*	sapphire woollystar	
Polemoniaceae	*Eriastrum sapphirinum subsp. dasyanthum*	sapphire woollystar	
Polemoniaceae	*Gilia angelensis*	chaparral gilia	
Polemoniaceae	*Gilia cana subsp. cana*	showy gilia	
Polemoniaceae	*Gilia capitata*	blue field-gilia	

Family	Species	Common Name	Wetland
Polemoniaceae	*Gilia capitata subsp. abrotanifolia*	blue field-gilia	
Polemoniaceae	*Gilia tricolor*	Tricolor gilia	
Polemoniaceae	*Leptodactylon californicum*	prickly phlox	
Polemoniaceae	*Leptodactylon californicum ssp. californicum*	California prickly phlox	
Polemoniaceae	*Leptosiphon grandiflorus*	large flowered leptosiphon	
Polemoniaceae	*Leptosiphon liniflorus*	narrowflower flaxflower	
Polemoniaceae	*Navarretia atractyloides*	hollyleaf pincushionplant	
Polemoniaceae	*Navarretia hamata subsp. hamata*	hooked pincushionplant	
Polemoniaceae	*Saltugilia splendens*		
Polygonaceae	*Chorizanthe parryi var. fernandina*	Parry's spineflower	RARE
Polygonaceae	*Chorizanthe staticoides*	Turkish rugging	
Polygonaceae	*Eriogonum elongatum*	longstem buckwheat	
Polygonaceae	*Eriogonum elongatum var. elongatum*	longstem buckwheat	
Polygonaceae	*Eriogonum fasciculatum*	California buckwheat	
Polygonaceae	*Eriogonum fasciculatum var. fasciculatum*	California buckwheat	
Polygonaceae	*Eriogonum fasciculatum var. foliolosum*	California buckwheat	
Polygonaceae	*Eriogonum gracile*	slender buckwheat	
Polygonaceae	*Pterostegia drymarioides*	woodland pterostegia	
Polygonaceae	*Rumex salicifolius var. salicifolius*	willow dock	OBL
Polypodiaceae	*Polypodium californicum*	California polypody	
Portulacaceae	*Calandrinia breweri*	Brewer's calandrinia	
Portulacaceae	*Calandrinia ciliata*	red maids	FACU
Portulacaceae	*Claytonia perfoliata subsp. mexicana*	miner's lettuce	FAC
Portulacaceae	*Claytonia perfoliata subsp. perfoliata*	miner's lettuce	FAC
Potamogetonaceae	*Stuckenia pectinata*	sago pondweed	OBL
Primulaceae	*Dodecatheon clevelandii*	padre's shootingstar	

Family	Species	Common Name	Wetland
Primulaceae	*Dodecatheon clevelandii subsp. clevelandii*	padre's shootingstar	
Pteridaceae	*Adiantum jordanii*	California maiden-hair	FAC
Pteridaceae	*Pellaea andromedifolia*	coffee fern	
Pteridaceae	*Pellaea mucronata*	bird's foot fern	
Pteridaceae	*Pentagramma triangularis subsp. triangularis*	gold back fern	
Ranunculaceae	*Clematis ligusticifolia*	creek clematis	FAC
Ranunculaceae	*Delphinium cardinale*	scarlet larkspur	
Ranunculaceae	*Delphinium parryi subsp. parryi*	San Bernardino larkspur	
Ranunculaceae	*Delphinium patens*	spreading larkspur	
Ranunculaceae	*Delphinium patens subsp. hepaticoideum*	spreading larkspur	
Ranunculaceae	*Ranunculus californicus*	California buttercup	FAC
Rhamnaceae	*Ceanothus crassifolius*	hoary leaved ceanothus	
Rhamnaceae	*Ceanothus cuneatus*	buckbrush	
Rhamnaceae	*Ceanothus cuneatus var. cuneatus*	buckbrush	
Rhamnaceae	*Ceanothus cyaneus*	Lakeside ceanothus	RARE
Rhamnaceae	*Ceanothus megacarpus*	big pod ceanothus	
Rhamnaceae	*Ceanothus megacarpus var. megacarpus*	big pod ceanothus	
Rhamnaceae	*Ceanothus oliganthus*	hairy ceanothus	
Rhamnaceae	*Ceanothus spinosus*	greenbark ceanothus	
Rhamnaceae	*Rhamnus californica*	California coffeeberry	
Rhamnaceae	*Rhamnus crocea*	redberry buckthorn	
Rhamnaceae	*Rhamnus ilicifolia*	hollyleaf redberry	
Rosaceae	*Adenostoma fasciculatum var. fasciculatum*	chamise	
Rosaceae	*Cercocarpus betuloides*	birch-leaf mountain-mahogany	
Rosaceae	*Cercocarpus betuloides var. betuloides*	birch-leaf mountain-mahogany	
Rosaceae	*Fragaria vesca*	California strawberry	

Family	Species	Common Name	Wetland
Rosaceae	*Heteromeles arbutifolia*	Toyon	
Rosaceae	*Holodiscus discolor*	Ocean spray	FAC
Rosaceae	*Horkelia cuneata*	wedge-leaf horkelia	
Rosaceae	*Potentilla glandulosa*	Common cinquefoil	FAC
Rosaceae	*Prunus ilicifolia*	holly leaf cherry	
Rosaceae	*Prunus ilicifolia subsp. ilicifolia*	holly leaf cherry	
Rosaceae	*Rosa californica*	California wild rose	FAC
Rubiaceae	*Galium angustifolium subsp. angustifolium*	narrowleaf bedstraw	
Rubiaceae	*Galium aparine*	common bedstraw	FACU
Rubiaceae	*Galium cliftonsmithii*	Santa Barbara bedstraw	
Rubiaceae	*Galium porrigens*	Nuttall's bedstraw	
Rubiaceae	*Galium porrigens var. porrigens*	Nuttall's bedstraw	
Salicaceae	*Populus fremontii*	Fremont cottonwood	FACW
Salicaceae	*Salix lasiolepis*	arroyo willow	FACW
Saxifragaceae	*Lithophragma affine*	common woodland star	
Saxifragaceae	*Lithophragma affine subsp. mixtum*	common woodland star	
Saxifragaceae	*Saxifraga californica*	California saxifrage	
Scrophulariaceae	*Antirrhinum coulterianum*	Coulter's snapdragon	
Scrophulariaceae	*Antirrhinum kelloggii*	Kellogg's snapdragon	
Scrophulariaceae	*Antirrhinum multiflorum*	Withered Snapdragon	
Scrophulariaceae	*Antirrhinum nuttallianum*	Nuttall's snapdragon	
Scrophulariaceae	*Castilleja affinis*	Indian paintbrush	
Scrophulariaceae	*Castilleja affinis subsp. affinis*	Indian paintbrush	
Scrophulariaceae	*Castilleja applegatei subsp. martinii*	wavyleaf Indian paintbrush	
Scrophulariaceae	*Castilleja exserta*	purple owl's clover	
Scrophulariaceae	*Castilleja foliolosa*	Texas paintbrush	

Family	Species	Common Name	Wetland
Scrophulariaceae	*Collinsia heterophylla*	purple Chinese houses	
Scrophulariaceae	*Cordylanthus rigidus subsp. setigerus*	bristly bird's beak	
Scrophulariaceae	*Keckiella cordifolia*	climbing penstemon	
Scrophulariaceae	*Linaria canadensis*	blue toad flax	
Scrophulariaceae	*Mimulus aurantiacus*	sticky monkeyflower	
Scrophulariaceae	*Mimulus aurantiacus var. pubescens*	sticky monkeyflower	
Scrophulariaceae	*Mimulus aurantiacus var. puniceus*	sticky monkeyflower	
Scrophulariaceae	*Mimulus brevipes*	wide throated yellow monkeyflower	
Scrophulariaceae	*Mimulus guttatus*	seep monkeyflower	OBL
Scrophulariaceae	*Penstemon centranthifolius*	scarlet bugler	
Scrophulariaceae	*Penstemon heterophyllus*	foothill penstemon	
Scrophulariaceae	*Penstemon heterophyllus var. australis*	southern foothill penstemon	
Scrophulariaceae	*Penstemon spectabilis*	showy penstemon	
Scrophulariaceae	*Scrophularia californica*	California Bee plant	FAC
Solanaceae	*Datura wrightii*	Jimson weed	
Solanaceae	*Solanum americanum*	American black nightshade	FAC
Solanaceae	*Solanum douglasii*	Douglas' nightshade	FAC
Solanaceae	*Solanum umbelliferum*	blue witch nightshade	
Solanaceae	*Solanum xanti*	chaparral nightshade	
Solanaceae	*Solanum xanti var. intermedium*	chaparral nightshade	
Typhaceae	*Typha latifolia*	broadleaf cattail	OBL
Urticaceae	*Hesperocnide tenella*	western stinging nettle	
Urticaceae	*Parietaria hespera*	western pellitory	
Urticaceae	*Parietaria hespera var. hespera*	western pellitory	
Urticaceae	*Urtica dioica subsp. holosericea*	giant creek nettle	FACW
Verbenaceae	*Verbena lasiostachys*	Common verbena	FAC

Family	Species	Common Name	Wetland
Verbenaceae	*Verbena lasiostachys var. lasiostachys*	Common verbena	FAC
Violaceae	*Viola pedunculata*	California Golden Violet	
Vitaceae	*Vitis girdiana*	Southern california grape	

APPENDIX 5.
FLORA OF INGLEWOOD AND CENTINELA CREEK FROM HERBARIUM RECORDS

Family	Species	Common Name	Wetland
Apiaceae	*Perideridia parishii subsp. latifolia*	wide leaved Parish's yampah	FACW
Apiaceae	*Sanicula arguta*	sharp toothed snakeroot	
Asteraceae	*Artemisia californica*	California sagebrush	
Asteraceae	*Centromadia parryi subsp. australis*	Parry's tarweed	FAC
Asteraceae	*Cirsium brevistylum*	Indian thistle	
Asteraceae	*Ericameria palmeri var. pachylepis*	broad scaled Palmer's goldenbush	
Asteraceae	*Gnaphalium palustre*	western marsh cudweed	FACW
Asteraceae	*Grindelia hirsutula*	hairy gumweed	FACW
Asteraceae	*Heterotheca grandiflora*	telegraphweed	
Asteraceae	*Lasthenia glabrata subsp. coulteri*	yellowray goldfields	FACW
Asteraceae	*Psilocarphus brevissimus*	woolly marbles	OBL
Asteraceae	*Stephanomeria exigua subsp. exigua*	slender stephanomeria	
Boraginaceae	*Pectocarya linearis subsp. ferocula*	sagebrush combseed	
Brassicaceae	*Rorippa palustris subsp. occidentalis*	western bog yellow cress	OBL
Brassicaceae	*Sibara virginica*	common rock cress	FAC
Caryophyllaceae	*Spergularia macrotheca var. leucantha*	sticky sandspurry	FAC
Caryophyllaceae	*Spergularia marina*	salt marsh sand spurry	OBL
Chenopodiaceae	*Atriplex serenana var. serenana*	saltscale	FAC
Chenopodiaceae	*Chenopodium californicum*	soaproot	
Convolvulaceae	*Calystegia macrostegia subsp. intermedia*	south coast morning-glory	
Convolvulaceae	*Cressa truxillensis*	spreading alkaliweed	FACW
Convululaceae	*Calystegia macrostegia ssp. intermedia*	south coast morning glory	
Cyperaceae	*Eleocharis acicularis*	needle spikerush	OBL
Cyperaceae	*Eleocharis acicularis var. acicularis*	needle spikerush	OBL
Cyperaceae	*Eleocharis macrostachya*	common spikerush	OBL
Cyperaceae	*Scirpus californicus*	California tule	OBL

Family	Species	Common Name	Wetland
Cyperaceae	*Scirpus maritimus*	prairie bulrush	OBL
Elatinaceae	*Elatine brachysperma*	short-seed waterwort	FACW
Euphorbiaceae	*Chamaesyce albomarginata*	rattlesnake weed	
Euphorbiaceae	*Croton setigerus*	dove weed	
Fabaceae	*Astragalus tener var. titi*	alkali milk-vetch	FACW
Fabaceae	*Astragalus trichopodus var. lonchus*	Santa Barbara milk-vetch	
Fabaceae	*Lotus heermannii*	Heermann's lotus	
Fabaceae	*Lotus strigosus*	Hairy Lotus	
Fabaceae	*Lotus strigosus var. hirtellus*	Hairy Lotus	
Fabaceae	*Lotus strigosus var. strigosus*	Hairy Lotus	
Fabaceae	*Lupinus bicolor subsp. microphyllus*	miniature lupine	
Fabaceae	*Trifolium ciliolatum*	foothill clover	
Fabaceae	*Trifolium gracilentum*	pinpoint clover	
Fabaceae	*Trifolium willdenovii*	tomcat clover	
Malvaceae	*Sidalcea malviflora subsp. sparsifolia*	dwarf checkerbloom	
Onagraceae	*Camissonia lewisii*	Lewis' evening primrose	
Onagraceae	*Camissonia strigulosa*	sandysoil suncup	
Onagraceae	*Epilobium pygmaeum*	smooth boisduvalia	OBL
Plantaginaceae	*Plantago elongata*	coastal plantain	FACW
Plantaginaceae	*Plantago subnuda*	tall coastal plantain	FACW
Poaceae	*Agrostis viridis*	green bentgrass	
Poaceae	*Alopecurus carolinianus*	Carolina foxtail	FACW
Poaceae	*Bromus carinatus*	California brome	
Poaceae	*Phalaris lemmonii*	Lemmon's canarygrass	FACW
Poaceae	*Phalaris minor*	littleseed canarygrass	
Poaceae	*Poa secunda*	one sided blue grass	FACW

Family	Species	Common Name	Wetland
Polemonaceae	*Navarretia fossalis*	spreading navarretia	
Polemoniaceae	*Gilia angelensis*	chaparral gilia	
Polemoniaceae	*Linanthus dianthiflorus subsp. dianthiflorus*	fringed linanthus	
Polemoniaceae	*Navarretia prostrata*	prostrate pincushionplant	OBL
Polemoniaceae	*Saltugilia splendens ssp. spendens*		
Portulacaceae	*Calandrinia ciliata var. menziesii*	red maids	FACU
Ranunculaceae	*Ranunculus californicus*	California buttercup	FAC
Rosaceae	*Heteromeles arbutifolia*	Toyon	
Salicaceae	*Salix lasiolepis*	arroyo willow	FACW
Solanaceae	*Solanum douglasii*	Douglas' nightshade	FAC
Verbenaceae	*Verbena bracteata*	bigbract verbena	FACW
Verbenaceae	*Verbena lasiostachys var. lasiostachys*	Common verbena	FAC
Violaceae	*Viola pedunculata*	California Golden Violet	

From: maryknight <kathy.knight@verizon.net>
Subject: **Additional Ballona Restoration NOI Comments**
Date: October 23, 2012 11:05:35 AM PDT
To: "Daniel P. Swenson" <daniel.p.swenson@usace.army.mil>, David Lawhead <DLawhead@dfg.ca.gov>

October 23, 2012

TO: Dr. Daniel P. Swenson, U.S. Army Corps of Engineers, Los Angeles District P.O. Box 532711, Los Angeles, CA 90053-2325
Mr. David Lawhead, California Dept. of Fish & Game, 3883 Ruffin Road, San Diego, CA 92123

FROM: Kathy Knight, (310) 613-1175, kathy.knight@verizon.net

RE: Additional Comments Re: Ballona Restoration NOI Comments

Dear Mr. Swenson and Mr. Lawhead:

I have these additional comments to add to the record regarding the proposed restoration of the Ballona Ecological Reserve. Please add them to the comments I have already mailed/delivered to you.

ALTERNATIVE RESTORATION PLAN

Please study seriously an ALTERNATIVE plan for restoration of the Ballona reserve. This plan would NOT entail major bulldozing and removing levees from the LA River.
This plan would have the following components:

1) Plan approved by Tongva Native Americans for their sacred site.
2) Plan may allow for minor earthmoving to make a couple of small channels for fresh water.
3) No water from Ballona Creek allowed into the wetlands until it is cleaned up to a tertiary level.
4) Use Bond funds available, from not doing an expensive major bulldozing/dredging/levee-building project, to buy buffer lands around the reserve to reduce road kill of Ballona wildlife in the area, and allow larger more stable populations of wildlife. Additional land would also make limited public trails less disturbing to wildlife, as they would have additional places to live.
5) Study the value of this plan for 5-10 years. Some alterations could be made during that time, based on the results.
6) Utilize local citizens who have been documenting/photographing this area for the past 20-30 years in the active science committee. Do not continue to relegate them to public comments of 2-3 minutes at in-frequent meetings, but rather make them integral participants in the science committees where they can communicate more fully with the other members. Some of them see wildlife that is never documented on the science cameras. Their input is CRITICAL to a

well-done evaluation of this area.
7) Continue to bring Los Angeles area students out to the wetlands to help clean-up the area, document flora and fauna, etc. so that they are interested in helping to watch over this land in the future.
8) Follow the natural course of the land/water. Please consult with Dr. Travis Longcore and his researchers on this.
9) Use this plan to teach the public that the first rule of restoration is to "Do No Further Harm". Teach the public that big expensive industrial solutions are not always the best, most permanent way to protect nature. A slower alternative that teaches people to respect nature, and allow its natural tendency to balance itself.

IF YOU WANT FURTHER INFORMATION ON SUCH A PLAN, LET ME KNOW AND I WILL WORK ON GETTING YOU MORE DETAILS. A PLAN LIKE THIS WOULD GIVE THE PUBLIC A REAL CHOICE, AND validate what the public is being told - that there IS NO preferred plan, that it is wide open on what will happen at Ballona.

OTHER COMMENTS:
1) I do not agree at all with bulldozing this site. But if you do, please reveal any background information regarding any bulldozing of Ballona, and if any company will benefit from mitigation credits, and any other financial connections to the restoration efforts, so that there is transparency on how and why these decisions are made.

2) REGARDING WATER STUDIES: Please study the impact of the water from Marina Del Rey on ANY proposed alternative for restoration. Marina Del Rey water is highly polluted from toxics from many boats (I have been told there are 7,000 boats there!). These boats have toxic chemicals applied to them to preserve them, and to run them, that leak into the water, plus people using the boats have been seen to dump liquids and trash into the water. Please test the water of Marina Del Rey very carefully and assess how that water will impact the wetlands, and how it could be kept separate from the wetlands.

2) Remove the trash (local groups and citizens can help on this issue) and find somewhere for homeless people to sleep. Don't make these issues a reason why the restoration has to be hurried.

Thank you very much.
Kathy Knight, MSW
(Have been volunteering and donating funds for 20 years to save and protect this precious ecosystem)
(310) 613-1175

P.S. THE REASON THAT IT IS CRITICAL TO STUDY THE WATER/GAS INTERACTION IS THAT THERE ARE MANY RESIDENTS AT PLAYA VISTA THAT COULD BE IMPACTED BY ANY changes.

October 22, 2012

Dr. Daniel P. Swenson, Chief
Los Angeles Section
U.S. Army Corps of Engineers
915 Wilshire Blvd.
Los Angeles, CA 90017

Mr. David Lawhead
California Dept. of Fish & Game
3883 Ruffin Road
San Diego, CA 92123

Comments on NOI to Prepare Joint EIS/EIR on Ballona Wetlands Restoration

Dear Mr. Swenson and Mr. Lawhead:

I have been volunteering since 1992 to help protect the Ballona wetlands ecosystem from development and bulldozing. I am Conservation Chair of the Sierra Club Airport Marina Group, but these comments are my own. The Sierra Club will be making comments separately.

As I understand the proposed project is for a full review of the area of the Ballona Ecological Reserve. It has never had a federal review before. And based on this review, a proposal will be made for what should be done to help enhance this valuable resource. I have the following comments/questions and requests for studies:

1) This entire area is a registered Sacred Site for the indigenous people of Los Angeles, the Tongva Native Americans, who have been living in this area for the past 10,000 years. This area is called Sa'angna in their culture. They had a very deep respect for nature and kept this area as a beautiful paradise.

They have suffered horribly through the past 300 years from having their land taken from them and their culture disrespected. The Playa Vista developers dug up over 1400 of their ancestors' graves to build their development. It is time that this process is stopped. Please respect their wishes and their culture when considering how to treat this land.

2) PLEASE STOP ALL ALTERATIONS AND/OR CONSTRUCTION ACTIVITIES ON THIS LAND UNTIL THE EIS/EIR IS APPROVED.

I have been told that approximately 60 core drillings have been made on the land in the past month. What is that for? How has that activity impacted plants and animals on the site? Please keep the land unaltered until this process is approved.

3) PLEASE EXPLAIN WHY THE 2005 JOINT EIS/EIR IS NOT BEING FOLLOWED

Why instead is this very narrowly focused restoration plan with only a fraction of the Ballona ecosystem being studied?

Marina del Rey would be reviewed under House Document 389.
The Corp would then report back to Congress to recommend any changes thereto.
The entire Ballona Watershed was considered.
The process was funded by Congress.
The process was requested by Congress.

The 2005 NOI covered the Ballona ecosystem, including Marina Del Rey, the Playa Vista Urban Runoff Basin (aka Fresh Water Marsh). Please follow the 2005 NOI, not this shortened one. All of the adjacent bodies of water need to be included into the Ballona Wetlands Study Area (BWSA) including, but not limited to, the Marina Del Rey Harbor, Oxford Lagoon, Del Rey Lagoon, Venice Canals, and Santa Monica Bay. The Ballona Ecosystem needs to be studied as a whole. Its waters and wildlife are interactive, and you can't study one section properly without studying the whole.

The Sierra Club Airport Marina Group supports this restoration process to continue under the more inclusive 2005 NOI. (See attached letter of support).

4) WHY HASN'T A PUBLIC HEARING BEEN HELD FOR THE NOI?

This current process is not conducive to the public being able to make full comments. Local citizens have fought to save this land for many years. They deserve to hear each other speak at a public hearing, not just have the walk around displays on August 16, 2012. This process is critical at the NOI stage, where the groundwork is being set on what to study in the EIS/EIR.

It would be beneficial to the Army Corps and Fish & Game to hear their concerns and for the public to be able to ask them questions.

Please extend the Oct. 23rd NOI deadline until a public hearing by the Army Corps and CDFG can be held. This request was made at the August display event, but thus far it has not happened.

5) PLEASE ANALYZE AND ASSESS HOW THE PLAYA VISTA AND BALLONA WETLANDS GROUNDWATER WILL BE IMPACTED BY THE PROPOSED RESTORATION PLANS.

How much groundwater is being taken out of the aquifer currently by Playa Vista and sent to Hyperion?

How much more water will be withdrawn if Playa Vista Phase 2 is built? What effect will that have on the wetlands?

How much water can be withdrawn from the Playa Vista site and not take away from the wetlands' source of underground water?

What effect is the withdrawing of this amount of water and this depletion of the aquifer having currently on the Ballona wetlands ecosystem?

What is the impact if the aquifer beneath Playa Vista and Ballona (the Silverado aquifer) which is a potential drinking water aquifer, is needed for public use due to drought?

Ballona is a non-adjudicated basin. As I understand, this means that entities can take as much water as they want from underneath their property. For example, Playa Vista is withdrawing a large amount of water under their development to maintain their gas mitigation system. As far as we know, it is unmonitored and sent straight to Hyperion. The area seems much drier than usual, even more so than in previous drought years like this one.

6) HOW WOULD ANY CHANGE IN THE HYDROLOGY (ESPECIALLY ADDITION OR WITHDRAWAL OF WATER) OF THE AREA IMPACT THE MIGRATORY GAS UNDER THE PLAYA VISTA DEVELOPMENT?

After 5 years of Grassroots Coalition and their expert, Dr. Bernard Endres, warning the Los Angeles Dept. of Building and Safety that there was a problem of escaping gas at the Playa Vista site, the Dept. finally ordered a peer review study

by Exploration Technolgies, Inc. (ETI). This study showed that Grassroots Coalition was right - there was a large amount of gas coming out of the site (see attached 4-13-2000 ETI gas map attached).

ETI stated that this gas is highly migratory (January 19,1999 letter attached). Also the site is subject to significant earthquakes in the future that can alter both the subsurface methane concentrations migrating from subsurface sources and degrade any methane mitigation system (July 23, 1999 ETI letter attached).

A December 15, 1999 letter (attached) from ETI said the Playa Vista area is a "High Potential Methane Zone" and that no excavations should be made below the ground table water, and a report should be filed before pumping of any groundwater.

Doesn't this documentation regarding the serious gas issue at Playa Vista warrant very serious studies on the effects of adding or changing the water dynamics of the area? We think that ETI should be consulted on any proposed changes to the hydrology/tidal influence in this area.

Please address the concerns of Dr. Bernard Endres, Grassroots Coalition's expert in his June 7, 2000 document to LA City entitled "An Evaluation of Gas Migration and Environmental Hazards Existing at the Playa Vista Project" (attached). Dr. Endres wrote a book about the Playa Del Rey oilfield and was very familiar with its aspects. On Issue #6 in this document, he says an evaluation of the special problems created by the 50 ft. gravel zone (the old Los Angeles River bed) under Ballona Creek needs to be performed due to the fact that it allows gas to build to high pressures from a rising water table.

Also, it is our understanding that Southern California Gas Co. which stores 7 billion cubic feet of gas just west of Lincoln Blvd. in a sandstone rock formation approximately 6,000 ft. below the ground should be consulted. We have been told that they maintain the pressure of this gas in the rock formation through a system of pressure that changes with the tides going in and out of the area.

Finally, if any changes to the hydrology of the area were to exacerbate the gas problem at Playa Vista, the Marina, or the Gas Co., who would be responsible financially? Would there be any risk of liability from the State of California?

7) Why is the Playa Vista Urban Runoff Basin (aka Fresh Water Marsh) left out of this EIS/EIR proposal when it is part of the wetlands? Please include this area in the EIS/EIR. It is part of this Ballona ecosystem.

Why isn't the dewatering of the Playa Vista site going to the Fresh Water Marsh, instead of being sent to Hyperion?
It is our understanding that it was required through the Playa Vista Environmental Impact Report.

Also what will be the impact on the Ballona Ecological Reserve if the Fresh Water Marsh has to be dredged every 5-15 years to remove toxic contamination build up from street runoff, as stated will have to happen in the Playa Vista Phase 1 EIR?

It is also our understanding that the Fresh Water Marsh is being maintained by the Playa Vista developer with watering from tap water sources. How much water does this use, and how will it be maintained when the developers are gone? We are concerned that the Playa Vista homeowners will not be able to afford to keep the Fresh Water Marsh watered. What impact would that have on the Ballona Reserve?

8) BALLONA CREEK SHOULD NOT BE ALLOWED TO POLLUTE THE WETLANDS

Ballona Creek should not be allowed, with all its street run-off contamination from a wide area of the Los Angeles basin, to flow into the Ballona Reserve just to "bring water to the wildlife." This is using the Ballona Reserve as an End of the Line clean-up basin to clean up Ballona Creek before it enters Santa Monica Bay.

A full EIR needs to be done of opening up Ballona Creek into the wetlands before it would ever be happen due to its toxic contamination from many miles of runoff sources.

Are you going to do an EIS/EIR on the impact of changing Ballona Creek and letting it go into the wetlands?

I talked to a scientist on your technical advisory committee, Dr. Richard Ambrose, who agreed that opening up Ballona Creek into the reserve would bring contamination, but he said the animals would benefit from the water.

Please analyze and assess how the pollution from Ballona Creek would impact

plant and animal life.

The Ballona Reserve looks dry now, but that is because the rainfall for 2011-2012 is only half of normal. (See attached rainfall charts). This land has gone through periodic droughts and heavy rainfall seasons for many years. It is a seasonal wetland, not a year-round wetland.

Also, what are the positive effects of a drought? It is our understanding that during droughts some of the invasive non-native plants die off, giving the native plants more chance to re-generate. Are there any other benefits?

Also, please analyze the upland habitat needed for the wildlife of Ballona. We understand from a previous study that the wetlands were 2,000 acres surrounded by 6,000 acres of uplands. So uplands are a very important part of the system, and the current proposed project looks like it will create too much wetland area vs. upland area.

9) THE BALLONA WETLANDS CANNOT CLEAN UP TOXIC POLLUTION FROM BALLONA CREEK

If Ballona Creek is opened up into the wetlands, how will the sediment be taken out of the wetlands, and how will the toxics sent into it from the creek be removed? In a study done by Dr. Rimmon C. Fay who spent his life studying the Ballona wetlands and Santa Monica Bay, wetlands can absorb and handle a certain amount of sewage waste. But they cannot handle toxic waste. It builds up in the soil, gets absorbed into plants, and therefore by wildlife. Wetlands cannot break down toxic chemicals into non-toxic chemicals.

How much would it cost to remove this sediment and toxic contamination from the wetlands, and how often would it have to be done?

10) ANY NEW WATER INTO THE WETLANDS NEEDS TO BE FROM A CLEAN SOURCE SO AS TO NOT DAMAGE IT MORE.

Any new water should be treated to a tertiary level to protect the plants and animals. Otherwise, this area may have to be periodically dredged every 5-15 years just like the Fresh Water Marsh.

What would be the cost of cleaning up the Ballona Creek water to a tertiary level?

11) WHAT IS THE EFFECT OF THE 20' HIGH LEVEES ON THE RESTORATION PROPOSAL PUT FORTH BY THE COASTAL CONSERVANCY? (See attached document)

Will they have an impact on Playa Del Rey? If a tsunami came through, the levees might protect Playa Vista, but could the water end up rebounding west back through the wetlands to Playa Del Rey, instead of being gradually absorbed to the east of Lincoln Blvd.?

It should be studied how the wetlands would fare in a tsunami. For example I have been told that in the 1930's a tsunami 9 ft. high went east past the 405 freeway. Another one in 2011 in Northern California caused $44 million in damage to harbors.

Are these levees being put there to protect Playa Vista and the large commercial interests at the site? What is the cost to taxpayers of these levees?

12) WHAT IS THE ESTIMATED COST OF THESE STUDIES AND PROPOSED PLAN TO RESTORE THE BALLONA WETLANDS?

13) SLOWER RESTORATION ALTERNATIVE

Please review the attached 7 GUIDING PRINCIPLES document that is supported by the Ballona Wetlands Land Trust, Sierra Club, Ballona Institute, Ballona Ecosystem Education Project, Grassroots Coalition, and Wetlands Defense Fund.

What would be the cost of a slower restoration? For example, take more time to study the land and see the effects of an ongoing restoration.

Please study the advantage of this type of restoration as a legitimate proposal. It would not be a no-project alternative, but it would be much less invasive than the proposed bulldozing/dredging of the site.

A slower, more careful restoration process would help avoid the mistakes made in the past, such as at the El Segundo Dunes in the 1990's. There LAX did a restoration where they had a company come in and plant native california

buckwheat plants to help the endangered El Segundo Blue butterfly recover. However, it was observed that the numbers of this species was going down even more. Only after careful studying of the situation did Dr. Rudi Mattoni find out that the PARTICULAR type of california buckwheat planted there was helping the El Segundo Blue's competitor butterfly increase in numbers. It hatched earlier than the El Segundo Blue on this particular type of buckwheat, and ate the food source up before the El Segundo Blue hatched. After these plants were removed and replaced by the right type of California buckwheat the El Segundo Blue started recovering and now is doing well at the dunes.

A massive bulldozing, dredging of the wetlands could destroy alot of this valuable information.

How would any bulldozing/dredging hurt/impact threatened and endangered species out there, such as the California Gnatcatcher and the Least Bell's Vireo? Isn't it the law that the habitat of these rare animals should not be altered or destroyed?

Students from Los Angeles area schools could come out and help do surveys and restore one area at a time, helping to teach them about nature and helping them to feel connected to Ballona as their wetlands.

14) ACQUISITION OF BUFFER LAND AROUND THE RESERVE

Please study the cost effectiveness of using restoration money towards acquiring more buffer land around the reserve.

Wouldn't this have a more beneficial effect on the plants and wildlife than bulldozing/dredging?

This reserve is in a highly developed area and the amount of road kill is already very high. According to a study in 2010, approximately 3,500 animals a year are killed on the roads around Ballona (see attached summary of road kill study).

And another intense development, Playa Vista Phase 2 was approved by the Los Angeles City Council in 2010. It is a few blocks east of the Reserve. According to the Playa Vista Phase 2 EIR, it would generate 24,000 additional car trips daily.

If that land and other buffer lands at risk of development were acquired, wouldn't that prove to be very beneficial to restoring and protecting wildlife and native flora at the Reserve?

15) STUDY AND FOLLOW THE NATURAL DYNAMICS AND HISTORY OF THE ECOSYSTEM

What is the natural flow of water on this land during the past 200 years?

As evidenced in photos that we have seen, there was not an estuarine habitat here with full tidal flow. Most of the time the wetlands were closed to the ocean, except in a rainy season.

According to research done by Dr. Travis Longcore the wetlands were mostly closed to the ocean. **Please review his lecture, entitled "Closure Dynamics of Southern California Estuaries and Implications for Restoration" given May 22, 2012 to the Los Angeles Audubon Society.** It is available on the website of Grassroots Coalition (www.saveballona.org). Hearing his presentation is critical to understanding the NATURAL balance of this area.

Please analyze the benefits to the wetlands and the species there of it being closed most of the time to the ocean.

The reason this issue needs to be studied more is that many times "restoration plans" include expensive bulldozing/dredging that do not follow the natural flow of the land/water on the site. It is not only expensive to bulldoze and dredge to begin with, but it does not last and must be done again. For example, the 1983 bulldozing of Malibu Lagoon to restore it did not work, and it recently has been bulldozed again. What was the cost 30 years ago and what was the cost this year at Malibu and who paid for it? Thirty years from now it will probably have to be bulldozed again - at what cost?

Also, the Bolsa Chica wetlands were dredged out and it keeps filling in because it does not reflect the natural flow of water and runoff. So every 2 years, it must be re-dredged at a cost of approximately $3 million. It is our understanding that in 2011 it had to be dredged at a cost of $13.3 million. Where does this money come from? Where would be the source of this money if it were needed at Ballona to maintain an unnatural estuarine habitat?

This waste of taxpayer bond money is a tragedy, especially in hard economic times. Any restoration of Ballona should be one that will not have to be repeated. What would be the cost of following the natural dynamics of this area, vs. creating a situation that does not? What would be the cost of bulldozing/dredging an estuarine habitat at Ballona that does not naturally exist now?

16) DO NOT DISTURB THE SOIL PLACED ON THE BALLONA RESERVE FROM THE DREDGING OF MARINA DEL REY, BEFORE IT IS ANALYZED FOR ITS VALUE AND THE TONGVA NATIVE AMERICANS HAVE BEEN CONSULTED AND AGREED TO ANY DISTURBANCE

Land that was placed onto the Ballona Reserve just south of Fiji Way is very valuable land. It was placed there when the Ballona wetlands north were dug up and Marina del Rey was built. It would have the original soil from that area that may be valuable later to study, it has native plants growing on it, and it may have Native American artifacts/historical parts to it.

This land should not be disturbed without first consulting with the Tongva Native Americans, and should most likely be left there.

Also please consult the California Native Plant Society for their input on this restoration of Native Plants at the Ballona Reserve.

Please keep me informed of any events and information relating to this Ballona wetlands area.

Thank you very much.

Kathy Knight

Kathy Knight
1122 Oak St.
Santa Monica, CA 90405
(310) 613-1175
Kathy.knight@verizon.net

Attachments:
Photo of Ballona wetlands in 1995
Sierra Club letter re 2005 NOI dated August 16, 2012
2 Annual Los Angeles Rainfall charts
ETI gas map of Playa Vista and So. California Gas Co Storage area of 4-13-2000
Letters dated January 19, 1999, July 23, 1999, and December 15, 1999 from ETI to LADBS and LA Building & Safety Dept. to PLAYA CAPITAL
An Evaluation of Gas Migration and Environmental Hazards Existing at the Playa Vista Site by Dr. Bernard Endres, June 7, 2000
Ballona Ecosystems Rejuvenation 7 Guiding Principles
Ballona Roadkill Statistical Document
Coastal Conservancy Proposed Construction Plan for Ballona Restoration

CC: DONNA MCCORMICK, ICPI — 10 —



Photo By Rob Kinslow 1995

A-1886 **View towards the Ballona Wetlands Ecosystem**
Los Angeles, California

BALLONA ECOSYSTEMS REJUVENATION

"SEVEN GUIDING PRINCIPLES"

1. 21st century, incremental, community involved ecosystem rejuvenation that is in harmony with natural laws . We are opposed to industrial-scale habitat conversion, including major bulldozing, which destroys existing ecosystems.

2. In appreciation of what is there now, recognize the resiliency of the ecosystems and identify areas that require no more than observation for the foreseeable future.

3. In recognition of the importance of gaining control of more acreage before it is built on, or otherwise negatively impacted, give priority to acquisition/addition of additional unprotected parcels of land at a reasonable price to the Ballona Wildlife Refuge, over restoration activities. Such land protection will increase habitat enhancing buffer zones for wildlife and plants, and decrease car trips in the area, which lead to animal road fatalities.

4. Utilize existing opportunities to access the refuge, such as the Ballona Creek bike path, and south earthen levy along Ballona Creek and install a walking/biking path around as much of the perimeter of the refuge as is ecologically feasible.

5. Utilizing existing infrastructure such as the old Pacific Railway bridge supports and other man made structures, along with materials that have the deepest sustainability, create wildlife, bicycle, and walking linkages that connect all areas of the ecosystems in a fashion that allow homo sapiens and animals alike, to safely go over or under all roads and waterways that divide the refuge.

6. In recognition of the importance of enhancing the beauty of the refuge, safety of birds and other mammals, and the reduction of light pollution, move all power, telephone, and cable lines underground, and remove the majority of street lighting.

7. Endangered, threatened, and imperiled species must be given priority for protection in any refuge alteration considerations.

Supported by numerous environmental and community groups, including Ballona Wetlands Land Trust, Sierra Club, Ballona Institute, Ballona Ecosystem Education Project, Grassroots Coalition and Wetlands Defense Fund

SIERRA CLUB
FOUNDED 1892
Angeles Chapter
Airport Marina Regional Group
3435 Wilshire Blvd., Ste. 320
Los Angeles, CA 90010

August 16, 2012

U.S. Army Corps of Engineers
Los Angeles District
915 Wilshire Blvd, Suite 1101
Los Angeles, CA 90017
Att:Col. Mark Toy Commander Los Angeles District
Att: Dr. Daniel P. Swenson
1416 9th St., 12th Floor

California Dept. of Fish & Game
1416 9th Street, 12th Floor
Sacramento, CA 95814
Att: Executive Director Charlton H. Bonham

Re: 2012 Notice of Joint EIS/EIR

This letter responds to the Notice of Intent to conduct a joint EIS/EIR pursuant to the National Environmental Policy Act and the California Environmental Protection Act at the Ballona Wetlands Ecological Preserve in the State of California, County of Los Angeles, in 2012.

The Club has resolved to support the joint EIR/EIS process noticed in the Federal Register on September 20, 2005 by the U.S. ACE Los Angeles District and the Santa Monica Bay Restoration Commission, a State Agency, as the local sponsor.

The position of the Club is that the new Notice of Intent placed in the Federal Register on July 25, 2012 contradicts and duplicates the former EIS noticed in 2005.

The Secretary of the Army has stated in writing that the 2005 joint EIS/EIR process is not terminated and is therefore current.

The reasoning of the resolution is as follows:

Another EIS process has been introduced by LA USACE that interferes with and contradicts the current process. The Corp has begun a new process that duplicates and reduces the scope of the 2005 Environmental Process, without first terminating it.

The two processes cannot exist concurrently, because of duplication, and the requirement for the first study to be completed. The first study has been fully funded by the U.S. Congress and the latter process has not.

The second process proposes to change the course of Ballona Creek, and to dredge and fill wetlands, prior to the completion of the first process and before the Corp can report its recommendations back to Congress.

Furthermore, the second process proposes to reintroduce tidal flow to a freshwater wetland system that was not historically connected to the to the ocean to the degree the new process implies.

The National Oceanic and Atmospheric Administration warned against this project, as it would destroy valuable upland habitat.

The U.S. Clean Water Act designates four separate Section 303(d) Impaired Waterways that are present.

- Marina del Rey
- Upper Ballona Creek
- Ballona Creek Estuary
- Ballona Wetlands

The 2012 Notice proposes to divert one Impaired Waterway into another. It is illegal to further impair a waterway that is already impaired.

The resolution reads as follows and represents the Sierra Club official stance on both of the aforesaid environmental processes.

RESOLUTION

Whereas, the Airport Marina Regional Group of the Angeles Chapter Sierra Club has jurisdiction over Marina del Rey,

Whereas, The Club supports National Planning for Environmental Restoration, Recreational Boating, Storm Damage Reduction, and is Supportive of other purposes the Congress of the United States intended for Marina del Rey such as a youth hostel and camping facilities.

Whereas, The U.S. Army Corp of Engineers Environmental Impact Statement process noticed in the Federal Register in 2005 supports the same aforesaid purposes that the Sierra Club supports,

Therefore, be it resolved by the Airport Marina Regional Group, Angeles Chapter of Sierra Club, supports the completion of the 2005 Environmental Review process Noticed in the Federal Register to conduct a review of Marina del Rey: September 20, 2005 (Volume 70, Number 181) [Notices] [Page 55116-55117]

END

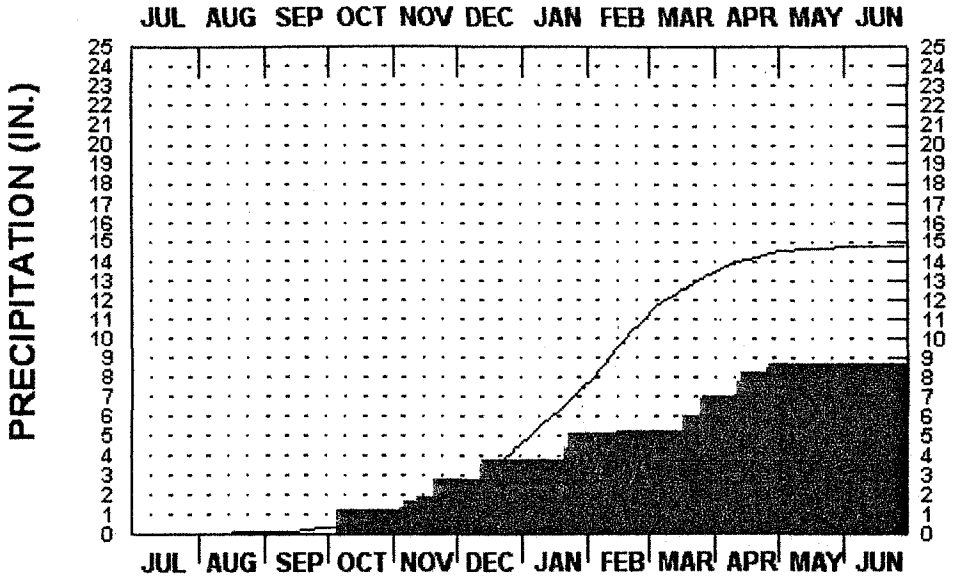
The Sierra Club supports a full range of alternatives for the restoration, which is called for in the 2005 Notice for Environmental Impact Statement pursuant to the National Environmental Policy Act. The Sierra Club does not support a limited range of alternatives as proposed by the 2012 Notice for an Environmental Impact Statement.

Sincerely,

Joe Young

Joe Young, Chair
Airport Marina Group
(310) 822-9676

SEASON-TO-DATE DOWNTOWN LOS ANGELES PRECIP FOR 2011-12 (BARS) VERSUS LONG-TERM AVERAGE (LINE TRACE)



'er the role of propofol, and
)th sides tried to use the
stimony of emergency
)om doctors to launch
)ening salvos.

Deputy Dist. Atty. David
'algren quizzed Cooper
)out the appropriate uses
'propofol.

"I've never seen or heard
'it used in a home setting, if
)at is what you are asking,"
)e said. She said that the
rug can endanger the respi-
)tory system and that hos-
)tal procedures require "a
erson whose only job is the
)onitoring of the sedation."

On cross-examination,
efense attorney J. Michael
lanagan asked her to con-
der a hypothetical situa-
)n that mirrored Murray's
)sertion to police that he
)ve Jackson only a small
nount of propofol — 25
lligrams — more than an
)ur before he stopped
eathing.

"If the patient was awake
d completely normal and
t sedated after the medi-
)ion [wore off] and then
)a subsequent problem...
ould not think it was re-
)d," she said.

But when Walgren asked
ether her conclusion was
)ed on the doctor's being
thful about the amount
ropofol he had given, she
l it was.

)riet.ryan@latimes.com
)es staff writer Victoria
) contributed to this
)rt.

found in the photographs found in Franklin's possessions, and the two other missing-person cases surfaced as a result of the publicity surrounding release of the photos, police said.

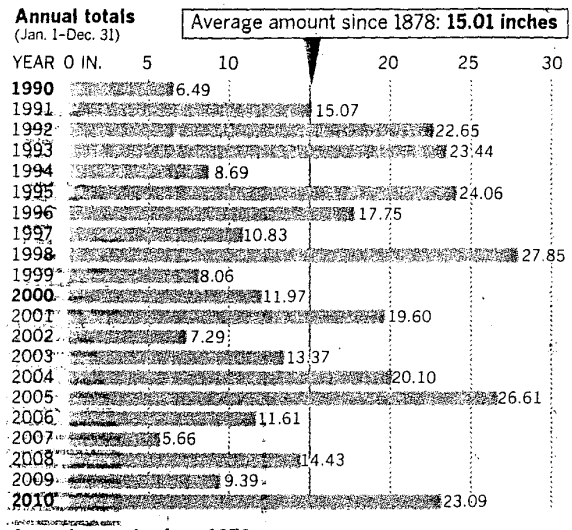
"We know who they are. They can't been seen in a substantial amount of time," Lisa Pensanti, was critical of the LAPD for releasing the photos and said more than a dozen of the women were relatives or friends.

Pensanti returned a call but did not immediately comment on the case.

andrew.blankstein@latimes.com

L.A. annual rainfall, 1990-2010

A total of 23.09 inches of rain was recorded in 2010 at the National Weather Service's downtown Los Angeles weather station, located at USC. Over 44% of the year's total, 10.23 inches, fell in December alone.



Annual records since 1878
Wettest 40.29 (1884) **Driest** 4.08 (1953)
Source: National Weather Service

Los Angeles Times

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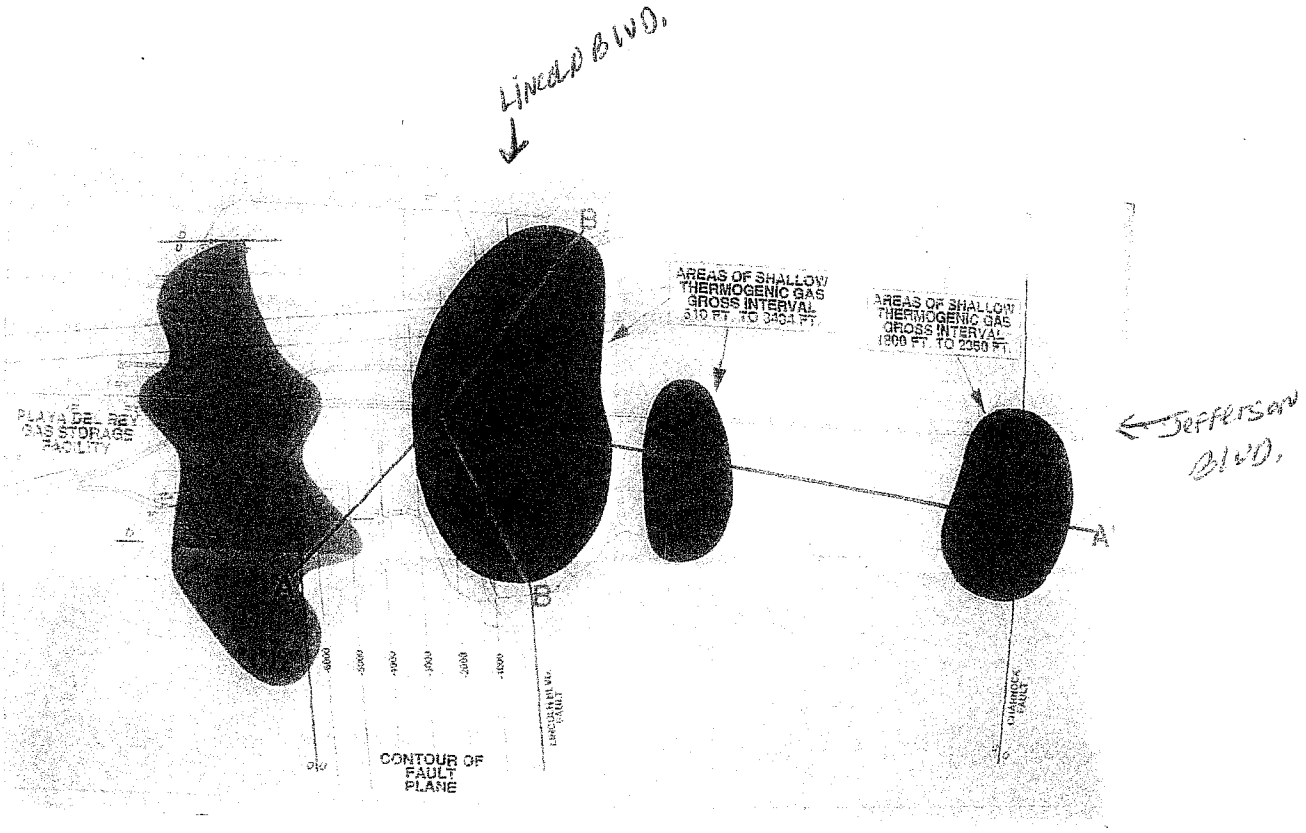

Exploration Technologies, Inc.

3406 Westchase Dr. Houston, Texas 77042 (713) 785-0993

Plate 1

Site Characterization

Playa Vista Development
First Phase Project
Los Angeles, California

Prepared For:
City of Los Angeles Department of Building and Safety

\99-211904-3000PR00001 Date Prepared: (04/13/00)

4/13/2000

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GENERAL MANAGER

RICHARD E. HOLGUIN
EXECUTIVE OFFICER

January 19, 1999

Log # 26682
C.D. --

METHANE CTRL FILE - 7

Playa Capital, LLC
12555 W. Jefferson Bl
Los Angeles, CA 90066

TRACT: Rancho La Ballona (DCC 2722 CF 64)
LOT: Ramona S De Machado 341.85095 Acres
LOCATION: 13250 Jefferson Bl

CURRENT REFERENCE REPORT/LETTER(S)	REPORT NO.	DATE(S) OF DOCUMENT	PREPARED BY
Methane Report	10610-22844-110.RT.GAS	10/14/98	Camp Dresser McK.
``	``	01/13/99	``

The referenced reports concerning recommendations for mitigation of methane gas for the First Phase of the Playa Vista development have been reviewed by the Grading Section of the Department of Building and Safety. The areal limits of the First Phase are shown on Figure 2-3 of the report. Most of the area is south of Ballona Creek and northeast of Lincoln Bl.

According to the report, significant levels of methane gas were detected on the southwest portion of the subject area. The report indicates that only buildings within the area of observed high concentrations of gas are recommended for mitigation measures. It is the experience of the Department that methane gas can be highly migratory and transient. Therefore, limiting mitigation measures to the area of high gas concentrations observed during the field investigation does not appear acceptable at this time. The reports are acceptable, provided the following conditions are complied with during site development:

1. All construction in the First Phase area shall comply with section 7104.2 of the Building Code and MGD #92.

2. Based upon the information in the report, the Second Phase area will also require mitigation for methane gas.

3. The use of a membrane or sealing materials other than 60 mil HDPE will require an approved Research Report.

4. The Gas Control Specialist shall review and approve the detailed plans prior to the issuance of any permits.

5. Installation of the gas mitigation devices shall be done under the observation and inspection of the Gas Control Specialist and the Department.

DAVID HSU
Chief of Grading Section

Dana Prevost

DANA PREVOST
Engineering Geologist II

DP:dp
26682
(213) 977-6329

cc: Camp Dresser & McKee
WLA District Office

July 23, 1999

Mr. David Hsu
Chief of Grading Section
City of Los Angeles
Dept. of Building and Safety
201 North Figueroa Street
Los Angeles, CA 90012-2827

PEER REVIEW
METHANE GAS CONCERNS FOR THE PLAYA VISTA PROJECT

First, let me take this opportunity to thank you and Victor Penera for selecting me as the Peer Reviewer for this very high-profile project. It is gratifying to be selected, and even more to be appreciated, particularly, after completing our initial, cursory evaluation of the facts in this case. Our meeting on Tuesday with Bruce Harrigan and Tim Connors of Playa Capitol, went as well as could be expected under the circumstances. I can't imagine a much more difficult technical and legal situation for the City of Los Angeles.

In fairness to all parties and in spite of all the work completed thus far, there is a great deal of very important information regarding the sources of subsurface methane that have not been adequately developed for proper scientific judgments to be completed regarding the safety aspects of the planned development. My associate, Rufus LeBlanc and I spent most of the morning outlining the type of sampling approach that should be required to determine the necessary information. This objective is made considerably more difficult by the size of the project (over 1000 acres) and the variety of potential methane sources known to exist within the project area. This is compounded by the fact that the Playa Vista site in the City of Los Angeles will be subjected to significant earthquakes in the future that can alter both the subsurface methane concentrations migrating from subsurface sources and
degrade any methane mitigation system. As you know, the problem is far from trivial.

Also included with this letter is our first invoice for work completed in June. I divided the invoice into two work segments because the initial instructions by Bruce Harrigan to our Sales Manager,

Frank Levy were considerably more restrictive than those issued by you and Victor Penera in our initial conversations. We reviewed the initial report along with the list of questions and comments that were sent to us and found that we could not render a fair nor honest judgment based on the very limited information initially received. Additional reports sent by the City of Los Angeles, along with several published papers (obtained from Rice Library and our archived DOG files) were used to verify and add to the information that was required for us to write a brief summary (letter, June 24,1999) report on the status of the project. Our previous summary report stands and still represents our main views and data needs, that must be addressed in order to successfully conclude this project.

Enclosed please find a progress report which focuses on the methane sources and our initial recommendations for obtaining the data required to solve the problems. A regional methane map based on all available shallow gas data is included for your review.

Sincerely,
EXPLORATION TECHNOLOGIES, INC.

Victor T. Jones III
President

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ANDREW A. ADELMAN
GENERAL MANAGER

WALT KRUKOW
EXECUTIVE OFFICER

December 15, 1999

Log # 29469
SOILS/GEOLOGY FILE - 2

Playa Vista Capital Corp.
12555 W. Jefferson Bl
Los Angeles, CA 90066

TRACT: 49104-03
LOT: 1, 2, 3, 9 & 10 // 5
LOCATION: 13151, 13163 & 13175 Fountain Park Dr // 5450 Lincoln Bl

CURRENT REFERENCE REPORT/LETTER(S)	REPORT NO.	DATE(S) OF DOCUMENT	PREPARED BY
Methane Report	-	12/15/99(revised)	Sepich Assoc.
Peer Review Report	-	12/14/99	Exploration Tech.

PREVIOUS REFERENCE REPORT/LETTER(S)	REPORT NO.	DATE(S) OF DOCUMENT	PREPARED BY
Department letter	27706-01	11/19/99	Bldg&Safety

The referenced reports concerning methane mitigation and monitoring systems for the Fountain Park Apartments and the Marketing Pavilion have been reviewed by the Grading Section of the Department of Building and Safety. Sepich Associates is the methane gas consultant for Playa Vista Capital and has provided the recommendations for the monitoring and mitigation of methane gas. Exploration Technologies, Inc is the Peer Reviewer for the City of Los Angeles, Department of Building and Safety. Based upon the acceptance of the plans and report by the Peer Reviewer, the Department is accepting the recommendations for the monitoring and mitigation of methane gas on the site.

The Fountain Park Apartments and the Marketing Pavilion methane mitigation shall conform to all requirements specified in Chapter 71 of the Building Code and MGD#92, as stipulated for areas designated as a "High Potential Methane Zone". The methane monitoring system is to be operated continuously, in addition to data gathering and reporting, during occupancy of the buildings. Furthermore, all building construction shall comply with the following supplemental requirements. The report is acceptable, provided the following conditions are complied with during site development:

1. An affidavit shall be filed with the County Recorders Office, in which the owners state that they agree to take responsibility for contracting with a methane gas consultant to insure that the methane monitoring systems are functioning correctly and to submit a report

containing the results of the monitoring to the Department of Building and Safety and the Peer Reviewer, a minimum of every three months, until such time as it is agreed to revise this requirement.

2. Internet access to the methane monitoring data shall be provided to the Department of Building and Safety, Exploration Technologies, Inc and the Fire Department.

3. Additional soil gas survey and monitoring wells shall be required as deemed necessary by the Peer Reviewer; this shall be completed prior to the first footing inspection.

4. All of the abandoned oil wells on the Playa Vista Development shall be re-abandoned subject to the current standards of the State of California Department of Oil, Gas and Geothermal Resources; the Certificate of Occupancy for the initial buildings on this site shall be withheld until verification of complete abandonment has been provided.

5. Obtain clearance from the Fire Department for the methane gas design and monitoring system, and other environmental issues.

6. Obtain clearance from the Department of Public Works, Bureau of Engineering, for H2S, BETX and other environmental issues.

7. The methane mitigation design includes the capability, or option, of changing the passive methane mitigation system to an active methane mitigation system. The system shall be converted to an active system when the level of methane reaches 75 percent of the L.E.L. in the monitoring system located under the building foundation vapor barrier.

8. No excavations shall be made below the groundwater table.

9. Prior to pumping of any groundwater, a supplemental report shall be submitted to the Grading Section for approval.

10. Installation of the recommended monitoring and mitigation systems shall be inspected by the methane gas consultant for Playa Vista Capital and the Building Inspector.

11. All recommendations of the report which are in addition to or more restrictive than the conditions contained herein shall be incorporated into the plans.

12. The methane gas engineer shall review and approve the detailed plans prior to issuance of any permits. This approval shall be by signature on the plans which clearly indicates that the gas engineer has reviewed the plans and that the plans include the recommendations contained in their reports.

13. A continuous gravel/clean sand mixture blanket shall be provided beneath all building slabs. This blanket shall be a minimum of 12 inches in thickness. De-watering pipes, if any, shall be located in trenches beneath the blanket.

14. Methane roof vent risers shall be enclosed in a one-hour fire rated enclosure.

15. Fire Sprinklers shall be provided throughout the Building.

16. An emergency power supply shall be provided for all methane gas ventilation and monitoring systems.

17. Incorporate the mitigation/ventilation systems into the final building plans.

18. Obtain approval for the specified 60mm thick impermeable membrane.

19. Building plans shall include complete details for vent pipes through footings.

20. Obtain plan check approval from Electrical, Mechanical and Fire Department.

DAVID HSU
Chief of Grading Section

Dana Prevost

DANA PREVOST
Engineering Geologist II

DP:dp
29469
(213) 977-6329

cc: Sepich Associates, Inc
Exploration Technologies, Inc
WLA District Office

AN EVALUATION OF GAS MIGRATION AND ENVIRONMENTAL HAZARDS EXISTING AT THE PLAYA VISTA PROJECT

BY: Dr. Bernard Endres, Ph.D.
Oil & Gas Consultant

DATE: June 7, 2000

LOCATION: City of Los Angeles,
City Hall

ISSUE #2

- CAN A MONITORING AND MITIGATION SYSTEM BE DESIGNED AND OPERATED WITH 100% RELIABILITY OVER THE LIFETIME OF THE PROJECT?

- A GAS MEMBRANE THAT WILL RESIST THE RUPTURE FORCES OF LIQUEFACTION DURING AN EARTHQUAKE.

- OPERATION OF SENSORS AND EQUIPMENT IN A CORROSIVE AND H2S ENVIRONMENT

- COSTS OF MAINTAINING THE SYSTEM OVER THE PROJECT LIFETIME.

ISSUE #4

- THE CITY OF LOS ANGELES METHANE ORDINANCE IS NOT ADEQUATE TO DEAL WITH THE GAS AND GEOLOGICAL HAZARDS EXISTING AT PLAYA VISTA

- LIQUEFACTION SEISMIC HAZARD ZONE REQUIRES SPECIFICALLY DESIGNED GAS MEMBRANE BARRIERS.

- SENSORS AND MONITORING EQUIPMENT MUST OPERATE IN A CORROSIVE AND H2S ENVIRONMENT.

- NATIONAL ELECTRICAL CODE REQUIREMENTS FOR A GAS EXPLOSION RISK FROM ELECTRICAL SPARKS MUST BE COMPLIED WITH, INCLUDING GAS MIGRATION INFORMATION, IN ELECTRICAL VAULTS.

ISSUE #6

- AN EVALUATION OF THE SPECIAL PROBLEMS CREATED BY THE HIGHLY PERMEABLE 50 FOOT GRAVEL ZONE NEEDS TO BE PERFORMED.

- ALLOWS GAS TO BUILD TO HIGH PRESSURES FROM A RISING WATER TABLE.

- HIGH DEGREE OF GAS MOBILITY UNDER THE ENTIRE SITE, MAKING GAS LEVEL PREDICTIONS DIFFICULT, IF NOT IMPOSSIBLE TO MAKE WITH CONFIDENCE.

- HIGH SULFATE LEVELS GIVING RISE TO H2S PRODUCTION BY SULFATE REDUCING BACTERIA ALREADY VERIFIED AS PRESENT.

ISSUE #8

- AN EVALUATION OF THE GAS MIGRATION HAZARDS INTO THE SURROUNDING COMMUNITY

- GAS MITIGATION AND MONITORING IS REQUIRED FOR THE SURROUNDING RESIDENTIAL AND COMMERCIAL BUILDINGS, INCLUDING U.S. REGIONAL POST OFFICE.

- THE CITY NEEDS TO URGENTLY EVALUATE THEIR PERMITTING PRACTICES FOR HOUSING CURRENTLY BEING CONSTRUCTED OVER GAS WELLS SOLD BY SOCALGAS (INCLUDING SALES NOT APPROVED BY THE PUBLIC UTILITIES COMMISSION).

ISSUE #10

- EVALUATE THE SUBSIDENCE HAZARDS POSED BY THE LONG TERM FLUID PRODUCTION BY SOCALGAS AND ITS PREDECESSORS

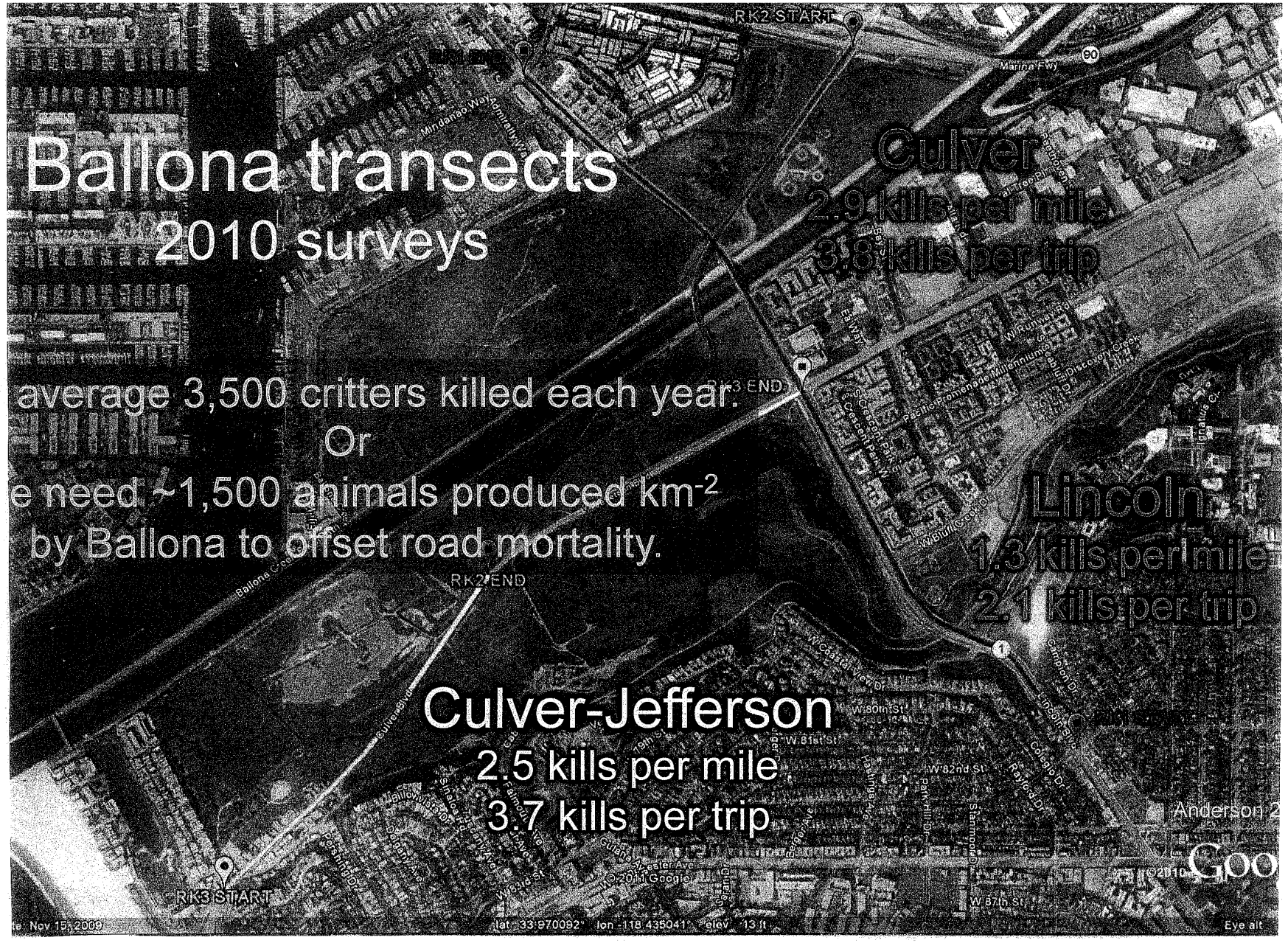
- NEARLY 2 FEET OF SUBSIDENCE IN 1970, AND INCREASING.
- NO SUBSIDENCE MONITORING SINCE 1970.
- STRESS AND STRAIN BUILD-UP WILL CAUSE INCREASED GAS MIGRATION ALONG FAULTS AND COULD TRIGGER EARTHQUAKES ALONG THESE FAULTS.
- IMMEDIATE IMPLEMENTATION OF MONITORING IS REQUIRED, INCLUDING FOR MICRO-SEISMIC ACTIVITY, TO PROTECT AGAINST GAS MIGRATION AND DAMAGE TO COASTAL STRUCTURES.

ISSUE #12

- EVALUATE THE EXTREME DANGER POSED BY THE REPRESSURIZATION OF THE UNDERGROUND GAS STORAGE FIELD AND PLAYA DEL REY OILFIELD

- INCREASED RISK OF GAS MIGRATION IN HUGE QUANTITIES ALONG THE LINCOLN BOULEVARD FAULT AND ALONG WELL BORES.

- FAULT BLOCK 13-1, LOCATED AT THE BASE OF THE LINCOLN BOULEVARD FAULT, HAS REPRESSURIZED FROM 1700 PSI TO APPROXIMATELY 2400 PSI IN RECENT TIMES.



nderson, Sean. 2012. Splatter Spotter: Exploring and Predicting Elevated Vertebrate Road Kill Across the Santa Monic Mountains and Beyond Chautauqua Lecture. Temescal Canyon Park, Pacific Palisades. August 22.

To: October 23, 2012

Mr. Daniel P. Swenson, Chief, Los Angeles Section
Army Corps of Engineers
915 Wilshire Blvd., Los Angeles CA 90017
Email: daniel.p.swenson@usace.army.mil

Mr. David Lawhead
California Dept. of Fish and Game
3883 Ruffin Road, San Diego, CA 92123
Email: DLawhead@dfg.ca.gov

Questions, Comments, and Recommendations by Douglas Fay on the proposed Ballona Wetlands Restoration Project NOI

1. Corps Release no. 12-015 Posted 9/26/12 Re: Termination of existing process at the request of the Santa Monica Bay Restoration Commission (SMBRC), a Joint Power Authority with the County of Los Angeles (County).

Question: Will the termination of the existing feasibility study and accompanying EIS result in a project consistent with a comprehensive Santa Monica Bay Restoration Plan (SMBRP), or fragment the process?

Comments: My concern, and the concern of others, is the 2008 SMBRP is a significantly flawed document, with minimal public input. I have made several attempts to address my concerns publicly that have been denied by individuals in the SMBRC leadership rolls, the SMBRC Governing Board, members of the Santa Monica Bay Restoration Foundation (SMBRF), and submitted documentation to the California Coastal Commission (CCC).

A (partial) document analysis I prepared of the 2008 SMBRP addressed to the SMBRC Governing Board was submitted to Scott Valor. Months later Mr. Valor told me he did not give the time critical document to the Governing Board members. This is only one example of several deliberate and documented actions to exclude and deter me from this process.

Also, the SMBRC has recently approved the development of Parcel OT, a parking lot adjacent to the Oxford Lagoon a.k.a. the Oxford Retention

Basin and the Oxford Retention Basin Multi-Use Enhancement Project, both of which are under the County's control. The Oxford Lagoon is part of the historical Ballona Wetlands that is primarily used for urban flood control discharge and retention prior to entering the Marina Del Rey (MDR) harbor through mechanical gates.
The Oxford Retention Basin Multi-Use Enhancement Project increases/enhances public access, which in turn reduces terrestrial habitat value. There is no significant aquatic habitat value due to the drastic variation of salinity levels that are catastrophic to most marine animals. This shows that their actions are based on politics, not science and sound restoration principles.
Current management practices of the Oxford Lagoon contradict SMBRP Goals and Objectives A. PRIORITY ISSUE: WATER QUALITY Goal 1: Improve water quality through treatment or elimination of pollutant discharges, Goal 2: Improve water quality through pollution prevention and source control, B. PRIORITY ISSUE: NATURAL RESOURCES Goal 4: Create and support policies and programs to protect natural resources.

Questions: Are these acceptable practices in the eyes of the Corps and CDFG? Please explain and elaborate if needed.

Are other documents being censored without the Governing Board's knowledge jeopardizing their abilities to evaluate and vote on proposed projects? Please explain and elaborate if needed.

What policies and programs to protect natural resources have been created by the SMBRC and implemented by government agencies and municipalities within the Santa Monica Bay watershed? Please explain and elaborate if needed.

What is the "commission's proposed restoration project"?

Comment: I do not see a link to a website in this document, or have detailed knowledge of the commission's proposed restoration project, which makes it difficult, if not impossible to comment on with an acceptable degree of accuracy.

Recommendation: Reverse your decision to accept the request by the SMBRC and proceed with the existing 2005 process.
Provide ample opportunities for the public to be educated and engaged in drafting a restoration project through the existing process.
Assure the public that the non-profit Santa Monica Bay Restoration Foundation (SMBRF) and SMBRC will not be controlling the process.

Investigate any wrong doings to members of the public including, but not limited to, misappropriation of public funds.

2. Corps Public Notice: SPL-2010-1155, Date: August 24, 2012

SUMMARY:

Comment: Historical maps show breaching of sand and full tidal exchange in the Del Rey Lagoon area of the coastline.

Questions: Is the restoration of this historic exchange in the proposed Ballona Wetlands Restoration Project (BWRP)?

If, and I quote, "The proposed project is intended to return the daily ebb and flow of tidal waters", then why wouldn't the first step to a restoration be limited to restoring the historical breaching?

What is the percentage of the proposed project's intended return of daily ebb and flow of tidal waters compared to historical levels within the wetlands?

Comment: I attended a lecture by Dr. Travis Longcore on May 22, 2012 entitled, "Closure Dynamics of Southern California Estuaries and Implications for Restoration."

Recommendation: View this lecture, reference it in the EIS/EIR, and answer the following questions. If you cannot easily obtain a copy, I will provide a copy upon request.

Questions: Do you agree that the historical photos, maps, and plant life show that the Ballona Wetlands were primary a fresh water to brackish wetlands? Please explain your answer and elaborate if needed.

Is there any historical data that shows the Ballona Wetlands ever had full tidal flow (ocean levels of salinity) throughout the proposed project area (approximately 600 acres)? Please explain your answer and elaborate if needed.

Is there any historical data that shows natural berming/levees adjacent to the Ballona Creek and around the parameter of the proposed project? Please explain your answer and elaborate if needed.

Is preservation of the historical Ballona Wetlands a concern? Please

explain and elaborate if needed.

SUPPLEMENTARY INFORMATION:

Comment: This document states, "The Corps intends to prepare a joint EIS/EIR to assess the environmental effects associated with the proposed project. CDFG is the state lead agency for the EIR pursuant to the California Environmental Quality Act (CEQA)."

Questions: Is the Corps the Federal lead agency for the project, the EIR, or just the EIS?

Is CDFG the State lead agency for the project, the EIS, or just the EIR?

If CDFG is the lead agency, are they required to act as stewards of the public?

If so, why are the SCC, SMBRF, SMBRC, DRP, and others, appearing to be dominating all aspects of the proposed BWRP process with limited/controlled public input?

If the Corps and CDFG intend to jointly prepare a Draft EIS/EIR for the proposed BWRP, is one Scoping Meeting all that is legally required?

Comment: The Scoping Meeting(s) schedule was limited to 3 hours on 1 day. I was unable to attend due to a conflicting work schedule. Scott Valor told me the minimum that State law requires will be all that is provided throughout this process. I'm assuming this is true if the SMBRF, that Mr. Valor is associated with, is influencing the process.

Questions: If public participation is critical then shouldn't there have been more than one Scoping Meeting?

Comment: This document states, "7. Availability of the DEIS/EIR. The DEIS/EIR is expected to be published and circulated in late 2012. A public hearing will be held after its publication to field comments on the document."

Questions: Is one public hearing on the DEIS/EIR sufficient?

Will it be limited in time?

Will there be opportunity for question and answer sessions?

Will speaker time during public comment be limited?

If public participation is critical then shouldn't there be more than one Public Hearing?

1. Background.

Comment: The background description is limited and vague.

Question: Where are the "attached figures"?

Comment: There were not any attached figures in the Corps SPECIAL PUBLIC NOTICE download.

Questions: If the Ballona Creek a.k.a. Ballona Flood Control Channel is "a component feature of a federal flood risk management project," could a project increase flood risk?

Who owns the Ballona Creek/Flood Control Channel portion that bisects the State owned Ballona Wetlands?

Who is legally responsible for liabilities associated with altering the alignment of the Ballona Creek/Flood Control Channel?

Will there be special laws and/or regulations drafted specifically for the proposed project?

Has a Federal/State wetlands project partnership similar to this proposed project been completed before?

Comment: If so, please describe with references.

Recommendations: Study and describe all of the water bodies associated with the Ballona Wetlands and the development adjacent to the proposed project and adjacent water bodies, including, but not limited to, industrial, commercial, residential, recreational, flood plain, polluted waters, and Native American data.

Study and describe how an alteration of what I am assuming are Federal waters/land/boundaries with State land/waters/boundaries will be conducted including, but not limited to, jurisdiction, law enforcement, management, maintenance, funding and liability.

2. Project Purpose and Need.

Comments: Regarding the statement, "In addition, the wetland habitat and natural hydrological functions in the area have been substantially degraded."

Questions: How have the natural hydrological functions been substantially degraded? Please explain your answer and elaborate if needed.

Who is responsible? Please explain your answer and elaborate if needed.

Is the degradation of the natural hydrology of the project area ongoing? Please explain your answer and elaborate if needed.

If so, is the degradation legal or illegal?

Comment: Regarding the statement, "Restoration of coastal wetlands is needed in order to increase available nursery and foraging habitat for wildlife and to provide recreational and educational opportunities to the public."

Questions: Will a comprehensive plan including all coastal waters and water sources originating inland be more effective at maintaining and increasing biodiversity than limiting the scope of study to coastal wetlands within the proposed project site? Please explain your answer and elaborate if needed.

What does CEQA require?

What are the recreational and educational opportunities proposed?

Comment: I'm told my grandfather and father hunted ducks in the Ballona Wetlands area.

Questions: Will regulated hunting and fishing be allowed publicly in the proposed project area?

Will Native Americans be allowed to hunt and fish in the proposed project area? Please explain your answer and elaborate if needed.

Comment: Regarding the statement, "A restored, optimally functioning wetland would also benefit the adjacent marine environment and enhance

the quality of tidal waters."

Questions: How does a wetland enhance the quality of tidal waters?

Does the proposed project intend to introduce polluted water sources into the wetlands?

How do polluted waters including, but not limited to, waters laden with synthetic chemical compounds affect the health and reproductive cycle of living organisms? Please explain your answer and elaborate if needed.

Are there endangered or threatened species within and/or adjacent to the proposed project area?

Would the proposed project need maintenance and funding to remove introduced pollutants in perpetuity? Please explain your answer and elaborate if needed.

Comments: Not mentioned in the Project Purpose and Need is the need, or should I say intent, to construct flood and tsunami control levees in an effort to mitigate and protect recently developed structures. Also, the significant amount of earth/soils, that are proposed to be moved, to build the massive levees, will significantly increase the amount of ocean waters, and thereby decrease the need to restore fresh water sources that have been depleted.

Questions: Do any of the proposed project alternatives appear to be flood control mitigation for the Playa Vista development? Please explain your answer and elaborate if needed.

If so, is it an acceptable practice, both morally and financially, by the Corps and CDFG to move forward with an NOI when the preferred restoration project appears to be based on flood control mitigation for adjacent lands?

What is the cost incurred to date to develop what I'm assuming is the preferred proposed project alternative? Please explain your answer and elaborate if needed.

How much of the expenses to date have gone to, or through, CDFG? Please explain and elaborate if needed.

Are you aware that a Santa Monica Bay Restoration Account (SMBRA)

exists?

Has any money gone in or out of the SMBRA for this project, or any other project that you are aware of?

Is the proposed restoration funded by grants? Please explain and elaborate if needed.

Does CDFG have detailed accounting records for all financial activities related to the BWRP? Please explain and elaborate if needed.

Are there financial accounting records and/or audits available for public viewing?

If so, how is it accessed? Please explain and elaborate if needed.

If not, why? Please explain and elaborate if needed.

Comment: Regarding the statement, "The purpose of the project is to restore ecological functions of the site, in part, by enhancing tidal flow." When the County introduced/increased urban flood control waters into the Oxford Lagoon, removed sources of fresh water, and manually maintained tidal flushing, the migratory bird population dropped significantly. I have witnessed Mallard ducklings expire in the MDR harbor due to lack of fresh water access.

Question: How do you enhance migratory bird habitat by enhancing tidal flow?

3. Proposed Action.

Comment: Regarding the statement: "CDFG is proposing a large-scale restoration of the Ballona Wetlands Ecological Reserve. The proposed project entails restoring, enhancing, and establishing native coastal wetland and upland habitats in the approximately 600-acre Ballona Wetlands Ecological Reserve."

Questions: Is CDFG proposing a large-scale restoration, or is the large-scale restoration proposal coming from the SMBRF and/or other organizations? Please explain and elaborate if needed.

Why is the State Coastal Conservancy (SCC) taking the lead in funding for planning and restoration of the CDFG property? Please explain and

elaborate if needed.

What is the roll of California Department of Parks and Recreation (DPR)?

Will CDFG control the proposed "Long-term operations and management activities including inspections, repairs, clean-up, vegetation maintenance, and related activities," or will they be subcontracted?

If subcontracted to who will they subcontracted to and why? Please explain and elaborate if needed.

Comment: The 2008 SMBRP states, "Determine preferred alternative by 2009."

Question: Does CDFG have a preferred alternative?

Does the SMBRC have a preferred alternative? Please explain and elaborate if needed.

If so, why hasn't it been released to the public so we can accurately comment on the NOI?

If a draft has been released, where can I obtain a copy?

4. Alternatives Considered.

Comment: Regarding the statement, "The feasibility of several alternatives is being considered and will be addressed in the DEIS/EIR."

Questions: What are the alternatives and where did they come from? Please explain and elaborate if needed.

Is the Proposed Ballona Wetlands Restoration Plan (BWRP)(Draft), Prepared in conjunction with the Ballona Wetlands Land Trust, Save Ballona Wetlands, and Rimmon C. Fay, Ph.D. dated June 21, 1995, submitted to the Corps, County, and City of Los Angeles included in the proposed alternatives? Please explain and elaborate if needed.

Is it a document that both the Corps and CDFG have in their possession and has been studied by staff biologists and engineers? Please explain and elaborate if needed.

Recommendation: If not, obtain the BWRP draft document dated June 21,

1995. (I have a copy if needed) Study and describe the viability of implementing this alternative with acknowledgement of current conditions: ownership, development, etc.

5. Scoping Process.

Comments: The Scoping Meeting was conducted on August 16, 2012 from 4:00 to 7:00 p.m. One 3 hour meeting was all that was provided. Regarding the statement, "providing useful information such as published and unpublished data, and knowledge of relevant issues and recommending mitigation measures to offset potential impacts from proposed actions."

Questions: What is being done to improve the diminishing water quality within the MDR harbor? Please explain and elaborate if needed.

What is proposed project plan and/or mitigation for being impacted by poor water quality, pollutants, and invasive species originating from within the MDR harbor? Please explain and elaborate if needed.

How many industrial dischargers are permitted into the Santa Monica Bay? Please explain and elaborate if needed.

What are they reportedly discharging? Please explain and elaborate if needed.

What are the locations of discharge? Please explain and elaborate if needed.

What is the reported volume of discharge daily/annually? Please explain and elaborate if needed.

What mitigation measures are in place to ensure there is no negative impact to water quality, and biological diversity and quantities? Please explain and elaborate if needed.

Are there any legal discharge permits issued anywhere within the Ballona Creek Flood Control Channel (BCFCC)? Please explain and elaborate if needed.

Have there been any reported accidental spills into the BCFCC within the past 10 years?

If so, how many and what was spilled? Please explain and elaborate if needed.

What are the specifics: date, time, estimated quantity, etc. and result: beach closures, number of days, etc.? Please explain and elaborate if needed.

What is the current biological assessment of the Ballona Wetlands? Please explain and elaborate if needed.

What is the current biological assessment of the Marina Del Rey harbor? Please explain and elaborate if needed.

What is the current biological assessment of the Del Rey Lagoon? Please explain and elaborate if needed.

What is the current biological assessment of the Oxford Lagoon? Please explain and elaborate if needed.

What is the current biological assessment of the Ballona Creek including all tributaries? Please explain and elaborate if needed.

What is the current biological assessment of the Venice Canals? Please explain and elaborate if needed.

What is the current biological assessment of the Santa Monica Bay? Please explain and elaborate if needed.

What was the annual historic high catch, combined recreational and commercial, in tons, taken from the Santa Monica Bay, include the year and as much data as possible including, but not limited to, variety of fish, shellfish, crustaceans, mammals, and value (adjusted)? Please explain and elaborate if needed.

What is the current annual catch, combined recreational and commercial, in tons, taken from the Santa Monica Bay, include the year and as much data as possible including, but not limited to, variety of fish, shellfish, crustaceans, mammals, and value? Please explain and elaborate if needed.

What plants and animals, both terrestrial and marine, are currently proposed to be restored and/or introduced to the above listed waterbodies directly related to the proposed project including, but not limited to, the

Ballona Wetlands, MDR harbor, Del Rey Lagoon, Oxford Lagoon, Ballona Creek flood control channel including all tributaries, the Venice Canals, and the Santa Monica Bay? Please explain and elaborate if needed.

What is the current percentage of annual take/catch, combined recreational and commercial, within the Santa Monica Bay, as a percentage of historical recorded highs? Please explain and elaborate if needed.

What is the estimated annual take/catch, combined recreational and commercial, within the Santa Monica Bay, increase over a 10 year period, with the currently proposed Ballona Wetlands Restoration project when completed? Please explain and elaborate if needed.

What is the annual consumption cost of seafood imported and sold within the Santa Monica Bay watershed? Please explain and elaborate if needed.

Would it be better for our local economy to reduce our dependence on imported seafood? Please explain and elaborate if needed.

Would implementing a comprehensive Santa Monica Bay Restoration Plan that strives to restore biomass to historical levels create a significant amount of new jobs in areas of, but not limited to, research, fisheries, aquaculture, education, scuba industry, hospitality, marine resources management, tourism, etc.? Please explain and elaborate if needed.

Have you read the 2008 SMBRP?

Are you aware of the fact that there is no mention of artificial reefs in the 2008 SMBRP?

Comment: 2 years ago I asked SMBRC Governing Board member and (then) HTB president Mark Gold a question about artificial reefs in the Santa Monica Bay? His reply was something to the effect of, "We didn't discuss them." A year later when I repeated what I thought I heard he corrected me saying something to the effect of, "No, the definition of artificial reefs!"

Questions: Does the Corps and/or CDFG have knowledge of artificial reefs in the Santa Monica Bay? Please explain and elaborate if needed.

Does the Corps (Federal) and CDFG (State) have a uniform definition for "artificial reefs" that can be included in the proposed project glossary of

terms? Please explain and elaborate if needed.

Are you aware of the fact that there is no language whatsoever in the 2008 SMBRP to do enhancement projects within the Santa Monica Bay, even though that it is worded into the mission statement of the SMBRF?

Are you aware of the fact that the majority of restoration projects funded by the SMBRC/SMBRF have been improperly classified as enhancement projects? Please explain and elaborate if needed.

Have pilot tide pools at varying depth, configurations, material, size, etc. within the existing Ballona Creek flood control channel to test the viability of removing the existing levees been proposed? Please explain and elaborate if needed.

Comments: I was invited by a member of the SMBRC to attend and participate in the annual Bay Watershed Council (BWC) working group to draft the annual work plan held on Feb. 12, 2012. When I arrived I was told I could not participate. SMBRF staff Mark Abrams was present and hired to prevent members of the public from participating in the working groups. I attempted to suggest the pilot tide pools during public comment while attending this humiliating experience.

This unacceptable behavior of members of the SMBRC/SMBRF that authorized and enforced this action completely contradicts the "Letter From the Director" SMBRC Executive Director Shelley Luce in the SMBRC Annual Report 2011 which states, "We are planning new workshops and other mechanisms for getting public input on the BRP and annual work plans."

Question: What actions will the Corps and CDFG take to assure the public that the behavior of this magnitude will not continue to occur throughout the proposed project process? Please explain and elaborate if needed.

Comment: Other actions that contradict sound science and restoration principles surround decisions made aware to me by Dr. Wang. Dr. Wang told me he did not read the Montrose Settlement Restoration Plan (MSRP). Specifically, Appendix A1 Construct Artificial Reefs and Fishing Access Improvements and Appendix A3 Restore Full Tidal Exchange Wetlands. There was $40 million in Federal MSRP grant money available in 1995.

Questions: Did the SMBRC and/or SMBRF apply for MSRP grant(s) for the

Ballona Wetlands and/or Santa Monica Bay projects? Please explain and elaborate if needed.

Did CDFG or any State agency apply for MSRP grant(s) for the Ballona Wetlands and/or Santa Monica Bay projects? Please explain and elaborate if needed.

Comments: Dr. Wang also told me the SMBRC did not propose/apply to incorporate the County's Parcel OT (the parking lot adjacent to the Oxford Lagoon) to expand the Oxford Lagoon which would have increased the viability of wildlife significantly. The County is planning to build a massive luxury senior living facility that will abut the Oxford Lagoon further reducing wildlife viability.
This action contradicts SMBRP B. PRIORITY ISSUE: NATURAL RESOURCES Goal 5: Acquire land for preservation of habitat and ecological services.

Question: Is development of vacant land adjacent to coastal wetlands that are compromised through management practices in the best interest of sound restoration principles?

Other actions that concern me are the Total Maximum Daily Loads (TMDLs), imposed by a Heal The Bay (HTB) lawsuit, that may not reflect natural occurring levels of waterways and waterbodies. For example, the TMDL approved for the Malibu Lagoon may be much cleaner than what naturally occurs within a healthy lagoon triggering an approval for a restoration project based on false and/or misleading information.

What is the scientific opinion of the Corps and CDFG on the establishment and enforcement of TMDLs that may not reflect naturally occurring water quality standards of all waterbodies and waterways associated with the proposed project? Please explain and elaborate if needed.

FINAL SUMMARY AND RECOMMENDATIONS

Why am I so concerned about the outcome of the historical Ballona Wetlands and Santa Monica Bay area you might ask?
I was born in Santa Monica, Ca at St. Johns Hospital in 1962 and raised on Howard Street adjacent to the railroad tracks and the Oxford Lagoon. There was so much wildlife present in the area when I was young. Dozens of ducks would land in our yard. Salamanders, lizards, and snakes could easily be found. Cancer crabs could be caught in the MDR harbor by the bucket full. Catching your limit of fish in the Bay seemed much easier. The

tidepools at Palos Verdes and Paradise Cove were abundant with life. Now 40 years later, the effects of urban development and associated pollution without sufficient mitigation have significantly compromised all life forms.

My father was Dr. Rimmon C. Fay, a second-generation Santa Monica Bay fisherman who, through education and experiences, became a leading expert of the Santa Monica Bay and California coastal pollution issues starting in the 1950s. His independence and contributions to environmental protection and education were epic, including his contributions to save the Ballona Wetlands.

With PhDs in Chemistry and Oceanography, countless California ocean dives, hours at sea, days on the beach growing up and fifty years as an ocean lifeguard, as owner/operator of Pacific Bio Marine biomedical research, supply & education, as a founding member of the CCC, and many more contributions worthy of honor and respect, Rim's input in the 1995 Proposed BWRP Draft deserves recognition.

I have a lifetime of experience learning from my father, have served on a land use advisory committee in Monterey County, CA, have several professional certifications in multiple fields including PADI Master Scuba Diver Trainer, Emergency First Response Instructor, ASE Master Technician, Toyota Expert Technician and a BAR Smog Technician License. I have traveled throughout the Pacific region, have hundreds of logged dives, survived the 2004 Asian Tsunami, and have ten years of experience with upper watershed management including over 500 hours of heavy equipment operation and maintenance.

My knowledge of the Santa Monica Bay may never eclipse my fathers. I do believe that I have a better general knowledge than most and have an exceptional ability to identify and fix problems that are obviously broken. The library of Dr. Rimmon C. Fay is in storage awaiting a location were it can be housed, digitized, and made available for all academia on a website. Valuable historical data pertaining to the proposed project may be in his library. Funding to make this information accessible has not been secured.

What are the additional recommendations and desired outcome that I would like to see for the Ballona Wetlands and Santa Monica Bay?

Strongly consider the history of the Tongva Native Americans and respect the current concerns of Johntommy Rosas. If he has registered the Ballona Wetlands as a Sacred Site, the massive alterations proposed should not be allowed in perpetuity. Any enhancements should be harmonious, based on time proven science independent of the SMBRC/SMBRF influence, and focused on restoring an ecosystem that is as natural and maintenance free

as possible.
Restore the historical levels of fresh water to the aquifer below the wetlands through natural recharge and/or injection wells.
Restore the historic levels of fresh surface water
Restore the native terrestrial animals to historical levels to the greatest extent possible including deer and bats.
Explore creating the habitat necessary to allow for greatest diversity of terrestrial animals with minimal change to existing conditions.
Ban domestic animals, especially cats and dogs, from the Ballona Wetlands and adjacent walking/viewing areas.
Install fencing and/or concrete barriers to prevent wildlife from entering roadways.
Install large culverts with solar lighting for animals to cross under existing roadways. Raise the roadways if needed to allow reasonable mobility.
Do not remove the Ballona Creek flood control levees.
Implement pilot test tidepools throughout the Ballona Creek flood control channel with varying designs, locations, and conditions.
Cut openings into the concrete of the existing Ballona Creek levees to allow for native trees to grow, providing habitat and shade for wildlife.
Do not consider opening the wetlands to full tidal flush until the source of ocean water is of the highest quality. The current water quality of the MDR harbor and Playa Del Rey nearshore waters are unacceptable at this time.

Research and implement restoring staff and funding to CDFG so that they truly are the lead agency in this process. I'm told that CDFG funding has been reduced which reduces their effectiveness to educate and enforce locally is reduced. I recently read where the non-profit Santa Monica Baykeeper were making transects across the Bay looking for illegal activity in the Marine Protected Areas (MPAs) in an effort to warn boaters of a potential CDFG citation. This behavior is not a cost effective way to manage marine resources.

Remove the SMBRF from this process. If they have research and recorded data through grant funding acquired from the public, this information shall be given to CDFG. Allowing a non-profit to have the amount of control and influence over State agencies and commissions, with limited public accountability, is not in the general public's or the environment's best interest including the Ballona Wetlands.

Implement partnerships with local educational institutions in an effort to recruit students from Kindergarten to College to participate in research, education, restoration, maintenance, monitoring and management programs, including SCUBA training and certification.

Create and nonpartisan independent review board with membership that is not financially associated to the proposed project and has term limits for members.

Make restoring the abundance and diversity of marine life in the Santa Monica Bay to historical levels a top priority. This can be achieved by:
Removing all forms of industrial pollution (thermal, sewage waste, and desalination brine) discharged directly into the Bay and ban in perpetuity.
Fully mitigating for all of the sand historically placed on the shoreline through natural rock and artificial reefing to replace the lost nearshore habitat.
Fully mitigating the sediment discharged from Hyperion in mid to deep waters through natural rock and artificial reefing to restore and possibly enhance the lost habitat diversity that biomass requires.
Establish and manage a significant amount of kelp forest in the Santa Monica Bay from El Segundo to north of the Santa Monica Pier.
Restore the historical breach to the Del Rey Lagoon.
Drastically change how the waters within the MDR harbor are managed including, but not limited to: mandatory nets on all docks to remove floating debris, developing and implementing a vacuum system for in-water boat bottom cleaning, and stronger enforcement of illegal spills.

IN CONCLUSION

My family has been in this process for three generations. My grandfather instilled the love and respect of nature and all that it has to offer to my father. My father shared that experience with me. And now I'm nurturing the values taught to me into my young son and daughter.

It was at my father's memorial that I promised Tom Hayden, the only politician to finally stand beside my father and fight for healing the Santa Monica Bay rather than treat it as a dumping ground. It was a surprise and pleasure to see him this morning in passing to say hello and thanks.

If there was one quote that sets the tone for why I'm fighting for the historical Ballona Wetlands it would be, "so preservation of a historic wetland is not a concern."
You'll find that quote on page 4 of the HTB letter to the CCC in support of the controversial Malibu Lagoon Restoration project.

Please judge wisely and favor restoring nature over alternatives influenced by huge sums of money and those that can easily lose their way.

Respectfully submitted,

10/23/12

Douglas Fay
644 Ashland Ave Apt A
Santa Monica, CA 90405
Tele: 310 437-0765
Email: douglaspfay@aol.com

Jones, Tanya

-----Original Message-----
From: Jonathan_D_Snyder@fws.gov [mailto:Jonathan_D_Snyder@fws.gov]
Sent: Tuesday, October 23, 2012 4:36 PM
To: Swenson, Daniel P SPL
Cc: Brittni_Moskus@fws.gov; Christine_Medak@fws.gov; Jackie_Morales@fws.gov
Subject: Ballona Wetlands Restoration Project NOI

Dan,
Please see the attached comment letter regarding the above-referenced NOI. Please contact Christine Medak at (760) 431-9440 x298 with any questions.

Sincerely,
Jonathan

_____
Jonathan Snyder
U.S. Fish and Wildlife Service
6010 Hidden Valley Road, Suite 101
Carlsbad, CA 92011
(760) 431-9440 x307
jonathan_d_snyder@fws.gov

Classification: UNCLASSIFIED
Caveats: NONE

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Carlsbad Fish and Wildlife Office
6010 Hidden Valley Road, Suite 101
Carlsbad, California 92011

In Reply Refer To:
FWS-LA-02B0010-13TA0023

OCT 23 2012

Dr. Daniel P. Swenson
U.S. Army Corps of Engineers
Los Angeles District
P.O. Box 532711
Los Angeles, California 90053-2325

Subject: Notice of Intent to Prepare a Draft Environmental Impact Statement/Environmental Impact Report for the Ballona Wetlands Restoration Project, City of Los Angeles and Unincorporated Los Angeles County, California

Dear Dr. Swenson:

We have reviewed the Notice of Intent (NOI) for the proposed Ballona Wetlands Restoration Project in the city of Los Angeles and unincorporated Los Angeles County, California. The proposed project will restore ecological functions within the 600-acre Ballona Wetlands Ecological Reserve (Reserve) by increasing tidal flow throughout the project area, removing invasive species, and planting native vegetation.

We offer the following comments and recommendations regarding project-associated biological benefits and impacts based on our review of the NOI and our knowledge of declining habitats and species within Los Angeles County. We provide these comments pursuant to our responsibilities under the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 *et seq.*), Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*), and in keeping with our agency's mission to work "with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people."

To facilitate the evaluation of the proposed project from the standpoint of fish and wildlife protection, we request the draft Environmental Impact Statement/Environmental Impact Report (DEIS/EIR) consider the following specific information:

1. *Project Purpose* – According to the NOI the purpose of the proposed project is to restore ecological function to the Reserve. In southern California the effects of fragmentation have been shown to decrease the number of resident bird species, decrease the diversity of small rodents, and decrease the diversity and cover of native plant species (e.g., Alberts et al. 1993; Bolger et al. 1991, Bolger et al. 1997; Soulé et al. 1988). In general, the ecological

function of habitat is correlated with it contiguity. As stated by the Ballona Wetlands Science Advisory Committee[1]:

> "Alternatives with larger, contiguous, areas of diverse estuarine wetland habitat are more likely to sustain populations of associated species. Alternatives with fewer roads, wider transitions and more channels would have a higher quality of wetland habitat because they would be more remote from noise, lights, cars, and other human impacts. Alternatives with larger areas of contiguous wetland would also have fewer impacts from, and require less active management for, invasive plant and animal species."

To maximize the benefit of the restoration project for rare and sensitive wetland species and to reduce the costs of management over the long term, we recommend available resources be directed foremost toward the creation of contiguous habitat and that project alternatives and phasing be prioritized accordingly.

2. *Species* – The DEIS/EIR should include quantitative and qualitative assessments of the biological resources and habitat types that will be impacted by the proposed project and its alternatives. To assist you, we are providing the enclosed list of federally listed endangered, threatened, proposed, and candidate species to consider in association with the proposed restoration project.

   The assessment of direct, indirect, and cumulative project impacts to fish and wildlife associated habitats should consider all facets of the project (e.g., construction, implementation, operation, and maintenance). In addition, the DEIS/EIS should consider the potential benefits of the proposed restoration project for each federally listed species that is known to occur or has the potential to occur in or adjacent to the project area from a regional perspective. For example, the tidewater goby (*Eucyclogobius newberryi*) is unlikely to occur in the project area due to the current lack of suitable habitat; however, the Recovery Plan for this species identifies the Reserve as a potential site for reintroduction should suitable habitat be restored (Service 2005). The California least tern (*Sternula antillarum browni*) currently nests on Venice Beach and forages in the Reserve. The establishment of an additional nest site within the Reserve, less than 1 mile from Venice Beach, would provide the terns with an alternative for when heavy predation pressure results in their abandonment from Venice Beach.

   The analysis of impacts to biological resources and habitat types should include detailed maps and tables summarizing specific acreages and locations of all habitat types, as well as an updated assessment of the number and distribution of all Federal candidate, proposed, or listed species; State-listed species; and locally sensitive species, on or near the project site that may be affected by the proposed project or project alternatives.

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[1] Memorandum to the Ballona Project Management Team, dated October 15, 2008. Retrieved from: http://www.santamonicabay.org/BWRP/BWRP_Documents/Feasibility%20Report/SAC%20recommendation.pdf.

3. *Habitats* – When evaluating the extent of proposed habitats restored within the project area, the DEIS/EIR should consider the dynamic nature of estuarine habitat (e.g., fluctuations in the distribution and quality of habitat over time) over both the short term (due to fluctuations in annual rainfall) and the long term (due to sea level rise). Upper salt marsh and upland habitats should be provided as a refuge for wading birds such as light-footed clapper rail (*Rallus longirostris levipes*) during high tides and to support pollinators of salt marsh plants such as salt marsh bird's beak (*Chloropyron maritimum* subsp. *maritimum*). Establishment of habitat with gentle slopes throughout the project area will allow for wetland fish and birds to adjust to sea level rise gradually over time.

4. *Existing Infrastructure* – The proposed project area is currently bisected by the Ballona Creek flood control channel, Culver Boulevard, Jefferson Boulevard, and Lincoln Boulevard. To maximize the extent of continuous habitat, we recommend that flood control protection for the surrounding residential and commercial development be relocated to the outside edge of the project area. Roadways and utilities should be relocated outside of the project area or otherwise raised above the flood zone on causeways to reestablish hydrologic continuity throughout the project area.

5. *Public Access* – Improving public access to the site will increase educational opportunities within the Reserve and help to foster public appreciation for native fish and wildlife resources; however, with increased public access, the Reserve will be vulnerable to increased degradation associated with human-generated disturbance, particularly unauthorized recreational use. To minimize degradation of restored habitats, we recommend long-term management of the Reserve include: (1) Regular inspections of recreational facilities, fencing and adjacent habitat to identify maintenance needs; (2) control of unauthorized human access to habitat areas; (3) fence maintenance; (4) trash removal; and (5) restoration of habitats impacted by unauthorized public uses. The increase in public access should be balanced with anticipated funding available for long-term management of Reserve.

We appreciate the opportunity to comment on the subject NOI. If you have any questions regarding these comments, please contact Christine Medak of this office at 760-431-9440, extension 298.

Sincerely,

for Karen A. Goebel
Assistant Field Supervisor

Enclosure

Literature Cited

Alberts, A. C., A. D. Richman, D. Tran, R. Sauvajot, C. McCalvin, and D. T. Bolger. 1993. Effects of habitat fragmentation on populations of native and exotic plants in southern California coastal scrub. *In* J. E. Keeley (ed.), Interface between ecology and land development in California, pp. 103-110. Southern California Academy of Science, Los Angeles, California.

Bolger, D. T., A. C. Alberts, and M. E. Soulé. 1991. Bird species occurrence patterns in habitat fragments: sampling, extinction and nested species subsets. American Naturalist 137:155-166.

Bolger, D. T., A. C. Alberts, R. M. Sauvajot, P. Potenza, C. McCalvin, D. Tran, S. Mazzoni, and M. E. Soulé. 1997. Responses of rodents to habitat fragmentation in coastal southern California. Ecological Applications 7:552-563.

Soulé, M. E., D. T. Bolger, A.C. Roberts, R. Sauvajot, J. Wright, M. Sorice, and S. Hill. 1988. Reconstructed dynamics of rapid extinctions of chaparral-requiring birds in urban habitat islands. Conservation Biology 2:75-92.

U.S. Fish and Wildlife Service. 2005. Recovery Plan for the Tidewater Goby (*Eucyclogobius newberryi*). U.S. Fish and Wildlife Service, Portland, Oregon. vi + 199 pp.

Enclosure

Federally Endangered, Threatened, Proposed, and Candidate Species to Consider in Association with the Ballona Wetlands Restoration Project, City of Los Angeles and Unincorporated Los Angeles County, California

October 22, 2012

Common Name	Scientific Name	Federal Status[i]
Birds		
western snowy plover	*Charadrius alexandrinus nivosus*	threatened, CH
coastal California gnatcatcher	*Polioptila californica californica*	threatened, CH
light-footed clapper rail	*Rallus longirostris levipes*	endangered, R
California least tern	*Sternula antillarum browni*	endangered
least Bell's vireo	*Vireo bellii pusillus*	endangered, CH
Invertebrates		
El Segundo blue butterfly	*Euphilotes battoides allyni*	endangered, R
Fish		
tidewater goby	*Eucyclogobius newberryi*	endangered, R
Plants		
Ventura marsh milk-vetch	*Astragalus pycnostachyus var. lanosissimus*	endangered, CH
coastal dunes milk-vetch	*Astragalus tener* var. *titi*	endangered
salt marsh bird's beak	*Chloropyron maritimum* subsp. *maritimum*	endangered
Brand's phacelia	*Phacelia stellaris*	candidate

[i] CH – Critical habitat designated but excludes the project area, R – Ballona Wetlands identified as a potential reintroduction area in the Recovery Plan for the species.

Jones, Tanya

To: McCormick, Donna
Subject: RE: addendum to Bigelow comment re Ballona Restoration

From: micheleanna b [mailto:micheleanna@gmail.com]
Sent: Tuesday, October 23, 2012 11:44 AM
To: McCormick, Donna
Subject: addendum to Bigelow comment re Ballona Restoration

Hello Ms McCormick,

I emailed a comment to you on 10/22/12 stating my views on the proposed Ballona Wetlands restoration.

I forgot to mention that I am a board member of a local nonprofit organization devoted to creek issues, Ballona Creek Renaissance.

However, I am writing to express my own personal opinion only, and not as a representative of BCR.

thank you,
Michele Bigelow

Jones, Tanya

From: Bruce Campbell [mailto:madroneweb@aol.com]
Sent: Tuesday, October 23, 2012 10:41 AM
To: McCormick, Donna; dlawhead@dfg.ca.gov; daniel.p.swenson@us.ace.army.mil
Subject: Scoping comments on Ballona (Public Notice / Application No. SPL-2010-1155

October 22, 2012

Bruce Campbell
3520 Overland Ave. # A 149
Los Angeles, CA 90034

Ballona Wetlands Restoration Project
US Army Corps of Engineers
California Dept. of Fish and Game
c/o Donna McCormick
1 Ada, Suite 100
Irvine, CA 92816

Re: Public Notice / Application No. SPL-2010-1155 (Scoping Comments on Ballona Wetlands Restoration Project

To Ms. McCormick, Mr. Lawhead, and Dr. Swenson, and to whom it may concern:

Thank you for your attention to this comment on the so-called "restoration" project in the publicly owned portions of the Ballona Wetlands.

First, we need a good baseline from which to work. There must be:

a.) new thorough inventories and counts of species (as well as a thorough review of existing research) so we have a better idea of what biota may be lost depending upon which alternative is chosen;

(To elaborate here, there must be a range of alternatives, and all the alternatives must calculate as best they can which species would win and which species would lose under each alternative in the near, mid, and far away time frames.) **All species (and certainly the federal and state endangered, threatened, rare, and species of concern species) must be considered in terms of what severe habitat alteration would do to those species in the near, mid, and far term.**

b. a thorough study on the hydrology of the Ballona Wetlands ecosystem -- both current (partially examining "dewatering" operations at Playa Vista) as well as historic.
****

The cart seems to be ahead of the horse in this process. **There is mention of five "preliminary" alternatives already advised by some groups. THERE MUST BE A REASONABLE RANGE OF ALTERNATIVES TO ABIDE BY NEPA AND CEQA. Besides the No Action / No Project Alternative which always must be offered, it is likely all the other alternatives are small variations of a major grandiose rearrangement of the ecosystem -- which is inadequate to satisfy the necessity to have a reasonable range of alternatives.**

Can you name any other DEIS/EIR that did not have a formal public scoping hearing accepting recorded vocal input by the public? Also, can you name any other project that already had 5 alternatives developed even before the scoping phase of a project?
****

In the past decade, we have lost a serious amount of upland coastal prairie habitat in the Ballona West Bluff area -- now 114 luxury homes. Please **discuss species that live in or depend on coastal prairies and upland areas in the Ballona area**, and the general food chain such as what birds eat what mammals or seafood, etc. How will each action alternative impact the critters that still survive despite widespread development following rodenticide use? Discuss this in the near, mid, and far terms.

****

I note a map on the Santa Monica Bay Restoration website which shows habitat types and has a Coastal Conservancy logo at the bottom. It says at the bottom that the map was from October 20, 2011, but then it also said that the study and I suppose a map of "existing habitats" in the Ballona area was conducted in 2007.

For each alternative presented, I call either for larger maps one can open up next to each other to compare "existing habitat" noted by CDFG alongside the grandiose plans for habitat alteration in the Preferred Alternative and what habitat types you see at Ballona after the large public works project is completed. Color the sections on the map accordingly please. It would also be good to see habitat maps in various phases of the bulldozing / earthmoving.

Also, please indicate for as many species as possible where some species would go in the meantime during the massive earthmoving / bulldozing phases of the proposed project.

Obviously there are plans for years or even decades of work for so-called "Ballona restoration." **Please indicate not only what CDFG "existing habitat types" are for certain sections of Ballona, but what the habitat types would be for various phases of the earthmoving project, and what you hope the habitat types in the various areas will be at the end of the project.**

****

Please discuss in the DEIS/DEIR what access there will be to the publicly-owned areas at the Ballona Wetlands at various stages of the Ballona "Restoration" project.

Are there any plans associated with this project, or under any of the alternatives, to transfer jurisdiction and oversight for the area from current overseeing agencies to some other agencies? Please elaborate as to why or why not.

Was the CDFG overview of species and mapping of habitat types half a decade ago considered sufficient by a range of biologists, or is there disagreement as to the thoroughness or timing or other aspects of this overview?

****

Will there be any attempted relocation or scaring away of certain species during some major ground-moving phases of the Ballona so-called "restoration" project? **Will different protocol be followed for species on federal or state Endangered Species Act lists, as versus other resident or visiting species in the area?** We need responses relating to **rare plant species as well as birds and other kinds of critters** of the area. **Will rare plants be relocated prior to bulldozing, and how will they be cared for in the interim, and will they be returned to the vicinity they were in before the bulldozing phase of their area?**

****

The NOP seems to indicate that the Ballona Wetlands area is pretty worthless unless it undergoes a major so-called "restoration" alternative based on massive bulldozing. I note that the "intent" of the project is to "return the daily ebb and flow of tidal waters", "maintain freshwater circulation", and to "augment the biological and physical functions and services in the project area".

When considering various alternatives, consider the term "return" and substantiate with valid studies that the ebb and flow of tidal waters which will take place at Ballona upon completion of that alternative is actually returning to an earlier era. As far as "maintain(ing) freshwater circulation", I assume you are calling the very polluted water of Ballona Creek to be "freshwater", is this correct?

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As far as #6 on page 6 of the NOP, it claims that "A public scoping hearing to receive input on the scope of the DEIS/EIR was conducted on August 16th, 2012". I have been to a lot of hearings, scoping and otherwise, and this was no hearing, but instead just a gathering of some folks by some easels to peer at a few maps. Thus, **there still is a need for an actual**

public scoping hearing to receive formal input into the record on the Ballona so-called restoration plan. When will this hearing occur, or will it occur? Has there ever been a "public scoping hearing" before which did not feature oral input by the public into what the scope of the study related to the project will entail? Who was the ultimate decisionmaker who decided not to accept formal vocal input by the public, and was that person pressured to allow as little public input as possible in the scoping phase?

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I notice under the third bullet point under the Proposed Action mentions "providing flood risk management for Culver Blvd. and surrounding developed areas". **Please (in your DEIS/EIR) mention which parts of the project are proposed in order to achieve "flood control."**

The NOP acts like only after grandiose restoration will the Ballona area be important for migrating birds, etc. It is the largest coastal wetland in L.A. County currently, and provides important habitat for many species.

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The most hopeful part of the NOP seems to be the part near the end that mentions that "Other alternatives that may be considered include restoring smaller portions of the 600-acre site, alternative designs that would provide differing amounts of various habitat types, and alternative designs for enhanced tidal flow." I STRONGLY URGE that the BEEP alternative (Ballona Ecosystem and Education Project) BE INCLUDED AS A FORMAL ALTERNATIVE in the DEIS/EIR.

Are the five preliminary alternatives which have been advised thus far all grandiose massive bulldozing alternatives, or do any consider smaller-scale projects perhaps impacting just a portion of the Ballona wetland complex?

Please discuss every person that was formally on any of the groups which advised the "five preliminary alternatives" and discuss their employer and possible financial interest either in planning or carrying out the grandiose restoration plan, in getting paid to "monitor" such a plan, as well as discuss direct and indirect links of these people to the Playa Vista development and related investors. Thus, every person on the Ballona Wetlands Working Group, Science Advisory Committee, and the Agency Advisory Committee involved with developing or preliminarily approving the five preliminary alternatives must be discussed in relation to employer and financial interest in the Ballona Wetlands vicinity.

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It is disingenuous for the NOP to claim that "Restoration of coastal wetlands is needed in order" "to provide recreational and educational opportunities to the public." Apparently one group controls access to the site and except for token tours, has been severely restricting or prohibiting access even to key members of groups which worked to get the state to purchase (theoretically to protect) the western part of the Ballona wetlands. Thus, there could be plenty of education and recreation going on, but the buddies of developers want to monopolize such.

Is meeting federal Total Maximum Daily Load targets considered a purpose for the project? If so, admit it in the documentation.

The fifth bullet point in the NOP discusses "maintenance of existing levels of flood risk management for areas surrounding the Ballona Wetlands site." **Is a purpose of a large so-called "restoration" scheme to enhance protection from floods, or just to maintain existing levels?**

Page 4 of the NOP talks of "conservative estimates" of "cubic yards of excavation" and "cubic yards of fill placement". What are less conservative estimates for the amount of excavated material and fill placement to be moved under varying alternatives for this project at Ballona?

Is it legally proper to divert a polluted "impaired" body of water (Ballona Creek) into another polluted "impaired" body of water (Ballona Wetlands)?

Please keep me updated as to when and where the formal scoping hearing will be on this project, and keep me updated on other aspects of the so-called "restoration" project as well.

Sincerely yours,

Bruce Campbell

Jones, Tanya

From: Natalie Carrere [mailto:ndcarrere@yahoo.com]
Sent: Tuesday, October 23, 2012 12:25 PM
To: McCormick, Donna
Subject: Comment on Ballona Wetlands Restoration Project

To Donna McCormick:

Here are my public comments on the Ballona Wetlands Restoration Project:

1. I would like the project to consider raising Culver Blvd and Jefferson Blvd. to allow the restored wetlands to have more continuity and be contiguous. I have observed many dead animals and birds on Culver Blvd. If the street was raised, waters/land could flow underneath.

2. I would like to see species impact reports on all known species in the area currently. This should help guide the project to determine the best restoration. While some species may be displaced, it is good to have that information. Also, studies should be done on what the restoration hopes to bring to the area in terms of species so that a full cost/benefit, from a species level, can be done.

3. If the proposed preferred alternative (#5) is adopted, it is my understanding that this would require ongoing dredging to maintain the area. What would be the financial impact to the City of Los Angeles and the State of California to maintain this dredging? What would be the environmental impact of this dredging to plants and wildlife. What are the alternatives to the dredging?

4. What actions will be taken to ensure respectful treatment of native american burial grounds or other sacred sites?

5. What will impact of bulldozing be on the existing native plants and species? What are the alternatives to large-scale bulldozing and has a cost-benefit analysis been performed? How long will it take for the plants and wildlife to return to the area if they are dug up/displaced/destroyed by bulldozing or other large scale digging? Could a less disruptive restoration accomplish the same ultimate goal of a restored wetland habitat?

6. What will be the impact of the proposed large berms on species, habitat and the water flow? Why do they need to be so large? What % of the existing habitat to restored will be effectively unusable due to the large proposed berms?

7. I signed up for the SMBRC newsletter and to be on their mailing list on March 5, 2012 with a confirmation from Donna Tuttle that I would be included from then on. I have received NO information, NO newsletter and NO notification of this comment period deadline (October 23, 2012). I believe the public has a right to be informed of this public project and request that SMBRC be more forthcoming, transparent and inclusive of the public in this process.

Sincerely,

Natalie Carrere
ndcarrere@yahoo.com

and YES, I would like to be included on the SMBRC email mailing list, as I requested back in March.

Jones, Tanya

From: mike chamness [mailto:mchamness@yahoo.com]
Sent: Tuesday, October 23, 2012 3:19 PM
To: dlawhead@dfg.ca.gov; daniel.p.swenson@us.ace.army.mil
Cc: McCormick, Donna
Subject: DON'T BULLDOZE THE BALLONA WETLANDS IN CA!

As a voter & a lover of the wetlands, I demand you do everything in your power to NOT BULLDOZE THE BALLONA WETLANDS.

Sincerely,

Mike Chamness
Venice, CA 90291

Jones, Tanya

From: Joyce Dillard [mailto:dillardjoyce@yahoo.com]
Sent: Tuesday, October 23, 2012 2:33 PM
To: Swenson, Daniel P SPL
Subject: Comments to NOI for Draft EIS/EIR- SPL-2010-1155 Ballona Wetlands Restoration Project due 10.23.2012

Ballona Wetlands is "an example of a wetland where tides are excluded by a tide gate (PERL, 1989, Boland and Zedler 1991, PERL unpublished data)" as stated in the book TIDAL WETLAND RESTORATION, A SCIENTIFIC PERSPECTIVE AND SOUTHERN CALIFORNIA FOCUS by Joy B. Zedler, Principal Author,1996.

The plans are to restore outflows, not inflows. There is no tidal influence. Flood risk would be from Sea-Level Rise or Tsunamis, not natural in nature. The storm drain aspect of this plan needs to be emphasized as the major thrust. Dredge and fill activities would need to be analyzed from sediment flows upland.

You would need to consider the Land Use in the Community Plans surrounding and/or contributing to Ballona. In the case of the Hollywood Community Plan, there is increased density and, consequently, anticipated increases in sediment flows because of the overbuilding. Those natural systems in the upland are ignored in this project, yet contribute to any drainage problem.

Sediment Management Plans in LA County are 100 years old and lack the foresight of anticipated capital costs and operation and maintenance costs.

We cannot even be assured that Earthquake Fault Mapping is current for the area.

We do not know the age and condition of pipelines and storm drains, both by the City of Los Angeles or the County of Los Angeles and their relationship to Ballona as an outfall. The NPDES MS4 permit, current and pending, are factors for the Draft EIS.

The factors listed in PRACTICAL PROXIES FOR TIDAL MARSH ECOSYSTEM SERVICES: APPLICATION TO INJURY AND RESTORATION by Charles H. Peterson, Kenneth W. Able, Christin Frieswyk DeJong, Michael F. Piehler, Charles A. Simenstad, and Joy B. Zedler from ADVANCES IN MARINE BIOLOGY, VOLUME 54 states:

Tidal marshes are valued, protected and restored in recognition of their ecosystem services:

(1) high productivity and habitat provision supporting the food web leading to fish and wildlife,
(2) buffer against storm wave damage,
(3) shoreline stabilization,
(4) flood water storage,
(5) water quality maintenance,
(6) biodiversity preservation,
(7) carbon storage and
(8) socio-economic benefits.

It is questionable whether this wetland restoration fits that criteria in such a highly urbanized area with continued plans for density and population growth. Would a restored nearshore environment reduce the effects of continued urbanization.

The Southern California Bight studies, which hold pollution close to shore, should be considered.

TMDL Storm Means data from the sub-watersheds should be analyzed as point sources versus Ballona as an end source. Again, aspects and inadequacies in the upland watershed should addressed including destruction/alteration of Ballona Creek such as the Echo Park Lake. Also, major projects such as Farmers Field (NFL Football Stadium) and its impacts on the Ballona Creek Watershed should be considered.

The Port of LA is included Ballona Creek in Wetlands Banking. Does this banking take precedence over Ballona itself.

Joyce Dillard
P.O. Box 31377
Los Angeles, CA 90031

Classification: UNCLASSIFIED
Caveats: NONE

Jones, Tanya

-----Original Message-----
From: douglaspfay@aol.com [mailto:douglaspfay@aol.com]
Sent: Tuesday, October 23, 2012 1:00 PM
To: DLawhead@dfg.ca.gov; Swenson, Daniel P SPL
Subject: Re: Proposed Ballona Wetlands Restoration Project questions

Dear Mr. Lawhead and Mr. Swenson,

Attached are my comments on the NOI. Please reply by email that you have received them.

Respectfully requested,

Douglas Fay

-----Original Message-----
From: David Lawhead <DLawhead@dfg.ca.gov>
To: douglaspfay <douglaspfay@aol.com>; Daniel.p.swenson <Daniel.p.swenson@usace.army.mil>
Sent: Mon, Oct 22, 2012 11:43 am
Subject: Re: Proposed Ballona Wetlands Restoration Project questions

Dear Mr. Fay,

You are correct that the close of the public comment period for the Ballona Wetlands Restoration Project NOP/NOI is October 23rd, at 5 pm (the close of business). In response to your other questions:

- You can send your comments to me electronically, however, if you send them to Donna.McCormick@icfi.com both Dr. Swenson and I will receive them at the same time.

- The Department of Fish and Game will accept your comments if they are postmarked by October 23rd.

- Comments received during the NOP/NOI scoping process are not individually responded to, but are considered in the development of the draft EIR/EIS that is still to be developed. Under CEQA, these comments do not require formal responses, but will be included in the draft EIR/EIS for the public to review. Comments received in the course of public review of the future Draft EIR/EIS will have formal responses in the Final EIR/EIS.

Thank you for submitting comments on the project.

David Lawhead
Staff Environmental Scientist
CA Dept. of Fish and Game

>>> <douglaspfay@aol.com> 10/20/2012 8:16 PM >>>
Dear Dr. Swenson & Mr. Lawhead,

It is my understanding that the Comment Period on the proposed BWRP ends October 23, 2012.

At what time of day on October 23, 2012 does the Comment Period close?

Can I send comments to you electronically by email before the deadline?

Will postmarked by October 23, 2012 submissions by postal mail be accepted?

Will all of my questions asked at this time (NOI) be answered and mailed to me prior to the Draft EIS/EIR being prepared?

Will acknowledgement of my comments and proposed alternatives be mailed to me prior to the Draft EIS/EIR being prepared?

Will a complete list of all letters, comments and questions and your replies be posted and available online prior to the Draft EIS?EIR being prepared?

I'm somewhat familiar with CEQA, but not the NOI process. If you could briefly elaborate on the format of comments on the NOI that is best for you, I would appreciate your reply ASAP by Monday, October 22, as the imposed deadline is near.

Respectfully submitted,

Douglas Fay
644 Ashland Ave Apt A
Santa Monica, CA 90405
Tele: 310 437-0765
email: douglaspfay@aol.com

Classification: UNCLASSIFIED
Caveats: NONE

To: October 23, 2012

Mr. Daniel P. Swenson, Chief, Los Angeles Section
Army Corps of Engineers
915 Wilshire Blvd., Los Angeles CA 90017
Email: daniel.p.swenson@usace.army.mil

Mr. David Lawhead
California Dept. of Fish and Game
3883 Ruffin Road, San Diego, CA 92123
Email: DLawhead@dfg.ca.gov

Questions, Comments, and Recommendations by Douglas Fay on the proposed Ballona Wetlands Restoration Project NOI

1. Corps Release no. 12-015 Posted 9/26/12 Re: Termination of existing process at the request of the Santa Monica Bay Restoration Commission (SMBRC), a Joint Power Authority with the County of Los Angeles (County).

Question: Will the termination of the existing feasibility study and accompanying EIS result in a project consistent with a comprehensive Santa Monica Bay Restoration Plan (SMBRP), or fragment the process?

Comments: My concern, and the concern of others, is the 2008 SMBRP is a significantly flawed document, with minimal public input. I have made several attempts to address my concerns publicly that have been denied by individuals in the SMBRC leadership rolls, the SMBRC Governing Board, members of the Santa Monica Bay Restoration Foundation (SMBRF), and submitted documentation to the California Coastal Commission (CCC).

A (partial) document analysis I prepared of the 2008 SMBRP addressed to the SMBRC Governing Board was submitted to Scott Valor. Months later Mr. Valor told me he did not give the time critical document to the Governing Board members. This is only one example of several deliberate and documented actions to exclude and deter me from this process.

Also, the SMBRC has recently approved the development of Parcel OT, a parking lot adjacent to the Oxford Lagoon a.k.a. the Oxford Retention

Basin and the Oxford Retention Basin Multi-Use Enhancement Project, both of which are under the County's control. The Oxford Lagoon is part of the historical Ballona Wetlands that is primarily used for urban flood control discharge and retention prior to entering the Marina Del Rey (MDR) harbor through mechanical gates.
The Oxford Retention Basin Multi-Use Enhancement Project increases/enhances public access, which in turn reduces terrestrial habitat value. There is no significant aquatic habitat value due to the drastic variation of salinity levels that are catastrophic to most marine animals. This shows that their actions are based on politics, not science and sound restoration principles.
Current management practices of the Oxford Lagoon contradict SMBRP Goals and Objectives A. PRIORITY ISSUE: WATER QUALITY Goal 1: Improve water quality through treatment or elimination of pollutant discharges, Goal 2: Improve water quality through pollution prevention and source control, B. PRIORITY ISSUE: NATURAL RESOURCES Goal 4: Create and support policies and programs to protect natural resources.

Questions: Are these acceptable practices in the eyes of the Corps and CDFG? Please explain and elaborate if needed.

Are other documents being censored without the Governing Board's knowledge jeopardizing their abilities to evaluate and vote on proposed projects? Please explain and elaborate if needed.

What policies and programs to protect natural resources have been created by the SMBRC and implemented by government agencies and municipalities within the Santa Monica Bay watershed? Please explain and elaborate if needed.

What is the "commission's proposed restoration project"?

Comment: I do not see a link to a website in this document, or have detailed knowledge of the commission's proposed restoration project, which makes it difficult, if not impossible to comment on with an acceptable degree of accuracy.

Recommendation: Reverse your decision to accept the request by the SMBRC and proceed with the existing 2005 process.
Provide ample opportunities for the public to be educated and engaged in drafting a restoration project through the existing process.
Assure the public that the non-profit Santa Monica Bay Restoration Foundation (SMBRF) and SMBRC will not be controlling the process.

Investigate any wrong doings to members of the public including, but not limited to, misappropriation of public funds.

2. Corps Public Notice: SPL-2010-1155, Date: August 24, 2012

SUMMARY:

Comment: Historical maps show breaching of sand and full tidal exchange in the Del Rey Lagoon area of the coastline.

Questions: Is the restoration of this historic exchange in the proposed Ballona Wetlands Restoration Project (BWRP)?

If, and I quote, “The proposed project is intended to return the daily ebb and flow of tidal waters”, then why wouldn’t the first step to a restoration be limited to restoring the historical breaching?

What is the percentage of the proposed project’s intended return of daily ebb and flow of tidal waters compared to historical levels within the wetlands?

Comment: I attended a lecture by Dr. Travis Longcore on May 22, 2012 entitled, “Closure Dynamics of Southern California Estuaries and Implications for Restoration.”

Recommendation: View this lecture, reference it in the EIS/EIR, and answer the following questions. If you cannot easily obtain a copy, I will provide a copy upon request.

Questions: Do you agree that the historical photos, maps, and plant life show that the Ballona Wetlands were primary a fresh water to brackish wetlands? Please explain your answer and elaborate if needed.

Is there any historical data that shows the Ballona Wetlands ever had full tidal flow (ocean levels of salinity) throughout the proposed project area (approximately 600 acres)? Please explain your answer and elaborate if needed.

Is there any historical data that shows natural berming/levees adjacent to the Ballona Creek and around the parameter of the proposed project? Please explain your answer and elaborate if needed.

Is preservation of the historical Ballona Wetlands a concern? Please

explain and elaborate if needed.

SUPPLEMENTARY INFORMATION:

Comment: This document states, “The Corps intends to prepare a joint EIS/EIR to assess the environmental effects associated with the proposed project. CDFG is the state lead agency for the EIR pursuant to the California Environmental Quality Act (CEQA).”

Questions: Is the Corps the Federal lead agency for the project, the EIR, or just the EIS?

Is CDFG the State lead agency for the project, the EIS, or just the EIR?

If CDFG is the lead agency, are they required to act as stewards of the public?

If so, why are the SCC, SMBRF, SMBRC, DRP, and others, appearing to be dominating all aspects of the proposed BWRP process with limited/controlled public input?

If the Corps and CDFG intend to jointly prepare a Draft EIS/EIR for the proposed BWRP, is one Scoping Meeting all that is legally required?

Comment: The Scoping Meeting(s) schedule was limited to 3 hours on 1 day. I was unable to attend due to a conflicting work schedule. Scott Valor told me the minimum that State law requires will be all that is provided throughout this process. I’m assuming this is true if the SMBRF, that Mr. Valor is associated with, is influencing the process.

Questions: If public participation is critical then shouldn’t there have been more than one Scoping Meeting?

Comment: This document states, “7. Availability of the DEIS/EIR. The DEIS/EIR is expected to be published and circulated in late 2012. A public hearing will be held after its publication to field comments on the document.”

Questions: Is one public hearing on the DEIS/EIR sufficient?

Will it be limited in time?

Will there be opportunity for question and answer sessions?

Will speaker time during public comment be limited?

If public participation is critical then shouldn't there be more than one Public Hearing?

1. Background.

Comment: The background description is limited and vague.

Question: Where are the "attached figures"?

Comment: There were not any attached figures in the Corps SPECIAL PUBLIC NOTICE download.

Questions: If the Ballona Creek a.k.a. Ballona Flood Control Channel is "a component feature of a federal flood risk management project," could a project increase flood risk?

Who owns the Ballona Creek/Flood Control Channel portion that bisects the State owned Ballona Wetlands?

Who is legally responsible for liabilities associated with altering the alignment of the Ballona Creek/Flood Control Channel?

Will there be special laws and/or regulations drafted specifically for the proposed project?

Has a Federal/State wetlands project partnership similar to this proposed project been completed before?

Comment: If so, please describe with references.

Recommendations: Study and describe all of the water bodies associated with the Ballona Wetlands and the development adjacent to the proposed project and adjacent water bodies, including, but not limited to, industrial, commercial, residential, recreational, flood plain, polluted waters, and Native American data.

Study and describe how an alteration of what I am assuming are Federal waters/land/boundaries with State land/waters/boundaries will be conducted including, but not limited to, jurisdiction, law enforcement, management, maintenance, funding and liability.

2. Project Purpose and Need.

Comments: Regarding the statement, “In addition, the wetland habitat and natural hydrological functions in the area have been substantially degraded.”

Questions: How have the natural hydrological functions been substantially degraded? Please explain your answer and elaborate if needed.

Who is responsible? Please explain your answer and elaborate if needed.

Is the degradation of the natural hydrology of the project area ongoing? Please explain your answer and elaborate if needed.

If so, is the degradation legal or illegal?

Comment: Regarding the statement, “Restoration of coastal wetlands is needed in order to increase available nursery and foraging habitat for wildlife and to provide recreational and educational opportunities to the public.”

Questions: Will a comprehensive plan including all coastal waters and water sources originating inland be more effective at maintaining and increasing biodiversity than limiting the scope of study to coastal wetlands within the proposed project site? Please explain your answer and elaborate if needed.

What does CEQA require?

What are the recreational and educational opportunities proposed?

Comment: I’m told my grandfather and father hunted ducks in the Ballona Wetlands area.

Questions: Will regulated hunting and fishing be allowed publicly in the proposed project area?

Will Native Americans be allowed to hunt and fish in the proposed project area? Please explain your answer and elaborate if needed.

Comment: Regarding the statement, “A restored, optimally functioning wetland would also benefit the adjacent marine environment and enhance

the quality of tidal waters."

Questions: How does a wetland enhance the quality of tidal waters?

Does the proposed project intend to introduce polluted water sources into the wetlands?

How do polluted waters including, but not limited to, waters laden with synthetic chemical compounds affect the health and reproductive cycle of living organisms? Please explain your answer and elaborate if needed.

Are there endangered or threatened species within and/or adjacent to the proposed project area?

Would the proposed project need maintenance and funding to remove introduced pollutants in perpetuity? Please explain your answer and elaborate if needed.

Comments: Not mentioned in the Project Purpose and Need is the need, or should I say intent, to construct flood and tsunami control levees in an effort to mitigate and protect recently developed structures. Also, the significant amount of earth/soils, that are proposed to be moved, to build the massive levees, will significantly increase the amount of ocean waters, and thereby decrease the need to restore fresh water sources that have been depleted.

Questions: Do any of the proposed project alternatives appear to be flood control mitigation for the Playa Vista development? Please explain your answer and elaborate if needed.

If so, is it an acceptable practice, both morally and financially, by the Corps and CDFG to move forward with an NOI when the preferred restoration project appears to be based on flood control mitigation for adjacent lands?

What is the cost incurred to date to develop what I'm assuming is the preferred proposed project alternative? Please explain your answer and elaborate if needed.

How much of the expenses to date have gone to, or through, CDFG? Please explain and elaborate if needed.

Are you aware that a Santa Monica Bay Restoration Account (SMBRA) exists?

Has any money gone in or out of the SMBRA for this project, or any other project that you are aware of?

Is the proposed restoration funded by grants? Please explain and elaborate if needed.

Does CDFG have detailed accounting records for all financial activities related to the BWRP? Please explain and elaborate if needed.

Are there financial accounting records and/or audits available for public viewing?

If so, how is it accessed? Please explain and elaborate if needed.

If not, why? Please explain and elaborate if needed.

Comment: Regarding the statement, “The purpose of the project is to restore ecological functions of the site, in part, by enhancing tidal flow.” When the County introduced/increased urban flood control waters into the Oxford Lagoon, removed sources of fresh water, and manually maintained tidal flushing, the migratory bird population dropped significantly. I have witnessed Mallard ducklings expire in the MDR harbor due to lack of fresh water access.

Question: How do you enhance migratory bird habitat by enhancing tidal flow?

3. Proposed Action.

Comment: Regarding the statement: “CDFG is proposing a large-scale restoration of the Ballona Wetlands Ecological Reserve. The proposed project entails restoring, enhancing, and establishing native coastal wetland and upland habitats in the approximately 600-acre Ballona Wetlands Ecological Reserve.”

Questions: Is CDFG proposing a large-scale restoration, or is the large-scale restoration proposal coming from the SMBRF and/or other organizations? Please explain and elaborate if needed.

Why is the State Coastal Conservancy (SCC) taking the lead in funding for planning and restoration of the CDFG property? Please explain and elaborate if needed.

What is the roll of California Department of Parks and Recreation (DPR)?

Will CDFG control the proposed “Long-term operations and management activities including inspections, repairs, clean-up, vegetation maintenance, and related activities,” or will they be subcontracted?

If subcontracted to who will they subcontracted to and why? Please explain and elaborate if needed.

Comment: The 2008 SMBRP states, “Determine preferred alternative by 2009.”

Question: Does CDFG have a preferred alternative?

Does the SMBRC have a preferred alternative? Please explain and elaborate if needed.

If so, why hasn’t it been released to the public so we can accurately comment on the NOI?

If a draft has been released, where can I obtain a copy?

4. Alternatives Considered.

Comment: Regarding the statement, “The feasibility of several alternatives is being considered and will be addressed in the DEIS/EIR.”

Questions: What are the alternatives and where did they come from? Please explain and elaborate if needed.

Is the Proposed Ballona Wetlands Restoration Plan (BWRP)(Draft), Prepared in conjunction with the Ballona Wetlands Land Trust, Save Ballona Wetlands, and Rimmon C. Fay, Ph.D. dated June 21, 1995, submitted to the Corps, County, and City of Los Angeles included in the proposed alternatives? Please explain and elaborate if needed.

Is it a document that both the Corps and CDFG have in their possession and has been studied by staff biologists and engineers? Please explain and elaborate if needed.

Recommendation: If not, obtain the BWRP draft document dated June 21, 1995. (I have a copy if needed) Study and describe the viability of

implementing this alternative with acknowledgement of current conditions: ownership, development, etc.

5. Scoping Process.

Comments: The Scoping Meeting was conducted on August 16, 2012 from 4:00 to 7:00 p.m. One 3 hour meeting was all that was provided. Regarding the statement, “providing useful information such as published and unpublished data, and knowledge of relevant issues and recommending mitigation measures to offset potential impacts from proposed actions.”

Questions: What is being done to improve the diminishing water quality within the MDR harbor? Please explain and elaborate if needed.

What is proposed project plan and/or mitigation for being impacted by poor water quality, pollutants, and invasive species originating from within the MDR harbor? Please explain and elaborate if needed.

How many industrial dischargers are permitted into the Santa Monica Bay? Please explain and elaborate if needed.

What are they reportedly discharging? Please explain and elaborate if needed.

What are the locations of discharge? Please explain and elaborate if needed.

What is the reported volume of discharge daily/annually? Please explain and elaborate if needed.

What mitigation measures are in place to ensure there is no negative impact to water quality, and biological diversity and quantities? Please explain and elaborate if needed.

Are there any legal discharge permits issued anywhere within the Ballona Creek Flood Control Channel (BCFCC)? Please explain and elaborate if needed.

Have there been any reported accidental spills into the BCFCC within the past 10 years?

If so, how many and what was spilled? Please explain and elaborate if

needed.

What are the specifics: date, time, estimated quantity, etc. and result: beach closures, number of days, etc.? Please explain and elaborate if needed.

What is the current biological assessment of the Ballona Wetlands? Please explain and elaborate if needed.

What is the current biological assessment of the Marina Del Rey harbor? Please explain and elaborate if needed.

What is the current biological assessment of the Del Rey Lagoon? Please explain and elaborate if needed.

What is the current biological assessment of the Oxford Lagoon? Please explain and elaborate if needed.

What is the current biological assessment of the Ballona Creek including all tributaries? Please explain and elaborate if needed.

What is the current biological assessment of the Venice Canals? Please explain and elaborate if needed.

What is the current biological assessment of the Santa Monica Bay? Please explain and elaborate if needed.

What was the annual historic high catch, combined recreational and commercial, in tons, taken from the Santa Monica Bay, include the year and as much data as possible including, but not limited to, variety of fish, shellfish, crustaceans, mammals, and value (adjusted)? Please explain and elaborate if needed.

What is the current annual catch, combined recreational and commercial, in tons, taken from the Santa Monica Bay, include the year and as much data as possible including, but not limited to, variety of fish, shellfish, crustaceans, mammals, and value? Please explain and elaborate if needed.

What plants and animals, both terrestrial and marine, are currently proposed to be restored and/or introduced to the above listed waterbodies directly related to the proposed project including, but not limited to, the Ballona Wetlands, MDR harbor, Del Rey Lagoon, Oxford Lagoon, Ballona

Creek flood control channel including all tributaries, the Venice Canals, and the Santa Monica Bay? Please explain and elaborate if needed.

What is the current percentage of annual take/catch, combined recreational and commercial, within the Santa Monica Bay, as a percentage of historical recorded highs? Please explain and elaborate if needed.

What is the estimated annual take/catch, combined recreational and commercial, within the Santa Monica Bay, increase over a 10 year period, with the currently proposed Ballona Wetlands Restoration project when completed? Please explain and elaborate if needed.

What is the annual consumption cost of seafood imported and sold within the Santa Monica Bay watershed? Please explain and elaborate if needed.

Would it be better for our local economy to reduce our dependence on imported seafood? Please explain and elaborate if needed.

Would implementing a comprehensive Santa Monica Bay Restoration Plan that strives to restore biomass to historical levels create a significant amount of new jobs in areas of, but not limited to, research, fisheries, aquaculture, education, scuba industry, hospitality, marine resources management, tourism, etc.? Please explain and elaborate if needed.

Have you read the 2008 SMBRP?

Are you aware of the fact that there is no mention of artificial reefs in the 2008 SMBRP?

Comment: 2 years ago I asked SMBRC Governing Board member and (then) HTB president Mark Gold a question about artificial reefs in the Santa Monica Bay? His reply was something to the effect of, “We didn’t discuss them.” A year later when I repeated what I thought I heard he corrected me saying something to the effect of, “No, the definition of artificial reefs!”

Questions: Does the Corps and/or CDFG have knowledge of artificial reefs in the Santa Monica Bay? Please explain and elaborate if needed.

Does the Corps (Federal) and CDFG (State) have a uniform definition for “artificial reefs” that can be included in the proposed project glossary of terms? Please explain and elaborate if needed.

Are you aware of the fact that there is no language whatsoever in the 2008 SMBRP to do enhancement projects within the Santa Monica Bay, even though that it is worded into the mission statement of the SMBRF?

Are you aware of the fact that the majority of restoration projects funded by the SMBRC/SMBRF have been improperly classified as enhancement projects? Please explain and elaborate if needed.

Have pilot tide pools at varying depth, configurations, material, size, etc. within the existing Ballona Creek flood control channel to test the viability of removing the existing levees been proposed? Please explain and elaborate if needed.

Comments: I was invited by a member of the SMBRC to attend and participate in the annual Bay Watershed Council (BWC) working group to draft the annual work plan held on Feb. 12, 2012. When I arrived I was told I could not participate. SMBRF staff Mark Abrams was present and hired to prevent members of the public from participating in the working groups. I attempted to suggest the pilot tide pools during public comment while attending this humiliating experience.

This unacceptable behavior of members of the SMBRC/SMBRF that authorized and enforced this action completely contradicts the “Letter From the Director” SMBRC Executive Director Shelley Luce in the SMBRC Annual Report 2011 which states, “We are planning new workshops and other mechanisms for getting public input on the BRP and annual work plans.”

Question: What actions will the Corps and CDFG take to assure the public that the behavior of this magnitude will not continue to occur throughout the proposed project process? Please explain and elaborate if needed.

Comment: Other actions that contradict sound science and restoration principles surround decisions made aware to me by Dr. Wang. Dr. Wang told me he did not read the Montrose Settlement Restoration Plan (MSRP). Specifically, Appendix A1 Construct Artificial Reefs and Fishing Access Improvements and Appendix A3 Restore Full Tidal Exchange Wetlands. There was $40 million in Federal MSRP grant money available in 1995.

Questions: Did the SMBRC and/or SMBRF apply for MSRP grant(s) for the Ballona Wetlands and/or Santa Monica Bay projects? Please explain and elaborate if needed.

Did CDFG or any State agency apply for MSRP grant(s) for the Ballona Wetlands and/or Santa Monica Bay projects? Please explain and elaborate if needed.

Comments: Dr. Wang also told me the SMBRC did not propose/apply to incorporate the County's Parcel OT (the parking lot adjacent to the Oxford Lagoon) to expand the Oxford Lagoon which would have increased the viability of wildlife significantly. The County is planning to build a massive luxury senior living facility that will abut the Oxford Lagoon further reducing wildlife viability.
This action contradicts SMBRP B. PRIORITY ISSUE: NATURAL RESOURCES Goal 5: Acquire land for preservation of habitat and ecological services.

Question: Is development of vacant land adjacent to coastal wetlands that are compromised through management practices in the best interest of sound restoration principles?

Other actions that concern me are the Total Maximum Daily Loads (TMDLs), imposed by a Heal The Bay (HTB) lawsuit, that may not reflect natural occurring levels of waterways and waterbodies. For example, the TMDL approved for the Malibu Lagoon may be much cleaner than what naturally occurs within a healthy lagoon triggering an approval for a restoration project based on false and/or misleading information.

What is the scientific opinion of the Corps and CDFG on the establishment and enforcement of TMDLs that may not reflect naturally occurring water quality standards of all waterbodies and waterways associated with the proposed project? Please explain and elaborate if needed.

FINAL SUMMARY AND RECOMMENDATIONS

Why am I so concerned about the outcome of the historical Ballona Wetlands and Santa Monica Bay area you might ask?
I was born in Santa Monica, Ca at St. Johns Hospital in 1962 and raised on Howard Street adjacent to the railroad tracks and the Oxford Lagoon. There was so much wildlife present in the area when I was young. Dozens of ducks would land in our yard. Salamanders, lizards, and snakes could easily be found. Cancer crabs could be caught in the MDR harbor by the bucket full. Catching your limit of fish in the Bay seemed much easier. The tidepools at Palos Verdes and Paradise Cove were abundant with life. Now 40 years later, the effects of urban development and associated

pollution without sufficient mitigation have significantly compromised all life forms.
My father was Dr. Rimmon C. Fay, a second-generation Santa Monica Bay fisherman who, through education and experiences, became a leading expert of the Santa Monica Bay and California coastal pollution issues starting in the 1950s. His independence and contributions to environmental protection and education were epic, including his contributions to save the Ballona Wetlands.
With PhDs in Chemistry and Oceanography, countless California ocean dives, hours at sea, days on the beach growing up and fifty years as an ocean lifeguard, as owner/operator of Pacific Bio Marine biomedical research, supply & education, as a founding member of the CCC, and many more contributions worthy of honor and respect, Rim's input in the 1995 Proposed BWRP Draft deserves recognition.
I have a lifetime of experience learning from my father, have served on a land use advisory committee in Monterey County, CA, have several professional certifications in multiple fields including PADI Master Scuba Diver Trainer, Emergency First Response Instructor, ASE Master Technician, Toyota Expert Technician and a BAR Smog Technician License. I have traveled throughout the Pacific region, have hundreds of logged dives, survived the 2004 Asian Tsunami, and have ten years of experience with upper watershed management including over 500 hours of heavy equipment operation and maintenance.
My knowledge of the Santa Monica Bay may never eclipse my fathers. I do believe that I have a better general knowledge than most and have an exceptional ability to identify and fix problems that are obviously broken. The library of Dr. Rimmon C. Fay is in storage awaiting a location were it can be housed, digitized, and made available for all academia on a website. Valuable historical data pertaining to the proposed project may be in his library. Funding to make this information accessible has not been secured.

What are the additional recommendations and desired outcome that I would like to see for the Ballona Wetlands and Santa Monica Bay?

Strongly consider the history of the Tongva Native Americans and respect the current concerns of Johntommy Rosas. If he has registered the Ballona Wetlands as a Sacred Site, the massive alterations proposed should not be allowed in perpetuity. Any enhancements should be harmonious, based on time proven science independent of the SMBRC/SMBRF influence, and focused on restoring an ecosystem that is as natural and maintenance free as possible.
Restore the historical levels of fresh water to the aquifer below the

wetlands through natural recharge and/or injection wells.
Restore the historic levels of fresh surface water
Restore the native terrestrial animals to historical levels to the greatest extent possible including deer and bats.
Explore creating the habitat necessary to allow for greatest diversity of terrestrial animals with minimal change to existing conditions.
Ban domestic animals, especially cats and dogs, from the Ballona Wetlands and adjacent walking/viewing areas.
Install fencing and/or concrete barriers to prevent wildlife from entering roadways.
Install large culverts with solar lighting for animals to cross under existing roadways. Raise the roadways if needed to allow reasonable mobility.
Do not remove the Ballona Creek flood control levees.
Implement pilot test tidepools throughout the Ballona Creek flood control channel with varying designs, locations, and conditions.
Cut openings into the concrete of the existing Ballona Creek levees to allow for native trees to grow, providing habitat and shade for wildlife.
Do not consider opening the wetlands to full tidal flush until the source of ocean water is of the highest quality. The current water quality of the MDR harbor and Playa Del Rey nearshore waters are unacceptable at this time.

Research and implement restoring staff and funding to CDFG so that they truly are the lead agency in this process. I'm told that CDFG funding has been reduced which reduces their effectiveness to educate and enforce locally is reduced. I recently read where the non-profit Santa Monica Baykeeper were making transects across the Bay looking for illegal activity in the Marine Protected Areas (MPAs) in an effort to warn boaters of a potential CDFG citation. This behavior is not a cost effective way to manage marine resources.

Remove the SMBRF from this process. If they have research and recorded data through grant funding acquired from the public, this information shall be given to CDFG. Allowing a non-profit to have the amount of control and influence over State agencies and commissions, with limited public accountability, is not in the general public's or the environment's best interest including the Ballona Wetlands.

Implement partnerships with local educational institutions in an effort to recruit students from Kindergarten to College to participate in research, education, restoration, maintenance, monitoring and management programs, including SCUBA training and certification.

Create and nonpartisan independent review board with membership that is

not financially associated to the proposed project and has term limits for members.

Make restoring the abundance and diversity of marine life in the Santa Monica Bay to historical levels a top priority. This can be achieved by:
Removing all forms of industrial pollution (thermal, sewage waste, and desalination brine) discharged directly into the Bay and ban in perpetuity.
Fully mitigating for all of the sand historically placed on the shoreline through natural rock and artificial reefing to replace the lost nearshore habitat.
Fully mitigating the sediment discharged from Hyperion in mid to deep waters through natural rock and artificial reefing to restore and possibly enhance the lost habitat diversity that biomass requires.
Establish and manage a significant amount of kelp forest in the Santa Monica Bay from El Segundo to north of the Santa Monica Pier.
Restore the historical breach to the Del Rey Lagoon.
Drastically change how the waters within the MDR harbor are managed including, but not limited to: mandatory nets on all docks to remove floating debris, developing and implementing a vacuum system for in-water boat bottom cleaning, and stronger enforcement of illegal spills.

IN CONCLUSION

My family has been in this process for three generations. My grandfather instilled the love and respect of nature and all that it has to offer to my father. My father shared that experience with me. And now I'm nurturing the values taught to me into my young son and daughter.

It was at my father's memorial that I promised Tom Hayden, the only politician to finally stand beside my father and fight for healing the Santa Monica Bay rather than treat it as a dumping ground. It was a surprise and pleasure to see him this morning in passing to say hello and thanks.

If there was one quote that sets the tone for why I'm fighting for the historical Ballona Wetlands it would be, "so preservation of a historic wetland is not a concern."
You'll find that quote on page 4 of the HTB letter to the CCC in support of the controversial Malibu Lagoon Restoration project.

Please judge wisely and favor restoring nature over alternatives influenced by huge sums of money and those that can easily lose their way.

Respectfully submitted,

Douglas Fay
644 Ashland Ave Apt A
Santa Monica, CA 90405
Tele: 310 437-0765
Email: douglaspfay@aol.com

Jones, Tanya

From: Margot Griswold [mailto:mgriswold@newfields.com]
Sent: Tuesday, October 23, 2012 3:06 PM
To: McCormick, Donna; dlawhead@dfg.ca.gov; daniel.p.swenson@us.ace.army.mil
Subject: Comment on Ballona Wetland NOP

To Whom It May Concern:

Please consider the following comments in preparation of the Draft Environmental Impact Report/Environmental Impact Statement for the Ballona Wetlands Restoration Project. These comments are submitted as a concerned citizen and practicing restoration ecologist. I have participated in many restoration project, revegetation and reclamation projects in California for the past 18 years.

First, the project description should be corrected to describe the project as wetlands “creation” not “restoration.” According to the International Society for Ecological Restoration, the term restoration properly used describes the process that will return a site to historical conditions with ecological functions that likely occurred in the past. Most of the alternatives that are described for the 'restoration' of Ballona wetlands include full daily tidal connection. According to the historic ecology of the area described in *Historical Ecology of the Ballona Creek Watershed* (Dark et al. 2011) this condition was unlikely. Quoting from the fact sheets on the Santa Monica Bay Restoration Commission website, " The loss of the historic connections between wetlands, its natural freshwater sources and the ocean …return the daily ebb and flow of tidal waters" appears mistaken. There was not a daily connection for much of the year in the historic Ballona wetlands. The 'restoration' alternatives generally being considered seem to be more appropriately termed 'creation'. These alternatives look like so many other coastal wetland plans that have been undertaken south of Los Angeles in Orange County and San Diego County.

Second, I have reviewed the baseline studies, and I find that the soil studies are not sufficient to make any decisions of the scope being discussed for the plans. And, further in reviewing the vegetation and avian studies, the areas where there is the least cover by exotic vegetation is found, coincidently with the greatest number of a rare and listed bird species is exactly where the most grading will occur in the alternatives presented. This makes no sense for a 'restoration' plan. The plan must preserve the existing and rare the Belding Savannah Sparrow population within the Ballona wetlands. There is no alternative that can mitigate for the loss of this population or its habitat.

Third, if the plan alternative preparer's have some idea for how the creek water, released from the engineered banks for the last mile, or so, run to the ocean will be managed, they have not indicated how this water will be cleaned of trash and toxic components coming down the creek.

Finally, I do not think that the restoration of Ballona wetlands needs to be this drastic based on the information presented thus far. I believe that the existing functions and values of the wetlands and adjacent upland areas could be restored and enhanced without such an expenditure of cash in the immediate future, to say nothing of the long term management will cost the tax payers of California. The goals of the project should be clearly stated. The draft plans should account for long term management and the cost of such management.

Sincerely,

Margot Griswold, Ph.D

Restoration Ecologist

3773 Moore Street

Los Angeles, CA 90066

Jones, Tanya

From: Susan Herrschaft [mailto:sherrschaft@yahoo.com]
Sent: Tuesday, October 23, 2012 12:26 PM
To: McCormick, Donna
Cc: dlawhead@dfg.ca.gov; daniel.p.swenson@us.ace.army.mil
Subject: Ballona Wetlands Restoration Project - Comments for Environmental Review Process

Dear Ms. McCormick:

Thank you for this opportunity to submit comments on the scope of the environmental review for the Ballona Wetlands Restoration Project. I am writing as a resident of the Villa Marina neighborhood, a community of 685 townhouses located directly adjacent to the Area C parcel.

I would like to provide comments on three specific issues that would directly affect our neighborhood.

1. Construction traffic during the restoration process.
We have heard mention that construction traffic during the restoration of Area C as well as the transportation of excess material from Areas A and B for stockpiling in Area C would be directed through the gateway entrance at La Villa Marina. Please analyze and explain, for each of the proposed alternatives you review, the impact of this scenario on surrounding neighborhoods (traffic, noise, air quality, parking), as well as how construction will impact commuter traffic on Lincoln Blvd., Culver Blvd., the 90 Marina Freeway, Mindanao, Fiji Way, Jefferson Blvd., or other adjacent roadways.

2. Public access following the restoration.
The addition of hiking/biking trails in Area C following the restoration will require points for the public to gain access. The availability of adequate parking for our neighborhood residents is already an issue – due to overflow from the nearby shopping center and weekend recreational traffic. Please analyze and explain, for each of the proposed alternatives you review, the impact on the Villa Marina neighborhood (traffic, noise, air quality, parking, littering, vandalism) of providing public access and/or parking at the La Villa Marina gateway, as well as alternatives using Culver Blvd. or other adjacent roadways.

3. Displacement and/or expansion of wildlife populations
The transportation and stockpiling/disposal of excess excavated material in Area C from the restoration of Areas A and B, as well as the restoration of Area C itself could disturb or displace wildlife. It is also expected that following restoration, native wildlife populations will increase. Please analyze and explain, for each of the proposed alternatives you review, the impact on surrounding neighborhoods of migrating wildlife due to displacement or expansion. Please also consider adopting a plan to educate neighborhood residents on what species they may begin to encounter and guidance on how to co-exist.

Again, thank you for this opportunity to respond.

Sue Herrschaft
Villa Marina

Jones, Tanya

-----Original Message-----
From: maryknight [mailto:kathy.knight@verizon.net]
Sent: Tuesday, October 23, 2012 11:08 AM
To: Swenson, Daniel P SPL; David Lawhead
Subject: Additional Ballona Restoration NOI Comments

October 23, 2012

TO: Dr. Daniel P. Swenson, U.S. Army Corps of Engineers, Los Angeles District P.O. Box 532711, Los Angeles, CA 90053-2325
Mr. David Lawhead, California Dept. of Fish & Game, 3883 Ruffin Road, San Diego, CA 92123

FROM: Kathy Knight, (310) 613-1175, kathy.knight@verizon.net

RE: Additional Comments Re: Ballona Restoration NOI Comments

Dear Mr. Swenson and Mr. Lawhead:

I have these additional comments to add to the record regarding the proposed restoration of the Ballona Ecological Reserve. Please add them to the comments I have already mailed/delivered to you.

ALTERNATIVE RESTORATION PLAN

Please study seriously an ALTERNATIVE plan for restoration of the Ballona reserve. This plan would NOT entail major bulldozing and removing levees from the LA River.
This plan would have the following components:

1) Plan approved by Tongva Native Americans for their sacred site.
2) Plan may allow for minor earthmoving to make a couple of small channels for fresh water.
3) No water from Ballona Creek allowed into the wetlands until it is cleaned up to a tertiary level.
4) Use Bond funds available, from not doing an expensive major bulldozing/dredging/levee-building project, to buy buffer lands around the reserve to reduce road kill of Ballona wildlife in the area, and allow larger more stable populations of wildlife. Additional land would also make limited public trails less disturbing to wildlife, as they would have additional places to live.
5) Study the value of this plan for 5-10 years. Some alterations could be made during that time, based on the results.
6) Utilize local citizens who have been documenting/photographing this area for the past 20-30 years in the active science committee. Do not continue to relegate them to public comments of 2-3 minutes at in-frequent meetings, but rather make them integral participants in the science committees where they can communicate more fully with the other members. Some of them see wildlife that is never documented on the science cameras. Their input is CRITICAL to a well-done evaluation of this area.
7) Continue to bring Los Angeles area students out to the wetlands to help clean-up the area, document flora and fauna, etc. so that they are interested in helping to watch over this land in the future.
8) Follow the natural course of the land/water. Please consult with Dr. Travis Longcore and his researchers on this.
9) Use this plan to teach the public that the first rule of restoration is to "Do No Further Harm". Teach the public that big expensive industrial solutions are not always the best, most permanent way to protect nature. A slower alternative that teaches people to respect nature, and allow its natural tendency to balance itself.

IF YOU WANT FURTHER INFORMATION ON SUCH A PLAN, LET ME KNOW AND I WILL WORK ON GETTING YOU MORE DETAILS. A PLAN LIKE THIS WOULD GIVE THE PUBLIC A REAL CHOICE, AND validate what the public is being told - that there IS NO preferred plan, that it is wide open on what will happen at Ballona.

OTHER COMMENTS:
1) I do not agree at all with bulldozing this site. But if you do, please reveal any background information regarding any bulldozing of Ballona, and if any company will benefit from mitigation credits, and any other financial connections to the restoration efforts, so that there is transparency on how and why these decisions are made.

2) REGARDING WATER STUDIES: Please study the impact of the water from Marina Del Rey on ANY proposed alternative for restoration. Marina Del Rey water is highly polluted from toxics from many boats (I have been told there are 7,000 boats there!). These boats have toxic chemicals applied to them to preserve them, and to run them, that leak into the water, plus people using the boats have been seen to dump liquids and trash into the water. Please test the water of Marina Del Rey very carefully and assess how that water will impact the wetlands, and how it could be kept separate from the wetlands.

2) Remove the trash (local groups and citizens can help on this issue) and find somewhere for homeless people to sleep. Don't make these issues a reason why the restoration has to be hurried.

Thank you very much.
Kathy Knight, MSW
(Have been volunteering and donating funds for 20 years to save and protect this precious ecosystem)
(310) 613-1175

P.S. Please confirm that you have received this email. Thank you.

Classification: UNCLASSIFIED
Caveats: NONE

Jones, Tanya

From: Jim Lamm [mailto:jim.lamm@sbcglobal.net]
Sent: Tuesday, October 23, 2012 1:18 PM
To: McCormick, Donna
Subject: Ballona Wetlands Restoration Comments

To: Ms McCormick, representing the Ballona Wetlands Restoration Project (SCH number: 2012071090)

From: Jim Lamm, Culver City resident (310-839-6896, jim.lamm@sbcglobal.net)

Introduction

At this time, I am submitting a few comments as an individual for consideration in the Ballona Wetlands Restoration Draft EIS/EIR.

For purposes of identification, I currently serve as president of Ballona Creek Renaissance (www.ballonacreek.org), adjunct instructor in wetlands ecology at Antioch University-Los Angeles, and BCR's representative in long-running restoration planning process and on the Bay Restoration Advisory Committee, the Ballona Creek Watershed Task Force, and the Assembly District 47 Environmental Cabinet. A retired architect and Culver City Planning Commissioner, my past experience includes working with many similar processes and stakeholders as a project unit manager on the consultant team for Metro's Universal City Red Line Station and Mid-City Extension Preliminary Design for tunnels and stations above underground Ballona Creek and a related subterranean gas-triggered Reassessment Study.

Comments on Process

1. For starters, I strongly encourage an ongoing process that is open, flexible, transparent, inclusive and responsive to the diverse array of stakeholders as well as the unfolding data and analyses.
2. From my perspective as one who values active listening, clear communication, and consensus-building to the greatest extent possible, I request that major concerns be fully heard, acknowledged, addressed, and, where appropriate, taken into account in the Draft aand Final EIS/EIR and the restoration design and implementation.

Comments on Studies, Plans, and Implementation

The following brief comments start with my overall view and touch on some concerns which I share to various degrees with other stakeholders with whom I have talked:

3. Moving from all-important process issues, I personally appreciate the depth and breadth of the studies, site investigations, and conceptual planning to date. However, there are some areas which warrant further development and/or communication. As stated publicly in one of the last public planning workshops at Loyola Marymount University, I am intrigued by the concept of allowing Ballona Creek to interact more fully with the adjoining wetlands. That, in turn, could allow the wetlands to provide more ecological function and benefit to the entire Ballona Creek Watershed and beyond.

4. However, to help ensure the success of that or another restoration plan, please fully consider and analyze both the above-noted process points and the following:
    a. the potential impact on and/or integration of the partially restored existing dunes and salt marsh. This could include further consideration of larger and/or more diverse zones, such as muted tidal, and a possible reduced amount of full tidal.
    b. the legal and ecological ramifications of allowing the urban runoff-affected Ballona Creek waters to interact with the wetlands for both wet weather and dry weather conditions. My hope and understanding is that the current water quality efforts underway through TMDLs, capture devices, rain gardens, and such will enable Ballona Creek to meet the targeted standards by the time of the restoration implementation and that this will help ensure that the wetlands will not be overwhelmed by pollution and trash. What if this is not the case?
    c. the relative sustainability and appropriateness of a restored wetlands with an wide open channel to the ocean vs. a possibly more historically and geographically accurate intermittent inland-ocean connection as has occurred here and elsewhere along the coast through dunes and lagoons.
    d. The characteristics of constructed wetlands, restored wetlands, and constructed-restored hybrids vs. the options under consideration

At this point I will leave more detailed or additional comments to the next phase. Thank you very much for your consideration.

Jones, Tanya

From: keith linker [mailto:keithlinker@gmail.com]
Sent: Tuesday, October 23, 2012 11:40 AM
To: McCormick, Donna
Subject: Ballona Wetlands Restoration Project Comments

Good Morning Ms. McCormick,

In response to the attached flier, please find, also attached, my comment letter and 2 enclosures. I appreciate the opportunity to offer input on this amazing project and look forward to seeing additional progress toward restoration.

Regards,
Keith Linker
Playa Vista Resident

October 23, 2012

Ballona Wetlands Restoration Project
C/O Donna McCormick (Donna.McCormick@icfi.com)
1 Ada, Ste. 100
Irvine, CA 92618

Via Electronic Mail Only

Subject: **Ballona Wetlands Restoration Project Comments**

I first want to express my appreciation for the work that has been done in developing and vetting the different alternatives for the restoration of Ballona Wetlands, and for the coordination that has gotten the project to this point in the planning process. I also appreciate the efforts to solicit and collect comments on this important project.

I am offering my input, under cover of this letter, in the attachment titled "Ballona Wetlands Restoration Project Comments, Keith Linker, October 23, 2012". However, I would first like to emphasize three main points, offered below in three bullet items, before delving into the detail provided in the attachment:

- First and foremost I strongly support this restoration and specifically the current alternative selected (attached, Figure 1a, dated 2012). As a resident of Playa Vista, I am far less concerned about short term truck traffic or other temporary construction related impacts to local residents/businesses or existing flora & fauna, and far more interested in and supportive of as full a restoration of the historic marsh and its function as is reasonably possible.

- Secondly, in the same vein, I fear the following goal: *"Refined alternatives should include preservation and enhancement of some upland and freshwater wetland habitat but should emphasize contiguous estuarine wetland habitat. Opportunities to create regionally significant habitat including vernal pools and native grasslands should be pursued, but not at the expense of the restoration of estuarine habitat."* has been compromised. Perhaps the reduction in the footprint of tidally influenced areas is due to pressure from opponents who may prefer to limit the minimal, short term impact of truck traffic removing excess soil, over the long term positive effect of increased wetland habitat. Whatever the reason, I want voice my concern over the potential of losing the opportunity to maximize the estuarine wetland habitat, as this is the primary driver of this project. To compromise the potential acreage that could be restored is to lose sight of the fundamental goal of this effort. It would be a loss to the vast number of species – including humans – that stand to benefit by regaining what was lost decades ago.

- Lastly, while the ecosystem functioning of this wetland is my primary interest, I believe it is critical to provide access (trails, boardwalks and overlooks) for people to see, first hand, the habitat that will exist in order to advance appreciation for and protection of this and other critical habitats. While there are many access areas planned, there are also many opportunities where access is not included, but could easily be offered.

Thank you again for the opportunity to comment on this incredible project.

Sincerely,



Keith Linker
13031 Villosa Pl. #128
Playa Vista, CA 90094
(310) 804-1139

Ballona Wetlands Restoration Project Comments
Keith Linker, October 23, 2012

ACCESS

TRAIL LINKAGES:

In order to encourage area residents and visitors to walk or bike through the wetland and better appreciate the natural beauty it has to offer, trails should connect to adjacent surrounding areas and should access each of the different ecosystem types at one or more location. This will encourage visitors to appreciate the wetland and increase the number of visitors who visit and appreciate the area and presumably care for and advocate for it. Examples include:

- In Area B: Linking the westerly terminus of the existing northerly path adjacent to West Jefferson Boulevard and the Freshwater Constructed Wetland to the south side of the intersection of Nicholson Street and Culver Drive or to a crossing of Jefferson and Culver near the existing signalized intersection; then linking the north side of Culver at that intersection to the beach ether at Argonaut Street, 62nd Street or other reasonable location.
- In Area B: Linking the north side of the intersection of Nicholson Street and Culver Drive to the beach ether at Argonaut Street, 62nd Street or other reasonable location.
- In Area B: Linking the west side of PCH, just north of West Jefferson Boulevard, to existing signalized intersection of Jefferson and Culver Boulevard; then linking the north side of Culver at that intersection to the beach ether at Argonaut Street, 62nd Street or other reasonable location.
- In Area C: Linking the north side of Culver Boulevard near the 90 Freeway to the east side of PCH near Fiji Way.

RECREATIONAL TRAILS:

The trail system should not only offer access to hikers and nature enthusiast, but should be open and accessible to joggers, bikers and dog walkers (on leash, of course). Trails should be wide enough to allow not only opposing traffic to safely pass with comfort but should allow for people traveling by different modes to overtake others traveling in the same direction safely and comfortably (suggested 12 foot wide DG or mulch pathways, either confined or unconfined with 2 foot shoulders). Include periodic widened areas ("Turnouts") along trails to facilitate passing, stopped travelers and parked maintenance vehicles. Alignment, sight distances and signage should consider all users with a focus on safety.

The opportunity to utilize this area for recreation and exercise is one that should not be missed, since those who are drawn for exercise – for example – may return to appreciate the natural habitat. The more people who appreciate the many aspects of the area, the better it will be protected and maintained, either through community advocacy, direct volunteer support or other formal or informal mechanism.

Ballona Wetlands Restoration Project Comments
Keith Linker, October 23, 2012

SCENIC OVERLOOKS:

As already mentioned, to encourage visitors who might not otherwise visit the wetland if they were not provided the opportunity to "get up close and personal" with the different ecosystems, the proposed overlooks, boardwalks and piers, should be expanded provided so each of the multiple ecosystem can be reasonably accessed. Not only will this offer an educational opportunity for students and casual visitors alike, it will reduce the potential for un-permitted access into areas that could both damage/disturb the flora and fauna and create safety/liability concerns. It would also minimize the disturbance of the resident species (particularly if signs or placards are placed strategically to indicate what activities are and are not permitted [e.g. take photos, but no fishing]). Specifically it is suggested that the following locations be considered:

- Include a boardwalk and scenic overlook in Area B near the Constructed Freshwater Wetland similar to the one offered in Area A for viewing both the Brackish Marsh and the Estuarine Low Marsh.
- Include a boardwalk and scenic overlook in west Area B to view the Estuarine Low Marsh at its interface with Ballona Creek. It is recognized however that flood control requirements and results of scour could preclude this option. Alternately, if an overlook were located on the north side of the Culver Blvd. crossing in Area A, this could accomplish the goal of offering an observation area in reasonable proximity to Ballona Creek.

PARKING AREAS:

While it makes sense to advocate for access generally, it is recognized that many "natural" areas can be "loved to death". In other words, habitat can clearly become compromised with too many people visiting the site, which not only can disturb the resident species, but can increase the potential for inappropriate use/access. Therefore, while a "formal parking/staging area (referenced on page 10 of the January 15, 2010 PWA Memo) is referenced for Areas A and B , it seems to make sense to limit the size/number of spaces to account for this possibility. It is also likely already considered, but worth making note that restrictions on time of use (e.g. dawn to dusk) and other controls be clearly established and strictly enforced (perhaps with the exception of permitted research work or Native American ceremonies) to prevent potential unintended uses. Presumably, LAPD & LA Sherriff Dept, CHP etc. will have input on this, which should be given due attention.

HABITAT

MAXIMIZING ESTUARINE HABITAT:

The interest/need to attempt to balance the soil onsite (i.e. minimize soil export [spoils]) is understood and appreciated. However, the primary goal of this project is restoring habitat and natural wetland functions. Therefore, it is critical to not lose sight of this goal and

continue to strive to maximize the potential areas for tidal influence, specifically “Intertidal Channels” and various “Marsh” areas.

MAXIMIZING “CRITICAL” HABITAT:

Early in the scoping process, a matrix was developed to rank the various benefits of each of the original 5 Alternatives. It is very important not to lose sight of this and particularly with regard to the most endangered habitats/species. It would be unforgivable to chip away at the many acres of tidal flats habitat that can be realized in certain alternatives by simply attempting to balance the soil movement onsite. Additionally, there appears to be two primary areas of lost opportunity. These are:

- Area B bounded by Jefferson, Culver and Lincoln. A culvert connects this area to Ballona Creek but virtually no Marsh habitat is created. Even if a small area of a couple acres adjacent to the proposed channel were lowered to allow tidal flows, this would be an easy way to improve the impact of this project. It would also reduce the isolation of the upstream marsh habitat (which already will be separated by a fairly lengthy culvert.
- North Area C, adjacent to Lincoln and Fiji Way. A culvert exists in this location, seawater will be introduced and available on the west side of Lincoln and could easily be connected to the east side of Lincoln. In fact, all the early alternatives (1-5) include a link for flow to pass under Lincoln, but in the current Proposed Restoration it does not. Discussion of why this change occurred has not been found.

WATER QUALITY

FULL TIDAL RESTORATION VIA OPEN TIDAL CHANNEL:

There seem to be two conflicting lines of thought regarding opening the marsh areas to full tidal influence. There is discussion of the potential for more “polluted” water from Ballona Creek impacting the wetlands, as well as discussion of the cleansing affect that wetlands have on these flows. I would like to weigh in on the side of favoring allowing the marsh ares to act as treatment for a portion of the flow from Ballona Creek. The alternative is discharge to the ocean and there is far less control on the fate of contaminants in that environment than there is in the wetland areas. Additionally, improving the quality of water discharged from Ballona Creek reduces negative impacts on local wildlife, thereby improving the opportunity for re-habitation of the wetlands themselves with the full diversity of flora and fauna anticipated.

Additionally, one means of combating ocean level rise is through siltation/deposition. The more areas which are sloped gently and receive an influx of water, the better, since these areas will tend toward keeping up with sea level rise (while perhaps not at the same rate, reducing the potentially dramatic effects is still a benefit.

Ballona Wetlands Restoration Project Comments
Keith Linker, October 23, 2012

LOCAL STORMWATER CAPTURE AND TREATMENT

Firstly I must enthusiastically applaud the inclusion of *"A small treatment wetland would also be constructed along the north boundary of Area C to treat off-site stormwater runoff that flows through this area before draining to Ballona Creek"*. This is a wonderful addition and a forward thinking approach to utilizing what is considered a liability (roadway and urban runoff) by making it an asset (source-water for wetland habitat) and having a positive overall impact on the quality of water in Ballona Creek.

To the degree that this approach can be applied elsewhere, I would like to strongly encourage it. Surface flow and even underground storm drains in adjacent roads and paths (Pacific Coast Highway, West Jefferson Boulevard, Culver Boulevard, Fiji Way, 90 Freeway, and Ballona Creek Bike Path) should be routed where possible into restored areas (seasonal wetlands, treatment wetlands, tidal areas, etc.). Not only will this offer additional treatment of storm water, improvement of quality of water in Ballona Creek, but would increase the flow/volume of water in seasonal wetlands, potentially increasing the habitat value by effectively increasing the depth and duration of seasonal influent water.

CARBON SEQESTRATION

MAXIMIZING TREE COVER AND WETLAND VEGETATION

Recognizing that one of the major unknowns of this project is the impact that sea level rise will have on the functioning of the project in the long term. Also, recognizing that, while it is not a stated goal of the project, maximizing the potential to sequester carbon dioxide in trees and wetland vegetation (cattails, bulrush, and similar salt/brackish water counterparts) should be a considered a positive potential project impact. While considering the constraints of including native plant materials, it makes sense to include trees or large shrubs in the upland habitat, which not only offer shade to the trail users but potentially offer habitat and foraging opportunities for targeted species. This may also offer opportunity to mound some of the deposit sites to allow for root systems of larger varieties of vegetation to become established and mature.

It would also make sense to maximize similar opportunities in the lower lying areas to realize multiple benefits. Including larger areas where wetland plans can become established, sequester carbon dioxide both above and below ground in the plant material, and potentially "build ground" by establishing root systems, colleting sediment, dying back and re-growing at higher levels as the organic and inorganic materials accumulate. The multiple benefits of this approach include carbon sequestration; fine sediment/pollutant removal, benthic habitat creation, ground building to offset sea rise, and simple aesthetic value to visitors.

Ballona Wetlands Restoration Project:
Overview



California's coastal wetlands support a wealth of precious wildlife habitat and play a crucial role in improving coastal water quality and reducing the harmful effects of floods and erosion on surrounding communities. Today, more than 95% of Southern California's wetlands have been lost due to human development – the largest loss of any state in the nation.

Rooted in years of scientific research and guided by community input, the Ballona Wetlands Restoration Project will revive critical wetland habitat and offer a remarkable natural space for the public's use and enjoyment. One of the most promising coastal wetland restoration opportunities in southern California, the Ballona Wetlands Restoration Project will return this highly degraded habitat into a thriving wildlife reserve and unique community asset.

The Ballona Wetlands

Stretching from Playa del Rey to Venice, the Ballona Wetlands once occupied a 2,000-acre expanse of critical coastal habitat. Now covering a 600-acre area, the Ballona Wetlands Ecological Reserve represents the largest opportunity for coastal wetland restoration in Los Angeles County. The site is owned by the state of California and managed by the California Department of Fish and Game as an ecological reserve. The State Coastal Conservancy and the California State Lands Commission are participating partners in the planning and restoration of the wetlands.

Why Restore the Ballona Wetlands?

More than a century of human neglect and abuse have left the Ballona Wetlands in a highly degraded state. Dredge spoils dumped on the wetlands during the construction of Marina del Rey and the Ballona Creek Flood Control Channel have severed the historic connection between the ocean and the freshwater creek. As a result, the site has lost many of the ecological functions of an estuarine wetland and it no longer supports many of the native species that once lived there.



Restoring the intrinsic structure and function of the Ballona Wetlands will give native species a chance to recover and thrive. The Ballona Wetlands Restoration Project will return the daily ebb and flow of tidal waters, maintain freshwater circulation, and support a more natural and healthy ecosystem. Creating suitable habitats and conditions will allow wetland vegetation to flourish and attract the insects, reptiles, amphibians, fishes, birds, and mammals that call wetlands home. As a restored site, the Ballona Wetlands will play a critical role as a migratory refuge for the millions of birds traveling from South American to Alaska each year. Further, this revitalization will provide the community with a valuable educational resource and an opportunity to create meaningful connections with the natural environment.

Who Is Planning the Project?

The Department of Fish and Game owns the land and is ultimately responsible for any changes to it. The Project Management Team includes the State Coastal Conservancy, the Department of Fish and Game, the State Lands Commission and the Santa Monica Bay Restoration Commission, the U.S. Army Corps of Engineers, and the Los Angeles County Department of Public Works. This team is working together to plan and design the restoration project. The Project Management Team also obtains input from the Ballona Wetlands Restoration Working Group, the Ballona Wetlands Science Advisory Committee, the Santa Monica Bay Restoration Commission Technical Advisory Committee, and the Agency Advisory Committee.

Who Is Funding the Restoration Project?

In 2004, the Costal Conservancy approved state board funds to support the planning and restoration of the Ballona Wetlands.

Ballona Wetlands Restoration Project

Advancing ecosystem health. Connecting communities with nature.



What are NEPA and CEQA and How Do They Apply to the Restoration Project?
The National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA) are federal and state laws, respectively, that require federal, state, and/or local agencies to identify the significant environmental impacts of a project and to provide documentation of these impacts.

Under NEPA and CEQA, the Ballona Wetlands Restoration project is required to prepare a rigorous Environmental Impact Statement (EIS) and Environmental Impact Report (EIR) to thoroughly evaluate all short-term and long-term environmental impacts and benefits of the project and project alternatives, so that a successful and comprehensive project can be implemented. As the land owner, the California Department of Fish and Game is the lead agency for CEQA. The federal process, NEPA, will be led by the U.S. Army Corps of Engineers.

How Do I Get Involved in the Project?
The CEQA/NEPA process provides multiple opportunities for the public to provide input on the alternative designs for evaluation in the environmental review process. Your first opportunity is during scoping under both CEQA and NEPA. During scoping, you can tell the lead agencies what topics and issues you believe need to be addressed in the environmental document and propose design alternatives for consideration.

Written comments on the scope of environmental review may be submitted at the scoping meeting or sent to the addresses listed below. **Comments will be accepted until October 23, 2012.**

Where Can I Get More Information About the Project?
Please visit www.ballonarestoration.org to learn more and find out how you can get involved. Here you will be able to access links to the project social media pages, read project informational documents, find answers to frequently asked questions ,and sign up for the project newsletter and email updates.



Donna McCormick, ICF International, (949) 333-6611, Donna.McCormick@icfi.com

David Lawhead. California Dept. of Fish & Game, (858) 627-3997, DLawhead@dfg.ca.gov

Dr. Daniel P. Swenson, U.S. Army Corps of Engineers, Los Angeles District, (213) 452-3414, Daniel.P.Swenson@usace.army.mil

Send Comments To:

Ballona Wetlands Restoration Project, C/O Donna McCormick, 1 Ada, Suite 100, Irvine, CA 92618
or
Donna.McCormick@icfi.com

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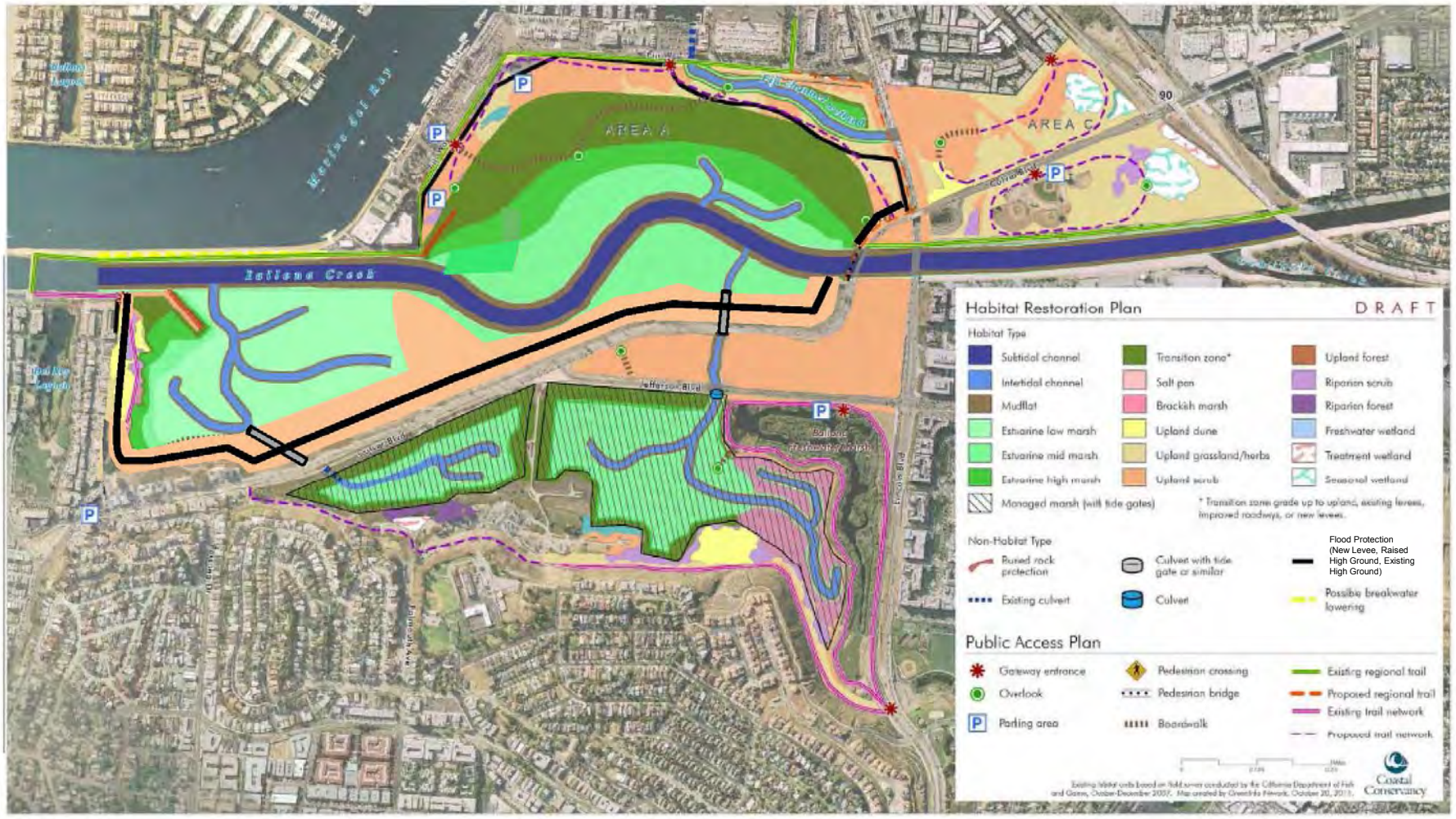

NOT TO SCALE

ESA PWA

Ballona Wetlands Restoration

Figure 1a

Proposed Restoration
Preliminary Sketch

Jones, Tanya

From: Barbara Lonsdale [mailto:barblonsdale@yahoo.com]
Sent: Tuesday, October 23, 2012 4:00 PM
To: McCormick, Donna; dlawhead@dfg.ca.gov; daniel.p.swenson@us.ace.army.mil; Elise.Swanson@mail.house.gov; lisa.pinto@mail.house.gov; theodate.cline@sen.ca.gov
Subject: re: Ballona Wetlands Restoration Project

Ballona Wetlands Restoration Project
LEAD AGENCIES:
United States Army Corps of Engineers
California Dept. of Fish & Game
c/o Donna McCormick
1 Ada, Suite 100
Irvine, CA 92816

What is the purpose and need of this project? It is obviously thriving and diverse environment as you can see here http://www.flickr.com/photos/stonebird/sets/447673/ with endangered and endemic species so why fix what's not broke (bulldoze nests, aquatic life, native plants etc.)? If you don't want to sit thru this guys hour presentation http://www.youtube.com/watch?v=1viLaZaVhQY&feature=share some key points are made at :43 Dr. Longcore discusses fresh water benefits vs open to the ocean n closure protects beaches from bacteria from city runoff n bird crap; :40 and :25 talks about how historically it wasn't always all water n was closed to the ocean which can be healthy as having an upland habitat full of native plants is natural there.

Has "restoration"
worked for the nearby Oxford Flood Control Basin on Washington or the Bolsa Chica wetlands just south of here that has to be dredged out EVERY YEAR with taxpayers money which uses a lot of energy (And it's open to the ocean so there's dolphins there now that are not supposed to be n sometimes they even get stuck). Go look at Malibu Lagoon where they jut bulldozed--it's a disaster!

Where is the public participation? A friendlier alternative such as that done at the Grand Canal between Washington and the Marina can be done (there a judge ruled in favor of our less destructive restoration).

And besides all of this environmental crap - it will exacerbate traffic n pollution in the area as whats happening now with construction.

You will be however, sold on THIS video which I believe is propaganda http://www.youtube.com/watch?v=0nGYnpWs-uU of course building the Marina piled excess dirt upon the wetlands but these water "experts" (they are not habitat or species experts) behind this are getting paid a lot of money which I believe that this is a waste of taxpayers money for a levee system that will only benefit Playa Vista built on a flood plain which is why some of the walls are to be 20 feet high! Even in their video the wetlands it is depicted as a highly functioning ecosystem--let's look into CEQA NEPA and Fish & Game sections 404 & 408 clean water acts as this project will flood these limited wetlands with polluted water as they can only filter so many toxins out.

Does State Parks even have the funds to do this? The Army Core of Engineers? Look what they did to the LA River-water that should be going underground aquifers to be able to tap into that source later n instead it's channeled out into the ocean while we spend billions a year transporting water to LA. Let's do a friendlier less invasive restoration with volunteers and school groups pulling the few invasive weeds n replanting natives while learning about estuaries. SAVE THE OWLS FROGS SNAKES COYOTES RABBITS. The Sierra Club agrees! 95% of California's wetlands gone--don't bulldoze this one! Use the money for

viewing platforms, a trail for public access n a ranger.

I have done the research and am very involved in the community as is my family in Santa Monica, CA.

Sincerely,

Barbara Lonsdale
The Venice Neighborhood Council Board member & Environmental Committee Chair
Vice President, The Venice Historical Society
Events Coordinator, The Venice Chamber of Commerce
Cultural Liaison, The Gabrieleno Band of Mission Indians
The Topanga Docents
The Sierra Club
Owner, AllTourNative
Sales, Yo! Venice!

Jones, Tanya

From: Jack Neff [mailto:jackneff01@yahoo.com]
Sent: Tuesday, October 23, 2012 4:49 PM
To: daniel.p.swenson@usace.army.mil; dlawhead@dfg.ca.gov
Cc: McCormick, Donna
Subject: Scoping Comments - Ballona Wetlands

The below text is from Ms. Ramona Merryman, 223 F Strand, Santa Monica, CA 90404

Dr. Daniel P. Swenson
daniel.p.swenson@usace.army.mil
US Army Corps of Engineers

David Lawhead
California Dept. of Fish & Game
dlawhead@dfg.ca.gov

Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92816
or by email to Donna.McCormick@icfi.com

Re: Scoping Comments re Santa Monica Bay Restoration Commission ("SMBRC") April 2012 Notice of Preparation of Draft EIR on Ballona Wetlands

To Interested Parties:

My interests are in the people and the land of the 2012 Ballona Wetlands. I am a native American woman who cares deeply for what is happening to people, especially woman, who have historically always been underserved by the powers which operate things like heavy equipment, a use inferred in SMBRC's proposed "restoration" alternatives. The land and women always suffer first and the most. The SMBRC's process in this regard shows there are severe differences of opinion in this political issue. The controversy is sufficient to demand that alternatives outside the interests of the SMBRC Project Management Team be included going forward.

The public has a right and we demand we be heard on the issue of end-of-pipeline treatment at Ballona Wetlands. The wetlands have served the public for millenia, right now we are not be able to be on them or even to see them. With proposed

"restoration" alternatives all will be lost, but for the political controversy, which is adequate to demand alternatives outside the interests of the SMBRC Project Management Team.

Public hearings are necessary so the public can share our input to state objections or agreements thereto.

Ramona Merryman

Ballona Wetlands Restoration Project

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Comment Card

Name: Anita Miller

Email: (optional)

☐ Add me to the mailing list (please provide email or mailing address):

Comments/issues: (Use additional sheets if necessary)

What will be the impact on the bike path?

Anita Miller

Submit written comments by *October 23, 2012* to:

Mail: Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92618

Email: Donna.McCormick@icfi.com

*****All comments submitted will become part of the Public Record***

Tape Here
Do Not
Staple

A-1986

Fold Here

Place Stamp Here



Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92618

Jones, Tanya

From: Cliff Moser [mailto:cliff.moser@gmail.com]
Sent: Tuesday, October 23, 2012 3:22 PM
To: McCormick, Donna
Subject: Ballona Wetlands comment

Hi, I'd like to comment on the wetlands scope.
I currently bike the creek bikepath and would like to see an extension and addition as part of the restoration.

Add a a path that parallels the 91 freeway to the development that runs near culver blvd and then intersect with the existing path to venice beach.

also add a bridge at the old centinela creek railroad creek pylons to connect to the south side of the creek which would then create a circle around the entire wetland (fresh and salt).

a connection to the bluff paths below Loyola Marymount through playa vista, with connections down to playa del rey,

this would create a network of usable bike paths that would support rediscovery of the wetlands once recreated.

thanks
Cliff Moser
Culver City
310.947.8509

Jones, Tanya

From: Jack Neff [mailto:jackneff01@yahoo.com]
Sent: Tuesday, October 23, 2012 4:38 PM
To: daniel.p.swenson@usace.army.mil; dlawhead@dfg.ca.gov
Cc: McCormick, Donna
Subject: Scoping Comments - Ballona Wetlands

Jack Neff's footnoted, illustrated version of below text is attached to this email.

Via Email

October 23, 2012

Dr. Daniel P. Swenson
daniel.p.swenson@usace.army.mil
US Army Corps of Engineers

David Lawhead
California Dept. of Fish & Game
dlawhead@dfg.ca.gov

Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92816
or by email to Donna.McCormick@icfi.com

Re: Scoping Comments re Santa Monica Bay Restoration Commission ("SMBRC") April 2012 Notice of Preparation of Draft EIR on Ballona Wetlands

To Interested Parties:

My interests are in the fresh water flowing from City of Los Angeles storm drains into the 2012 Ballona Wetlands. My interests arise from my role as Vice President/Executive Administrator of the Gabrielino/Tongva Springs Foundation, which works to preserve Kuruvungna Springs, also known as State Historic Site 522, the ancestral home of the descendants of Los Angeles' native Tongva people.

Kuruvungna Springs today consists of numerous aquifers among what were once a series of vast aquifers and fresh water sources in and around Los Angeles. As stewards of Kuruvungna Springs, the Gabrielino/Tongva Springs Foundation monitors

the nourishment of the Greater Ballona watershed (including the Ballona Wetlands) with flowing fresh water. Fresh water from Kuruvungna Springs (and from the aquifers throughout the Los Angeles Basin) ultimately dilutes other sources (including known pollutants) in the ebb and flow of tidal water merging from SM Bay, Marina Del Rey Harbor and the Venice Peninsula in the 2012 Ballona Wetlands.

As the second World Water Forum wisely stated "Water is everybody's business," so I encourage any person interested in the environmental outcome of local water sources like Kuruvungna Springs to demand the scope a Draft EIR be widened from the SMBRC alternatives to include broad-based public interests and the welfare of spiritual seekers, scientific researchers, teachers, students, historians, nature lovers, pet owners, public transit advocates, animal wildlife and plant species (including rare, threatened, endangered and critically endangered animals and plants which now reside in the 2012 Ballona Wetlands).

This image is a proportional representation of the ratio of the volume of fresh water on planet Earth to the planet's entire surface area.

Fortunately for Santa Monica Bay and the 4.5 million residents of the greater Los Angeles Basin, the 2012 Ballona Wetlands continues to be nourished by freshwater from the Greater Ballona watershed, including Kuruvungna Springs, Centinela Creek, Centinela Springs, and run-off from fresh water aquifers including, without limitation of the foregoing, Nicholas, Laurel, Coldwater, Benedict and Stone canyons are now contributing to freshwater habitats in the Ballona Wetlands.

Summary

The Ballona Wetlands are an impressionable surface area of land which bears continual marks of all impacts upon it, whether originating from the weather, the tides, animal or sea life or from human activity. All of the alternatives now proposed by the SMBRC as wetlands "restoration" are improvements, with the exception of the CEQA-

NEPA-mandated "no action," alternative No. ___. Any one of the proposed "restoration" alternatives will result in sustained human impact on the wetlands and the habitats therein. The first impact of the proposed "restoration" are improvements in the form of vehicle tread impressions, then with freshly-dropped petrochemical residua originating from said vehicles, followed by vehicle-driven landscape, habitat and existing infrastructure demolition before improvement for proposed newly paved areas of indeterminate size, locale and purpose. SMBRC alternatives need to be clarified and alternatives outside the interests of SMBRC Project Management Team must broaden out to include recognition of the 2012 Ballona Wetlands as an historic bio-region with cultural and spiritual significance to the community at large. Alternatives which protect the Ballona Wetlands habitat for a large number of threatened and critically-endangered animals and plants (as designated in 1995 by the Santa Monica Bay Restoration Project ("SMBRP") the organization which was formalized into the SMBRC in 2003) must also be included. The Ballona Wetlands are a living eco-system dependent on the unique combination of fresh water provided by the Greater Ballona Watershed, and tidal waters from Santa Monica Bay, Marina Del Rey Harbor and the Venice Peninsula. SMBRC Project Management Team acknowledges the tidal waters are "impaired waterways" and have an interest in mitigating or cleaning up the water impairments, but right now there is a disconnect between what the people employed by the SMBRC Project Management Team, who are thinking about they need to do to keep their jobs, and the call for wider institutional recognition that the alternatives for "restoration" SMBRC now proposes have a vast and troubling impact on long-standing plans for an authentic wetlands restoration.

Introduction

These scoping comments are submitted as 1) A comment and critique of the proposed 2012 Ballona Wetlands Restoration alternatives published by the Santa Monica Bay Restoration Commission ("SMBRC"), a state entity staffed by public sector employees and appointees partnered with a non-profit private foundation (the Santa Monica Bay Restoration Foundation "SMBRF"), and; 2) As discrete environmental proposals currently outside of the proposed alternatives for consideration for possible inclusion into the upcoming Draft Ballona Wetlands Restoration Plan.

As I understand the situation right now, the SMBRC has requested the Army Corps of Engineers terminate a feasibility study and EIS to evaluate the proposed restoration alternatives published by SMBRC. As a result of the Army Corps of Engineers granting SMBRC's request, the permit applications necessary for any of the action plan alternatives submitted by the Restoration Project Team will now bear the name of the SMBRC as the permit applicant. The substitution of the SMBRC to sit in the place of the original permit applicant, the Army Corps of Engineers, is sufficient reason to include proposals which are outside SMBRC's proposed alternatives. There must be a controversy within the alternatives proposed by the SMBRC, because why else would the Army Corps of Engineers right now abandon the 2012 Ballona Wetlands

"restoration" project during this scoping period and why would the SMBRC walk away from Civil Works cost-shared project funds to pay for the "restoration" alternatives?

The SMBRC alternatives all raise the issue of wetlands restoration, but there is no mention of wetlands restoration impacts, which begins when the first work truck pulls off the pavement. Whether that first "restoration" work truck leaves tire tread marks on dry soil or skid track in a wet puddle, during the subsequent seasons of dry and wet, the land will bear the impact of that first truck for years, whether or not that first track is paved over or not. Core sample teams in Autumn 2012 have recently tractored grades inside the Ballona Wetlands as a part of SMBRC's pre-plan construction traffic access creation, which indicates a very laissez faire attitude by the Project Management Team toward critically endangered habitat.

The SMBRC alternatives all raise the issue of which resources to expend on the proposed wetlands restoration, but there is no credible consideration in any of the restoration alternatives for a true no action alternative, that is the action of keeping work trucks on the pavement and off of the 2012 Ballona wetlands. Whether the chosen alternative ultimately increases expended resources exponentially above a single work truck is cause to broaden the scope of the SMBRC alternatives now proposed because the SMBRC alternatives call for improvements to precede all "restoration" activities.

The SMBRC alternatives as designed will produce significant restoration impacts, not restoration results. For example, the habitat throughout the Ballona Wetlands exists to a large extent that no amount of field monitoring can prevent disruption to the cycle of a nesting Great Blue Heron, at one time a critically endangered species, who is in the middle of a cycle of its own wildlife restoration. This was witnessed in the behavior of a Project Management Team supporter on August 16, 2012, when a group of Herons were "spooked" by this man's wild yelling and wide gesticulations.

The SMBRC Project Management Team

It is a great concern that the Executive Director of the SMBRC, Shelley Luce, is also directing the Project Management Team of the proposed "restoration" alternatives. The narrow choice of alternatives proposed by the Project Management Team places the Executive Director of the SMBRC in a position of conflict of interests. The mission of the SMBRC is of a far wider scope than that of the Project Management Team, which involves each team member to think only about keeping their job, whereas the Executive Director of the SMBRC, Dr. Luce, must have a wider perspective to include the interests of the entire Santa Monica Bay.

I personally questioned several members of the Project Management Team, including Dr. Luce, Dr. Swenson, Mr. Lawhead and Ms. Johnston on subjects including what the current policies are of their respective agencies would be applied to the 2012 Ballona

Wetlands. The answers I received from these Project Management Team members was that controversy exists as to whether build dams and fish ladders. No one would acknowledge the fact the Ballona Wetlands have undergone a successful self-remediation from the time of the creation of Marina Del Rey, in spite of the actions of Playa Vista and its predecessors. A once-polluted bio-region has over time, using naturally available tidal flow combining fresh water, Bay water, Harbor and Peninsula water to provide habitat for many endangered and threatened animals and plants, with no help from trucks or heavy equipment. The proposed "restoration" alternatives need to be widened to include this fact.

SMBRC alternatives propose classic "jobs versus the environment" planning which goes that jobs are good for the economy, the proposed alternatives create "restoration" jobs, therefore, the "restoration" alternatives published by SMBRC are good for the economy. The alternatives now published by SMBRC use this oversimplified calculation to obscure that the millions of dollars proposed for the "restoration" ($100-$200 million estimate cost for Ballona Channel alone) act as subsidies to buoy Ballona Wetlands developer Playa Vista's pending liabilities for parkland (B.E.E.P. vs. Playa Vista (2012)), open space set-asides (Culver Boulevard ball fiends), mitigation (aging underground methane gas monitors), storm run-off (silting and dredging 24/7 in a hopeless battle against the sea) and community safety (local natural gas storage wells).

2012 Ballona Wetlands is where Playa Vista sits, mid-project, as a hyped-up private development zone financed by considerable amounts public money, and utilizing resources on public land (the Ballona Wetlands). The promises made by Playa Vista since its beginning in 1997 are now looming as liabilities with significant back-end exposure for a wide open-ended environmental consequence, for which no adequate mitigation could possibly be forthcoming. For Playa Vista their logic has always been to increase the density of the Ballona Wetlands with resources and improvements, beginning with heavy equipment operated by drivers driving in the wetlands without any supervision or plan, which is also business as usual among those employed by SMBRC Project Management Team.

There are miles of trails in the wetlands which the SMBRC alternatives propose to eliminate. The Project Management Team has said pedestrian traffic will damage the land by walking on it, but the proposed "restoration" alternatives call for massive bulldozers to destroy and demolish existing habitat and infrastructure in the name of "restoration". SMBRC has now closed the entire Culver Boulevard area to the public. If the SMBRC wants to keep the public from seeing the thriving natural habitat in the 2012 Ballona Wetlands, this is proof a controversy exists as to the proposed "restoration" alternatives sufficient to broad the scope of alternatives to include an "off-limits" policy for heavy equipment in the critical and endangered habitat areas. SMBRC's Project Management Team has attempted to minimize this controversy by putting out the story that non-opposition to the proposed "restoration"

alternatives signify the public's overwhelming fear of natural disasters and public health emergencies justifies the vast logical leap to bureaucratically-mandated improvements for fast-tracking new linear roadways and infrastructure.

The August 16, 2012 public scoping fair staged by SMBRC's Project Management Team was another step taken to minimize or marginalize any controversy to the proposed "restoration" alternatives. Project manager Donna McCormick said "ICE International is the company that has been hired as the consultant to coordinate and write the environmental report." "Sometimes when we have lots of information already we can provide that, but we don't have alternatives identified yet," McCormick explained. This is untrue. According to the SMBRC Executive Summary to the Bay Restoration Plan 2008 Update the original Bay Restoration Plan was developed in 1995 in "recognition of the need to restore and protect Santa Monica Bay's priceless natural resources." While in 2012 Ms. McCormick said "We could bring some of those things but they are in draft form and they could change, and then people would think that isn't what they saw in the scoping meeting." "So we basically thought that the most important thing was to get people's comments back to us," the project manager continued. "We want to make that available. This type of forum, we think, is much better for getting a lot of discussion coming back to us instead of setting up a microphone and having people speaking one after another." (http://www.argonautnewspaper.com/articles/2012/08/23/news_-_features/top_stories/1.txt). The truth is that any member of the Project Management Team present on August 16, 2012 speaking at a microphone for the public would have created a firestorm of controversy, and this fact is sufficient to demand that broadened alternatives from outside the Project Management Team which provide for habitat preservation, protection and an off-limits policy for heavy equipment in critical, endangered habitats must be included going forward. Rejection of this idea sends the message that the Project Management Team can use bond money raised for public works project to finance a public relations campaign to steer control of the 2012 Ballona Wetlands solely to the Project Management Team.

In a related matter on the subject of bond money paying for public relations to seize control of public land, members of the Project Management Team have put out disinformation about the Ballona Wetlands since 2004 when they began promoting a "salt water wetland habitat" as a necessity to protect buildings from storm run-off. The 600 acres of open space in the 2012 Ballona Wetlands is a sufficient buffer for El Nino and La Nina sized storms affecting run-off in the Ballona Channel according to a 2005 Notice of Intent. I understand there is a 2012 Notice of Intent pending, but I expect the pending 2012 Notice of Intent to be a self-serving document put out on behalf of the Project Management Team. Any public discussion of this would have created a firestorm of controversy, and this fact is sufficient to demand that broadened alternatives from outside the Project Management Team which provide for habitat preservation, protection and an off-limits policy for heavy equipment in critical, endangered habitats must be included going forward.

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Secrecy

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Why does the State bureaucracy want to dump L.A.'s polluted urban street drainage into the Ballona Wetlands? Because they are under a court order to comply with a federal law that requires the massive L.A. urban region to stop allowing its storm drain system from funneling urban pollution to our ocean and beaches. But rather than planning and creating their long-promised upstream treatment system. The Ballona Wetlands are very remarkable because the land continues absorb fresh water and exude moisture while also being inundated by impaired waterways saturated with toxins and functions as an estuary for nationally-protected Ballona Creek.

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Greater Ballona Watershed feeds habitats as far east as Sepuleveda Boulevard along the Ballona Channel.

Is the shape of the Ballona Channel subject to change as a result of any of the "restoration" alternatives published by the SMBRC? Is there a relationship between the SMBRC proposed "restoration" alternative and the needs of Playa Vista Phase II to re-calculate storm-water impacts based on run-off volumes now coming off of Playa Vista Phase I? There are $25 million worth of studies on water flow studies available to the Project Management Team, most of which concern the current and foreseeable fresh water dewatering of building foundations and sewage infrastructure serving Playa Vista. I also understand that the City of Los Angeles may share Playa Vista's liabilities for damages arising from water-borne pollution running towards the Ballona Wetlands.

Public Law 228 (1938)

Jurisdiction over the Ballona Channel was established by Public Law 228 of 1938. None of the proposed "restoration" alternatives recognize the fact that any variance which involves the Ballona Channel requires an Act of Congress to alter Public Law 228 and waive the Clean Water Act of 1970. Estimated costs for changing the course and function of Ballona Channel is $100-$200 million to create an under-evaluated flood control alternative. This seat-of-the pants proposed "restoration" alternative adequate show bureaucratic indifference to rare, threatened, endangered habitat and is sufficient to demand the scope of the alternatives should include rigorous application of the Clean Water Act on the Ballona Wetlands in vetting the final alternatives. (See posts on this here: http://ballona-news.blogspot.com/search/label/Restoring%20and%20Unpaving%20Local%20Open%20Spaces%20to%20Clean%20Up%20Santa%20Monica%20Bay%20Beaches).

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When did SMBRC's mission of "improve water quality, conserve and rehabilitate natural resources, and protect the [Santa Monica] bay's benefits and values"ft change to "wants narrow range of alternatives limited to vehicle intrusions into sensitive critical fresh water and salt water habitats"? Questions about how the SMBRC changed that position is enough to open out the scope of alternatives to include the mission of maintaining the wildlife habitats (as to the State Ecological Preserve) and current fresh water flows onto the 2012 Ballona Wetlands.

The SMBRC Project Team and Playa Vista

Ballona is a biodiverse ecosystem which has had three natural habitat types persist since at least 1995: salt marsh, freshwater marsh and wildflower and sage covered uplands. Although since 1995 the total area of salt marsh, freshwater marsh and wildflower and sage covered uplands has been reduced (salt marsh, freshwater marsh areas have been by 2/3 reduced by Playa Vista development, wildflower and sage covered upland area reduced 95% by the Catellus housing development west of Lincoln south of Jefferson). Despite the reduction in habitat-available area, annually, and in cycles which have been observed for millennia, rare, endangered and critically-threatened species continue to reproduce in Ballona.

Under the proposed "restoration" alternatives, the freshwater marsh and the last remaining wildflower and sage covered uplands and their wildlife will be mostly eliminated. "Restoration" alternatives have plans for creating an urban pollution street drainage dump, and ignores the impact of the plan and execution of the proposed "restoration" on the rare, endangered and critically-threatened animals and plants of Ballona. The conclusion is that the designation of the Ballona Wetlands by the SMBRP in 1995 occurred when institutional values favored a relationship with existing animal and plant species who live in the Ballona Wetlands. In 2012 the institutional values of Playa Vista have been adopted by the SMBRC Project Management Team and only did so throughout a firestorm of controversy. There is a dream state which must come over a person who decides that the institutional values which form our work lives must somehow also aspire to provide a "higher good" to justify strong-arming the defenseless for a contractor-driven out-of-control mission from day one. This is sufficient reason to demand that alternatives outside the control of the SMBRC Project Management Team be included in every plan going forward from this time.

In the SMBRC Executive Summary to the Bay Restoration Plan 2008 Update the original Bay Restoration Plan was developed in 1995 in "recognition of the need to restore and protect Santa Monica Bay's priceless natural resources." Note that "The Santa Monica Bay Restoration Commission continues the mission of the Bay Restoration Project and the collaborative approach of the National Estuary Program but with a greater ability to accelerate the pace and effectiveness of Bay restoration efforts." (http://www.smbrc.ca.gov/about_us). The thinking that goes on in the heads

of people who work at their jobs with the SMBRC Project Management Team has devolved the Bay Restoration Plan to suit the needs of Playa Vista. This conceptual vacuity shows a controversy existed and still exists around the "greater ability to accelerate the pace and effectiveness of Bay restoration efforts." A "no action" alternative needs no acceleration to create an effective restoration, nature does that using wind, weather, tides, water, all substances which are found in the natural abundance in the 2012 Ballona Wetlands. This is an overwhelming reason to have a consensus that alternatives outside the control of the SMBRC Project Management Team be included in every plan going forward from this time.

The proposed "restoration" alternatives have risk of creating a ripple effect of restoration impacts from tires on the wetland to foreseeable newly paved areas.

The Project Management Team failed in the past to identify relationships between plants and animals in assessing the viability of habitat, for example the reproduction of endangered Blue Butterflies was attributed by advocates for the SMBRC to wildly speculative causes, but when a real-life scientific study was done, the reason the Blue Butterflies struggled was because tires on the ground had squashed and torn up the wild buckwheat the Blue Butterflies have eaten for thousands of years.

The Project Management Team has $6.2 million but have not assessed the risk to present day value. The scope of the "restoration" alternatives needs to be expanded to create accountability within the Project Management Team for their present insufficient species analysis.

Flood Control: Mandate or Raison D' Etre For the Project Management Team?

The proposed "restoration" alternatives published by SMBRC do not support a range of alternatives. "Dredge and fill" wants to widen the connection between the ocean and the 2012 Ballona Wetlands using vehicles, petrochemicals and pavement, all of which change the fundamental character of the wetlands, which is absorb fresh water at high tide and off-gas moisture during low tide and during the dry season.

Grave Desecrations

During construction of Playa Vista Phase I, Playa Vista unearthed long-buried human bodies belonging to members of the native Tongva people. Playa Vista attempted to cover up the number of graves it unearthed and its subsequent careless handling of human remains. Through political manueverings and favorable reporting in the media Playa Vista was able to avoid bad publicity. However during this period of public relations spin, Playa Vista promised to restore the remains to the site of their original interment. Right now the ancient graveyard of hundreds human bodies is still an open ditch, one mile long by 3 feet wide, 3 million cubic yards of soil disrupted and

removed. According to coverage in the May 31, 2012 "Argonaut" "several dozen fragile remains, were re-interred at Ballona Discovery Park in Playa Vista." There must be an alternative to the SMBRC alternatives which call for using heavy equipment to move massive amounts of water and earth and only give Playa Vista-grade promises to responsibly handle human remains.

Proposed Alternatives Outside the SMBRC Proposed "Restoration" Alternatives

New alternatives are needed in the interests of preserving and protecting the Ballona Wetlands:

1. Soil - New topsoil is habitat to rare, threatened and endangered plant life, including critical micro biota.
2. Ground water - Necessary for cyclical resurgence of seasonal life forms
3. Tidal inflow onto the Wetlands
4. Tidal outflow into the Bay, Channel, MDR Harbor and Venice Peninsula
5. Fresh water inflow from the Greater Ballona Watershed
6. Fresh water outflow from the Ballona Wetlands
7. Animal species (including migratory fowl and seasonal sea life) which rely on fresh water
8. Animal species (including migratory fowl and seasonal sea life) which rely on brackish water
9. Plant species (including annuals) which rely on fresh water
10. Plant species (including annuals) which rely on brackish water
11. As the site of the native Tongva village of Sa-Angna
12. For use as a natural outdoor sacred site for spiritual rites
13. For use as a natural outdoor classroom for students K-12, through post-doctorate studies
14. For use as an historic site illustrating the impact of human habitation on the wetlands

The current eco-system now in place in the Ballona Wetlands has value as a viable habitat for endangered and threatened animals and plant life.

Doing no harm to the habitat of the Ballona Wetlands means preserving the existing wildlife habitat for the Western Shrike, Kites, Harriers which are unique examples of wildlife in an urban setting.

The Ballona Wetlands are a native American sacred site, the location of "Sa-Angna," one-time village of the Tongva people native to Los Angeles. The Ballona Wetlands are also acknowledged for their significance as an intact local resource for outdoor classrooms for students studying a wide range of scientific disciplines.

Restoration results, for example, would further facilitate the habitat throughout the Ballona Wetlands to prevent disruption to the cycle of a nesting Great Blue Heron, at one time a critically endangered species, who is in the middle of a cycle of its own wildlife restoration.

The Vision

The action of doing nothing, means the SMBRC would stay conscious of the resources provided to it, without expending the earth and water resources which were ceded to the SMBRC. The action of establishing an "off-limits" policy to cyclical resources periodically available through atmospheric seasonal change.

Going forward a plan needs to protect the three existing wildlife habitats and existing trails and allows for fresh water inflow onto portions of the wetlands. If the SMBRC is doing their job, the results will that one day clean water will enter the Ballona Wetlands from the ocean--like it was 200 years ago.

Your very truly,

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Via Email

October 23, 2012

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dlawhead@dfg.ca.gov

Ballona Wetlands Restoration Project
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1 Ada, Suite 100
Irvine, CA 92816
or by email to Donna.McCormick@icfi.com

Re: Scoping Comments re Santa Monica Bay Restoration Commission ("SMBRC") April 2012 Notice of Preparation of Draft EIR on Ballona Wetlands

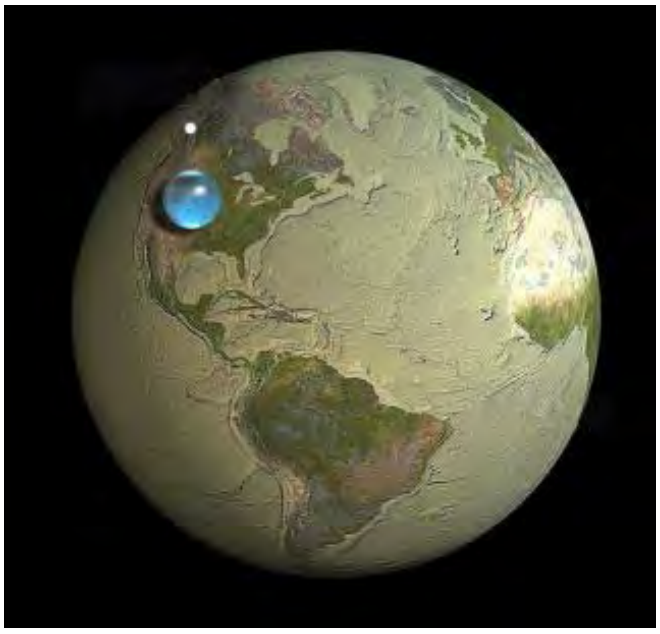
To Interested Parties:

My interests are in the fresh water flowing from City of Los Angeles storm drains into the 2012 Ballona Wetlands. My interests arise from my role as Vice President/Executive Administrator of the Gabrielino/Tongva Springs Foundation, which works to preserve Kuruvungna Springs, also known as State Historic Site 522, the ancestral home of the descendants of Los Angeles' native Tongva people.

Kuruvungna Springs today consists of numerous aquifers among what were once a series of vast aquifers and fresh water sources in and around Los Angeles. As stewards of Kuruvungna Springs, the Gabrielino/Tongva Springs Foundation

monitors the nourishment of the Greater Ballona watershed (including the Ballona Wetlands) with flowing fresh water. Fresh water from Kuruvungna Springs (and from the aquifers throughout the Los Angeles Basin) ultimately dilutes other sources (including known pollutants) in the ebb and flow of tidal water merging from SM Bay, Marina Del Rey Harbor and the Venice Peninsula in the 2012 Ballona Wetlands.

As the second World Water Forum wisely stated "Water is everybody's business," so I encourage any person interested in the environmental outcome of local water sources like Kuruvungna Springs to demand the scope a Draft EIR be widened from the SMBRC alternatives to include broad-based public interests and the welfare of spiritual seekers, scientific researchers, teachers, students, historians, nature lovers, pet owners, public transit advocates, animal wildlife and plant species (including rare, threatened, endangered and critically endangered animals and plants which now reside in the 2012 Ballona Wetlands).



This image is a proportional representation of the ratio of the volume of fresh water on planet Earth to the planet's entire surface area.

Fortunately for Santa Monica Bay and the 4.5 million residents of the greater Los

Angeles Basin, the 2012 Ballona Wetlands continues to be nourished by freshwater from the Greater Ballona watershed, including Kuruvungna Springs, Centinela Creek, Centinela Springs, and run-off from fresh water aquifers including, without limitation of the foregoing, Nicholas, Laurel, Coldwater, Benedict and Stone canyons are now contributing to freshwater habitats in the Ballona Wetlands.

Summary

The Ballona Wetlands are an impressionable surface area of land which bears continual marks of all impacts upon it, whether originating from the weather, the tides, animal or sea life or from human activity. All of the alternatives now proposed by the SMBRC as wetlands "restoration" are improvements, with the exception of the CEQA-NEPA-mandated "no action," alternative No. ___. Any one of the proposed "restoration" alternatives will result in sustained human impact on the wetlands and the habitats therein. The first impact of the proposed "restoration" are improvements in the form of vehicle tread impressions, then with freshly-dropped petrochemical residua originating from said vehicles, followed by vehicle-driven landscape, habitat and existing infrastructure demolition before improvement for proposed newly paved areas of indeterminate size, locale and purpose. SMBRC alternatives need to be clarified and alternatives outside the interests of SMBRC Project Management Team must broaden out to include recognition of the 2012 Ballona Wetlands as an historic bio-region with cultural and spiritual significance to the community at large. Alternatives which protect the Ballona Wetlands habitat for a large number of threatened and critically-endangered animals and plants (as designated in 1995 by the Santa Monica Bay Restoration Project ("SMBRP") the organization which was formalized into the SMBRC in 2003) must also be included. The Ballona Wetlands are a living eco-system dependent on the unique combination of fresh water provided by the Greater Ballona Watershed, and tidal waters from Santa Monica Bay, Marina Del Rey Harbor and the Venice Peninsula. SMBRC Project Management Team acknowledges the tidal waters are "impaired waterways" and have an interest in mitigating or cleaning up the water impairments, but right now there is a

disconnect between what the people employed by the SMBRC Project Management Team, who are thinking about they need to do to keep their jobs, and the call for wider institutional recognition that the alternatives for "restoration" SMBRC now proposes have a vast and troubling impact on long-standing plans for an authentic wetlands restoration.

Introduction

These scoping comments are submitted as 1) A comment and critique of the proposed 2012 Ballona Wetlands Restoration alternatives published by the Santa Monica Bay Restoration Commission ("SMBRC"), a state entity staffed by public sector employees and appointees partnered with a non-profit private foundation (the Santa Monica Bay Restoration Foundation "SMBRF"), and; 2) As discrete environmental proposals currently outside of the proposed alternatives for consideration for possible inclusion into the upcoming Draft Ballona Wetlands Restoration Plan.

As I understand the situation right now, the SMBRC has requested the Army Corps of Engineers terminate a feasibility study and EIS to evaluate the proposed restoration alternatives published by SMBRC. As a result of the Army Corps of Engineers granting SMBRC's request, the permit applications necessary for any of the action plan alternatives submitted by the Restoration Project Team will now bear the name of the SMBRC as the permit applicant. The substitution of the SMBRC to sit in the place of the original permit applicant, the Army Corps of Engineers, is sufficient reason to include proposals which are outside SMBRC's proposed alternatives. There must be a controversy within the alternatives proposed by the SMBRC, because why else would the Army Corps of Engineers right now abandon the 2012 Ballona Wetlands "restoration" project during this scoping period and why would the SMBRC walk away from Civil Works cost-shared project funds to pay for the "restoration" alternatives?

The SMBRC alternatives all raise the issue of wetlands restoration, but there is no mention of wetlands restoration impacts, which begins when the first work truck

pulls off the pavement. Whether that first "restoration" work truck leaves tire tread marks on dry soil or skid track in a wet puddle, during the subsequent seasons of dry and wet, the land will bear the impact of that first truck for years, whether or not that first track is paved over or not. Core sample teams in Autumn 2012 have recently tractored grades inside the Ballona Wetlands as a part of SMBRC's pre-plan construction traffic access creation, which indicates a very laissez faire attitude by the Project Management Team toward critically endangered habitat.

The SMBRC alternatives all raise the issue of which resources to expend on the proposed wetlands restoration, but there is no credible consideration in any of the restoration alternatives for a true no action alternative, that is the action of keeping work trucks on the pavement and off of the 2012 Ballona wetlands. Whether the chosen alternative ultimately increases expended resources exponentially above a single work truck is cause to broaden the scope of the SMBRC alternatives now proposed because the SMBRC alternatives call for improvements to precede all "restoration" activities.

The SMBRC alternatives as designed will produce significant restoration impacts, not restoration results. For example, the habitat throughout the Ballona Wetlands exists to a large extent that no amount of field monitoring can prevent disruption to the cycle of a nesting Great Blue Heron, at one time a critically endangered species, who is in the middle of a cycle of its own wildlife restoration. This was witnessed in the behavior of a Project Management Team supporter on August 16, 2012, when a group of Herons were "spooked" by this man's wild yelling and wide gesticulations.

<u>The SMBRC Project Management Team</u>

It is a great concern that the Executive Director of the SMBRC, Shelley Luce, is also directing the Project Management Team of the proposed "restoration" alternatives. The narrow choice of alternatives proposed by the Project Management Team places the Executive Director of the SMBRC in a position of conflict of interests. The mission of the SMBRC is of a far wider scope than that

of the Project Management Team, which involves each team member to think only about keeping their job, whereas the Executive Director of the SMBRC, Dr. Luce, must have a wider perspective to include the interests of the entire Santa Monica Bay.

I personally questioned several members of the Project Management Team, including Dr. Luce, Dr. Swenson, Mr. Lawhead and Ms. Johnston on subjects including what the current policies are of their respective agencies would be applied to the 2012 Ballona Wetlands. The answers I received from these Project Management Team members was that controversy exists as to whether build dams and fish ladders. No one would acknowledge the fact the Ballona Wetlands have undergone a successful self-remediation from the time of the creation of Marina Del Rey, in spite of the actions of Playa Vista and its predecessors. A once-polluted bio-region has over time, using naturally available tidal flow combining fresh water, Bay water, Harbor and Peninsula water to provide habitat for many endangered and threatened animals and plants, with no help from trucks or heavy equipment. The proposed "restoration" alternatives need to be widened to include this fact.

SMBRC alternatives propose classic "jobs versus the environment" planning which goes that jobs are good for the economy, the proposed alternatives create "restoration" jobs, therefore, the "restoration" alternatives published by SMBRC are good for the economy. The alternatives now published by SMBRC use this oversimplified calculation to obscure that the millions of dollars proposed for the "restoration" ($100-$200 million estimate cost for Ballona Channel alone) act as subsidies to buoy Ballona Wetlands developer Playa Vista's pending liabilities for parkland (B.E.E.P. vs. Playa Vista (2012)), open space set-asides (Culver Boulevard ball fiends), mitigation (aging underground methane gas monitors), storm run-off (silting and dredging 24/7 in a hopeless battle against the sea) and community safety (local natural gas storage wells).

2012 Ballona Wetlands is where Playa Vista sits, mid-project, as a hyped-up private development zone financed by considerable amounts public money, and

utilizing resources on public land (the Ballona Wetlands). The promises made by Playa Vista since its beginning in 1997 are now looming as liabilities with significant back-end exposure for a wide open-ended environmental consequence, for which no adequate mitigation could possibly be forthcoming. For Playa Vista their logic has always been to increase the density of the Ballona Wetlands with resources and improvements, beginning with heavy equipment operated by drivers driving in the wetlands without any supervision or plan, which is also business as usual among those employed by SMBRC Project Management Team.

There are miles of trails in the wetlands which the SMBRC alternatives propose to eliminate. The Project Management Team has said pedestrian traffic will damage the land by walking on it, but the proposed "restoration" alternatives call for massive bulldozers to destroy and demolish existing habitat and infrastructure in the name of "restoration". SMBRC has now closed the entire Culver Boulevard area to the public. If the SMBRC wants to keep the public from seeing the thriving natural habitat in the 2012 Ballona Wetlands, this is proof a controversy exists as to the proposed "restoration" alternatives sufficient to broad the scope of alternatives to include an "off-limits" policy for heavy equipment in the critical and endangered habitat areas. SMBRC's Project Management Team has attempted to minimize this controversy by putting out the story that non-opposition to the proposed "restoration" alternatives signify the public's overwhelming fear of natural disasters and public health emergencies justifies the vast logical leap to bureaucratically-mandated improvements for fast-tracking new linear roadways and infrastructure.

The August 16, 2012 public scoping fair staged by SMBRC's Project Management Team was another step taken to minimize or marginalize any controversy to the proposed "restoration" alternatives. Project manager Donna McCormick said "ICE International is the company that has been hired as the consultant to coordinate and write the environmental report." “Sometimes when we have lots of information already we can provide that, but we don’t have alternatives identified yet,” McCormick explained. This is untrue. According to the SMBRC Executive Summary to the Bay Restoration Plan 2008 Update the original Bay Restoration

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<u>Public Law 228 (1938)</u>

Jurisdiction over the Ballona Channel was established by Public Law 228 of 1938.

None of the proposed "restoration" alternatives recognize the fact that any variance which involves the Ballona Channel requires an Act of Congress to alter Public Law 228 and waive the Clean Water Act of 1970. Estimated costs for changing the course and function of Ballona Channel is $100-$200 million to create an under-evaluated flood control alternative. This seat-of-the pants proposed "restoration" alternative adequate show bureaucratic indifference to rare, threatened, endangered habitat and is sufficient to demand the scope of the alternatives should include rigorous application of the Clean Water Act on the Ballona Wetlands in vetting the final alternatives. (See posts on this here: http://ballona-news.blogspot.com/search/label/Restoring%20and%20Unpaving%20Local%20Open%20Spaces%20to%20Clean%20Up%20Santa%20Monica%20Bay%20Beaches)
.

Is the shape of the Ballona Channel subject to change as a result of any of the "restoration" alternatives published by the SMBRC? Is there a relationship between the SMBRC proposed "restoration" alternative and the needs of Playa Vista Phase II to re-calculate storm-water impacts based on run-off volumes now coming off of Playa Vista Phase I? There are $25 million worth of studies on water flow studies available to the Project Management Team, most of which concern the current and foreseeable fresh water dewatering of building foundations and sewage infrastructure serving Playa Vista. I also understand that the City of Los Angeles may share Playa Vista's liabilities for damages arising from water-borne pollution running towards the Ballona Wetlands. These questions all reveal a source of great controversy as political powers seek to re-shape the landscape at the cost of throwing off older values, which in this case is a California Ecological Preserve, sufficient reason to greatly widen the scope of alternatives going forward to include plans not of the SMBRC Project Management Team, but from scientists, students, community members and nature lovers.

When did SMBRC's mission of "improve water quality, conserve and rehabilitate natural resources, and protect the [Santa Monica] bay's benefits and values"ft change to "wants narrow range of alternatives limited to vehicle intrusions into sensitive critical fresh water and salt water habitats"? Questions about how the

SMBRC changed that position is enough to open out the scope of alternatives to include the mission of maintaining the wildlife habitats (as to the State Ecological Preserve) and current fresh water flows onto the 2012 Ballona Wetlands.[2]

The SMBRC Project Team and Playa Vista

Ballona is a biodiverse ecosystem which has had three natural habitat types persist since at least 1995: salt marsh, freshwater marsh and wildflower and sage covered uplands. Although since 1995 the total area of salt marsh, freshwater marsh and wildflower and sage covered uplands has been reduced (salt marsh, freshwater marsh areas have been by 2/3 reduced by Playa Vista development, wildflower and sage covered upland area reduced 95% by the Catellus housing development west of Lincoln south of Jefferson). Despite the reduction in habitat-available area, annually, and in cycles which have been observed for millennia, rare, endangered and critically-threatened species continue to reproduce in Ballona.

Under the proposed "restoration" alternatives, the freshwater marsh and the last remaining wildflower and sage covered uplands and their wildlife will be mostly eliminated. "Restoration" alternatives have plans for creating an urban pollution street drainage dump, and ignores the impact of the plan and execution of the proposed "restoration" on the rare, endangered and critically-threatened animals and plants of Ballona. The conclusion is that the designation of the Ballona Wetlands by the SMBRP in 1995 occurred when institutional values favored a relationship with existing animal and plant species who live in the Ballona Wetlands. In 2012 the institutional values of Playa Vista have been adopted by the SMBRC Project Management Team and only did so throughout a firestorm of controversy. There is a dream state which must come over a person who decides that the institutional values which form our work lives must somehow also aspire to provide a "higher good" to justify strong-arming the defenseless for a contractor-driven out-of-control mission from day one. This is sufficient reason to demand

[2] SMBRC Bay Restoration Plan 2008 Update, p.2, SMBRC.

that alternatives outside the control of the SMBRC Project Management Team be included in every plan going forward from this time.

In the SMBRC Executive Summary to the Bay Restoration Plan 2008 Update the original Bay Restoration Plan was developed in 1995 in "recognition of the need to restore and protect Santa Monica Bay's priceless natural resources." Note that "The Santa Monica Bay Restoration Commission continues the mission of the Bay Restoration Project and the collaborative approach of the National Estuary Program but with a greater ability to accelerate the pace and effectiveness of Bay restoration efforts." (http://www.smbrc.ca.gov/about_us). The thinking that goes on in the heads of people who work at their jobs with the SMBRC Project Management Team has devolved the Bay Restoration Plan to suit the needs of Playa Vista. This conceptual vacuity shows a controversy existed and still exists around the "greater ability to accelerate the pace and effectiveness of Bay restoration efforts." A "no action" alternative needs no acceleration to create an effective restoration, nature does that using wind, weather, tides, water, all substances which are found in the natural abundance in the 2012 Ballona Wetlands. This is an overwhelming reason to have a consensus that alternatives outside the control of the SMBRC Project Management Team be included in every plan going forward from this time.

The proposed "restoration" alternatives have risk of creating a ripple effect of restoration impacts from tires on the wetland to foreseeable newly paved areas.

The Project Management Team failed in the past to identify relationships between plants and animals in assessing the viability of habitat, for example the reproduction of endangered Blue Butterflies was attributed by advocates for the SMBRC to wildly speculative causes, but when a real-life scientific study was done, the reason the Blue Butterflies struggled was because tires on the ground had squashed and torn up the wild buckwheat the Blue Butterflies have eaten for thousands of years.

The Project Management Team has $6.2 million but have not assessed the risk to

present day value. The scope of the "restoration" alternatives needs to be expanded to create accountability within the Project Management Team for their present insufficient species analysis.

Flood Control: Mandate or Raison D' Etre For the Project Management Team?

The proposed "restoration" alternatives published by SMBRC do not support a range of alternatives. "Dredge and fill" wants to widen the connection between the ocean and the 2012 Ballona Wetlands using vehicles, petrochemicals and pavement, all of which change the fundamental character of the wetlands, which is absorb fresh water at high tide and off-gas moisture during low tide and during the dry season.

Grave Desecrations

During construction of Playa Vista Phase I, Playa Vista unearthed long-buried human bodies belonging to members of the native Tongva people. Playa Vista attempted to cover up the number of graves it unearthed and its subsequent careless handling of human remains. Through political manueverings and favorable reporting in the media Playa Vista was able to avoid bad publicity. However during this period of public relations spin, Playa Vista promised to restore the remains to the site of their original interment. Right now the ancient graveyard of hundreds human bodies is still an open ditch, one mile long by 3 feet wide, 3 million cubic yards of soil disrupted and removed. According to coverage in the May 31, 2012 "Argonaut" "several dozen fragile remains, were re-interred at Ballona Discovery Park in Playa Vista." There must be an alternative to the SMBRC alternatives which call for using heavy equipment to move massive amounts of water and earth and only give Playa Vista-grade promises to responsibly handle human remains.

Proposed Alternatives Outside the SMBRC Proposed "Restoration" Alternatives

New alternatives are needed in the interests of preserving and protecting the Ballona Wetlands:

1. Soil - New topsoil is habitat to rare, threatened and endangered plant life, including critical micro biota.
2. Ground water - Necessary for cyclical resurgence of seasonal life forms
3. Tidal inflow onto the Wetlands
4. Tidal outflow into the Bay, Channel, MDR Harbor and Venice Peninsula
5. Fresh water inflow from the Greater Ballona Watershed
6. Fresh water outflow from the Ballona Wetlands
7. Animal species (including migratory fowl and seasonal sea life) which rely on fresh water
8. Animal species (including migratory fowl and seasonal sea life) which rely on brackish water
9. Plant species (including annuals) which rely on fresh water
10. Plant species (including annuals) which rely on brackish water
11. As the site of the native Tongva village of Sa-Angna
12. For use as a natural outdoor sacred site for spiritual rites
13. For use as a natural outdoor classroom for students K-12, through post-doctorate studies
14. For use as an historic site illustrating the impact of human habitation on the wetlands

The current eco-system now in place in the Ballona Wetlands has value as a viable habitat for endangered and threatened animals and plant life.

Doing no harm to the habitat of the Ballona Wetlands means preserving the existing wildlife habitat for the Western Shrike, Kites, Harriers which are unique examples of wildlife in an urban setting.

The Ballona Wetlands are a native American sacred site, the location of "Sa-Angna," one-time village of the Tongva people native to Los Angeles. The

Donna McCormick
David Lawhead
Dr. Daniel Swenson
October 23, 2012

Ballona Wetlands are also acknowledged for their significance as an intact local resource for outdoor classrooms for students studying a wide range of scientific disciplines.

Restoration results, for example, would further facilitate the habitat throughout the Ballona Wetlands to prevent disruption to the cycle of a nesting Great Blue Heron, at one time a critically endangered species, who is in the middle of a cycle of its own wildlife restoration.

The Vision

The action of doing nothing, means the SMBRC would stay conscious of the resources provided to it, without expending the earth and water resources which were ceded to the SMBRC. The action of establishing an "off-limits" policy to cyclical resources periodically available through atmospheric seasonal change.

Going forward a plan needs to protect the three existing wildlife habitats and existing trails and allows for fresh water inflow onto portions of the wetlands. If the SMBRC is doing their job, the results will that one day clean water will enter the Ballona Wetlands from the ocean--like it was 200 years ago.

Your very truly,

Jack Neff
(310) 478-2835

Jones, Tanya

From: Leslie Purcell [mailto:lesliepurcell@gmail.com]
Sent: Tuesday, October 23, 2012 11:47 PM
To: daniel.p.swenson@usace.army.mil; dlawhead@dfg.ca.gov; McCormick, Donna
Subject: NOI Scoping comments

Please see attached comments.

thanks,
Leslie Purcell

Dr. Daniel P. Swenson,
Los Angeles Section, U.S. Army Corps of Engineers (ACOE)
915 Wilshire Blvd., Los Angeles, CA 90017

Mr. David Lawhead
California Dept. of Fish & Game
3883 Ruffin Road, San Diego, CA 92123

Ms. Donna McCormick, ICF International

October 23, 2012

RE: Comments on NOI to Prepare Joint EIS/EIR for Ballona Wetlands Restoration.

Following are my comments/questions for the Ballona Wetlands scoping process:

1. Please address what happened to the 1995 and 2005 EIS process.
2. Please address what happened to the lower Ballona Creek Watershed Ecosystem Restoration Study, with its recommendation to "proceed into the feasibility phase to develop an ecosystem restoration and watershed management plan for the lower Ballona Creek watershed", signed by LT Col. John V. Guenther, ACOE, Sept. 2002. Where is this plan, and the feasibility study? Is it being used in this current effort?

3. Many studies have been done on the Ballona wetlands and are available, such as the Ballona Creek Watershed Management Plan:
(http://www.swrcb.ca.gov/water_issues/programs/nps/docs/conference2003/01markhorne.pdf)
and Historical ecology:
(ftp://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/671_BallonaHistoricalEcology.pdf)

   Will the current EIS/EIR process utilize all such previous works?

4. Much public funding has already been expended on such studies, yet there is $6.25 million allocated for new engineering studies and alternative designs. Is this a good and necessary use of taxpayer dollars and/or bond monies? Who receives this funding, who disburses it, and what is the oversight as to the value of services provided and results delivered? Are restoration project proponents linked to those disbursing or receiving funding—is there impropriety or even the appearance of such?
5. What are the relationships between the various public and private entities involved in this current restoration planning process, including consultants, and how are they

related to adjacent developer interests such as Playa Vista/Playa Capital, as well as developments in the Marina del Rey and Playa del Rey areas?

6. Are the proposed levees to protect developers' interests rather than for ecological function and restoration? Could there be unintended consequences to other areas of the Ballona valley, the wetlands or Playa del Rey--as in New Orleans recently where rebuilt higher levees caused unforeseen flooding in outlying parishes.

7. I understood the previous EIS process to be an integrated comprehensive watershed-wide plan, including more of the watershed, addressing water quality upstream as well. Wouldn't this be a more ecologically sound approach than piece-mealing parts of the Ballona watershed?

8. Ballona Creek is an impaired water body—shouldn't water be cleaned up along the way and before entering the proposed wetlands restoration area?

9. Please analyse the needs of existing wildlife before, during, and after the proposed restoration process, including crossing opportunities above or below roadways, possibly lifting parts of the roadways (Culver, Jefferson) to provide such crossings for animals and water. 3500 animals killed annually at Ballona, according to Dr. Sean Anderson, CSUCI. Playa Vista was required to create a Lincoln Blvd. wildlife undercrossing, which has not been adequately done. Please investigate this failure.

10. Consider how to work with and protect existing habitat, plants and wildlife. From Lessons in Native American Plant Gathering: "…how to live *with* nature…Native American cultures acquired vast experience in how to use, manage, respect, and coexist with other forms of life" *(*referencing *Before the Wilderness*, anthology documenting environmental management practices of California Indians, M. Kat Anderson, coeditor). Please consult with local Tongva as to how to restore this land.

11. Please consider gradual, natural restoration, by hand, using small equipment and tools. This would be an opportunity for school and community groups to be actively involved in restoration, increasing participation and education, with social and psychological benefits.

12. The video, “Restoring Southern California Wetlands”, is a biased production promoting a severe and destructive engineering project as restoration, by people who have an interest in such an engineered restoration. Unbiased scientific analysis is needed as to restoration goals and methods. Restoration is not an engineering project! It is a labor of love for the community.

13. Go slow—listen, look, learn. Protect and create nesting habitat, rookeries, perches. Assess the overall health of the ecosystem, use the Precautionary Principle to preserve what is there, work to enhance it.

14. Analyse impacts of SoCalGas/Sempra’s storage, facilities, pipelines, wells. Are there gases escaping into the air? Is there toxic residue in the soils and leaching into the water? Please consider potential for shutting down these operations in the future. Consider long-range possibility of acquiring bluff for upland habitat, to mitigate for loss of West bluff upland habitat, including vernal pools, above wetlands.

15. Please investigate the defective process of earlier EIRs for Playa Vista: CDFG granted a streambed alteration permit to create “Riparian Corridor” which feeds into “Freshwater Marsh”, thereby enabling the digging up of a Tongva sacred site and burial area. In a conversation with DFG staff, I was told that the permit would not have been granted had they known of the burials there (over 1000 destroyed). Was the knowledge of the burials hidden or not disclosed to CDFG--a material misrepresentation? The SRI archaeologist knew of the significant burials, having told me prior to the excavation that there was a large burial area there.

16. Please address another defect in the earlier Playa Vista EIR—the Programmatic Agreement (PA) between ACOE and Tongva tribal representatives was more than 10 years old, and was not properly updated or agreed to by current tribal members. Two of the original signators were deceased at the time of the purported updating. The PA was therefore not valid. The State Native American Heritage Commission wrote several letters to this effect, asking for a cease-and-desist on the burial destruction.

17. Please analyse earthquake and liquefaction potential in regard to proposed restoration, including tsunami risk and predicted sea-level rise.

18. The Ballona aquifer is a potential drinking water source—how might this be affected by proposed large-scale earthmoving, and possible salt-water intrusion

19. Dredging off Ballona Creek channel brings up highly toxic material. How will the wetlands and waters be protected and cleaned-up, particularly if such proposed large-scale earth-moving occurs?

Leslie Purcell

lesliepurcell@gmail.com
310-570-6569

Jones, Tanya

From: Kerry Rasmussen [mailto:kerrymrasmussen@yahoo.com]
Sent: Tuesday, October 23, 2012 8:28 PM
To: keith linker; McCormick, Donna
Subject: Re: Ballona Wetlands Restoration Project Comments

This is great! Thanks for sharing, Keith.

Take care,
Kerry

From: keith linker <keithlinker@gmail.com>;
To: <Donna.McCormick@icfi.com>;
Bcc: <kerrymrasmussen@yahoo.com>;
Subject: Ballona Wetlands Restoration Project Comments
Sent: Tue, Oct 23, 2012 6:40:02 PM

Good Morning Ms. McCormick,

In response to the attached flier, please find, also attached, my comment letter and 2 enclosures. I appreciate the opportunity to offer input on this amazing project and look forward to seeing additional progress toward restoration.

Regards,
Keith Linker
Playa Vista Resident

Jones, Tanya

From: Gary Stickel [mailto:dregarystickel@att.net]
Sent: Tuesday, October 23, 2012 4:20 PM
To: McCormick, Donna
Cc: comdlawhead@dfg.ca.gov; daniel.p.swenson@us.ace.army.mil
Subject: Ballona Wetlands Restoration Project and Cultural Resources

Please see attached letter regarding the Ballona Wetlands Restoration Project.

Thank you,

E. Gary Stickel, Ph.D.
Tribal Archaeologist
Gabrieleno Band of Mission Indians

October 23, 2012

Ballona Wetlands Restoration Project
LEAD AGENCIES:
United States Army Corps of Engineers
California Dept. of Fish & Game
c/o Donna McCormick
1 Ada, Suite 100
Irvine, CA 92816

Re: Ballona Wetlands Project
cultural resources impacts

Dear Ms. McCormick,

It has come to my attention that the California Department of Fish & Game (CDFG) is planning large-scale grading and construction on the Ballona Wetlands Ecological Reserve for the purpose of "restoration." If due diligence is carried out with the proper agencies (SHPO, NAHC, etc.) it will be noted that cultural resources on this land have been negatively impacted within the past 25 years, with numerous prehistoric Native American remains disturbed in the process. Needless to say, local Native Americans consider this to be a sacred site.

Rather than proceeding with an overhaul of questionable necessity, it is strongly urged that the lead agencies explore less invasive restoration measures. In light of the extreme cultural sensitivity therein, the remaining integrity of the Wetlands Reserve should be preserved and protected. I thank you for your consideration in this matter.

Sincerely,

E. Gary Stickel, Ph.D.
Tribal Archaeologist
Gabrieleno Band of Mission
Indians

Jones, Tanya

From: L Terrell [mailto:fingersfly@ca.rr.com]
Sent: Tuesday, October 23, 2012 3:34 AM
To: McCormick, Donna
Subject: Comments on the Scoping of Ballona
Importance: High

Dear Ms. McCormick,

As you surely know, many of us who helped 'save' the Ballona Wetlands, do not want what we call 'industrial development' in the 600 acres. Over the 60 years since the outfill from the development of the Marina was dumped there, a whole ecosystem has developed, and what we have there already is quite amazing, if one takes the time to look, explore, see, enjoy, live with. One person who has helped document the great diversity, color, variety, and astonishing life that is the Ballona Wetlands, is Jonathan Coffin. If one just goes to his site on flickr "stonebird' you will find thousands! of beautiful photos of the ecosystem, and wildlife that make it their home. How can one go in there and bulldoze this life, these gifts from nature? If anyone in our midst knows these wetlands like the back of their hand, loves them as his own, (and they are our own', all of ours), it is Jonathan. Many of us don't believe in 'industrial development' of these wetlands. We didn't work so hard to save them, to have them bulldozed! That is just what we were against for them then, and are now, wanting very much to avoid any industrialized machinery, extreme re-making, large disturbances of the Lives and ecosystems, that have been doing fine, thank you.

We believe in gentle, hand tool type 'restoration' done carefully and s l o w l y, so as to disturb as little as possible the lives and homes of the abundance or plants, soils, critters, etc. that make Ballona their home. And each phase of any such 'restoration' as we envision, will be done with utmost caution and study of exactly What is There, from the tiniest ant/bug/spider/bacteria, to the largest mammals, which are probably the coyotes. I implore you to listen to those who have lived close by for many years, have walked the area for surely many thousands of days combined, and know it. These are the folks any agency that has designs on this area need to be consulting with, meeting with, listening to! This only makes common sense! One cannot learn about and get to know a piece of land by a 'survey', by spending days, even months in such an area. It takes Years to get to know and love and appreciate a piece of land and what is born, flowers, lives, dies, grows, spawns, nests, feeds, on it and in it.

No one who knows and loves a piece of land the way many of us do, could possibly be approving of literally bulldozing it! It feels/seems/is unconscionable to us. That is where many of us come from. Changing the 'character' of the place, at this point, just seems too much like man thinking he can come in and make better, something that now only exists on paper.

So I implore you to please listen, and listen carefully, to those who would not bulldoze. Take a walk with them, and see it how they do, learn all you can about what is there, before one shovel

of dirt is moved. Maybe then you can have/will begin to have, such a deep appreciation of what is already there, and maybe then there can be a real dialogue about how to proceed in as gentle and non-disturbing way as possible...over time, not in a bulldozing, destructive, violent way, but in a way that respects what is already there as much as possible. We have salt flats, we have 'prairie' where the great blue heron feed until they are a year old, where gray foxes make their homes, and thousands of other living things that have filled niches that those who would bulldoze could well know nothing of. Only the people who intimately know Ballona discovered the rare, and we thought forever gone, native flower popping up! Along with other discoveries over time.

Thank you for taking my words to heart, and know that we are not totally against 'restoration'. But it needs to be gentle, slow, and with human hands and tools, using the knowledge of the ones who best know and love this wonderful piece of land and open space within our midst.

Sincerely,
Lola Verdurer Terrell
Ballona advocate

Jones, Tanya

From: Jack Neff [mailto:jackneff01@yahoo.com]
Sent: Tuesday, October 23, 2012 4:55 PM
To: daniel.p.swenson@usace.army.mil; dlawhead@dfg.ca.gov
Cc: McCormick, Donna
Subject: John Ulloth - Scoping Comments-Ballona Wetlands

John Ulloth's paginated scoping comments re Ballona Wetlands are attached and as text below.

John Ulloth/ Ulloth Graphics
181 East Culver Boulevard, C
Play del Rey, California 90293

donna.mccormick@icfi.com
dlawhead@dfg.ca.gov
daniel.p.swenson@usace.army.mil

RE: **my official Scoping comments** to Scoping for Kill-It-To-Save-It Bulldozing Plans for La Ballona
August 20, 2012 revised/ extended October 20, 2012
(Bold type indicates subject matter to be addressed in detailed responses to this Scoping)

On behalf of nature: To whom it may concern: non-profit "partner" Santa Monica Bay "Restoration" Commission (SMBRC), Department of Fish & Game, California Coastal Commission, State Parks, and State of California

About a decade ago, I heard an outrageous debate on a L.A. area radio station over development vs. environment, both sides claiming to know best for the environment. The *place* that argument was over was La Ballona, the last large remaining refuge of wildness on Los Angeles' west side- I'd noticed on my way to the airport as one of the few places where traffic moved, the only place dark at night, the best place to hear a frog chorus... I concluded that was surely protected park land...

The first presenter in that radio debate said in essence: this *was* wasted land, it *was* going to be developed, and *if* environmentalists were smart, they'd work with developers to save those few westernmost acres worth saving. What? I couldn't believe I was hearing such pro-developer greenwashing tripe said out loud, on-air! Until another presenter argued it was *all* worth fighting for- to save it as a natural place.

I'd soon find out this was Los Angeles county's last, largest, & best surviving wetlands/ uplands complex, once ~3,000 acres in size, was tragically already "developed"- whittled down by that time to ~1,200 undeveloped acres, but not one inch of it had any protection of any kind from bulldozing & developer speculators intent on destroying it. That saving La Ballona was crucial for the survival of California's endemics (species that occur nowhere else), because only ~5% of the state's coastal wetland areas remained that hadn't been "developed" (almost always exclusively for human use). That saving the largest contiguous block of it, in as wild condition as possible, was essential for animals higher on the food chain (needing larger territories) to survive here. That Ballona was a critical stop for Monarch Butterflies, Snow Geese, & other migrating species. Along with many others, I got personally involved... community/ environmental/ church/ & political groups got involved... >126 groups formed a loose Coalition... to try to save La Ballona from bulldozers with press conferences, demonstrations/ movie pickets/ marches, street theatre, community education, a hunger strike- trying to find an pro-environmental way ahead, meeting with politicians, the would-be developers, & would-be tenants of Playa

Vista. Some local journalists risked their reputations to cover this "David vs. Goliath"-style story in a balanced way.

In the end, the city of Playa Vista got built despite community objection, killing plants & animals, sacrileging ancient native American gravesites- illegally removing the remains of hundreds of individuals to & from Santa Barbara- before reburying them elsewhere in Playa Vista, destroying remaining hydrology & habitat, and surrounding about half that remaining land. Playa Vista's sound-alarms do nothing to abate the endless burping of gasses that keep bubbling up, like they do at the Las Brea Tar Pits: Hydrogen Sulfate (stunting cognitive development in children), and leaking Natural gas that's already led to at least one death (a 1st-responder who illogically lit a match in an enclosed area that smelled of gas)- Natural gas that The Gas Company injects back into the salt domes beneath La Ballona for cheap-but-leaky storage. Playa Vista's earth movers heaped earth then ran over/ smashed possibly hundreds of capped gas/ oil well heads from the 1920's-1930's to make building pads. The Frenemies sold out to the developers, taking (a never-disclosed amount of) money to bless Playa Vista & defend its developers whenever they're attacked (to this day). The State bought half of what was left, paying way too much from the State's coffers (which only enabled developers cash to build quicker, when much of this land was wet & unbuildable anyway, and bank financing was otherwise hard for them to get)...

SMBRC is incompetent, and the process SMBRC started is already wrong; REMOVE THEM FROM THIS PROJECT AND IT'S LIKELY TO COLLAPSE FOR GOOD: Should the public idly stand by now that SMBRC/ other Frenemies of Ballona are trying to bulldoze & radically reshape the Public's 600 acres- "to kill it to save it" in the name of nature-annihilating "restoration"?... these same acres we fought to save from developers' bulldozing "Save it! Don't Pave It!"... when SMBRC's precedents (Steal-the-Bay) and its allies did little (or threw up obstacles) to save Ballona in the first place? SMBRC's "Kill it to save it" mentality, or Playa Vista's apologists' "Only 125 acres are worth saving", or developers' "Road lane expansion is necessary for all the traffic that's coming" (Hello! Frogs don't drive cars!) are among many incomprehensible nonsequiturs (the watershed is polluted; we must bulldoze downstream to clean it up), lies ("we don't have any plan yet"), and mis-conclusions based on mis-understandings (delta meander shapes observed at one point in time means that building fixed, randomly-curvy concreted channels would be good at Ballona) propagated about nature ("It's so degraded/ the invasives so bad that nothing in there is worth saving") & coastal wetlands generally (big salty holes for water storage are top priority (yet cleaning up or saving natural habitat at Marina del Rey is avoided, the Marina a bigger, saltier hole than ever existed in historic times that shares Ballona Creek's inlet/ outlet)... Since the State paid a record *$139,000,000 per acre* for these lands, doesn't that mean they extremely valuable in the condition they are in? This should completely disqualify SMBRC from doing anything at La Ballona, writing or sponsoring any of the Restoration Alternatives; the Community should be allowed to write at least half the total number of Final Alternatives, especially those emphasizing "Non-Bulldozer Phased Management," "Wildlife-Friendly," and "Historic" Alternatives; combining elements of these will automatically be more humane than the disasters that follow:

Having an argument about the highest & best use of land is one thing, having ASYMMETRICAL power & control of bulldozers & State backing to destroy LAND forever is another; SMBRC should be ineligible, particularly & completely disqualified, removed from any coastal or wetlands restoration project based on its track record:
And by "bulldozers/ bulldozing" I mean power & equipment emblematic of any mechanization regime for "industrial-scale habitat restoration;" this scale is almost always appropriate for permanently destroying/ altering/ degrading land; and almost never appropriate for restoring land back to natural conditions! Whether a Developer or Greenwashing "environmentalist" is in the cab of the bulldozer makes no difference to the flora & fauna being squished & maimed; widespread death is the same result. Having SMBRC, its predecessors, & allies in the driver's seat already has led to environmental crimes that are completely unacceptable & inapprorpiate for these 600 acres:

1) The creation of a toxic drain, funneling runoff from Playa Vista's parking lots & rooftops into a "Freshwater (sic) Marsh"- spewed into stolen wetlands (not internally: east of Lincoln, but greedily: west of Lincoln Boulevard), cutting down La Ballona's oldest & best mature native

willow grove (habitat needed to attract rare/ endangered birds) to do what?- plant willows! This is the "restoration" model of SMBRC, designed for & by humans; this may be professional landscaping, but THIS IS NOT restoration! Nature knows best, and we'd best get ourselves out of the way.

2) The total annihilation of the Malibu Lagoon west of the main channel of Malibu Creek, wrecking 3 bridges used as outdoor classrooms (over arms of a lagoon dug in 1983) and shortest route for Coastal (beach) Access. Of the many plants & animals (2 endangered species, & ~200 species of birds alone) that used Malibu Lagoon, nearly nothing lives there today, and won't for many years- nothing except bulldozers, and maybe MRSA bacteria (SMBRC was afraid to test for!) Both are environmental crimes, senseless "man-made" catastrophes based on ignorance and miscategorization of wetlands (Malibu & La Ballona Lagoons were seasonally-closed & brackish, not full-time-tidally-open deep salty estuary SMBRC is trying to build at Malibu) both will now never be the same. While the State is "under water" financially, the rape of Malibu Lagoon drained millions of dollars to execute wildlife, in a State Park; this is just criminal. The byproduct of a fatally flawed analysis (that high-organic, low-oxygen, brackish water that ducks use doesn't belong in coastal lagoons), and that alleged problems the rape of Malibu Lagoon intended to cure won't recur (where do fish & birds go to the bathroom?) Meanwhile, the rape of Malibu Lagoon did nothing to remove the upstream, human-caused sources of water pollution, or wildlife barriers (removal of Rindge Dam to give steelhead & other

fish a chance at upstream habitat as far as Ahmanson Ranch wasn't included); the same would be true at La Ballona.

As a foretaste of the "attractive nuisance" would happen all over Ballona, I've observed wide swaths recently cut through the plant material for the on-site coring operations (I believe this was done in support of this proposal) have opened avenues for unauthorized vehicle forays, trash & furniture dumping, and homeless encampments deeper in the wetlands. The width is excessive- looks like a road; Gas Company trucks seldom leave behind such an opening, or ensure locked gates close their driveways.

THE TOLL ON NATURE TAKES ITS TOLL ON THE PUBLIC: Malibu Lagoon was ~12 acres... La Ballona is ~600 acres but headed toward 0 if bulldozers have their way; there is just no "somewhere else" for coastal wetland dependent species in California to go- especially brackish (non-salt) wetlands- have almost all been wiped out! The coastal human community (that appreciates nature) in Malibu is exhausted, confused, angry, and broke from fighting these battles- that ultimately wind up in court out of the public's reach, because only a court ruling can knock sense into the thick skull of determined developers, and no level of government can really be trusted to keep tax money from being squandered, and keeping electeds constantly reminded to protect the environment,

Once in the cab of the bulldozer, the developers of what's now Playa Vista (City of Soviet-style prison blocks with neo-historic facades painted on, a future ghost town after the next large earthquake/ tsunami/ or after the state realizes it cant' pay claims from children getting brain damage from hydrogen sulfide & Natural gas leaking from the salt dome under Ballona/ south Marina) **could not be trusted... neither can SMBRC be trusted.**

"There is no right way to do a wrong thing!" SMBRC is now asking for the public's participation in the process of designing a "restoration" of acreage of La Ballona, but this is "putting the cart before the horse": Instead of producing a Purpose & Need, then Scoping, SMBRC has been disingenuous: hasn't officially "shown us their cards." During the scoping phase, SMBRC staffers denied in plain English that any "fix is in", or that SMBRC already has a plan. Without a doubt this is a lie: a range of at least 7 preliminary plans from bad to worse are already prepared (tellingly, a rough aerial sketch labelled "5A" illustrated a hardscaped Ballona Creek meander on an easel during SMBRC's initial August Scoping meeting- oops!) Choosing or blessing any of those pre-Scoping schemes cannot be allowed- if Malibu Lagoon's un-credible environmental documents were any guide, they are 1) Alternatives of unmitigatable damage to the environment ranging from bad to worse, 2) the current Coastal Commission's precedent for this will be to reject a pro-environmental compromise designed by

scientists: like one that met SMBRC's flawed Purpose & Need, retained direct coastal access, phased-in very small-scale channel dredging to allow native species to survive with room to move around its impacts, and retain a balance of seasonally brackish & seasonally salty wetlands. At the Scoping, SMBRC's staff urged us to put down everything we were thinking on an 8-1/2" x 11" paper for inclusion (that's enough?), but other staff told us right away there are several things "off the table": removing any roads, removing any structures, taking the Gas Company, acquiring any more land from Playa Vista or elsewhere. While their unwitting, unselfconscious, unvarnished honesty was delicious (as it's as surely a portal into SMBRC's covert "restoration" plans, as it is an index to its allied backers!) SMBRC might consider *professional* staff/ staff behavior next time...or not. There were at least 2 such "loose cannon" staffers (who also used the word "I" frequently at the Scoping!) But this was supposed to be Public Scoping Phase, not Public Self-Editing Phase: it is our job, not SMBRC's! to set the parameters. Of course, these "off the table" ideas staff mentioned would be the *top implementation priorities* of anyone designing Real Restoration (road traffic alone being the #1 cause of ~3,000 annual wildlife fatalities at Ballona). So I really can't help SMBRC because they're not really interested in hearing what the public has to say...

What kind of appropriate things a *qualified* lead agency should be doing *if Real Restoration was "on the table"*: (or more appropriately, because it's already so shriveled from its original size, Ongoing Management) for LaBallona:

1) "First, do no harm." Using this Precautionary Principle would have stopped the rape of Malibu Lagoon all at once, cold.
1A) "The first rule of intelligent tinkering is to save all the pieces," said Aldo Leopold. Just leave Ballona alone- for nature to continue its work- is not the worst thing for Ballona. Leaving it alone may be the best thing, yet somehow so hard to understand/ think straight once the bulldozer's keys have been turned, and bulldozer power's in *anyone's* hands.
On the Intelligent Tinkering front, I know slow, by-hand restoration can work because I've done it- part of the team managing "The Big Plant-In", a multi-year (2008-present) all-volunteer community restoration on the east bank of Grand Canal Lagoon on the east bank just south of Washington Boulevard Bridge, Venice. And I've tried to grow other beneficial Ballona Natives (like Ballona-native narrow-leaved Milkweed used by migrant & resident Monarch Butterflies) at our nurseries. Though not perfect, this tidally-influenced canal bank site (near the northern end of La Ballona's natural historic channel), was replanted with a self-sustaining community of tall native shrubs, wildflowers, herbs & grasses, the plant palette professionally designed, sourced & grown from Ballona-native genetics. Stored & growing in plant nurseries at 2 nearby schools, prescribed erosion control & native plants were placed at the lagoon- not by bulldozers- but all by volunteers using hand-tools: neighbors, school kids & collegians, service organizations, church groups, political campaigners... even foreign tourists, that generates community buy-in bulldozing never does. Dense non-native myoporum bushes that housed homeless people are gone, as are broken concrete slabs, Chilean pepper trees, castor bean, iceplant, annual garden flowers planted by under-educated locals... Existing native plants & grassy areas already there were retained, which paid off during a planting in 2010 when our volunteers discovered a mallard & nest under one of the retained shrubs on the site (she came back after about 1/2 an hour, successfully hatched & raised that brood). I've also noticed plant succession after we pu the natives back in many areas at the Big Plant-In. From our mostly-random planting, nature sorted things out: coyote bush engulfed surrounding smaller plants. Telegraph Weed & Coast Buckwheat at the highest & northern half gave way to Goldenbush, while pickleplant dominated closest to the (tidally-influenced) water's edge. Everlasting & Spiny Rush were overtaken by larger plants many places, but survived where other plantings perished in poor, gravelly soil. Weeds which plagued us from the 2nd year (mustard & non-native mallow) diminished, now choked out in most places by dense, self-seeding natives.
1B) Since the rape of Malibu committed in June 2012, the State would be foolish not to insist there be no project & no money-wasting at La Ballona or any other Southern California wetlands complex *Unless & Until* SMBRC/ State Parks/

Project contractors prove their ability to quickly grow back/ rapidly re-attract native, rare, & endangered species to re-inhabit to a thriving Malibu Lagoon. It took decades for nature to reclaim Malibu Lagoon and progressively bring natural diversity back since bulldozers carved lagoon channels out of ball fields built over earlier CalTrans' spoils (dumping grounds) in 1983. Even if this works and Malibu Lagoon were to look & function like it did before June 2012, supporting the same number of plant & animal species within say 2 years (this would be a miracle), this is not justification to bulldoze everything all at once; only small parts of La Ballona should be restored at a time, and experimentally, over a period of years in case anything goes wrong, taking no more than say 10% of a habitat or species so there are no extirpations at La Ballona. The animal capturing effort at Malibu was pathetic. And large & numerous quantities of native plants could have been boxed & kept at offsite nurseries for regrowing Malibu Lagoon quickly, but this was not done. Bulldozing everything at the same time -as if laying the foundation for an inanimate warehouse building- to instantly achieve all elements shown in the "ICF" plan is"magical thinking" that will not work and must not be allowed in any scheme. Do you know where Burrowing Owl habitat is for instance? I'm told they no longer live full-time in Ballona as they did until recently, but now only visits seasonally; what bulldozer power-take-off (PTO) attatchment is going to dig enough owl-acceptable replacement rodent holes for a sustainable population of them to live in after you've caved in all the rodent holes with bulldozers?

1C) Instead, SMBRC's likely to find catastrophic lagoon destruction encourages catastrophic foreign & weedy species invasion. Evidence of this is found at the industrial-scale "restoration" on west bank of the severed Ballona Lagoon in the Marina Peninsula (in City of LA, north of Lighthouse Bridge): as part of its "restoration", its 'genius' designers disturbed much of the upper canal bank soil & piled wood chip mulch on top (as lagoon soils are often alkaline, this probably tipped topsoil chemistry sharply toward

acidic). This spring, castor bean and other weeds explodeded, growing more thickly than ever, choking & towering over the native plants. But this invasion did not happen in adjacent areas south of Lighthouse bridge, where discovery & confirmation of the extremely rare Orcutt's Yellow Pincushion prevented both the scraping & mulching, as well as preventing the explosion of weeds. (For Malibu, SMBRC/ State Parks originally wanted to poison anything that escaped bulldozing with Agent Orange derivative "Round-up", but verbally removed it on the spot from the Malibu bulldozing hearing during the 2010 Coastal Commission due to audience outrage... yet had the proposers read the manufacturer's label, Round-up's prohibited from use anywhere near open water-courses).

2) FOR ECOLOGICAL HEALTH, CUt BACK ON SALT! We've already dug more salty holes (= harbors & channels) along the coast than nature'll ever need! So where is the apparent "need" for stormwater storage coming from? Southern California harbors & channels have displaced more brackish wetlands for salty- than ever existed in historic times. Nature has no need for more of this, so (Army Corps'/ L.A. County- driven) counterproductive element of floodwater storage posing as natural restoration should be scrapped. Instead, nature needs more of the brackish wetlands over the salty.

2A) DOES TABULA RAZA WORK? PROVE IT FIRST! *Besides* restoring Malibu Lagoon to pre-rape conditions, *before* running away to wreck Ballona on a large scale, the applicants' contractors should be required to *demonstrate they can "play God" for nature's benefit offsite*: Let the proposers prove the truth of their abiding faith in Tabula Raza (clean slate/ clean sheet of paper/ as if there was nothing there before) to those of us who don't believe it: Buy & close a distressed shopping center, excavate 2-12 acres of its parking lot, filling the bottom with a pond liner and salt water (with a pump for emergency drainage) to mimic the water column at La Ballona. Then, turn the contactors' bulldozers loose, filling the hole from sediment layers up to topsoil to plants & predators on top- to build the best mature brackish wetland & surrounding uplands money can buy. Setting the timeclock at "zero", and verifying their water column balancing success with regular corings, let's find out, if it can be done, how many years it will take to build a lush brackish wetland over salt table, and compare the quality of the resulting nature life support system. Let the contractors demonstrate their ability to build seasonal vernal pools, salt panne, crusty in the dry season, that support specialized animal communities, alkali flats, and stable drainage channels with bulldozers. Let them build vernal pools (recreating sediments laid down over millennia, & stock them with native seedbanks using bulldozers) like those lost to prior habitat destruction (such as the lost ones existing on the Ballona- adjacent 75 acre Westchester Blufftop field

west of Lincoln once used by raptors, now blanketed by contractors' houses. I'll predict the conclusion now: Recreating & balancing brackish wetlands above salty with bulldozers may be well-nigh impossible. If it even works, bulldozing champions will admit bulldozers & industrial-scale techniques don't do a good job, and most of the successful work will have been done slowly by hand. Habitat quality & species population & diversity will not match the original, and may be self-sustaining. Every honest bulldozer champion will concede minor repairing of the original La Ballona would be much easier. But this Tabula Raza project should be a mandatory prerequisite before bulldozing one inch of Ballona.

2A) Not one more inch of salt-water habitat type is needed! The creation of Marina del Rey itself (c. 1958-60) displaced 804 mostly-brackish acres, bringing far more salty water intrusion deeper & further inland than ever existed before Europeans arrived; (spectacular wetland losses at what's now Dana Point Harbor also comes to mind... that, to add insult to injury, also cost recreational users an irreplaceable surf break...)

2B) Global warming/ rising sea levels are on the way (3'- 4' higher by mid-21st Century) this means salt water is moving inland anyway. Farmers who grew celery, possibly beans there allegedly dumped "a couple feet on soil" on parts of Ballona in the past (those who use this as a hammer to justify bulldozing everything can't tell me where it is, where it came from (most likely native local soil dredging from other parts of Ballona) or how deep!) But what we actually need to do with that fill now is: Nothing! To wait! Admit our hubris & restrain our human urge to fool with it- if we just leave nature to work out the plant palette & its animals there, it will be *just right* as the sea levels rise over the next 40 years.

2C) The north Marina's polluted "Duck Pond" needs massive help: (unbelievably, it drains through to Mother's Beach!) including re-conversion to native plantings; this is another place for limited wetlands

restoration experimentation!

3) SPEND MONEY ON ACQUIRING MORE LAND FOR BALLONA INSTEAD OF WASTING MONEY TO DESTROY WHAT WE'VE GOT: Because so much of historic Ballona has already been destroyed (from ~3,000 acres, down to ~600), and wildness succeeds best (higher levels of the food chain) with the largest blocks of contiguous land possible, direct all efforts to acquire State funding to "Complete the Park": Add as many land parcels as possible for wild native plants & animals inside historic Ballona. Examples of this include a parcel of land at the north end of the southern remnant of Ballona Lagoon in Playa del Rey; currently within sight of its northern half, cut off by construction of Ballona Creek channelization (c.1938-40) Marina del Rey that extends to Venice. This land is for sale, and should be acquired by the state so this eminently "buildable" land doesn't become a 40' high wall of development that cuts off this viewshed. Another example is a long strip of land- a ~40' wide railway right of way adjacent to the southwest edge of western end the 90 Freeway that contains wetland (ditch with wetland plants) & upland species; if the Toyota dealership that owns it decides to culvert & pave it to maximize parked cars (the neighbors don't want this), Ballona plants & animals (like frogs that sing there, wading birds that eat them) would lose their habitat forever. Likewise, the retail garden center to the northeast, between the lanes of the 90 freeway, along with all other unpaved pieces within the CalTrans right of way should be merged or acquired to raise native plants for CalTrans & Coastal restorations, or made wild to extend the reach of native habitat... Unnecessary, useless, and destructive of native sites in the first place, travelers of the 90 freeway have nowhere to go; like the beneficial removal of San Francisco's Embarcadero Freeway, its complete dismantling west of the I-405 would save highway maintenance dollars, quiet our neighborhoods, be a great benefit to nature in the Ballona Valley, and never be missed in the future.

4) LAUNCH A COMMUNITY SUPPORt & EDUCATION program to enlist the public's help raising & maintaining sustainable populations of rare & native species from local genetics with organic methods in containers or yards.

I know the people of greater Ballona are interested in helping nature communally (group projects like the Big Plant-In) & individually (asking for native planting advice). This could extend to the greater Ballona valley as well (for cleaning projects on upstream watershed):

4A) Research and document Ballona Plant Lists & Ranges with coded & separate lists for: Recently extinct/ extirpated (last 100 years)/ Rare/ Endangered Native, Natives, Native American Plants (yerba mansa, tree tobacco, chia, etc.) Non-Native Beneficials (Anise, for its flower clusters that support butterflies.) Research and document Ballona Plant Lists & Ranges with coded & separate lists for: Invasive Pest Plants (Pampas Grass whose seed can blow 17 miles), & Weedy plants (non-native mustards & radish). Share Sourcing, Propagation, & Eradication methods for weedy & pest plants. Issues (ex.: using local biotic genetic material, & issues when it can't due to extirpation)

4D) Develop strategies to help nature offsite: (ex. planting native Narrow-leaved milkweed for Monarch butterflies. Jim K., one of our admirable neighbors on the Westchester Bluffs raises mass quantities of another species of milkweed plant in support of Monarch butterflies; he hosts resident & migrant populations around his yard.) (El Segundo Blue Butterflies. Bees or other "beneficial insects" (like pollinators or sensitive indicators of wild flora health). Hummingbirds. Other Wildlife-support: Cavity boxes (for bats, or bluebirds the Audubon Society wants to bring back) to make up for the loss of cavities in large-trunked trees. Feeders. Birdbaths. Reclaim & protect as much as possible of La Ballona real estate dominated by humans, focusing maximum benefits on species most at risk.

4E) Expand Education opportunities: Show tableau of plant groupings from each range type (from dunetop prairie to alkali flat), for use in grouping similar-need plants for gardeners, or educational garden (a long bed at area schools could sample a cross-section of Ballona's dune, lagoon, mineral flats, riparian, consolidated sandy bluff, prairie blufftop, vernal pools.)

5) GET THE WRONG PEOPLE & THEIR BAGGAGE OUT & the RIGHT PEOPLE IN.

5A) Homeless camps out of Ballona: I have nothing against homeless people- some are my friends. But the lone ranger who works Ballona has 3 or 4 other park properties to manage... For the time she's seen here, Ballona is not her favorite, and she doesn't like to patrol on foot. Slow- or No- action is taken on reports of chronically-occupied sites occupied by homeless individuals, small group camps,

& campfires (which also seem to attract large quantities of discards blanketing the ground that could literally send any present and future plan for Ballona up in smoke). More staff and a different mandate is needed to cover Ballona ground, and the homeless problem can only be solved by getting out of the truck for confrontation if necessary, & prompt eviction.

5B) BUST the dumpers: Tracking serial numbers on discarded televisions for instance can lead to the former owner, or unauthorized dumper, who can pay high fines or perform community service (hauling others' dumped junk) that can leverage the cleanup and spread the word that free dumping in Ballona is over.

5C) BRING IN RESEARCHERS & OBSERVERS: This is the way to conduct Scopings: by authorizing in appropriate people with minimal impact, to maximize beneficial knowledge of Ballona.

5D) CLEAN OUT THE RESERVE: A number of groups who worked hard to save Ballona used to do tours, cleanups, & abatement of invasives have been locked out of Ballona for several years by the Frenemies, who use this public land as their own estate; this is public land, their locks need to be cut, and their defacto taking needs to be reversed ASAP; an one-site storage container of theirs is in prime habitat, and needs to be hauled away now.

5E) BUILD THE VISITOR CENTER OFF THE RESERVE! The land area is so shrunken, we need every inch to work for nature; like all parkland, plopping a large building in the middle of the space- surrounded by a parking lot that will inevitably expand, is no good! At the east end of Playa del Rey are several building lots that might work well.

5F) FEND OFF PROPERTY ATTACKS ON THE RESERVE: An unauthorized gravel parking lot in Playa del Rey north of Gordon's Market & east the Matilla Center sits entirely on Ballona reserve lands. An unauthorized Friday carwash business conducts business there with hoses in the parking lot behind the Matilla Center, operating entirely on the State reserve; not only does the State receive no income from this, the car wash soap, dirt, and automotive fluids sink through the gravel into the wetlands; where's the EIR for that? Local architect Craig Fraulino publicly proposed using State lands (for free) to build an alley/ parking to serve the north "backs" of Culver Boulevard businesses, converting adjacent Titmouse Park (Los Angeles City) for a parking lot, and building a multi-storey parking garage over the

unauthorized gravel lot to accommodate businesses and Reserve vistors. As property lines begin immediately at the "backs" of these buildings, this is entirely on State lands. Several of these businesses have already dumped gravel on State Lands anyway- a defacto unauthorized alleyway for which they pay nothing... and because when nothing is done, the assumption is the owner (in this case, the State) doesn't care. When it was pointed out they haven't paid any money for this land, it's not for sale, their schemes have no scientific standing, they had no answer. Really, this property line should be immediately surveyed, fenced, closed, and lands restored by the State (there is a seasonal wetland just north of the buildings, & Silvery legless lizards have been found at the backs of the buildings). The ICF plan shows a black area along the backs of these businesses; the Legend describes it as "Other;" there is another large black block at the southe-central edge of the site where below The Gas Company property; this cannot go unexplained.

6) PROGRESSIVE Transportation NOW! Another large black mark slashing through the middle of La Ballona ICF map is the Culver Boulevard right-of-way, the main killing-grounds of La Ballona wildlife, whose speed limit is soon to be raised. Progressive Transportation here means: building a "complete steet", upending the dominance of cars everywhere, and reordering/ inverting our priorities to 1) Walking 2) Biking 3) Transit 4) Automobiles. Opportunities to apply this at La Ballona should be integral to nearly every Alternative, as they stop the slaughter of the *prime thing* people would visit want to see: WILDLIFE! First, put a stop sign at Culver & Pershing to slow the cars down. Convert 2 traffic lanes eastward from Culver Boulevard to parking lanes for Ballona visitors. 2nd, Sawcut & remove the foolish "Culver Loop." Divert all eastbound car traffic on Culver onto Jefferson with a row of steel bollards (only Fire & Police Departments can open), and another row of same bollards closing westbound Culver at the 91 freeway ramps. Sawcut & remove all but 1 lane (= 2 bike lanes) of existing paving between these 2 points; this is the new 2-way Culver bike trail. On the center top of the bridge over Lincoln, build a bike service station with water & parts, and binoculars for wildlife observation. 3rd, Provide a decomposed granite (d.g.) trail next to the bike trail. Rebuild the Los Angeles Pacific Railway (later Pacific Electric) on its historic alignment to Playa del Rey as a slow-moving, quiet

platform to observe wildlife from. Rebuild its bridge spanning its existing Art Deco abutments over Lincoln Boulevard. Store the rail cars (build copies of the ones at the Port of LA, built for the Waterfront Red Cars in San Pedro, which are exactly correct) into EZ storage (North side of Culver Boulevard, where it can meet the Culver City bus there. Skip the sight of roadkill, and enjoy the wildlife experience.

On behalf of nature- who knows best,

(John Jay Ulloth)

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RE: **MY OFFICIAL SCOPING COMMENTS** to Scoping for Kill-It-To-Save-It Bulldozing Plans for La Ballona
August 20, 2012 revised/ extended October 20, 2012
(Bold type indicates subject matter to be addressed in detailed responses to this Scoping)

On behalf of nature: To whom it may concern: non-profit "partner" Santa Monica Bay "Restoration" Commission (SMBRC), Department of Fish & Game, California Coastal Commission, State Parks, and State of California

About a decade ago, I heard an outrageous debate on a L.A. area radio station over development vs. environment, both sides claiming to know best for the environment. The *place* that argument was over was La Ballona, the last large remaining refuge of wildness on Los Angeles' west side- I'd noticed on my way to the airport as one of the few places where traffic moved, the only place dark at night, the best place to hear a frog chorus... I concluded that was surely protected park land...

The first presenter in that radio debate said in essence: this *was* wasted land, it *was* going to be developed, and *if* environmentalists were smart, they'd work with developers to save those few westernmost acres worth saving. What? I couldn't believe I was hearing such pro-developer greenwashing tripe said out loud, on-air! Until another presenter argued it was *all* worth fighting for- to save it as a natural place.

I'd soon find out this was Los Angeles county's last, largest, & best surviving wetlands/ uplands complex, once ~3,000 acres in size, was tragically already "developed"- whittled down by that time to ~1,200 undeveloped acres, but not one inch of it had any protection of any kind from bulldozing & developer speculators intent on destroying it. That saving La Ballona was crucial for the survival of California's endemics (species that occur nowhere else), because only ~5% of the state's coastal wetland areas remained that hadn't been "developed" (almost always exclusively for human use). That saving the largest contiguous block of it, in as wild condition as possible, was essential for animals higher on the food chain (needing larger territories) to survive here. That Ballona was a critical stop for Monarch Butterflies, Snow Geese, & other migrating species. Along with many others, I got personally involved... community/ environmental/ church/ & political groups got involved... >126 groups formed a loose Coalition... to try to save La Ballona from bulldozers with press conferences, demonstrations/ movie pickets/ marches, street theatre, community education, a hunger strike- trying to find an pro-environmental way ahead, meeting with politicians, the would-be developers, & would-be tenants of Playa Vista. Some local journalists risked their reputations to cover this "David vs. Goliath"-style story in a balanced way.

In the end, the city of Playa Vista got built despite community objection, killing plants & animals, sacrileging ancient native American gravesites- illegally removing the remains of hundreds of individuals to & from Santa Barbara- before reburying them elsewhere in Playa Vista, destroying remaining hydrology & habitat, and surrounding about half that remaining land. Playa Vista's sound-alarms do nothing to abate the endless burping of gasses that keep bubbling up, like they do at the Las Brea Tar Pits: Hydrogen Sulfate (stunting cognitive development in children), and leaking Natural gas that's already led to at least one death (a 1st-responder who illogically lit a match in an enclosed area that smelled of gas)- Natural gas that The Gas Company injects back into the salt domes beneath La Ballona for cheap-but-leaky storage. Playa Vista's earth movers heaped earth then ran over/ smashed possibly hundreds of capped gas/ oil well heads from the 1920's-1930's to make building pads. The Frenemies sold out to the developers, taking (a never-disclosed amount of) money to bless Playa Vista & defend its developers whenever they're attacked (to this day). The State bought half of what was left, paying way too much from the State's coffers (which only enabled developers cash to build quicker, when much of this land was wet & unbuildable anyway, and bank financing was otherwise hard for them to get)...

SMBRC IS INCOMPETENT, AND THE PROCESS SMBRC STARTED IS ALREADY WRONG; REMOVE THEM FROM THIS PROJECT AND IT'S LIKELY TO COLLAPSE FOR GOOD: Should the public idly stand by now that SMBRC/ other Frenemies of Ballona are trying to bulldoze & radically reshape the Public's 600 acres- "to kill it to save it" in the name of nature-annihilating "restoration"?... these same acres we fought to save from developers' bulldozing "Save it! Don't Pave It!"... when SMBRC's precedents (Steal-the-Bay) and its allies did little (or threw up obstacles) to save Ballona in the first place? SMBRC's "Kill it to save it" mentality, or Playa Vista's apologists' "Only 125 acres are worth saving", or developers' "Road lane expansion is necessary for all the traffic that's coming" (Hello! Frogs don't drive cars!) are among many incomprehensible nonsequiturs (the watershed is polluted; we must bulldoze downstream to clean it up), lies ("we don't have any plan yet"), and mis-conclusions based on mis-understandings (delta meander shapes observed at one point in time means that building fixed, randomly-curvy concreted channels would be good at Ballona) propagated about nature ("It's so degraded/ the invasives so bad that nothing in there is worth saving") & coastal wetlands generally (big salty holes for water storage are top priority (yet cleaning up or saving natural habitat at Marina del Rey is avoided, the Marina a bigger, saltier hole than ever existed in historic times that shares Ballona Creek's inlet/ outlet)... Since the State paid a record *$139,000,000 per acre* for these lands, doesn't that mean they extremely valuable in the condition they are in? This should completely disqualify SMBRC from doing anything at La Ballona, writing or sponsoring any of the Restoration Alternatives; the Community should be allowed to write at least half the total number of Final Alternatives, especially those emphasizing "Non-Bulldozer Phased Management," "Wildlife-Friendly," and "Historic" Alternatives; combining elements of these will automatically be more humane than the disasters that follow:

HAVING AN ARGUMENT ABOUT THE HIGHEST & BEST USE OF LAND IS ONE THING, HAVING ASYMMETRICAL POWER & CONTROL OF BULLDOZERS & STATE BACKING TO DESTROY LAND FOREVER IS ANOTHER; SMBRC SHOULD BE INELIGIBLE, PARTICULARLY & COMPLETELY DISQUALIFIED, REMOVED FROM ANY COASTAL OR WETLANDS RESTORATION PROJECT BASED ON ITS TRACK RECORD: And by "bulldozers/ bulldozing" I mean power & equipment emblematic of any mechanization regime for "industrial-scale habitat restoration;" this scale is almost always appropriate for permanently destroying/ altering/ degrading land; and almost never appropriate for restoring land back to natural conditions! Whether a Developer or Greenwashing "environmentalist" is in the cab of the bulldozer makes no difference to the flora & fauna being squished & maimed; widespread death is the same result. Having SMBRC, its predecessors, & allies in the driver's seat already has led to environmental crimes that are completely unacceptable & inapprorpiate for these 600 acres:

1) The creation of a toxic drain, funneling runoff from Playa Vista's parking lots & rooftops into a "Freshwater (sic) Marsh"- spewed into stolen wetlands (not internally: east of Lincoln, but greedily: west of Lincoln Boulevard), cutting down La Ballona's oldest & best mature native willow grove (habitat needed to attract rare/ endangered birds) to do what?- plant willows! This is the "restoration" model of SMBRC, designed for & by humans; this may be professional landscaping, but THIS IS NOT restoration! Nature knows best, and we'd best get ourselves out of the way.

2) The total annihilation of the Malibu Lagoon west of the main channel of Malibu Creek, wrecking 3 bridges used as outdoor classrooms (over arms of a lagoon dug in 1983) and shortest route for Coastal (beach) Access. Of the many plants & animals (2 endangered species, & ~200 species of birds alone) that used Malibu Lagoon, nearly nothing lives there today, and won't for many years- nothing except bulldozers, and maybe MRSA bacteria (SMBRC was afraid to test for!) Both are environmental crimes, senseless "man-made" catastrophes based on ignorance and miscategorization of wetlands (Malibu & La Ballona Lagoons were seasonally-closed & brackish, not full-time-tidally-open deep salty estuary SMBRC is trying to build at Malibu) both will now never be the same. While the State is "under water" financially, the rape of Malibu Lagoon drained millions of dollars to execute wildlife, in a State Park; this is just criminal. The byproduct of a fatally flawed analysis (that high-organic, low-oxygen, brackish water that ducks use doesn't belong in coastal lagoons), and that alleged problems the rape of Malibu Lagoon intended to cure won't recur (where do fish & birds go to the bathroom?) Meanwhile, the rape of Malibu Lagoon did nothing to remove the upstream, human-caused sources of water pollution, or wildlife barriers (removal of Rindge Dam to give steelhead & other

fish a chance at upstream habitat as far as Ahmanson Ranch wasn't included); the same would be true at La Ballona.
As a foretaste of the "attractive nuisance" would happen all over Ballona, I've observed wide swaths recently cut through the plant material for the on-site coring operations (I believe this was done in support of this proposal) have opened avenues for unauthorized vehicle forays, trash & furniture dumping, and homeless encampments deeper in the wetlands. The width is excessive- looks like a road; Gas Company trucks seldom leave behind such an opening, or ensure locked gates close their driveways.

THE TOLL ON NATURE TAKES ITS TOLL ON THE PUBLIC: Malibu Lagoon was ~12 acres... La Ballona is ~600 acres but headed toward 0 if bulldozers have their way; there is just no "somewhere else" for coastal wetland dependent species in California to go- especially brackish (non-salt) wetlands- have almost all been wiped out! The coastal human community (that appreciates nature) in Malibu is exhausted, confused, angry, and broke from fighting these battles- that ultimately wind up in court out of the public's reach, because only a court ruling can knock sense into the thick skull of determined developers, and no level of government can really be trusted to keep tax money from being squandered, and keeping electeds constantly reminded to protect the environment,
Once in the cab of the bulldozer, the developers of what's now Playa Vista (City of Soviet-style prison blocks with neo-historic facades painted on, a future ghost town after the next large earthquake/ tsunami/ or after the state realizes it cant' pay claims from children getting brain damage from hydrogen sulfide & Natural gas leaking from the salt dome under Ballona/ south Marina) **could not be trusted... neither can SMBRC be trusted.**

"THERE IS NO RIGHT WAY TO DO A WRONG THING!" SMBRC is now asking for the public's participation in the process of designing a "restoration" of acreage of La Ballona, but this is "putting the cart before the horse": Instead of producing a Purpose & Need, then Scoping, SMBRC has been disingenuous: hasn't officially "shown us their cards." During the scoping phase, SMBRC staffers denied in plain English that any "fix is in", or that SMBRC already has a plan. Without a doubt this is a lie: a range of at least 7 preliminary plans from bad to worse are already prepared (tellingly, a rough aerial sketch labelled "5A" illustrated a hardscaped Ballona Creek meander on an easel during SMBRC's initial August Scoping meeting- oops!) Choosing or blessing any of those pre-Scoping schemes cannot be allowed- if Malibu Lagoon's un-credible environmental documents were any guide, they are 1) Alternatives of unmitigatable damage to the environment ranging from bad to worse, 2) the current Coastal Commission's precedent for this will be to reject a pro-environmental compromise designed by scientists: like one that met SMBRC's flawed Purpose & Need, retained direct coastal access, phased-in very small-scale channel dredging to allow native species to survive with room to move around its impacts, and retain a balance of seasonally brackish & seasonally salty wetlands. At the Scoping, SMBRC's staff urged us to put down everything we were thinking on an 8-1/2" x 11" paper for inclusion (that's enough?), but other staff told us right away there are several things "off the table": removing any roads, removing any structures, taking the Gas Company, acquiring any more land from Playa Vista or elsewhere. While their unwitting, unselfconscious, unvarnished honesty was delicious (as it's as surely a portal into SMBRC's covert "restoration" plans, as it is an index to its allied backers!) SMBRC might consider *professional* staff/ staff behavior next time...or not. There were at least 2 such "loose cannon" staffers (who also used the word "I" frequently at the Scoping!) But this was supposed to be Public Scoping Phase, not Public Self-Editing Phase: it is our job, not SMBRC's! to set the parameters. Of course, these "off the table" ideas staff mentioned would be the *top implementation priorities* of anyone designing Real Restoration (road traffic alone being the #1 cause of ~3,000 annual wildlife fatalities at Ballona). So I really can't help SMBRC because they're not really interested in hearing what the public has to say...

WHAT KIND OF APPROPRIATE THINGS A *QUALIFIED* LEAD AGENCY SHOULD BE DOING *IF REAL RESTORATION WAS "ON THE TABLE"*: (or more appropriately, because it's already so shriveled from its original size, Ongoing Management) for LaBallona:

1) "FIRST, DO NO HARM." Using this Precautionary Principle would have stopped the rape of Malibu Lagoon all at once, cold.

1A) "THE FIRST RULE OF INTELLIGENT TINKERING IS TO SAVE ALL THE PIECES," said Aldo Leopold. Just leave Ballona alone- for nature to continue its work- is not the worst thing for Ballona. Leaving it alone may be the best thing, yet somehow so hard to understand/ think straight once the bulldozer's keys have been turned, and bulldozer power's in *anyone's* hands.

On the Intelligent Tinkering front, I know slow, by-hand restoration can work because I've done it- part of the team managing "The Big Plant-In", a multi-year (2008-present) all-volunteer community restoration on the east bank of Grand Canal Lagoon on the east bank just south of Washington Boulevard Bridge, Venice. And I've tried to grow other beneficial Ballona Natives (like Ballona-native narrow-leaved Milkweed used by migrant & resident Monarch Butterflies) at our nurseries. Though not perfect, this tidally-influenced canal bank site (near the northern end of La Ballona's natural historic channel), was replanted with a self-sustaining community of tall native shrubs, wildflowers, herbs & grasses, the plant palette professionally designed, sourced & grown from Ballona-native genetics. Stored & growing in plant nurseries at 2 nearby schools, prescribed erosion control & native plants were placed at the lagoon- not by bulldozers- but all by volunteers using hand-tools: neighbors, school kids & collegians, service organizations, church groups, political campaigners... even foreign tourists, that generates community buy-in bulldozing never does. Dense non-native myoporum bushes that housed homeless people are gone, as are broken concrete slabs, Chilean pepper trees, castor bean, iceplant, annual garden flowers planted by under-educated locals... Existing native plants & grassy areas already there were retained, which paid off during a planting in 2010 when our volunteers discovered a mallard & nest under one of the retained shrubs on the site (she came back after about 1/2 an hour, successfully hatched & raised that brood). I've also noticed plant succession after we pu the natives back in many areas at the Big Plant-In. From our mostly-random planting, nature sorted things out: coyote bush engulfed surrounding smaller plants. Telegraph Weed & Coast Buckwheat at the highest & northern half gave way to Goldenbush, while pickleplant dominated closest to the (tidally-influenced) water's edge. Everlasting & Spiny Rush were overtaken by larger plants many places, but survived where other plantings perished in poor, gravelly soil. Weeds which plagued us from the 2nd year (mustard & non-native mallow) diminished, now choked out in most places by dense, self-seeding natives.

1B) SINCE THE RAPE OF MALIBU COMMITTED IN JUNE 2012, THE STATE WOULD BE FOOLISH NOT TO INSIST THERE BE NO PROJECT & NO MONEY-WASTING AT LA BALLONA OR ANY OTHER SOUTHERN CALIFORNIA WETLANDS COMPLEX *UNLESS & UNTIL* SMBRC/ STATE PARKS/ PROJECT CONTRACTORS PROVE THEIR ABILITY TO QUICKLY GROW BACK/ RAPIDLY RE-ATTRACT NATIVE, RARE, & ENDANGERED SPECIES TO RE-INHABIT TO A THRIVING MALIBU LAGOON. It took decades for nature to reclaim Malibu Lagoon and progressively bring natural diversity back since bulldozers carved lagoon channels out of ball fields built over earlier CalTrans' spoils (dumping grounds) in 1983. Even if this works and Malibu Lagoon were to look & function like it did before June 2012, supporting the same number of plant & animal species within say 2 years (this would be a miracle), this is not justification to bulldoze everything all at once; only small parts of La Ballona should be restored at a time, and experimentally, over a period of years in case anything goes wrong, taking no more than say 10% of a habitat or species so there are no extirpations at La Ballona. The animal capturing effort at Malibu was pathetic. And large & numerous quantities of native plants could have been boxed & kept at offsite nurseries for regrowing Malibu Lagoon quickly, but this was not done. Bulldozing everything at the same time -as if laying the foundation for an inanimate warehouse building- to instantly achieve all elements shown in the "ICF" plan is"magical thinking" that will not work and must not be allowed in any scheme. Do you know where Burrowing Owl habitat is for instance? I'm told they no longer live full-time in Ballona as they did until recently, but now only visits seasonally; what bulldozer power-take-off (PTO) attatchment is going to dig enough owl-acceptable replacement rodent holes for a sustainable population of them to live in after you've caved in all the rodent holes with bulldozers?

1C) INSTEAD, SMBRC'S LIKELY TO FIND CATASTROPHIC LAGOON DESTRUCTION ENCOURAGES CATASTROPHIC FOREIGN & WEEDY SPECIES INVASION. Evidence of this is found at the industrial-scale "restoration" on west bank of the severed Ballona Lagoon in the Marina Peninsula (in City of LA, north of Lighthouse Bridge): as part of its "restoration", its 'genius' designers disturbed much of the upper canal bank soil & piled wood chip mulch on top (as lagoon soils are often alkaline, this probably tipped topsoil chemistry sharply toward

acidic). This spring, castor bean and other weeds explodeded, growing more thickly than ever, choking & towering over the native plants. But this invasion did not happen in adjacent areas south of Lighthouse bridge, where discovery & confirmation of the extremely rare Orcutt's Yellow Pincushion prevented both the scraping & mulching, as well as preventing the explosion of weeds. (For Malibu, SMBRC/ State Parks originally wanted to poison anything that escaped bulldozing with Agent Orange derivative "Round-up", but verbally removed it on the spot from the Malibu bulldozing hearing during the 2010 Coastal Commission due to audience outrage... yet had the proposers read the manufacturer's label, Round-up's prohibited from use anywhere near open water-courses).

2) FOR ECOLOGICAL HEALTH, CUT BACK ON SALT! We've already dug more salty holes (= harbors & channels) along the coast than nature'll ever need! So where is the apparent "need" for stormwater storage coming from? Southern California harbors & channels have displaced more brackish wetlands for salty- than ever existed in historic times. Nature has no need for more of this, so (Army Corps'/ L.A. County- driven) counterproductive element of floodwater storage posing as natural restoration should be scrapped. Instead, nature needs more of the brackish wetlands over the salty.

2A) DOES TABULA RAZA WORK? PROVE IT FIRST! *Besides* restoring Malibu Lagoon to pre-rape conditions, *before* running away to wreck Ballona on a large scale, the applicants' contractors should be required to *demonstrate they can "play God" for nature's benefit offsite*: Let the proposers prove the truth of their abiding faith in Tabula Raza (clean slate/ clean sheet of paper/ as if there was nothing there before) to those of us who don't believe it: Buy & close a distressed shopping center, excavate 2-12 acres of its parking lot, filling the bottom with a pond liner and salt water (with a pump for emergency drainage) to mimic the water column at La Ballona. Then, turn the contactors' bulldozers loose, filling the hole from sediment layers up to topsoil to plants & predators on top- to build the best mature brackish wetland & surrounding uplands money can buy. Setting the timeclock at "zero", and verifying their water column balancing success with regular corings, let's find out, if it can be done, how many years it will take to build a lush brackish wetland over salt table, and compare the quality of the resulting nature life support system. Let the contractors demonstrate their ability to build seasonal vernal pools, salt panne, crusty in the dry season, that support specialized animal communities, alkali flats, and stable drainage channels with bulldozers. Let them build vernal pools (recreating sediments laid down over millennia, & stock them with native seedbanks using bulldozers) like those lost to prior habitat destruction (such as the lost ones existing on the Ballona- adjacent 75 acre Westchester Blufftop field west of Lincoln once used by raptors, now blanketed by contractors' houses. I'll predict the conclusion now: Recreating & balancing brackish wetlands above salty with bulldozers may be well-nigh impossible. If it even works, bulldozing champions will admit bulldozers & industrial-scale techniques don't do a good job, and most of the successful work will have been done slowly by hand. Habitat quality & species population & diversity will not match the original, and may be self-sustaining. Every honest bulldozer champion will concede minor repairing of the original La Ballona would be much easier. But this Tabula Raza project should be a mandatory prerequisite before bulldozing one inch of Ballona.

2A) NOT ONE MORE INCH OF SALT-WATER HABITAT TYPE IS NEEDED! The creation of Marina del Rey itself (c. 1958-60) displaced 804 mostly-brackish acres, bringing far more salty water intrusion deeper & further inland than ever existed before Europeans arrived; (spectacular wetland losses at what's now Dana Point Harbor also comes to mind... that, to add insult to injury, also cost recreational users an irreplaceable surf break...)

2B) GLOBAL WARMING/ RISING SEA LEVELS ARE ON THE WAY (3'- 4' HIGHER BY MID-21ST CENTURY) THIS MEANS SALT WATER IS MOVING INLAND ANYWAY. Farmers who grew celery, possibly beans there allegedly dumped "a couple feet on soil" on parts of Ballona in the past (those who use this as a hammer to justify bulldozing everything can't tell me where it is, where it came from (most likely native local soil dredging from other parts of Ballona) or how deep!) But what we actually need to do with that fill now is: Nothing! To wait! Admit our hubris & restrain our human urge to fool with it- if we just leave nature to work out the plant palette & its animals there, it will be *just right* as the sea levels rise over the next 40 years.

2C) THE NORTH MARINA'S POLLUTED "DUCK POND" NEEDS MASSIVE HELP: (unbelievably, it drains through to Mother's Beach!) including re-conversion to native plantings; this is another place for limited wetlands

restoration experimentation!

3) SPEND MONEY ON ACQUIRING MORE LAND FOR BALLONA INSTEAD OF WASTING MONEY TO DESTROY WHAT WE'VE GOT: Because so much of historic Ballona has already been destroyed (from ~3,000 acres, down to ~600), and wildness succeeds best (higher levels of the food chain) with the largest blocks of contiguous land possible, direct all efforts to acquire State funding to "Complete the Park": Add as many land parcels as possible for wild native plants & animals inside historic Ballona. Examples of this include a parcel of land at the north end of the southern remnant of Ballona Lagoon in Playa del Rey; currently within sight of its northern half, cut off by construction of Ballona Creek channelization (c.1938-40) Marina del Rey that extends to Venice. This land is for sale, and should be acquired by the state so this eminently "buildable" land doesn't become a 40' high wall of development that cuts off this viewshed. Another example is a long strip of land- a ~40' wide railway right of way adjacent to the southwest edge of western end the 90 Freeway that contains wetland (ditch with wetland plants) & upland species; if the Toyota dealership that owns it decides to culvert & pave it to maximize parked cars (the neighbors don't want this), Ballona plants & animals (like frogs that sing there, wading birds that eat them) would lose their habitat forever. Likewise, the retail garden center to the northeast, between the lanes of the 90 freeway, along with all other unpaved pieces within the CalTrans right of way should be merged or acquired to raise native plants for CalTrans & Coastal restorations, or made wild to extend the reach of native habitat... Unnecessary, useless, and destructive of native sites in the first place, travelers of the 90 freeway have nowhere to go; like the beneficial removal of San Francisco's Embarcadero Freeway, its complete dismantling west of the I-405 would save highway maintenance dollars, quiet our neighborhoods, be a great benefit to nature in the Ballona Valley, and never be missed in the future.

4) LAUNCH A COMMUNITY SUPPORT & EDUCATION PROGRAM TO ENLIST THE PUBLIC'S HELP raising & maintaining sustainable populations of rare & native species from local genetics with organic methods in containers or yards.
I know the people of greater Ballona are interested in helping nature communally (group projects like the Big Plant-In) & individually (asking for native planting advice). This could extend to the greater Ballona valley as well (for cleaning projects on upstream watershed):

4A) RESEARCH AND DOCUMENT BALLONA PLANT LISTS & RANGES with coded & separate lists for: Recently extinct/ extirpated (last 100 years)/ Rare/ Endangered Native, Natives, Native American Plants (yerba mansa, tree tobacco, chia, etc.) Non-Native Beneficials (Anise, for its flower clusters that support butterflies.) Research and document Ballona Plant Lists & Ranges with coded & separate lists for: Invasive Pest Plants (Pampas Grass whose seed can blow 17 miles), & Weedy plants (non-native mustards & radish). Share Sourcing, Propagation, & Eradication methods for weedy & pest plants. Issues (ex.: using local biotic genetic material, & issues when it can't due to extirpation)

4D) DEVELOP STRATEGIES TO HELP NATURE OFFSITE: (ex. planting native Narrow-leaved milkweed for Monarch butterflies. Jim K., one of our admirable neighbors on the Westchester Bluffs raises mass quantities of another species of milkweed plant in support of Monarch butterflies; he hosts resident & migrant populations around his yard.) (El Segundo Blue Butterflies. Bees or other "beneficial insects" (like pollinators or sensitive indicators of wild flora health). Hummingbirds. Other Wildlife-support: Cavity boxes (for bats, or bluebirds the Audubon Society wants to bring back) to make up for the loss of cavities in large-trunked trees. Feeders. Birdbaths. Reclaim & protect as much as possible of La Ballona real estate dominated by humans, focusing maximum benefits on species most at risk.

4E) EXPAND EDUCATION OPPORTUNITIES: Show tableau of plant groupings from each range type (from dunetop prairie to alkali flat), for use in grouping similar-need plants for gardeners, or educational garden (a long bed at area schools could sample a cross-section of Ballona's dune, lagoon, mineral flats, riparian, consolidated sandy bluff, prairie blufftop, vernal pools.)

5) GET THE WRONG PEOPLE & THEIR BAGGAGE OUT & THE RIGHT PEOPLE IN.

5A) HOMELESS CAMPS OUT OF BALLONA: I have nothing against homeless people- some are my friends. But the lone ranger who works Ballona has 3 or 4 other park properties to manage... For the time she's seen here, Ballona is not her favorite, and she doesn't like to patrol on foot. Slow- or No- action is taken on reports of chronically-occupied sites occupied by homeless individuals, small group camps,

& campfires (which also seem to attract large quantities of discards blanketing the ground that could literally send any present and future plan for Ballona up in smoke). More staff and a different mandate is needed to cover Ballona ground, and the homeless problem can only be solved by getting out of the truck for confrontation if necessary, & prompt eviction.

5B) BUST THE DUMPERS: Tracking serial numbers on discarded televisions for instance can lead to the former owner, or unauthorized dumper, who can pay high fines or perform community service (hauling others' dumped junk) that can leverage the cleanup and spread the word that free dumping in Ballona is over.

5C) BRING IN RESEARCHERS & OBSERVERS: This is the way to conduct Scopings: by authorizing in appropriate people with minimal impact, to maximize beneficial knowledge of Ballona.

5D) CLEAN OUT THE RESERVE: A number of groups who worked hard to save Ballona used to do tours, cleanups, & abatement of invasives have been locked out of Ballona for several years by the Frenemies, who use this public land as their own estate; this is public land, their locks need to be cut, and their defacto taking needs to be reversed ASAP; an one-site storage container of theirs is in prime habitat, and needs to be hauled away now.

5E) BUILD THE VISITOR CENTER OFF THE RESERVE! The land area is so shrunken, we need every inch to work for nature; like all parkland, plopping a large building in the middle of the space- surrounded by a parking lot that will inevitably expand, is no good! At the east end of Playa del Rey are several building lots that might work well.

5F) FEND OFF PROPERTY ATTACKS ON THE RESERVE: An unauthorized gravel parking lot in Playa del Rey north of Gordon's Market & east the Matilla Center sits entirely on Ballona reserve lands. An unauthorized Friday carwash business conducts business there with hoses in the parking lot behind the Matilla Center, operating entirely on the State reserve; not only does the State receive no income from this, the car wash soap, dirt, and automotive fluids sink through the gravel into the wetlands; where's the EIR for that? Local architect Craig Fraulino publicly proposed using State lands (for free) to build an alley/ parking to serve the north "backs" of Culver Boulevard businesses, converting adjacent Titmouse Park (Los Angeles City) for a parking lot, and building a multi-storey parking garage over the unauthorized gravel lot to accommodate businesses and Reserve vistors. As property lines begin immediately at the "backs" of these buildings, this is entirely on State lands. Several of these businesses have already dumped gravel on State Lands anyway- a defacto unauthorized alleyway for which they pay nothing... and because when nothing is done, the assumption is the owner (in this case, the State) doesn't care. When it was pointed out they haven't paid any money for this land, it's not for sale, their schemes have no scientific standing, they had no answer. Really, this property line should be immediately surveyed, fenced, closed, and lands restored by the State (there is a seasonal wetland just north of the buildings, & Silvery legless lizards have been found at the backs of the buildings). The ICF plan shows a black area along the backs of these businesses; the Legend describes it as "Other;" there is another large black block at the southe-central edge of the site where below The Gas Company property; this cannot go unexplained.

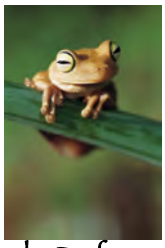
6) PROGRESSIVE TRANSPORTATION NOW! Another large black mark slashing through the middle of La Ballona ICF map is the Culver Boulevard right-of-way, the main killing-grounds of La Ballona wildlife, whose speed limit is soon to be raised. Progressive Transportation here means: building a "complete steet", upending the dominance of cars everywhere, and reordering/ inverting our priorities to 1) Walking 2) Biking 3) Transit 4) Automobiles. Opportunities to apply this at La Ballona should be integral to nearly every Alternative, as they stop the slaughter of the *prime thing* people would visit want to see: WILDLIFE! First, put a stop sign at Culver & Pershing to slow the cars down. Convert 2 traffic lanes eastward from Culver Boulevard to parking lanes for Ballona visitors. 2nd, Sawcut & remove the foolish "Culver Loop." Divert all eastbound car traffic on Culver onto Jefferson with a row of steel bollards (only Fire & Police Departments can open), and another row of same bollards closing westbound Culver at the 91 freeway ramps. Sawcut & remove all but 1 lane (= 2 bike lanes) of existing paving between these 2 points; this is the new 2-way Culver bike trail. On the center top of the bridge over Lincoln, build a bike service station with water & parts, and binoculars for wildlife observation. 3rd, Provide a decomposed granite (d.g.) trail next to the bike trail. Rebuild the Los Angeles Pacific Railway (later Pacific Electric) on its historic alignment to Playa del Rey as a slow-moving, quiet

platform to observe wildlife from. Rebuild its bridge spanning its existing Art Deco abutments over Lincoln Boulevard. Store the rail cars (build copies of the ones at the Port of LA, built for the Waterfront Red Cars in San Pedro, which are exactly correct) into EZ storage (North side of Culver Boulevard, where it can meet the Culver City bus there. Skip the sight of roadkill, and enjoy the wildlife experience.

On behalf of nature- who knows best,

(John Jay Ulloth)

BALLONA INSTITUTE
restoration, research, education, artistic expression



Wetlands Defense Fund

October 23, 2012

Ballona Wetlands Restoration Project
LEAD AGENCIES:
United States Army Corps of Engineers
Colonel Mark Toy c/o Daniel Swenson
California Dept. of Fish & Game
Director Charlton H. Conham, c/o David Lawhead

and c/o Donna McCormick
consultant hired by the Santa Monica Bay Restoration Foundation and/or
CA State Coastal Conservancy
1 Ada, Suite 100
Irvine, CA 92816

Re: NOP for Ballona Wetlands "restoration project"

Dear Colonel Toy DFG Director Bonham, and Ms. McCormick,:

Please accept these comments as part of the public response for scoping comments called for by the US Army Corps of Engineers and the California Dept. of Fish & Game. We understand that, as a result of requests by U.S. Congressmember Janice Hahn, CA Senator Ted Lieu and LA City Councilman Bill Rosendahl, that comments are still being accepted until 5 pm today. We are, thus, submitting these comments via email by 5 pm pacific time. We also understand you will accept comments from the Venice Neighborhood Council (VNC) tomorrow, based on an agreement made verbally between Mr. Lawhead and Marc Saltzberg of the VNC.

We have read and are in agreement with the official comments submitted by Sierra Club's authorized voice on this topic – Sierra Club's Ballona Wetlands Restoration Committee. Please include their comments in our submission, and also please reply to the following in your draft EIR/EIS documents so that the public can be fully informed about the plans for this project and any alternatives that might be considered.

1. Most importantly, please consider the Wildlife-Friendly Alternative that was developed by Playa del Rey-based Ballona Institute. Ballona Institute's naturalists and biologist have been the most consistent and persistent observers and documenters of wildlife

and habitat in the Greater Ballona Wetlands area since the 600+ acres of coastal lands became public in 2003-2004.

Please also consider this Wildlife-Friendly Alternative as the PREFERRED ALTERNATIVE, since it would adhere to the principles of the "Father of Ecological Restoration," Aldo Leopold, and would consider the impacts of what we don't know in terms of species which may not have been yet observed or documented, as well as the interdependency and connectedness of food webs and the equilibrium that has evolved during the past 50-80 years.

2. Please analyze and explain how the seasonal pond soil crusts will be protected during the proposed restoration and how, if not protected, what the loss will be to the various ecological systems which depend on them.

3. Please analyze and fully consider the ground-nesting bee species. Document them, explain their roles in the ecosystem as pollinators and describe the losses to the ecology of the various coastal mosaics of habitats that the destruction of these species' habitats will translate to.

4. Please apply the rejuvenation principles that our organizations, as well as Sierra Club and several other groups have supported to each of the proposed alternatives and proposed projects in the EIR/EIS process.

5. Please analyze and explain how each of the following bird species present within the 600+ acres of the Ballona Wetlands state-owned land, as well as associated adjacent wild lands, will be impacted by the proposed restoration plan, explain their roles in the ecosystem, explain their foraging, roosting, breeding and shelter needs and then explain how each will be impacted by each of the alternatives considered, including the Wildilfe-Friendly Alternative (attached to this email message.)

    a. White-tailed Kite *(Elanus leucurus)*
    b. Western Meadowlark *(Sturnella neglecta)*
    c. California Gnatcatcher *(Polioptila californica)*
    d. Least Bell's Vireo *(Vireo bellii pusillus)*
    e. Blue-Gray Gnatcatcher *(Polioptila carulea)*
    f. Great Blue Heron *(Ardea herodias)*
    g. Northern Harrier *(Circus cyaneus)*
    h. Burrowing Owl *(Athene cunicularia)*
    i. Great Egret *(Ardea alba)*

j. Ash-throated Flycatcher *(Myiarchus cinerascens)*
k. Yellow-headed Blackbird *(Xanthocephalus xanthocephalus)*
l. Bullock's Oriole *(Icterus bullockii)*
m. Lazuli Bunting *(Passerina amoena)*
n. Blue Grosbeak *(Passerina caerulea)*
o. Hooded Oriole *(Icterus cucullatus)*
p. Barn Owl *(Tyto alba)*
q. Great Horned Owl *(Bubo virginianus)*
r. Tree Swallow *(Tachycineta bicolor)*

6. Please analyze and explain how each of the following butterfly species , explain their foraging, roosting, nesting and shelter needs present within the 600+ acres of the Ballona Wetlands state-owned land, as well as associated adjacent wild lands, (and any others that should be documented and may be impacted) will be impacted by the proposed restoration plan, explain their roles in the ecosystem, explain their foraging, breeding and shelter needs and then explain how each will be impacted by each of the alternatives considered, including the Wildlife-Friendly Alternative (attached of this email message.)

a. Western Tiger Swallowtail Butterfly *(Papilio rutulus)*
b. Monarch Butterfly *(Danaus plexippus)*
c. El Segundo Blue Butterfly *(Euplilotes battoides allyni)*
d. Pygmy Blue Butterfly *(Brephidium exile)*
e. Wandering Skipper *(Panoquina errans)*
f. Painted Lady Butterfly *(Vanessa cardui)*
g. Acmon Blue Butterfly *(Plebejus acmon)*
h. Mourning Cloak *(Nymphalis antiopa)*
i. Buckeye Butterfly *(Junoia coenia)*
j. Mormon Metalmark *(Apodemia mormo)*
k. Red Admiral *(Vanessa atalanta)*

7. Please document, analyze and explain how the various spider species present within the 600+ acres of the Ballona Wetlands state-owned land, as well as associated adjacent wild lands, will be impacted by the proposed restoration plan, explain their roles in the ecosystem and then explain how each will be impacted by each of the alternatives considered, including the Wildlife-Friendly Alternative (attached of this email message.)

8. Please document, analyze and explain how each of the various moth species present within the 600+ acres of the Ballona Wetlands state-owned land, as well as associated

adjacent wild lands, will be impacted by the proposed restoration plan, explain their roles in the ecosystem and then explain how each will be impacted by each of the alternatives considered, including the Wildlife-Friendly Alternative (attached of this email message.)

9. Please document, analyze and explain how each of the various mushroom and other fungi species present within the 600+ acres of the Ballona Wetlands state-owned land, as well as associated adjacent wild lands, will be impacted by the proposed restoration plan, explain their roles in the ecosystem and then explain how each will be impacted by each of the alternatives considered, including the Wildlife-Friendly Alternative (attached of this email message.)

10. Please document, analyze and explain how each of the various lichen species present within the 600+ acres of the Ballona Wetlands state-owned land, as well as associated adjacent wild lands, will be impacted by the proposed restoration plan, explain their roles in the ecosystem and then explain how each will be impacted by each of the alternatives considered, including the Wildlife-Friendly Alternative (attached of this email message.)

11. Please document, analyze and explain how each of the various SAV (Submerged Aquatic Vegetation) species present within the 600+ acres of the Ballona Wetlands state-owned land, as well as associated adjacent wild lands, will be impacted by the proposed restoration plan, explain their roles in the ecosystem and then explain how each will be impacted by each of the alternatives considered, including the Wildlife-Friendly Alternative (attached of this email message.)

12. Please analyze and explain how the various ant and ant-like species present within the 600+ acres of the Ballona Wetlands state-owned land, as well as associated adjacent wild lands, including those documented in Area A (which is proposed for heavy dredging and alteration) in the Ralph Schreiber LA County Natural History Museum report will be impacted by the proposed restoration plan, explain their roles in the ecosystem and then explain how each will be impacted by each of the alternatives considered, including the Wildlife-Friendly Alternative (attached of this email message.)

13. Please analyze and explain how the various dragonfly and damselfly species present within the 600+ acres of the Ballona Wetlands state-owned land, as well as associated adjacent wild lands, will be impacted by the proposed restoration plan, explain their roles in the ecosystem and then explain how each will be impacted by each of the alternatives considered, including the Wildlife-Friendly Alternative (attached of this email message.)

14. Please analyze and explain how the various beetle species present within the 600+ acres of the Ballona Wetlands state-owned land, as well as associated adjacent wild lands, will be impacted by the proposed restoration plan, explain their roles in the ecosystem and then explain how each will be impacted by each of the alternatives considered, including the Wildlife-Friendly Alternative (attached of this email message.)

15. Please analyze and explain how the various additional insect species (not covered in other requests in this letter) present at Ballona will be impacted by the proposed restoration plan, explain their roles in the ecosystem and then explain how each will be impacted by each of the alternatives considered, including the Wildlife-Friendly Alternative (attached of this email message.)

16. Please analyze and explain the ecological significance of the Ballona Tule Fog, present approximately 1/3 to 2/3 of the mornings each year in the Ballona Valley, and then please analyze and explain how the proposed project, as well as various alternatives, would impact the presence of the Ballona Tule Fog, especially since observations include the non-presence of the Ballona Tule Fog in the deeper Ballona Creek channel, while its presence persists in Areas A, B and C.

    a. Which species are supported by the presence of the Ballona Tule Fog?

    b. How does the Ballona Tule Fog impact the ground saturation and ponding of water in seasonal ponds?

    c. How does the Ballona Tule Fog interact with the soils, the plants, the animals, and how would its diminishment impact these aspects of Ballona?

    d. How does the Ballona Tule Fog interact with other parts of the Greater Ballona Wetlands Ecosystem, including the Freshwater Marsh, the various City-owned Lagoons, the bluff restoration and LAWA-owned nearby open space, wild areas, and how would its diminishment or other impacts during construction and after impact these various areas?

17. Please analyze and explain how the various small mammal species (including, but not limited to the South Coast Marsh Vole – *Microtus californicus*) present within the 600+ acres of the Ballona Wetlands state-owned land, as well as associated adjacent wild lands, will be impacted by the proposed restoration plan, explain their roles in the ecosystem and then explain how each will be impacted by each of the alternatives considered, including the Wildlife-Friendly Alternative (attached of this email message.)

18. Please analyze and explain all impacts to wildlife and to adjacent neighborhoods the construction traffic, as well as air pollution from diesel fumes and any other environmental impacts from the heavy machinery contemplated for use in the industrial mechanized bulldozing and earthmoving alteration plan, as well as the associated impacts from other alternatives, including the Wildlife-Friendly Alternative.

19. Please detail, analyze and explain all impacts and from hardscape of concrete, steel and other contemplated unnatural features the proposed project would have on the habitat as well as on individual species and imperiled populations of species.

20. Please detail, analyze and explain all impacts to commuter traffic from contruction and other associated project components.

21. Please detail, analyze and explain which specific species will be helped by the proposed changes in soil elevation the project contemplates.

22. Please detail, analyze and explain which specific species will be helped by the proposed changes in water and soil salinity the project contemplates.

23. Please detail, analyze and explain which specific species will be helped by the proposed changes in soil elevation the project contemplates.

24. Please detail, analyze and explain which specific species will be helped by the proposed changes in pH the project contemplates.

25. Please detail, analyze and explain which specific species which COULD BE REINTRODUCED to the Ballona Wetlands Ecological Reserve will be helped by the proposed changes the project contemplates. Specifically, these species:

    a. Los Angeles Sunflower *(Helianthus oliveri)*
    b. Saltmarsh Bird's Beak *(Cordylanthus maritimus)*
    c. Pacific Pocket Mouse *(Perognatus longimembris pacificus)*
    d. Ventura Marsh Milk-vetch *(Astragalus pycnostachyus var. lanosissimus)*
    e. California Quail *(Callipepla californica)*
    f. Greater Roadrunner *(Geococcyx californianus)*
    g. Bald Eagle (nesting) *(Haliaeetus leuococephalus)*
    h. Osprey (nesting) *(Pandion haliaetus)*
    i. Tidewater Goby *(Eucyclogobius newberryi)*
    j.

26. Please analyze whether or not the above-listed species (in request #25) could be reintroduced to the Ballona Wetlands Ecological Reserve without the proposed project being completed and whether or not

27. Please review and analyze all relevant historical maps and reports related to the Ballona Wetlands and determine whether or not the proposed project and its alternatives protect and maintain features that were historically present on the Los Angeles coast during the last 300-500 years.

28. Please review and analyze all relevant scientific reports and other observations that indicate whether or not year-round full tidal openings to the sea were conditions that the Ballona marsh lands and its inhabitants evolved with.

29. Please review the legal requirements related to whether or not pollution from one impaired water body, i.e., Ballona Creek, is allowed to be diverted into another impaired water body, i.e., the Ballona Wetlands Ecological Reserve areas that are on either side of the Ballona Creek estuary.

30. Please analyze and explain how the interruption of secession of plants and the associated ecological systems will impact various species and habitats that have been healing and evolving since the 1960s when the last heavy alteration of Area A and Area C occurred. Include scientific predictions of how many years this secession will be set back and how many years it will be until a similar ecological equilibrium will be set.

31. Please analyze the equilibrium of the various mosaic of ecosystems present at the state-owned Ballona Wetlands ecosystem lands currently. Note the number of years each ecosystem type has been in a state of relative equilibrium, how many years it took to reach this state, and then predict how many more years it will take to achieve a similar state of equilibrium – if the proposed project proceeds. Please also include which species will be displaced with the proposed project and note how these species will be able to return – will they return on their own? How?

32. Please detail, analyze and explain how all cultural historical and religious resources, including both those from the native First Nation people, as well as those from the past 100 years, will be properly respected and avoided in terms of protection of these resources.

33. Please explain how the avoidance criteria for wetlands protection that the US EPA has often insisted upon will be upheld during the process of carrying out any and all of the alternatives discussed in the EIR/EIS.

Thank you once again for the opportunity to comment. We trust that you will research and reply to each and every one of these comments, as the rare and imperiled ecosystem that the Ballona Wetlands is, including its mosaic of habitat types is unique and irreplaceable.

Please add our organizations to your mailing list:
Wetlands Defense Fund
322 Culver Blvd., Ste. 317
Playa del Rey, CA 90293

Ballona Institute
322 Culver Blvd., Ste. 317
Playa del Rey, CA 90293

Should you have further questions, feel free to call Ballona Institute at: 310-823-7040 or Wetlands Defense Fund at (310) 821-9045.

Robert Roy van de Hoek

Robert Roy van de Hoek /s/

Conservation Biologist & President
Wetlands Defense Fund

Marcia Hanscom

Marcia Hanscom /s/

Executive Director
Ballona Institute

Support the Wildlife-Friendly Alternative for Ballona

"A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise."
~ Aldo Leopold, 1949, A Sand County Almanac

1. FIRST DO NO HARM ~ Detailed, seasonal, unbiased baseline surveys of the species and ecosystem at Ballona are needed in order to know what is here and to know how the ecological processes are interacting with the equilibrium which exists after more than 70 years of the Ballona Creek estuary channel being constructed and after nearly 50 years of the marsh mud having been placed on parts of Areas A & C. Protect all rare and imperiled species, and determine what habitat is needed to support this protection.

2. ACQUIRE MORE LAND ~ The Committee to Complete the Park has identified nine open spaces on the Ballona Wetlands Ecological Reserve edges where open space and habitat support the ecological functioning of Ballona. These places are threatened with development and erasure of the existing habitats; this land provides foraging space, wildlife corridors and other important functions for species which call Ballona home.

3. UNDERGROUND UTILITY WIRES ~ Current utility wires crisscross the Ecological Reserve, causing injury and death to birds and visual blight to the beautiful landscape.

4. COMMUNITY-BASED RESTORATION ~ Community groups have been and want to continue to remove non-native plant species (those which are not providing habitat to native animals) by hand with shovels and other tools (no poisons; no bulldozers.) This sort of go-slow human-involved regime not only enhances ecological education and stewardship values, but provides a far better chance of preservation of sensitive species which might be unknown to those doing the work.

5. REMOVE DEAD PALMS ~ These trees along Culver Boulevard; these are fire hazards, harbor nonnative animal species and cause visual blight of the beautiful landscape.

6. SECURE THE RESERVE ~ Fence and secure areas immediately adjacent to urbanized, inhabited areas to prevent dog, cat and human unauthorized trampling.

7. CALM TRAFFIC & ENCOURAGE WILDLIFE CROSSINGS ~ All roads traversing the Ecological Reserve need to have traffic calming measures implemented by LA DOT and CalTrans. Explore and implement wildlife crossings and other road conversions to decrease road kill of wildlife and to open up bicycle and walking paths.

8. VIEWING PLATFORMS & WALKING TRAIL ~ Install viewing platforms at four city-owned properties directly abutting the Ecological Reserve. Designate Cabora Dr. a historical walking trail, install view areas, including scopes and interpretive signage.

9. PARKING ~ Work collaboratively with the business and residential communities to create parking that works for everyone.

10. RESTORE ANIMALS & PLANTS ~ Build nesting platforms for Bald Eagle & Osprey. Return Roadrunner, Los Angeles Sunflower, Pacific Pocketmouse & California Quail.

FOR INFORMATION, call 310-823-7040. www.ballonainstitute.org/discover.html

1. 21st century, incremental, community involved ecosystem rejuvenation that is in harmony with natural laws . We are opposed to industrial-scale habitat conversion, including major bulldozing, which destroys existing ecosystems.

2. In appreciation of what is there now, recognize the resiliency of the ecosystems and identify areas that require no more than observation for the foreseeable future.

3. In recognition of the importance of gaining control of more acreage before it is built on, or otherwise negatively impacted, give priority to acquisition/addition of additional unprotected parcels of land at a reasonable price to the Ballona Wildlife Refuge, over restoration activities. Such land protection will increase habitat enhancing buffer zones for wildlife and plants, and decrease car trips in the area, which lead to animal road fatalities.

4. Utilize existing opportunities to access the refuge, such as the Ballona Creek bike path, and south earthen levy along Ballona Creek and install a walking/biking path around as much of the perimeter of the refuge as is ecologically feasible.

5. Utilizing existing infrastructure such as the old Pacific Railway bridge supports and other man made structures, along with materials that have the deepest sustainability, create wildlife, bicycle, and walking linkages that connect all areas of the ecosystems in a fashion that allow homo sapiens and animals alike, to safely go over or under all roads and waterways that divide the refuge.

6. In recognition of the importance of enhancing the beauty of the refuge, safety of birds and other mammals, and the reduction of light pollution, move all power, telephone, and cable lines underground, and remove the majority of street lighting.

7. Endangered, threatened, and imperiled species must be given priority for protection in any refuge alteration considerations.

Supported by numerous environmental and community groups, including Ballona Wetlands Land Trust, Sierra Club, Ballona Institute, Ballona Ecosystem Education Project, Grassroots Coalition and Wetlands Defense Fund

1/19/2012

Jones, Tanya

From: Ballona Wetlands [mailto:landtrust@ballona.org]
Sent: Tuesday, October 23, 2012 12:51 PM
To: daniel.p.swenson@usace.army.mil; DLawhead@dfg.ca.gov; McCormick, Donna; Shelley Luce
Cc: Walter Lamb
Subject: Scoping Comments for Ballona Restoration Project

Dear Project Team -

Please see the attached PDF file containing the public scoping comments from the Ballona Wetlands Land Trust in response to the NOI for the Ballona Wetlands Restoration Project. Please confirm receipt of this document. Please also do not hesitate to contact me by phone or by e-mail to discuss these comments. We look forward to reviewing the first draft of the EIS/EIR when it is complete.

Sincerely,

Walter Lamb
President
Ballona Wetlands Land Trust
310-839-3436

Ballona Wetlands Land Trust

Public Scoping Comments in Response to 7/25/2012 Notice of Intent to Prepare a Draft Environmental Impact Statement/Environmental Impact Report for the Proposed Ballona Wetlands Restoration Project

Submitted by Walter Lamb on 10/23/2012
walter.lamb@earthlink.net
310-839-3436
on behalf of the Ballona Wetlands Land Trust
landtrust@ballona.org

Confirmation of Receipt Requested

To:

Dr. Daniel P. Swenson, US Army Corp of Engineers
David Lawhead, California Department of Fish and Game
Dr. Shelley Luce, Santa Monica Bay Restoration Commission
Donna McCormick, ICF International

[Note: These comments were approved unanimously by our Board of Directors at our October 18th meeting.]

Most projects requiring environmental review under federal or state law have primary objectives that are not environmentally oriented, and the review process is designed to mitigate any negative environmental impacts associated with those projects. However, in the case of the Ballona Wetlands Restoration Project, the primary stated objective is to improve the environmental function of the site. Therefore, the EIS/EIR being prepared for this project must meet a higher standard by clearly demonstrating to the public not just that negative environmental impacts will be mitigated, but that the project will lead to a significant and measurable overall improvement in the ecological health of the site. As such, we urge the project team to address all of the important questions and comments being suggested by the public, even those that may not traditionally be within the scope of an EIS/EIR.

As the Santa Monica Bay Restoration Commission's Baseline Monitoring Reports indicate, the Ballona Wetlands already provide habitat for hundreds of species of plants and animals, some of which have special protection status at the state or federal level. To justify the significant cost and risk associated with reconstructing the entire ecosystem, the Environmental Impact Statement/Report must accomplish the following:

- Thoroughly document the incremental costs and risks of each alternative relative to each other alternative. This should include, but not be limited to:

  - Studying and documenting the potential risk of pollutants from the Ballona Creek entering into the wetlands and how that risk will be mitigated.
  - Researching and documenting examples of unintended consequences from past restoration efforts and explaining what measures the project team has taken or will take to avoid unintended consequences for this project.
    - See "On the Perils of Ecological Restoration: Lessons from the El Segundo Blue Butterfly" [Longcore et al, 1997] for a specific example of unintended consequences in a restoration.
    - See also "Handbook for Restoring Tidal Wetlands" [ed. Joy Zedler, 2001], Chapter 1, Section 1.3 for additional examples of unintended consequences in a restoration.
  - Analyzing and documenting the potential negative impact on any bird species favored by the existing habitat mix.
- Thoroughly document the anticipated incremental benefits to the ecosystem associated with each alternative relative to each other alternative. This should include, but not be limited to:
  - Studying and documenting the potential benefit of enhanced hydrology of the site by allowing greater tidal flow.
  - Analyzing and documenting the potential positive impact to any bird species favored by the proposed habitat mix.
- Demonstrate beyond a reasonable doubt that each anticipated benefit associated with a particular alternative will indeed materialize as a result of executing that alternative, and identify tangible metrics that would be used to determine the ultimate success or failure of the project in that regard. This should include, but not be limited to:
  - Using historical examples, demonstrate the expected improvement in the hydrology of the site for each alternative and document what metrics will be used to determine the extent of improvement achieved.
  - Using historical examples, document the anticipated impact of polluted waters on the ecosystem and document what metrics will be used to determine the success of various mitigation efforts.
- Explain why the incremental benefits for a particular alternative, by themselves, justify the incremental cost and risk of that alternative and demonstrate beyond reasonable doubt that the benefits associated with a particular alternative cannot be achieved by any smaller scale alternative. This should include, but not be limited to:
  - Analyzing the ability of each alternative to provide recreational and educational opportunities relative to other alternatives. For example, the existing site already provides significant educational and recreational opportunities and these activities are constrained primarily by access restrictions that aren't related to project design. When listing education and recreation as benefits for a particular alternative, the EIS/EIR

should focus only on what additional benefit that particular alternative makes possible relative to the other alternatives.

- As above, analyzing the relative benefits provided by each alternative for trash removal, removal of invasive species, enhanced hydrology, etc.

Costs / Risks:

In order to provide an objective environmental impact assessment, the project team must be as diligent in uncovering and communicating the various costs and risks associated with the different project design alternatives as they are in communicating the anticipated benefits. This includes:

- Providing examples of other restoration efforts in which the outcome fell short of the stated goals, what factors led to not achieving stated goals, and how the project team will avoid similar outcomes with this restoration project.
- Listing any assumptions and any possible risk factors which could cause the outcome of each particular alternative to fall short of its desired goals.
- Thoroughly documenting any anticipated negative consequences of each particular alternative, such as any loss of native species, habitat type, etc.

Benefits Specific to, and Exclusive to, Each Alternative Project Design:

Because the purpose of this project is to improve the ecological health of the Ballona Wetlands Ecological Reserve, the EIS/EIR must do more than address potential negative environmental impacts. To justify any project alternative, the EIS/EIR must clearly outline the specific benefits that each alternative is expected to achieve. The EIS/EIR must explain why each of these benefits can reasonably be expected to result from a particular alternative, list any assumptions upon which the benefit depends, and demonstrate why no less intrusive alternative could achieve a similar benefit. Sample benefits may include:

- The anticipation of new species that are currently rare or absent in the reserve. Arguments of this nature should provide detailed information on why the new species would be more likely to flourish under the conditions envisioned for a particular alternative. For instance, "Butterfly species X relies almost exclusively on plant Y for survival. Plant Y is expected to increase by 20% within 2 years of project inception."
- Increased recreational and educational opportunities. This type of benefit must be quantified consistently across all alternatives for "apples to apples" comparison.
- Enhanced water quality in the Santa Monica Bay. This type of benefit requires thorough scientific backing. Any assumptions or conditions must be clearly outlined. Alternatives such as upstream pollution mitigation should be studied and documented.

A more detailed listing of specific cost/benefit categories is below.

Risks/Benefits of Replanting and Fertilizer Use, etc.

The EIS/EIR should analyze and clearly document the details behind any planned replanting efforts, including any use of fertilizers as part of those efforts, and also analyze any potential short and long term impacts of those efforts and how the project team will mitigate against any potential negative impacts.

Hydrology Issues

The EIS/EIR should include a comprehensive hydrology study that analyzes and clearly documents all inflows and outflows of groundwater and surface water and also analyzes the potential impact of existing water usage from local communities on the current hydrology.

Species Level Impact Analysis

To truly understand the environmental impact of the various project alternatives requires a species level impact analysis. Such an analysis forecasts the likely impact of the project design on each individual species within the ecosystem. Since there are hundreds of species of plants and animals, and since resources for this EIS/EIR are limited, the most critical species should be addressed first and as many as possible in order of importance thereafter. If there are insufficient resources to cover a sufficient number of species in the analysis, then either more resources should be considered, or the lack of sufficient analysis should be documented and appropriately factored into the decision making process. After all analyzed species have been addressed, the EIS/EIR should include a list of all other species which currently utilize this ecosystem, or which have a reasonable likelihood of utilizing this ecosystem in the future, under the heading "Species not analyzed in this EIS/EIR" or something to that effect.

It is important to note that the limited species level impact analysis included in the 2010 Preferred Alternatives Memorandum is inadequate because it addresses too few species, contains too little detail, and often lacks any actual projection of the impact on a particular species. For instance, only seven species of birds are listed as target species. Dan Cooper's list of special status bird species includes 12 resident birds, 10 regularly occurring species, 8 non-regularly occurring species, 2 extirpated species, 8 species that were either extirpated prior to 1900 or that were always scarce, and 12 species that are not protected but which are locally significant and which depend heavily on the Ballona ecosystem.

Therefore, the EIS/EIR should include, at a minimum, detailed impact analysis for the following bird species (from http://www.cooperecological.com/special_status_speciesweb.htm):

F = Federally Endangered/Federally Threatened

S = State Endangered/State Threatened

C = Calif. Bird Species of Special Concern (see: http://www.prbo.org/cms/index.php?mid=230&module=browse)

FP = "Fully-protected" (see: http://www.dfg.ca.gov/hcpb/species/t_e_spp/fullypro/fully_pro.shtml)

I = Near-threatened (per BirdLife International's Red Data Book)

Resident (summer, winter or permanent)

Least Bittern C

California Brown Pelican S,F,FP

Redhead C

Peregrine Falcon S, FP

White-tailed Kite FP

Elegant Tern C,I

California Least Tern S,F,FP

Loggerhead Shrike C

Clark's Marsh Wren C

Belding's Savannah Sparrow S

Large-billed Savannah Sparrow C

Yellow-headed Blackbird C

Occurring regularly (but in migration only)

Brant C

Northern Harrier C

Western Snowy Plover F,C

Long-billed Curlew C

Royal Tern C

Burrowing Owl C

Vaux' Swift C

Willow Flycatcher C

California Swainson's Thrush C

Yellow Warbler C

"Locally significant" (though unprotected/non-sensitive) species particularly dependent on Ballona in coastal L.A. County, either currently or historically.

American Bittern

White-faced Ibis

Common Moorhen

Pacific Golden-Plover (extirpated 1980s)

Red Knot

Wilson's Phalarope

California Quail (extirpated 1980s)

Black-bellied Plover

Bonaparte's Gull

American Pipit

Western Meadowlark

Blue Grosbeak

Not regularly occurring, but occasionally seen

American White Pelican C

Black Skimmer C

Marbled Murrelet S,F,I

Short-eared Owl C (formerly wintered; extirpated 1980s)

Horned Lark C (formerly year-round resident; extirpated 1970s)

Olive-sided Flycatcher C

Bank Swallow C

Yellow-breasted Chat C

Totally extirpated (no recent records)

Light-footed Clapper Rail S,F,FP (two records since 1950s)

Black Tern C (four records since 1950s)

Either extirpated prior to 1900, or always scarce (not enough information)

Bald Eagle S,F,FP

Fulvous Whistling-Duck C

California Black Rail S, FP

Sandhill Crane C,S,FP

Mountain Plover C

Long-eared Owl C

Bell's Sage Sparrow C

California Gnatcatcher F

Additionally, there are many other species of bird, including but not limited to: Snowy and Great Egret, Black-necked Stilt, Red-tailed Hawk, Cooper's Hawk, American Kestrel, Common Yellow-throat, Ash-throated Flycatcher, etc. that are not considered sensitive species but which play an important role in connecting members of the public with the ecosystem via beginner bird walks. Therefore, it is important that as many bird species as possible be analyzed. Dan Cooper's annotated checklist and the Baseline Monitoring reports should be used as guides for species inclusion in this impact analysis.

More detailed analysis that what was offered in the 2010 memorandum is required. For instance, the analysis of the White-tailed Kite simply indicates that "The presence of white-tailed kites in the restored Ballona system *would* indicate functional upland habitats and small mammal populations." (italics added by me for emphasis). It is not sufficient to indicate what the presence of a particular species would indicate. The EIS/EIR must indicate what level of presence of a species is expected in the proposed new habitat mix. Since White-tailed Kites are consistently (albeit seasonally) reported in the ecosystem currently, the EIS/EIR should indicate whether more or fewer should be anticipated (or whether they

would be expected during a greater or shorter portion of the year, especially breeding) after the restoration.

It is also necessary to analyze potential impact at a more detailed level than habitat type. For instance, in their analysis of the current plan, the Los Angeles Audubon Society noted that "The plan appears to remove all existing habitat for the State-endangered Belding's Savannah Sparrow." However, it the 2010 memorandum's comments on the same species, project consultants predicted that "Restoration of large areas of marsh plain, as currently envisioned for Ballona, should substantially increase the size of the resident population." This makes clear the need for a more careful analysis of not just habitat type, but specific species relationships, such as Pickleweed in the case of Belding's Savannah Sparrow.

The same standards described for birds above also apply to all of the other categories of biological diversity as outlined in the Baseline Monitoring Reports (i.e. vegetation, ichthyofauna, herpetofauna, mammals, benthic invertebrates and terrestrial invertebrates). For instance, the EIS/EIR should analyze and document the impact of the various alternatives on the El Segundo Blue Butterfly, especially the impact of disturbing restored dune habitat in the Southwest corner of the reserve by adding a large dirt berm (as noted by Los Angeles Audubon Society's review of the current preferred alternative). Likewise, the EIS/EIR should analyze the impact on Lewis' Evening Primrose, which has been observed in multiple areas which would undergo significant change under the preferred alternative. These are just selected examples, and the EIS/EIR should analyze the impact on as many plant and animal species as possible, clearly documenting any species which are not studied and the reason they were not studied.

Potential Conflict Between Competing Objectives

It is to be expected that the various project alternatives must meet certain objectives that are not purely ecological in nature. However, any aspect or feature of a particular alternative that does not maximize the ecological potential of the Wetlands should be clearly documented and explained. This should include, but not be limited to, the following:

1. **Flood Control**

   The EIS/EIR should clearly document every feature that is designed primarily for flood control purposes and should analyze the impact of such features on the ecology of the site. For example, the EIS/EIR should study the ecological impact of several large dirt mounds and berms, depicted on the project map as "upland scrub," as well as the feature described on several grading maps as the "Habitat Peninsula." Which species of plant and animal are expected to flourish in these areas and how does that compare to the potential biodiversity that could be attained if a particular flood control feature were not necessary? [See above example on how the flood control berms could disturb habitat for El Segundo Blue Butterfly]

The EIS/EIR should analyze the threat of flooding and clearly document what areas and properties are at risk and would be the beneficiaries of the proposed flood control features. This should be depicted with clearly marked maps.

2. Pollution

The EIS/EIR should clearly document every feature that is designed primarily for pollution mitigation purposes and should analyze the impact of such features on the ecology of the site.

3. Other

The EIS/EIR should clearly document every feature that is designed primarily for any other purpose than ecological function and should analyze and document the impact of each such feature on the ecology of the site. This includes any feature or design aspect that relates to property rights/community issues, engineering constraints, infrastructure constraints, legal constraints, political constraints, etc.

Such disclosures and analysis are critical for the public to make informed decisions on the relative risk and reward of each alternative from an ecological perspective.

Road Kill

Studies have indicated that road kill accounts for up to 3,500 road kill deaths per year. This has negative ecological and human safety / public health ramifications. The EIS/EIR should include a study of road kill in and around the BWER and an analysis of how the various project alternatives will impact road kill. For instance, the EIS/EIR should study the impact of the various flood control features described above to determine whether they could lead more animals to cross busy surface streets.

Acquisition

The relatively small size of the reserve (600 acres) has been noted by the project team ("*Ballona Wetlands Restoration Goals and Objectives, Opportunities and Constraints*", July 2006) as a limiting factor in the restoration. There are still undeveloped parcels of land that could significantly benefit the restoration process. As such, the EIS/EIR should include an analysis of those parcels and the potential impact of acquiring those parcels on the overall health of the ecosystem. There are certainly many practical constraints standing in the way of such acquisition, and those should be included in the analysis, but they are not a valid reason to not conduct the analysis.

Impact on Human Interaction and Appreciation

The ongoing health of this ecosystem will require significant public support. If the public feels cut off from the ecosystem, they may be less willing to support necessary funding for ongoing maintenance and improvements. Reduced public interaction may also increase the risk of misuse of the ecosystem, such as dirt-bike trails, littering, camping by squatters, etc. This is an important socioeconomic aspect of the proposed restoration.

Therefore the EIS/EIR should study the impact of any feature that might reduce public connection with the land, such as the rerouting of the bike trail and flood control features that might obstruct the public view into the wetlands. An artist's rendering should be included for all project alternatives, especially the "preferred alternative" that clearly shows the various proposed topographical features and their impact on the over aesthetic of the area. Attitudinal surveys of the public should be conducted to gauge whether certain design features would make them more or less likely to appreciate this natural resource.

Short and Long Term Maintenance of the Restoration Site

The EIS/EIR should clearly document the plan for long term maintenance of the restoration site. This should include, but not be limited to:

- Documenting budgetary plans to ensure proper maintenance strategies can be carried out for as long as they are necessary to secure the long term ecological health of the restoration site
- Analyzing the possible need for irrigation and the details behind any possible irrigation plans
- Documenting plans to address herbivore species of birds, mammals and insects
- Documenting plans to address potential macroalgal blooms
- Documenting plans to address potential sedimentation issues
- Documenting plans to address potential exotic plant invasions

Modeling Methods

For every predicted result contained in the EIS/EIR, a detailed description should be included of the modeling methodology used, along with any assumptions, parameters and data inputs used to inform the model. This is necessary for the public to understand the scientific reliability of the findings being presented.

Alternative Solutions

We are reluctant to propose alternative design proposals because we lack the financial resources and expertise to design a complete solution from scratch. We believe that it is the responsibility of the

various project agencies to reevaluate and modify their preferred alternative as necessary until it meets the high standard that this critical ecosystem deserves.

That said, we are interested in seeing an analysis of the feasibility of partially elevating Culver Blvd and other roads and trails to create greater continuity between the various sections of the ecosystem and request that this analysis be included in the EIS/EIR. We also request that thorough analysis of other design proposals addressing different options for allowing more water into the Wetlands via less intrusive methods be included in the EIS/EIR.

Summary

The Ballona Wetlands currently provide important habitat to numerous species of plants and wildlife. As is true of any project of this scope, the "preferred alternative" carries inherent risk in that it reconstructs much of the ecosystem. Given the importance of this natural resource, it is imperative that the public fully understands the potential risk and rewards of all project alternatives in a way that not only facilitates informed decision making, but allows us to measure the success of the project against tangible metrics.

We recognize that thoroughly analyzing all of the many factors that could impact this complex ecosystem will not be an easy task. However, we also believe that anything less puts this ecosystem at unnecessary risk. We simply cannot afford to wind up with diminished or even equal ecological value at the end of such an expensive project. There must be a clear and substantial ecological benefit for the project to be justified. We wish the project team luck in preparing the draft EIS/EIR and look forward to offering additional comments when it is complete. In the meantime, project leaders should not hesitate to contact our organization for clarification or other guidance.

Jones, Tanya

To: McCormick, Donna
Subject: RE: Ballona Wetlands restoration project DEIR-EIS scoping comments

From: Rex Frankel [mailto:rexfrankel@yahoo.com]
Sent: Tuesday, October 23, 2012 2:43 PM
To: Daniel.p.swenson@usace.army.mil; McCormick, Donna
Subject: Ballona Wetlands restoration project DEIR-EIS scoping comments

October 23, 2012, 2:42pm

Here is a 66 page pdf of our comments on the NOP-NOI for the Ballona Wetlands project.

It explains the need for analysis of a historically accurate alternative that is based upon conditions approximately 200 years ago, as opposed to the State's preferred alternative which is based on returning to conditions 4000 years ago.

If you have trouble reading our attached comments, they are posted here:
https://picasaweb.google.com/Rare.Earth.fotos/BallonaAlternativePlan

Thank you,

Rex Frankel
President, Ballona Ecosystem Education Project
6038 west 75th Street
Los Angeles, CA 90045
310-738-0861

IT'S TIME TO SAVE THE BALLONA WETLANDS FROM THE POLLUTERS AND DEVELOPERS, AGAIN



IN THIS SLIDE SHOW, WE TRY TO ADDRESS 2 MAJOR ISSUES IN THE STATE'S PROPOSED RESTORATION OF THE BALLONA WETLANDS:

1. WHAT IS A RESTORATION?
SHOULD IT BENEFIT WILDLIFE AND THE PUBLIC INTEREST, OR PRIVATE INTERESTS AND POLLUTERS?

2. WHY FLOODING THE WETLANDS WITH

POLLUTED WATER IS NOT A RESTORATION

IN 2003, THE TAXPAYERS OF THE STATE OF CALIFORNIA PURCHASED THE REMAINING UNDEVELOPED 600 ACRES OF THE BALLONA WETLANDS FROM PLAYA VISTA, L.A.'S LARGEST DEVELOPER, AND PREVENTED THE CONSTRUCTION OF 7000 CONDOMINIUMS UPON THEM

UNFORTUNATELY: Since this land became "ours", the State's land managers have decided this land is a massive development opportunity, too. And they propose to dramatically change the land into something it never was.

WE DISAGREE:

We believe the trash and non-native weeds need to be removed. We believe the wetlands can be returned to what they were before L.A. was developed without unleashing massive bulldozing equipment

THE STATE'S PUBLICLY STATED OBJECTIVE: to maximize estuarine habitat—meaning flood it all (even if historically most of the Ballona Wetlands was not under water all the time)

HIDDEN OBJECTIVE:

--to provide flood protection for Playa Vista's condos at taxpayer expense, and

--to clean up Ballona Creek's massive pollution problem by turning clean wildlife habitat into a massive pollution dumpsite

ISSUE 1: what date should we restore the wetlands to?

TO WHAT YEAR DO WE RESTORE TO?
WHEN EUROPEAN SETTLERS ARRIVED, OR
TO AN ERA THAT COINCIDES WITH THE STATE'S OTHER OBJECTIVES?

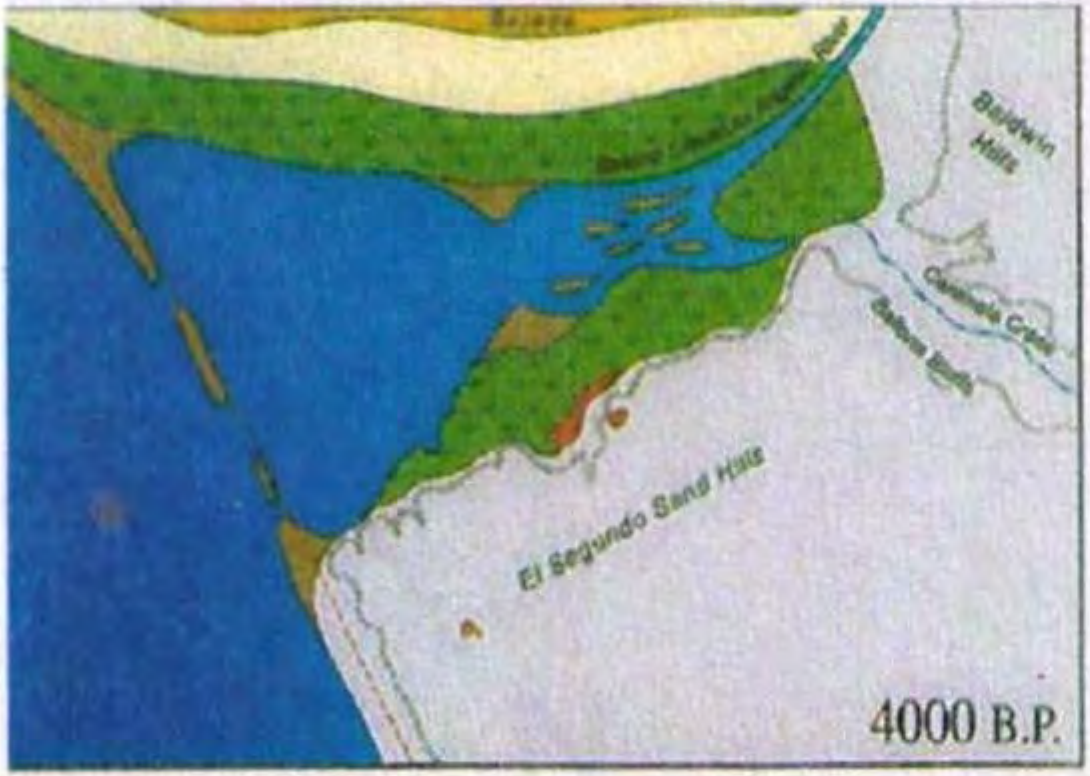
The State's plan would dig out a massive basin in the middle of the wetlands, and remove the levees along Ballona Creek, in order to provide full-time flooding to most of this land. This resembles to situation 4000 years ago.

In order to do this, 20 feet of soil would be removed from the northern wetlands parcel, and dumped 20 feet deep east of Lincoln Blvd and south of Culver Blvd. This would bury another 110 acres of wetlands and higher ground that is home to the rare Lewis' Primrose flower


+15
+20
REMOVE
20 FEET
+22
FILL WETLANDS
LINCOLN IS
NOW AT 10
FEET
ABOVE SEA
LEVEL

Stacking 20 feet of earth along Culver Blvd. would have the effect of preventing storms and sea-level rise from causing flooding of Playa Vista's condos. Is protecting a developer's flood-plain condos a good use of taxpayer money?

4000 years ago, Ballona Lagoon covered most of the lands now owned by the State and it was open to the ocean all year-round



4000 B.P.

Environment

- Sea level stabilizes
- Alluviation in inner bay leads to mudflats and sandbars
- Salt marsh expands to outer bay
- Beach spit barrier nearly closes outer bay
- Oyster and jackknife clams disappear, replaced by horn snails indicative of fresh water

Culture

- Settlement pattern remains stable
- LAN-62 community grows slowly

However, by 200 years ago, when the urbanization of Los Angeles began, a sand bar naturally formed every spring to keep the ocean out. So the Ballona wetlands dried up in the spring, summer and fall.



200 B.P.

Environment

- Sediments fill much of the lagoon
- Complex of sand islands and extensive salt and fresh water marshes develop

Culture

- Population congregates along lower Centinela Creek
- LAN-62 develops into a major village
- *Rancheria* settlements are established along lower Centinela Creek (LAN-211/H

Marsh
Sand
Alluvial fan
Coastal plain

Recorded archaeological site
Distributary channel
Approximate historical-period coastline
Escarpment

N

200 years ago, very little of the original 1700 acres of the wetlands or the 600 acres now remaining was a lagoon. Much of the lands that were lagoons 200 years ago are now saved as the Ballona Lagoon Marina Preserve, Del Rey Lagoon Park, the Venice canals and the Marina Del Rey yacht harbor. And contrary to popular belief, the Marina has substantial wildlife value, providing home to numerous types of shellfish, birds and seals.


Ballona Wetlands
Restoration Project
Historical Conditions
Historical Conditions
Historical Habitat Type (circa 1870s)
Marsh / Wetlands
Sand
Coastal Plain
Water
River / Creek
Current Ballona Wetlands Project Area Boundary
Coastal Conservancy

With the sandbar forming each spring, the inland wetlands dried up because the upstream Ballona Creek valley absorbed the rainfall. For an hour-long video explaining the history of the wetlands: See http://tinyurl.com/longcore-ballona

So, due to the formation of the sand-bar, 200 years ago the Ballona Wetlands had turned into a balance of three natural habitat communities, rather than just an arm of the ocean.

THOSE THREE HABITATS LARGELY ARE STILL PRESENT AT THE WETLANDS 200 YEARS LATER.

THEY ARE:

Salt marsh: home to fish from the ocean, migratory birds and numerous salt-water tolerant plants;



FRESHWATER MARSH:
Home to willow groves and frogs and numerous insects and amphibians;

AND UPLAND HABITAT:
Home to wildflowers, fragrant sagebrush, dense thickets of Laurel Sumac, and of course, miles of hiking paths



The State's endorsed plan to go back 4000 years bulldozes away much of the freshwater marsh and upland habitat to replace it with open ocean habitat.

Their plan also fills in 110 acres of wetlands, although they call it a wetland “restoration”

THE STATE'S PLAN IS NOT A RESTORATION TO WHAT BALLONA ONCE WAS:

It looks like 4000 years ago, in that it is open to the ocean all year round and is a mix of "fresh" water draining from the city and seawater. But 4000 years ago, this freshwater was clean, not full of urban pollution

So this is a restoration to something Ballona **never was**

A TRUE RESTORATION OF BALLONA IS TO WHAT IT WAS 200 YEARS AGO BEFORE MAN STARTED PLOWING, FARMING AND FILLING IN THE WETLANDS

ISSUE 2: The problem is that we cannot go back to exactly what it was 200 years ago as Ballona Creek is a polluted mess. It would actually harm the wetlands to reconnect them with Ballona Creek. It would not harm them, however, to reconnect them with the ocean.


Photo taken in Los Angeles, California

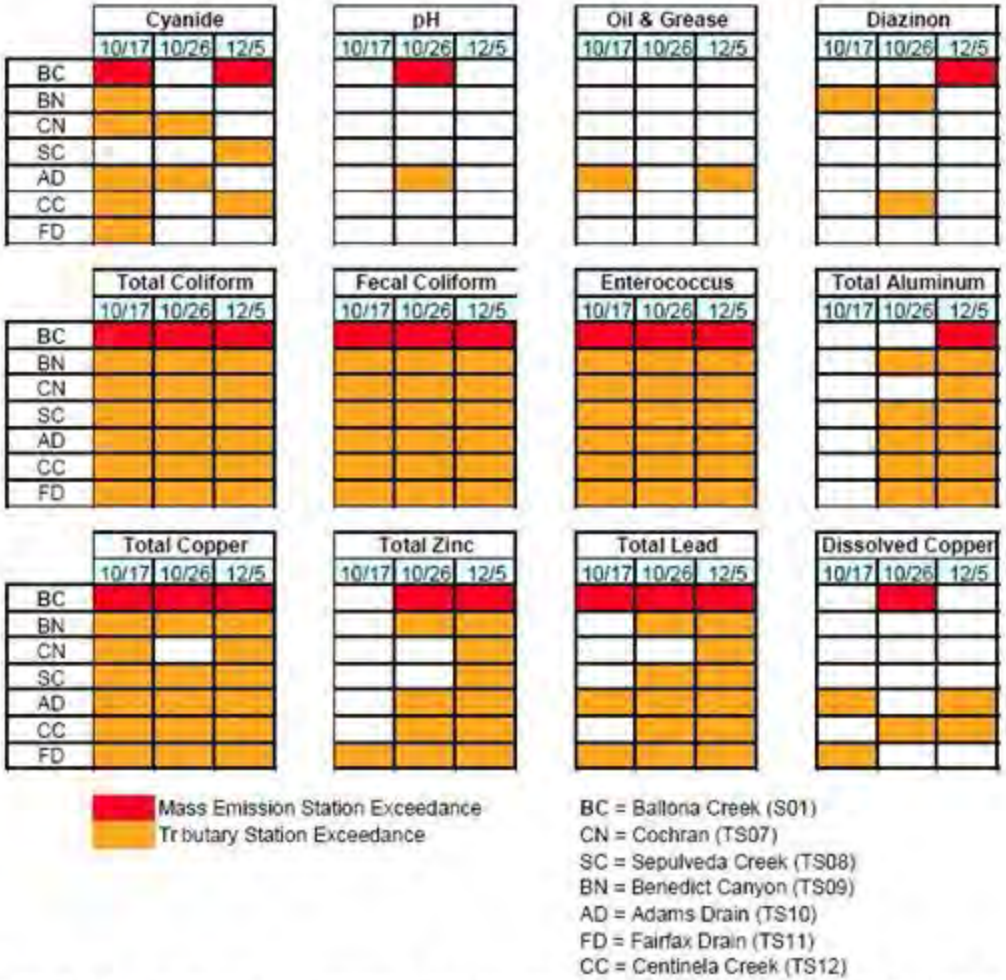


Figure 7-3. Comparative Summary of Constituents Frequently Exceeding WQOs at Ballona Creek and its Tributaries

ISN'T IT OK TO FLOOD WETLANDS WITH POLLUTED WATER? ISN'T POLLUTION FILTRATION SOMETHING WETLANDS ARE SUPPOSED TO DO?

NO. WETLANDS CAN FILTER POLLUTION, BUT THAT ISN'T NECESSARILY A GOOD THING. (JUST BECAUSE YOU CAN EAT AT MCDONALDS ALL THE TIME DOESN'T MEAN IT'S A GOOD THING)

Removing the levees which were built in 1937 would flood the wetlands with billions of gallons of polluted water with every rainstorm. So while the levees are not natural, they actually protect the wetlands today from L.A.'s pollution.

The conversion of the L.A. area from unpaved natural habitat into a concreted-over city means that rainfall mixes with all the oil, grease, trash, and dog-doo that fills our streets and eventually flows down Ballona Creek into the ocean.

This problem was created by developers paving over and filling all the natural wetlands and creeks in the Ballona valley. The natural ability of wetlands to hold and filter water pollutants has been lost in most of L.A.

So, we now have the very dirty Ballona Creek and the relatively clean Ballona Wetlands side by side. The State's proposal is to reconnect the creek and the wetlands.

We believe that with Ballona Wetlands being all that is left of this area's remaining historical wetlands that this would be a big mistake.

It is argued by proponents of the State's plan that the next-door Playa Vista development created a marsh system which they flood with polluted water and it is "just fine".

Actually, this is an apples to oranges comparison. The Playa Vista system has an extensive upstream filtration and treatment system designed to remove the urban pollution from the water before it crosses Lincoln Blvd and flows into this marsh.

The 51 acres of land devoted to pollution treatment totals 5% of the total 1000 acre area draining into the marsh system. Experts in the field of water pollution treatment say that this 5% total is necessary to provide enough natural plant and soil absorption capacity so that the marsh does not become super-toxic to wildlife.

If the levees are removed from Ballona Creek, the entire flow from 130 square miles of urbanized L.A. will poor into the Ballona Wetlands. 5% of this totals over 6 square miles. Unfortunately, the saved Ballona wetlands are just under 1 square mile.

Thus, the pollution from L.A. would overwhelm our fragile wetlands at six times their natural carrying capacity to clean pollution.

BUT OUR GOVERNMENT HAS A PLAN TO CLEAN UP BALLONA CREEK BEFORE THE LEVEES ARE REMOVED, RIGHT?

No. In order to clean up Ballona Creek so it would be safe to let it flow into the wetlands again means the taxpayers need to fund the removal of development from 5 square miles of urban L.A. in order to create natural wetland filtration systems alongside the creek.

Those of us that remember that it took 30 years to pry the vacant, unoccupied Ballona Wetlands out of the hands of a developer can understand what it would take to kick thousands of people off of 5 square miles of neighborhoods.

The city's own technical reports estimate a project like this citywide would cost $15 billion for land acquisition and construction. The cost to individual homeowners in L.A. would be $400 a month to pay for this project.

WILL VOTERS AND TAXPAYERS BE WILLING TO PAY THIS?

THIS IS WHY TYING RESTORATION OF THE BALLONA WETLANDS TO REMOVING THE LEVEES AND THUS TO A MASSIVE SPECULATIVE UPSTREAM CLEANUP PROJECT IS A BAD IDEA.

So if we had the equivalent of 6 Ballona Wetlands upstream that could filter L.A's pollution, then it would be safe to allow Ballona Creek to flow again into the Ballona Wetlands.
BUT WE DON'T.

SO WHILE WE CANNOT RETURN EVERYTHING TO AS IT WAS 200 YEARS AGO, WE CAN COME CLOSE AND PRESERVE ALL THAT WE LOVE ABOUT BALLONA WHILE BRINGING BACK WATER FOR BIRDS, FISH AND OTHER WILDLIFE

IT IS FEASIBLE TO BRING CLEAN, NOT DIRTY WATER BACK INTO THE WETLANDS FROM THE OCEAN.

Digging a few small channels to bring water into the wetlands again is a lot different than removing everything and starting over

New small ocean access channels could be dug from Del Rey Lagoon on the south side and through Fisherman's Village on the north side (as was proposed by the Playa Vista developer when they wanted to turn the wetlands into a yacht harbor)

Fisherman's Village is public land, owned by the residents of L.A. County.
And the original outlet of Ballona Creek next to Del Rey Lagoon park is owned by L.A. City.

So there are alternative ways to bring ocean water back into the wetlands without removing the levees and completely ripping out the entire marsh system

TO SUMMARIZE OUR ALTERNATIVE VISION:

In our plan, the trail system and current habitat mix are preserved and the water source is clean water from the ocean, not urban runoff polluted from Ballona Creek

Our plan leaves Ballona Creek levees and the bike path where they are. There could, however be places in the levee where smaller channels could lead into the wetlands from the creek close to the ocean where the water is likely to be cleaner.

Also, our region has substantial relatively-unpolluted groundwater which could be tapped into using wells to provide an upstream source of water for historically-accurate, newly-created creeks running through the wetlands

IN SUMMARY: Our plan restores the wetlands to their state before the development of L.A. began as much as is possible, but has none of the negative features of the State's proposed plan. It provides clean water to restore our fragile wetlands, without wiping out the entire site and starting over, and protects our beloved hiking trails.

FINALLY, AND MOST IMPORTANTLY:

Our plan costs much less than the $100 million State proposal. Based on the State's own estimates, our plan would likely cost around 1/3rd of their project's price

SUPPORT THE BEEP ALTERNATIVE VISION:
Print out this picture
Comments may be submitted until October 23rd, 2012 to
DONNA.MCCORMICK@icfi.com.
Or mailed to:
Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92816



FOR MORE INFORMATION ABOUT BEEP'S ALTERNATIVE:
http://ballona-news.blogspot.com/2012/08/first-big-public-hearing-on-ballona.html

TO SHARE A LINK TO THIS SLIDE SHOW:
http://tinyurl.com/ballona

Jones, Tanya

From: Rex Frankel [mailto:rexfrankel@yahoo.com]
Sent: Tuesday, October 23, 2012 4:40 PM
To: Daniel.p.swenson@usace.army.mil; McCormick, Donna
Subject: supplemental comments on Ballona Wetlands Restoration NOP-NOI

10/23/2012, 4:37 pm

To Ballona restoration project officials,

Please see 5 page attachment for my additional comments.

They are in addition to my previously sent comments which are posted here:
https://picasaweb.google.com/Rare.Earth.fotos/BallonaAlternativePlan

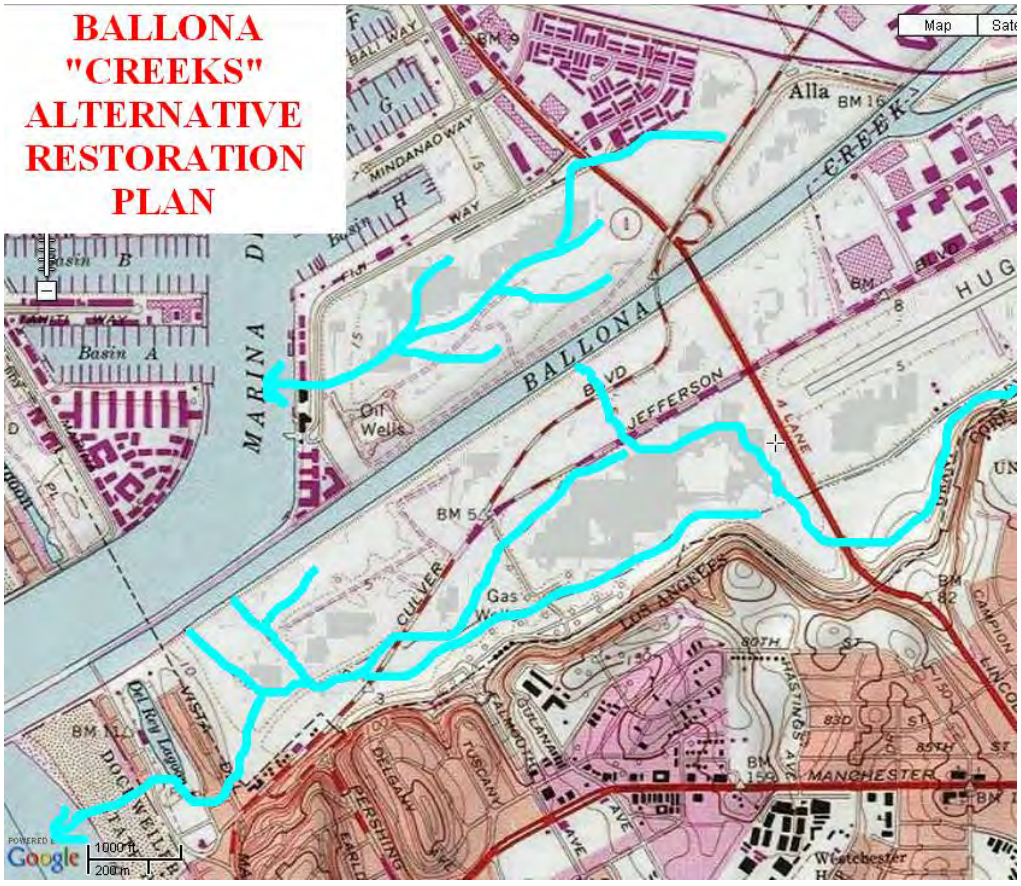
Rex Frankel
President, Ballona Ecosystem Education Project

COMMENTS ON BALLONA WETLANDS NOTICE OF PREPARATION:
FROM: Rex Frankel, President, Ballona Ecosystem Education Project

To: Daniel.p.swenson@usace.army.mil and DONNA.MCCORMICK@icfi.com
October 23, 2012, 4:00 pm

We believe the DEIR and EIS must include analysis of an alternative restoration plan based on returning the site to conditions existing before man began altering the land. This means a return to conditions of approximately 200 years ago. Such an alternative would still have room for creation of new estuarine habitat, but would preserve a balance of the three eco-types that are now present on the property: salt marsh, freshwater marsh and upland communities.

In this alternative, water would come through new small channels (approximately 20 feet wide) entering Parcel A through the Fisherman's Village site, and into Parcel B through the L.A. City-owned beach parcel which was the historical mouth of Ballona Creek, through Del Rey Lagoon, going east via a box culvert under Argonaut Place, then east into Parcel B via the alley known as Culver Place, daylighting into the wetlands immediately south of the backdune. Such water sources would be significantly cleaner than the water in Ballona Creek. Use of such sources would not tie the success of the wetlands restoration to yet-to-be-designed or paid-for plans to clean up the Ballona Creek's pollution problems.



Under the “return to the 1800’s Creeks” alternative, Ballona Creek’s levees would remain, and all funding would be spent restoring the wetlands and uplands where they are rather then expending $100 million to move them around. This plan features preservation of some artificial features, specifically the levees and the fill in parcel A and C, because under the State’s preferred plan, their removal would cause massive pollution impacts to the rest of the wetlands, elimination of long-used walking trails and upland habitat, and fill of other wetlands.



OUR OBJECTIONS TO THE STATE’S PREFERRED PLAN ARE SUMMARIZED BELOW:

PROJECT IS PRIMARILY DESIGNED TO BENEFIT PRIVATE AND OUTSIDE INTERESTS, NOT THE WILDLIFE AND LOCAL COMMUNITIES

INADEQUATE PROECT DESCRIPTION: PROJECT INCLUDES UNSTATED BUT OBVIOUS PROJECT FEATURES THAT PROVIDE NO RESTORATION BENEFIT
--removal of levees make wetlands a de-facto end of the pipe pollution treatment basin
--flood protection berms, walls and levees are clearly for Playa Vista’s flood-plain development
--design makes possible a deep water mitigation site providing credits to L.A. Port and “others” who have already stated their interest at public hearings on this project
--and the use of an incorrect date objective makes all these possible

PROJECT USES IMPROPER OBJECTIVE FOR A WETLANDS RESTORATION PROJECT
Uses wrong definition of restoration and wrong date sought to return to
--EIR must analyze a restoration project which uses 200 years ago as its objective, not 4000 years ago

PROJECT UNNECESSARILY FILLS IN 108 ACRES OF WETLANDS AND ‘WATERS OF THE UNITED STATES”, THEN REMOVES FILL FROM AROUND ANOTHER 108 ACRES OF FORMER WETLANDS
--ACCOMPLISHING WHAT THAT WE DON’T HAVE NOW?
--Why is some dredge spoil bad and some good?

PROJECT ELIMINATES VESTED PUBLIC TRAIL RIGHTS
Many miles of trails cannot be removed from the public trust merely because the landowner is now the State. These trails became prescriptive easements over many years of non-objection and non-posting of "right to pass by permission" signs per state law by the prior private owner. As the preferred project floods the area that includes the trails, the project creates significant and unmitigated impacts to coastal access.

OUR THREATENED TRAILS



THE PREFERRED PROJECT WHICH FILLS IN WETLANDS IS NOT THE LEAST ENVIRONMENTALLY DAMAGING PROJECT, THUS THE COASTAL ACT IS VIOLATED
--Which is why we have proposed the "return to the 1800's Creeks" alternative.

PIECEMEALING—
Approval of the preferred plan mandates approval of the larger, more impacting and extremely more expensive upstream creek cleanup project without revealing the upstream project's impacts and costs, nor providing funds to construct the upstream project

---

HOW THE IMPROPER TARGET DATE FOR RESTORATION FACILITATES PROJECTS WHICH HAVE NOTHING TO DO WITH RESTORATION:

RESTORATION DEFINED:
The U.S. EPA defines restoration as "on the most basic level, restoration is the process of returning a damaged ecosystem to its condition prior to disturbance (Cairns 1991, Berger 1991, and Caldwell 1991).". …(http://water.epa.gov/type/watersheds/archives/chap1.cfm)

Logically, one would not define restoration as to when the dinosaurs were here or when Los Angeles was covered with an inland sea, but to the time when man began dramatically altering it. This coincides with conditions around 200 years ago.

Unfortunately, the Project Management Team's (PMT) preferred alternative seeks to return the site to conditions of around 4000 years ago, when the entire site was an open arm of the ocean. This appears to be designed intentionally to accommodate 3 outside interests who have their own objectives which are unrelated to the restoration of the Ballona Wetlands to what they were before man's alteration began.

HIDDEN OBJECTIVES OF THE STATE'S PREFERRED PROJECT:

1--By merging the Ballona Wetlands and Ballona Creek, this allows the wetlands to filter the massive amounts of urban wet and dry season runoff that now flows from developed Los Angeles to the ocean. Cleaning up Ballona Creek has been ordered by the federal courts by 2021. Yet there is no plan nor funding do accomplish this goal. This is why the levees should remain. Neither pollution filtering nor constant flooding of the wetlands occurred 200 years ago. Filtering was not needed, as the water flowing down Ballona Creek was not polluted. Ballona creek did not regularly flood the entire wetlands area but flowed through small channels into a lagoon that was a quarter mile from the ocean. As the State's Ballona Wetlands Existing Conditions Final Report has revealed, "By 200 years ago, sediment accumulation almost entirely eliminated the lagoon and formed a complex of salt and freshwater marshes, ephemeral freshwater pools and sandy islands behind the barrier." (published 8/2006 at page 17.) Much of the small 1800's era historical lagoons in the Ballona Wetlands remain full of seawater in the publicly owned Ballona Lagoon Marine Preserve, Del Rey Lagoon city park, Grand Canal city park, the city-owned Venice Canals and the county-owned Marina Del Rey.

So, in the 1800's there was no massively wide Ballona Creek channel flooding the entire area as is in the preferred project.
Such a wide channel was in existence 4000 years ago, as figure 3-1 on page 21 of the Existing Conditions report shows.

However, 4000 years ago is not an appropriate date for any restoration project. Manipulation of the date sought to return to allows justification of virtually anything and is "junk" politicized science.

Filtering urban runoff is not a permitted use of existing wetlands under the Federal Clean Water Act. Government agencies are not allowed to worsen pollution loads of water bodies that are on the CWA 303d list. On the other hand, non-wetlands may be converted into treatment wetlands. But that is not the case here. Both parcels A and B are covered with federally-delineated jurisdictional wetlands. Even more of these 2 parcels are wetlands under the California Coastal Act's definition. Thus the Ballona Creek levees cannot be removed as long as the creek water violates the Clean Water Act. Cleaning up the water in Ballona Creek until it is clean enough so that it would be allowed to flow into the wetlands

is a long-off project which has no EIR or land acquisition plan nor any funding source. Completion of the project by the current court-ordered deadline 2021 is extremely unlikely.

2--By dredging a deep water basin in Ballona Creek, the PMT is creating an opportunity for the L.A. Port and "others" to purchase mitigation credits to compensate for their own wetland destruction projects. However, the Ballona Wetlands are already saved, thus, a mitigation project means that two areas of public owned wetlands (at public lands at L.A. Harbor and at Ballona) are destroyed in order to re-create 1 of them. Such an outcome is not equitable and flips the no-net-loss wetlands policy on its head.

3--Finally, the PMT's preferred project entails dredging out over 20 feet thick of soil from parcels A and B in order to then dump this soil in 20 foot hills along Jefferson Blvd and parcel C. The unstated objective here seems to be to provide tsunami and tidal surge protection for the lowland Playa Vista condominium development that was built in the last ten years in this flood-plain. Such a flood protection benefit paid for with taxpayer dollars would be an unconscionable gift to wealthy private interests. It is also historically inaccurate, either 4000 or 200 years ago.

Why not just restore the wetlands where they are, and restore the uplands where they are? Why spend $100 million switching their locations? The short answer is because the uplands are not in the location that blocks flood waters from hitting Playa Vista. And the other obvious reason is that Playa Vista probably does not want a treatment wetland for all of Ballona Creek's pollution across the street from their condos in parcel B.

Basically, the habitat switching in this project, uplands turned into wetlands and wetlands turned into uplands, is not necessary for the successful restoration of the Ballona Wetlands to pre-alteration conditions. There is no need for the massively destructive State preferred project unless your goal is to accomplish the hidden objectives we outlined above.

FINALLY,

Please put us on the notification list for all actions pertaining to the Ballona Wetlands Restoration Project.
Please send all notices to

Rex Frankel
6038 west 75th street
Loa Angeles, CA, 90045

Jones, Tanya

From: Katherine Pease [mailto:kpease@healthebay.org]
Sent: Tuesday, October 23, 2012 12:07 PM
To: McCormick, Donna
Subject: Ballona Wetlands Restoration Project scoping comments

Dear Ms. McCormick,

I am attaching Heal the Bay's comment letter on the notice of intent for the Ballona Wetlands Restoration Project.

Thank you.

Sincerely,

Katherine Pease

Katherine Pease | Watershed Scientist
Heal the Bay | 1444 9th Street | Santa Monica CA 90401
Tel: 310.451.1500 x 141 | Fax: 310.496.1902 | kpease@healthebay.org

Join us for Fishy Fest at the Santa Monica Pier Aquarium!



Heal the Bay

1444 9th Street
Santa Monica, CA 90401

ph 310 451 1500
fax 310 496 1902

info@healthebay.org
www.healthebay.org

October 23, 2012

Ballona Wetlands Restoration Project
c/o Donna McCormick
1 Ada, Suite 100
Irvine, CA 92618

Via Email: Donna.McCormick@icfi.com

Re: Ballona Wetlands Restoration Project Scoping Comments

Dear Ms. McCormick:

On behalf of Heal the Bay, a non-profit environmental organization with over 13,000 members dedicated to making the Santa Monica Bay and Southern California coastal waters and watersheds safe and healthy for people and local ecosystems, we have reviewed the Ballona Wetlands Restoration Project notice of intent and are very supportive of the effort to restore Ballona Wetlands.

Southern California has lost approximately 95% of its historic coastal wetlands. Much of the wetland habitat in this densely urbanized area has been destroyed or highly degraded. Although Ballona Wetlands is designated as an Ecological Reserve, it is severely degraded. The area has been filled with dredge material, effectively separating the creek from its floodplain and damaging the area's ecological function. The Ballona Wetlands restoration project is a historic opportunity to restore critical wetland habitat in the Santa Monica Bay. To ensure the most effective restoration planning and implementation process as possible, we encourage the US Army Corps of Engineers (US ACE) and California Department of Fish and Game (DFG) to evaluate restoration project alternatives that are comprehensive in nature and restore natural processes to the wetlands, including the flow of tidal waters, maintaining freshwater circulation, and supporting a healthy ecosystem that allows native species to recover and thrive. This project has the potential to greatly improve water quality in local streams and waterways, like Ballona Creek and Marina Del Rey harbor, and restore habitat for the endangered and sensitive species in the Ballona Wetlands.

It is important that a full suite of alternatives are evaluated that meet the project goals of restoring hydrological, ecological, and biological functions of the area. Each alternative examined should provide clear linkages between the action taken and improvements to water quality, habitat, and hydrology, as well as justification for any short term disturbance. Of particular concern are sensitive and endangered species that currently exist in the Ballona Wetlands; we urge the US ACE and DFG to address impacts to these species in all alternatives as well as assess how the improvements in habitat may serve to benefit these species, potentially resulting in increased population numbers.

Heal the Bay

1444 9th Street
Santa Monica, CA 90401

ph 310 451 1500
fax 310 496 1902

info@healthebay.org
www.healthebay.org

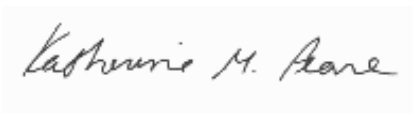
Furthermore, we recommend consideration of a tiered approach in the preparation and evaluation of alternatives. Since this is likely to be a large-scale, multi-year project, we would like to see alternatives that prioritize areas that are in greatest need of restoration, and provide a timeline in which those areas will be targeted first.

To ensure the most effective project planning, we encourage the US ACE and DFG to incorporate the following goals in the restoration alternatives preparation and evaluation:

- Focus the project on restoring processes and functions to allow for the long-term health of the ecosystem;
- Use sound scientific studies and recent monitoring data as a basis for understanding the historic and current baseline state of the wetlands;
- Restore Ballona Wetlands to as natural a state as possible;
- Incorporate climate change into project planning so rises in sea level, changes in temperature, and increases in ocean acidity can be accommodated as best possible; and
- Minimize impacts to endangered species and species of special concern.

We strongly support efforts to restore the Ballona Wetlands to a functioning, healthy ecosystem. Ballona Creek, Estuary, and Wetlands suffer from multiple issues, including numerous water quality impairments on the 303(d) list, significant sediment and habitat modifications, and unnatural hydrology. We recommend that the scoping committee consider a range of alternatives, all with the goals of long-term ecosystem health, including improved circulation, water quality, and habitat. We appreciate the opportunity to comment on this project and are excited to be involved as the restoration process gets underway.

Sincerely,





Katherine M. Pease, PhD
Watershed Scientist

Sarah Abramson Sikich, MESM
Coastal Resources Director



Ballona Wetlands Restoration Committee

October 23, 2012

Ballona Wetlands Restoration Project
LEAD AGENCIES:
United States Army Corps of Engineers
Colonel Mark Toy c/o Daniel Swenson
California Dept. of Fish & Game
Director Charlton H. Conham, c/o David Lawhead

And c/o Donna McCormick – consultant hired by the Santa Monica Bay Restoration Foundation and/or CA State Coastal Conservancy
1 Ada, Suite 100
Irvine, CA 92816

Re: NOP for Ballona Wetlands "restoration project"

Dear Ms. McCormick, Colonel Toy and DFG Director Bonham:

We appreciate the opportunity that California and U.S. law allows for the public to be included in scoping comments. While the law may not require actual public hearings during the scoping process, we remain extremely disappointed that there has been no public hearing prior to the draft EIR/EIS preparation. We continue to ask, as our Congressmember, the Honorable Jane Harman, our State Senator, The Honorable Ted Lieu and our Los Angeles City Councilmember, The Honorable Bill Rosendahl, have also asked, that you convene a hearing for the public to be able to hear each other, as well as for decision-makers to hear all relevant comments, some of which will not be heard fully when only submitted in writing.

In addition to this request, please respond to the following requests in the draft EIR and draft EIS documents that are prepared for the project you are proposing for the Ballona Wetlands Ecological Reserve, state-owned lands which were paid with bond funds voted on by the public, and which were – at the price of $139 million – the highest per/acre cost for land preservation in the history of the state of California.

1. Please analyze and explain how construction traffic by all of the proposed alternatives of this project will impact neighborhoods surrounding the ecological reserve, as well as how the construction will impact commuter traffic on Lincoln Blvd., Culver Blvd., the 90 Marina Fwy., Mindanao, Fiji Way and Jefferson Blvd.

2. Please analyze and explain how the rare and endangered species that are dependent in any way for habitat (shelter, resting, food, water or refuge) at the Ballona Wetlands Ecological Reserve will be impacted by the proposed project and any of its alternatives.

3. Please analyze and fully consider the "Wildlife Friendly Alternative" that has been submitted by Ballona Institute, and supported by Sierra Club, as one of your alternatives for this project, and explain fully why it is not the most environmentally preferable and least environmentally damaging alternative.

4. Please apply the rejuvenation principles that Sierra Club and several other groups have supported to each of the proposed alternatives and proposed project in the EIR/EIS process.

5. Please explain why the south levee, in its current state of equilibrium, is not one of the preferred walking trails for public access, given its proximity to the wildlife, its current use by dogwalkers, fishermen and others, and consider this path as one of the proposed major public trails.

6. Please explain why the south levee, in its current state of equilibrium, is not one of the preferred walking trails for public access, given its proximity to the wildlife, its current use by dogwalkers, fishermen and others, and consider this path as one of the proposed major public trails.

7. Please explain why Cabora Dr. is not one of the preferred walking trails for public access, given its proximity to the wildlife, its higher location and consider this path as one of the proposed major public trails.

8. Please explain and analyze the "Lincoln Blvd. fault" which was identified and described by Dr. Victor Jones during the Playa Vista construction approvals, and describe how this fault (which is still a fault, although not called that due to PV's lobbying activities, yet it still operates as a fault) will possibly impact aquifer activity that relates to flooding of the wetlands via the proposed restoration.

9. Please analyze and explain how the drawdown of the water table by Playa Vista based on its requirement by the LARWQCB to clean up contamination floating atop the groundwater – dumped presumably during the Hughes' ownership of the land before there were environmental laws – will impact the flooding of the wetlands, explain how the flooding of the wetlands will impact that aquifer, and explain how those waters will be separated, how any mixing will impact wildlife, how it will impact any drinking water portions of the aquifer and how it will impact the settling of the land beneath the Playa Vista residential and commercial buildings, as well as how all of this activity impacts the highly explosive methane seeps documented as present in this region.

10. Please analyze and explain how the underground gas storage at the Ballona Wetlands Ecological Reserve will be impacted by the proposed flooding of the wetlands by seawater and how any construction activities will impact the gas storage field and possible hazards to surrounding residents, as well as to wildlife.

11. Please analyze and explain which species are being managed for in this proposed "restoration," and how each of these species will be assisted or supported in their life cycles by the proposed restoration. Also please analyze this same topic for each of the alternatives considered, including the "Wildlife Friendly Alternative."

12. Please analyze and explain how sea level rise will impact the ecological reserve under each proposed alternative considered in the EIR/EIS.

13. Please analyze and explain how many people will be allowed to visit the ecological reserve each day – and how such visits will impact the wildlife. Include any sensitive times of year that might be different in terms of use due to restrictions that might be imposed.

14. Please analyze and explain how the construction of large buildings proposed along Fiji Way – including at the proposed boat storage facility and Fisherman's Village – may impact the proposed restoration, and considering the restoration alternatives, explain what the differences will be for flights from egrets and herons to and from their rookeries and roosting sites, given the proposed restoration alternatives.

15. Please analyze and explain how the Great Blue Heron and Great Egret rookeries on adjacent public lands will be impacted by the loss of upland habitat contemplated in various alternatives for the "restoration.

16. Please analyze and explain how any proper "restoration" can be planned in the presence of unknown, unregulated, unpredictable interference with the fresh water aquifer, as this aquifer passes under and to the east of Lincoln Blvd. and is underneath the Playa Vista business and residential development?

17. Please analyze and explain how the gas mitigation systems that are in place at Playa Vista, which require continual pumping and dispoal of large volumes of fresh water, which is disposed of, will be impacted by the proposed restoration, especially since it is apparent that this process is not properly nor consistently monitored. Also explain the effect on the supply of fresh water to the Ballona Wetlands, given these circumstances. What effects on the natural ecological balance will result?

18. Please analyze and explain how the Playa Vista Treatment Basin, also called the "Freshwater Marsh," will impact the natural mix of waters in the "restored" Ballona Wetlands, which would presumably received water from the aquifer, the treatment basin's runoff from Playa Vista and the Pacific Ocean. How much fresh water is pulled out of the fresh water aquifer, and will this water be free from contamination by the time the restoration begins? How can the public be assured of this?

19. Please analyze and explain how much water from off site is injected into the "freshwater marsh" to keep it full in dry times, and how will this input of water impact the Ballona Wetlands "restoration" plans?

20. Please explain how the Native American – First Nation – cultural and religions concerns will be respected – unlike previous situations on related Ballona Valley lands.

Thank you for the opportunity for Sierra Club to comment on the scoping of this proposed project.

Sincerely,

Marcia Hanscom /s/

Marcia Hanscom
Chair, Sierra Club Ballona Wetlands Restoration Committee
322 Culver Blvd., Ste. 317
Playa del Rey, CA 90293
(310) 821-9045

Support the Wildlife-Friendly Alternative for Ballona

"A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise."
~ Aldo Leopold, 1949, A Sand County Almanac

1. FIRST DO NO HARM ~ Detailed, seasonal, unbiased baseline surveys of the species and ecosystem at Ballona are needed in order to know what is here and to know how the ecological processes are interacting with the equilibrium which exists after more than 70 years of the Ballona Creek estuary channel being constructed and after nearly 50 years of the marsh mud having been placed on parts of Areas A & C. Protect all rare and imperiled species, and determine what habitat is needed to support this protection.

2. ACQUIRE MORE LAND ~ The Committee to Complete the Park has identified nine open spaces on the Ballona Wetlands Ecological Reserve edges where open space and habitat support the ecological functioning of Ballona. These places are threatened with development and erasure of the existing habitats; this land provides foraging space, wildlife corridors and other important functions for species which call Ballona home.

3. UNDERGROUND UTILITY WIRES ~ Current utility wires crisscross the Ecological Reserve, causing injury and death to birds and visual blight to the beautiful landscape.

4. COMMUNITY-BASED RESTORATION ~ Community groups have been and want to continue to remove non-native plant species (those which are not providing habitat to native animals) by hand with shovels and other tools (no poisons; no bulldozers.) This sort of go-slow human-involved regime not only enhances ecological education and stewardship values, but provides a far better chance of preservation of sensitive species which might be unknown to those doing the work.

5. REMOVE DEAD PALMS ~ These trees along Culver Boulevard; these are fire hazards, harbor nonnative animal species and cause visual blight of the beautiful landscape.

6. SECURE THE RESERVE ~ Fence and secure areas immediately adjacent to urbanized, inhabited areas to prevent dog, cat and human unauthorized trampling.

7. CALM TRAFFIC & ENCOURAGE WILDLIFE CROSSINGS ~ All roads traversing the Ecological Reserve need to have traffic calming measures implemented by LA DOT and CalTrans. Explore and implement wildlife crossings and other road conversions to decrease road kill of wildlife and to open up bicycle and walking paths.

8. VIEWING PLATFORMS & WALKING TRAIL ~ Install viewing platforms at four city-owned properties directly abutting the Ecological Reserve. Designate Cabora Dr. a historical walking trail, install view areas, including scopes and interpretive signage.

9. PARKING ~ Work collaboratively with the business and residential communities to create parking that works for everyone.

10. RESTORE ANIMALS & PLANTS ~ Build nesting platforms for Bald Eagle & Osprey. Return Roadrunner, Los Angeles Sunflower, Pacific Pocketmouse & California Quail.

FOR INFORMATION, call 310-823-7040. www.ballonainstitute.org/discover.html

1. 21st century, incremental, community involved ecosystem rejuvenation that is in harmony with natural laws . We are opposed to industrial-scale habitat conversion, including major bulldozing, which destroys existing ecosystems.

2. In appreciation of what is there now, recognize the resiliency of the ecosystems and identify areas that require no more than observation for the foreseeable future.

3. In recognition of the importance of gaining control of more acreage before it is built on, or otherwise negatively impacted, give priority to acquisition/addition of additional unprotected parcels of land at a reasonable price to the Ballona Wildlife Refuge, over restoration activities. Such land protection will increase habitat enhancing buffer zones for wildlife and plants, and decrease car trips in the area, which lead to animal road fatalities.

4. Utilize existing opportunities to access the refuge, such as the Ballona Creek bike path, and south earthen levy along Ballona Creek and install a walking/biking path around as much of the perimeter of the refuge as is ecologically feasible.

5. Utilizing existing infrastructure such as the old Pacific Railway bridge supports and other man made structures, along with materials that have the deepest sustainability, create wildlife, bicycle, and walking linkages that connect all areas of the ecosystems in a fashion that allow homo sapiens and animals alike, to safely go over or under all roads and waterways that divide the refuge.

6. In recognition of the importance of enhancing the beauty of the refuge, safety of birds and other mammals, and the reduction of light pollution, move all power, telephone, and cable lines underground, and remove the majority of street lighting.

7. Endangered, threatened, and imperiled species must be given priority for protection in any refuge alteration considerations.

Supported by numerous environmental and community groups, including Ballona Wetlands Land Trust, Sierra Club, Ballona Institute, Ballona Ecosystem Education Project, Grassroots Coalition and Wetlands Defense Fund

1/19/2012

Jones, Tanya

-----Original Message-----
From: Klecha, Anthony [mailto:AKlecha@semprautilities.com]
Sent: Tuesday, October 23, 2012 1:08 PM
To: Swenson, Daniel P SPL
Subject: SoCalGas' Comments on the Ballona Wetlands NOI, File #SPL-2010-1155
Importance: High

Dr. Swenson,

Please find attached, Southern California Gas Company's comments on the Notice of Intent to Prepare a Draft Environmental Impact Statement/Environmental Impact Report for the Ballona Wetlands Restoration Project.

Should you have any questions or need additional information, please feel free to contact me.

-Tony

Anthony A. Klecha

Principal Environmental Specialist

Southern California Gas Co.

Office: (213) 244-4339

Cell: (213) 393-0568

aklecha@semprautilities.com <mailto:aklecha@semprautilities.com>

Classification: UNCLASSIFIED
Caveats: NONE

Anthony A. Klecha
Principal Environmental Specialist

555 W. 5th Street
Mail Location GT17E2
Los Angeles, CA 90013

Tel: (213) 244-4339
Fax: (213) 244-8046
Mobile: (213) 393-0568
aklecha@semprautilities.com

Southern California Gas Company

A Sempra Energy utility®

October 23, 2012

Sent via Email

Dr. Daniel P. Swenson
U.S. Army Corps of Engineers – Los Angeles District
P.O. Box 5327111
Los Angeles, CA 90053-2325

Comments on the Notice of Intent to Prepare a Draft Environmental Impact Statement/Environmental Impact Report for the Ballona Wetlands Restoration Project

Dear Dr. Swenson:

Southern California Gas Company (SoCalGas) appreciates the opportunity to review and comment on the U.S. Army Corps of Engineers' (Corps) *Notice of Intent to Prepare a Draft Environmental Impact Statement/Environmental Impact Report (DEIS/EIR) for the Ballona Wetlands Restoration Project* (Project). We understand that the proposed project will entail restoring, enhancing, and creating native coastal wetland and upland habitats in the approximately 600-acre Ballona Wetlands Ecological Reserve. We also understand that the project would involve removing existing levees and constructing new levees; modifying existing infrastructure and utilities; and long-term operations and management activities. We further understand that the DEIS/EIR will consider several alternatives and is expected to be published in late 2012. Below, please find our comments for your consideration:

The Playa del Rey Storage Facility (Facility) is one of four operational natural gas storage fields within the SoCalGas service territory and has been operated since 1942. Storage fields enable SoCalGas to purchase and store natural gas when demand is low and withdraw gas for delivery when demand is high. Natural gas is stored at the Facility within a depleted oil reservoir of an average depth of 6,200 feet below ground surface. Storage fields like the Facility promote reliable natural gas service and protect customers against price spikes. Gas storage benefits all of SoCalGas' customers, from residential to large commercial and industrial customers. In addition, storage fields like the Facility fuel electric generation by power plants, thereby helping to ensure electric service reliability.

The Facility is located immediately adjacent to the southerly boundary of the Project's Area and is comprised of two general areas naturally divided by the coastal bluffs. The natural

processing plant site is located at the toe of the bluffs (north side) and contains a number of above ground storage tanks, vessels, production and observation wells, fire protection systems, and process equipment including electrical and piping infrastructure. The office portion of the Facility is located at the top of the bluffs (south side) and contains all of the office space as well as the compressor building, multiple storage areas, garage and workshop space, natural gas processing vessels, and a loading area.

A number of monitoring wells and associated piping are located outside of the boundaries of the Facility within the proposed Project site. A total of 17 active monitoring wells exist within the Project footprint: five within Area A (Del Rey 13, 14, 15, 17 and 19) and eleven within Area B (Del Rey 4, 5, 9, 11, and 12 and Vidor 1, 2, 3, 5, 14, 18). Two plugged and abandoned wells are also located within the footprint: Del Rey 16 in Area A and Vidor 4 in area B. An additional well (Del Rey 18) is located on developed property within the Marina; however, because the pipeline serving this well traverses the wetland, it too could be affected by the proposed Project.

While SoCalGas recognizes and appreciates the importance of this Project, it's critical that the DEIS/EIR fully consider our existing infrastructure and the need to maintain full-time all-weather access for heavy equipment to this infrastructure. It's also imperative that the Project team continue to collaborate with SoCalGas throughout the planning and implementation phases to ensure that we can continue to provide safe and reliable natural gas service to our customers.

We understand that Project scope is still under development, and that certain alternatives may include abandoning, raising and/or relocating SoCalGas facilities. Please note that any modifications to our facilities will have to be mutually determined and agreed upon by the Corps, the California Department of Fish and Game, and SoCalGas.

Once again, SoCalGas appreciates having the opportunity to comment during this scoping process, and we look forward to working together to address our respective important needs. Should you have any questions or require additional information, please feel free to contact me at (213) 244-4339.

Sincerely,



Anthony A. Klecha
Principal Environmental Specialist
Environmental Services Department
Southern California Gas Company

Jones, Tanya

-----Original Message-----
From: Dave Singleton [mailto:ds_nahc@pacbell.net]
Sent: Tuesday, October 23, 2012 8:21 AM
To: McCormick, Donna
Subject: Ballona Wetlands Restoration Project NOP

October 23, 2012

Dear Ms. McCormick:

The California native American Heritage Commission (NAHC) is the State of California 'trustee agency' for the protection of Native American cultural sites and burial grounds. It is also a 'reviewing agency' for the Stateclearinghouse for CEQA and NEPA environmental documents.

We are concerned that we may not have had an opportunity to review the CEQA NOP for this project with which we have been working, primarily through the California Coastal Conservancy as a participating agency.

Please provide us with the Statecleearinhouse Number so we can research whether or not we were able to respond to the NOP.

Thank you.

Dave Singleton
Program Analyst for Southern California
California Native American Heritage Commission
915 Capitol Mall, Room 364
Sacramento, CA 95814
(916) 653-6251

Jones, Tanya

From: Valerie Schadt [mailto:valerieschadt@mac.com]
Sent: Wednesday, October 24, 2012 10:08 AM
To: McCormick, Donna
Cc: landtrust@ballona.org
Subject: BALLONA CREEK

Hello-

My name is Westley, I am eight years old and love Ballona Creek. I go there every weekend to watch birds and other wildlife. It is important to me that you protect the wildlife. Please take care and the necessary steps in the renovation of the Ballona wetlands.



A-2153



A-2154



These are two photos I took. One of a Sharp Shined Hawk and the other of a Sanderling.

Thanks for your help.

Sincerely,

Westley Eftekhar

Ballona Wetlands Restoration Project

Advancing ecosystem health. Connecting communities with nature.

Comment Card

Name: DONALD OWENS

Email: (optional)

☒ Add me to the mailing list (please provide email or mailing address): 321 W. QUEEN ST #10 INGLEWOOD CA 90301

Comments/Issues: (Use additional sheets if necessary) WHAT IS BEHIND THE MOVING OF THE RIVER. IS THERE AN INTENT OF MORE URBAN SPRAWL? THIS IS A MULTI-PURPOSE AREA. WHY CONTAIN IT FUNTION? THE RECREATION & WILDLIFE AREA IS SHRINKING BEYOND WHAT IS ACCEPTABLE FOR THIS NEIGHBORHOOD.

Submit written comments by *October 23, 2012* to:

Mail: Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92618

Email: Donna.McCormick@icfi.com

***All comments submitted will become part of the Public Record**

Tape Here
Do Not
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A-2158

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DONALD OWENS
321 W. QUEEN ST #10
INGLEWOOD, CA 90301

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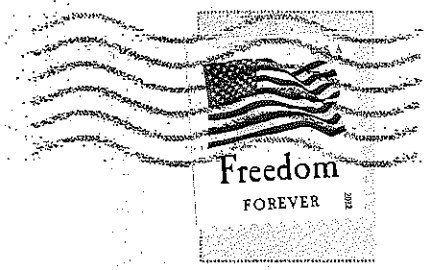


Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92618

Jones, Tanya

-----Original Message-----
From: patricia mc pherson [mailto:patriciamcpherson1@verizon.net]
Sent: Wednesday, October 24, 2012 12:44 PM
To: Swenson, Daniel P SPL; David Lawhead
Cc: jd@johnanthonydavis.com; Knight Kathy; Douglas Fay
Subject: Ballona Restoration EIS/R Comments-Grassroots Coalition

Dear Mr. Swenson,
Thank you for accepting the hard copies of NOI comments for Ballona from Grassroots Coalition(GC) ; John Davis; Kathy Knight/ Sierra Club; and Douglas Fay-- at the USACE Los Angeles offices.
And, in particular, thank you for reassuring us that the attachments that were given to you as part of our submissions from GC and J.Davis--would be copied and sent to CDFG by USACE personnel and not sent to outside entities to fulfill that purpose.
Thank you also for assuring us that USACE would retain the original materials we brought to you.

Included herein is a PDF of the GC comments without the attachments provided yesterday.

Should USACE or CDFG have any questions regarding any of the materials, please feel free to call.
Thank you,
Patricia McPherson, Grassroots Coalition
310 397 5779

ps A hard copy of the GC comments and 3 cd/dvd(s) were mailed to CDFG yesterday.

Classification: UNCLASSIFIED
Caveats: NONE

Oct. 22, 2012
TO: USACE, Daniel.P.Swenson @ USACE.ARMY.MIL
CDFG David Lawhead

FROM: GRASSROOTS COALITION, Patricia McPherson-President
3749 Greenwood Ave. Los Angeles, CA. 90066
PatriciaMcPherson1@verizon.net

Please extend the Oct. 23rd NOI deadline until a public hearing by the Army Corps and CDFG can be held. This request was made at the August display event, but thus far it has not happened.

RE: SCOPING COMMENTS AND QUERIES FOR THE 2012 NOI; JOINT EIS (CWA PERMITS) AND EIR FOR BALLONA WETLANDS RESTORATION PROJECT

ISSUE # 1:

OILFIELD GAS HAZARDS/ SOCALGAS/PLAYA VISTA/ WILDLIFE AND PUBLIC HAZARDS

SCOPING – High pressure gas storage operations of the Southern California Gas Company (SOCALGAS) operated within the partially depleted oil fields of Playa del Rey and Venice. New information is available that has not been utilized.

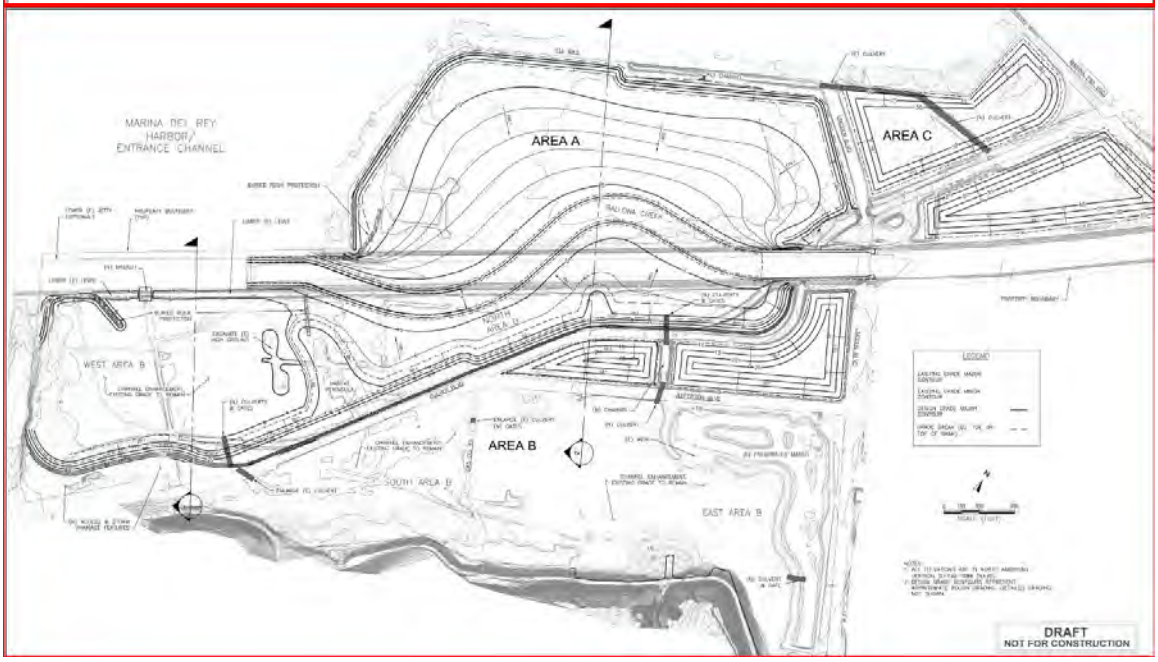
-needs to include studies that evaluate environmental harm from Ballona Channel changes (408 permit) and dredging/ filling of Ballona habitat pertaining to oilfield gas migration hazards and oilfield gas migration hazards that may be enhanced due to the SMBRC/COASTAL CONSERVANCY (CC) "PLAN"
.

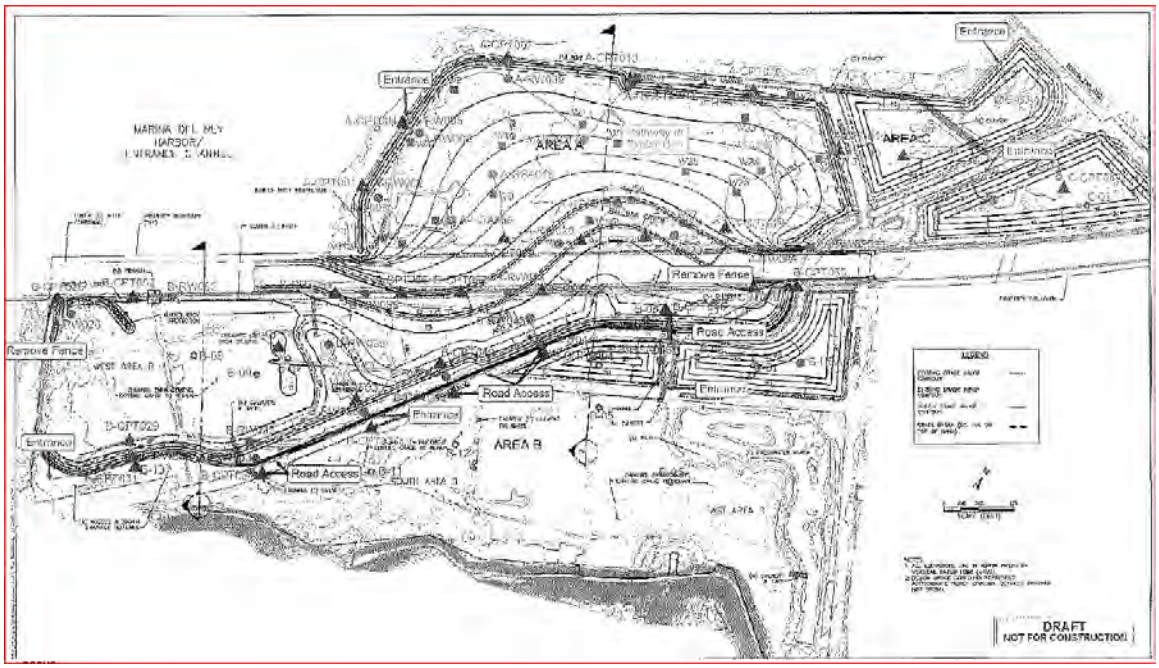
Background and overarching scoping needs-
The promised hydrology studies (2005 Joint EIR/EIS—between USACE & the Authority) of Ballona Wetlands have not been done. Instead, the SMBRC/FOUNDATION -director & staff and the California Coastal Conservancy have interfered with and stopped the areawide ecological studies and geotechnical studies of the federal review for restoration potentials in the greater Ballona region in order to promote a singular 'Plan' of destruction and experimental construction upon Ballona Wetlands- Areas A,B,C . This "Plan" excluded groundwater hydrology studies and focused upon hydrolics studies of surface water flows into Ballona Channel .

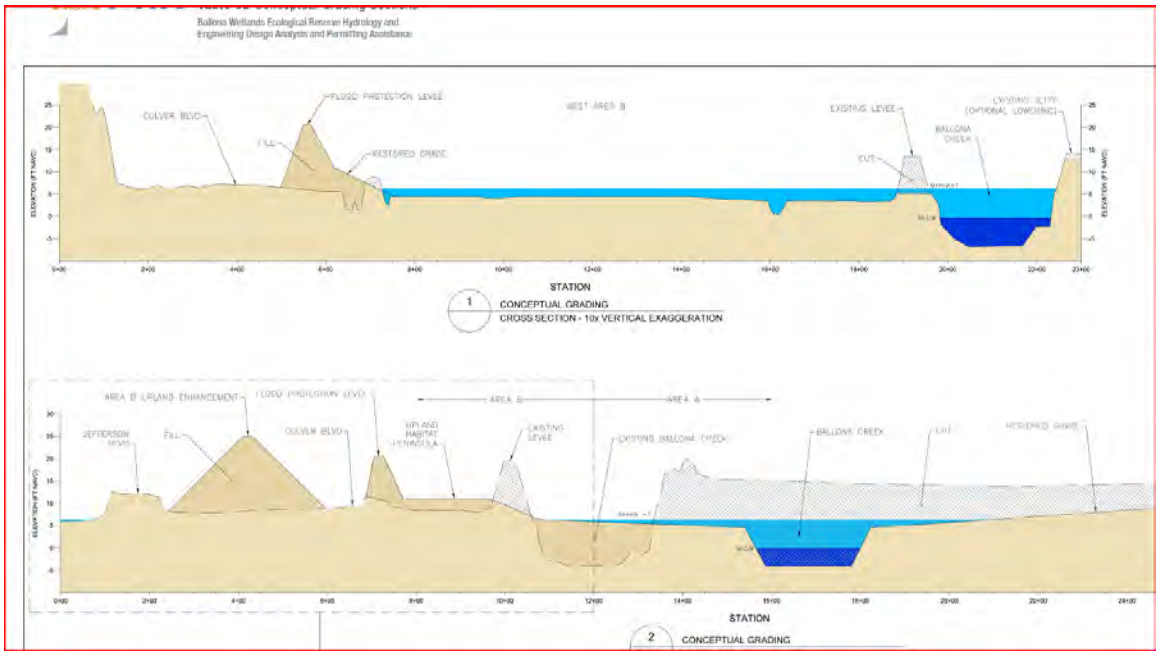
We believe that this 'Plan' is nothing more than a destruction of endangered species and wildlife habitat that is currently functioning well and that the Coastal Conservancy contracted- Psomas Co. contour maps of the "Plan" reveal that it is a flood control plan that only benefits a private development known as Playa Vista (Playa Capital LLC). The Proposition 12 bond funds have illegitimately been spent on private use protections to a development site that was illegally allowed to build in a flood plain. FEMA was not engaged for oversight comments as needed as the EIR process for Playa Vista was thwarted by failure to utilize the Clearinghouse as a gateway for proper notice to all pertinent agencies. (ETINA v City of LA; Playa Capital LLC) This failure by the lead agency- the City of Los Angeles- to include and enforce California Environmental Quality Act (CEQA) protocol of Clearinghouse utilization **PLACES THAT BURDEN NOW UPON USACE AND THE California Dept. of Fish and Game and its state agency partners. FEMA MUST NOW BE ENGAGED** and the issues that pertain to flood protection for Playa Vista must now be reviewed in light of the flood control devices and the preordained 'Plan' of development and construction proposed by SMBRC/Foundation and the California Coastal Conservancy.

The giant berms and levees-approximately 20 feet above current road level as shown in the contour plans – are NOT habitat; are NOT RESTORATION but instead are civil works flood protection devices to benefit Playa Vista.
Furthermore, the 'Plan's' intent to DREDGE Ballona is NOT RESTORATION but instead is simply an experimental attempt at an end of pipe solution to the toxic water and sediment flow down the Ballona Channel. The catch-basin shown in the 'Plan' does NOT enhance or restore Ballona but instead destroys the very habitat that the public has spent over 20 years to protect. The effects of the 'Plan' as a catch-basin and flood control project have not been studied. Current roadways, Marina del Rey and other beach front areas appear to be put in jeopardy from the project.

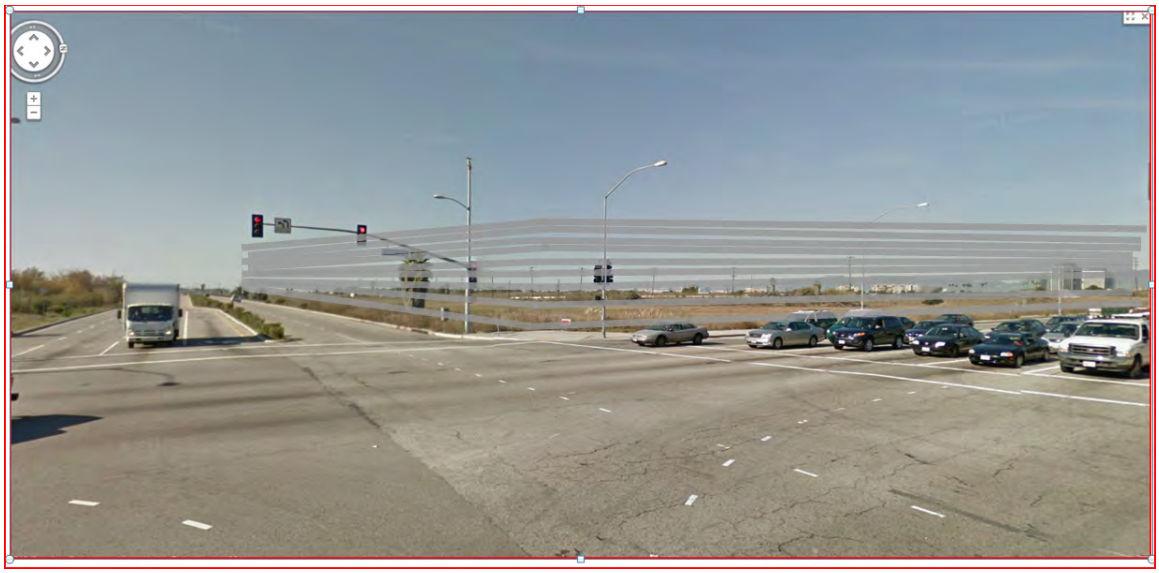

Topography
Topography
Elevation (in feet above mean sea level)
≤ 0 (approximately mean sea level)
0 - 1
1 - 5
5 - 10
10 - 15
15 - 20
20 - 50
50 - 100
100 - 150
> 150 feet above mean sea level
Ballona Wetlands Project Area Boundary
Coastal Conservancy
Loyola Marymount University


MARINA DEL REY HARBOR / ENTRANCE CHANNEL
AREA A
AREA B
AREA C
WEST AREA B
SOUTH AREA B
EAST AREA B
DRAFT
NOT FOR CONSTRUCTION





State 'Plan" –note the structural pyramids of berm/ levee and respond to how structures will be 'habitat'? Please include response for nearly vertical levee structures and how is this habitat? Or habitat protection?



View destroyed towards SM Bay AND height of NON-"restoration upland"- aka engineered flood control berm to protect Playa Vista –GC approximate visual

SCOPING:

Issues of safety, failure to utilize the bond funds as approved by the public; failure to work with and include the public's participation in restoration concepts and planning; the legitimacy of process -- promised and paid for by bond dollars v the exclusionary and preordained outcome plan by the SMBRC/Foundation and the Coastal Conservancy must be addressed in the SCOPING AND DRAFT EIS/R.

Response to conflict of interest allegations, illegal use of bond funds, lack of transparency issues raised and failure to perform in good faith toward restoration, acquisition of more of Ballona, and enhancement issues that would protect and utilize the freshwater resources of Ballona onsite must be addressed and raised for public awareness of these and other challenges leveled at the lead agencies and their 'partner' agencies.

SOCALGAS – Playa del Rey operations have not been adequately addressed. Migration of oilfield gas issues have not been addressed.

For example:

"GROUNDWATER MOVEMENT

The movement of local groundwater can greatly influence both the upward and lateral migration of the oilfield gases. For these reasons, a detailed hydrogeological study of the area is necessary. For purposes of environmental assessment, groundwater influences are crucial in the evaluation and interpretation of the experimental data.

For example, many of the environmental studies to evaluate soil contamination are carried out using relatively shallow soil probes that do NOT penetrate below the near surface aquifer zones. Accordingly, before proper experimental interpretations can be given to the gas concentrations, ***the hydrogeological conditions must be well known. A profound example, is where the aquifer conditions are being continually influenced by the nearby tidal forces of the Pacific Ocean.***

Furthermore, each of the oil field gas constituents has a different level of solubility in water."p.3

BTEX chemicals (benzene, toluene, ethylbenzene, p-xylene, o-xylene) and hydrogen sulfide (H2S) are chemicals known to be part of the oilfield gases surfacing in the Ballona Wetlands and Playa Vista. (Exploration Technologies(ETI) / City of Los Angeles 2000-1 gas reports; Still Workin On It – ETI)

And per SOCALGAS-PDR operations:
"…once upward migrating leaking gases, associated with each well, reaches the gravel zone it rapidly spreads out laterally within the highly permeable gravel zone.

The gravel zone extends easterly along the path of the ol Los Angeles Riverbed, and follows the current path of the county flood control channel. In terms of permeability, ***this gravel zone provides an excellent conduit for the gas to move easterly, and directly under the Playa Vista*** *real estate development currently under construction.*

This movement has been facilitated by the tidal action of the ocean, which acts as a "piston" (by analogy to an automobile engine) in providing a periodic, and pulsating, energy source in moving the gas from the location of the leaking wells, easterly under the Playa Vista development. At low tide, oil field gas rapidly moves up the old oil field well bores. At high tide the gas is "pushed" easterly as the rising ocean level influences the pressures within the gravel zone. P. 16 ENVIRONMENTAL AND HEALTH HAZARDS DUE TO METHANE AND OTHER OIL FIELD GAS MOVEMENT THROUGH SOILS Bernard Endres, PhD

Additionally, it is well known that both H2S and salt water have proven corrosive effects upon the casings and sealings of well bores. Numerous wells have been identified by SOCALGAS as having holes due to salt water corrosion in the PDR field. (See attachments of internal SOCALGAS documents citing leakage of SOCALGAS wells)
Example:
SCG-Playa del Rey operations:
"Historical drilling records reveal serious problems with achieving a competent cement seal when the surface casing was being cemented to the surrounding rock formation. This was especially serious for the Townlot Wells that were closer to the Pacific Ocean beach. ***…..Furthermore, saltwater intrusion from the nearby Pacific***

Ocean is also highly corrosive to the steel surface casing, and is known to cause significant deterioration of the concrete shoe materials."
CPUC LITIGATION Grassroots Coalition v SOCALGAS/ Bernard Endres PhD consulting expert of record
The Playa del Rey Gas Storage Facility Gas Migration Hazards; And The Duties Imposed To Monitor And Mitigate These Dangerous Conditions Mar. 24,2007
Case 00-05-010; 011;012



The area is just across from Playa Vista on west side of Lincoln Blvd. Note the tire tracks and site vacated after exposing gas and fluids broiling up in closeup provided below. Why wasn't this borehole and effluent contained? This wetland portion filled with pickleweed- a wetland indicatior species- will be destroyed by the State's Plan by filling up to 20' above road level in order to create what? A giant flood control mountain of vertical earth. The public paid for Ballona to be restored and enhanced ---not to use public dollars to provide private protection to Playa Vista. Please respond.



Image reveals recent borings left to broil up with oil and gases. Please provide discussion/ explanation/ testing data of this boring along with the rest of the boring done on Ballona in 2012.

SCOPING- Studies need to include evaluations of how monitoring will occur for gas leakage and contamination, where and what mitigation will need to occur regarding oil/gas wells or other wells acting as conduits for oilfield gas migration.

- **Who will be responsible for enhanced gas migration throughout the area due to the construction of the catch-basin (treatment wetland) and flood control protection to Playa Vista of the berms and levees ?**
- **-What mitigation will take place to prevent enhanced gas movement through the area due to the proposed tidal inundation and flows?**
- **What studies will be done to illuminate the potential gas movement changes?**
- **How and what mitigation measures will offset the enhanced liquefaction potentials caused by gas migration upon the proposed levees, berms and other construction devices of the channel changes and proposed experimental treatment basin?**
- **What liabilities and responsibilities do the state agencies including CDFG ; the Coastal Conservancy (CC); Santa Monica Bay Restoration Commission (SMBRC) and its individual personnel and the USACE have**

for affects upon the infrastructure and the environment for failure to evaluate the gas migration pathways?

- **Evaluation needs to take place –**
- **How will the proposed channel change/ berm and levee construction and dredging and increased tidal flow facilitate the migration of oilfield gases and dangerous accumulation of these gases—especially in light of the current failure to investigate and/or monitor at least one Playa Capitall LLC oilwell- University City Syndicate (freshwater marsh) that is off gassing millions of cubic feet of oilfield gases daily and numerous other SOCALGAS wells that have recently leaked reservoir gases to the surface?(DOGGR 1008 Order & SOCALGAS/ Grassroots Coalition Settlement Agreement gas studies showing 900,000 ppm of oilfield gases surfacing)**
- **-Since the riparian corridor and the catchbasin (freshwater marsh) are also part of the Ballona ecosystem and directly and/or indirectly affects the region via gas contamination and/or other contamination—what liabilities do the agencies of the EIR/EIS have for failure to include and address the overlapping environmental issues and their mitigation?**
- **The Playa Vista site- including the riparian corridor and the catch basin (freshwater marsh) need to be included in the EIS/EIR for the issues of gas migration/mitigation ; dewatering-hydrology as the areas directly and indirectly affect the region.**
- **Playa Vista was built in a flood plain without oversight -via CEQA clearinghouse notification- of FEMA. (ETINA v City of LA/Playa Capital LLC) Scoping now needs to include these issues of buildout in a flood plain and the ramifications of that buildout.**
- **-**

SCOPING- Gas migration evaluations need to be performed throughout the restoration area to update and map current oilfield gas migration patterns. The joint EIR/EIS must include available information pertaining to the oilfield gas migration hazards of Ballona.

-What soil gas and hydrology issues were discovered in 2012 as a result of the boring operations for berm and levee placement ?

- What geotechnical issues regarding the gravel zone and other underlying zones and aquifers were addressed and acknowledged as part of the same boring operations? These issues and scientifically legitimate answers by qualified and UNBIASED scientists must be included as part of the scoping issues.

- It appears that most if not all of the consultants utilized for work studies on Ballona have a lengthy and conflicted history of working for the Playa Vista, Playa Capital LLC; SOCALGAS- SOCALEdison (affiliated with SOCALGAS via gas storage needs and contracts) entities that have vested and monetary interests in Ballona both directly and indirectly.

- Why does the federal government and state agencies allow for such apparent conflict of interest to occur?
-Why aren't companies without such past and current financial ties to the Playa Vista development site and SOCALGAS/Edison being contracted for work on Ballona by the federal government and state agencies??

See- California Public Utilities Commission (CPUC)- Safety Branch Report citing the high likelihood of SOCALGAS reservoir gas leaking to the surface throughout Ballona and Playa Vista. The Nov. 2004 Consumer Protection and Safety Division report cites major concerns for SOCALGAS reservoir gas leakage:

"*C. 22 PPM . Helium from a shallow probe sample by John Sepich and Associate. Isotech Laboratory performed an isotopic analysis of a gas sample submitted by Sepich & Associates on 3/25/99. Secich and Associates was working for Playa Vista developers (developers of residential and business properties around the PDR Storage field. The isotopic analysis report indicates the gas sample was collected from Playa Vista Project Area –D. The analysis report also revealed presence of Ethane and 22 PPM Helium in the gas sample. The significance of this isotopic analysis report is the presence Storage Reservoir gas or Native PDR gas signature and the location where the gas sample was collect (Area—D of Playa Vista Project)."*

-"My opinion is that the probability of Storage Reservoir gas sample from PDR area containing Ethane and 22 PPM Helium is greater than 50 percent (>50%). Furthermore, the location where the sample was collected should be of major concern. Please see Appendix # C." p.6.

"III. Recommendations

A review of the aforementioned facts and findings suggest the existence of a potential safety hazard." P.9

The report recommends further study and investigation on pages 9-10 that includes but are not limited to :
3-dimensional geologic computer model that provides *"(well records, soil gas investigations, geo-technical borings, geophysical data, environmental borings, site contamination data, groundwater data, etc) to fully integrate and visually display geologic data 9strata and discontinuities) and other subsurface information (gas and groundwater locations) at the storage field."pg. 9*

<u>SCOPING-</u>These studies have not been performed and should be part of the scoping review for the federal and state review of Ballona.

Because of the vested financial interests of Playa Vista (Playa Capital LLC) and SOCALGAS and SOCALEdison (gas storage use of PDR field) ; Grassroots Coalition

believes that only contractors with no conflicted financial ties to these corporate entities should be allowed to perform geotechnical and environmental studies upon the Ballona region in order to perform unbiased studies.

GC is also concerned about the financial and conflicted interests of staff and board members of SMBRFoundation who provide direct and indirect influence upon both the SMBRC and the Coastal Conservancy.

SCOPING- Transparency does not exist in the Ballona restoration process and needs to be included in the scoping issues for the DEIR. Full public disclosure of the financial and economic issues must be addressed and addressed individually for all staff and board members of the private SMBRFoundation—including those that simultaneously hold positions of authority within the SMBRC, the Coastal Conservancy, other state or federal agencies.

Concerns regarding use of bond funds for the 'SMBRProject" which in 2002 became the SMBRCommission. The SMBRFOUNDATION claims in IRS documents that IT IS THE PROJECT. Thus, the SMBRFoundation takes in funding that is cited as being given to the SMBRC.
- Therefore, it is important for public awareness and participation for both the USACE and CDFG to address and make clear to the public---who actually is legally able contractually to receive and spend federal and state funds which are derived from the public.
-Conflict of interest issues must be addressed specifically by the USACE and CDFG that are responsive to specific queries raised by the public—including but not limited to the John Davis March 28, 2012 –REQUEST TO HOLD EMERGENCY MEETING TO RESCIND APPROVAL ACTION ON FILE NO. 04-088 ; the GC Amended Complaint to the Ca. Coastal Conservancy of August 2, 2012. Neither of these documents has had any response from the lead agencies partner—the Ca. Coastal Conservancy. The public has a right to know in order to make informed decisions.

See- 1008 Order -Division of Oil and Gas and Geothermal Resources (DOGGR) 2011
DOGGR 2011 Order for shut down of SOCALGAS gas injection operations pending investigation and control of escaping and surfacing reservoir gases.
The escaping reservoir gases utilized relatively new wells of SOCALGAS/PDR operations.

See- SETTLEMENT AGREEMENT (CPUC litigation Grassroots Coalition v SOCALGAS)

SCOPING -The EIS/EIR should contain information relative to the ongoing status of the SA.
Health and safety issues are critical to restoration of BAllona. SOCALGAS has not abided by the terms of the SA and GC has been working to ensure…

See-
The 2005 EIS/EIR scoping included the potential and likely negative environmental effects of eg.Poland Report issues identified by USACE in the construction of the Marina del Rey marina such as potential negative effects to the groundwater classified as potential drinking water) due to breeching clay layers from dredging the marina areas. The USACE cited likely salt water intrusion enhancement and needs for protection of freshwater from salt water contamination. The Poland Report cites the connection of the Ballona area to the west basin aquifer.

SCOPING- The 2012 EIS/EIR should include the Poland Report and the USACE 2005 EIS (House Document 389) issues raised regarding concerns of Ballona aquifer / West Basin contamination. For instance:

-what effects will dredging have upon further saltwater contamination in the area.

-how will freshwater resources of the area be protected? The House Document 389 cautioned against breeching a clay layer protecting deeper freshwater zones at Ballona.
Additionally, clay layers can contain secondary collector zones of oilfield gases.
Example- from the Fairfax explosion 1985-Ross-Dress-For-Less.

The pathway of gas migration to the surface included the 3rd Street Fault and an old abandoned well (Chilingar, personal communication). A shallow collector zone (large pocket) of trapped oilfield gas was discovered at a depth of approximately 15 m with pressures of approximately 1.8 kg/cm2 . This collector zone had sufficient porosity and permeability to serve as a temporary trap for the large quantities of upward migrating gases. **A clay layer served as a seal until its threshold pressure was exceeded.** After the explosion, permanent soil gas probes were installed to a depth of approximately 4.6 m in order to perform ongoing monitoring of the upward migrating gases
p 1446. 2012 Migration of Gas from Oil /Gas Fields
J. O. Robertson, G.V.Chilingar, L.F. Khilyuk, B. Endrea

-what mitigation will take place for preservation of the freshwater aquifers and streams?

-Freshwater zones must be protected from the invasion of oilfield gas chemicals; alternative restoration concepts must include options that provide absolute protection from exacerbation of oilfield gas migration contamination.

- SOCALGAS pipelines have not been acknowledged or addressed. Multiple SCG pipelines that surround and pass through Areas A and B have not had any evaluation and must be considered and mitigated and/or removed to prevent

further contamination to the area. (SEE Public Record Act requests to County and Beaches and Harbor)

- **new directional SCG wells that bottom out under Area A are, according to SCG- being used for fluid injection. What potential for direct or indirect harm to the environment exists now? And, what direct or indirect harm may occur to the environment and ecosystem due to potential fracturing of the formation from the fluid injection? What mitigation is proposed and who will maintain liability for harm to the environment?**

SCOPING:

PLAYA VISTA—There are numerous issues of potential for harm and diversion of groundwater that Playa Vista development project poses to the restoration of Ballona.

1. Groundwater diversion- see Groundwater Issues. Playa Vista must dewater the groundwater in order to keep gas evacuation pipes free of clogging from silt and water. The groundwater flow is toward the ocean thus any dewatering is depriving the wetlands from that groundwater and diverting water that would recharge the underlying aquifers.
   -The volumes of groundwater diversion and its potential harm to the wetlands has not been performed and needs to be performed.
   The potential for use onsite of Ballona must be part of any restoration analysis for BAllona.

"What is missing is any review of actual data from the Los Angeles Department of Sanitation. There are no Department of Sanitation documents in the Record which show actual or potential permitted groundwater discharges into the City Sewer System. "

. "Impacts of the project must be measured against the real conditions on the ground." (*Save Our Peninsula Comm. v. Monterey County Bd. of Supervisors* (2001) 87 Cal. App. 4th 99, 121 (citations omitted).) The City cannot simply rely on modeling data provided by Playa Vista, which has a vested interest in downplaying, limiting and minimizing the potential impacts of dewatering. (See *Id.* at 126 (discussing problems with relying solely on applicant generated data).) The City cannot delegate the duty to Playa Vista (or the public) to gather the necessary baseline information. (*Id.* at 122.)

"Petitioners specifically requested the City review its files from the Department of Sanitation in its "Notice of Information Required for Adequate CEQA Review" (5 RR 986.) In addition, a number of comments questioned the lack of actual data from the Department of Sanitation. (See e.g., 2 RR 428; 7 RR 1328; 1357.) In fact, five months before the final decision, Patricia McPherson stated at a public hearing "The Department of Sanitation has 65 - - 65 groundwater dewatering permits for the site

at Playa Vista. You chose five building to look at. You didn't give [the Peer Reviewers] a fair model to begin with." (7 RR 1357:line 24 to 1358: line 3.) The City simply ignored such comment and pretended that the Department of Sanitation did not exist. " page 5 of brief

It is the City's duty, not the public's to do the proper environmental investigation. (*Save Our Peninsula, supra*, 87 Cal. App. 4th at 122; *Sundstrom v. County of Mendocino* (1988) 202 Cal. App. 3d 296, 311.) The City violated the information disclosure provisions of CEQA by not providing records from the Department of Sanitation to the City Council and the public for review.

C. The City Abused Its Discretion By Failing to Inform the Regional Water Quality Control Board of its CEQA Review and Gathering the Appropriate Data.

Informing other governmental agencies that CEQA review is occurring is an incredibly important step in the CEQA process. Section 21080.3 of CEQA states:

> Prior to determining whether a negative declaration or environmental impact report is required for a project, the lead agency shall consult with all responsible agencies and trustee agencies. Prior to that required consultation, the lead agency may informally contact any of those agencies.

(Pub. Res. Code § 21080.3(a).)

Obviously, such consultation will only occur if the responsible or trustee agency that it is informed that it is evaluating a project (or a portion of a project) under CEQA. There is nothing in the record which demonstrates the City informed the Regional Water Quality Control Board (RWQCB) that it was participating in a CEQA process. The failure to inform a lead or trustee agency of the CEQA process is a prejudicial an abuse of discretion. (*Fall River Wild Trout Found. v. County of Shasta* (1999) 70 Cal. App. 4th 482, 492.)

This is not to imply that the RWQCB did not participate in the CLA process. However, the CLA process, according to the City's was not prepared under CEQA. As noted by Attorney Susan Pfann, "There's no requirement of how you about doing [a peer review] or whether or not you have to senditso certain agencies…its simply a study." (2 RR 403.) In this case, the City failed to inform the Regional Water Quality Control Board (RWQCB) of its CEQA process, instead simply requesting the RWQCB simply review Playa Vista's modeling program. Petitioners' specifically objected to the City's failure to notify the RWQCB of the process thereby triggering full CEQA review. (5 RR 943.) By solely requesting a review of the modeling study prepared by CDM, the City prevented the RWQCB from fully participating in a manner

required in a CEQA review process, and violated the information disclosure requirements of CEQA. (Pub. Res. Code 21005.)

The City may argue that its failure to inform the RWQCB that it was participating in a CEQA process was not a prejudicial because the RWQCB did make comments. Perhaps if the City had requested all the relevant data regarding dewater at Playa Vista and Ballona Wetlands possessed by the RWQCB, the City would have an argument. However, there is no evidence in the record that the City requested even basic data, such as NPDES permits or actual metering data, despite the fact that Petitioners specifically requested the City review NPDES permits in its study of significant effects. (5 RR 986.)

D. The City Failed to Gather or Present Data Necessary for Determining Whether Dewatering Activities Were Cumulatively Considerable.

The lack of information from the RWQCB and Department of Sanitation is especially egregious when one considers the lack of analysis of cumulative impacts. A lead agency must determine not only direct and indirect effects of a project are significant, but must also consider whether such impacts are cumulatively significant. (Guidelines section 15064.) As noted in the case law discussing cumulative impacts, "the outcome may appear startling once the nature of the cumulative impact problem has been grasped." (*Kings County Farm Bureau v. City of Hanford* (1990) 221 Cal. App. 3d 692, 721.) The City, by limiting its review solely to the five buildings identified by Playa Vista in its modeling data, failed to consider whether all dewatering activities taken together, may be cumulatively significant.

Phase I of the Playa Vista Development consists of 3,426 residential units, 1.25 million square feet of office and light industrial space, 35,000 acres of retail space and 300 hotel rooms on 246.3 acres of land. ((Environmentalism Through Inspiration and Non-Violent Action, et. al. v. City of Los Angeles, 2005 Cal. App. Unpub. LEXIS 9697, at 3.) ("ETINA v. LA") Despite the massive size, there is no description in the 2007 CLA Report of how many buildings are a part of Playa Vista Phase I, nor how many buildings have dewatering systems. This data should have been easily obtainable from

the Department of Sanitation, which issued industrial water permits for the dewatering systems. (3 RR 502.) Yet, it was not presented to the public.

If one were to search exhaustively through the administrative record, one would find a table described as "Construction and Vesting Status of Playa Vista Phase I" that was apparently submitted by Playa Vista on the date of the hearing. (2 RR 226.) The table identifies 39 Buildings in the "west end of the first phase" (2 RR 226-29.) Of those 39 buildings identified by Playa Vista, 18 of such buildings are identified as having "ground-water dewatering system" Yet, the table fails to identify how much dewatering is occurring at each site. Such information is crucial to knowing whether the dewatering at Playa Vista is cumulatively considerable.

In addition, other dewatering activities independent of buildings must be evaluated to determine whether there is a significant impact. It was incumbent on the City to request dewatering data from the RWQCB, the agency responsible for managing the states' water. Despite petitioners' request that such data be evaluated, there is no indication in the record that the City requested such information from the RWQCB. (3 RR 486.)

Of course, as indicated by the description as "Playa Vista Phase I", there is also Playa Vista Phase II. Despite this well-known fact, there is no analysis in the 2007 CLA report of Phase II. The 2007 CLA report indicates that the peer reviewers solely reviewed reports analyzing the potential impacts installed in Phase I of the Playa Vista development. (3 RR 473.) There is no analysis of the dewatering activities expected in Phase II of the Playa Vista Development.

For a proper analysis of the potential cumulative impacts requires an analysis of all dewatering activities at Playa Vista. This information is available from the RWQCB. But, the City failed to request such information. There is not information in the record which describes NPDES permits of the Playa Vista site or actual discharge volumes into Ballona Wetlands. Without providing the total volume of all dewatering activities, neither the City nor the public can properly evaluate or participate in the public process. "

Pages 6-8
Additional Objections In Opposition To Return To Writ—**ETINA v City of Los Angeles, Playa Capital LLC**

A. Evidence From the Los Angeles Department of Sanitation and the Regional Water Quality Control Board Demonstrates the City and Playa Vista Violated Information Disclosure Requirements of CEQA.

Public Resources Code section 21005 states,

> [N]oncompliance with the information disclosure provisions of this division which precludes relevant information from being presented to the public agency . . . may constitute a prejudicial abuse of discretion.

There a number of ways that an applicant or a lead agency may fail to comply with the information disclosure requirements. (*See e.g. Fall River Wild Trout Found. v. County of Shasta* (1999) 70 Cal. App. 4th 482, 493 (failing to notify DFG); *Cadiz Land Co. v. Rail Cycle* (2000) 83 Cal. App. 4th 74, 95 (failing to identify size of aquifer); *Sierra Club v. State Bd. of Forestry* (1994) 7 Cal. 4th 1215 (failing to study endangered species); *Save Our Peninsula, supra,* 87 Cal. App. 4th at 122 (failing to use actual data).) In fact, many cases which have sought to strike down environmental impact reports have sought to establish, through omission, that there has been non-compliance with the information disclosure requirements of CEQA. (*Association of Irritated Residents v. County of Madera* (2003) 107 Cal. App. 4th 1383, 1391.)

However, suppression of evidence is also a form of non-compliance. Evidence which clearly should be in the record, but has been improperly excluded, should be admissible to demonstrate a violation of Public Resources Code section 21005. Clearly evidence which has been withheld from the public, despite requests from the public for inclusion of such information, cannot be provided by the public. In addition, the public should be able to assume the lead agency will include documents which are required to be part of the administrative record under CEQA, such as documents in its own files on a project. (Pub. Res. Code 21167.6(e)(10).)

Such interpretation is supported by Western States which notes that extra-record evidence should be admissible to demonstrate procedural unfairness and agency misconduct. (*Western States Petroleum Ass'n v. Superior Court* (1995) 9 Cal. 4th 559, 575 n.5 & 579.) In *Western States,* the petroleum association attempted to introduce newly created expert evidence, prepared after the close of the public hearing, to demonstrate that the Air Resources Board failed to consider all relevant factors. The Supreme Court held, "extra-record evidence can never be admitted merely to contradict the evidence the administrative agency relied on in making a

quasi-legislative decision or to raise a question regarding the wisdom of that decision." In contrast, in this case Petitioners seek the court to consider documents which were in the agency's files or trustee agency's files to demonstrate a procedural defect in the City's CLA process.
In this case, there is extra-record evidence from the Department of Sanitation which demonstrates that the level of dewatering is almost five-fold greater than that which was presented in Playa Vista's modeling study. (Notice of Lodgment, Ex. 1.)[1] Brief pgs 9-10

SCOPING:

-The duty of cumulative groundwater dewatering now falls upon the state and federal agencies in the performance of this NEPA/ CEQA process.

- The duty of full disclosure with regard to state and federal agency behavior and process is also required in this NEPA/CEQA process- as cited above in the brief . Thus response to the John Davis and GC Complaints to the COASTAL CONSERVANCY regarding failure of due process, conflict of interest, prejudice ---require full evaluation and response.

" Still all the cases appear to agree that "[a] prejudicial abuse of discretion occurs if the failure to include relevant information precludes informed decisionmaking and

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IV. MOTION TO AUGMENT

A. This Court May Consider Relevant and Improperly Excluded Extra-Record Documents Because Petitioners Have Proven Such Documents Fall Under the Exception Enunciated by the Supreme Court of California.

Respondents contend that this Court may not consider two sets of relevant, extra-record documents: (1) documents from the LA City Department of Sanitation, including a table showing permitted discharges of up to 72,000 gallons per day, and (2) documents from the RWQCB showing permitted discharges of 950,000 gallons per day ("gpd"). (16 CT 3696-3700.) Though extra-record evidence is generally inadmissible, the Supreme Court of California has enunciated an exception to this general rule. "Extra-record evidence is admissible if the proponent shows that the evidence existed before the agency made its decision, but that it was impossible in the exercise of reasonable diligence to present it to the agency before the decision was made." (See *Cadiz Land Co.* v. *Rail Cycle* (2000) 83 Cal. App. 4th 74, 119 quoting *Western States Petroleum Assn. v. Superior Court*, *supra*, 9 Cal. 4th 559, 576-578.) This exception corresponds with Code of Civil Procedure section 1094.5, subdivision (e), which grants the court discretion to remand the case for reconsideration if the court finds "there is relevant evidence, which, in the exercise of reasonable diligence, could not have been produced at the administrative hearing or which was improperly excluded." (CCP § 1094.5.) Also, arguably, "extra-record evidence may be admissible to show 'agency misconduct.'" (*Id.* at 119 quoting *Western States Petroleum Assn.*, *supra*, 9 Cal. 4th at pp. 575-576, fn. 5.)
The Court may properly consider the extra-record documents at issue

informed public participation, thereby thwarting the statutory goals of the EIR process." (*Id*.; *See also*, *Save Our Peninsula Comm. v. Monterey County Bd. of Supervisors* (2001) 87 Cal. App. 4th 99, 118; *Sierra Club v. State Bd. of Forestry* (1994) 7 Cal. 4th 1215, 1235.)"The courts have looked not for perfection but for adequacy, completeness, and a good faith effort at full disclosure" (*County of Amador, supra,* 76 Cal. App. 4th at 954.) " Brief p. 3

here because the documents demonstrate the City failed to consider maximum permitted discharges, even though such documents were in existence prior to the City's decision. Maximum permitted discharges are relevant both to an analysis of cumulative impacts, and to an analysis of potential worst-case scenario impacts for methane dewatering. Though Petitioners exercised reasonable diligence in requesting access to and inclusion of these documents, the City failed to comply. (Code Civ. Proc. § 1094.5(e).) This failure to include or consider these documents amounts to suppression of evidence and agency misconduct. Accordingly, the extra-record documents at issue here fall under the narrow exception articulated in *Western States* and Code of Civil Procedure section 1094.5(e). *(Western States Petroleum Assoc*. v. *Superior Court* (1995) 9 Cal. 4th 559, 576-578.)

i. The Record of Proceedings Under Public Resources Code Section 21167.6(a) is Broad and Inclusive.

Pursuant to Public Resources Code Section 21167.6(a), the record of proceedings shall include a broad array of documents "relating to the subject of the action or proceeding." Public Resources Code Section 21167.6(e) is inclusive, providing a list of items that "shall be included," but specifying that the record "is not limited to" those items. The statute "contemplates that the administrative record will include pretty much everything that ever came near a proposed development or to the agency's compliance with CEQA in responding to that development." (*County of Orange v. Superior Court* (2003) 113 Cal. App. 4th 1, 10.)

2. **The 2007 Methane Mitigation AUDIT performed by the City of Los Angeles (City Controller- Laura Chick) needs to be included and analyzed** for determination of the effects of the gas mitigation dewatering. The AUDIT reveals that methane mitigation measures –including the critical 50' deep vent wells (that but for their ability to vent and not clog—the site was considered too dangerous to build (CLA Report)—
Had no mitigation monitoring and no proof that the systems were implanted or implemented in a fashion that they actually work. The Audit also shows that Playa Capital LLC and the City of LA were and are unable to identify where the 50' vent wells are.

3. Department of Sanitation records need to be evaluated for analysis of groundwater dewatering that has direct and indirect impacts upon the restoration of Ballona and current groundwater movement across the Ballona habitat.
   Playa Vista and the City of LA have irresponsibily failed to provide Best Management Practices for the groundwater of Playa Vista and thus upon the sensitive ecological areas of Ballona. Instead, Playa Vista has been improperly and potentially illegally allowed to discharge Ballona groundwater (classified as potential drinking water) into the Sanitary Sewer via WASTEWATER DISCHARGE APPLICATIONS AND SOME PERMITS.

4. **GRAVEL COLLUMNS**:
   No 408 permits were given to Playa Capital LLC for installation of hundreds of gravel collumns along Ballona Channel- the north side of Fountain Park Apts.
   -This 408 permit issue needs to be evaluated for potential illegalities of insertion of the gravel collumns- without permitting as well as evaluated for The known and established actions of the stone collumns to act as cross contamination and groundwater movement features for groundwater and gases.
   -GC supplied pictures to the City of Los Angeles and to the LA County Flood Control that depicted CRACKING along Ballona's south levee- on the north side of Fountain Park Apts. GC herein submits a video- BURNING QUESTIONS- that supplies video of the insertion process of those stone collumns and the apparent outgassing and vibration.
   - What effects do the collumns have upon the integrity of the Ballona levee to the east of Lincoln Blvd.?
   - Did Playa Capital LLC have to secure a 408 permit for insertion of the stone collumns since the collumns align along the fence line of the Ballona levee? And, potentially have the ability to undermine the earth of the levee itself due to the constant rise and fall of tidal action upon the ground waters?

   -The City of Los Angeles and County Flood Control only performed a visual inspection as was discussed during a Building and Safety Commission Hearing during the 2000 -1 timeframe. To GC's knowledge no alert was provided to the Army Corps of Engineers for input into this issue of present concern. The collumns while providing stability from liquefaction for the apartment complex appear to be potentially undermining the integrity of the Ballona levee to the east of Lincoln Blvd.

5. **CDFG HISTORIC LACK OF OVERSIGHT OF KEY HEALTH AND SAFETY ENVIRONMENTAL ISSUES THAT CDFG must address in the 2012 EIS/EIR;**
   Including its role or lack thereof of prudent oversight of health and safety issues.

Example of why clarification is needed- this GC letter to CDFG from 2003:

September 4, 2003

TO: THE CALIFORNIA DEPARTMENT OF FISH & GAME-
Mr. Raisbrook, Regional Manager
San Diego, California ***fx 858 467 4201***

FROM: GRASSROOTS COALITION-
Patricia McPherson

RE: ECOLOGICAL ASSESSMENT OF AREAS B AND D- PLAYA VISTA, 6775 CENTINELA AVENUE, LOS ANGELES, CALIFORNIA &

PHASE 2 EIR- PLAYA VISTA

Dear Mr. Raisbrook,

Grassroots Coalition respectfully requests that the California Department of Fish & Game clarify, in writing, its scope of review and involvement regarding the Playa Vista site.

The EIR for the Playa Vista Phase 2 is now available for review, as I am sure that you are aware. Also, the Los Angeles Regional Water Quality Control Board (LARWQCB) sent Grassroots an Ecological Assessment (EA) of Areas B and D of the Playa Vista site for review. The deadline for comments was mid-August. I have included the LARWQCB letter with its cc list. Grassroots did respond but also notified various Fish & Game personnel, including Brad Henderson- our local CA. Dept. of Fish & Game (DFG) biologist, of the EA. In my comments to the LARWQCB, I noted that DFG had not been given the EA. Apparently, the LARWQCB has now sent the EA to DFG and given the DFG a September 15, 2003 deadline (attached letter).

While Grassroots would appreciate comments from the DFG regarding the EIR and the EA, we believe it is vitally and fundamentally important to clarify, in writing, the DFG role and scope of review at the Playa Vista site. <u>In particular, our concern is that the oilfield gas issues at Playa Vista have not been assessed by any independent state agency</u>.

It is vitally important for the DFG to clarify that it has played no role in the oversight for and/or evaluation of the newly discovered oilfield gas contamination problems of the Playa Vista site as they relate to the biology and ecosystems of the area and/or any other capacity.

The California Environmental Protection Agency- Department of Toxic Substances Control (DTSC) did respond, in writing, to the LARWQCB regarding the City of Los Angeles' / Playa Capital gas study(May 2001), wherein DTSC stated the City study was incomplete and that:
-soil gas studies needed to be performed in native, undisturbed soils (studies performed thus far were done in soils that were predominantly disturbed from construction activities and had other problems noted by DTSC) and that,

- *an ecological risk assessment needed to be performed (LARWQCB does not perform ecological risk assessments);*
- *the DTSC sister agency, the LARWQCB, has not requested or required Playa Capital to fulfill the DTSC recommendations.*

Because the oilfield gases, including benzene, toluene and xylene (BTEX) and oilfield generated hydrogen sulfide (H2S) are not issues within the scope of review for the LARWQCB, and because the LARWQCB has not adhered to the DTSC recommendations, or requested DTSC to step in for oversight of the oilfield issues (of CAL EPA agencies, DTSC has oilfield toxics within their scope of review and expertise) , there continues to be no independent state oversight for evaluations of the oilfield issues.

DFG HISTORY

I have requested of the DFG, through numerous DFG personnel, including those in OSPR, of any ability of the DFG to engage in a biological study of the potential negative consequences of the oilfield operation gas migration hazards that we now know exist at the Ballona Wetlands, the site of Playa Vista. Furthermore, the impacts of the construction activities creating enhanced gas migration and H2S production are also issues that potentially affect the ecosystems of Ballona. Thus far, there has been no response from the DFG that it has the ability to engage in any way regarding any of these matters.

In conclusion, if the DFG does not clarify the fact that it has played no role in the oilfield gas issues and apparently cannot engage these issues under its scope of review and study, then any action and/or response the DFG does engage in at the Playa Vista site will leave and, has left a biological gap of oversight that needs to be clarified. ***It would be entirely misleading to the public*** *if the DFG were to continue involvement at the Playa Vista site and not clarify exactly what it does and does not include within its scope of review, with regard to its conclusions and/or recommendations regarding the Playa Vista site.*

Mr. Raisbrook, Grassroots Coalition respectfully requests a written clarification of the DFGs role in oversight of the newly discovered oilfield gases that are migrating to the surface at Playa Vista.

I'm sending along a Public Record Act request for your help in our providing a formal request for the information requested above and also because of our need for a copy of the Habitat Mititgation and Monitoring Plan (HMMP) for Playa Vista.

SCOPING: It is vitally important for CDFG AND OTHER AGENCIES TO MAKE CLEAR TO THE PUBLIC WHAT OVERSIGHT THEY DO AND DON'T HAVE.

ISSUE #2

SUBSIDENCE AND UPLIFT

SCOPING----SUBSIDENCE issues have not been addressed and must be addressed .

State law requires the avoidance of subsidence in coastal areas from oilfield fluid production..

- What are the effects and potential negative impacts due to ongoing subsidence?
- Why has this issue not been address and no monitoring has been done by the state even though it is a policy of this state in coastal areas.

-

***"SUBSIDENCE IS CAUSED BY FLUID WITHDRAWAL**:*

"Fluid withdrawal from a petroleum reservoir or aquifer leads to the inevitable result of causing land subsidence at the surface, and compaction of sands at the reservoir level. The compaction is due to a pressure decrease in the reservoir or aquifer, and causes the overlying formations and the land surface to sink. This deformation leads to fracturing of the geological formations in the surrounding areas, causes movement along existing fault structures, and damages the oil and gas well casings and seals. This gives rise to the upward migration of gas from the petroleum reservoir. The interaction between subsidence and gas migration is illustrated in Exhibit 1.

The geological deformation is greatest at the reservoir level and propagates to the surface as a bowl shaped configuration, as illustrated in Exhibit 2. The maximum subsidence is at the center of the bowl. For a petroleum reservoir, the extent of the subsidence bowl at the surface is approximately twice the areal extent of the reservoir. ….

As a general rule, the amount of subsidence experienced at the surface correlates directly with the volume of fluid production within the reservoir. …

2. FLUID WITHDRAWAL HAS CAUSED SIGNIFICANT SUBSIDENCE AT PLAYA VISTA, PLAYA DEL REY AND THE MARINA PENINSULA AREAS:

Fluid production of oil and brine water from the Playa del Rey and Venice oil fields caused nearly two feet of surface subsidence between 1927 and 1970. The California

Division of Oil and Gas (DOG) documented this in their Sixtieth Annual Report published in 1974. ..(exhibit 3)

…SOCALGAS has operated an extensive oil field dewatering program with the 'Del Rey Hills Area' and the 'Venice Area' for many years. This has been necessary since the gas storage operations requires continuous pumping of brine water from these areas to prevent invasion of the water into the primary storage zone reservoir.

The average daily production from their dewatering wells is approximately 2,500 barrels of brine water per day. This would equate to over 90,000 barrels per year, or over 27 million barrels of fluid production between 1970 and the present. It is inevitable that this has contributed to the subsidence problem, additional geological fracturing, and additional damage to the oil and gas well casings and seals.

3. <u>CITY OF LOS ANGELES SURVEY DATA HAS CONFIRMED THE EXISTENCE OF A SERIOUS SIBSIDENCE PROBLEM:</u>

I utilized survey data generated by the City of Los Angeles to evaluate the extent of the subsidence problem in the Playa Vista Area (near Jefferson Blvd. and Lincoln Blvd.) in the vicinity of the Playa del Rey oil field. The data utilized is presented in Exhibit 5.

…In summary, these data establish that the Jefferson/Lincoln area subsided .267 feet over a 14-year interval from 1956 to 1970. The Pacific /Lighthouse area, a well known subsidence prone area, subsided .265 feet over a 15-year interval from 1955 to 1970. Accordingly, these data confirm that the subsidence problems caused by oil field production are widespread, and extend to the areas that are under development at Playa Vista. No systematic monitoring of these problems has been undertaken since 1970.

4. <u>THE SUBSIDENCE PROBLEMS IMPACT THE INTEGRITY OF THE OIL AND GAS WELLS THROUGHOUT THE AREA:</u>

Fracturing of the geological formation and damage to the well casings from subsidence will cause upward migration of gas to the surface, exacerbating the near surface soil gas conditions. In the referenced area, over 200 oil wells were drilled and completed prior to the onset of the significant subsidence discussed in this document. Accordingly, subsidence must be recognized as a major contributor to the gas migration problems that have been documented at Playa Vista.

…It is apparent that the gas migration problems at Playa Vista are strongly interrelated with the movement of leaking gas easterly within these gravel zones as a result of being 'swept' by the tidal forces and wave energy within these permeable zones.

5. SURFACE DEFORMATION:

Deformation due to compression and extension at and near the land surface causes fissures in the soil and damages buildings, pipelines, and other structures. In the subject areas, these problems are complicated by the 100% liquefaction prone region that has been identified in the Seismic Hazards Map published by the Division of Mines and Geology, and by the near surface water table.

Regionally water tables will remain at nearly the same elevation after local subsidence lowers the land surface. The effect is to decrease the depth to the water level. If the water table rises (relative to the land surface), higher than the bottom slab of a building, the uplift pressure on the structure will be noticeably increased. This could cause the slab to eventually rupture.

Likewise, the below-slab installation of a gas membrane barrier for gas control purposes could be adversely impacted by these same uplift pressure conditions…..

City of Long Beach….an elaborate water injection program to mitigate the consequences of surface sinking and water incursion in this coastal area. …

The city of Redondo Beach failed to impose such a requirement on oil field operations conducted under the King Harbor Boat Marina. Approximately two feet of subsidence, which occurred over a period of 20 years of oil production, caused the breakwater rubble barrier, constructed by the U.S. Army Corps of Engineers , to sink. A winter storm in 1988 destroyed the rubble barrier, and the city of Redondo Beach and the U.S. Army Corps of Engineers were held liable for the millions of dollars of damage that resulted to the shoreline structures. They were found to have been negligent for failing to monitor for the subsidence and for their failure to take protective measures to minimize the risk of injury.

It is significant to point out that the level of subsidence measured in the Playa del Rey and Venice coastal areas through 1970 is similar to the subsidence that caused the destruction of the King Harbor at Redondo Beach.
(Society of Petroleum Engineers Paper 83504 Environmental Hazards Posed By The Los Angeles Basin Urban Oilfields: An Historical Perspective Of Lessons Learned- Bernard Endres PhD; George V. Chilingar PhD)

*…**A systems engineering approach is necessary in evaluating the interactive consequences of subsidence, gas migration and movement of gas through the near surface aquifers from the locations of the leaking wells. This requires a detailed evaluation of the hydrology and the tidal actions that are responsible for moving the gases easterly within the aquifers and under the Playa Vista development."pgs 1-8***

Bernard Endres PhD to LOS ANGELES BUILDING AND SAFETY

REGIONAL GROUND SUBSIDENCE AT PLAYA VISTA, PLAYA DEL REY AND THE MARINA PENINSULA, AND RELATED GAS MIGRATION PROBLEMS

(See also SOCALGAS- PDR p.768-9 ; 2012-The Environmental Aspects of Oil and Gas Production Subsidence by J.O. Robertson, G.V. Chilingar; L.F. Khilyuk, and Bernard Endres)

NOTE: The Settlement Agreement (SA) between SCG and Grassroots Coalition (GC) includes INSAR subsidence monitoring . However, SCG has not complied with the SA as it has not provided INSAR subsidence monitoring imagery of a high resolution necessary for expert review of the data. We are still requesting the imagery.

SCOPING-- The EIS/EIR needs to include a systems engineering approach for evaluation of the subsidence issues that are ongoing in the Ballona area.

(SOCALGAS has implemented a water injection program under Area A according to PDR –SOCALGAS officials however, no correlation or explanation has been provided by SOCGALGAS experts.)

-The EIS/R needs to provide thorough evaluations o this issue which overlaps the tidal influences and detriment to the freshwater aquifers that the 'estuarine' PLAN promotes.

-The EIS/R needs to provide ALL REASONABLE ALTERNATIVES of Ballona's restoration which has not been done. The public has been cut out of the process of alternative planning. Thus, the current EIS/R process is a ruse and a process that has fundamentally abused the taxpayers funding of review through bond money intended for a legitimate restoration process providing PUBLIC INCLUSION prior to this end point that has a predetermined outcome by the state agencies engaged.

-The newly adopted City of Los Angeles Methane Ordinance imposes a condition of dewatering in order to prevent the shallow water table---existing throughout the subject area—from invading the perforated pipes and gravel layer. The perforated pipes and gravel layer are required to passively vent the upward migrating oilfield gases from invading buildings and creating an explosion hazard.

If the perforated pipes and gravel layer are invaded by groundwater the gas venting systems become dysfunctional. Thus, dewatering becomes an essential part of implementing the City of LA Methane Ordinance. However, subsidence may result upon pumping the groundwater, necessary to achieve the dewatering, especially because numerous other ongoing decontamination dewatering is ongoing at Playa Vista. **The cumulative dewatering effects have not been addressed at the site since the ordinance was adopted by the City. This imposes a higher duty upon those responsible for protecting public safety.**

7 -

10.0 ENVIRONMENTAL CONCERNS

Cleanup and Land Disposal Sites

Within less than one mile of the Study Area, as shown on Figure 9, twenty-three sites with environmental concerns were identified on GeoTracker (SWRCB, 2010). Of these sites, 12 are leaking underground storage tanks sites (LUSTs), 10 are other clean-up sites, and 1 is a DTSC clean-up site. Sites identified as still active under regulatory oversight include 7 LUSTs, 7 other clean-up sites, the DTSC clean-up site, and the land disposal site. Table 2 provides a summary of the information available from GeoTracker for each site.

The active cleanup sites located up-gradient from the Study Area may pose a risk to the soil and water quality of Ballona Wetland.

Underground Methane Storage Reservoir

The Playa del Ray storage field, a large natural gas storage reservoir that is owned and operated by the Gas Company, is located at depth beneath most of Study Areas A and B, including the southern half of Marina del Rey, most of Playa del Rey, and the terminus of Ballona Creek (see Figure 10). The limits illustrated on Figure 10 include a quarter mile radius measured around the outer limits of the storage field, where the air and ground surface may be effected by fugitive gas or odors released from the natural gas storage reservoir or where subsidence may occur due to changes in pressure from within the reservoir. This radius is termed the area of potential influence by the Gas Company. Formerly an oil field that produced during the 1930s, it was converted to a natural gas storage reservoir when the pressure in the field dropped below optimal levels for oil production. The Playa del Rey storage field is located approximately 6,100 feet below the ground surface in Tertiary-age sandstone, which is capped by approximately 1,500 feet of impermeable shale. Fifty-four active wells and three compressors are used to inject and withdraw methane gas into and from the formation.

On December 20, 2007, a settlement agreement was approved by the California Public Utilities Commission (CPUC) in response to complaint cases against the Gas Company and its operation of the Playa del Rey storage field. This settlement includes an odor program, which involves routine patrols in the area for vagrant odors from the field, natural gas venting, engine and exhaust odor minimization, reduction of fugitive emissions, and the installation and maintenance of a meteorological station. Monitoring of the soil gas, subsidence, gas pressure, withdrawn gas chemistry, and released liquids are also included in the settlement agreement.

The Playa del Rey storage field poses an uncertain risk to Ballona Wetland and the habitat alternatives, with regard to possible release of methane gas and possible ground subsidence related to the operations of the storage reservoir.

SCOPING:

-The issues of thermogenic gas hazards and subsidence concerns raised herein by GC in detail have not been evaluated and need to be.

The CITY OF LOS ANGELES expert- Victor Jones of Exploration Technologies v Inc. current and past data production needs to be included in the SCOPING ASSESSMENTS.
-Still Workin On It must be included as it refers to the actual failures of the experimental gas mitigation systems which give rise to needs of groundwater withdrawal and the effects of that groundwater withdrawal.
--Include Jones' response to SOCALGAS regarding gas sampling and gas migration in the freshwater marsh (catch-basin) via the currently leaking well –University City Syndicate-(this well was last abandoned by Playa Capital LLC. With financing from the City of Los Angeles taxpayers.)

YouTube - Playa Vista Ga#18A265

YouTube - playa vista ga#18A23D

Reference below to University City Syndicate by Victor Jones- ETI
As part of overall review of the URS gas studies assessment for SOCALGAS.
(URS engagement with both Playa Vista and SOCALGAS should be considered a conflict of interest in any work performance of the restoration of BAllona.)

"It is particularly significant to note that this response is associated with an abandoned dry hole that is not a gas storage well, and has never produced oil or gas. The ETI data discussed above was collected in 2001 before the well was re-abandoned by Playa Vista. Following re-abandonment the leakage around this well has significantly increased and today is reported by DOGGER to be vigorously bubbling around the casing and includes additional vents more than 100 feet away from the casing. Actual Youtube videos http://www.youtube.com/watch?v=LR1r9X2VGZo&feature=geosearch and http://www.youtube.com/watch?v=NNA2f3GvUPg&NR=1) show these gas bubbles. An excellent report on this extensive gas leakage from the Syndicate-1 well is discussed in a 12 July 2010 letter report (Geoscience Seep Gas Analysis.pdf) submitted by Lewis Pandolfi.
A similar response to this could be found around any well in the general Playa del Rey area, regardless of whether it is, or was a gas storage well, or an abandoned oil and gas well. ***All old well casings are potential leakage conduits and all of the known wells, whether abandoned or not, should have been included in the planned phase I soil gas survey.*** *This increase in leakage activity is obviously related to the re-abandonment of the well. It can never be assumed that a re-abandonment of any well will always be successful. Follow-up soil gas surveys are the only way to prove that the re-abandonment was successful. " Exploration Technologies Inc., Victor Jones 2011*

Please also respond to the following comments:
The comments raised above (part of a FOIA response from USACE- GeoPentech Report) acknowledges uncertain risks to Ballona and the 'Plan'(s) but thus far the SMBRC/ COASTAL CONSERVANCY AND CDFG and USACE have ignored GC's

concerns and refused to allow GC to provide public presentations at SMBRC meetings or at Ballona watershed meetings--regarding these concerns. Once again, failure to communicate and share with the public , lack of transparency—is the proven objective with the agencies. The Ballona land was acquired with public bond money, the land belongs to the public and the agencies are supposed to be providing stewardship that includes feasibility of alternatives WITH the public. This has not occurred. Thus far, the state is acting as though Ballona is a residential development site owned by the state and that the public must respond TO ONLY WHAT THE STATE TELLS IT TO RESPOND TO AND OTHERWISE BUTT OUT!
This is apparently the state's attitude for its 'supposed' request for the USACE to disengage from the 2005 Joint EIS/R process and stop including the regional Ballona ecological areas and biological values.
According to USACE –FOIA'D documents, the state did not fulfill its contractual agreements. This failure causes the state to also lose the financial support of the federal government that are cited as 65% of restoration costs.



SCOPING:
This is just one example of high volume oilfield gas leaks to the surface—shown here are gas leaks leading to the shut down of the SOCALGAS gas injectio operations. (DOGGR 1008 Order)
-The Settlement Agreement and the follow up studies and the GC response to SOCALGAS and the CPUC need to be addressed and analyzed due to the extreme health and safety issues.

SCOPING:

- Needs to include recent DOGGR 1008 Order responsive documents and historic SOCALGAS documents (currently the state has provided only hearsay discussion from SOCALGAS). Some of those documents are included in this submission to alert regarding the oilfield gas migration hazards that SOCALGAS continues to avoid as it fails to abide by the Settlement Agreement between Grassroots Coalition and SOCALGAS.

Example document:
InterOffice (GAS COMPANY) CORRESPONDENCE
*Playa del Rey- Gas Migration_*
"The area where storage gas is currently surfacing is in the flat area. Sound logs suggest gas movement from a depth of about 1000' below sea level. The temperature anomaly in Del Rey 18 is approximately 1100' below sea level."

(Del Rey 18 is located at Fisherman's Village and the 'flats' are the land areas below the bluffs- GC)

"We have also had reports this year of gas containing helium present in the surface casing annulus of 26 wells. "

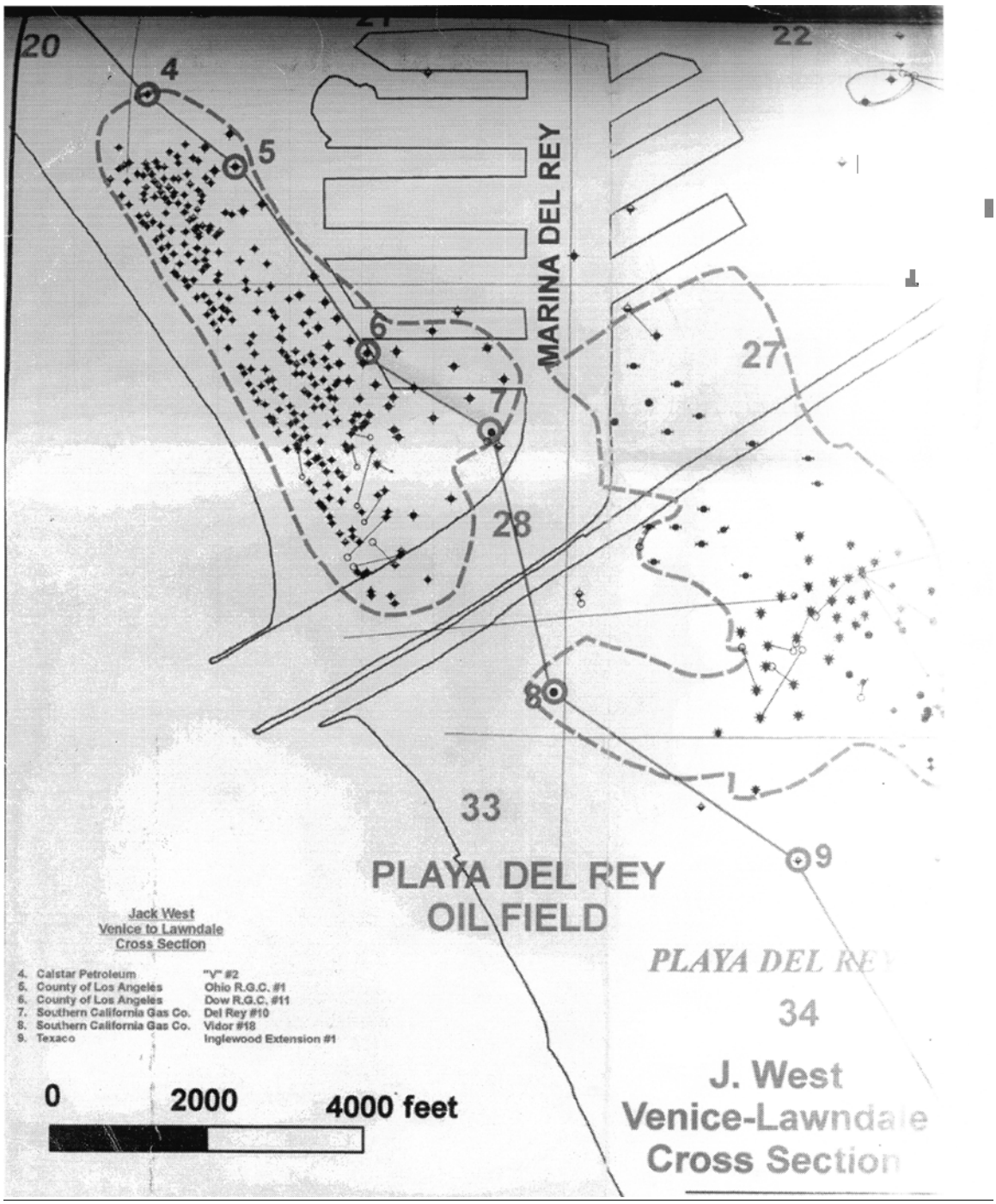
(Helium is often used as a marker for SOCALGAS reservoir gas migration since the gases piped in from Texas, Oklahoma …contain helium and the PDR field has no historic helium within the oilfield according to the City and DOGGR records. No native gas samples exist of the field from prior to injection of foreign gases. (CPUC discovery queries upon SOCALGAS)

SCOPING:

-Please provide accountability and legal legitimacy for withdrawing from the 2005 Joint EIS/R process.
-Please provide all financial accountability for federal funds already spent. How was the money spent and what was the outcome of the expenditures?

As can be seen in the diagram below, there are numerous active and abandoned wells that must be tested for leakage regularly. Further saltwater intrusion will present not only a potential for casing leakage due to that salt water corrosion but will also pose a more difficult circumstance within which to REPAIR and STOP the leakage and furtherance of at least the GREENHOUSE GASES.

- **Mitigation measures and monitoring of all wells must be part of the scoping of issues needing study and response. What is planned for such study and monitoring of these issues by the state and federal government?**
- **Thus far studies have not occurred. What assurance that these health and safety issues WILL be addressed and mitigation provided?**



ISSUE # 3

HYDROLOGY & DEWATERING

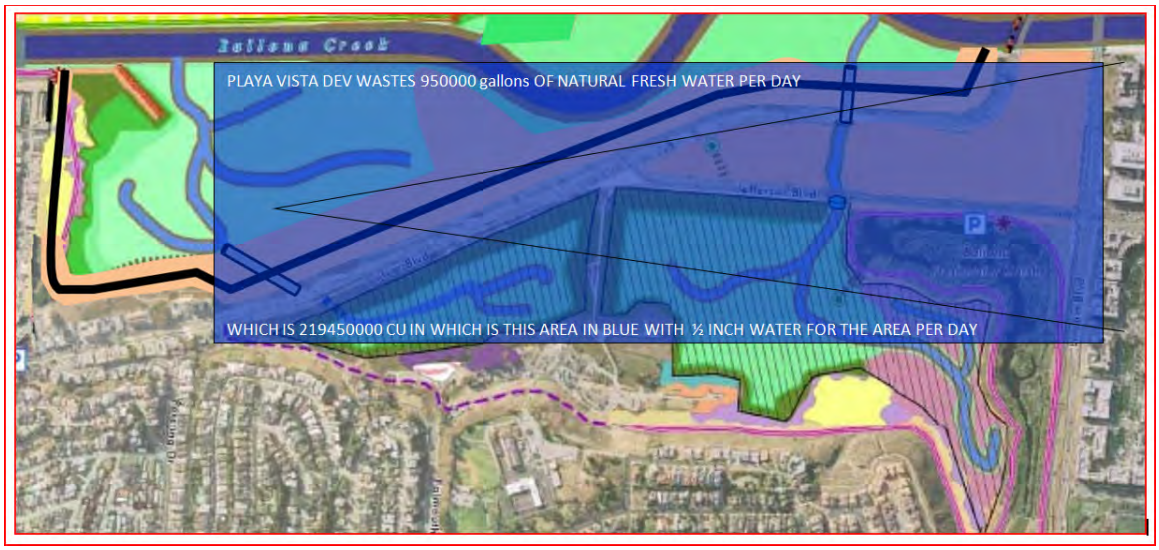
-Why have the state and federal agencies failed to provide the iterative process that was promised to the public for use of public bond money and federal taxpayer funding? Scoping needs to include the history of what has occurred and respond to

why and how the public has not been allowed to cross share information and be part of the planning process for restoration alternative planning of BAllona.

-Address why no hydrology studies of the near surface aquifers and streams have been done during the so-called 'feasibility' phase.
-During the 'feasibility' phase GC and others of the public requested an ACES program study be performed upon Ballona in order to fully understand the hydrology of the area which includes the underlying groundwaters and its surface waters.
-The ACES study needs to be performed.

[PDF]
ACES: Analytical Framework for Coastal and **Estuarine** Study
proceedings.esri.com/library/userconf/proc08/papers/.../pap_2183.pd...

-Why has there been no response from SMBRC/ Coastal Conservancy o this issue of concern and why was this request not provided to USACE AND CDFG?
-Provide hydrology studies that reveal the current levels, locations and sources of groundwater in Ballona.
-How have the groundwater levels changed over the past 20, 50, 100 years? What has caused those changes? And, how can the freshwater resources be restored and utilized for Ballona?
-What studies provide review of protection of the groundwater sources in Ballona ?
- Why has the ACES, sanctioned by the USACE, program for estuary mapping not been employed as requested by the public at Ballona?
-What freshwater resources are available for restoration purposes at Ballona and how can they be utilized?
-How much groundwater of Ballona is being diverted and/or otherwise not being allowed to recharge the area?
-What are the cumulative volumes of groundwater that Playa Vista is diverting from the wetlands and why is this allowed to occur?
-What studies have been done to assure the fresh groundwaters are not negatively impacted by the proposed 'Plan" and how can the "Plan" be implemented when diversion of contaminated and toxic Ballona Channel waters and sediments (as cited in the Weston Report on Coastal Conservancy CD) and further contaminated saltwater intrusion provides for one impaired water way into another. Is this not a violation of the Clean Water Act and Porter-Cologne?



This GC visual aid shows an approximate amount of water permitted by the Dept. of Sanitation- daily to Playa Vista for 'wastewater' dewatering. The removal and throwing away into the sanitary sewer system of this precious groundwater that is classified as 'potential drinking water' should not be allowed. This same volume would/could create a half acre pond at 1 foot deep---in one day.
SCOPING:
- Provide analysis of the actual volumes of groundwater being diverted from Ballona by Playa Vista and provide an analysis of how this water can be utilized onsite for restoration purposes. Especially, in light of the fact that Ballona is historicall dominated by freshwater flows.
-WHY is this water not being utilized onsite and for restoration purposes?
Is it not illegal for Playa Capital LLC to divert this volume of groundwater and throw it into Hyperion sewer treatment plant?
-CDFG's response regarding potential harm has thus far been---they do not know. That answer is unacceptable. Find out.

Documents from LARWQCB showing permitted discharges of 950,000 gallons per day (gpd)(16 CT 3696-3700) and LA City Department of Sanitation, including a table showing permitted discharges of up to 72,000 gpd.
-Why is this water being allowed to be diverted and thrown away and not utilized for groundwater recharge and/or a source of freshwater for BAllona restoration purposes?
-Diagrams included herein, reveal that utilizing the LARWQCB permitted discharge rate of 950,000 gallons per day; this volume of water would provide approximately ½ inch of water across the surface of most of Ballona Wetlands –south of the Ballona Channel. The same volume could provide in one day—a foot of water to a ponded area approximately ½ acre in size. The large volumes described would provide a source of freshwater to Ballona's restoration that would be incredibly valuable.
-Why have these sources of groundwater not been evaluated?

-How is it possible that Playa Vista can divert much needed groundwater away from Ballona? Especially in light of the1993 EIR for Playa Vista requires for an groundwater discharge:
-a preapproved beneficial plan for any such extraction and discharge (EIR Vol. 26 p 014945)
-tertiary treated groundwater from NPDES provides primary supply of freshwater for the wetland system (EIR Vol. IX- Executive Summary 1-2.
-"ongoing remediation of the known existing groundwater contamination in Area D and utilization of the resulting treated water for the beneficial use of supporting onsite vegetation, would result in a beneficial impact on ground water." P. 12- Exhibit B- Certification of EIR and Adoption of Mitigation and Monitoring and Reporting Program.
And,
"Culverts under Lincoln Boulevard should be of sufficient size to permit wildlife movement between Areas B and D without risk of injury or death from traffic hazards." P. 18. Mitigation and Monitoring Report

The EIR o Playa Vista also requires the
-avoidance of any long term dewatering due to negative environmental consequences
however, no cumulative analysis of groundwater extraction has been done, impacts of that groundwater dewatering have not been done and,
no enforcement of metering requirements has occurred.

-SCOPING:
-The Ballona region requires hydrologic review .

NOP of CDFG cites on page 1:
Project Summary and Proposed Action
The project entails restoring, enhancing, and creating native coastal wetland and upland habitats in the
approximately 600-acre Ecological Reserve. The reserve comprises previously filled and dredged coastal
wetland and upland habitat that would be restored by increasing tidal flow throughout the project area,
removing invasive species, and planting native vegetation. Figure 3 shows a conceptual design of the
proposed restoration. The main components of the project are:
l Habitat restoration of estuarine wetland and upland habitats connected to a realigned Ballona Creek.
l Removal of existing Ballona Creek levees and realignment of Ballona Creak to restore a more meandering channel.
l Construction of new levees to replace the existing Ballona Creek levees and to allow restoration of
tidally influenced wetlands while providing flood protection for Culver Boulevard and surrounding
areas.
l Installation of water control structures, including culverts with self-regulating tide gates or

similar
structures, to provide a full range of tides up to an elevation acceptable for flood management and
storm drainage, while protecting against some storm events.
l Maintenance of existing levels of flood protection for areas surrounding the Ballona Wetlands site and
inclusion of flood hazard management measures into the restored wetlands.

_____

This is description is of a preordained outcome.
The premise of restoring estuarine flow is false advertising. The CDFG already has the T-sheets –the historical studies of Ballona including that done by Travis Longcore PhD. The T-sheets and the Longcore and other scientific studies remove any doubt that Ballona was historically a wetland that utilized freshwater and was not primarily the estuarine environment that is being touted as the PROJECT.
Please review the T. Longcore lecture, entitled "Closure Dynamics of Southern California Estuaries and Implications for Restoration" simply google as it can be found on u-Tube.

-WHY does the CDFG mislead the public and not provide full disclosure?

- Provide the data to show what CDFG utilizes in order to claim restoration of historical functions of Ballona will occur. If not, why not?
- Provide the data to show 'restoration' a restoring of historic tidal influences will be occurring if the 'Plan /Project" is allowed to occur.
- Provide the ratio of current deep and mid-tidal – with tidal flux that already exists at Ballona- including the Marina del Rey, Del Rey lagoon, Ballona Lagoon, and the Ballona Channel itself as compared with the past 100 -200 years.
-

SCOPING:
-Realignment of Ballona's "meandering channel" is also false advertising by CDFG since the Ballona Channel never had to historically carry the high volumes of storm and runoff water that it currently carries. There is no 'restoration' of the historic Ballona Creek, only the forced entry of toxic LA City waters and sediment into what is now habitat for endangered species and rare native plants.
Why does the CDFG fail to provide a historically accurate account of what is proposing upon Ballona?
SCOPING:
-Why has CDFG not provided for Public participation and information sharing in the planning of alternatives for Ballona and instead is promoting a non-historical conversion project that creates a catch-basin end of pipe solution and flood control devices- NOT HABITAT-upland or otherwise—that protects ONLY PLAYA VISTA?

- Since the USACE has stated that it will no longer pursue the 2005 restoration process via the Joint EIS/EIR- and since the USACE is not requesting Ballona Channel changes, please discuss why the CDFG provides a false allusion of need for flood control for Culver Blvd. and what 'other areas'? Or, if CDFG believes there is a

current need to change the Channel for protection to the public from flooding---please list those needs and provide the data support.

SCOPING:
-PLEASE PROVIDE studies that determine ANY PROTECTION TO CULVER BLVD. OR OTHER AREAS ARE NECESSARY if the Ballona Channel is left in its current location.

CDFG provides false and misleading information in the NOP via omission of historical facts.
SCOPING:
_ Please discuss and provide any and all data that provides validation of CDFG's claims that the enormous –approximately 20' above road level with sides that must be ENGINEERED TO REMAIN VERTICAL 'upland habitat' is enhancing or restoring Ballona. Provide discussion and data support to show what can survive in the giant berms that are shown on the Psomas contour maps in Area C and south of the BAllona Channel and west of Lincoln Blvd. (Psomas-2012 contour maps)

-GC wishes to see multiple restoration alternatives that do not involve changing the BAllona Channel and that do not involve the massive bulldozing and dredging that is the singular 'Plan' or 'Project' cited in the CDFG NOP and is finalized by Psomas on its 2012 contour map.

- GC wishes to be engaged and provided with multiple alternatives that would embrace freshwater sources for protection and utilization for streams/ponds etc. This alternative has not been explored and needs to be explored, analyzed and presented for public review. Such alternatives would require less money to create and would/ could be self sustaining . Such alternatives would be respectful of the Native American heritage of the site and provide for habitat closely aligned with historic Ballona and its inhabitants—both human and wildlife and flora.

- Why has CDFG not allowed for public participation and sharing of data and information for the public to be engaged in alternative planning??

ISSUE # 4 PROCESS

Background and overarching scoping needs-
The promised hydrology studies (2005 Joint EIR/EIS—between USACE & the Authority) of Ballona Wetlands have not been done. Instead, the SMBRC/FOUNDATION -director & staff and the California Coastal Conservancy have interfered with and stopped the areawide ecological studies and geotechnical studies of the federal review for restoration potentials in the greater Ballona regio in order to promote a singular 'Plan' of destruction and experimental construction upon Ballona Wetlands- Areas A,B,C . This "Plan" excluded groundwater hydrology studies and focused upon hydrolics studies of surface water flows into Ballona Channel .

We believe that this 'Plan' is nothing more than a destruction of endangered species and wildlife habitat that is currently functioning well and that the Coastal Conservancy contracted- Psomas Co. contour maps of the "Plan" reveal that it is a flood control plan that only benefits a private development known as Playa Vista (Playa Capital LLC). The Proposition 12 bond funds have illegitimately been spent on private use protections to a development site that was illegally allowed to build in a flood plain. FEMA was not engaged for oversight comments as needed as the EIR process for Playa Vista was thwarted by failure to utilize the Clearinghouse as a gateway for proper notice to all pertinent agencies. (ETINA v City of LA; Playa Capital LLC) This failure by the lead agency- the City of Los Angeles- to include and enforce California Environmental Quality Act (CEQA) protocol of Clearinghouse utilization **PLACES THAT BURDEN NOW UPON USACE AND THE California Dept. of Fish and Game and its state agency partners. FEMA MUST NOW BE ENGAGED** and the issues that pertain to flood protection for Playa Vista must now be reviewed in light of the flood control devices and the preordained 'Plan' of development and construction proposed by SMBRC/Foundation and the California Coastal Conservancy.

The giant berms and levees-approximately 20 feet above current road level as shown in the contour plans – are NOT habitat; are NOT RESTORATION but instead are civil works flood protection devices to benefit Playa Vista.
Furthermore, the 'Plan's' intent to DREDGE Ballona is NOT RESTORATION but instead is simply an experimental attempt at an end of pipe solution to the toxic water and sediment flow down the Ballona Channel. The catch-basin shown in the 'Plan' does NOT enhance or restore Ballona but instead destroys the very habitat that the public has spent over 20 years to protect. The effects of the 'Plan' as a catch-basin and flood control project have not been studied. Current roadways, Marina del Rey and other beach front areas appear to be put in jeopardy from the project.

SCOPING:

Issues of safety, failure to utilize the bond funds as approved by the public; failure to work with and include the public's participation in restoration concepts and planning; the legitimacy of process -- promised and paid for by bond dollars v the exclusionary and preordained outcome plan by the SMBRC/Foundation and the Coastal Conservancy must be addressed in the SCOPING AND DRAFT EIS/R.

Response to conflict of interest allegations, illegal use of bond funds, lack of transparency issues raised and failure to perform in good faith toward restoration, acquisition of more of Ballona, and enhancement issues that would protect and utilize the freshwater resources of Ballona onsite must be addressed and raised for public awareness of these and other challenges leveled at the lead agencies and their 'partner' agencies.

A gross compartmentalism has taken place by the steward agencies in order to create a predetermined outcome – the 'Plan" that excluded the public and its participation.

The current Notice of Preparation by the CDFG provides appearance of –just starting- the process for restoration at Ballona. This is false and CDFG fails again to act in good faith and provide accurate history. Instead, the CDFG while stating verbally at the 'scoping meeting' (which was not a scoping meeting condusive to public awareness and cross sharing of information) that all alternatives are being considered—instead the NOP shows the story of preordained outcome of 'estuarine' environment ONLY AND CHANNEL CHANGES AND DREDGING ONLY.

- **SCOPING NEEDS** to address the NOP and its showing of a preemption of the iterative process as promised and bond funds provided for.
- **SCOPING NEEDS** to address and respond to why CDFG and its partner agencies have NOT abided by public participation in the planning of restoration concepts and are –instead promoting the SINGULAR PLAN of the construction of a flood control basin and flood protection device(es) to protect Playa Vista.

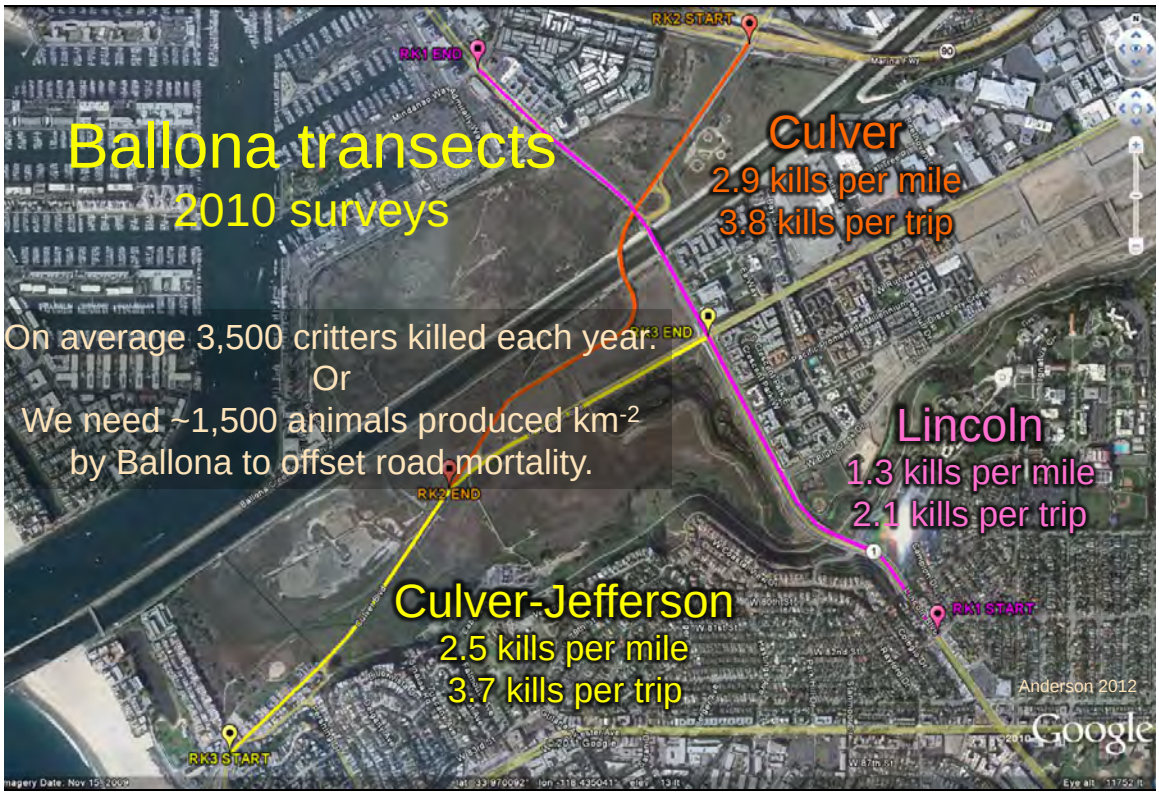
SCOPING NEEDS TO INCLUDE :
-Response to comments and questions within the Jan. 2012—Bond approval for $6,490,00. by John Davis to California Coastal Conservancy must be addressed.

- The John Davis to Ca. Coastal Conservancy document of March 28, 2012 entitled-
  Request to Hold Emergency Meeting to Rescind Approval Action on File No. 04-088 must be addressed and provided response since the issues pertain directly to the restoration of BAllona and the Coastal Conservancy's; USACE's, SMBRC's/FOUNDATION; CDFG 's in partnership---lack of adherence to stipulated use of public bond money for the publically owned Ballona Wetlands.
- Include response to the Amended Complaint to the Ca. Coastal Commission by Grassroots Coalition, dated August 2, 2012. The three documents ,490,00.are attached to this response.
- The partner agency – Ca . Coastal Conservancy has thus far provided no response whatsoever to these Complaints that have attached data support.
- The Amended Complaint by GC has an attached CD that contains Public Record Act documents from the Coastal Conservancy that provide the data support to the Amended Complaint. The contents of the CD should be part of this record and provided in full to the public for informed decision making. No agency is the 'owner' of Ballona Wetlands but instead the agencies play a role in stewardship of land OWNED BY THE PUBLIC. The public process has been hijacked by these stewards apparently to fulfill private corporate interests. This is not acceptable behavior by our state and federal agencies. Therefore, any attempt to obfuscate the history of Ballona and its 'restoration' path – a path that was to fully include the public to provide alternative planning via informed decision sharing and making—is considered further proof of hostile hijacking of due process.

SCOPING:

Needs to include the history of the "restoration" process of Ballona, including but not limited to the 1995 and 2005 Notice of Intent and the contractual agreements between the USACE and the Authority- SMBRC/County Flood Control. The history must include CDFG's participation in that process and acknowledge for accountability purposes- why that process is not being adhered to at present.

-Acknowledgement of the congressional issues of House Document 389 and any and all Feasibility Reports need to be accounted for as to intent and outcome.
Wildlife Issues:
Credit for Graphic:
Anderson, Sean. 2012. Splatter Spotter: Exploring and Predicting Elevated Vertebrate Road Kill Across the Santa Monic Mountains and Beyond. Chautauqua Lecture. Temescal Canyon Park, Pacific Palisades. August 22.



The EIR process with Playa Vista –mitigation provided for culverts for wildlife movement to prevent roadkill. Playa Vista has not honored this EIR requirement of mitigation and CDFG and the City of Los Angeles refuse to enforce it. Thus, how can the public expect CDFG to promote and protect the wildlife interests in the 2012 EIS/EIR? History reveals itself with our state and federal agencies failing to protect the environment and its wildlife. Corporate interests and money appear to be the driving force behind the state's "Plan" of Ballona destruction and construction into a

flood control project to protect Playa Vista and as an experimental end of pipe solution to the toxic waters and sediments of Ballona Channel. Please address these allegations.

Endangered Species habitat and nesting areas will be destroyed. The Belding Savannah Sparrow –as one example- is a non migratory bird that utilizes both side of the Ballona Channel for nesting and foraging. The intended massive bulldozing /dyking and filling of Ballona will destroy its habitat. See the Coastal Conservancy – Public Record Act requested CD for documents pertaining to wildlife issues.

Vague comments by state agency personnel vaguely recite in emails and minutes of private meetings—that the Beldings will just have to move.
This attitude is excrutiatingly unscientific and it is painful to read suc callous rubbish but it does reveal the throw away mentality that the state agents have.
Thus far, the taxpayers have not been included in any alterative planning as required and thus far their money has been spent –apparently in its entirety of Prop. 12- for hydraulics studies for their singular end goal of creation of a catch-basin and flood control construction for Playa Vista.

Page 13- Additional Complaint –GC to Coastal Conservancy—August 2 2012
The next parargraph, written by the note-taker- cited by CC a being CC or SMBRC staff- states the goal-
"Estuarine biodiversity is the primary objective of the analysis."
(CD- June 23, 2008 SAC Conference Call Memo)

"The project goal is to create functional estuarine habitat…";
"1. Maximize area of estuarine habitat.";
Opportunities to create regionally significant habitat including vernal pools and…should be pursued but ***not at the expense of restoration of estuarine habitat."****p. 14 Additional GC Complaint to Coastal Conservancy*

The public/Working Group was not allowed to participate in the decision making and was not advised as to the differing opinions rendered by the SAC team.

Pages 16-17 of the Additional Complaint of GC to the Coastal Conservancy:
(the Coastal Conservancy continues to be nonresponsive)

"Rare ecosystems of the coastal marsh area are discussed internally by the SAC team with the CC project manager and staff of the Foundation; the information is not broadcasted for public awareness, inclusion of discussion and decision making as promised.

"Rich noted that the discussion of grasslands should include mention of the historical native grassland prairie ecosystems that previously existed in the area. The rarity of native grasslands should be discussed,,," (CD- 6/28/08 SAC Conference Call)

"Rarity section…complex of prairie and vernal pool…
Wet grasslands formed extensive areas were also palustrine wetlands above highest high tide.." (CD- SAC Call 6/23/08)

"…there is native biodiversity in the non-tidal saline soils. …. At Ballona, these wetlands at Area A, for example, are the only habitat where Alkali Barley (Hordeum depressum) is known to occur in the Ballona Ecosystem. This annual grass was probably the dominant native annual grass in naturally occurring non-tidal saline soils at Ballona." (CD- 11/23/08, Wayne Ferren communication to Mary Small…)

And,
"The region has a shortage of mudflat for shorebirds, high marsh for animals and salt marsh bird's beak, marsh-upland transition for rare shrubs (eg. , box thorn) that are used by animals,…

The region has a shortage of dune habitat and back – dune depressions that support clean-water brackish marsh for aquatic plants and animals.

One could also list maritime scrub, which remains in several places "…
(CD- Joy Zedler (SAC) correspondence)

Thus , without public /Working Group inclusion and input into the formation of the alternatives and later failure to include the public /Working Group comments and concerns regarding the PWA Alternatives that are presented at one public meeting--the CC and Foundation staff continue to work behind publically closed doors to focus upon the 'Preferred Alternative", now known as Alternative 5 presented in the 1/19/12, Staff Recommendation request for funding. Alternative 5 requires massive, non-historic, extraordinary, experimental and knowingly toxic changes to occur on the land masses of Area A and B so that **"biodiversity = highest richness of estuarine dependent species."**

And also from the Additional Complaint—GC to Coastal Conservancy-p 17-18:

Contrary to the 8/13/04 CC Memo which promised transparency and public inclusion in the alternative planning process which would "restore and enhance" a mix of wetland habitats….and that would implement a technically feasible, cost effective, ecologically beneficial and sustainable restoration.
Instead, <u>the public was shut out of the planning process; and SAC knowledge regarding the **needs and dangers posed by Alternative 5 are not made public:**</u>
"This alternative makes the greatest change to the site, would be the hardest to reverse and consequently has the most risk." (CD- 9/12/08 MEMO from SAC to PMT)

" *..this alternative would **require reliance on upstream flood control and pollutant removal**, and could necessitate periodic removal of accumulated pollutants for some portions of the restored wetlands. Furthermore, it is unknown how the flow and*

sediment yield from the upper watershed would affect the sustainability of the marsh in terms of scour or sediment deposition." CD, P. 4of 9, 10/15/08 SAC MEMO, emphasis added.

There is no evidence of any such large scale BMP (Best Management Practice) planning or proposals for 'flood control and pollutant removal" occurring upstream on Ballona Creek.

And,

"*Eric suggested that there be a statement up front indicating that this site will not be self-sustainable, but will need to be actively managed in perpetuity. "* CD- 7/7/08 SAC Conference Call)

Discussion and comments made from key federal agencies were withheld from the public, including but not limited to **NOAA communications regarding concern of toxicity of Ballona Creek upon the remaining wetlands should the levy removal and dredging take place.** (CD- National Oceanic Atmospheric Association email)

Studies that discuss the toxicity of the Ballona Creek waters and sediment to life in the waters and sediment were not released or shared with the public:

"These sediments were toxic to aquatic organisms, potentially from organic compounds in these sediments. Ballona Creek has been identified as a potential source of tidal flows into Areas A, B, and C in each of the proposed restoration alternatives. Therefore, there is concern to tidal marsh areas, resulting in a negative impact to the habitats and biological resources." (CD- Weston –Technical Memorandum 11/26/07; Water Quality Data Gap Investigation Ballona Wetlands Restoration Project- Pohl , P.E., Ph.D.)

And,

" The July 2006 report by Weston also concludes that there are concerns related to water and sediment quality adjacent to the tidal channels. Consequently there is a need to develop a strategy to evaluation the potential ecological risk associated with influent water or sediment quality to the restored wetlands.

The scientific questions regarding sediment and water quality cannot be answered based on the information currently available, and will ultimately depend on the design of the project." (CD- Memorandum 3/8/08; Subject:

APPROACH FOR ADDRESSING SEDIMENT AND WATER QUALITY ISSUES)

And;

"*Eric- Conc(ept) D—is it attempt to move water and sediment into system*

Wayne- breaching levee bringing trash, water pollution and sediment into entire area is problematic.

John Dixon-important to describe these NOT as projects, but a directions.

Ambrose- maybe D is too extreme—this won't happen anyway.

Dixon- do feasible maximum tidal, not D—need to scale back

Jeremy- may need to do that, take out realignment Ballona—include realign on Hydrologic options"
(CD-10/30/06 SAC Conference Call)
Thus, any discussion of any alternative habitat planning for Ballona is suppressed and deep-sixed from any public awareness as the state agents-promote unbeknownst to the public—a singular outcome of the estuarine-"Plan" requiring massive bulldozing and BAllona Channel changes and engineered flood control berms and levees.
GC has concerns regarding members of the private non-profit- the SMBR Foundation –who are also in key decision making positions to promote the 'Plan" that are directors of SMBRC and project planners of the Coastal Conservancy . The SMBRFoundation has past and present strong ties to corporate interests including Playa Capital LLC.

ISSUE- REMEDIATION
<u>SCOPING-</u>

-What and how will the remediation needs of SOCALGAS be analyzed?
ABANDONMENT/DEMOLITION STUDY- Playa del Rey Storage Field- Nov. 22 1993 cites:
"Phase III-Tank Farm Abandonment and Final Clean-Up
…Environmental remediation may require significant disposal of contaminated soil and the importation of clean fill. There is also a potential for the discovery of ground water contamination. This environmentally sensitive area will no doubt provide significant challenges related to keeping our costs within forecasts. There is a potential for very high clean-up costs beyond current estimates because the Ballona Wetlands are immediately adjacent to our facilities."
-What studies are planned and how will the potential mitigation be remediated?
-Groundwater studies need to be included in a restoration of Ballona that pertain to SOCALGAS operations. The high potential of groundwater contamination is acknowledged above in the Jacobson Engineering Report prepared for SOCALGAS.

Please include all the attached documents for review and assessment for the public.
Patricia McPherson, Grassroots Coalition- President

Jones, Tanya

-----Original Message-----
From: David Jacobs [mailto:djacobs@ucla.edu]
Sent: Thursday, October 25, 2012 9:31 AM
To: McCormick, Donna
Subject: Comments regarding restoration in Ballona

Please see the attached pdf thank you for your effort.

UNIVERSITY O CALIFORNIA, LOS ANGELES

UCLA

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SANTA BARBARA • SANTA CRUZ

DEPARTMENT OF ECOLOGY AND EVOLUTIONARY BIOLOGY
621 CHARLES E. YOUNG DRIVE SOUTH
BOX 951606
LOS ANGELES, CALIFORNIA 90095-1606

FAX: (310) 206-3987

October 23, 12

Ballona Wetlands Restoration Project
C/O Donna McCormick
1 Ada, Suite 100
Irvine, CA 92816

To Interested Parties:

As a Biologist and Geologist engaged in research on the estuaries of California and the Gulf of California from Genetic, Geomorphologic and Historical Ecologic perspectives, and as someone who resides in the area, I am pleased to provide comment on the prospective restoration at Ballona. The comments provided include concerns about the current plans, as well as some alternative possible restoration schemes. I hope these provide a useful basis for additional discussion and ultimately improve the final design. I would be more than happy to engage in further discussions of these matters.

Please see the comments below.

Sincerely,

David K. Jacobs
Professor
Ecology & Evolutionary Biology
UCLA
621 Young Drive South
Los Angeles, CA 90095

Restoration Issues at Ballona

Context

Ballona -Historically Closing System- Now Constrained by Urban Setting

Concerns regarding Current Restoration Plans for a tidal system at Ballona –

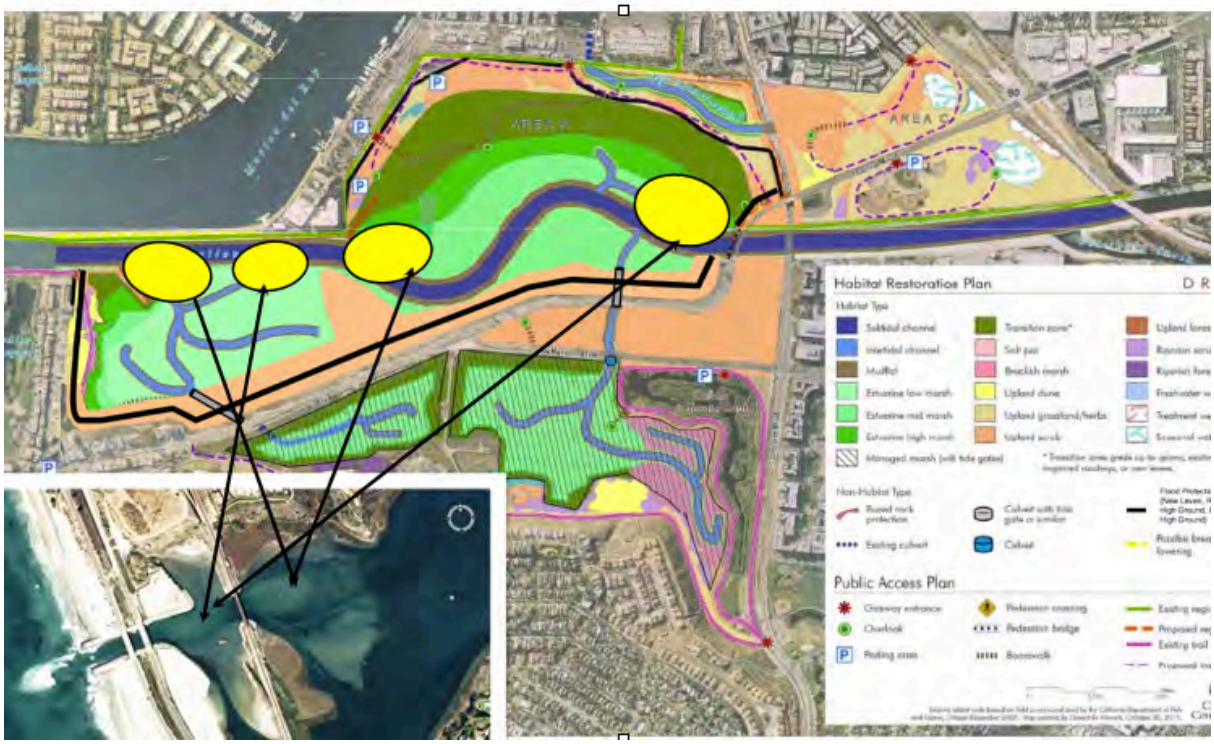
1) The proposed restoration plans as they now stand involves type conversion of historically highly varied dynamic/seasonal system with significant fresh water input that was predominantly isolated from the sea, to a tidal system. The restoration does not focus on the heterogenous brackish to fresh, and seasonally variable habitats historically present. And, current restoration plans take a relatively static view of a naturally dynamic landscape. Development of a more process oriented historical treatment would help illuminate the seasonal and episodic dynamics of the historic habitat. Capturing or replicating some aspects of these dynamics may greatly benefit native wildlife. A better understanding of landscape processes would also permit avoidance of potential pitfalls. Historic dynamism also suggests that designs that permit active management may be desirable. One significant concern is the planned establishment of tidal drainage channels, especially near the margin of the system. These will effectively further, extend the drainage effort begun in the early 20th century continuing the trend toward desiccation of marginal riparian habitat. Thus the planned restoration may extend rather than mitigate impacts of previous anthropogenic landscape modification. It should be noted that the wetlands historically present at Ballona appears to have been very biologically productive, and the heterogenous fresh to brackish water landscape present historically supported species that are now thought of as exclusively freshwater or saltmarsh as well as species that thrive in brackish water or episodically flooded settings many of which are rare today.

2) Consideration of the consequence of sediment supply, and reworking of sediments within the proposed restoration, appears insufficient. Flood-tide delta formation has impacted Ballona historically, and southern California estuarine restorations generally. Flood tide deltas at Ballona are evident from the first T-sheet maps presumably having formed following early 19th Century flood opening, and flood tide delta formation followed all attempts at opening the system, as documented from historical records and early 20th century aerial photography. More recently, underestimates of sediment delivery from the beach-side, due to flood tide delta formation, have impacted restorations at Batiquitos and Bolsa Chica. Given current restoration plans the added tidal flux associated with the increased tidal prism will likely draw significant sediment into the system, altering the form and process of the estuary in ways that are difficult to predict and control. The alternative is more extensive dredging than currently practiced, including dredging *within* the restoration. Thus the potential for increased dredging cost is a significant concern with current plans. Effort should be made to anticipate these costs relative to any design, so that a formal cost benefit analysis between upfront and ongoing costs can be presented in an inclusive manner.

At the moment there is a very substantial build up of sediments in the flood control channel. Regular, but non-quantitative, observation suggests approximately a meter of sediment has accumulated along about 2km of the channel. Previous reports suggest that no such accumulation occurs. This discrepancy may be a consequence of accumulation followed by episodic flood removal. This issue requires further study, including an assessment of sediments currently present and their sources (upstream, beach-side, or local bed erosion). Episodically removal of sediments from the system during floods appears to be a significant service provided by the current Flood Control channel. Removal of the channel will lead to deposition of

any such sediments in the restoration area potentially dramatically altering its configuration. It seems almost certain that the subtidal habitat currently present in the Flood channel will be eliminated in sediment redistribution. In addition the sediments in the restoration area will be subject to reworking in floods even in the absence of external sources. Given the unpredictability of sediment reworking, the ultimate form of the system is unknown and difficult to determine. This makes the project as currently constituted a significant role of the dice. For example without knowledge of the final form of the estuary the response of the system to flood flows cannot be assessed.

Likely Sites of Flood and Ebb Tide Delta Formation Relative to One Proposed Restoration Plan - with inset of Sediment Accumulation at Batiquitos



3) Current plans are not focused on, and appear unlikely to provide, optimal benefit to the range wildlife historically present and currently of concern. Clear plans for specific wildlife benefits such as accommodation of wintering waterfowl or migrating shore birds do not appear to be addressed. More importantly the habitat needs of native species that are endangered, threatened, or of concern, such as least tern, and rails, or that were associated with the fresher and seasonal habitats historically present, such as tidewater goby, stickleback, as well as reptiles and amphibians, such as the south coast garter snake (a species of concern) do not appear to have been considered in the design. This is a significant issue and should receive focused attention.

4) Proposed designs will no longer bypass "First Flush" contaminants associated with the initiation of rainfall, likely yielding contaminated marshlands. Currently, initial flows are exported through the flood control channel. In combination with the absence of scouring flows, lack of bypass can be expected to result in deposition of fine-grained sediments facilitating eutrophic conditions, in addition to concentrating specific anthropogenic toxins in the restoration area. This problem may well be exacerbated by sediment reworking during the post construction evolution of the system.

5) Plans as currently constituted involve movement of very large amounts of material and construction of extensive marginal dikes to the system. They involve comprehensive rearrangement of the landscape. This raises a number of potential concerns including elimination of natural surfaces and drainage, as well as further isolation by dikes of the system from its marginal upland habitat. Moreover the dikes themselves occupy significant area limiting the area potentially restorable to actual wetland. The scale of material movement required could be more limited if the plans were more responsive to the current landscape configuration. Marginal dikes require rerouting of drainage external to the restoration and make for unusual steep grades and habitat barriers that may further limit access and movement of fish, amphibians, reptiles and invertebrates in an already dissected landscape.

High ground is currently present adjacent to the channel levees especially in area A. Alteration of designs so that they did not require movement of higher ground could potentially significantly reduce material movement and cost. In addition, planning would benefit from more up to date and detailed topographic information. All elevations maps currently associated with the project have significant anomalies relative to the current landscape.

Current plans propose elimination of historic aspects of the landscape that have persisted to date including marsh and pan surfaces in Area B that are much as they were in 19th century maps. Very few surfaces in lowland landscapes are preserved in the LA region. Intact landscapes preserve a sedimentary succession which in turn preserves historic information. Such surfaces also maintain established soil process and soil biota. These should not be eliminated without due consideration of the potential loss of scientific information and biological resources.

Current cultural uses of the existing and channel and levee system will also be impacted. This includes UCLA/LMU crew teams which have used protected straight flood control channel for races for the last 70 years. The large relatively inaccessible restoration area may also present issues of access for first responders or vector control. And the loss of current channels and levees could limit egress in an emergency. There are likely other issues of this type that should be directly addressed and balanced against the cultural and recreational benefits conferred by the restoration plan.

6) Of very significant concern is that restoration planning does not appear to have been well integrated with necessary road-work/infrastructure development. Currently, Culver Blvd is a designated a "Tsunami Escape Route" despite the fact that it is at about the level of the highest high-tide as it traverses Ballona. Similarly parts of Lincoln Blvd are very low. Much design effort seems to have been put on continuing to protect these features with new levees even as old levees are removed. It would seem that elevating these roads 3 or 4 meters is critically important from a natural hazard standpoint, and would simplify the restoration problem. It also seems that some of the material that would be removed for restoration could serve as road fill. There, is a lot of anthropogenic fill that needs to be removed, in addition to clay rich marsh material. The former may be better than the latter for road support. This, issue appears to require more coordination and study.

Design Objectives for Restoration

Given the above list of concerns it seems that the design objectives of the project at Ballona ought to be reconsidered or expanded.

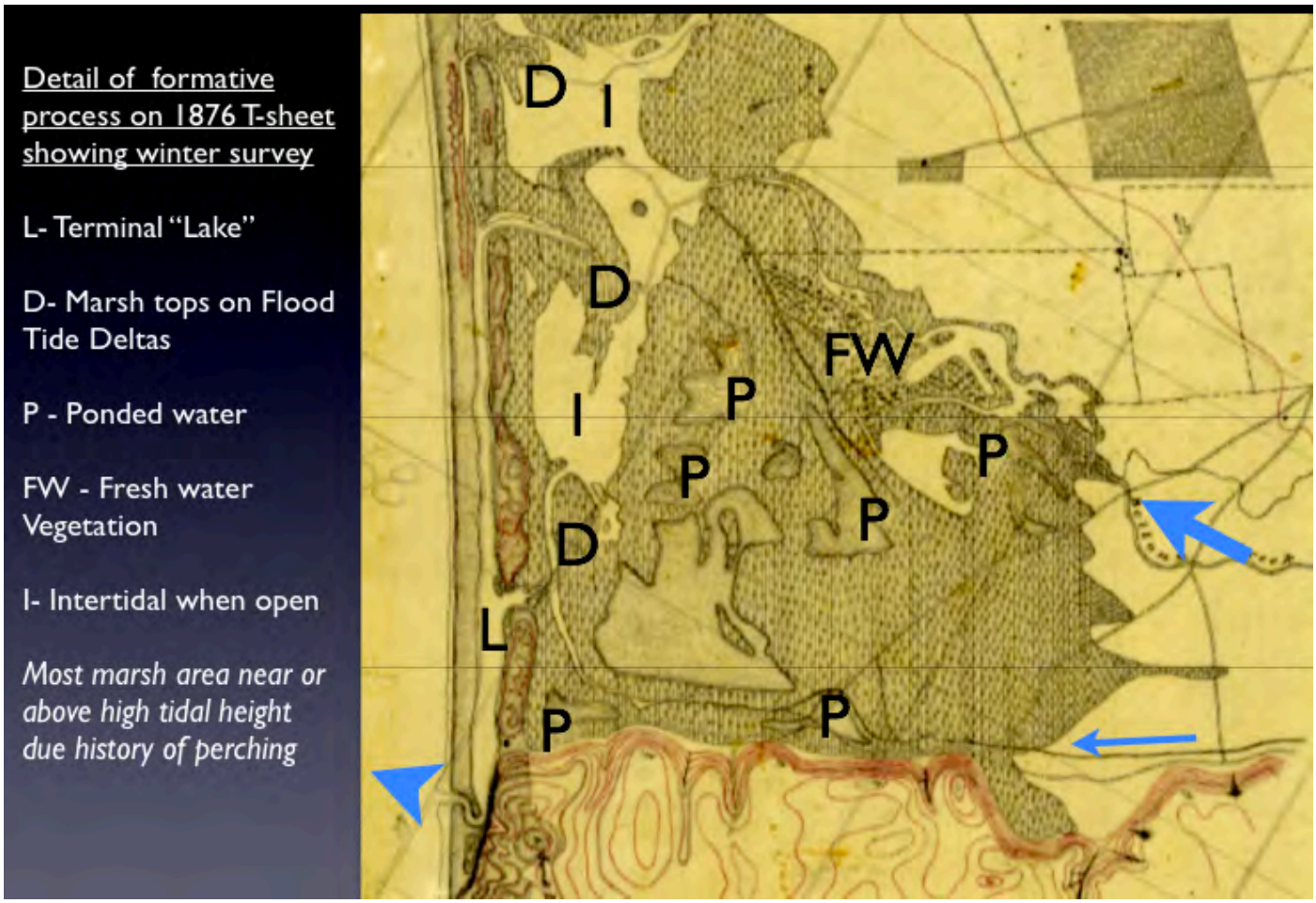
Restoration objectives should:
a) Specifically address recovery of taxa that were historically present and are now listed of interest or concern.
b) Replicate process, such as scour, that initially helped form and sustain California estuarine systems.
c) Maintain beneficial if artificial processes such as sediment expulsion, and contaminant bypass by the flood control channel.
d) Not unduly penetrate freshwater and riparian areas with new drainage channels.
e) Work with the existing landscape to mitigate ancillary impacts and undue earth movement.
f) Coordinate with necessary infrastructure enhancement and roadwork.

Historical considerations relative to restoration objectives
Restoration planning can and should employ historic landscapes processes and habitat information to improve outcomes and avoid risks. Estuaries are the product of a dynamic history. Thus there is no simple way to return to the past. This is especially true given the constraints of the urban setting surrounding Ballona. However consideration of the processes and succession of events that produced the current landscape, as well as comparison to processes at other locations, can help clarify opportunities and risks inherent with various restoration designs. Otherwise the restoration may come into conflict with ongoing or recurring processes. Furthermore, historical information can help clarify the nature of habitats that existed and the processes that sustained them as well as which habitat types have been most impacted by adjacent anthropogenic modification. This in turn can clarify how habitats can be reconstructed so that they sustain or permit the restoration of species which were historically present rather than creating potentially diverse, but largely anomalous or non-endemic communities of organisms.

A review of formative history of Ballona (see Jacobs et al. 2011 for detail) provides insights that may help clarify which restoration designs may be more or less sustainable, and which provide the greatest habitat benefits or improvement, relative to wildlife.

Formation of current conditions at Balllona occured in the following rough succession of steps.
a) Sea level rise initially flooded the Ballona Creek Valley yielding a marine embayment by approximately 7 or 8000 years ago.
b) By 4000 years ago coastal evolution involving shoreline retreat, such as formed the shore cliff at Santa Monica, generated a beach and spit that were continuous across the mouth of the bay producing a bar built/closing estuary largely isolated from the sea where freshwater conditions were sustained for long periods of time. Due to the presence of a distributory alluvial fan where the Los Angeles River exits the San Fernando Valley, natural process connected and disconnected the Los Angeles River from the Ballona Creek. Thus fresh water delivery to the system has varied even beyond that which is produced by the dramatic variation in annual precipitation in the region.
c. Early 19th century Los Angeles River flood flows through Ballona set the stage for the final evolution of the system recorded in the first detailed mapping published in 1876. These flood flows likely yielded the

following dynamic succession. Flood flows exited Ballona through gaps in the coastal duneline scouring out channels such that they were open to the sea. Tidal influence built flood tide deltas immediately inside the duneline at multiple locations. Subsequent spit formation formed an outer Lagoon. This 2 mile long feature was typically or closed to the sea, and is often referred to as a lake in late nineteenth century (Dark et al. 2011). The resultant estuarine system as mapped was multiply subdivided and interconnected internally, had multiple perched and ponded bodies of water as well as desiccated high intertidal flats, and vegetated water bodies supplied by Ballona creek. The surface of Ballona was almost completely above the low-tide waterline behind the dunes as indicated by the mapped low-tide line. Marsh surfaces lack typical tidal channels consistent with long periods of closure. The majority of marsh surface appears to be quite high in the intertidal. High marsh surfaces are consistent with pooling behind the dunes or beach berm, as is typical behavior of comparable west facing systems along the California coast. These observations from Tsheets suggest that the system was subject to a variable hydrography with overflow of much of the landscape, including all of the area available for restoration, by freshwater when stream flows were adequate and beach berms sustained an impounded system. This is consistent with the early 20th century photographic record of Ballona flooding. During lower flow periods much of the landscape would have been partially desiccated with remnant pools and water marshes where freshwater flows continued to enter the system, much as is depicted in 1876. Only immediately following periods of high flow that induced breaching would tidal influence have penetrated the system in the Mid and Late 19th Century.



d.) In 1887 the first attempts were made to jetty-open Ballona and sustain a port. These efforts appear to have initially failed due, in part, due to rapid long-shore sand movement and closure of the artificial opening. A sustained jetty maintained opening was finally constructed in 1906. Although managed breaching of the lagoon preceded this date. Early 20th-century imagery documents flood-tide delta formation associated with the tidal conditions produced by this opening. They also record new drainage channels penetrating to the southern margin of Ballona (Area C) for agricultural purposes. Large impoundments were also sustained, presumably for duck hunting, through the midcentury. e) In 1938 the flood control channel was constructed limiting surface flooding in the system and generating a persistent tidal estuary such as had not been present for a number of millenia. Dredging from this construction appears to be primarily responsible for the high ground observed on the south side of area A. The 30s and 40s were also characterized by oil field and road development on the marsh surface.
f) Post WW2 rapid development of much of the watershed, changed the nature of the drainage, and was followed by Marina construction in the 1960s. The Marina constitutes a significant alteration of the habitat, introducing extensive hard substrate in the Marina and its jetty system as well as deeper subtidal protected habitat.
g) Elimination of signifcant open land in Playa Vista construction and the establishment of a freshwater wetland complex represent additional substantial changes in the wetland landscape at Ballona this Millenium.

Given the above historic succession:
It is important to note that the anthropogenic trend above includes the establishment of significant perennial tidal habitat where tidal habitats were previously only intermittent. Significant perennial tidal habitat is now found in the flood control channel and in the Del Rey and "Ballona" - remnants of the historic frontal lagoon. Thus there is perennially tidal habitat where none previously existed and there is a deeper subtidal aspect to much of this habitat. In addition, although there was likely extensive marsh and willow thickets upstream in the watershed historically (e. g. Dark et al. 2011), it is unlikely that perennial fresh water was much more extensive at Ballona in the 19th Century than that supplied by the current freshwater wetland. Thus perennially tidal and perennially freshwater settings are present and comparable or significantly more extensive than what was present historically.

What is missing currently from Ballona, and from restoration planning, is hydrologically complex seasonal and intermittent fresh and brackish water habitats which were clearly very extensive at Ballona historically. These habitats supported a broad suite of native taxa many of which are seriously impacted or absent form the system today.

The importance of scouring events - Historically at Ballona scour from large fresh-water flows served to remove sediments from the system. As noted above the landscape recorded in the 1876 Tsheet is in part a product of major scour events associated with the early 19th Century floods. Flooding of the scale required to produce the necessary scour to reduce sediments can no longer operate widely due to urban development and flood risk. *However the hydraulic flood control channel serves to rework and export sediment during high stream- flow events. This will no longer occur in restoration designs which do not maintain the channel – the restoration will instead act as a sediment trap.* In the sketches of restoration alternatives that follow sediment scour is achieved by managing tide through multiple gates so that

outflow velocity can achieve higher than inflow so that scour inducing outflows can be produced intermittently at a variety of locations within estuaries to mitigate the accumulation off fine sediment.

Historically intra-estuarine flood and ebb tide deltas formed at Ballona at every opportunity when the system was connected to the sea. Such deltas form where tidal flows decelerate as they enter wider bodies of water. As noted other California "restorations" have failed to properly anticipate the delivery of sediment to the system from the beach/ocean side. This concern is clearly merited at Ballona as sediment bars are often observed to build to low tide in flood near the mouth of the channle under current dredging regimes (pers observation). Thus in this instance history and regional experience speaks to processes in the region that are likely to conflict with certain estuary designs rendering them difficult to sustain over time.

Broad suggestions for restoration at Ballona

1) Retain flood tidal channel and levees to expel sediment from system, bypass contaminants during first flush, as well as flood protection. This maintains the potential for tide gating should be needed in response to sea-level rise.

2) Use of Multiple gates (multiple inflow, single outflow) and the drop to the flood channel to provide scour to lateral marsh channels. Multiple open gates on incoming tide would minimize velocity and sediment import. Opening of one gate at a time during an outgoing "spring" tide or tide series would generate scouring flow replicating scouring flow produced historically by stream flooding. This would minimize sedimentation or allow controlled sediment accumulation in response to sea-level rise. Gates should be designed and operated to enhance bypass of first-flush contaminants.

3) Gates or closures such as slot- boards or valved culverts should be used to replicate seasonal wetland dynamics consistent with focused habitat and species restoration objectives. In several cases these can use preexisting raised roadbeds as partitions for habitat management.

Some specific restoration suggestions

Area B- *Surround and support the existing freshwater wetland with seasonally variable wetlands similar in function to those historically present. Integrate tidal operation of "North" Area B with existing Ballona flood control channel*

1) Avoid draining areas with freshwater resources/potential, with tidal/drainage channels. In particular it would be preferable to manage Area B "South of Culver" Boulevard as a "winter wet" seasonal or intermittent freshwater to brackish water wetland with reduction of current channels, which were extended to this region early in the 20th century for drainage purposes. Fresh water from the adjacent freshwater wetland could then be used generate a seasonal hydrology. A spillway for this purpose is already present at the freshwater wetland.

2) Area B North of Culver – Greater connection to flood control channel by an additional of an upstream tide gate. Gates could be designed and operated to generate scour near openings to the channel, and to integrate with Ballona Creek tidal function as appropriate. In this restoration scheme, removal of roadbeds and oil field structures, to facilitate surface-flow penetration of "spring tides", may be the only other modification of the within "North Area B" landscape needed. In the suggested design, gates to Ballona Creek channel should be operated to maximize penetration of high tide and perhaps to support seasonal perching of higher water levels, not to effectively drain the landscape by gating out higher tides as is now the case. Intermittently brackish conditions would be enhanced by flow from the Ballona Channel

3) Culver Blvd may need to be raised to accommodate higher water in North Area B. Raising of the Blvd also appears to be essential in the longer term given threats from sea-level rise and tsunamis. Resolution of this issue and negotiations with transportation authorities to this end should proceed sooner rather than later. Fill from restoration could be used to raise the roadbed, limiting costs. Spans along Culver could permit some integration and communication between wetland areas currently separated by the active roads.

4) The Area between Culver Boulevard and Jefferson Blvd could be used as a summer-closed habitat with intermittent opening to the tides in the winter through a gate or valve. Such habitats sustain endangered tidewater gobies. Freshwater for this system could be sourced from the adjacent freshwater wetland. A gate or valve to the flood control channel could be used to generate intermittent tidal conditions

Schematic of options for Area B
Produces heterogeneous habitat. Very Little Earth moved- Low cost. Considerable habitat benefit. As numbered on image: 1 North of Culver, multiple gated to enhance scour and avoid periodic contamination, periodic closure possible; 2 Summer closed- 90% closure. 4 winter- spring wet fall dry conditions augment from perennial wetland; 3 More brackish due to High tidal influence and out flow from 4.



Area C - *Recover freshwater flow from Ballona channel to generate a range of intermittent fresh to brackish environments with flow through to Area A.*

1) Water would be conveyed from Ballona Creek channel (and treated) in the low area immediately west of the 90 freeway and south of Culver Boulevard. These waters could then be transported by gates or pumps, depending on design, to the portion of Area C north of Culver Boulevard.

2) Area C north of Culver could replicate a perched/flooded deeper water (@1meter) condition in winter for waterfowl. Spring drawdown could provide forging opportunities for least tern to feed on atherinids or other small fish increasing rearing success in the tern colony. Fill could be used to raise portions of adjacent Culver and Lincoln Blvd.

3) Fresh/brackish water outflow could be conveyed to area A by culvert, or ideally under a raised span on Lincoln boulevard to Area A and C could be functionally connected. A range of plans could accomplish these objectives. The Area North of Culver is relatively low in elevation, despite extensive piles of fill, and could contribute to the overall restoration plan with relatively modest movement of material. Such fill could be used to raise Lincoln & Culver Blvds. A range of possibilities that vary in terms of how much earth is moved and whether or not water is lifted mechanically from Ballona Creek should be considered. Location of treatment efforts could also vary. Two such possibilities are shown below

Schematic of options for Area C
First option - surfaces in the upper reaches of tidal range driven from tides in the flood control channels that could be manipulated flow through adjacent treatment marshes& scour channels. These areas could be managed as pooled water for wintering waterfowl, rendered tidal during shore bird migration and/or lowered during tern breeding season to provide forage opportunities.



A practical option for Area C would involve lifting water that was treated upstream



Possible Upstream treatment *or treatment South of Culver with lift to Area C*



<u>Area A</u> *Gates or connections to Area C, the Flood Control Channel, and the Marina, interconnect the wet landscape. Brackish water flow provided from area Area C permits variable salinity/intermittent brackish conditions. Gates would permit muting tides and allow scour management. Suggested design sketches vary in amounts of "upland" habitat.*

<u>1)</u> Gates to Flood Control Channel and the marina permit scour and closure. Import of fresher water from Area C also is practical. This permits alternation of tidal and perched brackish conditions.

2) Perched or muted conditions seasonally could permit the isolation of a muted tide high marsh suitable for Clapper Rail reproduction in Late Spring.

3) Different design options would yield different ratios of upland and wetland at variable cost. Restoration would follow the topography. A priority should be placed on restoration of the lower

North and East portion of Area A. Current High ground adjacent to the levees and around former oil field structures to the Southwest would be maintained as upland lowering cost.

Schematic of options for Area A

Larger restoration option for Area A



Smaller restoration option for Area A



Refernces

Dark, S., E. D. Stein, D. Bram, J. Osuna, J. Monteferante, T. Longcore, R. Grossinger, and E. Beller. 2011. Historical ecology of the Ballona Creek watershed. Southern California Coastal Water Research Project. Technical Report #671.

Jacobs, D., E. S. Stein, and T. Longcore. 2011. Classification of California estuaries based on natural closure patterns: templates for restoration and management. Southern California Coastal Water Research Project Technical Publication No. 619a.

Colonel Kimberly Colloton
Commander and District Engineer
Los Angeles District
U.S. Army Corps of Engineers
P.O. Box 532711
Los Angeles, CA 90053-2325

November 1, 2013

Attention Mr. Richard Leifield, Chief of Engineering

Dear Colonel Colloton:

Grassroots Coalition submits this initial letter as a rebuttal to the 408 Permit Submittal request from the parties cited below for the BALLONA WETLANDS RESTORATION PROJECT.

**RE: 408 PERMIT SUBMITTAL A (INITIAL SUBMITTAL)
BALLONA WETLANDS RESTORATION PROJECT and Cover Letter from Los Angeles County Flood Control District (LAFCD) and the California Department of Fish and Wildlife's Submittal A (Initial Submittal) for a Section 408 Permit be granted to the LACFCD for the proposed alteration/modification of a Federal project...namely the Ballona Channel.**

Prospective Permittees
Ms. Menerva Ariki
Los Angeles County Flood Control District
Watershed Management Division, 11th floor
900 South Fremont Avenue
Alhambra, CA 91803
Phone: (626) 458-4316

Mr. Edmund Pert
California Department of Fish and Wildlife
4949 Viewridge Avenue
San Diego, CA 92123
Phone: (858) 467-4210

Location of the proposed project
**USGS Quad: Venice Quadrangle, 7.5 Minute
Township 2S, Range 15W, Unsectioned
LatlLong: 33°58'01.14" N, 118°26'22.21" W**

This rebuttal and request for denial of the requested permit is based upon:

1. **Failure of the prospective permittees to provide true and accurate information in the request.**
2. **Failure of the prospective permittees to adhere to the bond language qualifications**

for restoration of Ballona Wetlands Ecological Reserve to which the public has provided over $165 million dollars. Permittee provides false and misleading information to the public per status of EIR/S process and 408, 404 permit requests status.

3. **Failure of the prospective permittees to provide qualified studies in order to provide for adequate evaluation, including but not limited to groundwater and surface hydrology studies of the Ballona Wetlands, including but not limited to failure to identify and ameliorate or provide any meaningful attempt at maintaining the historic freshwater aquifers and seasonal surface freshwaters of Ballona Wetlands Ecological Reserve.**
4. **Failure of the USACE to provide accountability of the close out studies and data pertaining to an ecological review – a Joint EIR/S begun in 2005 and stopped via a questionable signature by Shelly Luce, director of a private business known as the Santa Monica Bay Restoration Foundation. The Luce signature that was theoretically authorized by the Santa Monica Bay Restoration Commission (SMBRC) and the County Flood Control District. However, Public Record Act requests reveal no authorization via notification to the SMBRC or subsequent vote to allow for such signature and subsequent stoppage of the Joint 2005-12 EIR/S.**
5. **Failure on the part of the USACE to verify authorization of the Luce signature as having authority to request an end to the 2005-20012 Joint EIR/S that was consummated with a contract.**

The following includes portions of the 408 request by prospective permittees in *italics* and rebuttal by Grassroots Coalition in bold non-italic :

3. Purpose and Need
A substantial portion of California's historic coastal wetlands have been lost. Restoration of coastal wetland is needed in order to increase available nursery and foraging habitat for wildlife and to provide recreation and educational opportunities to the public.

The premise provided above, we consider to be false. The Ballona Wetlands Ecological Reserve is a predominantly seasonal freshwater habitat of upland/ wetland complex that historically is predominantly closed to the ocean. The region, within the last couple hundred years has been opened to the Santa Monica Bay via manmade construction including but not limited to the Del Rey Lagoon, Ballona Lagoon, Marina del Rey and the Ballona Channel. Thus, the area now has a far greater constant nursery and saltwater habitat than historically present in the last several hundred plus years. Furthermore, during the construction of Marina del Rey, the Poland Report warns against further degradation of the clay layers whose disturbance, such as in the creation of the marina, led to unwanted and degrading salt water intrusion. The Poland Report advises the protection of the rest of the Ballona area in order to protect the groundwater.
Historically, there were freshwater wells serving as drinking water wells in the Playa del Rey area. The groundwaters of Ballona are classified as potential drinking water and as such should be protected from further contamination. The Poland Report also cites the connectivity between the West Basin drinking water aquifers with the Ballona aquifers and the need for protection of the water quality.

The 2005-12 Joint EIR/S was to address these issues but has not . The congressional house document 389 and US Public Law 780 was to be addressed and has still not been addressed.

Recent letters from the California Coastal Commission to Playa Vista personnel (Playa Vista is located on the historic Ballona wetlands) address an inquiry regarding non-permitted drains put in by and for Playa Vista. The wetland drainage system has been known to exist by CDFW but has not been removed since the public's acquisition of Ballona in 2003. Ecological reports done on the Ballona Wetlands Ecological Reserve do not reflect any information regarding the drains and thus, do not provide any impact information.

The Ballona Wetlands Ecosystem is one of the last remaining major coastal wetlands in the County of Los Angeles. It is estimated that historically the wetlands ecosystem spanned more than 2,000 acres in the vicinity of the site. Development occurring over the last century greatly reduced the Ballona Wetland area, now estimated at approximately 600 acres. In addition, the wetland habitat and natural hydrological functions in the area have been substantially degraded.

While citing hydrological degradation the applicants provide no reason for such and no hydrology studies have been done of the surface and groundwaters of Ballona Wetlands Ecological Reserve. There is no information disclosing the CDFW's participation in the removal of freshwaters of Ballona Wetlands Ecological Reserve that would include but not be limited to :
their failure to disclose the newly discovered drainage devices ;

that Playa Vista has lowered the groundwaters approximately 15 feet (LARWQCB) due to dewatering done for contamination clean up on the Playa Vista site as well as constant dewatering to remove the rainwaters and groundwaters from entering the experimental gas intake systems of Playa Vista.

Best Management Practices and Playa Vista EIR measures that cite-- groundwaters will be cleansed at the surface and returned to recharge the groundwaters--HAVE NOT HAD ADHERENCE TO THIS REQUIREMENT. Instead, the state is continuing to allow Playa Vista to throw the groundwaters into the sanitary sewers. CDFW has provided no research pertaining to this issue and provided no alternative planning for a historically seasonal freshwater system restoration based upon reclamation and use of its own freshwaters that are currently being removed.

The consequences of the groundwater removal have not been studied however, the California Coastal Commission staff in recent hearings stated that the drainage devices were harmful to the wetlands.
The CCC staff has also stated that removal of Ballona's groundwaters within its jurisdiction of the coastal zone that negatively affect the function of Ballona Wetlands Ecological Reserve is of concern and within their jurisdiction for review. This issue has only recently come to the attention of the CCC. Grassroots Coalition and Sierra Club members are currently engaged in providing the CCC with LA City Dept. of Sanitation records pertaining to this issue of concern.

The project site provides habitat for a diversity of plants and wildlife species, but most on-site habitat exhibit relatively low physical and biological functions and services.

The statement above is refutable with evidence showing otherwise. A systematic and skewed assessment of the Ballona site has been perpetrated by CDFW that can be attributed, in part to a failure to protect the site from encampments, fires and vandalism which are instead used in a public relations campaign to mislead and promote the end of pipe catch/basin treatment plan and flood control Project requested in the 408 levee removal Project.

The proposed project is intended to return the daily ebb and flow of tidal waters,

Historically incorrect comment. Ballona is predominantly a seasonal freshwater system that did not perform with a daily ebb and flow of tidal waters. Ballona was historically shut off from the Santa Monica Bay unless and until winter storms produced enough water to open the area to the Bay.

maintain freshwater circulation,

The statement of maintaining freshwater circulation is false.
The freshwaters of Ballona Wetlands have not had hydrological studies and no studies have been done to quantify the damage already done by CDFW due to the allowance of undisclosed drainage devices in the wetlands –not having been removed since the public acquired Ballona.
There have been no Best Management Practices performed for returning the groundwaters of Ballona Wetlands Ecological Reserve and the groundwaters being removed by the Playa Vista development site. EIR mitigation requirements of the Playa Vista site DO INCLUDE cleansing of the groundwater and its return to the groundwaters of Ballona for recharge however, this has not occurred.

augment the physical and biological functions and services in the project area while still maintaining the required level of flood protection to the surrounding community.

There is no need for any further flood control as the Ballona Channel provides that flood control.
The Channel levees are utilized heavily by the public for recreation and viewing into Ballona Wetlands. The Channel is also heavily used by crew teams of multiple universities that have equipment and buildings situated next to the Ballona Channel.

Restoring the wetland functions and services would allow native wetland vegetation to be reestablished, providing important habitat for a variety of wildlife species. As a restored site, the Ballona

Please review the information provided that includes quotes from NOAA and other scientists that that state that the levee removal will invite toxic pollution of Ballona Wetlands, will be highly risky as a restoration effort and will be the hardest to undo such changes.

Wetlands would play an important role to provide seasonal habitat for migratory birds. A restored and optimally functioning wetland would also benefit the adjacent marine environment and enhance the quality of tidal waters.

The end of pipe, catch-basin pollution control that is envisioned in this Plan by the county and CDFW, is a risky venture that is incompatible with the status the public has garnered-Ecological Reserve. CDFW has already excluded the Playa Vista catch-basin from the Reserve as requested by Catherine Tyrrell on behalf of Playa Vista as she states that it is a flood control device and therefore incompatible with an Ecological Reserve.

Furthermore, science shows that a 6-sqaure mile area would be needed to attempt to cleanse the toxins of water and sediment of the Ballona Channel. The area where the levees are being requested for removal would allow toxic flows into an area less than 600 acres. Thus, there is no scientific reasoning being applied in this request.

The proposed project would provide the community with a self-sustaining, native open space in a highly urbanized area.

The documents herein provided cite to quotes from the science advisory panel that state that this requested treatment to Ballona will NOT BE SELF SUSTAINING. Data shows that sites that have undergone such drastic bulldozing and dredging ARE NOT SELF SUSTAINING. Bolsa Chica is such an example. Bolsa Chica now requires regular dredging that creates a constant destruction pattern upon the underwater habitat at great expense to the taxpayer.

We request full participation in this USACE 408 review process which has not had transparency or public involvement. It is only due to a Public Record Act request from the public to CDFW that we are even aware of this Letter to USACE.

The Conceptual-level plans have not been shared with the public and we have not been made aware of a Preliminary Design Report; Preliminary Hydrology and Hydraulics Report.
We ask that you please provide these reports and allow them to be publicly available.

We request the same availability for public review of any and all Real Estate Analysis and Anticipated Operations and Maintenance Requirements.

Respectfully,
GRASSROOTS COALITION, Patricia McPherson

FROM: Grassroots Coalition,
Patricia McPherson, President
Patriciamcpherson1@verizon.net

August 2, 2012

TO:
California Coastal Conservancy
Attn. Executive Director, San Schuchat &
All Governing Board Member and Alternates

CC
John Chiang- CA. State Controller
Matosantos- CA. Dept. of Finance Director
Bill Lockyer- CA. State Treasurer
John Laird- Dept. of Natural Resources
U.S. Army Corps of Engineers Attn. Commander Mark Toy
U.S. Senator Barbara Boxer
U.S. Congress Person Maxine Waters
L.A.Councilman Bill Rosendahl

RE: Complaint- Supporting the 3/29/12 REQUEST TO RESCIND APPROVAL FOR STAFF RECOMMENDATION APPROVAL ON 1/19/12 awarding $6,490,00. for: FILE NO. 04-088-

BALLONA WETLANDS RESTORATION ENGINEERING AND TECHNICAL STUDIES

The following paper from Grassroots Coalition (GC) represents GC's opinion of its findings and data support garnered via the Public Record Act and the Freedom of Information Act.

This document also requests the Coastal Conservancy to stop its illegitimate interference in the approved and ongoing 2005 Joint EIS/EIR process between the Sponsor-- Santa Monica Bay Restoration Commission (SMBRC)/ LA County Flood Control and, the U.S. Army Corps of Engineers.

The Coastal Conservancy, using its control over public bond money, has shut out the public process and taken its influence as a financially powerful board member of the SMBRC and partner of the California Department of Fish & Game (DFG), the lead agency of the publicly owned Ballona Wetlands—to fund a process that is contradictory to the 2005 federal process that was requested by Congress.

The Coastal Conservancy is propelling a bait and switch – a NEW Joint EIR/EIS process and a NEW Notice of Intent (NOI) that undermines and attempts to extinguish the current 2005 Joint EIS/EIR APPROVED PROCESS with its attendant safeguards of multiple habitat restoration alternatives.

The Coastal Conservancy is instead, illegitimately propelling a singular outcome that stops restoration of Ballona and protection of its endangered species to instead convert the habitat into a non-historical dredged out estuarine habitat that promotes LA Port expansion and other financial deals.

Background:
In 2004, Ballona Wetlands acreage was purchased via PUBLIC funding for approximately $140 million. **The land is owned by the public** and is currently administered by the California Dept. of Fish and Game (freshwater marsh portion by the State Lands Commission) .

Important, new information contained herein reflects a Coastal Conservancy (CC) Public Record Act (PRA) response consisting of numerous heretofore undisclosed CC documents contained on a CD. The CD was provided after the 1/19/12 CC Governing Board Hearing in Los Angeles, CA. and, after the CC Governing Board's Hearing in Ventura, CA. on 3/29/12.

I.
The Coastal Conservancy PRA CD provides evidence to show that misleading and/or incorrect information was presented in the Staff Recommendation of 1/19/12 (File No. 04-088)

The newly disclosed Coastal Conservancy documents (CD) reveal:

A. potential misuse of public bond money (Prop. 12, PRC 5096.352 (f) and or (b)(1));
B. lack of disclosure, lack of public process and transparency of process regarding the Coastal Conservancy's involvement and; associations with other agencies --federal- US Army Corps of Engineers (USACE) and; state agencies and; a private nonprofit- the Santa Monica Bay Restoration Foundation (Foundation) that pertain to Ballona Wetlands in Los Angeles, CA.
C. Prop. 12 (Number 172 of Dept. of Natural Resources Listing of Prop. 12 bond grants; 3760-30203-0005(2)(B)07) Coastal Conservancy bond grant to The Southern California Coastal Water Research Project (SCWRP) -Ballona Wetlands Restoration. The Coastal Conservancy, contrary to the bond grant language and intention of allowing for a "scientific advisory committee" (SAC) to review and advise regarding **'enhancement'** plans for the restoration goals of Ballona Wetlands; the Coastal Conservancy instead propelled and directed SCCWRP members and other contractors to perform a singular outcome of **'creation' of a full tidal/ estuarine, non-historical , treatment wetland as an end of pipe, experimental solution to the toxic contamination of Ballona Creek.**

The CC Staff Recommendation is a non-historically oriented goal and thus fails to adhere to bond language for "enhancement" of Ballona Wetlands and also fails to adhere to "restoration" as defined by Southern California Wetlands Recovery Project (SCWRP). (See p.3 SCWRP restoration definition) And, contrary to publically stated and written goals of transparency and interchange, the CC and SMBRC precluded the public and Working Group from participating and interfacing with SAC. Thus, the CC and SMBRC, utilizing all public bond dollars have effectively shut the public out of the Ballona Wetland Restoration design process.

Contrary to comments made below in the Staff Recommendation 1/19/12 (File No. 04-088), the conceptual restoration plan was **not** developed in a public process and the public and other parties were **precluded** from participation in all facets of the development of the restoration alternatives

"Cooperation: The conceptual restoration plan was developed in a public process with input from a Science Advisory Committee, an Agency Advisor Committee, and the Ballona Working Group made up of representatives of local nonprofit organizations, agency staff and members of the public. Individual public members also participated in all facets of the development of the restoration alternatives."
(p. 9 of 9 1/19/12 Staff Recommendation; Emphasis added.)

The CD documents reveal that the conceptual restoration plan was developed by the Coastal Conservancy and by the executive director and staff of Santa Monica Bay Restoration Commission- a California state agency.

Note- the SMBRCommission's executive director and most staff are not state personnel . Since 2005, the executive director and staff of the SMBRFoundation (a private 501c3) simultaneously act as SMBRC staff and executive director. IRS records reveal payment to the Foundation's executive director and staff from the Foundation. We have found no contractual authority for such private persons to serve as state officers of a state agency or as staff of a state agency. We are currently requesting an assessment and investigation into these matters of great public concern.

The CD documents reveal that the Coastal Conservancy Staff Recommendation was created:

1. in a void of public/ Working Group input acknowledgement and use.
2. in a vacuum of interchange between the Scientific Advisory Committee and the public/ Working Group and the USACE contractual agreements.
3. while failing to disclose scientific findings to all parties and;
4. while failing to provide process as written by the Coastal Conservancy.
5. without adherence to the 2005, contractual agreement between the United States Army Corps of Engineers (USACE) and the Sponsor (aka the Authority- SMBRC & LA County Flood Control) wherein a Joint EIR/ EIS of Corps certified programs of environmental review would take place and;

6. without CC Governing Board authorization and without public disclosure-- the CC Project Manager created an enterprise consisting of a 'new' Joint EIR/EIS process ostensibly intended to circumvent the 2005 approved process. (JD submission to CC 3/29/12)
7.

Lack of Disclosure Has Led To An Inability To Make Informed Decisions

I.

A. Proposition 12 Funds-The Public's Intent - To Acquire, Protect and Restore Is Not Fulfilled.

The Prop. 12, Public Resource Code (PRC) Section 5096.352 language states, " (f) Twenty-five million dollars ($25,000,000) of the funds shall be allocated to **acquire, protect, and restore** wetlands projects that are a minimum of 400 acres in size in any county with a population greater than 5,000,000. (Emphasis added. The Ballona Wetlands is distinguished as fulfilling this specific criteria.)

Restoration—specifically refers to actions taken to obtain a former state of a natural condition. (Southern California Wetlands Recovery Project (SCWRP)- Science Advisory Panel (SAP)- Glossary of Terms)

Estuarine wetlands- are subtidal and intertidal habitats that are semi-enclosed by land, have access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land (Cowardin et. Al. 1979)SCWRP, SAP Glossary)

. Ballona was not historically continually open and connected to the ocean and large, inundating flows of fresh water occurred infrequently only during major flood events (CD- SAC docs; USGS docs provided to CC by J. Davis; CC's T-sheets).

> **"The project we are recommending is enormous in scale."** CC- MarySmall (JD PRA Response attachment in 3/28/12 CC Hearing-Request)

Contrary to "protecting and restoring" the Ballona habitat, the approval of the Engineering and Technical Studies & SMBRC bond awards will specifically promote a singular outcome— massive destruction of currently functioning habitat that will not 'obtain a former state of a natural condition' but, will instead endeavor upon a non-historically oriented, experimental estuarine treatment wetland project expected to encounter yearly flooding and scouring events. The project is not expected to be self-sustaining but instead expected to promote a perpetual money pit of contracts for monitoring and unknown but expected repairs and fixes- - future landscape changes further transfiguring the flora and fauna. (CD/SAC)

A failure to adhere to grant proposal requirements, as dictated by the State of Ca. Finance Dept. in recent audits, continues

.

NOTE: While the Coastal Conservancy promotes the idea that it provides bond grants to the SMBRC, the Coastal Conservancy has actually never provided any bond money to the SMBRC as per the 2002,

SB 1381 Keuhl bill that established a Treasury Account for the SMBRC. Instead, the Coastal Conservancy provides public bond money grants to the private nonprofit—the SMBRFoundation—typically without a grant proposal having been provided—as is the case in the 1/19/12 grant approval.
Recent audits of the CC by the California Dept. of Finance require that the CC adhere to grant proposal requirements established by the Dept of Finance. However, the CC's failure to adhere continues as is the case in the 1/19/12 grant approval.

The currently clean land (LARWQCB) and functioning habitats—include endangered and rare Southern California native plants and wildlife, which will be destroyed in order to create the end of pipe, treatment wetland for toxic Ballona Creek waters and sediments. (CD-SAC) The full tidal, estuarine goal also appears to discharge political favors for LA Port expansion(s) approvals that need wetland mitigation credit(s) and/or extensive fill material from Ballona.
(See e-mails regarding LA Port - letters of support for the Staff Reccommendation)

Contrary to the 8/13/04 CC MEMO (p.4), the CD -SAC documents reveal wildlife and habitat destruction and dangers, endless and exorbitant financial costs, inability to show sustainability and potential legal quagmires that were not revealed to the public/ Working Group and other parties-- some of whom were asked to sign onto Coastal Conservancy pre-scripted letters of support for the 1/19/12 Staff Recommendation.*

*Contrary to the promised 'transparency' of process; CC and SMBRC staff improperly lobbied for letters of support for the 1/19/12 Staff Recommendation prior to a public notification of an agenda and release of the Staff Report thusly, discriminating against all others by failing to provide the same comment opportunity prior to the issuance of the Staff Report.

The public has a right to know the full extent of issues regarding changes to Ballona. Whatever decisions are rendered, they should not be based upon piecemealed, truncated and biased information as has currently been provided.

PROPOSITION 12 Identification of Funds; Status of Funds
The Staff Recommendation(SR) is unclear which Proposition 12 funds are being requested. Two possible funding sections of Prop. 12 are:
- Proposition 12 bond money discussed in the SR as specifically for Ballona Wetlands is listed under Public Resource Code (PRC) Section 5096.352 (f)). The accounting for these funds was not provided in the Staff Recommendation and remains unknown.
-Other Prop 12 funds include: PRC Section 5096.352(b)(1)—to the Santa Monica Bay Restoration Project/Bay Watershed Council; that account status remains unclear also.
(In 2002, Senate Bill 1381 (Keuhl) transformed the SMBR"Project" into the SMBRCommission. Prop. 12, PRC language utilizes the Bay Watershed Council. The ByLaws of the the Bay Watershed Council (BWC) remained intact which now give rise to

questions regarding the actual existence of the BWC after SB 1381 which may influence the use of the Prop 12 bond funds.)

I.

B. 5-6. The Coastal Conservancy Project Manager and SMBRC Executive Director/ Staff, Have Not Been Forthright With the Public Regarding Disclosure of Process Changes Pertaining to Federal (USACE) Contractual Agreements

U.S. ARMY CORPS OF ENGINEERS

1994, Sept.28 Adopted- "Resolved by the Committee on Public Works and Transportation of the United States House of Representatives, That the Secretary of the Army is requested to review the report of the Chief of Engineers on Playa del Rey Inlet and Basin, Venice, California published as House Document 389, Eighty-third Congress, Second Session, and other pertinent reports, to determine whether modifications of the recommendations contained therein are advisable at the present time, in the interest of navigation, hurricane and storm damage reduction, environmental restoration and other purposes at Marina del Rey Harbor, Los Angeles, California, with consideration given to the disposal of contaminated sediments from the entrance channel required under the existing operation and maintenance program at Marina del Rey Harbor."

In 2005, USACE Noticed and embarked upon an areawide ecological review- an EIS- of the historic Ballona Wetlands area that included the U.S. 83th Congress -- House Document 389 under Public Law 780. Map-Enclosure No. 1 (General Plan of Improvement) reveals the entire Ballona region as part of this action including but not limited to Ballona Lagoon, Del Rey Lagoon and the Sanctuary area , Ballona Creek, Centinela Creek etc. (See language of the USACE Lower Ballona Creek Restoration Reconnaissance Study and; Feasibility Study). This EIS was predicated upon having a local Sponsor as part of the review process and to aid in the outreach to the PUBLIC and the creation of the Joint EIR/EIS process.
SMBRC/LA Flood Control (the Authority) aka the Sponsor-- contractually agreed to the Joint EIR/EIS in 2005.
The contract included having the Sponsor (Authority) provide at least 6 public meetings dedicated to providing time for USACE representatives to discuss the USACE status of the Joint EIR/ EIS process. The follow through for such meetings has not occurred.
(In various earlier approved bond requests for Ballona projects; Project Manager Mary Small eliminates reference to the 2005 contractual agreement for a Joint EIR/EIS which jointly provides for the Ballona Restoration Alternatives (2005 contract between- USACE and SMBRC/LA Flood Control aka Authority) Instead Ms. Small's staff recommendations inform the CC Governing Board that as of 2005 only the Ca. Dept. of Fish & Game, State Lands Commission and SMBRC are part of the oversight of Ballona and alludes that the Conservancy has the restoration alternatives planning duties:

(Ballona Wetland Improved Public Access; File No. 04-088; 7/21/10)
"In 2005, the Conservancy initiated conceptual planning and feasibility analysis of restoration alternatives

for the property. This project is being implemented in partnership with the DFG and the State Lands Commission, the two state agency owners of the property and the Santa Monica Bay Restoration Commission. The feasibility analysis was completed in 2008, after a delay due to the bond freeze, and the project partners are now initiating environmental review and detailed engineering of a long-term, phased restoration project. When the restoration planning began, the Conservancy funded the development of an Interim Site Stewardship Plan to address the pressing concerns related to site management. As discussed above, in 2008 the Conservancy provided a grant to MRCA to fund construction of some site improvements and to fund planning, design and preparation of permit applications for additional access improvements. Based on the completed planning work, the MRCA and the project partners determined that it will be more cost effective and logical to pursue implementation of most access improvements as part of the environmental review and permitting for the long-term phased restoration project.
PROJECT FINANCING:
Coastal Conservancy $280,000
MRCA 120,000
SMBRC, US EPA funds 20,000
Total Project Cost $420,000"

This is an omission of pertinent and critical fact given in order to garner public bond money. (See J. Davis 3/28/12 Request to CC Gov. Brd.; USACE/CC minutes of meeting(s) and page 6)
See also File No. 04-088 on page 17.
Additionally, the bond money was approved but accountability for its use has not been forthcoming. And,
No fund award was given to SMBRC from the USEPA as cited above. The Treasury Account set up for the SMBRC under SB1381 was not utilized. Instead, ostensibly the USEPA funds went to the private nonprofit, the Foundation. The Foundation, as a private non-profit 501c3, provides no accountability to the public.

The Coastal Conservancy, had also made promises to the public regarding transparency and public inclusion in the entire process of exploring **all reasonable alternatives for enhancement of Ballona.**

For example in an early Coastal Conservancy MEMO dated 8/13/04 to California Department of Fish & Game (DFG) and the State Lands Commission (SLC), the **GOALS/PRINCIPALS read in part-**

*"**The restoration plan** will be based on the best science, incorporate technical scientific expertise and **will be developed through a transparent planning process that allows stakeholders to provide input and comment on all restoration planning products.** The restoration planning process will develop and analyze a **range of alternatives to implement the following project goals:***
-Restore and enhance a mix of wetland habitats to benefit endangered and threatened species as well as other migratory and resident species;
-Provide for wildlife-oriented public access and recreation opportunities; and –
***Implement a technically feasible, cost effective, ecologically beneficial and sustainable restoration."** (Emphasis added.)*

And,

"..restoration will be conducted within the landscape and watershed context, with attention paid ***to adjacent and ecologically related resources."*** Pg. 1

According to CD documents, the Coastal Conservancy's Ballona project manager participated in USACE meetings in the 2004 timeframe citing inclusion of the areawide ecosystem eg. Ballona Lagoon, Del Rey Lagoon, the Sanctuary area, Marina del Rey and others that paralleled the activities of ecosystem review as described by the USACE (Reconnaissance Study; Lower Ballona Creek Restoration Feasiblity Study; 3/28/12 J.Davis submission to CC)

However, in contradiction to the 8/13/04 Memo cited above, the context of the larger historic boundaries of Ballona Wetlands were later arbitrarily dropped, without public notification or discussion. The CC Project Manager discusses no longer including the adjacent and ecologically related resources as part of the Joint EIR/EIS restoration evaluation performed with the USACE:

6/2/10 CC, SMBRC, USACE Ballona Coordination Meeting Minutes:

"II. b. Mary Small: Have all the PMP sections looked at the same project area? Parts still refer to Ballona Lagoon, Grand Canal, Venice Canals and Oxford Basin, which are no longer in the study area. (3/28/12 CC hearing; J. Davis Attachment)

And, the Project Manager discusses instead a 'new' process for which there is no ostensible authority and to which the public has not been made aware:

"Mary Small: If the Corps falls too behind, we will work with Corps Regulatory for a permit for their activities (NEPA/CEQA, design, permitting, and Phase 1 construction)" and;

"Mary Small: It was always our understanding that the Corps would use our restoration alternatives. It makes us nervous that this was never in writing."(6/28/10 Ballona Ecosystem Restoration Planning Management Meeting)

It was never the public's understanding that the Corps would be held to Coastal Conservancy and Foundation staff's restoration alternatives. Legal legitimacy for such behavior is also questionable. And,

"Suggested response

1) *The EIS/EIR process begun in 2005 was for the Army Corps' Lower Ballona Ecosystem Restoration Feasibility Study, that project and the associated environmental review has not been completed and is not moving forward at this time. The EIR/S process for the proposed enhancement project will be separate." 2/7/12*

CC/Mary Small to Ca.Dept. Fish & Game- Rick Mayfield per response to Davis Ballona CEQA process query. (JDavis attachment 3/28/12 Request to CC Board)

Thus, the CC switch in process is 'suggested' to be disclosed to a member of the public after seeking and garnering approval for the 1/19/12 Staff Recommendation.
(3/28/12 CC Hearing, Davis PRA attachment to Request)

This new and unauthorized process discussion continues in the same email, 2/7/12, from Shelley Luce to Mary Small and Rick Mayfield (CDFG):

...." ***The EIR/EIS*** *that* ***we want to start*** *is for a separate project, i.e. the BWER restoration/ enhancement project. ".* (emphasis added.)

The EIR/EIS that they want to start IS NOT on a separate project but instead on the same project but having eliminated the '94/ 2005 Joint EIR/EIS process; scope of review; environmental safeguards and full range of alternatives inherent in '94/ 2005 approved process.
In other words, the CC attempts to have the public and the USACE but out of their way so that the CC can control the project --using the public's dollar--alongside its political allies.

And, while Mary Small provides the appearance that the Request For Proposals is new online--*" the request for services ....went out today"....*
2/8/12 CC email (JDavis PRA response attachment in 3/28/12 Request to CC Board)

The Coastal Conservancy, had already put out an online RFP in 2010 for the work requested for approval in the 1/19/12 Staff Recommendation. Thus, it appears that as of 2010, the outcome was already a done deal behind the public scene.

Changes, such as this were not communicated to the Public/ Working Group and the ongoing status of the relationship with the USACE as per the Joint EIR/EIS was not communicated either. In fact, the USACE- Sect. of the Army was not made aware of the attempt to extinguish the earlier, approved process. Any extinguishing of the approved EIR/EIS process (including House Document 389) would have to abide by the USACE process of removal. The process provides accountability for reasoning as to the ending of the project as well as detailed accounting for money spent and what had occurred throughout the process. This activity has not occurred and the USACE has provided a letter stipulating that the approved process is maintained and that investigation into the matter has started. (USACE-J.Davis communication).

It is also unclear whether USACE/SPONSOR information was communicated to the Science Advisory Committee or other parties. Specific USACE work projects, including response to House Document 389 and work quality/certification needs are not communicated in any of the CD-SAC meeting notes which appears to show that the SAC team (contracted and paid for with public funds) were fulfilling ONLY the arbitrary GOALS as set forth by the CC Project Manager and SMBRC staff. Issues

such as the protection of groundwater (classified as potential drinking water), an issue of House Doc. 389 and current Los Angeles- Best Management Practices (BMPs) are absent in the meeting minutes.

Thus, the CC and SMBRC staff, provided for an atmosphere of further disconnect, lack of transparency and compartmentalization of information sharing.
And,
the public/Working Group was not made aware that the CC considered itself a part of the USACE/SPONSOR contract (which it is not) —so much a part, that Mary Small apparently believed that the CC would provide the alternative(s) for the USACE in the Joint EIR/EIS:

6/28/10 Ecosystem Restoration Planning Management Meeting:
II. C. 2." *Mary Small: It was always our understanding that the Corps would use our restoration alternatives. It makes us nervous that this was was never in writing.".*.

This type of very questionable influence was not conveyed publically. According to the USACE, Joint EIR/EIS language, the USACE study would provide for all reasonable alternatives and the process would embrace public disclosure and participation.
The Coastal Conservancy and SMBRC staff have not been forthright with the public regarding status of the Joint EIR/EIS.

I.

B. 1- 3. The CD reveals SAC meetings, reports and concerns not shared with the public/the Working Group and other parties. Conversely, the public/ Working Group comments and concerns are not cross- shared.

Contrary to the 1/19/12 Staff Recommendation, the public, Working Group and others have not been engaged by the Coastal Conservancy as promised and have not been provided with full information from the Science Advisory Committee (SAC) group in order to make informed decisions and provide input throughout the process to date.
Prop. 12 bond money was also provided from the Natural Resources Dept. to the Coastal Conservancy specifically to provide a GRANT to the Southern California Coastal Waters Research Project (SCCWRP)(#172) for creation of a SAC team. Thus, the SAC team was paid with public dollars to perform as an independent scientific advisory panel to provide input and advice regarding historical restoration options. Contrary to the GRANT purposes, the Coastal Conservancy's Ballona Project Manager and SMBRC staff instead told the SAC team what the intended outcome was and that all input was to secure that goal—namely full tidal estuarine and levee removal.
Thus, the Prop. 12 bond money was not utilized as intended.
The Coastal Conservancy and SMBRC staff kept the public and the Working Group out of the SAC loop of information and knowledge thereby thwarting and distancing

any meaningful interchanges and participation as falsely stated in the Staff Recommendation below.

Staff Recommendation excerpt:
"Cooperation: The conceptual restoration plan was developed in a public process with input from a Science Advisory Committee, an Agency Advisor Committee, and the Ballona Working Group made up of representatives of local nonprofit organizations, agency staff and members of the public. Individual public members also participated in all facets of the development of the restoration alternatives."
(p. 9 of 9 Staff Recommendation 1/19/12)

And, contrary to assurances that the public would be notified and included on all SAC meetings, the public was not notified or included.

"MARY S. all SAC meeting are public, all interested parties will be notified and invited, meetings will be structured with SAC addressing issues first and public comment period at the end." (CD- 7/20/05 LMU Ballona SAC MTG.)

A 2004 MEMO discusses –
"Ballona Restoration Planning Working Group: Stakeholder Committee and Public Involvement
*"A Ballona Restoration Planning Working Group (brpwg) made up of interested organizations, agencies, and individuals, will meet periodically to obtain project status updates, to provide input, and to support the restoration planning process. These meetings will be open to the public. Subcommittees may be established to address specific issues that may arise during planning."*pg.2

The language above provided for the public involvement at the start of the process that began with 'interim stewardship' meetings, (eg. trash cleanup and education tours) which did occur. As time passed, meetings stopped, informational sharing from agencies and the science team became nonexistent and; the public's comments were not included in the planning process that continued behind closed doors.
-Website topic- SAC meeting minutes- was not accessible to the public. Instead, when clicked – the website told the viewer entry was not allowed.
-SAC meetings, though described as open to the public, were not. The CD documents reveal that the SAC meetings were, in the main, telephonic and not inclusive of the public. Reports and Memos were not shared with the public but utilized internally.

A continued failure to acknowledge the public and Working Group is also documented via the 2012 Science Advisory Meeting that was held days after the Staff Recommendation Approval. The SAC meeting was also a first in years for actually occurring and, that public notice was provided.

The Public/ the Working Group:

- provided strong objections to the proposed Plan, providing written testimony as well as oral testimony.
- listed issues that needed to be addressed properly; asked for responses that thus far have gone unanswered and,
- again requested the area be considered in its totality of ecosystem variety and benefits utilizing the historic system of Ballona.
- reminded the SAC that the area now has more saltwater --deep and mid habitat than historically existed at Ballona due to the Marina del Rey; Ballona Lagoon Marine Preserve; Del Rey Lagoon; Ballona Creek itself and; as well as freshwater due to the newly created catch-basin- aka, the freshwater marsh. (historically= the last couple hundred years)
- SAC numerical analysis of habitat types was in error. Ratios of entire Ballona Wetlands historic habitat applied to be fulfilled in Areas A, B, C alone is a faulty analysis. The SAC- ratio numbers that pertained to former water habitat and land elevations were either incorrect and/or not documented by SAC.
- cited and documented that SAC dredge spoils deposition locations and volumes were incorrect. (USGS Documents and maps provided by John Davis to the Coastal Conservancy)

The CC and SMBRC continue to fail to respond.
Note: The CC continues to fail to respond to queries and comments provided by the public and its so-called "Working Group" members from 1/19/12 and 3/29/12.

FAILURE TO INCLUDE THE WORKING GROUP COMMENTS AND REQUESTS
Despite providing comments, documentation and evidence regarding the topics listed above and others; there is no documentation provided from the Coastal Conservancy on the CD that any of the public/ Working Group communications were included for any meaningful response or use.

The CD documents reveal no inclusion of the public in any decision making for the alternatives.
Public comments provided to SMBRC and the Coastal Conservancy regarding Ballona specific studies such as the Phil Williams & Assoc. report, that did not address or incorrectly addressed issues, such as the migrating oilfield gas and reservoir gas leakage from SOCALGAS had no meaningful response. There is no showing that the CC or SMBRC staff ever shared these concerns with the SAC team, much less did any meaningful, good faith follow up with the public to understand how the gases may impact restoration. The same holds true for issues regarding protection and utilization of the Ballona aquifer groundwater hydrology. Repeated requests from stakeholders to be given ½ hour presentation time to provide information regarding hydrology and groundwater diversion issues, before the SMBRC have been met with silence (The CC is part of the SMBRC) .

I.B.

CONTROL OF MESSAGE AND OUTCOME
The CC and SMBRC Staff:
Allow For No Public/ Working Group Participation In The Planning Process;
Fail to Disclose Science Advisory Committee (SAC) Conference Calls, Memorandums and Reports For Planning of Alternatives;
Feasibility, Cost, Sustainability, Ecosystem Pros and Cons Are Not Disclosed;
And
The CC & SMBRC Staff Arbitrarily Define Project Goal=Estaurine

Staff Recommendation excerpt:
"Cooperation: The conceptual restoration plan was developed in a public process with input from a Science Advisory Committee, an Agency Advisor Committee, and the Ballona Working Group made up of representatives of local nonprofit organizations, agency staff and members of the public. Individual public members also participated in all facets of the development of the restoration alternatives."
(p. 9 of 9 Staff Recommendation 1/19/12)

The 1/19/12 Staff Recommendation excerpt is false. The public/ Working Group was neither privy to the SAC meetings and information created nor included in the planning process to participate in all facets of the development of the restoration alternatives.
The following excerpts from the CD document an internal discussion revealing the CC and SMBRC staff created and controlled the alternative selection:

"Wayne (Wayne Ferren) suggested that biological sustainability be defined as no loss of habitat types & functions, major guilds, and sensitive species over the project site as a whole." July 7, 2008 SAC Conference Call.

And;

"Joy (Joy Zedler) asked how biodiversity is being defined? ***Sean indicated that biodiversity = highest richness of estuarine dependent species****. If this is how we are defining biodiversity, it should be stated clearly in the document.* (emphasis added; Sean Berquist was SMBRC staff and Foundation staff during this timeframe) and,

"Wayne suggested that we clarify that biodiversity is the sustainable richness of representative interdependent native estuarine habitats along with their associated and expected species biodiversity. "(CD-June 23, 2008 SAC Conference Call)

The next parargraph, written by the note-taker- cited by CC as being CC or SMBRC staff- states the goal-
"Estuarine biodiversity is the primary objective of the analysis."
(CD- June 23, 2008 SAC Conference Call Memo)

This same Memo also sets forth a GOAL that was not shared with the public/ Working Group.
"The project goal is to create functional estuarine habitat...";
"1. Maximize area of estuarine habitat.";
Opportunities to create regionally significant habitat including vernal pools and...should be pursued but ***not at the expense of restoration of estuarine habitat."***

The public/Working Group was not allowed to participate in the decision making and was not advised as to the differing opinions rendered by the SAC team.

Since this timeframe and without public notification or disclosure the Coastal Conservancy and staff of the Foundation have worked to eliminate the areawide review of ecosystem function and alternative habitat plans—including a public debate regarding the pros and cons of each system -- to instead focus upon a predetermined singular outcome of removal of Ballona Creek levees and dredging of Ballona to 'landscape' and convert the land from its historic natural function to an entirely new, artificial and unnatural function that precludes all habitat function that does not primarily promote the estuarine full tidal premise.

And though asked publically where this 'Plan- Alternative 5 " came from, no response has been forthcoming from either the CC or Foundation staff.

The CD docs however now shed light as to the creation of this "preferred plan". The overtones of financial leverage dominate the first half of the letter and serve to advance a predetermined outcome that is seen fulfilled in the Coastal Conservancy Staff Recommendation—the removal of levees to create the treatment wetlands.

July 10, 2007 SMBRC letter from Shelley Luce to Coastal Conservancy's Ballona Project Manager- Mary Small:

"Dear Mary,
The Santa Monica Bay Restoration Commission, a National Estuary Program of the US EPA, has been pleased to participate in the acquisition and restoration of the Ballona wetlands at all levels over the last several years. We are proud partners in the restoration planning, and currently have one staff member dedicated full time to the planning effort, while I serve on the Ballona Wetlands Science Advisory Committee (SAC). The SMBRC is also an active local partner in the Army Corps of Engineers' Lower Ballona Ecosystem Restoration Feasibility Study and are participating in clean up and restoration plans for Ballona Lagoon, the Grand Canal, Marine del Rey and the Oxford Basin. We have also awarded several millions of dollars of bond monies under our purview to projects designed to improve water quality and habitat in the Ballona Creek watershed. Ballona wetlands restoration is clearly a very high priority of the SMBRC and the EPA.
I have reviewed the restoration design alternatives that are being developed by the consulting team and I am disappointed that they do not fully consider important restoration options, thereby limiting potential habitat, biodiversity and water quality improvements in the wetlands complex. The Ballona SAC requested design alternatives that encompass the "extremes" of restoration planning, i.e. from minimal intervention to maximal structural changes, as well as alternatives in between. The current proposed

alternatives do not provide this and need to be modified, or an additional (fourth) alternative is needed.
SMBRC feels that the restoration design for Ballona wetlands must represent a true restoration of maximum ecological functions and services for the area. Actual restoration work will not begin for months or years, and will be a long term and costly process. The best approach is to include design alternatives that are not limited by current infrastructure or fiscal concerns, since these factors will certainly change over the duration of the restoration process. Similarly, factors such as poor water quality in Ballona Creek will continue to change as Total Maximum Daily Loads and other regulatory measures are implemented. It does not serve us to design the restoration as though it would be undertaken and completed in the very near future, under existing physical or financial constraints.
I would like to request that the design team include at least one design alternative that proposes to
• remove all or part of the levees on one or both sides of Ballona Creek;
• daylight the channel connecting the freshwater marsh to the creek in Area B, and Stingray Creek to Marina del Rey in Area A;
• raise Culver Boulevard to increase flows between the north and south sections of Area B; and
• increase connectivity between Ballona Creek and Areas A and B."

Our staff Wetlands Restoration Manager Sean Bergquist is available to work closely with the consulting team to ensure the revised or new alternatives include features that stakeholders and the SAC members supported. The revised or new alternatives should be presented as one of the group of alternatives for consideration under CEQA and by stakeholders and the SAC.

Given our experience in and commitment to the Ballona wetlands and surrounding interconnected areas, the SMBRC staff, Governing Board and Watershed Council have a great deal to contribute to the restoration process. Please feel free to consult us further during development of the restoration design alternatives and we look forward to continuing our partnership to restore Ballona wetlands.
Sincerely,
Shelley Luce, D.Env.
Executive Director

An e-mail 7/17/07 from SMBRCommission & Foundation executive officer Shelley Luce,
"RE: design alternative for Ballona wetland restoration" and Phil Williams & Associates' (PWA) Jeremy Lowe –
"We've sketched out Alternative 5 as described in Shelley's letter. Is this what you were envisaging?"

Luce: *" Thank you for your response Jeremy. This is a good start for a 5th alternative. Sean and Jessica are adding/changing some details and will forward to you. "*
(presumably-Sean Berquist and Jessica Hall– both Foundation paid staff/ SMBRC staff)

The CD documents also reveal two sets of drawings and plans for the levy removal and levy replacement—by Jessica Hall, a Foundation paid staffer.

Ms. Luce is the Executive Director of the Foundation; no contractual agreements

have been produced by the SMBRCommission or the State Water Board that provide any authority for her to act in capacity of Executive Director of the State Agency-

Santa Monica Bay Restoration Commission which was created under SB 1381 Keuhl as a non regulatory state agency within the State Water Board. There have been no contractual agreements forthcoming by the State Water Board or federal authorities that provide for any SMBRC or federal EPA- National Estuary Program (NEP)- dedicated funding to be handed over to the SMBR Foundation. There is a treasury account that was formed under SB1381 in 2002.

The treasury account has never been used. The attendant oversight and accountability by the State Treasurer has likewise not been utilized.

Ms. Luce has been utilizing both the e-mail address and physical location of the LARWQCB as her work address. The utilization of the addresses has led to common belief that Ms. Luce is a Water Board employee. It is unknown but possible at this time to believe that the utilization of the addresses created a belief that Ms. Luce is LARWQCB personnel, which has in turn, provided Ms. Luce with access to controlling positions on various committees such as IRWMP (Integrated Resource Water Management Program). It would seem that by creating, via continued use of LARWQCB email address and business address, a very public belief that Ms. Luce is a Water Board employee may constitute impersonating a Water Board employee. The following is an e-mail exchange between Ms. Luce and a person with long associations with the Water Board and has acted as a contractor in Ballona restoration matters.

'Travis Longcore travislongcore@laaudubon.org wrote:

Bounced from your waterboards address. Are you no longer a Water Board employee? –

Travis

On Sep 19, 2011, at 2:29 PM, Shelley Luce wrote:

***No, not for many years**. Most of our staff are with our SMBR Foundation. I will check my calendar and get back to you on this meeting, thank you for the invitation.*

Shelley" (emphasis added)

Ms. Luce does not appear to answer directly about herself with regard to the Foundation, or what she means by "our SMBR Foundation". She also does not explain her past personal use of the LARWQCB addresses while not employed and why she suddenly discontinued the practice.

Ms. Luce's resume cites her experience prior to SMBRCommission / Foundation as having been employed by Heal the Bay- the organization that has become institutionalized as part of the SMBRC. Our research indicates Ms. Luce was working in some capacity at LARWQCB during the years 1999-2001- prior to her finishing degrees from UCLA. It appears that her continued use of the Water Board e-mail address after no longer providing service to the California Water Resources Control Board has led/misled many people. (A PRA to LARWQCB is pending for identification of duties.)

Coastal Conservancy- PRA Response to J. Davis

Rare ecosystems of the coastal marsh area are discussed internally by the SAC team with the CC project manager and staff of the Foundation; the information

is not broadcasted for public awareness, inclusion of discussion and decision making as promised.

"Rich noted that the discussion of grasslands should include mention of the historical native grassland prairie ecosystems that previously existed in the area. The rarity of native grasslands should be discussed,,," (CD- 6/28/08 SAC Conference Call)

"Rarity section...complex of prairie and vernal pool...
Wet grasslands formed extensive areas were also palustrine wetlands above highest high tide.." (CD- SAC Call 6/23/08)

"...there is native biodiversity in the non-tidal saline soils. .... At Ballona, these wetlands at Area A, for example, are the only habitat where Alkali Barley (Hordeum depressum) is known to occur in the Ballona Ecosystem. This annual grass was probably the dominant native annual grass in naturally occurring non-tidal saline soils at Ballona." (CD- 11/23/08, Wayne Ferren communication to Mary Small...)

And,
"The region has a shortage of mudflat for shorebirds, high marsh for animals and salt marsh bird's beak, marsh-upland transition for rare shrubs (eg. , box thorn) that are used by animals,...

The region has a shortage of dune habitat and back – dune depressions that support clean-water brackish marsh for aquatic plants and animals.

One could also list maritime scrub, which remains in several places "...
(CD- Joy Zedler (SAC) correspondence)

Thus , without public /Working Group inclusion and input into the formation of the alternatives and later failure to include the public /Working Group comments and concerns regarding the PWA Alternatives that are presented at one public meeting--the CC and Foundation staff continue to work behind publically closed doors to focus upon the 'Preferred Alternative", now known as Alternative 5 presented in the 1/19/12, Staff Recommendation request for funding. Alternative 5 requires massive, non-historic, extraordinary, experimental and knowingly toxic changes to occur on the land masses of Area A and B so that **"biodiversity = highest richness of estuarine dependent species."**

Contrary to the 8/13/04 CC Memo which promised transparency and public inclusion in the alternative planning process which would "restore and enhance" a mix of wetland habitats....and that would implement a technically feasible, cost effective, ecologically beneficial and sustainable restoration.
Instead, the public was shut out of the planning process; and SAC knowledge regarding the **needs and dangers posed by Alternative 5 are not made public:**

"This alternative makes the greatest change to the site, would be the hardest to reverse and consequently has the most risk." (CD- 9/12/08 MEMO from SAC to PMT)

" *..this alternative would* ***require reliance on upstream flood control and pollutant removal****, and could necessitate periodic removal of accumulated pollutants for some portions of the restored wetlands. Furthermore, it is unknown how the flow and sediment yield from the upper watershed would affect the sustainability of the marsh in terms of scour or sediment deposition."* CD, P. 4of 9, 10/15/08 SAC MEMO, emphasis added.

There is no evidence of any such large scale BMP (Best Management Practice) planning or proposals for 'flood control and pollutant removal" occurring upstream on Ballona Creek.

And,

"Eric suggested that there be a statement up front indicating that this site will not be self-sustainable, but will need to be actively managed in perpetuity. " (CD- 7/7/08 SAC Conference Call)

Discussion and comments made from key federal agencies were withheld from the public, including but not limited to **NOAA communications regarding concern of toxicity of Ballona Creek upon the remaining wetlands should the levee removal and dredging take place.** (CD- National Oceanic Atmospheric Association email)

Studies that discuss the toxicity of the Ballona Creek waters and sediment to life in the waters and sediment were not released or shared with the public:

"These sediments were toxic to aquatic organisms, potentially from organic compounds in these sediments. Ballona Creek has been identified as a potential source of tidal flows into Areas A, B, and C in each of the proposed restoration alternatives. Therefore, there is concern to tidal marsh areas, resulting in a negative impact to the habitats and biological resources." (CD- Weston –Technical Memorandum 11/26/07; Water Quality Data Gap Investigation Ballona Wetlands Restoration Project- Pohl , P.E., Ph.D.)

And,

" The July 2006 report by Weston also concludes that there are concerns related to water and sediment quality adjacent to the tidal channels. Consequently there is a need to develop a strategy to evaluation the potential ecological risk associated with influent water or sediment quality to the restored wetlands.

The scientific questions regarding sediment and water quality cannot be answered based on the information currently available, and will ultimately depend on the design of the project." (CD- Memorandum 3/8/08; Subject:

APPROACH FOR ADDRESSING SEDIMENT AND WATER QUALITY ISSUES)

And;

"Eric- Conc(ept) D—is it attempt to move water and sediment into system

Wayne- breaching levee bringing trash, water pollution and sediment into entire area is problematic.

John Dixon-important to describe these NOT as projects, but a directions.

Ambrose- maybe D is too extreme—this won't happen anyway.

Dixon- do feasible maximum tidal, not D—need to scale back

Jeremy- may need to do that, take out realignment Ballona—include realign on Hydrologic options"
(CD-10/30/06 SAC Conference Call)

Additional -SPECIFICS OF THE STAFF RECOMMENDATION 1/19/12

The 1/19/12 Staff Recommendation misleads the public and the Governing Board as seen on pg. 3 of 9, paragraph 5-

" In order to complete the environmental analysis required under the National Environmental Policy Act and the California Environmental Quality Act ***and to apply for permits*** *to implement the project,* ***detailed technical work must be completed."*** *(Emphasis added.)*

What is not disclosed to the reader, is an entire change of process from the Congressionally approved 2005 Joint EIR/EIS process requirements.

The Staff Recommendation sentence itself is also very misleading. The applications for permits to the USACE for implementation of the Coastal Conservancy "Plan", namely the destruction of the levees and the dredging of Ballona have been in process prior to this Staff Recommendation. The Plan-regarding garnering the USACE permits-including the 408- was already in process. (CD)

The Conservancy in its partnership with SMBRC fails to let the public know that they have been working to end the congressionally approved federal portion of the study which entails a full ecological review of the area between the Westchester Bluffs, the Santa Monica Bay, the Santa Monica mountains to a few miles inland – which would also provide for a full review of ALL REASONABLE ALTERNATIVES for enhancement of the ecosystem. (See minutes of USACE/Sponsor meetings provided in the 3/28/12 Request to Rescind File No.04-088; EIS Lower Ballona Creek Restoration Feasibility Study 2005)

Undisclosed is the take-over of process for Ballona 'restoration' guided by the Coastal Conservancy that may disengage the USACE analysis provided for in the established 2005 Joint EIR/EIS.
Instead, it appears that the Coastal Conservancy along with SMBRC staff seek to simply garner permits from the USACE ostensibly for destruction of habitat on Ballona, in particular Area A and B of Ballona. Specifically, the CC and SMBRC staff seek permits (eg 408) for levee and land destruction and removal. It appears that the extensive dredging and massive bulldozing may provide the necessary fill for the LA Port. Questions from the public regarding the CC/SMBRC/ USACE status have gone unanswered. (CD docs and SMBRC April meeting -submission by GC)

Contrary to discussion in the Staff Recommendation—Area A is vegetated primarily by native plants and native wildlife and, is host to endangered species including but not limited to the Belding's Savannah Sparrow.
Not provided to the public are documents and communications which provide, in part, narrative of 'moving' Belding Savannah Sparrows to areas not planned for dredging. This information is vital for public discussion especially since, destruction of the Belding's habitat may wreak havoc upon the Belding population that utilizes Ballona year round. (CD)

- Pg. 3 of 9 discusses hydrology/hydraulics studies that need to be done. What is not discussed with the reader are the multiple public requests for actual onsite hydrology studies that would include Ballona aquifer and groundwater studies that would provide the knowledge for alternatives inclusive of groundwater use onsite. Ballona has multiple aquifers underlying the site. The aquifers are classified as potential drinking water sources and are part of the West Basin aquifers which intermingle to the south and east. (Poland Report)

- None of the concerns raised in House Document 389 (part of the USACE review) regarding problems associated with further saltwater intrusion have been discussed. The elimination of the USACE EIS as part of the Joint EIR/EIS would hasten the Coastal Conservancy's and SMBRC staff GOALS = Estuarine which in turn would potentially threaten contamination of the underground aquifers as per House Document 389 literature. None of the above has been made a part of any review despite repeated requests from the public for such studies.

- The SOCALGAS operations and oilfield gas migration throughout the Ballona area have also not been discussed despite repeated requests from the public.
- Thus pg 9 of 9 is insufficient and incorrect in its comments regarding the Local Coastal Program and the Coastal Act, including but not limited to the

fact that there is no LCP language that states Ballona requires action as the Staff Recommendation implies as per 31252.

- Staff Recommendation- Pg. 8 of 9 Under "Sea level rise vulnerability"
- The Staff fail to alert the reader that the 'broad areas of mid marsh and high marsh" depicted--showing a meandering Ballona Creek mid-way between Area A and B-- will be inundated with yearly flood waters of the contaminated Ballona Creek –potentially killing nesting or burrowing life in the low, mid and high marsh areas. Concerns by the SAC team regarding scouring, trash and contamination were not disclosed in the Staff Report and have not been shared with the public.
- The Staff fail to inform the reader that the Preferred Plan creates a non historic cycling of yearly floods, debris and contamination as part of an end of pipe solution, a treatment wetland device .
- The Staff Recommendation does not disclose the SAC discussion of concerns regarding the creation of a treatment wetland.
- The Staff Recommendation does not alert the reader as to what is achieved with the use of the bond funds via "hydraulics" information. Will the hydraulics information be exclusive to new levy construction?
- The Staff Recommendation does not disclose to the reader, the need for upcreek flood control or contamination control as is discussed by SAC.

31400- The Staff Recommendation cites enhancement of future NEW trails.
The Coastal Conservancy has already awarded large grants specifically for the Ballona Bike Trail (File No. 07-058-01) which, currently exists and is heavily utilized by the public. Since, much public funding has already been utilized and will be utilized further for the pathway, why should that same importance of pathway be taken away at Ballona?
Removal of the levees would not only take away a heavily utilized public biking and hiking trail but would also take away the pathway's use as an observatory promenade for viewing the interior of Ballona. The levees provide an important opportunity for viewing without intruding.

The Coastal Conservancy and other agencies have failed to embrace and include the public on this issue as well. Using the public's hard earned money while keeping the public out of the planning process reveals the Coastal Conservancy has not acted in good faith.

Grant Award of $280,000 to Mountains Recreation and Conservation Authority (MRCA) File No. 04-088 from Staff Recommendation 7/21/10.

1. The Mountains Recreation and Conservation Authority governing board refused to approve the use of bond money for the trailhead(s) and other enhancement s at Ballona. The Board agreed with members of the public. Namely, that due to the ongoing **Joint EIR/EIS** process' requirements being

more stringent than a singular EIR; those added requirements had to be fulfilled prior to any further decision making taking place.

Mr. Edmiston, at the meeting, asked did they want him to return the money?-

Ostensibly the bond money had already been approved and given to MRCA. Where did the money go? And;

2. The 1/19/12 Staff Recommendation cites NEW levy demolition and bike trails ,
"the proposed project could provide a new segment of the Coastal Trail . .....the project is located at the intersection of the California Coastal Trail and the Ballona Creek Trail, and may offer a significant opportunity for the development of improved connections between these trails." P. 7 of 9 .

- Since the Coastal Conservancy has been intent upon levee removal of Ballona Creek and dredging the land in the near future; why did the Conservancy give bond money to MRCA for trail head construction and enhancements for Area A (in particular)--apparently an area it intends to soon demolish and dredge? These inconsistencies appear to show misuse of public funds; paying for contractors and salaries for projects that lead nowhere.
- Furthermore, it appears that when the CC Project Manager of Ballona desires to garner public bond money; the wetlands (or bike path) are discussed in a decidedly positive depiction as below:

"Despite the degradation of site resources, significant wetland habitat remains within the Ballona Wetlands. Plant species within the project site include wetland indicators such as pickleweed, marsh heather, saltgrass, arrowgrass and glasswort, and a variety of upland and exotic species including brome, iceplant, oxalis, and ryegrass. Bird surveys indicate that the site is used seasonally by a variety of migratory shorebirds, as well as by typical shoreline residents (gulls, terns, and ducks) and typical upland birds including small raptors. Bird species of special interest observed in the project area include nesting pairs of Belding's Savannah sparrow and foraging use by California least terns.
The proposed project will be implemented primarily on the portion of the BWER north of the Ballona Creek channel (Exhibit 2). This area of the reserve currently has very limited public access and suffers from illegal uses. The proposed project seeks to improve the resources on the site, increasing public use while discouraging illegal activities through improvements to fencing and signage." File No. 04-088

This same project manager provides an entirely different depiction in the negative—when public bond money is requested for demolition purposes on the same piece of property. Note also the language of utilizing funds to safeguard the property directly contradicts the 1/19/12 Staff Recommendation of the 6 plus million wherein the Project Manager cites the need to demolish and dredge the same area as a means of eliminating public use by the homeless instead of—the aforementioned request for money to protect the same area. (See also Ms. Small e-mails discussing need to show greater degradation in order to secure the desired outcome. (J. Davis 3/28/12 Request to CC))
It appears that the Ballona habitat is characterized dependent upon financial requests---not on reality or science based requests.

- Despite repeated requests for public follow up with regard to the bond money and that project, (including a request made for information at the recent Ballona Watershed Task Force Meeting) none has been forthcoming from MRCA staff or CC staff.

"In 2008, the Conservancy authorized funds to the MRCA for planning, final design and implementation of specific public access improvements identified in the Ballona Wetlands Early BALLONA WETLANDS PUBLIC ACCESS IMPROVEMENTS
Action Plan. MRCA has completed much of that work and as a result of that planning effort, the project partners determined that some of the specific access improvements identified in that plan may need to be re-evaluated and others should be reviewed and permitted as part of the larger wetland restoration project. Rather than pursue the Early Action Plan improvements, the project partners decided that it is a higher priority to develop targeted educational and public access programs in the northern 300 acre portion of the site where there is currently almost no public access. The proposed project would also provide funding for MRCA to continue working on planning public access improvements for inclusion in the ultimate restoration project."

This inconsistency for request/approval and follow-up on bond funds continues to remain unexplained.

And,how does removal of the levees- the lower leg of the "Class 1 bike path" fit with the public's money expended below?:
*"In 2000, the Conservancy helped fund a regional plan for creation of a "Park to Playa" river parkway from the Baldwin Hills to Marina Del Rey. The plan envisioned creation of a parkway along Ballona Creek to link expanded parks at the Baldwin Hills to the beaches and the Coastal Trail. In 2001, the Conservancy helped fund the Ballona Creek and Trail Focused Special Study which identified potential improvements to the creek and trail. Consistent with that study, the Conservancy has also provided funding for the construction of a pedestrian bridge in Culver City which increased access to the Ballona Creek Trail. That project has been completed. This project will help to implement the vision of the "Park to Playa" and the Focused Study, developing a multi-benefit, gateway park that will increase access to the trail and enhance the experience of trail users. **File No. 07-058-01; Project Manager Mary Small***

Conservancy funds for this project are expected to derive from the Conservancy's FY2002/03 appropriation from Proposition 40")

3. Staff Reccommendation pg. 9 of 9 re: Consistency With Local Coastal Policies fails to provide accurate Local Coastal Plan (LCP)background information.

The Coastal Commission certified the first LUP in 1984, the La Ballona MDR Land Use

Plan.

The Land Use Plan was then changed to reflect two distinctly different Land Use Plans, the La Ballona
Plan and the new and different MDR LUP.

It is questionable as to if the California Coastal Commission certified another Land Use Plan for the Playa Vista Project.

Consistency with the California Coastal Act must be consistent with Chapter 3 of that Act.

The Project will not restore, but will instead convert the land from one historic natural function to an entirely new function that is unnatural.
Lack of saltwater connection is demonstrated in historic maps from the U.S. Geological Survey. (A USGS map was submitted at the public hearing on Jan 19,2012. The CC remains nonresponsive)

Grassroots Coalition respectfully requests a written response to this Additional Complaint and maintains its request for response to the 3/29/12 REQUEST TO RESCIND APPLICATION FOR STAFF RECOMMENDATION APPROVAL ON 1/19/12, to award $6,490,000 Ballona Wetlands Restoration Engineering and Technical Studies. (File 04-088)

The PRA response CD cited herein, is on file with the Coastal Conservancy. Copies of the CD are available upon request and/or are being forwarded.

GC also reserves its right to amend this Complaint and Request with additional information.

Attached is the 3/28/12 Request to Rescind from John Davis to Ca.Coastal Conservancy regarding File No. 04-088

Respectfully,
Patricia McPherson, Grassroots Coalition-President

Jones, Tanya

-----Original Message-----
From: maryknight [mailto:kathy.knight@verizon.net]
Sent: Tuesday, November 13, 2012 3:46 PM
To: David Lawhead; Swenson, Daniel P SPL
Subject: Ballona Community Meeting Thursday November 29, 2012

Dear Mr. Lawhead and Mr. Swenson:

I want to invite you both to our next Ballona Restoration Community Meeting. The Sierra Club Airport Marina Group is sponsoring these meetings so that the community has a chance to speak and listen to each other's concerns about restoration of the 600 acres that they fought so hard for many years to preserve.

We would very much like to have both of you attend, so that you can hear our concerns and we can ask you questions.

As I have mentioned to you, we wanted more than the open house held on Fiji way in Marina Del Rey. We requested that the Army Corps and Dept of Fish and Game hold a public hearing where the public can hear what other people have to say, but so far it hasn't happened. So we are trying to do it ourselves.

The next Ballona Community Meeting is scheduled for:

Thursday, November 29th
6-7:30 pm
Burton Chace Park Community Room
(at the far west end of Mindanao Way in Marina Del Rey)

Please let me know if you can make this meeting. We really hope you can!
Kathy Knight,
(310) 450-5961 cell (310) 613-1175
kathy.knight@verizon.net

Mr. Swenson asked for a report on the last meeting, so I am providing it to you:

ISSUES RAISED AT BALLONA COMMUNITY MEETING ON OCT. 4th 2012:

This area is a Sacred Site of the Tongva Native Americans, who are the indigenous people of the Los Angeles area. They have been living here for 10,000 years. We need to start acknowledging and respecting their culture more.

This project seems more like a flood control project to protect Playa Vista, which was built in a flood plain, from damage from floods. It would make 20 ft. high levees that would block the view of the public of the wetlands when they drive on Lincoln Blvd. and Culver Blvd.

Playa Vista is dewatering their gas mitigation system and pumping the water to Hyperion. The aquifer under the wetlands is being depleted rather than replenished. This dewatering of the aquifer should be studied and documented. This water is needed for the wetlands to provide habitat for wildlife including migrating birds.

We need more community meetings with Fish and Game and the Army Corps attending so we can communicate and ask questions of them, prior to expenditure of any more public funds.

The animals and plants need to be studied carefully over a period of time. The government should reach out more to the local citizens who have studied this ecosystem for a long time (some of them for over 25 years) and can document a long term history of the area. They worked hard to save it, when other government agencies such as the Coastal Conservancy, had given up on saving it. These local citizens kept working to save it because of all the important wildlife and plants that they were documenting.

A small amount of salt/fresh water could be allowed into Ballona, but without any of the major bulldozing that the Coastal Conservancy wants to do.

Any restoration should follow the 7 Guiding Principles supported by community environmental groups (See handout from meeting).

Under Section 303(d) of the U.S. Clean Water Act, an impaired waterway cannot further pollute another waterway. Therefore Ballona Creek east and west of Lincoln Blvd. cannot be allowed to flow into the wetlands and pollute them. Other than naturally occurring hydration, no freshwater shall be allowed into the wetlands that has not been treated to tertiary levels.

All of the adjacent bodies of water need to be included into the Ballona Wetlands Study Area (BWSA) including, but not limited to, the Marina Del Rey Harbor, Oxford Lagoon, Del Rey Lagoon, Venice Canals, and Santa Monica Bay. There are still quite a bit of wildlife and sea creatures in the Marina area.

Classification: UNCLASSIFIED
Caveats: NONE

Jones, Tanya

From: Cliff Moser [mailto:cliff.moser@gmail.com]
Sent: Saturday, November 17, 2012 7:01 PM
To: McCormick, Donna
Subject: Re: Ballona Wetlands comment

Hi Donna, I'd like to be involved with the planning on this as much as I can. I'm an architect living in Culver City and ride the Ballona Creek bike path daily.

I don't know what I can do to help, but I've sketched some ideas and attached them to this email.

On Tue, Oct 23, 2012 at 3:21 PM, Cliff Moser <cliff.moser@gmail.com> wrote:
Hi, I'd like to comment on the wetlands scope.
I currently bike the creek bikepath and would like to see an extension and addition as part of the restoration.

Add a a path that parallels the 91 freeway to the development that runs near culver blvd and then intersect with the existing path to venice beach.

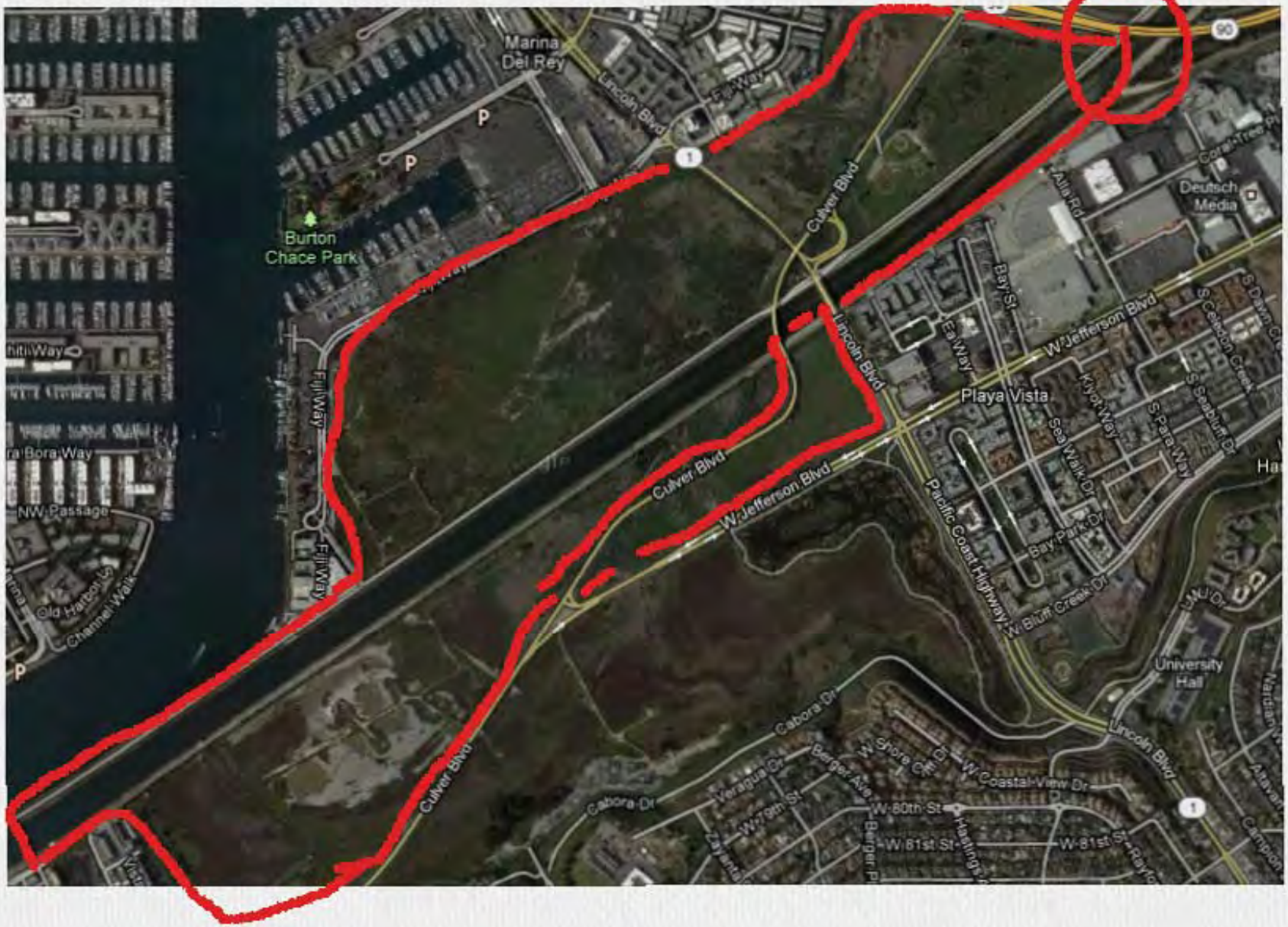
also add a bridge at the old centinela creek railroad creek pylons to connect to the south side of the creek which would then create a circle around the entire wetland (fresh and salt).

a connection to the bluff paths below Loyola Marymount through playa vista, with connections down to playa del rey,

this would create a network of usable bike paths that would support rediscovery of the wetlands once recreated.

thanks
Cliff Moser
Culver City
310.947.8509

NEW BRIDGE



Marina Del Rey
Lincoln Blvd
Fiji Way
Burton Chace Park
Culver Blvd
Playa Vista
W Jefferson Blvd
Pacific Coast Highway
Bay St
Ea Way
Alla Rd
Deutsch Media
Coral Tree Pl
Kiyot Way
Sea Walk Dr
S Para Way
S Seabluff Dr
S Celedon Creek
Bay Park Dr
W Bluff Creek Dr
University Hall
Cabora Dr
Veragua Dr
Berger Ave
W 79th St
W 80th St
W 81st St
W Coastal View Dr
Hastings
NW Passage
Old Harbor Ln
Channel Walk



A-2251



A-2252



A-2253



A-2254

Jones, Tanya

From: David Lawhead [mailto:DLawhead@dfg.ca.gov]
Sent: Thursday, October 25, 2012 9:12 AM
To: ds_nahc@pacbell.net
Cc: McCormick, Donna; Diana Hurlbert
Subject: NAHC Comment Letter on Ballona Wetlands NOP

Dave,

Donna McCormick from ICF forwarded me an October 23rd e-mail from you indicating concern that you had not reviewed and responded to the Ballona Wetlands Restoration Project NOP, since the comment period closed on Tuesday. I did receive a comment letter from you, dated August 2, 2012, which discussed your areas of issue and concern. I have attached the letter. If you have additional comments, please forward to me or Donna as soon as possible. Thanks for your input into the project.

Dave

David Lawhead
Staff Environmental Scientist
CA Dept. of Fish and game
South Coast Region
33883 Ruffin Road
San Diego, CA 92123
(858) 627-3997

NATIVE AMERICAN HERITAGE COMMISSION
915 CAPITOL MALL, ROOM 364
SACRAMENTO, CA 95814
(916) 653-6251
Fax (916) 657-5390
Web Site www.nahc.ca.gov
ds_nahc@pacbell.net

August 2, 2012

Mr. David Lawhead, Project Planner
California Department of Fish & Game
3883 Ruffin Road
San Diego, CA 92123

Re: SCH#2012071090 CEQA Notice of Preparation (NOP); draft Environmental Impact Report (DEIR) for the **Ballona Wetlands Restoration Project;** The Ballona Wetlands Ecological Reserve is located in the western portion of the City of Los Angeles (partially within unincorporated Los Angeles County), south of The City of Marina Del Rey and north of Playa Del Rey; approximately 1.5 miles west of Interstate 405 and approximately 0.25 miles east of Santa Monica Bay; Los Angeles County, California.

Dear Mr. Lawhead:

The Native American Heritage Commission (NAHC), the State of California 'Trustee Agency' for the protection and preservation of Native American cultural resources pursuant to California Public Resources Code §21070 and affirmed by the Third Appellate Court in the case of EPIC v. Johnson (1985: 170 Cal App. 3rd 604).

This letter includes state and federal statutes relating to Native American historic properties or resources of religious and cultural significance to American Indian tribes and interested Native American individuals as 'consulting parties' under both state and federal law. State law also addresses the freedom of Native American Religious Expression in Public Resources Code §5097.9. This project is also subject to California Government Code Section 65352.3 *et seq.*

The California Environmental Quality Act (CEQA – CA Public Resources Code 21000-21177, amendments effective 3/18/2010) requires that any project that causes a substantial adverse change in the significance of an historical resource, that includes archaeological resources, is a 'significant effect' requiring the preparation of an Environmental Impact Report (EIR) per the CEQA Guidelines defines a significant impact on the environment as 'a substantial, or potentially substantial, adverse change in any of physical conditions within an area affected by the proposed project, including ...objects of historic or aesthetic significance." In order to comply with this provision, the lead agency is required to assess whether the project will have an adverse impact on these resources within the 'area of potential effect (APE), and if so, to mitigate that effect. The NAHC did conduct a Sacred Lands File search of the project site, therefore 'area of potential effect' or APE, and Native American cultural resources were identified within the APE.

The NAHC "Sacred Sites,' as defined by the Native American Heritage Commission and the California Legislature in California Public Resources Code §§5097.94(a) and 5097.96. Items in

the NAHC Sacred Lands Inventory are confidential and exempt from the Public Records Act pursuant to California Government Code §6254 (r).

Early consultation with Native American tribes in your area is the best way to avoid unanticipated discoveries of cultural resources or burial sites once a project is underway. Culturally affiliated tribes and individuals may have knowledge of the religious and cultural significance of the historic properties in the project area (e.g. APE). We strongly urge that you make contact with the list of Native American Contacts on the attached list of Native American contacts, to see if your proposed project might impact Native American cultural resources and to obtain their recommendations concerning the proposed project. Pursuant to CA Public Resources Code § 5097.95, the NAHC requests cooperation from other public agencies in order that the Native American consulting parties be provided pertinent project information. Consultation with Native American communities is also a matter of environmental justice as defined by California Government Code §65040.12(e). Pursuant to CA Public Resources Code §5097.95, the NAHC requests that pertinent project information be provided consulting tribal parties, including archaeological studies. The NAHC recommends *avoidance* as defined by CEQA Guidelines §15370(a) to pursuing a project that would damage or destroy Native American cultural resources and Section 2183.2 that requires documentation, data recovery of cultural resources.

Furthermore, the NAHC if the proposed project is under the jurisdiction of the statutes and regulations of the National Environmental Policy Act (e.g. NEPA; 42 U.S.C. 4321-43351). Consultation with tribes and interested Native American consulting parties, on the NAHC list, should be conducted in compliance with the requirements of federal NEPA and Section 106 and 4(f) of federal NHPA (16 U.S.C. 470 *et seq*), 36 CFR Part 800.3 (f) (2) & .5, the President's Council on Environmental Quality (CSQ, 42 U.S.C 4371 *et seq.* and NAGPRA (25 U.S.C. 3001-3013) as appropriate. The 1992 *Secretary of the Interiors Standards for the Treatment of Historic Properties* were revised so that they could be applied to all historic resource types included in the National Register of Historic Places and including cultural landscapes. Also, federal Executive Orders Nos. 11593 (preservation of cultural environment), 13175 (coordination & consultation) and 13007 (Sacred Sites) are helpful, supportive guides for Section 106 consultation. The aforementioned Secretary of the Interior's *Standards* include recommendations for all 'lead agencies' to consider the historic context of proposed projects and to "research" the cultural landscape that might include the 'area of potential effect.'

Confidentiality of "historic properties of religious and cultural significance" should also be considered as protected by California Government Code §6254(r) and may also be protected under Section 304 of he NHPA or at the Secretary of the Interior discretion if not eligible for listing on the National Register of Historic Places. The Secretary may also be advised by the federal Indian Religious Freedom Act (cf. 42 U.S.C., 1996) in issuing a decision on whether or not to disclose items of religious and/or cultural significance identified in or near the APEs and possibility threatened by proposed project activity.

Furthermore, Public Resources Code Section 5097.98, California Government Code §27491 and Health & Safety Code Section 7050.5 provide for provisions for inadvertent discovery of human remains mandate the processes to be followed in the event of a discovery of human remains in a project location other than a 'dedicated cemetery'.

To be effective, consultation on specific projects must be the result of an ongoing relationship between Native American tribes and lead agencies, project proponents and their contractors, in the opinion of the NAHC. Regarding tribal consultation, a relationship built

around regular meetings and informal involvement with local tribes will lead to more qualitative consultation tribal input on specific projects.

Finally, when Native American cultural sites and/or Native American burial sites are prevalent within the project site, the NAHC recommends 'avoidance' of the site as referenced by CEQA Guidelines Section 15370(a).

If you have any questions about this response to your request, please do not hesitate to contact me at (916) 653-6251.

Sincerely,

Dave Singleton
Program Analyst

Cc: State Clearinghouse

Attachment: Native American Contact List

Native American Contact
Los Angeles County
August 2, 2012

LA City/County Native American Indian Comm
Ron Andrade, Director
3175 West 6th St, Rm. 403
Los Angeles , CA 90020
randrade@css.lacounty.gov
(213) 351-5324
(213) 386-3995 FAX

Gabrielino Tongva Nation
Sam Dunlap, Chairperson
P.O. Box 86908 Gabrielino Tongva
Los Angeles , CA 90086
samdunlap@earthlink.net

(909) 262-9351 - cell

Ti'At Society/Inter-Tribal Council of Pimu
Cindi M. Alvitre, Chairwoman-Manisar
3094 Mace Avenue, Apt. B Gabrielino
Costa Mesa, , CA 92626
calvitre@yahoo.com
(714) 504-2468 Cell

Gabrielino Tongva Indians of California Tribal Council
Robert F. Dorame, Tribal Chair/Cultural Resources
P.O. Box 490 Gabrielino Tongva
Bellflower , CA 90707
gtongva@verizon.net
562-761-6417 - voice
562-761-6417- fax

Tongva Ancestral Territorial Tribal Nation
John Tommy Rosas, Tribal Admin.
Private Address Gabrielino Tongva
,
tattnlaw@gmail.com
310-570-6567

Gabrielino-Tongva Tribe
Bernie Acuna
1875 Century Pk East #1500 Gabrielino
Los Angeles , CA 90067
(619) 294-6660-work
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(310) 587-0170 - FAX
bacuna1@gabrieinotribe.org

Gabrieleno/Tongva San Gabriel Band of Mission
Anthony Morales, Chairperson
PO Box 693 Gabrielino Tongva
San Gabriel , CA 91778
GTTribalcouncil@aol.com
(626) 286-1632
(626) 286-1758 - Home
(626) 286-1262 -FAX

Gabrielino-Tongva Tribe
Linda Candelaria, Chairwoman
1875 Century Pk East #1500 Gabrielino
Los Angeles , CA 90067
lcandelaria1@gabrielinoTribe.org
626-676-1184- cell
(310) 587-0170 - FAX

This list is current only as of the date of this document.

Distribution of this list does not relieve any person of the statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resources Code and Section 5097.98 of the Public Resources Code.

This list is applicable for contacting local Native Americans with regard to cultural resources for the proposed SCH#2012071090; CEQA Notice of Preparation (NOP); draft Environmental Impact Report (DEIR) for the Ballona Wetlands Restoration Project; located near the City of Marina Del Rey and Santa Monica Bay and part of the Ballona Creek watershed; los Angeles County, California .

Native American Contact
Los Angeles County
August 2, 2012

Santa Ynez Tribal Elders Council
Freddie Romero, Cultural Preservation Conslnt
P.O. Box 365 Chumash
Santa Ynez , CA 93460
freddyromero1959@yahoo.
805-688-7997, Ext 37

Gabrieleno Band of Mission Indians
Andrew Salas, Chairperson
P.O. Box 393 Gabrielino
Covina , CA 91723
(626) 926-4131
gabrielenoindians@yahoo.
com

This list is current only as of the date of this document.

Distribution of this list does not relieve any person of the statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resources Code and Section 5097.98 of the Public Resources Code.

This list is applicable for contacting local Native Americans with regard to cultural resources for the proposed SCH#2012071090; CEQA Notice of Preparation (NOP); draft Environmental Impact Report (DEIR) for the Ballona Wetlands Restoration Project; located near the City of Marina Del Rey and Santa Monica Bay and part of the Ballona Creek watershed; los Angeles County, California .

APPENDIX B
Project Description

B1. Preliminary Design Report
B2. Stormwater Management Plan
B3. Conceptual Habitat Restoration and Adaptive Management Plan
B4. Construction Equipment and Sequencing
B5. Preliminary Operation and Maintenance Plan
B6. Mitigation Monitoring and Reporting Program
B7. Ballona Wetlands Inundation Memo
B8. Ballona Wetland Feasibility Report
B9. Restoration Projects Cost Comparison
B10. Conceptual Cost Analysis to Raise Culver and Jefferson Boulevards

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APPENDIX B1
Preliminary Design Report

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Draft

BALLONA WETLANDS RESTORATION PROJECT

Preliminary Design Report

Prepared for
California State Coastal Conservancy

July 15, 2016

ESA PWA



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Draft

BALLONA WETLANDS RESTORATION PROJECT

Preliminary Design Report

Prepared for
California State Coastal Conservancy

July 15, 2016

ESA PWA

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1. INTRODUCTION

This Preliminary Design Report (PDR) documents the main project elements of the first three alternatives developed for the Ballona Wetlands Restoration Project (the Project) (Alternative 4 is the no-project alternative). The Project entails several key design considerations and this PDR addresses these considerations in order to focus engineering efforts toward completion of the project design.

This report is organized as follows:

- Section 1 – Introduction: Summary introduction to the project purpose, location, and project areas, followed by a brief summary of the three project alternatives to be discussed in detail in this report.
- Section 2 - Existing Conditions, Constraints, and Design Criteria: Discussion of existing site conditions and constraints that inform design criteria.
- Sections 3 to 5 - Preliminary Design by Alternative: Details of each project alternative. Alternative 1 is presented first, followed by Alternatives 2 and 3. Many of the design details described in Alternative 1 apply to Alternatives 2 and 3, so the descriptions of Alternatives 2 and 3 focus on differences from Alternative 1.
- Section 6 – Construction Methods and Phasing: Discussion of constructions methods applicable to all alternatives.
- Section 7 – Operations and Maintenance: Discussion of operations and maintenance approaches applicable to all alternatives.

1.1 PROJECT PURPOSE

The Ballona Wetlands Restoration Project (Ballona Project) entails restoration, expansion and enhancement of wetlands adjacent to lower Ballona Creek, and associated site modifications necessary to avoid adverse effects to surrounding property and interests. The Project objectives are described in the EIR/S Chapter 1, which build on the goals and objectives in the Conceptual Restoration Plan (PWA 2008). The main objectives of the Project for the purpose of this Preliminary Design Report are to:

1. Restore ecological functions and services at the Ballona Wetlands, in part by maximizing tidal influence where practically feasible to achieve predominantly estuarine conditions.
2. Maintain flood risk management levels by ensuring there is no reduction to the conveyance capacity of 46,000 cubic feet second (cfs) and by reducing flood risk to the surrounding communities and infrastructure for the 100-year flood event.
3. Provide public access for compatible onsite passive recreation and educational activities.

The primary objective of the project is the restoration, enhancement and creation of estuarine and associated habitats that support a natural range of habitat structures. The restoration plans include a variety of wetland and upland habitats that incorporate transitional links between the uplands and the wetlands to sustain multiple levels of biodiversity and to support a diverse range of native flora and fauna. The incorporation of wide transition and buffer areas adjacent to large, contiguous areas of diverse intertidal wetland habitat are intended to allow for adaptation to sea level rise while minimizing the need

for active management. To support the project objectives, preliminary grading plans include setting back the flood control levees from the Ballona Creek channel to provide wetlands habitat adjacent to the creek channel and wide transitional buffer areas between tidal wetlands and an engineered flood control levee.

1.2 PROJECT LOCATION AND RESTORATION AREAS

The Project is primarily within the Ballona Wetlands Ecological Reserve which is located in the western portion of the City of Los Angeles and partially within unincorporated Los Angeles County, south of Marina Del Rey and north of Playa Del Rey (Figure 1.1). The site is approximately 1.5 miles west of Interstate 405 and approximately 0.25 mile east of Santa Monica Bay. The 577-acre site is bisected by and includes a channelized reach of Ballona Creek, and it is traversed by Culver Boulevard, Jefferson Boulevard, and Lincoln Boulevard

The site is divided into several areas as shown on Figure 1.2:

- Area A: North of Ballona Creek, west of Lincoln Boulevard, and south of Fiji Way;
- Area B: South of Ballona Creek, subdivided into:
  - North Area B – south of Ballona Creek, north of Culver Blvd, and northeast of existing Southern California Gas Company (SoCalGas) gas well infrastructure
  - West Area B - south Ballona Creek, north of Culver Blvd, west of existing SoCalGas gas well infrastructure
  - South Area B – south of Culver Blvd and west of the SoCalGas access road
  - Southeast Area B – south of West Jefferson Blvd, east of the SoCalGas access road, and west of the existing Freshwater Marsh
  - East Area B – south of Culver Blvd, west of Lincoln Blvd, north of W. Jefferson Blvd
- Area C: North of Ballona Creek, east of Lincoln Boulevard, subdivided into:
  - North Area C, north of Culver Blvd
  - South Area C, south of Culver Blvd

1.3 PROJECT ALTERNATIVES

Three project alternatives were developed as part of the planning and preliminary design of the project. A summary of each of these alternatives is provided below.

1.3.1 Alternative 1 - Full Restoration

Alternative 1 would restore connectivity of Ballona Creek to a broad wetland floodplain across the Ballona Reserve by removing the existing levees and creating a sinuous channel with two meander bends as shown in Figure 1.3. Sub-tidal and intertidal channels would extend from Ballona Creek into adjacent vegetated tidal wetlands, providing habitat diversity and tidal circulation. In Area A, soil would be removed to restore tidal wetlands near the creek with gently sloping transitional and upland habitats between the wetlands, and a new levee would be constructed at the perimeter of Area A along Fiji Way and Lincoln Boulevard. Shallow depressions in the transitional and upland areas would be created to form small salt pans and seasonal wetlands. Tidal wetlands would also be restored in Area B between Ballona

Creek and upland habitats along the new Culver Boulevard and West Area B Levees. Soil removed from Area A would be placed to construct the new levees and create restored uplands in North Area C and South Area C.

In South Area B, existing wetlands would be enhanced by removing invasive plant species, restoring native vegetation, excavating new channels and salt pans, and managing wetland hydrology via new water control structures connected to Ballona Creek through the new Culver Boulevard levee. Brackish marsh would be created near the existing Freshwater Marsh and also may form along the upstream edge of Ballona Creek.

In North Area C, the Fiji Ditch would be realigned and restored with riparian habitat along the new channel. The existing Fiji Ditch in Area A would be retained and enhanced through replacement of invasive plant species with native plantings. The existing habitats in East Area B would be enhanced through invasive plant species removal and revegetation. Revegetation activities would include removing invasive plant species and seeding/planting native plant species in these areas.

Flood protection would be maintained and enhanced through construction of new engineered earthen levees along the perimeter of Area A adjacent to Fiji Way and Lincoln Boulevard, and in Area B along Culver Boulevard and immediately east of the dune habitat in West Area B. The new levees would be set back from the existing Ballona Creek channel in order to connect the proposed realigned creek with its restored wetland floodplain, allowing a variety of coastal wetland habitats and adjacent transitional and upland habitats to form within the floodplain. The levees would be broad and gently sloped away from roadways and buildings, protecting development from the inundation of the restored Ballona Creek wetland floodplain while providing for transitional wetland habitats to develop as sea level rises.

New trails and bike paths constructed along the levees would encourage safe use by visitors, and gateway entrances would be added to the Ballona Reserve with educational and art installations. A three-story parking structure would be constructed along Fiji Way for use by the public, Department of Beaches and Harbors, and California Department of Fish and Wildlife (CDFW) staff. The new structure would reduce the existing parking area footprint in that location by approximately 0.68 acre and would add 39 new parking spaces (for a total of 302 parking spaces). Upgrades to the existing West Culver Parking Lot would improve drainage and install sidewalks.

The existing SoCalGas wells would be decommissioned (i.e., capped and abandoned in place in accordance with applicable law) within the Ballona Reserve and related pipelines would be abandoned or modified to accommodate the proposed restoration activities.

Alternative 1 would occur in two phases:

- **Phase 1:** Restoration of Area A and North Area B and realignment of the Ballona Creek channel, enhancement of the existing managed wetlands in South/Southeast Area B, construction of new perimeter flood protection levees and an Interim Levee protecting West Area B. Phase 1 would only decommission the gas wells within the footprint of the Phase 1 restoration. Other wells, including wells in Area A and West Area B, would be maintained until they are decommissioned in Phase 2.

- **Phase 2:** Full tidal restoration of West Area B and construction of the new West Area B perimeter flood protection levee. Remaining gas wells would be decommissioned and the well removal areas restored during Phase 2.

In Phase 1, restoration would not occur in West Area B and the valuable habitats in this area would be protected with an Interim Levee as shown in Figure 1.4. The existing Ballona Creek levee and water control structures that currently allow for muted tidal action in West Area B would remain in place, unchanged during Phase 1. During Phase 1, the Area A and Culver Boulevard levees would be constructed. Phase 1 would also include construction of an Interim Levee connecting the new Culver Boulevard levee to the existing Ballona Creek levee to protect the habitat in West Area B. The Culver Boulevard Levee and the western portion of East Area B would be used to stockpile fill from Area A for use in Phase 2 construction of the West Area B Levee and salt pan berm. Phase 2 restoration actions would be delayed until the successful creation of habitat in Area A and North Area B has been demonstrated through monitoring, allowing for restoration and enhancement of West Area B. In Phase 2, the stockpiled material would be moved from the Culver Boulevard Levee and East Area B to West Area B, and the Interim Levee separating North Area B from West Area B would be lowered and breached to provide full tidal restoration while protecting the existing salt pan in West Area B.

1.3.2 Alternative 2 - Partial Restoration

Alternative 2 (shown in Figure 1.5) is similar to Phase 1 of Alternative 1. Alternative 2 restores functioning tidal habitat creation while limiting interim impacts to sensitive species habitats. Alternative 2 would maintain West Area B in its present, managed tidal regimen. While implementation of Alternative 2 would restore less full tidal wetland in the Ballona Reserve as compared to Alternative 1, it would avoid any impacts to the salt pan and the State-listed endangered Belding's savannah sparrow habitat.

In Alternative 2, existing armored levees on the Ballona Creek channel adjacent to the Ballona Reserve would be removed and Ballona Creek would be realigned to flow in a natural meandering pattern as described in Alternative 1. However, the southern levee of the Ballona Creek channel adjacent to West Area B would remain intact, and the existing water control structures would remain. As a result, this alternative restores a mix of fully tidal wetlands and managed wetlands in the Ballona Reserve and retains existing habitats in West Area B. Alternative 2 would include the first restoration phase described in Alternative 1, but not the second and final restoration phase. Alternative 2 would not include the stockpiled fill along the Culver Boulevard levee and East Area B as in the first phase of Alternative 1.

New earthen levees would be built around the northern perimeter of Area A and along the north side of Culver Boulevard in North Area B. The Interim Levee identified in Alternative 1 would become the permanent location for the West Area B Levee in Alternative 2. The levees would be broad and gently sloped away from roadways and buildings, protecting development from potential flooding of Ballona Creek, and providing upland and transitional habitat zones. The new levees would be set back from Ballona Creek in order to connect the creek with its floodplain, allowing wetland habitat to form within the floodplain.

As with Alternative 1, Alternative 2 would provide new trails and bicycle paths that would encourage safe use by visitors, as well as, gateway entrances with educational and art installations. However, Alternative 2 would differ from Alternative 1 in that the trail would go along the West Area B Levee (as in Phase 1 of Alternative 1) instead of going around the perimeter of West Area B.

In Alternative 2, Area C North would be filled to a higher elevation than in Alternative 1. Area C South would also be raised to accommodate fill excavated from Area A. The baseball fields in Area C would be replaced (depending upon external funding) at a higher elevation following the placement of fill in that location. Fill would also be placed in all of East Area B in Alternative 2, as opposed to Alternative 1, where fill would just be stockpiled in the western portion of East Area B.

In addition, the existing SoCalGas wells would be decommissioned within the Ballona Reserve and pipelines would be abandoned or modified, as needed, to accommodate the proposed restoration activities.

1.3.3 Alternative 3 - Levee Culverts & Oxbow

Alternative 3 is intended to reduce temporary and permanent impacts to Federal and state jurisdictional wetlands, and eliminate any impacts to the salt pan in West Area B, the existing marsh in South and Southeast Area B and the State-listed endangered Belding's savannah sparrow habitat. However, Alternative 3 would result in restoring less tidal wetland and other habitats in the Ballona Reserve than proposed under Alternatives 1 or 2.

Alternative 3 would have a substantially smaller project footprint than Alternatives 1 and 2. Restoration under Alternative 3 would be focused in Area A and Area C only as shown in Figure 1.6. Area B would not be actively restored and habitats would remain in their current condition (e.g., muted tidal in West and South/Southeast Area B, nontidal in the remainder of Area B).

In Alternative 3, the existing armored levees on the Ballona Creek channel adjacent to the Ballona Reserve would remain intact. No levee breaching would occur. Instead, two new culvert water control structures would be installed within the northern Ballona Creek levee to support tidal restoration in Area A similar to Alternative 1, with an oxbow channel. The proposed channel alignment would mimic natural channel forms and support desired native habitats, vegetation, and wildlife species. The southern Ballona Creek channel levee would remain unchanged from its current condition. Alternative 3 would include restoration of Area A and a new perimeter flood risk management levee.

A new earthen levee would be built around the northern perimeter of Area A protecting development from potential flooding of Ballona Creek as described in Alternative 1. Adjacent to the levee, broad and gently sloped grading would provide upland and transitional habitat zones between the levee and the restored wetlands within the restored Ballona Reserve. Between the new perimeter levee and the existing Ballona Creek channel levee a variety of coastal wetland habitats would be restored within the created marshplain similar to those proposed in Alternative 1. In Area A, similar to Alternative 1, soil would be removed to restore tidal wetlands with gently sloping transitional and upland habitats between the

wetlands and a new levee constructed along Fiji Way. Slight depressions in the transitional and upland areas would be created to form new salt pans and seasonal wetlands. Soil removed from Area A would be exported off-site. The existing Fiji Ditch in Area A would be retained and enhanced. North and South Area C would be enhanced without grading. Nonnative vegetation would be removed along the banks of Fiji Ditch, targeting invasive species removal, and the banks would be revegetated and stabilized with native plants.

As in Alternative 1, Alternative 3 would provide new trails and bicycle paths in Area A, which would encourage safe use by visitors, as well as gateway entrances with educational and art installations. There would be no new trails in Area B or in Area C. A new parking structure along Fiji Way for use by DBH, CDFW staff, and the public would reduce the existing parking area footprint within this portion of the Ballona Reserve by approximately 0.8 acre. Alternative 3 would include improvements to the existing West Culver Parking Lot in West Area B to make access safer and more appealing to visitors.

1.4 ANNOTATED BIBLIOGRAPHY OF DOCUMENTS RELEVANT TO THE PROJECT DESIGN

1.4.1 Ballona Wetlands Restoration Project Preliminary Hydrology and Hydraulics Report, Draft (May, 8, 2013)

ESA PWA, 2013. Ballona Wetlands Restoration Project Preliminary Hydrology and Hydraulics Report, Draft. May 8, 2013. (Appendix F7 of the EIR/S)

This report summarizes the results of preliminary hydrologic, hydraulic, hydrodynamic, sediment transport, and geomorphic analyses that were used to inform the development of the preliminary restoration design for Alternative 1. The purpose of the report is to evaluate the preliminary design relative to current flood management and sediment transport conditions, and to inform design development to accommodate geomorphic processes and future sea level rise (SLR). The report includes analyses applicable to the preliminary design of Ballona Creek, Area A, North Area B, and West Area B (including Culver Boulevard). Analysis pertaining to South and Southeast Area B is documented in a separate memo (see Section 1.4.4 below).

The hydrology section of the report documents the design flow used for the project, basis for the n-year hydrographs and peak flows, the tidal datums, coastal flooding conditions, tsunami risk, and the estimates of SLR. Representative starting water levels at the downstream end of Ballona Creek were determined through review of prior studies to identify appropriate design flows for use in the hydraulic analysis and assessment of tidal conditions in Santa Monica Bay.

Estimates of SLR were used in the hydraulic analysis to evaluate potential future flooding conditions. In 2010, the Ocean Protection Council released a draft resolution which revised previous global sea-level rise projections. The resolution advises California state agencies to consider 10-17 inches of SLR by 2050 and 31-69 inches by 2100 (measured from a 2000 baseline) (OPC, 2010). The 2100 estimates reflect the range in greenhouse gas emission scenarios, with low emissions resulting in 31-

50 inches of sea-level rise and high emissions resulting in 43-69 inches. To date, emissions have been tracking on the high scenario. Assuming continuation of the high emissions trajectory, the higher range of SLR projections would apply. The high estimate is similar to the Army Corp of Engineers' Modified NRC-III curve which predicts 59 inches by 2100 (from a 1992 baseline) (USACE, 2011). Therefore, 59 inches by 2100 was selected as the SLR scenario for this analysis.

In addition to incorporating SLR, model runs were also conducted incorporating an assumption for bed aggradation under a long period of rising sea levels. For these runs, it was assumed that the amount of bed aggradation would match SLR at the mouth of Ballona Creek (i.e. 59 inches of aggradation) and the aggradation would project linearly back to meet the existing channel bed elevation at approximately Lincoln Boulevard. This condition was selected as a conservative assumption pending refinements in modeling and design as it is not clear if sediment supply is sufficient to realize this amount of aggradation by 2100.

The primary hydraulic and sediment transport analyses were conducted using a one-dimensional (1D), steady-state HEC RAS model. Because of the spatial complexity of the proposed project, a two-dimensional (2D) hydrodynamic model was also developed to simulate both flood flows and tidal conditions on the site. Results from the 2D model were used to inform the set-up of the 1D model to appropriately simulate 2D processes and flow expansion and contraction and to verify 1D model results. The results of the hydraulic and hydrodynamic modeling were used to verify and refine levee elevations based on freeboard criteria and develop the preliminary armoring plan for Ballona Creek.

1.4.2 Ballona Wetlands Restoration Project Preliminary Hydrology and Hydraulics Report ADDENDUM.

ESA, 2015. Ballona Wetlands Restoration Project Preliminary Hydrology and Hydraulics Report ADDENDUM. *Memorandum prepared for the Ballona Wetlands Restoration Project Management Team, September 28, 2015, updated November 5, 2015.* (Appendix F8 of the EIR/S)

This memorandum was prepared as an addendum to the Draft Preliminary Hydrology and Hydraulics Report dated May 8, 2013 and includes Alternative 1 (Phases 1 and 2), Alternative 2, and Alternative 3. It describes additional hydraulic analyses performed to evaluate the alternatives and the sediment deposition scenarios for Ballona Creek channel to inform potential channel maintenance limits. This addendum includes analyses applicable to the preliminary design of Ballona Creek, Area A, North Area B, and West Area B (including Culver Boulevard). Analysis pertaining to South and Southeast Area B is documented in a separate memo (see Section 1.4.4 below).

The table below provides a summary of the model scenarios applied to each of the alternatives, as well as the existing condition.

Table 1-1. Hydraulic model run catalog

Scenario	Flow Rate (Q)	Downstream Boundary	Bed Aggradation

Design Flood	46,000 cfs	7.63 ft NAVD	-
Sea Level Rise (SLR)	46,000 cfs	7.63 ft NAVD + SLR	-
SLR + Aggradation	46,000 cfs	7.63 ft NAVD + SLR	SLR
Flood Frequency	Q2, 5, 10, 25, 50, 100, 200, 500	MHHW	-
Sedimentation Scenario	46,000 cfs	7.63 ft NAVD	Tidal Geometry, 2 feet, 4 feet deposition

The results of Design Flood, SLR, SLR+Aggradation, and Flood Frequency scenarios showed that freeboard was greater than 3 feet for all alternatives. This analysis was done using a project levee elevation of 20.5 ft NAVD for Alternatives 1 and 2 and existing levee elevations for the existing condition and Alternative 3. Levee elevations were further refined in the preliminary design based on these results.

The results of sedimentation scenarios showed that all of the alternatives maintain some level of positive freeboard in Area A and West Area B with 2 feet and 4 feet of bed aggradation scenarios. Under the equilibrium tidal channel hydraulic geometry scenario (tidal geometry in Table 1-1), modeled water levels exceed the elevation of the existing West Area B levee and the jetty between Ballona Creek and Marina del Rey harbor during the design flood event. Additionally, Alternative 2 shows overtopping in Area A with the tidal hydraulic geometry condition. The results indicate that channel maintenance to remove sedimentation from the channel could potentially be required if deposition reaches the level represented by equilibrium tidal geometry. The equilibrium tidal geometry scenario assumes tidal sediment transport processes will dominate long term sedimentation in the channel and that sufficient sediment is available for the channel to aggrade to equilibrium hydraulic geometry dimensions. This is considered a conservative assumption because the channel is sediment supply limited and therefore not expected to aggrade to equilibrium hydraulic geometry dimensions.

1.4.3 Ballona Wetlands Restoration Project Preliminary Hydrology and Hydraulics Report, Addendum 1 Sediment Transport Analysis.

ESA PWA, 2014. Ballona Wetlands Restoration Project Preliminary Hydrology and Hydraulics Report, Addendum 1 Sediment Transport Analysis. *Memorandum prepared for California State Coastal Conservancy December 6, 2013, revised February 18, 2014 and April 21, 2014.* (Appendix F10 of the EIR/S)

This memorandum was prepared as an addendum to the Preliminary Hydrology and Hydraulics Report (ESA PWA 2013) and documents the results of analyses conducted to determine the sensitivity of the sediment transport modeling to the following sediment transport parameters: 1) bed material grain size distribution (GSD), 2) tidal boundary condition, and 3) incoming sediment load, including GSD and total load (taring curve). The results of the sensitivity analyses will be used to improve model agreement with the historic scour and deposition as reflected in the channel profile, to

inform the Risk and Uncertainty (R&U) analysis required for Submittal B of the 408 permit, and to inform the next phase of project design development, including design refinement for scour protection features and characterization of long-term erosion and deposition patterns and equilibrium conditions for the restored wetlands. This addendum includes analyses applicable to the preliminary design of Ballona Creek, Area A, North Area B, and West Area B (including Culver Boulevard). Analysis pertaining to South and Southeast Area B is documented in a separate memo (see Section 1.4.4 below).

The key findings of the analysis are summarized as follows:

- Sediment supply to the study area is low relative to the sediment transport capacity and the site can be characterized as generally sediment supply-limited. Sediment transport model results support this conclusion, with all sensitivity runs generally showing more potential for scour than for sediment deposition under existing conditions.
- Since the channel was constructed, the profile has been relatively stable, although some scour is observed immediately downstream of the terminus of the concrete channel lining.
- Baseline conditions model results over-predicted scour relative to the observed channel profile at the concrete to earthen channel bottom transition as well as in the vicinity of the existing bridges. This result suggests that either the GSD of bed sediments is higher than what was sampled, or that other factors such as channel armoring and/or buried coarse sediments have historically mitigated scour potential during flood events.
- Model results indicate that over a reasonable range of combinations, the water surface profile is not sensitive to bed material GSD, sediment load GSD, or total sediment load parameters. Of the four parameters analyzed, the water surface is only sensitive to the tidal boundary condition. This result will be explored further as part of the R&U analysis.
- Initial project conditions model results show that at the channel bottom transition from concrete to earthen the change in scour relative to existing conditions is within 0.1 ft for a 100-year event suggesting minimal changes in the historically scoured reach.
- Project conditions model results demonstrate local increases in shear and erosion may be caused by channel expansion and contraction at the upstream and downstream ends of the project reach. This result will be used to inform the next phase of project design development.

1.4.4 Draft Area B Managed Wetlands Preliminary Design.

ESA, 2015. Draft Area B Managed Wetlands Preliminary Design. Memorandum prepared for the Ballona Wetlands Restoration Project Management Team, August 3, 2015, updated November 6, 2015. (Appendix F9 of the EIR/S)

This memorandum was prepared as an addendum to the September 2015 Preliminary Design Report (ESA) and the May 2013 Draft Hydraulics and Hydrology Report (ESA PWA) and provides the detailed hydrology basis of design for the South and Southeast Area B managed wetlands enhancements, including design criteria for channels, berms, and water control structures as well as hydraulic modeling of existing and project conditions for typical operations and flood scenarios. This

memo describes the preliminary design for Alternative 1 only, but is applicable to Alternative 2 as well.

Hydraulic modeling was conducted to evaluate water levels under existing and project conditions and to design the berm elevations and hydraulic structure dimensions. The goal of the design is to maintain or increase the level of flood protection along Culver Boulevard, Jefferson Boulevard, and the Gas Company property, while increasing tidal elevations within South and Southeast Area B to achieve the design objective of improving habitat. The model extent includes Ballona Creek, West Area B, South Area B, and Southeast Area B, with West, South, and Southeast Area B modeled as storage areas. The table below provides a summary of the model scenarios applied to Alternative 1, as well as the existing condition.

Table 1-2. Hydraulic model run catalog for South and Southeast Area B

Scenario	Flow Rate (Q)	Downstream Boundary	SLR
Typical Tides	-	Two week typical tides	-
Design Event	46,000 cfs	Spring high tide	-
SLR	-	Two week typical tides	9-inches, 19-inches, 32-inches, 59-inches
Design Event with SLR	46,000 cfs	End of neap tides	59-inches

An unsteady tidal signal was used for the downstream boundary of the model. For the typical tides scenarios, a two week tide time series from December 2011 was used, in order to include a spring and neap cycle. For the storm runs, a one-day tide time series from February 2007 was used to represent a spring high tide cycle. The peak tidal water level of 6.22 ft NAVD was timed to occur just before the peak flow in Ballona Creek, when water levels in South and Southeast Area B would be at their highest due to the leaking self-regulating tide gates. The downstream water level used to design the flood control channel (7.6 ft NAVD), was not modeled, but may be in future efforts for the 408 Submittal B. Bed aggradation within Ballona Creek was also not included in the model. Model results show that the Alternative 1 would maintain or increase the level of flood protection under the Design Event with SLR, increase the tide range in South and Southeast Area B (enhancing pickleweed-dominant salt marsh, without increasing the tide range in West Area B), improve resiliency to sea level rise, and allow for management flexibility and adaptive management, thus achieving all of the design objectives.

2. EXISTING CONDITIONS, CONSTRAINTS, AND DESIGN CRITERIA

The purpose of this section is to document the existing conditions and constraints that informed the Project design criteria and overall development of the alternative designs.

2.1 EXISTING TOPOGRAPHY AND DATUMS

The project civil surveying consultant, PSOMAS, prepared current topographic base maps for the project using aerial photogrammetry, ground surveys, and bathymetric surveys. The topographic base map for the project site is presented in Figure 2.1.

Ballona Creek has channel bed invert elevations ranging from EL -2 to -8 ft NAVD and is bordered on both sides by flood protection levees with elevations sloping from around EL 20 ft NAVD at Culver Blvd down to about EL 15 ft NAVD at the western project boundary. The existing elevations in Area A, which range from about EL 10 to 23 ft NAVD, are 5 to 18 ft above present-day wetland elevations due to the placement of dredged material during the construction of Marina del Rey harbor, the Ballona Creek channel, and other facilities. Existing elevations in North Area B range from about EL 6 to 9 ft NAVD. The higher areas are filled above current marsh habitat elevations. West Area B ranges from EL 3.5 ft to 6.5 ft NAVD. Elevations in South and Southeast Area B range from EL 4.5 ft to 6.0 ft NAVD. South and Southeast Area B are bordered by the higher elevations of both the Freshwater Marsh berm and the Westchester Bluffs. Existing elevations in East Area B range from about 6 to 12 feet NAVD and are currently from 5 to 15 feet below adjacent street level. North and South Area C ranges from about 12 to 28 feet NAVD.

Appendix A provides more detailed existing topographic maps and information on PSOMAS's survey protocols and results and a real estate analysis of existing property boundaries and easements that is presented separately (Appendix A).

2.1.1 Tidal Datums

Coastal water levels and tidal datums for the Project are listed in Table 2-2 below. These elevations will be used to design both the habitat restoration and engineering elements of the Project.

2.1.2 Habitat Elevations

Table 2-2 lists habitat elevations used for the design of restoration elements of the project. Existing managed tidal conditions apply to West Area B, South Area B, and Southeast Area B. Habitat elevation ranges were calculated based on inundation levels and frequency (ESA 2015). Figure 2.2 shows existing habitats at the Ballona Project site.

Table 2-1 Coastal Water Levels and Datums

	MLLW (ft)	NAVD (ft)	NGVD (ft)
100-year tide (FEMA)	9.1	8.9	6.5
Max. observed (11/30/1982 7:54)	8.5	8.3	5.9
HAT (12/2/1990 16:12)	7.3	7.1	4.6
MHHW	5.4	5.2	2.8
MHW	4.7	4.5	2.1
MTL	2.8	2.6	0.2
MSL	2.8	2.6	0.2
NGVD	2.6	2.4	0.0
MLW	0.9	0.7	-1.7
NAVD	0.2	0.0	-2.4
MLLW	0.0	-0.2	-2.6
LAT (1/1/87 0:00)	-2.0	-2.2	-4.6
Min. observed (12/17/1933 15:42)	-2.8	-3.0	-5.5

Notes: Tidal datums from NOAA/NOS Santa Monica Tide Station 9410840, 1983-2001 Epoch
NAVD to NGVD conversion from NOAA/NGS
100-year tide from FEMA (2008) Flood Insurance Study for Los Angeles County (based on studies completed in 1984)
HAT = highest astronomical tide
MHHW = mean higher high water
MHW = mean high water
MTL = mean tide level
MSL = mean sea level
MLW = mean low water
MLLW = mean lower low water
LAT = lowest astronomical tide
NAVD = North American Vertical Datum of 1988
NGVD = National Geodetic Vertical Datum of 1929

Table 2-2 Habitat Elevations Ranges

Habitat Type	Elevation Ranges (ft NAVD)	
	Fully Tidal Conditions	West Area B - Managed Tidal Conditions
Upland	> 7.3	> 4.3
Transition	6.3 to 7.3	3.6 to 4.3
High Marsh	5.4 to 6.3	3.3 to 3.6
Mid Marsh	3.8 to 5.4	2.7 to 3.3
Low Marsh	2.7 to 3.8	2.1 to 2.7
Mud Flat	-0.2 to 2.7	-0.2 to 2.1
Subtidal	< -0.2	< -0.2

2.2 FLOOD PROTECTION CRITERIA

2.2.1 Ballona Creek

Alternatives 1 and 2 of the project entail realignment of flood control levees subject to approval by the US Army Corps of Engineers and Los Angeles County (ESA PWA, 2012b). The governing flood source is from high flows in Ballona Creek resulting from rainfall in the tributary watershed increasing flowrates toward the ocean. The project flood control objective is to provide an equivalent or increased level of flood protection relative to existing conditions.

The LA District Corps of Engineers' Operation and Maintenance Manual identifies the design capacity of Ballona Creek within the Project Area as 46,000 cubic feet per second (cfs) with a minimum of two feet of freeboard based on the original 1935 Corps channel design (USACE 1999). However, more contemporary flood management criteria may need to be applied as the result of permitting and other requirements, even if the new criteria represent an “upgrade” relative to the original design and/or the existing level of flood protection. Flood flows with and without project, including anticipated future sea levels, have been modeled in a separate Ballona Wetlands Restoration Project Preliminary Hydrology and Hydraulics Report (H&H Report) (ESA PWA, 2013, amended July 2015).

2.2.2 Localized Stormwater Runoff Sources

The elevations in Area B and some adjacent properties are below flood levels, and tributary properties rely on Area B for storm runoff storage (ESA PWA, 2012b). Area B currently receives limited tidal circulation and drains to Ballona Creek through existing tide gates. Tributary areas adjacent to Area B rely on the site to accept local rainfall runoff without backing up or overflowing onto developed areas. These drainage ways are:

- Freshwater Marsh (FWM) for Playa Vista (Southeast Area B): Depending on the maintained water surface elevation, the FWM is designed to overflow into Southeast Area B above a 1 year rainfall runoff event for the Playa Vista development. Therefore, the water level in Southeast Area B must not exceed the overflow weir at the FWM, and the high water level in Southeast Area B must be low enough to accommodate overflow from the FWM.
- Playa del Rey (West Area B): The area of Playa del Rey at the southwest corner of Area B experiences localized flooding under some circumstances. This is a symptom of poor drainage for this area in a sump condition. The project concept includes an area for a stormwater detention basin on the inboard (Playa del Rey) side of the new levee.
- Roadways (Area B): The Culver and Jefferson roadways in Area B are low in elevation and close to groundwater. There is a groundwater infiltration gallery at the intersection of these two roads. The lowest area of the roadway is along Culver, west of the junction with Jefferson. Earth berms may be required to reduce the risk of high water flooding, along with the installation of conveyance and storage channels, culverts and tide gates.
- Gas Company facilities (primarily Area B, also west Area A): There are industrial facilities in South Area B that are constructed on fill but are low enough to be flooded under some higher

tidal waters. Gas wells in the southwestern corner of Area A are above tidal elevations and drain towards lower areas within Area A.

2.2.3 Coastal Sources

The coastal flood sources (high tides, storm surge, surface waves and tsunami) do not govern levee design since these water levels are lower than the fluvial design water levels (i.e., lower than the flood levels associates with rainfall-runoff storm events and resulting Ballona Creek flows).

Sea level is expected to rise at an accelerated rate. Relative sea level rise is the addition of vertical land motion with sea level change. The restoration and flood management approach would consider the effects of future sea-level rise (per the California Governor's Executive Order S-13-08 and the State Coastal Conservancy's Climate Change Policy adopted June 4, 2009) (ESA PWA, 2012b). The restoration is being designed to accommodate future accelerated sea level rise scenarios. This may involve either constructing new levees to higher elevations or constructing levees that can easily accommodate future elevation increases based on actual sea level rise.

A report addressing sea level rise for the west coast of the continental US was released in 2012 and was used to update the State's interim guidance (NAS 2012; OPC 2013; CCC, 2015). The new sea level rise estimates are similar to the interim guidance, except for a slightly lower "maximum" rise by the year 2100. United States Army Corps of Engineers recently re-issued federal agency guidance that is currently consistent with that of the State of California (USACE, 2011). This guidance document requires consideration of several sea level rise scenarios from a range of sea level rise acceleration. These sea level rise scenarios are similar to the State guidance documents, and we anticipate selection of scenarios that satisfy both State and Federal requirements. In the meantime, we use the more conservative USACE (2011) estimate and assume that sea level rise will amount to approximately 59 inches by 2100.

2.3 SOILS AND GEOTECHNICAL INVESTIGATIONS

The majority of construction involves earthwork, primarily excavation to realign Ballona Creek and to create tidal marsh and transitional habitat in Area A, and fill to build new engineered flood control levees set back from the Ballona Creek channel. The project has performed geotechnical investigations and sampling and analysis for chemicals, metals and general agronomic properties to inform design decisions to optimize the use of soils at the project site.

2.3.1 Geotechnical Engineering Properties

The project Geotechnical Engineer, Group Delta, performed a geotechnical investigation and analyses to develop design and construction recommendations for the new flood control levees and to examine the stability of the existing levees. The geotechnical investigation included a field program with soil borings to collect samples for laboratory analysis and Cone Penetration Testing (CPT) in areas of the new proposed levees, near existing levees, and within areas of planned excavation to inform design level geotechnical analysis. The design level geotechnical report was finalized in July 2013, and is attached as Appendix B.

The primary engineering soil parameters that will affect earthwork include:

- Grain size, fraction of organics
- Bulk density, moisture content and volume change with compaction
- Shear strength, plasticity
- Permeability
- Seismic response, liquefaction potential
- Consolidation, settlement
- Slope stability, bearing capacity
- Active / passive pressure
- Other (existing levee stability, offsets for excavation adjacent to existing levees, etc.)

Materials for construction of the new perimeter levees will be primarily excavated from Area A. Soils within Area A are layered reflecting the placement of hydraulic dredge material from the construction of the adjacent Marina del Rey in the upper 10 to 15 feet underlain by native silts with interbedded sands. The hydraulic fill primarily consists of inorganic, low plasticity silts and silty sands with some lean clay and elastic silts. In general, this material is anticipated to be acceptable for levee construction.

The Geotechnical Investigation Report provided analysis of the static stability and dynamic loading of the proposed and existing levees. In addition, estimates of the anticipated settlement of the new levees and compaction factors for use of onsite material were provided. Seepage rates for work near Ballona Creek were also provided.

The analyses indicated that the proposed levees provided adequate Factors of Safety for both static and dynamic conditions for the loading conditions analyzed. The design approach based on the geotechnical recommendations for specific levee sections are described below in Section 3.10.

2.3.2 Soil Chemistry

As part of the site reconnaissance and assessment, tests have been conducted to determine the location and concentrations in area of potential soil contamination. These tests will guide specific construction techniques, sediment removal, and sediment management. While the site has a history of uses that may have introduced contaminates, the existing data indicate that the earth to be excavated can be reused on site, with select materials used in surface and habitat areas.

The use history includes agriculture, oil drilling and natural gas storage. In addition, the soil chemistry below previously filled areas may be affected by low oxygen levels or limited organics. The soil chemistry is important from the perspectives of appropriate sequestration in fill areas, biological uptake in restored areas, and vegetation establishment. A detailed field exploration effort has been undertaken to investigate the chemical properties of the soils to be excavated and those to be at or just below the anticipated finished grades. The data collection plans and observations during sampling are provided in Appendix C. Based on the initial limited testing, soil chemistry is anticipated to be consistent with storage in fill areas, and that offhaul of material due to contamination will not be required. Also, the use of soil

amendments or backfill with selected soils will be evaluated to enhance vegetation establishment and wetland ecology.

2.3.2.1 Chemical Properties

The project site has a history of oil and gas exploration. Investigations performed by Weston Solutions in 2008 and in 2012 indicate that all chemicals of concern, including PAHs, PCBs, pesticides, VOCs, TPHg, TPHd, BETX, and metals were below the California Human Health Screening Levels (CHHSL) or Preliminary Remediation Goal (PRG) soil criteria for potential residential land use, with the following exceptions (Weston 2009, Appendix C). Arsenic and iron were measured at ambient concentrations greater than residential CHHSLs and PRGs, but at concentrations consistent with natural marine sediments. Additionally, one sample showed elevated concentrations of PAHs just above the CHHSLs for residential land use, but well below soil criteria for potential commercial or industrial land use.

Ecological Criteria

The criteria (ER-Ls and ER-Ms) developed by Long et al. (1995) are helpful in assessing the potential biological impact of elevated constituents of concern. Another measure of potential ecological impacts is the Beneficial Reuse criteria for wetland restoration, developed by the San Francisco Regional Water Quality Control Board (2000) and refined for use outside of San Francisco Bay by Germano & Associates (2004). The Beneficial Reuse criteria have different values for material that will be used as wetland surface (more conservative) and wetland foundation material (less conservative). The use of these screening criteria for sediments in the Ballona Wetlands is appropriate when used as a tiered approach, including bioassays to determine actual toxic effects to the benthic community.

The 2008 and 2012 sediment samples were compared to the ER-Ls, ER-Ms, and Beneficial Reuse values to determine potential ecological impacts. The results showed that several metals slightly exceeded the ER-L values, including arsenic, cadmium, copper, lead, mercury, nickel, silver, zinc, total DDT, and total chlordane (Appendix C). However, no metals exceeded the corresponding ER-M or wetland surface Beneficial Reuse values, except silver, indicating relatively low concentrations. While silver exceeded the wetland surface Beneficial Reuse value, it was below the wetland foundation value and within the range of concentrations historically found in the existing Area B wetland.

Soil Suitability Classifications

Based on the initial sample results detailed above, the project intends to perform more detailed sampling of soils that will be excavated at the site to assess the suitability of specific areas/depths of onsite soils for use as:

- Wetland Cover Material – materials that meet the regulatory requirements for wetland cover based on ER-M screening and bioassay results (pending regulatory review and approval). Wetland cover may be used anywhere on site, but will be prioritized for use in the upper three feet of the channel and wetland surface.
- Upland Cover Material – materials that meet the human health screening levels, but exceed wetland cover standards. Upland cover material would be used for any upland placement or below three feet of wetland cover material within the channels or wetland surface.

- Non-Hazardous Material – materials that are below the state and federal thresholds for hazardous waste (Title 22), but exceed the human health screening levels. Non-hazardous material may be placed in upland areas (levees and soil mounds) capped with a minimum of three feet of upland cover material.
- Hazardous Materials – materials that exceed the state and federal thresholds for hazardous waste (Title 22) will be disposed of offsite.

In the 2012 investigation, the results of the analytical analysis of samples taken at approximately the proposed depth of the new marsh surface indicate that copper and total DDT in the proposed wetland surface exceeded the ER-L values, but were below the wetland surface criteria. Silver exceeded the ER-L and wetland surface Beneficial Reuse criteria, but was within the range of concentrations found historically in Area B (Appendix C).

The results of the analytical analysis of samples taken at the proposed depth of the realigned channel indicate that concentration of metals, pesticides, PAHs, and PCB are all below the most stringent guidelines including the ER-L values and the wetland surface criteria.

While these preliminary findings indicate areas within the planned wetland habitat are generally within the Wetland cover standards and below the ER-M levels, the project anticipates encountering materials that do not meet the wetland cover standards. In these areas, materials that are not suitable for wetland cover will be over excavated and replaced with soil selected to be appropriate for a wetland. Provided material excavated is non-hazardous, all material would be reused on site according the Soil Suitability Classifications detailed above.

Based on this limited data, the project may anticipate over-excavation and replacement of approximately 50,000 and up to 100,000 cubic yards (CY) of material.

2.3.3 Wetlands and Uplands Suitability (Agronomy)

In conjunction with the chemical and geotechnical sampling, a limited number of sediment samples were also analyzed for general agronomic characteristics. The ability for plants to establish rapidly is associated with soil chemistry. Since the excavated finished grades are well below the existing ground surface in Area A, the chemistry may not be conducive to plant establishment.

Agronomy tests included analyses for soluble and exchangeable major nutrients, boron, USDA texture, organic matter, micronutrients, and neutralization/acid generation potential. These analyses are intended to identify general soil parameters that may impede the establishment of marsh and upland transition vegetation at the site or other factors that may impact the evolution of the site to support a healthy mosaic of vegetated habitat. These tests will inform decisions on the need to identify select materials from the project site for use as “top soil” or the potential need to augment the post-construction surface soils to address nutrient or organic matter deficiencies.

Based on these initial analyses, it has been determined that soil salinity may be an issue in the excavated soils, with surface soils containing lower levels of salts and subsurface soils containing salts at levels too high for even the most salt-tolerant plant species. In addition, levels of several essential plant nutrients may be too low to support desired levels of plant growth. Specifically, nitrogen, phosphorus, calcium, and zinc were found to be lower than preferred for the establishment of healthy native plant communities. Given the low levels of these plant nutrients in soils at the site, limited application of fertilizer (possibly green waste compost) may be needed.

Analyses of sodium absorption ratios show an imbalance between sodium and soluble calcium and magnesium in the sub-surface soils, which can negatively affect soil structure and water infiltration in soils used outside of a salt marsh setting (e.g., soils used for upland & transitional restoration). Incorporation of gypsum combined with extensive leaching may be necessary to reduce sodium levels and improve sodium absorption ratios. Soil texture was shown to range between sand and loam, with most samples being relatively sandy. The more coarsely textured soils (i.e., sandy soils) will have reduced water holding capacity and may not be suitable for establishing plant communities adapted to mesic conditions. The use of soil amendments to increase the water holding capacity of on-site soil may be necessary if sufficient amounts of finely textured soils cannot be sourced on-site.

The project is intended to be a balance earthwork project, and "top soils" will be sourced from onsite excavation to the extent possible. In order to develop a more complete understanding of agronomic properties of the soils that will be excavated, more extensive analysis of soil texture and chemistry will be required. Samples will be collected and analyzed from both the areas to be excavated and areas of existing salt-adapted and salt-sensitive vegetation—this will provide a detailed understanding of the range of physical and chemical soil conditions across the site, as well as the range of salinities tolerated by existing plant communities at the site. Analyses will be designed to identify the vertical and horizontal distribution of important physical and chemical soil properties; these data will be used to inform the salvage and re-use of excavated soils during the restoration.

Finer textured soils with high organic content will be incorporated into the top 1 to 2 feet of mudflat and tidal wetland habitat up to the mean high water line, above which more coarsely textured soils may be incorporated. Highly saline subsoils, as well as highly saline surface soils, will be used for the construction of salt pan habitat. To the extent feasible, existing lower saline soils located in the upper horizons in Area A will be used to create upland habitat. Existing surface soils will be excavated and reused at the surface of upland and transitional habitats. Where saline soils are used to create upland habitat, the project intends to cover the soils with a 3- to 4-foot cap of non-saline soil salvaged from the upper horizons in Area A. In the upland fill areas in Area C, surface soils may need to be amended with gypsum and/or extensively leached with freshwater. Although there is potential for salts to be wicked up through the soil profile over time, a thick cap of non-saline soil will allow plants to become established and to acclimate to slowly increasing salinity levels.

Based on these agronomic test results, the upper 2-3 feet of soils will be over-excavated for reuse as top soil. Within areas targeted for upland and transitional habitat, a 3-4 feet thick layer of coarser top soils will be placed in areas with higher salinity subsoils. In areas with lower salinity subsoils closer to Fiji

Ditch in Area, the top soil layer thickness may be reduced. Alternatively, the project may use gypsum amendments and leaching to address the agronomic issues with onsite soils.

Within marsh areas (generally at or below MHHW), the project design would consider a number of potential approaches:

- A 1-2 feet thick layer of finer grained top soils could be placed at the surface,
- Subsoils at design grades could be augmented with organic matter, and/or
- Use of recycled water to help lower salinities to levels conducive to salt marsh vegetation.

2.4 UTILITIES

The project civil engineering consultant, PSOMAS, prepared current utility base maps for the project using methods and protocols documented in Appendix A. Existing utilities in the area are shown in Figure 2.3.

2.4.1 Southern California Gas Company Infrastructure

The Southern California Gas Company (SoCalGas) owns and operates natural gas storage wells and associated pipelines within the Ecological Reserve property and holds easements over these areas. Some of the wells in the restoration project area are not actively being used in the storage operations and can be considered for abandonment without being relocated. Abandonment entails removing all near surface components, which would eliminate constraints on restoration. Other wells are monitoring wells that are necessary for storage operations and would need to be relocated. SoCalGas' long-term plan is to consolidate gas infrastructure within its facility along the southern bluff by abandoning gas wells in the wetlands and installing replacement wells via directional drilling from their facilities to the extent possible. The Project is working closely with SoCalGas to coordinate the restoration with gas infrastructure plans. The coordinated plans involve three general priorities for gas infrastructure decommissioning:

1. Priority 1 (required for restoration): Certain gas wells and pipelines must be abandoned and/or modified to facilitate the restoration, while other gas infrastructure can be avoided by the restoration by protecting the infrastructure in place.
2. Priority 2 (desired for restoration): Abandonment of other gas infrastructure is desirable for the restoration and to SoCalGas because it increases the extent of restoration and progresses SoCalGas' long-term plan; however, these modifications are not required for the restoration.
3. Priority 3 (desired by SoCalGas): The remaining gas infrastructure can be avoided by the restoration without compromising the extent or function of the restoration, but is desired by SoCalGas to accomplish their long-term plan.

SoCalGas conducts all work related to the facilities they own. Some gas infrastructure (e.g., some abandoned wells and pipelines) may not be owned by SoCalGas, in which case the Project may conduct any work needed to modify the infrastructure. SoCalGas' plans to decommission their onsite infrastructure are dependent on funding. Figure 2-3 shows the Gas Company facilities including wells and

pipelines. The EIR/S will analyze the potential impacts associated with the removal, abandonment and/or replacement of all gas infrastructure within the Ecological Reserve.

2.5 PUBLIC USES

Existing public uses will be accommodated and/or mitigation will be provided. Culver Boulevard, Jefferson Boulevard and Lincoln Boulevard (State Highway One) traverse the project site and will be maintained. Public access exists along the north Ballona Creek levee on a County maintained bike path. All other public access is only allowed by issuance of an access permit from the California Department of Fish & Wildlife.

A public access plan is being developed to maintain existing uses and provide additional access opportunities. Anticipated elements, such as a pedestrian bridge across Ballona Creek are included in this preliminary design. Also shown in the preliminary design is parking and access at the southwest corner of Area B, where existing parking is heavily used. Other public access elements include observation decks, boardwalks and trails and bike paths.

3. PRELIMINARY DESIGN – ALTERNATIVE 1 – FULL RESTORATION

This section presents the design details for Alternative 1 – Full Restoration. Alternatives 2 and 3 are discussed in Sections 4 and 5 respectively, and focus on differences from Alternative 1. Each alternative is comprised of restoration and improvements to a combination of areas (Ballona Creek, Area A, North Area B, West Area B, South and Southeast Area B, and North and South Area C). Each area is in turn defined by a combination of elements related to habitat restoration, engineering, and public access. This section describes the preliminary design for Alternative 1 by both areas and elements, with areas used to describe multiple features within a given area and elements used to describe features that are the same in all areas. This section starts with a brief summary of the different project elements, followed by detailed descriptions of the areas and elements, and ends with estimates of construction quantities and costs.

A general description of Alternative 1 is provided in Section 1.3.1. Alternative 1 would be implemented in phases, with restoration of Area A and North Area B and enhancement in South & Southeast Area B occurring in the Phase 1 and full restoration, including restoration of full tidal exchange to Area B West, occurring in Phase 2. Overviews are presented in Figures 1.3 for the completed Alternative (Phase 2) and Figure 1.4 for the interim restoration (Phase 1).

3.1 PROJECT ELEMENTS

There are three types of project elements that define each alternative; restoration elements, engineering elements, and public access elements.

3.1.1 Restoration Elements

- Ballona Creek Realignment
- Tidal Wetland Habitats – Low, Mid, High Marsh, Salt Pans, and Brackish Marsh
- Tidal Channels
- Riparian Habitat
- Transition Habitats including seasonal wetlands
- Upland Habitat

3.1.2 Engineering Elements

- Flood Control Levees
- Hydraulic Structures – culverts with control gates
- Natural Gas Infrastructure – abandonment/relocation

3.1.3 Public Access Elements

- Trails
- Bridges
- Parking

- Ball Fields

RESTORATION ELEMENTS

3.2 BALLONA CREEK REALIGNMENT

Under Alternative 1, a fully-connected Ballona Creek channel and wetland system would be restored across the site, beginning west of the Culver Bridge and extending through the site to the southwest (downstream) project boundary. The existing levees would be removed, and a more sinuous channel with two meander bends would be created through the site. The existing Ballona Creek channel would be filled between the meanders. The realigned Ballona Creek Channel is presented in Figure 3.1 and channel sections are presented in Figures 3.2 and 3.2. The proposed channel alignment is designed to replicate a more natural channel form and support the desired habitat, vegetation, and wildlife species. The channel alignment is also intended to avoid cultural resource areas identified by Tongva tribal representatives and cultural resource studies.

Once constructed, the earthen channel would not be confined to a rigid alignment. Some gradual channel migration and localized erosion and sedimentation are anticipated to occur as a result of natural geomorphic processes. The overall channel location would be guided by the sloping restored marshplain and adjacent upland habitats. The channel alignment would only be fixed where required to protect adjacent infrastructure. In these locations (such as along the new Culver Blvd Levee), the restoration proposes setback bank armoring (e.g. buried rock protection; see Section 3.2.3). In areas where buried rock is utilized to protect new levees, the rock will be sized appropriately to resist scour and arrest any significant channel meander to protect the new levees. The restored Ballona Creek banks and floodplain would experience periodic erosion and deposition, which are typical for natural river and estuary environments. The goal is to accommodate and support this level of channel and floodplain dynamics, while protecting developed areas outside the project boundaries.

3.2.1 Channel Sizing

The realigned channel is generally sized to match the existing channel dimensions, with a top width of approximately 250 feet at MHHW. Channel depths would be similar to existing depths, ranging from about 2 to 8 feet below MLLW (channel bed invert elevation of about EL -2 to -8 ft NAVD). The channel banks would be graded to slopes of approximately 5H:1V (horizontal:vertical) to provide intertidal sediment flats and low marsh habitat. On the inside of meander bends, the channel bank would have a flatter slope to create a channel bar or bench typical of natural river systems to add to habitat complexity. The bench would extend at a 20H:1V slope from EL 4.5 ft. to EL 0.5 ft. This bench would result in a low flow channel that is about 80 feet narrower (at EL 0.5 ft) than the existing channel.

The San Elijo Lagoon/Escondido Creek channel in Del Mar, CA was identified as a reference site for the channel design and cross-section. Additional reference data and channel cross-section refinements will be considered in subsequent design phases.

Potential equilibrium channel dimensions for typical fluvial and tidal flows were estimated using empirical hydraulic geometry relationships (see H&H Report Section 6). This assessment indicates that the existing and proposed channel dimensions are somewhat larger than the predicted equilibrium channel dimensions. However, the predicted equilibrium dimensions assume adequate sediment supply. Ballona Creek is a sediment-supply limited system, and channel dimensions may not fill in to equilibrium dimensions with a limited sediment supply. A smaller channel size closer to equilibrium dimensions may be considered in subsequent design refinement (see H&H Report Section 6).

3.2.2 Sinuosity

The realigned channel sinuosity (ratio of channel length to distance between channel endpoints) is approximately 1.2, which is comparable to the sinuosity of other natural Southern California creek and tidal wetland systems (i.e., natural existing and historic systems).

3.2.3 Armoring

The project anticipates that the meanders will be constructed by filling the existing channel with rock dikes to form the channel crossings and buttress fill placed between them. These dikes are shown on Figure 3.1, spanning the existing Ballona Creek channel. The dikes would be created with a rock gradation that includes a wide range of sizes to limit migration of sediment between the voids. Between the upstream and downstream rock dikes, the existing channel would be filled with earth to form the channel crossings.

Following construction, the rock dikes would be left in place to help armor the channel meander bends. Larger rock will be placed as an overlay on the rock dikes to armor against high velocity and turbulence induced scour. During final design, the project will determine the height and width of these rock dikes to provide adequate armor at the channel meanders. Earth fill may be placed to cover the rock dikes to provide a natural channel bank, allowing the rock fill to form a back stop against erosion to prevent the channel from reoccupying the existing straight alignment.

Armoring may also be incorporated around the bridge pilings that support the Lincoln and Culver Bridges. At the preliminary design level, this is shown as a broad armoring of the channel bed from upstream of the Lincoln Boulevard Bridge to downstream of the Culver Boulevard Bridge. During detailed design, the armor size, thickness and depth would be refined based on the results of hydraulic modeling and scour calculations. This armoring may also be optimized to protect each pile and/or buried to maintain the natural creek bed material.

3.2.4 Berms and Islands

Berms and islands are included adjacent to the realigned Ballona Creek channel at the top of bank of the channel. These features are intended to mimic the low berms that form adjacent to natural tidal channels as coarser sediment drops out of suspension where overbank flows leave the channel. These features are also intended to divide the main Ballona Creek corridor from adjacent marsh drainage basins to support

larger (higher order) tributary tidal channel networks within the marsh (see Sections 3.3 and 3.4). In addition, these features help guide more frequent flood flows to overbank areas away from the flood control levees and away from the existing straight Ballona Creek alignment.

Islands are larger features located on the inside of the first two meander bends. In the preliminary grading plans, the islands extend up to EL 8.0 ft NAVD and would support high marsh and transitional plants. These islands would provide refuge during high tides and moderate storm flows and provide an area for wildlife away from predators, humans, and pets.

Berms along Ballona Creek are lower features located along the channel extending up to EL 6.5 ft NAVD. The berms help to concentrate flows into the higher order tidal drainage channel networks that convey tidal exchange into the marsh basins adjacent to the larger Ballona Creek channel. The berms would support high marsh plants and provide high tide refuge for wildlife.

3.2.5 Levee Breaching and Lowering

The existing Ballona Creek levee would be lowered to match the restoration grades as shown on the grading plans. At locations where the new Ballona Creek alignment crosses the existing levee, the existing levee would be breached to the full width and depth of the planned Ballona Creek section taking into account the oblique angle of the crossing. The existing concrete and rock armoring would be removed. Concrete armor may be recycled for use on site to surface trails and access roads.

3.3 AREA A – TIDAL WETLAND, TRANSITION ZONE, AND UPLAND RESTORATION

Grading plans for restoration in Area A and North Area B are presented in Figures 3.4 and 3.5. Restoration activities in Area A include:

- Construction of a flood control levee around the perimeter of Area A (See Section 3.11)
- Excavation of meander bends in the Ballona Creek channel (discussed above)
- Creation of a broad flat marshplain with a tidal channel network
- Creation of a wide gradual transitional and upland slope between the restored marshplain and the flood control levee

The existing elevations in Area A which range from about EL 10 to 23 ft NAVD, are 5 to 18 ft above present-day marshplain elevations due to the placement of dredged material during the construction of Marina del Rey harbor, the modern Ballona Creek channel, and other facilities. The restoration proposes to excavate and grade Area A to restore marsh, transition zone, and upland habitats as shown in Figure 3.4 for Phase 1 and Figure 3.5 for Phase 2, and in the corresponding cross sections presented in Figures 3.6 and 3.7. The restoration would create a wide gently-sloping transition from the levee and upland habitats along the perimeter of Area A down to vegetated marsh habitat and mudflat habitat adjacent to the restored Ballona Creek channel.

The broad transitional slopes between wetland and upland habitats are intended to increase the resiliency of the restored wetlands to future sea-level rise. These gradual slopes would allow wetland habitats to

transgress up slope with rising sea levels through the conversion of upland transition habitats to wetland habitats. This process of "coastal rollover" has occurred over geologic time, and is expected to continue and accelerate with projected sea level rise. The H&H Report (Section 6) includes an assessment and figures showing estimated habitat projections for future sea-level rise scenarios.

3.3.1 Tidal Marsh

The Area A restored tidal marshplain will range in elevation from mid marsh (EL 4.5 ft NAVD) at the banks of the smallest first order channels up to high marsh (EL 6.3 ft NAVD) at the upland transition zone (see habitat elevations in Table 2-2). Marshplain slopes will range from about 50H:1V to 150H:1V. Preliminary grading plans include three main networks of tidal channels connecting to the Ballona Creek meander bends. This grading will form three marsh "drainage basins," two larger basins in east and west Area A and one smaller basin near the existing gas well infrastructure at the western limit of Area A. These marsh drainage basins will encourage the restoration of larger (higher order) tidal channel systems and associated habitat complexity. The eastern marsh channel basin is also intended to convey Ballona Creek overbank flows during storm events.

The marshplain will be graded to create a complex microtopography within the marsh. The intent is to create quiescent conditions to limit erosion and encourage vegetation establishment. Within the drainage basins, sub-basins will be created to guide tidal flows towards smaller first order tidal channels. Sub-basins will be bounded by higher elevation drainage divides (EL 5.5 ft NAVD) with lower elevations (EL 4.5 ft NAVD) adjacent to the smallest first order channels. Along larger channels, higher grades and low berms will be incorporated to limit over flows and force tidal exchange through the first order channels.

WRA's CHRAMP (Comprehensive Habitat Restoration and Adaptive Management Plan) describes the tidal marsh revegetation plan. For the purposes of this PDR, we assume the following tidal marsh revegetation approach:

- Introduction of cordgrass to establish low marsh vegetation primarily along smaller first order channels to control erosion.
- Reliance on natural recruitment of pickleweed and other salt marsh vegetation in mid marsh areas between El 4.5 ft and EL 5.4 ft NAVD.
- Planting of pickleweed and other salt marsh vegetation in high marsh areas between EL 5.4 to 6.3 ft NAVD since natural recruitment in this high marsh zone is expected to take many years.

Soil treatments and planting plans are discussed in more detail in Section 3.10.

3.3.2 Salt Pans

Small, shallow salt pans 0.5 to 1 foot deep will be created around the perimeter of Area A high marsh in areas away from excavated first order channels. Salt pans are intended to allow infrequent tidal inundation during the highest spring tides resulting in shallow ponding, evaporation, high soil salinity (e.g., salt crust formation), and decreased vegetation establishment. Salt pan depressions will be over-excavated by 1 to 2 feet and back-filled with compacted clay material with high residual salts to encourage ponding and to

promote unvegetated, high-saline conditions. Sill elevations will be between EL 6.0 and 6.5 ft NAVD to allow for tidal inundation during the approximately 2-4 highest spring tide cycles per year. Within the pans, micro-topography would be graded to provide varied elevations to support a range of ponded depths generally between 4 to 12 inches at full inundation.

With future sea-level rise, salt pans are expected to eventually become vegetated marsh as they are increasingly inundated. Restored seasonal wetlands (Section 3.3.4) are intended to provide future salt pan habitat with sea-level rise.

3.3.3 Transition Zone and Upland

Transition zone and upland habitats will be restored around the perimeter of Area A as shown on Figures 3.4 and 3.5 with design sections presented on Figures 3.6 and 3.7. This wetland-upland transition zone is intended to provide ecotone habitat in the near term and areas for marsh transgression with projected future sea-level rise over the longer term. Undulating transition and upland habitat areas will be graded, with shallower slopes of 80H:1V to 100H:1V and steeper slopes of up to 40H:1V forming coves. The flatter areas will slope down to areas for salt pans between tidal channels and the coves will slope down to smaller tidal channels. Higher upland mounds (shown in the preliminary design as idealized land forms at EL 20 ft NAVD in Figures 3.4 and 3.5) will provide irregular upland topography and the opportunities to restore dune habitat. During detailed design, these mounds will be contoured to provide a more natural topography and may be lowered to EL 15 ft NAVD to increase areas for salt pans at lower elevations.

Transition zone habitats will be between EL 6.3 to 7.3 ft NAVD and upland habitats will be above El 7.3 ft NAVD as described in Table 2-2. WRA's CHRAMP describes the transition zone and upland revegetation plan. For the purposes of this PDR, we assume these areas will be hydroseeded or drill seeded with a native upland mix and planted and irrigated/maintained as appropriate.

3.3.4 Seasonal Wetlands

Seasonal wetlands will be created by excavating 0.5 to 1 foot depressions in upland areas at the eastern and western ends of Area A as shown in Figures 3.4 and 3.5. The intent is to capture and pond runoff from upland areas.

During detailed design, seasonal wetlands will be sized based on a ratio of contributing upland area to ponded area taking into account soils and runoff potential. At the western end of Area A, proposed parking lots and garages would provide freshwater runoff that could be routed to wetland depressions to increase the acreage of seasonal wetlands. Seasonal wetland depressions will be over-excavated by 1 to 2 feet and back-filled with compacted, select material to encourage ponding. Seasonal wetland sill elevations will be between EL 7.0 and 8.0 ft NAVD. With future sea-level rise, seasonal wetlands are expected to eventually become tidally inundated and gradually convert to salt pan habitat.

3.3.5 Phasing

Most of the restoration of Area A will occur in Phase 1 (Figure 3.4). Removal of gas wells in the western portion Area A and lowering of the gas well area is anticipated to occur during Phase 2 of the project. In Phase 1, the gas wells would remain in place at existing grades as shown in Figure 3.4. In Phase 2 the wells will be abandoned and the area around the wells will be excavated to create restored wetland, transition zone, and upland habitat as shown on Figure 3.5. Preliminary design sections for the Phase 2 are presented in Figure 3.7. During detailed design the design elevation of the lowered gas well area will be revisited taking into account rate of sea level rise and potentially raised to account for higher tidal elevations when Phase 2 will be implemented.

Material excavated from the gas well area would be utilized to raise the perimeter levee and upland habitat around Area A during the completion of Phase 2.

3.4 NORTH AREA B– TIDAL WETLAND, TRANSITION ZONE, AND UPLAND RESTORATION

Restoration activities in North Area B are also presented on Figures 3.4 & 3.5 and include:

- Construction of a flood control levee along Culver Blvd (Section 3.11)
- Excavation of meander bend in the Ballona Creek channel (discussed above)
- Creation of a broad, flat marshplain with a tidal channel network
- Creation of a transitional and upland slope between the restored marshplain and the flood control levee

Restoration of North Area B will occur coincident to the restoration of Area A. Fill generated through the excavation of Area A during Phase 1 will be transported across Ballona Creek and placed in North Area B to create a new flood control levee along Culver Blvd. During Phase 1, additional fill will be stockpiled along the Culver Levee and in East Area B for construction of the West Area B Levee in Phase 2. The engineered flood control levees are discussed in Section 3.11.

Preliminary grading plans for the North Area B tidal wetland, transitional zone and upland under Alternative 1 Phase 1 & 2 are presented on Figures 3.4 and 3.5 and design sections are presented on Figures 3.6 and 3.7.

3.4.1 Tidal Wetland

Tidal marsh will be restored between the new Culver Levee and the realigned portion of Ballona Creek in North Area B, with a full tidal connection between the wetlands and Ballona Creek. Existing elevations in North Area B range from about EL 6 to 9 ft NAVD. The higher areas are filled above current marsh habitat elevations.

Similar to Area A, North Area B will be graded down to create a mid to high marshplain drainage basin between the realigned channel and the new levee, with elevations from 4.5 ft to 6.3 ft NAVD. The

marshplain would be graded to slope towards a tidal channel system that drains downstream to the outside bend of the Area B channel meander. The marshplain basin and channel system are also intended to convey Ballona Creek overbank flows during storm events.

3.4.2 Transition Zone and Upland

Transition zone and upland habitats will be created between the marshplain and the new levee as shown in Figure 3.5. Transitional slopes would vary between 20H:1V and 40H:1V and upland slopes would range from 10H:1V to 20H:1V. The transitional zone would also include a small upland peninsula to help guide Ballona Creek overflows away from the Culver Levee and towards Ballona Creek.

3.4.3 Phasing

Construction of North Area B would occur in two phases. During Phase 1, the marshplain, tidal channel network, and Ballona Creek meanders would be excavated and the Culver Levee would be constructed. Material for the West Area B Levee would be stockpiled along the new Culver Blvd levee and in East Area B during Phase 1 (see Section 3.11). In Phase 2, the stockpiled material would be removed from the Culver Levee, and the area would be graded to create transitional and upland slopes between the levee and the tidal marsh.

During Phase 1, an Interim Levee would also be constructed between North and West Area B, to maintain West Area B as muted tidal and salt pan habitat while the restoration in Area A and North Area B evolves into vegetated tidal marsh. In Phase 2, the Interim Levee would be lowered to create a habitat peninsula at EL 11 ft NAVD and the material would be used to construct a low flat berm at EL 8 ft NAVD to help maintain the existing salt pan in West Area B.

3.5 WEST AREA B – TIDAL WETLAND, TRANSITION ZONE, AND UPLAND RESTORATION

Under Alternative 1, restoration of West Area B would occur in two phases. In Phase 1, the existing managed marsh and salt pans in West Area B will be maintained and managed under the current muted tidal regime (Figure 3.8).

In Phase 2, restoration of West Area B will include:

- Construction of the West Area B Flood Control Levee (Section 3.10)
- Creation of transition and upland habitats along the West Area B Flood Control Levee (Figure 3.9)
- Construction of a low berm around the existing salt pans to maintain this habitat with increased tidal exchange
- Excavation to enhance the existing channel network
- Lowering and breaching the existing Ballona Creek levee to increase tidal exchange within West Area B

Implementation of Phase 2 will proceed within an adaptive management plan (see WRA's CHRAMP). A component of the adaptive management plan is to successfully restore habitats in other areas of the site prior to implementation of Phase 2 to minimize potential impacts of West Area B full tidal restoration.

3.5.1 Phase 1 – Muted Tidal Marsh

During Phase 1 of Alternative 1, West Area B will be maintained and managed as it is under the existing condition as shown in Figure 3.8. An Interim Levee will be constructed between West Area B and the restored North Area B (see Section 3.11.2.3) to protect West Area B from tidal inundation and flood levels in Ballona Creek.

Shallow stormwater detention wetlands would be created just north of Culver Boulevard to capture and treat stormwater runoff from the Culver Boulevard corridor. The stormwater wetlands would discharge to the West Area B wetlands.

3.5.2 Phase 2 – Tidal Marsh, Salt Pans, Transition Zone, and Upland Restoration

In Phase 2 of Alternative 1, the western portion of West Area B would be restored to full tidal conditions while protecting and maintaining existing salt pan habitat in the eastern portion of West Area B. Grading elements included in West Area B during Phase 2 are presented in Figure 3.9.

Restoration of tidal habitat in the western half of West Area B will be accomplished by removing the existing tide gate, breaching the existing Ballona Creek levee, and lowering the adjacent sections of Ballona Creek levee to MHHW (5.2 ft NAVD88). The Ballona Creek levee breach would be about 100 ft wide with an invert elevation of about -3.0 ft NAVD88. The existing channel network will be enhanced and a new subtidal and tidal channel will be constructed (see Section 3.7.4). The existing managed marsh in West Area B is at elevations that are expected to support mudflat, low marsh and mid marsh habitat after full tidal restoration. A large portion of the existing pickleweed vegetation in this area is at elevations that would support low and mid marsh under full tidal conditions and these areas may gradually convert to low marsh vegetation. During final design, low berms that extend up to mid marsh elevations to support pickleweed may be created adjacent to excavated tidal channels.

In the eastern half of West Area B, the existing salt pans would be preserved and expanded. To preserve the salt pans, a new berm would be constructed around the edge of the West Area B salt pan to limit tidal inundation to the area under the full tidal regime. The berm would be constructed with a gentle 20:1 slope up to about 7.5 feet NAVD, which would allow the existing salt pans to maintain the current hydrologic regime with up to 1 to 1.5 feet of sea level rise. The berm would incorporate a lower crest, which would function as a spillway to allow the highest spring tides to shallowly flood the existing salt ponds several times per year. The crest would be armored with buried rock or coir matting to protect from erosion. To accommodate rising sea levels, the crest would incorporate either a flashboard system or would be regraded to raise the elevation at which the highest tides overtop the spillway to flood the salt pans. Along the eastern edge of the salt pans the Interim Levee would be lowered to EL 8.5 ft NAVD to protect the salt pan from inundation for fluvial events up to about a 5-year return period. The existing salt pan

habitat would be expanded by removing the existing gas wells within the salt pan area and lowering the well pads and access roads to about EL 4 ft NAVD to match surrounding elevations.

The area where the Interim Levee abuts the Culver Blvd levee will be regraded to create an upland habitat peninsula to provide high tide refugia and upland habitat. This peninsula would guide and re-converge Ballona Creek storm flows into the existing channel alignment downstream. The peninsula would have a crest elevation of 11 ft NAVD and 20H:1V side slopes to the adjacent marshplain and salt pan.

WRA's CHRAMP includes a revegetation plan. For the purposes of this PDR, we assume that cordgrass will be introduced to West Area B to establish vegetated low marsh habitat. In the absence of cordgrass, West Area B is expected to convert to mudflat habitat over time.

3.6 SOUTH AND SOUTHEAST AREA B – MANAGED WETLAND RESTORATION AND ENHANCEMENT

Under Alternative 1, the existing muted tidal managed wetlands in South and Southeast Area B will be enhanced by restoring tidal channels and increasing tidal exchange. At the far eastern extent of Southeast Area B, berms would be used to enhance brackish marsh supported by freshwater discharge from the adjacent FWM.

Enhancement of South and Southeast Area B will occur primarily in Phase 1 as shown in Figure 3.10. Additional modifications and/or replacement of water control structures used to manage these areas will be needed after the restoration of West Area B in Phase 2 as shown in Figure 3.11. Details of the water control structures can be found in Section 3.12.

The existing areas of pickleweed and other mid marsh plants in South and Southeast Area B are at elevations that will allow them to persist as mid marsh habitat after increasing tidal exchange. In South and Southeast Area B, sinuous and branching tidal channel networks will be excavated through the marsh habitats to improve tidal exchange, provide additional foraging habitat and protection from predators, and to increase habitat diversity (see Section 3.7.3). These tidal channel systems would connect to the restored Ballona Creek channel via water control structures connected to North and West Area B to manage tidal exchange and stormwater discharge through the new flood control levees.

In South Area B, the tidal range would be managed to maintain the existing eucalyptus grove at the southern edge of the area for monarch roosting and blue heron habitat. High tides would be limited in elevation to prevent salinity- and hydrology-related impacts to the eucalyptus grove. Existing eucalyptus habitat and dune habitat would be enhanced through non-native plant removal.

In the eastern-most portion of Southeast Area B, freshwater outflows from the existing FWM would be increased via new/modified water control structures to provide more brackish marsh. A low berm and culvert structure would be constructed between the brackish marsh and the managed tidal wetland to impound freshwater outflows to manage brackish marsh conditions by controlling rates of freshwater outflow and exchange of tidal flows.

Along Culver and Jefferson Boulevards and the SoCalGas facility, berms would be constructed to protect the adjacent infrastructure from extreme tides and high water levels during storm events. The berms would have a crest of EL 9 ft NAVD, a top width of 8 ft, 5H:1V side slopes of the developed side, and 10-20H:1V side slopes on the marsh side. The berms would be offset at least 30-feet from the edge of the road/development. Bioswales would be graded along Culver and Jefferson Boulevards to convey, treat, and retain storm water runoff from the adjacent roadways.

In Phase 1, water levels in the South and Southeast Area B managed wetlands will be controlled by two new water control structures at the locations shown in Figures 3.10. The water control structure in the north will employ self-regulating tide gates to allow for tidal inundation up to an elevation acceptable for flood management and storm drainage, and close during larger storm events in Ballona Creek to limit high water levels in South and Southeast Area B (see Appendix D for more details). The water control structure in the west will have a weir box that will allow flood water levels to flow into West Area B from South Area B locations, but will otherwise maintain water levels in West Area B as is. In Phase 2, the weir box will be removed, the culverts will be extended through the West Area B Levee, and self-regulating tide gates will be added. This will allow for additional control of flood management and storm drainage. The managed wetlands, berms, and water control structures will be designed to protect Culver Blvd, W. Jefferson Blvd, the SoCaGas facilities, and areas draining to the FWM from flooding during storm events greater than approximately a 2-year return period event including the design storm event (LA County capital flood).

The FWM was designed to overflow into Southeast Area B and then drain to South and West Area B, under an average managed high tide level near mean higher high water (EL 5.2 ft NAVD, Psomas 1999). In this scenario, Psomas (1999) showed that Culver Blvd. and the SoCalGas Company would not be flooded in the design storm event. The existing levee between the FWM and East Area B is above the elevation of normal ocean high tides and would be maintained as is.

South and Southeast Area B flood scenarios and water levels are analyzed in Appendix D. Appendix E includes calculated rainfall-runoff hydrology for areas draining to Southeast and South Area B. Hydraulic analyses will be performed to design the South and Southeast Area B water control structures and assess water levels for flood conditions.

3.7 TIDAL CHANNELS

Networks of branching, sinuous tidal channels will be excavated in the restored wetlands. The tidal channel networks will extend from and drain to Ballona Creek. The tidal channels will convey tidal flows and sediment to the restored wetlands, providing tidal circulation (inundation and drainage) to support wetland vegetation and functions.

The tidal channel planform layout (e.g., channel length per marsh area and sinuosity) and sizing (cross-section dimensions) will be based on empirical tidal channel layout/sizing data from reference wetlands (tidal channel hydraulic geometry relationships; PWA 1995 and Williams and others 2002). Larger

(higher order) tidal channels branch (bifurcate) into smaller (lower order) channels. Based on wetland area, the largest channel systems are fifth order, meaning the channels branch into smaller channels five times (ending in the smallest or first order channels). The Preliminary Design assumes excavation of the full channel network, including first order channels, because complete tidal channel networks are not expected to form naturally after restoration. The intent is to restore larger (higher order) channel systems to create a greater range of channel habitats and habitat complexity. The larger channel systems are generally laid out to drain to the outside bends of the realigned Ballona Creek channel as in natural wetland systems.

Figure 3.12 shows the preliminary tidal channel layout by channel order for higher order channels. The smaller channels (second order and the smallest/first order channels) are not shown in Figure 3.12, except for smaller channels draining directly to Ballona Creek. Channel layout will be updated and marshplain micro-topography will be incorporated into detailed designs. Table 3-1 lists preliminary tidal channel dimensions by channel order.

Table 3-1 Tidal Channel Dimensions by Channel Order.

Channel order	Top width at MHHW (ft)	Bottom width (ft)	Side slope (H:V)	Invert elevation (ft NAVD)	Depth (ft below MHHW)	Depth (ft below MLLW)	Note
5	80	10	5	-1.8	7	1.6	Subtidal
4	35	5	3	0.2	5	-0.4	Subtidal/intertidal
3	20	4	2	1.2	4	-1.4	Intertidal
2	10	4	1	2.2	3	-2.4	Intertidal
1	7	3	1	3.2	2	-3.4	Intertidal

Note: Channels are ordered from smallest (first order) to largest. Two first order channels join to form a second order channel, two second order channels join to form a third order channel, etc.

Within existing marsh areas in West, South, Southeast, and East Area B, material excavated to construct tidal channels will be utilized to create low berms to protect adjacent infrastructure and placed adjacent to the excavated channels (sidecast) to form low berms adjacent to the channels. Channel berms would be up to two feet high, depending on the elevation of the adjacent wetland. This approach creates channel berms and higher marsh habitat that are found in natural marsh systems and provides an efficient method for handling excavated material while limiting impacts to existing marsh areas.

3.7.1 Area A

Two large fourth order channel systems and one smaller second order channel system will be restored in Area A (see Figures 3.4, 3.5, and 3.12, and Table 3-1). These channel systems will connect to the outside of the Ballona Creek Area A meander bends and will extend into the Area A marsh areas to the east and west. The east Area A channel system will also convey Ballona Creek overbank storm flows through the restored marsh floodplain and back into Ballona Creek. Channel berms along the realigned Ballona Creek will define the marsh drainage areas and outlets for the Area A tidal channel systems (see Section 3.2.4).

3.7.2 North Area B

A third order channel system will be excavated in the restored marsh area in North Area B (see Figures 3.4, 3.5, and 3.12, and Table 3-1). This channel system is intended to convey tidal flows, overbank storm flows and drainage from the existing Freshwater Marsh adjacent to Southeast Area B. The Ballona Creek berm at the upstream end of this channel system (along the outside of the first Ballona Creek meander bend) will be armored to reduce the potential for scour and channel avulsion (see Section 3.2.3).

Smaller first and second order channels will drain the western end of restored marsh in North Area B.

A fifth order channel will also be excavated in North Area B to connect the fifth order tidal channel system in South and Southeast Area B to Ballona Creek via a water control structure (see Section 3.12).

3.7.3 South and Southeast Area B

Alternative 1 includes excavation of a large fifth order channel system in South and Southeast Area B. This channel system would connect to Ballona Creek via two new water control structures (see Section 3.12) connecting to North Area B and West Area B. The intent of this channel system is to convey tidal flows and provide tidal inundation throughout the managed marsh within South and Southeast Area B. In Southeast Area B, larger channels will extend to the FWM outflow locations to convey freshwater discharges and encourage brackish marsh development. The FWM outflow structures to Southeast Area B are discussed in Section 3.12.2. The South and Southeast Area B channel systems will be connected via a water control structure in the Gas Company Road (e.g., a new structure; see Section 3.13).

The main South Area B tidal channel will cross the existing gas pipeline in this area (see Figure 2.3). A section of the gas pipeline may be replaced to run under the channel as described in Section 3.14.4. No other channels will be excavated across the pipeline to preserve access to the pipeline from the south and north. The pipeline in Southeast Area B will be relocated to the Gas Company Rd so that channels can be constructed in this area.

3.7.4 West Area B

Alternative 1 includes excavation of a large fifth order channel system within the full tidal wetland area between the new West Area B Levee and the salt pan berm. The fifth order channel will connect to the new water control structure to convey flows to South Area B.

3.8 EAST AREA B –UPLAND FILL PLACEMENT AND HABITAT RESTORATION

Soil excavated to restore wetlands in Area A would be stockpiled temporarily in the western portion of East Area B in Phase 1 for use in Phase 2 levee construction (Figures 3.4 & 3.5). The proposed fill would be placed on an upland area that was previously filled, and existing wetlands on the eastern portion of East Area B would not be disturbed in Alternative 1. The proposed elevations in Phase 1 would range

from about 18 feet NAVD to 20 feet NAVD. Corresponding fill heights would range from about 10 feet to 12 feet above existing grade, and up to about 10 feet above Culver Boulevard.

During Phase 2, fill stockpiled in East Area B would also be removed to build the West Area B Levee and the salt pan berm. The upland restoration areas would be graded to create upland habitat that would route rainfall to flow into the adjacent wetlands.

3.9 NORTH AND SOUTH AREA C – UPLAND FILL PLACEMENT AND HABITAT RESTORATION

In Alternative 1, upland habitats would be enhanced in North and South Area C, with an emphasis on coastal sage scrub and grassland habitat. Within North Area C, the existing Fiji Ditch would be relocated to create seasonal wetlands and a riparian corridor (Figure 3.13). All restoration would occur during Phase 1. The existing ball fields on South Area C would remain unchanged.

3.9.1 Upland Habitat

Soil excavated to restore wetlands in Area A would be placed in North and South Area C to create elevated areas of upland habitat. Existing elevations in Area C range from about EL 12 to 25 feet NAVD. Within Area C North, soil would be filled up to an elevation between EL 40 and 55 feet NAVD raising existing grades by 15 to 38 feet. Within Area C South, the eastern portion of the site east of the existing ball fields would be filled up to EL 26 to 38 ft NAVD, or up to about 16 feet above existing grades. Side slopes of the upland areas would vary from about 3H:1V to 20H:1V.

In Area C North, the uplands would be graded to drain to swales around the perimeter of the fill areas. The swales would route runoff to the Fiji Ditch riparian and seasonal wetland corridor. In the northwest corner of North Area C, a settling basin would be constructed within Fiji Ditch just before the culvert under Lincoln Boulevard to provide water quality treatment prior to discharge of stormwater from the parcel.

Drainage for South Area C would be collected in a network of graded surface bio-swales and channels and underground drainage conduits, and discharged into existing drainage facilities in Culver Boulevard and at the Culver Boulevard/Lincoln Boulevard intersection. In addition, runoff from the eastern portion of South Area C would be directed to existing seasonal wetlands adjacent to the Marina Freeway (SR 90) on-ramp, enhancing the native vegetation cover and biological function.

3.9.2 Fiji Ditch Realignment and Riparian Habitat

The existing Fiji Ditch in North Area C would be realigned and restored to support riparian habitat. The existing channel functions as a storm drain ditch running from Culver Boulevard to the Lincoln Boulevard storm drain system, with an overflow culvert under Lincoln Boulevard to the Fiji Ditch in Area A. The restored Fiji Ditch would include a riparian corridor with a low flow channel meandering between the higher elevation upland areas incorporating seasonal wetland depressions. The low flow channel

would be 10 to 15 feet wide with an invert sloping from EL 6 to 4 ft NAVD. The base of the riparian corridor would vary from 70 to 120 feet wide, with an average width of about 90 feet.

3.10 AGRONOMY & PLANTINGS

3.10.1 Upland and Transition Habitat Areas

The uplands and transition habitat areas above high tide will need relatively low salinity soils to support upland plantings. Uplands and transition habitat areas are proposed in Area A, Area B along the Culver Levee, and Area C North & South. The proposed design approach is to harvest the upper 3+ feet of soil (which should be relatively low salinity soil) for reuse in upland and transitional areas. The approach is to over-excavate into existing saline soils and place a layer of low salinity soil at the surface. Salvaging as much topsoil as possible (even weedy topsoil) would benefit upland restoration areas. Any harvested topsoil would then be spread over as many areas as needed to the greatest depth possible. A 3-foot cap would be ideal; however, there may not be an adequate volume of harvested topsoil to achieve this. After the topsoil is evenly spread over the restoration areas, it should be deep ripped (3 to 5 ft) so the bottom layers of topsoil are broken up and mixed with the higher saline soil. The idea is to create a small gradient as the topsoil transitions to the base soil type. The deep ripping may also occur after the first few layers of topsoil are placed and before the final layers are spread.

Some amendments (i.e. nitrogen) actually benefit weeds or weedy species more than they benefit native plants. In general, native species to southern Californian climates are well adapted to low soil nutrient conditions (this is fairly well documented). Adequate organic matter in the soil can be a limiting factor for native plant establishment. Organic amendments, such as oat straw or pine bark, has shown to be beneficial and may be readily available. These amendments result in an increase in microbial activity and actually reduce available nitrogen while increasing soil organic matter. Both organic amendments may be placed in thin layers on the surface after the site is prepared through a hydromulch application or hand spreading.

Leaching soils to remove excess salts would be an alternative to harvesting and replacing topsoil; however, using water to leach soils may not be desirable. Leaching with recycled water may be an option, but would require appropriate regulatory permits. To adequately leach soils of salts, the addition of several acre feet of water over the entire site may be necessary. If time is available, allowing natural rainfall patterns over a 2-3 year period may give the restoration the time needed to adequately leach soils. Another option that has been researched in far eastern countries is phytoremediation, or using halophytic plants to pull salts out from the soil and harvesting them before the salts are deposited on the surface prior to plant desiccation. Halophytic plants typically store salts pulled from the root zone into the leaves then deposit salts on the surface once the plants die. There are several weedy halophytes that would readily grow under the saline conditions onsite (Mesembryanthemum crystallinum, Suaeda australis, Chenopodium album, Salsola vermiculata, Sarcocornia quinqueflora, Portulaca oleracea, Atriplex spp., Allenrolfea occidentalis, Tetragonia tetragonioides, Salicornia europaea, Sesuvium portulacastrum, Crambe maritima, Glycyrrhiza glabra, Distichlis spicata, Sporobolus virginicus, Bruguiera gymnorrhiza, Aegiceras corniculatum, Sonneratia apetala, Avicennia marina, Rhizophora mucronata, Plantago media,

and Suaeda maritima). Granted, many of these species are problematic weeds, so if introduced to the site, a management plan would need to be in place to control/harvest the species, as needed, then eradicate the species once the soils have been stabilized.

For upland sites, there may be two planting approaches: high density plantings or low density plantings. High density plantings (2,500 to 3,000 plants per acre, 3 to 4 ft on center) will give more rapid colonization and cover. However, weeding visits may be slower since it takes more time to weed around native plants. Low density plantings (800 to 1,500 plants per acre, 6 to 7 ft on center) may yield slower establishment, but weeding visits would move more quickly. Higher density plantings may be the most beneficial since it allows a site to reach performance goals more rapidly and eliminates the need for remedial plantings.

Weeding efforts are typically highest during the early years of a restoration project, then taper off once plantings become established and the weed seed bank is depleted. In the first and second years, up to five weeding visits may be necessary with the goal of treating weeds before they flower and set seed. Weeding through herbicide applications is generally the most efficient and cost effective method while hand pulling weeds is the most labor intensive.

Irrigation systems for restoration projects are typically above-ground PVC systems that are designed and built in the field then removed after the second or third year of restoration. Unlike turf irrigation systems where head-to-head coverage is desired, field fit systems may have little overlap and are merely designed to get container plants established using large rotor style heads. These systems may have simple battery operated timers since a power source may not be available. Another popular system uses a series of mainlines with 2 inch quick coupler (Cam adapters) attachments approximately every 100 ft. To use the system, an operator would plug in a fire hose at each coupling, then hand water the container plants within the surrounding area. The operator would then move throughout the site connecting to the next available coupling. In either case, vandalism of any irrigation system is common, especially in areas that are open to the public. Therefore, irrigation systems need to be checked and maintained routinely.

Within the Vegetation Free and Vegetation Management Zones along the new flood control levees, irrigation maybe performed either via a temporary irrigation system or via a water truck. Temporary systems could be isolated when not in use to limit the potential for damage to the levee slopes from leaks. Additionally, temporary systems could be isolated during levee inspections and the rainy season to limit any potential for system leaks to impact levee inspections. Alternatively, use of water trucks to apply irrigation water along the Vegetation Free and Vegetation Management Zones would address any concerns related to irrigation system leaks along the new flood control levees. The project team will work with LA County and the Corps to develop acceptable requirements for irrigation along the flood control levees.

Soil salinity in restored wetland areas may have higher salinities than desired; however, allowing natural tidal flushing prior to planting activities has the potential to lower salinities to appropriate levels. The highest tides generally occur around January of each year. This also coincides with winter rainfall patterns where freshwater is draining into marshes and wetland areas. Therefore, from a planting perspective, it

would be ideal to plant after at least one month of above average tidal flushing and following several large rain events. Treatments could also include over-excavation and placement of 1 to 2 feet of moderate salinity soils. This treatment would likely be limited to areas that are around MHHW. Like upland areas, marshes and wetlands would benefit from the placement of wetland topsoil, if available. Other amendments have been added to salt marsh restoration soils including kelp (organic matter) and commercial products like Biosol (slow release fertilizer)

3.10.2 Salt Marsh Restoration Areas

Native salt marsh species are all halophytes and include pickleweed (Sarcocornia spp.), saltgrass (Distichlis spicata), alkali heath (Frankenia salina), fleshy Jaumea (Jaumea carnosa), spiny rush (Juncus acutus), and others. The exact species and composition (density and distribution) should be collected from a native and healthy reference marsh site within the vicinity of the project site. Because adequate hydrology (tidal flushing and rain) is generally not a concern, restored salt marsh areas typically do not need supplemental irrigation. Furthermore, salt marshes have been successfully restored using smaller (2-foot rose pot) container plants planted in higher densities (up to 10,000 plants/acre, 2 ft on-center). This density provides rapid colonization of the salt marsh. Plantings should occur following winter rains when the soil conditions tend to be less saline. Planting windows may range from December through March.

ENGINEERING ELEMENTS

3.11 NEW PERIMETER LEVEES

A primary project element is replacing the existing Ballona Creek levees with new engineered flood control levees set back from Ballona Creek. The proposed levees will be engineered to meet or exceed current flood control standards.

The proposed flood control levees under Alternative 1 are shown on the levee plans presented on Figures 3.15 and 3.16, for Phase 1 and Phase 2 respectively. There are four new flood control levees proposed for Alternative 1:

- Area A Levee - located around the perimeter of Area A
- Culver Levee - located north of Culver Boulevard from the Culver Boulevard bridge and west to the SoCal Gas well area
- West Area B Levee – from the west end of the Culver Levee connecting to the existing Ballona Creek south levee at the downstream project boundary (Phase 2)
- Interim Levee – a temporary levee connecting the Culver Levee with the existing Ballona Creek south levee (Phase 1)

3.11.1 Levee Crest Elevations and Freeboard

Hydraulic modeling has been performed to estimate water surface elevations along the project site for a number of flood events, including the design flow rate for Lower Ballona Creek (46,000 cfs) cited in the LA District Corps maintenance manual (USACE 1999), with a variety of tail water conditions, including

the LA County design tail water of 7.6-feet NAVD, and is documented in the H&H Report (ESA 2015). Hydraulic modeling has been performed for the existing channel conditions (based on recent survey by PSOMAS) and for the preliminary grading plans for Alternative 1, Phase 1 & Phase 2, presented in Figures 1.4 and 1.3, respectively. The hydraulic modeling approach, methods, and results are presented in detail in the H&H Report.

Design levee heights will ultimately be determined following a full risk and uncertainty analysis to provide adequate freeboard to meet the requirements of the US Army Corps of Engineers, LA County, and FEMA for the Year 2100 sea level rise tail water levels. At the preliminary design stage, levee heights were determined separately for Area A and Area B.

In Area A, the existing Ballona Creek levee slopes from EL 20.4 ft down to EL 16.6 ft NAVD heading downstream from the eastern boundary of the parcel to the western boundary. Since existing grades in Area A are relatively high with large volumes of material available from excavation to create the desired wetland and transitional habitat on this parcel, the preliminary design reflects a relatively conservative levee crest of EL 20.5 ft NAVD for the perimeter around the entire parcel.

In Area B, the existing Ballona Creek levee slopes from EL 20.2 ft NAVD at the Culver Boulevard Bridge down to EL 12.9 ft NAVD at the downstream boundary of West Area B. Levee construction in Area B, requires transport of material from the excavation of Area A across Ballona Creek. Also, in West Area B, levee construction will result in impacts to existing wetland habitat. To help limit the volume of material transported across the creek and to limit impacts of the levee footprint on wetland habitat, the levee heights in the preliminary design have been optimized based on the results of preliminary hydraulic modeling. The levee height was set to provide at least 2 feet of freeboard above the highest water level modeled in the preliminary hydraulic modeling, which combined the most conservative assumptions for design flow, tail water, sea level rise and bed aggradation, i.e. using the US Army Corps of Engineers Design Flow (46,000 cfs) with the LA County design tailwater of EL 7.6 ft NAVD adjusted for 59 inches of sea level rise and adding 59 inches of bed aggregation. Based on this modeling, the preliminary levee crest is set to slope from EL 18.5 ft NAVD just west of the Culver Boulevard Bridge down to EL 16.0 feet at the downstream limit of West Area B. The risk and uncertainty analysis would likely result in lower water levels than this worst case modeling, and the design levee crest may be adjusted somewhat during final design to meet all regulatory requirements.

Freeboard estimates for existing conditions with and without sea level rise, and project conditions for Alternative 1, Phase 1 and Phase 2, with and without sea level rise are presented below in Table 3.2. Water surface profiles and preliminary design levee heights are presented in Figure 3.14. All freeboard estimates are based on the levee crest following completion of long-term settlement.

Freeboard for existing conditions along Area A/North Area B ranges from 5.0 to 6.5 feet and averages 5.8 feet. Along the West Area B reach, existing freeboard ranges from 3.1 to 3.8 feet and averages 3.5 feet. Freeboard was also estimated for the existing channel configuration for the Year 2100 sea level rise scenario with the downstream tailwater increased to account for 4.9 feet of sea level rise. Accounting for

sea level rise, freeboard drops to an average of 2.6 feet along Area A/North Area B and 0.6 feet along West Area B.

Along the proposed Area A perimeter levee, the flat EL 20.5 ft NAVD levee crest would provide an average of 6.0 feet of freeboard during Phase 1 of Alternative 1. Following implementation of Phase 2, freeboard along Area A would increase to an average of 6.7 feet with current tidal conditions. Accounting for sea level rise through 2100, freeboard would average 5.2 feet along the Area A perimeter levee. As compared to the existing levee, the proposed Area A perimeter levee would increase average freeboard by about 2.8 feet when accounting for sea level rise through 2100.

During Phase 1, the Culver Levee would include a wider and higher crest of EL 20.5 ft NAVD to stockpile soil for construction of the West Area B Levee during Phase 2. During this interim period the freeboard along the Culver Levee would average 5.7 feet. During Phase 2, the proposed Culver Levee would be lowered to a crest elevation of EL 18.5 ft NAVD during full buildout in Phase 2. This levee crest would provide an average freeboard of 4.7 feet with current tidal conditions and 3.2 feet accounting for sea level rise through 2100. Average freeboard along the Culver Levee would increase by 1.4 feet for the scenario with sea level rise through 2100 compared to the no-project scenario.

The West Area B Levee would be constructed during Phase 2 with a crest elevation sloping from EL 18.0 ft NAVD to 16.0 ft NAVD at the downstream tie in with the existing Ballona Creek levee. This levee crest elevation would provide an average of 6.2 feet of freeboard with existing tidal conditions and an average of 3.4 feet of freeboard accounting for estimated sea level through 2100. Along the proposed West Area B Levee, freeboard would increase by about 3.9 feet when accounting for sea level rise through 2100 compared to the no-project scenario.

North of Ballona Creek, the right bank consists of the existing levee/jetty that is left unchanged under the preliminary project design. Elevated water levels in the vicinity of Area B under project conditions reduce the amount of freeboard provided by the existing levee/jetty along the right bank by up to 0.8 foot. The majority of the right bank is formed by the jetty that separates Ballona Creek from the Marina Del Rey and a reduction in freeboard along the jetty may not represent a significant increase in flood risk. However, as discussed in Section 3.11.2.1, there is a length of the existing levee between the upstream end of the jetty and the downstream end of the new proposed North Area A Levee that may need to be raised in order to maintain or improve the existing level of flood protection.

Based on the preliminary H&H Report, estimated freeboard increases at the downstream project limits (with the exception noted in the preceding paragraph). During later design phases, following a full risk and uncertainty analysis, the levee heights may be refined and lowered to provide adequate freeboard to meet the requirements of the US Army Corps of Engineers, LA County, and FEMA for the Year 2100 sea level rise tail water levels.

3.11.2 Levee Design Sections and Construction

Preliminary levee design sections for the proposed new flood control levees are provided on Figures 3.18 and 3.19. In general, the proposed levee designs include a compacted core constructed of low permeability material with 2H:1V slopes on the dry side and flatter 3H:1V slopes on the creek side. Subgrade preparation varies based on location and material, and is described for each levee reach below. On both creek and land sides of the levees, additional fill will be placed beyond the compacted core at varying slopes of 5H:1V to 20H:1V to support upland and transitional habitat. On the creek side, the slopes would provide a wide flat bench to dissipate wind-waves and to protect the levee core from erosion. At the western margins of the site, these slopes may incorporate sandy dune features to support dune habitat. Along the eastern, upstream reaches, the slopes would be graded to provide more of an undulating shoreline with variation in both steepness and elevation.

Armoring of the new flood control levees would vary, as described below, incorporating:

- rock (or concrete) on the levee face in areas of high velocity and erosion potential primarily at tie-ins to the existing concrete armored levee,
- buried rock or soil cement in areas of moderate erosion potential,
- vegetation in areas where the levees are separated from the creek channel by hundreds of feet with very gradual slopes.

The new perimeter levees would also support an access road that would provide access for LA County inspections and maintenance and provide public pedestrian and bicycle paths (see Section 3.15 for public access details).

General geotechnical recommendations provided in the Preliminary Geotechnical Design Summary, include:

- Subgrade preparation including removal of vegetation, organic materials and soft unsuitable materials, over-excavation, and compaction.
- Over-excavation and removal of abandoned utility lines, former channels, former celery dump (in Area A), and any permeable lenses.
- Removal of standing water from the excavated subgrade.
- Placement of geogrid (Tensar BX 1200) to stabilize the lowest 1-2 feet of levee fill.
- Construction of levees slowly with fill placement in thin layers, moisture conditioned, and with loose lifts limited to 6-8 inches and a total compacted lift thickness of no more than 6-inches.
- Compaction to at least 90% relative density (ASTM D1557) with testing for every 500 cubic yards of fill or two feet of thickness.
- Lifts would be placed along the entire length of the levee prior to placement of the following lift.
- Slow construction in lifts will tend to reduce post construction settlement. As the preliminary design moves toward final design, the project will consider post construction settlement and adjust design height to account for anticipated long term settlement.
- Surcharge proposed crossings for culverts and water control structures.

Specific features for the each levee reach are described below.

Table 3-2 Freeboard for Existing Conditions and Proposed Project

	Freeboard (ft)											
	Area A/B North (RS 6079 to 10019)						West Area B (RS 3055 to 5853)					
	North Area B - Left Bank			Area A - Right Bank			West Area B - Left Bank			Ex. North Levee - Right Bank		
Design Flood (46,000cfs)	**Reach Average**	**Maximum**	**Minimum**	**Reach Average**	**Maximum**	**Minimum**	**Reach Average**	**Maximum**	**Minimum**	**Reach Average**	**Maximum**	**Minimum**
Existing Conditions[1]	6.1	6.5	5.4	5.6	6.3	5.0	3.7	4.2	3.1	5.4	6.4	4.3
Existing Conditions w/ SLR[12]	2.8	3.4	1.7	2.4	3.1	1.4	0.8	1.7	-0.2	2.5	3.9	1.5
Alt 1, Phase 1[3]	5.7	6.8	5.4	5.7	6.9	5.4	5.7	9.5	3.2	5.5	7.4	3.8
Alt 1, Phase 2[4]	4.7	5.8	4.4	6.7	7.8	6.4	6.2	7.4	5.7	4.1	5.7	3.1
Alt 1, Phase 2 w/ SLR[2,4]	3.2	3.8	3.0	5.2	5.8	5.0	3.4	4.4	3.1	1.4	2.4	0.5

[1] Existing conditions freeboard is the difference between the predicted water surface and the existing levee elevation based on 2012 surveys.

[2] SLR = Sea level rise of 59 inches.

[3] Alternative 1, Phase 1 project conditions freeboard along Area A/B North is the difference between the predicted water surface and a flat levee crest of EL 20.5 ft NAVD included for the preliminary design for the proposed levees. Along West Area B, Alternative 1, Phase 1 project conditions freeboard is the difference between the predicted water surface and the 2012 surveyed elevation of existing levees to remain in the interim phase.

[4] Alternative 1, Phase 2 project conditions freeboard is the difference between the preliminary design levee crest (EL 20.5 ft NAVD in Area A and EL 18.5 ft NAVD sloping to 16.5 ft NAVD in Area B North and West) and the predicted water surface, except for the right bank along West Area B where the existing levee elevation was assumed for preliminary design analyses (see discussion in Section 3.11.1).

3.11.2.1 North Area A Levee

The preliminary plan layout for the North Area A Levee is shown on Figures 3.15 and 3.16 and a typical preliminary levee design section is presented in Figure 3.17.

The proposed Area A Levee would tie into the existing Ballona Creek levee at Culver Boulevard at the upstream limit of the marsh restoration area. The proposed levee would follow the perimeter of Area A with a minimum 30- foot offset from Fiji Way and Lincoln Boulevard and set just south of the Fiji channel. The offset would accommodate the existing parking lots and planned parking improvements along Fiji Way and avoid existing natural gas monitoring well, Del Rey 17.

The downstream end of the new Area A Levee ties into the existing Ballona Creek levee at the west end of Area A. Preliminary hydraulic modeling shows about a 1 ft increase in the design flood water surface profile downstream of this location, and an equivalent reduction in freeboard for the existing north levee/jetty downstream of Area A (i.e., along West Area B; see the H&H Report, Section 3.3). The section of the existing levee immediately upstream of the jetty would be raised to maintain or improve the level of flood protection for development at the end of Fiji Way.

In Area A the new proposed flood control levee is generally located 800 to 1200 feet from the realigned Ballona Creek channel. The levee core incorporates a 2H:1V slope on the dry side and flatter 3H:1V slopes on the creek side from the crest at EL 20.5 feet NAVD to existing grade. On the land side, habitat fill will be placed outboard of the core at a slope of 6H:1V from the crest to existing elevation. On the creek side, habitat fill will be placed at 10H:1V slope from the crest at EL 20.5 feet down to EL 11.0 feet NAVD. Below EL 11.0 feet NAVD, the design ground surface will slope down to the Area A high marshplain at EL 6.3 feet NAVD with a gradually, flat transitional slope varying from 40H:1V to 150H:1V. This wide flat slope will support upland and transitional vegetation which will protect the levee core from higher velocity flows in the main Ballona Creek channel. Habitats within these zones are described in Section 3.3.

Area A is comprised of 15 to 25 feet of loosely consolidated hydraulic dredge material from the excavation of Marina del Rey above historic Ballona marsh soils. Given the unconsolidated existing materials, subgrade preparation will be particularly important in Area A. Subgrade preparation in Area A is anticipated to include:

- Removal of existing vegetation and over-excavation to a depth of 4 feet below grade.
- Along the levee core, over-excavation may be extended down to 6 feet below grade to provide a keyway.

Hard rock or soil cement armoring is not planned for most of the Area A perimeter levee due to the wide flat slopes and tidal wetland basins between levee and creek channel. Armoring will be utilized at the upstream and downstream levee tie ins, transitioning from surface rock adjacent to the existing concrete armored Ballona Creek levees to buried rock as the new perimeter levee wraps into the restoration site.

The proposed Area A Levee would be constructed during Phase 1. Depending upon the ultimate sequencing of gas well abandonment and lowering of the gas well area, the proposed levee may be completed to an elevation lower than the EL 20.5 ft NAVD design grade (while maintaining adequate freeboard for existing tidal conditions). During Phase 2, material excavated from the gas well area could be used to raise the Area A perimeter levee up to EL 20.5 ft NAVD or higher.

3.11.2.2 Culver Levee

A new levee would be constructed north of Culver Boulevard to replace the existing south Ballona Creek channel levee to protect Culver Boulevard and areas to the south from flooding. Plan view layout of the Culver Levee is shown on Figure 3.15 for Phase 1 and Figure 3.16 for Phase 2 and design sections are presented on Figures 3.17 and 3.18.

In Phase 1, the Culver Boulevard levee would initially be constructed with a top width of 120 feet and a crest of EL 20.5 ft NAVD in order to stockpile fill from Area A for use in Phase 2 levee construction. Following Phase 1, the Culver Boulevard levee, including stockpiled fill, would have an outboard slope of about 5H:1V from the levee crest down to restored North Area B marsh at EL 6.5 feet NAVD on the creek side and an inboard slope to 3H:1V to existing elevations on the land side. The levee would be offset from Culver Boulevard by about 30 feet to limit settlement impacts to existing utilities along Culver Boulevard. The 30 feet offset would also allow for creation of a vegetated swale to convey, treat and store stormwater runoff from the levee slope and Culver Boulevard. At the eastern end of the levee, a wide plateau would be constructed between Culver Boulevard and the old railroad alignment. This wider section is intended to vary the widening of the restored Ballona Creek floodplain to help spread the hydraulic drop of flood levels as flood flows enter the Project site. The plateau also provides a landing for the proposed pedestrian and bicycle bridge over Ballona Creek.

In Phase 2, the stockpiled material along the levee would be removed to build the West Area B Levee. The levee crest would be lowered to EL 18.5 ft NAVD and the top width would be reduced from 120 feet to 20 feet. The creek side levee slope would be varied to create a flat transitional slope down to marhsplain elevations:

- At the upper elevations, above EL 15 ft NAVD, a 5H:1V slope would be employed,
- Between EL 15 down to 10 ft NAVD, a flatter 10H:1V slope would be employed
- Along the active transitional zone, below below EL 10 ft NAVD, the slope would flatten to 20H:1V in areas of fill and up to 40H:1V in areas of excavation.

In Area B, the subgrade is generally comprised of historic marsh soils, which are relatively close to groundwater. Preliminary plans for subgrade preparation for the Culver Levee incorporate:

- Removal of existing vegetation and over-excavation to a depth of 2 feet below grade.
- Along the levee core, over-excavation would be extended down to 4 feet below grade to provide a keyway.

Armoring including either buried rock or soil cement would be utilized along Culver Levee. Surface armoring would be incorporated at the tie in to the existing concrete armored Ballona Creek levee. As the

Culver Levee turns to the south, the surface armoring would transition into buried rock or soil cement along the length of the Culver Levee. Armoring may not be required where the levee core would be separated from Ballona creek by greater than 80 feet of vegetated upland and transitional habitat.

3.11.2.3 West Area B Levee

The West Area B Levee would be constructed as part of Phase 2 of Alternative 1. The preliminary layout for the West Area B Levee is shown on Figure 3.16 and design sections are presented on Figures 3.18. Figure 3.22 shows an example of how the levee may look after construction.

The West Area B Levee would continue the Culver Levee beyond the abutment with the Interim Levee around the perimeter of West Area B running along the south and west side of West Area B and tie in to the existing downstream segment of the south Ballona Creek levee. The West Area B Levee would be constructed through the existing wetlands, avoiding the existing dune habitat. North of the businesses at the west end of Culver Boulevard, the West Area B Levee would be offset from the property boundary to avoid the stormwater detention and treatment wetland and access improvements implemented in Phase 1.

The West Area B Levee would have a levee core, width, slopes and subgrade treatments similar to the Phase 2 Culver Levee described above. The levee crest elevation would transition from EL 18 ft NAVD at the upland peninsula down to 16.0 feet NAVD at the tie in with the existing south Ballona Creek levee. The proposed crest elevations would include an allowance for sea level rise and improve the existing level of flood risk protection. The West Area B Levee would be constructed with a top width of 20 feet. The levee would include a 12-foot-wide maintenance access road on top that also would be used to provide compatible public access trails.

Similar to the Culver Levee, the West Area B Levee will be constructed on historic marsh soils with high groundwater. In addition the West Area B Levee will cross existing channels in several locations. Subgrade preparation is anticipated to include:

- Removal of existing vegetation and over-excavation to a depth of 2 feet below grade.
- Along the levee core, over-excavation would be extended down to 4 feet below grade to provide a keyway.
- At channel crossings, the channels will be blocked on either side of the levee core and dewatered. Loose, unsuitable material would be over excavated and the channel area will be rebuilt with compacted fill.

West Area B will be primarily a backwater area during flood events, and erosion potential is expected to be limited along most of the levee reach. Therefore, we anticipate that armoring will be limited to the downstream most reach of the levee. We expect to use rock facing at the tie-in to the existing Ballona Creek South levee transitioning to buried soil cement or rock protection of the levee core along the downstream most reach of the levee.

3.11.2.4 Interim Area B Levee

Alternative 1 will be phased with full restoration of West Area B delayed for a number of years until the restoration in Area A demonstrates success. During this interim period, a temporary levee will connect the Culver Levee to the existing Ballona Creek South Levee just east and north of the existing natural gas monitoring well cluster in West Area B. This Interim Levee is shown on the levee plan in Figure 3.15 and in the section on Figure 3.17. The Interim Levee would have a crest elevation of 20.5 feet NAVD, with 5H:1V side slopes on the outboard Ballona Creek side and 3H:1V slopes on the inboard side. Subgrade preparation will be similar to the Culver and West Area B Levees discussed above.

The Interim Levee will incorporate buried rock or soil cement armoring along much of its length. Rock facing is planned at the tie in with the South Ballona Creek levee.

Under Phase 2 of Alternative 1, the Interim Levee would be lowered to EL 8.5 ft NAVD and reconfigured into the salt pan berm and upland peninsula as described in Section 3.5. Buried armor installed in Phase 1 on the outboard side of the Interim Levee would be retained to protect the berm and peninsula from erosion where Ballona Creek flows would converge back into the existing channel alignment downstream.

3.11.3 Armoring

Armoring of the existing side slopes of Ballona Creek consists of concrete and rock. The new flood control levees will be set back away from the Ballona Creek channel. The additional flow capacity provided by the setback levees and the resulting reduction in flow velocities and shear stresses provide opportunities to utilize alternative measures for levee protection.

With the primary objective of the project being to create and restore habitat, the intent is to keep the use of traditional armor, and especially concrete, to a minimum. Where flow velocities and scouring potential allow, vegetation will be used to protect the levees. Where additional risk is identified, the levee core consisting of compacted and stabilized soil would be protected with a cladding of either rock or soil cement, covered by less compacted soils that allow planting and habitat establishment. The typical levee cross-sections for Area B presented on Figures 3.17 and 3.18 illustrate this approach. Along Area A, where the perimeter levee is set back from Ballona Creek by 800 to 1200 feet, the preferred armoring method would be to rely upon vegetation established on the flat, vegetated transitional slopes (100:1 sloping up to 40:1 and 10:1). Where higher flows do occur and scour potential is increased, rock cladding covered by soil and plantings would be utilized. At the tie-ins with the existing Ballona Creek levees, surface rock would be employed along the new levees where velocities and shear stress are expected to be highest at the convergence and divergence of creek flows. And finally, at existing and proposed bridge locations, soil cement would be used where applicable and concrete surfacing would be utilized where required.

The rock slope protection is shown conceptually in Figures 3.17 and 3.18. During subsequent analysis and design, a number of key design decisions will be made related to the details of rock slope protection:

1. Scour analyses will be utilized to determine the depth of the toe of the rock slope protection to protect the levee core if the main channel meanders towards the levee.
2. Rock sizing will be determined assuming that the rock is exposed to scour and wind-waves, using design level flow rates and wind-wave run-up analysis.
3. The thickness of the rock protection will be determined from rock size using procedures documented in the USACOE Shore Protection Manual.

Figures 3.19 and 3.20 show the relative risk of erosion based on velocities predicted by hydraulics models for the 100-year return period flowrate (please see the H&H Report). There are four (4) levels of erosion risk, as follows:

Level 1: Level 1 is the highest level of erosion risk. These areas are the most likely to include surface rock revetment or possibly concrete channel lining transitioning to buried rock.

Level 2: Level 2 areas have reduced erosion likelihood due to lower predicted velocities. However, the velocities are high enough to pose some erosion risk and the consequences of erosion are relatively high. For example, the levee along Culver Boulevard is included primarily because erosion impacting levee integrity may affect the roadway. In these areas, buried armoring consisting of soil cement or rock revetment are considered most likely.

Level 3: Level 3 areas have erosion potential but the consequences of erosion are considered low. For example, erosion of the north bank of the new Ballona Channel during a high flow event would be a manifestation of natural processes in the restoration area, and could provide ecological benefit with no damage to infrastructure.

Level 4: All other areas not marked are either outside the project or the erosion potential and the damage risk due to the project are low. In the low risk areas within the project limits, vegetation and possibly turf reinforcement (where needed) would be used.

Further analysis is required to refine the need for armoring, and its design. Discussions with the Los Angeles County and US Army Corps of Engineers will inform the selected armoring approaches and locations, including the use of vegetation. A more detailed discussion is included in Appendix F-2. Please see the H&H Report for descriptions of predicted hydraulics.

3.11.4 Plantings/Vegetation

Planting plans along levee alignments are intended to implement a tiered approach applying the US Army Corps of Engineers – Guidelines for Landscape Planting and Vegetation at Levees (ETL 1110-2-583, April 2014). The proposed planting plans strike a balance between use of upland grasses in a vegetation free zone along the levee core and a vegetation management zone with grasses and small, shallow rooted shrubs between the vegetation free zone and the areas dedicated to upland and transitional habitat.

The conceptual planting plan for levees is presented in Figure 3.21. The conceptual planting plan identifies three zones of vegetation along levees:

- Vegetation Free Zone – This zone follows Corps guidance providing a zone of perennial upland grasses along the levee core that would be mowed to facilitate inspection of the levee core. The Vegetation Free Zone would extend 15 feet beyond the toe of the levee core along the steeper land side of the levee. Along the creek side of the levee, where existing grades would be raised to create broad, flat transitional slopes ranging from 10H:1V to 20H:1V and flatter to support the habitat objectives of the project, the Vegetation Free Zone would extend 15' beyond the levee core.

- Vegetation Maintenance Zone – This zone provides an area of upland grasses and small shallow rooted shrubs that may be mowed as needed to facilitate inspections or selective removal of shrubs that could impact the integrity of the levee core. The Vegetation Management Zone would extend to 15 feet beyond the toe of the buried levee core on the water side of the levee. In this zone the levee core would be buried by 8 to 10 feet of soil to support the habitat objectives of the project. The intent would be that mowing or select vegetation removal would not be regularly needed, but would be included in project permits to facilitate any maintenance and inspections should issues arise. The planting list within the Vegetation Management Zone would add low shrubs with small root balls that are limited to 2-3 feet in depth to the perennial grasses included in the Vegetation Free Zone. A root free zone of at least 3 feet would be maintained above the levee core.

- Habitat Zone – The Habitat Zone is located 15 feet from the levee core toe. In areas of higher levee fill (i.e. West Area B) this zone would incorporate 6 to 10 feet of soil above the levee toe at slopes of 10-20H:1V. This zone would support the full range of habitat plantings included in the upland and transitional habitat mix. However, given the nature of the habitat plantings planned along the upland transition, the habitat mix would only add lemonade berry, a deeper rooted (4.5 feet deep) and taller shrub (9 feet), to the Vegetation Maintenance Zone planting mix. Within the Habitat Zone, regular inspection is not anticipated.

3.11.5 Existing Levee Improvements

For those portions of Areas A and B where new levees will join the existing levees, ground improvements will be constructed for the transition of the new proposed levees and the existing levees per the Geotechnical Investigation Report (Appendix B). The transitional distance for the ground improvements will be based on the mitigation of loads imposed by the new proposed levees upon the existing levees.

3.11.5.1 Levee Tie-Ins

Levee tie ins refer to the locations where new levees abut existing levees, and construction activity is included in the preliminary design to develop an integrated and seamless flood control system by "tying" the levees together. Tie ins are located at the upstream and downstream limits of the Area A Levee, at the upstream limit of the Culver Levee and at the downstream limits of the West Area B and Interim Levees. In areas where the existing Ballona Creek levees will remain long term, the project geotechnical engineer recommends implementation of ground improvements, such as deep soil mixing, to increase seismic

stability and to reduce seismic deformations. The extent of ground improvement would extend 80 feet from the centerline of the new levee crest at each tie-in.

The Deep Soil Mixing (DSM) ground improvement zone for existing levees is anticipated to be about 20 feet wide. The ground improvement zone should have a minimum average strength of 1,500 psf. DSM columns should extend down to EL -13 ft NAVD between Lincoln and Culver Boulevards at the upstream tie-ins, down to EL -25 ft NAVD at the downstream Area A tie-in and down to EL -35 ft NAVD at the downstream Area B tie-in.

In addition, the existing levee crest elevations would be raised in areas at the tie in locations.

3.11.5.2 Ballona Creek Levees – Area A & B

During construction in Area A and Area B, the project will maintain a minimum 70-foot wide offset for excavations adjacent to existing levees to maintain an adequate static Factor Safety during a design flood event during construction. The offset will provide a stability berm against the existing levees. Excavation within the offset would only occur immediately prior to breaching.

3.11.5.3 Ballona Creek Levee - Area C

In Alternative 1, the South Area C fill mound is located adjacent to the existing North Ballona Creek Levee. To limit potential impacts associated with loading fill behind the existing levee, soil placed to create upland habitat in South Area C will be offset from the Ballona Creek channel by a minimum of 70 feet.

3.12 WATER CONTROL STRUCTURES

Under Alternative 1, existing water control structures will be modified or removed and new water control structures installed. Key water control structures are shown on Figure 3.23 with numbers identifying each new or existing structure that will be modified in Alternative 1.

Water control structures are generally identified from left to right (Figure 3.23):

1. West Area B Culvert – Culvert with gate installed in the West Area B Levee during Phase 2 to connect the existing wetland behind the levee (adjacent to the dunes) with the restored West Area B full tidal wetlands. This culvert will be located in an existing channel crossed by the levee. Either a slide-flap combination gate or a self-regulating tide gate may be employed to manage muted tidal conditions and to provide storm drainage in the remnant wetland behind the West Area B Levee.

2. South Area B Water Control Structure – During Phase 1, a flashboard riser weir structure and culvert would be installed in the new berm along Culver Boulevard to limit tidal exchange between South Area B and West Area B and maintain the existing tidal regime in West Area B. During storm events, runoff in South Area B would over top the flashboard riser for discharge in West Area B.

During Phase 2, the flashboard riser/culvert in the new berm and the existing culvert under Culver Boulevard connecting South Area B to West Area B would be replaced by new larger culverts and gates to provide increased tidal exchange between West and South Area B and to manage stormwater levels in South Area B. The culverts would consist of a bank of four to six 60-inch dia. culverts or rectangular culverts with similar capacity that would be installed in the West Area B Levee and under Culver Boulevard to connect West Area B to South Area B. Flows through the culverts would be controlled by a combination of self-regulating tide gates (set to close with elevated water levels in Ballona Creek) and slide/flap gates. The gates would be installed on a pile supported headwall or attached directly to pile supported culverts. The intent would be to manage increased tidal exchange in South Area B during normal non-storm periods while maximizing stormwater discharge during extreme rainfall/runoff events.

3. Southeast Area B Water Control Structure – During Phase 1, culvert and gate structure similar to the South Area B Phase 2 Water Control Structure would be installed in the new Culver Levee and under Culver Boulevard to connect North Area B to Southeast Area B. The structure would include a bank of four to six 60-inch dia. culverts (or rectangular culverts) and a combination of self-regulating tide gates and slide/flap. Similar to the South Area B structure, the intent would be to provide increased tidal exchange to Southeast Area B while maximizing stormwater discharge during extreme rainfall events.

4. Gas Company Road Culvert – During Phase 1, the existing drainage culvert under the Gas Company Rd. between South and Southeast Area B will be replaced by a bank of four to six 60-inch dia. culverts or rectangular culverts with similar capacity. The bank of culverts will facilitate increased tidal exchange between South and Southeast Area B. Slide-flap gates would be installed on each end of each culvert to allow for isolation of South and Southeast Area B to facilitate maintenance on Structures #2 & #3.

5. Freshwater Marsh Water Control Structure – The existing Freshwater Marsh Structure would remain structurally unchanged in Alternative 1. During Phase 1, the outlet to Ballona Creek would be reworked by lowering the existing Ballona Creek Levee to marsh elevations and a new tidal channel would connect to the existing outfall and headwall. At the existing flashboard riser structure, additional flashboards may be added to raise the elevation where the Freshwater Marsh overtops to discharge to Ballona Creek. The intent would be to route more freshwater flows to Southeast Area B to improve brackish marsh habitat.

6. Freshwater Marsh Overflow Weir – The existing Freshwater Marsh Overflow Weir would be modified to increase discharge of freshwater runoff to Southeast Area B. Modification could include lowering a portion of the overflow weir and incorporating a number of flashboards at lower elevations to control and increase overflows from the freshwater marsh. Alternatively, a new culvert/flashboard riser directing overflows to Southeast Area B could be installed at the northwest end of the Freshwater Marsh.

7. Brackish Marsh Culvert – A new culvert would be installed in the low berm separating the brackish marsh with the central portion of Southeast Area B. This culvert would be fitted with a weir box to facilitate limited tidal exchange with higher salinity water from Southeast Area B and permit stormflows discharged from the freshwater marsh to flow to Southeast Area B.

3.12.1 Culver Boulevard Utility Crossings

The South and Southeast Area B Water Control Structure culverts would be sized to accommodate tidal flows and provide local storm drainage from South/Southeast Area B to Ballona Creek. Under Culver Boulevard, the structures will incorporate box culverts to facilitate crossing utilities installed in the road including a 230 kV electrical line, and communications lines. On either side of the road crossing, the culverts may be transitioned to taller box culverts or round pipes.

3.12.2 Freshwater Marsh Management

The existing FWM serves multiple functions, including acting as the downstream end of a stormwater conveyance system and providing attenuation of upstream storm flow volume and flow rate, water quality treatment of urban inflow, and freshwater habitat.

Storm drainage from the Playa Vista area currently flows into the Freshwater Marsh and out to Ballona Creek through a culvert with a drainage flap gate (Structure #5 in Figure 3.23). During periods of high flow in Ballona Creek, the flap gate closes and stormwater drainage is retained in the Freshwater Marsh until water levels in Ballona Creek recede. As currently configured, the Freshwater Marsh can store runoff volumes up to the 1-year storm event before overtopping the overflow weir into Southeast Area B. This overflow was designed to prevent storm drainage from backing up into the Playa Vista riparian corridor and flooding upstream areas that drain to the Freshwater Marsh.

There are a number of key functional elements of the FWM that will be maintained as is or adjusted with the project. These include:

1. Existing habitat areas within the perimeter berm of the FWM will remain undisturbed.

2. Maximum water levels within the Freshwater Marsh will be maintained similar to the current maximum levels to limit stormwater backup and flooding within upstream areas that drain to the freshwater marsh. As sea levels rise, the Freshwater Marsh Overflow Weir may be adjusted to limit salt water intrusion into the freshwater marsh.

3. The Freshwater Marsh Water Control Structure (Structure #6) will be maintained in its current configuration as described above. At the south end of this structure, a flashboard weir structure allows elevation adjustments from approximately EL -0.3 ft to 7.3 ft NAVD. This wide range allows full dewatering of the FWM to facilitate maintenance. The structure utilizes a multi-stage conduit, depending on location to convey runoff to Ballona Creek. The main conduit is a10-ft wide by 6-ft tall reinforced concrete box. At Jefferson and Culver Boulevards, the structure

transitions to a double, 10-ft wide by 3-ft tall reinforced concrete box to pass under existing utilities in the roads. At the connection to the Ballona Creek, the conduit transitions to a triple 5 foot diameter reinforced concrete pipe (RCP) that discharge to the creek through a headwall with flap gates. As discussed above, this head wall will remain in place with the project, the existing levee will be lowered to marsh elevations, and a new tidal channel will connect to the headwall as shown on the grading plans (Figures 3.4 & 3.5).

4. The Freshwater Marsh Overflow Weir (Structure #6) incorporates flashboards to adjust the overflow elevation. The lowest and currently set elevation is approximately EL 7.0 ft NAVD and flashboards may be added to raise the overflow elevation to EL 9.25 ft NAVD. The overflow weir can be modified by adding flashboards to raise overtopping elevation as needed. The weir structure elevation could be adjusted to raise the flashboard adjustment range to between EL 7.0 ft and 10.0 ft NAVD if the flashboard pilings are extended. As discussed above, the existing overflow weir structure may be modified to incorporate lower flashboards or second flashboard rise and culvert could be installed to increase freshwater outflows to support brackish habitat.

5. There is also a small existing overflow pipe (24-in diameter) at the south end of the Freshwater Marsh that has a valve structure, which is currently closed. This pipe provides an alternate drain location for dewatering of the FWM for maintenance, for water quality circulation within the FWM, and for "freshening" of brackish marsh in Southeast Area B. This outflow would be maintained for minor non-storm flows, to maintain circulation.

6. The Freshwater Marsh management would be modified to increase discharge into the brackish marsh area in Southeast Area B. Raising the flashboards in the FWM Water Control Structure (Structure #5) and lowering the overflow weir elevation (Structure #6) would allow runoff from smaller frequent events to be discharged into the brackish marsh area. Larger storm events would be routed through both structures to limit flooding of low-lying, upstream properties. Further analysis is required to ascertain the effects of sea level rise on the available storage, and whether increased tidal range can be accommodated (see additional discussion in Section 3.6).

3.13 STORMWATER MANAGEMENT PLAN

A Preliminary Stormwater Management Plan is presented in Appendix G, and proposed stormwater management Best Management Practices (BMPs) are presented in Figure 3.24. Project specific stormwater management BMPs are described below. In addition, an existing area of flooding along Culver Boulevard is discussed below along with specific measures included in the Stormwater Management Plan to address flooding along Culver Boulevard.

3.13.1 Proposed Construction Period Stormwater Management BMPs

The primary objective of stormwater management during construction is to manage site conditions to limit the migration of pollutants from the site. Since the majority of construction activities involve

earthwork, the primary pollutants of concern include sediment migration via stormwater runoff and airborne dust.

BMPs implemented during construction are anticipated to include:

- Watering active earthwork areas and access roads to reduce airborne dust.
- Use of straw waddles, silt fences, etc. to trap eroded sediments in runoff.
- Installation of filter fabric or fiber rolls at existing stormdrain inlets to trap eroded sediments.
- Application of temporary soil coatings for longer term access roads.
- Hydroseeding for erosion control.
- Installation of sheeting to cover soil stockpiles.
- Use of interim stormwater detention and settling basins to capture runoff and settle eroded sediments.
- Use of a vehicle staging area, including oil drip collection for fueling and maintenance of construction equipment.
- Use of wheel washes at construction entrances/exits to limit tracking of mud onto adjacent streets.

3.13.2 Proposed Long term Stormwater Management BMPs

A number of site specific stormwater BMPs have been incorporated into the project design as shown on Figure 3.24. Given that the project will result in wetlands restoration, the project as a whole will tend to improve water quality both for stormwater flowing through the project site to Ballona Creek and for runoff conveyed by Ballona Creek through the restored wetlands.

Specific stormwater BMPs in the restoration design include:

- Bioswales would be installed along the toe of slopes along new levees and upland fill placement areas and along existing roads to collect and convey runoff from adjacent slopes and roads. Bioswales utilize dense grasses in wide, shallow drainage channels to filter runoff, facilitate bio-uptake of constituents in runoff, and promote infiltration of runoff.

  Bioswales would range in depth from a few inches up to two feet and vary in width from three to twenty feet. Where bioswales capture runoff from small isolated areas, the swales would contain the volume estimated from a 100-year rainfall event, and would function like a linear detention feature. Where bioswales capture larger volumes of runoff, the swales would function as conveyance features to route runoff to additional stormwater wetlands. Longitudinal slope would be shallow, generally less than one percent. Bioswales that are utilized along existing roadways would incorporate a mix of vegetation and soils targeted to allow the breakdown of runoff constituents expected from road runoff.

Bioswales would be installed along:

- Area A Perimeter Levee – along the outboard toe adjacent to Fiji Way to route runoff to seasonal wetlands in Area A.
- Culver & West Area B Levees – along the outboard toe adjacent to Culver Boulevard to route runoff to the stormwater retention wetlands in West Area B.
- South and Southeast Area B – Along the south side of Culver and Jefferson Boulevards to route runoff to the stormwater retention wetlands in West Area B.
- East Area B – to capture runoff from the proposed Phase 1 fill stock pile and from Jefferson and Culver Boulevards.
- Area C North – along the toe of the proposed fill areas to route runoff to the restored Fiji Ditch riparian corridor.
- Area C South – Along Culver Boulevard and around the perimeter of the proposed fill area to route runoff to the restored Fiji Ditch riparian corridor in North Area C, existing seasonal wetlands at the toe of the HWY 90 embankment, and to existing storm drainage lines at Culver & Lincoln Boulevards.

- Pretreatment Basins/stormwater treatment wetlands would be utilized throughout the project area to collect stormwater that may be impacted by onsite or off-site pollutants and/or sediment laden runoff. These basins would be designed to allow for the settlement of suspended sediments prior to discharge into the restored and enhanced wetlands within the project. Pretreatment basins would be sized to capture the runoff volumes from localized upgradient impervious surfaces and designed to accommodate the pollutants and runoff anticipated from the upgradient area.

  Pretreatment basins/stormwater treatment wetlands would be utilized in the following areas:

  - Area A – collecting runoff from the Beaches and Harbors parking lot at the west end of Area A.
  - West Area B – collecting runoff from Gordon's Market parking lot.
  - South & Southeast Area B – five basins collecting runoff from storm drains discharging areas along the Westchester Bluffs.
  - North Area C – Along the realigned Fiji Ditch prior to discharge across Lincoln Boulevard.
  - West Area B – collecting runoff from Culver Boulevard just north of Nicholson Street. This basin will serve for water quality treatment and peak flow attenuation with sufficient volume function for the 100-year flood event to mitigate existing flooding issues along Culver Boulevard.

3.13.3 West Culver Boulevard - Existing Conditions

At the southwest corner of Area B is a developed commercial area fronting Culver Boulevard. This development is at a very low elevation, in some cases below 6.0 ft NAVD. This is a low point of Culver Boulevard and has historically had flooding problems at, and adjacent to, the intersection of Culver Boulevard and Nicholson. There are a number of storm drains that discharge runoff from the Westchester

Bluffs through South and Southeast Area B towards the low point in Culver Boulevard. The culvert that transfers this runoff under Culver Boulevard to West Area B is undersized, leading to flooding at this intersection. The problem is exacerbated when high water levels in Ballona Creek delay drainage in West Area B, causing runoff to back up and flood the intersection and adjacent low-lying properties.

3.13.4 West Culver Boulevard - Proposed Drainage Conditions

With the construction of the proposed Culver and West Area B Levees, the Culver Boulevard & Nicholson intersection area will be separated from direct tidal influence. However, storage volume for the excess overflow drainage in West Area B will also be eliminated. To capture stormwater runoff in that is conveyed to this intersection, a new stormwater pretreatment basin/water quality wetland will be constructed between the commercial properties and the proposed levee with sufficient storage volume to accommodate upgradient and local runoff. The pretreatment basin/water quality wetland would discharge into West Area B through a drainage culvert with flap-gate.

This basin will also function as a water quality treatment measure to address pollutant load from the proposed paved fire access road behind the commercial properties, as well as a portion of the runoff from the existing paved area of Culver Boulevard. Other areas of Culver Boulevard further east will drain to a bio-swale between the Culver Levee and Culver Boulevard.

3.14 NATURAL GAS STORAGE FACILITIES

Alternative 1 would decommission existing gas wells within the Ballona Reserve and abandon or modify gas pipelines to accommodate the restoration. SoCalGas would implement well abandonments and relocations. SoCalGas would replace certain monitoring wells before abandoning them by directionally drilling new wells from within SoCalGas property along the southern bluff. Other wells could be abandoned without replacement. In Phase 1, Alternative 1 the gas wells that are within the Phase 1 restoration would be decommissioned. All other wells, including the Area A wells and wells within the West Area B salt pan, would be maintained until they are decommissioned during Phase 2. Once the Area A wells are abandoned, this portion of Area A would be graded and restored.

3.14.1 Gas Infrastructure Decommissioning Plan

The prioritized plan for gas infrastructure decommissioning is summarized below. Wells and gas lines to be removed or replaced are presented in Figures 3-25, 3-26, and 3-27.

Area A:

Phase 1

- Abandon inactive Area A pipeline
- Modify the abandoned Del Rey (DR) 16 well as needed to accommodate restoration grading (e.g., re-abandon or over-excavate)

Phase 2

- Plug and abandon DR 13, 14, 15, 17, 18, and 19

- Abandon active pipeline serving DR 18, from DR 18 to SoCalGas Company facility
- Drill new wells from main plant area to replace DR 17, 18, and 19

Area B:

Phase 1

- Drill new wells to main plant area to replace DR 12 and plug and abandon DR 12 (to allow for channel meander excavation)
- Modify pipeline serving Area A from proposed Culver Levee to existing Creek crossing (e.g., replace section of pipe at lower elevation to accommodate levee construction and wetland restoration).
- Relocate Line 1167 Pipeline in Southeast B into the Gas Company Road

Phase 2

- Drill new wells to main plant area to replace DR 9, 12 and Vidor 18
- Plug and abandon DR 4, 5, 9, 11 and Vidor 1, 2, 3, 5, 14, and 18
- Modify the abandoned Vidor 4 well as needed to accommodate restoration grading (e.g., re-abandon or over-excavate)

During construction of Phase 1, wells that are to remain (e.g., through Phase 2) will be provided a setback and flood protection. Flood protection will primarily consist of construction of a levee around well areas that are below flood elevations. Full-time, all-weather access for heavy equipment will need to be maintained by SoCalGas to all wells that remain.

3.14.2 Phase 1 Well Abandonment

In Phase 1, site excavation would be directed around the wells in Area A, creating sloping upland transition habitat up to the wells. DR 17 along Fiji Way will be avoided by constructing the new Area A perimeter levee to the east of this well.

Within Area B, DR 12 will be abandoned to allow for the channel realignment. The Interim Levee between the new Culver Levee and the existing south Ballona Creek levee along West Area B will be constructed to protect and avoid the cluster of wells in West Area B, which includes Vidor 1, 2, and 3 and DR 4, 5, and 9. Phase 1 allows for these wells to be maintained as is. In South and Southeast Area B, Vidor 5 and 14 will be abandoned as well to allow for construction of tidal channels, salt pans, and the berm along Jefferson Blvd.

3.14.3 Phase 2 Well Abandonment

In Phase 2, Del Rey 13, 14, 15, 17, 18, and 19 would be abandoned in Area A and the surrounding area would be graded and restored.

In West Area B, Vidor 1, 2, 3, and 18 and DR 4, 5, and 9 would be abandoned to allow for full tidal restoration. DR 11 in East Area B would be abandoned to allow for upland restoration.

3.14.4 Pipeline Protection and Relocation

In Phase 1, the section of the gas pipeline between the Gas Company and the existing Creek crossing to Area A would be modified to allow levee construction and wetland restoration (e.g., by replacing the section of pipe at lower elevation and by placing the pipe in a sleeve under the new Culver Levee to address the potential of differential settlement of the pipeline).

In Southeast Area B, the portion of the Line 1167 30-inch natural gas transmission pipeline crossing the wetland to Jefferson Blvd. will be relocated along the Gas Company Road. These relocations must be completed prior to grading within their respective areas. Other gas pipelines to remain in place will be avoided by setting earthwork back by an appropriate distance.

The existing abandoned pipeline through Area A and along the north Ballona Creek levee will be capped at both ends beyond the limits of restoration earthwork. The abandoned pipeline section within Area A will be removed as needed for restoration grading. Other abandoned pipelines may be encountered during restoration grading and will be removed. Other pipelines can remain in place and will be set back an appropriate distance.

All pipelines that traverse the new levees will be abandoned in accordance with guidance provided in USACOE EM 1110-2-1913. Shallow pipelines will be removed and backfilled during grubbing operations. Deep lines that are not feasible to remove, will be sealed with concrete.

Figures 3.25 thru 3.27 show the gas pipeline relocation plan.

3.15 PUBLIC ACCESS FACILITIES

The Project would develop and improve public access, recreation, and interpretative opportunities within the Project site under Phase 1, as shown in Figure 3.28 and under Phase 2, as shown in Figure 3.29.

Public Access to the project site will be facilitated through parking, trails, overlooks, and recreation fields. Details of the public access facilities are provided below.

3.15.1 Parking

3.15.1.1 Area A

A new three-level parking structure would be built on the site of the existing Department of Beaches and Harbors (DBH)-operated parking lot in order to consolidate parking at this location into a smaller footprint. Conceptual plans for this parking structure are provided in Figures 3.30 and 3.31. The parking structure would reduce the footprint of the existing parking area and increase the area available for upland habitat in the Ballona Reserve by approximately 0.68 acre. The structure would be accessed from a driveway off Fiji Way with right-turn in, right-turn out access only.

A total of 302 parking spaces would be included on the three floors of the parking structure, including standard, compact, and ADA-accessible spaces, along with an area for motorcycle parking. The parking structure would increase available parking by 39 spaces as compared to the existing parking lot. A total of 20 spaces would be dedicated to DBH vehicles and ten spaces would be provided for CDFW staff. Remaining spaces would be publically available, paid parking spaces using pay stations. The top deck of the structure would include parking and an observation deck with signage, maps, and telescopes allowing views of the reconstructed wetlands in Area A and beyond. Hours of operation for public use of the parking structure would be from dawn to dusk, and the structure would be locked after hours. Interior parking lot lighting would be installed to provide security and safety for individuals using the parking facility. The design of the parking structure would minimize ambient light spillover from the interior onto the constructed wetlands in Area A. Similarly, exterior lighting would be directed away from adjacent, sensitive habitats. Focused exterior lighting would be directed downward to encourage way-finding, and exterior ambient lighting would be installed to provide security and safety for individuals walking to and from the parking structure.

A CDFW office trailer, additional parking, and equipment storage would be located next to the proposed parking structure. The Project would not affect the footprint or configuration of the existing parking lot along Fiji Way leased by the Sheriff's Department (62 spaces).

3.15.1.2 Area B

The West Culver Parking Lot, currently a poorly drained gravel lot that can accommodate approximately 50 cars, would be paved and striped, include improved drainage, and install sidewalks. Approximately 43 parking places would be provided for daytime use (Figure 3.32). A separate bus and emergency vehicle access would enter from Culver Boulevard just east of the intersection with Nicholson Street and would include a dedicated drop-off/pickup area for buses. The entrance to the Ballona Reserve from the West Culver Parking Lot would include interpretive signs, shade structures, and seating. The West Culver Parking Lot would also be graded to divert stormwater runoff to planted bio-swales and a pre-treatment stormwater wetland before it enters the Ballona Reserve.

3.15.1.3 Area C

In Alternative 1, no changes are proposed for the existing ball fields and gravel parking in South Area C.

3.15.2 Trails

The trail layouts are presented on Figure 3.28 for Phase 1 and Figure 3.29 for Phase 2. Trail details such as observation decks, elevated boardwalks, and typical pedestrian and bike trails are shown on Figures 3.33 – 3.36. Appendix H provides details on the bike path route connections.

3.15.2.1 Area A

In Area A, the major pedestrian and bike paths would follow the perimeter levee tops. The pedestrian trails in Area A would generally follow the perimeter levee but would be set off the levee tops toward the wetland landscape, affording closer views of the habitat areas. In Phase 1, a pedestrian trail loop would be built in Area A along the slopes around the existing SoCalGas wells, as shown in Figure 3.28. Because

this area would be above the wetland grade, this trail would allow viewing vistas across the site. Approximately 2,000 linear feet of trails and elevated boardwalks would cross Area A in an approximately east/west direction to allow visitors to walk out over the wetlands and transitional slopes to afford closer views of Ballona Reserve habitats. Elevated boardwalks, would allow visitors to walk out over the wetlands and view wildlife without impacting habitats. Finally, a new pedestrian trail would connect Area A to Area C via a new bridge over Lincoln Boulevard and Ballona Creek, as described below.

3.15.2.2 Area B

The existing dunes and pedestrian trails in West Area B would remain unchanged by the Project. All earthwork and disturbance would be offset from this valued dune habitat.

In Phase 1, a new bicycle and pedestrian path would be built along the new Culver and Interim Levees and the existing south Ballona Creek levee along West Area B, connecting to the existing paths at the Pacific Avenue Bridge, as shown in Figure 3.28. This Area B path would connect to Area A via a new bridge across Ballona Creek near the Culver Boulevard Bridge.

In Phase 2, the bicycle and pedestrian path would be relocated to the new West Area B Levee as shown in Figure 3.29, replacing the path along the Interim and South Ballona Creek Levees. A pedestrian trail would be set off of the levee tops toward the restored wetlands following the wetland perimeter, traversing away from the levee road and around the upland peninsula to provide better views of the wetland landscape and wildlife.

3.15.2.3 Area C

As shown in Figures 3.28 and 3.29, an approximately 3,800-linear-foot pedestrian loop trail system would be incorporated into the North Area C upland hills, following material placement and grading, including an approximately 1,400-linear-foot loop trail on the west side of the improved Fiji Ditch riparian corridor and another 2,400-linear-foot loop trail on the east side of the riparian corridor. Secondary entrances to the trails would be provided from Culver Boulevard, Lincoln Boulevard, and the housing complex located immediately north of the site. Trail placement would be designed to facilitate both better views of the Ballona Reserve landscape and management, maintenance, and emergency access. The pedestrian trail in Area C would connect to Area A via a new bridge across Lincoln Boulevard near the intersection with Culver Boulevard.

A pedestrian loop trail system would be incorporated into South Area C following material placement and grading. Secondary entrances to the trail would be provided from the bike path along the Ballona Creek levee and from Culver Boulevard near the baseball fields.

3.15.3 Bridges

A new bicycle and pedestrian bridge over Ballona Creek would be constructed adjacent to the Culver Boulevard vehicular bridge between Area A and North Area B. The bridge would be 25 feet wide and would include an 11-foot wide pedestrian path, 10-foot wide bicycle path, and 2-foot wide shoulders. The

bridge would connect the existing Ballona Creek Bike Path to the proposed Ballona Reserve pedestrian and bicycle path system. An overlook would be provided, with interpretive signs highlighting information about the rerouting of Ballona Creek. A new pedestrian bridge would also be provided over Lincoln Boulevard connecting Area A with North Area C. The bridges would serve two purposes. During construction, the bridges would allow movement of soil from Area A to Areas B and C, reducing the need to use surface streets such as Culver Boulevard and Lincoln Boulevard. After construction is completed, the bridges would allow visitors to cross Ballona Creek and Lincoln Boulevard using paths and trails within Ballona Reserve.

3.15.4 Maintenance Roads and Fire Access

Maintenance routes would provide access to the Ballona Reserve for maintenance and emergency vehicles and access to SoCalGas facilities within the Ballona Reserve, primarily using the levee-top bicycle paths. Controlled access points to the levee-top paths would be provided for use by Ballona Reserve management, maintenance, SoCalGas, and emergency vehicles only.

Improved access would also be constructed in West Area B behind the commercial businesses along Culver Boulevard for emergency vehicles and bus access to the West Culver Parking Lot, as well as for public access within designated daylight hours.

3.15.5 Overlooks

Overlooks would be positioned along paths and trails to provide views and information about the Ballona Reserve (see Figure 3.33). Overlooks would include informational signage and, in some locations, directional signs. Benches to accommodate small groups would also be included in some locations.

3.16 ENGINEER'S ESTIMATES

Preliminary estimates of earthwork quantities have been developed based on the preliminary grading plans and design approaches described in this PDR. Engineer's estimates of construction costs will be developed subsequently.

3.16.1 Earthwork Quantities

The engineer's estimate of earthwork volumes is provided in Table 3.3. At this preliminary design level, the earthwork volume estimates indicate that the project will include excavation of about 2,400,000 cubic yards of material (in-place). Material for creation of levees, upland transitional habitat, and marsh topographic features including islands, berms, pans, and seasonal wetlands will include placement of 1,230,000 to 1,360,000 cubic yards of excavated material (based on in-place excavation volumes adjusted for density changes). The net placement in the onsite upland fill placement areas in Area C is about 1,060,000 cubic yards with 10,000 to 110,000 cubic yards of off-site export.

Mass earthwork volume estimates were prepared using AUTOCAD Civil 3D software by examining volumetric differences between existing grade based upon the site base topography prepared by PSOMAS and the preliminary grading plans for presented in previous sections. The mass grading estimates were further refined to account for density changes between in-place excavation of primarily, loosely consolidated material in Area A to compacted fill placed in lifts primarily for levees and stability berms. At this preliminary stage, a volumetric reduction of 15 to 25 percent was assumed between in-place excavation and in-place fill. In addition, settlement estimates for levees in Area A and Area B were incorporated into estimates of levee core volumes reflecting about 2 inches of settlement per foot of fill. Estimates of volumetric changes due to compaction and settlement were based upon recommendations documented in the Geotechnical Design Report (Appendix B). Earthwork estimates for levees also reflected the geotechnical recommendations for subgrade preparation including over-excavation and compaction.

Estimates for excavation of tidal channels within Area A and North Area B assumed that all channel material excavated from these areas would be utilized to create upland transitional fill or placed in the Area B and C fill placement areas. Channels excavated in West, South, and East Area B assumed that all excavated material would be side cast to create low berms adjacent to the excavated channels. This approach limits the need to truck material out of these areas that currently support sensitive existing marsh habitat.

The preliminary earthwork estimates do not reflect special handling of any materials that do not meet the wetland cover or upland cover standards or any hazardous materials. Following additional soils analyses to better understand the level and extent of any existing impacts and consultation with the regulating agencies regarding appropriate standards for materials classification, handling, and cover depths, the earthwork quantities will be refined to reflect any special handling that is anticipated. At this stage, we have assumed that 10,000 to 110,000 cubic yards of material may be off hauled for disposal offsite including any potentially hazardous materials.

Table 3-3 Alternative 1 Earthwork Estimate

Phase	Area	Estimated Earthwork Volumes (cubic yards)			Notes
		Cut	Fill	Cut/Fill Balance Transport (Cut-Fill)	
Phase 1	Area A*	1,730,000	(330,000) to (360,000)	1,400,000 to 1,370,000	Excavation for wetland restoration Placement for levee construction Transport to Area B and North Area C
	North Area B	310,000	(530,000) to (570,000)	(220,000) to (260,000)	Transport from Area A Excavation for wetland restoration Placement for levee construction Placement/stockpiling for Phase 2 levee construction
	East Area B	—	(50,000) to (80,000)	(50,000) to (80,000)	Transport from Area A Placement for upland restoration Placement/stockpiling for Phase 2 levee construction
	South/Southeast Area B	10,000	(10,000)	—	Transport from Area A Excavation for channel enhancements Placement for berm construction
	North Area C	40,000	(760,000)	(720,000)	Transport from Area A Placement for upland restoration
	South Area C	—	(300,000)	(300,000)	Transport from Area A Placement for upland restoration
	Subtotal	*2,090,000*	*(1,980,000) to (2,080,000)*	*10,000 – 110,000*	*Potential for off-site export of 10,000 to 110,000 cubic yards*
Phase 2	North Area B	190,000	—	190,000	Excavation of stockpiled soil for west Area B levee construction
	East Area B	50,000 to 80,000	—	50,000 to 80,000	Excavation of stockpiled soil for west Area B levee construction Transport to west Area B
	West Area B	70,000	(310,000) to (340,000)	(240,000) to (270,000)	Excavation for levee lowering/breaching and channel enhancements
	Subtotal	*310,000 to 340,000*	*(310,000) to (340,000)*	—	*On-site balance of cut and fill*
Total		***2,400,000 to 2,430,000***	***(2,290,000) to (2,420,000)***	***10,000 – 110,000***	***Potential for off-site export of 10,000 to 110,000 cubic yards***

NOTES: Fill placement volumes account for compaction of lower-density soil excavated from Area A when it is placed and compacted to a higher density in a fill placement area. Note that with projects that have levee fill volumes of several hundred thousand cubic yards, slight changes in the degree of slope or the width of the levees could greatly affect the amount of excess soil that would be created.

* Estimates are based on Option 1 in Phase 2 of Alternative 1, in which Area A wells would be removed and the Area A restoration would be completed in Phase 2.

SOURCE: ESA, 2014.

4. PRELIMINARY DESIGN - ALTERNATIVE 2 – PARTIAL RESTORATION

Alternative 2 – Partial Restoration is generally similar in scope to Phase 1 of Alternative 1 – Full Restoration, as shown in Figure 1.5. The major difference between Alternative 1 and Alternative 2 is that under Alternative 2, West Area B would remain in its existing condition and would not be restored to full tidal exchange. Differences between Alternative 2 and 1 are highlighted below.

Design details for the following areas and elements are the same under Alternative 2 and described in Alternative 1 (see Section 3): Ballona Creek, Area A, North Area B, South and Southeast Area B, Tidal Channels (excluding West Area B), and Stormwater Management.

4.1 DIFFERENCES FROM ALTERNATIVE 1

4.1.1 West Area B

Under Alternative 2, West Area B will not be restored and will remain as is with a muted tidal regime controlled by the existing water control structure. The existing levee along the south bank of Ballona Creek will remain in place, and a new North/West levee (same as the Interim Levee in Alternative 1) would connect the existing Ballona Creek levee to the new Culver Boulevard levee to complete the flood protection around West Area B.

4.1.2 East Area B

Soil excavated to restore wetlands in Area A would be placed in East Area B. Proposed grading in East Area B is shown in plan and in section on Figures 4.1 and 4.2. Existing elevations in East Area B are 5 to 15 feet below street level and range from about 6 to 12 feet NAVD. Fill placement would raise the elevations from about 8 feet NAVD at the western end up to 20 feet NAVD at the northern end near the existing levee. Corresponding fill heights would range from a few feet at Lincoln & Jefferson to about 14 feet above existing grade near the Lincoln and Culver bridges. The proposed grades would be no more than 8 feet above the adjacent street level. The upland restoration areas would be graded so that rainfall would flow into seasonal wetland depressions around the perimeter of the fill areas to provide water quality treatment and habitat.

4.1.3 North and South Area C

Restoration of North and South Area C would be similar to that described under Alternative 1. Grading plans for North and South Area C are shown on Figure 4.3. Soil excavated to restore wetlands in Area A would be placed in North and South Area C to create elevated areas of upland habitat. Within Area C North, soil would be filled up to an elevation between EL 40 and 52 feet NAVD raising existing grades by 17 to 34 feet.

In South Area C, fill would be placed across the site. The baseball fields would be rebuilt on the higher grades if external funding becomes available for construction, operation and maintenance. Up to about 13

to 25 feet of soil would be placed to raise elevations up to between 38 and 45 feet NAVD. The upland areas would be graded so that rainfall would flow into and support seasonal wetlands and other upland habitats in Area C. Side slopes of the upland areas would vary from about 3:1 to 20:1.
Fiji Ditch would be realigned and riparian habitat would be created as described in Alternative 1. Storm drainage in Area C South and North would also be routed to the realigned Fiji Ditch as in Alternative 1.

4.1.4 New Perimeter Levees

The levee design details are the same under Alternative 2 as under Alternative 1, with the exception that the West Area B Levee would not be constructed and the Interim Levee would be built as a permanent levee.

4.1.4.1 Culver Levee

The new Culver Boulevard levee would extend from the south end of the Culver Boulevard Bridge, where it would tie in to the existing Ballona Creek channel levee, along Culver Boulevard to just west of the intersection of Culver Boulevard and Jefferson Boulevard, where it would tie into the North/West Area B Levee (Figures 1.5 and 4.1). The Culver Boulevard levee would be constructed similar to the Alternative 1 Phase 2 levee including a wide plateau between Culver Boulevard and the old railroad alignment, and a 20-foot top-width section along Culver Boulevard. The levee design section and armoring would be similar to Alternative 1, Phase 2.

The Culver Boulevard levee would have a higher crest (EL 19.5 ft NAVD) to provide similar levels of freeboard for Alternative 2 as described for Alternative 1. The intent is to provide at least 2 feet of freeboard above the highest modeled water surface elevation, i.e. a Design Flow of 46,000 cfs, a tail water of EL 7.6 ft NAVD adjusted for 59 inches of sea level rise, and with the channel bed aggraded by 59 inches. The final crest elevation would be determined following the risk and uncertainty analysis in consultation with Los Angeles County and the Corps.

4.1.4.2 North/West Area B Levee

The North/West Area B Levee is similar to the Interim Levee described in Alternative 1, Phase 1. The North/West Area B would connect the Culver Boulevard levee to the existing southern Ballona Creek channel levee just north of the existing natural gas monitoring well cluster in West Area B (Figures 1.5 and 4.1). Similar to the Alternative 1 Interim Levee, The North/West Area B Levee would be constructed with 5:1 side slopes along Ballona Creek. Subgrade preparation would be similar to the Interim Levee discussed in Alternative 1, Phase 1. The North/West Area B Levee would incorporate buried rock or soil cement armoring along much of its length (Figure 3.19). Rock facing would be used at the tie in with the southern Ballona Creek channel levee.

4.1.5 Water Control Structures

Alternative 2 water control structures are the same as those described in Alternative 1 (Figure 3.23) with the following exceptions:

- Structure 1 – Would not be included (as this structure would not be required)

- Structure 2 – New culverts would be shorter, extending to the north side of Culver Boulevard. Also the number of culverts would be reduced from Alternative 1 to one to two 42-inch dia. culverts.

4.1.6 Natural Gas Storage Facilities

Alternative 2 would decommission existing gas wells within the Ballona Reserve and abandon or modify gas pipelines as in Alternative 1, Phases 1 and 2, except for in West Area B. In West Area B, well abandonment would not be required for Alternative 2; however, abandonment of the remaining wells would still be desired in all cases as part of the overall restoration and improvement of the Ballona Reserve. SoCalGas would continue to proceed with well abandonment per its decommissioning plans; however, the specific timing of the remaining SoCalGas activities would not be driven by the restoration.

4.1.7 Public Access Facilities

Improvements to public access, recreation, environmental education, and interpretative opportunities within the Project site would be comparable to those described for Phase 1 of Alternative 1 (Figure 3-28).

Alternative 2 would include a bike path and pedestrian trail around East Area B that connects to the bike and pedestrian bridge at Culver Boulevard and the trail that runs along the south Ballona Creek channel levee and the Culver Levee. As a part of this Alternative, the bike path would be constructed only within the Project's boundaries. Connections to paths or potential paths external to the Reserve are not part of Alternative 2. All other public access and visitor facilities improvements would be as described under Alternative 1.

Additionally, Alternative 2 would raise the existing elevation of the baseball fields and replace the existing fields with three new fields, if external funding becomes available for this purpose. Depending on the receipt of funding, this analysis assumes that the fields would include one 90-foot diamond and two 60-foot diamonds. The existing baseball fields occupy approximately 6.2 acres of land primarily devoid of vegetation. The replacement fields would occupy approximately 5.5 acres and be planted with a typical athletic turf grass.

4.2 ENGINEER'S ESTIMATES

Preliminary estimates of earthwork quantities have been developed based on the preliminary grading plans and design approaches described in this PDR. Engineer's estimates of construction costs will be developed subsequently.

4.2.1 Earthwork Quantities

The engineer's estimate of earthwork volumes is provided in Table 4.1. At this preliminary design level, the earthwork volume estimates indicate that the Alternative 2 of the project would include excavation of about 2,090,000 cubic yards of material (in-place). Material for creation of levees, upland transitional

habitat, and marsh topographic features including islands, berms, pans, and seasonal wetlands will include placement of 700,000 to 760,000 cubic yards of excavated material (based on in-place excavation volumes adjusted for density changes). The net placement in the onsite upland fill placement areas in East Area B and Area C is about 1,420,000 cubic yards with up to 10,000 cubic yards of off-site export.

Quantities for Alternative 2 were computed with similar methods as Alternative 1:

- Mass earthwork volume estimates was prepared using AUTOCAD Civil 3D.
- Density changes for levee construction were estimated as a volumetric reduction of 15 to 25 percent was assumed between in-place excavation and in-place fill.
- Levee settlement was assumed to be about 2 inches of settlement per foot of fill.
- Material excavated for tidal channels within Area A and North Area B would be utilized to create upland transitional fill or placed in the Area B and C fill placement areas.
- Material excavated for channels excavated in South, and Southeast Area B assumed that all excavated material would be side cast to create low berms adjacent to the excavated channels.

Under Alternative 2, the preliminary earthwork estimates included an assumption that 10,000 cubic yards of material may be off hauled for disposal offsite. Depending upon the results of additional soils testing and consultation with regulatory agencies off-haul may be increased if hazardous materials area encountered during detailed investigations or construction.

Table 4-1 Alternative 2 Earthwork Soil Volume

Area	Estimated Earthwork Volumes (cubic yards)			Notes
	Cut	Fill	Cut/Fill Balance Transport (Cut-Fill)	
Area A	1,730,000	(330,000) to (360,000)	1,400,000 to 1,370,000	Excavation for wetland restoration Placement for levee construction Transport to Area B and North Area C
North Area B	310,000	(360,000) to (390,000)	(50,000) to (80,000)	Transport from Area A Excavation for wetland restoration Placement for levee construction
East Area B	—	(340,000)	(340,000)	Transport from Area A Placement for upland restoration
South/Southeast Area B	10,000	(10,000)	—	Transport from Area A Excavation for channel enhancements Placement for berm construction
North Area C	40,000	(540,000)	(500,000)	Transport from Area A Placement for upland restoration
South Area C	—	(540,000)	(540,000)	Transport from Area A Placement for upland restoration
Total	***2,090,000***	***(2,120,000) to (2,180,000)***	***0 to 10,000***	*On-site balance of cut and fill expected with potential for off-site export of up to 10,000 cubic yards*

NOTE: Fill placement volumes account for compaction of lower-density soil excavated from Area A when it is placed and compacted to a higher density in a fill placement area. Note that with projects that have levee fill volumes of several hundred thousand cubic yards, slight changes in the degree of slope or the width of the levees could greatly affect the amount of excess soil that would be created.

SOURCE: ESA, 2014.

5. PRELIMINARY DESIGN - ALTERNATIVE 3 – LEVEE CULVERTS AND OXBOW

Alternative 3 would have a substantially smaller project footprint than Alternatives 1 or 2. Under Alternative 3, restoration would be focused in Area A and Area C only, as shown in Figure 1.6. All other areas (Ballona Creek, North Area B, West Area B, East Area B, and South and Southeast Area B) would remain as they are under existing conditions.

5.1 DIFFERENCES FROM ALTERNATIVE 1

5.1.1 Area A

In Area A, the existing Ballona Creek levee would be maintained and wetland restoration would be setback from the levee and connected via culverts in the levee as shown in Figures 1.6 and 5.1. Soil would be excavated to create marshplain near the existing Ballona creek levee fringed by a transition zone and upland to a perimeter levee crest along Fiji Way similar to Alternative 1.

Along the existing levee, excavation would be offset by a minimum of 100 feet to limit impacts to this levee and employ 10-20H:1 slopes down to the restored marshplain. The excavated soil would be used to build a perimeter levee similar to Alternative 1. Excess soil would be exported off-site via trucking or possibly barge.

An oxbow channel would be constructed within Area A and connected to Ballona Creek via two banks of culverts installed in the Ballona Creek levee. Channel depths would be similar to existing channel depths, ranging from about 2 to 8 feet below MLLW (channel bed invert elevation of about -2 to -8 feet NAVD). The restored oxbow channel would have a top width of approximately 250 feet. The channel banks would be graded to slopes of approximately 5:1 to provide mudflat and low marsh habitat. Once constructed, the majority of the earthen oxbow channel would not be confined to a rigid alignment. Some gradual channel migration and localized erosion and sedimentation would occur. The overall channel location would be guided by the sloping restored marshplain and adjacent upland habitats.

5.1.2 Water Control Structures

Two new water control structures would be installed in the existing north Ballona Creek channel levee to connect Ballona Creek to the oxbow and floodplain. The culverts would be sized to provide tidal flows from Ballona Creek to Area A. Each of the two banks of culverts in the levee would consist of multiple culverts and gates (e.g., six 5-foot-diameter culverts with gates). The gates would be adjustable and allow for management of flows in and out of the two structures and management of water levels (e.g., for seasonal habitat management and to limit extreme water levels).

5.1.3 North and South Area C

In Area C, upland habitat would be enhanced without grading. Enhancement would include invasive removal and replanting.

5.1.4 Public Access Facilities

Access facilities would include construction of three primary entrances into the Ballona Reserve with adjacent parking, new trails, new interpretive features, and park amenities (e.g., benches). Improvements to public access, recreation, environmental education, and interpretative opportunities within Area A and Area C would be comparable to those described for Alternative 1 (Figure 3.29). Within in West Area B, public access improvements would include the West Culver Parking Lot improvements as described in Alternative 1.

Alternative 3 would not include any new pedestrian and bicycle paths south of Ballona Creek in Area B. The existing bicycle and pedestrian access would remain along the north side of existing Ballona Creek channel, with a new access loop around the new Area A perimeter levee. All other public access and visitor facilities improvements would be as described under Alternative 1.

5.2 ENGINEER'S ESTIMATES

Preliminary estimates of earthwork quantities have been developed based on the preliminary grading plans and design approaches described in this PDR. Engineer's estimates of construction costs will be developed subsequently.

5.2.1 Earthwork Quantities

The engineer's estimate of earthwork volumes is provided in Table 5.1. At this preliminary design level, the earthwork volume estimates indicate that the Alternative 3 of the project would include excavation of about 1,420,000 cubic yards of material (in-place). Material for creation of levees around Area A will include placement of about 190,000 cubic yards of excavated material (based on in-place excavation volumes adjusted for density changes). Up to 1,230,000 cubic yards of remaining material would be exported off-site.

Quantities for Alternative 3 were computed with similar methods as Alternative 1:

- Mass earthwork volume estimates was prepared using AUTOCAD Civil 3D.
- Density changes for levee construction were estimated as a volumetric reduction of 15 to 25 percent was assumed between in-place excavation and in-place fill.
- Levee settlement was assumed to be about 2 inches of settlement per foot of fill.
- Material excavated for tidal channels within Area A would be utilized to create upland transitional fill or transported off-site.

Under Alternative 3, the preliminary earthwork estimates include up to 1,230,000 cubic yards of material that would be off hauled for disposal offsite. Depending upon the results of additional soils testing and consultation with regulatory agencies a portion of this off-haul (roughly 10,000 to 110,000 cubic yards) may include hazardous materials for regulated off-site disposal.

ALTERNATIVE 3 EARTHWORK SOIL VOLUME

Area	Estimated Earthwork Volumes (cubic yards)			Notes
	Cut	Fill	Cut/Fill Balance Transport (Cut-Fill)	
Area A	1,420,000	(190,000)	1,230,000	Excavation for wetland restoration Placement for levee construction
Total	***1,420,000***	***(190,000)***	***1,230,000***	***Off-site export of 1,230,000 cubic yards***

NOTE: Fill placement volumes account for compaction of lower-density soil excavated from Area A when it is placed and compacted to a higher density in a fill placement area. Note that with projects that have levee fill volumes of several hundred thousand cubic yards, slight changes in the degree of slope or the width of the levees could greatly affect the amount of excess soil that would be created.

SOURCE: ESA, 2014.

6. CONSTRUCTION METHODS AND PHASING

6.1 CONSTRUCTION METHODS

There are several important considerations affecting construction:

- Transporting soil between Area A and Areas C and B, which entails crossing Ballona Creek and/or busy roadways;
- Lowering and breaching existing levees to inundate Areas A and B, and the new channel meanders;
- Using soil bearing and construction equipment with groundwater elevation high relative to finished grades, which will affect the feasibility of using conventional construction equipment.
- Excavating channels and filling berms, which entails excavating channels in existing wetland;
- Re-aligning the Ballona Channel, which entails filling the existing flood control channel;
- Ensuring stability of the existing levee along the north side of Ballona Creek during excavation of Area A;
- Relocating interfering utilities;
- Constructing or supporting new drainage facilities to avoid upstream drainage impacts;
- Interim stockpiling of soils between phases;
- Drying of soils to re-use as structural fill;
- Operating during environmental windows and waiting for habitat establishment (previously discussed);
- Clearing and grubbing to allow for grading and treatment of invasive vegetation removed;
- Revegetating restored habitats;
- Abandoning gas wells and the replacement process;
- Other considerations.

These considerations are addressed in the following sections.

6.1.1 Soil Transport

The intent of the Alternative 2 grading design is that at the completion of construction, excavation and fill will be balanced on-site. The final design for Alternatives 1 and 3 could also mix and match grading plans in Area C and East Area B to achieve this as well. This means that no import or export of soils is anticipated other than if contaminated soils are discovered at levels that require offhaul and offsite disposal. And volumes for these are expected to be negligible from a grading quantities standpoint. Therefore truck routes and other transport methods should be limited to the projects areas and the immediately adjacent roadways. A series of exhibits are provided showing the routing options expected in Appendix I.

Soil transport is expected to be accomplished using one or more of the methods identified in Table 6.1. The likelihood of different construction methods will be revisited based on additional geotechnical analysis of soil conditions.

Wheeled scrapers and trucks can traverse adjacent roadways, but the strong preference is to provide routes that avoid roadways. This puts a premium on installation of a bridge or crossing across Ballona Creek, and a temporary bridge across Lincoln Boulevard. Both options are available, which could leave the transport of soils to the uplands areas of East Area B as the only area that would require transport on roadways. The relatively small volumes of soils this area is capable of accepting may make it cost prohibitive to do anything other than simply crossing Culver Blvd.

Table 6-1 Earthwork Transport Options

Method	Associated with	Cost	Conditions	Application
Scrapers	Self contained	Low unit cost	Dry, firm, open	Within Area A, and if possible to Area C and portions of Area B,
Trucks	Excavators, Dozers	Moderate unit costs, with multiple handling		Possible means to reduce impacts to crossings between areas and support to other methodology listed
Conveyor	Excavators, Dozers, Trucks	Moderate unit cost plus mobilization	Confined without vehicular access	Possible means of crossing Ballona Creek and roads
Low ground pressure	Excavators, Dozers, Trucks, Mats	High unit cost	Wet, weak	Anticipated for areas below groundwater elevation, wetland channel excavation and sidecast berms
Hydraulic	Dredge	High mob, low unit cost	Open water, ample water supply	Not anticipated but possible in lowest areas

Photographs of a conveyor in operation are provided in Appendix J.

6.1.1.1 Across Ballona Channel

Methods for moving earth across Ballona Channel are provided in Table 6.2.

Table 6-2 Ballona Creek Crossing Methods

	Appropriate Equipment			
Method	**Expected**	**Possible**	**Conditions**	**Application**
Existing Bridge	Trucks	Scrapers	Road closures, restricted hours	Use Culver, close one direction during selected dates and times
Temporary Bridge	Trucks, Scrapers	Conveyor	Mobilization	Use old railway alignment to cross Lincoln and or Ballona Creek
Barge / floating crossing	Scrapers, Trucks	Conveyor	Mobilization, dry season	Straight between Areas A and B across Ballona; wide enough for scrapers
Temporary ford	Scrapers, Trucks	Conveyor	Mobilization, dry season	Two options: (1) straight between Areas A and B and (2) along north bank under Culver and Lincoln Bridges

Permanent Bridge	Scrapers, Trucks	Conveyor	Mobilization, phasing	Crossing Ballona Creek
Culvert	Conveyor		Limited space, dry season	Fiji channel from Area A under Lincoln to North Area C under Culver to South Area C

6.1.1.2 Across Roadways

Additional consideration is needed to determine how to get earth between Culver and Jefferson Blvds using Ballona Crossings other than the existing Culver roadway or a new bridge that crosses Culver as well.

6.1.2 Levee Lowering and Breaching

Levee lowering involves a phased removal of earth to maximize the quantity that is moved prior to breaching and to limit the risk of uncontrolled breaching. The figure "Levee Lowering" in Appendix J shows how this work is staged. In multi-year construction, the minimum section of earth levee to remain through the winter is specified (e.g. "Phase 2" in drawing). The construction contractor is also required to sequence his work to prevent site inundation, and typically does this by leaving a small raised area (e.g. the "check berm" in the photograph) until final earthwork. The final earthwork often consists of dozer operation to quickly remove the check berm and side cast earth into the site. This last work may be timed for a neap tide (approximately one week period) and staged to maintain egress along portions of the levee (that is, consideration of access and breach locations) to facilitate phased lowering as portions of the project are completed. Alternatively the contractor may use steel sheet pile coffer dams along the levee to allow for levee lowering at all tide levels.

Breaching is also phased, similar to levee lowering. If possible, shoring is avoided because installation and removal induce additional environmental impacts and costs. The breaching is usually accomplished by two long reach excavators working on the lowered levee on either side of the breach to be excavated. At first, earth may be loaded to trucks and taken elsewhere. However, once the levee section is reduced to the point of incipient breaching at the next high tide, the operation shifts into a high production rate mode with excavated material sidecast. Often, other excavators and low-ground pressure dozers re-handle the side cast earth and displace it farther away from the breach, thereby limiting the height of the side cast and maximizing the excavation rate. The work continues until the breach is excavated or the tides approach the levee surface. For larger breaches, multiple days or weeks may be required, resulting in relatively high potential velocities. In this case, an internal and potentially external earth berm (sometimes called a "donut" or "dredge lock") can be constructed to limit the area of impact during construction. Steel sheet pile coffer dams may also be used to limit tidal inundation of breach excavations. See Figure "Breaching" in Appendix J.

6.1.3 Soil Bearing and Construction Equipment

Much of the Ballona earthwork may be accomplished by traditional land based equipment. In particular, the maximum use of scrapers will provide the greatest economy.

Wetland restoration construction requires special equipment and construction methods. High groundwater and weak soils can preclude use of traditional land equipment and increases the unit costs of construction. The Construction Equipment figure in Appendix J provides pictures of some examples. These are as follows:

- Low ground pressure: smaller, lighter equipment with large surface area tires or treads that reduce bearing pressure.
- Mats: Timber planks (thick) lashed together and moved by bucket-type equipment.
- Long reach excavator: Track or wheel mounted excavator with a long arm and small bucket to allow extended reach to over 40 feet.
- Clamshell and Dragline Crane: Usually track mounted, can reach 60 feet or more.
- Amphibious Excavator: Can float, and can excavate in shallow standing water.
- Rotary Ditcher: Excavates with rotating wheels that spray sediment across adjacent areas, resulting in a narrow ditch. Typically pulled behind other equipment but can be self-propelled.
- Floating equipment: Cranes and excavators can be floated on barges for both transport and operation. Equipment can be trucked in and assembled to work in land-locked water bodies.
- Hydraulic dredge: A water and sediment mixture can be excavated and pumped. (Not expected in this project)

6.1.4 Tidal Channel Excavation and Earth Berm / Terrace Fill

ESA has developed and implemented approaches for restoring tidal marsh morphology using limited earthwork, strategically configured to limit costs and intervention, that lead to enhanced and more rapid habitat establishment. Tidal channel and marsh berm construction are one of the tools used. The concept is depicted in the Tidal Channel and Berm Figure in Appendix J. Channels are excavated and material side cast to form low height, flat sloped embankments (berms). The berms are shaped by the excavation bucket and or other equipment, but are not typically compacted. An exception is berms placed above tidal wetland for riparian or wetland forest habitat, which are more readily compacted.

6.1.5 Ballona Channel Realignment

The project includes a realignment of Ballona Channel from a straight to a meandering planform. This will require filing the existing channel. We anticipate that this can be accomplished with the following construction sequence:

- The new channel is excavated
- The new channel is breached
- The old channel is blocked on the upstream and downstream ends, with flows bypassing to the new channel
- The old channel is filled between the blocked areas.

Blocking the channel can be accomplished in several ways:

- Rubble fill: A rock dike is constructed with floating equipment or “over the top” from land. The rock is graded to have a wide range of sizes, limiting contiguous voids and subsequent sediment migration.
- Sheet piling is placed. The plan form could be a linear wall with steel or concrete, or have a cellular structure with steel.
- Precast concrete gravity structures, interlocking
- Use of temporary fabric and sheet structures such as:
  - Water or soil filled fabric tubes
  - Metal frames and plastic sheets.

Filling the blocked channel can be accomplished several ways:

- Dumping of earth from the sides; and building out
- Hydraulic slurry of sands, with subsequent earth moving above water
- Land based equipment in a dewatered condition.

Figure “Fill in Water” in Appendix J shows how islands and port fills are constructed.

Given that the Area A earth source is above grade and primarily silty, use of hydraulic dredge methods is not preferred, but may be necessary in certain areas. Given that Ballona Creek is shallow and relatively calm water, use of temporary fabric and sheet structures may be preferred. Dewatering of the fill area may be practical, and land based equipment may be used.

6.1.6 Construction Period Levee Stability

Construction period levee stability will be addressed by staged construction with geotechnical recommendations.

Levee construction often requires a phased construction to compensate for settlement and to avoid overloading the subgrade and causing shear failure and mass movements. The increased weight of an earth levee will typically result in consolidation of underlying soils and settlement. The increased weight will also increase the shear stresses in the foundation soils, and can cause shear failure and deformation, and greatly compromise the levee construction. Consequently, levee construction often requires a second construction phase one or more years later to compensate for settlement. The risk of slope failure can be reduced and the rate of construction increased by using flatter slopes. Conceptually, placing more material with a flatter slope reduces the gradient in loading and the maximum shear stress in the underlying earth. The Levee figure in Appendix J shows examples of mud levees on weak soils with “stability berms.” Stability berms are an additional mass, typically in the form of a bench or terrace, beyond the “core” of the levee. The stability berms can provide attributers such as ecologic ecotone, wave protection and access. The Levee figures and photos in Appendix J show a two phase construction with anticipated initial settlement.

6.1.7 Clearing and Grubbing and Invasive Plant Material Treatment

Vegetation will be cleared and grubbed prior to grading. Native plants can be salvaged and reused for revegetation of restored areas. Invasive plants will be stockpiled on-site and treated (e.g., composted). The preferred approach will be to bury invasive plant material in upland fill areas at a depth below which the invasive vegetation can reestablish. WRA's draft RAMP discusses this consideration, and future phases of the design will detail the approach for handling invasive vegetation.

6.1.8 Revegetation

WRA has developed a draft Conceptual Restoration and Adaptive Management Plan (RAMP) that includes a conceptual revegetation plan and outlines revegetation design considerations. The RAMP and subsequent revegetation design will be incorporated into future phases of the Project design. Revegetation of restored wetland areas will rely on natural recruitment (see Section 2.5.1), with the possibility of targeted installation of salt marsh vegetation as discussed in the RAMP. Transition zone and upland habitats will require active revegetation and irrigation. The suitability of topsoil for target vegetation is an important consideration (see Section 2.2.3) and management of topsoil may be required, particularly for revegetated upland areas where soil amendment or leaching of soil salinity may be needed.

6.1.9 Gas Well Abandonment and Replacement Process

The following information was provided by SoCalGas on the process for abandoning gas wells and drilling new wells to replace abandoned wells.

6.1.9.1 Site Preparation

Access Roads: Two inches of compacted ¾-inch base rock will be used to bring the access roads to the wells. The roads will be 12 feet in width on the straightaways and 20 feet in width at the corner of the turns, and capable of supporting standard highway permitted trucks up to 80,000 pounds.

Well Site Locations: Two inches of compacted ¾-inch base rock will be used to create a work pad 120 feet by 170 feet centered at the wellhead.

The project duration will require a minimum of five (5) working days per well.

The following parameters are required to effectively provide for the abandonment of gas storage wells operated by SoCalGas in the Ballona Wetlands:

- Certain well abandonments will need to be undertaken before the levees are removed, to avoid flooding of the wellsite locations.
- Other wells will need to be abandoned prior to grading activity.
- If wells are being replaced, replacement wells must be drilled and determined to be successful before the well being replaced is abandoned.

Once the wells are abandoned, the restoration of the wellsite locations can be undertaken in conjunction with the planned restoration grading and site construction planned by the Ballona Wetlands Restoration Project.

6.1.9.2 Well Abandonment

Well abandonment should be undertaken after the access road and the well site location have been prepared. The process of abandoning a well includes bringing in a workover rig to remove downhole piping and setting cement plugs to isolate the producing zones. The wellhead is removed and the well casing is cut and capped approximately five (5) feet below grade. All concrete cellar material and piping is then removed.

Each well abandonment will require a minimum of 30 to a maximum of 45 12-hour work days (8 AM to 8 PM) to complete.

The following equipment will be required to complete the well abandonment work:

1 - Mobile Production Rig with 106-foot high mast
1 - Mobile Rig Pump with engine and circulating pit with shaker
1 - Solids Bin
1 - Rig Equipment Truck
1 - Portable Generator
1 - Rig Crew Trailer
2 - 500 bbl portable liquid storage tanks
1 - Roll Off Trash Bin
2 - Roll Off Cement Bins
1 - Portable Restroom and Service Truck
1 - Cement Pump Truck
1 - Bulk Cement Truck
3 - Wireline Logging Trucks (USIT/perforating/Misc. tools)
1 - 120 bbl or 80 bbl Vacuum Truck
6 - Service Pickup Trucks (various onsite contractors)
1 - Delivery Truck (Tractor/Flatbed Trailer)
1 - Stinger Truck with flatbed trailer

Each wellsite will need to be accessible to install soil gas monitoring probes and monitor for gas leakage for two months following abandonment. If no gas leakage is detected during the initial two month period following abandonment, direct access to the well will no longer be required. If gas leakage is detected, deeper probes will need to be installed and monitored for six months. After it has been determined that there is no further gas leakage, the probes can be removed. SoCalGas will continue to conduct well gas leakage surveys on each abandoned well every six months. In the case of the well subsequently being submerged under water, another means of monitoring the well will be determined, such as checking for gas bubbles percolating in the water above the abandoned well.

If well leakage occurs that requires re-abandonment, then the appropriate responsible entity (SoCalGas or the State) will re-establish roads and wellpads to execute such work.

6.1.9.3 Drilling New Well

The process of drilling a new well involves moving in a large rig capable of working 24 hours per day and having the necessary equipment to drill and install casing. The drilling rig is moved in on as many as 30 flatbed trucks and then assembled on location. Prior to move in, a cellar is first dug and shored using a cellar ring or concrete walls. Then a conductor pipe is installed in the ground and the drilling rig is rigged up. The drilling operation involves directional drilling a hole to the zone of interest. Once the hole is drilled to the proper depth, casing is installed and cemented in place. The drilling rig is then disassembled and moved out of the location. A smaller work-over rig is then needed to complete the well by installing tubing and other completion equipment.

Each new well will require a minimum of thirty-five to a maximum of fifty 24-hour work days.
The following equipment will be required to complete the drilling of a new well:

- 1 - Drilling Rig with substructure, catwalk, drawworks, 149-foot high mast, with 11-inch Class IIIB 5M BOPE
- 2 - Skid Mounted Rig Pumps
- 1 - 600 bbl Mud Pit with shakers, circulating pumps, mud cleaner, centrifuge, mud mixing dock
- 2 - Solids Bins for drill cuttings
- 3 – Diesel (or NatGas powered) Electric Generators with SCR House
- 1 - Accumulator Unit
- 1 - Top Drive Power Unit
- 1 - Dog House/Tool Room/Crew Change Room
- 2 - Portable Generators
- 4 - 500 bbl portable liquid storage tanks
- 1 - Cement Pump Truck(s)
- 1 - Bulk Cement Truck(s)
- 3 - Wireline Logging Trucks (Open Hole Logging/USIT/perforating/Misc. tool running)
- 2 - 120 bbl or 80 bbl Vacuum Truck
- 1 - Roll Off Trash Bin
- 2 - Roll Off Cement Bins
- 1 - Portable Restroom(s) and Service Truck
- 8 - Service Pickup Trucks (various onsite contractors)
- 2 - Delivery Trucks (Tractor/Flatbed Trailer)
- 1 - Stinger Truck with flatbed trailer
- 4 - Residential Trailers (for onsite supervision)
- 1 - Mud Logging Trailer/Unit
- 1 - Directional Drilling Trailer/Control Room
- 1 - Casing Running Equipment/Crew
- 1 - Forklift (8 ton rated)
- 1 - Rig Equipment Truck

2 - 90 or 150 ton Cranes (for rig up/rig down)
30 to 50 Flat Bed Trailers and Trucks (for move in and move out)
1 - Backhoe

6.1.9.4 New Well Completion Operations

A workover rig is used to install the downhole tubing and associated monitoring equipment following move out of the drilling rig. All surface piping including monitoring and instrumentation is then installed after the workover rig is moved out.

Each completion will require seven to ten 12-hour work days (8 AM to 8 PM).

The following equipment will be required for the new well completion operations:

1 - Mobile Production Rig with 106-foot high mast
1 - Mobile Rig Pump with engine and circulating pit with shaker
1 - Rig Equipment Truck
1 - Portable Generator
1 - Rig Crew Trailer
2 - 500 bbl portable liquid storage tanks
1 - Roll Off Trash Bin
1 - Portable Restroom and Service Truck
2 - Wireline Trucks (USIT/Misc tools)
1 - 120 bbl or 80 bbl Vacuum Truck
5 - Service Pickup Trucks (various onsite contractors)
1 - Delivery Truck (Tractor/Flatbed Trailer)
1 - Stinger Truck with flatbed trailer

6.1.9.5 Investigate and Remediate Contamination from Abandonment or Drilling of Gas Wells

During the abandonment, work-over, or drilling of gas wells in the Ballona Wetlands, heavy petroleum hydrocarbons (e.g., crude oil) may be present in near-surface soil. This is incidental contamination from normal oil field activities, such as spills of work-over fluid, small oil spills or leaks. Before the wells are drilled and after well abandonment, SoCalGas and its consultants will perform an investigation of potential oil contamination in near-surface soils (down to 15 feet below ground surface). If significant amounts of petroleum are found, SoCalGas and its contractor will remediate or remove the contamination for off-site disposal. Cleanup levels are normally 10,000 ppm, 1,000 ppm, or 100 ppm of Total Petroleum Hydrocarbons, depending on depth to ground water and soil type.

Each investigation may take up to two (2) weeks to complete; remediation work at each site may continue for up to two (2) months.

The following equipment will be required to complete remediation activities:

1 - Drilling Rig

1 - Backhoe
4 - Trucks

6.2 CONSTRUCTION SEQUENCING

Construction of Alternative 1 is anticipated to occur in two phases consisting of multiple sequences. The sequences would be grouped into two primary construction periods.

6.2.1 Phase 1

In Phase 1, Area A site preparation would occur, including utility relocation, construction of bridges across Ballona Creek and Lincoln Boulevard for soil transport, and clearing and grubbing. Then soil would be excavated and used to build the Area A perimeter levee. Site preparation of North Area B would occur, including utility relocation, clearing and grubbing, and over-excavation along the levee alignment. Soil excavated from Area A would be transported to Area B and used to construct the Culver Boulevard Levee and the Interim Levee. North Area C and South Area C would be cleared and grubbed and additional soil excavated from Area A would be transported to these areas and placed and graded to form new upland areas. The baseball fields may not need to be closed during construction. Soil for levee construction in Phase 2 would be stockpiled within the Culver and Interim Levees and East Area B.

For the South/Southeast Area B wetland enhancement, water-control structures would be installed and modified, and wetland enhancements, including channel excavation, berm construction, and invasive plant removal, would be completed.

Once the new levees are in place, the channel meanders would be constructed. The new channel meanders would be excavated behind the existing levees, the existing levees would be breached to connect the new meanders to the existing Ballona Creek channel, and the existing Ballona Creek channel segments between the meander bends then would be blocked and filled. This sequence would maintain an open Ballona Creek channel throughout the construction process. The existing levee then would be removed.

Finally, the public access features, including new bicycle and pedestrian paths and the West Area B fire access road and stormwater drainage improvements would be completed. The proposed parking structure across from Fisherman’s Village along Fiji Way and parking improvements in the West Culver Parking Lot are included in Phase 1, although the availability of funding may affect the actual timing of construction.

6.2.2 Phase 2

In Phase 2, the wells in West Area B would be abandoned and relocated. Clearing and grubbing would occur along the alignment of the new West Area B levee and salt pan berm. The West Area B levee and salt pan berm would be constructed using the fill stockpiled in the Culver and interim levees and East Area B. A water control structure would be installed to connect the existing channel from West Area B to behind the dunes. A new water control structure would be installed in the levee, and Culver Boulevard would be extended to reach under the West Area B Levee. Tidal channels would be excavated in West Area B. The Interim and south Ballona Creek Levees would be lowered, regraded into the upland peninsula and salt pan berm, and breached. The wells in Area A would be abandoned and the area would be graded sloping down to marshplain. Revegetation would occur on the levees, berm, peninsula, and East Area B.

Table 6-3

Alternative 1 Construction Sequence Stages

Sequence #	Restoration Phase	Project Area(s)	Activity Description
1	1	B	Southeast Area B gas line 1167—remove and relocate existing gas line to Gas Company Road
2	1	B	South Area B enhancement – enhancement including channel excavation
3	1	A	Area A gas line removal and Del Rey 16 well modification-- remove existing inactive gas line. This well is assumed to be 5 feet below grade and would require a pothole to locate the well.
4	1	A & B	Pedestrian/bicycle bridge—relocate bicycle path under proposed bridge and construct pedestrian/bicycle bridge across channel with connection to bicycle path under the bridge
5	1	A & C	Lincoln Boulevard Bridge—build Lincoln Boulevard Bridge next to Culver Boulevard Bridge to connect Area A to Area C
6	1	A	Clear, grub, and stockpile before grading Area A
7	1	A	Excavate Area A—excavation starts 70 feet north of levee
8	1	A	Construct north levee—grading and construction of levee within Area A with or without gas wells remaining
9	1	B	North Area B north gas line relocation and Del Rey 12 well abandonment and replacement—remove and relocate active gas lines within sleeve;
10	1	B	Clear and grub North Area B
11	1	B	North Area B over-excavate and stockpile—excavate along Culver Boulevard—Jefferson Boulevard to 70 feet south of levee
12	1	B	Construct Culver Boulevard levee—grading and construction of levee
13	1	B	Clear, grub, and stockpile before grading East Area B
14	1	B	East Area B grading
15	1	C	Clear and grub North and South Area C
16	1	A & C	Area A grading and export to North and South Area C
17	1	C	Finish grading for uplands in North and South Area C
18	1	B	Area B box culverts—install two new culverts on Culver Boulevard and Jefferson Boulevard and realignment of Freshwater Marsh outlet
19	1	A & B	Area A and North Area B—excavate and breach existing levees
20	1	A & B	Area A and North Area B—block and fill existing levees
21	1	A & B	Area A and North Area B—remove existing levees
22	1	B	West Area B – construct fire access road, reconstruct Area B parking lot, and construct storage basin
23	1	A & B	Construct bicycle path, pedestrian walk, and amenities along top of levee
24	1	A	Export soil from Area A to off-site landfill or ocean disposal site
25	2	B	West Area B well abandonment and replacement
26	2	B	Clear and grub West Area B levee alignment
27	2	B	Construct West Area B levee—excavate stockpiled material from Culver Boulevard levee and East Area B, grading and construction of levee
28	2	B	West Area B fire access road—construct the fire access road. The portion of connecting Culver Boulevard to the levee top must be built with Sequence 27

Sequence #	Restoration Phase	Project Area(s)	Activity Description
29	2	B	West Area B channel grading
30	2	B	Extension of bicycle path along south levee to Playa del Rey—extend the bicycle path along the top of the south levee to Playa del Rey with amenities
31	2	B	West Area B excavate and breach existing levees—remove existing levee at Ballona Creek and build levee on West Area B
32	2	B	West Area B remove existing levees—remove existing levee at Ballona Creek and build Levee on West Area B
33	2	A	Area A gasline and well abandonment and replacement
34	2	A	Area A grading and export to East Area B
35	2	B	Finish grading for uplands—complete grading in East Area B and construct optional bicycle path under Lincoln Boulevard Bridge

NOTE:

* Performed concurrently.

7. OPERATIONS AND MAINTENANCE

The intent of the Project is to restore a wetland and creek habitat and flood protection system that is sustained by natural processes and requires minimal operations and maintenance (O&M) activities. A new long term O&M Agreement (between LACFCD, CDFW and all project proponents) will need to be established identifying all new operation and maintenance responsibilities that address 1) the newly modified channel and levees 2) water control structures 3) habitat and vegetation and 4) a number of other miscellaneous proposed items. The new long term O&M Agreement will identify those responsible for flood control and non-flood control aspects of the project.

7.1 EXISTING LA COUNTY O&M

The LA County Flood Control District currently performs maintenance of the existing flood control channel. The USACE (1999) *LA District Operation, Maintenance, Repair, Replacement, and Rehabilitation Manual, Los Angeles County Drainage Area, CA* documents O&M responsibilities and procedures. Table 7-1 lists current LA County maintenance activities (P. Holland, LA County DPW, pers. comm.) and which activities are anticipated to be continued for the Project.

Table 7-1 Existing LA County O&M activities and anticipated continuation of existing O&M.

Current LA County O&M Activities	Anticipated Continuation of Existing O&M Activities	Note
1. Clean channel invert	No	See Section 7.2
2. Clean trash net	Yes	No change anticipated
3. Inspect and lock gates	Yes	Some new gate locations
4. Inspect and service flap gates	Yes	Existing West Area B SRT flap gates to remain in the Interim Phase; new structures and gates (see Section 7.4 and 3.12)
5. Inspect and service sub-drains	Yes	For existing sub-drains to remain within Project area
6. Maintenance and repair of fence and gates	Yes	Some new fence and gate locations
7. Maintenance and repair of weep holes	Yes	For existing levees and weep holes to remain
8. Midge control	TBD	
9. Operation and maintenance of tidal gates	Yes	Existing West Area B SRT flap gates to remain in the Interim Phase; new structures and gates (see Section 7.4 and 3,12)
10. Pre-emergent weed control	TBD	
11. Spill response	Yes	
12. Weed removal	TBD	
13. Trash free contract	TBD	

TBD = to be determined in coordination with LA County

7.2 BALLONA CREEK CHANNEL - MONITORING AND MAINTENANCE

The restored Ballona Creek channel is intended to have no substantial maintenance requirements. A monitoring and as-needed maintenance program will be developed for the channel. The level of channel erosion and deposition during storm flow events is anticipated to be acceptable for the restoration and flood management. The levee heights will be designed to meet flood criteria with a reduced channel cross-section (see the H&H Report Section 6 for additional discussion). This reduced channel cross-section will define a maintenance limit for the channel. The channel cross-section will be monitored to confirm that the cross-section and flood performance is within the maintenance limit. Any major debris or blockage of the channel that may negatively affect flood protection or restoration performance would need to be removed; however, this is not anticipated.

In locations where armoring is installed to limit erosion, the scour protection would be inspected and maintained as-needed; however, maintenance is not anticipated to be needed.

7.3 PERIMETER LEVEES - MONITORING AND MAINTENANCE

The levees themselves are intended to have no substantial maintenance requirements. The expected maintenance along the levees will be the periodic repaving of the bike path and walking trail, replacement or repair of fencing that may be installed, replacement or repair of any overlook or educational equipment placed along the walking trail, and trash collection and graffiti removal is encouraged for public involvement and habitat care. It is possible that minor erosion measures may be needed periodically.

7.4 WATER CONTROL STRUCTURES

Flap gates will need regular inspection and maintenance to ensure proper operation. Inspection of other structures will also periodically occur, but problems are unlikely, except in the very long term. Gates may be adjusted seasonally for habitat management (see Section 3.12)

7.5 HABITAT AND VEGETATION – MONITORING AND MAINTENANCE

Portions of the restored site will be planted (e.g., upland, transition zone, high marsh, and low marsh), while other marsh areas may rely on natural recruitment of salt marsh vegetation (e.g., mid marsh). WRA's CHRAMP includes a revegetation plan, including monitoring and maintenance. Vegetation maintenance, irrigation, and weeding may be required for certain habitats (e.g., for transition and upland habitat plantings).

Trash removal may also occur for some trash from that is not caught at the existing trash net/boom between Lincoln Blvd. and Culver Blvd. upstream of the restored wetlands and enters restored habitats at accessible locations.

8. LIST OF ACRONYMS

1

bgs	below ground surface
CHRAMP	Comprehensive Habitat Restoration and Adaptive Management Plan
FWM	Freshwater Marsh
H&H Report	Preliminary Flood Hydrology and Hydraulics Report
MHHW	Mean Higher High Water
MHW	Mean High Water
MLLW	Mean Lower Low Water
MTL	Mean Tide Level
NAVD	North American Vertical Datum of 1988
NGVD	National Geodetic Vertical Datum of 1929
O&M	Operations and Maintenance
PDR	Preliminary Design Report
PID	Photoionization Detector
RS	River Stationing
SAP	Sampling and Analysis Work Plan

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Eddie Divita, P.E.

Input was provided by the following PSOMAS staff:

2 Mike Crehan, P.E.

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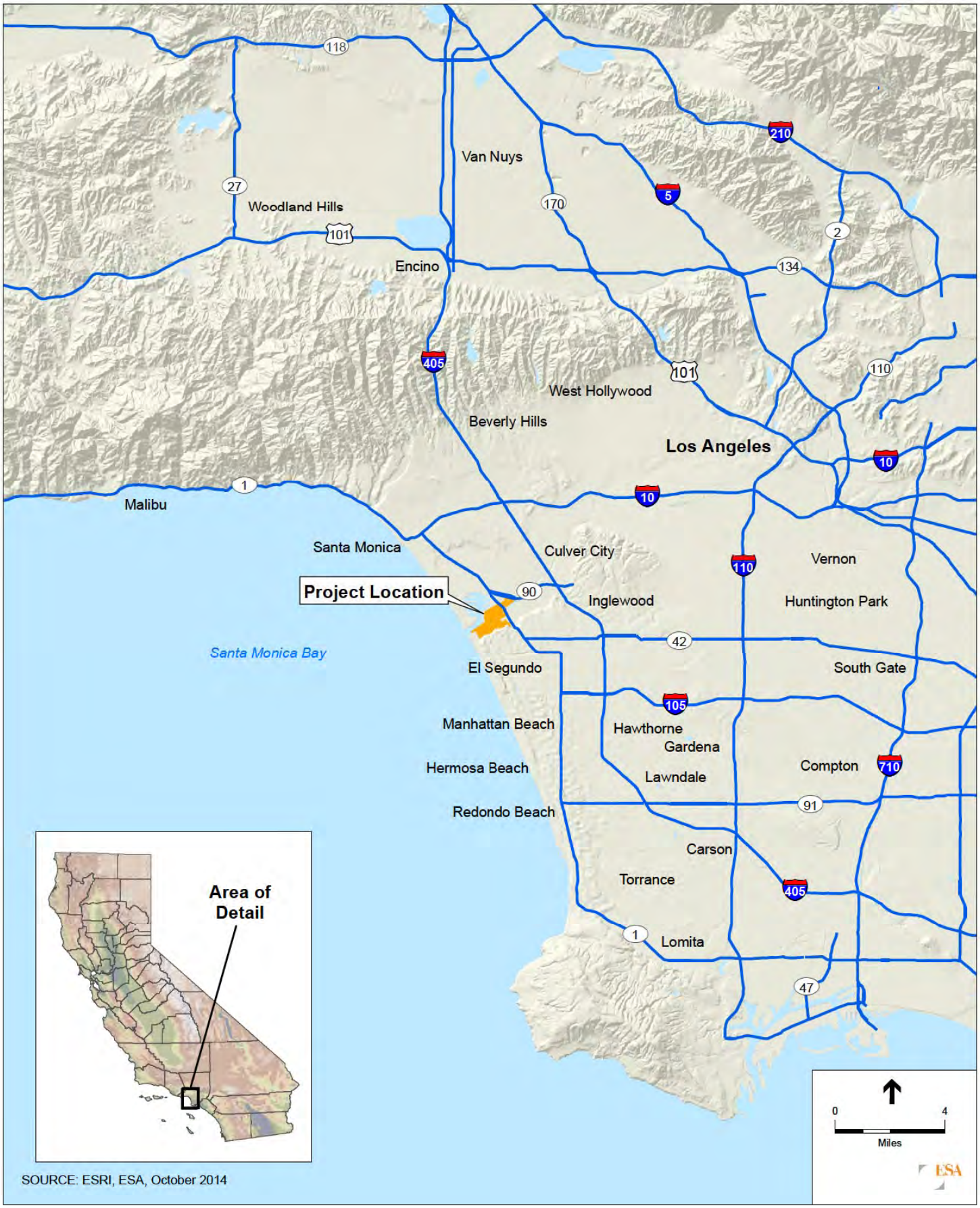
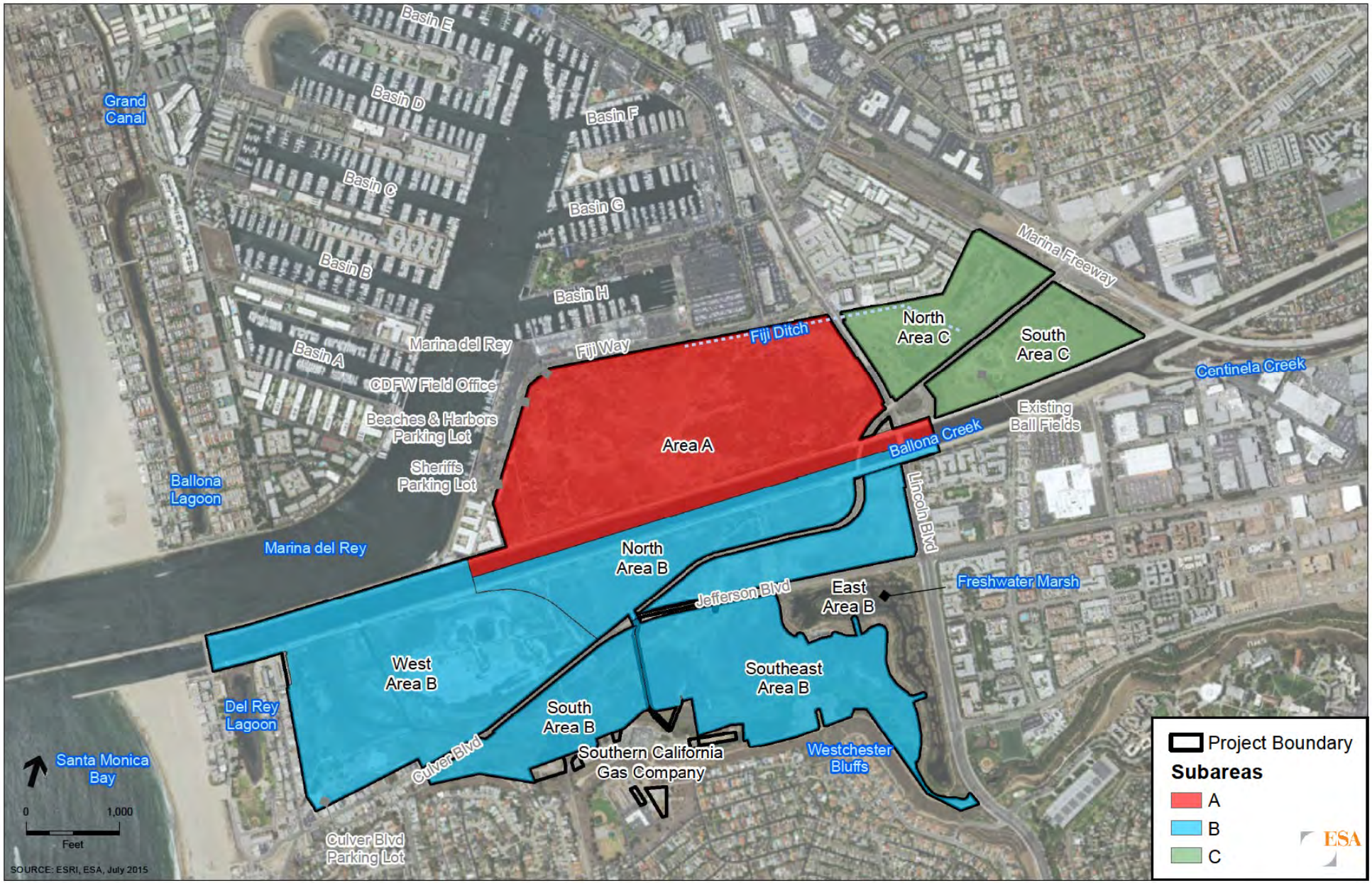


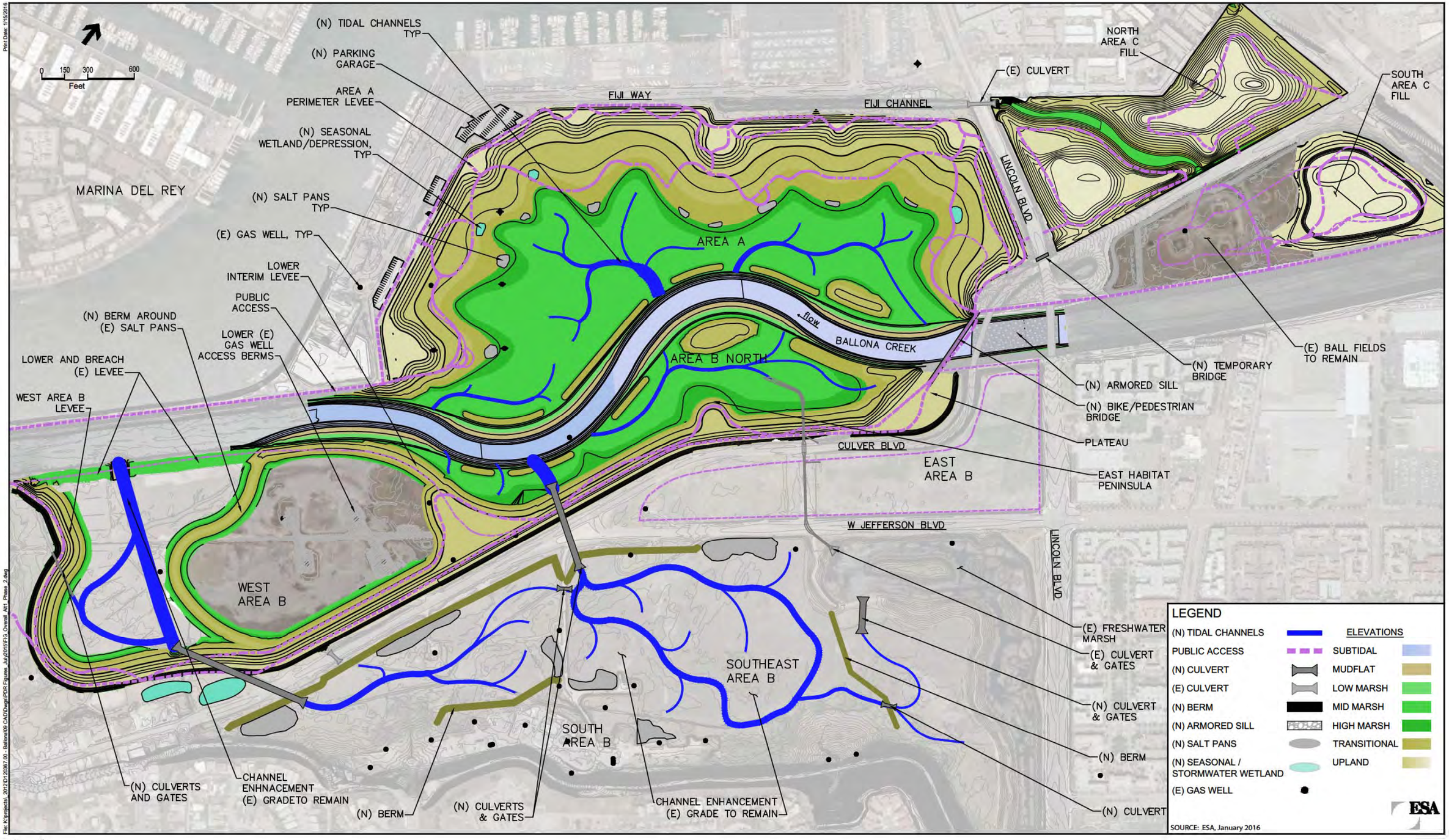
Ballona Wetlands Restoration Project

Figure 1.1
Regional Location



Ballona Wetlands Restoration Project

Figure 1.2
Ballona Wetlands Project Areas



Ballona Wetlands Restoration Project

FIGURE 1.3
ALTERNATIVE 1, PHASE 2
FULL RESTORATION

Print Date: 1/15/2016

0 150 300 600
Feet

MARINA DEL REY

(N) TIDAL CHANNELS TYP
PARKING LOT
AREA A PERIMETER LEVEE
(N) SALT PANS TYP,
(N) SEASONAL WETLAND/DEPRESSION, TYP.
(E) GAS WELL, TYP
INTERIM LEVEE
PUBLIC ACCESS

FIJI WAY
FIJI CHANNEL
(E) CULVERT
NORTH AREA C FILL
LINCOLN BLVD
30
SOUTH AREA C FILL

AREA A
AREA B NORTH
flow
BALLONA CREEK
CULVER LEVEE W/ STOCK PILE
CULVER BLVD
EAST AREA B FILL
EAST AREA B
W JEFFERSON BLVD
LINCOLN BLVD

(N) TEMPORARY BRIDGE
(N) ARMORED SILL
(N) BIKE/PEDESTRIAN BRIDGE
PLATEAU
EAST HABITAT PENINSULA

WEST AREA B
SOUTHEAST AREA B
SOUTH AREA B

(N) CULVER STORMWATER DETENTION WETLAND
(N) BERM
MODIFY (E) CULVERTS
(N) BERM
(N) CULVERTS & GATES
CHANNEL ENHANCEMENT (E) GRADE TO REMAIN

(E) FRESHWATER MARSH
(E) CULVERT & GATES
(N) CULVERT & GATES
(N) BERM
(N) CULVERT

LEGEND

		ELEVATIONS
(N) TIDAL CHANNELS		SUBTIDAL
PUBLIC ACCESS		MUDFLAT
(N) CULVERT		LOW MARSH
(E) CULVERT		MID MARSH
(N) BERM		HIGH MARSH
(N) ARMORED SILL		TRANSITIONAL
(N) SALT PANS		UPLAND
(N) SEASONAL / STORMWATER WETLAND		
(E) GAS WELL		

ESA

SOURCE: ESA, JANUARY 2016

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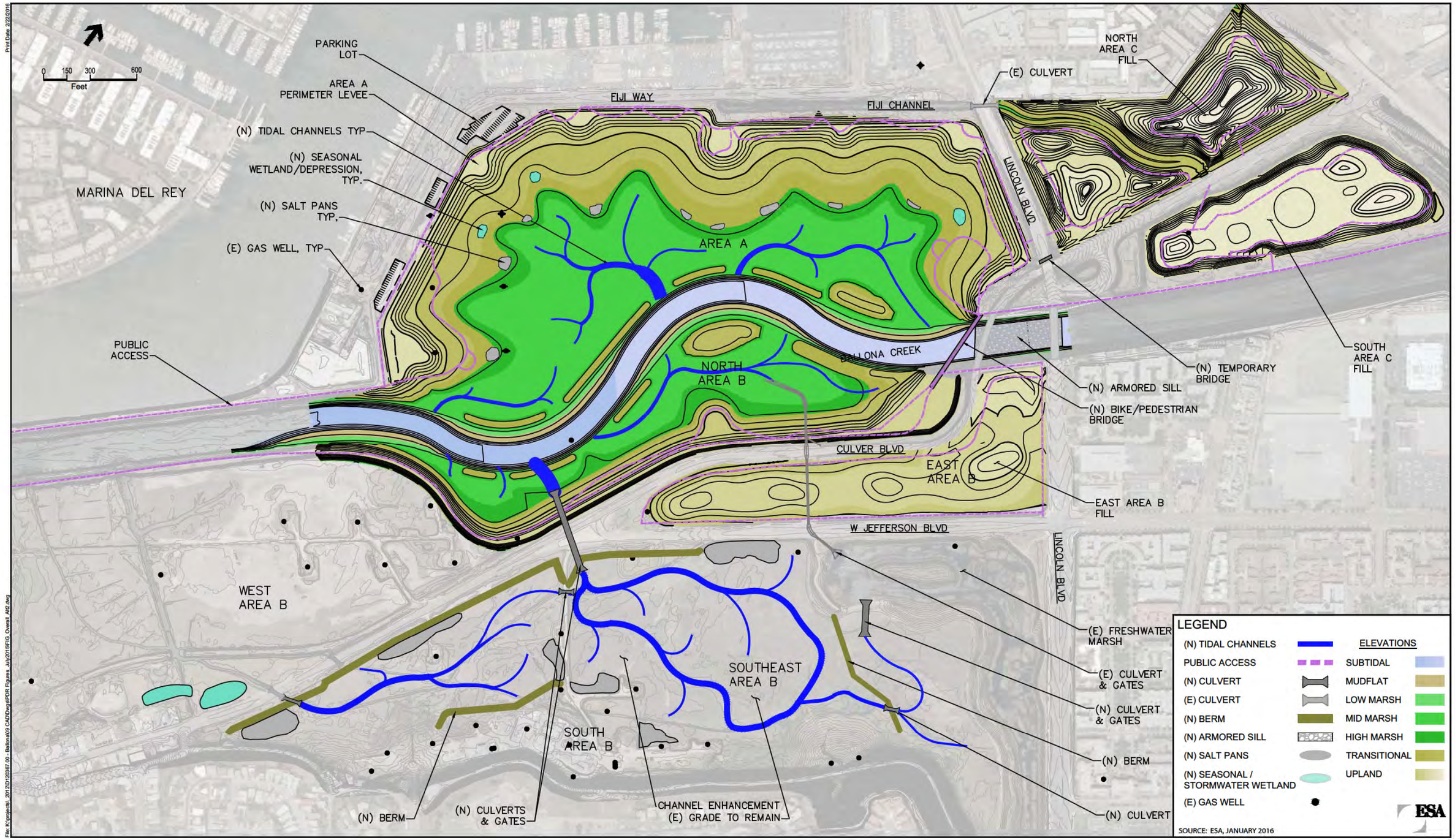
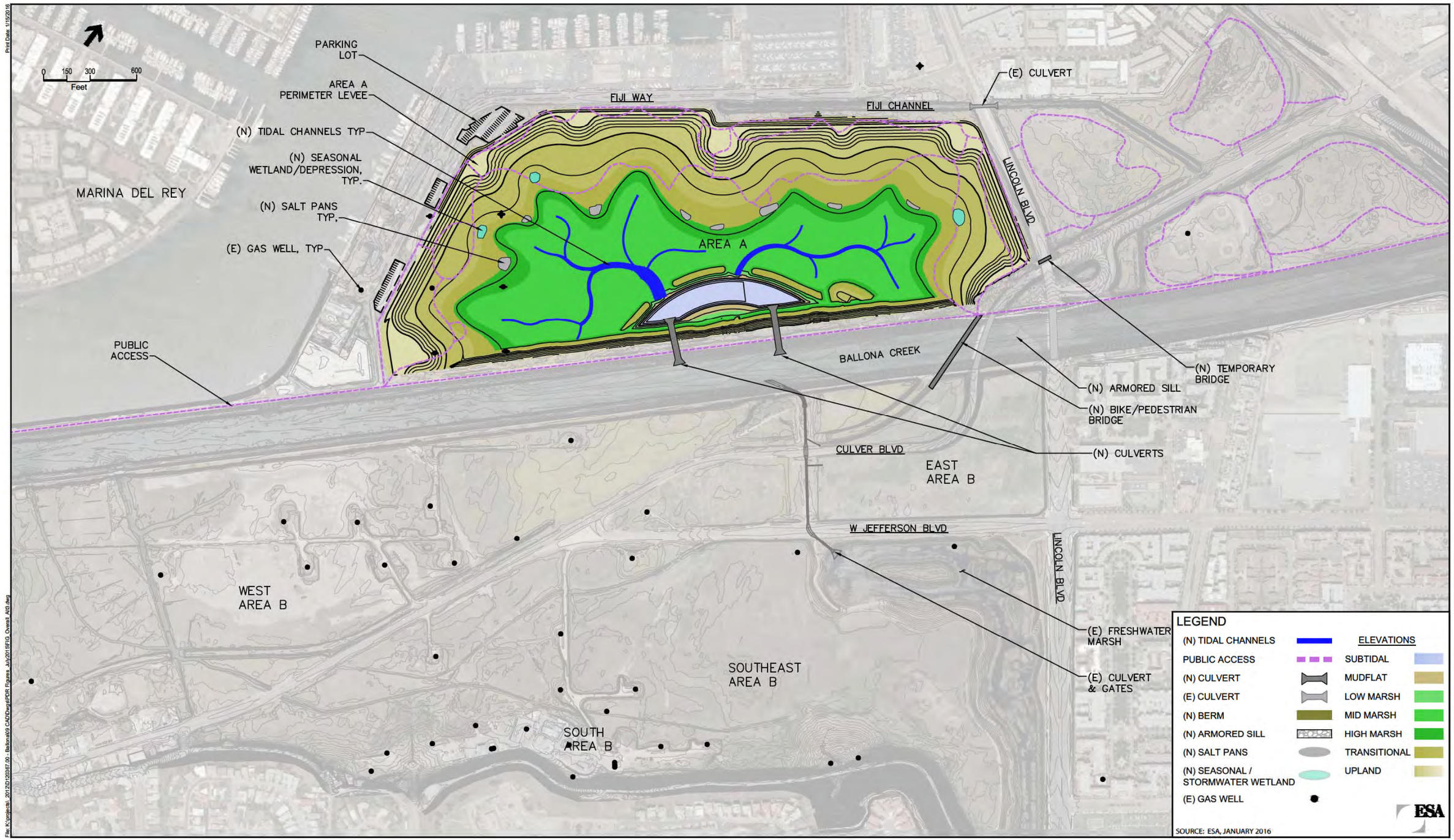
Ballona Wetlands Restoration Project

FIGURE 1.4
ALTERNATIVE 1, PHASE 1
FULL RESTORATION



Ballona Wetlands Restoration Project

FIGURE 1.5
ALTERNATIVE 2
Partial Restoration



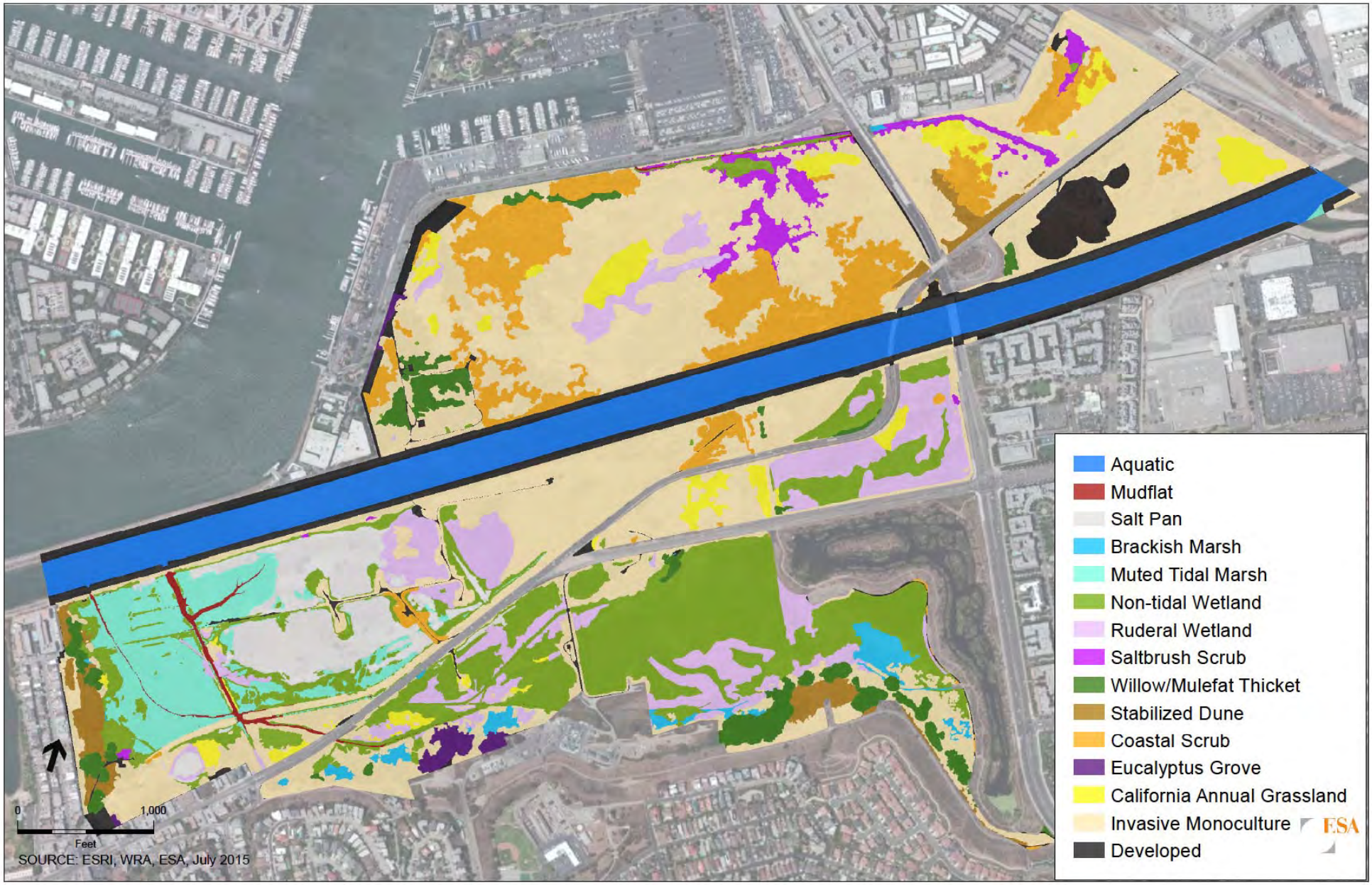
Ballona Wetlands Restoration Project

FIGURE 1.6
ALTERNATIVE 3
Levee Culverts and Oxbow



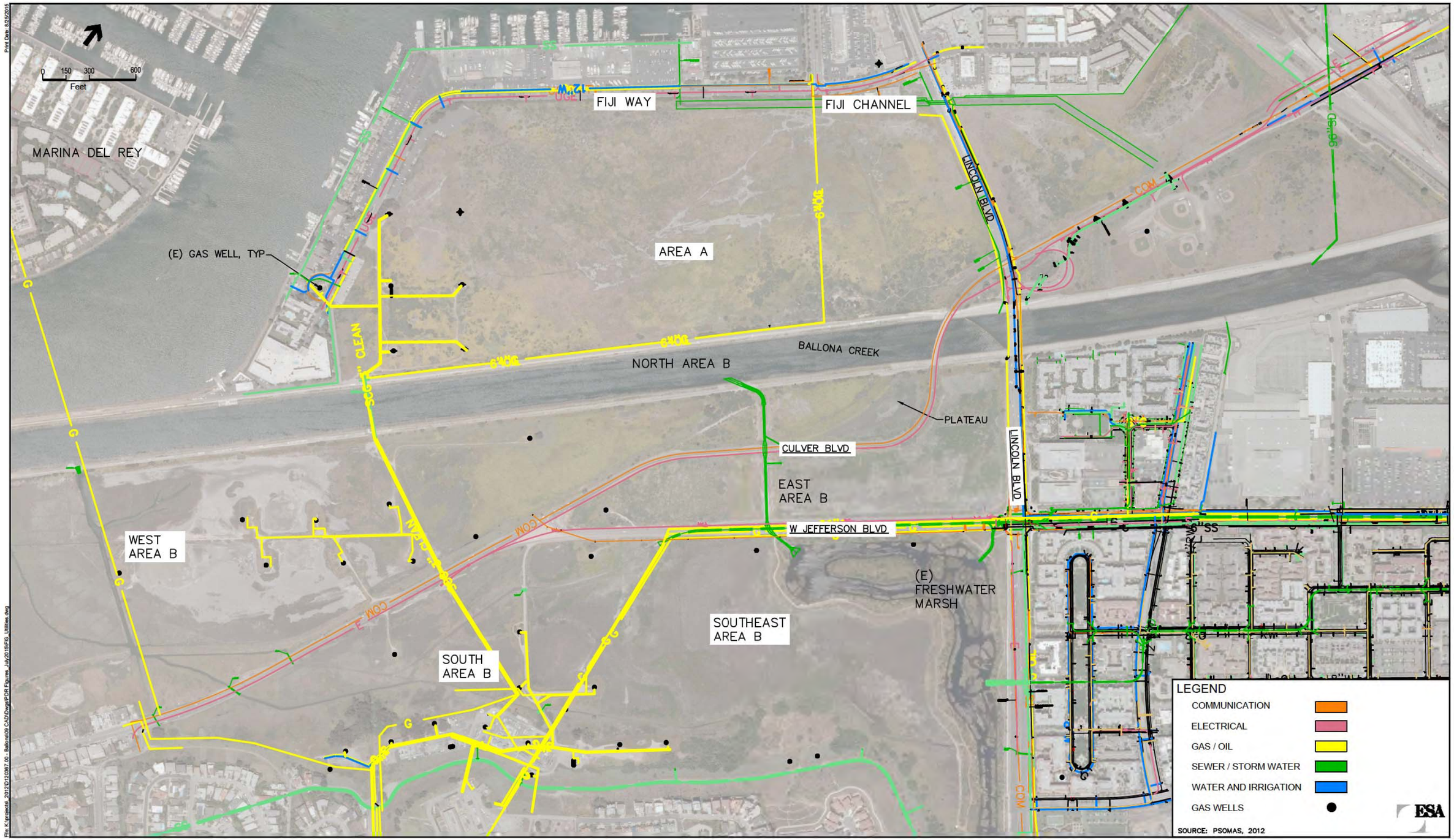
Ballona Wetlands Restoration Project

Figure 2.1
Existing Topography Map



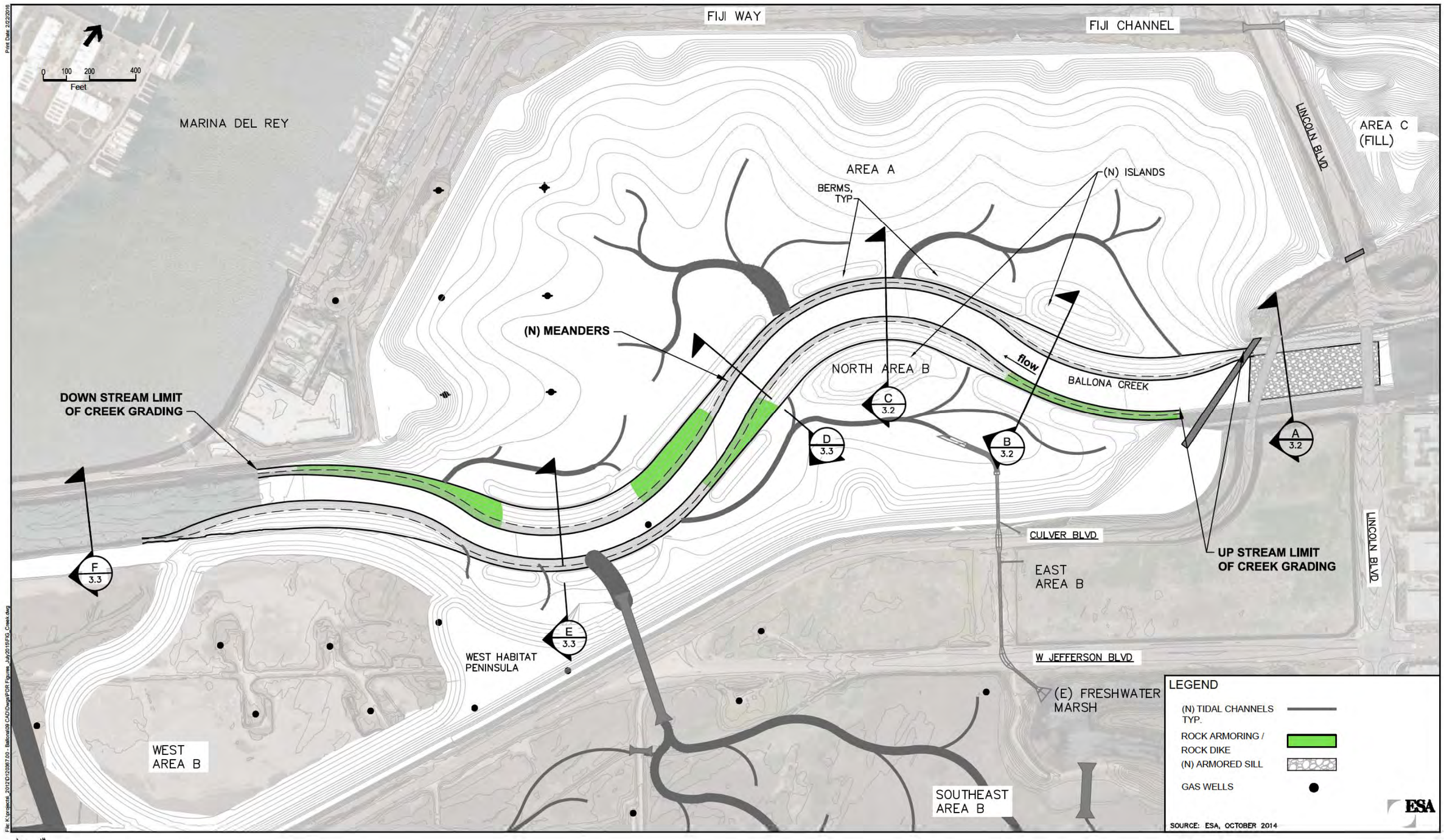
Ballona Wetlands Restoration Project

Figure 2.2
Existing Habitats Map



Ballona Wetlands Restoration Project

FIGURE 2.3
EXISTING UTILITIES MAP



Ballona Wetlands Restoration Project

FIGURE 3.1
ALTERNATIVE 1
BALLONA CREEK REALIGNMENT

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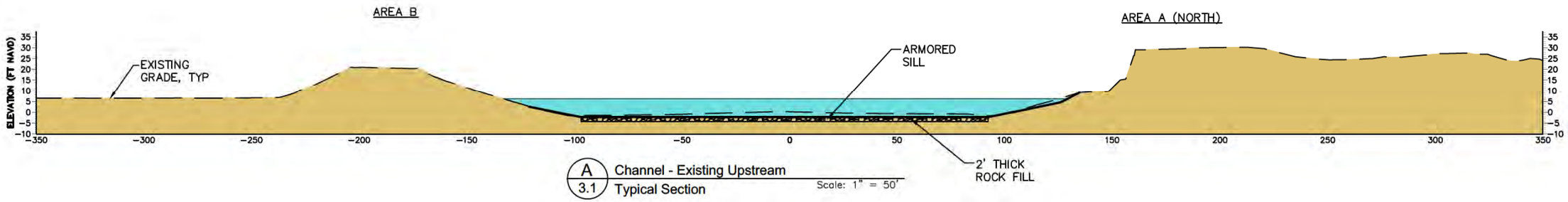
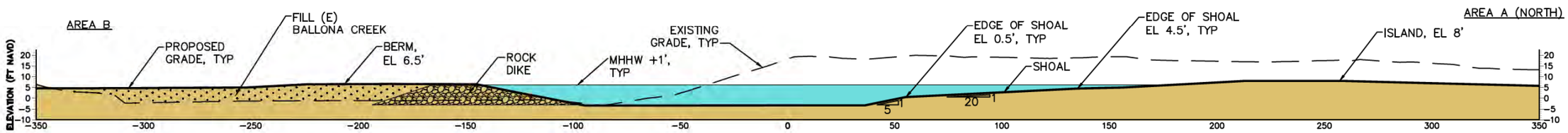


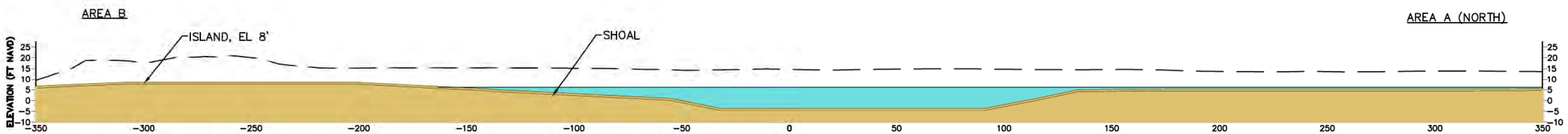
A 3.1 Channel - Existing Upstream Typical Section

Scale: 1" = 50'



B 3.1 Channel - Upstream Meander Typical Section

Scale: 1" = 50'



C 3.1 Channel - Middle Meander Typical Section

Scale: 1" = 50'

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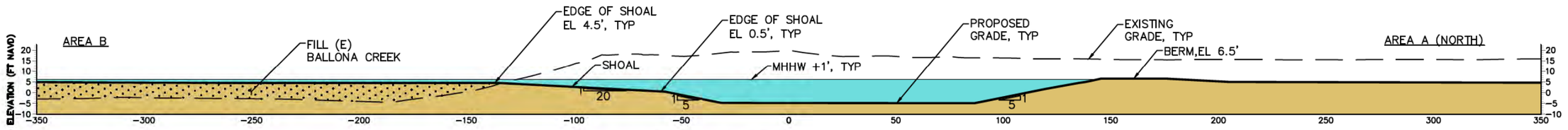
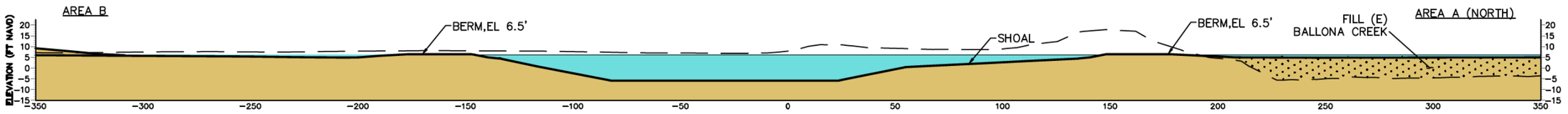
FIGURE 3.2
ALTERNATIVE 1 - BALLONA CREEK
UPSTREAM CHANNEL SECTIONS

Print Date: 9/24/2015



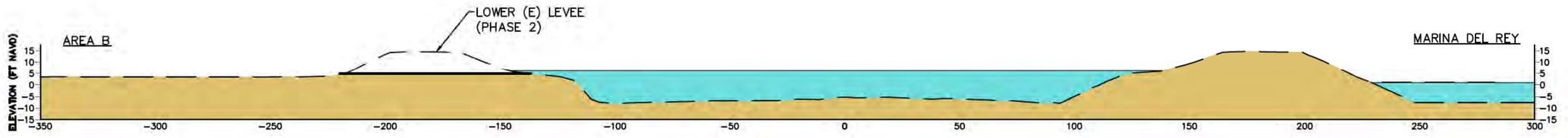
D 3.1 Channel - Transition Typical Section

Scale: 1" = 50'



E 3.1 Channel - Downstream Meander Typical Section

Scale: 1" = 50'



F 3.1 Channel - Existing Downstream Typical Section

Scale: 1" = 50'

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Ballona Wetlands Restoration Project

FIGURE 3.3
ALTERNATIVE 1 - BALLONA CREEK
DOWNSTREAM CHANNEL SECTIONS

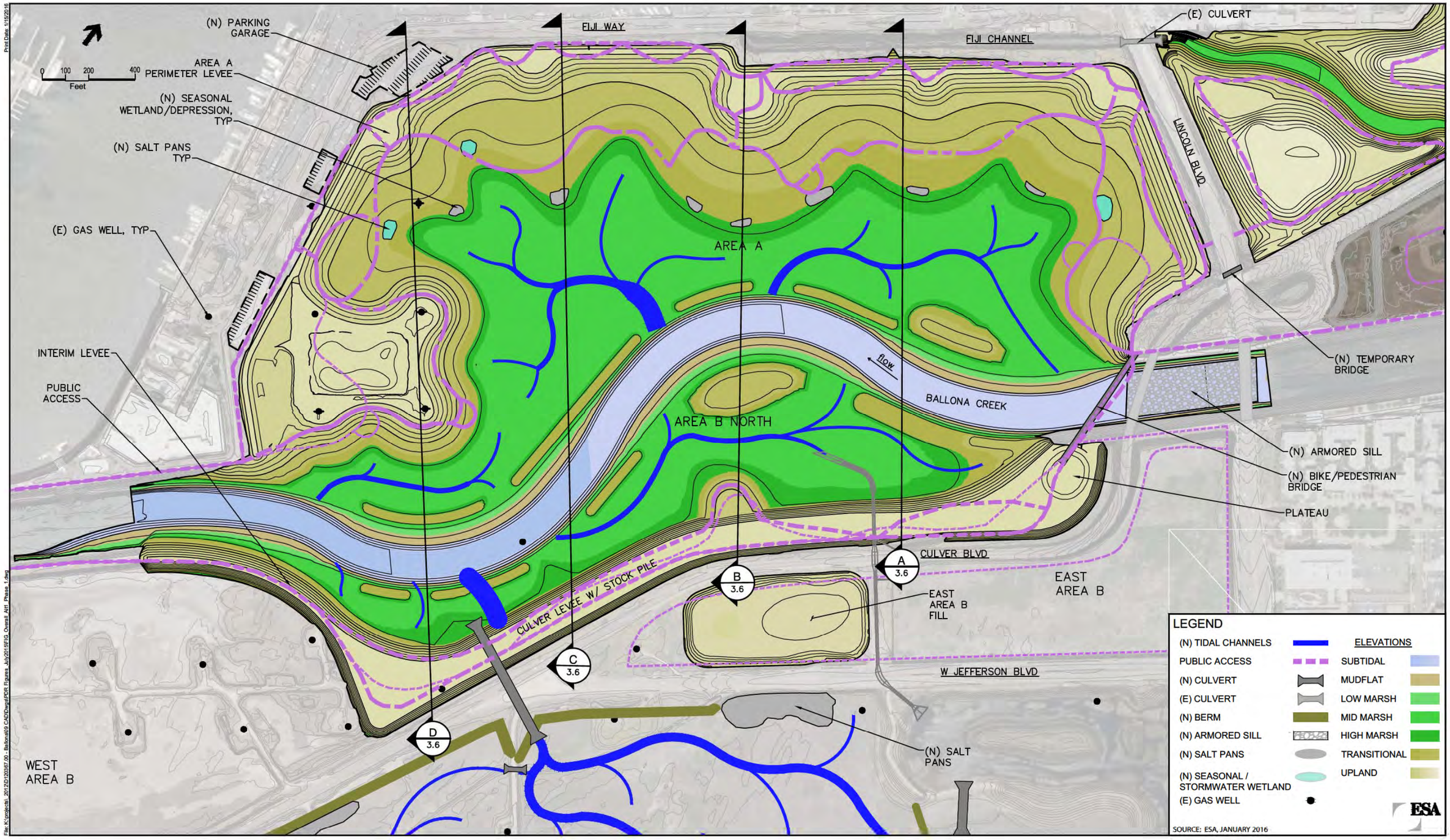

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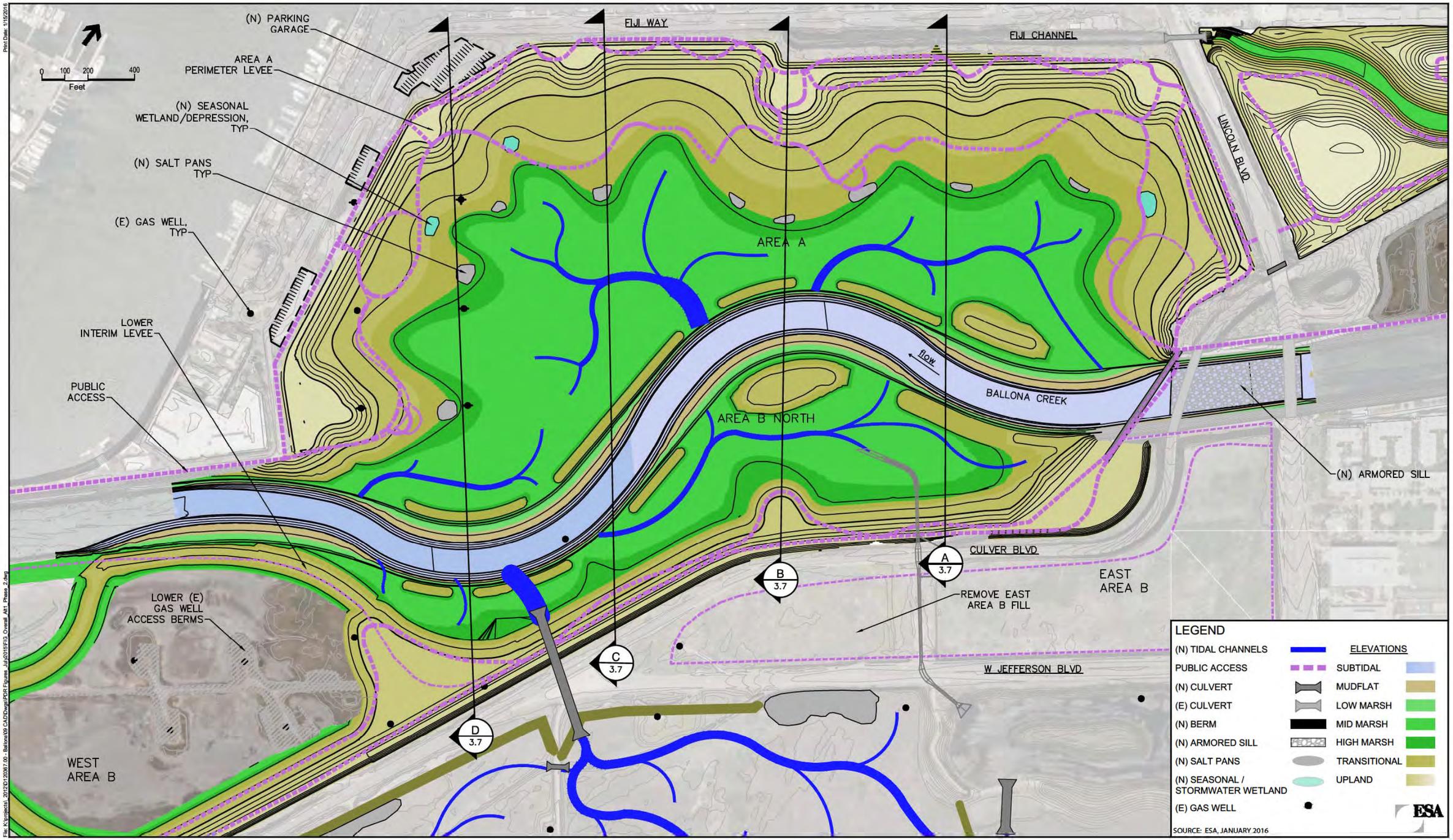
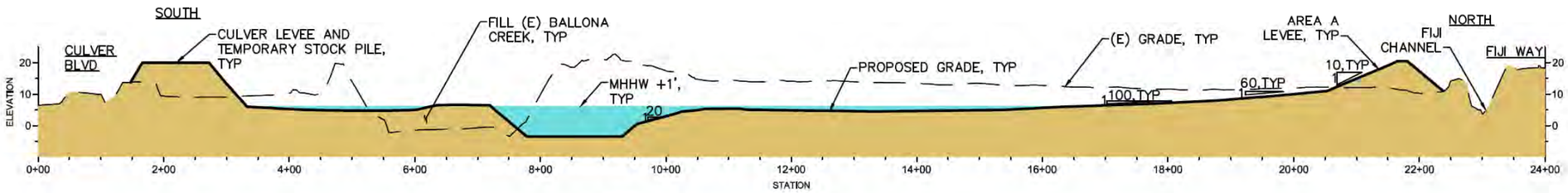
FIGURE 3.4
ALTERNATIVE 1, PHASE 1
AREA A AND NORTH AREA B - GRADING PLAN



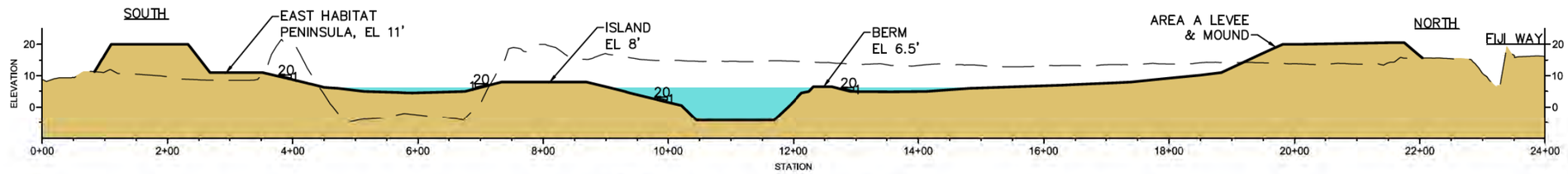
Ballona Wetlands Restoration Project

FIGURE 3.5
ALTERNATIVE 1, PHASE 2
AREA A AND NORTH AREA B - GRADING PLAN



A 3.4 Area A & Area B - Grading Section

Scale:
H: 1" = 200'
V: 1" = 40'



B 3.4 Area A & Area B - Grading Section

Scale:
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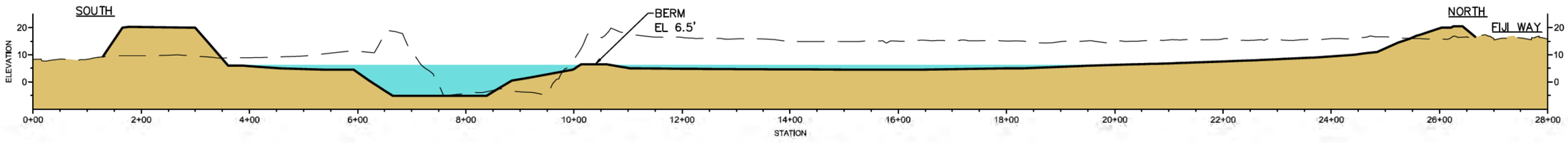
V: 1" = 40'



C 3.4 Area A & Area B - Grading Section

Scale:
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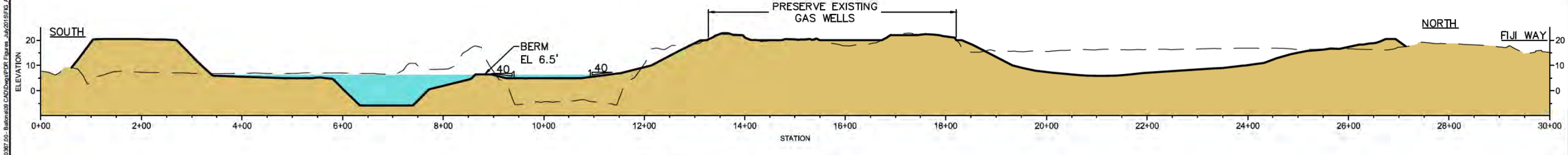
V: 1" = 40'



D 3.4 Area A & Area B - Grading Section

Scale:
H: 1" = 200'
V: 1" = 40'

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Ballona Wetlands Restoration Project

FIGURE 3.6
ALTERNATIVE 1, PHASE 1
AREA A AND NORTH AREA B - GRADING SECTIONS

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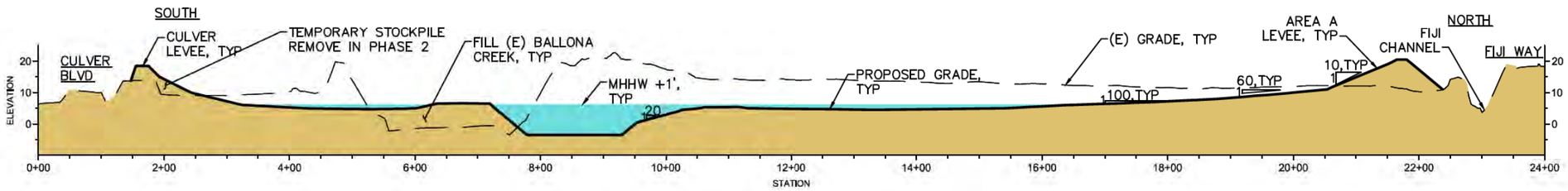

A 3.5 Area A & Area B - Grading Section

Scale:
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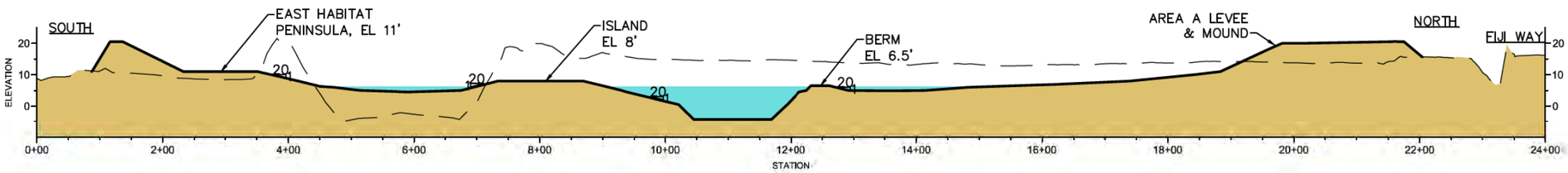
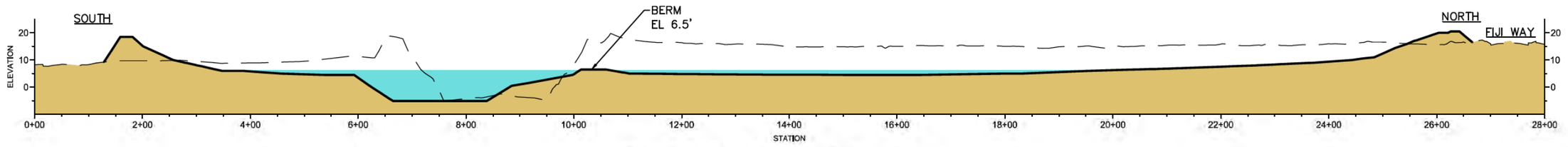
V: 1" = 40'



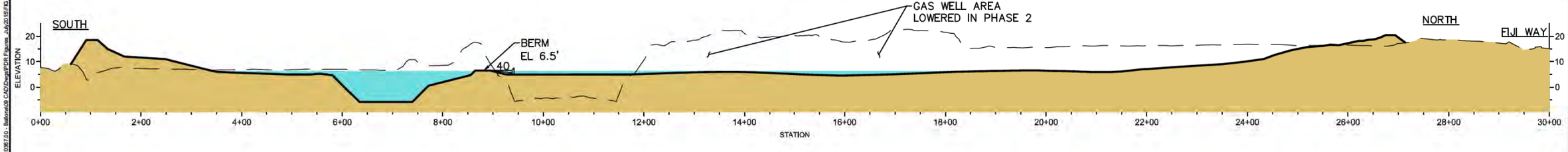
B 3.5 Area A & Area B - Grading Section

Scale:
H: 1" = 200'
V: 1" = 40'



C 3.5 Area A & Area B - Grading Section

Scale:
H: 1" = 200'
V: 1" = 40'



D 3.5 Area A & Area B - Grading Section

Scale:
H: 1" = 200'
V: 1" = 40'

ESA

Print Date: 9/11/2015

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FIGURE 3.7
ALTERNATIVE 1, PHASE 2
AREA A AND NORTH AREA B GRADING SECTIONS

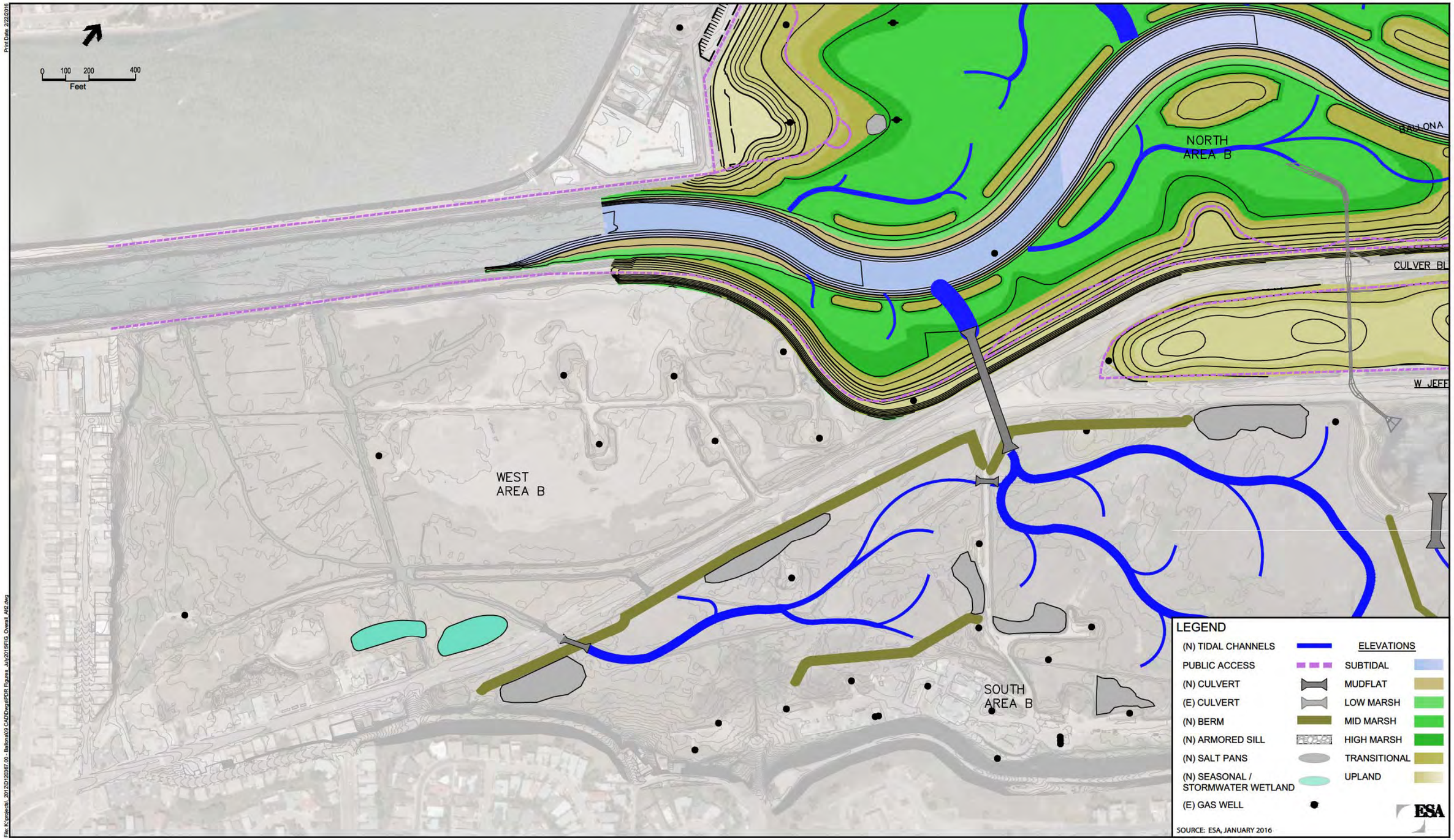

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FIGURE 3.8
ALTERNATIVE 1, PHASE 1
WEST AREA B - GRADING PLAN

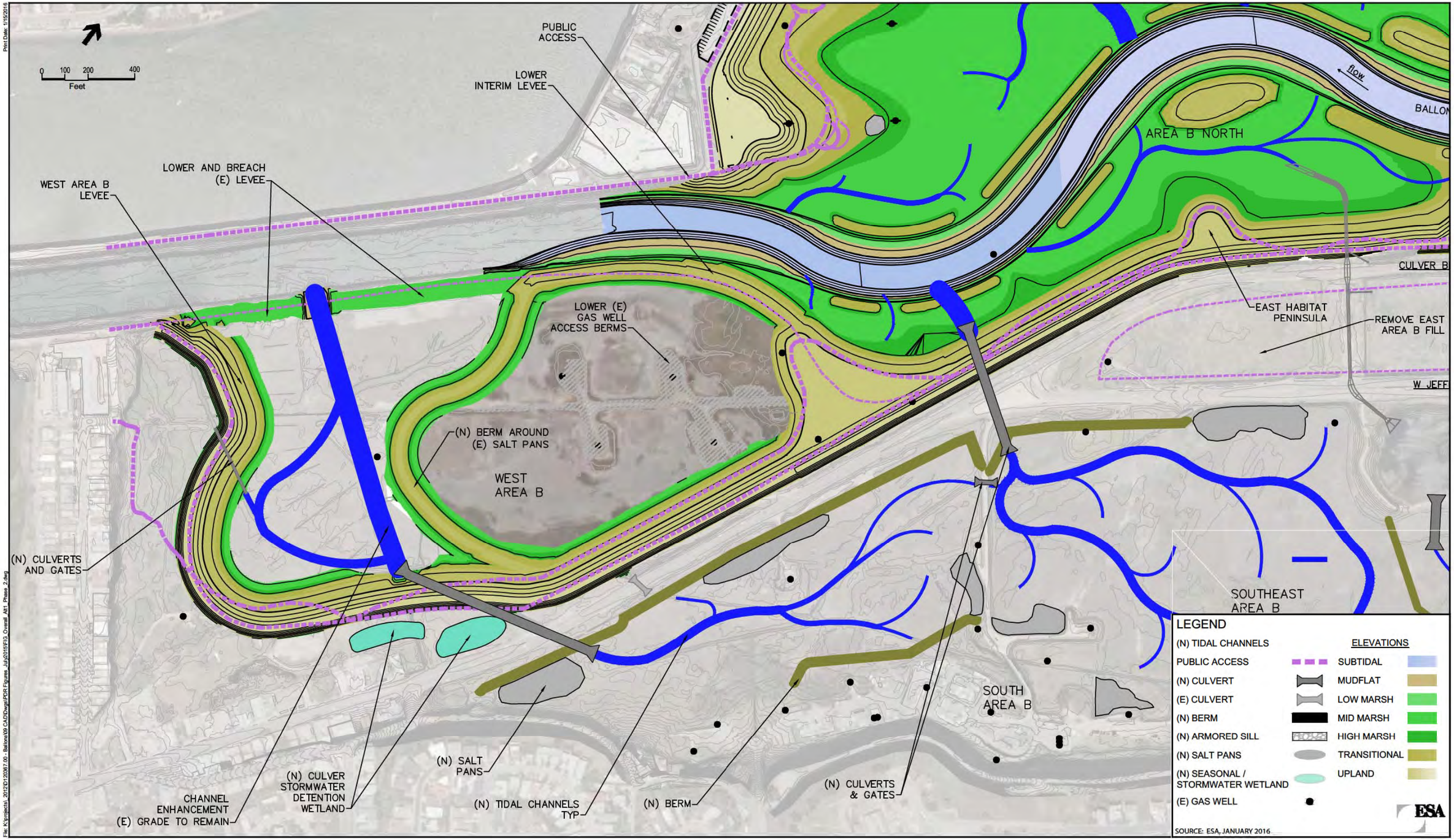

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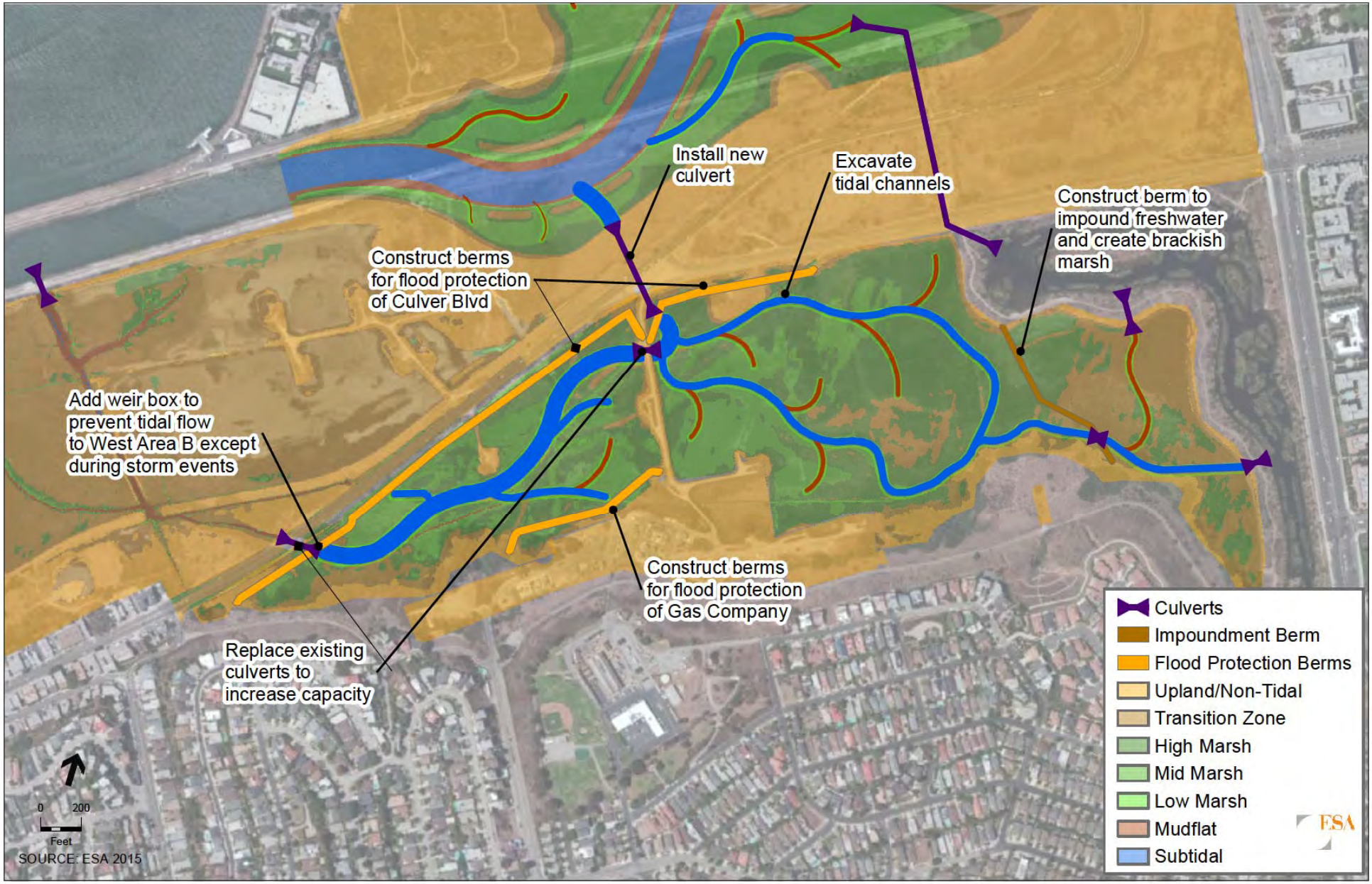
FIGURE 3.9
ALTERNATIVE 1, PHASE 2
WEST AREA B - GRADING PLAN



Ballona Wetlands Restoration Project

Figure 3.10
Alternative 1, Phase 1
South and Southeast Area B Grading Plan



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Figure 3.11
Alternative 1, Phase 2
South and Southeast Area B Grading Plan

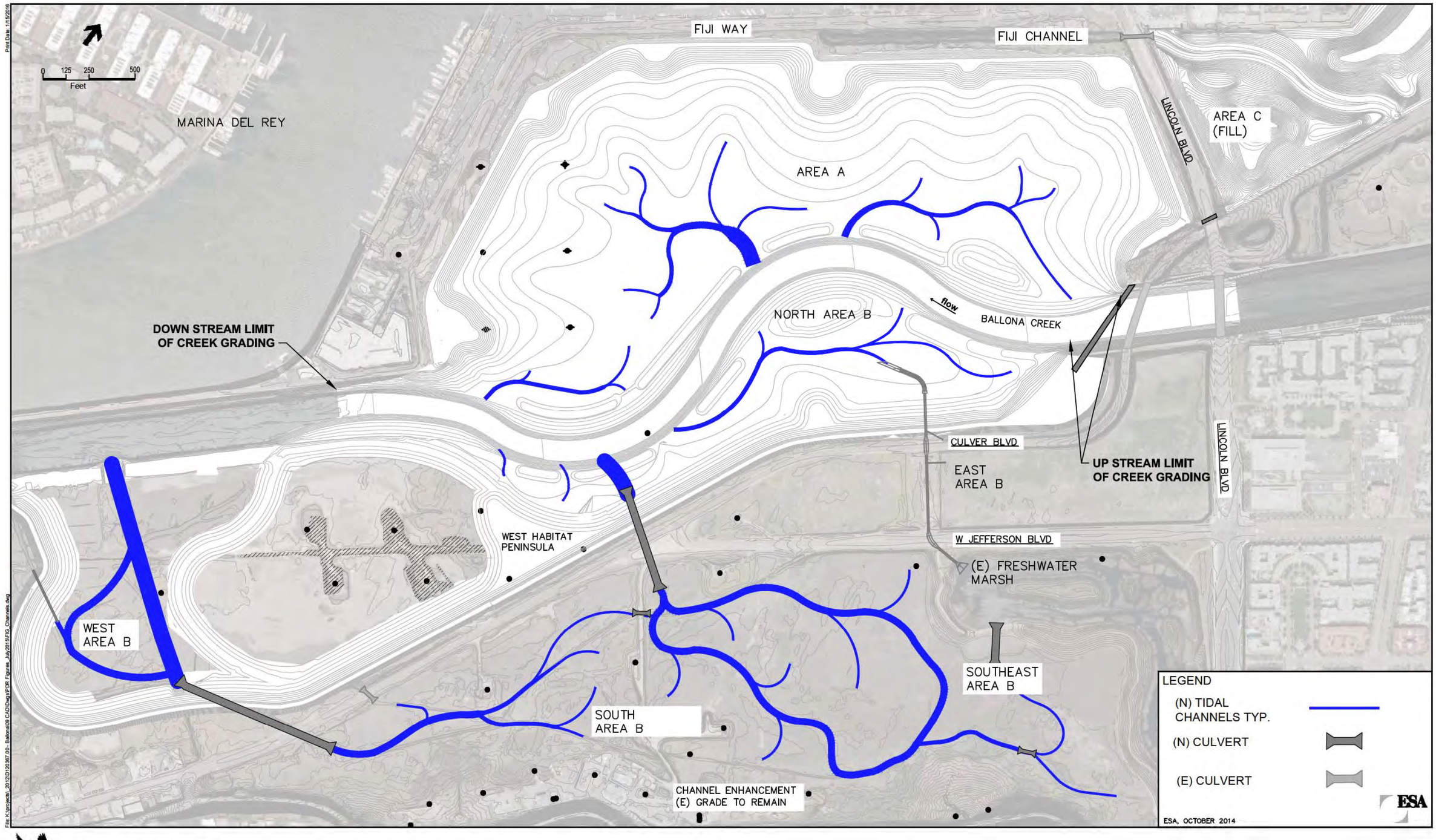

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FIGURE 3.12
ALTERNATIVE 1, PHASE 2
TIDAL CHANNEL NETWORK

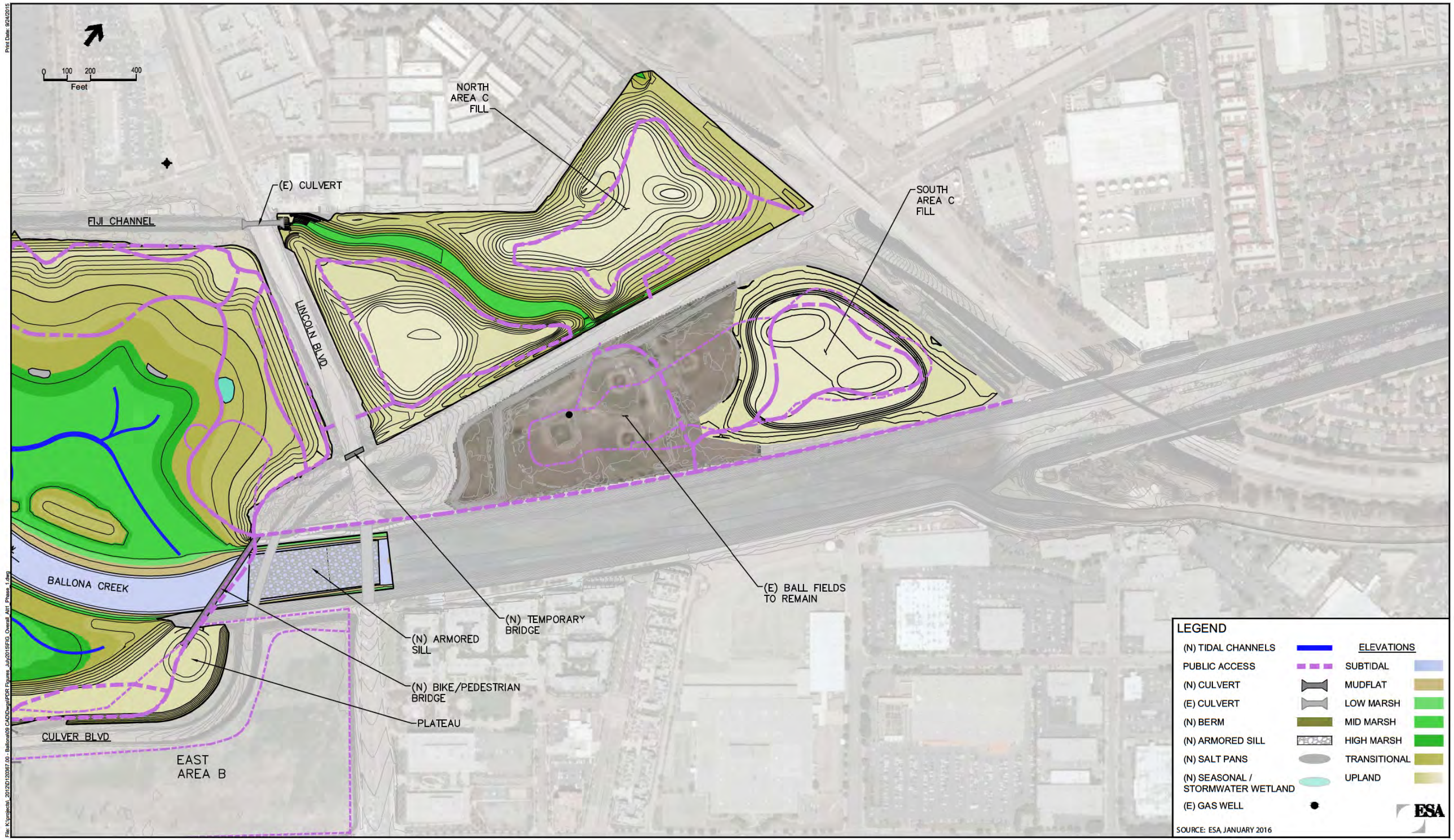

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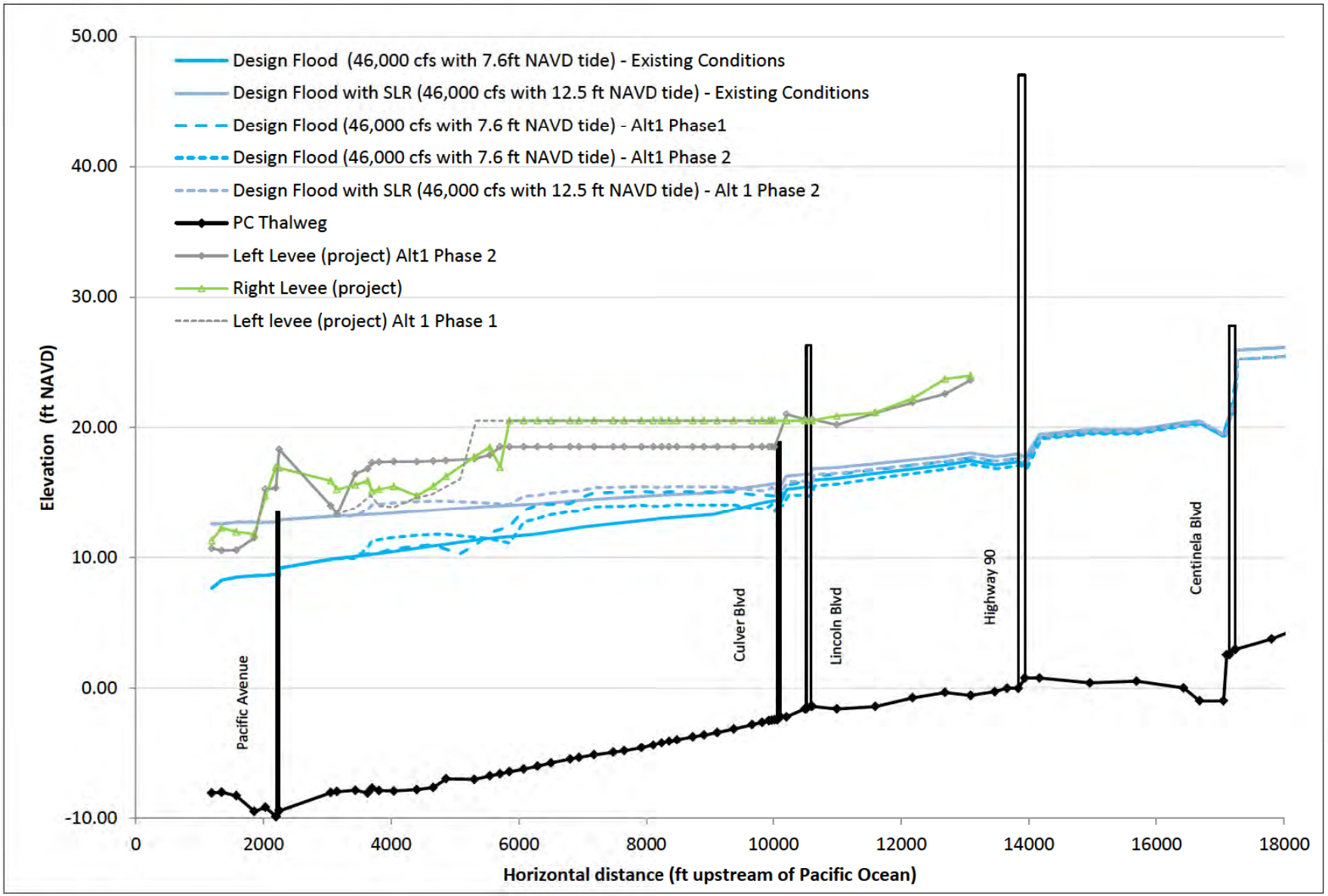
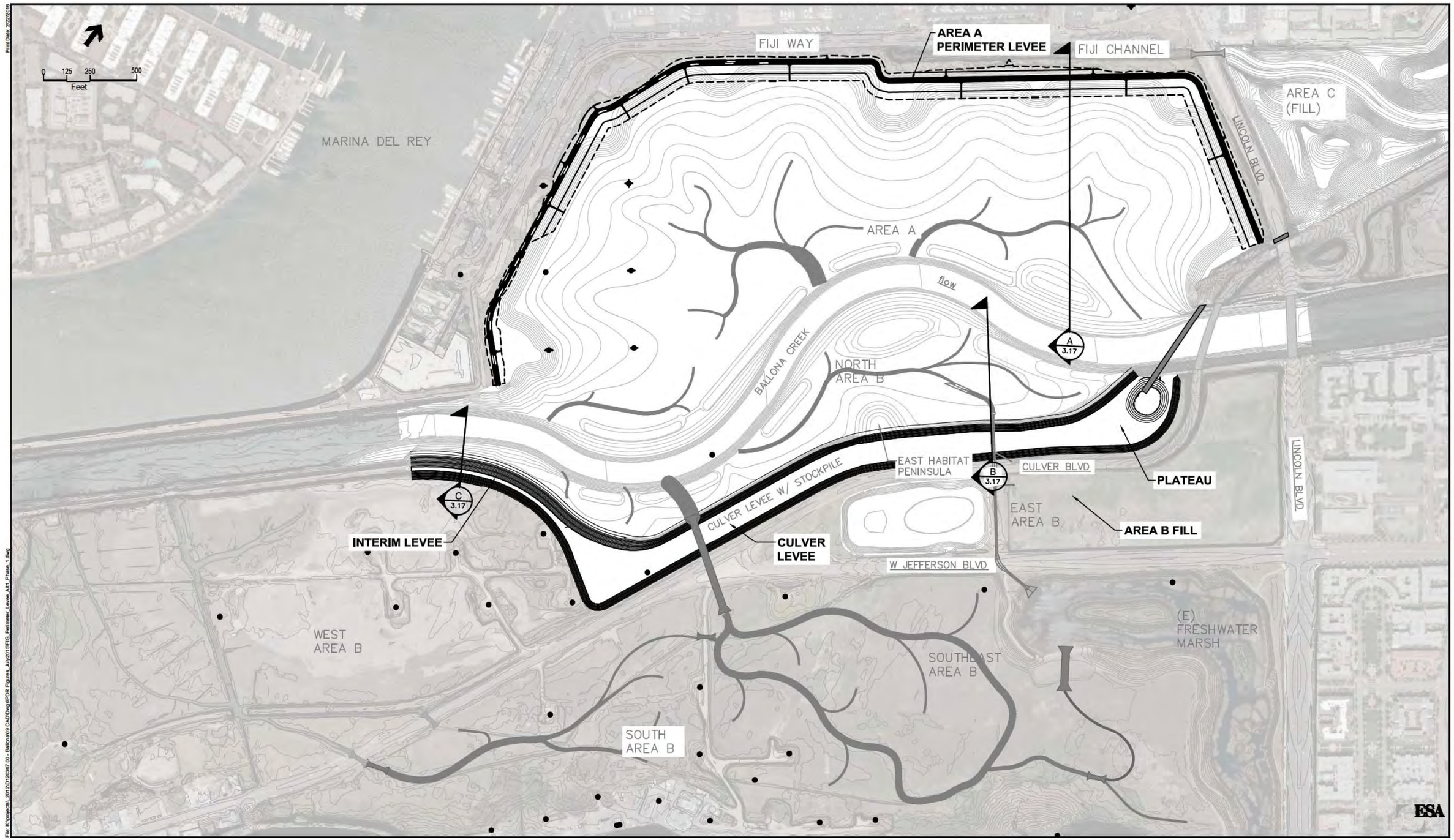
FIGURE 3.13
ALTERNATIVE 1, PHASE 1
AREA C - GRADING PLAN



Ballona Wetland Restoration. D120367

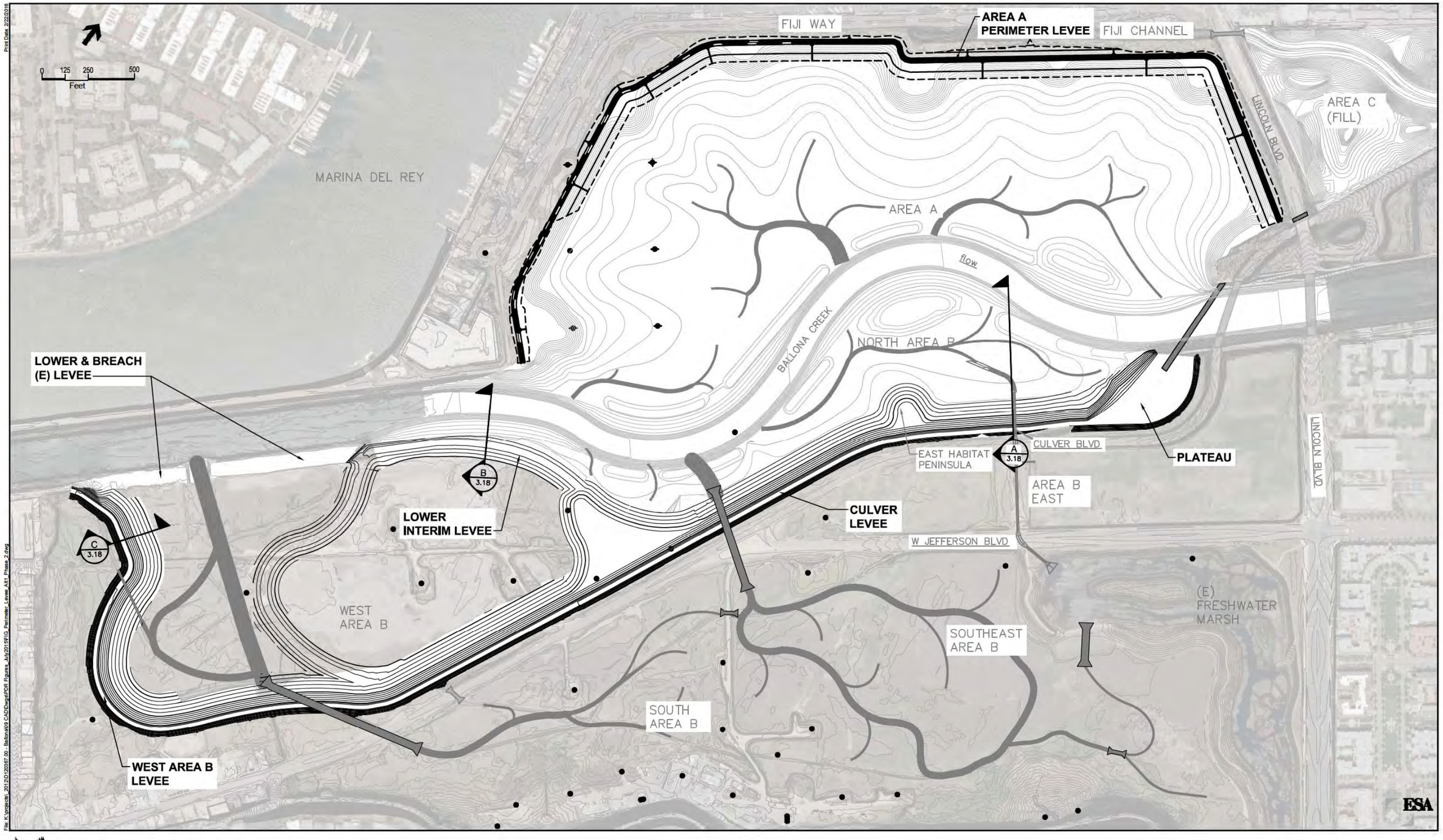
Figure 3.14

Design Flood and Velocity Profiles
Existing vs. Project Conditions



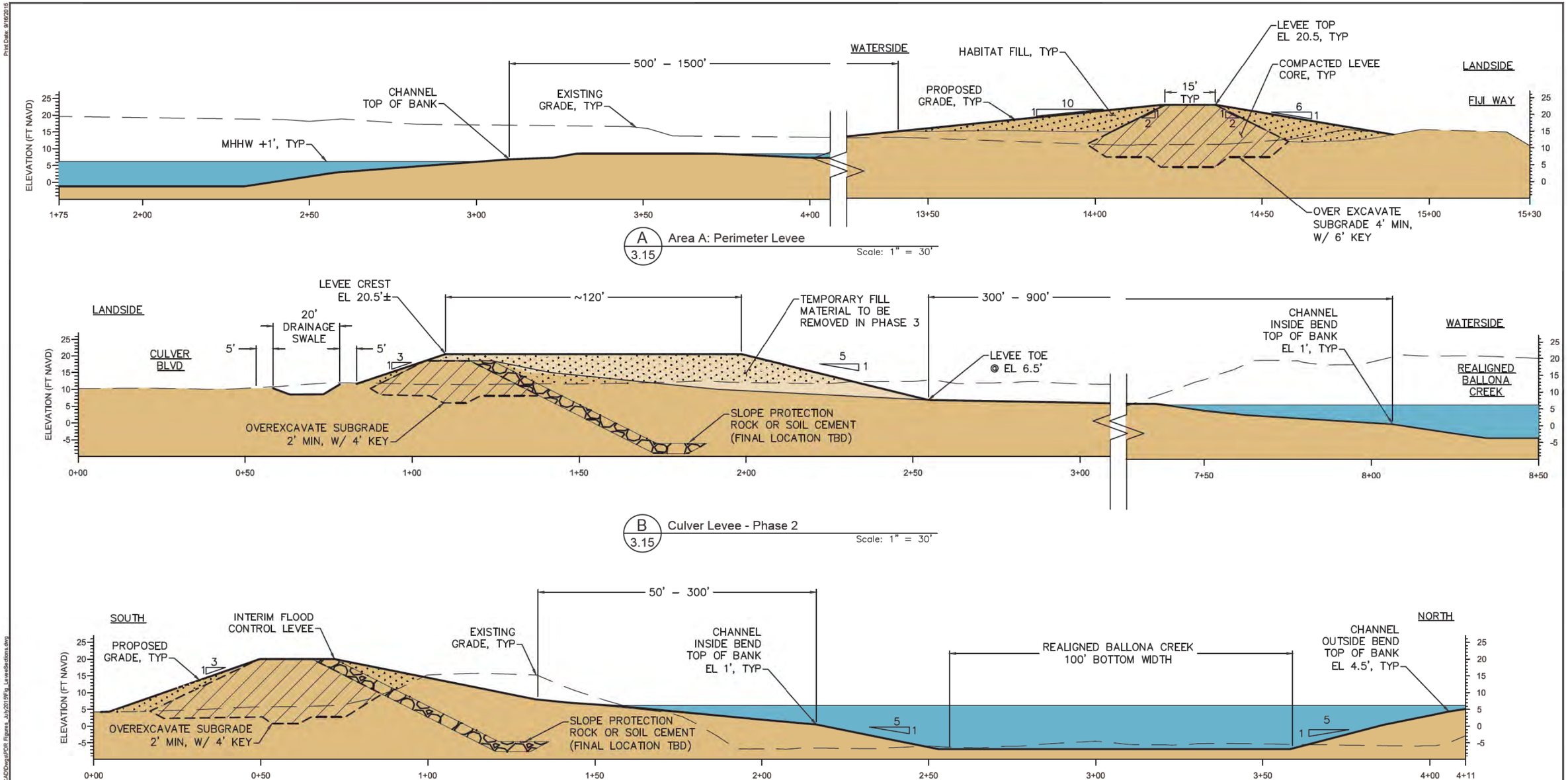
Ballona Wetlands Restoration Project

FIGURE 3.15
ALTERNATIVE 1, PHASE 1
LEVEES PLAN



Ballona Wetlands Restoration Project

FIGURE 3.16
ALTERNATIVE 1, PHASE 2
LEVEES PLAN



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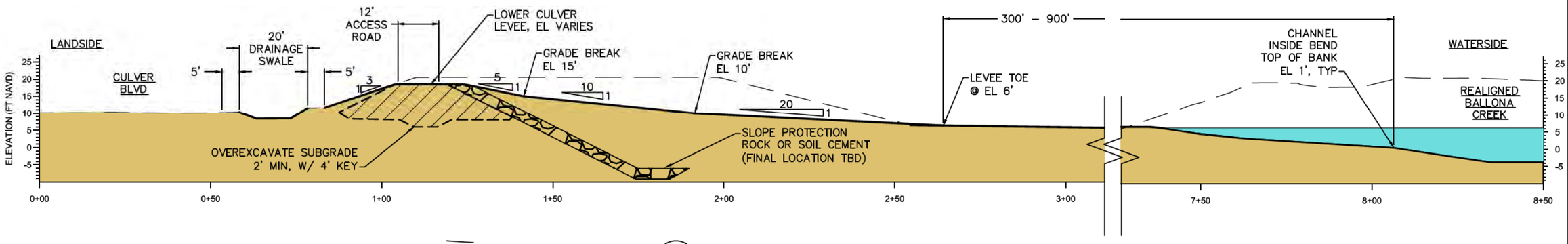
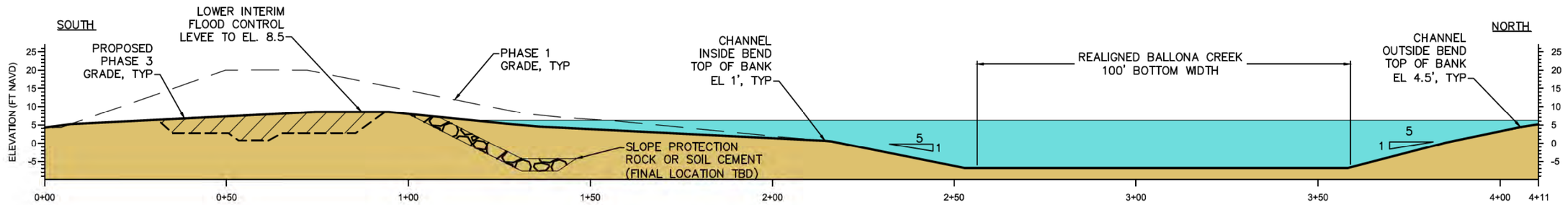
Ballona Wetlands
Restoration Project

FIGURE 3.17
ALTERNATIVE 1, PHASE 1
LEVEE SECTIONS



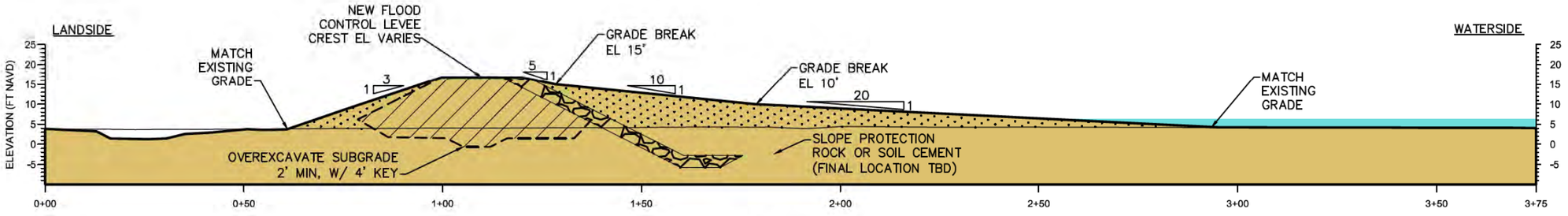
A 3.16 Culver Levee - Phase 2

Scale: 1" = 30'



B 3.16 Lowered Interim Levee

Scale: 1" = 30'



C 3.16 Area B West Levee

Scale: 1" = 30'

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FIGURE 3.18
ALTERNATIVE 1, PHASE 2
LEVEE SECTIONS

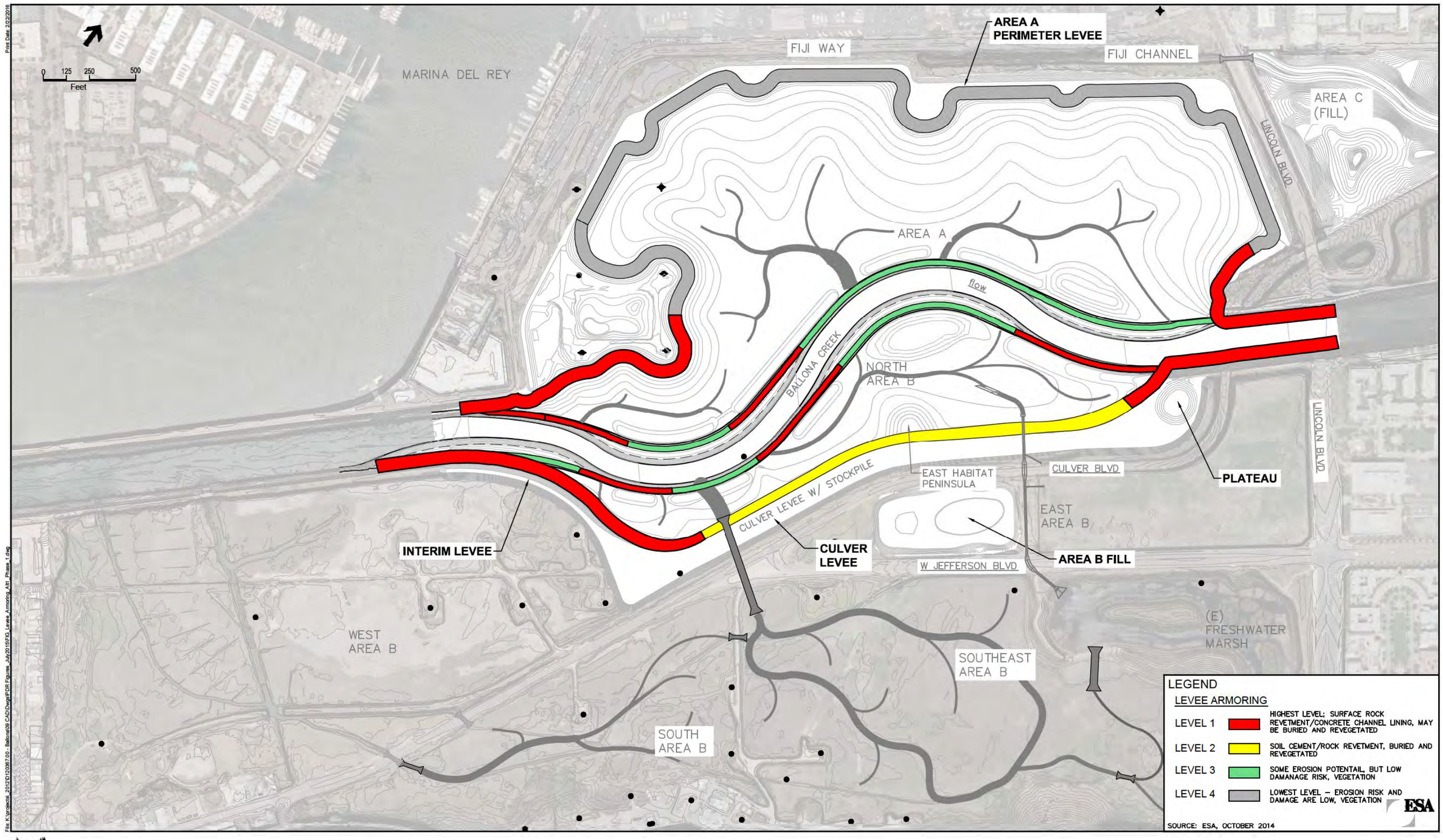

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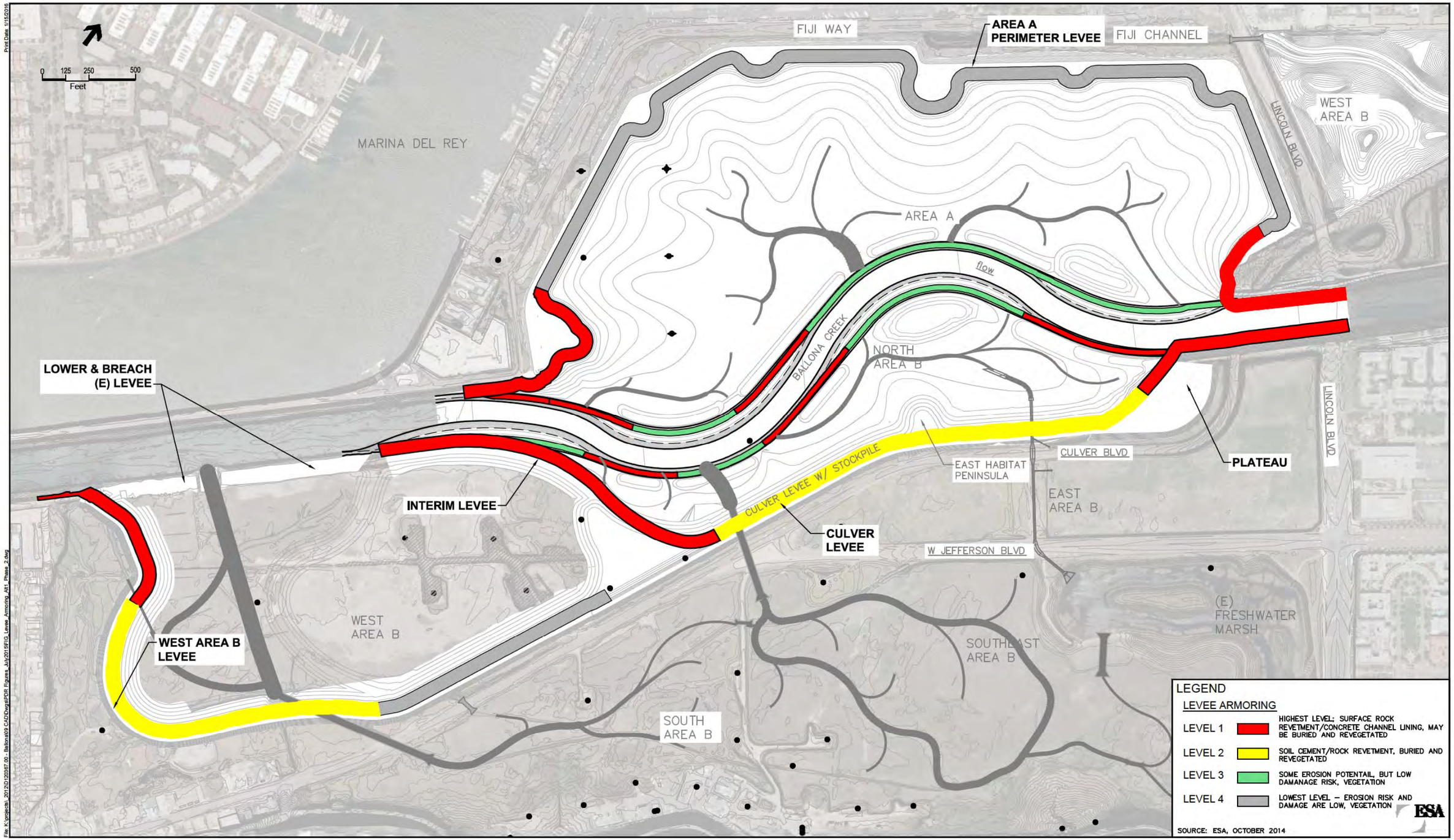
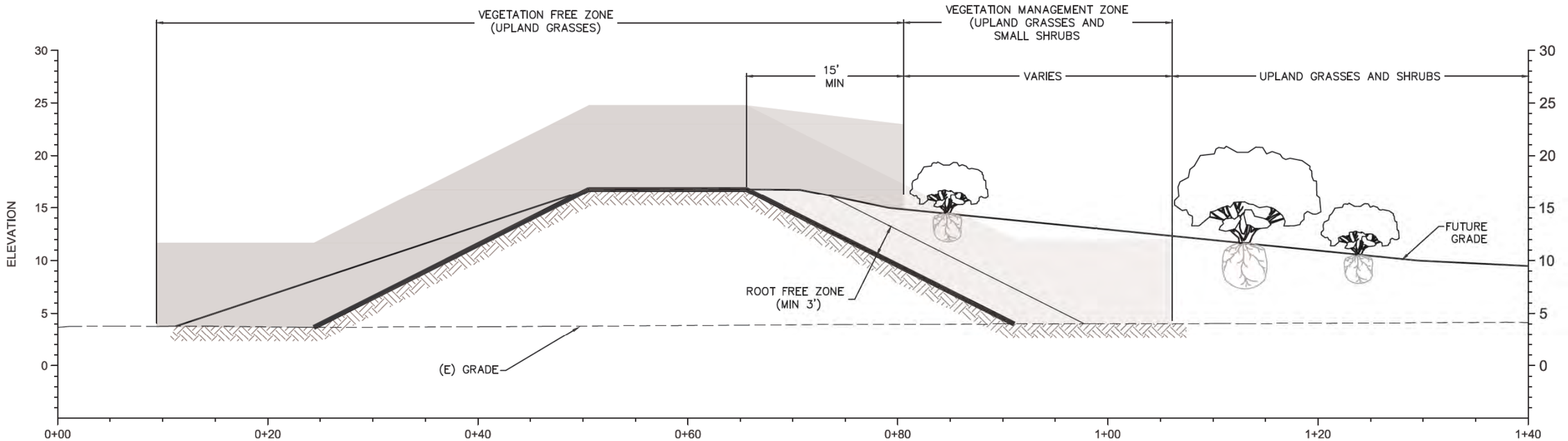
FIGURE 3.19
ALTERNATIVE 1, PHASE 1
ARMORING PLAN

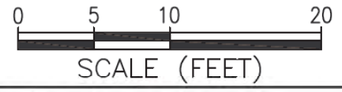


Ballona Wetlands Restoration Project

FIGURE 3.20
ALTERNATIVE 1, PHASE 2
ARMORING PLAN

Print Date: 9/16/2015





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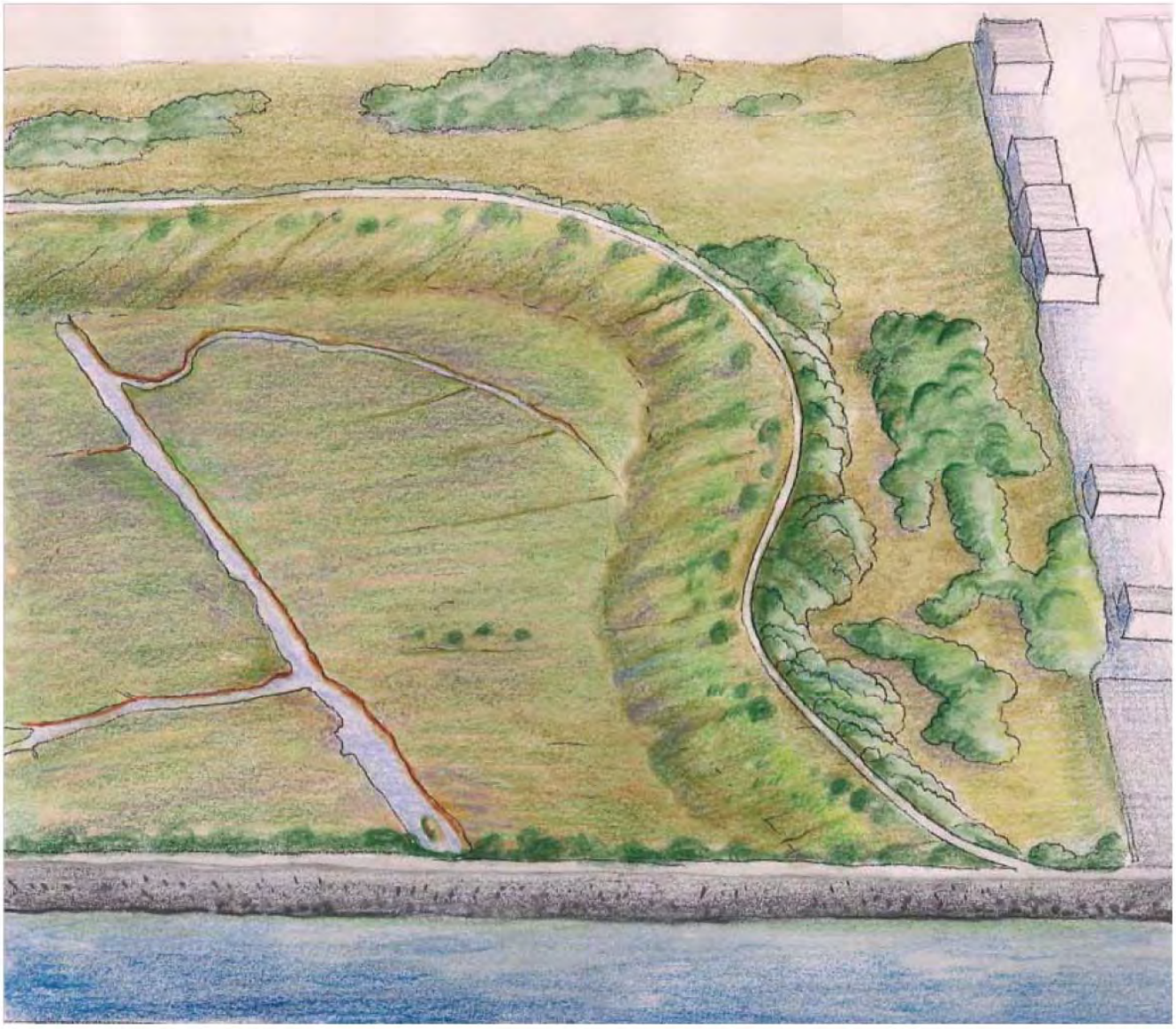
Ballona Wetlands Restoration Project

FIGURE 3.21
ALTERNATIVE 1
VEGETATION AND PLANTINGS ADJACENT TO LEVEES



SOURCE: ESA , October 2012

ESA

Ballona Wetlands Restoration Project

Figure 3-22
Alternative 1 -West Area B Levee - Artists Rendering

Print Date: 1/15/2016

0 125 250 500
Feet

FIJI WAY

FIJI CHANNEL

LINCOLN BLVD

AREA C
(FILL)

MARINA DEL REY

AREA A

NORTH AREA B

flow

BALLONA CREEK

DOWN STREAM LIMIT
OF CREEK GRADING

5

CULVER BLVD

EAST
AREA B

UP STREAM LIMIT
OF CREEK GRADING

LINCOLN BLVD

3

WEST HABITAT
PENINSULA

W JEFFERSON BLVD

(E) FRESHWATER
MARSH

1

WEST
AREA B

4

6

SOUTHEAST
AREA B

2

SOUTH
AREA B

7

CHANNEL ENHANCEMENT
(E) GRADE TO REMAIN

LEGEND

(N) TIDAL
CHANNELS TYP.

(N) CULVERT

(E) CULVERT

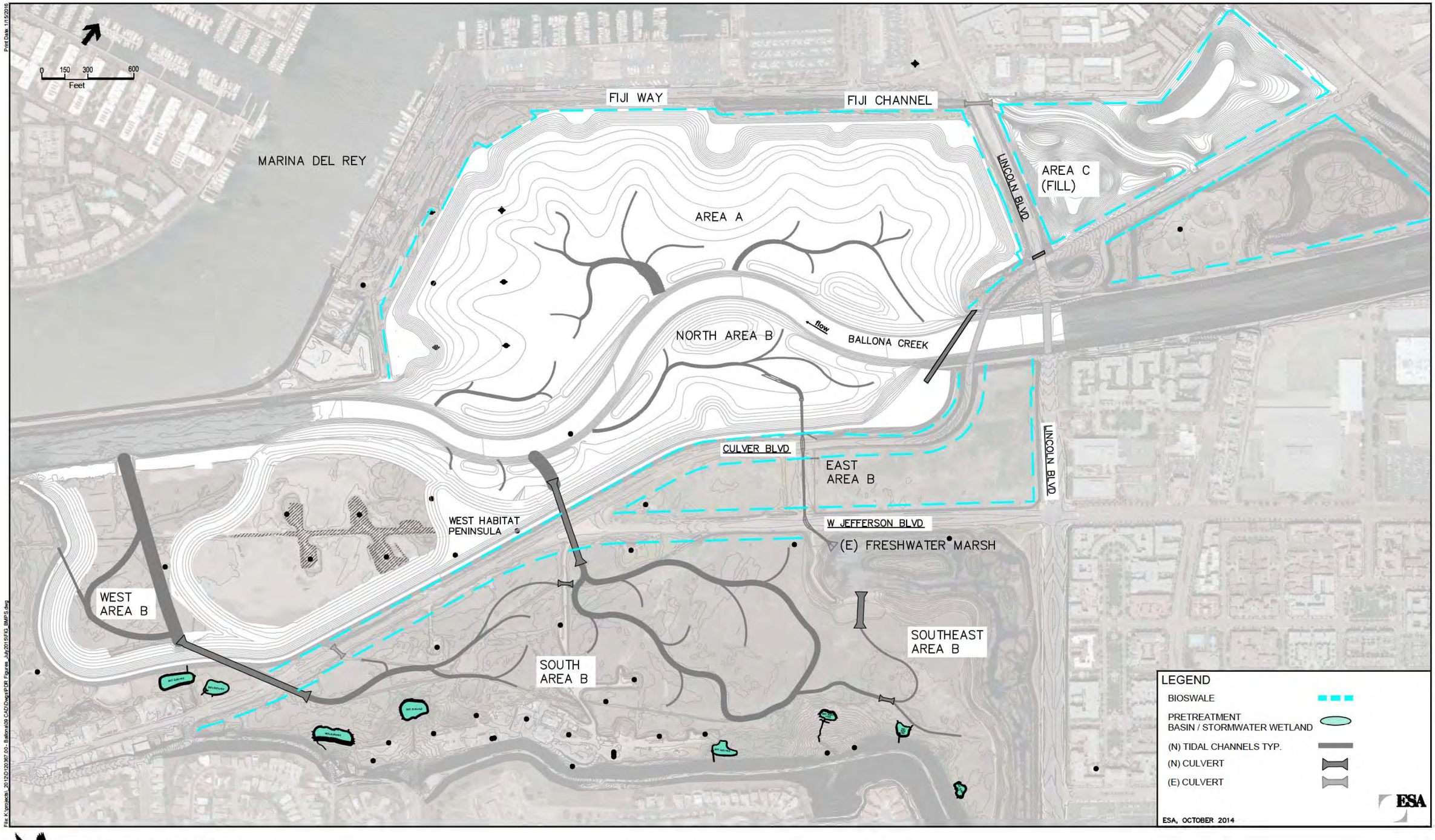
ESA

SOURCE: ESA, OCTOBER 2014

File: K:\projects\...\Ballona\09 CAD\Dwg\PDR Figures_July2015\FIG. Water Control Structures.dwg

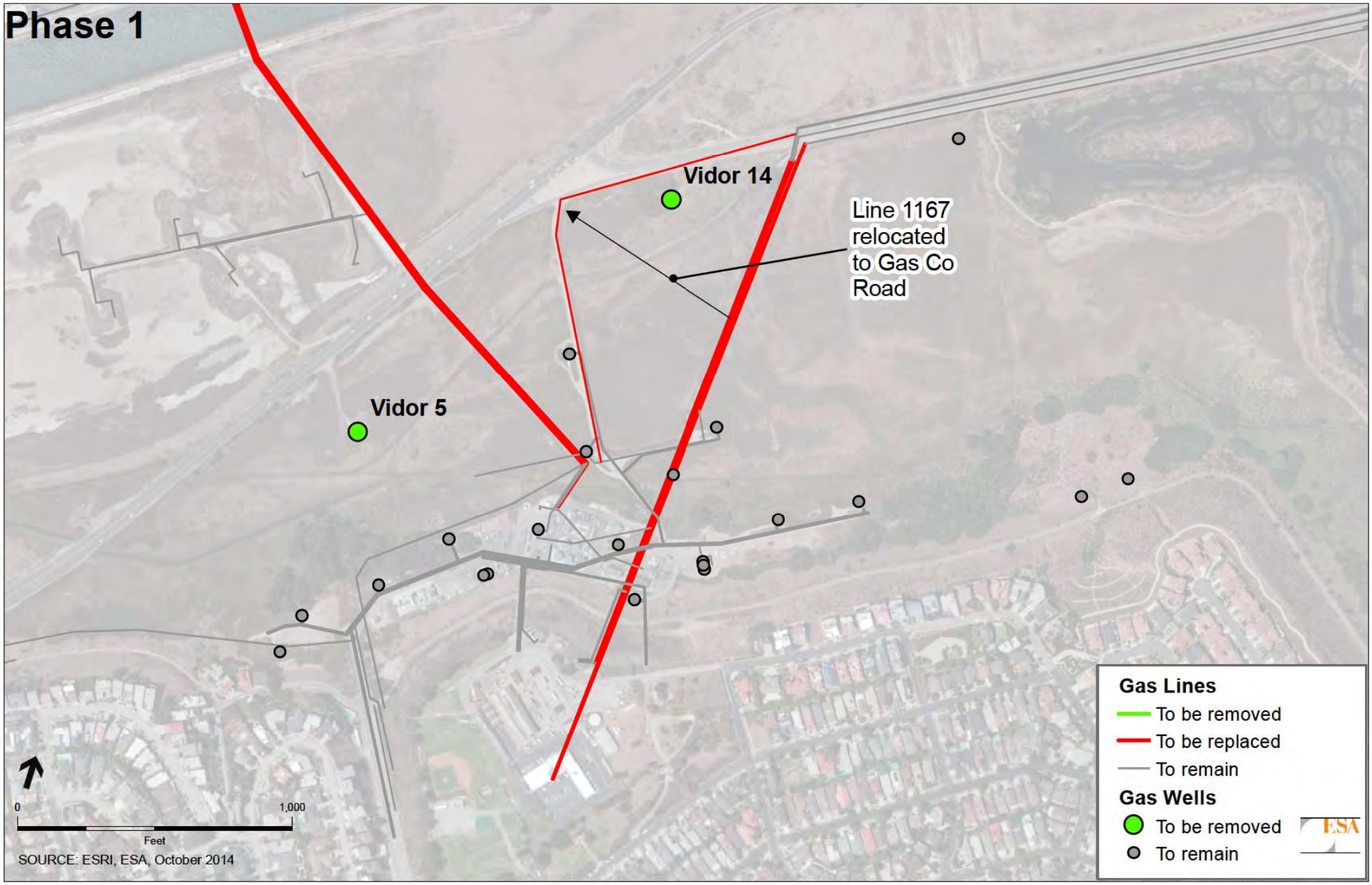
Ballona Wetlands
Restoration Project

FIGURE 3.23
ALTERNATIVE 1 - PHASE 2
WATER CONTROL STRUCTURES



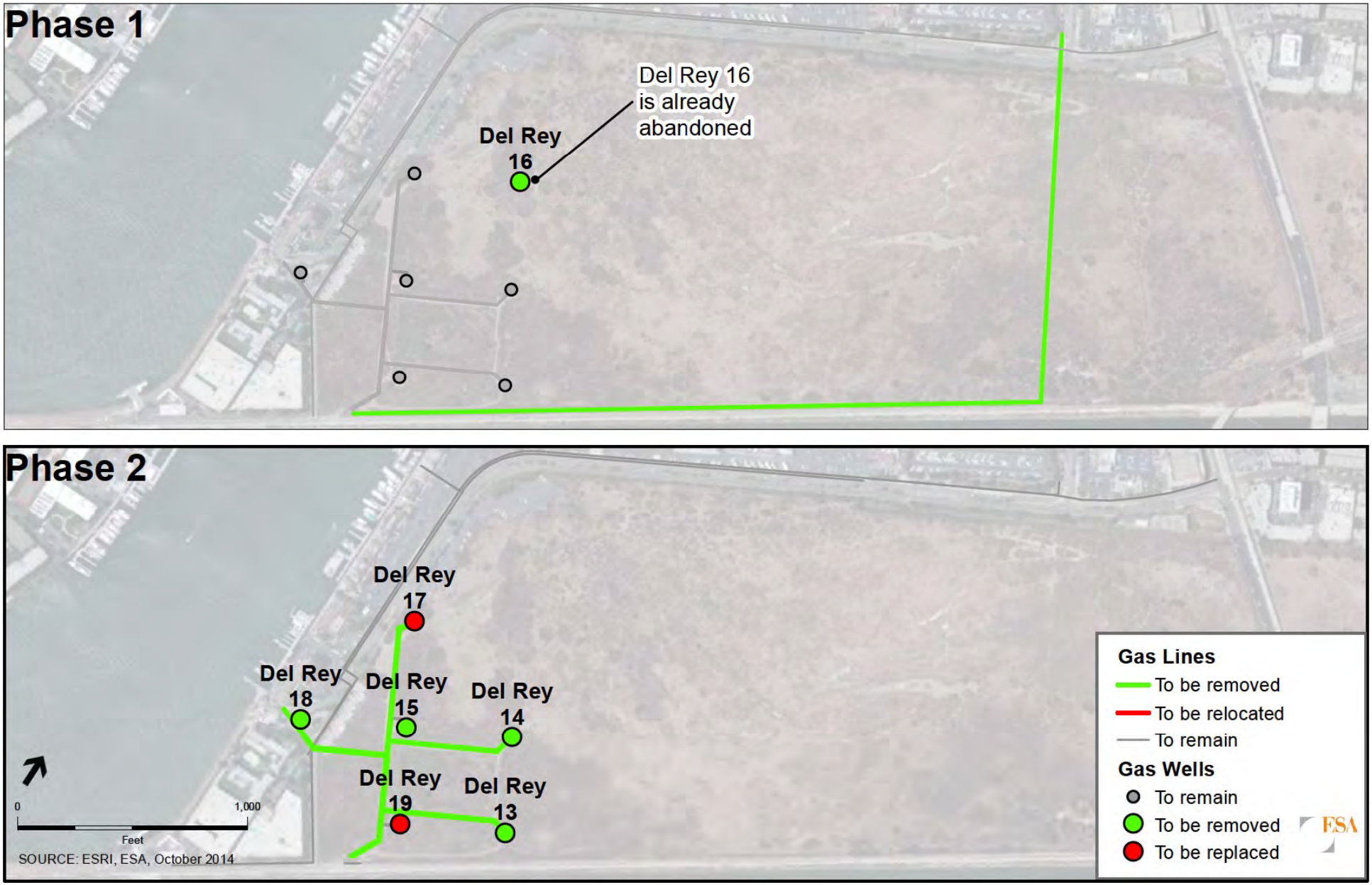
Ballona Wetlands Restoration Project

FIGURE 3.24
ALTERNATIVE 1
STORMWATER BMP's



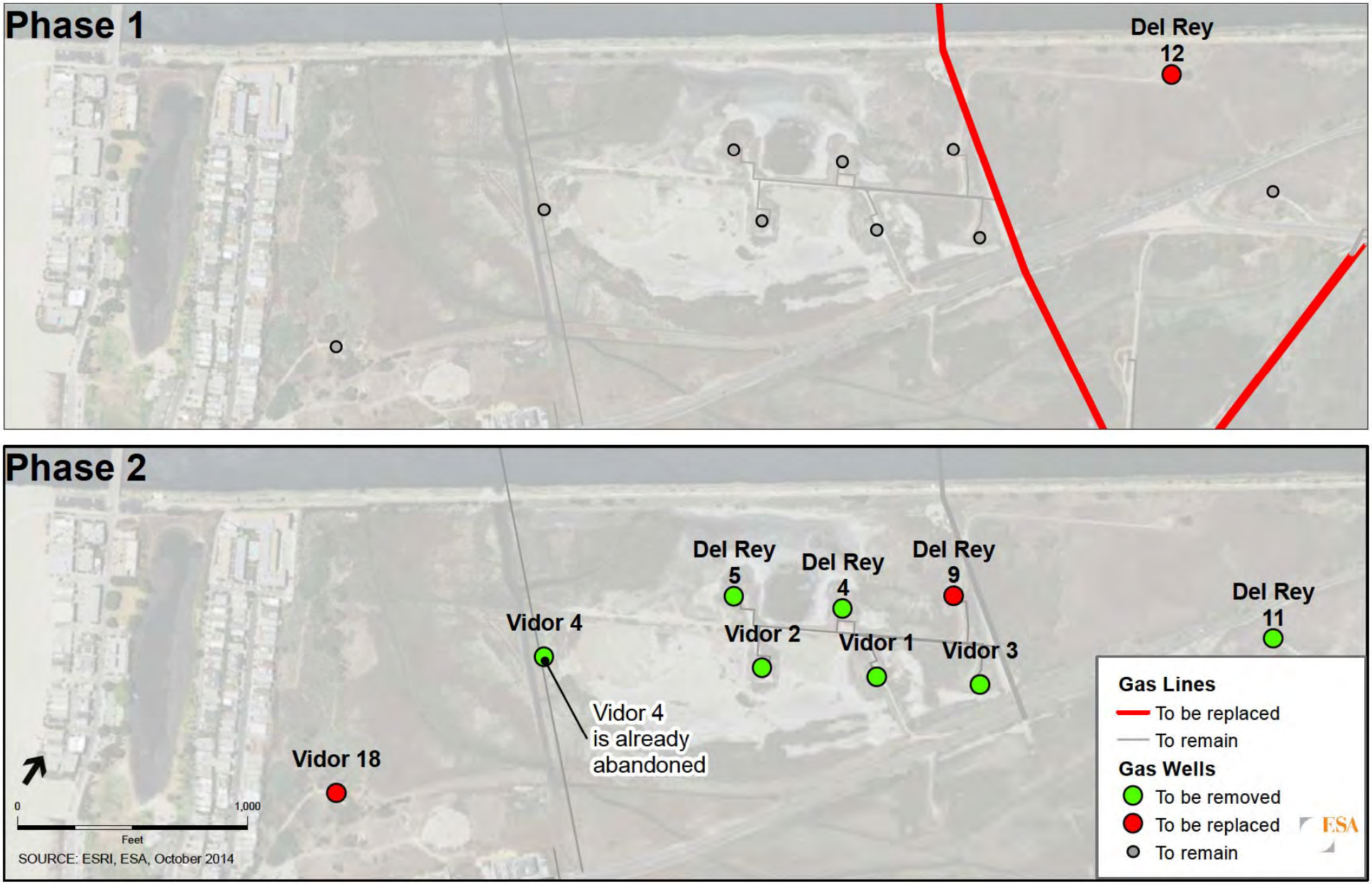
Ballona Wetlands Restoration Project

Figure 3-25
Southern California Gas Company Well Decommissioning:
South Area B



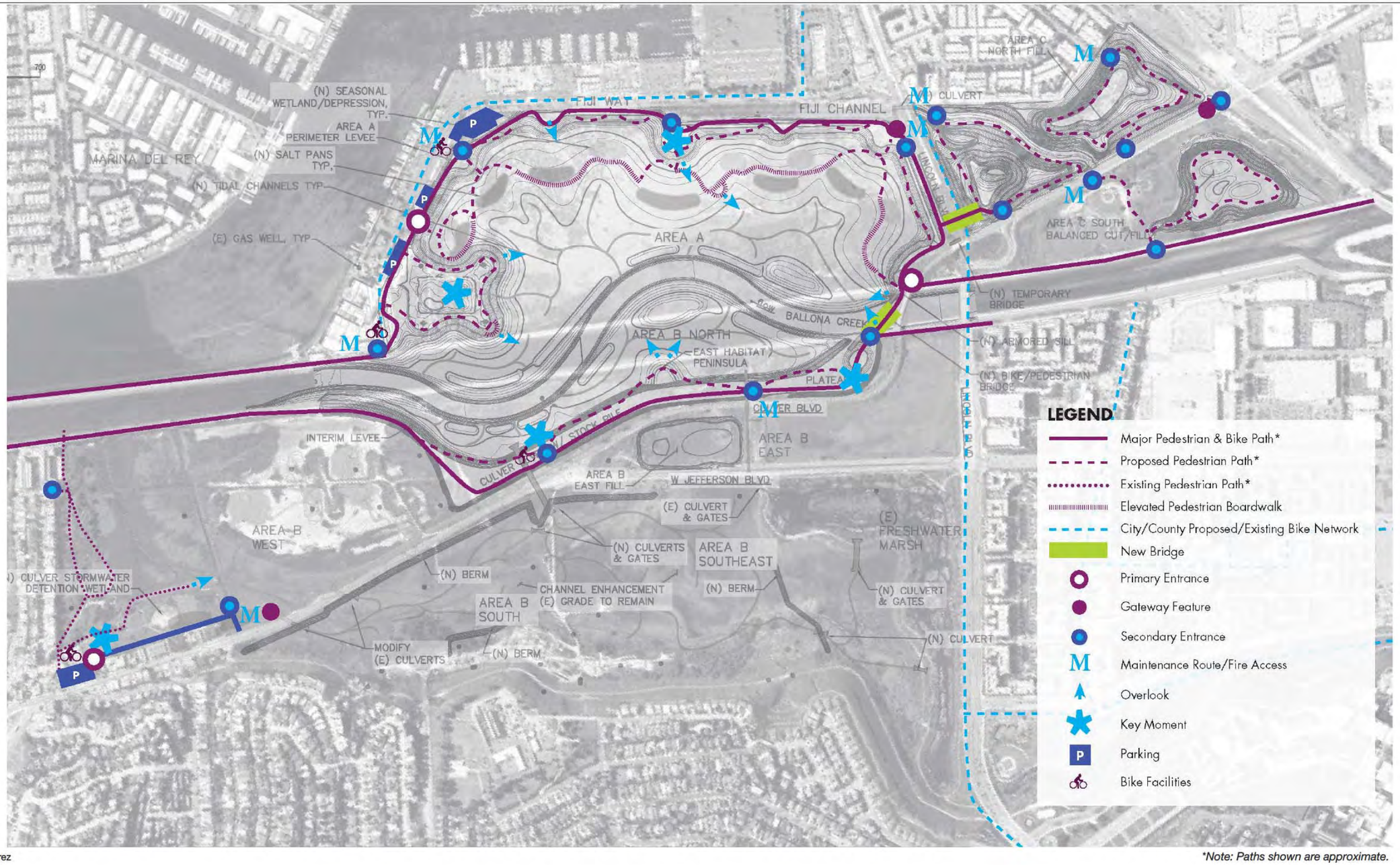
Ballona Wetlands Restoration Project

Figure 2-26
Southern California Gas Company Well Decommissioning: Area B



Ballona Wetlands Restoration Project

Figure 3-27
Southern California Gas Company Well Decommissioning: West and East Area B



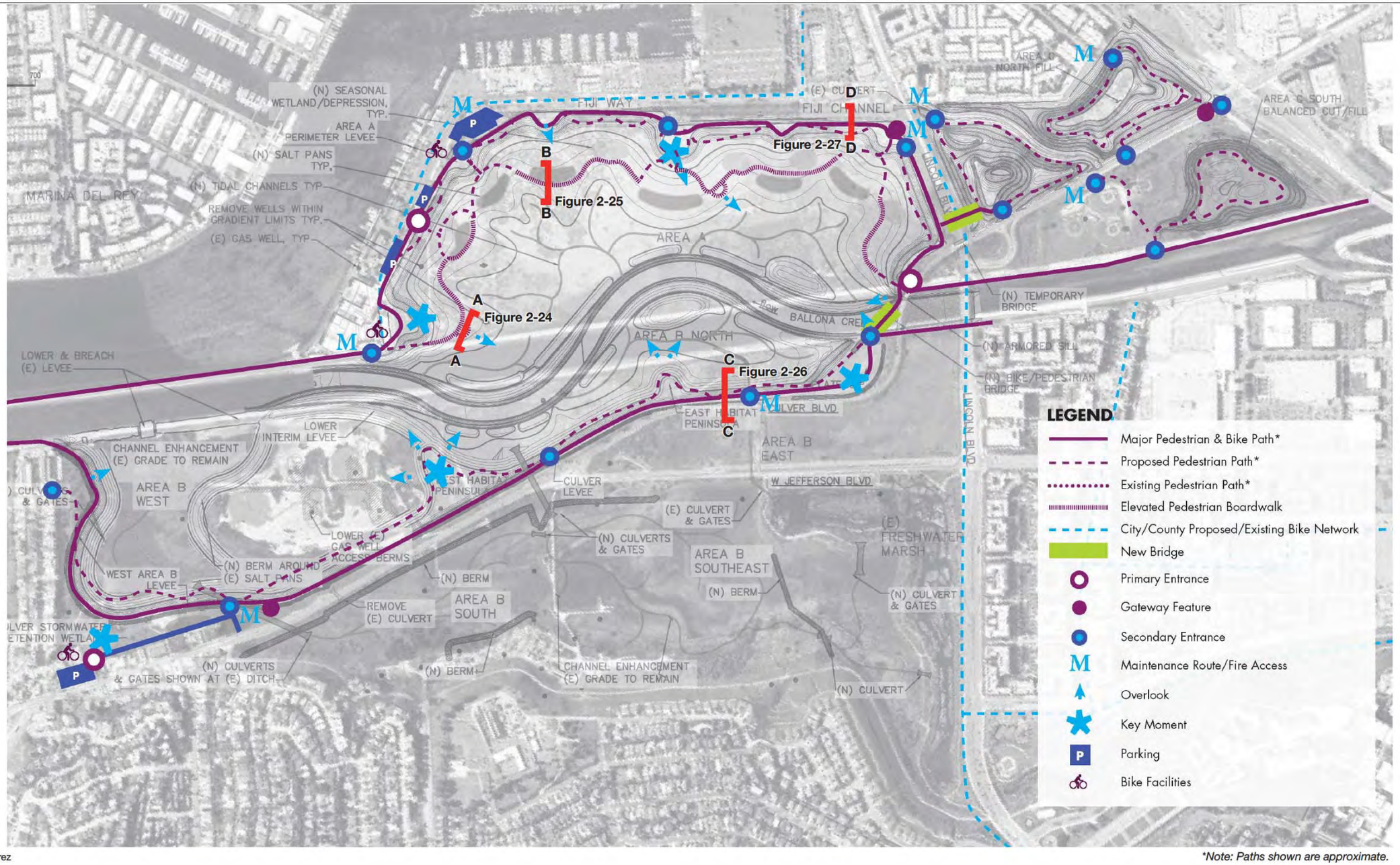
SOURCE: Meléndrez

*Note: Paths shown are approximate.

ESA

Ballona Wetlands Restoration Project

Figure 3-28
Alternative 1, Phase 1: Public Access Plan



SOURCE: Meléndrez

*Note: Paths shown are approximate.

ESA

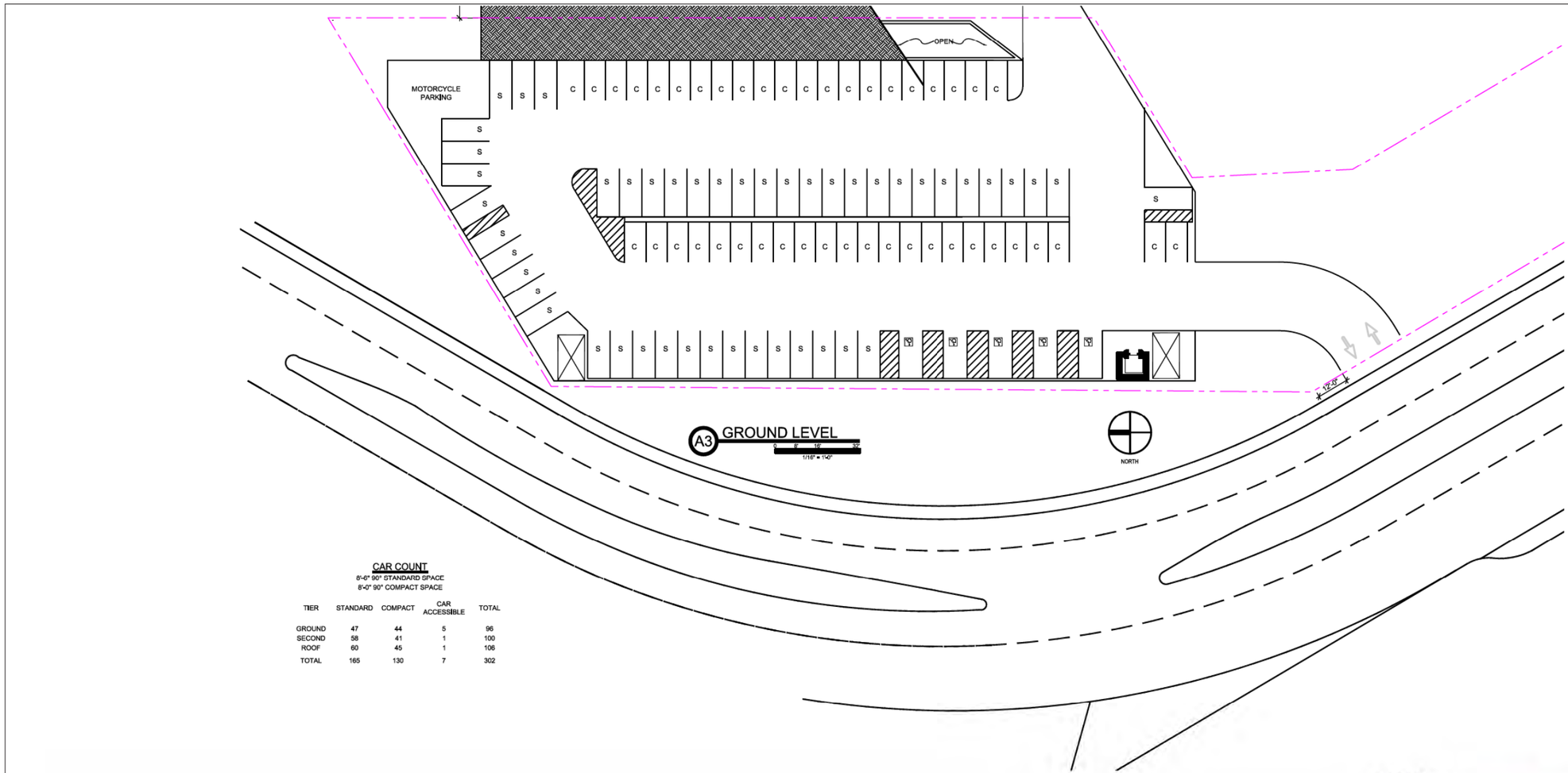
Ballona Wetlands Restoration Project

Figure 3-29
Alternative 1, Phase 2 : Public Access Plan Detail



Ballona Wetlands Restoration Project

Figure 3-30
Area A Parking



CAR COUNT

8'-6" 90° STANDARD SPACE
8'-0" 90° COMPACT SPACE

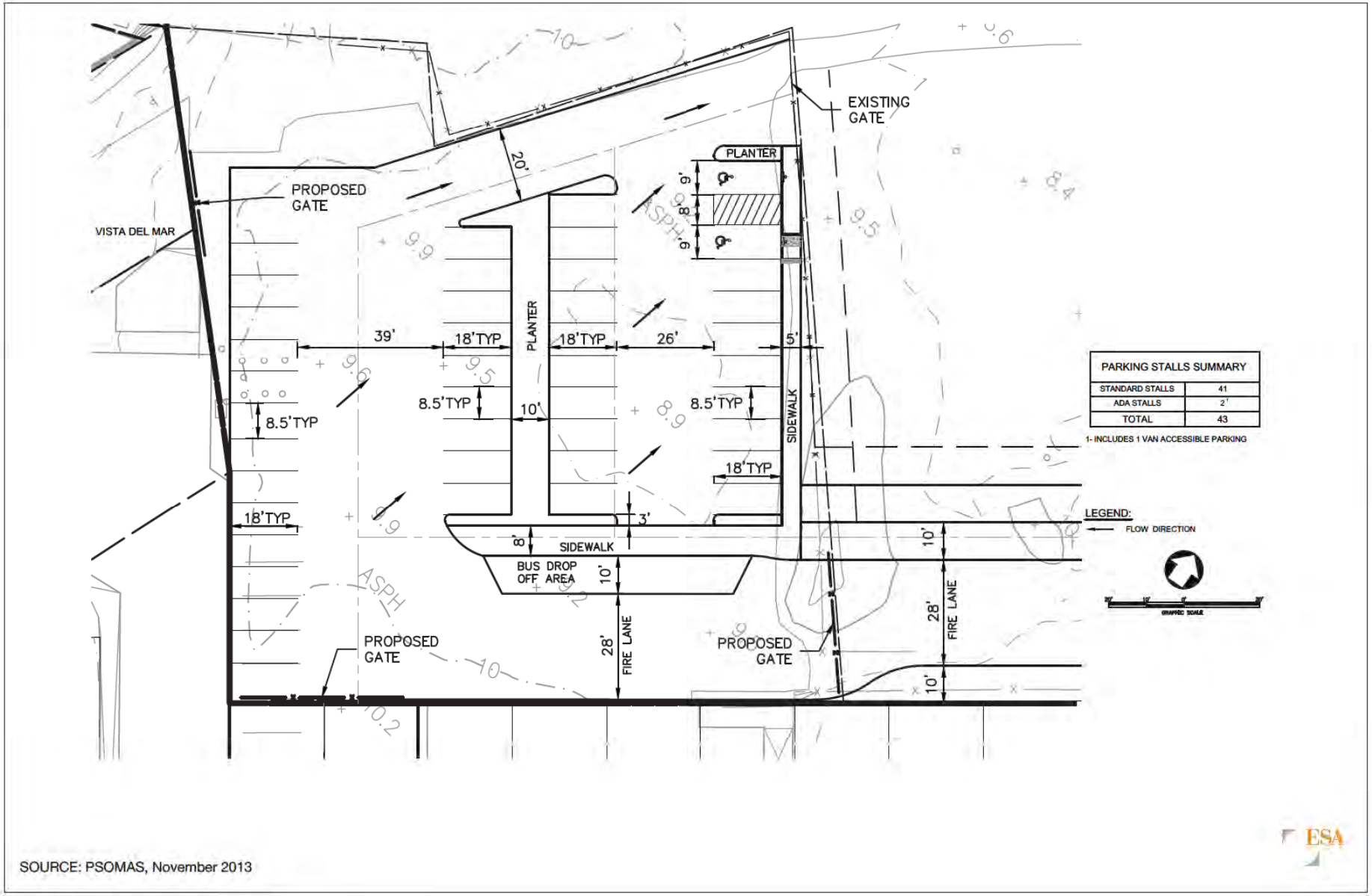
TIER	STANDARD	COMPACT	CAR ACCESSIBLE	TOTAL
GROUND	47	44	5	96
SECOND	58	41	1	100
ROOF	60	45	1	106
TOTAL	165	130	7	302



SOURCE: Department of Beaches and Harbors, February 2014

ESA

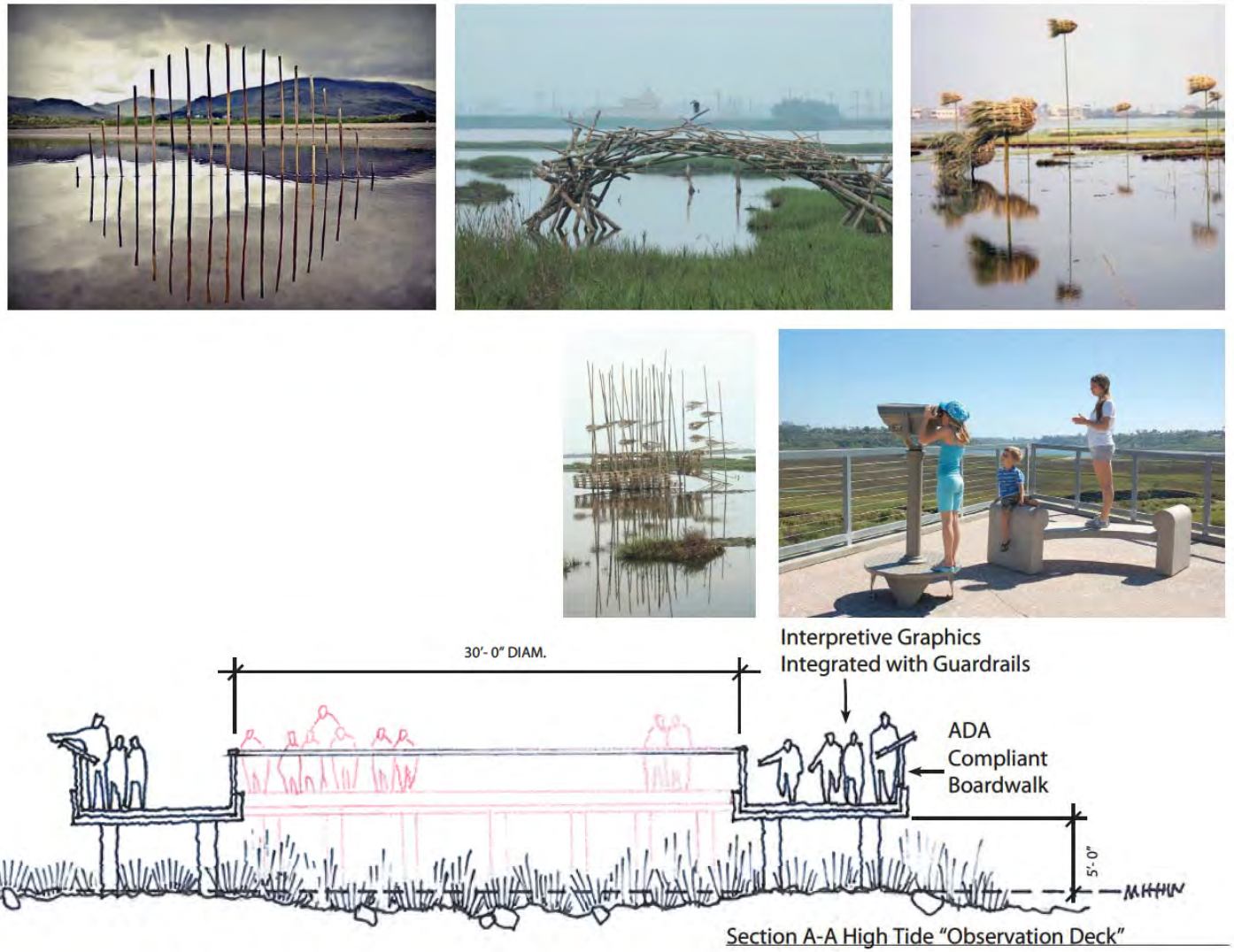
Figure 3-31
New Beaches and Harbor's Parking Structure



SOURCE: PSOMAS, November 2013

Ballona Wetlands Restoration Project

Figure 3-32
West Area B Parking Lot



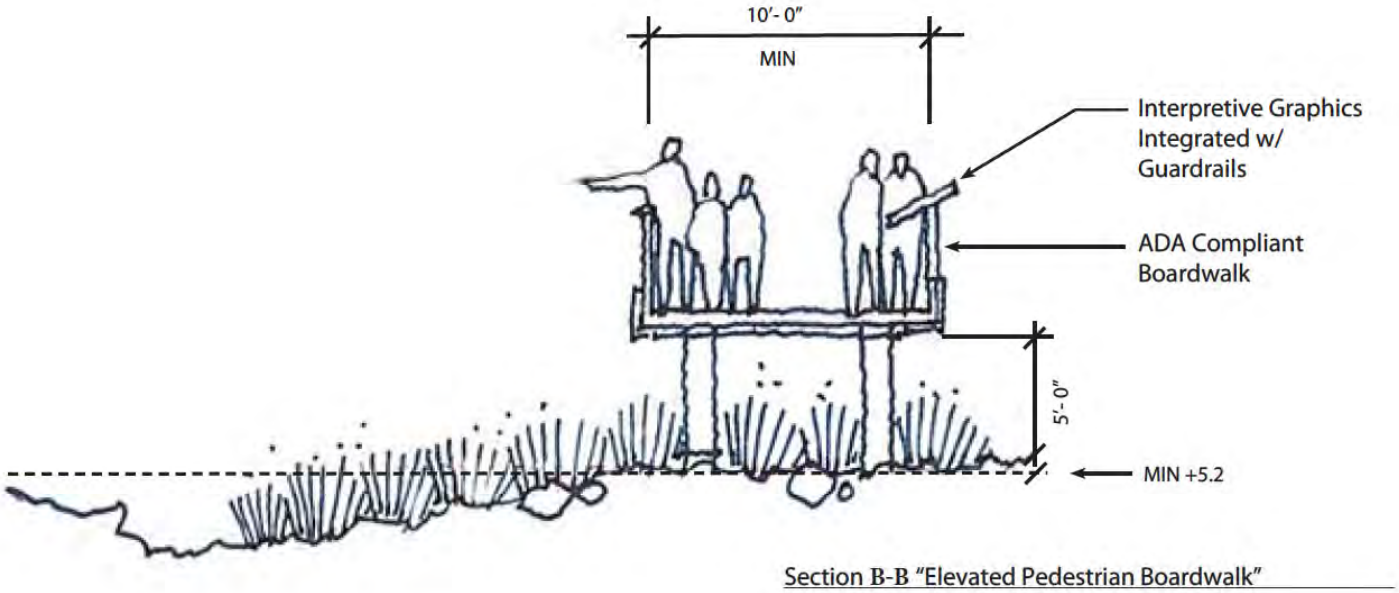
SOURCE: Melendrez, July 2013

ESA

Ballona Wetlands
Restoration Project

Figure 3-33
Typical Observation Deck





Section B-B "Elevated Pedestrian Boardwalk"

SOURCE: Melendrez, July 2013

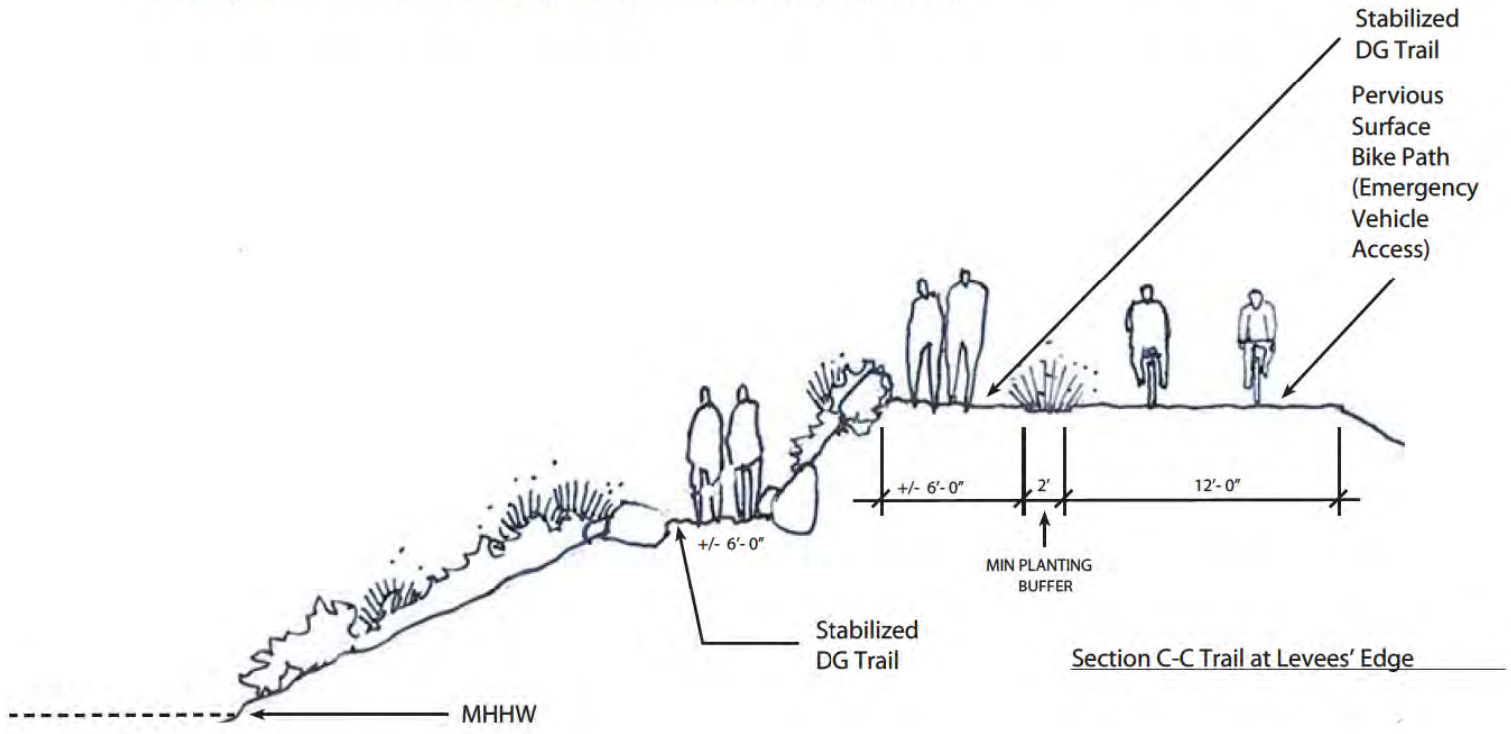
ESA

Ballona Wetlands
Restoration Project

Figure 3-34
Typical Elevated Pedestrian Boardwalk



Photos representative of proposed trails, large trees are not representative of vegetation proposed.



Section C-C Trail at Levees' Edge

SOURCE: Melendrez, July 2013

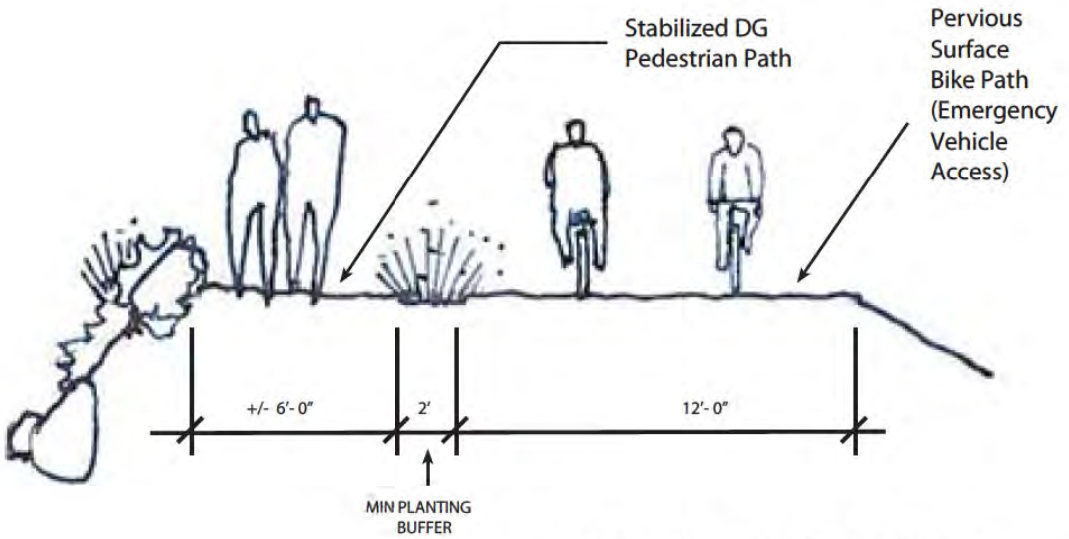
ESA

Ballona Wetlands
Restoration Project

Figure 3-35
Typical Trail at Levees' Edge







Section D-D "Pedestrian & Bike Trail"

SOURCE: Melendrez, July 2013

ESA

Ballona Wetlands
Restoration Project

Figure 3-36
Typical Pedestrian & Bike Trail



* Visualization depicts potential concept for a Gateway Element at one of the main intersection identified (Fiji Way and Lincoln Boulevard). Actual design and siting will vary.

SOURCE: Melendrez, July 2013

ESA

Ballona Wetlands Restoration Project

Figure 3-37
Typical Gateway Element Visualization



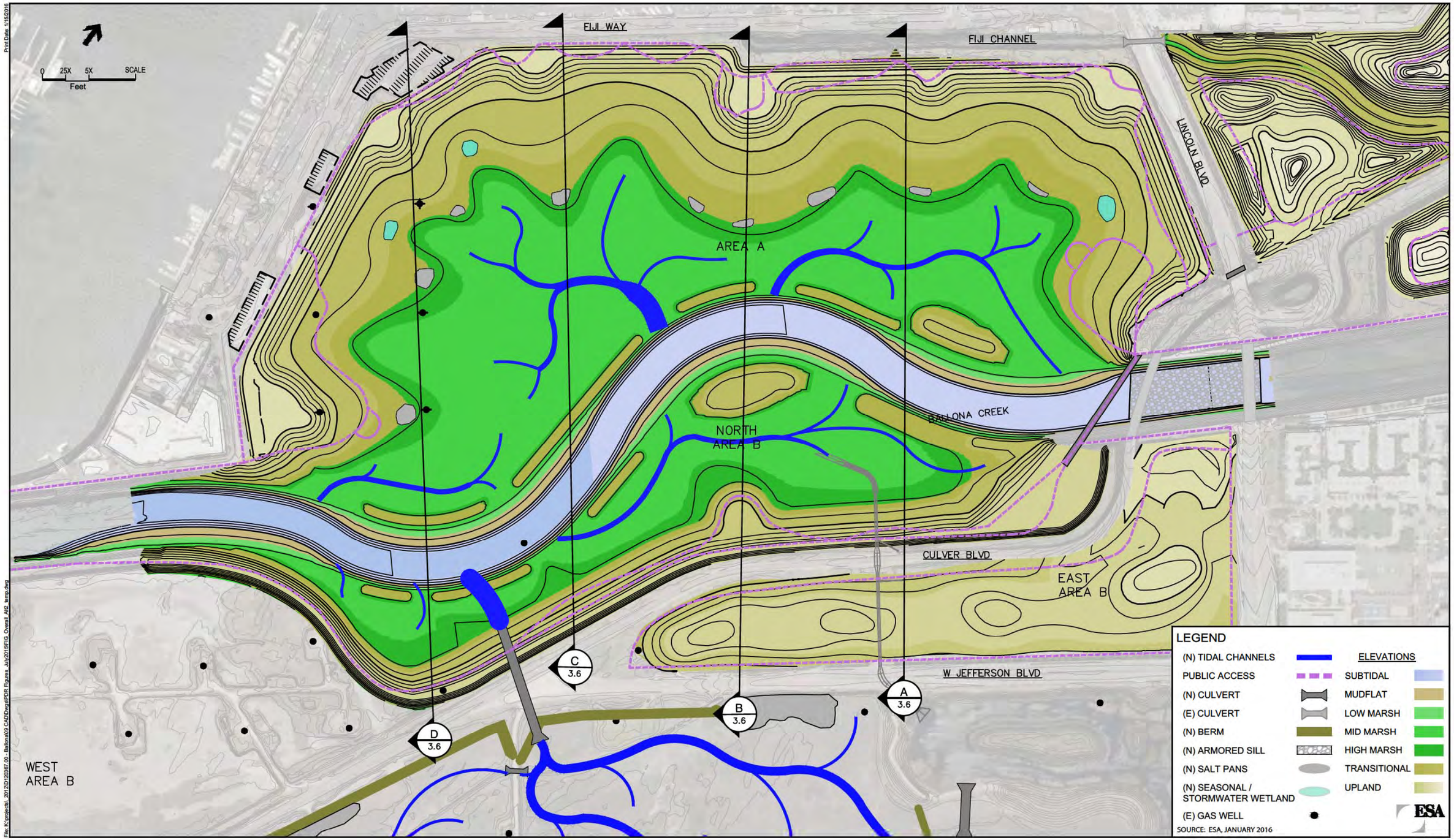
* Visualization depicts potential concept for a Key Moment. Actual design and siting will vary.

SOURCE: Melendrez, July 2013

ESA

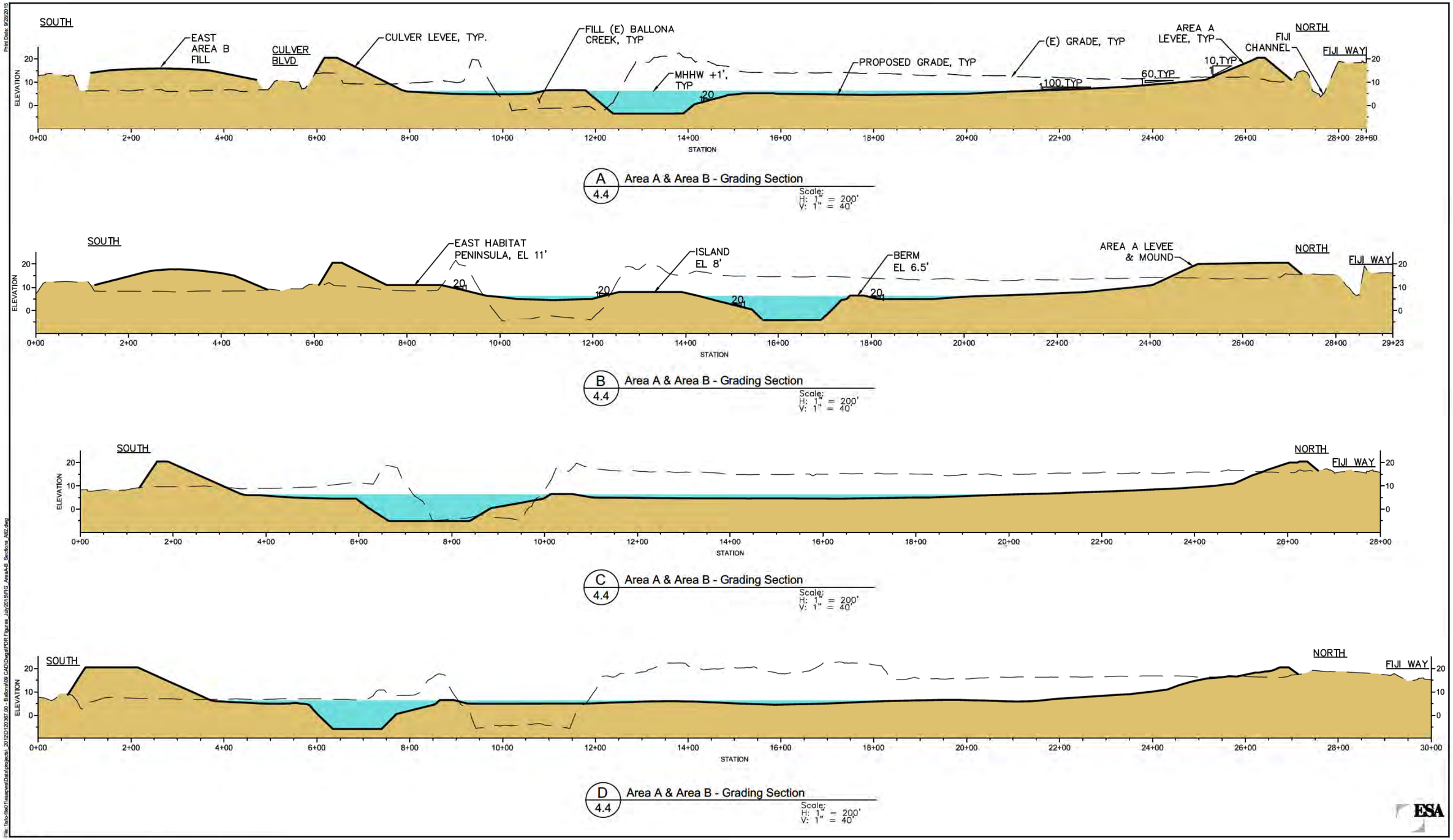
Ballona Wetlands Restoration Project

Figure 3-38
Typical Key Moment Visualization



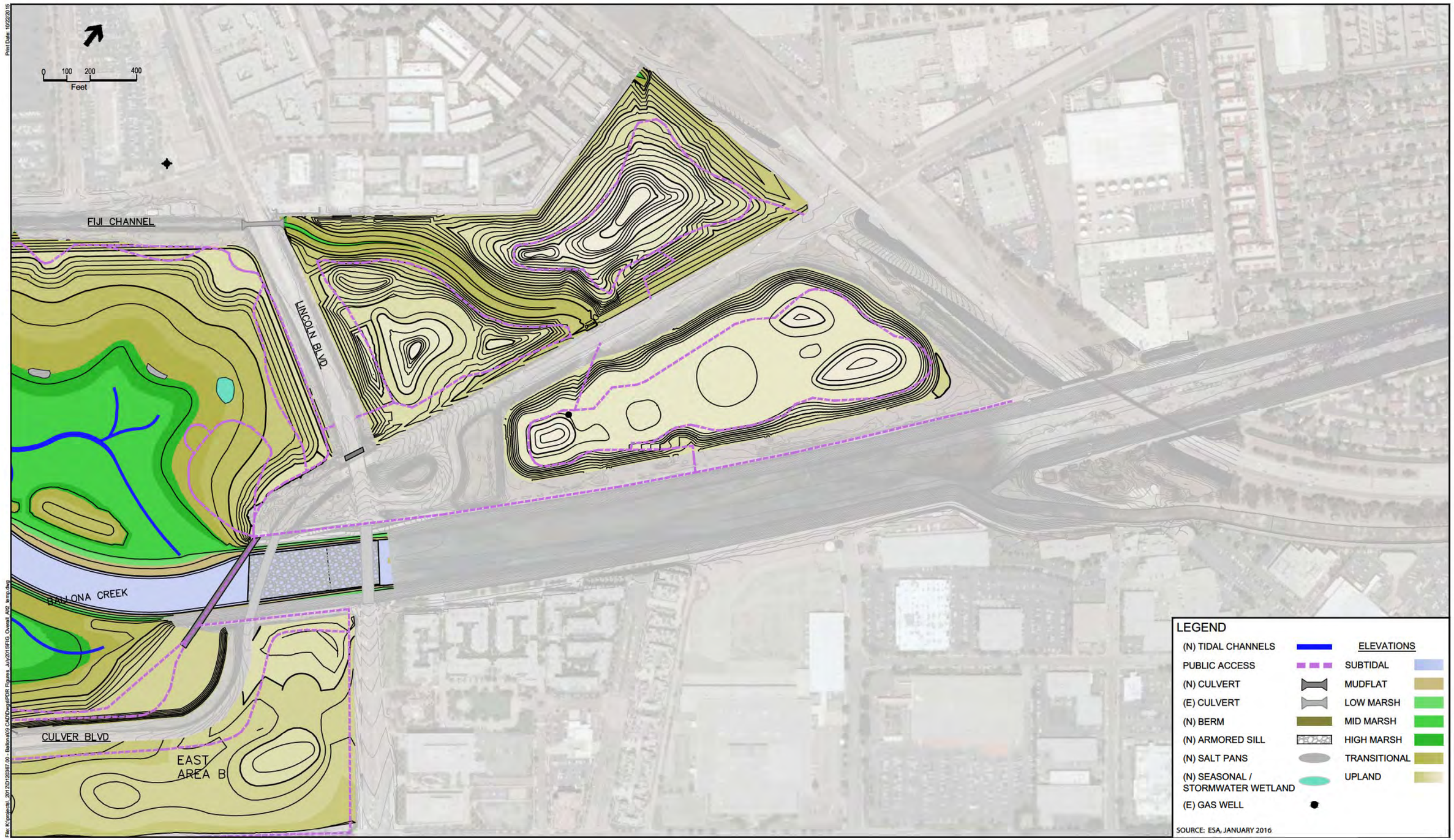
Ballona Wetlands Restoration Project

FIGURE 4.1
ALTERNATIVE 2
AREA A AND AREA B - GRADING PLAN



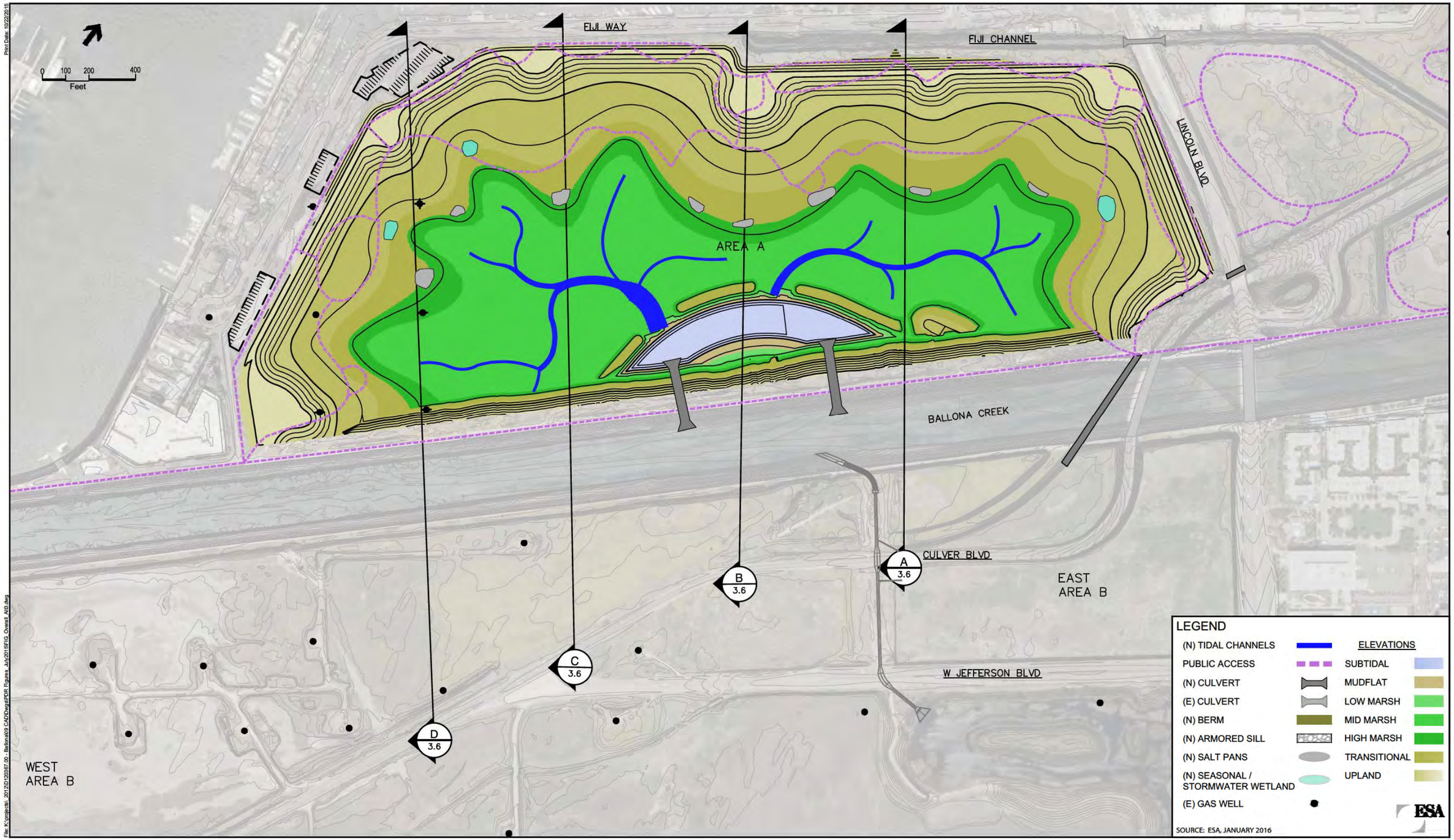
Ballona Wetlands Restoration Project

FIGURE 4.2
ALTERNATIVE 2
AREA A AND NORTH AREA B - GRADING SECTIONS



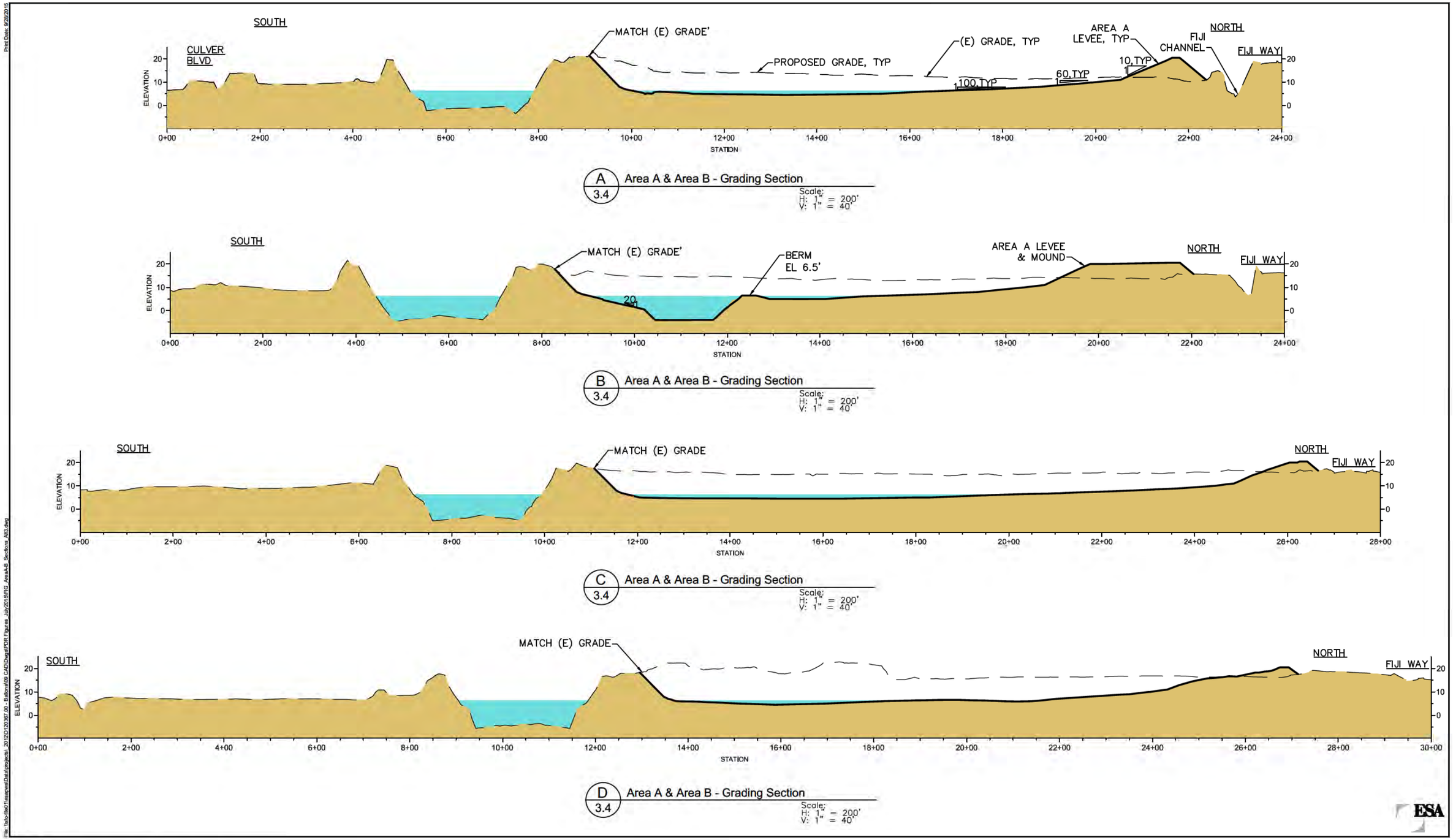
Ballona Wetlands Restoration Project

FIGURE 4.3
ALTERNATIVE 2
AREA C - GRADING PLAN



Ballona Wetlands Restoration Project

FIGURE 5.1
ALTERNATIVE 3
AREA A - GRADING PLAN

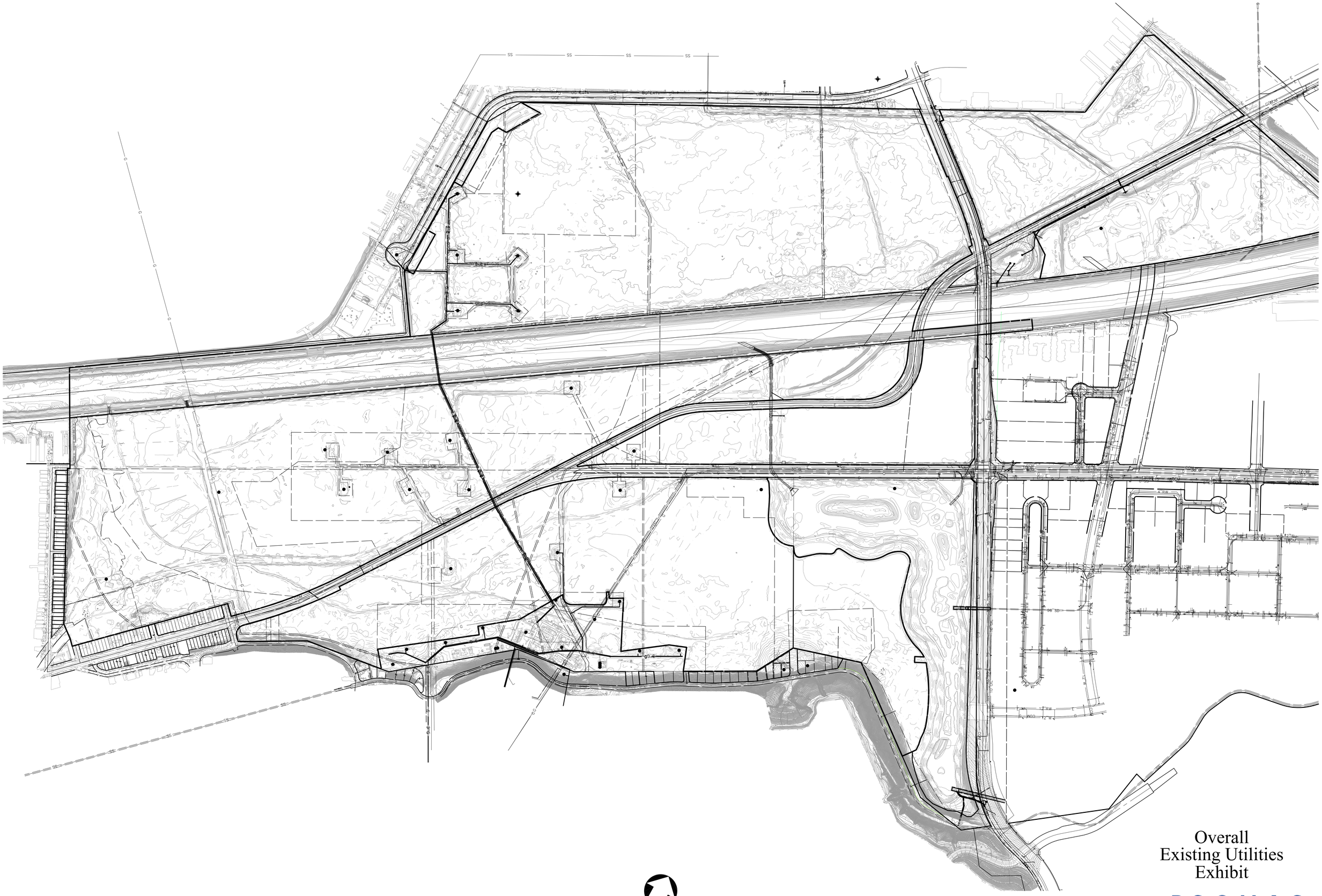


Ballona Wetlands Restoration Project

FIGURE 5.2
ALTERNATIVE 3
AREA A AND NORTH AREA B - GRADING SECTIONS

Appendix A
Existing Conditions

APPENDIX - EXISTING CONDITIONS/SURVEY	
Drawing Number	**Exhibit Title**
BR001	Overall Existing Utilities Exhibit
BR010	Overall Existing Topography Exhibit
BR018	Orthophoto Exhibit
BR034-01	Constraints Map Area A
BR034-02	Constraints Map Area B
BR034-03	Constraints Map Area C
BR042	PTR Review
BR043-1	Ballona Survey Control Report NAD83
BR044-1	Ballona Survey Vert Datum Conv Report
BR045-1-01	Project Locations
--	Stewart Title Preliminary Title Report (4)



Overall Existing Utilities Exhibit

CALIFORNIA COASTAL CONSERVANCY

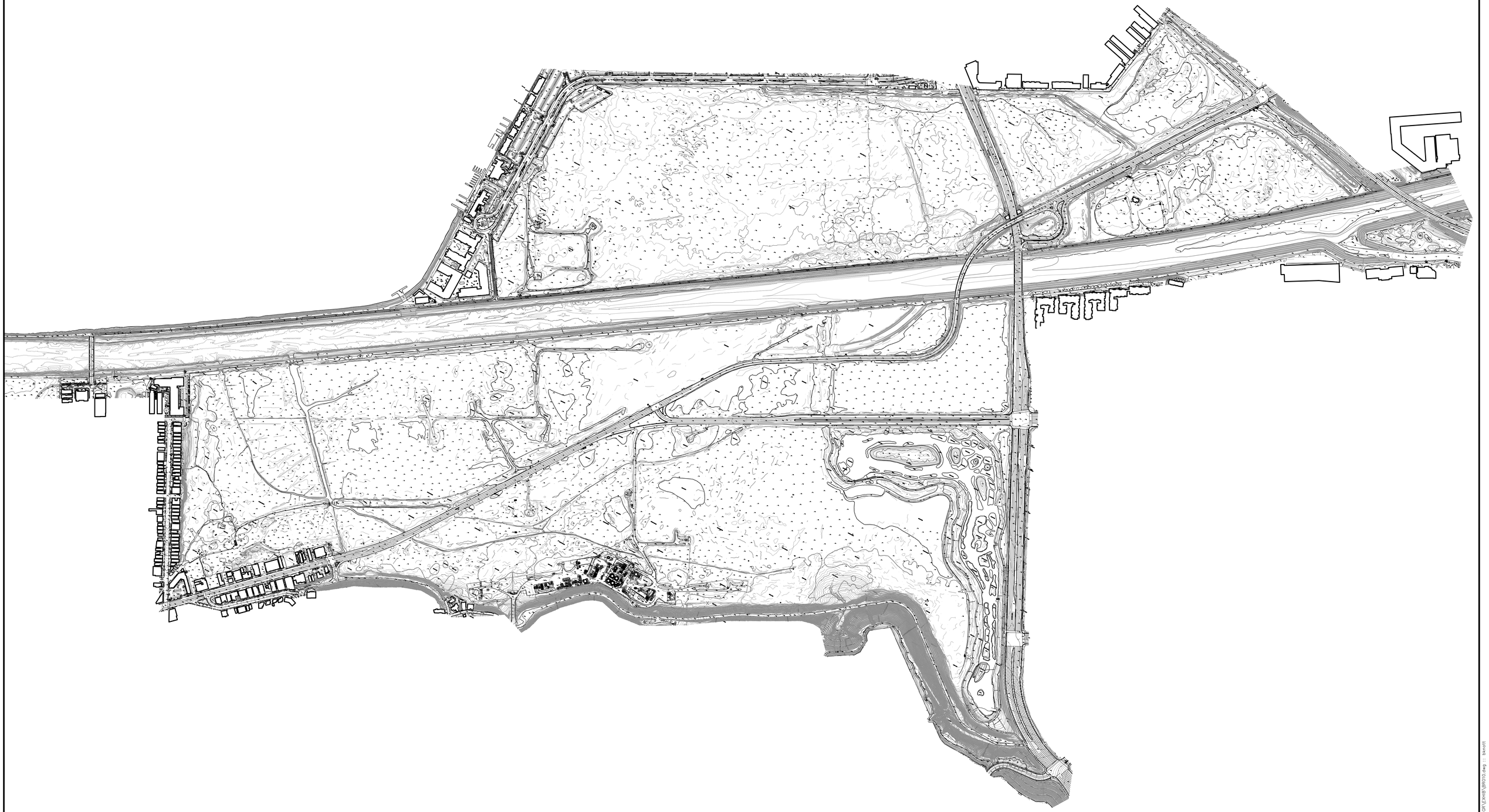
250' 125' 0' 250' 500'
GRAPHIC SCALE
Note: For reduced sized prints, original scale is in inches
B1-155

PSOMAS

DATE: 05-29-12 REVISED ON:
JOB No:1CCC010100

SHEET 1 OF 1
BR001

Plotted: 3/26/2013 10:47:11 AM :: Saved: 3/26/2013 10:46:54 AM :: W:\1CCC010100\ENGR\EXHIB\BR001.dwg :: bknott



CALIFORNIA COASTAL CONSERVANCY



GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

B1-156

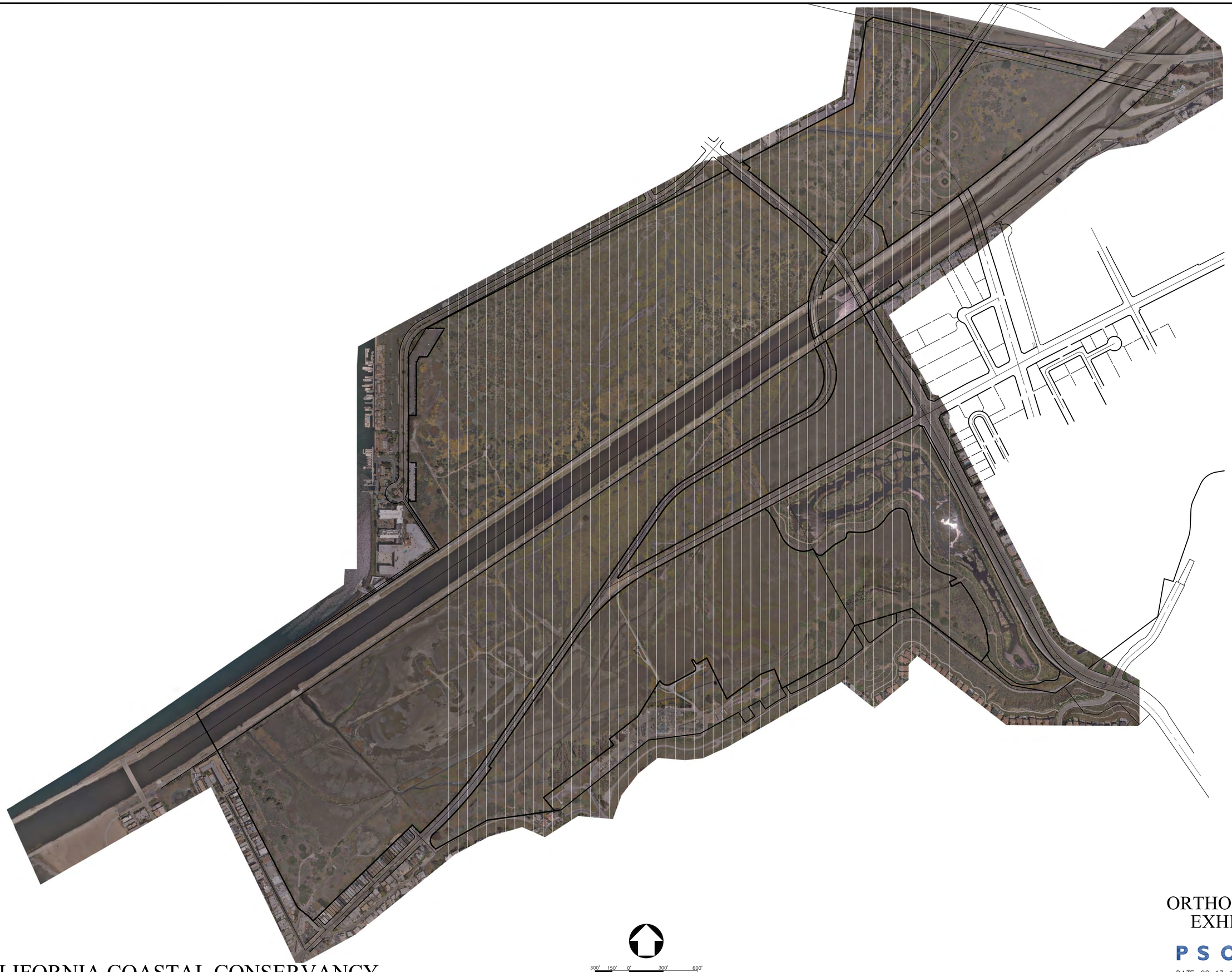
Overall Existing Topography Exhibit

PSOMAS

DATE: 06-28-12 REVISED ON:
JOB No:1CCC010100

SHEET 1 OF 1
BR010

Plotted: 3/26/2013 11:06:27 AM :: Saved: 3/26/2013 11:06:16 AM :: W:\1CCC010100\ENGR\EXHIB\BR010.dwg :: bknott



CALIFORNIA COASTAL CONSERVANCY

300' 150' 0' 300' 600'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

B1-157

ORTHOPHOTO EXHIBIT

PSOMAS

DATE: 08-13-12 REVISED ON:

JOB No:1CCC010100

SHEET 1 OF 1

BR018

Plotted: 3/26/2013 11:18:20 AM :: Saved: 3/26/2013 11:17:22 AM :: W:\1CCC010100\ENGR\EXHIB\BR018.dwg :: bknott

FOR AREAS A AND AREA B LESS FRESHWATER MARSH

COMMENTS

BOUNDARY LINES. . . . WERE ESTABLISHED FROM RECOVERED CITY, COUNTY AND/OR PRIVATE SURVEY MONUMENTS WHOSE CHARACTER AND SOURCE ARE SO NOTED ON THE SURVEY.

LEGAL DESCRIPTION . . FROM INFORMATION SUPPLIED BY CLIENT. USUALLY A TITLE POLICY OR TITLE REPORT.

EASEMENTS . . . . . . PLOTTABLE EASEMENTS ARE SHOWN FROM AN OWNER SUPPLIED TITLE REPORT. NON-PLOTTABLE ONES ARE NOTED ON THE SURVEY AS HAVING "EFFECT OF". BECAUSE OUR SERVICE IS LIMITED TO REPORTING ON EASEMENT LOCATIONS WE STRONGLY RECOMMEND LEGAL COUNSEL BE RETAINED TO REPORT ON TITLE PAPERS IN THEIR ENTIRETY.

TITLE REPORT. . . . . STEWART TITLE OF CALIFORNIA, INC. PRELIMINARY TITLE REPORT NO. 040104934 (AREA A), DATED OCTOBER 29, 2003, NO. 040115088 AMENDED (BALLONA WETLANDS PARCEL), DATED OCTOBER 29, 2003, AND NO. 040104935 (AREA B RESIDENTIAL), DATED NOVEMBER 1, 2003.

EXCEPTION NO. PER TITLE REPORT NO. 040115088

EXCEPTION NO. PER TITLE REPORT NO. 040104934

EXCEPTION NO. PER TITLE REPORT NO. 040104935

CULTURE . . . . BY PHOTOGRAMMETRIC PROCESSES FROM AERIAL PHOTOGRAPHY DATED APRIL 27, 2012 AND COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS.

EFFECT OF . . . . . . A POLE LINE EASEMENT, 2 FEET WIDE, APPROXIMATELY DESCRIBED IN INSTRUMENT NO. 1509 RECORDED SEPTEMBER 24, 1940 IN BOOK 17818 PAGE 325, OFFICIAL RECORDS. THE EXACT LOCATION OF SAID EASEMENT IS INDETERMINATE IN NATURE.

[5] [36]

EFFECT OF . . . . . . THE FREE AND UNOBSTRUCTED RIGHT TO EXPLORE, MINE AND PRODUCE GAS, OIL AND OTHER HYDROCARBON SUBSTANCES PER DEED RECORDED MAY 29, 1945, AS INSTRUMENT NO. 6, IN BOOK 21983 PAGE 305, OFFICIAL RECORDS AND MODIFIED BY DEEDS RECORDED FEBRUARY 5, 1959 AS INSTRUMENT NO. 4213 IN WOK D-356 PAGE 958, OFFICIAL RECORDS AND RECORDED AUGUST 21, 1959 AS INSTRUMENT NO. 4834 IN BOOK D-579, PAGE 972, OFFICIAL RECORDS AND IN AGREEMENT RECORDED MARCH 15, 1961 AS INSTRUMENT NO. 3819 IN BOOK D-1156 PAGE 518, OFFICIAL RECORDS, PLOTTED HEREON.

[7]

EFFECT OF . . . . . . THE EXCLUSIVE RIGHT TO USE THE SURFACE, REGARDLESS OF DEPTH, FOR THE INJECTION OF GAS INTO, THE STORAGE OF GAS IN, AND/OR WITHDRAWAL OF GAS FROM SAID PROPERTY AS RESERVED BY SOUTHERN CALIFORNIA GAS COMPANY, IN DEED RECORDED NOVEMBER 21, 1946 AS INSTRUMENT NO. 1046 IN BOOK 23939 PAGE 338, OFFICIAL RECORDS, AND MODIFIED BY DEEDS RECORDED FEBRUARY 6, 1959 AS INSTRUMENT NO. 4278 IN BOOK D-358 PAGE 367, OFFICIAL RECORDS AND BY INSTRUMENT RECORDED AUGUST 14, 1959 IN BOOK M-339, PAGE 989, OFFICIAL RECORDS, PLOTTED HEREON.

[8]

EFFECT OF . . . . . . AN AGREEMENT BETWEEN HUGHES TOOL COMPANY AND SOUTHERN CALIFORNIA GAS COMPANY DATED AUGUST 15, 1963 REC AUGUST 30, 1963 AS INST NO 7055, IN BOOK M-1338, PAGE 287, O.R. FOR THE EXCLUSIVE RIGHT TO USE SUBSURFACE MINERAL, OIL AND/OR GAS ZONES FOR INJECTING, STORING AND WITHDRAWING NATURAL GAS AND FOR REPRESSURING THE SAME; BUT WITH NO RIGHT TO USE THE SURFACE OR TO CARRY ON SUCH OPERATION EXCEPT BETWEEN A DEPTH OF 500 FEET TO 7000 FEET, BELOW THE SURFACE, PLOTTED HEREON.

[9] [14] [7]

EFFECT OF . . . . . . MEMORANDUM OF AGREEMENT PER DOCUMENT RECORDED APRIL 23, 1996 AS INSTRUMENT NO. 96-637590 WHICH IS BETWEEN MTP-PV AND THE CITY OF CULVER CITY MAKING RECORD THE "CULVER CITY AGREEMENT.

[15] [69]

EFFECT OF . . . . . . MASTER DECLARATION OF COVENANTS, CONDITIONS, RESTRICTIONS, AND RESERVATION OF EASEMENTS INCLUDING BUT NOT LIMITED TO VARIOUS EASEMENTS FOR INGRESS AND EGRESS, PUBLIC SERVICE USE, WATER, TELECOMMUNICATION, ECT. REC FEBRUARY 7, 2000 PER INST NO 00-0187083, AMENDED TO BY THE FOLLOWING: JULY 20, 2000 BY INST NO. 00-1123906, JAN 18, 2000 BY INST NO 00-1961844, AND NOVEMBER 26, 2002 BY INST NO 02-2875171.

[18]

EFFECT OF . . . . . . COVENANTS, CONDITIONS AND RESTRICTION IN DEED EXECUTED BY TITLE GUARANTEE AND TRUST COMPANY, A CORPORATION RECORDED OCTOBER 22, 1926 IN BOOK 6070, PAGE 310 AS INSTRUMENT NO. 708 OFFICIAL RECORDS.

[4]

EFFECT OF . . . . . . ANY RIGHT, AFFECTING THOSE PORTIONS OF LAND WITHIN A STRIP OF LAND 90 FEET WIDE OF PACIFIC LIGHTING GAS COMPANY (SUCCESSOR TO THE INTEREST OF INDUSTRIAL FUEL SUPPLY COMPANY IN AND TO) LAND, AS DISCLOSED BY INSTRUMENTS OF RECORD, AMONG THEM BEING AN INSTRUMENT RECORDED APRIL 10, 1936 IN BOOK 14042, PAGE 179 OFFICIAL RECORDS. SAID ITEM FALLS WITHIN BALLONA CREEK.

[11]

EFFECT OF . . . . . . RIGHTS, INCLUDING THE RIGHT OF INGRESS AND EGRESS, NECESSARY FOR THE PRODUCTION OF HYDROCARBONS AND MINERALS FROM THE SURFACE OF PARCEL 2 PER BOOK 21983, PAGE 305, OFFICIAL RECORDS, AMONG OTHERS.

[12]

EFFECT OF . . . . . . EXCLUSIVE RIGHT TO USE THE SUBSURFACE OF PARCEL 3 AND A PORTION OF PARCEL 4 FOR NATURAL GAS PURPOSES, INCLUDING THE RIGHT OF INGRESS AND EGRESS AND OTHER SURFACE RIGHTS PER BOOK 23939, PAGE 338, OFFICIAL RECORDS, AMONG OTHERS.

[13]

EFFECT OF . . . . . . PROVISIONS, CONDITIONS AND OBLIGATIONS, AFFECTING THE PROPERTY AND RIGHTS RESERVED TO UNITED STATES OF AMERICA, CONTAINED IN DECREE ENTERED FEBRUARY 5, 1952 IN UNITED STATE'S DISTRICT COURT, SOUTHERN DISTRICT OF CALIFORNIA, CENTRAL DIVISION; CASE NO. 2454-B, CIVIL, A CERTIFIED COPY OF WHICH RECORDED FEBRUARY 13, 1952, AS. INSTRUMENT NO. 3526, IN BOOK 38244, PAGE 354; OFFICIAL RECORDS.

[20]

EFFECT OF . . . . . . ALL RIGHTS TO FISSIONABLE MATERIAL WITH THE RIGHT TO ENTER UPON THE LAND AND PROSPECT FOR, MINE AND REMOVE FISSIONABLE MATERIALS, HAVE BEEN RESERVED TO SOUTHERN CALIFORNIA GAS CO. PER BOOK. 45847, PAGE 89, OFFICIAL RECORDS.

[21]

EFFECT OF . . . . . . AN EASEMENT FOR INCIDENTAL PURPOSES NECESSARY TO DEVELOPMENT OF A SMALL CRAFT HARBOR AND RECREATION AREA PER BOOK 54087, PAGE 164, OFFICIAL RECORDS, AFFECTS LAND NORTHWESTERLY OF THE SOUTHEASTERLY LINE OF L.A. CO. FLOOD CONTROL DISTRICT RIGHT-OF-WAY PER BOOK 16382, PAGE 191, OFFICIAL RECORDS.

[27]

EFFECT OF . . . . . . THE RIGHT TO PRODUCE OIL, GAS AND HER HYDROCARBON SUBSTANCES BY DIRECTIONAL DRILLING, BUT NO RIGHT TO SURFACE ENTRY AS RESERVED BY PACIFIC ELECTRIC RAILWAY COMPANY, IN DEED RECORDED APRIL 3, 1946 IN BOOK 22930, PAGE 272, OFFICIAL RECORDS.

[29]

EFFECT OF . . . . . . EXCLUSIVE RIGHT TO USE THE SUBSURFACE FOR NATURAL GAS PURPOSES, INCLUDING THE RIGHT OF INGRESS AND EGRESS AND OTHER SURFACE RIGHTS PER BOOK 23939, PAGE 338, OFFICIAL RECORDS, AMONG OTHERS.

[6]

EFFECT OF . . . . . . NO RIGHTS TO FISSIONABLE MATERIAL, SAID RIGHTS HAVING BEEN RESERVED WITH THE RIGHT TO ENTER UPON THE LAND AND PROSPECT FOR, MINE AND REMOVE FISSIONABLE MATERIALS PER BOOK 45847, PAGE 89, OFFICIAL RECORDS.

[9]

EFFECT OF . . . . . . AN EASEMENT FOR POLES WITH CROSS ARMS AND WIRES FOR A PRIVATE TELEPHONE SYSTEM PER UNRECORDED SURFACE LEASE DATED JUNE 1, 1933, AND TRANSFERRED AND CONVEYED TO UNION OIL COMPANY BY ASSIGNMENT OF LEASE FROM P.M. PIKE INVESTMENT COMPANY, DATED JANUARY 27, 1943. LEASE DOCUMENT NOT AVAILABLE.

[10]

EFFECT OF . . . . . . AN AGREEMENT DATED JANUARY 18, 1952, EXECUTED BY AND BETWEEN, SOUTHERN CALIFORNIA GAS COMPANY, THEREIN CALLED "THE GAS CO." AND HUGHES TOOL COMPANY, A DELAWARE CORPORATION, THEREIN CALLED "HUGHES", RELATING TO ACQUISITION BY THE GAS CO. OF CERTAIN RESERVED RIGHTS OF THE UNITED STATES OF AMERICA, AS SET FORTH IN A STIPULATION REFERRED TO THEREIN, UPON THE CONDITIONS, COVENANTS AND PROVISIONS CONTAINED IN SAID AGREEMENT, RECORDED JANUARY 18, 1952 AS INSTRUMENT NO. 2738 IN BOOK 28075, PAGE 427, OFFICIAL RECORDS.

[11]

EFFECT OF . . . . . . THE RIGHT AFFECTING THOSE PORTIONS OF THE RAMONA S. DE MACHADO 341.85095 ALLOTMENT AS CONTAINED IN THE DEED TO THE PACIFIC ELECTRIC RAILWAY COMPANY RECORDED AUGUST 4, 1926 AS INST NO. 1540 IN BOOK 4680 PAGE 108 AND IN THE DEED TO LOS ANGELES PACIFIC COMPANY RECORDED JULY 14, 1908 IN BOOK 3805 PAGE 107 OF DEEDS, AND IN THE DEED TO LOS ANGELES PACIFIC COMPANY, RECORDED JULY 14, 1909 IN BOOK 3806 PAGE 107 OF DEEDS, ALL OF OFFICIAL RECORDS.

[14]

PARTIAL EASEMENT LIST:

FOLLOWING EASEMENTS ARE PLOTTED HEREON:

[43] 13.67' STRIP EASEMENT ALONG THE EAST SIDE OF BLOCK 1 LOT 9 PLAYA DEL REY TOWNSITE M.B. 2 / 63-66. SAID EASEMENT IS FOR MAINTENANCE OF EXISTING STRUCTURES AT THE TIME OF RECORDING REC JUL 8, 1991 AS INST NO 91-1033269

[44] 13.67' STRIP EASEMENT ALONG THE EAST SIDE OF BLOCK 2 LOT 8, 9 PLAYA DEL REY TOWNSITE M.B. 2 / 63-66. SAID EASEMENT IS FOR MAINTENANCE OF EXISTING STRUCTURES AT THE TIME OF RECORDING REC JUL 15, 1991 AS INST NO 91-1079416

[45] 13.67' STRIP EASEMENT ALONG THE EAST SIDE OF BLOCK 2 LOT 3 PLAYA DEL REY TOWNSITE M.B. 2 / 63-66. SAID EASEMENT IS FOR MAINTENANCE OF EXISTING STRUCTURES AT THE TIME OF RECORDING REC JUL 15, 1991 AS INST NO 91-1079417

[46] 13.67' STRIP EASEMENT ALONG THE EAST SIDE OF BLOCK 1 LOT 14 PLAYA DEL REY TOWNSITE M.B. 2 / 63-66. SAID EASEMENT IS FOR MAINTENANCE OF EXISTING STRUCTURES AT THE TIME OF RECORDING REC JUL 15, 1991 AS INST NO 91-1079418

[47] 13.67' STRIP EASEMENT ALONG THE EAST SIDE OF BLOCK 1 LOT 10 PLAYA DEL REY TOWNSITE M.B. 2 / 63-66. SAID EASEMENT IS FOR MAINTENANCE OF EXISTING STRUCTURES AT THE TIME OF RECORDING REC JUL 15, 1991 AS INST NO 91-1079419

[48] 13.67' STRIP EASEMENT ALONG THE EAST SIDE OF BLOCK 2 LOT 12 PLAYA DEL REY TOWNSITE M.B. 2 / 63-66. SAID EASEMENT IS FOR MAINTENANCE OF EXISTING STRUCTURES AT THE TIME OF RECORDING REC JUL 15, 1991 AS INST NO 91-1079420

[49] 13.67' STRIP EASEMENT ALONG THE EAST SIDE OF BLOCK 1 LOT 6 PLAYA DEL REY TOWNSITE M.B. 2 / 63-66. SAID EASEMENT IS FOR MAINTENANCE OF EXISTING STRUCTURES AT THE TIME OF RECORDING REC JUL 15, 1991 AS INST NO 91-1079421

[50] [52] 13.67' STRIP EASEMENT ALONG THE EAST SIDE OF BLOCK 2 LOT 7 PLAYA DEL REY TOWNSITE M.B. 2 / 63-66. SAID EASEMENT IS FOR MAINTENANCE OF EXISTING STRUCTURES AT THE TIME OF RECORDING REC JUL 26, 1991 AS INST NO 91-1162895 AND 91-1164701

[51] 13.67' STRIP EASEMENT ALONG THE EAST SIDE OF BLOCK 2 LOT 4 PLAYA DEL REY TOWNSITE M.B. 2 / 63-66. SAID EASEMENT IS FOR MAINTENANCE OF EXISTING STRUCTURES AT THE TIME OF RECORDING REC JUL 26, 1991 AS INST NO 91-1164700

[53] 13.67' STRIP EASEMENT ALONG THE EAST SIDE OF BLOCK 2 LOT 17 PLAYA DEL REY TOWNSITE M.B. 2 / 63-66. SAID EASEMENT IS FOR MAINTENANCE OF EXISTING STRUCTURES AT THE TIME OF RECORDING REC JUL 26, 1991 AS INST NO 91-1164702

[54] 13.67' STRIP EASEMENT ALONG THE EAST SIDE OF LOT 1 TRACT 8806 M.R. 119 / 35. SAID EASEMENT IS FOR MAINTENANCE OF EXISTING STRUCTURES AT THE TIME OF RECORDING REC JUL 8, 1991 AS INST NO 91-1033269

[55] 13.67' STRIP EASEMENT ALONG THE EAST SIDE OF BLOCK 2 LOT 6 PLAYA DEL REY TOWNSITE M.B. 2 / 63-66. SAID EASEMENT IS FOR MAINTENANCE OF EXISTING STRUCTURES AT THE TIME OF RECORDING REC AUG 19, 1991 AS INST NO 91-1299573

[56] 13.67' STRIP EASEMENT ALONG THE EAST SIDE OF BLOCK 1 LOT 15 PLAYA DEL REY TOWNSITE M.B. 2 / 63-66. SAID EASEMENT IS FOR MAINTENANCE OF EXISTING STRUCTURES AT THE TIME OF RECORDING REC OCT 2, 1991 AS INST NO 91-1556070

[57] 13.67' STRIP EASEMENT ALONG THE EAST SIDE OF BLOCK 2 LOT 5 PLAYA DEL REY TOWNSITE M.B. 2 / 63-66. SAID EASEMENT IS FOR MAINTENANCE OF EXISTING STRUCTURES AT THE TIME OF RECORDING REC OCT 2, 1991 AS INST NO 91-1556071

[58] 13.67' STRIP EASEMENT ALONG THE EAST SIDE OF BLOCK 2 LOT 11 PLAYA DEL REY TOWNSITE M.B. 2 / 63-66. SAID EASEMENT IS FOR MAINTENANCE OF EXISTING STRUCTURES AT THE TIME OF RECORDING REC OCT 2, 1991 AS INST NO 91-1556072

[59] 13.67' STRIP EASEMENT ALONG THE EAST SIDE OF BLOCK 1 LOT 5 PLAYA DEL REY TOWNSITE M.B. 2 / 63-66. SAID EASEMENT IS FOR MAINTENANCE OF EXISTING STRUCTURES AT THE TIME OF RECORDING REC OCT 31, 1991 AS INST NO 91-1730658

[60] [61] [64] [65] 13.67' STRIP EASEMENT ALONG THE EAST SIDE OF LOT 1 TRACT 34661 M.R. 946 / 8,9. SAID EASEMENT IS FOR MAINTENANCE OF EXISTING STRUCTURES AT THE TIME OF RECORDING REC OCT 31, 1991 AS INST NO'S 91-1730659, AND 91-1730660, AND THEN REC NOV 8, 1991 AS INST NO'S 1779301, AND 91-1779302.

[62] 13.67' STRIP EASEMENT ALONG THE EAST SIDE OF BLOCK 1 LOT 13 PLAYA DEL REY TOWNSITE M.B. 2 / 63-66. SAID EASEMENT IS FOR MAINTENANCE OF EXISTING STRUCTURES AT THE TIME OF RECORDING REC APR 15, 1991 AS INST NO 91-1730661

[63] 13.67' STRIP EASEMENT ALONG THE EAST SIDE OF BLOCK 2 LOT 10 PLAYA DEL REY TOWNSITE M.B. 2 / 63-66. SAID EASEMENT IS FOR MAINTENANCE OF EXISTING STRUCTURES AT THE TIME OF RECORDING REC NOV 8, 1991 AS INST NO 91-1779300

[66] 13.67' STRIP EASEMENT ALONG THE EAST SIDE OF BLOCK 1 LOT 12 PLAYA DEL REY TOWNSITE M.B. 2 / 63-66. SAID EASEMENT IS FOR MAINTENANCE OF EXISTING STRUCTURES AT THE TIME OF RECORDING REC NOV 27, 1991 AS INST NO 91-1883228

[67] 13.67' STRIP EASEMENT ALONG THE EAST SIDE OF BLOCK 1 LOT 17 PLAYA DEL REY TOWNSITE M.B. 2 / 63-66. SAID EASEMENT IS FOR MAINTENANCE OF EXISTING STRUCTURES AT THE TIME OF RECORDING REC MAY 8, 1992 AS INST NO 92-832608

[68] 13.67' STRIP EASEMENT ALONG THE EAST SIDE OF BLOCK 2 LOT 15 PLAYA DEL REY TOWNSITE M.B. 2 / 63-66. SAID EASEMENT IS FOR MAINTENANCE OF EXISTING STRUCTURES AT THE TIME OF RECORDING REC JUN 9, 1992 AS INST NO 92-1046530

[77] 13.67' STRIP EASEMENT ALONG THE EAST SIDE OF BLOCK 1 LOTS 19, 20 PLAYA DEL REY TOWNSITE M.B. 2 / 63-66. SAID EASEMENT IS FOR MAINTENANCE OF EXISTING STRUCTURES AT THE TIME OF RECORDING REC FEB 17, 2000 AS INST NO 00-251447

FOR FRESHWATER MARSH

COMMENTS

BOUNDARY LINES. . . . WERE ESTABLISHED FROM RECOVERED CITY, COUNTY AND/OR PRIVATE SURVEY MONUMENTS WHOSE CHARACTER AND SOURCE ARE SO NOTED ON THE SURVEY.

LEGAL DESCRIPTION . . FROM INFORMATION SUPPLIED BY CLIENT. USUALLY A TITLE POLICY OR TITLE REPORT.

EASEMENTS . . . . . . PLOTTABLE EASEMENTS ARE SHOWN FROM AN OWNER SUPPLIED TITLE REPORT. NON-PLOTTABLE ONES ARE NOTED ON THE SURVEY AS HAVING "EFFECT OF". BECAUSE OUR SERVICE IS LIMITED TO REPORTING ON EASEMENT LOCATIONS WE STRONGLY RECOMMEND LEGAL COUNSEL BE RETAINED TO REPORT ON TITLE PAPERS IN THEIR ENTIRETY.

TITLE REPORT. . . . . STEWART TITLE OF CALIFORNIA, INC. PRELIMINARY TITLE REPORT NO. 040207570 (WETLANDS), DATED DECEMBER 12, 2003.

EXCEPTION NO. PER TITLE REPORT NO. 040207570

CULTURE . . . . BY PHOTOGRAMMETRIC PROCESSES FROM AERIAL PHOTOGRAPHY DATED APRIL 27, 2012 AND COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS.

EFFECT OF . . . . . . THE RIGHTS TO ENTER UPON PORTIONS OF PARCELS SHOWN ON L.S. MAP BOOK 29, PAGE 36 FOR STREET AND/OR ALLEY CONSTRUCTION AND MAINTENANCE FOR THE BENEFIT OF ABUTTING LAND, TO MAKE NECESSARY IMPROVEMENTS FOR THE PROPER DRAINAGE OF SAID PORTIONS OF PARCELS AND ABUTTING LAND, TO AT ANY TIME DEDICATE ANY OR ALL OF SAID PARCELS FOR PUBLIC STREET AND/OR ALLEY PURPOSES, AND TO GRANT EASEMENTS FOR PUBLIC UTILITIES WHICH UPON SAID DEDICATION SHALL MERGE IN SAID PUBLIC STREETS AND/OR ALLEYS AS RESERVED PER BOOK 10561, PAGE 279 AMONG OTHERS.

[6]

EFFECT OF . . . . . . ALL RIGHTS TO FISSIONABLE MATERIAL WITH THE RIGHT TO ENTER UPON THE LAND AND PROSPECT FOR, MINE AND REMOVE FISSIONABLE MATERIALS, HAVE BEEN RESERVED TO SOUTHERN CALIFORNIA GAS CO. PER BOOK. 45847, PAGE 89, OFFICIAL RECORDS.

[9]

DOES NOT EFFECT . . . AN OIL AND GAS LEASE RECORDED FEBRUARY 13, 1930 IN BOOK 9673, PAGE 357, SAID LEASE BEING AMENDED ON FEBRUARY 10, 1931 IN BOOK 10552, PAGE 308, AND AGAIN ON DECEMBER 20, 1959 AS INSTRUMENT 2971 IN BOOK M418, PAGE 501, REMAINING OIL LEASE PARCELS ARE OUTSIDE OF PIQ AND SHOWN ON TRUST FOR PUBLIC LANDS ALTA DATED OCTOBER 15, 2003, PREPARED BY PSOMAS UNDER JOB NO. 1PCC020623 TASK 100

[4]

DOES NOT EFFECT . . . COVENANTS, CONDITIONS, RESTRICTIONS, EASEMENTS, AND AGREEMENT TO CONVEY PROPERTY AS RECORDED DECEMBER 8, 1997 AS INSTRUMENT NO 97-1945635, EXCEPTION EFFECTS PROP SOUTH OF CABORA RD, OUTSIDE OF PIQ

[16]

DOES NOT EFFECT . . . EASEMENTS FOR SEWER PURPOSES RECORDED PER TRACT MAP NO 9167 MB 172-46/49 SAID SEWER EASEMENTS LIE WEST OF HASTINGS AVE, OUTSIDE OF PIQ

[22]

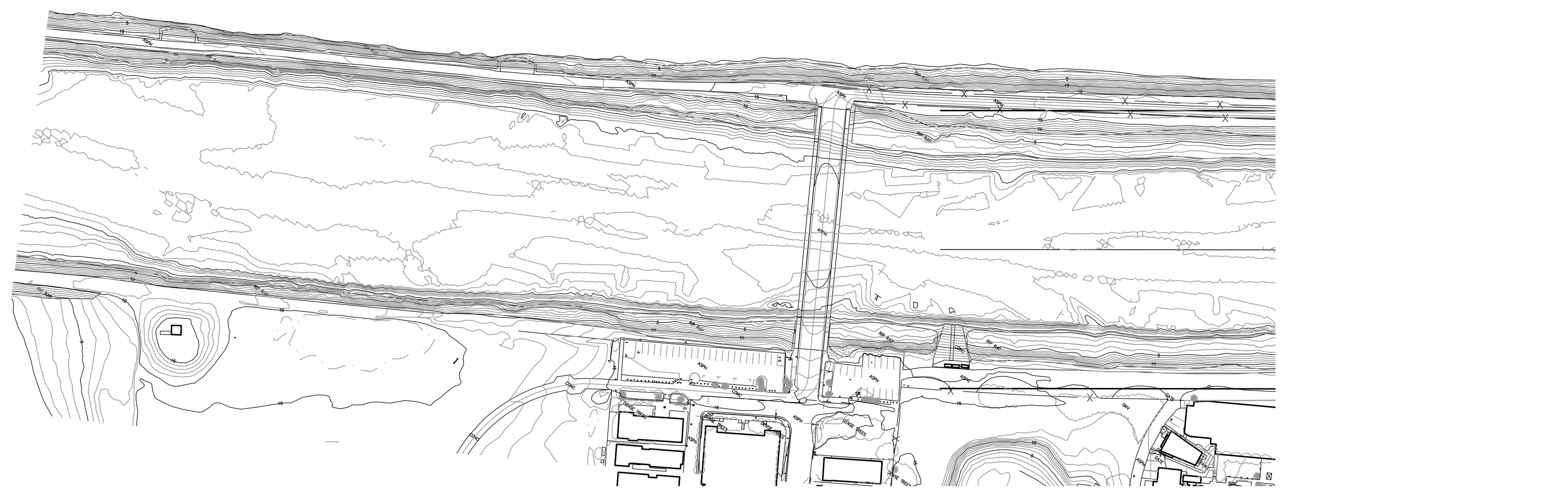
DOES NOT EFFECT . . . EASEMENTS FOR SEWER, WATER, GAS, AND CONDUIT PURPOSES RECORDED IN BOOK 11238 PAGE 265 O.R. SAID EASEMENTS LIE WEST OF HASTINGS AVE, OUTSIDE OF PIQ.

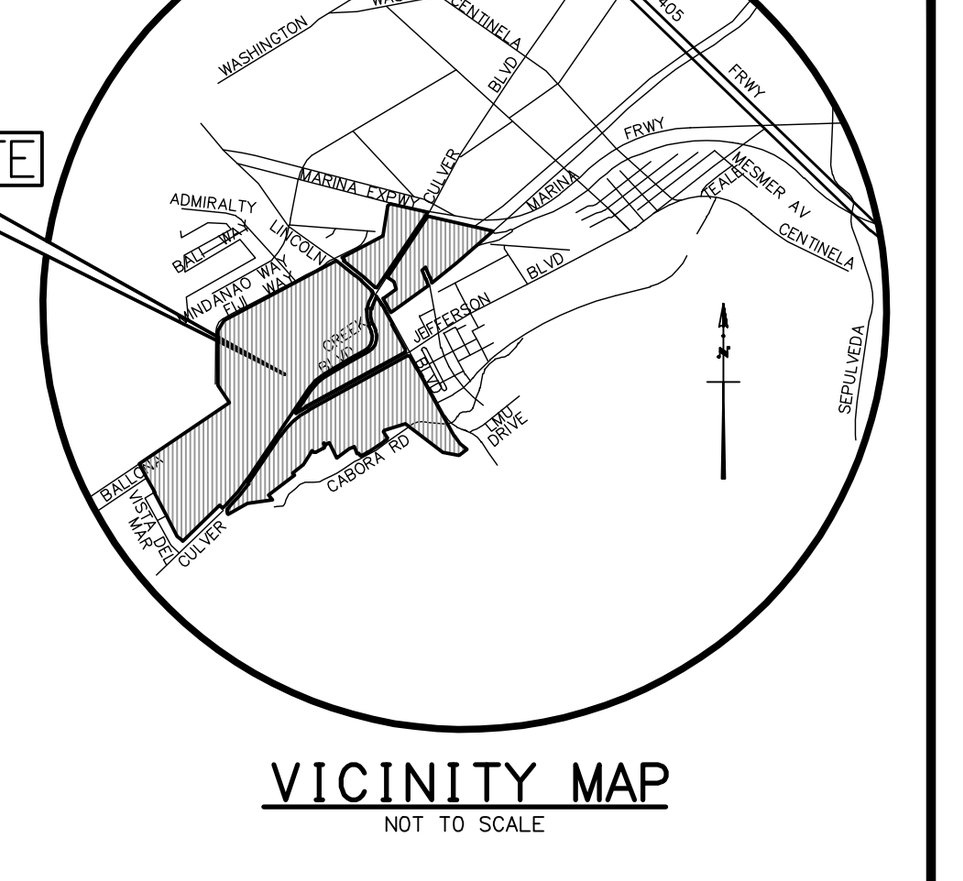
[23]

LEGEND

	PROPERTY/BOUNDARY LINE
	STREET R/W LINE
	CURB LINE (FROM 1"=20' ON TO 1"=200')
	CURB LINE (1"=10', 1"=8', 1"=16')
	CENTER LINE
	FLOW LINE
	LOT LINE/PARCEL LINE
	EASEMENT LINE (W=WIDTH)
	CONTOUR LINE
	BUILDING FOOT PRINT LINE
	OVERHANG LINE
	CHAIN LINK FENCE LINE
	WROUGHT IRON FENCE LINE
	GUARD RAIL
	WALL
	EDGE OF ASPHALT PAVING
CB	CATCH BASIN W/ACCESS HOLE
MH	MANHOLE (SEWER, STORM DRAIN, POWER, TELE.)
PP/TP	POWER POLE (PP)/TELEPHONE POLE (TP)
	SIGN (ALL KINDS)
	STREET LIGHT
	TRAFFIC SIGNAL
	TRAFFIC SIGNAL W/STREET LIGHT
	YARD LIGHT
	FIRE DEPARTMENT CONNECTION
	FIRE HYDRANT
DS	DOWNSPOUT
FDC	FIRE DEPARTMENT CONNECTION
PIV	POST INDICATOR VALVE
	DIRECTION OF WATER DRAINAGE FLOW
PM	PARKING METER
GM/WM	GAS/WATER METER
GV/WV	GAS/WATER VALVE
EPB/SLPB/TSPB/UPB	ELEC./STREET LIGHT/TRAFFIC/UNKNOWN PULL BOX
	TREE IN WELL W/TRUNK DIAMETER
PL	PLANTER
MW	MONITORING WELL

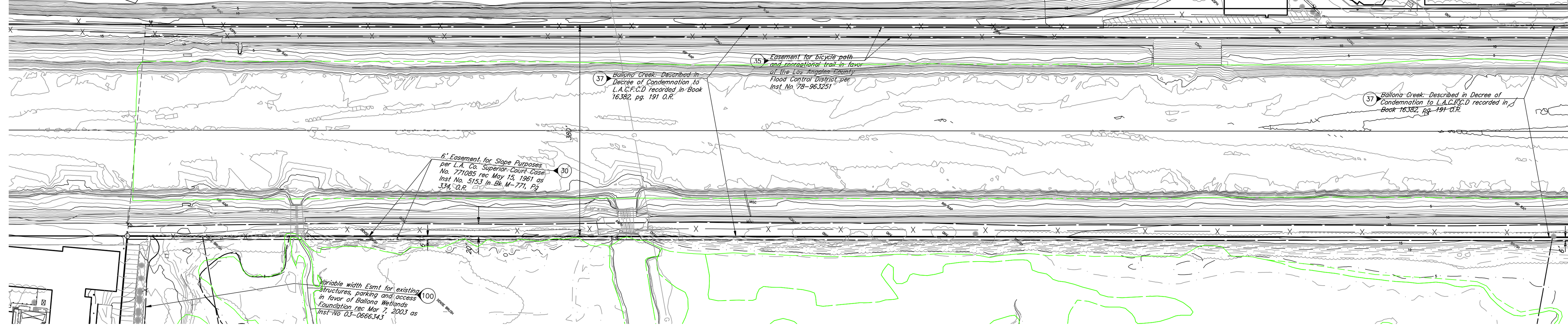
GP	GUARD POST
APPR.	APPROACH (DRIVEWAY)
BFP	BACKFLOW PREVENTER
CO	CLEAN OUT
CHLK	CHAINLINK (FENCE/GATE)
WI	WROUGHT IRON (FENCE/GATE)
	BENCHMARK
123.4	TOPOGRAPHIC SPOT ELEVATION, NO LEADER
BW	BACK OF WALK ELEVATION
EC	EDGE OF CONCRETE ELEVATION
EG	EDGE OF GUTTER ELEVATION
EP	EDGE OF PAVEMENT ELEVATION
FL	FLOW LINE ELEVATION
TC	TOP OF CURB ELEVATION
TG	TOP OF GRATE ELEVATION
TW	TOP OF WALL ELEVATION
TF	TOP OF FOOTING ELEVATION
RIM	MANHOLE RIM ELEVATION
INV	MANHOLE INVERT ELEVATION
ER	ELEC RISER
EVT	ELEC VAULT
CD	CURB DRAIN
DI	DRAIN INLET
HB	HOSE BIB
WR	WATER RISER
GB	GRADE BREAK
(2)	RECORD LOT/PARCEL NUMBER
(100.00')	RECORD DIMENSION OR BEARING IF DIFFERENT THAN MEASURED
/F	IMPROVEMENT FACE
/E	IMPROVEMENT EDGE
/Ed	IMPROVEMENT END
N/E/S/W	NORTH/EAST/SOUTH/WEST LOCATION OF IMPROVEMENT W/RESPECT TO REFERENCE NORTH AND PROPERTY LINE.
NE/SE/SW/NW	NORTHEAST/SOUTHEAST/SOUTHWEST/NORTHWEST LOCATION OF IMPROVEMENT W/RESPECT TO REFERENCE NORTH AND PROPERTY LINE.
NAME	ADJACENT PROPERTY OWNER
	GAS / OIL WELL
	CORP JURISDICTION LINE





VICINITY MAP
NOT TO SCALE





100' 50' 0' 100' 200'

NOTE: For reduced size prints, original scale is in inches

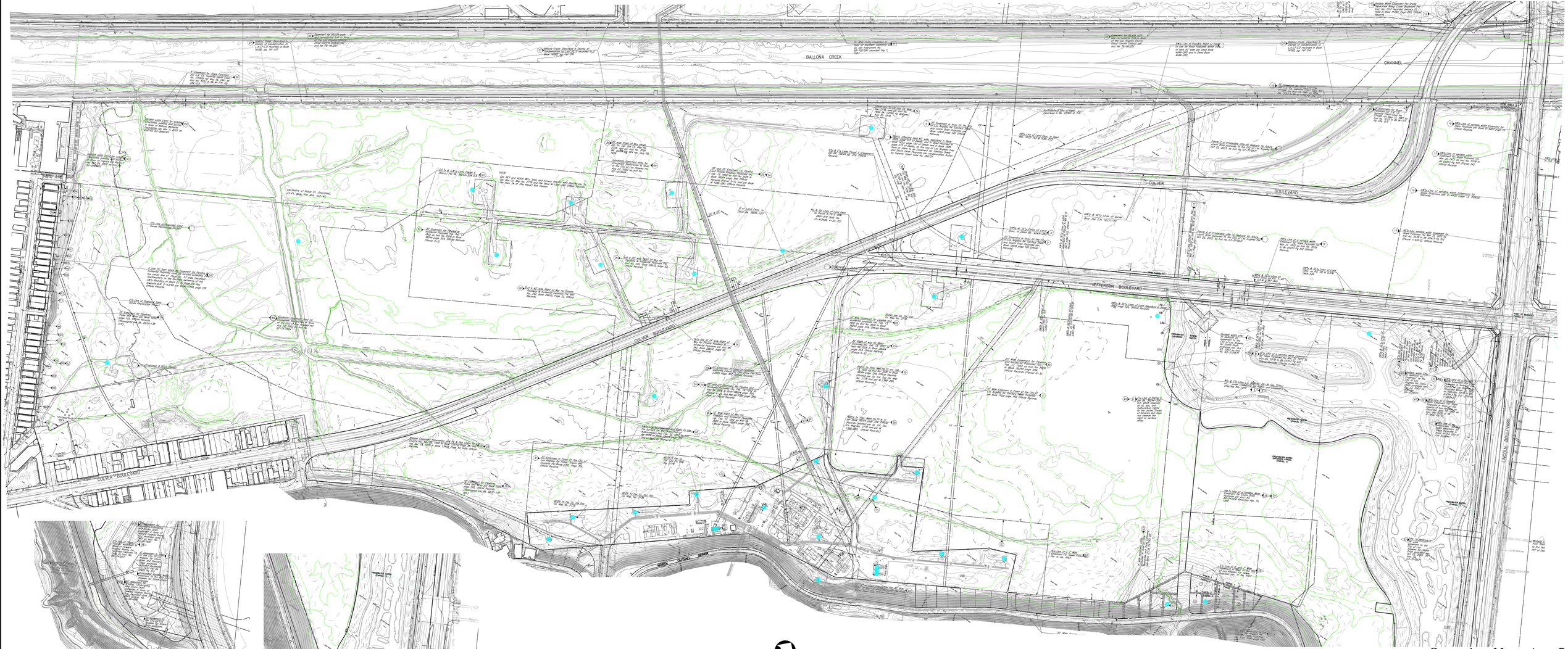
California State Coastal Conservancy
Ballona Wetlands Ecological Reserve

Constraints Map - Area A

PSOMAS

DATE: 10/30/12 REVISED ON:
JOB No: 1CCC010100

Plotted: 10/30/12 08:40:08 \\westla1\Projects\1CCC010100\SURVEY\DESIGN\PL\BR034-01.DWG johlappe


BALLONA CREEK
CHANNEL
CULVER BOULEVARD
JEFFERSON BOULEVARD
NICOLL BOULEVARD
MOBILE AVE
MOBILE AVE
MOBILE AVE



California State Coastal Conservancy
Ballona Wetlands Ecological Reserve

100' 50' 0' 100' 200'

NOTE: For reduced size prints, original scale is in inches

B1-160

Constraints Map - Area C

PSOMAS

DATE: 10/30/12 REVISED ON:
JOB No: 1CCC010100

BR034-03

Area	Order No	Schedule B Item No	PTR Date	Document No	Description	Easement Holder	Project / Affect
B - Exp Wet	40207570	1	2/3/2004	N/A	Taxes		none
B - Exp Wet	40207570	2	2/3/2004	N/A	Supplemental Taxes		none
B - Exp Wet	40207570	3	2/3/2004	Bk 6070, Pg 310, Inst No 708, OR, rec'd 10/22/1926			
B - Exp Wet	40207570	4	2/3/2004	N/A	Intentionally Deleted		none
B - Exp Wet	40207570	5	2/3/2004	Bk 10651, Pg 279, OR			
B - Exp Wet	40207570	6	2/3/2004	No reference provided	right of others to enter land for grading, surfacing, culverts, gutters, etc	unknown, not stated in PTR	***limits not stated, potential conflict***
B - Exp Wet	40207570	7	2/3/2004	Bk 12483, Pg 310, OR	storm drain & sewer easement	Los Angeles, City of	
B - Exp Wet	40207570	8	2/3/2004	N/A	Intentionally Deleted		none
B - Exp Wet	40207570	9	2/3/2004	Bk 45847, Pg 89, Inst No 580, rec'd 10/15/1954			
B - Exp Wet	40207570	10	2/3/2004	Court Decree, Action No 2454, entered 7/12/1946	pole line easement		
B - Exp Wet	40207570	11	2/3/2004	Agreement dated 8/15/1963	exclusive right by So Cal Gas Co to use subsurface mineral, oil, gas, etc, rights	Southern California Gas Company	
B - Exp Wet	40207570	12	2/3/2004	N/A	Intentionally Deleted		none
B - Exp Wet	40207570	13	2/3/2004	N/A	Intentionally Deleted		none
B - Exp Wet	40207570	14	2/3/2004	N/A	Intentionally Deleted		none
B - Exp Wet	40207570	15	2/3/2004	Inst No 89-247257, rec'd 2/15/1989	easement for slope support	Howard Hughes Realty, Inc	
B - Exp Wet	40207570	16	2/3/2004	N/A	Intentionally Deleted		none
B - Exp Wet	40207570	17	2/3/2004	N/A	Intentionally Deleted		none
B - Exp Wet	40207570	18	2/3/2004	N/A	Intentionally Deleted		none
B - Exp Wet	40207570	19	2/3/2004	N/A	Intentionally Deleted		none
B - Exp Wet	40207570	20	2/3/2004	N/A	Intentionally Deleted		none
B - Exp Wet	40207570	21	2/3/2004	N/A	Intentionally Deleted		none
B - Exp Wet	40207570	22	2/3/2004	N/A	Intentionally Deleted		none
B - Exp Wet	40207570	23	2/3/2004	Bk 11238, Pg 265, OR	pole lines, conduits, utilities	Title Guarantee and Trust Company	
B - Exp Wet	40207570	24	2/3/2004	Bk 11238, Pg 265, OR	prohibits sale of intoxicating liquors	Title Guarantee and Trust Company	none
B - Exp Wet	40207570	25	2/3/2004	Tract No 9167, MB	sewer easement	Los Angeles, City of	
B - Exp Wet	40207570	26	2/3/2004	N/A	Intentionally Deleted		none
B - Exp Wet	40207570	27	2/3/2004	N/A	Intentionally Deleted		none
B - Exp Wet	40207570	28	2/3/2004	N/A	Intentionally Deleted		none
B - Exp Wet	40207570	29	2/3/2004	Inst No 03-2184705, rec'd 7/30/2003	agreement,	West Basin Mun Water Dist & PCC	
B - Exp Wet	40207570	30	2/3/2004	N/A	Intentionally Deleted		none
B - Exp Wet	40207570	31	2/3/2004	N/A	matters disclosed by inspection / survey	unknown	unknown, if any

B - Exp Wet	40207570	32	2/3/2004	N/A	matters disclosed by ALTA survey, prepared by Psomas	unknown	unknown, if any
B - Exp Wet	40207570	33	2/3/2004	Inst No 03-3702805, rec'd 12/9/2003	Tax Lien		
B - Exp Wet	40207570	34	2/3/2004	Inst No 03-3702806, rec'd 12/9/2003	Tax Lien		
B - Exp Wet	40207570	35	2/3/2004	Inst No 03-3702807, rec'd 12/9/2003	Tax Lien		

Area	Order No	Schedule B Item No	PTR Date	Document No	Description	Easement Holder	Project / Affect
A	40104934	1	10/29/2003	N/A	Taxes		none
A	40104934	2	10/29/2003	N/A	Supplemental Taxes & Assessments		none
A	40104934	3	10/29/2003	Bk 11430 Pg 265, Inst No 1217, OR, rec'd 1/22/1932	slope easements	Los Angeles, County of	
A	40104934	4	10/29/2003	Bk 10481 Pg 126, Inst No 753, OR, rec'd 11/3/1930	sewer & storm drain easement	Los Angeles, City of	
A	40104934	5	10/29/2003	Bk 17818 Pg 325, Inst No 1509, OR, rec'd 9/24/1940	pole lines	Southern California Edison Company	
A	40104934	6	10/29/2003	Bk 18482 Pg 367, Inst No 1257, OR, rec'd 6/27/1941	pole lines and conduits	Associated Telephone Company	
A	40104934	7	10/29/2003	Bk 21983 Pg 305, Inst No 6, OR, rec'd 5/29/1945	exploration, mine, drill, produce, transport	Union Oil Company of California	blanket
A	40104934	7	10/29/2003	Bk D-356 Pg 958, Inst No 4213, OR, rec'd 2/5/1959 and Bk D-579 Pg 972, Inst No 4834, OR, rec'd 8/21/1958 and Bk D-1156 Pg 518, Inst No 3819, OR, rec'd 3/15/1961	modified Bk 21983 Pg 305, Inst No 6, OR, rec'd 5/29/1945	Union Oil Company of California	blanket
A	40104934	8	10/29/2003	Bk 23939 Pg 338, Inst No 1046, OR, rec'd 11/21/1946	exclusive right for injection of gas into	Southern California Gas Company	
A	40104934	8	10/29/2003	Bk D-358 Pg 367, Inst No 4278, OR, rec'd 2/6/1959 and Bk M-339 Pg 989, OR, rec'd 8/14/1959	modified Bk 23939 Pg 338, Inst No 1046, rec'd 11/21/1946	Southern California Gas Company	
A	40104934	9	10/29/2003	Agreement dated 8/15/1963	exclusive right by So Cal Gas Co to use subsurface mineral, oil, gas, etc, rights	Southern California Gas Company	
A	40104934	10	10/29/2003	Bk D-2166 Pg 904, OR, rec'd ???	operating, drilling, wells, cleaning, etc	Southern California Gas Company	
A	40104934	10	10/29/2003	Bk M-1338 Pg 280, OR, rec'd 8/30/1963	limits Bk D-2166 Pg 904, OR, rec'd ???	Southern California Gas Company	
A	40104934	11	10/29/2003	Inst No 83-1027591, rec'd 9/1/1983	gas easement	Southern California Gas Company	
A	40104934	12	10/29/2003	Bk M-771 Pg 334, Inst No 5153, OR, rec'd 5/15/1961	slope easement	Los Angeles, County, Flood Control	
A	40104934	13	10/29/2003	none stated	off record leases	unknown	unknown
A	40104934	13 A	10/29/2003	unrecorded lease dated 10/12/1998	doc not provided	Los Angeles, County, tenant	unknown
A	40104934	13 B	10/29/2003	unrecorded lease dated 10/12/2001	doc not provided	Los Angeles, County, tenant	unknown
A	40104934	13 C	10/29/2003	unrecorded lease dated 8/2/1995	doc not provided	Los Angeles, County, tenant	unknown
A	40104934	14	10/29/2003	Inst No 90-1515157, rec'd 8/31/1990	roadway, vehicular ingress & egress		
A	40104934	15	10/29/2003	Inst No 96-637590, rec'd 4/23/1996	memorandum of agreement		
A	40104934	16	10/29/2003	Inst No 97-1625347, rec'd 10/16/1997	deed of trust		
A	40104934	16	10/29/2003	Inst No 97-2009527, rec'd 12/23/1997	deed of trust		

A	40104934	16	10/29/2003	Inst No 99-828132, rec'd 5/5/1999	subordination & standstill agreement		
A	40104934	16	10/29/2003	Inst No 99-828134, rec'd 5/7/1999	subordination agreement		
A	40104934	16	10/29/2003	Inst No 02-2013250, rec'd 8/27/2002	subordination agreement		
A	40104934	16	10/29/2003	Inst No 03-185461, rec'd 6/27/2003	substitution of trustee		
A	40104934	16	10/29/2003	Inst No 03-3175571, rec'd 10/23/2003	irrevocable offer to dedicate		
A	40104934	17	10/29/2003	intentionally deleted	N / A	N / A	N / A
A	40104934	18	10/29/2003	intentionally deleted	N / A	N / A	N / A
A	40104934	19	10/29/2003	intentionally deleted	N / A	N / A	N / A
A	40104934	20	10/29/2003	intentionally deleted	N / A	N / A	N / A
A	40104934	21	10/29/2003	intentionally deleted	N / A	N / A	N / A
A	40104934	22	10/29/2003	Inst No 01-1688057, rec'd 9/7/2001	memorandum of option		
A	40104934	23	10/29/2003	intentionally deleted	N / A	N / A	N / A
A	40104934	24	10/29/2003	intentionally deleted	N / A	N / A	N / A
A	40104934	25	10/29/2003	intentionally deleted	N / A	N / A	N / A
A	40104934	26	10/29/2003	Inst No 02-557076, rec'd 3/2/2002	tax lein		
A	40104934	27	10/29/2003	Inst No 02-2013247, rec'd 8/27/2002	deed of trust		
A	40104934	28	10/29/2003	Inst No 03-1722853, rec'd 6/17/2003	tax lein		
A	40104934	29	10/29/2003	Inst No 03-2623553, rec'd 9/8/2003	tax lein		
A	40104934	30	10/29/2003	Inst No 03-2623666, rec'd 9/8/2003	tax lein		
A	40104934	31	10/29/2003	intentionally deleted	N / A	N / A	N / A
A	40104934	32	10/29/2003	Inst No 03-3162873, rec'd 10/22/2003	subordination agreement		
A	40104934	33	10/29/2003	N / A	water rights, claims or title to water	N / A	remains

Area	Order No	Schedule B Item No	PTR Date	Document No	Description	Easement Holder	Project / Affect
B - Resid	40104935	1	11/1/2003	N/A	Taxes		none
B - Resid	40104935	1.1	11/1/2003	N/A	Taxes		none
B - Resid	40104935	1.2	11/1/2003	N/A	Taxes		none
B - Resid	40104935	1.3	11/1/2003	N/A	Taxes		none
B - Resid	40104935	2	11/1/2003	N/A	Supplemental Taxes		none
B - Resid	40104935	2.1	11/1/2003	N/A	CFD, Special Assessments		review, amount?, can it be removed
B - Resid	40104935	3	11/1/2003	Bk 4049, Pg 265, of Deeds & Bk 4049 Pg 262 of Deeds	easement for road purposes		
B - Resid	40104935	4	11/1/2003	Bk 10418, Pg 126, OR	easement for storm & sewer purposes		
B - Resid	40104935	5	11/1/2003	Bk 3805 Pg 107 Deeds	easement for storm & sewer purposes		
B - Resid	40104935	5	11/1/2003	Bk 1633 Pg 143 Deeds	easement for storm & sewer purposes		
B - Resid	40104935	5	11/1/2003	Bk 1685 Pg 233 Deeds	easement for storm & sewer purposes		
B - Resid	40104935	6	11/1/2003	Inst No 1046 Bk 23939 Pg 338 OR	oil & gas	Southern California Gas Company	
B - Resid	40104935	6	11/1/2003	Inst No 4278, Bk D-358 Pg 367 OR, rec'd 2/6/1959	oil & gas, modification	Southern California Gas Company	
B - Resid	40104935	6	11/1/2003	Bk D-339 Pg 989 OR, rec'd 8/14/1959	oil & gas, modification	Southern California Gas Company	
B - Resid	40104935	7	11/1/2003	Agreement dated 8/15/1963, notes Inst No 7055, Bk M1338 Pg 287, OR rec'd 8/30/1963	exclusive right by So Cal Gas Co to use subsurface mineral, oil, gas, etc, rights	Southern California Gas Company	
B - Resid	40104935	8	11/1/2003	N/A	Intentionally Deleted		none
B - Resid	40104935	9	11/1/2003	Inst No 580, Bk 45847 Pg 89, OR rec'd 10/15/1954	reservation		
B - Resid	40104935	10	11/1/2003	unrecorded lease per Decree entered 7/12/1946 in Action No 2454, United States District Court, Southern District, Central Division	need doc, report calls for easement for pole lines	unknown	
B - Resid	40104935	11	11/1/2003	Inst No 2738, Bk 38075 Pg 427, OR rec'd 1/18/1952	easements, pipelines, etc	Southern California Gas Company	
B - Resid	40104935	11	11/1/2003	Bk M1338 Pg 280, OR rec'd 8/30/1963	quitclaims portions of Inst No 2738, Bk 38075	Southern California Gas Company	
B - Resid	40104935	12	11/1/2003	N/A	Intentionally Deleted		none
B - Resid	40104935	13	11/1/2003	N/A	Intentionally Deleted		none
B - Resid	40104935	14	11/1/2003	Bk 22930 Pg 272, OR rec'd 4/3/1946	reservation of oil & gas rights by PERR over portions of RR ROW		

B - Resid	40104935	15	11/1/2003	Inst No 5153, Bk M-771 Pg 334, OR rec'd 5/15/1961	condemnation, flood control channel	Los Angeles Flood Control District	
B - Resid	40104935	16	11/1/2003	N/A	Intentionally Deleted		none
B - Resid	40104935	17	11/1/2003	Inst No 5578, Bk D5413 Pg 512, OR rec'd 3/31/1972	slope easements	Los Angeles, County	
B - Resid	40104935	17	11/1/2003	Inst No 2934, OR rec'd 4/26/1972, Order Nunc Pro Tunc	modifies Inst No 5578, Bk D5413 Pg 512, OR rec'd 3/31/1972	Los Angeles, County	
B - Resid	40104935	18	11/1/2003	Inst No 5578, Bk D5413 Pg 512, OR rec'd 3/31/1972	drainage easement	Los Angeles, County	
B - Resid	40104935	19	11/1/2003	Inst No 3730, Bk D-4402 Pg 13, OR rec'd 6/13/1969	condemnation, easement	USA, Dept of Public Works	
B - Resid	40104935	20	11/1/2003	N/A	Intentionally Deleted		none
B - Resid	40104935	21	11/1/2003	N/A	Intentionally Deleted		none
B - Resid	40104935	22	11/1/2003	Inst No 96-637590, OR rec'd 4/23/1996	Memorandum of Agreement		
B - Resid	40104935	23	11/1/2003	Inst No 97-1625347, OR rec'd 10/16/1997	deed of trust		
B - Resid	40104935	23	11/1/2003	Inst No 97-2009527, OR rec'd 12/23/1997	deed of trust		
B - Resid	40104935	23	11/1/2003	Inst No 99-828132, OR rec'd 5/5/1999	subordination agreement		
B - Resid	40104935	23	11/1/2003	Inst No 99-828134, OR rec'd 5/7/1999	subordination agreement		
B - Resid	40104935	23	11/1/2003	Inst No 03-1845461, OR rec'd 6/27/2003	substitution of trustee		
B - Resid	40104935	24	11/1/2003	Inst No 99-0828132, OR rec'd 5/7/1999	deed of trust		
B - Resid	40104935	24	11/1/2003	Inst No 99-0828133, OR rec'd 5/7/1999	assigment		
B - Resid	40104935	24	11/1/2003	Inst No 02-2556853, OR rec'd 10/28/2002	substitution of trustee		
B - Resid	40104935	24	11/1/2003	Inst No 03-770751, OR rec'd 3/19/2003	modifies Inst No 99-0828132, OR rec'd 5/7/1999		
B - Resid	40104935	25	11/1/2003	N/A	Intentionally Deleted		none
B - Resid	40104935	26	11/1/2003	Inst No 00-0240767, OR rec'd 2/16/2000	Tax Lein		
B - Resid	40104935	27	11/1/2003	Inst No 01-1688057, OR rec'd 9/7/2001	Memorandum of Option		
B - Resid	40104935	28	11/1/2003	N/A	Intentionally Deleted		none
B - Resid	40104935	29	11/1/2003	N/A	Intentionally Deleted		none

PSOMAS

Balancing the Natural and Built Environment

BALLONA WETLANDS ECOLOGICAL RESERVE
AREAS "A", "B" AND "C"
PROJECT CONTROL REPORT

Project:	Ballona Wetlands Ecological Reserve
Project Location:	Approximate center of the project: LAT: N33.9682269° and LON: W118.4389525°
Project Manager:	John Chiappe, PLS
Project Surveyor:	Sergei Builoff, PLS
Date:	September 21, 2012

INTRODUCTION

The following project report describes the coordinate system and vertical datum utilized for the development of the Survey Control Network across Areas "A", "B" and "C" of the Ballona Wetlands Ecological Reserve.

COORDINATE SYSTEM

California State Plane Coordinate System, Zone 5 (SPC (0405 CA 5)), based on North American Datum of 1983 (NAD 83 - NSRS2007) (Epoch: 2007.0) Reference Frame. The average combination scale factor for the project is 1.00001581 calculated at Station AJ1940 (NGS PID AJ1940 - Southern California integrated GPS network (SCIGN) continuous GPS (CGPS) Monument) having NAD 83 values of North 1,807,427.136 feet and East 6,431,998.337 feet. The grid distances can be converted to the ground distances by applying the reverse combination scale factor of 0.99998419. Grid distance x reverse combination factor: 0.99998419 = ground distance.

VERTICAL DATUM

Vertical values shown hereon are based upon North American Vertical Datum of 1988 (NAD88) using US National Geodetic Survey Benchmarks listed below.

PID – AE1735 (Vert order - First, Class II). Benchmark is located at Los Angeles, on the northeast corner of Slauson Avenue and Hannum Avenue intersection, 14.7 ft (4.5m) east of the traffic signal and 6.9 ft (2.1 M) south of 2.0 ft (0.6M) high block wall. Found a standard 3.25 inch MWD BCM stamped SF 135 1996, flush at the southeast corner of 4.5 ft (1.4 m) by 8.5 ft (2.6 m) catch basin. Ref. MWD FB 4034 01 087. Published elevation value for this Benchmark is 32.56 feet (1997 Adjustment).

555 South Flower Street
Suite 4400
Los Angeles, CA 90071

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PID – DY1295 (Vert Order - First, Class II). Benchmark is located at Playa Del Rey, at the intersection of Vista Del Mar, Vista Del Mar Lane and Culver Boulevard, cemented in a drill hole in the top of the north end of a large storm drain, 62.0 feet south of the center of culver boulevard, 17.5 feet northeast of the northeast corner of a small cafe building at 6805 Vista Del Mar, 16.0 feet west of the center of Vista Del Mar, 4.0 feet south of powerline pole 26448Y, 3.8 feet north of the center of the storm drain and 0.7 foot west of the east edge of the west curb of Vista Del Mar. Published elevation value for this Benchmark is 17.94 feet (1995 Adjustment).

PID – DY2444 (Vert Order - First, Class I). Benchmark is located in Marina Del Rey, at 13715 Fiji Way, near the southeast corner of a concrete catch basin, 49.6 m (162.7 ft) northeast of the southeast corner of the El Torrito restaurant at 13715 Fiji Way, 5.9 m (19.4 ft) west of the centerline of the southbound lanes of the way, 4.5 m (14.8 ft) north of the north end of a bus pull-out, and 0.3 m (1.0 ft) above the level of the way. Published elevation value for this Benchmark is 15.09 feet (2007 Adjustment).

PID – DY1289 (Vert Order - First, Class I). Benchmark is located at Venice, about 2.2 miles southeast along Pacific Avenue from the post office, in top of the center of the west concrete wing wall of the northwest concrete abutment at the west corner of a concrete bridge over Ballona Creek, 6.9 feet southwest of the southwest curb of the Avenue, 23 feet southwest of the center line of the Avenue, 5.0 feet southeast of the northwest end of the wing wall, about level with the curb, and about 1/2 foot higher than the Avenue. Published elevation value for this Benchmark is 19.35 feet (1995 Adjustment).

COORDINATE VALUES

STA	NORTHING*	EASTING*	ELEV* (NAVD88)	DESCRIPTION
1003	1813412.22	6430759.34	22.08	Set PK Nail &Tin & Paint Aerial Target
1005	1811540.44	6431690.15	15.44	SET 1"Iron Pipe & Plastic Plug & Fabric Panel
1009	1814457.65	6431003.99	22.92	Set PK Nail &Tin & Paint Aerial Target
1010	1809407.48	6424043.01	17.26	Set PK Nail &Tin & Paint Aerial Target
1013	1812232.32	6428295.64	18.03	Set PK Nail &Tin & Paint Aerial Target
1014	1811298.94	6426894.12	17.49	Set PK Nail &Tin & Paint Aerial Target
1016	1813838.74	6427746.27	16.83	Set PK Nail &Washer, "PSOMAS" & Paint Aerial Target
1020	1810214.79	6428790.82	9.98	Set PK Nail &Washer, "PSOMAS" & Paint Aerial Target
1021	1815067.66	6430325.00	17.33	SET 1"Iron Pipe & Plastic Plug & Fabric Panel
1025	1813002.22	6426533.33	15.09	NGS Brass Disk, PID DY2444
1026	1807655.26	6425712.95	17.94	NGS Brass Disk, PID DY1295 stamped "P50 RESET 1972 "
1027	1810428.89	6430677.60	51.01	Set PK Nail & Washer, "PSOMAS"
1050	1808546.55	6425269.03	32.38	Found 2" Brass Disk, stamped "1970", Down 1.20'
1052	1814851.96	6429314.97	10.38	Found Brass Disk in Well stamped "RE7078", Down 0.55'
1054	1812488.87	6431196.50	13.63	Set Spike &Washer, "LS7230"

* - All coordinate values shown hereon are in U.S. Survey Feet.

BALLONA WETLANDS ECOLOGICAL RESERVE
AREAS "A", "B" AND "C"
VERTICAL DATUM CONVERSION

Project:	Ballona Wetlands Ecological Reserve
Project Location:	Approximate center of the project: LAT: N33.9682269° and LON: W118.4389525°
Project Manager:	John Chiappe, PLS
Project Surveyor:	Sergei Builoff, PLS
Date:	October 17, 2012

INTRODUCTION

The following project report describes local correction factors to convert elevation values from the official vertical datum used by the different agencies to the vertical datum utilized for the development of the Survey Control Network across Areas "A", "B" and "C" of the Ballona Wetlands Ecological Reserve.

PROJECT VERTICAL DATUM

Vertical values shown hereon are based upon North American Vertical Datum of 1988 (NAVD88) using US National Geodetic Survey (NGS) Benchmarks AE1735, DY1295, DY2444, and DY1289. For the full description of the vertical datum for this project see the "Project Control Report" by S. Builoff and J. Chiappe dated September 21, 2012.

LOCAL CORRECTION FACTORS

To convert from City of Los Angeles, National Geodetic Vertical Datum of 1929 (NGVD 29), 1985 adjustment, to the Project Vertical Datum, add 2.41 feet to the elevation value. This correction factor is based upon the difference of the published elevations calculated at a single project benchmark having NGS PID No. DY1289 and City of Los Angeles Benchmark No. 17-02070.

To convert from City of Los Angeles, NAVD 88, 2000 adjustment, to the Project Vertical Datum, add 0.00 feet to the elevation value. This correction factor is based upon the difference of published elevations calculated at a single project benchmark having NGS PID No. DY1296 and City of Los Angeles Benchmark No. 17-15078.

To convert from County of Los Angeles, NAVD 88, 2005 adjustment, to the Project Vertical Datum, subtract 0.06 feet from the elevation value. This correction factor is based upon the difference of published elevations calculated at a single project benchmark having NGS PID No. DY1295 and County of Los Angeles Benchmark No. Y10923 (Hawthorne – Torrance Quad).

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Los Angeles, CA 90071-2416

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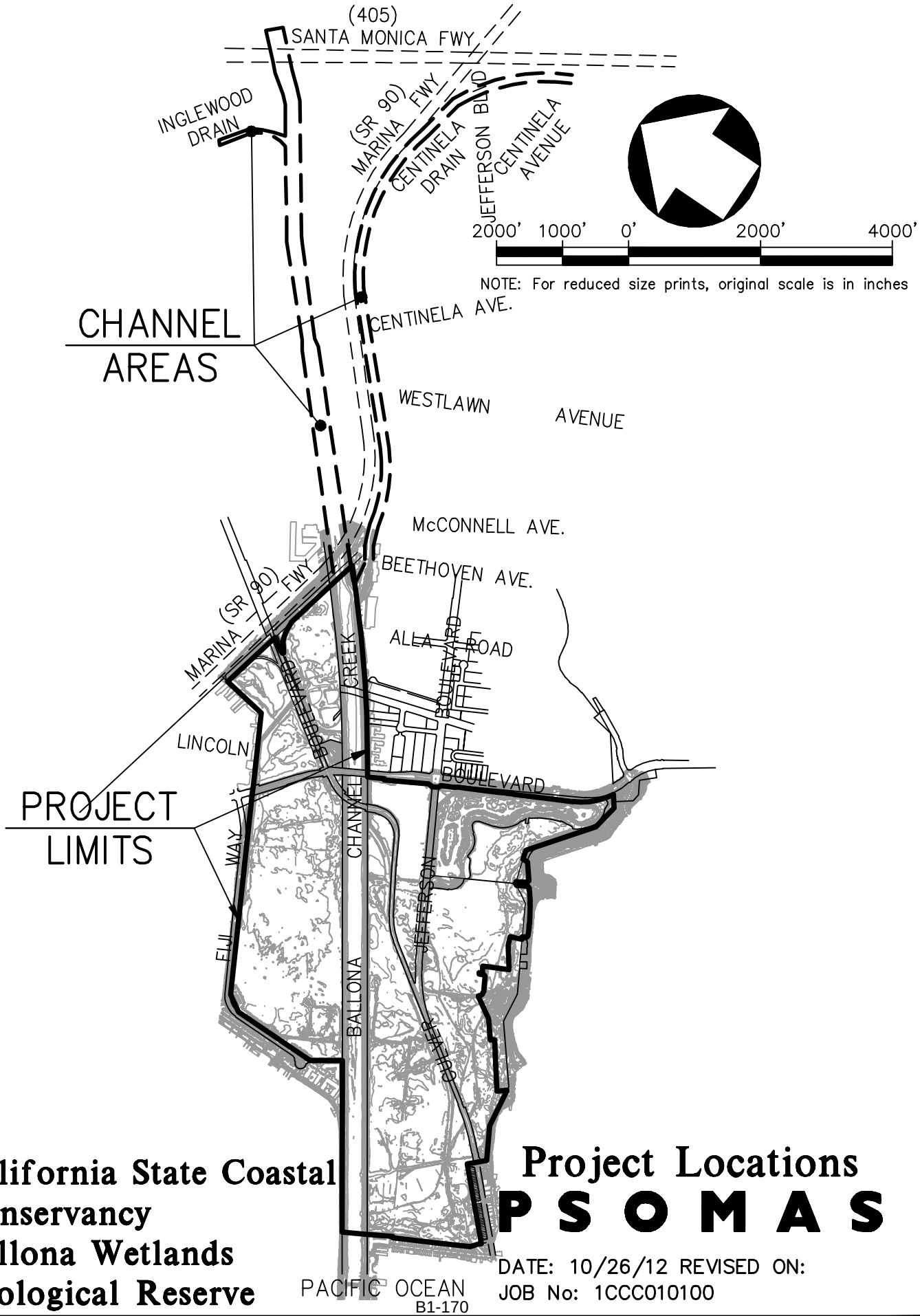

California State Coastal Conservancy
Ballona Wetlands Ecological Reserve

Project Locations
PSOMAS

DATE: 10/26/12 REVISED ON:
JOB No: 1CCC010100

| V-TP01 | V-SI01 |

Plotted: 10/26/12 12:06:21 \\westla1\Projects\1CCC010100\SURVEY\TECHNICAL_REPORTS\BR045-01.DWG jchiappe

BR045-01

stewart
title of california

Sanctity of Contract

STEWART TITLE OF CALIFORNIA, INC.,
LOS ANGELES DIVISION
525 N. BRAND BLVD.
GLENDALE, CA 91203
(818) 502-2700
www.stewarttitlela.com

MEMBER CALIFORNIA LAND TITLE ASSOCIATION

PRELIMINARY REPORT

PLAYA VISTA
12555 W. JEFFERSON, #300
LOS ANGELES, CA 90066
Attn: CATHERINE TYRRELL

Order Number: 040104934 Your Reference: AREA "A"

In response to the above referenced application for a Policy of Title Insurance, Stewart Title of California, Inc. hereby reports that it is prepared to issue, or cause to be issued, as of the date hereof, a Policy or Policies of Title Insurance describing the land and the estate or interest therein hereinafter set forth, insuring against loss which may be sustained by reason of any defect, lien or encumbrance not shown or referred to as an Exception below or not excluded from coverage pursuant to the printed Schedules, Conditions and Stipulations of said Policy forms.

The printed Exceptions and exclusions from the coverage and Limitations on Covered Risks of said Policy or Policies are set forth in Exhibit A attached. Limitations on Covered Risks applicable to the CLTA and ALTA Homeowner's Policies of Title Insurance which establish a Deductible Amount and a maximium Dollar Limit of Liability for certain coverages are also set forth in Exhibit A. Copies of the Policy forms should be read. They are available from the office which issued this report.

Please read the exceptions shown or referred to below and the exceptions and exclusions set forth in Exhibit A of this report carefully. The exceptions and exclusions are meant to provide you with notice of matters which are not covered under the terms of the title insurance policy and should be carefully considered.
It is important to note that this preliminary report is not a written representation as to the condition of title and may not list all liens, defects, and encumbrances affecting title to the land.

This report, (and any supplements or amendments hereto) is issued solely for the purpose of facilitating the issuance of a policy of title insurance and no liability is assumed hereby. If it is desired that liability be assumed prior to the issuance of a policy of title insurance a Binder or Commitment should be requested.

Dated as of October 29, 2003 at 7:30 A.M. **Amended**

LARRY MCGUIRE, Sr. Title Officer, V.P.
(818) 502-2723 Fax: (818) 241-9173
e-mail address: lmcguire@stewart.com

WIL CAMPOS, Title Officer
(818) 502-2724 Fax: (818) 241-9173
e-mail address: wcampos@stewart.com

PRELIMINARY REPORT

The form of Policy of Title Insurance contemplated by this report is:

California Land Title Association Standard Coverage Policy

SCHEDULE A

The Estate or Interest in the land hereinafter described or referred to covered by this report is:

FEE

Title to said estate or interest at the date hereof is vested in:

PLAYA CAPITAL COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY

Continued on next page

LEGAL DESCRIPTION

THE LAND REFERRED TO HEREIN IS SITUATED IN THE STATE OF CALIFORNIA, COUNTY OF LOS ANGELES, DESCRIBED AS FOLLOWS:

AREA "A"

PARCEL 1: (SUMMA PARCEL 26) (QUAD II) (4211-16-5)

THAT PORTION OF THE RANCHO LA BALLONA, IN THE COUNTY OF LOS ANGELES, BOUNDED BY THE FOLLOWING DESCRIBED LINES:

BEGINNING AT THE MOST EASTERLY CORNER OF LOT TWO (2) OF TRACT NO. 25165, AS SHOWN ON MAP RECORDED IN BOOK 674, PAGES 30, ET SEQ. OF MAPS RECORDS OF SAID COUNTY; THENCE ALONG THE BOUNDARY OF SAID TRACT NO. 25165, SOUTH 62 DEGREES 01' 26" WEST, 1921.44 FEET, SOUTH 62 DEGREES 02' 50" WEST, 1117.91 FEET, SOUTH 31 DEGREES 01' 18" WEST, 291.35 FEET, SOUTH 1309.16 FEET AND SOUTH 34 DEGREES 08' 33" EAST, 490.00 FEET TO THE NORTHWESTERLY LINE OF THE 380 FOOT WIDE BALLONA CREEK FLOOD CONTROL CHANNEL, AS DESCRIBED IN DECREE OF CONDEMNATION RECORDED IN BOOK 16382, PAGE 191, OFFICIAL RECORDS OF SAID COUNTY; THENCE ALONG SAID NORTHWESTERLY LINE, NORTH 55 DEGREES 51' 27" EAST, 3951.72 FEET TO A POINT IN THE WESTERLY LINE OF CULVER BOULEVARD AS DESCRIBED IN DEED TO THE COUNTY OF LOS ANGELES, RECORDED IN BOOK 16371, PAGE 72 OFFICIAL RECORDS OF SAID COUNTY, A RADIAL LINE OF THE CURVE IN SAID WESTERLY LINE BEARS NORTH 81 DEGREES 06' 41" WEST, TO SAID LAST MENTIONED POINT; THENCE NORTHERLY ALONG SAID WESTERLY LINE ON A CURVE, CONCAVE TO THE EAST, HAVING A RADIUS OF 900 FEET, A DISTANCE OF 394.80 FEET TO THE END OF SAID CURVE; THENCE TANGENT TO SAID CURVE AND ALONG THE NORTHWESTERLY LINE OF SAID CULVER BOULEVARD, NORTH 34 DEGREES 01' 21" EAST, 40.18 FEET TO THE SOUTHWESTERLY LINE OF THE 60 FOOT STRIP OF LAND DESCRIBED IN DEED TO THE STATE OF CALIFORNIA, RECORDED SEPTEMBER 17, 1932, AS INSTRUMENT NO. 597, IN BOOK 11722 PAGE 329, OFFICIAL RECORDS OF SAID COUNTY; THENCE ALONG SAID SOUTHWESTERLY LINE, NORTH 55 DEGREES 58' 39" WEST, 60.00 FEET TO THE NORTHWESTERLY LINE OF SAID 60 FOOT STRIP; THENCE ALONG SAID NORTHWESTERLY LINE, NORTH 34 DEGREES 01' 21" EAST, 27.75 FEET TO A POINT IN THE SOUTHWESTERLY LINE OF LINCOLN BOULEVARD, 100 FEET WIDE, A RADIAL LINE OF THE CURVE IN SAID SOUTHWESTERLY LINE BEARS NORTH 49 DEGREES 02' 43" EAST, TO SAID POINT; THENCE NORTHWESTERLY ALONG SAID SOUTHWESTERLY LINE ON A CURVE, CONCAVE TO THE SOUTHWEST, HAVING A RADIUS OF 1950 FEET, A DISTANCE OF 348.54 FEET TO THE END OF SAID CURVE; THENCE TANGENT TO SAID CURVE AND ALONG THE SOUTHWESTERLY LINE OF SAID LINCOLN BOULEVARD, NORTH 51 DEGREES 11' 44" WEST, 759.57 FEET TO THE POINT OF BEGINNING.

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EXCEPT THEREFROM THAT PORTION OF SAID LAND WITHIN A STRIP OF LAND, TEN (10) FEET WIDE, THE NORTHEASTERLY LINE OF WHICH IS DESCRIBED AS FOLLOWS:

BEGINNING AT THE INTERSECTION OF THE SOUTHEASTERLY BOUNDARY OF LOT TWO (2), TRACT NO. 25165, AS SHOWN ON MAP RECORDED IN BOOK 674, PAGE 30 TO 34, INCLUSIVE, OF MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY, WITH THE SOUTHWESTERLY BOUNDARY OF THAT CERTAIN 100 FOOT STRIP OF LAND DESCRIBED IN DEED TO STATE OF CALIFORNIA, FOR LINCOLN BOULEVARD, RECORDED OCTOBER 26, 1931, AS INSTRUMENT NO. 516, IN BOOK 11130, PAGE 339, OFFICIAL RECORDS, IN THE OFFICE OF SAID RECORDER; THENCE SOUTH 51 DEGREES 15' 30" EAST, ALONG SAID LINCOLN BOULEVARD 550.00 FEET.

THE SOUTHEASTERLY LINE OF SAID TEN (10) FOOT STRIP OF LAND SHALL BE PROLONGED AT THE BEGINNING THEREOF SO AS TO TERMINATE IN SAID SOUTHEASTERLY LINE.

ALSO EXCEPT THEREFROM ALL MINERALS, OIL, GAS AND OTHER HYDROCARBON SUBSTANCES IN, UNDER OR RECOVERABLE FROM THAT PORTION OF SAID LAND LYING SOUTHWESTERLY OF A LINE DESCRIBED AS FOLLOWS:

BEGINNING AT THE MOST SOUTHERLY CORNER OF THE LAND DESCRIBED IN DEED TO JOSEPH PIERSON, RECORDED JULY 26, 1940 IN BOOK 17715, PAGE 91, OFFICIAL RECORDS, AS INSTRUMENT NO. 11; THENCE SOUTH 27 DEGREES 53' 30" EAST, 1000 FEET TO THE MOST EASTERLY CORNER OF SAID LAND OF PIERSON; THENCE ALONG THE SOUTHEASTERLY LINE OF SAID LAND, SOUTH 62 DEGREES 06' 30" WEST, 676.43 FEET TO A POINT DISTANT NORTH 62 DEGREES 06' 30" WEST, 323.57 FEET FROM THE MOST NORTHERLY CORNER OF THE LAND DESCRIBED IN SAID DEED TO PIERSON; THENCE SOUTHEASTERLY PARALLEL WITH THE NORTHEASTERLY LINE OF DEL REY BEACH, AS SHOWN ON MAP RECORDED IN BOOK 6, PAGE 186 OF MAPS, RECORDS OF SAID COUNTY, TO THE SOUTHEASTERLY LINE OF THE LAND HEREINABOVE DESCRIBED.

INSTRUMENTS EXECUTED BY ARNOLD D. HASKELL, EUGENE P. CLARK, J. H. RISENHEBERGER, PAUL NOURSE AND UNION OIL COMPANY OF CALIFORNIA, WHEREBY THEY WAIVE ANY RIGHTS THAT THEY MAY HAVE TO ERECT OR CONSTRUCT UPON SURFACE OF:

THAT PART OF THE RANCHO LA BALLONA, IN THE COUNTY OF LOS ANGELES, DESCRIBED AS FOLLOWS:

BEGINNING AT A POINT IN THE NORTHWEST LINE OF THE 42.24 ACRE TRACT OF LAND ALLOTTED TO GREGORIA TALAMANTES BY THE FINAL DECREE OF PARTITION OF SAID RANCHO LA BALLONA HAD IN CASE NO. 965 OF THE DISTRICT COURT OF THE FIRST JUDICIAL DISTRICT OF THE STATE OF CALIFORNIA, WHICH POINT LIES SOUTH 62 DEGREES 06' 30" WEST, 1249.73 FEET, MEASURED ALONG SAID NORTHWEST LINE FROM A

Continued on next page

TWO-INCH IRON PIPE SET IN CONCRETE AT THE MOST SOUTHERLY CORNER OF LOT SEVEN (7) OF PRADERA TRACT, AS SAID TRACT IS DELINEATED UPON A MAP RECORDED IN BOOK 16, PAGE 38 OF MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY, SAID POINT ALSO BEING THE WEST CORNER OF A 22.96 ACRE PARCEL OF LAND DEEDED BY DEL REY COMPANY TO JOSEPH PIERSON, AS PER DEED RECORDED IN BOOK 17715, PAGE 91, OFFICIAL RECORDS OF SAID COUNTY; THENCE SOUTH 62 DEGREES 06' 30" WEST, 1006.37 FEET ALONG SAID NORTHWEST LINE OF 42.24 ACRE TRACT TO A FOUR-INCH STAKE; THENCE SOUTH 27 DEGREES 53' 30" EAST, 700 FEET NORMAL TO THE LAST MENTIONED COURSE TO A FOUR-INCH STAKE; THENCE NORTH 62 DEGREES 06' 30" EAST, 581.37 FEET PARALLEL TO SAID NORTHWEST LINE OF THE 42.24 ACRE TRACT, TO A FOUR-INCH STAKE; THENCE NORTH 27 DEGREES 53' 30" WEST, 50 FEET NORMAL TO THE LAST MENTIONED COURSE TO A FOUR-INCH BY FOUR-INCH STAKE; THENCE NORTH 62 DEGREES 06' 30" EAST, 150 FEET PARALLEL TO SAID NORTHWEST LINE OF THE 42.24 ACRE TRACT, TO A FOUR-INCH BY FOUR-INCH STAKE; THENCE SOUTH 27 DEGREES 53' 30" EAST, 50 FEET NORMAL TO THE LAST MENTIONED COURSE TO A FOUR-INCH BY FOUR-INCH STAKE; THENCE NORTH 62 DEGREES 06' 30" EAST, 275 FEET PARALLEL TO SAID NORTHWEST LINE OF THE 42.24 ACRE TRACT, TO A FOUR-INCH STAKE IN THE SOUTHWEST LINE OF SAID 22.96 ACRE PARCEL OF LAND DEEDED TO JOSEPH PIERSON; THENCE NORTH 27 DEGREES 35' 30" WEST, 700 FEET NORMAL TO SAID NORTHWESTERLY LINE OF THE 42.24 ACRE TRACT TO THE POINT OF BEGINNING MARKED BY A FOUR-INCH BY FOUR-INCH STAKE, ANY OIL WELL RIG OR OTHER STRUCTURE OF ANY NATURE OR KIND, BUT DO NOT WAIVE, BUT EXPRESSLY RESERVE RIGHT TO REMOVE FROM, OR FROM UNDER SAID REAL PROPERTY ANY MINERAL, OIL, GAS OR OTHER HYDROCARBON SUBSTANCES CONTAINED IN, OR WHICH IS OR MAY BE UNDER SAME, BY MEANS OF ANY WELL OR OTHER STRUCTURE ERECTED UPON REAL PROPERTY OTHER THAN THE PROPERTY DESCRIBED IN PARCEL 2 AND TO PROJECT ANY WELLS, THE DRILLING OF WHICH IS COMMENCED OUTSIDE OF THE BOUNDARIES OF SAID PARCEL 1, UNDER SAID REAL PROPERTY FOR PURPOSE OF REMOVING SAID OIL, GAS OR OTHER HYDROCARBON SUBSTANCES, RECORDED IN BOOK 19794, PAGE 69; IN BOOK 19797, PAGE 54; IN BOOK 19802, PAGE 55 AND IN BOOK 19761, PAGE 213, OFFICIAL RECORDS.

PARCEL 2: (QUAD II) (4211-15-7)

THAT PORTION OF THE RANCHO LA BALLONA, IN THE COUNTY OF LOS ANGELES, DESCRIBED AS FOLLOWS:

BEGINNING AT THE INTERSECTION OF THE NORTHWESTERLY LINE OF THE 380 FEET STRIP OF LAND DESCRIBED IN THE DECREE OF CONDEMNATION TO LOS ANGELES COUNTY FLOOD CONTROL DISTRICT, RECORDED IN BOOK 16382 PAGE 191, OFFICIAL RECORDS, WITH THE SOUTHWESTERLY LINE OF ROOSEVELT HIGHWAY, NOW LINCOLN BOULEVARD; THENCE NORTHWESTERLY ALONG SAID SOUTHWESTERLY LINE ON A CURVE TO THE LEFT 137.23 FEET, TO THE SOUTHEASTERLY LINE OF CULVER BOULEVARD, AS DESCRIBED IN DEED TO THE COUNTY OF LOS ANGELES, RECORDED IN BOOK

Continued on next page

16371 PAGE 72, OFFICIAL RECORDS; THENCE SOUTHWESTERLY ALONG SAID SOUTHEASTERLY LINE 261.05 FEET, TO THE NORTHWESTERLY LINE SAID 380 FOOT STRIP; THENCE ALONG SAID NORTHWESTERLY LINE, NORTH 55 DEGREES 51' 27" EAST, 220.17 FEET TO THE POINT OF BEGINNING.

EXCEPT THEREFROM ALL MINERALS, OIL, GAS AND OTHER HYDROCARBON SUBSTANCES IN, UNDER OR RECOVERABLE FROM THAT PORTION OF SAID LAND LYING SOUTHWESTERLY OF A LINE DESCRIBED AS FOLLOWS:

BEGINNING AT THE MOST NORTHERLY CORNER OF THE LAND DESCRIBED IN DEED TO JOSEPH PIERSON, RECORDED JULY 26, 1940, AS INSTRUMENT NO. 11, IN BOOK 17715 PAGE 91, OFFICIAL RECORDS OF SAID COUNTY; THENCE SOUTH 27 DEGREES 53' 30" EAST, 1000 FEET TO THE MOST EASTERLY CORNER OF SAID LAND OF PIERSON; THENCE ALONG THE SOUTHEASTERLY LINE OF SAID LAND, SOUTH 62 DEGREES 06' 30" WEST, 676.43 FEET TO A POINT DISTANT NORTH 62 DEGREES 06' 30" EAST, 323.57 FEET FROM THE MOST SOUTHERLY CORNER OF THE LAND DESCRIBED IN SAID DEED TO PIERSON; THENCE SOUTHEASTERLY PARALLEL WITH THE NORTHEASTERLY LINE OF DEL REY BEACH, AS SHOWN ON MAP RECORDED IN BOOK 5 PAGE 186 OF MAPS, RECORDS OF SAID COUNTY, TO THE SOUTHEASTERLY LINE OF THE LAND HEREINBEFORE DESCRIBED.

END OF LEGAL DESCRIPTION

Continued on next page

SCHEDULE B

At the date hereof, exceptions to coverage in addition to the printed exceptions and exclusions contained in said policy or policies would be as follows:

1. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$1,401.48 OPEN
2ND INSTALLMENT	$1,401.48 OPEN
EXEMPTION	NONE
CODE AREA	1478
ASSESSMENT NO.	4211-015-007

1.1. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$92,040.28 OPEN
2ND INSTALLMENT	$92,040.28 OPEN
EXEMPTION	NONE
CODE AREA	1478
ASSESSMENT NO.	4211-016-005

2. THE LIEN OF SUPPLEMENTAL TAXES, IF ANY, ASSESSED PURSUANT TO THE PROVISIONS OF CHAPTER 3.5 (COMMENCING WITH SECTION 75) OF THE REVENUE AND TAXATION CODE OF THE STATE OF CALIFORNIA.

2.1. ASSESSMENTS, FOR COMMUNITY FACILITY DISTRICTS AFFECTING SAID LAND WHICH MAY EXIST BY VIRTUE OF ASSESSMENT MAPS OR NOTICES FILED BY SAID DISTRICTS.

THE FOLLOWING MATTERS AFFECT QUAD II

3. AN EASEMENT FOR THE PURPOSE SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT

GRANTED TO	COUNTY OF LOS ANGELES
PURPOSE	EXTENDING EMBANKMENT SLOPES BEYOND THE SOUTH-EASTERLY LIMITS OF CULVER BOULEVARD FOR CONSTRUCTING AN OVERHEAD GRADE SEPARATION SEPARATING CULVER BOULEVARD FROM LINCOLN BOULEVARD
RECORDED	JANUARY 22, 1932 AS INSTRUMENT NO. 1217, IN BOOK 11340 PAGE 265, OFFICIAL RECORDS
AFFECTS	THAT PORTION OF PARCELS 1 AND 2 OF QUAD II MORE PARTICULARLY DESCRIBED IN SAID DOCUMENT

Continued on next page

4. AN EASEMENT AFFECTING THE PORTION OF SAID LAND AND FOR THE PURPOSES STATED HEREIN, AND INCIDENTAL PURPOSES,

IN FAVOR OF	CITY OF LOS ANGELES
FOR	SANITARY SEWER AND STORM DRAIN
RECORDED	NOVEMBER 3, 1930 AS INSTRUMENT NO. 753, IN BOOK 10418, PAGE 126, OFFICIAL RECORDS
AFFECTS	THAT PORTION OF PARCEL 1 OF QUAD II MORE PARTICULARLY DESCRIBED IN SAID DOCUMENT

5. AN EASEMENT AFFECTING THE PORTION OF SAID LAND AND FOR THE PURPOSES STATED HEREIN, AND INCIDENTAL PURPOSES,

IN FAVOR OF	SOUTHERN CALIFORNIA EDISON COMPANY, LTD.
FOR	A POLE LINE
RECORDED	SEPTEMBER 24, 1940 AS INSTRUMENT NO. 1509, IN BOOK 17818, PAGE 325, OFFICIAL RECORDS
AFFECTS	A PORTION OF PARCEL 1 OF QUAD II AS MORE PARTICULARLY DESCRIBED IN SAID DOCUMENT

6. AN EASEMENT AFFECTING THE PORTION OF SAID LAND AND FOR THE PURPOSES STATED HEREIN, AND INCIDENTAL PURPOSES,

IN FAVOR OF	ASSOCIATED TELEPHONE COMPANY, LTD.
FOR	POLE LINES AND CONDUITS
RECORDED	JUNE 27, 1941 AS INSTRUMENT NO. 1257, IN BOOK 18482, PAGE 367, OFFICIAL RECORDS
AFFECTS	A PORTION OF PARCEL 1 OF QUAD II AS MORE PARTICULARLY DESCRIBED IN SAID DOCUMENT

7. THE FREE AND UNOBSTRUCTED RIGHT FROM TIME TO TIME TO EXPLORE FOR, MINE FOR, DRILL FOR, PRODUCE, TREAT, TRANSPORT, STORE AND REMOVE MINERALS, OIL, GAS AND OTHER HYDROCARBON SUBSTANCES AND INCIDENTAL PURPOSES, AS MORE FULLY DEFINED IN AND AS RESERVED BY UNION OIL COMPANY OF CALIFORNIA, A CORPORATION, IN THE DEED RECORDED MAY 29, 1945 AS INSTRUMENT NO. 6, IN BOOK 21983, PAGE 305, OFFICIAL RECORDS.

SAID RIGHTS, INSOFAR AS THEY AFFECT PORTIONS OF SAID LAND, WERE MODIFIED BY DEEDS FROM UNION OIL COMPANY OF CALIFORNIA, RECORDED FEBRUARY 5, 1959 AS INSTRUMENT NO. 4213, IN BOOK D-356, PAGE 958, OFFICIAL RECORDS, AND RECORDED AUGUST 21, 1958 AS INSTRUMENT NO. 4834, IN BOOK D-579, PAGE 972, OFFICIAL RECORDS, AND BY AGREEMENT RECORDED MARCH 15, 1961 AS INSTRUMENT NO. 3819, IN BOOK D-1156, PAGE 518, OFFICIAL RECORDS.

SAID MATTER AFFECTS: PARCEL 1 OF QUAD II

8. THE EXCLUSIVE RIGHT, AFFECTING THAT PORTION OF SAID LAND INCLUDED WITHIN THE LAND DESCRIBED IN DEED NEXT REFERRED TO, TO USE THE SUBSURFACE OF SAID LAND AND ALL ZONES CONTAINED THEREIN, REGARDLESS OF DEPTH, FOR THE INJECTION OF GAS INTO, THE STORAGE OF GAS IN, AND/OR THE WITHDRAWAL OF GAS FROM SAID PROPERTY, AND

Continued on next page

INCIDENTAL PURPOSES, AS MORE FULLY DESCRIBED IN AND AS RESERVED BY SOUTHERN CALIFORNIA GAS COMPANY, IN DEED RECORDED NOVEMBER 21, 1946 AS INSTRUMENT NO. 1046, IN BOOK 23939, PAGE 338, OFFICIAL RECORDS.

SAID RIGHTS, INSOFAR AS THEY AFFECT A PORTION OF SAID LAND, WERE MODIFIED BY DEED FROM SOUTHERN CALIFORNIA GAS COMPANY, RECORDED FEBRUARY 6, 1959 AS INSTRUMENT NO. 4278, IN BOOK D-358, PAGE 367, OFFICIAL RECORDS, AS MODIFIED BY AN INSTRUMENT RECORDED AUGUST 14, 1959 IN BOOK M-339, PAGE 989, OFFICIAL RECORDS.

SAID MATTER AFFECTS: PARCEL 1 OF QUAD II

9. AN AGREEMENT AFFECTING PARCEL 1 OF QUAD II DATED AUGUST 15, 1963, WHEREBY HUGHES TOOL COMPANY, A CORPORATION, HEREBY CONVEYS TO SOUTHERN CALIFORNIA GAS COMPANY, A CORPORATION, THE EXCLUSIVE RIGHT TO USE SUBSURFACE MINERAL, OIL AND/OR GAS ZONES FOR INJECTING, STORING AND WITHDRAWING NATURAL GAS (WHETHER PROVIDED FROM SUCH OR OTHER PROPERTY) THEREIN AND THEREFROM AND FOR REPRESSURING THE SAME; BUT WITH NO RIGHT TO USE THE SURFACE OR TO CARRY ON SUCH OPERATION EXCEPT BETWEEN A DEPTH OF 500 FEET TO 7000 FEET FROM THE SURFACE THEREOF, WHICH AGREEMENT ALSO RECITES THAT:

HUGHES TOOL COMPANY HEREBY COVENANTS AND AGREES TO PROHIBIT EXPLORATION FOR MINERAL, OIL, GAS OR OTHER HYDROCARBONS BETWEEN DEPTH OF 500 FEET TO 7000 FEET FROM THE SURFACE, RECORDED AUGUST 30, 1963 AS INSTRUMENT NO. 7055, IN BOOK M-1338, PAGE 287, OFFICIAL RECORDS.

10. AN EASEMENT AFFECTING THE PORTION OF SAID LAND AND FOR THE PURPOSES STATED HEREIN, AND INCIDENTAL PURPOSES,

GRANTED TO	SOUTHERN CALIFORNIA GAS COMPANY
PURPOSE	WORKING, OPERATING, CLEANING OUT, DEEPENING, REDRILLING, PLUGGING BACK AND ABANDONING DEL REY WELLS, 11, 12, 13, 14, 15, 17 AND 19 AND FOR THE CONSTRUCTION, INSTALLATION, OPERATION, MAINTENANCE AND REMOVAL OF PIPELINES, TOGETHER WITH THE RIGHT TO CONSTRUCT AND MAINTAIN A PRIVATE ROADWAY
RECORDED	IN BOOK D 2166, PAGE 904, OF OFFICIAL RECORDS
AFFECTS	A PORTION OF SAID LAND MORE PARTICULARLY DESCRIBED IN SAID DOCUMENT

ALL EASEMENTS AND RIGHTS OF WAY INCLUDING THOSE FOR PIPE LINES, PRIVATE ROADWAY AND INGRESS AND EGRESS IN, ON, OVER, THROUGH AND ACROSS THE SAID PARCEL, ARE LIMITED BY AND SUBJECT TO THE PROVISIONS AND CONDITIONS OF THE QUITCLAIM BY SOUTHERN CALIFORNIA GAS COMPANY IN THE AGREEMENT DATED AUGUST 15, 1963, RECORDED AUGUST 30, 1963 IN BOOK M1338, PAGE 280, OF OFFICIAL

Continued on next page

RECORDS.

11. AN EASEMENT FOR THE PURPOSE SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT

GRANTED TO	SOUTHERN CALIFORNIA GAS COMPANY, A CALIFORNIA CORPORATION
PURPOSE	UTILITIES
RECORDED	SEPTEMBER 1, 1983
INSTRUMENT/FILE NO	83-1027591, OF OFFICIAL RECORDS
AFFECTS	A STRIP OF LAND 15 FEET WIDE AS THEREIN DESCRIBED

12. AN ACTION IN THE SUPERIOR COURT

COMMENCED	MAY 15, 1961
ENTITLED	LOS ANGELES FLOOD CONTROL DISTRICT VS. SHELL OIL COMPANY, ET AL.
CASE NO.	771085
COUNTY OF	LOS ANGELES
NATURE OF ACTION	TO CONDEMN THE SLOPE EASEMENT FOR THE WIDENING OF FLOOD CONTROL CHANNEL
NOTICE OF SAID ACTION RECORDED	MAY 15, 1961 AS INSTRUMENT NO. 5153, IN BOOK M771, PAGE 334, OF OFFICIAL RECORDS

SAID MATTER AFFECTS A PORTION OF SAID LAND AS MORE PARTICULARLY DESCRIBED IN SAID DOCUMENT.

13. RIGHTS OF THE FOLLOWING UNDER VARIOUS OFF-RECORD LEASES, AGREEMENTS AND LICENSES, TO USE PORTION OF SAID LAND:

A. LEASE BETWEEN PLAYA PHASE 1 COMMERCIAL LAND COMPANY, LLC, AS LANDLORD, AND THE COUNTY OF LOS ANGELES, AS TENANT, DATED OCTOBER 12, 1998.

B. LEASE BETWEEN PLAYA CAPITAL COMPANY, LLC, AS LANDLORD, AND THE COUNTY OF LOS ANGELES, AS TENANT, DATED OCTOBER 29, 2001.

C. LEASE BETWEEN MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP, AS LANDLORD, AND THE COUNTY OF LOS ANGELES, AS TENANT, DATED AUGUST 2, 1995.

14. AN EASEMENT FOR THE PURPOSE SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT

GRANTED TO	U.S. TRUST COMPANY OF CALIFORNIA, N.A., AS TRUSTEE

Continued on next page

PURPOSE	ROADWAY IMPROVEMENTS AND FOR VEHICULAR ACCESS, INGRESS AND EGRESS
RECORDED	AUGUST 31, 1990
INSTRUMENT/FILE NO	90-1515157, OF OFFICIAL RECORDS
AFFECTS	A PORTION OF QUAD IV AND QUAD II AND ALL OF QUAD I

REFERENCE IS MADE TO SAID DOCUMENT FOR FULL PARTICULARS

15. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED	"MEMORANDUM OF AGREEMENT"
DATED	JANUARY 4, 1996

BY: MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED

RECORDED	APRIL 23, 1996
INSTRUMENT/FILE NO	96-637590, OF OFFICIAL RECORDS

REFERENCE IS MADE TO SAID DOCUMENT FOR FULL PARTICULARS

16. DEED OF TRUST TO SECURE AN INDEBTEDNESS IN THE AMOUNT SHOWN BELOW, AND ANY OTHER OBLIGATIONS SECURED THEREBY:

AMOUNT	$60,400,000.00
DATED	SEPTEMBER 2, 1997
TRUSTOR	PLAYA CAPITAL COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY
TRUSTEE	FIRST AMERICAN TITLE INSURANCE COMPANY
BENEFICIARY	PLAYA INVESTMENTS, LLC, A DELAWARE LIMITED LIABILITY COMPANY
RECORDED	OCTOBER 16, 1997
INSTRUMENT NO.	97-1625347 OF OFFICIAL RECORDS

AND RE-RECORDED DECEMBER 23, 1997, AS INSTRUMENT/FILE NO. 97-2009527, OF OFFICIAL RECORDS

A SUBORDINATION, AND STANDSTILL AGREEMENT, DATED MAY 5, 1999, AFFECTING THE DEED OF TRUST SHOWN ABOVE AND THE DEED OF TRUST RECORDED MAY 5, 1999 AS INSTRUMENT NO. 99-828132, OF OFFICIAL RECORDS RECORDED MAY 7, 1999 AS INSTRUMENT NO. 99-828134, OF OFFICIAL RECORDS.

SAID DEED OF TRUST HAS BEEN SUBORDINATED BY THE PROVISIONS OF AN INSTRUMENT

DATED	AUGUST 13, 2002
EXECUTED BY	PLAYA CAPITAL COMPANY, LLC, A DELAWARE LIMITED LIABILITY PLAYA INVESTMENTS, LLC, A DELAWARE LIMITED LIABILITY COMPANY

Continued on next page

	AND RESIDENTIAL FUNDING CORPORATION
RECORDED	AUGUST 27, 2002
INSTRUMENT/FILE NO	02-2013250, OFFICIAL RECORDS
SUBORDINATED TO	ITEM NO. 27

SUBSTITUTION OF TRUSTEE UNDER SAID DEED OF TRUST WHICH NAMES AS THE SUBSTITUTED TRUSTEE, THE FOLLOWING:

TRUSTEE	FIRST AMERICAN TITLE INSURANCE COMPANY
RECORDED	JUNE 27, 2003
INSTRUMENT/FILE NO	03-185461 OF OFFICIAL RECORDS

SAID INSTRUMENT HAS BEEN SUBORDINATED BY THAT CERTAIN IRREVOCABLE OFFER TO DEDICATE:

DATED	SEPTEMBER 19, 2003
EXECUTED BY	BANK OF THE WEST AS SUCCESSOR IN INTEREST TO UNITED CALIFORNIA BANK, AS SUCCESSOR IN INTEREST TO TOKAI BANK OF CALIFORNIA, A CALIFORNIA BANKING CORPORATION
RECORDED	OCTOBER 23, 2003
INSTRUMENT/FILE NO	03-3175571 OFFICIAL RECORDS
SUBORDINATED TO	ITEM 31

17. INTENTIONALLY DELETED.

18. INTENTIONALLY DELETED.

19. INTENTIONALLY DELETED.

20. INTENTIONALLY DELETED.

21. INTENTIONALLY DELETED.

22. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED	MEMORANDUM OF OPTION
DATED	AUGUST 8, 2001

BY AND BETWEEN: PLAYA CAPITAL COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY; THE TRUST FOR PUBLIC LAND, A CALIFORNIA NONPROFIT PUBLIC BENEFIT CORPORATION UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED

RECORDED	SEPTEMBER 7, 2001
INSTRUMENT/FILE NO	01-1688057, OF OFFICIAL RECORDS

23. INTENTIONALLY DELETED.

24. INTENTIONALLY DELETED.

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25. INTENTIONALLY DELETED.

26. A LIEN FOR UNSECURED PROPERTY TAXES FILED BY THE TAX COLLECTOR OF THE COUNTY SHOWN, FOR THE AMOUNT SET FORTH, AND ANY OTHER AMOUNTS DUE:

COUNTY	LOS ANGELES
TAXPAYER	PLAYA CAPITAL COMPANY LLC
YEAR/ACCOUNT NO	01/40745622
AMOUNT	$5,433.45
RECORDED	MARCH 8, 2002
INSTRUMENT NO.	02-557076 OF OFFICIAL RECORDS

27. DEED OF TRUST TO SECURE AN INDEBTEDNESS IN THE AMOUNT SHOWN BELOW, AND ANY OTHER OBLIGATIONS SECURED THEREBY:

AMOUNT	$40,000,000.00
DATED	AUGUST 13, 2002
TRUSTOR	PLAYA CAPITA COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY
TRUSTEE	STEWART TITLE OF CALIFORNIA
BENEFICIARY	RESIDENTIAL FUNDING CORPORATION
RECORDED	AUGUST 27, 2002
INSTRUMENT NO.	02-2013247 OF OFFICIAL RECORDS

28. A LIEN FOR UNSECURED PROPERTY TAXES FILED BY THE TAX COLLECTOR OF THE COUNTY SHOWN, FOR THE AMOUNT SET FORTH, AND ANY OTHER AMOUNTS DUE:

COUNTY	LOS ANGELES
TAXPAYER	PLAYA CAPITAL COMPANY LLC LESSEE C/O ASCOM HASLER
YEAR/ACCOUNT NO	02/49914335
AMOUNT	$117.06
RECORDED	JUNE 17, 2003
INSTRUMENT NO.	03-1722853 OF OFFICIAL RECORDS

29. A LIEN FOR UNSECURED PROPERTY TAXES FILED BY THE TAX COLLECTOR OF THE COUNTY SHOWN, FOR THE AMOUNT SET FORTH, AND ANY OTHER AMOUNTS DUE:

COUNTY	LOS ANGELES
TAXPAYER	PLAYA CAPITAL LESSEE C/O GTE
YEAR/ACCOUNT NO	02/49917153
AMOUNT	$1,693.89
RECORDED	SEPTEMBER 8, 2003
INSTRUMENT NO.	03-2623553 OF OFFICIAL RECORDS

30. A LIEN FOR UNSECURED PROPERTY TAXES FILED BY THE TAX COLLECTOR OF THE COUNTY SHOWN, FOR THE AMOUNT SET FORTH, AND ANY OTHER AMOUNTS DUE:

COUNTY	LOS ANGELES
TAXPAYER	PLAYA CAPITAL LESSEE

Continued on next page

	C/O GTE
YEAR/ACCOUNT NO	02/49917151
AMOUNT	$2,547.47
RECORDED	SEPTEMBER 8, 2003
INSTRUMENT NO.	03-2623666 OF OFFICIAL RECORDS

31. INTENTIONALLY DELETED.

32. THE MATTERS CONTAINED IN AN INSTRUMENT:

ENTITLED	MEMORANDUM OF AGREEMENT TO SUBORDINATE
DATED	AUGUST 8, 2001

BY AND BETWEEN: PLAYA CAPITAL COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY AND THE TRUST FOR PUBLIC LAND, A CALIFORNIA NONPROFIT PUBLIC BENEFIT CORPORATION UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED.

RECORDED	OCTOBER 22, 2003
INSTRUMENT NO.	03-3162873, OFFICIAL RECORDS

33. WATER RIGHTS, CLAIMS OR TITLE TO WATER IN OR UNDER SAID LAND, WHETHER OR NOT SHOWN BY THE PUBLIC RECORDS.

34. MATTERS WHICH MAY BE DISCLOSED BY AN INSPECTION OR BY A SURVEY OF SAID LAND SATISFACTORY TO THIS COMPANY, OR BY INQUIRY OF THE PARTIES IN POSSESSION THEREOF.

++++++++++++++++++++ REQUIREMENTS ++++++++++++++++++++++++++

1. THE REQUIREMENT THAT STEWART TITLE OF CALIFORNIA, INC. BE INFORMED OF WHAT TYPE OF TITLE INSURANCE COVERAGE/POLICIES ARE BEING REQUESTED, SO THAT WE MAY PROVIDE YOU WITH ANY ADDITIONAL REQUIREMENTS OR EXCEPTIONS THAT WE MAY HAVE OR THAT APPLY.

2. PRIOR TO THE ISSUANCE OF ANY POLICY OF TITLE INSURANCE, THE COMPANY WILL REQUIRE THE FOLLOWING WITH RESPECT TO PLAYA CAPITAL COMPANY, LLC, A CALIFORNIA LIMITED LIABILITY COMPANY:

   1. A COPY OF ITS OPERATING AGREEMENT AND ANY AMENDMENTS THERETO MUST BE SUBMITTED TO THE COMPANY FOR REVIEW.

   2. A CERTIFIED COPY OF ITS ARTICLES OF ORGANIZATION (LLC-1), ANY CERTIFICATE OF CORRECTION (LLC-11), CERTIFICATE OF AMENDMENT (LLC-2), OR RESTATEMENT OF ARTICLES OF ORGANIZATION (LLC-10) MUST BE SUBMITTED TO THE COMPANY FOR REVIEW.

   3. WITH RESPECT TO ANY DEED, DEED OF TRUST, LEASE, SUBORDINATION

Continued on next page

AGREEMENT OR OTHER DOCUMENT OR INSTRUMENT EXECUTED BY SUCH LIMITED LIABILITY COMPANY AND PRESENTED TO THE COMPANY FOR RECORDING OR UPON WHICH THE COMPANY IS ASKED TO RELY, SUCH DOCUMENT OR INSTRUMENT MUST BE EXECUTED IN ACCORDANCE WITH THE FOLLOWING:

(A) IF THE LIMITED LIABILITY COMPANY PROPERLY OPERATES THROUGH OFFICERS APPOINTED OR ELECTED PURSUANT TO THE TERMS OF THE WRITTEN OPERATING AGREEMENT, SUCH DOCUMENT OR INSTRUMENT MUST BE EXECUTED BY AT LEAST TWO DULY ELECTED OR APPOINTED OFFICERS AS FOLLOWS: THE CHAIRMAN OF THE BOARD, THE PRESIDENT, VICE PRESIDENT, AND ANY SECRETARY, ASSISTANT SECRETARY, THE CHIEF FINANCIAL OFFICER OR ANY ASSISTANT TREASURER.

(B) IF THE LIMITED LIABILITY COMPANY PROPERLY OPERATES THROUGH A MANAGER OR MANAGERS IDENTIFIED IN THE ARTICLES OF ORGANIZATION AND/OR DULY ELECTED PURSUANT TO THE TERMS OF A WRITTEN OPERATING AGREEMENT, SUCH DOCUMENT OR INSTRUMENT MUST BE EXECUTED BY AT LEAST TWO SUCH MANAGERS OR BY ONE MANAGER IF THE LIMITED LIABILITY COMPANY PROPERLY OPERATES WITH THE EXISTENCE OF ONLY ONE MANAGER.

4. OTHER REQUIREMENTS WHICH THE COMPANY MAY IMPOSE FOLLOWING ITS REVIEW OF THE MATERIAL REQUIRED HEREIN AND OTHER INFORMATION WHICH THE COMPANY MAY REQUIRE.

END OF EXCEPTIONS

Continued on next page

NOTES

A. LENDERS NOTE:

IF AN ALTA LOAN POLICY - 1970, AMENDED 10-17-70 (AMENDED 12-6-85) IS REQUESTED, THE FOLLOWING WILL BE ADDED AS AN EXCLUSION FROM COVERAGE:

ANY CLAIM, WHICH ARISES OUT OF THE TRANSACTION CREATING THE INTEREST OF THE MORTGAGEE INSURED BY THIS POLICY, BY REASON OF THE OPERATION OF FEDERAL BANKRUPTCY, STATE INSOLVENCY, OR SIMILAR CREDITORS' RIGHTS LAWS THAT IS BASED ON:

(I) THE TRANSACTION CREATING THE INTEREST OF THE INSURED MORTGAGEE BEING DEEMED A FRAUDULENT CONVEYANCE OR FRAUDULENT TRANSFER; OR

(II) THE SUBORDINATION OF THE INTEREST OF THE INSURED MORTGAGEE AS A RESULT OF THE APPLICATION OF THE DOCTRINE OR EQUITABLE SUBORDINATION; OR

(III) THE TRANSACTION CREATING THE INTEREST OF THE INSURED MORTGAGEE BEING DEEMED A PREFERENTIAL TRANSFER EXCEPT WHERE THE PREFERENTIAL TRANSFER RESULTS FROM THE FAILURE:

(A) TO TIMELY RECORD THE INSTRUMENT OF TRANSFER; OR

(B) OF SUCH RECORDATION TO IMPART NOTICE TO A PURCHASER FOR VALUE OR A JUDGEMENT OR LIEN CREDITOR.

B. IF AN OWNERS POLICY WILL BE REQUESTED, PLEASE BE AWARE THAT UNLESS INSTRUCTED OTHERWISE, WE WILL ISSUE A CLTA STANDARD COVERAGE OWNERS POLICY. IF A DIFFERENT FORM OF POLICY IS CONTEMPLATED FOR THIS TRANSACTION, PLEASE ADVISE AND CONTACT YOUR TITLE OFFICER FOR ADDITIONAL REQUIREMENTS

Continued on next page

stewart
title of california

Sanctity of Contract

CALIFORNIA "GOOD FUNDS" LAW

California Insurance Code Section 12413.1 regulates the disbursement of escrow and sub-escrow funds by title companies. The law requires that funds be deposited in the title company escrow account and available prior to disbursement. Funds received by Stewart Title of California, Inc. (Stewart Title) via wire transfer may be disbursed upon receipt. Funds received via cashier's checks or teller checks drawn on a California Bank may be disbursed on the next business day after the day of deposit. If funds are received by any other means, recording and/or disbursement may be delayed, and you should contact your title or escrow officer. All escrow and sub-escrow funds received will be deposited with other escrow funds in one or more non-interest bearing escrow accounts in a financial institution selected by Stewart Title. Stewart Title may receive certain direct or indirect benefits from the financial institution by reason of the deposit of such funds or the maintenance of such accounts with the financial institution, and Stewart Title shall have no obligation to account to the depositing party in any manner for the value of, or pay to such party, any benefit received by Stewart Title. Such benefits shall be deemed additional compensation to Stewart Title for its services in connection with the escrow or sub-escrow.

WIRING INSTRUCTIONS

IF YOU ANTICIPATE HAVING FUNDS WIRED TO STEWART TITLE OF CALIFORNIA, INC. OUR WIRING INFORMATION IS AS FOLLOWS:

ADDITIONAL NOTE: DIRECT WIRE TRANSFERS TO:
CITY NATIONAL BANK
5601 E. SLAUSON AVE
CITY OF COMMERCE, CALIFORNIA 90040
ROUTING NO. 122016066
CREDIT TO STEWART TITLE OF CALIFORNIA, INC.
ACCOUNT # 013 218811
REF: (ORDER # 040104934, TITLE OFFICER NAME: LARRY MCGUIRE)

WHEN INSTRUCTING THE FINANCIAL INSTITUTION TO WIRE FUNDS, IT IS VERY IMPORTANT THAT YOU REFERENCE STEWART TITLE'S ORDER NUMBER.

SHOULD YOU HAVE ANY QUESTIONS IN THIS REGARD PLEASE CONTACT YOUR TITLE OFFICER IMMEDIATELY.

stewart
title of california

Sanctity of Contract

STEWART TITLE OF CALIFORNIA, INC.,
LOS ANGELES DIVISION
525 N. BRAND BLVD.
GLENDALE, CA 91203
(818) 502-2700
www.stewarttitlela.com

MEMBER CALIFORNIA LAND TITLE ASSOCIATION

PRELIMINARY REPORT

PLAYA VISTA
12555 W. JEFFERSON, #300
LOS ANGELES, CA 90066
Attn: CATHERINE TYRRELL

Order Number: 040104935

Your Reference: AREA B RESIDENTIAL

In response to the above referenced application for a Policy of Title Insurance, Stewart Title of California, Inc. hereby reports that it is prepared to issue, or cause to be issued, as of the date hereof, a Policy or Policies of Title Insurance describing the land and the estate or interest therein hereinafter set forth, insuring against loss which may be sustained by reason of any defect, lien or encumbrance not shown or referred to as an Exception below or not excluded from coverage pursuant to the printed Schedules, Conditions and Stipulations of said Policy forms.

The printed Exceptions and exclusions from the coverage and Limitations on Covered Risks of said Policy or Policies are set forth in Exhibit A attached. Limitations on Covered Risks applicable to the CLTA and ALTA Homeowner's Policies of Title Insurance which establish a Deductible Amount and a maximium Dollar Limit of Liability for certain coverages are also set forth in Exhibit A. Copies of the Policy forms should be read. They are available from the office which issued this report.

Please read the exceptions shown or referred to below and the exceptions and exclusions set forth in Exhibit A of this report carefully. The exceptions and exclusions are meant to provide you with notice of matters which are not covered under the terms of tbe title insurance policy and should be carefully considered.
It is important to note that this preliminary report is not a written representation as to the condition of title and may not list all liens, defects, and encumbrances affecting title to the land.

This report, (and any supplements or amendments hereto) is issued solely for the purpose of facilitating the issuance of a policy of title insurance and no liability is assumed hereby. If it is desired that liability be assumed prior to the issuance of a policy of title insurance a Binder or Commitment should be requested.

Dated as of November 01, 2003 at 7:30 A.M.

LARRY MCGUIRE, Sr. Title Officer, V.P.
(818) 502-2723 Fax: (818) 241-9173
e-mail address: lmcguire@stewart.com

WIL CAMPOS, Title Officer
(818) 502-2724 Fax: (818) 241-9173
e-mail address: wcampos@stewart.com

PRELIMINARY REPORT

The form of Policy of Title Insurance contemplated by this report is:

California Land Title Association Standard Coverage Policy

SCHEDULE A

The Estate or Interest in the land hereinafter described or referred to covered by this report is:

A FEE

Title to said estate or interest at the date hereof is vested in:

PLAYA CAPITAL COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY

Continued on next page

LEGAL DESCRIPTION

THE LAND REFERRED TO HEREIN IS SITUATED IN THE STATE OF CALIFORNIA, COUNTY OF LOS ANGELES, DESCRIBED AS FOLLOWS:

AREA B RESIDENTIAL

THAT PORTION OF THE RANCHO LA BALLONA, IN THE CITY OF LOS ANGELES IN THE COUNTY OF LOS ANGELES, STATE OF CALIFORNIA, BOUNDED AS FOLLOWS:

NORTHEASTERLY BY THE SOUTHWESTERLY LINE OF ROOSEVELT HIGHWAY, 100 FEET WIDE, PER BOOK 7188, PAGE 367, OFFICIAL RECORDS OF SAID COUNTY;

NORTHWESTERLY BY THE SOUTHEASTERLY LINE OF THE 380 FOOT STRIP OF LAND DESCRIBED IN THE DECREE OR CONDEMNATION TO LOS ANGELES COUNTY FLOOD CONTROL DISTRICT, RECORDED IN BOOK 16332 PAGE 191, OFFICIAL RECORDS OF SAID COUNTY;

SOUTHEASTERLY BY THE NORTHWESTERLY LINE OF SAID JEFFERSON BOULEVARD, FORMERLY PLAYA STREET, 33 FEET WIDE, AS SHOWN ON TOWNSITE OF PLAYA DEL REY, AS PER MAP RECORDED IN BOOK 107, PAGE 40, OF MISCELLANEOUS RECORDS OF SAID COUNTY;

SOUTHWESTERLY BY THE FOLLOWING DESCRIBED LAND:

BEGINNING AT A POINT ON THE NORTHWESTERLY LINE OF JEFFERSON BOULEVARD, 100 FOOT WIDE, DISTANT THEREON SOUTH 61 DEGREES 14 MINUTES 57 SECONDS WEST 2,217.38 FEET FROM THE SOUTHERLY TERMINUS OF THE LINE SHOWN AS SOUTH 4 DEGREES 42 MINUTES 40 SECONDS WEST, 65.51 FEET OF THE LAND DESIGNATED AS PARCEL 2B IN LIS PENDENS RECORDED SEPTEMBER 3, 1965 AS INSTRUMENT NO. 5086, IN BOOK M-1969 PAGE 549, OFFICIAL RECORDS OF SAID COUNTY, SAID POINT ALSO BEING THE BEGINNING OF A TANGENT CURVE, CONCAVE TO THE NORTH AND HAVING A RADIUS OF 957.00 FEET; THENCE WESTERLY 569.49 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 34 DEGREES 05 MINUTES 44 SECONDS TO THE BEGINNING OF A COMPOUND CURVE, CONCAVE TO THE NORTHEAST AND HAVING A RADIUS OF 20.00 FEET; THENCE NORTHWESTERLY 32.08 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 91 DEGREES 53 MINUTES 53 SECONDS TO THE BEGINNING OF A REVERSE CURVE, CONCAVE TO THE WEST AND HAVING A RADIUS OF 850.00 FEET; THENCE NORTHERLY 259.52 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 17 DEGREES 29 MINUTES 37 SECONDS; THENCE NORTH 10 DEGREES 15 MINUTES 03 SECONDS WEST 284.01 FEET TO THE BEGINNING OF A CURVE, CONCAVE TO THE EAST AND HAVING A RADIUS OF 750.00 FEET; THENCE NORTHERLY 55.94 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 04 DEGREES 16 MINUTES 25 SECONDS TO THE NON-TANGENT SOUTHEASTERLY LINE OF THE

Continued on next page

LAND DESCRIBED IN BOOK 16355, PAGE 127, OFFICIAL RECORDS, SAID LINE ALSO BEING THE WESTERLY PROLONGATION OF SAID SOUTHEASTERLY LINE OF THE LAND DESCRIBED IN BOOK 16382, PAGE 191, OFFICIAL RECORDS.

EXCEPT THEREFROM THAT PORTION OF CULVER BOULEVARD, AS DESCRIBED IN DEED TO THE COUNTY OF LOS ANGELES, RECORDED IN BOOK 16371 PAGE 72, OFFICIAL RECORDS OF SAID COUNTY;

ALSO EXCEPT THEREFROM THAT PORTION OF CULVER BOULEVARD, AS SHOWN AS AN UNNAMED ROAD ON THE MAP RECORDED IN BOOK 4049 PAGE 265 OF DEEDS, RECORDS OF SAID COUNTY;

ALSO EXCEPT THEREFROM THAT PORTION OF SAID LAND DESIGNATED AS PARCEL 1-44 IN LIS PENDENS RECORDED JANUARY 13, 1970 AS INSTRUMENT NO. 1564, IN BOOK M3387 PAGE 860, OFFICIAL RECORDS OF SAID COUNTY.

ALSO EXCEPT THEREFROM THAT PORTION OF SAID LAND DESIGNATED AS PARCEL 2B IN LIS PENDENS RECORDED SEPTEMBER 3, 1965 AS INSTRUMENT NO. 5086, IN BOOK M-1969 PAGE 549, OFFICIAL RECORDS OF SAID COUNTY.

ALSO EXCEPT THEREFROM THAT PORTION OF SAID LAND DESIGNATED AS PARCELS 9-18 IN FINAL ORDER OF CONDEMNATION RECORDED APRIL 22, 1977 AS INSTRUMENT NO. 77-413488, OFFICIAL RECORDS OF SAID COUNTY.

EXCEPTING FROM PORTION OF THE ABOVE DESCRIBED LAND, ALL THE MINERAL RIGHTS TOGETHER WITH THE EXCLUSIVE RIGHT TO USE THE SUBSURFACE OIL AND GAS FORMATIONS FOR INJECTING, STORING AND WITHDRAWING NATURAL GAS THEREIN AND THEREFROM AND FOR REPRESSURING THE SAME, EXCLUDING HOWEVER, THE RIGHT TO GO UPON OR USE THE SURFACE OF SAID LAND FOR ANY OF SAID PURPOSES, AS RESERVED BY THE UNITED STATES OF AMERICA, BY DECREE ENTERED FEBRUARY 15, 1948 IN THE UNITED STATES DISTRICT COURT, SOUTHERN DISTRICT OF CALIFORNIA, CENTRAL DIVISION, CASE NO. 2454-B CIVIL, A CERTIFIED COPY OF WHICH WAS RECORDED MARCH 25, 1949 AS INSTRUMENT NO. 342, IN BOOK 29672, PAGE 52, OFFICIAL RECORDS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY.

THIS LEGAL DESCRIPTION WAS PREPARED AS A CONVENIENCE AND IS NOT INTENDED FOR THE USE IN THE DIVISION AND/OR CONVEYANCE OF LAND IN VIOLATION OF THE SUBDIVISION MAP ACT OF THE STATE OF CALIFORNIA.

END OF LEGAL DESCRIPTION

Continued on next page

SCHEDULE B

At the date hereof, exceptions to coverage in addition to the printed exceptions and exclusions contained in said policy or policies would be as follows:

1. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$167.21 OPEN
2ND INSTALLMENT	$167.21 OPEN
EXEMPTION	NONE
CODE AREA	1508
ASSESSMENT NO.	4211-015-002

1.1. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$25,259.75 OPEN
2ND INSTALLMENT	$25,259.74 OPEN
EXEMPTION	NONE
CODE AREA	1502
ASSESSMENT NO.	4211-015-006

1.2. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$12,137.09 OPEN
2ND INSTALLMENT	$12,137.08 OPEN
EXEMPTION	NONE
CODE AREA	1502
ASSESSMENT NO.	4211-016-006

1.3. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$5,450.02 OPEN
2ND INSTALLMENT	$5,450.01 OPEN
EXEMPTION	NONE
CODE AREA	1502
ASSESSMENT NO.	4211-017-004

2. THE LIEN OF SUPPLEMENTAL TAXES, IF ANY, ASSESSED PURSUANT TO THE PROVISIONS OF CHAPTER 3.5 (COMMENCING WITH SECTION 75) OF THE REVENUE AND TAXATION CODE OF THE STATE OF CALIFORNIA.

2.1. ASSESSMENTS, FOR COMMUNITY FACILITY DISTRICTS AFFECTING

Continued on next page

SAID LAND WHICH MAY EXIST BY VIRTUE OF ASSESSMENT MAPS OR NOTICES FILED BY SAID DISTRICTS.

3. THE RIGHT OF THE PUBLIC TO USE FOR ROAD PURPOSES, THAT PORTION OF SAID PARCEL 5 QUAD III WHICH IS INCLUDED WITHIN THE STRIPS OF LAND, 50 FEET IN WIDTH, DESCRIBED IN THOSE CERTAIN DEEDS TO COUNTY OF LOS ANGELES, RECORDED IN BOOK 4049, PAGE 265 OF DEEDS, AND IN BOOK 4049, PAGE 262, OF DEEDS.

4. AN EASEMENT AFFECTING THE PORTION OF SAID LAND AND FOR THE PURPOSES STATED HEREIN, AND INCIDENTAL PURPOSES CONDEMNED BY FINAL DECREE

IN FAVOR OF	COUNTY OF LOS ANGELES
FOR	SANITARY SEWER AND STORM DRAIN
CASE NO.	260321 SUPERIOR COURT
RECORDED	IN BOOK 10418, PAGE 126, OF OFFICIAL RECORDS

SAID MATTER AFFECTS A PORTION OF SAID LAND AS MORE PARTICULARLY DESCRIBED IN SAID DOCUMENT.

5. SUCH RIGHTS, AFFECTING THOSE PORTIONS OF SAID LAND WITHIN TWO STRIPS OF LAND, EACH 60 FEET WIDE, DESCRIBED IN BOOK 3805, PAGE 107 OF DEEDS, AND IN DEED RECORDED IN BOOK 1633, PAGE 143 OF DEEDS, AND IN BOOK 1685, PAGE 233 OF DEEDS, AS THE CITY OF LOS ANGELES MAY HAVE OR CLAIM TO AN EASEMENT FOR SANITARY SEWER AND STORM DRAIN PURPOSES OVER THAT PORTION OF SAID LAND LYING WITHIN THE SOUTHEASTERLY PROLONGATION OF THE 20 FOOT STRIP OF LAND DESCRIBED AS PARCEL 5 IN THE CONDEMNATION ACTION BROUGHT BY THE CITY OF LOS ANGELES AFFECTING ADJOINING PROPERTY, CASE NO. 260321, SUPERIOR COURT, LOS ANGELES COUNTY ABOVE DESCRIBED.

6. THE EXCLUSIVE RIGHT, AFFECTING THAT PORTION OF SAID LAND INCLUDED WITHIN THE LAND DESCRIBED IN DEED NEXT REFERRED TO, TO USE THE SUBSURFACE OF SAID LAND AND ALL ZONES CONTAINED THEREIN, REGARDLESS OF DEPTH, FOR THE INJECTION OF GAS INTO, THE STORAGE OF GAS IN, AND/OR THE WITHDRAWAL OF GAS FROM SAID PROPERTY AND INCIDENTAL PURPOSES MORE FULLY DESCRIBED IN AND AS RESERVED BY SOUTHERN CALIFORNIA GAS COMPANY, IN DEED RECORDED NOVEMBER 21, 1946 AS INSTRUMENT NO. 1046, IN BOOK 23939, PAGE 338, OFFICIAL RECORDS.

SAID RIGHTS, INSOFAR AND THEY AFFECT A PORTION OF SAID LAND, WERE MODIFIED BY DEED FROM SOUTHERN CALIFORNIA GAS COMPANY, RECORDED FEBRUARY 6, 1959 AS INSTRUMENT NO. 4278, IN BOOK D-358, PAGE 367, OFFICIAL RECORDS, AS MODIFIED BY AN INSTRUMENT RECORDED AUGUST 14, 1959 IN BOOK M-339, PAGE 989, OFFICIAL RECORDS.

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

7. AN AGREEMENT AFFECTING PARCELS 1, 3 AND 5 OF QUAD III, DATED

Continued on next page

AUGUST 15, 1963, WHEREBY HUGHES TOOL COMPANY, A CORPORATION, CONVEYS TO SOUTHERN CALIFORNIA GAS COMPANY, A CORPORATION, THE EXCLUSIVE RIGHT TO USE SUBSURFACE MINERAL, OIL AND/OR GAS ZONES FOR INJECTING, STORING AND WITHDRAWING NATURAL GAS (WHETHER PROVIDED FROM SUCH OR OTHER PROPERTY) THEREIN AND THEREFROM AND FOR REPRESSURING THE SAME; BUT, WITH NO RIGHT TO USE THE SURFACE OR TO CARRY ON SUCH OPERATION EXCEPT BETWEEN A DEPTH OF 500 FEET TO 7000 FEET FROM THE SURFACE THEREOF, WHICH AGREEMENT ALSO RECITES THAT

HUGHES TOOL COMPANY HEREBY COVENANTS AND AGREES TO PROHIBIT EXPLORATION FOR MINERAL, OIL, GAS OR OTHER HYDROCARBONS BETWEEN THE DEPTH OF 500 FEET TO 7000 FEET FROM THE SURFACE, RECORDED AUGUST 30, 1963 AS INSTRUMENT NO. 7055, IN BOOK M1338, PAGE 287, OFFICIAL RECORDS.

8. INTENTIONALLY DELETED.

9. RESERVATION AND EXCEPTION CONTAINED IN DEED FROM RECONSTRUCTION FINANCE CORPORATION AND UNITED STATES OF AMERICA, BOTH ACTING BY AND THROUGH GENERAL SERVICES ADMINISTRATOR TO SOUTHERN CALIFORNIA GAS COMPANY, A CORPORATION, DATED DECEMBER 1, 1953, RECORDED OCTOBER 15, 1954 AS INSTRUMENT NO. 580, IN BOOK 45847, PAGE 89, OFFICIAL RECORDS, THE LOCATION AND TERMS OF WHICH ARE MORE PARTICULARLY DESCRIBED THEREIN.

10. AN EASEMENT OVER SAID LAND FOR A SINGLE LINE OF POLES, WITH CROSS-ARMS AND WIRES, FOR PRIVATE TELEPHONE PURPOSES, TOGETHER WILL ALL RIGHTS OF WAY COVERING THE CONSTRUCTION AND MAINTENANCE OF SUCH FACILITIES, AS CONVEYED BY UNRECORDED SURFACE LEASE FROM DEL REY COMPANY TO P. M. PIKE, DATED JUNE 1, 1933 AND BY MESNE ASSIGNMENTS TRANSFERRED AND CONVEYED TO UNION OIL COMPANY OF CALIFORNIA, BY ASSIGNMENT OF LEASE FROM P. M. PIKE INVESTMENT COMPANY, DATED JANUARY 27, 1943, AS PROVIDED IN DECREE ENTERED JULY 12, 1946 IN ACTION NO. 2454, CIVIL, UNITED STATES DISTRICT COURT, SOUTHERN DISTRICT OF CALIFORNIA, CENTAL DIVISION.

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

11. THE EFFECT OF AN AGREEMENT, DATED JANUARY 18, 1952, EXECUTED BY AND BETWEEN SOUTHERN CALIFORNIA GAS COMPANY, A CORPORATION THEREIN CALLED "THE GAS CO." AND HUGHES TOOL COMPANY, A DELAWARE CORPORATION, THEREIN CALLED "HUGHES", RELATING TO THE UNITED STATES OF AMERICA, AS SET FORTH IN STIPULATION REFERRED TO THEREIN, UPON THE CONDITIONS, COVENANTS AND PROVISIONS CONTAINED IN SAID AGREEMENT, RECORDED JANUARY 18, 1952 AS INSTRUMENT NO. 2738 IN BOOK 38075, PAGE 427, OFFICIAL RECORDS.

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

Continued on next page

ALL EASEMENTS AND RIGHTS OF WAY INCLUDING THOSE FOR PIPE LINES, PRIVATE ROADWAY AND INGRESS AND EGRESS IN, ON, OVER, THROUGH AND ACROSS THE SAID PARCEL, ARE LIMITED BY AND SUBJECT TO THE PROVISIONS AND CONDITIONS OF THE QUITCLAIM BY SOUTHERN CALIFORNIA GAS COMPANY IN THE AGREEMENT DATED AUGUST 15, 1963, RECORDED AUGUST 30, 1963 IN BOOK M1338, PAGE 280 OF OFFICIAL RECORDS.

THE INTEREST OF "HUGHES" HAVING SUCCEEDED TO PLAYA CAPITAL CORPORATION

12. INTENTIONALLY DELETED.

13. INTENTIONALLY DELETED.

14. THE RIGHT AFFECTING THOSE PORTIONS OF THE RAMONA S. DE MACHADO 341.85095 ACRE ALLOTMENT IN THE RANCHO LA BALLONA, IN THE COUNTY OF LOS ANGELES, STATE OF CALIFORNIA, AS SHOWN ON MAP FILED IN CASE NO. 2722, DISTRICT COURT, AND RECORDED IN BOOK 3, PAGE 204 ET SEQ., OF MISCELLANEOUS RECORDS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY, DESCRIBED AS FOLLOWS:

THOSE CERTAIN PARCEL OF LAND DESIGNATED AS "FIRST", "SECOND" AND "THIRD", IN THE DEED TO THE PACIFIC ELECTRIC RAILWAY COMPANY, RECORDED AUGUST 4, 1926 AS INSTRUMENT NO. 1540, IN BOOK 4680, PAGE 108, OFFICIAL RECORDS;

AND

THAT PORTION OF A STRIP OF LAND, 110 FEET IN WIDTH, DESIGNATED AS "CLAUSE 9" IN THE DEED TO LOS ANGELES PACIFIC COMPANY, RECORDED JULY 14, 1908 IN BOOK 3805, PAGE 107 OF DEEDS; LYING SOUTHEASTERLY OF A LINE PARALLEL WITH AND DISTANT NORTHWESTERLY 33 FEET, MEASURED RADIALLY FROM THE NORTHWESTERLY LINE OF THE STRIP OF LAND, 60 FEET IN WIDTH DESIGNATED AS "CLAUSE 1", IN SAID DEED TO LOS ANGELES PACIFIC COMPANY;

AND THAT PORTION OF THE STRIP OF LAND, 60 FEET IN WIDTH, PARTLY WITHIN THE CITY OF LOS ANGELES, DESIGNATED AS "CLAUSE 1" IN SAID DEED TO LOS ANGELES PACIFIC COMPANY, RECORDED JULY 14, 1909 IN BOOK 3806 PAGE 107 OF DEEDS, BOUNDED SOUTHERLY BY THE NORTHERLY LINE OF CULVER BOULEVARD (FORMERLY MESMER AVENUE), AS DESCRIBED IN DEED TO THE CITY OF LOS ANGELES, RECORDED OCTOBER 15, 1927 IN BOOK 7709, PAGE 148, OFFICIAL RECORDS, AND BOUNDED NORTHEASTERLY BY THE SOUTHWESTERLY LINE OF THE LAND DESCRIBED AS PARCEL 7 IN DECLARATION OF TAKING RECORDED NOVEMBER 4, 1942 AS INSTRUMENT NO. 612, IN BOOK 19608, PAGE 246, OFFICIAL RECORDS.

TO PRODUCE OIL, GAS AND OTHER HYDROCARBON SUBSTANCES FROM SAID

Continued on next page

LAND BY DIRECTIONAL DRILLING OR ANY OTHER MEANS NOT REQUIRING THE OCCUPANCY OF THE SURFACE OF SAID LAND OR OF ANY PORTION THEREOF, INCLUDING THE RIGHT TO COMBINE SAID PROPERTY IN ANY COMMUNITY OIL LEASE, BUT NOT INCLUDING THE RIGHT TO ENTER UPON OR OCCUPY ANY PORTION OF THE SURFACE OF SAID LAND FOR SUCH PURPOSES, AS RESERVED BY PACIFIC ELECTRIC RAILWAY COMPANY, IN DEED RECORDED APRIL 3, 1946 IN BOOK 22930, PAGE 272, OFFICIAL RECORDS.

SAID MATTER AFFECTS: PARCELS 2, 4, AND 5 OF QUAD III

15. AN ACTION IN THE SUPERIOR COURT

COMMENCED	MAY 15, 1961
ENTITLED	LOS ANGELES FLOOD CONTROL DISTRICT VS. SHELL OIL COMPANY, ET AL.
CASE NUMBER	771085
COUNTY OF	LOS ANGELES
NATURE OF ACTION	TO CONDEMN THE SLOPE EASEMENT FOR THE WIDENING OF FLOOD CONTROL CHANNEL
NOTICE OF SAID ACTION RECORDED	MAY 15, 1961 AS INSTRUMENT NO. 5153 IN BOOK M-771, PAGE 334, OFFICIAL RECORDS
AFFECTS	THOSE PORTIONS OF PARCELS 4 AND 5 OF QUAD III MORE PARTICULARLY DESCRIBED IN SAID DOCUMENT

16. INTENTIONALLY DELETED.

17. AN EASEMENT AFFECTING THE PORTION OF SAID LAND AND FOR THE PURPOSES STATED HEREIN, AND INCIDENTAL PURPOSES CONDEMNED BY FINAL DECREE

IN FAVOR OF	COUNTY OF LOS ANGELES
FOR	SLOPE EASEMENTS
CASE NO.	968057 SUPERIOR COURT, LOS ANGELES COUNTY
RECORDED	MARCH 31, 1972 AS INSTRUMENT NO. 5578, IN BOOK D5413, PAGE 512, OFFICIAL RECORDS
AFFECTS	PARCELS 1 AND 3 OF QUAD III

AS AMENDED BY ORDER NUNC PRO TUNC RECORDED APRIL 26, 1972 AS INSTRUMENT NO. 2934, OFFICIAL RECORDS.

SAID MATTER AFFECTS A PORTION OF SAID LAND AS MORE PARTICULARLY DESCRIBED IN SAID DOCUMENT.

18. AN EASEMENT AFFECTING THE PORTION OF SAID LAND AND FOR THE PURPOSES STATED HEREIN, AND INCIDENTAL PURPOSES CONDEMNED BY FINAL DECREE

IN FAVOR OF | COUNTY OF LOS ANGELES

Continued on next page

FOR	PERMANENT DRAINAGE EASEMENT
CASE NO.	974384, SUPERIOR COURT, LOS ANGELES COUNTY
RECORDED	MARCH 31, 1972 AS INSTRUMENT NO. 5578, IN BOOK D-5413, PAGE 512, OFFICIAL RECORDS
AFFECTS	PARCELS 1 AND 3 OF QUAD III

SAID MATTER AFFECTS A PORTION OF SAID LAND AS MORE PARTICULARLY DESCRIBED IN SAID DOCUMENT.

19. AN EASEMENT AFFECTING THE PORTION OF SAID LAND AND FOR THE PURPOSES STATED HEREIN, AND INCIDENTAL PURPOSES CONDEMNED BY FINAL DECREE

IN FAVOR OF	THE PEOPLE OF THE STATE OF CALIFORNIA, ACTING BY AND THROUGH THE DEPARTMENT OF PUBLIC WORKS
FOR	PUBLIC HIGHWAY SLOPES PURPOSES
CASE NO.	867869, SUPERIOR COURT, LOS ANGELES COUNTY
RECORDED	JUNE 13, 1969 AS INSTRUMENT NO. 3730, IN BOOK D-4402, PAGE 13, OF OFFICIAL RECORDS
AFFECTS	PARCEL 1, AND 3 OF QUAD III

SAID MATTER AFFECTS A PORTION OF SAID LAND AS MORE PARTICULARLY DESCRIBED IN SAID DOCUMENT.

20. INTENTIONALLY DELETED.

21. INTENTIONALLY DELETED.

22. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED	"MEMORANDUM OF AGREEMENT"
DATED	JANUARY 4, 1996

BY: MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED

RECORDED	APRIL 23, 1996
INSTRUMENT/FILE NO	96-637590, OF OFFICIAL RECORDS

REFERENCE IS MADE TO SAID DOCUMENT FOR FULL PARTICULARS

23. DEED OF TRUST TO SECURE AN INDEBTEDNESS IN THE AMOUNT SHOWN BELOW, AND ANY OTHER OBLIGATIONS SECURED THEREBY:

AMOUNT	$60,400,000.00
DATED	SEPTEMBER 2, 1997
TRUSTOR	PLAYA CAPITAL COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY
TRUSTEE	FIRST AMERICAN TITLE INSURANCE COMPANY
BENEFICIARY	PLAYA INVESTMENTS, LLC, A DELAWARE LIMITED LIABILITY COMPANY
RECORDED	OCTOBER 16, 1997

Continued on next page

INSTRUMENT NO. | 97-1625347 OF OFFICIAL RECORDS

AND RE-RECORDED DECEMBER 23, 1997, AS INSTRUMENT/FILE NO. 97-2009527, OF OFFICIAL RECORDS

A SUBORDINATION, AND STANDSTILL AGREEMENT, DATED MAY 5, 1999, AFFECTING THE DEED OF TRUST SHOWN ABOVE AND THE DEED OF TRUST RECORDED MAY 5, 1999 AS INSTRUMENT NO. 99-828132, OF OFFICIAL RECORDS RECORDS MAY 7, 1999 AS INSTRUMENT NO. 99-828134, OF OFFICIAL RECORDS.

SUBSTITUTION OF TRUSTEE UNDER SAID DEED OF TRUST WHICH NAMES AS THE SUBSTITUTED TRUSTEE, THE FOLLOWING:

TRUSTEE	FIRST AMERICAN TITLE INSURANCE COMPANY
RECORDED	JUNE 27, 2003
INSTRUMENT/FILE NO	03-1845461 OF OFFICIAL RECORDS

24. DEED OF TRUST TO SECURE AN INDEBTEDNESS IN THE AMOUNT SHOWN BELOW, AND ANY OTHER OBLIGATIONS SECURED THEREBY:

AMOUNT	$30,000,000.00
DATED	MAY 5, 1999
TRUSTOR	PLAYA CAPITAL COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY; PLAYA PHASE I COMMERCIAL LAND COMPANY, LLC., A DELAWARE LIMITED LIABILITY COMPANY AND PLAYA PARCEL E CAPITAL COMPANY, LLC., A DELAWARE LIMITED LIABILITY COMPANY
TRUSTEE	STEWART TITLE COMPANY
BENEFICIARY	TOKAI BANK OF CALIFORNIA, A CALIFORNIA BANKING CORPORATION
RECORDED	MAY 7, 1999
INSTRUMENT NO.	99-0828132 OF OFFICIAL RECORDS

AFFECTS: THE HEREIN DESCRIBED LAND AND OTHER LAND

THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED	"ABSOLUTE ASSIGNMENT OF LEASES, LEASE GUARANTEES, RENTS, ISSUES AND PROFITS"

BY: TOKAI BANK OF CALIFORNIA, A CALIFORNIA BANKING CORPORATION UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED

RECORDED	MAY 7, 1999
INSTRUMENT/FILE NO	99-0828133, OF OFFICIAL RECORDS

SUBSTITUTION OF TRUSTEE UNDER SAID DEED OF TRUST WHICH NAMES AS THE SUBSTITUTED TRUSTEE, THE FOLLOWING:

TRUSTEE	UNITED CALIFORNIA BANK, A CALIFORNIA CORPORATION SUCCESSOR TO TOKAI BANK OF CALIFORNIA

Continued on next page

RECORDED	OCTOBER 28, 2002
INSTRUMENT NO	02-2556853 OF OFFICIAL RECORDS

AN INSTRUMENT PURPORTS TO MODIFY THE TERMS OF SAID DEED OF TRUST AS THEREIN PROVIDED

EXECUTED BY	PLAYA CAPITAL COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY; PLAYA PHASE I COMMERCIAL LAND COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY AND BANK OF THE WEST, A CALIFORNIA BANKING CORPORATION
DATED	JANUARY 5, 2003
RECORDED	MARCH 19, 2003
INSTRUMENT/FILE NO	03-770751, OFFICIAL RECORDS

25. INTENTIONALLY DELETED.

26. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED	"NOTICE OF SPECIAL TAX LIEN CITY OF LOS ANGELES COMMUNITY FACILITIES DISTRICT NO. 5 (PLAYA VISTA-MASTER PLAN)"

UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED

RECORDED	FEBRUARY 16, 2000
INSTRUMENT/FILE NO	00-0240767, OF OFFICIAL RECORDS

27. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED	MEMORANDUM OF OPTION
DATED	AUGUST 8, 2001

BY AND BETWEEN: PLAYA CAPITAL COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY; THE TRUST FOR PUBLIC LAND, A CALIFORNIA NONPROFIT PUBLIC BENEFIT CORPORATION UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED

RECORDED	SEPTEMBER 7, 2001
INSTRUMENT/FILE NO	01-1688057, OF OFFICIAL RECORDS

28. INTENTIONALLY DELETED.

29. INTENTIONALLY DELETED.

30. IF AMERICAN LAND TITLE ASSOCIATION (ALTA) FORM OR OTHER POLICY IN EXTENDED COVERAGE FORM IS CONTEMPLATED BY THIS PRELIMINARY REPORT, THE POLICY WILL CONTAIN THE FOLLOWING ADDITIONAL EXCEPTIONS TO COVERAGE:

(A) ANY RIGHTS, INTERESTS OR CLAIMS OF PARTIES IN POSSESSION OF THE LAND NOT SHOWN BY THE PUBLIC RECORD.

(B) ANY EASEMENTS OR LIENS NOT SHOWN BY THE PUBLIC RECORD.

Continued on next page

(C) ANY FACTS ABOUT THE LAND WHICH A CORRECT SURVEY WOULD DISCLOSE AND WHICH ARE NOT SHOWN BY THE PUBLIC RECORD.

(D) ANY WATER RIGHTS, CLAIMS OR TITLE TO WATER ON OR UNDER THE LAND.

31. THE REQUIREMENT THAT STEWART TITLE OF CALIFORNIA, INC. BE INFORMED OF WHAT TYPE OF TITLE INSURANCE COVERAGE/POLICIES ARE BEING REQUESTED, SO THAT WE MAY PROVIDE YOU WITH ANY ADDITIONAL REQUIREMENTS OR EXCEPTIONS THAT WE MAY HAVE OR THAT APPLY.

32. INTENTIONALLY DELETED.

33. A LIEN FOR UNSECURED PROPERTY TAXES FILED BY THE TAX COLLECTOR OF THE COUNTY SHOWN, FOR THE AMOUNT SET FORTH, AND ANY OTHER AMOUNTS DUE:

COUNTY	LOS ANGELES
TAXPAYER	PLAYA CAPITAL COMPANY LLC
YEAR/ACCOUNT NO	01/40745622
AMOUNT	$5,433.45
RECORDED	MARCH 8, 2002
INSTRUMENT NO.	02-557076 OF OFFICIAL RECORDS

34. THE MATTERS CONTAINED IN AN INSTRUMENT:

ENTITLED	PERMANENT ECOSYSTEM RESTORATION EASEMENT AGREEMENT
DATED	AUGUST 15, 2002

BY AND BETWEEN: PLAYA CAPITAL COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY AND THE CITY OF LOS ANGELES UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED.

RECORDED	AUGUST 22, 2002
INSTRUMENT NO.	02-1977694, OFFICIAL RECORDS

REFERENCE IS MADE TO SAID DOCUMENT FOR FULL PARTICULARS.

35. INTENTIONALLY DELETED.

36. THE MATTERS CONTAINED IN AN INSTRUMENT:

ENTITLED	AGREEMENT
DATED	JUNE 1, 2002

BY AND BETWEEN: WEST BASIN MUNICIPAL WATER DISTRICT AND PLAYA CAPITAL COMPANY, LLC UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED.

RECORDED	JULY 30, 2003
INSTRUMENT NO.	03-2184705, OFFICIAL RECORDS

REFERENCE IS MADE TO SAID DOCUMENT FOR FULL PARTICULARS.

37. THE MATTERS CONTAINED IN AN INSTRUMENT:

Continued on next page

ENTITLED	MEMORANDUM OF AGREEMENT TO SUBORDINATE
DATED	AUGUST 8, 2001

BY AND BETWEEN: PLAYA CAPITAL COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY AND THE TRUST FOR PUBLIC LAND, A CALIFORNIA NONPROFIT PUBLIC BENEFIT CORPORATION UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED.

RECORDED	OCTOBER 22, 2003
INSTRUMENT NO.	03-3162873, OFFICIAL RECORDS

38. A LIEN FOR UNSECURED PROPERTY TAXES FILED BY THE TAX COLLECTOR OF THE COUNTY SHOWN, FOR THE AMOUNT SET FORTH, AND ANY OTHER AMOUNTS DUE:

COUNTY	LOS ANGELES
TAXPAYER	PLAYA CAPITAL COMPANY LLC LESSEE C/O ASCOM HASLER
YEAR/ACCOUNT NO	02/49914335
AMOUNT	$117.06
RECORDED	JUNE 17, 2003
INSTRUMENT NO.	03-1722853 OF OFFICIAL RECORDS

39. A LIEN FOR UNSECURED PROPERTY TAXES FILED BY THE TAX COLLECTOR OF THE COUNTY SHOWN, FOR THE AMOUNT SET FORTH, AND ANY OTHER AMOUNTS DUE:

COUNTY	LOS ANGELES
TAXPAYER	PLAYA CAPITAL LESSEE C/O GTE
YEAR/ACCOUNT NO	02/49917153
AMOUNT	$1,693.89
RECORDED	SEPTEMBER 8, 2003
INSTRUMENT NO.	03-2623553 OF OFFICIAL RECORDS

40. A LIEN FOR UNSECURED PROPERTY TAXES FILED BY THE TAX COLLECTOR OF THE COUNTY SHOWN, FOR THE AMOUNT SET FORTH, AND ANY OTHER AMOUNTS DUE:

COUNTY	LOS ANGELES
TAXPAYER	PLAYA CAPITAL LESSEE C/O GTE
YEAR/ACCOUNT NO	02/49917151
AMOUNT	$2,547.47
RECORDED	SEPTEMBER 8, 2003
INSTRUMENT NO.	03-2623666 OF OFFICIAL RECORDS

41. AN IRREVOCABLE OFFER TO DEDICATE REAL PROPERTY RECORDED OCTOBER 23, 2003 AS INSTRUMENT NO. 03-3175571 OF OFFICIAL RECORDS WHEREIN A PORTION OF SAID LAND WAS OFFERED FOR DEDICATION TO PUBLIC USE FOR STORM DRAIN PURPOSES.

AFFECTS | SAID LAND

42. WATER RIGHTS, CLAIMS OR TITLE TO WATER IN OR UNDER SAID

Continued on next page

LAND, WHETHER OR NOT SHOWN BY THE PUBLIC RECORDS.

43. MATTERS WHICH MAY BE DISCLOSED BY AN INSPECTION OR BY A SURVEY OF SAID LAND SATISFACTORY TO THIS COMPANY, OR BY INQUIRY OF THE PARTIES IN POSSESSION THEREOF.

END OF EXCEPTIONS

Continued on next page

NOTES

A. LENDERS NOTE:

IF AN ALTA LOAN POLICY - 1970, AMENDED 10-17-70 (AMENDED 12-6-85) IS REQUESTED, THE FOLLOWING WILL BE ADDED AS AN EXCLUSION FROM COVERAGE:

ANY CLAIM, WHICH ARISES OUT OF THE TRANSACTION CREATING THE INTEREST OF THE MORTGAGEE INSURED BY THIS POLICY, BY REASON OF THE OPERATION OF FEDERAL BANKRUPTCY, STATE INSOLVENCY, OR SIMULAR CREDITORS' RIGHTS LAWS THAT IS BASED ON:

(I) THE TRANSACTION CREATING THE INTEREST OF THE INSURED MORTGAGEE BEING DEEMED A FRAUDULENT CONVEYANCE OR TRANSFER; OR

(II) THE SUBORDINATION OF THE INTEREST OF THE INSURED MORTGAGEE AS A RESULT OF THE APPLICATION OF THE DOCTRINE OF EQUITABLE SUBORDINATION; OR

(III) THE TRANSACTION CREATING THE INTEREST OF THE INSURED MORTGAGEE BEING DEEMED A PREFERENTIAL TRANSFER EXCEPT WHERE THE PREFERENTIAL TRANSFER RESULTS FROM THE FAILURE:

(A) TO TIMELY RECORD THE INSTRUMENT OF TRANSFER; OR (B) OF SUCH RECORDATION TO IMPART NOTICE TO A PURCHASER FOR VALUE OR A JUDGEMENT OR LIEN CREDITOR.

B. IF AN OWNERS POLICY WILL BE REQUESTED, PLEASE BE AWARE THAT UNLESS INSTRUCTED OTHERWISE, WE WILL ISSUE A CLTA STANDARD COVERAGE OWNERS POLICY. IF A DIFFERENT FORM OF POLICY IS CONTEMPLATED FOR THIS TRANSACTION, PLEASE ADVISE AND CONTACT YOUR TITLE OFFICER FOR ADDITIONAL REQUIREMENTS

Continued on next page

stewart title of california

Sanctity of Contract

CALIFORNIA "GOOD FUNDS" LAW

California Insurance Code Section 12413.1 regulates the disbursement of escrow and sub-escrow funds by title companies. The law requires that funds be deposited in the title company escrow account and available prior to disbursement. Funds received by Stewart Title of California, Inc. (Stewart Title) via wire transfer may be disbursed upon receipt. Funds received via cashier's checks or teller checks drawn on a California Bank may be disbursed on the next business day after the day of deposit. If funds are received by any other means, recording and/or disbursement may be delayed, and you should contact your title or escrow officer. All escrow and sub-escrow funds received will be deposited with other escrow funds in one or more non-interest bearing escrow accounts in a financial institution selected by Stewart Title. Stewart Title may receive certain direct or indirect benefits from the financial institution by reason of the deposit of such funds or the maintenance of such accounts with the financial institution, and Stewart Title shall have no obligation to account to the depositing party in any manner for the value of, or pay to such party, any benefit received by Stewart Title. Such benefits shall be deemed additional compensation to Stewart Title for its services in connection with the escrow or sub-escrow.

WIRING INSTRUCTIONS

IF YOU ANTICIPATE HAVING FUNDS WIRED TO STEWART TITLE OF CALIFORNIA, INC. OUR WIRING INFORMATION IS AS FOLLOWS:

ADDITIONAL NOTE: DIRECT WIRE TRANSFERS TO:
CITY NATIONAL BANK
5601 E. SLAUSON AVE
CITY OF COMMERCE, CALIFORNIA 90040
ROUTING NO. 122016066
CREDIT TO STEWART TITLE OF CALIFORNIA, INC.
ACCOUNT # 013 218811
REF: (ORDER # 040104935, TITLE OFFICER NAME: LARRY MCGUIRE)

WHEN INSTRUCTING THE FINANCIAL INSTITUTION TO WIRE FUNDS, IT IS VERY IMPORTANT THAT YOU REFERENCE STEWART TITLE'S ORDER NUMBER.

SHOULD YOU HAVE ANY QUESTIONS IN THIS REGARD PLEASE CONTACT YOUR TITLE OFFICER IMMEDIATELY.

stewart
title of california

Sanctity of Contract

STEWART TITLE OF CALIFORNIA, INC.,
LOS ANGELES DIVISION
525 N. BRAND BLVD.
GLENDALE, CA 91203
(818) 502-2700
www.stewarttitle1a.com

MEMBER CALIFORNIA LAND TITLE ASSOCIATION

PRELIMINARY REPORT

LATHAM & WATKINS
633 WEST FITH, SUITE 4000
LOS ANGELES, CA
Attn: ANE CAHILL PRIESTER

Order Number: 040115088

Your Reference: BALLONA WETLANDS PARCEL

In response to the above referenced application for a Policy of Title Insurance, Stewart Title of California, Inc. hereby reports that it is prepared to issue, or cause to be issued, as of the date hereof, a Policy or Policies of Title Insurance describing the land and the estate or interest therein hereinafter set forth, insuring against loss which may be sustained by reason of any defect, lien or encumbrance not shown or referred to as an Exception below or not excluded from coverage pursuant to the printed Schedules, Conditions and Stipulations of said Policy forms.

The printed Exceptions and exclusions from the coverage and Limitations on Covered Risks of said Policy or Policies are set forth in Exhibit A attached. Limitations on Covered Risks applicable to the CLTA and ALTA Homeowner's Policies of Title Insurance which establish a Deductible Amount and a maximium Dollar Limit of Liability for certain coverages are also set forth in Exhibit A. Copies of the Policy forms should be read. They are available from the office which issued this report.

Please read the exceptions shown or referred to below and the exceptions and exclusions set forth in Exhibit A of this report carefully. The exceptions and exclusions are meant to provide you with notice of matters which are not covered under the terms of the title insurance policy and should be carefully considered.
It is important to note that this preliminary report is not a written representation as to the condition of title and may not list all liens, defects, and encumbrances affecting title to the land.

This report, (and any supplements or amendments hereto) is issued solely for the purpose of facilitating the issuance of a policy of title insurance and no liability is assumed hereby. If it is desired that liability be assumed prior to the issuance of a policy of title insurance a Binder or Commitment should be requested.

Dated as of October 29, 2003 at 7:30 A.M. **Amended**

LARRY MCGUIRE, Sr. Title Officer, V.P.
(818) 502-2723 Fax: (818) 241-9173
e-mail address: lmcguire@stewart.com

WIL CAMPOS, Title Officer
(818) 502-2724 Fax: (818) 241-9173
e-mail address: wcampos@stewart.com

PRELIMINARY REPORT

The form of Policy of Title Insurance contemplated by this report is:

California Land Title Association Standard Coverage Policy

SCHEDULE A

The Estate or Interest in the land hereinafter described or referred to covered by this report is:

A FEE

Title to said estate or interest at the date hereof is vested in:

PLAYA CAPITAL COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY

Continued on next page

LEGAL DESCRIPTION

THE LAND REFERRED TO HEREIN IS SITUATED IN THE STATE OF CALIFORNIA, COUNTY OF LOS ANGELES, DESCRIBED AS FOLLOWS:

PARCEL I:

PORTION PARCEL 2: (QUAD III) (APN 4211-14-4 & 12 AND 4211-17-4) AREA B

THOSE PORTIONS OF THE RANCHO LA BALLONA AND THE RANCHO SAUSAL REDONDO, IN THE COUNTY OF LOS ANGELES, STATE OF CALIFORNIA, DESCRIBED AS FOLLOWS:

BEGINNING AT A POINT IN THE NORTHERLY PROLONGATION THE EASTERLY LINE OF BLOCK 1 OF THE PLAYA DEL REY TOWNSITE, AS PER MAP RECORDED IN BOOK 2 PAGE 63 ET SEQ. OF MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY, DISTANT 13.5 FEET FROM THE MOST NORTHERLY CORNER OF SAID BLOCK; THENCE ALONG THE CENTER LINE OF THE 33 FOOT STRIP OF LAND WHICH WAS FORMERLY PLAYA STREET (NOW VACATED) ON A COURSE OF ABOUT NORTH 61° 20" EAST, ABOUT 3860 FEET TO A POINT DISTANT 283.92 FEET EASTERLY FROM THE INTERSECTION OF SAID CENTER LINE WITH THE CENTER LINE OF 60 FOOT STRIP OF LAND DESCRIBED IN DEED TO LOS ANGELES PACIFIC COMPANY, RECORDED IN BOOK 3805 PAGE 107 OF DEEDS, AND BEING EASTERLY EXTREMITY OF THE PORTION OF PLAYA STREET, AS VACATED; THENCE PARALLEL WITH THE EASTERLY LINE OF SAID 60 FOOT STRIP OF LAND, SOUTH 33° 46′ WEST, 36.06 FEET, MORE OR LESS TO THE SOUTHERLY LINE OF SAID PLAYA STREET; THENCE ALONG THE SAME, NORTH 61° EAST, TO A POINT 25.502 CHAINS WESTERLY FROM THE NORTHERLY PROLONGATION OF THE WESTERLY LINE OF THE 80.70 ACRE TRACT OF LAND DESCRIBED IN DEED TO R. J. NORTHAM, RECORDED IN BOOK 2091 PAGE 127 OF DEEDS; THENCE PARALLEL WITH THE WESTERLY LINE OF SAME, SOUTH 29° EAST, 20.02 CHAINS TO A POINT ESTABLISHED AS STATION 15 OF THE RANCHO LA BALLONA BY PROCEEDINGS HAD IN CASE NO. 20065 OF THE SUPERIOR COURT OF LOS ANGELES COUNTY; THENCE SOUTH 27° 45′ WEST, 337.85 FEET TO A POINT IN THE NORTHWESTERLY LINE OF BLOCK 71 OF M.L. WICKS ADDITION TO TOWN OF PORT BALLONA, AS PER MAP RECORDED IN BOOK 23 PAGE 33 ET SEQ. OF MISCELLANEOUS RECORDS; THENCE SOUTH 60° 45′ WEST, 1386 FEET TO A POINT IN THE NORTHERLY LINE OF BLOCK 60 OF THE TOWN OF PORT BALLONA AND DESIGNATED AS STATION 17 ON MAP THEREOF, RECORDED IN BOOK 16 PAGE 47 ET SEQ. OF MISCELLANEOUS RECORDS; THENCE SOUTH 82° 30′ WEST, 462 FEET TO STATION 18; THENCE SOUTH 52 DEGREES WEST, 990 FEET TO STATION 19; THENCE SOUTH 82° WEST, 660 FEET TO STATION 20-B; THENCE SOUTH 60° 45′ WEST, 528 FEET TO STATION 21, SHOWN ON SAID LAST MENTIONED MAP; THENCE ALONG THE NORTHEASTERLY LINE OF NICHOLSON STREET, SHOWN ON MAP OF PLAYA DEL REY TOWNSITE, RECORDED IN BOOK

Continued on next page

2 PAGE 63 ET SEQ., OF MAPS, NORTH 44° 11' WEST, 297.93 FEET TO THE NORTH EXTREMITY THEREOF; THENCE ALONG THE NORTHWESTERLY LINE OF SAID TOWNSITE, SOUTH 45° 49' WEST, TO THE NORTHEASTERLY LINE OF BLOCK "E" OF SAID TOWNSITE; THENCE ALONG SAID LAST MENTIONED LINE, NORTH 44° 11' WEST, 61.35 FEET TO THE MOST NORTHERLY CORNER OF SAID BLOCK; THENCE NORTH 51° 40' WEST, 119.03 FEET TO THE MOST EASTERLY CORNER OF BLOCK 2 OF SAID TOWNSITE; THENCE ALONG THE EASTERLY LINE OF BLOCK 1 AND 2 AND THE PROLONGATION THEREOF; NORTH 27° 30' WEST, 1178.85 FEET, MORE OR LESS, TO THE POINT OF BEGINNING.

A PORTION OF SAID LAND IS ALSO SHOWN AS LOT 22, IN BLOCK 27 OF THE TOWN OF PORT BALLONA, IN SAID COUNTY AND STATE, AS PER MAP RECORDED IN BOOK 16 PAGE 47 ET SEQ. OF MISCELLANEOUS RECORDS OF SAID COUNTY AND A PORTION OF FOURTH AVENUE, VACATED AS SHOWN ON SAID MAP OF THE TOWN OF PORT BALLONA.

EXCEPT THEREFROM THAT PORTION OF SAID LAND WITHIN THE STRIP OF LAND CONVEYED TO THE COUNTY OF LOS ANGELES, BY DEED RECORDED IN BOOK 4049 PAGE 262 OF DEEDS.

ALSO EXCEPT THEREFROM THAT PORTION OF SAID LAND WITHIN A STRIP OF LAND 15 FEET WIDE, AS DESCRIBED IN BOOK 4243 PAGE 133, OF OFFICIAL RECORDS OF SAID COUNTY.

ALSO EXCEPT THEREFROM THAT PORTION OF SAID LAND DESIGNATED AS PARCEL 1-45 IN LIS PENDENS RECORDED ON JANUARY 13, 1970 AS INSTRUMENT NO. 1564, IN BOOK M-3387 PAGE 860, OF OFFICIAL RECORDS OF SAID COUNTY.

ALSO EXCEPT THOSE PORTIONS OF SAID LAND DESIGNATED AS PARCELS 9-18 AND 9-19 IN FINAL ORDER OF CONDEMNATION RECORDED APRIL 22, 1977 AS INSTRUMENT NO. 77-413488, OF OFFICIAL RECORDS OF SAID COUNTY.

ALSO EXCEPT THOSE PORTIONS OF SAID LAND DESIGNATED AS PARCELS 7-16, 7-17 AND 7-20 IN DECREE OF CONDEMNATION RECORDED APRIL 22, 1977 AS INSTRUMENT NO. 77-413489, OF OFFICIAL RECORDS.

ALSO EXCEPT THEREFROM THE FOLLOWING PARCEL OF LAND:

BEGINNING AT THE INTERSECTION OF THE SOUTHEASTERLY LINE OF PLAYA STREET AND THE WESTERLY LINE OF ROOSEVELT HIGHWAY AS DESCRIBED IN THE DEED RECORDED IN BOOK 7448, PAGE 77, OFFICIAL RECORDS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY, THENCE ALONG SAID SOUTHEASTERLY LINE OF PLAYA STREET SOUTH 61° 14' 57" WEST 48.91 FEET; THENCE SOUTH 28° 45' 03" EAST 33.50 FEET TO THE SOUTHEASTERLY LINE OF THE LAND DESCRIBED IN BOOK 5662, PAGE 124 OF OFFICIAL RECORDS OF SAID COUNTY, SAID LINE BEING THE SOUTHEASTERLY LINE OF JEFFERSON BOULEVARD, 100.00 FEET

Continued on next page

WIDE, AS IT NOW EXISTS; THENCE ALONG SAID SOUTHEASTERLY LINE SOUTH 61° 14′ 56" WEST 1539.30 FEET TO THE TRUE POINT OF BEGINNING; THENCE SOUTH 16° 19′ 09" WEST 8.47 FEET TO THE BEGINNING OF A TANGENT CURVE CONCAVE TO THE EAST HAVING A RADIUS OF 5.00 FEET; THENCE SOUTHERLY 6.38 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 73° 08′ 41" TO THE BEGINNING OF A TANGENT LINE; THENCE ALONG SAID LINE SOUTH 56° 49′ 32" EAST 22.19 FEET TO THE BEGINNING OF A TANGENT CURVE CONCAVE TO THE SOUTHWEST HAVING A RADIUS OF 30.00 FEET; THENCE SOUTHEASTERLY 12.99 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 24° 49′ 02" TO THE BEGINNING OF A TANGENT LINE; THENCE SOUTH 32° 00′ 30" EAST 89.53 FEET TO THE BEGINNING OF A TANGENT CURVE CONCAVE TO THE SOUTHWEST HAVING A RADIUS OF 99.00 FEET; THENCE SOUTHEASTERLY 11.32 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 6° 33′ 09" TO THE BEGINNING OF A TANGENT LINE; THENCE SOUTH 25° 27′ 21" EAST 145.17 FEET TO THE BEGINNING OF A TANGENT CURVE CONCAVE TO THE NORTHEAST HAVING A RADIUS OF 225.00 FEET; THENCE SOUTHEASTERLY 57.82 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 14° 43′ 26" TO THE BEGINNING OF A NON-TANGENT CURVE CONCAVE TO THE NORTHEAST HAVING A RADIUS OF 235.00 FEET THROUGH WHICH A RADIAL LINE BEARS SOUTH 49° 56′ 17" WEST; THENCE SOUTHEASTERLY 150.98 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 36° 48′ 36" TO THE BEGINNING OF A TANGENT CURVE CONCAVE TO THE NORTH HAVING A RADIUS OF 160.00 FEET; THENCE EASTERLY 57.55 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 20° 36′ 35" TO THE BEGINNING OF A TANGENT CURVE CONCAVE TO THE NORTH HAVING A RADIUS OF 200.00 FEET; THENCE EASTERLY 66.46 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 19° 02′ 19" TO A LINE PARALLEL WITH THE WESTERLY LINE OF THE 80.70 ACRE TRACT OF LAND DESCRIBED IN DEED TO R. J. NORTHAM, RECORDED IN BOOK 2091 PAGE 127 OF DEEDS, RECORDS OF SAID COUNTY, AND WHICH PASSES THROUGH STATION 15 OF SAID RANCHO, AS ESTABLISHED BY THE PROCEEDINGS IN CASE NO. 20065, LOS ANGELES COUNTY SUPERIOR COURT; THENCE ALONG SAID PARALLEL LINE, NORTH 28° 45′ 47" WEST 519.43 FEET TO SAID SOUTHEASTERLY LINE OF JEFFERSON BOULEVARD, 100.00 FEET WIDE THENCE ALONG SAID SOUTHEASTERLY LINE SOUTH 61° 14′ 56" WEST 194.86 FEET TO THE TRUE POINT OF BEGINNING.

ALSO EXCEPT THAT PORTION OF THE RANCHO LA BALLONA, IN THE CITY OF LOS ANGELES, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA, AND LOTS 11, 12, 15, 16 AND 17 OF BLOCK 11 OF TRACT NO. 9809, AS PER MAP RECORDED IN BOOK 145, PAGES 91 TO 96, INCLUSIVE OF MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY, DESCRIBED AS FOLLOWS:

BEGINNING AT STATION NO. 18 ON THE SOUTHERLY LINE OF SAID RANCHO LA BALLONA AS SHOWN ON CITY ENGINEERS FILED BOOK 20306, PAGES 62 THROUGH 64, INCLUSIVE; THENCE ALONG SAID SOUTHERLY LINE OF RANCHO LA BALLONA, SOUTH 81° 52′ 51" WEST 59.50 FEET;

Continued on next page

THENCE LEAVING SAID SOUTHERLY LINE, NORTH 39° 28′ 43" WEST 153.10 FEET; THENCE NORTH 52° 57′ 34" EAST 779.07 FEET; THENCE NORTH 36° 52′ 42" WEST 65.63 FEET; THENCE NORTH 51° 34′ 01" EAST 321.49 FEET; THENCE NORTH 31° 12′ 59" EAST 272.11 FEET; THENCE NORTH 31° 24′ 58" EAST 81.95 FEET; THENCE NORTH 33° 13′ 42" EAST 22.51 FEET TO THE BEGINNING OF A NON-TANGENT CURVE, CONCAVE NORTHERLY, HAVING A RADIUS OF 69.60 FEET AND TO WHICH BEGINNING A RADIAL LINE BEARS SOUTH 65° 47′ 22" WEST; THENCE NORTHEASTERLY ALONG SAID CURVE 114.61 FEET THROUGH A CENTRAL ANGLE OF 94° 20′ 51"; THENCE NORTH 61° 26′ 31" EAST 126.71 FEET; THENCE NORTH 61° 35′ 44" EAST 103.29 FEET TO THE BEGINNING OF A CURVE CONCAVE WESTERLY, AND HAVING A RADIUS OF 33.60 FEET; THENCE NORTHER ALONG SAID CURVE 52.70 FEET THROUGH A CENTRAL ANGLE OF 89° 51′ 37"; THENCE NORTH 28° 15′ 53" WEST 64.96 FEET; THENCE NORTH 60° 05′ 31" EAST 16.51 FEET TO THE BEGINNING OF A NON-TANGENT CURVE CONCAVE NORTHEASTERLY, HAVING A RADIUS OF 129.60 FEET AND TO WHICH BEGINNING A RADIAL LINE BEARS SOUTH 64° 20′ 22" WEST; THENCE SOUTHEASTERLY ALONG SAID CURVE 50.04 FEET THROUGH A CENTRAL ANGLE OF 22° 07′ 13"; THENCE NORTH 59° 50′ 23" EAST 105.12 FEET; THENCE SOUTH 26° 09′ 13" EAST 404.67 FEET; THENCE NORTH 53° 31′ 00" EAST 368.80 FEET; THENCE NORTH 68° 54′ 43" EAST 134.67 FEET; THENCE SOUTH 21° 03′ 39" EAST 184.51 FEET TO THE NORTHERLY CORNER OF SAID LOT 17; THENCE ALONG THE NORTHEASTERLY, EASTERLY AND SOUTHEASTERLY LINES OF SAID LOT 17 OF THE FOLLOWING THREE COURSES:

(1) SOUTH 33° 25′ 07" EAST 65.09 FEET TO THE BEGINNING OF A CURVE, CONCAVE WESTERLY AND HAVING A RADIUS OF 15.00 FEET;

(2) ALONG SAID CURVE 25.32 FEET THROUGH A CENTRAL ANGLE OF 96° 43′ 15";

(3) SOUTH 63° 18′ 07" WEST 33.79 FEET TO THE BEGINNING OF A CURVE CONCAVE SOUTHEASTERLY, HAVING A RADIUS OF 515.00 FEET;

THENCE ALONG SAID CURVE, BEING THE SOUTHEASTERLY LINE OF SAID LOTS 17 AND 16, 68.09 FEET THROUGH A CENTRAL ANGLE OF 07° 34′ 30"; THENCE ALONG SAID SOUTHEASTERLY LINE OF LOTS 16 AND 15, SOUTH 55° 43′ 37" WEST 103.79 FEET TO THE SOUTHERLY CORNER OF SAID LOT 15; THENCE ALONG THE SOUTHWESTERLY LINE OF SAID LOT 15, NORTH 34° 17′ 15" WEST 90.88 FEET TO THE SOUTHERLY LINE OF SAID RANCH LA BALLONA; THENCE SOUTHWESTERLY ALONG SAID SOUTHERLY LINE OF THE RANCHO LA BALLONA AND THE NORTHWESTERLY LINES OF LOTS 13 AND 14 OF SAID TRACT NO. 9809, SOUTH 60° 52′ 33" WEST 115.45 FEET TO THE NORTHERLY CORNER OF SAID LOT 12; THENCE ALONG THE NORTHEASTERLY LINE OF SAID LOT 12, SOUTH 34° 16′ 38" EAST 101.24 FEET TO THE EASTERLY CORNER OF SAID LOT 12; THENCE SOUTHWESTERLY ALONG THE SOUTHEASTERLY LINE OF SAID LOTS 12 AND 11, SOUTH 55° 43′ 37" WEST 88.53 FEET TO THE BEGINNING OF A CURVE CONCAVE NORTHWESTERLY AND HAVING A RADIUS OF 485.00

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FEET; THENCE CONTINUING ALONG SAID SOUTHEASTERLY LINE OF LOT 11, 14.85 FEET, THROUGH A CENTRAL ANGLE OF 01° 43′ 21" TO THE SOUTHERLY CORNER OF SAID LOT 11; THENCE NORTHWESTERLY ALONG THE SOUTHWESTERLY LINE OF SAID LOT 11, THENCE NORTH 32° 32′ 59" WEST 110.07 FEET TO SAID SOUTHERLY LINE OF RANCHO LA BALLONA; THENCE CONTINUING ALONG SAID SOUTHERLY LINE OF THE RANCHO LA BALLONA THE FOLLOWING THREE COURSES:

(1) SOUTH 60° 52′ 33" WEST 389.52 FEET;

(2) SOUTH 82° 37′ 06" WEST 462.08 FEET;

(3) SOUTH 51° 11′ 48" WEST 994.54 FEET TO THE POINT OF BEGINNING.

PARCEL II:

PORTION PARCEL 3: (QUAD III) (APN 4211-15-2,6) AREA B

THAT PORTION OF THE RANCHO LA BALLONA, IN THE COUNTY OF LOS ANGELES, STATE OF CALIFORNIA, DESCRIBED AS FOLLOWS:

BEGINNING AT THE INTERSECTION OF THE NORTHWESTERLY LINE OF JEFFERSON BOULEVARD, WITH THE SOUTHWESTERLY LINE OF ROOSEVELT HIGHWAY; THENCE ALONG SAID SOUTHWESTERLY LINE, NORTH 28° 34′ 28" WEST, 1021.55 FEET TO ITS INTERSECTION WITH THE SOUTHEASTERLY LINE OF THE 380 FOOT STRIP OF LAND DESCRIBED IN THE DECREE OF CONDEMNATION TO LOS ANGELES COUNTY FLOOD CONTROL DISTRICT, RECORDED IN BOOK 16382 PAGE 191, OFFICIAL RECORDS; THENCE ALONG SAID SOUTHEASTERLY LINE, SOUTH 56° 02′ 32" WEST, 409.90 FEET TO ITS INTERSECTION WITH THE EASTERLY LINE OF CULVER BOULEVARD, AS DESCRIBED IN DEED TO THE COUNTY OF LOS ANGELES, RECORDED IN BOOK 16371 PAGE 72, OF OFFICIAL RECORDS; THENCE SOUTHERLY AND SOUTHWESTERLY ALONG THE EASTERLY AND SOUTHEASTERLY LINES OF CULVER BOULEVARD, AS DESCRIBED IN SAID LAST MENTIONED DEED TO AND ALONG THE SOUTHEASTERLY LINE OF CULVER BOULEVARD, SHOWN AS AN UNNAMED ROAD ON THE MAP RECORDED IN BOOK 4049 PAGE 265 OF DEEDS, RECORDS OF SAID COUNTY, TO THE NORTHWESTERLY LINE OF SAID JEFFERSON BOULEVARD; THENCE NORTH 61° 25′ 32" EAST, ALONG THE NORTHWESTERLY LINE OF SAID JEFFERSON BOULEVARD OF THE POINT OF BEGINNING.

EXCEPT THEREFROM THAT PORTION OF SAID LAND DESIGNATED AS PARCEL 1-44 IN LIS PENDENS RECORDED JANUARY 13, 1970 AS INSTRUMENT NO. 1564, IN BOOK M-3387 PAGE 860, OFFICIAL RECORDS OF SAID COUNTY.

ALSO EXCEPT THEREFROM THAT PORTION OF SAID LAND DESIGNATED AS PARCEL 2B IN LIS PENDENS, RECORDED SEPTEMBER 3, 1965 AS INSTRUMENT NO. 5086 IN BOOK M-1969 PAGE 549, OF OFFICIAL RECORDS.

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ALSO EXCEPT THEREFROM THAT PORTION OF SAID LAND LYING SOUTHWESTERLY OF THE NORTHEASTERLY LINE OF THE LAND DESCRIBED IN THE DEED TO UNION OIL COMPANY OF CALIFORNIA, RECORDED MAY 29, 1945 IN BOOK 22063 PAGE 4, OF OFFICIAL RECORDS.

ALSO EXCEPT THEREFROM THAT PORTION LYING EASTERLY AND NORTHEASTERLY OF THE FOLLOWING DESCRIBED LINE:

BEGINNING AT A POINT ON THE NORTHWESTERLY LINE OF JEFFERSON BOULEVARD, 100 FOOT WIDE, DISTANT THEREON SOUTH 61° 14' 57" WEST, 2,217.38 FEET FROM THE SOUTHERLY TERMINUS OF THE LINE SHOWN AS SOUTH 4° 42' 40" WEST, 65.51 FEET OF THE LAND DESIGNATED AS PARCEL 2B IN LIS PENDENS RECORDED SEPTEMBER 3, 1965 AS INSTRUMENT NO. 5086, IN BOOK M-1969 PAGE 549, OF OFFICIAL RECORDS OF SAID COUNTY, SAID POINT ALSO BEING THE BEGINNING OF A TANGENT CURVE, CONCAVE TO THE NORTH AND HAVING A RADIUS OF 957.00 FEET; THENCE WESTERLY 569.49 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 34° 05' 44" TO THE BEGINNING OF A COMPOUND CURVE, CONCAVE TO THE NORTHEAST AND HAVING A RADIUS OF 20.00 FEET; THENCE NORTHWESTERLY 32.08 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 91° 53' 53" TO THE BEGINNING OF A REVERSE CURVE, CONCAVE TO THE WEST AND HAVING A RADIUS OF 850.00 FEET; THENCE NORTHERLY 259.52 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 17° 29' 37"; THENCE NORTH 10° 15' 03" WEST 284.01 FEET TO THE BEGINNING OF A CURVE, CONCAVE TO THE EAST AND HAVING A RADIUS OF 750.00 FEET; THENCE NORTHERLY 55.94 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 04° 16' 25" TO THE NON-TANGENT SOUTHEASTERLY LINE OF THE LAND DESCRIBED IN BOOK 16355 PAGE 127, OFFICIAL RECORDS, SAID LINE ALSO BEING THE WESTERLY PROLONGATION OF SAID SOUTHEASTERLY LINE OF THE LAND DESCRIBED IN BOOK 16382 PAGE 191, OF OFFICIAL RECORDS.

ALSO EXCEPT ALL THE OIL OR MINERALS RIGHTS UNDERLYING SAID LAND, AS RESERVED BY PACIFIC ELECTRIC RAILWAY COMPANY, IN DEED RECORDED APRIL 3, 1946 IN BOOK 22930 PAGE 272, OFFICIAL RECORDS, FROM THOSE PORTION OF THE RAMONA S. DE MACHADO 341.85095 ACRE ALLOTMENT IN THE RANCHO LA BALLONA, AS SHOWN ON MAP FILED IN CASE NO. 2722, DISTRICT COURT AND RECORDED IN BOOK 3 PAGE 204 ET SEQ., OF MISCELLANEOUS RECORDS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY, DESCRIBED AS FOLLOWS:

A. THOSE CERTAIN PARCELS OF LAND DESCRIBED AS "FIRST", "SECOND" AND "THIRD", IN THE DEED TO THE PACIFIC ELECTRIC RAILWAY COMPANY, RECORDED AUGUST 4, 1926 IN BOOK 4680 PAGE 108, OFFICIAL RECORDS.

B. THAT PORTION OF A STRIP OF LAND, 100 FEET IN WIDTH, DESIGNATED AS "CLAUSE 9" IN THE DEED TO LOS ANGELES PACIFIC COMPANY, RECORDED JULY 14, 1909 IN BOOK 3805 PAGE 107 OF DEEDS,

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LYING SOUTHEASTERLY OF A LINE PARALLEL WITH AND DISTANT NORTHWESTERLY 33 FEET, MEASURED RADIALLY FROM THE NORTHWESTERLY LINE OF THE STRIP OF LAND, 60 FEET IN WIDTH, DESIGNATED AS "CLAUSE 1" IN SAID DEED TO LOS ANGELES PACIFIC COMPANY.

C. THAT PORTION OF THE STRIP OF LAND, 60 FEET IN WIDTH, PARTLY WITHIN THE CITY OF LOS ANGELES DESIGNATED AS "CLAUSE 1" IN SAID DEED TO LOS ANGELES PACIFIC COMPANY, RECORDED JULY 14, 1909 IN BOOK 3805 PAGE 107 OF DEEDS, BOUNDED SOUTHERLY BY THE NORTHERLY LINE OF CULVER BOULEVARD (FORMERLY MESMER AVENUE), AS DESCRIBED IN DEED TO THE CITY OF LOS ANGELES, RECORDED OCTOBER 15, 1927 IN BOOK 7709 PAGE 148, OFFICIAL RECORDS AND BOUNDED NORTHEASTERLY BY THE SOUTHWESTERLY LINE OF THE LAND DESCRIBED AS PARCEL 7 IN DECLARATION OF TAKING.

ALSO EXCEPT THEREFROM THE RIGHT TO ALL OIL, GAS AND OTHER HYDROCARBONS IN SAID LAND, TOGETHER WITH THE EXCLUSIVE RIGHT TO USE PERPETUALLY THE SUBSURFACE OIL AND/OR GAS FORMATIONS FOR INSPECTING, STORING AND WITHDRAWING NATURAL GAS THEREIN AND THEREFROM AND FOR REPRESSURING THE SAME, BUT NOT EXCLUDING OR RESERVING, HOWEVER, THE RIGHT TO GO UPON OR USE THE SURFACE OF SAID LAND OR ANY PART OR PORTIONS THEREOF, AS RESERVED BY THE UNITED STATES OF AMERICA AND ITS ASSIGNS BY DECREE ENTERED FEBRUARY 5, 1952, IN UNITED STATES DISTRICT COURT, SOUTHERN DISTRICT OF CALIFORNIA, CENTRAL DIVISION, CASE NO. 2454-B CIVIL, A CERTIFIED COPY OF WHICH WAS RECORDED FEBRUARY 13, 1952, AS INSTRUMENT NO. 3526, IN BOOK 38244, PAGE 354, OFFICIAL RECORDS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY, FROM THE PORTION OF SAID PARCEL DESCRIBED AS FOLLOWS:

BEGINNING AT THE INTERSECTION OF THE CENTER LINE OF PLAYA STREET, AS VACATED BY ORDER OF THE BOARD OF SUPERVISORS ON APRIL 10, 1905, WITH THE CENTER LINE OF THE 60 FOOT STRIP OF LAND DESCRIBED IN DEED TO LOS ANGELES PACIFIC COMPANY, RECORDED IN BOOK 3805 PAGE 107 OF DEEDS; THENCE ALONG THE CENTER LINE OF PLAYA STREET, AS VACATED SOUTH 61 DEGREES 20 MINUTES WEST, 1890 FEET; THENCE SOUTH 28 DEGREES 40 MINUTES EAST, 388 FEET; THENCE NORTH 61 DEGREES 20 MINUTES EAST 1890 FEET; THENCE SOUTH 28 DEGREES 40 MINUTES EAST 388 FEET; THENCE NORTH 61 DEGREES 20 MINUTES EAST, 990 FEET; THENCE SOUTH 28 DEGREES 40 MINUTES EAST, 635 FEET; THENCE SOUTH 61 DEGREES 20 MINUTES WEST, 335 FEET; THENCE SOUTH 28 DEGREES 40 MINUTES EAST 475 FEET, MORE OR LESS, TO THE SOUTH LINE OF RANCHO LA BALLONA; THENCE ALONG SAID RANCHO LINE, NORTH 82 DEGREES EAST, 90 FEET, MORE OR LESS, TO A POINT ESTABLISHED AS STATION 19 OF RANCHO LA BALLONA BY PROCEEDINGS HAD IN LOS ANGELES COUNTY SUPERIOR COURT, CASE NO. 20065; THENCE NORTH 52 DEGREES EAST, 990 FEET TO STATION 18; THENCE NORTH 82 DEGREES 30 MINUTES EAST, 462 FEET TO STATION 17; THENCE NORTH 60 DEGREES 45 MINUTES EAST, 1386 FEET TO STATION 16; THENCE NORTH 27 DEGREES 45 MINUTES EAST 150 FEET,

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THENCE NORTH 28 DEGREES 40 MINUTES WEST, 1080 FEET; THENCE SOUTH 61 DEGREES 20 MINUTES WEST 235 FEET; THENCE NORTH 28 DEGREES 40 MINUTES WEST 155 FEET; THENCE SOUTH 61 DEGREES 20 MINUTES WEST, 430 FEET; THENCE NORTH 28 DEGREES 40 MINUTES WEST, 163.5 FEET, MORE OR LESS, TO THE SOUTHEASTERLY LINE OF PLAYA STREET, 33 FEET WIDE, (NOW JEFFERSON BOULEVARD); THENCE SOUTH 61 DEGREES 20 MINUTES WEST, ALONG SAID SOUTHEASTERLY LINE OF PLAYA STREET TO THE NORTHEASTERLY LINE OF THAT PORTION OF SAID PLAYA STREET, VACATED BY SAID ORDER OF THE BOARD OF SUPERVISORS OF SAID COUNTY; THENCE NORTHEASTERLY ALONG THE NORTHERLY LINES OF SAID VACATED PORTION OF PLAYA STREET TO THE CENTER LINE OF SAID PLAYA STREET; THENCE SOUTHWESTERLY ALONG SAID CENTER LINE OF PLAYA STREET TO THE POINT OF BEGINNING.

ALSO EXCEPT FROM THAT PORTION OF SAID LAND INCLUDED WITHIN THE LINES OF PARCEL 7, AS DESCRIBED IN THE DECLARATION OF TAKING, RECORDED NOVEMBER 4, 1942 IN BOOK 19608 PAGE 346, OFFICIAL RECORDS, ALL THE MINERAL RIGHTS AND ESTATE IN SAID LAND; TOGETHER WITH THE EXCLUSIVE RIGHT TO USE THE SUBSURFACE OIL AND GAS FORMATIONS FOR INJECTING, STORING AND WITHDRAWING NATURAL GAS THEREIN AND THEREFROM AND FOR REPRESSURING THE SAME, EXCLUDING HOWEVER, THE RIGHT TO GO UPON OR USE THE SURFACE OF SAID LAND FOR ANY OF SAID PURPOSES, AS EXCEPTED AND RESERVED TO THE UNITED STATES OF AMERICA, IN DECREE REVERTING TITLE ENTERED FEBRUARY 15, 1949 IN ACTION NO. 2454-B, CIVIL, UNITED STATES DISTRICT COURT, CENTRAL DIVISION, A CERTIFIED COPY OF WHICH WAS RECORDED MARCH 25, 1949 IN BOOK 29672, PAGE 52, OFFICIAL RECORDS.

PARCEL III:

PORTION PARCEL 4: (QUAD III) (4211-17-3)

THAT PORTION OF SAID RANCHO LA BALLONA, IN THE COUNTY OF LOS ANGELES, STATE OF CALIFORNIA, DESCRIBED AS FOLLOWS:

BEGINNING AT THE INTERSECTION OF THE CENTER LINE OF PLAYA STREET, WITH THE SOUTHERLY PROLONGATION OF THE EASTERLY LINE OF DEL REY BEACH, AS SHOWN ON MAP OF DEL REY BEACH, RECORDED IN BOOK 6 PAGE 186 OF MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY; THENCE ALONG SAID EASTERLY LINE AND THE PROLONGATION THEREOF; NORTH 29 DEGREES 07 MINUTES 02 SECONDS WEST, 2843.71 FEET TO THE MOST NORTHERLY CORNER OF BLOCK 13 OF SAID DEL REY BEACH; THENCE ALONG THE LINE ESTABLISHED BY DEED BETWEEN G. W. COLTON AND A. R. FRASER, ET AL., RECORDED IN BOOK 2108 PAGE 13 OF DEEDS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY, NORTH 62 DEGREES 46 MINUTES 07 SECONDS EAST, 63.43 FEET TO THE SOUTHEAST CORNER OF THE TRACT OF LAND DESCRIBED IN DEED TO A. R. FRASER, ET AL., RECORDED IN BOOK 2072 PAGE 134 OF DEEDS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY;

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THENCE ALONG THE SOUTHERLY LINE OF THE ADDISON SANFORD 132.51 ACRE ALLOTMENT IN SAID RANCHO LA BALLONA AND ALONG THE NORTHWESTERLY LINE OF THE 42.24 ACRE TRACT OF LAND ALLOTTED TO GREGORIA TALAMANTES BY THE FINAL DECREE OF PARTITION OF SAID RANCHO LA BALLONA, HAD IN CASE NO. 965 OF THE DISTRICT COURT OF THE FIRST JUDICIAL DISTRICT, OF THE STATE OF CALIFORNIA, NORTH 62 DEGREES 08 MINUTES 00 SECONDS EAST, 2238.24 FEET TO THE SOUTHWESTERLY LINE OF THE PARCEL OF LAND DESCRIBED IN THE DEED BETWEEN LA BALLONA LAND AND DEVELOPMENT COMPANY AND JOSEPH PIERSON RECORDED IN BOOK 19795 PAGE 20, OFFICIAL RECORDS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY; THENCE ALONG SAID LAST MENTIONED SOUTHWESTERLY LINE, SOUTH 27 DEGREES 52 MINUTES 00 SECONDS EAST, 700 FEET; THENCE ALONG THE SOUTHEASTERLY LINE OF SAID LAST MENTIONED PARCEL OF LAND ALONG THE FOLLOWING COURSES AND DISTANCES; NORTH 62 DEGREES 08 MINUTES 00 SECONDS EAST 581.37 FEET, NORTH 27 DEGREES 52 MINUTES 00 SECONDS WEST, 50 FEET, NORTH 62 DEGREES 08 MINUTES 00 SECONDS EAST, 150 FEET, SOUTH 27 DEGREES 52 MINUTES 00 SECONDS EAST, 50 FEET, NORTH 62 DEGREES 08 MINUTES 00 SECONDS EAST 275 FEET TO A POINT IN THE SOUTHWESTERLY LINE OF THE PARCEL OF LAND DESCRIBED IN THE DEED BETWEEN DEL REY COMPANY AND JOSEPH PIERSON, RECORDED IN BOOK 17715 PAGE 91, OFFICIAL RECORDS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY, DISTANT SOUTH 27 DEGREES 52 MINUTES 00 SECONDS EAST, 700 FEET FROM THE NORTHWEST CORNER OF SAID LAST MENTIONED PARCEL OF LAND; THENCE ALONG SAID LAST MENTIONED SOUTHWESTERLY LINE, SOUTH 27 DEGREES 52 MINUTES 00 SECONDS EAST, 300 FEET; THENCE ALONG THE SOUTHEASTERLY LINE OF SAID LAST MENTIONED PARCEL OF LAND, NORTH 62 DEGREES 08 MINUTES 00 SECONDS EAST, 323.57 FEET; THENCE PARALLEL WITH SAID EASTERLY LINE OF DEL REY BEACH, SOUTH 29 DEGREES 07 MINUTES 02 SECONDS EAST, 874.91 FEET TO THE CENTER LINE OF THE 380 FOOT STRIP OF LAND DESCRIBED IN THE DEED BETWEEN DEL REY COMPANY AND LOS ANGELES COUNTY FLOOD CONTROL DISTRICT, RECORDED IN BOOK 16355 PAGE 127, OFFICIAL RECORDS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY; THENCE ALONG SAID CENTER LINE, NORTH 55 DEGREES 56 MINUTES 35 SECONDS EAST, 885.31 FEET; THENCE PARALLEL WITH SAID EASTERLY LINE OF DEL REY BEACH, SOUTH 29 DEGREES 07 MINUTES 02 SECONDS EAST, 984.93 FEET TO THE NORTHWESTERLY LINE OF JEFFERSON BOULEVARD, FORMERLY PLAYA STREET; THENCE ALONG JEFFERSON BOULEVARD (AND BEING THE SOUTHERLY LINE OF THE 26.30833 ACRE TRACT OF LAND ALLOTTED TO JOSE DE LA LUZ MACHADO BY SAID FINAL DECREE OF PARTITION) SOUTH 61 DEGREES 20 MINUTES 38 SECONDS WEST, TO THE SOUTHEASTERLY LINE OF THE 60 FOOT STRIP OF LAND DESCRIBED IN THE DEED TO LOS ANGELES PACIFIC COMPANY, RECORDED IN BOOK 3805 PAGE 107 OF DEEDS, RECORDS OF SAID COUNTY; THENCE SOUTHWESTERLY ALONG SAID LAST MENTIONED SOUTHEASTERLY LINE TO THE CENTER LINE OF PLAYA STREET, AS VACATED BY ORDER OF THE BOARD OF SUPERVISORS OF SAID COUNTY ON APRIL 10, 1905; THENCE ALONG SAID CENTER LINE OF PLAYA STREET, AS VACATED, SOUTH 61 DEGREES 20 MINUTES 00 SECONDS WEST, TO THE POINT OF BEGINNING.

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EXCEPT THEREFROM THAT PORTION OF SAID LAND LYING NORTHWESTERLY OF THE NORTHWESTERLY LINE OF SAID 380 FOOT STRIP OF LAND, AS DESCRIBED IN SAID DEED RECORDED IN BOOK 16355 PAGE 127, OFFICIAL RECORDS.

ALSO EXCEPT THEREFROM THAT PORTION OF SAID LAND, 15 FEET WIDE, AS DESCRIBED IN BOOK 4821 PAGE 11, OFFICIAL RECORDS OF SAID COUNTY.

ALSO EXCEPT THEREFROM THAT PORTION OF SAID LAND WITHIN THE STRIP OF LAND CONVEYED TO THE COUNTY OF LOS ANGELES, BY DEED RECORDED IN BOOK 4049 PAGE 265 OF DEEDS.

ALSO EXCEPT THEREFROM THAT PORTION OF SAID LAND, IF ANY, INCLUDED WITHIN A PARCEL OF LAND DESIGNATED AS PARCEL 1-44 IN LIS PENDENS RECORDED JANUARY 13, 1970 AS INSTRUMENT NO. 1564, IN BOOK M-3387 PAGE 860, OFFICIAL RECORDS.

ALSO EXCEPT THOSE PORTIONS OF SAID LAND DESIGNATED AS PARCELS 9-18 AND 9-19 IN FINAL ORDER OF CONDEMNATION RECORDED APRIL 22, 1977 AS INSTRUMENT NO. 77-413488, OFFICIAL RECORDS OF SAID COUNTY.

ALSO EXCEPT THEREFROM THAT PORTION LYING EASTERLY AND NORTHEASTERLY OF THE FOLLOWING DESCRIBED LINE:

BEGINNING AT A POINT ON THE NORTHWESTERLY LINE OF JEFFERSON BOULEVARD, 100 FOOT WIDE, DISTANT THEREON SOUTH 61° 14′ 57" WEST 2,217.38 FEET FROM THE SOUTHERLY TERMINUS OF THE LINE SHOWN AS SOUTH 4° 42′ 40" WEST, 65.51 FEET OF THE LAND DESIGNATED AS PARCEL 2B IN LIS PENDENS RECORDED SEPTEMBER 3, 1965 AS INSTRUMENT NO. 5086, IN BOOK M-1969 PAGE 549, OF OFFICIAL RECORDS OF SAID COUNTY, SAID POINT ALSO BEING THE BEGINNING OF A TANGENT CURVE, CONCAVE TO THE NORTH AND HAVING A RADIUS OF 957.00 FEET; THENCE WESTERLY 569.49 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 34° 05′ 44" TO THE BEGINNING OF A COMPOUND CURVE, CONCAVE TO THE NORTHEAST AND HAVING A RADIUS OF 20.00 FEET; THENCE NORTHWESTERLY 32.08 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 91° 53′ 53" TO THE BEGINNING OF A REVERSE CURVE, CONCAVE TO THE WEST AND HAVING A RADIUS OF 850.00 FEET; THENCE NORTHERLY 259.52 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 17° 29′ 37"; THENCE NORTH 10° 15′ 03" WEST 284.01 FEET TO THE BEGINNING OF A CURVE, CONCAVE TO THE EAST AND HAVING A RADIUS OF 750.00 FEET; THENCE NORTHERLY 55.94 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 04° 16′ 25" TO THE NON-TANGENT SOUTHEASTERLY LINE OF THE LAND DESCRIBED IN BOOK 16355 PAGE 127, OF OFFICIAL RECORDS, SAID LINE ALSO BEING THE WESTERLY PROLONGATION OF SAID SOUTHEASTERLY LINE OF THE LAND DESCRIBED IN BOOK 16382 PAGE 191, OF OFFICIAL RECORDS.

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ALSO EXCEPTING FROM THE ABOVE DESCRIBED LAND ALL THE MINERAL RIGHTS TOGETHER WITH THE EXCLUSIVE RIGHT TO USE THE SUBSURFACE OIL AND GAS FORMATIONS FOR INJECTING, STORING AND WITHDRAWING NATURAL GAS THEREIN AND THEREFROM AND FOR REPRESSURING THE SAME, EXCLUDING HOWEVER, THE RIGHT TO GO UPON OR USE THE SURFACE OF SAID LAND FOR ANY OF SAID PURPOSES, AS RESERVED BY THE UNITED STATES OF AMERICA, BY DECREE ENTERED FEBRUARY 15, 1948 IN THE UNITED STATES DISTRICT COURT, SOUTHERN DISTRICT OF CALIFORNIA, CENTRAL DIVISION, CASE NO. 2454-B CIVIL, A CERTIFIED COPY OF WHICH WAS RECORDED MARCH 25, 1949 AS INSTRUMENT NO. 342, IN BOOK 29672 PAGE 52, OFFICIAL RECORDS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY, FROM THAT PORTION OF SAID PARCEL DESCRIBED AS FOLLOWS:

BEGINNING AT THE INTERSECTION OF THE CENTER LINE OF PLAYA STREET, AS VACATED BY ORDER OF THE BOARD OF SUPERVISORS OF SAID COUNTY ON APRIL 10, 1905, WITH THE CENTER LINE OF THE 60 FOOT STRIP OF LAND DESCRIBED IN THE DEED TO LOS ANGELES PACIFIC COMPANY, RECORDED IN BOOK 3805 PAGE 107 OF DEEDS, RECORDS OF SAID COUNTY; THENCE ALONG CENTER LINE OF PLAYA STREET, AS VACATED, SOUTH 51 DEGREES 20 MINUTES WEST, 1890 FEET; THENCE NORTH 28 DEGREES 40 MINUTES WEST, 280 FEET; THENCE NORTH 61 DEGREES 20 MINUTES, EAST, 2290 FEET; THENCE SOUTH 28 DEGREES 40 MINUTES EAST, 280 FEET, MORE OR LESS, TO THE CENTER LINE OF JEFFERSON BOULEVARD, (FORMERLY PLAYA STREET); THENCE SOUTH 61 DEGREES 20 MINUTES WEST, ALONG SAID CENTER LINE OF JEFFERSON BOULEVARD, 400 FEET, TO THE POINT OF BEGINNING.

ALSO EXCEPT FROM THAT PORTION OF SAID LAND INCLUDED WITHIN THE LINES OF PARCEL 7, AS DESCRIBED IN THE DECLARATION OF TAKING, RECORDED NOVEMBER 4, 1942 IN BOOK 19608 PAGE 346, OFFICIAL RECORDS, ALL THE MINERAL RIGHTS AND ESTATE IN SAID LAND; TOGETHER WITH THE EXCLUSIVE RIGHT TO USE THE SUBSURFACE OIL AND GAS FORMATIONS FOR INJECTING, STORING AND WITHDRAWING NATURAL GAS THEREIN AND THEREFROM AND FOR REPRESSURING THE SAME, EXCLUDING HOWEVER, THE RIGHT TO GO UPON OR USE THE SURFACE OF SAID LAND FOR ANY OF SAID PURPOSES, AS EXCEPTED AND RESERVED TO THE UNITED STATES OF AMERICA, IN DECREE REVESTING TITLE ENTERED FEBRUARY 15, 1949 IN ACTION NO. 2454-B, CIVIL, UNITED STATES DISTRICT COURT, CENTRAL DIVISION, A CERTIFIED COPY OF WHICH WAS RECORDED MARCH 25, 1949 IN BOOK 29672 PAGE 52, OFFICIAL RECORDS.

PARCEL IV:

PARCEL 6: (QUAD III) (4211-16-7 & 8 AND 4211-15-8 & 9)

THOSE PORTIONS OF RANCHO LA BALLONA, IN THE COUNTY OF LOS ANGELES, STATE OF CALIFORNIA INCLUDED WITHIN THE LINES OF LA BALLONA FLOOD CONTROL CHANNEL 380 FEET WIDE, AS CONDEMNED BY LOS ANGELES COUNTY FLOOD CONTROL DISTRICT, BY FINAL DECREE OF

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CONDEMNATION, RECORDED AS INSTRUMENT NO. 984 ON FEBRUARY 10, 1939 IN BOOK 16382 PAGE 191, OFFICIAL RECORDS, LYING EASTERLY OF LAND DESCRIBED IN DEED TO UNION OIL COMPANY, RECORDED AS INSTRUMENT NO. 5 ON MAY 29, 1945 IN BOOK 22063 PAGE 4 OF OFFICIAL RECORDS, AND WESTERLY OF THE WESTERLY LINE OF THE LAND DESCRIBED IN THE DEED TO STATE OF CALIFORNIA, (KNOWN AS LINCOLN BOULEVARD), AND RECORDED IN BOOK 11065 PAGE 312, OFFICIAL RECORDS.

EXCEPT THEREFROM THAT PORTION OF RANCHO LA BALLONA, IN THE COUNTY OF LOS ANGELES, AS DESCRIBED IN THE DEED FROM DEL REY COMPANY, A CORPORATION, TO PACIFIC ELECTRIC RAILWAY COMPANY, A CORPORATION, AND RECORDED JANUARY 19, 1939 IN BOOK 16319 PAGE 244, OFFICIAL RECORDS.

ALSO EXCEPT THEREFROM ALL MINERALS, ORES, GAS, OIL AND HYDROCARBON SUBSTANCES LYING UNDER OR CONTAINED THEREIN, TOGETHER WITH THE RIGHT TO EXPLORE FOR, DRILL FOR, MINE AND REMOVE ANY OF SAID MINERALS, ORES, OIL, GAS, OR OTHER HYDROCARBON SUBSTANCES WITH RIGHT OF WAY NECESSARY AND CONVENIENT FOR PURPOSES OF EXPLORING FOR, MINING, OR REMOVING ANY OF SAID MINERALS, ORES, OIL, GAS OR OTHER HYDROCARBON SUBSTANCES AS CONVEYED BY VARIOUS DEEDS OF RECORD, AMONG THEM BEING ONE RECORDED IN BOOK 16278 PAGE 385 OFFICIAL RECORDS.

PARCEL V:

PARCEL 7: (QUAD III) (4114-1-16, 17, 18, 19, 20) AREA B

INTENTIONALLY DELETED.

PARCEL VI:

PARCEL 8: (QUAD III) (4114-2-1, 2, 3, 4, 5, 6, 7, 8) AREA B

LOTS 1 TO 8 INCLUSIVE OF BLOCK 10 OF TRACT NO. 9167, IN THE CITY OF LOS ANGELES, AS PER MAP RECORDED IN BOOK 172 PAGES 46 ET SEQ. OF MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY.

EXCEPT ALL THE MINERAL RIGHTS AND ESTATE IN SAID LAND; TOGETHER WITH THE EXCLUSIVE RIGHT TO USE THE SUBSURFACE OIL AND GAS FORMATIONS FOR INJECTING, STORING AND WITHDRAWING NATURAL GAS THEREIN AND THEREFROM AND FOR REPRESSURING THE SAME, EXCLUDING HOWEVER, THE RIGHT TO GO UPON OR USE THE SURFACE OF SAID LAND FOR ANY OF SAID PURPOSES, AS EXCEPTED AND RESERVED TO THE UNITED STATES OF AMERICA, IN DECREE REVESTING TITLE ENTERED FEBRUARY 15, 1949 IN ACTION NO. 2454-B, CIVIL, UNITED STATES DISTRICT COURT, CENTRAL DIVISION, A CERTIFIED COPY OF WHICH WAS RECORDED

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MARCH 25, 1949 IN BOOK 29672 PAGE 52, OFFICIAL RECORDS.

PARCEL VII:

PARCEL 9: (QUAD III) (4114-2-9, 10, 11, 12, 13) AREA B

LOTS 9 TO 13 INCLUSIVE IN BLOCK 10 OF TRACT NO. 9167, IN THE CITY OF LOS ANGELES, AS PER MAP RECORDED IN BOOK 172 PAGES 46 TO 49 OF MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY.

EXCEPT ONE-HALF OF ALL RIGHTS, TITLE AND INTEREST IN AND TO ALL MINERALS, OIL, GAS AND OTHER HYDROCARBON SUBSTANCES IN AND UNDER SAID LAND, BUT WITHOUT ANY RIGHT OF ENTRY THEREON, AS RESERVED BY ELLEN MINDRUP GENTRY IN DEED RECORDED NOVEMBER 15, 1946 IN BOOK 23926 PAGE 182, OFFICIAL RECORDS.

ALSO EXCEPTING THE RESERVATION AS RECITED IN THE DEED FROM THE BEVERLY HILLS NATIONAL BANK AND TRUST COMPANY, A CORPORATION, RECORDED NOVEMBER 28, 1949 IN BOOK 31573 PAGE 374, OFFICIAL RECORDS, AS FOLLOWS:

"EXCEPTING AND RESERVING THEREFROM ONE-HALF OF ALL RIGHT, TITLE AND INTEREST IN AND TO ALL MINERALS, OIL, GAS AND OTHER HYDROCARBON SUBSTANCES IN AND UNDER SAID LAND, BUT WITHOUT ANY RIGHT OF ENTRY THEREON."

PARCEL VIII:

PORTION PARCEL 11: (QUAD IV) AREA D

THAT PORTION OF RANCHO LA BALLONA, IN THE COUNTY OF LOS ANGELES, STATE OF CALIFORNIA, INCLUDED WITHIN THE LINES OF LA BALLONA FLOOD CONTROL CHANNEL 380 FEET WIDE, AS DESCRIBED IN FINAL DECREE OF CONDEMNATION, RECORDED FEBRUARY 10, 1939 IN BOOK 16382 PAGE 191, OF OFFICIAL RECORDS, WHICH LIES BETWEEN THE SOUTHWESTERLY LINE OF INGLEWOOD DIVISION OF LOS ANGELES PACIFIC COMPANY (NOW PACIFIC ELECTRIC RAILWAY COMPANY) RIGHT OF WAY, AS DESCRIBED IN DEED TO SAID COMPANY, RECORDED IN BOOK 4581 PAGE 147 OF DEEDS AND THE NORTHEASTERLY LINE OF ROOSEVELT HIGHWAY, AS DESCRIBED IN DEED TO THE STATE OF CALIFORNIA, RECORDED IN BOOK 11065 PAGE 312, OF OFFICIAL RECORDS.

EXCEPT THEREFROM THAT PORTION WITHIN TRACT NO. 49104-03 IN THE CITY OF LOS ANGELES, AS PER MAP RECORDED IN BOOK 1240 PAGE 26 TO 32 INCLUSIVE OF MAPS, IN THE SAID OFFICE OF THE COUNTY.

THIS LEGAL DESCRIPTION IS NOT INTENDED FOR USE IN THE DIVISION AND/OR CONVEYANCE OF LAND VIOLATION OF THE SUBDIVISION MAP ACT OF THE STATE OF CALIFORNIA.

END OF LEGAL DESCRIPTION

Continued on next page

SCHEDULE B

At the date hereof, exceptions to coverage in addition to the printed exceptions and exclusions contained in said policy or policies would be as follows:

1. INTENTIONALLY DELETED.

1.1. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$36.18 OPEN
2ND INSTALLMENT	$36.17 OPEN
EXEMPTION	NONE
CODE AREA	1502
ASSESSMENT NO.	4211-014-004

1.2. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$3,493.45 OPEN
2ND INSTALLMENT	$3,593.45 OPEN
EXEMPTION	NONE
CODE AREA	1502
ASSESSMENT NO.	4211-014-012

1.3. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$36.92 OPEN
2ND INSTALLMENT	$36.90 OPEN
EXEMPTION	NONE
CODE AREA	1478
ASSESSMENT NO.	4211-017-003

1.4. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$5,450.02 OPEN
2ND INSTALLMENT	$5,450.01 OPEN
EXEMPTION	NONE
CODE AREA	1502
ASSESSMENT NO.	4211-017-004

1.5. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

Continued on next page

1ST INSTALLMENT	$12,137.09 OPEN
2ND INSTALLMENT	$12,137.08 OPEN
EXEMPTION	NONE
CODE AREA	1502
ASSESSMENT NO.	4211-016-006

1.6. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$106.85 OPEN
2ND INSTALLMENT	$106.85 OPEN
EXEMPTION	NONE
CODE AREA	1502
ASSESSMENT NO.	4211-016-007

1.7. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$43.55 OPEN
2ND INSTALLMENT	$43.54 OPEN
EXEMPTION	NONE
CODE AREA	1478
ASSESSMENT NO.	4211-016-008

1.8. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$26.69 OPEN
2ND INSTALLMENT	$26.67 OPEN
EXEMPTION	NONE
CODE AREA	1478
ASSESSMENT NO.	4211-015-008

1.9. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$92.12 OPEN
2ND INSTALLMENT	$92.11 OPEN
EXEMPTION	NONE
CODE AREA	1502
ASSESSMENT NO.	4211-015-009

1.10. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$91.99 OPEN
2ND INSTALLMENT	$91.98 OPEN
EXEMPTION	NONE
CODE AREA	1502
ASSESSMENT NO.	4211-007-014

Continued on next page

1.11. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$91.99 OPEN
2ND INSTALLMENT	$91.98 OPEN
EXEMPTION	NONE
CODE AREA	414
ASSESSMENT NO.	4211-007-015

1.12. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$78.04 OPEN
2ND INSTALLMENT	$78.03 OPEN
EXEMPTION	NONE
CODE AREA	1502
ASSESSMENT NO.	4211-007-042

1.13. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$216.90 OPEN
2ND INSTALLMENT	$216.89 OPEN
EXEMPTION	NONE
CODE AREA	1502
ASSESSMENT NO.	4211-007-043

2. THE LIEN OF SUPPLEMENTAL TAXES, IF ANY, ASSESSED PURSUANT TO THE PROVISIONS OF CHAPTER 3.5 (COMMENCING WITH SECTION 75) OF THE REVENUE AND TAXATION CODE OF THE STATE OF CALIFORNIA.

3. ASSESSMENTS, FOR COMMUNITY FACILITY DISTRICTS AFFECTING SAID LAND WHICH MAY EXIST BY VIRTUE OF ASSESSMENT MAPS OR NOTICES FILED BY SAID DISTRICTS.

4. COVENANTS, CONDITIONS, AND RESTRICTIONS (RESTRICTIONS, IF ANY, BASED UPON RACE, COLOR, RELIGION, SEX, HANDICAP, FAMILIAL STATUS OR NATIONAL ORIGIN ARE DELETED.) AS SET FORTH IN THE DOCUMENT DESCRIBED

EXECUTED BY	TITLE GUARANTEE & TRUST CO., A CORP.
RECORDED	OCTOBER 22, 1926
INSTRUMENT/FILE NO	708, IN BOOK 6070 PAGE 310 OF OFFICIAL RECORDS

SAID MATTER AFFECTS: PARCEL 2 OF QUAD III

5. AN EASEMENT FOR THE PURPOSE SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT

GRANTED TO	CITY OF LOS ANGELES
PURPOSE	SANITARY SEWER
RECORDED	IN BOOK 7428, PAGE 140, OFFICIAL RECORDS

Continued on next page

AFFECTS	A STRIP OF LAND HAVING A UNIFORM WIDTH OF 10 FEET ACROSS A PORTION OF PARCEL 2 OF QUAD III MORE PARTICULARLY DESCRIBED IN SAID DOCUMENT

(AS SHOWN ON THAT CERTAIN ALTA SURVEY DATED FEBRUARY & MARCH, 1984 AND REVISED FEBRUARY 15, 1989, PREPARED BY PSOMAS AND ASSOCIATES UNDER JOB NO. 1 HUG 0701-03)

6. AN EASEMENT FOR THE PURPOSE SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT

GRANTED TO	CITY OF LOS ANGELES
PURPOSE	POLES, TOWER AND CONDUITS
RECORDED	IN BOOK 7765, PAGE 316, OF OFFICIAL RECORDS
AFFECTS	THAT PORTION OF PARCEL 2 OF QUAD III BEING A 20 FOOT STRIP OF LAND, AS MORE PARTICULARLY DESCRIBED IN SAID DOCUMENT

(AS SHOWN ON THAT CERTAIN ALTA SURVEY DATED FEBRUARY & MARCH, 1984 AND REVISED FEBRUARY 15, 1989, PREPARED BY PSOMAS AND ASSOCIATES UNDER JOB NO. 1 HUG 0701-03)

7. INTENTIONALLY DELETED.

8. INTENTIONALLY DELETED.

9. AN EASEMENT AFFECTING THE PORTION OF SAID LAND AND FOR THE PURPOSES STATED HEREIN, AND INCIDENTAL PURPOSES CONDEMNED BY FINAL DECREE

IN FAVOR OF	COUNTY OF LOS ANGELES
FOR	SANITARY SEWER AND STORM DRAIN
CASE NO.	260321 SUPERIOR COURT
RECORDED	IN BOOK 10418, PAGE 126, OF OFFICIAL RECORDS

SAID MATTER AFFECTS A PORTION OF SAID LAND AS MORE PARTICULARLY DESCRIBED IN SAID DOCUMENT.

(AS SHOWN ON THAT CERTAIN ALTA SURVEY DATED FEBRUARY & MARCH, 1984 AND REVISED FEBRUARY 15, 1989, PREPARED BY PSOMAS AND ASSOCIATES UNDER JOB NO. 1 HUG 0701-03)

10. INTENTIONALLY DELETED.

11. ANY RIGHT, AFFECTING THOSE PORTIONS WITHIN THE STRIP OF LAND 90 FEET WIDE, OF PACIFIC LIGHTING GAS SUPPLY COMPANY (SUCCESSOR TO THE INTEREST OF INDUSTRIAL FUEL SUPPLY COMPANY) IN AND TO LAND, AS DISCLOSED BY INSTRUMENTS OF RECORD, AMONG THEM BEING AN INSTRUMENT RECORDED APRIL 10, 1936 IN BOOK 14042, PAGE 179, OFFICIAL RECORDS.

Continued on next page

12. THE FREE AND UNOBSTRUCTED RIGHT FROM TIME TO TIME TO EXPLORE FOR, MINE FOR, DRILL FOR, PRODUCE, TREAT, TRANSPORT, STORE AND REMOVE MINERALS, OIL, GAS AND OTHER HYDROCARBON SUBSTANCES AND INCIDENTAL PURPOSES AS MORE FULLY DESCRIBED IN AND AS RESERVED BY UNION OIL COMPANY OF CALIFORNIA, A CORPORATION, IN THE DEED RECORDED MAY 29, 1945 AS INSTRUMENT NO. 6, IN BOOK 21983, PAGE 305, OF OFFICIAL RECORDS.

SAID RIGHTS, INSOFAR AS THE AFFECT PORTIONS OF SAID LAND, WERE MODIFIED BY DEEDS FROM UNION OIL COMPANY OF CALIFORNIA, RECORDED FEBRUARY 5, 1959 AS INSTRUMENT NO. 4213 IN BOOK D-356, PAGE 958, OF OFFICIAL RECORDS, AND RECORDED AUGUST 21, 1958 AS INSTRUMENT NO. 4834, IN BOOK D-579, PAGE 972, OFFICIAL RECORDS, AND BY AGREEMENT RECORDED MARCH 15, 1961 AS INSTRUMENT NO. 3819, IN BOOK D-1156, PAGE 518, OFFICIAL RECORDS.

SAID MATTER AFFECTS: PARCEL 2 OF QUAD III

13. THE EXCLUSIVE RIGHT, AFFECTING THAT PORTION OF SAID LAND INCLUDED WITHIN THE LAND DESCRIBED IN DEED NEXT REFERRED TO, TO USE THE SUBSURFACE OF SAID LAND AND ALL ZONES CONTAINED THEREIN, REGARDLESS OF DEPTH, FOR THE INJECTION OF GAS INTO, THE STORAGE OF GAS IN, AND/OR THE WITHDRAWAL OF GAS FROM SAID PROPERTY AND INCIDENTAL PURPOSES MORE FULLY DESCRIBED IN AND AS RESERVED BY SOUTHERN CALIFORNIA GAS COMPANY, IN DEED RECORDED NOVEMBER 21, 1946 AS INSTRUMENT NO. 1046, IN BOOK 23939, PAGE 338, OFFICIAL RECORDS.

SAID RIGHTS, INSOFAR AND THEY AFFECT A PORTION OF SAID LAND, WERE MODIFIED BY DEED FROM SOUTHERN CALIFORNIA GAS COMPANY, RECORDED FEBRUARY 6, 1959 AS INSTRUMENT NO. 4278, IN BOOK D-358, PAGE 367, OFFICIAL RECORDS, AS MODIFIED BY AN INSTRUMENT RECORDED AUGUST 14, 1959 IN BOOK M-339, PAGE 989, OFFICIAL RECORDS.

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

14. AN AGREEMENT AFFECTING PARCELS 1, 3 AND 5 OF QUAD III, DATED AUGUST 15, 1963, WHEREBY HUGHES TOOL COMPANY, A CORPORATION, CONVEYS TO SOUTHERN CALIFORNIA GAS COMPANY, A CORPORATION, THE EXCLUSIVE RIGHT TO USE SUBSURFACE MINERAL, OIL AND/OR GAS ZONES FOR INJECTING, STORING AND WITHDRAWING NATURAL GAS (WHETHER PROVIDED FROM SUCH OR OTHER PROPERTY) THEREIN AND THEREFROM AND FOR REPRESSURING THE SAME; BUT, WITH NO RIGHT TO USE THE SURFACE OR TO CARRY ON SUCH OPERATION EXCEPT BETWEEN A DEPTH OF 500 FEET TO 7000 FEET FROM THE SURFACE THEREOF, WHICH AGREEMENT ALSO RECITES THAT

HUGHES TOOL COMPANY HEREBY COVENANTS AND AGREES TO PROHIBIT EXPLORATION FOR MINERAL, OIL, GAS OR OTHER HYDROCARBONS BETWEEN

Continued on next page

THE DEPTH OF 500 FEET TO 7000 FEET FROM THE SURFACE, RECORDED AUGUST 30, 1963 AS INSTRUMENT NO. 7055, IN BOOK M1338, PAGE 287, OFFICIAL RECORDS.

15. INTENTIONALLY DELETED.

16. INTENTIONALLY DELETED.

17. INTENTIONALLY DELETED.

18. A LEASE WITH CERTAIN TERMS, COVENANTS AND PROVISIONS SET FORTH THEREIN

TYPE OF LEASE	OIL AND GAS
DATED	FEBRUARY 17, 1930
LESSOR	CHARLES R. WILSON, A SINGLE MAN
LESSEE	UNION OIL COMPANY OF CALIFORNIA, A CORPORATION
TERM	TWENTY YEARS FROM THE DATE THEREOF AND SO LONG THEREAFTER AS OIL, GAS OR OTHER HYDROCARBON SUBSTANCES IN QUANTITIES DEEMED PAYING BY LESSEE
RECORDED	FEBRUARY 13, 1930 IN BOOK 9673, PAGE 357, OF OFFICIAL RECORDS
AFFECTS	PARCEL 2 OF QUAD III

AND AS MODIFIED BY AN INSTRUMENT

EXECUTED BY: TITLE GUARANTEE & TRUST CO., A CORPORATION AND SAID UNION OIL COMPANY OF CALIFORNIA, A CORPORATION RECORDED: SEPTEMBER 16, 1942 IN BOOK 19523, PAGE 302, OF OFFICIAL RECORDS

THE INTEREST OF THE LESSEE UNDER SAID LEASE WAS TERMINATED AS TO THAT PORTION OF THE LEASED LAND INCLUDED WITHIN THE LAND DESCRIBED AS PORTION 6 IN DECLARATION OF TAKING BY THE UNITED STATES OF AMERICA, RECORDED NOVEMBER 4, 1942 IN BOOK 19608, PAGE 346, OFFICIAL RECORDS, HEREINAFTER REFERRED TO BY SAID DECLARATION OF TAKING.

AN AGREEMENT, DATED JANUARY 9, 1931, BY AND BETWEEN CHARLES R. WILSON AND UNION OIL COMPANY OF CALIFORNIA, A CORPORATION, RELATIVE TO THE PRODUCTION OF OIL, GAS AND OTHER HYDROCARBON SUBSTANCES FROM THE LAND HEREIN DESCRIBED AND LAND ADJOINING SAID LAND AND THE PAYMENT OF ROYALTIES THEREFOR, RECORDED FEBRUARY 10, 1931 IN BOOK 10552, PAGE 308, OFFICIAL RECORDS.

AN ASSIGNMENT OF LESSEE'S INTEREST IN SAID LEASE WAS

EXECUTED BY	UNION OIL COMPANY OF CALIFORNIA
TO	SOUTHERN CALIFORNIA GAS COMPANY
RECORDED	DECEMBER 30, 1959 IN BOOK M 418, PAGE 501, AS INSTRUMENT NO. 2971, OFFICIAL RECORDS

Continued on next page

ALL EASEMENTS AND RIGHTS OF WAY INCLUDING THOSE FOR PIPE LINES, PRIVATE ROADWAY AND INGRESS AND EGRESS IN, ON, OVER, THROUGH AND ACROSS THE SAID PARCEL, ARE LIMITED BY AND SUBJECT TO THE PROVISIONS AND CONDITIONS OF THE QUITCLAIM BY SOUTHERN CALIFORNIA GAS COMPANY IN THE AGREEMENT DATED AUGUST 15, 1963, RECORDED AUGUST 30, 1963 IN BOOK M1338, PAGE 280, OF OFFICIAL RECORDS.

THE PRESENT OWNERSHIP OF THE LEASEHOLD CREATED BY SAID LEASE AND OTHER MATTERS AFFECTING THE INTEREST OF THE LESSEE ARE NOT SHOWN HEREIN.

19. AN EASEMENT FOR THE PURPOSE SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT

GRANTED TO	SOUTHERN CALIFORNIA EDISON COMPANY, LTD.
PURPOSE	POLE LINES
RECORDED	AUGUST 22, 1945 IN BOOK 23585, PAGE 307, OF OFFICIAL RECORDS

SAID MATTER AFFECTS A PORTION OF SAID LAND AS MORE PARTICULARLY DESCRIBED IN SAID DOCUMENT.

(AS SHOWN ON THAT CERTAIN ALTA SURVEY DATED FEBRUARY & MARCH, 1984 AND REVISED FEBRUARY 15, 1989, PREPARED BY PSOMAS AND ASSOCIATES UNDER JOB NO. 1 HUG 0701-03)

20. EASEMENTS, RIGHTS AND RIGHTS OF WAY, RESERVED TO UNITED STATES, IN DECREE ENTERED FEBRUARY 5, 1952, IN ACTION NO. 2454-B CIVIL, UNTIED STATES OF AMERICA DISTRICT COURT, SOUTHERN DISTRICT OF CALIFORNIA, CENTRAL DIVISION, CERTIFIED COPY OF WHICH WAS RECORDED FEBRUARY 13, 1952 AS INSTRUMENT NO. 3526, IN BOOK 38244, PAGE 354, OFFICIAL RECORDS, WHICH EASEMENTS, RIGHTS AND RIGHTS OF WAY ARE MORE PARTICULARLY SET FORTH IN SAID DOCUMENT.

ALL EASEMENTS AND RIGHTS OF WAY INCLUDING THOSE FOR PIPE LINES, PRIVATE ROADWAY AND INGRESS AND EGRESS IN, ON, OVER, THROUGH AND ACROSS THE SAID PARCEL, ARE LIMITED BY AND SUBJECT TO THE PROVISIONS AND CONDITIONS OF THE QUITCLAIM BY SOUTHERN CALIFORNIA GAS COMPANY IN THE AGREEMENT DATED AUGUST 15, 1963, RECORDED AUGUST 30, 1963 IN BOOK M1338, PAGE 280, OF OFFICIAL RECORDS.

(AS SHOWN ON THAT CERTAIN ALTA SURVEY DATED FEBRUARY & MARCH, 1984 AND REVISED FEBRUARY 15, 1989, PREPARED BY PSOMAS AND ASSOCIATES UNDER JOB NO. 1 HUG 0701-03)

21. RESERVATION AND EXCEPTION CONTAINED IN DEED FROM RECONSTRUCTION FINANCE CORPORATION AND UNITED STATES OF AMERICA,

Continued on next page

BOTH ACTING BY AND THROUGH GENERAL SERVICES ADMINISTRATOR TO SOUTHERN CALIFORNIA GAS COMPANY, A CORPORATION, DATED DECEMBER 1, 1953, RECORDED OCTOBER 15, 1954 AS INSTRUMENT NO. 580, IN BOOK 45847, PAGE 89, OFFICIAL RECORDS, THE LOCATION AND TERMS OF WHICH ARE MORE PARTICULARLY DESCRIBED THEREIN.

22. A LEASE WITH CERTAIN TERMS, COVENANTS AND PROVISIONS SET FORTH THEREIN

TYPE OF LEASE	OIL AND GAS
DATED	DECEMBER 5, 1934
LESSOR	W. F. NICHOLS, SINGLE
LESSEE	W. J. WILLIAMS
TERM	AS THEREIN PROVIDED
RECORDED	APRIL 5, 1935 IN BOOK 13403, PAGE 50, OF OFFICIAL RECORDS
AFFECTS	THE FOLLOWING:

PARCEL 1: LOT 22 IN BLOCK 27 OF TOWN OF PORT BALLONA, IN THE COUNTY OF LOS ANGELES, STATE OF CALIFORNIA, AS PER MAP RECORDED IN BOOK 16, PAGE 47 OF MISCELLANEOUS RECORDS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY.

PARCEL 2: THAT PORTION OF 4TH AVENUE, AS SHOWN ON THE MAP OF TOWN OF PORT BALLONA, IN THE COUNTY OF LOS ANGELES, STATE OF CALIFORNIA, AS PER MAP RECORDED IN BOOK 16, PAGE 47, ET SEQ., OF MISCELLANEOUS RECORDS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY, WHICH LIES BETWEEN THE NORTHEASTERLY PROLONGATION OF THE NORTHWESTERLY AND SOUTHEASTERLY LINES OF LOT 22 IN BLOCK 27 OF SAID TRACT.

ALL OF SAID 4TH AVENUE ABOVE DESCRIBED WAS VACATED BY ORDER ADOPTED BY THE BOARD OF SUPERVISORS OF THE COUNTY OF LOS ANGELES ON NOVEMBER 13, 1956, A CERTIFIED COPY THEREOF BEING RECORDED NOVEMBER 28, 1956 AS INSTRUMENT NO. 2572, IN BOOK 52972, PAGE 36, OFFICIAL RECORDS, EXCEPT THAT PORTION THEREOF LYING NORTHWESTERLY OF A CURVE CONCENTRIC WITH AND 25 FEET SOUTHEASTERLY, MEASURED RADIALLY FROM THAT CERTAIN CURVE, HAVING A RADIUS OF 3844.83 FEET IN THE SOUTHEASTERLY BOUNDARY OF CULVER BOULEVARD, 50 FEET WIDE, AS SHOWN ON THE MAP FILED IN BOOK 37, PAGE 31 OF RECORDS OF SURVEYS OF SAID COUNTY.

THE PRESENT OWNERSHIP OF THE LEASEHOLD CREATED BY SAID LEASE AND OTHER MATTERS AFFECTING THE INTEREST OF THE LESSEE ARE NOT SHOWN HEREIN.

23. ALL EASEMENTS AND RIGHTS AND INCIDENTAL PURPOSES OVER PORTIONS OF PARCEL 2 OF QUAD III AS SET FORTH IN SECTION 959.1 OF THE STREETS AND HIGHWAYS CODE OF THE STATE OF CALIFORNIA, AS CONTAINED IN THE ORDER ADOPTED NOVEMBER 13, 1956 BY THE BOARD OF

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SUPERVISORS OF THE COUNTY OF LOS ANGELES, A CERTIFIED COPY THEREOF BEING RECORDED NOVEMBER 28, 1956 IN BOOK 52972, PAGE 36, OFFICIAL RECORDS.

24. AN EASEMENT OVER SAID LAND FOR A SINGLE LINE OF POLES, WITH CROSS-ARMS AND WIRES, FOR PRIVATE TELEPHONE PURPOSES, TOGETHER WITH ALL RIGHTS OF WAY COVERING THE CONSTRUCTION AND MAINTENANCE OF SUCH FACILITIES, AS CONVEYED BY UNRECORDED SURFACE LEASE FROM DEL REY COMPANY TO P. M. PIKE, DATED JUNE 1, 1933 AND BY MESNE ASSIGNMENTS TRANSFERRED AND CONVEYED TO UNION OIL COMPANY OF CALIFORNIA, BY ASSIGNMENT OF LEASE FROM P. M. PIKE INVESTMENT COMPANY, DATED JANUARY 27, 1943, AS PROVIDED IN DECREE ENTERED JULY 12, 1946 IN ACTION NO. 2454, CIVIL, UNITED STATES DISTRICT COURT, SOUTHERN DISTRICT OF CALIFORNIA, CENTRAL DIVISION.

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

25. THE EFFECT OF AN AGREEMENT, DATED JANUARY 18, 1952, EXECUTED BY AND BETWEEN SOUTHERN CALIFORNIA GAS COMPANY, A CORPORATION THEREIN CALLED "THE GAS CO." AND HUGHES TOOL COMPANY, A DELAWARE CORPORATION, THEREIN CALLED "HUGHES", RELATING TO THE UNITED STATES OF AMERICA, AS SET FORTH IN STIPULATION REFERRED TO THEREIN, UPON THE CONDITIONS, COVENANTS AND PROVISIONS CONTAINED IN SAID AGREEMENT, RECORDED JANUARY 18, 1952 AS INSTRUMENT NO. 2738 IN BOOK 38075, PAGE 427, OFFICIAL RECORDS.

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

ALL EASEMENTS AND RIGHTS OF WAY INCLUDING THOSE FOR PIPE LINES, PRIVATE ROADWAY AND INGRESS AND EGRESS IN, ON, OVER, THROUGH AND ACROSS THE SAID PARCEL, ARE LIMITED BY AND SUBJECT TO THE PROVISIONS AND CONDITIONS OF THE QUITCLAIM BY SOUTHERN CALIFORNIA GAS COMPANY IN THE AGREEMENT DATED AUGUST 15, 1963, RECORDED AUGUST 30, 1963 IN BOOK M1338, PAGE 280 OF OFFICIAL RECORDS.

26. EASEMENTS AND RIGHTS OF WAY RESERVED TO THE UNITED STATES OF AMERICA IN DECREE RESERVING TITLE, ENTERED FEBRUARY 15, 1949 IN ACTION NO. 2454-B CIVIL, UNITED STATES DISTRICT COURT, CENTRAL DIVISION, A CERTIFIED COPY OF WHICH WAS RECORDED MARCH 25, 1949 AS INSTRUMENT NO. 342, IN BOOK 29672, PAGE 52, OFFICIAL RECORDS, WHICH EASEMENT AND RIGHTS OF WAY ARE SET FORTH IN SAID DECREE AS FOLLOWS:

A. THE RIGHT-OF-WAY, FROM TIME TO TIME, TO LAY, CONSTRUCT, MAINTAIN, OPERATE, REPAIR, ALTER AND REMOVE PIPE LINES, INCLUDING, BUT NOT LIMITED TO ONE 6" AND ONE 16" PIPE LINE, AS NOW LAID, FOR THE TRANSPORTATION OF OIL, GAS, WATER AND OTHER SUBSTANCES ALONG A STRIP OF LAND, 20 FEET IN WIDTH, WITH THE RIGHT OF INGRESS AND EGRESS TO AND FROM THE SAME, OVER, THROUGH,

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UNDER AND ALONG THAT CERTAIN PARCEL OF LAND SITUATED IN THE COUNTY OF LOS ANGELES, STATE OF CALIFORNIA, DESCRIBED AS PARCEL NO. 7, IN THAT CERTAIN ACTION ENTITLED, UNITED STATES VS. CERTAIN PARCELS OF LAND IN THE CITY OF LOS ANGELES, ET AL., CASE NO. 2454-B CIVIL, THE CENTER LINE OF SAID 20 FOOT RIGHT-OF-WAY BEING DESCRIBED AS FOLLOWS:

BEGINNING AT A POINT IN THE NORTHWESTERLY LINE OF THE 60 FOOT STRIP OF LAND DESIGNATED AS PARCEL NO. 7, AFORESAID, DISTANT THEREON SOUTHWESTERLY 370 FEET, MORE OR LESS, FROM ITS INTERSECTION WITH THE NORTHWESTERLY LINE OF PLAYA STREET, AS VACATED BY ORDER OF THE BOARD OF SUPERVISORS OF SAID COUNTY ON APRIL 10, 1905; THENCE SOUTHEASTERLY TO POINT IN THE SOUTHEASTERLY LINE OF SAID 60 FOOT STRIP OF LAND DISTANT THEREON SOUTHWESTERLY 490 FEET, MORE OR LESS, FROM ITS INTERSECTION WITH SAID NORTHWESTERLY LINE OF PLAYA STREET, AS VACATED.

B. THE RIGHT-OF-WAY, FROM TIME TO TIME, TO LAY, CONSTRUCT, MAINTAIN, OPERATE, REPAIR, ALTER AND REMOVE PIPE LINES FOR THE TRANSPORTATION OF OIL, GAS, WATER AND OTHER SUBSTANCES AND TO CONSTRUCT, MAINTAIN, OPERATE AND REMOVE TELEPHONE LINES, INCLUDING, BUT NOT LIMITED TO ONE 4" OIL LINE, ONE 5" WATER LINE AND ONE TELEPHONE CONDUIT, ALONG A STRIP OF LAND, 20 FEET IN WIDTH, WITH RIGHT OF INGRESS AND EGRESS TO AND FROM THE SAME, OVER, THROUGH, UNDER AND ALONG THAT CERTAIN PARCEL OF LAND SITUATED IN THE COUNTY OF LOS ANGELES, STATE OF CALIFORNIA, DESCRIBED AS PARCEL NO. 7, IN THAT CERTAIN ACTION ENTITLED, UNITED STATES OF AMERICA, VS. CERTAIN PARCELS OF LAND IN THE CITY OF LOS ANGELES, ET AL., CASE NO. 2654-B CIVIL, THE CENTER LINE OF SAID 20 FOOT RIGHT-OF-WAY BEING DESCRIBED AS FOLLOWS:

BEGINNING AT A POINT ON THE NORTHWESTERLY LINE OF THE 60 FOOT STRIP OF LAND, DESIGNATED A PARCEL NO. 7 AFORESAID, DISTANT THEREON SOUTHWESTERLY 688 FEET, MORE OR LESS, FROM ITS INTERSECTION WITH THE NORTHWESTERLY LINE OF PLAYA STREET, AS VACATED BY ORDER OF THE BOARD OF SUPERVISORS OF SAID COUNTY ON APRIL 10, 1905; THENCE SOUTHWESTERLY TO POINT IN THE SOUTHEASTERLY LINE OF SAID 60 FOOT STRIP OF LAND, DISTANT THEREON SOUTHWESTERLY 808 FEET, MORE OR LESS, FROM ITS INTERSECTION WITH SAID NORTHWESTERLY LINE OF PLAYA STREET, AS VACATED.

C. THE RIGHT-OF-WAY, FROM TIME TO TIME, TO CONSTRUCT, MAINTAIN, USE, REPAIR, ALTER AND REMOVE A PRIVATE ROADWAY ALONG A STRIP OF LAND, 40 FEET IN WIDTH, WITH THE RIGHT OF INGRESS AND EGRESS TO AND FROM THE SAME OVER, THROUGH AND ALONG THAT CERTAIN PARCEL OF LAND SITUATED IN THE COUNTY OF LOS ANGELES, STATE OF CALIFORNIA, DESCRIBED AS PARCEL 7 IN THAT CERTAIN ACTION ENTITLED UNITED STATES VS. CERTAIN PARCEL OF LAND IN THE CITY OF LOS ANGELES, ET AL., CASE NO. 2454-B CIVIL, THE CENTER LINE

Continued on next page

OF SAID 40 FOOT RIGHT-OF-WAY BEING DESCRIBED AS FOLLOWS:

BEGINNING A A POINT IN THE NORTHWESTERLY LINE OF THE 60 FOOT STRIP OF LAND DESIGNATED AS PARCEL NO. 7, AFORESAID, DISTANT THEREON SOUTHWESTERLY 850 FEET, MORE OR LESS, FROM ITS INTERSECTION WITH THE NORTHWESTERLY LINE OF PLAYA STREET, AS VACATED BY ORDER OF THE BOARD OF SUPERVISORS OF SAID COUNTY ON APRIL 10, 1905; THENCE SOUTHEASTERLY AT RIGHT ANGLES 60 FEET TO A POINT IN THE SOUTHEASTERLY LINE OF SAID 60 FOOT STRIP OF LAND, DISTANT THEREON SOUTHWESTERLY 970 FEET, MORE OR LESS, FROM ITS INTERSECTION WITH SAID NORTHWESTERLY LINE OF PLAYA STREET, AS VACATED.

TOGETHER WITH THE CONTINUATION OF SAID RIGHT-OF-WAY FOR PRIVATE ROADWAY ON SAID PARCEL NO. 7 ALONG A STRIP OF LAND, 14 FEET IN WIDTH, THE CENTER LINE OF WHICH IS DESCRIBED AS FOLLOWS:

BEGINNING AT A POINT IN THE NORTHEASTERLY LINE OF THE ABOVE DESCRIBED 40 FOOT STRIP OF LAND, DISTANT THEREON NORTHWESTERLY 7 FEET FROM ITS INTERSECTION WITH THE SOUTHEASTERLY OF SAID 60 FOOT STRIP OF LAND; THENCE NORTHEASTERLY PARALLEL WITH AND 7 FEET NORTHWESTERLY, MEASURED AT RIGHT ANGLES, FROM SAID SOUTHWESTERLY LINE, 130 FEET, MORE OR LESS.

ALL EASEMENTS AND RIGHTS OF WAY INCLUDING THOSE FOR PIPE LINES, PRIVATE ROADWAY AND INGRESS AND EGRESS IN, ON, OVER, THROUGH AND ACROSS THE SAID PARCEL, ARE LIMITED BY AND SUBJECT TO THE PROVISIONS AND CONDITIONS OF THE QUITCLAIM BY SOUTHERN CALIFORNIA GAS COMPANY IN THE AGREEMENT DATED AUGUST 15, 1963, RECORDED AUGUST 30, 1963 IN BOOK M1338, PAGE 280 OF OFFICIAL RECORDS.

(AS SHOWN ON THAT CERTAIN ALTA SURVEY DATED FEBRUARY & MARCH, 1984 AND REVISED FEBRUARY 15, 1989, PREPARED BY PSOMAS AND ASSOCIATES UNDER JOB NO. 1 HUG 0701-03)

27. AN EASEMENT FOR THE PURPOSE SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT

GRANTED TO	COUNTY OF LOS ANGELES
PURPOSE	CONSTRUCTING, MAINTAINING, OPERATING AND USING CHANNELS OR FACILITIES NECESSARY FOR THE DEVELOPMENT OF A SMALL CRAFT HARBOR AND RECREATION AREA
RECORDED	APRIL 1, 1957 IN BOOK 54087, PAGE 164, OFFICIAL RECORDS
AFFECTS	PARCELS 4, 5, AND 6 OF QUAD III

28. AN EASEMENT FOR THE PURPOSE SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT

Continued on next page

GRANTED TO	INDUSTRIAL FUEL SUPPLY COMPANY, A CORPORATION
PURPOSE	PIPE LINE
RECORDED	SEPTEMBER 17, 1931 IN BOOK 11148, PAGE 126, OF OFFICIAL RECORDS

SAID MATTER AFFECTS A PORTION OF SAID LAND AS MORE PARTICULARLY DESCRIBED IN SAID DOCUMENT.

(AS SHOWN ON THAT CERTAIN ALTA SURVEY DATED FEBRUARY & MARCH, 1984 AND REVISED FEBRUARY 15, 1989, PREPARED BY PSOMAS AND ASSOCIATES UNDER JOB NO. 1 HUG 0701-03)

29. THE RIGHT AFFECTING THOSE PORTIONS OF THE RAMONA S. DE MACHADO 341.85095 ACRE ALLOTMENT IN THE RANCHO LA BALLONA, IN THE COUNTY OF LOS ANGELES, STATE OF CALIFORNIA, AS SHOWN ON MAP FILED IN CASE NO. 2722, DISTRICT COURT, AND RECORDED IN BOOK 3, PAGE 204 ET SEQ., OF MISCELLANEOUS RECORDS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY, DESCRIBED AS FOLLOWS:

THOSE CERTAIN PARCELS OF LAND DESIGNATED AS "FIRST", "SECOND" AND "THIRD", IN THE DEED TO THE PACIFIC ELECTRIC RAILWAY COMPANY, RECORDED AUGUST 4, 1926 AS INSTRUMENT NO. 1540, IN BOOK 4680, PAGE 108, OFFICIAL RECORDS;

AND

THAT PORTION OF A STRIP OF LAND, 110 FEET IN WIDTH, DESIGNATED AS "CLAUSE 9" IN THE DEED TO LOS ANGELES PACIFIC COMPANY, RECORDED JULY 14, 1908 IN BOOK 3805, PAGE 107 OF DEEDS; LYING SOUTHEASTERLY OF A LINE PARALLEL WITH AND DISTANT NORTHWESTERLY 33 FEET, MEASURED RADIALLY FROM THE NORTHWESTERLY LINE OF THE STRIP OF LAND, 60 FEET IN WIDTH DESIGNATED AS "CLAUSE 1", IN SAID DEED TO LOS ANGELES PACIFIC COMPANY;

AND THAT PORTION OF THE STRIP OF LAND, 60 FEET IN WIDTH, PARTLY WITHIN THE CITY OF LOS ANGELES, DESIGNATED AS "CLAUSE 1" IN SAID DEED TO LOS ANGELES PACIFIC COMPANY, RECORDED JULY 14, 1909 IN BOOK 3806 PAGE 107 OF DEEDS, BOUNDED SOUTHERLY BY THE NORTHERLY LINE OF CULVER BOULEVARD (FORMERLY MESMER AVENUE), AS DESCRIBED IN DEED TO THE CITY OF LOS ANGELES, RECORDED OCTOBER 15, 1927 IN BOOK 7709, PAGE 148, OFFICIAL RECORDS, AND BOUNDED NORTHEASTERLY BY THE SOUTHWESTERLY LINE OF THE LAND DESCRIBED AS PARCEL 7 IN DECLARATION OF TAKING RECORDED NOVEMBER 4, 1942 AS INSTRUMENT NO. 612, IN BOOK 19608, PAGE 346, OFFICIAL RECORDS.

TO PRODUCE OIL, GAS AND OTHER HYDROCARBON SUBSTANCES FROM SAID LAND BY DIRECTIONAL DRILLING OR ANY OTHER MEANS NOT REQUIRING THE OCCUPANCY OF THE SURFACE OF SAID LAND OR OF ANY PORTION THEREOF, INCLUDING THE RIGHT TO COMBINE SAID PROPERTY IN ANY COMMUNITY OIL LEASE, BUT NOT INCLUDING THE RIGHT TO ENTER UPON

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OR OCCUPY ANY PORTION OF THE SURFACE OF SAID LAND FOR SUCH PURPOSES, AS RESERVED BY PACIFIC ELECTRIC RAILWAY COMPANY, IN DEED RECORDED APRIL 3, 1946 IN BOOK 22930, PAGE 272, OFFICIAL RECORDS.

SAID MATTER AFFECTS: PARCELS 2, 4, AND 5 OF QUAD III

30. AN ACTION IN THE SUPERIOR COURT

COMMENCED	MAY 15, 1961
ENTITLED	LOS ANGELES FLOOD CONTROL DISTRICT VS. SHELL OIL COMPANY, ET AL.
CASE NUMBER	771085
COUNTY OF	LOS ANGELES
NATURE OF ACTION	TO CONDEMN THE SLOPE EASEMENT FOR THE WIDENING OF FLOOD CONTROL CHANNEL
NOTICE OF SAID ACTION RECORDED	MAY 15, 1961 AS INSTRUMENT NO. 5153 IN BOOK M-771, PAGE 334, OFFICIAL RECORDS
AFFECTS	THOSE PORTIONS OF PARCELS 4 AND 5 OF QUAD III MORE PARTICULARLY DESCRIBED IN SAID DOCUMENT

(AS SHOWN ON THAT CERTAIN ALTA SURVEY DATED FEBRUARY & MARCH, 1984 AND REVISED FEBRUARY 15, 1989, PREPARED BY PSOMAS AND ASSOCIATES UNDER JOB NO. 1 HUG 0701-03)

31. AN EASEMENT AFFECTING THE PORTION OF SAID LAND AND FOR THE PURPOSES STATED HEREIN, AND INCIDENTAL PURPOSES CONDEMNED BY FINAL DECREE

IN FAVOR OF	COUNTY OF LOS ANGELES
FOR	SLOPE EASEMENTS
CASE NO.	968057 SUPERIOR COURT, LOS ANGELES COUNTY
RECORDED	MARCH 31, 1972 AS INSTRUMENT NO. 5578, IN BOOK D5413, PAGE 512, OFFICIAL RECORDS
AFFECTS	PARCELS 2 OF QUAD III

AS AMENDED BY ORDER NUNC PRO TUNC RECORDED APRIL 26, 1972 AS INSTRUMENT NO. 2934, OFFICIAL RECORDS.

SAID MATTER AFFECTS A PORTION OF SAID LAND AS MORE PARTICULARLY DESCRIBED IN SAID DOCUMENT.

(AS SHOWN ON THAT CERTAIN ALTA SURVEY DATED FEBRUARY & MARCH, 1984 AND REVISED FEBRUARY 15, 1989, PREPARED BY PSOMAS AND ASSOCIATES UNDER JOB NO. 1 HUG 0701-03)

32. INTENTIONALLY DELETED.

33. INTENTIONALLY DELETED.

Continued on next page

34. AN EASEMENT FOR THE PURPOSE SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT

GRANTED TO	SOUTHERN CALIFORNIA GAS COMPANY, A CALIFORNIA CORPORATION
PURPOSE	PIPE LINE AND PRIVATE DRIVEWAY PURPOSES
RECORDED	AUGUST 30, 1963 IN BOOK M-1338, PAGE 280, OFFICIAL RECORDS
AFFECTS	A STRIP OF LAND, 25 FEET IN WIDTH, BEING 12.5 FEET ON EITHER SIDE OF SAID CENTER LINE OF PARCELS 5-1 AND 6-2, AS DESCRIBED THEREIN

(AS SHOWN ON THAT CERTAIN ALTA SURVEY DATED FEBRUARY & MARCH, 1984 AND REVISED FEBRUARY 15, 1989, PREPARED BY PSOMAS AND ASSOCIATES UNDER JOB NO. 1 HUG 0701-03)

35. AN EASEMENT FOR THE PURPOSE SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT

GRANTED TO	LOS ANGELES COUNTY FLOOD CONTROL DISTRICT
PURPOSE	BICYCLE TRAIL
RECORDED	AUGUST 30, 1978
INSTRUMENT/FILE NO	78-963251, OF OFFICIAL RECORDS
AFFECTS	PARCELS 4, 5 AND 6 OF QUAD III

36. AN EASEMENT FOR THE PURPOSE SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT

GRANTED TO	SOUTHERN CALIFORNIA GAS COMPANY
PURPOSE	PUBLIC UTILITIES
RECORDED	AUGUST 30, 1963 IN BOOK D2166, PAGE 904 AS INSTRUMENT NO. 7056, OF OFFICIAL RECORDS

SAID MATTER AFFECTS A PORTION OF SAID LAND AS MORE PARTICULARLY DESCRIBED IN SAID DOCUMENT.

(AS SHOWN ON THAT CERTAIN ALTA SURVEY DATED FEBRUARY & MARCH, 1984 AND REVISED FEBRUARY 15, 1989, PREPARED BY PSOMAS AND ASSOCIATES UNDER JOB NO. 1 HUG 0701-03)

ALL EASEMENTS AND RIGHTS OF WAY INCLUDING THOSE FOR PIPE LINES, PRIVATE ROADWAY AND INGRESS AND EGRESS IN, ON, OVER, THROUGH AND ACROSS THE SAID PARCEL, ARE LIMITED BY AND SUBJECT TO THE PROVISIONS AND CONDITIONS OF THE QUITCLAIM BY SOUTHERN CALIFORNIA GAS COMPANY IN THE AGREEMENT DATED AUGUST 15, 1963, RECORDED AUGUST 30, 1963 IN BOOK M1338, PAGE 280, OF OFFICIAL RECORDS.

37. AN EASEMENT AFFECTING SAID LAND FOR THE PURPOSE OF CONFINING FLOOD WATERS WITHIN THE LINES OF LA BALLONA FLOOD CONTROL

Continued on next page

CHANNEL, 380 FEET WIDE, THE CENTER LINE OF SAID CHANNEL BEING MORE PARTICULARLY DESCRIBED IN PROCEEDINGS HAD IN LOS ANGELES COUNTY SUPERIOR COURT CASE NO. 397002, AS REQUIRED IN BOOK 515, PAGE 388 OF OFFICIAL RECORDS, AND RECORDED IN BOOK 16355, PAGE 127, OFFICIAL RECORDS, AND BY FINAL DECREE OF CONDEMNATION, A CERTIFIED COPY OF SAID DECREE RECORDED IN BOOK 16382, PAGE 191, OFFICIAL RECORDS.

BY DEED RECORDED IN BOOK 21861, PAGE 273, OFFICIAL RECORDS, LOS ANGELES COUNTY FLOOD CONTROL DISTRICT QUITCLAIMED ALL INTEREST IN THE EASEMENT AS ACQUIRED BY DEED RECORDED IN BOOK 515, PAGE 388 OF OFFICIAL RECORDS, EXCEPT THAT PORTION OF SAID EASEMENT INCLUDED WITHIN THE BOUNDARIES OF SAID 380 FOOT CHANNEL.

SAID MATTER AFFECTS: PARCELS 4, 5 AND 6 OF QUAD III

(AS SHOWN ON THAT CERTAIN ALTA SURVEY DATED FEBRUARY & MARCH, 1984 AND REVISED FEBRUARY 15, 1989, PREPARED BY PSOMAS AND ASSOCIATES UNDER JOB NO. 1 HUG 0701-03)

38. AN EASEMENT TO EXTEND EMBANKMENT SLOPES BEYOND THE SOUTHEASTERLY LIMITS OF CULVER BOULEVARD FOR THE PURPOSE OF CONSTRUCTING AN OVERHEAD GRADE SEPARATION, SEPARATING CULVER BOULEVARD FROM LINCOLN BOULEVARD, OVER THAT PORTION OF SAID LAND MORE PARTICULARLY DESCRIBED IN AND GRANTED TO THE COUNTY OF LOS ANGELES, BY DEED RECORDED IN BOOK 11340, PAGE 265, OFFICIAL RECORDS.

SAID MATTER AFFECTS: PARCEL 6 OF QUAD III

39. AN EASEMENT FOR THE PURPOSE SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT

GRANTED TO	SOUTHERN CALIFORNIA GAS COMPANY, A CORPORATION
PURPOSE	PIPE LINES AND/OR OIL WELL PURPOSES
RECORDED	AUGUST 21, 1959 AS INSTRUMENT NO. 4834, AND BY DOCUMENT RECORDED IN BOOK 19597, PAGE 105, OFFICIAL RECORDS, AND BY DOCUMENT RECORDED IN BOOK D356, PAGE 958, OFFICIAL RECORDS, AND ALSO DISCLOSED IN AN ASSIGNMENT OF EASEMENTS AND RIGHTS OF WAY RECORDED NOVEMBER 23, 1959 IN BOOK D672, PAGE 138, OFFICIAL RECORDS
AFFECTS	PORTIONS OF QUAD III AS MORE PARTICULARLY DESCRIBED THEREIN

ALL EASEMENTS AND RIGHTS OF WAY INCLUDING THOSE FOR PIPE LINES, PRIVATE ROADWAY AND INGRESS AND EGRESS IN, ON, OVER, THROUGH AND ACROSS THE SAID PARCEL, ARE LIMITED BY AND SUBJECT TO THE PROVISIONS AND CONDITIONS OF THE QUITCLAIM BY SOUTHERN CALIFORNIA GAS COMPANY IN THE AGREEMENT DATED AUGUST 15, 1963,

Continued on next page

RECORDED AUGUST 30, 1963 IN BOOK M1338, PAGE 280 OF OFFICIAL RECORDS.

(AS SHOWN ON THAT CERTAIN ALTA SURVEY DATED FEBRUARY & MARCH, 1984 AND REVISED FEBRUARY 15, 1989, PREPARED BY PSOMAS AND ASSOCIATES UNDER JOB NO. 1 HUG 0701-03)

40. INTENTIONALLY DELETED.

41. INTENTIONALLY DELETED.

42. THE MATTERS CONTAINED IN AN INSTRUMENT:

ENTITLED	GRANTS OF EASEMENTS AND AGREEMENT TO CONVEY WATER AND RECORD
DATED	DECEMBER 8, 1997

BY AND BETWEEN: PLAYA CAPITAL COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY AND HOWARD HUGHES REALTY, INC., A NEVADA CORPORATION UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED.

RECORDED	DECEMBER 10, 1997
INSTRUMENT NO.	97-1945635, OFFICIAL RECORDS

42A. THE MATTERS CONTAINED IN AN INSTRUMENT:

ENTITLED	EXCESS PROPERTY EASEMENT AGREEMENT
DATED	DECEMBER 8, 1997

BY AND BETWEEN: PLAYA CAPITAL COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY AND HOWARD HUGHES REALTY, INC., A NEVADA CORPORATION UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED.

RECORDED	DECEMBER 10, 1997
INSTRUMENT NO.	97-1945636, OFFICIAL RECORDS

43. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED	"EASEMENT AGREEMENT"
DATED	APRIL 15, 1991

BY AND BETWEEN: FRANK L. MARTZ AND MAJORIE OKAMOTO, AS OWNERS, AND MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP, UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED

RECORDED	JULY 8, 1991
INSTRUMENT/FILE NO	91-1033269, OF OFFICIAL RECORDS

REFERENCE IS MADE TO SAID DOCUMENT FOR FULL PARTICULARS

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

44. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED	"EASEMENT AGREEMENT"

Continued on next page

DATED | APRIL 15, 1991
BY AND BETWEEN: WILLIAM V. BALLOUGH AND MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP, UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED
RECORDED | JULY 15, 1991
INSTRUMENT/FILE NO | 91-1079416, OF OFFICIAL RECORDS

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

45. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED | EASEMENT AGREEMENT
DATED | APRIL 15, 1991
BY AND BETWEEN: MURRAY HANDELMAN AND MAXINE HANDELMAN, AND MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP, UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED

RECORDED | JULY 15, 1991
INSTRUMENT/FILE NO | 91-1079417, OF OFFICIAL RECORDS

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

46. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED | "EASEMENT AGREEMENT"
DATED | APRIL 15, 1991
BY AND BETWEEN: BEVERLY P. KING AND MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP, UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED
RECORDED | JULY 15, 1991
INSTRUMENT/FILE NO | 91-1079418, OF OFFICIAL RECORDS

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

47. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED | "EASEMENT AGREEMENT"
DATED | APRIL 15, 1991
BY AND BETWEEN: JAMES B. AYERS AND PUALA M. AYERS AND MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP, UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED
RECORDED | JULY 15, 1991
INSTRUMENT/FILE NO | 91-1079419, OF OFFICIAL RECORDS

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

48. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED | "EASEMENT AGREEMENT"

Continued on next page

DATED | APRIL 15, 1991
BY AND BETWEEN: THOMAS C. BAILEY AND MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED
RECORDED | JULY 15, 1991
INSTRUMENT/FILE NO | 91-1079420, OF OFFICIAL RECORDS

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

49. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED | "EASEMENT AGREEMENT"
DATED | APRIL 15, 1991
BY AND BETWEEN: GLORIA P. BRUCE, TRUSTEE OF THE GLORIA PERI BRUCE LIVING TRUST UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED
RECORDED | JULY 15, 1991
INSTRUMENT/FILE NO | 91-1079421, OF OFFICIAL RECORDS

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

50. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED | "EASEMENT AGREEMENT"
DATED | APRIL 15, 1991
BY AND BETWEEN: RICHARD H. KIRSCHNER AND PAUL SCIBETTA AND MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED
RECORDED | JULY 26, 1991
INSTRUMENT/FILE NO | 91-1162895, OF OFFICIAL RECORDS

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

51. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED | "EASEMENT AGREEMENT"
DATED | APRIL 15, 1991
BY AND BETWEEN: SCOTT W. LEFTWICH, JAMES M. LEFTWICH AND TONI A. LEFTWICH, AND MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP, UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED

RECORDED | JULY 26, 1991
INSTRUMENT/FILE NO | 91-1164700, OF OFFICIAL RECORDS

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

52. THE MATTERS CONTAINED IN AN INSTRUMENT

Continued on next page

ENTITLED	"EASEMENT AGREEMENT"
DATED	APRIL 15, 1991

BY AND BETWEEN: RICHARD H. KIRSCHNER AND PAUL SCIBETTA, AND MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP, UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED

RECORDED	JULY 26, 1991
INSTRUMENT/FILE NO	91-1164701, OF OFFICIAL RECORDS

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

53. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED	"EASEMENT AGREEMENT"
DATED	APRIL 15, 1991

BY AND BETWEEN: BERNICE TOES AND MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP, UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED

RECORDED	JULY 26, 1991
INSTRUMENT/FILE NO	91-1164702, OF OFFICIAL RECORDS

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

54. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED	"EASEMENT AGREEMENT"
DATED	APRIL 15, 1991

BY AND BETWEEN: VERNON D. YOUNG AND MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP, UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED

RECORDED	AUGUST 19, 1991
INSTRUMENT/FILE NO	91-1299572, OF OFFICIAL RECORDS

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

55. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED	"EASEMENT AGREEMENT"
DATED	APRIL 15, 1991

BY AND BETWEEN: CHARLES R. LEIB AND JULIA A. LEIB, AND MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED

RECORDED	AUGUST 19, 1991
INSTRUMENT/FILE NO	91-1299573, OF OFFICIAL RECORDS

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

56. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED	"EASEMENT AGREEMENT"

Continued on next page

DATED | APRIL 15, 1991
BY AND BETWEEN: SAM SHER AND NETTIE SHER, AND MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP, UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED
RECORDED | OCTOBER 2, 1991
INSTRUMENT/FILE NO | 91-1556070, OF OFFICIAL RECORDS

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

57. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED | "EASEMENT AGREEMENT"
DATED | APRIL 15, 1991
BY AND BETWEEN: MARTIN H. LAVITT AND PENNY LAVITT, AND MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED
RECORDED | OCTOBER 2, 1991
INSTRUMENT/FILE NO | 91-1556071, OF OFFICIAL RECORDS

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

58. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED | "EASEMENT AGREEMENT"
DATED | APRIL 15, 1991
BY AND BETWEEN: CARL A. BLOMQUIST AND MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED
RECORDED | OCTOBER 2, 1991
INSTRUMENT/FILE NO | 91-1556072, OF OFFICIAL RECORDS

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

59. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED | "EASEMENT AGREEMENT"
DATED | APRIL 15, 1991
BY AND BETWEEN: LILLIAN E. SNORTUM AND MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP, UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED
RECORDED | OCTOBER 31, 1991
INSTRUMENT/FILE NO | 91-1730658, OF OFFICIAL RECORDS

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

60. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED | "EASEMENT AGREEMENT"
DATED | APRIL 15, 1991
BY AND BETWEEN: RICHARD BRADLEY AND MARJORIE BRADLEY, AND

Continued on next page

MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED

RECORDED	OCTOBER 31, 1991
INSTRUMENT/FILE NO	91-1730659, OF OFFICIAL RECORDS

REFERENCE IS MADE TO SAID DOCUMENT FOR FULL PARTICULARS

SAID MATTER AFFECTS: QUAD III

61. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED	"EASEMENT AGREEMENT"
DATED	APRIL 15, 1991

BY AND BETWEEN: ALLEN J. NUGIER AND MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP, UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED

RECORDED	OCTOBER 31, 1991
INSTRUMENT/FILE NO	91-1730660, OF OFFICIAL RECORDS

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

62. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED	"EASEMENT AGREEMENT"
DATED	APRIL 15, 1991

BY AND BETWEEN: PATRICIA M. BROWN AND MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP, UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED

RECORDED	OCTOBER 31, 1991
INSTRUMENT/FILE NO	91-1730661, OF OFFICIAL RECORDS

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

63. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED	"EASEMENT AGREEMENT"
DATED	APRIL 15, 1991

BY AND BETWEEN: ANN CARLTON BOSE AND ALLEN J. NUGIER, AND MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP, UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED

RECORDED	NOVEMBER 8, 1991
INSTRUMENT/FILE NO	91-1779300, OF OFFICIAL RECORDS

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

64. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED	"EASEMENT AGREEMENT"

Continued on next page

DATED | APRIL 15, 1991
BY AND BETWEEN: TOM BEAUDETTE AND MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED
RECORDED | NOVEMBER 8, 1991
INSTRUMENT/FILE NO | 91-1779301, OF OFFICIAL RECORDS

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

65. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED | "EASEMENT AGREEMENT"
DATED | APRIL 15, 1991
BY AND BETWEEN: ALLEN J. NUGIER AND MAGUIRE THOMAS PARTNERS-PLAYA-VISTA, A CALIFORNIA LIMITED PARTNERSHIP UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED
RECORDED | NOVEMBER 8, 1991
INSTRUMENT/FILE NO | 91-1779302, OF OFFICIAL RECORDS

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

66. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED | "EASEMENT AGREEMENT"
DATED | OCTOBER 29, 1991
BY AND BETWEEN: NOT SHOWN UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED
RECORDED | NOVEMBER 27, 1991
INSTRUMENT/FILE NO | 91-1883228, OF OFFICIAL RECORDS

REFERENCE IS MADE TO SAID DOCUMENT FOR FULL PARTICULARS

SAID MATTER AFFECTS: PARCEL 3 OF QUAD III

67. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED | "EASEMENT AGREEMENT"
DATED | APRIL 15, 1991
BY AND BETWEEN: EVERETT WILBUR AND MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED
RECORDED | MAY 8, 1992
INSTRUMENT/FILE NO | 92-832608, OF OFFICIAL RECORDS

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

68. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED | "EASEMENT AGREEMENT"
DATED | APRIL 15, 1991

Continued on next page

BY AND BETWEEN: B. MAX IVERSON AND MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP, UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED

RECORDED	JUNE 9, 1992
INSTRUMENT/FILE NO	92-1046530, OF OFFICIAL RECORDS

SAID MATTER AFFECTS: PARCELS 2 AND 4 OF QUAD III

69. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED	"MEMORANDUM OF AGREEMENT"
DATED	JANUARY 4, 1996

BY: MAGUIRE THOMAS PARTNERS-PLAYA VISTA, A CALIFORNIA LIMITED PARTNERSHIP UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED

RECORDED	APRIL 23, 1996
INSTRUMENT/FILE NO	96-637590, OF OFFICIAL RECORDS

REFERENCE IS MADE TO SAID DOCUMENT FOR FULL PARTICULARS

SAID MATTER AFFECTS: QUAD II, QUAD III AND IV

70. INTENTIONALLY DELETED.

71. INTENTIONALLY DELETED.

72. INTENTIONALLY DELETED.

73. INTENTIONALLY DELETED.

74. INTENTIONALLY DELETED.

75. INTENTIONALLY DELETED.

76. INTENTIONALLY DELETED.

77. THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED	EASEMENT AGREEMENT

UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED

RECORDED	FEBRUARY 17, 2000
INSTRUMENT/FILE NO	00-251447, OF OFFICIAL RECORDS

78. DEED OF TRUST TO SECURE AN INDEBTEDNESS IN THE AMOUNT SHOWN BELOW, AND ANY OTHER OBLIGATIONS SECURED THEREBY:

AMOUNT	$60,400,000.00
DATED	SEPTEMBER 2, 1997
TRUSTOR	PLAYA CAPITAL COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY
TRUSTEE	FIRST AMERICAN TITLE INSURANCE COMPANY

Continued on next page

BENEFICIARY	PLAYA INVESTMENTS, LLC, A DELAWARE LIMITED LIABILITY COMPANY
RECORDED	OCTOBER 16, 1997
INSTRUMENT NO.	97-16256347 OF OFFICIAL RECORDS

AN RE-RECORDED DECEMBER 23, 1997, AS INSTRUMENT NO. 97-2009527, OF OFFICIAL RECORDS.

A SUBORDINATION, AND STANDSTILL AGREEMENT, DATED MAY 5, 1999 AFFECTING THE DEED OF TRUST SHOWN ABOVE AND THE DEED OF TRUST RECORDED MAY 5, 1999 AS INSTRUMENT NO. 99-828122, OF OFFICIAL RECORDS RECORDED MAY 7, 1999 AS INSTRUMENT NO. 99-828134, OF OFFICIAL RECORDS.

AFFECTS: THE HEREIN DESCRIBED LAND AND OTHER LAND.

SAID DEED OF TRUST HAS BEEN SUBORDINATED BY THE PROVISIONS OF AN INSTRUMENT

DATED	APRIL 17, 2003
EXECUTED BY	PLAYA INVESTMENTS, LLC, A DELAWARE LIMITED LIABILITY COMPANY AND PLAYA CAPITAL COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY
RECORDED	APRIL 24, 2003
INSTRUMENT/FILE NO	03-1162167, OFFICIAL RECORDS
SUBORDINATED TO	ITEMS NOS. 100 & 101

SUBSTITUTION OF TRUSTEE UNDER SAID DEED OF TRUST WHICH NAMES AS THE SUBSTITUTED TRUSTEE, THE FOLLOWING:

TRUSTEE	FIRST AMERICAN TITLE INSURANCE COMPANY
RECORDED	JUNE 27, 2003
INSTRUMENT/FILE NO	03-1845461 OF OFFICIAL RECORDS

79. DEED OF TRUST TO SECURE AN INDEBTEDNESS IN THE AMOUNT SHOWN BELOW, AND ANY OTHER OBLIGATIONS SECURED THEREBY:

AMOUNT	$30,000,000.00
DATED	MAY 5, 1999
TRUSTOR	PLAYA CAPITAL COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY; PLAYA PHASE I COMMERCIAL LAND COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY AND PLAYA PARCEL E CAPITAL COMPANY, LLC., A DELAWARE LIMITED LIABILITY COMPANY
TRUSTEE	STEWART TITLE COMPANY
BENEFICIARY	TOKAI BANK OF CALIFORNIA, A CALIFORNIA BANKING CORPORATION
RECORDED	MAY 7, 1999
INSTRUMENT NO.	99-0828132 OF OFFICIAL RECORDS

Continued on next page

AFFECTS: THE HEREIN DESCRIBED LAND AND OTHER LAND.

THE MATTERS CONTAINED IN AN INSTRUMENT

ENTITLED	"ABSOLUTE ASSIGNMENT OF LEASES, LEASE GUARANTEES, RENTS, ISSUES AND PROFITS"

BY: TOKAI BANK OF CALIFORNIA, A CALIFORNIA BANKING CORPORATION
UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED

RECORDED	MAY 7, 1999
INSTRUMENT NO.	99-0828133, OF OFFICIAL RECORDS

SUBSTITUTION OF TRUSTEE UNDER SAID DEED OF TRUST WHICH NAMES AS THE SUBSTITUTED TRUSTEE, THE FOLLOWING:

TRUSTEE	TOKAI BANK OF CALIFORNIA, A CALIFORNIA BANKING CORPORATION
RECORDED	SEPTEMBER 17, 1999
INSTRUMENT NO.	99-1777009, OF OFFICIAL RECORDS

SUBSTITUTION OF TRUSTEE UNDER SAID DEED OF TRUST WHICH NAMES AS THE SUBSTITUTED TRUSTEE, THE FOLLOWING:

TRUSTEE	UNITED CALIFORNIA BANK, A CALIFORNIA CORPORATION, SUCCESSOR TO TOKAI BANK OF CALIFORNIA
RECORDED	AUGUST 27, 2002
INSTRUMENT/FILE NO	02-2013243 OF OFFICIAL RECORDS

AN INSTRUMENT PURPORTS TO MODIFY THE TERMS OF SAID DEED OF TRUST AS THEREIN PROVIDED

EXECUTED BY	PLAYA INVESTMENTS, LLC, A DELAWARE LIMITED LIABILITY COMPANY AND PLAYA CAPITAL COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY AND PLAYA PHASE 1 COMMERCIAL LAND COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY AND BANK OF THE WEST, A CALIFORNIA BANKING CORPORATION
DATED	JANUARY 5, 2003
RECORDED	MARCH 19, 2002
INSTRUMENT/FILE NO	02-0770751, OFFICIAL RECORDS

SAID INSTRUMENT HAS BEEN SUBORDINATED BY THAT CERTAIN IRREVOCABLE OFFER TO DEDICATE:

DATED	SEPTEMBER 19, 2003
EXECUTED BY	BANK OF THE WEST
RECORDED	OCTOBER 23, 2003
INSTRUMENT/FILE NO	03-3175571 OFFICIAL RECORDS
SUBORDINATED TO	ITEM 108

Continued on next page

80. RIGHTS OF THE FOLLOWING UNDER VARIOUS OFF-RECORD LEASES, AGREEMENTS AND LICENSES, TO USE PORTION OF SAID LAND:

A. LICENSE AGREEMENT BETWEEN HHPLP AND JACK GORDON, DATED JULY 13, 1987.

SAID MATTER AFFECTS: PORTION OF PARCEL 2 OF QUAD III

B. LICENSE AGREEMENT BETWEEN SUMMA CORPORATION AND GERALD W. COLVIN, DATED JUNE 15, 1984.

SAID MATTER AFFECTS: PORTION OF PARCEL 2 OF QUAD III

C. LICENSE AGREEMENT BETWEEN SUMMA CORPORATION AND JUNE MALTCHEFF, DATED OCTOBER 25, 1983.

SAID MATTER AFFECTS: PORTION OF PARCEL 2 OF QUAD III

D. LICENSE AGREEMENT BETWEEN SUMMA CORPORATION AND LUC MATILLA, DATED JULY 7, 1984.

SAID MATTER AFFECTS: PORTION OF PARCEL 2 OF QUAD III

E. LICENSE AGREEMENT BETWEEN SUMMA CORPORATION AND WESTREY CLUBS, INC., DATED MAY 1, 1983.

SAID MATTER AFFECTS: PORTION OF PARCEL 2 OF QUAD III

81. THE MATTERS CONTAINED IN AN INSTRUMENT:

ENTITLED	MEMORANDUM OF OPTION

BY AND BETWEEN: PLAYA CAPITAL COMPANY LLC, A DELAWARE LIMITED LIABILITY COMPANY AND THE TRUST FOR PUBLIC LAND, A CALIFORNIA NONPROFIT PUBLIC BENEFIT CORPORATION UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED.

RECORDED	SEPTEMBER 7, 2001
INSTRUMENT NO.	01-1688057, OFFICIAL RECORDS

REFERENCE IS MADE TO SAID DOCUMENT FOR FULL PARTICULARS.

82. INTENTIONALLY DELETED.

83. INTENTIONALLY DELETED.

84. A LIEN FOR UNSECURED PROPERTY TAXES FILED BY THE TAX COLLECTOR OF THE COUNTY SHOWN, FOR THE AMOUNT SET FORTH, AND ANY OTHER AMOUNTS DUE:

COUNTY	LOS ANGELES
FISCAL YEAR	2001-2002
TAXPAYER	PLAYA CAPITAL COMPANY LLC
COUNTY ID	01/40745622

Continued on next page

AMOUNT	$5,433.45
RECORDED	MARCH 8, 2002
INSTRUMENT NO.	02-0557076 OF OFFICIAL RECORDS

85. RIGHTS OF PARTIES IN POSSESSION.

86. MATTERS WHICH MAY BE DISCLOSED BY AN INSPECTION OR BY A SURVEY OF SAID LAND SATISFACTORY TO THIS COMPANY, OR BY INQUIRY OF THE PARTIES IN POSSESSION THEREOF.

87. AN EASEMENT OR OTHER PROVISIONS FOR THE PURPOSES SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SHOWN ON THE RECORDED MAP:

MAP NO.	TRACT NO. 27933
EASEMENT PURPOSE	BAY STREET
AFFECTS	PARCEL VIII (PORTION OF PARCEL II QUAD IV AREA D)

88. INTENTIONALLY DELETED.

89. THE MATTERS CONTAINED IN AN INSTRUMENT:

ENTITLED	PERMANENT ECOSYSTEM RESTORATION EASEMENT AGREEMENT
DATED	AUGUST 15, 2002

BY AND BETWEEN: PLAYA CAPITAL COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY AND THE CITY OF LOS ANGELES AND ITS PERMITTED SUCCESSORS AND ASSIGNS UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED.

RECORDED	AUGUST 22, 2002
INSTRUMENT NO.	02-1977694, OFFICIAL RECORDS

REFERENCE IS MADE TO SAID DOCUMENT FOR FULL PARTICULARS.

90. THE MATTERS CONTAINED IN AN INSTRUMENT:

ENTITLED	EASEMENT AGREEMENT
DATED	OCTOBER 24, 2002

BY AND BETWEEN: LAGUNA DEL REY, LLC, A CALIFORNIA LIMITED LIABILITY COMPANY AND PLAYA CAPITAL COMPANY, LLC, A CALIFORNIA LIMITED LIABILITY COMPANY UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED.

RECORDED	NOVEMBER 7, 2002
INSTRUMENT NO.	02-2669323, OFFICIAL RECORDS

REFERENCE IS MADE TO SAID DOCUMENT FOR FULL PARTICULARS.

++++++++ THE FOLLOWING MATTERS AFFECT PARCELS V, VI, VIII +++++++++
AND/OR AS INDICATED

Continued on next page

91. INTENTIONALLY DELETED.

92. AN EASEMENT FOR THE PURPOSES SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SHOWN OR AS OFFERED FOR DEDICATION ON THE RECORDED MAP SHOWN BELOW

MAP NO	9167
IN FAVOR OF	THE CITY OF LOS ANGELES
EASEMENT PURPOSE	SANITARY SEWERS
AFFECTS	THE REAR 7.00 FEET OF LOTS 1 TO 11 AND 13 OF PARCELS 8 AND 9 OF QUAD III

(AS SHOWN ON THAT CERTAIN ALTA SURVEY DATED FEBRUARY & MARCH, 1984 AND REVISED FEBRUARY 15, 1989, PREPARED BY PSOMAS AND ASSOCIATES UNDER JOB NO. 1 HUG 0701-03)

93. AN EASEMENT FOR THE PURPOSE SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT

GRANTED TO	TITLE GUARANTEE AND TRUST COMPANY, A CORPORATION
PURPOSE	POLES, CONDUITS, SEWER, WATER AND GAS PIPES
RECORDED	IN BOOK 11238, PAGE 265, OFFICIAL RECORDS
AFFECTS	PORTIONS OF PARCELS 8, 9 AND 11 OF QUAD III AS MORE PARTICULARLY DESCRIBED IN SAID DOCUMENT

94. THE PROVISIONS IN THE DEED PROHIBITING THE BUYING, SELLING OR HANDLING OF INTOXICATING LIQUORS UPON SAID LAND, ALSO PROVIDE THAT A VIOLATION THEREOF SHALL NOT DEFEAT OR RENDER INVALID THE LIEN OF ANY MORTGAGE OR DEED OF TRUST MADE IN GOOD FAITH AND FOR VALUE, ANY OTHER COVENANTS, CONDITIONS AND RESTRICTIONS IN SAID DEED BEING UNENFORCEABLE,

IN FAVOR OF	TITLE GUARANTEE AND TRUST COMPANY, A CORPORATION
RECORDED	IN BOOK 11238, PAGE 265, OF OFFICIAL RECORDS

SAID MATTER AFFECTS: PARCELS 8, 9 AND 11 OF QUAD III

95. AN EASEMENT FOR THE PURPOSES SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SHOWN OR AS OFFERED FOR DEDICATION ON THE RECORDED MAP SHOWN BELOW

MAP NO	SUBDIVISION 9167
IN FAVOR OF	THE CITY OF LOS ANGELES
EASEMENT PURPOSE	SANITARY SEWERS
AFFECTS	THE NORTH 4 FEET OF LOTS 1 AND 2 AND THE NORTH 7 FEET OF LOTS 4, 5 AND 6 OF PARCELS 10 AND 11 OF QUAD III

(AS SHOWN ON THAT CERTAIN ALTA SURVEY DATED FEBRUARY & MARCH, 1984 AND REVISED FEBRUARY 15, 1989, PREPARED BY PSOMAS AND

Continued on next page

ASSOCIATES UNDER JOB NO. 1 HUG 0701-03)

96. INTENTIONALLY DELETED.

97. INTENTIONALLY DELETED.

98. INTENTIONALLY DELETED.

99. COVENANTS, CONDITIONS, AND RESTRICTIONS AS SET FORTH IN INSTRUMENT RECORDED FEBRUARY 7, 2000 AS INSTRUMENT NO. 00-187083, OFFICIAL RECORDS, BUT OMITTED ANY COVENANT, CONDITION OR RESTRICTION, IF ANY, BASED ON RACE, COLOR, RELIGION, SEX, HANDICAP, FAMILIAL STATUS OR NATIONAL ORIGIN UNLESS AND ONLY TO THE EXTENT THAT THE COVENANT, CONDITION OR RESTRICTION; (A) IS EXEMPT UNDER TITLE 42 OF THE UNITED STATES CODE; OR (B) RELATES TO HANDICAP, BUT DOES NOT DISCRIMINATE AGAINST HANDICAPPED PERSONS.

NOTE: SECTION 12956.1 OF THE GOVERNMENT CODE PROVIDES THE FOLLOWING: IF THIS DOCUMENT CONTAINS ANY RESTRICTIONS BASED ON RACE, COLOR, RELIGION, SEX, FAMILIAL STATUS, MARITAL STATUS, DISABILITY, NATIONAL ORIGIN, OR ANCESTRY, THAT RESTRICTION VIOLATES STATE AND FEDERAL FAIR HOUSING LAWS AND IS VOID, AND MAY BE REMOVED PURSUANT TO SECTION 12956.1 OF THE GOVERNMENT CODE. LAWFUL RESTRICTIONS UNDER STATE AND FEDERAL LAW ON THE AGE OF OCCUPANTS IN SENIOR HOUSING OR FOR OLDER PERSONS SHALL NOT BE CONSTRUED AS RESTRICTIONS BASED ON FAMILIAL STATUS.

SAID COVENANTS, CONDITIONS AND RESTRICTIONS HAVE BEEN MODIFIED BY AN INSTRUMENT:

RECORDED	NOVEMBER 26, 2002
INSTRUMENT NO.	02-2875170 OF OFFICIAL RECORDS

SAID COVENANTS, CONDITIONS AND RESTRICTIONS HAVE BEEN MODIFIED BY AN INSTRUMENT:

RECORDED	NOVEMBER 26, 2002
INSTRUMENT NO.	02-2875171 OF OFFICIAL RECORDS

100. THE MATTERS CONTAINED IN AN INSTRUMENT:

ENTITLED	EASEMENT AGREEMENT
DATED	FEBRUARY 21, 2003

BY AND BETWEEN: BALLONA WETLANDS FOUNDATION, A CALIFORNIA NON-PROFIT PUBLIC BENEFIT CORPORATION AND PLAYA CAPITAL COMPANY, LLC, A CALIFORNIA LIMITED LIABILITY COMPANY UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED.

RECORDED	MARCH 7, 2003
INSTRUMENT NO.	03-0666343, OFFICIAL RECORDS

Continued on next page

REFERENCE IS MADE TO SAID DOCUMENT FOR FULL PARTICULARS.

101. THE MATTERS CONTAINED IN AN INSTRUMENT:
ENTITLED | DEED RESTRICTION
BY : PLAYA CAPITAL COMPANY, LLC, A CALIFORNIA LIMITED LIABILITY COMPANY UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED.
RECORDED | MARCH 7, 2003
INSTRUMENT NO. | 03-0666344, OFFICIAL RECORDS

REFERENCE IS MADE TO SAID DOCUMENT FOR FULL PARTICULARS.

102. AN EASEMENT FOR THE PURPOSE SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT:

GRANTEE	CITY OF LOS ANGELES, A MUNICIPAL CORPORATION
PURPOSE	PUBLIC STREET
RECORDED	MAY 1, 2003
INSTRUMENT/FILE NO.	03-1249250, OF OFFICIAL RECORDS

SAID MATTER AFFECTS A PORTION OF SAID LAND AS MORE PARTICULARLY DESCRIBED IN SAID DOCUMENT.

103. THE MATTERS CONTAINED IN AN INSTRUMENT:
ENTITLED | AGREEMENT FOR EXEMPTION OF 2002/03 STANDBY CHARGE
DATED | JUNE 1, 2002
BY AND BETWEEN: WEST BASIN MUNICIPAL WATER DISTRICT AND PLAYA CAPITAL COMPANY, LLC UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED.
RECORDED | JULY 30, 2003
INSTRUMENT NO. | 03-2184704, OFFICIAL RECORDS

REFERENCE IS MADE TO SAID DOCUMENT FOR FULL PARTICULARS.

104. THE MATTERS CONTAINED IN AN INSTRUMENT:
ENTITLED | AGREEMENT FOR EXEMPTION OF 2002/03 STANDBY CHARGE
DATED | JUNE 1, 2002
BY AND BETWEEN: WEST BASIN MUNICIPAL WATER DISTRICT AND PLAYA CAPITAL COMPANY, LLC UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED.
RECORDED | JULY 30, 2003
INSTRUMENT NO. | 03-2184705, OFFICIAL RECORDS

REFERENCE IS MADE TO SAID DOCUMENT FOR FULL PARTICULARS.

105. A LIEN FOR UNSECURED PROPERTY TAXES FILED BY THE TAX COLLECTOR OF THE COUNTY SHOWN, FOR THE AMOUNT SET FORTH, AND

Continued on next page

ANY OTHER AMOUNTS DUE:

COUNTY	LOS ANGELES
TAXPAYER	PLAYA CAPITAL COMPANY LLC LESSEE C/O ASCOM HASLER
YEAR/ACCOUNT NO	02/49914335
AMOUNT	$117.06
RECORDED	JUNE 17, 2003
INSTRUMENT NO.	03-1722853 OF OFFICIAL RECORDS

106. A LIEN FOR UNSECURED PROPERTY TAXES FILED BY THE TAX COLLECTOR OF THE COUNTY SHOWN, FOR THE AMOUNT SET FORTH, AND ANY OTHER AMOUNTS DUE:

COUNTY	LOS ANGELES
TAXPAYER	PLAYA CAPITAL LESSEE C/O GTE
YEAR/ACCOUNT NO	02/49917153
AMOUNT	$1,693.89
RECORDED	SEPTEMBER 08, 2003
INSTRUMENT NO.	03-2623553 OF OFFICIAL RECORDS

107. A LIEN FOR UNSECURED PROPERTY TAXES FILED BY THE TAX COLLECTOR OF THE COUNTY SHOWN, FOR THE AMOUNT SET FORTH, AND ANY OTHER AMOUNTS DUE:

COUNTY	LOS ANGELES
TAXPAYER	PLAYA CAPITAL LESSEE C/O GTE
YEAR/ACCOUNT NO.	02/49917151
AMOUNT	$2,547.47
RECORDED	SEPTEMBER 08, 2003
INSTRUMENT NO.	03-2623666 OF OFFICIAL RECORDS

108. AN IRREVOCABLE OFFER TO DEDICATE REAL PROPERTY RECORDED OCTOBER 23, 2003 AS INSTRUMENT NO. 03-3175571, OFFICIAL RECORDS WHEREIN A PORTION OF SAID LAND WAS OFFERED FOR DEDICATION TO PUBLIC USE FOR PUBLIC STORM DRAIN PURPOSES.
AFFECTS| SAID LAND

109. THE MATTERS CONTAINED IN AN INSTRUMENT:

ENTITLED	MEMORANDUM OF AGREEMENT TO SUBORDINATE

BY AND BETWEEN: PLAYA CAPITAL COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY AND THE TRUST FOR PUBLIC LAND, A CALIFORNIA NONPROFIT BENEFIT CORPORATION UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED.

RECORDED	OCTOBER 22, 2003
INSTRUMENT NO.	03-3162873, OFFICIAL RECORDS

REFERENCE IS MADE TO SAID DOCUMENT FOR FULL PARTICULARS.

110. RIGHTS OF PARTIES IN POSSESSION OF SAID LAND BY REASON OF UNRECORDED LEASES.

Continued on next page

111. MATTERS WHICH MAY BE DISCLOSED BY AN INSPECTION OR BY A SURVEY OF SAID LAND SATISFACTORY TO THIS COMPANY, OR BY INQUIRY OF THE PARTIES IN POSSESSION THEREOF.

++++++++++++++++++++ REQUIREMENTS ++++++++++++++++++++

1. PRIOR TO THE ISSUANCE OF ANY POLICY OF TITLE INSURANCE, THE COMPANY WILL REQUIRE THE FOLLOWING WITH RESPECT TO PLAYA CAPITAL COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY:

1. A COPY OF ITS OPERATING AGREEMENT AND ANY AMENDMENTS THERETO MUST BE SUBMITTED TO THE COMPANY FOR REVIEW.

2. A CERTIFIED COPY OF ITS ARTICLES OF ORGANIZATION (LLC-1), ANY CERTIFICATE OF CORRECTION (LLC-11), CERTIFICATE OF AMENDMENT (LLC-2), OR RESTATEMENT OF ARTICLES OF ORGANIZATION (LLC-10) MUST BE SUBMITTED TO THE COMPANY FOR REVIEW.

3. WITH RESPECT TO ANY DEED, DEED OF TRUST, LEASE, SUBORDINATION AGREEMENT OR OTHER DOCUMENT OR INSTRUMENT EXECUTED BY SUCH LIMITED LIABILITY COMPANY AND PRESENTED TO THE COMPANY FOR RECORDING OR UPON WHICH THE COMPANY IS ASKED TO RELY, SUCH DOCUMENT OR INSTRUMENT MUST BE EXECUTED IN ACCORDANCE WITH THE FOLLOWING:

(A) IF THE LIMITED LIABILITY COMPANY PROPERLY OPERATES THROUGH OFFICERS APPOINTED OR ELECTED PURSUANT TO THE TERMS OF THE WRITTEN OPERATING AGREEMENT, SUCH DOCUMENT OR INSTRUMENT MUST BE EXECUTED BY AT LEAST TWO DULY ELECTED OR APPOINTED OFFICERS AS FOLLOWS: THE CHAIRMAN OF THE BOARD, THE PRESIDENT, VICE PRESIDENT, AND ANY SECRETARY, ASSISTANT SECRETARY, THE CHIEF FINANCIAL OFFICER OR ANY ASSISTANT TREASURER.

(B) IF THE LIMITED LIABILITY COMPANY PROPERLY OPERATES THROUGH A MANAGER OR MANAGERS IDENTIFIED IN THE ARTICLES OF ORGANIZATION AND/OR DULY ELECTED PURSUANT TO THE TERMS OF A WRITTEN OPERATING AGREEMENT, SUCH DOCUMENT OR INSTRUMENT MUST BE EXECUTED BY AT LEAST TWO SUCH MANAGERS OR BY ONE MANAGER IF THE LIMITED LIABILITY COMPANY PROPERLY OPERATES WITH THE EXISTENCE OF ONLY ONE MANAGER.

4. OTHER REQUIREMENTS WHICH THE COMPANY MAY IMPOSE FOLLOWING ITS REVIEW OF THE MATERIAL REQUIRED HEREIN AND OTHER INFORMATION WHICH THE COMPANY MAY REQUIRE.

Continued on next page

2. THIS COMPANY WILL REQUIRE THAT A FULL COPY OF ANY UNRECORDED LEASES BE SUBMITTED TO US, TOGETHER WITH ALL SUPPLEMENTS, ASSIGNMENTS AND AMENDMENTS, BEFORE ISSUING ANY POLICY OF TITLE INSURANCE.

3. THIS COMPANY IS REQUIRING THAT THE ATTACHED "OWNERS INFORMATION STATEMENT" BE COMPLETED BY THE OWNER OF THE ESTATE DESCRIBED OR REFERRED TO IN SCHEDULE A, IMMEDIATELY PRIOR TO THE CLOSE OF THIS TRANSACTION AND RETURNED TO US FOR OUR APPROVAL.

THE PURPOSE OF THE OWNERS INFORMATION STATEMENT IS TO PROVIDE THIS COMPANY WITH CERTAIN INFORMATION THAT CANNOT NECESSARILY BE ASCERTAINED BY MAKING A PHYSICAL INSPECTION OF THE LAND.

PLEASE CONTACT US IN THE EVENT YOU REQUIRE ASSISTANCE IN COMPLETING SAID OWNERS INFORMATION STATEMENT.

4. PROVIDE RELEASE/RECONVEYANCE INSTRUMENTS FOR DEEDS OF TRUST OF RECORD AS FOLLOWS:

A. IF INSTITUTIONAL LENDER WE MUST BE PROVIDED A DEMAND FOR PAYMENT. IF SERVICED BY OTHER THAN THE BENEFICIARY WE MUST BE PROVIDED A COPY OF THE LOAN SERVICING AGREEMENT.

B. IF AN INDIVIDUAL LENDER WE MUST BE PROVIDED DEMAND FOR PAYMENT TOGETHER WITH THE ORIGINAL NOTE. DEED OF TRUST AND SIGNED REQUEST FOR FULL RECONVEYANCE, REQUEST FOR FULL RECONVEYANCE MUST BE SIGNED BY BOTH SPOUSES IF BENEFICIAL INTEREST IS IN ONE SPOUSE ALONE.

C. IF BENEFICIARY IS A TRUST, WE MUST BE PROVIDED A FULL COPY OF SAID TRUST, TOGETHER WITH THE ORIGINAL NOTE, DEED OF TRUST AND SIGNED REQUEST FOR FULL RECONVEYANCE.

D. IF THE LOAN IS FOR A REVOLVING LINE OF CREDIT, THE ACCOUNT MUST BE FROZEN, OTHERWISE WE WILL HOLD AN AMOUNT EQUAL TO THE AVAILABLE CREDIT LIMIT.

5. IT IS THE POLICY OF THIS COMPANY TO MAKE ALL REQUIRED PAYOFFS.

THE COMPANY WILL REQUIRE CURRENT, WRITTEN PAYOFF DEMANDS ADDRESSED TO STEWART TITLE OF CALIFORNIA, INC. OR OUR ESCROW CUSTOMER. NONCURRENT AND EXPIRED DEMANDS WILL NORMALLY NOT BE ACCEPTABLE BUT THEY MAY BE ACCEPTED AT THE DISCRETION OF THE COMPANY IF VERBAL UPDATING CAN BE OBTAINED.

THE COMPANY WILL HOLD AN AMOUNT EQUAL TO ONE MONTHLY MORTGAGE PAYMENT UNTIL ACCEPTANCE BY THE LENDER OF OUR PAYOFF ON ANY

Continued on next page

NONCURRENT OR EXPIRED BENEFICIARY DEMAND, WHETHER OR NOT VERBALLY UPDATED.

THE COMPANY WILL ALSO HOLD AN AMOUNT EQUAL TO ONE MONTHLY MORTGAGE PAYMENT UNTIL ACCEPTANCE BY THE LENDER OF OUR PAYOFF ON ANY DEMAND WHICH INCLUDES A PAYMENT MADE WITHIN 14 DAYS OF CLOSING UNLESS THE COMPANY HAS BEEN PROVIDED WITH SATISFACTORY PROOF OF PAYMENT (I.E. A CANCELLED CHECK OR WRITTEN CONFIRMATION OF CHECK CLEARANCE.)

PLEASE BE ADVISED THAT THE COMPANY WILL REQUIRE THAT THE BENEFICIARY OR BENEFICIARIES SIGN AN ESTIMATED CLOSING COST STATEMENT ANYTIME WE ARE PRESENTED FOR PAYOFF A NET PROCEEDS DEMAND OR A DEMAND IN WHICH THE BENEFICIARY OR BENEFICIARIES ARE ACCEPTING FOR PAYOFF LESS THAN WHAT THEY ARE OWED.

6. IT IS THE POLICY OF STEWART TITLE OF CALIFORNIA - LOS ANGELES DIVISION TO COLLECT ALL TITLE CHARGES AND DEDUCT SAID CHARGES UPON RECORDING WHEN STEWART TITLE IS DOING THE PAYOFF.

END OF EXCEPTIONS

Continued on next page

NOTES

A. LENDERS NOTE:

IF AN ALTA LOAN POLICY - 1970, AMENDED 10-17-70 (AMENDED 12-6-85) IS REQUESTED, THE FOLLOWING WILL BE ADDED AS AN EXCLUSION FROM COVERAGE:

ANY CLAIM, WHICH ARISES OUT OF THE TRANSACTION CREATING THE INTEREST OF THE MORTGAGEE INSURED BY THIS POLICY, BY REASON OF THE OPERATION OF FEDERAL BANKRUPTCY, STATE INSOLVENCY, OR SIMILAR CREDITORS' RIGHTS LAWS THAT IS BASED ON:

(I) THE TRANSACTION CREATING THE INTEREST OF THE INSURED MORTGAGEE BEING DEEMED A FRAUDULENT CONVEYANCE OR FRAUDULENT TRANSFER; OR

(II) THE SUBORDINATION OF THE INTEREST OF THE INSURED MORTGAGEE AS A RESULT OF THE APPLICATION OF THE DOCTRINE OR EQUITABLE SUBORDINATION; OR

(III) THE TRANSACTION CREATING THE INTEREST OF THE INSURED MORTGAGEE BEING DEEMED A PREFERENTIAL TRANSFER EXCEPT WHERE THE PREFERENTIAL TRANSFER RESULTS FROM THE FAILURE:

(A) TO TIMELY RECORD THE INSTRUMENT OF TRANSFER; OR

(B) OF SUCH RECORDATION TO IMPART NOTICE TO A PURCHASER FOR VALUE OR A JUDGEMENT OR LIEN CREDITOR.

B. IF AN OWNERS POLICY WILL BE REQUESTED, PLEASE BE AWARE THAT UNLESS INSTRUCTED OTHERWISE, WE WILL ISSUE A CLTA STANDARD COVERAGE OWNERS POLICY. IF A DIFFERENT FORM OF POLICY IS CONTEMPLATED FOR THIS TRANSACTION, PLEASE ADVISE AND CONTACT YOUR TITLE OFFICER FOR ADDITIONAL REQUIREMENTS

Continued on next page

stewart
title of california

Sanctity of Contract

CALIFORNIA "GOOD FUNDS" LAW

California Insurance Code Section 12413.1 regulates the disbursement of escrow and sub-escrow funds by title companies. The law requires that funds be deposited in the title company escrow account and available prior to disbursement. Funds received by Stewart Title of California, Inc. (Stewart Title) via wire transfer may be disbursed upon receipt. Funds received via cashier's checks or teller checks drawn on a California Bank may be disbursed on the next business day after the day of deposit. If funds are received by any other means, recording and/or disbursement may be delayed, and you should contact your title or escrow officer. All escrow and sub-escrow funds received will be deposited with other escrow funds in one or more non-interest bearing escrow accounts in a financial institution selected by Stewart Title. Stewart Title may receive certain direct or indirect benefits from the financial institution by reason of the deposit of such funds or the maintenance of such accounts with the financial institution, and Stewart Title shall have no obligation to account to the depositing party in any manner for the value of, or pay to such party, any benefit received by Stewart Title. Such benefits shall be deemed additional compensation to Stewart Title for its services in connection with the escrow or sub-escrow.

WIRING INSTRUCTIONS

IF YOU ANTICIPATE HAVING FUNDS WIRED TO STEWART TITLE OF CALIFORNIA, INC. OUR WIRING INFORMATION IS AS FOLLOWS:

ADDITIONAL NOTE: DIRECT WIRE TRANSFERS TO:
CITY NATIONAL BANK
5601 E. SLAUSON AVE
CITY OF COMMERCE, CALIFORNIA 90040
ROUTING NO. 122016066
CREDIT TO STEWART TITLE OF CALIFORNIA, INC.
ACCOUNT # 013 218811
REF: (ORDER # 040115088, TITLE OFFICER NAME: LARRY MCGUIRE)

WHEN INSTRUCTING THE FINANCIAL INSTITUTION TO WIRE FUNDS, IT IS VERY IMPORTANT THAT YOU REFERENCE STEWART TITLE'S ORDER NUMBER.

SHOULD YOU HAVE ANY QUESTIONS IN THIS REGARD PLEASE CONTACT YOUR TITLE OFFICER IMMEDIATELY.

stewart
title of california

Sanctity of Contract

STEWART TITLE OF CALIFORNIA, INC.,
LOS ANGELES DIVISION
525 N. BRAND BLVD.
GLENDALE, CA 91203
(818) 502-2700
www.stewarttitlela.com

MEMBER CALIFORNIA LAND TITLE ASSOCIATION

PRELIMINARY REPORT

PSOMAS AND ASSOCIATES
11444 OLYMPIC BOULEVARD SUITE 750
LOS ANGELES, CA 90065
Attn: JOHN CHIAPPE

Order Number: 040207570

Your Reference: EXPANDED WETLANDS PARCELS

In response to the above referenced application for a Policy of Title Insurance, Stewart Title of California, Inc. hereby reports that it is prepared to issue, or cause to be issued, as of the date hereof, a Policy or Policies of Title Insurance describing the land and the estate or interest therein hereinafter set forth, insuring against loss which may be sustained by reason of any defect, lien or encumbrance not shown or referred to as an Exception below or not excluded from coverage pursuant to the printed Schedules, Conditions and Stipulations of said Policy forms.

The printed Exceptions and exclusions from the coverage and Limitations on Covered Risks of said Policy or Policies are set forth in Exhibit A attached. Limitations on Covered Risks applicable to the CLTA and ALTA Homeowner's Policies of Title Insurance which establish a Deductible Amount and a maximium Dollar Limit of Liability for certain coverages are also set forth in Exhibit A. Copies of the Policy forms should be read. They are available from the office which issued this report.

Please read the exceptions shown or referred to below and the exceptions and exclusions set forth in Exhibit A of this report carefully. The exceptions and exclusions are meant to provide you with notice of matters which are not covered under the terms of the title insurance policy and should be carefully considered.
It is important to note that this preliminary report is not a written representation as to the condition of title and may not list all liens, defects, and encumbrances affecting title to the land.

This report, (and any supplements or amendments hereto) is issued solely for the purpose of facilitating the issuance of a policy of title insurance and no liability is assumed hereby. If it is desired that liability be assumed prior to the issuance of a policy of title insurance a Binder or Commitment should be requested.

Dated as of February 03, 2004 at 7:30 A.M.
Updated

LARRY MCGUIRE, Sr. Title Officer, V.P.
(818) 502-2723 Fax: (818) 241-9173
e-mail address: lmcguire@stewart.com

WIL CAMPOS, Title Officer
(818) 502-2724 Fax: (818) 241-9173
e-mail address: wcampos@stewart.com

PRELIMINARY REPORT

The form of Policy of Title Insurance contemplated by this report is:

California Land Title Association Standard Coverage Policy

American Land Title Association Owners Policy - Form B

SCHEDULE A

The Estate or Interest in the land hereinafter described or referred to covered by this report is:

A FEE

Title to said estate or interest at the date hereof is vested in:

PLAYA CAPITAL COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY

Continued on next page

LEGAL DESCRIPTION

THE LAND REFERRED TO HEREIN IS SITUATED IN THE STATE OF CALIFORNIA, COUNTY OF LOS ANGELES, DESCRIBED AS FOLLOWS:

Parcel 1: (Quad III) (APN 4211-14-7, 8, 9, 13, 14)

That portion of the 341.85 acre tract of the land allotted to Ramona S. de Machado by the Decree of Partition of a portion of the Rancho la Ballona, in the City of Los Angeles, County of Los Angeles, State of California, in Case No. 2722, of the District Court of said County, being also shown on the Map recorded in Book 3 Page 204 et seq., of Miscellaneous Records, in the office of the County Recorder of said County, described as follows:

Beginning at a point in the southerly line of Playa Street, 33 feet wide, as shown on said Map at its intersection with the northerly prolongation of the westerly line of the 80.70 acre tract of land described in deed to R. J. Northam, recorded in Book 2091 Page 127 of Deeds, Records of said County; thence to and along the westerly line of said land of Northam, South 29° East, 2657.60 feet to the most southerly corner of said land, said corner lying on the southerly line of said Rancho la Ballona; thence South 53° West, 344.48 feet to Station 12 of said Rancho; thence North 81° West, 6 chains to Station 13 of said Rancho; thence North 52° 45' West, 17 chains to Station 14 of said Rancho; thence South 73° West, 8 chains to Station 15 of said Rancho, as established by the proceedings in Case No. 20065, Los Angeles County Superior Court; thence parallel with the westerly line of said land of Northam, North 29° West, 20.05 chains to said southerly line of Playa Street; thence along said line of Playa Street, North 61° East, to the Point of Beginning.

Except therefrom that portion of said land lying northeasterly of the southwesterly line of Roosevelt Highway (100 feet wide), as described in the Deed recorded in Book 7448 Page 77, Official Records of said County, and its northwesterly prolongation.

Also except therefrom that portion of said land described as follows:

Beginning at the most westerly corner of that certain parcel of land described in Deed recorded on April 15, 1926 in Book 5662 Page 124, Official Records; thence southeasterly along the southwesterly line of said certain parcel, described in said Deed, to the most southerly corner of said certain parcel;

Continued on next page

thence northeasterly along the southeasterly line of said certain parcel to the most westerly corner of the land designated as Parcel 4A, in lis pendens, recorded September 3, 1965, as Instrument No. 5086, in Book M1969 Page 549, Official Records; thence along the southwesterly lines of said Parcel 4A, the following three courses:

1) South 73° 35' 35" East, 49.58 feet;

2) South 28° 45' 46" East, 336.00 feet;

3) North 61° 14' 14" East, 6.00 feet to said southwesterly line of Roosevelt Highway (100 feet wide); thence northerly along said Roosevelt Highway and its prolongation to the northwesterly line of the land described in said Deed recorded in Book 5662 Page 124, Official Records; thence southwesterly along said northwesterly line of the land described in said last mentioned deed to the Point of Beginning.

Also except therefrom that portion of said land lying northerly and easterly of the following described line:

Beginning at the intersection of the southeasterly line of Playa Street, 33 feet wide, as shown on said Map recorded in Book 3 Page 204 et seq., of Miscellaneous Records, and the westerly line of Roosevelt Highway as described in the deed recorded in Book 7448, Page 77, Official Records, in the Office of the County Recorder of said County; thence along said southeasterly line of Playa Street South 61°14'57" West 49.01 feet; thence South 28°45'03" East 33.50 feet to the southeasterly line of the land described in Book 5662, Page 124 of Official Records of said County, said line being the southeasterly line of Jefferson Boulevard, 100.00 feet wide, as it now exists; thence along said southeasterly line, South 61°14'57" West 1539.20 feet, to the TRUE POINT OF BEGINNING; thence South 16°19'09" West 8.47 feet to the beginning of a curve concave to the east and having a radius of 5.00 feet; thence southerly 6.38 feet along said curve through a central angle of 73°08'41"; thence South 56°49'32" East 22.19 feet to the beginning of a curve concave to the southwest and having a radius of 30.00 feet; thence southeasterly 12.99 feet along said curve through a central angle of 24°49'02"; thence South 32°00'30" East 89.53 feet to the beginning of a curve concave to the southwest and having a radius of 99.00 feet; thence southeasterly 11.32 feet along said curve through a central angle of 6°33'09"; thence South 25°27'21" East 145.17 feet to the beginning of a curve concave to the northeast and having a radius of 225.00 feet; thence southeasterly 57.82 feet along said curve through a central angle of 14°43'26" to the beginning of a curve concave to the northeast having a radius

Continued on next page

of 235.00 feet and to beginning which a radial line bears South 49°56'17" West; thence southeasterly 150.98 feet along said curve through a central angle of 36°48'36" to the beginning of a compound curve concave to the north and having a radius of 160.00 feet; thence easterly 57.55 feet along said curve through a central angle of 20°36'35" to the beginning of a compound curve concave to the north and having a radius of 200.00 feet; thence easterly 66.47 feet along said curve through a central angle of 19°02'32"; thence South 35°45'16" East 46.75 feet; thence South 49°40'26" East 15.74 feet to the beginning of a curve concave to the north and having a radius of 38.00 feet; thence easterly 53.66 feet along said curve through a central angle of 80°54'25"; thence North 49°25'09" East 120.50 feet; thence North 55°28'40" East 26.75 feet; thence North 62°21'19" East 81.50 feet to the beginning of a curve concave to the northwest and having a radius of 41.00 feet; thence northerly 46.72 feet along said curve through a central angle of 65°17'19" to the beginning of a reverse curve concave to the southeast and having a radius of 30.50 feet; thence northerly 40.83 feet along said curve through a central angle of 76°42'09; thence South 88°02'41" East 45.28 feet to the beginning of a curve concave to the south and having a radius of 212.00 feet; thence easterly 18.86 feet along said curve through a central angle of 5°05'55" to the beginning of a compound curve concave to the northwest and having a radius of 268.00 feet; thence easterly 307.90 feet along said curve through a central angle of 65°49'31" to the beginning of a reverse curve concave to the southeast and having a radius of 215.00 feet; thence northeasterly 119.37 feet along said curve through a central angle of 31°48'41" to the beginning of a compound curve concave to the south and having a radius of 77.00 feet; thence easterly and southerly 136.95 feet along said curve through a central angle of 101°54'15"; thence South 15°03'21" East 240.16 feet to the beginning of a curve concave to the east and having a radius of 425.00 feet; thence southerly 448.04 feet along said curve through a central angle of 60°24'06" to the beginning of a reverse curve concave to the southwest and having a radius of 213.00 feet; thence southeasterly 78.18 feet along said curve through a central angle of 21°01'51"; thence on a non-tangent line South 63°06'40" West 70.80 feet; thence South 26°53'20" East 44.00 feet; thence North 63°06'40" East 87.85 feet to the beginning of a curve concave to the southwest and having a radius of 213.00 feet and to which beginning a radial line bears North 48°17'32" East; thence southeasterly 13.42 feet along said curve through a central angle of 3°36'39" to the beginning of a compound curve concave to the southwest and having a radius of 1360.00 feet; thence southerly 475.87 feet along said curve through a central angle of 20°02'53"; thence South 10°40'08" East 43.66 feet; thence South 3°14'13" East 56.39 feet; thence

Continued on next page

South 11°21'02" East 45.97 feet; thence South 3°05'37" East 43.54 feet; thence South 35°35'02" West 31.24 feet; thence South 26°46'54" East 63.00 feet; thence South 42°48'31" East 83.00 feet; thence South 46°47'13" East 124.00 feet; thence South 57°39'29" East 103.50 feet; thence South 77°21'27" East 66.00 feet; thence North 85°15'14" East 125.00 feet; thence North 66°35'11" East 74.00 feet; thence North 89°16'30" East 82.50 feet; thence North 62°39'40" East 29.50 feet; thence North 24°39'33" East 31.00 feet; thence North 12°19'04" East 50.41 feet; thence North 41°35'09" East 31.75 feet along the southwesterly prolongation of a radial line to the curved southwesterly line of Roosevelt Highway (100 feet wide) as described in the Deed recorded in Book 7448 Page 77, Official Records of said County.

Parcel 10: (Quad III) (APN 4114-3-11)

Lot 1, Block 12 of Tract No. 9167, in the City of Los Angeles, County of Los Angeles, State of California, as per map recorded in Book 172 Pages 46 et seq. of Maps, in the Office of the County Recorder of said County.

Parcel 11: (Quad III) (APN 4114-3-12, 13, 14, 15, 16)

Lots 2 through 6 inclusive, in Block 12 of Tract No. 9167, in the City of Los Angeles, County of Los Angeles, State of California, as per Map recorded in Book 172 Pages 46 through 49 of Maps, in the Office of the County Recorder of said County.

This Legal Description is shown on the accompanying "LEGAL DESCRIPTION MAP, EXPANDED WETLANDS PARCEL" Exhibit and is made a part hereof for reference purposes and is not intended for the use in the division and/or conveyance of land in violation of the Subdivision Map Act of the State of California.

END OF LEGAL DESCRIPTION

Continued on next page

SCHEDULE B

At the date hereof, exceptions to coverage in addition to the printed exceptions and exclusions contained in said policy or policies would be as follows:

1. PROPERTY TAXES, WHICH ARE A LIEN NOT YET DUE AND PAYABLE, INCLUDING ANY ASSESSMENTS COLLECTED WITH TAXES, TO BE LEVIED FOR THE FISCAL YEAR 2004 - 2005 WHICH ARE A LIEN NOT YET PAYABLE.

1.1. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$20.15 PAID
2ND INSTALLMENT	$20.15 OPEN
EXEMPTION	NONE
CODE AREA	1502
ASSESSMENT NO.	4211-014-007

1.2. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$23.10 PAID
2ND INSTALLMENT	$23.10 OPEN
EXEMPTION	NONE
CODE AREA	1502
ASSESSMENT NO.	4211-014-008

1.3. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$17.55 PAID
2ND INSTALLMENT	$17.54 OPEN
EXEMPTION	NONE
CODE AREA	1502
ASSESSMENT NO.	4211-014-009

1.4. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$5,440.78 PAID
2ND INSTALLMENT	$5,440.78 OPEN
EXEMPTION	NONE
CODE AREA	1502
ASSESSMENT NO.	4211-014-013

Continued on next page

1.5. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$352.46 PAID
2ND INSTALLMENT	$352.46 OPEN
EXEMPTION	NONE
CODE AREA	1508
ASSESSMENT NO.	4211-014-014

1.6. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$19.06 PAID
2ND INSTALLMENT	$19.06 OPEN
EXEMPTION	NONE
CODE AREA	68
ASSESSMENT NO.	4114-003-011

1.7. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$15.64 PAID
2ND INSTALLMENT	$15.64 OPEN
EXEMPTION	NONE
CODE AREA	68
ASSESSMENT NO.	4114-003-012

1.8. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$15.97 PAID
2ND INSTALLMENT	$15.96 OPEN
EXEMPTION	NONE
CODE AREA	68
ASSESSMENT NO.	4114-003-013

1.9. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$20.79 PAID
2ND INSTALLMENT	$20.79 OPEN
EXEMPTION	NONE
CODE AREA	68
ASSESSMENT NO.	4114-003-014

1.10. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$15.33 PAID
2ND INSTALLMENT	$15.33 OPEN

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EXEMPTION	NONE
CODE AREA	68
ASSESSMENT NO.	4114-003-015

1.11. GENERAL AND SPECIAL CITY AND/OR COUNTY TAXES, INCLUDING ANY PERSONAL PROPERTY TAXES AND ANY ASSESSMENTS COLLECTED WITH TAXES, FOR THE FISCAL YEAR 2003-2004:

1ST INSTALLMENT	$15.32 PAID
2ND INSTALLMENT	$15.32 OPEN
EXEMPTION	NONE
CODE AREA	68
ASSESSMENT NO.	4114-003-016

1.12. SAID LAND HAS BEEN DECLARED TAX DEFAULTED FOR DELINQUENT TAXES FOR THE

FISCAL YEAR	1999-2000
REDEEM PRIOR TO	FEBRUARY 29, 2004
AMOUNT TO REDEEM	$56.85

AFFECTS PARCEL NO: 4114-003-016

PARTIAL PAYMENT ON FILE-EXAMINATION OF COUNTY RECORDS REQUIRED

2. THE LIEN OF SUPPLEMENTAL TAXES, IF ANY, ASSESSED PURSUANT TO THE PROVISIONS OF CHAPTER 3.5 (COMMENCING WITH SECTION 75) OF THE REVENUE AND TAXATION CODE OF THE STATE OF CALIFORNIA AND ASSESSMENTS, FOR COMMUNITY FACILITY DISTRICTS AFFECTING SAID LAND WHICH MAY EXIST BY VIRTUE OF ASSESSMENT MAPS OR NOTICES FILED BY SAID DISTRICTS.

3. COVENANTS, CONDITIONS, AND RESTRICTIONS AS SET FORTH IN INSTRUMENT RECORDED OCTOBER 22, 1926 IN BOOK 6070, PAGE 310 AS INSTRUMENT NO. 708, OFFICIAL RECORDS, BUT OMITTED ANY COVENANT, CONDITION OR RESTRICTION, IF ANY, BASED ON RACE, COLOR, RELIGION, SEX, HANDICAP, FAMILIAL STATUS OR NATIONAL ORIGIN UNLESS AND ONLY TO THE EXTENT THAT THE COVENANT, CONDITION OR RESTRICTION; (A) IS EXEMPT UNDER TITLE 42 OF THE UNITED STATES CODE; OR (B) RELATES TO HANDICAP, BUT DOES NOT DISCRIMINATE AGAINST HANDICAPPED PERSONS.

NOTE: SECTION 12956.1 OF THE GOVERNMENT CODE PROVIDES THE FOLLOWING: IF THIS DOCUMENT CONTAINS ANY RESTRICTIONS BASED ON RACE, COLOR, RELIGION, SEX, FAMILIAL STATUS, MARITAL STATUS, DISABILITY, NATIONAL ORIGIN, OR ANCESTRY, THAT RESTRICTION VIOLATES STATE AND FEDERAL FAIR HOUSING LAWS AND IS VOID, AND MAY BE REMOVED PURSUANT TO SECTION 12956.1 OF THE GOVERNMENT CODE. LAWFUL RESTRICTIONS UNDER STATE AND FEDERAL LAW ON THE AGE OF OCCUPANTS IN SENIOR HOUSING OR FOR OLDER PERSONS SHALL NOT BE CONSTRUED AS RESTRICTIONS BASED ON FAMILIAL STATUS.

4. INTENTIONALLY DELETED.

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5. COVENANTS, CONDITIONS, AND RESTRICTIONS AS SET FORTH IN INSTRUMENT RECORDED IN BOOK 10561 PAGE 279, OFFICIAL RECORDS, BUT OMITTED ANY COVENANT, CONDITION OR RESTRICTION, IF ANY, BASED ON RACE, COLOR, RELIGION, SEX, HANDICAP, FAMILIAL STATUS OR NATIONAL ORIGIN UNLESS AND ONLY TO THE EXTENT THAT THE COVENANT, CONDITION OR RESTRICTION; (A) IS EXEMPT UNDER TITLE 42 OF THE UNITED STATES CODE; OR (B) RELATES TO HANDICAP, BUT DOES NOT DISCRIMINATE AGAINST HANDICAPPED PERSONS.

NOTE: SECTION 12956.1 OF THE GOVERNMENT CODE PROVIDES THE FOLLOWING: IF THIS DOCUMENT CONTAINS ANY RESTRICTIONS BASED ON RACE, COLOR, RELIGION, SEX, FAMILIAL STATUS, MARITAL STATUS, DISABILITY, NATIONAL ORIGIN, OR ANCESTRY, THAT RESTRICTION VIOLATES STATE AND FEDERAL FAIR HOUSING LAWS AND IS VOID, AND MAY BE REMOVED PURSUANT TO SECTION 12956.1 OF THE GOVERNMENT CODE. LAWFUL RESTRICTIONS UNDER STATE AND FEDERAL LAW ON THE AGE OF OCCUPANTS IN SENIOR HOUSING OR FOR OLDER PERSONS SHALL NOT BE CONSTRUED AS RESTRICTIONS BASED ON FAMILIAL STATUS.

SAID COVENANTS, CONDITIONS, AND RESTRICTIONS PROVIDE THAT A VIOLATION THEREOF SHALL NOT DEFEAT OR RENDER INVALID THE LIEN OF ANY MORTGAGE OR DEED OF TRUST MADE IN GOOD FAITH AND FOR VALUE.

6. THE RIGHT TO ENTER UPON SAID LAND AT ANY TIME FOR THE PURPOSE OF GRADING, SURFACING, OILING AND MAINTAINING THE SAME FOR STREET AND/OR ALLEY PURPOSES, FOR THE USE AND BENEFIT OF THE LAND ABUTTING THEREON AND TO PUT IN CULVERTS, GUTTERS AND ALL NECESSARY IMPROVEMENTS FOR THE PROPER DRAINAGE OF SAID LAND AND ABUTTING THEREON AND THE RIGHT AT ANY TIME TO DEDICATE SAID PARCELS OF LAND OR ANY OF THEM TO THE PUBLIC FOR STREET AND/OR ALLEY PURPOSES AND TO GRANT EASEMENTS FOR PUBLIC UTILITIES ACROSS, UNDER AND ALONG THE SAME, SAID DEDICATION TO BE COMPLETE AND SUFFICIENT WITHOUT THE CONSENT OF OR EXECUTION BY ANY OWNER OF ANY LAND ABUTTING ON OR ADJACENT TO SAID LAND AND UPON SUCH DEDICATION THE EASEMENT GRANTED HEREBY SHALL CEASE TO BE PRIVATE AND SHALL MERGER IN THE PUBLIC EASEMENT FOR GENERAL STREET AND OR ALLEY PURPOSES, AS RESERVED IN THE ABOVE MENTIONED DEEDS.

7. AN EASEMENT FOR THE PURPOSE SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT

GRANTED TO	CITY OF LOS ANGELES
PURPOSE	STORM DRAIN AND SANITARY SEWER
RECORDED	IN BOOK 12483, PAGE 310, OFFICIAL RECORDS

SAID MATTER AFFECTS A PORTION OF SAID LAND AS MORE PARTICULARLY DESCRIBED IN SAID DOCUMENT.

"(AS SHOWN ON THAT CERTAIN ALTA SURVEY DATED FEBRUARY AND MARCH

Continued on next page

1984 AND REVISED FEBRUARY 1989, PREPARED BY PSOMAS AND ASSOCIATES UNDER JOB NO. 1 HUG 01701-03)".

8. INTENTIONALLY DELETED.

9. RESERVATION AND EXCEPTION CONTAINED IN DEED FROM RECONSTRUCTION FINANCE CORPORATION AND UNITED STATES OF AMERICA, BOTH ACTING BY AND THROUGH GENERAL SERVICES ADMINISTRATOR TO SOUTHERN CALIFORNIA GAS COMPANY, A CORPORATION, DATED DECEMBER 1, 1953, RECORDED OCTOBER 15, 1954 AS INSTRUMENT NO. 580, IN BOOK 45847, PAGE 89, OFFICIAL RECORDS, THE LOCATION AND TERMS OF WHICH ARE MORE PARTICULARLY DESCRIBED THEREIN.

10. AN EASEMENT OVER SAID LAND FOR A SINGLE LINE OF POLES, WITH CROSS-ARMS AND WIRES, FOR PRIVATE TELEPHONE PURPOSES, TOGETHER WILL ALL RIGHTS OF WAY COVERING THE CONSTRUCTION AND MAINTENANCE OF SUCH FACILITIES, AS CONVEYED BY UNRECORDED SURFACE LEASE FROM DEL REY COMPANY TO P. M. PIKE, DATED JUNE 1, 1933 AND BY MESNE ASSIGNMENTS TRANSFERRED AND CONVEYED TO UNION OIL COMPANY OF CALIFORNIA, BY ASSIGNMENT OF LEASE FROM P. M. PIKE INVESTMENT COMPANY, DATED JANUARY 27, 1943, AS PROVIDED IN DECREE ENTERED JULY 12, 1946 IN ACTION NO. 2454, CIVIL, UNITED STATES DISTRICT COURT, SOUTHERN DISTRICT OF CALIFORNIA, CENTAL DIVISION.

11. AN AGREEMENT DATED AUGUST 15, 1963, WHEREBY HUGHES TOOL COMPANY, A CORPORATION, CONVEYS TO SOUTHERN CALIFORNIA GAS COMPANY, A CORPORATION, THE EXCLUSIVE RIGHT TO USE SUBSURFACE MINERAL, OIL AND/OR GAS ZONES FOR INJECTING, STORING AND WITHDRAWING NATURAL GAS (WHETHER PROVIDED FROM SUCH OR OTHER PROPERTY) THEREIN AND THEREFROM AND FOR REPRESSURING THE SAME; BUT, WITH NO RIGHT TO USE THE SURFACE OR TO CARRY ON SUCH OPERATION EXCEPT BETWEEN A DEPTH OF 500 FEET TO 7000 FEET FROM THE SURFACE THEREOF, WHICH AGREEMENT ALSO RECITES THAT

HUGHES TOOL COMPANY HEREBY COVENANTS AND AGREES TO PROHIBIT EXPLORATION FOR MINERAL, OIL, GAS OR OTHER HYDROCARBONS BETWEEN THE DEPTH OF 500 FEET TO 7000 FEET FROM THE SURFACE, RECORDED AUGUST 30, 1963 AS INSTRUMENT NO. 7055, IN BOOK M1338, PAGE 287, OFFICIAL RECORDS.

12. INTENTIONALLY DELETED.

13. INTENTIONALLY DELETED.

14. INTENTIONALLY DELETED.

15. AN EASEMENT FOR THE PURPOSE SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT

GRANTED TO | HOWARD HUGHES REALTY, INC.

Continued on next page

PURPOSE	THE CONSTRUCTION, INSTALLATION, MAINTENANCE, OPERATION, REPAIR AND REPLACEMENT OF SLOPE SUPPORT IMPROVEMENTS
RECORDED	FEBRUARY 15, 1989
INSTRUMENT/FILE NO	89-247257, OF OFFICIAL RECORDS

SAID MATTER AFFECTS A PORTION OF SAID LAND AS MORE PARTICULARLY DESCRIBED IN SAID DOCUMENT.

COVENANTS, CONDITIONS AND RESTRICTIONS IN THE ABOVE RECORDED INSTRUMENT. (RESTRICTIONS, IF ANY, BASE ON RACE, COLOR, RELIGION OR NATIONAL ORIGIN ARE DELETED).

16. INTENTIONALLY DELETED.

17. INTENTIONALLY DELETED.

18. INTENTIONALLY DELETED.

19. INTENTIONALLY DELETED.

20. INTENTIONALLY DELETED.

21. INTENTIONALLY DELETED.

22. INTENTIONALLY DELETED.

23. AN EASEMENT FOR THE PURPOSE SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT

GRANTED TO	TITLE GUARANTEE AND TRUST COMPANY, A CORPORATION
PURPOSE	POLES, CONDUITS, SEWER, WATER AND GAS PIPES
RECORDED	IN BOOK 11238, PAGE 265, OFFICIAL RECORDS
AFFECTS	PORTIONS OF PARCELS 8, 9 AND 11 OF QUAD III AS MORE PARTICULARLY DESCRIBED IN SAID DOCUMENT

24. THE PROVISIONS IN THE DEED PROHIBITING THE BUYING, SELLING OR HANDLING OF INTOXICATING LIQUORS UPON SAID LAND, ALSO PROVIDE THAT A VIOLATION THEREOF SHALL NOT DEFEAT OR RENDER INVALID THE LIEN OF ANY MORTGAGE OR DEED OF TRUST MADE IN GOOD FAITH AND FOR VALUE, ANY OTHER COVENANTS, CONDITIONS AND RESTRICTIONS IN SAID DEED BEING UNENFORCEABLE,

IN FAVOR OF	TITLE GUARANTEE AND TRUST COMPANY, A CORPORATION
RECORDED	IN BOOK 11238, PAGE 265, OF OFFICIAL RECORDS

SAID MATTER AFFECTS: PARCELS 8, 9 AND 11 OF QUAD III

25. AN EASEMENT FOR THE PURPOSES SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SHOWN OR AS OFFERED FOR DEDICATION ON THE

Continued on next page

RECORDED MAP SHOWN BELOW

MAP NO	SUBDIVISION 9167
IN FAVOR OF	THE CITY OF LOS ANGELES
EASEMENT PURPOSE	SANITARY SEWERS
AFFECTS	THE NORTH 4 FEET OF LOTS 1 AND 2 AND THE NORTH 7 FEET OF LOTS 4, 5 AND 6 OF PARCELS 10 AND 11 OF QUAD III

(AS SHOWN ON THAT CERTAIN ALTA SURVEY DATED FEBRUARY & MARCH, 1984 AND REVISED FEBRUARY 15, 1989, PREPARED BY PSOMAS AND ASSOCIATES UNDER JOB NO. 1 HUG 0701-03)

26. INTENTIONALLY DELETED.

27. INTENTIONALLY DELETED.

28. INTENTIONALLY DELETED.

29. THE MATTERS CONTAINED IN AN INSTRUMENT:

ENTITLED	AGREEMENT
DATED	JUNE 1, 2002

BY AND BETWEEN: WEST BASIN MUNICIPAL WATER DISTRICT AND PLAYA CAPITAL COMPANY, LLC UPON THE TERMS AND CONDITIONS AND COVENANTS THEREIN PROVIDED.

RECORDED	JULY 30, 2003
INSTRUMENT NO.	03-2184705, OFFICIAL RECORDS

REFERENCE IS MADE TO SAID DOCUMENT FOR FULL PARTICULARS.

30. INTENTIONALLY DELETED.

31. MATTERS WHICH MAY BE DISCLOSED BY AN INSPECTION OR BY A SURVEY OF SAID LAND SATISFACTORY TO THIS COMPANY, OR BY INQUIRY OF THE PARTIES IN POSSESSION THEREOF.

32. ANY RIGHTS, INTERESTS OR CLAIMS WHICH MAY EXIST OR ARISE BY REASON OF THE FOLLOWING MATTERS DISCLOSED BY A SURVEY PREPARED BY PSOMAS ON DECEMBER 08, 2003 AND DESIGNATED AS JOB NO. IPCC020623 TASK 102 AND BY INSPECTION OF SAID LAND:

A. THE FACT THAT CHAINLINK FENCES OVER THE SOUTHWESTERLY PORTION OF SAID LAND LIE PARTLY OVER SAID LAND AND PARTLY OVER THE ADJOINING LAND TO THE SOUTHWEST.

B. INTENTIONALLY DELETED.

C. THE FACT THAT THE CONCRETE CURB OVER THE EASTERLY PORTION OF SAID LAND LIES PARTLY OVER SAID LAND AND THE ADJOINING LAND TO THE SOUTHEAST.

Continued on next page

D. THE FACT THAT THE BROKEN PAVEMENT ROADWAY OVER THE EASTERLY BOUNDARY OF SAID LAND LIES PARTLY OVER SAID LAND AND PARTLY OVER THE ADJOINING LAND TO THE SOUTHEAST.

E. THE FACT THAT RIP-RAP DRAIN STRUCTURE IS LOCATED ACROSS THE SOUTHEASTERLY BOUNDARY OF SAID LAND.

F. THE FACT THAT A CATCH BASIN AND MANHOLE ARE LOCATED OVER THE EASTERLY PORTION OF SAID LAND.

THE ABOVE SURVEY EXCEPTIONS ARE SUBJECT TO A PHYSICAL INSPECTION OF SAID LAND.

33. A LIEN FOR UNSECURED PROPERTY TAXES FILED BY THE TAX COLLECTOR OF THE COUNTY SHOWN, FOR THE AMOUNT SET FORTH, AND ANY OTHER AMOUNTS DUE:

COUNTY	LOS ANGELES
TAXPAYER	PLAYA CAPITAL CO LLC LESSEE
YEAR/ACCOUNT NO	03/49110434
AMOUNT	$78.37
RECORDED	DECEMBER 9, 2003
INSTRUMENT NO.	03-3702805 OF OFFICIAL RECORDS

34. A LIEN FOR UNSECURED PROPERTY TAXES FILED BY THE TAX COLLECTOR OF THE COUNTY SHOWN, FOR THE AMOUNT SET FORTH, AND ANY OTHER AMOUNTS DUE:

COUNTY	LOS ANGELES
TAXPAYER	PLAYA CAPITAL COMPANY LLC ET AL
YEAR/ACCOUNT NO	03/40796359
AMOUNT	$4,910.17
RECORDED	DECEMBER 9, 2003
INSTRUMENT NO.	03-3702806 OF OFFICIAL RECORDS

35. A LIEN FOR UNSECURED PROPERTY TAXES FILED BY THE TAX COLLECTOR OF THE COUNTY SHOWN, FOR THE AMOUNT SET FORTH, AND ANY OTHER AMOUNTS DUE:

COUNTY	LOS ANGELES
TAXPAYER	PLAYA CAPITAL COMPANY LLC ET AL
YEAR/ACCOUNT NO	03/40796360
AMOUNT	$4,156.82
RECORDED	DECEMBER 9, 2003
INSTRUMENT NO.	03-3702807 OF OFFICIAL RECORDS

++++++++++++++++++++ REQUIREMENTS ++++++++++++++++++++++

1. THIS COMPANY WILL REQUIRE THE FOLLOWING DOCUMENTS IN ORDER TO

Continued on next page

INSURE A CONVEYANCE OR ENCUMBRANCE BY THE CORPORATION OR UNINCORPORATED ASSOCIATION NAMED BELOW:

CORPORATION: PLAYA CAPITAL COMPANY, LLC, A DELAWARE LIMITED LIABILITY COMPANY

(A) A COPY OF THE CORPORATION BY-LAWS OR ARTICLES.

(B) AN ORIGINAL OR CERTIFIED COPY OF THE RESOLUTION AUTHORIZING THE SUBJECT TRANSACTION.

(C) IF THE ARTICLES OR BY-LAWS REQUIRE APPROVAL BY A "PARENT" ORGANIZATION, WE WILL ALSO REQUIRE A COPY OF THOSE BY-LAWS OR ARTICLES.

(D) IF AN UNINCORPORATED ASSOCIATION, A STATEMENT PURSUANT TO APPLICABLE LAW (SUCH AS CALIFORNIA CORPORATION CODE SECTION 20002). THE RIGHT IS RESERVED TO ADD REQUIREMENTS OR ADDITIONAL ITEMS AFTER COMPLETION OF SUCH REVIEW.

2. PROVIDE RELEASE/RECONVEYANCE INSTRUMENTS FOR DEEDS OF TRUST OF RECORD AS FOLLOWS:

A. IF INSTITUTIONAL LENDER WE MUST BE PROVIDED A DEMAND FOR PAYMENT. IF SERVICED BY OTHER THAN THE BENEFICIARY WE MUST BE PROVIDED A COPY OF THE LOAN SERVICING AGREEMENT.

B. IF AN INDIVIDUAL LENDER WE MUST BE PROVIDED DEMAND FOR PAYMENT TOGETHER WITH THE ORIGINAL NOTE. DEED OF TRUST AND SIGNED REQUEST FOR FULL RECONVEYANCE, REQUEST FOR FULL RECONVEYANCE MUST BE SIGNED BY BOTH SPOUSES IF BENEFICIAL INTEREST IS IN ONE SPOUSE ALONE.

C. IF BENEFICIARY IS A TRUST, WE MUST BE PROVIDED A FULL COPY OF SAID TRUST, TOGETHER WITH THE ORIGINAL NOTE, DEED OF TRUST AND SIGNED REQUEST FOR FULL RECONVEYANCE.

D. IF THE LOAN IS FOR A REVOLVING LINE OF CREDIT, THE ACCOUNT MUST BE FROZEN, OTHERWISE WE WILL HOLD AN AMOUNT EQUAL TO THE AVAILABLE CREDIT LIMIT.

3. IT IS THE POLICY OF THIS COMPANY TO MAKE ALL REQUIRED PAYOFFS.

THE COMPANY WILL REQUIRE CURRENT, WRITTEN PAYOFF DEMANDS ADDRESSED TO STEWART TITLE OF CALIFORNIA, INC. OR OUR ESCROW CUSTOMER. NONCURRENT AND EXPIRED DEMANDS WILL NORMALLY NOT BE ACCEPTABLE BUT THEY MAY BE ACCEPTED AT THE DISCRETION OF THE COMPANY IF VERBAL UPDATING CAN BE OBTAINED.

Continued on next page

THE COMPANY WILL HOLD AN AMOUNT EQUAL TO ONE MONTHLY MORTGAGE PAYMENT UNTIL ACCEPTANCE BY THE LENDER OF OUR PAYOFF ON ANY NONCURRENT OR EXPIRED BENEFICIARY DEMAND, WHETHER OR NOT VERBALLY UPDATED.

THE COMPANY WILL ALSO HOLD AN AMOUNT EQUAL TO ONE MONTHLY MORTGAGE PAYMENT UNTIL ACCEPTANCE BY THE LENDER OF OUR PAYOFF ON ANY DEMAND WHICH INCLUDES A PAYMENT MADE WITHIN 14 DAYS OF CLOSING UNLESS THE COMPANY HAS BEEN PROVIDED WITH SATISFACTORY PROOF OF PAYMENT (I.E. A CANCELLED CHECK OR WRITTEN CONFIRMATION OF CHECK CLEARANCE.)

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END OF EXCEPTIONS

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REF: (ORDER # 040207570, TITLE OFFICER NAME: LARRY MCGUIRE)

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Appendix B
Geotechnical Memo

GEOTECHNICAL INVESTIGATION REPORT
BALLONA WETLANDS RESTORATION PROJECT
MARINA DEL REY AREA
LOS ANGELES COUNTY, CALIFORNIA

Prepared for:

Santa Monica Bay Restoration Commission
1 LMU Drive, North Hall
Pereira Annex MS:8160
Los Angeles, California, 90045

Prepared by

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GDC Project No. LA-962A
July 1, 2013

GROUP DELTA CONSULTANTS

Geotechnical Engineering
Geology
HydroGeology
Earthquake Engineering
Materials Testing & Inspection
Forensic Services

July 1, 2013 LA-962A

Santa Monica Bay Restoration Commission
1 LMU Drive, North Hall
Pereira Annex MS:8160
Los Angeles, California, 90045

Attention: Ms. Diana Hurlbert
Restoration Project Coordinator

Subject: Geotechnical Investigation Report
Ballona Wetlands Restoration Project
Marina Del Rey Area
Los Angeles County, California

Dear Ms. Diana Hurlbert:

Group Delta Consultants, Inc. is pleased to submit this Geotechnical Report for the Ballona Wetlands Restoration Project. This report summarizes the results of our geotechnical investigation, laboratory testing and engineering analyses for the project and provides geotechnical recommendations for the proposed earthwork and construction.

We appreciate the opportunity to provide geotechnical services for this significant project. If you have any questions pertaining to this report, or if we can be of further service, please do not hesitate to contact us.

Very truly yours,
Group Delta Consultants, Inc.

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Michael D. Reader, G.E.
Principal/CEO

Distribution: (10) copies to addressee

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GEOTECHNICAL INVESTIGATION REPORT
BALLONA WETLANDS RESTORATION PROJECT
MARINA DEL REY AREA
LOS ANGELES COUNTY, CALIFORNIA

EXECUTIVE SUMMARY

This report presents the results of our geotechnical investigation performed in support of the restoration of the Ballona Wetland under the conditions of a United States Army Corps of Engineers (USACE) 408 permit. The proposed restoration would restore estuarine wetland and upland habitats that are connected to a realigned Ballona Creek. The project area is shown in Figures 1 and 2 (Areas A, B and C).

The project site encompasses about 600 acres between Marina Del Rey to the north and Playa Del Rey to the south. Key elements of the restoration are described in the Preliminary Design Report (PDR; ESA PWA, 2013a) for the project, and include:

Ballona Creek Channel Restoration

- Removal of the existing north and south levees in four locations, and the realignment of the channel for the creation of a natural meandering channel. This requires backfilling a portion of the existing channel
- Armoring against current induced erosion at locations of potential high creek flow velocities.

Area A

- Mass excavation to reclaim wetlands lost when the area was hydraulically filled during the development of Marina Del Rey. The excavation will slope down to the south from Fiji Way at a gradient of about 10 horizontal to 1 vertical or flatter, to a maximum depth of about 20 to 25 feet in the area of the existing channel. The excavation will remove primarily hydraulic fill soils.
- Construction of flood protection levees along the west, north and east perimeter of Area A. The levees will generally extend about 5 to 10 feet above the existing grade.

Area B

- Construction of flood protection levees along the north side of Culver Boulevard and east of the dunes in West Area B. The levees will generally extend up to a maximum of about 15 feet above existing grade.
- Full restoration of wetlands between the new levees and the realigned Ballona Channel and managed restoration of the wetlands area located south of the new levees.

- The area between Culver and Jefferson Boulevards will be used as a balance site, where excess cut material will be placed and compacted, resulting in uplands habitat.

Area C

- North Area C, located north of Culver Boulevard, will also be used as a balance site where excess cut material will be placed and compacted with primarily uplands habitat created.
- South Area C will be graded with uplands and will be the site for the construction of a planned complimentary service facility to the Wetlands Restoration Project.

Other Elements

- Construction of a pedestrian/bicycle bridge spanning the Ballona Channel near the existing Culver Boulevard Bridge, and an at-grade bicycle path along the new levee in Area B.
- Construction of buried culverts in Area B, extending under Culver Boulevard.

Group Delta Consultants (GDC) conducted a geotechnical subsurface investigation for the project during September/October 2012. The investigation included a total of 25 rotary wash borings, 31 cone penetration tests (CPT), 8 hollow stem auger borings and 1 hand auger boring. In addition, 10 borings were performed for obtaining samples for chemical, environmental and erosion testing. Explorations were advanced to a maximum depth of 71.5 feet. Shear Wave Velocity measurements were performed in 7 of the CPTs. Four field permeability tests were performed to evaluate the permeability of the soils in the area where the Ballona Channel will be breached. The findings from the GDC investigation were supplemented by data from previous geotechnical and environmental investigations conducted within the project areas to characterize the soil properties (Law Crandall, 1988, 1991; Diaz Yourman & Associates, 2010; and Weston Solutions, 2009).

Based on our findings and analyses, it is our opinion that the project is feasible from a geotechnical standpoint and can be successfully accomplished as planned, following the recommendations addressed in this report. The major geotechnical factors affecting the project are briefly discussed below.

The stability analyses performed indicate that the new levees planned will be stable and meet or exceed the minimum factor of safety required under static, seismic and rapid drawdown conditions. Where a new levee ties into an existing levee, the existing levee will experience additional loading and settlement that can cause cracking of the existing levee. Therefore, it is recommended that mitigation measures, such as deep soil mixing, be performed at and adjacent to tie-in locations to improve the stability of the existing levees that will remain in Areas A and B. In

Area C, the restoration project will not alter or impose any new loads on the existing levees. It is recommended that any surcharge loads planned in Area C should be setback a minimum of 70 feet away from the top of the channel slope.

The soils that will be excavated in Area A were found to be loose/soft and have high moisture contents, generally ranging about 5% to 35% above the optimum. Therefore, the use of heavy scrapers and dozers is expected to be limited. The excavation must be carefully planned and conducted to avoid overstressing the soils and/or bogging down equipment. The need for excavators, support mats, moving haul roads, low ground pressure equipment and dredging should be considered in planning how to accomplish the excavation. The need to control the ground water should also be anticipated during excavation. Because of the high moisture content in the excavated soils, it will be necessary to dry the excavated soils prior to placement, which will require spreading and turning/disking.

The soils excavated from Area A will also undergo significant volume reduction when compacted for the levee construction. This loss of volume is estimated to range up to 20 to 30 percent. Additional soil "loss" will also occur as the soft soils below the new levees settle under the embankment load.

Prior to placement of compacted fill for the new levees, the subgrade soils along the levee alignments should be excavated and recompacted to a minimum depth 4 feet under the levee "core." The levee "core" is defined as the zone of the levee within 3 to 1 slopes extending down from the edges of the levee crest. Beyond the core, the removal should extend to a depth of 2 feet for a minimum equipment width, as shown in Appendix I (Plates I-2 through I-4). Outside the removal zones, vegetation should be stripped.

The actual limits for removals should be determined by the project geotechnical engineer during construction, based on the conditions exposed. Deeper removals under the levee core will be needed if unsuitable soils are present. In particular, deeper removals should be planned where the levee crosses the existing drainage channels in West Area B. Deeper excavation should also be planned to remove buried organics in the area of a celery dump known to have been present in northeast Area A. The location and limits of the celery dump will be determined during grading operations.

If permeable sand layers are exposed that could provide a path for seepage under the new levee core. It will be necessary to overexcavate and replace such layers to the limits determined by the project geotechnical engineer during grading. In particular, shallow sand layers may extend below the alignment of the levee planned in West Area B, because of the proximity of the natural dunes.

If wet and/or soft soils are exposed in the excavation made for removals, the excavation will need to be performed using an excavator or low ground pressure equipment. In addition, geogrid (Tensar BX 1200 or equivalent) may be needed to stabilize the exposed bottom and provide a firm working surface before the new fill can be placed.

In general, the hydraulic fill in Area A is a fine-grained silty to clayey loose/soft soil with a high moisture content, and the near surface native soils and fill in area B are moderately soft to soft with a high moisture content and a shallow ground water table. Temporary excavations should be planned at a maximum inclination of 1-1/2 (horizontal) to 1 (vertical).

The subgrade conditions along the new levees generally consist of moderately soft to soft fine-grained silts and clays that are weak and compressible. Therefore, the selection and operation of equipment and the placement of compacted fill for levees should be planned and controlled to avoid overstressing these soils. The fill should be advanced uniformly without creating unbalanced loads. The rate of fill placement should also be controlled to allow the soft soils to consolidate and gain strength. Increasing the height of the fill slowly, at about 5 feet per month, will also provide time for settlement to occur and mitigate the potential for differential settlement to create cracks in the embankment. Recommendations for monitoring the fill settlement are discussed in Section 15.8.

The new levee in West Area B will cross two existing drainage channels (Refer to Figure 4A). Both of these channels range from 5 to 8 feet in depth and are expected to contain soft sediment. The easternmost of these channels crosses perpendicular to the levee alignment. The westernmost channel extends under the length of the planned levee at the west end of Area B. It should be anticipated that there is the possibility that other old channels may also be present in the area, and may have been filled in. All soft and sandy material should be removed and replaced with compacted fill. The excavation for these removals will extend below ground water and, dewatering will be required to accomplish the removals and backfilling. Shoring or cofferdams are anticipated to be needed. The exposed bottom should be stabilized with geogrid before placing backfill.

The new levees will range from about 5 to 10 feet high in Area A to a maximum of 15 feet high in Area B. The levee fill will cause compression of the underlying native silts and clays and any remaining hydraulic fill, resulting in settlement on the order of 1 to 2 inches for every foot of fill placed. Therefore, the maximum settlement is expected to range from about 10 inches to on the order of 2.5 feet. It is anticipated that 90 percent of the consolidation settlement will essentially be complete within three to six months of fill placement. Settlement plates should be installed to monitor the rate of settlement to confirm when primary compression is complete, as

well as to control the rate of fill loading. Capping of the levee core should be planned as the last step of grading, after settlements are complete.

New culverts should not be installed until 90% of the primary consolidation is completed. Culvert locations could be surcharged in advance of placement of the levee embankment to avoid a delay in their installation. A temporary culvert pipe can be installed before placing the fill. Once the settlement is completed, the temporary pipe can be excavated, removed and the permanent culvert installed and backfilled.

The proposed pedestrian and bicycle bridge can be supported on piles installed into the dense sand and gravel bearing layer that underlies the site at a depth of about 50 to 60 feet.

1.0 INTRODUCTION

This report presents the results of our geotechnical investigation conducted in support for the restoration of the Ballona Wetland under the conditions of a United States Army Corps of Engineers (USACE) 408 permit. The proposed restoration would restore estuarine wetland and upland habitats that are connected to a realigned Ballona Creek.

The project site is shown on the Vicinity Map in Figure 1 and is comprised of approximately 600 acres, between Marina Del Rey (to the north) and Playa Del Rey (to the south), and from about 2,000 feet east of the Pacific Ocean to about 10,500 feet farther upstream along Ballona Creek. The project is divided into three primary Areas: Areas A, B and C. Area A is located north of Ballona Creek and west of Lincoln Boulevard. Area B is located south of Ballona Creek, and Area C is located north of Ballona Creek and east of Lincoln Boulevard.

The Ballona Wetlands Restoration Project (Project) involves the expansion and enhancement of wetlands adjacent to lower Ballona Creek, and associated site modifications necessary to avoid adverse effects to the surrounding property and interests. The Project includes removing the existing flood control levees, constructing new flood protection levees around the perimeter of Area A and along the north side of Culver Boulevard in Area B, upland of the restored wetlands; constructing a new creek meander channel; mass excavating of soil from Area A to remove previously placed dredged fill; full restoration of wetlands between the new levees and the realigned Ballona Channel; and placement of excess cut material as compacted fill in North Area C and in Area B between Culver and Jefferson Boulevards. The project also includes the construction of a pedestrian and bicycle bridge spanning Ballona Creek near the Culver Boulevard Bridge; an at-grade bicycle path along the new Area B levee; and, the construction of culverts to provide drainage of south Area B (ESA PWA, 2013a).

2.0 PURPOSES AND SCOPE OF WORK

The purposes of this investigation were to investigate the subsurface conditions within the project site by performing field explorations; characterize the soil conditions; identify the geotechnical factors impacting the project; geotechnical analyses to evaluate the feasibility of the project from a geotechnical standpoint, and development of recommendations for design and construction, including earthwork, construction of levees, the pedestrian bridge and culverts.

Our scope of work for the Project includes the following:

- Performing a site reconnaissance and developing a Geotechnical Work Plan for the planning and executing the field investigation, depicting the proposed

exploratory boring locations and access routes for review and approval by the appropriate agencies. The Geotechnical Work Plan was also used to obtain permits from the California Department of Fish and Wildlife, USACE and the California Coastal Commission.

- Review of available published geotechnical and geologic maps and reports pertaining to the project area, including previous geotechnical and environmental reports for the property.
- Conducting a field investigation including drilling 25 rotary wash borings, 8 hollow stem borings, and 31 Cone Penetrations tests (CPT), performing shear wave velocity measurements at seven locations using specially equipped CPTs, and conducting four field permeability tests. In addition, 10 borings were performed to obtain representative samples for chemical, biological and erosion testing, performed and analyzed by others.
- Performing geotechnical laboratory testing on selected representative samples to evaluate their physical properties and engineering characteristics. Collected samples for chemical testing, and sediment analysis were sent to outside laboratories for testing, as directed by the project environmental consultant.
- Performing engineering analyses of the field and laboratory data to develop geotechnical recommendations for the design and development of the wetland restoration project. This included performing stability analyses of the proposed levees under static, seismic and rapid drawdown conditions and development of recommendations concerning excavation; levee design and construction; stripping/clearing, excavation; dewatering; removals; placement of fill; anticipated settlements; foundation support of the pedestrian bridge and culverts and recommendations to address constructing options, phasing, monitoring and logistics.
- Attending and participating in project meetings, telephone calls, and reviews, as requested.
- Preparation of this Geotechnical Investigation Report.

3.0 HISTORICAL BACKGROUND

3.1 Historical Land Use

The following information was taken from a report by the U.S. Environmental Protection Agency (USEPA), titled "*Ballona Creek Wetlands, Total Maximum Loads for Sedimentation and Invasive Exotic Vegetation*" (USEPA, 2012). Table 1 summarizes some of the anthropogenic activities perform at Ballona Wetlands since the early 1900s until 1960s.

During the late 1800's the Ballona Wetlands were used by several hunting lodges and resorts for recreation. Rail lines were constructed through the marsh in the 1880's and roadways were built between 1900 and 1910. Oil and gas exploration and production began in the 1930's and in 1934 Ballona Creek was channelized to the ocean. The channelization of Ballona Creek (See aerial photos in Appendix C) caused flow to the wetlands and lagoons to be limited, and caused them to dry (USEPA, 2012).

Between the 1930's and 1950's, oil derricks were built throughout the wetland areas including the construction of dikes, which caused the wetlands to be drained or artificial ponds to develop. The Marina Del Rey development in the late 1950's removed a large portion of the remaining wetlands, when hydraulic fill was placed in Area A. As a result, the wetlands shrank to less than 200 acres, about 10 percent of the original area (USEPA, 2012).

The precise limits of Ballona Creek Wetlands are complex. Until about 2004, only the undeveloped Area B (south of Ballona Creek and north of Culver Boulevard) was identified as the Ballona Creek Wetlands. The construction of tide gates between the late 1990s to early 2000s restored some tidal flushing to the central portion of Area B. In 2001, the State of California retained Area C (north of Ballona Creek and east of Lincoln Boulevard) as part of a tax settlement. The Freshwater Marsh was completed in 2008 (south of Jefferson Boulevard and west of Lincoln Boulevard), where storm water runoff from the Playa Vista development and Jefferson Drain is discharged (USEPA, 2012).

Table 1: Anthropogenic Activities at Ballona Wetlands since the 1880's

Time period	Anthropogenic Activity	Impact
1880's to Early 1900s	Pacific Electric railroad tracks built on artificial fill earthen berms altered tidal flows in areas A, B and C	Sediment deposition; habitat alteration; reduced tidal flushing
1918	Lincoln and Jefferson Blvds. were constructed. Surface flows from eastern portions of wetlands were routed into culverts under Culver Blvd. in area B	Sediment movement; habitat alteration; reduced and/or restricted freshwater flows
1920s	Artificial fill was dumped in several places to construct oil and gas drilling platforms and protect them from extreme tides, and to build on artificial fill berms for access roads for the platforms; The Gas Company Rd. in Area B especially restricts flows from the east, and platforms and access roads in Area A created depressions where water continues to pond sporadically	Sediment deposition; habitat alteration; reduced tidal flushing and/or restricted freshwater flows
1930-1958	Farming of lima beans and barley in Areas B (east of The Gas Company Rd.) and C resulted in filling of many natural tidal channels	Sediment deposition and transport; habitat burial
1930s	Ballona Creek was straightened and channelized in concrete levees by the USACE; culverts with flap gates allowed drainage from Area B but prevented tidal inflows (except when gates malfunctioned)	Sediment deposition; habitat alteration; reduced and/or restricted freshwater flows and tidal flushing
1950s-60s	Centinela Ditch was excavated through Area B before 1950. The ditch directed freshwater flows from east of Lincoln Blvd. along the south border of the wetlands area. In 1962, Centinela Creek was fully channelized in concrete and diverted to Ballona Creek channel at Centinela Ave, at the then-eastward extent of the remaining wetlands.	Sediment deposition and removal; reduced and/or restricted freshwater flows
1960s	The southwest portion of the extant wetlands in 1960 was dredged to create Marina Del Rey marina. The dredged mud was deposited on what is now Area A, and raised the land surface 12 – 15 feet above previous mean sea level.	Sediment deposition; reduced tidal flushing

Excerpt from, *U. S. Environmental Protection Agency, 2012, Ballona Creek Wetlands, Total Maximum Loads for Sedimentation and Invasive Exotic Vegetation*

3.2 Historical Aerial Photos

Historical aerial photos from the UCLA Spence oblique aerial photo collection and other photos available on line at HistoricAerials.com (http://www.historicaerials.com) were reviewed to identify changes that occurred a within the project site from 1924 to 2005.

The Spence oblique aerial collection includes photographs taken from 1924 to 1938, which span the period before and after the construction of the Ballona Creek levees. Copies of some of these photographs are included in Appendix C. In the 1924 and 1928 photos, parcels to the east of the wetlands were being farmed. Ballona Creek had meandering channels throughout its central portion and Centinela Creek was flowing along the north edge of the El Segundo Sand Hills. At that time, water from both creeks was blocked by the coastal sand dunes and flowed to the north through the sand dune complex, then west to the coastal waters near the El Segundo Sand Hills.

The1933 Spence aerial photos show widespread farming parcels located through the Ballona Gap, with a moderate density of oil wells along the coast. Ballona Creek flowed west to the sand dune hills along the coast while the Centinela Creek flowed north along the toe area of the Westchester Cliffs to the west. In 1937, the photos show the Ballona Creek channel has concrete levee slopes east of Lincoln Boulevard with rip rap levees to the west. They show that when the channel was excavated, most of the excavated soils was placed on the north side and lesser amounts placed on the south side of the channel, as hydraulic fill for the levee. Construction of the levee system core was built up using the excavated soils. The 1938 photos indicate an increase of oil well density along the coast and inland to the east, with farm parcels increasing to the north.

The HistoricalAerials.com collection included aerial photos from the years 1952, 1972, 1980 and 2003 – 2005. The 1952 photo shows that the Marina Del Rey Harbor channel was not yet dredged and farm parcels were scattered within the Ballona Wetland area, and were more abundant to the north. The 1972 and 1980 photos show the Marina Del Rey Harbor channel as dredged with the dredged hydraulic fill placed across Area A and part of Area C. The old Howard Hughes Airport is visible east of Lincoln Boulevard and south of Jefferson Boulevard. The 1972 and 1980 photos show that to the north, the majority of the farming was gone and was replaced with residential and commercial buildings. By this time most of the farmland had been developed to the north. The 2003 – 2005 aerial photos show the airport as abandoned and the Playa Vista development under construction.

4.0 SITE DESCRIPTION

The Ballona Wetlands Restoration Project area consists of over 600 acres and is located in the northwest corner of the Los Angeles Basin, just south of Marina Del Rey. The project is divided into three primary Areas: Areas A, B and C, as shown in Figure 2. Area A is located north of Ballona Creek and west of Lincoln Boulevard. Area B is located south of Ballona Creek, and Area C is located north of Ballona Creek and east of Lincoln Boulevard. A brief description of each of the areas is provided in the USEPA (2012) report, as is summarized below.

4.1 Area A

Area A is approximately 139 acres in size and lies north of Ballona Creek, west of Lincoln Boulevard and south of Fiji Way (Figure 2). Elevations range between approximately 12 and 20 feet NAVD, with the higher ground located near Fiji Way. The original grade generally ranged from Elevation +2 to +10 feet NAVD. Fill was placed in Area A during the excavation of Ballona Creek in the early 1930's and in the 1960's when dredged soils from the development of Marina Del Rey were placed on the site. Area A is generally undeveloped, with the exception of a parking area along the western boundary and an unlined drainage channel located along Fiji Way located along the northern boundary in the eastern portion of the area (Fiji ditch). The Gas Company also currently maintains five monitoring well pad sites in the western end of this area (USEPA, 2012).

4.2 Area B

Area B is approximately 338 acres in size and lies south of Ballona Creek and west of Lincoln Boulevard. Area B extends south to Cabora Drive, a utility access road located near the base of the Playa Del Rey Bluffs (Figure 2). To the west, Area B extends into the natural sand dunes that border homes along Vista Del Mar. Elevations across Area B typically range between approximately +5 and +8 feet NAVD in the lower flat portions, and slopes up to about 50 feet NAVD below the Del Rey Bluffs, south of Culver Boulevard. Area B contains the largest area of remnant unfilled wetlands with abandoned agricultural lands to the southwest and the existing Freshwater Marsh to the northeast. The Gas Company has easements in Area B for 12 well sites (1 injection/withdrawal well and 11 monitoring wells) and a system of access roads (USEPA, 2012).

4.3 Area C

Area C is located north of Ballona Creek and east of Lincoln Boulevard (Figure 2). The Marina Freeway forms the northeastern border of Area C. The area is approximately 64 acres in size and is traversed in an east-west direction by Culver Boulevard. North Area C lies north of Culver and south Area C lies to the south. Area C contains fill from the construction of the Ballona Creek channel, and fill

generated from developments such as Marina Del Rey, the Pacific Electric Railroad, the raising of Culver Boulevard and the Marina Freeway. Elevations within Area C range from approximately +7 to +28 feet NAVD. Area C is mostly undeveloped with the exception of 4 baseball fields and supporting minor structures, located in the west portion of south Area C. The Gas Company has no facilities in Area C (USEPA, 2012).

5.0 DESCRIPTION OF PROJECT

The proposed restoration would restore estuarine wetland and upland habitats that are connected to a realigned Ballona Creek. The construction will be performed in phases.

1) Phase 1 involves excavation in Area A and construction of new levees around the enhanced wetland areas in Areas A and B.
2) Phase 2 involves excavation of a new meander channel for Ballona Creek; breaching and removing the existing Ballona Creek levees and filling in Ballona Creek between breach points; and, increasing muted tidal action in South Area B by constructing new culverts.
3) Phase 3 involves restoring tidal action to West Area B by lowering and breaching the intermediate Ballona Creek levee placed during phase1 in the eastern portion of West Area B.

Key Elements of the Restoration:

Key elements of the restoration project are described in the PDR (ESA PWA, 2013a), and include:

Ballona Creek Channel Restoration

- Removal of the existing levees downstream of the Culver Boulevard Bridge for a length of about 4,000 feet along the existing north levee and about 6,000 feet along the existing south levee, and the lowering and realignment of the channel for the creation of a natural meandering channel.

Area A

- Mass excavation to reclaim wetlands lost when the area was hydraulically filled during the development of Marian Del Rey. The excavation will slope down to the south from Fiji Way at a gradient of about 10 horizontal to 1 vertical to approximate elevation of 11 feet, and then at flatter gradients of about 100H:1V (horizontal to vertical) to a maximum depth of about 20 to 25 feet below the existing grade near the existing channel. The excavation will remove primarily hydraulic fill soils.

- Construction of flood protection levees along the west, north and east perimeter of Area A. The levees will generally extend about 5 to 10 feet above the existing grade in Area A.

Area B

- Construction of flood protection levees along the north side of Culver Boulevard in north and west Area B and east of the dunes in West Area B. The levees will generally extent up to a maximum of about 15 feet above existing grade.
- Full restoration of wetlands between the new levees and the realigned Ballona Channel and managed restoration of the wetlands area located south of the new levees.
- The area between Culver and Jefferson Boulevards will be used as a balance site, where excess cut material will be placed and compacted.

Area C

- North Area C, located north of Culver Boulevard, will also be used as a balance site where excess cut material will be placed and compacted.
- South Area C may be graded and developed by others as a complimentary service facility to the Wetlands Restoration Project.

Other Elements

- Construction of a pedestrian and bicycle bridge spanning the Ballona Channel near the Culver Boulevard Bridge, and an at-grade bicycle path along the new levee in Area B.
- Construction of buried culverts.

5.1 New Perimeter Levees

New engineered flood control levees will be built along the north, west and east perimeter of Area A and in Area B, north of Culver Boulevard and east of the dunes in West Area B. The proposed levees will be designed to meet or exceed the current flood control standards. The hydraulic analysis has been performed for hydraulic modeling for a number of flood events, including the project 100-year design flow, and future sea level rise (SLR), as included in the Preliminary Hydrology and Hydraulics Report of the project (ESA PWA, 2013b). The SLR is considered to be approximately 4.9 feet by 2100. The locations of the new levees are shown on Figure 4A.

At the preliminary design level, the perimeter levees have been designed with a constant levee crest of El. 20.5 feet NAVD. With this design elevation, the minimum freeboard considering SLR along the new levees will be about 4 feet (i.e. 3.81 feet). In general, all levees will include a compacted low permeability core with 3H:1V side

slopes. However, the actual levee slopes are significantly flatter with creek side slopes as flat as 10H:1V.

5.1.1 Area A Levee

The proposed levee is planned to follow the perimeter of Area A with a minimum of about 30 feet offset from Fiji Way and Lincoln Boulevard. and placed just south of Fiji Channel (Figure 4A). The proposed levee will be offset to maintain the existing parking lots along Fiji Way and to avoid existing natural gas monitoring well, Del Rey 17. The levee will tie into the existing Ballona Creek levee at Culver Boulevard, at the upstream limit of the marsh restoration area.

The levee incorporates an idealized 6H:1V protected side slope and a 10H:1V channel side slope from El. 20.5 feet at the crest down to El. 11.0 feet. This levee is generally located 800 to 1,200 feet from the realigned Ballona Creek Channel.

5.1.2 Culver Levee in Area B

The Culver levee in Area B includes three distinct design sections.

1) The first section includes a wide plateau at the upstream limit between Culver Boulevard and the old railroad alignment. This wide section is intended to vary the widening of the restored Ballona Creek floodplain to help even out the hydraulic drop of flood levels as flood flows enter the Wetland Restoration Project Site.
2) A narrow section (20 feet top width) along Culver Boulevard, extending to the intersection with Jefferson Boulevard.
3) A wide section (100 feet top width) along Culver Boulevard, from Jefferson Boulevard, to West Area B.

The culver levee sections are planned with a minimum 30 foot offset from Culver Boulevard, and will be built with 3H:1V protected outside side slopes, and 10H:1V interior slopes down to El. +6.5 feet NAVD, with a flatter transitional slope to the adjacent tidal marsh plain.

5.1.3 West Area B Levee

The proposed West Area B Levee (Figure 4A) will be located about 300 feet east of the toe of the natural dunes that border the west end of West Area B. The levee will have a top width of 20 feet, a 3H:1V slope toward the existing dunes to the west and a 10H:1V slope down to the existing managed marsh to the east.

5.1.4 Temporary Area B Levee

The project will be phased will full restoration of West Area B delayed for a number of years until the restoration in Area A and North Area B demonstrates success. During this interim period, a temporary levee will connect the Culver Levee to the existing Ballona Creek South Levee just north of the existing natural gas monitoring well cluster in West Area B. The location of this levee is shown in Figure 4A.The temporary levee will be constructed with 5H:1V side slopes on the channel side, and a 3H:1V slope on the protected side.

5.2 Excavation and Channel Realignment

The reintroduction and revival of critical wetland habitat, involves mass grading, soil excavation and hauling of previously placed dredged materials to lower the grades in Area A to create tidal wetlands, salt pans, transitional habitat, upland habitat and seasonal wetlands.

Realignment of Ballona Creek will entail construction of new meander channel segments and filling of the existing channel segment that will be abandoned. A fully-connected Ballona Creek channel and wetland system will be restored across the site, beginning west of the Culver Bridge and extending through the site to the southwest (downstream) project boundary. The channel banks would be graded to slopes of approximately 5H:1V.

5.3 Stockpiles in Area B and Area C

The intent of the project is to balance earthwork on site. Excess excavated soils will be placed as stockpile fill in portions of Areas B and North Area C. The fill mounds in East Area B will be located in the area south of Culver Boulevard and North of Jefferson Boulevard Fill mounds will be offset from the streets to avoid significant settlements in roadways or utility lines, and will be sloped at a gradient of 10H:1V. The height of the fill mounds will be depend on the amount of excess soils.

5.4 Hydraulic Structures (Culverts)

Two new water control structures will be installed in Area B at the locations shown on Plate I-1. Both culverts will extend under the new Culver Levee and under Culver Boulevard.

5.5 Public Access Plan

A public access plan is being developed to maintain existing uses and provide additional access opportunities. Anticipated elements include a pedestrian bridge west of the Culver Boulevard Bridge, and parking and access at the southwest corner of Area B, where existing parking and trails are heavily used.

It should be noted that the Annenberg Foundation currently has plans for development in portions of Area C. Additional public access to other areas within the Wetlands may be created as part of these planned developments.

6.0 SUMMARY OF PREVIOUS INVESTIGATIONS

Several geotechnical investigations have previously been performed at the Project Site by Law Crandall Inc., Diaz Yourman & Associates, and Weston Solutions (Law Crandall, 1988, 1991; Diaz Yourman & Associates, 2010; and Weston Solutions, 2009). The previous investigations by Law Crandall, Inc. and Diaz Yourman & Associates were performed primarily for geotechnical purposes. Law Crandall, Inc. performed preliminary geotechnical investigations in each of the Areas within the project (Areas A, B and C) and presented the results of investigations in separate reports. Diaz Yourman & Associates performed a preliminary geotechnical investigation for Areas B and C. The investigations by Weston Solutions, Inc. were performed primarily for the chemistry and environmental testing of the soils present.

Data from these previous investigations was reviewed and used to supplement the information developed during the current investigation. However, in general, the previous investigations were performed to primarily characterize the physical properties, and limited data is provided regarding the engineering properties of the soils encountered. A summary of each of the previous investigations is provided below. The locations of the field explorations performed during these previous investigations are shown in Figure 3. Boring logs and CPT interpretations of previous investigations are included in Appendix A2. Selected results of the previous laboratory testing are presented in Appendix B2

GDC also has long-term experience with similar soils present within the Playa Vista Development, located east of Lincoln Boulevard. The experience at the Playa Vista Development was used in characterizing the engineering properties of the soils at this site.

6.1 Area A

Law Crandall, Inc. - 1991 Area A –Playa Vista Marina

This report presents the results of a preliminary geotechnical investigation of Area A for a then-proposed Playa Vista Marina, which included excavation to about Elevation -15 feet. Law Crandall, Inc. had done an earlier study to determine the location of an existing natural gas storage reservoir and the effect of the reservoir on the marina construction. In this study they investigated the physical characteristics

of the soils to provide recommendations for perimeter wall lateral earth pressures, and foundation support.

The field investigation included 20 borings (14 Rotary Wash and 6 Bucket-type borings) and 5 cone penetration tests (CPT) that were performed in December 1988 and January 1989.

According to this report, fill soils were encountered to 9 to 17 feet below ground surface, and consisted primarily of silts, clays and silty sands. The majority of the fill was placed hydraulically during dredging of the Marina Del Rey Harbor although some dump fill was also apparent to be present. Beneath the fill, the site is underlain by Holocene Alluvium extending to an estimated depth of 100 feet below ground surface. The alluvial deposits are predominantly cohesive soils to depths of about 50 to 70 feet and are underlain by dense sand and gravel. The upper cohesive soils consist of soft to medium stiff silts and clays with some layers of loose to dense silty sand and sand and occasional minor layers of peat. The alluvial deposits are of estuarine origin and contain decomposing organic materials, which generate the organic odor (hydrogen sulfide). The dense sands and gravel deposits were encountered at depths between 48 and 67 feet. These coarser sediments were described by Poland (1959) as the "50-foot-Gravel" a ground water aquifer.

Early Pleistocene San Pedro Formation sediments underlie the Holocene deposits. The sediments consist primarily of sand with some gravel, with some interbeds of silt. This layer extends to a depth of about 200 feet below ground surface. Below the Pleistocene soils underlies 5,800 feet of Tertiary age sedimentary rocks, which rest on metamorphic basement rocks of the Mesozoic Catalina Schist.

Groundwater was encountered in the borings at depths about 7 to 15 feet below ground surface corresponding to elevations of about +0 to +10 NAVD. The site was identified as potentially liquefiable. Liquefaction settlements on the order of 1 to 4 inches were indicated to be anticipated in looser interbedded sandy layers.

According to the report some peat deposits were encountered, but the peat deposits were below the ground water level and thus not subject to oxidation and drying. Collapsible soils were not encountered.

Law Crandall, Inc. - 1991 Area A – Playa Vista Marina – Supplemental Report

This report provides supplementary information for the 1991 Marina Report. According to this report a review of Los Angeles County Waste Management records revealed the presence of a former dump site, known as the *Celery Dump*, in the northeast portion of Area A that could affect ground water quality. The celery dump was apparently operated between 1945 and 1953. Two borings were drilled to depths of 17 and 22 feet to collect ground water samples for laboratory analyses

and to explore for organic materials that might be present from the former celery dump. Two additional shallow borings were also drilled to further explore the organic materials. Ground water was encountered at a depth of 14 to 17 feet.

The results of the environmental testing showed higher lead concentrations that were deemed acceptable for disposing of the ground water into the ocean. According to the report settlement due to placement of the fill in the area was estimated to be about 2 inches per foot of fill placed.

Weston Solutions, 2009 – Area A – Preliminary Geotechnical Investigation and Beneficial Use Assessment – for Port of Los Angeles

A total of five alternatives were assessed for the Restoration Project in Area A. The objectives of this preliminary Area A study were to identify the geotechnical, chemical, and physical characteristics of the soil and existing dredged material, determine the potential used of the dredged material and assess the cost associated with excavation and transporting the material. Chemical and geotechnical testing were performed on the samples collected from 20 direct push borings drilled to a maximum depth of about 24 feet. The geotechnical testing on the samples was limited to physical properties of the soils.

6.2 Area B

Law Crandall, Inc. - 1991 Area B – Proposed Wetland Restoration and Development north of Jefferson Boulevard

The investigation for the Wetland Restoration Project included 32 initial borings including 7 borings in the existing levee, and 5 additional borings to study a proposed embankment near Culver Boulevard in January and February of 1991. Additionally 21 borings were drilled in December of 1986 and April of 1987. Monitoring wells were installed in 12 of the borings to measure the fluctuations in the ground water levels beneath the site. Most of the borings were drilled using 5-inch-diameter rotary wash drilling equipment to a depth of approximately 20 to 60 feet. Six (6) borings were performed using 8-inch-diameter hollow-stem auger equipment to a depth of approximately 30 feet. Additionally, six 8-inch-diameter hand auger borings were drilled to a depth of 5 to 9 feet below the existing grade.

The report identified the artificial fill at the roads as dark reddish-brown sand, silty sand, and sandy silt. According to this report the surface soils near the western boundary are composed of Holocene dune sands. The sand dunes were characterized as poorly cemented, highly susceptible to erosion and at least 30 feet deep.

According to this report settlement due to placement of the fill in the area was estimated to be about 1.5 inches per foot of fill placed. Liquefaction and seismic settlement were anticipated to be limited. The ground water level ranged from about 0.1 to 4.5 feet below the ground surface, corresponding to elevations of +4 to +7.5 feet NAVD.

6.3 Areas B and C

Diaz Yourman & Associates, 2010 Areas B & C – Proposed improvement and restoration of Ballona Creek wetlands

The purpose of this study was to provide subsurface sediment sampling and laboratory testing on the sediment samples to determine the physical and chemical characteristics of sediments located in Areas B & C. Field investigation was performed using hollow-stem auger drilling equipment in February of 2009 and included drilling 13 borings in Area B and 7 boings in Area C to depths ranging from 16 to 32 feet below the existing grade, as well as collecting grab samples at three locations in Area B. Samples were collected for chemistry testing down to elevation -5 feet MLLW and for geotechnical testing down to elevation -10 feet MLLW.

Ground water was encountered in the borings at depths ranging from 2 to 11 feet bgs corresponding to elevations +8 and 2 feet NAVD in Area B, and at depths ranging from 17 to 23 feet bgs corresponding to Elevation +6 and +2 feet NAVD in Area C.

6.4 Area C

Law Crandall, Inc. - 1988 Area C – Report of Contamination Assessment

A study was performed to determine if soil or ground water contamination is present on the subject property. Up to 15 feet of fill were identified in the borings. The "50-foot-Gravel" layer was identified to be present at a depth of 60 feet. This investigation included 16 borings and 5 monitoring wells. The findings of this investigation indicated that no significant soil or ground water contamination is present beneath the site.

Law Crandall, Inc. - 1991 Area C – Proposed Development in Area C

The site conditions were explored by drilling 5 borings to depths of 60 to 75 feet using 5-inch-diameter rotary wash drilling equipment. Fill soils from 4 to 15 feet were encountered in the borings. At depths of about 41 to 57 feet below the existing grade the dense sandy and gravelly layer "50-foot Gravel" was identified.

The report used information from an earlier contamination assessment study at the site, which included 16 borings and 5 monitoring wells. According to the report settlement due to placement of the fill in the area was estimated to be about 1 inch per foot of fill placed. Water was measured in the borings at depths of 12 to 22 feet below the existing grade, corresponding to elevations between +0 to +6 feet NAVD.

7.0 SUBSURFACE EXPLORATION BY GDC

GDC conducted a geotechnical subsurface investigation for the project site from September 11, 2012 to October 22, 2012. Prior to the subsurface investigation, a geotechnical investigation work plan (GDC, 2012) was prepared, which outlined and defined the procedures for obtaining the necessary access and work permits, developing access routes and a plan to avoid special status plants, minimize impact to natural habitat, and/or archaeological sites within the project area. This work plan also describes the drilling equipment, soil sampling (including geotechnical, chemistry, and agronomy sampling), post-investigation site cleanup, and the laboratory testing program (geotechnical, chemical, and agronomy). The geotechnical investigation work plan and procedures were followed prior to, during, and subsequent to the field exploration, to obtain necessary site information for the project while minimizing environmental impact to the project.

The investigation consisted of rotary-wash and hollow-stem auger soil borings, one hand auger boring, and cone penetration tests. Exploration locations were planned approximately every 700 feet along the length of the levees. Typically, two explorations were performed at the crest and the toe of the levee. The exploration locations are shown in Figure 3. Geotechnical drive samples and bulk samples of the encountered materials were obtained from the borings, and tested in the laboratory to evaluate the physical and engineering characteristics of the subsurface materials encountered. In addition to geotechnical sampling, samples for chemical testing, and sediment analysis, were also collected in 10 borings, as directed by the project environmental consultants. Boring logs and CPT interpretations are included in Appendix A1. Geotechnical laboratory test results are included in Appendix B1.

7.1 Soil Borings

Twenty five (25) rotary wash borings were advanced to a maximum depth of 71.5 feet in Areas A and B. The rotary wash borings were located along the proposed levees as well as along the existing Ballona Creek levees. Eight (8) hollow stem auger borings were drilled to a maximum depth of 31.5 feet in planned excavation areas within Area A, and surcharge areas within Areas B and C. One hand auger boring was drilled to a depth of 5 feet in West Area B, where access was limited, due the presence of protected habitat plant. All borings were drilled from approximate elevations ranging from +5 to +21.1 feet NAVD. Subsurface materials were visually

logged and classified by a GDC field engineer in accordance with the Unified Soil Classification System (USCS).

Drive samples and bulk samples of the encountered materials were obtained from the borings and recorded on the boring logs. Drive samples were obtained with a California Sampler lined with 1-inch high metal sample rings and a Standard Penetration Test (SPT) sampler. Standard penetration tests (SPT) were conducted in accordance with ASTM D 1586 and samples were collected. Six-inch-long Shelby tubes were also used for sampling relatively undisturbed soil samples in the rotary wash borings.

In addition, representative bulk samples were taken within the upper 5 feet, as well as at depths as deep as 20 feet for compaction testing, expansion potential and corrosion testing, as well as chemistry and agronomy testing.

The boring logs are presented in Appendix A1.

7.2 Cone Penetration Tests (CPT)

Thirty one (31) Cone Penetration Test (CPT) probes were conducted at the site on from September 13, 2012 to October 15, 2012. The CPTs were generally advanced to depths ranging from 48 to 71.5 feet below existing grade. The CPT soundings were performed in general accordance with ASTM D3441, using a truck-mounted electric piezocone penetrometer. The locations of the soundings are shown in Figure 3.

As the CPT probe was advanced, electronic instruments recorded a continuous profile of both the tip and frictional resistances, which were then analyzed using established correlations, to classify the soils and evaluate insitu properties, including density, strength and compressibility. Additional details concerning the field exploration program, including copies of all the boring and CPT logs, are included in Appendix A.

The CPT logs and interpretations are presented in Appendix A1.

7.3 Shear Wave Velocity Measurement using CPTs

Shear Wave Velocity measurements were performed in seven (7) of the CPTs (A-CPT001, A-CPT004, A-CPT022, B-CPT031, B-CPT041, B-CPT048, and C-CPT060) to a depth of 70 feet, using a Seismic CPT. For the test large amplitude shear waves were generated by striking a seismic beam at the ground surface, and recording shear waves at various depths using a seismometer in the cone penetrometer. The seismic CPT test is typically performed at 5-foot intervals. The results of the seismic shear wave velocity measurements are presented in Appendix A1.

The average shear wave velocity in the upper 30 meters (Vs30) was estimated to be 202 m/s (662 feet/s). The shear wave velocity is used in seismic hazard analyses for the project.

Shear Wave Velocity Profiles are included in Appendix D.

7.4 Field Permeability Testing

As part of our field exploration program, four field permeability tests were performed at depths of 5 and 10 feet, at two exploration locations (i.e., A-HSA064 and A-HSA066) near the existing north levee to evaluate the permeability of the near surface soils. The tests were performed by filling hollow stemmed borings with water and estimating permeability of near surface soils using the falling head method, by measuring the drop in water elevation in the hole, over time. The results of the field permeability testing are presented in Appendix E.

7.5 Laboratory Testing Program

The following geotechnical laboratory testing was performed to evaluate the physical properties and engineering characteristics of representative subsurface materials at the site. The tests include:

- Natural moisture content & dry unit weight
- Atterberg Limit Tests
- Percent passing No. 200 sieve
- Grain Size Distribution
- Consolidation
- Direct shear
- Lab Vane shear
- Pocket penetrometer
- Expansion index
- Compaction
- Corrosivity (pH, sulfate, chloride, electrical resistivity)

A detailed description of the GDC geotechnical laboratory testing program and test results are presented in Appendix B1.

8.0 GEOLOGY AND SOIL CONDITIONS

8.1 Regional Geology and Faulting

Regionally, the Ballona Wetlands are located near the western edge of the southwest block of the Los Angeles Basin, within the Peninsular Range Geomorphic Province. To the north, the Peninsular Range Geomorphic Province merges with the Santa Monica Mountains, which is within the Transverse Range Geomorphic Province of California.

The project site is located within the seismically active area of southern California, and has the potential to experience strong ground shaking from local and regional faults. Table 2 provides a summary of the active faults in the site area, which have the potential to general strong ground shaking, within 30 kilometers of the Project Site. A Fault Map showing the major faults in the vicinity of the site is included in Appendix D (Plate D-1).

The closest mapped fault near the site is the Charnock Fault, mapped as being present about 1 mile east of the site. The Charnock Fault has been speculated to be a ground water barrier, a fault or both (Poland, 1959; Geo-Consultants, Inc, 1999). Various investigators concluded that the Charnock Fault was a deep fault and did not break the Pleistocene "50"-foot gravel layer, giving evidence that it is not active. During one of the latest investigations by Davis and Namson Consulting Geologists (2000), and Thomas Wright (1991), using seismic reflection and oil well data, it was concluded that the Charnock Fault was not detected within the depth of the geophysical acquisition and oil well data. Namson and Davis (2000) further suggested that if the Charnock Fault exists below the extent of the seismic reflection acquisition, the fault would likely be 1 to 2 million years old. The mapped location of the Charnock fault is also included in Appendix D (Plate D-2).

Table 2: Major Faults in the Vicinity of the Site

Fault Name	Type of Faulting	Maximum Magnitude (Mw)	Distance from Site (km)	Slip Rate (mm/yr)
Newport-Inglewood	Strike Slip	7.5	7.3	1.0
Santa Monica	Strike Slip	7.3	7.8	2.6
Palos Verdes	Strike Slip	7.7	8.9	3.0
Malibu Coast	Strike Slip	6.7	10.2	0.3
Puente Hills	Thrust	7.0	11.7	0.7
Hollywood	Strike Slip	6.7	12.8	1.0
Elysian Park (Upper)	Reverse	6.7	20.4	1.3
Anacapa-Dume	Reverse	7.2	23.7	3.0
Raymond	Strike Slip	6.8	25.9	1.5
Verdugo	Reverse	6.9	28.0	0.5

Note: USGS Fault Database (2008)

8.2 Historical Earthquakes

Historically, several major earthquakes with a Magnitude of 5.9 to 6.7 have occurred not too far from the Project Site. A brief description of the most recent of these historical earthquakes follows.

8.2.1 Long Beach Earthquake of 1933

The 6.4 magnitude Long Beach earthquake took place on March 10, 1933, causing widespread damage to buildings throughout Southern California. The epicenter was offshore, southeast of Long Beach on the Newport-Inglewood Fault, and approximately 35 miles south east of the site. The estimated ground motion caused at the site was less than 0.1g.

Although only moderate in terms of magnitude, this earthquake caused serious damage to weak masonry structures on land fill from Los Angeles south to Laguna Beach. Property damage was estimated at $40 million, and 115 people were killed. The earthquake was felt almost everywhere in the 10 southern counties of California. Damage to school buildings, which were among the structures most commonly and severely damaged by this earthquake, led to the State Legislature passing the Field Act, which now regulates building-construction practices in California (earthquake.usgs.gov).

8.2.2 San Fernando Earthquake of 1971

The 6.6 magnitude San Fernando earthquake occurred on February 9, 1971, in a sparsely populated area of the San Gabriel Mountains, near the city of San Fernando. It lasted about 60 seconds, and, in that brief span of time, took 65 lives, injured more than 2,000, and caused property damage estimated at $505 million. The epicenter was located about 30 miles north of the site. The Modified Mercalli Intensity (MMI) felt at the site ranged from V to VI (i.e. Moderate to Strong), corresponding to PGA values in the range of 0.04g to 0.18g and Peak Ground Velocity (PGV) of about 3 to 16 cm/sec (www.cisn.org).

8.2.3 Whittier Narrows Earthquake of 1987

The 5.9 magnitude Whittier Narrows earthquake occurred in the southern San Gabriel Valley and surrounding communities of Southern California on October 1, 1987. The epicenter was in the town of Rosemead, about 22 miles east of the site. The earthquake was caused by slip on a blind throughst fault near the northern end of the Whittier Fault, which is part of the Elsinore Fault Zone, on a previously unknown fault structure. There was no surface rupture. The Modified Mercalli Intensity (MMI) felt at the site was V (i.e. Moderate) corresponding to PGA values in the range of 0.04g to 0.09g and Peak Ground Velocity (PGV) of about 3 to 8 cm/sec (www.cisn.org).

8.2.4 Northridge Earthquake of 1994

The Northridge Earthquake occurred on January 17, 1994 in Northridge, California, approximately 20 miles northeast of the site. It was a magnitude 6.7 earthquake and ended up being the most costly earthquake in United States history.

The shaking heavily damaged communities throughout the San Fernando Valley and Simi Valley, and within the surrounding mountains north and west of Los Angeles, causing 20 billion dollars of loss.

Sixty people were killed, more than 7,000 were injured, and more than 40,000 buildings suffered damaged. This earthquake was occurred about 18 miles north of the site. The Modified Mercalli Intensity (MMI) felt at the site ranged from VI to VII (i.e. Strong to Very Strong) corresponding to PGA values in the range of 0.20g to 0.30g and Peak Ground Velocity (PGV) of about 30 cm/sec (www.cisn.org; and earthquake.usgs.gov).

8.3 Local Geology

The Ballona Wetlands are located in the Ballona Gap, which is bounded by the El Segundo Sand Hills to the south and the Ocean Park Plain to the north. The Ballona Gap was formed by erosion, repeated sea level fluctuations, and river channel migration. During the Holocene period, the Los Angeles River channel flowed though the Ballona Gap, while today the Los Angeles River flows through the Dominguez Gap and the Ballona Creek flows though the Ballona Gap.

The geologic map of the site is included in Appendix C (Plate C-1). In the Ballona Creek region, marine and non-marine sediments are around 6,000 feet thick and unconformably overlay the crystalline basement rock of the Mesozoic aged Catalina Schist.

During recent historic times, fill has been placed over the natural deposits, locally. The upper 50 feet of sediments consists of Holocene aged fluvial silts, clay and sand deposits from the flooding of creeks and streams, tidal marshes and sand dunes and other windblown deposits that filled the Ballona Valley. These Holocene sediments overlay on top of the "50 foot" gravel in isolated areas and the San Pedro and Pico Formations. Below the San Pedro and Pico Formations, the lower Tertiary formations were found to be rich in petroleum.

8.3.1 Local Site Micro-Seismicity

From 1994 to 2012, 10 micro-earthquakes were recorded near the site area with magnitudes in the range of 2.3 M_L to 3.5 M_L (Local Magnitude) and with epicenters at a depth of 9 to 16 kilometers. These micro-events occurred within a 3-kilometer

radius from the approximate center point of the restoration area located at 33.974N and 118.438W. Table 3 summarizes the epicenter data for these 10 events (http://earthquake.usgs.gov/earthquakes/eqarchives/epic/). A map showing the location of the epicenters is included in Appendix D (Plate D-2).

Table 3: Mapped Epicenter for Recent Micro-Earthquakes within 3 km of Site

DATE_TIME	LAT	LON	DEP	MAG	MT	SC
2011-12-21 17:06:22.59	33.978	-118.413	11.2	2.4	ml	pde
2009-06-07 09:02:58.62	33.967	-118.428	16.2	2.3	ml	pde
2009-05-12 09:01:24.27	33.992	-118.456	10.0	2.5	ml	pde
2008-10-22 22:03:33.87	33.989	-118.431	11.8	2.5	ml	pde
2005-06-23 10:32:11.23	33.980	-118.423	15.7	2.8	ml	pde
2004-03-23 01:51:29.00	33.967	-118.430	9.9	2.8	ml	pde
2000-09-16 13:24:41.33	33.976	-118.424	12.2	3.3	ml	pde
1994-12-11 10:48:26.17	33.989	-118.435	14.1	3.5	ml	pde
1994-07-21 22:57:50.76	33.973	-118.439	12.0	2.8	ml	pde
1994-01-18 18:46:58.63	33.964	-118.434	15.8	3.1	ml	pde

Notes: 1) LAT = latitude; LON = Longitude; DEP = Depth; MAG = Magnitude; MT = Magnirude Type; SC = Source
2) ml = Richter Local Magnitude
3) pde = Preliminary Determination of Epicenters.

It should be noted that none of the reported micro-earthquakes are shallow (minimum depth is 9.9 km) and that the depth and magnitude estimates were generated using seismometers located at relatively large distances from the source. Thus the accuracy of this data, including their location, is approximate. In our opinion, this micro-seismicity does not reveal the presence of shallow (near surface) active faults in the subject area.

8.4 Surface Conditions

8.4.1 Area A

Surface conditions in Area A consist of a somewhat level brushy soil surface. The surface elevation typically ranges from about +12 feet to +20 feet NAVD. The brush found to be low to medium in height with isolated patches of exposed to thinly vegetated soil. Area A is currently fenced off and is undeveloped with the exception of a parking area along the western boundary and a drainage channel along the northern boundary. The existing Ballona Creek levees are located along the southern edge of Area A. An excavated, unlined drainage channel known as the "Fiji Ditch" runs parallel to Fiji Way along the northern boundary in the eastern portion of the area, and drains to the ocean through an existing culvert perpendicular to Fiji Way. The elevations within Fiji Ditch are as low as about El. +4 feet NAVD. In addition, the Gas Company operates five gas monitoring well sites in

the western end of the area. In general, the surface soils are dry and loose. Some areas have abundant rodent activity and are difficult to walk over.

8.4.2 Area B

Area B which lies south of Ballona Creek, is undeveloped, and contains the largest area of the existing wetlands with elevations at about +5 feet NAVD. Though some fill is present in this area, most of the fills are limited to Culver Boulevard and Jefferson Boulevard Roads. Area B is divided into four sections: north, south, west and east. The existing Ballona Creek levees are located along the northern edge of Area B (north and west). The Gas Company maintains a gas storage facility beneath the site in the oil field between north Area B and west Area B. South Area B is located south of Jefferson Blvd and East Area B is located south of Culvert Blvd. and west of Lincoln Blvd.

8.4.3 Area C

Area C is located north of Ballona Creek and east of Lincoln Boulevard. The Marina Freeway forms the northeastern border of Area C. The area is approximately 64 acres in size and is divided into a north and south portion by Culver Boulevard.

North Area C is undeveloped and contains low mounds, low to medium-high brush and isolated patches of exposed to thinly vegetated soil. The surface elevation typically ranges from about +14 feet to +17 feet NAVD. The Fiji Ditch runs southeast to northwest through the center of the site. In south Area C, the western portion contains baseball diamonds and associated minor structures, with some trees and grass. The eastern portion is undeveloped. The elevation is typically about +20 to +24 feet NAVD, There is a low area adjacent to the on/off ramps which has an elevation of +9 feet NAVD. The elevation of the levee along the channel ranges from about +19 feet to +22 feet NAVD.

8.5 Subsurface Conditions

Generalized subsurface profiles developed from the borings and CPTs performed in each area of the site are presented in Figures 5A, 5C, and 5D for Area A, Figures 5B and 5C for Area B and in Figures 5E and 5F for Area C. The soil conditions in each area are described below.

8.5.1 Area A

Surface elevations at exploration locations generally range approximately between +12 to +21 feet NAVD. Three distinct layers were identified in our exploration locations.

Plots of moisture content, dry density, and consistency of Area A soils from our investigation and previous investigations are shown in Appendix B3 and B4, respectively (Plates B3-1 through B3-4 and B4-1 through B4-4).

8.5.1.1 Layer No. 1: Artificial (Hydraulic) Fill

Artificial fill primarily from dredging of Marina Del Rey and Ballona Creek Channel cover the surface of Area A. The thickness of the Fill layer varies from 8 to 20 feet, with bottom of the layer at elevations ranging from El -3 feet NAVD near the channel to El +9 feet NAVD near Fiji Way.

The fill materials encountered in our explorations were consistent with the findings of previous investigation and are comprised predominantly of soft to medium stiff sandy silts and clays (ML, and CL), and loose to medium dense silty sands (SM). To a lesser extent, other soil types encountered in the borings include poorly graded sands and gravels (SP, GP) as well as small layers of elastic silts (MH).

Moisture contents in the fill soils ranges from 6 to 57 percent, and dry densities range from 64 to 117 pcf. Liquid Limit ranges from 28 to 69, and Plasticity Index ranges from 13 to 37.

8.5.1.2 Layer No. 2: Fine Grained Soils with Interbedded Sands Layers

Below the Fill layer, lies a predominantly fine grained layer with interbedded sand and silt layers. This layer is approximately 35 to 50 feet thick, and predominantly includes very soft to medium stiff clays and silts (CL, CH, ML, and MH), and loose to medium dense sands (SM, SC, and SP). Some denser/stiffer soils are also present within this layer, but individual layers are not found to be laterally continuous.

Moisture contents in this layer ranges from 15 to 91 percent, and dry densities range from 44 to 115pcf. Liquid Limit ranges from 29 to 92, and Plasticity Index ranges from 8 to 40. Undrained Shear Strengths in the layer generally varies in the range of 250 psf and 2,000 psf, with typical values between 500 and 1,500 psf. Plots of undrained shear strength results from laboratory vane shear within Area A soils are included on Plate B3-1.

8.5.1.3 Layer No. 3: Dense to Very Dense Sands and Gravels

Dense to very dense sands are present at depth of about 55 to 70 feet NAVD (El -32 to El -52) with SPT blow counts greater than 30 blows per foot. The CPT tip resistance is generally greater than 100tsf, which depicts that the materials are generally very dense.

8.5.2 Area B

Surface elevations at exploration locations in Area B generally range approximately between +5 to +8 feet NAVD, and as high as El +21 feet at existing levees and eastern portions of Culver Blvd. Three distinct layers were identified in our exploration locations.

Plots of moisture content, dry density and consistency of Area B soils from our investigation and previous investigations are shown in Appendix B3 and B4, respectively (Plates B3-15 through B3-18, and B4-7 through B4-10).

8.5.2.1 Layer No. 1: Artificial Fill

A Fill layer is also present in non-wetland areas within Area B. The thickness of the Fill layer varies from 0 to about 15 feet, with bottom of the layer at elevations ranging from El 0 to El +6 NAVD.

The Fill materials predominantly include loose to medium dense silty sands (SM) and soft to stiff sandy silts and clays (ML). Other soil types encountered in the borings include poorly graded silty sands and gravels (SP-SM, GP).

Moisture contents in the Fill soils ranges from 21 to 31 percent, and dry densities range from 76 to 94pcf. Materials in this layer were either non-plastic or had low plasticity.

8.5.2.2 Layer No. 2: InterbeddedFine Grained and Coarse Grained Soils

Below the Fill layer, lies interbedded fine grained and coarse grained soils. Immediately below the fill very soft to medium stiff fine grained soils are present to about El -5 to -10 feet NAVD. These soils predominately consist of fat clays (CH) with lesser amounts of elastic silts (MH), low to medium plasticity clays and silts (CL, ML). Interbedded loose to very dense sands and fine grained soils extend below El -10 feet to about El -45. The interbedded sand layers are generally thicker on the west side of the Area B, with a thickness of about 35 feet near the sand dunes. Moisture contents in this layer ranges from 14 to 81 percent, and dry densities range from 51 to 118pcf. Liquid Limit ranges from 27 to 84, and Plasticity Index ranges from 3 to 50. Undrained Shear Strengths in the layer generally varies in the range of 250 psf and 2,000 psf, with typical values between 300 and 1,500 psf. Plots of undrained shear strength results from laboratory vane shear within Area B soils are included on Plate B3-14.

8.5.2.3 Layer No. 3: Dense to Very Dense Sands

Dense to very dense sands are present at depth of about 60 to 70 feet NAVD (El -45 to El -58) with SPT blow counts generally greater than 40 blows per foot. The CPT

tip resistance is generally greater than 100 tsf, which depicts that the materials are generally very dense.

8.5.3 Area C

Surface elevations at exploration locations in Area C generally range approximately between +13 to +24 feet NAVD. Three distinct layers were identified in our exploration locations.

Plots of moisture content, dry density and consistency of Area B soils from our investigation and previous investigations are shown in Appendix B3 and B4, respectively (Plates B3-21 through B3-24, and B4-13 through B4-16).

8.5.3.1 Layer No. 1: Artificial Fill

Artificial Fill is present in the upper 8 to 15 feet of Area C. The thickness of the Fill layer varies from 8 to 15 feet, with bottom of the layer at elevations ranging from El +7 to El +15 NAVD.

The Fill materials are a mixture of fine grained and coarse grained soils, and predominantly include loose to medium dense silty sands (SM) and soft to stiff sandy silts and clays (ML, and CL). Other soil types encountered in the borings include poorly graded sands and clayey sand (SP, SC) as well as high plasticity silts and clays (MH, CH).

Moisture contents in the Fill soils ranges from 2 to 53 percent, and dry densities range from 69 to 119pcf. Liquid Limit ranges from 40 to 71, and Plasticity Index ranges from 13 to 36.

8.5.3.2 Layer No. 2: InterbeddedFine Grained and Coarse Grained Soils

Below the Fill layer, interbedded layers of fine grained and coarse grainedsoils are present. This layer is approximately 40 to 50 feet thick, and predominantly includes soft to stiff clays and silts (CL, CH, ML, and MH), and loose to dense sands (SM, SC, and SP).

Moisture contents in this layer ranges from 8 to 53 percent, and dry densities range from 68 to 134pcf. Liquid Limit ranges from 24 to 75, and Plasticity Index ranges from 12 to 47. Undrained Shear Strengths in the layer generally varies in the range of 500 psf and 2,500 psf.

8.5.3.3 Layer No. 3: Dense to Very Dense Sands

Dense to very dense sands are present at depth of about 50 to 60 feet (El -30 to El -33 NAVD). The CPT tip resistance is generally greater than 200 tsf, which depicts that the materials are generally very dense.

8.6 Generalized Subsurface Cross sections

Based on the subsurface explorations performed, generalized subsurface cross sections along the length of the new levees planned in Area A and Area B are shown on Figures 5A and 5B, and a generalized subsurface profile along the existing Ballona Creek levees is shown on Figure 5C. These profiles include borings and CPTs located within about 100 feet of the levee alignment.

A generalized subsurface cross section within the interior of Area A showing the soils that will be excavated is presented on Figure 5D. Two generalized subsurface profiles were developed for Area C. An East-West cross section in Area C south, as shown on Figure 5E, and a North-South cross section extending through both north and south Area C is shown on Figure 5F.

In addition, for the analysis of levee stability, generalized subsurface cross-sections, were developed at critical locations that were selected for analyses based on the subsurface and topographical conditions encountered. The locations of these critical sections are shown on Figure 4 (4A and 4B). The cross-sections are labeled A-A' through L-L' and are shown in Figure 6 (6A through 6L). These cross-sections were chosen conservatively at locations where either softer and/or thicker fine-grained soils were present or where the topography was steepest, for static analyses, and where the thickness of the liquefied soils was thickest, for seismic analyses. The cross-sections are discussed in greater detail in the Slope Stability Section of this report.

9.0 SEISMICITY

9.1 Seismic Hazard Analysis

A probabilistic seismic hazard analysis (PSHA) is the preferred approach for seismic evaluation of levees. The PSHA incorporates an earthquake's frequency of occurrence for different magnitude events occurring on various seismic sources, the uncertainty of an earthquake's location, and a ground motion prediction, including its uncertainty of occurrence. A ground motion return period for seismic evaluation was selected based on the levee's category and the agency that coordinates the evaluation policy, and is often about the same level as the flood return period.

For levees in urban areas, such as the levees in this project, the Department of Water Resource (DWR, 2012) requires a 200-year return period for seismic evaluations, which is consistent with the targeted 200-year flood protection level. A return period of 224 years, defined as having a 20% probability of exceedence in 50 years, was adopted for seismic evaluation of the levees for the Project.

A PSHA was performed using the 2008 Interactive Deaggregation Tool Developed by USGS (USGS, 2008), for a return period of 224 years, and using a $V_{s,30}$ of 202 m/s (based on our seismic CPT measurements which are presented in Appendix D (Plates D-14 through D-17). The 2008 Interactive Deaggregation Tool is available on the web, and utilizes the 2008 Next Generation Attenuation (NGA) ground motion prediction equations (GMPEs).

The acceleration response spectrum based on USGS Deaggregations (2008) and a return period of 224 years is presented in Table4. The Deaggregation Results are shown in Appendix D.

Table 4: Acceleration Response Spectrum

Period (Sec)	Sa (g)
0.0	0.32
0.1	0.53
0.2	0.69
0.3	0.71
0.5	0.63
1.0	0.43
2.0	0.23
3.0	0.15
4.0	0.11
5.0	0.08

9.2 Design Earthquake

The design earthquake was selected based on the deaggregation of the seismic hazards for a return period of 224 years, at peak ground acceleration (PGA). Therefore, the design earthquake for this project was selected as an earthquake with a PGA of 0.32g, with a Magnitude of 6.7 that occurs at a distance of 13 kilometers from the site.

9.3 Seismic Hazards

The site is not within the Alquist-Priolo Earthquake Fault Zone, or a Fault Rupture Study Area. The closest Alquist-Priolo Earthquake Fault Zone is associated with the Newport-Inglewood fault, and is located approximately 3.5 miles east of the site. Based on the available geologic data, active or potentially active faults with the potential for surface fault rupture are not known to be located directly beneath or projecting toward the site. Therefore, the potential for surface rupture due to fault plane displacement propagating to the surface at the site is considered remote.

All low-lying areas along California's coast are subject to potentially dangerous tsunamis. Tsunamis are long-period waves generated primarily from distant and local offshore earthquakes, landslides, or volcanic eruptions. The magnitude of the potential hazard is a function of the coastline configuration, sea floor topography, individual wave characteristics, and distance and direction from the source. Two tsunamis, due to the 1960 Chile Earthquake, caused damage in the Los Angeles and Long Beach Harbors. In 1960, waves up to 5 feet in height occurred in Cerritos Channel, and currents up to 12 knots were reported. A 5-foot run-up for a 100-year tsunami, and an 8-foot run-up for a 500-year tsunami are predicted near the Marina Del Rey area (Ziony, Editor, 1985). If a 100-year and 500-year tsunamis coincide with high tide, the maximum water elevation near the site may reach El. +11 and +14 feet NAVD, respectively. Although the damage potential from a tsunami is expected to be low, it cannot be ruled out.

The possibility of seiches (wave oscillations in a body of water due to earthquake shaking) within the Ballona Creek is considered remote.

The hills to the south of the site in Playa Del Rey are mapped in the City of Los Angeles Landslide Map, according to the website, NavigateLA.lacity.org. However, these hillsides are relatively far from any Project Improvements and there does not appear to pose a threat to project improvement.

Seismic slope stability is discussed under Slope Stability Analysis. Seismic Hazard Maps for the Project Site are also included in Appendix D (Plates D-18 through D-21).

10.0 GROUNDWATER CONDITIONS

10.1 Groundwater in Current and Previous Investigations

Groundwater was measured in GDC's investigation at some of the hollow stem boring locations in Area A, and Area C and in one hand auger boring in Area B. A summary of groundwater measurements in our investigation is shown in Table 5.

Depth to groundwater was also measured in selected borings in the previous geotechnical investigations, as shown in Table 5. The elevations were presented in mean sea level (MSL) datum. Since the datum adopted for the Project is the North American Vertical Datum (NAVD), we have converted the MSL elevations to NAVD datum. The highest measured groundwater elevation was 10 feet NAVD in Area A.

Table 5: Groundwater Measured in Current and Previous Investigations

Area	Report	Depths (feet)	Approximate Elevations (NAVD)
A	Current Investigation by GDC	7 to 17	-6 to 5
	Law Crandall, 1991	7 to 15	0 to 10
	Law Crandall, 1991 (Supplementary Report)	14 to 17	N/A
B	Current Investigation by GDC	2	3
	Law Crandall, 1991	0.1 to 4.5	4 to 7
	Diaz Yourman & Associates	2 to 11	2 to 8
C	Current Investigation by GDC	18	-2
	Law Crandall, 1991	12 to 22	0 to 6
	Diaz Yourman & Associates	17 to 23	2 to 6
Note: N/A = Not Available			

10.2 Historically Highest Groundwater

The CGS Open File Report 98-36 Venice Quadrangle (CGS, 1998) includes Historically Highest Groundwater Contours and Borehole Log Data Locations for the Venice Quadrangle, which includes the project site. Historical highest groundwater map is shown in Appendix D (Plate D-19). Historically highest groundwater is at a depth of less than 5 feet in Area B (El. +0 to +5 feet), and at depths of 5 to 10 feet in Areas A, and C, (corresponding to approximate elevations of about El. +5 to +15 feet NAVD).

10.3 Design Groundwater

According to the in-progress USACE Technical Letter, dated September 1, 2012 (USACE, 2012) titled, "Guidelines for Seismic Evaluation of Levees", a typical "coincident water level" should be considered for the liquefaction triggering analysis and seismic slope stability analysis for design of levees." According to this Technical Letter, the water level should be assumed to be the highest of the following three conditions:

1) Median Annual Water Level (in Ballona Creek or groundwater): This water level corresponds to mean sea level (MSL), which corresponds to Elevation +2.6 feet NAVD.

2) Typical Seasonal Water Level: This water level could be conservatively assumed to be the flood water level in the creek during a relatively typical water level fluctuation, e.g., during a typical winter rainstorm. For this condition we used a water level for a two-year flood conservatively assumed to be around +9 feet NAVD.

3) Mean High Tide Elevation (including Sea Level Rise): The Mean Higher High Water (MHHW) elevation corresponds to an elevation of+5.2 feet NAVD. Assuming a Sea Level Rise of 4.6 feet, by 2100, this water level can be estimated to be at about +9.8 feet NAVD.

Based on the above, a coincident water level of +10 feet NAVD was adopted for the liquefaction triggering and seismic slope stability analyses. It is noted that a design groundwater level of +10 feet is also consistent with measurements taken during previous and current geotechnical investigations, and with the historically highest groundwater level for the site area.

It should be noted that other groundwater levels are used for non-seismic load cases, depending on the loading conditions, as applicable.

11.0 LIQUEFACTION

Liquefaction involves the sudden loss in strength of a saturated, cohesionless soil (predominantly sand or non-plastic silt/clay) caused by the build-up of pore water pressure during cyclic loading, such as that produced by an earthquake. This increase in pore water pressure can temporarily transform the soil into a fluid mass, resulting in vertical settlement and can also cause lateral ground deformations. Typically, liquefaction occurs in areas where there are loose sands and the depth to groundwater is less than 50 feet from the surface. Seismic shaking can also cause soil compaction and ground settlement without liquefaction occurring, including settlement of dry sands above the water table.

The site is located within a State of California Liquefaction Hazard Zone mapped by California Geologic Survey (CGS reference), as indicated in Appendix D (Plate D-19).

The site is underlain by relatively young and loose/soft interbedded deposits of fine-grained silt/clay with relatively thin discontinuous layers of sandy or non-plastic silt. Based on our analyses localized liquefaction is predicted to occur in the sand and non-plastic silt lenses and layers during the design earthquake. The results of the

liquefaction analysis are presented in Appendix E. The post-liquefaction settlement was estimated at CPT locations using the NCEER Method (Youd et al., 2001) based on the design earthquake and the design groundwater for the project. Post-Liquefaction Settlement on the order of 0 to 3 inches is anticipated for the design earthquake.

The site is relatively flat, and the proposed levees are located approximately 300 to 1,200 feet away from the meandering channel. Therefore, it is anticipated that the layers in which liquefaction occurs are essentially laterally confined and that the main effect from liquefaction will be post-liquefaction settlement. This was partly confirmed by an estimation of free field lateral spreading was performed using the Youd et al. (2002) method (Plates E-30 and E-31). Free field lateral spreading displacement was estimated to be on the order of 3 to 6 inches at the location of the new levees, at a distance of about 300 to 1000 feet from the meander channel. The results of the analyses are also presented in Appendix E (Plates E-30 through E-32).

Liquefaction causes a temporary loss of strength during and immediately after an earthquake. The strength of soils that liquefy is typically very small and is typically known as the post-liquefaction undrained shear strength. To take into account the temporary loss of strength due to liquefaction we performed stability and deformation analyses using post-liquefaction undrained shear strength. These analyses are presented in the slope stability section provide estimates of lateral deformations of levees and embankments.

12.0 SEEPAGE ANALYSES

As discussed earlier, four field permeability tests were performed at depths of 5 and 10 feet, at two exploration locations (A-HSA064 and A-HSA066) near the existing north Ballona Creek levee, to evaluate the permeability of the soils near the base of the levee section. Based on the field tests, the average permeability of the soils was estimated to be in the range of 3.2×10^{-4} cm/s to 1.5×10^{-3} cm/s. The upper bound permeability value of 1.5×10^{-3} cm/s was used in numerical Finite Element seepage models using the RocScience computer program, Slide (version 5), for evaluation of the hydraulic gradients and discharge values expected along critical levee sections. The discharge values were also evaluated for the lower bound estimated permeability value, in order to obtain a rough range of the anticipated seepage discharge values expected through the levees. Figures depicting our seepage analyses are presented in Appendix F.

12.1 Factor of Safety Against Piping

12.1.1 Introduction

To evaluate the Factor of Safety (FOS) against piping during construction, the hydraulic gradient was estimated for the following conditions:

1) Existing north levee during excavation of Area A and the new channel
2) Existing south Area B levee at downstream end of the project

12.1.2 Existing Levees During Excavation of Area A

The hydraulic gradient was evaluated assuming a steady state seepage condition with channel water level of El +18 at the location of existing north levee, after completion of the excavation of the new north meander channel (under dry condition), and prior to the breach of the levee. This analysis assumes the unlikely condition of a having a long-term high water level of El +18 (i.e. steady state), while the excavations of the meander channel is being completed. It should be noted that El +18 assumed for this analyses is higher than the design flood elevation (El +17). The exit hydraulic gradient for this conservative and highly improbable scenario was estimated to be approximately 0.2 (Plate F-3). Thus, the FOS for piping was calculated to be at least FOS = 5.0 (FOS_{min} = 1.0). This implies that piping potential is remote for lower, for more likely high water conditions.

12.1.3 Existing Levees During 100 Year Flood in West Area B

Second, the hydraulic gradient was evaluated assuming a steady state seepage condition with channel water level of El +13 (i.e. corresponding to the high water elevation during a 100-year flood event, including bed aggradation and also sea level rise) at the downstream of West Area B, where the existing levees are expected to remain. The existing levee crest elevation at its lowest point in Area B (i.e. El. +14) was used in this analysis. The exit hydraulic gradient for this very conservative scenario (steady state) was estimated to be approximately 0.27 (Plate F-4). Therefore, the FOS for piping was calculated to be at least FOS = 3.7 (FOS_{min} = 1.0).

12.1.4 New Levees During 100 Year Floods

The above results indicate that an internal erosion failure is not likely to occur for the existing levees, which are very steep compared to the new levees. The flatness of the new levees implies a longer flow path and thus much lower hydraulic gradients. Therefore, our seepage analyses in Appendix F indicate that the likelihood of piping for the new levees is remote.

12.2 Seepage Discharge Values

12.2.1 General

The discharge flow that is anticipated to seep into the excavation in Area A was evaluated using the range of permeabilities obtained from our field permeability tests, at the location of existing north levee, after completion of the excavation of the

new north meander channel (under dry condition), and prior to the breach of the levee. The following two conditions were considered.

1) A typical transient condition of tidal changes over a period of a week.
2) After a storm event that would raise the water level in the channel to El +18 for a period of 10 days.

12.2.2 Discharge Due to Typical Tidal Changes

For this transient seepage analysis, it was first assumed that a steady state condition was reached with a water level at El +3 corresponding to an average tide level in the channel. Then, water levels corresponding to typical tidal changes at Santa Monica Bay over a period of one week were applied along the channel location as transient water levels. The discharge in the excavation zone was evaluated at different steps during the analysis. Very minor fluctuations of the discharge values were computed as a result of tidal fluctuations in the channel (Plates F-7 to F-16).

The typical discharge values due to tidal changes in the channel were estimated to be in the range of about 0.04 to 0.19 ft^3/hour/ft, or approximately 0.3 to 1.43 gallons/hour/ft. Assuming a total excavation length of 1,500 feet in Zone A, complete dewatering would require a pumping capacity in the range of 60 to 285 ft^3/hour (Plates F-7 to F-16). Our seepage analyses are presented in Appendix F.

12.2.3 Discharge Due to a Major Storm

The seepage discharge rates after a 10-day storm event were estimated using a transient seepage analysis. For this analysis, a steady state condition was reached with water level in the channel at El +3 corresponding to an average tide level. Subsequently the water level in the channel was raised to El +18 for a period of 10 days to simulate a 10-day storm. The water level was then lowered to El +3 after the 10-day period.

The discharge rates were calculated to be in the range 0.045 to 0.21ft^3/hour/ft, or approximately 0.33 to 1.57 gallons/hour/ft (Plates F-18 to F-29). The discharge values in the excavation zone showed an increase of approximately ten percent following the storm relative to the typical discharge rates. This implies that discharge from a major storm that lasts for a fairly long period of time is only marginally more that the discharge into the excavation during normal tidal fluctuations.

Our estimates do not include drainage run-off. Our seepage analyses are included in Appendix F.

12.3 Rapid Drawdown

Past performance of the existing levees along the Ballona Channel indicate that rapid drawdown is not an issue. This is likely due to the relatively low permeability and strength of the existing materials. Furthermore, as can be seen from the results

of seepage analyses, the tidal fluctuations affect only a small volume of soil, located near the surface of the levees. This is also evident from observing the results of the seepage analyses during and after a 10-day storm.

Rapid drawdown is a condition that can affect levees when the water in the channel drops quickly following a long period of high water. Under such conditions, the soils within the embankment are usually fully saturated during the high water period. Shortly after drawdown the stabilizing external water pressure on the slope is removed, while the internal pore pressures within the saturated soils have not dissipated. The levees at Ballona Creek are geographically not prone to long period high water in the channel, where a large volume of levee soils become saturated. Therefore, a steady state high water condition will likely not develop at Ballona Creek levees. As a result, the likelihood of deep-seated failure during rapid drawdown failure is remote.

While shallow saturation of surface soils is possible on the slopes, due to the flatness of the protected slope of the new levees, the possibility of a surficial rapid drawdown failure also appears to be very low due to the strength of the materials. For example, assuming rapid drawdown creating a 5-foot-thick zone of saturation on a 5H:1V slope, the normal stress and shear stress at the base of the zone of saturation are on the order of 600 and 120 psf, respectively. Therefore, in order for the infinite slope to be stable, the base of the saturated zone should have either minimum undrained shear strength, S_u = 120 psf. At a depth of 5-feet out investigation typically showed undrained shear strengths of 300 psf, or higher. Therefore, further rapid drawdown analyses were not considered necessary for the levees.

13.0 SLOPE STABILITY OF LEVEES

13.1 Introduction

The static and seismic slope stability of the new (proposed) levees and the portions of the existing levees that will remain were evaluated for a 100-year flood event, and an earthquake with a hazard return period of 224 years. It was also found that the results of the analyses are not sensitive to higher water elevations in the channel (i.e., a less frequent, higher return period, flood event.)

Additionally, static slope stability of the existing north levee was evaluated for the temporary condition which involves the construction of the new meander channels. It should be noted that the existing north levee will be breached after the Area A excavation and the construction of the meander channel; however the construction will likely take several years, and thus the levee static stability was considered for a long term and not a short term condition.

The cross sections used for the slope stability analyses are shown in Figures 6 (6A through 6L). Slope stability analyses were performed at 12 locations along the new and the existing levees in areas (Sections A-A' through L-L').

Cross sections were made at locations were the levee cross section changes, as well as in areas where there was a significant change in subsurface soil conditions. Six conservatively selected idealized soil profiles were used for stability analyses.

13.2 Soil Strength Parameters

Soil strength parameters were assigned to each layer using field and laboratory data from our investigations as well as selected information from previous investigations (Tables G-1 through G-12 in Appendix G). The basis for adopted static soil strength parameters follow.

- Undrained shear strength in fine-grained clayey and silty soils were primarily selected on the basis of the results of a Geonor H-60 laboratory vane shear testing of Shelby Tube samples collected, as well as using correlations of undrained shear strength with CPT tip resistance (Plates G-7 through G-9). A number of direct shear tests were also performed on the clayey/silty soils to select the drained strength parameters of the fine-grained soils for use in the steady state long-term analyses (B1-3h and B1-3q).

- Shear strength soils parameters for fill soils, were conservatively selected based on the results of a number of direct shear tests performed on fill soils (Plates G-10 and G-11). Existing levee materials were slightly stronger than the fill soils based on direct shear test results. Therefore, a slightly higher cohesion value was adopted for levee embankment soils. New levee material strengths were taken to be the same as those of existing levees. This is conservative as the new levees will be compacted to modern standards that yield higher strengths.

- Shear strength parameters in coarser-grained sandy soils were conservatively selected based on the results of the direct shear parameters.

Liquefaction analyses indicated there are layers and lenses that will likely liquefy during a major seismic event. Therefore, stability analyses using the residual (post-liquefaction) shear strength were performed for seismic stability analyses.

- For seismic analyses, post-liquefaction residual strength of the liquefied layers were estimated using Seed and Harder (1990) correlations with blow counts, using representative SPT blow counts, corrected for the effects of overburden, energy, and fines content of the liquefied materials.

Plates showing shear strength ranges and adopted values for fill soils and undrained shear strength of fine-grained soils are included in Appendix G (Plates G-7 through G-11). Plates showing the depths and residual strength parameters are the liquefied soils are also included in Appendix G (Plates G-12 through G-15).

13.3 Idealized Soil Profiles

Six conservative idealized soil profiles were adopted along the alignment of the new and the existing levees based on distinct variations in the subsurface profile. Each of the levee cross sections analyzed was assumed to be underlain by one of the following idealized soil profiles.

- East Area A Profile (Levee Sections A-A' and B-B' and Existing North Levee; Table G-1 and G-2)
- West Area A Profile (Levee Sections C-C' and D-D'; Table G-3 and G-4)
- Eastern Ballona Creek Profile (Levee Sections E-E' and F-F'; Table G-5 and G-6)
- East Area B Profile (Levee Section G-G'; Table G-7 and G-8)
- West Area B Profile (Levee Sections H-H', I-I', J-J' and K-K'; Table G-9 and G-10)
- Area C Profile (Levee Section L-L'; Table G-11 and G-12)

13.4 Levee Cross Section Locations

Selected levee cross sections used for slope stability analyses are briefly discussed below.

- Section A-A' and Section B-B' were included to evaluate the stability of the new Area A perimeter levees in eastern portion of Area A.

- Section C-C' was included to evaluate the stability of the new Area A perimeters levees in western portion of Area A.

- Section D-D' was included to evaluate the stability of the existing portion of the north levee located at the downstream end of the new Area A levees. This is the downstream location were the existing north levees will tie in to the new levees and will remain as part of the improvements of the project.

- Section E-E' was included to evaluate the stability of the existing south levees just downstream of Lincoln Boulevard after placement of the Area B fill mounds to the south between Culver Boulevard and Jefferson Boulevard These existing levees will remain as part of the improved project and will tie into the new Culver Boulevard Levees.

- Section F-F' was included to evaluate the stability of the upstream end of the Culver Boulevard Area B levees. This is the widest section of the Culver Blvd Area B levees, and includes the old railroad fill area.

- Section G-G' was included to evaluate the stability of the Culver Boulevard Area B levees in East Area B.

- Section H-H' was included to evaluate the stability of the wide portion of Area B levees and using a West Area B subsurface soil profile.

- Section I-I' was included to evaluate the stability of the West Area B levees. The section in this area is planned with a varying wet side slope of ranging from 5H:1V to 10H:1V. The section analyzed was conservatively selected to have a 5H:1V wet side slope.

- Section J-J' was included to evaluate the stability of the temporary levees that will be built as part of the interim project. These levees will likely remain for many years after the first phase of construction, and thus, are analyzed as permanent levees.

- Section K-K' was included to evaluate the stability of the existing levees that remain a part of the improvement project, and tie-in to the new West Area B levees at the downstream end of Area B. Please note that this portion of the existing levees may be raised for flood management.

- Section L-L' was included to evaluate the stability of the existing north Area C levees located upstream of Lincoln Blvd. along the south side of South Area C. These levees will remain as part of the project, but are not affected by the improvements in the project.

13.5 Levee Cross Section Locations

The following loading conditions were considered in our levee slope stability analyses:

i) End of construction condition: This loading condition assumes that grading is being performed during the dry season and that the channel water elevation is affected primarily by tides. For stability, the critical stage of this loading condition is when excavations have reached the lowest level and surcharges are the highest, i.e., at the end of construction.

ii) High water short term condition: This conservative loading condition assumes that a near full channel water elevation is present due to large rainstorms, As previously discussed the duration of such event is not long enough for steady

state conditions to develop and the corresponding soils to become fully saturated. Nevertheless, our analysis conservatively assumes the pore pressures of a fully developed steady state phreatic surface in coarse-grained materials, while undrained shear strength is used for fine-grained soils. This loading condition is more stringent than typically adopted conditions, and thus generally not considered by USACE for slope stability analysis of levees. This loading condition is most analogous to a long term steady state stability analysis in terms of water level, except for its conservatism in the strength assumptions. As can be seen in Table 6, the high water short term condition consistently yields lower FOS values, than the high water long term (steady state) stability condition.

iii) Long term steady state stability: This loading condition also assumes that a near full channel water elevation has been present for a long time due to large rainstorms. This loading condition is similar to the previous one, except that steady state pore pressures are assumed for all soils. Therefore, drained soil strength parameters are applicable for both the coarse-grained and fine-grained soils. This loading condition was analyzed for only a few levee cross sections, to verify that the Factor of Safety (FOS) values for this condition are higher than the high water short term condition. It should be noted that the minimum FOS slope stability requirement for the long-term steady state condition was conservatively adopted for both the short-term and long-term high water conditions.

iv) Seismic slope stability during the design earthquake: The site contains low density materials that are prone to liquefaction during a major earthquake. This seismic loading condition considers where appropriate post-earthquake strength parameters, to evaluate the potential of slide failures during the design earthquake (i.e., if FOS < 1.0).

v) Deformation analysis for seismic condition: To estimate permanent seismic displacements, a seismic slope stability is first performed to calculate the yield acceleration, i.e., the acceleration that results in FOS=1.0. Then displacements of the levee are estimated for the design event earthquake using simplified methods such as Bray and Rathje (1998) method. The performance of levees is considered acceptable, if the permanent seismic displacements are estimated to be below 6 inches (15 cm).

13.6 Factor of Safety Criteria and Design Considerations

i) Short-term condition: A minimum FOS> 1.3 is adopted for sudden and short term loading conditions, e.g., immediately after the end of construction of the new and remaining levees. Undrained soil strengths parameters are

used to evaluate the resisting forces. A water level at Elevation +5 feet NAVD was assumed in the channel.

ii) High water short-term and long-term conditions: A minimum FOS > 1.5 is adopted for both short term and long term steady state conditions with water level conservatively selected at El +17 feet NAVD in the channel for the new levees and the existing levees, with the exception of the existing levee downstream of Area B (Section K-K'), where the water level was selected to be at El +13 NAVD, corresponding to the estimated high water for the 100-year flood at this location. It should be noted that short-term stability is essentially not very sensitive to a change in the water level in the channel.

iii) FOS > 1.0 is required for post-liquefaction condition, using undrained strength parameters and post-liquefaction residual shear strength for liquefiable soils. The water level in the analyses was assumed to be at El +10 NAVD for levee sections in Areas A and C, and assuming a groundwater at existing ground surface (i.e. ground surface elevation outside of the levee embankment cross section) for Area B, since generally ground surface elevations are lower than El +10 NAVD.

iv) A FOS greater than 1.0 under the previous loading condition (iii) does not guarantee acceptable performance. Hence, a deformation analysis was performed to evaluate the seismic displacements under design earthquake conditions. Seismic displacements on the order of 15 cm are generally considered acceptable for levees. The yield acceleration used in the deformation analysis is the horizontal acceleration that produces a FOS equal to 1.0. The yield acceleration was calculated for each levee section using conventional slope stability methods and the Bray and Rathje (1998) method was used to estimate seismic displacements.

A summary of the analyses results is presented in Table 6. The results of the slope stability analyses are included in Appendix G.

Table 6: Summary of Slope Stability Analyses

Section Analyzed	Static Factor of Safety			Seismic Stability		
	End of Construction Short term Stability	High Water Short Term Stability	High Water Long Term Stability (Steady State)	Post-liquefaction (Seismic)	Yield Acceleration	Deformations (cm)
	$FOS_{min} > 1.3$	$FOS_{min} > 1.5$	$FOS_{min} > 1.5$	$FOS_{min} > 1.0$		
Section A-A'	3.39	3.35	5.21	2.38	0.09	4
Section B-B'	3.51	4.32	N/C	2.38	0.08	4
Section C-C'	3.45	5.28	N/C	2.42	0.10	4
Section D-D'	1.49 [1]	2.28	N/C	1.29	0.05	47
Section E-E'	1.57	2.07	N/C	1.33	0.08	40
Section F-F'	2.19	2.19	N/C	1.59	0.10	3
Section G-G'	2.55	2.73	3.42	1.79	0.05	9
Section H-H'	1.94	1.87	N/C	1.24	0.04	8
Section I-I'	1.68	1.61	2.29	1.17	0.04	11
Section J-J'	2.09	2.48	N/C	1.47	0.05	6
Section K-K'	1.58	2.13	N/C	1.26	0.04	15
Section L-L'	1.60	2.26	N/C	1.40	0.08	30

Note: N/C = not calculated

13.7 Discussion on the Slope Stability Results of New and Remaining Levees

The stability of the new and existing levees was analyzed at the end of construction, during high water (short term and long term), and seismic conditions. A discussion follows.

- **End of Construction Condition:** The FOS for the end of construction short-term condition with channel water levels at elevation +5 feet NAVD was found to be satisfactory for the new and existing levee sections that were analyzed ($FOS_{min} > 1.3$).

- **High Water Short Term Condition**: The FOS for the high water condition assuming short term loading is satisfactory for the new and existing levee sections that were analyzed ($FOS_{min} > 1.5$).

- **Post-liquefaction Condition:** During the design earthquake it is anticipated that some soil layers will liquefy, and thus lose significant resistance. The FOS calculated using post-liquefaction residual shear strength was found to be greater than 1.0 for a water level at El +10 NAVD, or at ground surface (for Area B). As a result the likelihood of a catastrophic flow slide failure is remote.

- **Yield Acceleration and Deformation Analysis:** A deformation analysis using the Bray and Rathje (1998) method calculated displacements on the order of 4 to 11 centimeters (approximately 1.5 to 4.5 inches) for the new levees, and displacements on the order of 15 to 47 centimeters (approximately 6 to 19 inches) for the existing levees under the design earthquake. Generally displacements less than 15 cm (about 6 inches) are considered acceptable for non-inhabited structures. Therefore, in our opinion, the calculated displacements for the new levees are deemed acceptable. However, the displacements in the existing levees are large, and do not meet current seismic criteria. Where the new levees will tie into an existing levee, excessive deformation and cracking of the existing levee is a concern not only during seismic conditions, but also due to the additional loading and settlement that will be caused by construction of the new levee. Therefore, mitigation measures are recommended for all the existing levees where new levees will tie-in.

13.8 Post Excavation Stability of the Existing North Levee in Area A

During the excavations within Area A and the new meander channel north of the existing levee, the Existing North Levee along the existing channel provides flood protection, and therefore should remain functional. Post Excavation stability of the existing north levee was evaluated assuming the excavation in Area A will take at least several months to be completed. Additionally it was assumed that the

excavation will be performed in dry condition using dewatering, because this is the critical assumption for slope stability. However, the excavation may also be performed in the wet.

For this condition, the water level in the existing Ballona Creek channel was assumed to be about El +7 NAVD corresponding to approximately a 2-year flood condition. The water level in the protected side of the levee was assumed to be 1 to 2 feet below the elevation of the invert, at about El -6. Since the loading would be sudden, undrained soil strength parameters were used. Because the excavations in Area A will likely take at least several months, a minimum FOS of 1.5 was adopted,

Pursuant to our discussions with the civil designer, we assumed that the excavation in the protected side of the existing north levee will be sloped at 2.5H:1V to the top of the meander channel (approximately El +5 NAVD), and the meander channel will be sloped at 5H:1V to an invert elevation of El -5 NAVD. The distance between the bottom of the excavation on the protected side of the levee and the top of the meander channel forms a "stability berm". The analysis was performed with varying distance from the toe of the excavation. The results of the analyses show that a minimum distance of 70 feet from the protected edge of crest is needed to satisfy a FOS of 1.5.

Thus, to maintain the existing levee functional, the excavation in Area A should be performed in two distinct stages:

- **First Stage:** If the excavation is performed under "dry" conditions (i.e., with dewatering), excavation of Area A, should be initially performed at least 70 feet away from the existing levee protected side edge of crest. This stage will result in the creation of a "stability berm". <u>If the excavation is not dewatered and the excavation is performed under wet conditions, a berm is not required for stability.</u>

- **Second Stage:** Local excavation of the "stability berm" and existing levee should be performed immediately prior to breaching of the levee. Please note that locally lowering the top of the levee, prior to breaching, in areas where the levee will be breached, will also temporarily increase the static FOS.

13.9 Effect of Water Level in the Channel on Seismic Stability

13.9.1 Introduction

As discussed in the slope stability section, post liquefaction seismic stability analyses and seismic deformations analyses were performed assuming a design groundwater at Elevation +10 feet NAVD for levee sections in Areas A and C. For Area B the groundwater was assumed to be at the existing ground surface outside of the levee embankment, since the ground surface elevations are generally lower than Elevation +10 feet NAVD.

In all areas, for the seismic analysis the assumed water level in the channel is lower than the water level that occurs during an extreme high flow condition. Due to the low probability of the design earthquake coinciding with the period of high water, it is common practice to perform seismic slope stability and deformation analyses using water levels that are usually present in the channel, instead of extreme event water levels.

However, an evaluation was also made of the effect of changes in water level in the channel on the predicted seismic displacements for new and existing levees that will remain. A discussion of the findings of this evaluation is provided below.

13.9.2 New Levees

Our analyses show that the new levees are stable under post liquefaction conditions, and the predicted seismic displacements are within the acceptable range, based on a design water level Elevation of +10 feet NAVD in Areas A and C, and assuming a water level at the ground surface in Area B.

The new levees will be constructed a minimum distance of about 400 feet from the meander channel. As a result, the seismic stability of new levees will generally not be impacted by water level fluctuations in the meander channel (either tidal or seasonal). At the locations of the new levees, the water level is generally equal to the groundwater level, which is affected primarily by precipitation. Therefore, the effect of the water level in the channel on seismic displacements is negligible, for the new levees.

13.9.3 Existing Levees

The effect of changes in water level in the channel on the seismic displacements predicted for the existing levees was investigated for the levee located immediately downstream of Lincoln Boulevard (Section E-E'). The following four water levels were considered:

Case 1 – The water in the channel and in the area outside the channel coincide with the ground surface elevation of +7 feet NAVD. This is the design groundwater condition adopted for the previously presented seismic stability analyses of existing levees.

Case 2 – The water in the channel and in the area outside the channel is at Elevation +3 feet NAVD. This condition approximately corresponds to the average tidal condition.

Case 3 – A water level in the channel at Elevation +0 feet NAVD (corresponding to low tide) and a groundwater level outside the channel at Elevation +7 feet NAVD.

Case 4 – A water level in the channel of +0 feet NAVD and a groundwater level outside the channel at Elevation +3 feet NAVD.

The results of the seismic deformation slope stability analyses are included in Appendix G (Plates G-69 and G-70, and G-148 through G-153). A summary of the cases analyzed, including the estimated yield acceleration (ky) and calculated seismic displacements is presented in Table 7.

Table 7: Effect of Water Level on Seismic Displacement of Existing Levees

Case	Water Conditions		Yield Acceleration (ky) in units of g	Seismic Displacement (cm)
	Groundwater Elevation (feet; NAVD)	Channel Water Elevation (feet; NAVD)		
1	7	7	0.08	40
2	3	3	0.08	40
3	7	0	0.06	64
4	3	0	0.07	50

As indicated in Table 7, the maximum predicted deformation occurs when the water level in the channel corresponds with the low tide. However, the estimated seismic displacement for all cases is at least 40 cm (16 inches), which is unacceptable. On this basis, the variation in the water level in the channel has no effect on the acceptability of the performance of the existing levees, which for each Case are deficient under seismic conditions.

13.10 Mitigation Measures for the Remaining Existing Levees

As noted earlier, the Ballona Creek channel and levees were constructed in the 1930s, at a time when there was little geotechnical field quality control (including compaction testing) and virtually no geotechnical earthquake engineering. Portions of the existing levees in Areas A and B will act as abutments to the new levees, and consequently, will receive significant loading. If unimproved, we anticipate that in these "abutment areas" the existing levees will experience significant static settlement, and additional lateral displacements under seismic conditions. As discussed above, our analyses indicate that the original levees do not meet current USACE seismic requirements, and calculated displacements under the design earthquake are excessive even without additional loading.

Where a new levee ties into an existing levee, the existing levee will experience additional load and settlement that can cause cracking of the existing levee. Therefore, it is recommended that mitigation measures, such as deep soil mixing, be performed at and adjacent to tie-in locations to improve the stability of the existing levees that will remain in Areas A and B.

Ground Improvement is recommended at all locations where the new levees tie-in to an existing levee. These locations are delineated in Figure 7 and include:

- The existing south levee along the Ballona Creek channel between Lincoln Blvd. and Culver Blvd. Ground improvement should extend from the tie-in location for a minimum length of 80 feet from the centerline of the new levee crest (Figure 7).

- the existing north levees located along the Ballona Creek channel downstream of the new Area A levees. Ground improvement should extend from the tie-in location of the new and the existing levees for a minimum length of 80 feet from the centerline of the new levee crest (Figure 7).

- The existing south levee located along the Ballona Creek channel downstream of the new West Area B levee. Ground Improvement should extend from the tie-in point to the downstream property line (Figure 7). We understand that the crest elevation along this existing levee may be raised for additional flood protection. If ground improvement recommendations are followed, the levee can be raised without negatively impacting the integrity of the existing levee. The ground improvement should be done along the crest of the levee, and completed before the final grade is raised.

The Deep Soil Mixing (DSM) ground improvement zone for existing levees is anticipated to be on the order of 20 feet wide. The ground improvement zone should have a minimum average strength of 1,500 psf. The columns should extend to El -13 feet along south Ballona Creek channel between Lincoln Blvd. and Culver Blvd. down to El -25 feet downstream of the new Area A levees, and down to El -35 downstream of the West Area B new levees.

Please note that the alternative of replacing the deficient portions of the existing levees with new levee with flatter slope is significantly more costly. Rebuilding portions of the existing levees properly would require excavating to El. 0 NAVD to remove potentially liquefiable soils. This means that excavations should be extended below tide level and below groundwater using cofferdams and dewatering. Furthermore, surcharging a portion of any levee will also apply lateral loads on piles of Lincoln Boulevard and Culver Boulevard Bridges.

In Area C, where the existing levee will also remain, the restoration project will not alter or impose new loads to the existing levees, since stockpile soils will be placed a minimum of about 400 feet away from the edge of the channel. It is recommended that any surcharge or structure proposed near the unimproved existing levees be setback a minimum of 70 feet away from the top of the channel slope.

Please note that grading and development is currently planned in Area C, but will be kept at a minimum distance of 70 feet away from the top of the channel slope.

14.0 SETTLEMENT ANALYSES

14.1 Anticipated Settlements and Time Rate

A total of 20 consolidation tests were performed on representative soil samples collected during our field investigation. Settlement of the proposed levee embankments and surcharge areas was estimated using the consolidation test data, which was supplemented using correlations with liquid limit, and moisture content. In addition, we supplemented our settlement analyses with the extensive experience gained from surcharging similar nearby soils over the past 10 years, as the geotechnical engineer for the Playa Vista development, located immediately east of Lincoln Boulevard.

The consolidation test results showed that the soils are essentially normally consolidated below a depth of about 10 to 20 feet and slightly to moderately over-consolidated at shallower depths. The interpretation plots of consolidation parameters are provided in Appendix H.

The settlements under and extending out from the toe of new levees and embankments were evaluated for different surcharge heights and geometries. The results are provided in Table H-1 included in Appendix H.

The results indicate the anticipated settlement under new fill load is estimated to range from about 1 to 2 inches for every foot of embankment fill placed (i.e., a 10-foot high levee or embankment is anticipated to settle between 10 and 20 inches). More specifically, we anticipate that in Area A and B, settlements per foot of fill surcharge are likely to be about 1.5 to 2 inches, whereas 1.0 to 1.5 inches are anticipated in Area C.

Our analyses show that surcharges will cause a settlement bowl that may extend on the order of 30 to 50+ feet beyond the toe of the embankments, depending on the height of embankment. A summary of the estimated settlements, anticipated under levees of various heights is included in Table 8 for eight selected embankment locations and embankment heights ranging from about 5 to 15 feet.

Group Delta has significant experience with monitoring settlements in similar compressible soils during the development of the Playa Vista Development, located immediately east of Lincoln Boulevard, north and south of Jefferson Boulevard. Over the past 10 years, data has been collected from surcharge monitoring programs on numerous building sites. Representative data from these programs are graphically summarized on Plate H-47 (Appendix H), indicates 90 percent of primary consolidation occurred within about 100 to 150 days, generally considered to fall in a range of 3 to 6 months.

Based on the laboratory data and the empirical data from Playa Vista, within the Ballona wetlands primary consolidation during placement of the levees is expected to be 90 percent complete within three to six months of application of the last load increment.

Therefore, capping of the levee core should be planned as the last step of grading at least three to six months after completion of the levees, to raise the crest grade to the desired design elevation for flood control, after at least 90 percent of the primary consolidation has completed. Capping of the slopes is not required beyond the levee core.

Due to the soft nature of the subgrade soils and the large anticipated settlements, construction techniques typically used in soft ground, e.g., swamps have been considered. We recommended constructing levees slowly and using thin lifts to reduce post-construction long-term differential settlements and reduce the potential transverse cracking. For this purpose, the rate of fill placement should proceed at about 5 feet of fill per month or slower. The rate of settlement of the fill will be monitored during construction, and should be used to control the actual rate of fill placement.

14.2 Recommended Setback of New Embankments

Because of the soft nature of the existing ground, a settlement "bowl" will develop beyond the toe of new levees and surcharge areas and the resulting differential settlement could impact existing utility lines, pavement and other nearby improvements. A profile showing the shape and magnitude of the settlement bowl is presented on Plate H-7 (Appendix H).

The risk of damaging structures and utilities is generally considered minimal when the slope of the differential settlement, Δ / L, (where Δ is the differential settlement over a distance L) is less than about 1/480 (i.e., 1-inch in 40-feet). Based on the height of the fill planned, analyses indicate this controlling differential settlement slope generally occurs at a distance on the order of 25 to 30 feet beyond the toe of the embankment, and roughly coincides with the location where the total settlement is about 1-inch. However, it should be noted that the settlement bowl shown on Plate H-7 occurs perpendicular to the toe of the fill, and the existing improvements are oriented parallel to the fill toe. Therefore, the differential settlement along the improvements will actually be much less.

Using the 1/480 criteria, the following minimum setbacks between the toe of embankments and streets or utility lines are recommended. However, other, more stringent, criteria could be necessary for specific utilities, and the final criteria should be reviewed with utility agency.

Area A

- The toe of the new perimeter Area A levees should be setback along Fiji Way and from the existing parking lot pavement according to the following:
    - If the height of the levee is greater than 4 feet, the minimum setback should be 30 feet.
    - For levees that are 4 feet or less in height, the minimum setback should be 20 feet.
- In Area A, where the new levee will be placed near the Fiji Ditch, the toe of the levee should be setback behind a 3 to 1 slope extending up from the bottom of the Fiji Ditch.
- In the future, widening of Lincoln Boulevard is planned. The new levee planned along the west side of Lincoln Boulevard should be setback behind a 3 to 1 slope extending up from the west edge of the planned widening.

Area B

- The toe of the Area B levee should be setback a minimum of 30 feet from Culver Boulevard.
- The toe of the fill mounds placed in Area B should be setback a minimum of 30 feet from Culver Boulevard., Jefferson Boulevard, and Lincoln Boulevard.

Area C

- The toe of the fill mounds planned in North Area C should be setback a minimum of 25 feet from Culver Boulevard.

14.3 Protecting Utilities from Settlements

Where new culverts will extend under new the Area B levees, it should be planned to pre-load the area to remove most of the settlement prior to constructing of the culverts. This is discussed further in Section 15.8. If there are any existing, active or abandoned gas lines or other utility buried along the planned alignment of a levee, provisions should be made to relocate or reinstall them in a shallow trench that extends over the embankment fill. This would also provide easy access for any future maintenance.

Table 8: Summary of Estimates of Settlement at Different Sections along the Embankments

Area	Section	Approximate Embankment Height (feet)	Max Settlement (inches)	Max Settlement per foot of Fill (inches)	Settlement at Dry Side Toe (inches)	Settlement 10 feet from Dry Side Toe (inches)	Settlement 30 feet from Dry Side Toe (inches)	Settlement 50 feet from Dry Side Toe (inches)
Area A	Section A-A'	10	15.3	1.5	3.1	1.8	0.7	0.3
	Section B-B'	10	17.1	1.7	3.2	1.9	0.8	0.3
	Section C-C'	5	7.9	1.6	2.4	1.4	0.5	0.2
Area B	Section F-F'	14	26.7	1.9	5.8	3.4	1.3	0.6
	Section H-H'	14	26.3	1.9	5.8	3.4	1.3	0.6
	Section I-I'	15	26.0	1.7	5.8	3.4	1.3	0.6
	Surcharge Area B	25	41.4	1.7	2.2	1.4	0.6	0.3
Area C	Surcharge Area C	30	25.3	0.9	1.5	0.9	0.4	0.2

15.0 GRADING

15.1 General

The primary areas of grading for the project include:

- Excavation of approximately 2 million cubic yards of soil from Area A, to reclaim wetlands lost when the area was hydraulically filled during the development of Marina Del Rey. The excavation will slope down to the south from Fiji Way at a gradient of about 10 horizontal to 1 vertical to approximate elevation of 11 feet, and at flatter gradients of about 100H:1V (horizontal to vertical) to a maximum depth of about 20 to 25 feet in the area of the existing channel. The excavation will remove primarily hydraulic fill soils.

- The soils excavated from Area A will be used to construct the new levees around the west, north and east perimeter of Area A, and in Area B north of Culver Boulevard and east of the dunes in West Area B. The levees will generally extend about 5 to 10 feet above the existing grade in Area A, and up to a maximum of 15 feet above existing grade in Area B.

- Excavation of the meander channel for Ballona Creek and the lowering and breaching of the existing levees, at four locations.

- Any excavated soil not needed for new levee construction will be placed as compacted fill in north Area C and in Area B, between Culver Boulevard and Jefferson Boulevard.

The soils that will be excavated in Area A were found to be loose/soft and have high moisture contents, i.e., approximately 5% to 35% above the optimum moisture content. The alignments for the levees are in areas where the foundation soils are moderately soft to soft, and the ground water table is high. Therefore, earthwork must be carefully planned and conducted to avoid disturbing the soils, and the need for low ground pressure equipment and excavators should be planned. The use of heavy scrapers and dozers to excavate the soils in Area A is expected to be limited, and is discussed in Section 15.5.

Because of the high moisture content in the soils that will be excavated in Area A, it will be necessary to dry the soils before they can be used as compacted fill. Spreading and turning/disking will be needed to dry the excavated soils. In addition the loose soils excavated from Area A will undergo a significant compression, i.e., volume loss, when compacted for the levee construction. Volume loss is discussed below, in Section 15.7.

15.2 Clearing and Stripping

Prior to the start of earthwork, the areas planned for grading should be cleared of any trees and brush and stripped of any vegetation. When removing trees and bushes, all roots larger than 1-inch in diameter should be removed. All stripped vegetation should be removed from the site.

15.3 Removals

Prior to placement of compacted fill for the new levees, the subgrade soils along the levee alignments should be excavated and recompacted. The minimum limits for the recompaction under levees are shown in Appendix I (Plates I-2 through I-4) and are described below.

- Under the "core" of the levee, the removal and recompaction should extend to a minimum depth of 4 feet below the existing grade. The core is defined as the area within 3 (horizontal) to 1 (vertical) slopes extending down from the edge of the levee crest.

- Beyond the core, the removal should extend to a minimum depth of at least 2 feet below the existing grade for a minimum equipment width (10+ feet). Beyond this equipment width (10+ feet), specific overexcavation is not required under the flat (10 to 1) slopes planned, but vegetation should be stripped before placing fill,

- The actual limits for removals should be determined by the project geotechnical engineer during construction, based on the local conditions exposed during excavation. Deeper removals will be needed where unsuitable soils are present. In particular, deeper removals should be planned where the levees cross the existing drainage channels in West Area B. Please note that old buried channels may be present that require similar treatment. Deeper excavation should also be planned to remove buried organics in the area of the celery dump known to have been present in east Area A.

- In addition, if highly permeable layers are exposed in the excavation for levees, these layers would provide a path for seepage to occur, it will be necessary to overexcavate and replace these permeable layers to the limits determined by the project geotechnical engineer in the field.

- When wet and/or soft soils are exposed in the excavation made for removals, the excavation will need to be carefully performed using an excavator or low ground pressure equipment to avoid disturbing the soils and prevent equipment from bogging down. In addition, geogrid (Tensar BX 1200 or equivalent) may be needed to stabilize the exposed bottom and provide a firm working surface before new compacted fill can be placed.

15.4 Earthwork

All grading should conform to the requirements of the 2010 California Building Code, and the general grading recommendations outlined below.

1. The grading contractor is responsible for notifying the project geotechnical engineer of a pre-grading meeting prior to the start of earthwork operations and anytime that the operations are resumed after an interruption.

2. Prior to the start of earthwork the project civil engineer should locate any existing utilities in the area. Existing utilities should be removed, relocated or protected, as appropriate.

3. As discussed in Section 15.3, the subgrade soils along the new levee alignments should be overexcavated and recompacted to a minimum depth of 4 feet under the levee core, and 2 feet of overexcavation for a minimum of an equipment width beyond the levee core (Refer to Appendix I). Deeper removals will be needed where unsuitable soils are present. All removals should be performed under the direction of the project geotechnical engineer.

4. Temporary excavations in the soft, loose and wet soils should be planned at a maximum inclination of 1-1/2 (horizontal) to 1 (vertical).

5. The bottoms of excavations should be checked and approved by the project geotechnical engineer before placing any fill. If the bottoms of excavations encounter soft or wet soils, a 1 to 2 foot layer of dry soil with low permeability may be required to be placed over Biaxial Geogrid (Tensar BX 1200, or equivalent) to provide a firm base to support construction equipment and compaction activities. All fill material used under new levees should have low permeability to avoid providing a path for seepage, and must be approved by the geotechnical engineer before being placed. Dewatering of the excavation should also be anticipated.

6. All fill placed should be compacted to at least 90 percent of the maximum dry density determined by the most current ASTM D 1557 standard.

7. The soils encountered in Area A that will be excavated generally consist of fine-grained silty and clayey soils. It is anticipated that most of these soils will be suitable for use in the construction of new levees. However, as discussed in Section 15.5.2, much of the soils that will be excavated are very wet and will require spreading/disking to dry them back before they can be compacted in fills. Sandy soils will not be allowed to be used for the "core" of

the levees (per "core" definition in section 15.3, above). All fill soils shall be approved by the project geotechnical engineer.

8. All import soils should be free of highly expansive clay, organics, debris, rocks greater than 3 inches in any dimension, and other deleterious material. Import soils should have a maximum of about 60 percent passing the number 200 sieve and should have an Expansion Index of less than 60. Import soils should be approved by the geotechnical engineer before being brought to the site.

9. All earthwork and grading should be performed under the observation of the project geotechnical engineer. Compaction testing of the fill soils shall be performed at the discretion of geotechnical engineer. A test should be performed for approximately every 500 cubic yards of fill placed. If specified compaction is not achieved, additional compactive effort, moisture conditioning of the fill soils, and/or removal and recompaction of the below-minimum-compaction soils will be required.

10. Asphalt concrete used for levee roads shall conform to the 2012 "Green Book" or the equivalent, and shall be compacted to at least 95 percent relative compaction.

11. If, in the opinion of the geotechnical engineer, contractor, or owner, an unsafe condition is created or encountered during grading, all work in the area shall be stopped until measures can be taken to mitigate the unsafe condition. An unsafe condition shall be considered any condition that creates a danger to workers, on-site structures, on-site construction, or any off-site properties or persons.

15.5 Excavation

15.5.1 Excavation Slopes

In general, the hydraulic fill in Area A is a fine-grained silty to clayey lose/soft soil with a high moisture content, and the near surface native soils and fill in area B are and moderately soft to soft with a high moisture content and a shallow ground water table. Temporary excavations should be planned at a maximum inclination of 1-1/2 (horizontal) to 1 (vertical).

Surcharge loads, such as vehicular traffic, heavy construction equipment, and stockpiled materials, should be kept away from the top of temporary excavations a horizontal distance at least equal to the depth of excavation. Surface drainage should be controlled and prevented from running down the slope face. Seeping of

water should not be allowed within the excavation. Construction equipment and foot traffic should be kept off excavation slopes to minimize sloughing.

All excavation slopes and shoring systems should meet the minimum requirements of the Occupational Safety and Health (OSHA) Standards. Maintaining safe and stable slopes on excavations is the responsibility of the contractor and will depend on the nature of the soils and groundwater conditions encountered and his method of excavation. Excavations during construction should be carried out in such a manner that failure or ground movement will not occur. The contractor should perform any additional studies deemed necessary to supplement the information contained in this report for the purpose of planning and executing his excavation plan.

15.5.2 Excavation Methods – Area A

The soils that will be excavated in Area A were found to be loose/soft and have a high moisture content, ranging approximately 5% to 35% above the optimum moisture content. Therefore, the use of heavy scrapers and dozers is expected to be limited. The excavation must be carefully planned and conducted to avoid overstressing the soils and/or bogging down equipment. The need for excavators, support mats, moving haul roads, low ground pressure equipment and dredging should be considered in planning how to accomplish the excavation. The need to control the ground water perched within the hydraulic fill should also be anticipated during excavation.

As noted previously, it will be necessary to dry the excavated soils back before they can be used in compacted fill. This will require having an area where the soils can be spread and turned and/or disked. In addition the loose soils excavated from Area A are expected to undergo a significant volume loss when compacted for the levee construction, which is discussed in Section 15.7.

15.6 Fill Placement

15.6.1 General

The subgrade conditions along the new levee alignments generally consist of moderately soft to soft, wet, fine-grained silt and clay soils. The excavated soils are also generally silty and clayey, and hence, can be used for construction of the embankments. In addition, these soils are compressible and will settle on the order of 1 to 2 inches for every foot of fill placed. Therefore, the placement of compacted fill for levees should be planned and controlled to avoid overstressing the soils. Based on experience with similar soft soils, the fill should be advanced uniformly along the entire length of each levee without creating unbalanced loads. Furthermore the rate of fill placement should be controlled to allow the soft soils to slowly consolidate and gain strength. Increasing the height of the fill slowly will also

provide time for settlement to occur and thus mitigate the potential for differential settlement to create cracks in the embankment. Recommendations for monitoring the fill settlement are discussed in Section 15.8.

Following removals and before placing fill, the bottoms of excavations should be checked and approved by the project geotechnical engineer. If the bottom is soft or wet, a 1 to 2 foot layer of dry soil with low permeability may be required to be placed over Biaxial Geogrid (Tensar BX 1200, or equivalent) to provide a firm base to support construction equipment and compaction activities. Dewatering of the excavation should also be anticipated. The soil used for the backfill should have a low permeability to avoid creating a seepage path under the levee. All fill must be approved by the geotechnical engineer before being placed.

15.6.2 Special Considerations

In West Area B the alignment of the new levee will cross two existing channels. These channels range from about 5 to 8 feet deep and are expected to contain soft sediment, and may also contain sands eroded from the dunes present in West Area B. The easternmost of these channels crosses perpendicular to the levee alignment, about 300 feet east of the west end of Area B. The westernmost channel crosses extends under the length of the planned levee at the west end of Area B (Refer to Figure 4A). In addition, it should be anticipated that there is the possibility that other old channels may also be present, and may have been filled in.

At channel crossings, all soft and sandy material should be removed and replaced with compacted fill. The excavation for this removal will extend below the ground water. Therefore, dewatering will be required to accomplish the removal and backfilling. The exposed bottom should be stabilized with geogrid and a 1 to 2 foot layer of dry soil with low permeability, to provide a firm base to support construction equipment and compaction activities.

During construction of levees, after removals and before placing any fill, the geotechnical engineer should check for the presence of any sand layers that may extend below the alignment of the levee. This could be a particular problem in West Area B, because of the proximity of the natural dunes, there is the potential for eroded sand layers to be present throughout this area. If found to be present, the sand layers should be overexcavated and replaced with low permeability fill soils, to protect against seepage. The presence of any sand layers should also be looked for in all areas where the new levees are constructed.

15.7 Volume Change

The soils excavated from Area A will undergo significant volume reduction as they are compacted for the new levees. Based on our field explorations and the results of lab testing of representative soils, including in-situ density tests, compaction tests

and consolidation tests, the gross estimated range of the anticipated volume change that will occur is summarized below.

However, these values are based on limited data for such a large site and should be considered as gross ball-park estimates for gross planning purposes only. The actual amount of volume change is difficult to predict and will depend on the materials in situ density, final in place compacted density achieved, amount of soil blending that occurs in the handling process, and other factors.

- Volume loss of excavated soils taken from Area A that then compacted to a minimum density of 90% modified proctor (average of 92%) is in the range of 15% to 25%.

- Volume loss due to stripping of vegetation, where present, is estimated to range from about 2 to 4 inches.

- Volume loss from compacting the existing subgrade soils along the alignment of new levees and/or in areas to receive excess fill, is estimated to range from 15 to 25% in Area A, and from 10 to 20% in Area B and Area C.

- The anticipated settlement in Areas A and B as a result of placement of fill is on the order of 1.5 to 2 inches per foot of fill placed.

- Settlement in Areas C as a result of placement of fill is on the order of 1.0 to 1.5 inches per foot of fill placed.

- Volume loss due to "spillage" during hauling, wind, etc. may be on the order of 1%.

Recommended Volume Change Monitoring Program

To develop a better estimate of the volume reduction that occurs during construction, it is recommended that a monitoring program be conducted to during the initial phases of the earthwork. This will require surveying to determine, the volume excavated in Area A and the volume of fill placed to create a new embankment with that volume of excavated soil. In addition, a settlement monitoring program should be established the actual amount of settlement that occurs during filling. The settlement monitoring program is discussed in Section 15.8.

15.8 Settlement Monitoring

To evaluate both the magnitude and the rate of actual settlements during construction, it is recommended that a settlement monitoring program be developed and maintained. A detail of a settlement plate is provided in Figure 8. In

general, settlement plates should be installed on about 400-to 500-foot spacing along the alignment for new levees. The plates should be installed after removal and recompaction of the subgrade, and before placing the embankment fill.

The settlement plates should be surveyed every week as the fill placement is being placed, bi-weekly for the first two months after completion of the fill placement, and monthly thereafter, until 90 percent of the primary consolidation is deemed complete. Each time the plate is read, the elevation of the top of the fill should also be recorded. Care should be taken not to damage the monuments during grading. If a monument is irreparably damaged or destroyed, a replacement monument should be immediately installed within 10 feet of the lost monument and a new survey baseline established for the new monument.

16.0 CULVERTS

16.1 General

Two new culvert structures will be constructed to connect south Area B to the restored wetlands. The locations of the culverts are shown in Figure I-1 in Appendix I. Each of the culverts will extend under Culver Boulevard and the new Area B (Culver) levee.

Settlement on the order of about 20 to 27 inches is expected to occur as a result of construction of the new Culver levee. To minimize the potential for settlement of the culvert after construction, two options are presented.

- Culverts can be constructed after 90% of the primary consolidation is completed, after placing the Culver levee. This will require excavation of the new levee, installation of the culverts and then replacement of the levee fill.

- As an alternative, the culvert areas can be pre-surcharged 3 to 4 feet higher than the design levee height at each location along the alignment of the culvert. After 90% of the primary consolidation is complete, the surcharge can be removed to install the culvert.

A temporary culvert pipe can be installed before placing the fill. Once the settlement is completed, the temporary pipe can be removed and the permanent culvert can be installed.

Generally, it is expected that 90% of the primary settlement will occur within about three to six months. Settlement monitoring should be performed at culvert locations to determine when primary consolidation is complete and installation of the culverts can begin.

16.2 Construction Considerations

Excavations and shoring for culverts should comply with current OSHA regulations, and observed by the designated competent person on site. Excavations for the culverts should be planned at a maximum inclination of 1-1/2 (horizontal) to 1 (vertical). However, since the culverts will be installed below groundwater level, water should be controlled by installing sheet piles and performing dewatering, in lieu of sloping. The shoring should be designed for a lateral soil pressure equal to an equivalent fluid pressure of 40 pcf, if unbraced, and if braced, for a uniform pressure (psf) of 30H, where H is the height of the excavation. Both pressures assume the excavation is dewatered, and there are no hydrostatic pressures on the sheet piles.

The civil engineer should identify the presence of existing utilites in the area. Provisions should be developed to protect existing utilities, by supporting the utilities to span between the sheet piles. Because of the high volume of daily traffic on culver Boulevard, a traffic plan and phasing schedule are need to maintain traffic flow during construction of the culverts.

Very soft or wet soils are anticipated at the base of the Culverts. The bottoms of the excavation should be checked and approved by the project geotechnical engineer. If the bottom is soft or wet, a 1 to 2 foot layer of soil with low permeability may be required to be placed over Biaxial Geogrid (Tensar BX 1200, or equivalent) to provide a firm base to support construction equipment and compaction activities. Dewatering of the excavation should also be anticipated, and compaction of all fill should be performed in the dry. The soil used for the backfill should have a low permeability to avoid creating a seepage path under the levee. All fill must be approved by the geotechnical engineer before being placed. To minimize the potential of seepage around the culvert, a properly designed concrete headwall should be used at the entry and exit points of the culvert.

The bedding zone is defined as area containing the material specified that is supporting, surrounding, and extending to 1 foot above the top of Culvert. The bedding shall satisfy the requirements of Standard Specifications for Public Works Construction (SSPWC) Section 306-1.2.1.

Backfill shall be considered as starting 1-foot above, and 1-foot to the sides the Culvert. On-site excavated materials can be used as backfill. However, wet soils will need to be dried back. Any material larger than 3 inches in any dimensions shall be removed before backfilling. All backfill shall be placed in lifts not exceeding six to eight inches in thickness and be compacted to at least 90 percent of relative compaction as determined by the ASTM D-1557.

16.3 Earth Pressures on Culverts

Culverts should be designed for vertical and horizontal earth pressures according to pressures shown on Figure 9. Due to presence of shallow ground water, horizontal earth pressures shown on Figure 9, include hydrostatic earth pressures in addition to at-rest earth pressures.

For portions of the culverts, passing below Culver Blvd., traffic loads can be modeled as 2 feet of soil surcharge or 240 psf vertical pressures. For rigid wall of the culverts, a uniform lateral pressure of 100 psf should be added to the horizontal pressures, as shown on Figure 9.

17.0 PEDESTRIAN BRIDGE

As part of the public access plan, a pedestrian bridge is planned to be constructed west of the Culver Boulevard Bridge. Due to anticipated large loads of the bridge, presence of moderately to highly compressible clays below the site, and variable potential for liquefaction settlements anticipated across the site, it is recommended to use deep foundations for support of the pedestrian bridge. Pile foundation recommendations are provided below. The bridge may also be designed to accommodate trucks hauling excavated soil from Area A to Area B.

17.1 Pile Foundations

Due to the presence of moderately to highly compressible clays below the site, and variable potential for liquefaction settlements anticipated across the site, it is recommended to use deep foundations for support of the pedestrian bridge. The piles should be installed to practical refusal, about 3 to 5 feet into the dense sands below about El. -45 feet. We estimate the final tip elevations for piles to be roughly El. -50 feet.

We recommend the proposed building be supported using one of the following pile installation systems:

14-inch square

- Driven piles (square pre-stressed concrete)

14-inch diameter

- Auger cast displacement piles (ACD)

Based on our previous experience at the nearby Playa Vista, these pile types and diameter sizes can be successfully constructed. If driven piles are used we recommend that a Pile Driving Analyzer (PDA) be used during driving.

17.2 Pile Axial Capacity

Based on the results of our analyses and our experience at Playa Vista, allowable pile loads of 220 kips for 14-inch square driven piles, and 200 kips for 14-inch diameter ACD piles are recommended. .

Downdrag loads must be considered from ground settlement due to the potential liquefaction during a major seismic event. The downdrag calculations indicate that downdrag loads ranging from about 81 to 102 kips could develop during design seismic events.

If the site grade is raised (e.g., for elevating the roadway), additional downdrag loads may be expected that depend on final elevations. We recommend that downdrag loads from consolidation settlement due to any new fill be evaluated.

It should be noted that the maximum downdrag loads are based on the assumption that no settlement of the pile occurs due to the application of the downdrag load. It is estimated that piles could settle about 0.25 inches as the downdrag load is applied. This settlement will significantly reduce the downdrag load. However, for conservatism, we assumed the full downdrag.

Table 9 summarizes the axial pile capacity for the considered pile types.

Table 9: Axial Pile Capacity

Type	Pile Diameter	Allowable Compression	Allowable Uplift
Driven	14-inch square	220 k	125 k
ACD	14-inch round	200 k	100 k

It is generally recommended that the piles be installed to at least 3 pile diameters of penetration or practical refusal into the dense sands. Therefore, the final tip elevations for most piles are expected to be about El. -50 feet.

We recommend that piles be installed with a minimum 3 diameters center-to-center spacing. For piles with a minimum 3 diameters center-to-center spacing and two to three pile groups, no reduction in axial capacity is required.

17.3 Pile Settlement

It is anticipated these piles would settle about 0.25 inch under the recommended allowable load. No significant differential settlement is expected under static loads.

The additional settlement as a result of the design seismic event is estimated to be 0.25 inches or less. Hence, the estimated settlement including the static loads as well as drag loads due to potential liquefaction is anticipated to be about 0.5-inch. Differential settlement of similarly loaded columns may be taken as 50% of the total settlement.

17.4 Pile Lateral Capacity

We evaluated the lateral capacity of the recommended piles using the computer program LPILE 6.0 (Ensoft, 2010). The lateral capacities at 0.25 inches, 0.5 inches and 1.0 inch of pile head deflection, for both fixed head and free head conditions, and for single piles, are provided in Table 10. To utilize a fixed head condition, the pile and pile cap connections must be able to translate laterally without rotation, and be designed for the fixed head moment.

Table 10: Lateral Pile Capacity

Condition	Pile Type	Pile Head Deflection (inch)	Max Shear (kips)	Max Moment (kip-ft)	Depth to Max. Moment (feet)
Fixed	14-inch (square)	0.25	17	76	0
		0.5	31	146	0
		1	52	267	0
	14-inch (round)	0.25	14	56	0
		0.5	25	105	0
		1	41	192	0
Free	14-inch (square)	0.25	6	25	6.5
		0.5	12	50	6.5
		1	19	92	7
	14-inch (round)	0.25	5	19	6
		0.5	9	37	6
		1	15	68	6.5

Deflection, shear and moment diagrams for the piles under lateral load are provided in Appendix J. We recommend the project structural engineer verify the maximum moment capacity of the pile.

17.5 Lateral Resistance

For lateral resistance of pile caps, we recommend an allowable passive fluid pressure of 300 pcf above the water table (El. +10 feet NAVD). Friction resistance should not be used for pile caps due to potential seismic settlement, which may cause a slight separation between the pile caps and the subgrade soils.

18.0 CONSTRUCTION OF THE MEANDER CHANNEL

To create the new meander channel for Ballona Creek will require lowering and breaching of the existing levees. The construction of the meander will require careful planning, phasing and coordination. In general, the existing levee is lowered as much as possible prior to final breaching, to minimize the risk of uncontrolled breaching. Just prior to the breaching, the new meander channel is excavated.

The contractor could also use strategically located sheet piles and/or coffer dams to safely control the breaching. The use of coffer dams will also provide protection, so that with dewatering, the abandoned levee channel can be backfilled in the dry. The contractor's plans for the breaching and backfilling of the abandoned channel should be submitted for review and approval, before proceeding. The contractor's method should provide for controlled breaching and for the abandoned channel to be backfilled in the dry. Armor rock riprap is needed at the ends of the meander channel fill to provide protection against erosion. Since the fill will be compacted and the ends will have riprap, the ends of the meander channel fill are not critical for slope stability.

If the backfill in the abandoned creek channel is not adequately compacted, it could liquefy during a strong earthquake and flow laterally into the new meander channel. Potentially liquefiable backfill would require soil improvement along the edges to prevent lateral spreading into the new meander channel. This would be undesirable and expensive.

19.0 VEGETATION PLANTING

Generally, trees and deep rooted vegetation are not recommended on levees, since they have long term detrimental effects by creating voids due to root growth and root decay, hence having a potentially negative impact on the integrity of the levee (piping risk). The potential negative impact of the vegetation planting beyond the levee core is considered remote, because the flatness of the levee slopes results in a especially wide core.

Hydroseeding a native mix of plants (preferable perennial shallow rooted) is recommended to protect the surface of the levees again erosion.

Beyond the "vegetation-free zone" of the flood protection levees, larger vegetation and plants may be permitted.

Specific guidelines for the types and locations of the vegetation allowed on the levees should be addressed by the USACE.

20.0 ENVIRONMENTAL ISSUES

Evaluation of environmental issues for this project and their impact on site development are outside our scope of work and are the responsibility of the project environmental consultant.

21.0 CONCLUDING REMARKS

This investigation was performed in accordance with generally accepted Geotechnical Engineering principles and practice. The professional engineering work and judgments presented in this report meet the standard of care of our profession at this time. No other warranty, expressed or implied, is made. This report has been prepared for the Santa Monica Bay Restoration Commission, and their design consultants. It may not contain sufficient information for other parties or other purposes, and should not be used for other projects or other purposes without review and approval by GDC.

The recommendations for this project, to a high degree, are dependent upon proper quality control of site grading, fill and backfill placement. The recommendations are made contingent on the opportunity for GDC to observe the earthwork operations. This firm should be notified of any pertinent changes in the project, or if conditions are encountered in the field, which differ from those described herein. If parties other than GDC are engaged to provide such services, they must be notified that they will be required to assume complete responsibility for the geotechnical phase of the project, and must either concur with the recommendations in this report or provide alternate recommendations.

22.0 STATEMENT OF RESPONSIBILITY

We have reviewed the reports referenced in Appendix A2. Except as presented in this report, we concur with their findings and accept responsibility for using their results. However, the recommendations contained in our report supersede the recommendations contained in the reports in Appendix A2.

23.0 REFERENCES

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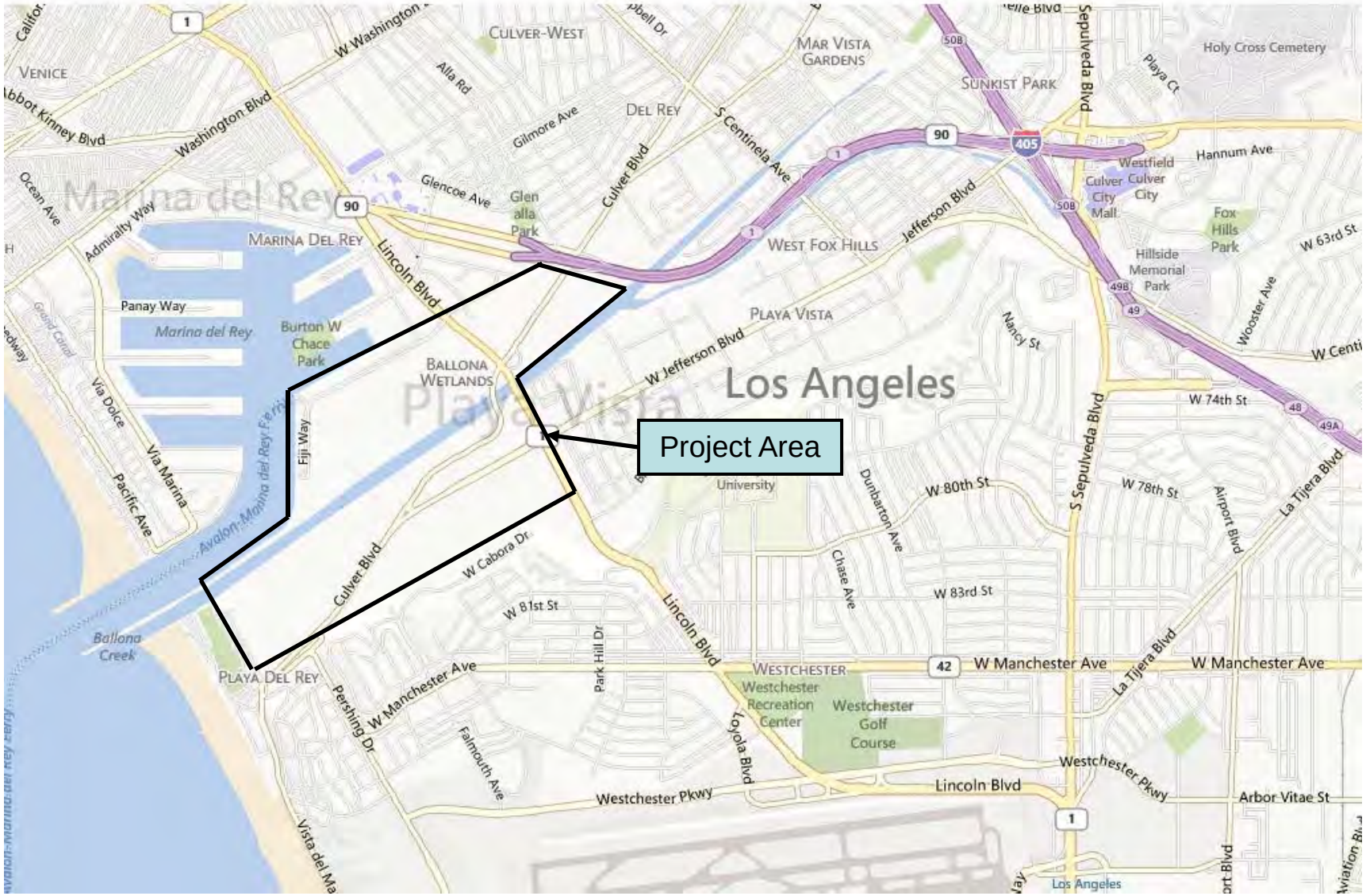
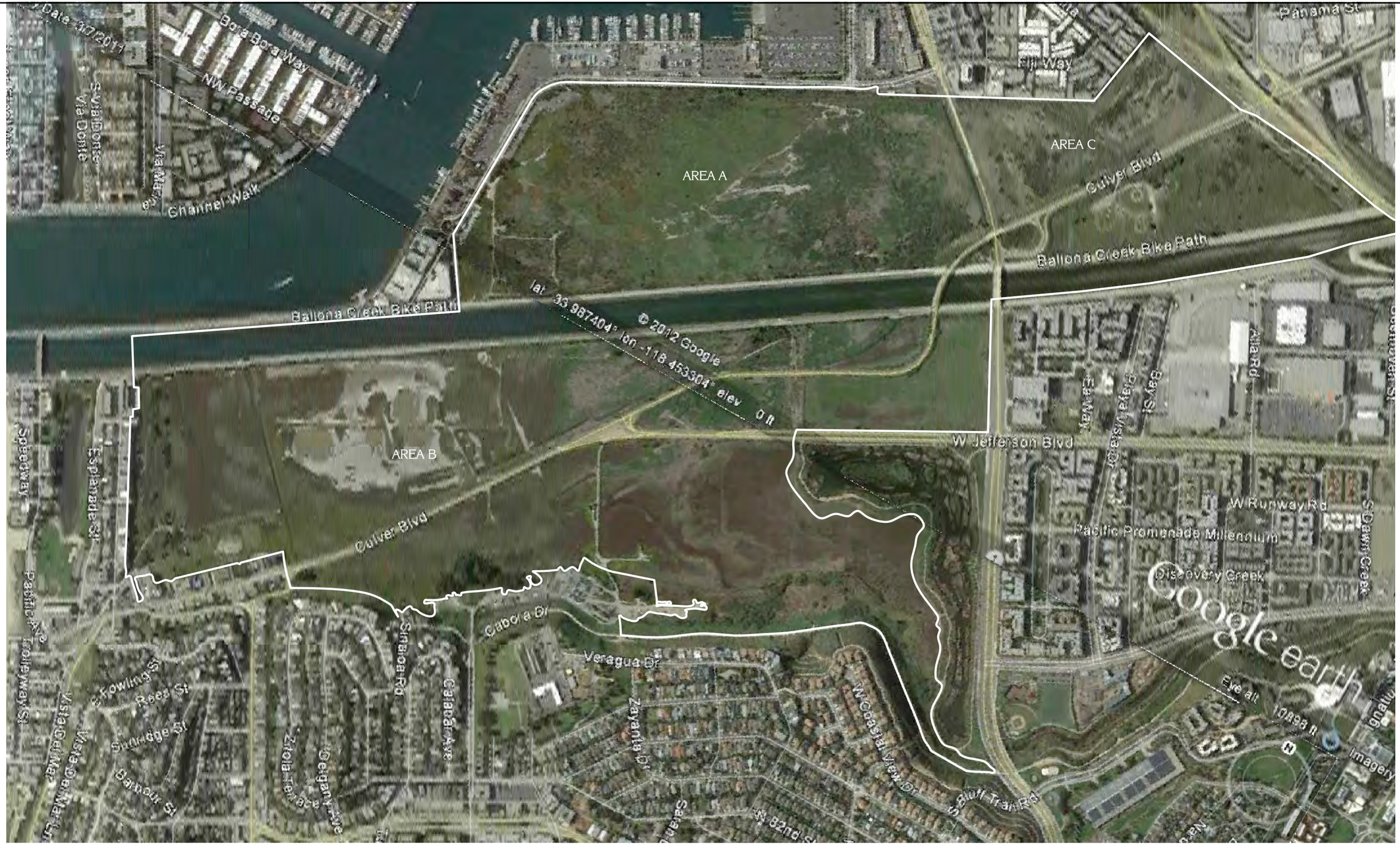
FIGURES

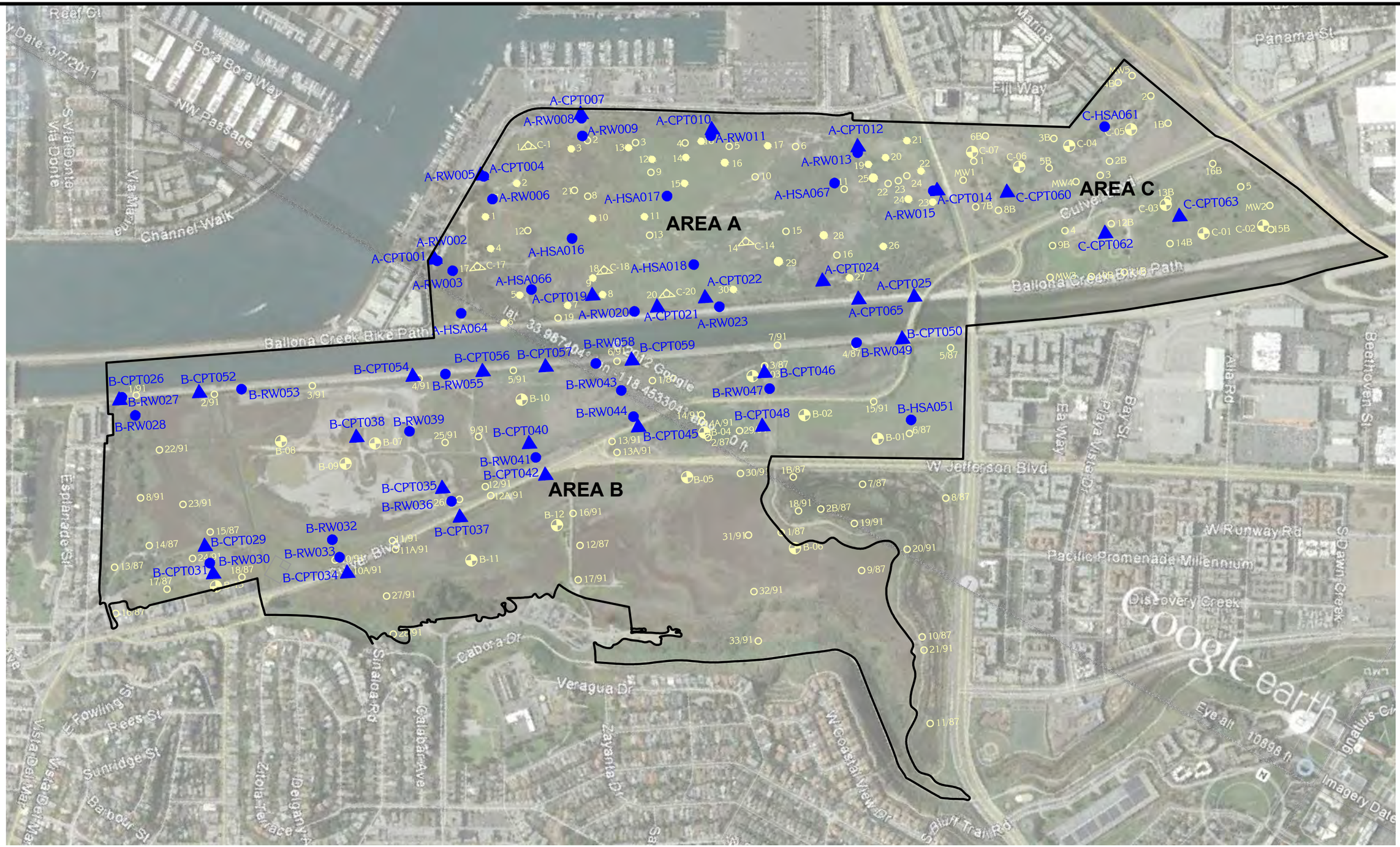


GROUP DELTA CONSULTANTS	**Vicinity Map**	Project Number: LA-962A Date: 5/28/2013
Group Delta Consultants. INC. 370 Amapola Ave. Torrance, Ca 90501	**Ballona Creek Wetlands Restoration**	Figure 1



DATE: 8/28/12	DRAWN BY: A. Helma	GROUP DELTA CONSULTANTS	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	SITE PLAN	PROJECT NUMBER: LA962A
REVISION:	APPROVED BY: P. Kashighandi			Ballona Wetlands Restoration Los Angeles, CA	SCALE: 1" = 750'
REVISION:	B1-357				FIGURE NUMBER: 2

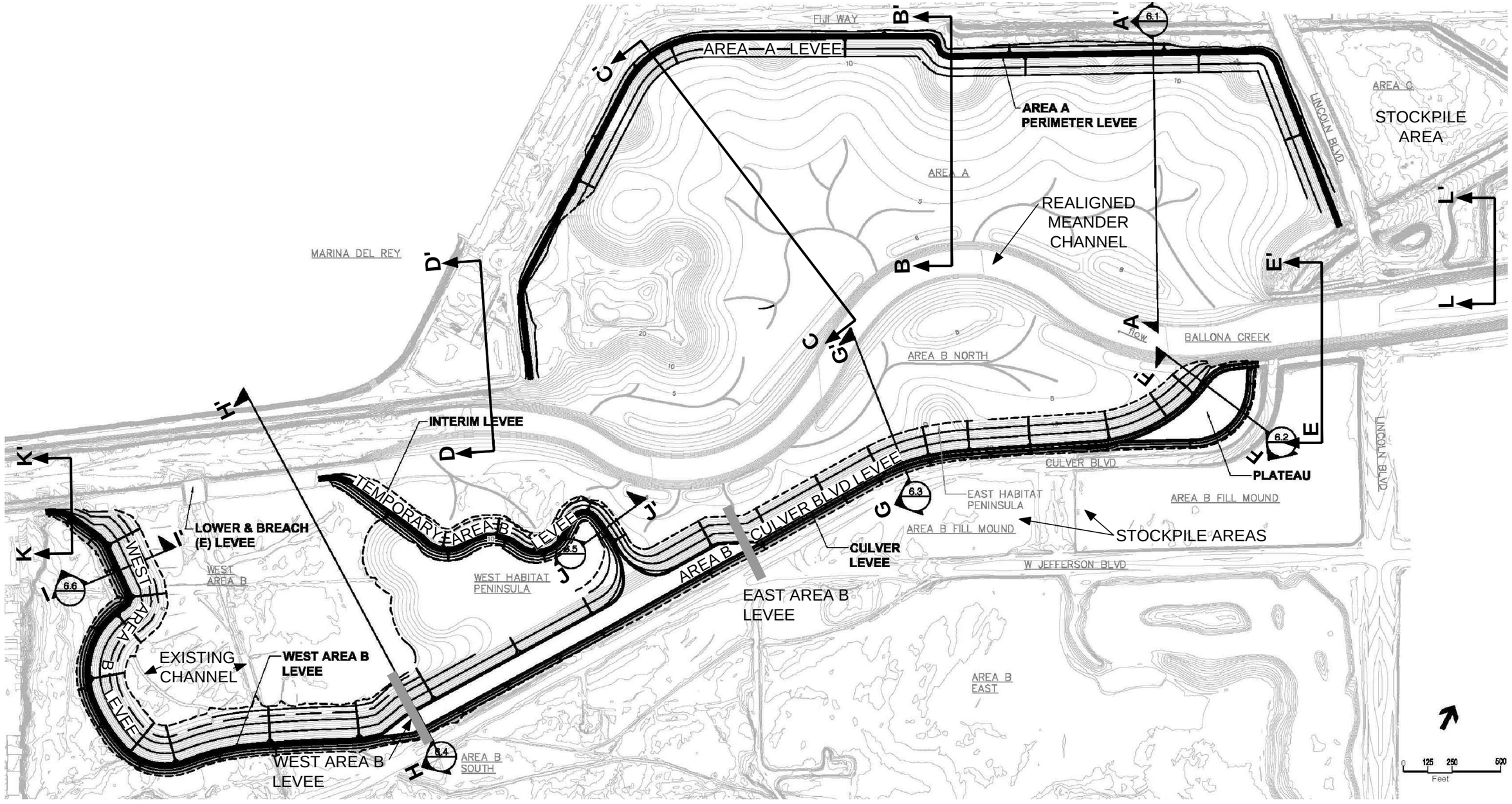
N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Drawings\L-962 Figures 1-3 - Site Plan.prev and prop borings.dwg



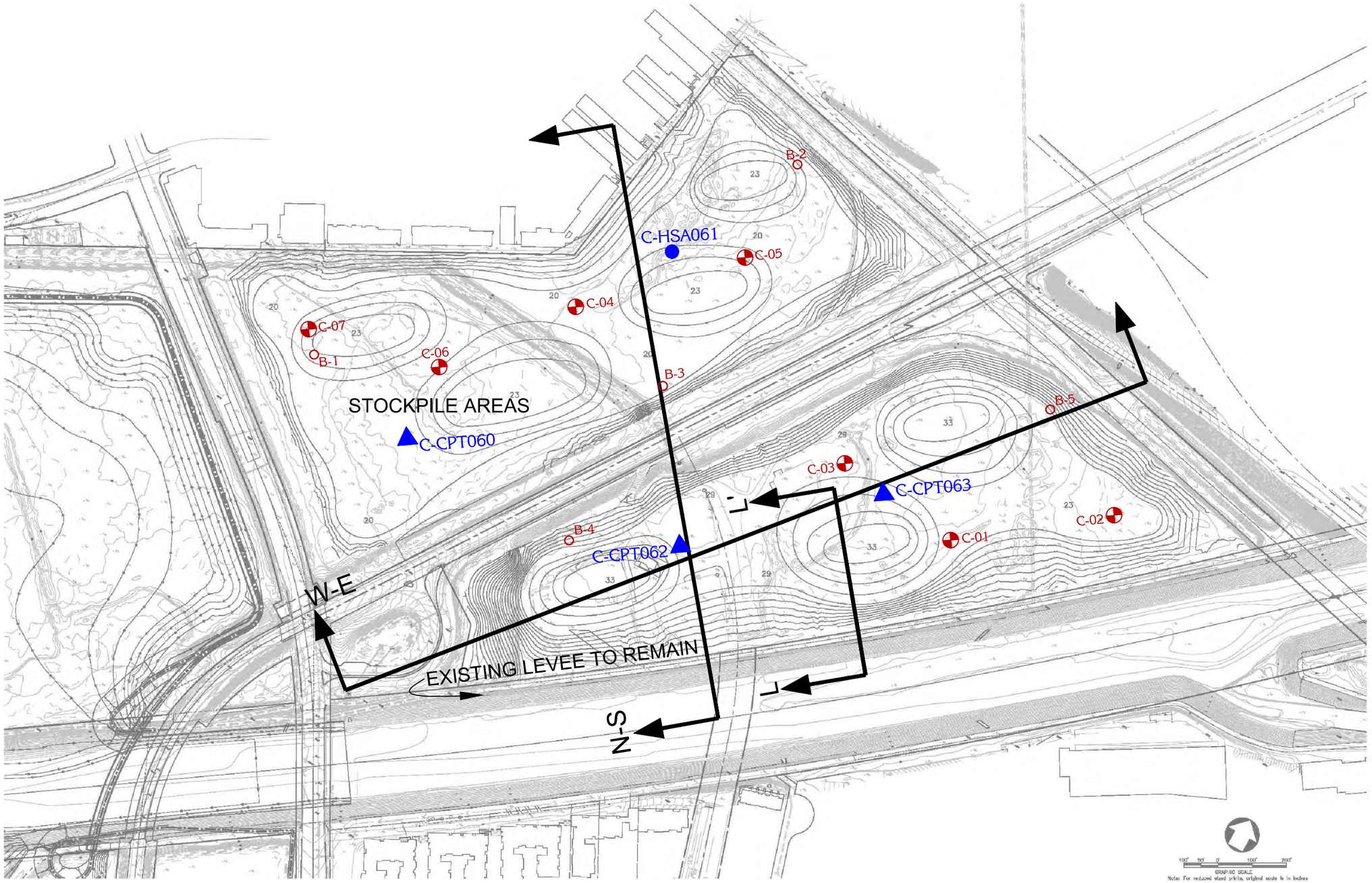
LEGEND

- A-RW002 GDC Boring (RW/HSA) Location
- A-CPT001 GDC CPT Location
- 33/91 Law Crandall Boring Locations (1991)
- 18/87 Law Crandall Boring Locations (1987)
- 24 Law Crandall Boring Locations in Area A (1991)
- B-13 Diaz Yourman Boring Locations in Area B (2010)
- C-07 Diaz Yourman Boring Locations in Area C (2010)
- 30 Weston Boring Locations (2009)

DATE: 1/22/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	PREVIOUS AND CURRENT INVESTIGATION BORINGS	PROJECT NUMBER: LA962A
REVISION:	APPROVED BY: P. Kashighandi		Ballona Wetlands Restoration Los Angeles, CA	SCALE: 1" = 750'
REVISION:	B1-358			FIGURE NUMBER: 3



DATE: 12/4/2012	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	PROPOSED GRADING PLAN AND CROSS SECTIONS	PROJECT NUMBER: L962A
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi			BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	SCALE: AS SHOWN
REVISION:	B1-359				FIGURE NUMBER: 4A



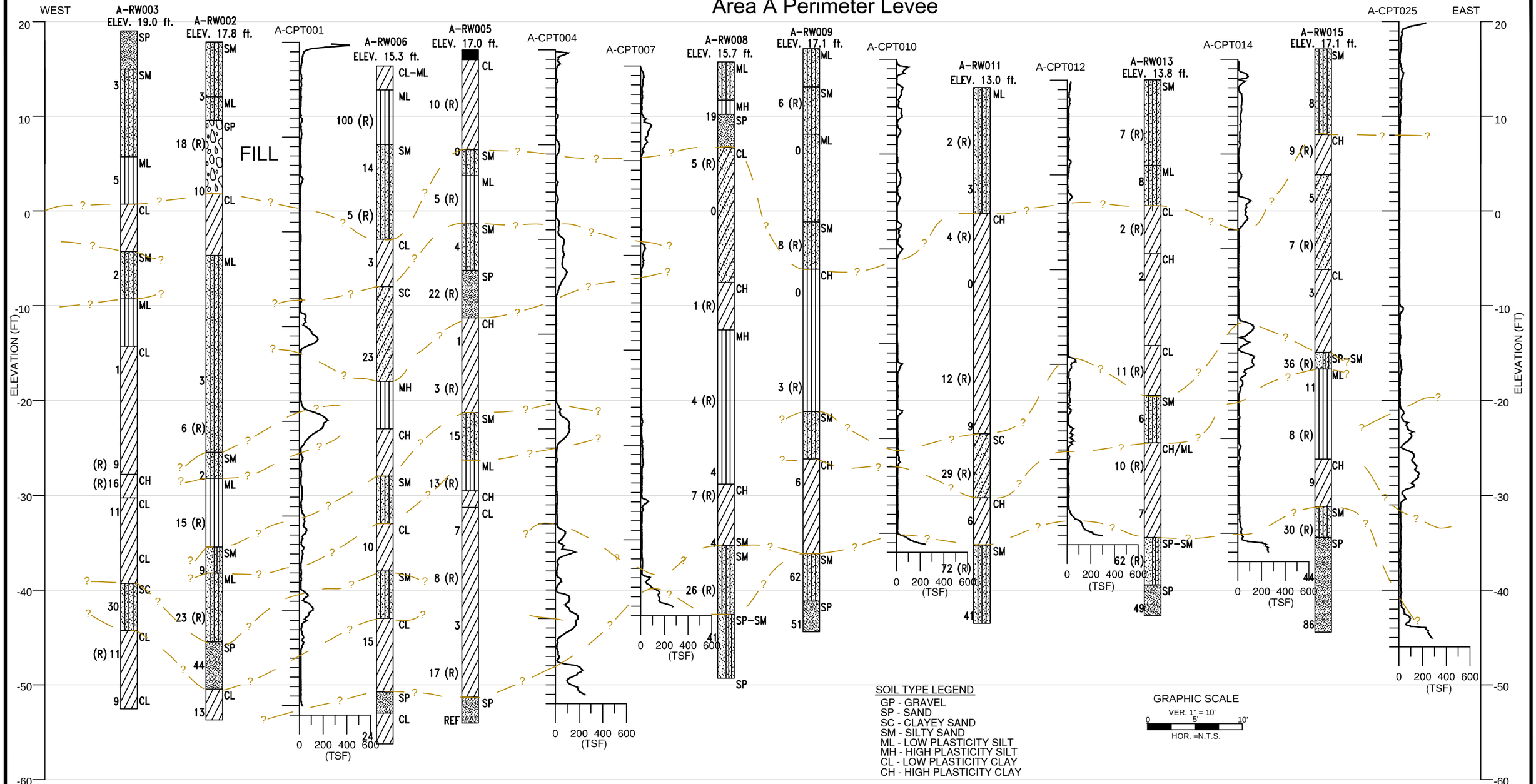
LEGEND

● C-RW002	GDC Boring (RW/HSA) Location
▲ C-CPT001	GDC CPT Location
O B-5	Law Crandall Boring Locations in Area C (1991)
C-07	Diaz Yourman Boring Locations in Area C (2010)

DATE: 1/22/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	AREA C GRADING PLAN AND CROSS SECTIONS (LEVEE AND PERIMETER) BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi		
REVISION:	B1-360		

PROJECT NUMBER: LA962A
SCALE: AS SHOWN
FIGURE NUMBER: 4B

Area A Perimeter Levee



SOIL TYPE LEGEND

GP - GRAVEL
SP - SAND
SC - CLAYEY SAND
SM - SILTY SAND
ML - LOW PLASTICITY SILT
MH - HIGH PLASTICITY SILT
CL - LOW PLASTICITY CLAY
CH - HIGH PLASTICITY CLAY

GRAPHIC SCALE

VER. 1" = 10'
0 5' 10'
HOR. =N.T.S.

LEGEND

9 SPT N-Value
20 (R) Blowcounts of Modified California Ring Sample
— ? — Interpreted Layer Boundry

NOTE

(1) PROFILE INCLUDES BORINGS WITHIN ABOUT 100 FEET OF THE PROPOSED AREA A PERIMETER LEVEES.
(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.
(3) BORINGS ARE SHOWN FROM WEST TO EAST. HORIZONTAL DISTANCES BETWEEN BORINGS ARE NOT TO SCALE.

DATE: 2/21/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	SUBSURFACE PROFILE ALONG AREA A PERIMETER LEVEE BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi		PROJECT NUMBER: L962A SCALE: AS SHOWN
REVISION:	B1-361		FIGURE NUMBER: 5A

Area B Perimeter Levee

WEST

EAST

ELEVATION (FT)

FILL

B-RW027 ELEV. 13.0 ft.
12 (R) SM
SP-SM
0 MH
0 SM
29 SP-SM
18 (R) SM
10 SP
100 (R)
47 (R)
38 SM
9 (R) CH
11 ML
42 SM
22

B-RW030 ELEV. 6.1 ft.
SM
0 CH
2 (R)
0 SM
39 (R)
5
28 (R)
9
10

B-CPT031

B-RW032 ELEV. 8.2 ft.
7 SM
0 CH
0 SM
20
37 ML
9 (R) CL
0
43 (R) SP
43 SM
95
82 (R)
91 SP

B-RW033 ELEV. 6.3 ft.
SP-SM
7 (R) CH
7
54 SP
6 SM
38 ML
5 SM
ML
5 CH
13 SM
76 (R)
21 SC
33 (R)
34 SP

B-CPT034

B-CPT035

B-RW036 ELEV. 9.1 ft.
1 SM
1 CH
1 SM
2 ML
CH
1 ML
1 CL
10 SM
ML
4 SM
9 (R) CL
17
59 SP

B-CPT037

B-CPT040

B-RW041 ELEV. 6.8 ft.
ML
SM
0 CH
0 ML
19 SM
CH
CL
0
7 CH/CL
CL
27 (R)
1
CH
7
68 (R) SW
45 SW

B-RW043 ELEV. 8.8 ft.
ML
1 CH
1 SP
CH
1 CL
11
5 (R)
CL
10 (R) SM
6
100 (R) SP
34

B-RW044 ELEV. 9.2 ft.
ML
CH
1
1 SC
CH
3 SC
6
35 (R) SP
9
8 (R) CL
SP
32
GP
57

B-CPT045

B-RW047 ELEV. 11.5 ft.
4 SM
ML
CL
0 CH
4 CL
8 SM
SP
CH
11
9 (R) SM
22
SP
100 (R) GP
35

B-CPT050

0 200 400 600 (TSF)

LEGEND

9	SPT N-Value
20 (R)	Blowcounts of Modified California Ring Sample
— ? —	Interpreted Layer Boundry

NOTE

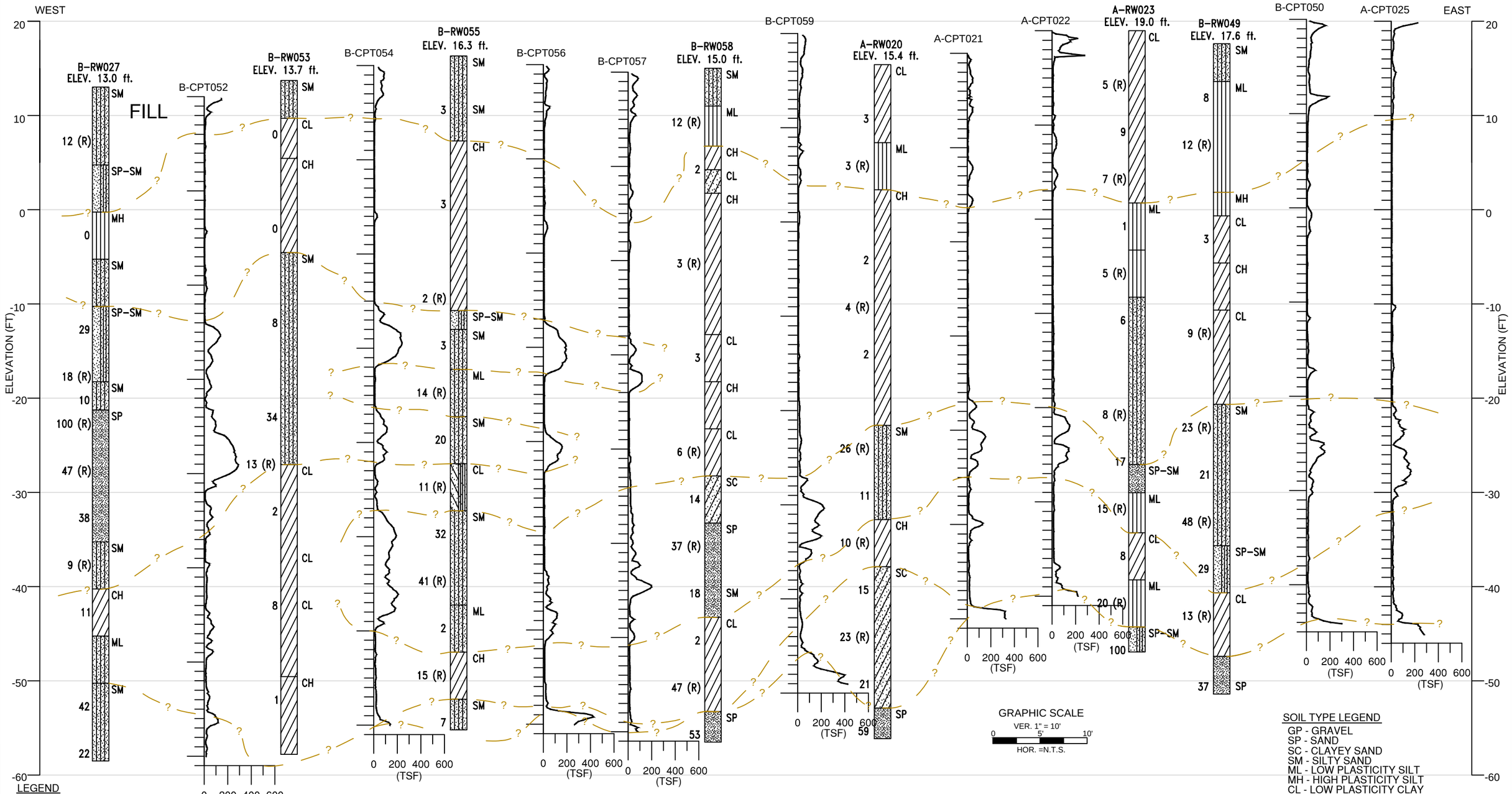
(1) PROFILE INCLUDES BORINGS WITHIN ABOUT 100 FEET OF THE PROPOSED AREA B LEVEES (WEST AREA B AND CULVER BLVD).
(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.
(3) BORINGS ARE SHOWN FROM WEST TO EAST. HORIZONTAL DISTANCES BETWEEN BORINGS ARE NOT TO SCALE.

GRAPHIC SCALE
VER. 1" = 10'
0 5' 10'
HOR. =N.T.S.

SOIL TYPE LEGEND
GP - GRAVEL
SP - SAND
SC - CLAYEY SAND
SM - SILTY SAND
ML - LOW PLASTICITY SILT
MH - HIGH PLASTICITY SILT
CL - LOW PLASTICITY CLAY
CH - HIGH PLASTICITY CLAY

DATE: 12/18/2012	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	SUBSURFACE PROFILE ALONG AREA B PERIMETER LEVEE BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi		PROJECT NUMBER: L962A
REVISION:	B1-362		SCALE: AS SHOWN
			FIGURE NUMBER: 5B

Borings Along Ballona Creek Levee



GRAPHIC SCALE
VER. 1" = 10'
0 5' 10'
HOR. =N.T.S.

SOIL TYPE LEGEND
GP - GRAVEL
SP - SAND
SC - CLAYEY SAND
SM - SILTY SAND
ML - LOW PLASTICITY SILT
MH - HIGH PLASTICITY SILT
CL - LOW PLASTICITY CLAY
CH - HIGH PLASTICITY CLAY

LEGEND
9 SPT N-Value
20 (R) Blowcounts of Modified California Ring Sample
— ? — Interpreted Layer Boundry

NOTE
(1) PROFILE INCLUDES BORINGS WITHIN ABOUT 100 FEET OF THE EXISTING BALLONA CREEK LEVEES.
(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.
(3) BORINGS ARE SHOWN FROM WEST TO EAST. HORIZONTAL DISTANCES BETWEEN BORINGS ARE NOT TO SCALE.

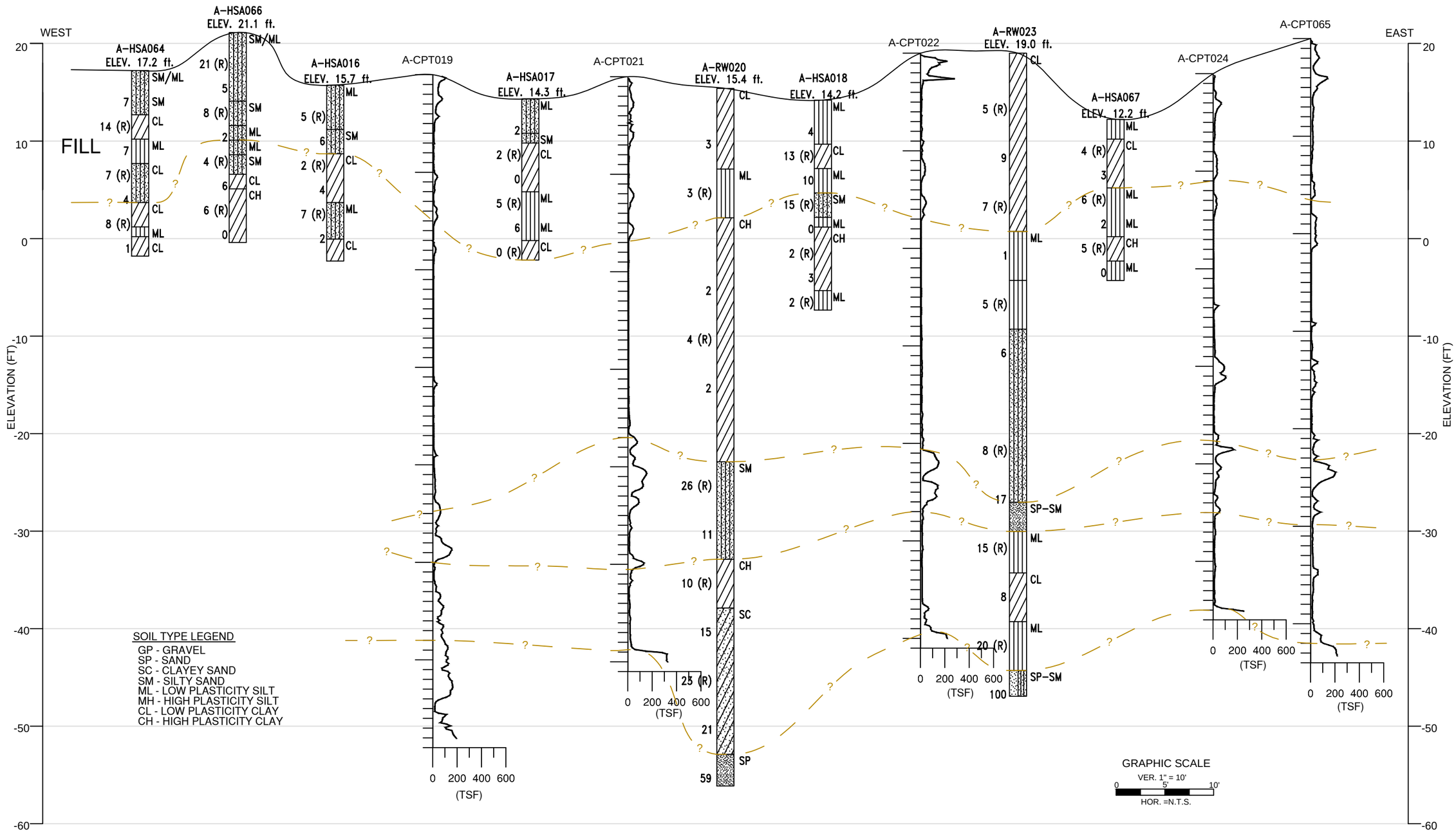
DATE: 12/18/2012	DRAWN BY: K. Madamba	
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi	
REVISION:	B1-363	

GROUP DELTA CONSULTANTS, INC
370 Amapola Ave.
Suite 212
Torrance, CA. 90501

SUBSURFACE PROFILE ALONG BALLONA CREEK CHANNEL

BALLONA WETLANDS RESTORATION PROJECT
LOS ANGELES, CA

PROJECT NUMBER:	L962A
SCALE:	AS SHOWN
FIGURE NUMBER:	5C



SOIL TYPE LEGEND

GP - GRAVEL
SP - SAND
SC - CLAYEY SAND
SM - SILTY SAND
ML - LOW PLASTICITY SILT
MH - HIGH PLASTICITY SILT
CL - LOW PLASTICITY CLAY
CH - HIGH PLASTICITY CLAY

LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

— ? — Interpreted Layer Boundry

NOTE

(1) PROFILE INCLUDES BORINGS WITHIN ABOUT 100 FEET WITHIN AREA A EXCAVATION ZONE.
(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.
(3) BORINGS ARE SHOWN FROM WEST TO EAST. HORIZONTAL DISTANCES BETWEEN BORINGS ARE NOT TO SCALE.

DATE: 12/18/2012	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	SUBSURFACE PROFILE WITHIN AREA A EXCAVATION ZONE	PROJECT NUMBER: L962A
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi		BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	SCALE: AS SHOWN
REVISION:	B1-364			FIGURE NUMBER: 5D

WEST

EAST

ELEVATION (FT)

30
20
10
0
-10
-20
-30
-40
-50

FILL

B-4
C-CPT062
C-3
C-CPT063
C-1
B-5
C-2

SM
ML
SM
ML
CL
SP
MH
ML
SP
ML
SP

CL
CH
CL
CH
SC
SP
SP-SC
CL
ML

SC
ML
CL
CH
CL
SC
SP-SC
CH

CL
ML
MH
CL
ML
CL
ML
SW
SP

SC
CH
SC
CL
SP-SC

0
200
400
600
(TSF)

0
200
400
600
(TSF)

SOIL TYPE LEGEND

GP - GRAVEL
SP - SAND
SC - CLAYEY SAND
SM - SILTY SAND
ML - LOW PLASTICITY SILT
MH - HIGH PLASTICITY SILT
CL - LOW PLASTICITY CLAY
CH - HIGH PLASTICITY CLAY

GRAPHIC SCALE

VER. 1" = 10'

0 5' 10'

HOR. =N.T.S.

LEGEND

C-CPT062 = GDC (2012)
C-HSA062 = GDC (2012)
B-4 = LAW CRANDALL (1991)
C-1 = DIAZ YOURMAN (2010)
— ? — Interpreted Layer Boundry

BORING LEGEND

9 SPT N-Value
20 (R) Blowcounts of Modified California Ring Sample

NOTE

(1) PROFILE INCLUDES GDC's BORINGS/CPT's AND SELECTED BORINGS FROM PREVIOUS INVESTIGATIONS WITHIN AREA C.
(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.
(3) BORINGS ARE SHOWN FROM WEST TO EAST. HORIZONTAL DISTANCES BETWEEN BORINGS ARE NOT TO SCALE.

DATE: 12/4/2012	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	SUBSURFACE PROFILE ALONG SOUTH AREA C (W-E)
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi		BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION:	B1-365		PROJECT NUMBER: L962A SCALE: AS SHOWN FIGURE NUMBER: 5E

SOUTH

NORTH

ELEVATION (FT)

30 20 10 0 -10 -20 -30 -40 -50

C-CPT062 C-CPT063 B-4 C-3 C-CPT060 B-3 C-4 C-5 C-HSA061 B-2

FILL

C-HSA061 ELEV. 16.0 ft.

0 200 400 600 (TSF)

SOIL TYPE LEGEND

GP - GRAVEL
SP - SAND
SC - CLAYEY SAND
SM - SILTY SAND
ML - LOW PLASTICITY SILT
MH - HIGH PLASTICITY SILT
CL - LOW PLASTICITY CLAY
CH - HIGH PLASTICITY CLAY

GRAPHIC SCALE

VER. 1" = 10'

0 5' 10'

HOR. =N.T.S.

LEGEND

C-CPT062 = GDC (2012)
C-HSA061 = GDC (2012)
B-3 = LAW CRANDALL (1991)
C-3 = DIAZ YOURMAN (2010)
— ? — Interpreted Layer Boundry

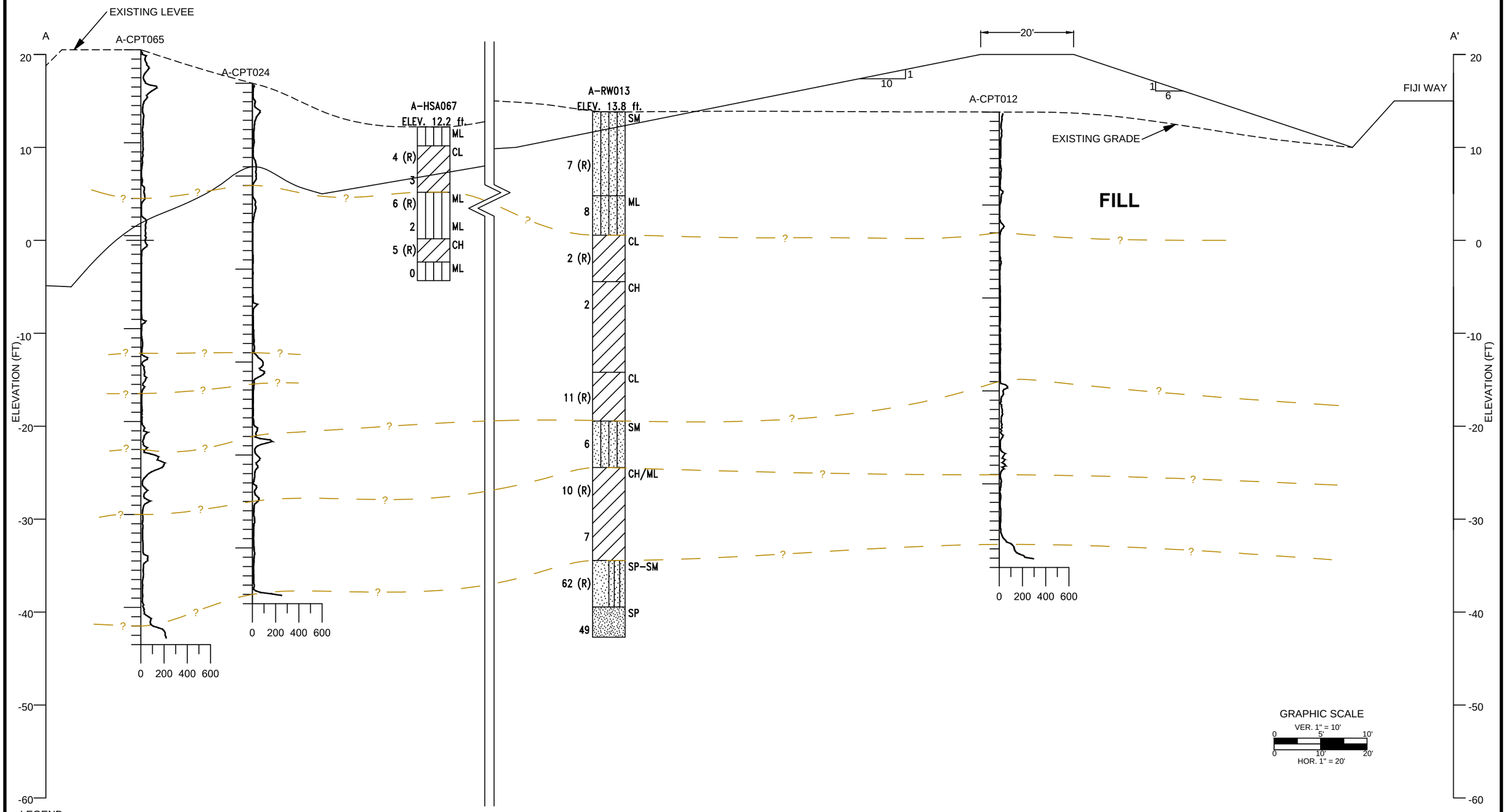
BORING LEGEND

9 SPT N-Value
20 (R) Blowcounts of Modified California Ring Sample

NOTE

(1) PROFILE INCLUDES GDC's BORINGS/CPT's AND SELECTED BORINGS FROM PREVIOUS INVESTIGATIONS WITHIN AREA C.
(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.
(3) BORINGS ARE SHOWN FROM SOUTH TO NORTH. HORIZONTAL DISTANCES BETWEEN BORINGS ARE NOT TO SCALE.

DATE: 12/4/2012	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	SUBSURFACE PROFILE WITHIN AREA C (N-S)
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi		BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION:	B1-366		PROJECT NUMBER: L962A SCALE: AS SHOWN FIGURE NUMBER: 5F



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

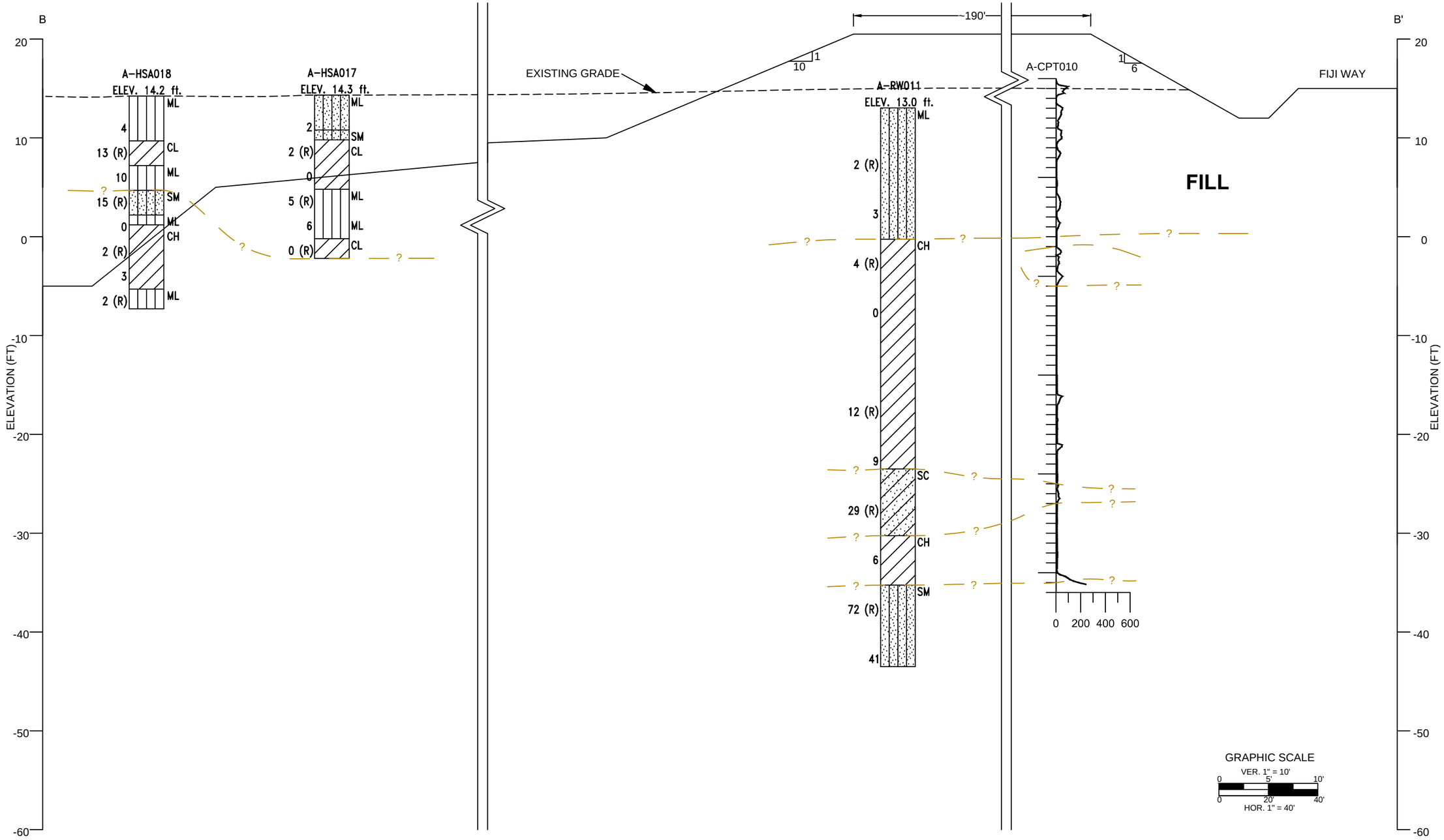
— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	CROSS SECTION A-A'
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi		BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION:	B1-367		PROJECT NUMBER: L962A SCALE: AS SHOWN FIGURE NUMBER: 6A



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

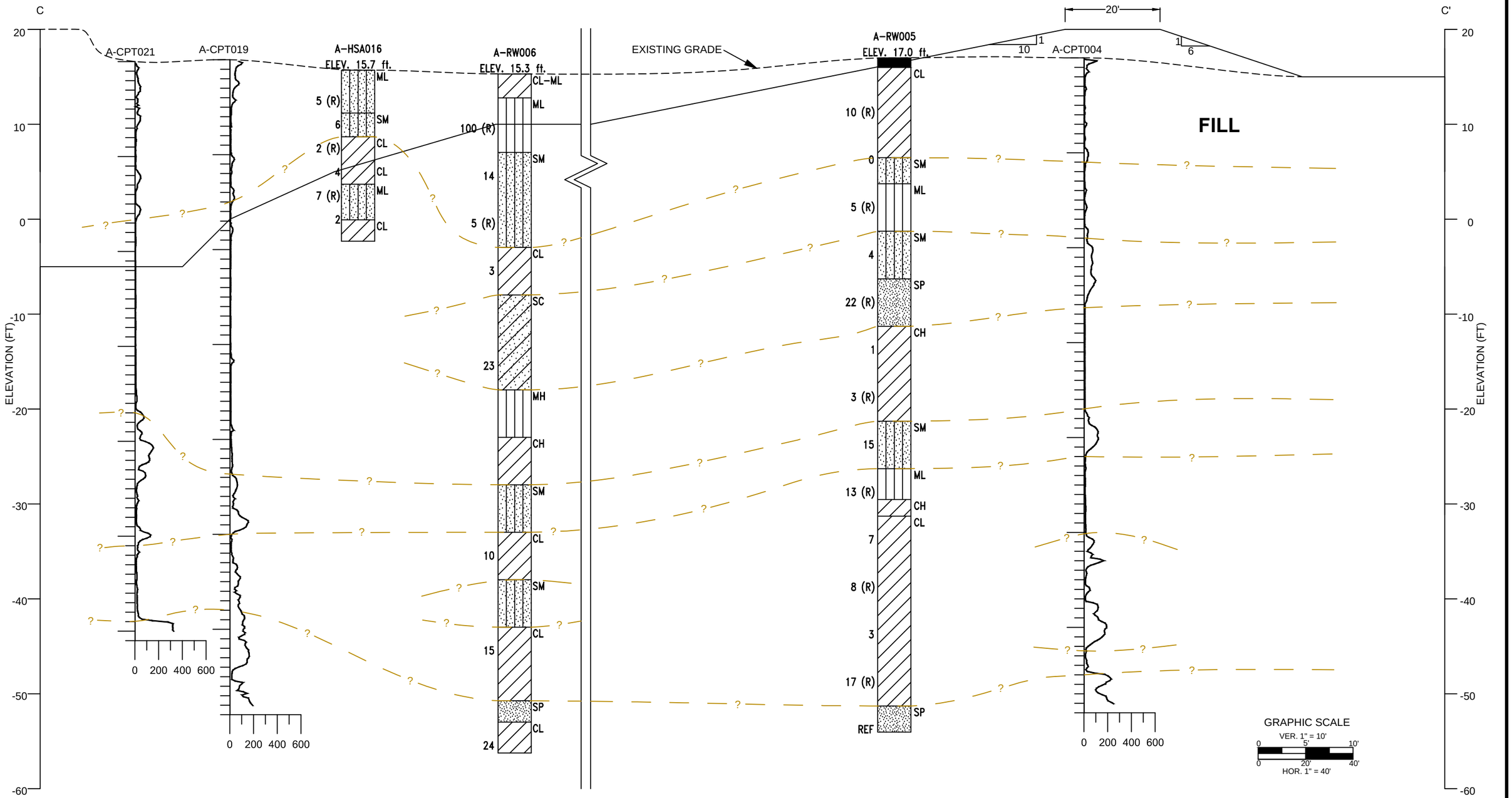
— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	CROSS SECTION B-B'
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi		BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION:	B1-368		PROJECT NUMBER: L962A SCALE: AS SHOWN FIGURE NUMBER: 6B



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

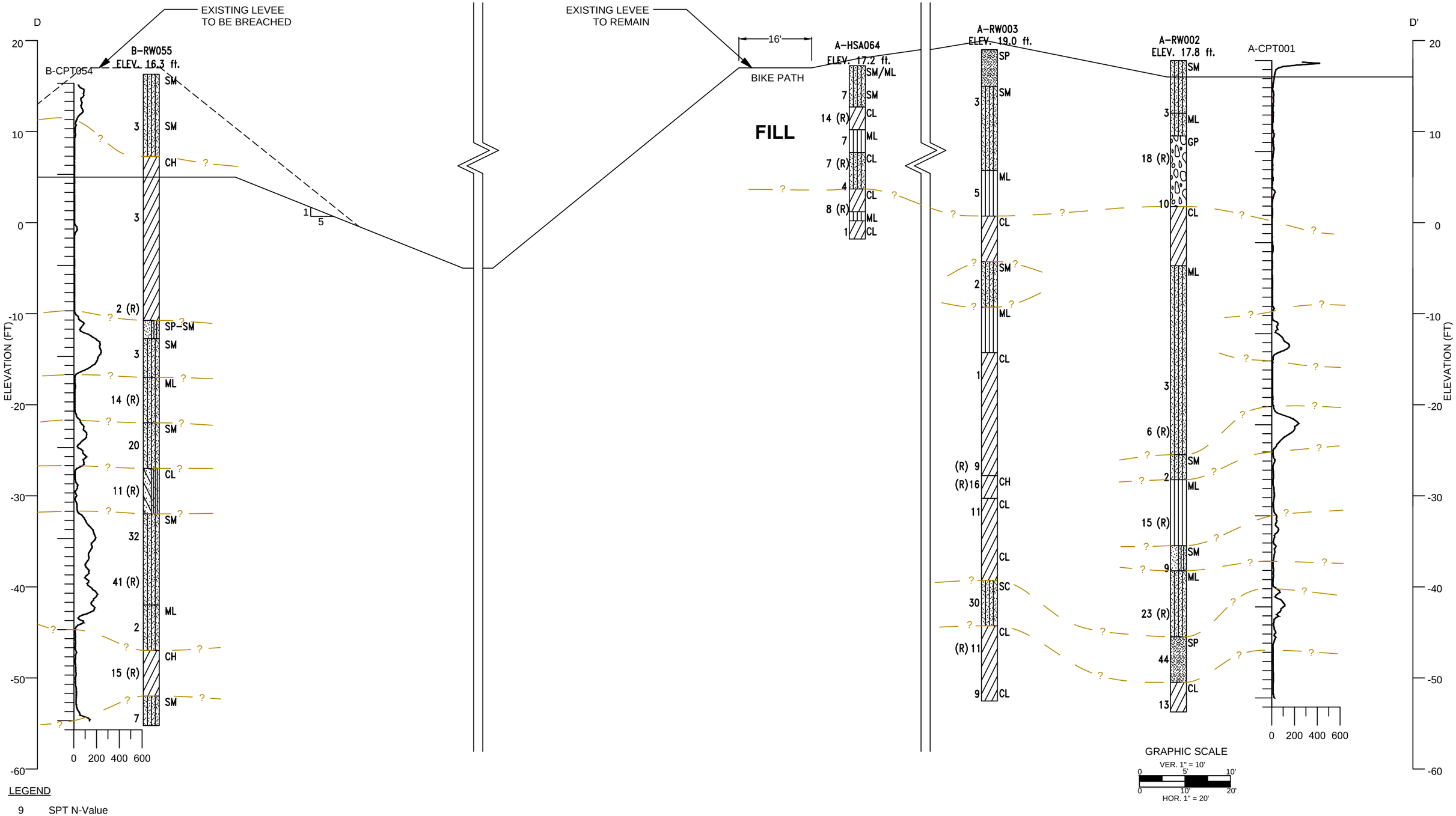
— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	CROSS SECTION C-C'
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi		BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION:	B1-369		PROJECT NUMBER: L962A SCALE: AS SHOWN FIGURE NUMBER: 6C



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

— ? — Interpreted Layer Boundry

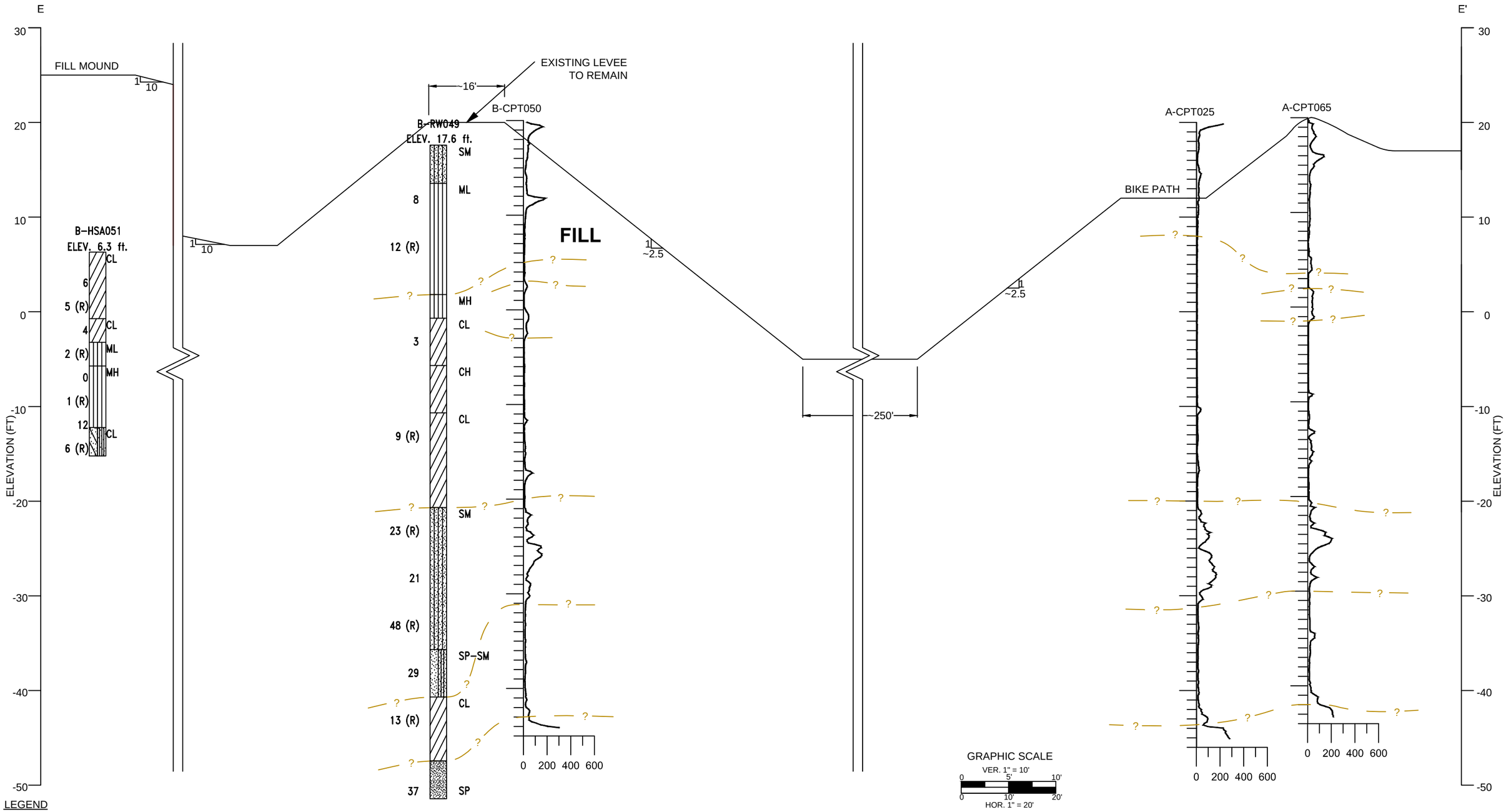
NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	CROSS SECTION D-D'
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi		BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION:	B1-370		

PROJECT NUMBER:	L962A
SCALE:	AS SHOWN
FIGURE NUMBER:	6D



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	CROSS SECTION E-E'
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi		BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION:	B1-371		PROJECT NUMBER: L962A SCALE: AS SHOWN FIGURE NUMBER: 6E

F

F'

AREA B FILL MOUND

1
10

~50

CULVER
BLVD

1
~3

1
~3

30'
MIN. OFFSET

1
3

~250'

B-CPT050

~20

B-RW049
ELEV. 17.6 ft.

EXISTING LEVEE
TO BE BREACHED

1
10

1
~2.5

1
~2.5

B-HSA051
ELEV. 6.3 ft.

FILL

EXISTING GRADE

ELEVATION (FT)

30
20
10
0
-10
-20
-30
-40
-50

B-HSA051: CL 6 / 5 (R) / CL 4 / 2 (R) ML / 0 MH / 1 (R) / 12 / CL 6 (R)

B-RW049: SM 8 / ML 12 (R) / MH / CL 3 / CH / CL 9 (R) / SM 23 (R) / 21 / 48 (R) / SP-SM 29 / CL 13 (R) / SP 37

0 200 400 600

GRAPHIC SCALE
VER. 1" = 10'
0 5' 10'
0 20' 40'
HOR. 1" = 40'

LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

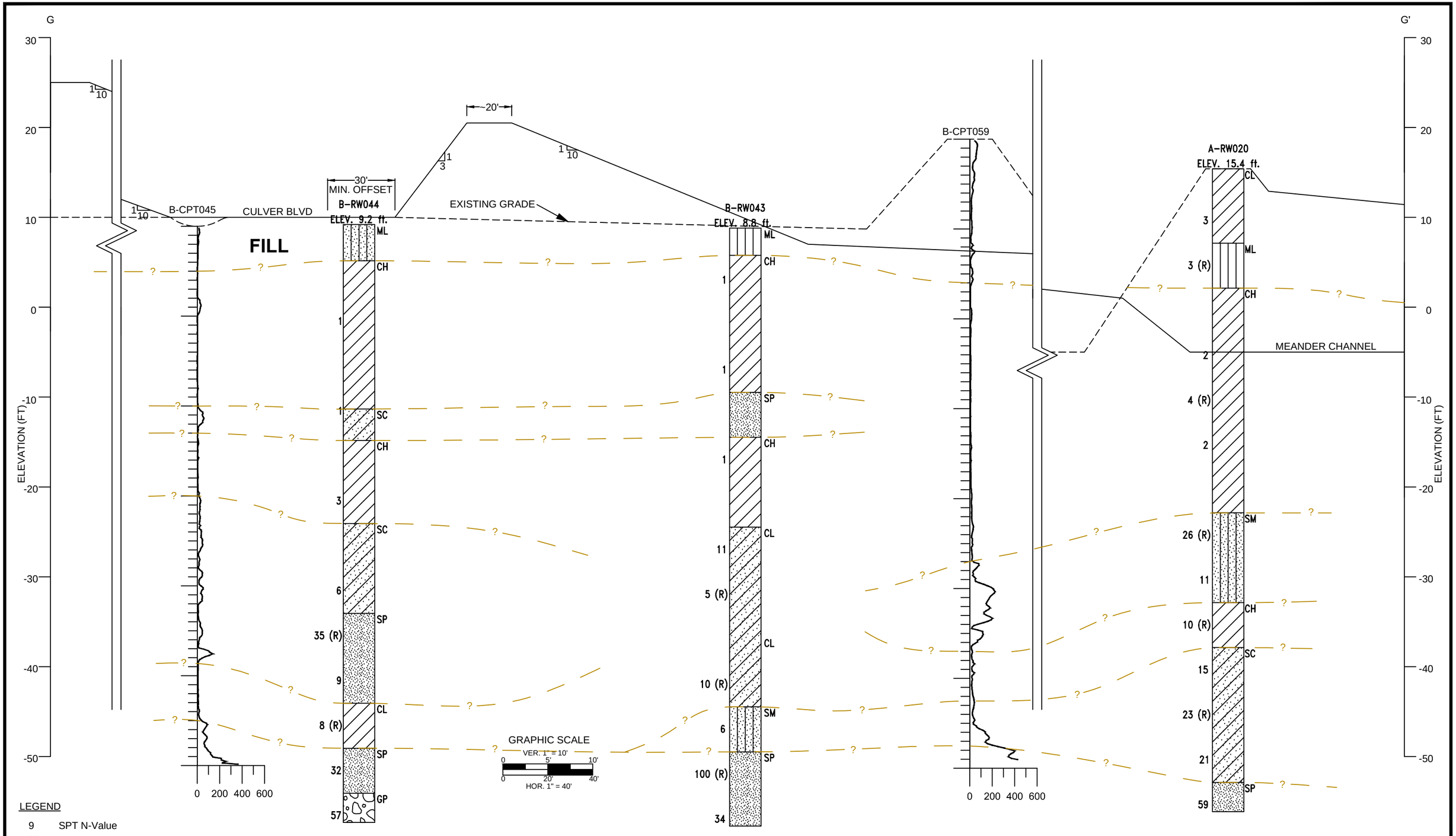
— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	PROJECT NUMBER: L962A
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi	CROSS SECTION F-F'	SCALE: AS SHOWN
REVISION:	B1-372	BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	FIGURE NUMBER: 6F



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

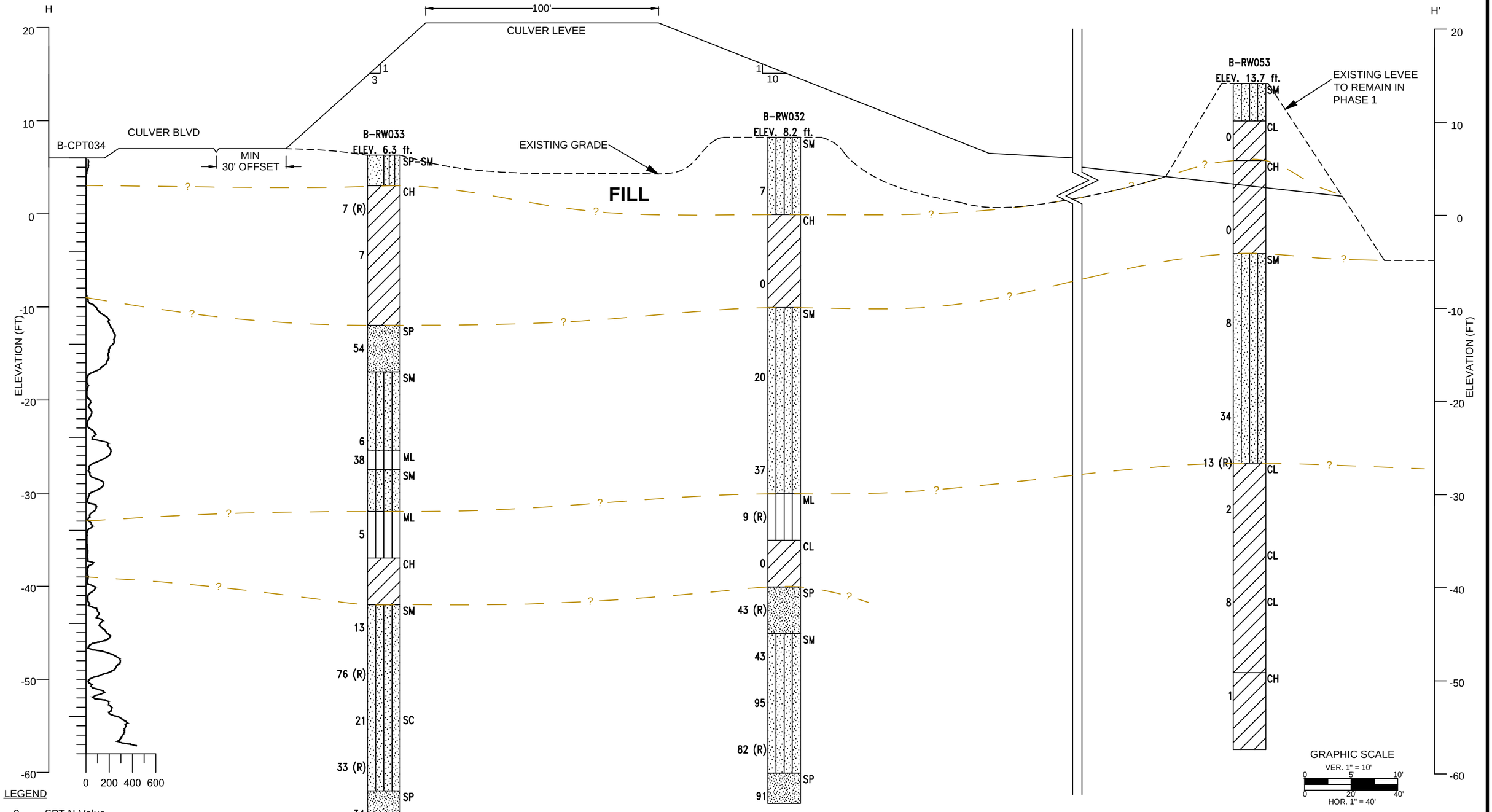
— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	CROSS SECTION G-G'
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi		BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION:	B1-373		PROJECT NUMBER: L962A SCALE: AS SHOWN FIGURE NUMBER: 6G



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

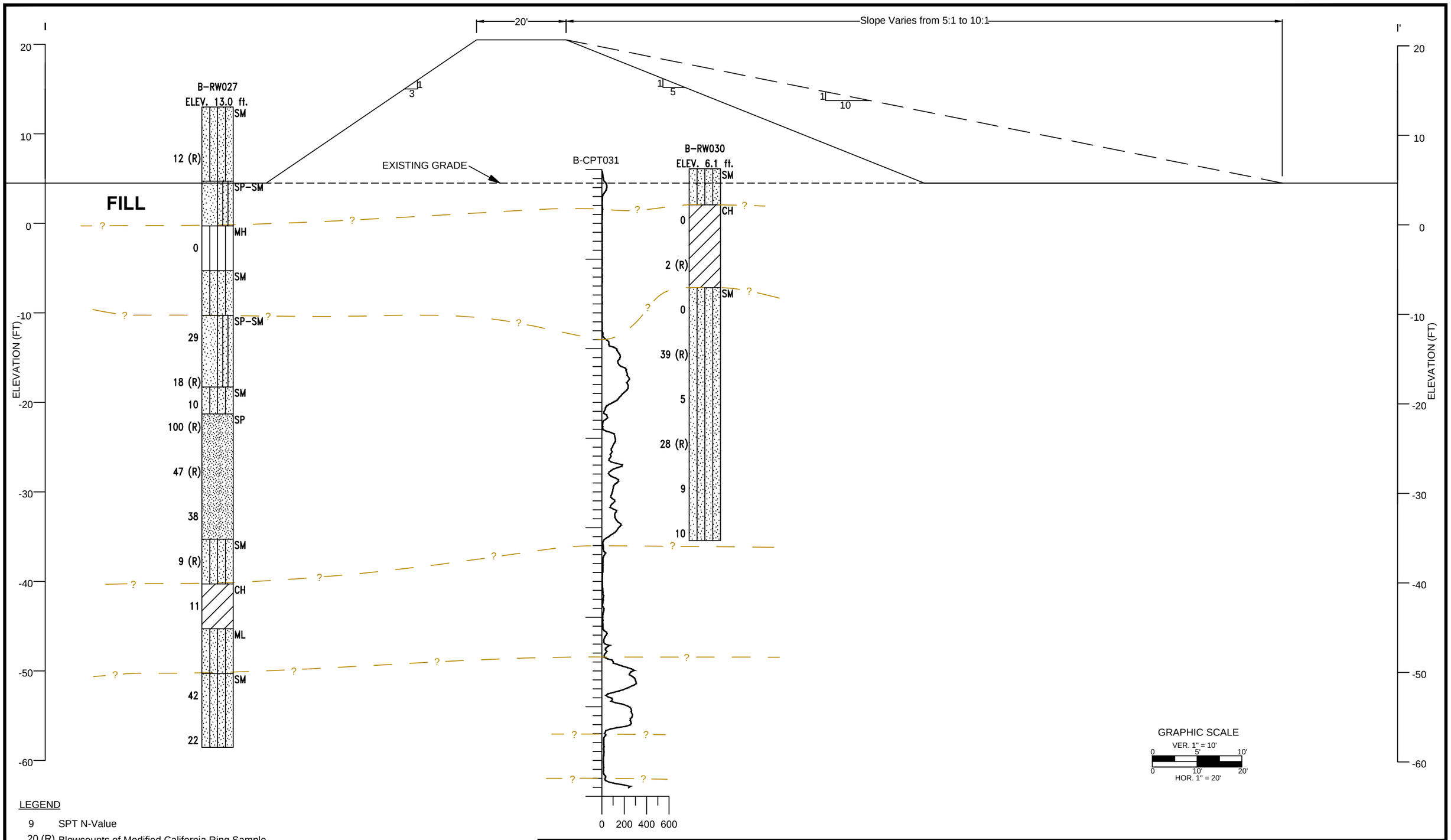
— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	PROJECT NUMBER: L962A
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi	CROSS SECTION H-H'	SCALE: AS SHOWN
REVISION:	B1-374	BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	FIGURE NUMBER: 6H



GRAPHIC SCALE
VER. 1" = 10'
0 5' 10'
0 10' 20'
HOR. 1" = 20'

LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

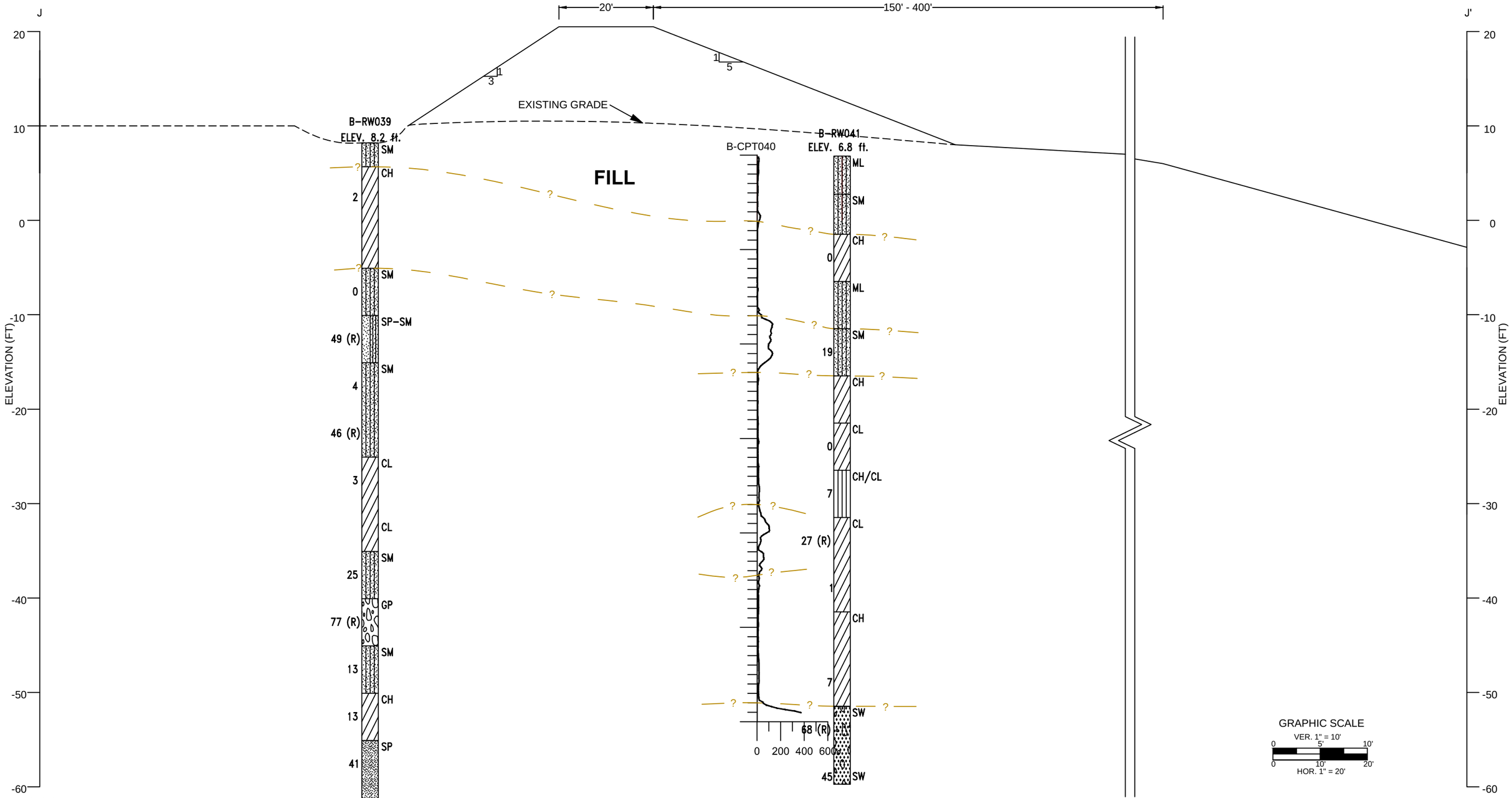
— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	PROJECT NUMBER: L962A
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi	CROSS SECTION I-I'	SCALE: AS SHOWN
REVISION:	B1-375	BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	FIGURE NUMBER: 6I



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

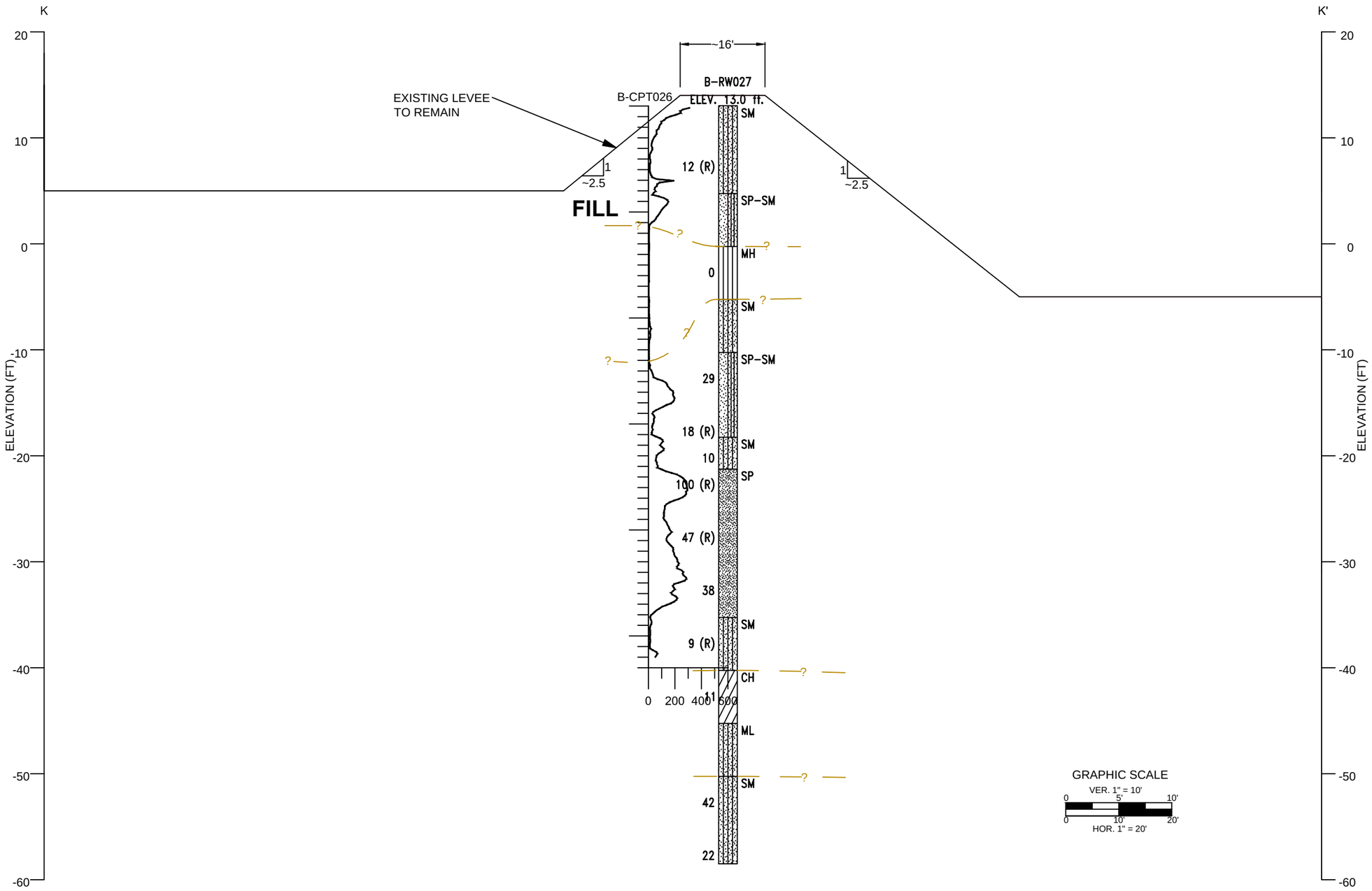
— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	CROSS SECTION J-J'
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi		BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION:	B1-376		PROJECT NUMBER: L962A SCALE: AS SHOWN FIGURE NUMBER: 6J



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	PROJECT NUMBER: L962A
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi	CROSS SECTION K-K'	SCALE: AS SHOWN
REVISION:	B1-377	BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	FIGURE NUMBER: 6K

L

L'

EXISTING LEVEE
TO REMAIN

~2.5

1

C-1

C-CPT063

C-CPT062

C-2

SC

ML

CL

CH

SC

CH

SC

CL

CL

SC

SP-SC

SP-SC

CH

FILL

ELEVATION (FT)

30

20

10

0

-10

-20

-30

-40

-50

0

200

400

600

GRAPHIC SCALE

VER. 1" = 10'

0 5' 10'

0 10' 20'

HOR. 1" = 20'

LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

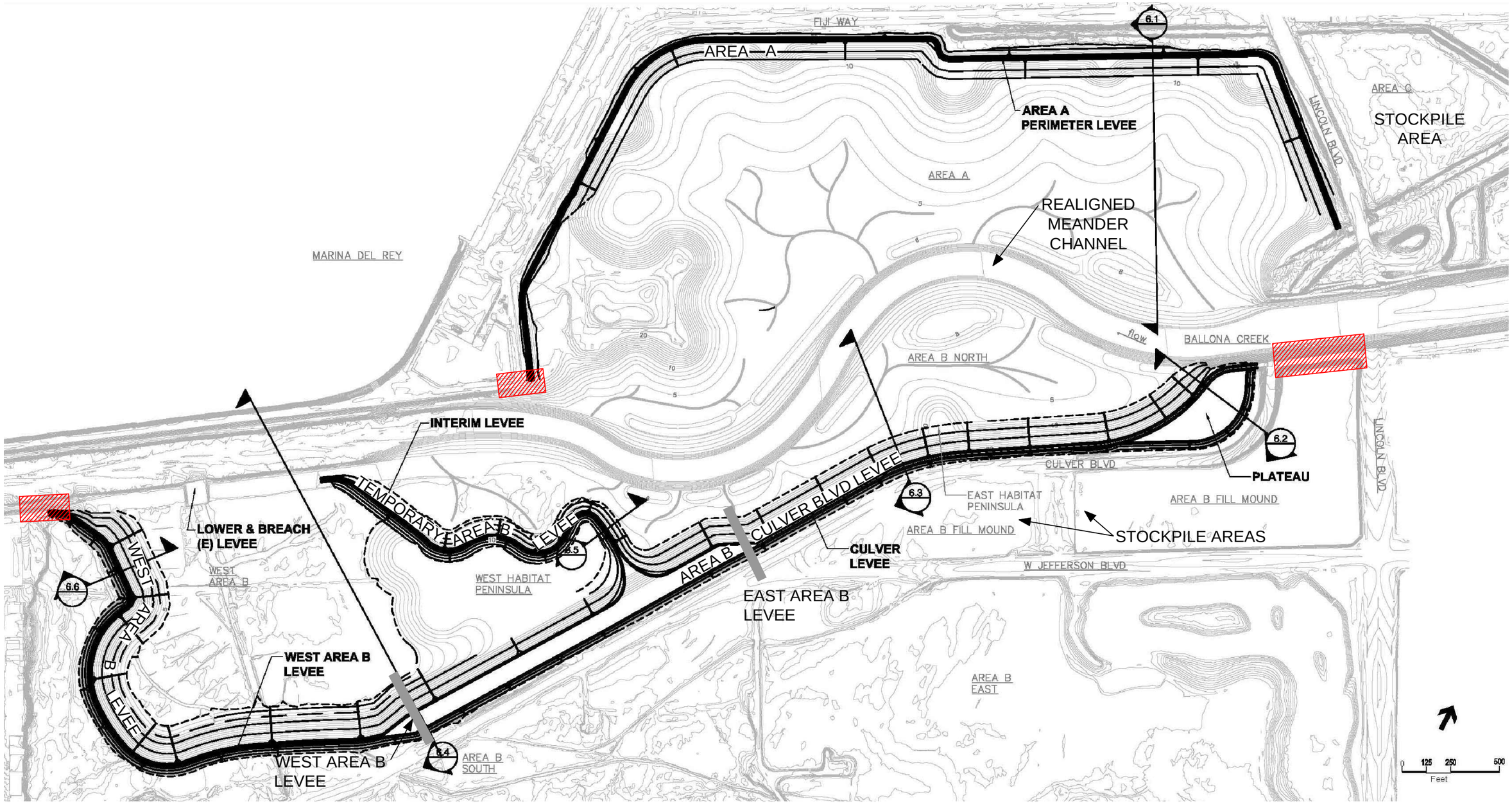
— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

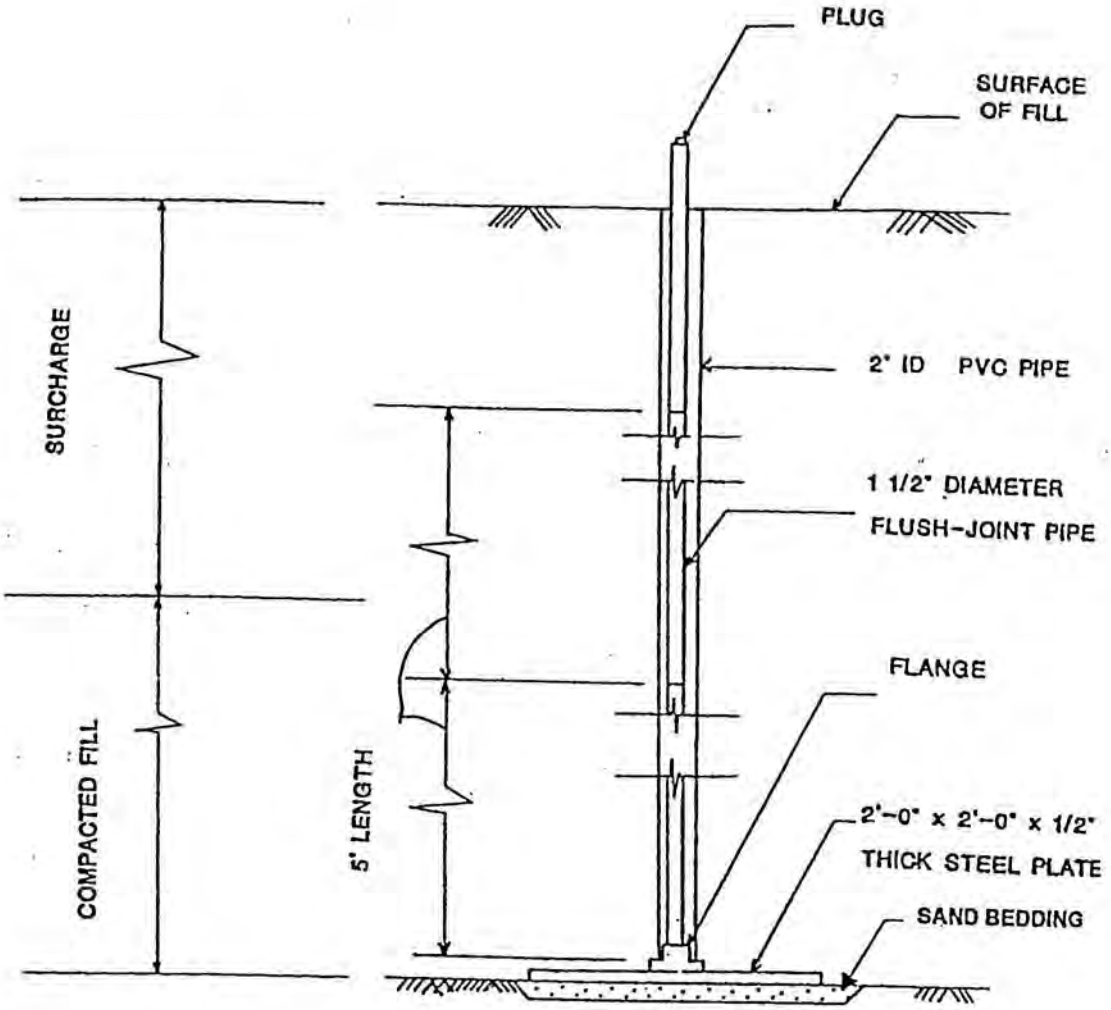
DATE: 12/4/2012	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	CROSS SECTION L-L'
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi		BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION:	B1-378		PROJECT NUMBER: L962A SCALE: AS SHOWN FIGURE NUMBER: 6L



LEGEND

ZONES OF GROUND IMPROVEMENTS

DATE: 6/28/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	DELINEATED ZONES OF GROUND IMPROVEMENT BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	PROJECT NUMBER: L962A
REVISION:	APPROVED BY: P. Kashighandi				SCALE: AS SHOWN
REVISION:	B1-379				FIGURE NUMBER: 7



Ballona Wetlands Restoration Project

Settlement Monitoring Plate Detail

PROJECT NUMBER: LA-962A8

DATE:

REVISED:

SCALE: NOT TO SCALE

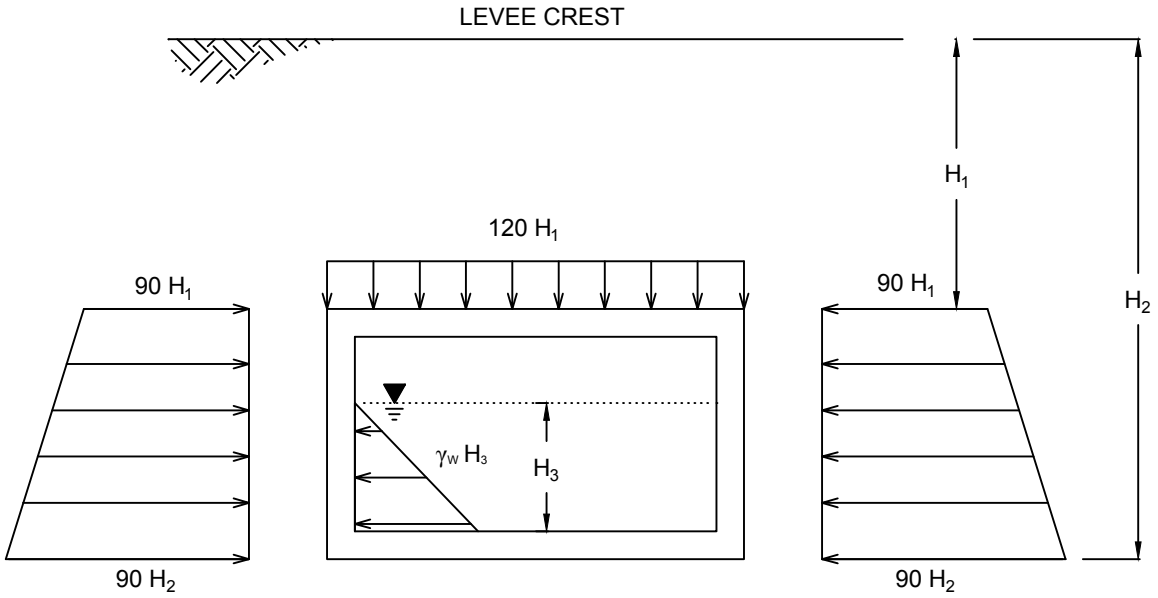
DRAWN BY: T Ybarra

APPROVED BY: T Armstrong

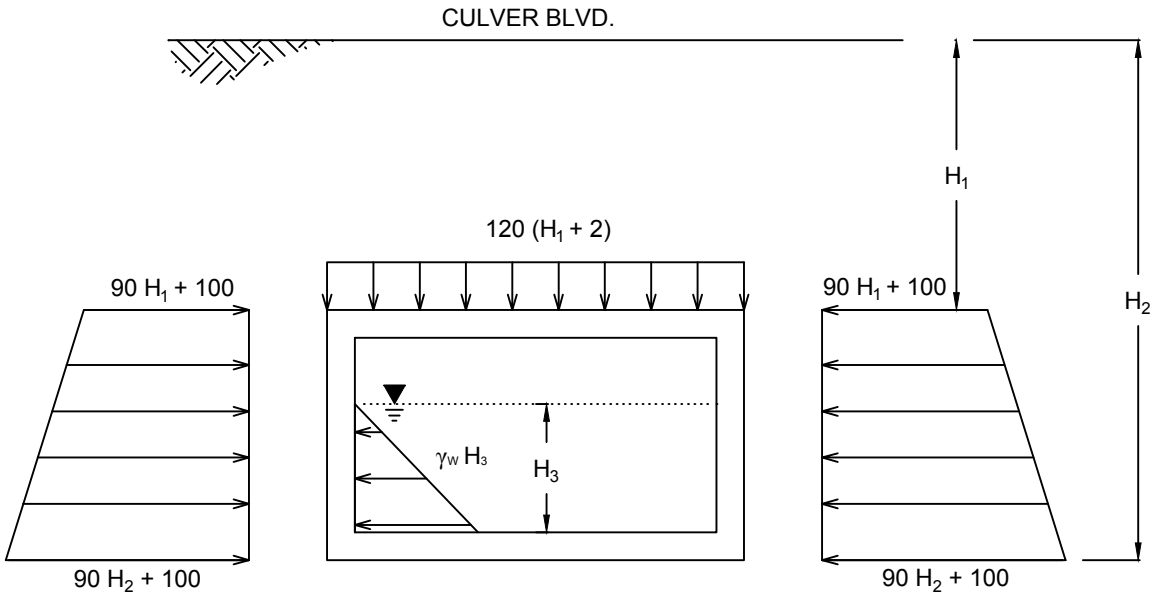
FIGURE: 8

GROUP DELTA CONSULTANTS, INC.

UNDER LEVEE



UNDER CULVER BLVD.



NOTE: ALL PRESSURES ARE IN UNITS OF POUNDS PER SQUARE FOOT (psf). ALL DEPTHS ARE IN UNITS OF FEET (ft).

GROUP DELTA CONSULTANTS	**GROUP DELTA CONSULTANTS, INC.** ENGINEERS AND GEOLOGISTS 370 Amapola Ave, Suite 212 Torrance, CA 90501 (310) 320-5100	PROJECT NUMBER: L962A
	PROJECT NAME: BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CALIFORNIA	FIGURE NUMBER: 9
	LATERAL EARTH PRESSURE FOR CULVERTS	

APPENDIX A1
GDC FIELD EXPLORATION

APPENDIX A1
GDC FIELD EXPLORATION

A1.1 INTRODUCTION

GDC conducted a geotechnical subsurface investigation for the project site from September 11, 2012 to October 22, 2012. Prior to the geotechnical subsurface investigation, a geotechnical investigation work plan (GDC, 2012) was prepared. The work plan outlined the procedures for obtaining site access and work permits; defined access routes to avoid special status plants as well as plans to minimize impact to natural habitats and/or archaeological sites within the project area. The work plan also describes the drilling equipment, soil sampling schedule (geotechnical, chemical, and agronomical sampling), post-investigation site cleanup, and laboratory testing program (geotechnical, chemical, and agronomical). The geotechnical investigation work plan was referenced throughout the project to obtain necessary site information while minimizing environmental impact to the project site.

The investigation consisted of rotary wash borings, hollow-stem auger borings, hand auger borings, and cone penetration tests. The exploration locations are shown in Figure 3 of the report. A summary of the field investigations is provided in Table A1-1.

A1.2 SOIL BORINGS

Twenty five (25) rotary wash borings were advanced to depths ranging from 56.5 to 71.5 feet in Areas A, B and C of the project site. The rotary wash borings were selected along the proposed levees as well as along the existing Ballona Creek levees. Eight (8) hollow stem auger borings were drilled to a depths ranging from 16 31.5 feet in areas planned for excavation in Area A, and surcharge areas within Areas B and C. In addtition, direct push exploration were also conducted to obtain environmental samples at the location of our hollow stem borings. Boring B-RW028 originally planned as a rotary wash boring in Area B, was drilled using hand auger equipment to a depth of 5 feet, due of proximity of special species plants. All borings were drilled at approximate elevations ranging from +5 to +21.1 feet NAVD. Subsurface materials were visually classified and recorded by a GDC field engineer in accordance with the Unified Soil Classification System (USCS).

Drive samples, bulk samples and push samples of the encountered materials were obtained from the borings and recorded on the boring logs. Drive samples were obtained with a California Sampler ring sampler and a Standard Penetration Test (SPT) sampler. The California Sampler, lined with 1-inch tall rings, has an outside diameter of 3-inches, and the inside diameter of 2.42-inches. The samples were retained in brass rings and placed in sealed plastic canisters to prevent moisture

loss. Standard penetration tests (SPT) were conducted using a standard 2-inch outside diameter, 1.375-inch inside diameter, split-spoon sampler in accordance with ASTM D 1586. SPT samples were placed in sealable plastic bags to prevent loss of moisture. The SPT and California samplers were driven into the soil at the using a 140-pound hammer free-falling 30 inches. The penetration resistance (or "blowcounts") were recorded in blows per six inches of driving. When soft fine grained soils were encountered, 6-inch-long Shelby tubes were used for sampling relatively undisturbed soil samples in the rotary wash borings.

Representative bulk samples were taken within the upper 5 feet, and selectively at depths as deep as 20 feet for compaction testing, expansion potential, corrosion testing, as well as chemical and agronomical testing. Bulk samples were placed into polyethylene bags. Additional chemistry testing samples were also obtained using direct push sampling equipment under the supervision of a project environmental engineer. Chemistry and agronomy samples were provided to the project environmental engineers for their use.

Additionally, four field permeability tests were performed at depths of 5 and 10 feet, at boring locations A-HSA064 and A-HSA066 near the existing north levee and existing gas injection wells to evaluate the permeability of the near surface soils. The tests were performed by filling the hollow stem auger borings with water and estimating permeability of near surface soils by measuring the drop in water elevation in the hole over time. The results of the field permeability testing are presented in Appendix F.

A key for soil classification and a legend for the logs of test borings are presented in Figures A1-1a and A1-1b. The boring logs are attached at the end of this Appendix.

A1.3 CONE PENETRATION TESTS (CPT)

Thirty one (31) cone penetration test (CPT) soundings were conducted at the site on from September 13, 2012 to October 15, 2012. The CPT soundings were generally advanced to depths ranging from 48 to 71.5 feet below existing grade. Two CPT locations in Area B (B-CPT029 and B-CPT042) encountered refusal at shallow depths, and had to be abandoned. In addition, B-CPT046 encountered shallow refusal at at a depth of 6 feet after making several attempts for advancement in adjacent locations. The CPT soundings were performed in general accordance with ASTM D3441, using a truck-mounted electric piezocone penetrometer. The locations of the soundings are shown in Figure 3 in the main body of the report.

CPTs are advanced from the ground surface with a truck-mounted hydraulic ram that pushes a steel rod with a conical tip and a cylindrical friction-sleeve into the ground. The conical tip has a 60-degree apex angle and a projected cross-sectional area of 1.55 square inches. The cylindrical friction sleeve has a surface area of 23.25 square inches. Both the tip and the sleeve have outside diameters of 1.4 inches.

As the rod is advanced, electronic instruments measure and record both the tip resistance and the frictional resistance on the sleeve. The tip and frictional resistance are then analyzed, using available correlations, to estimate soil classification, density, strength, and compressibility of the subsurface materials. Unlike soil borings, in which drive samples are typically taken at discrete intervals, the CPT provides a continuous record of soil properties with depth. Hence, the CPT can define the subsurface soil profile with much higher resolution than a soil boring, often detecting thin layers that are easily missed with conventional drilling and sampling.

Using a Seismic CPT test setup, Shear Wave Velocity measurements were performed in seven (7) of the CPTs to a maximum depth of 70 feet. The measurements were generally obtained in 5-foot intervals. The test involves generating large amplitude shear waves by striking a seismic beam at ground surface, and recording shear waves using a built-in seismometer in the cone penetrometer at various depths. The results of the seismic shear wave velocity measurements are presented in Appendix F.

The CPT logs and interpretations are presented at the end of this Appendix.

A1.4 LIST OF THE ATTACHED TABLE AND FIGURES

The following table and figures are attached and complete this appendix:

Table A1-1	Field Exploration Summary
Figure A1-1a	Key for Soil Classification
Figure A1-1b	Legend of CPT Interpretation Input
Figure A1-1c	Boring Log Legend
Figures A1-2 to A1-35	Boring Logs
Figures A1-36 to A1-66	CPT Logs

TABLE A1-1
FIELD EXPLORATION SUMMARY

Exploration No.	Date Performed	Ground Surface Elevation (feet, NAVD)	Total Depth (feet)	Exploration Type
A-CPT001	10/15/12	17.8	70	Cone Penetration Test
A-RW002	10/5/12	17.8	71.5	Rotary Wash Boring
A-RW003	9/21/12	19	71.5	Rotary Wash Boring
A-CPT004	10/15/12	17	68	Cone Penetration Test
A-RW005	10/9/12	17	71	Rotary Wash Boring
A-RW006	9/13/12	15.3	71.5	Rotary Wash Boring
A-CPT007	9/24/12	15.3	57	Cone Penetration Test
A-RW008	9/27/12	15.7	65	Rotary Wash Boring
A-RW009	9/27/12	17.1	61.5	Rotary Wash Boring
A-CPT010	9/24/12	16	51	Cone Penetration Test
A-RW011	9/28/12	13	56.5	Rotary Wash Boring
A-CPT012	9/24/12	13.8	48	Cone Penetration Test
A-RW013	9/26/12	13.8	56.5	Rotary Wash Boring
A-CPT014	9/24/12	16	51	Cone Penetration Test
A-RW015	10/2/12	17.1	61.5	Rotary Wash Boring
A-HSA016	10/10/12	15.7	18	Hollow Stem Auger Boring
A-HSA017	10/10/12	14.3	16.5	Hollow Stem Auger Boring
A-HSA018	10/10/12	14.2	21.5	Hollow Stem Auger Boring
A-CPT019	9/24/12	16.8	68	Cone Penetration Test
A-RW020	10/3/12	15.4	71.5	Rotary Wash Boring
A-CPT021	9/24/12	16.6	59	Cone Penetration Test
A-CPT022	9/26/12	19	59	Cone Penetration Test
A-RW023	10/3/12	19	65.9	Rotary Wash Boring
A-CPT024	9/24/12	16.9	55	Cone Penetration Test
A-CPT025	9/26/12	20	65	Cone Penetration Test
A-HSA064	10/15/12	17.2	19	Hollow Stem Auger Boring
A-CPT065	9/26/12	20.5	63	Cone Penetration Test
A-HSA066	10/15/12	21.1	21.5	Hollow Stem Auger Boring
A-HSA067	10/10/12	12.2	16.5	Hollow Stem Auger Boring
B-CPT026	9/14/12	13	52	Cone Penetration Test
B-RW027	9/24/12	13	71.5	Rotary Wash Boring
B-RW028	10/22/12	5	5	Hand Auger Boring
B-RW030	10/4/12	6.1	41.5	Rotary Wash Boring
B-CPT031	10/10/12	6	69	Cone Penetration Test
B-RW032	9/14/12	8.2	71.5	Rotary Wash Boring
B-RW033	9/12/12	6.3	71.5	Rotary Wash Boring
B-CPT034	9/13/12	6	63	Cone Penetration Test
B-CPT035	9/13/12	7.4	67	Cone Penetration Test
B-RW036	9/17/12	9.1	71.5	Rotary Wash Boring
B-CPT037	9/13/12	5	70	Cone Penetration Test
B-CPT038	9/13/12	8.4	68	Cone Penetration Test
B-CPT039	9/17/12	8.2	71	Cone Penetration Test
B-CPT040	10/15/12	6.9	59	Cone Penetration Test
Continued				

TABLE A1-1
FIELD EXPLORATION SUMMARY (CONTINUED)

Exploration No.	Date Performed	Ground Surface Elevation (feet, NAVD)	Total Depth (feet)	Exploration Type
B-RW041	9/20/12	6.8	66.5	Rotary Wash Boring
B-RW043	9/19/12	8.8	66.5	Rotary Wash Boring
B-RW044	9/19/12	9.2	66.5	Rotary Wash Boring
B-CPT045	9/13/12	9	60	Cone Penetration Test
B-CPT046	10/15/12	10.6	6	Cone Penetration Test
B-RW047	9/18/12	11.5	66.5	Rotary Wash Boring
B-CPT048	10/15/12	11	63	Cone Penetration Test
B-RW049	10/1/12	17.6	69	Rotary Wash Boring
B-CPT050	9/14/12	20.2	64	Cone Penetration Test
B-HSA051	10/16/12	6.3	21.5	Hollow Stem Auger Boring
B-CPT052	9/14/12	12	70	Cone Penetration Test
B-RW053	9/24/12	13.7	71.5	Rotary Wash Boring
B-CPT054	9/14/12	15.3	70	Cone Penetration Test
B-RW055	9/25/12	16.3	71.5	Rotary Wash Boring
B-CPT056	9/14/12	15.4	70	Cone Penetration Test
B-CPT057	9/14/12	14.6	70	Cone Penetration Test
B-RW058	9/25/12	15	71.5	Rotary Wash Boring
B-CPT059	9/14/12	18.7	70	Cone Penetration Test
C-CPT060	10/10/12	14.6	49	Cone Penetration Test
C-HSA061	10/16/12	16	31.5	Hollow Stem Auger Boring
C-CPT062	10/10/12	23	57	Cone Penetration Test
C-CPT063	10/10/12	23.2	55	Cone Penetration Test

KEY FOR SOIL CLASSIFICATION

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D-2487)				
PRIMARY DIVISIONS			***GROUP SYMBOL***	***SECONDARY DIVISIONS***
COARSE GRAINED SOILS (less than 50% fines passing the No. 200 Sieve)	GRAVEL (% GRAVEL > % SAND)	CLEAN GRAVEL (Less than 5% fines)	GW	Well-graded gravel, gravel with sand, little or no fines
			GP	Poorly-graded gravel, gravel with sand, little or no fines
		"DIRTY" GRAVEL (More than 12% fines)	GM	Silty gravel, silty gravel with sand, silty or non-plastic fines
			GC	Clayey gravel, clayey gravel with sand, clayey or plastic fines
	SAND (% SAND ≥ % GRAVEL)	CLEAN SAND (Less than 5% fines)	SW	Well-graded sand, sand with gravel, little or no fines
			SP	Poorly-graded sand, sand with gravel, little or no fines
		"DIRTY" SAND (More than 12% fines)	SM	Silty sand, silty sand with gravel, silty or non-plastic fines
			SC	Clayey sand, clayey sand with gravel, clayey or plastic fines
FINE GRAINED SOILS (50% or more fines passing the No. 200 Sieve)	SILTS AND CLAYS (Liquid Limit less than 50)		ML	Inorganic silt, sandy silt, gravelly silt, or clayey silt with low plasticity
			CL	Inorganic clay of low to medium plasticity, sandy clay, gravelly clay, silty clay, Lean Clay
			OL	Low to medium plasticity Silt or Clay with significant organic content (vegetative matter)
	SILTS AND CLAYS (Liquid Limit 50 or more)		MH	Inorganic elastic silt, sandy silt, gravelly silt, or clayey silt of medium to high plasticity
			CH	Inorganic clay of high plasticity, Fat Clay
			OH	Medium to high plasticity Silt or Clay with significant organic content (vegetative matter)
HIGHLY ORGANIC SOILS			PT	Peat or other highly organic soils

Note: Dual symbols are used for coarse grained soils with 5 to 12% fines (ex: SP-SM), and for soils with Atterberg Limits falling in the CL-ML band in the Plasticity Chart. Borderline classifications between groups may be indicated by two symbols separated by a slash (ex: CL/CH, SW/GW).

CONSISTENCY CLASSIFICATION				
COARSE GRAINED SOILS		***FINE GRAINED SOILS***		
Blowcount SPT[1] (CAL)[2]	Consistency	Blowcount[3] SPT[1] (CAL)[2]	Consistency	Undrained Shear Strenth[3], S_u (ksf)
0-4 (0-6)	Very Loose	<2 (<3)	Very Soft	< 0.25
		2-4 (3-6)	Soft	0.25 -0.50
5-10 (7-15)	Loose	5-8 (7-12)	Medium Stiff	0.50 - 1.0
11-30 (16-45)	Med. Dense	9-15 (13-22)	Stiff	1.0 - 2.0
31-50 (46-75)	Dense	16-30 (23-45)	Very Stiff	2.0 - 4.0
>50 (>75)	Very Dense	>31 (>45)	Hard	> 4.0

MOISTURE CLASSIFICATION
DRY - Absence of moisture, dusty, dry to the touch **MOIST-** Damp but no visible water **WET-** Visible free water, usually soil is below water table

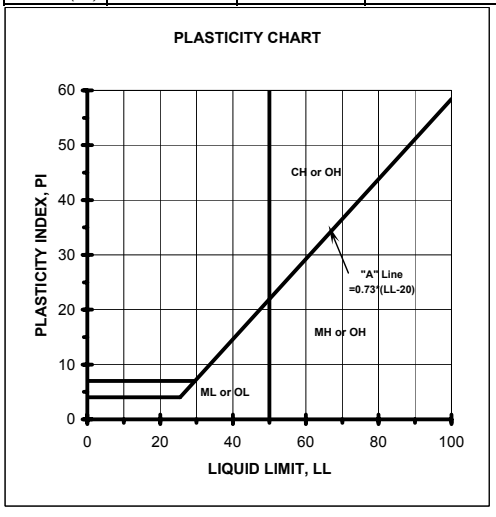
CONSISTENCY NOTES:

1. Number of blows of a 140-lb. hammer falling 30-inches to drive a 2-inch OD (1.375-inch ID) **SPT Sampler** [ASTM D-1585] the final 12-inches of driving
2. Number of blows of a 140-lb. hammer falling 30-inches to drive a 3-inch OD (2.42-inch ID) **California Ring Sampler** the final 12-inches of driving.
3. Undrained shear strength of cohesive soils predicted from field blowcounts is generally unreliable. Where possible, consistency should be based on S_u data from pocket penetrometer, torvane, or laboratory testing.

CLASSIFICATION CRITERIA BASED ON LABORATORY TESTS

Grain Size Classification

CLAY AND SILT	SAND			GRAVEL		COBBLES		BOULDERS	
	Fine	Medium	Coarse	Fine	Coarse				
US Std Sieve	**No. 200**	**No. 40**	**No. 10**	**No. 4**	**3/4"**	**3"**		**12"**		
Grain Size (mm)	0.075	0.425	2	4.75	19.1	76.2		304.8		



Classification of earth materials shown on the logs is based on field inspection and should not be construed to imply laboratory analysis unless so stated.

Granular Soil Gradation Parameters

Coefficient of Uniformity: $C_u = D_{60} / D_{10}$

Coefficient of Curvature: $C_C = (D_{30})^2 / (D_{10} \times D_{60})$

D_{10}= 10% of the soil is finer than this diameter

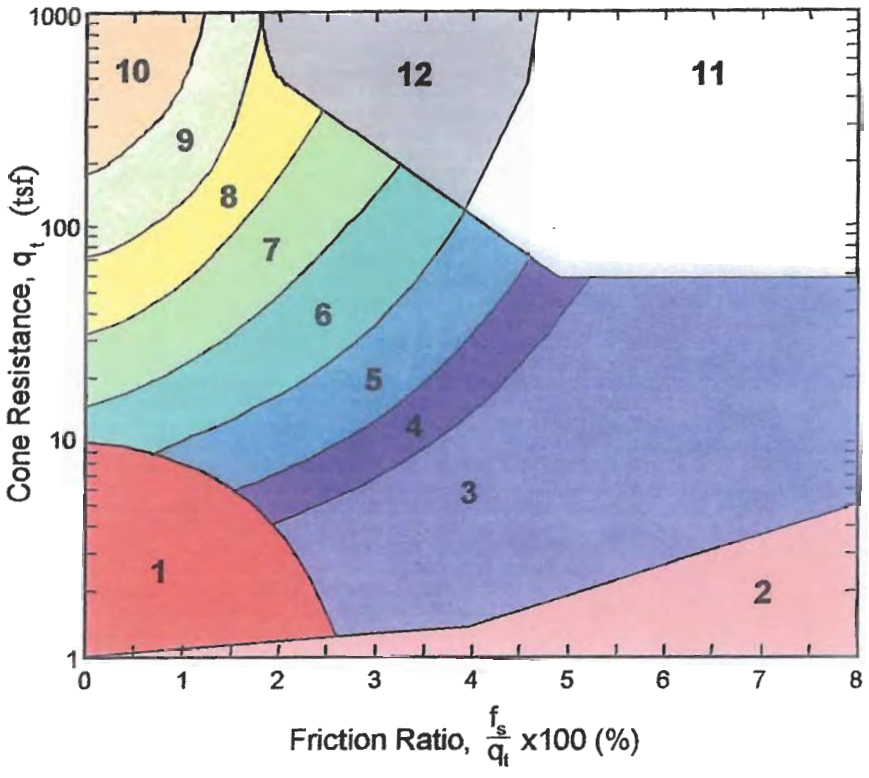
D_{30}= 30% of the soil is finer than this diameter

D_{30}= 60% of the soil is finer than this diameter

Group Symbol	Gradation or Plasticity Requirement
SW	C_u>6 and C_c between 1 and 3
GW	C_u>4 and C_c between 1 and 3
GP or SP	Clean gravel or sand not meeting requirement for GW or SW
GM or SM	Plots below "A" Line on Plasticity Chart or PI < 4
GC or SC	Plots above "A" Line on Plasticity Chart and PI > 7

FIGURE A1-1a

CPT Soil Behavior Type Legend
(Robertson et al. 1986)



Zone	Soil Behavior Type
1	Sensitive, Fine Grained
2	Organic Material
3	Clay
4	Silty Clay to Clay
5	Clayey Silt to Silty Clay (Silt Mix)
6	Sandy Silt to Clayey Silt
7	Silty Sand to Sandy Silt (Sand Mix)
8	Sand to Silty Sand
9	Sand
10	Gravelly Sand to Sand
11	Very Stiff Fine Grained*
12	Sand to Clayey Sand*

*Overconsolidated or cemented

Figure A1-1b

LOG OF TEST BORING

PROJECT NAME Ballona Wetlands		**PROJECT NUMBER** LA-962A	**BORING** **LEGEND**
SITE LOCATION Marina Del Rey, CA	**START**	**FINISH**	**SHEET NO.** 1 of 1
DRILLING COMPANY Cascade	**DRILLING METHOD** Rotary Wash	**LOGGED BY** NB	**CHECKED BY** PK
DRILLING EQUIPMENT CME 85	**BORING DIA. (in)** 3.875"	**TOTAL DEPTH (ft)**	**GROUND ELEV (ft)**
SAMPLING METHOD SPT & Cal. Mod.	**NOTES**		**DEPTH/*ELEV.* GROUND WATER (ft)** ▼ / *na*

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	% PASSING #200	ATTERBERG LIMITS LL:PL:PI	POCKET PEN (tsf)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
5			B-1									
10			R-2									
15			S-3									
20												

BULK, CAL, SPT - Refers to the sampling method as described below

BULK - Refers to collecting sample by method of placing disturbed soil cuttings into a large plastic bag

CAL (CALIFORNIA MODIFIED) - A 3.0" o.d. split tube sampler lined with 2.42" i.d. metal sample rings generally driven into the soil by a 140 lbs. hammer free falling 30 inch

SPT (STANDARD PENETRATION TEST) - A 2.0" o.d. split spoon sampler with a 1.375" i.d. driven into the soil with a 140# hammer free falling a height of 30"

ABBREVIATIONS FOR OTHER TESTS:

AL = Atterberg Limits	GS = Grain Size Analyses
CN = Consolidation	PP = Pocket Pen
CO = Corrosivity	RV = R-Value
CP = Laboratory Compaction	WA = Wash on #200 Sieve
DS = Direct Shear	EI = Expansion Index
LL = Liquid Limit	TV = Torvane

GDC_LOG_BORING_1A_LA2_L-675 PRODUCT 425.GPJ GDCLOG.GDT 11/17/11

GROUP DELTA CONSULTANTS, INC.
370 Amapola Avenue, Suite 212
Torrance, CA 90501

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.=

Figure A1-1c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW002**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/5/2012	10/5/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	17.8	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	15													**Artificial Fill (af)**
5														**Silty Sand (SM)**, brown, dry to moist, fine to coarse grained sand, little oxidation, trace organics.
			S-1	1 1 2	3									**Alluvium (Qa)**
	10													**Sandy Silt (ML)**, gray, moist, soft, fine to medium grained sand, low plasticity.
10														**Sandy Gravel (GP)**, gray, moist to wet, medium dense, medium to coarse grained sand, fine to coarse gravel, trace shells.
			R-2	4 8 10	18	15								
	5													
15														-Loose, trace coarse gravel.
			S-3	2 5 5	10									**Sandy/Gravely Clay (CL)**, gray, moist, coarse grained sand, trace fine to coarse gravel, low to medium plasticity.
	0													
20														
	-5													**Sandy Silt (ML)**, gray, fine grained sand, H2S odor.

GDC_LOG_BORING_2011 L-962_PART 1.GPJ GDCLOG.GDT 1/24/13

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THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE
A1-2 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW002**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/5/2012	10/5/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	17.8	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			B-4					65			PA			Driller having problems keeping hole open due to caving from gravel material. Drilled to reach more clayey material to thicken mud.
	-10													
30														
	-15													
35			S-5	1 1 2	3			74			PA			**Sandy Silt (ML)**, gray, moist, soft, fine grained sand, low plasticity, trace shell fragments, trace organics, H2S odor.
	-20													
40			R-6	3 3 3	6	42	78			1.25	DS			**Clayey Silt (ML)**, gray, moist, soft, low to medium plasticity, trace oxidation.
	-25													**Silty Sand (SM)**, gray, moist, very loose, fine grained sand.
45			S-7	5 1 1	2			49			PA			**Clayey Silt (ML)**, gray, moist, low plasticity, trace shell fragments, trace oxidation.
	-30													

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FIGURE
A1-2 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW002**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/5/2012	10/5/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	17.8	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			R-8	5 7 8	15	22	106			1.0				-Loose, fine to medium grained sand, low plasticity, trace oxidation.
	-35													**Silty Sand (SM)**, gray, wet, loose, fine to medium coarse grained sand, trace fine gravel.
55			S-9	8 5 4	9					1.5				**Sandy Silt (ML)**, gray, moist, stiff, fine grained sand, low to medium plasticity.
	-40													
60			R-10	5 7 16	23	27	90			1.5				-Trace organics.
	-45													
65			S-11	27 22 22	44									**Sand (SP)**, gray, wet, dense, fine to coarse grained sand, trace fine gravel.
	-50													
70			S-12	3 6 7	13	34								**Lean Clay (CL)**, gray, moist, stiff, low to medium plasticity, trace organics. Note: Few fine grained sand in tip of sampler.
	-55													Boring terminated at 71.5 ft. Groundwater not measured. Hole backfilled with bentonite grout.

GDC_LOG_BORING_2011 L-962_PART 1.GPJ GDCLOG.GDT 1/24/13

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Torrance, CA 90501

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE
A1-2 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW003**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/21/2012	9/21/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	19	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			B-1											**Artificial Fill (af)** **Sand (SP)**, brown, dry, loose, little roots, trace fine to coarse gravel. -Increase in density, no roots.
	15													
5			S-2	4 2 1	3			16			PA			**Silty Sand (SM)**, brown, wet, very loose, fine grained sand, trace medium grained sand, no plasticity.
	10													
10			SH-3			23	99				DS			-Gray, fine to medium grained sand, few shell fragments.
	5													**Sandy Silt (ML)**, gray, wet, medium stiff, fine grained sand, low plasticity, trace shell fragments.
15			S-4	1 3 2	5									
	0													**Alluvium (Qa)** **Silty Clay (CL)**, gray, moist, fine grained sand, trace oxidation. Vane Shear = 0.5 ksf
20			SH-5			54	71		40:21	0.35				
	-5													**Silty Sand (SM)**, gray, wet, very loose, fine grained sand, trace shell fragments, slight H2S odor.

GDC_LOG_BORING_2011 L-962_PART 1.GPJ GDCLOG.GDT 1/24/13

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FIGURE
A1-3 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW003**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/21/2012	9/21/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	19	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-6	2 1 1	2									
	-10													**Sandy Silt (ML)**, gray, moist, soft, low to medium plasticity, little shell fragments.
30			SH-7			37	85			0.25	C DS			Vane Shear = 1.4 ksf
	-15													**Sandy Clay (CL)**, gray, moist, very soft, fine grained sand, medium plasticity, few organics, trace fine rootlets, trace shell fragments, H2S odor.
35			S-8	0 0 1	1				47:28					
	-20													
40			S-9							0.25				-No rootlets, no H2S odor.
	-25													
45			R-10	2 4 5	9									-No recovery, firm.
			R-11	5 7 9	16					0.75				**Fat Clay (CH)**, gray, moist, medium stiff, high plasticity, trace shell fragments.
	-30													**Clay with Sand (CL)**, gray, moist, stiff, fine grained sand,

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FIGURE
A1-3 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW003**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/21/2012	9/21/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	19	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-12	2 5 6	11					1.75				medium plasticity.
	-35													
55			SH-13			32	89		34:11	0.5				**Lean Clay (CL)**, gray, wet, medium stiff, few fine grained sand, medium plasticity. Vane shear = 0.9 ksf
	-40													**Clayey Sand (SC)**, gray, wet, medium dense, fine grained sand, trace medium grained sand, trace organics.
60			S-14	8 14 16	30									
	-45													**Sandy Clay (CL)**, gray, wet, medium stiff, fine grained sand, medium, some tree roots up to ~1/2" in diameter and over 2.5" long. Vane shear = 0.37 ksf
65			R-15	3 5 6	11	30	89		29:8					
	-50													
70			S-16	2 3 6	9	34				0.25				**Lean Clay (CL)**, gray, moist, stiff, medium plasticity, trace fine grained sand, trace roots, trace calcite.
	-55													Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

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FIGURE
A1-3 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW005**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/9/2012	10/9/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71	17	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														Asphalt
	15													**Artificial Fill (af)** **Lean Clay (CL)**, olive brown, moist, medium stiff, trace fine grained sand, medium plasticity, few sea shells.
5			R-1	3 5 5	10	30	89				C DS			
	10													
10			S-2	0 0 0	0									**Alluvium (Qa)** **Silty Sand (SM)**, gray, wet, very loose, fine grained sand, few shell fragments.
	5													**Silt (ML)**, gray, wet, soft, trace fine grained sand, none to low plasticity, trace sea shells, trace rootlets.
15			R-3	2 2 3	5	45	77				C			
	0													**Silty Sand (SM)**, mottled gray and orangish brown, wet, very loose, fine grained sand, none to low plasticity, some oxidation, trace sea shells.
20			S-4	2 1 3	4			28			PA			
	-5													**Sand (SP)**, gray, wet, medium dense, fine grained sand, trace fines.

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FIGURE
A1-4 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW005**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/9/2012	10/9/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71	17	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			R-5	12 14 8	22	28	94							
	-10													
30			S-6	0 0 1	1	81			92:51	0.25				**Fat Clay (CH) or Organic Matter (OH)** gray, moist, very soft, high plasticity, laminations of fine shell fragments, H2S odor.
	-15													
35			R-7	0 0 3	3	64	63				DS			-Soft, trace shell fragments. Vane shear = 0.32 ksf
	-20													
40			S-8	4 5 10	15			41			PA			**Silty Sand (SM)**, gray, wet, medium dense, fine grained sand.
	-25													**Clayey Silt (ML)**, gray, moist, medium stiff, few fine grained sand, low plasticity.
45			R-9	4 6 7	13	34	88			0.75				**Fat Clay (CH)**, gray, moist, high plasticity.
	-30													**Silty Clay (CL)**, gray, moist, firm, few fine grained sand, medium plasticity.

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FIGURE
A1-4 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW005**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/9/2012	10/9/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71	17	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-10	1 3 4	7	28				0.75				
	-35													
55			R-11	2 3 5	8									-Little recovery with sand catcher.
	-40													
60			S-12	0 1 2	3	38				0.25				-Wet, soft, trace fine grained sand, trace wood fibers, trace fine rootlets.
	-45													
65			R-13	6 7 10	17									-Stiff.
	-50													
														Sand (SP), gray, wet, very dense, fine grained sand, trace fines, one gravel in tip of sampler.
70			S-14	40 50/5"	REF									
	-55													Boring terminated at 71 ft. Groundwater not measured. Boring backfilled with bentonite grout.

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FIGURE
A1-4 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW006**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/13/2012	9/13/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	15.3	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	15		B-1											**Artificial Fill (af)** **Silty Clay w/ Sand (CL)**, brown, dry, fine grained sand, low plasticity, trace shell fragments, trace fine gravel.
5	10		R-2	14 50/3"	100	6	88	54			DS PA			**Sandy Silt (ML)**, brown, dry, hard, fine grained sand, with hard dark gray clay seams. trace of gravel and cobbles
10	5		S-3	4 7 7	14			30			PA			**Silty Sand with Clay (SM)**, brown, moist, medium dense, fine grained sand, trace roots.
15	0		R-4	1 2 3	5	16	106							-Wet, very loose.
														Alluvium (Qa) **Silty Clay (CL)**, gray, wet, soft, trace oxidation, micaceous.
20	-5		S-5	1 1 2	3				50:23					**Clayey Sand (SC)**, gray, wet, loose, fine grained sand, few oxidation, trace shell fragments, low plasticity.

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FIGURE
A1-5 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW006**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/13/2012	9/13/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	15.3	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-10		SH-6			33	87	32			PA			-Shelby tube disturbed ~2" remain.
30	-15		S-7	11 15 8	23									-Medium dense, trace organics.
35	-20		SH-8			68	65		64:31		C			**Clayey Silt (MH)** with laminations of light gray silt and light brown silt, gray, wet, trace fine grained sand, few shell fragments, strong H2S odor (~7ppm on gas meter), high plasticity. Vane Shear = 0.65 ksf
40	-25		S-9			57			53:24					**Silty Clay (CH)**, gray, wet, soft, little shell fragments and sea shells, strong H2S odor, micaceous, high plasticity.
45	-30		SH-10			27	99							**Silty Sand (SM)**, gray, wet, medium dense, fine grained sand, trace sea shells.
														Silty Clay (CL), gray, moist, medium stiff, low to medium plasticity.

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FIGURE
A1-5 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW006**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/13/2012	9/13/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	15.3	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-35		S-11	0 5 5	10				44:21	0.5				
55	-40		SH-12			25	100							**Silty Sand (SM)**, gray, wet, fine grained sand.
60	-45		S-13	1 6 9	15				48:24	1.25				**Silty Clay (CL)**, gray, wet, stiff, low to medium plasticity, trace shell fragments, micaceous.
65	-50		SH-14											**Poorly Graded Sand (SP)**, gray, wet, fine to medium grained sand.
														Sandy Clay (CL), gray, moist, stiff, fine grained sand, medium plasticity, trace organics.
70	-55		S-15	6 7 17	24				32:13	1.25				
														Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

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FIGURE
A1-5 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW008**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/27/2012	9/28/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	65	15.7	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	15													**Artificial Fill (af)**
														Silt with Sand (ML), gray, dry, fine grained sand, no plasticity, trace organics.
5														**Elastic Silt (MH)**, gray, moist, trace fine grained sand, high plasticity.
	10		S-1	4 7 12	19			88			PA			**Sand (SP)**, brown, medium dense, fine grained sand, trace coarse grained sand, trace fine gravel.
10														**Alluvium (Qa)**
	5		R-2	2 3 2	5	32	83		48:25	1.25	DS			**Sandy Clay (CL)**, gray, wet, stiff, fine grained sand, medium plasticity, micaceous.
15														
	0		S-3	0 0 0	0					0.25				-Very soft, trace organics, slight H2S odor.
20														
	-5		SH-4											-No recovery.
														Fat Clay (CH), gray, wet, very soft, trace fine grained sand, high plasticity, shell fragments, H2S odor.

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FIGURE
A1-6 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW008**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/27/2012	9/28/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	65	15.7	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-10		R-5	0 0 1	1	63	64		50:23	0.25				
30	-15		SH-6			61	63		68:34	0.25	C			**Elastic Silt (MH)**, gray, wet, high plasticity, trace shell fragments, H2S odor. Vane Shear = 0.6 ksf
35	-20		R-7	1 1 3	4	50	71			0.25				-Soft.
40	-25		SH-8											-No recovery.
			S-9	2 2 2	4					0.25				-Moist, very soft.
45	-30		R-10	2 3 4	7	44	74		54:26	0.25				**Fat Clay (CH)**, gray, soft, wet, trace fine grained sand, high plasticity.

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FIGURE
A1-6 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW008**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/27/2012	9/28/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	65	15.7	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-35		S-11	3 2 2	4					0.25				-Moist, trace organics.
														Silty Sand (SM), gray, wet, very loose, fine to medium grained sand, trace organics.
55	-40		R-12	7 12 14	26	211	24							**Peat (PT)** , brown, moist.
60	-45		S-13	13 19 22	41									**Sand with Silt (SP-SM)**, gray, wet, fine to medium grained sand, trace coarse grained sand, trace fine gravel, trace organics, trace seams of silt.
65	-50		S-14											**Sand with Gravels (SP)**, gray, wet, fine to coarse grained sand, fine to coarse gravel. NOTE: Hole kept collapsing, most of sample (S-14) was collapsed soil, blow counts not accurate. Boring terminated at 65 ft. Groundwater not measured. Boring backfilled with bentonite grout.
70	-55													

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FIGURE
A1-6 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW009**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/27/2012	9/27/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	61.5	17.1	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	15													**Artificial Fill (af)** **Silt with Sand (ML)**, gray, dry, fine grained sand, no plasticity, few shell fragments, trace organics.
5			R-2	2 2 4	6	23	89	29			PA			**Silty Sand (SM)**, gray and olive brown, moist, very loose, fine grained sand, no plasticity, few oxidation, trace shell fragments, micaceous.
	10													
10			S-3	0 0 0	0			76			PA			**Alluvium (Qa)** **Sandy Silt (ML)**, gray, wet, very soft, fine grained sand, none to low plasticity.
	5													
15			SH-4			40	83							-Trace oxidation, highly micaceous.
	0													
														Silty Sand (SM), gray, wet, loose, fine grained sand, little oxidation.
20			R-5	4 4 4	8	35	79							
	-5													
														Fat Clay (CH), gray, moist, very soft, high plasticity, H2S odor, trace organics.

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FIGURE
A1-7 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW009**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/27/2012	9/27/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	61.5	17.1	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-6	0 0 0	0				56:36					
	-10													
30			SH-7			48	73							-Soft, trace fine grained sand, no organics, trace shell fragments. Vane Shear = 0.6 ksf
	-15													
35			R-8	0 1 2	3	56	65			0.25				-Very soft, no fine grained sand.
	-20													
40			SH-9			28	94	47			PA			**Silty Sand (SM)**, gray, moist, fine grained sand, micaceous, few blebs of lightly cemented Sandy Silt.
	-25													
45			S-10	3 3 3	6					1.25				**Fat Clay (CH)**, gray and dark grayish brown, moist, stiff, few fine grained sand, medium plasticity.
	-30													

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FIGURE
A1-7 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW009**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/27/2012	9/27/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	61.5	17.1	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			SH-11			106	44		72:34	1.0				-Gray, wet, stiff, high plasticity, some organics.
	-35													
55			S-12	5 27 35	62									**Silty Sand (SM)**, gray, wet, very dense, fine grained sand, few organics. -Fine to coarse grained sand, fine to coarse gravel.
	-40													
60			S-13	23 27 24	51									**Sand (SP)**, gray, wet, very dense, fine to medium grained sand, trace fine to coarse gravel.
	-45													Boring terminated at 61.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
65														
	-50													
70														
	-55													

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FIGURE
A1-7 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW011**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/28/2012	9/28/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	56.5	13	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			B-1											**Artificial Fill (af)**
														Silt with Sand (ML), gray, dry, fine grained sand, no plasticity, trace organics.
	10													
5			R-2	1 1 1	2	29	88		28:1		C			**Sandy Silt (ML)**, gray, wet, very soft, fine grained sand, low to medium plasticity.
	5													
10			S-3	1 1 2	3									-Soft, trace fine grained sand, trace oxidation, trace roots, micaceous.
	0													
15			R-4	2 2 2	4	41	74		62:33					**Fat Clay (CH)**, gray, wet, soft, high plasticity, some oxidation, trace roots, micaceous. Vane Shear = 0.25 ksf
	-5													
20			S-5	0 0 0	0				66:36					-Trace fine grained sand, trace sea shells, trace organics, slight H2S odor.
	-10													

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FIGURE
A1-8 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW011**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/28/2012	9/28/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	56.5	13	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			SH-6						63:35					-Few fine grained sand.
	-15													
30			R-7	2 4 8	12	24	96			0.75				-Moist, medium stiff, trace fine grained sand.
	-20													
35			S-8	1 6 3	9					0.25				-Soft, trace blebs of lightly cemented soil.
	-25													**Clayey Sand (SC)**with Silt seams, gray, wet, medium dense, fine grained sand, trace medium to coarse grained sand.
40			R-9	9 12 17	29	23	102							
	-30													**Silty Clay (CH)**, gray, moist, medium stiff, trace fine grained sand, high plasticity, some organics.
45			S-10	0 2 4	6				58:30	0.5				
	-35													**Silty Sand (SM)**, gray, moist, dense, fine to coarse grained sand, few fine to coarse gravel, ~40% fines, little organics.

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FIGURE
A1-8 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW011**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/28/2012	9/28/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	56.5	13	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			R-11	3 12 50	72	18								
	-40													
55			S-12	17 22 29	41									-No organics, decrease in fines.
	-45													Boring terminated at 56.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
60														
	-50													
65														
	-55													
70														
	-60													

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FIGURE
A1-8 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW013**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/26/2012	9/26/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	56.5	13.8	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			B-1											**Artificial Fill (af)** **Silty Sand (SM)**, brown, dry, fine to coarse grained sand, fine to coarse gravel, few organics, trace shell fragments, denser than other locations in Area A.
5	10		R-2	0 4 3	7	20	117							-Loose, no organics, few shell fragments.
	5													**Alluvium (Qa)** **Sandy Silt (ML)**, olive brown, wet, medium stiff, highly micaceous, some oxidation.
10			S-3	3 4 4	8			84			PA			
	0													**Lean Clay (CL)**, olive brown, wet, soft, medium plasticity, highly micaceous, some oxidation. Vane Shear = 0.3 ksf
15			R-4	0 0 2	2	48	71	88	47:20		C PA			
	-5													**Fat Clay (CH)**, gray, wet, soft, few fine grained sand, high plasticity, trace shell fragments, H2S odor.
20			S-5	0 1 1	2				56:28					
	-10													

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FIGURE
A1-9 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW013**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/26/2012	9/26/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	56.5	13.8	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			SH-6								C			-No recovery.
	-15													**Lean Clay (CL)**, gray, wet, medium stiff, trace coarse grained sand, medium plasticity. NOTE: Increase in stiffness at bottom.
30			R-7	5 5 6	11	15	115		34:16					Vane Shear = 1.2 ksf
	-20													**Silty Sand (SM)**, gray, wet, loose, fine grained sand, trace fine gravel.
35			S-8	3 3 3	6									
	-25													Interbedded layers of Fat Clay (CH) and Silt (ML): **Fat Clay (CH)**, gray, moist, stiff, medium to high plasticity, and; **Silt (ML)**, gray, wet, stiff, trace fine grained sand, medium plasticity.
40			R-9	4 4 6	10	57	69			1.25				
	-30													
45			S-10	3 3 4	7									**Peat (PT)**, brown, moist, firm, 4" layer of **Fat Clay (CH)**, tree stump or branch >3".
	-35													**Sand with Silt (SP-SM)**, gray, wet, dense, fine to medium grained sand, trace organics (wood fibers).

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FIGURE
A1-9 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW013**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/26/2012	9/26/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	56.5	13.8	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			R-11	22 27 35	62	21	104							
	-40													**Sand with Gravel (SP)**, gray, wet, dense, fine to medium grained sand, few coarse grained sand, fine to coarse gravel, trace clay.
55			S-12	15 24 25	49									
														Boring terminated at 56.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
	-45													
60														
	-50													
65														
	-55													
70														
	-60													

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FIGURE
A1-9 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW015**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/2/2012	10/2/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa/J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	61.5	17.1	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	15		B-1											**Artificial Fill (af)** **Silty Sand (SM)**, brown, dry, fine to coarse grained sand, few fine to coarse gravels, trace cobble, little sea shells, little rootlets/branches.
5			S-2	1 4 4	8									-Dark gray to brown, moist, loose, fine to medium grained sand, low to medium plasticity, trace shell fragments, little oxidation.
	10													
10			R-3	2 4 5	9	27			57:35	0.75				**Alluvium (Qa)** **Fat Clay (CH)**, dark gray to brown, moist, stiff, fine grained sand, high plasticity, little medium grained sand. Vane Shear = 1.1 ksf
	5													
15			S-4	1 2 3	5			43			PA			**Clayey Sand (SC)**, gray with mottled brown, moist, loose, fine grained sand, some oxidation, micaceous.
	0													
20			R-5	5 4 3	7	43	78				DS			-Wet, low plasticity, large shell fragments.
	-5													**Silty Clay (CL)**, gray, moist, medium stiff, trace fine grained sand, medium plasticity, H2S odor.

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FIGURE
A1-10 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW015**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/2/2012	10/2/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa/J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	61.5	17.1	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-6	0 1 2	3					0.75				
	-10													
30			SH-7											-Moist, fine to medium grained sand.
	-15													**Sand with Silt (SP-SM)**, gray, wet, medium dense, fine to coarse grained sand.
			R-8	13 18 18	36	25	107				DS			
35														**Silt (ML)** , gray, wet, soft, trace fine grained sand, none to low plasticity, ~3" layer of **Sand with Silt (SM)**
			S-9	4 5 6	11			63		0.25	PA			
	-20													
40			R-10	3 4 4	8	25								**Sandy Silt (ML)**, gray, wet, firm, fine grained sand, trace coarse grained sand, low plasticity.
	-25													
45			S-11	1 4 5	9				57:29	0.5				**Fat Clay (CH)**, gray, moist, medium stiff, high plasticity, some organics.
	-30													**Silty Sand (SM)**, gray, moist to wet, medium dense, fine grained sand, trace organics.

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FIGURE
A1-10 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW015**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/2/2012	10/2/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa/J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	61.5	17.1	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			R-12	9 15 15	30	25	100	44		0.5	PA			
	-35													**Sand (SP)**, gray, wet, very dense, fine to coarse grained sand, few fine subangular gravel.
55			S-13	12 27 27	44									
	-40													
60			S-14	48 40 46	86									-Few fine to coarse gravel.
	-45													Boring terminated at 61.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
65														
	-50													
70														
	-55													

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FIGURE
A1-10 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-HSA016**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/10/2012	10/10/2012	1 of 1

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85 All Terrain	Hollow Stem Auger	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		8	18	15.7	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	15		B-1								CP			**Artificial Fill (af)** **Sandy Silt (ML)**, brown, dry, fine grained sand, little organics.
			R-2	1 2 3	5	25	81	65		2.5	PA			-Very stiff, moist, trace organics, trace oxidation, trace fine rootlets, trace clay seams, trace calcite or salt.
5	10		S-3	2 4 2	6									**Silty Sand (SM)**, light brown, dry, loose, fine grained sand.
			R-4 B-5	1 1 1	2	51	70							**Alluvium (Qa)** **Silty Clay (CL)**, gray, wet, very soft, few fine grained sand, medium plasticity.
10	5		S-6	0 1 3	4	41								**Clay (CL)**, gray, wet, soft, medium plasticity, laminations of silty sand, some organics (wood fibers and rootlets).
			R-7	1 3 4	7	36	85			0.25				**Sandy Silt (ML)**, gray, wet, soft, fine grained sand, no plasticity, few oxidation, trace organics, trace fine rootlets, micaceous.
15	0		S-8	0 0 2	2	41				0.25				-Light gray. **Clay (CL)**, light gray, moist, soft, medium plasticity.
			B-9						37:12					-Gray, wet.
20	-5													Boring terminated at 18 ft. Groundwater not encountered. Boring backfilled with tamped cuttings.

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FIGURE
A1-11

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-HSA017**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/10/2012	10/10/2012	1 of 1

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85 All Terrain	Hollow Stem Auger	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		8	16.5	14.3	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			B-1								CP			**Artificial Fill (af)** **Sandy Silt (ML)**, light brown, dry, fine grained sand, no plasticity, little organics, trace snail shells.
			S-2	0 1 1	2			56			PA			-Brown, moist, soft, low plasticity, little oxidation.
	10													**Silty Sand (SM)**, gray, moist, very loose, fine grained sand.
5			R-3	0 1 1	2	57	64							**Silty Clay (CL)**, gray, wet, soft, medium plasticity.
			B-4											
			S-5	0 0 0	0	49								-Very soft.
	5													
10			R-6	0 2 3	5	37	82	77		0.25	PA			**Silt (ML)**, gray, wet, soft, trace fine grained sand, low plasticity, trace wood fiber. -Soft, little oxidation.
			S-7	0 3 3	6	39								**Silt with Sand (ML)**, mottled gray and orangish brown, wet, medium stiff, some oxidation, trace organics, micaceous.
	0													
15			R-8 B-9	0 0 0	0	48	74			0.25				**Silty Clay (CL)**, mottled gray and orangish brown, wet, soft, some oxidation, trace organics, micaceous.
														Boring terminated at 16.5 ft. Groundwater not encountered. Boring backfilled with tamped cuttings.
	-5													
20														
	-10													

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FIGURE
A1-12

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-HSA018**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/10/2012	10/10/2012	1 of 1

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85 All Terrain	Hollow Stem Auger	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		8	21.5	14.2	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			B-1								CP			**Artificial Fill (af)** **Silt (ML)**, brown, dry, trace fine grained sand, low plasticity, little organics (dry brush).
			S-2	1 1 3	4	6								-Little recovery.
5	10		R-3	3 7 6	13	29	92			2.0				**Silty Clay (CL)**, brown, moist, very stiff, medium plasticity, trace shell fragments, trace calcite, micaceous.
			S-4	3 4 6	10	28				1.5				**Clayey Silt (ML)**, brown, moist, stiff, medium plasticity, trace shell fragments, trace calcite, few oxidation, micaceous.
10	5		R-5	4 7 8	15	23	95	38			PA			**Alluvium (Qa)** Interbedded layers of **Silty Sand (SM) and Silty Clay (CL)**, gray, moist, loose/stiff, fine grained sand, trace fine rootlets in SM, trace organics in CL.
			S-6	1 0 0	0	33			63:32					**Silt (ML)**, gray, wet, very soft, no plasticity, few oxidation, micaceous.
15	0		R-7	1 0 2	2	48	75			0.25				**Fat Clay (CH)**, light gray, moist, very soft, high plasticity, trace sea shells. **Fat Clay (CH)**, gray, wet, soft, few oxidation, trace organics.
			S-8 B-9	0 1 2	3	46								-Trace fine rootlets, micaceous.
20	-5		R-9	0 0 2	2	46	73							**Clayey Silt (ML)**, gray, wet, very soft, few fine grained sand, few shell fragments, H2S odor.
	-10													Boring terminated at 21.5 ft. Groundwater not encountered. Boring backfilled with tampered cuttings.

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FIGURE
A1-13

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW020**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/3/2012	10/3/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	15.4	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	15													**Artificial Fill (af)**
														Silty Clay (CL), brown, moist, oxidation, trace shells.
5														
	10		S-2	1 1 2	3	52				0.5				-Gray, moist, soft, low to medium plasticity.
														Silt (ML), gray, wet, very soft, fine to medium grained sand, none to low plasticity, trace shells.
10														
	5		R-3	1 2 1	3	53	71			0.15				
														Alluvium (Qa)
15														**Silty Clay (CH)**, gray, moist to wet, fine to medium grained sand, high plasticity, some oxidation, trace shell fragments.
	0		SH-4			83			63:35					
20														
	-5		S-5	0 1 1	2	46			50:24					-Soft, high plasticity, fine grained sand, trace organics.

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FIGURE
A1-14 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW020**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/3/2012	10/3/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	15.4	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-10		R-6	1 2 2	4	91	48		75:40	0.1				-Moist to wet, H2S odor.
30	-15		S-7	0 1 1	2	46								-Soft, few shell fragments, H2S odor, no organics.
35	-20		SH-8			50	70		73:40					-Moist, stiff, few oxidation. Vane shear = 0.75 ksf
40	-25		R-9	9 13 13	26	20	109	28			PA			**Silty Sand (SM)**, gray, moist, medium dense, fine to coarse grained sand.
45	-30		S-10	5 5 6	11									-Fine to medium grained sand, few organics.
														Fat Clay (CH), gray, moist, medium stiff, fine grained sand, high plasticity.

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FIGURE
A1-14 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW020**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/3/2012	10/3/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	15.4	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-35		R-11	3 5 5	10	42	77		52:28	0.75				
55	-40		S-12	7 8 7	15									**Clayey Sand (SC)**, gray, wet, medium dense, fine grained sand, none to low plasticity, trace wood chunks.
60	-45		R-13	11 12 11	23	22	102							-Medium dense, no wood chunks, no plasticity.
65	-50		S-14	5 7 14	21									-Fine grained sand.
70	-55		S-15	25 27 32	59									**Sand (SP)**, gray, wet, very dense, fine to coarse grained sand, few fine gravel.
														Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

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FIGURE
A1-14 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW023**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/3/2012	10/3/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	65.9	19	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			1											**Artificial Fill (af)** **Sandy Clay (CL)**, brown, dry, fine to medium grained sand, low plasticity, some roots/branches, few snail shells.
	15													
5			2	1 2 3	5	42	80	82			PA			-Gray, moist, soft, fine grained sand, trace roots, trace shell fragments.
	10													
10			3	2 4 5	9	37			38:13					-Stiff, trace roots.
	5													
15			4	1 2 5	7	48	72			0.25				-Medium stiff, low to medium plasticity.
	0													**Alluvium (Qa)** **Silt (ML)** , gray, moist, very soft, fine grained sand, medium plasticity, oxidation.
20			5	0 0 1	1	48			46:16					
	-5													**Clayey Silt (ML)**, gray, moist to wet, soft, medium plasticity, few shells, strong H2S odor.

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FIGURE
A1-15 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW023**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/3/2012	10/3/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	65.9	19	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			6	1 2 3	5	62	64			0.5				
	-10													**Sandy Silt (ML)**, gray, moist, stiff, low plasticity, trace shells.
30			7	1 2 4	6			70		1.25	PA			
	-15													
35			8			30	91			1.0				-Stiff, fine to medium grained sand, trace coarse grained sand, low to medium plasticity.
	-20													
40			9	2 4 4	8	48	71			0.1				-Medium stiff, trace roots.
	-25													
45			10	7 10 7	17									-Low plasticity, no roots.
														Silty Sand (SP-SM), gray, wet, fine to coarse grained sand.
	-30													**Clayey Silt (ML)**, gray, moist, stiff, low to medium plasticity, trace organics.

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FIGURE
A1-15 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW023**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/3/2012	10/3/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	65.9	19	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			11	6 7 8	15	32	90			1.5				
	-35													**Silty Lean Clay (CL)**, gray, moist, medium stiff, medium plasticity, trace organics.
55			12	3 4 4	8	35				0.75				
	-40													**Clayey Silt (ML)**, gray, moist, very stiff, low to medium plasticity, trace organics.
60			13	7 10 10	20	32	89			2.75				
	-45													**Silty Sand (SP-SM)**, gray, wet, very dense, fine to medium grained sand, coarse gravel.
65			14	60	100									
														Boring terminated at 65.9 ft. Groundwater not measured. Boring backfilled with bentonite grout.
	-50													
70														
	-55													

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FIGURE
A1-15 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-HSA064**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/15/2012	10/15/2012	1 of 1

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85 All Terrain	Hollow Stem Auger	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		8	19	17.2	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														Artificial Fill (af)
	15		S-1	1 4 3	7	9		45			PA			**Silty Sand (SM)**, light brown, dry, loose, fine grained sand, few fine roots, few shell fragments, trace dark brown clay seams.
5			R-2	6 6 8	14	24	95			>4.5				**Clay (CL)**, olive brown and gray, moist, hard, medium plasticity, some oxidation, few sea shells.
	10		S-3	3 4 3	7	27				2.5				**Clayey Silt (ML)**, olive brown and gray, moist, very stiff, low plasticity.
10			R-4	2 3 4	7	35	82							**Sandy Clay (CL)**, olive brown, wet, medium stiff, fine grained sand, few shell fragments, trace organics.
	5		S-5	0 0 4	4				42:20					**Alluvium (Qa)**
15			R-6	0 4 4	8	37	84							**Silty Clay (CL)**, light gray and gray, moist, medium stiff, medium plasticity, trace shell fragments.
	0													**Silt (ML)**, gray, moist, medium stiff, micaceous.
			S-7	0 0 1	1	42			43:20					**Silty Clay (CL)**, gray, wet, very soft, little shell fragments.
20														Boring terminated at 19 ft. Groundwater not measured. Boring backfilled with tamped cuttings.
	-5													

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FIGURE
A1-16

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-HSA066**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/15/2012	10/15/2012	1 of 1

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85 All Terrain	Hollow Stem Auger	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		8	21.5	21.1	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	20		B-1								CP			**Artificial Fill (af)** **Sandy Silt (ML)**, light brown, dry, fine grained sand, none to low plasticity, trace dead ice plant.
			R-2	9 11 10	21	10	90			>4.5				- Hard, increase in fine grained sand, no plasticity, no ice plant, trace fine roots.
5	15		S-3	1 2 3	5	10								-Medium stiff.
			R-4	2 3 5	8	33	83	48			PA			**Silty Sand (SM)**, grayish brown, wet, loose, fine grained sand, trace organics, trace shell fragments.
10	10		S-5	0 1 1	2	38								**Sandy Silt (ML)**, grayish brown, moist, soft, fine grained sand, little oxidation, micaceous.
			R-6	0 0 4	4	42	75							**Alluvium (Qa)** **Sandy Silt (ML)**, gray, moist, soft, fine grained sand, micaceous. **Silty Sand (SM)**, gray, moist, very loose, fine grained sand, micaceous.
15	5		S-7	0 3 3	6	51								**Silty Clay (CL)**, light gray, moist, medium stiff, medium plasticity.
			R-8	1 3 3	6	46	73		71:39					**Silty Fat Clay (CH)**, gray, moist, soft, high plasticity. -Brownish gray, medium plasticity, some oxidation, micaceous.
20	0		S-9	0 0 0	0	56			51:24					-Gray, very soft, trace shell fragments, H2S odor.
														Boring terminated at 21.5 ft. Groundwater not measured. Boring backfilled with tamped cuttings.

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FIGURE
A1-17

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-HSA067**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/10/2012	10/10/2012	1 of 1

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85 All Terrain	Hollow Stem Auger	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		8	16.5	12.2	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														Artificial Fill (af)
														Silt (ML), light brown, dry, low plasticity.
	10													**Silty Clay (CL)**, brown, moist, soft, low to medium plasticity, few oxidation, trace calcite, slightly micaceous.
			R-1	1 2 2	4	36	74			0.25				
5			S-2	0 1 2	3	46				0.5				
	5													**Alluvium (Qa)**
			R-3	1 3 3	6	36	78			0.75				**Silt (ML)**, olive brown, moist, medium stiff, trace fine grained sand, no plasticity, highly micaceous.
10			S-4	0 0 2	2	48								**Clayey Silt (ML)**, light brown, wet, soft, trace fine grained sand, low plasticity, few organics, trace sea shells.
	0													**Fat Clay (CH)**, olive brown, wet, medium stiff, trace fine grained sand, high plasticity, some oxidation, trace shell fragments, trace calcite or salt, micaceous.
			R-5	1 2 3	5	40	79		69:37					
15			S-6	0 0 0	0	45								**Silt (ML)**, mottled gray and orangish brown, wet, very soft, low plasticity, some to mostly oxidation, trace shell fragments, trace organics.
	-5													Boring terminated at 16.5 ft. Groundwater not measured. Boring backfilled with tampered cuttings.
20														
	-10													

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FIGURE
A1-18

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW027**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/24/2012	9/24/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	13	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														Artificial Fill (af)
														Silty Sand with Gravel (SM), light brown, dry, fine to coarse grained sand, fine to coarse gravel.
	10													
5			R-1	3 5 7	12	21	94				DS			**Silty Sand (SM)**, brown, moist, loose, fine grained sand, trace clay seams, trace rusted metal.
	5													
														Sand with Silt (SP-SM), brown, wet, fine grained sand, trace wood ~2" long and ~1/2" wide.
10			SH-2			23	103							
	0													**Elastic Silt (MH)**, gray, wet, very soft, high plasticity.
15			S-3	0 0 0	0				71:33	0.25				- Brown, few shells, few rootlets, micaceous.
	-5													**Alluvium (Qa)**
20			SH-4			35	83				DS			**Silty Sand (SM)**, gray, wet, fine grained sand, few shell fragments, trace fine rootlets, micaceous.
	-10													**Sand with Silt (SP-SM)**, gray, wet, medium dense, fine grained sand, H2S odor.

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FIGURE
A1-19 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW027**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/24/2012	9/24/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	13	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-5	9 14 15	29									
	-15													
30			R-6	7 8 10	18									-No recovery.
														Silty Sand (SM), gray, wet, loose, fine grained sand, trace shell fragments.
	-20		S-7	4 4 6	10									
35			R-8	38 50/5"	100	24	100							**Sand (SP)**, gray, wet, very dense, fine grained sand, trace organics, trace fines.
	-25													
40			R-9	18 21 26	47	28								-Dense.
	-30													
45			S-10	14 18 20	38									
	-35													
														Silty Sand (SM), gray, wet, firm, fine grained sand, low plasticity, trace shell fragments, micaceous.

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FIGURE
A1-19 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW027**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/24/2012	9/24/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	13	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			R-11	2 4 5	9	34	86	88			PA			
	-40													**Fat Clay(CH)**, dark brown, moist, stiff, fine grained sand, high plasticity.
55			S-12	4 5 6	11				58:31	1.5				
	-45													**Sandy Silt (ML)**, gray, wet, medium stiff, fine grained sand, low plasticity.
60			SH-13			21	107	50		0.75	PA			
	-50													**Silty Sand (SM)**, greenish gray, wet, dense, fine to coarse grained sand, trace fine gravel, multi colored sand and gravel.
65			S-14	11 22 20	42									
	-55													
70			S-15	5 8 14	22			29			PA			-Gray, medium dense, fine grained sand.
	-60													Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

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FIGURE
A1-19 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW028**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/22/2012	10/22/2012	1 of 1

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling		Hand Auger	N. Briffa/E. Ycoy	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
			5	5	▽ 4.0 / *1.0* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			B-1											**Artificial Fill (af)**
														Sandy Silt (ML), brown, dry, fine grained sand, trace fine gravel.
														Silt (ML), brown, moist, low plasticity, few shells.
														Alluvium (Qa)
														Silt (ML), brown, moist, low plasticity, few shells, laminations of Silty Clay (CL) and Peat (Pt):
5	0													**Silty Clay (CL)**, gray and brown, moist, medium plasticity, little oxidation.
														Peat (Pt), dark brownish gray, moist.
														Silty Sand (SM), gray, wet, fine grained sand.
														Fat Clay (CH), gray, wet, medium to high plasticity.
														Boring terminated at 5 ft.
														Groundwater encountered at 4 ft.
														Boring backfilled with tamped cuttings.
10	-5													
15	-10													
20	-15													

GDC_LOG_BORING_2011 L-962_PART 1.GPJ GDCLOG.GDT 1/24/13

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THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE
A1-20

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW030**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/4/2012	10/4/2012	1 of 2

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	41.5	6.1	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	5		1											**Artificial Fill (af)** **Silty Sand (SM)**, brown, dry, fine to coarse grained sand, few roots/grass.
5	0		2	0 0 0	0	65			72:40					**Alluvium (Qa)** **Fat Clay (CH)**, light gray, moist, very soft, fine to coarse grained sand, high plasticity, trace shells.
10	-5		3	0 1 1	2	81	51		70:37	0.05				-Gray, trace organics, trace shell fragments, H2S odor.
15	-10		4	0 0 0	0			31			PA			**Silty Sand (SM)**, gray, wet, very loose, fine to medium grained sand, low plasticity, trace shell fragments.
20	-15		5	7 14 25	39	31	92							-Medium dense, none to low plasticity, slight H2S odor.

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FIGURE
A1-21 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW030**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/4/2012	10/4/2012	2 of 2

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	41.5	6.1	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-20		6	3 3 2	5									-Loose, fine to coarse grained sand, no plasticity, no H2S odor, little to some shells/shell fragments.
30	-25		7	8 12 16	28	25	99				DS			-Medium dense, fine to medium grained sand, none to low plasticity, trace shells.
35	-30		8	3 3 6	9									-Loose, fine grained sand.
40	-35		9	6 5 5	10									-Fine to medium grained sand, low plasticity, some shells.
														Boring terminated at 41.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
45	-40													

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FIGURE
A1-21 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW032**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/14/2012	9/14/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	8.2	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			B-1											**Artificial Fill (af)** **Silty Sand (SM)**, brown, dry, fine to coarse grained sand, few fine to coarse gravel, little organics.
	5													
5			S-2	15 6 1	7									-Loose, decrease in organics, no coarse gravel.
	0													**Alluvium (Qa)** **Fat Clay (CH)**, gray, wet, high plasticity, trace sea shells, slight H2S odor, micaceous.
10			SH-3			58	66		71:43		CS			Vane Shear = 0.42 ksf
	-5													
15			S-4	0 0 0	0	60								-No shells, no H2S.
	-10													**Silty Sand (SM)**, gray, wet, some shell fragments. No recovery in shelby tube.
20			SH-5			40	83	28			PA			
	-15													

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FIGURE
A1-22 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW032**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/14/2012	9/14/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	8.2	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-6	8 9 11	20									- gray, wet, medium dense, fine grained sand, micaceous.
	-20													
30			SH-7			34	89				DS			-Increase in silt, no recovery in shelby tube.
	-25													
35			S-8	11 17 20	37									-Dense, decrease in silt, ~15%.
	-30													**Sand Silt (ML)**, gray, wet, medium stiff, fine grained sand, micaceous.
40			R-9	3 4 5	9	35	85				DS			
	-35													**Sandy Silty Clay (CL)**, gray, wet, soft, fine grained sand, medium plasticity, micaceous, trace shell fragments.
45			S-10	0 0 0	0				36:13	0.5				
	-40													**Sand (SP)**, gray, wet, medium dense, fine to medium grained sand, few coarse grained sand, trace shell fragments.

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FIGURE
A1-22 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW032**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/14/2012	9/14/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	8.2	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			R-11	20 26 17	43	21	104							
	-45													**Silty Sand (SM)**, gray, wet, dense, fine grained sand, trace organics.
55			S-12	7 21 22	43			21			PA			
	-50													
60			S-13	17 45 50/4"	95			28			PA			-Very dense, micaceous, dark brown wood fibers in organics and silt.
	-55													
65			R-14	3 32 50/3"	82									No Recovery. Hole collapsed when inserting rod for next sample.
	-60													**Sand (SP)**, gray, wet, very dense, fine to medium grained sand, trace organics (wood fibers).
70			S-15	27 44 47	91									
	-65													Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

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FIGURE
A1-22 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW033**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/11/2012	9/12/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in. (Auto/Manual)		3.875	71.5	6.3	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	5													**Artificial Fill (af)** **Sand with Silt (SP-SM)**, yellowish brown, dry, fine grained sand. -Moist.
5	0		R-1	3 3 4	7	63	59							**Alluvium (Qa)** **Fat Clay (CH)**, gray, wet, medium stiff, high plasticity, trace organics, trace sea shells and shell fragments, slight H2S odor, trace burned wood or charcoal.
10	-5		S-2	2 3 4	7									
15	-10		SH-3			76			75:42					-Soft, no H2S odor, trace fine grained sand. Vane Shear = 0.25 ksf
20	-15		S-4	14 26 28	54									**Sand (SP)**, gray, wet, dense fine grained sand, trace shell fragments.
														Silty Sand (SM) with clay laminations, gray, wet, fine grained sand, few shell fragments, slight H2S odor, pocket of light brown fine grained sand.

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FIGURE
A1-23 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW033**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/11/2012	9/12/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in. (Auto/Manual)		3.875	71.5	6.3	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-20		SH-5			47	73	30			PA			-No recovery.
30	-25		S-6	3 4 2	6									
			S-7	8 18 20	38					1.25				**Sandy Silt (ML)**, gray, wet, stiff, fine grained sand, trace shell fragments.
35	-30		SH-8			30	91							**Silty Sand (SM)**, gray, wet, fine grained sand, trace shell fragments.
40	-35		S-9	1 2 3	5				28:3	0.75				**Sandy Silt (ML)**, gray, wet, medium stiff, fine grained sand, low plasticity, trace shell fragments.
45	-40		SH-10			42	82		53:31	0.5				**Fat Clay (CH)**, gray, wet, medium stiff, high plasticity. Vane Shear = 0.7 ksf
														Silty Sand (SM), gray, wet, medium dense, fine grained sand.

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FIGURE
A1-23 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW033**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/11/2012	9/12/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in. (Auto/Manual)		3.875	71.5	6.3	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-45		S-11	7 9 4	13									
55			R-12	18 34 42	76			27			PA			-Very dense, trace organics, micaceous.
	-50													
60			S-13	2 5 16	21									-Interbedded with layers of **Clayey Sand (SC)**, gray, wet, medium dense, fine to medium grained sand, trace organics in (SC).
	-55													
65			R-14	18 20 13	33									-Trace organics.
	-60													-Gravels (drill rig chatter)
														Poorly Graded Sand with Gravel (SP) gray, wet, dense, fine to coarse grained sand, fine to coarse gravel, drilling mud mixed in sample.
70			S-15	14 15 19	34									
	-65													Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

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FIGURE
A1-23 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW036**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/17/2012	9/17/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	9.1	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														Base (~18").
														Artificial Fill (af) Silty Sand (SM) , light brown, wet, very loose, fine grained sand, few gray clay seams.
5	5		S-1	3 1/12"	1									
	0													**Alluvium (Qf)** **Fat Clay (CH)**, gray, wet, soft, micaceous, high plasticity in clay, trace oxidation. Vane Shear = 0.3 ksf
10			SH-2			42	78		60:32		CS			
	-5													
15			S-3	0 0 1	1				69:38					-H2S odor.
	-10													**Silty Sand (SM)**, gray, wet, fine grained sand, micaceous, H2S odor, trace shell fragments.
20			SH-4			26	97							
	-15													**Sandy Silt (ML)**, gray, wet, soft, fine grained sand, micaceous, H2S odor, few shell fragments.

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FIGURE
A1-24 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW036**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/17/2012	9/17/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	9.1	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-5	6 1 1	2					0.25				
	-20													**Fat Clay (CH)**, gray, wet, medium stiff, micaceous, trace shell fragments, high plasticity.
30			SH-6			60	65	95	63:32	0.5	C DS PA			
	-25													**Silt with Sand (ML)**, gray, wet, very soft, fine grained sand, micaceous, trace shell fragments, low plasticity.
35			S-7	0 0 1	1					0.25				
	-30													**Silty Clay (CL)**, dark gray, moist, stiff, low to medium plasticity, few fine grained sand.
40			SH-8			22	106			1.75				
	-35													**Sandy Clay (CL)**, gray, wet, soft, fine grained sand, low to medium plasticity.
45			S-9	4 4 6	10			50		0.25	PA			
	-40													**Silty Sand (SM)**, gray, wet, fine grained sand, trace organics.

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THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE
A1-24 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW036**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/17/2012	9/17/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	9.1	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			SH-10			25	101							
	-45													**Silt (ML)**, gray, wet, soft, low to medium plasticity, few fine grained sand.
55			S-11	1 1 3	4					0.75				
	-50													**Silty Sand (SM)**, gray, wet, loose, fine grained sand, trace organics.
60			R-12	6 5 4	9									
	-55													**Silty Clay (CL)**, gray, wet, soft, medium plasticity, few organics (wood chunks ~1/8" in diameter).
65			S-13	8 8 9	17					0.25				
	-60													**Sand (SP)**, gray, wet, very dense, fine to medium grained sand, trace fines.
70			S-14	28 29 30	59									
	-65													Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

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FIGURE
A1-24 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW039**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/17/2012	9/17/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	8.2	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
0	5													**Artifical Fill (af)**
														Silty Sand with Gravel (SM), brown, dry, fine to coarse grained sand, fine gravel, few organics.
														Alluvium (Qa)
5	0		S-1	1 1 1	2				65:37	0.5				**Fat Clay (CH)**, olive brown, moist, soft, micaceous, high plasticity, few oxidation.
10	-5		SH-2			57	69		68:37					-Gray, wet, trace shell fragments and sea shells, no oxidation, slight H2S odor. Vane shear = 0.4 ksf
15	-10		S-3	0 0 0	0			33			PA			**Silty Sand (SM)**, gray, wet, fine grained sand, some shell fragments, H2S odor, low plasticity, possible organic.
														Sand with Silt (SP-SM), gray, wet, dense, fine grained sand, few shell fragments.
20	-15		R-4	8 26 23	49	22	104							
														Silty Sand (SM), gray, wet, very loose, fine grained sand, some silt, micaceous.

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FIGURE
A1-25 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW039**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/17/2012	9/17/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	8.2	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-5	2 1 3	4									
	-20													
30			R-6	8 19 27	46	27	97							-Dense
	-25													**Silty Clay (CL)**, gray, wet, soft, trace fine grained sand, trace shell fragments, low to medium plasticity.
35			S-7	0 1 2	3				40:15	0.5				
	-30													
40			SH-8			20	108		30:14	1.75				**Sandy Clay (CL)**, gray, moist, stiff, some fine grained sand, medium plasticity, trace medium grained sand, trace organics. Vane shear = 1.9 ksf
	-35													**Silty Sand (SM)**, gray, wet, medium dense, fine to coarse grained sand.
45			S-9	8 12 13	25									
	-40													**Poorly Graded Gravel with Sand (GP)** greenish gray, wet, very dense, medium to coarse grained sand, fine to coarse subrounded gravel.

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FIGURE
A1-25 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW039**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/17/2012	9/17/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	8.2	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			R-10	8 30 47	77	14	118							
	-45													**Silty Sand (SM)**, gray, wet, medium dense, fine grained sand, some fines.
55			S-11	3 5 8	13									
	-50													**Silty Clay (CH)**, gray, moist, stiff, high plasiticity, trace rootlets ~1/16" in diameter.
60			S-12	3 5 8	13					1.75				
	-55													**Sand (SP)**, gray, wet, dense, fine to medium grained sand, trace fines.
65			S-13	12 19 22	41									
	-60													
70			S-14	13 19 33	52									- Light gray, wet, very dense, fine grained sand, trace medium grained sand, trace fines.
	-65													Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

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FIGURE
A1-25 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW041**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/20/2012	9/20/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	66.5	6.8	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			B-1											**Artificial Fill (af)** **Silt with Sand (ML)**, brown, dry, little organics, no plasticity.
	5													
5			SH-2			31	88	45			C DS PA			**Alluvium (Qa)** **Silty Sand (SM)**, gray, wet, fine grained sand, micaceous, few oxidation, trace fine rootlets.
	0													
10			S-3	0 0 0	0									**Fat Clay (CH)**, gray, wet, very soft, high plasticity, trace organics, H2S odor.
	-5													
15			SH-4			33	81				DS			**Sandy Silt (ML)**, gray, wet, fine grained sand, low plasticity, little shell fragments, 1 sea shell ~1.5", H2S odor.
	-10													
20			S-5	8 9 10	19			17			PA			**Silty Sand (SM)**, medium dense, few shell fragments.
	-15													**Fat Clay (CH)**, gray, wet, medium stiff, high plasticity, trace shell fragments.

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FIGURE
A1-26 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW041**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/20/2012	9/20/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	66.5	6.8	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			SH-6			52	67		75:42		C			Vane shear = 0.5 ksf
	-20													
														Lean Clay (CL), gray, wet, medium plasticity, trace shell fragments, 1 sea shell ~1.5".
30			S-7	0 0 0	0				40:20	0.5				
	-25													
														Interbedded layers of Silty Clay (CH) and Sandy Clay (CL): -**Silty Clay (CH)**, gray, moist, medium stiff, medium plasticity.
35			S-8	1 2 5	7					2.0				-**Sandy Clay (CL)**, gray, wet, medium stiff, fine grained sand, trace shell fragments, trace fine rootlets.
	-30													
														Lean Clay (CL), gray, moist, medium stiff, trace fine grained sand, medium plasticity.
40			R-9	8 11 16	27	21	103		33:13	1.25				Vane shear = 0.8 ksf
	-35													
45			S-10	0 0 1	1					0.25				-Wet, very soft, trace organics.
	-40													
														Fat Clay (CH), gray, wet, medium stiff, fine grained sand, high plasticity, micaceous.

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FIGURE
A1-26 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW041**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/20/2012	9/20/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	66.5	6.8	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			SH-11			28	94			0.75				Vane shear = 0.8 ksf
	-45													
55			S-12	1 3 4	7				59:34	1.25				-Moist, stiff, trace fine grained sand.
	-50													
60			R-13	32 31 37	68	9	131	6			PA			**Well Graded Sand with Gravel (SW)** gray, wet, dense, fine to coarse grained sand, fine to coarse gravel, trace fines, gravels up to 2".
	-55													
65			S-14	20 22 23	45									**Sand (SW)**, gray, wet, fine to coarse grained sand, few fine to coarse gravel, gravels up to ~1".
	-60													Boring terminated at 66.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
70														
	-65													

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FIGURE
A1-26 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW043**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/19/2012	9/19/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	66.5	8.8	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			B-1											**Artificial Fill (af)** **Sandy Silt (ML)**, brown, dry, none to low plasticity, fine grained sand, few roots.
	5													**Alluvium (Qa)** **Fat Clay (CH)**, olive brown, moist, medium stiff, few oxidation streaks, trace fine grained sand, high plasticity, H2S odor.
5			S-2	0 0 1	1	49				0.5				
	0													
10			SH-3			53	104		59:34	0.25				-Gray, wet, soft, few fine grained sand, micaceous, trace shell fragments, H2S odor. Vane shear = 0.5 ksf
	-5													
15			S-4	0 0 1	1	80								
	-10													**Sand (SP)**, gray, wet, fine grained sand, some shells above shelby tube, no fines.
20			SH-5			29								
	-15													**Fat Clay (CH)**, gray, wet, soft, trace fine grained sand, high plasticity, 1" layer with mostly shell fragments and wood chunk above (width of sampler)

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FIGURE
A1-27 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW043**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/19/2012	9/19/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	66.5	8.8	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-6	0 0 1	1	60			63:35					
	-20													
30			SH-7			33				1.25				-Stiff, dark gray, no shells, no wood, trace fine grained sand, no ring samples. Vane shear = 1.25 ksf
	-25													**Sandy Clay (CL)**, gray , wet, stiff, fine grained sand, medium plasticity, trace wood pieces.
35			S-8	5 5 6	11				47:27					
	-30													
40			R-9	5 3 2	5	32	89							-Soft, increase in fines, few wood fibers >1" long, trace black inclusions.
	-35													-Medium Stiff, fine to medium grained sand, trace wood fibers.
45			S-10							0.75				**Lean Clay (CL)**, gray, wet, medium stiff, medium plasticity, trace fine grained sand, trace wood fibers.
	-40													

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FIGURE

A1-27 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW043**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/19/2012	9/19/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	66.5	8.8	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			R-11	2 4 6	10	37	85		44:24	0.75				Vane shear = 0.65 ksf
	-45													**Silty Sand (SM)**, gray, wet, loose, fine grained sand, trace organics.
55			S-12	0 2 4	6									
	-50													**Sand with Gravel (SP)**, gray, wet, very dense, fine to medium grained sand, few coarse grained sand, few fine to coarse gravel, coarse gravel up to 2.5".
60			R-13	47 50 50/4"	100	16	112							
	-55													
65			S-14	16 17 17	34									
	-60													Boring terminated at 66.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
70														
	-65													

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FIGURE
A1-27 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW044**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/19/2012	9/19/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	66.5	9.2	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														Artificial Fill (Qa)
														Sandy Silt (ML), brown, dry, fine grained sand, none to low plasticity.
	5													**Alluvium (Qa)**
5			SH-1			58	63		84:52	0.39				**Fat Clay (CH)**, olive brown, moist, medium stiff, trace fine grained sand, high plasticity, trace calcite, trace oxidation.
														Vane shear = 0.75 ksf
	0													
10			S-2	0 0 1	1	53								-Wet, very soft.
	-5													
15			SH-3			42	76		64:37	0.32				-Moist.
														Vane shear = 0.55 ksf
	-10													
20			S-4	0 0 1	1									-Gray, wet.
														Clayey Sand (SC), gray, wet, very loose, fine grained sand.
	-15													**Fat Clay (CH)**, gray, wet, medium stiff, fine grained sand, high plasticity, little shells in middle of sampler.

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FIGURE
A1-28 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW044**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/19/2012	9/19/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	66.5	9.2	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			SH-5			38	77		58:34	0.5				Vane shear = 0.55 ksf
	-20													
30			S-6	0 0 3	3									-Moist, few shell fragments.
	-25													**Clayey Sand (SC)**, gray, moist, fine grained sand, medium plasticity, trace organics, trace shell fragments.
35			SH-7			24	103				DS			
	-30													
40			S-8	5 4 2	6									-Wet, loose.
	-35													**Sand with Gravels (SP)**, gray, wet, medium dense, fine to medium grained sand, fine gravel.
45			R-9	16 17 18	35	21	109							
	-40													

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FIGURE
A1-28 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW044**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/19/2012	9/19/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	66.5	9.2	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-10	10 7 2	9									-Loose. Note: Most of sample fell out with sand catcher on.
	-45													**Lean Clay (CL)**, gray, moist, medium stiff, trace fine grained sand, medium plasticity.
55			R-11	3 3 5	8	33	89		39:21	0.75	C			
	-50													**Sand (SP)**, gray, wet, dense, fine to medium grained sand, trace coarse grained sand, piece of wood ~3/8" in diameter.
60			S-12	11 11 21	32									
	-55													**Poorly - Graded Gravel with Sand (GP)** gray, wet, very dense, medium to coarse grained sand, fine to coarse gravel.
65			S-13	17 22 35	57									
														Boring terminated at 66.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
70	-60													
	-65													

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FIGURE
A1-28 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW047**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/18/2012	9/18/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	66.5	11.5	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	10		B-1											**Artifical Fill (af)** **Silty Sand with Gravels (SM)**, light brown, dry, few organics.
5	5		S-2	2 2 2	4			60			PA			**Alluvium (Qa)** **Sandy Silt (ML)**, olive brown, moist, soft, fine grained sand, none to low elasticity.
10	0		SH-3			50	74		40:18	0.25				**Lean Clay (CL)**, olive brown, wet, medium stiff, medium plasticity, trace fine grained sand. Vane Shear = 0.6 ksf
15	-5		S-4	0 0 0	0					0.15				**Fat Clay (CH)**, gray, wet, very soft, high plasticity, micaceous.
20	-10		SH-5			65	59		82:50	0.75				-Medium stiff, not micaceous, laminations of light pinkish brown Clay with Sand, some sea shells in upper portion of sample, strong H2S odor. Vane shear = 0.9 ksf
														Sandy Clay (CL), gray, wet, soft, fine grained sand, medium plasticity, few organics, trace shell fragments, micaceous.

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FIGURE
A1-29 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW047**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/18/2012	9/18/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	66.5	11.5	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-15		S-6	0 0 4	4			84	48:27		PA			
30			SH-7			23	105			0-2.25				-Moist, very soft to very stiff, few fine grained sand, low to medium plasticity.
	-20													
35			S-8	2 3 5	8									**Silty Sand (SM)**, gray, moist, loose, fine grained sand, some fines, trace shell fragments.
	-25													
40			SH-9											**Sand (SP)**, gray, wet, medium grained sand, trace coarse grained sand, trace fine gravel.
	-30													
45			S-10	3 5 6	11				57:36	1.5				**Fat Clay (CH)**, gray, wet, stiff, high plasticity, micaceous.
	-35													

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FIGURE
A1-29 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW047**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/18/2012	9/18/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	66.5	11.5	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-40		R-11	4 4 5	9	35	78		52:30	0.75				-Moist, soft. Vane shear = 0.4 ksf
55	-45		S-12	11 12 10	22									**Silty Sand (SM)**, gray, wet, medium dense, fine grained sand, trace organics.
60	-50		R-13	26 50/4"	100	19	108							**Sand (SP)**, gray, wet, very dense, fine to medium grained sand, few coarse grained sand, few fg.
65	-55		S-14	17 18 17	35									**Poorly graded Gravel with Sand (GP)** gray, wet, dense, medium to coarse grained sand, fine to coarse gravel, subangular gravels.
70	-60													Boring terminated at 66.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

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FIGURE
A1-29 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW049**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/1/2012	10/1/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	69	17.6	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			B-1											**Artificial Fill (af)** **Silty Sand with Gravel (SM)**, brown, dry, fine to coarse grained sand, fine to coarse gravel.
	15													
5			S-2	3 4 4	8									**Silt (ML)**, brown, moist, medium stiff, low plasticity, trace roots.
	10													
10			R-3	2 4 8	12	31	81			1.25				-Olive brown, low to medium plasticity, trace dark brown clay seams. Vane Shear = 0.7 ksf
	5													
15			SH-4			37	74	55	84:43	0.25	PA			-None to low plasticity, increase in roots, highly micaceous, no clay seams. Vane Shear = 0.5 ksf **Elastic Silt (MH)**, dark brown with orange spots of Silt, high plasticity, trace hair or fiber, trace shell fragments.
	0													**Alluvium (Qa)** **Lean Clay (CL)**, gray, wet, soft, low to medium plasticity, some laminations and pinholes of oxidation, micaceous.
20			S-5	2 1 2	3				27:7					
	-5													**Fat Clay (CH)**, gray, wet, medium stiff, trace fine grained sand, high plasticity, micaceous, H2S odor.

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FIGURE
A1-30 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW049**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/1/2012	10/1/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	69	17.6	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			SH-6			63	62		67:34	0.5				Vane Shear = 1.0 ksf
	-10													**Silty Clay (CL)**, gray, wet, medium stiff, few fine grained sand, low to medium plasticity, trace shell fragments, slight H2S odor.
30			R-7	3 4 5	9	32	89			1.0				
	-15													
35			SH-8			28	96		40:17	1.25				-Moist, stiff, trace fine grained sand, medium plasticity, trace rootlets. Vane Shear = 1.1 ksf
	-20													
40			R-9	10 10 13	23	22	105				DS			**Silty Sand (SM)**, gray, wet, medium dense, fine to coarse grained sand.
	-25													
45			S-10	9 9 12	21									-Fine grained sand, trace seams of Elastic Silt.
	-30													

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FIGURE
A1-30 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW049**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/1/2012	10/1/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	69	17.6	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			R-11	14 20 28	48	18	106							-Dense, fine to medium grained sand, trace fine gravel.
	-35													
55			S-12	16 14 15	29									**Sand with Silt (SP-SM)**, gray, wet, medium dense, fine to medium grained sand, few coarse grained sand.
	-40													
60			R-13	4 5 8	13	31	85		39:16	1.0				**Silty Clay (CL)**, gray, moist, stiff, few fine grained sand, medium plasticity, trace organics. Vane Shear = 1.0 ksf
	-45													
65			SH-14											No recovery.
	-50		S-15	3 14 23	37	21								**Sand (SP)**, gray, wet, dense, fine to medium grained sand, trace fines.
70														Boring terminated at 69 ft. Groundwater not measured. Boring backfilled with bentonite grout.
	-55													

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FIGURE
A1-30 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-HSA051**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/16/2012	10/16/2012	1 of 1

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85 All Terrain	Hollow Stem Auger	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		8	21.5	6.3	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			B-1											**Artificial Fill (af)**
	5													**Clay (CL)**, brown, dry, low to medium plasticity, trace organics, trace sea shells, few fine roots, trace white residue. -Moist
			S-2	0 2 4	6	17								-Firm, no snail shells.
5			R-3	1 2 3	5	42	76							-Soft, light brown and gray, moist, medium plasticity.
	0													**Alluvium (Qa)**
			S-4	1 2 2	4									Interbedded layers of **Silty Clay (CL) and Clayey Silt (ML)**, gray, wet, soft, fine grained sand, few oxidation, trace fine rootlets, micaceous.
10			R-5	0 0 2	2	49	68							**Clayey Silt (ML)**, gray, wet, very soft, low plasticity, trace oxidation, some small to large shell fragments, H2S odor.
	-5													
			S-6	0 0 0	0				87:44					**Elastic Silt (MH)**, gray, wet, very soft, few fine grained sand, medium plasticity, few shell fragments, few tan color blebs of organics or CH, strong H2S odor.
15														
			R-7	0 0 1	1	103	43							-Trace fine rootlets.
	-10													
			S-8	0 5 7	12									-Increase in shell fragments.
														Sandy Clay (CL), gray, wet, stiff, some fine grained sand, trace sea shells, H2S odor.
20			R-9	0 2 4	6	17	111							
	-15													Boring terminated at 21.5 ft. Groundwater not encountered. Boring backfilled with tamped cuttings. Strong H2S odor occurred at ~20'. H2S reading of >150 ppm.

GDC_LOG_BORING_2011 L-962_PART 1.GPJ GDCLOG.GDT 1/24/13

GROUP DELTA CONSULTANTS, INC.
370 Amaploa Ave., Suite 212
Torrance, CA 90501

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE
A1-31

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW053**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/24/2012	9/24/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	13.7	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														Artificial Fill (af)
														Silty Sand with Gravel (SM), brown, dry, fine to coarse sand, fine to coarse gravel.
	10													
5			S-1	0 0 0	0				48:27					**Alluvium (Qa)**
														Lean Clay (CL), olive brown, wet, very soft, trace fine grained sand, highly micaceous, interbedded layers of Fat Clay (CH).
	5													
10			SH-2			66	61		66:39		C			**Fat Clay (CH)**, dark brown and gray, moist, medium stiff, high plasticity.
														Vane Shear = 0.8 ksf
	0													
15			S-3	0 0 0	0									- Gray, wet, very soft, few sea shells.
	-5													
20			SH-4			34	87	35	28:4		PA			**Silty Sand (SM)**, gray, wet, fine grained sand, low plasticity, little shells, H2S odor.
	-10													

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FIGURE
A1-32 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW053**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/24/2012	9/24/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	13.7	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-5	4 4 4	8									- Loose, trace shell fragments.
	-15													
30			SH-6			29	92	30			DS PA			- No H2S odor.
	-20													
35			S-7	16 17 17	34			15			PA			- Dense
	-25													
40			R-8	12 7 6	13									-No recovery
	-30													**Lean Clay (CL)**, gray, moist, soft, medium plasticity, trace shell fragments.
45			S-9	1 1 1	2				47:27	0.5				
	-35													

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FIGURE
A1-32 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW053**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/24/2012	9/24/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	13.7	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			SH-10			20	108		32:17	2.0				**Silty Clay with Sand (CL)**, gray, moist, stiff, fine grained sand, medium plasticity, micaceous. Vane Shear = 1.5 ksf
	-40													
55			S-11	2 3 5	8			65		0.25	PA			**Sandy Clay (CL)**, gray, wet, soft, fine grained sand, medium plasticity, micaceous.
	-45													
60			SH-12			34	87		38:13	2.5				- Moist, very stiff. Vane Shear = 2.2 ksf
	-50													**Fat Clay (CH)**, gray, moist, stiff, high plasticity.
65			S-13	0 0 1	1					1.5				
	-55													
70			SH-14			39	81		81:53	2.0				- Very stiff, trace fine grained sand.
	-60													Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

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FIGURE
A1-32 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW055**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/25/2012	9/25/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	16.3	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	15													**Artificial Fill (af)**
														Silty Sand with Gravels (SM), brown, dry, fine to coarse grained sand, fine to coarse gravel.
5														
	10		S-1	1 2 1	3									**Silty Sand (SM)**, brown, moist, very loose, fine grained sand, trace coarse grained sand, trace oxidation, trace shell fragments.
10														**Alluvium (Qa)**
	5		SH-2			42	78		52:24					**Fat Clay (CH)**, olive brown, wet, medium stiff, high plasticity, few thin layers of oxidation (vertical), trace shell fragments, micaceous.
														Vane Shear = 0.7 ksf
15														
	0		S-3	0 0 3	3					0.75				-Light olive brown, moist, trace fine grained sand, micaceous.
20														
	-5		SH-4			65	60			0.5				-Gray, H2S odor, seams of light gray, dry, very stiff **Silt**.
														Vane Shear = 0.5 ksf

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FIGURE
A1-33 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW055**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/25/2012	9/25/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	16.3	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-10		R-5	1 1 1	2									-No recovery.
			SH-6			26	61							**Sand with Silt (SP-SM)**, gray, wet, fine grained sand.
30	-15		S-7	0 1 2	3									**Silty Sand (SM)**, gray, wet, very loose, fine grained sand, H2S odor.
35	-20		R-8	5 8 6	14	39	78	59		0.25	PA			**Sandy Silt (ML)**, gray, wet, soft, fine grained sand, none to low plasticity, micaceous.
40	-25		S-9	10 10 10	20									**Silty Sand (SM)**, gray, moist, medium dense, trace fine grained sand, micaceous.
45	-30		R-10	0 5 6	11	22	83		32:14	1.0				**Silty Clay with Sand (CL)**, gray, moist, stiff, fine grained sand, medium plasticity, trace shell fragments.
														Silty Sand (SM), gray, wet, dense, fine to coarse grained sand.

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FIGURE
A1-33 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW055**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/25/2012	9/25/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	16.3	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-35		S-11	10 16 16	32									
55														-Medium dense, few fine gravel, decrease in fines.
	-40		R-12	20 19 22	41	14	115							
														Sandy Silt (ML), gray, wet, soft, fine grained sand, trace medium grained sand, low plasticity.
60														
	-45		S-13	0 1 1	2					0.5				
														Fat Clay (CH), gray, moist, stiff, high plasticity, micaceous, trace calcite.
65														
	-50		R-14	4 8 7	15	38	85			1.0				
														Silty Sand (SM), gray, wet, loose, fine to medium grained sand, few organics (roots).
70														
	-55		S-15	1 3 4	7									
														Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

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FIGURE
A1-33 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW058**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/25/2012	9/25/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	15	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														Artificial Fill (af)
														Silty Sand with Gravels (SM), brown, dry, fine to coarse grained sand, fine to coarse gravel.
5	10		R-1	5 5 7	12	18	96	55			PA			**Silt (ML)**, olive brown, moist, medium stiff, laminations of oxidation, highly micaceous.
														Fat Clay (CH), gray, moist, soft, high plasticity.
10	5		S-2	1 1 1	2				58:30	2.25				**Alluvium (Qa)**
														Sandy Clay (CL), orangish brown, moist, soft, fine grained sand, medium plasticity, mostly oxidized.
														Fat Clay (CH), gray, moist, medium stiff, high plasticity, H2S odor, interbedded layers of peat and silt.
15	0		SH-3			74	58		75:42	1.5				Vane Shear = 0.65 ksf
20	-5		R-4	2 1 2	3	66	61							- Soft, few oxidation, micaceous, no H2S odor.

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FIGURE
A1-34 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW058**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/25/2012	9/25/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	15	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			SH-5			85	51		71:38					- Trace shell fragments, micaceous, H2S odor.
30	-15		S-6	1 1 2	3									**Lean Clay (CL)**, gray, wet, medium stiff, low to medium plasticity, trace shell fragments. Vane Shear = 0.85 ksf
35	-20		SH-7			44	74							**Fat Clay (CH)**, gray, wet, high plasticity, micaceous.
40	-25		R-8	4 2 4	6	25	98							**Lean Clay (CL)**, gray, wet, soft, few fine grained sand, medium plasticity, trace shell fragments.
45	-30		S-9	2 6 8	14									**Clayey Sand (SC)**, gray, wet, medium dense, fine grained sand.
														Silty Sand with Gravel (SP), gray, wet, medium dense, fine to coarse grained sand, fine to coarse gravel, angular gravels.

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FIGURE
A1-34 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW058**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/25/2012	9/25/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	15	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			R-10	32 28 9	37	13	123							
55	-40		S-11	8 8 10	18									**Silty Sand (SM)**, gray, wet, medium dense, fine grained sand, trace coarse grained sand, trace organics.
60	-45		S-12	1 1 1	2				48:28	0.5				**Lean Clay (CL)**, gray, moist, soft, trace fine grained sand, medium plasticity.
65	-50		R-13	9 21 26	47	28	96			>4.5				-Hard, no fine grained sand, decrease in moisture.
70	-55		S-14	17 24 29	53									**Sand (SP)**, gray, wet, very dense, fine grained sand, trace coarse grained sand, trace fine gravel, few organics (wood fibers).
														Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

GDC_LOG_BORING_2011 L-962_PART 1.GPJ GDCLOG.GDT 1/31/13

GROUP DELTA CONSULTANTS, INC.
370 Amaploa Ave., Suite 212
Torrance, CA 90501

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE
A1-34 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**C-HSA061**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/16/2012	10/16/2012	1 of 2

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85 All Terrain	Hollow Stem Auger	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		8	31.5	16	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	15													**Artificial Fill (af)**
			R-1	4 4 4	8	5	90	11			PA			**Silty Sand (SM)**, light brown, dry, fine grained sand, few medium grained sand, trace dry brush. -Grayish brown, loose, few olive brown clay seams, no dry brush.
5			S-2	1 2 3	5									
	10													
			R-3	1 0 1	1	7	88							-Very loose, increase in fines.
10														**Alluvium (Qa)**
	5		S-4	2 5 3	8	18				2.25				**Clay (CL)**, mottled gray and light gray, moist, very stiff, few fine to medium grained sand, medium plasticity, few oxidation, trace organics, trace pieces of shale.
			R-5			19	111			1.0				**Clay with Sand (CL)**, gray, moist, stiff, fine to medium grained sand, medium plasticity, few oxidation, trace pieces of shale.
15														**Sandy Silt (ML)**, mottled brown and gray, moist, medium stiff, fine grained sand, low plasticity, trace fine rootlets.
	0		S-6	1 1 7	8			67		0.5	PA			Note: Auto hammer broke. Switched to down hole hammer.
			R-7	1 7 16	23	17	111		24:4					-Wet, very stiff, some fine grained sand, low plasticity, increase in sand at bottom.
20														
	-5		S-8	1 2 4	6									-Brown, fine to medium grained sand.
			R-9	4 8 17	25	23	102	52			PA			-Mottled brown and gray, very stiff, fine grained sand, low plasticity.

GDC_LOG_BORING_2011 L-962_PART 1.GPJ GDCLOG.GDT 1/24/13

GROUP DELTA CONSULTANTS, INC.
370 Amaploa Ave., Suite 212
Torrance, CA 90501

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE
A1-35 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**C-HSA061**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/16/2012	10/16/2012	2 of 2

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85 All Terrain	Hollow Stem Auger	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		8	31.5	16	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-10		S-10	4 4 2	6	36								**Silty Clay (CL)**, mottled gray and brown, wet, medium stiff, trace fine grained sand, low to medium plasticity.
30	-15		R-11	2 7 4	11	38	83		55:27	0.5				**Fat Clay (CH)**, mottled gray and brown, wet, medium stiff, trace fine grained sand, high plasticity.
														Boring terminated 31.5 ft. Groundwater not encountered. Boring backfilled with tamped cuttings.
35	-20													
40	-25													
45	-30													

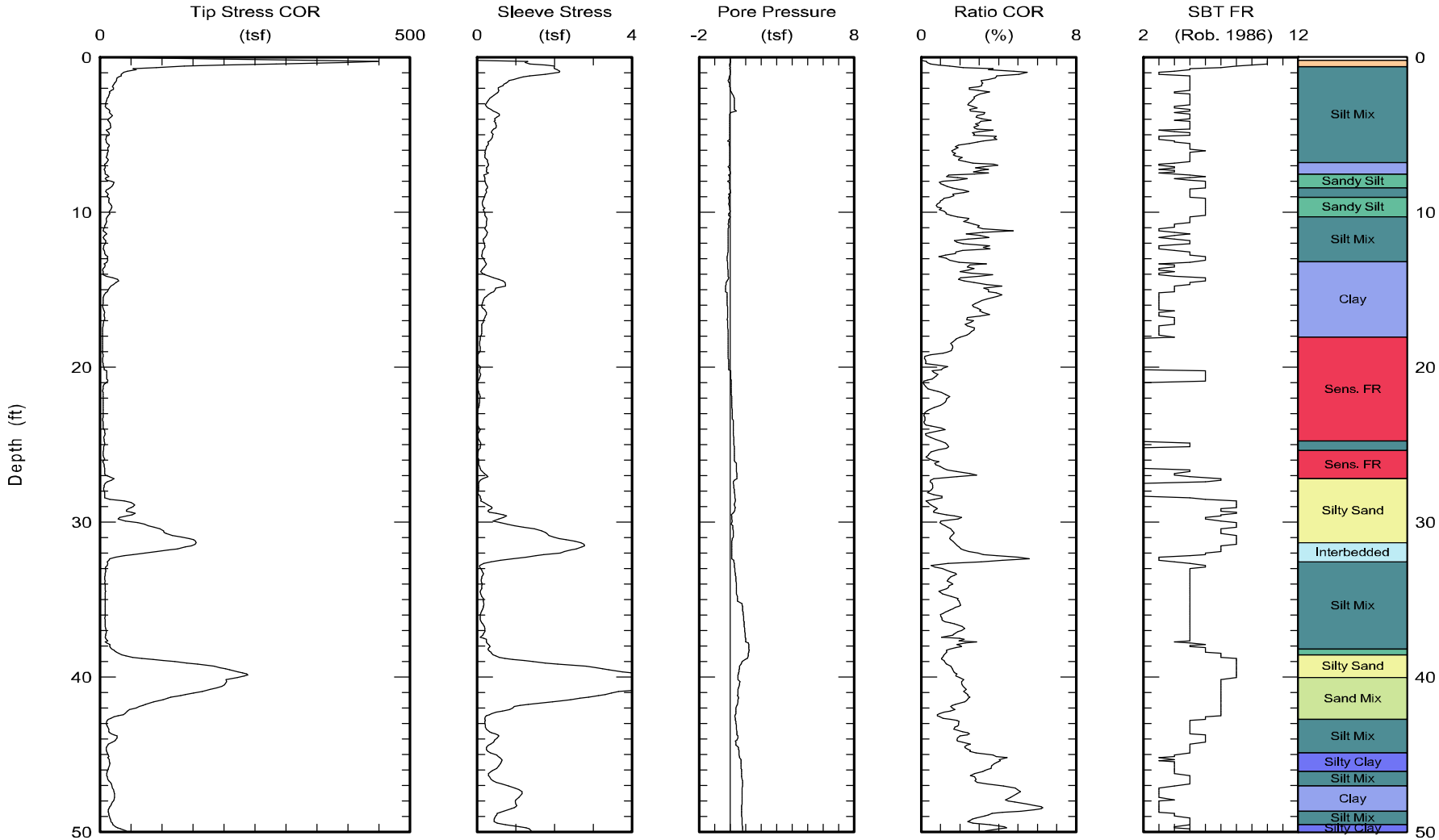
GDC_LOG_BORING_2011 L-962_PART 1.GPJ GDCLOG.GDT 1/24/13

GROUP DELTA CONSULTANTS, INC.
370 Amaploa Ave., Suite 212
Torrance, CA 90501

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE
A1-35 b

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 15/Oct/2012 Test ID: CPT-001 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 70.16 (ft)

FIGURE

A1-36 a

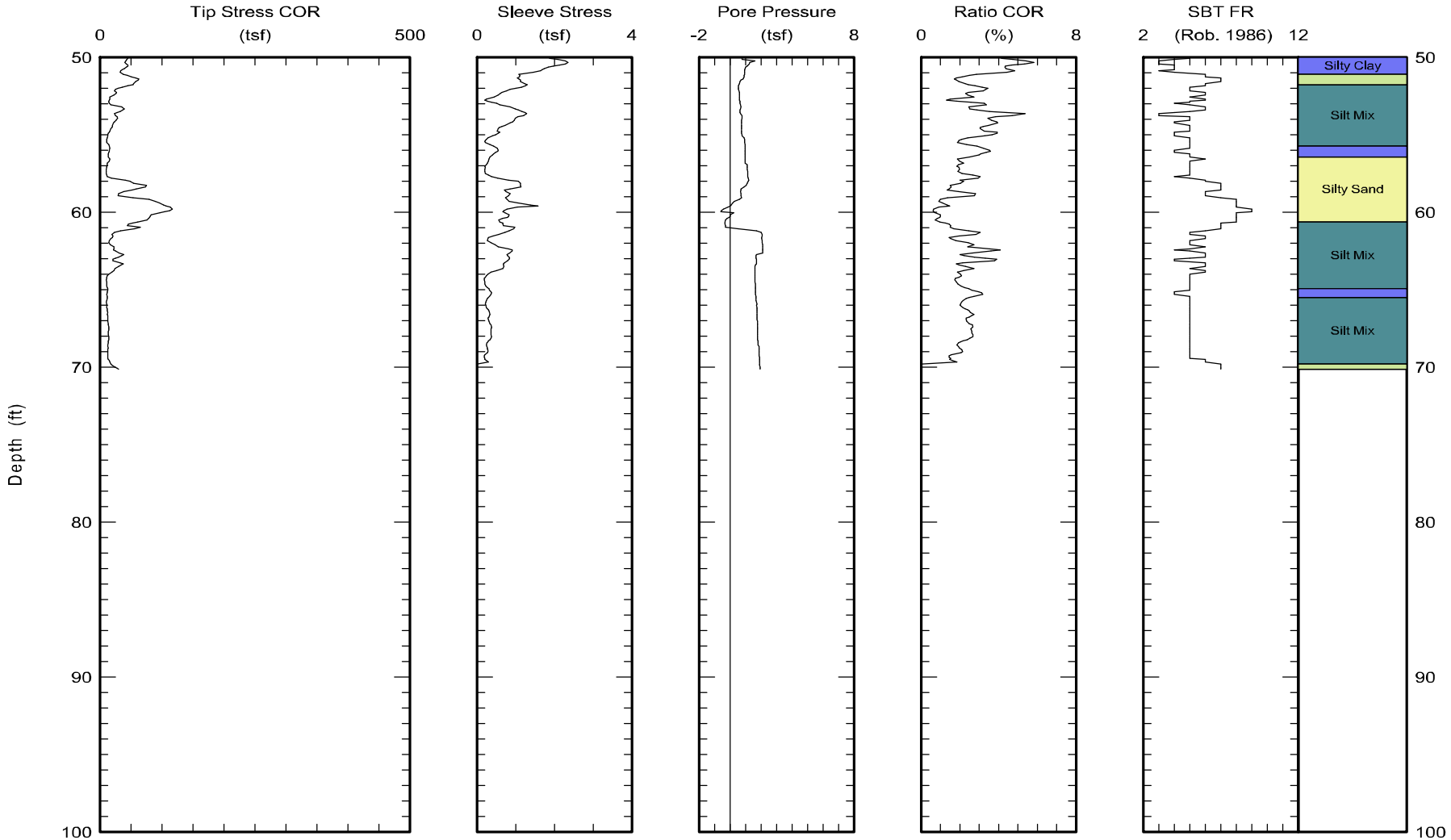
Test ID: CPT-001
File: Z15O1202C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 15/Oct/2012
Test ID: CPT-001
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



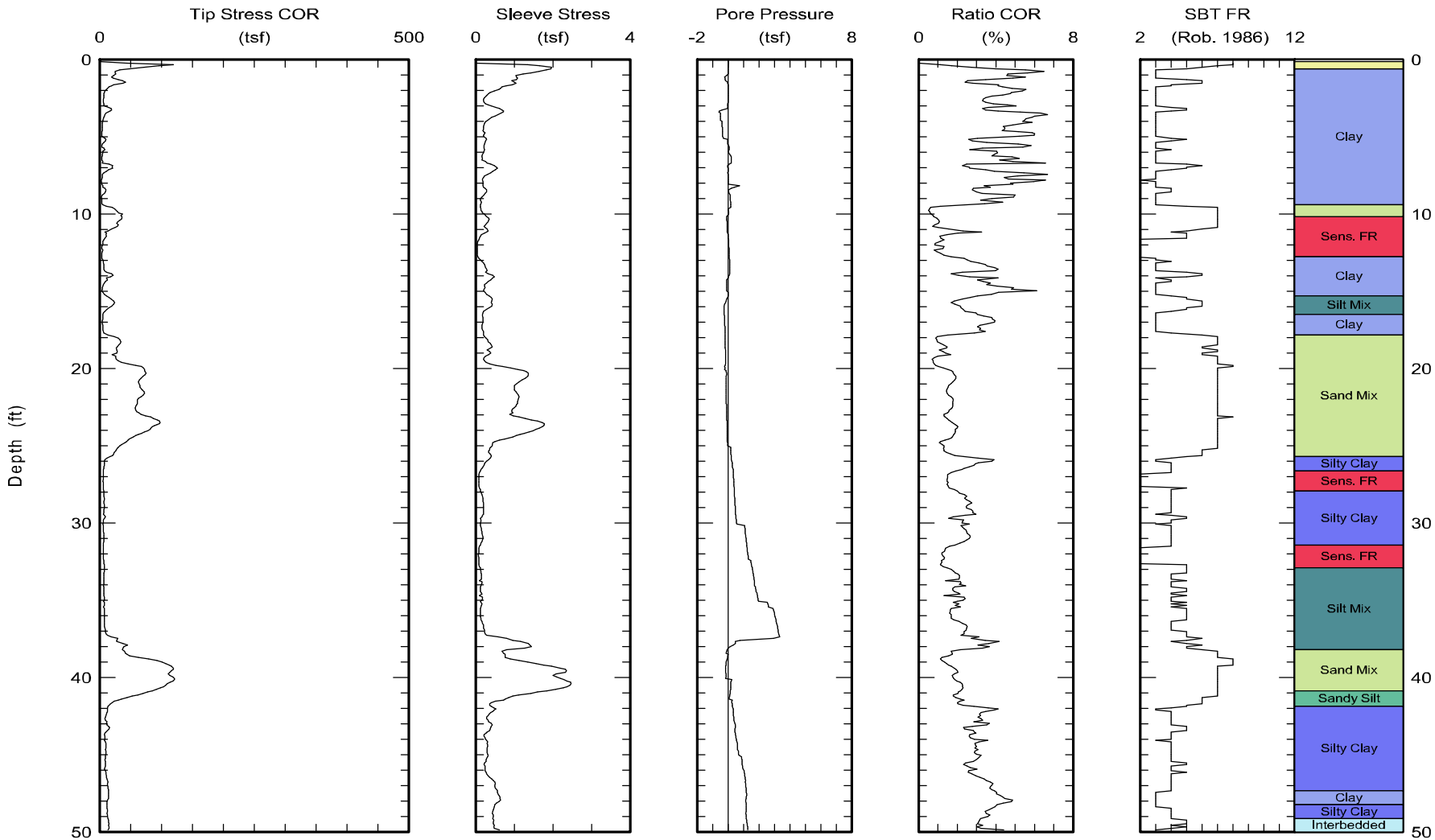
Maximum depth: 70.16 (ft)

FIGURE

A1-36 b

Test ID: CPT-001
File: Z15O1202C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 15/Oct/2012 Test ID: CPT-004 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 68.56 (ft)

FIGURE

A1-37 a

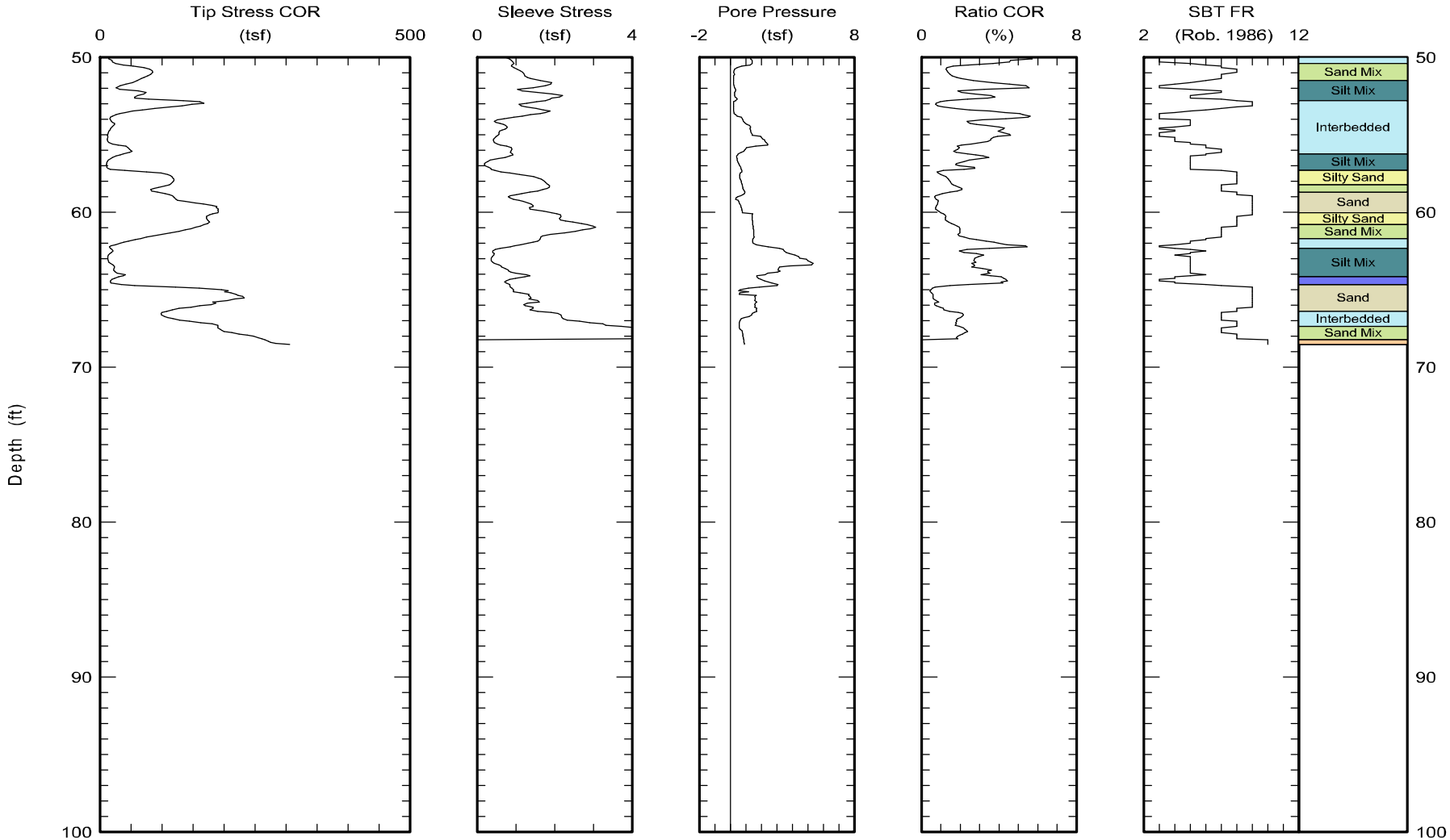
Test ID: CPT-004
File: Z15O1203C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 15/Oct/2012
Test ID: CPT-004
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



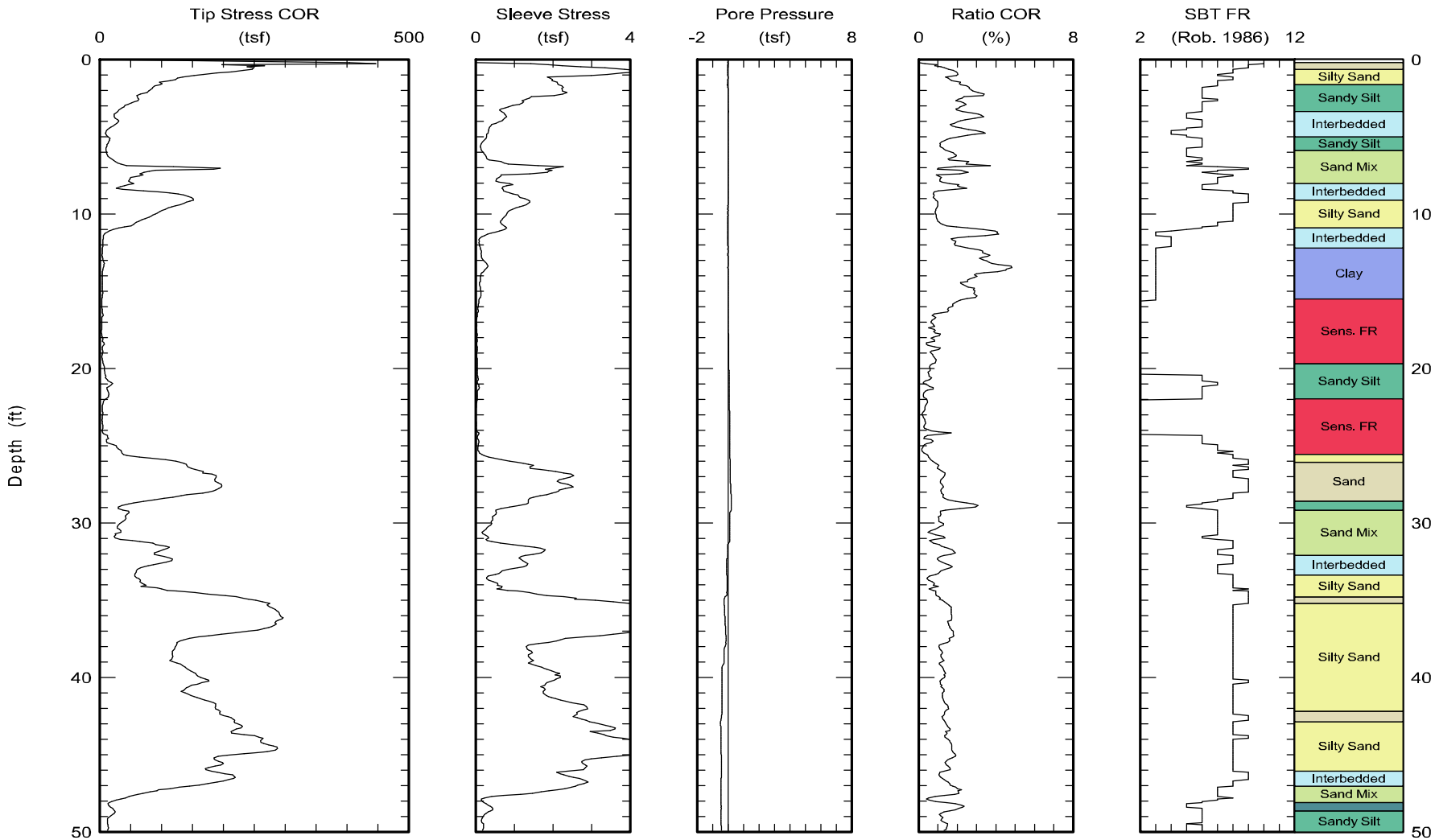
Maximum depth: 68.56 (ft)

FIGURE

A1-37 b

Test ID: CPT-004
File: Z15O1203C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 14/Sep/2012 Test ID: B-CPT-026B Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 52.39 (ft)

FIGURE

A1-38 a

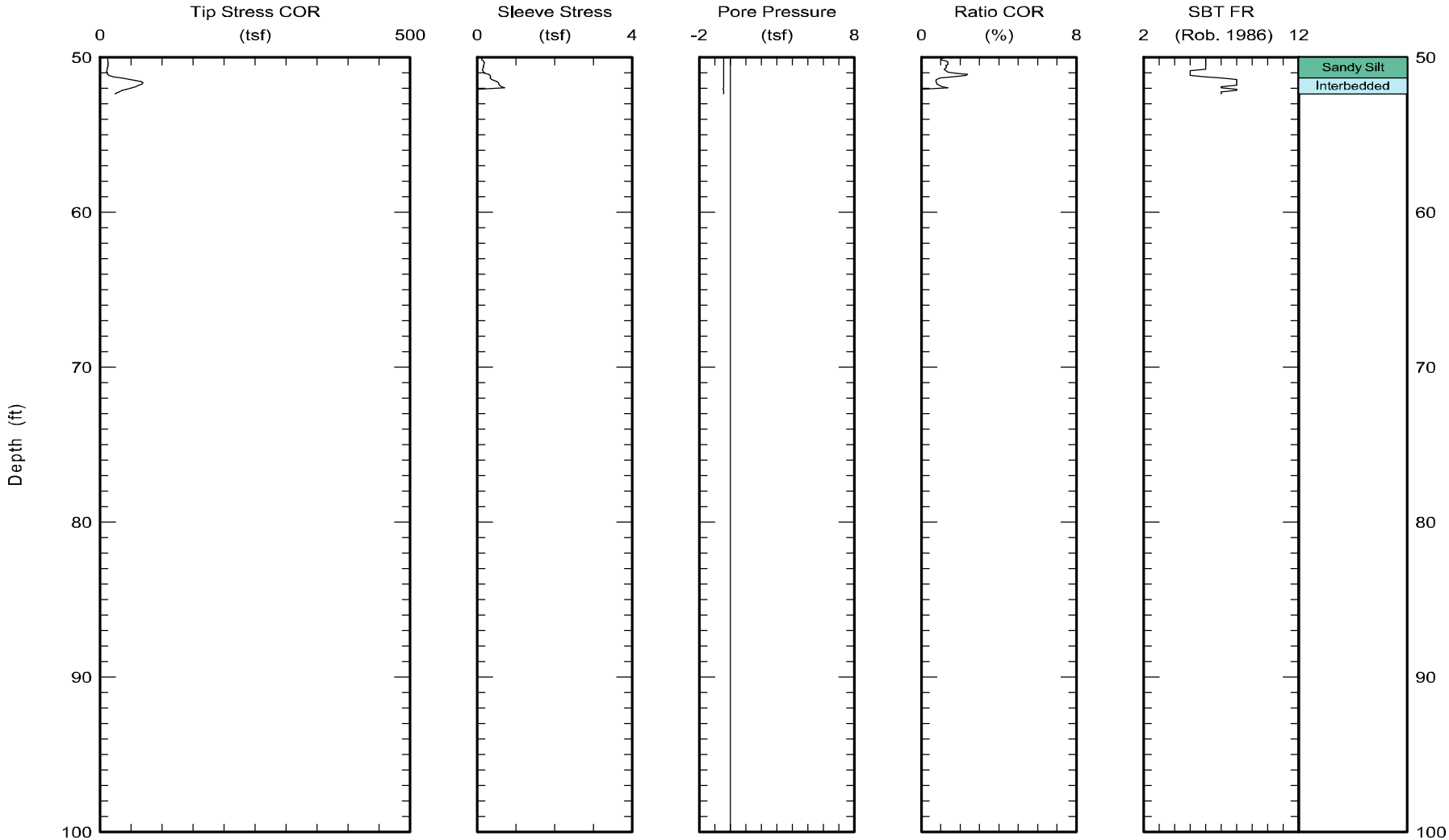
Test ID: B-CPT-026B
File: Z14S1212C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 14/Sep/2012
Test ID: B-CPT-026B
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



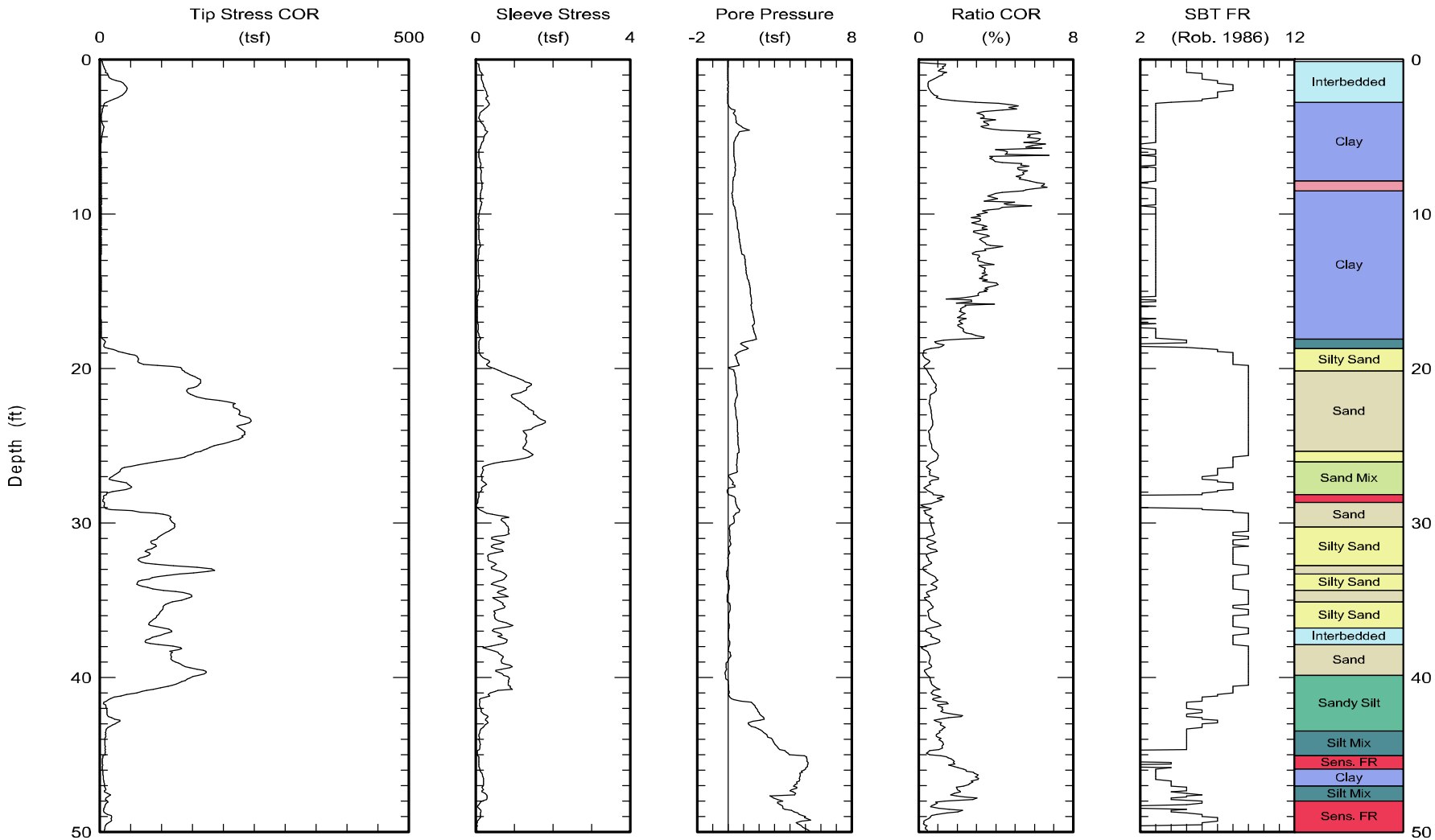
Maximum depth: 52.39 (ft)

FIGURE

A1-38 b

Test ID: B-CPT-026B
File: Z14S1212C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 10/Oct/2012 Test ID: CPT-031 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 69.62 (ft)

FIGURE

A1-39 a

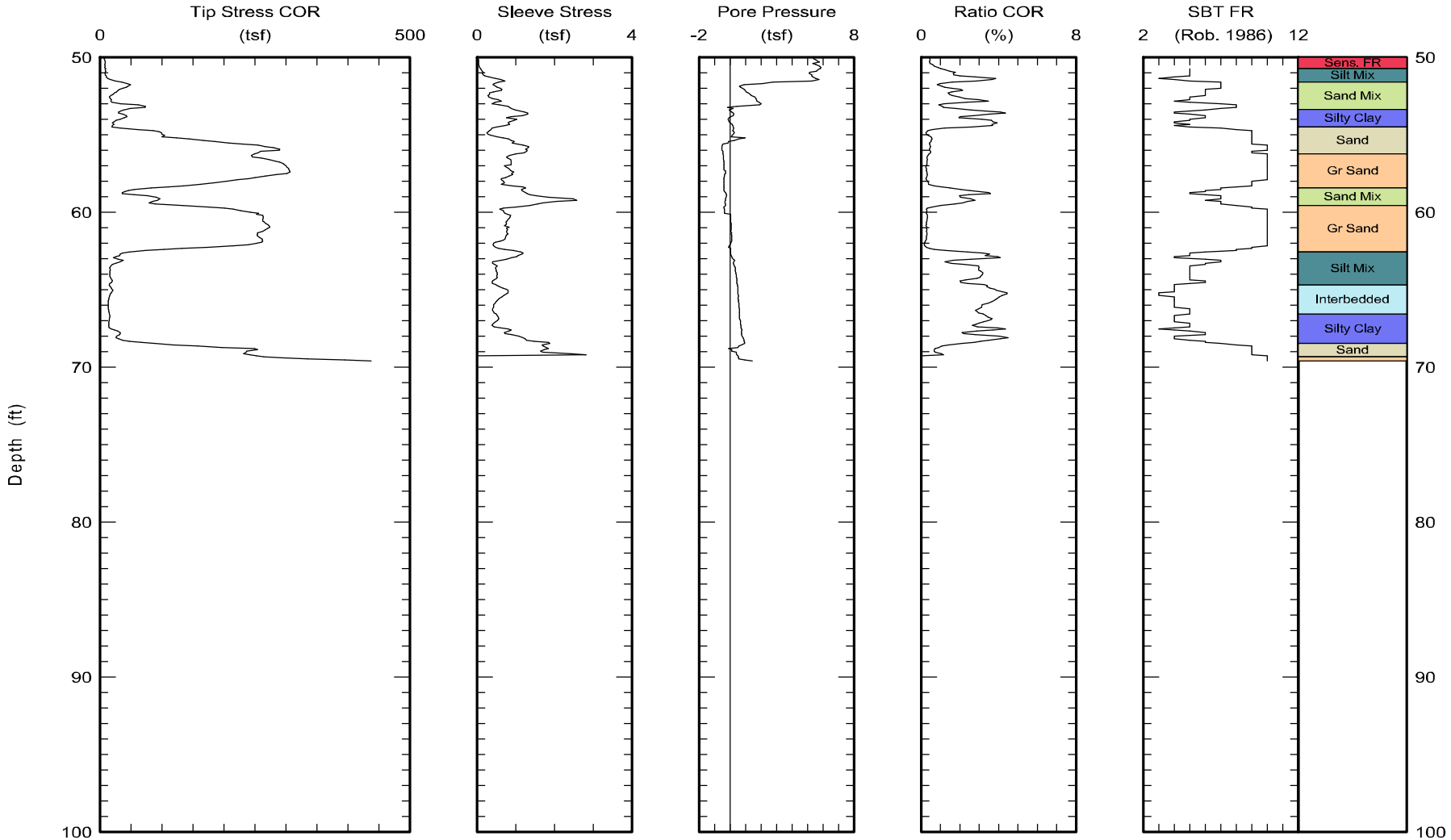
Test ID: CPT-031
File: Z10O1201C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 10/Oct/2012
Test ID: CPT-031
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 69.62 (ft)
Page 2 of 2

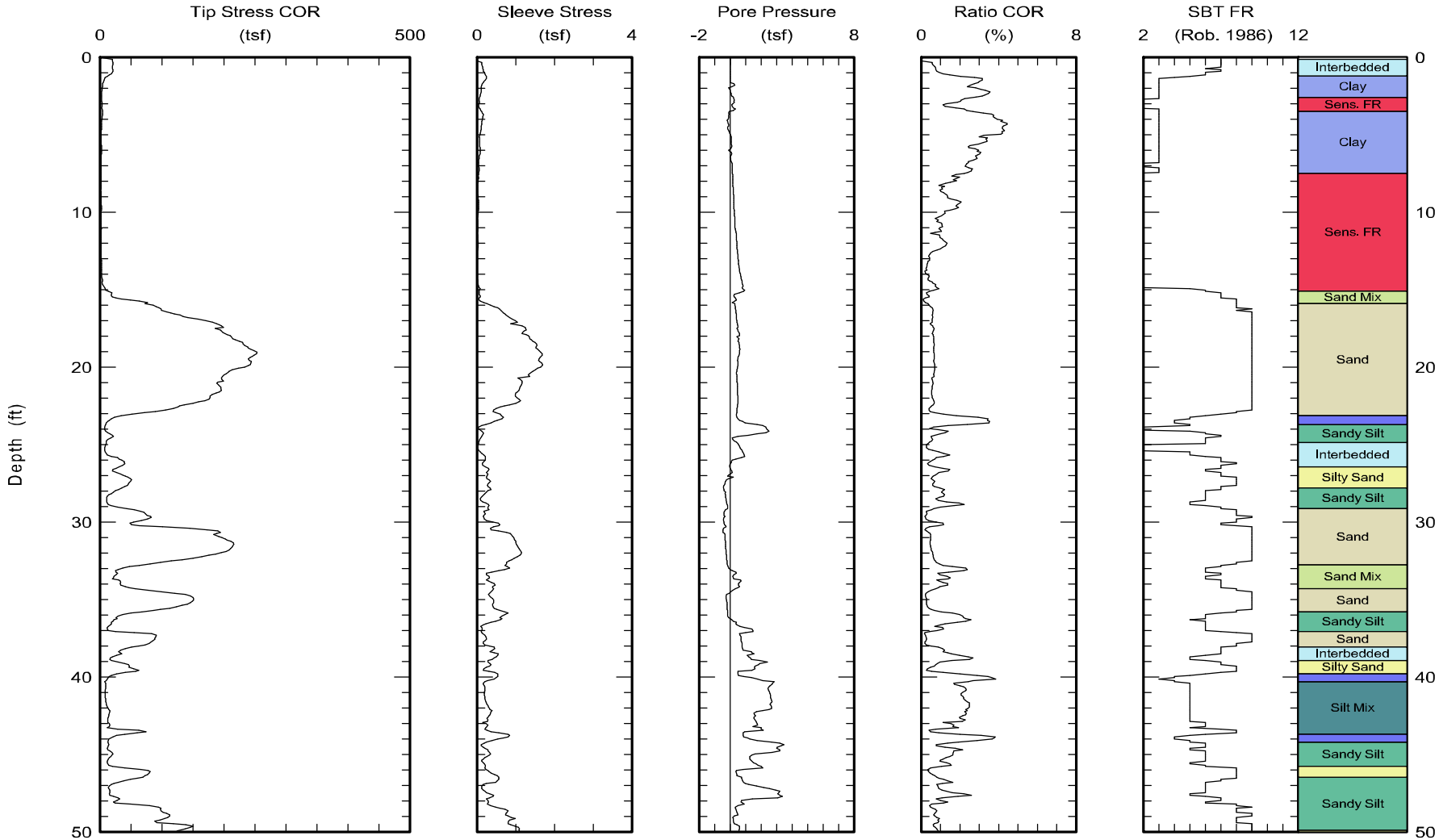
FIGURE

A1-39 b

B1-482

Test ID: CPT-031
File: Z10O1201C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 13/Sep/2012 Test ID: B-CPT-034 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



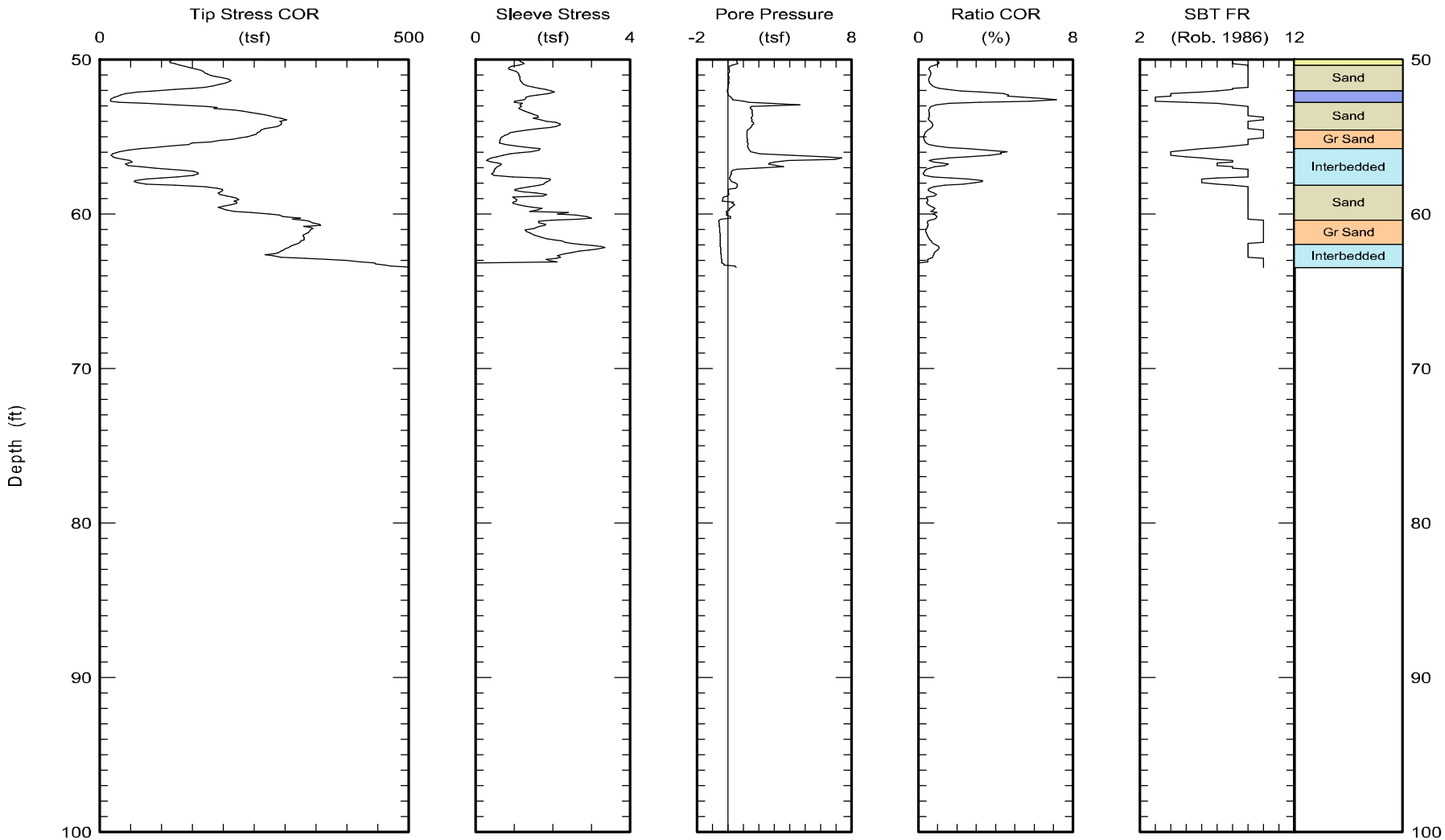
Maximum depth: 63.48 (ft)

FIGURE

A1-40 a

Test ID: B-CPT-034
File: Z13S1202C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 13/Sep/2012 Test ID: B-CPT-034 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 63.48 (ft)

FIGURE

A1-40 b

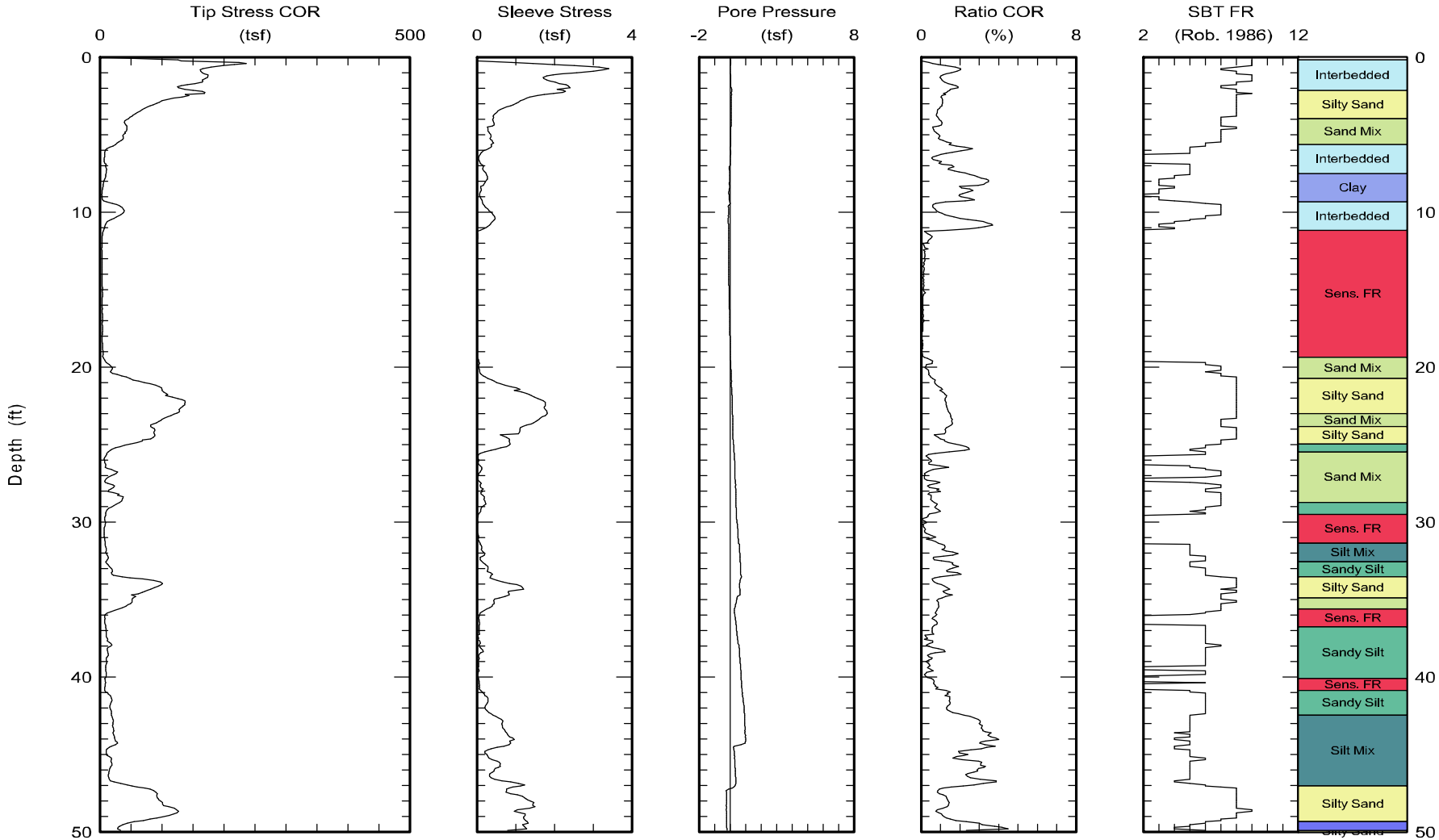
Test ID: B-CPT-034
File: Z13S1202C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 13/Sep/2012
Test ID: B-CPT-035
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



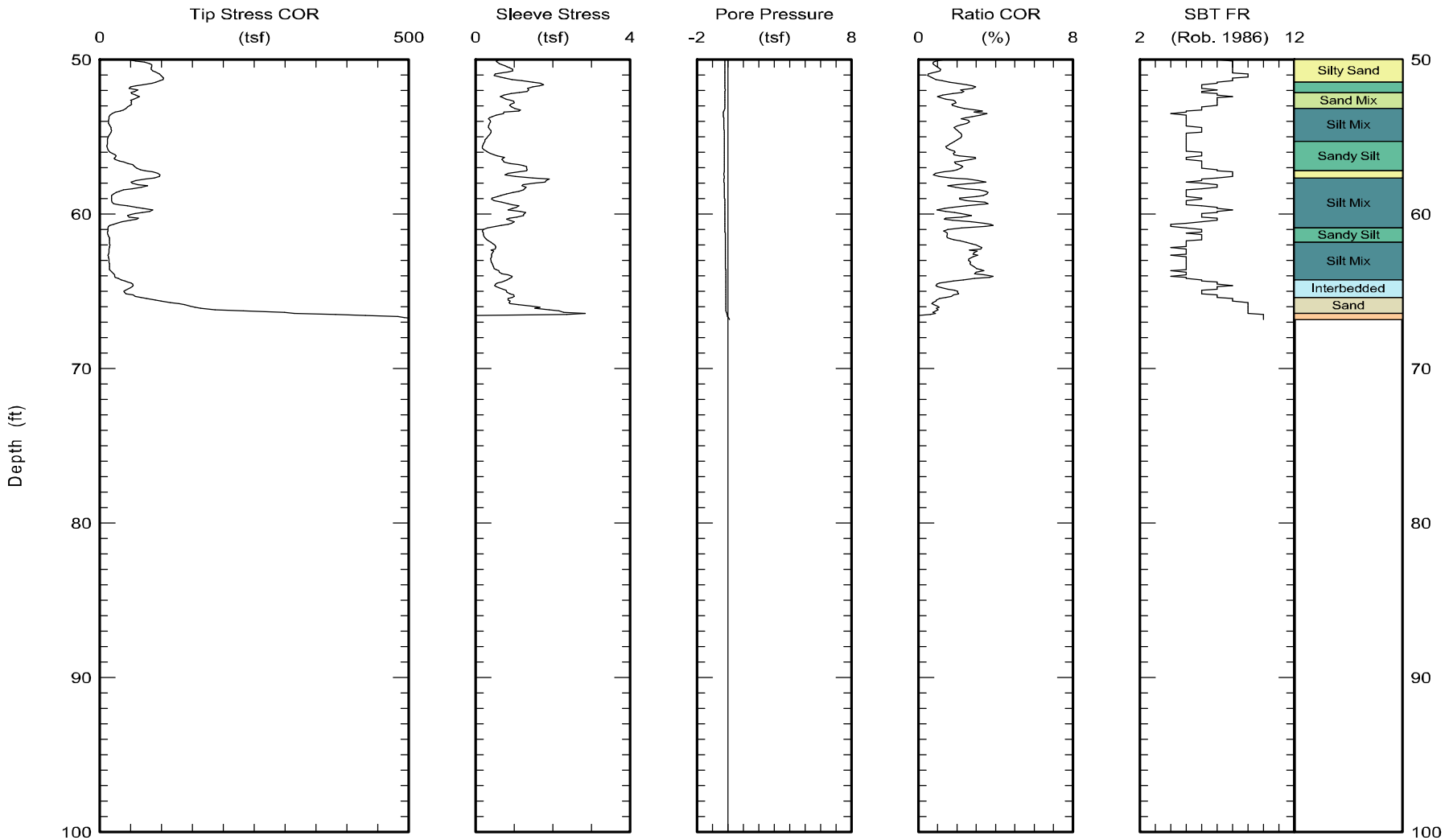
Maximum depth: 66.86 (ft)

FIGURE

A1-41 a

Test ID: B-CPT-035
File: Z13S1205C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 13/Sep/2012 Test ID: B-CPT-035 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



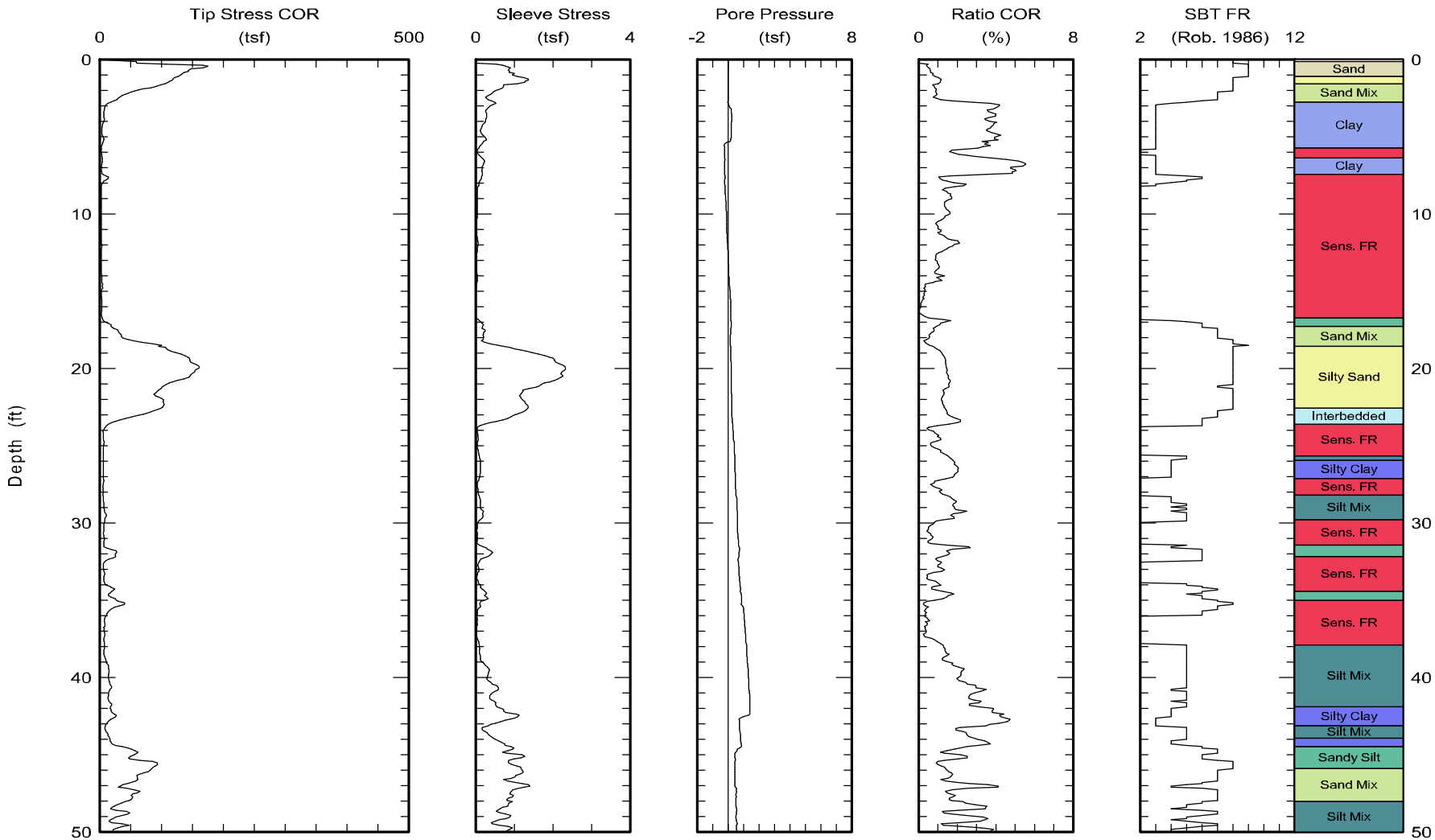
Maximum depth: 66.86 (ft)

FIGURE

A1-41 b

Test ID: B-CPT-035
File: Z13S1205C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 13/Sep/2012 Test ID: B-CPT-037 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



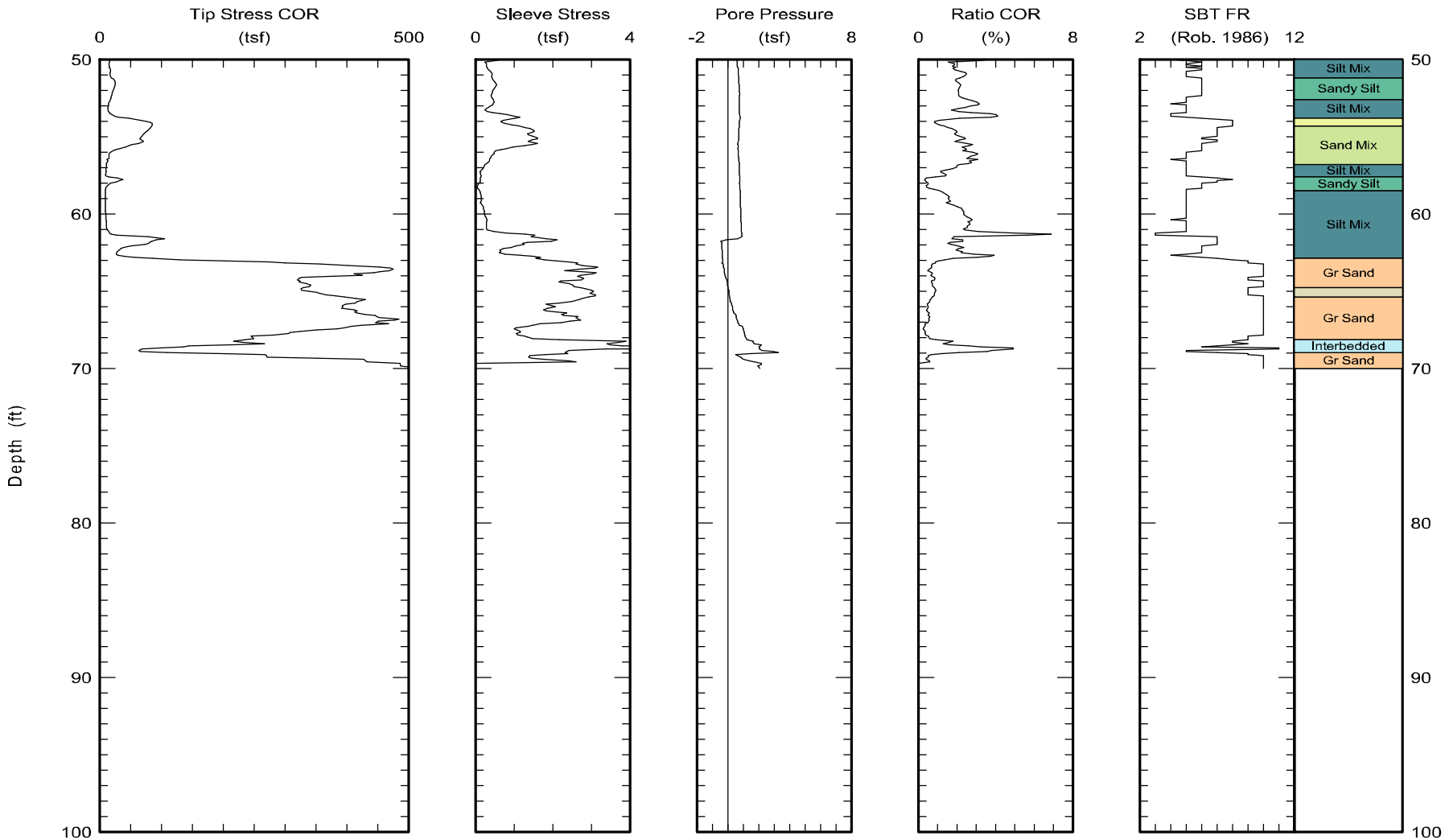
Maximum depth: 70.01 (ft)

FIGURE

A1-42 a

Test ID: B-CPT-037
File: Z13S1203C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 13/Sep/2012 Test ID: B-CPT-037 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 70.01 (ft)

FIGURE

A1-42 b

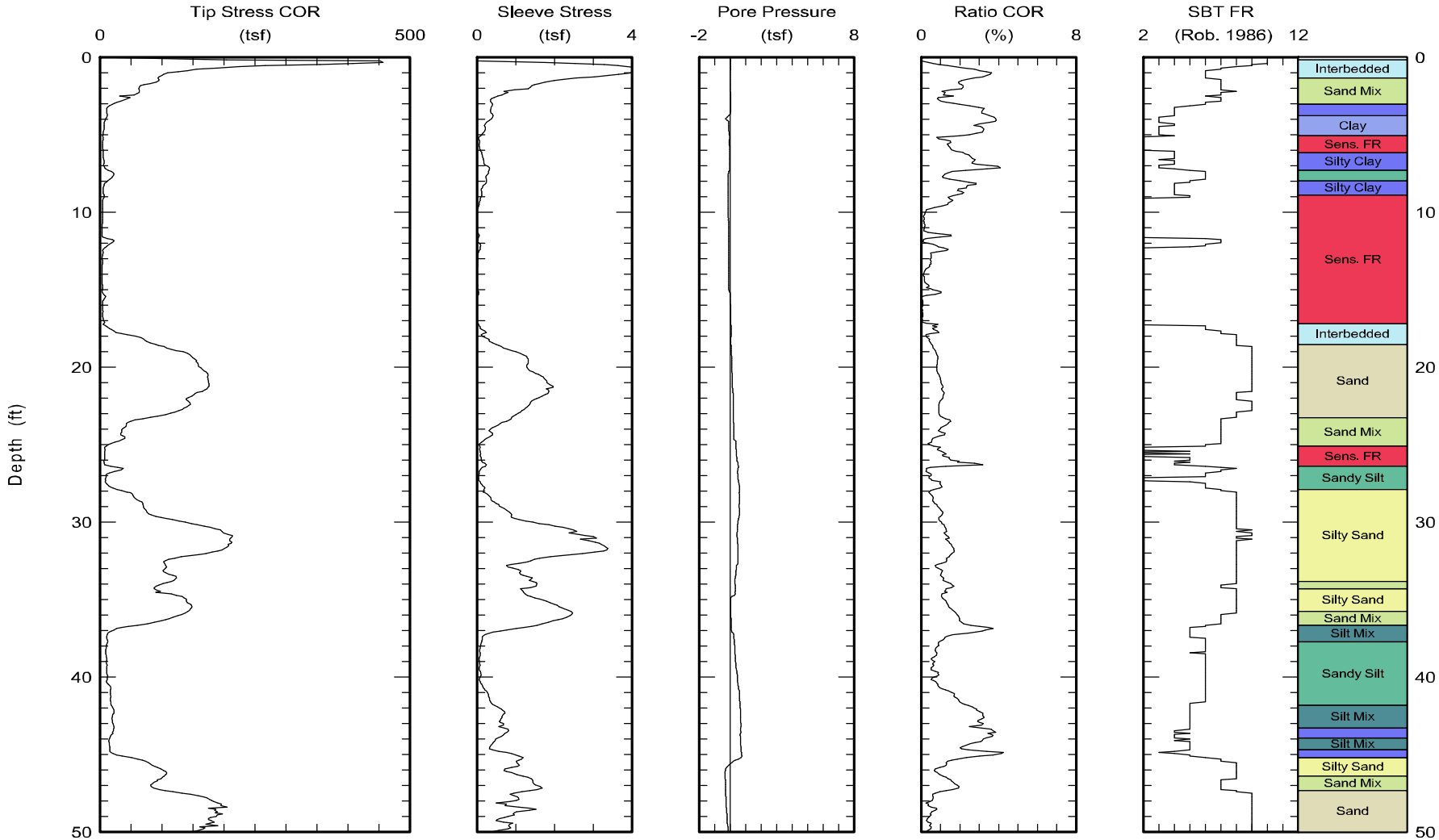
Test ID: B-CPT-037
File: Z13S1203C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 13/Sep/2012
Test ID: B-CPT-038
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 67.93 (ft)

FIGURE

A1-43 a

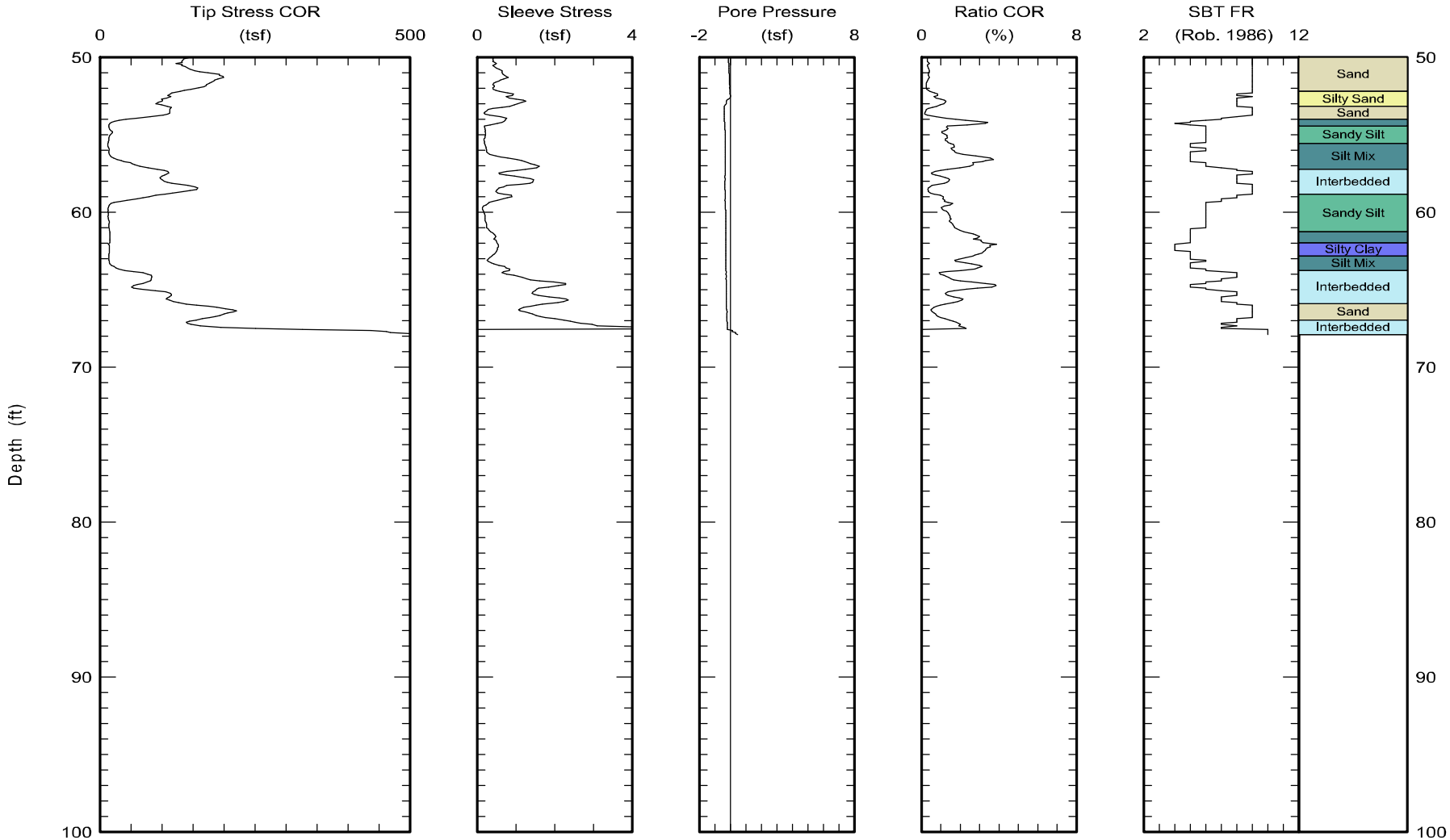
Test ID: B-CPT-038
File: Z13S1204C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 13/Sep/2012
Test ID: B-CPT-038
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 67.93 (ft)

FIGURE

A1-43 b

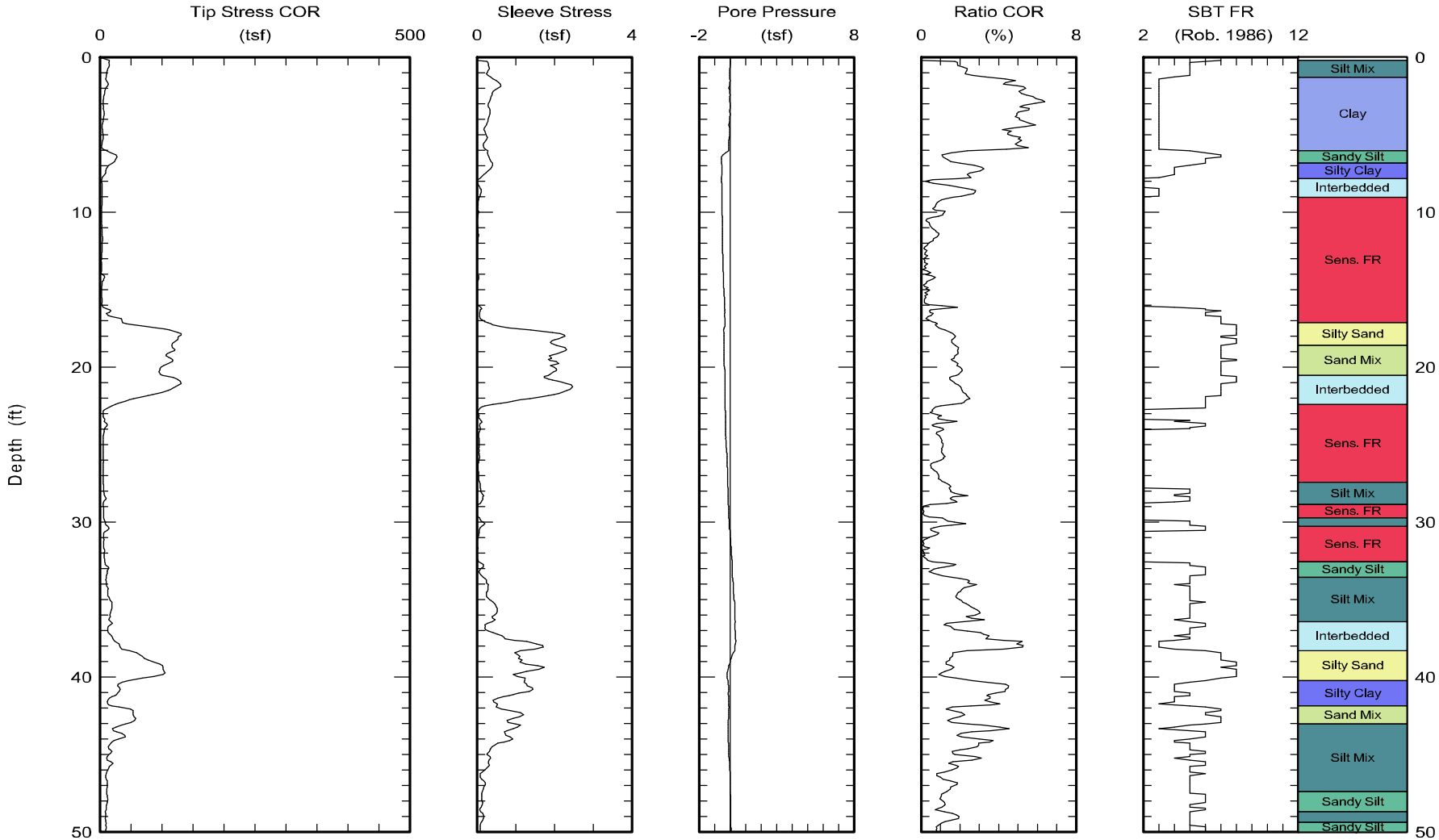
Test ID: B-CPT-038
File: Z13S1204C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 15/Oct/2012
Test ID: CPT-040
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 59.88 (ft)

FIGURE

A1-44 a

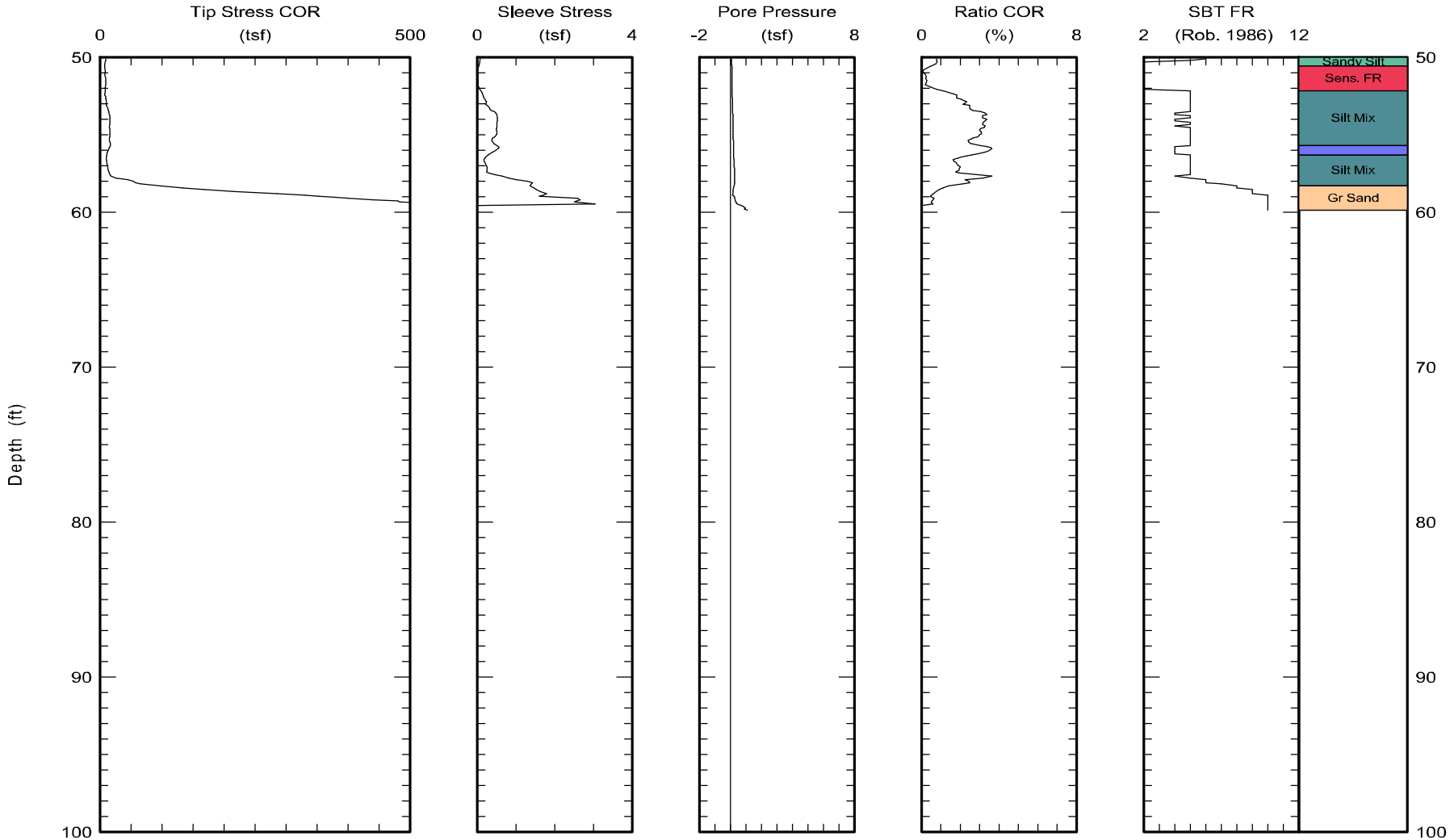
Test ID: CPT-041
File: Z15O1209C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 15/Oct/2012
Test ID: CPT-040
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 59.88 (ft)

FIGURE

A1-44 b

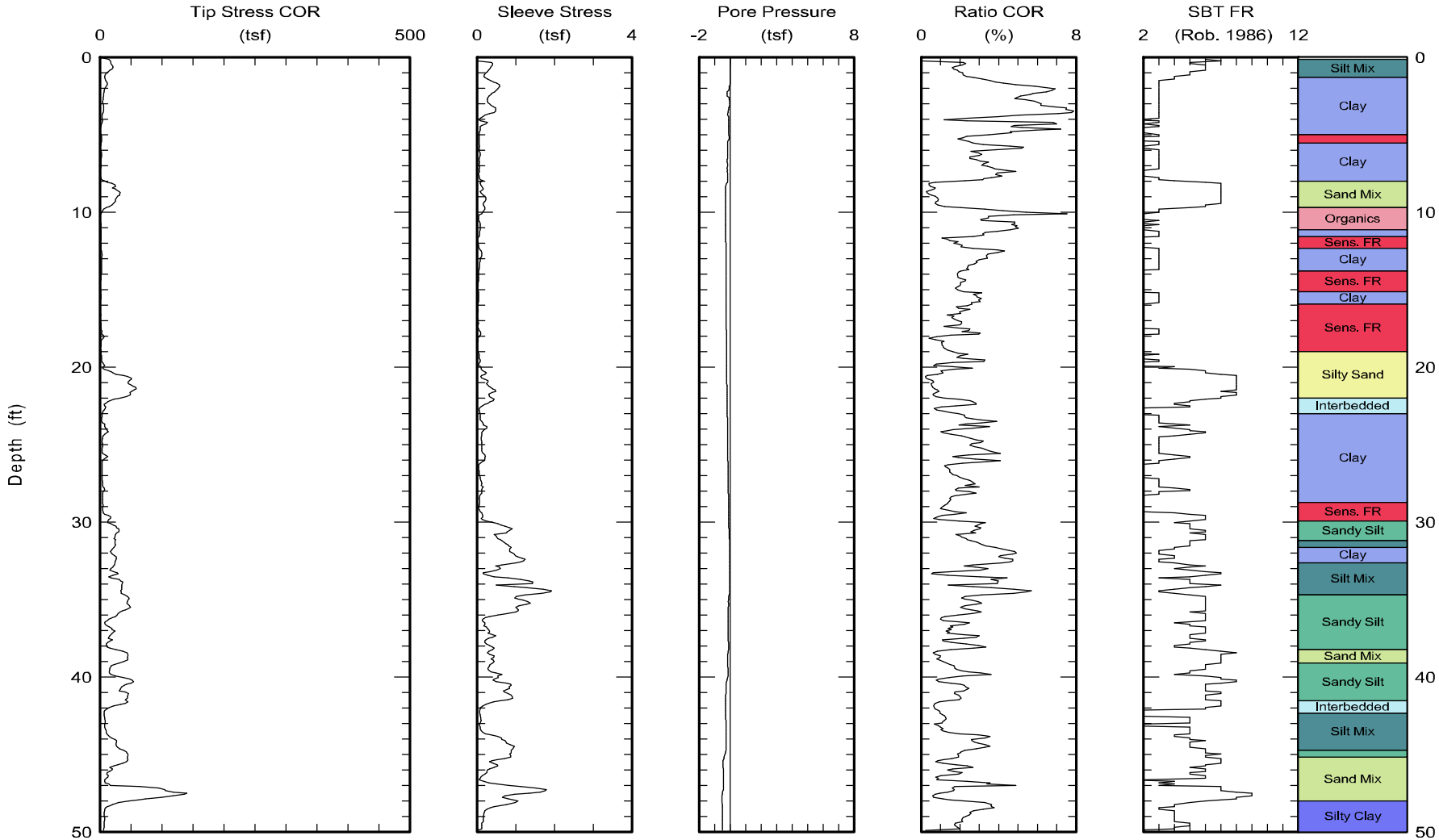
Test ID: CPT-041
File: Z15O1209C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 13/Sep/2012
Test ID: B-CPT-045
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 60.03 (ft)

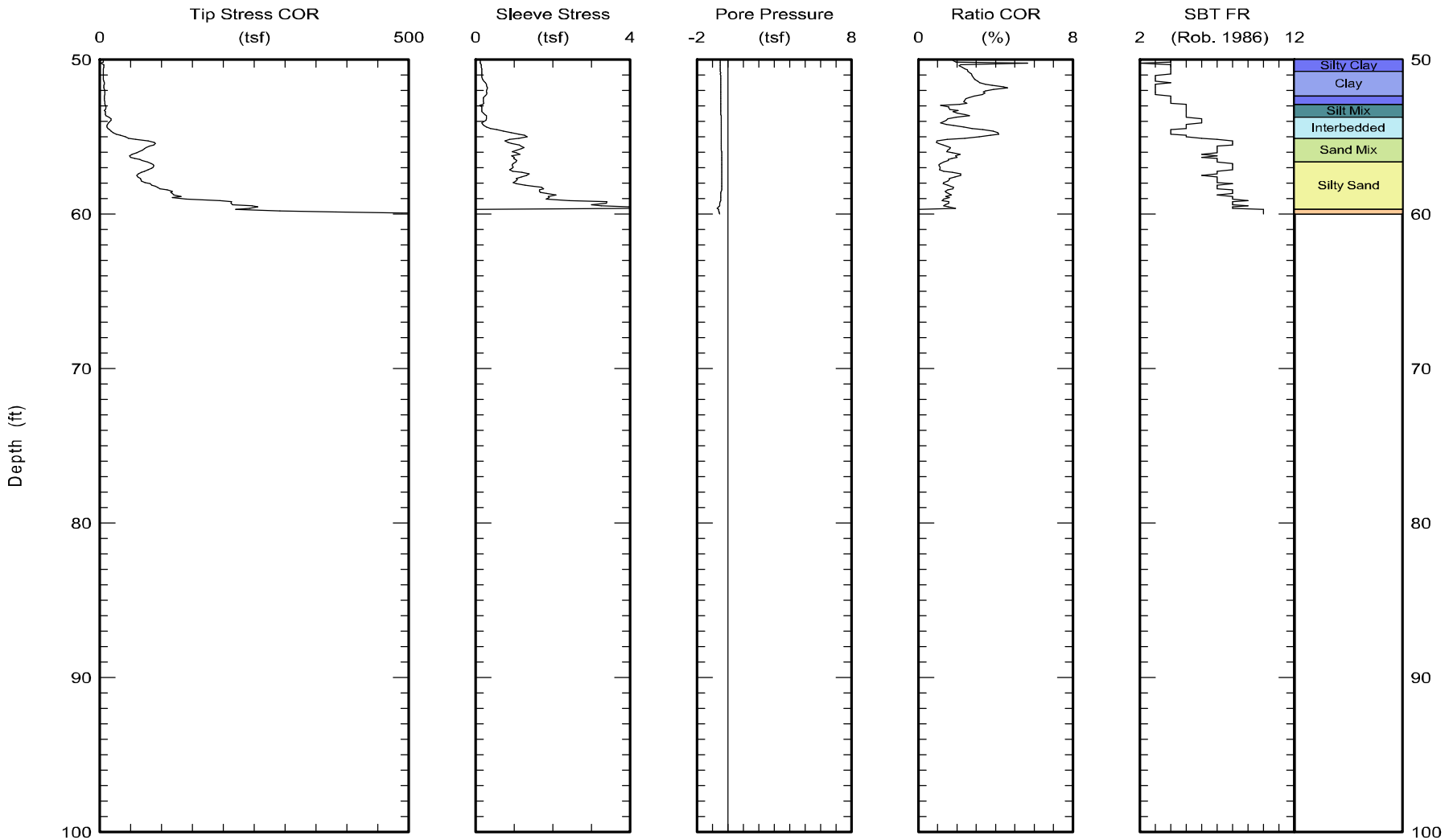
FIGURE

A1-45 a

B1-493

Test ID: B-CPT-045
File: Z13S1207C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 13/Sep/2012 Test ID: B-CPT-045 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 60.03 (ft)

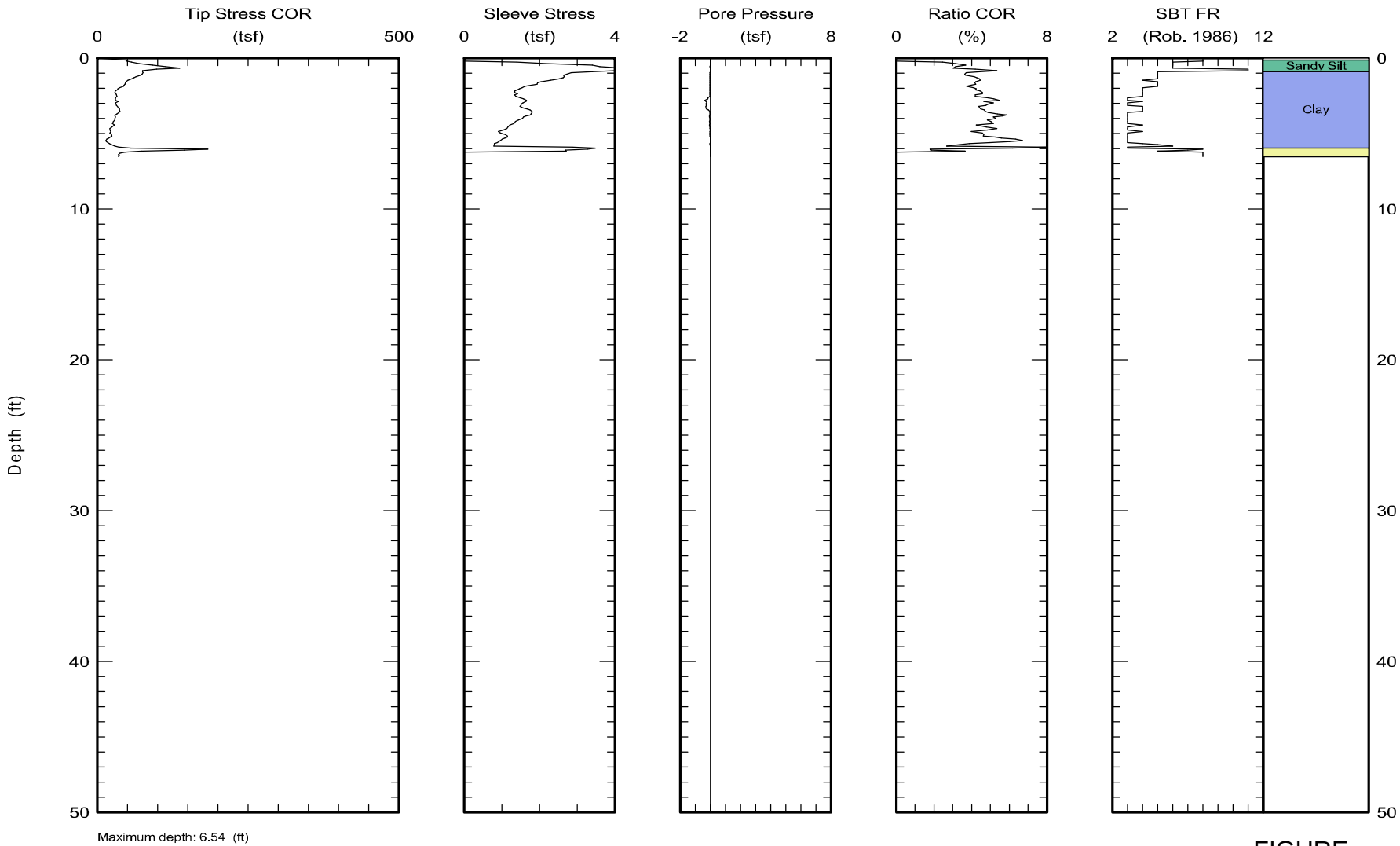
FIGURE

A1-45 b

B1-494

Test ID: B-CPT-045
File: Z13S1207C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 15/Oct/2012 Test ID: CPT-046C Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	

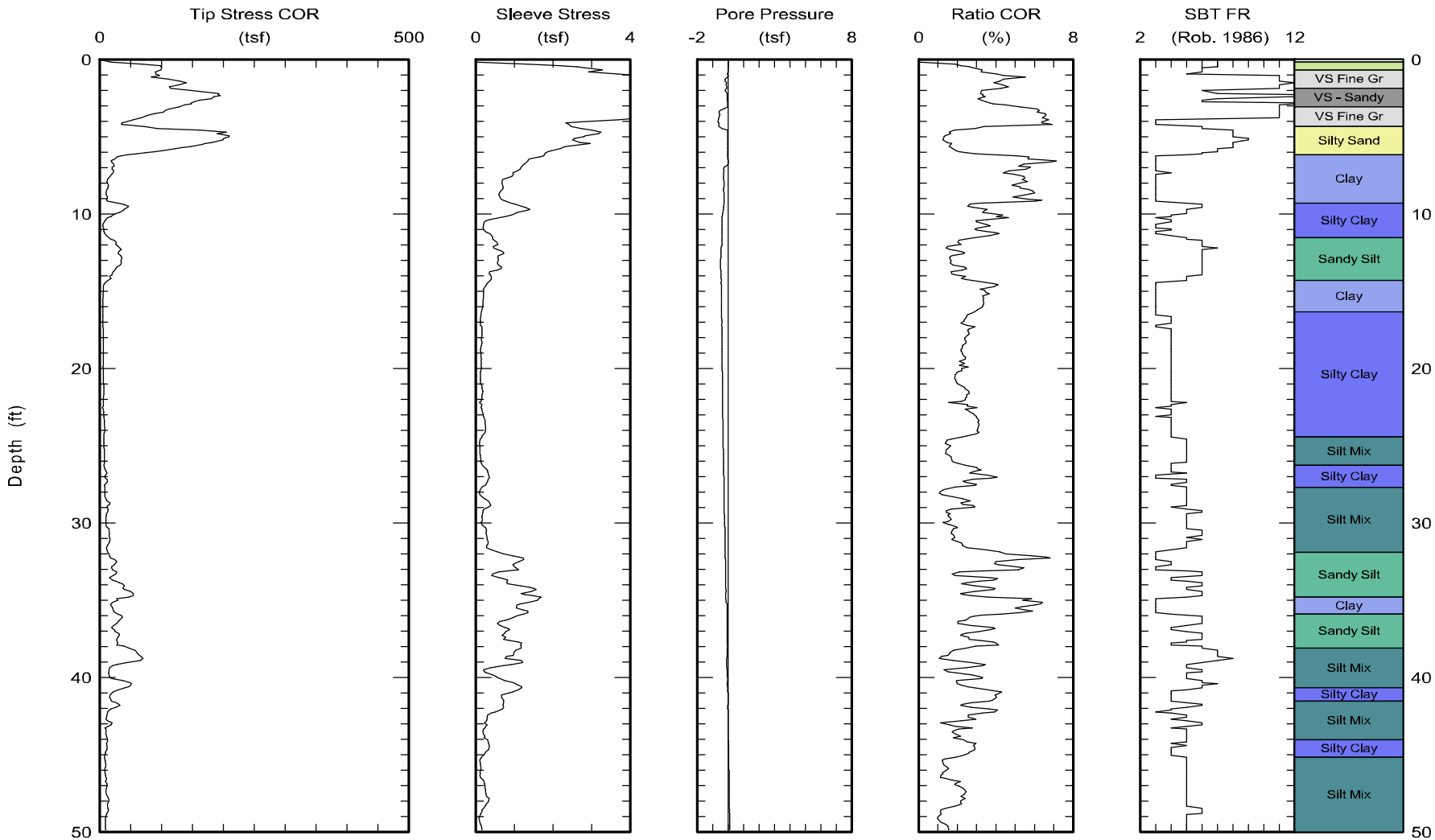


FIGURE

A1-46

Test ID: CPT-046C
File: Z15O1208C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 15/Oct/2012 Test ID: CPT-048 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 62.85 (ft)

FIGURE

A1-47 a

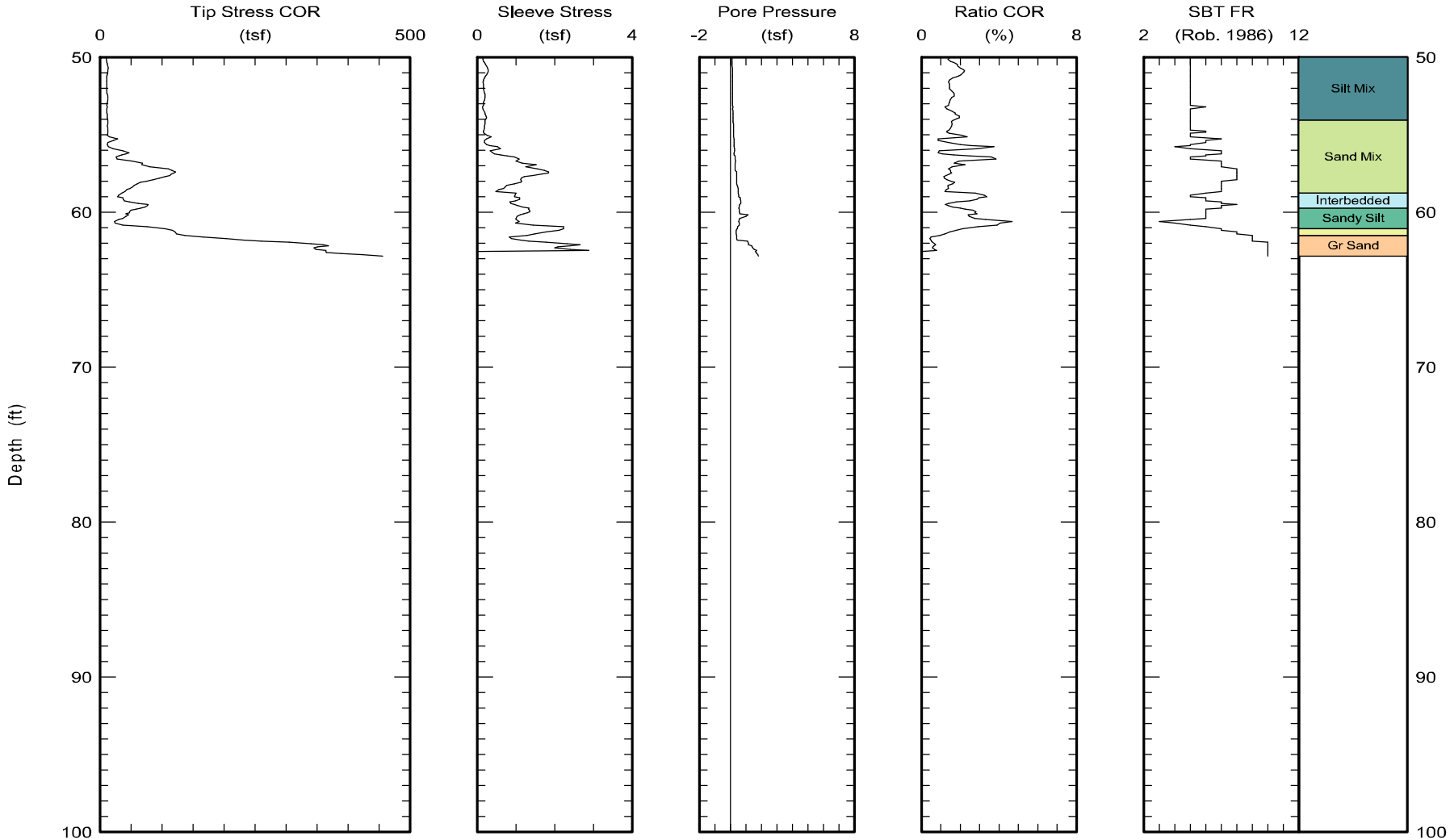
Test ID: CPT-048
File: Z15O1204C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 15/Oct/2012
Test ID: CPT-048
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 62.85 (ft)
Page 2 of 2

FIGURE

A1-47 b

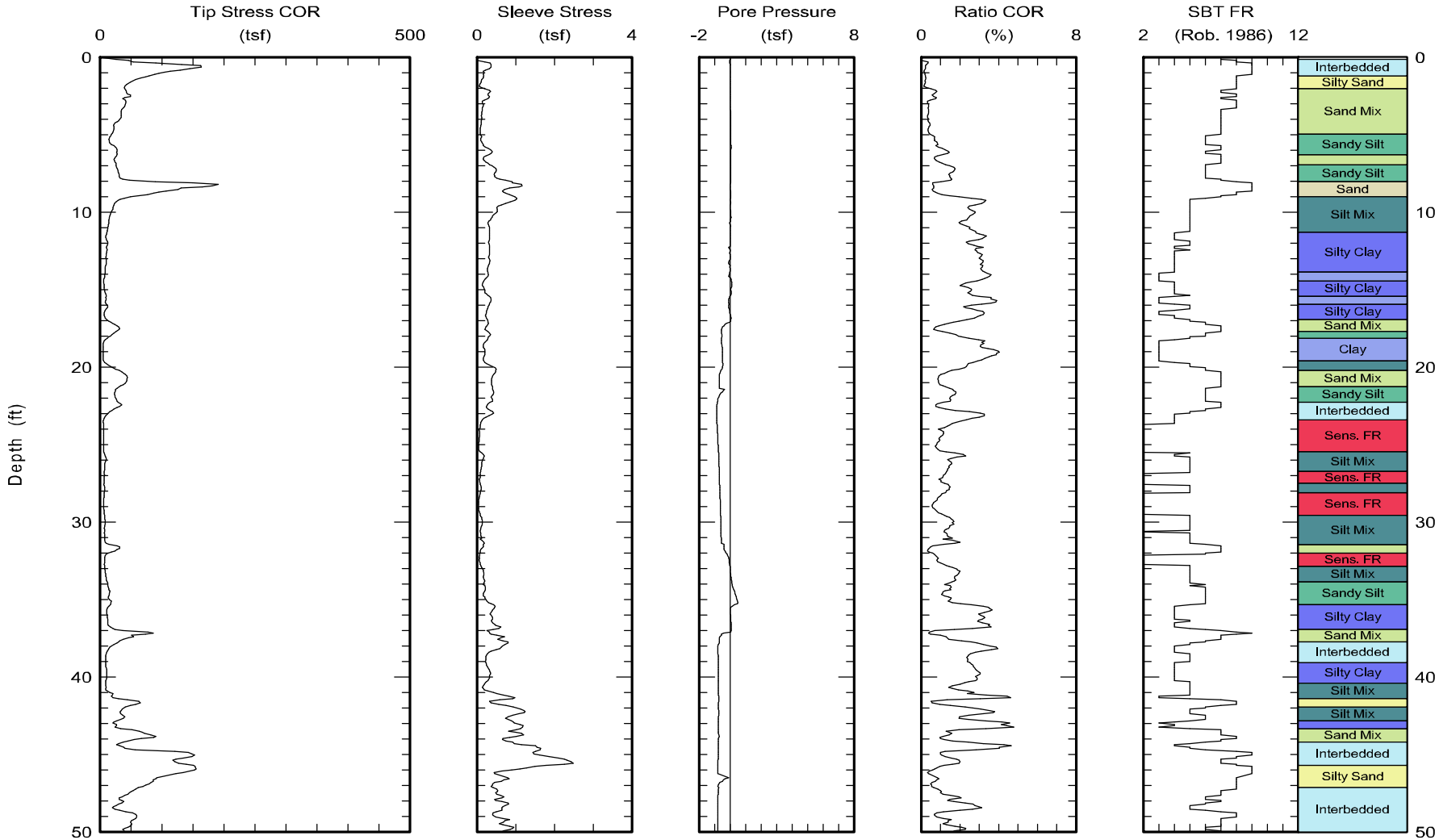
Test ID: CPT-048
File: Z15O1204C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 14/Sep/2012
Test ID: B-CPT-050
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 64.39 (ft)

FIGURE

A1-48 a

B1-498

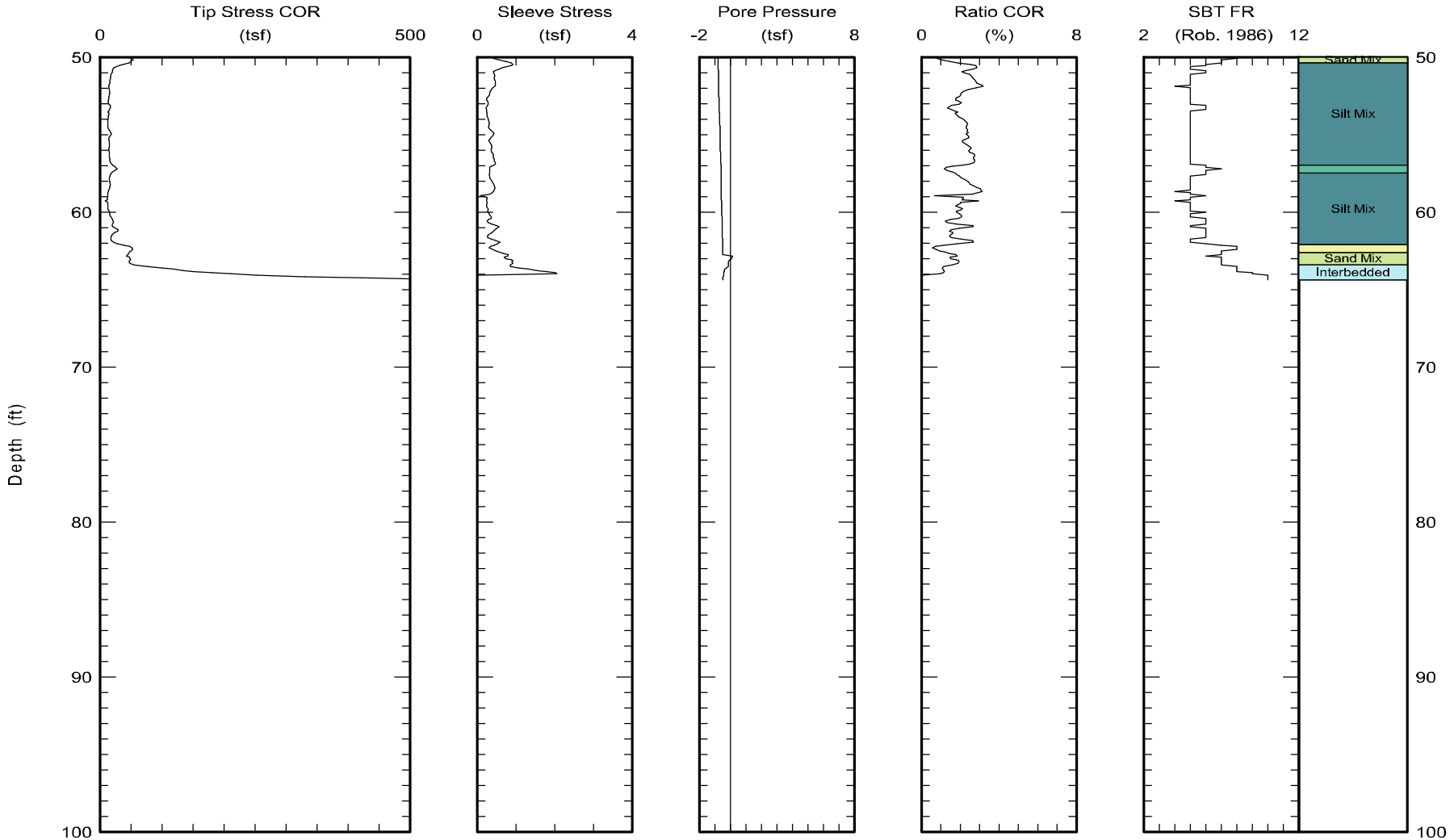
Test ID: B-CPT-050
File: Z14S1201C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 14/Sep/2012
Test ID: B-CPT-050
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 64.39 (ft)

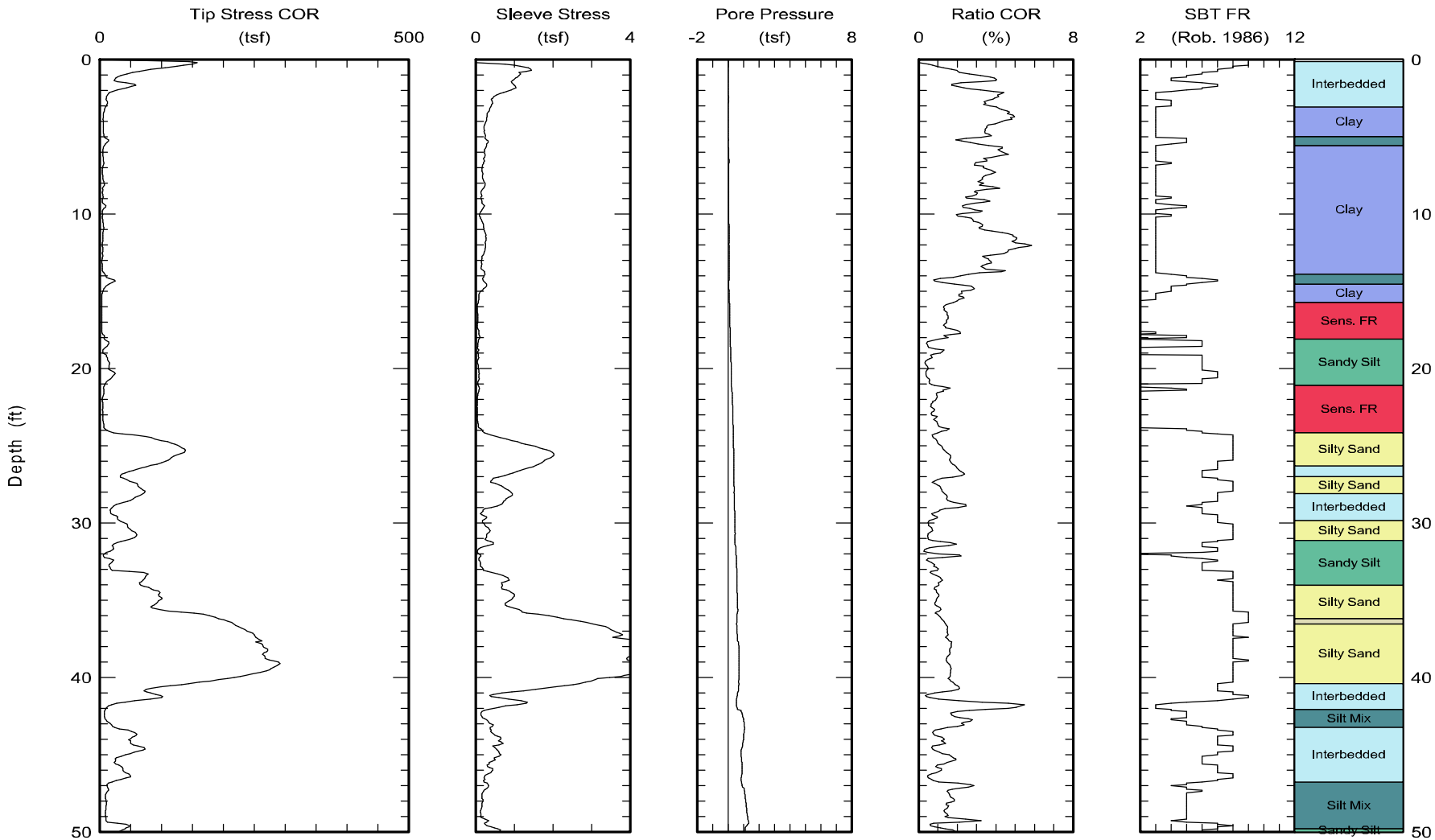
FIGURE

B1-499

A1-48 b

Test ID: B-CPT-050
File: Z14S1201C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 14/Sep/2012 Test ID: B-CPT-052 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 70.14 (ft)

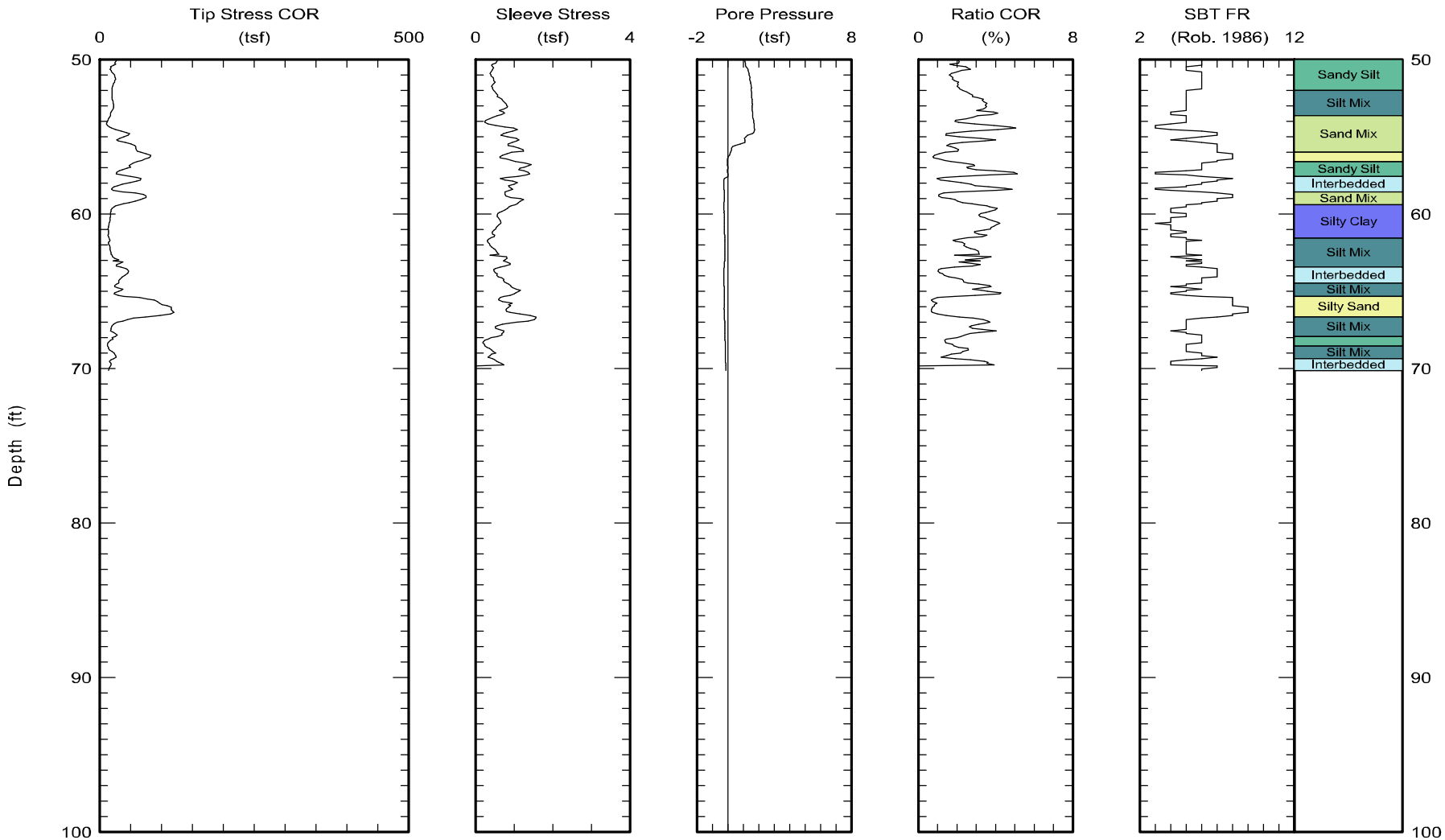
FIGURE

A1-49 a

B1-500

Test ID: B-CPT-052
File: Z14S1209C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 14/Sep/2012 Test ID: B-CPT-052 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 70.14 (ft)

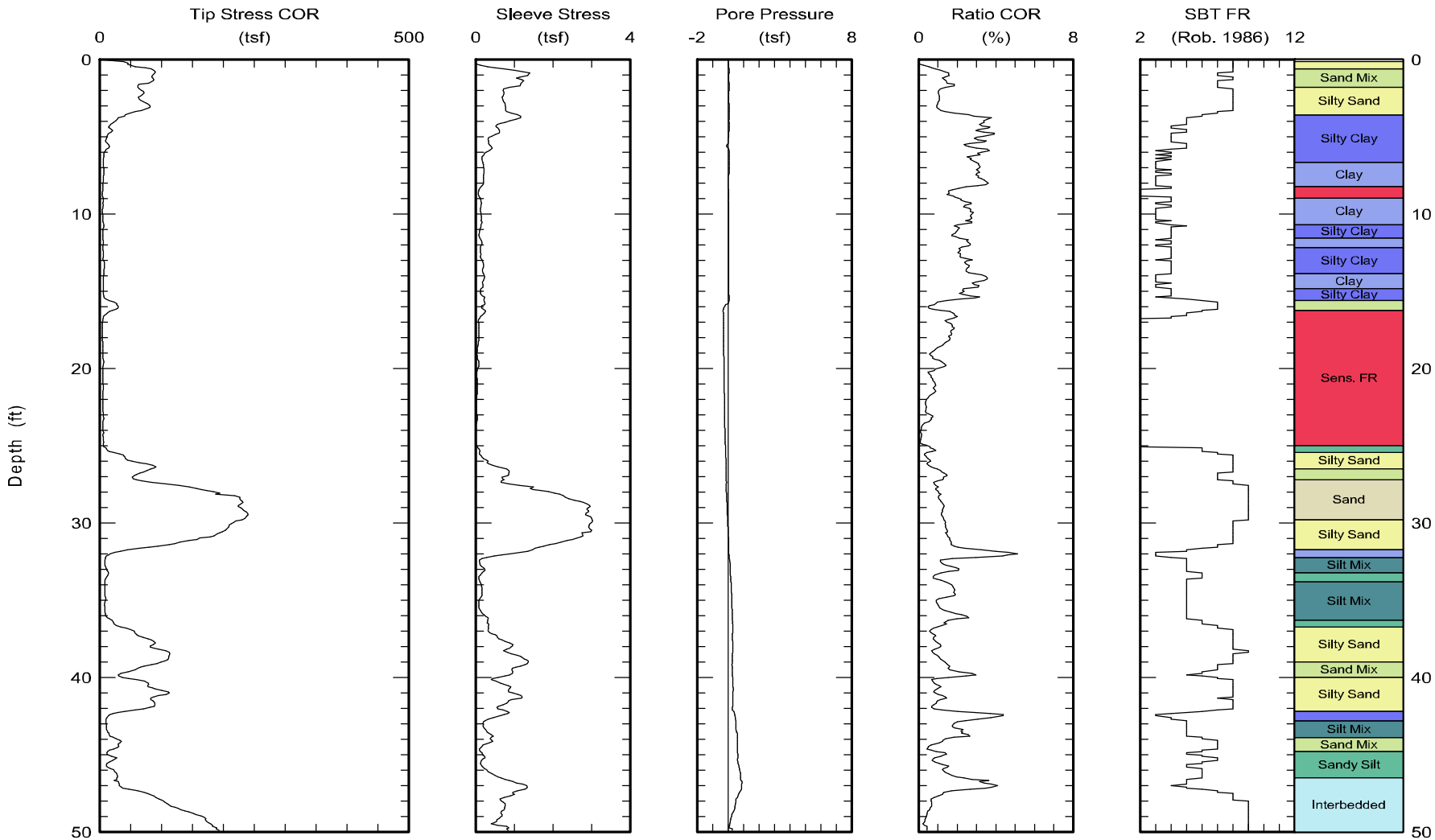
FIGURE

A1-49 b

B1-501

Test ID: B-CPT-052
File: Z14S1209C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 14/Sep/2012 Test ID: B-CPT-054 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 70.15 (ft)

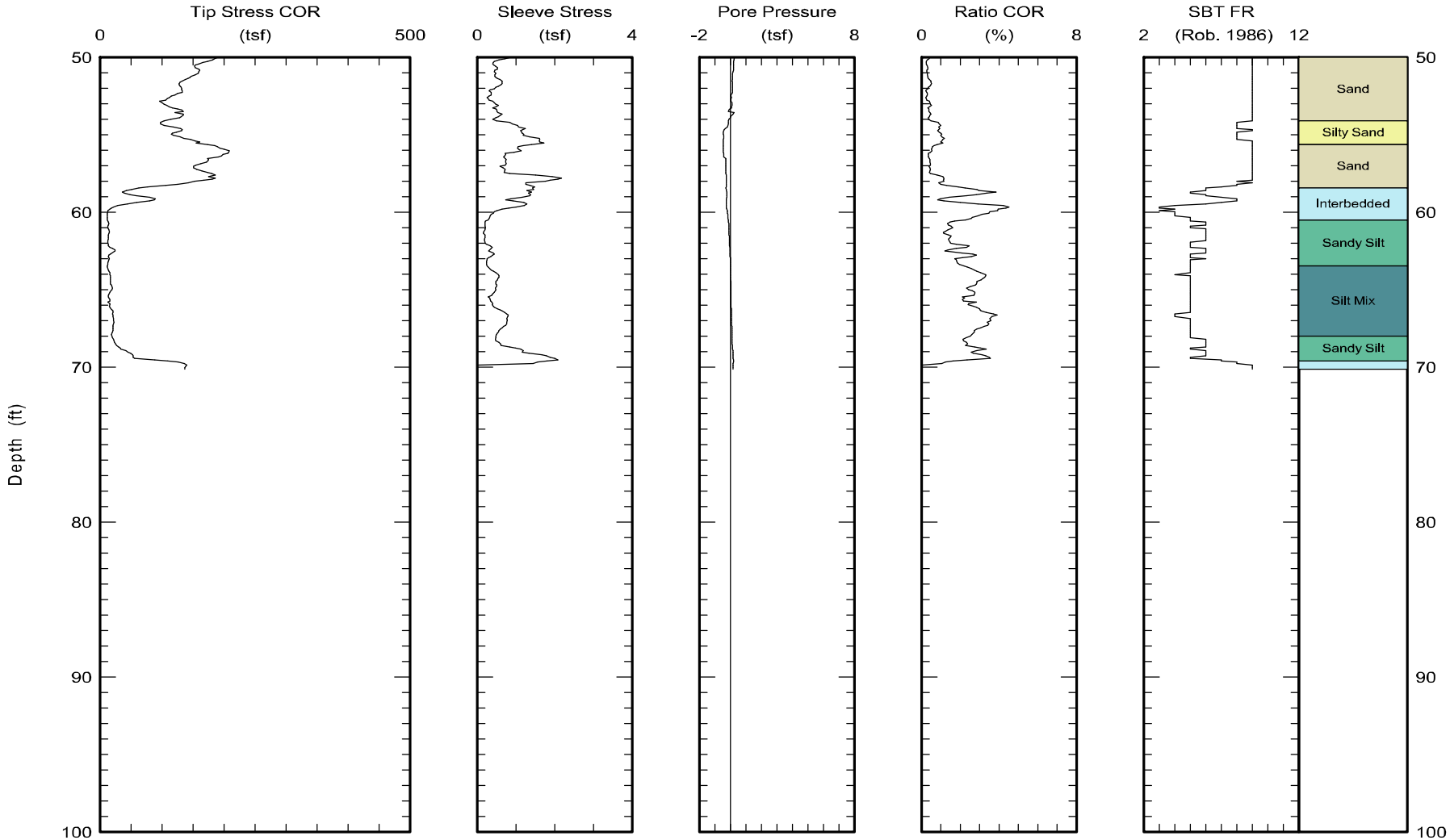
FIGURE

A1-50 a

B1-502

Test ID: B-CPT-054
File: Z14S1207C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 14/Sep/2012 Test ID: B-CPT-054 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 70.15 (ft)

FIGURE

A1-50 b

B1-503

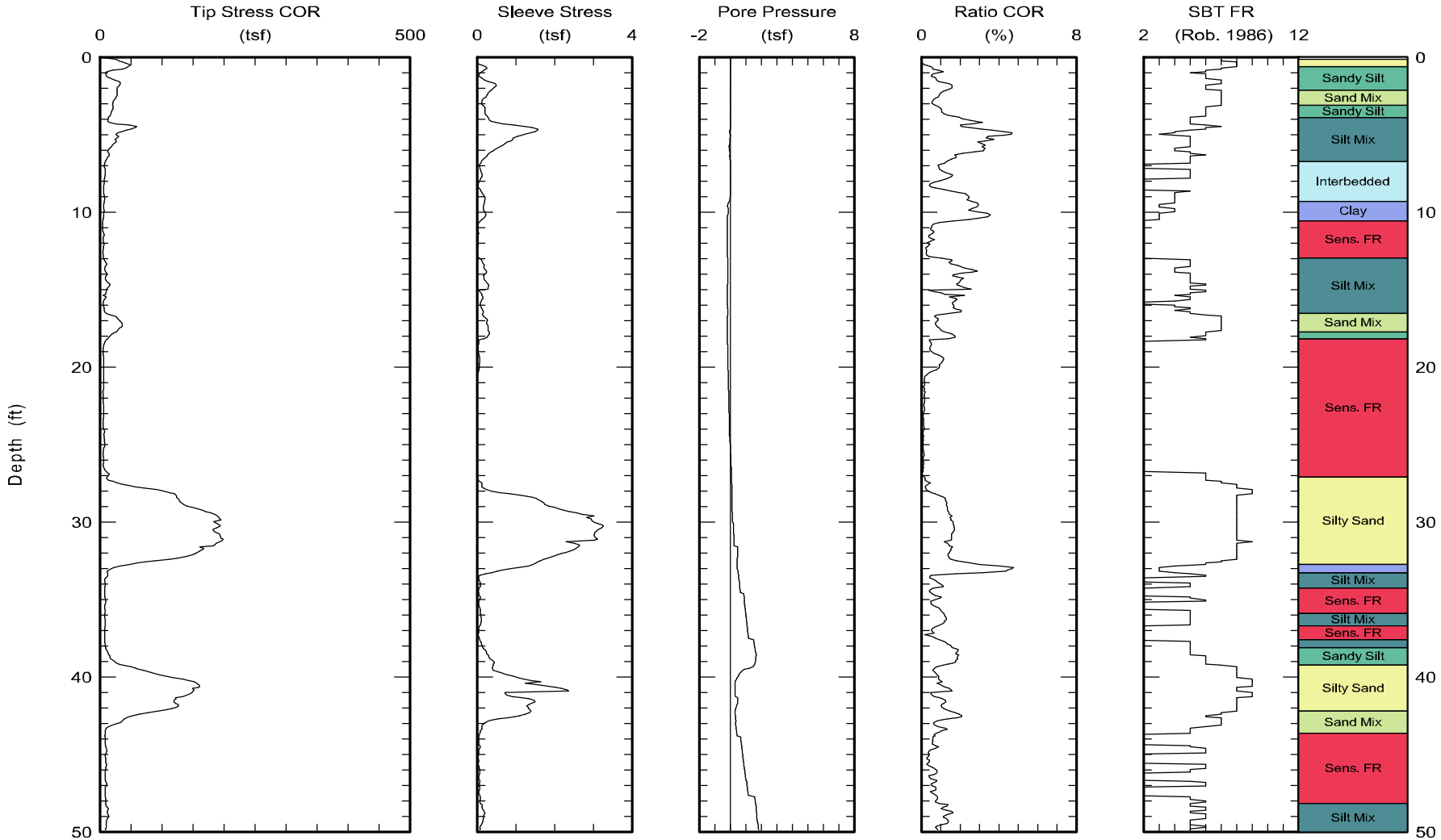
Test ID: B-CPT-054
File: Z14S1207C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 14/Sep/2012
Test ID: B-CPT-056
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 70.07 (ft)

FIGURE

A1-51 a

B1-504

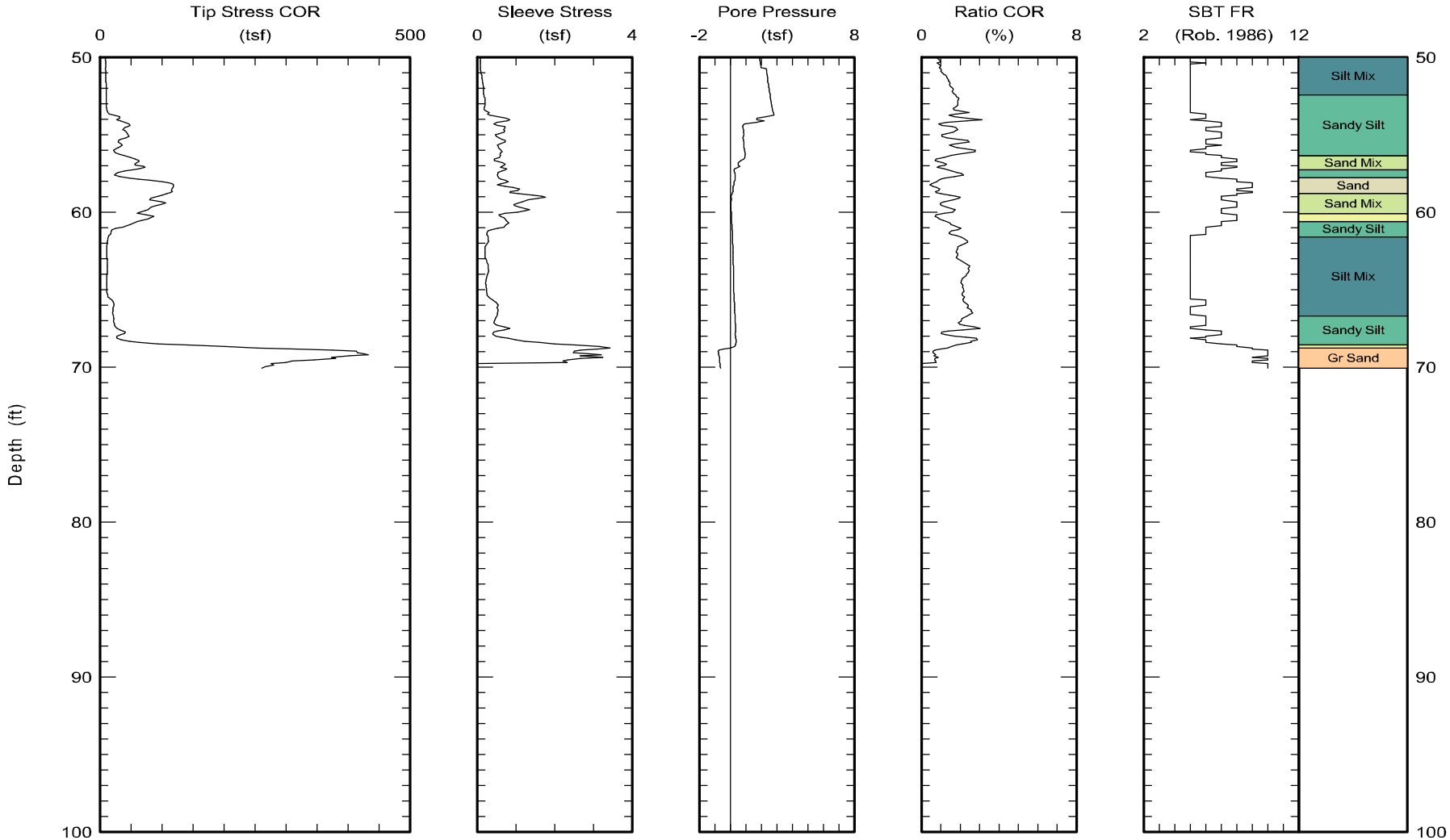
Test ID: B-CPT-056
File: Z14S1206C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 14/Sep/2012
Test ID: B-CPT-056
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 70.07 (ft)

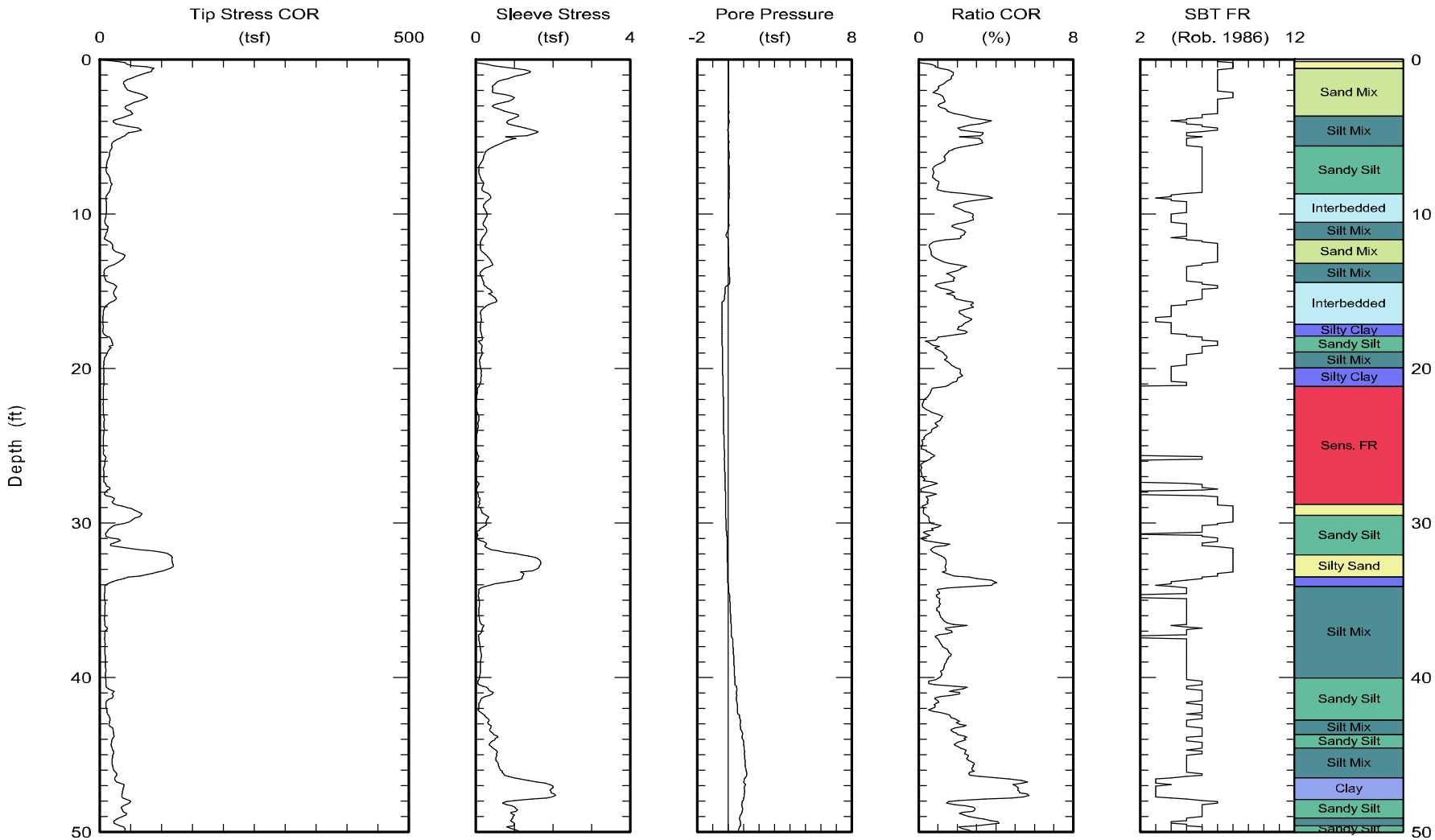
FIGURE

B1-505

A1-51 b

Test ID: B-CPT-056
File: Z14S1206C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 14/Sep/2012 Test ID: B-CPT-057 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 70.61 (ft)

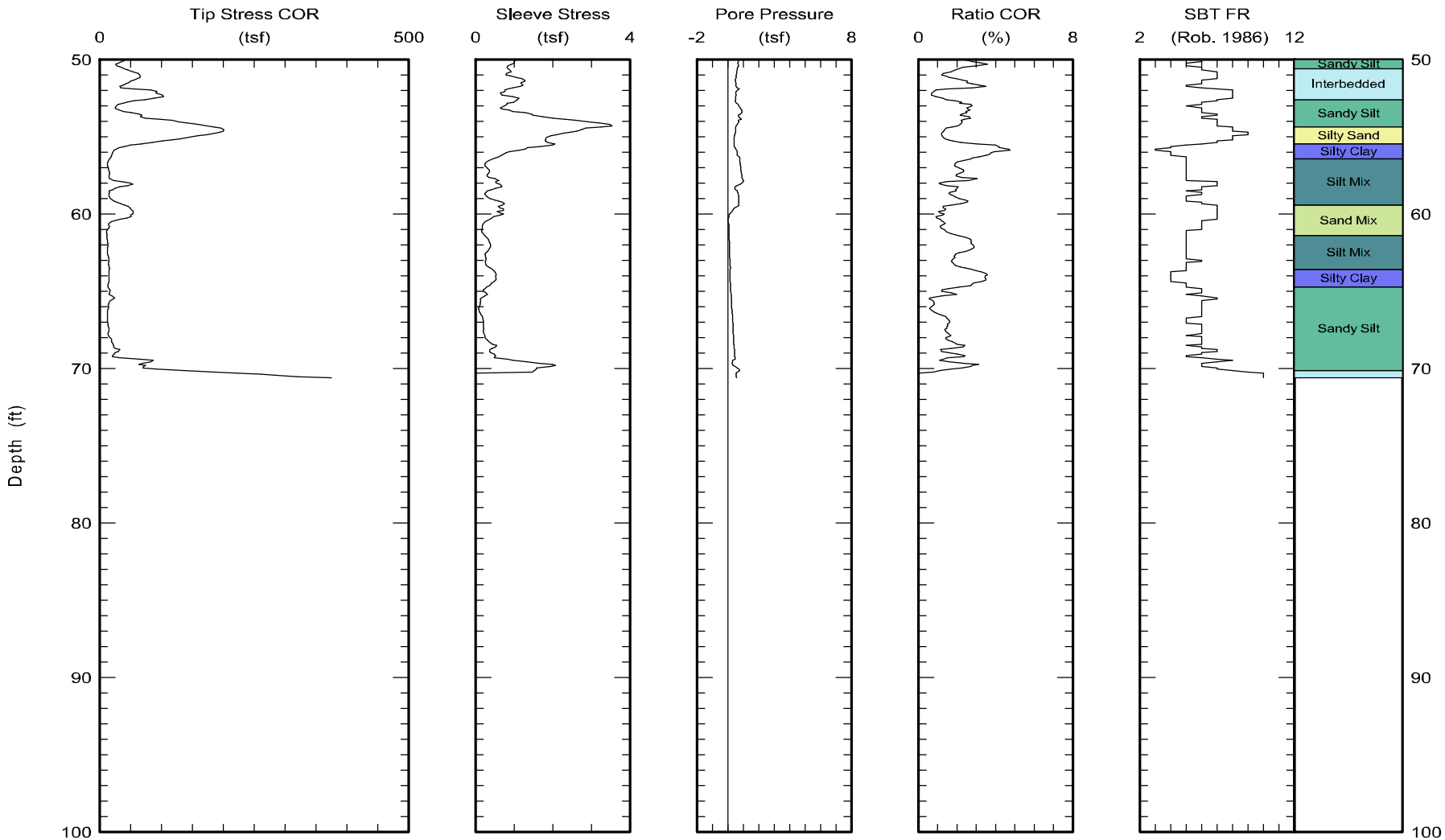
FIGURE

B1-506

A1-52 a

Test ID: B-CPT-057
File: Z14S1205C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 14/Sep/2012 Test ID: B-CPT-057 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 70.61 (ft)

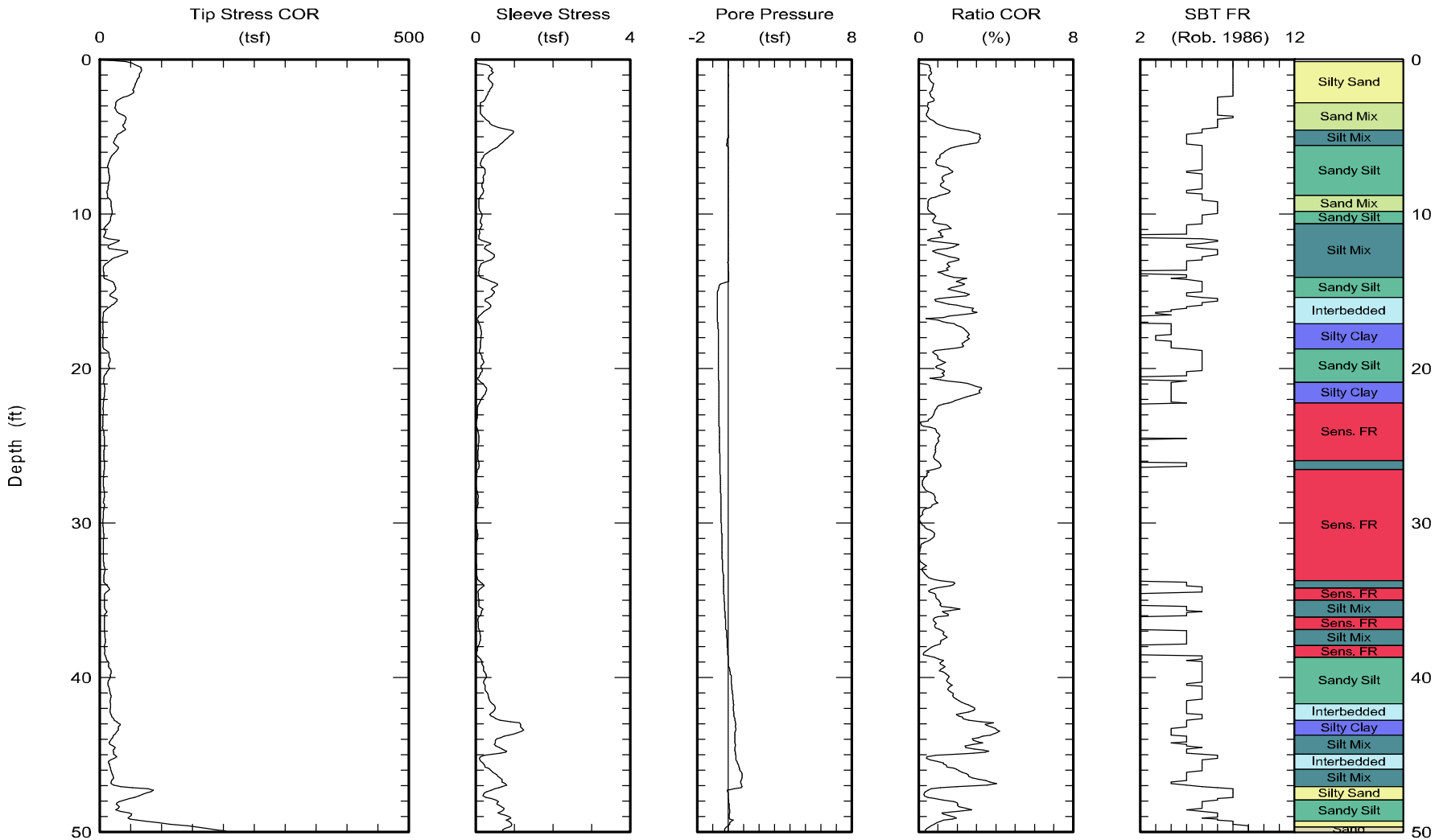
FIGURE

A1-52 b

B1-507

Test ID: B-CPT-057
File: Z14S1205C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 14/Sep/2012 Test ID: B-CPT-059 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 69.50 (ft)

FIGURE

A1-53 a

B1-508

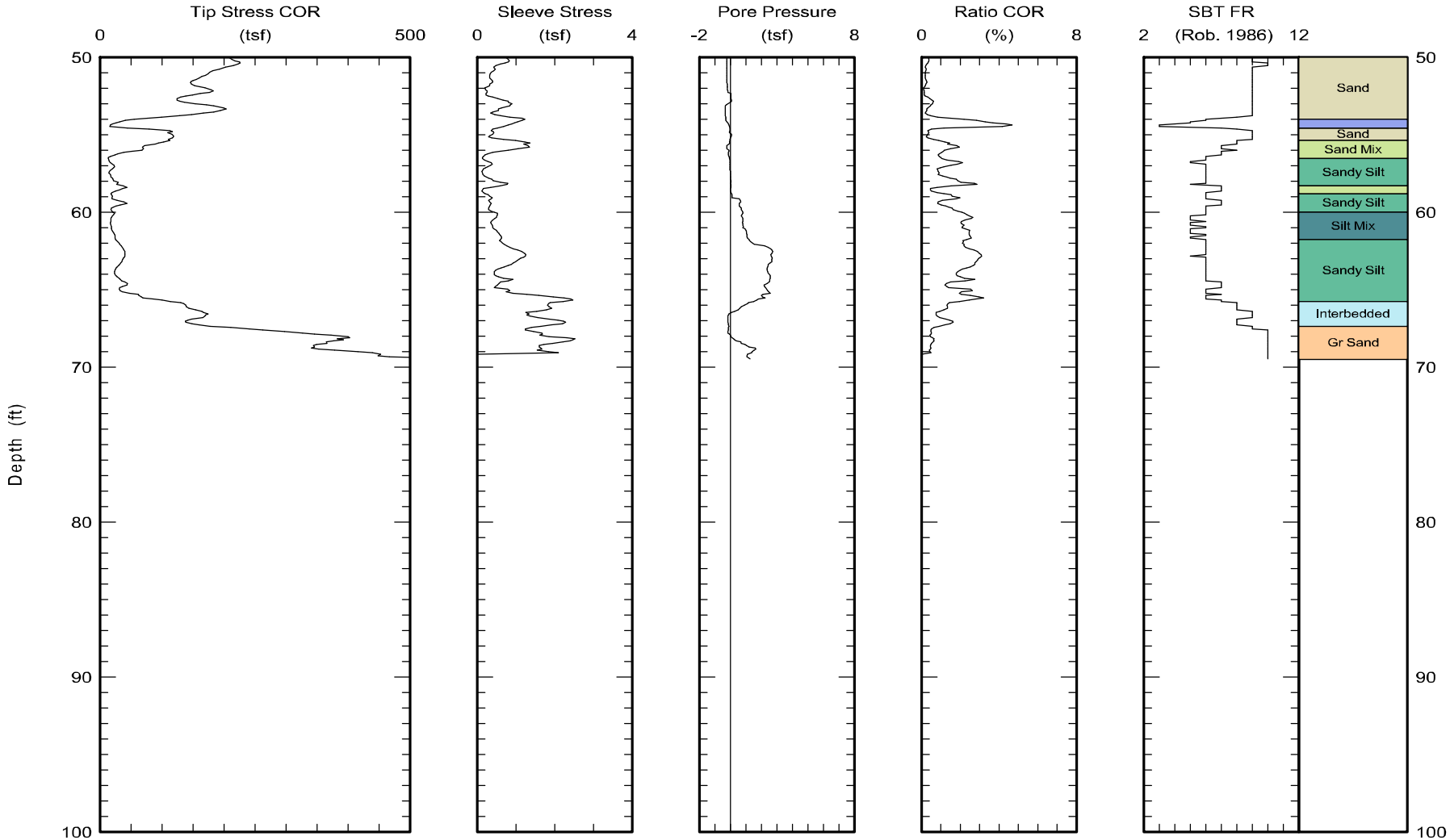
Test ID: B-CPT-059
File: Z14S1204C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 14/Sep/2012
Test ID: B-CPT-059
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



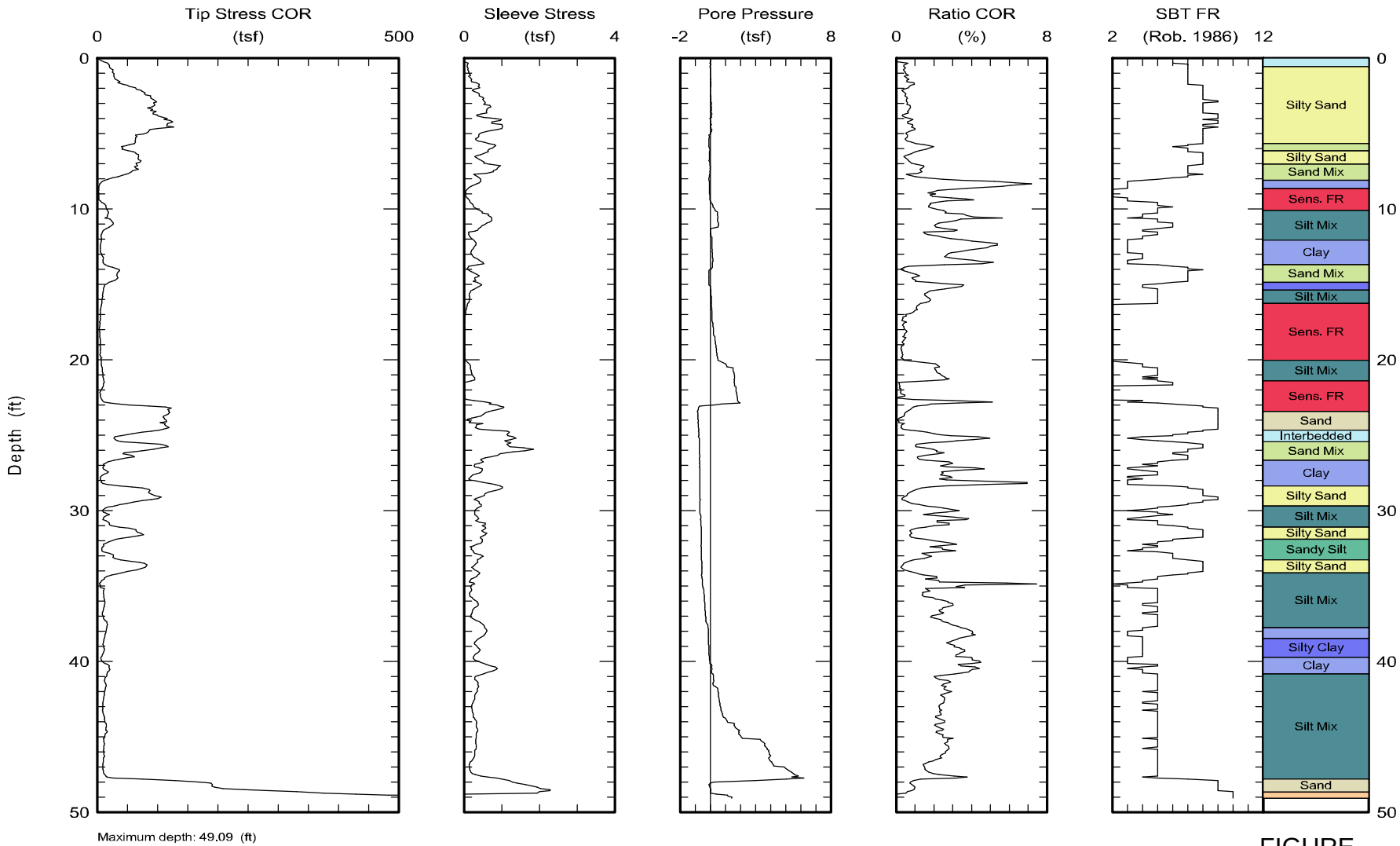
Maximum depth: 69.50 (ft)

FIGURE

A1-53 b

Test ID: B-CPT-059
File: Z14S1204C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 10/Oct/2012 Test ID: CPT-060 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



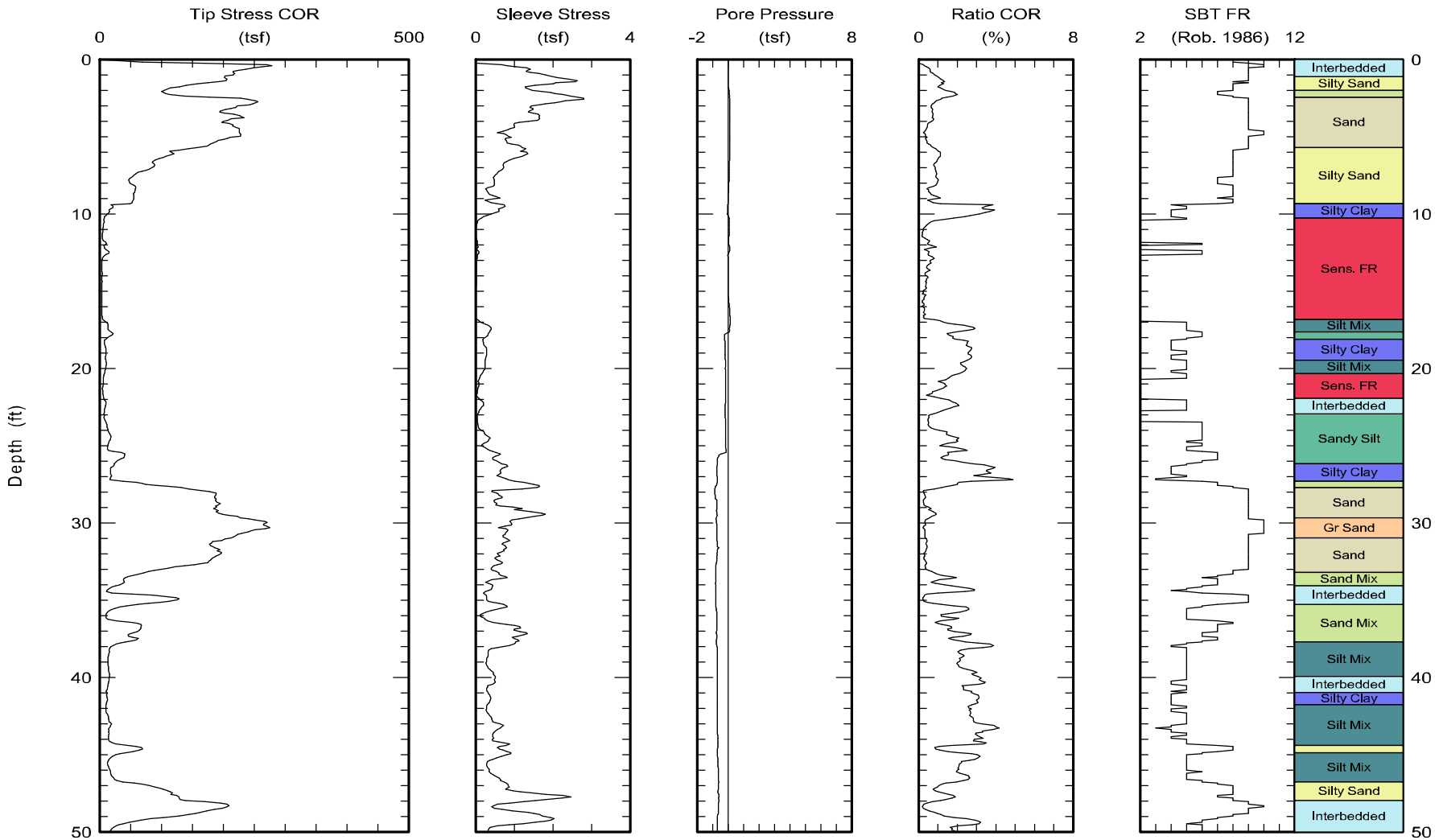
FIGURE

A1-54

B1-510

Test ID: CPT-060
File: Z10O1207C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 10/Oct/2012 Test ID: CPT-062 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



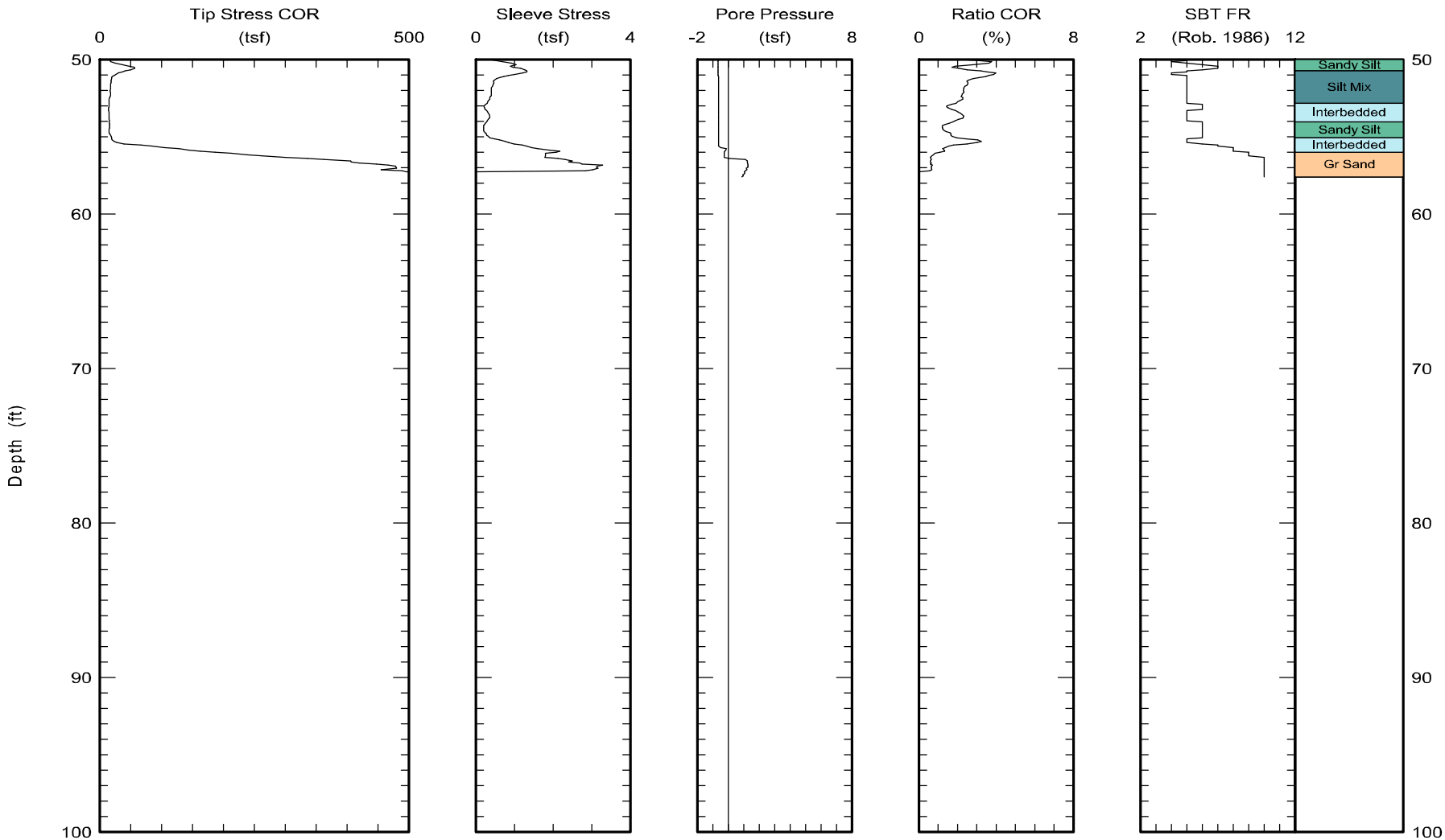
Maximum depth: 57.62 (ft)

FIGURE

A1-55 a

Test ID: CPT-062
File: Z10O1203C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 10/Oct/2012 Test ID: CPT-062 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



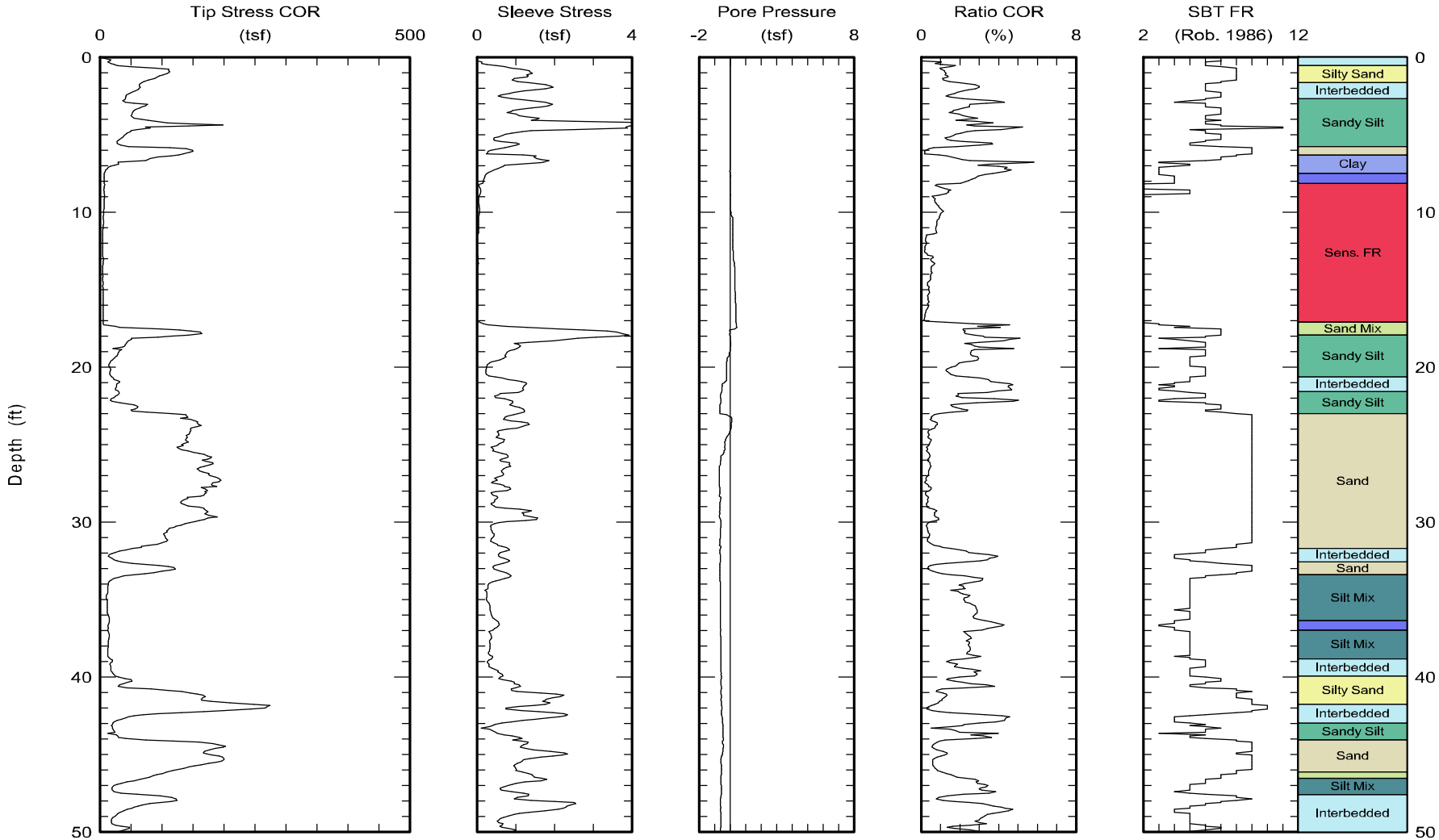
Maximum depth: 57.62 (ft)

FIGURE

A1-55 b

Test ID: CPT-062
File: Z10O1203C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 10/Oct/2012 Test ID: CPT-063 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 55.03 (ft)

FIGURE

A1-56 a

B1-513

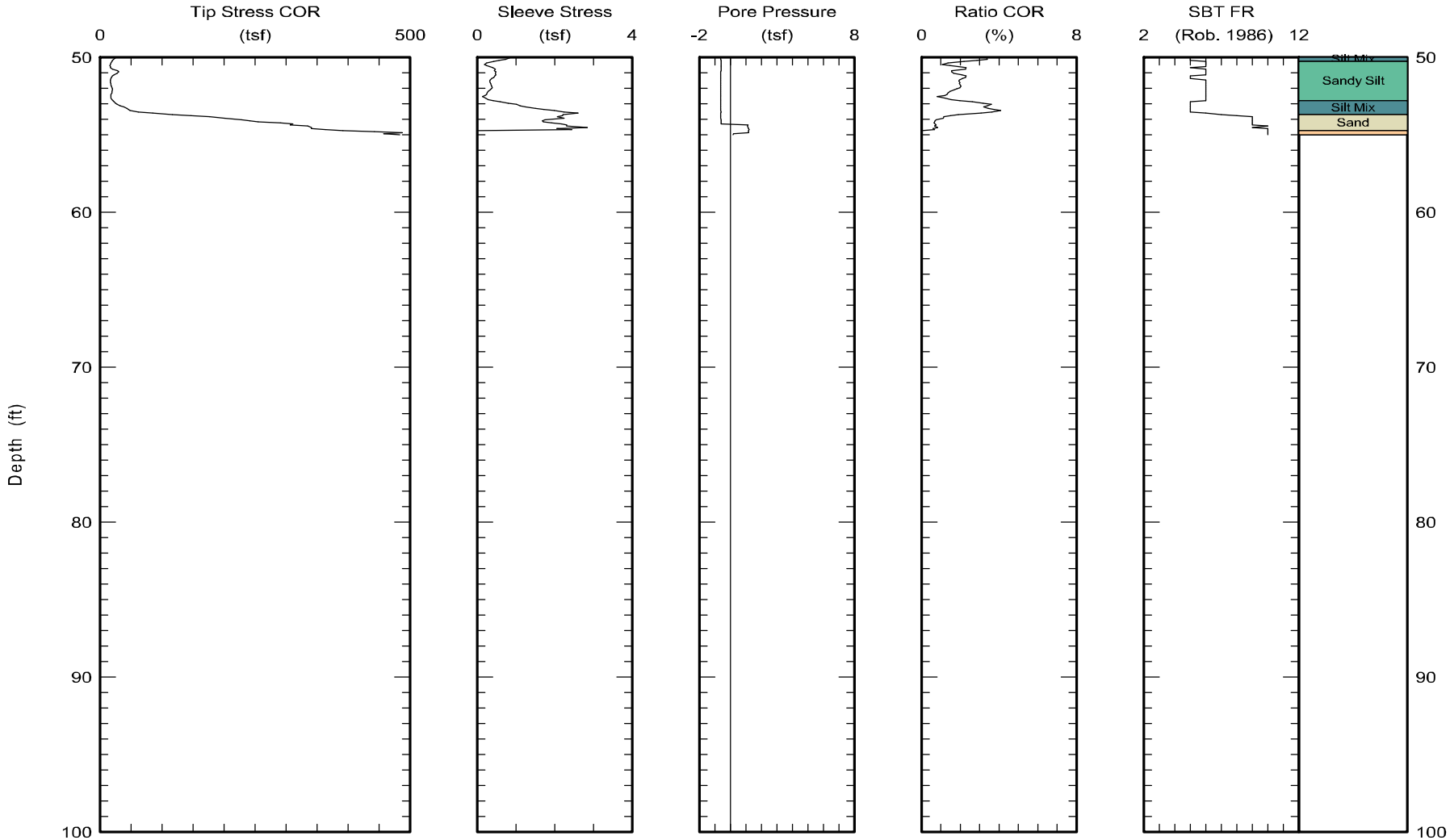
Test ID: CPT-063
File: Z10O1205C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 10/Oct/2012
Test ID: CPT-063
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 55.03 (ft)

FIGURE

A1-56 b

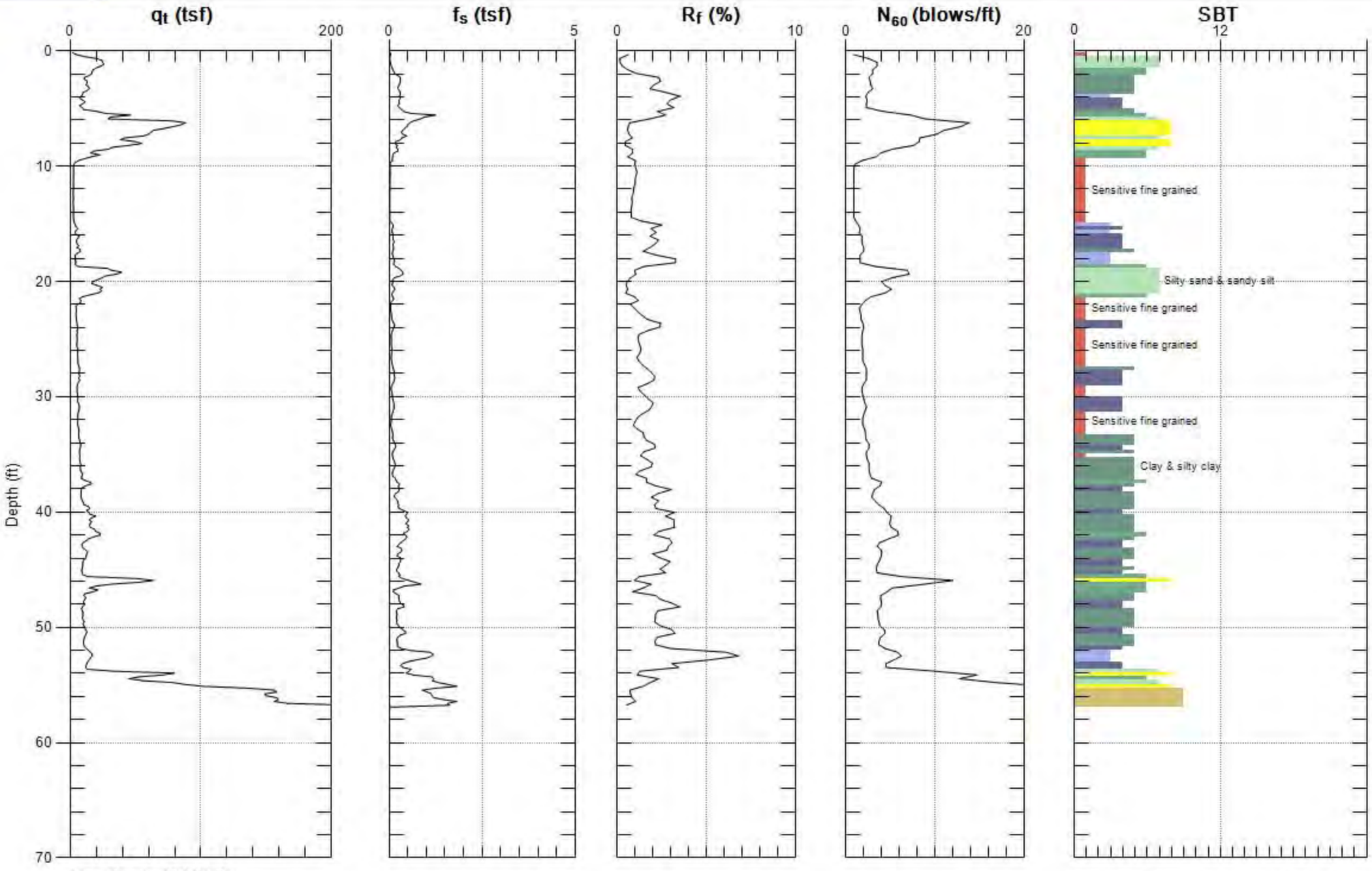
Test ID: CPT-063
File: Z10O1205C.ECP

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: ACPT-007

Engineer: E.HOLLIDAY
Date: 9/24/2012 08:23



Max. Depth: 57.087 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

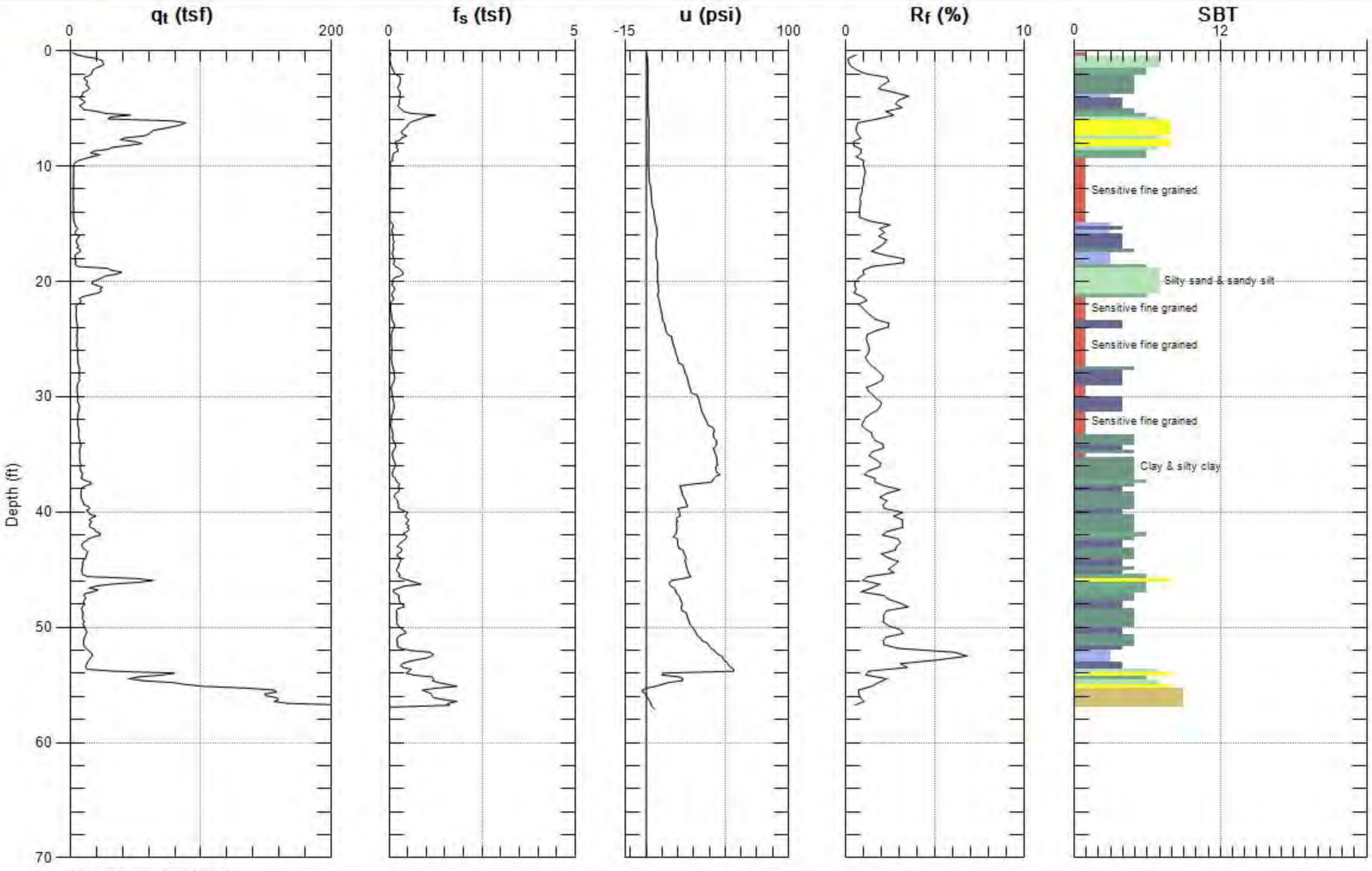
FIGURE A1-57 a

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: ACPT-007

Engineer: E.HOLLIDAY
Date: 9/24/2012 08:23



Max. Depth: 57.087 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

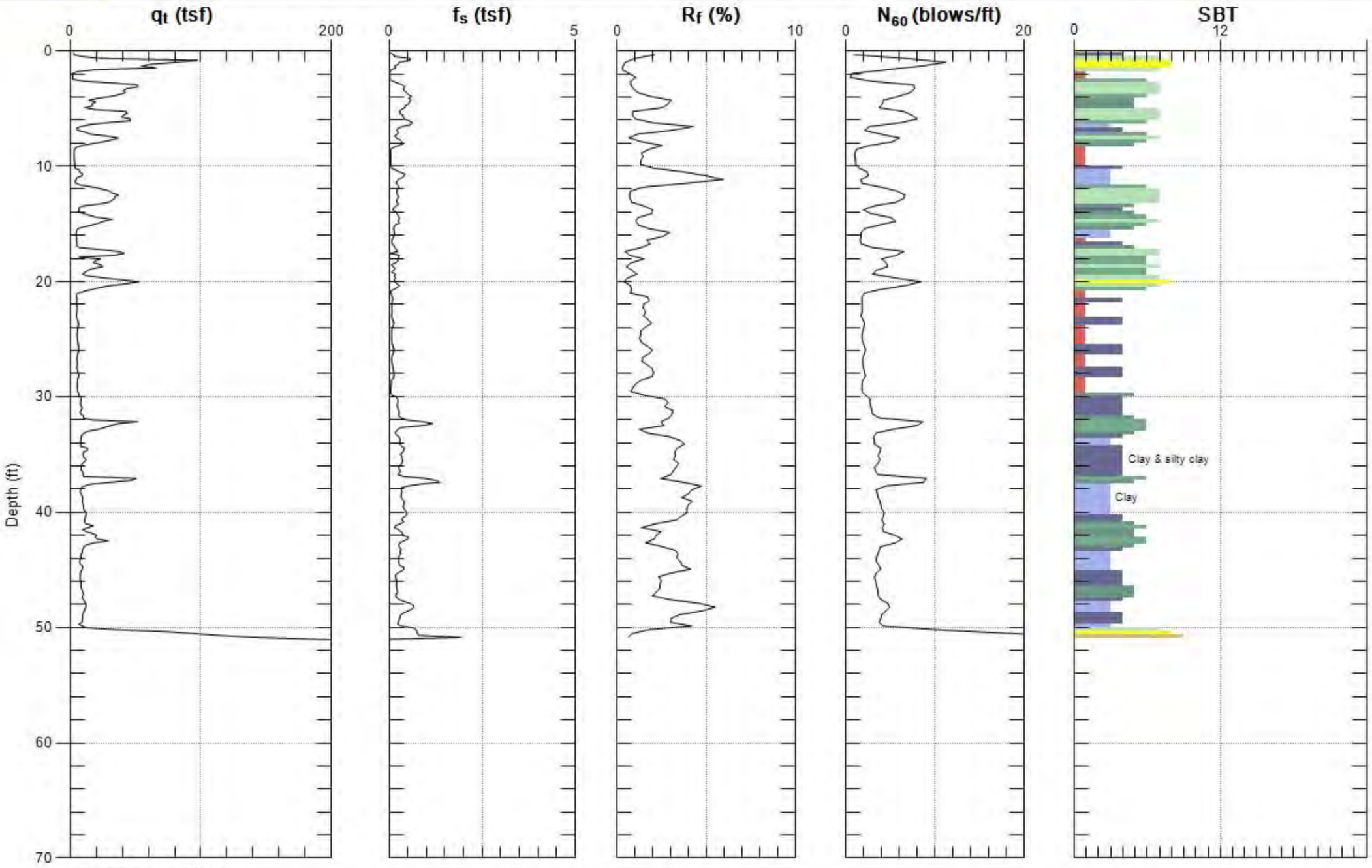
FIGURE A1-57 b

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-010

Engineer: E.HOLLIDAY
Date: 9/24/2012 09:19



Max. Depth: 51.181 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-58 a

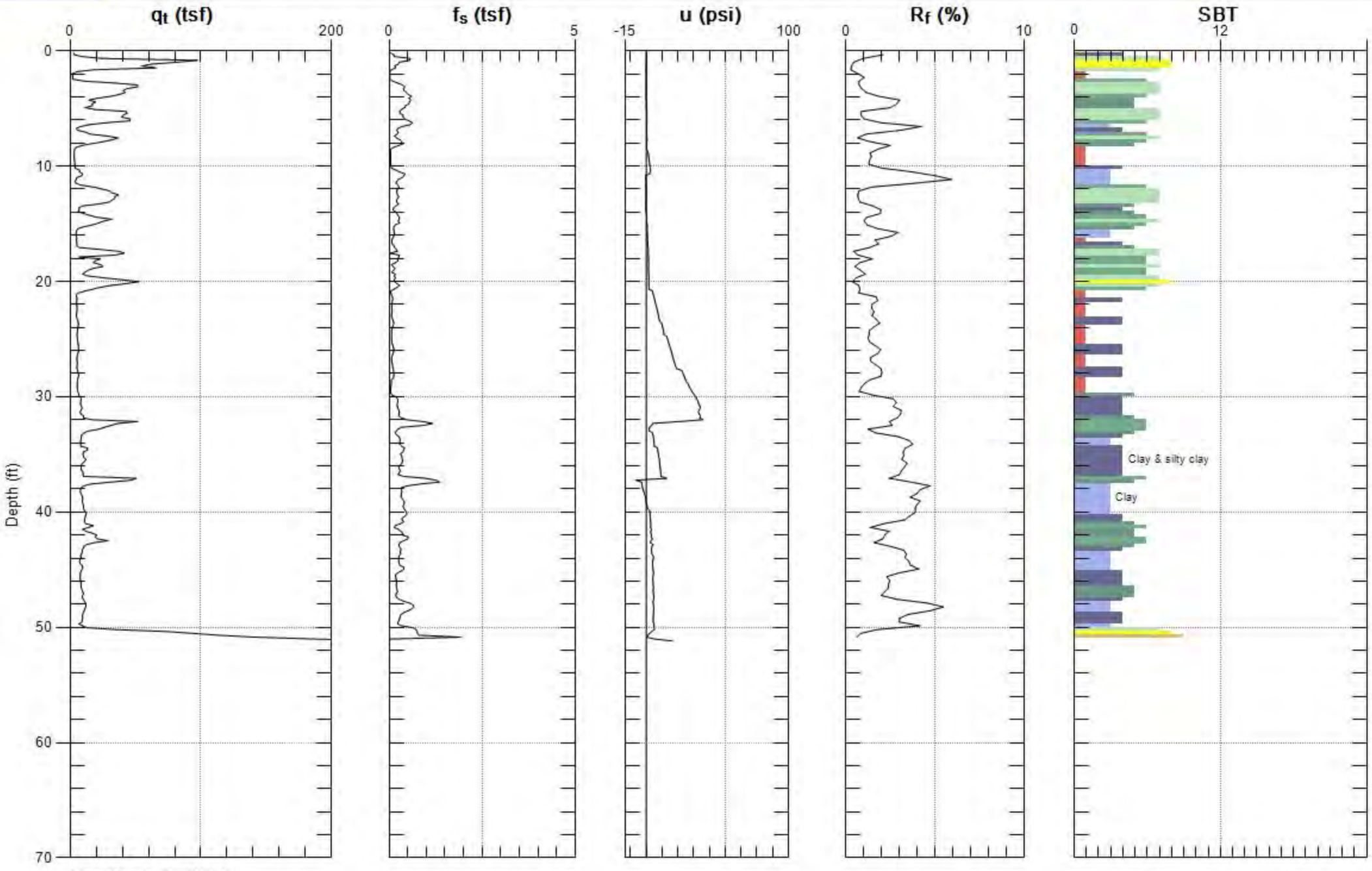
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-010

Engineer: E.HOLLIDAY
Date: 9/24/2012 09:19



Max. Depth: 51.181 (ft)
Avg. Interval: 0.328 (ft)

B1-518 FIGURE A1-58 b

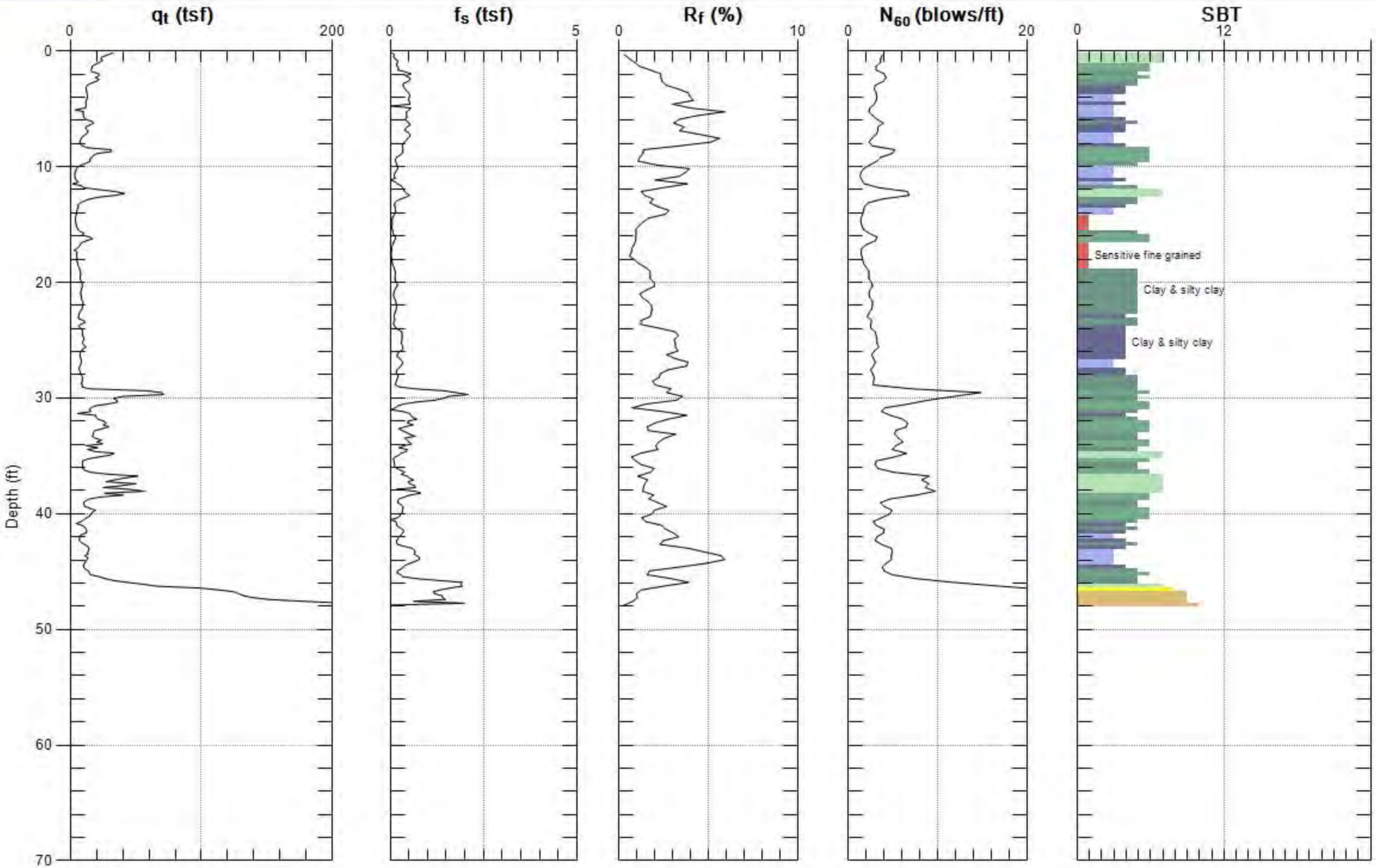
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-012

Engineer: E.HOLLIDAY
Date: 9/24/2012 09:59



Max. Depth: 48.064 (ft)
Avg. Interval: 0.328 (ft)

B1-519

FIGURE A1-59 a

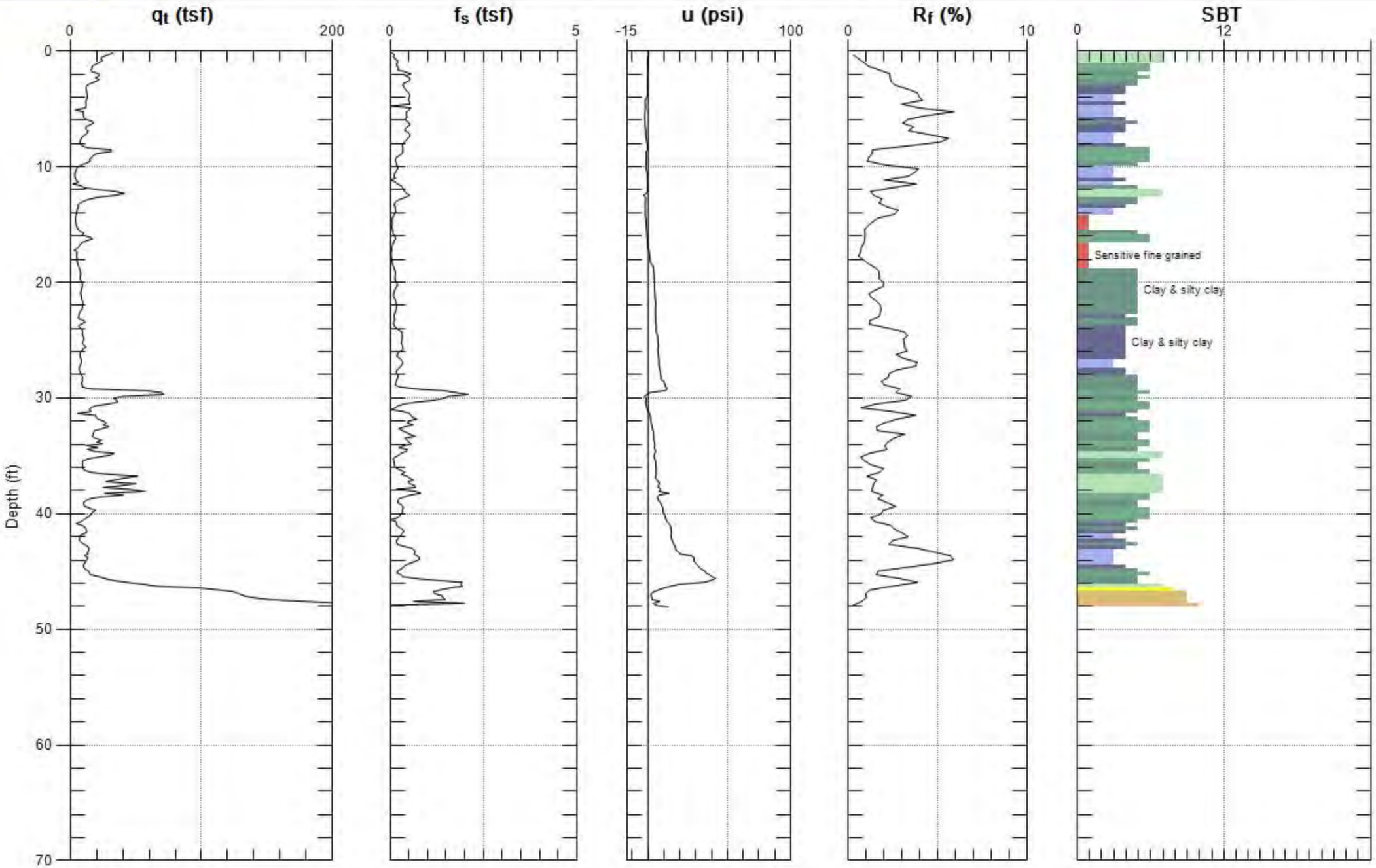
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-012

Engineer: E.HOLLIDAY
Date: 9/24/2012 09:59



Max. Depth: 48.064 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-59 b

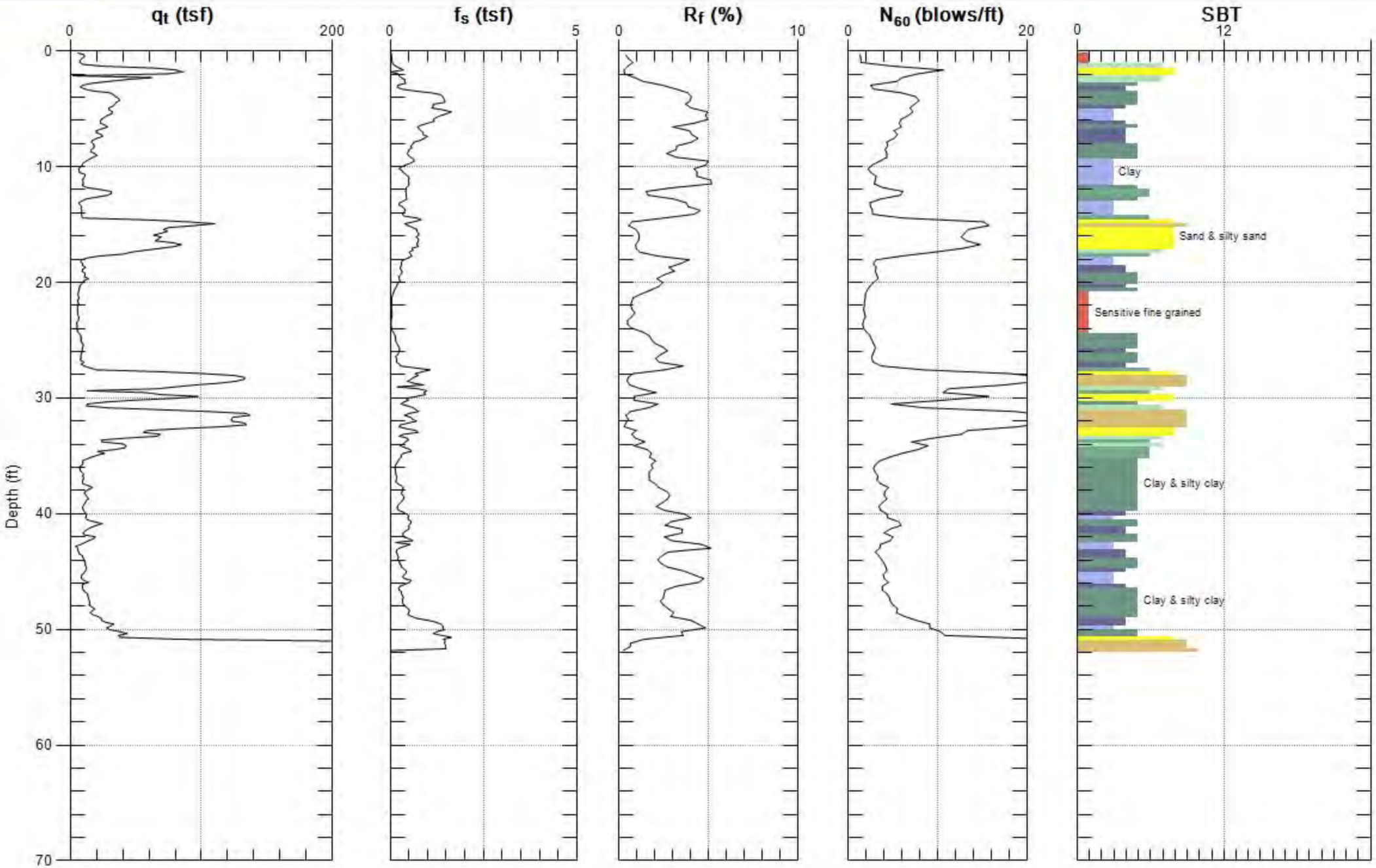
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-014

Engineer: E.HOLLIDAY
Date: 9/24/2012 10:28



Max. Depth: 52.001 (ft)
Avg. Interval: 0.328 (ft)

B1-521

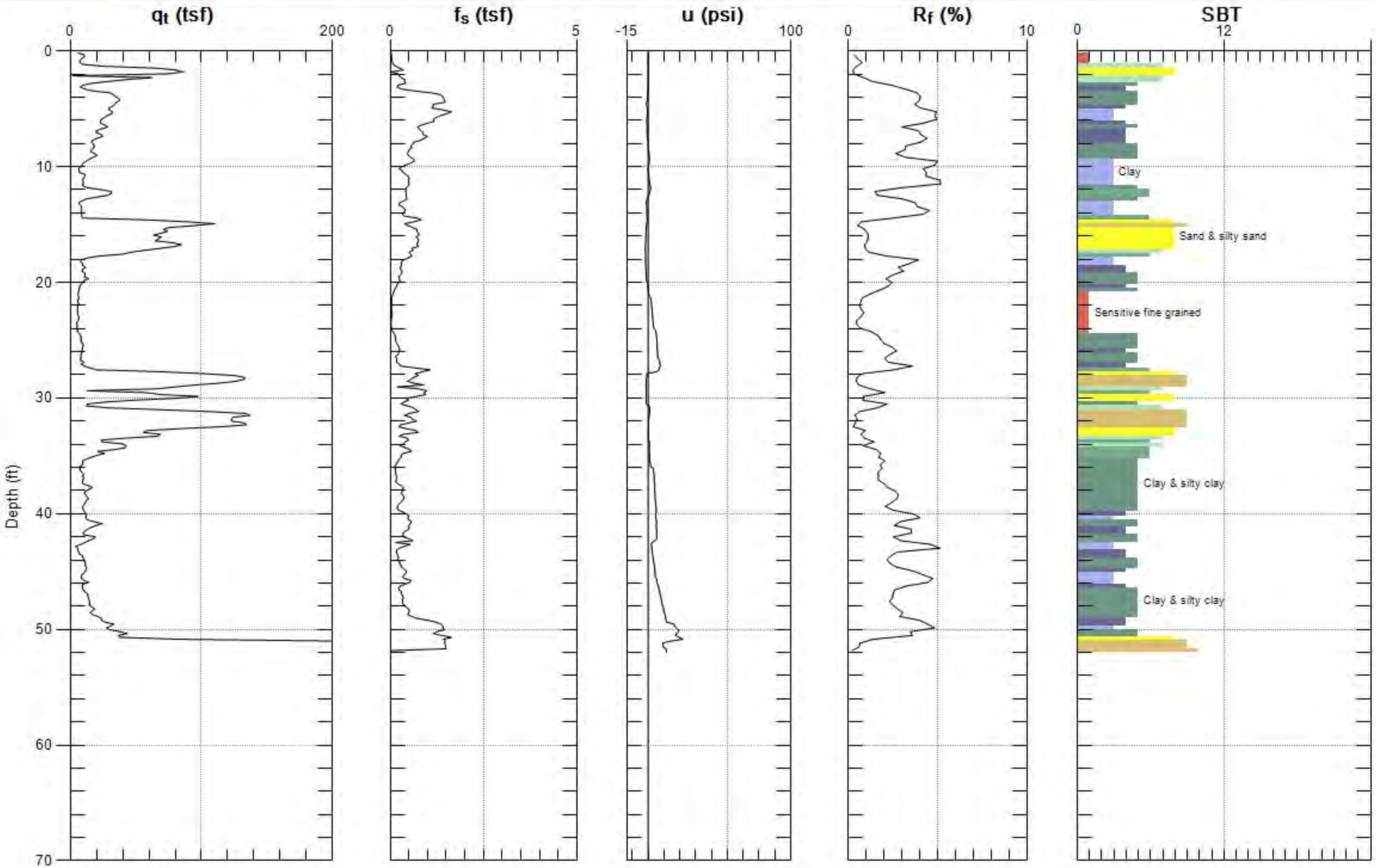
FIGURE A1-60 a

SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-014
Engineer: E.HOLLIDAY
Date: 9/24/2012 10:28



Max. Depth: 52.001 (ft)
Avg. Interval: 0.328 (ft)

B1-522 FIGURE A1-60 b

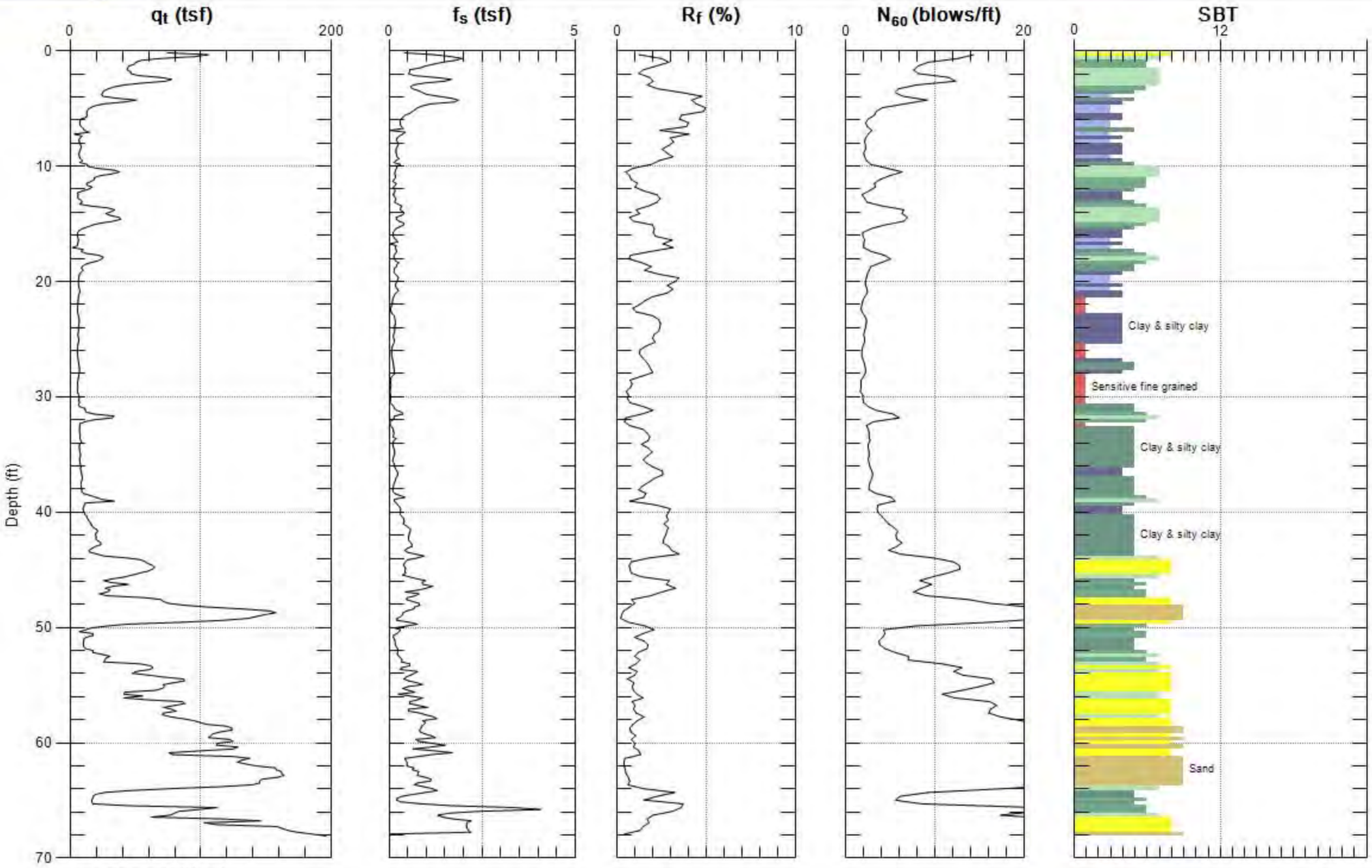
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-019

Engineer: E.HOLLIDAY
Date: 9/24/2012 12:47



Max. Depth: 68.077 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-61 a

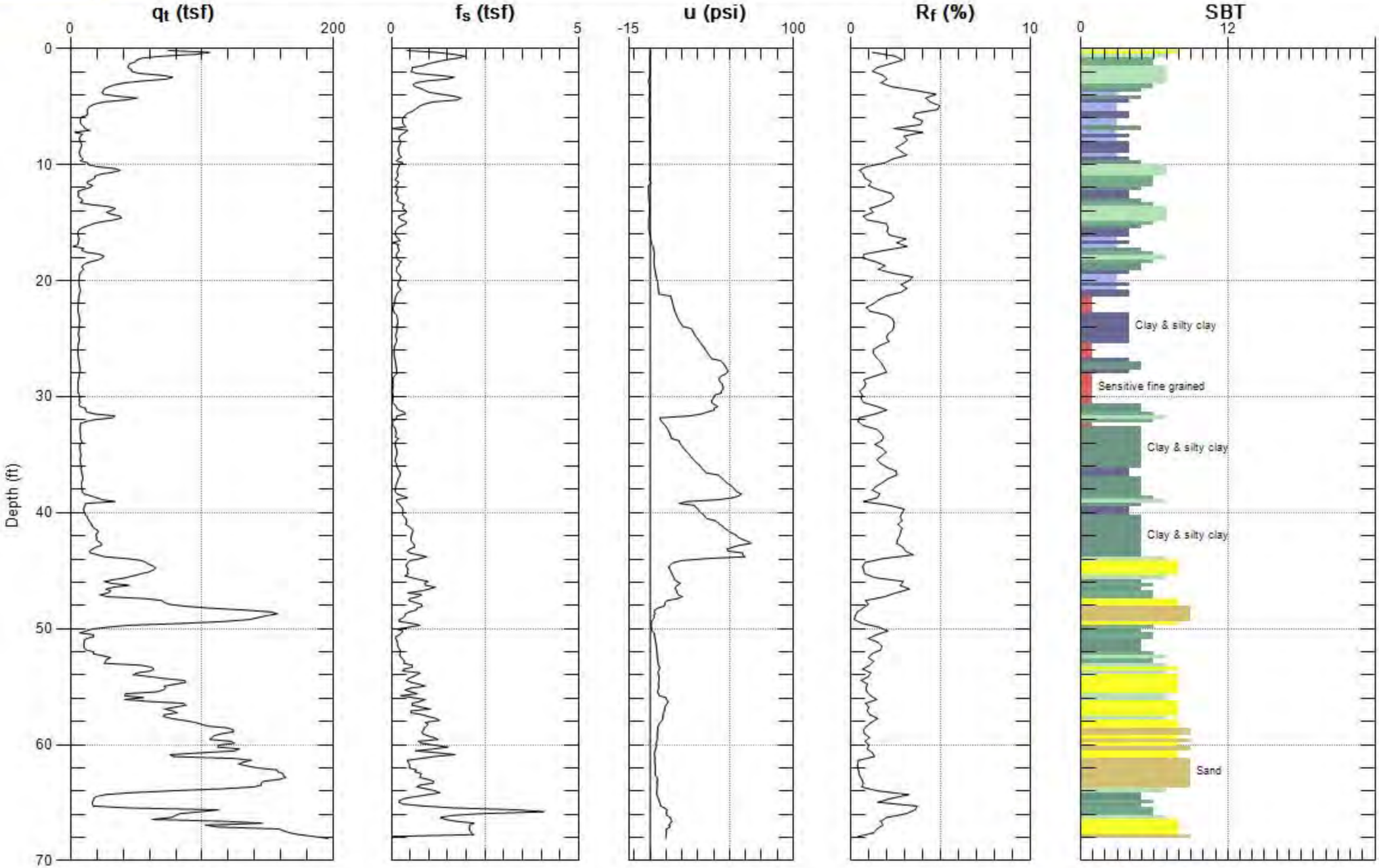
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-019

Engineer: E.HOLLIDAY
Date: 9/24/2012 12:47



Max. Depth: 68.077 (ft)
Avg. Interval: 0.328 (ft)

B1-524

FIGURE A1-61 b

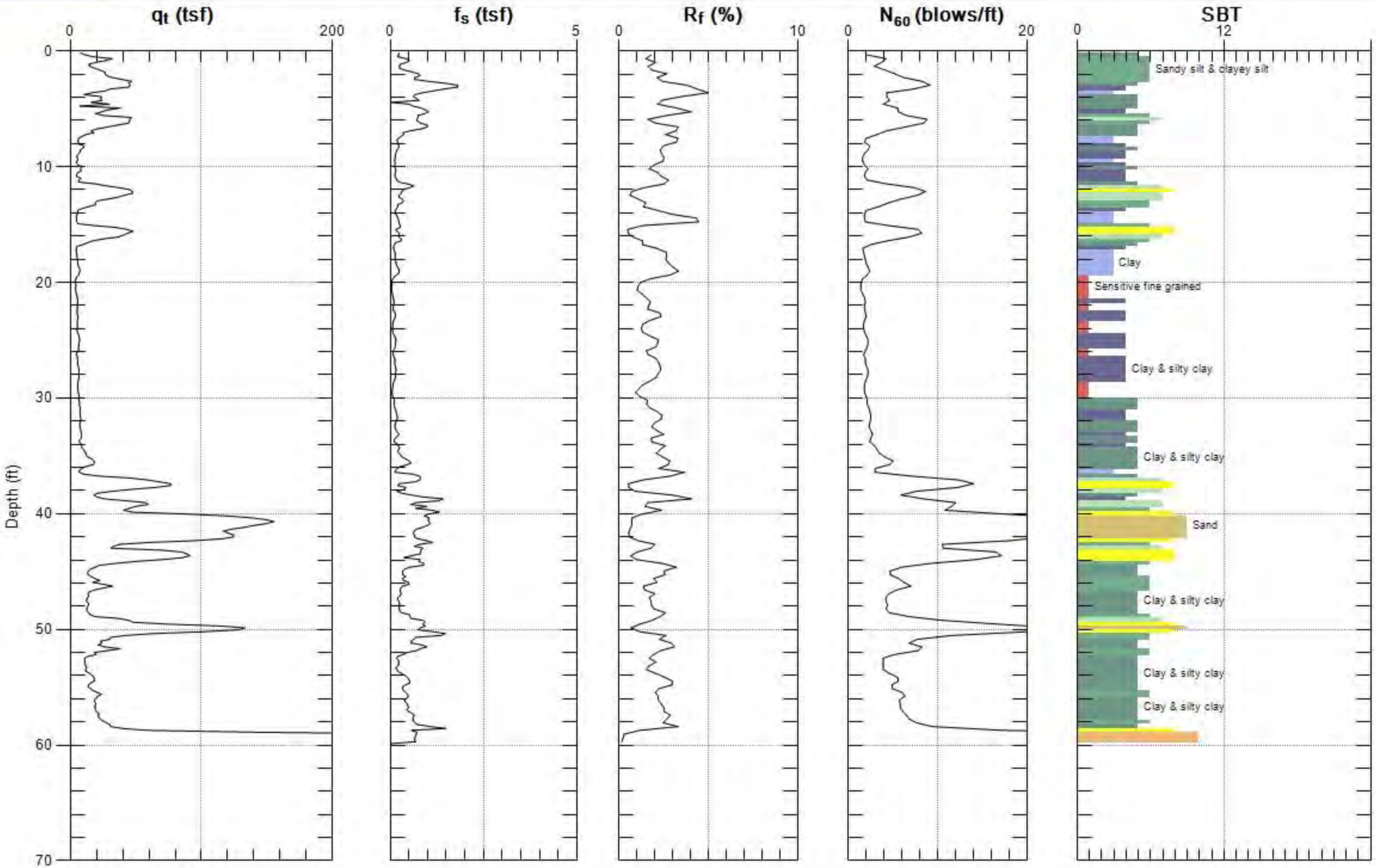
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-021

Engineer: E.HOLLIDAY
Date: 9/24/2012 01:28



Max. Depth: 60.039 (ft)
Avg. Interval: 0.328 (ft)

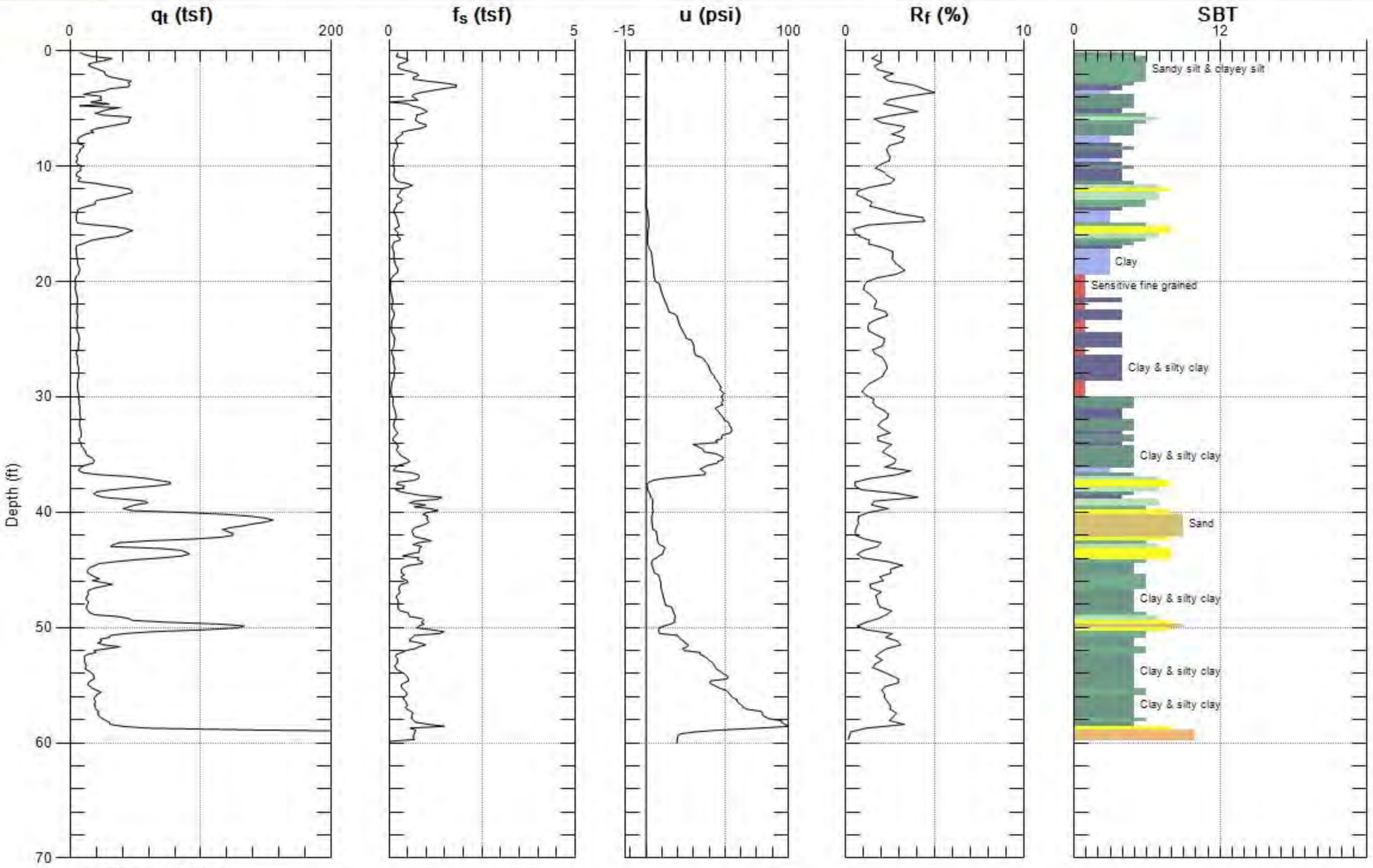
SBT: Soil Behavior Type (Robertson 1990)

FIGURE A1-62 a

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-021
Engineer: E.HOLLIDAY
Date: 9/24/2012 01:28



Max. Depth: 60.039 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-62 b

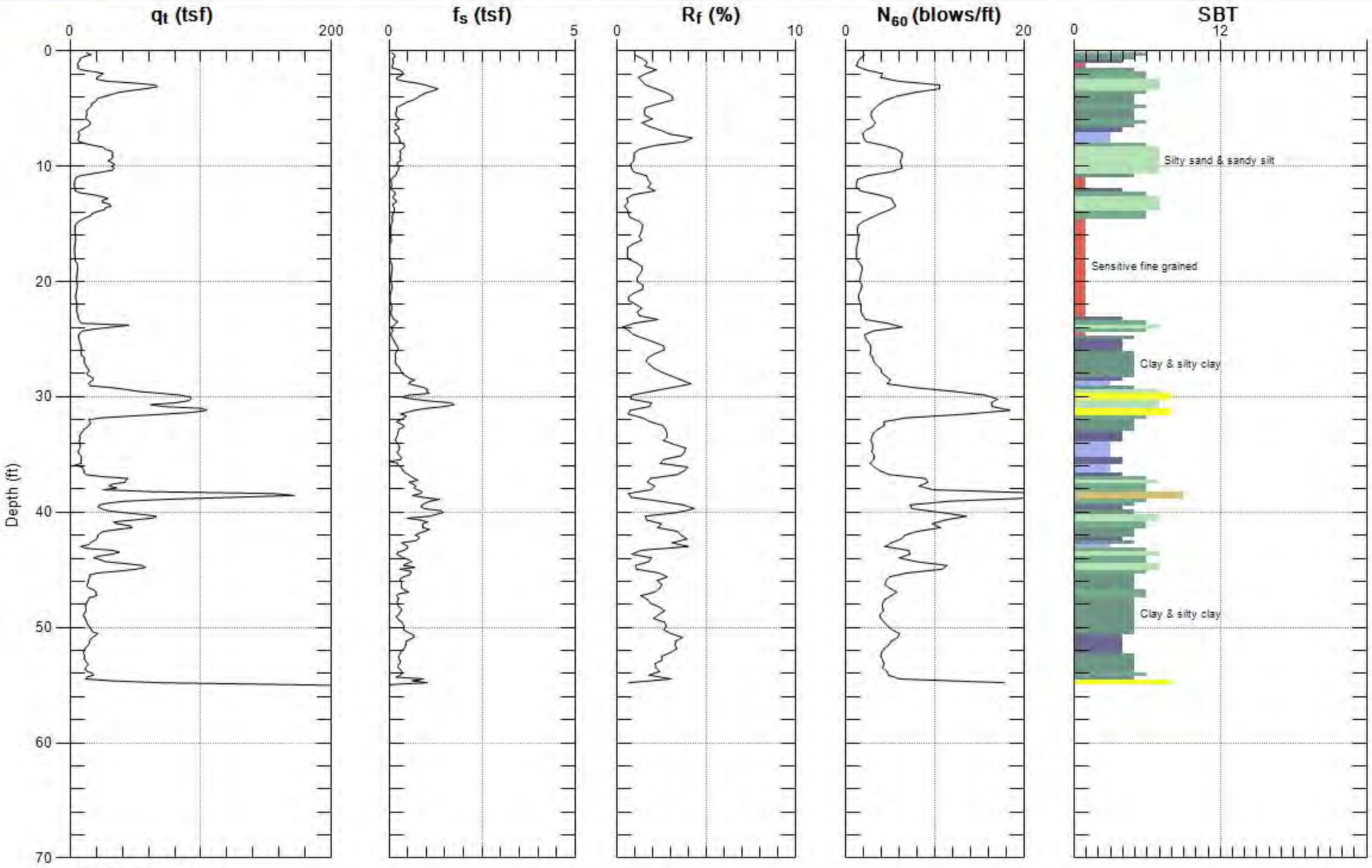
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-024

Engineer: E.HOLLIDAY
Date: 9/24/2012 11:40



Max. Depth: 55.118 (ft)
Avg. Interval: 0.328 (ft)

B1-527

FIGURE A1-63 a

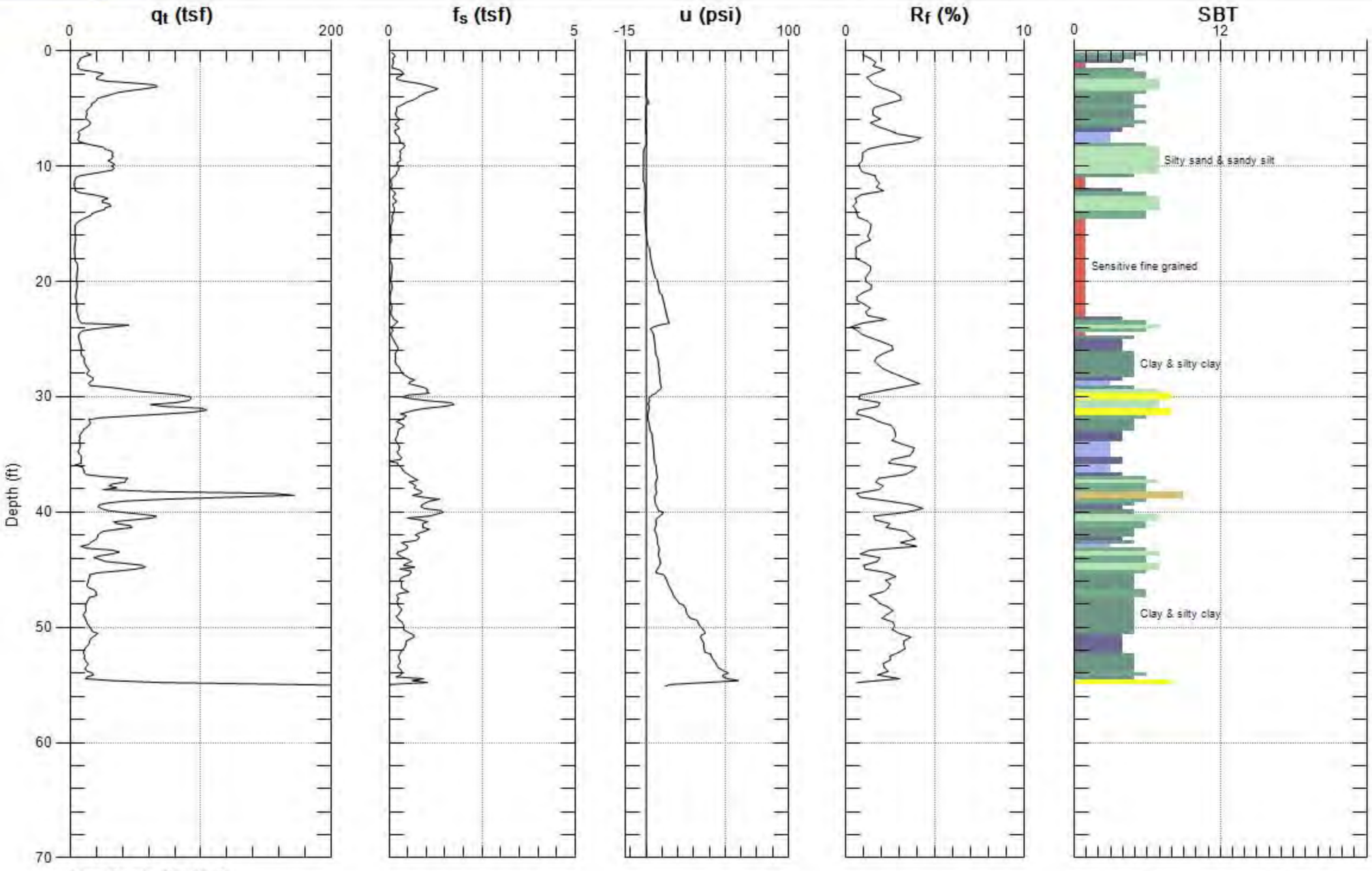
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-024

Engineer: E.HOLLIDAY
Date: 9/24/2012 11:40



Max. Depth: 55.118 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-63 b

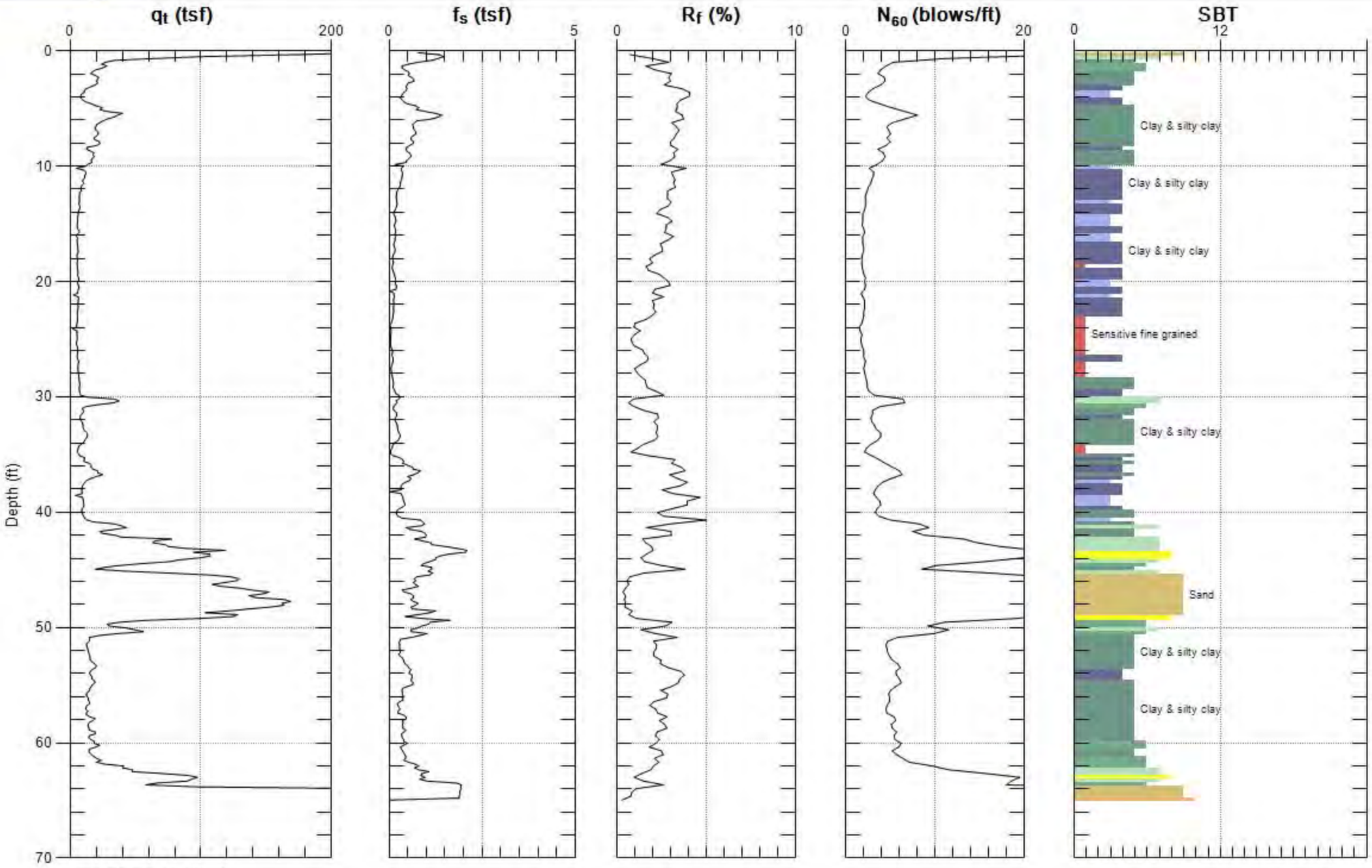
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-025

Engineer: E.HOLLIDAY
Date: 9/26/2012 10:30



Max. Depth: 65.125 (ft)
Avg. Interval: 0.328 (ft)

B1-529

FIGURE A1-64 a

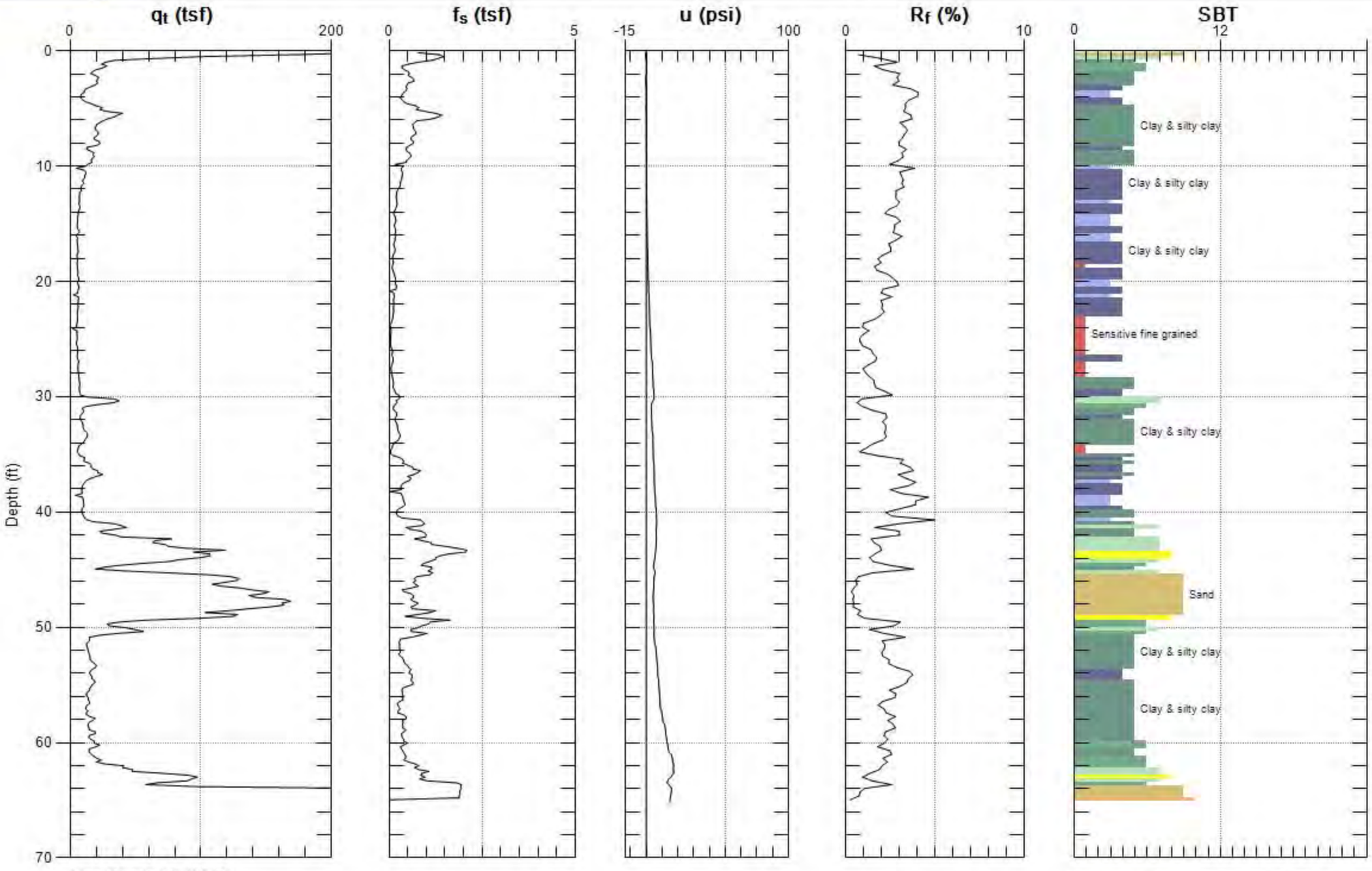
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-025

Engineer: E.HOLLIDAY
Date: 9/26/2012 10:30



Max. Depth: 65.125 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

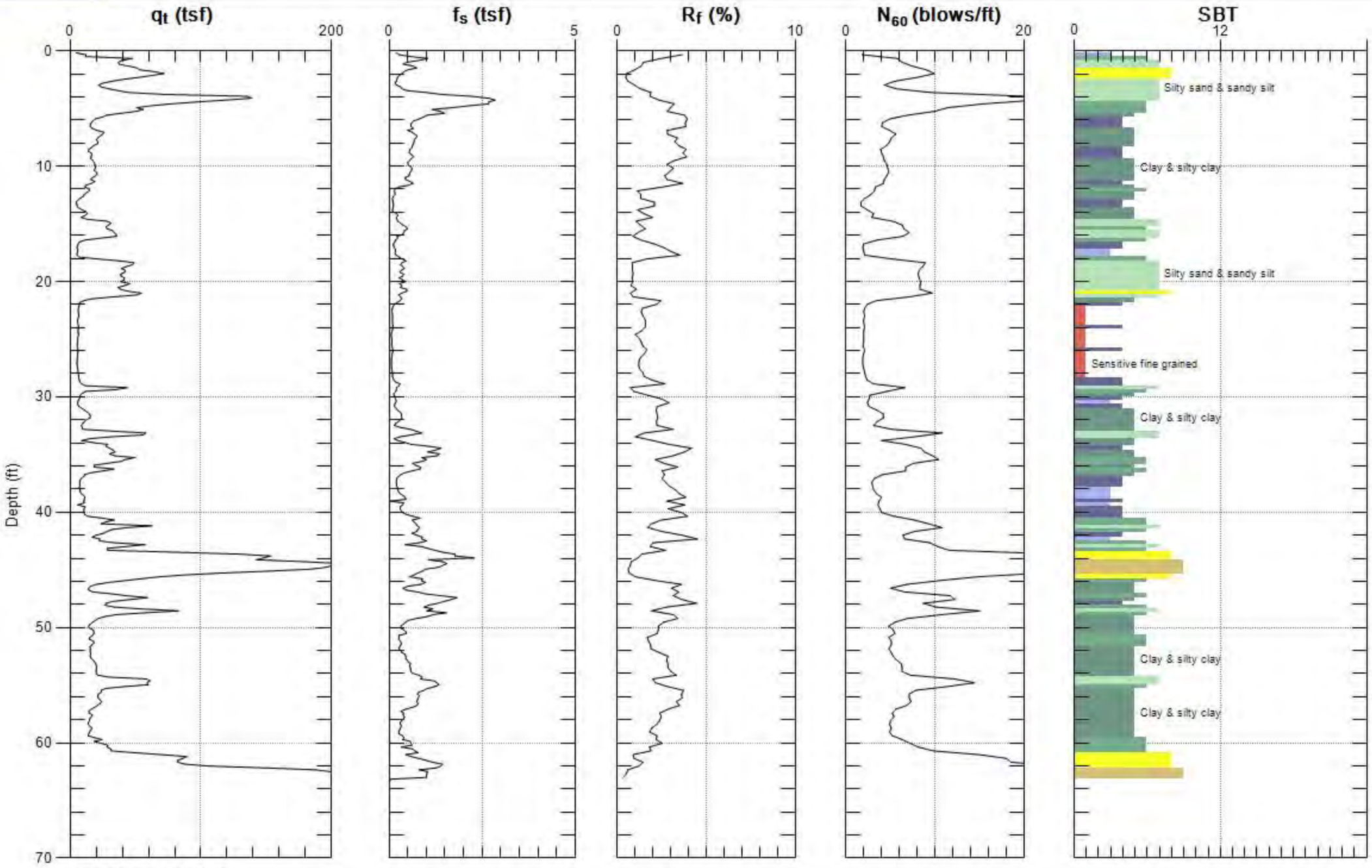
FIGURE A1-64 b

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-065

Engineer: E.HOLLIDAY
Date: 9/26/2012 09:52



Max. Depth: 63.320 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

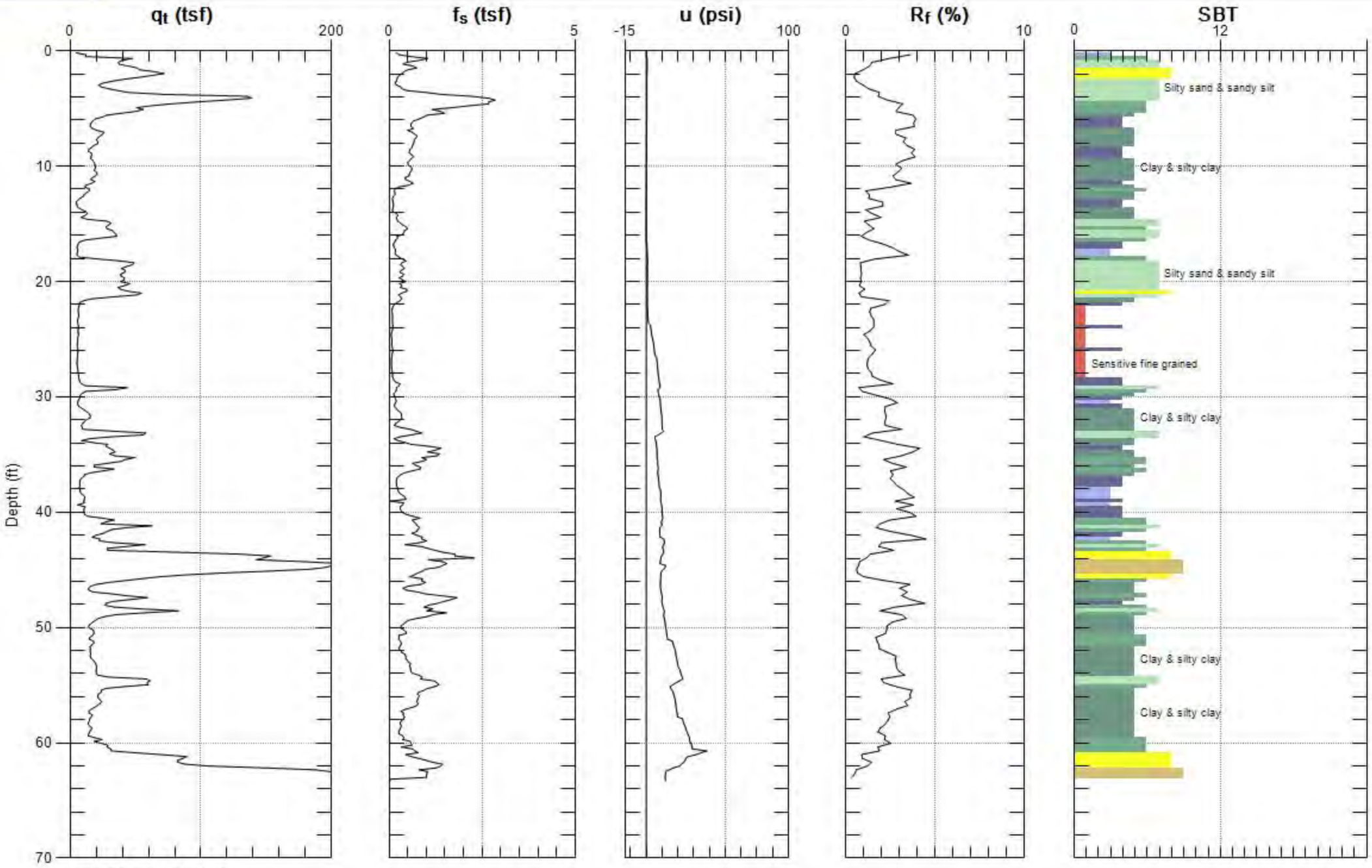
FIGURE A1-65 a

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-065

Engineer: E.HOLLIDAY
Date: 9/26/2012 09:52



Max. Depth: 63.320 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

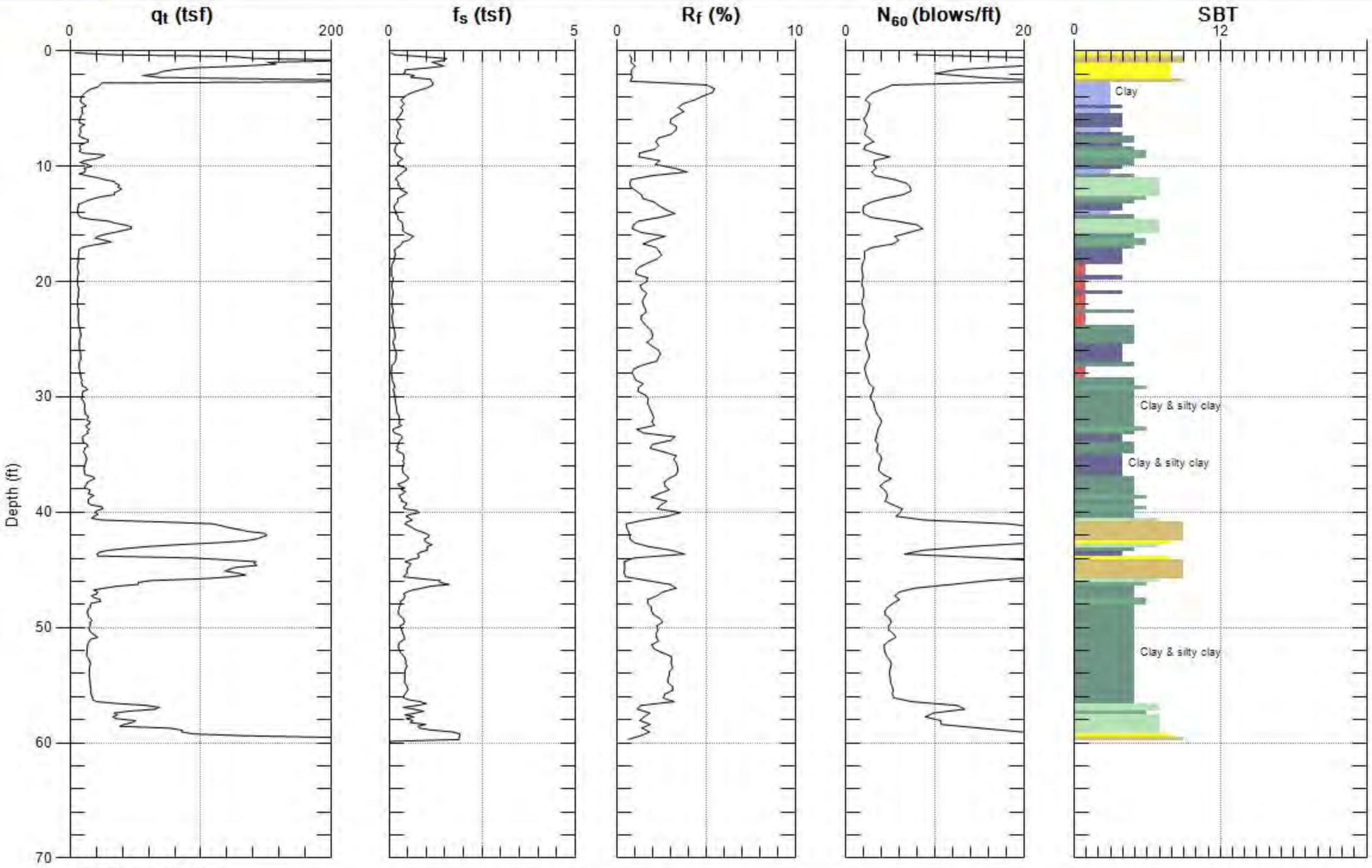
FIGURE A1-65 b

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-SCPT-022

Engineer: E.HOLLIDAY
Date: 9/26/2012 08:18



Max. Depth: 60.039 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-66 a

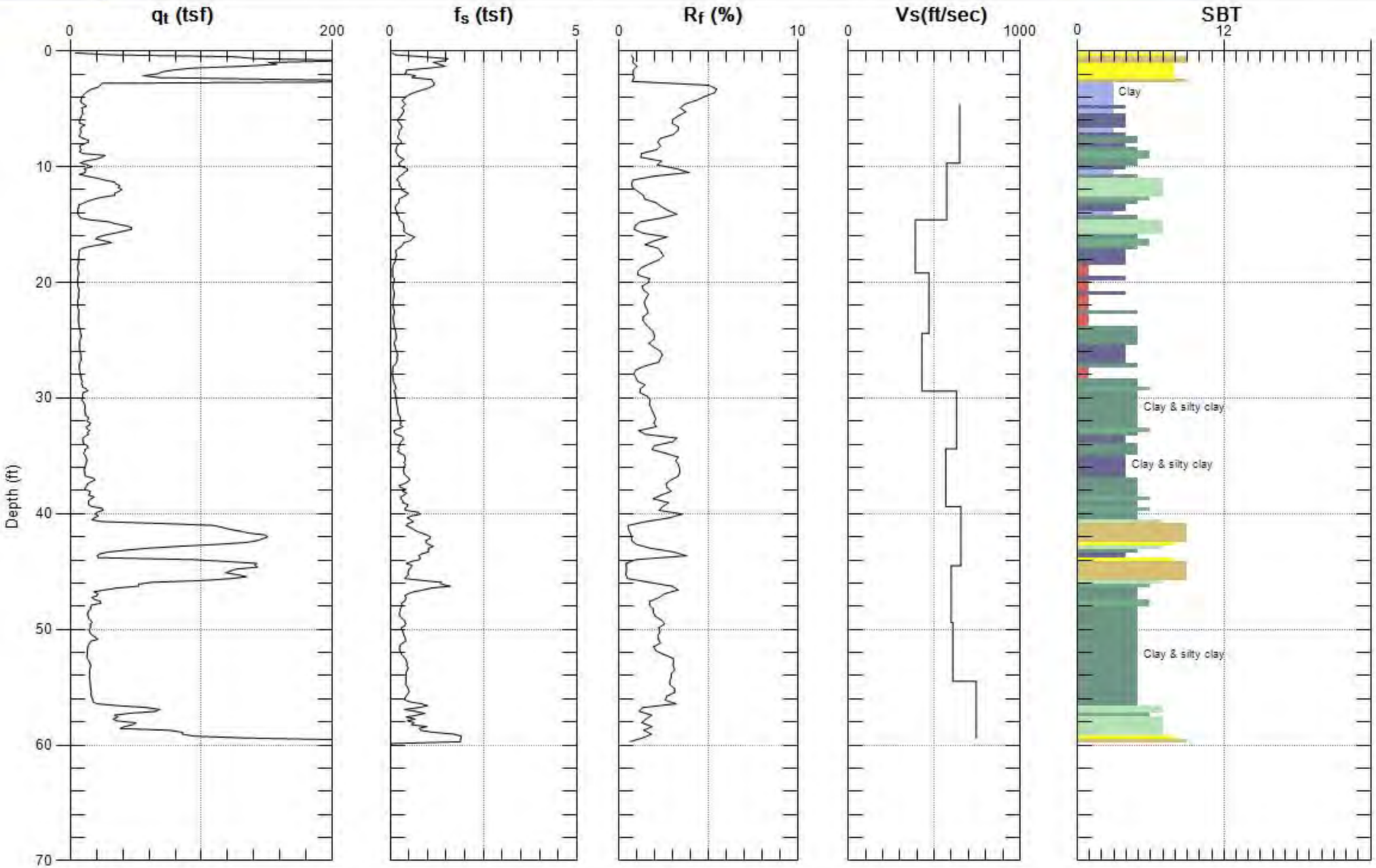
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-SCPT-022

Engineer: E.HOLLIDAY
Date: 9/26/2012 08:18



Max. Depth: 60.039 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

FIGURE A1-66 b

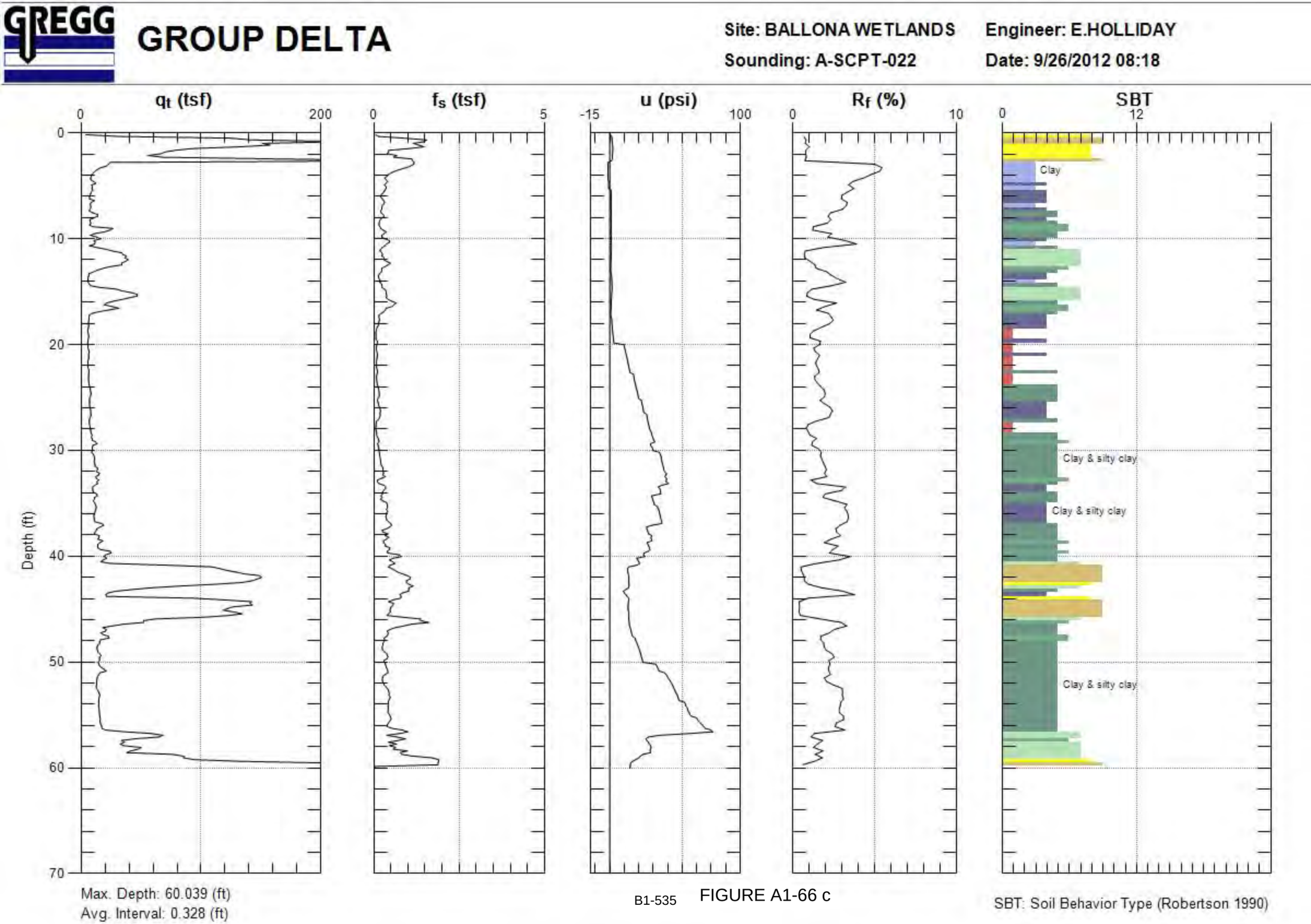


FIGURE A1-66 c

APPENDIX A2
FIELD EXPLORATIONS BY OTHERS

APPENDIX A2
PREVIOUS FIELD EXPLORATIONS

A2.1 INTRODUCTION

Several previous geotechnical and environmental investigations have been performed at the site location. Data from previous investigations by Law Crandall, Inc., Weston Solutions, Inc. and Diaz Yourman & Associates were used for preliminary analyses of this interim report. The exploration locations are shown in Figure 3 of the report.

Borings by Law Crandall, Inc. and Diaz Yourman & Associates were performed primarily for geotechnical purposes. Law Crandall, Inc. performed preliminary geotechnical investigations in each of the Areas within the project (Areas A, B and C) and presented the results of investigations within different areas in separate reports. Diaz Yourman & Associates performed a preliminary geotechnical investigation for Areas B and C. Borings by Weston Solutions, Inc. were performed primarily for the purpose of chemistry and environmental testing, and are not included in this Appendix. A summary of the geotechnical field investigations by Law Crandall, Inc. and Diaz Yourman & Associates, including previous geotechnical borings, is provided in this Appendix.

A2.2 LAW CRANDALL, INC. INVESTIGATIONS

In Area A, field investigation by Law Crandall, Inc. included 20 borings and 5 cone penetration tests (CPT). Drilling was performed in December 1988 and January 1989. Fourteen (14) of the borings were drilled using 5-inch-diameter rotary wash drilling equipment, while the other six (6) borings were performed using a bucket-type drilling equipement. Drilling mud was used for rotary wash borings to prevent caving. The rotary wash borings were drilled to a depth of approximately 60 feet. The bucket-type borings were drilled to a depth of approximately 16 to 20 feet below the existing grade using 16- and 18-inch bucket-type drilling equipment. Subsurface materials were visually classified and recorded by a field technician in accordance with the Unified Soil Classification System (USCS), and undisturbed and disturbed samples were collected for laboratory testing. Standard penetration tests (SPT) were performed in selected borings. CPTs were also advanced to a maximum depth of approximately 60 feet. The logs of borings and CPTs performed during this investigation are presented in this Appendix.

In Area B, field investigation by Law Crandall, Inc. included 32 borings in January and February 1991, and 21 borings at earlier investigation dates of December of 1986 and April of 1987. Most of the borings were drilled using 5-inch-diameter rotary wash drilling equipment to a depth of approximately 20 to 60 feet. Drilling mud was used for rotary wash borings to prevent caving. The drilling mud was removed following completion of the drilling to permit measurement of the

groundwater level. Six (6) borings were performed using 8-inch-diameter hollow stem auger equipment to a depth of approximately 30 feet. Additionally, six 8-inch-diameter hand auger borings were drilled to a depth of 5 to 9 feet below the existing grade. At twelve locations, the rotary wash borings were converted to groundwater monitoring wells to measure the fluctuations in the groundwater levels. Subsurface materials were visually classified and recorded by a field technician in accordance with the Unified Soil Classification System (USCS), and undisturbed and disturbed samples were collected for laboratory testing. Standard penetration tests (SPT) were performed in 21 of more recent borings as well as several of the earlier borings. The logs of borings performed during this investigation are presented in this Appendix.

In Area C, geotechnical field investigation by Law Crandall, Inc. included 5 borings. Drilling was performed in June 1991. The borings were drilled using 5-inch-diameter rotary wash drilling equipment. Drilling mud was used for rotary wash borings to prevent caving. The drilling mud was removed following completion of the drilling to permit measurement of the groundwater level. The rotary wash borings were drilled to a depth of approximately 60 to 75 feet. Subsurface materials were visually classified and recorded by a field technician in accordance with the Unified Soil Classification System (USCS), and undisturbed and bulk samples were collected for laboratory testing. Standard penetration tests (SPT) were performed in all borings in accordance with the ASTM Designation D1986-84 test procedure. Prior to the geotechnical field investigation Law Crandall, Inc. performed an investigation in 1988 for contamination assessment, which included drilling 17 8-inch hollow-stem auger borings. The logs of borings performed during both investigations are presented in this Appendix.

A2.3 DIAZ YOURMAN & ASSOCIATES INVESTIGATION

Field investigation by Diaz Yourman & Associates in Areas B and C included a total of 20 deep borings (13 borings in Area B and 7 borings in Area C), as well as three grab samples in Area B. The borings were drilled by Layne Christenson Company in February 2009, with a rubber tire-mounted CME-750 rig using hollow-stem auger drilling equipment to depths ranging from 16 to 32 feet below the existing grade. Subsurface samples were collected for both geotechnical and bulk chemistry testing. Grab samples for sediments were collected near the tidal gates of the Ballona Creek using a hand auger. Drive samples were collected with a 2.4-inch-inside-diameter (3.0-inch-outside diameter) modified California split-barrel sample lined with brass tubes and a standard split-spoon penetrometer with dimensions in accordance with ASTM 3550 and 1586, respectively. Both samplers were driven with a 140-pound hammer falling 30 inches. After samples were collected, boreholes were backfilled with soils cuttings and bentonite chips. The logs of borings performed during this investigation are presented in this Appendix.

A2.4 REFERENCES

Diaz Yourman & Associates, 2010, Geotechnical Investigation, Ballona wetlands, task Order No. 003, Contract No. W912PL-06-D-004, Los Angeles County, California, PN 2006, 023.05 for the USACE, 2010.

Law Crandall, 1988, "Report of Contamination Assessment, Playa Vista Project – Parcel C, Culvert Boulevard Between Lincoln Boulevard and Marina Freeway, Los Angeles, California", for Howard Hughes Properties, 1988.

Law Crandall, 1991, "Report of Preliminary Geotechnical Investigation, Proposed Marina, Playa Vista Project - Parcel A, Lincoln Boulevard and Ballona CreekLos Angeles County, California".

Law Crandall, 1991, "Supplementary Information, Proposed Marina, Playa Vista Project-Parcel A, Lincoln Boulevard and Ballona Creek, Los Angeles County, California".

Law Crandall, 1991, "Report of Geotechnical Investigation, Proposed Wetlands Restoration and Proposed Development, North of Jefferson Boulevard, Playa Vista Project – Parcel B, Los Angeles, California".

Law Crandall, 1991 "Report of Preliminary Geotechnical Investigation, Playa Vista Project – Parcel C, Culver and Lincoln Boulevards, Los Angeles, California," a report prepared for Maguire Thomas Partners, August 7, 1991.

BORING 1

DATE DRILLED: January 5, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 14.9*

JOB AE-88473 DATE 1/19/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							SM	FILL - SILTY SAND - fine, brown
							ML	FILL - CLAYEY SILT - dark grey
			17.8	91	9		SM	FILL - SILTY SAND - fine, lenses of Clayey Silt, brownish grey
10	5							
			22.2	101	17			Some seashells
							ML	FILL - SANDY SILT - lenses of Clayey Silt, some seashells, grey
5	10	6						
			41.2	77	1			SURFACE OF NATURAL SOIL
							ML	CLAYEY SILT - some seashells, grey
0	15							
		6						
			47.3	74	3			
-5	20						ML	SANDY SILT - grey
		11						
			62.4	60	2		MH	CLAYEY SILT - dark grey (LL = 68; PI = 21)
-10	25							
		2						
-15	30		79.9	53	2			Organic odor
		3						
-20	35							
			59.4	65	2			
							ML	CLAYEY SILT - brownish grey
-25	40	18						

* Elevations provided by Psomas & Associates.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.1a

BORING 1 (Continued)

DATE DRILLED: January 5, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			31.5	89	3	
-30	45	9				
-35	50		29.0	88	3	
-40	55		21.6	106	18	
-45	60		34.2	87	6	



Bluish grey

SM — SILTY SAND - fine, bluish grey

ML — CLAYEY SILT - dark grey

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Drilled 18" - Diameter Bucket Boring 5' south of Rotary Wash Boring to a depth of 11-1/2' on 1/12/89 for water level determination. Water seepage encountered at a depth of 9-1/2'. Caving below 9-1/2' (to 2' in diameter).

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

B AE-88473 DATE 1/19/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

BORING 2

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 14.1

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10	5		37.8	80	2		ML	FILL - SANDY SILT - some seashells, brown
								Large amount of seashells, greyish brown
			12.9	93	4		SM	FILL - SILTY SAND - fine, light brown
5	10		59.3	66	1			Layers of Sandy Silt, some seashells, dark grey
			26.6	99	4			Grey
			43.6	76	< 1		ML	FILL - CLAYEY SILT - grey (LL = 43; PI = 10; oven dry LL = 39)
0	15		34.0	88	3		ML	SURFACE OF NATURAL SOIL SANDY SILT - slightly Clayey, brown and grey
								Some seashells
-5	20							Large amount of seashells
							MH	CLAYEY SILT - organic odor, grey
-10	25		77.9	55	1			
-15	30		48.4	71	2			Dark grey
-20	35		54.3	69	2			
-25	40		35.4	85	4		ML	CLAYEY SILT - dark grey
								(LL = 39; PI = 5)

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.2a

B AE-88473 DATE 1/19/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD BK

BORING 2 (Continued)

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-30	45		33.8	86	4	
-35	50		52.3	65	3	
-40	55		19.1	111	18	
-45	60		19.5	104	54	



Layer of Peat

Traces of Peat

ML SANDY SILT - bluish grey

SM SILTY SAND - fine, some Gravel, traces of Peat, bluish grey

SP SAND - fine to medium, few Gravel and Cobbles, greyish brown

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 35' at completion of drilling. Water level measured at 7' after removal of mud. Boring grouted with cement-bentonite mixture.

Note: The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

JOB AE-88473 DATE 1/19/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

BORING 3

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 13.4

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10	0						SM	FILL - SILTY SAND - fine, light brown
			4.3	93	5			
	5						ML	FILL - CLAYEY SILT - brownish grey
			16.0	90	2			
5							SM	FILL - SILTY SAND - fine, light brown
							ML	FILL - CLAYEY SILT - dark grey
	10		45.8	76	< 1			
		6						SURFACE OF NATURAL SOIL
0							ML	SANDY SILT - grey
	15							Layer of Clayey Silt with seashells
			54.0	71	1			
							ML	CLAYEY SILT - greyish brown
-5		5						
	20						ML	SANDY SILT - some seashells, dark grey
			37.6	83	2			
-10							MH	CLAYEY SILT - organic odor, dark grey
	25	2						
			77.5	53	1			
-15	30							
		4						
-20			50.2	73	1			
	35							Layer of Silty Sand
							ML	CLAYEY SILT - dark grey
		9						
-25								
	40		32.8	90	2			

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

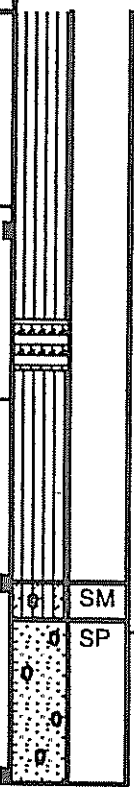
PLATE A - 1.3a

AE-88473 DATE 1/19/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

BORING 3 (Continued)

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-30	45	9	34.8	87	3	
-35	50	5				
-40	55		19.5	110	11	
-45	60		17.8	112	32	



Layer of Peat

SILTY SAND - fine to medium, some Gravel, traces of Peat, grey

SAND - medium to coarse, about 15% Gravel, light grey

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

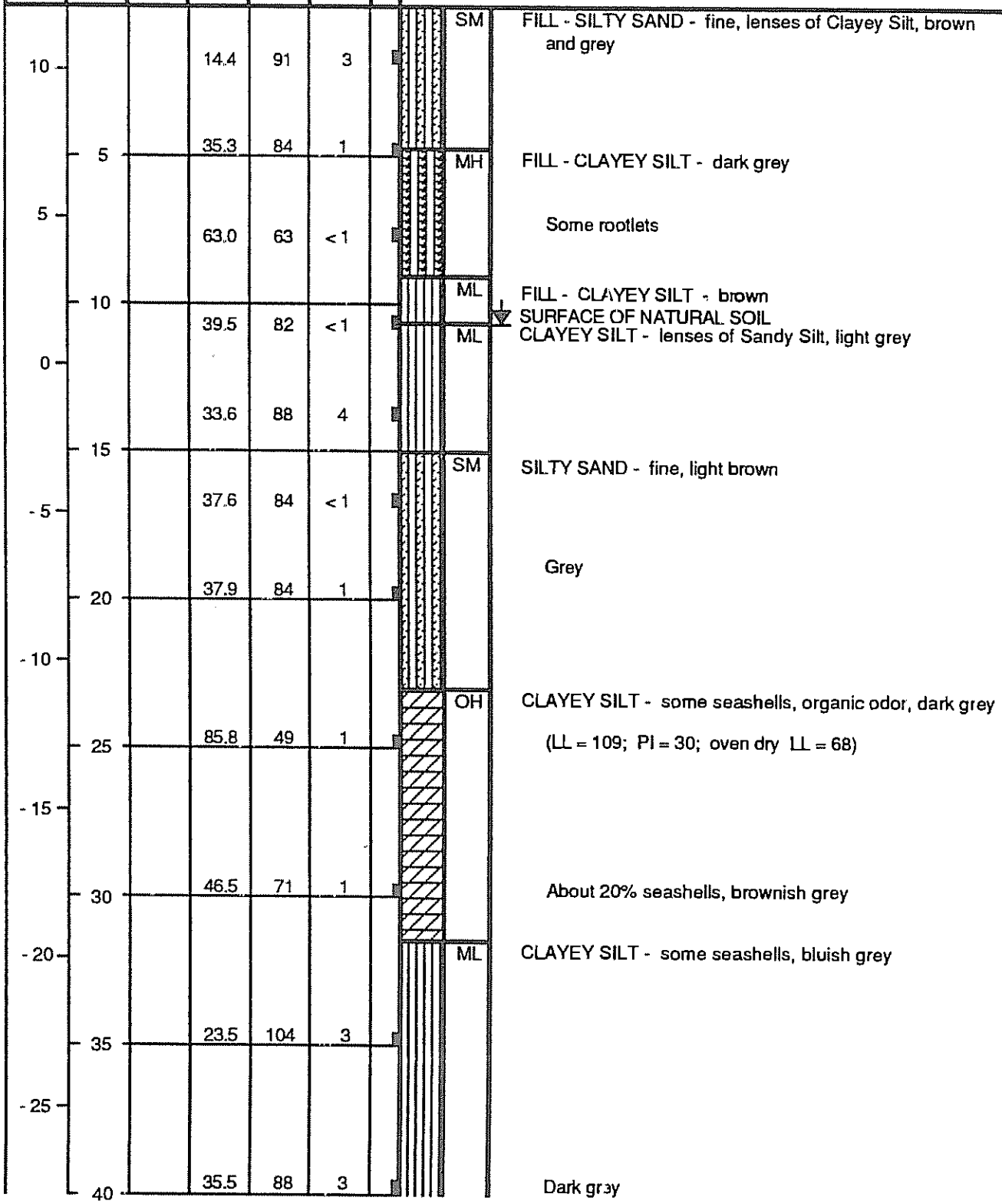
JOB AE-88473 DATE 1/19/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 4

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 12.1



(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.4a

BORING 4 (Continued)

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-30	45		81.3	49	3	
-35	50		22.7	104	5	
-40	55		12.5	129	40	
-45	60		8.2	137	50	



Traces of Peat

PT — PEAT - brown

ML — CLAYEY SILT - traces of Peat, dark grey

SP — SAND - fine to coarse, about 30% Gravel and Cobbles, grey

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

AE-88473 DATE 1/19/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD BJC

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

BORING 5

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 10.9

JOB AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10							ML	FILL - SANDY SILT - lenses of Clayey Silt, greyish brown and dark grey
			48.7	73	1			
	5						SM	FILL - SILTY SAND - fine, light brown
5			57.5	66	<1		MH	FILL - CLAYEY SILT - dark grey (LL = 50; PI = 13)
								SURFACE OF NATURAL SOIL
	10		36.8	84	4		ML	CLAYEY SILT - traces of organic matter, dark grey
0		5						Some Sand
	15							
-5			37.8	84	1		SM	SILTY SAND - fine, brownish grey
	20						MH	CLAYEY SILT - organic odor, bluish grey
-10		1						Few shells (LL = 68; PI = 24)
	25		56.6	66	1			
-15								
		14					ML	CLAYEY SILT - dark grey
	30							
-20			25.1	101	5			Lenses of Sandy Silt
	35							
-25		24					SP	SAND - fine to coarse, few Gravel, bluish grey
	40						ML	CLAYEY SILT - bluish grey

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.5a

BORING 5 (Continued)

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-30			29.2	89	6	
	45	8				
-35						
			17.7	114	54	
-40	50					
		53				
-45	55		9.4	128	39	
	60					
-50						
	65					

Traces of Peat

SP SAND - fine to coarse, some Silt, some Gravel and Cobbles, grey

Large amount of Gravel and Cobbles

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

B AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

BORING 6

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 8.1

JOB AE-88473 DATE 1/20/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
5			39.6	83	2		ML	FILL - CLAYEY SILT - lenses of Sandy Silt, dark grey
	5		53.7	70	< 1			
0			50.7	70	< 1			
	10		42.2	80	< 1			SURFACE OF NATURAL SOIL
							ML	CLAYEY SILT - grey
-5			52.2	69	1		ML	SANDY SILT - brownish grey
	15						MH	CLAYEY SILT - some seashells, bluish grey
-10			70.5	57	< 1			Dark grey
	20		70.4	57	< 1		ML	SANDY SILT - layers of Clayey Silt, bluish grey
-15								
	25		23.5	103	2			
-20								
	30		20.9	107	2			
-25							SM	SILTY SAND - fine, bluish grey
	35		16.5	114	11		ML	SANDY SILT - bluish grey
-30							PT	PEAT - brown to dark brown
	40		59.7	64	2		ML	CLAYEY SILT - large amount of Peat, dark brown

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

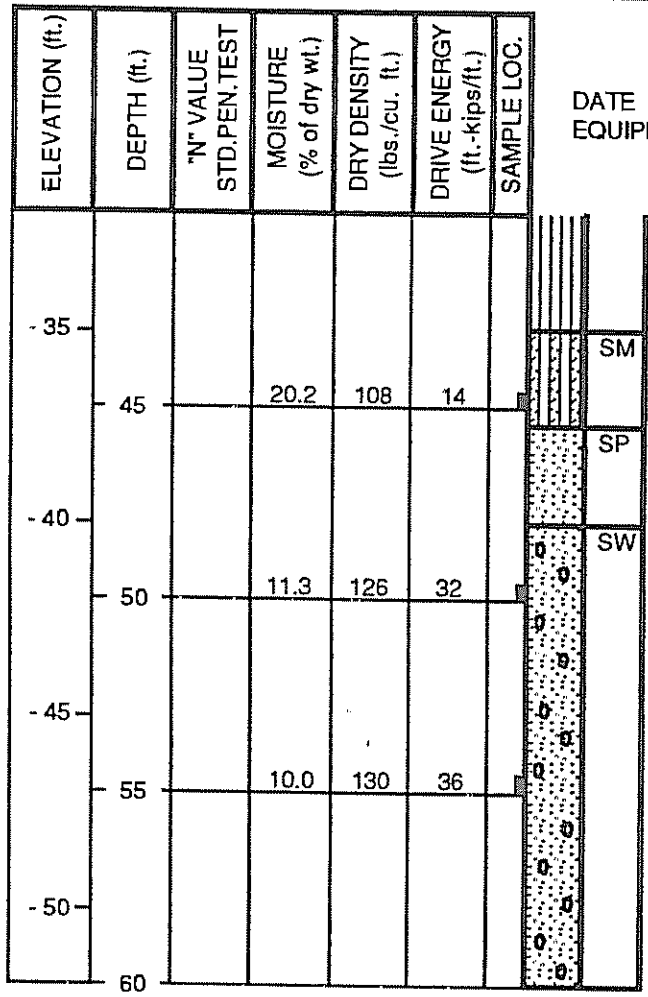
LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.6a

AE-88473 DATE 1/20/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

BORING 6 (Continued)

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash



SILTY SAND - fine to medium, bluish grey

SAND - fine, grey

SAND - well graded, about 20% Gravel, grey

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Drilled 18" - Diameter Bucket Boring 5' south of Rotary Wash Boring to a depth of 12-1/2' on 1/12/89 for water level determination. Water seepage encountered at a depth of 11'. Hole squeezing in below 11'.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

BORING 7

DATE DRILLED: January 5, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 12.3

JOB AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10	0		20.3	96	6		ML	FILL - SANDY SILT - brown
			29.0	88	2			Lenses of Clayey Silt Some seashells, brown and grey
5	5		37.6	86	1			
			46.5	76	1		ML	FILL - CLAYEY SILT - some Sand, light grey Large amount of seashells
0	10		31.9	83	1			Brownish grey
								SURFACE OF NATURAL SOIL
			35.0	87	4		ML	CLAYEY SILT - lenses of Sandy Silt, light grey
-5	15		32.6	87	1			
	20		80.1	53	1		MH	CLAYEY SILT - some organic matter, light grey
-10	25		78.0	54	2			
-15	30		36.6	84	2			Bluish grey
-20	35		46.6	72	2			
-25	40		33.6	88	7			

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.7a

BORING 7 (Continued)

DATE DRILLED: January 5, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

B ____ AE-88473 ____ DATE ____ 1/20/89 ____ F.T. ____ BG ____ DR. ____ dmh ____ O.E. ____ JC ____ W.P. ____ dmh ____ CHKD ____

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-30	45		36.8	81	5			(LL = 56; PI = 23)
-35	50		23.8	103	10		ML	SANDY SILT - few seashells, bluish grey
-40	55		26.6	96	6		ML	Black CLAYEY SILT - grey
-45	60		22.5	102	40		SP	SAND - fine to medium, grey

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 60' at completion of drilling. Water level measured at 7' after removal of mud. Boring grouted with cement-bentonite mixture.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

BORING 8

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 16" - Diameter Bucket

ELEVATION 12.9

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10	5		24.8	92	< 1		ML	FILL - SANDY SILT - brownish grey Some lumps of Clayey Silt
5	10		33.8	89	< 1		ML	FILL - CLAYEY SILT - grey (LL = 37; PI = 8)
			57.4	70	< 1		MH	FILL - CLAYEY SILT - bluish grey Brownish grey
0	15		48.1	73	< 1		ML	SURFACE OF NATURAL SOIL CLAYEY SILT - light brown
-5	20		35.8	86	< 1			

NOTE: Water seepage encountered at 13'. Water level measured at 15' at completion of drilling and at 13' 20 minutes later. Caving below 13'.

JOB AE-88473 DATE 1/20/89 F.T. TC DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.8

B AE-88473 DATE 1/20/89 F.T. TC DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 9

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 16" - Diameter Bucket

ELEVATION 12.0

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10	0		19.2	96	< 1		SM	FILL - SILTY SAND - fine, light brown
							ML	FILL - SANDY SILT - greyish brown
			41.6	82	< 1		ML	FILL - CLAYEY SILT - dark grey
5	5		64.0	62	< 1		MH	FILL - CLAYEY SILT - dark grey
			47.9	72	< 1			
0	10		55.6	68	< 1		ML	SURFACE OF NATURAL SOIL CLAYEY SILT - some Sand, some cemented nodules, dark brown
-5	15							
	20							

NOTE: Water seepage encountered at 13-1/2'. Water level measured at 13' 20 minutes after completion of drilling. Caving below 12'. Hole squeezed in below 14' after drilling to 17'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

BORING 10

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 16" - Diameter Bucket

ELEVATION 10.6

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10							ML	FILL - SANDY SILT - brown
			32.9	89	< 1			
							MH	FILL - CLAYEY SILT - bluish grey and brown
			62.5	61	< 1			Some organic matter
	5							
5			83.5	53	< 1			Lenses of Sandy Silt
							ML	FILL - CLAYEY SILT - brownish grey
			32.7	86	< 1			
								▼ SURFACE OF NATURAL SOIL
	10						ML	SANDY SILT - brownish grey
0								
			35.0	88	< 1			
			37.4	87	< 1			
	15						ML	CLAYEY SILT - bluish grey
-5								
	20							

NOTE: Water seepage encountered at a depth of 11'. Caving below 11'. Hole squeezed in below 12-1/2' after drilling to 16'.

JOB AE-88473 DATE 1/20/89 F.T. TC DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.10

JOB AE-88473 DATE 1/20/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

BORING 11

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 10.3

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10							ML	FILL - CLAYEY SILT - greyish brown
			14.2	94	4		SM	FILL - SILTY SAND - fine, greyish brown
5	5						ML	FILL - CLAYEY SILT - some organic matter, brown
			39.6	83	4		ML	FILL - SANDY SILT - light grey
0	10		41.7	83	2			▼ SURFACE OF NATURAL SOIL
		3					MH	CLAYEY SILT - traces of organic matter, light greyish brown
								Greyish brown
-5	15		48.1	74	< 1			Some seashells, organic odor, grey
		0						Bluish grey
-10	20		77.6	52	< 1			
		5						
-15	25							
			19.1	109	1			Some Sand, dark grey
-20	30						SP SM	SAND - fine to coarse, some Silt, about 10% Gravel, dark grey
		33						
			25.7	99	7		ML	SANDY SILT - bluish grey
-25	35							
		14					MH	CLAYEY SILT - bluish grey
	40		46.5	75	2			(LL = 67; PI = 32; oven dry LL = 62)

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

BORING 11 (Continued)

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-30								
		11						Traces of Peat
-35	45		26.6	97	7			Some Sand
							SP	SAND - fine to medium, grey
		58					SW	SAND - well graded, about 30% Gravel, grey
-40	50							
			7.6	119	36			
-45	55						SP	SAND - fine to medium, some Gravel, light grey
	60		21.9	105	28			

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

JOB AE-88473 DATE 1/20/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.11b

BORING 12

DATE DRILLED: January 12, 1989
EQUIPMENT USED: 18" - Diameter Bucket

ELEVATION 13.2

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10			20.1	85	2		ML	FILL - CLAYEY SILT - layers of Sandy Silt, light brown and brown
			30.3	83	< 1			Some organic matter
	5						ML	FILL - SANDY SILT - layers of Clayey Silt, brown and dark grey
5			22.7	91	< 1			
			27.7	87	< 1			
	10						MH	FILL - CLAYEY SILT - dark grey
			45.6	75	< 1			
0								SURFACE OF NATURAL SOIL
							MH	CLAYEY SILT - some Sand, few seashells, brownish grey
	15		53.4	69	< 1			
- 5								
	20		40.2	81	< 1			Bluish grey

NOTE: Water seepage encountered at a depth of 13'. Water level measured at 16' 10 minutes after completion of drilling. Caving below 13' (to 2' in diameter).

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

B ____ AE-88473 ____ DATE ____ 1/20/89 ____ F.T. ____ FH ____ DR. ____ dmh ____ O.E. ____ JC ____ W.P. ____ dmh ____ CHKD ____

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

BORING 13

DATE DRILLED: January 12, 1989
EQUIPMENT USED: 18" - Diameter Bucket

ELEVATION 11.6

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10			39.4	83	< 1		ML	FILL - SANDY SILT - light brown
							ML	FILL - CLAYEY SILT - bluish grey
			21.3	83	< 1		ML	FILL - SANDY SILT - light brown
	5						MH	FILL - CLAYEY SILT - bluish grey
5			62.5	65	< 1			
			35.8	87	< 1			Layers of Silty Sand and Sandy Silt, grey and dark grey
	10							
0			34.0	87	< 1			SURFACE OF NATURAL SOIL
							ML	CLAYEY SILT - some organic matter, bluish grey
	15		30.5	92	1			Brownish grey
- 5							MH	CLAYEY SILT - bluish grey
	20							

NOTE: Water seepage encountered at a depth of 12'. Water level measured at 14-1/2' 10 minutes after completion of drilling. Caving below 12' (to 2' in diameter).

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB AE-88473 DATE 1/20/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.13

BORING 14

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 11.8

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10			19.9	92	5		ML	FILL - CLAYEY SILT - some rootlets, brownish grey
			24.3	86	5			Light brown
5	5							
			25.6	91	3		ML	FILL - SANDY SILT - greyish brown
								Some organic matter
	10		51.6	70	2			Dark brown to black, organic odor, some seashells
0								SURFACE OF NATURAL SOIL
			47.8	78	3		ML	CLAYEY SILT - light grey
	15						ML	SILT - brownish grey
-5			37.9	83	3			
							MH	CLAYEY SILT - few seashells, organic odor, bluish grey
	20							
-10			64.6	67	1			
			43.5	74	1			Lenses of Sandy Silt, light grey
	25							Dark grey
-15								
			32.8	91	1		ML	CLAYEY SILT - some Peat, dark grey
	30							(LL = 38; PI = 11)
-20								
			27.1	96	1			
	35							
-25			23.8	99	5			
	40							

(CONTINUED ON FOLLOWING PLATE)

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

B ___ AE-88473 ___ DATE ___ 1/20/89 ___ F.T. ___ BG ___ DR. ___ dmh ___ O.E. ___ JC ___ W.P. ___ dmh ___ CHKD ___

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

BORING 14 (Continued)

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.	
-30	45		45.4	76	3		Bluish grey
			29.1	93	5		Dark grey
-35	50		35.9	84	4		
-40			80.2	52	4		Layers of Peat, dark brownish grey and brown
-45	55		89.6	45	4		
-50	60		31.1	93	7		Dark grey
	65						

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

JOB AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.14b

B AE-88473 DATE 1/20/89 F.T. TC DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 15

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 16" - Diameter Bucket

ELEVATION 10.7

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10							ML	FILL - SANDY SILT - greyish brown
			24.2	92	2			
								Lenses of Clayey Silt
	5		30.9	81	< 1			
5							ML	FILL - CLAYEY SILT - greyish brown
			40.0	80	< 1			Some organic matter
								Layer of Silty Sand
			44.2	79	< 1			SURFACE OF NATURAL SOIL
							ML	SANDY SILT - grey
0	10						MH	CLAYEY SILT - light grey
			51.9	69	< 1			(LL = 59; PI = 20)
	15							
- 5			43.9	79	< 1			Brownish grey
	20							

NOTE: Water seepage encountered at a depth of 12'. Water level measured at 12-1/2' 10 minutes after completion of drilling. Caving below 12'. Hole squeezed in below 13-1/2' after drilling to 16'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

BORING 16

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 11.3

JOB AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10			43.6	73	1		ML	FILL - CLAYEY SILT - brownish grey
			18.4	95	5		ML	FILL - SANDY SILT - light brown
5	5		21.4	84	1		ML	FILL - CLAYEY SILT - brown
	10		18.5	110	7		ML	FILL - SANDY SILT - few Gravel, brownish grey
0			48.5	71	2		MH	SURFACE OF NATURAL SOIL CLAYEY SILT - some Sand, traces of organic matter, dark grey
	15	3						Brownish grey
-10	20		71.7	56	2			Few seashells, organic odor, bluish grey
	25	4						Dark grey
-15			26.9	97	3			Layer of Sandy Silt, traces of Peat, dark greyish brown
-20	30	23						
	35		42.8	77	2			Traces of Peat
-25	40	15					ML	CLAYEY SILT - bluish grey

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.16a

B AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD

BORING 16 (Continued)

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.	
-30			23.8	100	8		Some Sand
	45	8					
-35			37.3	85	8		Dark grey
	50	15					Traces of Peat
-40							
	55		32.5	86	6		
-45							
	60		10.5	129	72	SP	SAND - fine to coarse, some Gravel and Cobbles, light grey
-50							
	65						

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Drilled 18" - Diameter Bucket Boring 5' east of Rotary Wash Boring to a depth of 13' on 1/12/89 for water level determination. Water seepage encountered at a depth of 11-1/2'. No caving.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

BORING 17

DATE DRILLED: December 30, 1988
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 18.2

JOB AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
15			19.3	110	14		CL	FILL - SANDY CLAY - reddish brown
			14.5	114	13			Lenses of Silty Sand, some organic matter, brown and light grey
	5		15.3	115	5			Lenses of Clayey Silt, pieces of brick, reddish brown and brown
10			20.6	107	4			
	10						ML	FILL - SANDY SILT - grey
			27.0	96	7			
5								
			35.0	86	2			
	15							
			11.8	117	13		SM	FILL - SILTY SAND - fine, some vegetation, hydrocarbon odor, traces of hydrocarbon, dark brown to black
0								SURFACE OF NATURAL SOIL
							MH	CLAYEY SILT - brownish grey
	20	6						
-5								Large amount of seashells, organic odor, grey
	25		63.8	60	3			
-10		3						
	30							
-15			28.1	94	18		SM	SILTY SAND - fine, grey
	35	18						
-20			46.8	77	3		MH	CLAYEY SILT - some seashells, grey
	40							

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.17a

BORING 17 (Continued)

DATE DRILLED: December 30, 1988
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
								Bluish grey
-25	45	8	23.7	94	45		SM	SILTY SAND - fine, grey
-30	50	10	19.9	109	16		ML	CLAYEY SILT - some seashells, bluish grey Some Sand
-35	55		20.6	109	5		ML	SANDY SILT - slightly Clayey, grey
-40	60		27.6	94	5		ML	CLAYEY SILT - some cemented lumps, bluish grey
			33.4	90	5			

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 40' at completion of drilling. Water level measured at 15-1/2' 4 days after removal of mud. Boring grouted with sand and cement slurry.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD BL

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

BORING 18

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 12.7

JOB AE-88473 DATE 1/20/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD BK

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10	0		35.4	87	2		ML	FILL - SANDY SILT - greyish brown
								Lenses of Clayey Silt
	5		9.0	88	1			
5			59.1	62	< 1		ML	FILL - CLAYEY SILT - bluish grey
								Dark grey (LL = 45; PI = 14)
	10		38.0	84	< 1			Brownish grey
0								SURFACE OF NATURAL SOIL
			56.1	66	< 1		MH	CLAYEY SILT - greyish brown
	15						ML	SANDY SILT - lenses of Clayey Silt, brown and grey
- 5			38.6	84	1			
							MH	CLAYEY SILT - some seashells, organic odor, grey
	20		46.8	74	1			
- 10								
	25		74.6	53	< 1			Brownish grey
- 15								Some Sand, dark grey
	30		32.1	90	1			
- 20								No Sand, bluish grey
	35		51.0	68	< 1			
- 25							ML	CLAYEY SILT - bluish grey
	40		22.8	104	6			

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.18a

BORING 18 (Continued)

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
- 30	45		22.9	88	5	SM
- 35	50		39.4	78	3	ML
- 40	55		32.0	92	2	
- 45	60		42.6	78	2	

SILTY SAND - fine, grey

CLAYEY SILT - dark grey

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Drilled 18" - Diameter Bucket Boring 5' east of Rotary Wash Boring to a depth of 16' on 1/12/89 for water level determination. Water seepage encountered at a depth of 11'. Caving below 11' (to 2' in diameter).

DB AE-88473 DATE 1/20/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

BORING 19

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 14.9

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
			22.1	92	6		SM	FILL - SILTY SAND - fine, lenses of Clayey Silt, brown and grey Large amount of seashells
			5.0	102	11			Light brown
10	5						ML	FILL - SANDY SILT - lenses of Clayey Silt, some seashells, grey and brown
			29.5	92	8			
5	10		43.4	81	2		ML	FILL - CLAYEY SILT - greyish brown
			43.4	76	1			Some Sand, some vegetation, grey and black
0	15		40.4	80	1			▽ SURFACE OF NATURAL SOIL
							MH	CLAYEY SILT - brownish grey
-5	20	3						
			42.1	77	1			Few seashells, organic odor, dark grey
-10	25							
		1						
-15	30						SM	SILTY SAND - fine, few seashells, organic odor, dark grey
			26.5	98	12		MH	CLAYEY SILT - brownish grey
-20	35	1						
			58.6	62	2			Few seashells
-25	40							

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.19a

BORING 19 (Continued)

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
		4	46.6	73	2			Lenses of Silty Sand, traces of Peat, dark grey
-30	45	4						
-35	50		47.6	76	6		SP	GRAVELLY SAND - fine to coarse, about 40% Gravel and Cobbles, lenses of Sandy Silt, traces of Peat, black
		25						
-40	55		11.0	122	27		GW	GRAVEL - well graded, some Sand, few Cobbles, black
-45	60		9.0	120	24			
-50	65							

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.19b

BORING 20

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 12.3

JOB AE-88473 DATE 1/20/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations end times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10			29.2	94	7		ML	FILL - SANDY SILT - light brown
	5						ML	FILL - CLAYEY SILT - brownish grey
5			24.0	96	3		ML	FILL - SANDY SILT - lenses of Clayey Silt, grey and brown
	10		41.1	80	1		ML	SURFACE OF NATURAL SOIL SANDY SILT - some organic matter, dark grey
0		5						
	15		32.8	90	4			Brownish grey
-5		0					MH	CLAYEY SILT - some seashells, organic odor, brown and dark grey
	20		48.7	72	<1			Dark grey
-10	25	0						
-15			57.4	64	<1			
	30	0						
-20			54.4	68	1			Grey
	35	8						
-25			20.7	109	8		SM	SILTY SAND - fine, dark grey
	40							

(CONTINUED ON FOLLOWING PLATE)

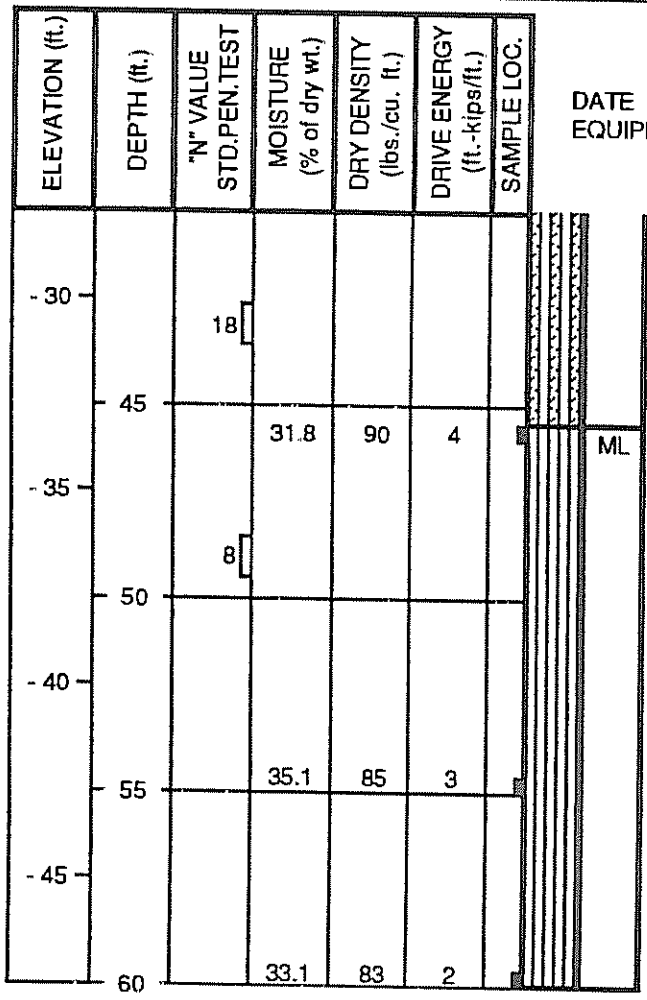
LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.20a

BORING 20 (Continued)

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash



Layers of Clayey Silt

CLAYEY SILT - lenses of Silty Sand, dark grey

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

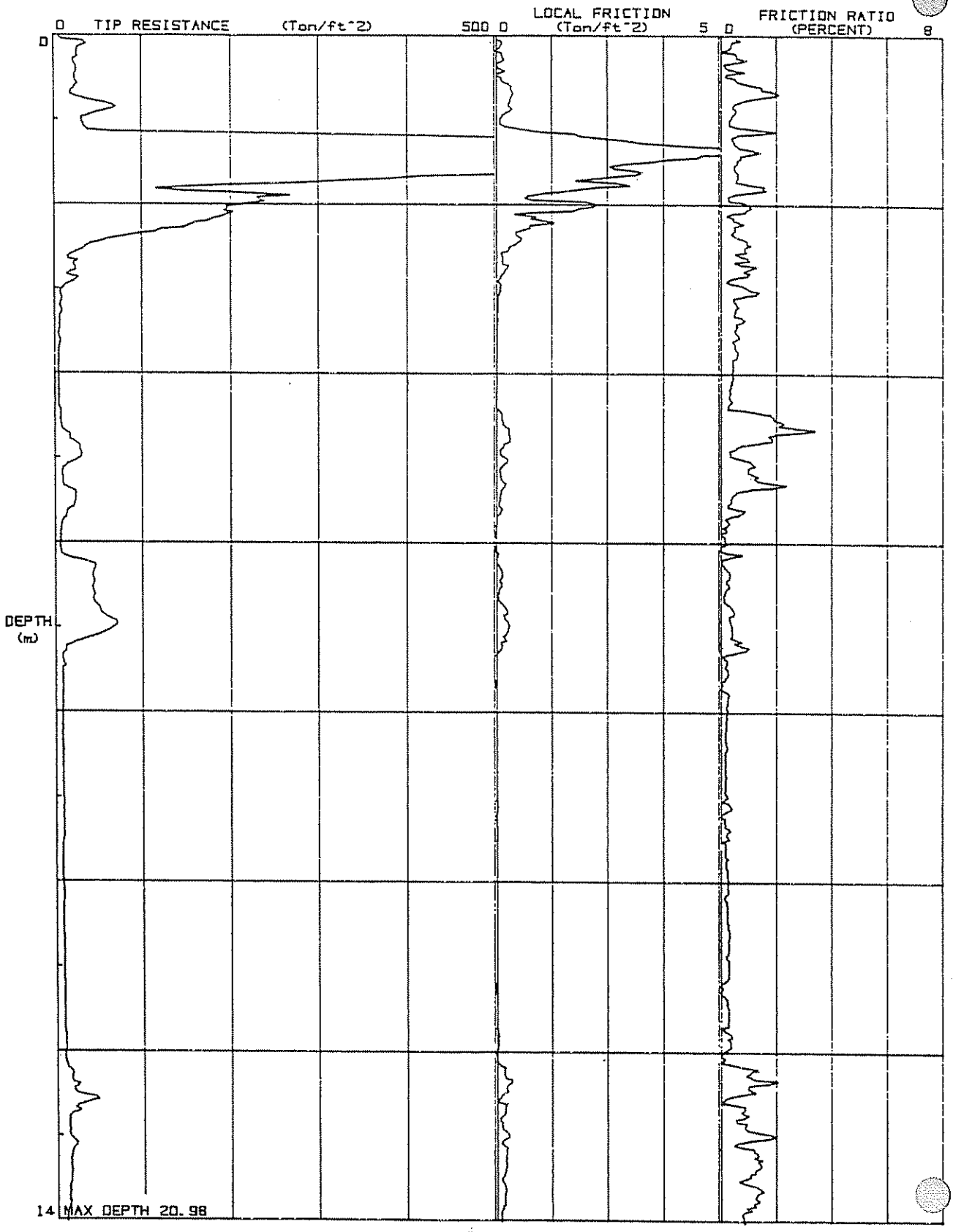
JOB AE-88473 DATE 1/20/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

C.P.T. - 1

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 14.9 FT *

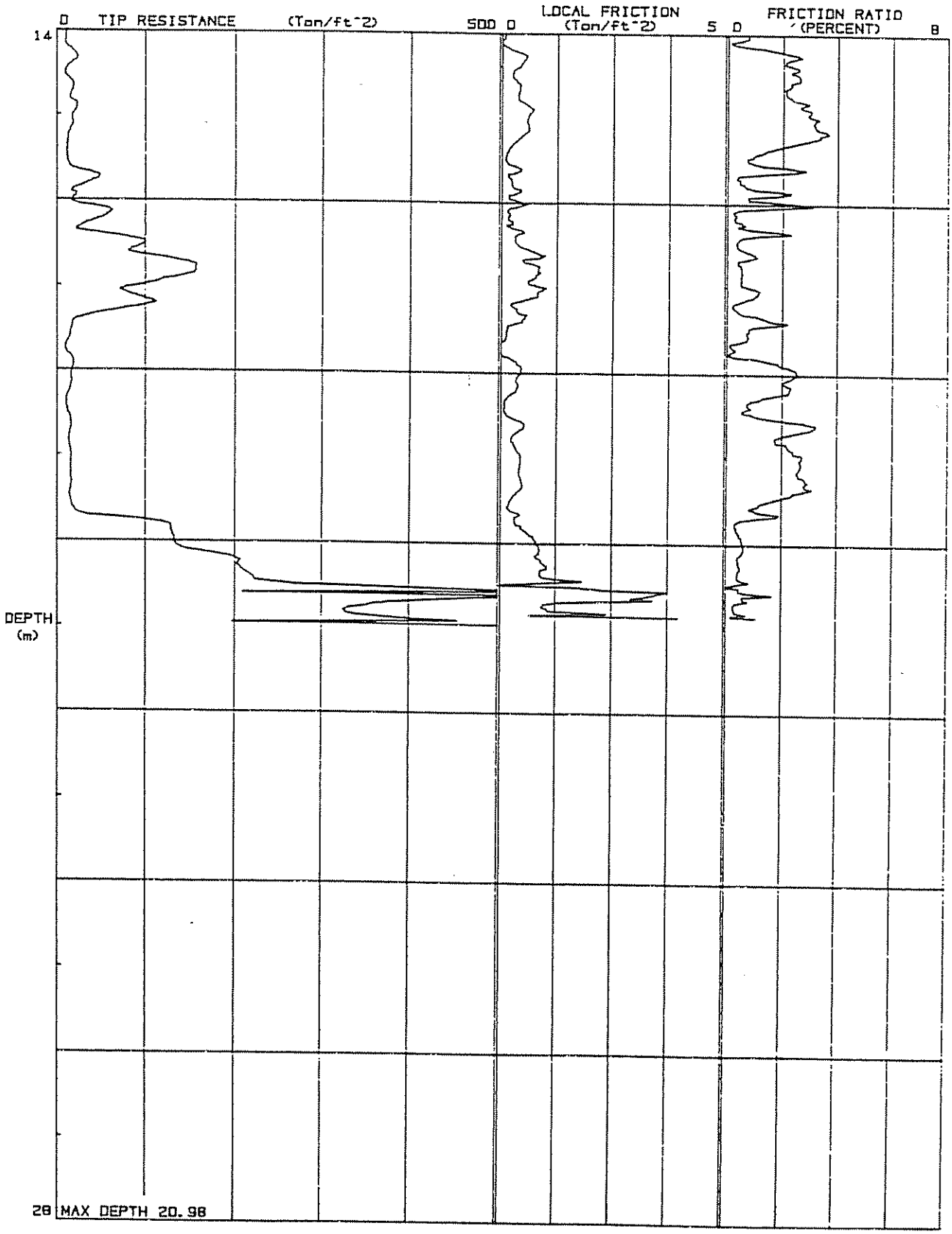


* Elevations provided by Psomas and Associates

(CONTINUED)

C.P.T. - 1

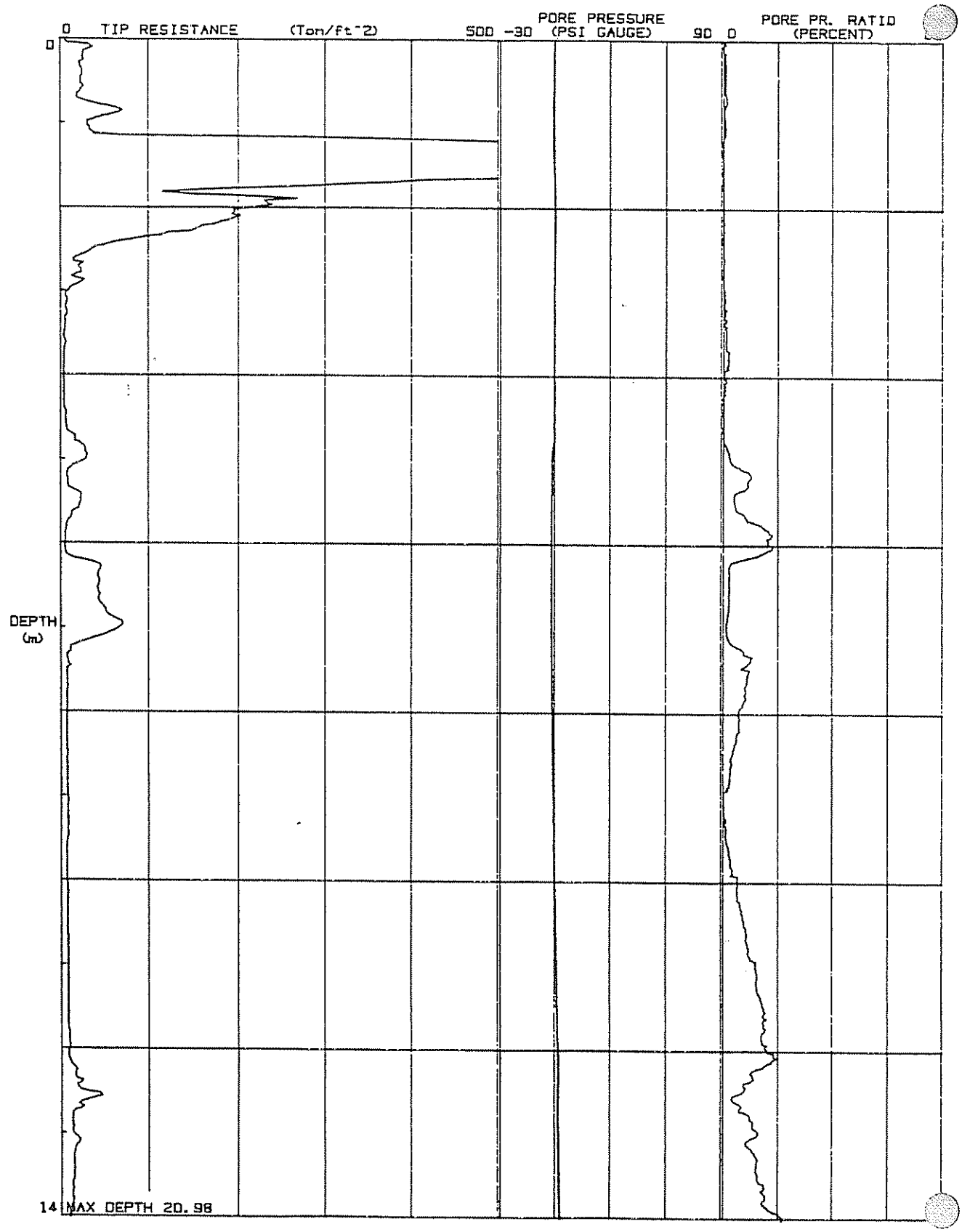
CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 14.9 FT



(CONTINUED)

C.P.T. - 1

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 14.9 FT



(CONTINUED)

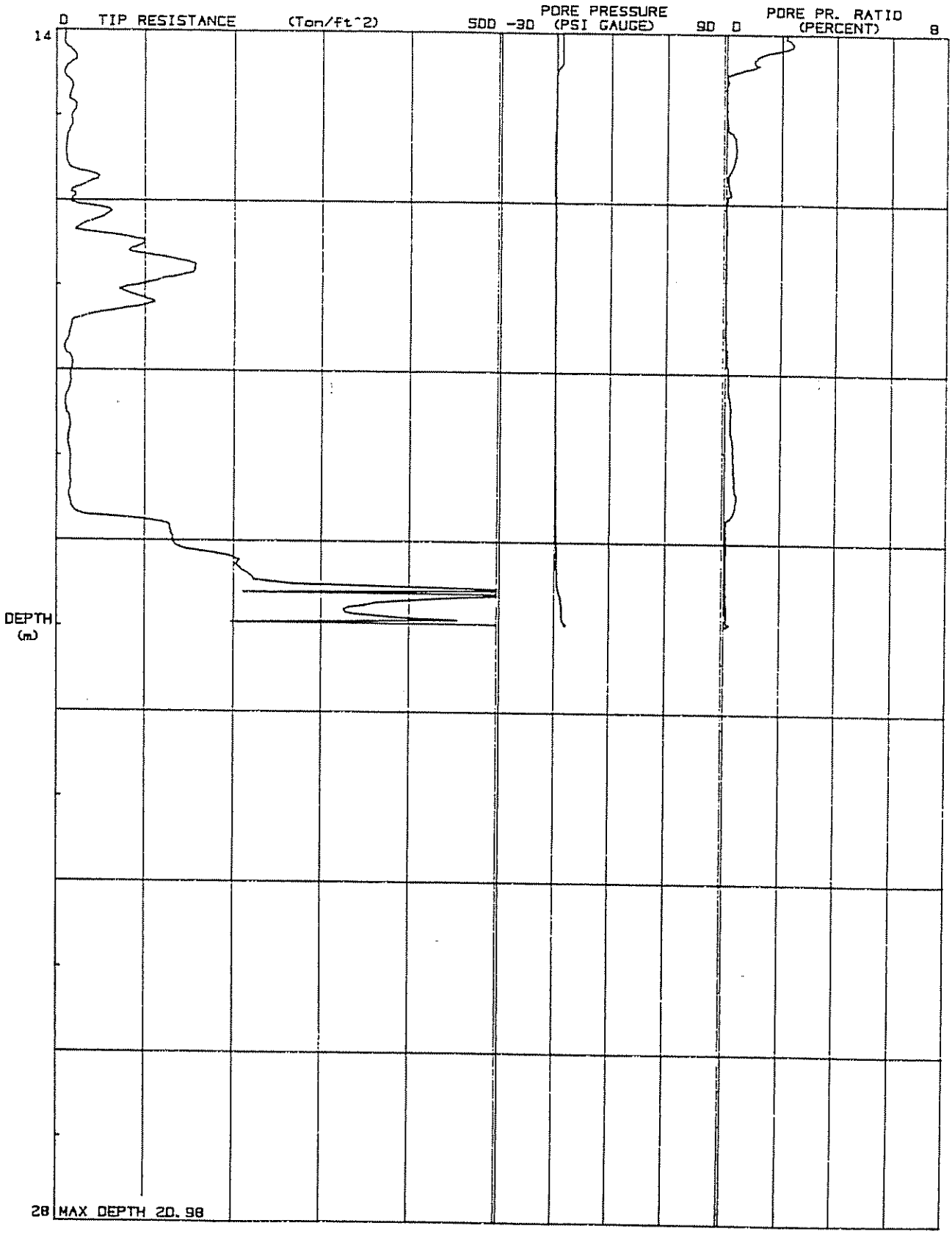
Area A - Law Crandall CPTs

B1-576

PLATE A2-37

C.P.T. - 1

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 14.9 FT

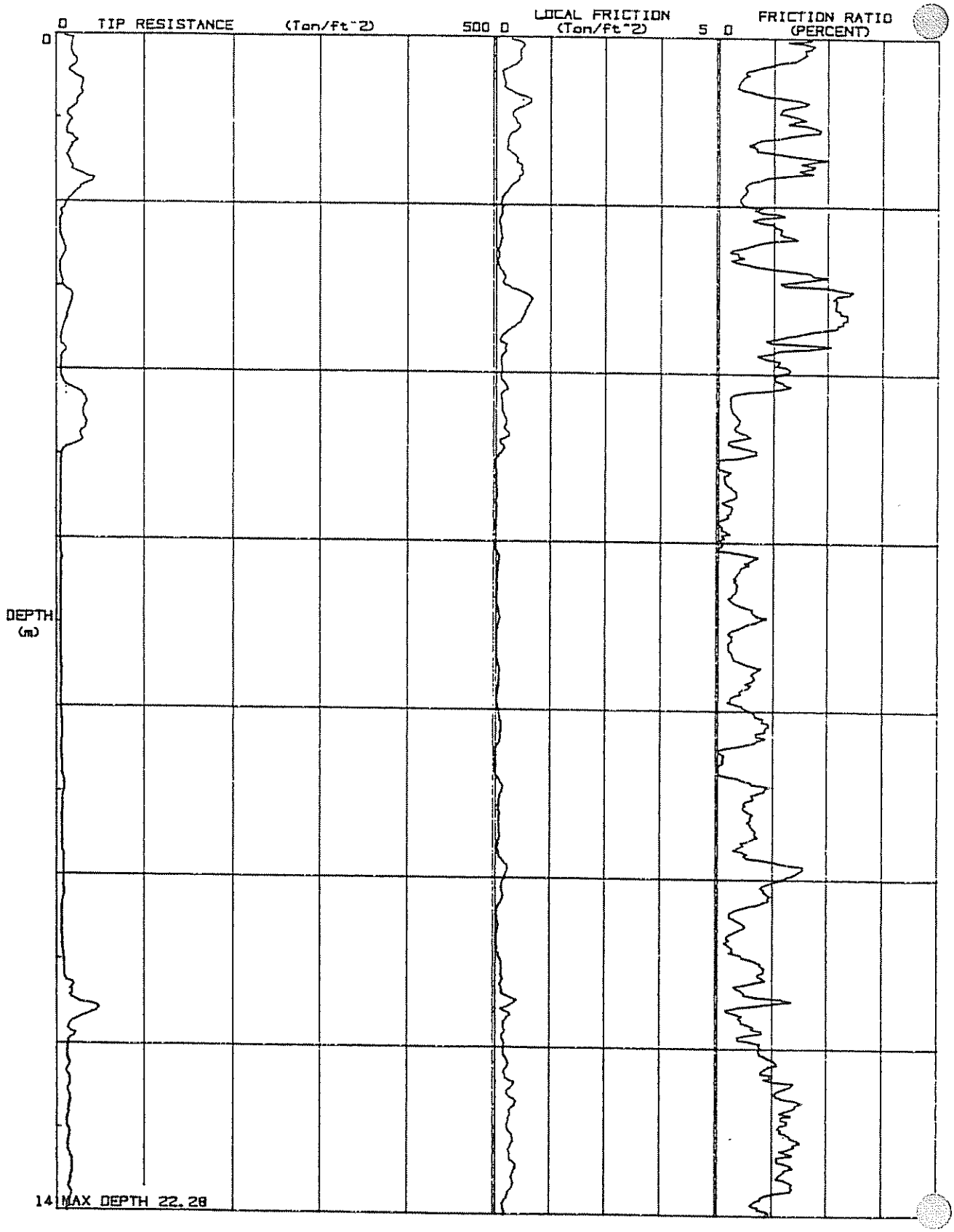


Area A - Law Crandall CPTs
B1-577

PLATE A2-38

C.P.T. - 14

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 11.8 FT



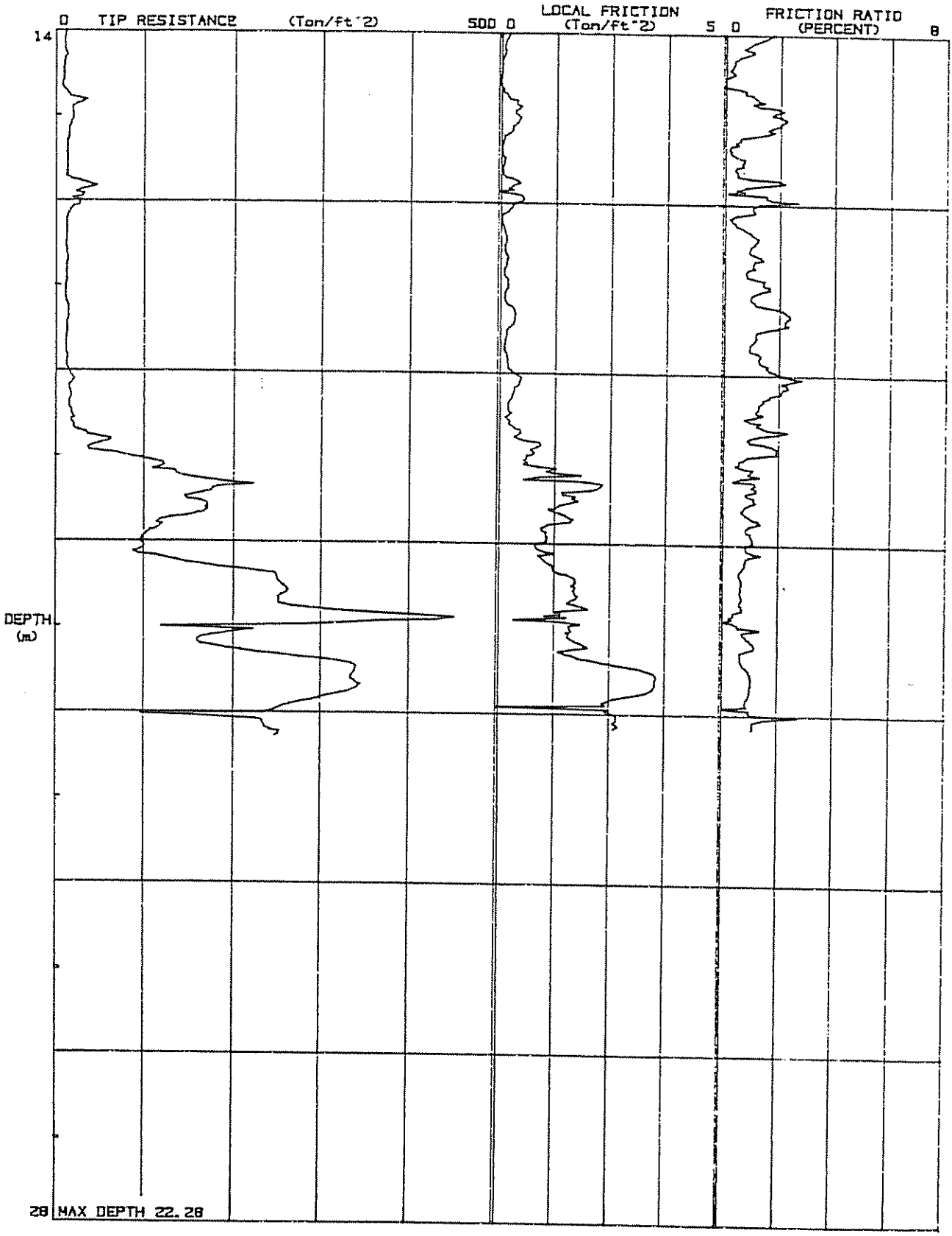
(CONTINUED)

Area A - Law Crandall CPTs
B1-578

PLATE A2-39

C.P.T. - 14

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 11.8 FT



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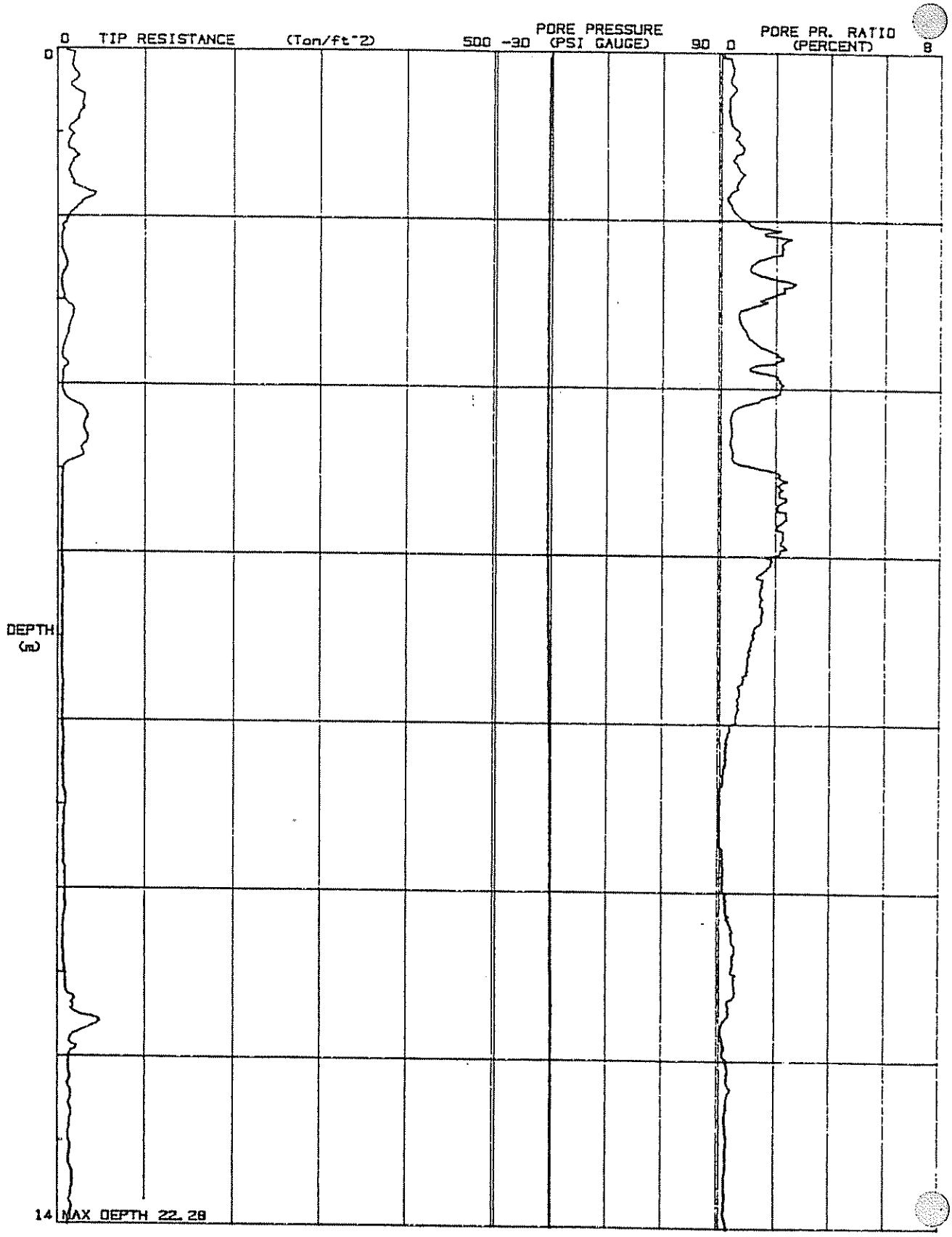
C.P.T. - 14

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 11.8 FT



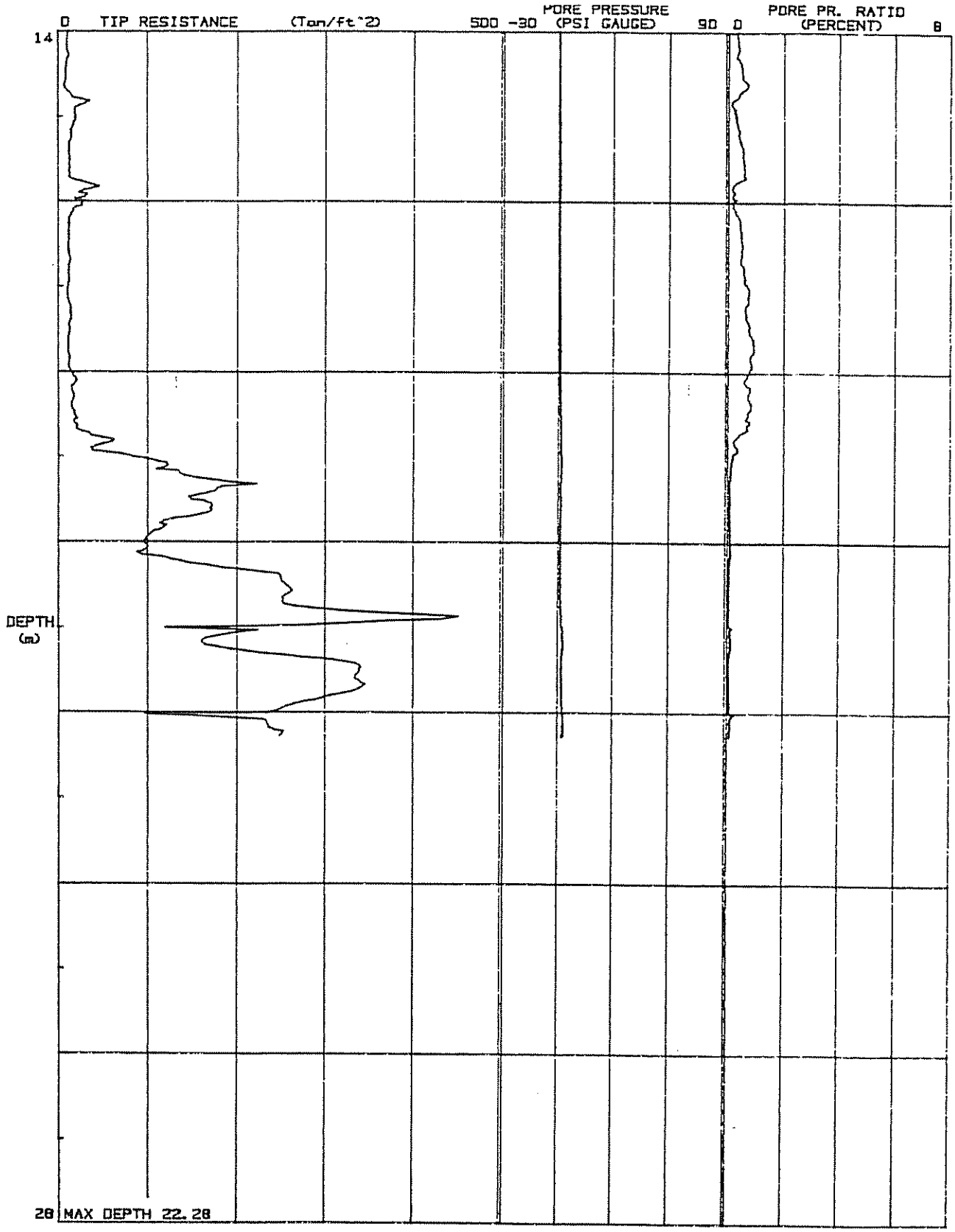
(CONTINUED)

Area A - Law Crandall CPTs
B1-580

PLATE A2-41

C.P.T. - 14

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 11.8 FT

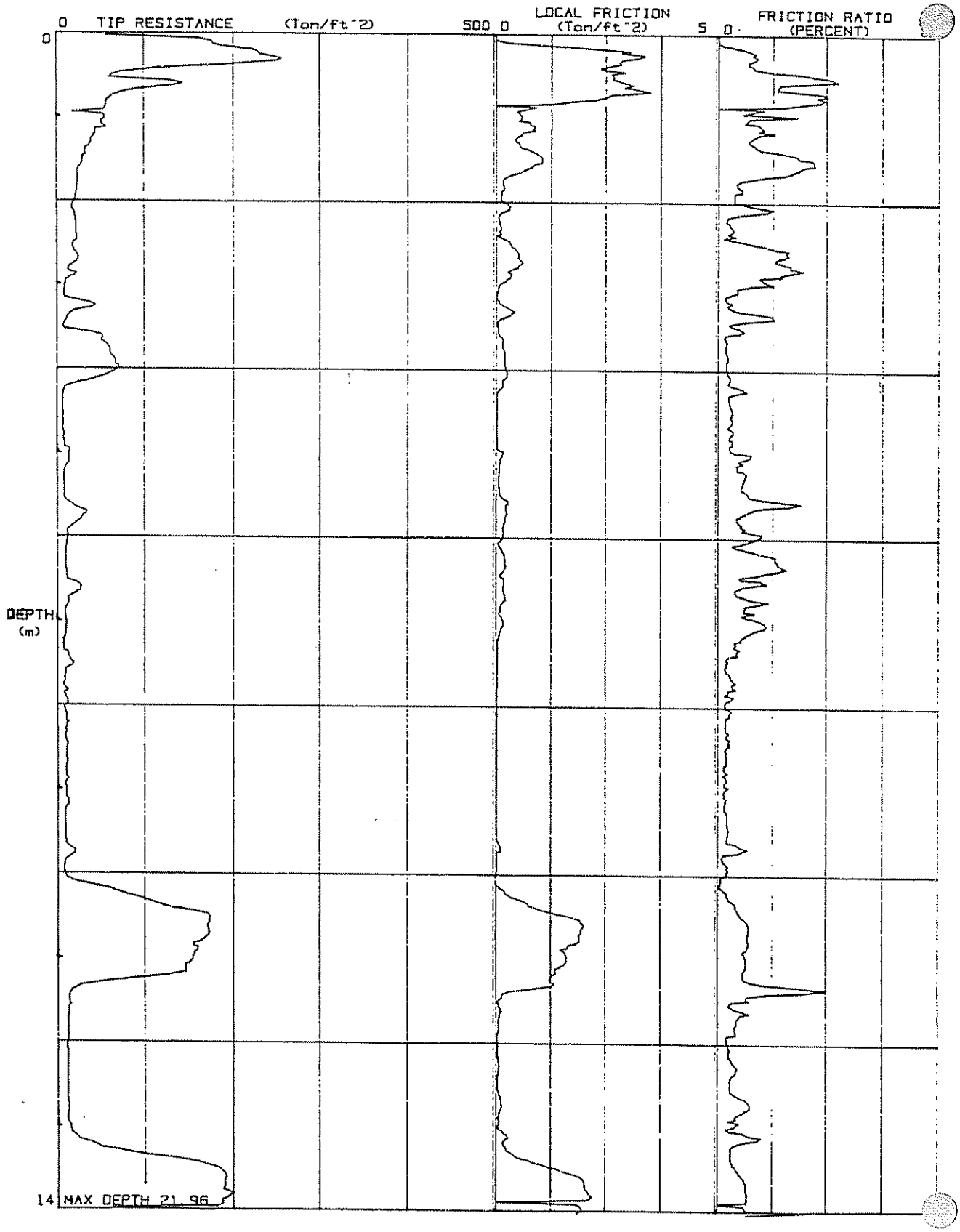


Area A - Law Crandall CPTs
B1-581

PLATE A2-42

C.P.T. - 17

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 18.2 FT



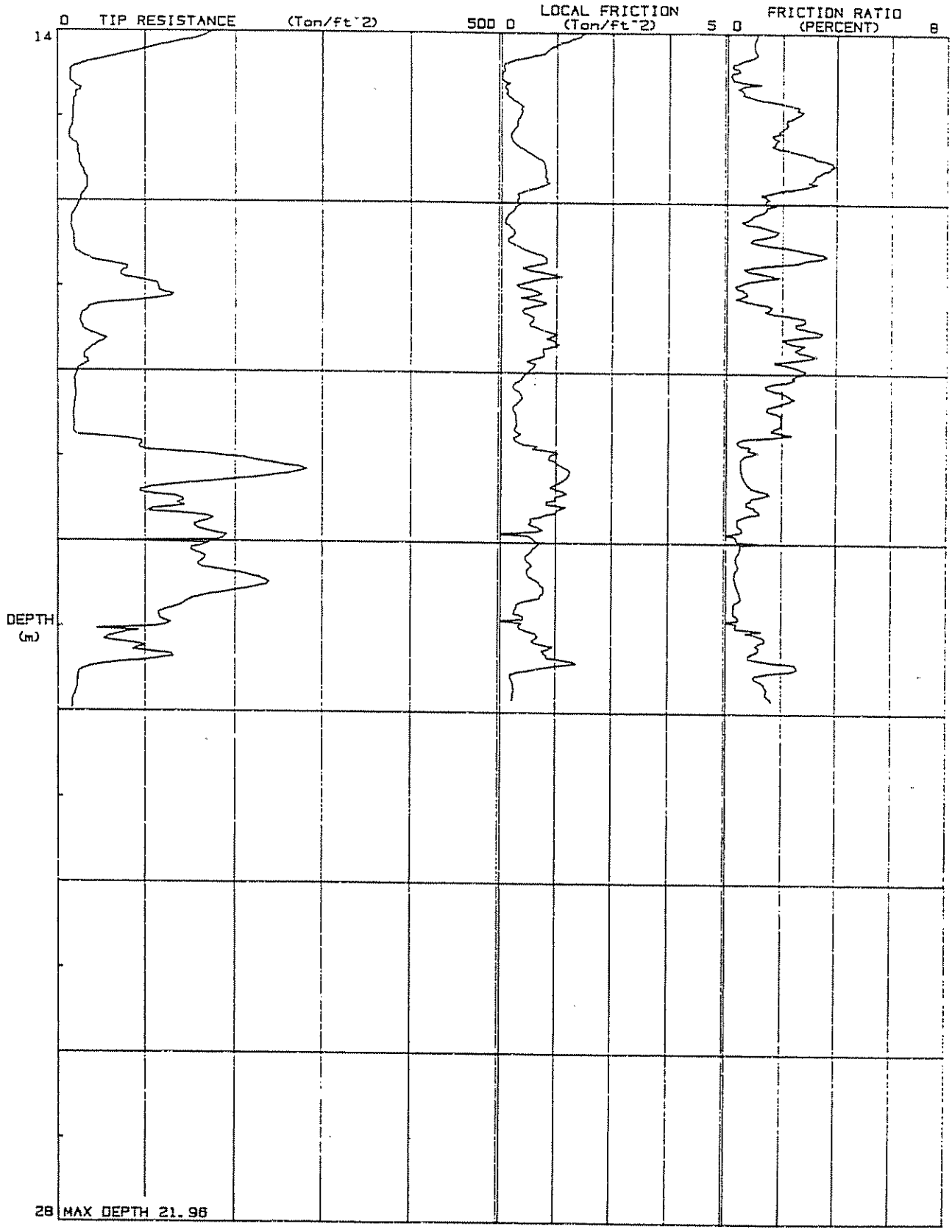
(CONTINUED)

Area A - Law Crandall CPTs
B1-582

PLATE A2-43

C.P.T. - 17

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 18.2 FT



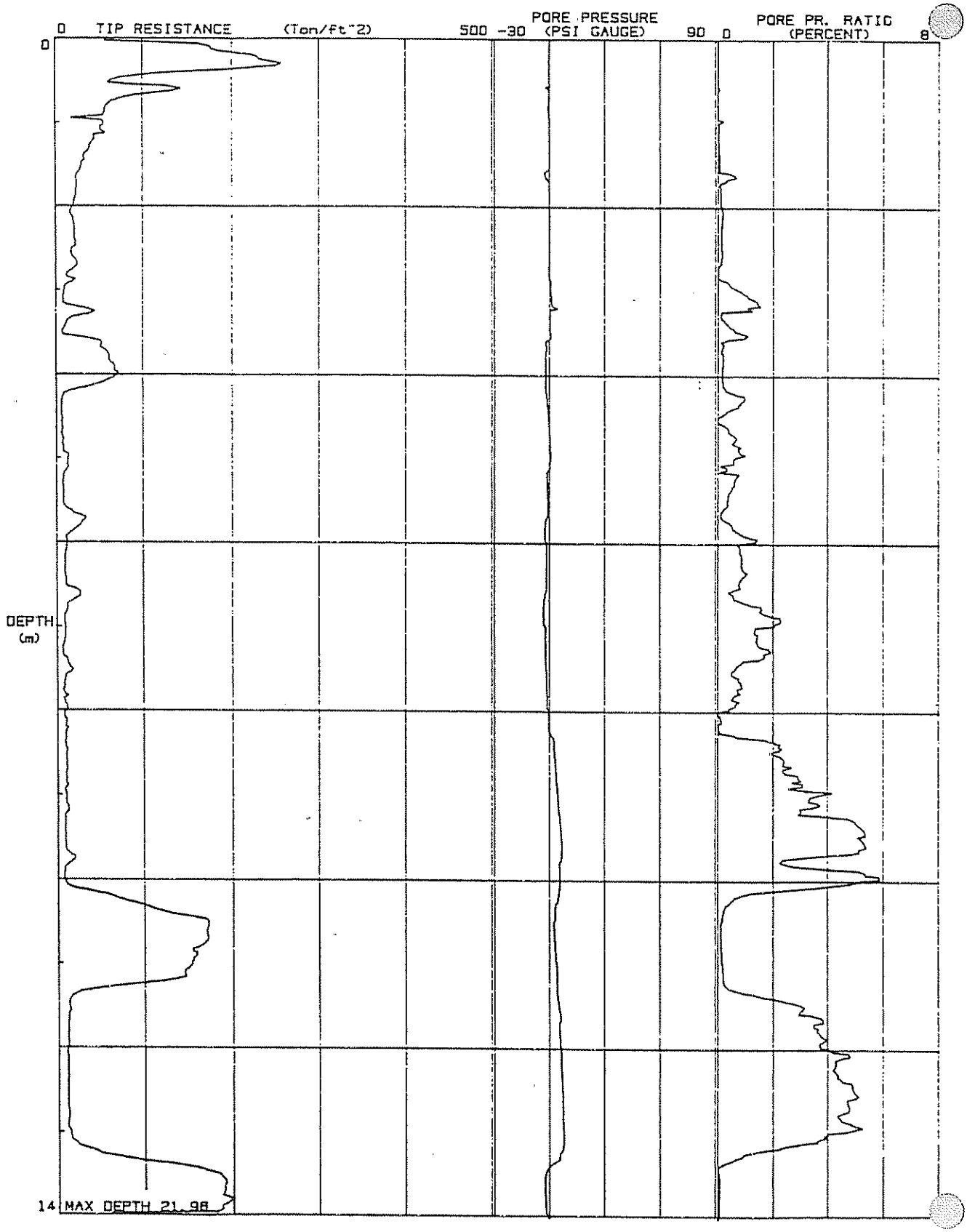
(CONTINUED)

Area A - Law Crandall CPTs
B1-583

PLATE A2-44

C.P.T. - 17

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 18.2 FT



(CONTINUED)

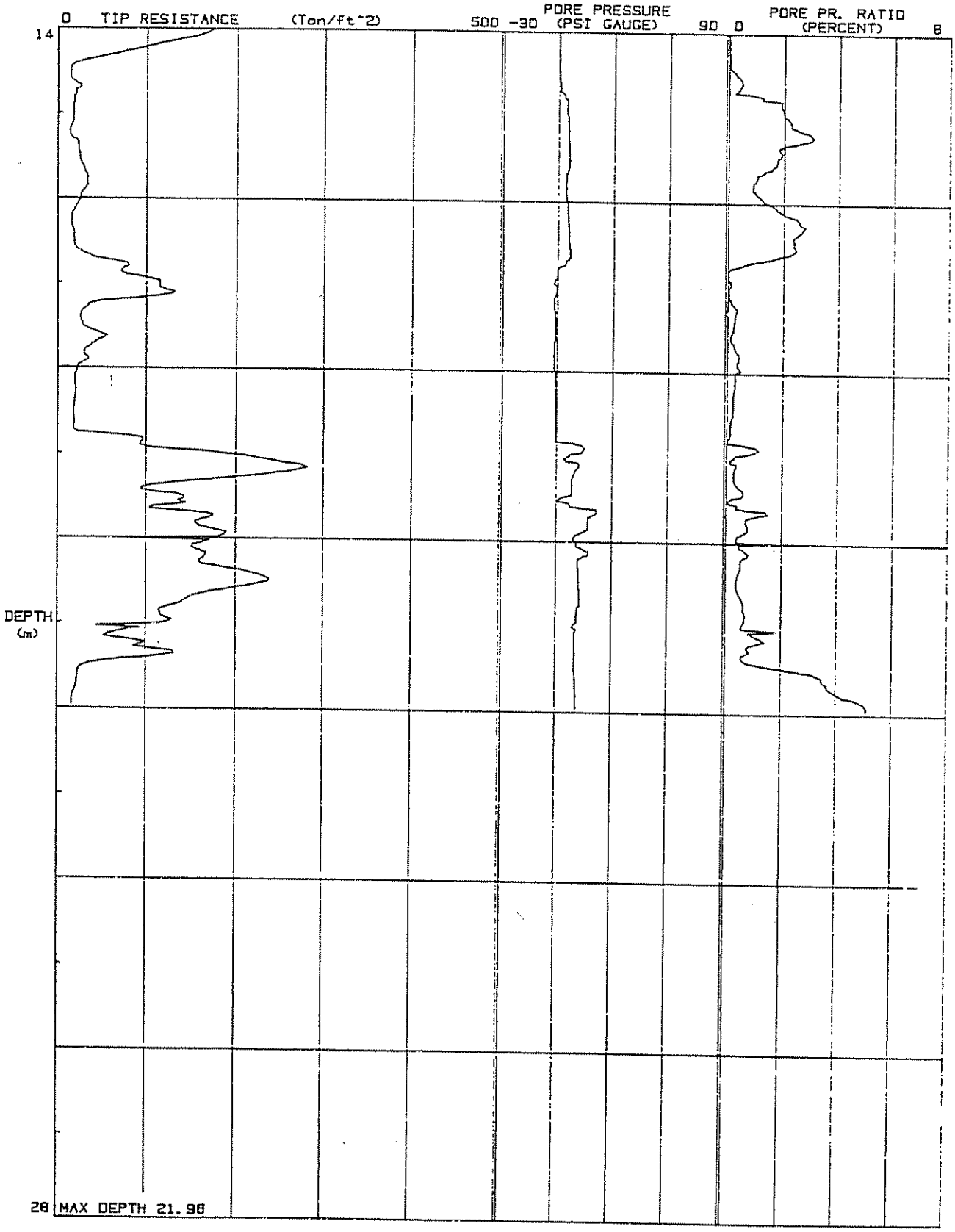
Area A - Law Crandall CPTs
B1-584

PLATE A2-45

PLATE B-1.3c

C.P.T. - 17

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 18.2 FT



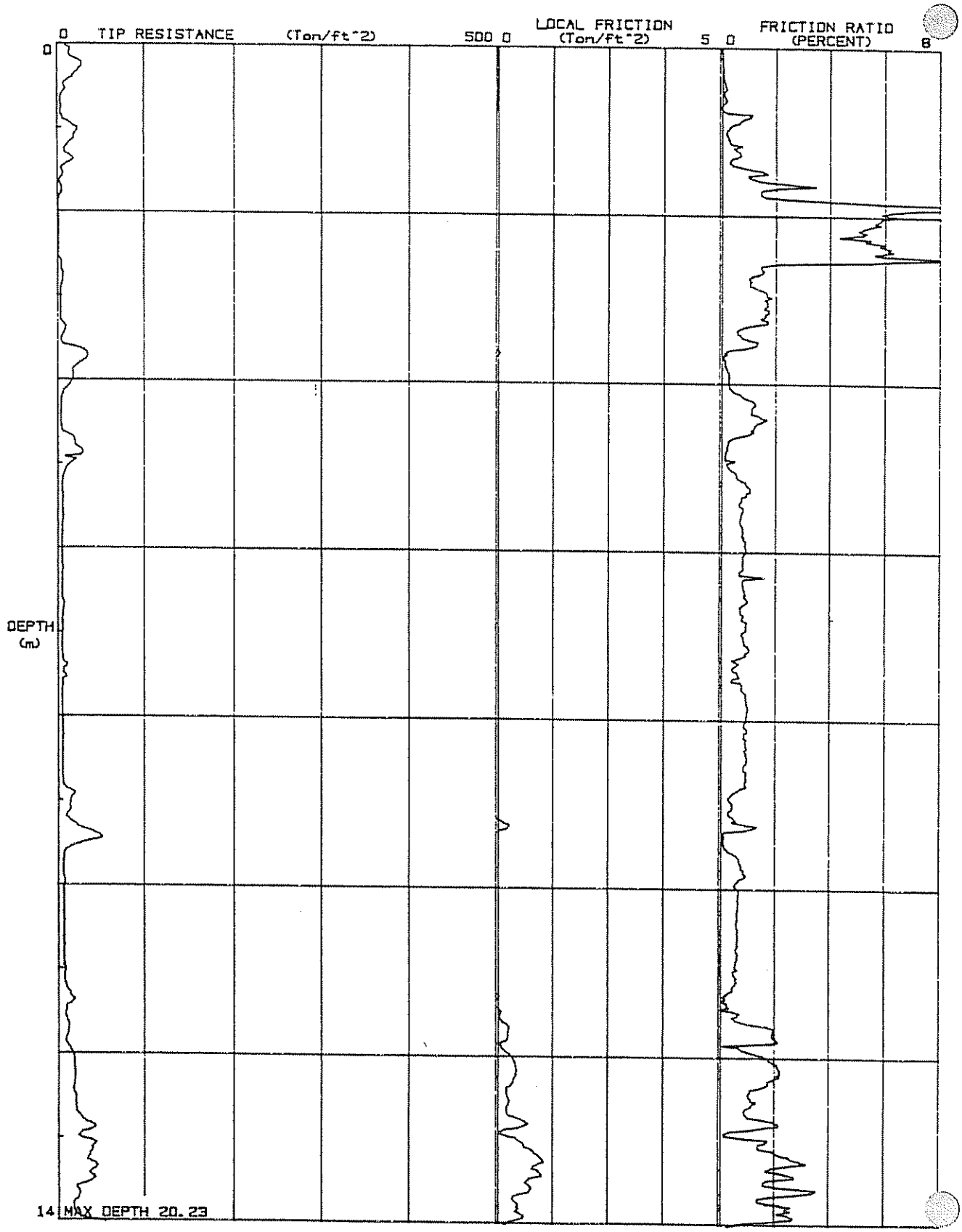
Area A - Law Crandall CPTs
B1-585

PLATE A2-46

PLATE B-1 33

C.P.T. - 18

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 12.7 FT



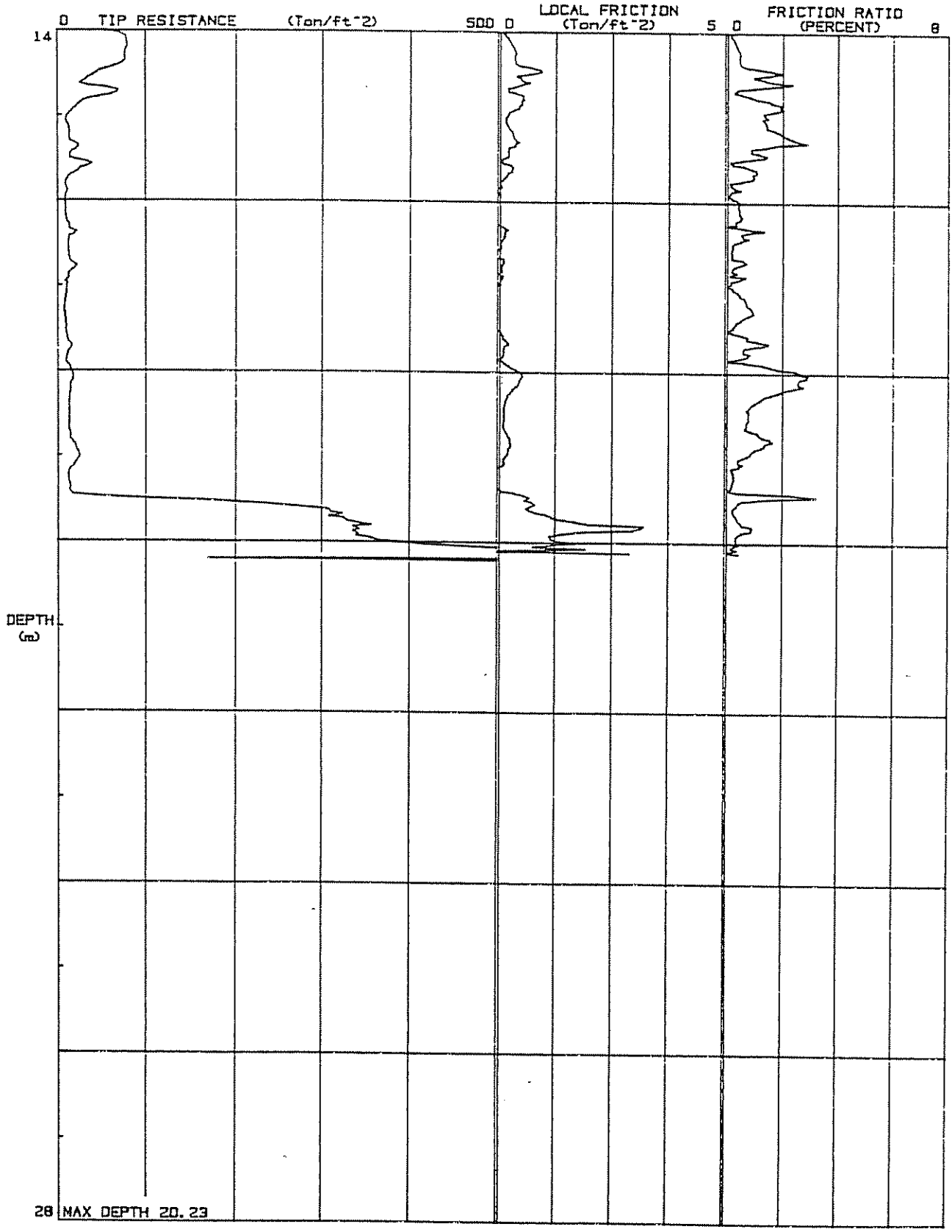
(CONTINUED)

Area A - Law Crandall CPTs
B1-586

PLATE A2-47

C.P.T. - 18

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 12.7 FT



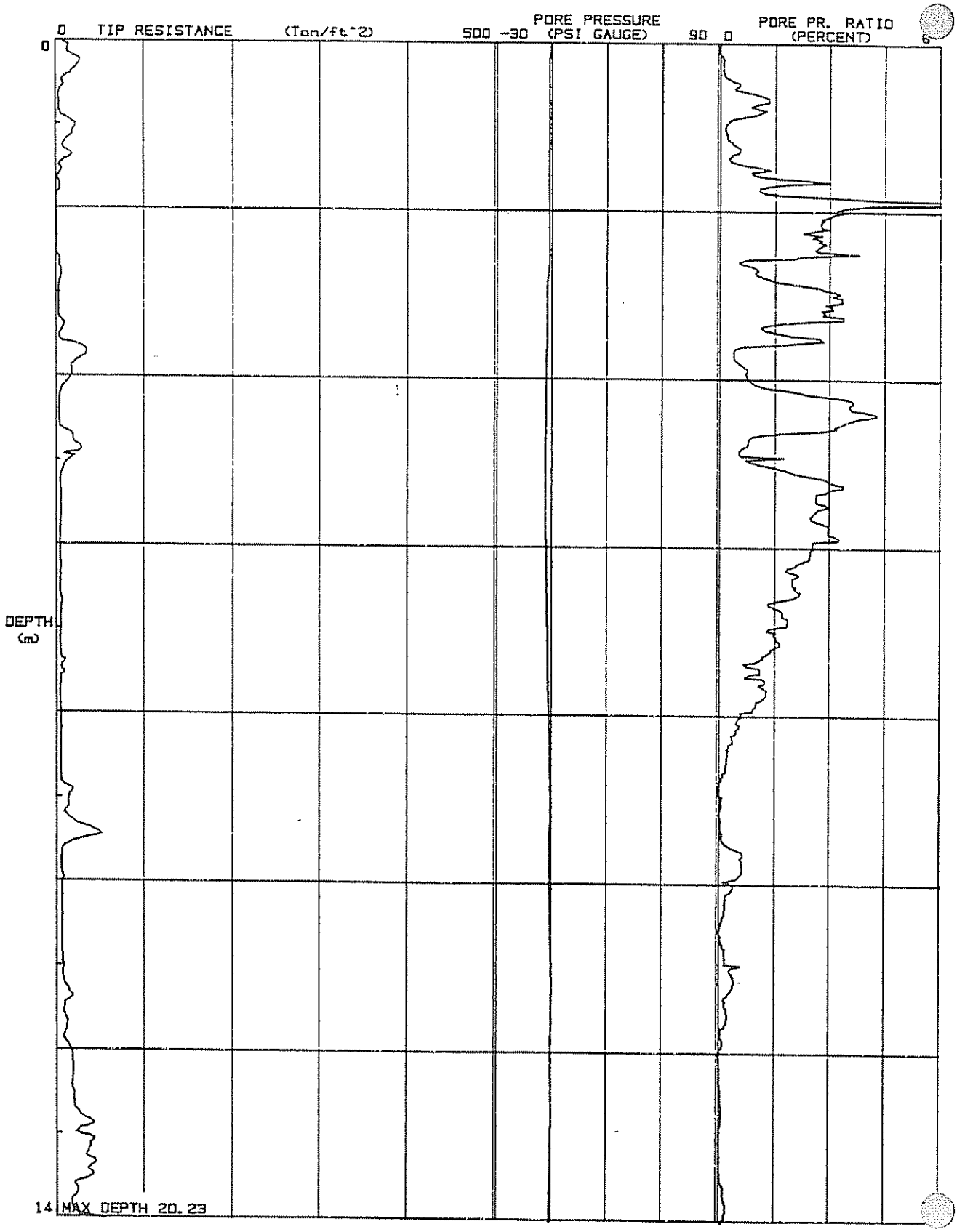
(CONTINUED)

Area A - Law Crandall CPTs
B1-587

PLATE A2-48

C.P.T. - 18

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 12.7 FT



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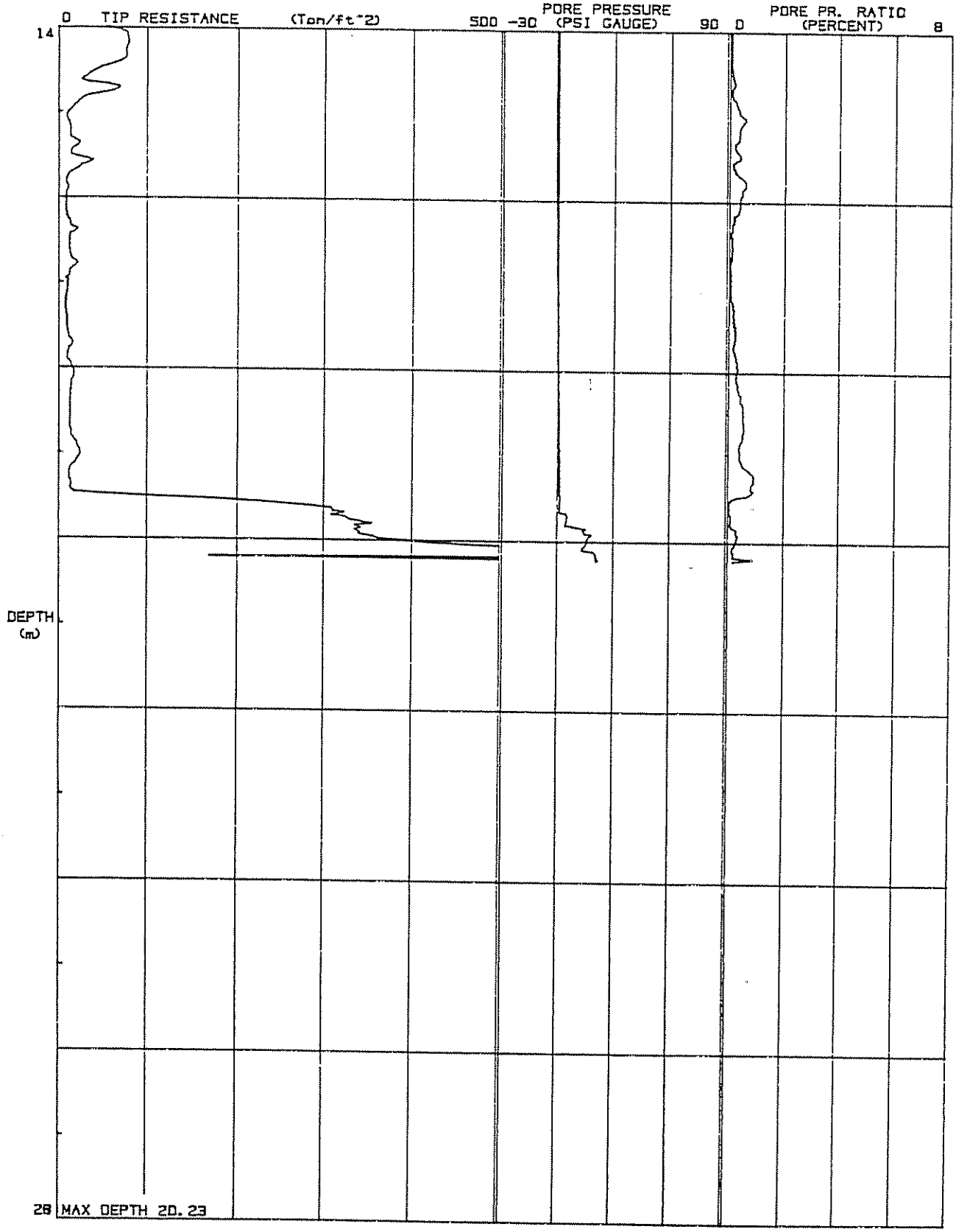
C.P.T. - 18

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 12.7 FT

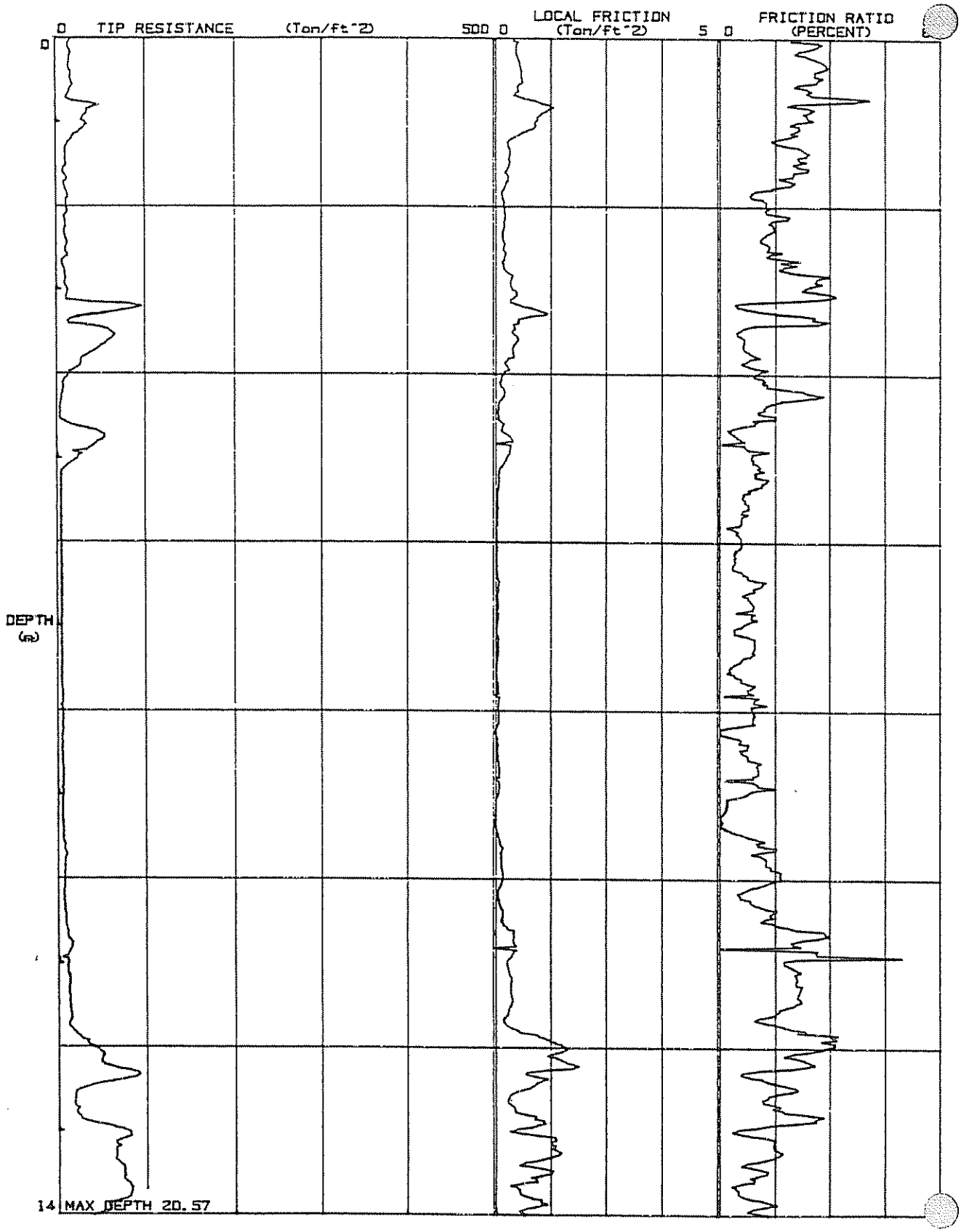


Area A - Law Crandall CPTs
B1-589

PLATE A2-50

C.P.T. - 20

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 12.3 FT



(CONTINUED)

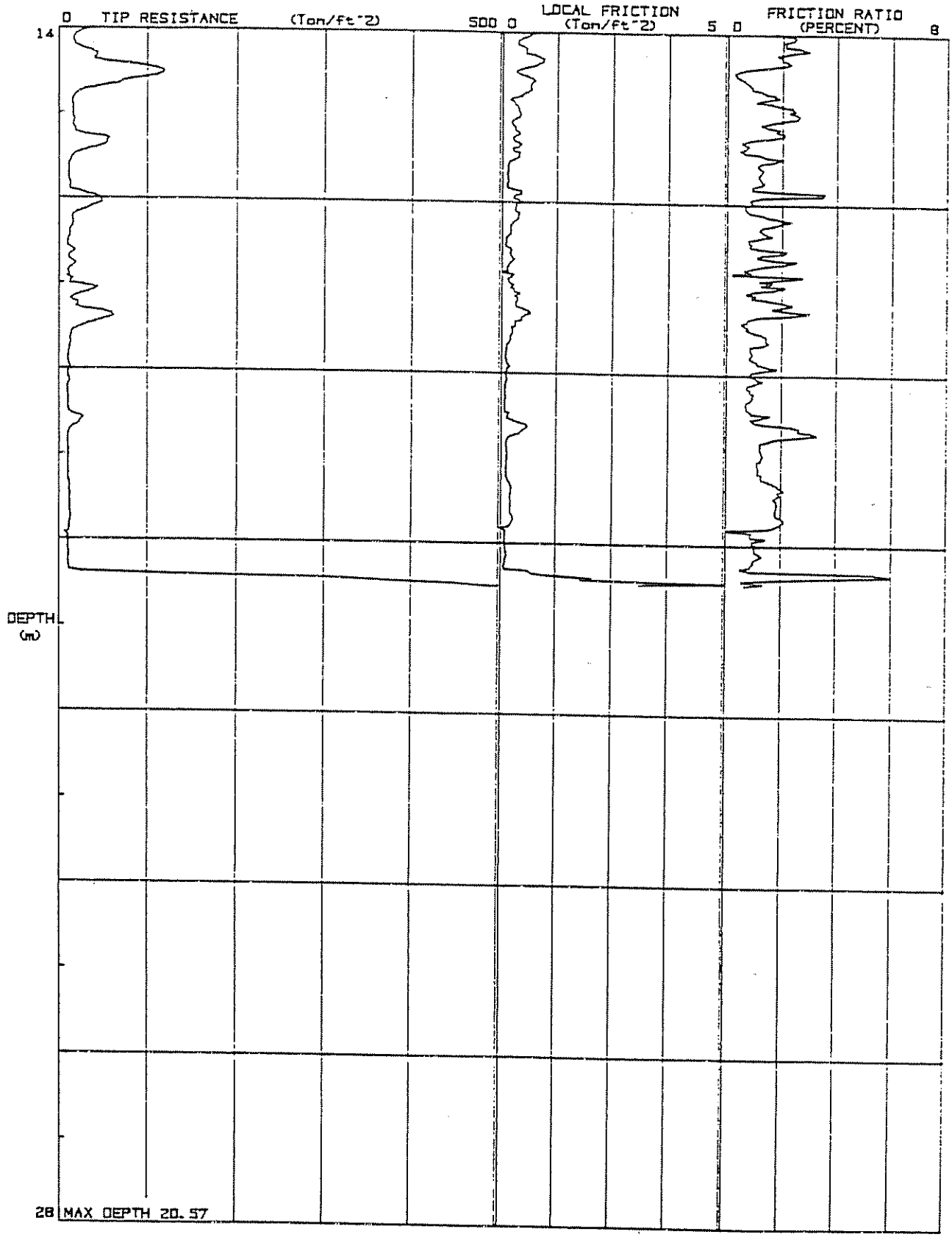
Area A - Law Crandall CPTs
B1-590

PLATE A2-51

PLATE B-1.5a

C.P.T. - 20

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 12.3 FT



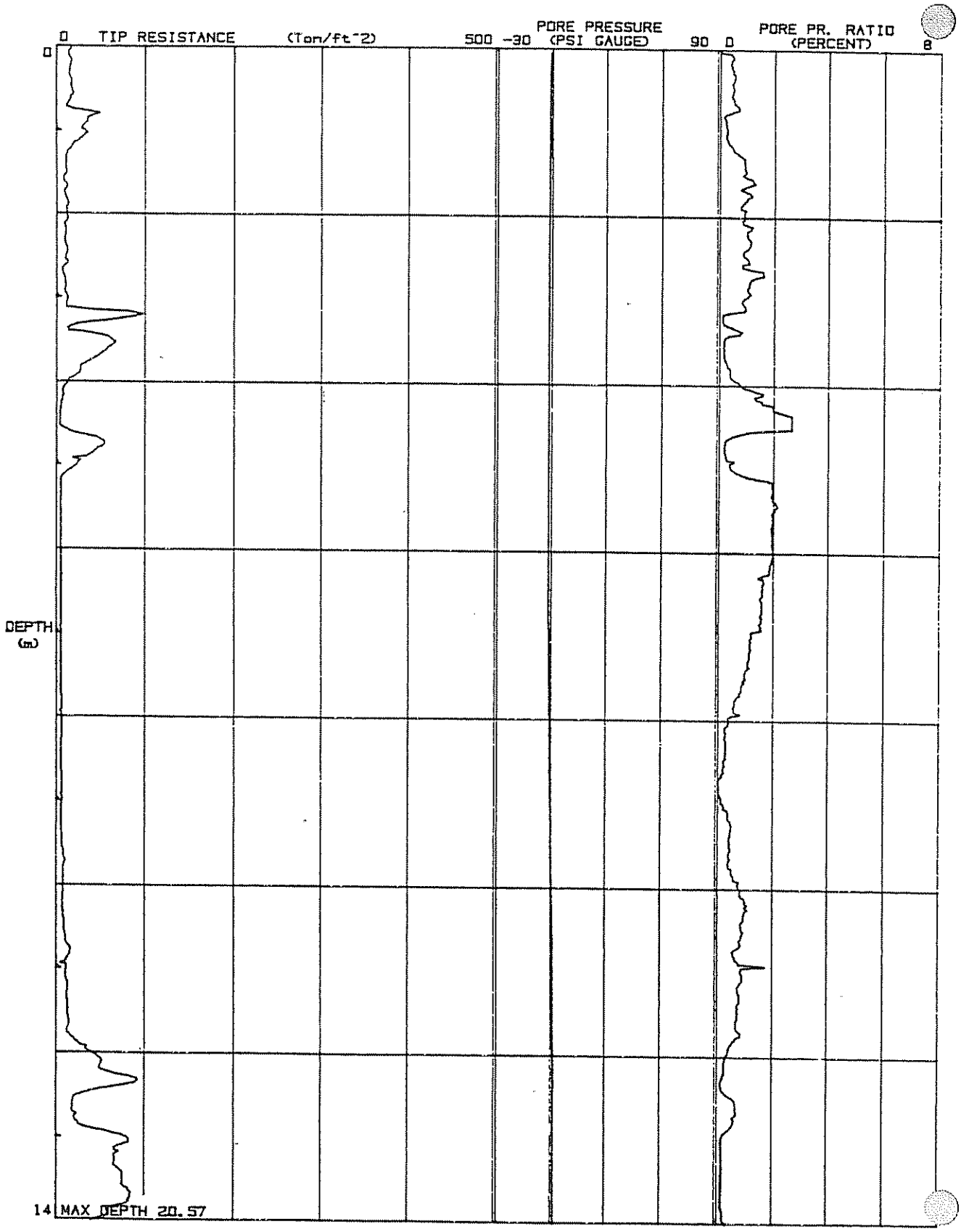
(CONTINUED)

Area A - Law Crandall CPTs
B1-591

PLATE A2-52

C.P.T. - 20

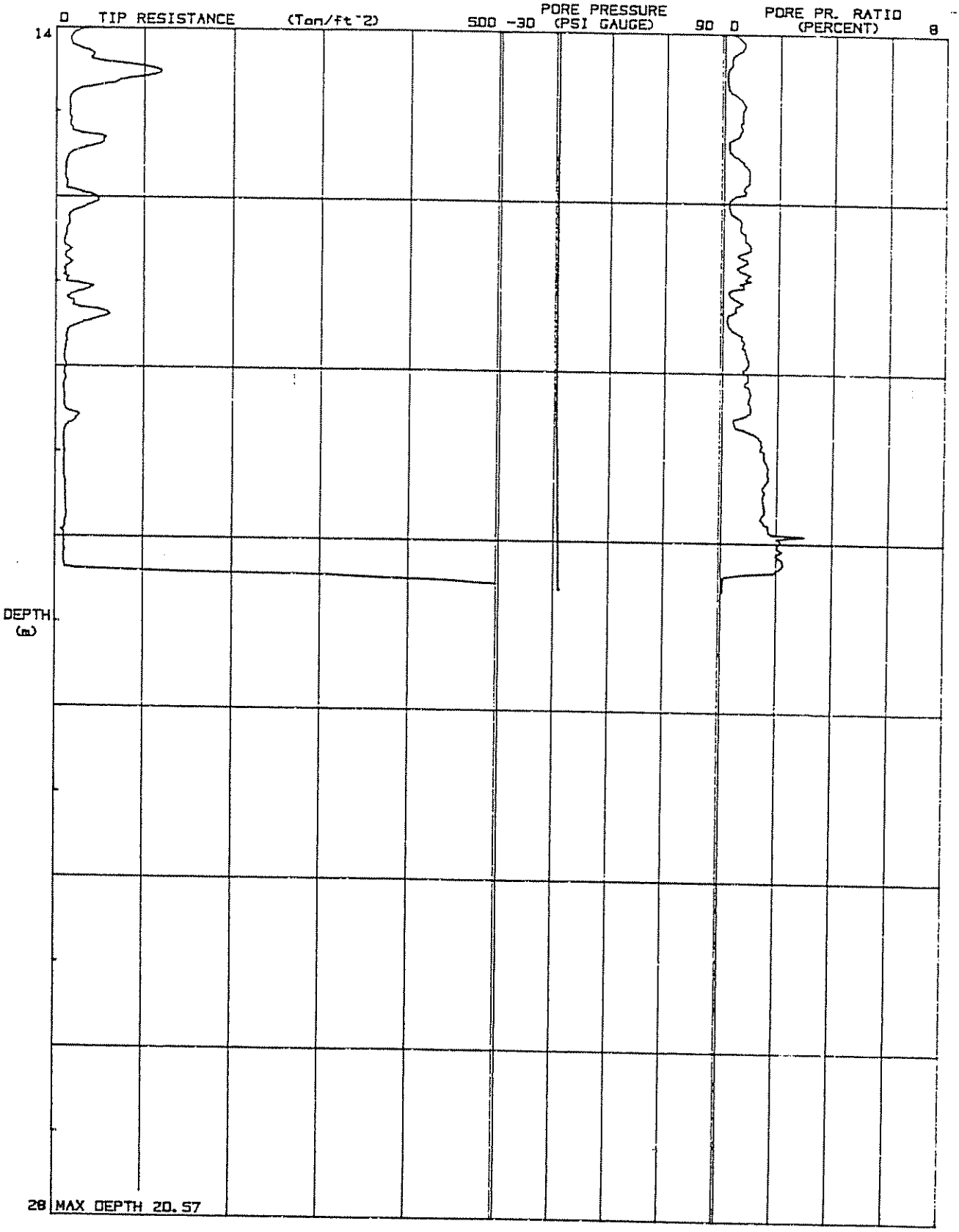
CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 12.3 FT



(CONTINUED)

C.P.T. - 20

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 12.3 FT



Area A - Law Crandall CPTs
B1-593

PLATE A2-54

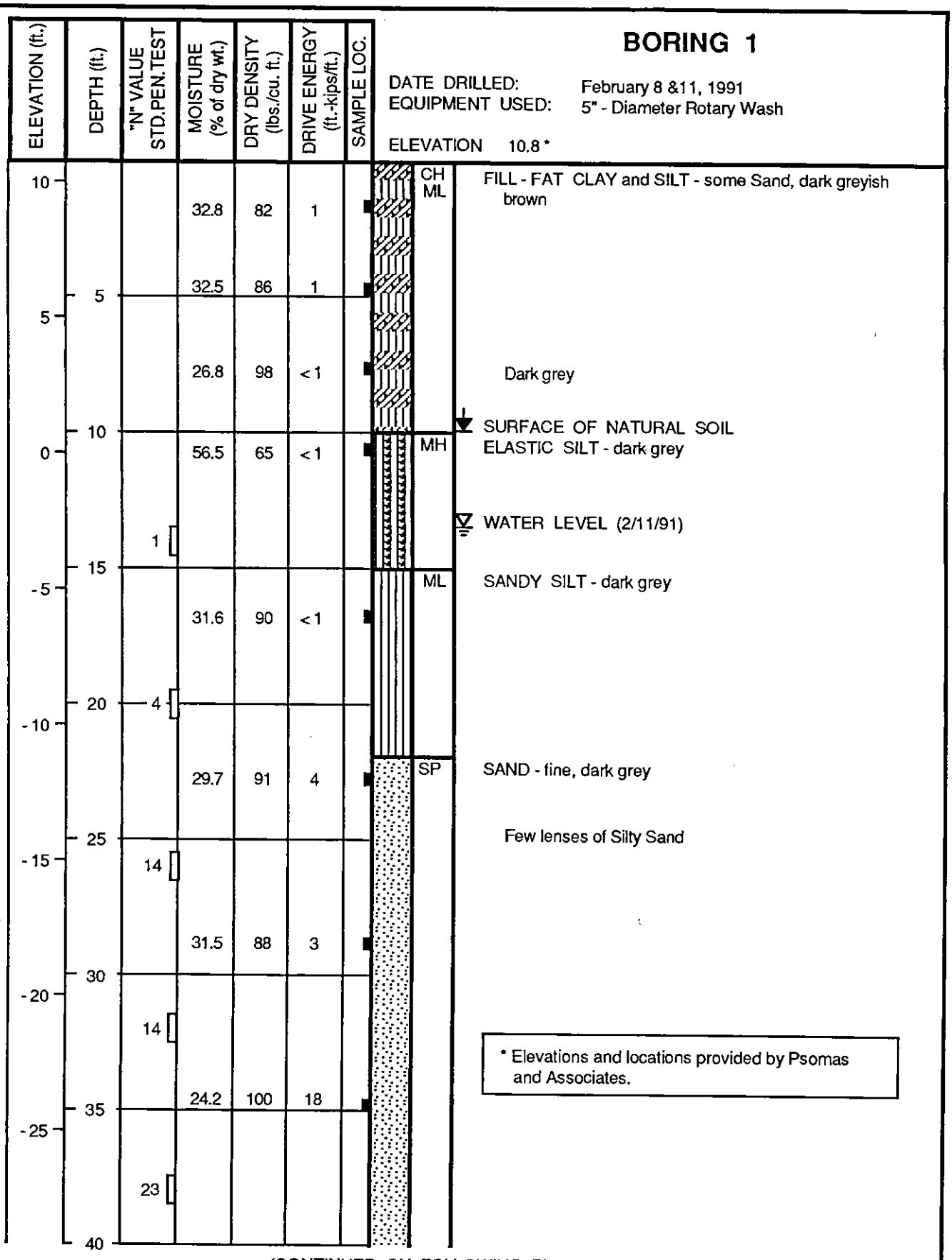
PLATE A2-54

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 1

DATE DRILLED: February 8 &11, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash
ELEVATION 10.8 *



* Elevations and locations provided by Psomas and Associates.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LAW/CRANDALL, INC.

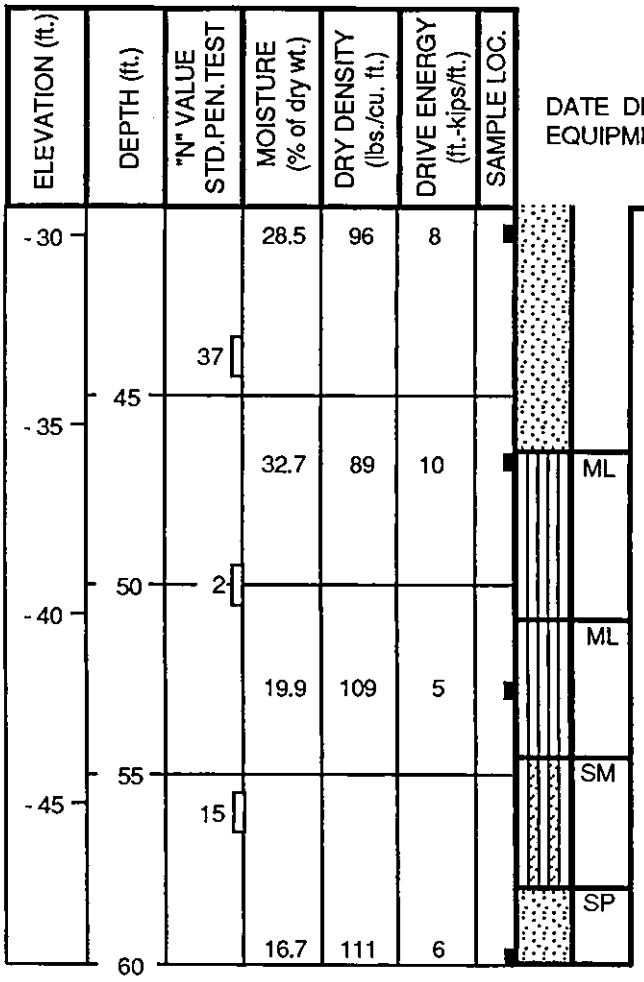
PLATE A-1.1a

JOB L91028.AEQ DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 1 (Continued)

DATE DRILLED: February 8 &11, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash



SANDY SILT - dark grey

CLAYEY SILT - dark grey

SILTY SAND - fine, dark grey

SAND - fine, grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Water level measured at 13-1/2' 15 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A-1.1b

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Fig

BORING 2

DATE DRILLED: February 8, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash
ELEVATION 11.5

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10			28.9	92	4	■	CL ML	FILL - SILTY CLAY and SILT - some Sand, some seashells, dark brownish grey
	5		26.2	96	2	■		
5			55.9	68	1	■		
	10							SURFACE OF NATURAL SOIL
0			56.5	66	< 1	■	CH	FAT CLAY - dark grey
								WATER LEVEL (2/11/91)
		1					MH	ELASTIC SILT - dark grey
	15							
-5			45.7	72	< 1	■		
		5					ML	SANDY SILT - fine, dark grey
	20							
-10			38.8	81	< 1	■		
	25						SM	SILTY SAND - fine, dark grey
		26						
-15			30.2	91	4	■		
	30						ML	CLAYEY SILT - dark grey
-20		12						
			23.5	107	11	■	SP	SAND - fine, dark grey
	35							
-25								
		17						
	40							

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Water level measured at 11-1/2' on 2/11/91. Grouted boring with a cement-bentonite slurry after water level determination.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.2

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

BORING 3

DATE DRILLED: February 8, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 12.1

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10	0		10.0	105	6	■	SM	FILL - SILTY SAND - dark brown
			47.5	72	1	■	ML	FILL - CLAYEY SILT - dark greyish brown
5	5		48.6	73	< 1	■		▼ SURFACE OF NATURAL SOIL
							ML	CLAYEY SILT - some lenses of Sand, dark grey
0	10		42.3	77	< 1	■		
		1						
-5	15		42.6	76	< 1	■		
		1						Some seashells
-10	20		37.1	85	< 1	■		
							SP	SAND - fine, dark grey
-15	25	27						
			24.2	100	22	■		
-20	30	12					ML	SANDY SILT - some seashells, dark grey
			36.0	85	< 1	■		
-25	35	26					SP	SAND - fine, dark grey
	40							

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LAW/CRANDALL, INC.

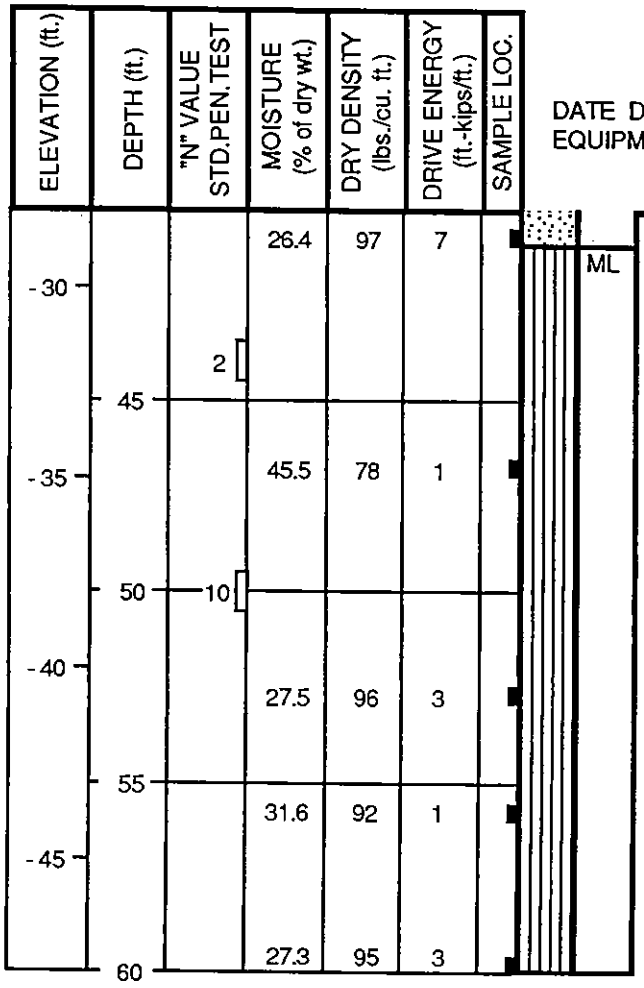
PLATE A - 1.3a

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 3 (Continued)

DATE DRILLED: February 8, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash



CLAYEY SILT - some fine Sand, dark grey

Layers of Sand

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Water level measured at 13' on 2/11/91. Grouted boring with cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.3b

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD FH

BORING 4

DATE DRILLED: February 4, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 13.3

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10	0		23.8	91	2		ML	FILL - SANDY SILT - some Sand and Clay, dark greyish brown
5	5		34.6	83	1			Greyish brown
			50.0	73	<1		ML	FILL - CLAYEY SILT - grey
0	10		49.9	70	<1			Dark grey
			43.5	78	1			SURFACE OF NATURAL SOIL
-5	15	4					ML	SILT - some lenses of Sandy Silt, dark grey
			48.1	73	<1			Many seashells
-10	20	1						
	25		27.4	96	5		SM	SILTY SAND - fine, dark grey
-15		38					SP	SAND - fine, dark grey
	30		27.2	98	18			
-20							ML	CLAYEY SILT - dark grey
	35	1						
-25								
	40		22.6	96	10		SP	SAND - fine, dark grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Water level measured at 13-1/2' on 2/11/91. Grouted boring with a cement-bentonite slurry after water level determination.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.4

JOB 191028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD FH

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 5

DATE DRILLED: February 4, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash
ELEVATION 14.4

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
			23.5	93	2		ML	FILL - SANDY SILT - dark greyish brown
10	5		32.4	91	4			Light brownish grey Some Clay
5	10		25.8	80	1			Dark brown
		2						SURFACE OF NATURAL SOIL
							CL	SILTY CLAY - dark grey
0	15		43.3	78	< 1		ML	CLAYEY SILT - grey
		11						
-5	20		55.2	69	< 1		MH	ELASTIC SILT - grey
		1						
-10	25		49.6	72	< 1			Dark grey
							SM	SILTY SAND - fine, some seashells, dark grey
-15	30	15						
			22.7	99	18		SP	SAND - fine, grey
-20	35						MH	ELASTIC SILT - some lenses of Sandy Silt, dark grey
		2						
-25	40		52.6	70	2			(LL = 52, PI = 18)

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LAW/CRANDALL, INC.

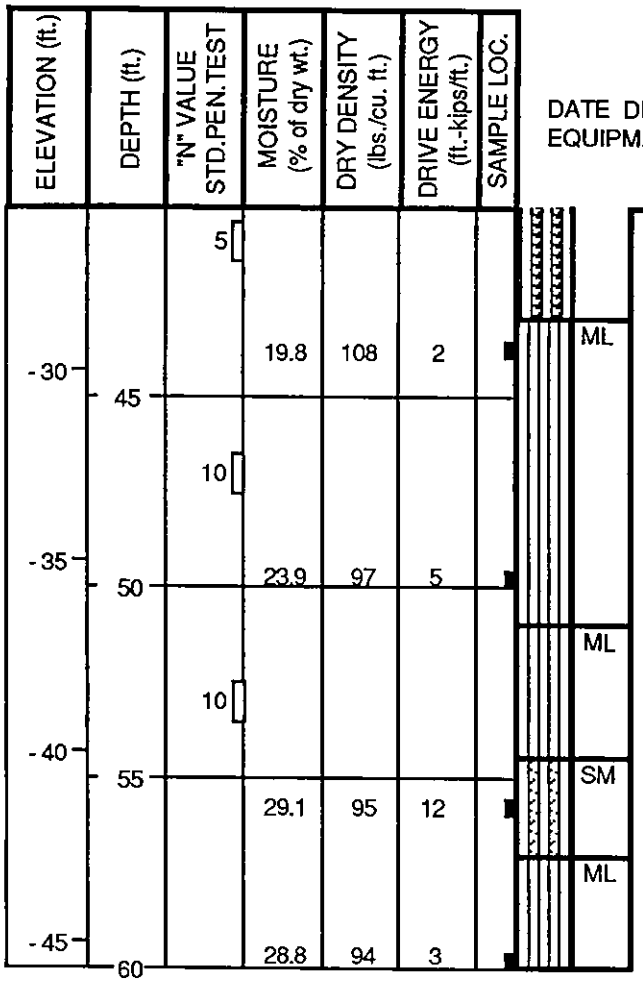
PLATE A - 1.5a

JOB 191028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 5 (Continued)

DATE DRILLED: February 4, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash



SANDY SILT - dark grey

CLAYEY SILT - dark grey

SILTY SAND - fine, some seams of Sandy Silt, dark grey

CLAYEY SILT - some Sand, some seashells, dark grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 25' after completion of drilling. Water level measured at 14-1/2' on 2/5/91. Grouted boring with cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.5b

JOB L91028.AEQ DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

BORING 6

DATE DRILLED: February 2, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 16.1

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
15			17.6	95	2	
	5		11.9	91	1	
10			16.3	85	< 1	
	10		14.9	85	< 1	
5		2				
	15					
0			34.4	87	2	
	20	4				
-5			47.9	73	1	
	25					
-10		2				
			68.8	55	1	
	30					
-15		1				
			63.1	63	< 1	
	35					
-20		4				
	40		24.2	102	2	

SM — FILL - SILTY SAND - fine to medium, some Sandy Silt, dark greyish brown

Dark brownish grey
About 10% Gravel

Grey

Brownish grey

SURFACE OF NATURAL SOIL

ML — SANDY SILT - some lenses of Sand, brownish grey

MH — ELASTIC SILT - some lenses of Sand, dark grey

(LL = 52, PI = 18)
Some seashells

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 25' after completion of drilling. Water level measured at 16' on 2/4/91. Grouted boring with a cement-bentonite slurry after water level determination.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.6

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

BORING 7

DATE DRILLED: February 2, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 17.5

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
15	0		6.0	94	2		SP ML	FILL - SAND and SANDY SILT - fine, brown
	5		8.3	121	7			Greyish brown
10			11.9	120	7			Dark brown
	10	26						About 20% Gravel
5								SURFACE OF NATURAL SOIL
	15						ML	CLAYEY SILT - dark grey
0		4						
	20		34.7	88	2		ML	SANDY SILT - dark greyish brown
-5		1					MH	ELASTIC SILT - dark grey
	25		59.7	67	2			Dark brownish grey
-10		1						
	30		48.5	72	2			Dark grey
-15								
	35	6						
-20							ML	SANDY SILT - dark grey
	40							

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LAW/CRANDALL, INC.

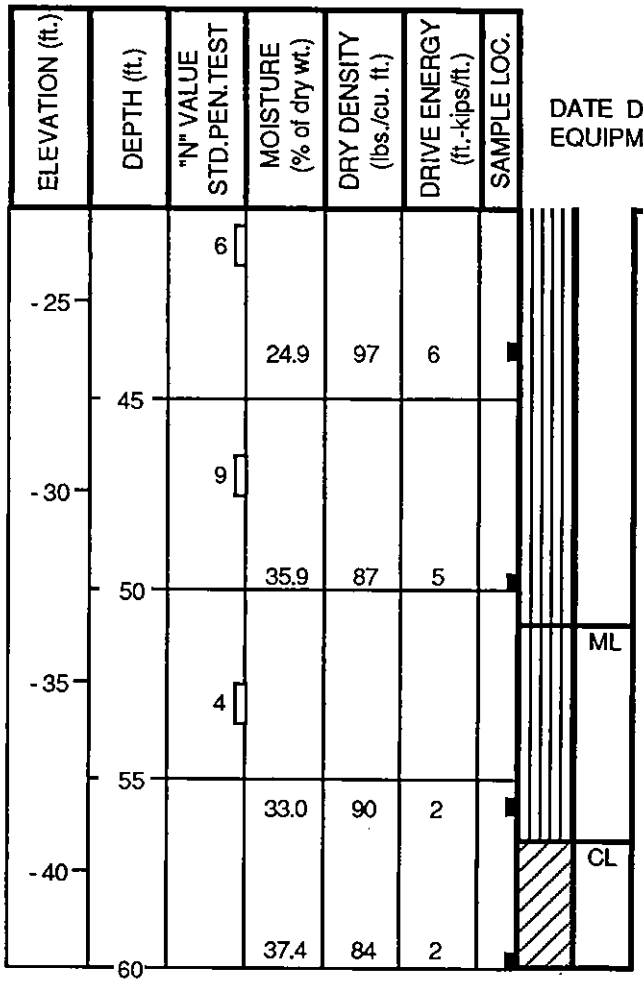
PLATE A - 1.7a

JOB L91028.AEQ DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 7 (Continued)

DATE DRILLED: February 2, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash



Layers of Sand

CLAYEY SILT - dark grey

SILTY CLAY - dark grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Water level measured at 17' on 2/4/91. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.7b

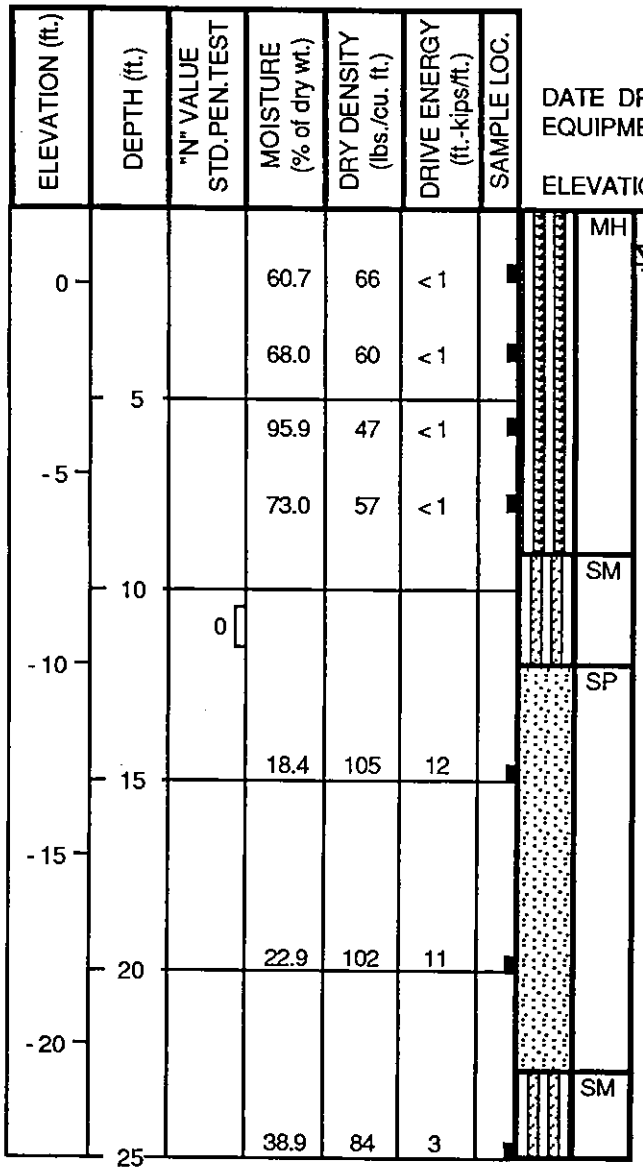
JOB L91028.AEQ DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 8

DATE DRILLED: January 31, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 2.0



MH ELASTIC SILT - some lenses of fine Sand, mottled grey and dark grey

WATER LEVEL (1/31/91)

Light grey

Some seashells, dark grey

SM SILTY SAND - fine, dark grey

SP SAND - fine, grey

Dark grey

SM SILTY SAND - fine, layers of Sandy Silt, dark grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 15' after completion of drilling. Water level measured at 1-1/2' 15 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A-1.8

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

BORING 9

DATE DRILLED: January 30, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 3.6

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		44.9	67	1		ML	FILL - CLAYEY SILT - some lenses of fine Sand, dark brownish grey
			31.5	92	1			SURFACE OF NATURAL SOIL
-5	5		42.0	81	1		ML	SANDY SILT - some seashells, dark brownish grey
			59.7	65	< 1		MH	WATER LEVEL (1/31/91)
-10	10	1						ELASTIC SILT - dark brownish grey
	15		28.8	92	< 1		SM	SILTY SAND - fine, dark grey
-15							SP	SAND - fine, grey
	20		25.3	98	11			
-20							MH	ELASTIC SILT - dark grey
	25		52.3	72	1			

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 15' after completion of drilling. Water level measured at 5-1/2' 15 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A-1.9

JOB 191028.AEO DATE 3/1/91 F.T. LS/AR DR. ph O.E. JLB W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 10-A

DATE DRILLED: February 12, 1991
EQUIPMENT USED: 8" - Diameter Hand Auger

ELEVATION 3.8

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		6.0	106			ML SP	FILL - SANDY SILT and SAND - brown
			50.6	71			CH	SURFACE OF NATURAL SOIL FAT CLAY - dark grey
-5	5		69.9	57			MH	ELASTIC SILT - grey
	10							

NOTE: Water level measured at 4-1/2' after completion of drilling. No caving.

BORING 10

DATE DRILLED: February 1, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 4.7

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		7.2	111	5		SM SP	FILL - SILTY SAND and SAND - fine, light brown
	5		66.1	62	< 1		MH	SURFACE OF NATURAL SOIL ELASTIC SILT - some layers of Sandy Silt, dark grey
-5			60.8	64	< 1			
	10	1	54.8	68	< 1			
-10	15		41.8	81	< 1			Some seashells
-15	20		24.2	100	12		SP	SAND - fine, grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 15' after completion of drilling. Water level measured at 6' 10 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A-1.10

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 11-A

DATE DRILLED: February 12, 1991
EQUIPMENT USED: 8" - Diameter Hand Auger

ELEVATION 3.8

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		5.9	97			SM SP	FILL - SILTY SAND and SAND - fine to medium, mottled light brown and brown
			57.1	65			CH	SURFACE OF NATURAL SOIL FAT CLAY - dark grey
-5	5		56.5	67			MH	ELASTIC SILT - some seashells, grey
	10							

NOTE: Water level measured at 4' after completion of drilling. No caving.

BORING 11

DATE DRILLED: January 31, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 7.2

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
5	0		36.8	80	2		CL ML	FILL - SILTY CLAY and SILT - mottled grey and brown
	5		40.7	80	< 1		MH	SURFACE OF NATURAL SOIL ELASTIC SILT - mottled light grey and grey
0		1						
	10		53.3	68	< 1			Some seashells
-5		0						
	15		89.1	51	< 1			
-10							ML	SANDY SILT - dark grey
	20	4						

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LAW/CRANDALL, INC.

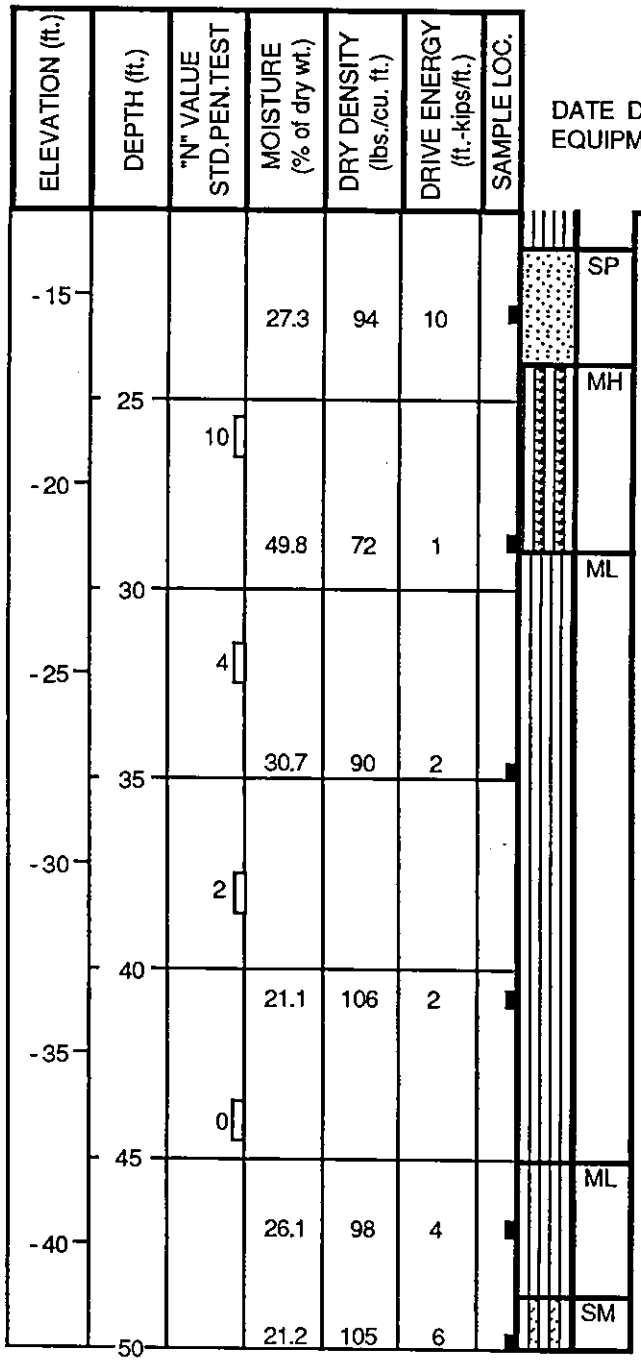
PLATE A-1.11a

JOB 191028.AEQ DATE 3/15/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 11 (Continued)

DATE DRILLED: January 31, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash



SAND - fine, some seashells, grey

ELASTIC SILT - some Sand, grey

CLAYEY SILT - some layers of Sandy Silt, some seashells, dark grey

SANDY SILT - dark grey

SILTY SAND - fine, dark grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Water level measured at 6' 15 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.11b

JOB L91028.AEO DATE 3/1/91 F.T. LS/AR DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 12A

DATE DRILLED: February 12, 1991
EQUIPMENT USED: 8" - Diameter Hand Auger

ELEVATION 4.6

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
0	0		6.5	104		
			27.2	76		
-5	5		39.8	83		
	10					

SM ML — FILL - SILTY SAND and SILT - fine, brown

Some Clay, dark brown

SURFACE OF NATURAL SOIL

CL — SILTY CLAY - dark grey

ML — CLAYEY SILT - brownish grey

NOTE: Water not encountered. No caving.

BORING 12

DATE DRILLED: January 31, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 6.6

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
5	0		42.6	66	1	
			42.6	71	1	
	5		42.9	79	< 1	
0			57.4	67	< 1	
	10	1				
-5						
	15		61.1	63	< 1	
-10						
	20		27.8	96	9	

CL — FILL - SILTY CLAY - light brownish grey

SURFACE OF NATURAL SOIL

MH — ELASTIC SILT - mottled grey and light grey

Some seashells, dark grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 15' after completion of drilling. Water level measured at 9-1/2' 15 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

SP — SAND - fine, some seashells, grey

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A-1.12

JOB L91028.AEO DATE 3/1/91 F.T. LS/AR DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 13A

DATE DRILLED: February 12, 1991
EQUIPMENT USED: 8" - Diameter Hand Auger

ELEVATION 5.8

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
5			23.4	99		
			32.0	89		
			53.5	69		
0	5		40.6	76		
	10					

ML CH SP — FILL - SANDY SILT, CLAY and SAND - fine, mottled light grey, brown, dark grey and dark brown

SURFACE OF NATURAL SOIL

ML — SANDY SILT - some Clay, brownish grey

NOTE: Water not encountered. No caving.

BORING 13

DATE DRILLED: January 28, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 5.3

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
5			22.8	83	4	
0	5	2				
			50.0	73	1	
-5	10	1				
			63.2	62	<1	
-10	15	1				
	20		30.3	94	3	

CL ML — FILL - SILTY CLAY and SILT - mottled brown, black and grey

SURFACE OF NATURAL SOIL

ML — SANDY SILT - brown

MH — ELASTIC SILT - some layers of Sandy Silt, brownish grey

Traces of organic matter, dark grey

Some seashells

SM — SILTY SAND - fine, some seashells, dark grey

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LAW/CRANDALL, INC.

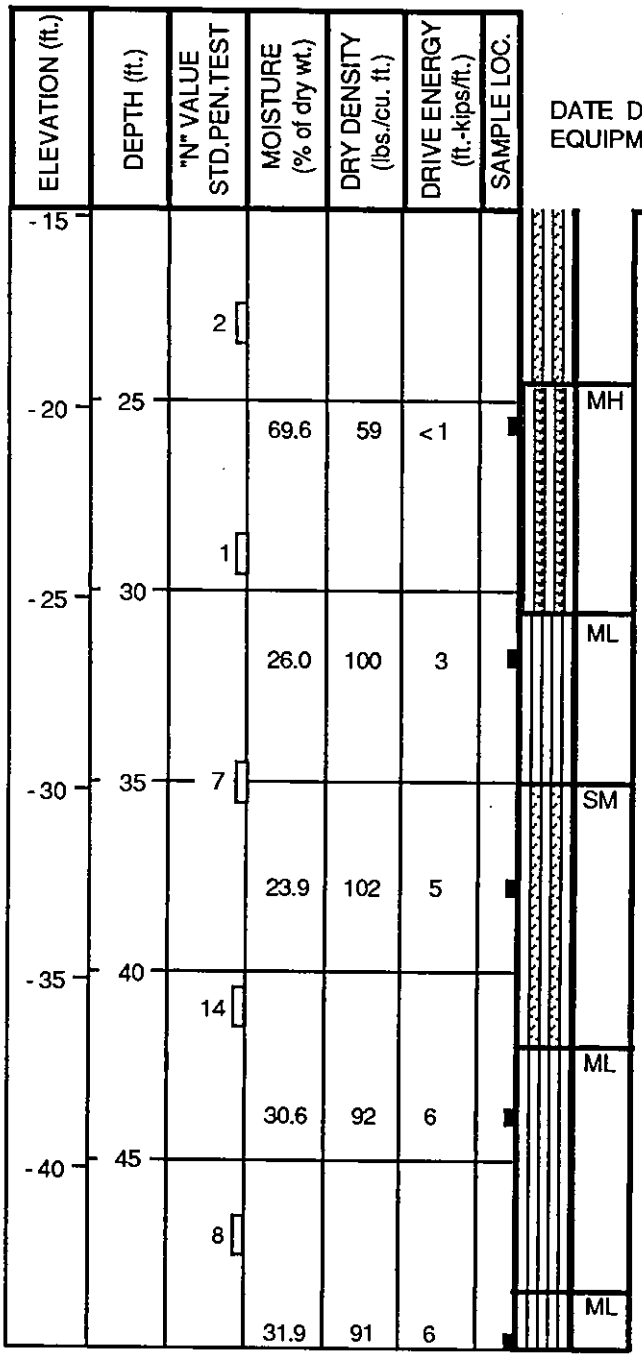
PLATE A - 1.13a

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 13 (Continued)

DATE DRILLED: January 28, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash



MH	ELASTIC SILT - some lenses of fine Sand, dark grey Some organic matter
ML	SANDY SILT - some seashells, dark grey
SM	SILTY SAND - fine, some layers of Sandy Silt, grey
ML	SANDY SILT - some layers of Clayey Silt, dark grey
ML	CLAYEY SILT - dark grey

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 30' after completion of drilling. Water level measured at 6' on 1/29/91. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.13b

JOB L91028.AEO DATE 3/1/91 F.T. LS/AR DR. ph O.E. JLB W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 14A

DATE DRILLED: February 13, 1991
EQUIPMENT USED: 8" - Diameter Hand Auger

ELEVATION 6.3

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
5			14.4	108		
			23.3	93		
	5		49.4	69		
0			44.1	72		
	10					

ML — FILL - SANDY SILT - some Clay, mottled brown and grey

SURFACE OF NATURAL SOIL

ML — SANDY SILT - grey
Some Clay

NOTE: Water not encountered. No caving.

BORING 14

DATE DRILLED: February 1, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 7.1

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
5			19.0	82	4	
			49.4	68	1	
	5		42.4	77	< 1	
0			53.4	68	< 1	
	10		58.6	63	< 1	
-5						
	15	2				
-10						
	20		60.9	65	< 1	

ML SP — FILL - SANDY SILT and SAND - fine, some caliche, brown

SURFACE OF NATURAL SOIL

CH — FAT CLAY - mottled grey and light grey

MH — ELASTIC SILT - some lenses of Sand, brownish grey

(LL = 66, PI = 23)

Dark grey

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 15' after completion of drilling. Water level measured at 10' 15 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.14

JOB 191028.AEO DATE 3/1/91 F.T. LS/AR DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 15A

DATE DRILLED: February 13, 1991
EQUIPMENT USED: 8" - Diameter Hand Auger

ELEVATION 10.7

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
10			21.6	82		
			12.1	95		
	5		10.0	114		
5			3.5	101		
			36.2	80		
	10					

ML CL — FILL - SANDY SILT and CLAY - some Sand, mottled light grey, light brown and brown

Some layers of Sand

SURFACE OF NATURAL SOIL

CL — SILTY CLAY - dark grey

ML — SANDY SILT - grey

NOTE: Water not encountered. No caving.

BORING 15

DATE DRILLED: February 1, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 4.1

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			18.1	81	3	
			45.7	70	1	
0	5		34.4	88	2	
			48.2	74	< 1	
-5	10	1				
-10	15		90.8	48	< 1	
-15	20		12.1	125	5	

ML — FILL - SANDY SILT - grey

SURFACE OF NATURAL SOIL

MH — ELASTIC SILT - mottled light grey, grey and dark grey

Layer of Sandy Silt, grey

Dark grey

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 15' after completion of drilling. Water level measured at 13-1/2' 30 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

ML — SANDY SILT - about 10% Gravel, dark grey

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.15

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

BORING 16

DATE DRILLED: January 30, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 7.6

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
5	0		7.7	119	7	
			9.2	115	2	
0	5	2	56.6	66	<1	
-5	10		58.1	61	<1	
-10	15	1				
	20		29.6	95	2	
-15						
	25		28.3	95	9	

SM/ML 3" Asphaltic Paving
FILL - SILTY SAND and SILT - fine, reddish brown

SURFACE OF NATURAL SOIL

CL SILTY CLAY - some seashells, dark grey

MH ELASTIC SILT - dark grey

ML SANDY SILT - some seashells, dark grey

SP SAND - fine, some seashells, grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 15' after completion of drilling. Water level measured at 10-1/2' 10 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A-1.16

JOB L91028.AEQ DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

BORING 18 *

DATE DRILLED: January 29, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 3.2

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		45.0	66	2		CH	FAT CLAY - some caliche, mottled black and dark grey
			49.0	71	1		MH	ELASTIC SILT - some layers of Sand, dark grey
	5							Layer of Sandy Silt
-5			49.0	74	< 1			
			43.5	79	< 1			(LL = 48, PI = 12)
	10	1						About 30% seashells
-10								Few seashells
	15		37.7	84	< 1			Sand seam
-15							ML	SANDY SILT - some layers of Elastic Silt, about 20% seashells, dark grey
	20		52.6	71	< 1			
-20								
	25		17.7	112	2			

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 15' after completion of drilling. Water level measured at 6-1/2' 15 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

* Boring 17 was deferred.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A-1.17

JOB L91028.AEQ DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

BORING 19

DATE DRILLED: January 29, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 3.6

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		36.4	81	2		CL	SILTY CLAY - some caliche, mottled black, grey and dark grey
			37.6	84	1		ML	SANDY SILT - grey
-5	5		54.5	68	< 1		ML	CLAYEY SILT - dark grey
			34.9	84	1		MH	ELASTIC SILT - some layers of Sand, dark grey
-10	10	2						About 50% seashells (from 10' to 12-1/2')
	15		85.9	50	< 1			
-15	20		52.2	72	2			
-20	25		21.3	107	3			

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 15' after completion of drilling. Water level measured at 6-1/2' 10 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.18

JOB L91028.AEQ DATE 3/1/91 F.T. LS DR. ph O.E. JLB W.P. ph CHKD

F-H

BORING 20

DATE DRILLED: January 29, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 3.1

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		62.9	58	1		CH	FAT CLAY - some caliche, mottled grey and brown
								Dark grey
			38.1	79	1		ML	SANDY SILT - brownish grey
	5							Dark grey
			50.6	68	1		MH	ELASTIC SILT - dark grey
-5			24.9	96	< 1			Layer of Sandy Silt
							SM	SILTY SAND - fine, grey
	10						MH	ELASTIC SILT - some layers of Sandy Silt, dark grey
-10			75.4	55	< 1			
	15	1						
-15								
	20		33.0	91	< 1			
-20								Some seashells
	25		45.5	77	1			

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 20' after completion of drilling. Water level measured at 8' 10 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A-1.19

JOB L91028.AEQ DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

BORING 21

DATE DRILLED: January 29, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 3.2

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		44.9	77	1		CL	SILTY CLAY - dark grey
			36.0	84	<1		ML	SANDY SILT - dark grey
-5	5		49.2	69	<1		MH	ELASTIC SILT - some seashells, grey and dark grey
			48.7	70	1			
-10	10	2						
	15		23.7	97	<1		ML	SANDY SILT - dark grey
-15								
	20		24.3	99	2			
-20							MH	ELASTIC SILT - dark grey
	25		45.7	76	<1			

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 15' after completion of drilling. Water level measured at 3-1/2' 10 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.20

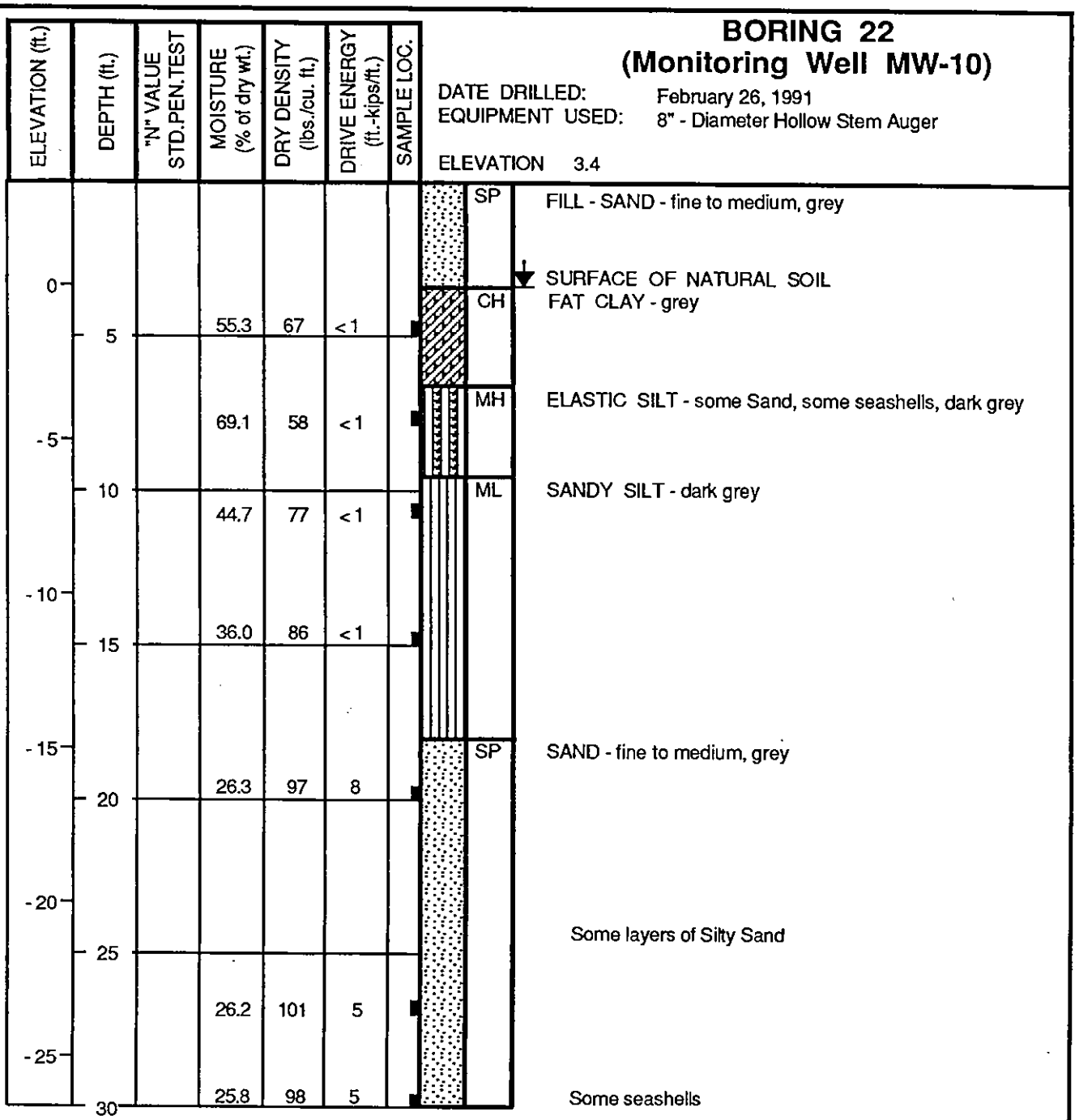
JOB L91028.AEQ DATE 3/1/91 F.T. AR DR. ph O.E. JLR W.P. ph CHKD

F-4

BORING 22
(Monitoring Well MW-10)

DATE DRILLED: February 26, 1991
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

ELEVATION 3.4



NOTE: Installed water level monitoring well; see Appendix C for well construction details.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.21

JOB 191028.AEO DATE 3/1/91 F.T. AR DR. ph O.E. JLR W.P. ph CHKD

BORING 23
(Monitoring Well MW-11)

DATE DRILLED: February 25, 1991
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

ELEVATION 1.8

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0							MH	ELASTIC SILT - some organic matter, mottled grey and brown
	5		55.6	66	< 1			
-5			73.9	56	< 1			
	10		76.9	54	< 1			Dark grey
-10							ML	SANDY SILT - dark grey
	15		26.2	97	2			Some seashells
-15							SM	SILTY SAND - fine, dark grey
	20		22.6	104	4			
-20								
	25		38.6	85	4			
-25								
	30		31.1	92	5			

NOTE: Installed water level monitoring well; see Appendix C for well construction details.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

PLATE A2-82

B1-621

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.22

JOB 191028.AEO DATE 3/22/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

BORING 24
(Monitoring Well MW-12)

DATE DRILLED: February 11, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 3.2

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		15.0	106	2		SP	FILL - SAND - fine, some Silt and Clay, brown and grey
								SURFACE OF NATURAL SOIL
	5		98.8	46	< 1		MH	ELASTIC SILT - grey
-5			72.7	58	< 1			Dark grey
	10		91.2	49	< 1			
-10								
	15		29.0	94	1		SM	SILTY SAND - fine, some layers of Sandy Silt, some seashells, dark grey
-15							SP	SAND - fine, grey
	20		25.2	92	18			
-20								
	25							Some layers of Silt Some seashells
-25								
	30		22.3	100	3			

NOTE: Drilling mud used in drilling process. Flushed mud from boring using clear water after completion of drilling. Installed water level monitoring well; see Appendix C for well construction details.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

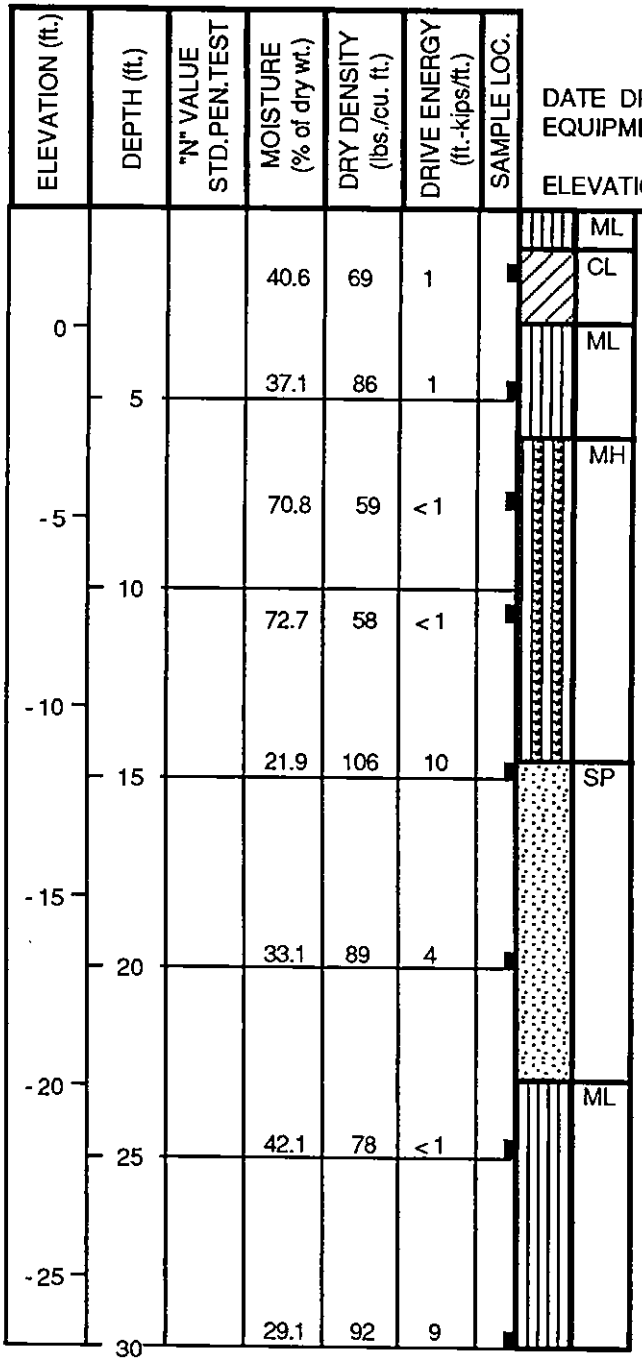
PLATE A - 1.23

JOB L91028.AEO DATE 3/22/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

BORING 25
(Monitoring Well MW-13)

DATE DRILLED: February 7, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 3.2



SANDY SILT - brown
SILTY CLAY - mottled grey and dark grey

SANDY SILT - brownish grey

ELASTIC SILT - dark grey

SAND - fine, dark grey

SANDY SILT - dark grey

NOTE: Drilling mud used in drilling process. Flushed mud from boring using clear water after completion of drilling. Installed water level monitoring well; see Appendix C for well construction details.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.24

BORING 26
(Monitoring Well MW-14)

DATE DRILLED: February 7, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 6.4

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
5			34.6	79	2	
	5		56.5	65	< 1	
0			44.2	78	< 1	
	10		70.0	58	< 1	
-5			93.4	48	< 1	
	15					
-10			29.0	93	4	
	20					
-15			40.9	79	4	
	25					
-20			42.3	76	1	
	30					

CL ML — FILL - SILTY CLAY and SILT - brownish grey and grey

SURFACE OF NATURAL SOIL

MH — ELASTIC SILT - some layers of Sandy Silt, some seashells, dark grey

SM — SILTY SAND - fine, dark grey

Some layers of Silt

NOTE: Drilling mud used in drilling process. Flushed mud from boring using clear water after completion of drilling. Installed water level monitoring well; see Appendix C for well construction details.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L91028.AEO DATE 3/22/91 F.T. LS DR. ph O.E. JLB W.P. ph CHKD

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A-1.25

JOB L91028.AEO DATE 3/22/91 F.T. AR DR. ph O.E. JLR W.P. ph CHKD

BORING 27
(Monitoring Well MW-15)

DATE DRILLED: February 27, 1991
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

ELEVATION 2.2

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		47.9	67	2		CH	FAT CLAY - brownish grey
	5		43.7	77	1		MH	ELASTIC SILT - some seashells, grey
-5			75.7	55	< 1			Dark grey
-10	10		97.0	47	< 1			
	15		29.1	93	2		SM	SILTY SAND - fine, dark grey
-20								
	20		26.1	100	6		SP	SAND - fine, dark grey
-25								
	25		60.1	66	1		MH	ELASTIC SILT - dark grey
-30								
	30		51.1	69	1			

NOTE: Installed water level monitoring well; see Appendix C for well construction details.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.26

JOB 191028.AEQ DATE 3/22/91 F.T. AR DR. ph O.E. JLR W.P. ph CHKD

BORING 28
(Monitoring Well MW-16)

DATE DRILLED: March 5, 1991
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

ELEVATION 3.7

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		30.4	91	3		SP	SAND - fine to medium, brown
	5		52.3	72	1		MH	ELASTIC SILT - grey
-5	10		78.4	54	< 1			
			82.1	52	< 1			Dark grey
-10	15							
-15	20		34.4	86	5		SP	SAND - fine, dark grey
-20	25		62.4	63	< 1		MH	ELASTIC SILT - dark grey
-25	30		18.9	115	4		SP	SAND - fine to medium, dark grey

NOTE: Installed water level monitoring well; see Appendix C for well construction details.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.27

JOB L91028.AEO DATE 3/22/91 F.T. LS DR. ph O.E. JLB W.P. ph CHKD

BORING 29
(Monitoring Well MW-17)

DATE DRILLED: February 6, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 5.9

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
5			38.6	67	2		CL ML	FILL - SILTY CLAY and SILT - some caliche, brownish grey Mottled light and dark grey
								SURFACE OF NATURAL SOIL
							CL	SILTY CLAY -grey
	5		36.7	79	1			
0							ML	CLAYEY SILT - light grey
			35.1	88	1		ML	SANDY SILT - brownish grey
	10						MH	ELASTIC SILT - dark grey
-5			65.6	62	<1			
	15		90.5	51	<1			Some seashells
-10								
	20		54.5	68	<1			
-15								
	25		44.2	76	1			Layer of Sandy Silt
-20								
	30		23.4	104	2			

NOTE: Drilling mud used in drilling process. Flushed mud from boring using clear water after completion of drilling. Installed water level monitoring well; see Appendix C for well construction details.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.28

JOB L91028.AEO DATE 3/22/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

BORING 30
(Monitoring Well MW-18)

DATE DRILLED: February 5, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 2.9

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		53.3	67	< 1		CH	FILL - FAT CLAY - some caliche, dark brownish grey
								SURFACE OF NATURAL SOIL
	5		47.1	69	1		MH	ELASTIC SILT - some layers of Sandy Silt, brownish grey
-5			54.1	69	< 1			Dark grey
	10		82.2	53	< 1			Organic odor
-10								
	15		53.5	71	< 1		ML	CLAYEY SILT - dark grey
-15								
	20		40.9	83	1		ML	SANDY SILT - dark grey
-20								
	25		22.1	105	1			
-25								
	30		28.1	95	3			

NOTE: Drilling mud used in drilling process. Flushed mud from boring using clear water after completion of drilling. Installed water level monitoring well; see Appendix C for well construction details.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

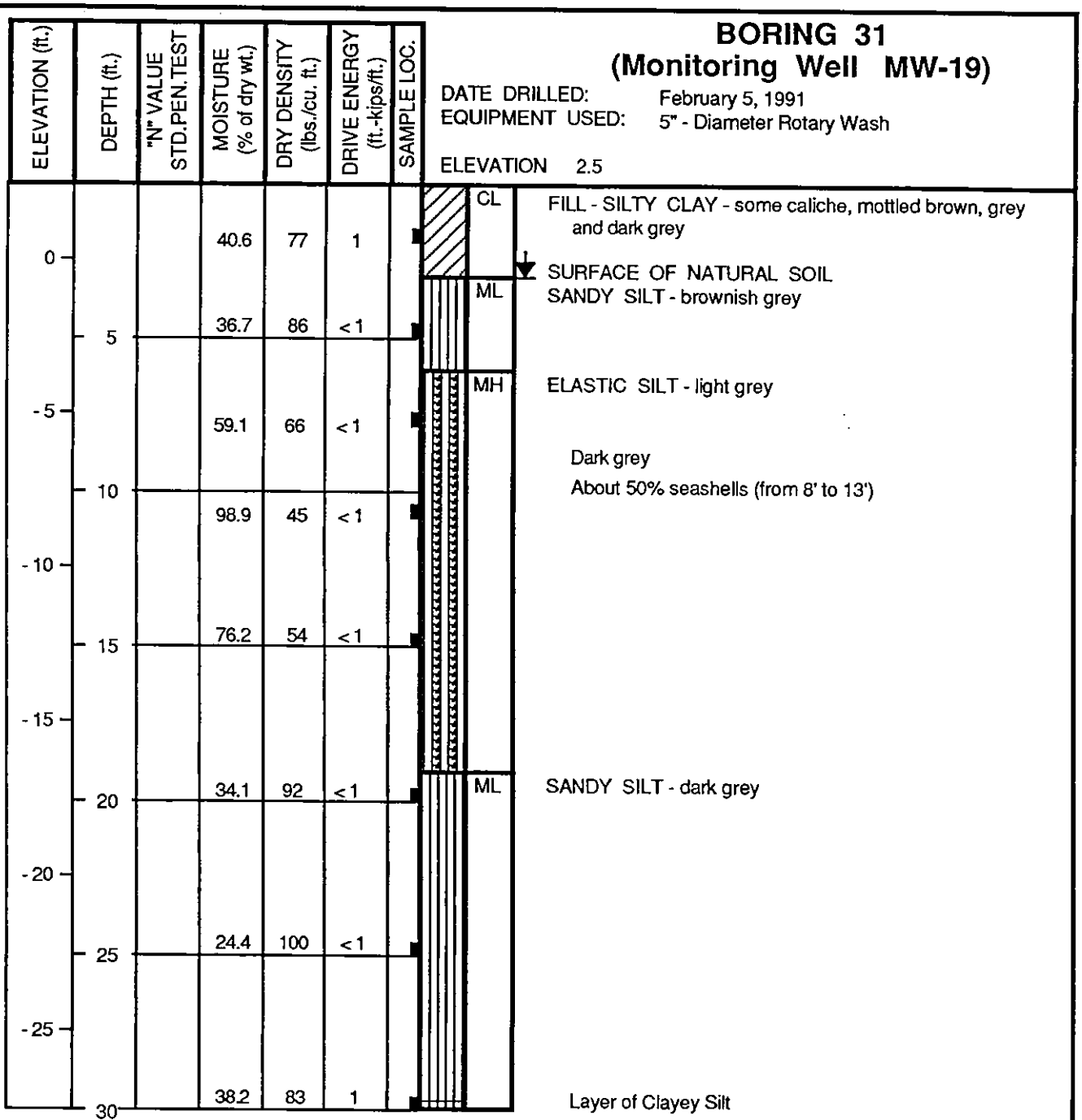
PLATE A - 1.29

JOB L91028.AEQ DATE 3/22/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

BORING 31
(Monitoring Well MW-19)

DATE DRILLED: February 5, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 2.5



NOTE: Drilling mud used in drilling process. Flushed mud from boring using clear water after completion of drilling. Installed water level monitoring well; see Appendix C for well construction details.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.30

JOB 191028.AEO DATE 3/22/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

BORING 32
(Monitoring Well MW-20)

DATE DRILLED: February 6, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 2.7

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		43.5	74	1		CL	SILTY CLAY - dark brown
	5		59.8	64	< 1		MH	ELASTIC SILT - some layers of Clay, brownish grey
-5			51.8	71	< 1			Grey
	10		90.6	49	< 1			Dark grey
-10								
	15							
-15			39.3	82	< 1			
	20							
-20								
	25		70.1	58	< 1			
-25								
	30		73.5	55	< 1			

NOTE: Drilling mud used in drilling process. Flushed mud from boring using clear water after completion of drilling. Installed water level monitoring well; see Appendix C for well construction details.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW / CRANDALL, INC.

PLATE A - 1.31

BORING 33
(Monitoring Well MW-21)

DATE DRILLED: March 6, 1991
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

ELEVATION 4.9

JOB L91028.AEQ DATE 3/22/91 F.T. AR DR. ph O.E. BK W.P. ph CHKD EH

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	5		11.3	82	4		SP	SAND - fine to medium, some rootlets, brown
			54.7	68	3		CH	FAT CLAY - traces of organic matter, dark grey
			97.9	50	1		MH	ELASTIC SILT - some rootlets, dark grey
-5	10		23.2	105	4		SM	SILTY SAND - fine, dark grey
-10	15						SW	SAND - well graded, few Gravel, dark grey
-15	20		21.0	107	4			
							SP	SAND - fine, dark grey
-20	25		20.8	112	6			
								Light grey
-25	30		17.2	114	12			

NOTE: Drilling mud used in drilling process. Flushed mud from boring using clear water after completion of drilling. Installed water level monitoring well; see Appendix C for well construction details.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.32

BORING 1
(LCA AE-87133)

DATE DRILLED: April 7, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 5.8*

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. Ip O.E. DW W.P. Ip CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
5			33.4	84	1		CL	SILTY CLAY - some Sand, brownish grey
	5		42.3	79	1		ML	SANDY SILT - light greyish brown
0			48.2	73	< 1		CH	FAT CLAY - light greyish brown
	10		54.6	69	< 1			Some organic matter (LL = 64, PI = 35)
- 5			53.8	68	< 1		MH	ELASTIC SILT - brownish grey
	15		79.2	56	< 1			Layers with large amounts of shells Sulphur odor
- 10			55.5	67	< 1			
	20							
- 15			57.2	67	< 1			
	25							Layers and lenses of Sand and shells
- 20								
	30	0						
- 25							ML	SANDY SILT - some Clay, grey
	35	8						
- 30							SP	SAND - fine, some Gravel, grey
	40		11.9	117	13			

* Elevations provided by Psomas and Associates on 4/20/87.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

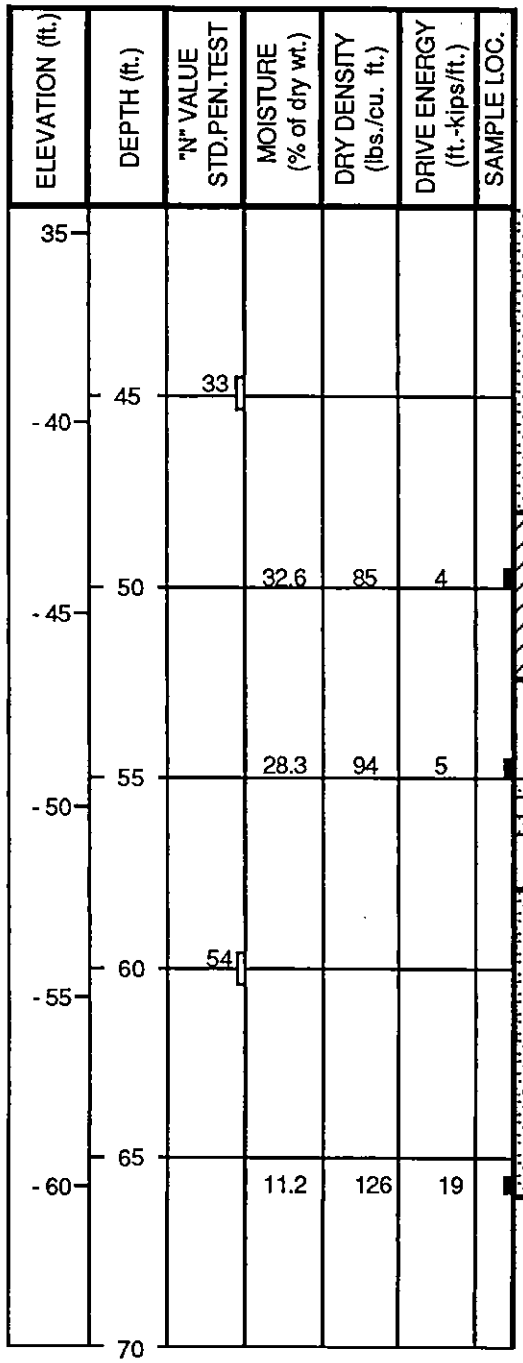
LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.33a

BORING 1 (Continued)

(LCA AE-87133)

DATE DRILLED: April 7, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash



SILTY CLAY - dark grey

SANDY SILT - some Clay, dark grey

Layers of Sand

SAND - well graded, about 25% Gravel, some Cobbles, light grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 20'. Backfilled annular space with pea gravel. Water level measured at a depth of 5' on 5/4/87.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. dmh lp CHKD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.33b

BORING 2
(LCA AE-87133)

DATE DRILLED: April 9, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 5.4

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. dmh lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
5							ML	SANDY SILT - some Clay, light brown
			35.4	86	3		CL	SILTY CLAY - streaks of alkali, dark brownish grey
0	5		45.8	77	1			
			43.5	81	1		ML	SANDY SILT - some organic matter, light greyish brown
- 5	10		52.0	70	< 1		CH	FAT CLAY - few shells, brownish grey
			46.7	76	< 1		MH	ELASTIC SILT - some organic matter, brownish grey
- 10	15		110.6	42	< 1			Dark grey (LL = 81, PI = 40)
- 15	20		52.8	71	< 1			Layers of Sandy Silt
			42.0	80	< 1			
- 20	25							
		0						
- 25	30							
			22.2	108	3		ML	SANDY SILT - some Clay, light brownish grey
- 30	35							
		24						
	40							

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.34a

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. lp. CHKD

BORING 2 (Continued)

(LCA AE-87133)

DATE DRILLED: April 9, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-40						
	45		24.9	104	2	
-45						
	50		35.9	87	1	
-50						
	55		31.6	92	2	
-55						
	60	60				
-60						
	65		13.2	123	28	
-65						
	70					

Layer of coarse Sand and Gravel

CL SILTY CLAY - brownish grey

Dark grey

ML SANDY SILT - dark grey

SW SAND - well graded, some Gravel, light grey

About 25% Gravel

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 20' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 20'. Backfilled annular space with pea gravel. Water level measured at a depth of 5-1/2' on 5/4/87.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.34b

BORING 3
(LCA AE-87133)

DATE DRILLED: April 8, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 6.6

JOB 91028.AEQ DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
5			27.6	90	3		ML	FILL - SANDY SILT - some Clay, mottled brown and grey
							CL	SILTY CLAY - some organic matter, streaks of alkali, dark brownish grey
	5		42.0	78	1		ML	SANDY SILT - light brown
0							CH	FAT CLAY - some organic matter, light greyish brown
			55.8	69	< 1			
	10		35.2	86	1			Layers of Sandy Silt
- 5							MH	ELASTIC SILT - some shells and organic matter, brownish grey
		2						
	15							
-10			72.3	58	< 1			
			99.6	46	< 1			Light greyish brown Sulphur odor
	20							
-15								
	25		58.1	67	< 1			
- 20								
			21.9	108	1			Layers of Sandy Silt
	30							
- 25								
		27						
	35						SP	SAND - fine, some Silt, grey
- 30							SW	SAND - well graded, about 25% Gravel, grey
		56						
	40							

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

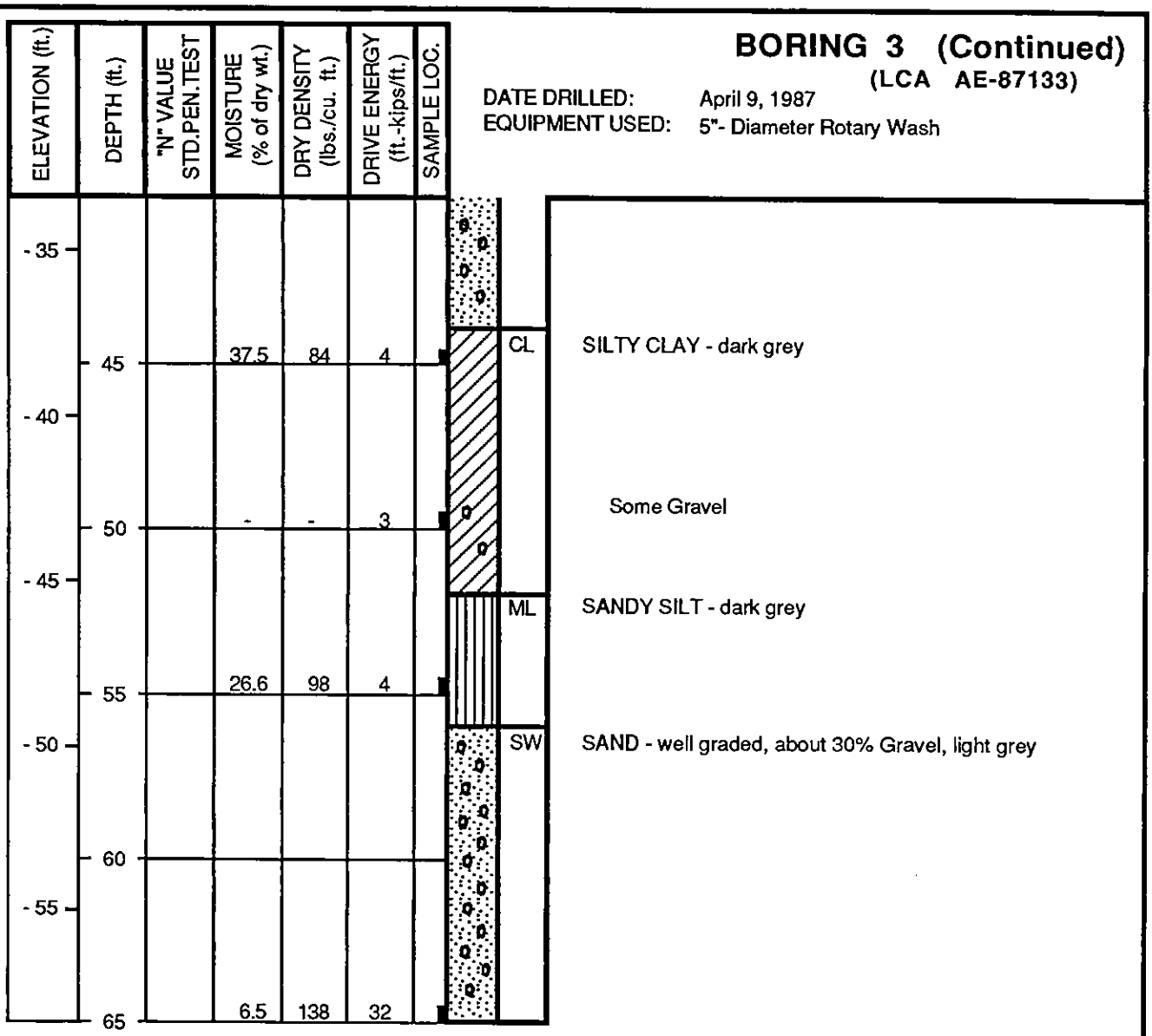
PLATE A - 1.35a

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. lp CHKD

BORING 3 (Continued)

(LCA AE-87133)

DATE DRILLED: April 9, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash



NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 20'. Backfilled annular space with pea gravel. Water level measured at a depth of 6' on 5/4/87.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.35b

BORING 4

(LCA AE-87133)

DATE DRILLED: April 8, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 7.3

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
5			25.9	90	2		CL	FILL - SILTY CLAY - mottled brown
							ML	FILL - SANDY SILT - some Clay, mottled brown and grey
	5		39.7	80	1		CL	SILTY CLAY - streaks of alkali, dark greyish brown
0			49.4	71	< 1		CH	FAT CLAY - light greyish brown
								Lenses of Sandy Silt
	10		37.9	83	2		SM	SILTY SAND - fine, light grey
- 5			45.7	77	< 1		MH	ELASTIC SILT - some organic matter, few shells, light grey
	15							
- 10			74.1	57	< 1			(LL = 52, PI = 24)
	20		96.8	47	< 1			Light greyish brown Sulphur odor
- 15								
	25		29.1	94				Black
- 20								Layers of Sandy Silt
	30	2						
- 25								
	35		22.6	106			SP	SAND - fine, layers of Sandy Silt, light grey
- 35								
	40	9					SM	SILTY SAND - fine, layers of Sandy Silt, grey

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.36a

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. lp CHKD

BORING 4 (Continued)

(LCA AE-87133)

DATE DRILLED: April 8, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-40	45		40.0	82	2		CH	FAT CLAY - dark grey Black
-45	50		38.8	83	2			Dark grey (LL = 56, PI = 28)
-50	55		14.8	120	16		ML	SANDY SILT - some Clay, black
-55	60		18.8	112	32		SW	SAND - well graded, some Silt and Gravel, grey About 30% Gravel, some Cobbles Layers of fine Sand
-60	65		22.0	106	32		SP	SAND - fine, some Gravel, grey
-65	70							

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 20'. Backfilled annular space with pea gravel. Water level measured at a depth of 7-1/2' on 5/4/87.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.36b

BORING 5
(LCA AE-87133)

DATE DRILLED: April 10, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 4.2

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0						ML	SANDY SILT - brownish grey
			35.0	87	1			
	5		57.0	70	< 1		MH	ELASTIC SILT - light greyish brown
-5							ML	SANDY SILT - light greyish brown
	10		-	-	1			
							MH	ELASTIC SILT - few shells, dark grey
			45.6	75	< 1			
-10							CH	FAT CLAY - few shells, dark grey
	15		69.6	62	< 1			
			65.1	62	< 1			
-15							CL ML	SILTY CLAY - lenses of shells, few Gravel, black
	20		20.1	111	1			(LL = 24, PI = 7)
-20							SM	SILTY SAND - fine, few shells, dark grey
	25		26.5	99	7			
							CL	SILTY CLAY - layers of Sandy Silt, dark grey
-25		12						
	30							
							ML	SANDY SILT - some Clay, dark grey
-30								
	35		32.0	91	3			
							MH	ELASTIC SILT - layers of Silty Sand, dark grey
-35		6						
	40							

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.37a

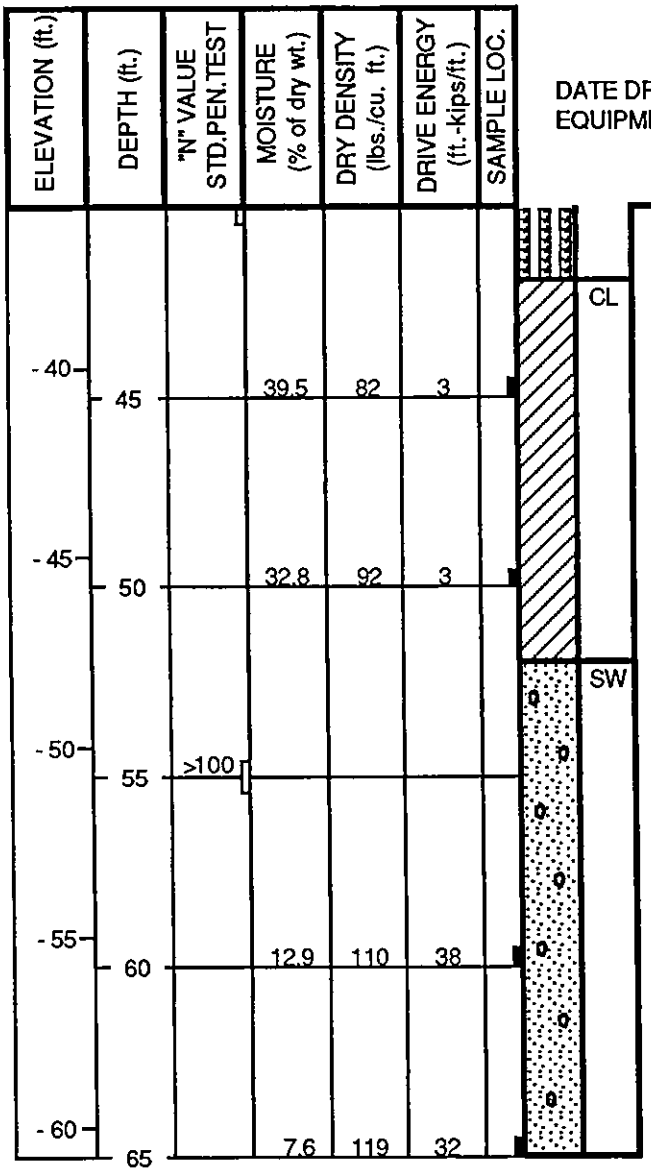
JOB L91028.AEO DATE 5/15/91 F.T. JD DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 5 (Continued)

(LCA AE-87133)

DATE DRILLED: April 10, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash



SILTY CLAY - layers of Silty Sand, some organic matter, dark grey

SAND - well graded, some Gravel, grey

About 25% Gravel

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 15' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 19'. Backfilled annular space with pea gravel. Water level measured at a depth of 6' on 5/4/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.37b

BORING 6
(LCA AE-87133)

DATE DRILLED: April 9, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 3.6

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		37.9	78	1		CL	SILTY CLAY - some organic matter, dark brownish grey
	5		66.9	57	< 1		CH	FAT CLAY - light greyish brown (LL= 84, PI = 51)
-5			40.6	81	1			Layers of Sandy Silt
	10		39.1	84	< 1			Large amount of shells, sulphur odor
-10			108.7	43	< 1		MH	ELASTIC SILT - light grey
	15		100.6	46	< 1			Some shells, sulphur odor
-15								Light brownish grey
	20		57.4	66	< 1			
-20								Layers of Sandy Silt
	25		19.2	113	1			
-25								
	30	18					SP	SAND - fine, grey
							SW	SAND - well graded, about 25% Gravel, grey
-30								
	35	44						
-35							CL	SILTY CLAY - dark grey
	40		34.9	89	3			

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.38a

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. lp CHKD

BORING 6 (Continued)

(LCA AE-87133)

DATE DRILLED: April 9, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-40	45		37.8	83	1			(LL = 33, PI = 11)
-45	50		33.0	89	2		ML	SANDY SILT - dark grey
-50	55						SW	SAND - well graded, about 30% Gravel, some Cobbles, grey
-55	60		30.9	95	28		SM	SILTY SAND - fine, grey
-60	65							

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 25' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 17'. Backfilled annular space with pea gravel. Water level measured at a depth of 3' on 5/4/87.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.38b

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. lp O.E. DW W.P. dmh lp CHKD

BORING 7
(LCA AE-87133)

DATE DRILLED: April 13, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 3.9

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		52.6	62	1		CH	FAT CLAY - brownish grey
	5						ML	SANDY SILT - light greyish brown
			43.5	81	1		MH	ELASTIC SILT - some shells, greyish brown
-5			46.8	76	1			Large amount of shells
	10		53.6	68	< 1			Dark grey
-10								Light brownish grey
	15		79.5	58	< 1			
			55.7	68	< 1		CH	FAT CLAY - few shells, grey
-15	20		30.9	92	1		ML	SANDY SILT - few shells, dark grey
							ML	CLAYEY SILT - layers of Silty Sand, dark grey
-20	25		25.5	100	2			
-25								
	30	9						
-30							ML	SANDY SILT - some Clay, dark grey
	35		26.3	100	4			
-35							ML	CLAYEY SILT - some Sand, dark grey
	40							

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.39a

PLATE A2-105

B1-644

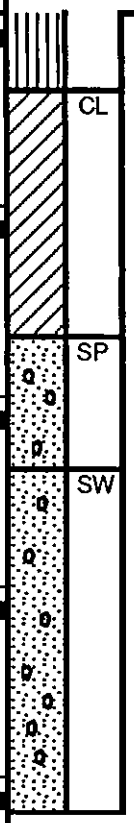
JOB L91028.AEO DATE 5/15/91 F.T. JD DR. lp O.E. DW W.P. lp CHKD

BORING 7 (Continued)

(LCA AE-87133)

DATE DRILLED: April 13, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			28.7	95	2	
-40	45		40.5	81	2	
-45	50		21.7	103	11	
-50	55		12.1	132	12	
-55	60		13.4	125	22	
-60	65					



CL — SILTY CLAY - some organic matter, black

SP — SAND - fine, few Gravel, grey

SW — SAND - well graded, some Silt, about 15% Gravel, grey

About 25% Gravel

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 35' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 19'. Backfilled annular space with pea gravel. Water level measured at a depth of 4-1/2' on 5/4/87.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.39b

BORING 8
(LCA AE-87133)

DATE DRILLED: April 10, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 4.0

JOB L91028.AEO DATE 5/15/91 F.T. BW DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	5		54.8	63	1		CH	FAT CLAY - some organic matter, brownish grey
- 5	10		47.6	75	< 1			Light greyish brown (LL = 55, PI = 25)
			42.8	80	< 1			
-10	15		46.7	76	< 1		MH	ELASTIC SILT - some Sand and organic matter, few shells, grey
			64.8	62	< 1			
-15	20		106.3	43	< 1			Light greyish brown
-20	25		57.6	66	< 1			Grey
-25	30		45.0	77	< 1			Dark grey
-30	35		58.5	63	< 1		SM	SILTY SAND - fine, few shells, dark grey
-35	40		19.5	105	10		SW	SAND - well graded, some Silt and Gravel, grey

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.40a

JOB L91028.AEO DATE 5/15/91 F.T. BW DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 8 (Continued)

(LCA AE-87133)

DATE DRILLED: April 10, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
		38				
-40	45		19.7	110	11	
-45	50		31.6	94	3	
-50	55		10.4	128	65	
-55	60		12.0	114	32	
-60	65					

Layers of fine Sand

SM SILTY SAND - fine, few Gravel, greyish brown

CL SILTY CLAY - dark grey

SW SAND - well graded, about 15% Gravel, grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 35' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 19'. Backfilled annular space with pea gravel. Water level measured at a depth of 1-1/2' on 5/4/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.40b

BORING 9
(LCA AE-87133)

DATE DRILLED: April 15, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 3.2

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		34.3	84	1		CL	SILTY CLAY - rootlets, dark brown
	5		35.6	89	1		ML	SANDY SILT - light greyish brown
- 5		6	33.0	86	< 1			Brownish grey
	10		79.8	53	1		MH	ELASTIC SILT - lenses of Sand, dark grey
-10			101.9	45	< 1			
	15		87.3	49	< 1			
-15								
	20		55.9	67	< 1			
		1					ML	SANDY SILT - few shells, dark grey
- 20								
	25		60.7	65	< 1		MH	ELASTIC SILT - layers of Sand, dark grey
- 25								
	30		38.6	81	< 1			Some shells
- 30								
	35		42.5	80	< 1			
		6						
- 35							SP	SAND - fine, some Silt, grey
	40		22.8	104	14			

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. lp O.E. DW W.P. lp CHKD

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.41a

PLATE A2-109

B1-648

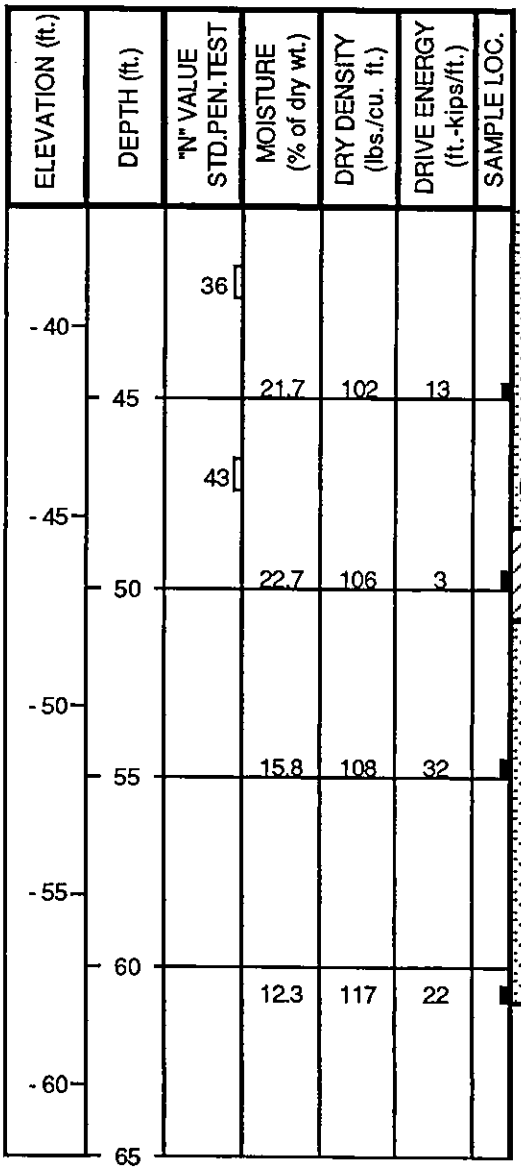
JOB L91028.AEO DATE 5/15/91 F.T. JD DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 9 (Continued)

(LCA AE-87133)

DATE DRILLED: April 15, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash



Few Gravel

CL — SILTY CLAY - some Sand filled cracks, dark grey and brown

SW — SAND - well graded, some Silt, about 20% Gravel, grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 19'. Backfilled annular space with pea gravel. Water level measured at a depth of 4' on 5/4/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.41b

BORING 10
(LCA AE-87133)

DATE DRILLED: April 15, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 4.0

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	5		56.5	64	1		MH	ELASTIC SILT - light brownish grey
			41.7	80	1		ML	SANDY SILT - grey
- 5	10		38.9	85	1		MH	ELASTIC SILT - some organic matter, dark grey
			64.3	61	< 1			Lenses of Sand
-10	15		89.7	50	< 1			
			12.4	115	3		SP	SAND - fine, some Silt and Gravel, grey
-15	20	23						
			51.3	72	< 1		MH	ELASTIC SILT - some Sand filled cracks, dark grey
- 20	25							Medium to large amount of organic matter
			40.7	79	< 1			
- 25	30						SM	SILTY SAND - fine, grey
			17.9	108	2			
- 30	35	9						
			20.8	109	4		ML	SANDY SILT - some Clay, dark grey
- 35	40	22					SM	SILTY SAND - fine, some Gravel, grey

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. lp O.E. DW W.P. lp CHKD

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.42a

BORING 10 (Continued)

(LCA AE-87133)

DATE DRILLED: April 15, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			16.7	115	6	
-40	45	10	62.4	59	-	
			21.8	106	9	
-45	50	35	27.7	100	24	
-50	55		13.8	126	34	
-55	60		28.1	99	24	
-60	65					

Layer of Elastic Silt

SP — SAND - fine, some Silt, grey

SW — SAND - well graded, some Gravel, grey

ML — SANDY SILT - grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 35' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 19'. Backfilled annular space with pea gravel. Water level measured at a depth of 2-1/2' on 5/4/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.42b

BORING 11
(LCA AE-87133)

DATE DRILLED: April 7, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 5.8

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
5			18.1	107	2		CL	FILL - SAND - fine, light brown SILTY CLAY - some Sand and organic matter, dark brown
	5		43.8	76	1			
0			46.4	74	1		CH	FAT CLAY - light brownish grey
- 5	10		54.2	69	1		MH	ELASTIC SILT - lenses of Sand, grey
			86.8	51	< 1			
-10	15		87.3	51	< 1			Sulpher odor
			67.3	59	< 1			Some organic matter, dark grey
-15	20		92.6	47	< 1			(LL = 60, PI = 24)
- 20	25		84.4	52	< 1			
- 25	30		42.5	81	< 1			
- 30	35		25.3	100	3		SM	SILTY SAND - fine, layers of Elastic Silt, dark grey
	40							

(CONTINUED ON FOLLOWING PLATE)

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L91028.AEO DATE 5/15/91 F.T. ____ DR. ____ lp ____ O.E. ____ DW ____ W.P. ____ lp ____ CHKD ____

PLATE A2-113

B1-652

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.43a

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 11 (Continued)

(LCA AE-87133)

DATE DRILLED: April 7, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-35	45	0					MH	ELASTIC SILT - layers of Silty Sand, dark grey
-40		24					SW	SAND - well graded, some Gravel, grey
	50							About 25% Gravel
-45			13.5	122	13			
	55	46					SP	SAND - fine, some Silt, grey
-50							SW	SAND - well graded, about 30% Gravel, grey
	60							
-55								
	65		30.4	92	19		ML	SANDY SILT - grey
-60	70							

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 25' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 19'. Backfilled annular space with pea gravel. Water level measured at a depth of 2' on 5/4/87.

LOG OF BORING

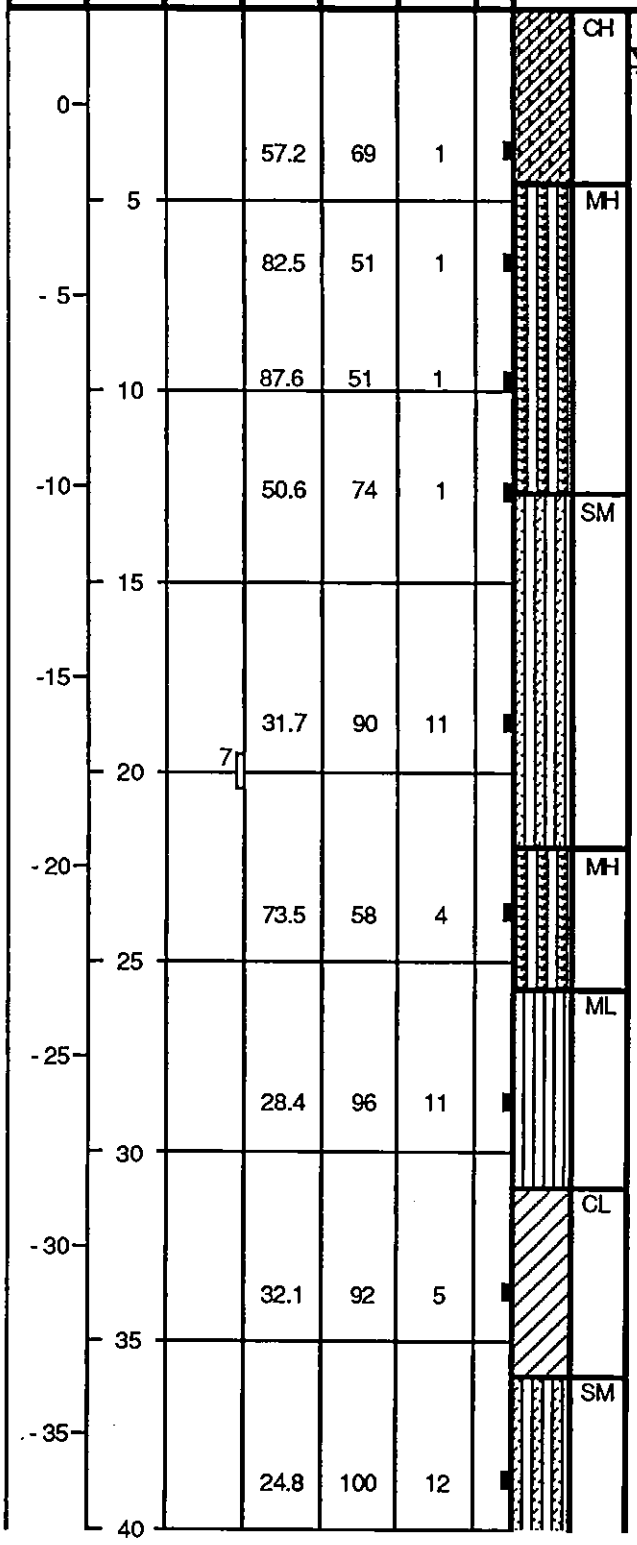
LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.43b

BORING 12
(LCA AE-87133)

DATE DRILLED: April 13, 1987
EQUIPMENT USED: 8"- Diameter Hollow Stem Auger

ELEVATION 2.5



CH FAT CLAY - dark grey
WATER LEVEL (4/14/87)
(LL = 61, PI = 29)
MH ELASTIC SILT - grey
Some Sand
SM SILTY SAND - fine, grey
Some shells
Lenses of Silt
MH ELASTIC SILT - grey
ML SANDY SILT - some shells, grey
CL SILTY CLAY - grey
SM SILTY SAND - fine, grey

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L91028.AEO DATE 5/15/91 F.T. TC DR. lp O.E. DW W.P. lp CHKD

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.44a

PLATE A2-115

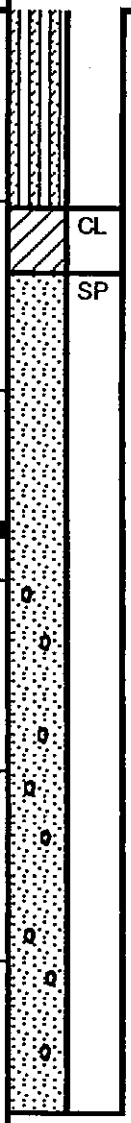
B1-654

BORING 12 (Continued)

(LCA AE-87133)

DATE DRILLED: April 13, 1987
EQUIPMENT USED: 8"- Diameter Hollow Stem Auger

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-40	45	8				
-45	50					
-50	55	46	13.3	112	20	
-55	60					
-60	65	70				
-65	70					



CL SILTY CLAY - grey

SP SAND - fine, grey

Lenses of Clay

Some Silt

Some Gravel

NOTE: Water level measured at a depth of 1-1/2' on 4/14/87.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB 191028.AEO DATE 5/15/91 F.T. TC DR. lp O.E. DW W.P. lp CHKD

PLATE A2-116

B1-655

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.44b

BORING 13
(LCA AE-87133)

DATE DRILLED: December 29, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION +6

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
5			7.8	101	4		SP	SAND - fine, light grey
								WATER LEVEL (7/16/87)
0	5		51.9	70	1		MH	ELASTIC SILT - some organic matter, grey
-5	10		78.3	52	<1			
		<1						Dark grey
-10	15		52.9	64	1		SM	SILTY SAND - fine to medium, some layers of Sand, some organic matter, dark grey
		9						
-15	20		20.1	111	11			Layers with large amount of shells
		13						
-20	25		29.3	92	7			
-25	30	38						
			28.2	95	13			
-30	35							
		23						
	40		24.9	99	5			

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L91028.AEO DATE 5/15/91 F.T. LS DR. dmh O.E. BK W.P. dmh CHKD

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.45a

PLATE A2-117

B1-656

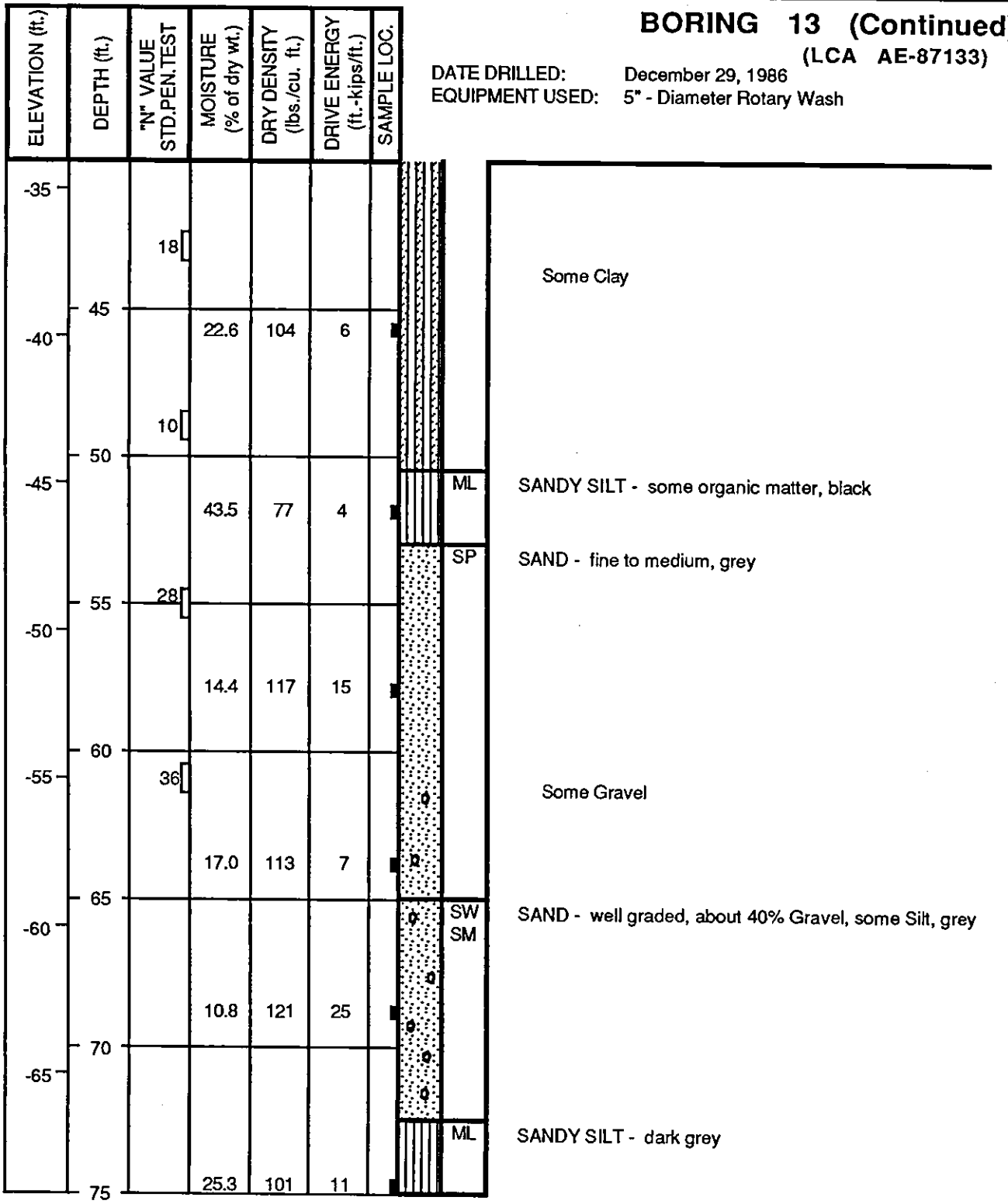
BORING 13 (Continued)

(LCA AE-87133)

DATE DRILLED: December 29, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

JOB L91028.AEO DATE 5/15/91 F.T. LS DR. dmh O.E. BK W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.



NOTE: Drilling mud used in drilling process. Mud removed to a depth of about 15'. Water level measured at 3' 15 minutes after removal of mud and at 3' on 12/31/86; bottom of boring at 3-1/2'. Set 5' of 2"-diameter perforated PVC pipe for water level determination (on 12/31/86). Backfilled annular space with pea gravel. Placed metal cover over pipe.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.45b

BORING 14
(LCA AE-87133)

DATE DRILLED: December 30, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION +7

JOB L91028.AEO DATE 5/15/91 F.T. LS DR. dmh O.E. BK W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
5			42.1	80	3		SP	FILL - SAND - fine, light brown
			56.6	65	2		CL	FILL - SILTY CLAY - lenses of fine Sand, mottled grey and dark grey
	5							▽ WATER LEVEL (7/15/87)
0			62.3	56	1		MH	ELASTIC SILT - some organic matter, dark grey
	10		49.4	73	<1			Hydrogen sulfide odor
-5								
	15		69.0	57	<1			
-10							SM	SILTY SAND - fine, dark grey
	20		61.0	64	2			Some Clay
-15								
	25		39.7	79	2			
-20							SP SM	SAND - fine, some Silt, dark grey
	30		24.1	100	25			
-25								
	35		26.3	97	18			
-30							SM	SILTY SAND - fine, dark grey
	40		30.1	91	8			

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.46a

BORING 14 (Continued)

(LCA AE-87133)

DATE DRILLED: December 30, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

JOB L91028.AEO DATE 5/15/91 F.T. LS DR. dmh O.E. BK W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-35	45		28.6	95	10	
-40	50		33.0	89	3	
-45	55		24.9	101	13	
-50	60		94.9	55	7	
-55	65		35.0	91	7	
-60	70		22.7	106	32	
-65	75		14.3	115	36	

Some layers of Elastic Silt

Some organic matter

SP SM SAND - fine, some Silt, dark grey

Some Gravel

NOTE: Drilling mud used in drilling process. Mud removed to a depth of about 15'. Water level measured at 3' on 12/31/86; bottom of boring at 20'. Backfilled boring with pea gravel to a depth of 10'. Set 10' of 2"-diameter PVC pipe with lower 5' perforated for water level determination (on 12/31/86). Backfilled annular space with pea gravel. Placed metal cover over pipe. Water level measured at 4' on 1/13/87; bottom of boring at 8-1/2'.

LOG OF BORING

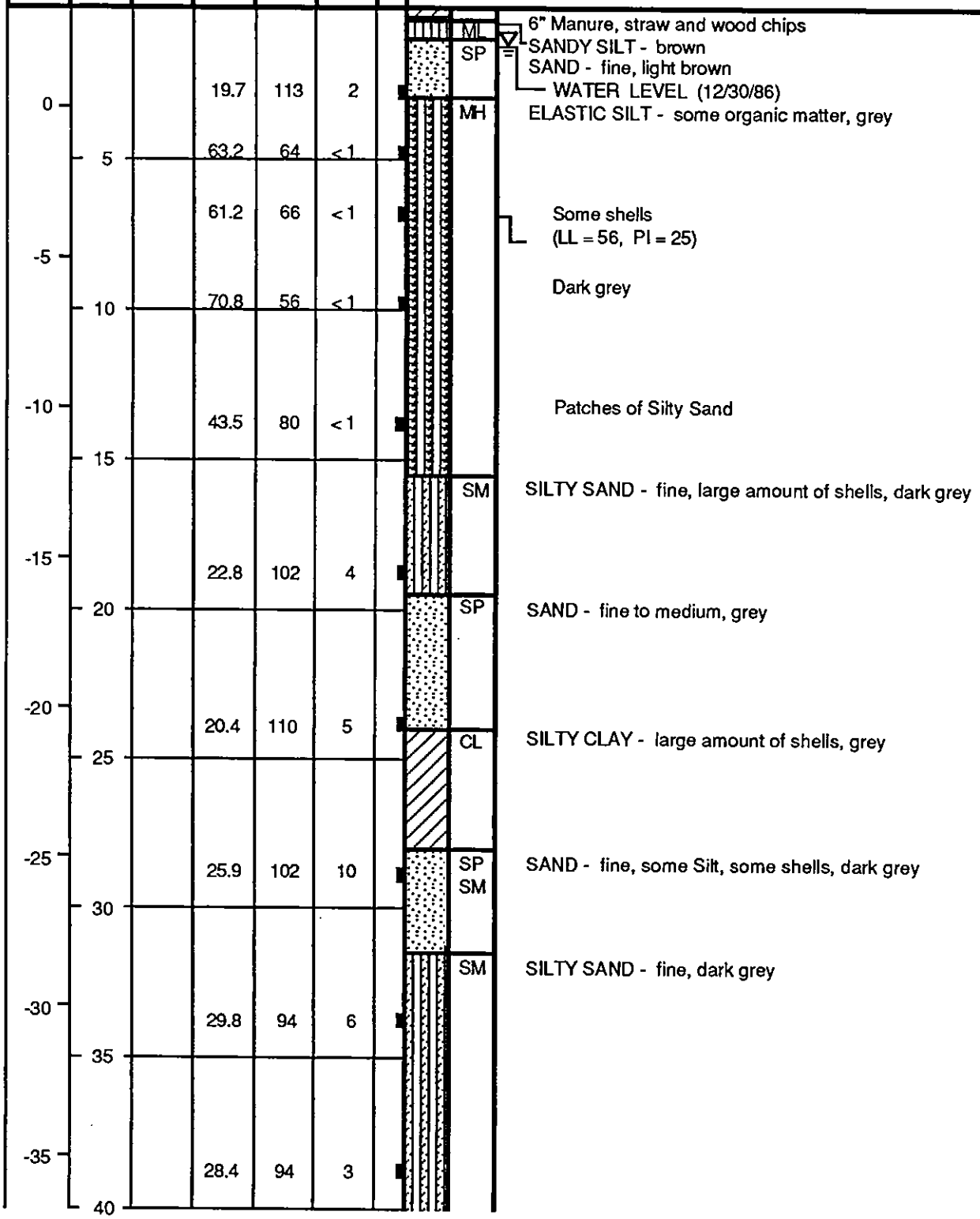
LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.46b

BORING 15
(LCA AE-87133)

DATE DRILLED: December 30, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION +3



Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. dmh O.E. DW W.P. dmh CHKD

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.47a

PLATE A2-121

B1-660

BORING 15 (Continued)

(LCA AE-87133)

DATE DRILLED: December 30, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. dmh O.E. DW W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-40	45		46.2	80	2	
-45	50		27.5	96	4	
-50	55		26.0	98	18	
-55	60		15.6	115	16	
-60	65		17.0	115	30	
-65	70		16.2	116	48	
-70	75		21.7	107	30	

ML — SANDY SILT - some Clay and shells, dark grey
Some streaks of organic matter
Patches of Sand

Layers of Silty Sand

SP — SAND - fine, grey

Some Gravel

SW SM — SAND - well graded, some Silt, about 20% Gravel, grey

Large amount of Gravel, dark grey

Few Gravel

NOTE: Drilling mud used in drilling process. Mud removed to a depth of about 10'. Water level measured at 1-1/2' 30 minutes after removal of mud; bottom of boring at 7'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.47b

BORING 16
(LCA AE-87133)

DATE DRILLED: December 30, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION +8

JOB L91028.AEO DATE 5/15/91 F.T. LS DR. dmh O.E. DW W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
			4.3	127	11		SP	FILL - SAND - fine, some Silt, light brown
5			19.1	98	6		SP	SAND - fine, light greyish brown WATER LEVEL (12/31/86)
	5							
0			56.2	67	3		MH	ELASTIC SILT - grey
	10		52.9	66	< 1			
-5								
	15		70.5	57	< 1			Some organic matter, dark grey (LL = 51, PI = 22)
-10								
	20		29.6	91	3		SM	SILTY SAND - fine, dark grey
-15								Large amount of shells
	25		26.1	102	7			
-20							SP SM	SAND - fine, some Silt, grey
	30		20.6	107	20			
-25								Dark grey
	35		24.9	98	13			
-30								Light grey
	40		20.8	106	27			

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.48a

BORING 16 (Continued)

(LCA AE-87133)

DATE DRILLED: December 30, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

JOB L91028.AEO DATE 5/15/91 F.T. LS DR. dmh. O.E. DW W.P. dmh. CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-35	45		17.3	112	23			Large amount of shells, dark grey Layer of Silty Clay
-40							SM	SILTY SAND - fine, dark grey
	50		59.9	64	2		MH	ELASTIC SILT - dark grey
-45							SM	SILTY SAND - fine, few layers of Silty Clay, dark grey
-50	55		28.9	93	6			
	60		31.4	81	5			
-55								
	65		32.5	93	9			Some organic matter Some Gravel
-60								
	70		18.8	113	4			
-65							SP	SAND - fine to medium, about 20% Gravel, dark grey
	75		15.7	109	23			

NOTE: Drilling mud used in drilling process. Mud removed to a depth of about 15'. Water level measured at 4-1/2' 15 minutes after removal of mud and at 4' on 12/31/86; bottom of boring at 4-1/2'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.48b

BORING 17
(LCA AE-87133)

DATE DRILLED: December 30, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION +5

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
			10.0	125	7		SM	FILL - SILTY SAND fine, brown
							SP	SAND - fine, greyish brown WATER LEVEL (12/31/86)
							MH	ELASTIC SILT - some organic matter and shells, grey
0	5		59.4	65	< 1			
			75.0	55	< 1			(LL = 58, PI = 26)
-5	10	<1						Dark grey
			72.1	58	< 1			
-10	15	<1						
							SM	SILTY SAND - fine, dark grey
-15	20		24.7	101	2			
							SP	SAND - fine, grey
		36						
-20	25		22.7	103	16			Dark grey Some Silt
		14						
-25	30		21.4	104	8			Large amount of shells
-30	35	24						
			19.6	106	11			
-35	40							

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. dmh O.E. DW W.P. dmh CHKD

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.49a

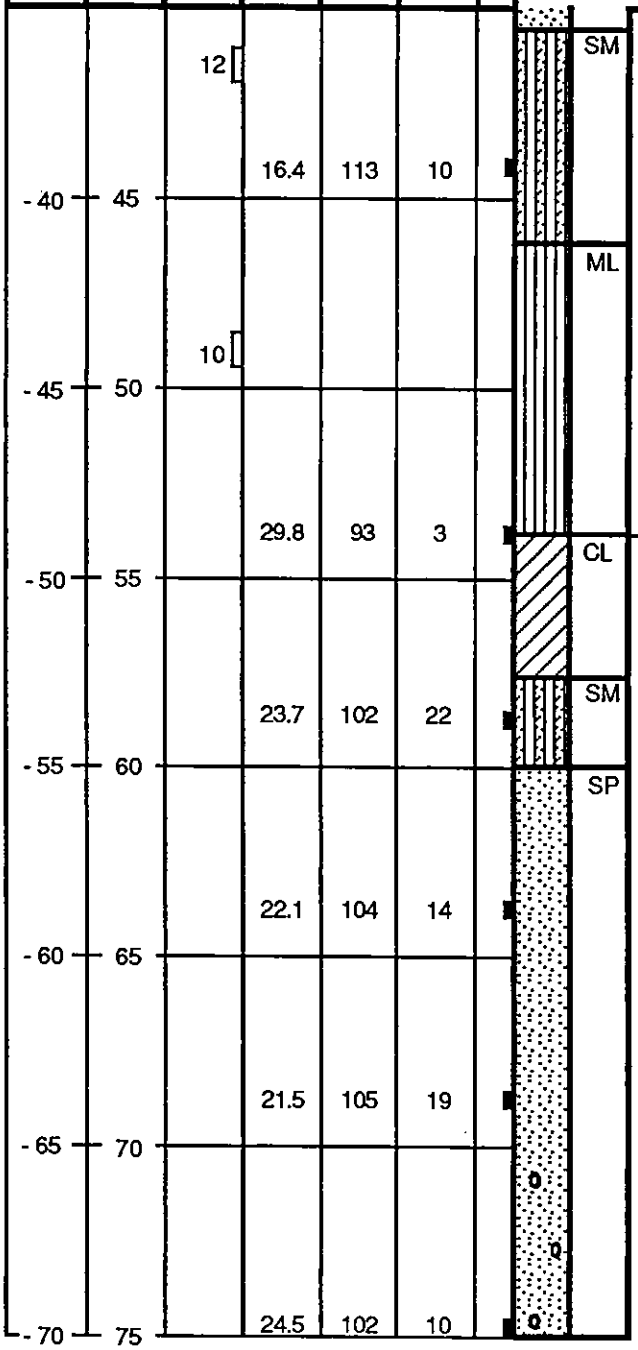
PLATE A2-125

B1-664

BORING 17 (Continued)

(LCA AE-87133)

DATE DRILLED: December 30, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash



SM SILTY SAND - fine, dark grey

Fine to medium

ML CLAYEY SILT - some Sand, dark grey

Some organic matter

CL SILTY CLAY - dark grey
(LL = 34, PI = 16)

SM SILTY SAND - fine, dark grey

SP SAND - fine, dark grey
Some patches of Silt

Some Gravel

Some Silt, grey

NOTE: Drilling mud used in drilling process. Mud removed to a depth of about 15'. Water level measured at 2-1/2' 30 minutes after removal of mud and at 2' on 12/31/86; bottom of boring at 3'.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. dmh O.E. DW W.P. dmh CHKD

PLATE A2-126

B1-665

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.49b

BORING 18
(LCA AE-87133)

DATE DRILLED: December 29, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION +4

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		20.1	104	5		SP	SAND - fine, light greyish brown WATER LEVEL (7/16/87)
	5		58.0	66	< 1		MH	ELASTIC SILT - some shells, some organic matter, grey
-5	10		54.5	68	< 1			Some Sandy layers with shells
	15	< 1	90.3	48	< 1			Dark grey
-10	20	< 1	19.1	110	8		SP	Some layers of Silty Sand SAND - fine to medium, grey
-15	25	38	27.9	96	4		ML	CLAYEY SILT - some Sand, grey
-20	30	18	24.5	101	24		SP SM	SAND - fine, some Silt, dark grey
-25	35	18					SM	SILTY SAND - fine to medium, large amount of shells, dark grey
-30	40							Alternating layers of Silty Sand and Sand with large amount of shells
-35								

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. dmh O.E. DW W.P. dmh CHKD

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.50a

PLATE A2-127

B1-666

BORING 18 (Continued)

(LCA AE-87133)

DATE DRILLED: December 29, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. dmh O.E. DW W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-40	45	13	20.9	110	7	
			50.4	73	2	
-45	50	<1				
-50	55		26.2	95	5	
-55	60		22.5	105	4	
-60	65		23.6	101	17	
-65	70		15.3	117	19	
-70	75		21.4	104	39	

ML — CLAYEY SILT - some organic matter, dark grey

Lenses of Peat

ML — SANDY SILT - some organic matter, dark grey

Layers of Sand

SP — SAND - fine to medium, few Gravel and shells, grey

SW SM — SAND - well graded, some Silt, about 30% Gravel, dark grey

Layer of Clay

NOTE: Drilling mud used in drilling process. Mud removed to a depth of about 15'. Water level measured at 2-1/2' 30 minutes after removal of mud and at 1-1/2' on 12/31/86; bottom of boring at 17' and 8' respectively. Set 10' of 2"-diameter PVC pipe with lower 5' perforated for water level determination (on 12/31/86). Backfilled annular space with pea gravel. Placed metal cover over pipe. Water level measured at 1' on 1/13/87; bottom of boring at 10'.

LOG OF BORING

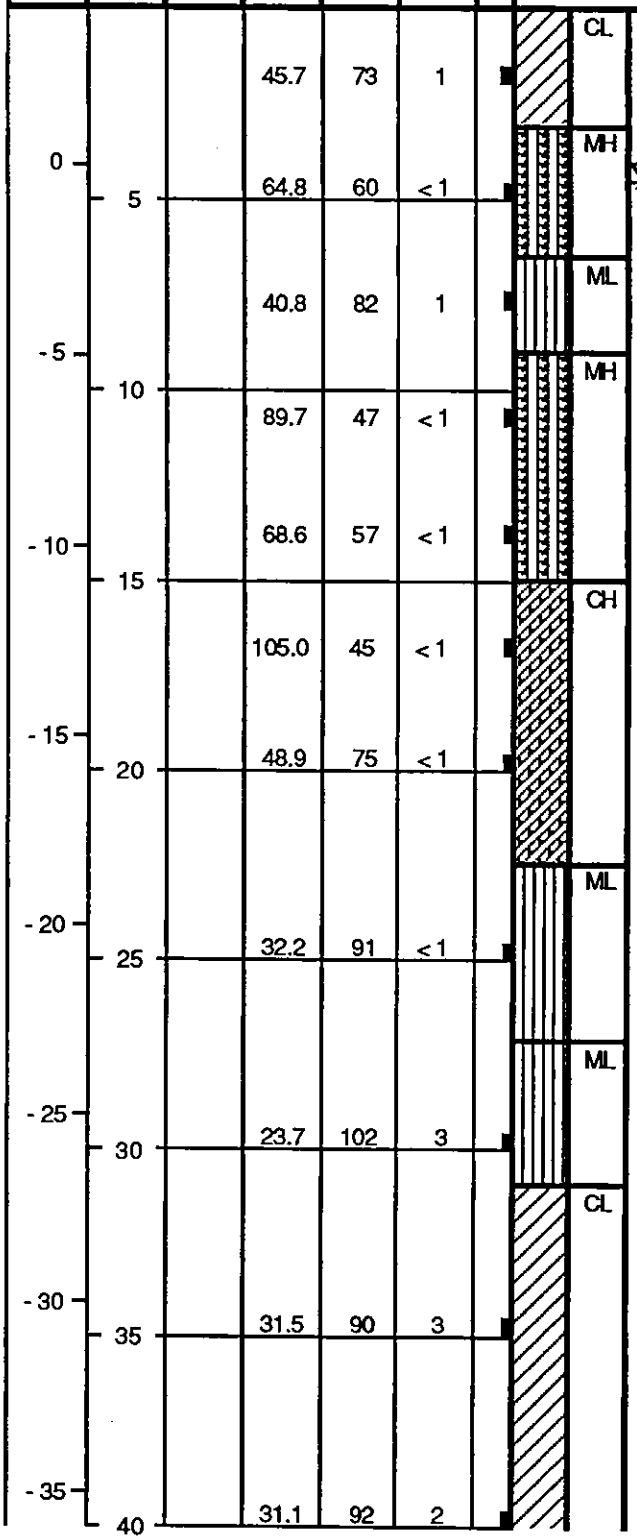
LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.50b

BORING 1
(LCA AE-86416)

DATE DRILLED: April 13, 1987
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION +4.1 *



CL — SILTY CLAY - black

MH — ELASTIC SILT - some Sand, few shells, brownish grey

WATER LEVEL (6/22/87)

ML — SANDY SILT - few shells, brownish grey
(Non plastic)

MH — ELASTIC SILT - large amount of shells, grey

CH — FAT CLAY - organic odor, brownish grey

ML — SANDY SILT - some Clay, few shells, grey

(LL = 25, PI = 1)

ML — CLAYEY SILT - some Sand, brownish grey

CL — SILTY CLAY - lenses of Sandy Silt, grey

(LL = 38, PI = 17)

Dark grey

* Elevations provided by Psomas and Associates on 4/20/87.

(CONTINUED ON FOLLOWING PLATE)

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. dmh O.E. DW W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.51a

BORING 1 (Continued)

(LCA AE-86416)

DATE DRILLED: April 13, 1987
EQUIPMENT USED: 5" - Diameter Rotary Wash

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. dmh O.E. DW W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-40	45		30.4	95	3	
-45	50		18.9	112	5	
-50	55		12.3	127	34	
-55	60		11.1	131	32	
-60	65		23.4	104	38	

Lenses of Sand

SM SILTY SAND - fine, grey

SW SAND - well graded, about 15% Gravel, grey

Layers of Silty Sand

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 35' after completion of drilling. Installed perforated 2"-diameter PVC pipe to a depth of 18-1/2'. Backfilled annular space with pea Gravel. Water level measured at a depth of 4-1/2' on 6/22/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.51b

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. dmh O.E. DW W.P. dmh CHKD

BORING 2
(LCA AE-86416)

DATE DRILLED: April 13, 1987
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION +2.8

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		32.1	82	2		CL	SILTY CLAY - streaks of alkali, dark brown
			48.4	71	< 1		CH	FAT CLAY - light brownish grey WATER LEVEL (6/22/87)
-5	5		57.0	67	< 1			(LL = 69, PI = 39)
			45.5	74	< 1		MH	ELASTIC SILT - grey Large amount of shells
-10	10		66.0	54	< 1			
	15	1						Fewer shells
-15			51.1	72	1			
	20		41.1	81	< 1			Some Sand
-20								
	25						ML	SANDY SILT - few shells, black
-25			33.1	92	2			
		1						Some Clay
	30						CL	SILTY CLAY - some organic matter, dark grey
-30			32.8	91	2			(LL = 35, PI = 14)
								Lenses of Sand
	35		30.3	94	2			
-35								
	40						SM	SILTY SAND - fine, grey

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.52a

BORING 2 (Continued)

(LCA AE-86416)

DATE DRILLED: April 13, 1987
EQUIPMENT USED: 5" - Diameter Rotary Wash

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. dmh O.E. DW W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-40	45	30	19.8	102	6			
-45	50		23.6	102	6		CL	SILTY CLAY - some organic matter, dark grey
-50	55	53	16.1	105	6		ML	SANDY SILT - dark grey
-55	60		13.3	119	28		SW	SAND - well graded, about 10% Gravel, grey
-60	65		28.4	96	22		ML	SANDY SILT - grey
-65	70		27.2	99	14		SM	SILTY SAND - fine, grey
-70	75		31.0	94	17			
-75	80		29.8	93	14			

About 25% Gravel
Layers of fine Sand

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 25' after completion of drilling. Installed perforated 2"-diameter PVC pipe to a depth of 18-1/2'. Backfilled annular space with pea Gravel. Water level measured at a depth of 3' on 6/22/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.52b

JOB 191028.AEO DATE 5/15/91 F.T. JD DR. dmh O.E. DW W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 3
(LCA AE-86416)

DATE DRILLED: April 14, 1987
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION +2.5

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		60.7	64	< 1		CH	FAT CLAY - greyish brown
								▽ WATER LEVEL (6/22/87)
	5		64.9	62	< 1			Light greyish brown
-5			52.3	70	< 1		MH	ELASTIC SILT - some Sand, grey
	10							Layer of shells
-10			83.2	53	< 1			Some organic matter
	15		98.0	47	< 1			
-15			94.3	50	< 1			Brownish grey
	20		39.7	81	< 1			Grey
-20								
	25		35.1	87	1			
-25							ML	SANDY SILT - large amount of shells, dark grey
	30		35.2	80	1			
-30		0					MH	ELASTIC SILT - some Sand, grey
	35		25.1	97	< 1			
-35							CL	SILTY CLAY - some Sand and organic matter, dark grey
	40							

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.53a

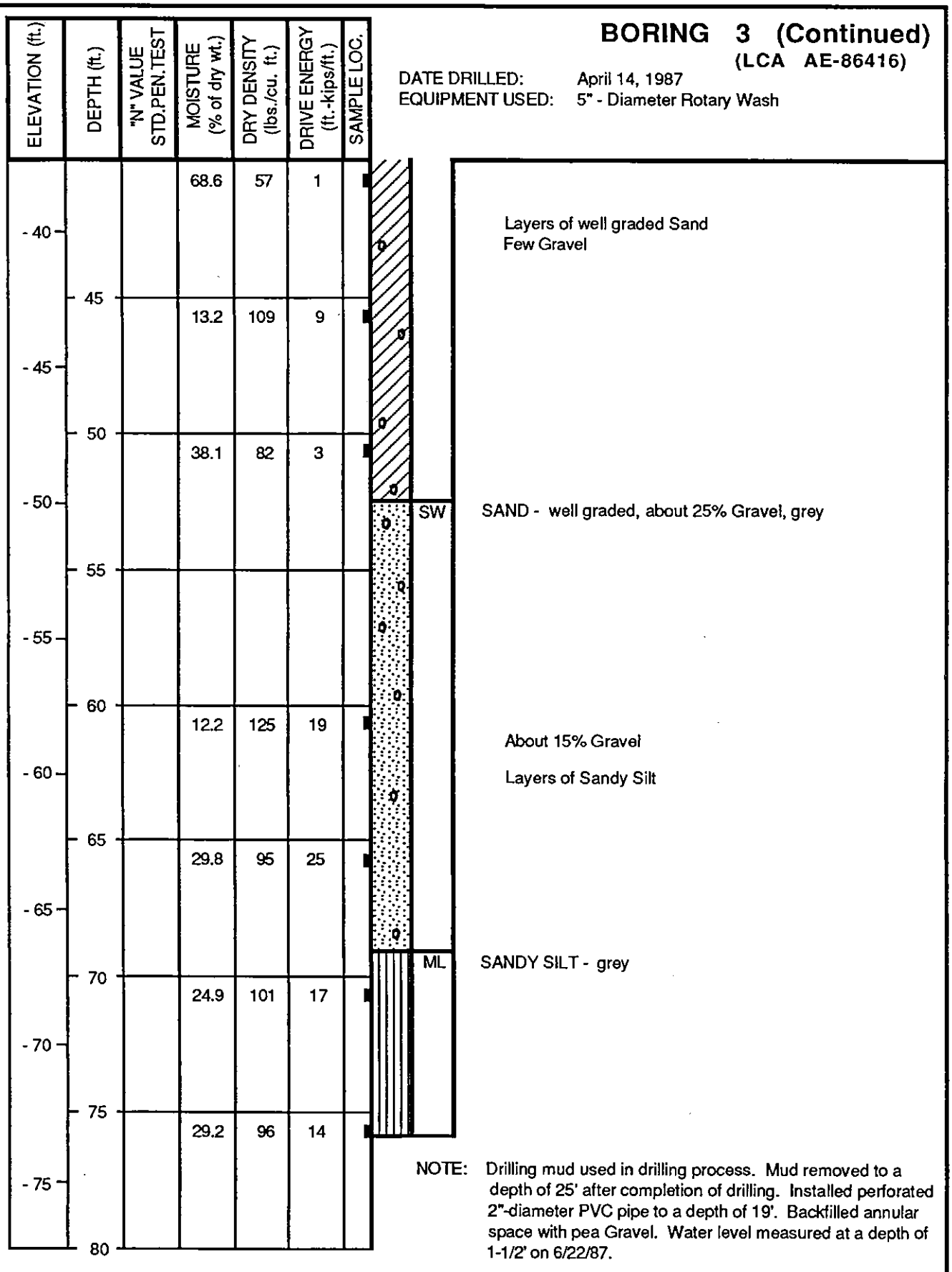
JOB L91028.AEO DATE 5/15/91 F.T. JD DR. dmh O.E. DW W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 3 (Continued)

(LCA AE-86416)

DATE DRILLED: April 14, 1987
EQUIPMENT USED: 5" - Diameter Rotary Wash



NOTE: Drilling mud used in drilling process. Mud removed to a depth of 25' after completion of drilling. Installed perforated 2"-diameter PVC pipe to a depth of 19'. Backfilled annular space with pea Gravel. Water level measured at a depth of 1-1/2' on 6/22/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.53b

SOIL CLASSIFICATION SYSTEM-ASTM D2487

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE-GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE-GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

"Push" Sampler

Split Barrel "Drive" Sampler With Liner

Standard Penetration Test (SPT) Sampler

Bag Sample

Concrete/Rock Core

Groundwater Surface

SPT "N" = 0.65 x modified California blows per foot

NP = Nonplastic
EI = Expansion Index Test
SG = Specific Gravity
SE = Sand Equivalent
UC = Unconfined Comp.
CD = Consol. Drained Triaxial.
CU = Consol. Undrained Triaxial.
UU = Undrained, Unconsol. Triaxial.
RV = R-Value
CA = Chemical Analysis
DS = Direct Shear
CN = Consolidation
CP = Collapse Potential
SA = Grain size; HD = Hydrometer
MD = Compaction Test
HC = Hydraulic Conductivity Test
[PID] Reading in ppm above background

PLATE

B1

USACE Ballona Creek Watershed
Project No. 2006-023.05

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	7 MLLW
LATITUDE:	33° 58' 17.6" N	**LONGITUDE:**	118° 26' 1.8" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	16.5
DATE STARTED:	2/24/09	**DATE COMPLETED:**	2/24/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				1 1 2	2		FAT CLAY (CH): very dark gray, moist, very soft, high plasticity, few roots						
5				1 2 2	3	0.25	SILT (ML): olive brown, moist, soft, low plasticity, micaceous		39	41	7	98	
	5			2 4 7	7		SANDY SILT (ML): olive brown, wet, medium stiff, low plasticity, fine-grained sand ▽		32			52	
0				1 2 2	3	0.75	ELASTIC SILT (MH): grayish brown, wet, soft, medium plasticity, veins of oxidation, micaceous		43	55	22	98	
-5	10			1 1 2	2		very dark gray, very soft, trace shell fragments, sulfur odor		60			93	
	15			1 1 1	1	0.75	gray		91			93	
-10							Bottom of boring at 16.5 feet. Groundwater encountered at 6 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
	20												
-15													
	25												
-20													

LOG OF BORING B-01

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PLATE
B2

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	7 MLLW
LATITUDE:	33° 58' 16.1" N	**LONGITUDE:**	118° 26' 7.1" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	16.5
DATE STARTED:	2/24/09	**DATE COMPLETED:**	2/24/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				1 1 2	2		LEAN CLAY with SAND (CL): very dark brown, moist, very soft, medium plasticity, fine- to coarse-grained sand, little roots						
5				1 2 3	3		FAT CLAY (CH): gray, moist, soft, high plasticity, trace dark spots		39	50	32	97	
	5						SANDY SILT (ML): dark grayish brown, wet, medium stiff, low plasticity, fine-grained sand, micaceous		37			53	
0				3 5 4	6								
							LEAN CLAY (CL): olive brown, wet, very soft, medium plasticity, oxidation						
				1 1 2	2				40			98	
	10						SANDY LEAN CLAY (CL): olive brown, wet, very soft, medium plasticity, fine-grained sand, micaceous		38			51	
-5				1 1 2	2		FAT CLAY (CH): very dark gray, wet, very soft, high plasticity, sulfur odor		83			95	
	15						ELASTIC SILT (MH): gray, wet, very soft, medium plasticity, sulfur odor		107	64	17	96	
				1 1 2	2								
-10							Bottom of boring at 16.5 feet. Groundwater encountered at 6 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
	20												
-15													
	25												
-20													

LOG OF BORING B-02

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USACE Ballona Creek Watershed
Project No. 2006-023.05

PLATE
B3

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	10 MLLW
LATITUDE:	33° 58' 16.1" N	**LONGITUDE:**	118° 26' 12.6" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	19.5
DATE STARTED:	2/23/09	**DATE COMPLETED:**	2/23/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				2 4 8	8		SANDY SILT (ML): very dark grayish brown, moist, medium stiff, low plasticity, fine- to coarse-grained sand, trace fine to coarse gravel, little roots		19			66	
				50/6"	65		POORLY GRADED SAND with GRAVEL (SP): dark yellowish brown, moist, very dense, fine- to coarse-grained sand, fine to coarse gravel						
5	5			2 3 4	5		LEAN CLAY (CL): light brownish gray, moist, medium stiff, medium plasticity		45	46	21	99	
0	10			2 2 4	4		very dark grayish brown, soft, micaceous ▽		37			91	
				0 1 1	1	0.25	ELASTIC SILT (MH): dark gray, wet, very soft, medium plasticity, micaceous		42			98	
-5	15			1 2 2	3		FAT CLAY (CH): dark gray, wet, soft, high plasticity, trace shell fragments		62	73	46	90	
				1 1 2	2		gray, very soft, sulfur odor		87			96	
-10	20						Bottom of boring at 19.5 feet. Groundwater encountered at 11 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-15	25												
-20													

LOG OF BORING B-03

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USACE Ballona Creek Watershed

Project No. 2006-023.05

PLATE

B4

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	8 MLLW
LATITUDE:	33° 58' 11.2" N	**LONGITUDE:**	118° 26' 13.0" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	16.5
DATE STARTED:	2/24/09	**DATE COMPLETED:**	2/24/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				1 3 2	3		SILT with SAND (ML): brown, moist, soft, low plasticity, fine- to medium-grained sand, few roots		20			74	
5				4 6 8	9		LEAN CLAY (CL): very dark brown, moist, stiff, medium plasticity, trace roots, calcite stringer		34			91	
	5			4 4 6	6		SILT (ML): olive brown, wet, medium stiff, nonplastic, micaceous		34	NP	NP	98	
0				3 4 3	5		SANDY SILT (ML): olive brown, wet, medium stiff, low plasticity, fine-grained sand, micaceous		36			66	
	10			0 2 1	2		SILT (ML): very dark gray, wet, very soft, low plasticity, trace shell fragments, sulfur odor		42	40	7	99	
-5	15			1 1 1	1				100			93	
-10							Bottom of boring at 16.5 feet. Groundwater encountered at 6 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
	20												
-15													
	25												
-20													

LOG OF BORING B-04

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USACE Ballona Creek Watershed
Project No. 2006-023.05

PLATE
B5

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	7 MLLW
LATITUDE:	33° 58' 7.9" N	**LONGITUDE:**	118° 26' 11.9" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	16.5
DATE STARTED:	2/25/09	**DATE COMPLETED:**	2/25/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
5				1 1 2	2		LEAN CLAY with SAND (CL): dark brown, moist, very soft, medium plasticity, fine-grained sand, trace roots		23			83	
				1 2 3	3		gray, soft						
0	5			2 6 4	6		▽ olive gray, wet, medium stiff, micaceous		34			82	
				1 1 1	1		ELASTIC SILT (MH): olive gray, wet, very soft, medium plasticity, trace shell fragments		49	62	29	98	
-5	10			0 1 2	2		FAT CLAY (CH): dark gray, wet, very soft, high plasticity, sulfur odor		59			90	
-10	15			0 1 1	1		few shell fragments		95	67	38	95	
							Bottom of boring at 16.5 feet. Groundwater encountered at 6 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-15	20												
-20	25												

LOG OF BORING B-05

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PLATE
B6

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION: See Figure 2	**ELEVATION AND DATUM (feet):** 6 MLLW
LATITUDE: 33° 58' 6.8" N	**LONGITUDE:** 118° 26' 0.9" W
DRILLING EQUIPMENT: Hand Auger	**DRILLING METHOD:** Hand Auger
BORING DIAMETER (inches): 4	**BORING DEPTH (feet):** 8
DATE STARTED: 2/25/09	**DATE COMPLETED:** 2/25/09
SPT HAMMER DROP: 30 inches **WT:** 140 lbs	**DRIVE HAMMER DROP:** inches **WT:** lbs
LOGGED BY: JMS **CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)** **ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
5							FAT CLAY (CH): dark olive brown, moist, high plasticity, little roots		54			98	
							ELASTIC SILT (MH): very dark brown, wet, medium plasticity		46	70	36	99	
0	5						FAT CLAY (CH): dark grayish brown, wet, soft, high plasticity		43			97	
-5	10						Bottom of boring at 8 feet. Groundwater encountered at 2 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-10	15												
-15	20												
-20	25												

LOG OF BORING B-06

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PLATE
B7

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	4 MLLW
LATITUDE:	33° 57' 56.6" N	**LONGITUDE:**	118° 26' 39.7" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	16.5
DATE STARTED:	2/19/09	**DATE COMPLETED:**	2/19/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				3 4 5	6		POORLY GRADED SAND with CLAY (SP-SC): brown, moist, loose, fine- to medium-grained sand, trace fine gravel, trace roots						
							▽ FAT CLAY (CH): dark gray, wet, soft, high plasticity						
0				1 2 3	3				58			98	
	5						SILT (ML): very dark gray, wet, soft, low plasticity, micaceous						
				2 2 3	3				26	33	6	95	
-5							ELASTIC SILT (MH): very dark gray, wet, very soft, medium plasticity, trace shell fragments						
	10			1 1 2	2				40	59	24	96	
							FAT CLAY (CH): very dark gray, wet, very soft, high plasticity, sulfur odor						
				1 1 2	2				60			92	
-10							CLAYEY SAND (SC): very dark gray, wet, loose, fine-grained sand, trace shell fragments, sulfur odor						
	15			2 3 5	5				34			39	
							Bottom of boring at 16.5 feet. Groundwater encountered at 2 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-15													
	20												
-20													
	25												
-25													

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USACE Ballona Creek Watershed

Project No. 2006-023.05

PLATE

B8

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	4 MLLW
LATITUDE:	33° 57' 52.7" N	**LONGITUDE:**	118° 26' 48.7" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	16.5
DATE STARTED:	2/18/09	**DATE COMPLETED:**	2/18/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				3 4 5	6		FAT CLAY (CH): olive brown, moist, medium stiff, high plasticity, micaceous		41	67	44	99	
				3 3 4	5		FAT CLAY with SAND (CH): grayish brown, moist, medium stiff, high plasticity, fine-grained sand, micaceous		36			80	
0	5			0 0 0	0		FAT CLAY (CH): olive gray, wet, very soft, high plasticity, trace shell fragments		71			97	
-5	10			1 2 3	3		dark gray, soft, no shell fragments		58	53	24	98	
				0 0 5	3		CLAYEY SAND (SC): gray, wet, very loose, fine-grained sand, trace shell fragments		40			36	
-10	15			4 11 23	22		dark gray, medium dense		26			16	
							Bottom of boring at 16.5 feet. Groundwater encountered at 5 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-15	20												
-20	25												
-25													

LOG OF BORING B-08

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PLATE
B9

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION: See Figure 2	**ELEVATION AND DATUM (feet):** 4 MLLW
LATITUDE: 33° 57' 55.3" N	**LONGITUDE:** 118° 26' 42.1" W
DRILLING EQUIPMENT: CME 750	**DRILLING METHOD:** Hollow Stem Auger
BORING DIAMETER (inches): 8	**BORING DEPTH (feet):** 16.5
DATE STARTED: 2/19/09	**DATE COMPLETED:** 2/19/09
SPT HAMMER DROP: 30 inches **WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches **WT:** 140 lbs
LOGGED BY: JMS **CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)** **ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				3 3 4	5		CLAYEY SAND (SC): dark grayish brown, wet, loose, fine- to coarse-grained sand						
							FAT CLAY (CH): dark brown, wet, soft, high plasticity		43	64	37	99	
0				1 2 2	3		gray		52	58	29	99	
	5						ELASTIC SILT (MH): dark gray, wet, soft, medium plasticity, micaceous						
				1 2 2	3				58			97	
-5				1 1 1	1		very soft		81			97	
	10						CLAYEY SAND (SC): very dark gray, wet, loose, fine-grained sand, few shell fragments, sulfur odor						
				2 3 7	6				37			35	
-10													
	15			2 3 7	6				25			14	
							Bottom of boring at 16.5 feet. Groundwater encountered at 0 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-15													
	20												
-20													
	25												
-25													

LOG OF BORING B-09

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PLATE
B10

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	8 MLLW
LATITUDE:	33° 58' 6.1" N	**LONGITUDE:**	118° 26' 28.6" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	16.5
DATE STARTED:	2/18/09	**DATE COMPLETED:**	2/18/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				1 1 2	2		SILT with SAND (ML): brown, moist, very soft, low plasticity, fine- to medium-grained sand, micaceous, trace roots		29			76	
5				1 4 4	5		FAT CLAY (CH): dark brown, moist, medium stiff, high plasticity, color gradient, soft white deposites throughout		54			93	
	5			3 3 4	5		SILT (ML): olive brown, wet, medium stiff, nonplastic		31	NP	NP	94	
0													
	10			2 2 3	3		LEAN CLAY (CL): olive brown, wet, soft, medium plasticity		59			100	
-5				1 1 2	2		SILT (ML): gray, wet, very soft, low plasticity		48	46	15	100	
	15			1 2 1	2		SANDY LEAN CLAY (CL): gray, wet, very soft, medium plasticity, fine-grained sand, few shell fragments, sulfur odor		48			52	
-10				3 5 9	9		POORLY GRADED SAND with SILT (SP-SM): gray, wet, loose, fine-grained sand, few shell fragments, strong sulfur odor		29			12	
	20						Bottom of boring at 19.5 feet. Groundwater encountered at 6 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-15													
	25												
-20													

LOG OF BORING B-10

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PLATE
B11

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION: See Figure 2	**ELEVATION AND DATUM (feet):** 6 MLLW
LATITUDE: 33° 57' 53.0" N	**LONGITUDE:** 118° 26' 26.3" W
DRILLING EQUIPMENT: CME 750	**DRILLING METHOD:** Hollow Stem Auger
BORING DIAMETER (inches): 8	**BORING DEPTH (feet):** 16.5
DATE STARTED: 2/19/09	**DATE COMPLETED:** 2/19/09
SPT HAMMER DROP: 30 inches **WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches **WT:** 140 lbs
LOGGED BY: JMS **CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)** **ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
5				1 2 2	3		LEAN CLAY (CL): brown, moist, soft, medium plasticity, some organics		37			90	
	5			2 2 2	3		ELASTIC SILT (MH): brownish gray, moist, soft, medium plasticity, trace shell fragments ▽ wet		72	80	40	96	
0				1 0 1	1		very soft, sulfur odor		58			91	
	10			0 1 1	1		dark gray		60	61	28	97	
-5									71			90	
	15			1 2 2	3		CLAYEY SAND (SC): very dark gray, wet, very loose, fine-grained sand, few shell fragments		54			45	
-10							Bottom of boring at 16.5 feet. Groundwater encountered at 5 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
	20												
-15													
	25												
-20													

LOG OF BORING B-11

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PLATE
B12

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	6 MLLW
LATITUDE:	33° 57' 58.3" N	**LONGITUDE:**	118° 26' 20.2" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	16.5
DATE STARTED:	2/20/09	**DATE COMPLETED:**	2/20/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
5				1 2 2	3		LEAN CLAY (CL): dark brown, moist, soft, medium plasticity, trace roots		49			98	
				3 3 4	5		ELASTIC SILT (MH): light gray, moist, medium stiff, medium plasticity, few shell fragments		45			97	
	5						▽ wet						
0				0 1 2	2		dark gray, very soft, trace shell fragments, sulfur odor		69			96	
	10			0 0 3	2		olive gray		84	52	13	95	
-5				1 1 1	1		dark gray		59			90	
	15			2 2 3	3		SANDY FAT CLAY (CH): gray, wet, soft, high plasticity, fine-grained sand, trace shell fragments, sulfur odor		56			56	
-10							Bottom of boring at 16.5 feet. Groundwater encountered at 5 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
	20												
-15													
	25												
-20													

LOG OF BORING B-12

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PLATE
B13

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	6 MLLW
LATITUDE:	33° 57' 42.6" N	**LONGITUDE:**	118° 26' 46.9" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	16.5
DATE STARTED:	2/19/09	**DATE COMPLETED:**	2/19/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
5				1 2 3	3		CLAYEY SAND (SC): brown, wet, very loose, fine- to medium-grained sand		17			21	
							FAT CLAY (CH): light gray, wet, soft, high plasticity						
	5			1 1 3	3				65			97	
0				0 0 1	1		very soft		56	60	29	96	
	10			1 0 1	1		trace shell fragments, sulfur odor		93			95	
-5				1 1 1	1		no shell fragments		65			99	
	15			1 1 2	2		CLAYEY SAND (SC): gray, wet, very loose, fine-grained sand		43			47	
-10							Bottom of boring at 16.5 feet. Groundwater encountered at 1 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
	20												
-15													
	25												
-20													

LOG OF BORING B-13

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USACE Ballona Creek Watershed
Project No. 2006-023.05

PLATE
B14

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	23 MLLW
LATITUDE:	33° 58' 43.6" N	**LONGITUDE:**	118° 25' 40.4" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	31.5
DATE STARTED:	2/18/09	**DATE COMPLETED:**	2/18/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				2 3 5	5		CLAYEY SAND (SC): brown, moist, loose, fine- to medium-grained sand, trace roots		15			37	
20				7 6 7	8		SILT with SAND (ML): dark brown, moist, medium stiff, nonplastic, fine- to medium-grained sand						
	5			2 2 2	3		LEAN CLAY (CL): grayish brown, moist, soft, medium plasticity		34	40	20	96	
15									34			90	
				3 4 5	6		SANDY LEAN CLAY (CL): gray, moist, medium stiff, medium plasticity, fine-grained sand		22			59	
	10			1 3 6	6		FAT CLAY (CH): gray, moist, medium stiff, high plasticity, sulfur odor, some white spots		46	75	47	92	
10													
	15			4 6 9	10		FAT CLAY with SAND (CH): gray, moist, stiff, high plasticity, fine-grained sand		27			83	
5				1 3 5	5		LEAN CLAY (CL): gray, moist, medium stiff, medium plasticity, micaceous		33			95	
	20			3 9 19	18		CLAYEY SAND (SC): dark gray, moist, medium dense, fine- to medium-grained sand ▽ wet		13			28	
0				9 12 14	17		POORLY GRADED SAND with CLAY and GRAVEL (SP-SC): dark gray, wet, medium dense, fine- to coarse-grained sand, fine to coarse gravel		12			7	
	25												
-5				4 13 16	19								

LOG OF BORING C-01

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USACE Ballona Creek Watershed

Project No. 2006-023.05

PLATE

B15

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				2 2 5	5		FAT CLAY (CH): gray, wet, medium stiff, high plasticity		34			99	
-10	35						Bottom of boring at 31.5 feet. Groundwater encountered at 23 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-15	40												
-20	45												
-25	50												
-30	55												
-35	60												
-40	65												
-45													

LOG OF BORING C-01

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USACE Ballona Creek Watershed

Project No. 2006-023.05

PLATE

B16

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION: See Figure 2	**ELEVATION AND DATUM (feet):** 19 MLLW
LATITUDE: 33° 58' 48.7" N	**LONGITUDE:** 118° 25' 37.0" W
DRILLING EQUIPMENT: CME 750	**DRILLING METHOD:** Hollow Stem Auger
BORING DIAMETER (inches): 8	**BORING DEPTH (feet):** 28.5
DATE STARTED: 2/17/09	**DATE COMPLETED:** 2/17/09
SPT HAMMER DROP: 30 inches **WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches **WT:** 140 lbs
LOGGED BY: JMS **CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)** **ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				5 10 11	14		CLAYEY SAND (SC): dark brown, moist, medium dense, fine- to coarse-grained sand, trace fine gravel, trace roots		12			42	
				6 4 4	5		POORLY GRADED SAND with SILT (SP-SM): brown, moist, loose, fine- to medium-grained sand						
15	5						FAT CLAY (CH): olive brown, moist, medium stiff, high plasticity, trace roots						
				3 3 4	5		no roots, some oxidation		45	57	36	98	
10	10			3 4 4	5		gray		48			96	
				4 5 7	8		CLAYEY SAND (SC): very dark brown, moist, loose, fine-grained sand		18			23	
5	15			5 5 11	10		SANDY LEAN CLAY (CL): very dark gray, moist, stiff, medium plasticity, fine-grained sand, some oxidation		20			52	
				3 4 11	10		dark gray		19			52	
0	20						▽ wet						
				2 4 15	12		olive brown, fine- to medium-grained sand						
-5	25			5 6 17	15		POORLY GRADED SAND with CLAY (SP-SC): dark grayish brown, moist, medium dense, fine- to coarse-grained sand, trace fine gravel		19			7	
				8 9 14	15				14			7	
-10							Bottom of boring at 28.5 feet. Groundwater encountered at 20 ft below ground surface.						

LOG OF BORING C-02

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USACE Ballona Creek Watershed

Project No. 2006-023.05

PLATE

B17

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
							Boring backfilled with bentonite chips then cuttings.						
-15	35												
-20	40												
-25	45												
-30	50												
-35	55												
-40	60												
-45	65												
-50													

LOG OF BORING C-02

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USACE Ballona Creek Watershed
Project No. 2006-023.05

PLATE
B18

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	23 MLLW
LATITUDE:	33° 58' 45.3" N	**LONGITUDE:**	118° 25' 44.7" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	34.5
DATE STARTED:	2/17/09	**DATE COMPLETED:**	2/17/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				4 8 15	15		SANDY LEAN CLAY (CL): brown, moist, very stiff, medium plasticity, fine- to coarse-grained sand, trace concrete pieces - FILL		17			61	
20				8 22 50/5"	53		hard, trace organics		16			61	
	5			5 4 4	5		FAT CLAY (CH): olive brown, moist, medium stiff, high plasticity, some oxidation, micaceous		46			97	
15				2 3 5	5		SANDY LEAN CLAY (CL): olive brown, moist, medium stiff, medium plasticity, fine-grained sand		23			57	
	10			1 2 3	3		soft		23			52	
10							FAT CLAY (CH): gray, moist, soft, high plasticity						
	15			1 2 3	3				51	53	26	100	
				5 12 15	18		CLAYEY SAND (SC): reddish brown, moist, medium dense, fine- to medium-grained sand, trace fine gravel		14			46	
5	20						▽ wet						
				2 11 13	16		POORLY GRADED SAND with GRAVEL (SP): dark gray, wet, medium dense, fine- to coarse-grained sand, fine to coarse gravel		15			3	
0				5 8 13	14		POORLY GRADED SAND with CLAY and GRAVEL (SP-SC): dark gray, wet, medium dense, fine- to coarse-grained sand, fine to coarse gravel		13			9	
	25			2 2 4	4		LEAN CLAY with SAND (CL): olive brown, wet, soft, medium plasticity, fine-grained sand		27			71	
-5													

LOG OF BORING C-03

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USACE Ballona Creek Watershed

Project No. 2006-023.05

PLATE

B19

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				3 4 3	5		SANDY LEAN CLAY (CL): olive brown, wet, medium stiff, medium plasticity, fine-grained sand		23			53	
-10				2 2 2	3		SILT (ML): olive brown, wet, soft, nonplastic		38	NP	NP	99	
	35						Bottom of boring at 34.5 feet. Groundwater encountered at 20 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-15													
	40												
-20													
	45												
-25													
	50												
-30													
	55												
-35													
	60												
-40													
	65												
-45													

LOG OF BORING C-03

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USACE Ballona Creek Watershed

Project No. 2006-023.05

PLATE

B20

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	17 MLLW
LATITUDE:	33° 58' 45.8" N	**LONGITUDE:**	118° 25' 56.7" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	25.5
DATE STARTED:	2/23/09	**DATE COMPLETED:**	2/23/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				2 5 11	10		POORLY GRADED SAND with CLAY and GRAVEL (SP-SC): brown, moist, loose, fine- to coarse-grained sand, fine gravel		4			5	
15				6 8 8	10				8			11	
	5						SANDY LEAN CLAY (CL): brown, moist, stiff, medium plasticity, fine-grained sand		18			60	
10				1 3 4	5		CLAYEY SAND (SC): gray, moist, loose, fine-grained sand		23			44	
	10			5 10 13	15		SANDY FAT CLAY (CH): dark gray, moist, very stiff, high plasticity, fine- to coarse-grained sand		20			57	
5				3 4 6	6		ELASTIC SILT (MH): light gray, moist, medium stiff, medium plasticity		38	54	23	95	
	15			3 6 7	8		SANDY FAT CLAY (CH): gray, moist, medium stiff, high plasticity, fine- to coarse-grained sand, trace fine gravel		23			60	
0				2 2 6	5		▽ wet, some oxidation		22			68	
	20			1 3 4	5		SANDY SILT (ML): olive brown, wet, medium stiff, low plasticity, fine-grained sand		23			61	
-5				1 3 5	5		SILT with SAND (ML): brownish gray, wet, medium stiff, nonplastic, fine-grained sand		24	NP	NP	79	
	25						Bottom of boring at 25.5 feet. Groundwater encountered at 18 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-10													

LOG OF BORING C-04

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USACE Ballona Creek Watershed

Project No. 2006-023.05

PLATE

B21

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	17 MLLW
LATITUDE:	33° 58' 49.2" N	**LONGITUDE:**	118° 25' 49.1" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	25.5
DATE STARTED:	2/23/09	**DATE COMPLETED:**	2/23/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
15				3 10 13	15		SANDY LEAN CLAY (CL): dark brown, moist, very stiff, medium plasticity, fine- to coarse-grained sand, trace roots		21			65	
				4 5 6	7		POORLY GRADED SAND with SILT and GRAVEL (SP-SM): olive brown, moist, medium dense, fine- to coarse-grained sand, fine to coarse gravel		16			25	
	5						SILTY SAND (SM): dark gray, moist, loose, fine- to coarse-grained sand, trace fine to coarse gravel, trace shell fragments						
10				3 5 4	6		CLAYEY SAND (SC): very dark grayish brown, moist, loose, fine-grained sand, micaceous		25			38	
	10			3 6 10	10		FAT CLAY (CH): very dark gray, moist, stiff, high plasticity						
5				3 6 9	10		SANDY LEAN CLAY (CL): gray, moist, stiff, medium plasticity, fine-grained sand, some oxidation		19			57	
	15			4 5 13	12		SILTY SAND with GRAVEL (SM): olive brown, moist, medium dense, fine- to coarse-grained sand, fine to coarse gravel		15			21	
0							▽						
				2 3 11	9		POORLY GRADED SAND (SP): dark grayish brown, wet, loose, fine- to coarse-grained sand						
	20			3 3 3	4		very loose						
-5							SILT (ML): brown, wet, medium stiff, low plasticity						
	25			4 7 6	8				43	47	19	99	
-10							Bottom of boring at 25.5 feet. Groundwater encountered at 17 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						

LOG OF BORING C-05

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USACE Ballona Creek Watershed

Project No. 2006-023.05

PLATE

B22

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	17 MLLW
LATITUDE:	33° 58' 42.1" N	**LONGITUDE:**	118° 25' 58.5" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	28.5
DATE STARTED:	2/20/09	**DATE COMPLETED:**	2/20/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				1 3 4	5		POORLY GRADED SAND with GRAVEL (SP): brown, moist, loose, fine- to coarse-grained sand, fine to coarse gravel, trace shell fragments, trace roots		4			3	
15				4 7 5	8		POORLY GRADED SAND with SILT and GRAVEL (SP-SM): dark gray, moist, loose, fine- to coarse-grained sand, fine to coarse gravel		4			5	
	5			5 6 7	8		POORLY GRADED SAND with GRAVEL (SP): grayish brown, moist, loose, fine- to coarse-grained sand, fine gravel		2			2	
10				3 3 4	5		LEAN CLAY (CL): olive brown, moist, medium stiff, medium plasticity		30			91	
	10			2 2 4	4		FAT CLAY (CH): light gray, moist, soft, high plasticity, brown spots		43	57	35	98	
5													
	15			2 3 5	5		medium stiff, oxidation spots, micaceous		39			100	
0				1 2 3	3		▽ SANDY LEAN CLAY (CL): dark gray, wet, soft, medium plasticity, fine- to medium-grained sand		29	42	23	70	
	20			2 4 6	6		medium stiff		22			62	
-5													
	25			3 5 7	8		SANDY FAT CLAY (CH): gray, wet, medium stiff, high plasticity, fine-grained sand		22			55	
-10				5 7 8	10		CLAYEY SAND (SC): gray, wet, loose, fine-grained sand, trace shell fragments, trace roots		23			21	
							Bottom of boring at 28.5 feet. Groundwater encountered at 17 ft below ground surface.						

LOG OF BORING C-06

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USACE Ballona Creek Watershed

Project No. 2006-023.05

PLATE

B23

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
							Boring backfilled with bentonite chips then cuttings.						
-15													
	35												
-20													
	40												
-25													
	45												
-30													
	50												
-35													
	55												
-40													
	60												
-45													
	65												
-50													

LOG OF BORING C-06

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Project No. 2006-023.05

PLATE
B24

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	17 MLLW
LATITUDE:	33° 58' 41.4" N	**LONGITUDE:**	118° 26' 3.8" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	28.5
DATE STARTED:	2/20/09	**DATE COMPLETED:**	2/20/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
15				1 1 2	2		SILTY SAND (SM): brown, moist, very loose, fine- to medium-grained sand, trace fine gravel, trace roots		7			15	
				2 2 5	5		SILTY SAND with GRAVEL (SM): brown, moist, loose, fine- to coarse-grained sand, fine to coarse gravel		8			15	
10	5			3 5 6	7		FAT CLAY with SAND (CH): dark gray, moist, medium stiff, high plasticity, fine-grained sand, micaceous		30			75	
							SILT (ML): dark gray, moist, medium stiff, low plasticity						
	10			3 5 7	8				31	49	13	92	
5							FAT CLAY (CH): dark gray, moist, soft, high plasticity, some oxidation spots						
				2 2 3	3				42			88	
							SILT with SAND (ML): light gray, moist, soft, low plasticity, fine-grained sand						
	15			1 3 3	4								
0							▽ wet						
				0 0 1	1		very soft		51			71	
	20						FAT CLAY with SAND (CH): dark gray, wet, very soft, high plasticity, fine-grained sand						
-5				1 4 5	6		medium stiff		27	51	33	74	
							SANDY FAT CLAY (CH): dark gray, wet, medium stiff, high plasticity, fine-grained sand						
	25			2 4 3	5				23			62	
-10							CLAYEY SAND (SC): gray, wet, loose, fine- to medium-grained sand						
				3 5 5	6				20			31	
							Bottom of boring at 28.5 feet. Groundwater encountered at 17 ft below ground surface.						

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USACE Ballona Creek Watershed

Project No. 2006-023.05

PLATE

B25

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
-15	35						Boring backfilled with bentonite chips then cuttings.						
-20	40												
-25	45												
-30	50												
-35	55												
-40	60												
-45	65												
-50													

LOG OF BORING C-07

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USACE Ballona Creek Watershed
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PLATE
B26

BORING 1

DATE DRILLED: June 19, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 13*

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10	0		5.0	105	3		SP	FILL - SAND - fine, some Clay and Gravel, light greyish brown
			18.8	86	2			
	5		20.1	89	4			▼ SURFACE OF NATURAL SOIL
5			23.4	101	2		ML	CLAYEY SILT - greyish brown
	10						CL	SILTY CLAY - brownish grey
		4						
0			48.3	74	<1		MH	ELASTIC SILT - light brown
	15							(LL = 64; PI = 31)
		1						
-5								
	20		53.4	68	1			Few seashells, grey
		7					ML	SANDY SILT - dark grey
-10								
	25		18.8	112	7			
-15								Layer of well graded Sand
		15						
	30		17.4	112	10			
-20								
	35	4						
-25			23.0	106	5		MH	ELASTIC SILT - dark grey
	40							

* Elevations refer to datum of reference survey; see Plate 1.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LAW/CRANDALL, INC.

BORING 1 (Continued)

DATE DRILLED: June 19, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.	
-30	45		49.3	73	2		Layer of Peat
-35		9					
	50		18.3	112	33	SP	SAND - fine, about 10% Gravel, dark grey
-40		72				SW	SAND - well graded, about 20% Gravel, grey
	55		8.0	137	33		
-45							
	60		10.2	123	33		Some Clayey Silt

NOTE: Drilling mud used in drilling process. Mud removed to 30' at completion of drilling. Water level measured at 12-1/2' after removal of mud; bottom of boring at 21'. Boring grouted.

JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD FH

Note: The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A2-162 1.1b

BORING 2

DATE DRILLED: June 20, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 12

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10	0		16.0	83	5		CL	SILTY CLAY - dark grey
			30.7	88	2			
5	5		27.3	93	3			
			17.8	110	8			
0	10	11					ML	CLAYEY SILT - grey
			21.9	106	2			
-5	15	17					SM	SILTY SAND - fine, about 10% Gravel, brown
	20		28.6	95	3		ML	SANDY SILT - grey
-10		8					ML	CLAYEY SILT - grey
	25		31.7	92	3			
-15		6					CL	SILTY CLAY - grey
	30		31.8	93	6			Layer of Sandy Silt, dark grey
-20		10						
	35		35.0	86	4			
-25	40							

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LAW/CRANDALL, INC.

BORING 2 (Continued)

DATE DRILLED: June 20, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-30	45	22	23.5	105	12		ML	SANDY SILT - brownish grey
-35	50	73	12.2	128	21		SW	SAND - well graded, about 20% Gravel, greyish brown
-40	55	52						Layer of well graded Gravel
-45	60		13.1	117	36			
			10.1	121	36			Yellowish brown

NOTE: Drilling mud used in drilling process. Mud removed to 30' at completion of drilling. Water level measured at 15' 15 minutes after removal of mud; bottom of boring at 21'. Boring grouted.

JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

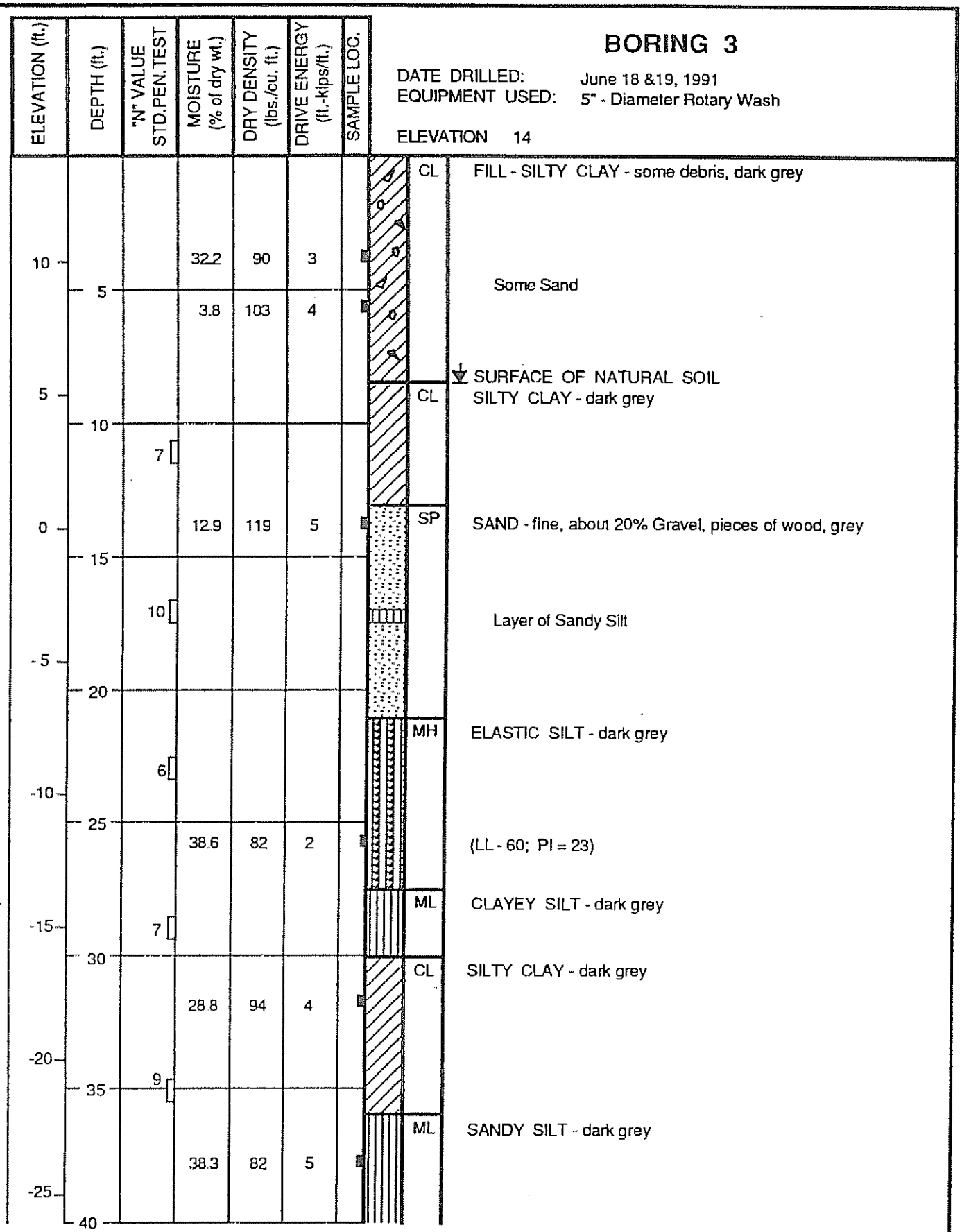
LAW/CRANDALL, INC.

PLATE A-1.2b

BORING 3

DATE DRILLED: June 18 &19, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 14



Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LAW/CRANDALL, INC.

BORING 3 (Continued)

DATE DRILLED: June 18 &19, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD FH

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
		27					SP	SAND - fine, grey
-30	45		14.6	121	23			
		65						Fine to coarse Sand, about 20% Gravel
-35	50		13.0	125	36			
-40		95 (10" pen)						
	55		6.4	118	33		SW	SAND - well graded, about 20% Gravel, grey
-45								
	60		8.9	126	30			

NOTE: Drilling mud used in drilling process. Mud removed to 30' at completion of drilling. Water level measured at 15-1/2' after removal of mud; bottom of boring at 26'. Boring grouted.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

BORING 4

DATE DRILLED: June 17, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 20

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
			10.5	118	6		SP SM	FILL - SAND and SILTY SAND - fine, brown
			19.3	103	4		ML	FILL - CLAYEY SILT - greyish brown
15	5		24.3	98	2			
			15.8	103	2		SM	FILL - SILTY SAND - fine, greyish brown
								▽ SURFACE OF NATURAL SOIL
10	10	2					ML	CLAYEY SILT - dark grey
			34.9	86	2			
5	15	6						
			36.3	84	2			
0	20	1						
-5	25		23.2	104	2		CL	SILTY CLAY - some Sand, greyish brown (LL = 30; PI = 12)
		2						
-10	30						SP	SAND - fine, dark grey
			18.4	112	15			
-15	35	11						
							MH	ELASTIC SILT - grey
			33.9	89	8			
-20	40							

(CONTINUED ON FOLLOWING PLATE)

JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

BORING 4 (Continued)

DATE DRILLED: June 17, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD

Note: The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
			26.2	100	4		ML	CLAYEY SILT - grey
-25	45	13						
-30	50		19.1	114	8		SP	SAND - fine, dark grey
		19					ML	SANDY SILT - dark grey
-35	55		23.8	102	5			
							SP	SAND - fine, grey
-40	60		14.4	118	15			
								About 20% Gravel, few Cobbles (to 6" in size)
-45	65							
-50	70		22.2	106	36			No Gravel
	75		7.9	130	36			

NOTE: Drilling mud used in drilling process. Mud removed to 30' at completion of drilling. Water level measured at 22-1/2' 15 minutes after removal of mud; bottom of boring at 34'. Boring grouted.

LOG OF BORING

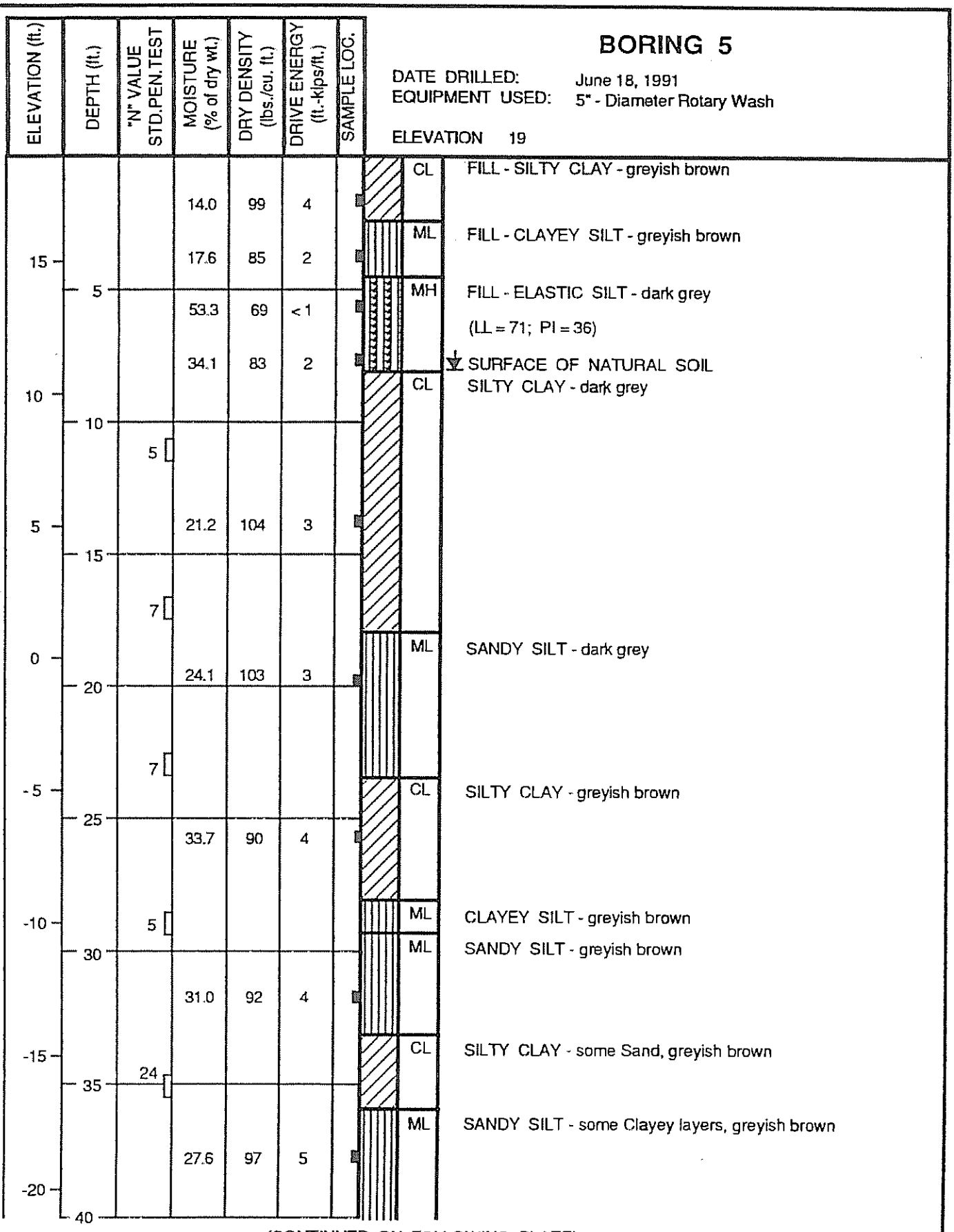
LAW/CRANDALL, INC.

Area C - Law Crandall Borings

BORING 5

DATE DRILLED: June 18, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 19



(CONTINUED ON FOLLOWING PLATE)

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD

LOG OF BORING

LAW/CRANDALL, INC.

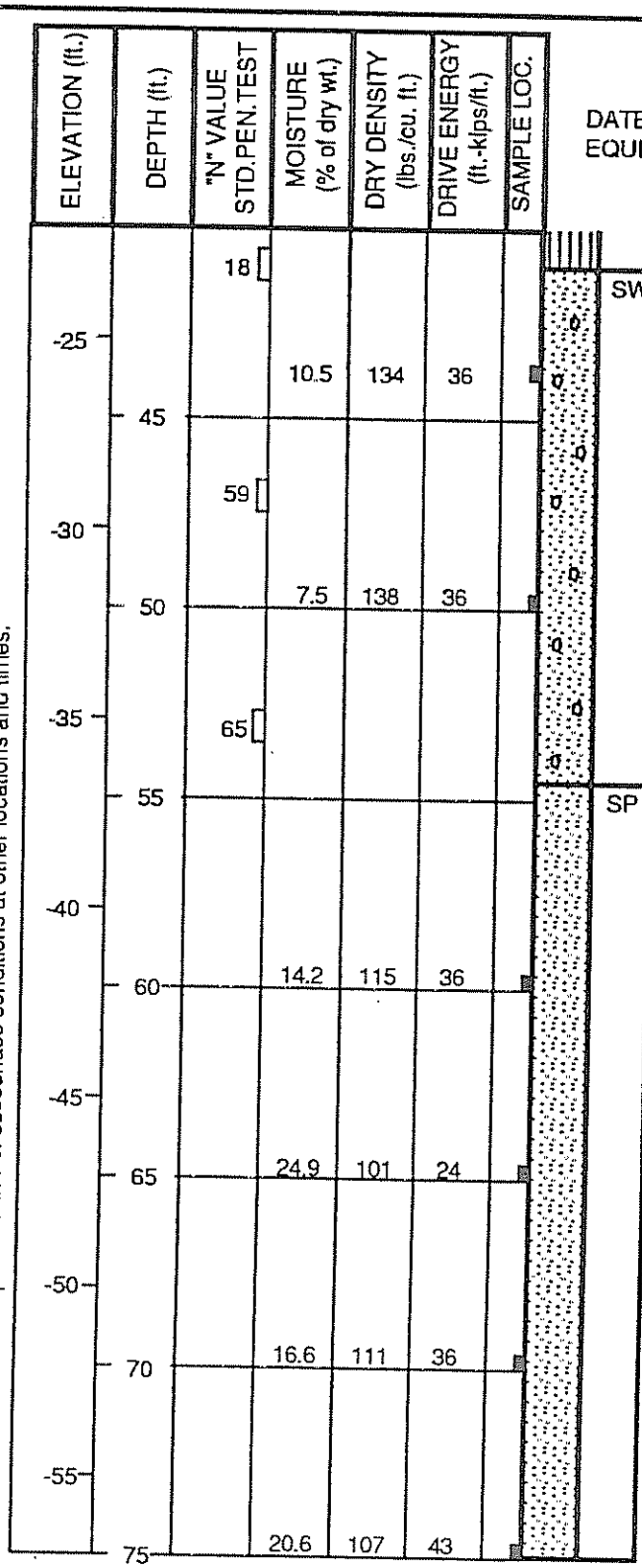
Area C - Law Crandall Borings

PLATE A2-169.1.5a

JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD

BORING 5 (Continued)

DATE DRILLED: June 18, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash



SW SAND - well graded, about 30% Gravel, brown

Dark grey

SP SAND - fine, grey

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

NOTE: Drilling mud used in drilling process. Mud removed to 40' at completion of drilling. Water level measured at 22-1/2' 15 minutes after removal of mud; bottom of boring at 44'. Boring grouted.

LOG OF BORING

Area C - Law Crandall Borings

LAW / CRANDALL, INC.

B1-709

PLATE A2 170

PLATE A - 1.5b

JOB F-88218 DATE 7/6/88 F.T. ____ DR. ____ lp ____ S.G. ____ FB ____ W.P. ____ lp ____ CHKD ____

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING B - 1

DATE DRILLED: June 21, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						SP, CL, ML
10						SM
15						

SP FILL - GRAVELLY SAND - moist, fine to coarse grained Sand, brown

CL SILTY CLAY - very moist, blackish grey with lenses of brownish grey Clayey Silt

ML CLAYEY SILT - very moist, multicolored grey and greyish brown

SM SILTY SAND - very moist to wet, fine grained, reddish brown mottled with greenish grey

NOTE: Total depth 10'. Ground water level not encountered.

BORING B - 2

DATE DRILLED: June 21, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						SM, SP
10						
15						

SM FILL - SILTY SAND - moist, fine to coarse grained Sand, some blackish grey Silty Clay lumps

Mostly fine to medium grained Sand

SP POORLY GRADED SAND - wet, fine to coarse grained Sand, some blackish grey lumps
No sample recovered, possibly sampling on top of Cobbles

NOTE: Total depth 10'. Ground water level not encountered.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - A

JOB F-88218 DATE 7/6/88 F.T. ____ DR. ____ lp ____ S.G. ____ FB ____ W.P. ____ lp ____ CHKD ____

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING B - 3

DATE DRILLED: June 21, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						
10						
15						

ML FILL - GRAVELLY SILT - moist, Sandy, brown

SP POORLY GRADED SAND - moist, fine to medium grained Sand, brown

Wet

NOTE: Total depth 7'. Ground water level not encountered.

BORING B - 4

DATE DRILLED: June 21, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						
10						
15						

SM FILL - SILTY SAND - moist, fine grained, greyish brown

MH CLAYEY SILT - wet, greenish grey

▽ WATER LEVEL
Wet to saturated

NOTE: Total depth 7'. Ground water level at 7'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - B

JOB F-88218 DATE 7/6/88 F.T. ____ DR. ____ lp ____ S.G. ____ FB ____ W.P. ____ lp ____ CHKD ____

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING B - 5

DATE DRILLED: June 22, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						ML, CL
10						
15						

ML — FILL - CLAYEY SILT - very moist, greyish brown

Very moist to wet

CL — SILTY CLAY - wet with vertical 0.01' thick Silty fine Sand lense

Wet to saturated

NOTE: Total depth 10'. Ground water level not encountered.

BORING B - 6

DATE DRILLED: June 22, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						SP
10						
15						

SP — FILL - SAND - very moist, gravelly, fine to coarse grained Sand, brown

Mostly fine to coarse grained Sand, wet

Saturated at 5.5'

NOTE: Total depth 6'. Saturated at 5.5'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - C

JOB F-88218 DATE 7/6/88 F.T. DR. lp S.G. FB W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING B - 7

DATE DRILLED: June 22, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						
10						
15						

SM — FILL - SILTY SAND - moist, fine grained, some fine Gravel and Clay lumps

MH — CLAYEY SILT - very moist to wet, some seashells

SM — SILTY SAND - wet, fine grained, brownish grey

ML — SANDY SILT - wet, fine grained, brownish grey

▽

NOTE: Total depth 15'. Ground water level at 13'.

BORING B - 8

DATE DRILLED: June 22, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						
10						
15						

SP — FILL - SAND - very moist, fine to coarse Sand with some Clay lumps, brown, locally with Gravel

Very moist to wet

ML — CLAYEY SILT - wet, dark greenish grey

Wet to saturated

NOTE: Total depth 15'. Ground water not encountered. Sloughing from 13' to 15'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - D

JOB F-88218 DATE 7/6/88 F.T. DR. lp S.G. FB W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING B - 9

DATE DRILLED: June 23, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						
10						
15						

SM — FILL - SILTY SAND - dry to moist, fine to coarse Sand, brown to reddish brown

Very moist, fine to medium grained, thin lenses of blackish grey Silty Clay

SP — SAND - wet, predominately fine grained Sand

SM — SILTY SAND - wet, fine grained Sand, dark greenish grey

NOTE: Total depth 15'. Ground water level not encountered.

BORING B - 10

DATE DRILLED: June 23, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						
10						
15						

SM — FILL - SILTY SAND - moist, fine grained, some seashells

Abundant seashells, Clay lumps

Very moist to wet, brownish grey

Color change to dark greenish grey at 9.75'.

NOTE: Total depth 15'. Ground water level not encountered.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - E

JOB F-88218 DATE 7/6/88 F.T. ____ DR. ____ lp ____ S.G. ____ FB ____ W.P. ____ lp ____ CHKD ____

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING B - 11

DATE DRILLED: June 23, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						SM
10						
15						

FILL - SILTY SAND - moist, fine grained, abundant seashells, brownish grey

Very moist, abundant seashells, some blackish grey Clay lumps, fine to coarse grained Sand

Very moist, fine grained Sand

Very moist to wet, dark greenish grey

NOTE: Total depth 15'. Ground water level not established.

BORING B - 12

DATE DRILLED: June 21, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						SM
10						CL
15						

3" Thick Asphaltic Paving
FILL - SILTY SAND - dry, fine grained, reddish brown

Very moist, fine to medium grained Sand

SILTY CLAY - wet, grey mottled with dark greenish grey and greyish brown

Wet, grey mottled with greyish brown

NOTE: Total depth 15'. Ground water level not encountered.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - F

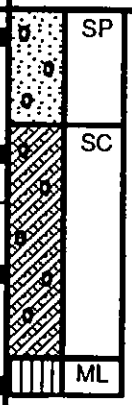
JOB F-88218 DATE 7/6/88 F.T. ____ DR. ____ lp ____ S.G. FB ____ W.P. ____ lp ____ CHKD ____

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING B - 13

DATE DRILLED: June 23, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						
10						
15						



SP — FILL - SILTY SAND - moist, Gravelly, fine to coarse grained Sand, reddish brown

SC — CLAYEY SAND - very moist, fine to medium grained Sand, some Gravel, reddish brown

Very moist to wet, some dark greenish grey Clay lumps

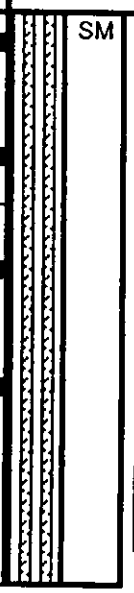
ML — CLAYEY SILT - wet, dark greenish grey

NOTE: Total depth 10'. Ground water level not encountered.

BORING B - 14

DATE DRILLED: June 23, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						
10						
15						



SM — FILL - SILTY SAND - dry to moist, Clayey, brown

Very moist, fine to medium Sand, some seashells

NOTES: Total depth 15'. Ground water level not encountered.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - G

JOB F-88218 DATE 7/6/88 F.T. DR. lp S.G. FB W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING B - 15

DATE DRILLED: June 27, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						
10						
15						

ML FILL - CLAYEY SILT - moist, Gravelly, about 10% concrete fragments and glass, greyish brown

SM FILL - SILTY SAND - moist, fine grained, about 5% concrete fragments, greyish brown

CL SILTY CLAY - very moist, greenish grey

Very moist, dark grey mottled with brownish grey

NOTE: Total depth 15'. Ground water level not encountered.

BORING B - 16

DATE DRILLED: June 27, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						
10						
15						

ML FILL - SANDY SILT - moist, fine, reddish brown

Moist to very moist, Gravelly, brown

Very moist, brown grading to blackish and greenish grey

CL SILTY CLAY - wet, dark greenish grey

NOTE: Total depth 15'. Wet below 10'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

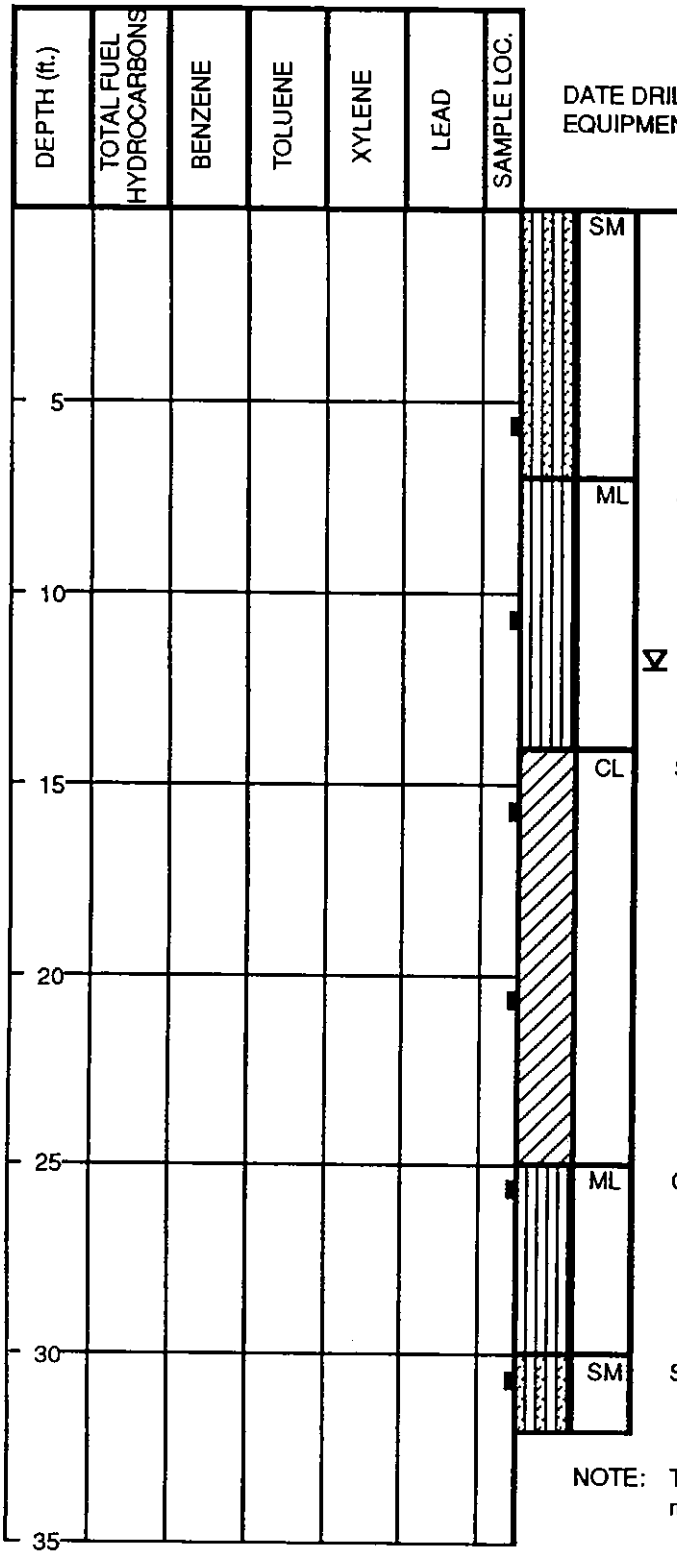
PLATE 2 - H

BORING MW - 1

DATE DRILLED: June 22, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

JOB F-88218 DATE 7/5/88 F.T. DR. lp S.G. FB W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.



SM	FILL - SILTY SAND - moist to very moist, fine to medium grained, brown	
	Very moist	
ML	SANDY SILT - very moist to wet, fine grained, greyish brown	▽
CL	SILTY CLAY - saturated, grey mottled with brown	
	Saturated, dark grey with abundant seashells	
ML	CLAYEY SILT - saturated, dark greenish grey	
SM	SILTY SAND - saturated, fine, slightly Clayey, dark greenish grey	

NOTE: Total depth 32'. Ground water level at 12'. Converted into monitoring well.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2-1

BORING MW - 2

DATE DRILLED: June 27, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

JOB F-88218 DATE 7/5/88 F.T. ____ DR. ____ lp ____ S.G. FB ____ W.P. ____ lp ____ CHKD ____

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.		
5							SM	FILL - SILTY SAND - dry to moist, fine, brownish grey to greenish grey
								Moist, greenish grey
10							CL	SILTY CLAY - very moist, dark grey
15							CL	SILTY CLAY - very moist, dark greenish grey mottled with reddish brown
20							SM	SILTY SAND - wet to saturated, fine to medium grained Sand, grey
25							SP	SAND - saturated, fine to coarse grained Sand, gravelly, dark grey
30								
35								
40								Clayey, grey

NOTE: Total depth 40.5'. Ground water level at 18.5'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

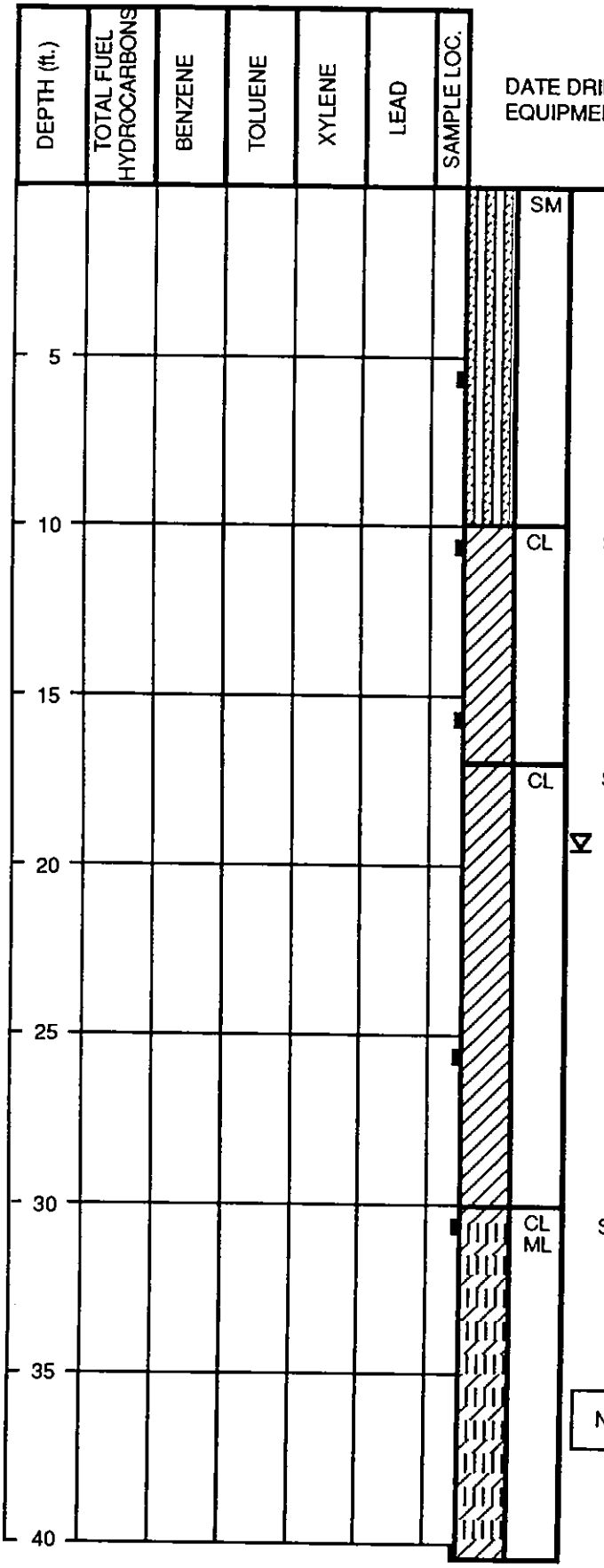
PLATE 2 - J

BORING MW - 3

DATE DRILLED: June 22, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

JOB F-88218 DATE 7/5/88 F.T. ____ DR. ____ lp ____ S.G. FB ____ W.P. ____ lp ____ CHKD ____

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.



SM — FILL - SILTY SAND - dry to moist, fine grained, greyish brown to dark greenish grey

Moist, about 30% seashells, and 5% Clay lumps

CL — SILTY CLAY - very moist, dark grey

Siltier

CL — SILTY CLAY - wet to saturated, dark greenish grey

▽

CL ML — SILTY CLAY/CLAYEY SILT - saturated, dark greenish grey

NOTE: Total depth 40.5'. Ground water level at 19.5'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - K

BORING MW - 4

DATE DRILLED: June 28, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						
10						
15						
20						
25						
30						
35						



ML — FILL - SANDY SILT - dry to moist, fine grained, brownish grey

ML — CLAYEY SILT - moist to very moist, dark greenish grey

SP — GRAVELLY SAND - saturated, fine to coarse grained Sand, dark greenish grey to grey

SM — SILTY SAND - saturated, fine grained, dark greenish grey

CL — SILTY CLAY - saturated, greenish grey

NOTE: Total depth 30.5'. Ground water level at 11'.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

Job F-88218 DATE 7/5/88 F.T. ____ DR. ____ lp ____ S.G. FB ____ W.P. ____ lp ____ CHKD ____

LOG OF BORING

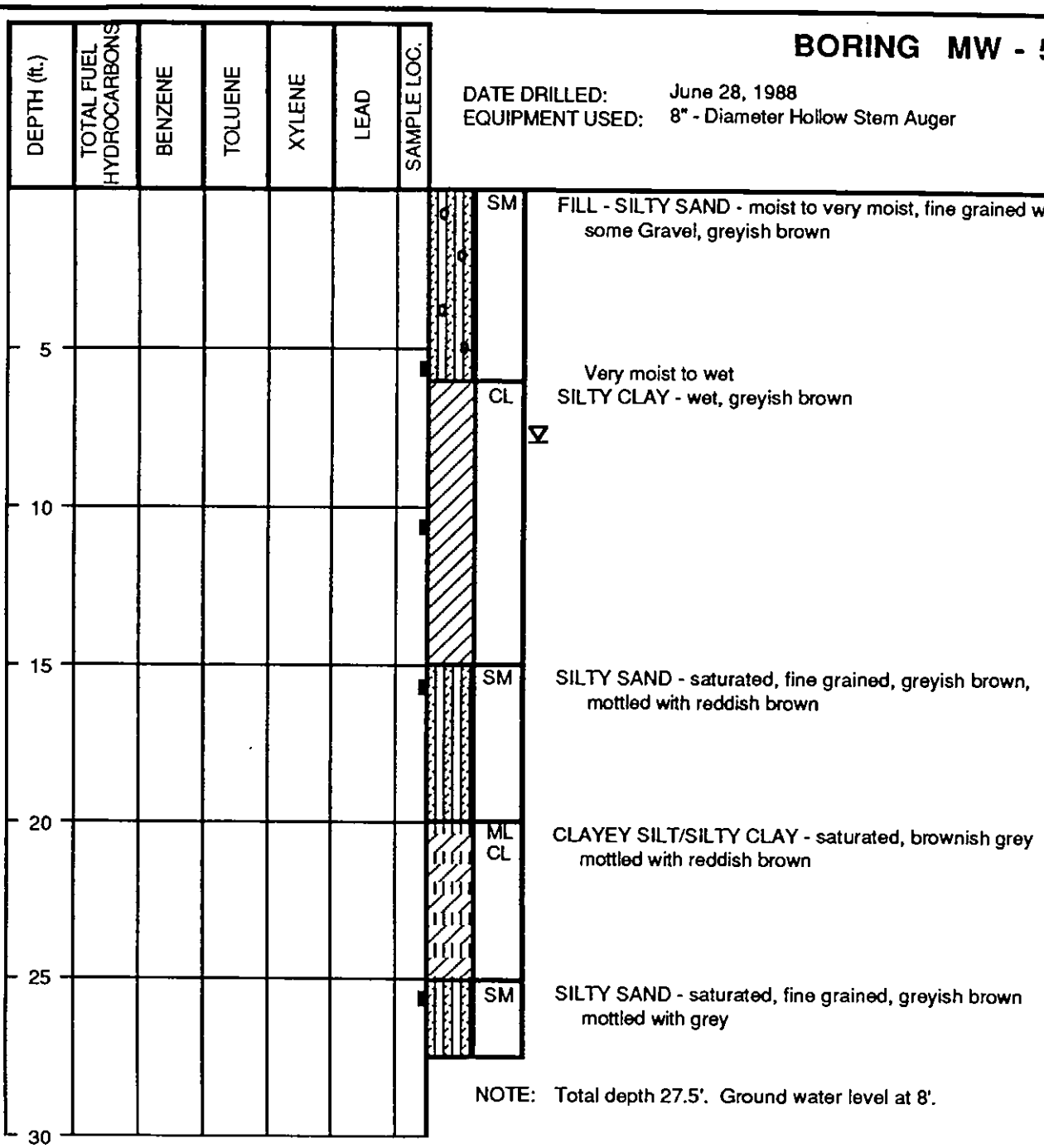
LeROY CRANDALL AND ASSOCIATES

PLATE 2 - L

JOB F-88218 DATE 7/5/88 F.T. ____ DR. ____ lp ____ S.G. FB ____ W.P. ____ lp ____ CHKD ____

BORING MW - 5

DATE DRILLED: June 28, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger



FILL - SILTY SAND - moist to very moist, fine grained with some Gravel, greyish brown

Very moist to wet
SILTY CLAY - wet, greyish brown

SILTY SAND - saturated, fine grained, greyish brown, mottled with reddish brown

CLAYEY SILT/SILTY CLAY - saturated, brownish grey mottled with reddish brown

SILTY SAND - saturated, fine grained, greyish brown mottled with grey

NOTE: Total depth 27.5'. Ground water level at 8'.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - M

APPENDIX B1
GDC LABORATORY TESTING

APPENDIX B1
LABORATORY TESTING

B1.1 General

The laboratory testing program performed for this investigation by GDC included determination of Moisture Content, Dry Unit Weight, Atterberg Limits, Consolidation, Pocket Penetrometer, Laboratory Vane Shear, Direct Shear, Expansion Index, Corrosivity, Compaction, and Grain Size/Percent Passing No. 200 Sieve. Descriptions of these tests are given below.

B1.2 Moisture Content and Dry Unit Weight

The natural moisture content and dry unit weight of California ring samples were determined in general accordance with ASTM D 2216 and ASTM D2937. Results of these tests are presented on the boring logs in Appendix A1.

B1.3 Atterberg Limits

Soil plasticity was evaluated by measuring the Atterberg limits. This test includes Liquid Limit (LL) and Plastic Limit (PL) tests to determine the Plasticity Index (PI) in accordance with ASTM D4318. Results of these tests are illustrated in the plasticity charts shown in Figures B1-1a to B1-1p and are presented on the boring logs in Appendix A1.

B1.4 Grain Size Distribution and Percent Passing No. 200 Sieve:

Representative samples were dried, weighed, soaked in water until individual soil particles were separated, and then washed on the No. 200 sieve. The percentage of fines (soil passing No. 200 sieve) was determined for selected samples in accordance with ASTM D 1140. For selected samples the washed fraction retained on the No. 200 sieve was then screened on a No. 4 sieve, and the fraction retained on No. 4 was weighed to determine the percentage of gravel. For selected samples, the washed material retained on No. 200 sieve was shaken through a standard stack of sieves in accordance with ASTM D 422 to determine the grain size distribution. The results of grain size distribution tests are plotted in Figures B1-4a through B1-4b of this appendix. The relative proportion (or percentage) by dry weight of fines (passing No. 200 sieve) are listed on the boring records in Appendix A1.

B1.5 Consolidation

The consolidation characteristics of the foundation soils were determined by performing one-dimensional consolidation in general accordance with ASTM D2435, using a floating ring consolidometer and dead weight system. Results of these tests are presented in Figures B1-2a to B1-2t.

B1.6 Direct Shear Test

To determine the shear strength parameters of the on-site soils, direct shear tests were performed on selected undisturbed drive samples in accordance with ASTM D 3080. After the initial weight and volume measurements were made, the sample was placed in a calibrated shear machine and a selected normal load was applied. The samples were submerged, allowed to consolidate, and then were sheared to failure. Shear stress and sample deformation were monitored throughout the test. The process was repeated under two additional normal loads. The test results are graphically presented in Figures B1-3a and B1-3t.

B1.7 Pocket Penetrometer

Undrained shear strengths (S_u) of cohesive samples were measured using a pocket penetrometer. The measured S_u values (in ksf) are presented in the boring logs of Appendix A1.

B.7 Miniature Vane Shear

Shear strength of selected cohesive samples was estimated in the laboratory in general accordance with ASTM D 4648 using a Geonor™ Inspection Vane Tester H-60 Miniature Vane Shear device with a 16 x 32 mm vane having an area ratio of 14%, respectively. The test consists of inserting the miniature shear vane into the soil sample, rotating the vane at a constant rate until the cylindrical surface surrounding the vane fails in shear, measuring the maximum torque exerted on the vane during testing, and calculating the unit shearing resistance on the cylindrical surface. Undrained shear strengths measured in the test are presented in the boring logs of Appendix A1.

B1.8 Soil Expansion Index

A silty sand sample of near surface soil in boring B-RW049 was collected from the site and tested to determine the expansion index. Testing was performed according to ASTM D4829. The results of these tests are presented in Table B1-1.

B1.9 Soil Corrosivity

Corrosivity testing included performing soil pH and resistivity (Caltrans Test Method 643), water-soluble chlorides (ASTM D512), and water soluble sulfates (ASTM D516). The test results are summarized in Table B1-2.

B1.10 Compaction

Compaction testing was performed on 10 representative bulk sample of the fill soils encountered in Area A. Testing was performed according to ASTM D1557-91. The results of the compaction test is summarized in Table B1-3.

B1.12 List Tables and Figures

The following table and figures are attached and complete this appendix:

Table B1-1	Soil Expansion
Table B1-2	Soil Corrosivity
Table B1-3	Compaction
Figures B1-1a to B1-1p	Atterberg Limits Plots
Figures B1-2a to B1-2t	Consolidation Plots
Figures B1-3a to B1-3t	Direct Shear Plots
Figures B1-4a to B1-4b	Sieve Analysis Plots

Table B1-1. Soil Expansion

Boring	Sample Depth, feet	Expansion Index
B-RW049	0 to 1	0 (very low)

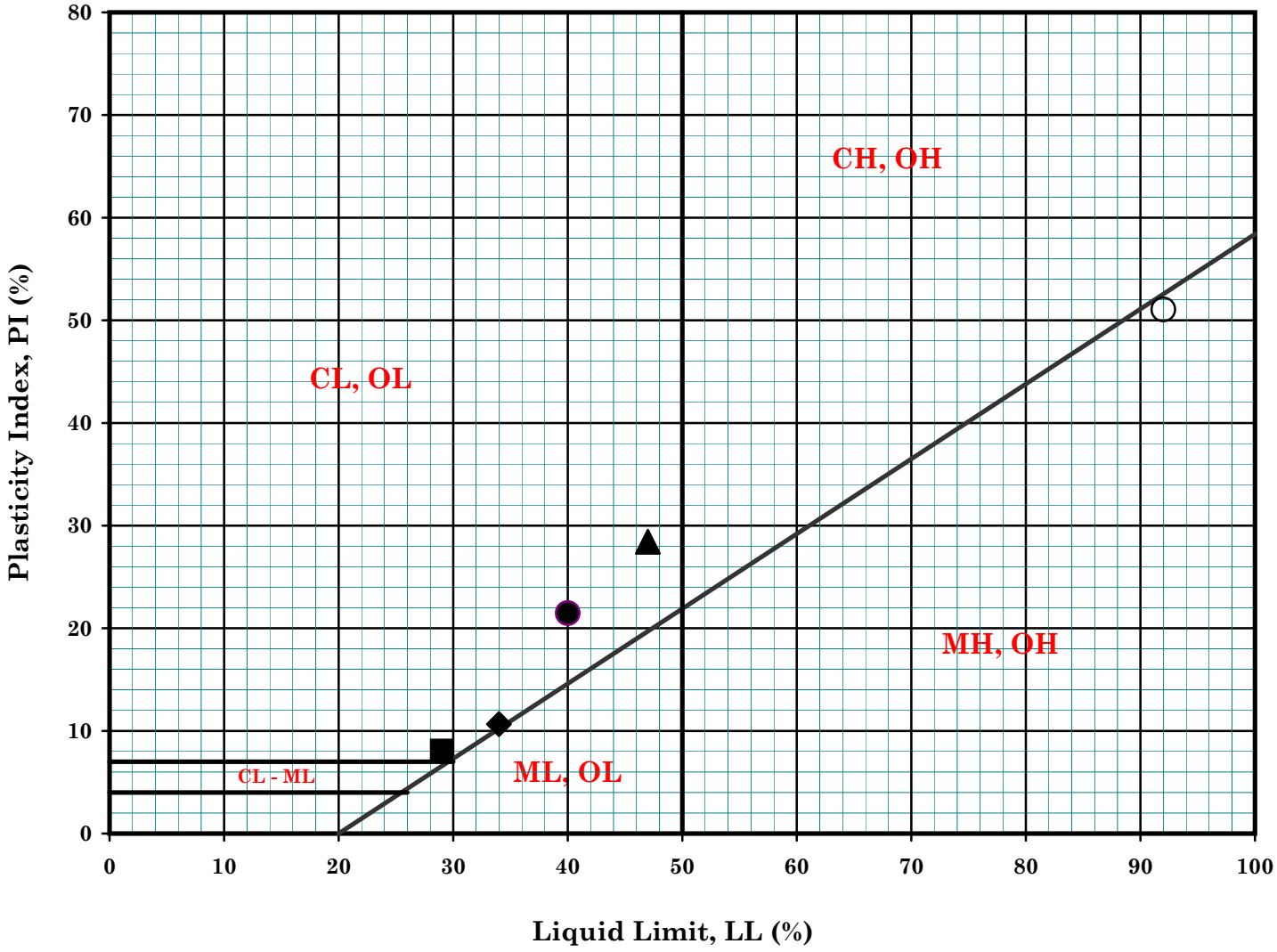
Table B1-2. Soil Corrosivity

Boring	Sample Depth, feet	pH	Chlorides ppm	Sulfates (% by weight)	Minimum Resistivity ohm-cm
B-RW049	0 to 1	7.61	55	0.04	1441

Table B1-3. Compaction

Boring	Sample Depth, feet	Maximum Dry Density, (pcf)	Optimum Moisture Content, (%)
A-HSA016	0-1	107.5	15
A-HSA016	8	121	12.5
A-HSA016	17	116	13
A-HSA017	0-1	105	15.5
A-HSA017	6.5	119.5	13
A-HSA017	15	119	13
A-HSA018	0-1	110	15
A-HSA018	18	116	15
A-HSA066	0-1	112.5	15
A-HSA067	0-1	109.5	16.5

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●	A-RW003	SH5B	20.0	21.5	6.1	6.6		40	19	21	Dark Greenish Gray Silty Clay (CL)
▲	A-RW003	S8	35.0	36.5	10.7	11.1		47	19	28	Very Dark Greenish Gray Silty Clay (CL)
◆	A-RW003	R13A	55.0	56.5	16.8	17.2		34	23	11	Very Dark Greenish Gray Silty Clay (CL)
■	A-RW003	R15	65.0	66.5	19.8	20.3		29	21	8	Very Dark Greenish Gray Silty Clay (CL)
○	A-RW005	S6	30.0	31.5	9.2	9.6		92	41	51	Dark Olive Brown Clay or Silt w/ Shells and Organic Matters (OH)
△											
◇											
□											

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Ballona Creek Wetlands Restoration

Project No. : LA962A

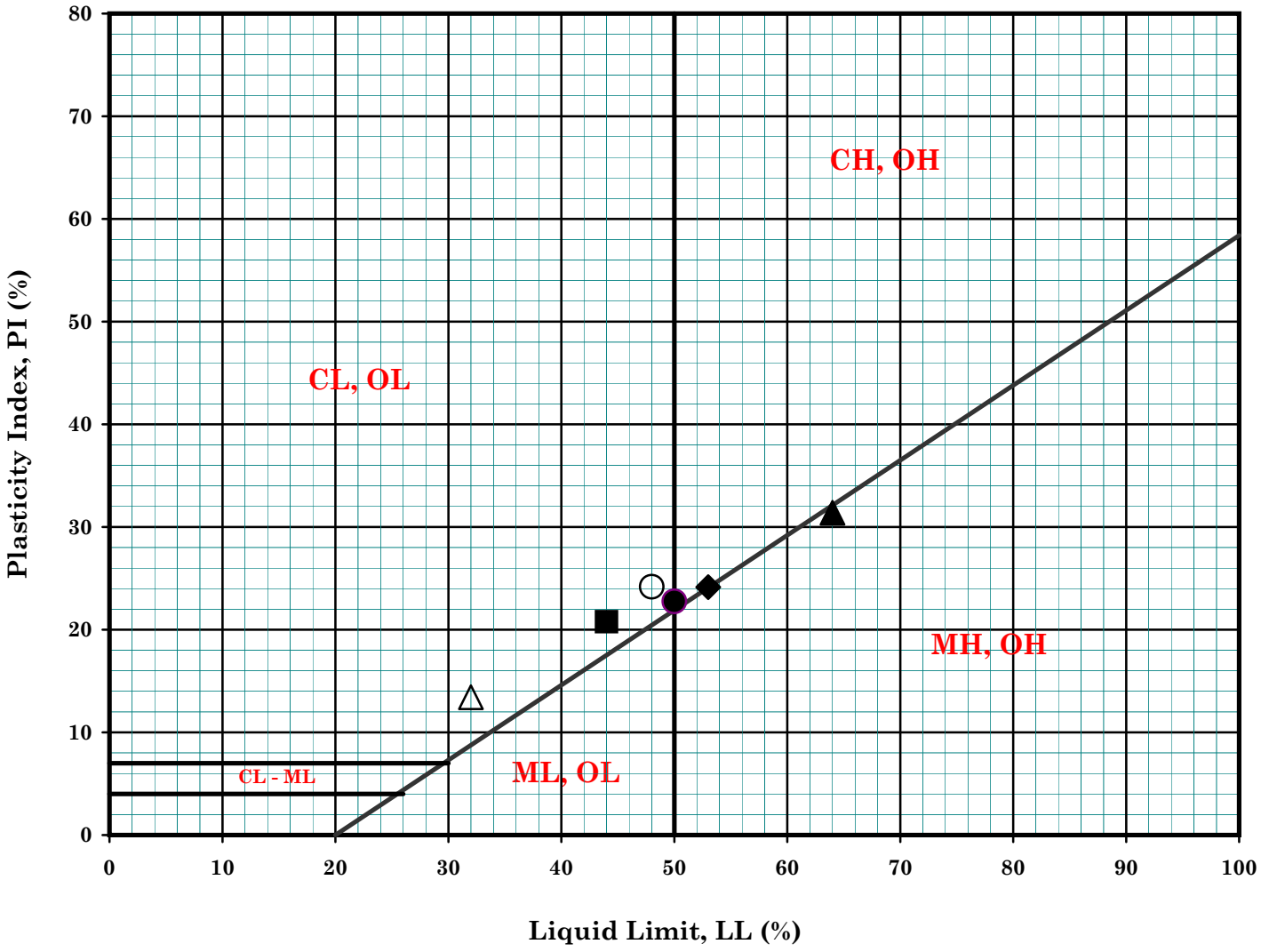
Date : 01/28/13

B1-727

ATTERBERG LIMITS
(ASTM D-4318-84)

Figure No. : B1-1a

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●	A-RW006	S5	20.0	21.5	6.1	6.6		50	27	23	Dark Grayish Brown Silty Clay (CL)
▲	A-RW006	SH8B	35.0	36.5	10.7	11.1		64	33	31	Dark Olive Gray Clayey Silt (MH)
◆	A-RW006	S9	40.0	41.5	12.2	12.7		53	29	24	Dark Olive Gray Clay / Silt with Shells (CH)
■	A-RW006	S11	50.0	51.5	15.3	15.7		44	23	21	Very Dark Greenish Gray Silty Clay (CL)
○	A-RW006	S13	60.0	61.5	18.3	18.8		48	24	24	Very Dark Greenish Gray Silty Clay (CL)
△	A-RW006	S15	70.0	71.5	21.4	21.8		32	19	13	Very Dark Greenish Gray Sandy Silty Clay (CL)
◇											
□											

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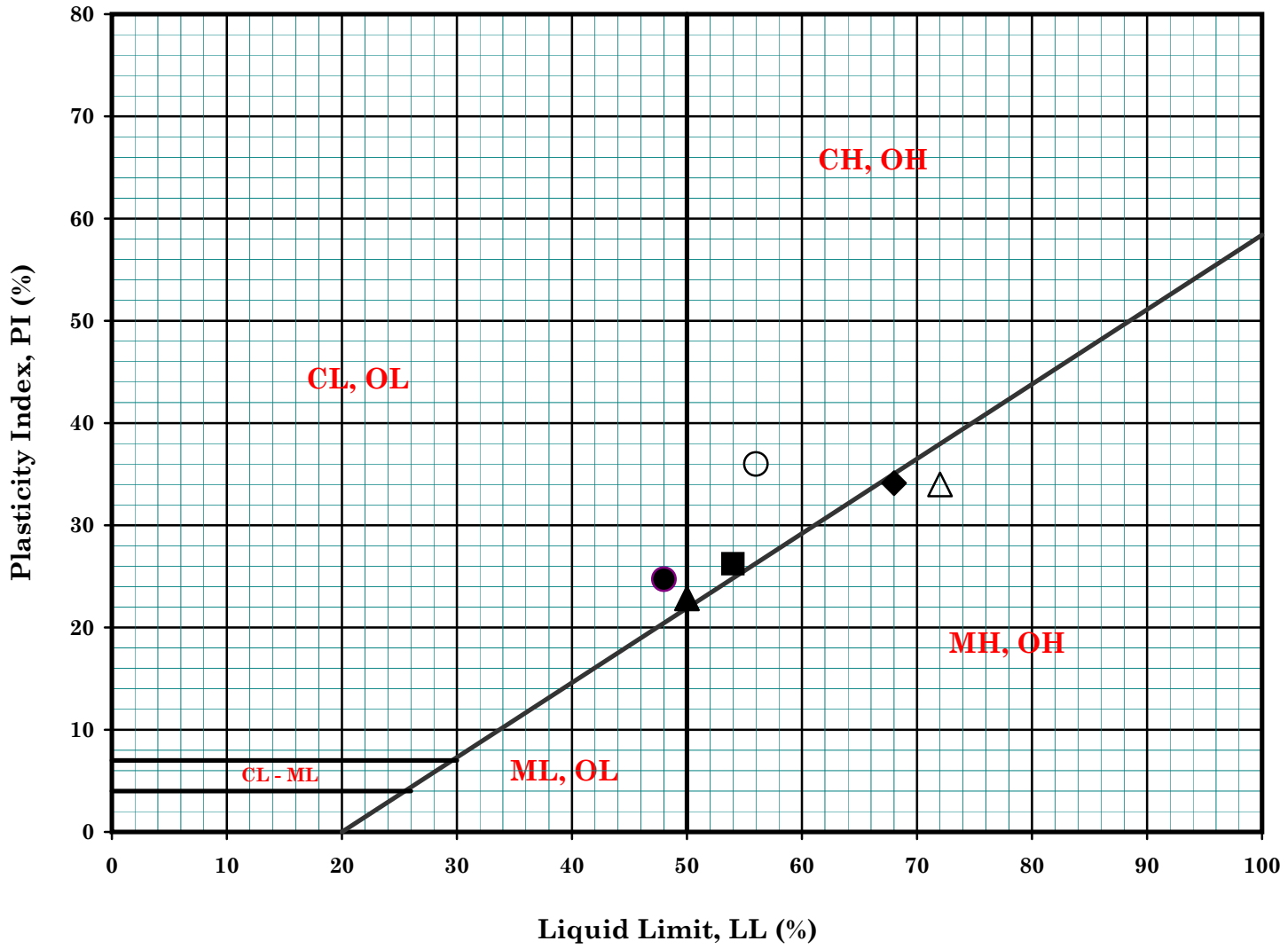
B1-728

ATTERBERG LIMITS
(ASTM D-4318-84)

Figure No. : B1-1b

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●	A-RW008	R2	10.0	11.5	3.1	3.5		48	23	25	Dark Greenish Gray Silty Clay with Sand (CL)
▲	A-RW008	R5	25.0	26.5	7.6	8.1		50	27	23	Dark Greenish Gray Lean / Fat Clay with Traces of Shells (CL / CH)
◆	A-RW008	R6A	30.0	31.5	9.2	9.6		68	34	34	Dark Greenish Gray Clayey Silt with Traces of Shells (MH)
■	A-RW008	R10	45.0	46.5	13.7	14.2		54	28	26	Very Dark Greenish Gray Fat Clay (CH)
○	A-RW009	S6	25.0	26.5	7.6	8.1		56	20	36	Dark Greenish Gray Fat Clay (CH)
△	A-RW009	R11A	50.0	51.5	15.3	15.7		72	38	34	Very Dark Greenish Gray to Black Clay w/ Organic Matter (OH)
◇											
□											

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ATTERBERG LIMITS
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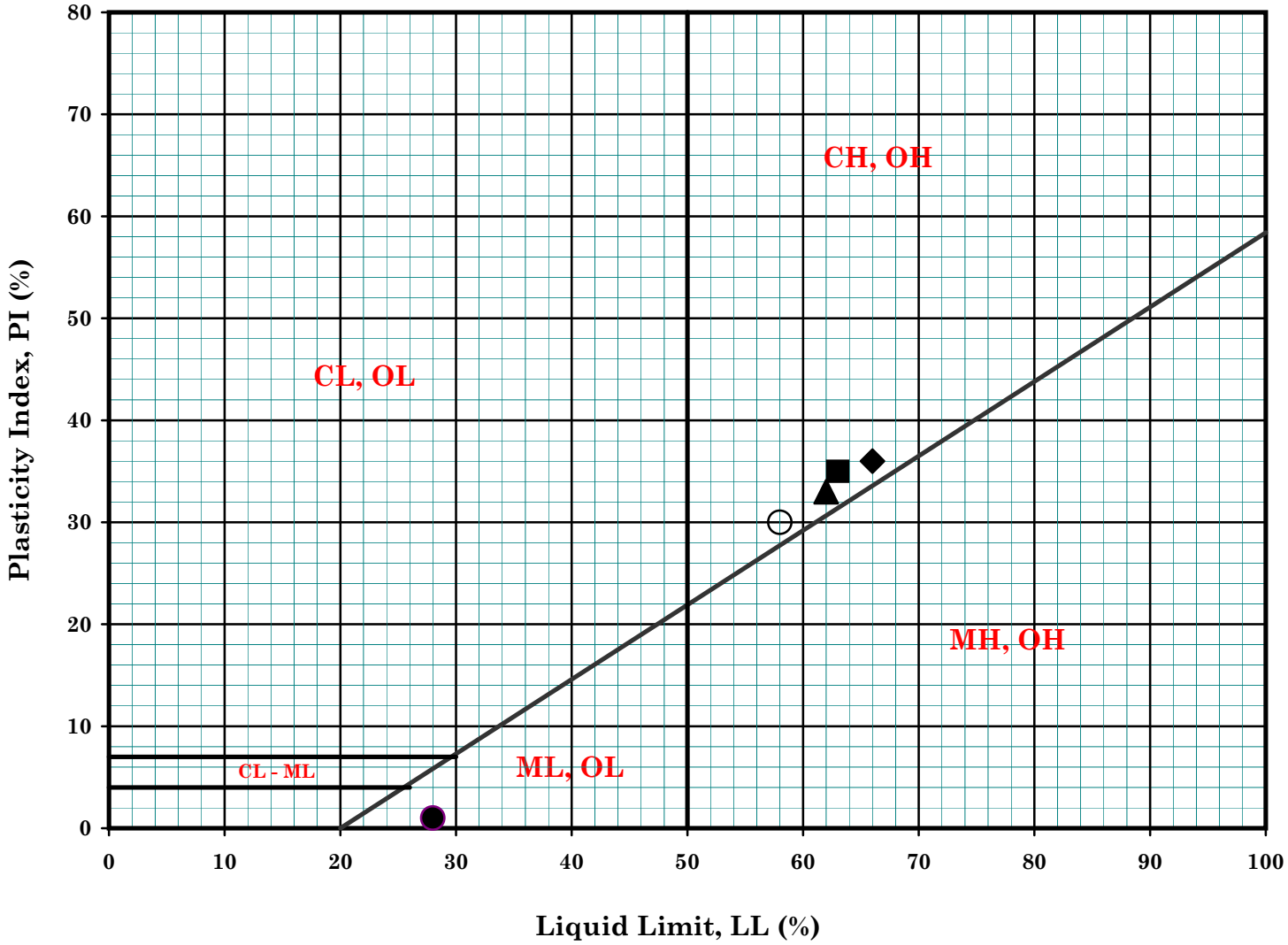
Figure No. : B1-1c

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●	A-RW011	R2	5.0	6.5	1.5	2.0		28	27	1	Dark Greenish Gray Sandy Silt (ML)
▲	A-RW011	R4	15.0	16.5	4.6	5.0		62	29	33	Light Olive Brown Fat Clay (CH)
◆	A-RW011	S5	20.0	21.5	6.1	6.6		66	30	36	Dark Greenish Gray Fat Clay (CH)
■	A-RW011	R6A	25.0	26.5	7.6	8.1		63	28	35	Dark Greenish Gray Fat Clay with Traces of Shells (CH)
○	A-RW011	S10	45.0	46.5	13.7	14.2		58	28	30	Very Dark Gray Fat Clay (CH)
△											
◇											
□											

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ATTERBERG LIMITS
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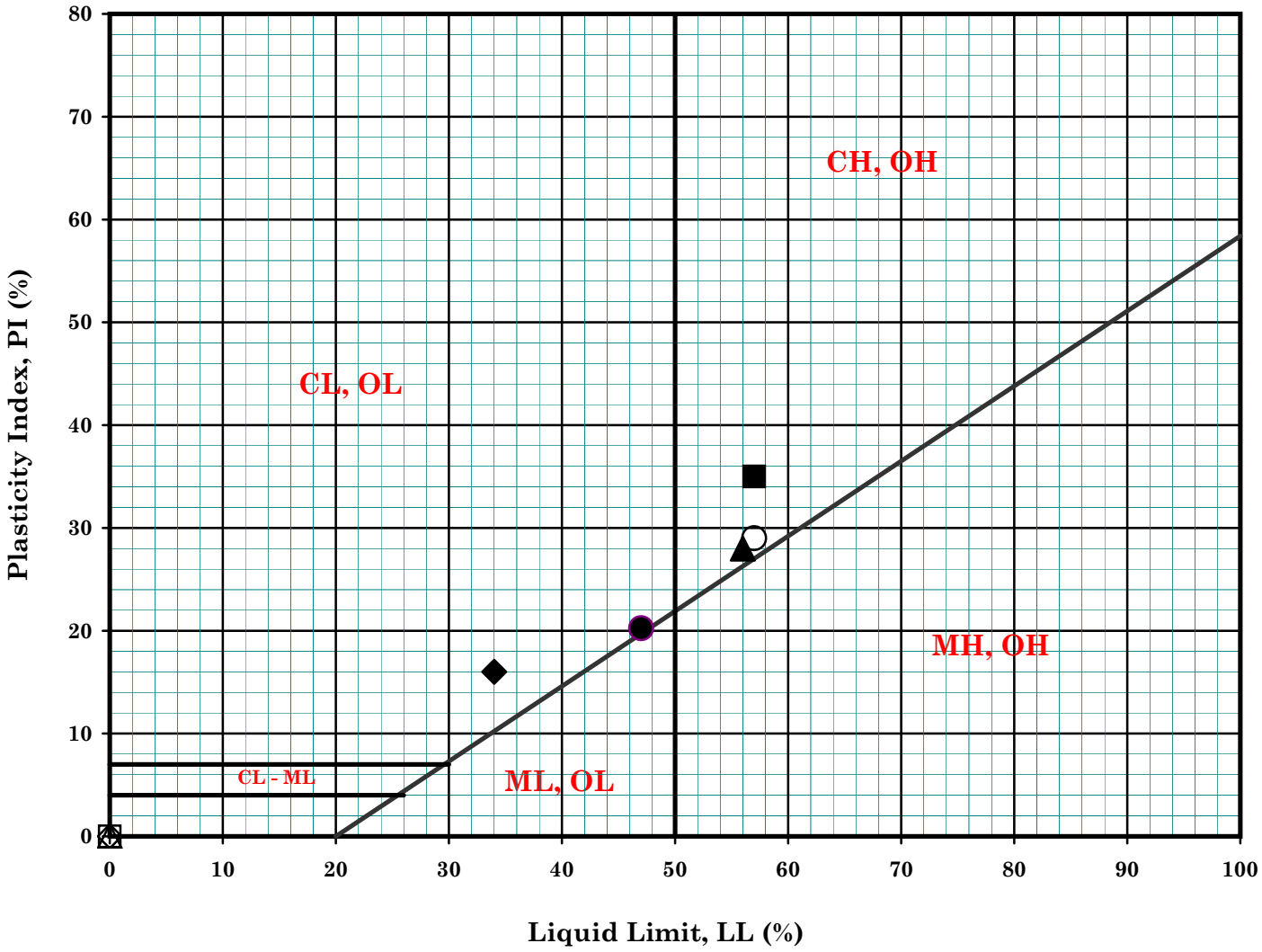
Figure No. : B1-1d

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●	A-RW013	R4	15.0	16.5	4.6	5.0		47	27	20	Olive Brown Silty Clay (CL)
▲	A-RW013	S5	20.0	21.5	6.1	6.6		56	28	28	Dark Greenish Gray Fat Clay (CH)
◆	A-RW013	R7	30.0	31.5	9.2	9.6		34	18	16	Very Dark Greenish Gray Sandy Clay w/ Traces of Gravel (CL)
■	A-RW015	R3	10.0	11.5	3.1	3.5		57	22	35	Very Dark Greenish Gray Fat Clay (CH)
○	A-RW015	S11	45.0	46.5	13.7	14.2		57	28	29	Dark Greenish Gray Fat Clay (CH)
△											
◇											
□											

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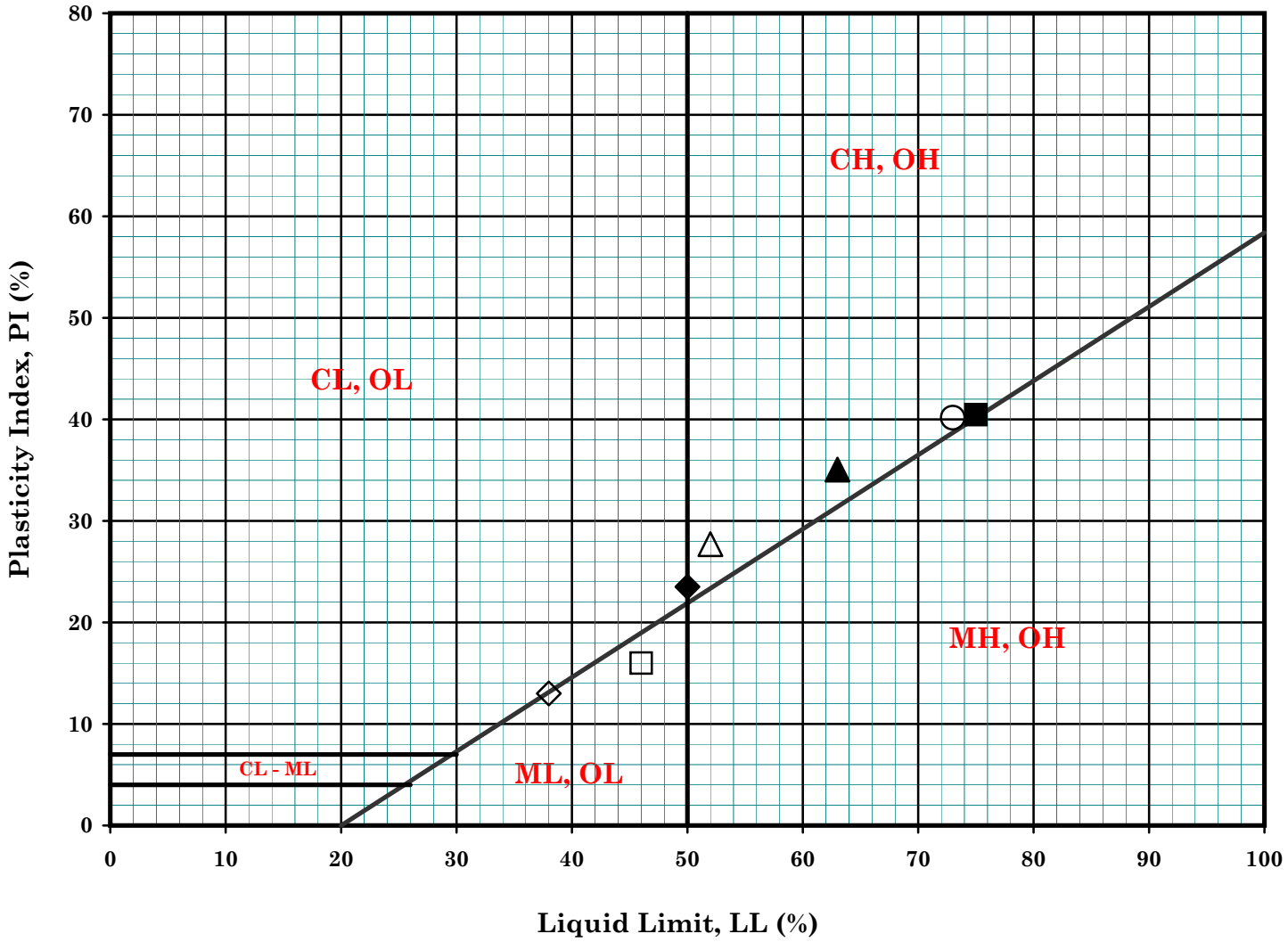
Project No. : LA962A

Date : 10/20/12

ATTERBERG LIMITS
(ASTM D-4318-84)

Figure No. : B1-1e

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●											
▲	A-RW020	R4A	15.0	16.5	4.6	5.0		63	28	35	Olive Brown Fat Clay (CH)
◆	A-RW020	S5	20.0	21.5	6.1	6.6		50	26	24	Dark Greenish Gray Silty Clay / Clayey Silt w/ Shells (CL/CH)
■	A-RW020	R6	25.0	26.5	7.6	8.1		75	35	40	Dark Greenish Gray Clay / Silt (CH / MH)
○	A-RW020	R8A	35.0	36.5	10.7	11.1		73	33	40	Dark Greenish Gray Silty Clay to Fat Clay (CH)
△	A-RW020	R11	50.0	51.5	15.3	15.7		52	24	28	Very Dark Greenish Gray Clay with Organic Matter (CH / OH)
◇	A-RW023	S3	10.0	11.5	3.1	3.5		38	25	13	Very Dark Greenish Gray Sandy Silty Clay/Sandy Clayey Silt (CL/ML)
□	A-RW023	S5	20.0	21.5	6.1	6.6		46	30	16	Dark Greenish Gray Sandy Clayey Silt (ML)

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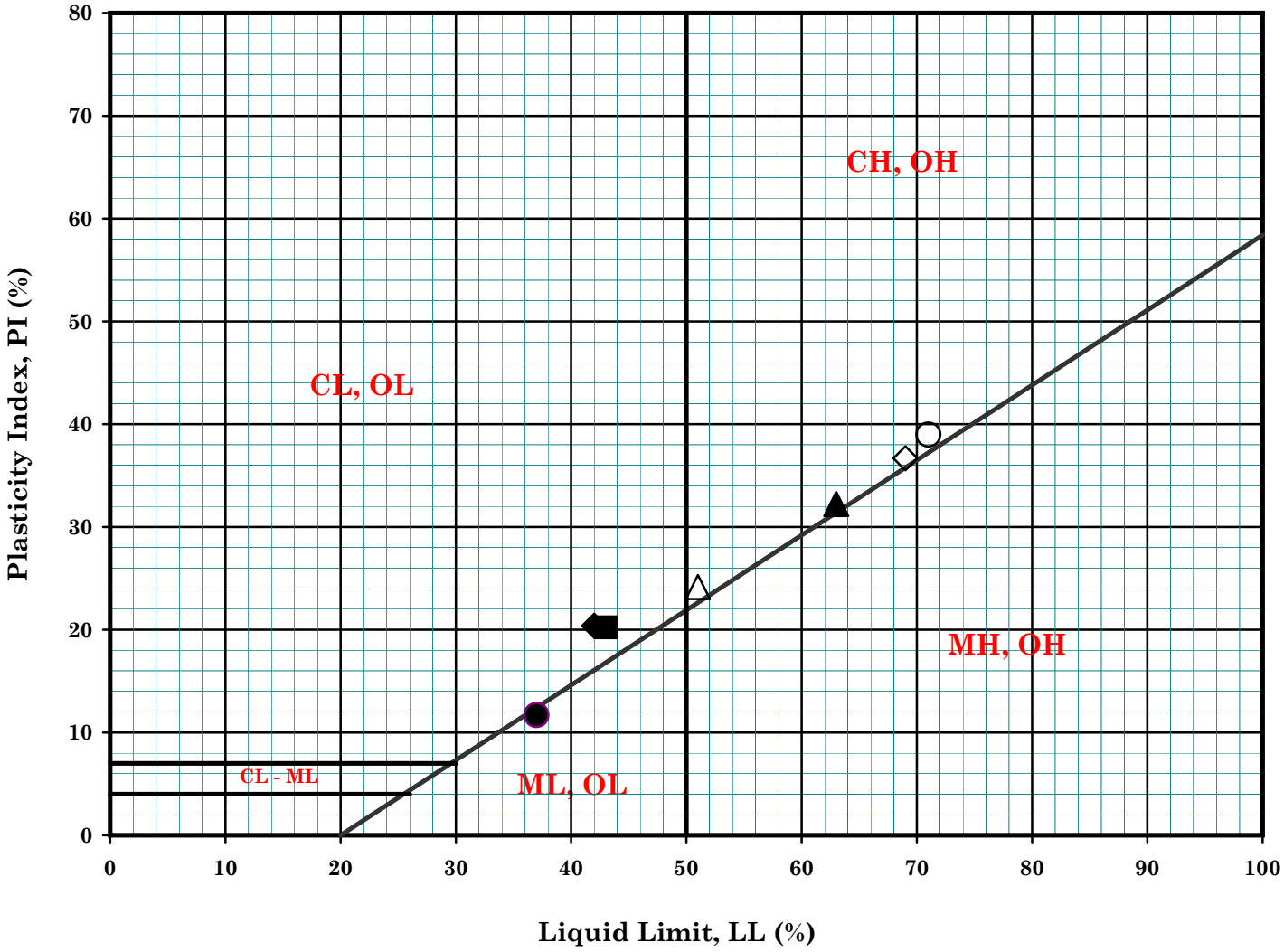
Date : 11/9/12

ATTERBERG LIMITS
(ASTM D-4318-84)
Figure No. : B1-1f

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●	A-HSA016	B9	17.0	18.5	5.2	5.6		37	25	12	Dark Olive Gray Sandy Silt / Sandy Clay (CL-ML)
▲	A-HSA018	S6	12.5	14.0	3.8	4.3		63	31	32	Light Greenish Gray Clayey Silt / Clay (MH-CH)
◆	A-HSA064	S5	12.5	14.0	3.8	4.3		42	22	20	Olive Gray Sandy Clay with Shells (CL)
■	A-HSA064	S7	17.5	19.0	5.3	5.8		43	23	20	Dark Grayish Brown Silty Clay with Shells (CL)
○	A-HSA066	R8	17.5	19.0	5.3	5.8		71	32	39	Olive Brown Fat Clay (CH)
△	A-HSA066	S9	20.0	21.5	6.1	6.6		51	27	24	Dark Greenish Gray Fat Clay w/ Traces of Shells (CH)
◇	A-HSA067	R5	12.5	14.0	3.8	4.3		69	32	37	Olive Brown Fat Clay (CH)
□											

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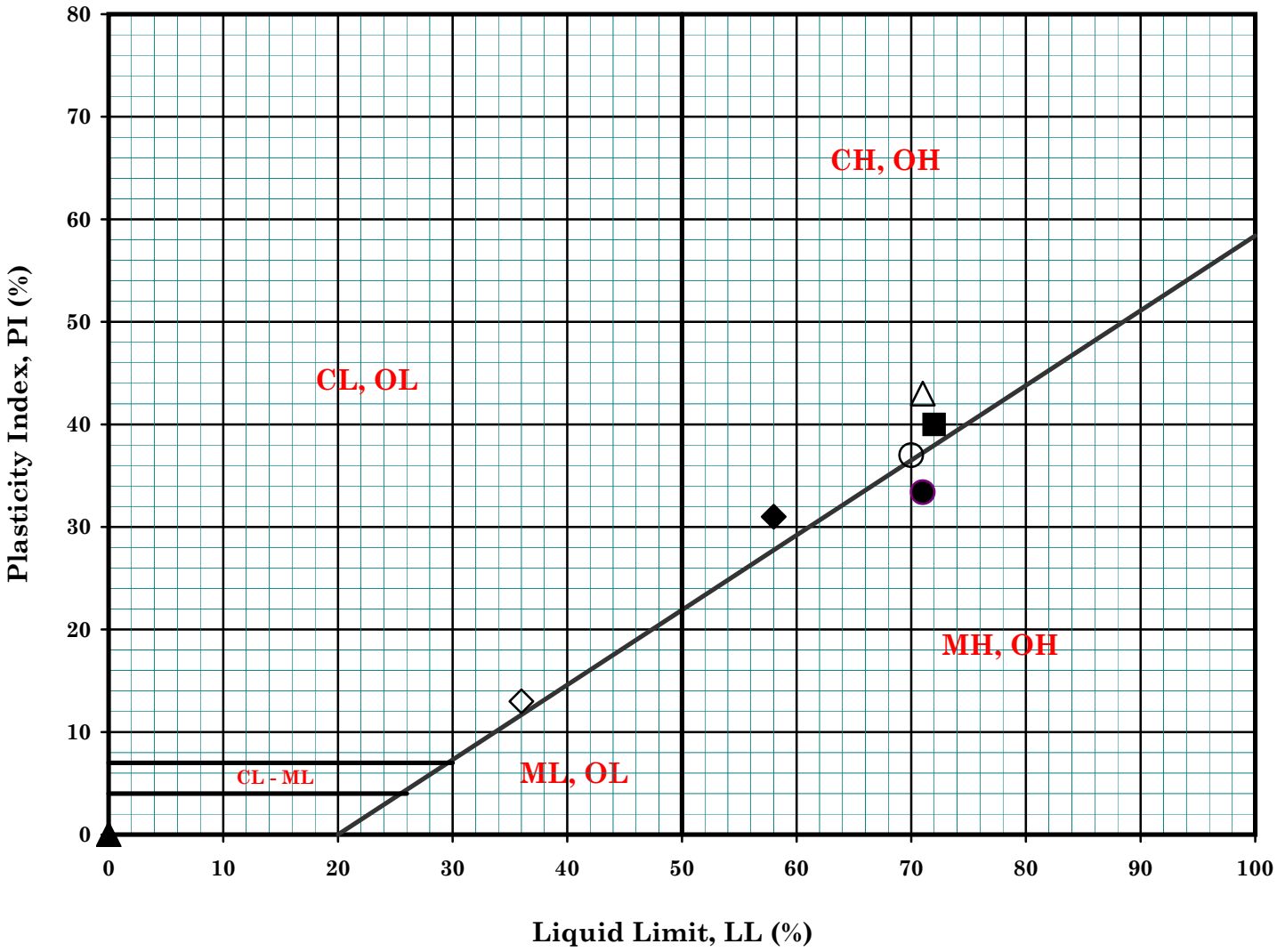
Project No. : LA962A

Date : 11/19/12

ATTERBERG LIMITS
(ASTM D-4318-84)

Figure No. : B1-1g

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●	B-RW027	S3	15.0	16.5	4.6	5.0		71	38	33	Very Dark Greenish Gray Clayey Silt with Traces of Shells (MH)
▲	B-RW027	R4A	20.0	21.5	6.1	6.6		0	0	0	Dark Geenish Gray Silty Fine Sand with traces of Shells (NP)
◆	B-RW027	S6	25.0	26.5	7.6	8.1		58	27	31	Dark Greenish Gray Fat Clay (CH)
■	B-RW030	S2	5.0	6.5	1.5	2.0		72	32	40	Olive Brown Fat Clay (CH)
○	B-RW030	R3	10.0	11.5	3.1	3.5		70	33	37	Olive Brown Fat Clay with Shells (CH)
△	B-RW032	R3A	10.0	11.5	3.1	3.5		71	28	43	Light Olive Brown Fat Clay (CH)
◇	B-RW032	S10	45.0	46.5	13.7	14.2		36	23	13	Very Dark Greenish Gray Sandy Silty Clay (CL)
□											

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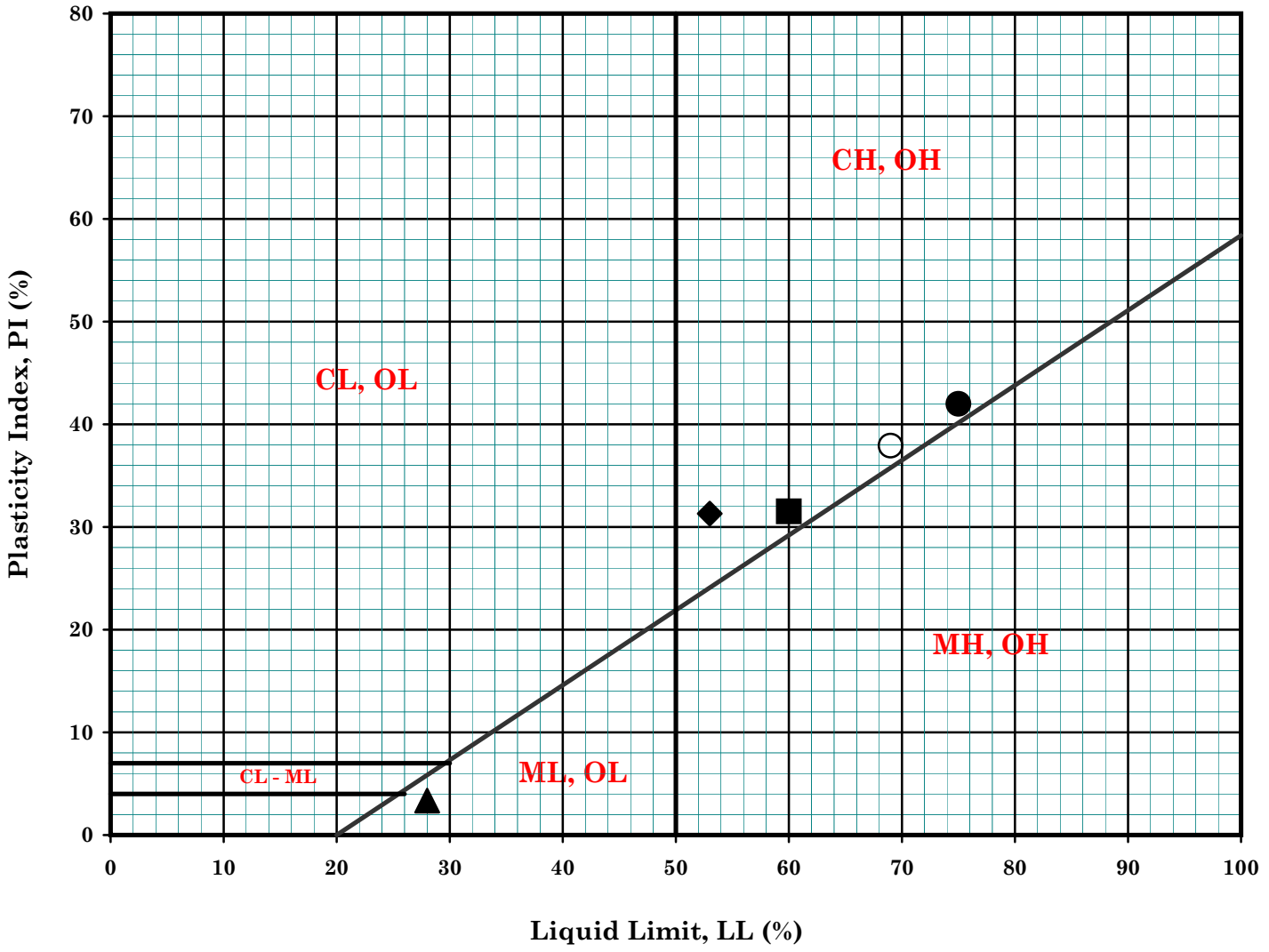
Date : 11/02/12

ATTERBERG LIMITS
(ASTM D-4318-84)
Figure No. : B1-1h

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●	B-RW033	R3A	15.0	16.5	4.6	5.0		75	33	42	Dark Greenish Gray Fat Clay (CH)
▲	B-RW033	S9	40.0	41.5	12.2	12.7		28	25	3	Very Dark Greenish Gray Sandy Silt with Shells (ML)
◆	B-RW033	R10A	45.0	46.5	13.7	14.2		53	22	31	Very Dark Greenish Gray Fat Clay (CH)
■	B-RW036	R2A	10.0	11.5	3.1	3.5		60	28	32	Dark Greenish Gray Fat Clay (CH)
○	B-RW036	S3	15.0	16.5	4.6	5.0		69	31	38	Dark Olive Gray Fat Clay (CH)
△											
◇											
□											

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Ballona Creek Wetlands Restoration

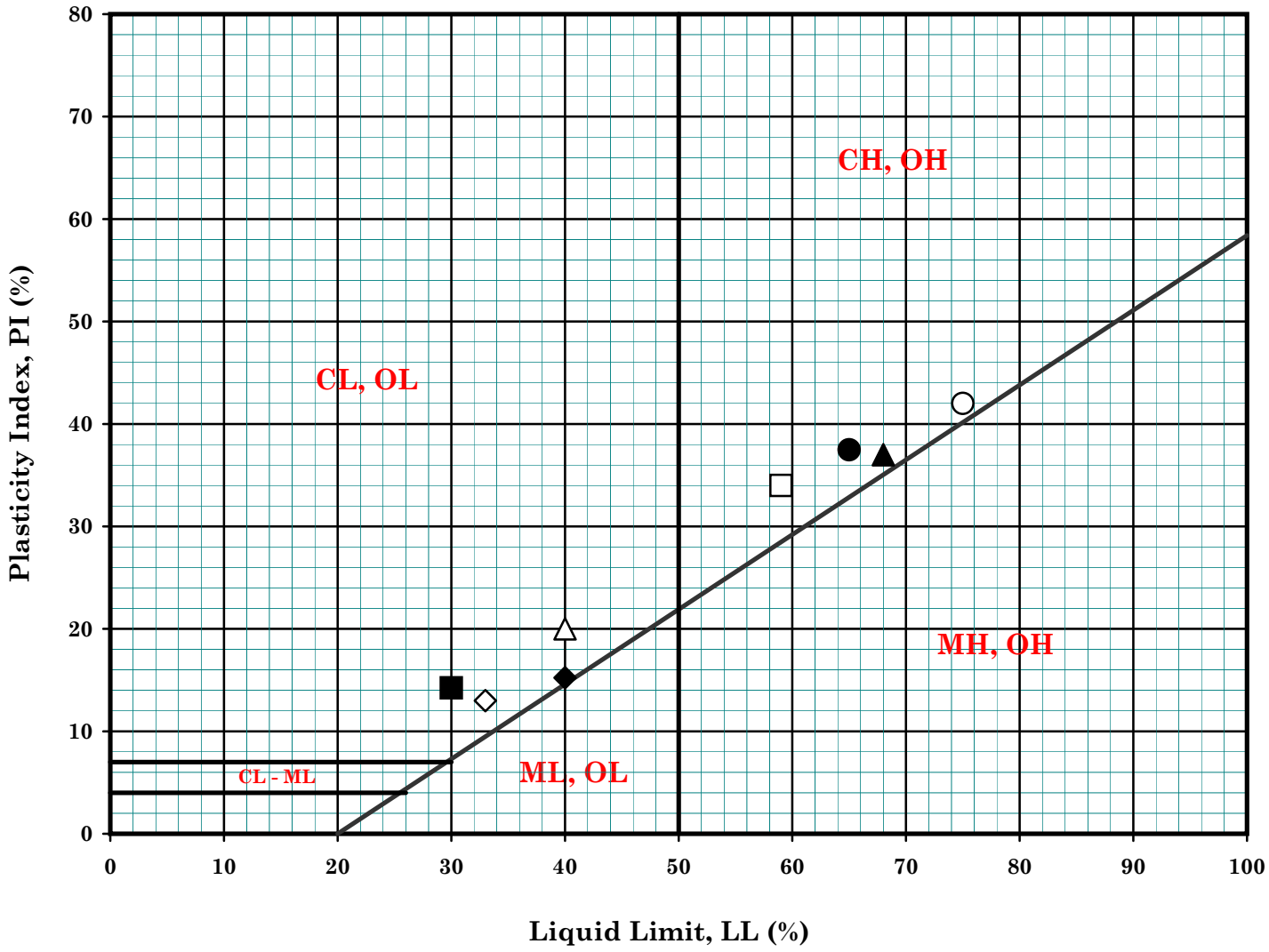
Project No. : LA962A

Date : 01/28/13

ATTERBERG LIMITS
(ASTM D-4318-84)

Figure No. : B1-1i

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●	B-RW039	S1	5.0	6.5	1.5	2.0		65	28	37	Dark Yellowish Brown Fat Clay
▲	B-RW039	SH2B	10.0	11.5	3.1	3.5		68	31	37	Olive Gray Fat Clay with Shells (CH)
◆	B-RW039	S7	35.0	36.5	10.7	11.1		40	25	15	Very Dark Greenish Gray Silty Clay / Clayey Silt with Shells
■	B-RW039	R8A	40.0	41.5	12.2	12.7		30	16	14	Very Dark Greenish Gray Sandy Clay
○	B-RW041	R6A	25.0	26.5	7.6	8.1		75	33	42	Dark Greenish Gray Fat Clay (CH)
△	B-RW041	S7	30.0	31.5	9.2	9.6		40	20	20	Very Dark Greenish Gray Silty Clay (CL)
◇	B-RW041	R9	40.0	41.5	12.2	12.7		33	20	13	Very Dark Greenish Gray Silty Clay (CL)
□	B-RW041	S12	55.0	56.5	16.8	17.2		59	25	34	Dark Gray Fat Clay (CH)

Remark :

GROUP DELTA CONSULTANTS

Ballona Creek Wetlands Restoration

Project No. : LA962A

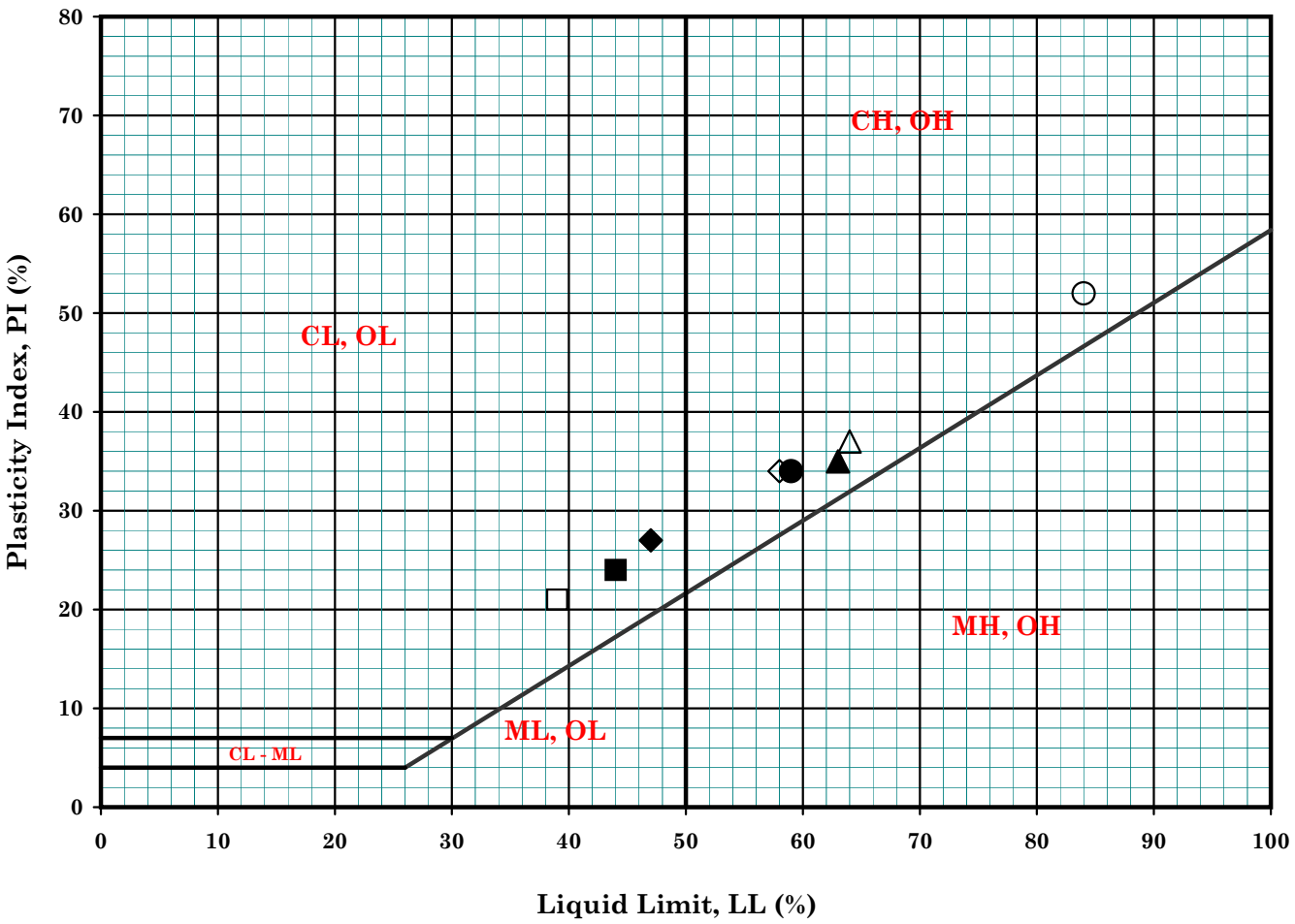
Date : 01/28/13

ATTERBERG LIMITS
(ASTM D-4318-84)

B1-736

Figure No. : B1-1j

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	LI	Description
●	B-RW043	R3A	10.0	11.5	3.1	3.5		59	25	34		Dark Greenish Gray Fat Clay (CH)
▲	B-RW043	S6	25.0	26.5	7.6	8.1		63	28	35		Very Dark Greenish Gray Fat Clay (CH)
◆	B-RW043	SH7B	30.0	31.5	9.2	9.6		47	20	27		Very Dark Greenish Gray Lean Clay (CL)
■	B-RW043	R11	50.0	51.5	15.3	15.7		44	20	24		Very Dark Greenish Gray Lean Clay (CL)
○	B-RW044	R1A	5.0	6.5	1.5	2.0		84	32	52		Dark Greenish Gray Fat Clay (CH)
△	B-RW044	SH3B	15.0	16.5	4.6	5.0		64	27	37		Dark Greenish Gray Fat Clay (CH)
◇	B-RW044	R5A	25.0	26.5	7.6	8.1		58	24	34		Very Dark Gray Fat Clay (CH)
□	B-RW044	R11	55.0	56.5	16.8	17.2		39	18	21		Dark Gray Silty Lean Clay (CL)

Remarks :

GROUP DELTA CONSULTANTS

Ballona Creek Wetlands Restoration

Project No. : LA962A

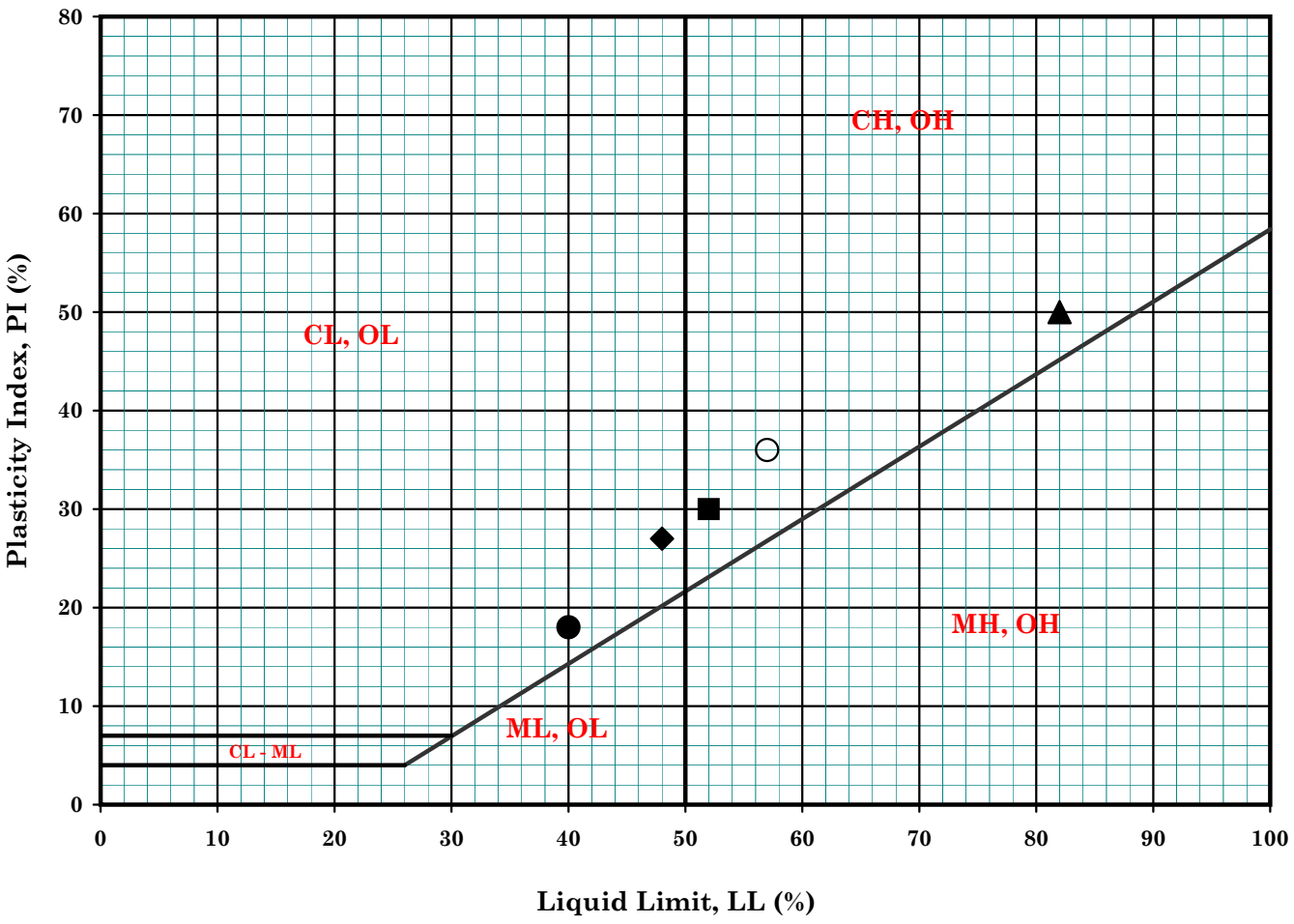
Date : 10/12/12

ATTERBERG LIMITS

(ASTM D-4318 / CT-204 / T-89)

Figure No. : B1-1k

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	LI	Description
●	B-RW047	SH3A	10.0	11.5	3.1	3.5		40	22	18		Light Gray Silty Lean Clay(CL)
▲	B-RW047	SH5A	20.0	16.5	6.1	5.0		82	32	50		Dark Greenish Gray Fat Clay (CH)
◆	B-RW047	S6	25.0	26.5	7.6	8.1		48	21	27		Dark Gray Silty Lean Clay (CL)
■	B-RW047	R11	50.0	51.5	15.3	15.7		52	22	30		Very Dark Gray Fat Clay (CH)
○	B-RW047	S10	45.0	46.5	13.7	14.2		57	21	36		Very Dark Gray Fat Clay (CH)
△												
◇												
□												

Remarks :

GROUP DELTA CONSULTANTS

Ballona Creek Wetlands Restoration

Project No. : LA962A

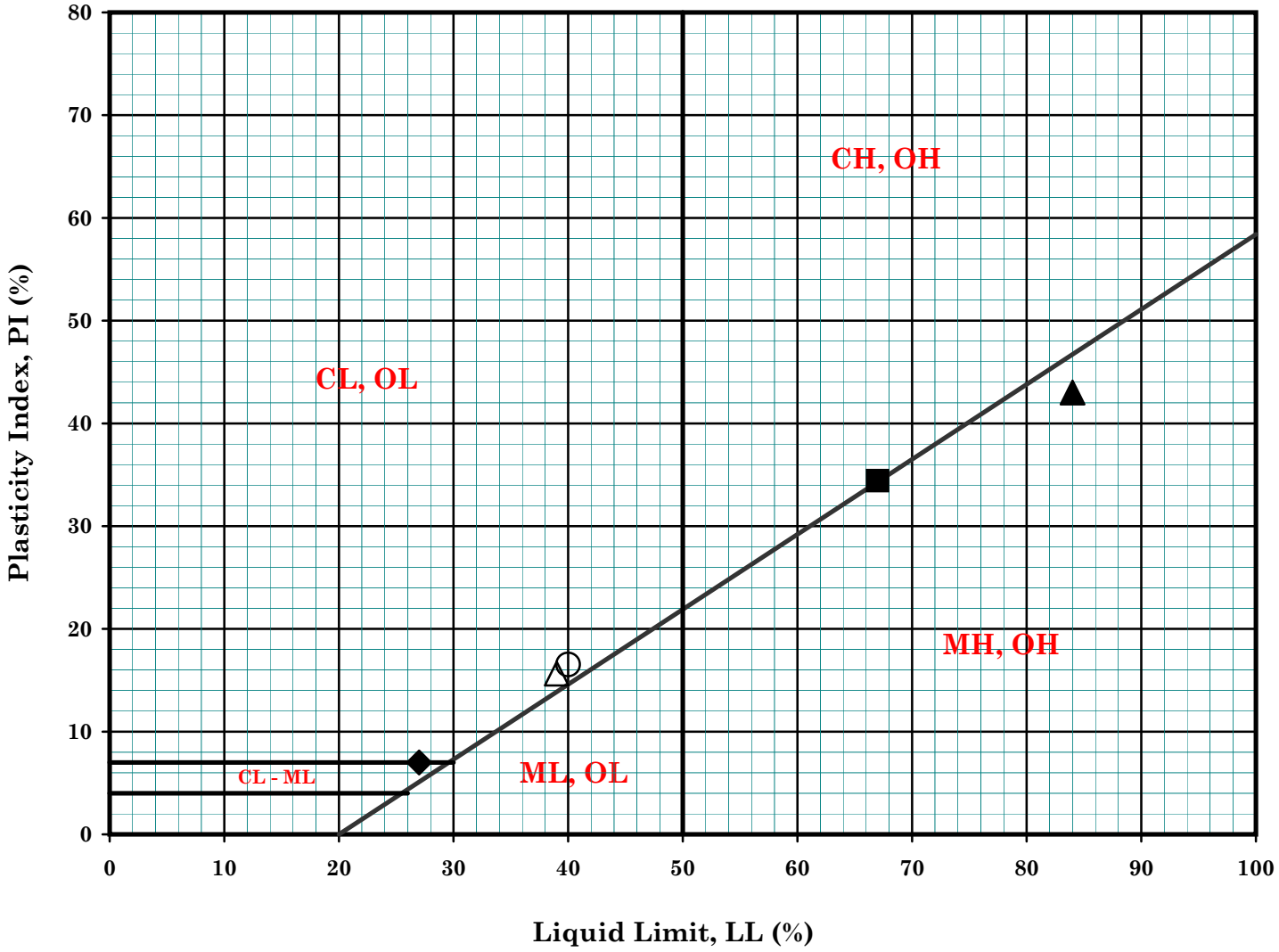
Date : 10/11/12

ATTERBERG LIMITS

(ASTM D-4318 / CT-204 / T-89)

Figure No. : B1-11

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●											
▲	B-RW049	R4A	15.0	16.5	4.6	5.0		84	41	43	Black to Light Olive Brown Silt or Clay with Organic Matter (OH)
◆	B-RW049	S5	20.0	21.5	6.1	6.6		27	20	7	Light Brown Clayey Silt (ML-CL)
■	B-RW049	R6A	25.0	26.5	7.6	8.1		67	33	34	Dark Geenish Gray Silt / Clay with Traces of Shells (CH/MH)
○	B-RW049	R8A	35.0	36.5	10.7	11.1		40	23	17	Very Dark Greenish Gray Silty Clay (CL)
△	B-RW049	R13	60.0	61.5	18.3	18.8		39	23	16	Very Dark Greenish Gray Sandy Silty Clay (CL)
◇											
□											

Remark :

GROUP DELTA CONSULTANTS

Ballona Creek Wetlands Restoration

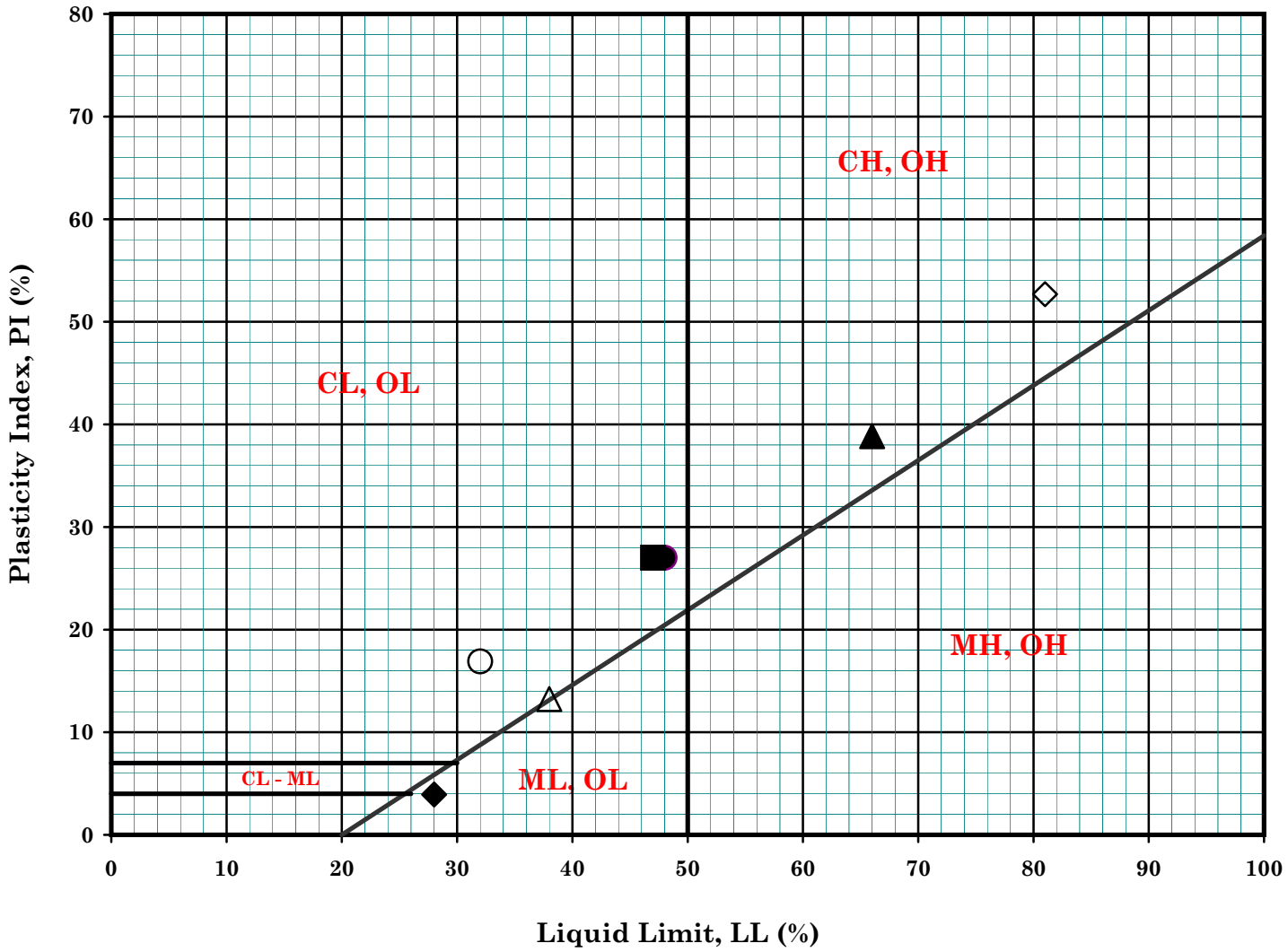
Project No. : LA962A

Date : 11/02/12

ATTERBERG LIMITS
(ASTM D-4318-84)

Figure No. : B1-1m

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●	B-RW053	S1	5.0	6.5	1.5	2.0		48	21	27	Dark Gray Silty Lean Clay with Shells (CL)
▲	B-RW053	R2A	10.0	11.5	3.1	3.5		66	27	39	Dark to Light Olive Brown Clay with traces of Shells (CH)
◆	B-RW053	SH4B	20.0	21.5	6.1	6.6		28	24	4	Dark Greenish Gray Clayey Sandy Silt with Traces of Shells (ML)
■	B-RW053	S9	45.0	46.5	13.7	14.2		47	20	27	Dark Gray Silty Lean Clay with Shells (CL)
○	B-RW053	R10A	50.0	51.5	15.3	15.7		32	15	17	Dark Greenish Gray Sandy Clay (CL)
△	B-RW053	R12A	60.0	61.5	18.3	18.8		38	25	13	Very Dark Greenish Gray Silty Clay / Clayey Silt (CL/ML)
◇	B-RW053	R14A	70.0	71.5	21.4	21.8		81	28	53	Very Dark Greenish Gray Fat Clay (CH)
□											

Remark :

GROUP DELTA CONSULTANTS

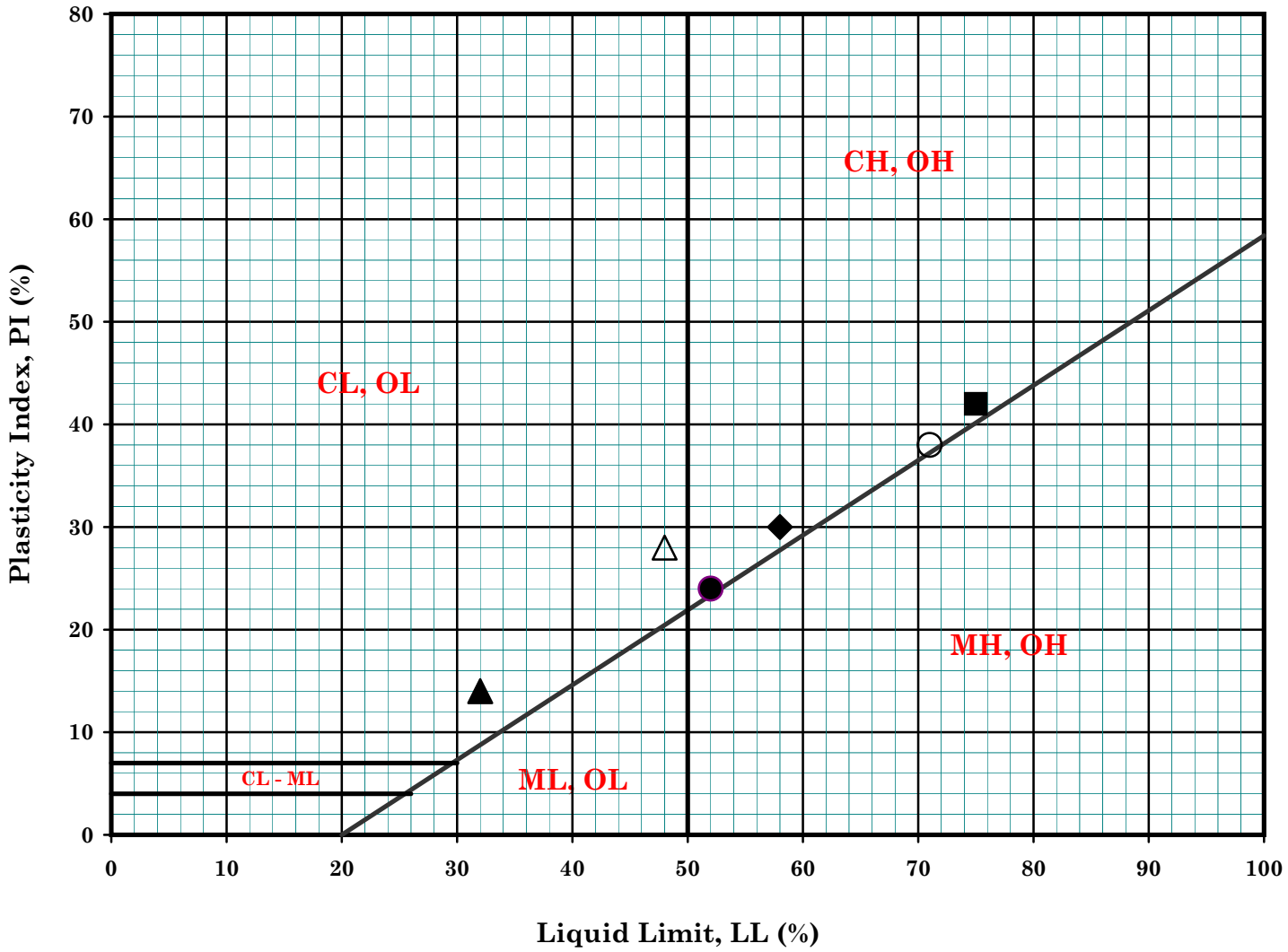
Ballona Creek Wetlands Restoration

Project No. : LA962A

Date : 11/02/12

ATTERBERG LIMITS
(ASTM D-4318-84)
Figure No. : B1-1n

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●	B-RW055	R2A	10.0	11.5	3.1	3.5		52	28	24	Yellowish Brown Clay with Shells (CH)
▲	B-RW055	R10	45.0	46.5	13.7	14.2		32	18	14	Very Dark Greenish Gray Sandy Clay with Traces of Gravel (CL)
◆	B-RW058	S2	10.0	11.5	3.1	3.5		58	28	30	Brown Fat Clay (CH)
■	B-RW058	R3A	15.0	16.5	4.6	5.0		75	33	42	Olive Clay with Organic Matter (CH or OH)
○	B-RW058	R5A	25.0	26.5	7.6	8.1		71	33	38	Dark Olive Brown Fat Clay with Traces of Shells (CH)
△	B-RW058	S12	60.0	61.5	18.3	18.8		48	20	28	Dark Gray Silty Lean Clay with Shells (CL)
◇											
□											

Remark :

GROUP DELTA CONSULTANTS

Ballona Creek Wetlands Restoration

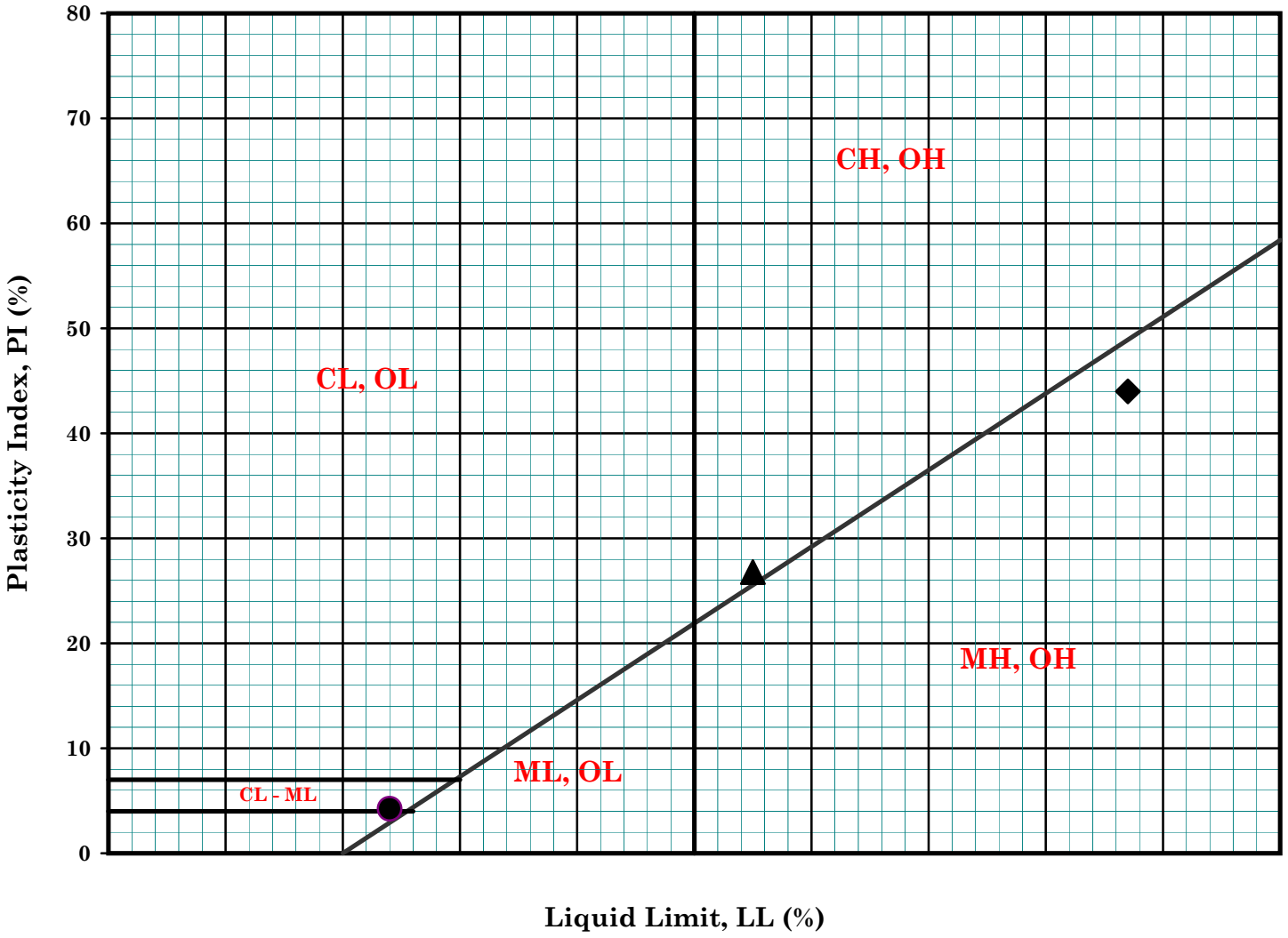
Project No. : LA962A

Date : 11/02/12

ATTERBERG LIMITS
(ASTM D-4318-84)

Figure No. : B1-1o

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●	C-HSA061	R7	17.5	19.0	5.3	5.8		24	20	4	Dark Olive Brown Sandy Clay-Sandy Silt with Fine Gravel (CL-ML)
▲	C-HSA061	R11	30.0	31.5	9.2	9.6		55	28	27	Olive Brown Silty Clay to Fat Clay (CH)
◆	B-HSA051	S6	12.5	14.0	3.8	4.3		87	43	44	Dark Olive Gray Clayey Silt (MH)
■											
○											
△											
◇											
□											

Remark :

GROUP DELTA CONSULTANTS

Ballona Creek Wetlands Restoration

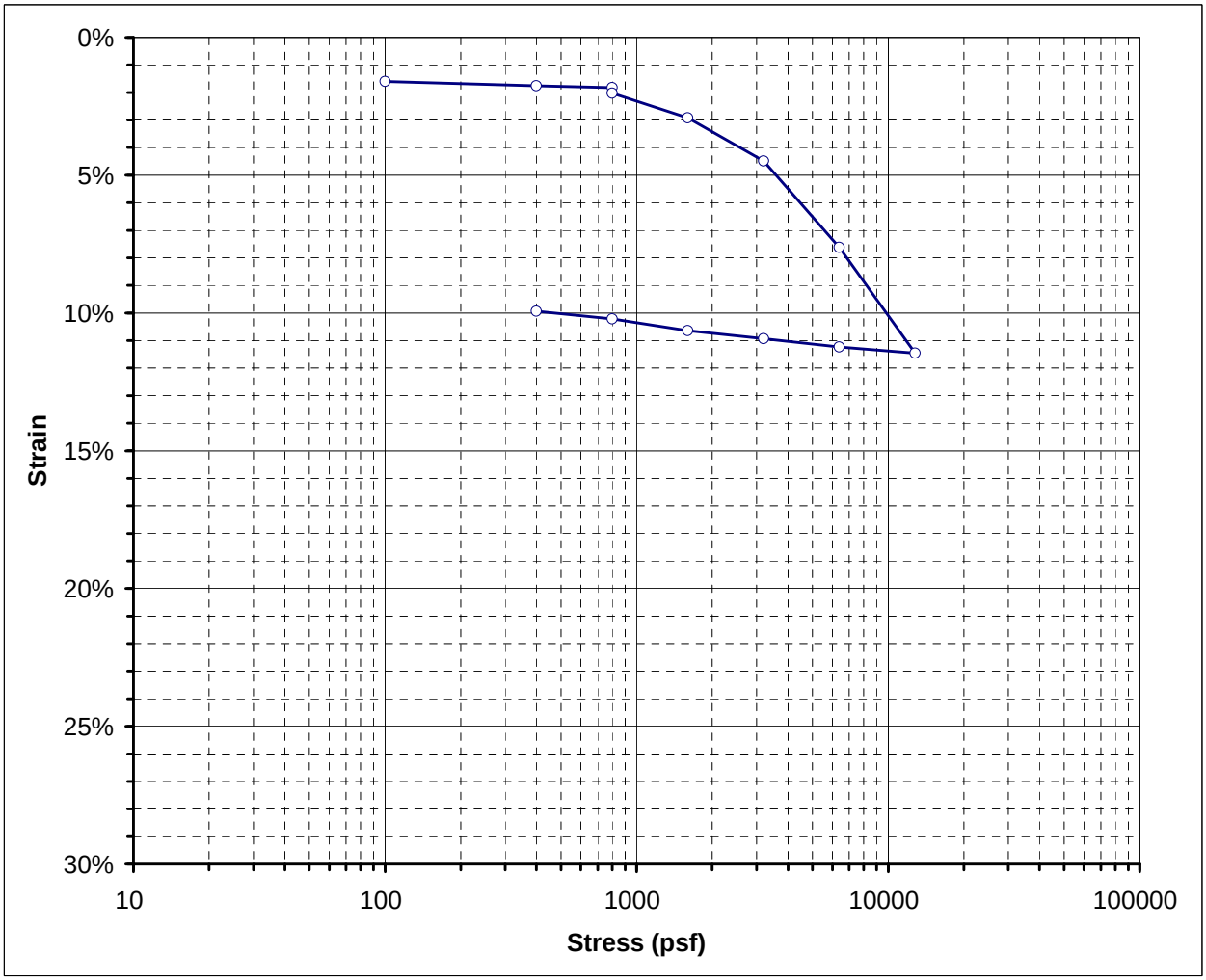
Project No. : LA962A

Date : 11/19/12

ATTERBERG LIMITS
(ASTM D-4318-84)

Figure No. : B1-1p

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW003	**Sample Depth**	30 ft
Sample No.	R7A	**USCS**	0

BEFORE TEST

Initial Moisture Content:	35.6%	
Initial Dry Unit Wt:	85.8	pcf
Initial Total Unit Wt.:	116.3	pcf
Initial Void Ratio:	1.0301	
Initial Degree of Saturation:	96.3%	

AFTER TEST

Final Moisture Content:	30.2%	
Final Dry Unit Wt:	94.4	pcf
Final Total Unit Wt.:	112.8	pcf
Final Void Ratio:	0.8450	
Final Degree of Saturation:	99.6%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.60%	0.9976
400	1.75%	0.9945
800	1.82%	0.9931
800	2.02%	0.9890
1600	2.92%	0.9709
3200	4.49%	0.9390
6400	7.63%	0.8753
12800	11.45%	0.7976
6400	11.23%	0.8021
3200	10.93%	0.8082
1600	10.64%	0.8141
800	10.22%	0.8226
400	9.94%	0.8283

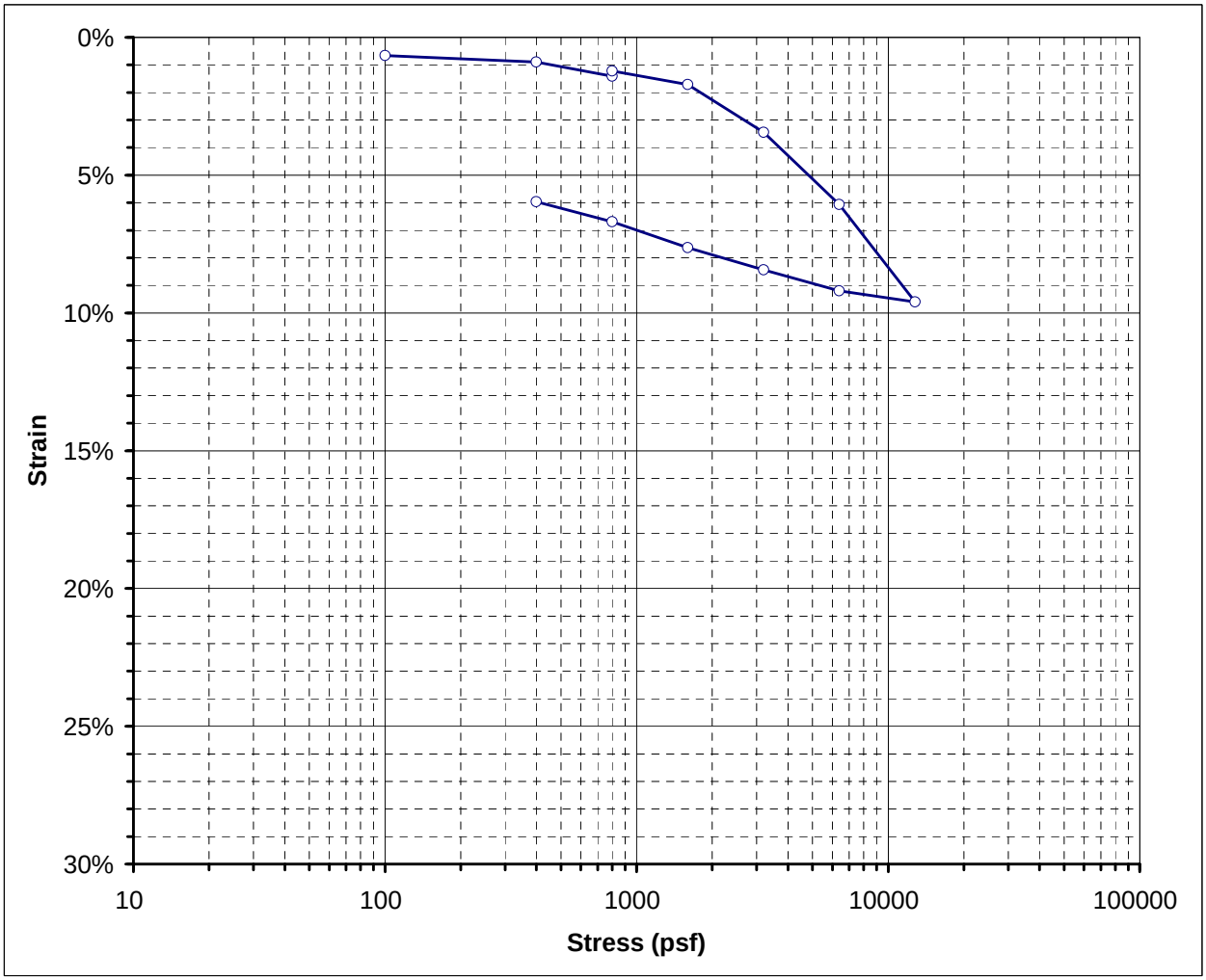
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2a

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-3-12\Consol A-RW003R7A@30'_1.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW005	**Sample Depth**	5 ft
Sample No.	R1	**USCS**	0

BEFORE TEST

Initial Moisture Content:	37.4%	
Initial Dry Unit Wt:	82.0	pcf
Initial Total Unit Wt.:	112.7	pcf
Initial Void Ratio:	1.1234	
Initial Degree of Saturation:	92.9%	

AFTER TEST

Final Moisture Content:	36.4%	
Final Dry Unit Wt:	86.5	pcf
Final Total Unit Wt.:	110.1	pcf
Final Void Ratio:	1.0129	
Final Degree of Saturation:	100.2%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	0.66%	1.1093
400	0.90%	1.1043
800	1.41%	1.0935
800	1.21%	1.0976
1600	1.71%	1.0870
3200	3.45%	1.0501
6400	6.06%	0.9947
12800	9.60%	0.9195
6400	9.19%	0.9281
3200	8.44%	0.9442
1600	7.63%	0.9613
800	6.69%	0.9812
400	5.96%	0.9968

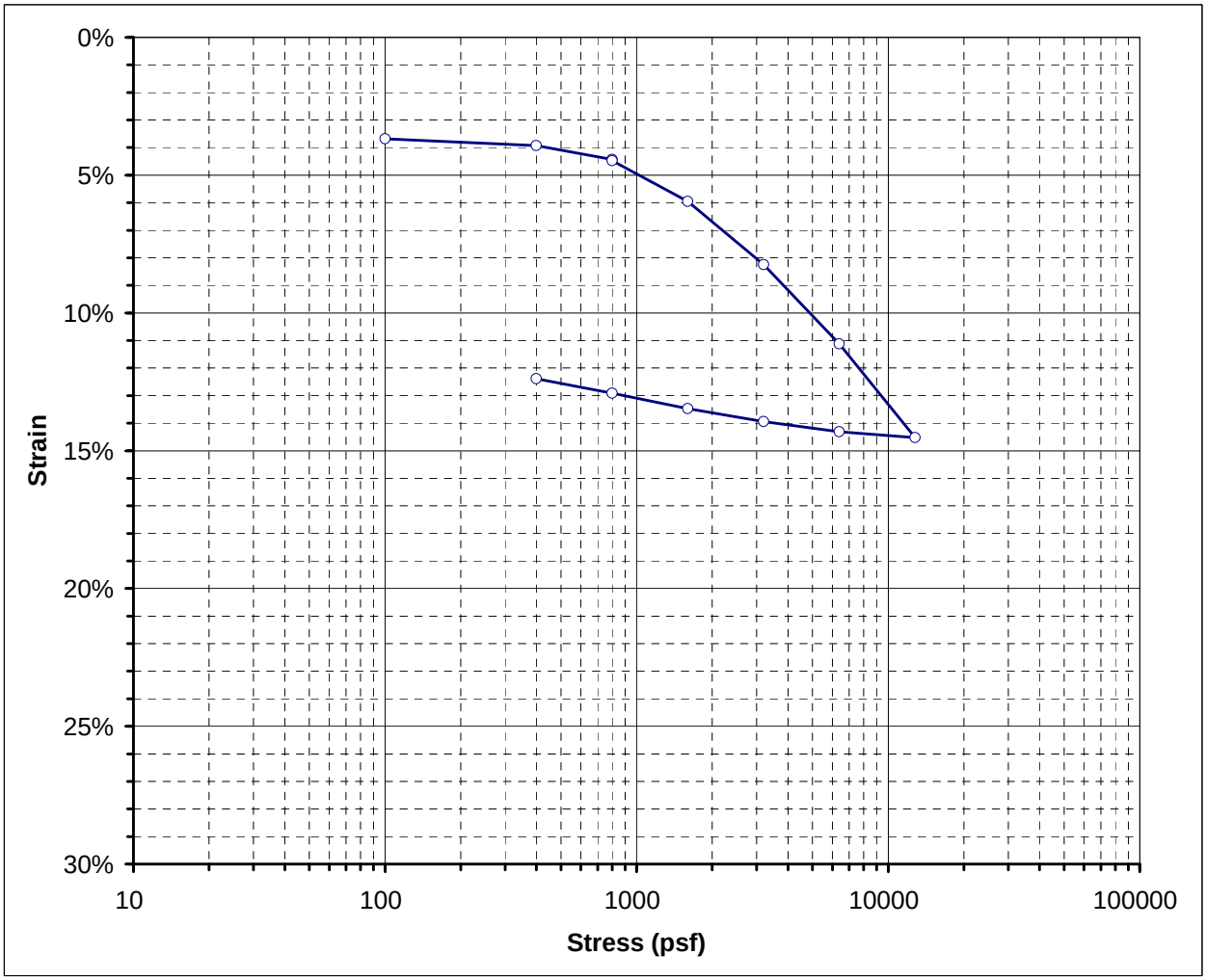
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2b

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-30-12\A-RW005 R1@5'_3.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW005	**Sample Depth**	15 ft
Sample No.	R3	**USCS**	0

BEFORE TEST

Initial Moisture Content:	43.7%	
Initial Dry Unit Wt:	77.9	pcf
Initial Total Unit Wt.:	111.9	pcf
Initial Void Ratio:	1.2358	
Initial Degree of Saturation:	98.7%	

AFTER TEST

Final Moisture Content:	35.5%	
Final Dry Unit Wt:	87.5	pcf
Final Total Unit Wt.:	115.5	pcf
Final Void Ratio:	0.9895	
Final Degree of Saturation:	100.0%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	3.68%	1.1536
400	3.93%	1.1480
800	4.43%	1.1367
800	4.47%	1.1358
1600	5.95%	1.1028
3200	8.25%	1.0513
6400	11.13%	0.9871
12800	14.52%	0.9111
6400	14.31%	0.9158
3200	13.94%	0.9242
1600	13.48%	0.9345
800	12.91%	0.9471
400	12.39%	0.9588

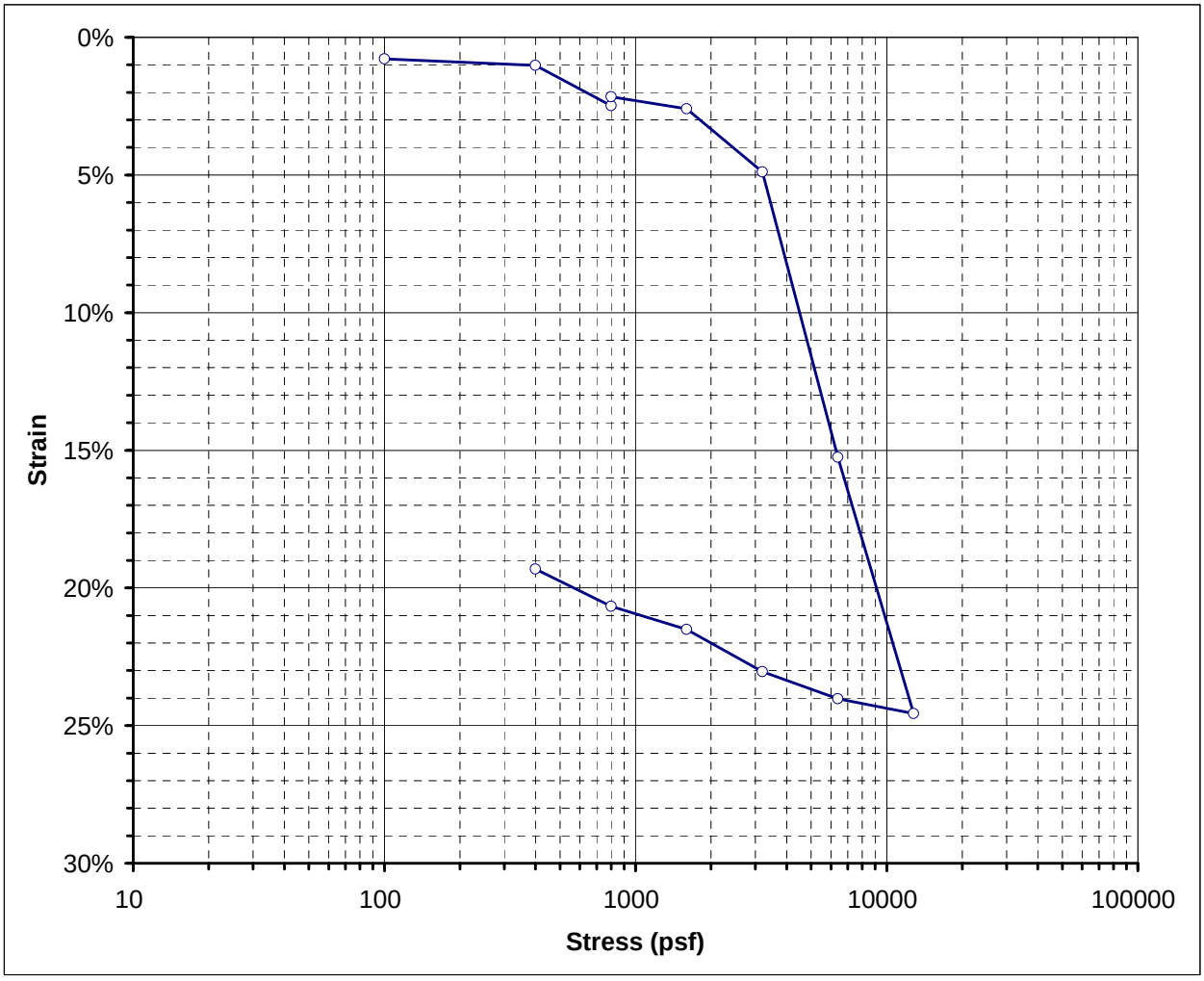
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2c

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-30-12\A-RW005 R3@15'_4.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW006	**Sample Depth**	35 ft
Sample No.	R8A	**USCS**	MH

BEFORE TEST

Initial Moisture Content:	75.0%	
Initial Dry Unit Wt:	56.1	**pcf**
Initial Total Unit Wt.:	98.2	**pcf**
Initial Void Ratio:	2.1032	
Initial Degree of Saturation:	99.5%	

AFTER TEST

Final Moisture Content:	59.2%	
Final Dry Unit Wt:	68.1	**pcf**
Final Total Unit Wt.:	124.1	**pcf**
Final Void Ratio:	1.5571	
Final Degree of Saturation:	106.1%	

Water Added at: 800 **psf**

ATTERBERG LIMITS					
LL=	64	**PL=**	33	**PI=**	31

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	0.78%	2.0790
400	1.02%	2.0716
800	2.48%	2.0263
800	2.16%	2.0362
1600	2.60%	2.0225
3200	4.89%	1.9515
6400	15.25%	1.6300
12800	24.56%	1.3411
6400	24.03%	1.3575
3200	23.04%	1.3882
1600	21.51%	1.4357
800	20.67%	1.4618
400	19.31%	1.5040

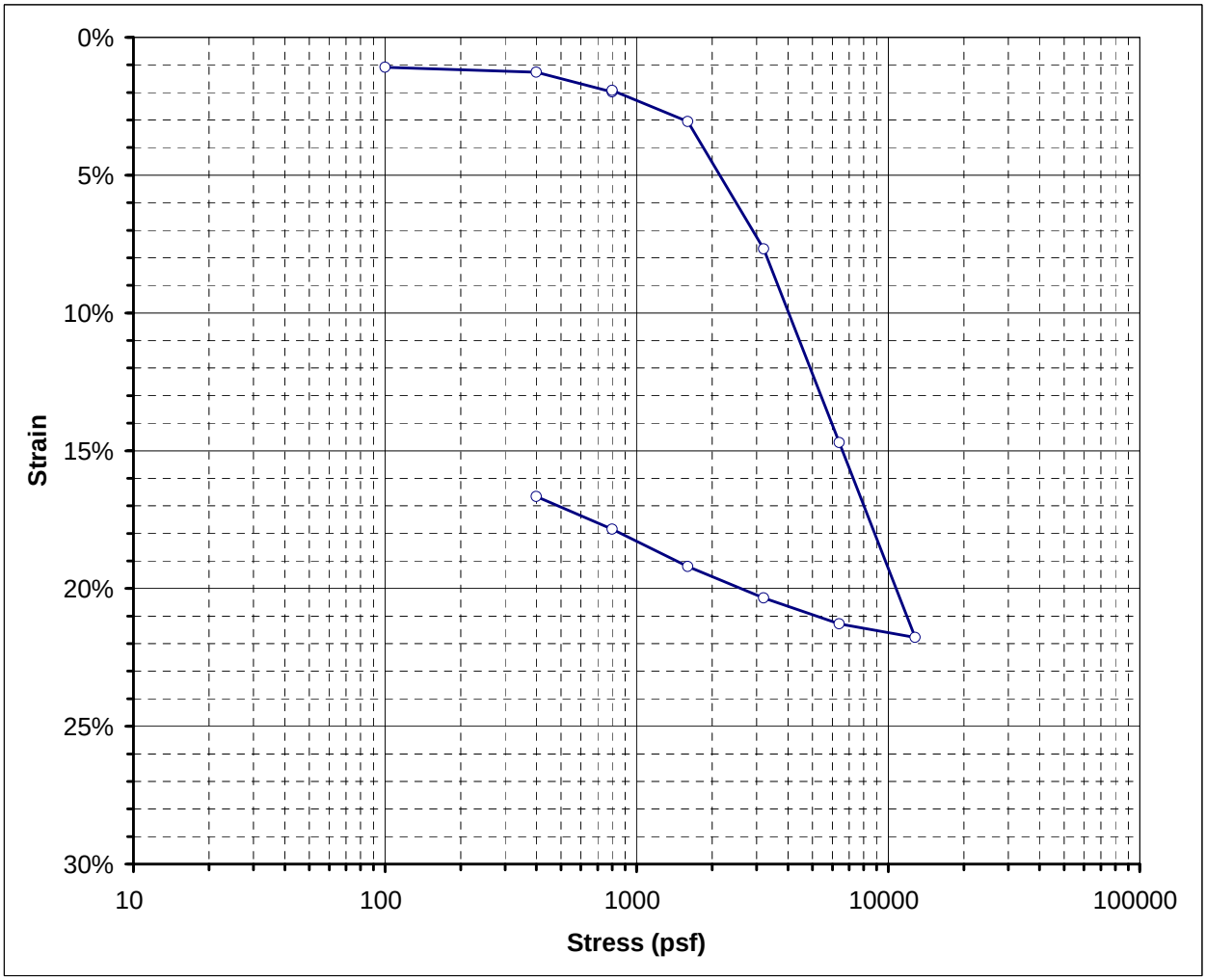
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2d

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 9-21-12\Consol A-RW006R8A@35'_1.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW008	**Sample Depth**	30 ft
Sample No.	R6A	**USCS**	0

BEFORE TEST

Initial Moisture Content:	62.1%	
Initial Dry Unit Wt:	63.1	pcf
Initial Total Unit Wt.:	102.2	pcf
Initial Void Ratio:	1.7601	
Initial Degree of Saturation:	98.4%	

AFTER TEST

Final Moisture Content:	49.2%	
Final Dry Unit Wt:	74.4	pcf
Final Total Unit Wt.:	120.7	pcf
Final Void Ratio:	1.3389	
Final Degree of Saturation:	102.5%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.09%	1.7301
400	1.26%	1.7254
800	1.98%	1.7055
800	1.92%	1.7071
1600	3.06%	1.6757
3200	7.68%	1.5482
6400	14.70%	1.3544
12800	21.78%	1.1590
6400	21.28%	1.1728
3200	20.34%	1.1987
1600	19.20%	1.2302
800	17.85%	1.2675
400	16.66%	1.3003

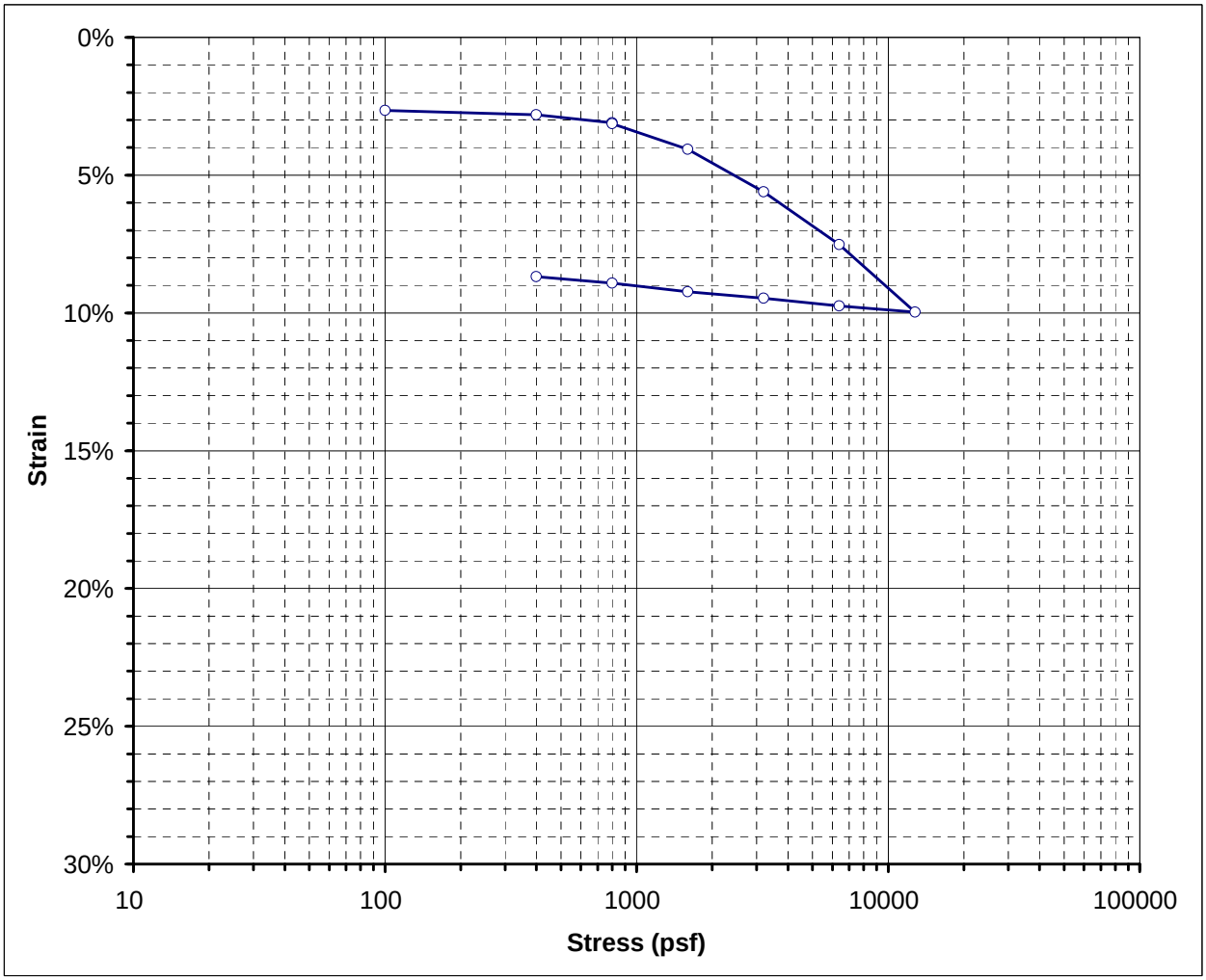
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2e

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-17-12\Consol A-RW008R6A@30'_1.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW011	**Sample Depth**	5
Sample No.	R2	**USCS**	0

BEFORE TEST

Initial Moisture Content:	35.2%	
Initial Dry Unit Wt:	86.8	pcf
Initial Total Unit Wt.:	117.3	pcf
Initial Void Ratio:	1.0058	
Initial Degree of Saturation:	97.6%	

AFTER TEST

Final Moisture Content:	29.0%	
Final Dry Unit Wt:	94.1	pcf
Final Total Unit Wt.:	114.3	pcf
Final Void Ratio:	0.8507	
Final Degree of Saturation:	95.0%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	2.65%	0.9526
400	2.80%	0.9495
800	3.10%	0.9435
800	3.13%	0.9429
1600	4.06%	0.9243
3200	5.61%	0.8933
6400	7.52%	0.8550
12800	9.97%	0.8058
6400	9.74%	0.8104
3200	9.46%	0.8159
1600	9.24%	0.8205
800	8.92%	0.8269
400	8.68%	0.8317

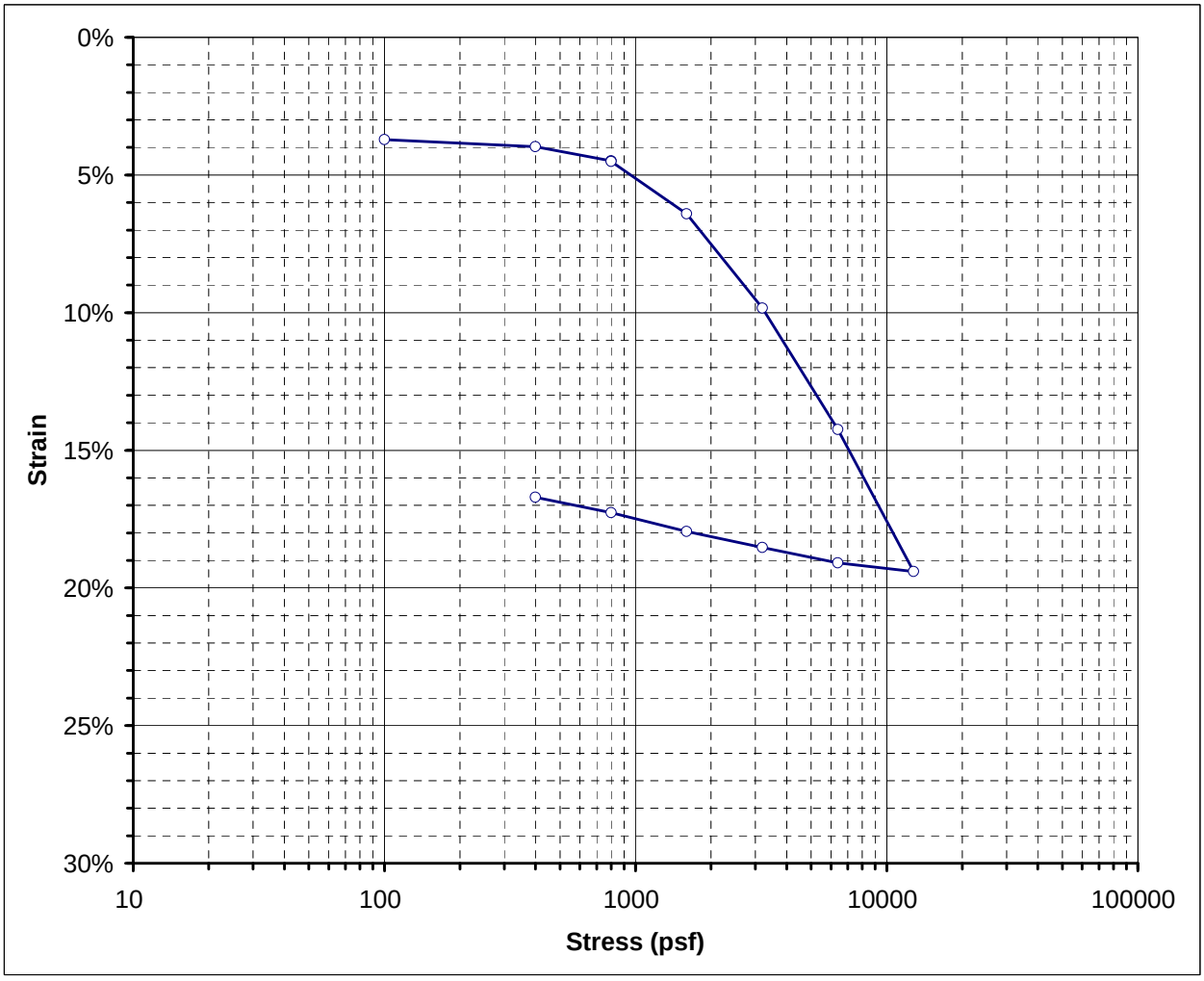
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2f

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-17-12\Consol A-RW011R2@5'_2.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW013	**Sample Depth**	15
Sample No.	R4	**USCS**	0

BEFORE TEST

Initial Moisture Content:	50.9%	
Initial Dry Unit Wt:	73.3	pcf
Initial Total Unit Wt.:	110.6	pcf
Initial Void Ratio:	1.3750	
Initial Degree of Saturation:	103.3%	

AFTER TEST

Final Moisture Content:	38.6%	
Final Dry Unit Wt:	86.7	pcf
Final Total Unit Wt.:	123.5	pcf
Final Void Ratio:	1.0076	
Final Degree of Saturation:	106.9%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	3.71%	1.2868
400	3.97%	1.2807
800	4.49%	1.2684
800	4.51%	1.2679
1600	6.41%	1.2228
3200	9.84%	1.1414
6400	14.24%	1.0367
12800	19.41%	0.9141
6400	19.09%	0.9216
3200	18.53%	0.9349
1600	17.95%	0.9487
800	17.27%	0.9650
400	16.70%	0.9783

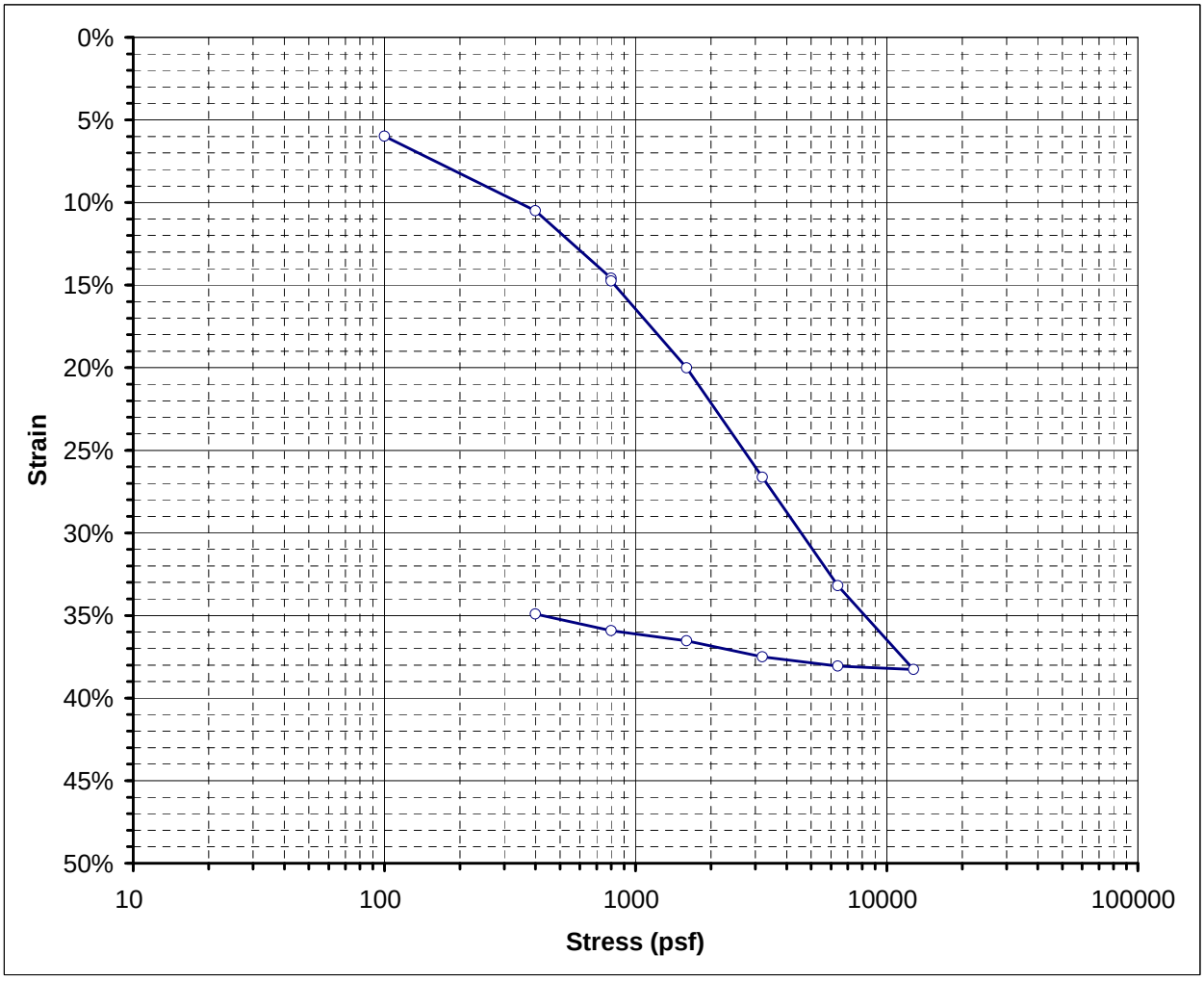
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2g

C:\Documents and Settings\kristenc\Desktop\Consol A-RW013R4@15'_3.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW030	**Sample Depth**	10
Sample No.	R3	**USCS**	0

BEFORE TEST

Initial Moisture Content:	107.6%	
Initial Dry Unit Wt:	43.5	pcf
Initial Total Unit Wt.:	90.3	pcf
Initial Void Ratio:	3.0033	
Initial Degree of Saturation:	100.0%	

AFTER TEST

Final Moisture Content:	61.0%	
Final Dry Unit Wt:	64.6	pcf
Final Total Unit Wt.:	152.6	pcf
Final Void Ratio:	1.6946	
Final Degree of Saturation:	100.5%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	5.99%	2.7633
400	10.49%	2.5833
800	14.58%	2.4197
800	14.75%	2.4128
1600	20.01%	2.2022
3200	26.63%	1.9373
6400	33.19%	1.6745
12800	38.26%	1.4715
6400	38.06%	1.4795
3200	37.51%	1.5016
1600	36.53%	1.5410
800	35.92%	1.5652
400	34.92%	1.6053

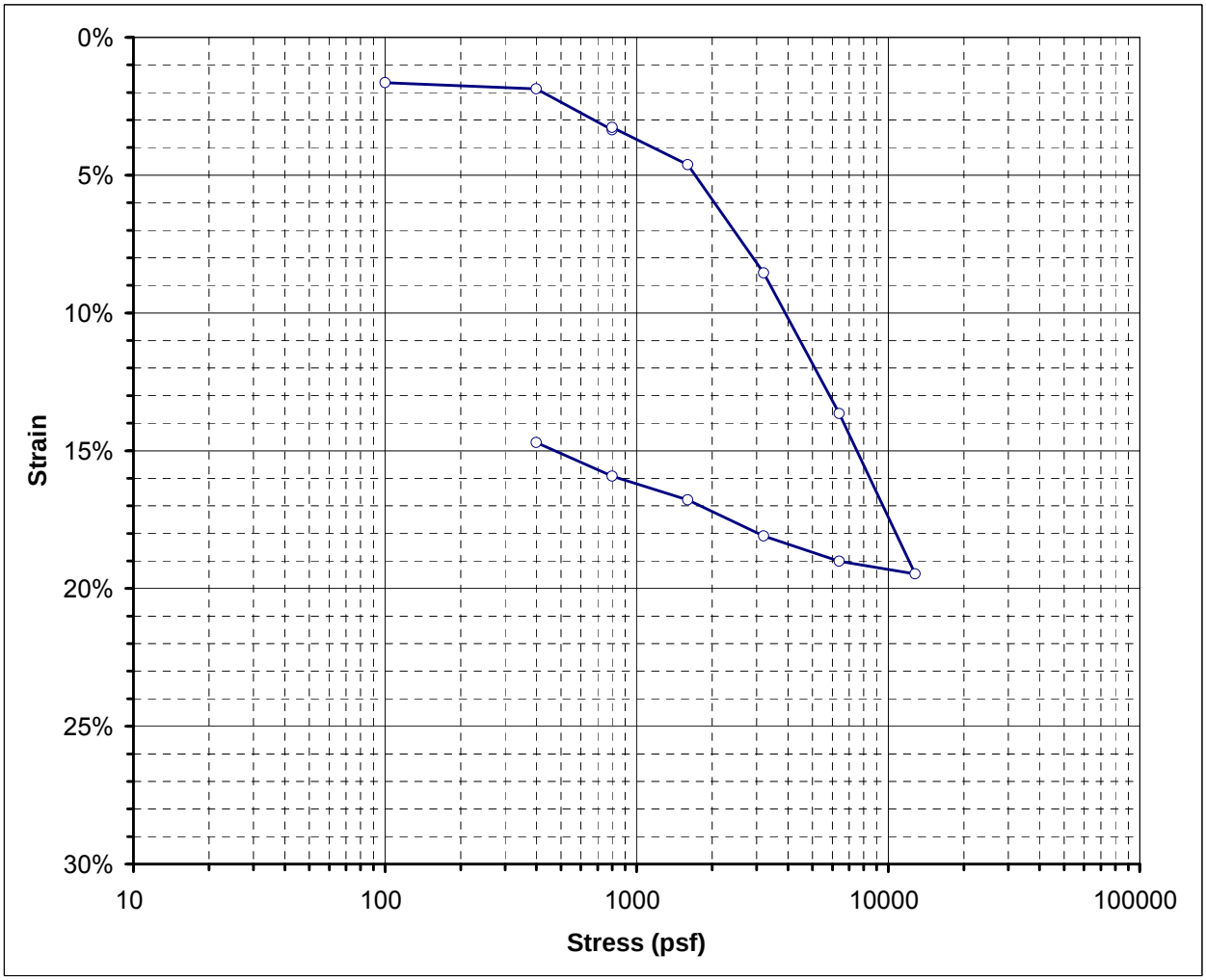
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2h

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 11-9-12\B-RW030 R3@10'_1.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW032	**Sample Depth**	10
Sample No.	R3A	**USCS**	CH

BEFORE TEST

Initial Moisture Content:	53.5%	
Initial Dry Unit Wt:	69.4	pcf
Initial Total Unit Wt.:	106.6	pcf
Initial Void Ratio:	1.5080	
Initial Degree of Saturation:	99.1%	

AFTER TEST

Final Moisture Content:	44.0%	
Final Dry Unit Wt:	79.8	pcf
Final Total Unit Wt.:	118.1	pcf
Final Void Ratio:	1.1817	
Final Degree of Saturation:	103.9%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=	71	**PL=**	28	**PI=**	43

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.65%	1.4667
400	1.87%	1.4612
800	3.35%	1.4239
800	3.26%	1.4262
1600	4.62%	1.3922
3200	8.55%	1.2935
6400	13.65%	1.1656
12800	19.47%	1.0198
6400	19.01%	1.0314
3200	18.09%	1.0543
1600	16.79%	1.0870
800	15.92%	1.1087
400	14.71%	1.1391

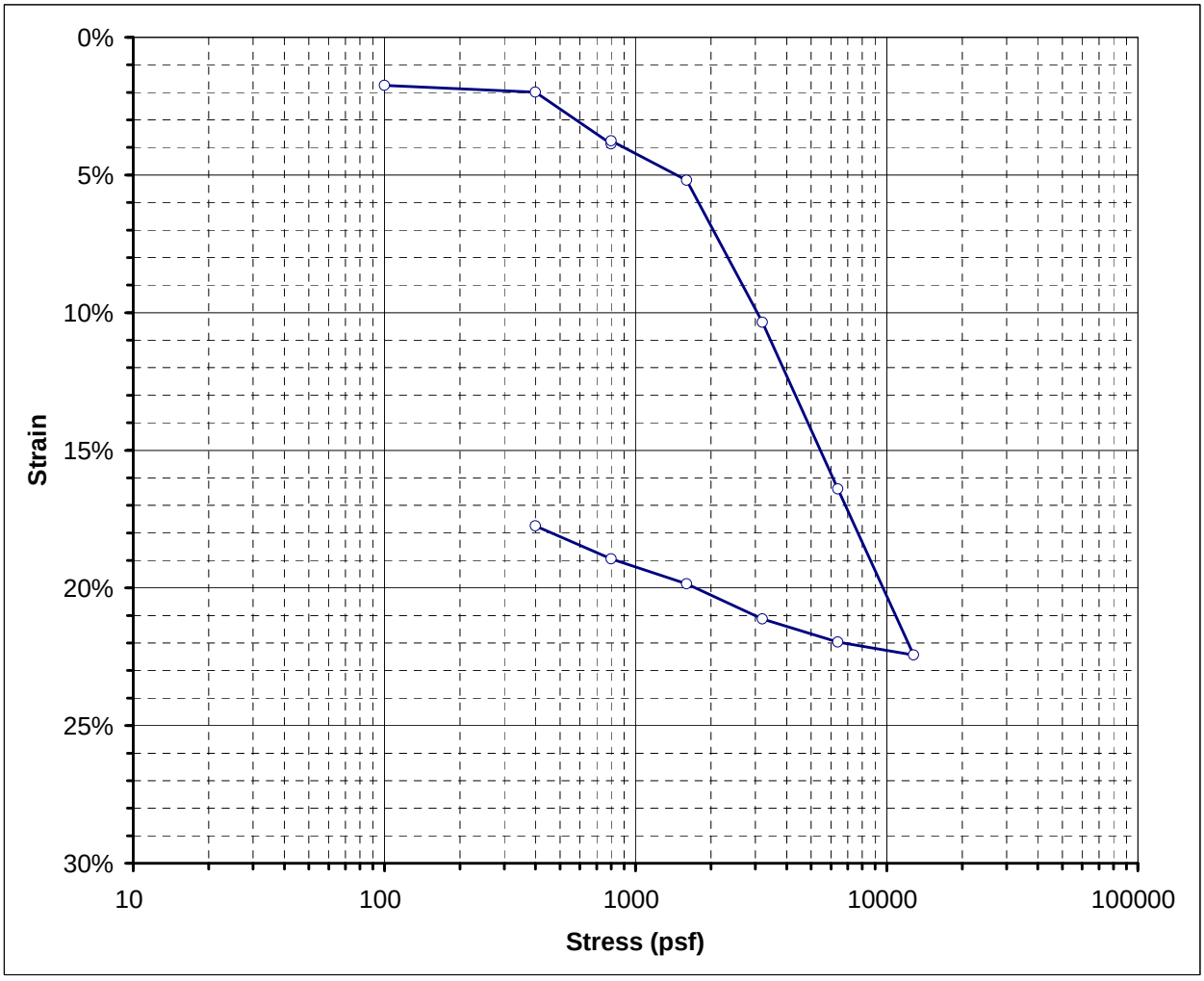
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2i

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 9-21-12\Consol B-RW032R3A@10'_2.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW036	**Sample Depth**	10
Sample No.	R2A	**USCS**	CH

BEFORE TEST

Initial Moisture Content:	51.2%	
Initial Dry Unit Wt:	71.3	**pcf**
Initial Total Unit Wt.:	107.7	**pcf**
Initial Void Ratio:	1.4431	
Initial Degree of Saturation:	98.9%	

AFTER TEST

Final Moisture Content:	39.0%	
Final Dry Unit Wt:	84.8	**pcf**
Final Total Unit Wt.:	122.3	**pcf**
Final Void Ratio:	1.0521	
Final Degree of Saturation:	103.3%	

Water Added at: 800 **psf**

ATTERBERG LIMITS					
LL=	60	**PL=**	28	**PI=**	32

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.75%	1.4004
400	1.99%	1.3945
800	3.88%	1.3484
800	3.76%	1.3513
1600	5.19%	1.3163
3200	10.35%	1.1902
6400	16.41%	1.0423
12800	22.44%	0.8949
6400	21.97%	0.9064
3200	21.12%	0.9270
1600	19.85%	0.9581
800	18.95%	0.9802
400	17.75%	1.0094

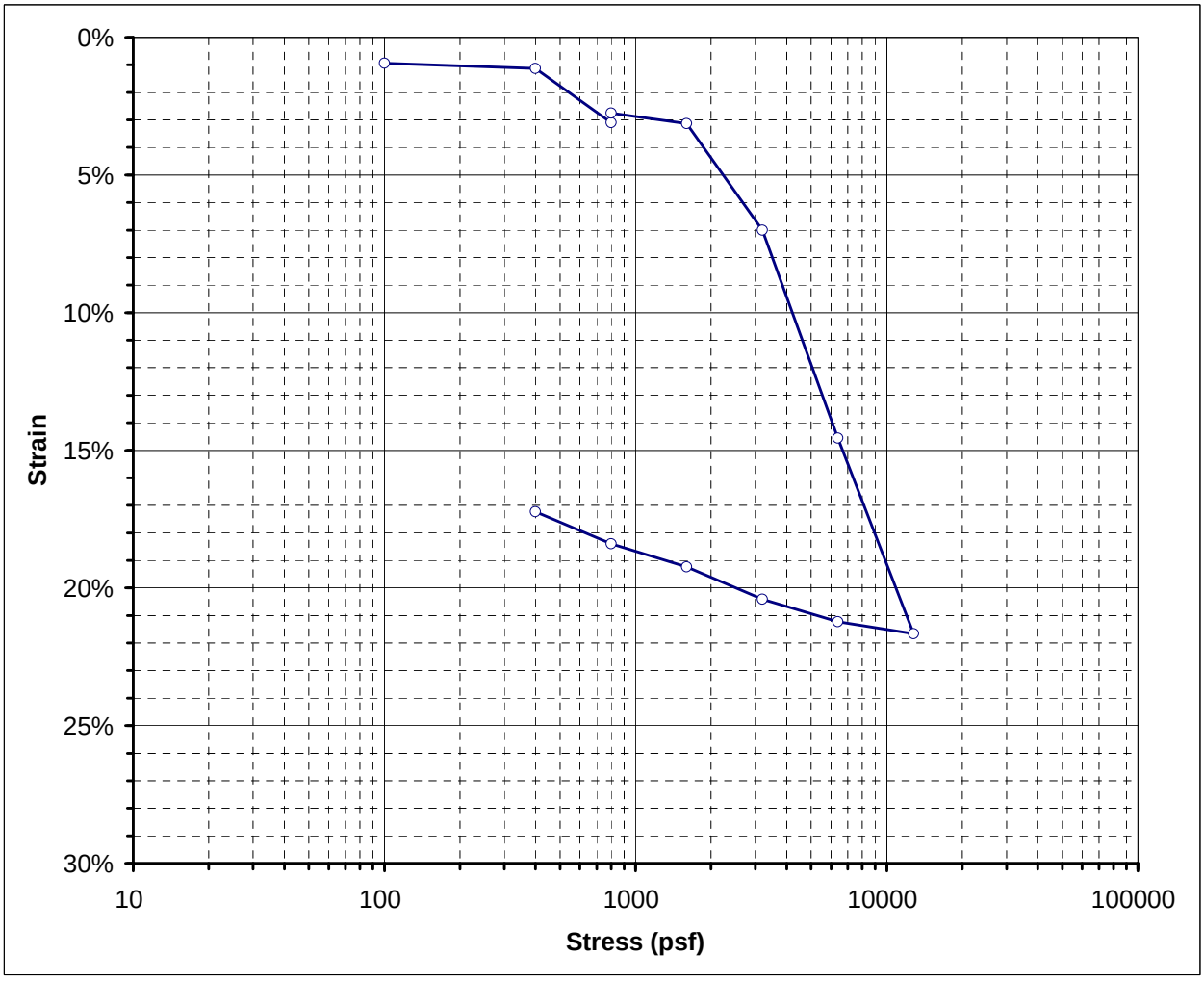
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2j

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 9-21-12\Consol B-RW036R2A@10'_3.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW036	**Sample Depth**	30
Sample No.	R6A	**USCS**	MH

BEFORE TEST

Initial Moisture Content:	58.8%	
Initial Dry Unit Wt:	64.8	**pcf**
Initial Total Unit Wt.:	102.9	**pcf**
Initial Void Ratio:	1.6871	
Initial Degree of Saturation:	97.3%	

AFTER TEST

Final Moisture Content:	46.7%	
Final Dry Unit Wt:	76.3	**pcf**
Final Total Unit Wt.:	121.1	**pcf**
Final Void Ratio:	1.2809	
Final Degree of Saturation:	101.6%	

Water Added at: 800 **psf**

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	0.93%	1.6619
400	1.13%	1.6568
800	3.10%	1.6039
800	2.75%	1.6131
1600	3.14%	1.6028
3200	7.01%	1.4988
6400	14.56%	1.2958
12800	21.67%	1.1048
6400	21.23%	1.1167
3200	20.41%	1.1386
1600	19.24%	1.1702
800	18.39%	1.1929
400	17.24%	1.2239

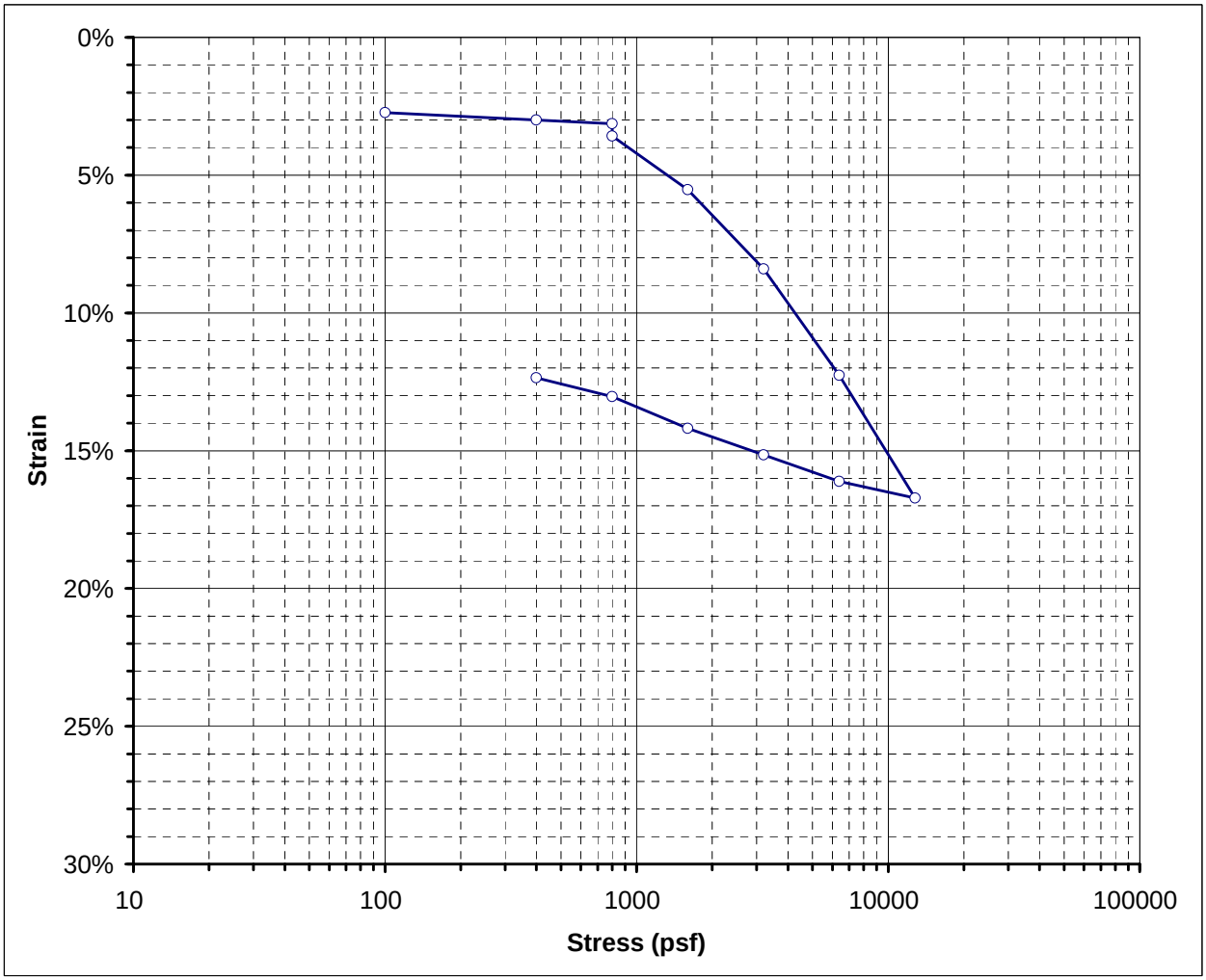
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2k

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 9-21-12\Consol B-RW036R6A@30'_4.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW041	**Sample Depth**	5 ft
Sample No.	R2A	**USCS**	0

BEFORE TEST

Initial Moisture Content:	47.4%	
Initial Dry Unit Wt:	75.0	pcf
Initial Total Unit Wt.:	110.6	pcf
Initial Void Ratio:	1.3207	
Initial Degree of Saturation:	100.2%	

AFTER TEST

Final Moisture Content:	39.5%	
Final Dry Unit Wt:	84.4	pcf
Final Total Unit Wt.:	115.2	pcf
Final Void Ratio:	1.0622	
Final Degree of Saturation:	103.7%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	2.73%	1.2573
400	3.00%	1.2510
800	3.13%	1.2480
800	3.58%	1.2376
1600	5.53%	1.1925
3200	8.41%	1.1256
6400	12.26%	1.0361
12800	16.72%	0.9328
6400	16.12%	0.9467
3200	15.16%	0.9690
1600	14.18%	0.9915
800	13.03%	1.0183
400	12.35%	1.0341

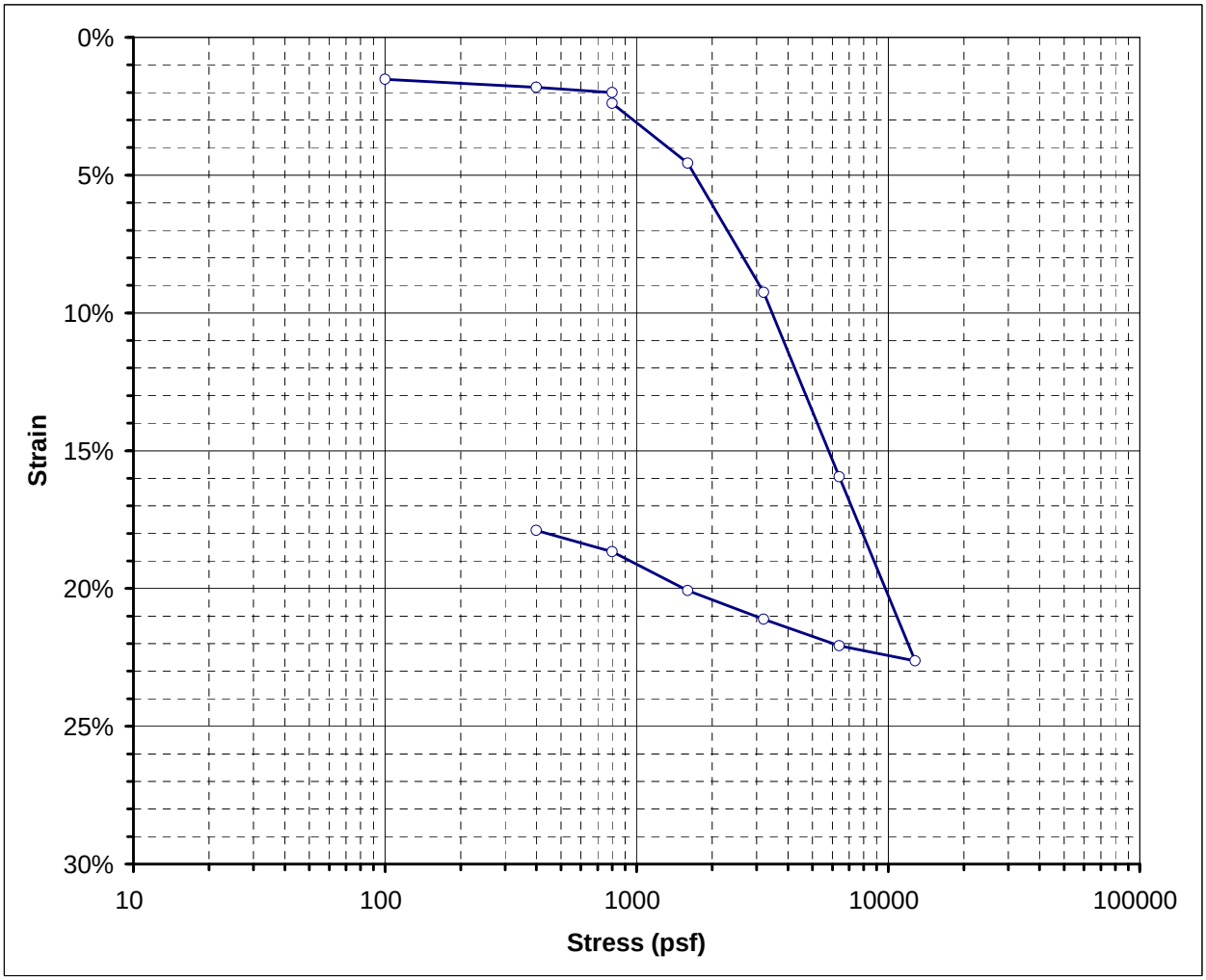
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2l

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-3-12\Consol B-RW041R2A@5'_2.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW041	**Sample Depth**	25 ft
Sample No.	R6A	**USCS**	0

BEFORE TEST

Initial Moisture Content:	58.0%	
Initial Dry Unit Wt:	65.2	pcf
Initial Total Unit Wt.:	103.0	pcf
Initial Void Ratio:	1.6717	
Initial Degree of Saturation:	96.8%	

AFTER TEST

Final Moisture Content:	45.4%	
Final Dry Unit Wt:	78.3	pcf
Final Total Unit Wt.:	122.9	pcf
Final Void Ratio:	1.2229	
Final Degree of Saturation:	103.5%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=	64	**PL=**	33	**PI=**	31

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.52%	1.6311
400	1.81%	1.6234
800	2.00%	1.6183
800	2.40%	1.6076
1600	4.57%	1.5496
3200	9.25%	1.4246
6400	15.94%	1.2459
12800	22.63%	1.0671
6400	22.08%	1.0818
3200	21.11%	1.1077
1600	20.08%	1.1353
800	18.67%	1.1729
400	17.89%	1.1938

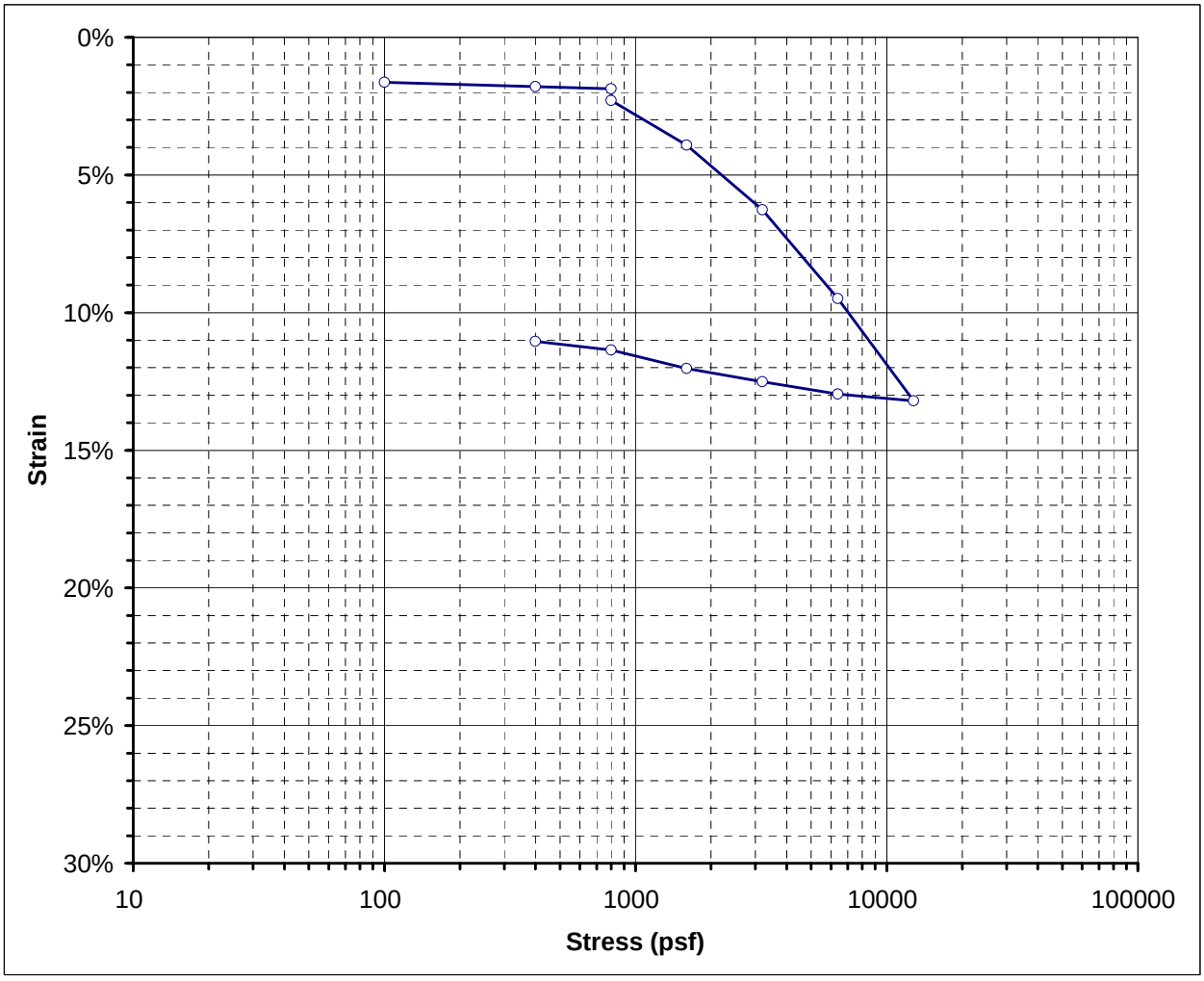
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2m

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-3-12\Consol B-RW041R6A@25'_3.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW044	**Sample Depth**	55 ft
Sample No.	R11	**USCS**	0

BEFORE TEST

Initial Moisture Content:	33.3%	
Initial Dry Unit Wt:	88.0	pcf
Initial Total Unit Wt.:	117.3	pcf
Initial Void Ratio:	0.9775	
Initial Degree of Saturation:	95.0%	

AFTER TEST

Final Moisture Content:	27.8%	
Final Dry Unit Wt:	98.4	pcf
Final Total Unit Wt.:	114.5	pcf
Final Void Ratio:	0.7692	
Final Degree of Saturation:	100.9%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.63%	0.9452
400	1.79%	0.9420
800	1.86%	0.9406
800	2.29%	0.9321
1600	3.92%	0.9000
3200	6.26%	0.8536
6400	9.49%	0.7898
12800	13.21%	0.7163
6400	12.96%	0.7213
3200	12.51%	0.7302
1600	12.02%	0.7397
800	11.36%	0.7528
400	11.04%	0.7591

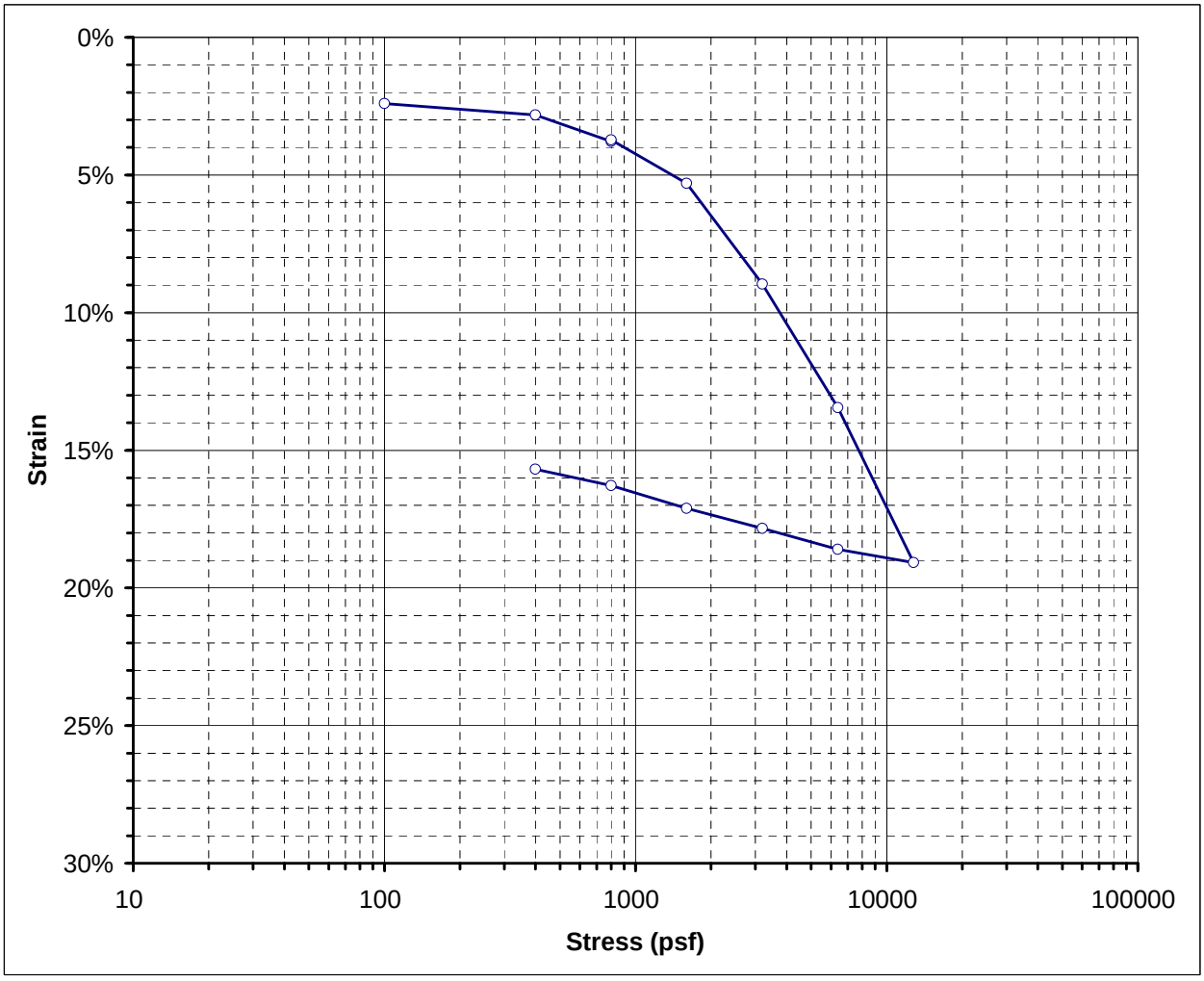
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2n

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-3-12\Consol B-RW044R11@55'_4.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW049	**Sample Depth**	15
Sample No.	R4A	**USCS**	0

BEFORE TEST

Initial Moisture Content:	72.7%	
Initial Dry Unit Wt:	56.2	pcf
Initial Total Unit Wt.:	97.1	pcf
Initial Void Ratio:	2.0975	
Initial Degree of Saturation:	96.7%	

AFTER TEST

Final Moisture Content:	59.5%	
Final Dry Unit Wt:	65.9	pcf
Final Total Unit Wt.:	120.1	pcf
Final Void Ratio:	1.6422	
Final Degree of Saturation:	101.0%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	2.40%	2.0230
400	2.82%	2.0103
800	3.78%	1.9805
800	3.73%	1.9820
1600	5.30%	1.9333
3200	8.96%	1.8200
6400	13.45%	1.6810
12800	19.08%	1.5065
6400	18.60%	1.5214
3200	17.84%	1.5450
1600	17.10%	1.5677
800	16.28%	1.5931
400	15.69%	1.6114

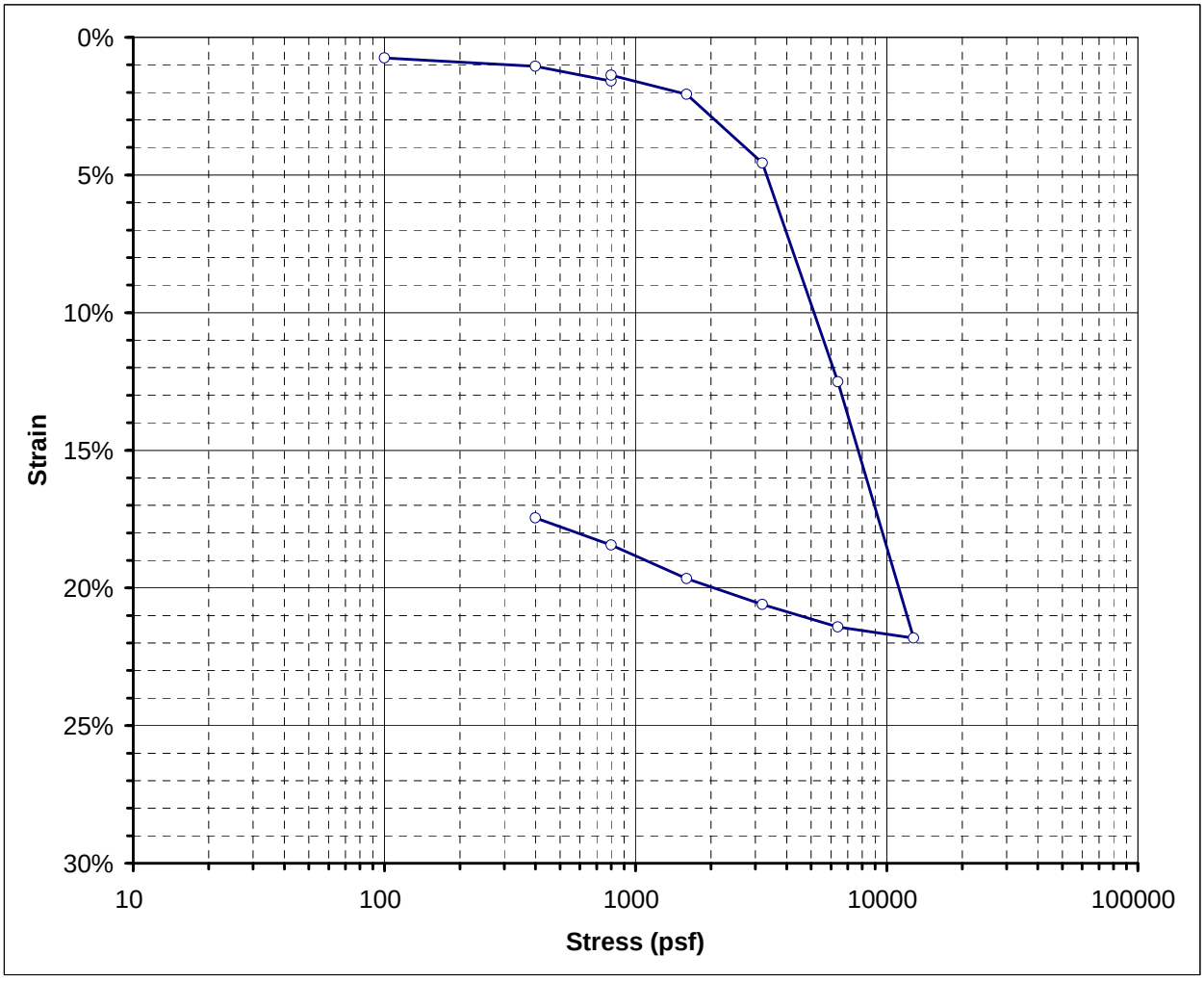
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2o

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-17-12\Consol A-RW049R4A@15'_4.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW049	**Sample Depth**	25 ft
Sample No.	R6A	**USCS**	0

BEFORE TEST

Initial Moisture Content:	64.3%	
Initial Dry Unit Wt:	60.4	**pcf**
Initial Total Unit Wt.:	99.2	**pcf**
Initial Void Ratio:	1.8822	
Initial Degree of Saturation:	95.2%	

AFTER TEST

Final Moisture Content:	50.8%	
Final Dry Unit Wt:	72.4	**pcf**
Final Total Unit Wt.:	122.8	**pcf**
Final Void Ratio:	1.4048	
Final Degree of Saturation:	100.8%	

Water Added at: 800 **psf**

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	0.75%	1.8605
400	1.05%	1.8518
800	1.59%	1.8362
800	1.37%	1.8426
1600	2.07%	1.8224
3200	4.57%	1.7505
6400	12.51%	1.5217
12800	21.82%	1.2532
6400	21.42%	1.2647
3200	20.60%	1.2884
1600	19.66%	1.3155
800	18.44%	1.3508
400	17.45%	1.3791

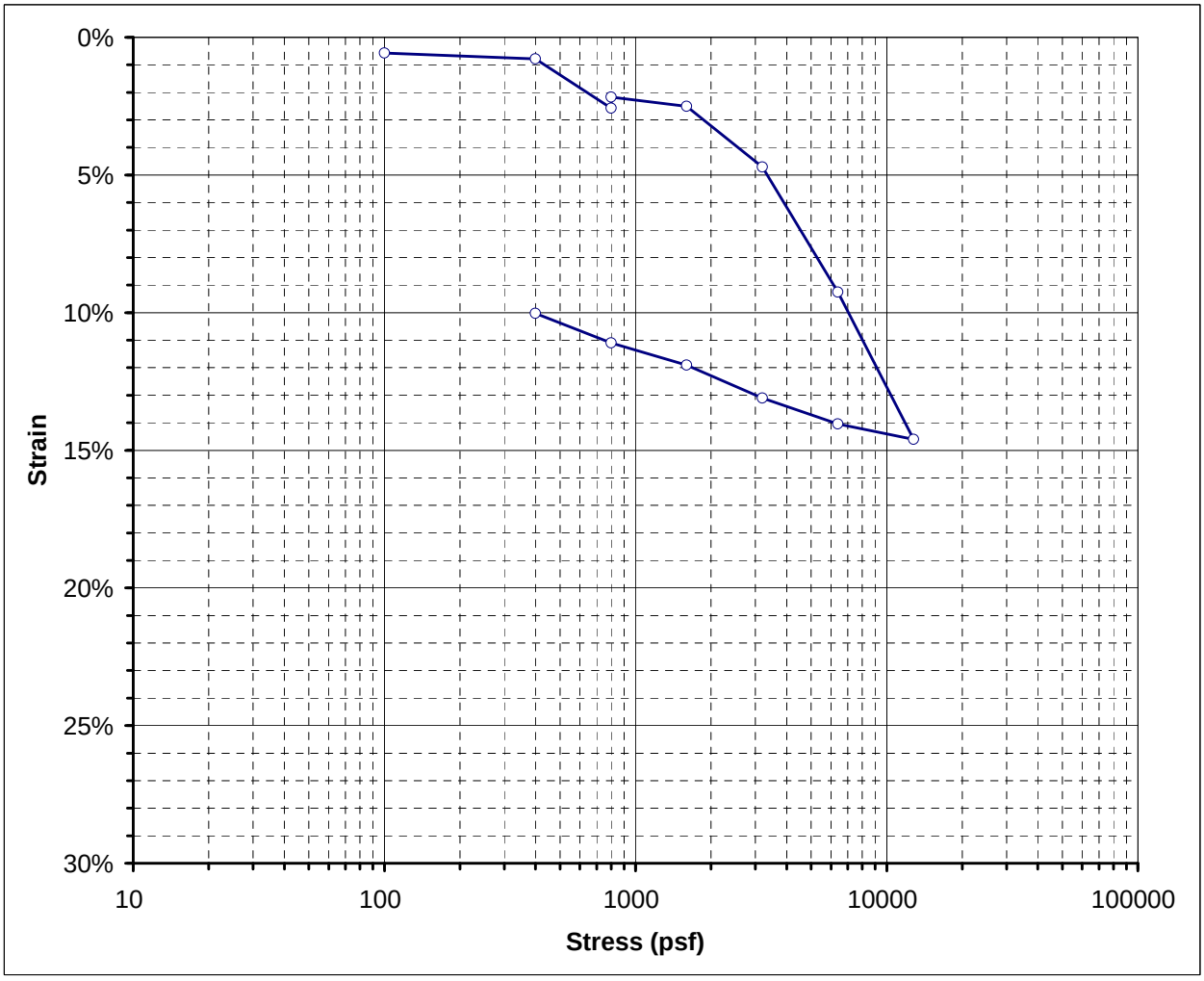
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2p

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-30-12\A-RW049 R6A@25'_1.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-HSA051	**Sample Depth**	5 ft
Sample No.	R3	**USCS**	0

BEFORE TEST

Initial Moisture Content:	45.1%	
Initial Dry Unit Wt:	75.7	pcf
Initial Total Unit Wt.:	109.9	pcf
Initial Void Ratio:	1.2998	
Initial Degree of Saturation:	96.9%	

AFTER TEST

Final Moisture Content:	40.9%	
Final Dry Unit Wt:	82.5	pcf
Final Total Unit Wt.:	111.6	pcf
Final Void Ratio:	1.1111	
Final Degree of Saturation:	102.6%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	0.57%	1.2867
400	0.78%	1.2819
800	2.58%	1.2406
800	2.17%	1.2498
1600	2.51%	1.2422
3200	4.71%	1.1915
6400	9.26%	1.0869
12800	14.60%	0.9641
6400	14.05%	0.9768
3200	13.11%	0.9984
1600	11.90%	1.0261
800	11.10%	1.0445
400	10.03%	1.0692

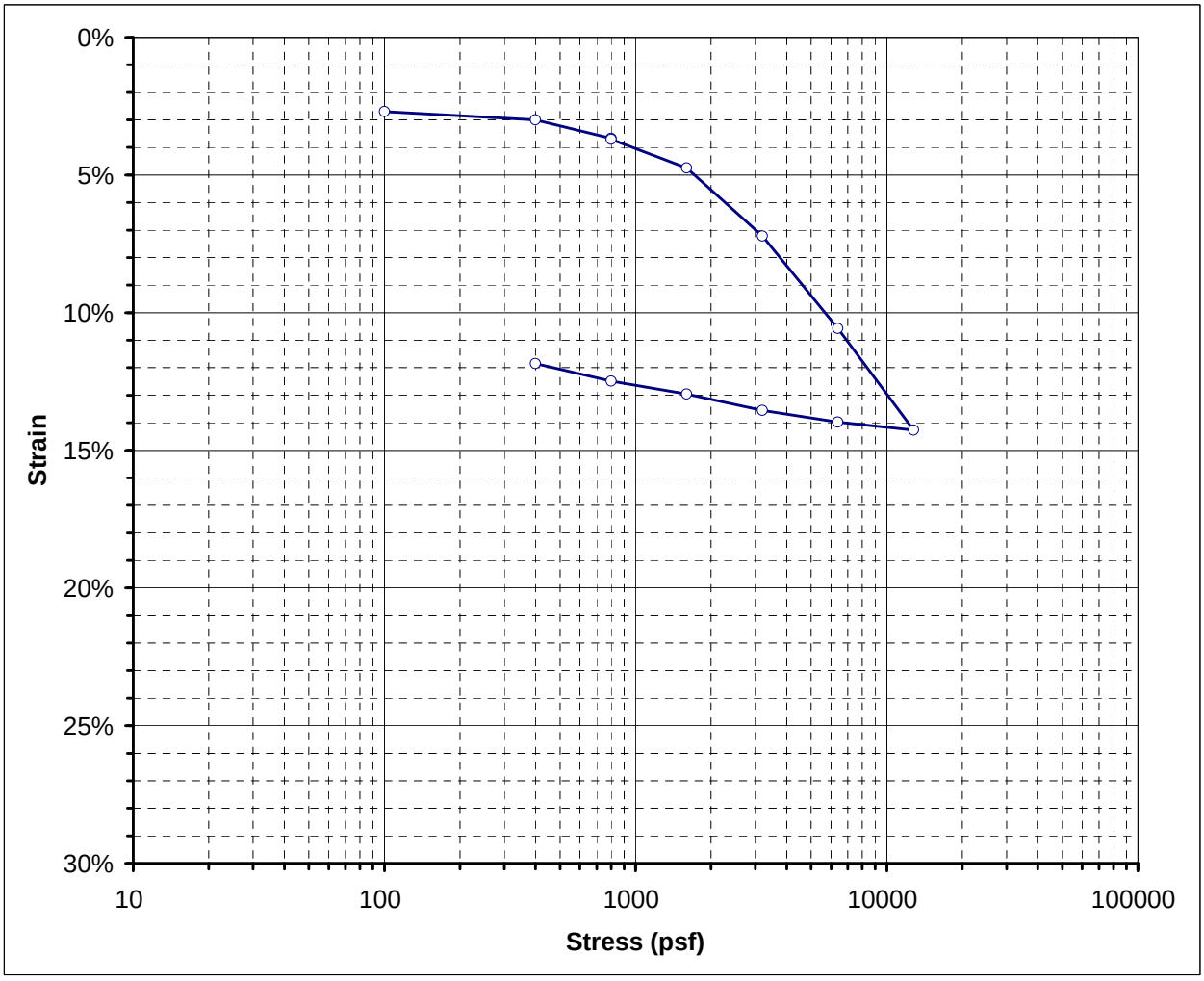
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2q

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 11-9-12\B-HSA051 R3@5'_2.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-HSA051	**Sample Depth**	10 ft
Sample No.	R5	**USCS**	0

BEFORE TEST

Initial Moisture Content:	43.6%	
Initial Dry Unit Wt:	77.5	pcf
Initial Total Unit Wt.:	111.3	pcf
Initial Void Ratio:	1.2466	
Initial Degree of Saturation:	97.5%	

AFTER TEST

Final Moisture Content:	36.8%	
Final Dry Unit Wt:	86.3	pcf
Final Total Unit Wt.:	114.5	pcf
Final Void Ratio:	1.0165	
Final Degree of Saturation:	100.9%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	2.69%	1.1861
400	2.99%	1.1793
800	3.67%	1.1642
800	3.70%	1.1635
1600	4.74%	1.1401
3200	7.22%	1.0845
6400	10.57%	1.0091
12800	14.27%	0.9260
6400	13.98%	0.9326
3200	13.55%	0.9423
1600	12.95%	0.9556
800	12.48%	0.9662
400	11.85%	0.9804

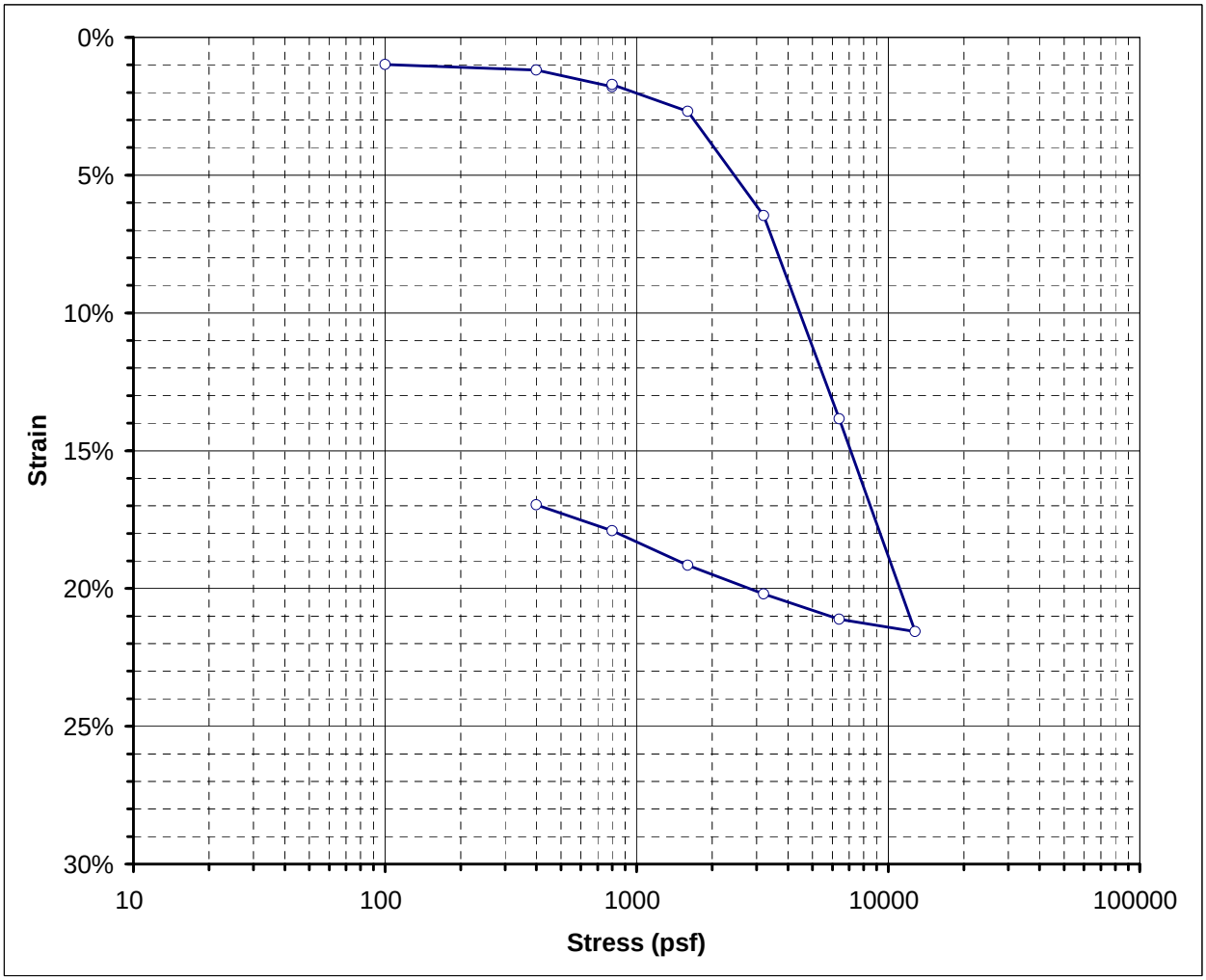
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2r

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 11-9-12\B-HSA051 R5@10'_3.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW053	**Sample Depth**	10 ft
Sample No.	R2A	**USCS**	0

BEFORE TEST

Initial Moisture Content:	59.5%	
Initial Dry Unit Wt:	63.9	**pcf**
Initial Total Unit Wt.:	101.8	**pcf**
Initial Void Ratio:	1.7261	
Initial Degree of Saturation:	96.1%	

AFTER TEST

Final Moisture Content:	47.6%	
Final Dry Unit Wt:	76.2	**pcf**
Final Total Unit Wt.:	122.1	**pcf**
Final Void Ratio:	1.2845	
Final Degree of Saturation:	103.4%	

Water Added at: 800 **psf**

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	0.98%	1.6993
400	1.19%	1.6937
800	1.79%	1.6773
800	1.71%	1.6795
1600	2.69%	1.6528
3200	6.47%	1.5498
6400	13.84%	1.3488
12800	21.56%	1.1384
6400	21.12%	1.1504
3200	20.20%	1.1755
1600	19.16%	1.2038
800	17.90%	1.2382
400	16.96%	1.2638

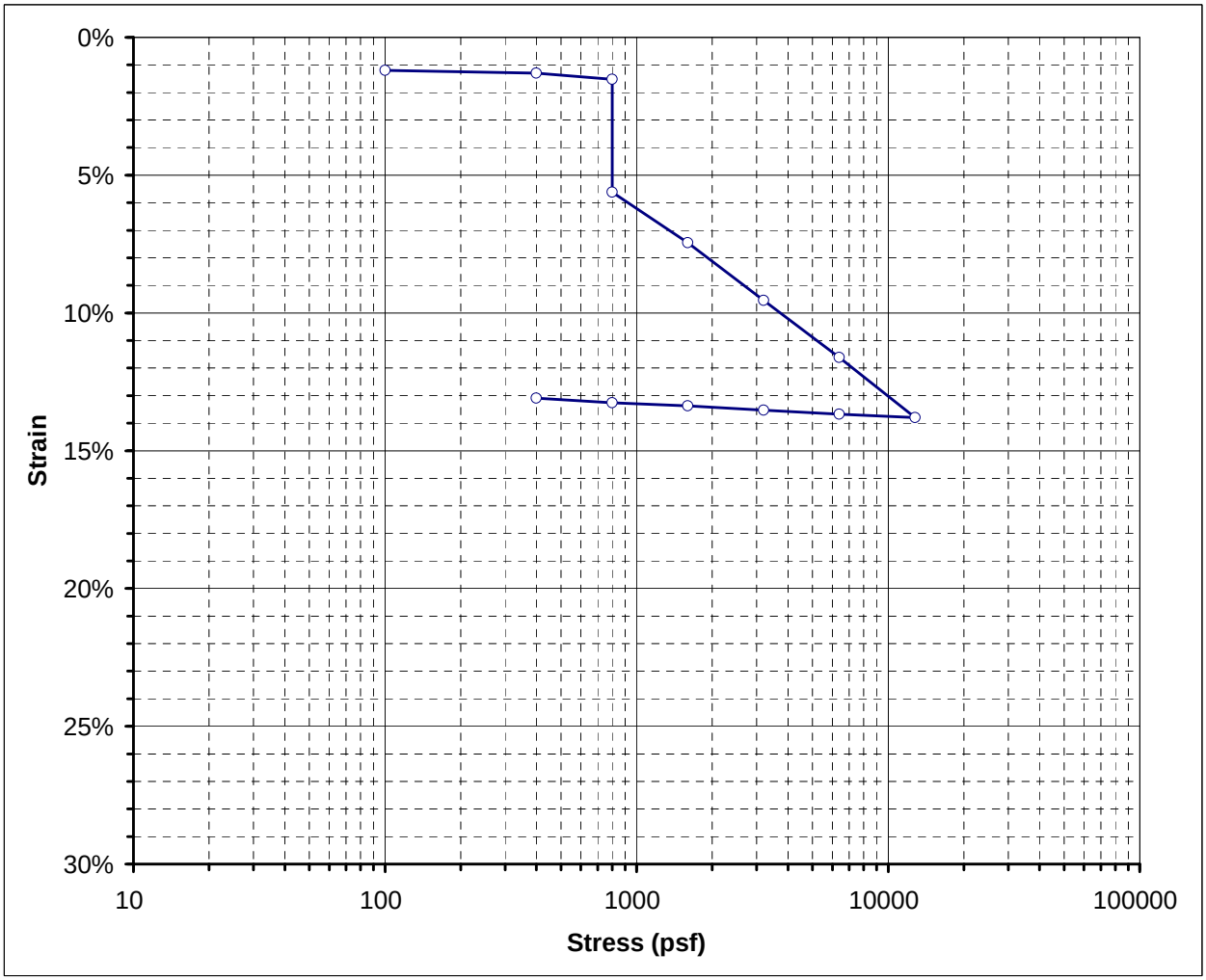
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2s

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-30-12\A-RW053 R2A@10'_2.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	C-HSA061	**Sample Depth**	7.5 ft
Sample No.	R3	**USCS**	0

BEFORE TEST

Initial Moisture Content:	7.2%	
Initial Dry Unit Wt:	88.6	pcf
Initial Total Unit Wt.:	94.9	pcf
Initial Void Ratio:	0.9655	
Initial Degree of Saturation:	20.8%	

AFTER TEST

Final Moisture Content:	20.7%	
Final Dry Unit Wt:	101.4	pcf
Final Total Unit Wt.:	117.1	pcf
Final Void Ratio:	0.7167	
Final Degree of Saturation:	80.7%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

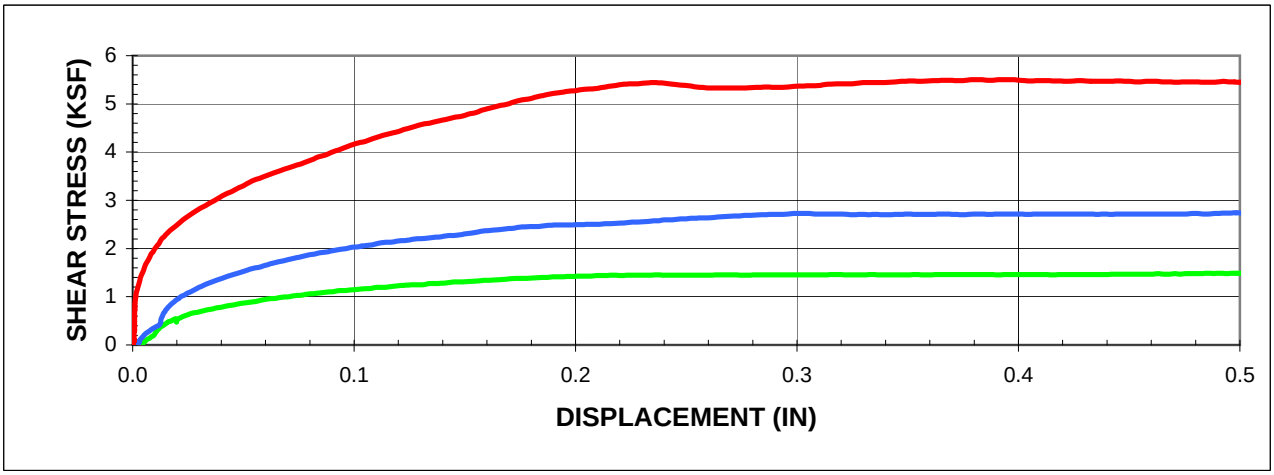
PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.20%	0.9419
400	1.30%	0.9400
800	1.52%	0.9356
800	5.62%	0.8551
1600	7.45%	0.8191
3200	9.55%	0.7778
6400	11.61%	0.7373
12800	13.80%	0.6943
6400	13.67%	0.6968
3200	13.53%	0.6996
1600	13.37%	0.7027
800	13.26%	0.7049
400	13.09%	0.7082

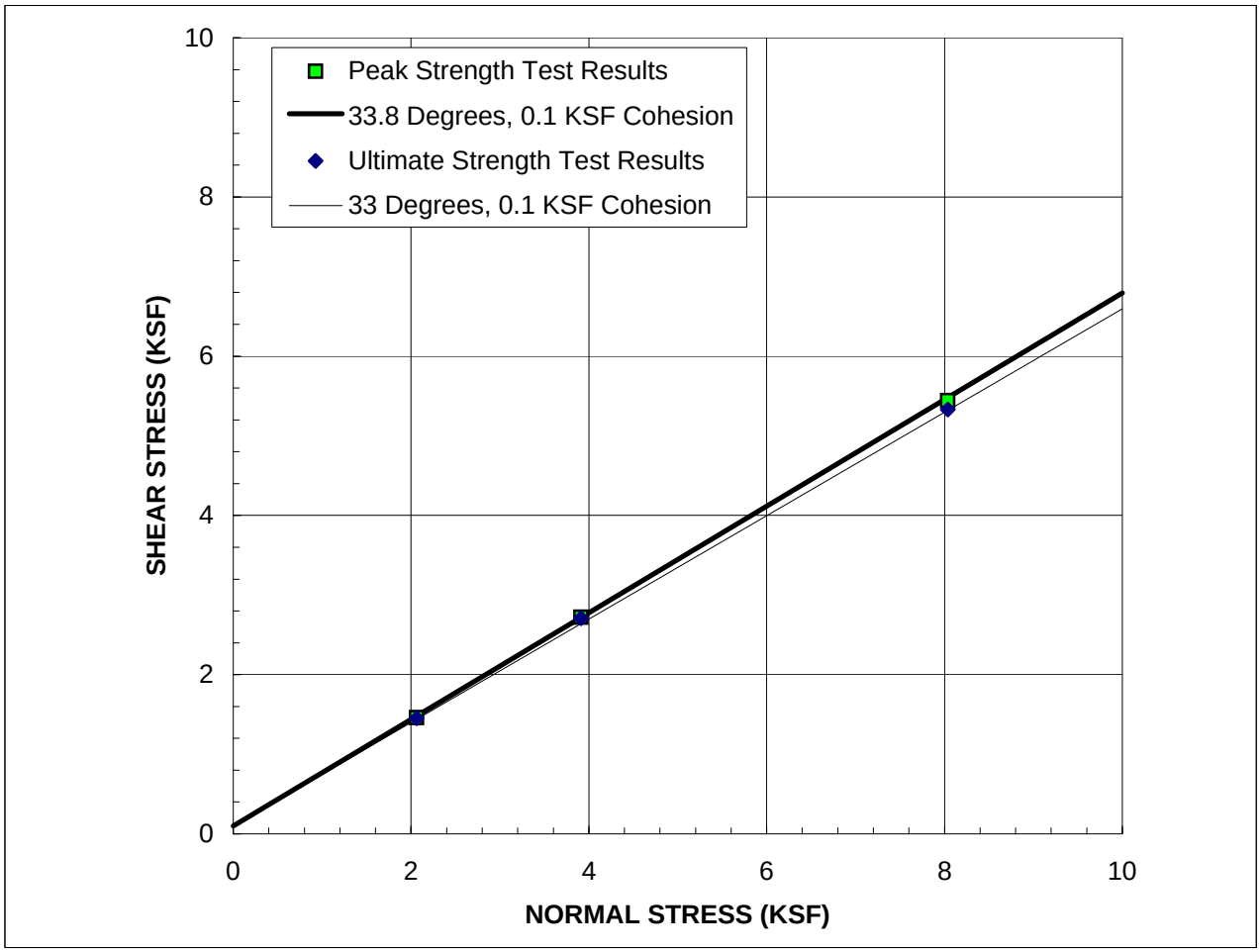
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2t

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 11-9-12\C-HSA061 R3@7.5'_4.xls





SAMPLE: A-RW002 R6@40'

Description:	Very Dark Greenish Gray Sandy Silty Clay with Traces of Shells

STRAIN RATE: 0.0025 IN/MIN

(Sample was consolidated and drained)

	PEAK	**ULTIMATE**
ϕ'	33.8 ^{o}	33.0 ^{o}
c'	0.10 KSF	0.10 KSF

	IN-SITU	**AS-TESTED**
γ_d	PCF	0.0 PCF
w_c	%	36.1 %

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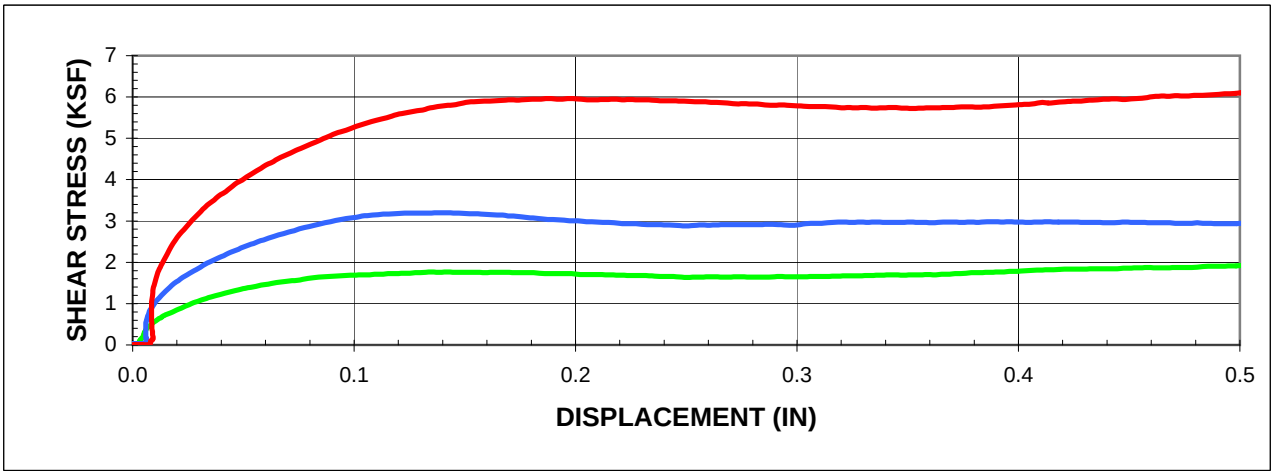
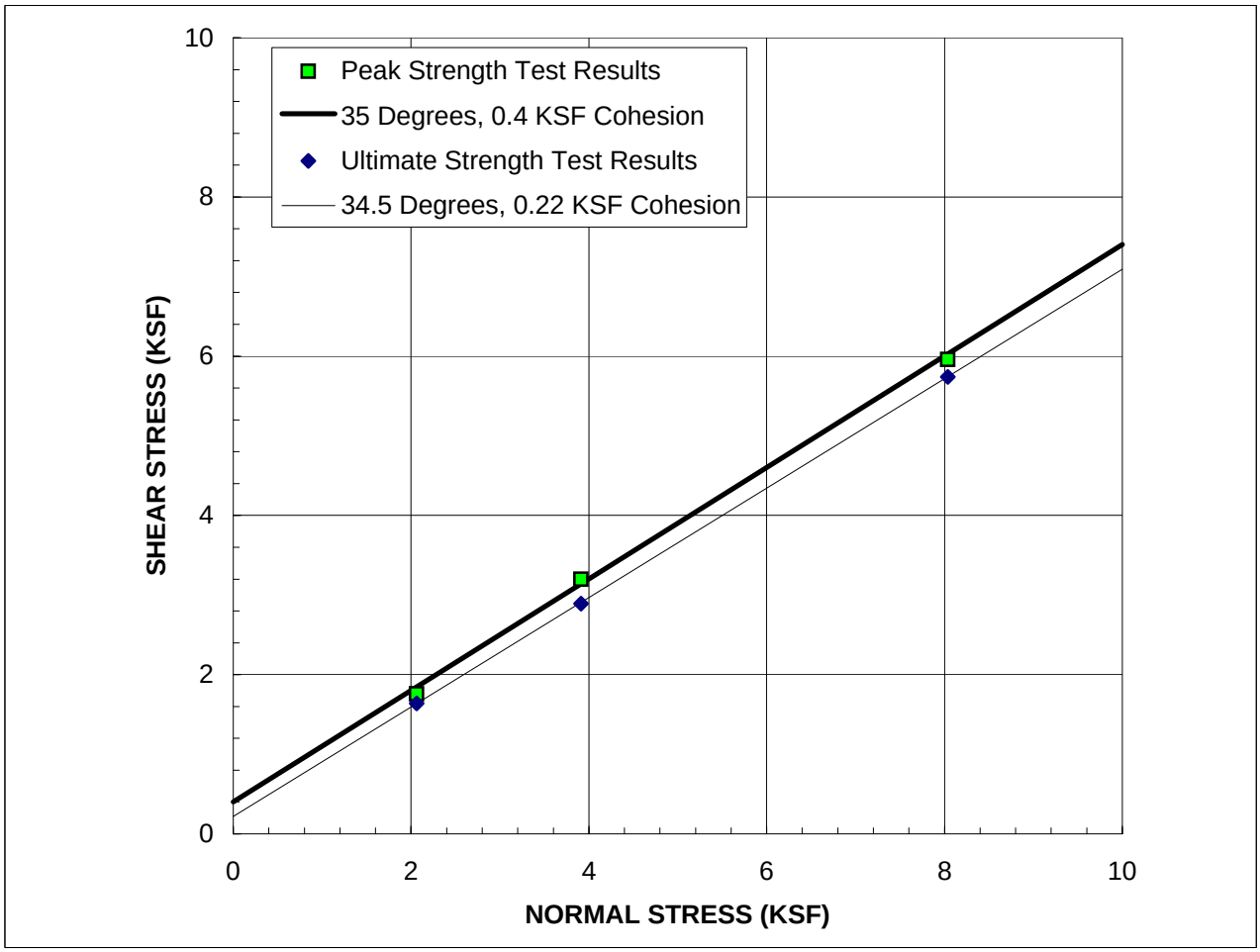
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3a





SAMPLE: A-RW003 R3A@10'

Description:	Very Dark Greenish Gray Clayey Sand with Traces of Shells

STRAIN RATE: 0.0050 IN/MIN

(Sample was consolidated and drained)

	PEAK	ULTIMATE
ϕ'	35 °	34.5 °
c'	0.40 KSF	0.22 KSF

	IN-SITU	AS-TESTED
γ_d	PCF	0.0 PCF
w_c	%	22.0 %

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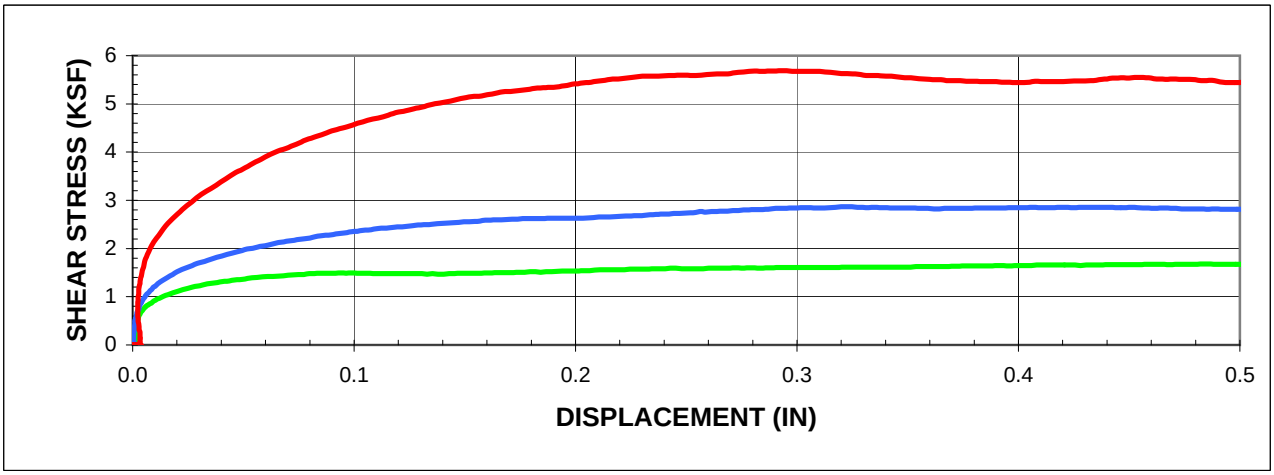
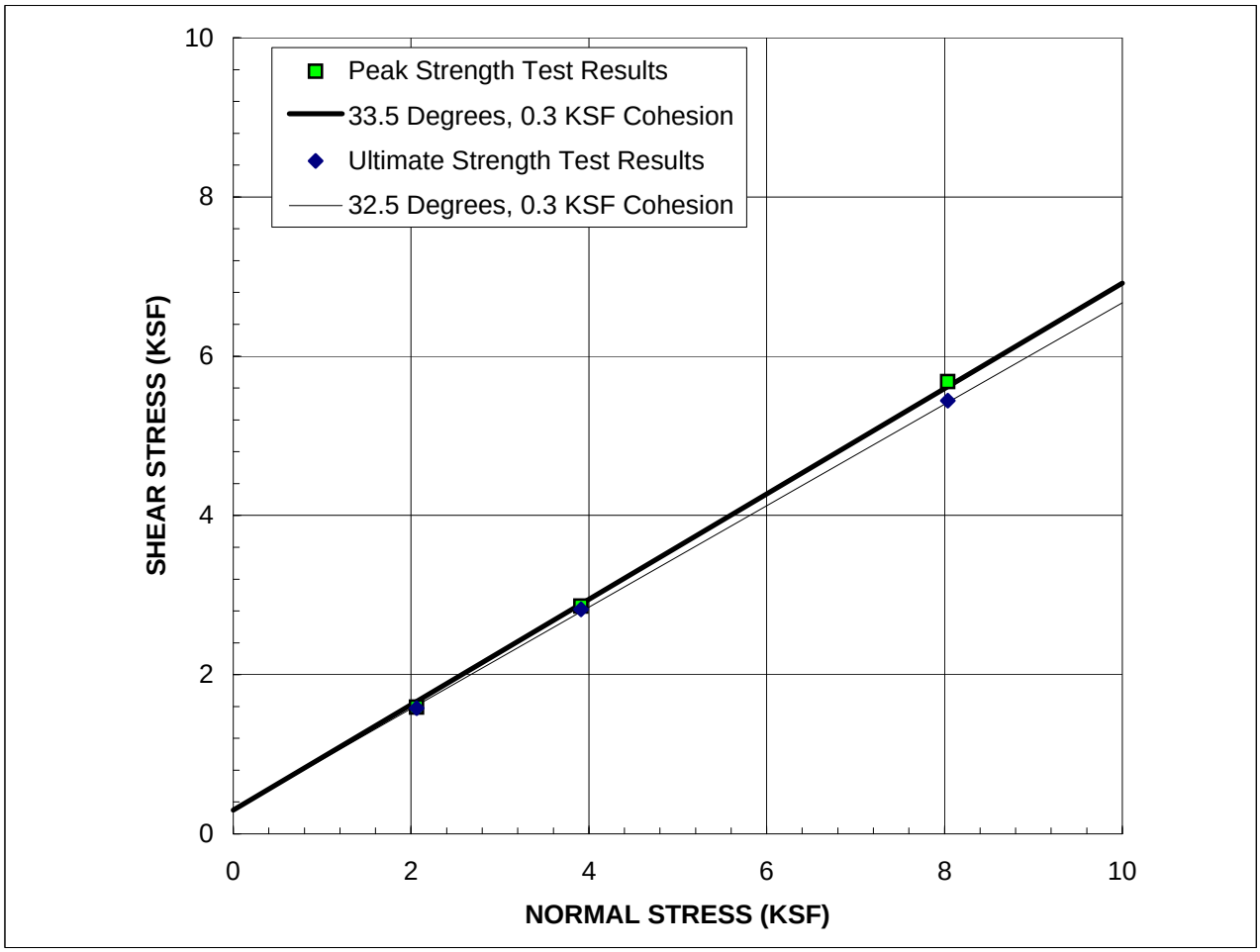
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3b





SAMPLE: A-RW003 R7A@30'

Description:	Very Dark Greenish Gray Sandy Clay with Shells

	PEAK	**ULTIMATE**
ϕ'	33.5 ^{o}	32.5 ^{o}
c'	0.30 KSF	0.30 KSF

STRAIN RATE: 0.0030 IN/MIN

(Sample was consolidated and drained)

	IN-SITU	**AS-TESTED**
γ_d	PCF	0.0 PCF
w_c	%	29.3 %

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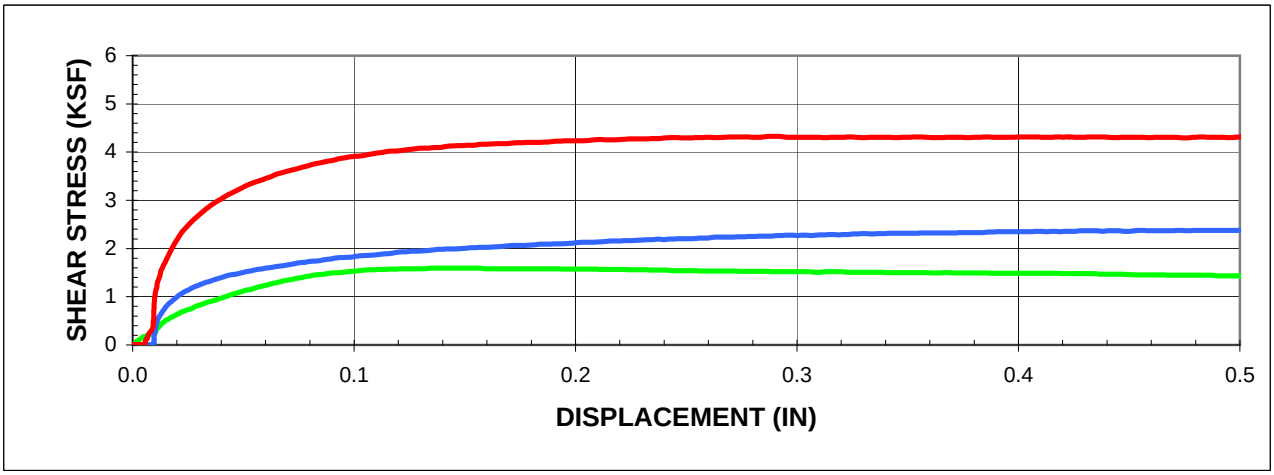
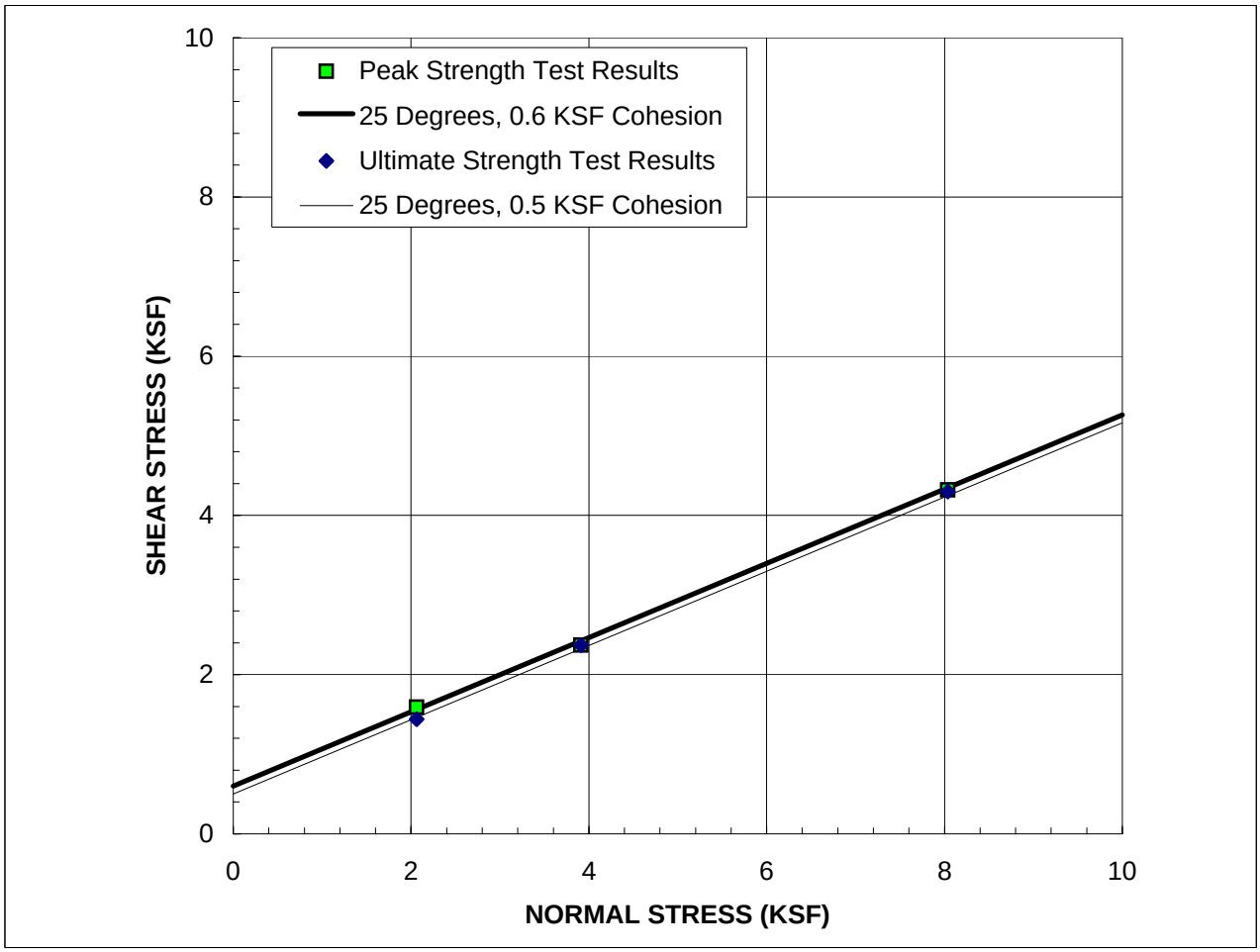
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3c





SAMPLE: A-RW005 R1@5'

Description: Olive Brown Clay with Shells

STRAIN RATE: 0.0025 IN/MIN

(Sample was consolidated and drained)

	PEAK	ULTIMATE
ϕ'	25.0 ^{o}	25.0 ^{o}
c'	0.60 KSF	0.50 KSF

	IN-SITU	AS-TESTED
γ_d	PCF	0.0 PCF
w_c	%	28.3 %

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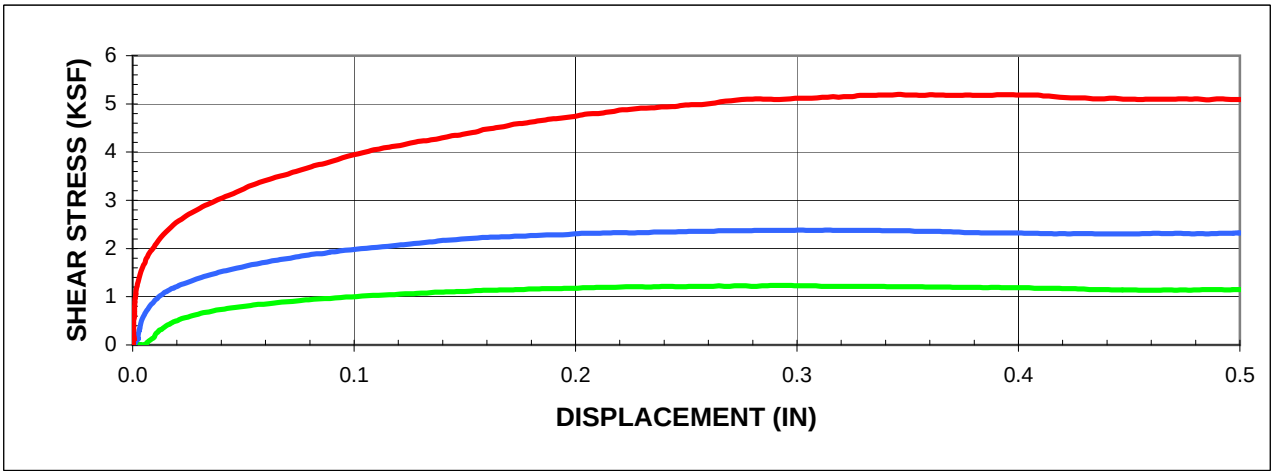
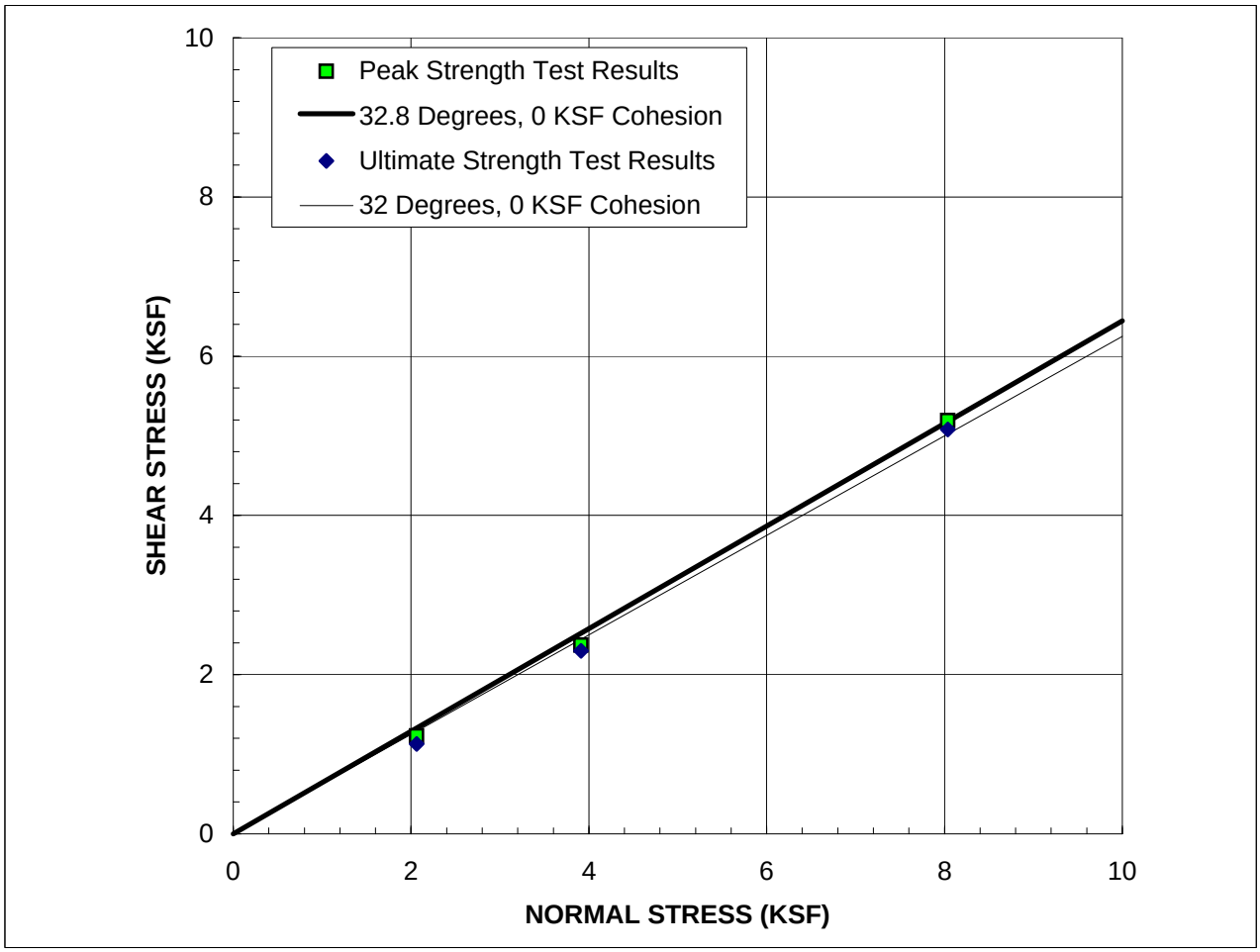
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3d





SAMPLE: A-RW005 R7@35'

Description:	Very Dark Greenish Gray Sandy Silty Clay with Traces of Shells

STRAIN RATE: 0.0025 IN/MIN

(Sample was consolidated and drained)

	PEAK	ULTIMATE
ϕ'	32.8 ^{o}	32 ^{o}
c'	0.00 KSF	0.00 KSF

	IN-SITU	AS-TESTED
γ_d	PCF	0.0 PCF
w_c	%	43.8 %

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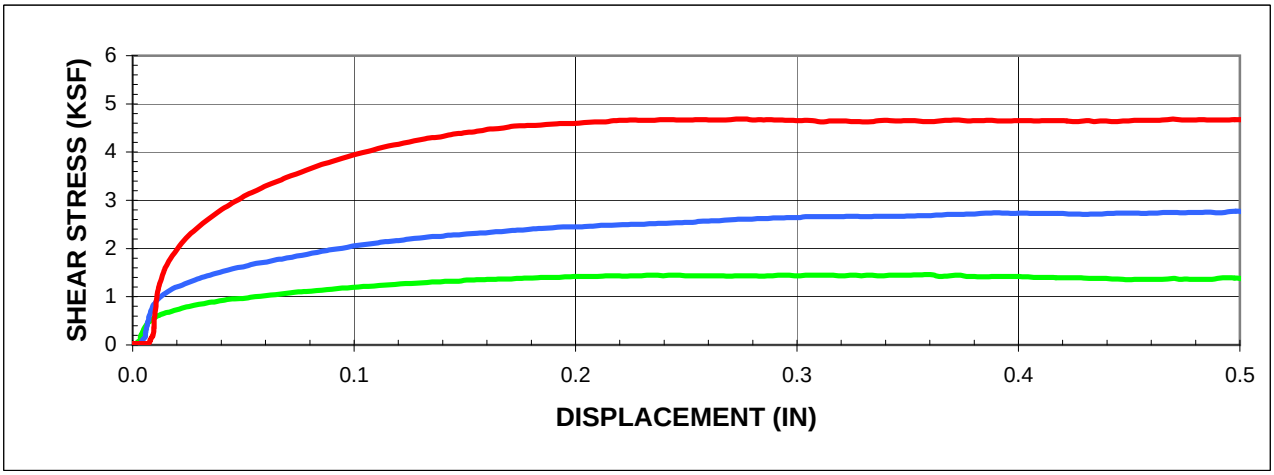
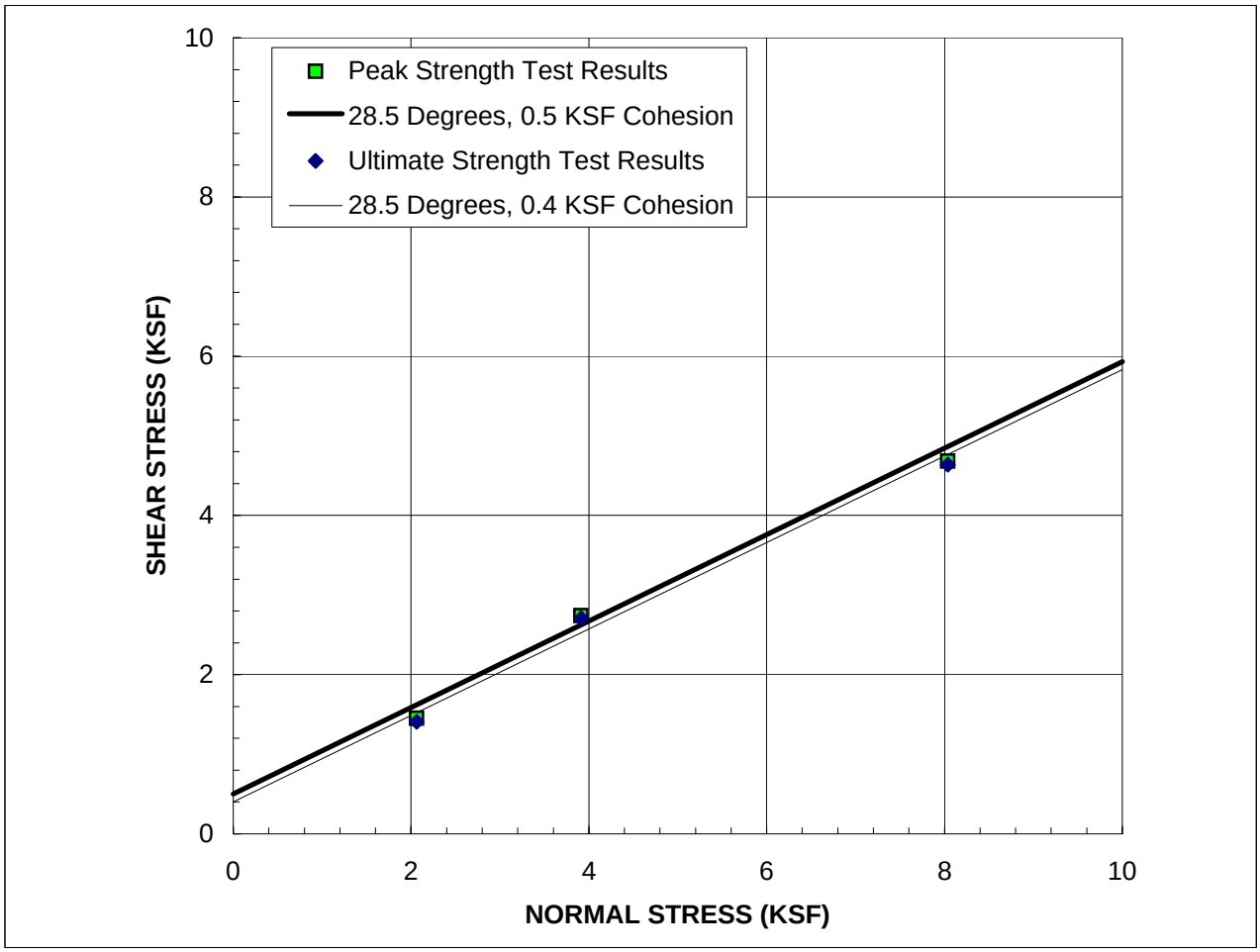
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3e





SAMPLE: A-RW006 R2@5'

Description:	Dark Brown Sandy Silt with Clay and Traces of Gravel with Asphalt

STRAIN RATE: 0.0030 IN/MIN

(Sample was consolidated and drained)

	PEAK	ULTIMATE
ϕ'	28.5 ^{o}	28.5 ^{o}
c'	0.50 KSF	0.40 KSF

	IN-SITU	AS-TESTED
γ_d	PCF	0.0 PCF
w_c	%	17.5 %

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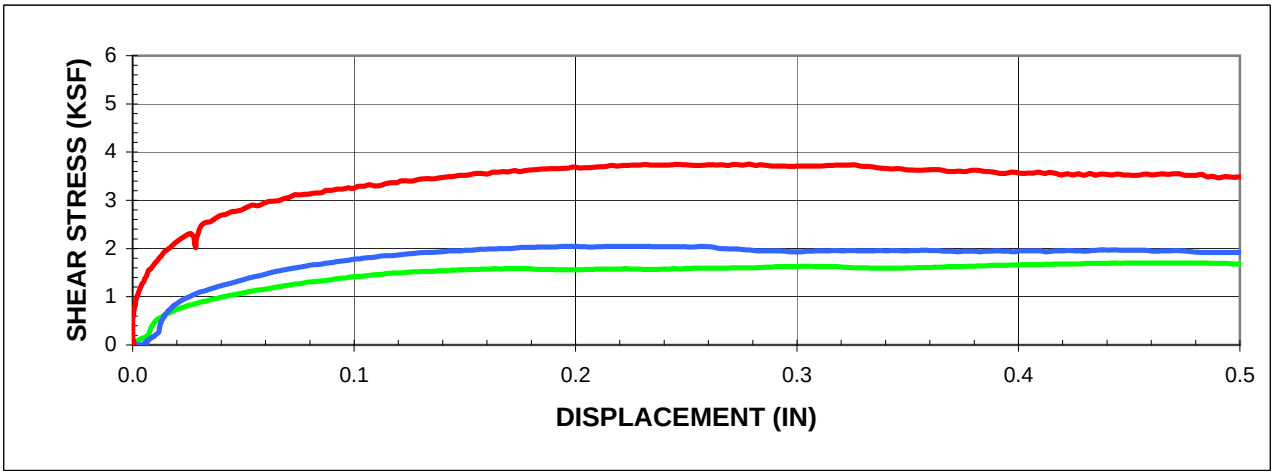
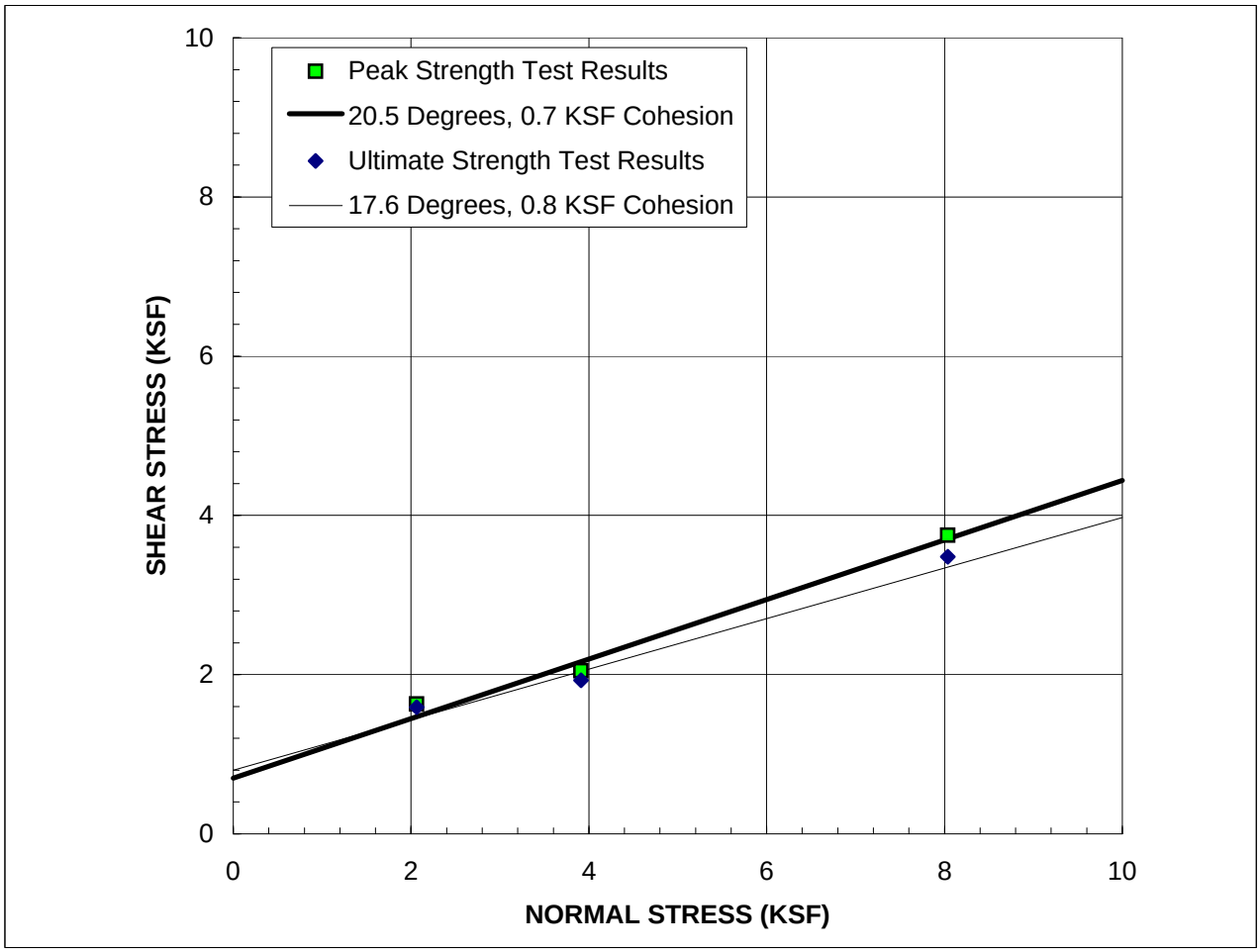
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3f





SAMPLE: A-RW008 R2@10'

Description: Olive Silty Clay with Sand

	PEAK	ULTIMATE
ϕ'	20.5 ^{o}	17.6 ^{o}
c'	0.70 KSF	0.80 KSF

STRAIN RATE: 0.0025 IN/MIN

(Sample was consolidated and drained)

	IN-SITU	AS-TESTED
γ_d	PCF	0.0 PCF
w_c	%	37.7 %

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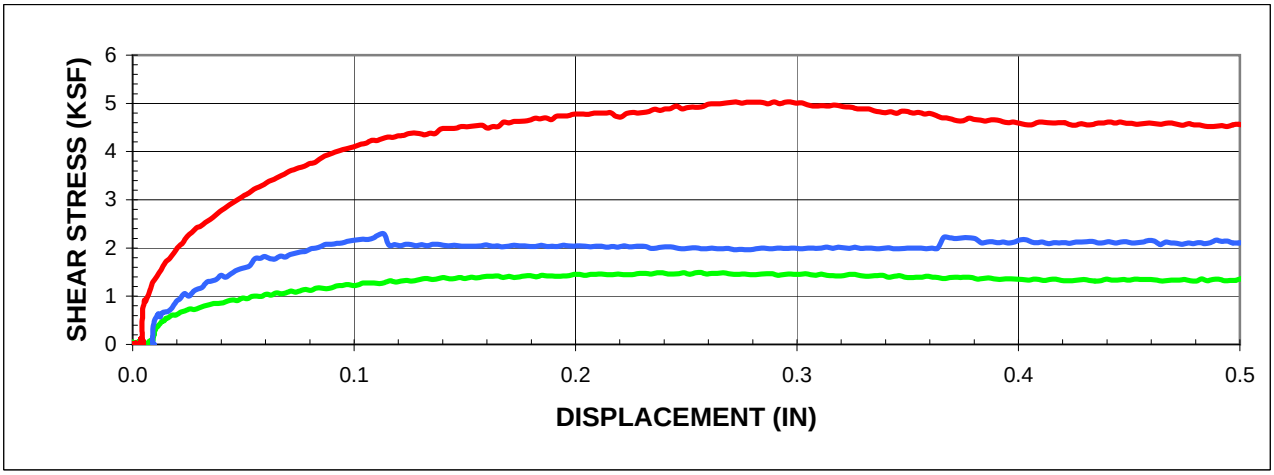
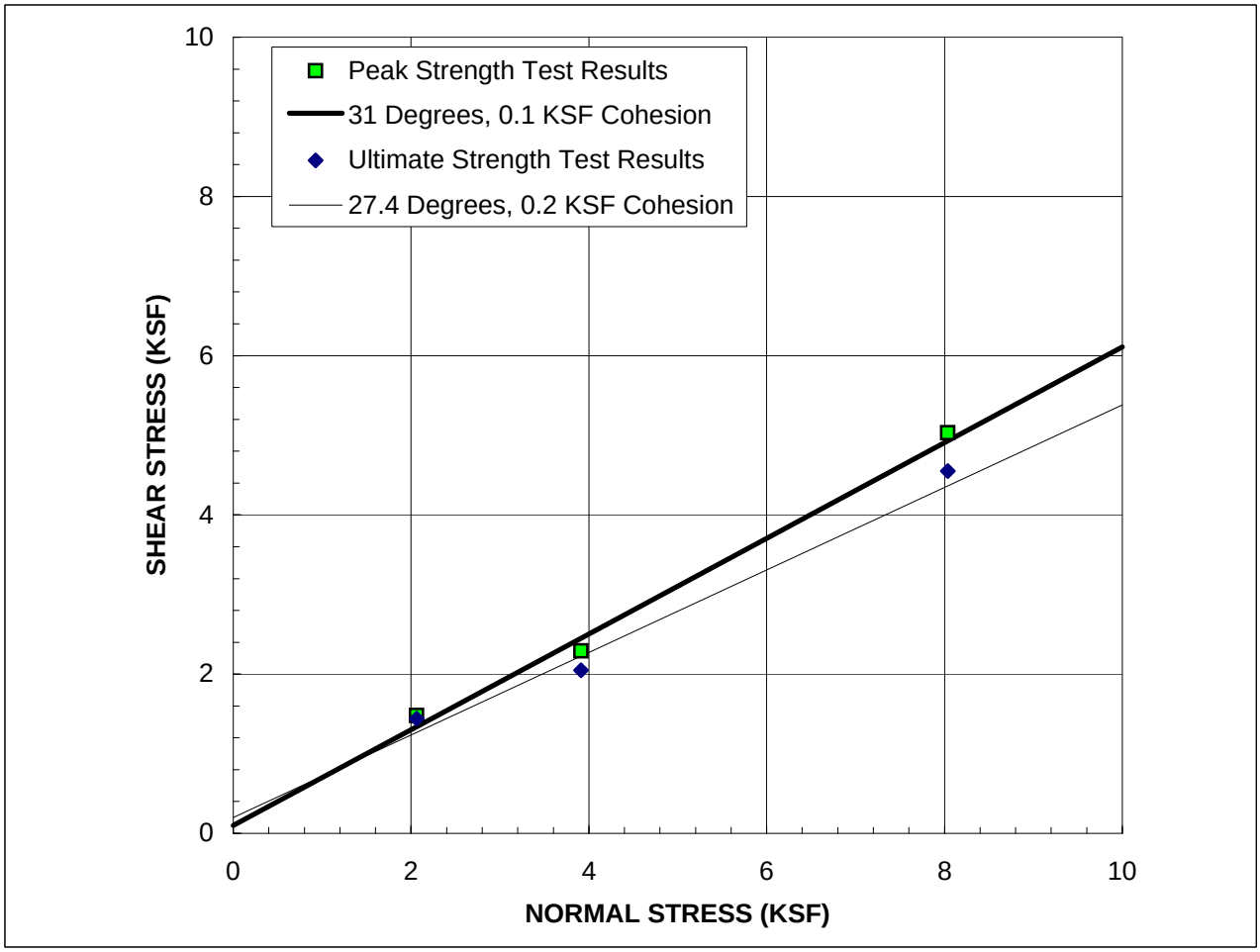
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3g





SAMPLE: A-RW015 R5@20'

Description: Very Dark greenish Gray Silty Sand with Traces of Shells

STRAIN RATE: 0.0050 IN/MIN

(Sample was consolidated and drained)

	PEAK	ULTIMATE
ϕ'	31 ^{o}	27.4 ^{o}
c'	0.10 KSF	0.20 KSF

	IN-SITU	AS-TESTED
γ_d	PCF	0.0 PCF
w_c	%	34.8 %

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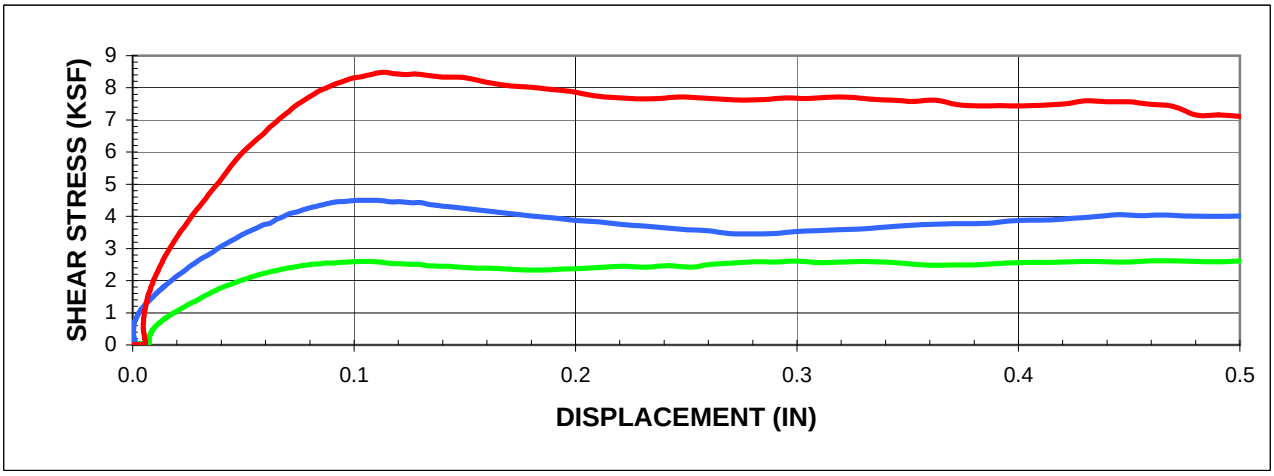
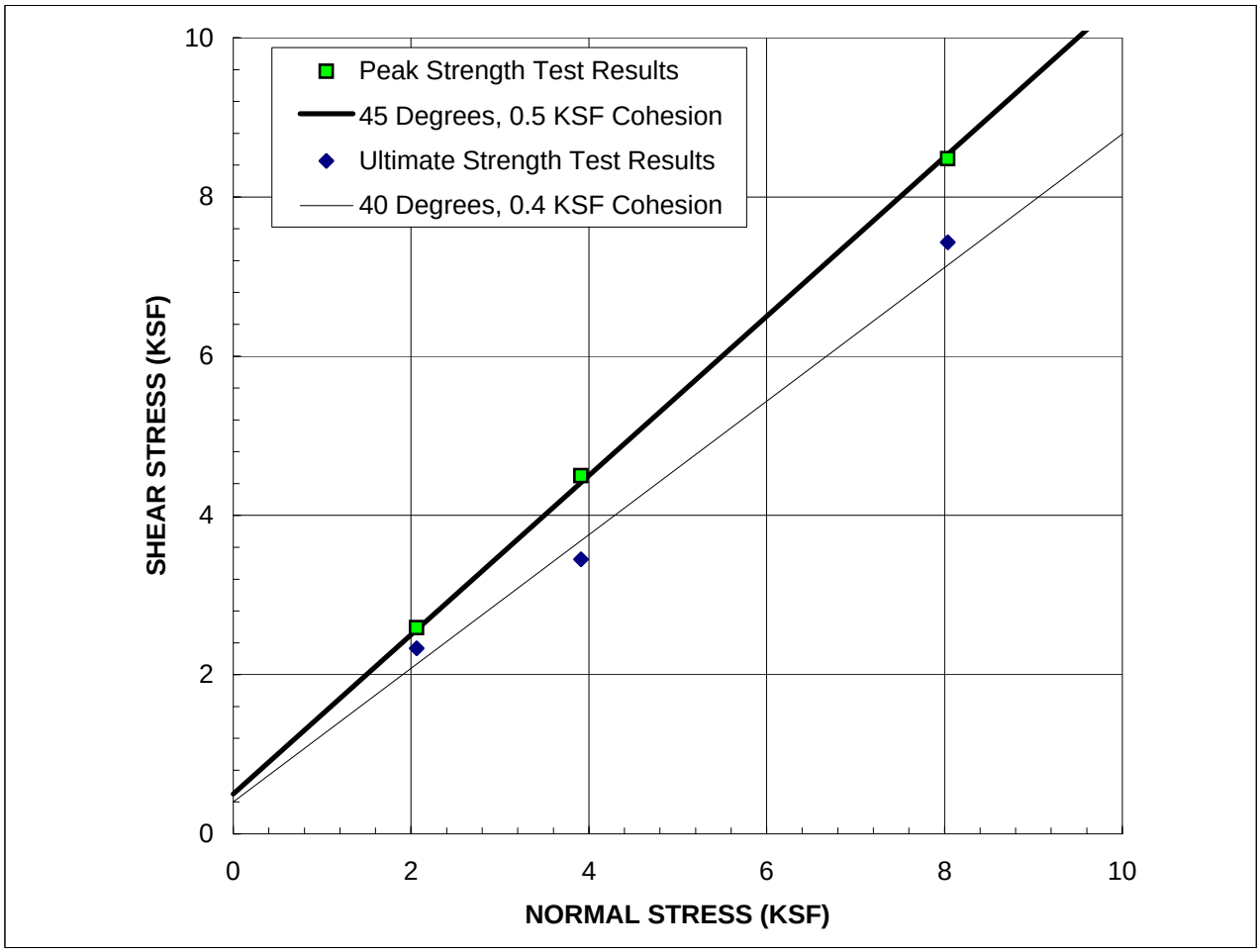
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3h





SAMPLE: A-RW015 R8@32.5

Description:	Very Dark Greenish Gray Coarse Sand

STRAIN RATE: 0.0250 IN/MIN

(Sample was consolidated and drained)

	PEAK	**ULTIMATE**
ϕ'	45 ^{o}	40 ^{o}
c'	0.50 KSF	0.40 KSF

	IN-SITU	**AS-TESTED**
γ_d	PCF	0.0 PCF
w_c	%	19.1 %

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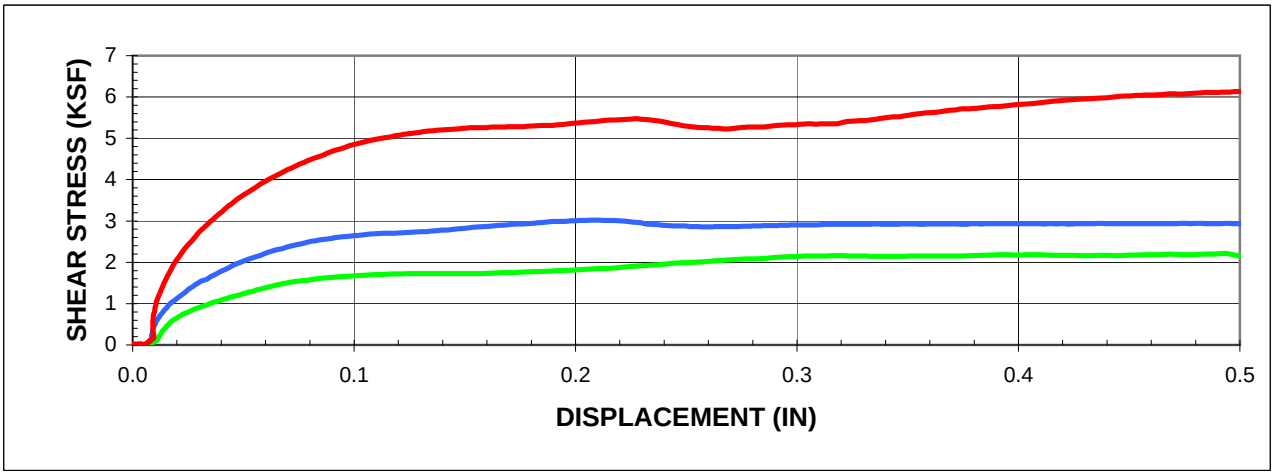
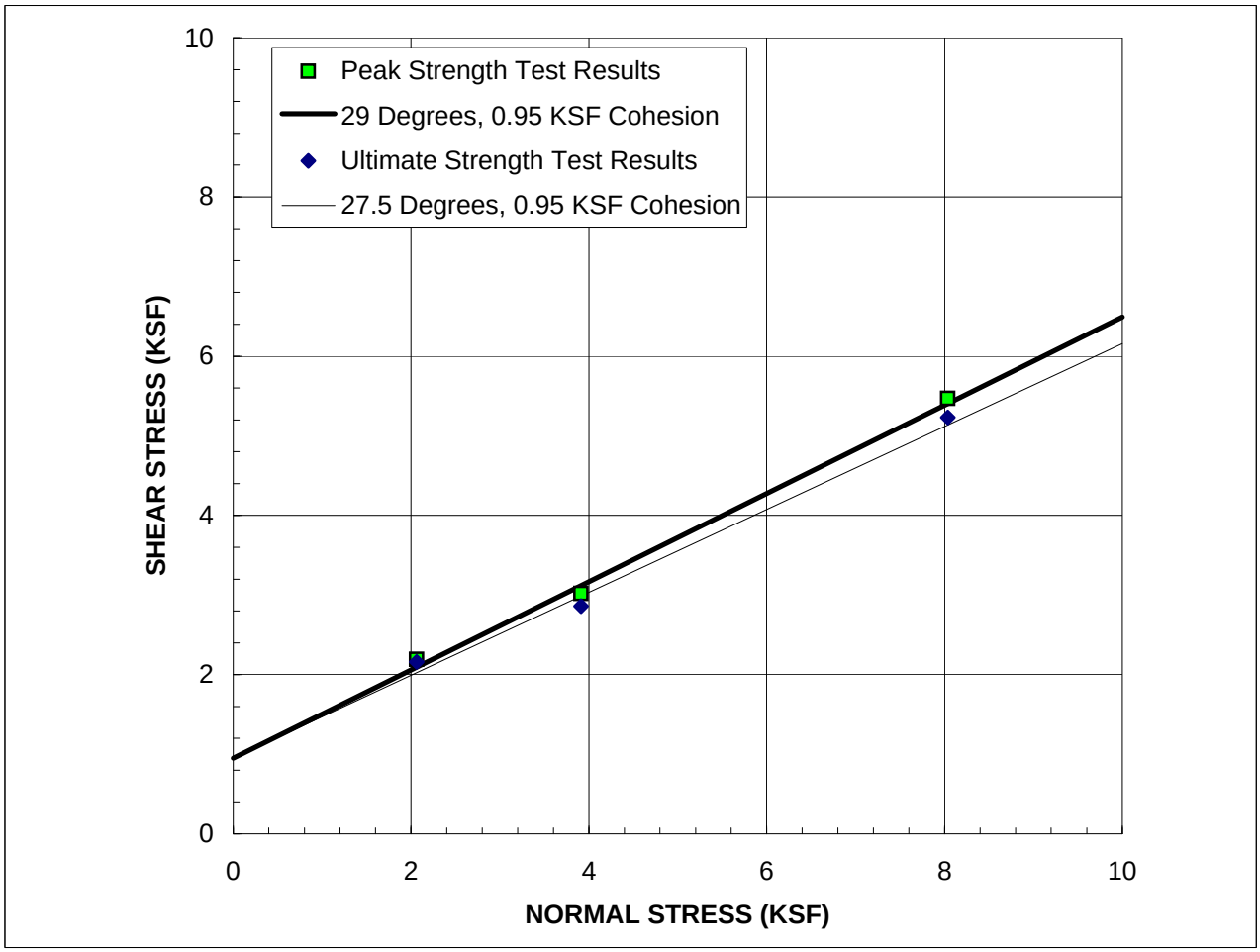
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3i





SAMPLE: B-RW027 R1@5'

Description:	Yellowish Brown Clayey Fine Sand

STRAIN RATE: 0.0050 IN/MIN

(Sample was consolidated and drained)

	PEAK	ULTIMATE
ϕ'	29.0 ^{o}	27.5 ^{o}
c'	0.95 KSF	0.95 KSF

	IN-SITU	AS-TESTED
γ_d	PCF	0.0 PCF
w_c	%	25.3 %

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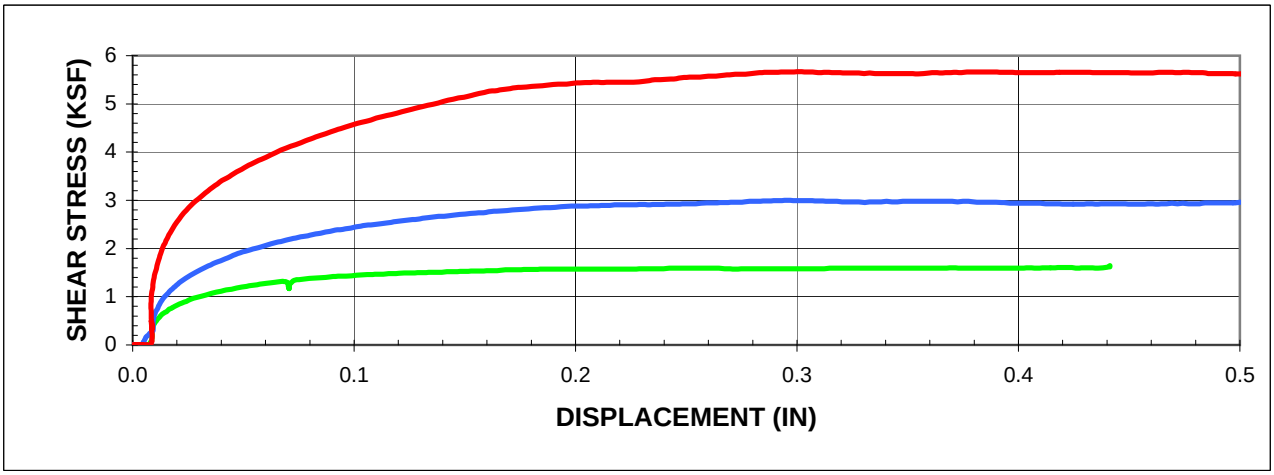
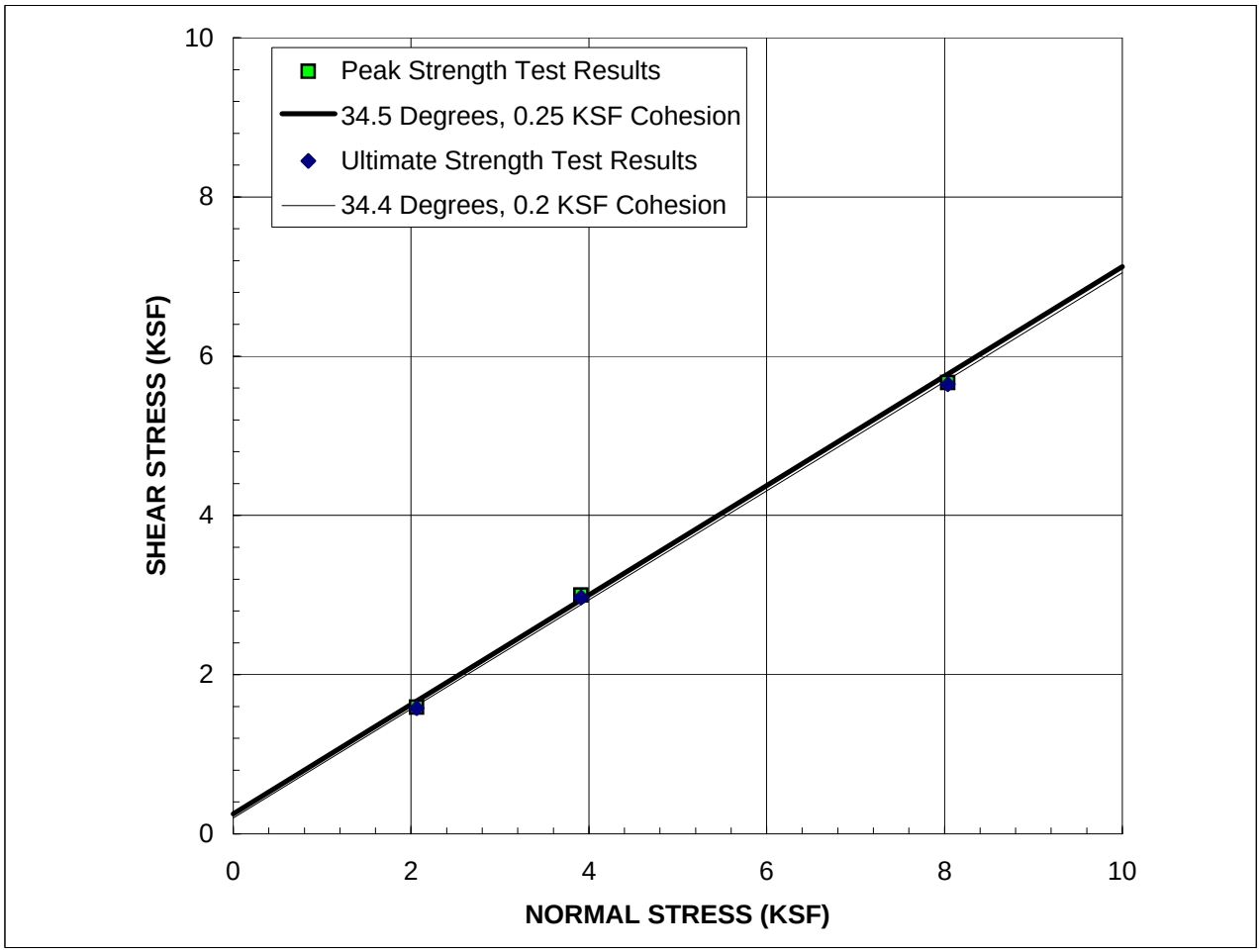
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3j





SAMPLE: B-RW027 R4A@20'

Description:	Dark Greenish Gray Silty Sand with Traces of Shells

STRAIN RATE: 0.0050 IN/MIN

(Sample was consolidated and drained)

	PEAK	ULTIMATE
ϕ'	34.5 ^{o}	34.4 ^{o}
c'	0.25 KSF	0.20 KSF

	IN-SITU	AS-TESTED
γ_d	PCF	0.0 PCF
w_c	%	33.3 %

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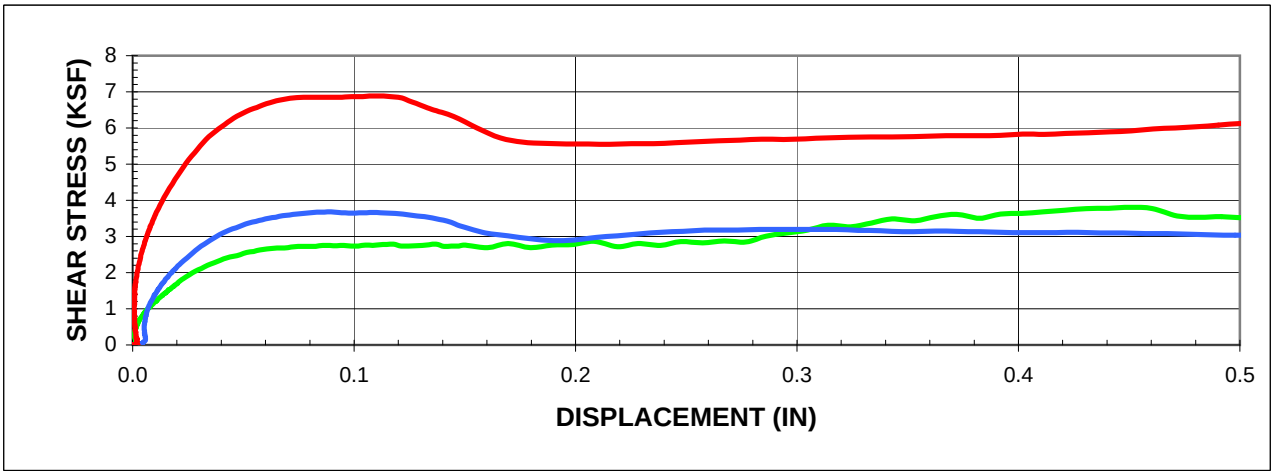
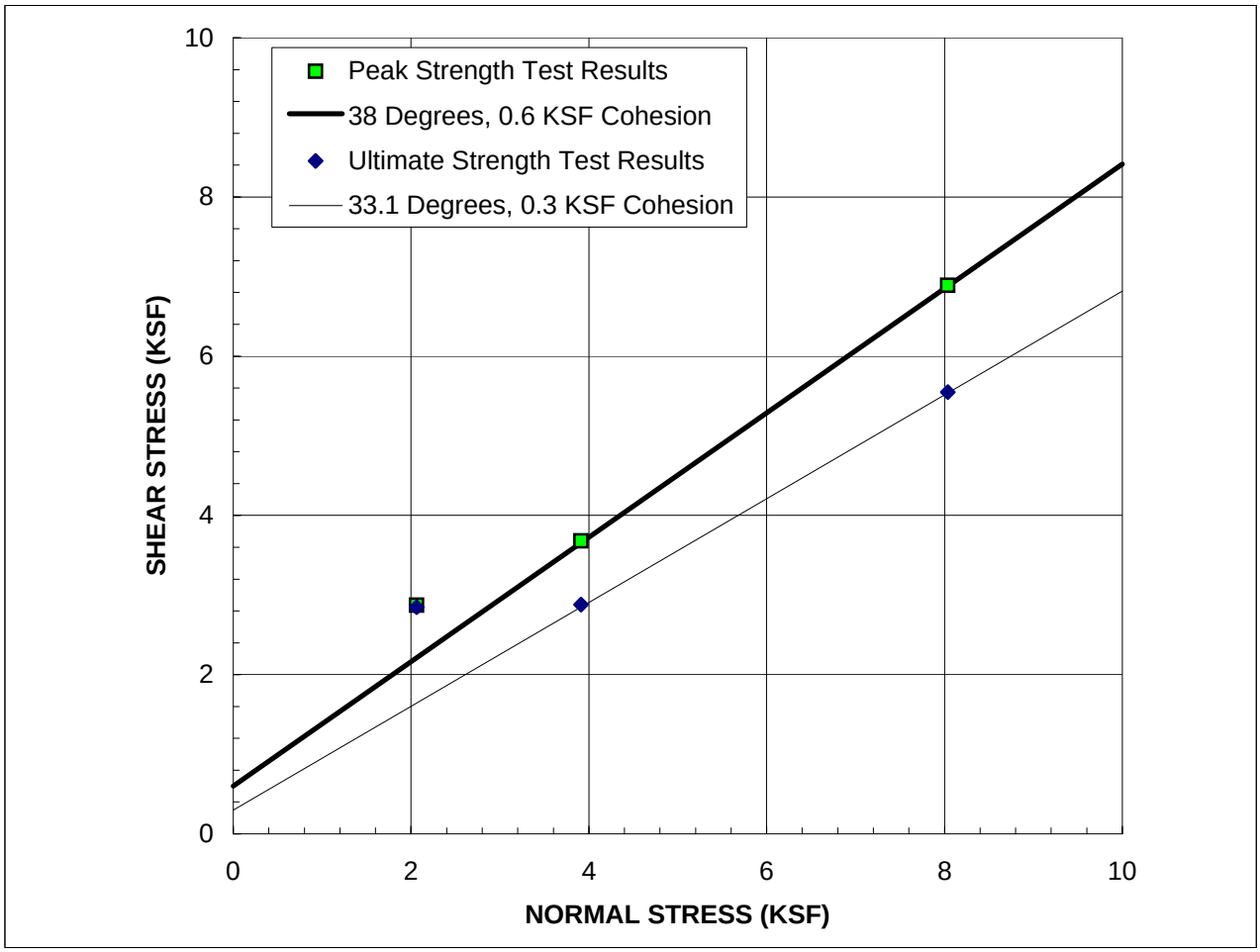
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3k





SAMPLE: B-RW030 R7@30'

Description:	Very Dark Greenish Gray Fine Sand with Silt and Traces of Shells

STRAIN RATE: 0.0250 IN/MIN

(Sample was consolidated and drained)

	PEAK	ULTIMATE
ϕ'	38.0 ^{o}	33.1 ^{o}
c'	0.60 KSF	0.30 KSF

	IN-SITU	AS-TESTED
γ_d	PCF	0.0 PCF
w_c	%	26.3 %

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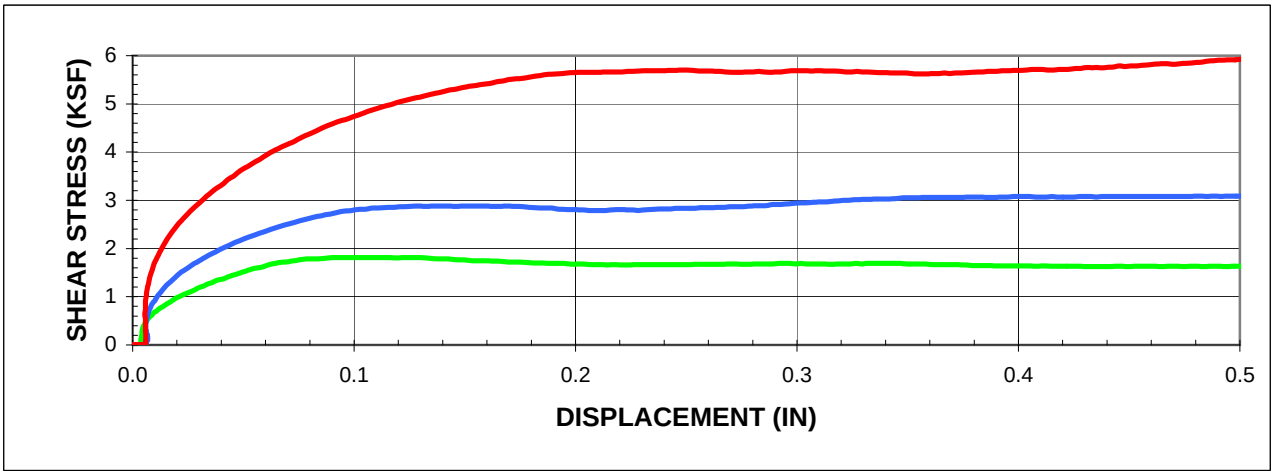
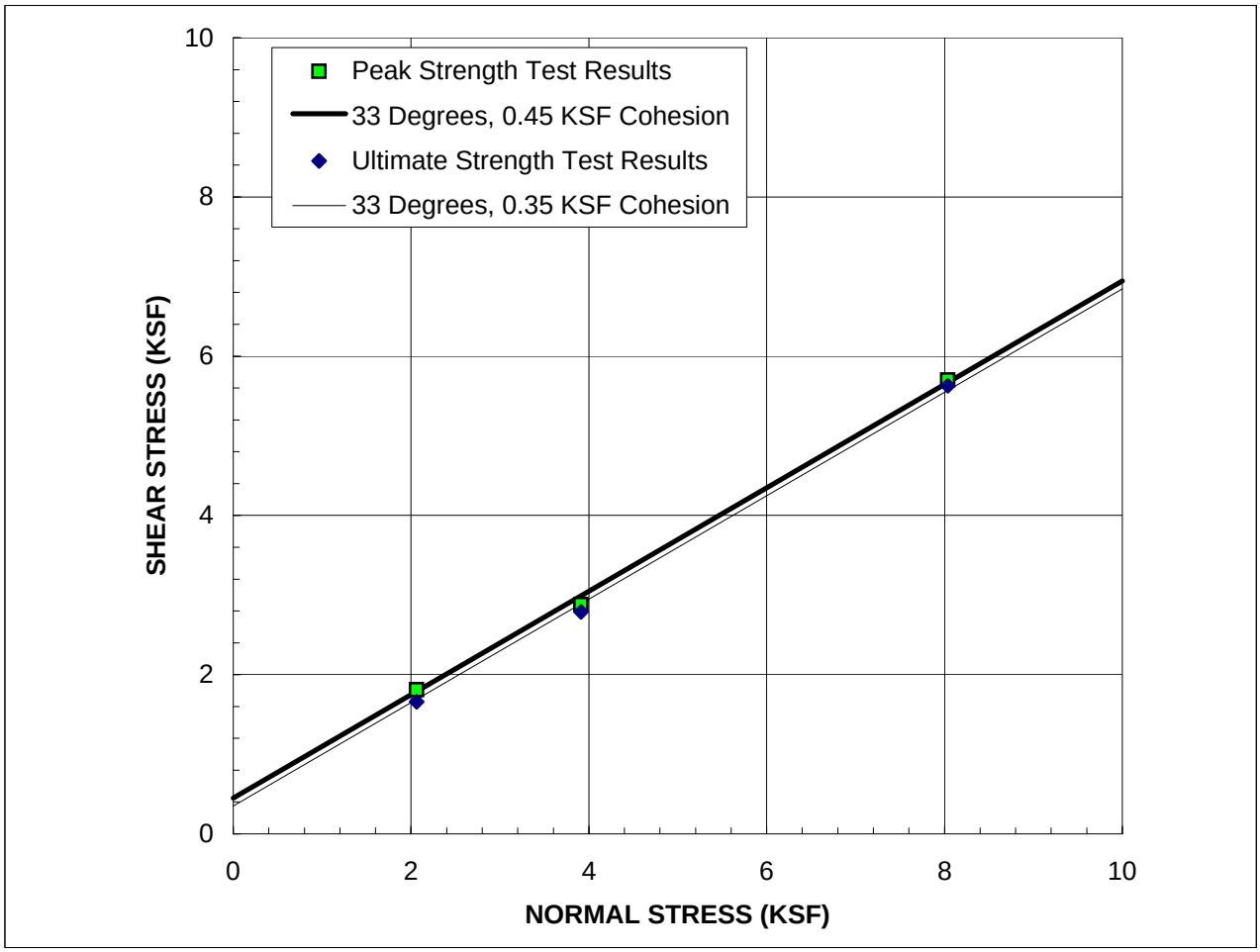
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3l





SAMPLE: B-RW032 R7A@30'

Description:	Very Dark Greenish Gray Silty Sand with Shells

STRAIN RATE: 0.0050 IN/MIN

(Sample was consolidated and drained)

	PEAK	**ULTIMATE**
ϕ'	33 ^{o}	33 ^{o}
c'	0.45 KSF	0.35 KSF

	IN-SITU	**AS-TESTED**
γ_d	PCF	0.0 PCF
w_c	%	30.0 %

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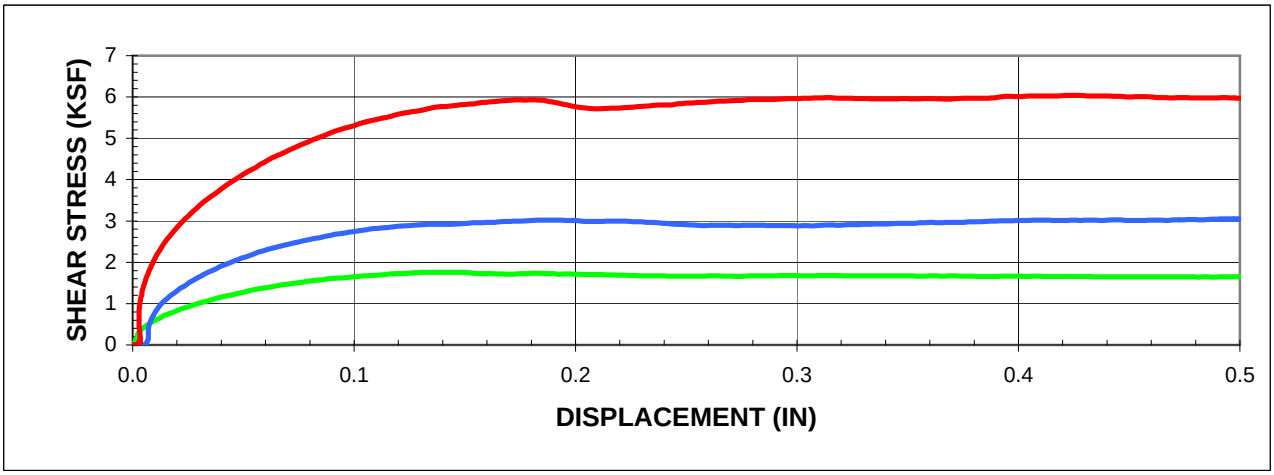
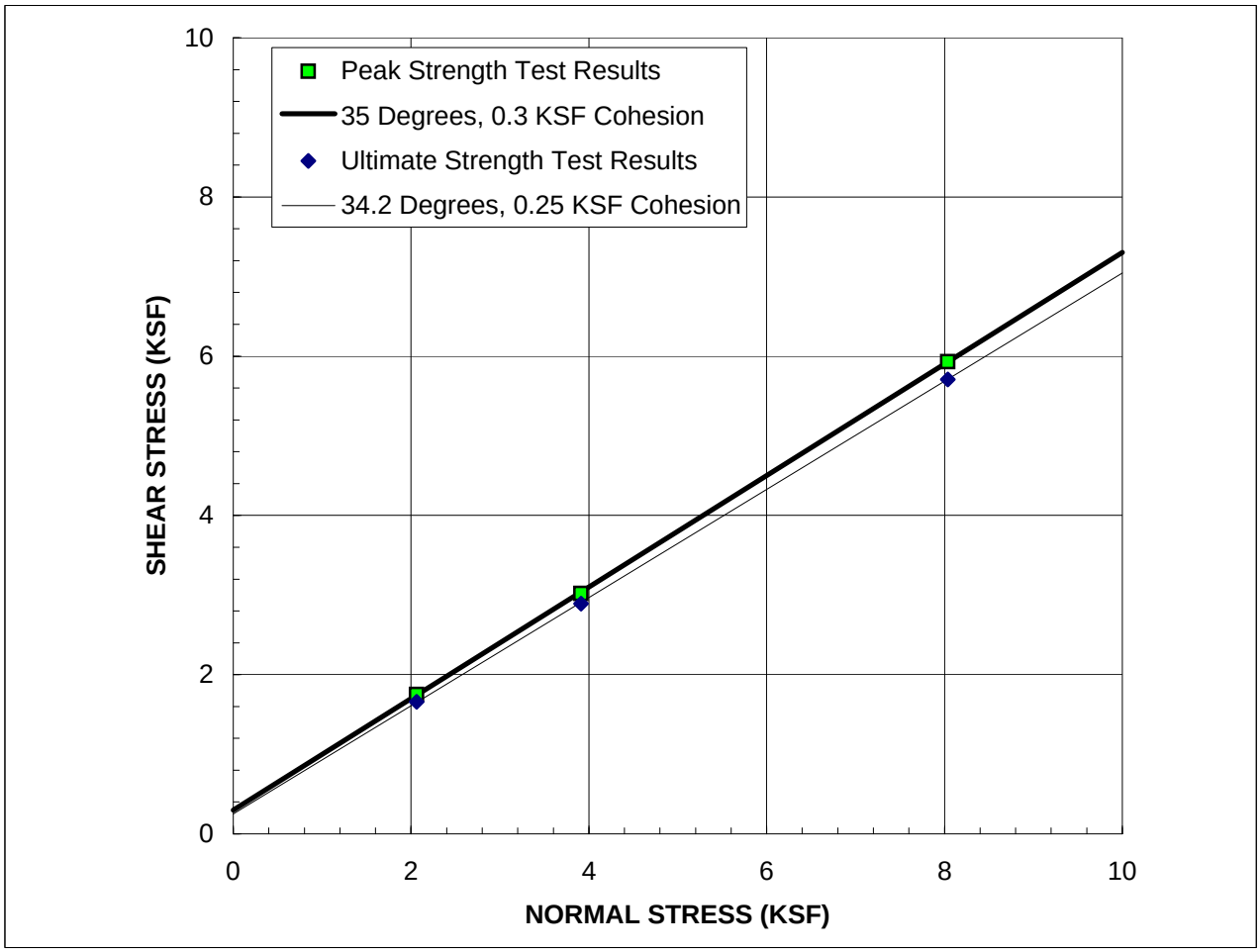
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3m





SAMPLE: B-RW032 R9@40'

Description:	Very Dark Greenish Gray Silty Sand

STRAIN RATE: 0.0050 IN/MIN

(Sample was consolidated and drained)

	PEAK	**ULTIMATE**
ϕ'	35 ^{o}	34.2 ^{o}
c'	0.30 KSF	0.25 KSF

	IN-SITU	**AS-TESTED**
γ_d	PCF	0.0 PCF
w_c	%	31.0 %

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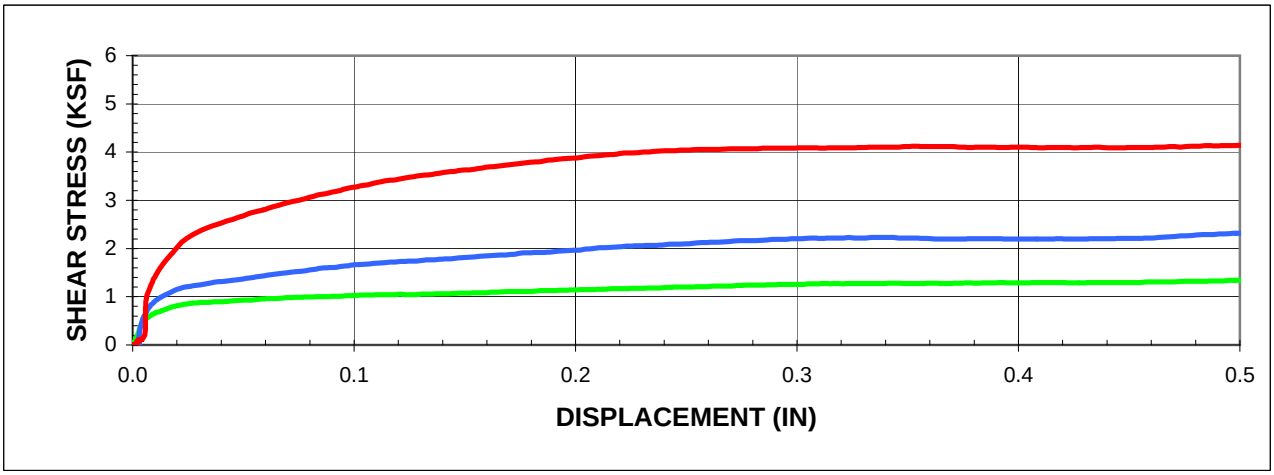
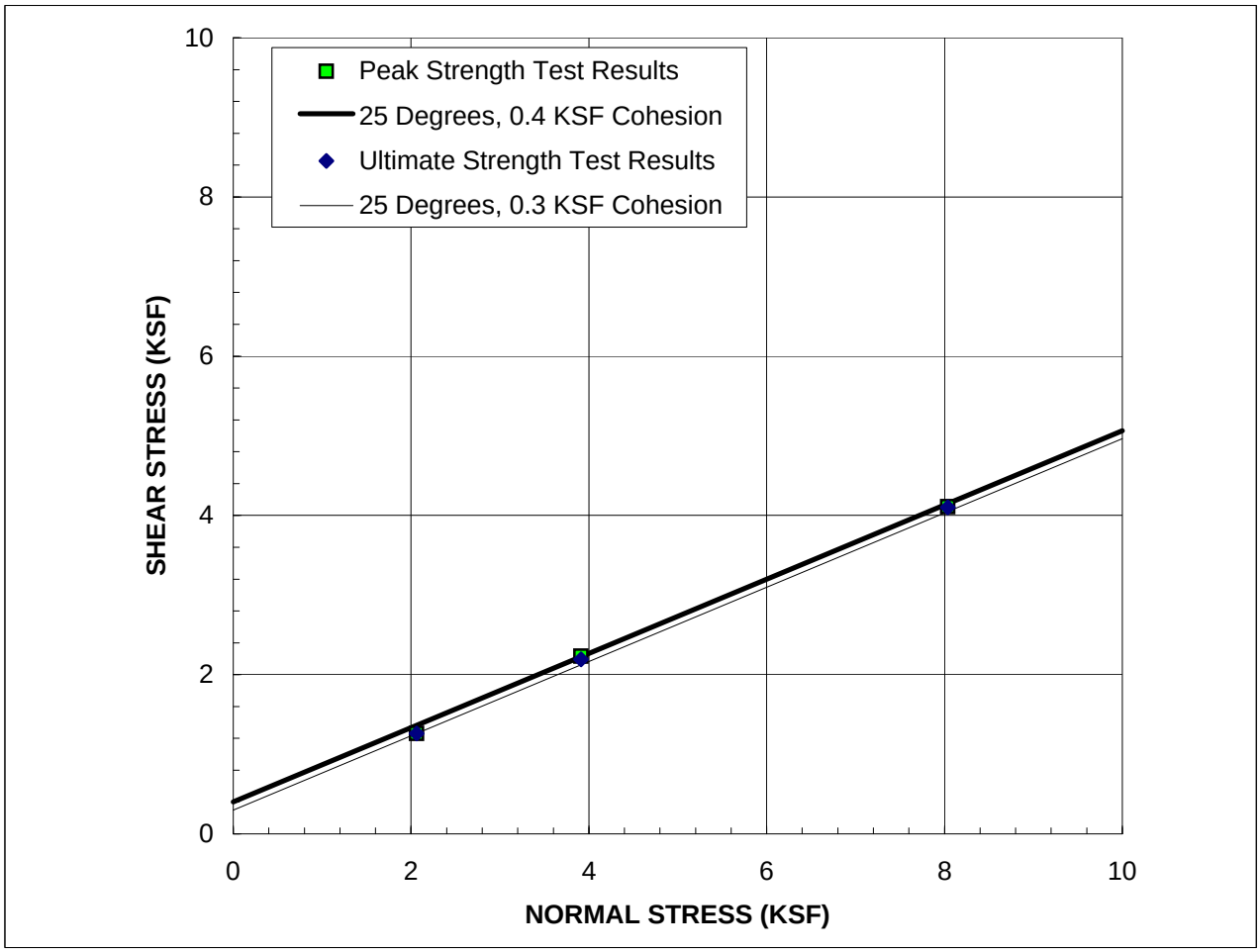
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3n





SAMPLE: B-RW036 R6A@30'

Description:	Very Dark Greenish Gray Sandy Silty Clay with Traces of Shells

STRAIN RATE: 0.0030 IN/MIN

(Sample was consolidated and drained)

	PEAK	ULTIMATE
ϕ'	25 ^{o}	25 ^{o}
c'	0.40 KSF	0.30 KSF

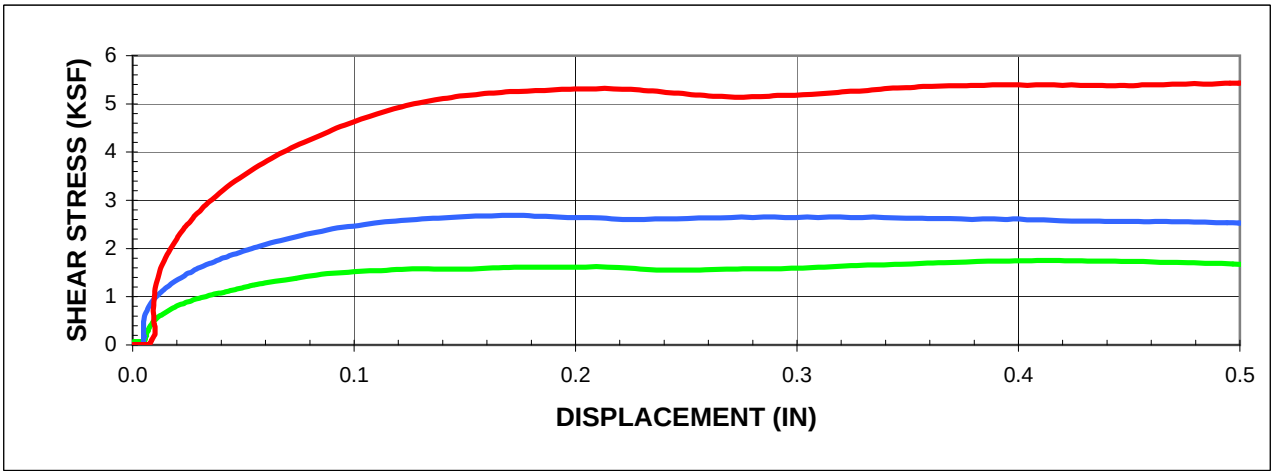
	IN-SITU	AS-TESTED
γ_d	PCF	0.0 PCF
w_c	%	48.1 %

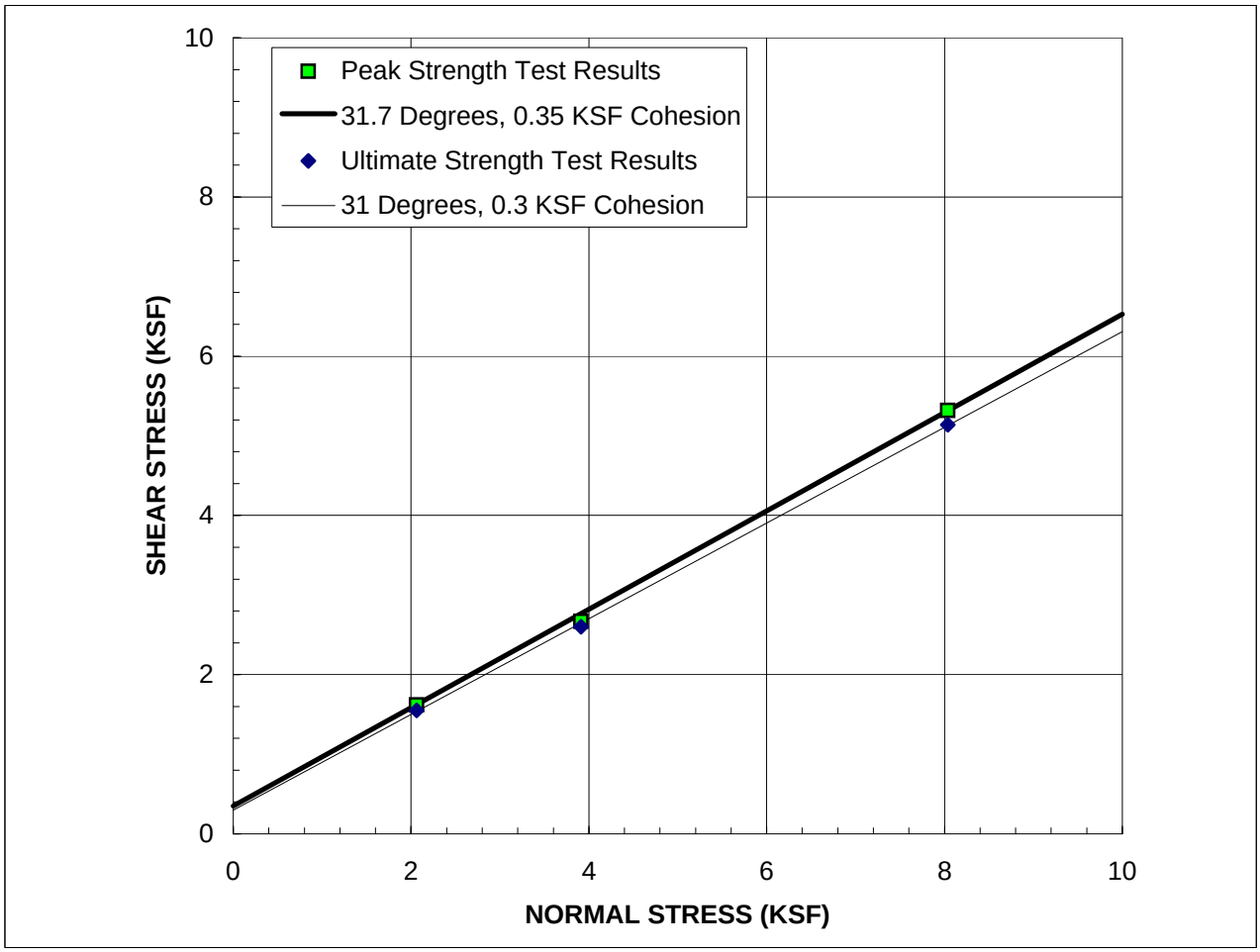
GROUP DELTA CONSULTANTS
370 Amapola Ave., Suite 212, Torrance, CA 90501
32 Mauchly, Suite B, Irvine, CA 92618
4201 Santa Ana St., Suite F, Ontario, CA 91761
9245 Activity Road, Suite 103, San Diego, CA 92126

DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3o





SAMPLE: B-RW041 R2A@5'

Description:	Yellowish Brown Clayey Silty Sand

STRAIN RATE: 0.0050 IN/MIN

(Sample was consolidated and drained)

	PEAK	**ULTIMATE**
ϕ'	31.7 ^{o}	31 ^{o}
c'	0.35 KSF	0.30 KSF

	IN-SITU	**AS-TESTED**
γ_d	PCF	0.0 PCF
w_c	%	36.1 %

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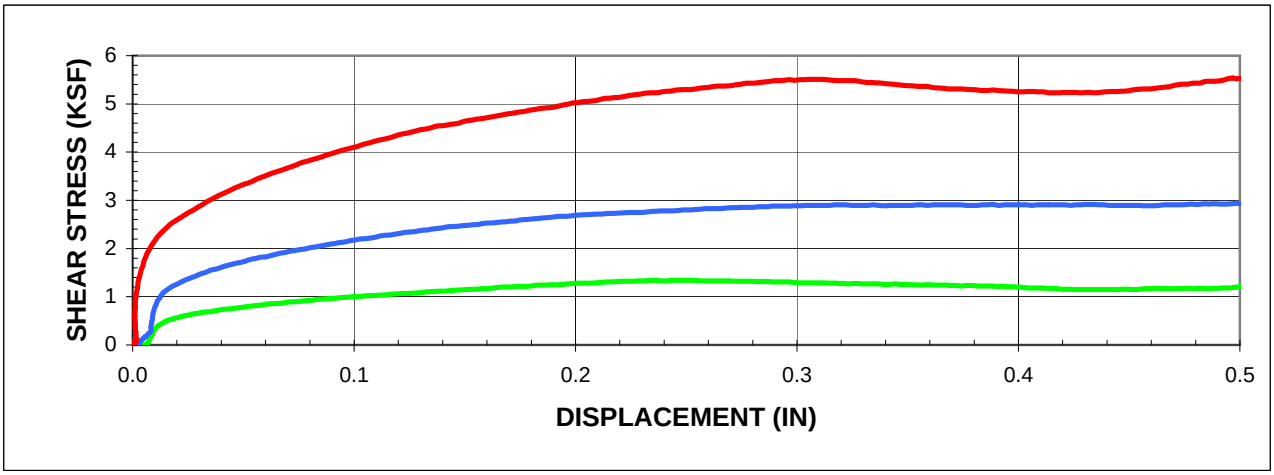
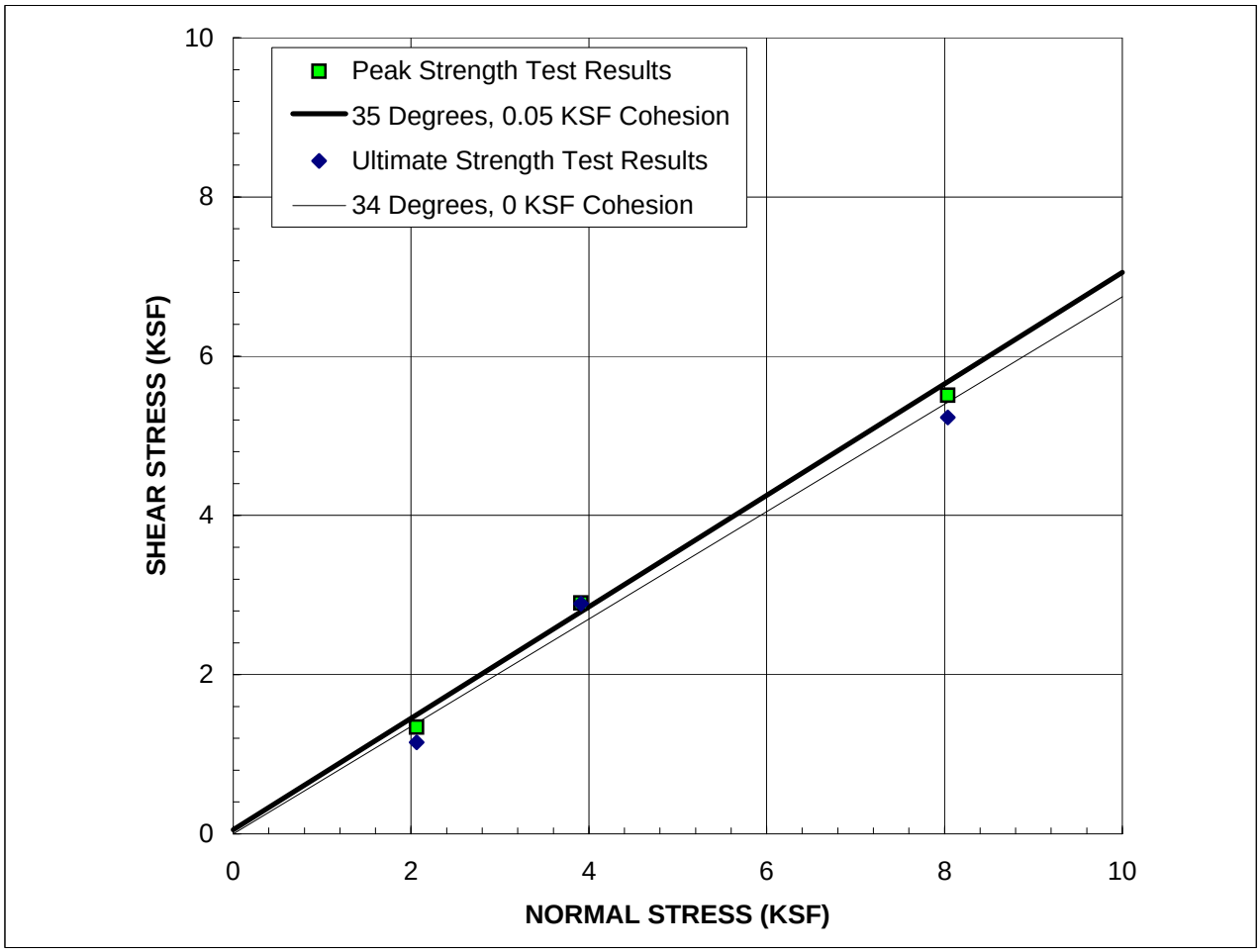
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3p





SAMPLE: B-RW041 R4A@15'

Description:	Dark Greenish Gray Clayey Silt / Silty Clay with Sand

	PEAK	**ULTIMATE**
ϕ'	35 ^{o}	34 ^{o}
c'	0.05 KSF	0.00 KSF

STRAIN RATE: 0.0025 IN/MIN

(Sample was consolidated and drained)

	IN-SITU	**AS-TESTED**
γ_d	PCF	0.0 PCF
w_c	%	43.8 %

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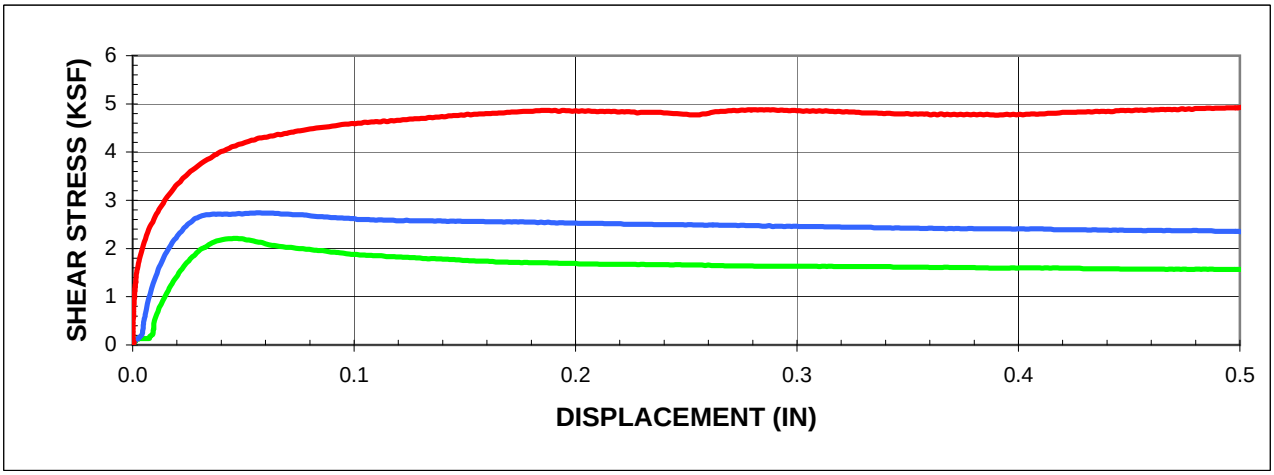
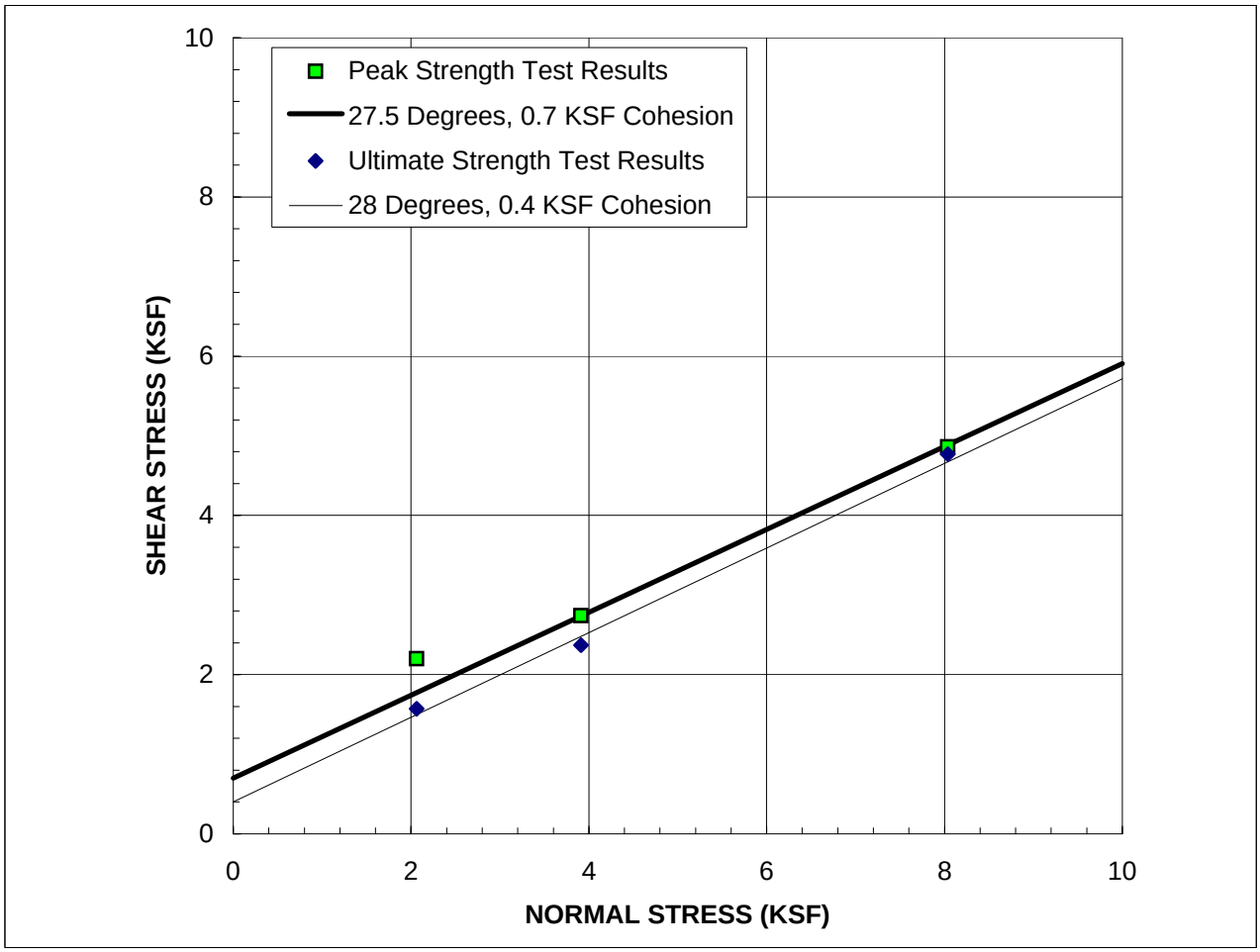
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3q





SAMPLE: B-RW044 R7A@35'

Description:	Very Dark Greenish Gray Clay

STRAIN RATE: 0.0025 IN/MIN

(Sample was consolidated and drained)

	PEAK	ULTIMATE
ϕ'	27.5 ^{o}	28.0 ^{o}
c'	0.70 KSF	0.40 KSF

	IN-SITU	AS-TESTED
γ_d	PCF	0.0 PCF
w_c	%	23.3 %

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370 Amapola Ave., Suite 212, Torrance, CA 90501
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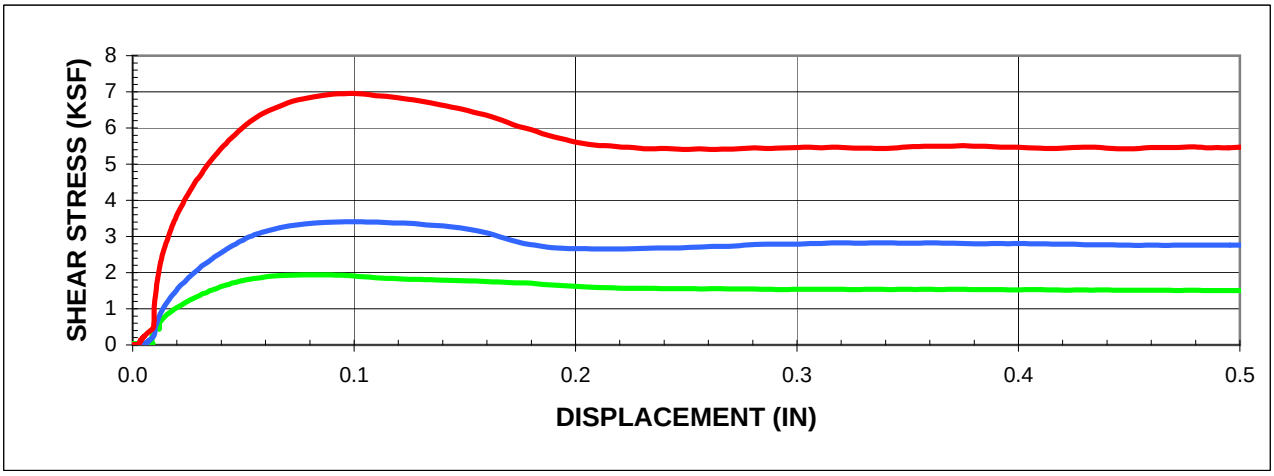
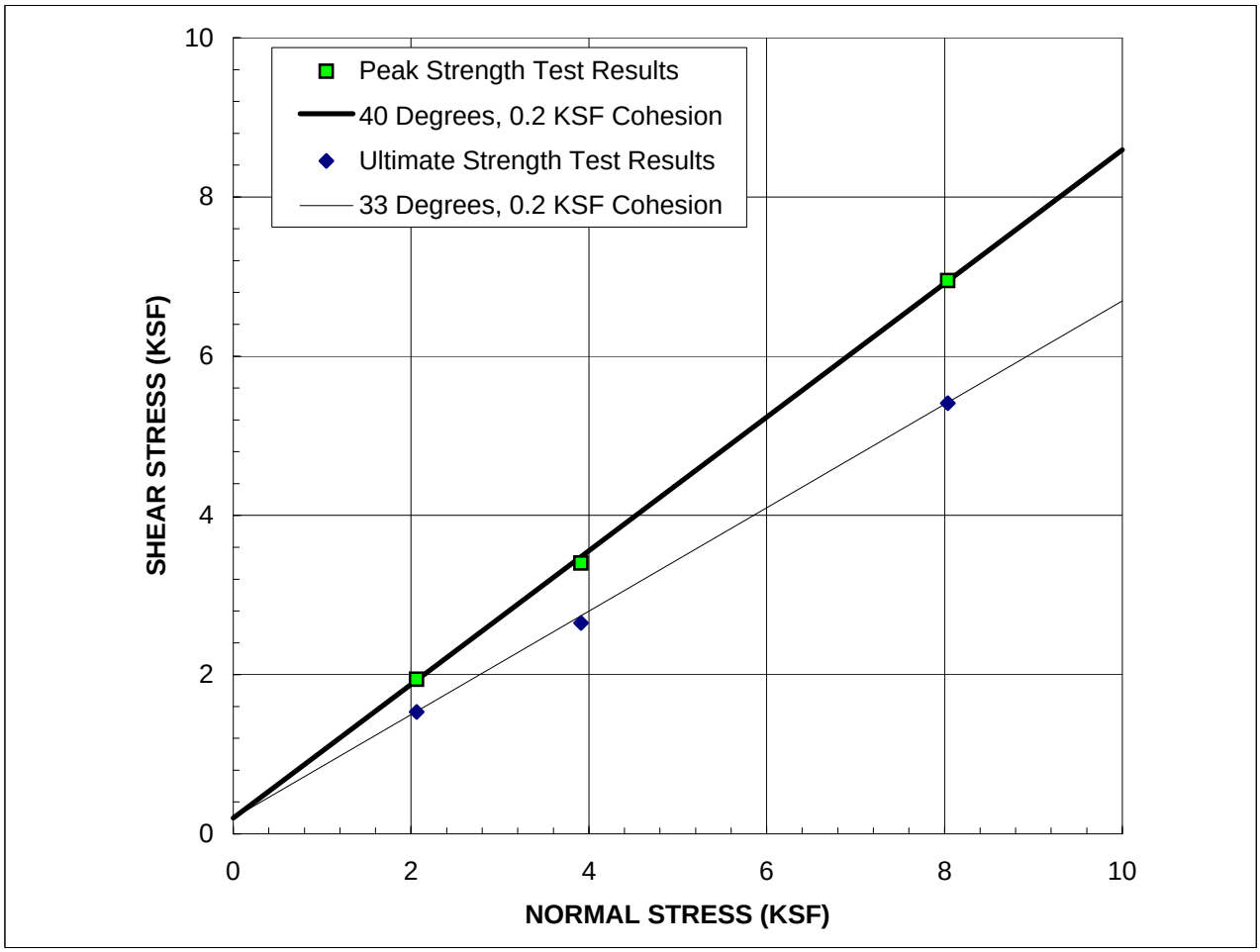
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3r





SAMPLE: B-RW049 R9@40'

Description: Dark Greenish Gray Sand

STRAIN RATE: 0.0250 IN/MIN

(Sample was consolidated and drained)

	PEAK	ULTIMATE
ϕ'	40 ^{o}	33 ^{o}
c'	0.20 KSF	0.20 KSF

	IN-SITU	AS-TESTED
γ_d	PCF	0.0 PCF
w_c	%	23.0 %

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370 Amapola Ave., Suite 212, Torrance, CA 90501
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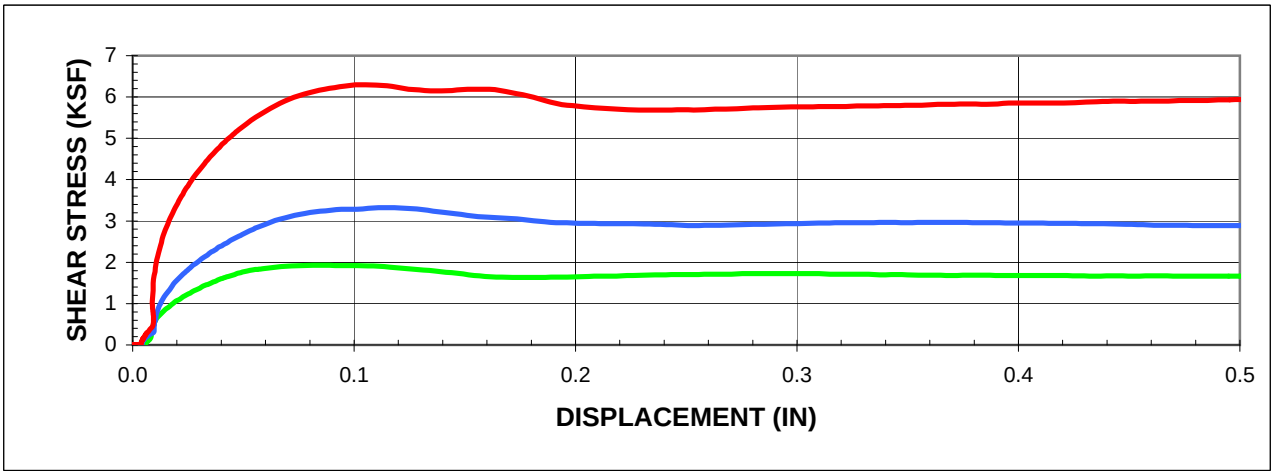
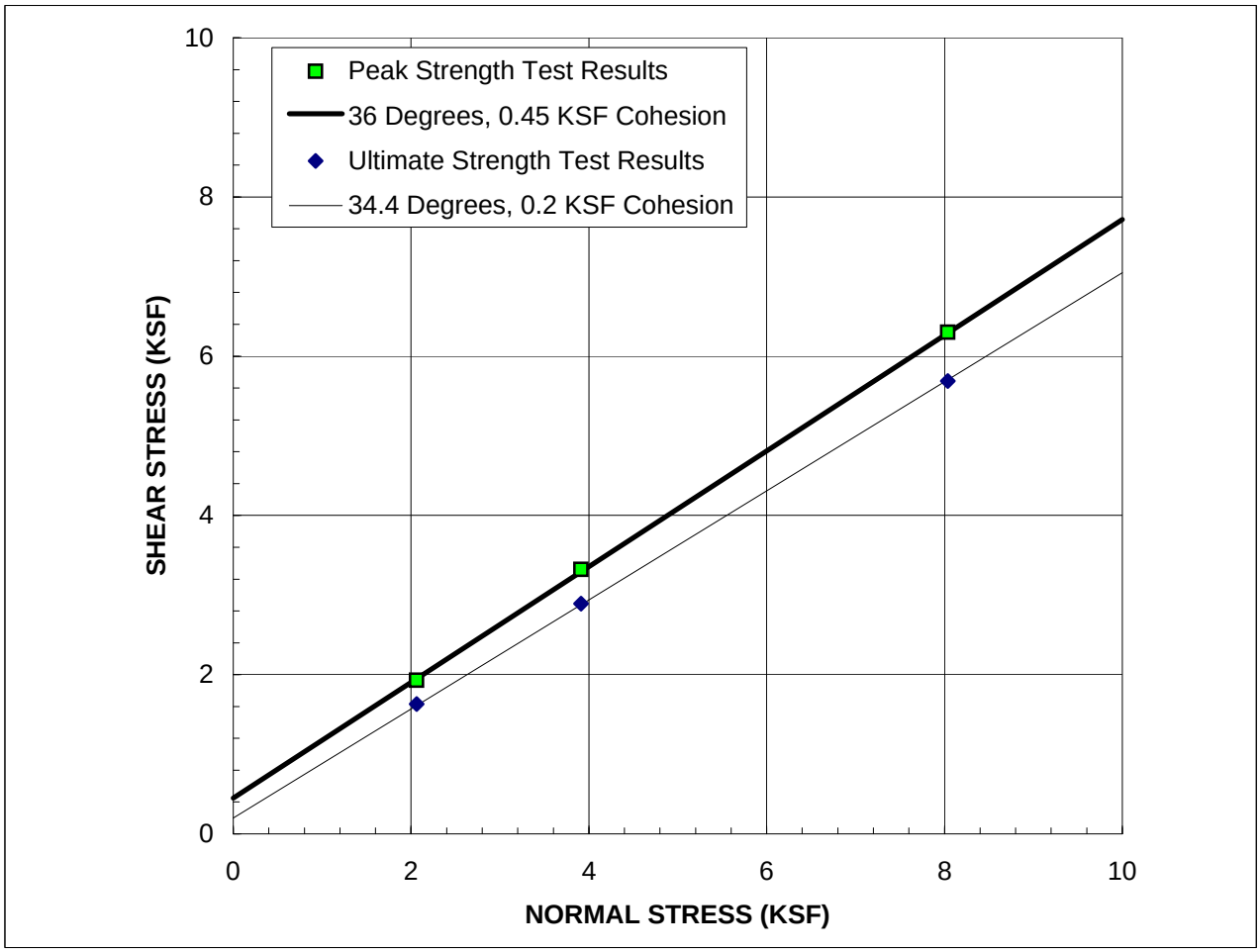
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3s





SAMPLE: B-RW053 R6A@30'

Description:	Very Dark Greenish Gray Silty Sand

STRAIN RATE: 0.0050 IN/MIN

(Sample was consolidated and drained)

	PEAK	**ULTIMATE**
ϕ'	36 ^{o}	34.4 ^{o}
c'	0.45 KSF	0.20 KSF

	IN-SITU	**AS-TESTED**
γ_d	PCF	0.0 PCF
w_c	%	29.4 %

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370 Amapola Ave., Suite 212, Torrance, CA 90501
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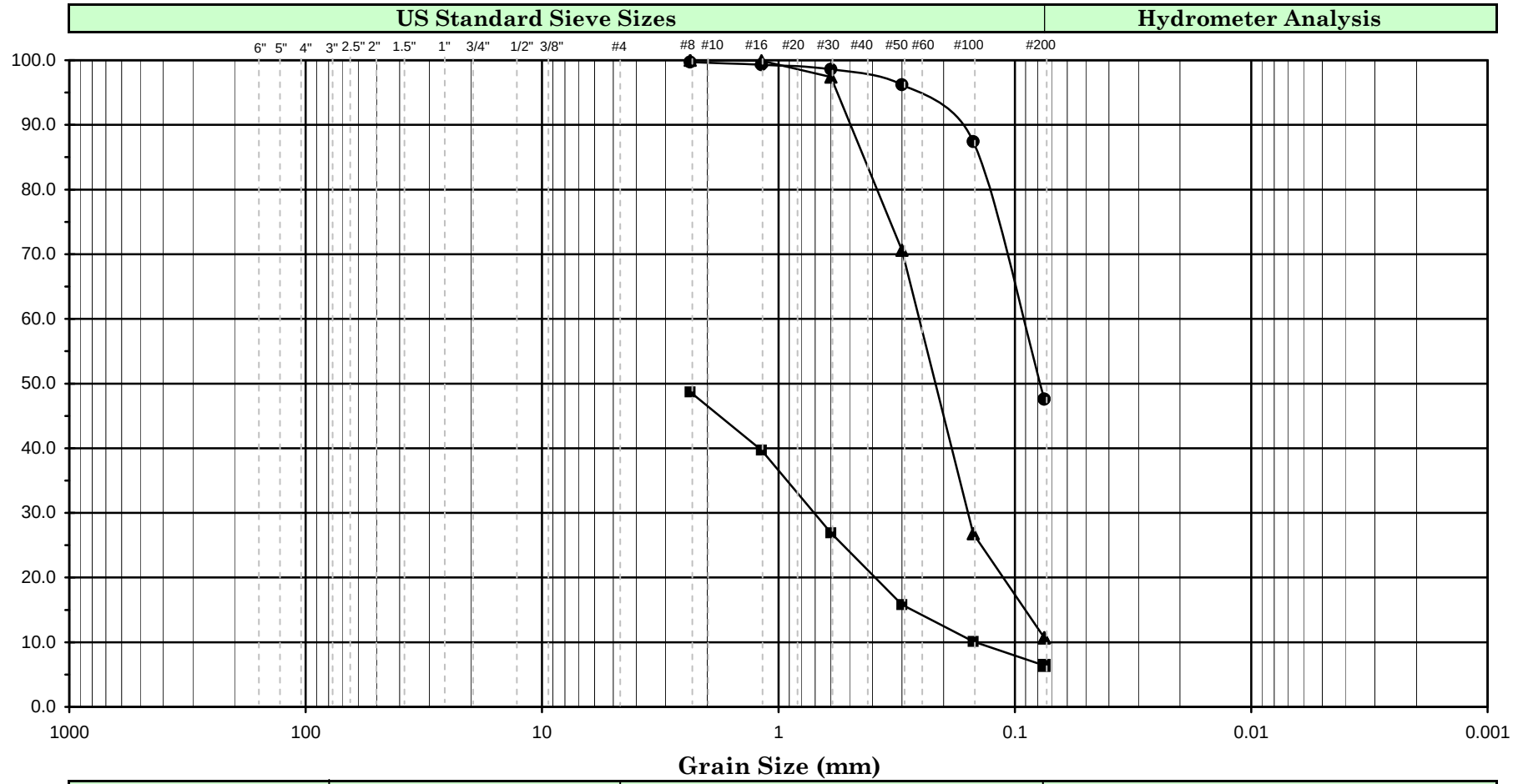
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3t



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

Symbol	Boring Number	Sample Number	Depth (ft)		Depth (m)		Soil Color	Soil Description	U.S.C.S.
●	A-HSA066	R4	7.5	9.0	2.3	2.7	Dark Grayish Brown	Clayey Sand with Shells	SC
▲	C-HSA061	R1	2.5	4.0	0.8	1.2	Yellowish Brown	Poorly graded Sand with Silt	SP-SM
■	B-RW041	R13	60.0	61.5	18.3	18.8	Dark Greenish Gray	Poorly graded Sand with Silt and Gravel	SP-SM
◆									
○									
△									
Remark									

GROUP DELTA CONSULTANTS

Ballona Creek Wetlands Restoration

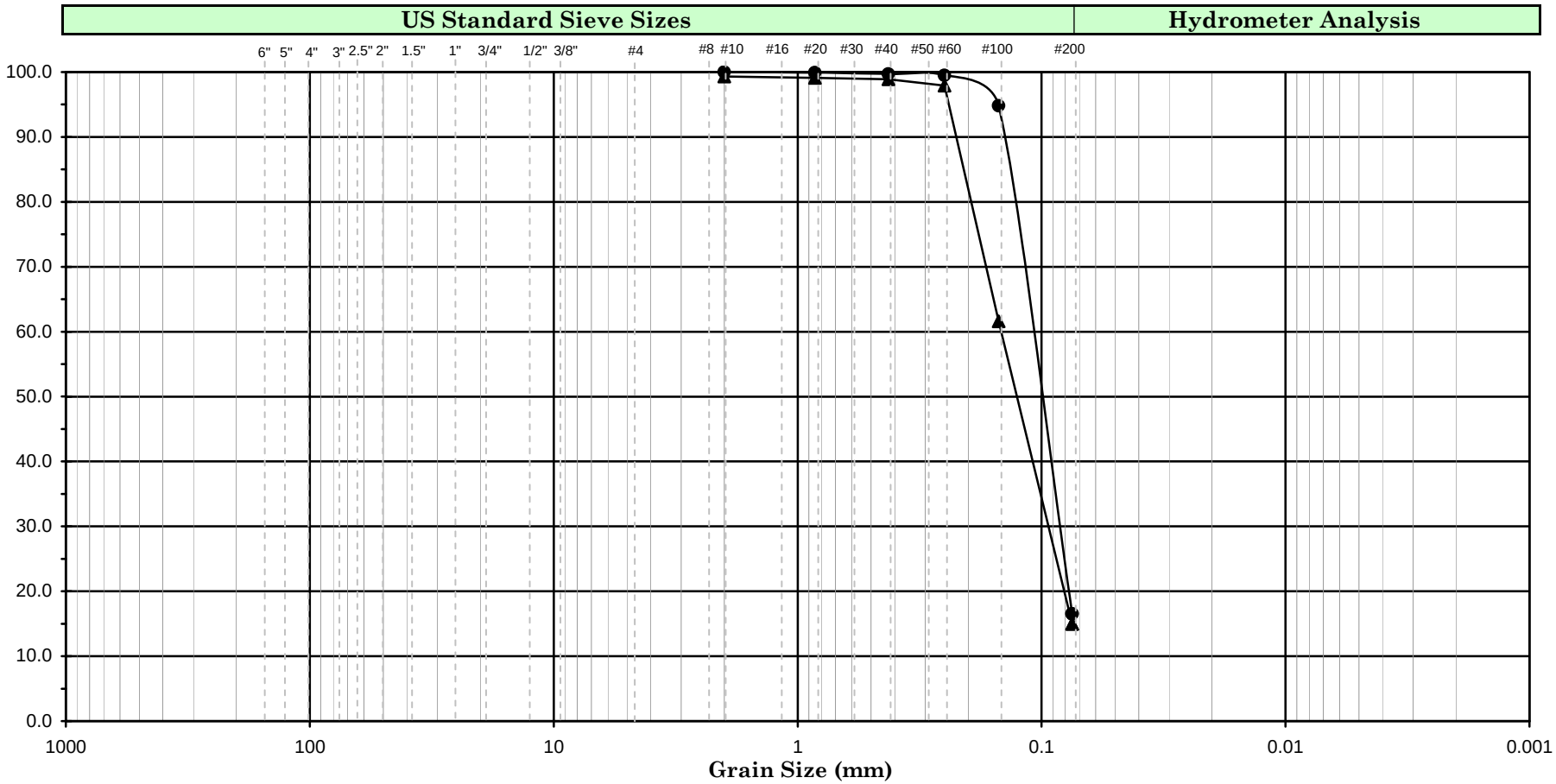
Project No. : LA962A

Date B1-783 **01/28/13**

GRAIN SIZE ANALYSIS

(ASTM D-422-63)

Figure No. : B1-4a



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

Symbol	Boring Number	Sample Number	Depth (ft)		Depth (m)		Soil Color	Soil Description	U.S.C.S.
●	B-RW041	S5	20.0	21.5	6.1	6.6	Very Dark Greenish Gray	Sand with Silt	SM
▲	B-RW053	S7	35.0	36.5	10.7	11.1	Dark Greenish Gray	Sand with Silt	SM
■									
◆									
○									
△									
Remark									

GROUP DELTA CONSULTANTS

Ballona Creek Wetlands Restoration

Project No. : LA962A

Date B1-784 **01/28/13**

GRAIN SIZE ANALYSIS

(ASTM D-422-63)

Figure No. : B1-4b

APPENDIX B2
LABORATORY TESTING BY OTHERS

APPENDIX B
PREVIOUS LABORATORY TESTING

B2.1 General

Laboratory testing has been conducted as part of the previous geotechnical and environmental investigations at Ballona Creek Wetlands site. A short summary of the geotechnical laboratory testing programs adopted in previous investigations by Law Crandall, Inc. Diaz.Yourman & Associates and Weston Solutions, Inc. are presented below.

B2.2 Law Crandall, Inc. Laboratory Testing

Area A:

Field moisture content and dry density tests were performed on undisturbed samples. Atterberg limit tests were also performed on selected samples. Liquid limit tests were repeated on some oven-dried samples to assess the organic content. Direct shear tests were performed on selected undisturbed samples to determine the strength of the soils. The direct shear tests were performed at field and increased moisture content and at various different surcharge pressures on in-situ samples and some remolded samples. Confined consolidation tests were performed on 23 undisturbed samples to determine the compressibility of the soils. The samples were tested at field moisture content. Particle size analyses were performed using mechanical sieve analysis and hydrometer analysis testing methods on six samples. Compaction tests in accordance with the ASTM Designation D1557-70 were also performed on samples from two borings. Permeability tests were performed on ten undisturbed samples to determine the coefficient of permeability of the soils, under confining pressures of 200 and 1,000 psf. Soil corrosivity tests were also performed on eleven samples.

Area B

Field moisture content and dry density tests were performed on undisturbed samples. Atterberg limit tests were also performed on 4 samples. Direct shear tests were performed on selected undisturbed samples to determine the strength of the soils. The tests were performed at field and increased moisture content and at various different surcharge pressures. Tests were also performed on some remolded samples. Confined consolidation tests were performed on 10 undisturbed samples and 2 remolded samples to determine the compressibility of the soils. Most samples were tested at field moisture content, while three of the samples were tested at increased moisture content. Compaction tests in accordance with the ASTM Designation D1557-78 were performed on samples from two borings. Expansion Index tests were performed on two samples in accordance with Uniform Building Code No. 29-2 method. Permeability tests were performed on eight undisturbed samples to determine the coefficient of permeability of the soils, under

confining pressure of 200 psf. Particle size analyses were performed on representative samples to aid in classification of the soils.

Area C

Field moisture content and dry density tests were performed on undisturbed samples. Atterberg limit tests were also performed on three samples. Direct shear tests were performed on selected undisturbed samples to determine the strength of the soils. The tests were performed at field and near saturation moisture content, and at field overburden and increased surcharge pressures. Direct shear tests were also performed on some remolded samples. Confined consolidation tests were performed on 5 undisturbed samples to determine the compressibility of the soils. Four samples were tested at field moisture content, while one of the samples was tested at increased moisture content. Particle size analyses were performed using mechanical sieve analysis on two samples. Also, Expansion Index test was performed on one sample in accordance with Uniform Building Code No. 29-2 method.

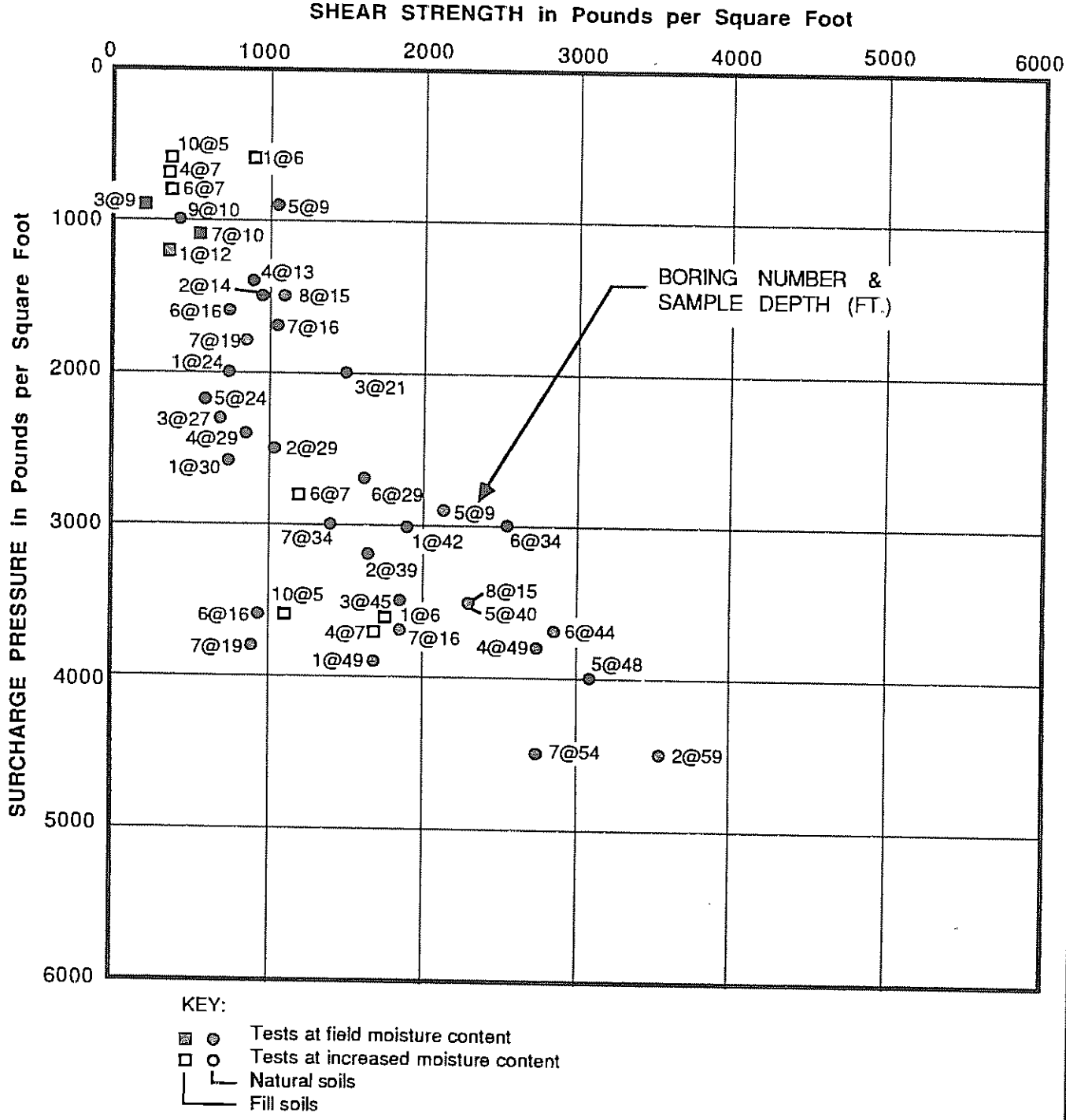
B2.3 Diaz.Yourman & Associates Laboratory Testing

Laboratory testing by Diaz.Yourman & Associates was limited to Areas B and C, and included field moisture content test and particle size analysis testing (including full sieve, percent passing #200 sieves, and hydrometer testing) on most samples, as well as Atterberg limits tests on selected samples. Furthermore, compaction tests were performed on three selected samples.

B2.4 Weston Solutions, Inc. Laboratory Testing

In addition to environmental testing, geotechnical sampling and testing was included as part of Weston's testing program in Area A. Geotechnical tests including in-situ moisture content, grain-size distribution tests (including mechanical sieve analyses and hydrometer testing), and Atterberg limits tests were performed on selected geotechnical samples.

JOB AE-88473 DATE 1/31/89 DR lp O.E. JC CHKD.



DIRECT SHEAR TEST DATA

LeROY CRANDALL AND ASSOCIATES

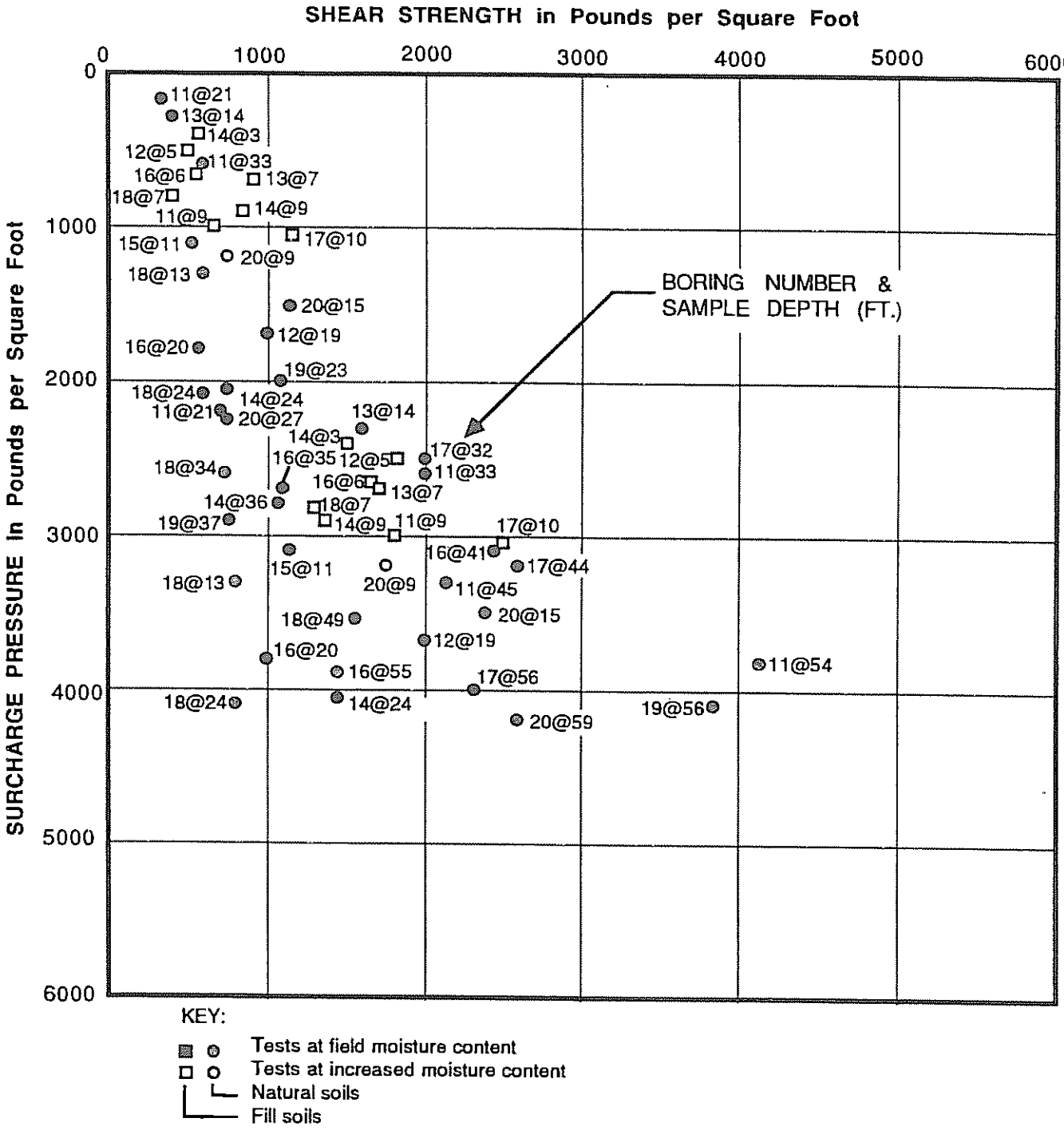
Law Crandall Area A

PLATE A - 3.1

B1-788

PLATE B2-1

JOB AE-88473 DATE 1/31/89 DR lp O.E. JC CHKD.



DIRECT SHEAR TEST DATA

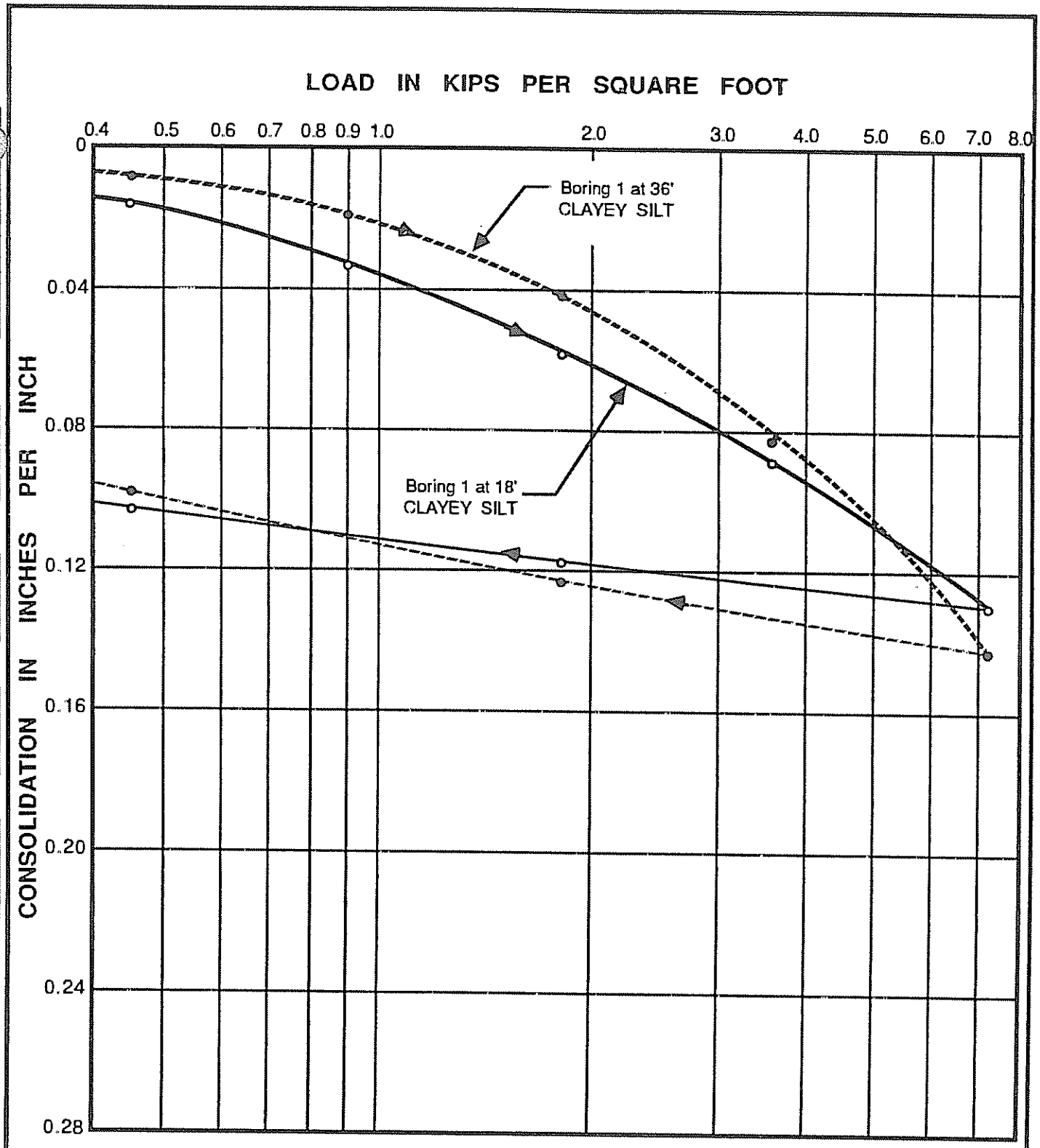
LeROY CRANDALL AND ASSOCIATES

PLATE A - 3.2

Law Crandall Area A

PLATE B2-2

B1-789

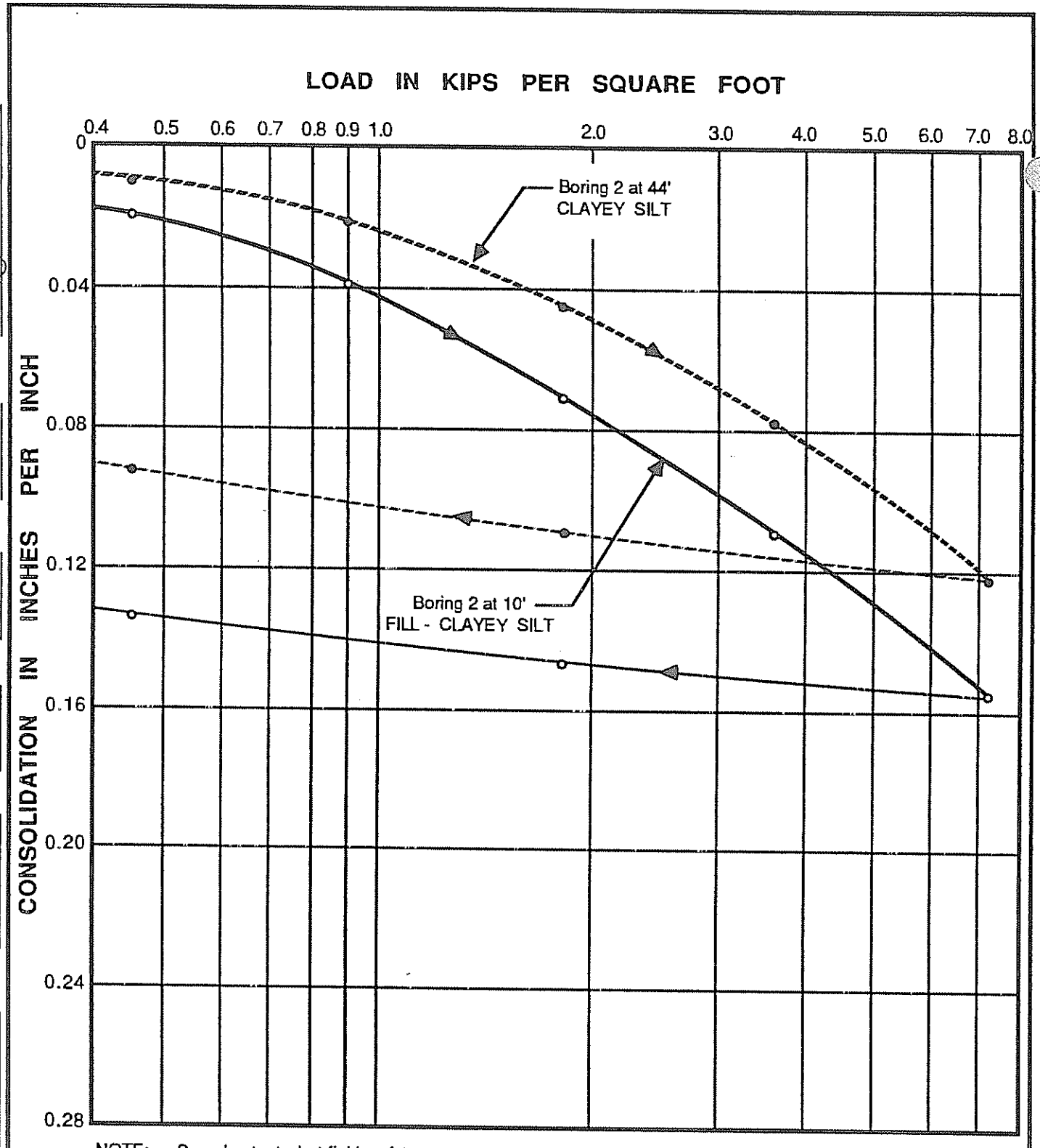


NOTE: Samples tested at field moisture content.

JOB AE-88473 DATE 1/25/89 DR. dmh W.P. dmh O.E. JC CHKD

CONSOLIDATION TEST DATA

LeROY CRANDALL AND ASSOCIATES



NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA

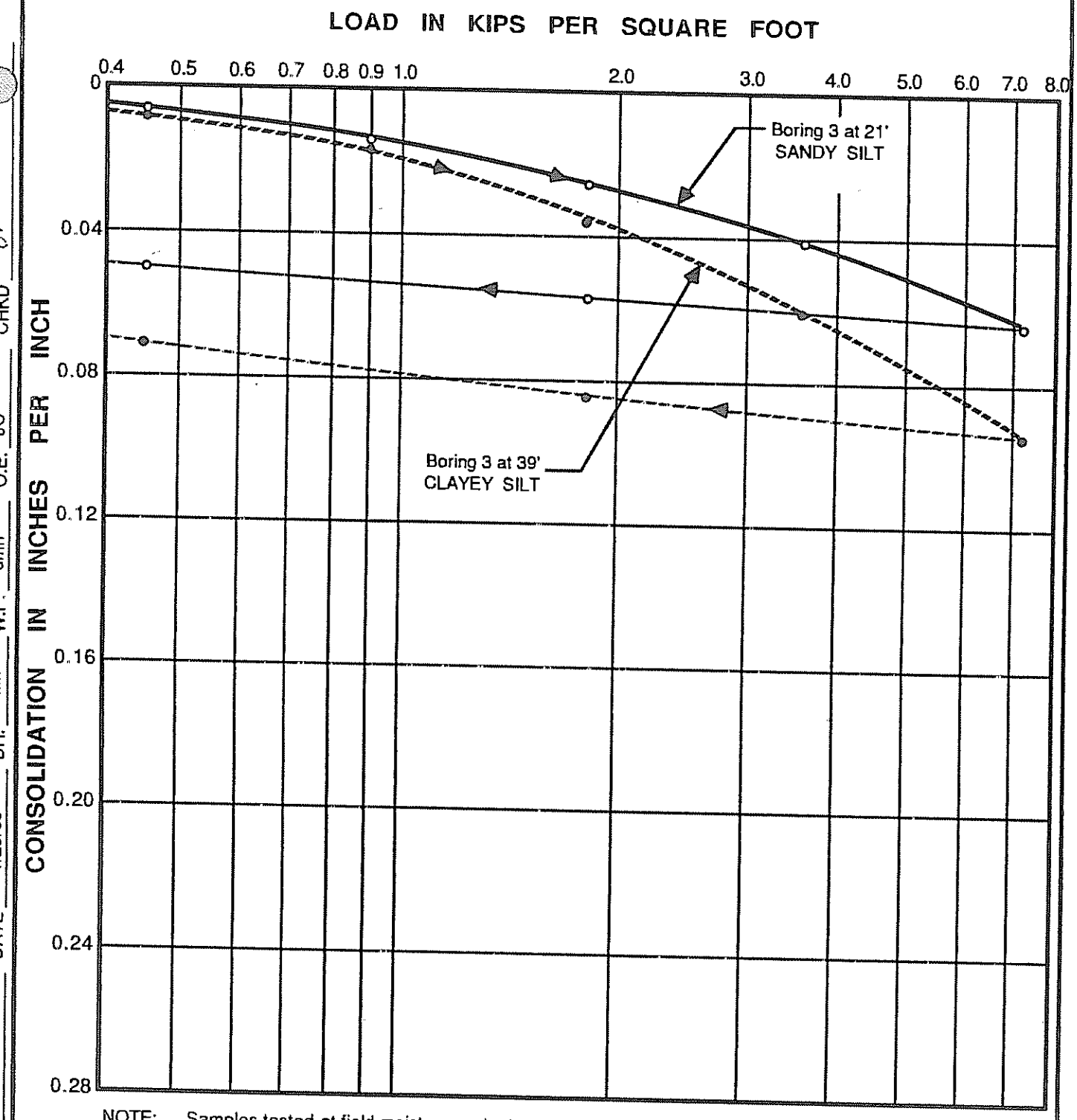
LeROY CRANDALL AND ASSOCIATES

PLATE A-4.2

Law Crandall Area A

B1-791

PLATE B2-4

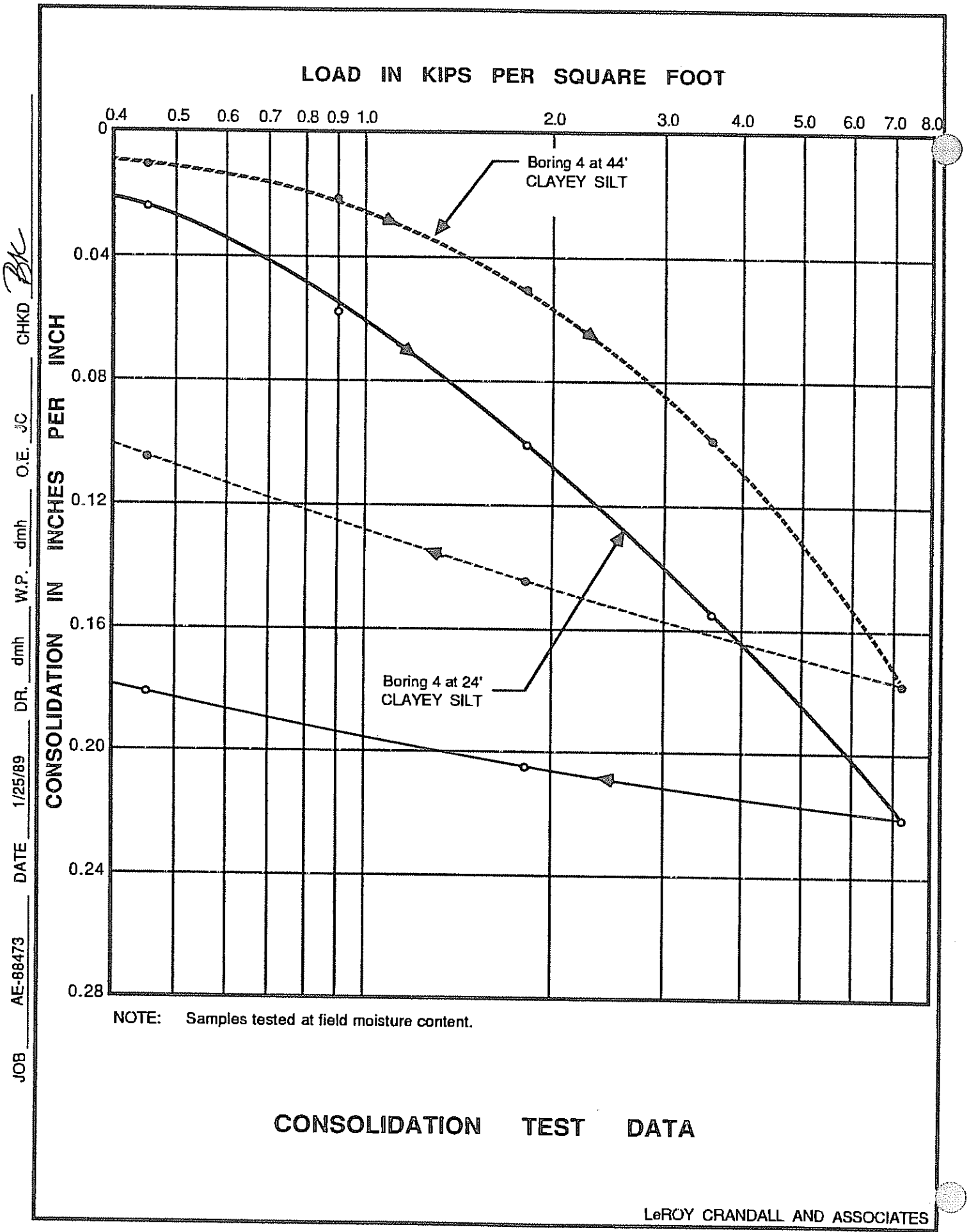


NOTE: Samples tested at field moisture content.

JOB AE-88473 DATE 1/25/89 DR. dmh W.P. dmh O.E. JC CHKD BK

CONSOLIDATION TEST DATA

LeROY CRANDALL AND ASSOCIATES

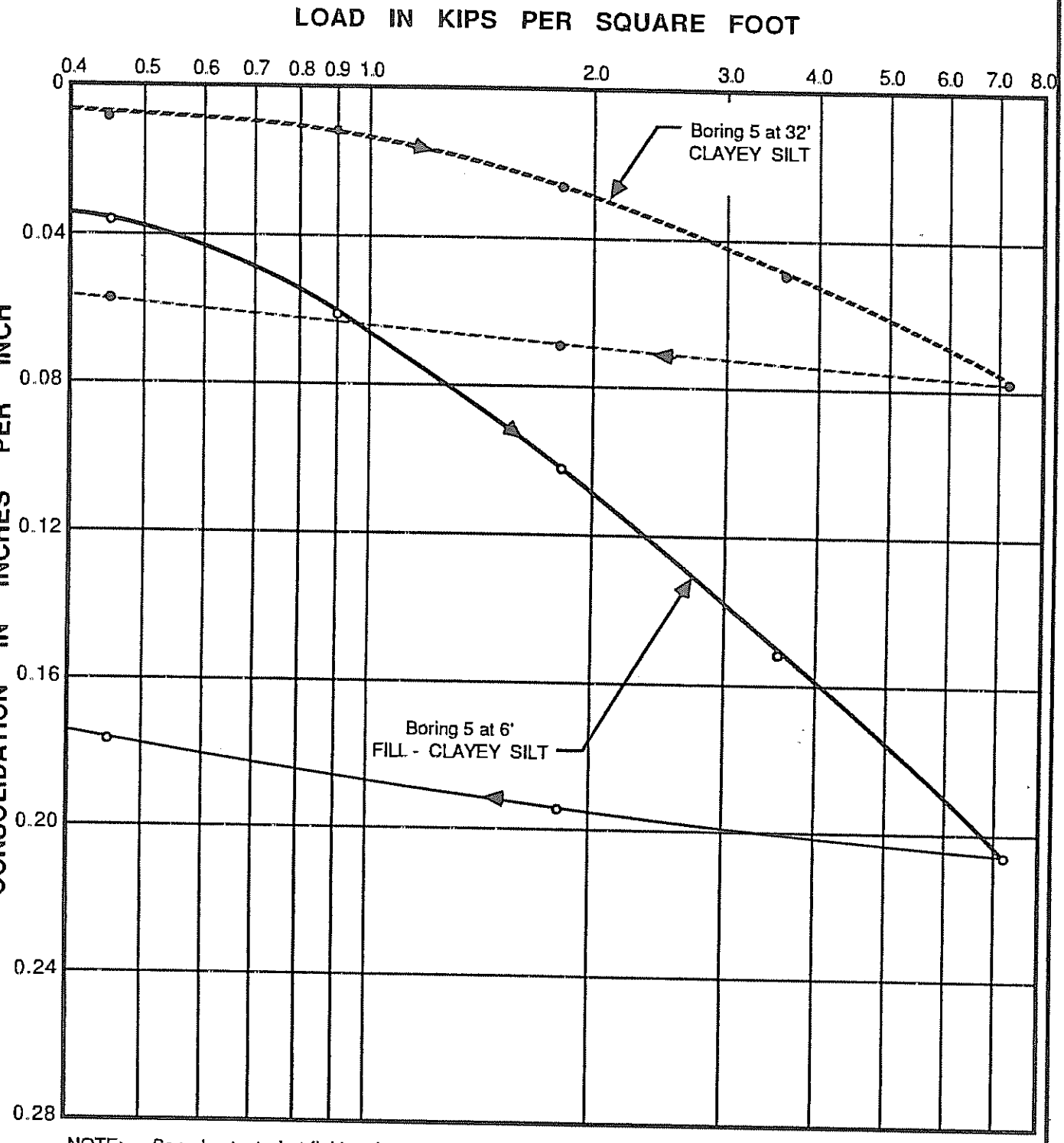


Law Crandall Area A

B1-793

PLATE B2-6

JOB AE-88473 DATE 1/25/89 DR. dmh W.P. dmh O.E. JC CHKD

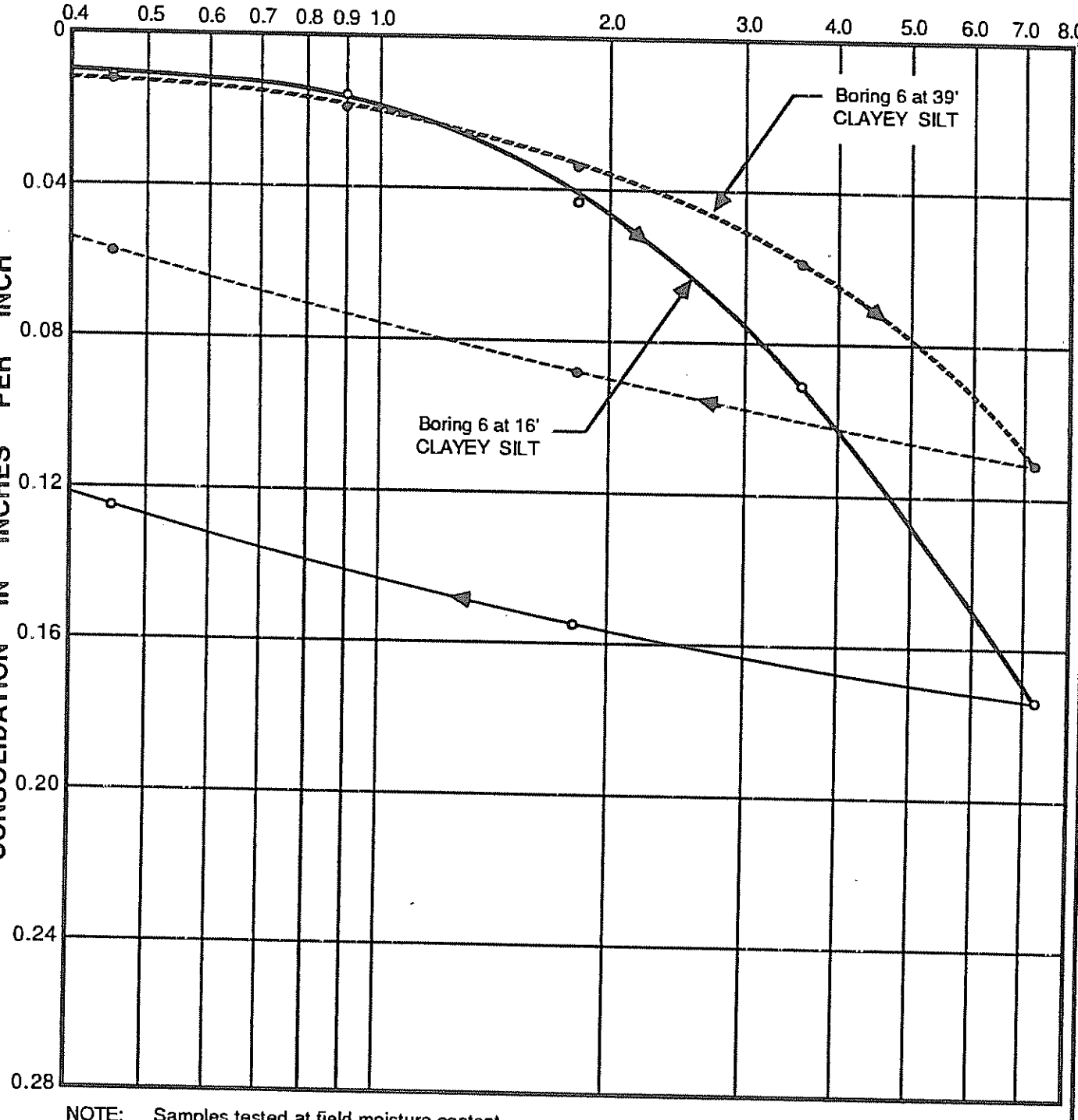


NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA

LeROY CRANDALL AND ASSOCIATES

JOB AE-88473 DATE 1/25/89 DR. dmh W.P. dmh O.E. JC CHKD

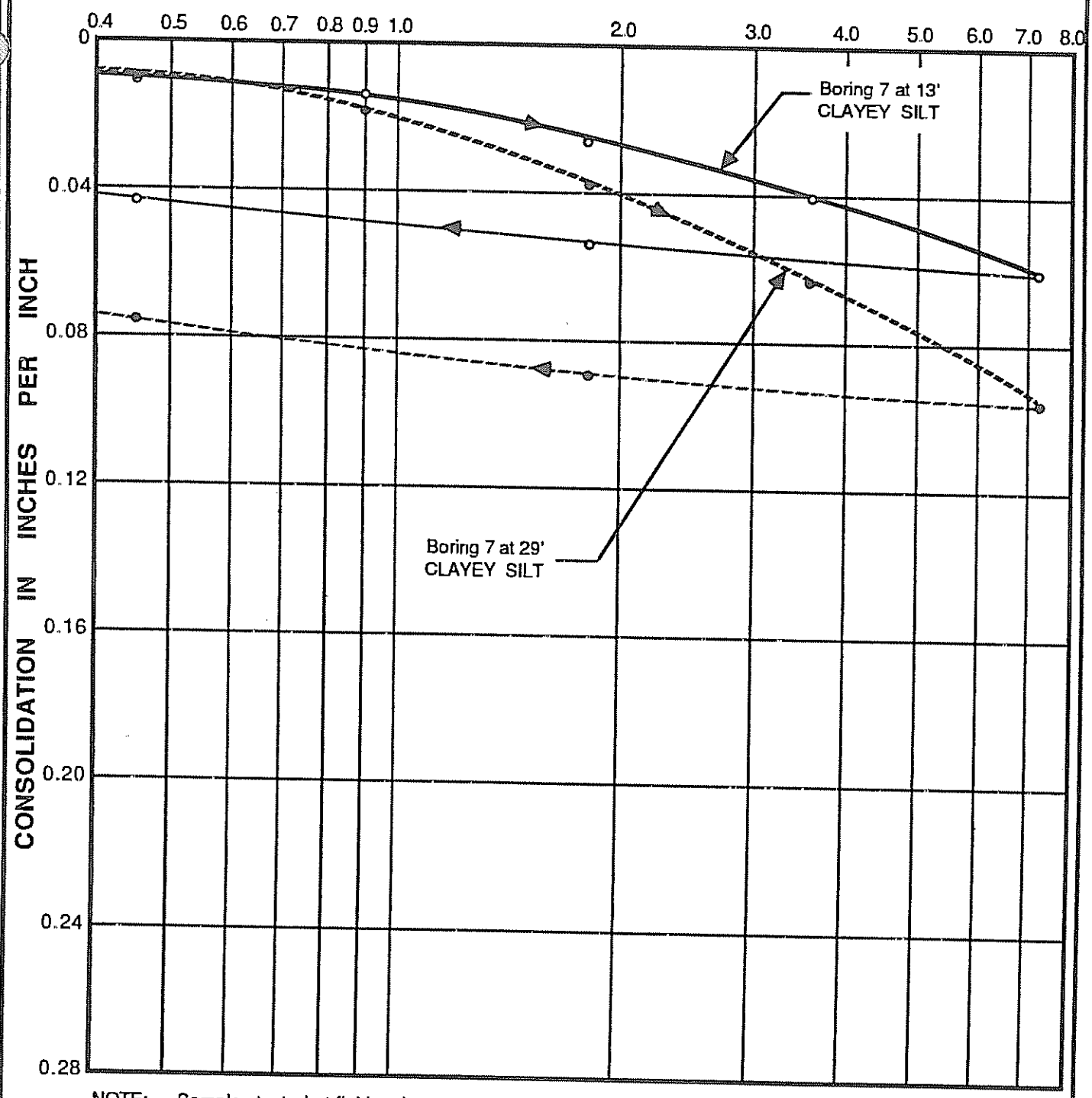


NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA

LeROY CRANDALL AND ASSOCIATES

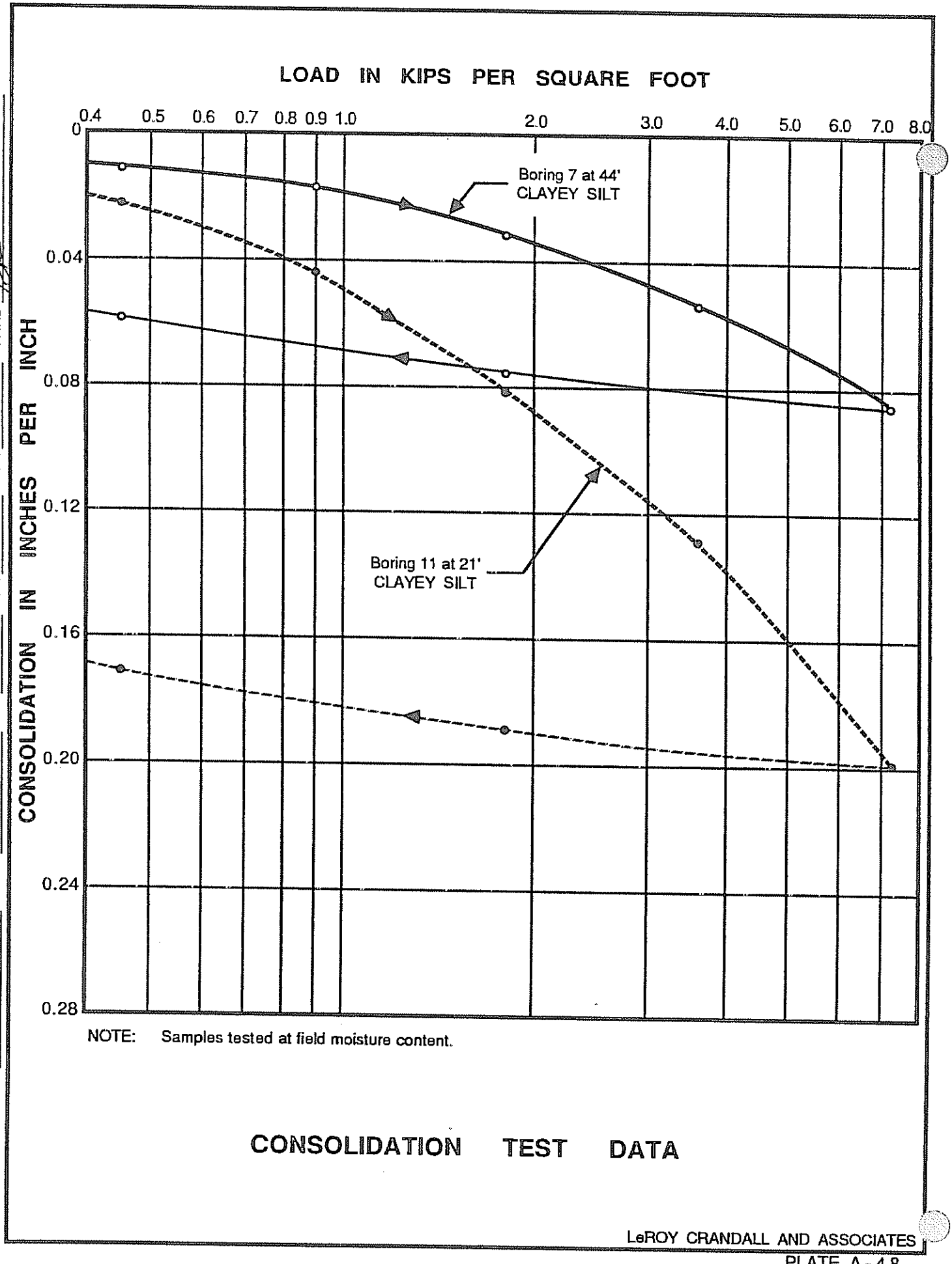
JOB AE-88473 DATE 1/25/89 DR. dmh W.P. dmh O.E. JC CHKD



NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA

LeROY CRANDALL AND ASSOCIATES



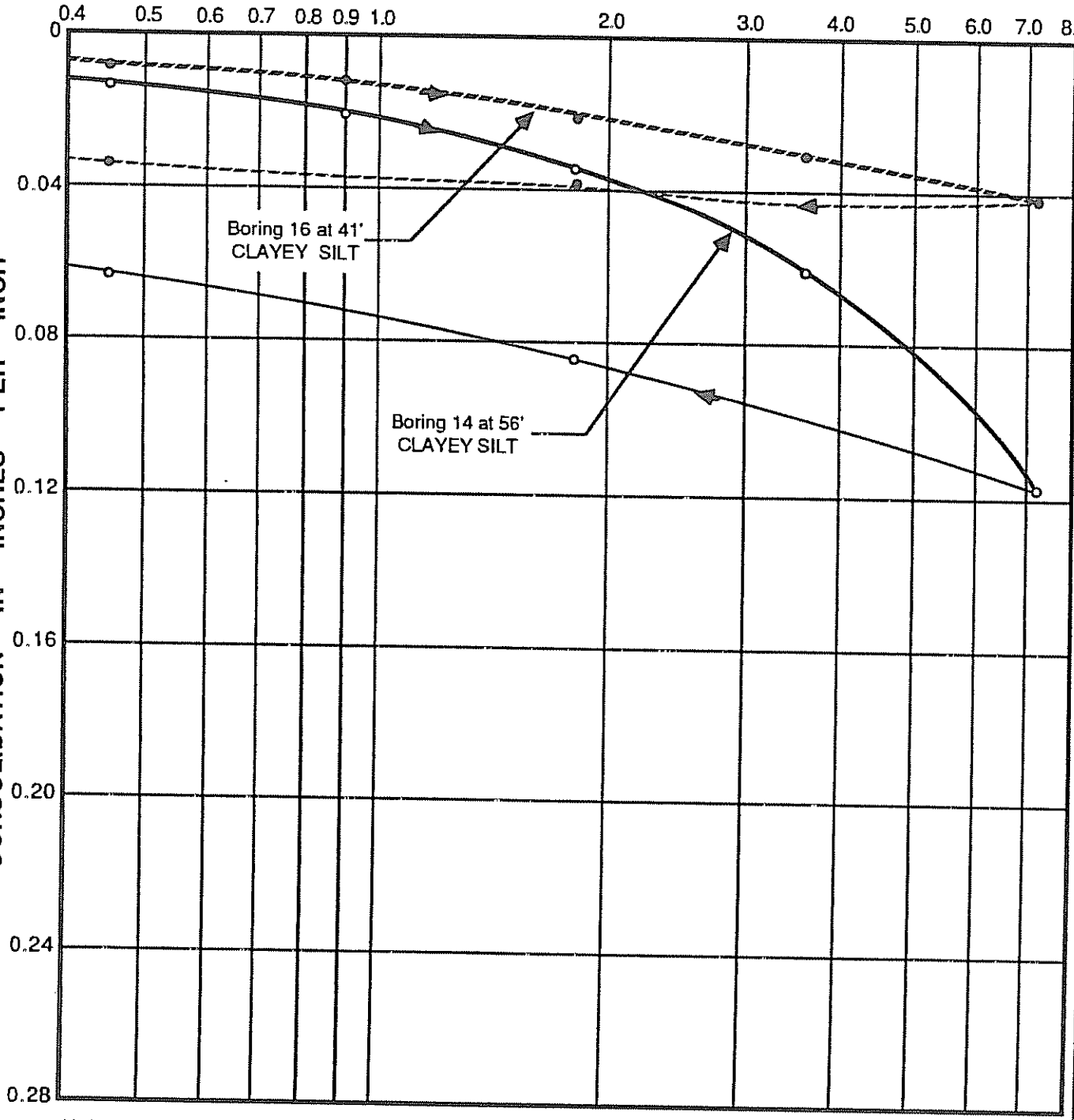
NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA

LeROY CRANDALL AND ASSOCIATES

PLATE A-4.8

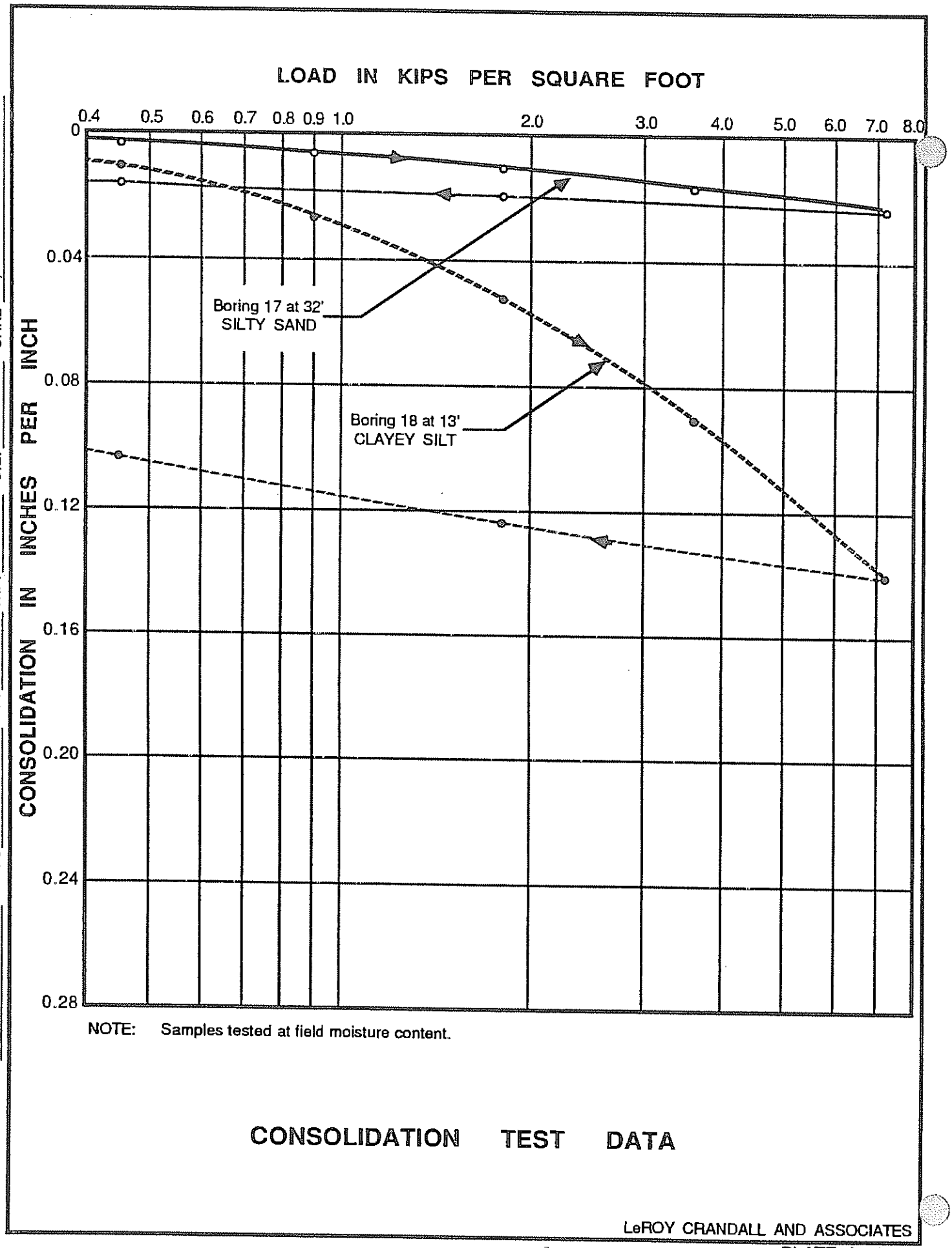
JOB AE-88473 DATE 1/25/89 DR. dmh W.P. dmh O.E. JC CHKD



NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA

LeROY CRANDALL AND ASSOCIATES



NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA

LeROY CRANDALL AND ASSOCIATES

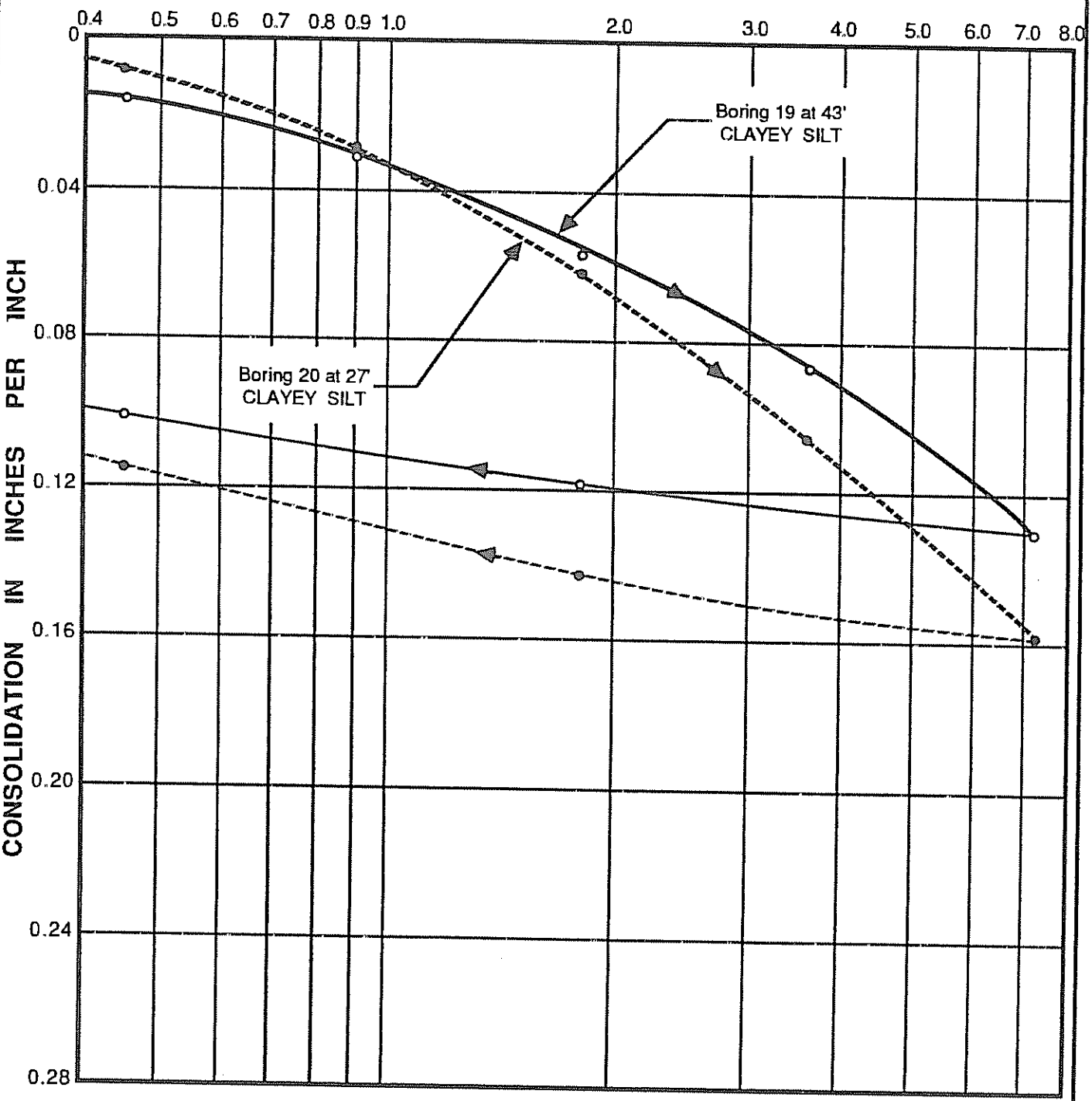
PLATE A - 4.10

Law Crandall Area A

B1-799

PLATE B2-12

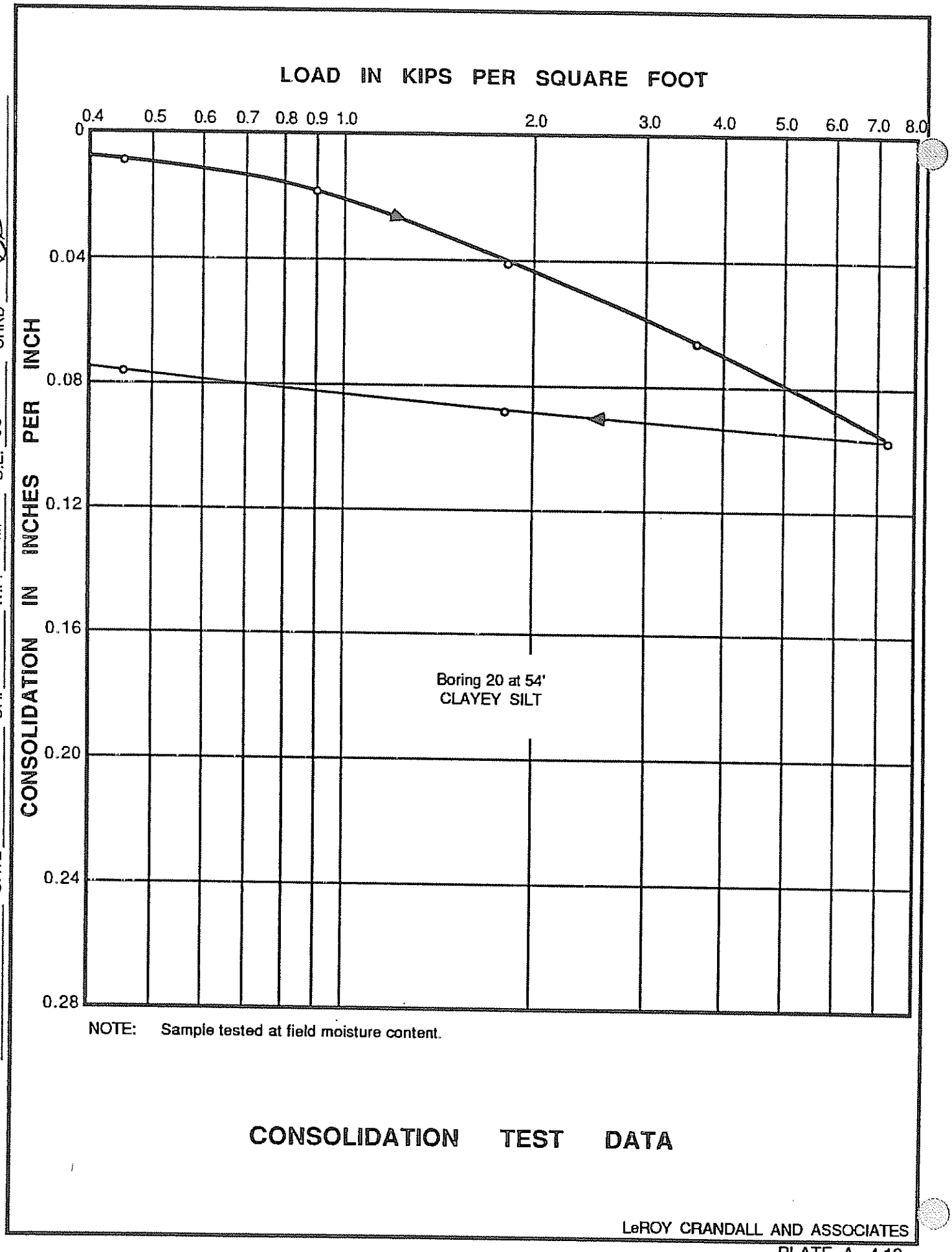
JOB AE-88473 DATE 1/25/89 DR. dmh W.P. dmh O.E. JC CHKD



NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA

LeROY CRANDALL AND ASSOCIATES



CONSOLIDATION TEST DATA

LeROY CRANDALL AND ASSOCIATES

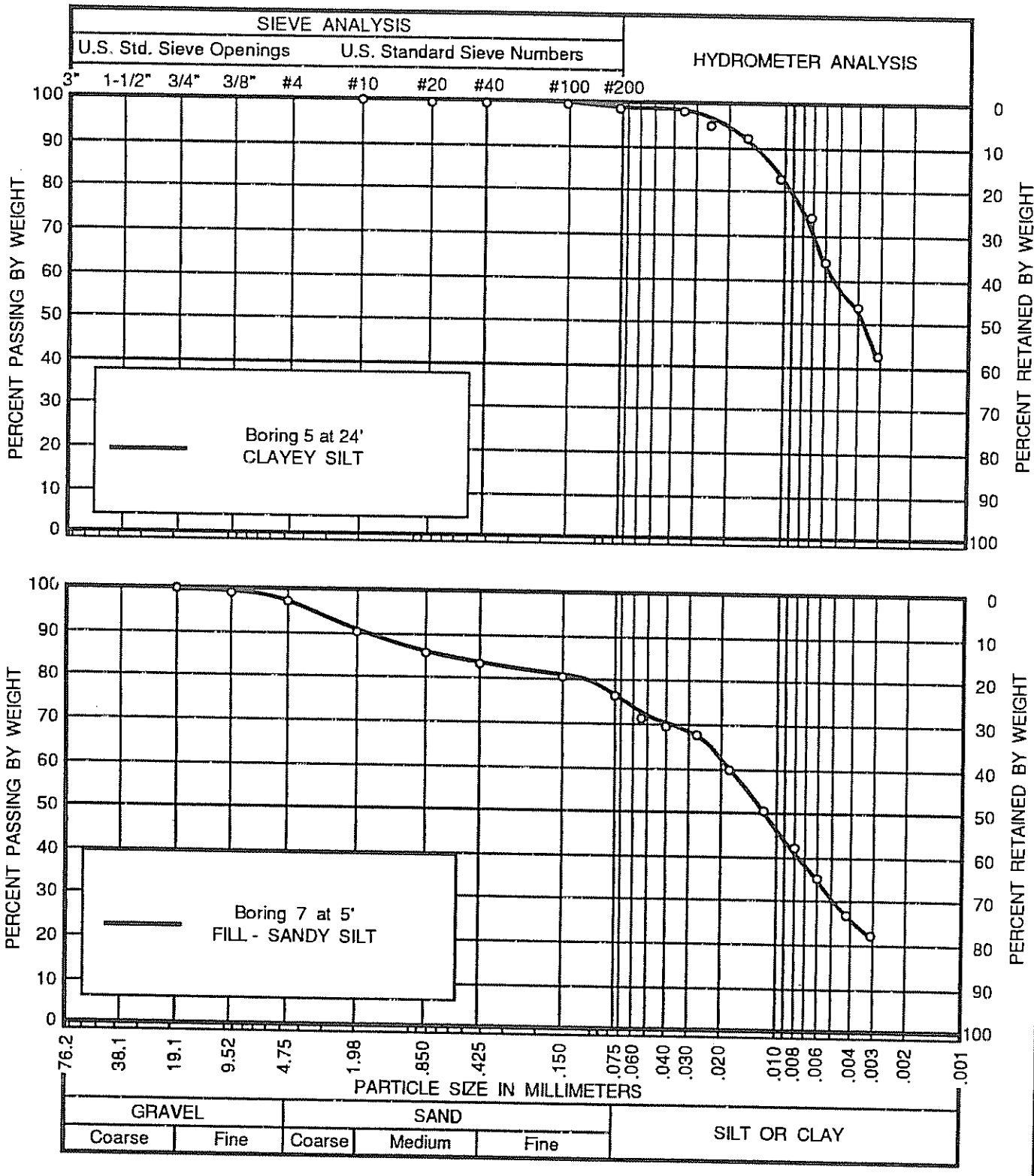
PLATE A - 4.12

Law Crandall Area A

B1-801

PLATE B2-14

JOB AE-88473 DATE 3/23/89 BY dmh O.E. BK CHKD.



PARTICLE SIZE DISTRIBUTION

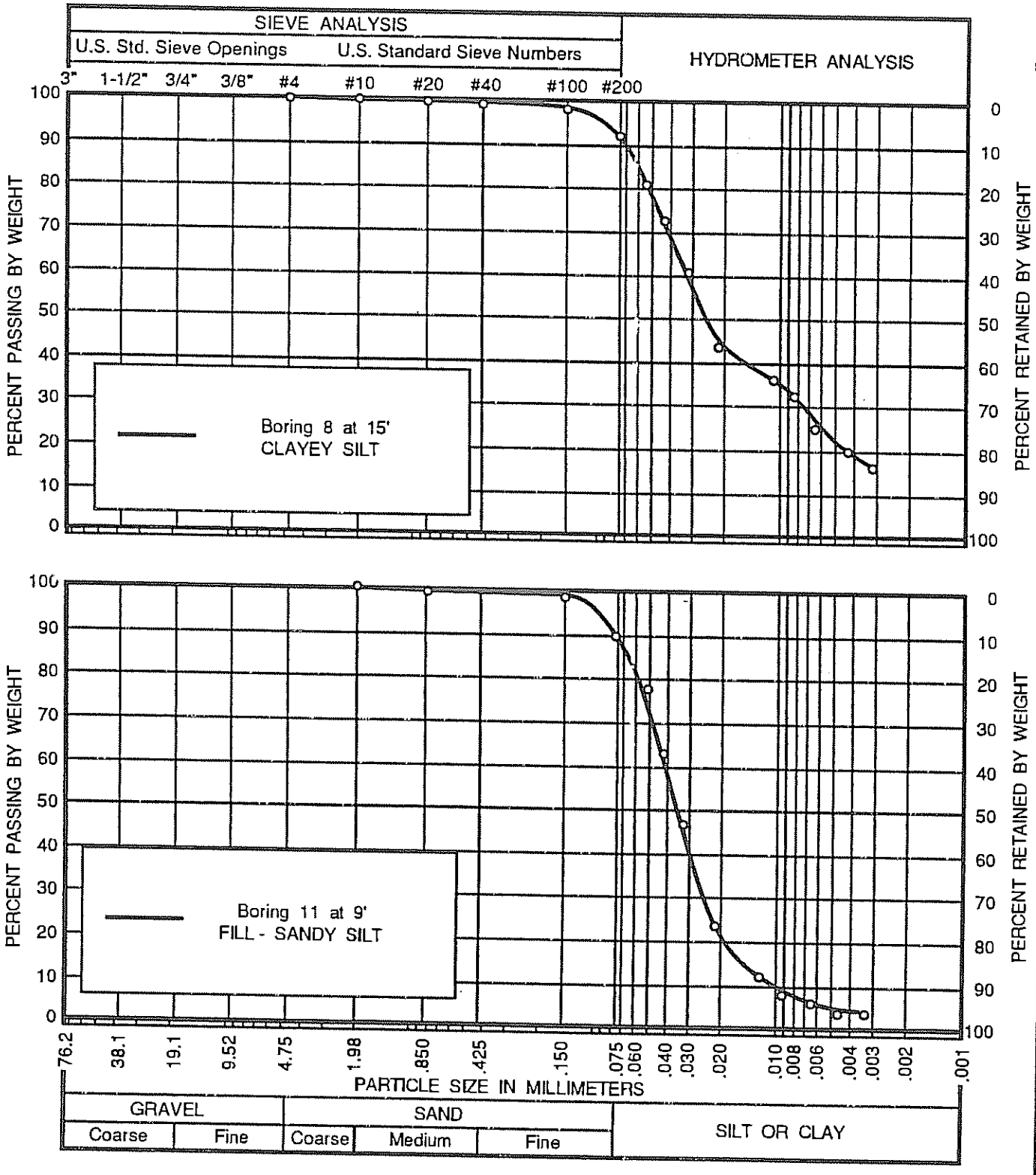
LeROY CRANDALL AND ASSOCIATES

Law Crandall Area A

PLATE A - 5.1

PLATE B2-15

JOB AE-88473 DATE 3/23/89 BY dmh O.E. BK CHKD.



PARTICLE SIZE DISTRIBUTION

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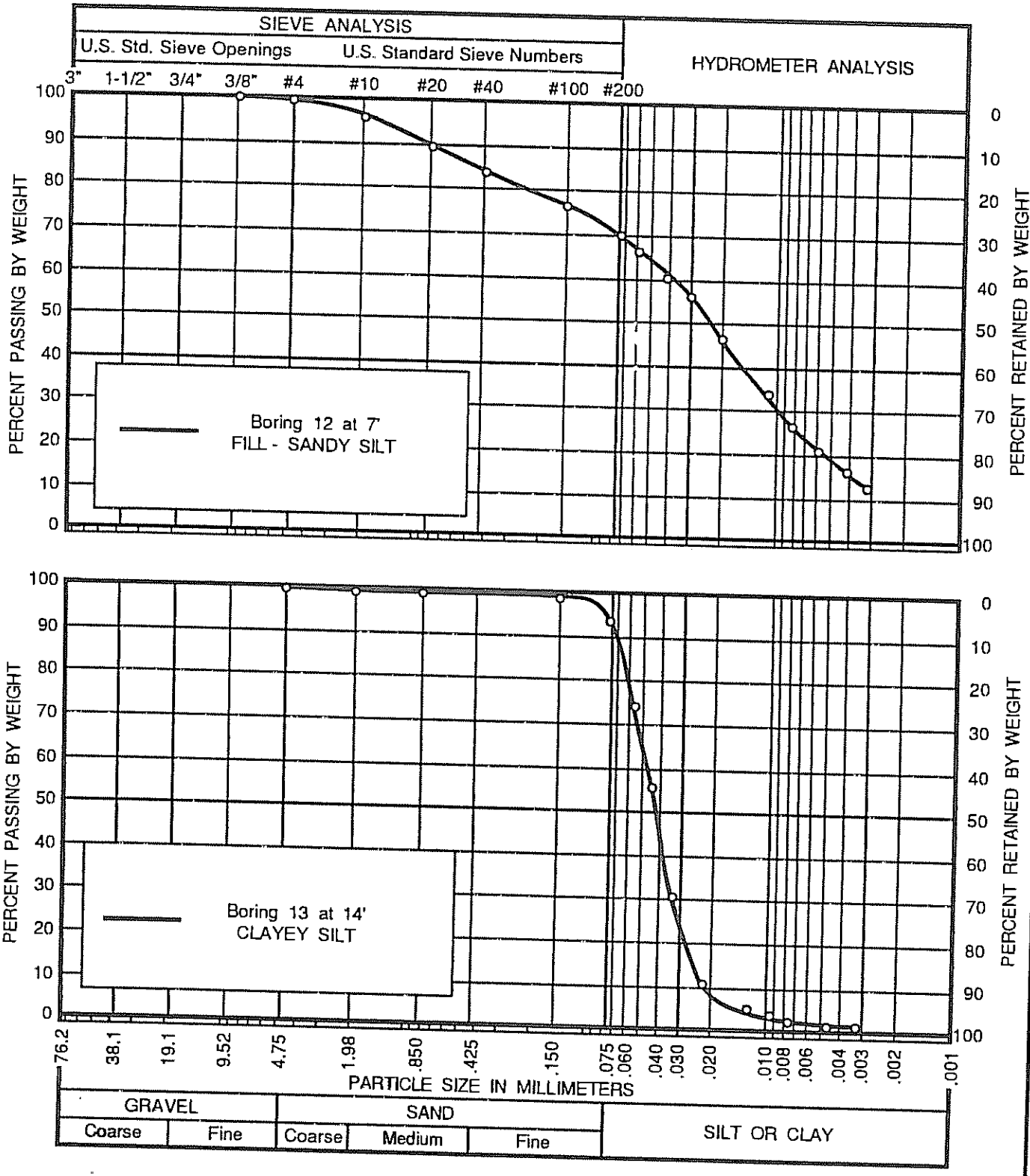
PLATE A-5.2

Law Crandall Area A

B1-803

PLATE B2-16

JOB AE-88473 DATE 3/23/89 BY dmh O.E. BK CHKD



PARTICLE SIZE DISTRIBUTION

LeROY CRANDALL AND ASSOCIATES

Law Crandall Area A

PLATE A-5.3

PLATE B2-17

JOB AE-88473 DATE 1/26/89 W.P. dmh O.E. JC CHKD

BORING NUMBER AND SAMPLE DEPTH :	8 at 0' to 4'	9 at 4' to 8'
SOIL TYPE :	FILL - SANDY SILT	FILL - CLAYEY SILT
MAXIMUM DRY DENSITY : (lbs./cu. ft.)	116	110
OPTIMUM MOISTURE CONTENT : (% of dry wt.)	14	19

TEST METHOD : ASTM Designation D1557 - 70

COMPACTION TEST DATA

LeROY CRANDALL AND ASSOCIATES

PLATE A - 6

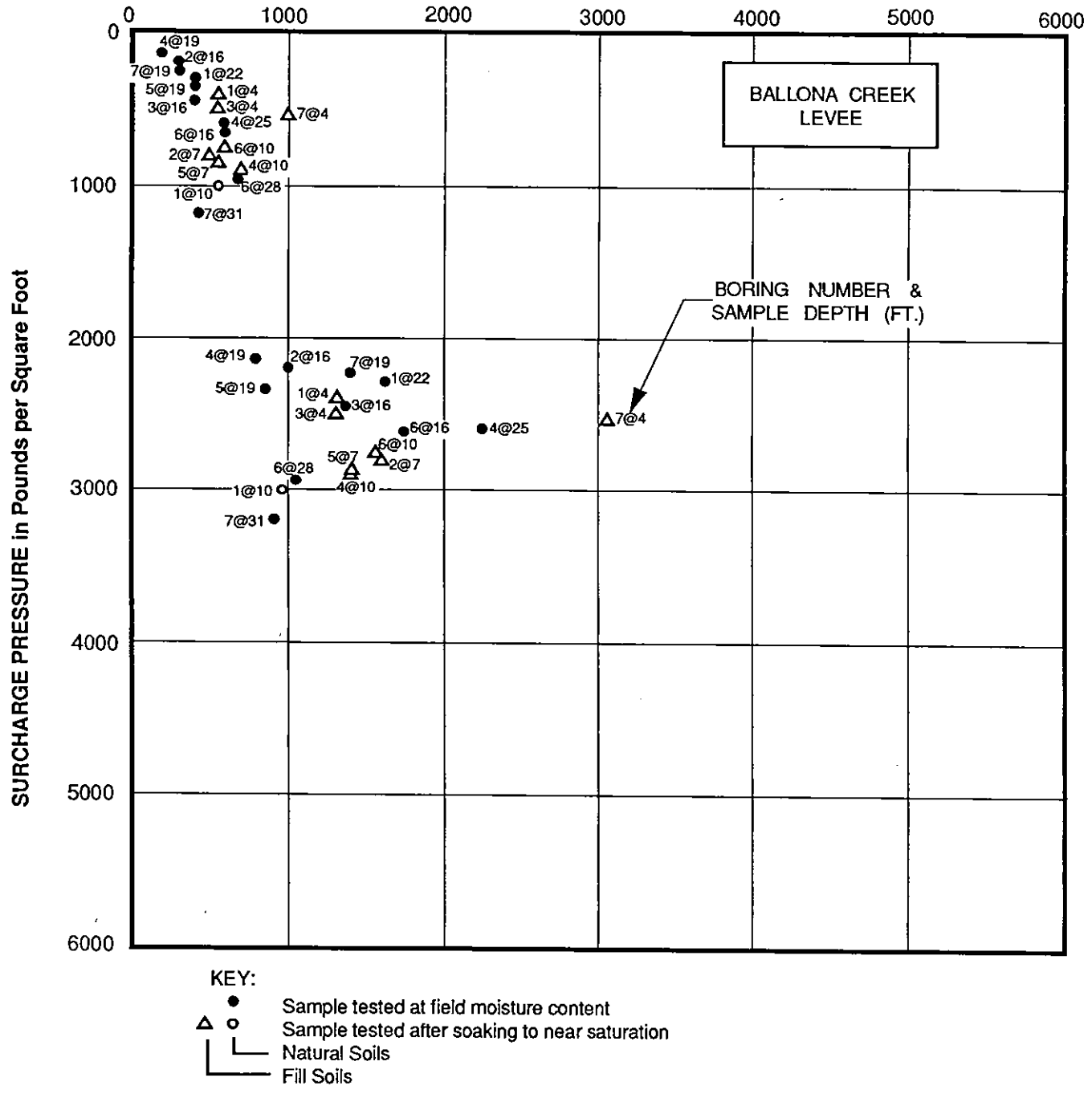
JOB AE-88473 DATE 1/26/89 W.P. dmh O.E. JC CHKD

BORING NUMBER AND SAMPLE DEPTH	SOIL TYPE	SURCHARGE PRESSURE (psf)	COEFFICIENT OF PERMEABILITY Ft./Yr.	Cm./Sec.
1 at 24'	CLAYEY SILT	900	0.1	1×10^{-7}
2 at 14'	SANDY SILT	200	11.1	1×10^{-5}
4 at 19'	SILTY SAND	500	3.6	3×10^{-6}
5 at 16'	SILTY SAND	400	1.9	2×10^{-6}
6 at 29'	SANDY SILT	1000	0.1	1×10^{-7}
11 at 33'	SANDY SILT	1000	7.5	7×10^{-6}
12 at 14'	CLAYEY SILT	200	0.1	1×10^{-7}
14 at 20'	CLAYEY SILT	600	0.1	1×10^{-7}
16 at 28'	SANDY SILT	1000	0.1	9×10^{-8}
19 at 23'	CLAYEY SILT	900	0.3	3×10^{-7}

PERMEABILITY TEST DATA

LeROY CRANDALL AND ASSOCIATES

JOB L91028.AEO DATE 4/1/91 DR ph O.E. JLR CHKD.

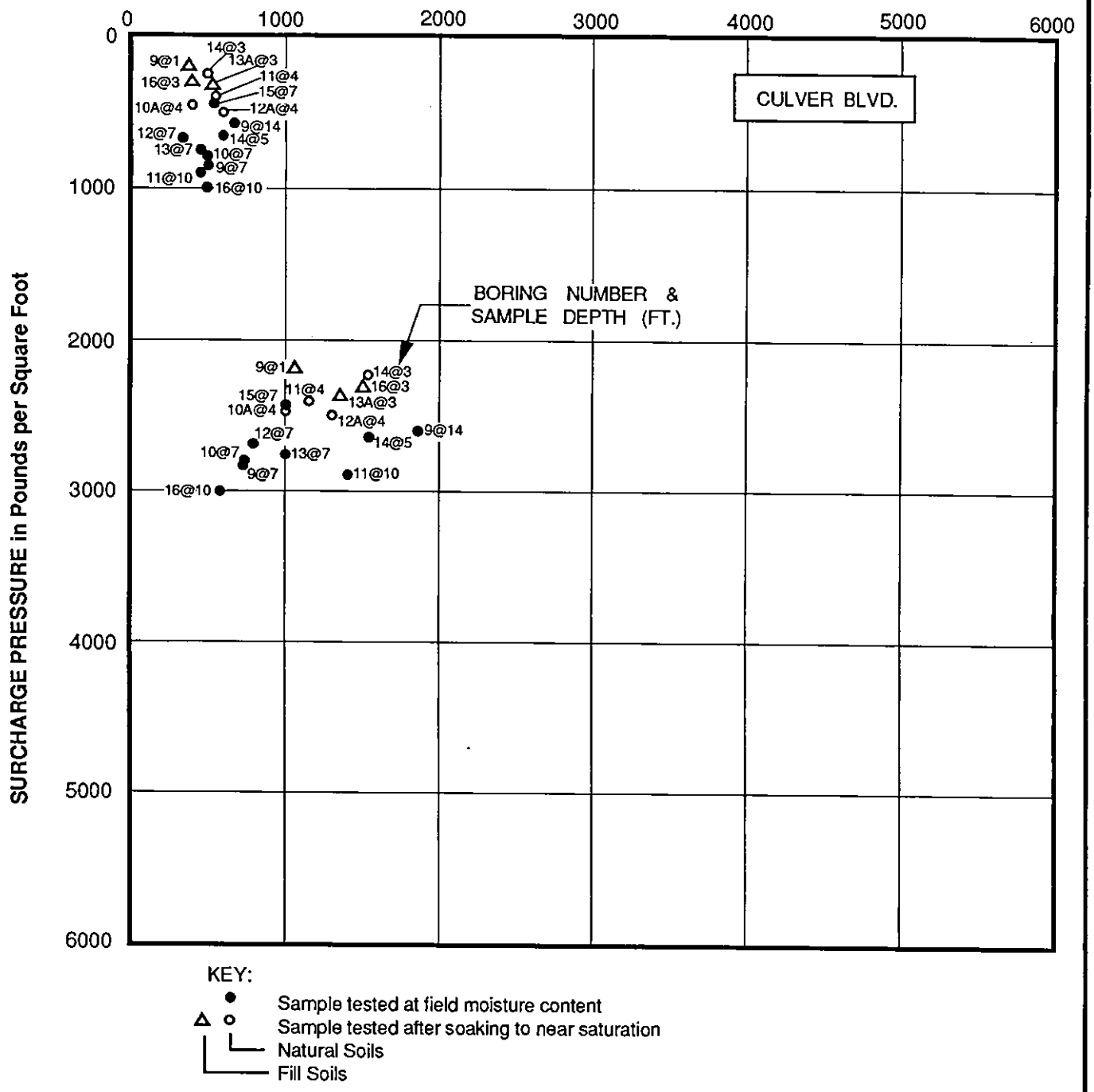


DIRECT SHEAR TEST DATA

LAW/CRANDALL, INC.

PLATE A-3.1

JOB L91028.AEO DATE 4/1/91 DR ph O.E. JLR CHKD. _____

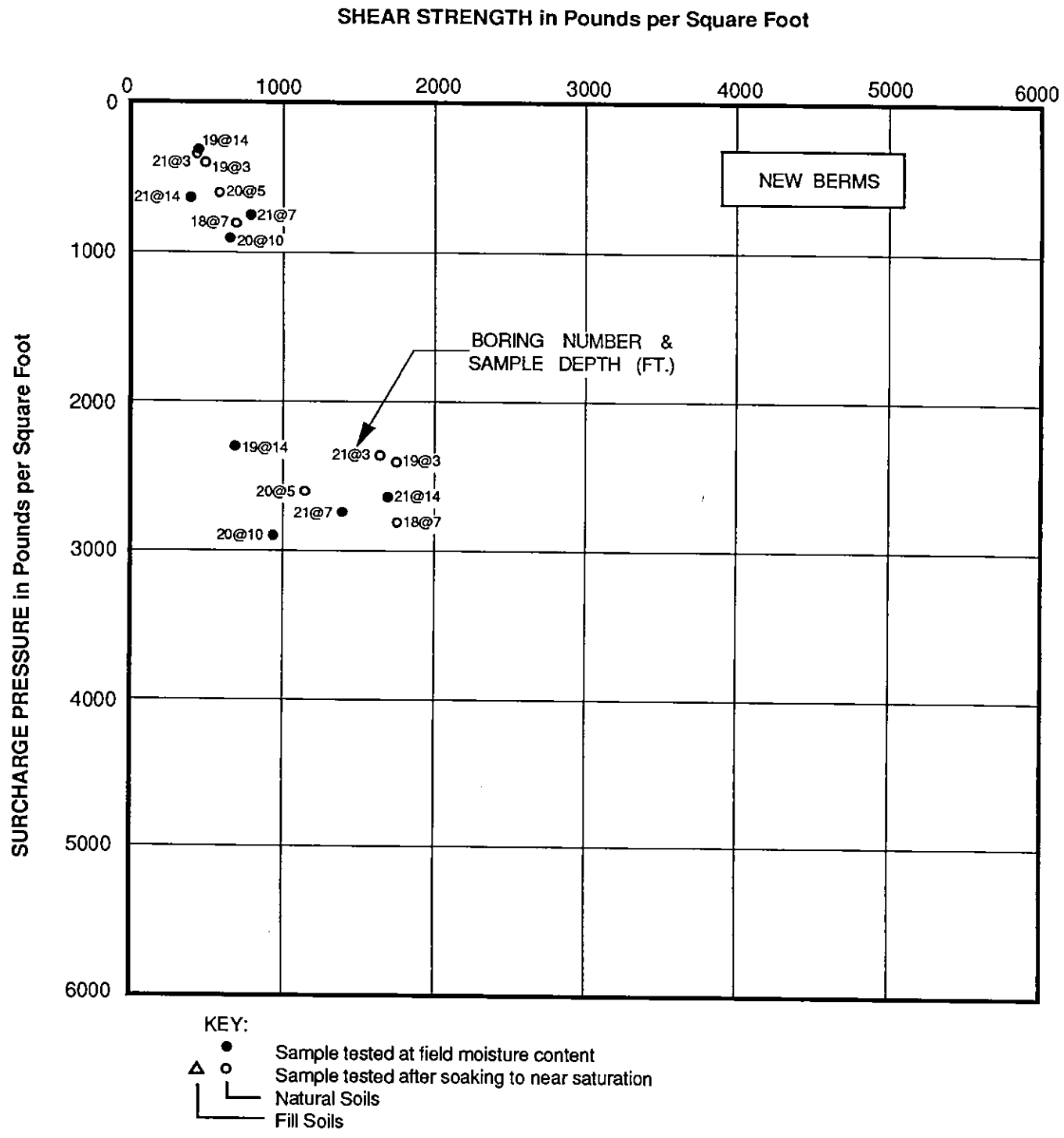


DIRECT SHEAR TEST DATA

LAW/CRANDALL, INC.

PLATE A-3.2

JOB L91028.AEQ DATE 4/1/91 DR ph O.E. FH CHKD.

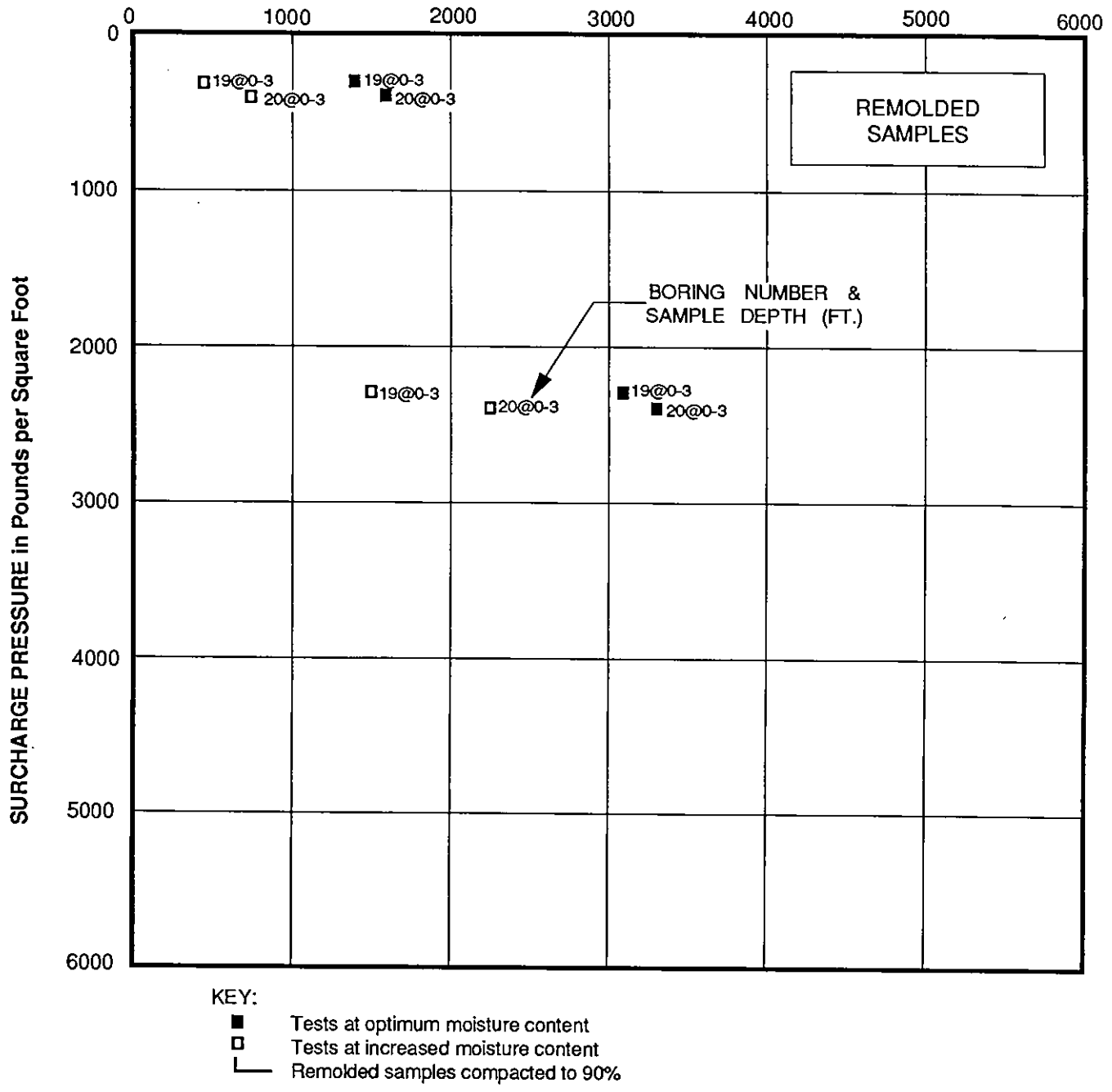


DIRECT SHEAR TEST DATA

LAW/CRANDALL, INC.

PLATE A-3.3

JOB L91028.AEQ DATE 4/1/91 DR ph O.E. FH CHKD.

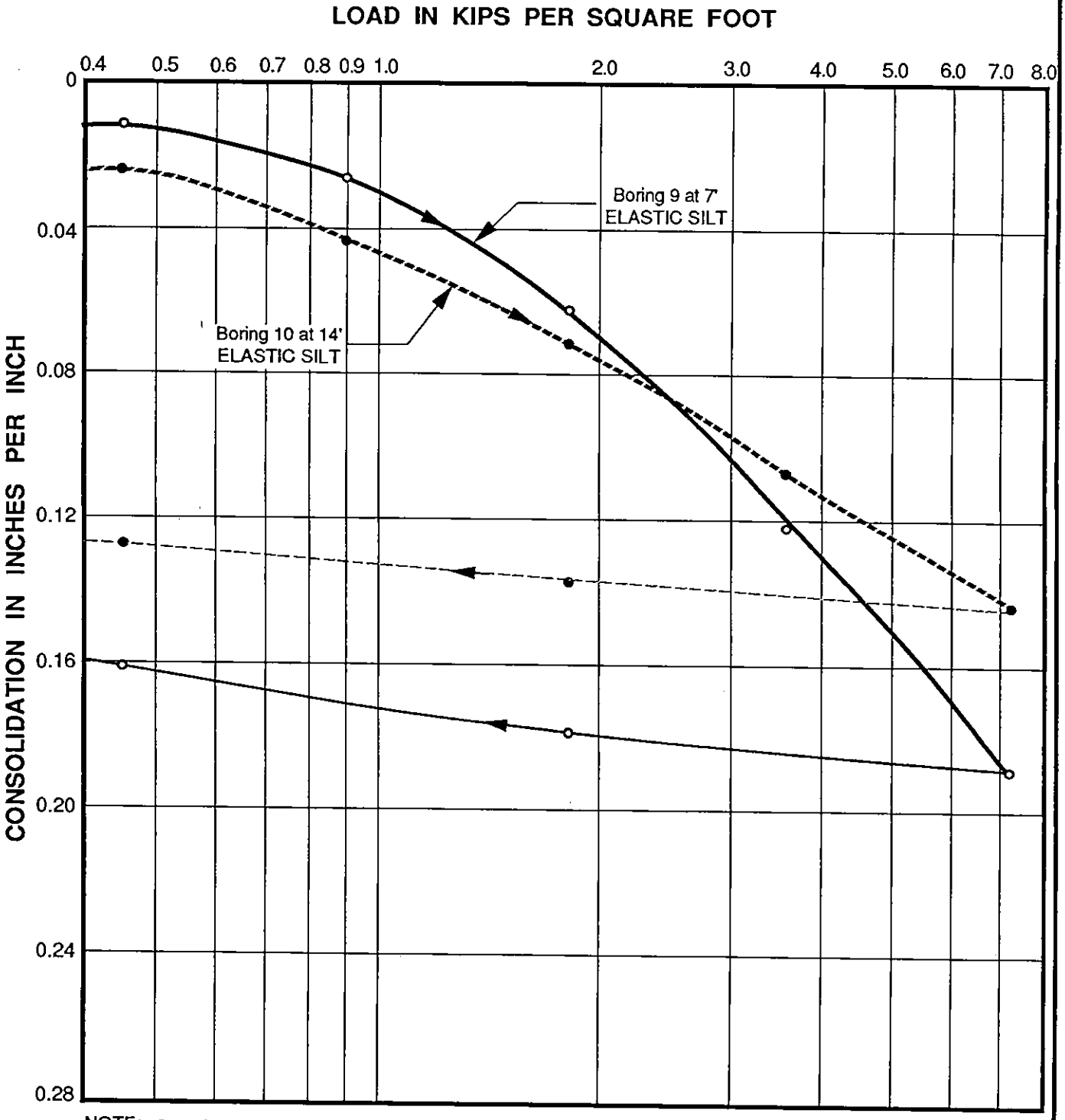


DIRECT SHEAR TEST DATA

LAW/CRANDALL, INC.

PLATE A-3.4

JOB L91028.AEO DATE 3/29/91 DR. ph W.P. ph O.E. JLR/BK CHKD



NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA

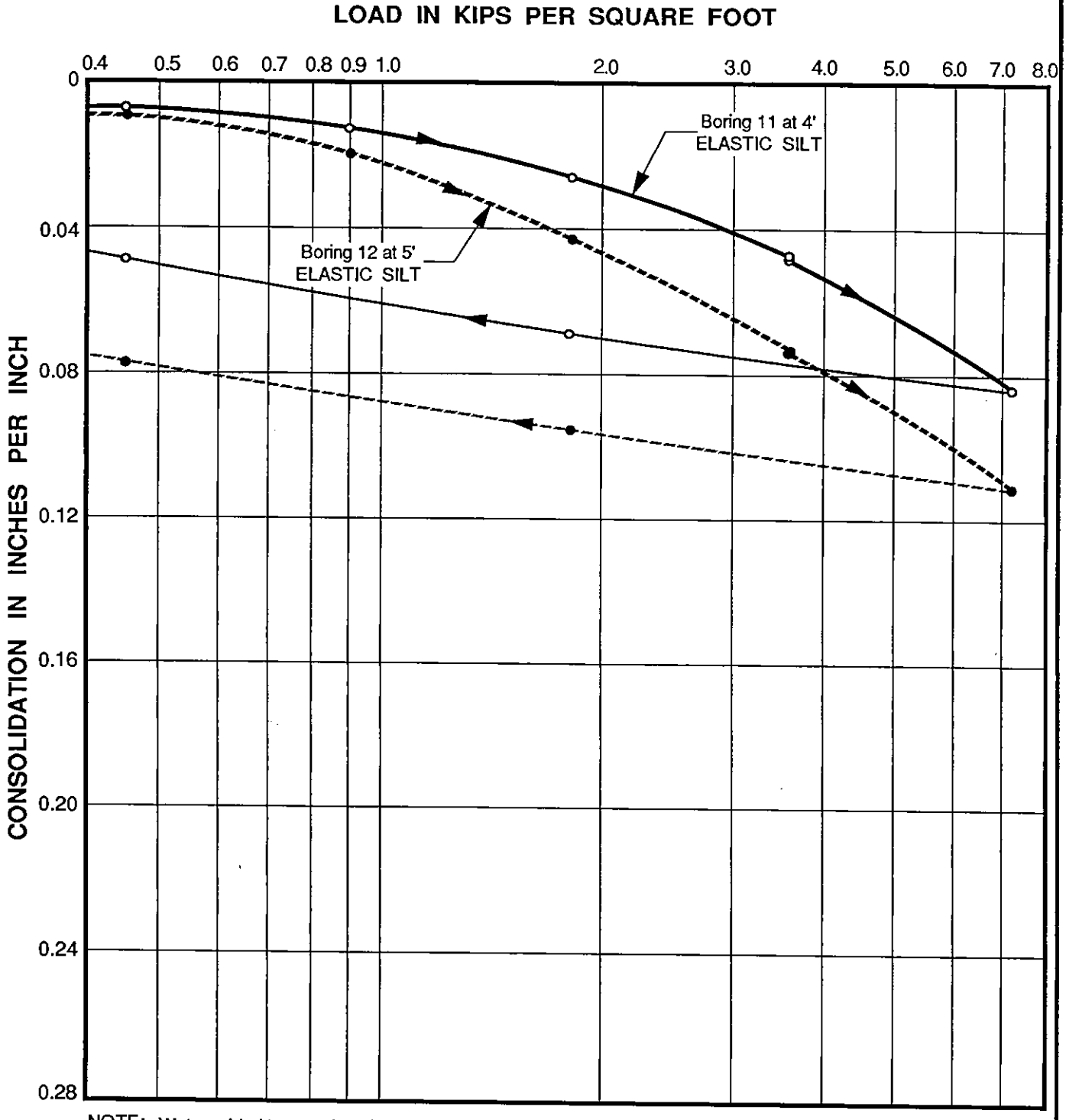
LAW/CRANDALL, INC.

Law Crandall Area B

PLATE A-4.1

PLATE B2-24

JOB L91028.AEO DATE 3/29/91 DR. ph W.P. ph O.E. JLR/BK CHKD



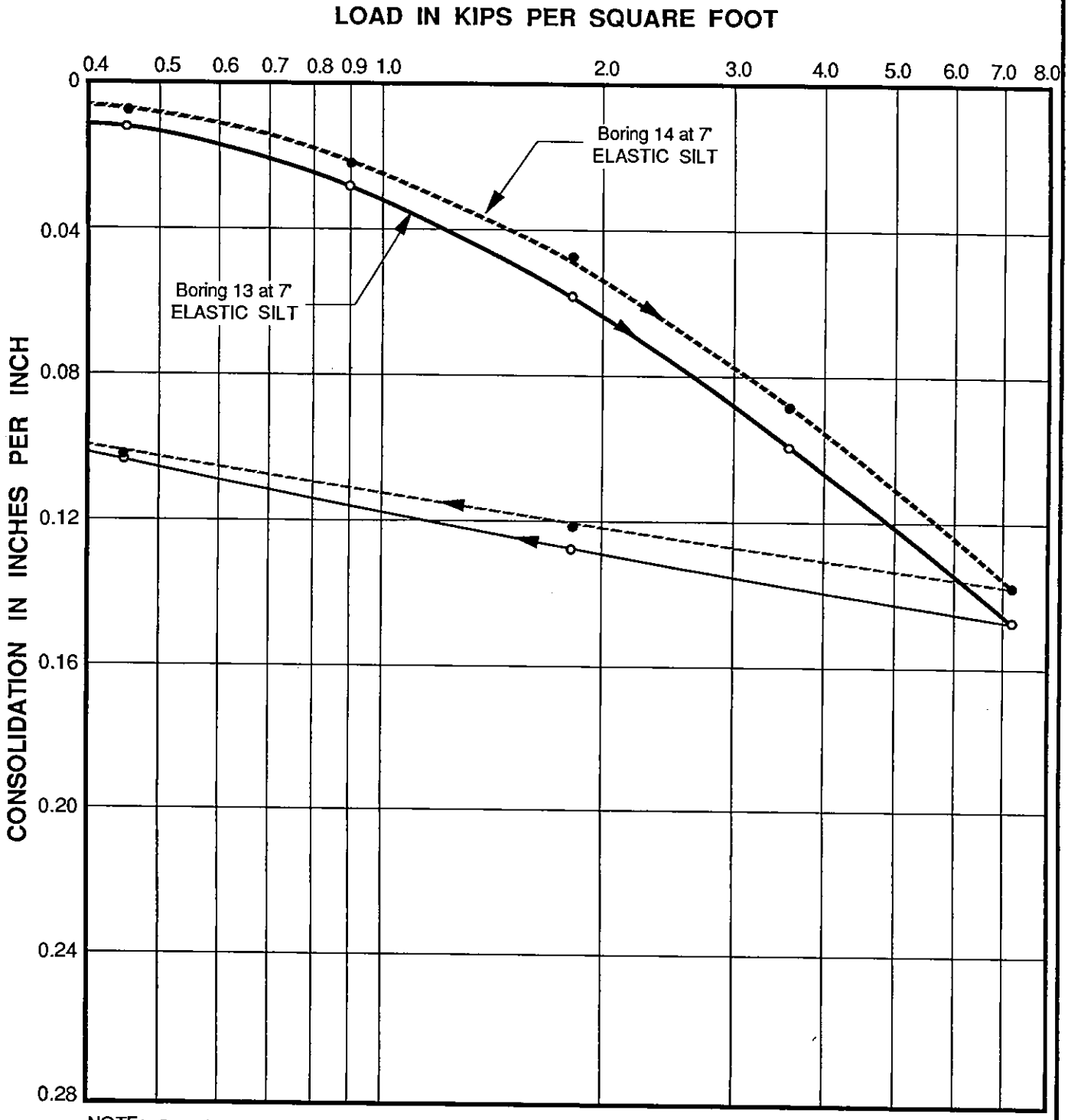
NOTE: Water added to samples after consolidation under a load of 3.6 kips per square foot.

CONSOLIDATION TEST DATA

LAW/CRANDALL, INC.

PLATE A-4.2

JOB L91028.AEO DATE 3/29/91 DR. ph W.P. ph O.E. JLR/BK CHKD



NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA

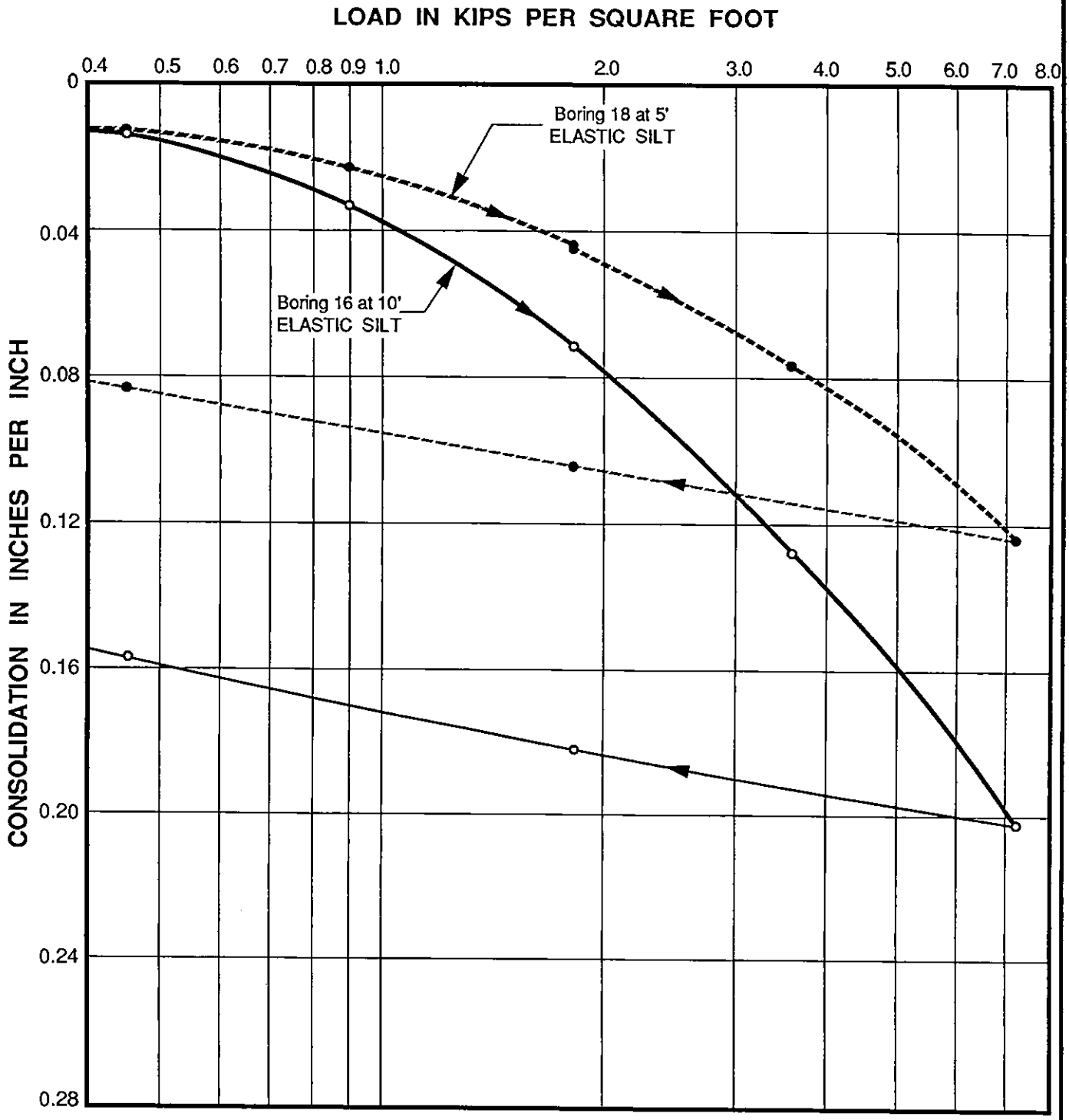
LAW/CRANDALL, INC.

Law Crandall Area B

PLATE A-4.3

PLATE B2-26

JOB L91028.AEO DATE 3/29/91 DR. ph W.P. ph O.E. JLR/BK CHKD



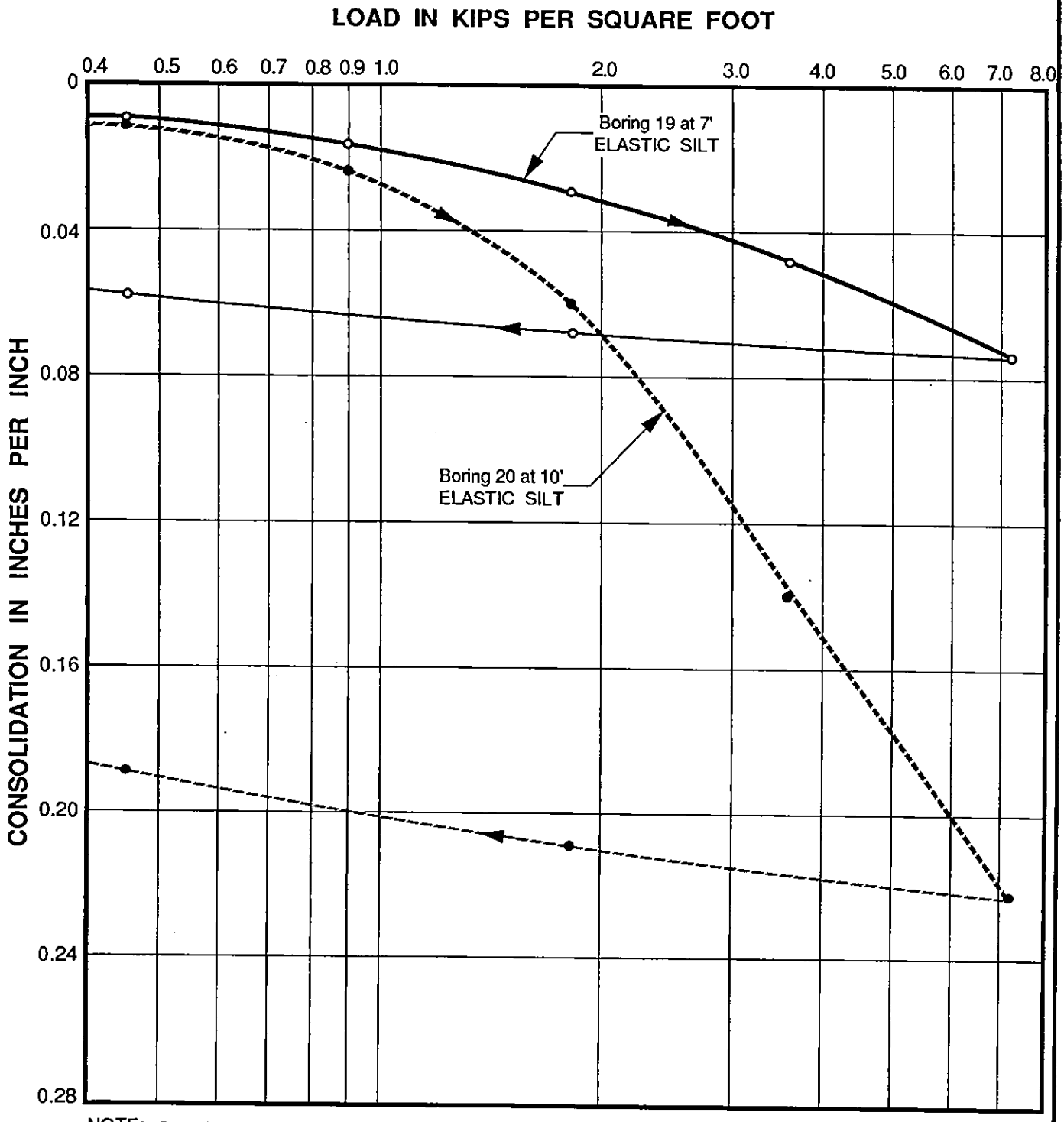
NOTE: Water added to sample from Boring 18 after consolidation under a load of 1.8 kips per square foot. The other sample tested at field moisture content.

CONSOLIDATION TEST DATA

LAW/CRANDALL, INC.

PLATE A-4.4

JOB L91028.AEQ DATE 3/29/91 DR. ph W.P. ph O.E. JLR/BK CHKD

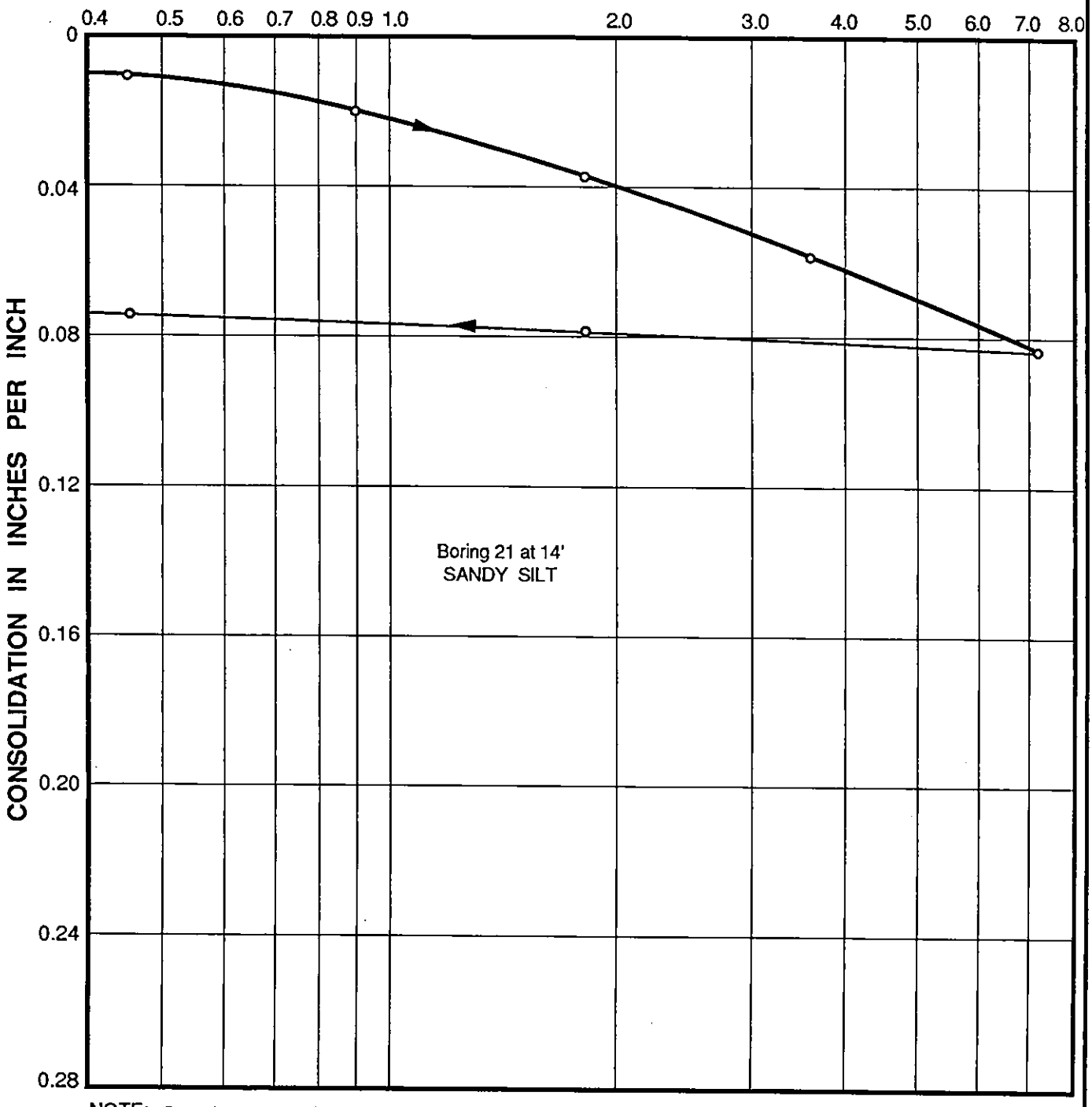


NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA

LAW/CRANDALL, INC.

JOB L91028.AEO DATE 3/29/91 DR. ph W.P. ph O.E. JLR/BK CHKD



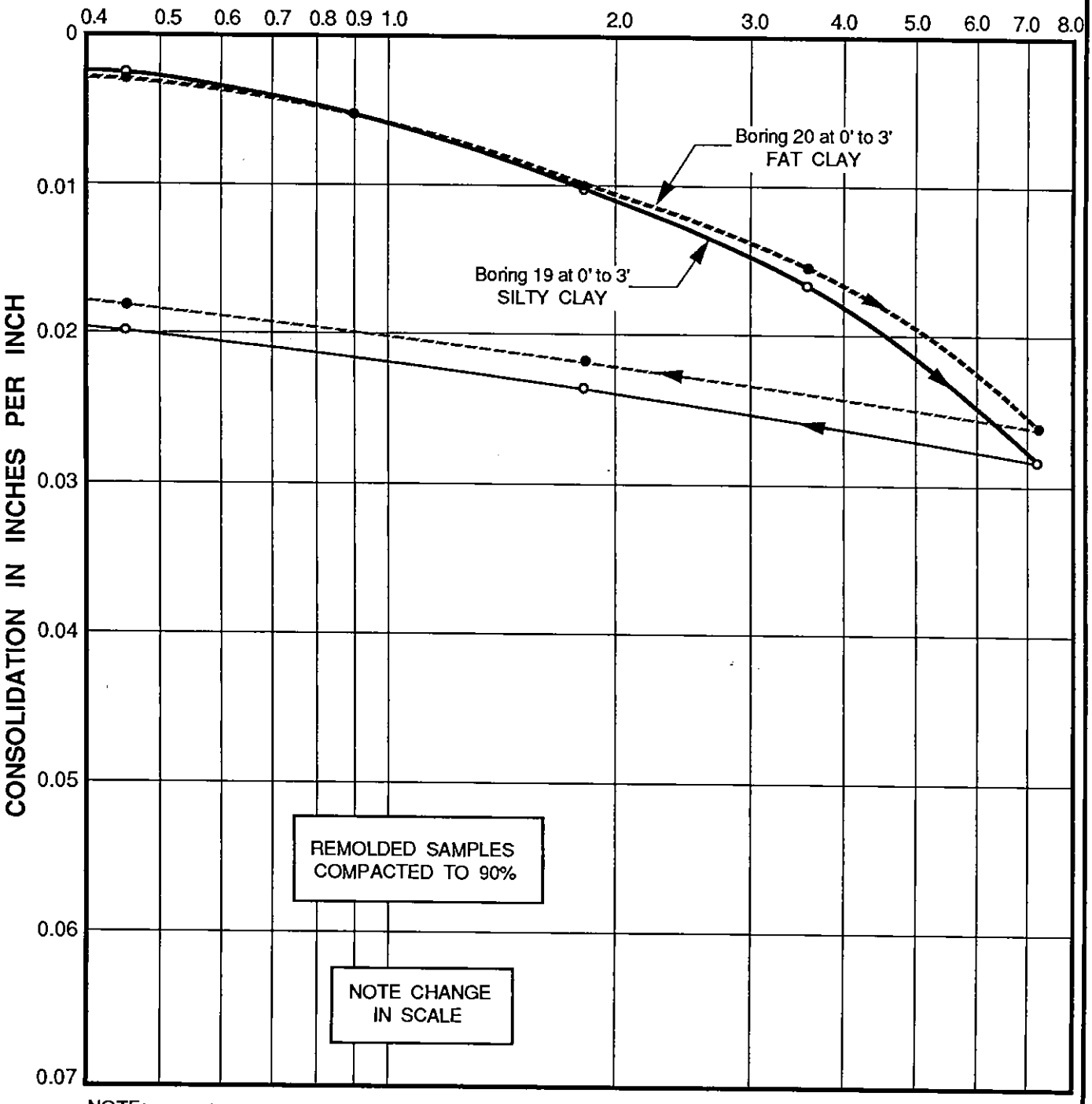
NOTE: Sample tested at field moisture content.

CONSOLIDATION TEST DATA

LAW/CRANDALL, INC.

PLATE A - 4.6

JOB L91028.AEO DATE 3/29/91 DR. ph W.P. ph O.E. JLR/BK CHKD



NOTE: Samples tested at optimum moisture content.

CONSOLIDATION TEST DATA

LAW/CRANDALL, INC.

Law Crandall Area B

PLATE A-4.7

PLATE B2-30

JOB L91028.AEQ DATE 4/1/91 W.P. ph O.E. FH CHKD

BORING NUMBER AND SAMPLE DEPTH :	19 at 0' to 3'	20 at 0' to 3'
SOIL TYPE :	SILTY CLAY	FAT CLAY
MAXIMUM DRY DENSITY : (lbs./cu. ft.)	114	109
OPTIMUM MOISTURE CONTENT : (% of dry)	14	18

TEST METHOD: ASTM Designation D1557 - 78

COMPACTION TEST DATA

LAW/CRANDALL, INC.

PLATE A-5

BORING NUMBER AND SAMPLE DEPTH:	19 at 0' to 3'	20 at 0' to 3'
SOIL TYPE:	SILTY CLAY	FAT CLAY
CONFINING PRESSURE: (lbs./sq. ft.)	144	144
INITIAL MOISTURE CONTENT: (% of dry wt.)	13.0	13.0
FINAL MOISTURE CONTENT: (% of dry wt.)	33.8	38.1
DRY DENSITY: (lbs./cu. ft.)	98	99
EXPANSION INDEX:	87	155

TEST METHOD: Uniform Building Code Standard No. 29-2, Expansion Index Test

EXPANSION INDEX TEST DATA

JOB L91028.AEQ DATE 4/1/91 W.P. ph O.E. FH CHKD

LAW/CRANDALL, INC.

JOB L91028.AEO DATE 4/1/91 W.P. ph O.E. JLR CHKD

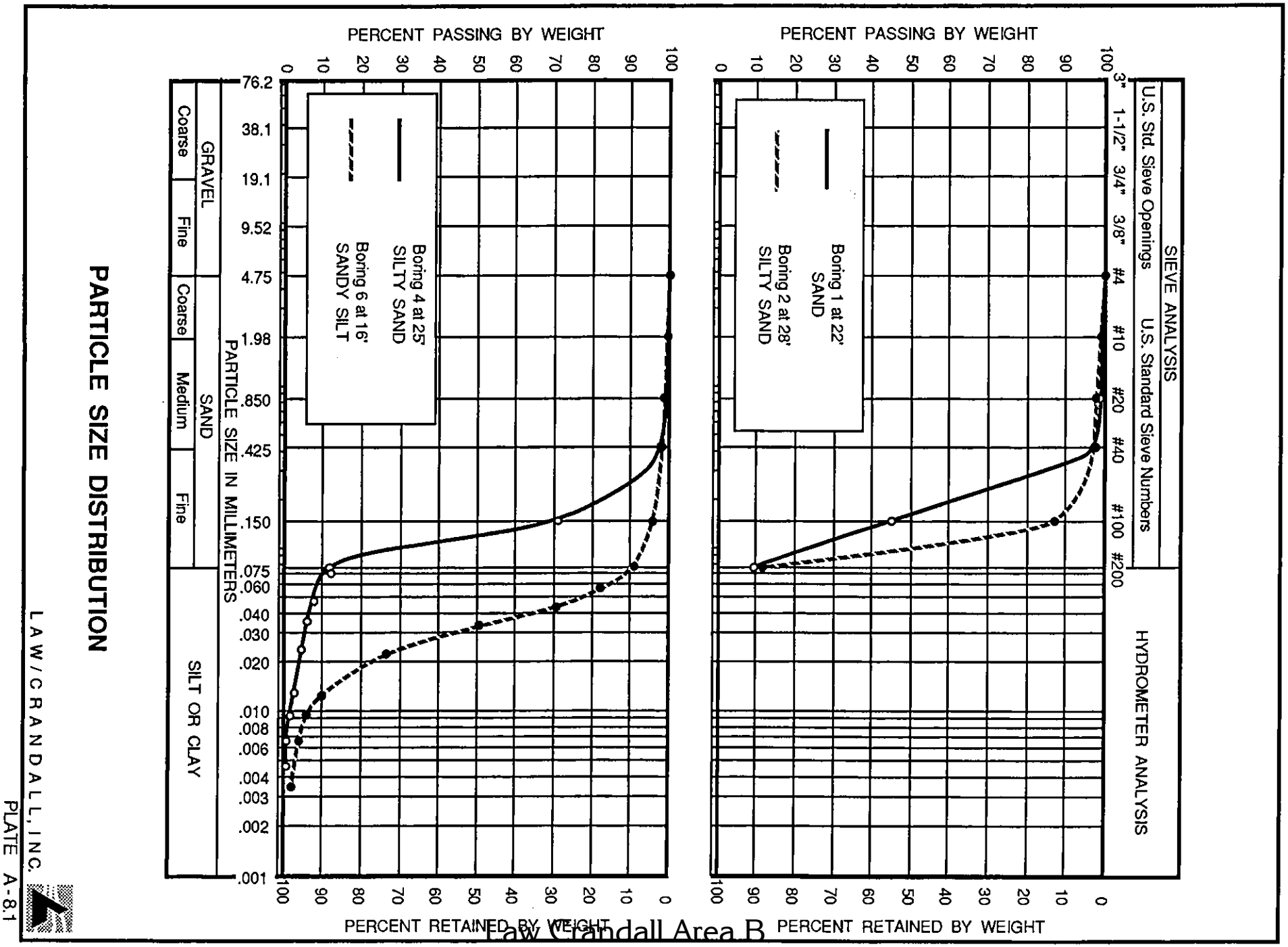
BORING NUMBER AND SAMPLE DEPTH (ft.)	SOIL TYPE	COEFFICIENT OF PERMEABILITY (cm / sec)
9 at 7'	ELASTIC SILT	3.6×10^{-7}
10 at 5'	ELASTIC SILT	1.7×10^{-7}
11 at 10'	ELASTIC SILT	1.9×10^{-7}
12 at 5'	ELASTIC SILT	5.1×10^{-7}
16 at 10'	ELASTIC SILT	9.7×10^{-8}
18 at 7'	ELASTIC SILT	8.7×10^{-7}
20 at 10'	ELASTIC SILT	9.7×10^{-8}
24 at 14'	SILTY SAND	1.4×10^{-6}

PERMEABILITY TEST DATA

LAW/CRANDALL, INC.

PLATE A-7

JOB 191028.AEQ DATE 4/1/91 DR ph O.E. FH CHKD.



PARTICLE SIZE DISTRIBUTION

LAW/CRANDALL, INC.

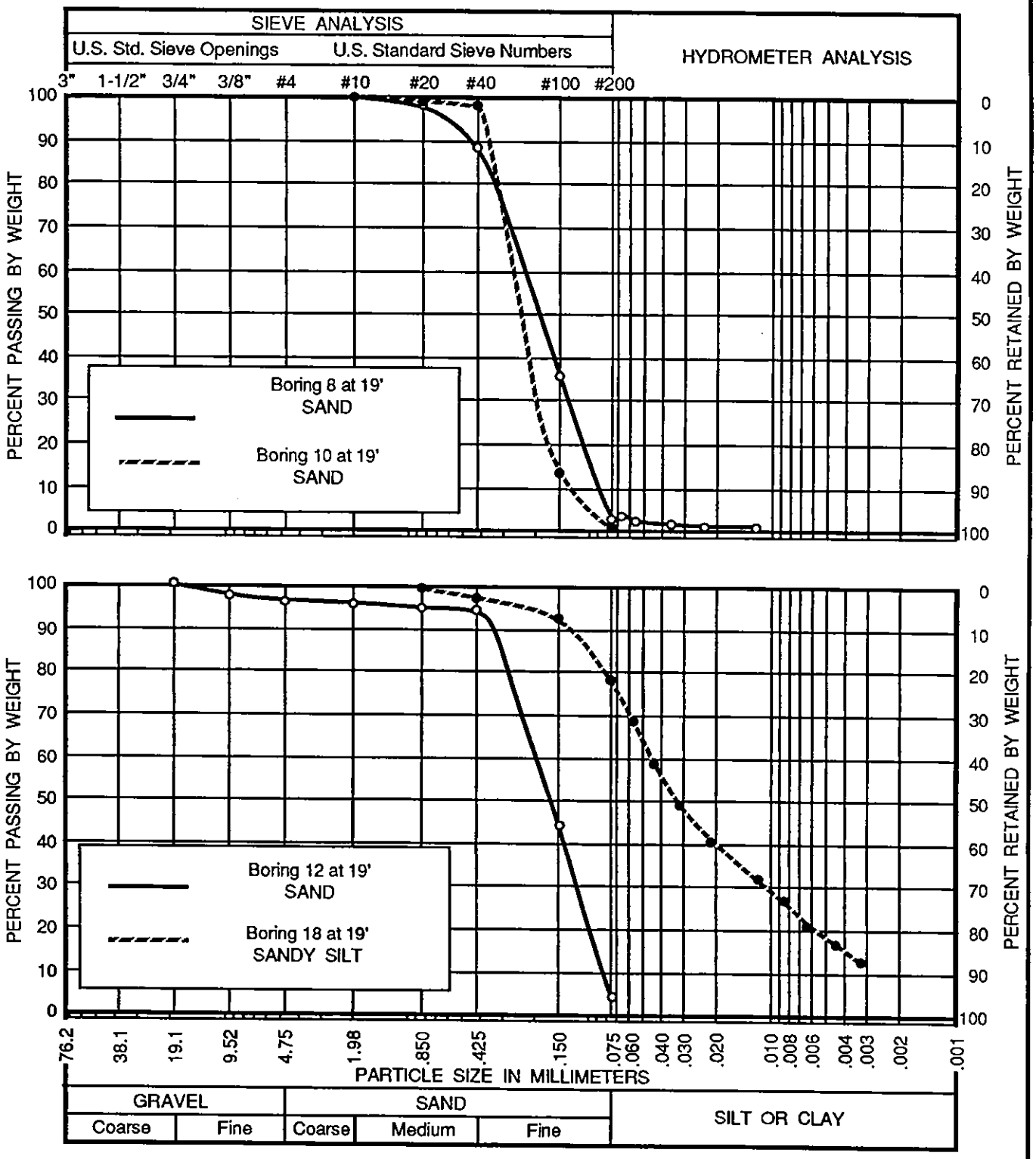
PLATE A-8.1

Law Crandall Area B

B1-821

PLATE B2-34

JOB L91028.AEO DATE 4/1/91 DR ph O.E. BK CHKD.



PARTICLE SIZE DISTRIBUTION

LAW/CRANDALL, INC.

Law Crandall Area B

PLATE A-8.2

PLATE B2-35

Table C2 - GEOTECHNICAL LABORATORY TEST SUMMARY

BORING NUMBER	DEPTH (feet)	SOIL TYPE	INSITU MOISTURE CONTENT (percent)	PERCENTAGE PASSING SIEVE NO. 200	LIQUID LIMIT	PLASTICITY INDEX
B-1	3	ML	39	98	41	7
	6	ML	32	52	--	--
	9	MH	43	98	55	22
	12	MH	60	93	--	--
	15	MH	91	93	--	--
B-2	3	CH	39	97	50	31
	6	ML	37	53	--	--
	9	CL	40	98	--	--
	10	CL	38	51	--	--
	12	CH	83	95	--	--
	15	MH	107	96	64	17
B-3	0	ML	19	66	--	--
	6	CL	45	99	46	21
	9	CL	37	91	--	--
	12	MH	42	98	--	--
	15	CH	62	90	73	45
	18	CH	87	96	--	--
B-4	0	ML	20	94	--	--
	3	CL	34	91	--	--
	6	ML	34	98	NP	NP
	9	ML	36	66	--	--
	12	ML	42	99	40	2
	15	ML	100	93	--	--
B-5	0	CL	23	83	--	--
	6	CL	34	82	--	--
	9	MH	49	98	62	29
	12	CH	59	90	--	--
	15	CH	95	95	62	38
B-6	0	CH	54	98	--	--
	2.5	MH	46	99	70	35
	4.5	CH	43	92	--	--
B-7	3	CH	58	98	--	--
	6	ML	26	95	33	7
	9	MH	40	96	59	25
	12	CH	60	92	--	--
	15	SC	34	39	--	--
B-8	0	CH	41	99	67	45
	3	CH	36	80	--	--
	6	CH	71	97	--	--
	9	CH	58	98	53	24
	12	SC	40	36	--	--
	15	SC	26	16	--	--
B-9	1	CH	43	99	64	37
	3	CH	52	99	58	29
	6	MH	58	97	--	--
	9	MH	81	97	--	--
	12	SC	37	35	--	--
	15	SC	25	14	--	--
B-10	0	ML	29	76	--	--
	3	CH	54	93	--	--
	6	ML	31	94	NP	NP
	9	CL	59	100	--	--
	12	ML	48	100	46	15
	15	CL	48	52	--	--
	18	SM	29	12	--	--

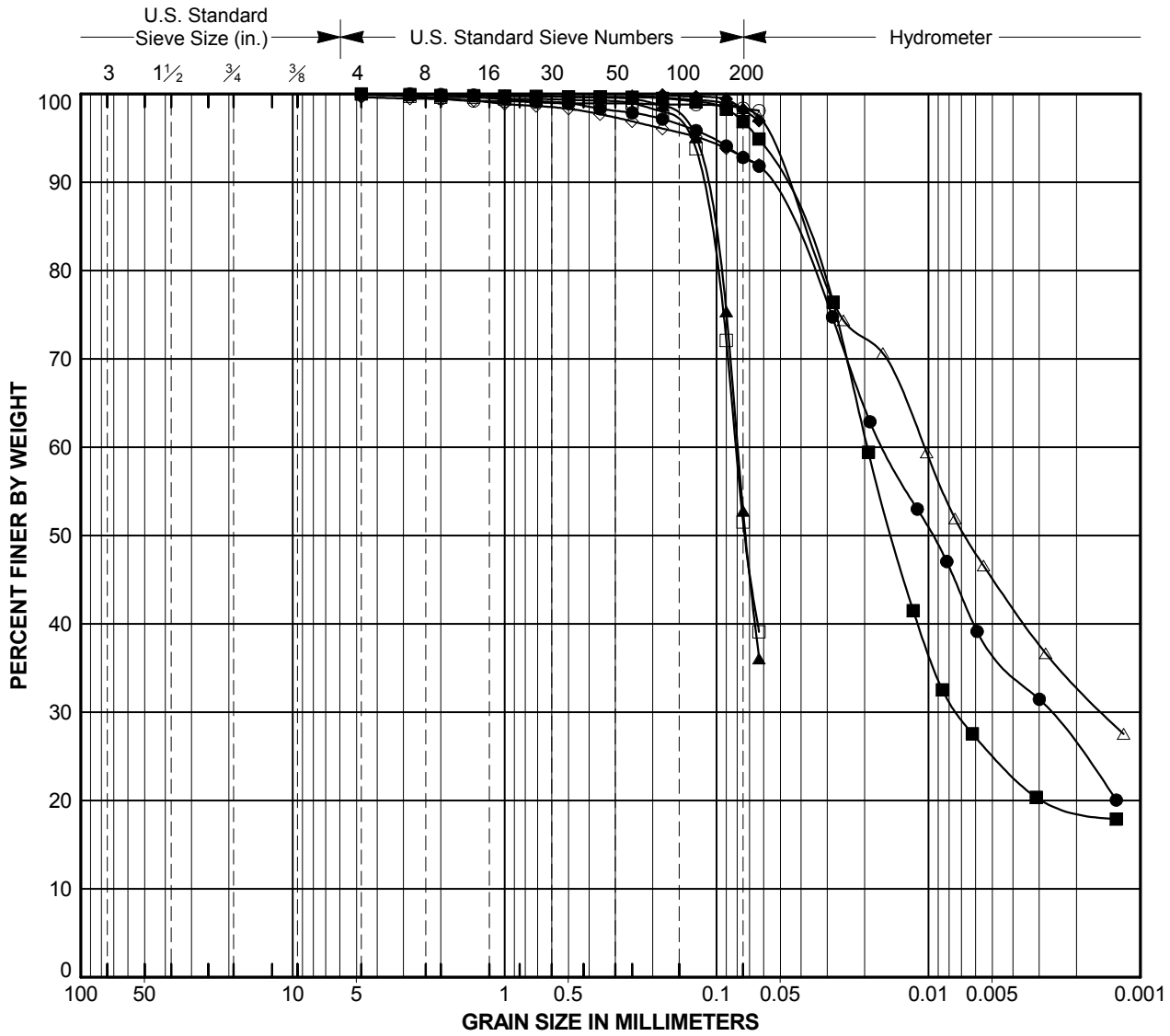
Table C2 - GEOTECHNICAL LABORATORY TEST SUMMARY

BORING NUMBER	DEPTH (feet)	SOIL TYPE	INSITU MOISTURE CONTENT (percent)	PERCENTAGE PASSING SIEVE NO. 200	LIQUID LIMIT	PLASTICITY INDEX
B-11	0	CL	37	90	--	--
	3	MH	72	96	80	40
	6	MH	58	91	--	--
	9	MH	60	97	61	28
	12	MH	71	90	--	--
	15	SC	54	45	--	--
B-12	0	CL	49	98	--	--
	3	MH	45	97	--	--
	6	MH	69	96	--	--
	9	MH	84	95	52	13
	12	MH	59	90	--	--
	15	CH	56	56	--	--
B-13	0	SC	17	21	--	--
	3	CH	65	97	--	--
	6	CH	56	96	60	29
	9	CH	93	95	--	--
	12	CH	65	99	--	--
	15	SC	43	47	--	--
C-1	0	SC	15	37	--	--
	6	CL	34	96	40	20
	7	CL	34	90	--	--
	9	CL	22	59	--	--
	12	CH	46	92	25	47
	15	CH	27	83	--	--
	18	CL	33	95	--	--
	21	SC	13	28	--	--
	24	SP-SC	12	7	--	--
	30	CH	34	99	--	--
C-2	0	SC	12	42	--	--
	6	CH	45	98	57	36
	9	CH	48	96	--	--
	12	SC	18	23	--	--
	15	CL	20	52	--	--
	18	CL	19	52	--	--
	24	SP-SC	19	7	--	--
	27	SP-SC	14	7	--	--
C-4	0	SP	4	5	--	--
	3	SP	8	11	--	--
	4	SP	18	60	--	--
	6	SC	23	44	--	--
	9	CH	20	57	--	--
	12	MH	38	95	54	23
	15	CH	23	60	--	--
	18	CH	22	68	--	--
	21	ML	23	61	--	--
	24	ML	24	79	NP	NP
C-5	0	CL	21	65	--	--
	3	SM	16	25	--	--
	6	SC	25	38	--	--
	12	CL	19	57	--	--
	15	SM	15	21	--	--
	24	ML	43	99	47	19

Table C2 - GEOTECHNICAL LABORATORY TEST SUMMARY

BORING NUMBER	DEPTH (feet)	SOIL TYPE	INSITU MOISTURE CONTENT (percent)	PERCENTAGE PASSING SIEVE NO. 200	LIQUID LIMIT	PLASTICITY INDEX
C-6	0	SP	4	3	--	--
	3	SP-SM	4	5	--	--
	6	SP	2	2	--	--
	9	CL	30	91	--	--
	12	CH	43	98	57	36
	15	CH	39	100	--	--
	18	CL	29	70	42	23
	21	CL	22	62	--	--
	24	CH	22	55	--	--
	27	SC	23	21	--	--
C-7	0	SM	7	15	--	--
	3	SM	8	15	--	--
	6	CH	30	75	--	--
	9	ML	31	92	49	12
	12	CH	42	88	--	--
	18	ML	51	71	--	--
	21	CH	27	74	51	33

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	B-01	3.0	SILT (ML)	39	41	7	98
□	B-01	6.0	SANDY SILT (ML)	32			52
△	B-01	9.0	ELASTIC SILT (MH)	43	55	22	98
◇	B-01	12.0	ELASTIC SILT (MH)	60			93
●	B-01	15.0	ELASTIC SILT (MH)	91			93
■	B-02	3.0	FAT CLAY (CH)	39	50	31	97
▲	B-02	6.0	SANDY SILT (ML)	37			53
◆	B-02	9.0	LEAN CLAY (CL)	40			98

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

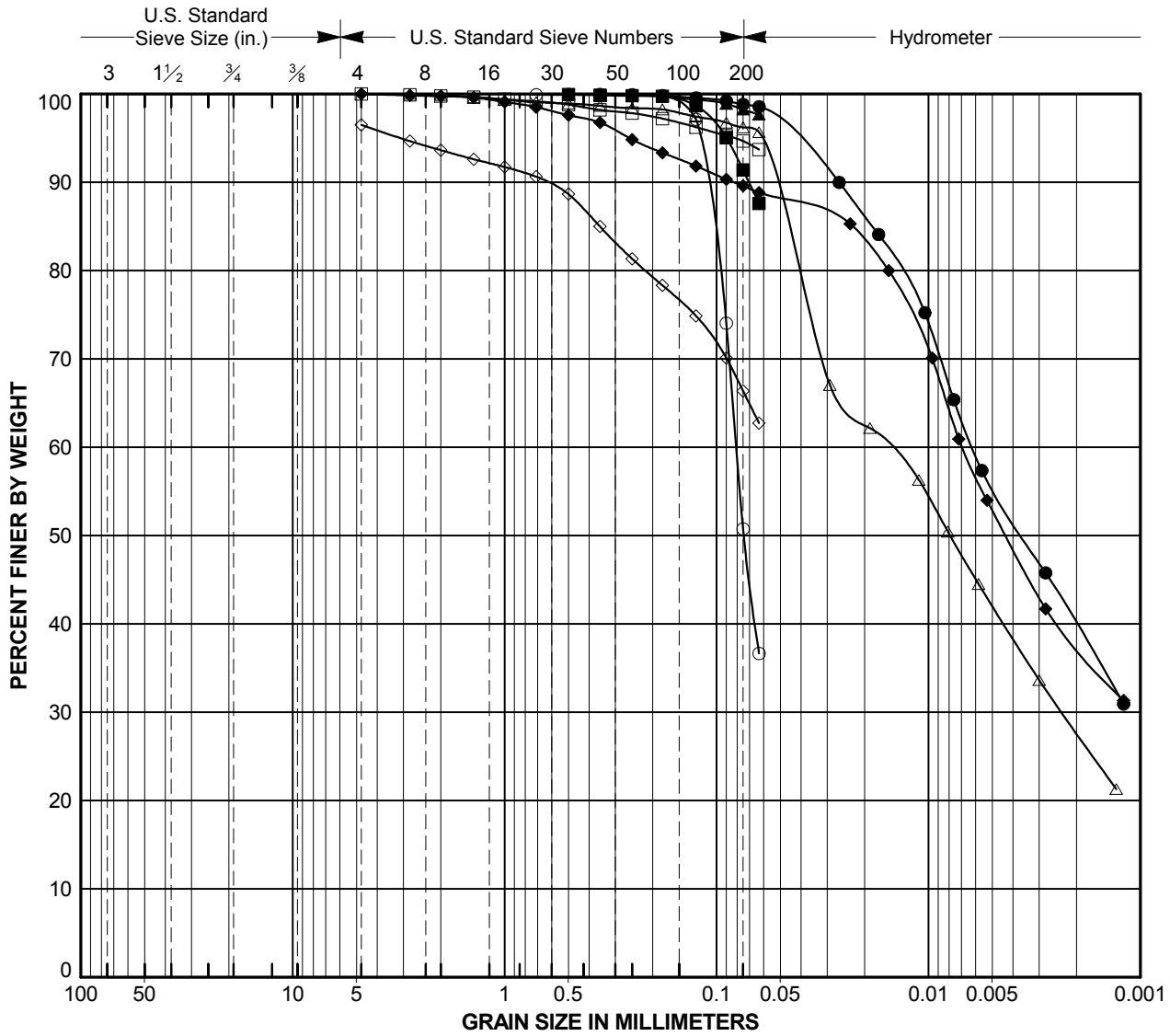
Project No. 2006-023.05

Diaz Yourman Areas B and C

PLATE

C1

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	B-02	10.0	SANDY LEAN CLAY (CL)	38			51
□	B-02	12.0	FAT CLAY (CH)	83			95
△	B-02	15.0	ELASTIC SILT (MH)	107	64	17	96
◇	B-03	0.0	SANDY SILT (ML)	19			66
●	B-03	6.0	LEAN CLAY (CL)	45	46	21	99
■	B-03	9.0	LEAN CLAY (CL)	37			91
▲	B-03	12.0	ELASTIC SILT (MH)	42			98
◆	B-03	15.0	FAT CLAY (CH)	62	73	45	90

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

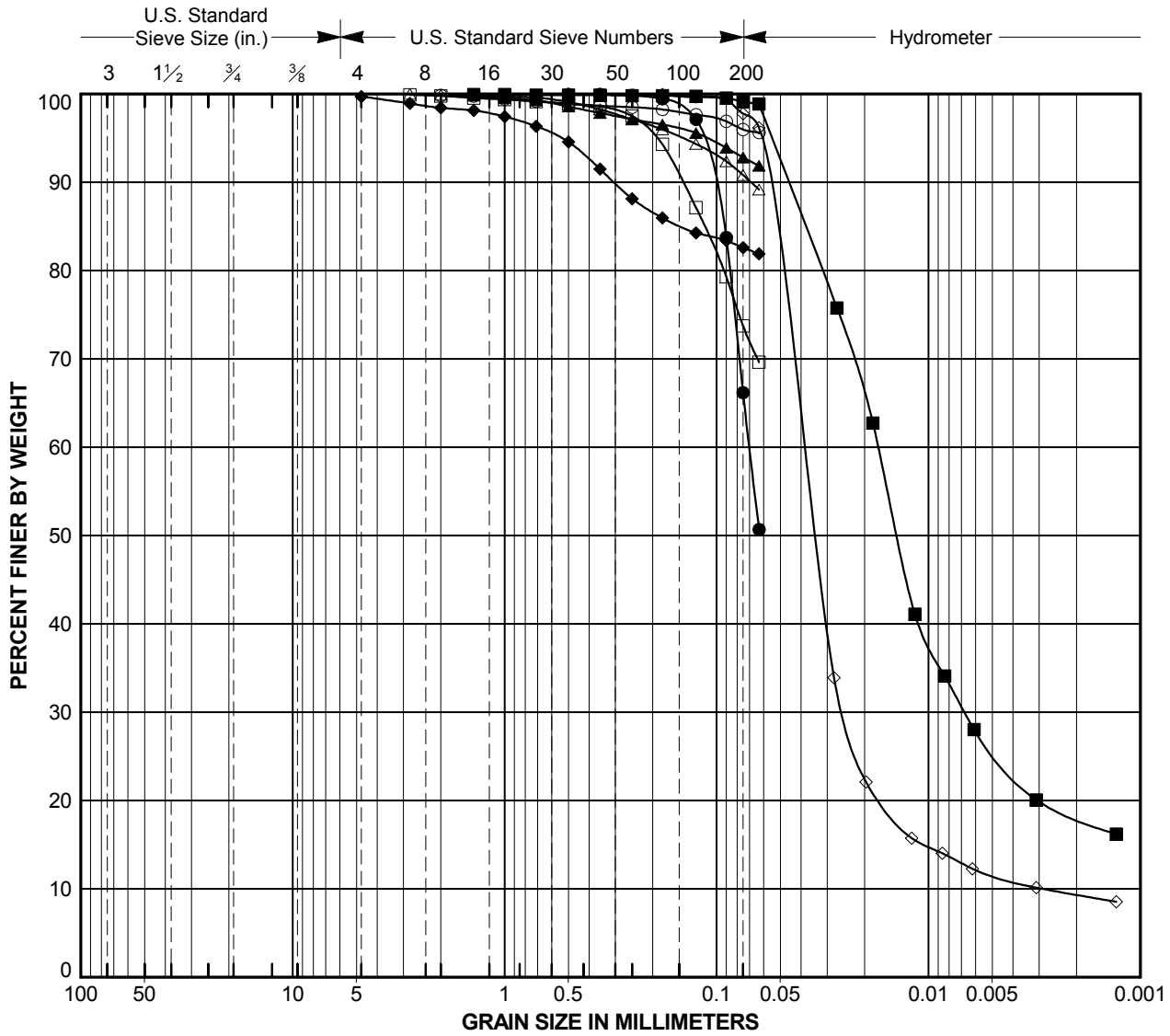
Project No. 2006-023.05

Diaz Yourman Areas B and C

PLATE

C2

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	B-03	18.0	FAT CLAY (CH)	87			96
□	B-04	0.0	SILT WITH SAND (ML)	20			74
△	B-04	3.0	LEAN CLAY (CL)	34			91
◇	B-04	6.0	SILT (ML)	34	NP	NP	98
●	B-04	9.0	SANDY SILT (ML)	36			66
■	B-04	12.0	SILT (ML)	42	40	7	99
▲	B-04	15.0	SILT (ML)	100			93
◆	B-05	0.0	LEAN CLAY WITH SAND (CL)	23			83

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

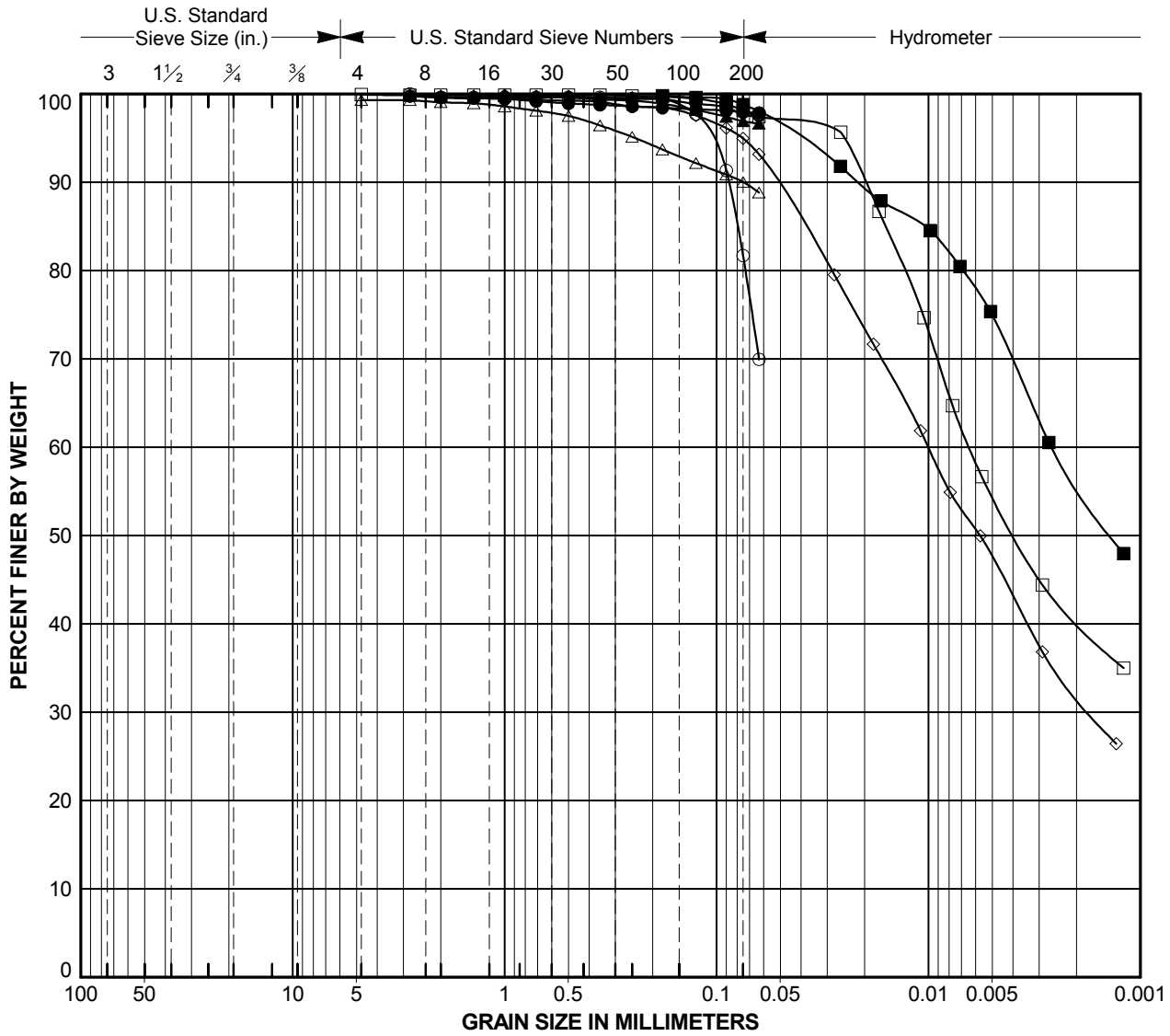
Project No. 2006-023.05

Diaz Yourman Areas B and C

PLATE

C3

Template: DY_SIEVE_WIN



COBBLES	Coarse	Fine	Coarse	Medium	Fine	SILT or CLAY
	GRAVEL		SAND			

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	B-05	6.0	LEAN CLAY WITH SAND (CL)	34			82
□	B-05	9.0	ELASTIC SILT (MH)	49	62	29	98
△	B-05	12.0	FAT CLAY (CH)	59			90
◇	B-05	15.0	FAT CLAY (CH)	95	67	38	95
●	B-06	0.0	FAT CLAY (CH)	54			98
■	B-06	2.5	ELASTIC SILT (MH)	46	70	35	99
▲	B-06	4.5	FAT CLAY (CH)	43			97
◆	B-07	3.0	FAT CLAY (CH)	58			98

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

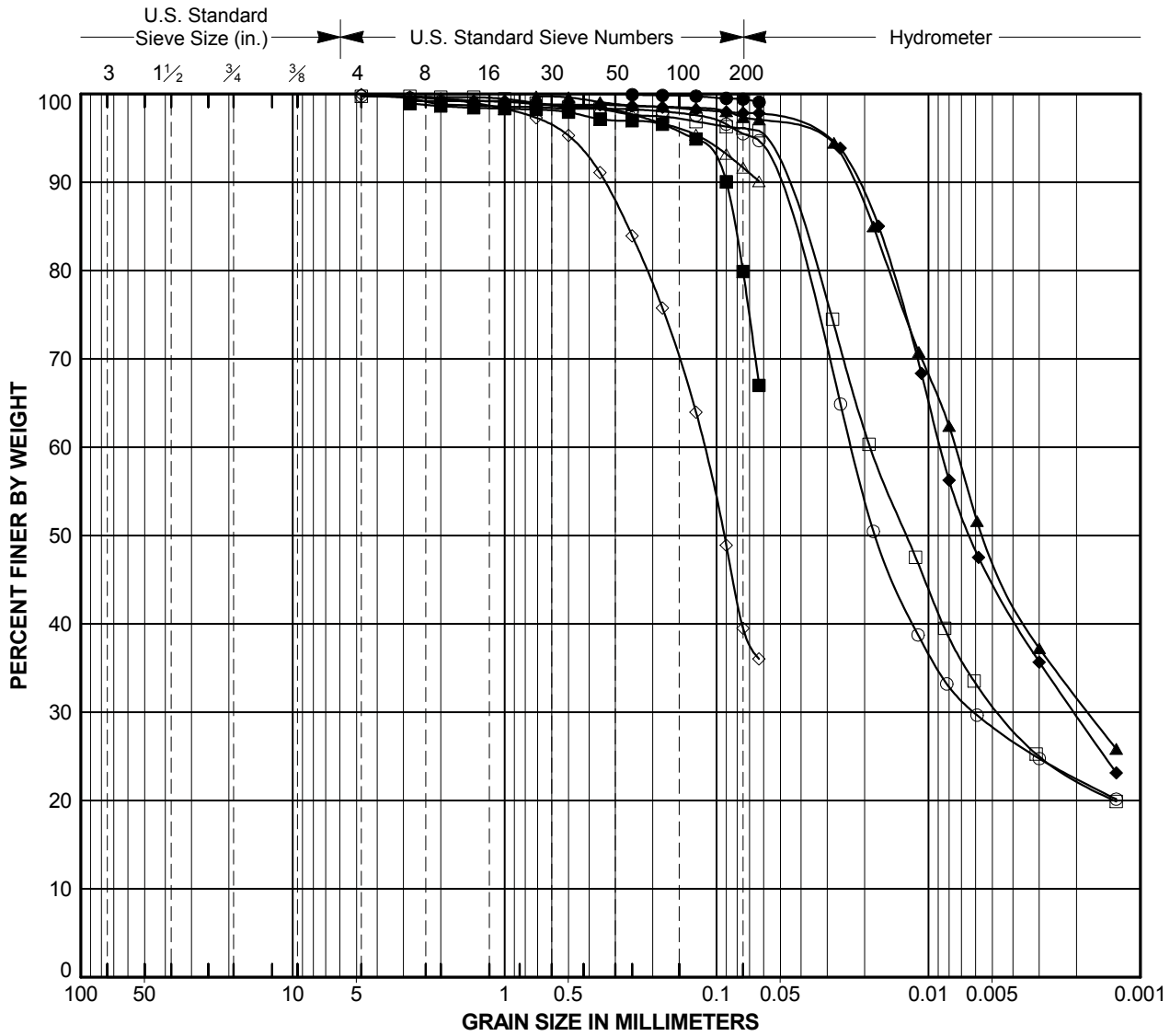
Project No. 2006-023.05

Diaz Yourman Areas B and C

PLATE

C4

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	B-07	6.0	SILT (ML)	26	33	7	95
□	B-07	9.0	ELASTIC SILT (MH)	40	59	25	96
△	B-07	12.0	FAT CLAY (CH)	60			92
◇	B-07	15.0	CLAYEY SAND (SC)	34			39
●	B-08	0.0	FAT CLAY (CH)	41	67	45	99
■	B-08	3.0	FAT CLAY WITH SAND (CH)	36			80
▲	B-08	6.0	FAT CLAY (CH)	71			97
◆	B-08	9.0	FAT CLAY (CH)	58	53	24	98

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

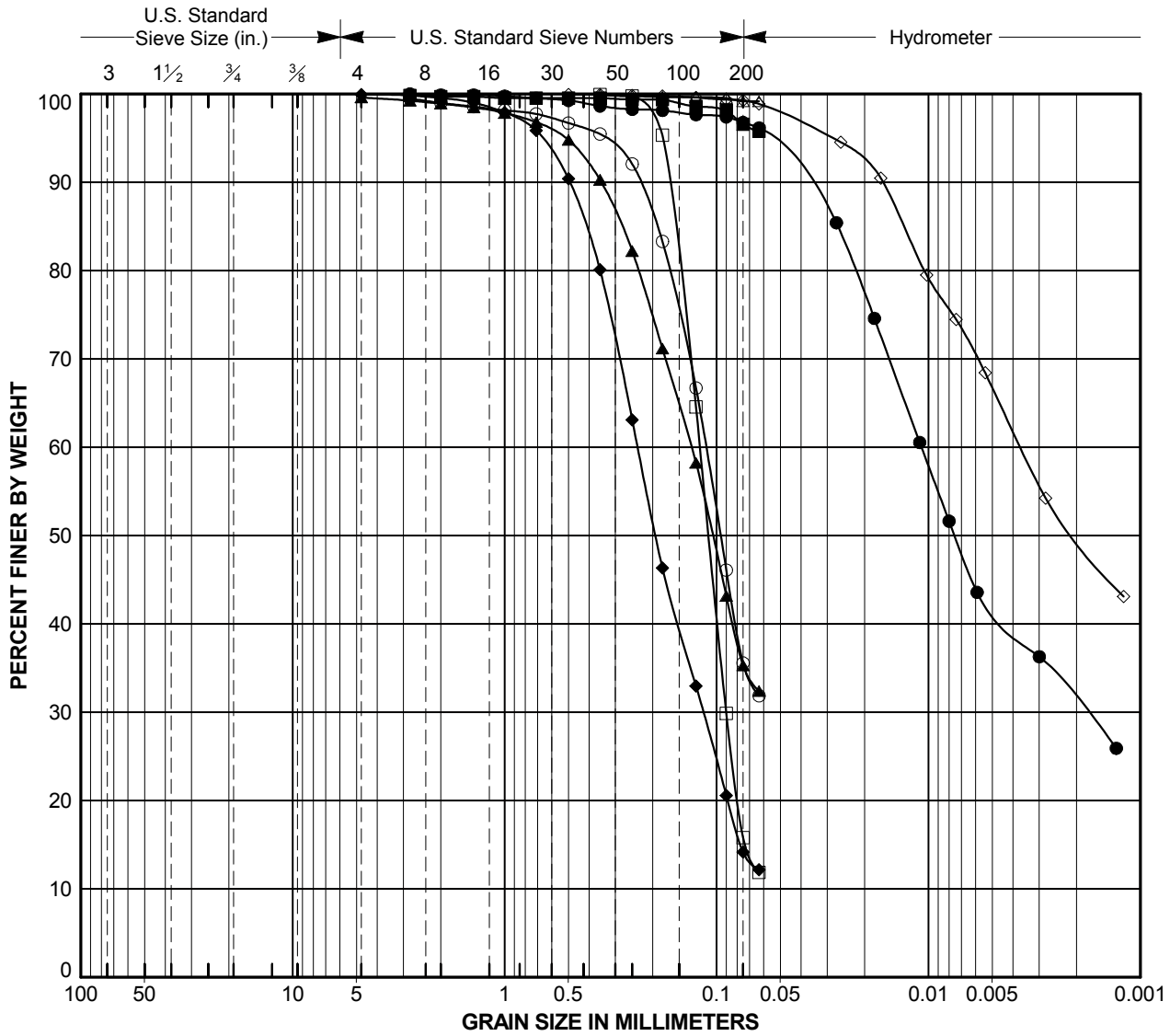
Project No. 2006-023.05

Diaz Yourman Areas B and C

PLATE

C5

Template: DY_SIEVE_WIN



COBBLES	Coarse	Fine	Coarse	Medium	Fine	SILT or CLAY
	GRAVEL		SAND			

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	B-08	12.0	CLAYEY SAND (SC)	40			36
□	B-08	15.0	CLAYEY SAND (SC)	26			16
△	B-09	1.0	FAT CLAY (CH)	43	64	37	99
◇	B-09	3.0	FAT CLAY (CH)	52	58	29	99
●	B-09	6.0	ELASTIC SILT (MH)	58			97
■	B-09	9.0	ELASTIC SILT (MH)	81			97
▲	B-09	12.0	CLAYEY SAND (SC)	37			35
◆	B-09	15.0	CLAYEY SAND (SC)	25			14

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

Project No. 2006-023.05

PLATE

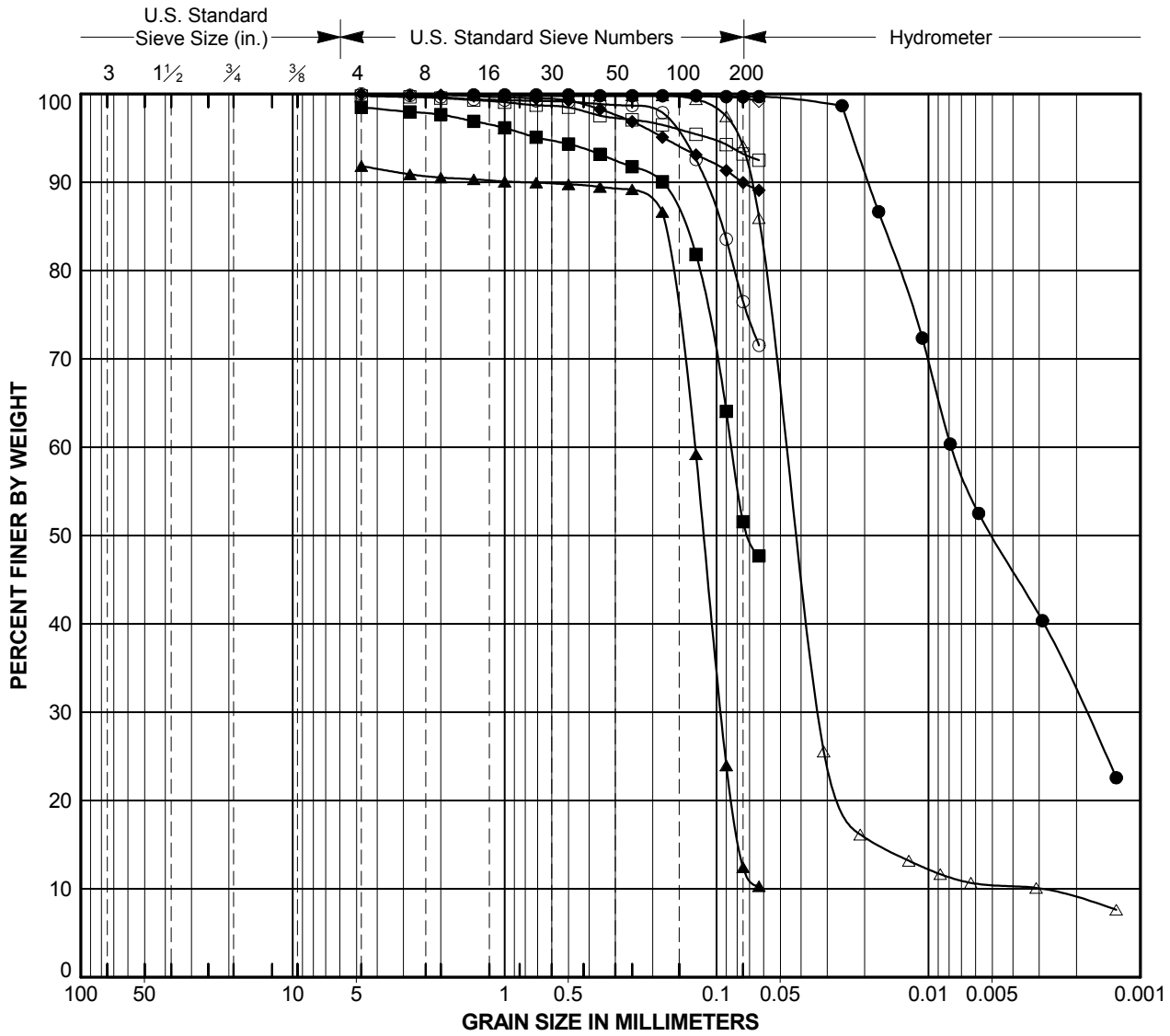
C6

Diaz Yourman Areas B and C

B1-831

PLATE B2-44

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	B-10	0.0	SILT WITH SAND (ML)	29			76
□	B-10	3.0	FAT CLAY (CH)	54			93
△	B-10	6.0	SILT (ML)	31	NP	NP	94
◇	B-10	9.0	LEAN CLAY (CL)	59			100
●	B-10	12.0	SILT (ML)	48	46	15	100
■	B-10	15.0	SANDY LEAN CLAY (CL)	48			52
▲	B-10	18.0	POORLY GRADED SAND WITH SILT (SP-SM)	29			12
◆	B-11	0.0	LEAN CLAY (CL)	37			90

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

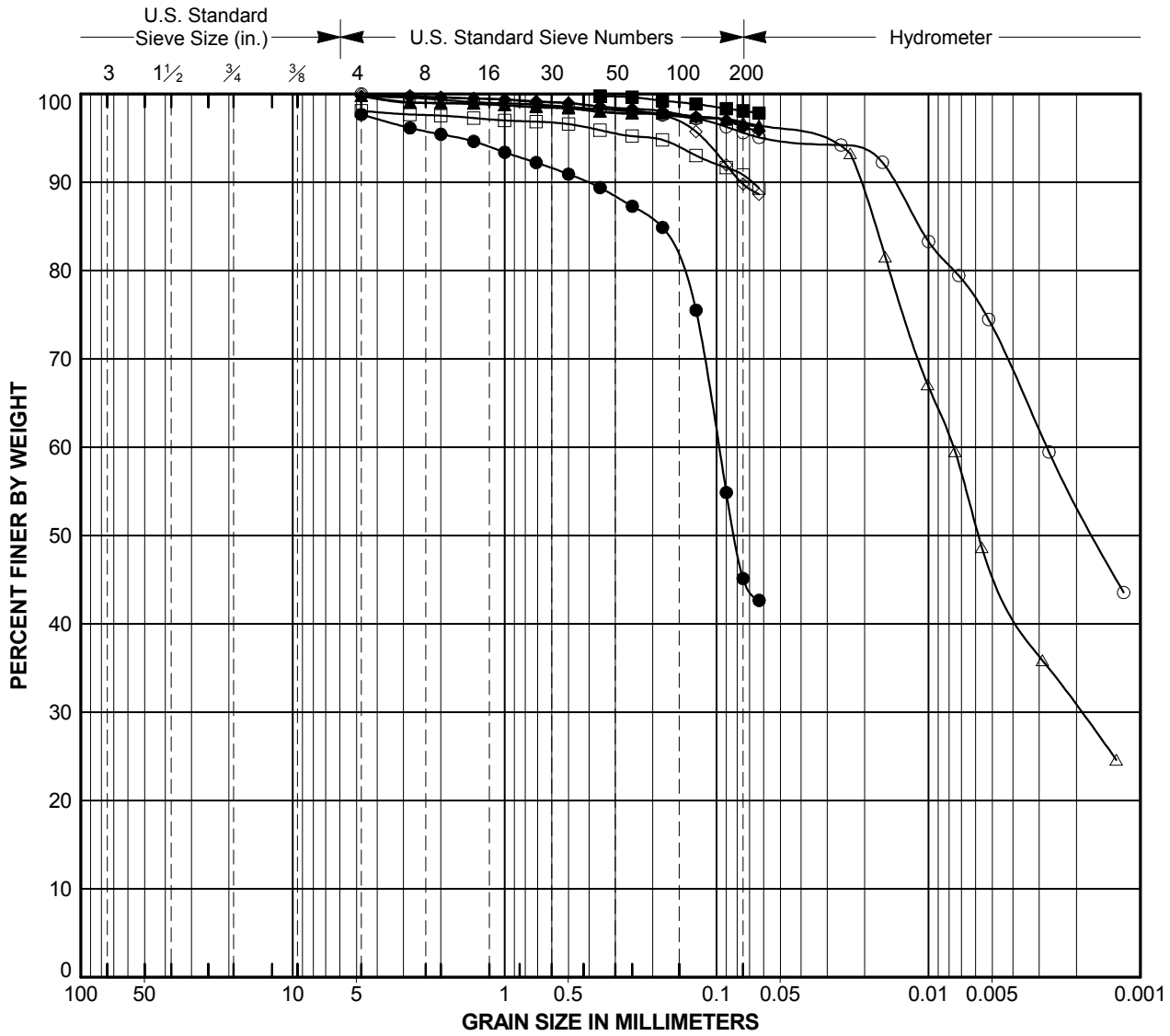
Project No. 2006-023.05

Diaz Yourman Areas B and C

PLATE

C7

Template: DY_SIEVE_WIN



COBBLES	Coarse	Fine	Coarse	Medium	Fine	SILT or CLAY
	GRAVEL		SAND			

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	B-11	3.0	ELASTIC SILT (MH)	72	80	40	96
□	B-11	6.0	ELASTIC SILT (MH)	58			91
△	B-11	9.0	ELASTIC SILT (MH)	60	61	28	97
◇	B-11	12.0	ELASTIC SILT (MH)	71			90
●	B-11	15.0	CLAYEY SAND (SC)	54			45
■	B-12	0.0	LEAN CLAY (CL)	49			98
▲	B-12	3.0	ELASTIC SILT (MH)	45			97
◆	B-12	6.0	ELASTIC SILT (MH)	69			96

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

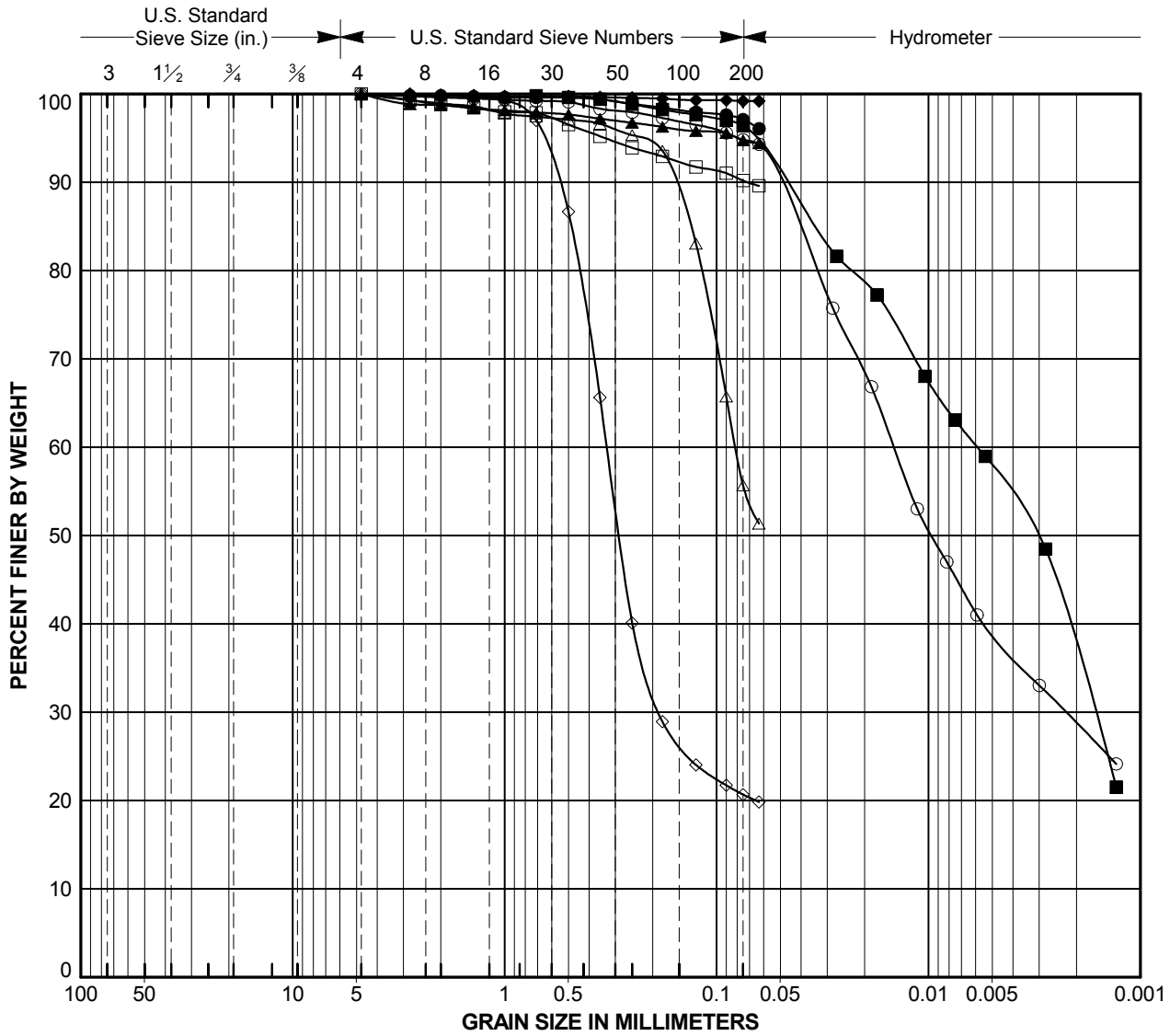
Project No. 2006-023.05

Diaz Yourman Areas B and C

PLATE

C8

Template: DY_SIEVE_WIN



COBBLES	Coarse	Fine	Coarse	Medium	Fine	SILT or CLAY
	GRAVEL		SAND			

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	B-12	9.0	ELASTIC SILT (MH)	84	52	13	95
□	B-12	12.0	ELASTIC SILT (MH)	59			90
△	B-12	15.0	SANDY FAT CLAY (CH)	56			56
◇	B-13	0.0	CLAYEY SAND (SC)	17			21
●	B-13	3.0	FAT CLAY (CH)	65			97
■	B-13	6.0	FAT CLAY (CH)	56	60	29	96
▲	B-13	9.0	FAT CLAY (CH)	93			95
◆	B-13	12.0	FAT CLAY (CH)	65			99

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

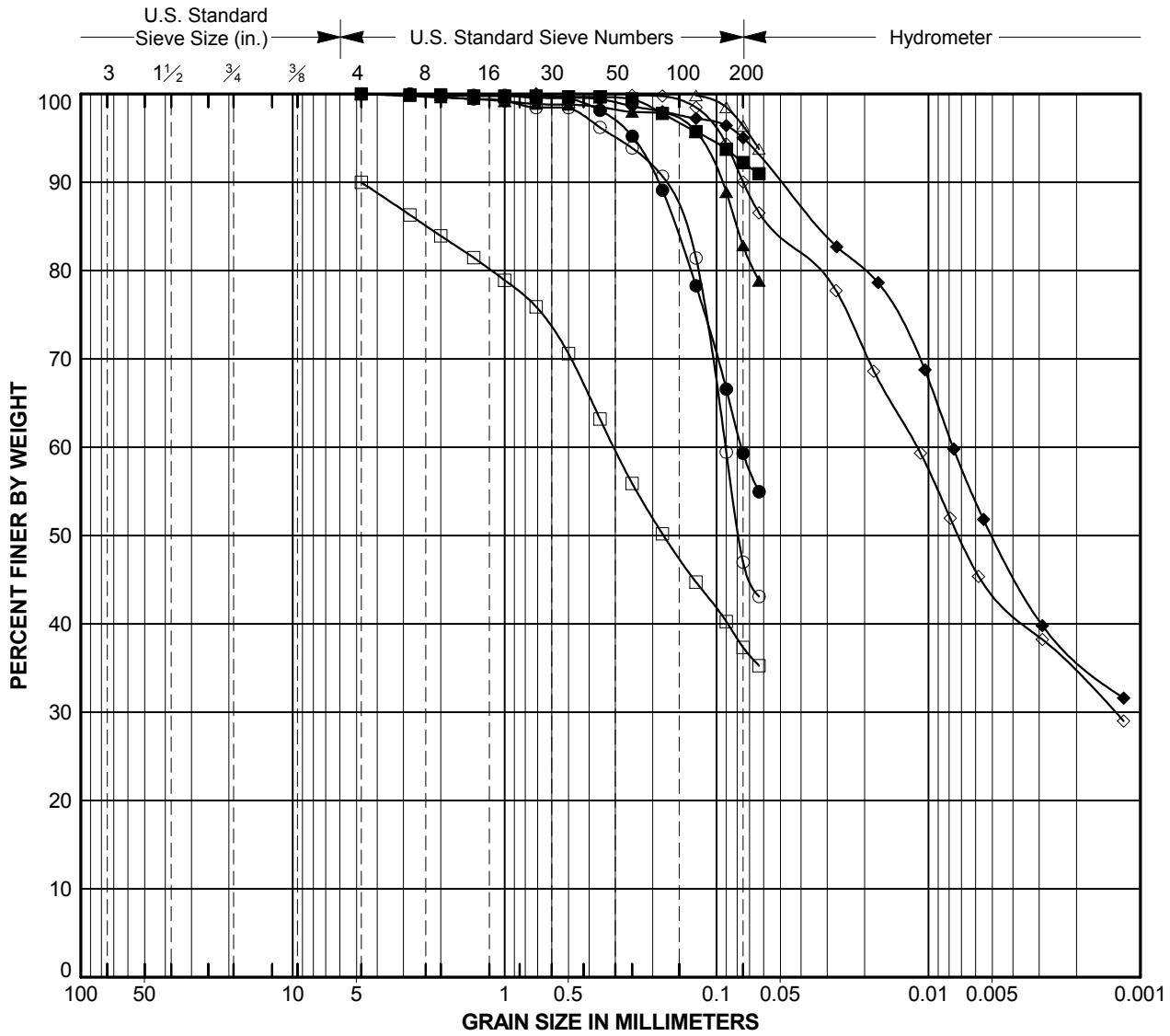
Project No. 2006-023.05

Diaz Yourman Areas B and C

PLATE

C9

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	B-13	15.0	CLAYEY SAND (SC)	43			47
□	C-01	0.0	CLAYEY SAND (SC)	15			37
△	C-01	6.0	LEAN CLAY (CL)	34	40	20	96
◇	C-01	7.0	LEAN CLAY (CL)	34			90
●	C-01	9.0	SANDY LEAN CLAY (CL)	22			59
■	C-01	12.0	FAT CLAY (CH)	46	75	47	92
▲	C-01	15.0	FAT CLAY WITH SAND (CH)	27			83
◆	C-01	18.0	LEAN CLAY (CL)	33			95

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

Project No. 2006-023.05

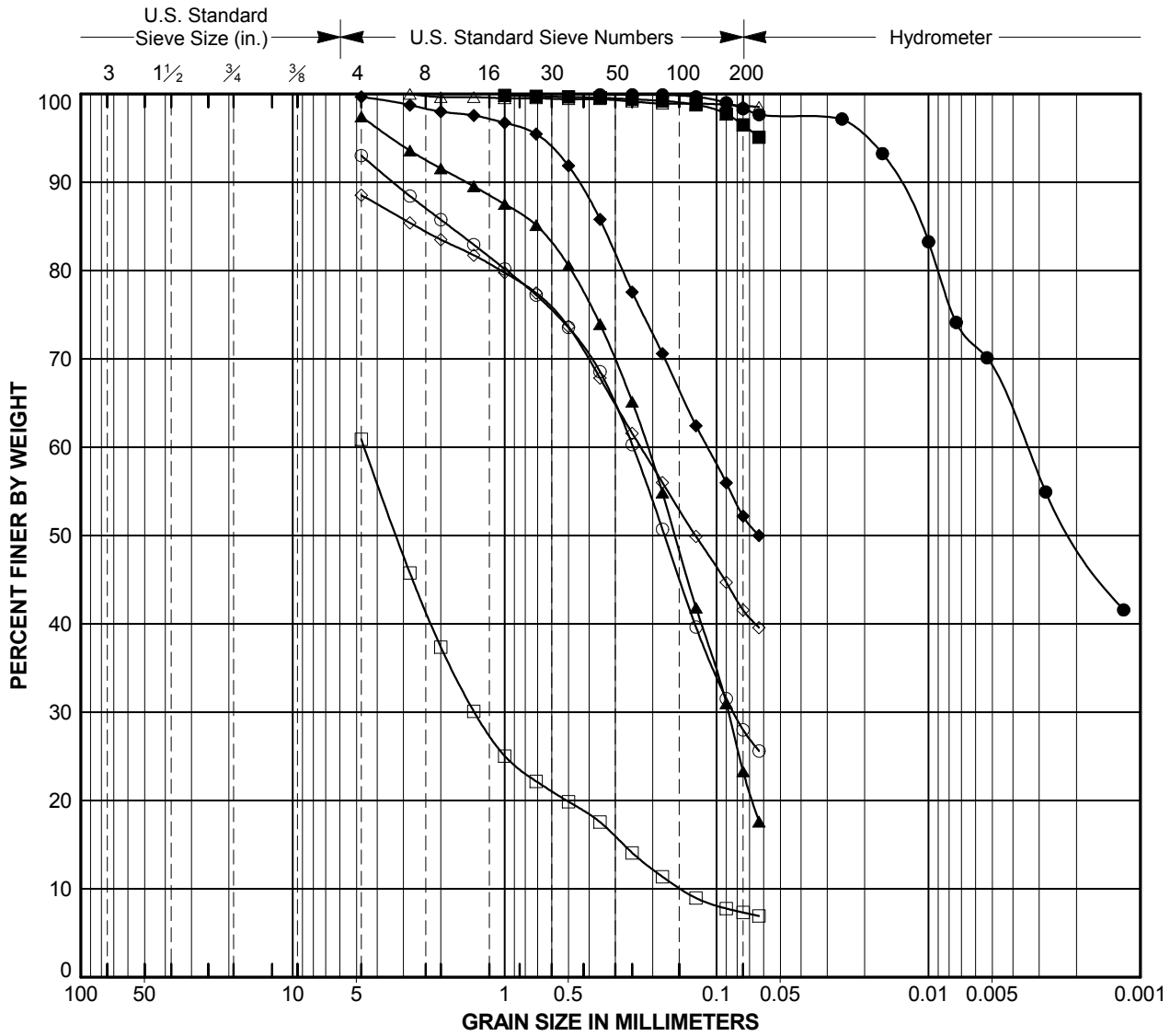
Diaz Yourman Areas B and C

PLATE

C10

PLATE B2-48

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	C-01	21.0	CLAYEY SAND (SC)	13			28
□	C-01	24.0	POORLY GRADED SAND WITH CLAY AND GRAVEL (SP-SC)	12			7
△	C-01	30.0	FAT CLAY (CH)	34			99
◇	C-02	0.0	CLAYEY SAND (SC)	12			42
●	C-02	6.0	FAT CLAY (CH)	45	57	36	98
■	C-02	9.0	FAT CLAY (CH)	48			96
▲	C-02	12.0	CLAYEY SAND (SC)	18			23
◆	C-02	15.0	SANDY LEAN CLAY (CL)	20			52

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

Project No. 2006-023.05

Diaz Yourman Areas B and C

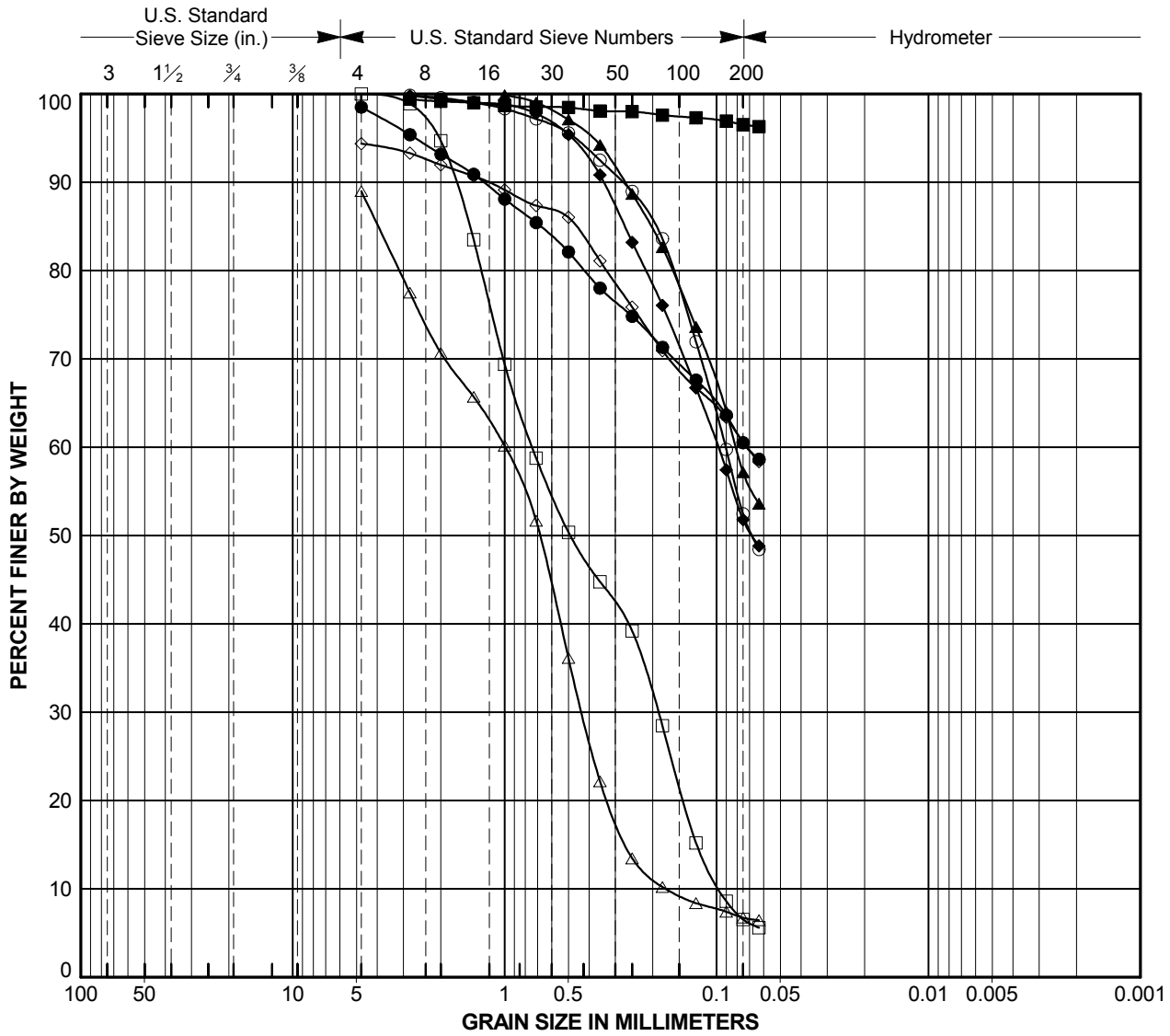
PLATE

C11

B1-836

PLATE B2-49

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	C-02	18.0	SANDY LEAN CLAY (CL)	19			52
□	C-02	24.0	POORLY GRADED SAND WITH CLAY (SP-SC)	19			7
△	C-02	27.0	POORLY GRADED SAND WITH CLAY (SP-SC)	14			7
◇	C-03	0.0	SANDY LEAN CLAY (CL)	17			61
●	C-03	3.0	SANDY LEAN CLAY (CL)	16			61
■	C-03	6.0	FAT CLAY (CH)	46			97
▲	C-03	9.0	SANDY LEAN CLAY (CL)	23			57
◆	C-03	12.0	SANDY LEAN CLAY (CL)	23			52

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

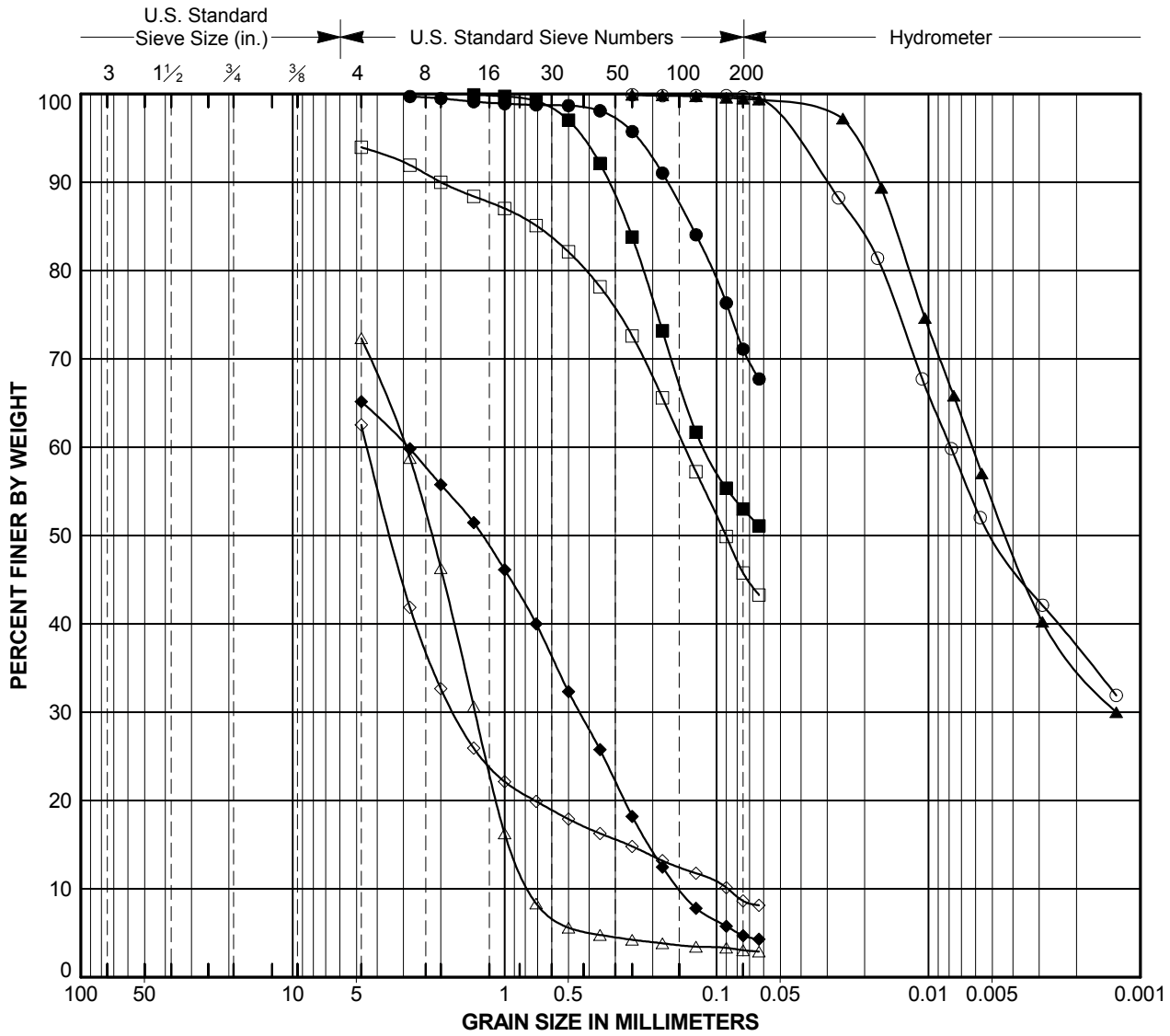
Project No. 2006-023.05

Diaz Yourman Areas B and C

PLATE

C12

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	C-03	15.0	FAT CLAY (CH)	51	53	26	100
□	C-03	18.0	CLAYEY SAND (SC)	14			46
△	C-03	21.0	POORLY GRADED SAND WITH GRAVEL (SP)	15			3
◇	C-03	24.0	POORLY GRADED SAND WITH CLAY AND GRAVEL (SP-SC)	13			9
●	C-03	27.0	LEAN CLAY WITH SAND (CL)	27			71
■	C-03	30.0	SANDY LEAN CLAY (CL)	23			53
▲	C-03	33.0	SILT (ML)	38	NP	NP	99
◆	C-04	0.0	POORLY GRADED SAND WITH CLAY AND GRAVEL (SP-SC)	4			5

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

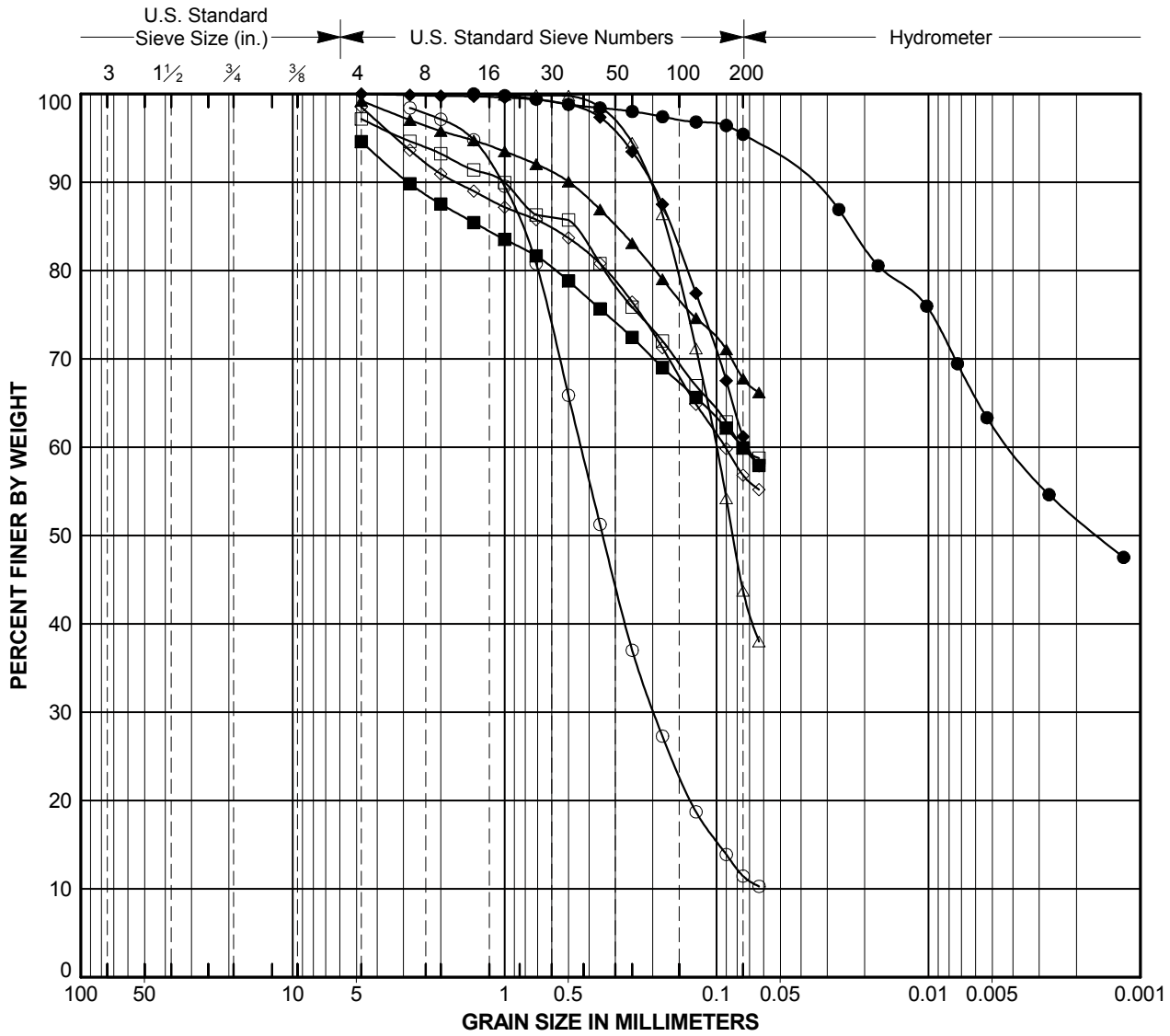
Project No. 2006-023.05

Diaz Yourman Areas B and C

PLATE

C13

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	C-04	3.0	POORLY GRADED SAND WITH CLAY AND GRAVEL (SP-SC)	8			11
□	C-04	4.0	SANDY LEAN CLAY (CL)	18			60
△	C-04	6.0	CLAYEY SAND (SC)	23			44
◇	C-04	9.0	SANDY FAT CLAY (CH)	20			57
●	C-04	12.0	ELASTIC SILT (MH)	38	54	23	95
■	C-04	15.0	SANDY FAT CLAY (CH)	23			60
▲	C-04	18.0	SANDY FAT CLAY (CH)	22			68
◆	C-04	21.0	SANDY SILT (ML)	23			61

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

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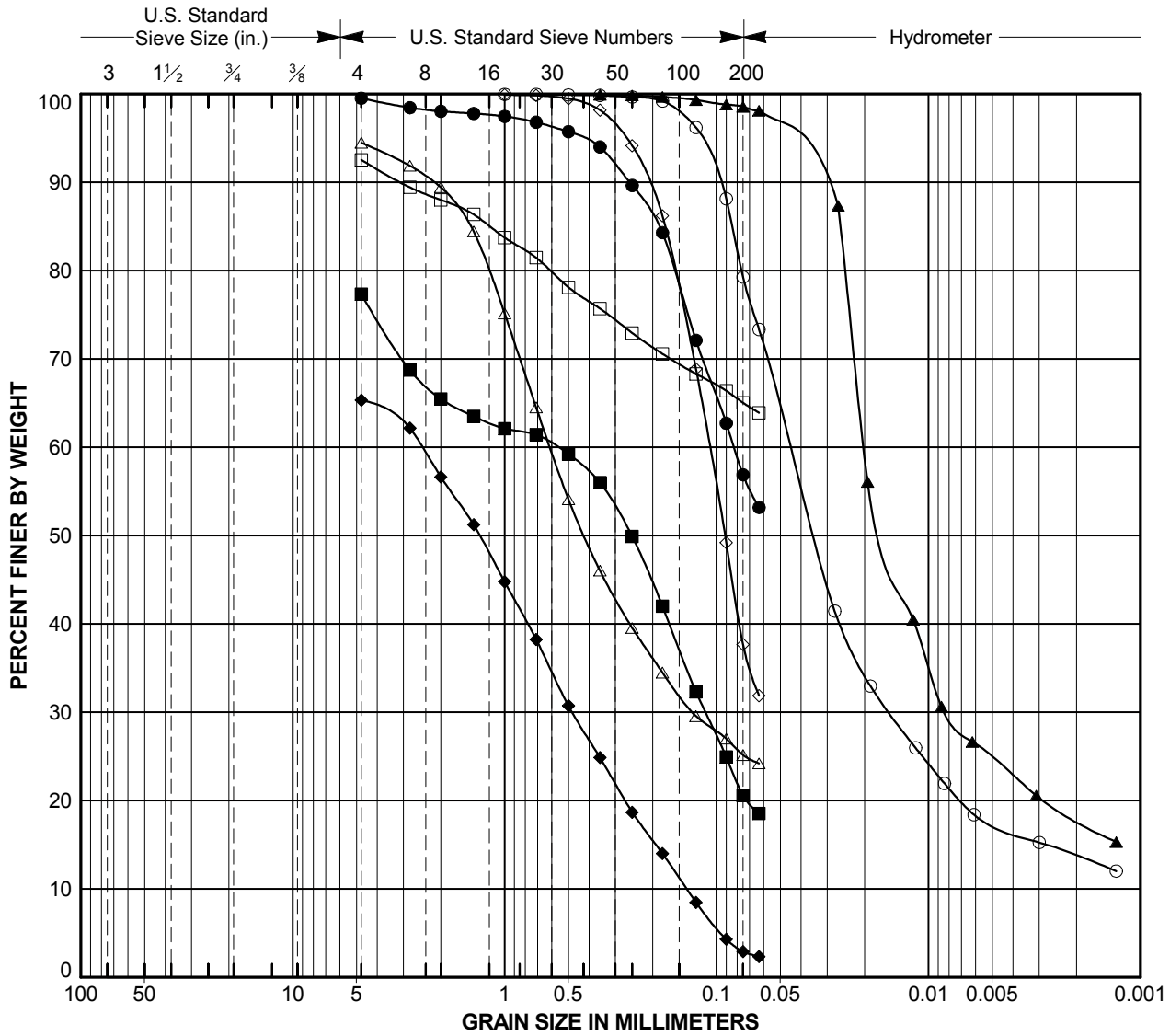
Diaz Yourman Areas B and C

PLATE

C14

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	C-04	24.0	SILT WITH SAND (ML)	24	NP	NP	79
□	C-05	0.0	SANDY LEAN CLAY (CL)	21			65
△	C-05	3.0	SILTY SAND (SM)	16			25
◇	C-05	6.0	CLAYEY SAND (SC)	25			38
●	C-05	12.0	SANDY LEAN CLAY (CL)	19			57
■	C-05	15.0	SILTY SAND WITH GRAVEL (SM)	15			21
▲	C-05	24.0	SILT (ML)	43	47	19	99
◆	C-06	0.0	POORLY GRADED SAND WITH GRAVEL (SP)	4			3

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

Project No. 2006-023.05

Diaz Yourman Areas B and C

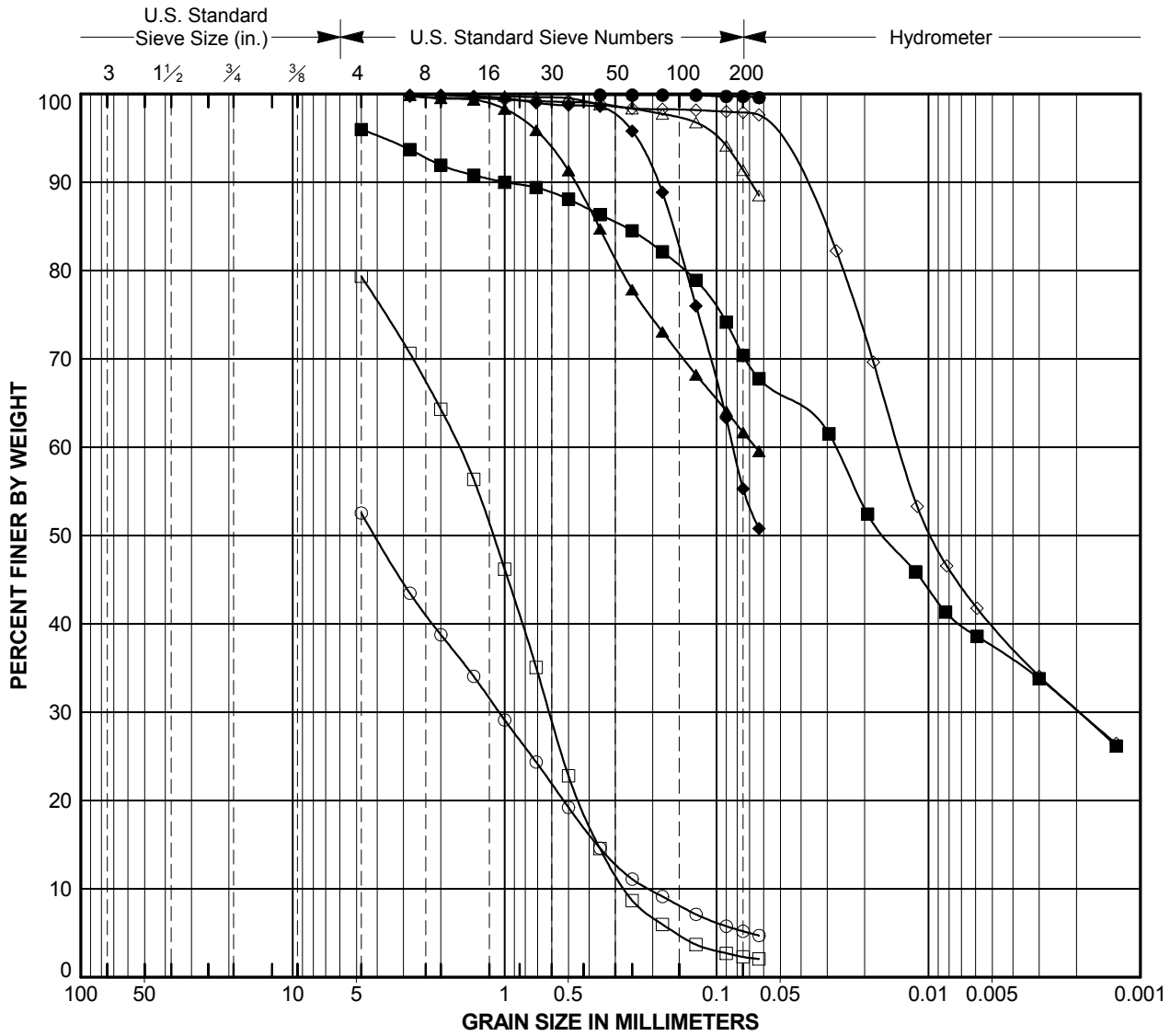
B1-840

PLATE

C15

PLATE B2-53

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	C-06	3.0	POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)	4			5
□	C-06	6.0	POORLY GRADED SAND WITH GRAVEL (SP)	2			2
△	C-06	9.0	LEAN CLAY (CL)	30			91
◇	C-06	12.0	FAT CLAY (CH)	43	57	36	98
●	C-06	15.0	FAT CLAY (CH)	39			100
■	C-06	18.0	SANDY LEAN CLAY (CL)	29	42	23	70
▲	C-06	21.0	SANDY LEAN CLAY (CL)	22			62
◆	C-06	24.0	SANDY FAT CLAY (CH)	22			55

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

Project No. 2006-023.05

Diaz Yourman Areas B and C

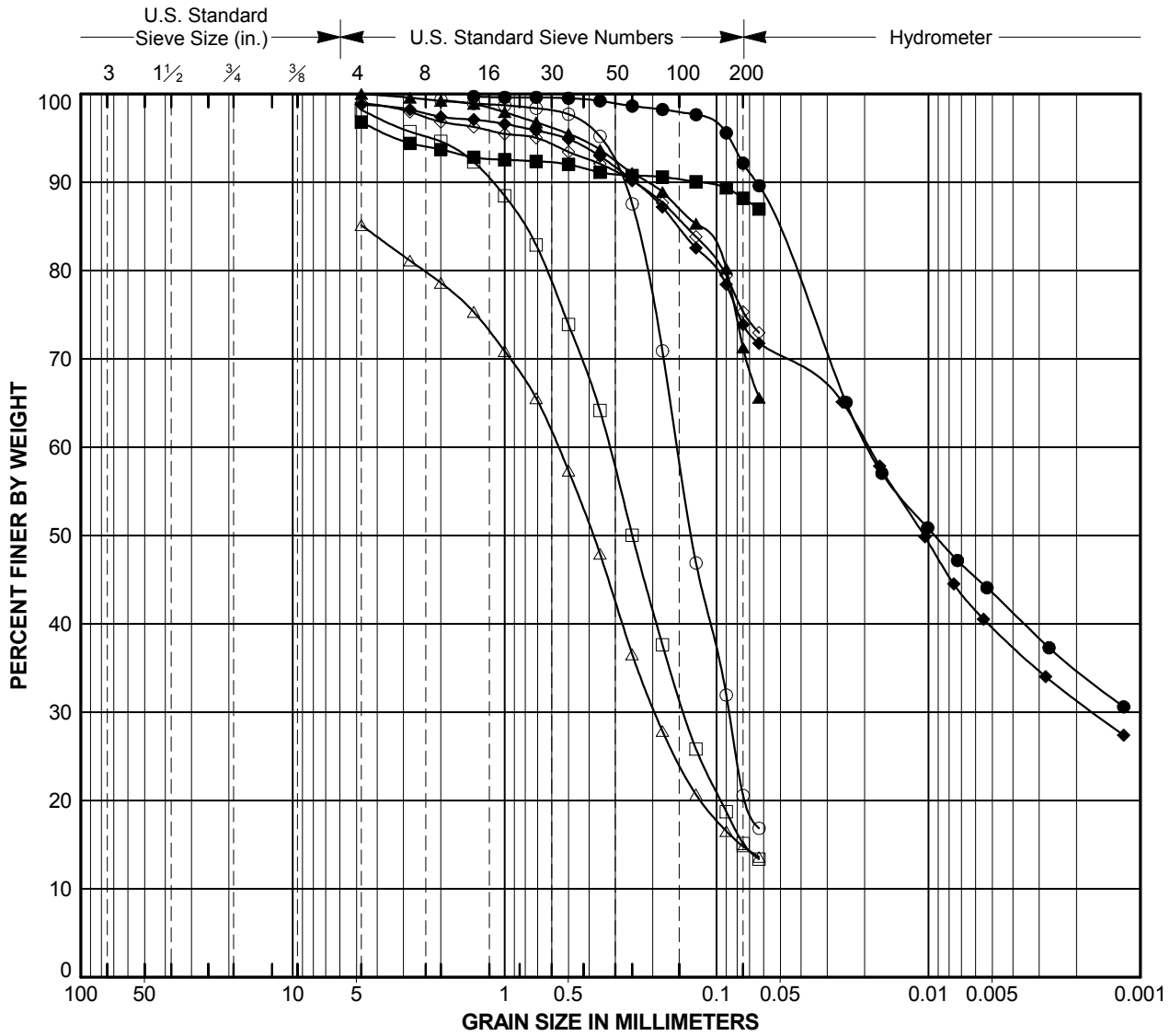
B1-841

PLATE

C16

PLATE B2-54

Template: DY_SIEVE_WIN



COBBLES	Coarse	Fine	Coarse	Medium	Fine	SILT or CLAY
	GRAVEL		SAND			

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	C-06	27.0	CLAYEY SAND (SC)	23			21
□	C-07	0.0	SILTY SAND (SM)	7			15
△	C-07	3.0	SILTY SAND WITH GRAVEL (SM)	8			15
◇	C-07	6.0	FAT CLAY WITH SAND (CH)	30			75
●	C-07	9.0	SILT (ML)	31	49	12	92
■	C-07	12.0	FAT CLAY (CH)	42			88
▲	C-07	18.0	SILT WITH SAND (ML)	51			71
◆	C-07	21.0	FAT CLAY WITH SAND (CH)	27	51	33	74

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

Project No. 2006-023.05

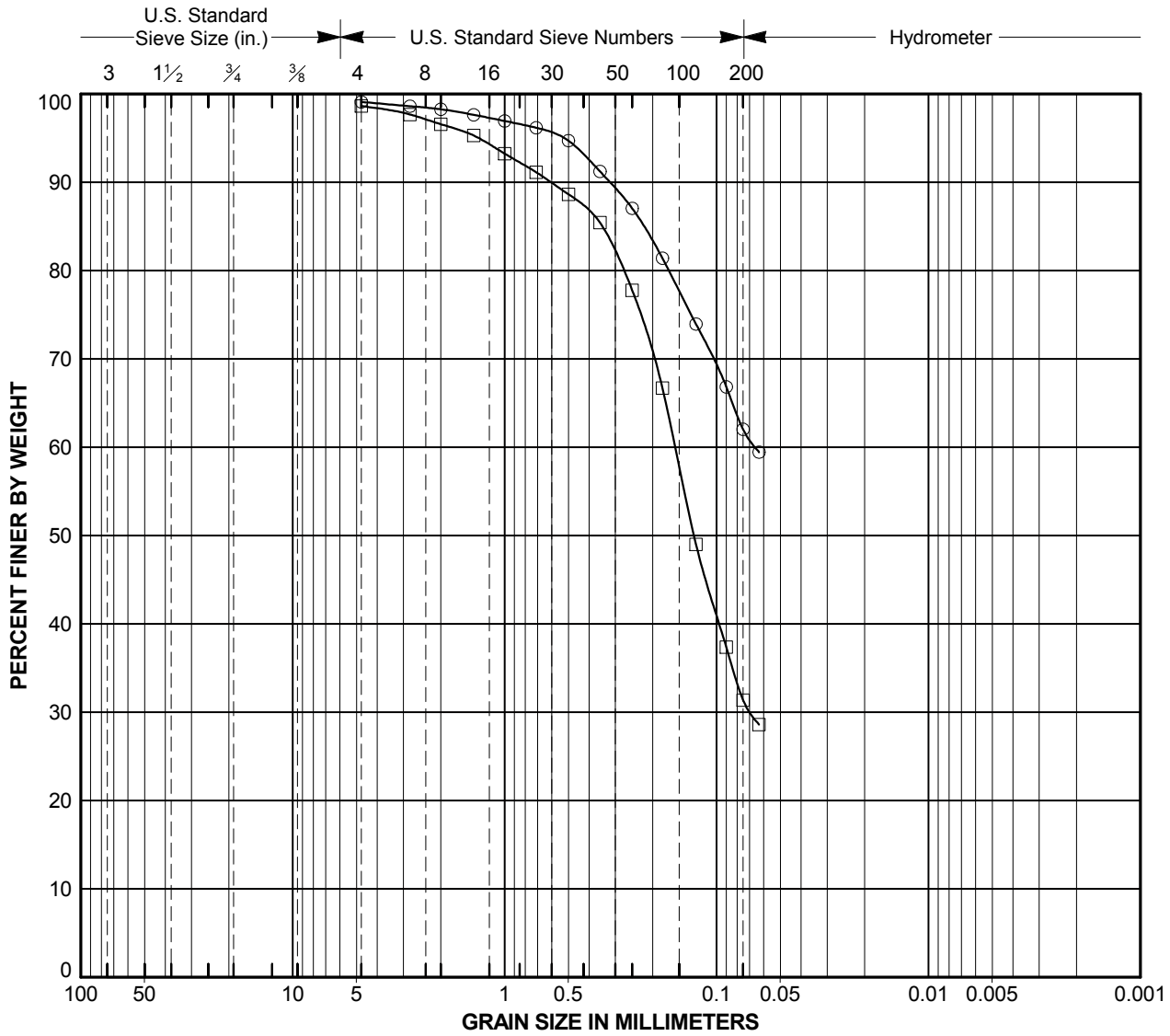
Diaz Yourman Areas B and C

PLATE

C17

PLATE B2-55

Template: DY_SIEVE_WIN



COBBLES	Coarse	Fine	Coarse	Medium	Fine	SILT or CLAY
	GRAVEL		SAND			

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	C-07	24.0	SANDY FAT CLAY (CH)	23			62
□	C-07	27.0	CLAYEY SAND (SC)	20			31

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

Project No. 2006-023.05

Diaz Yourman Areas B and C

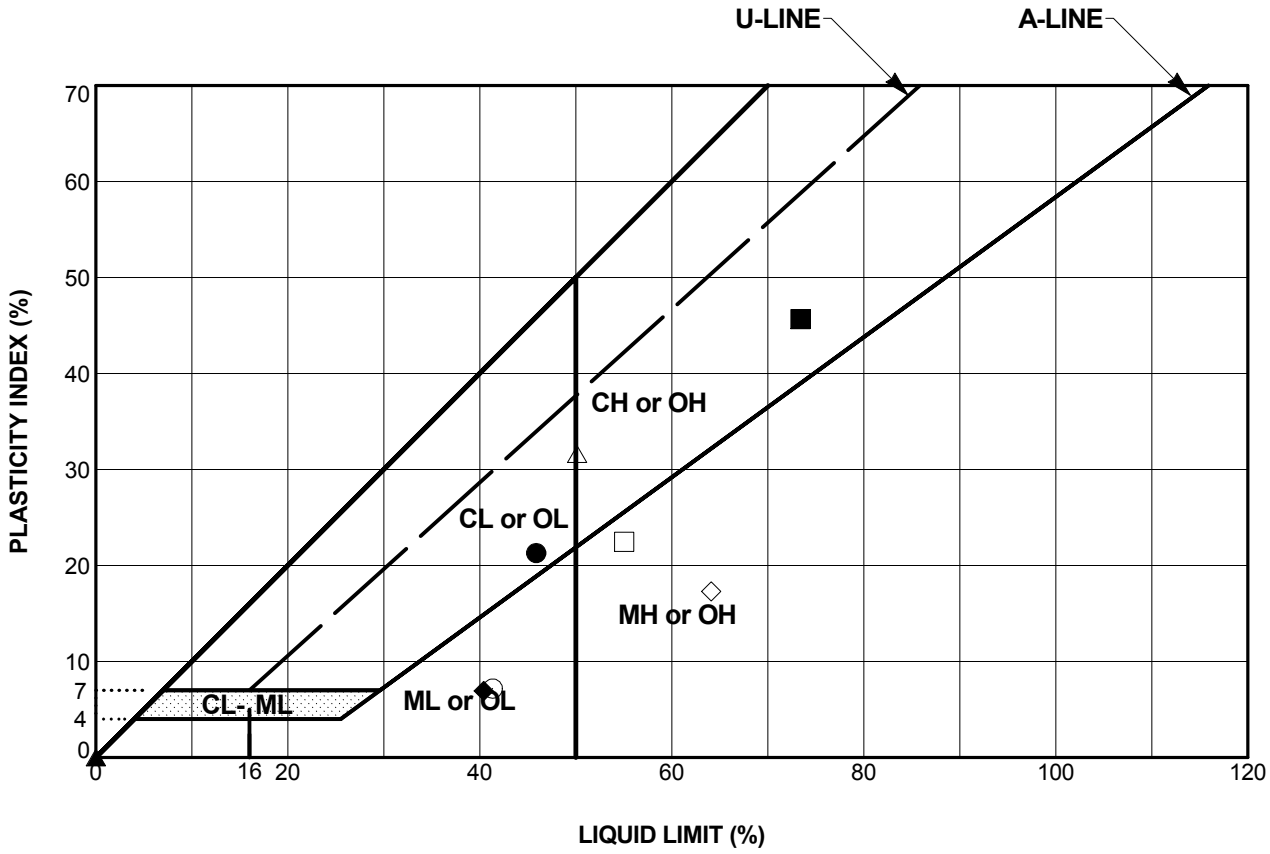
B1-843

PLATE

C18

PLATE B2-56

Template: DY_ATTERBERG_CHART_WIN



Laboratory Testing by: Diaz Yourman & Associates

Test Method: ASTM D4318-05

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	B-01	3.0	SILT (ML)	39	41	34	7	98
□	B-01	9.0	ELASTIC SILT (MH)	43	55	33	22	98
△	B-02	3.0	FAT CLAY (CH)	39	50	19	31	97
◇	B-02	15.0	ELASTIC SILT (MH)	107	64	47	17	96
●	B-03	6.0	LEAN CLAY (CL)	45	46	25	21	99
■	B-03	15.0	FAT CLAY (CH)	62	73	28	45	90
▲	B-04	6.0	SILT (ML)	34	NP	NP	NP	98
◆	B-04	12.0	SILT (ML)	42	40	33	7	99

PLASTICITY CHART

USACE Ballona Creek Watershed

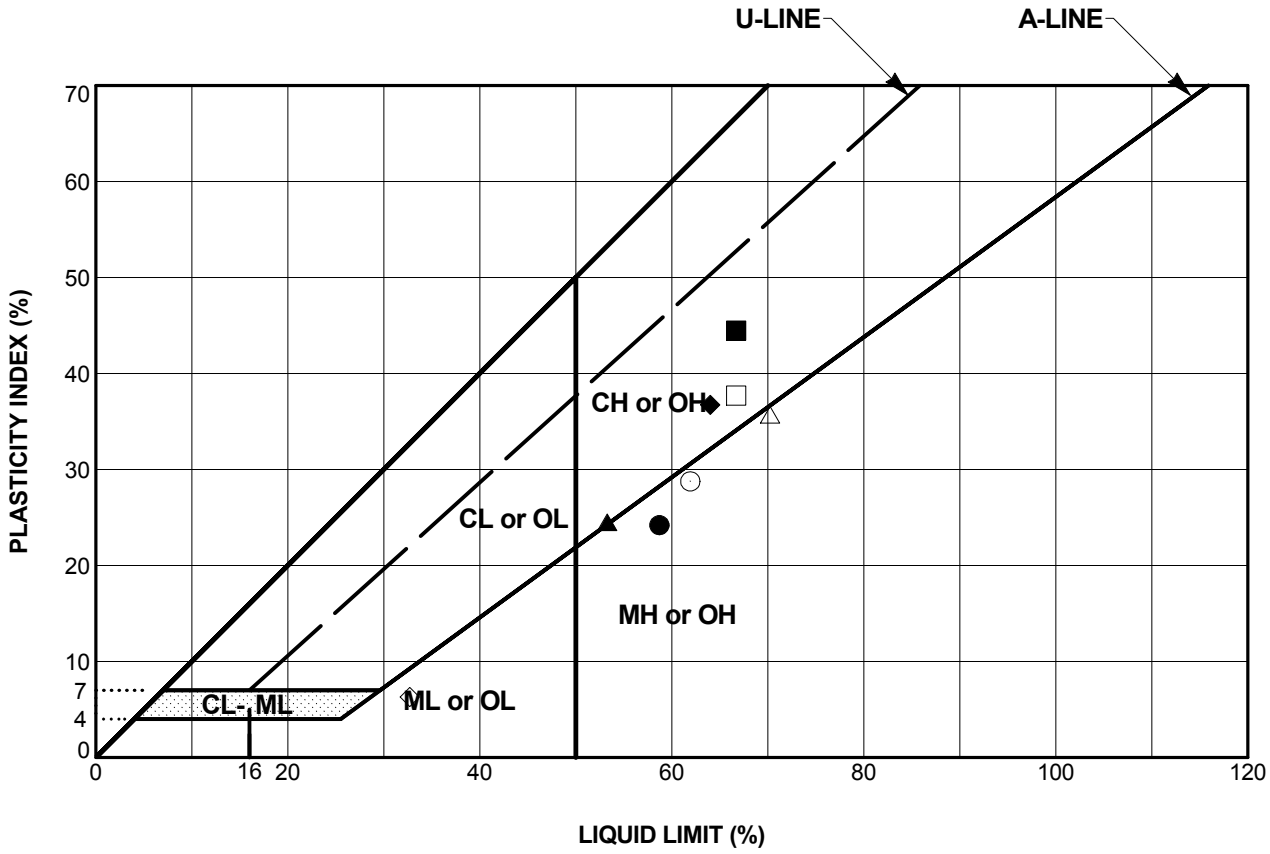
Project No. 2006-023.05

Diaz Yourman Areas B and C

PLATE

C19

Template: DY_ATTERBERG_CHART_WIN



Laboratory Testing by: Diaz Yourman & Associates

Test Method: ASTM D4318-05

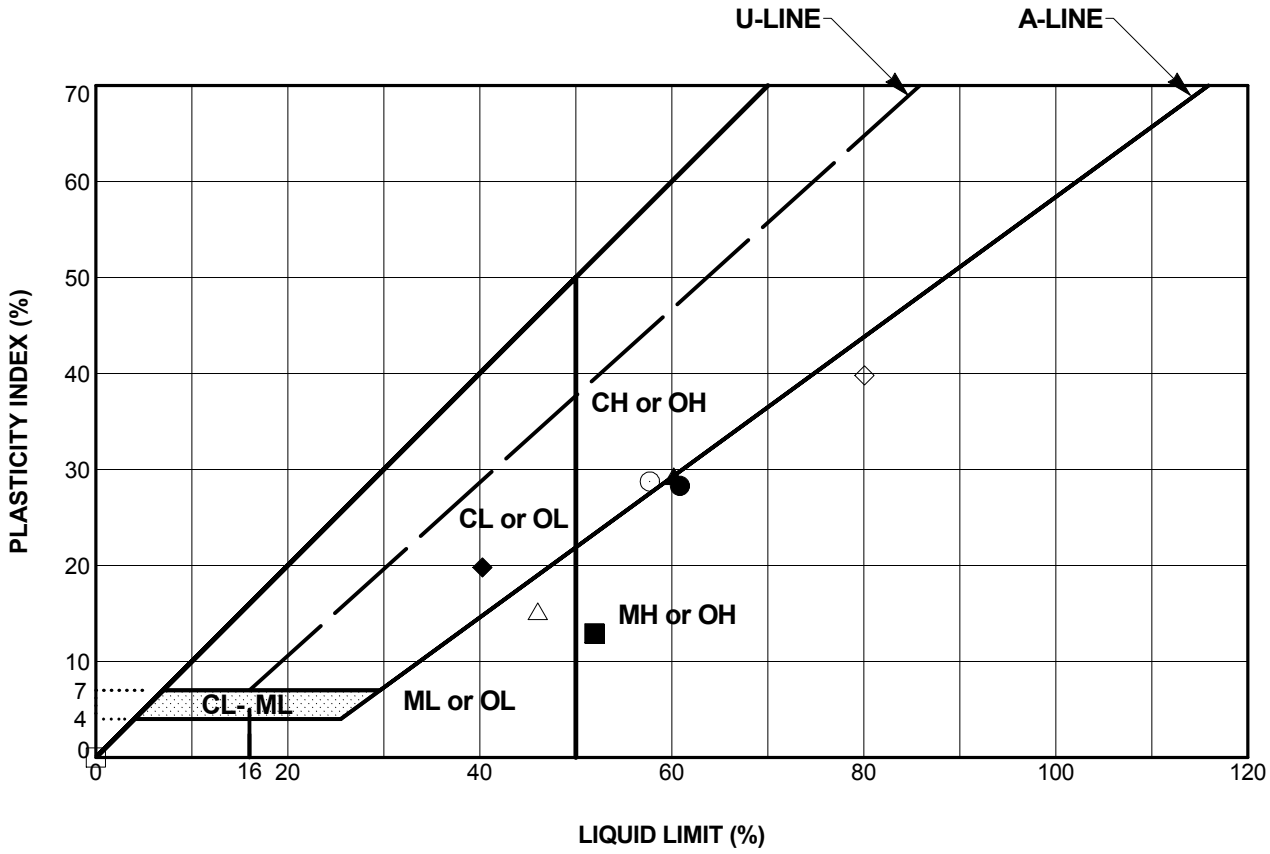
Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	B-05	9.0	ELASTIC SILT (MH)	49	62	33	29	98
□	B-05	15.0	FAT CLAY (CH)	95	67	29	38	95
△	B-06	2.5	ELASTIC SILT (MH)	46	70	35	35	99
◇	B-07	6.0	SILT (ML)	26	33	26	7	95
●	B-07	9.0	ELASTIC SILT (MH)	40	59	34	25	96
■	B-08	0.0	FAT CLAY (CH)	41	67	22	45	99
▲	B-08	9.0	FAT CLAY (CH)	58	53	29	24	98
◆	B-09	1.0	FAT CLAY (CH)	43	64	27	37	99

PLASTICITY CHART

USACE Ballona Creek Watershed
Project No. 2006-023.05
Diaz Yourman Areas B and C

PLATE
C20

Template: DY_ATTERBERG_CHART_WIN



Laboratory Testing by: Diaz Yourman & Associates

Test Method: ASTM D4318-05

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	B-09	3.0	FAT CLAY (CH)	52	58	29	29	99
□	B-10	6.0	SILT (ML)	31	NP	NP	NP	94
△	B-10	12.0	SILT (ML)	48	46	31	15	100
◇	B-11	3.0	ELASTIC SILT (MH)	72	80	40	40	96
●	B-11	9.0	ELASTIC SILT (MH)	60	61	33	28	97
■	B-12	9.0	ELASTIC SILT (MH)	84	52	39	13	95
▲	B-13	6.0	FAT CLAY (CH)	56	60	31	29	96
◆	C-01	6.0	LEAN CLAY (CL)	34	40	21	20	96

PLASTICITY CHART

USACE Ballona Creek Watershed

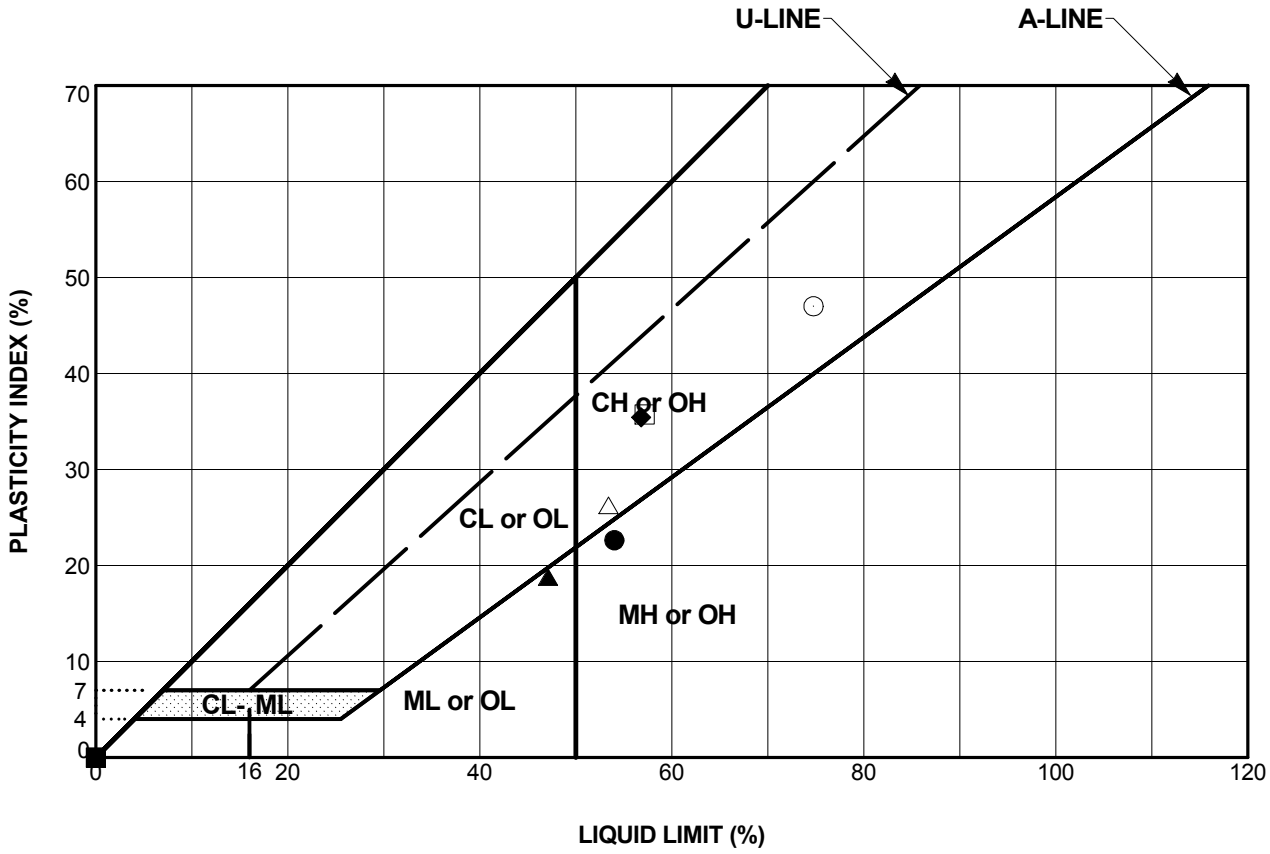
Project No. 2006-023.05

Diaz Yourman Areas B and C

PLATE

C21

Template: DY_ATTERBERG_CHART_WIN



Laboratory Testing by: Diaz Yourman & Associates

Test Method: ASTM D4318-05

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	C-01	12.0	FAT CLAY (CH)	46	75	28	47	92
□	C-02	6.0	FAT CLAY (CH)	45	57	21	36	98
△	C-03	15.0	FAT CLAY (CH)	51	53	27	26	100
◇	C-03	33.0	SILT (ML)	38	NP	NP	NP	99
●	C-04	12.0	ELASTIC SILT (MH)	38	54	31	23	95
■	C-04	24.0	SILT WITH SAND (ML)	24	NP	NP	NP	79
▲	C-05	24.0	SILT (ML)	43	47	28	19	99
◆	C-06	12.0	FAT CLAY (CH)	43	57	21	36	98

PLASTICITY CHART

USACE Ballona Creek Watershed

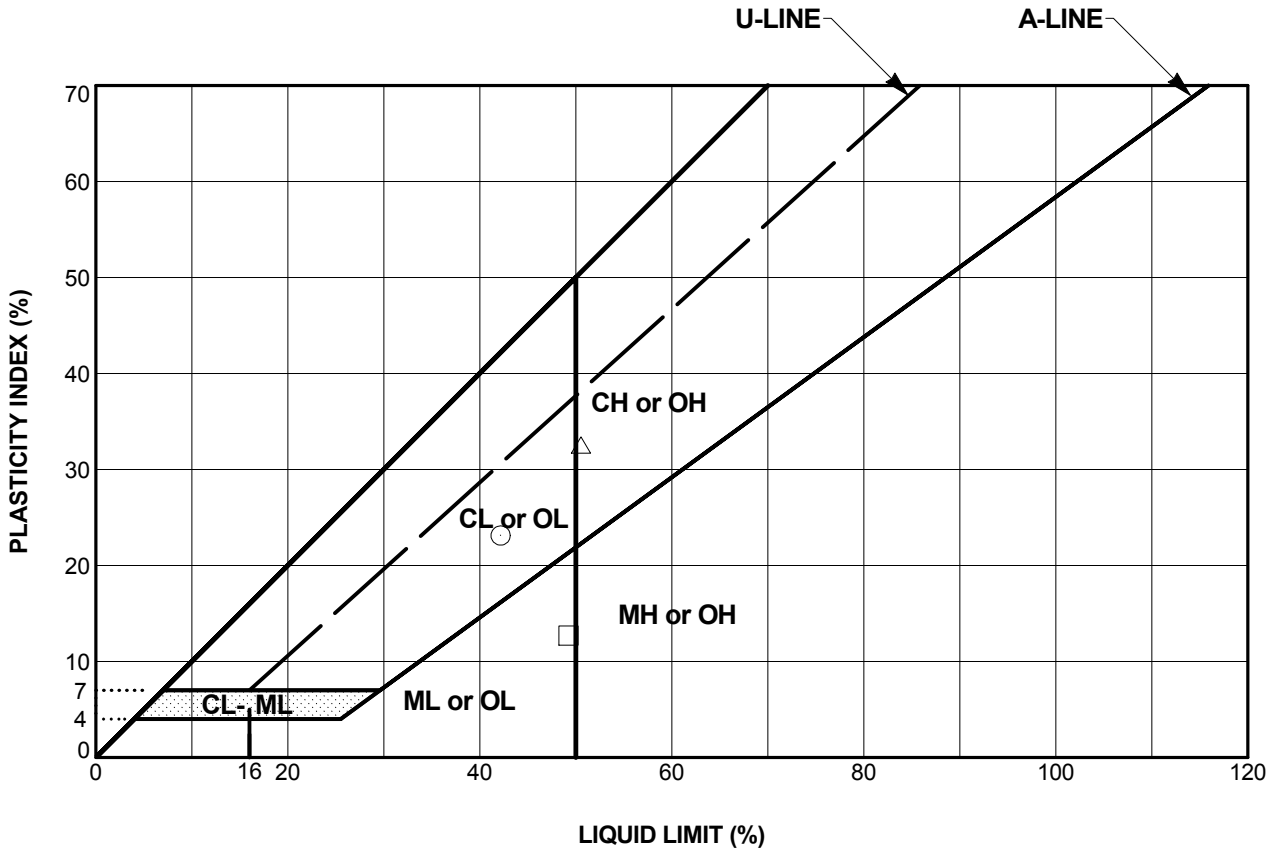
Project No. 2006-023.05

Diaz Yourman Areas B and C

PLATE

C22

Template: DY_ATTERBERG_CHART_WIN



Laboratory Testing by: Diaz Yourman & Associates

Test Method: ASTM D4318-05

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	C-06	18.0	SANDY LEAN CLAY (CL)	29	42	19	23	70
□	C-07	9.0	SILT (ML)	31	49	37	12	92
△	C-07	21.0	FAT CLAY WITH SAND (CH)	27	51	18	33	74

PLASTICITY CHART

USACE Ballona Creek Watershed
Project No. 2006-023.05
Diaz Yourman Areas B and C

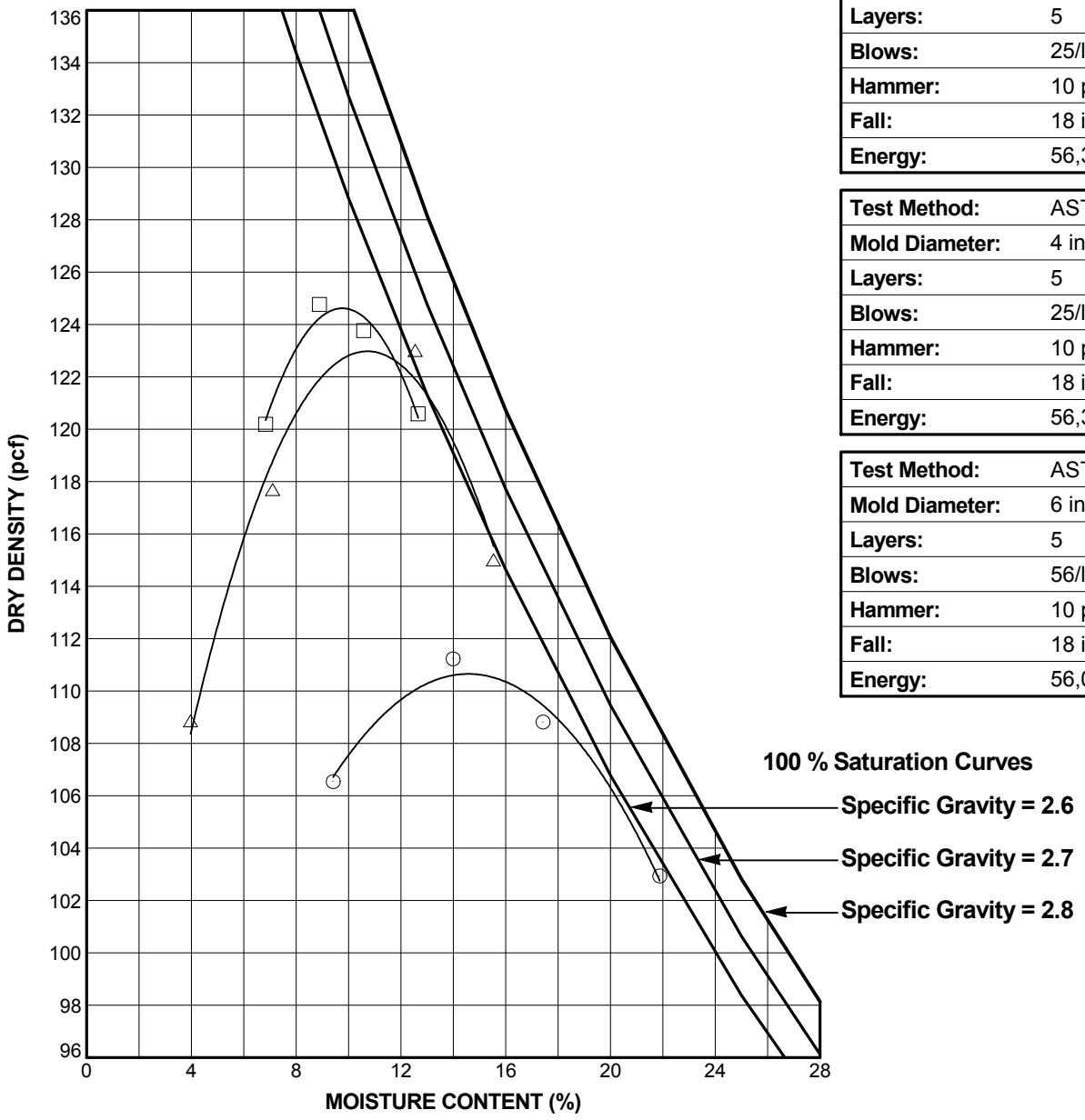
PLATE
C23

Template: DY_COMPACT_4_PLOTS_WIN REV FEB07

Test Method:	ASTM D1557-91(A)
Mold Diameter:	4 inches
Layers:	5
Blows:	25/layer
Hammer:	10 pounds
Fall:	18 inches
Energy:	56,300 ft-lbs/cu ft

Test Method:	ASTM D1557-91(B)
Mold Diameter:	4 inches
Layers:	5
Blows:	25/layer
Hammer:	10 pounds
Fall:	18 inches
Energy:	56,300 ft-lbs/cu ft

Test Method:	ASTM D1557-91(C)
Mold Diameter:	6 inches
Layers:	5
Blows:	56/layer
Hammer:	10 pounds
Fall:	18 inches
Energy:	56,000 ft-lbs/cu ft



Laboratory Testing by: Diaz Yourman & Associates

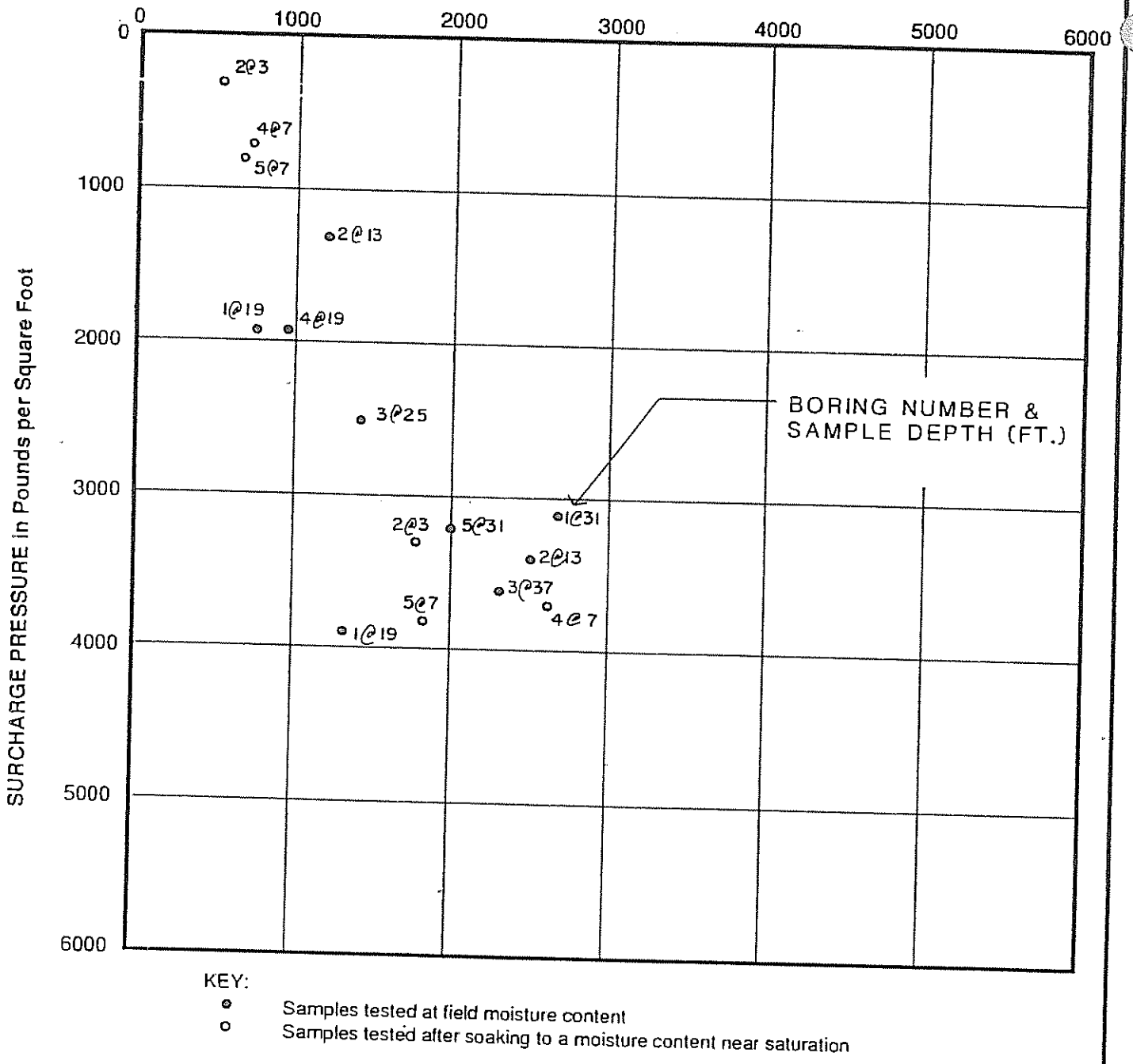
Symbol	Source	Depth (feet)	Classification	Optimum Moisture Content (%)	Max. Dry Density (pcf)	Liquid Limit (%)	Plasticity Index (%)	%<#200 Sieve	ASTM Test Method
○	B-02	0.0	LEAN CLAY WITH SAND (CL)	16	112				1557A
□	B-13	0.0	CLAYEY SAND (SC)	10	126			21	1557A
△	C-01	0.0	CLAYEY SAND (SC)	10.5	124.5			37	1557A

COMPACTION TEST DATA

USACE Ballona Creek Watershed
Project No. 2006-023.05

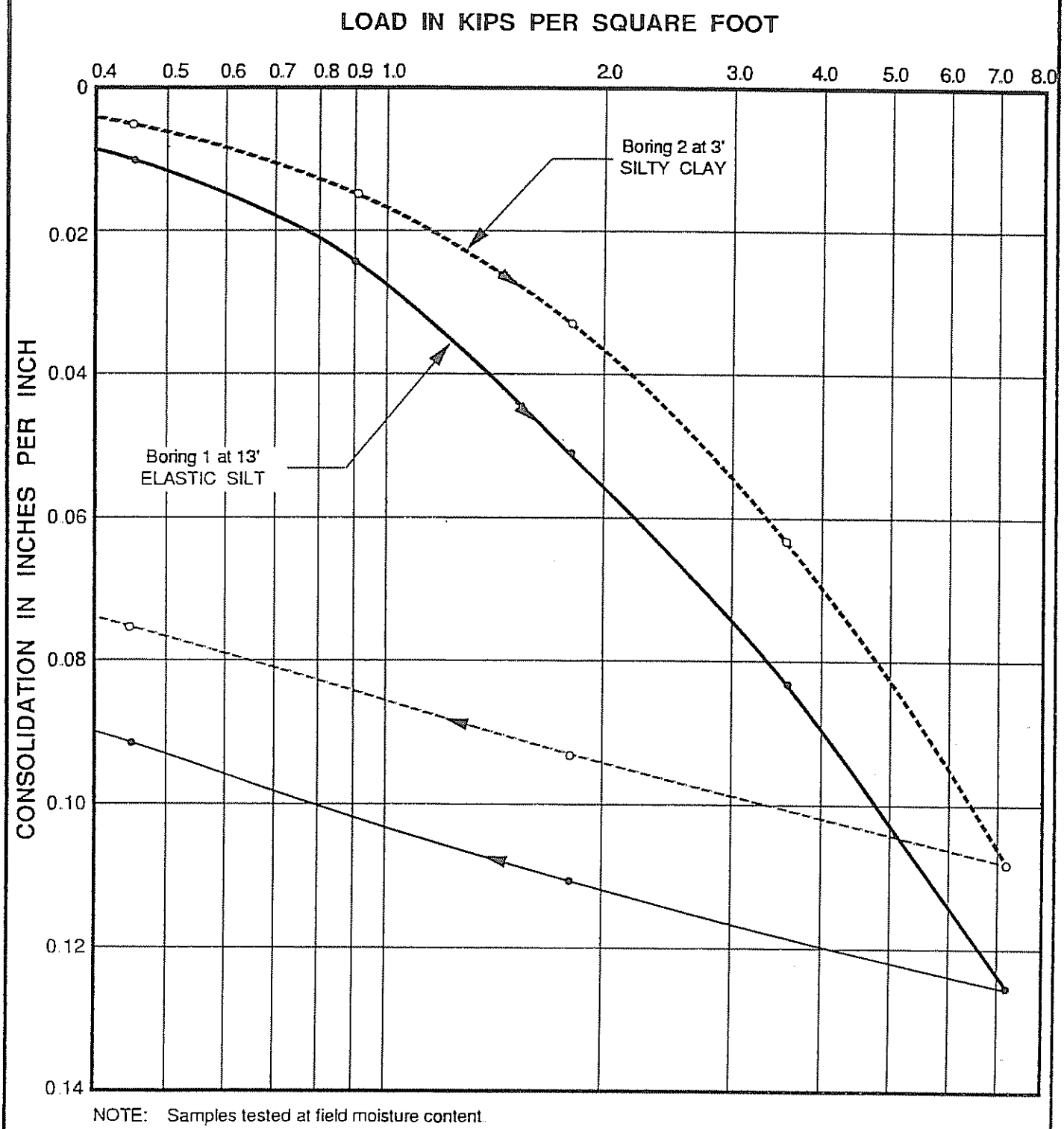
PLATE
C24

Diaz Yourman Areas B and C



DIRECT SHEAR TEST DATA

JOB L91177.AEB DATE 7/12/91 DR. lk O.E. HRL CHKD FH



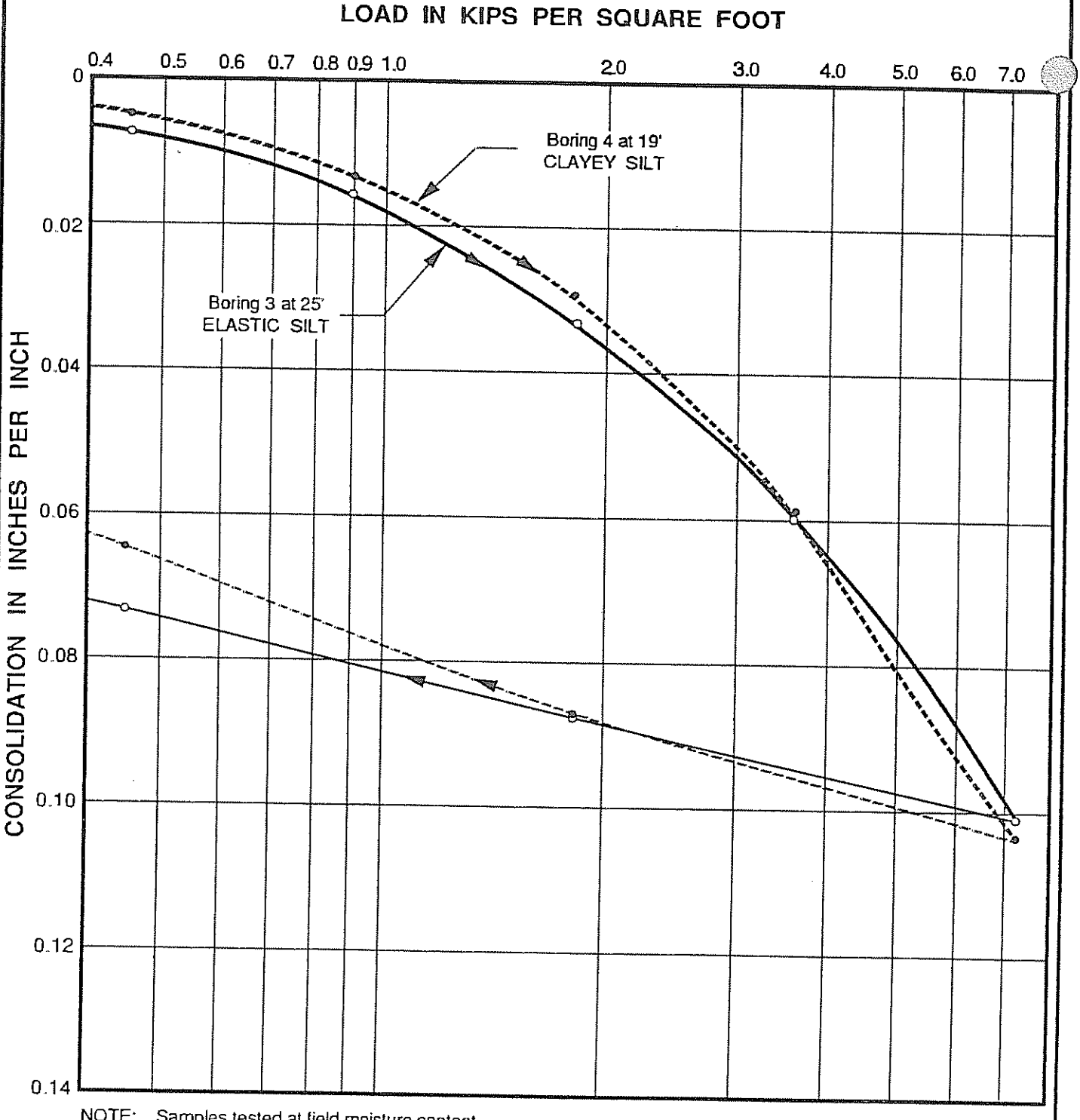
NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA

Law Crandall Area C LAW/CRANDALL, INC.

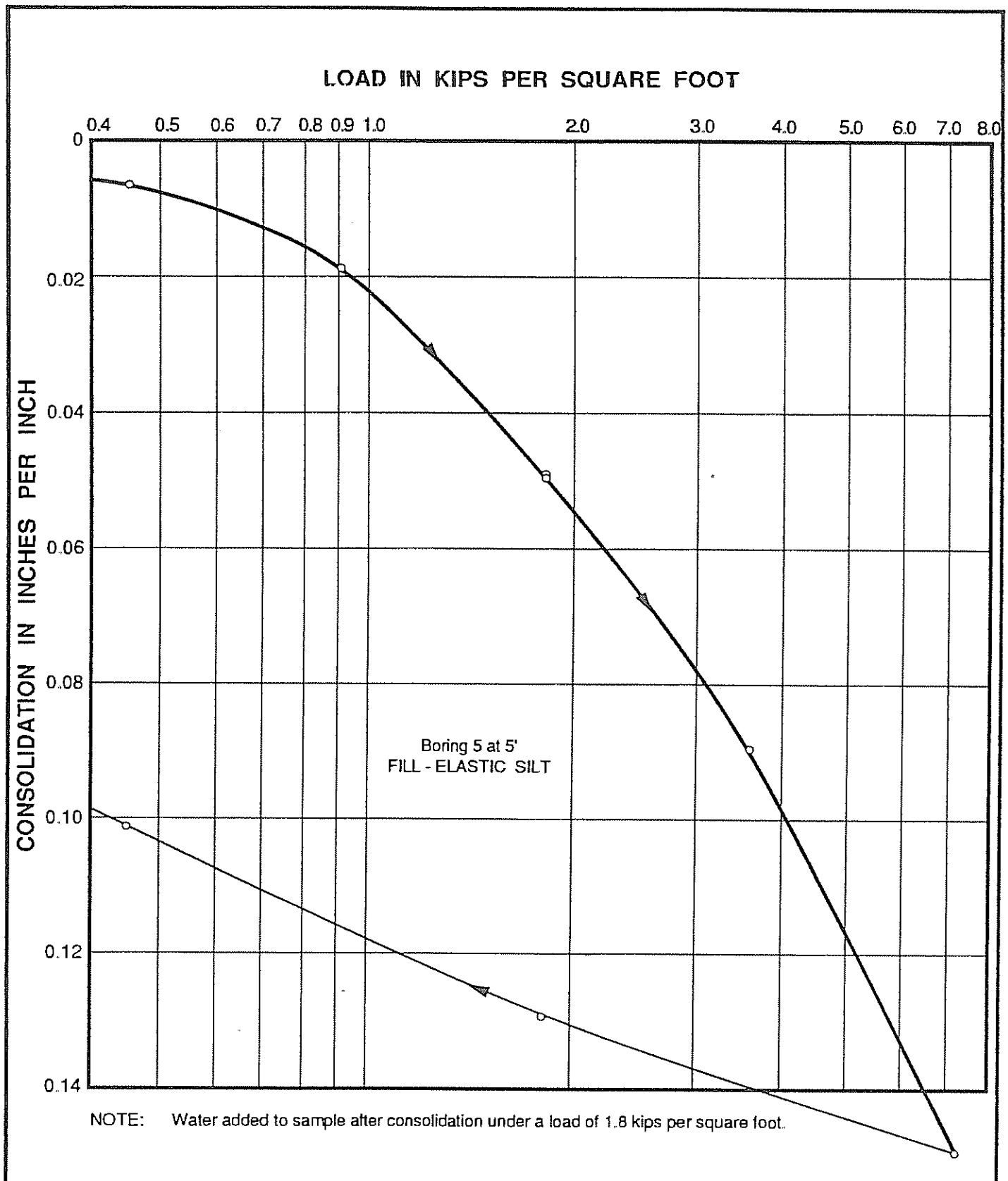
PLATE B2-64.1

JOB L91177.AEB DATE 7/12/91 DR. lk O.E. HRL CHKD FH



NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA



NOTE: Water added to sample after consolidation under a load of 1.8 kips per square foot.

CONSOLIDATION TEST DATA

Law Crandall Area C LAW/CRANDALL, INC.

PLATE B2-664.3

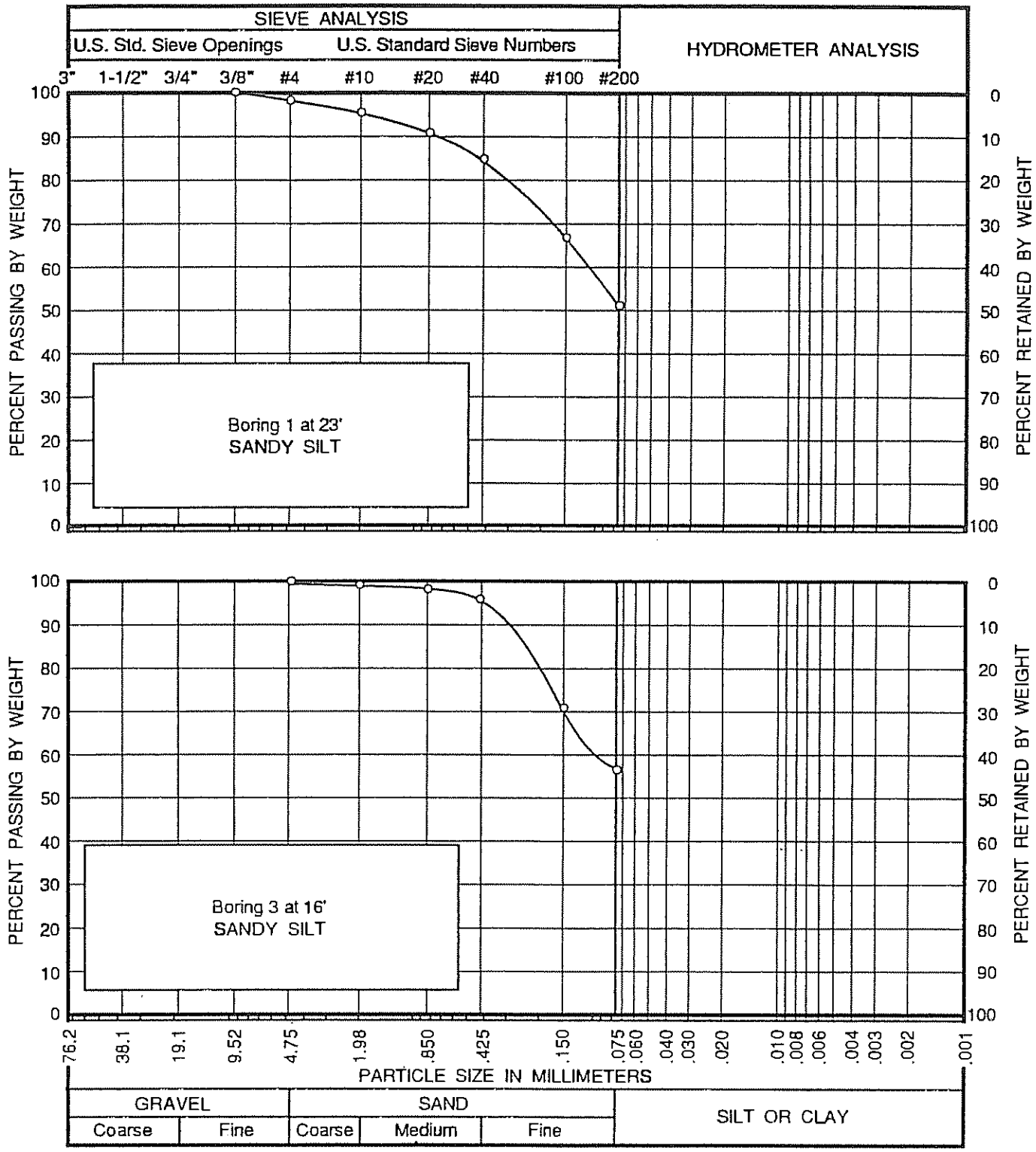
JOB L91177.AEB DATE 7/12/91 DR. lk O.E. HRL CHKD EH

BORING NUMBER AND SAMPLE DEPTH:	2 at 1' and 2 at 3' (Combined Sample)
SOIL TYPE:	SILTY CLAY
CONFINING PRESSURE: (lbs./sq. ft.)	144
INITIAL MOISTURE CONTENT: (% of dry wt.)	13.3
FINAL MOISTURE CONTENT: (% of dry wt.)	34.7
DRY DENSITY: (lbs./cu. ft.)	98
EXPANSION INDEX:	95

TEST METHOD: Uniform Building Code Standard No. 29-2, Expansion Index Test

EXPANSION INDEX TEST DATA

JOB L91177.AEB DATE 7/12/91 DR. lk O.E. HRL CHKD



PARTICLE SIZE DISTRIBUTION

Law Crandall Area C LAW/CRANDALL, INC.

PLATE B2-6A - 6

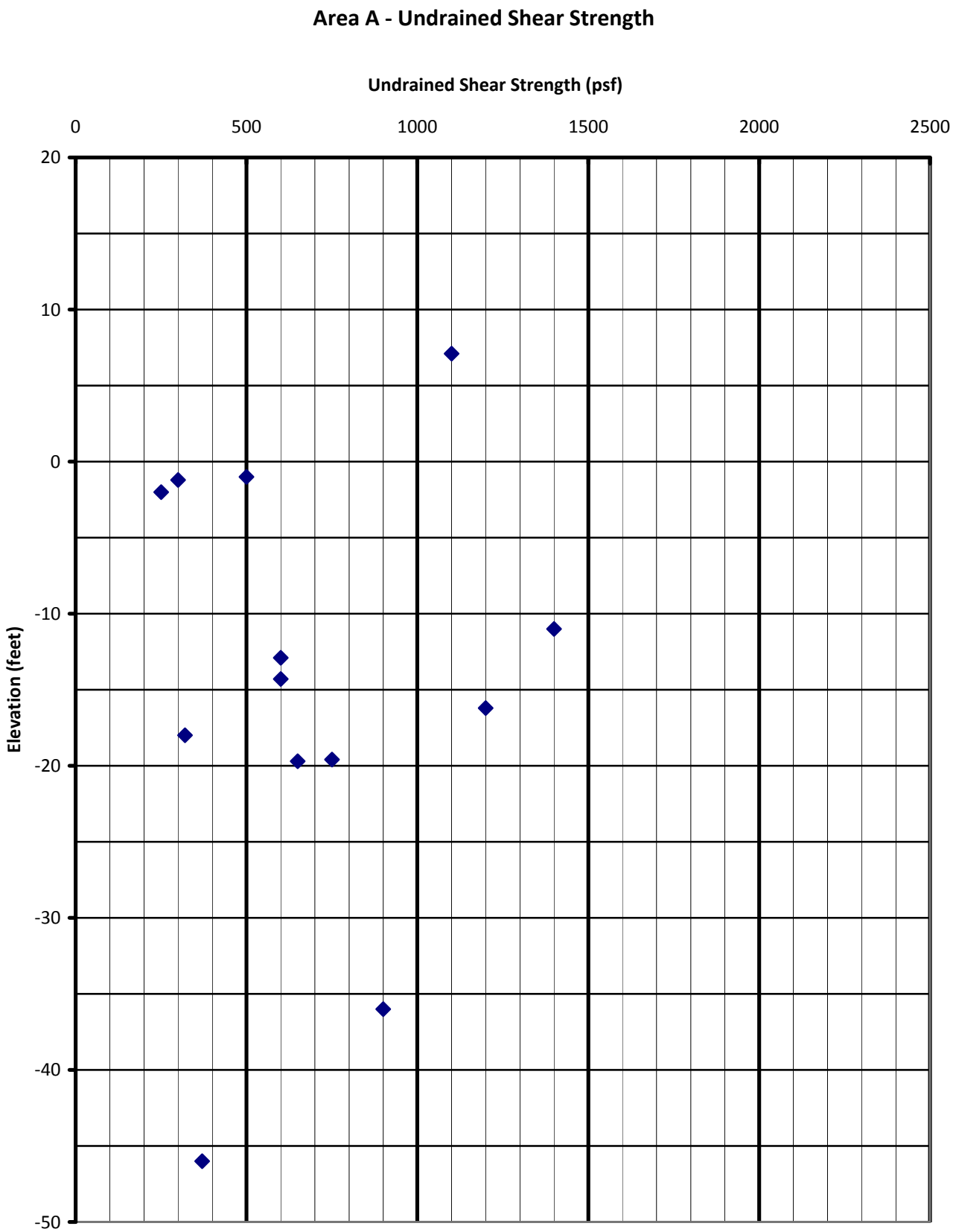
APPENDIX B3
LABORATORY TESTING INTERPRETATIONS OF GDC INVESTIGATION

APPENDIX B3
LABORATORY TESTING INTERPRETATIONS

B3.1 General

The following interpretation plots were generated based on the results of our laboratory data in Areas A, B, and C:

Plate B3-1	Area A – Undrained Shear Strength
Plate B3-2	Variation of Moisture Content with Depth – Area A
Plate B3-3	Variation of Dry Density with Depth – Area A
Plate B3-4	Variation of Liquid Limit with Depth – Area A
Plate B3-5	Variation of Plastic Limit with Depth – Area A
Plate B3-6	Variation of Fines Content with Depth – Area A
Plate B3-7	Plot of Moisture Content vs. Dry Density – Area A
Plate B3-8	Variation of Moisture Content with Elevation – Area A Fill Soils
Plate B3-9	Variation of Dry Density with Elevation – Area A Fill Soils
Plate B3-10	Variation of Liquid Limit with Elevation – Area A Fill Soils
Plate B3-11	Variation of Plastic Limit with Elevation – Area A Fill Soils
Plate B3-12	Variation of Fines Content with Elevation – Area A Fill Soils
Plate B3-13	Plot of Moisture Content vs. Dry Density – Area A Fill Soils
Plate B3-14	Area B – Undrained Shear Strength
Plate B3-15	Variation of Moisture Content with Depth – Area B
Plate B3-16	Variation of Dry Density with Depth – Area B
Plate B3-17	Variation of Liquid Limit with Depth – Area B
Plate B3-18	Variation of Plastic Limit with Depth – Area B
Plate B3-19	Variation of Fines Content with Depth – Area B
Plate B3-20	Plot of Moisture Content vs. Dry Density – Area B
Plate B3-21	Variation of Moisture Content with Depth – Area C
Plate B3-22	Variation of Dry Density with Depth – Area C
Plate B3-23	Variation of Liquid Limit with Depth – Area C
Plate B3-24	Variation of Plastic Limit with Depth – Area C
Plate B3-25	Variation of Fines Content with Depth – Area C
Plate B3-26	Plot of Moisture Content vs. Dry Density – Area C

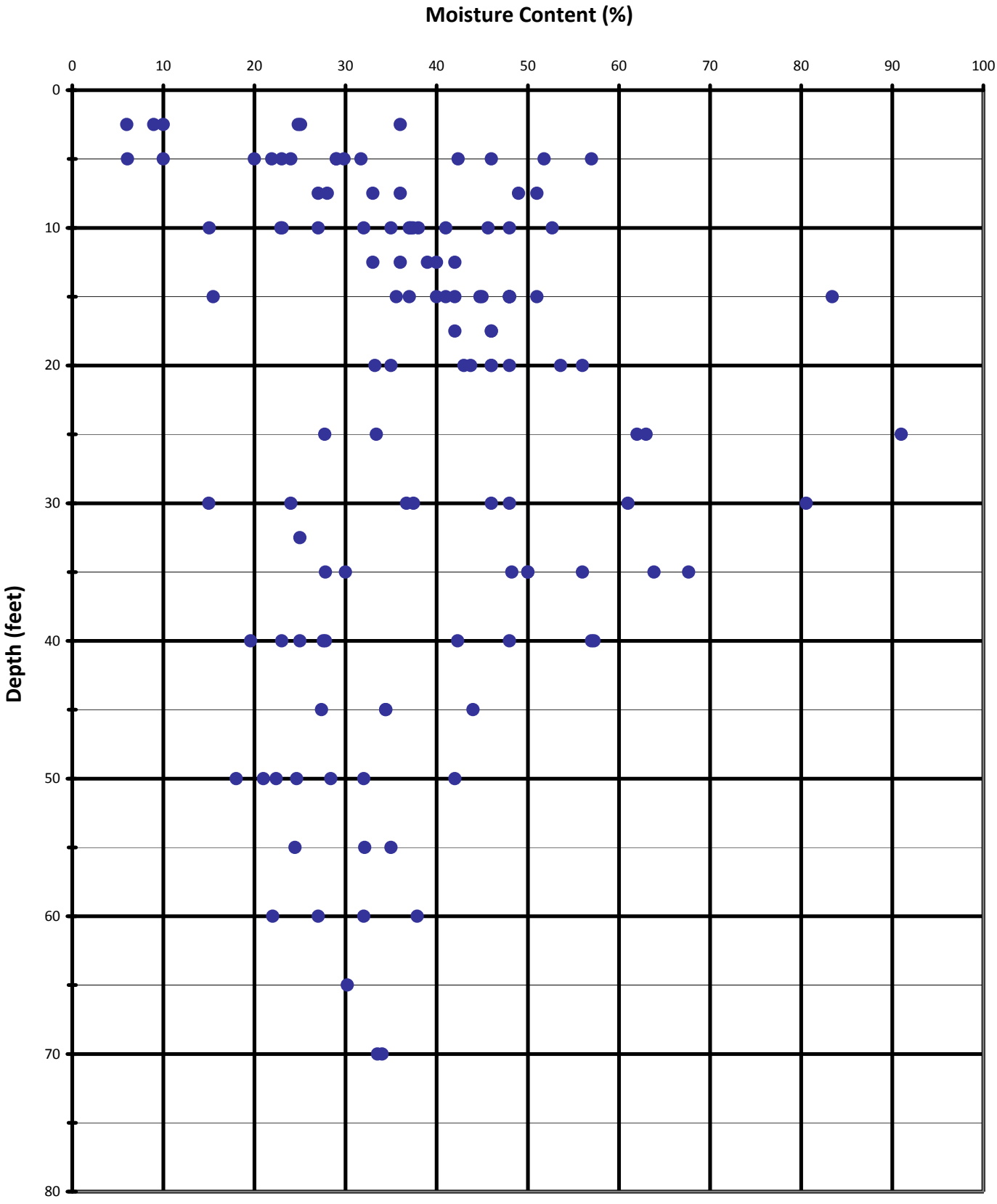


Laboratory Vane Shear - Area A

B1-858

PLATE B3-1

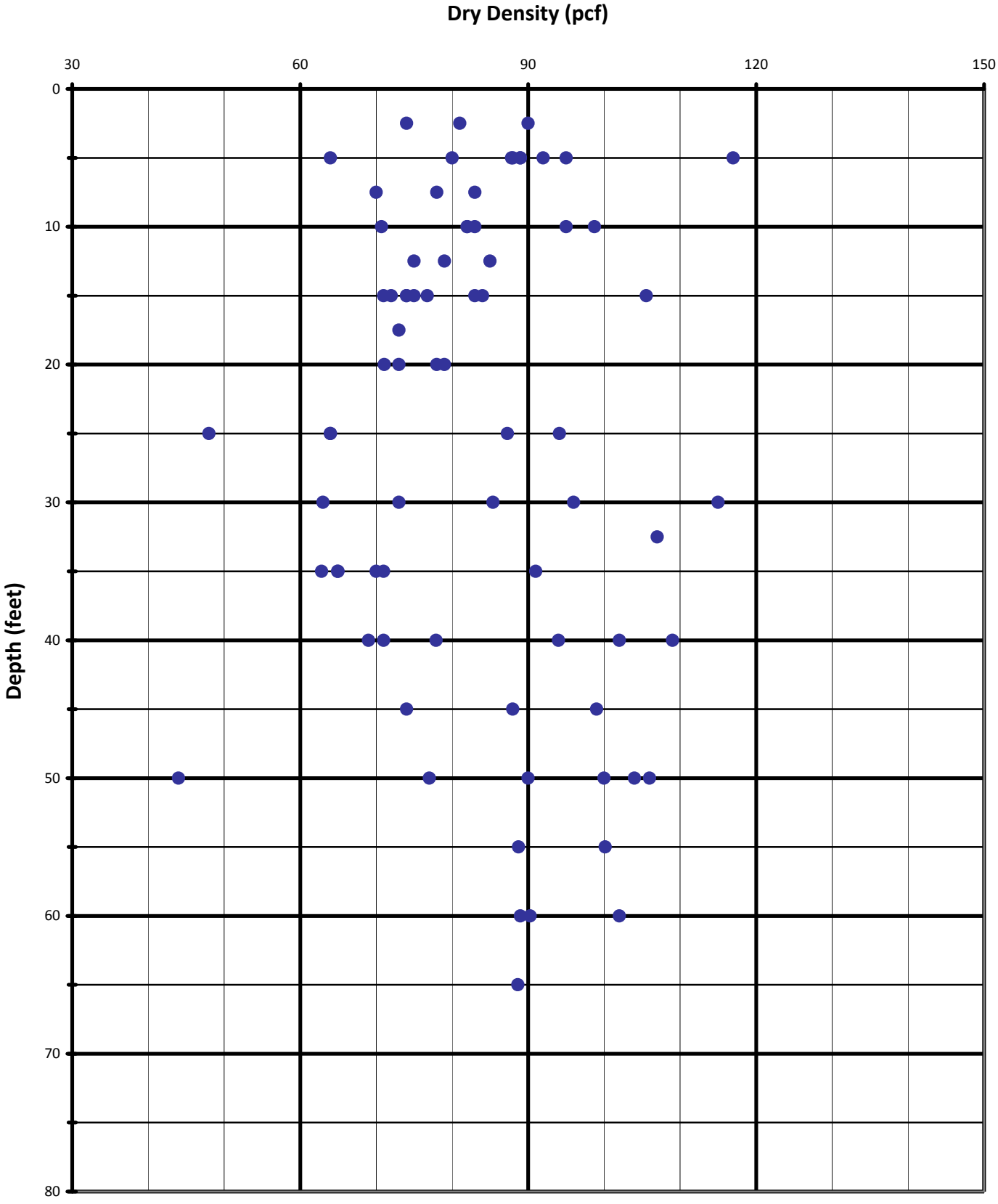
Variation of Moisture Content with Depth



Area A
B1-859

PLATE B3-2

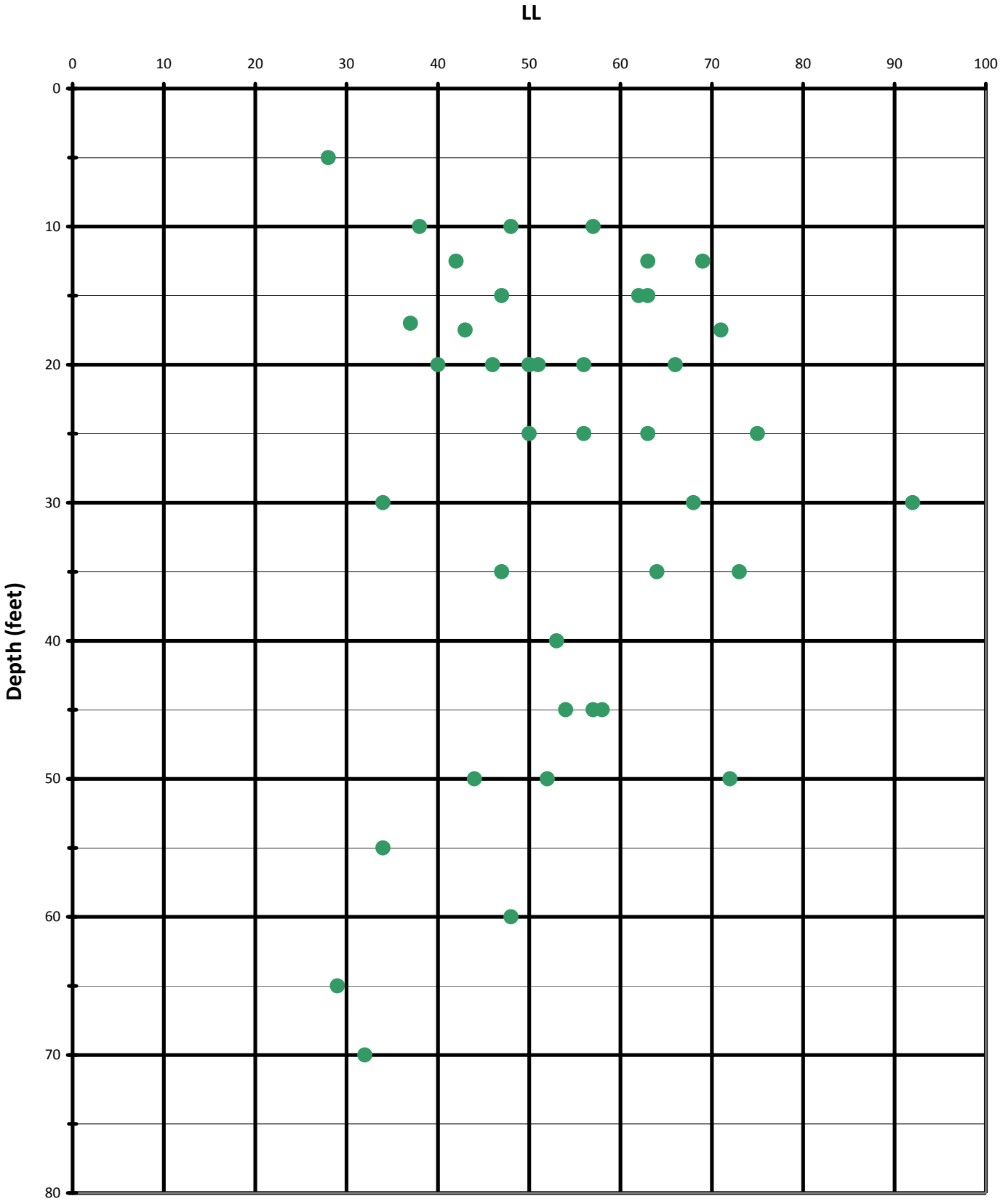
Variation of Dry Density with Depth



Area A
B1-860

PLATE B3-3

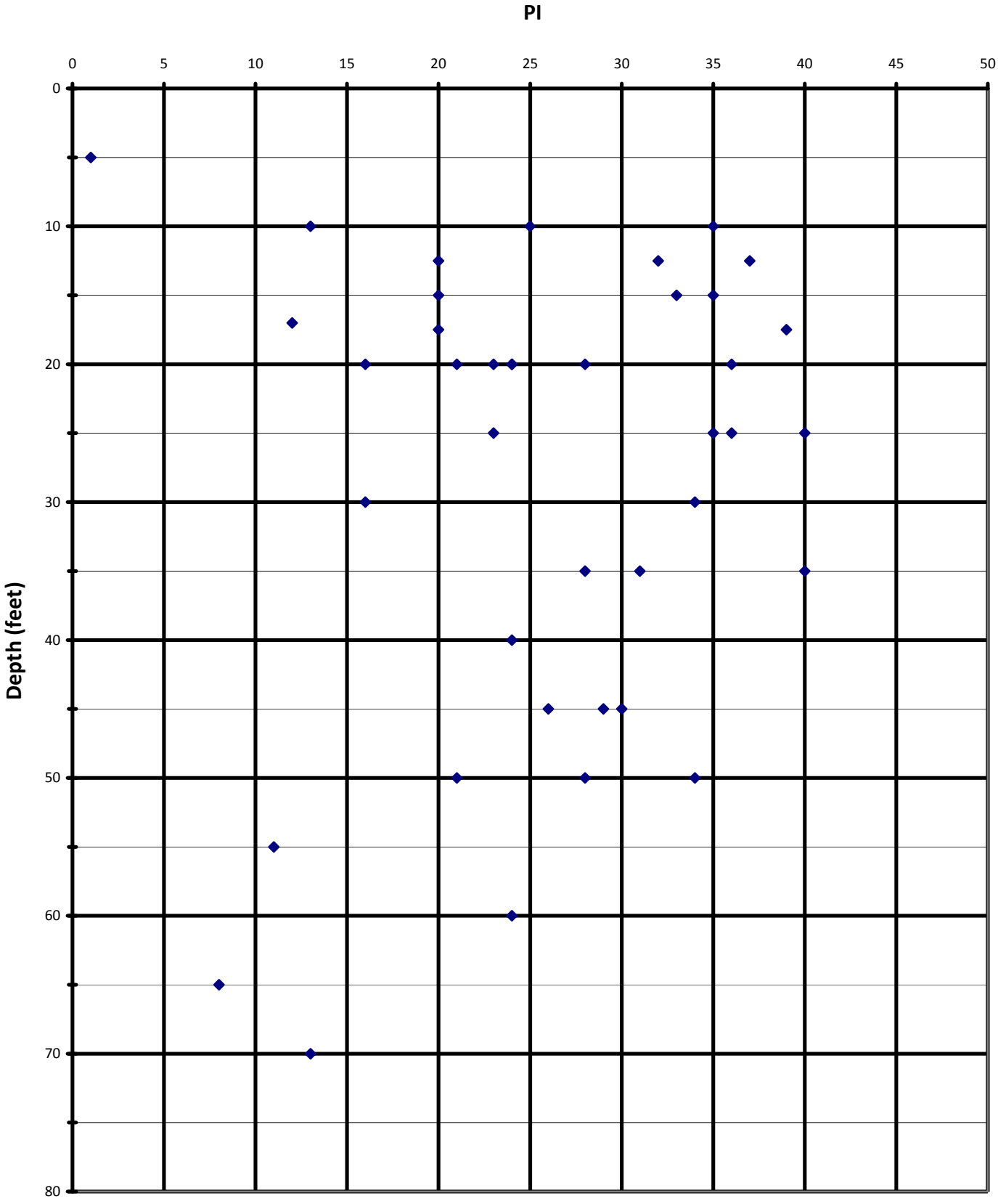
Variation of Liquid Limit with Depth



Area A
B1-861

PLATE B3-4

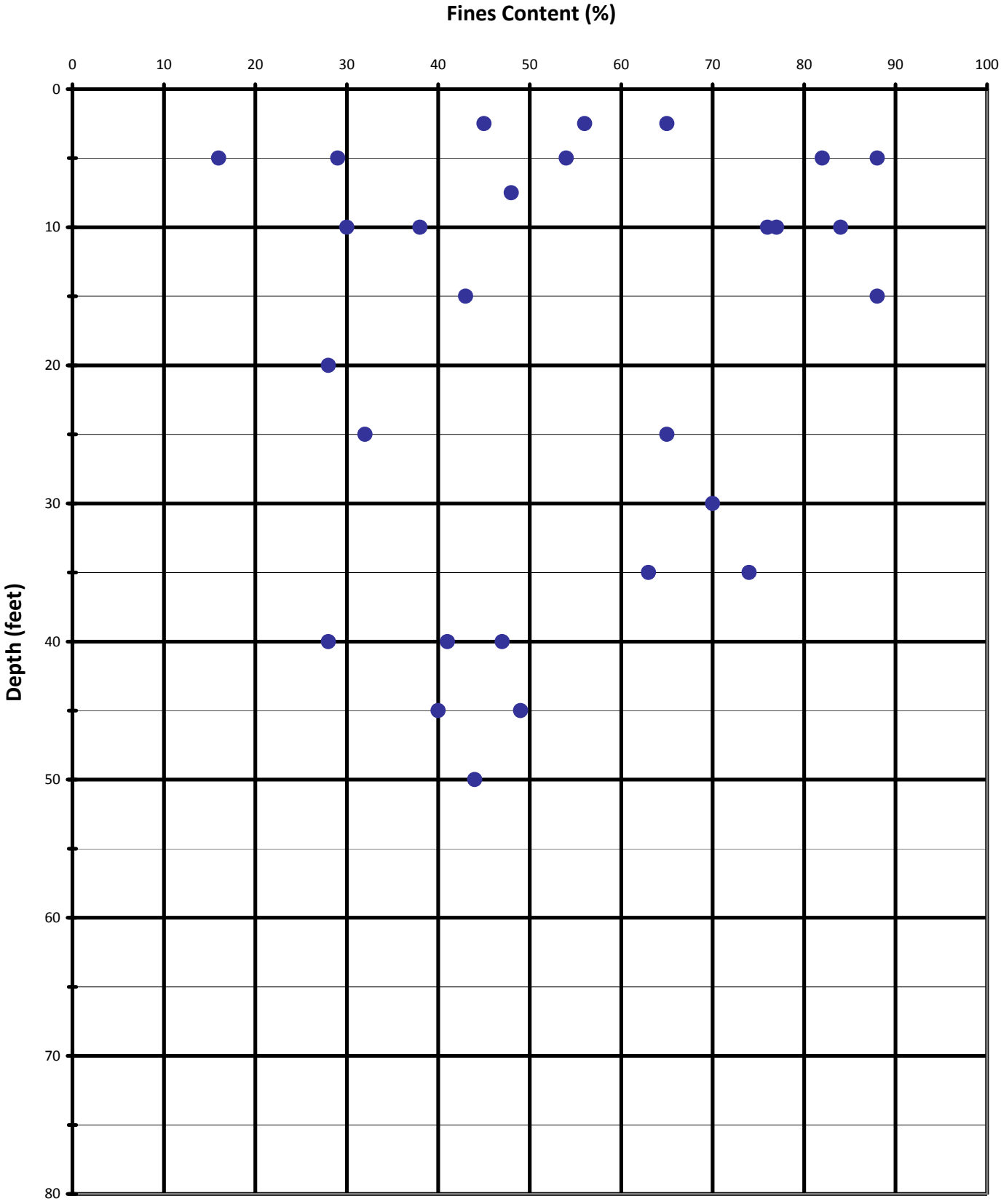
Variation of Plasticity Index with Depth



Area A
B1-862

PLATE B3-5

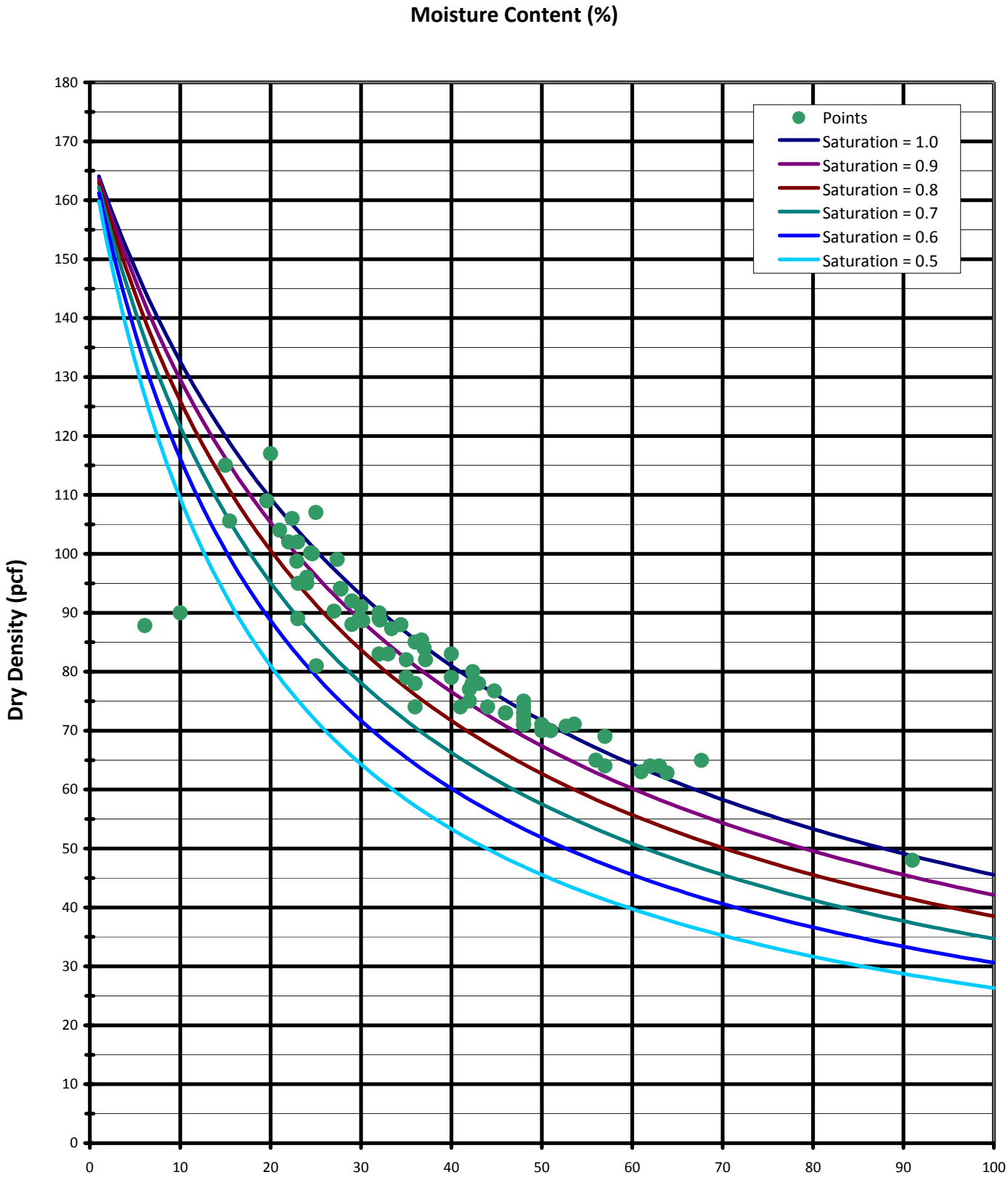
Variation of Fines Content with Depth



Area A
B1-863

PLATE B3-6

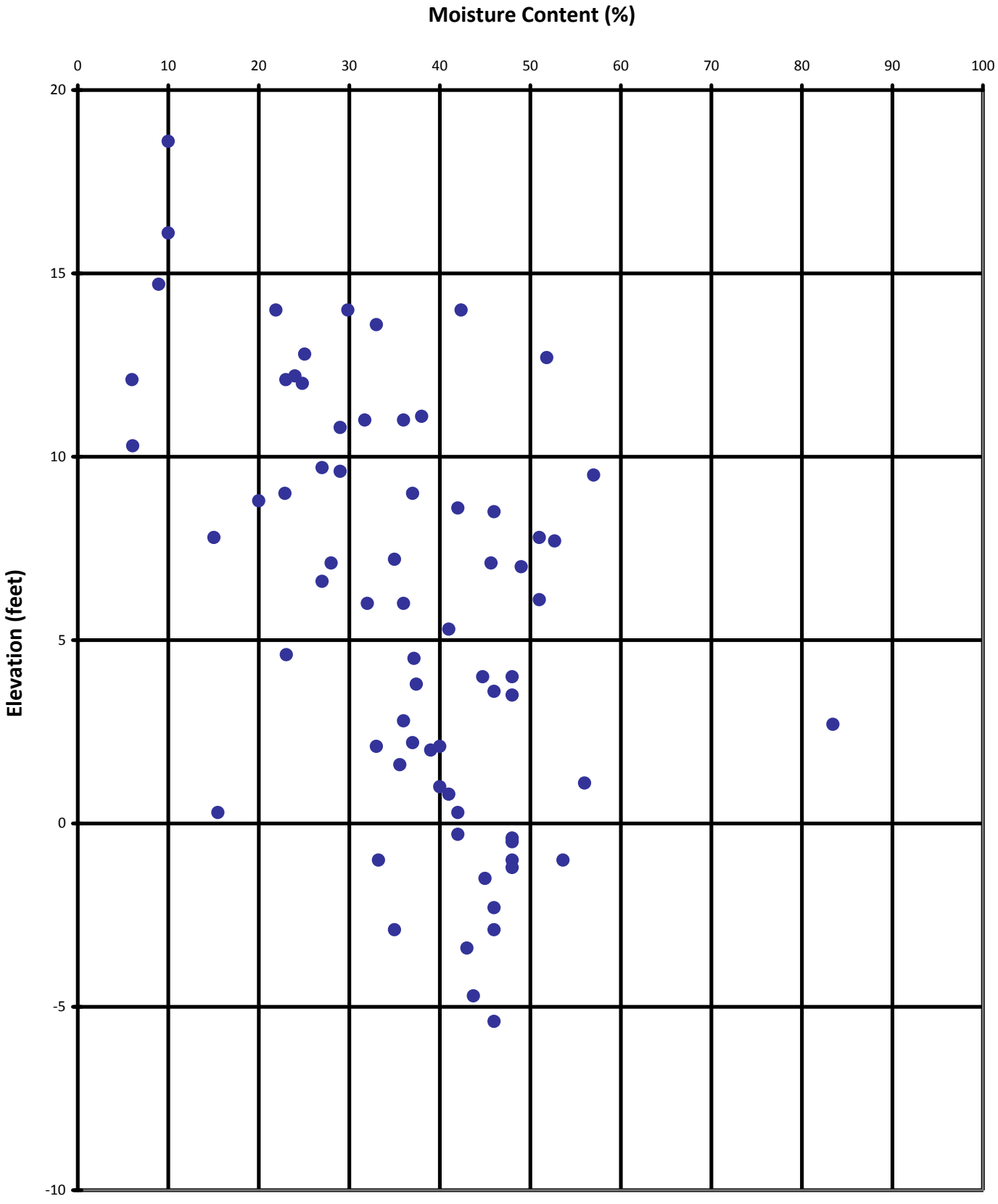
Moisture Content vs Dry Density



Area A
B1-864

PLATE B3-7

Variation of Moisture Content with Elevation

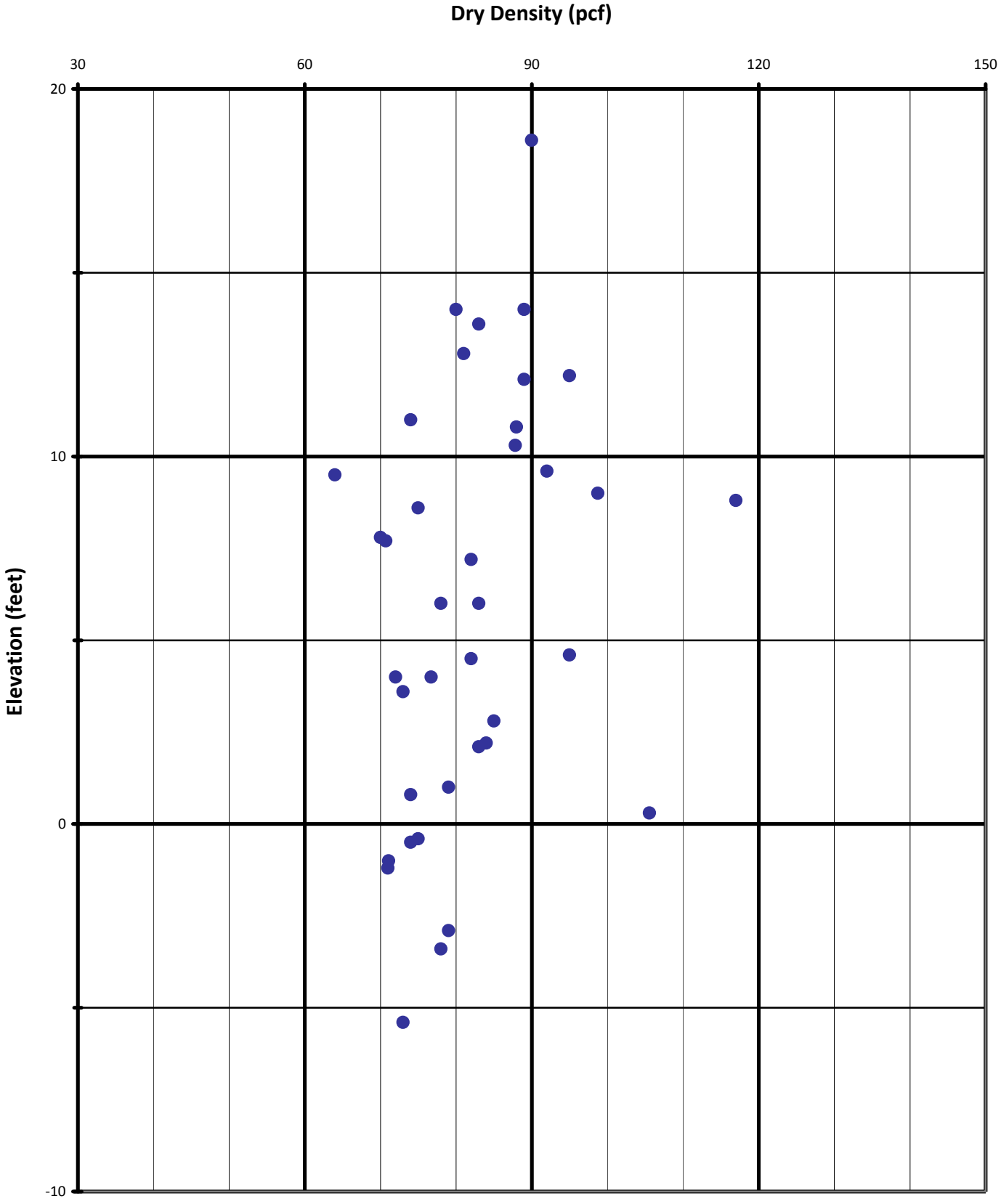


Fill Soils - Area A

B1-865

PLATE B3-8

Variation of Dry Density with Elevation

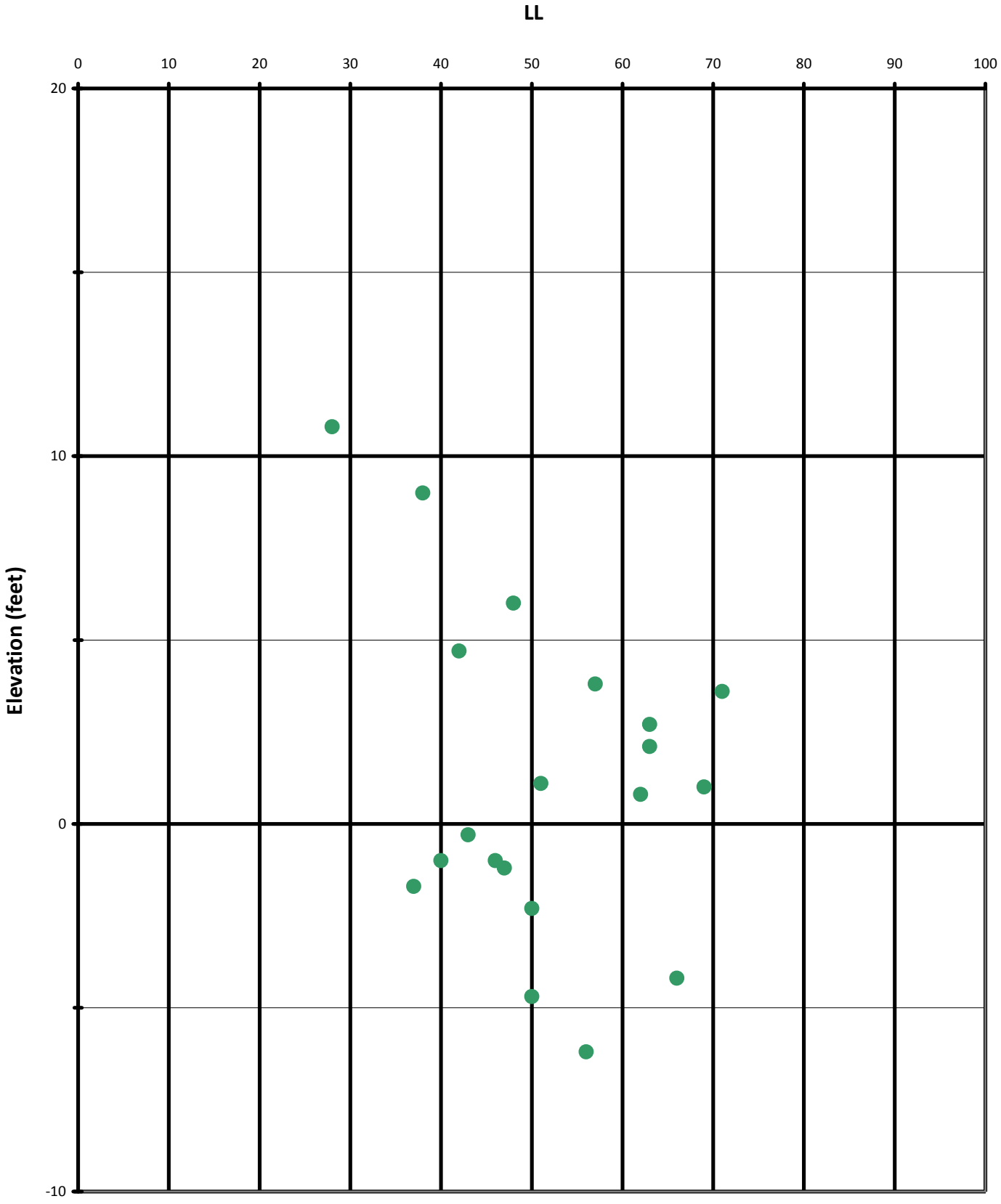


Fill Soils - Area A

B1-866

PLATE B3-9

Variation of Liquid Limit with Elevation

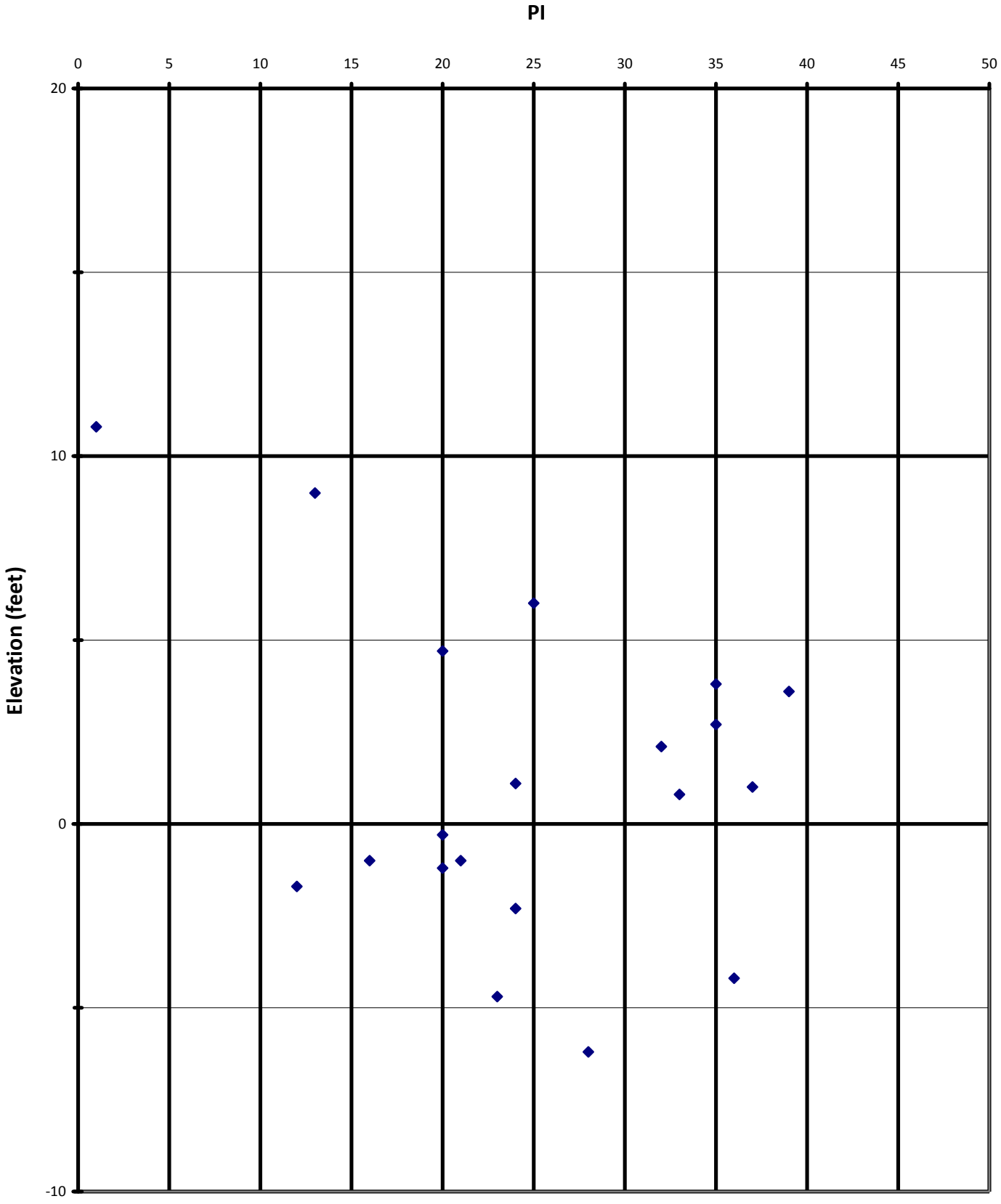


Fill Soils - Area A

B1-867

PLATE B3-10

Variation of Plasticity Index with Elevation

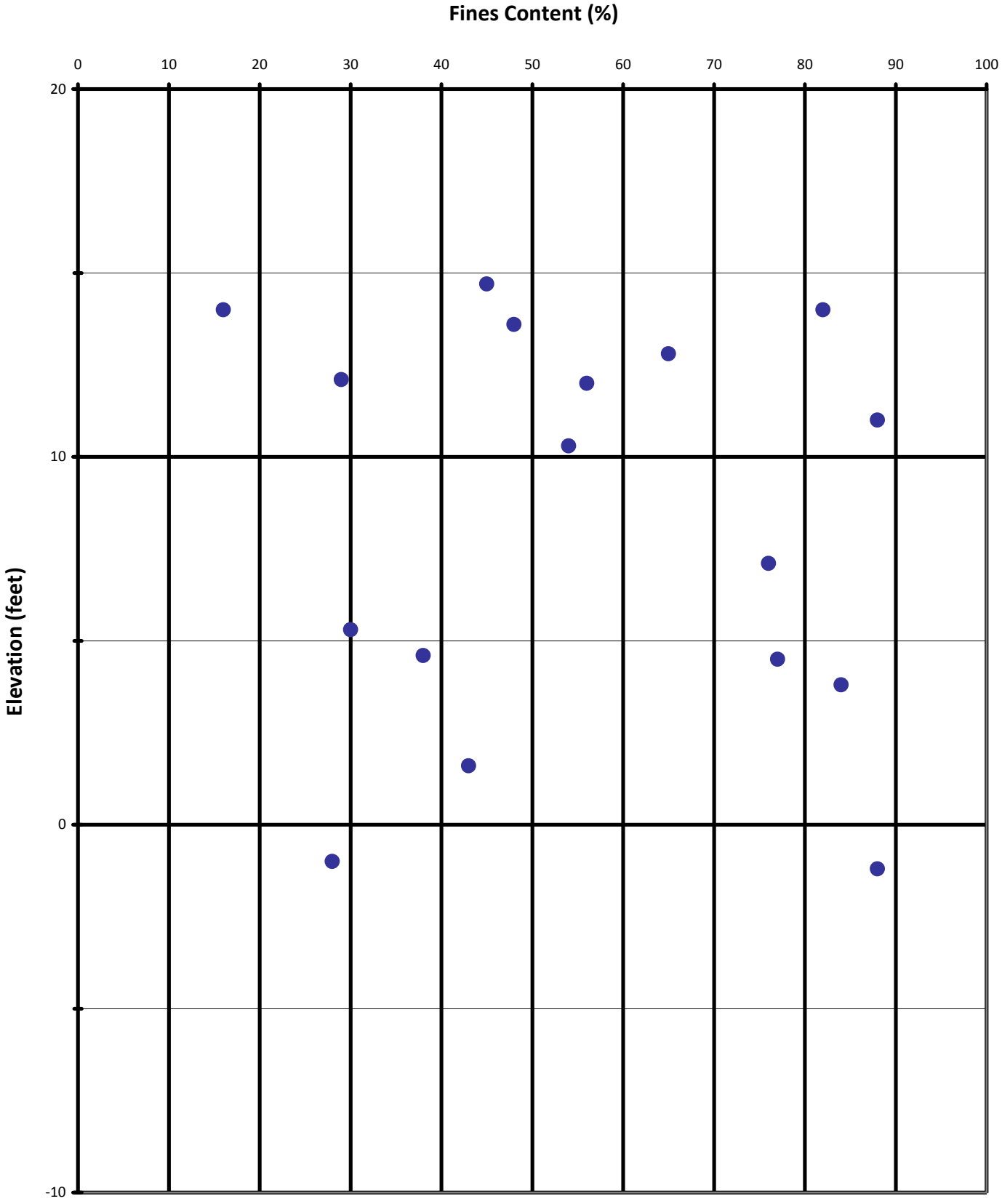


Fill Soils - Area A

B1-868

PLATE B3-11

Variation of Fines Content with Elevation

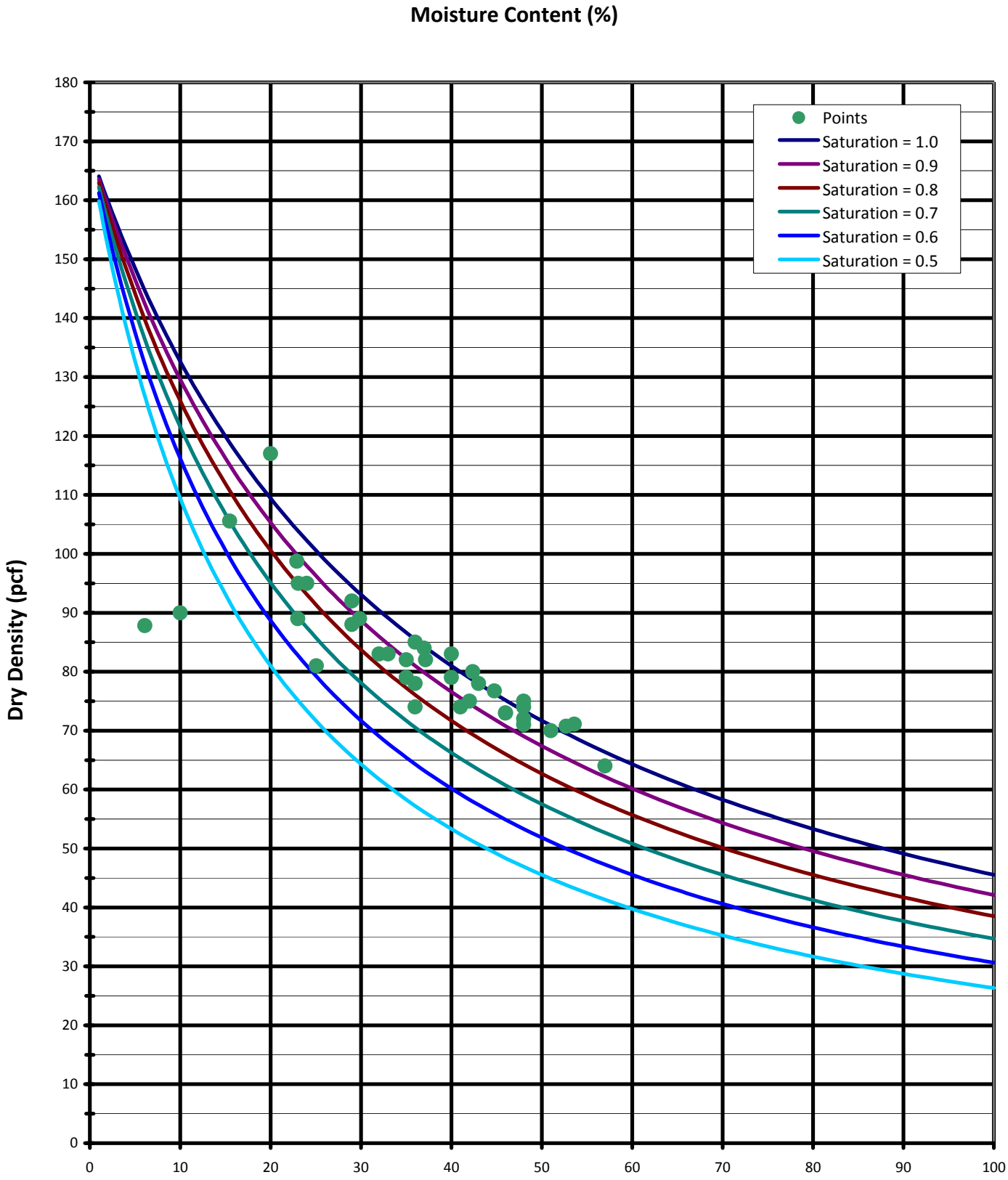


Fill Soils - Area A

B1-869

PLATE B3-12

Moisture Content vs Dry Density

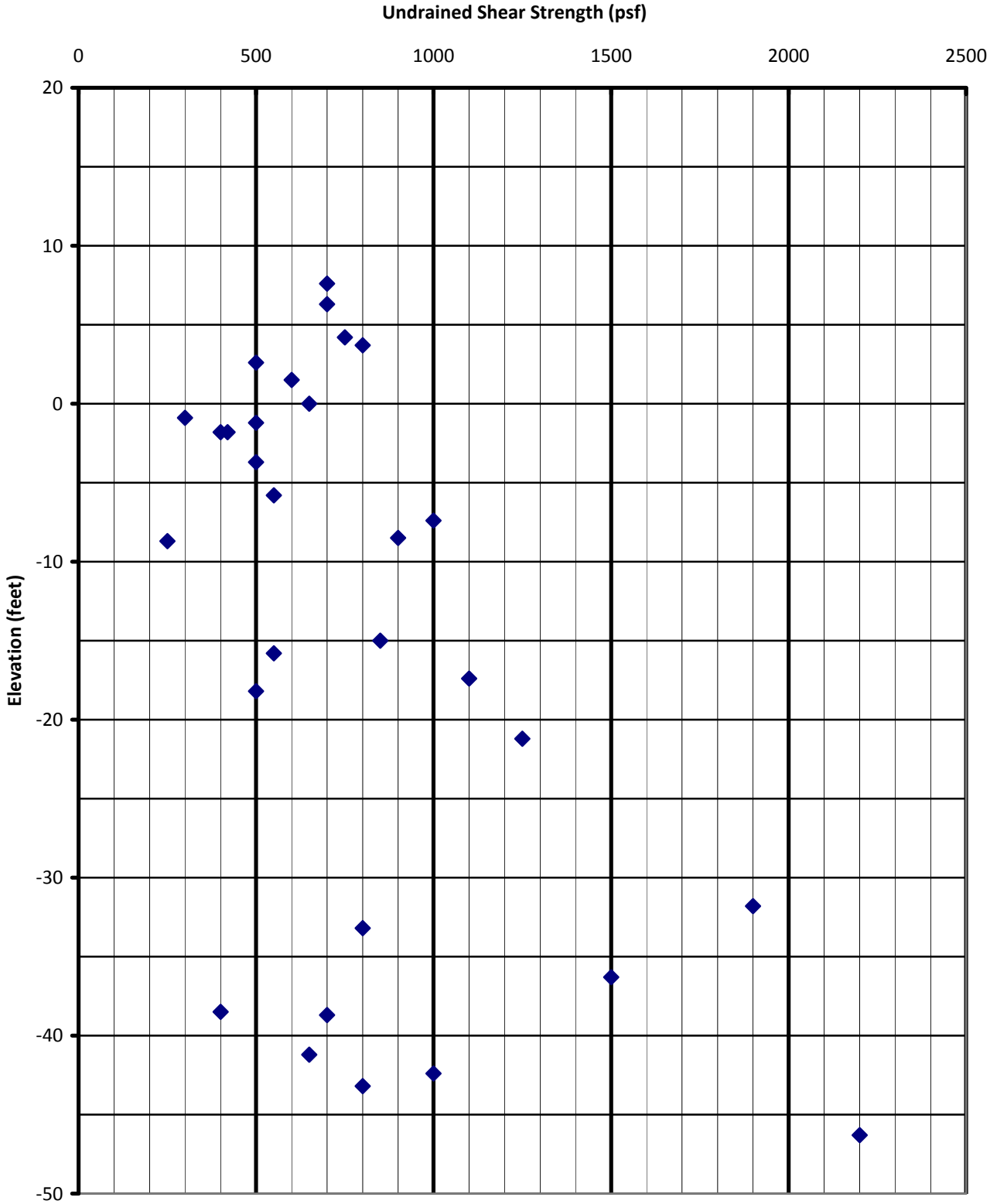


Fill Soils - Area A

B1-870

PLATE B3-13

Area B - Undrained Shear Strength

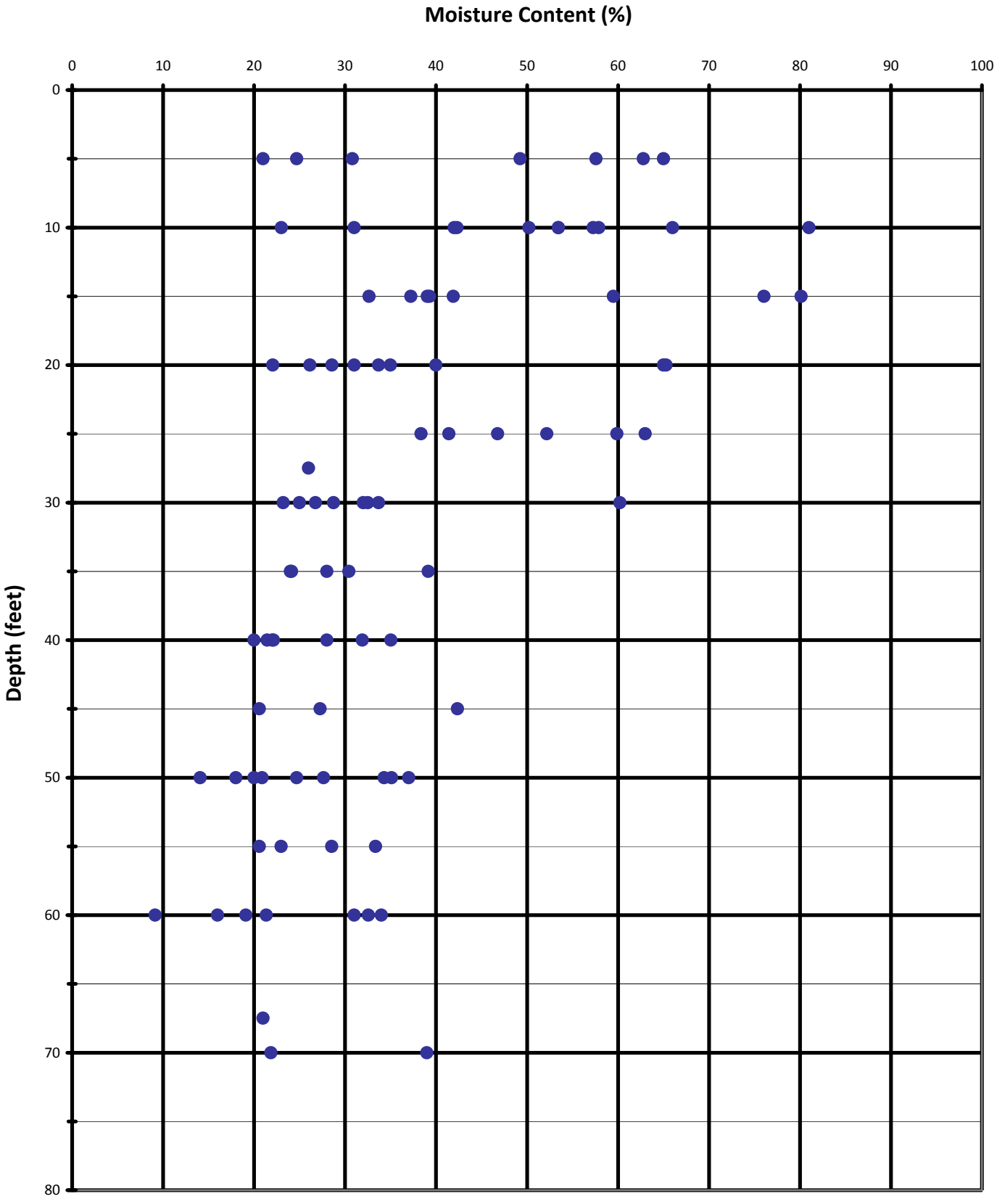


Laboratory Vane Shear - Area B

B1-871

PLATE B3-14

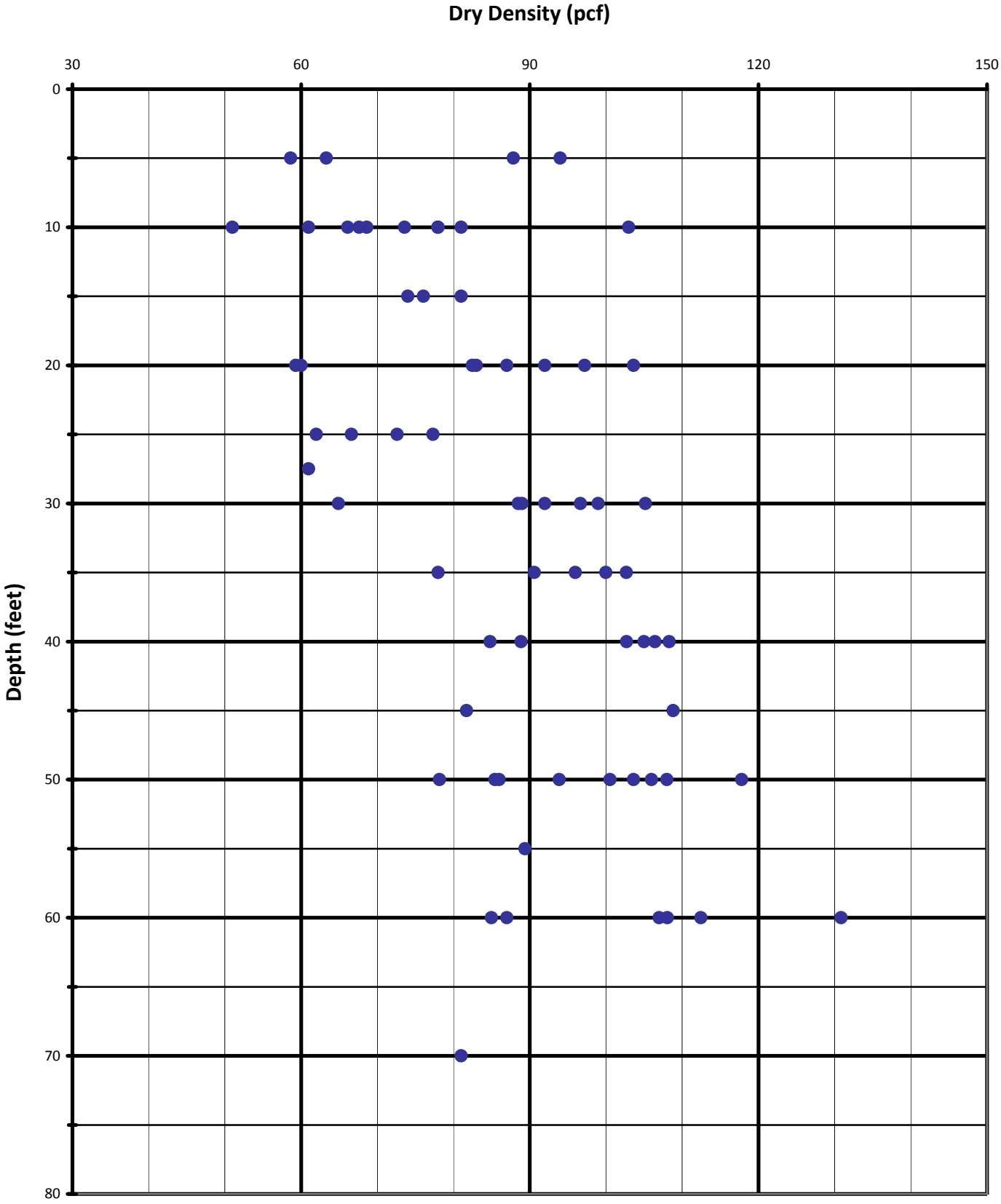
Variation of Moisture Content with Depth



Area B
B1-872

PLATE B3-15

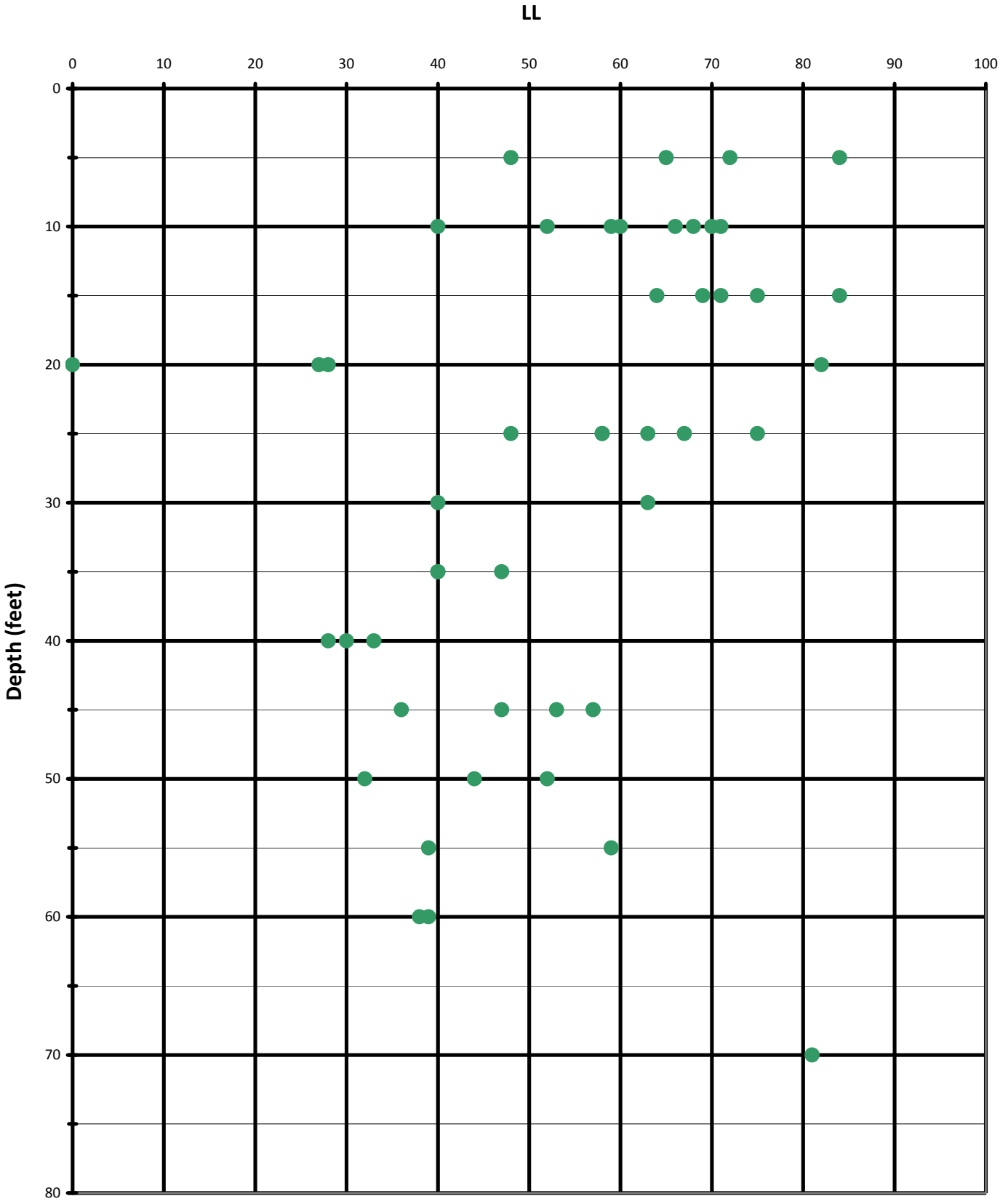
Variation of Dry Density with Depth



Area B
B1-873

PLATE B3-16

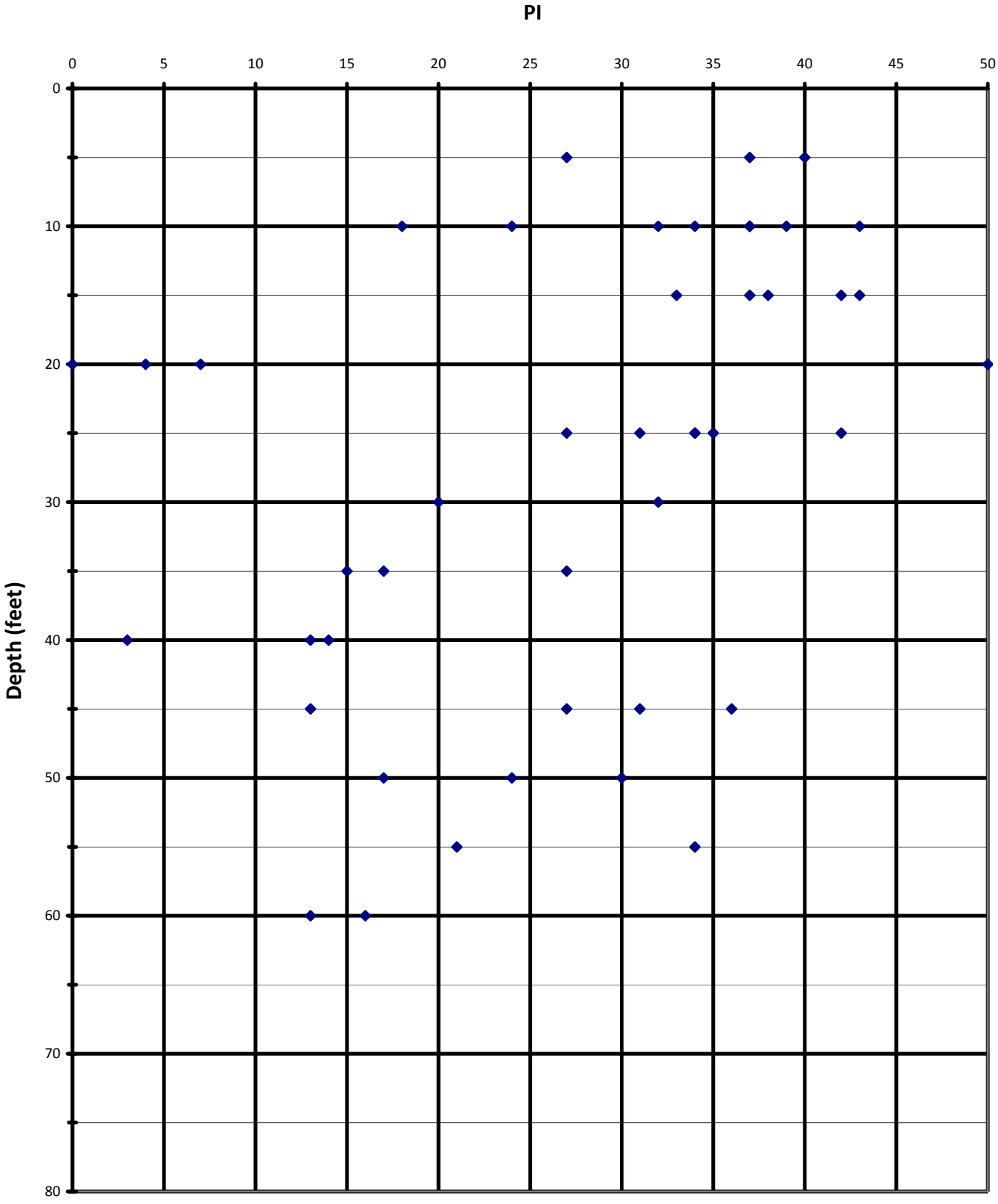
Variation of Liquid Limit with Depth



Area B
B1-874

PLATE B3-17

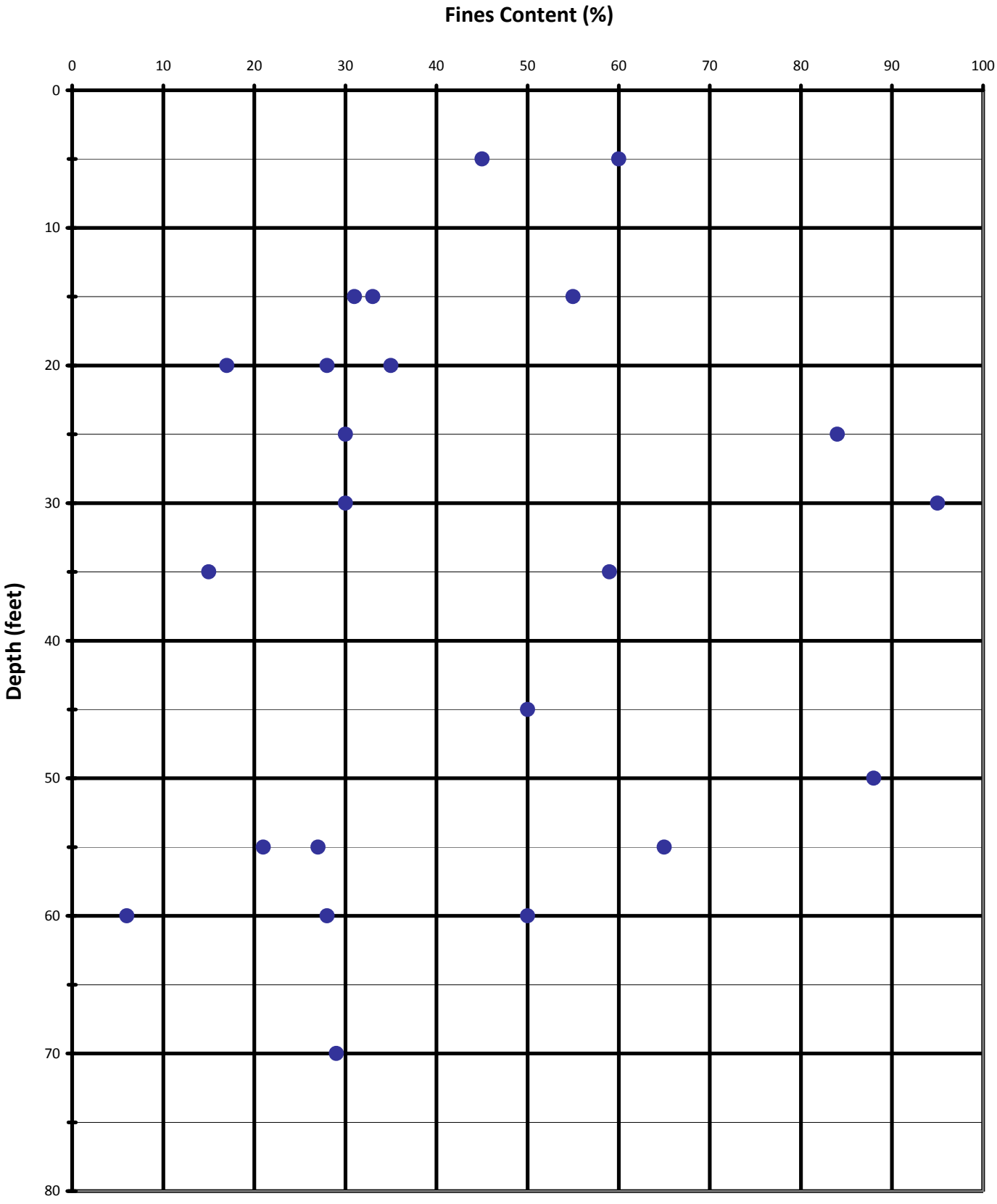
Variation of Plasticity Index with Depth



Area B
B1-875

PLATE B3-18

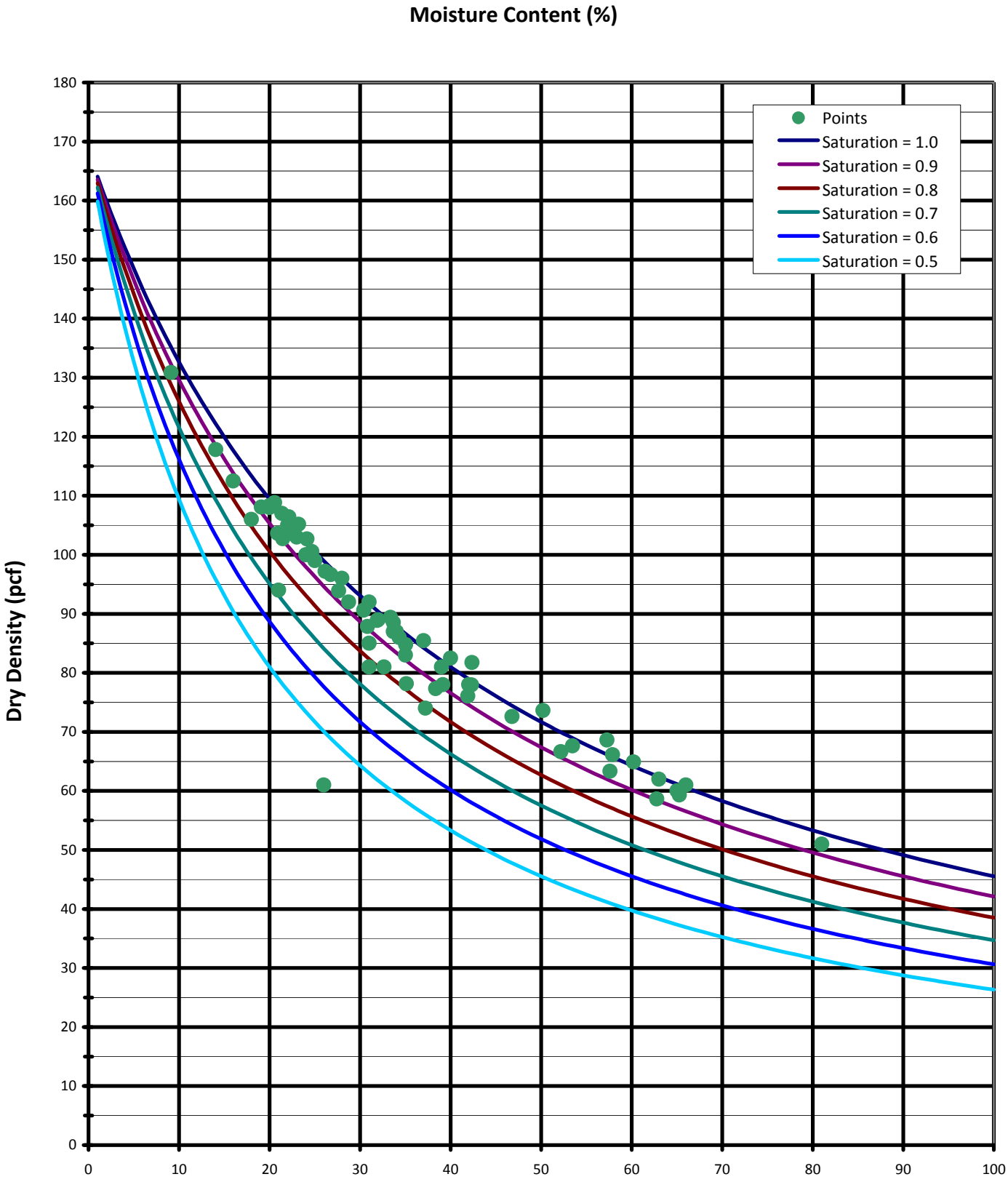
Variation of Fines Content with Depth



Area B
B1-876

PLATE B3-19

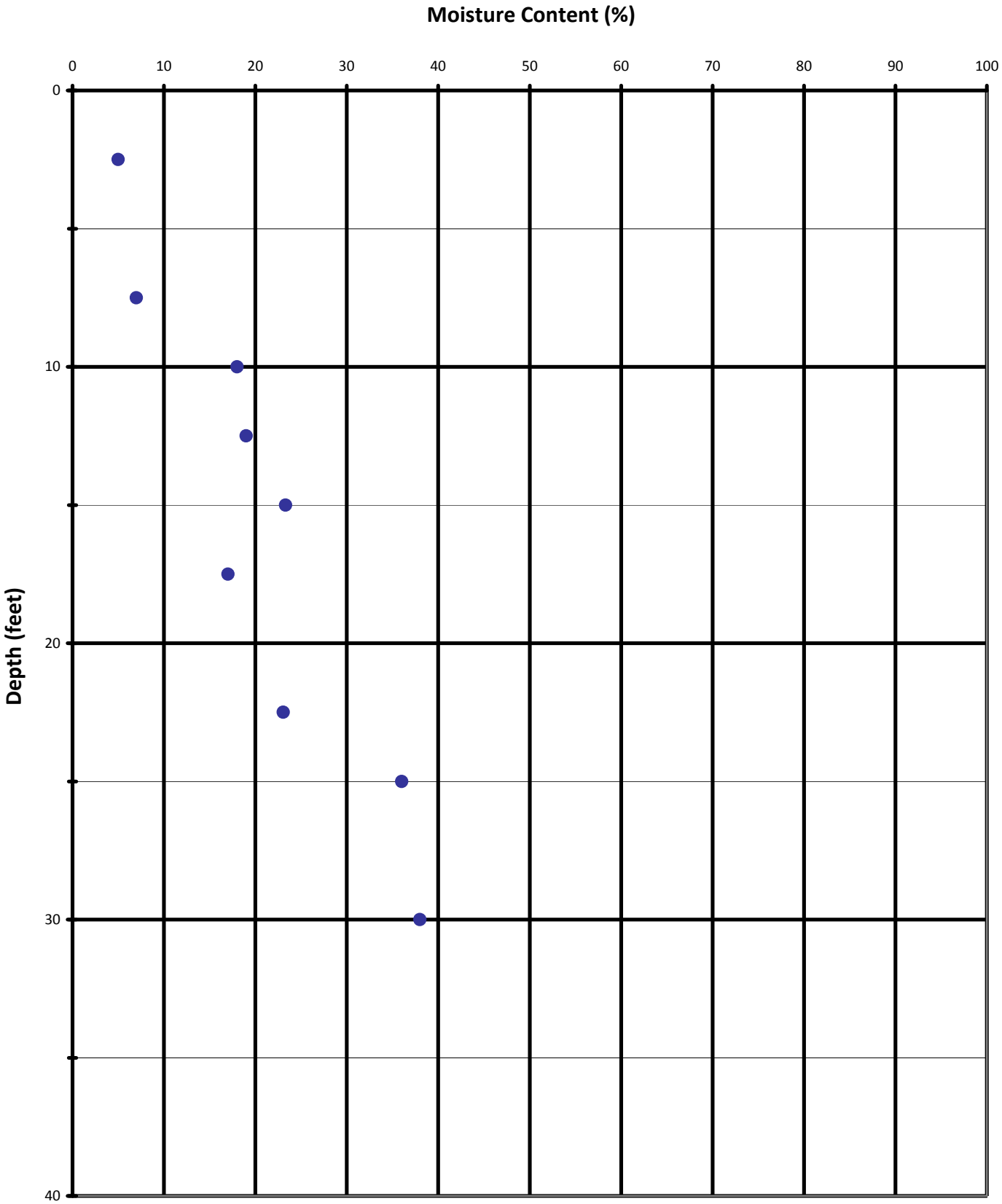
Moisture Content vs Dry Density



Area B
B1-877

PLATE B3-20

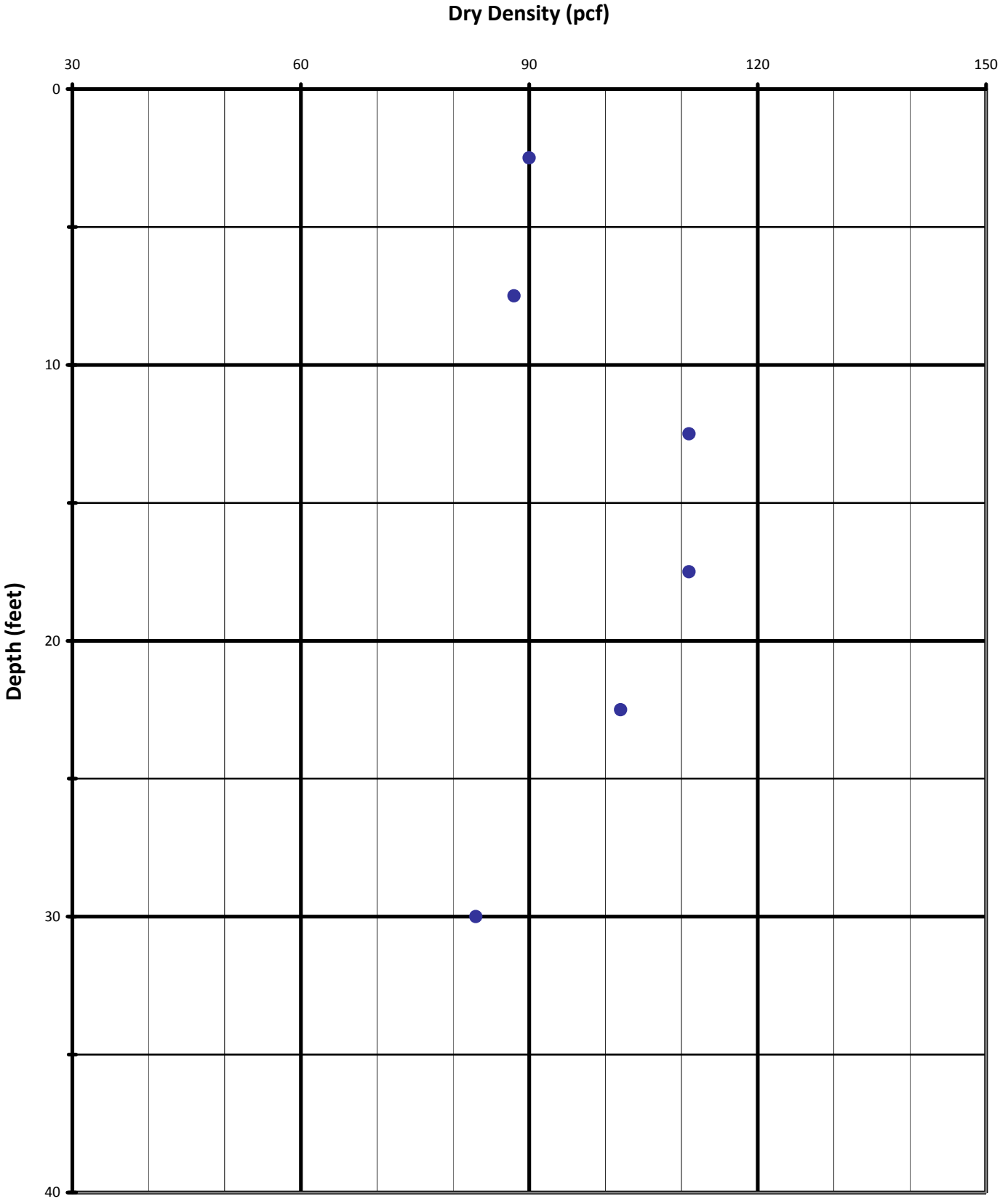
Variation of Moisture Content with Depth



Area C
B1-878

PLATE B3-21

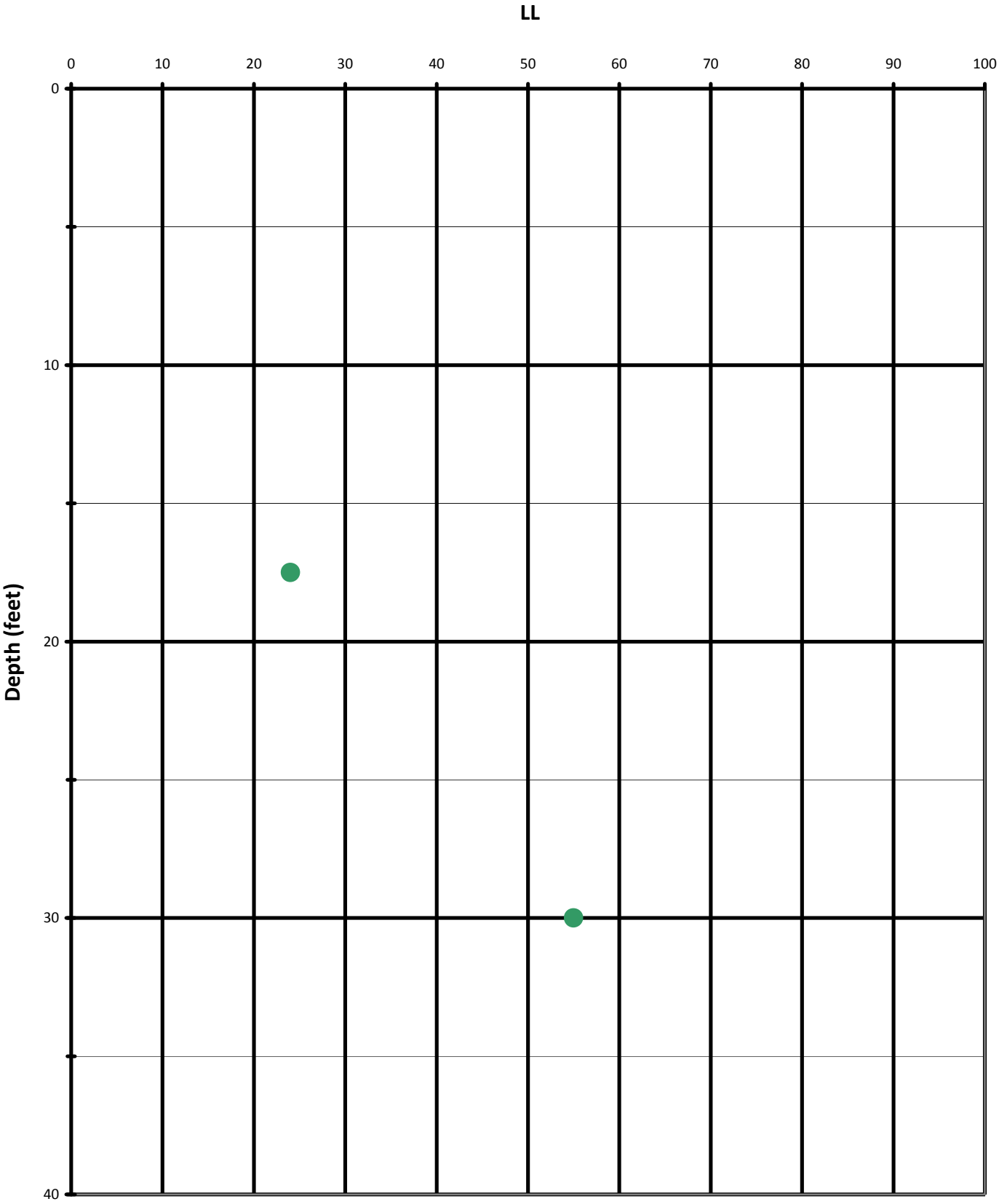
Variation of Dry Density with Depth



Area C
B1-879

PLATE B3-22

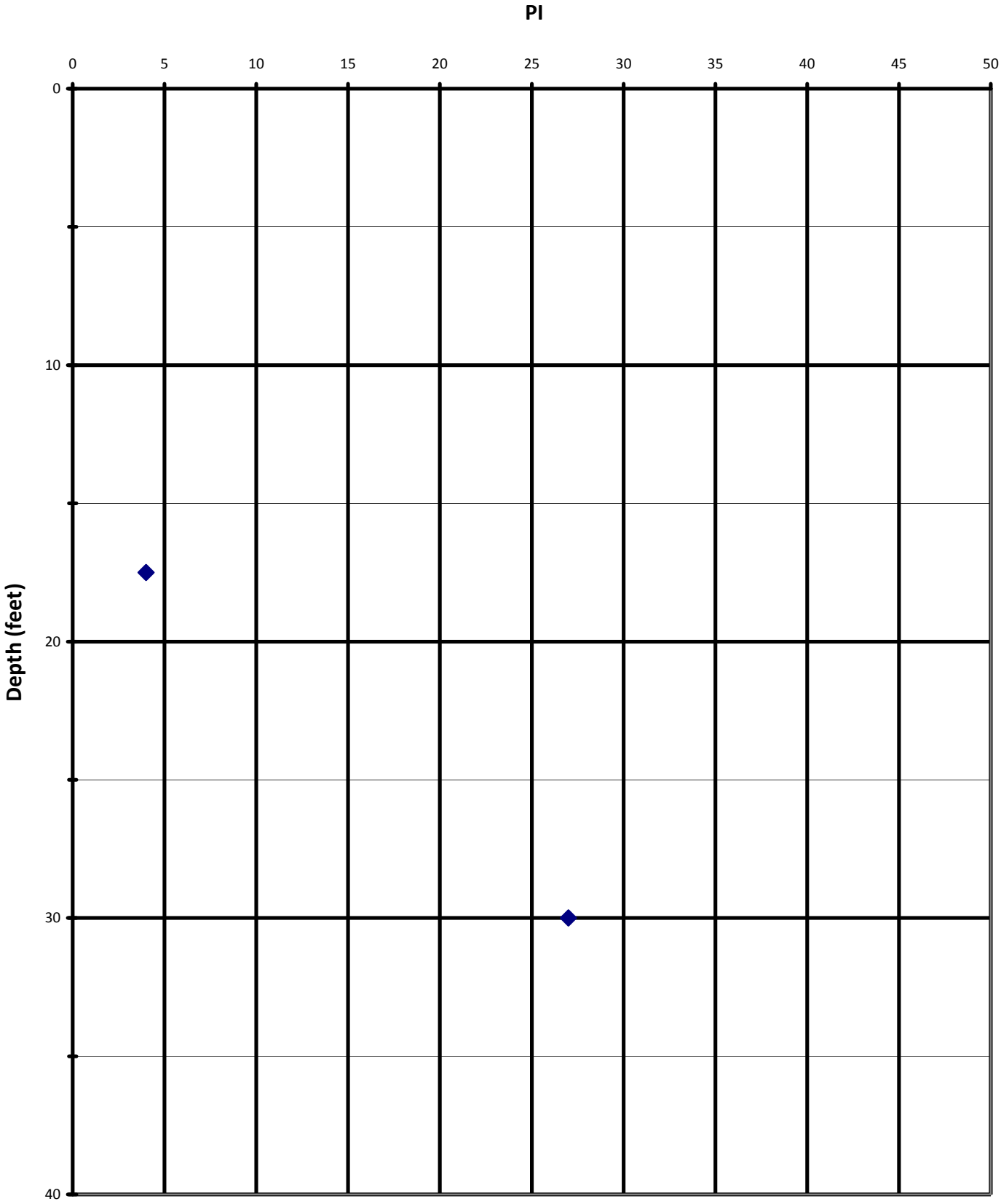
Variation of Liquid Limit with Depth



Area C
B1-880

PLATE B3-23

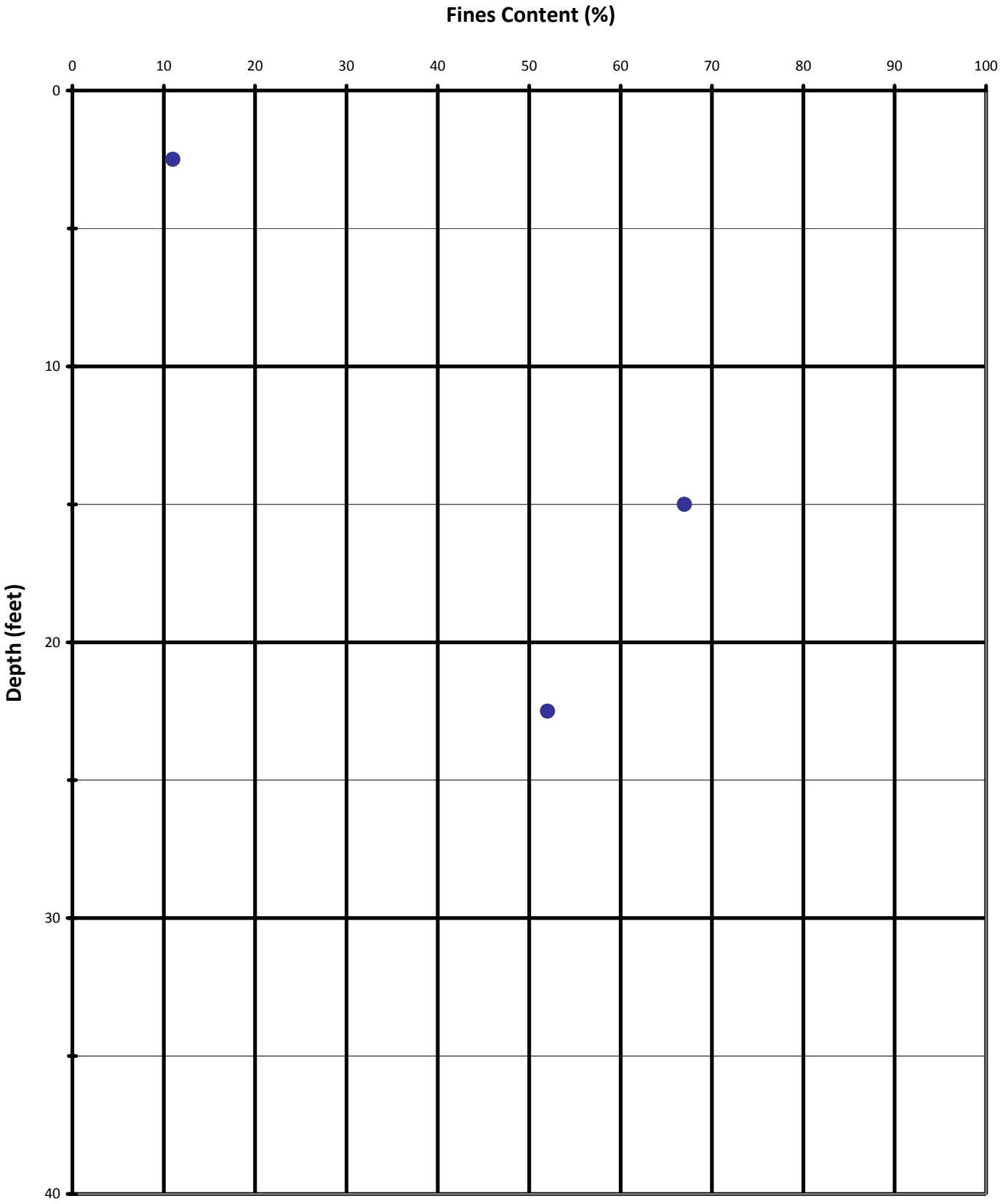
Variation of Plasticity Index with Depth



Area C
B1-881

PLATE B3-24

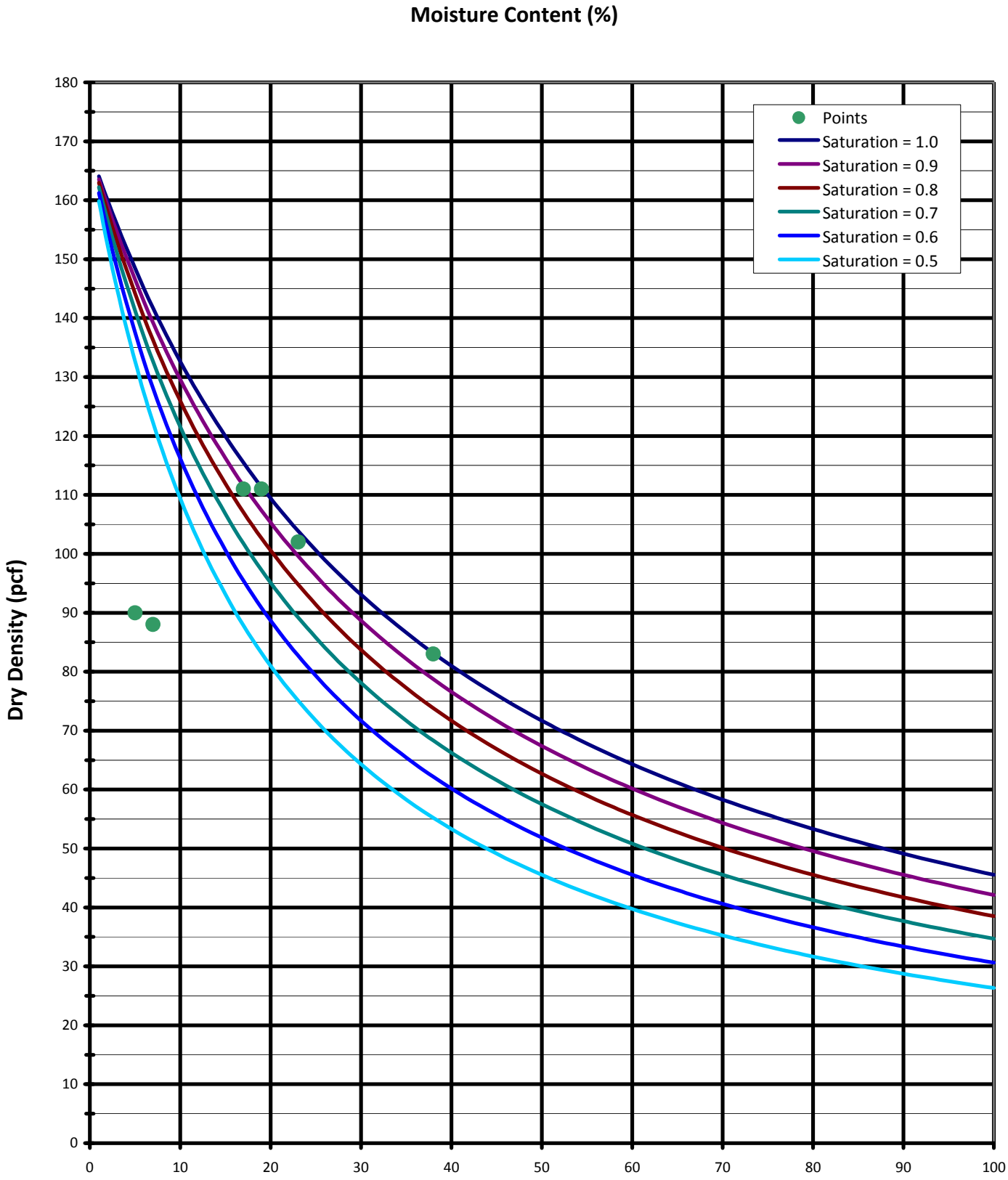
Variation of Fines Content with Depth



Area C
B1-882

PLATE B3-25

Moisture Content vs Dry Density



Area C
B1-883

PLATE B3-26

APPENDIX B4
LABORATORY TESTING INTERPRETATIONS OF INVESTIGATIONS BY OTHERS

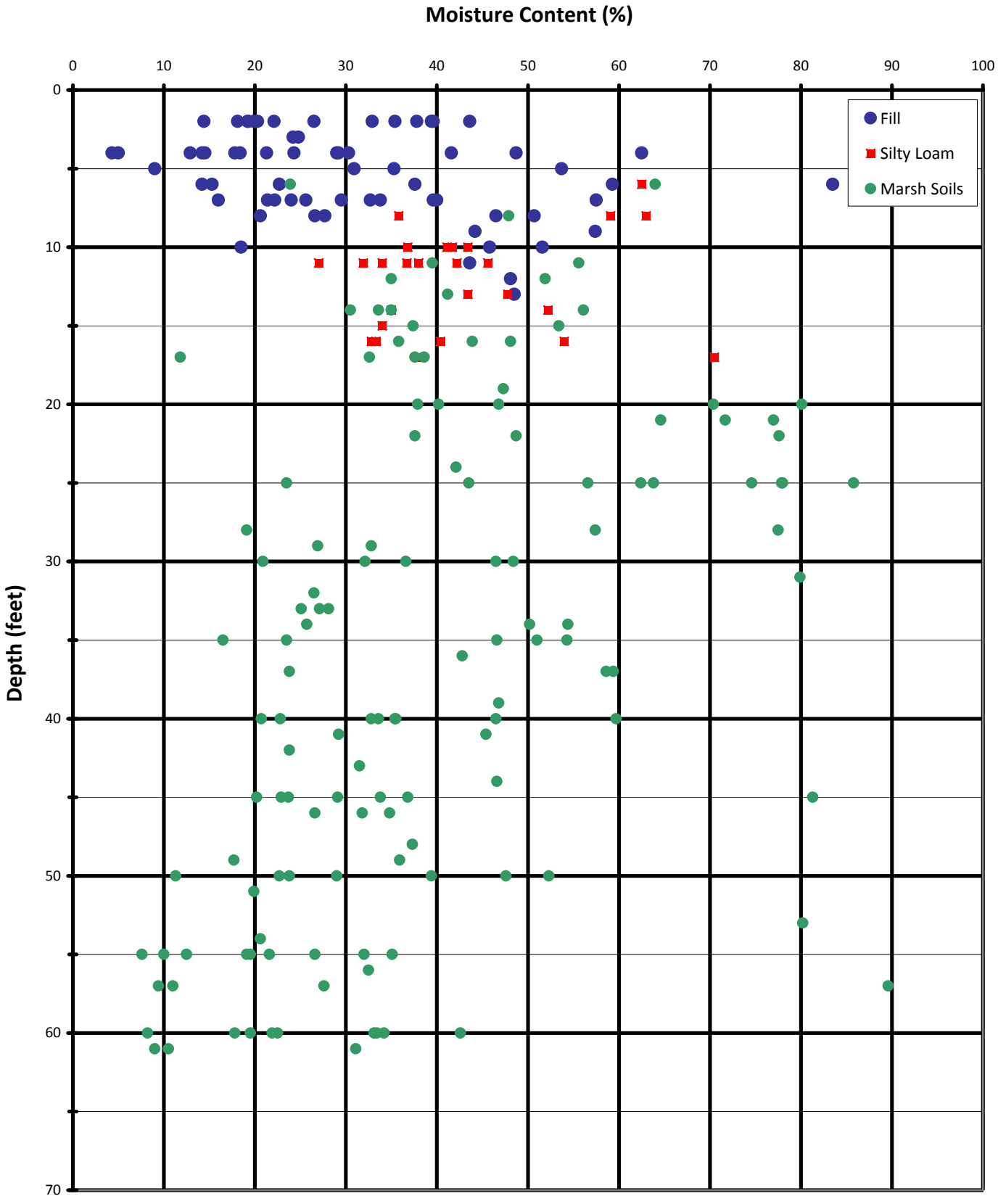
APPENDIX B4
LABORATORY TESTING INTERPRETATIONS

B4.1 General

The following interpretation plots were generated based on the results of laboratory testing data by other investigators, in Areas A, B, and C:

Plate B4-1	Variation of Moisture Content with Depth – Area A
Plate B4-2	Variation of Dry Density with Depth – Area A
Plate B4-3	Variation of Liquid Limit with Depth – Area A
Plate B4-4	Variation of Plastic Limit with Depth – Area A
Plate B4-5	Variation of Fines Content with Depth – Area A
Plate B4-6	Plot of Moisture Content vs. Dry Density – Area A
Plate B4-7	Variation of Moisture Content with Depth – Area B
Plate B4-8	Variation of Dry Density with Depth – Area B
Plate B4-9	Variation of Liquid Limit with Depth – Area B
Plate B4-10	Variation of Plastic Limit with Depth – Area B
Plate B4-11	Variation of Fines Content with Depth – Area B
Plate B4-12	Plot of Moisture Content vs. Dry Density – Area B
Plate B4-13	Variation of Moisture Content with Depth – Area C
Plate B4-14	Variation of Dry Density with Depth – Area C
Plate B4-15	Variation of Liquid Limit with Depth – Area C
Plate B4-16	Variation of Plastic Limit with Depth – Area C
Plate B4-17	Variation of Fines Content with Depth – Area C
Plate B4-18	Plot of Moisture Content vs. Dry Density – Area C

Variation of Moisture Content with Depth

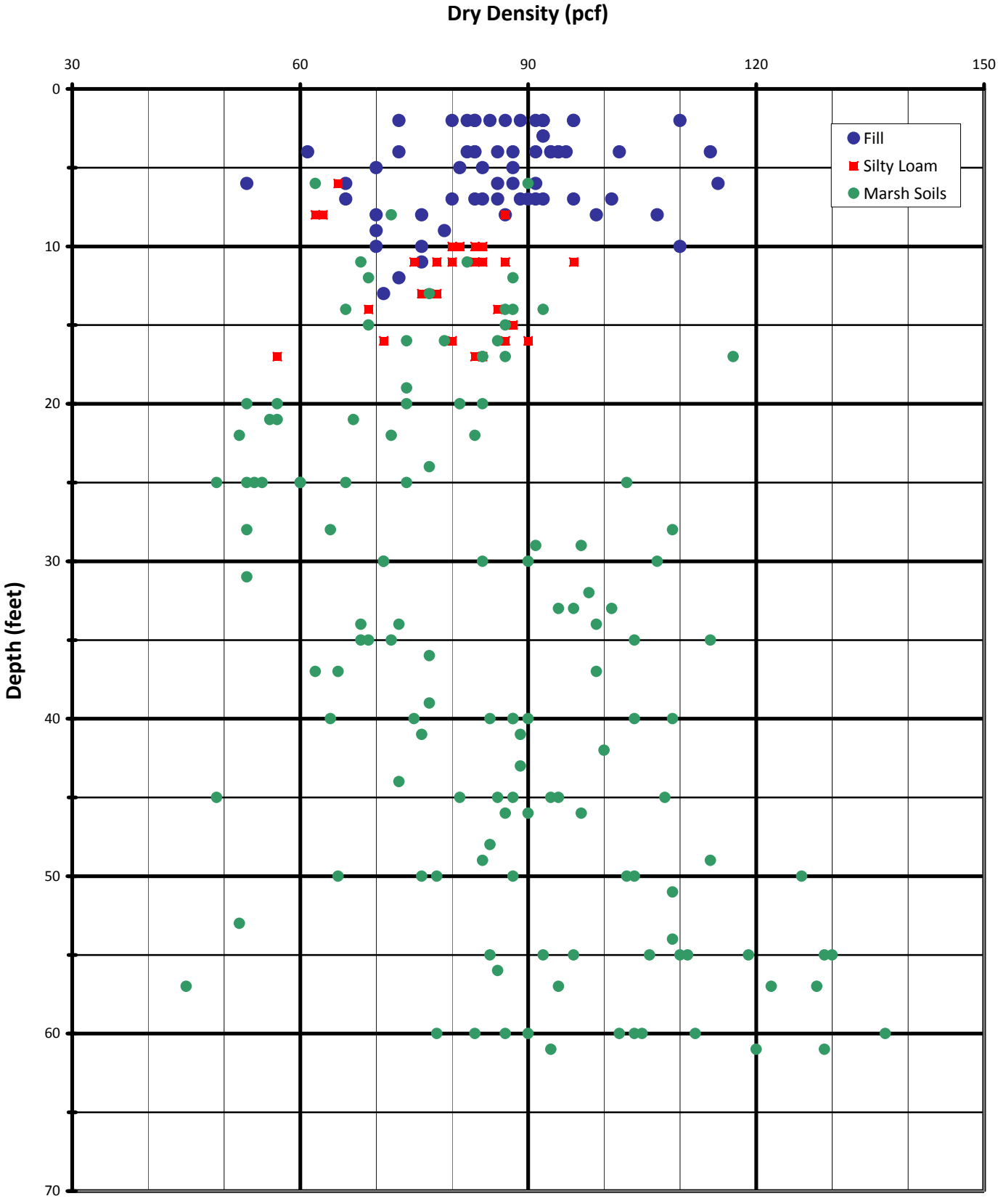


Area A

B1-886

PLATE B4-1

Variation of Dry Density with Depth

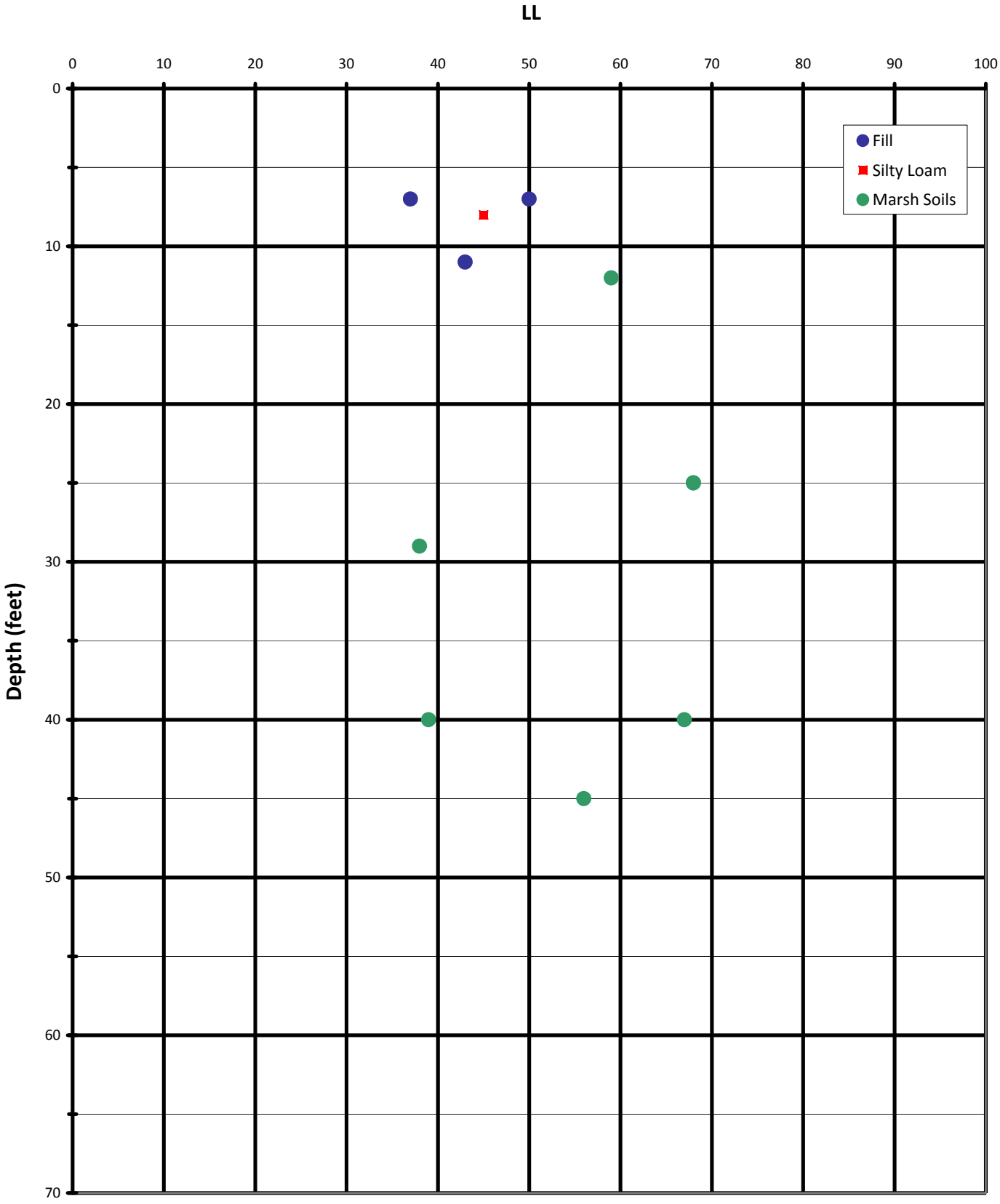


Area A

B1-887

PLATE B4-2

Variation of Liquid Limit with Depth

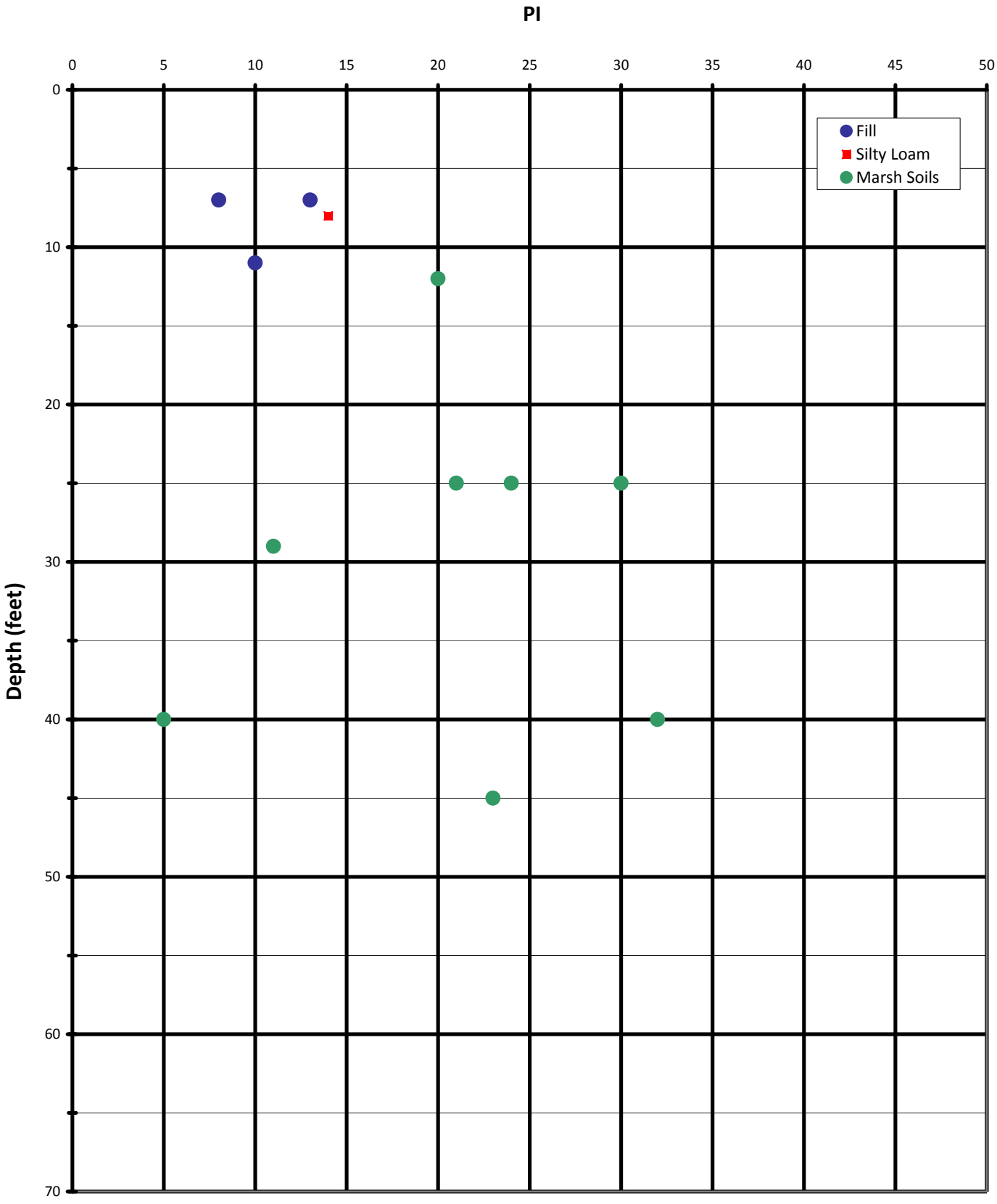


Area A

B1-888

PLATE B4-3

Variation of Plasticity Index with Depth

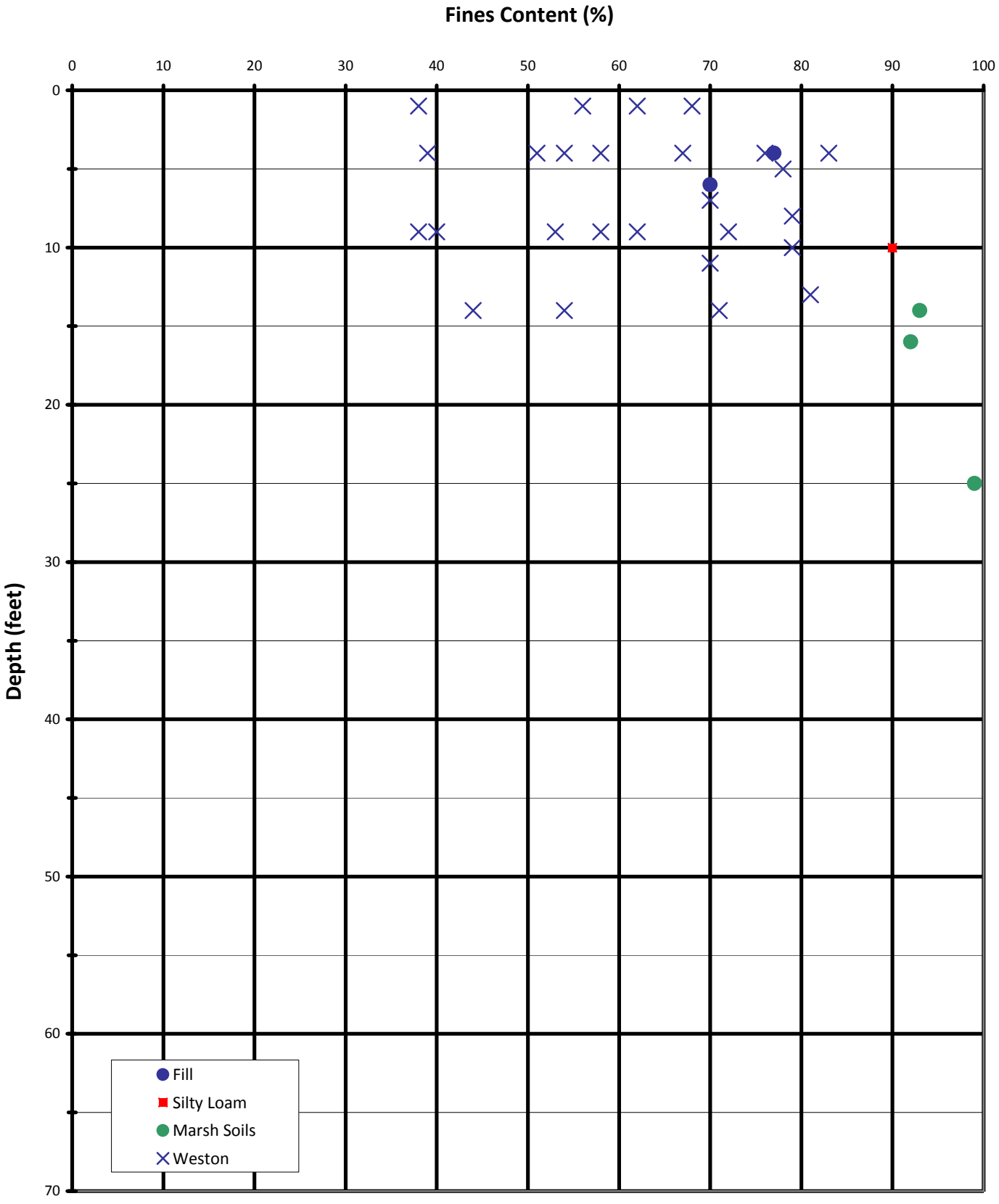


Area A

B1-889

PLATE B4-4

Variation of Fines Content with Depth

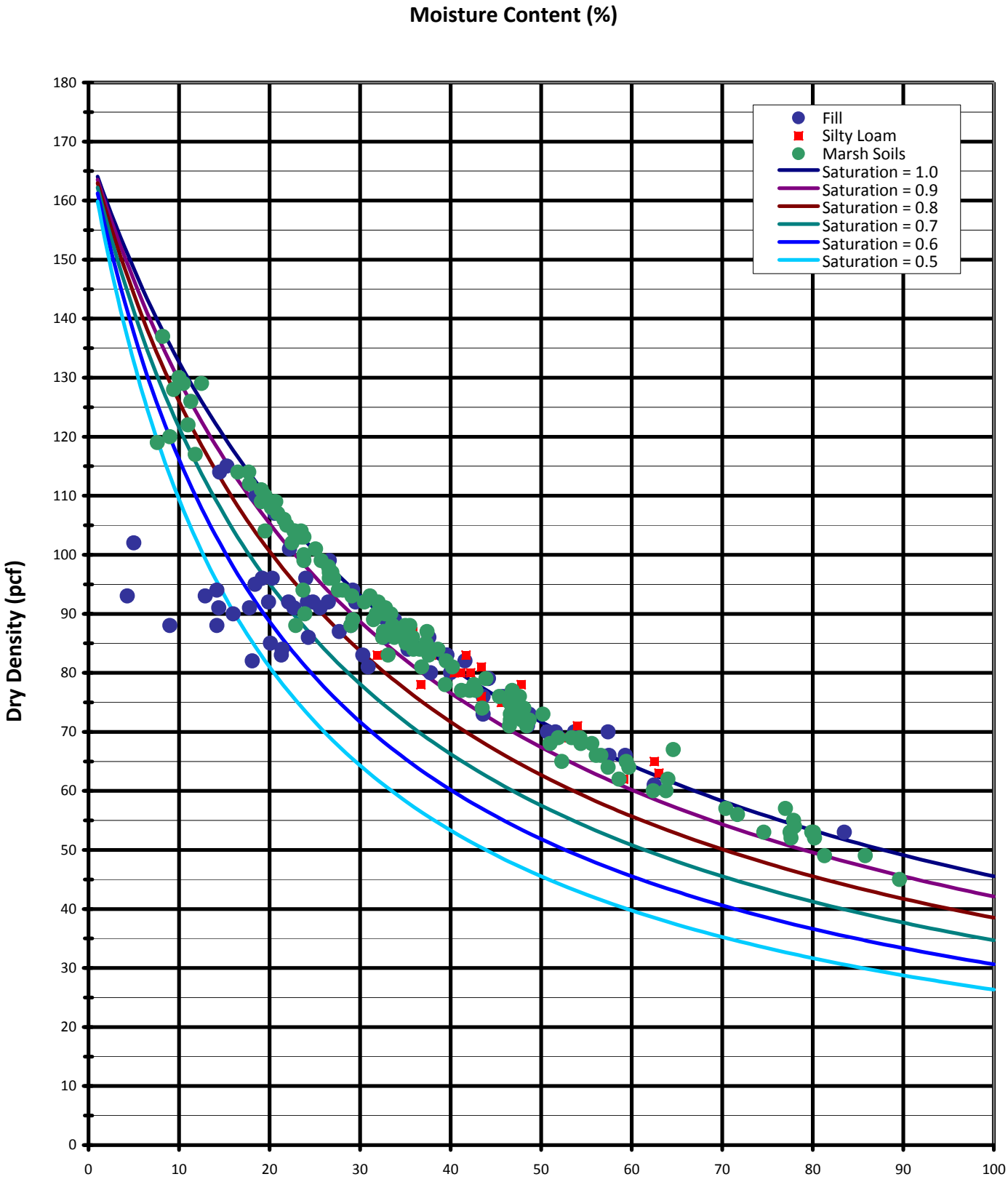


Area A

B1-890

PLATE B4-5

Moisture Content vs Dry Density

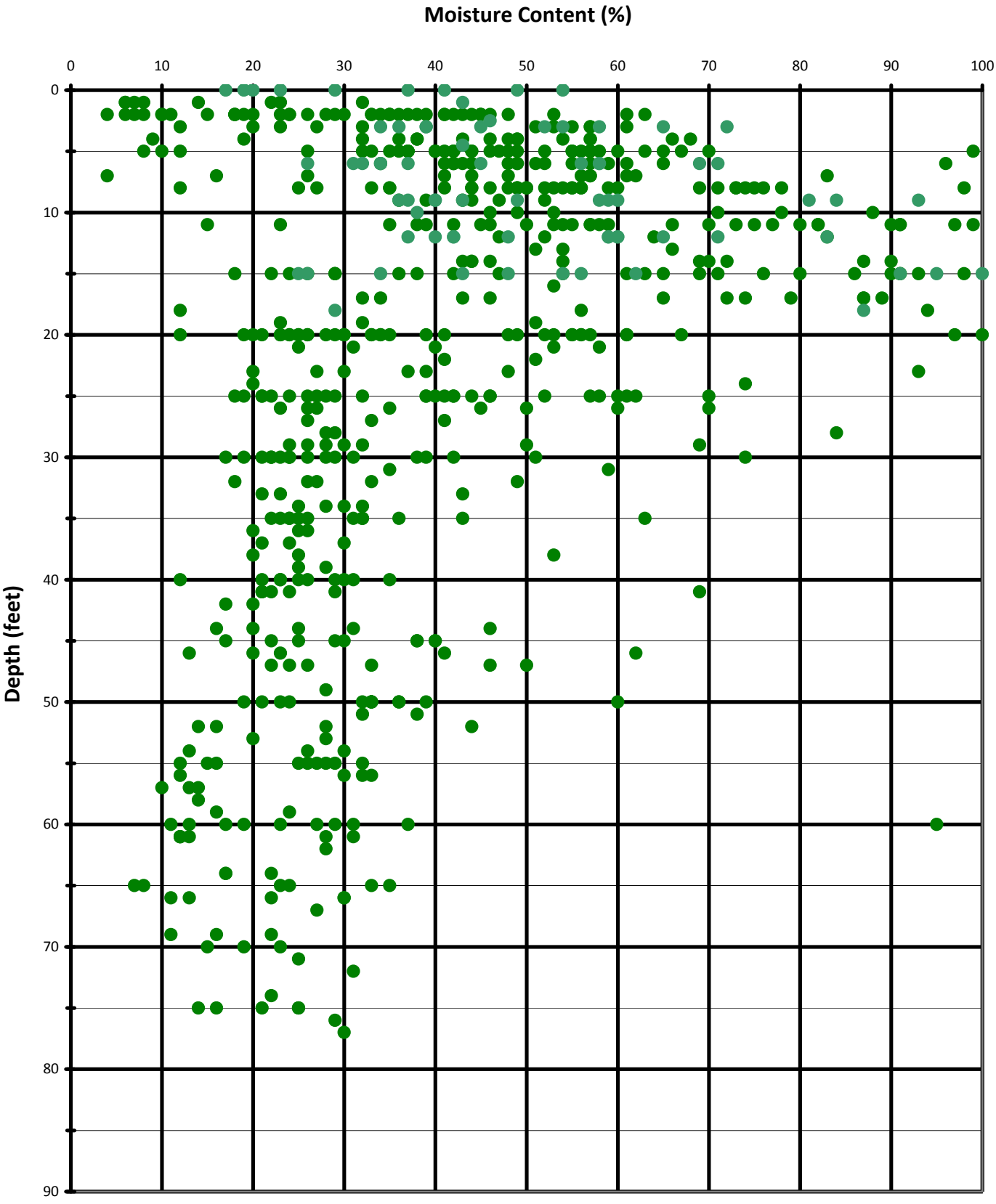


Area A

B1-891

PLATE B4-6

Variation of Moisture Content with Depth

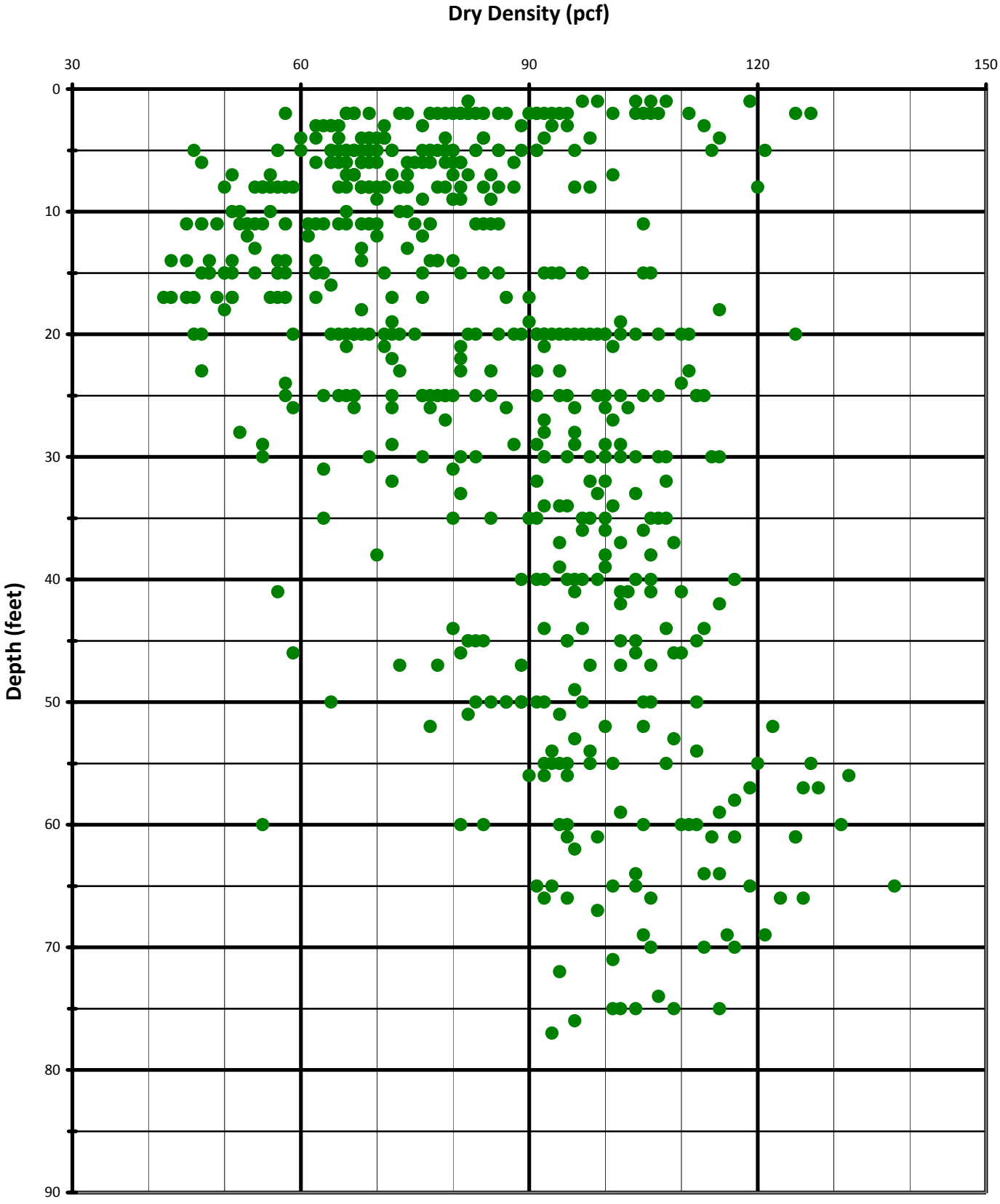


Area B

B1-892

PLATE B4-7

Variation of Dry Density with Depth

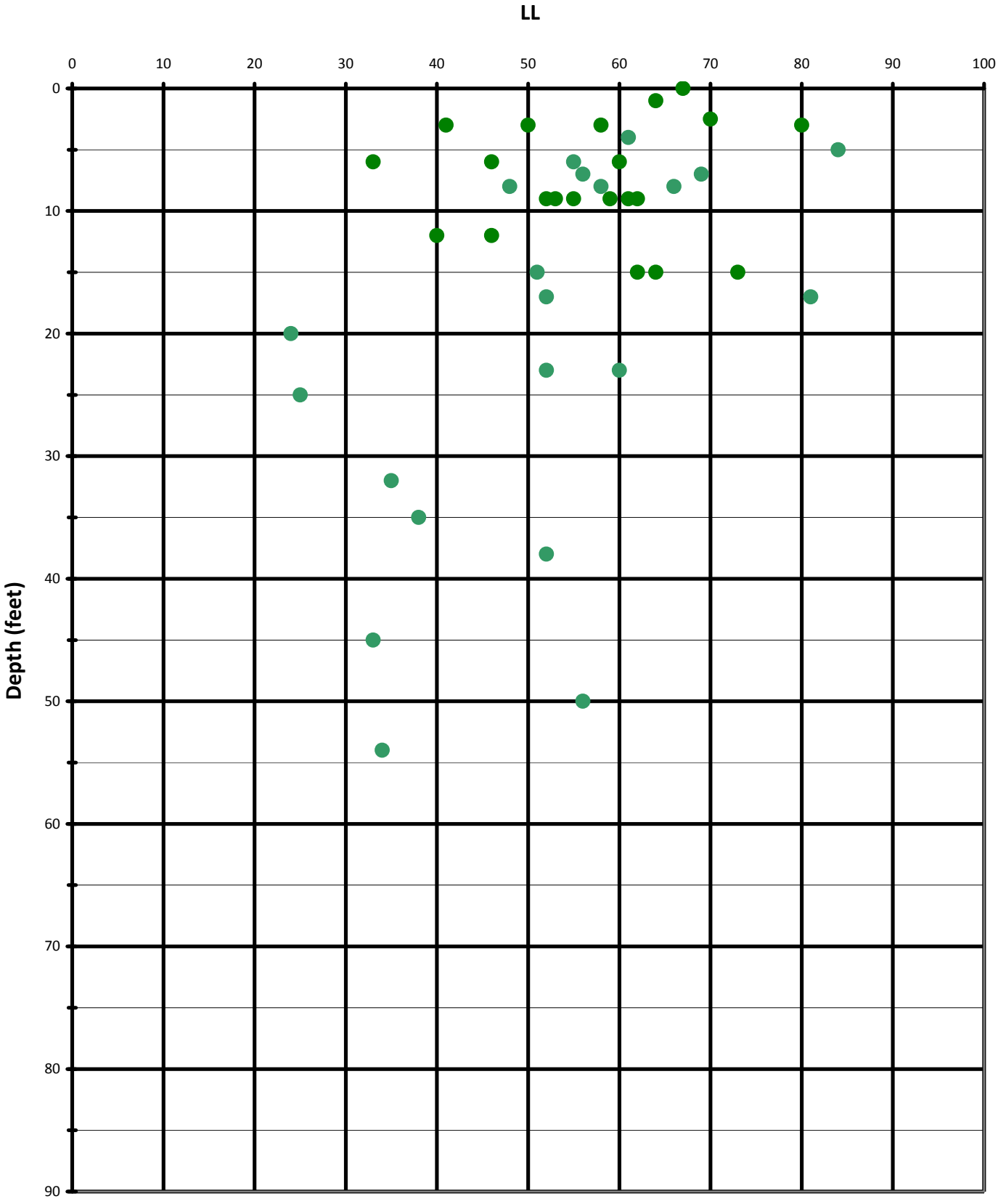


Area B

B1-893

PLATE B4-8

Variation of Liquid Limit with Depth

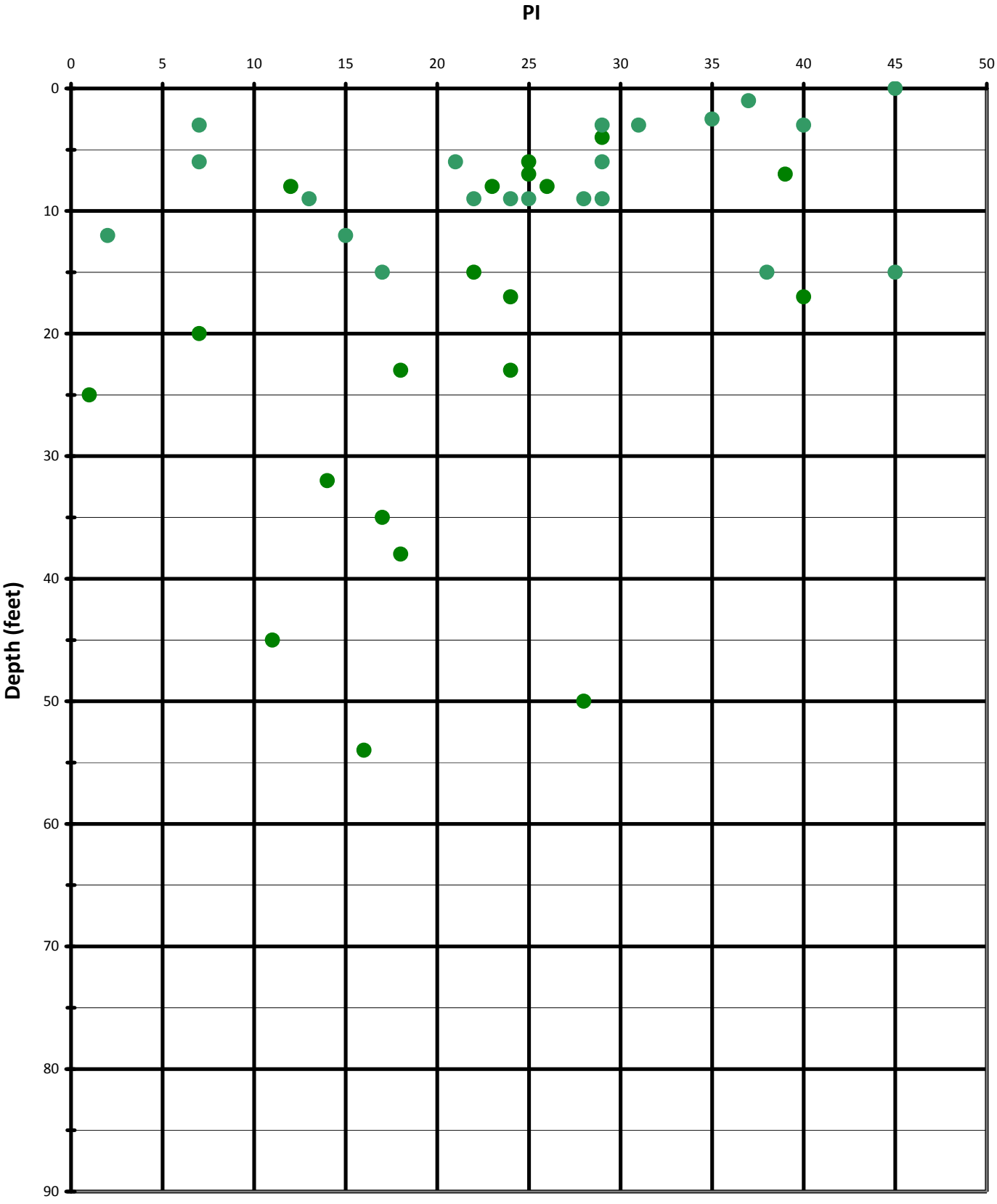


Area B

B1-894

PLATE B4-9

Variation of Plasticity Index with Depth

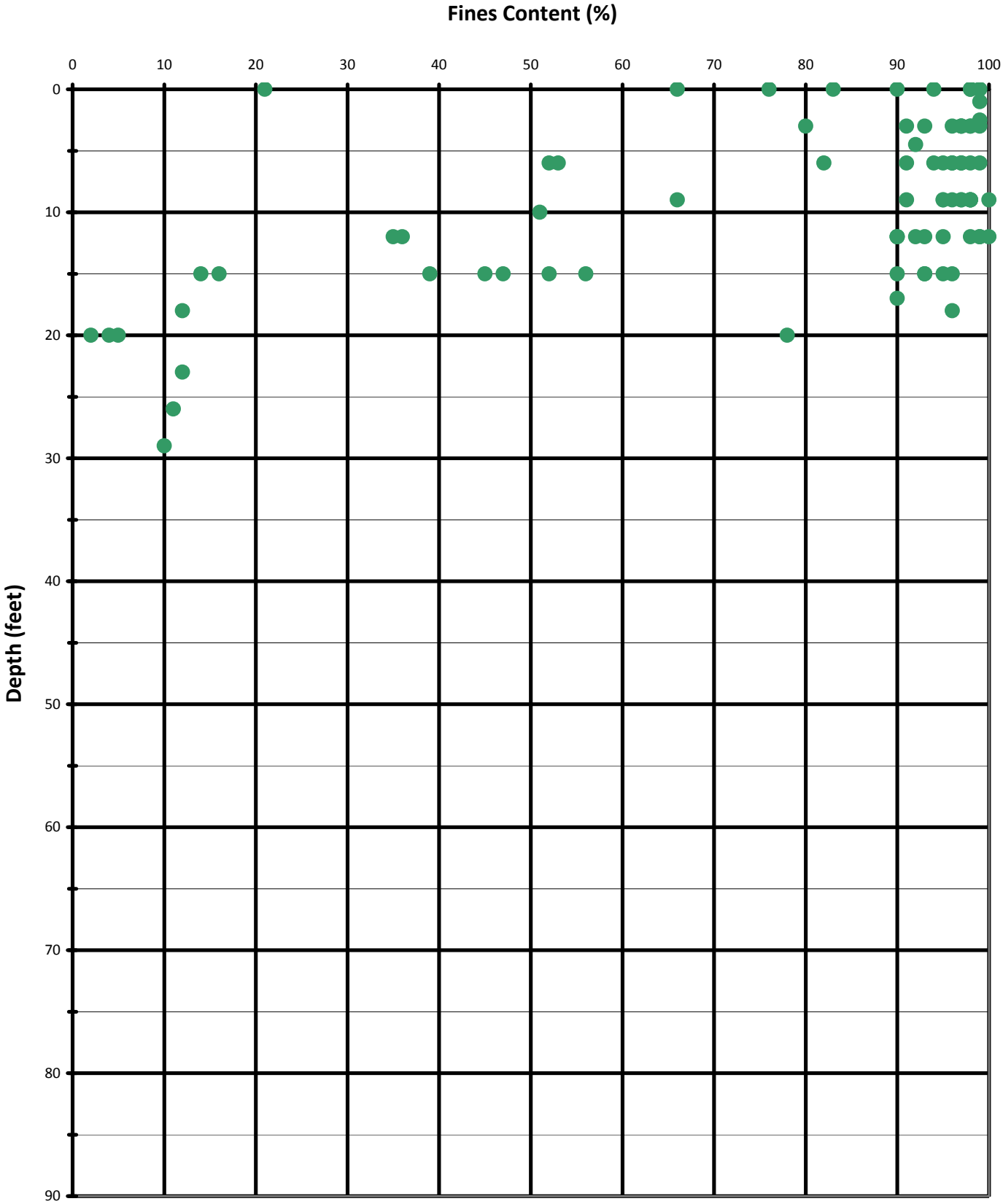


Area B

B1-895

PLATE B4-10

Variation of Fines Content with Depth

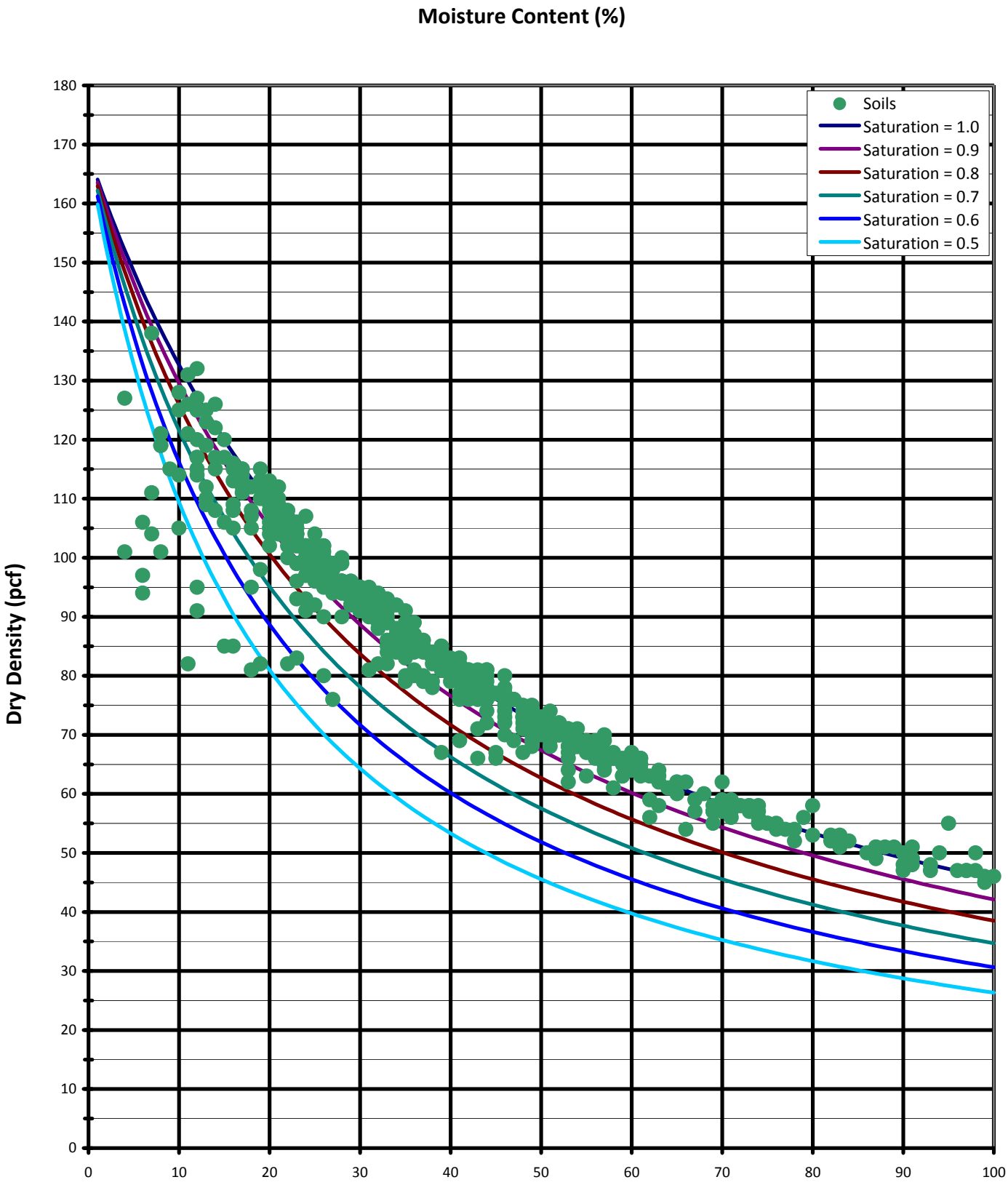


Area B

B1-896

PLATE B4-11

Moisture Content vs Dry Density

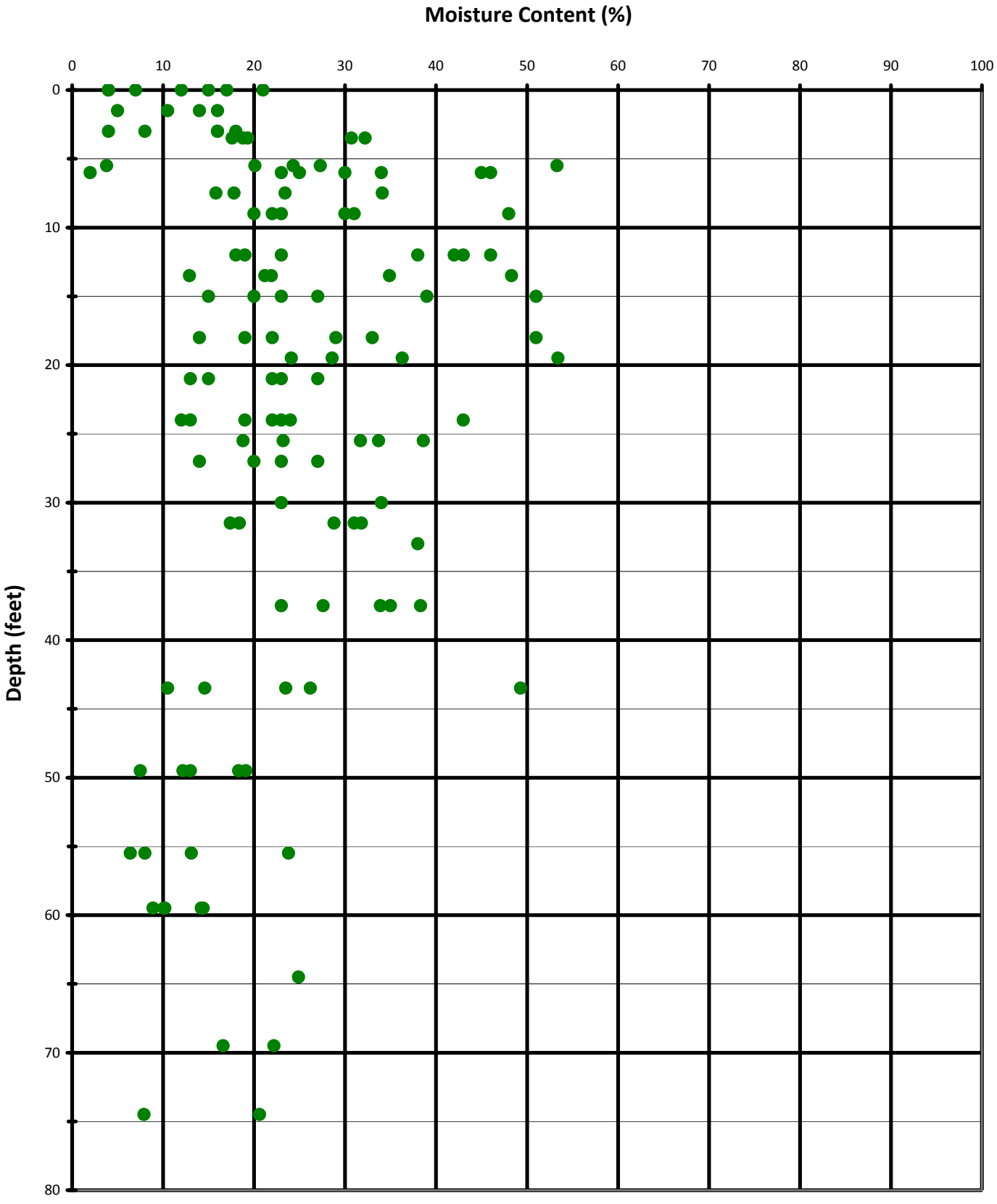


Area B

B1-897

PLATE B4-12

Variation of Moisture Content with Depth

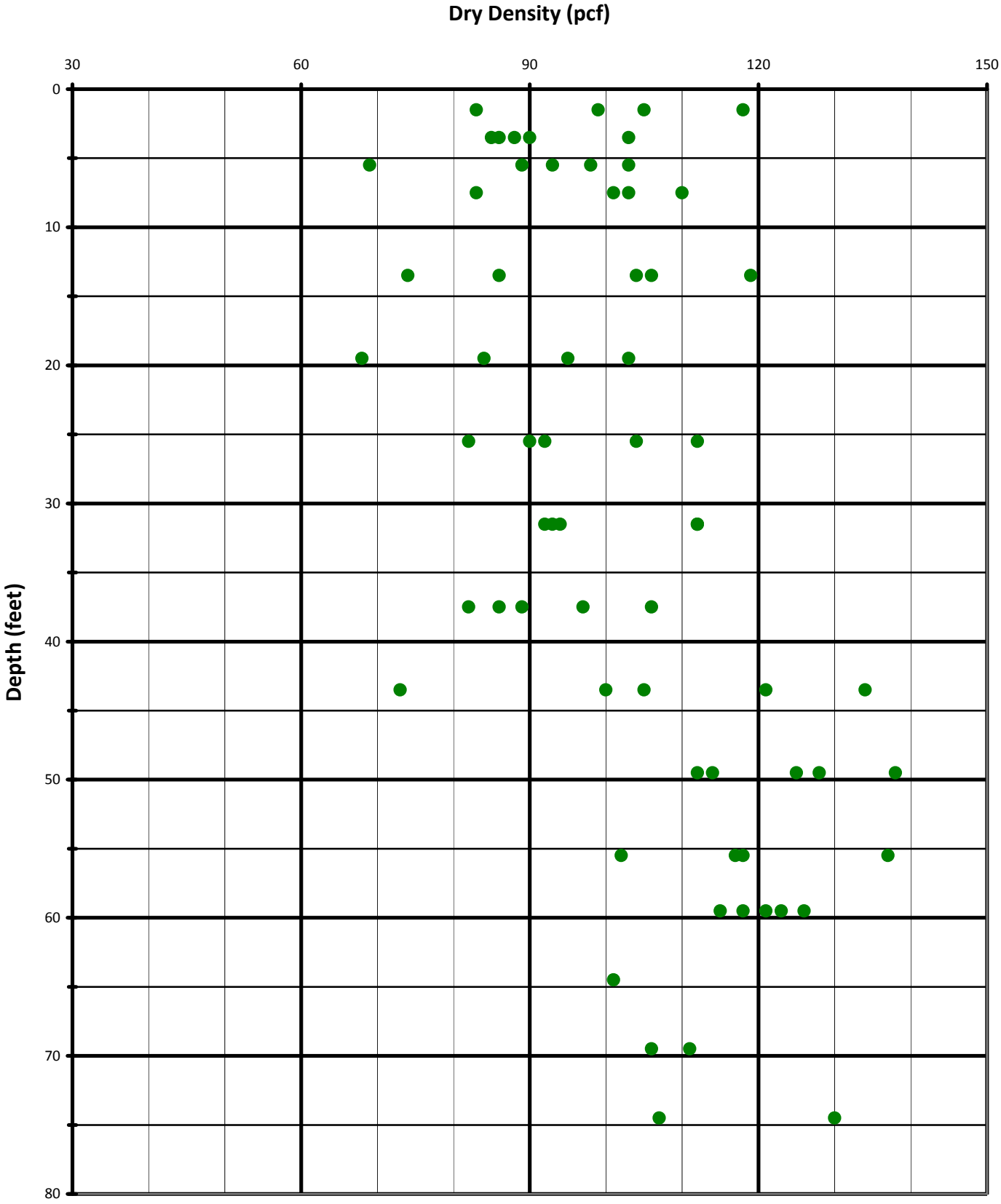


AREA C

B1-898

PLATE B4-13

Variation of Dry Density with Depth

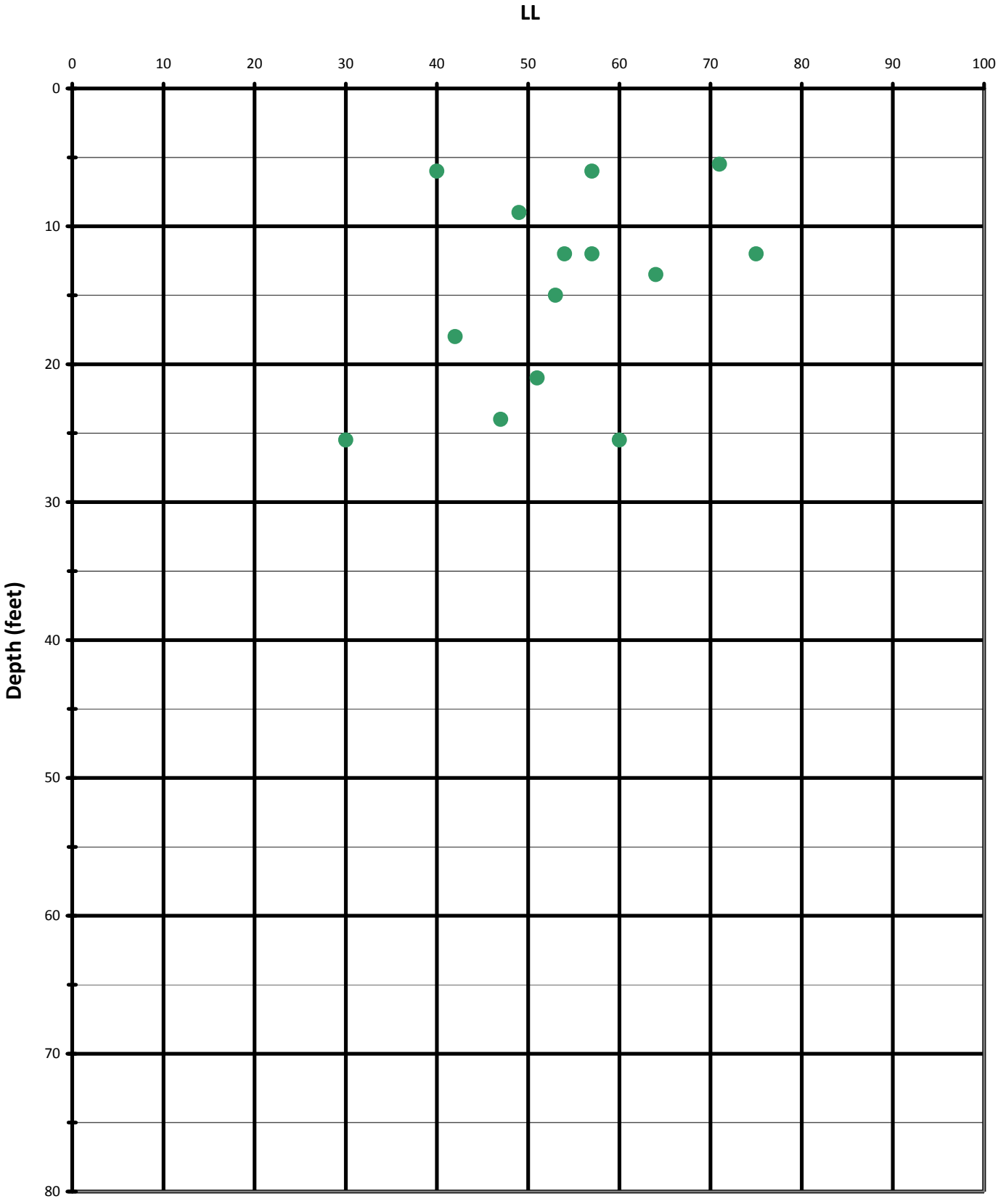


AREA C

B1-899

PLATE B4-14

Variation of Liquid Limit with Depth

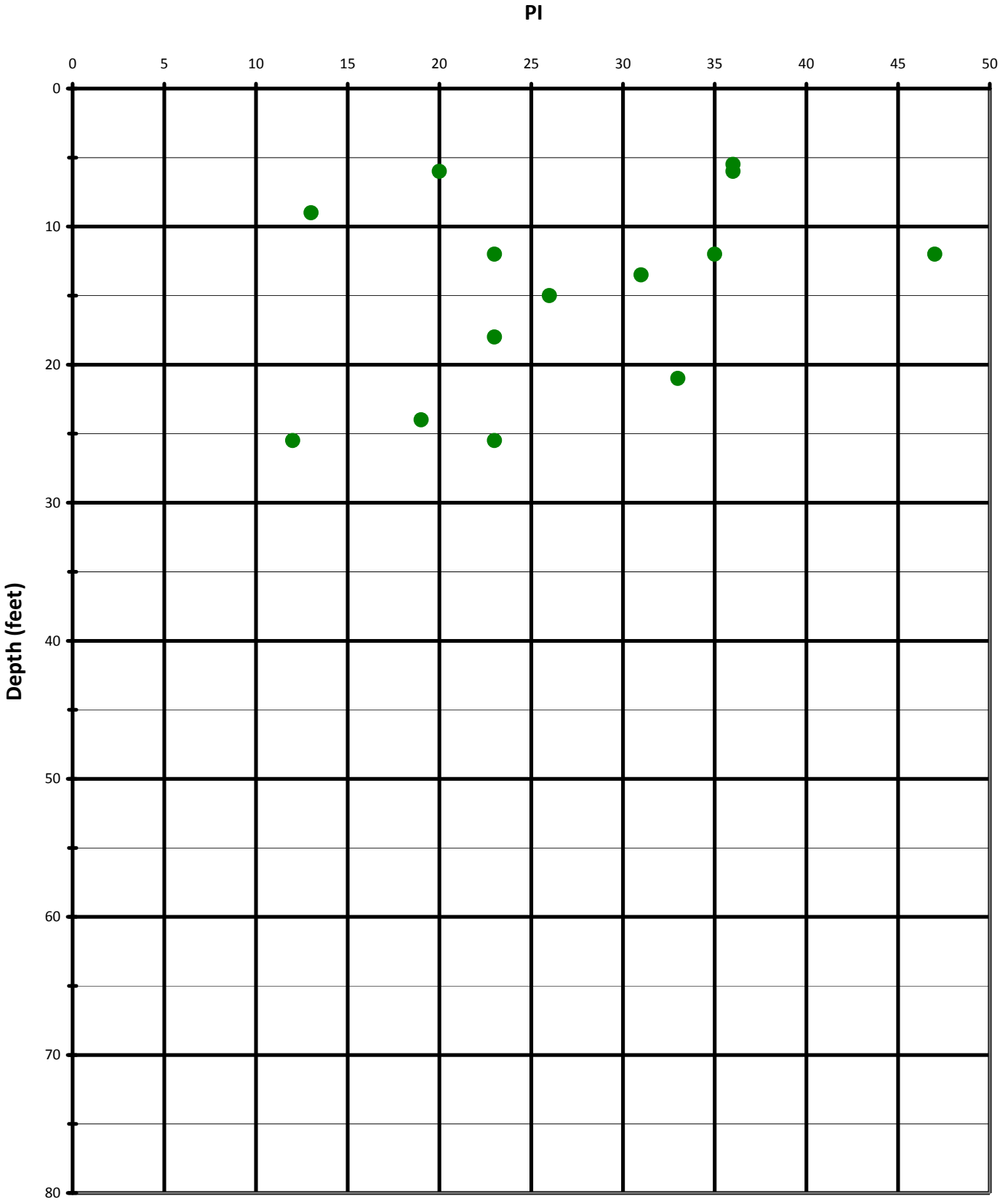


AREA C

B1-900

PLATE B4-15

Variation of Plasticity Index with Depth

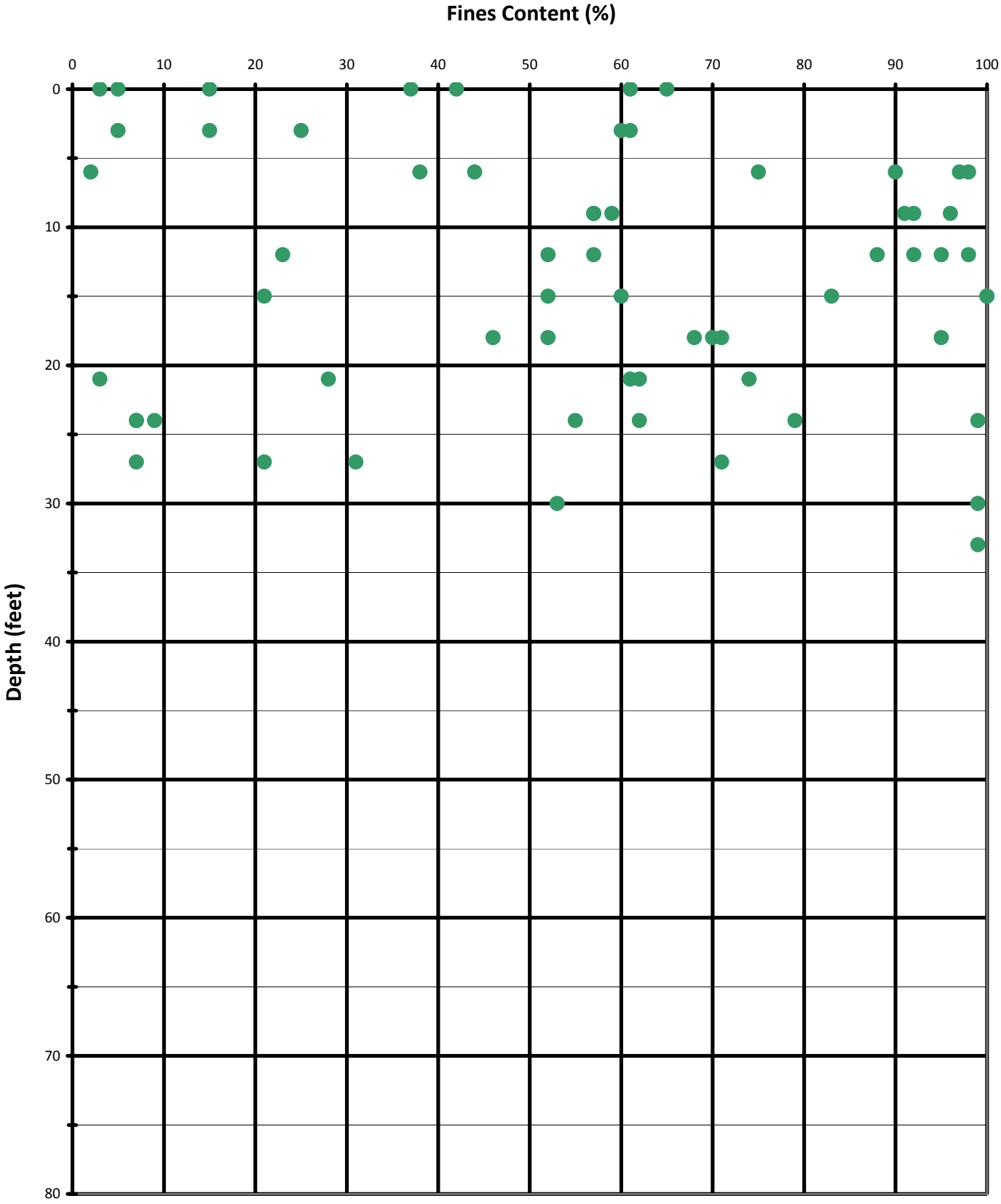


AREA C

B1-901

PLATE B4-16

Variation of Fines Content with Depth

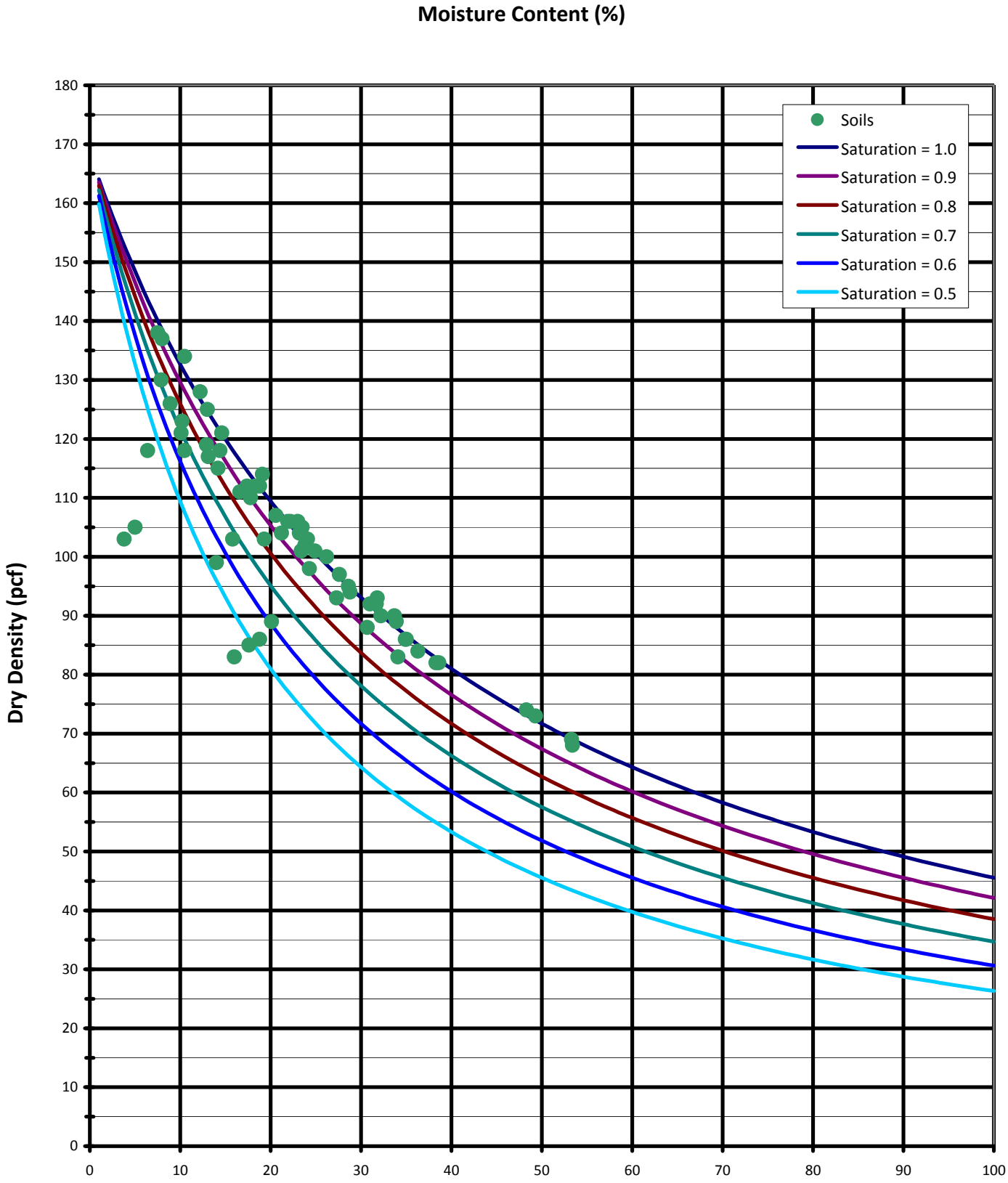


AREA C

B1-902

PLATE B4-17

Moisture Content vs Dry Density



AREA C

B1-903

PLATE B4-18

APPENDIX C
GEOLOGIC MAP / AERIAL PHOTOS

APPENDIX C
GEOLOGIC MAP/AERIAL PHOTOS

C.1 Contents

This appendix includes a geologic map, aerial photos of Ballona Wetlands selected from the UCLA Library Spence Collection of Aerial Photos (from years 1924 to 1938), and Topographic Maps from USGS prior and after the construction of the existing levees.

A list of the plates presented in this appendix follows:

Plate C-1	Geologic Map
Plate C-2 through C-9	UCLA Library Spence Aerial Photos (circa 1924-1938)
Plate C-10 and C-11	USGS Topographic Maps (1924 and 1942)



DATE: 6/28/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	GEOLOGIC MAP	PROJECT NUMBER: LA962A
REVISION:	APPROVED BY: P. Kashighandi			Ballona Wetlands Restoration Los Angeles, CA	SCALE: 1" = 750'
REVISION:	B1-906				PLATE NUMBER: C-1



Playa Del Rey - View of Bluffs to the South of Ballona Creek - 1924

PLATE C-2

UCLA Library - Spence Photos - 1924



PLATE C-3

Marina Del Rey - Ballona Lagoons - Northward View - 1928

UCLA Library - Spence Photos - 1928



Marina Del Rey - Westward View - Showing Oil Wells, Ballona Lagoon, Culver Boulevard, and Pacific Electric Railroad - 1933

PLATE C-4

UCLA Library - Spence Photos - 1933



B1-910

PLATE C-5

Marina Del Rey- Eastward View - Showing Ballona Lagoon, Oil Wells, Culver Boulevard passing through in a southwestly direction

UCLA Library - Spence Photos - 1933



PLATE C-6

Ballona Creek Levees - 1937 - Eastward View

UCLA Library - Spence Photos - 1937



Ballona Creek Levees - 1937 - Eastward View

B1-912

PLATE C-7

UCLA Library - Spence Photos - 1937



B1-913

PLATE C-8

Marina Del Rey - Eastward view showing Pacific Electric Railroad, Lincoln Boulevard, Realignment of Culver Boulevard, and Ballona Creek Levees - 1937

UCLA Library - Spence Photos - 1937



Marina Del Rey - Eastward view showing Completed Ballona Creek Levee - 1938

B1-914

PLATE C-9

UCLA Library - Spence Photos - 1938

1924 USGS

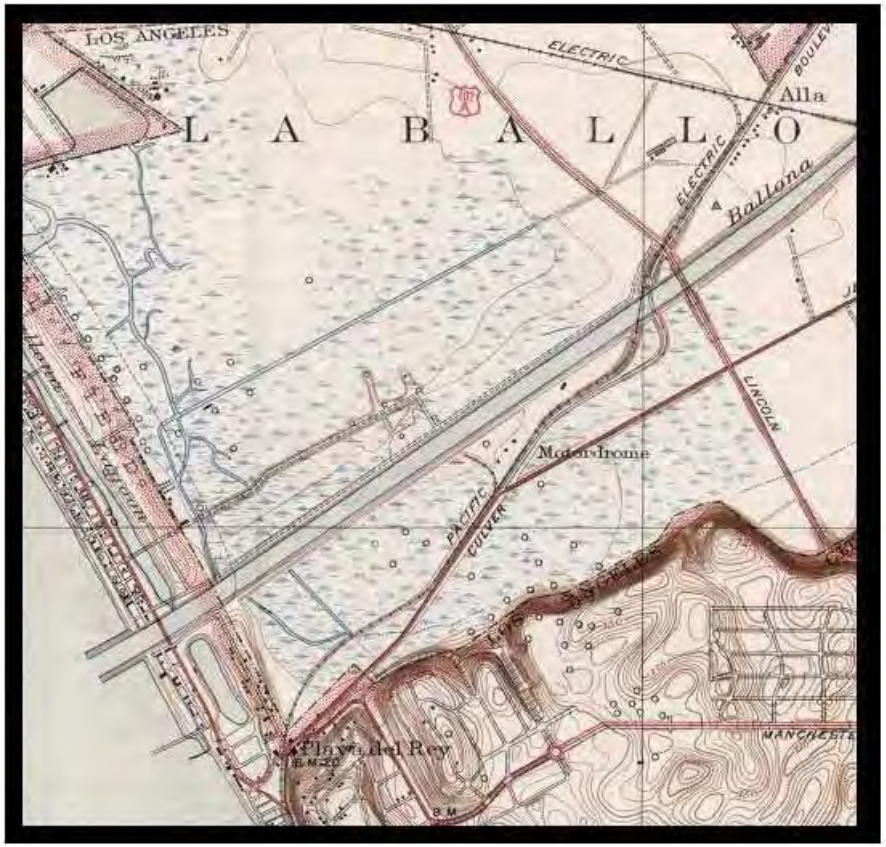


Historic Topo:	**Venice**
Edition Date:	1924
Scale 1:	24000
County:	Los Angeles .
Longitude:	33°50', 33°55', 34°00'
Latitude:	118°20', 118°25', 118°30'
Township:	T2S SBM, T3S SBM.
Range:	R14W SBM, R15W SBM.
Bodies of Water:	Ballona Lagoon, Santa Monica Bay.
Place Names:	Alla, Culver Garden, Cypress Grove, Del Ray,
Schools:	Playa Del Rey School, Venice High School.
RR/Utilities:	Pacific Electric.
Roadways/Trails:	Coast Boulevard, Collingwood Street, El Segu
Land Grants:	La Ballona, Sausal Redondo.
File name:	HT_834.jpg

USGS TOPO MAPS - 1924

PLATE C-10

1942 USGS



Historic Topo:	**Venice**
Edition Date:	1934, 1942
Scale 1:	24000
County:	Los Angeles .
Longitude:	33°50', 33°55', 34°00'
Latitude:	118°20', 118°25', 118°30'
Township:	T2S SBM, T3S SBM.
Range:	R14W SBM, R15W SBM.
Bodies of Water:	Ballona Lagoon, Santa Monica Bay.
Place Names:	Alla, Culver City, Culver Garden, Cypress Grove, Del Ray,
Schools:	Playa Del Rey School, Venice High School.
RR/Utilities:	Pacific Electric.
Roadways/Trails:	Coast Boulevard, Collingwood Street, El Segundo Avenue, Boulevard.
Land Grants:	La Ballona, Sausal Redondo.
File name:	HT_835.jpg

USGS TOPO MAPS - 1942

PLATE C-11

APPENDIX D
SEISMIC HAZARD MAPS AND SEISMIC DESIGN CRITERIA

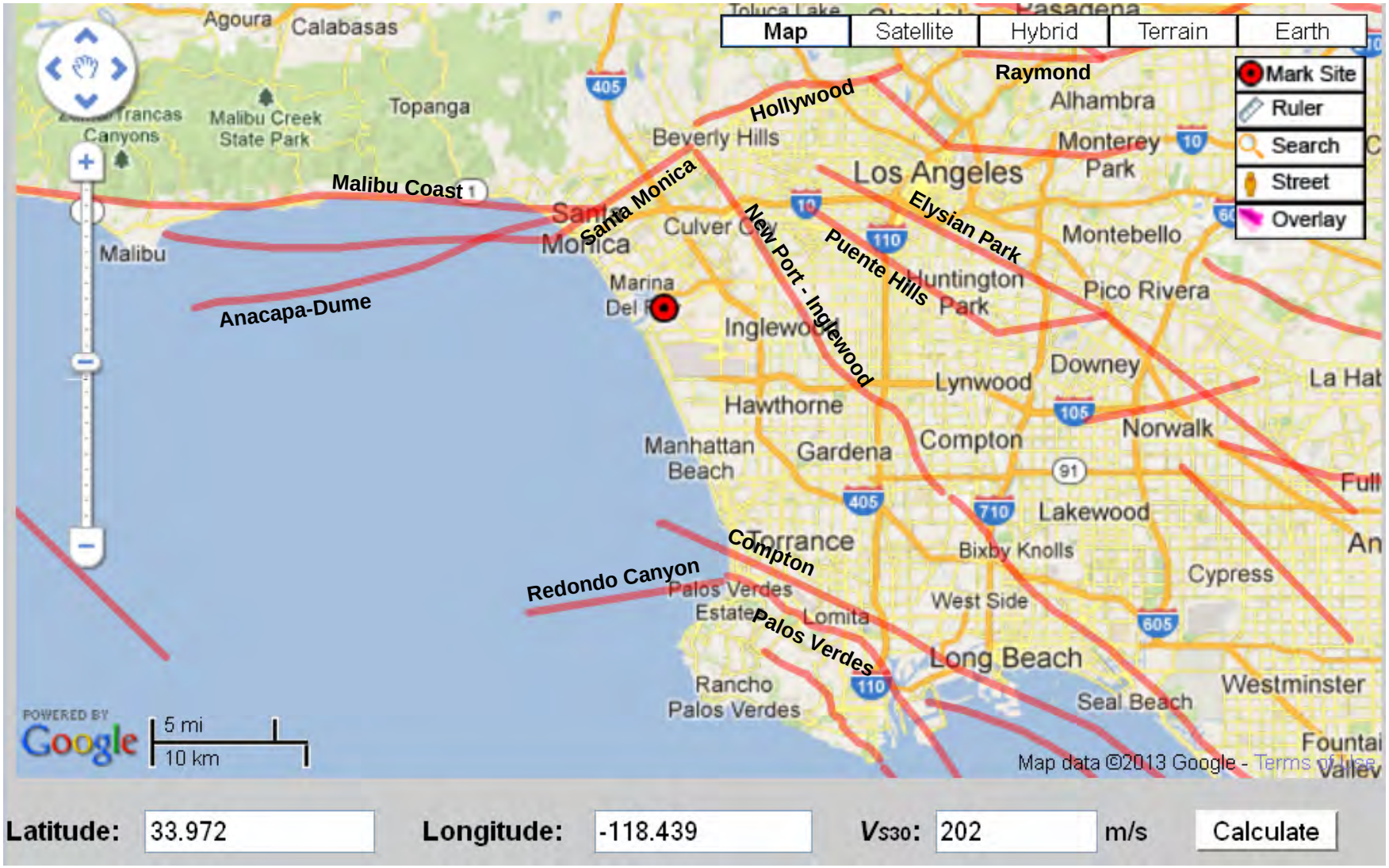
APPENDIX D
SEISMIC HAZARD MAPS / SEISMIC DESIGN CRITERIA

D.1 Contents

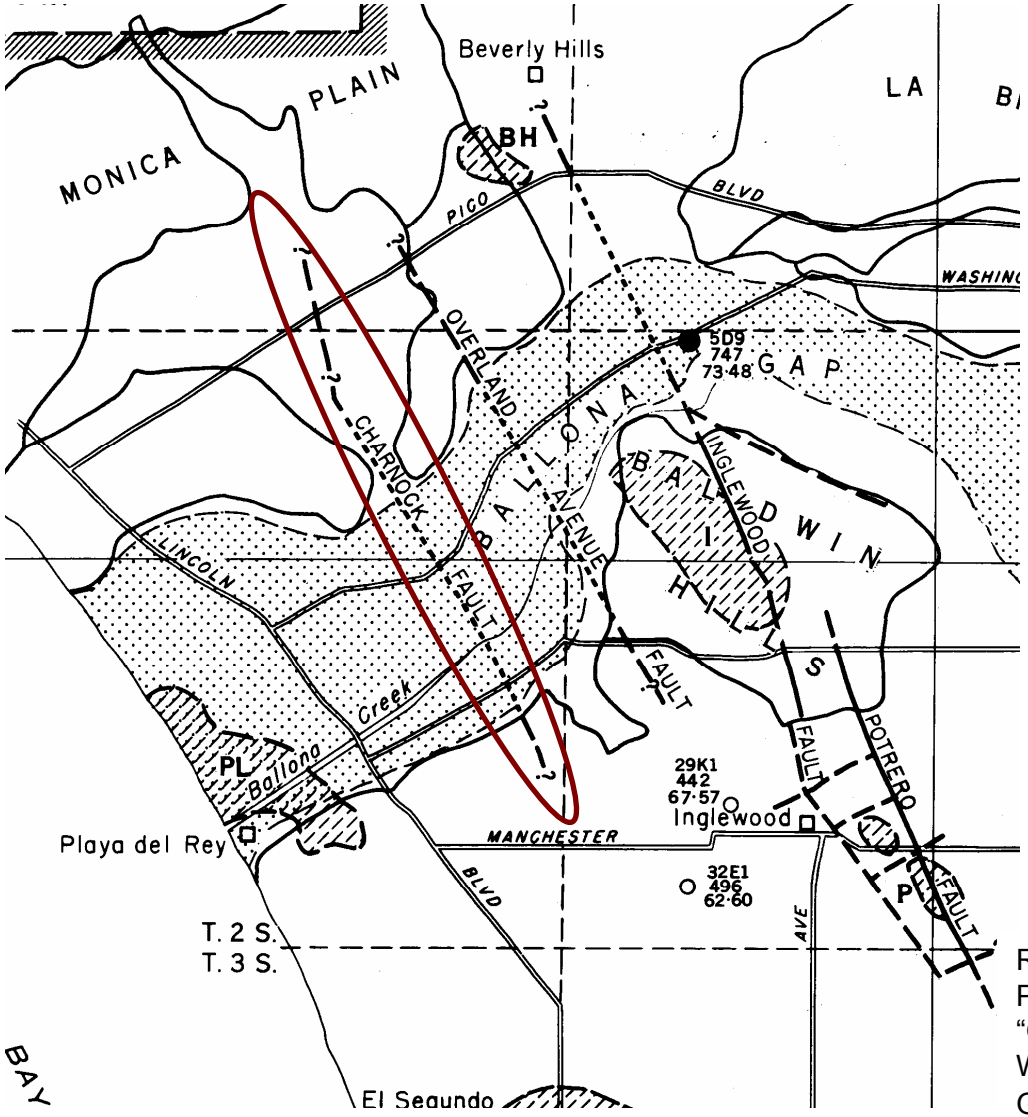
This appendix includes the seismic hazard maps and seismic design criteria adopted for the Ballona Wetlands Restoration Project.

A list of the plates presented in this appendix follows:

Plate D-1	CALTRANS Fault Map
Plate D-2	Mapped Location of Charnock Fault
Plate D-3	Estimation of Epicenter and Local Magnitude at or in the Vicinity of the Site (Past 10 years)
Plate D-4 through D-13	USGS Deaggregation Results at Ballona Wetlands for Return Period of 224 years (Vs = 202 m/s)
Plate D-14 through D-17	Shear Wave Velocity Profiles (Area A, B, West B, and C)
Plate D-18	CGS Historically Highest Ground Water Contour Map
Plate D-19	CGS Liquefaction Hazard Zone Map
Plate D-20	CGS Landslide Hazard Zone Map
Plate D-21	Navigate LA – Fault Rupture Study Zones and Landslide



GROUP DELTA CONSULTANTS	**Caltrans Fault Map**	Project Number LA-962A Date: 2/19/2013
Group Delta Consultants. INC. 370 Amapola Ave. Torrance, Ca 90501	Ballona Creek Wetlands Restoration Project Marina Del Rey, CA	PLATE D-1



EXPLANATION

Area underlain by Gaspur water-bearing zone or "50-foot gravel"

Fault, long dashes where approximately located, short dashes where concealed

Approximate location of ground-water barrier not related to known faults

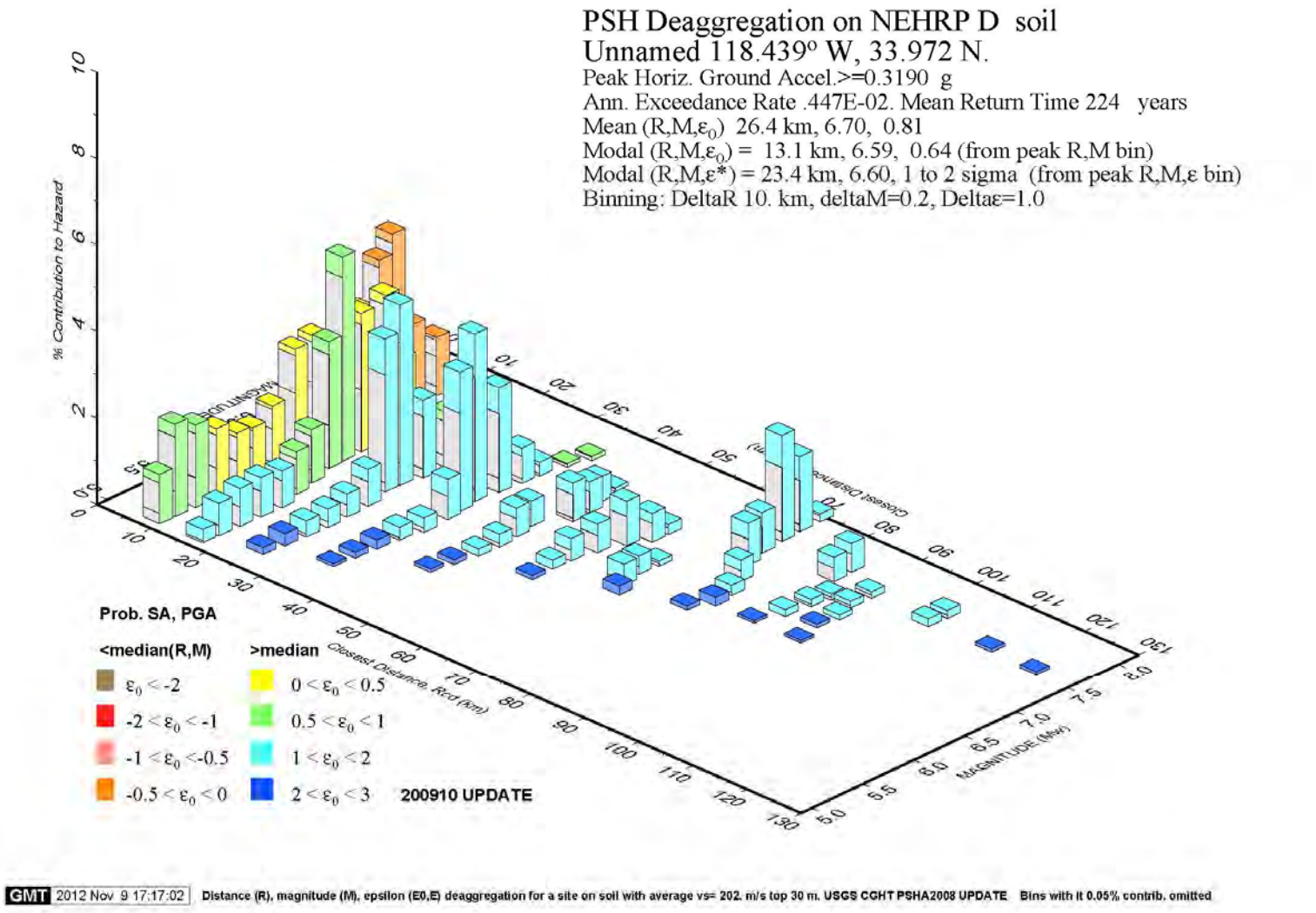
Reference:
Poland et al., 1959
"Geology, Hydrology, and Chemical Character of Ground Waters in the Torrance – Santa Monica Area, California Geologic Survey Water - Supply Paper 146"

GROUP DELTA CONSULTANTS	**Map showing Charnock Fault**	**Project Number LA-962A** **Date: 3/11//2013**
Group Delta Consultants. INC. 370 Amapola Ave. Torrance, Ca 90501	Ballona Creek Wetlands Restoration Project Marina Del Rey, CA	**PLATE D-2**



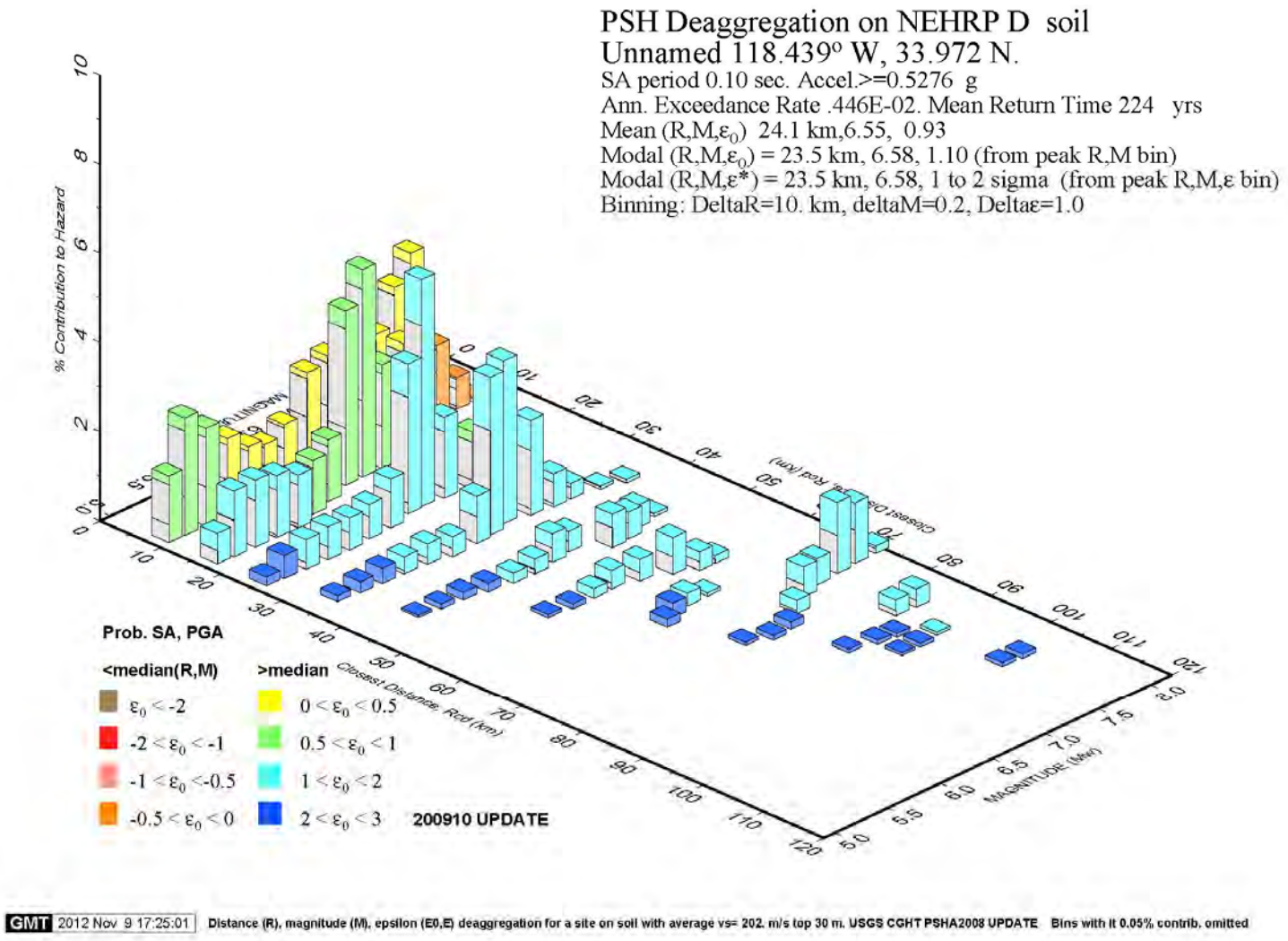
Estimation of Epicenter and Local Magnitude at or in the Vicinity of the Site (Past 10 years)

PLATE D-3



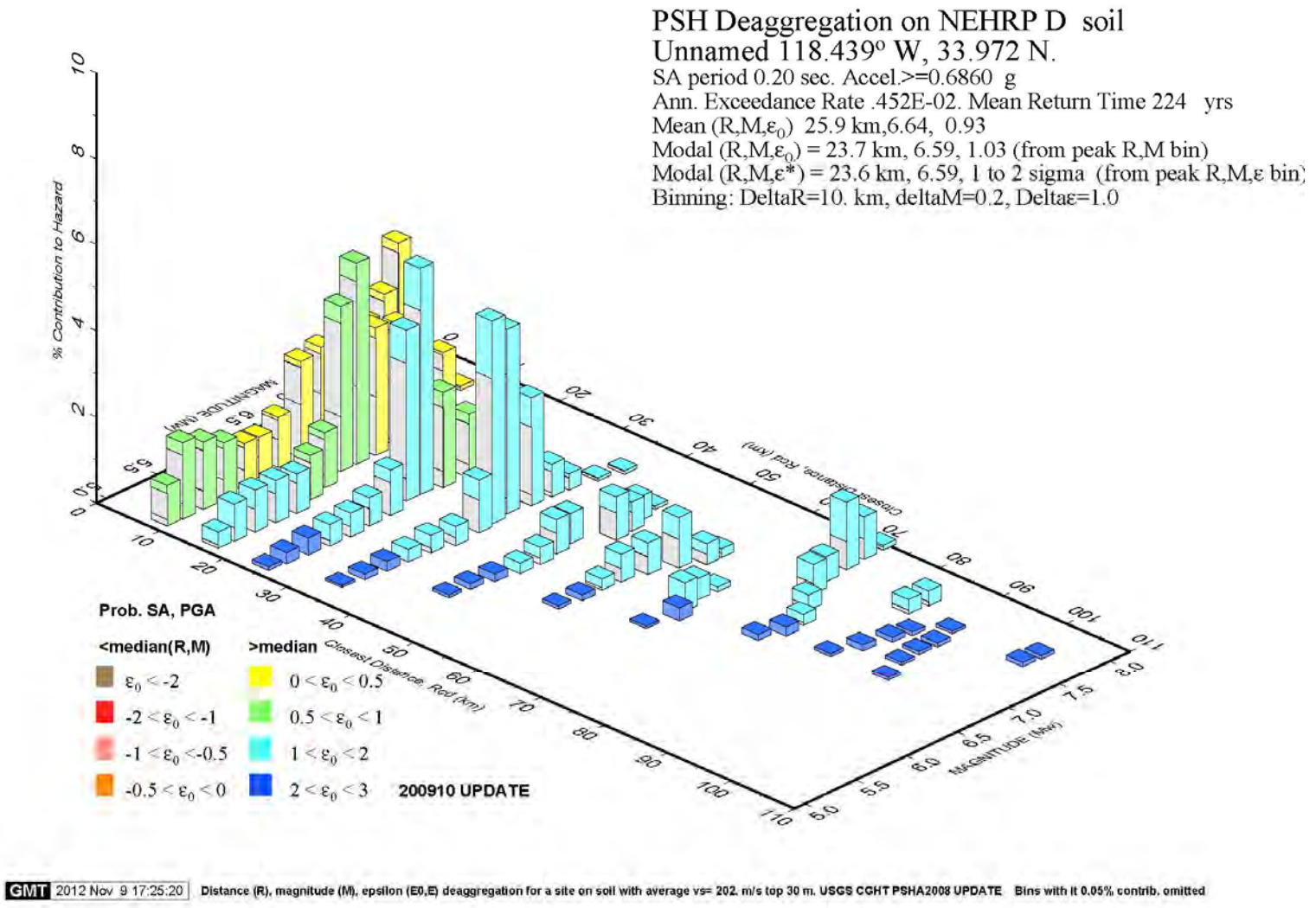
USGS Deaggregation at Ballona Wetlands for a Return Period of 224 years (Vs30 = 202 m/s)
At PGA

PLATE D-4



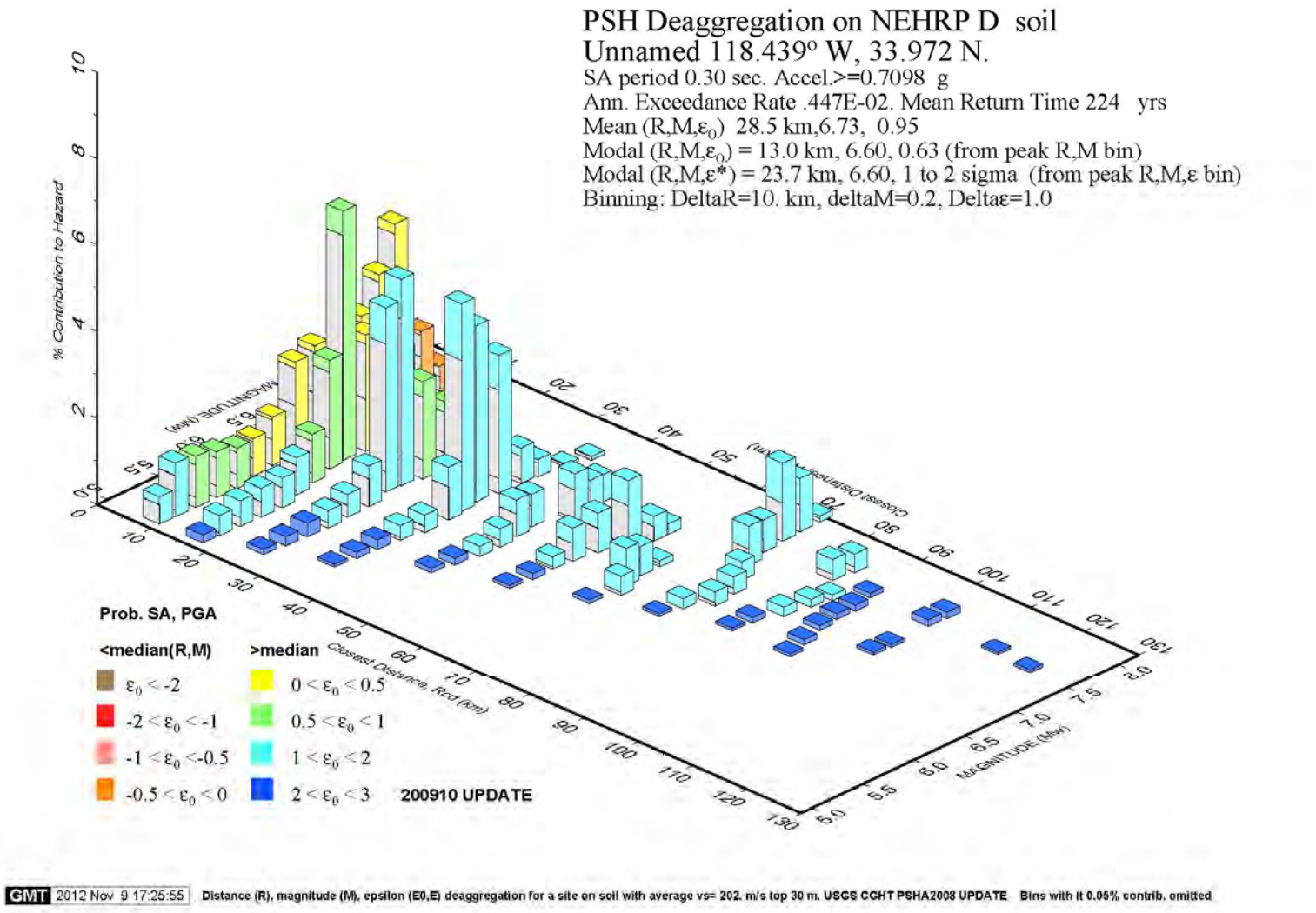
USGS Deaggregation at Ballona Wetlands for a Return Period of 224 years (Vs30 = 202 m/s)
At T=0.1 second

PLATE D-5



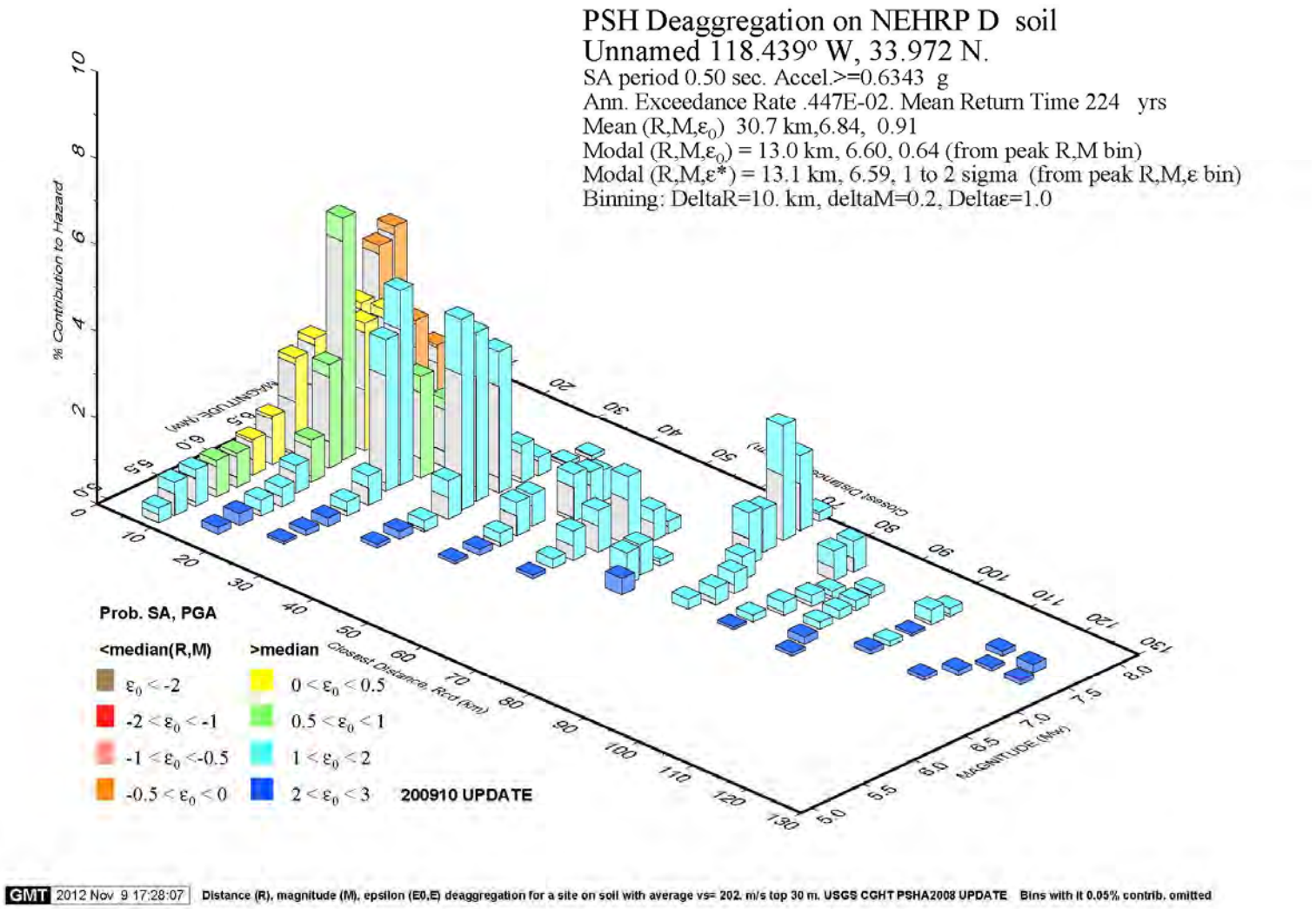
USGS Deaggregation at Ballona Wetlands for a Return Period of 224 years (Vs30 = 202 m/s)
At T=0.2 second

PLATE D-6



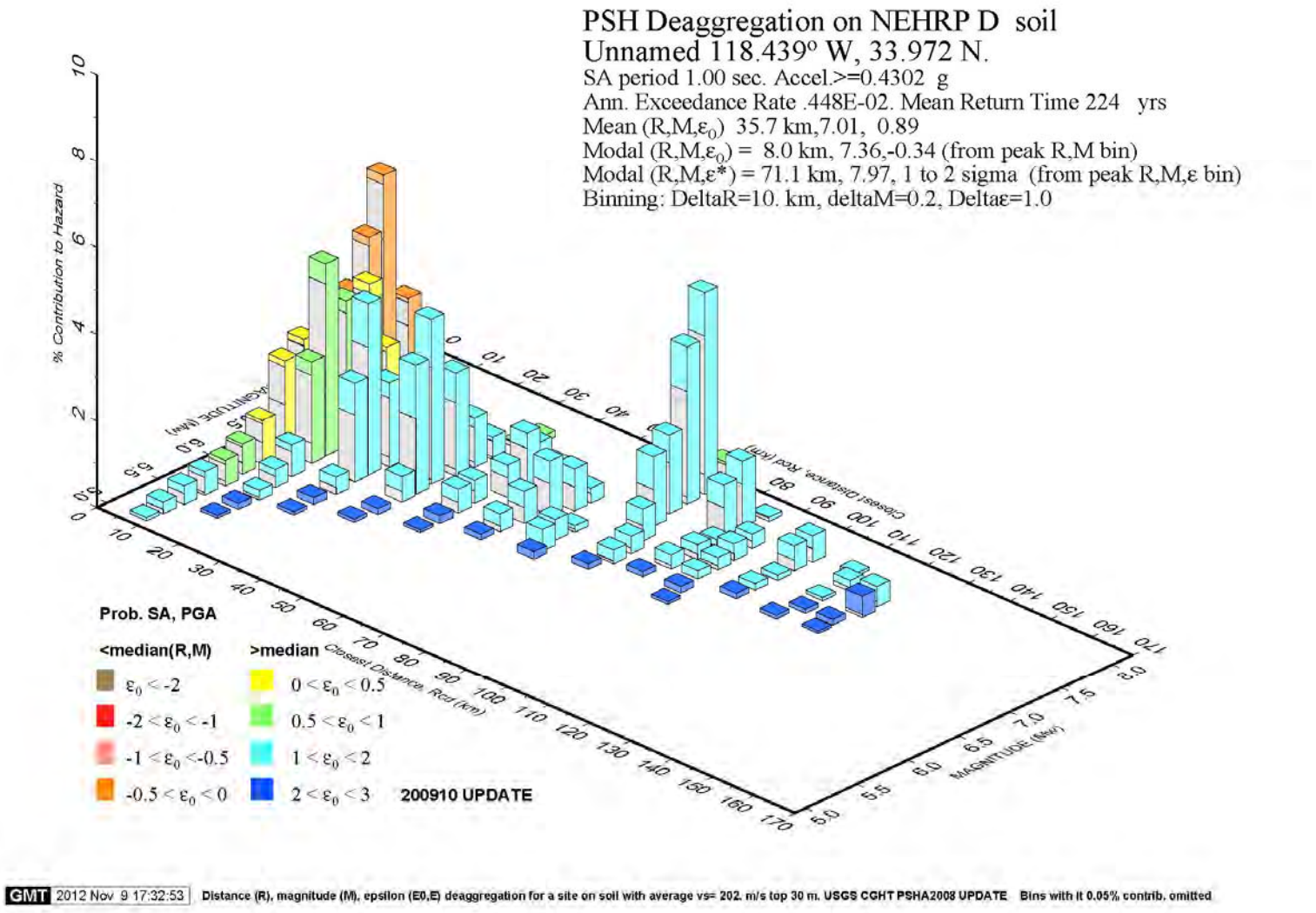
USGS Deaggregation at Ballona Wetlands for a Return Period of 224 years (Vs30 = 202 m/s)
At T=0.3 second

PLATE D-7



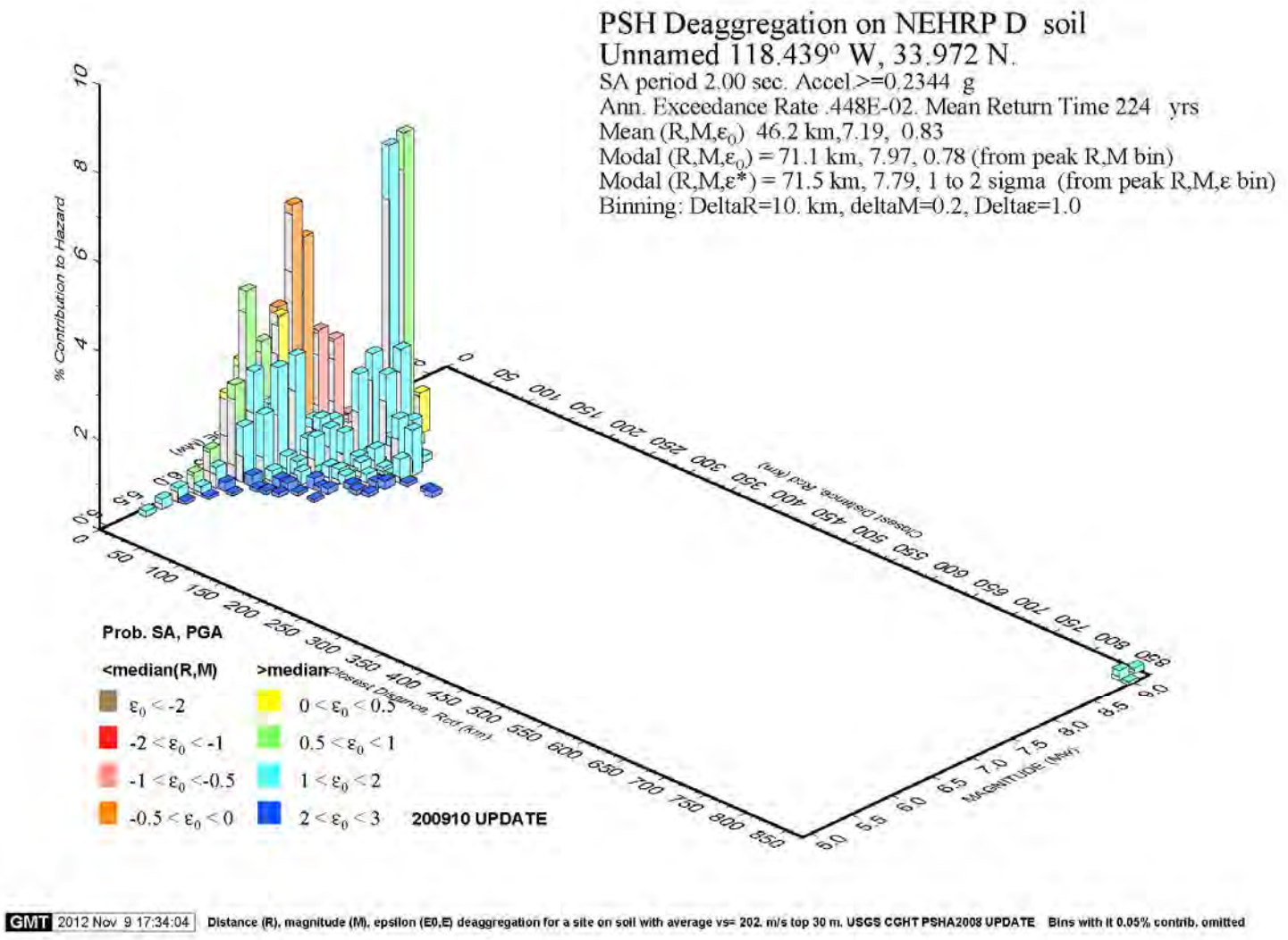
USGS Deaggregation at Ballona Wetlands for a Return Period of 224 years (Vs30 = 202 m/s)
At T=0.5 second

PLATE D-8



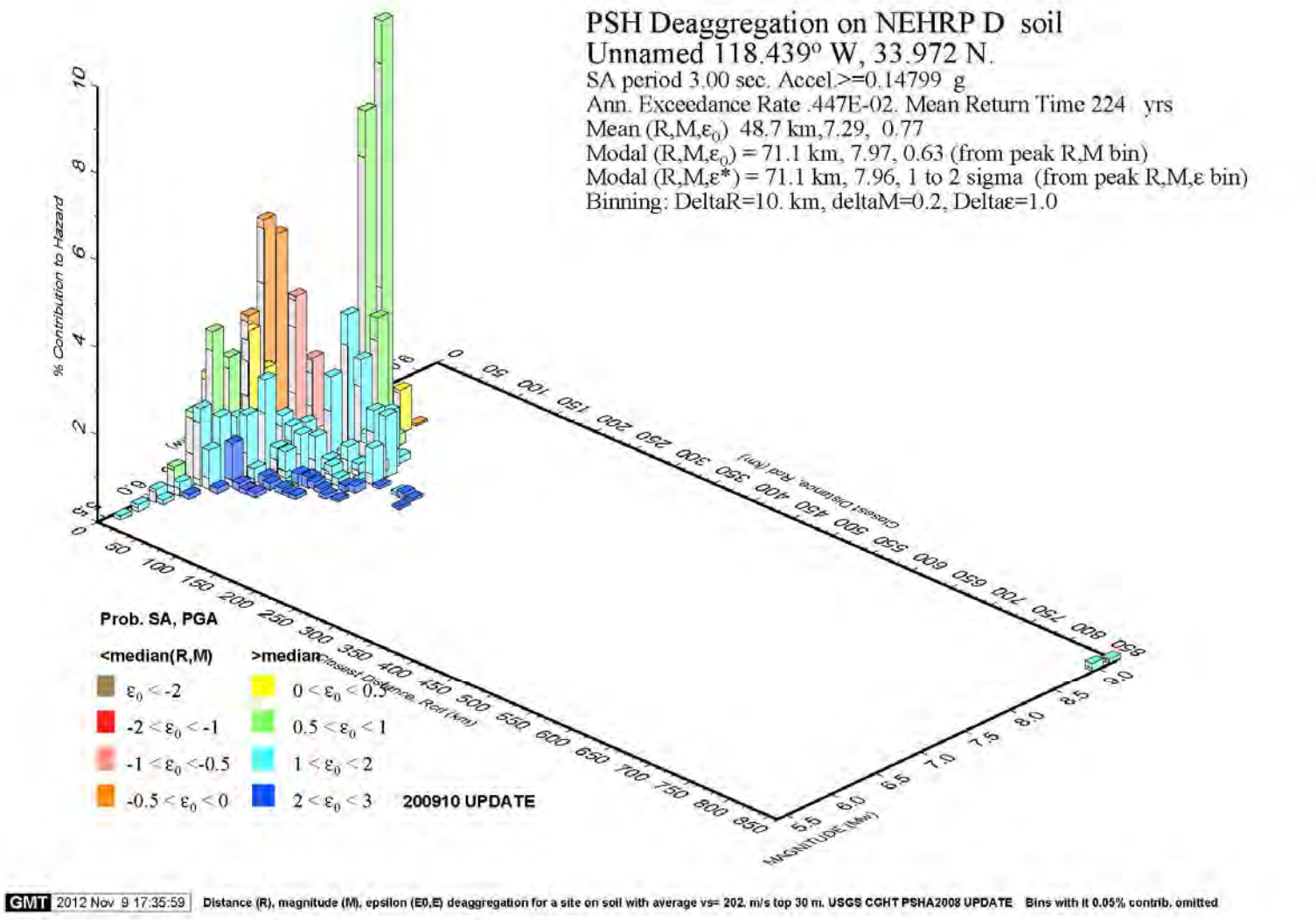
USGS Deaggregation at Ballona Wetlands for a Return Period of 224 years (Vs30 = 202 m/s)
At T=1.0 second

PLATE D-9



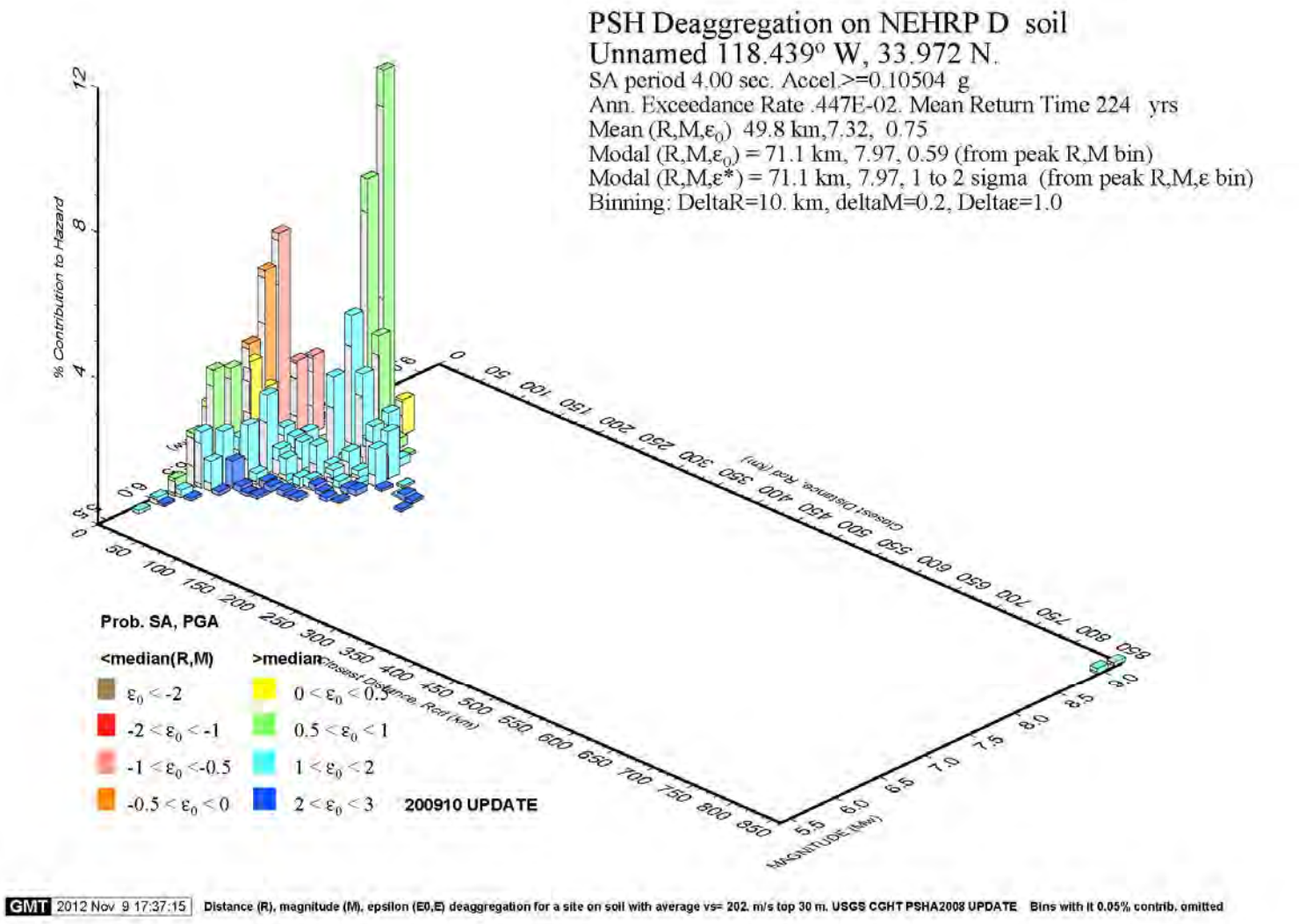
USGS Deaggregation at Ballona Wetlands for a Return Period of 224 years (Vs30 = 202 m/s)
At T=2.0 second

PLATE D-10



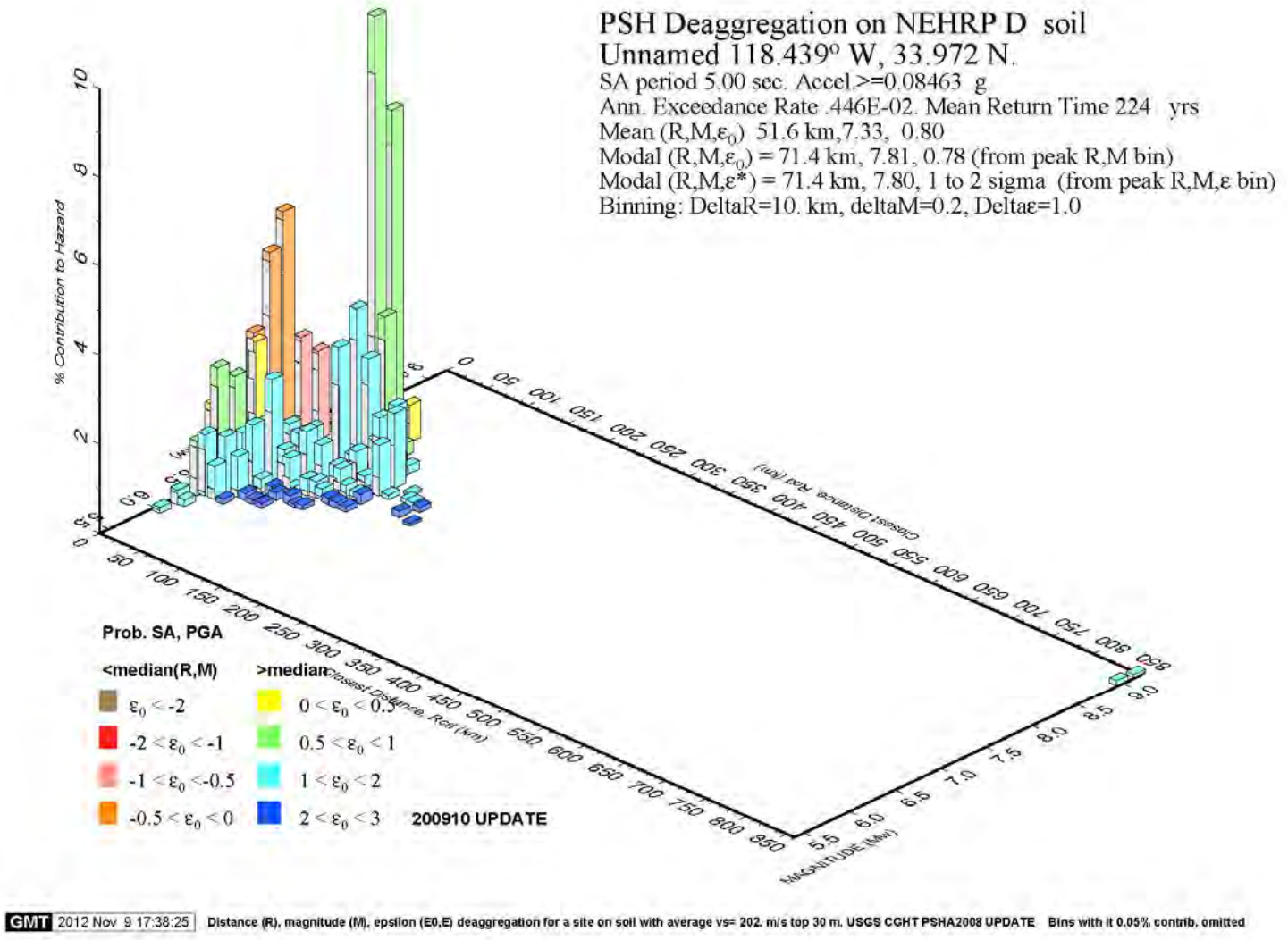
USGS Deaggregation at Ballona Wetlands for a Return Period of 224 years (Vs30 = 202 m/s)
At T=3.0 second

PLATE D-11



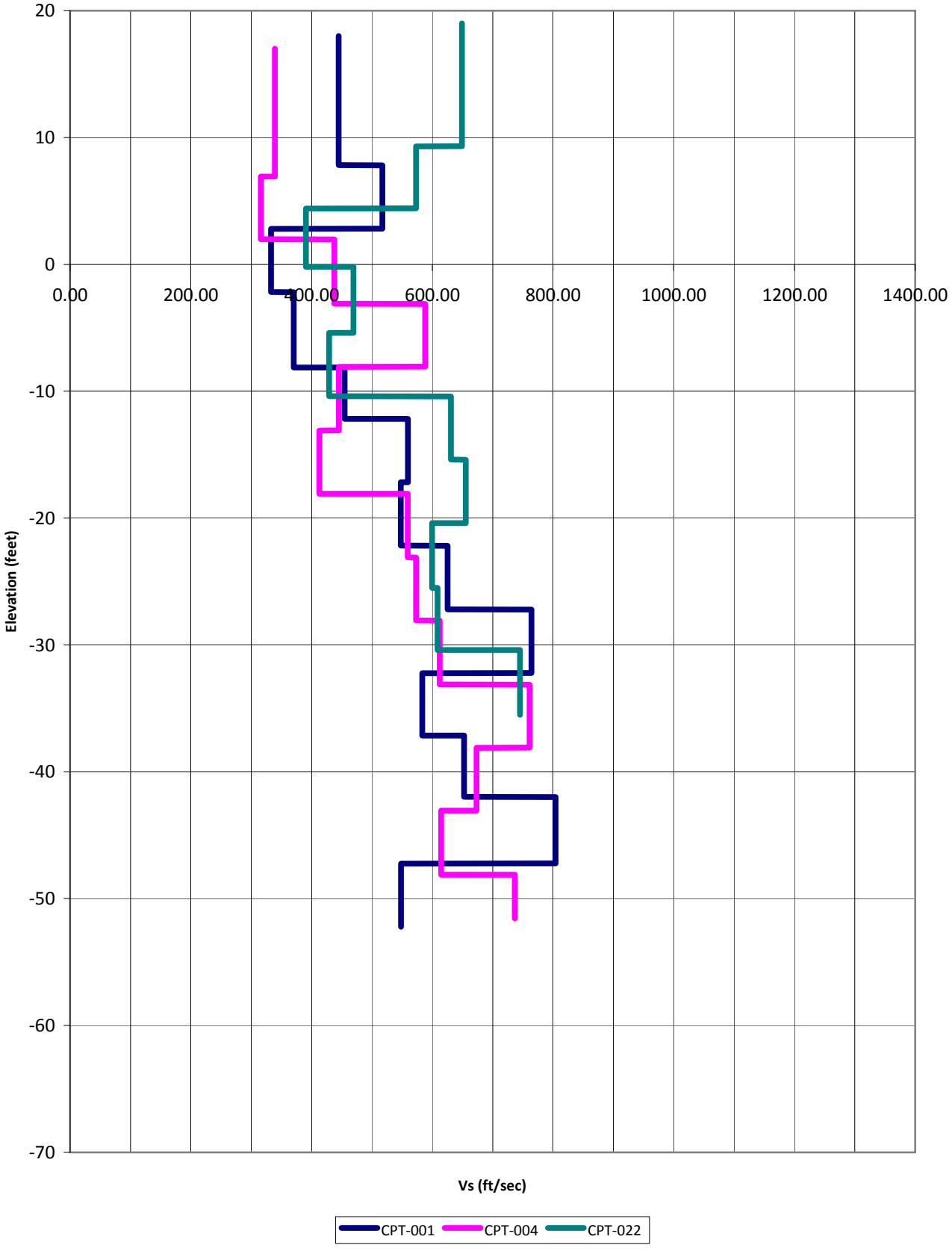
USGS Deaggregation at Ballona Wetlands for a Return Period of 224 years (Vs30 = 202 m/s)
At T=4.0 second

PLATE D-12



USGS Deaggregation at Ballona Wetlands for a Return Period of 224 years (Vs30 = 202 m/s)
At T=5.0 second

PLATE D-13

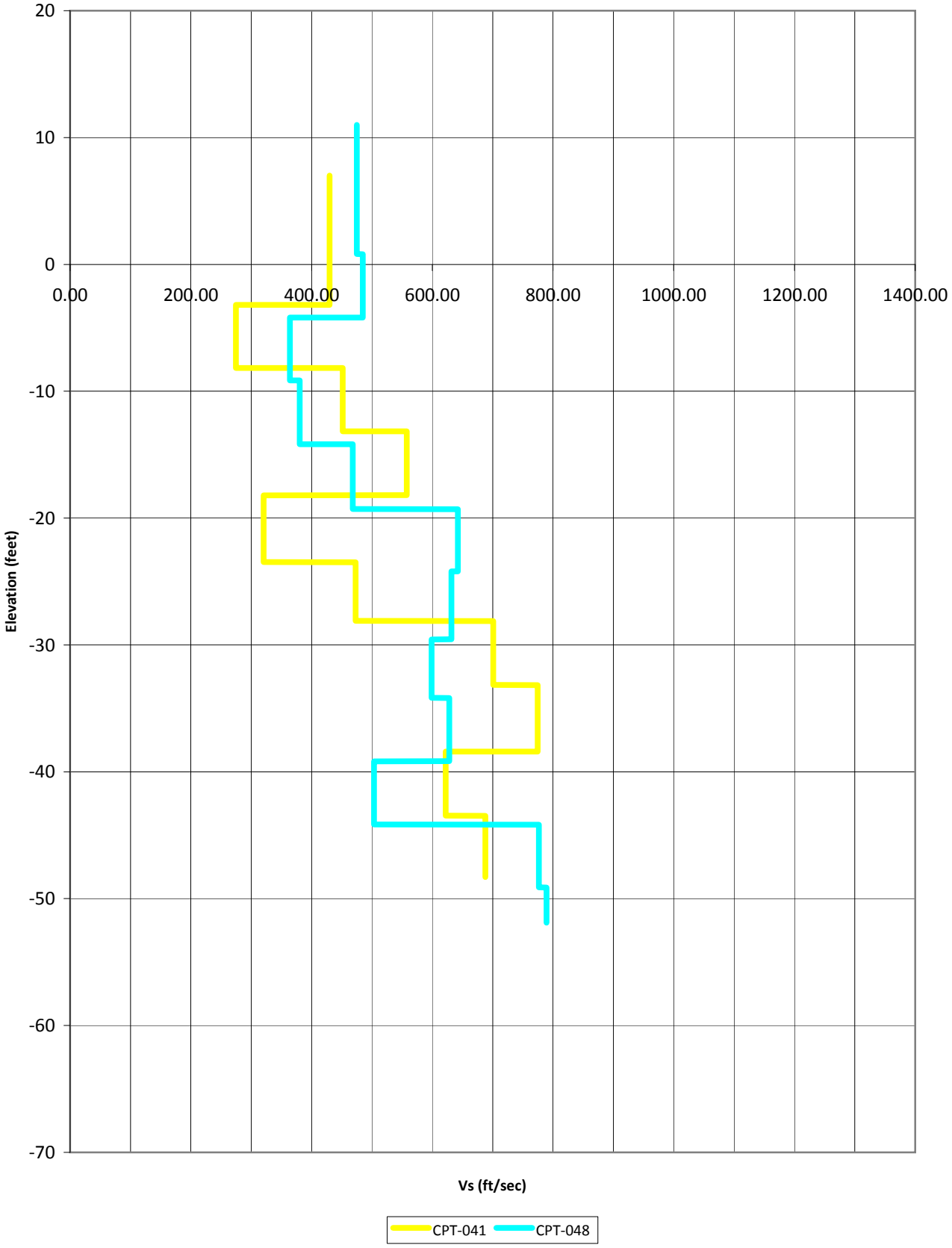


Shear Wave Velocity Profile

Area A

B1-982

PLATE D-14

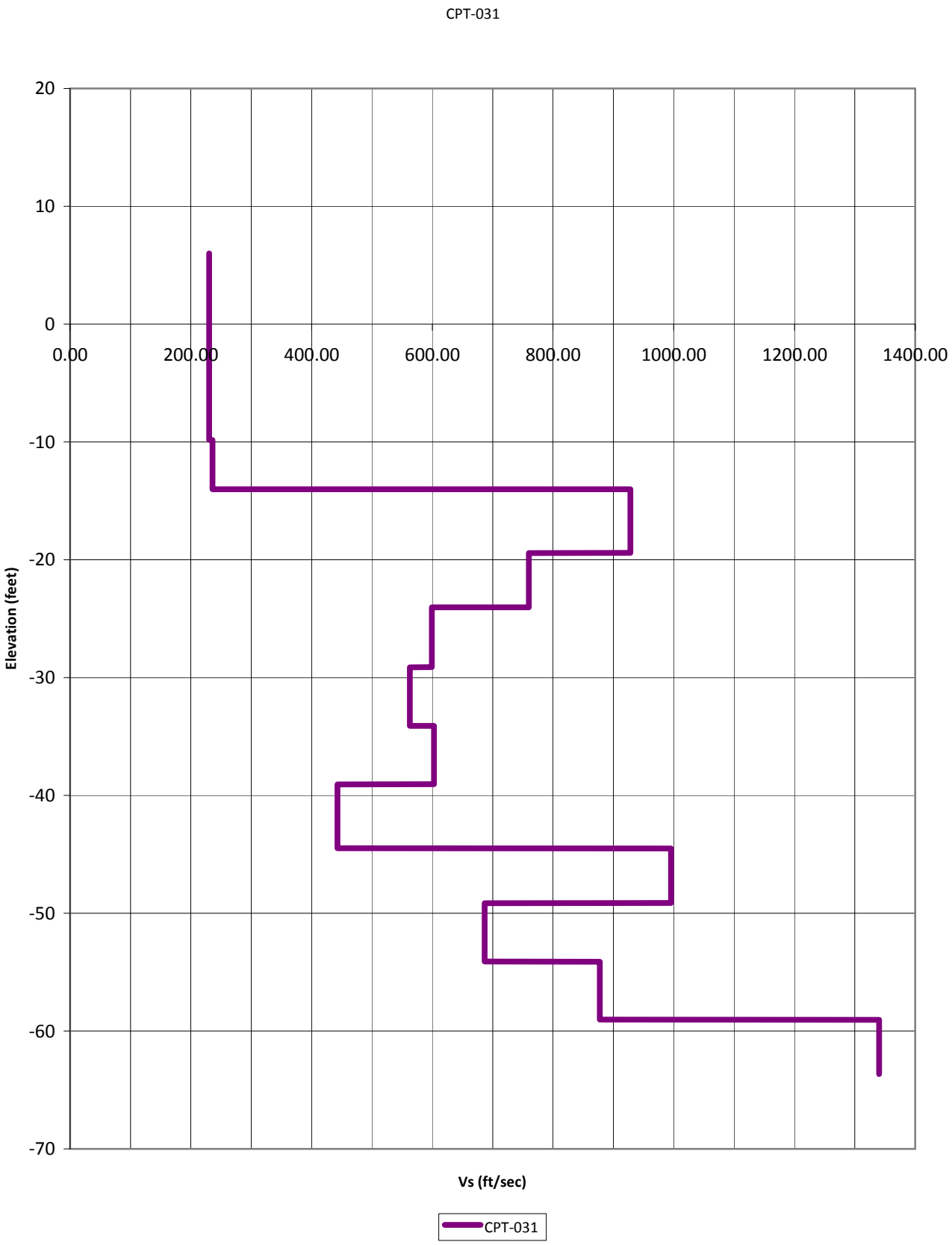


Shear Wave Velocity Profile

Area B

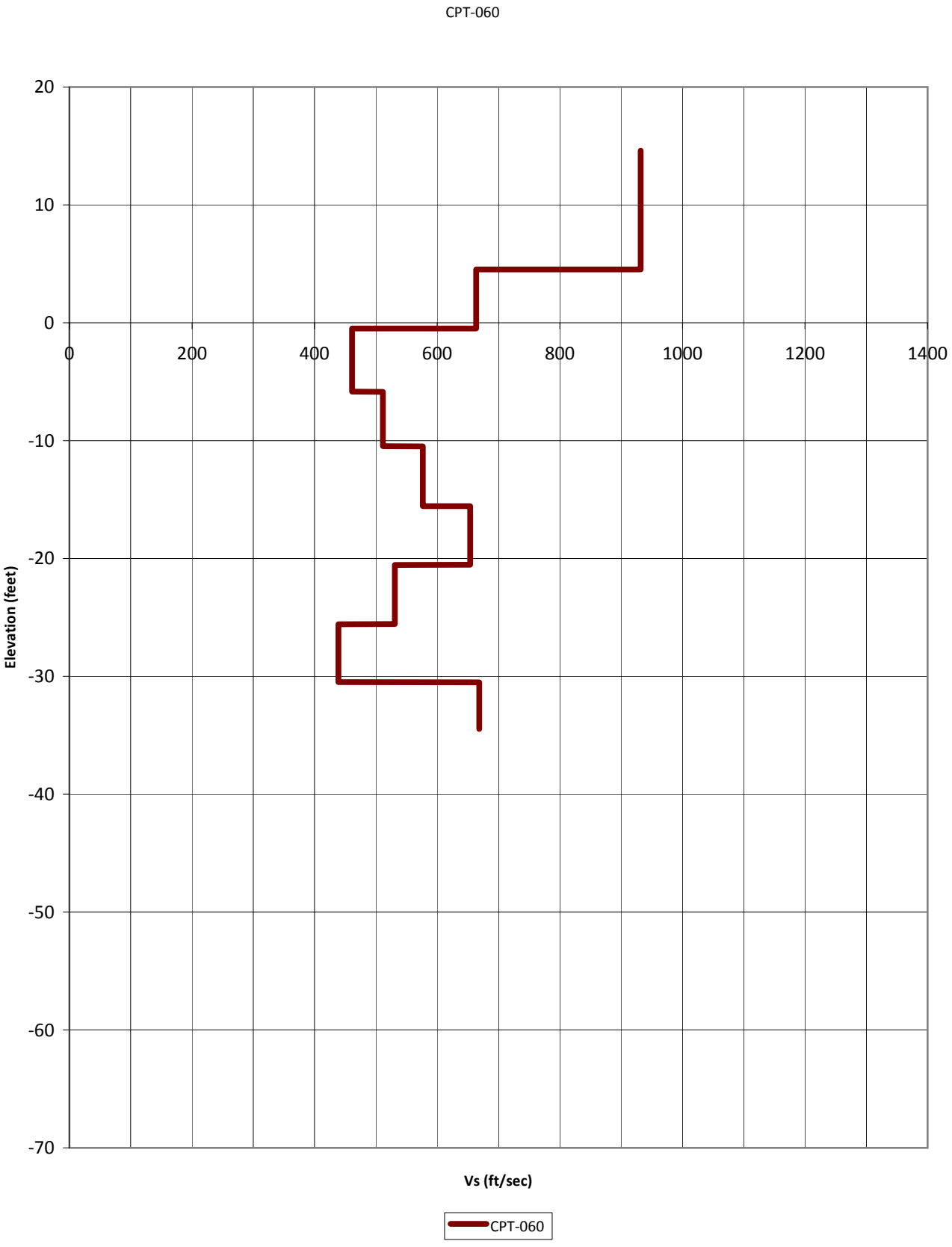
B1-983

PLATE D-15



Shear Wave Velocity Profile
West Area B

PLATE D-16

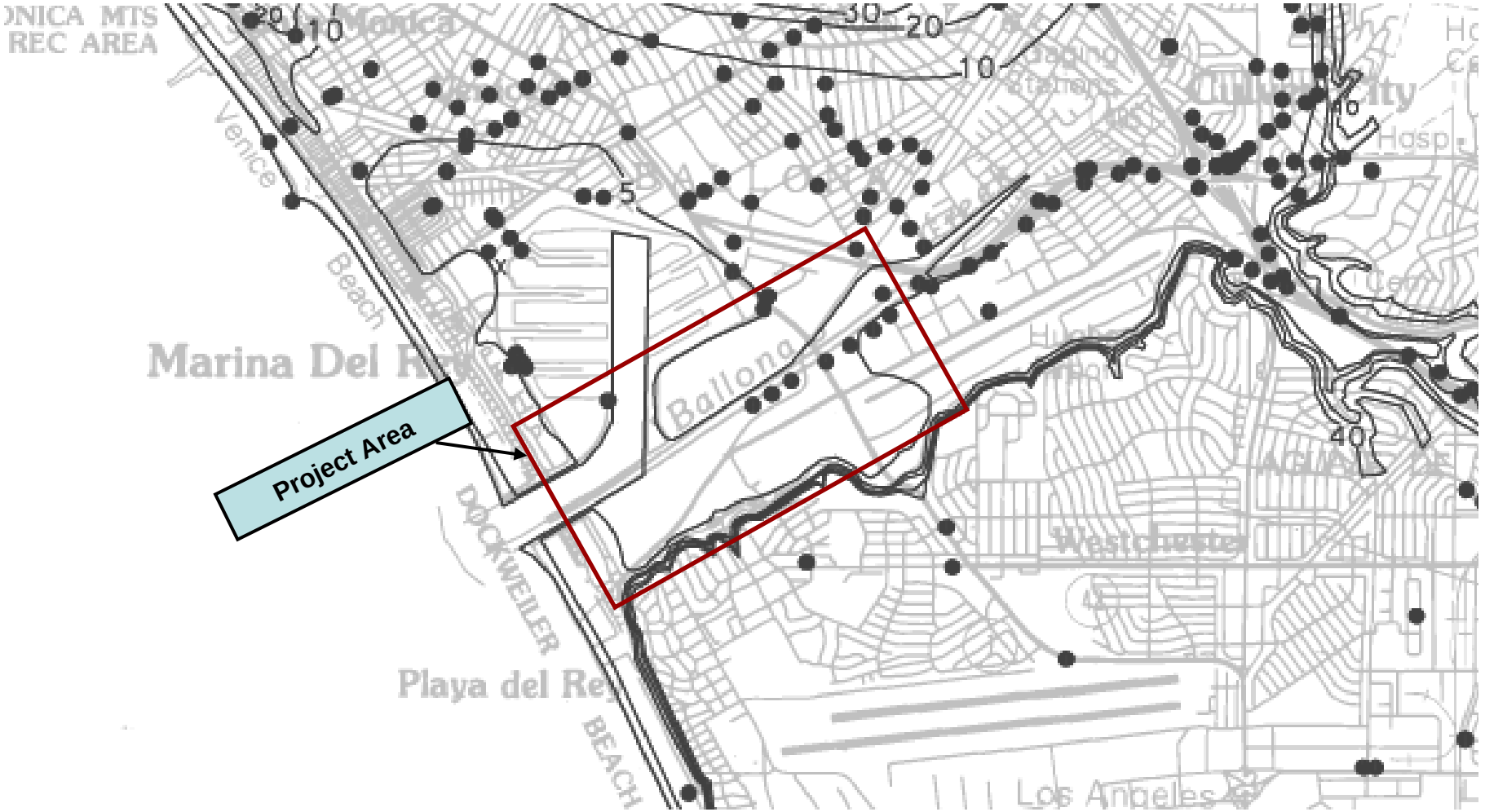


Shear Wave Velocity Profile

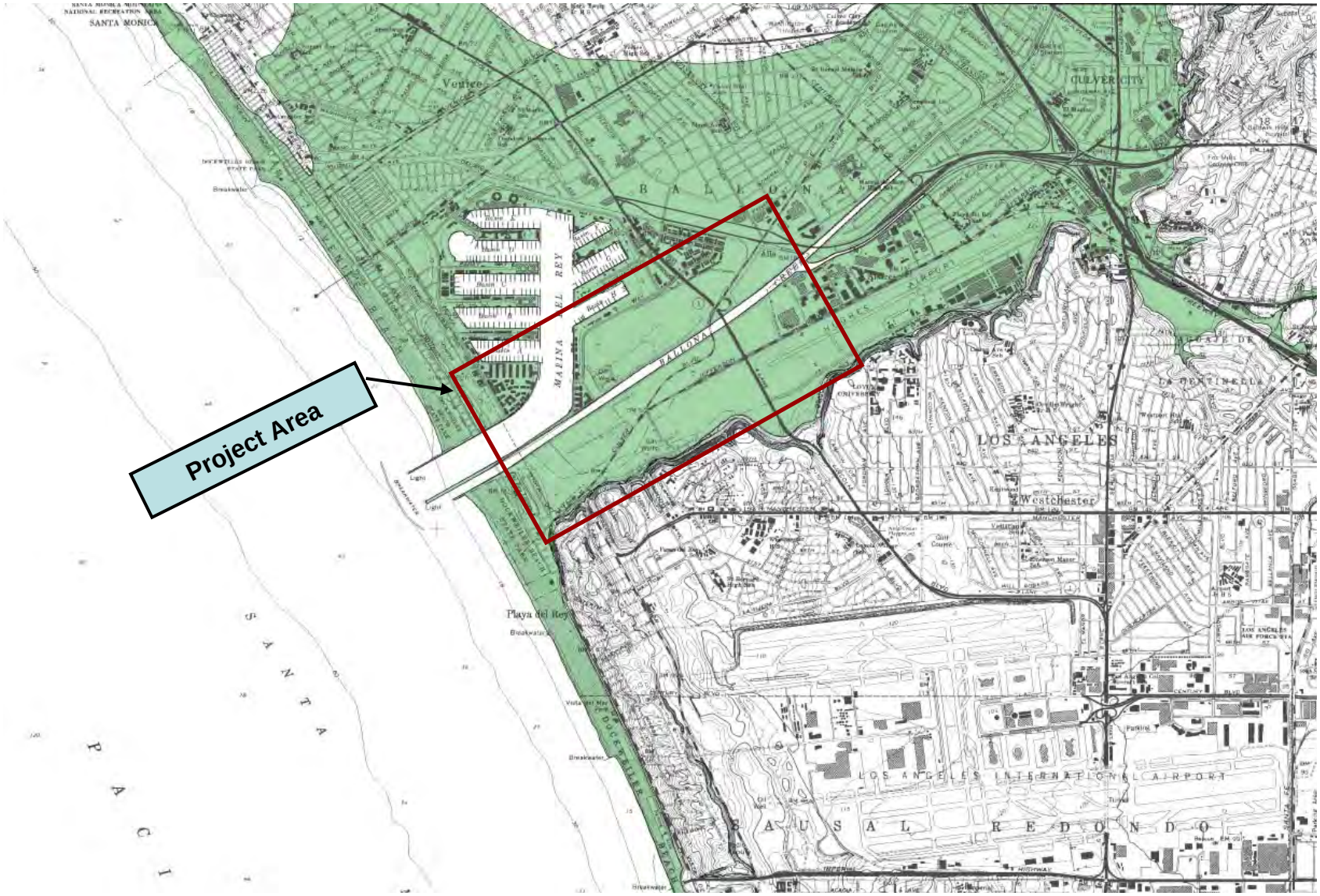
Area C

B1-985

PLATE D-17



GROUP DELTA CONSULTANTS	**CGS Historically Highest Ground Water Contour Map**	Project Number LA-962A Date: 11/9/2012
Group Delta Consultants. INC. 370 Amapola Ave. Torrance, Ca 90501	Ballona Creek Wetlands Restoration Project Marina Del Rey, CA	PLATE D-18



CGS Liquefaction Hazard Zone Map

Project Number LA-962A

Date: 11/9/2012

Group Delta Consultants. INC.
370 Amapola Ave.
Torrance, Ca 90501

Ballona Creek Wetlands Restoration Project
Marina Del Rey, CA

PLATE D-19



Plate 2.1 Landslide inventory, Shear Test Sample Locations, Venice Quadrangle.

shear test sample location landslide

GROUP DELTA CONSULTANTS

CGS Landslide Hazard Zone Map

Project Number LA-962A

Date: 11/9/2012

Group Delta Consultants. INC.
370 Amapola Ave.
Torrance, Ca 90501

Ballona Creek Wetlands Restoration Project
Marina Del Rey, CA

PLATE D-20

NavigateLA



GROUP DELTA CONSULTANTS	**Navigate LA – Faults Rupture Study Zones and Landslides**	Project Number LA-962A Date: 11/9/2012
Group Delta Consultants. INC. 370 Amapola Ave. Torrance, Ca 90501	Ballona Creek Wetlands Restoration Project Marina Del Rey, CA	PLATE D-21

APPENDIX E
LIQUEFACTION SETTLMENT AND LATERAL SPREADING

APPENDIX E
LIQUEFACTION SETTLEMENT AND LATERAL SPREADING

E.1 Contents

This appendix includes the results estimates of post liquefaction settlements within the site and lateral spreading displacements of the new levees.

Post liquefaction settlements were performed using the Youd et al. (2001) method for estimation of post liquefaction settlements using the results of the CPTs within the area. The analyses assume design earthquake parameters for a 224 year return period, and a design groundwater at El. +10 feet NAVD.

Lateral spreading displacements were estimated using Youd et al. (2002) method based on distances of about 300 and 1000 feet from the meander channel, as would be applicable for the new levees.

A list of the plates presented in this appendix follows:

Plate E-1 through E-29 Post-liquefaction Settlements based on CPTs
Plate E-30 and E-32 Range of Lateral Spreading Displacements for New Levees

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT001

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	17.80 ft
GWT Elev. During Test	0.30 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$

+++ $FS = (CRR_{7.5}/CSR)\ MSF\ K_\sigma\ K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	17.50 ft below ground surface
GWT Depth For Design, Zwd =	7.80 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	13.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	1.15 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	1.15 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_l (in.)	Cumulative Settlement Profile (in.)
0.50	188.17	1.56	0.83	sand	16.8	1.66	62	60	60	60	0.95	1.00	1,798.77	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	105.9	0.007	0.000	0.00	1.15
1.50	26.63	0.92	3.47	clayey silt to silty clay	15.8	1.00	13	180	180	180	2.33	2.04	181.14	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.15
2.50	14.13	0.41	2.86	clayey silt to silty clay	14.8	1.00	7	300	300	300	2.54	3.00	109.37	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.15
3.50	14.38	0.42	2.90	clayey silt to silty clay	13.8	1.00	7	420	420	420	2.60	3.31	104.00	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.15
4.50	14.98	0.45	2.99	clayey silt to silty clay	12.8	1.00	7	540	540	540	2.53	2.91	116.59	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.15
5.50	12.13	0.32	2.64	clayey silt to silty clay	11.8	1.00	6	660	660	660	2.61	N/A	N/A	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.15
6.50	11.68	0.24	2.05	clayey silt to silty clay	10.8	1.00	6	780	780	780	2.61	N/A	N/A	0.985	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.15
7.50	9.53	0.24	2.49	silty clay to clay	9.8	1.00	6	900	900	900	2.77	N/A	N/A	0.983	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.15
8.50	16.22	0.24	1.45	sandy silt to clayey silt	8.8	1.00	6	1,020	976	1,020	2.52	2.90	67.23	0.980	1.000	0.213	0.108	0.678	YES	2.8	11.9	428	15.9	N/A	0.181	0.02	1.13
9.50	16.05	0.16	1.02	sandy silt to clayey silt	7.8	1.00	6	1,140	1,034	1,140	2.46	2.57	57.29	0.978	1.000	0.224	0.097	0.580	YES	2.8	11.3	389	15.2	N/A	0.457	0.05	1.07
10.50	11.43	0.23	2.03	clayey silt to silty clay	6.8	1.00	6	1,260	1,092	1,260	2.70	N/A	N/A	0.976	N/A	0.234	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
11.50	7.85	0.21	2.72	silty clay to clay	5.8	1.00	5	1,380	1,149	1,380	2.93	N/A	N/A	0.973	N/A	0.243	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
12.50	8.32	0.16	1.93	clayey silt to silty clay	4.8	1.00	4	1,500	1,207	1,500	2.84	N/A	N/A	0.971	N/A	0.251	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
13.50	8.00	0.18	2.22	silty clay to clay	3.8	1.00	5	1,620	1,264	1,620	2.91	N/A	N/A	0.969	N/A	0.258	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
14.50	20.03	0.56	2.79	clayey silt to silty clay	2.8	1.66	17	1,740	1,322	1,740	2.36	2.17	88.36	0.966	1.000	0.265	0.144	0.727	YES	2.8	20.6	1,200	N/A	N/A	0.000	0.00	1.07
15.50	7.27	0.25	3.49	clay	1.8	1.00	7	1,860	1,380	1,860	3.08	N/A	N/A	0.964	N/A	0.270	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
16.50	6.73	0.19	2.86	clay	0.8	1.00	7	1,980	1,437	1,980	3.08	N/A	N/A	0.962	N/A	0.276	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
17.50	5.28	0.13	2.54	clay	-0.2	1.00	5	2,100	1,495	2,100	3.16	N/A	N/A	0.959	N/A	0.280	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
18.50	4.67	0.08	1.75	sensitive fine grained	-1.2	1.00	2	2,220	1,552	2,158	3.14	N/A	N/A	0.957	N/A	0.285	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
19.50	5.08	0.03	0.50	sensitive fine grained	-2.2	1.00	3	2,340	1,610	2,215	2.88	5.52	33.03	0.955	N/A	0.289	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
20.50	10.00	0.07	0.66	sandy silt to clayey silt	-3.2	1.00	4	2,460	1,668	2,273	2.65	3.64	41.68	0.952	N/A	0.292	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
21.50	5.32	0.04	0.78	sensitive fine grained	-4.2	1.00	3	2,580	1,725	2,330	2.97	N/A	N/A	0.950	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
22.50	5.40	0.04	0.80	sensitive fine grained	-5.2	1.00	3	2,700	1,783	2,388	2.97	N/A	N/A	0.948	N/A	0.298	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
23.50	5.22	0.02	0.38	sensitive fine grained	-6.2	1.00	3	2,820	1,840	2,446	2.88	5.54	30.74	0.945	N/A	0.301	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
24.50	7.50	0.06	0.75	sensitive fine grained	-7.2	1.00	4	2,940	1,898	2,503	2.84	5.15	40.17	0.943	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
25.50	6.18	0.04	0.69	sensitive fine grained	-8.2	1.00	3	3,060	1,956	2,561	2.92	5.92	37.26	0.941	N/A	0.306	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
26.50	7.02	0.10	1.39	clayey silt to silty clay	-9.2	1.00	4	3,180	2,013	2,618	3.01	N/A	N/A	0.938	N/A	0.308	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
27.50	11.82	0.10	0.84	sandy silt to clayey silt	-10.2	1.00	5	3,300	2,071	2,676	2.70	3.97	45.75	0.936	N/A	0.310	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
28.50	23.13	0.11	0.47	silty sand to sandy silt	-11.2	1.00	8	3,420	2,128	2,734	2.31	2.00	44.77	0.934	0.988	0.312	0.087	0.369	YES	2.8	9.4	280	12.9	N/A	2.145	0.26	0.82
29.50	44.48	0.48	1.07	silty sand to sandy silt	-12.2	1.00	15	3,540	2,186	2,791	2.23	1.76	74.69	0.931	0.977	0.314	0.119	0.493	YES	2.8	15.4	712	20.1	N/A	1.114	0.13	0.68
30.50	89.57	1.30	1.45	silty sand to sandy silt	-13.2	1.00	30	3,660	2,244	2,849	2.08	1.41	119.58	0.926	0.958	0.314	0.239	0.972	YES	2.8	27.8	1,200	35.0	N/A	0.033	0.00	0.68
31.50	130.97	2.44	1.86	silty sand to sandy silt	-14.2	1.66	72	3,780	2,301	2,906	1.73	1.06	213.46	0.918	0.945	0.314	N/A	N/A	NO	N/A	N/A	N/A	77.0	N/A	0.000	0.00	0.68
32.50	19.67	0.63	3.21	clayey silt to silty clay	-15.2	1.66	16	3,900	2,359	2,964	2.53	2.93	84.19	0.909	0.956	0.313	0.135	0.552	YES	2.8	16.2	791	N/A	N/A	0.000	0.00	0.68
33.50	8.57	0.13	1.53	clayey silt to silty clay	-16.2	1.00	4	4,020	2,416	3,022	3.01	N/A	N/A	0.901	N/A	0.312	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
34.50	8.80	0.12	1.36	clayey silt to silty clay	-17.2	1.00	4	4,140	2,474	3,079	2.98	N/A	N/A	0.893	N/A	0.311	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
35.50	8.67	0.15	1.67	clayey silt to silty clay	-18.2	1.00	4	4,260	2,532	3,137	3.05	N/A	N/A	0.885	N/A	0.310	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
36.50	8.65	0.14	1.57	clayey silt to silty clay	-19.2	1.00	4	4,380	2,589	3,194	3.04	N/A	N/A	0.877	N/A	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
37.50	10.43	0.20	1.83	clayey silt to silty clay	-20.2	1.00	5	4,500	2,647	3,252	3.00	N/A	N/A	0.869	N/A	0.307	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
38.50	38.50	0.48	1.24	silty sand to sandy silt	-21.2	1.00	13	4,620	2,704	3,310	2.37	2.18	72.34	0.861	0.931	0.306	0.115	0.468	YES	2.8	12.8	493	17.0	N/A	1.529	0.18	0.49
39.50	191.38	3.04	1.59	sand to silty sand	-22.2	1.00	48	4,740	2,762	3,367	1.90	1.19	193.95	0.852	0.879	0.304	N/A	N/A	NO	N/A	N/A	N/A	41.1	N/A	0.000	0.00	0.49
40.50	199.73	4.30	2.15	silty sand to sandy silt	-23.2	1.00	67	4,860	2,820	3,425	1.99	1.29	217.34	0.844	0.872	0.303	N/A	N/A	NO	N/A	N/A	N/A	66.1	N/A	0.000	0.00	0.49
41.50	101.99	2.26	2.21	silty sand to sandy silt	-24.2	1.66	56	4,980	2,877	3,482	1.89	1.18	166.16	0.836	0.865	0.301	N/A	N/A	NO	N/A	N/A	N/A	56.2	N/A	0.000	0.00	0.49
42.50	27.32	0.36	1.33	sandy silt to clayey silt	-25.2	1.00	11	5,100	2,935	3,540	2.57	3.12	63.93	0.828	0.921	0.299	0.104	0.428	YES	2.8	11.0	371	14.9	N/A	1.840	0.22	0.27
43.50	18.42	0.37	1.98	sandy silt to clayey silt	-26.2	1.00	7	5,220	2,992	3,598	2.82	N/A	N/A	0.820	N/A	0.298	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
44.50	14.42	0.34	2.34	clayey silt to silty clay	-27.2	1.00	7	5,340	3,050	3,655	2.97	N/A	N/A	0.812	N/A	0.296	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
45.50	14.82	0.58	3.87	silty clay to clay	-28.2	1.00	10	5,460	3,107	3,713	3.09	N/A	N/A	0.804	N/A	0.294	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
46.50	13.62	0.41	2.96	clayey silt to silty clay	-29.2	1.00	7	5,580	3,165	3,770	3.07	N/A	N/A	0.795	N/A	0.292	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
47.50	22.00	1.06	4.77	clay	-30.2	1.00	22	5,700	3,223	3,828	3.01	N/A	N/A	0.787	N/A	0.290	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
48.50	16.22	0.84	5.11	clay	-31.2	1.00	16	5,820	3,280	3,886	3.15	N/A	N/A	0.779	N/A	0.288	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
49.50	22.52	0.76	3.35	clayey silt to silty clay	-32.2	1.00	11	5,940	3,338	3,943	2.91	N/A	N/A	0.771	N/A	0.285	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
50.50	41.47	1.96	4.69	silty clay to clay	-33.2	1.00	28	6,060	3,395	4,001	2.79	N/A	N/A	0.763	N/A	0.283	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
51.50	49.78	1.18	2.35	sandy silt to clayey silt	-34.2	1.66	33	6,180	3,453	4,058	2.18	1.61	100.86	0.755	0.821	0.281	0.175	0.684	YES	2.8	25.9	1,200	32.8	N/A	0.041	0.00	0.27
52.50	21.00	0.58	2.73	clayey silt to silty clay	-35.2	1.00	11	6,300	3,511	4,116	2.90	N/A	N/A	0.747	N/A	0.279	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
53.50	29.18	1.03	3.51	clayey silt to silty clay	-36.2	1.00	15	6,420	3,568	4,174	2.85	N/A	N/A	0.739	N/A	0.276	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
54.50	19.02	0.68	3.53	silty clay to clay	-37.2	1.00	13	6,540	3,626	4,231	3.02	N/A	N/A	0.730	N/A	0.274	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
55.50	13.17	0.35	2.65	clayey silt to silty clay	-38.2	1.00	7	6,660	3,683	4,289	3.11	N/A	N/A	0.722	N/A	0.272	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
56.50	14.05	0.36	2.52	clayey silt to silty clay	-39.2	1.00	7	6,780	3,741	4,346	3.07	N/A	N/A	0.714	N/A	0.269	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
57.50	15.17	0.34	2.20	clayey silt to silty clay	-40.2	1.00	8	6,900	3,799	4,404	3.01	N/A	N/A	0.706	N/A	0.267	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
58.50	52.13	0.95	1.82	silty sand to sandy silt	-41.2	1.00	17	7,020	3,856	4,462	2.48	2.67	85.15	0.698	0.845	0.264	0.137	0.587	YES	2.8	14.4	629	19.0	N/A	0.289	0.03	0.23
59.50	92.83	0.93	1.00	sand to silty sand	-42.2	1.00	23	7,140	3,914	4,519	2.06	1.39	92.21	0.690	0.820	0.262	0.153	0.640	YES	1.3	16.8	850	18.7	N/A	0.308	0.04	0.20
60.50	72.43	0.70	0.96	sand to silty sand	-43.2	1.00	18	7,260	3,971	4,577	2.14	1.54	79.08	0.682	0.837	0.259	0.126	0.543	YES	1.3	13.3	534	15.0	N/A	1.643	0.20	0.00

max=	1,200
min=	280
avg=	698

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT004

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	17.00 ft
GWT Elev. During Test	0.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$

+++ $FS = (CRR_{7.5}/CSR)\ MSF\ K_\sigma\ K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	17.00 ft below ground surface
GWT Depth For Design, Zwd =	7.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	21.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	1.14 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	1.14 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +															RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_l (in.)	Cumulative Settlement Profile (in.)
0.50	47.68	1.31	2.74	sandy silt to clayey silt	16.0	1.66	32	60	60	60	1.65	1.00	457.98	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	69.4	N/A	N/A	N/A	1.14
1.50	23.57	0.89	3.79	silty clay to clay	15.0	1.66	26	180	180	180	2.08	1.42	185.19	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.14
2.50	6.97	0.29	4.12	clay	14.0	1.00	7	300	300	300	2.73	N/A	N/A	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.14
3.50	11.33	0.53	4.72	clay	13.0	1.66	19	420	420	420	2.50	2.78	113.99	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.14
4.50	4.33	0.22	5.12	clay	12.0	1.00	4	540	540	540	3.10	N/A	N/A	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.14
5.50	6.90	0.24	3.46	clay	11.0	1.00	7	660	660	660	2.88	N/A	N/A	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.14
6.50	7.58	0.26	3.36	clay	10.0	1.00	8	780	780	780	2.89	N/A	N/A	0.985	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.14
7.50	8.62	0.34	3.88	clay	9.0	1.00	9	900	869	900	2.91	N/A	N/A	0.983	N/A	0.212	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.14
8.50	6.52	0.23	3.44	clay	8.0	1.00	7	1,020	926	1,020	3.00	N/A	N/A	0.980	N/A	0.224	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.14
9.50	12.68	0.14	1.07	sandy silt to clayey silt	7.0	1.00	5	1,140	984	1,140	2.55	3.05	55.17	0.978	1.000	0.236	0.096	0.541	YES	2.8	9.5	286	13.1	N/A	2.037	0.24	0.90
10.50	30.49	0.28	0.91	silty sand to sandy silt	6.0	1.66	17	1,260	1,042	1,260	1.89	1.18	82.51	0.976	1.000	0.245	0.132	0.719	YES	2.8	24.0	1,200	30.4	N/A	0.048	0.01	0.89
11.50	8.35	0.13	1.58	clayey silt to silty clay	5.0	1.66	7	1,380	1,099	1,380	2.52	2.85	53.17	0.973	1.000	0.254	0.094	0.493	YES	2.8	11.1	378	N/A	N/A	0.000	0.00	0.89
12.50	4.17	0.06	1.44	sensitive fine grained	4.0	1.00	2	1,500	1,157	1,500	3.05	N/A	N/A	0.971	N/A	0.262	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.89
13.50	9.82	0.27	2.73	silty clay to clay	3.0	1.00	7	1,620	1,214	1,620	2.87	N/A	N/A	0.969	N/A	0.269	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.89
14.50	8.78	0.31	3.53	clay	2.0	1.00	9	1,740	1,272	1,740	2.99	N/A	N/A	0.966	N/A	0.275	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.89
15.50	16.15	0.37	2.31	clayey silt to silty clay	1.0	1.66	13	1,860	1,330	1,860	2.39	2.28	74.81	0.964	1.000	0.280	0.119	0.566	YES	2.8	16.7	839	N/A	N/A	0.000	0.00	0.89
16.50	8.07	0.22	2.77	silty clay to clay	0.0	1.00	5	1,980	1,387	1,980	2.99	N/A	N/A	0.962	N/A	0.285	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.89
17.50	7.65	0.19	2.48	silty clay to clay	-1.0	1.00	5	2,100	1,445	2,069	2.99	N/A	N/A	0.959	N/A	0.290	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.89
18.50	30.60	0.35	1.15	silty sand to sandy silt	-2.0	1.00	10	2,220	1,502	2,126	2.32	2.01	70.98	0.957	1.000	0.294	0.113	0.514	YES	2.8	12.7	487	16.9	N/A	1.496	0.18	0.71
19.50	36.17	0.34	0.95	silty sand to sandy silt	-3.0	1.00	12	2,340	1,560	2,184	2.22	1.71	70.01	0.955	1.000	0.298	0.112	0.501	YES	2.8	14.3	621	18.8	N/A	1.198	0.14	0.57
20.50	69.24	1.21	1.75	silty sand to sandy silt	-4.0	1.00	23	2,460	1,618	2,242	2.16	1.58	121.38	0.952	1.000	0.301	0.246	1.091	YES	2.8	24.6	1,200	31.2	N/A	0.055	0.01	0.56
21.50	68.00	1.06	1.56	silty sand to sandy silt	-5.0	1.00	23	2,580	1,675	2,299	2.14	1.53	113.79	0.950	1.000	0.304	0.217	0.952	YES	2.8	23.9	1,200	30.4	N/A	0.061	0.01	0.56
22.50	60.93	1.00	1.64	silty sand to sandy silt	-6.0	1.00	20	2,700	1,733	2,357	2.20	1.66	108.51	0.948	1.000	0.307	0.199	0.864	YES	2.8	21.5	1,200	27.5	N/A	0.080	0.01	0.55
23.50	88.15	1.53	1.73	silty sand to sandy silt	-7.0	1.00	29	2,820	1,790	2,414	2.10	1.45	135.18	0.945	1.000	0.310	0.310	1.335	NO	N/A	N/A	N/A	37.1	N/A	0.019	0.00	0.54
24.50	52.98	0.85	1.61	silty sand to sandy silt	-8.0	1.66	29	2,940	1,848	2,472	1.94	1.23	111.97	0.943	1.000	0.312	0.211	0.900	YES	2.8	29.1	1,200	36.6	N/A	0.022	0.00	0.54
25.50	21.53	0.37	1.73	sandy silt to clayey silt	-9.0	1.66	14	3,060	1,906	2,530	2.29	1.90	69.48	0.941	1.000	0.314	0.111	0.472	YES	2.8	15.5	725	20.2	N/A	1.095	0.13	0.41
26.50	6.75	0.17	2.42	silty clay to clay	-10.0	1.00	5	3,180	1,963	2,587	3.15	N/A	N/A	0.938	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
27.50	6.00	0.10	1.59	sensitive fine grained	-11.0	1.00	3	3,300	2,021	2,645	3.12	N/A	N/A	0.936	N/A	0.318	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
28.50	7.28	0.18	2.44	silty clay to clay	-12.0	1.00	5	3,420	2,078	2,702	3.14	N/A	N/A	0.934	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
29.50	7.20	0.18	2.42	silty clay to clay	-13.0	1.00	5	3,540	2,136	2,760	3.15	N/A	N/A	0.931	N/A	0.321	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
30.50	6.15	0.15	2.42	silty clay to clay	-14.0	1.00	4	3,660	2,194	2,818	3.24	N/A	N/A	0.926	N/A	0.321	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
31.50	6.23	0.12	1.89	silty clay to clay	-15.0	1.00	4	3,780	2,251	2,875	3.18	N/A	N/A	0.918	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
32.50	6.70	0.09	1.29	sensitive fine grained	-16.0	1.00	3	3,900	2,309	2,933	3.08	N/A	N/A	0.909	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
33.50	6.95	0.15	2.05	silty clay to clay	-17.0	1.00	5	4,020	2,366	2,990	3.17	N/A	N/A	0.901	N/A	0.318	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
34.50	6.75	0.15	2.04	silty clay to clay	-18.0	1.00	5	4,140	2,424	3,048	3.20	N/A	N/A	0.893	N/A	0.317	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
35.50	6.78	0.13	1.83	silty clay to clay	-19.0	1.00	5	4,260	2,482	3,106	3.19	N/A	N/A	0.885	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
36.50	7.58	0.18	2.16	silty clay to clay	-20.0	1.00	5	4,380	2,539	3,163	3.18	N/A	N/A	0.877	N/A	0.315	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
37.50	23.82	0.77	3.19	clayey silt to silty clay	-21.0	1.00	12	4,500	2,597	3,221	2.81	N/A	N/A	0.869	N/A	0.313	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
38.50	52.55	0.94	1.78	silty sand to sandy silt	-22.0	1.00	18	4,620	2,654	3,278	2.34	2.10	95.85	0.861	0.924	0.312	0.162	0.641	YES	2.8	16.5	821	21.4	N/A	0.405	0.05	0.36
39.50	113.20	1.99	1.76	silty sand to sandy silt	-23.0	1.00	38	4,740	2,712	3,336	2.09	1.44	139.83	0.852	0.885	0.310	0.334	1.274	YES	2.8	32.0	1,200	40.1	N/A	0.000	0.00	0.36
40.50	107.65	2.25	2.09	silty sand to sandy silt	-24.0	1.66	59	4,860	2,770	3,394	1.85	1.15	173.58	0.844	0.878	0.308	N/A	N/A	NO	N/A	N/A	N/A	59.7	N/A	0.000	0.00	0.36
41.50	35.81	0.76	2.12	sandy silt to clayey silt	-25.0	1.66	24	4,980	2,827	3,451	2.23	1.73	86.33	0.836	0.896	0.306	0.140	0.545	YES	2.8	20.9	1,200	26.7	N/A	0.085	0.01	0.35
42.50	10.73	0.36	3.36	silty clay to clay	-26.0	1.00	7	5,100	2,885	3,509	3.17	N/A	N/A	0.828	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.35
43.50	11.28	0.31	2.74	silty clay to clay	-27.0	1.00	8	5,220	2,942	3,566	3.10	N/A	N/A	0.820	N/A	0.303	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.35
44.50	9.95	0.30	3.01	silty clay to clay	-28.0	1.00	7	5,340	3,000	3,624	3.19	N/A	N/A	0.812	N/A	0.301	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.35
45.50	9.13	0.26	2.81	silty clay to clay	-29.0	1.00	6	5,460	3,058	3,682	3.22	N/A	N/A	0.804	N/A	0.298	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.35
46.50	11.53	0.39	3.28	silty clay to clay	-30.0	1.00	8	5,580	3,115	3,739	3.16	N/A	N/A	0.795	N/A	0.296	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.35
47.50	13.92	0.58	4.11	clay	-31.0	1.00	14	5,700	3,173	3,797	3.15	N/A	N/A	0.787	N/A	0.294	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.35
48.50	12.18	0.49	3.93	clay	-32.0	1.00	12	5,820	3,230	3,854	3.20	N/A	N/A	0.779	N/A	0.292	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.35
49.50	14.30	0.49	3.36	silty clay to clay	-33.0	1.00	10	5,940	3,288	3,912	3.09	N/A	N/A	0.771	N/A	0.290	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.35
50.50	41.67	0.92	2.20	sandy silt to clayey silt	-34.0	1.00	17	6,060	3,346	3,970	2.57	3.17	89.70	0.763	0.876	0.287	0.147	0.598	YES	2.8	14.6	647	19.2	N/A	1.029	0.12	0.23
51.50	63.07	1.52	2.40	sandy silt to clayey silt	-35.0	1.00	25	6,180	3,403	4,027	2.41	2.36	114.32	0.755	0.845	0.285	0.219	0.866	YES	2.8	20.6	1,200	26.3	N/A	0.080	0.01	0.22
52.50	82.49	1.60	1.94	silty sand to sandy silt	-36.0	1.00	27	6,300	3,461	4,085	2.26	1.84	115.25	0.747	0.835	0.283	0.222	0.876	YES	2.8	22.0	1,200	28.1	N/A	0.069	0.01	0.21
53.50	57.45	1.35	2.34	sandy silt to clayey silt	-37.0	1.66	38	6,420	3,518	4,142	2.13	1.51	108.12	0.739	0.804	0.280	0.198	0.756	YES	2.8	29.2	1,200	36.7	N/A	0.019	0.00	0.21
54.50	17.78	0.62	3.43	silty clay to clay	-38.0	1.00	12	6,540	3,576	4,200	3.04	N/A	N/A	0.730	N/A	0.278	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
55.50	24.25	0.60	2.42	sandy silt to clayey silt	-39.0	1.00	10	6,660	3,634	4,258	2.83	N/A	N/A	0.722	N/A	0.275	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
56.50	24.97	0.58	2.30	sandy silt to clayey silt	-40.0	1.00	10	6,780	3,691	4,315	2.81	N/A	N/A	0.714	N/A	0.273	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
57.50	75.28	0.93	1.24	sand to silty sand	-41.0	1.00	19	6,900	3,749	4,373	2.18	1.63	89.52	0.706	0.845	0.270	0.147	0.612	YES	1.3	14.1	597	15.8	N/A	1.532	0.18	0.02
58.50	102.48	1.58	1.54	silty sand to sandy silt	-42.0	1.00	34	7,020	3,806	4,430	2.14	1.53	113.99	0.698	0.794	0.268	0.218	0.861	YES	2.8	25.8	1,200	32.5	N/A	0.041	0.00	0.02
59.50	157.78	1.25	0.79	sand	-43.0	1.00	32	7,140	3,864	4,488	1.81	1.11	126.41	0.690	0.797	0.265	0.268	1.075	YES	0.0	21.1	1,200	21.1	N/A	0.119	0.01	0.00
60.50	175.23	2.32	1.32	sand to silty sand	-44.0	1.00	44	7,260	3,922	4,546	1.93	1.21	151.90	0.682	0.764	0.262	0.406	1.577	NO	N/A	N/A	N/A	33.0	N/A	0.038	0.00	0.00
																						max= 1,200					
																						min= 286					
																						avg= 943					

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	A-CPT007

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	15.30 ft
GWT Elev. During Test	0.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	15.30 ft below ground surface
GWT Depth For Design, Zwd =	5.30 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	13.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	1.06 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	1.06 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_i (in.)	Cumulative Settlement Profile (in.)
0.50	16.44	0.03	0.19	silty sand to sandy silt	14.3	1.00	5	60	60	60	1.57	1.00	94.92	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	16.2	0.012	0.026	0.00	1.06
1.50	19.10	0.11	0.60	sandy silt to clayey silt	13.3	1.00	8	180	180	180	1.94	1.23	78.40	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	20.6	N/A	N/A	N/A	1.06
2.50	12.52	0.28	2.26	clayey silt to silty clay	12.3	1.00	6	300	300	300	2.52	2.85	92.24	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.06
3.50	11.08	0.28	2.55	clayey silt to silty clay	11.3	1.00	6	420	420	420	2.52	2.87	102.38	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.06
4.50	9.28	0.27	2.96	silty clay to clay	10.3	1.00	6	540	540	540	2.69	N/A	N/A	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.06
5.50	33.18	0.72	2.18	sandy silt to clayey silt	9.3	1.00	13	660	648	660	2.31	1.99	116.03	0.987	1.000	0.209	0.225	1.436	NO	N/A	N/A	N/A	32.1	N/A	0.034	0.00	1.06
6.50	76.04	0.47	0.62	sand to silty sand	8.3	1.00	19	780	705	780	1.70	1.04	132.89	0.985	1.000	0.227	0.298	1.756	NO	N/A	N/A	N/A	34.4	N/A	0.026	0.00	1.05
7.50	50.91	0.33	0.64	sand to silty sand	7.3	1.00	13	900	763	900	1.87	1.16	95.44	0.983	1.000	0.241	0.161	0.890	YES	1.3	20.3	1,200	22.4	N/A	0.086	0.01	1.04
8.50	29.77	0.19	0.64	silty sand to sandy silt	6.3	1.00	16	1,020	820	1,020	1.78	1.00	76.97	0.980	1.000	0.254	0.122	0.644	YES	2.8	25.8	1,200	32.6	N/A	0.038	0.00	1.04
9.50	9.00	0.07	0.74	clayey silt to silty clay	5.3	1.00	7	1,140	878	1,140	2.29	1.00	22.49	0.978	1.000	0.264	0.069	0.347	YES	2.8	12.7	485	N/A	N/A	0.000	0.00	1.04
10.50	2.65	0.03	1.06	sensitive fine grained	4.3	1.00	1	1,260	936	1,260	3.11	N/A	N/A	0.976	N/A	0.273	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.04
11.50	2.58	0.03	0.98	sensitive fine grained	3.3	1.00	1	1,380	993	1,380	3.13	N/A	N/A	0.973	N/A	0.281	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.04
12.50	2.45	0.02	0.86	sensitive fine grained	2.3	1.00	1	1,500	1,051	1,500	3.16	N/A	N/A	0.971	N/A	0.288	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.04
13.50	2.50	0.02	0.80	sensitive fine grained	1.3	1.00	1	1,620	1,108	1,620	3.16	N/A	N/A	0.969	N/A	0.294	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.04
14.50	2.73	0.03	0.98	sensitive fine grained	0.3	1.00	1	1,740	1,166	1,740	3.18	N/A	N/A	0.966	N/A	0.300	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.04
15.50	4.39	0.10	2.16	clay	-0.7	1.00	4	1,860	1,224	1,848	3.14	N/A	N/A	0.964	N/A	0.305	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.04
16.50	5.58	0.12	2.08	silty clay to clay	-1.7	1.00	4	1,980	1,281	1,905	3.05	N/A	N/A	0.962	N/A	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.04
17.50	6.02	0.11	1.77	silty clay to clay	-2.7	1.00	4	2,100	1,339	1,963	2.99	N/A	N/A	0.959	N/A	0.313	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.04
18.50	6.98	0.15	2.17	silty clay to clay	-3.7	1.00	5	2,220	1,396	2,020	2.99	N/A	N/A	0.957	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.04
19.50	30.45	0.28	0.93	silty sand to sandy silt	-4.7	1.00	10	2,340	1,454	2,078	2.26	1.84	65.63	0.955	1.000	0.320	0.106	0.444	YES	2.8	12.8	492	16.9	N/A	1.576	0.19	0.85
20.50	20.71	0.11	0.52	silty sand to sandy silt	-5.7	1.66	11	2,460	1,512	2,136	2.01	1.00	39.44	0.952	1.000	0.322	0.083	0.343	YES	2.8	13.9	580	18.3	N/A	1.406	0.17	0.68
21.50	8.18	0.08	0.96	clayey silt to silty clay	-6.7	1.00	4	2,580	1,569	2,193	2.79	N/A	N/A	0.950	N/A	0.325	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
22.50	4.65	0.05	1.17	sensitive fine grained	-7.7	1.00	2	2,700	1,627	2,251	3.09	N/A	N/A	0.948	N/A	0.327	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
23.50	5.25	0.11	2.18	silty clay to clay	-8.7	1.00	3	2,820	1,684	2,308	3.18	N/A	N/A	0.945	N/A	0.329	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
24.50	5.40	0.07	1.35	sensitive fine grained	-9.7	1.00	3	2,940	1,742	2,366	3.08	N/A	N/A	0.943	N/A	0.331	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
25.50	5.46	0.07	1.28	sensitive fine grained	-10.7	1.00	3	3,060	1,800	2,424	3.07	N/A	N/A	0.941	N/A	0.333	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
26.50	5.81	0.07	1.19	sensitive fine grained	-11.7	1.00	3	3,180	1,857	2,481	3.04	N/A	N/A	0.938	N/A	0.334	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
27.50	6.76	0.11	1.67	silty clay to clay	-12.7	1.00	5	3,300	1,915	2,539	3.06	N/A	N/A	0.936	N/A	0.335	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
28.50	6.52	0.13	1.97	silty clay to clay	-13.7	1.00	4	3,420	1,972	2,596	3.12	N/A	N/A	0.934	N/A	0.337	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
29.50	5.42	0.07	1.34	sensitive fine grained	-14.7	1.00	3	3,540	2,030	2,654	3.13	N/A	N/A	0.931	N/A	0.338	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
30.50	6.22	0.12	1.91	silty clay to clay	-15.7	1.00	4	3,660	2,088	2,712	3.16	N/A	N/A	0.926	N/A	0.338	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
31.50	6.14	0.09	1.45	sensitive fine grained	-16.7	1.00	3	3,780	2,145	2,769	3.11	N/A	N/A	0.918	N/A	0.336	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
32.50	6.06	0.06	1.02	sensitive fine grained	-17.7	1.00	3	3,900	2,203	2,827	3.06	N/A	N/A	0.909	N/A	0.335	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
33.50	6.77	0.11	1.55	clayey silt to silty clay	-18.7	1.00	3	4,020	2,260	2,884	3.10	N/A	N/A	0.901	N/A	0.333	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
34.50	7.52	0.15	1.93	silty clay to clay	-19.7	1.00	5	4,140	2,318	2,942	3.11	N/A	N/A	0.893	N/A	0.332	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
35.50	7.49	0.13	1.67	clayey silt to silty clay	-20.7	1.00	4	4,260	2,376	3,000	3.09	N/A	N/A	0.885	N/A	0.330	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
36.50	8.44	0.12	1.40	clayey silt to silty clay	-21.7	1.00	4	4,380	2,433	3,057	3.01	N/A	N/A	0.877	N/A	0.328	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
37.50	11.92	0.22	1.82	clayey silt to silty clay	-22.7	1.00	6	4,500	2,491	3,115	2.92	N/A	N/A	0.869	N/A	0.326	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
38.50	8.47	0.21	2.43	silty clay to clay	-23.7	1.00	6	4,620	2,548	3,172	3.15	N/A	N/A	0.861	N/A	0.325	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
39.50	11.67	0.26	2.18	clayey silt to silty clay	-24.7	1.00	6	4,740	2,606	3,230	2.99	N/A	N/A	0.852	N/A	0.323	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
40.50	15.56	0.47	3.01	clayey silt to silty clay	-25.7	1.00	8	4,860	2,664	3,288	2.96	N/A	N/A	0.844	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
41.50	18.32	0.48	2.62	clayey silt to silty clay	-26.7	1.00	9	4,980	2,721	3,345	2.87	N/A	N/A	0.836	N/A	0.318	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
42.50	11.54	0.34	2.96	silty clay to clay	-27.7	1.00	8	5,100	2,779	3,403	3.09	N/A	N/A	0.828	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
43.50	12.07	0.29	2.37	clayey silt to silty clay	-28.7	1.00	6	5,220	2,836	3,460	3.03	N/A	N/A	0.820	N/A	0.314	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
44.50	9.54	0.26	2.71	silty clay to clay	-29.7	1.00	6	5,340	2,894	3,518	3.17	N/A	N/A	0.812	N/A	0.312	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
45.50	29.99	0.36	1.21	silty sand to sandy silt	-30.7	1.00	10	5,460	2,951	3,575	2.51	2.82	63.10	0.804	0.923	0.309	0.103	0.412	YES	2.8	10.3	327	14.0	N/A	1.982	0.24	0.44
46.50	23.30	0.36	1.53	sandy silt to clayey silt	-31.7	1.66	15	5,580	3,009	3,633	2.32	2.01	63.22	0.795	0.902	0.307	0.103	0.406	YES	2.8	14.2	613	18.7	N/A	1.268	0.15	0.29
47.50	10.97	0.28	2.52	clayey silt to silty clay	-32.7	1.00	5	5,700	3,067	3,691	3.11	N/A	N/A	0.787	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
48.50	9.54	0.25	2.65	silty clay to clay	-33.7	1.00	6	5,820	3,124	3,748	3.19	N/A	N/A	0.779	N/A	0.302	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
49.50	10.15	0.23	2.22	clayey silt to silty clay	-34.7	1.00	5	5,940	3,182	3,806	3.13	N/A	N/A	0.771	N/A	0.299	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
50.50	11.77	0.34	2.88	silty clay to clay	-35.7	1.00	8	6,060	3,239	3,863	3.13	N/A	N/A	0.763	N/A	0.297	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
51.50	11.06	0.27	2.45	clayey silt to silty clay	-36.7	1.00	6	6,180	3,297	3,921	3.13	N/A	N/A	0.755	N/A	0.294	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
52.50	15.43	0.94	6.10	clay	-37.7	1.00	15	6,300	3,355	3,979	3.23	N/A	N/A	0.747	N/A	0.292	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
53.50	22.38	0.45	2.01	sandy silt to clayey silt	-38.7	1.00	9	6,420	3,412	4,036	2.79	N/A	N/A	0.739	N/A	0.289	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
54.50	64.20	1.09	1.71	silty sand to sandy silt	-39.7	1.00	21	6,540	3,470	4,094	2.31	1.99	97.02	0.730	0.852	0.286	0.165	0.655	YES	2.8	17.8	950	22.9	N/A	0.101	0.01	0.28
55.50	137.03	1.24	0.91	sand	-40.7	1.00	27	6,660	3,527	4,151	1.88	1.17	120.69	0.722	0.831	0.284	0.243	0.951	YES	0.0	19.0	1,083	19.0	N/A	1.011	0.12	0.16
56.50	176.53	1.32	0.75	sand	-41.7	1.66	58	6,780	3,585	4,209	1.43	1.00	218.31	0.714	0.792	0.281	N/A	N/A	NO	N/A	N/A	N/A	40.3	N/A	0.000	0.00	0.16
57.50	49.22	0.61	1.23	silty sand to sandy silt	-42.7	1.00	16	6,900	3,643	4,267	2.33	2.06	75.16	0.706	0.860	0.278	0.119	0.493	YES	2.8	14.0	595	18.5	N/A	1.041	0.12	0.03
58.50	112.23	0.91	0.81	sand to silty sand	-43.7	1.00	28	7,020	3,700	4,324	1.93	1.22	100.36	0.698	0.817	0.275	0.174	0.689	YES	1.3	20.4	1,200	22.5	N/A	0.098	0.01	0.02
59.50	87.65	1.27	1.45	silty sand to sandy silt	-44.7	1.00	29	7,140	3,758	4,382	2.17	1.60	102.62	0.690	0.810	0.273	0.180	0.716	YES	2.8	22.5	1,200	28.7	N/A	0.063	0.01	0.01
60.50	65.28	0.75	1.15	silty sand to sandy silt	-45.7	1.00	22	7,260	3,815	4,439	2.22	1.72	81.12	0.682	0.831	0.270	0.130	0.533	YES	2.8	17.4	914	22.5	N/A	0.096	0.01	0.00
																						max=	1,200				
																						min=	327				
																						avg=	834				

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	A-CPT010

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	16.00 ft
GWT Elev. During Test	0.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw = 16.00 ft below ground surface

GWT Depth For Design, Zwd = 6.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils = 13.00 feet

Earthquake-Induced Settlements:

- Liquefaction-Induced Settlement = 1.32 inches <--- Saturated Sands
- Seismic Compaction Settlement = 0.00 inches <--- Dry or Unsaturated Sands

Total: 1.32 inches

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_t (in.)	Cumulative Settlement Profile (in.)
0.50	42.96	0.29	0.68	silty sand to sandy silt	15.0	1.00	14	60	60	60	1.51	1.00	248.00	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	34.2	0.009	0.008	0.00	1.32
1.50	31.23	0.10	0.32	silty sand to sandy silt	14.0	1.00	10	180	180	180	1.62	1.00	104.11	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	26.2	0.018	0.022	0.00	1.32
2.50	21.15	0.16	0.75	sandy silt to clayey silt	13.0	1.00	8	300	300	300	2.05	1.37	75.04	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	22.3	N/A	N/A	N/A	1.32
3.50	38.51	0.47	1.23	silty sand to sandy silt	12.0	1.66	21	420	420	420	1.72	1.05	146.04	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	48.4	0.022	0.000	0.00	1.32
4.50	17.39	0.49	2.80	clayey silt to silty clay	11.0	1.00	9	540	540	540	2.57	3.13	104.68	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.32
5.50	39.93	0.37	0.92	silty sand to sandy silt	10.0	1.66	22	660	660	660	1.71	1.04	120.12	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	50.0	0.027	0.000	0.00	1.32
6.50	15.32	0.40	2.60	clayey silt to silty clay	9.0	1.00	8	780	749	780	2.56	3.11	99.47	0.985	1.000	0.213	0.172	1.073	YES	2.8	15.1	686	N/A	N/A	0.000	0.00	1.32
7.50	25.22	0.25	1.00	silty sand to sandy silt	8.0	1.66	14	900	806	900	1.93	1.22	80.40	0.983	1.000	0.228	0.128	0.751	YES	2.8	23.5	1,200	29.9	N/A	0.047	0.01	1.32
8.50	5.77	0.12	2.13	silty clay to clay	7.0	1.00	4	1,020	864	1,020	2.91	N/A	N/A	0.980	N/A	0.241	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.32
9.50	3.40	0.05	1.34	sensitive fine grained	6.0	1.00	2	1,140	922	1,140	3.04	N/A	N/A	0.978	N/A	0.252	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.32
10.50	6.97	0.27	3.81	clay	5.0	1.00	7	1,260	979	1,260	3.02	N/A	N/A	0.976	N/A	0.261	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.32
11.50	8.93	0.24	2.71	silty clay to clay	4.0	1.00	6	1,380	1,037	1,380	2.86	N/A	N/A	0.973	N/A	0.269	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.32
12.50	32.10	0.23	0.70	silty sand to sandy silt	3.0	1.66	18	1,500	1,094	1,500	1.83	1.00	71.85	0.971	1.000	0.277	0.114	0.552	YES	2.8	23.3	1,200	29.5	N/A	0.059	0.01	1.31
13.50	15.59	0.18	1.15	sandy silt to clayey silt	2.0	1.00	6	1,620	1,152	1,620	2.52	2.87	59.03	0.969	1.000	0.283	0.099	0.467	YES	2.8	9.7	297	13.3	N/A	2.083	0.25	1.06
14.50	19.87	0.25	1.24	sandy silt to clayey silt	1.0	1.66	13	1,740	1,210	1,740	2.15	1.55	65.57	0.966	1.000	0.289	0.106	0.490	YES	2.8	16.9	864	21.9	N/A	0.160	0.02	1.04
15.50	9.47	0.15	1.62	clayey silt to silty clay	0.0	1.00	5	1,860	1,267	1,860	2.77	N/A	N/A	0.964	N/A	0.294	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.04
16.50	4.99	0.10	2.00	silty clay to clay	-1.0	1.00	3	1,980	1,325	1,949	3.09	N/A	N/A	0.962	N/A	0.299	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.04
17.50	24.30	0.16	0.67	silty sand to sandy silt	-2.0	1.00	8	2,100	1,382	2,006	2.27	1.86	54.25	0.959	1.000	0.303	0.095	0.418	YES	2.8	10.9	363	14.7	N/A	1.869	0.22	0.82
18.50	19.55	0.17	0.87	sandy silt to clayey silt	-3.0	1.00	8	2,220	1,440	2,064	2.42	2.39	54.97	0.957	1.000	0.307	0.095	0.415	YES	2.8	10.5	340	14.2	N/A	1.942	0.23	0.58
19.50	17.39	0.13	0.76	sandy silt to clayey silt	-4.0	1.00	7	2,340	1,498	2,122	2.44	2.50	50.27	0.955	1.000	0.310	0.092	0.395	YES	2.8	9.6	288	13.1	N/A	2.115	0.25	0.33
20.50	25.65	0.15	0.57	silty sand to sandy silt	-5.0	1.66	14	2,460	1,555	2,179	1.95	1.00	48.15	0.952	1.000	0.313	0.090	0.384	YES	2.8	16.4	809	21.3	N/A	0.456	0.05	0.27
21.50	5.06	0.08	1.65	sensitive fine grained	-6.0	1.00	3	2,580	1,613	2,237	3.12	N/A	N/A	0.950	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
22.50	5.09	0.08	1.50	sensitive fine grained	-7.0	1.00	3	2,700	1,670	2,294	3.11	N/A	N/A	0.948	N/A	0.319	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
23.50	5.91	0.10	1.73	silty clay to clay	-8.0	1.00	4	2,820	1,728	2,352	3.08	N/A	N/A	0.945	N/A	0.321	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
24.50	5.47	0.07	1.29	sensitive fine grained	-9.0	1.00	3	2,940	1,786	2,410	3.07	N/A	N/A	0.943	N/A	0.323	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
25.50	6.18	0.10	1.67	silty clay to clay	-10.0	1.00	4	3,060	1,843	2,467	3.08	N/A	N/A	0.941	N/A	0.325	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
26.50	5.54	0.09	1.54	sensitive fine grained	-11.0	1.00	3	3,180	1,901	2,525	3.12	N/A	N/A	0.938	N/A	0.326	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
27.50	5.63	0.11	1.91	silty clay to clay	-12.0	1.00	4	3,300	1,958	2,582	3.17	N/A	N/A	0.936	N/A	0.328	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
28.50	5.80	0.09	1.48	sensitive fine grained	-13.0	1.00	3	3,420	2,016	2,640	3.12	N/A	N/A	0.934	N/A	0.329	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
29.50	6.12	0.07	1.08	sensitive fine grained	-14.0	1.00	3	3,540	2,074	2,698	3.04	N/A	N/A	0.931	N/A	0.331	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
30.50	8.23	0.23	2.74	silty clay to clay	-15.0	1.00	5	3,660	2,131	2,755	3.12	N/A	N/A	0.926	N/A	0.331	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
31.50	9.70	0.29	3.03	silty clay to clay	-16.0	1.00	6	3,780	2,189	2,813	3.09	N/A	N/A	0.918	N/A	0.330	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
32.50	29.05	0.64	2.21	sandy silt to clayey silt	-17.0	1.66	19	3,900	2,246	2,870	2.27	1.85	84.04	0.909	0.966	0.328	0.135	0.530	YES	2.8	18.9	1,066	24.3	N/A	0.159	0.02	0.26
33.50	9.35	0.24	2.61	silty clay to clay	-18.0	1.00	6	4,020	2,304	2,928	3.08	N/A	N/A	0.901	N/A	0.327	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.26
34.50	10.28	0.35	3.41	silty clay to clay	-19.0	1.00	7	4,140	2,362	2,986	3.12	N/A	N/A	0.893	N/A	0.326	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.26
35.50	10.39	0.34	3.27	silty clay to clay	-20.0	1.00	7	4,260	2,419	3,043	3.11	N/A	N/A	0.885	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.26
36.50	9.21	0.29	3.14	silty clay to clay	-21.0	1.00	6	4,380	2,477	3,101	3.16	N/A	N/A	0.877	N/A	0.323	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.26
37.50	26.36	0.86	3.27	clayey silt to silty clay	-22.0	1.66	22	4,500	2,534	3,158	2.43	2.44	94.59	0.869	0.929	0.321	0.159	0.613	YES	2.8	20.2	1,200	N/A	N/A	0.000	0.00	0.26
38.50	8.63	0.34	3.91	clay	-23.0	1.00	9	4,620	2,592	3,216	3.26	N/A	N/A	0.861	N/A	0.319	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.26
39.50	9.98	0.40	4.00	clay	-24.0	1.00	10	4,740	2,650	3,274	3.21	N/A	N/A	0.852	N/A	0.317	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.26
40.50	11.57	0.42	3.59	silty clay to clay	-25.0	1.00	8	4,860	2,707	3,331	3.13	N/A	N/A	0.844	N/A	0.315	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.26
41.50	14.74	0.30	2.03	clayey silt to silty clay	-26.0	1.00	7	4,980	2,765	3,389	2.89	N/A	N/A	0.836	N/A	0.313	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.26
42.50	18.09	0.36	1.97	sandy silt to clayey silt	-27.0	1.66	12	5,100	2,822	3,446	2.49	2.73	63.18	0.828	0.925	0.311	0.103	0.410	YES	2.8	11.9	431	16.0	N/A	1.695	0.20	0.05
43.50	8.72	0.29	3.31	clay	-28.0	1.00	9	5,220	2,880	3,504	3.26	N/A	N/A	0.820	N/A	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
44.50	8.45	0.32	3.77	clay	-29.0	1.00	8	5,340	2,938	3,562	3.31	N/A	N/A	0.812	N/A	0.307	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
45.50	7.98	0.21	2.59	silty clay to clay	-30.0	1.00	5	5,460	2,995	3,619	3.25	N/A	N/A	0.804	N/A	0.305	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
46.50	8.93	0.21	2.31	silty clay to clay	-31.0	1.00	6	5,580	3,053	3,677	3.18	N/A	N/A	0.795	N/A	0.302	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
47.50	10.48	0.34	3.23	silty clay to clay	-32.0	1.00	7	5,700	3,110	3,734	3.20	N/A	N/A	0.787	N/A	0.300	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
48.50	10.73	0.50	4.63	clay	-33.0	1.00	11	5,820	3,168	3,792	3.29	N/A	N/A	0.779	N/A	0.298	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
49.50	9.21	0.31	3.41	clay	-34.0	1.00	9	5,940	3,226	3,850	3.28	N/A	N/A	0.771	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
50.50	94.10	0.80	0.85	sand to silty sand	-35.0	1.00	24	6,060	3,283	3,907	1.98	1.28	93.81	0.763	0.859	0.293	0.157	0.613	YES	1.3	18.2	993	20.1	N/A	0.427	0.05	0.00

	max=	1,200
	min=	288
	avg=	749

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	A-CPT012

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	13.80 ft
GWT Elev. During Test	0.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	13.80 ft below ground surface
GWT Depth For Design, Zwd =	3.80 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	11.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	1.47 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	1.47 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_l (in.)	Cumulative Settlement Profile (in.)
0.50	24.82	0.14	0.55	silty sand to sandy silt	12.8	1.00	8	60	60	60	1.63	1.00	143.28	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	21.9	0.011	0.016	0.00	1.47
1.50	17.96	0.31	1.75	sandy silt to clayey silt	11.8	1.00	7	180	180	180	2.24	1.77	105.76	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	19.7	N/A	N/A	N/A	1.47
2.50	17.84	0.43	2.43	clayey silt to silty clay	10.8	1.00	9	300	300	300	2.42	2.39	110.19	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
3.50	12.61	0.47	3.71	silty clay to clay	9.8	1.00	8	420	420	420	2.59	3.25	131.98	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
4.50	11.08	0.41	3.69	clay	8.8	1.00	11	540	496	540	2.67	N/A	N/A	0.990	N/A	0.224	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
5.50	10.27	0.44	4.33	clay	7.8	1.00	10	660	554	660	2.77	N/A	N/A	0.987	N/A	0.245	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
6.50	13.97	0.46	3.32	silty clay to clay	6.8	1.00	9	780	612	780	2.61	N/A	N/A	0.985	N/A	0.261	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
7.50	9.15	0.46	5.02	clay	5.8	1.00	9	900	669	900	2.90	N/A	N/A	0.983	N/A	0.275	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
8.50	19.39	0.33	1.69	sandy silt to clayey silt	4.8	1.00	8	1,020	727	1,020	2.45	2.51	80.63	0.980	1.000	0.286	0.129	0.600	YES	2.8	13.7	563	18.0	N/A	1.227	0.15	1.33
9.50	13.18	0.17	1.32	sandy silt to clayey silt	3.8	1.00	9	1,140	784	1,140	2.24	1.76	61.33	0.978	1.000	0.296	0.101	0.458	YES	2.8	14.4	623	18.9	N/A	1.177	0.14	1.19
10.50	4.06	0.15	3.68	clay	2.8	1.00	4	1,260	842	1,260	3.18	N/A	N/A	0.976	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.19
11.50	7.84	0.21	2.69	silty clay to clay	1.8	1.00	5	1,380	900	1,380	2.87	N/A	N/A	0.973	N/A	0.311	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.19
12.50	26.73	0.38	1.44	sandy silt to clayey silt	0.8	1.00	18	1,500	957	1,500	2.03	1.34	85.96	0.971	1.000	0.316	0.139	0.586	YES	2.8	23.2	1,200	29.5	N/A	0.069	0.01	1.18
13.50	6.36	0.14	2.14	silty clay to clay	-0.2	1.00	4	1,620	1,015	1,620	2.93	N/A	N/A	0.969	N/A	0.322	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.18
14.50	4.23	0.08	1.88	silty clay to clay	-1.2	1.00	3	1,740	1,072	1,696	3.08	N/A	N/A	0.966	N/A	0.326	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.18
15.50	6.58	0.06	0.97	sensitive fine grained	-2.2	1.00	3	1,860	1,130	1,754	2.78	N/A	N/A	0.964	N/A	0.330	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.18
16.50	11.25	0.10	0.90	sandy silt to clayey silt	-3.2	1.00	7	1,980	1,188	1,812	2.30	1.96	47.45	0.962	1.000	0.333	0.090	0.358	YES	2.8	10.6	347	14.4	N/A	1.931	0.23	0.95
17.50	4.83	0.03	0.65	sensitive fine grained	-4.2	1.00	2	2,100	1,245	1,869	2.87	5.37	37.00	0.959	N/A	0.336	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.95
18.50	5.79	0.07	1.16	sensitive fine grained	-5.2	1.00	3	2,220	1,303	1,927	2.91	N/A	N/A	0.957	N/A	0.339	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.95
19.50	7.67	0.13	1.73	clayey silt to silty clay	-6.2	1.00	4	2,340	1,360	1,984	2.90	N/A	N/A	0.955	N/A	0.342	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.95
20.50	8.52	0.14	1.66	clayey silt to silty clay	-7.2	1.00	4	2,460	1,418	2,042	2.86	N/A	N/A	0.952	N/A	0.344	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.95
21.50	9.05	0.14	1.57	clayey silt to silty clay	-8.2	1.00	5	2,580	1,476	2,100	2.83	N/A	N/A	0.950	N/A	0.345	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.95
22.50	7.40	0.13	1.79	silty clay to clay	-9.2	1.00	5	2,700	1,533	2,157	2.96	N/A	N/A	0.948	N/A	0.347	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.95
23.50	8.48	0.13	1.51	clayey silt to silty clay	-10.2	1.00	4	2,820	1,591	2,215	2.88	N/A	N/A	0.945	N/A	0.349	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.95
24.50	9.64	0.31	3.17	silty clay to clay	-11.2	1.00	6	2,940	1,648	2,272	3.01	N/A	N/A	0.943	N/A	0.350	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.95
25.50	9.70	0.31	3.18	silty clay to clay	-12.2	1.00	6	3,060	1,706	2,330	3.02	N/A	N/A	0.941	N/A	0.351	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.95
26.50	7.97	0.26	3.22	clay	-13.2	1.00	8	3,180	1,764	2,388	3.12	N/A	N/A	0.938	N/A	0.352	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.95
27.50	7.46	0.22	2.92	clay	-14.2	1.00	7	3,300	1,821	2,445	3.13	N/A	N/A	0.936	N/A	0.353	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.95
28.50	8.94	0.18	2.04	clayey silt to silty clay	-15.2	1.00	4	3,420	1,879	2,503	2.98	N/A	N/A	0.934	N/A	0.353	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.95
29.50	46.97	1.41	3.00	sandy silt to clayey silt	-16.2	1.00	19	3,540	1,936	2,560	2.48	2.66	127.14	0.931	1.000	0.354	0.271	1.022	YES	2.8	19.4	1,123	24.9	N/A	0.195	0.02	0.92
30.50	26.33	0.55	2.09	sandy silt to clayey silt	-17.2	1.00	11	3,660	1,994	2,618	2.58	3.22	84.89	0.926	1.000	0.353	0.137	0.517	YES	2.8	12.0	437	16.0	N/A	1.748	0.21	0.71
31.50	16.33	0.49	2.98	clayey silt to silty clay	-18.2	1.00	8	3,780	2,052	2,676	2.86	N/A	N/A	0.918	N/A	0.352	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.71
32.50	24.22	0.42	1.74	sandy silt to clayey silt	-19.2	1.00	10	3,900	2,109	2,733	2.58	3.21	74.80	0.909	0.989	0.350	0.119	0.448	YES	2.8	11.1	375	14.9	N/A	1.873	0.22	0.49
33.50	20.00	0.52	2.59	clayey silt to silty clay	-20.2	1.00	10	4,020	2,167	2,791	2.76	N/A	N/A	0.901	N/A	0.348	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.49
34.50	21.24	0.36	1.70	sandy silt to clayey silt	-21.2	1.00	8	4,140	2,224	2,848	2.64	N/A	N/A	0.893	N/A	0.346	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.49
35.50	13.79	0.12	0.87	sandy silt to clayey silt	-22.2	1.00	6	4,260	2,282	2,906	2.67	N/A	N/A	0.885	N/A	0.344	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.49
36.50	23.17	0.32	1.36	sandy silt to clayey silt	-23.2	1.00	9	4,380	2,340	2,964	2.57	3.14	64.71	0.877	0.968	0.341	0.105	0.398	YES	2.8	10.4	335	14.1	N/A	1.965	0.24	0.25
37.50	36.54	0.53	1.45	silty sand to sandy silt	-24.2	1.00	12	4,500	2,397	3,021	2.40	2.32	77.53	0.869	0.958	0.339	0.123	0.465	YES	2.8	12.7	488	16.9	N/A	1.629	0.20	0.06
38.50	29.82	0.47	1.58	sandy silt to clayey silt	-25.2	1.66	20	4,620	2,455	3,079	2.19	1.65	73.37	0.861	0.941	0.337	0.117	0.435	YES	2.8	18.7	1,051	24.1	N/A	0.189	0.02	0.03
39.50	13.32	0.30	2.23	clayey silt to silty clay	-26.2	1.00	7	4,740	2,512	3,136	2.93	N/A	N/A	0.852	N/A	0.335	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.03
40.50	12.01	0.19	1.56	clayey silt to silty clay	-27.2	1.00	6	4,860	2,570	3,194	2.90	N/A	N/A	0.844	N/A	0.332	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.03
41.50	9.60	0.27	2.82	silty clay to clay	-28.2	1.00	6	4,980	2,627	3,251	3.14	N/A	N/A	0.836	N/A	0.330	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.03
42.50	10.70	0.32	3.00	silty clay to clay	-29.2	1.00	7	5,100	2,685	3,309	3.12	N/A	N/A	0.828	N/A	0.327	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.03
43.50	12.89	0.70	5.46	clay	-30.2	1.00	13	5,220	2,743	3,367	3.21	N/A	N/A	0.820	N/A	0.325	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.03
44.50	11.44	0.37	3.20	silty clay to clay	-31.2	1.00	8	5,340	2,800	3,424	3.12	N/A	N/A	0.812	N/A	0.322	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.03
45.50	29.29	0.92	3.13	clayey silt to silty clay	-32.2	1.00	15	5,460	2,858	3,482	2.75	N/A	N/A	0.804	N/A	0.319	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.03
46.50	104.71	1.47	1.41	sand to silty sand	-33.2	1.00	26	5,580	2,915	3,539	2.06	1.39	120.53	0.795	0.882	0.317	0.243	0.903	YES	1.3	21.0	1,200	23.1	N/A	0.181	0.02	0.01
47.50	188.21	1.16	0.61	sand	-34.2	1.00	38	5,700	2,973	3,597	1.63	1.00	154.37	0.787	0.854	0.314	0.422	1.532	NO	N/A	N/A	N/A	28.1	N/A	0.078	0.01	0.00

max=	1,200
min=	335
avg=	704

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	A-CPT014

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	16.00 ft
GWT Elev. During Test	0.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw = 16.00 ft below ground surface

GWT Depth For Design, Zwd = 6.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils = 14.00 feet

Earthquake-Induced Settlements:

- Liquefaction-Induced Settlement = 0.83 inches <--- Saturated Sands
- Seismic Compaction Settlement = 0.00 inches <--- Dry or Unsaturated Sands

Total: 0.83 inches

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_t (in.)	Cumulative Settlement Profile (in.)
0.50	8.66	0.05	0.54	sensitive fine grained	15.0	1.00	4	60	60	60	2.01	1.31	65.54	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.83
1.50	54.88	0.17	0.32	sand to silty sand	14.0	1.66	23	180	180	180	1.11	1.00	302.88	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	43.0	0.015	0.000	0.00	0.83
2.50	25.56	0.33	1.27	sandy silt to clayey silt	13.0	1.00	10	300	300	300	2.12	1.49	98.29	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	25.9	N/A	N/A	N/A	0.83
3.50	24.49	0.93	3.81	silty clay to clay	12.0	1.00	16	420	420	420	2.51	2.81	150.22	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.83
4.50	33.69	1.31	3.90	clayey silt to silty clay	11.0	1.00	17	540	540	540	2.46	2.56	166.27	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.83
5.50	27.89	1.37	4.89	clay	10.0	1.00	28	660	660	660	2.54	2.96	189.59	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.83
6.50	23.82	0.87	3.67	silty clay to clay	9.0	1.00	16	780	749	780	2.60	3.31	128.68	0.985	1.000	0.213	0.278	1.739	NO	N/A	N/A	N/A	N/A	N/A	0.000	0.00	0.83
7.50	20.13	0.84	4.16	silty clay to clay	8.0	1.00	13	900	806	900	2.63	N/A	N/A	0.983	N/A	0.228	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.83
8.50	17.54	0.53	3.01	clayey silt to silty clay	7.0	1.00	9	1,020	864	1,020	2.60	3.31	108.80	0.980	1.000	0.241	0.200	1.107	YES	2.8	15.1	687	N/A	N/A	0.000	0.00	0.83
9.50	12.87	0.53	4.14	clay	6.0	1.00	13	1,140	922	1,140	2.81	N/A	N/A	0.978	N/A	0.252	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.83
10.50	8.69	0.37	4.30	clay	5.0	1.00	9	1,260	979	1,260	2.97	N/A	N/A	0.976	N/A	0.261	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.83
11.50	11.48	0.48	4.21	clay	4.0	1.00	11	1,380	1,037	1,380	2.89	N/A	N/A	0.973	N/A	0.269	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.83
12.50	22.82	0.42	1.85	sandy silt to clayey silt	3.0	1.66	15	1,500	1,094	1,500	2.18	1.61	82.20	0.971	1.000	0.277	0.132	0.635	YES	2.8	20.3	1,200	25.9	N/A	0.079	0.01	0.82
13.50	8.02	0.33	4.05	clay	2.0	1.00	8	1,620	1,152	1,620	3.03	N/A	N/A	0.969	N/A	0.283	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.82
14.50	40.27	0.54	1.34	silty sand to sandy silt	1.0	1.00	13	1,740	1,210	1,740	2.22	1.71	88.72	0.966	1.000	0.289	0.145	0.669	YES	2.8	17.2	893	22.3	N/A	0.143	0.02	0.80
15.50	78.51	0.64	0.81	sand to silty sand	0.0	1.00	20	1,860	1,267	1,860	1.86	1.16	113.95	0.964	1.000	0.294	0.218	0.987	YES	1.3	21.7	1,200	23.8	N/A	0.098	0.01	0.79
16.50	72.42	0.74	1.02	sand to silty sand	-1.0	1.00	18	1,980	1,325	1,949	1.96	1.25	111.32	0.962	1.000	0.299	0.208	0.930	YES	1.3	19.7	1,152	21.7	N/A	0.199	0.02	0.77
17.50	47.27	0.58	1.23	silty sand to sandy silt	-2.0	1.66	26	2,100	1,382	2,006	1.85	1.15	108.18	0.959	1.000	0.303	0.198	0.871	YES	2.8	28.8	1,200	36.3	N/A	0.024	0.00	0.76
18.50	9.68	0.33	3.36	clay	-3.0	1.00	10	2,220	1,440	2,064	2.98	N/A	N/A	0.957	N/A	0.307	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.76
19.50	10.83	0.27	2.52	silty clay to clay	-4.0	1.00	7	2,340	1,498	2,122	2.88	N/A	N/A	0.955	N/A	0.310	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.76
20.50	7.38	0.15	1.97	silty clay to clay	-5.0	1.00	5	2,460	1,555	2,179	2.98	N/A	N/A	0.952	N/A	0.313	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.76
21.50	6.06	0.04	0.71	sensitive fine grained	-6.0	1.00	3	2,580	1,613	2,237	2.87	5.40	38.47	0.950	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.76
22.50	5.75	0.04	0.75	sensitive fine grained	-7.0	1.00	3	2,700	1,670	2,294	2.92	5.85	38.46	0.948	N/A	0.319	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.76
23.50	5.36	0.03	0.54	sensitive fine grained	-8.0	1.00	3	2,820	1,728	2,352	2.90	5.74	34.31	0.945	N/A	0.321	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.76
24.50	7.27	0.12	1.62	clayey silt to silty clay	-9.0	1.00	4	2,940	1,786	2,410	2.99	N/A	N/A	0.943	N/A	0.323	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.76
25.50	9.19	0.22	2.38	silty clay to clay	-10.0	1.00	6	3,060	1,843	2,467	2.99	N/A	N/A	0.941	N/A	0.325	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.76
26.50	8.39	0.18	2.19	silty clay to clay	-11.0	1.00	6	3,180	1,901	2,525	3.02	N/A	N/A	0.938	N/A	0.326	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.76
27.50	48.12	0.68	1.42	silty sand to sandy silt	-12.0	1.00	16	3,300	1,958	2,582	2.26	1.82	88.61	0.936	1.000	0.328	0.145	0.589	YES	2.8	16.9	865	21.9	N/A	0.535	0.06	0.70
28.50	117.01	0.59	0.50	sand	-13.0	1.00	23	3,420	2,016	2,640	1.68	1.03	119.52	0.934	0.997	0.329	0.239	0.965	YES	0.0	20.4	1,200	20.4	N/A	1.164	0.14	0.56
29.50	60.52	0.76	1.26	silty sand to sandy silt	-14.0	1.00	20	3,540	2,074	2,698	2.16	1.57	93.15	0.931	0.989	0.331	0.155	0.619	YES	2.8	20.2	1,200	25.8	N/A	0.099	0.01	0.55
30.50	35.17	0.47	1.32	silty sand to sandy silt	-15.0	1.00	12	3,660	2,131	2,755	2.37	2.19	74.73	0.926	0.985	0.331	0.119	0.472	YES	2.8	12.8	494	17.0	N/A	1.601	0.19	0.36
31.50	119.31	0.58	0.49	sand	-16.0	1.00	24	3,780	2,189	2,813	1.68	1.00	114.05	0.918	0.970	0.330	0.218	0.856	YES	0.0	20.1	1,198	20.1	N/A	1.196	0.14	0.21
32.50	102.38	0.48	0.47	sand	-17.0	1.66	34	3,900	2,246	2,870	1.43	1.00	159.95	0.909	0.955	0.328	0.461	1.787	NO	N/A	N/A	N/A	28.3	N/A	0.081	0.01	0.20
33.50	45.71	0.42	0.92	silty sand to sandy silt	-18.0	1.00	15	4,020	2,304	2,928	2.20	1.67	70.92	0.901	0.963	0.327	0.113	0.445	YES	2.8	15.4	716	20.1	N/A	1.184	0.14	0.06
34.50	32.02	0.42	1.30	silty sand to sandy silt	-19.0	1.66	18	4,140	2,362	2,986	2.11	1.47	71.95	0.893	0.954	0.326	0.115	0.448	YES	2.8	17.3	900	22.4	N/A	0.386	0.05	0.01
35.50	11.89	0.22	1.81	clayey silt to silty clay	-20.0	1.00	6	4,260	2,419	3,043	2.91	N/A	N/A	0.885	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
36.50	8.71	0.15	1.73	clayey silt to silty clay	-21.0	1.00	4	4,380	2,477	3,101	3.04	N/A	N/A	0.877	N/A	0.323	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
37.50	11.78	0.24	1.99	clayey silt to silty clay	-22.0	1.00	6	4,500	2,534	3,158	2.95	N/A	N/A	0.869	N/A	0.321	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
38.50	12.34	0.34	2.72	clayey silt to silty clay	-23.0	1.00	6	4,620	2,592	3,216	3.02	N/A	N/A	0.861	N/A	0.319	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
39.50	10.46	0.24	2.34	clayey silt to silty clay	-24.0	1.00	5	4,740	2,650	3,274	3.06	N/A	N/A	0.852	N/A	0.317	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
40.50	14.14	0.49	3.43	silty clay to clay	-25.0	1.00	9	4,860	2,707	3,331	3.04	N/A	N/A	0.844	N/A	0.315	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
41.50	14.94	0.44	2.94	clayey silt to silty clay	-26.0	1.00	7	4,980	2,765	3,389	2.98	N/A	N/A	0.836	N/A	0.313	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
42.50	9.06	0.35	3.82	clay	-27.0	1.00	9	5,100	2,822	3,446	3.27	N/A	N/A	0.828	N/A	0.311	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
43.50	8.45	0.20	2.39	silty clay to clay	-28.0	1.00	6	5,220	2,880	3,504	3.19	N/A	N/A	0.820	N/A	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
44.50	11.55	0.33	2.88	silty clay to clay	-29.0	1.00	8	5,340	2,938	3,562	3.10	N/A	N/A	0.812	N/A	0.307	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
45.50	9.83	0.44	4.44	clay	-30.0	1.00	10	5,460	2,995	3,619	3.29	N/A	N/A	0.804	N/A	0.305	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
46.50	10.60	0.29	2.74	silty clay to clay	-31.0	1.00	7	5,580	3,053	3,677	3.14	N/A	N/A	0.795	N/A	0.302	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
47.50	14.48	0.35	2.42	clayey silt to silty clay	-32.0	1.00	7	5,700	3,110	3,734	2.98	N/A	N/A	0.787	N/A	0.300	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
48.50	18.05	0.52	2.89	clayey silt to silty clay	-33.0	1.00	9	5,820	3,168	3,792	2.95	N/A	N/A	0.779	N/A	0.298	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
49.50	28.10	1.25	4.44	silty clay to clay	-34.0	1.00	19	5,940	3,226	3,850	2.90	N/A	N/A	0.771	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
50.50	62.12	1.40	2.26	sandy silt to clayey silt	-35.0	1.00	25	6,060	3,283	3,907	2.39	2.29	110.80	0.763	0.855	0.293	0.206	0.804	YES	2.8	20.6	1,200	26.3	N/A	0.083	0.01	0.00
51.50	243.30	1.16	0.48	sand	-36.0	1.00	49	6,180	3,341	3,965	1.50	1.00	188.25	0.755	0.814	0.290	N/A	N/A	NO	N/A	N/A	N/A	34.6	N/A	0.033	0.00	0.00

max= 1,200
min= 494
avg= 1,007

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	A-CPT019

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	16.80 ft
GWT Elev. During Test	0.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	16.80 ft below ground surface
GWT Depth For Design, Zwd =	6.80 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	19.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	2.05 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	2.05 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_t (in.)	Cumulative Settlement Profile (in.)
0.50	72.08	1.46	2.02	silty sand to sandy silt	15.8	1.00	24	60	60	60	1.75	1.07	445.07	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	54.0	0.008	0.000	0.00	2.05
1.50	46.26	0.74	1.61	silty sand to sandy silt	14.8	1.00	15	180	180	180	1.92	1.21	186.06	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	36.5	0.016	0.013	0.00	2.05
2.50	59.46	1.10	1.84	silty sand to sandy silt	13.8	1.00	33	300	300	300	1.66	1.01	256.05	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	72.0	0.016	0.000	0.00	2.05
3.50	27.69	0.97	3.50	clayey silt to silty clay	12.8	1.00	14	420	420	420	2.44	2.50	151.34	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.05
4.50	29.09	1.28	4.38	silty clay to clay	11.8	1.00	32	540	540	540	2.23	1.74	161.20	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.05
5.50	11.79	0.47	4.01	clay	10.8	1.00	12	660	660	660	2.74	N/A	N/A	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.05
6.50	9.40	0.31	3.27	silty clay to clay	9.8	1.00	6	780	780	780	2.80	N/A	N/A	0.985	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.05
7.50	8.02	0.27	3.40	clay	8.8	1.00	8	900	856	900	2.90	N/A	N/A	0.983	N/A	0.215	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.05
8.50	7.67	0.21	2.72	silty clay to clay	7.8	1.00	5	1,020	914	1,020	2.87	N/A	N/A	0.980	N/A	0.228	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.05
9.50	9.02	0.21	2.36	silty clay to clay	6.8	1.00	6	1,140	972	1,140	2.80	N/A	N/A	0.978	N/A	0.239	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.05
10.50	27.06	0.18	0.65	silty sand to sandy silt	5.8	1.00	9	1,260	1,029	1,260	2.16	1.58	59.44	0.976	1.000	0.248	0.100	0.535	YES	2.8	14.2	606	18.6	N/A	0.185	0.02	2.03
11.50	15.45	0.15	0.94	sandy silt to clayey silt	4.8	1.66	10	1,380	1,087	1,380	2.17	1.59	55.14	0.973	1.000	0.257	0.096	0.496	YES	2.8	15.1	691	19.8	N/A	0.157	0.02	2.01
12.50	7.60	0.15	1.95	silty clay to clay	3.8	1.00	5	1,500	1,144	1,500	2.87	N/A	N/A	0.971	N/A	0.265	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.01
13.50	19.01	0.27	1.43	sandy silt to clayey silt	2.8	1.00	8	1,620	1,202	1,620	2.50	2.79	68.35	0.969	1.000	0.272	0.110	0.539	YES	2.8	11.2	386	15.1	N/A	1.703	0.20	1.81
14.50	32.47	0.30	0.92	silty sand to sandy silt	1.8	1.66	18	1,740	1,260	1,740	1.91	1.19	80.91	0.966	1.000	0.278	0.129	0.621	YES	2.8	22.0	1,200	28.1	N/A	0.068	0.01	1.80
15.50	11.42	0.23	2.00	clayey silt to silty clay	0.8	1.00	6	1,860	1,317	1,860	2.76	N/A	N/A	0.964	N/A	0.283	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.80
16.50	5.94	0.15	2.60	clay	-0.2	1.00	6	1,980	1,375	1,980	3.09	N/A	N/A	0.962	N/A	0.288	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.80
17.50	11.84	0.17	1.46	clayey silt to silty clay	-1.2	1.00	6	2,100	1,432	2,056	2.70	N/A	N/A	0.959	N/A	0.293	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.80
18.50	16.42	0.19	1.13	sandy silt to clayey silt	-2.2	1.66	11	2,220	1,490	2,114	2.24	1.78	56.09	0.957	1.000	0.297	0.096	0.434	YES	2.8	13.4	540	17.7	N/A	1.377	0.17	1.63
19.50	7.77	0.18	2.34	silty clay to clay	-3.2	1.00	5	2,340	1,548	2,172	3.00	N/A	N/A	0.955	N/A	0.300	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.63
20.50	6.77	0.20	2.98	clay	-4.2	1.00	7	2,460	1,605	2,229	3.12	N/A	N/A	0.952	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.63
21.50	6.12	0.10	1.61	sensitive fine grained	-5.2	1.00	3	2,580	1,663	2,287	3.04	N/A	N/A	0.950	N/A	0.307	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.63
22.50	5.93	0.08	1.33	sensitive fine grained	-6.2	1.00	3	2,700	1,720	2,344	3.02	N/A	N/A	0.948	N/A	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.63
23.50	6.73	0.16	2.39	silty clay to clay	-7.2	1.00	4	2,820	1,778	2,402	3.11	N/A	N/A	0.945	N/A	0.312	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.63
24.50	6.28	0.13	2.14	silty clay to clay	-8.2	1.00	4	2,940	1,836	2,460	3.12	N/A	N/A	0.943	N/A	0.314	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.63
25.50	5.93	0.10	1.70	silty clay to clay	-9.2	1.00	4	3,060	1,893	2,517	3.11	N/A	N/A	0.941	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.63
26.50	5.87	0.08	1.43	sensitive fine grained	-10.2	1.00	3	3,180	1,951	2,575	3.09	N/A	N/A	0.938	N/A	0.318	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.63
27.50	6.84	0.13	1.89	silty clay to clay	-11.2	1.00	5	3,300	2,008	2,632	3.09	N/A	N/A	0.936	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.63
28.50	5.98	0.06	0.99	sensitive fine grained	-12.2	1.00	3	3,420	2,066	2,690	3.03	N/A	N/A	0.934	N/A	0.321	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.63
29.50	5.92	0.04	0.63	sensitive fine grained	-13.2	1.00	3	3,540	2,124	2,748	2.96	6.29	35.62	0.931	N/A	0.323	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.63
30.50	7.24	0.07	0.96	sensitive fine grained	-14.2	1.00	4	3,660	2,181	2,805	2.95	N/A	N/A	0.926	N/A	0.323	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.63
31.50	20.33	0.22	1.07	sandy silt to clayey silt	-15.2	1.66	13	3,780	2,239	2,863	2.23	1.75	55.65	0.918	0.972	0.322	0.096	0.386	YES	2.8	14.1	597	18.5	N/A	1.374	0.16	1.47
32.50	9.03	0.07	0.75	clayey silt to silty clay	-16.2	1.00	5	3,900	2,296	2,920	2.83	5.00	40.71	0.909	N/A	0.321	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
33.50	7.75	0.14	1.74	clayey silt to silty clay	-17.2	1.00	4	4,020	2,354	2,978	3.08	N/A	N/A	0.901	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
34.50	7.44	0.13	1.69	clayey silt to silty clay	-18.2	1.00	4	4,140	2,412	3,036	3.10	N/A	N/A	0.893	N/A	0.319	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
35.50	7.56	0.12	1.62	clayey silt to silty clay	-19.2	1.00	4	4,260	2,469	3,093	3.09	N/A	N/A	0.885	N/A	0.318	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
36.50	8.33	0.20	2.38	silty clay to clay	-20.2	1.00	6	4,380	2,527	3,151	3.14	N/A	N/A	0.877	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
37.50	8.60	0.15	1.77	clayey silt to silty clay	-21.2	1.00	4	4,500	2,584	3,208	3.07	N/A	N/A	0.869	N/A	0.315	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
38.50	13.25	0.19	1.45	clayey silt to silty clay	-22.2	1.00	7	4,620	2,642	3,266	2.84	N/A	N/A	0.861	N/A	0.313	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
39.50	14.70	0.23	1.59	sandy silt to clayey silt	-23.2	1.00	6	4,740	2,700	3,324	2.83	N/A	N/A	0.852	N/A	0.311	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
40.50	12.33	0.35	2.82	silty clay to clay	-24.2	1.00	8	4,860	2,757	3,381	3.05	N/A	N/A	0.844	N/A	0.310	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
41.50	18.48	0.51	2.75	clayey silt to silty clay	-25.2	1.00	9	4,980	2,815	3,439	2.89	N/A	N/A	0.836	N/A	0.308	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
42.50	20.83	0.56	2.69	clayey silt to silty clay	-26.2	1.00	10	5,100	2,872	3,496	2.84	N/A	N/A	0.828	N/A	0.306	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
43.50	25.53	0.64	2.50	sandy silt to clayey silt	-27.2	1.00	10	5,220	2,930	3,554	2.75	N/A	N/A	0.820	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
44.50	60.51	0.43	0.71	sand to silty sand	-28.2	1.00	15	5,340	2,987	3,611	2.08	1.43	70.70	0.812	0.904	0.302	0.113	0.451	YES	1.3	12.6	479	14.3	N/A	1.931	0.23	1.24
45.50	41.48	0.61	1.47	silty sand to sandy silt	-29.2	1.00	14	5,460	3,045	3,669	2.41	2.34	78.51	0.804	0.904	0.300	0.125	0.503	YES	2.8	13.0	511	17.3	N/A	1.462	0.18	1.06
46.50	31.19	0.89	2.84	sandy silt to clayey silt	-30.2	1.00	12	5,580	3,103	3,727	2.73	N/A	N/A	0.795	N/A	0.298	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.06
47.50	59.82	0.65	1.09	silty sand to sandy silt	-31.2	1.00	20	5,700	3,160	3,784	2.20	1.67	79.44	0.787	0.878	0.295	0.127	0.502	YES	2.8	17.3	903	22.4	N/A	0.158	0.02	1.04
48.50	134.91	0.53	0.39	sand	-32.2	1.00	27	5,820	3,218	3,842	1.66	1.00	106.36	0.779	0.854	0.293	0.192	0.746	YES	0.0	19.5	1,130	19.5	N/A	1.052	0.13	0.92
49.50	81.41	0.40	0.50	sand to silty sand	-33.2	1.66	34	5,940	3,275	3,899	1.61	1.00	105.33	0.771	0.834	0.291	0.189	0.722	YES	1.3	25.5	1,200	27.8	N/A	0.073	0.01	0.91
50.50	13.11	0.19	1.46	clayey silt to silty clay	-34.2	1.00	7	6,060	3,333	3,957	2.93	N/A	N/A	0.763	N/A	0.289	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.91
51.50	11.33	0.19	1.63	clayey silt to silty clay	-35.2	1.00	6	6,180	3,391	4,015	3.03	N/A	N/A	0.755	N/A	0.286	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.91
52.50	24.60	0.28	1.12	sandy silt to clayey silt	-36.2	1.00	10	6,300	3,448	4,072	2.62	N/A	N/A	0.747	N/A	0.284	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.91
53.50	53.97	0.49	0.91	silty sand to sandy silt	-37.2	1.00	18	6,420	3,506	4,130	2.22	1.71	69.56	0.739	0.862	0.281	0.111	0.455	YES	2.8	15.3	709	20.0	N/A	0.302	0.04	0.87
54.50	73.59	0.59	0.80	sand to silty sand	-38.2	1.00	18	6,540	3,563	4,187	2.07	1.40	77.45	0.730	0.857	0.279	0.123	0.505	YES	1.3	14.0	596	15.8	N/A	1.595	0.19	0.68
55.50	58.87	0.54	0.92	sand to silty sand	-39.2	1.00	15	6,660	3,621	4,245	2.19	1.65	72.15	0.722	0.868	0.276	0.115	0.482	YES	1.3	11.4	398	13.1	N/A	2.118	0.25	0.43
56.50	69.53	0.72	1.04	sand to silty sand	-40.2	1.00	17	6,780	3,679	4,303	2.16	1.58	80.99	0.714	0.854	0.274	0.129	0.539	YES	1.3	13.2	525	14.9	N/A	1.763	0.21	0.21
57.50	76.31	0.88	1.15	sand to silty sand	-41.2	1.00	19	6,900	3,736	4,360	2.16	1.57	87.78	0.706	0.845	0.271	0.143	0.594	YES	1.3	14.3	614	16.0	N/A	1.493	0.18	0.04
58.50	107.92	0.94	0.87	sand to silty sand	-42.2	1.00	27	7,020	3,794	4,418	1.97	1.26	98.59	0.698	0.815	0.269	0.169	0.685	YES	1.3	19.5	1,132	21.5	N/A	0.108	0.01	0.02
59.50	113.67	0.97	0.85	sand to silty sand	-43.2	1.00	28	7,140	3,851	4,475	1.94	1.23	100.98	0.690	0.807	0.266	0.176	0.712	YES	1.3	20.3	1,200	22.4	N/A	0.095	0.01	0.01
60.50	112.56	1.15	1.02	sand to silty sand	-44.2	1.00	28	7,260	3,909	4,533	2.00	1.30	104.38	0.682	0.805	0.263	0.186	0.758	YES	1.3	20.0	1,188	22.1	N/A	0.096	0.01	0.00
																					max=	1,200				
																					min=	386				
																					avg=	769				

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	A-CPT021

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	16.60 ft
GWT Elev. During Test	0.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	16.60 ft below ground surface
GWT Depth For Design, Zwd =	6.60 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	13.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	0.77 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.01 inches	<--- Dry or Unsaturated Sands
Total:	0.78 inches	

INPUT SOIL PROFILE (CPT DATA)				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)
0.50	19.24	0.33	1.73	silty sand to sandy silt
1.50	21.70	0.46	2.12	silty sand to sandy silt
2.50	40.57	1.15	2.85	silty sand to sandy silt
3.50	23.66	1.01	4.27	clayey silt to silty clay
4.50	21.27	0.56	2.62	silty clay to clay
5.50	33.40	0.83	2.49	clay
6.50	29.44	0.79	2.67	silty clay to clay
7.50	8.68	0.25	2.92	clay
8.50	7.92	0.19	2.38	silty clay to clay
9.50	5.73	0.13	2.27	silty clay to clay
10.50	6.88	0.14	2.02	silty sand to sandy silt
11.50	20.27	0.38	1.87	sandy silt to clayey silt
12.50	38.98	0.29	0.75	silty clay to clay
13.50	13.47	0.21	1.55	sandy silt to clayey silt
14.50	5.08	0.20	3.87	silty sand to sandy silt
15.50	35.36	0.23	0.64	clayey silt to silty clay
16.50	20.67	0.21	1.00	clay
17.50	4.82	0.12	2.46	clayey silt to silty clay
18.50	5.94	0.17	2.83	sandy silt to clayey silt
19.50	5.76	0.16	2.77	silty clay to clay
20.50	4.24	0.05	1.14	clay
21.50	5.44	0.09	1.65	sensitive fine grained
22.50	5.38	0.11	2.08	sensitive fine grained
23.50	5.35	0.08	1.44	silty clay to clay
24.50	6.26	0.11	1.75	silty clay to clay
25.50	6.26	0.12	1.94	silty clay to clay
26.50	5.36	0.11	2.00	sensitive fine grained
27.50	6.30	0.14	2.29	silty clay to clay
28.50	5.95	0.10	1.74	sensitive fine grained
29.50	6.04	0.07	1.07	sensitive fine grained
30.50	6.88	0.11	1.64	sensitive fine grained
31.50	7.49	0.17	2.31	sandy silt to clayey silt
32.50	7.47	0.15	2.00	clayey silt to silty clay
33.50	7.85	0.16	2.07	clayey silt to silty clay
34.50	9.94	0.23	2.30	clayey silt to silty clay
35.50	15.70	0.42	2.70	clayey silt to silty clay
36.50	14.24	0.41	2.89	silty clay to clay
37.50	64.25	0.49	0.77	clayey silt to silty clay
38.50	27.60	0.69	2.51	clayey silt to silty clay
39.50	49.60	0.88	1.78	sandy silt to clayey silt
40.50	124.15	1.04	0.84	silty clay to clay
41.50	126.75	0.76	0.60	clayey silt to silty clay
42.50	59.31	0.87	1.46	clayey silt to silty clay
43.50	79.24	0.68	0.86	sandy silt to clayey silt
44.50	22.85	0.60	2.64	sand to silty sand
45.50	18.29	0.39	2.16	silty sand to sandy silt
46.50	20.29	0.31	1.53	sandy silt to clayey silt
47.50	13.24	0.23	1.76	silty sand to sandy silt
48.50	16.58	0.38	2.28	sand
49.50	82.23	0.84	1.03	sand to silty sand
50.50	56.96	0.98	1.71	clayey silt to silty clay
51.50	26.41	0.73	2.76	clayey silt to silty clay
52.50	13.33	0.25	1.90	sandy silt to clayey silt
53.50	12.72	0.23	1.78	silty sand to sandy silt
54.50	16.32	0.46	2.83	sand to silty sand
55.50	18.97	0.41	2.15	sand to silty sand
56.50	18.83	0.44	2.36	sand to silty sand
57.50	21.42	0.58	2.70	sand to silty sand
58.50	47.00	0.90	1.92	sand to silty sand
59.50	296.19	0.61	0.21	sand to silty sand

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +																RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_l (in.)	Cumulative Settlement Profile (in.)
15.6	1.00	6	60	60	60	2.04	1.35	150.44	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	18.1	0.012	0.022	0.00	0.78
14.6	1.00	7	180	180	180	2.23	1.75	126.76	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	19.8	0.020	0.033	0.00	0.78
13.6	1.00	14	300	300	300	2.22	1.71	178.74	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	32.6	0.021	0.020	0.00	0.78
12.6	1.00	12	420	420	420	2.55	3.06	157.86	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.78
11.6	1.00	14	540	540	540	2.48	2.67	109.49	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.78
10.6	1.00	33	660	660	660	2.35	2.13	123.90	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.78
9.6	1.66	32	780	780	780	2.13	1.51	118.04	0.985	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.78
8.6	1.00	9	900	844	900	2.82	N/A	N/A	0.983	N/A	0.218	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.78
7.6	1.00	5	1,020	901	1,020	2.83	N/A	N/A	0.980	N/A	0.231	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.78
6.6	1.00	4	1,140	959	1,140	2.96	N/A	N/A	0.978	N/A	0.242	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.78
5.6	1.00	2	1,260	1,017	1,260	2.88	N/A	N/A	0.976	N/A	0.251	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.78
4.6	1.00	8	1,380	1,074	1,380	2.53	2.91	80.40	0.973	1.000	0.260	0.128	0.659	YES	2.8	12.6	477	16.7	N/A	1.201	0.14	0.63
3.6	1.66	43	1,500	1,132	1,500	1.77	1.00	85.79	0.971	1.000	0.268	0.139	0.692	YES	5.0	54.7	1,200	N/A	N/A	0.000	0.00	0.63
2.6	1.66	9	1,620	1,189	1,620	2.34	2.10	60.67	0.969	1.000	0.274	0.101	0.490	YES	2.8	12.7	488	16.9	N/A	1.330	0.16	0.47
1.6	1.00	2	1,740	1,247	1,740	3.22	N/A	N/A	0.966	N/A	0.280	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
0.6	1.00	18	1,860	1,305	1,860	2.10	1.46	63.96	0.964	1.000	0.286	0.104	0.487	YES	2.8	21.1	1,200	N/A	N/A	0.000	0.00	0.47
-0.4	1.66	34	1,980	1,362	1,980	2.11	1.48	61.23	0.962	1.000	0.291	0.101	0.465	YES	5.0	39.4	1,200	N/A	N/A	0.000	0.00	0.47
-1.4	1.00	2	2,100	1,420	2,044	3.18	N/A	N/A	0.959	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-2.4	1.00	2	2,220	1,477	2,101	3.14	N/A	N/A	0.957	N/A	0.299	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-3.4	1.00	4	2,340	1,535	2,159	3.16	N/A	N/A	0.955	N/A	0.303	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-4.4	1.00	4	2,460	1,593	2,217	3.12	N/A	N/A	0.952	N/A	0.306	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-5.4	1.00	3	2,580	1,650	2,274	3.09	N/A	N/A	0.950	N/A	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-6.4	1.00	3	2,700	1,708	2,332	3.16	N/A	N/A	0.948	N/A	0.312	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-7.4	1.00	4	2,820	1,765	2,389	3.10	N/A	N/A	0.945	N/A	0.314	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-8.4	1.00	4	2,940	1,823	2,447	3.08	N/A	N/A	0.943	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-9.4	1.00	4	3,060	1,881	2,505	3.11	N/A	N/A	0.941	N/A	0.318	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-10.4	1.00	3	3,180	1,938	2,562	3.20	N/A	N/A	0.938	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-11.4	1.00	4	3,300	1,996	2,620	3.17	N/A	N/A	0.936	N/A	0.322	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-12.4	1.00	3	3,420	2,053	2,677	3.15	N/A	N/A	0.934	N/A	0.323	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-13.4	1.00	3	3,540	2,111	2,735	3.05	N/A	N/A	0.931	N/A	0.325	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-14.4	1.00	3	3,660	2,169	2,793	3.09	N/A	N/A	0.926	N/A	0.325	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-15.4	1.00	3	3,780	2,226	2,850	3.14	N/A	N/A	0.918	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-16.4	1.00	4	3,900	2,284	2,908	3.11	N/A	N/A	0.909	N/A	0.323	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-17.4	1.00	4	4,020	2,341	2,965	3.11	N/A	N/A	0.901	N/A	0.322	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-18.4	1.00	5	4,140	2,399	3,023	3.04	N/A	N/A	0.893	N/A	0.321	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-19.4	1.00	8	4,260	2,457	3,081	2.90	N/A	N/A	0.885	N/A	0.319	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-20.4	1.00	9	4,380	2,514	3,138	2.96	N/A	N/A	0.877	N/A	0.318	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-21.4	1.66	53	4,500	2,572	3,196	1.74	1.00	93.81	0.869	0.904	0.316	0.157	0.598	YES	2.8	44.9	1,200	N/A	N/A	0.000	0.00	0.47
-22.4	1.00	14	4,620	2,629	3,253	2.69	N/A	N/A	0.861	N/A	0.315	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-23.4	1.00	20	4,740	2,687	3,311	2.37	2.18	93.41	0.852	0.917	0.313	0.156	0.609	YES	2.8	18.2	999	23.5	N/A	0.153	0.02	0.45
-24.4	1.00	83	4,860	2,745	3,369	1.85	1.14	121.13	0.844	0.881	0.311	0.245	0.927	YES	5.0	68.8	1,200	N/A	N/A	0.000	0.00	0.45
-25.4	1.66	105	4,980	2,802	3,426	1.45	1.00	177.30	0.836	0.874	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	0.000	0.00	0.45
-26.4	1.00	30	5,100	2,860	3,484	2.26	1.83	90.91	0.828	0.881	0.307	0.150	0.573	YES	2.8	25.3	1,200	N/A	N/A	0.000	0.00	0.45
-27.4	1.66	52	5,220	2,917	3,541	1.72	1.05	113.95	0.820	0.860	0.305	0.218	0.818	YES	2.8	42.2	1,200	52.3	N/A	0.000	0.00	0.45
-28.4	1.00	6	5,340	2,975	3,599	2.81	N/A	N/A	0.812	N/A	0.303	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.45
-29.4	1.00	6	5,460	3,033	3,657	2.85	N/A	N/A	0.804	N/A	0.301	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.45
-30.4	1.00	8	5,580	3,090	3,714	2.73	N/A	N/A	0.795	N/A	0.299	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.45
-31.4	1.00	4	5,700	3,148	3,772	2.95	N/A	N/A	0.787	N/A	0.297	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.45
-32.4	1.00	3	5,820	3,205	3,829	2.92	N/A	N/A	0.779	N/A	0.294	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.45
-33.4	1.00	21	5,940	3,263	3,887	2.08	1.42	91.11	0.771	0.869	0.292	0.150	0.597	YES	1.3	16.1	782	18.0	N/A	1.297	0.16	0.30
-34.4	1.66	47	6,060	3,321	3,945	2.03	1.35	98.61	0.763	0.816	0.290	0.169	0.636	YES	2.8	36.4	1,200	N/A	N/A	0.000	0.00	0.30
-35.4	1.00	13	6,180	3,378	4,002	2.80	N/A	N/A	0.755	N/A	0.287	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
-36.4	1.00	5	6,300	3,436	4,060	3.00	N/A	N/A	0.747	N/A	0.285	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
-37.4	1.00	4	6,420	3,493	4,117	3.01	N/A	N/A	0.739	N/A	0.282	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
-38.4	1.00	4	6,540	3,551	4,175	3.02	N/A	N/A	0.730	N/A	0.280	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
-39.4	1.00	5	6,660	3,609	4,233	2.89	N/A	N/A	0.722	N/A	0.277	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
-40.4	1.00	5	6,780	3,666	4,290	2.92	N/A	N/A	0.714	N/A	0.275	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
-41.4	1.00	5	6,900	3,724	4,348	2.91	N/A	N/A	0.706	N/A	0.272	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
-42.4	1.00	12	7,020	3,781	4,405	2.53	2.90	84.67	0.698	0.874	0.269	0.136	0.591	YES	1.3	9.2	273	10.8	N/A	2.472	0.30	0.00
-43.4	1.00	74	7,140	3,839	4,463	1.26	1.00	213.78	0.690	0.770	0.267	N/A	N/A	NO	N/A	N/A	N/A	54.5	N/A	0.000	0.00	0.00
																max=	1,200					
																min=	273					
																avg=	971					

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	A-CPT022

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	19.00 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$

+++ $FS = (CRR_{7.5}/CSR)\ MSF\ K_\sigma\ K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	16.00 ft below ground surface
GWT Depth For Design, Zwd =	9.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	12.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	0.47 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	0.47 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r(psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_t (in.)	Cumulative Settlement Profile (in.)
0.50	130.52	0.99	0.76	sand	18.0	1.00	26	60	60	60	1.25	1.00	753.54	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	44.4	0.009	0.000	0.00	0.47
1.50	90.65	0.80	0.89	sand to silty sand	17.0	1.00	23	180	180	180	1.53	1.00	302.15	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	42.9	0.015	0.000	0.00	0.47
2.50	91.71	1.03	1.12	sand to silty sand	16.0	1.66	38	300	300	300	1.37	1.00	392.08	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	70.1	0.017	0.000	0.00	0.47
3.50	12.80	0.67	5.24	clay	15.0	1.00	13	420	420	420	2.69	N/A	N/A	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
4.50	9.58	0.36	3.75	clay	14.0	1.00	10	540	540	540	2.74	N/A	N/A	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
5.50	8.50	0.29	3.38	clay	13.0	1.00	8	660	660	660	2.81	N/A	N/A	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
6.50	8.45	0.27	3.19	clay	12.0	1.00	8	780	780	780	2.84	N/A	N/A	0.985	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
7.50	10.08	0.24	2.42	silty clay to clay	11.0	1.00	7	900	900	900	2.74	N/A	N/A	0.983	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
8.50	10.11	0.18	1.76	clayey silt to silty clay	10.0	1.00	5	1,020	1,020	1,020	2.69	N/A	N/A	0.980	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
9.50	16.23	0.28	1.75	sandy silt to clayey silt	9.0	1.00	6	1,140	1,109	1,140	2.59	3.29	71.74	0.978	1.000	0.209	0.114	0.730	YES	2.8	11.4	395	15.3	N/A	0.196	0.02	0.45
10.50	12.21	0.36	2.91	silty clay to clay	8.0	1.00	8	1,260	1,166	1,260	2.79	N/A	N/A	0.976	N/A	0.219	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.45
11.50	33.41	0.24	0.73	silty sand to sandy silt	7.0	1.00	11	1,380	1,224	1,380	2.14	1.53	65.30	0.973	1.000	0.228	0.106	0.619	YES	2.8	16.2	794	21.1	N/A	0.088	0.01	0.43
12.50	28.77	0.36	1.24	silty sand to sandy silt	6.0	1.66	16	1,500	1,282	1,500	2.02	1.33	79.07	0.971	1.000	0.236	0.126	0.711	YES	2.8	21.1	1,200	27.0	N/A	0.062	0.01	0.43
13.50	7.55	0.18	2.32	silty clay to clay	5.0	1.00	5	1,620	1,339	1,620	2.95	N/A	N/A	0.969	N/A	0.244	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
14.50	14.19	0.25	1.74	clayey silt to silty clay	4.0	1.00	7	1,740	1,397	1,740	2.66	N/A	N/A	0.966	N/A	0.250	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
15.50	39.50	0.39	1.00	silty sand to sandy silt	3.0	1.00	13	1,860	1,454	1,860	2.18	1.63	75.34	0.964	1.000	0.256	0.120	0.623	YES	2.8	16.5	818	21.4	N/A	0.097	0.01	0.42
16.50	23.64	0.48	2.01	sandy silt to clayey silt	2.0	1.66	16	1,980	1,512	1,949	2.24	1.78	80.11	0.962	1.000	0.262	0.128	0.651	YES	2.8	18.7	1,045	24.0	N/A	0.085	0.01	0.41
17.50	7.78	0.18	2.31	silty clay to clay	1.0	1.00	5	2,100	1,570	2,006	2.99	N/A	N/A	0.959	N/A	0.267	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
18.50	5.99	0.11	1.76	silty clay to clay	0.0	1.00	4	2,220	1,627	2,064	3.05	N/A	N/A	0.957	N/A	0.272	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
19.50	5.98	0.08	1.25	sensitive fine grained	-1.0	1.00	3	2,340	1,685	2,122	2.99	N/A	N/A	0.955	N/A	0.276	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
20.50	6.11	0.09	1.48	sensitive fine grained	-2.0	1.00	3	2,460	1,742	2,179	3.03	N/A	N/A	0.952	N/A	0.280	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
21.50	5.84	0.09	1.46	sensitive fine grained	-3.0	1.00	3	2,580	1,800	2,237	3.06	N/A	N/A	0.950	N/A	0.283	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
22.50	6.31	0.10	1.51	sensitive fine grained	-4.0	1.00	3	2,700	1,858	2,294	3.04	N/A	N/A	0.948	N/A	0.286	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
23.50	6.59	0.10	1.51	clayey silt to silty clay	-5.0	1.00	3	2,820	1,915	2,352	3.04	N/A	N/A	0.945	N/A	0.289	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
24.50	7.78	0.15	1.94	silty clay to clay	-6.0	1.00	5	2,940	1,973	2,410	3.03	N/A	N/A	0.943	N/A	0.292	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
25.50	7.10	0.14	1.97	silty clay to clay	-7.0	1.00	5	3,060	2,030	2,467	3.08	N/A	N/A	0.941	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
26.50	7.82	0.18	2.32	silty clay to clay	-8.0	1.00	5	3,180	2,088	2,525	3.09	N/A	N/A	0.938	N/A	0.297	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
27.50	7.17	0.08	1.06	sensitive fine grained	-9.0	1.00	4	3,300	2,146	2,582	2.97	N/A	N/A	0.936	N/A	0.299	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
28.50	8.54	0.10	1.16	clayey silt to silty clay	-10.0	1.00	4	3,420	2,203	2,640	2.92	N/A	N/A	0.934	N/A	0.301	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
29.50	10.54	0.14	1.29	clayey silt to silty clay	-11.0	1.00	5	3,540	2,261	2,698	2.86	N/A	N/A	0.931	N/A	0.303	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
30.50	10.28	0.18	1.74	clayey silt to silty clay	-12.0	1.00	5	3,660	2,318	2,755	2.94	N/A	N/A	0.926	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
31.50	12.20	0.24	1.97	clayey silt to silty clay	-13.0	1.00	6	3,780	2,376	2,813	2.91	N/A	N/A	0.918	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
32.50	13.60	0.23	1.71	clayey silt to silty clay	-14.0	1.00	7	3,900	2,434	2,870	2.84	N/A	N/A	0.909	N/A	0.303	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
33.50	10.92	0.27	2.48	clayey silt to silty clay	-15.0	1.00	5	4,020	2,491	2,928	3.03	N/A	N/A	0.901	N/A	0.303	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
34.50	11.62	0.25	2.12	clayey silt to silty clay	-16.0	1.00	6	4,140	2,549	2,986	2.97	N/A	N/A	0.893	N/A	0.302	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
35.50	11.93	0.39	3.27	silty clay to clay	-17.0	1.00	8	4,260	2,606	3,043	3.08	N/A	N/A	0.885	N/A	0.301	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
36.50	11.58	0.39	3.37	silty clay to clay	-18.0	1.00	8	4,380	2,664	3,101	3.10	N/A	N/A	0.877	N/A	0.300	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
37.50	14.23	0.39	2.75	clayey silt to silty clay	-19.0	1.00	7	4,500	2,722	3,158	2.98	N/A	N/A	0.869	N/A	0.299	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
38.50	15.05	0.36	2.37	clayey silt to silty clay	-20.0	1.00	8	4,620	2,779	3,216	2.92	N/A	N/A	0.861	N/A	0.298	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
39.50	18.38	0.45	2.44	clayey silt to silty clay	-21.0	1.00	9	4,740	2,837	3,274	2.86	N/A	N/A	0.852	N/A	0.296	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
40.50	25.33	0.60	2.35	sandy silt to clayey silt	-22.0	1.00	10	4,860	2,894	3,331	2.73	N/A	N/A	0.844	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
41.50	126.77	0.74	0.59	sand	-23.0	1.00	25	4,980	2,952	3,389	1.76	1.08	112.61	0.836	0.879	0.293	0.213	0.851	YES	0.0	19.5	1,131	19.5	N/A	1.053	0.13	0.28
42.50	104.24	1.04	1.00	sand to silty sand	-24.0	1.66	43	5,100	3,010	3,446	1.66	1.01	142.24	0.828	0.849	0.292	0.348	1.350	NO	N/A	N/A	N/A	36.9	N/A	0.018	0.00	0.28
43.50	43.49	0.83	1.90	sandy silt to clayey silt	-25.0	1.00	17	5,220	3,067	3,504	2.46	2.56	89.76	0.820	0.890	0.290	0.147	0.603	YES	2.8	15.9	769	20.8	N/A	0.273	0.03	0.24
44.50	130.99	0.52	0.40	sand	-26.0	1.00	26	5,340	3,125	3,562	1.67	1.00	104.80	0.812	0.862	0.289	0.187	0.746	YES	0.0	19.6	1,147	19.6	N/A	0.464	0.06	0.19
45.50	106.03	0.75	0.70	sand to silty sand	-27.0	1.66	44	5,460	3,182	3,619	1.58	1.00	139.18	0.804	0.830	0.287	0.331	1.278	YES	1.3	34.0	1,200	36.7	N/A	0.019	0.00	0.19
46.50	30.92	0.91	2.95	clayey silt to silty clay	-28.0	1.00	15	5,580	3,240	3,677	2.75	N/A	N/A	0.795	N/A	0.285	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
47.50	19.36	0.36	1.87	sandy silt to clayey silt	-29.0	1.00	8	5,700	3,298	3,734	2.82	N/A	N/A	0.787	N/A	0.283	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
48.50	14.03	0.27	1.95	clayey silt to silty clay	-30.0	1.00	7	5,820	3,355	3,792	2.97	N/A	N/A	0.779	N/A	0.281	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
49.50	15.34	0.37	2.38	clayey silt to silty clay	-31.0	1.00	8	5,940	3,413	3,850	2.98	N/A	N/A	0.771	N/A	0.279	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
50.50	16.81	0.37	2.22	clayey silt to silty clay	-32.0	1.00	8	6,060	3,470	3,907	2.93	N/A	N/A	0.763	N/A	0.277	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
51.50	13.66	0.29	2.11	clayey silt to silty clay	-33.0	1.00	7	6,180	3,528	3,965	3.01	N/A	N/A	0.755	N/A	0.275	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
52.50	13.41	0.38	2.87	clayey silt to silty clay	-34.0	1.00	7	6,300	3,586	4,022	3.10	N/A	N/A	0.747	N/A	0.273	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
53.50	14.86	0.45	3.03	clayey silt to silty clay	-35.0	1.00	7	6,420	3,643	4,080	3.08	N/A	N/A	0.739	N/A	0.271	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
54.50	14.85	0.43	2.88	clayey silt to silty clay	-36.0	1.00	7	6,540	3,701	4,138	3.07	N/A	N/A	0.730	N/A	0.268	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
55.50	15.76	0.47	2.97	clayey silt to silty clay	-37.0	1.00	8	6,660	3,758	4,195	3.06	N/A	N/A	0.722	N/A	0.266	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
56.50	32.02	0.65	2.02	sandy silt to clayey silt	-38.0	1.00	13	6,780	3,816	4,253	2.69	N/A	N/A	0.714	N/A	0.264	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
57.50	44.03	0.62	1.42	silty sand to sandy silt	-39.0	1.00	15	6,900	3,874	4,310	2.48	2.67	71.51	0.706	0.855	0.262	0.114	0.497	YES	2.8	12.8	495	17.0	N/A	1.145	0.14	0.05
58.50	50.96	0.75	1.47	silty sand to sandy silt	-40.0	1.00	17	7,020	3,931	4,368	2.38	2.23	80.95	0.698	0.842	0.259	0.129	0.561	YES	2.8	14.3	617	18.8	N/A	0.260	0.03	0.02
59.50	148.80	1.58	1.06	sand	-41.0	1.00	30	7,140	3,989	4,426	1.92	1.21	126.98	0.690	0.793	0.257	0.270	1.115	YES	0.0	20.0	1,186	20.0	N/A	0.144	0.02	0.00

max=	1,200
min=	395
avg=	900

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	A-CPT024

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	16.90 ft
GWT Elev. During Test	0.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw = 16.90 ft below ground surface

GWT Depth For Design, Zwd = 6.90 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils = 19.00 feet

Earthquake-Induced Settlements:

- Liquefaction-Induced Settlement = 1.31 inches <--- Saturated Sands
- Seismic Compaction Settlement = 0.00 inches <--- Dry or Unsaturated Sands

Total: 1.31 inches

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_l (in.)	Cumulative Settlement Profile (in.)
0.50	9.40	0.12	1.24	clayey silt to silty clay	15.9	1.00	5	60	60	60	2.18	1.61	87.66	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.31
1.50	13.07	0.23	1.75	clayey silt to silty clay	14.9	1.00	7	180	180	180	2.35	2.10	91.69	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.31
2.50	37.77	0.55	1.44	silty sand to sandy silt	13.9	1.00	13	300	300	300	2.02	1.33	130.08	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	30.7	0.022	0.022	0.00	1.31
3.50	40.61	1.03	2.53	sandy silt to clayey silt	12.9	1.66	27	420	420	420	1.92	1.21	176.85	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	59.9	N/A	N/A	N/A	1.31
4.50	17.49	0.42	2.39	clayey silt to silty clay	11.9	1.00	9	540	540	540	2.52	2.88	96.80	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.31
5.50	12.81	0.21	1.66	clayey silt to silty clay	10.9	1.00	6	660	660	660	2.57	3.15	70.34	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.31
6.50	11.99	0.21	1.76	clayey silt to silty clay	9.9	1.00	6	780	780	780	2.56	3.07	74.59	0.985	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.31
7.50	7.14	0.26	3.63	clay	8.9	1.00	7	900	863	900	2.96	N/A	N/A	0.983	N/A	0.213	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.31
8.50	26.29	0.35	1.33	sandy silt to clayey silt	7.9	1.00	11	1,020	920	1,020	2.32	2.00	77.56	0.980	1.000	0.226	0.123	0.729	YES	2.8	17.5	927	22.7	N/A	0.080	0.01	1.30
9.50	31.94	0.28	0.86	silty sand to sandy silt	6.9	1.00	11	1,140	978	1,140	2.15	1.56	71.08	0.978	1.000	0.237	0.113	0.638	YES	2.8	16.9	863	21.9	N/A	0.087	0.01	1.29
10.50	22.23	0.21	0.95	sandy silt to clayey silt	5.9	1.00	15	1,260	1,035	1,260	2.02	1.33	67.83	0.976	1.000	0.247	0.109	0.589	YES	2.8	21.3	1,200	27.3	N/A	0.064	0.01	1.28
11.50	3.60	0.06	1.75	sensitive fine grained	4.9	1.00	2	1,380	1,093	1,380	3.13	N/A	N/A	0.973	N/A	0.256	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.28
12.50	15.83	0.13	0.82	sandy silt to clayey silt	3.9	1.00	6	1,500	1,151	1,500	2.44	2.48	51.79	0.971	1.000	0.263	0.093	0.471	YES	2.8	10.1	318	13.8	N/A	2.004	0.24	1.04
13.50	26.87	0.14	0.51	silty sand to sandy silt	2.9	1.66	15	1,620	1,208	1,620	1.86	1.00	57.24	0.969	1.000	0.270	0.097	0.481	YES	2.8	19.3	1,110	24.8	N/A	0.084	0.01	1.03
14.50	12.60	0.10	0.75	sandy silt to clayey silt	1.9	1.66	8	1,740	1,266	1,740	2.24	1.00	26.21	0.966	1.000	0.276	0.072	0.347	YES	2.8	11.7	418	15.7	N/A	1.599	0.19	0.84
15.50	3.93	0.05	1.37	sensitive fine grained	0.9	1.00	2	1,860	1,323	1,860	3.11	N/A	N/A	0.964	N/A	0.282	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
16.50	4.02	0.05	1.15	sensitive fine grained	-0.1	1.00	2	1,980	1,381	1,980	3.08	N/A	N/A	0.962	N/A	0.287	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
17.50	3.54	0.02	0.57	sensitive fine grained	-1.1	1.00	2	2,100	1,439	2,063	3.03	7.08	32.12	0.959	N/A	0.291	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
18.50	4.81	0.05	1.08	sensitive fine grained	-2.1	1.00	2	2,220	1,496	2,120	3.02	N/A	N/A	0.957	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
19.50	5.35	0.07	1.25	sensitive fine grained	-3.1	1.00	3	2,340	1,554	2,178	3.02	N/A	N/A	0.955	N/A	0.299	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
20.50	5.06	0.06	1.25	sensitive fine grained	-4.1	1.00	3	2,460	1,611	2,235	3.05	N/A	N/A	0.952	N/A	0.302	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
21.50	4.73	0.04	0.78	sensitive fine grained	-5.1	1.00	2	2,580	1,669	2,293	3.01	N/A	N/A	0.950	N/A	0.305	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
22.50	5.42	0.07	1.24	sensitive fine grained	-6.1	1.00	3	2,700	1,727	2,351	3.05	N/A	N/A	0.948	N/A	0.308	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
23.50	19.76	0.14	0.73	sandy silt to clayey silt	-7.1	1.66	13	2,820	1,784	2,408	2.12	1.00	34.65	0.945	1.000	0.311	0.079	0.339	YES	2.8	14.7	655	19.3	N/A	1.205	0.14	0.69
24.50	8.64	0.08	0.94	clayey silt to silty clay	-8.1	1.00	4	2,940	1,842	2,466	2.81	N/A	N/A	0.943	N/A	0.313	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.69
25.50	8.14	0.20	2.45	silty clay to clay	-9.1	1.00	5	3,060	1,899	2,523	3.06	N/A	N/A	0.941	N/A	0.315	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.69
26.50	9.84	0.18	1.80	clayey silt to silty clay	-10.1	1.00	5	3,180	1,957	2,581	2.92	N/A	N/A	0.938	N/A	0.317	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.69
27.50	13.05	0.28	2.16	clayey silt to silty clay	-11.1	1.00	7	3,300	2,015	2,639	2.86	N/A	N/A	0.936	N/A	0.319	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.69
28.50	15.61	0.56	3.60	silty clay to clay	-12.1	1.00	10	3,420	2,072	2,696	2.93	N/A	N/A	0.934	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.69
29.50	55.69	0.87	1.56	silty sand to sandy silt	-13.1	1.00	19	3,540	2,130	2,754	2.25	1.79	96.87	0.931	0.981	0.322	0.165	0.669	YES	2.8	18.6	1,041	24.0	N/A	0.155	0.02	0.67
30.50	82.40	1.19	1.44	silty sand to sandy silt	-14.1	1.00	27	3,660	2,187	2,811	2.10	1.45	114.36	0.926	0.968	0.322	0.219	0.878	YES	2.8	26.0	1,200	32.8	N/A	0.049	0.01	0.67
31.50	66.36	0.51	0.77	sand to silty sand	-15.1	1.66	27	3,780	2,245	2,869	1.71	1.00	103.70	0.918	0.959	0.321	0.184	0.732	YES	1.3	24.3	1,200	26.5	N/A	0.091	0.01	0.66
32.50	13.41	0.31	2.32	clayey silt to silty clay	-16.1	1.00	7	3,900	2,303	2,927	2.90	N/A	N/A	0.909	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.66
33.50	7.83	0.21	2.72	silty clay to clay	-17.1	1.00	5	4,020	2,360	2,984	3.18	N/A	N/A	0.901	N/A	0.319	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.66
34.50	7.16	0.26	3.58	clay	-18.1	1.00	7	4,140	2,418	3,042	3.29	N/A	N/A	0.893	N/A	0.318	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.66
35.50	7.81	0.22	2.87	silty clay to clay	-19.1	1.00	5	4,260	2,475	3,099	3.21	N/A	N/A	0.885	N/A	0.317	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.66
36.50	11.21	0.40	3.60	clay	-20.1	1.00	11	4,380	2,533	3,157	3.12	N/A	N/A	0.877	N/A	0.315	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.66
37.50	36.15	0.67	1.86	sandy silt to clayey silt	-21.1	1.00	14	4,500	2,591	3,215	2.51	2.80	83.47	0.869	0.937	0.314	0.134	0.534	YES	2.8	14.2	609	18.7	N/A	1.311	0.16	0.50
38.50	98.01	0.84	0.86	sand to silty sand	-22.1	1.66	41	4,620	2,648	3,272	1.62	1.00	141.03	0.861	0.894	0.312	0.341	1.302	NO	N/A	N/A	N/A	35.7	N/A	0.028	0.00	0.50
39.50	32.75	1.04	3.18	clayey silt to silty clay	-23.1	1.00	16	4,740	2,706	3,330	2.70	N/A	N/A	0.852	N/A	0.311	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.50
40.50	50.06	1.04	2.07	sandy silt to clayey silt	-24.1	1.00	20	4,860	2,763	3,387	2.41	2.36	100.41	0.844	0.909	0.309	0.174	0.684	YES	2.8	18.2	995	23.5	N/A	0.144	0.02	0.48
41.50	32.86	0.91	2.77	sandy silt to clayey silt	-25.1	1.66	22	4,980	2,821	3,445	2.33	2.04	93.43	0.836	0.900	0.307	0.156	0.610	YES	2.8	19.4	1,121	24.9	N/A	0.096	0.01	0.47
42.50	15.83	0.58	3.64	silty clay to clay	-26.1	1.00	11	5,100	2,879	3,503	3.03	N/A	N/A	0.828	N/A	0.305	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
43.50	26.61	0.34	1.29	sandy silt to clayey silt	-27.1	1.00	11	5,220	2,936	3,560	2.57	3.14	62.69	0.820	0.922	0.303	0.103	0.418	YES	2.8	10.8	356	14.6	N/A	1.889	0.23	0.24
44.50	43.53	0.53	1.21	silty sand to sandy silt	-28.1	1.66	24	5,340	2,994	3,618	2.03	1.33	78.62	0.812	0.880	0.301	0.125	0.488	YES	2.8	20.7	1,200	26.4	N/A	0.085	0.01	0.23
45.50	17.73	0.43	2.44	clayey silt to silty clay	-29.1	1.00	9	5,460	3,051	3,675	2.90	N/A	N/A	0.804	N/A	0.299	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
46.50	15.94	0.37	2.31	clayey silt to silty clay	-30.1	1.00	8	5,580	3,109	3,733	2.93	N/A	N/A	0.795	N/A	0.297	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
47.50	14.89	0.24	1.58	sandy silt to clayey silt	-31.1	1.00	6	5,700	3,167	3,791	2.88	N/A	N/A	0.787	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
48.50	11.42	0.28	2.45	clayey silt to silty clay	-32.1	1.00	6	5,820	3,224	3,848	3.10	N/A	N/A	0.779	N/A	0.293	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
49.50	12.76	0.32	2.51	clayey silt to silty clay	-33.1	1.00	6	5,940	3,282	3,906	3.06	N/A	N/A	0.771	N/A	0.290	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
50.50	17.59	0.55	3.10	clayey silt to silty clay	-34.1	1.00	9	6,060	3,339	3,963	2.99	N/A	N/A	0.763	N/A	0.288	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
51.50	13.42	0.44	3.30	silty clay to clay	-35.1	1.00	9	6,180	3,397	4,021	3.12	N/A	N/A	0.755	N/A	0.286	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
52.50	10.88	0.29	2.66	silty clay to clay	-36.1	1.00	7	6,300	3,455	4,079	3.17	N/A	N/A	0.747	N/A	0.283	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
53.50	12.96	0.29	2.23	clayey silt to silty clay	-37.1	1.00	6	6,420	3,512	4,136	3.05	N/A	N/A	0.739	N/A	0.281	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
54.50	41.91	0.48	1.14	silty sand to sandy silt	-38.1	1.66	23	6,540	3,570	4,194	2.06	1.38	71.93	0.730	0.841	0.278	0.115	0.462	YES	2.8	18.8	1,056	24.2	N/A	0.090	0.01	0.22
55.50	15.76	0.47	2.97	clayey silt to silty clay	-39.1	1.00	8	6,660	3,627	4,251	3.05	N/A	N/A	0.722	N/A	0.276	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.22
56.50	32.02	0.65	2.02	sandy silt to clayey silt	-40.1	1.00	13	6,780	3,685	4,309	2.68	N/A	N/A	0.714	N/A	0.273	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.22
57.50	44.03	0.62	1.42	silty sand to sandy silt	-41.1	1.00	15	6,900	3,743	4,367	2.47	2.62	72.16	0.706	0.862	0.271	0.115	0.489	YES	2.8	12.7	490	16.9	N/A	1.283	0.15	0.07
58.50	50.96	0.75	1.47	silty sand to sandy silt	-42.1	1.00	17	7,020	3,800	4,424	2.37	2.20	81.49	0.698	0.850	0.268	0.130	0.551	YES	2.8	14.2	611	18.7	N/A	0.375	0.04	0.02
59.50	148.80	1.58	1.06	sand	-43.1	1.00	30	7,140	3,858	4,482	1.91	1.20	128.54	0.690	0.803	0.265	0.278	1.120	YES	0.0	19.9	1,173	19.9	N/A	0.184	0.02	0.00

max= 1,200
min= 318
avg= 871

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	A-CPT025

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	20.00 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$

+++ $FS = (CRR_{7.5}/CSR)\ MSF\ K_\sigma\ K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	17.00 ft below ground surface
GWT Depth For Design, Zwd =	10.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	8.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	0.29 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	0.29 inches	

INPUT SOIL PROFILE (CPT DATA)				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)
0.50	87.79	1.11	1.27	sand to silty sand
1.50	21.28	0.46	2.14	sandy silt to clayey silt
2.50	20.04	0.57	2.83	clayey silt to silty clay
3.50	10.43	0.40	3.86	clay
4.50	16.19	0.55	3.38	silty clay to clay
5.50	31.94	1.13	3.53	clayey silt to silty clay
6.50	20.76	0.67	3.25	clayey silt to silty clay
7.50	20.52	0.65	3.15	clayey silt to silty clay
8.50	16.60	0.52	3.15	clayey silt to silty clay
9.50	16.04	0.47	2.90	clayey silt to silty clay
10.50	10.63	0.35	3.29	silty clay to clay
11.50	9.58	0.31	3.20	silty clay to clay
12.50	7.46	0.21	2.80	silty clay to clay
13.50	7.07	0.19	2.74	silty clay to clay
14.50	5.95	0.16	2.68	clay
15.50	6.02	0.16	2.70	clay
16.50	5.53	0.15	2.78	clay
17.50	5.79	0.14	2.37	silty clay to clay
18.50	5.55	0.10	1.80	silty clay to clay
19.50	6.05	0.14	2.23	silty clay to clay
20.50	5.90	0.15	2.50	silty clay to clay
21.50	5.84	0.13	2.18	silty clay to clay
22.50	5.76	0.12	2.03	silty clay to clay
23.50	4.99	0.06	1.20	sensitive fine grained
24.50	4.95	0.05	0.98	sensitive fine grained
25.50	5.38	0.06	1.07	sensitive fine grained
26.50	5.81	0.10	1.64	sensitive fine grained
27.50	6.16	0.07	1.11	sensitive fine grained
28.50	6.97	0.10	1.49	clayey silt to silty clay
29.50	7.95	0.18	2.20	silty clay to clay
30.50	24.38	0.19	0.79	silty sand to sandy silt
31.50	8.82	0.17	1.97	clayey silt to silty clay
32.50	9.69	0.21	2.18	clayey silt to silty clay
33.50	12.14	0.26	2.16	clayey silt to silty clay
34.50	6.88	0.08	1.16	sensitive fine grained
35.50	10.95	0.30	2.78	silty clay to clay
36.50	19.50	0.66	3.40	clayey silt to silty clay
37.50	12.50	0.45	3.56	silty clay to clay
38.50	8.11	0.27	3.38	clay
39.50	9.98	0.36	3.65	clay
40.50	11.22	0.39	3.50	silty clay to clay
41.50	32.05	0.83	2.60	sandy silt to clayey silt
42.50	68.66	1.14	1.66	silty sand to sandy silt
43.50	100.05	1.65	1.65	silty sand to sandy silt
44.50	46.94	1.06	2.25	sandy silt to clayey silt
45.50	106.30	0.88	0.82	sand to silty sand
46.50	129.32	0.58	0.45	sand
47.50	154.94	0.66	0.43	sand
48.50	130.19	0.80	0.62	sand
49.50	56.42	1.05	1.87	silty sand to sandy silt
50.50	35.13	0.69	1.95	sandy silt to clayey silt
51.50	13.43	0.29	2.13	clayey silt to silty clay
52.50	15.00	0.33	2.18	clayey silt to silty clay
53.50	17.74	0.51	2.90	clayey silt to silty clay
54.50	17.17	0.61	3.55	silty clay to clay
55.50	14.53	0.40	2.78	clayey silt to silty clay
56.50	13.79	0.30	2.20	clayey silt to silty clay
57.50	13.66	0.33	2.43	clayey silt to silty clay
58.50	15.13	0.39	2.58	clayey silt to silty clay
59.50	16.65	0.37	2.24	clayey silt to silty clay
60.50	17.85	0.38	2.11	clayey silt to silty clay

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +																RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_l (in.)	Cumulative Settlement Profile (in.)
19.0	1.66	36	60	60	60	1.23	1.00	839.18	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	67.2	0.008	0.000	0.00	0.29
18.0	1.00	9	180	180	180	2.24	1.78	126.25	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	22.4	N/A	N/A	N/A	0.29
17.0	1.00	10	300	300	300	2.43	2.43	125.49	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
16.0	1.00	10	420	420	420	2.66	N/A	N/A	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
15.0	1.00	11	540	540	540	2.54	2.98	128.61	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
14.0	1.00	16	660	660	660	2.47	2.64	146.69	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
13.0	1.00	10	780	780	780	2.54	2.96	124.54	0.985	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
12.0	1.00	10	900	900	900	2.57	3.12	116.69	0.983	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
11.0	1.00	8	1,020	1,020	1,020	2.67	N/A	N/A	0.980	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
10.0	1.00	8	1,140	1,140	1,140	2.69	N/A	N/A	0.978	N/A	0.203	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
9.0	1.00	7	1,260	1,229	1,260	2.89	N/A	N/A	0.976	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
8.0	1.00	6	1,380	1,286	1,380	2.93	N/A	N/A	0.973	N/A	0.217	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
7.0	1.00	5	1,500	1,344	1,500	3.00	N/A	N/A	0.971	N/A	0.225	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
6.0	1.00	5	1,620	1,402	1,620	3.03	N/A	N/A	0.969	N/A	0.233	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
5.0	1.00	6	1,740	1,459	1,740	3.11	N/A	N/A	0.966	N/A	0.240	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
4.0	1.00	6	1,860	1,517	1,860	3.12	N/A	N/A	0.964	N/A	0.246	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
3.0	1.00	6	1,980	1,574	1,980	3.18	N/A	N/A	0.962	N/A	0.252	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
2.0	1.00	4	2,100	1,632	2,069	3.13	N/A	N/A	0.959	N/A	0.257	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
1.0	1.00	4	2,220	1,690	2,126	3.10	N/A	N/A	0.957	N/A	0.262	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
0.0	1.00	4	2,340	1,747	2,184	3.12	N/A	N/A	0.955	N/A	0.266	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
-1.0	1.00	4	2,460	1,805	2,242	3.17	N/A	N/A	0.952	N/A	0.270	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
-2.0	1.00	4	2,580	1,862	2,299	3.16	N/A	N/A	0.950	N/A	0.274	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
-3.0	1.00	4	2,700	1,920	2,357	3.16	N/A	N/A	0.948	N/A	0.277	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
-4.0	1.00	2	2,820	1,978	2,414	3.12	N/A	N/A	0.945	N/A	0.280	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
-5.0	1.00	2	2,940	2,035	2,472	3.10	N/A	N/A	0.943	N/A	0.283	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
-6.0	1.00	3	3,060	2,093	2,530	3.09	N/A	N/A	0.941	N/A	0.286	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
-7.0	1.00	3	3,180	2,150	2,587	3.15	N/A	N/A	0.938	N/A	0.289	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
-8.0	1.00	3	3,300	2,208	2,645	3.05	N/A	N/A	0.936	N/A	0.291	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
-9.0	1.00	3	3,420	2,266	2,702	3.07	N/A	N/A	0.934	N/A	0.293	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
-10.0	1.00	5	3,540	2,323	2,760	3.11	N/A	N/A	0.931	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
-11.0	1.66	13	3,660	2,381	2,818	2.11	1.48	54.68	0.926	0.957	0.296	0.095	0.411	YES	2.8	14.1	603	18.6	N/A	1.225	0.15	0.14
-12.0	1.00	4	3,780	2,438	2,875	3.05	N/A	N/A	0.918	N/A	0.296	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.14
-13.0	1.00	5	3,900	2,496	2,933	3.05	N/A	N/A	0.909	N/A	0.296	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.14
-14.0	1.00	6	4,020	2,554	2,990	2.96	N/A	N/A	0.901	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.14
-15.0	1.00	3	4,140	2,611	3,048	3.08	N/A	N/A	0.893	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.14
-16.0	1.00	7	4,260	2,669	3,106	3.08	N/A	N/A	0.885	N/A	0.294	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.14
-17.0	1.00	10	4,380	2,726	3,163	2.91	N/A	N/A	0.877	N/A	0.293	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.14
-18.0	1.00	8	4,500	2,784	3,221	3.10	N/A	N/A	0.869	N/A	0.292	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.14
-19.0	1.00	8	4,620	2,842	3,278	3.28	N/A	N/A	0.861	N/A	0.291	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.14
-20.0	1.00	10	4,740	2,899	3,336	3.21	N/A	N/A	0.852	N/A	0.290	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.14
-21.0	1.00	7	4,860	2,957	3,394	3.16	N/A	N/A	0.844	N/A	0.289	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.14
-22.0	1.00	13	4,980	3,014	3,451	2.68	N/A	N/A	0.836	N/A	0.287	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.14
-23.0	1.00	23	5,100	3,072	3,509	2.26	1.82	100.91	0.828	0.875	0.286	0.176	0.717	YES	2.8	20.1	1,194	25.7	N/A	0.084	0.01	0.13
-24.0	1.66	55	5,220	3,130	3,566	1.82	1.12	148.75	0.820	0.836	0.284	0.386	1.514	NO	N/A	N/A	N/A	54.6	N/A	0.000	0.00	0.13
-25.0	1.00	19	5,340	3,187	3,624	2.52	2.88	95.31	0.812	0.878	0.283	0.161	0.664	YES	2.8	16.7	848	21.7	N/A	0.148	0.02	0.11
-26.0	1.00	27	5,460	3,245	3,682	1.93	1.22	101.45	0.804	0.852	0.281	0.177	0.715	YES	1.3	20.9	1,200	23.0	N/A	0.098	0.01	0.10
-27.0	1.00	26	5,580	3,302	3,739	1.71	1.00	100.64	0.795	0.849	0.280	0.175	0.708	YES	0.0	18.9	1,072	18.9	N/A	0.477	0.06	0.05
-28.0	1.00	31	5,700	3,360	3,797	1.64	1.00	119.54	0.787	0.832	0.278	0.239	0.954	YES	0.0	22.5	1,200	22.5	N/A	0.099	0.01	0.03
-29.0	1.66	43	5,820	3,418	3,854	1.48	1.00	164.91	0.779	0.807	0.276	N/A	N/A	NO	N/A	N/A	N/A	31.1	N/A	0.050	0.01	0.03
-30.0	1.00	19	5,940	3,475	3,912	2.38	2.24	95.93	0.771	0.859	0.274	0.162	0.678	YES	2.8	16.2	798	21.1	N/A	0.149	0.02	0.01
-31.0	1.66	23	6,060	3,533	3,970	2.25	1.81	79.01	0.763	0.841	0.272	0.126	0.519	YES	2.8	19.3	1,114	24.8	N/A	0.084	0.01	0.00
-32.0	1.00	7	6,180	3,590	4,027	3.03	N/A	N/A	0.755	N/A	0.270	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-33.0	1.00	7	6,300	3,648	4,085	2.99	N/A	N/A	0.747	N/A	0.268	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-34.0	1.00	9	6,420	3,706	4,142	3.00	N/A	N/A	0.739	N/A	0.266	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-35.0	1.00	11	6,540	3,763	4,200	3.07	N/A	N/A	0.730	N/A	0.264	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-36.0	1.00	7	6,660	3,821	4,258	3.08	N/A	N/A	0.722	N/A	0.262	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-37.0	1.00	7	6,780	3,878	4,315	3.05	N/A	N/A	0.714	N/A	0.260	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-38.0	1.00	7	6,900	3,936	4,373	3.09	N/A	N/A	0.706	N/A	0.257	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-39.0	1.00	8	7,020	3,994	4,430	3.06	N/A	N/A	0.698	N/A	0.255	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-40.0	1.00	8	7,140	4,051	4,488	2.99	N/A	N/A	0.690	N/A	0.253	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-41.0	1.00	9	7,260	4,109	4,546	2.95	N/A	N/A	0.682	N/A	0.250	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
																max=	1,200					
																min=	603					
																avg=	1,004					

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT026

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	13.00 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \infty}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	10.00 ft below ground surface
GWT Depth For Design, Zwd =	3.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	16.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	2.31 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	2.31 inches	

INPUT SOIL PROFILE (CPT DATA)				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)
0.50	239.18	2.65	1.11	sand
1.50	103.30	2.11	2.04	silty sand to sandy silt
2.50	60.72	1.59	2.62	sandy silt to clayey silt
3.50	29.23	0.73	2.49	sandy silt to clayey silt
4.50	17.20	0.38	2.21	clayey silt to silty clay
5.50	13.28	0.18	1.37	sandy silt to clayey silt
6.50	25.92	0.67	2.57	sandy silt to clayey silt
7.50	84.57	1.25	1.48	silty sand to sandy silt
8.50	77.98	0.86	1.11	sand to silty sand
9.50	126.50	1.18	0.93	sand to silty sand
10.50	62.21	0.74	1.18	silty sand to sandy silt
11.50	7.37	0.23	3.05	clay
12.50	4.68	0.15	3.17	clay
13.50	5.90	0.24	4.01	clay
14.50	4.55	0.12	2.60	clay
15.50	4.33	0.11	2.46	clay
16.50	4.42	0.05	1.06	sensitive fine grained
17.50	3.35	0.03	0.84	sensitive fine grained
18.50	5.58	0.04	0.66	sensitive fine grained
19.50	5.27	0.04	0.76	sensitive fine grained
20.50	11.44	0.05	0.46	sandy silt to clayey silt
21.50	13.58	0.06	0.43	sandy silt to clayey silt
22.50	5.17	0.02	0.32	sensitive fine grained
23.50	4.68	0.02	0.35	sensitive fine grained
24.50	11.62	0.06	0.54	sandy silt to clayey silt
25.50	51.43	0.24	0.46	sand to silty sand
26.50	154.23	1.71	1.11	sand
27.50	191.15	2.32	1.21	sand
28.50	99.75	1.52	1.52	silty sand to sandy silt
29.50	40.55	0.53	1.31	silty sand to sandy silt
30.50	30.12	0.29	0.96	silty sand to sandy silt
31.50	81.61	1.09	1.34	sand to silty sand
32.50	94.55	1.20	1.27	sand to silty sand
33.50	62.58	0.48	0.77	sand to silty sand
34.50	155.35	1.46	0.94	sand
35.50	278.95	4.48	1.61	sand to silty sand
36.50	282.60	4.64	1.64	sand to silty sand
37.50	161.95	2.66	1.64	sand to silty sand
38.50	118.52	1.40	1.18	sand to silty sand
39.50	141.72	1.79	1.26	sand to silty sand
40.50	155.78	1.91	1.23	sand to silty sand
41.50	168.59	2.30	1.36	sand to silty sand
42.50	207.23	2.77	1.34	sand to silty sand
43.50	234.58	3.47	1.48	sand to silty sand
44.50	267.75	4.60	1.72	sand to silty sand
45.50	188.20	2.99	1.59	sand to silty sand
46.50	197.58	2.56	1.30	sand to silty sand
47.50	78.23	1.37	1.76	silty sand to sandy silt
48.50	19.92	0.32	1.61	sandy silt to clayey silt
49.50	13.70	0.18	1.35	sandy silt to clayey silt
50.50	12.85	0.16	1.27	sandy silt to clayey silt
51.50	41.63	0.41	0.97	silty sand to sandy silt
52.50	50.60	0.71	1.40	silty sand to sandy silt

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +																RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ_v' (psf)	Effective Vert. Stress (Test) σ_v' (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r(psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_t (in.)	Cumulative Settlement Profile (in.)
12.0	1.66	79	60	60	60	1.05	1.00	2,286.45	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	134.6	0.006	0.000	0.00	2.31
11.0	1.00	34	180	180	180	1.79	1.10	378.98	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	75.2	0.013	0.000	0.00	2.31
10.0	1.66	40	300	300	300	1.77	1.08	281.51	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	87.0	N/A	N/A	N/A	2.31
9.0	1.00	12	420	389	420	2.31	1.98	131.54	0.992	1.000	0.223	0.292	1.746	NO	N/A	N/A	N/A	28.9	N/A	0.051	0.01	2.31
8.0	1.00	9	540	446	540	2.47	2.63	95.82	0.990	1.000	0.249	0.162	0.867	YES	2.8	17.4	916	N/A	N/A	0.000	0.00	2.31
7.0	1.00	5	660	504	660	2.46	2.58	68.39	0.987	1.000	0.269	0.110	0.545	YES	2.8	11.8	425	15.8	N/A	1.521	0.18	2.12
6.0	1.00	10	780	562	780	2.42	2.39	116.75	0.985	1.000	0.285	0.228	1.069	YES	2.8	19.4	1,123	24.9	N/A	0.088	0.01	2.11
5.0	1.00	28	900	619	900	1.90	1.19	180.28	0.983	1.000	0.297	N/A	N/A	NO	N/A	N/A	N/A	55.4	N/A	0.000	0.00	2.11
4.0	1.00	19	1,020	677	1,020	1.85	1.14	153.07	0.980	1.000	0.307	0.414	1.796	NO	N/A	N/A	N/A	31.1	N/A	0.057	0.01	2.11
3.0	1.66	52	1,140	734	1,140	1.34	1.00	345.65	0.978	1.000	0.316	N/A	N/A	NO	N/A	N/A	N/A	75.2	N/A	0.000	0.00	2.11
2.0	1.66	34	1,260	792	1,229	1.65	1.01	164.74	0.976	1.000	0.323	N/A	N/A	NO	N/A	N/A	N/A	57.6	N/A	0.000	0.00	2.11
1.0	1.00	7	1,380	850	1,286	2.91	N/A	N/A	0.973	N/A	0.329	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.11
0.0	1.00	5	1,500	907	1,344	3.11	N/A	N/A	0.971	N/A	0.334	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.11
-1.0	1.00	6	1,620	965	1,402	3.10	N/A	N/A	0.969	N/A	0.338	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.11
-2.0	1.00	5	1,740	1,022	1,459	3.12	N/A	N/A	0.966	N/A	0.342	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.11
-3.0	1.00	4	1,860	1,080	1,517	3.14	N/A	N/A	0.964	N/A	0.345	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.11
-4.0	1.00	2	1,980	1,138	1,574	2.97	N/A	N/A	0.962	N/A	0.348	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.11
-5.0	1.00	2	2,100	1,195	1,632	3.07	N/A	N/A	0.959	N/A	0.351	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.11
-6.0	1.00	3	2,220	1,253	1,690	2.81	4.88	38.70	0.957	N/A	0.353	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.11
-7.0	1.00	3	2,340	1,310	1,747	2.88	5.48	39.63	0.955	N/A	0.355	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.11
-8.0	1.00	5	2,460	1,368	1,805	2.51	2.82	38.99	0.952	1.000	0.356	0.082	0.309	YES	2.8	7.6	204	10.8	N/A	2.474	0.30	1.81
-9.0	1.66	9	2,580	1,426	1,862	2.15	1.00	26.64	0.950	1.000	0.358	0.072	0.269	YES	2.8	12.1	445	16.2	N/A	1.737	0.21	1.60
-10.0	1.00	3	2,700	1,483	1,920	2.80	4.76	30.81	0.948	N/A	0.359	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.60
-11.0	1.00	2	2,820	1,541	1,978	2.87	5.42	30.88	0.945	N/A	0.360	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.60
-12.0	1.00	5	2,940	1,598	2,035	2.54	2.99	41.12	0.943	1.000	0.361	0.084	0.312	YES	2.8	7.4	196	10.5	N/A	2.513	0.30	1.30
-13.0	1.00	13	3,060	1,656	2,093	1.94	1.00	56.52	0.941	1.000	0.361	0.097	0.357	YES	1.3	13.9	584	15.7	N/A	1.798	0.22	1.08
-14.0	1.00	31	3,180	1,714	2,150	1.78	1.09	181.94	0.938	1.000	0.362	N/A	N/A	NO	N/A	N/A	N/A	29.7	N/A	0.080	0.01	1.07
-15.0	1.00	38	3,300	1,771	2,208	1.75	1.07	217.52	0.936	1.000	0.363	N/A	N/A	NO	N/A	N/A	N/A	36.4	N/A	0.028	0.00	1.07
-16.0	1.66	55	3,420	1,829	2,266	1.71	1.05	180.69	0.934	1.000	0.363	N/A	N/A	NO	N/A	N/A	N/A	67.1	N/A	0.000	0.00	1.07
-17.0	1.00	14	3,540	1,886	2,323	2.29	1.93	80.43	0.931	1.000	0.363	0.128	0.471	YES	2.8	15.3	712	20.0	N/A	1.319	0.16	0.91
-18.0	1.00	10	3,660	1,944	2,381	2.34	2.07	63.18	0.926	1.000	0.363	0.103	0.381	YES	2.8	12.0	436	16.0	N/A	1.758	0.21	0.70
-19.0	1.00	20	3,780	2,002	2,438	2.07	1.40	113.87	0.918	1.000	0.360	0.217	0.804	YES	1.3	19.8	1,166	21.9	N/A	1.108	0.13	0.57
-20.0	1.00	24	3,900	2,059	2,496	2.01	1.31	121.93	0.909	0.990	0.358	0.249	0.917	YES	1.3	22.5	1,200	24.7	N/A	0.277	0.03	0.53
-21.0	1.00	16	4,020	2,117	2,554	2.02	1.33	81.10	0.901	0.984	0.356	0.130	0.478	YES	1.3	15.2	697	17.0	N/A	1.642	0.20	0.34
-22.0	1.00	31	4,140	2,174	2,611	1.77	1.08	161.24	0.893	0.968	0.354	N/A	N/A	NO	N/A	N/A	N/A	27.2	N/A	0.097	0.01	0.33
-23.0	1.00	70	4,260	2,232	2,669	1.77	1.09	286.95	0.885	0.957	0.351	N/A	N/A	NO	N/A	N/A	N/A	65.8	N/A	0.000	0.00	0.33
-24.0	1.00	71	4,380	2,290	2,726	1.78	1.09	288.48	0.877	0.947	0.349	N/A	N/A	NO	N/A	N/A	N/A	65.9	N/A	0.000	0.00	0.33
-25.0	1.00	40	4,500	2,347	2,784	1.94	1.23	183.36	0.869	0.938	0.346	N/A	N/A	NO	N/A	N/A	N/A	38.5	N/A	0.011	0.00	0.32
-26.0	1.00	30	4,620	2,405	2,842	1.94	1.23	132.63	0.861	0.933	0.344	0.297	1.075	YES	1.3	26.2	1,200	28.6	N/A	0.084	0.01	0.31
-27.0	1.00	35	4,740	2,462	2,899	1.90	1.19	152.27	0.852	0.920	0.341	0.408	1.469	NO	N/A	N/A	N/A	33.3	N/A	0.048	0.01	0.31
-28.0	1.00	39	4,860	2,520	2,957	1.87	1.16	161.06	0.844	0.912	0.339	N/A	N/A	NO	N/A	N/A	N/A	36.1	N/A	0.028	0.00	0.31
-29.0	1.00	42	4,980	2,578	3,014	1.88	1.17	173.92	0.836	0.904	0.336	N/A	N/A	NO	N/A	N/A	N/A	38.5	N/A	0.011	0.00	0.30
-30.0	1.00	52	5,100	2,635	3,072	1.82	1.12	201.88	0.828	0.896	0.333	N/A	N/A	NO	N/A	N/A	N/A	46.3	N/A	0.000	0.00	0.30
-31.0	1.00	59	5,220	2,693	3,130	1.82	1.12	226.24	0.820	0.888	0.331	N/A	N/A	NO	N/A	N/A	N/A	51.6	N/A	0.000	0.00	0.30
-32.0	1.00	67	5,340	2,750	3,187	1.83	1.13	258.65	0.812	0.880	0.328	N/A	N/A	NO	N/A	N/A	N/A	58.1	N/A	0.000	0.00	0.30
-33.0	1.00	47	5,460	2,808	3,245	1.91	1.20	190.29	0.804	0.873	0.325	N/A	N/A	NO	N/A	N/A	N/A	41.2	N/A	0.000	0.00	0.30
-34.0	1.66	82	5,580	2,866	3,302	1.52	1.00	273.31	0.795	0.866	0.322	N/A	N/A	NO	N/A	N/A	N/A	69.2	N/A	0.000	0.00	0.30
-35.0	1.66	43	5,700	2,923	3,360	1.91	1.20	128.39	0.787	0.859	0.319	0.277	0.994	YES	2.8	36.1	1,200	45.0	N/A	0.000	0.00	0.30
-36.0	1.00	8	5,820	2,981	3,418	2.74	N/A	N/A	0.779	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
-37.0	1.00	5	5,940	3,038	3,475	2.86	N/A	N/A	0.771	N/A	0.314	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
-38.0	1.00	5	6,060	3,096	3,533	2.89	N/A	N/A	0.763	N/A	0.311	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
-39.0	1.00	14	6,180	3,154	3,590	2.31	1.99	65.82	0.755	0.896	0.308	0.107	0.414	YES	2.8	13.2	523	17.4	N/A	1.467	0.18	0.13
-40.0	1.00	17	6,300	3,211	3,648	2.33	2.06	82.08	0.747	0.882	0.305	0.131	0.508	YES	2.8	15.3	707	20.0	N/A	1.066	0.13	0.00

max=	1,200
min=	196
avg=	733

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT031

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	6.00 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	6.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \to \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	3.00 ft below ground surface
GWT Depth For Design, Zwd =	0.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	20.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	1.99 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	1.99 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +															RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ_v' (psf)	Effective Vert. Stress (Test) σ_v' (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_i (in.)	Cumulative Settlement Profile (in.)
0.50	8.10	0.09	1.15	clayey silt to silty clay	5.0	1.00	4	60	29	60	2.08	1.42	96.05	0.999	1.000	0.433	0.162	0.501	YES	2.8	9.7	N/A	N/A	N/A	0.000	0.00	1.99
1.50	33.45	0.19	0.58	silty sand to sandy silt	4.0	1.00	11	180	86	180	1.60	1.00	160.94	0.997	1.000	0.432	N/A	N/A	NO	N/A	N/A	N/A	27.7	N/A	0.383	0.05	1.94
2.50	24.75	0.31	1.25	sandy silt to clayey silt	3.0	1.66	16	300	144	300	1.69	1.03	157.55	0.994	1.000	0.431	0.444	1.374	NO	N/A	N/A	N/A	38.4	N/A	0.015	0.00	1.94
3.50	3.77	0.15	3.85	clay	2.0	1.00	4	420	202	389	2.83	N/A	N/A	0.992	N/A	0.430	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
4.50	5.05	0.23	4.33	clay	1.0	1.00	5	540	259	446	2.83	N/A	N/A	0.990	N/A	0.429	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
5.50	2.62	0.15	5.75	clay	0.0	1.00	3	660	317	504	3.19	N/A	N/A	0.987	N/A	0.428	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
6.50	2.27	0.11	4.58	clay	-1.0	1.00	2	780	374	562	3.24	N/A	N/A	0.985	N/A	0.427	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
7.50	2.55	0.14	5.35	clay	-2.0	1.00	3	900	432	619	3.28	N/A	N/A	0.983	N/A	0.426	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
8.50	2.82	0.15	5.09	clay	-3.0	1.00	3	1,020	490	677	3.27	N/A	N/A	0.980	N/A	0.425	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
9.50	2.97	0.13	4.18	clay	-4.0	1.00	3	1,140	547	734	3.23	N/A	N/A	0.978	N/A	0.424	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
10.50	2.40	0.08	3.20	clay	-5.0	1.00	2	1,260	605	792	3.29	N/A	N/A	0.976	N/A	0.423	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
11.50	2.68	0.09	3.24	clay	-6.0	1.00	3	1,380	662	850	3.28	N/A	N/A	0.973	N/A	0.422	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
12.50	2.35	0.08	3.20	clay	-7.0	1.00	2	1,500	720	907	3.37	N/A	N/A	0.971	N/A	0.421	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
13.50	1.83	0.07	3.53	clay	-8.0	1.00	2	1,620	778	965	3.56	N/A	N/A	0.969	N/A	0.420	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
14.50	2.37	0.10	3.67	clay	-9.0	1.00	2	1,740	835	1,022	3.47	N/A	N/A	0.966	N/A	0.419	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
15.50	1.80	0.06	2.70	clay	-10.0	1.00	2	1,860	893	1,080	3.59	N/A	N/A	0.964	N/A	0.418	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
16.50	1.85	0.05	2.23	sensitive fine grained	-11.0	1.00	1	1,980	950	1,138	3.55	N/A	N/A	0.962	N/A	0.417	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
17.50	2.60	0.07	2.39	clay	-12.0	1.00	3	2,100	1,008	1,195	3.40	N/A	N/A	0.959	N/A	0.416	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
18.50	11.12	0.09	0.82	sandy silt to clayey silt	-13.0	1.00	4	2,220	1,066	1,253	2.58	3.19	48.61	0.957	1.000	0.415	0.090	0.291	YES	2.8	8.4	235	11.7	N/A	2.326	0.28	1.66
19.50	67.00	0.25	0.37	sand to silty sand	-14.0	1.00	17	2,340	1,123	1,310	1.72	1.00	89.40	0.955	1.000	0.414	0.146	0.472	YES	1.3	22.0	1,200	24.2	N/A	1.076	0.13	1.53
20.50	149.81	0.95	0.64	sand	-15.0	1.00	30	2,460	1,181	1,368	1.56	1.00	194.98	0.952	1.000	0.413	N/A	N/A	NO	N/A	N/A	N/A	36.2	N/A	0.035	0.00	1.53
21.50	152.55	1.15	0.75	sand	-16.0	1.00	31	2,580	1,238	1,426	1.61	1.00	193.86	0.950	1.000	0.412	N/A	N/A	NO	N/A	N/A	N/A	36.1	N/A	0.036	0.00	1.52
22.50	219.10	1.34	0.61	sand	-17.0	1.00	44	2,700	1,296	1,483	1.45	1.00	272.18	0.948	1.000	0.411	N/A	N/A	NO	N/A	N/A	N/A	50.9	N/A	0.000	0.00	1.52
23.50	234.98	1.63	0.69	sand	-18.0	1.00	47	2,820	1,354	1,541	1.47	1.00	285.63	0.945	1.000	0.410	N/A	N/A	NO	N/A	N/A	N/A	53.5	N/A	0.000	0.00	1.52
24.50	222.10	1.30	0.58	sand	-19.0	1.00	44	2,940	1,411	1,598	1.44	1.00	264.40	0.943	1.000	0.409	N/A	N/A	NO	N/A	N/A	N/A	49.7	N/A	0.000	0.00	1.52
25.50	150.53	1.30	0.86	sand	-20.0	1.66	50	3,060	1,469	1,656	1.38	1.00	290.84	0.941	1.000	0.408	N/A	N/A	NO	N/A	N/A	N/A	54.8	N/A	0.000	0.00	1.52
26.50	46.82	0.28	0.59	sand to silty sand	-21.0	1.00	12	3,180	1,526	1,714	2.01	1.31	70.35	0.938	1.000	0.407	0.112	0.369	YES	1.3	14.0	590	15.8	N/A	1.827	0.22	1.30
27.50	35.45	0.19	0.52	silty sand to sandy silt	-22.0	1.66	20	3,300	1,584	1,771	1.81	1.00	65.95	0.936	1.000	0.406	0.107	0.351	YES	2.8	23.6	1,200	29.9	N/A	0.092	0.01	1.29
28.50	8.43	0.07	0.80	clayey silt to silty clay	-23.0	1.00	4	3,420	1,642	1,829	2.77	N/A	N/A	0.934	N/A	0.405	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.29
29.50	78.17	0.41	0.53	sand to silty sand	-24.0	1.00	20	3,540	1,699	1,886	1.81	1.12	94.58	0.931	1.000	0.404	0.159	0.525	YES	1.3	21.5	1,200	23.6	N/A	1.104	0.13	1.16
30.50	113.10	0.81	0.71	sand to silty sand	-25.0	1.00	28	3,660	1,757	1,944	1.76	1.08	130.03	0.926	1.000	0.401	0.284	0.946	YES	1.3	30.0	1,200	32.6	N/A	0.067	0.01	1.15
31.50	85.01	0.54	0.64	sand to silty sand	-26.0	1.00	21	3,780	1,814	2,002	1.84	1.14	101.31	0.918	1.000	0.398	0.177	0.593	YES	1.3	22.6	1,200	24.8	N/A	0.870	0.10	1.05
32.50	99.32	0.40	0.40	sand	-27.0	1.00	20	3,900	1,872	2,059	1.68	1.00	102.66	0.909	1.000	0.394	0.181	0.611	YES	0.0	19.6	1,141	19.6	N/A	1.453	0.17	0.87
33.50	103.27	0.64	0.62	sand to silty sand	-28.0	1.00	26	4,020	1,930	2,117	1.77	1.09	114.33	0.901	1.000	0.391	0.219	0.748	YES	1.3	26.4	1,200	28.8	N/A	0.097	0.01	0.86
34.50	118.85	0.66	0.55	sand	-29.0	1.00	24	4,140	1,987	2,174	1.70	1.04	123.59	0.893	1.000	0.387	0.256	0.881	YES	0.0	22.8	1,200	22.8	N/A	1.119	0.13	0.73
35.50	104.30	0.62	0.59	sand to silty sand	-30.0	1.00	26	4,260	2,045	2,232	1.77	1.08	111.76	0.885	0.992	0.384	0.210	0.724	YES	1.3	26.0	1,200	28.4	N/A	0.098	0.01	0.72
36.50	91.42	0.65	0.71	sand to silty sand	-31.0	1.00	23	4,380	2,102	2,290	1.87	1.16	103.28	0.877	0.983	0.380	0.182	0.630	YES	1.3	22.7	1,200	24.9	N/A	0.433	0.05	0.66
37.50	92.20	0.67	0.73	sand to silty sand	-32.0	1.00	23	4,500	2,160	2,347	1.87	1.16	103.33	0.869	0.974	0.376	0.183	0.630	YES	1.3	22.6	1,200	24.8	N/A	0.417	0.05	0.61
38.50	120.58	0.52	0.43	sand	-33.0	1.00	24	4,620	2,218	2,405	1.66	1.00	114.51	0.861	0.964	0.373	0.220	0.758	YES	0.0	22.0	1,200	22.0	N/A	1.143	0.14	0.48
39.50	150.62	0.72	0.48	sand	-34.0	1.00	30	4,740	2,275	2,462	1.60	1.00	141.21	0.852	0.951	0.369	0.342	1.174	YES	0.0	27.1	1,200	27.1	N/A	0.118	0.01	0.46
40.50	118.30	0.82	0.70	sand	-35.0	1.66	39	4,860	2,333	2,520	1.48	1.00	181.40	0.844	0.940	0.366	N/A	N/A	NO	N/A	N/A	N/A	34.9	N/A	0.040	0.00	0.46
41.50	22.51	0.20	0.86	sandy silt to clayey silt	-36.0	1.00	9	4,980	2,390	2,578	2.47	2.64	54.27	0.836	0.963	0.362	0.095	0.336	YES	2.8	10.7	354	14.5	N/A	1.926	0.23	0.23
42.50	19.22	0.26	1.30	sandy silt to clayey silt	-37.0	1.00	8	5,100	2,448	2,635	2.65	N/A	N/A	0.828	N/A	0.359	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
43.50	11.22	0.13	1.14	clayey silt to silty clay	-38.0	1.00	6	5,220	2,506	2,693	2.86	N/A	N/A	0.820	N/A	0.355	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
44.50	8.38	0.09	0.96	clayey silt to silty clay	-39.0	1.66	7	5,340	2,563	2,750	2.65	3.66	42.17	0.812	N/A	0.352	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
45.50	3.83	0.09	1.77	sensitive fine grained	-40.0	1.00	2	5,460	2,621	2,808	3.65	N/A	N/A	0.804	N/A	0.348	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
46.50	5.60	0.19	2.85	clay	-41.0	1.00	6	5,580	2,678	2,866	3.48	N/A	N/A	0.795	N/A	0.345	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
47.50	10.32	0.24	2.14	clayey silt to silty clay	-42.0	1.00	5	5,700	2,736	2,923	3.08	N/A	N/A	0.787	N/A	0.341	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
48.50	9.12	0.10	1.05	clayey silt to silty clay	-43.0	1.00	5	5,820	2,794	2,981	2.99	N/A	N/A	0.779	N/A	0.338	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
49.50	12.77	0.05	0.39	sandy silt to clayey silt	-44.0	1.00	5	5,940	2,851	3,038	2.66	3.69	36.10	0.771	N/A	0.334	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
50.50	7.33	0.06	0.71	sensitive fine grained	-45.0	1.00	4	6,060	2,909	3,096	3.05	N/A	N/A	0.763	N/A	0.331	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
51.50	22.72	0.40	1.71	sandy silt to clayey silt	-46.0	1.00	9	6,180	2,966	3,154	2.72	N/A	N/A	0.755	N/A	0.327	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
52.50	24.56	0.44	1.79	sandy silt to clayey silt	-47.0	1.00	10	6,300	3,024	3,211	2.70	N/A	N/A	0.747	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
53.50	44.10	1.02	2.31	sandy silt to clayey silt	-48.0	1.00	18	6,420	3,082	3,269	2.55	3.01	96.02	0.739	0.887	0.320	0.162	0.600	YES	2.8	16.6	833	21.6	N/A	0.482	0.06	0.17
54.50	50.70	0.56	1.09	silty sand to sandy silt	-49.0	1.00	17	6,540	3,139	3,326	2.26	1.84	74.51	0.730	0.885	0.316	0.118	0.442	YES	2.8	15.9	765	20.7	N/A	1.039	0.12	0.04
55.50	201.12	0.98	0.49	sand	-50.0	1.00	40	6,660	3,197	3,384	1.56	1.00	159.08	0.722	0.829	0.313	0.454	1.606	NO	N/A	N/A	N/A	30.9	N/A	0.059	0.01	0.04
56.50	268.27	0.95	0.35	gravelly sand to sand	-51.0	1.00	45	6,780	3,254	3,442	1.38	1.00	210.31	0.714	0.823	0.309	N/A	N/A	NO	N/A	N/A	N/A	34.1	N/A	0.038	0.00	0.03
57.50	280.95	0.81	0.29	gravelly sand to sand	-52.0	1.66	78	6,900	3,312	3,499	1.02	1.00	361.49	0.706	0.817	0.306	N/A	N/A	NO	N/A	N/A	N/A	58.6	N/A	0.000	0.00	0.03
58.50	99.32	1.06	1.07	sand to silty sand	-53.0	1.00	25	7,020	3,370	3,557	2.03	1.34	102.37	0.698	0.845	0.302	0.180	0.670	YES	1.3	20.0	1,181	22.0	N/A	0.195	0.02	0.01
59.50	132.62	1.55	1.17	sand to silty sand	-54.0	1.00	33	7,140	3,427	3,614	1.96	1.25	126.44	0.690	0.818	0.299	0.268	0.979	YES	1.3	26.0	1,200	28.3	N/A	0.072	0.01	0.00

	max=	1,200
	min=	235
	avg=	1,000

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT035

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	7.40 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	7.40 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \longrightarrow \infty}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	4.40 ft below ground surface
GWT Depth For Design, Zwd =	0.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	25.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	2.07 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	2.07 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_i (in.)	Cumulative Settlement Profile (in.)
0.50	175.98	2.02	1.15	sand	6.4	1.00	35	60	29	60	1.31	1.00	1,466.53	0.999	1.000	0.433	N/A	N/A	NO	N/A	N/A	N/A	59.8	N/A	0.000	0.00	2.07
1.50	156.73	2.05	1.31	sand to silty sand	5.4	1.00	39	180	86	180	1.46	1.00	754.08	0.997	1.000	0.432	N/A	N/A	NO	N/A	N/A	N/A	72.3	N/A	0.000	0.00	2.07
2.50	130.05	1.59	1.22	sand to silty sand	4.4	1.00	54	300	144	300	1.23	1.00	802.48	0.994	1.000	0.431	N/A	N/A	NO	N/A	N/A	N/A	98.4	N/A	0.000	0.00	2.07
3.50	63.90	0.59	0.92	sand to silty sand	3.4	1.00	16	420	202	420	1.66	1.01	203.54	0.992	1.000	0.430	N/A	N/A	NO	N/A	N/A	N/A	31.0	N/A	0.089	0.01	2.06
4.50	42.17	0.36	0.86	silty sand to sandy silt	2.4	1.00	14	540	259	534	1.82	1.12	131.09	0.990	1.000	0.429	0.290	0.901	YES	2.8	26.7	1,200	33.7	N/A	0.062	0.01	2.05
5.50	27.98	0.37	1.31	sandy silt to clayey silt	1.4	1.66	19	660	317	591	1.80	1.10	128.59	0.987	1.000	0.428	0.278	0.866	YES	2.8	34.3	1,200	42.8	N/A	0.000	0.00	2.05
6.50	7.87	0.09	1.10	clayey silt to silty clay	0.4	1.00	4	780	374	649	2.56	3.07	55.90	0.985	1.000	0.427	0.096	0.301	YES	2.8	9.5	285	N/A	N/A	0.000	0.00	2.05
7.50	9.67	0.22	2.24	clayey silt to silty clay	-0.6	1.66	8	900	432	707	2.37	2.18	75.05	0.983	1.000	0.426	0.119	0.374	YES	2.8	16.3	800	N/A	N/A	0.000	0.00	2.05
8.50	4.75	0.13	2.70	clay	-1.6	1.00	5	1,020	490	764	2.89	N/A	N/A	0.980	N/A	0.425	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.05
9.50	19.92	0.17	0.85	sandy silt to clayey silt	-2.6	1.00	8	1,140	547	822	2.22	1.71	65.03	0.978	1.000	0.424	0.106	0.332	YES	2.8	15.2	701	19.9	N/A	1.473	0.18	1.87
10.50	20.70	0.38	1.82	sandy silt to clayey silt	-3.6	1.66	14	1,260	605	879	2.10	1.46	90.89	0.976	1.000	0.423	0.150	0.473	YES	2.8	23.5	1,200	29.8	N/A	0.098	0.01	1.86
11.50	4.58	0.03	0.73	sensitive fine grained	-4.6	1.00	2	1,380	662	937	2.70	4.03	42.31	0.973	N/A	0.422	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.86
12.50	3.82	0.01	0.22	sensitive fine grained	-5.6	1.00	2	1,500	720	995	2.63	3.54	29.06	0.971	N/A	0.421	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.86
13.50	3.60	0.01	0.19	sensitive fine grained	-6.6	1.00	2	1,620	778	1,052	2.68	3.84	28.10	0.969	N/A	0.420	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.86
14.50	3.73	0.01	0.13	sensitive fine grained	-7.6	1.00	2	1,740	835	1,110	2.65	3.67	26.40	0.966	N/A	0.419	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.86
15.50	4.10	0.00	0.08	sensitive fine grained	-8.6	1.00	2	1,860	893	1,167	2.60	3.34	25.06	0.964	N/A	0.418	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.86
16.50	4.27	0.00	0.04	sensitive fine grained	-9.6	1.00	2	1,980	950	1,225	2.60	3.31	24.69	0.962	1.000	0.417	0.071	0.226	YES	5.0	7.7	208	N/A	N/A	0.000	0.00	1.86
17.50	4.30	0.00	0.04	sensitive fine grained	-10.6	1.00	2	2,100	1,008	1,283	2.61	3.41	24.51	0.959	N/A	0.416	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.86
18.50	4.18	0.00	0.04	sensitive fine grained	-11.6	1.00	2	2,220	1,066	1,340	2.64	3.60	24.18	0.957	N/A	0.415	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.86
19.50	8.08	0.03	0.31	sensitive fine grained	-12.6	1.00	4	2,340	1,123	1,398	2.56	3.08	33.24	0.955	1.000	0.414	0.078	0.251	YES	5.0	9.8	303	N/A	N/A	0.000	0.00	1.86
20.50	36.33	0.20	0.55	silty sand to sandy silt	-13.6	1.00	12	2,460	1,181	1,455	2.04	1.36	64.42	0.952	1.000	0.413	0.105	0.339	YES	2.8	17.0	873	22.0	N/A	1.266	0.15	1.71
21.50	103.53	1.13	1.09	sand to silty sand	-14.6	1.00	26	2,580	1,238	1,513	1.85	1.14	150.62	0.950	1.000	0.412	0.398	1.289	YES	1.3	31.1	1,200	33.7	N/A	0.059	0.01	1.70
22.50	132.07	1.76	1.33	sand to silty sand	-15.6	1.00	33	2,700	1,296	1,571	1.84	1.14	186.82	0.948	1.000	0.411	N/A	N/A	NO	N/A	N/A	N/A	41.5	N/A	0.000	0.00	1.70
23.50	96.18	1.46	1.52	silty sand to sandy silt	-16.6	1.00	32	2,820	1,354	1,628	1.99	1.28	150.11	0.945	1.000	0.410	0.395	1.285	YES	2.8	38.3	1,200	47.6	N/A	0.000	0.00	1.70
24.50	78.52	0.90	1.14	sand to silty sand	-17.6	1.66	33	2,940	1,411	1,686	1.66	1.01	156.81	0.943	1.000	0.409	0.439	1.432	NO	N/A	N/A	N/A	39.6	N/A	0.004	0.00	1.70
25.50	17.18	0.30	1.76	sandy silt to clayey silt	-18.6	1.00	7	3,060	1,469	1,743	2.61	N/A	N/A	0.941	N/A	0.408	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.70
26.50	14.98	0.08	0.51	sandy silt to clayey silt	-19.6	1.00	6	3,180	1,526	1,801	2.44	2.49	42.66	0.938	1.000	0.407	0.086	0.281	YES	2.8	9.1	267	12.6	N/A	2.196	0.26	1.44
27.50	15.32	0.08	0.49	sandy silt to clayey silt	-20.6	1.00	6	3,300	1,584	1,859	2.43	2.45	42.09	0.936	1.000	0.406	0.085	0.280	YES	2.8	9.2	268	12.6	N/A	2.189	0.26	1.17
28.50	29.73	0.18	0.59	silty sand to sandy silt	-21.6	1.66	16	3,420	1,642	1,916	1.90	1.00	54.34	0.934	1.000	0.405	0.095	0.313	YES	2.8	19.6	1,140	25.1	N/A	0.837	0.10	1.07
29.50	11.05	0.07	0.58	sandy silt to clayey silt	-22.6	1.00	4	3,540	1,699	1,974	2.60	3.34	41.67	0.931	N/A	0.404	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
30.50	7.62	0.02	0.22	sensitive fine grained	-23.6	1.00	4	3,660	1,757	2,031	2.64	3.56	29.91	0.926	N/A	0.401	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
31.50	8.81	0.10	1.07	clayey silt to silty clay	-24.6	1.00	4	3,780	1,814	2,089	2.84	N/A	N/A	0.918	N/A	0.398	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
32.50	12.92	0.18	1.37	clayey silt to silty clay	-25.6	1.00	6	3,900	1,872	2,147	2.74	N/A	N/A	0.909	N/A	0.394	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
33.50	50.90	0.45	0.87	silty sand to sandy silt	-26.6	1.00	17	4,020	1,930	2,204	2.11	1.48	76.80	0.901	1.000	0.391	0.122	0.417	YES	2.8	19.0	1,076	24.4	N/A	0.889	0.11	0.97
34.50	71.78	0.89	1.23	sand to silty sand	-27.6	1.66	30	4,140	1,987	2,262	1.78	1.09	129.84	0.893	1.000	0.387	0.284	0.978	YES	1.3	29.3	1,200	31.8	N/A	0.070	0.01	0.96
35.50	34.73	0.30	0.85	silty sand to sandy silt	-28.6	1.66	19	4,260	2,045	2,319	1.96	1.25	71.18	0.885	0.993	0.384	0.114	0.392	YES	2.8	20.6	1,200	26.4	N/A	0.173	0.02	0.94
36.50	8.75	0.06	0.68	clayey silt to silty clay	-29.6	1.00	4	4,380	2,102	2,377	2.81	4.83	40.69	0.877	N/A	0.380	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.94
37.50	12.42	0.06	0.45	sandy silt to clayey silt	-30.6	1.00	5	4,500	2,160	2,435	2.59	3.26	38.22	0.869	0.985	0.376	0.082	0.286	YES	2.8	7.3	193	10.4	N/A	2.533	0.30	0.63
38.50	12.70	0.08	0.65	sandy silt to clayey silt	-31.6	1.00	5	4,620	2,218	2,492	2.65	3.64	42.81	0.861	N/A	0.373	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
39.50	10.12	0.04	0.34	sandy silt to clayey silt	-32.6	1.00	4	4,740	2,275	2,550	2.66	3.68	33.82	0.852	N/A	0.369	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
40.50	8.57	0.06	0.69	clayey silt to silty clay	-33.6	1.00	4	4,860	2,333	2,607	2.86	5.28	40.33	0.844	N/A	0.366	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
41.50	16.27	0.23	1.42	sandy silt to clayey silt	-34.6	1.00	7	4,980	2,390	2,665	2.73	N/A	N/A	0.836	N/A	0.362	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
42.50	19.60	0.48	2.41	clayey silt to silty clay	-35.6	1.00	10	5,100	2,448	2,723	2.79	N/A	N/A	0.828	N/A	0.359	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
43.50	22.08	0.76	3.40	clayey silt to silty clay	-36.6	1.00	11	5,220	2,506	2,780	2.85	N/A	N/A	0.820	N/A	0.355	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
44.50	17.78	0.55	3.06	clayey silt to silty clay	-37.6	1.00	9	5,340	2,563	2,838	2.91	N/A	N/A	0.812	N/A	0.352	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
45.50	17.18	0.47	2.70	clayey silt to silty clay	-38.6	1.00	9	5,460	2,621	2,895	2.90	N/A	N/A	0.804	N/A	0.348	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
46.50	19.00	0.57	2.98	clayey silt to silty clay	-39.6	1.00	10	5,580	2,678	2,953	2.89	N/A	N/A	0.795	N/A	0.345	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
47.50	83.72	1.00	1.19	sand to silty sand	-40.6	1.00	21	5,700	2,736	3,011	2.08	1.42	101.68	0.787	0.908	0.341	0.178	0.631	YES	1.3	18.4	1,017	20.4	N/A	1.212	0.15	0.49
48.50	113.13	1.30	1.15	sand to silty sand	-41.6	1.66	47	5,820	2,794	3,068	1.66	1.01	159.97	0.779	0.875	0.338	0.461	1.593	NO	N/A	N/A	N/A	42.1	N/A	0.000	0.00	0.49
49.50	55.47	1.22	2.20	sandy silt to clayey silt	-42.6	1.00	22	5,940	2,851	3,126	2.40	2.32	107.69	0.771	0.894	0.334	0.196	0.700	YES	2.8	20.5	1,200	26.3	N/A	0.097	0.01	0.48
50.50	77.98	0.74	0.95	sand to silty sand	-43.6	1.00	19	6,060	2,909	3,183	2.06	1.38	89.40	0.763	0.895	0.331	0.146	0.529	YES	1.3	16.8	852	18.7	N/A	1.383	0.17	0.31
51.50	84.08	1.16	1.38	sand to silty sand	-44.6	1.00	21	6,180	2,966	3,241	2.13	1.52	104.90	0.755	0.887	0.327	0.187	0.678	YES	1.3	17.8	960	19.8	N/A	1.224	0.15	0.16
52.50	54.76	0.97	1.77	silty sand to sandy silt	-45.6	1.66	30	6,300	3,024	3,299	2.04	1.36	100.00	0.747	0.860	0.324	0.173	0.614	YES	2.8	26.3	1,200	33.2	N/A	0.046	0.01	0.16
53.50	24.82	0.69	2.77	clayey silt to silty clay	-46.6	1.00	12	6,420	3,082	3,356	2.81	N/A	N/A	0.739	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.16
54.50	17.07	0.37	2.15	clayey silt to silty clay	-47.6	1.00	9	6,540	3,139	3,414	2.90	N/A	N/A	0.730	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.16
55.50	13.13	0.23	1.77	clayey silt to silty clay	-48.6	1.00	7	6,660	3,197	3,471	2.97	N/A	N/A	0.722	N/A	0.313	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.16
56.50	35.10	0.78	2.23	sandy silt to clayey silt	-49.6	1.00	14	6,780	3,254	3,529	2.63	N/A	N/A	0.714	N/A	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.16
57.50	77.77	1.35	1.73	silty sand to sandy silt	-50.6	1.00	26	6,900	3,312	3,587	2.24	1.78	107.65	0.706	0.847	0.306	0.196	0.724	YES	2.8	22.2	1,200	28.2	N/A	0.075	0.01	0.15
58.50	42.52	1.05	2.48	sandy silt to clayey silt	-51.6	1.00	17	7,020	3,370	3,644	2.60	N/A	N/A	0.698	N/A	0.302	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.15
59.50	46.10	0.86	1.87	silty sand to sandy silt	-52.6	1.00	15	7,140	3,427	3,702	2.50	2.77	85.38	0.690	0.873	0.299	0.138	0.537	YES	2.8	14.1	600	18.6	N/A	1.251	0.15	0.00
60.50	37.88	0.90	2.38	sandy silt to clayey silt	-53.6	1.00	15	7,260	3,485	3,759	2.64	N/A	N/A	0.682	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
																					max=	1,200					
																					min=	193					
																					avg=	862					

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT037

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	5.00 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	5.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \infty}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw = 2.00 ft below ground surface

GWT Depth For Design, Zwd = 0.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils = 14.00 feet

Earthquake-Induced Settlements:

- Liquefaction-Induced Settlement = 0.93 inches <--- Saturated Sands
- Seismic Compaction Settlement = 0.00 inches <--- Dry or Unsaturated Sands

Total: 0.93 inches

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_i (in.)	Cumulative Settlement Profile (in.)
0.50	127.88	0.67	0.52	sand	4.0	1.00	26	60	29	60	1.04	1.00	1,065.69	0.999	1.000	0.433	N/A	N/A	NO	N/A	N/A	N/A	43.5	N/A	0.000	0.00	0.93
1.50	101.18	0.97	0.96	sand to silty sand	3.0	1.66	42	180	86	180	1.13	1.00	806.04	0.997	1.000	0.432	N/A	N/A	NO	N/A	N/A	N/A	77.1	N/A	0.000	0.00	0.93
2.50	29.52	0.40	1.34	sandy silt to clayey silt	2.0	1.66	20	300	144	269	1.66	1.01	183.52	0.994	1.000	0.431	N/A	N/A	NO	N/A	N/A	N/A	44.9	N/A	0.000	0.00	0.93
3.50	7.55	0.29	3.78	clay	1.0	1.00	8	420	202	326	2.59	3.24	136.80	0.992	1.000	0.430	0.318	0.987	YES	5.0	17.8	959	N/A	N/A	0.000	0.00	0.93
4.50	4.42	0.17	3.84	clay	0.0	1.00	4	540	259	384	2.84	N/A	N/A	0.990	N/A	0.429	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
5.50	4.53	0.16	3.54	clay	-1.0	1.00	5	660	317	442	2.85	N/A	N/A	0.987	N/A	0.428	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
6.50	3.88	0.16	4.11	clay	-2.0	1.00	4	780	374	499	2.99	N/A	N/A	0.985	N/A	0.427	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
7.50	7.13	0.16	2.19	silty clay to clay	-3.0	1.66	8	900	432	557	2.47	2.62	66.59	0.983	1.000	0.426	0.107	0.337	YES	5.0	18.4	1,016	N/A	N/A	0.000	0.00	0.93
8.50	3.38	0.06	1.75	sensitive fine grained	-4.0	1.00	2	1,020	490	614	2.91	N/A	N/A	0.980	N/A	0.425	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
9.50	3.07	0.05	1.48	sensitive fine grained	-5.0	1.00	2	1,140	547	672	2.96	N/A	N/A	0.978	N/A	0.424	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
10.50	2.96	0.03	1.17	sensitive fine grained	-6.0	1.00	1	1,260	605	730	2.95	N/A	N/A	0.976	N/A	0.423	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
11.50	2.93	0.05	1.60	sensitive fine grained	-7.0	1.00	1	1,380	662	787	3.06	N/A	N/A	0.973	N/A	0.422	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
12.50	3.28	0.04	1.22	sensitive fine grained	-8.0	1.00	2	1,500	720	845	2.98	N/A	N/A	0.971	N/A	0.421	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
13.50	3.25	0.03	0.97	sensitive fine grained	-9.0	1.00	2	1,620	778	902	2.97	N/A	N/A	0.969	N/A	0.420	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
14.50	4.15	0.03	0.64	sensitive fine grained	-10.0	1.00	2	1,740	835	960	2.81	4.85	38.73	0.966	N/A	0.419	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
15.50	3.40	0.01	0.24	sensitive fine grained	-11.0	1.00	2	1,860	893	1,018	2.77	4.57	28.42	0.964	N/A	0.418	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
16.50	3.97	0.02	0.54	sensitive fine grained	-12.0	1.00	2	1,980	950	1,075	2.85	5.19	35.94	0.962	N/A	0.417	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
17.50	24.82	0.19	0.75	silty sand to sandy silt	-13.0	1.00	8	2,100	1,008	1,133	2.23	1.73	60.60	0.959	1.000	0.416	0.101	0.323	YES	2.8	13.8	574	18.2	N/A	1.614	0.19	0.74
18.50	81.40	0.58	0.71	sand to silty sand	-14.0	1.00	20	2,220	1,066	1,190	1.79	1.10	122.31	0.957	1.000	0.415	0.250	0.805	YES	1.3	27.7	1,200	30.1	N/A	0.093	0.01	0.72
19.50	144.83	1.97	1.36	sand to silty sand	-15.0	1.00	36	2,340	1,123	1,248	1.80	1.11	214.05	0.955	1.000	0.414	N/A	N/A	NO	N/A	N/A	N/A	50.5	N/A	0.000	0.00	0.72
20.50	140.19	2.14	1.52	sand to silty sand	-16.0	1.00	35	2,460	1,181	1,306	1.85	1.15	209.65	0.952	1.000	0.413	N/A	N/A	NO	N/A	N/A	N/A	48.0	N/A	0.000	0.00	0.72
21.50	96.40	1.29	1.33	sand to silty sand	-17.0	1.00	24	2,580	1,238	1,363	1.93	1.22	149.56	0.950	1.000	0.412	0.391	1.268	YES	1.3	30.5	1,200	33.1	N/A	0.064	0.01	0.72
22.50	93.60	1.27	1.35	sand to silty sand	-18.0	1.00	39	2,700	1,296	1,421	1.64	1.00	192.01	0.948	1.000	0.411	N/A	N/A	NO	N/A	N/A	N/A	50.7	N/A	0.000	0.00	0.72
23.50	24.65	0.42	1.71	sandy silt to clayey silt	-19.0	1.66	16	2,820	1,354	1,478	2.17	1.60	79.31	0.945	1.000	0.410	0.126	0.412	YES	2.8	21.8	1,200	27.8	N/A	0.157	0.02	0.70
24.50	6.30	0.06	0.90	sensitive fine grained	-20.0	1.00	3	2,940	1,411	1,536	2.86	N/A	N/A	0.943	N/A	0.409	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.70
25.50	6.15	0.08	1.34	sensitive fine grained	-21.0	1.00	3	3,060	1,469	1,594	2.97	N/A	N/A	0.941	N/A	0.408	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.70
26.50	6.15	0.12	1.93	silty clay to clay	-22.0	1.00	4	3,180	1,526	1,651	3.07	N/A	N/A	0.938	N/A	0.407	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.70
27.50	6.13	0.07	1.07	sensitive fine grained	-23.0	1.00	3	3,300	1,584	1,709	2.96	N/A	N/A	0.936	N/A	0.406	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.70
28.50	6.17	0.10	1.64	silty clay to clay	-24.0	1.00	4	3,420	1,642	1,766	3.06	N/A	N/A	0.934	N/A	0.405	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.70
29.50	8.80	0.16	1.74	clayey silt to silty clay	-25.0	1.00	4	3,540	1,699	1,824	2.93	N/A	N/A	0.931	N/A	0.404	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.70
30.50	7.00	0.04	0.61	sensitive fine grained	-26.0	1.00	4	3,660	1,757	1,882	2.82	4.98	38.45	0.926	N/A	0.401	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.70
31.50	13.54	0.20	1.45	sandy silt to clayey silt	-27.0	1.00	5	3,780	1,814	1,939	2.73	N/A	N/A	0.918	N/A	0.398	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.70
32.50	12.32	0.14	1.10	sandy silt to clayey silt	-28.0	1.00	5	3,900	1,872	1,997	2.71	N/A	N/A	0.909	N/A	0.394	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.70
33.50	7.60	0.06	0.78	sensitive fine grained	-29.0	1.00	4	4,020	1,930	2,054	2.86	N/A	N/A	0.901	N/A	0.391	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.70
34.50	19.80	0.24	1.18	sandy silt to clayey silt	-30.0	1.00	8	4,140	1,987	2,112	2.55	3.05	60.67	0.893	1.000	0.387	0.101	0.347	YES	2.8	10.5	340	14.2	N/A	1.961	0.24	0.46
35.50	23.72	0.09	0.37	silty sand to sandy silt	-31.0	1.66	13	4,260	2,045	2,170	1.97	1.00	38.84	0.885	0.994	0.384	0.082	0.285	YES	2.8	15.4	714	20.1	N/A	1.376	0.17	0.30
36.50	8.00	0.03	0.41	sensitive fine grained	-32.0	1.00	4	4,380	2,102	2,227	2.76	4.46	34.37	0.877	N/A	0.380	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
37.50	7.53	0.05	0.69	sensitive fine grained	-33.0	1.00	4	4,500	2,160	2,285	2.89	N/A	N/A	0.869	N/A	0.376	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
38.50	7.87	0.11	1.34	clayey silt to silty clay	-34.0	1.00	4	4,620	2,218	2,342	3.01	N/A	N/A	0.861	N/A	0.373	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
39.50	13.92	0.29	2.07	clayey silt to silty clay	-35.0	1.00	7	4,740	2,275	2,400	2.87	N/A	N/A	0.852	N/A	0.369	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
40.50	16.48	0.45	2.67	clayey silt to silty clay	-36.0	1.00	8	4,860	2,333	2,458	2.88	N/A	N/A	0.844	N/A	0.366	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
41.50	15.77	0.47	2.96	clayey silt to silty clay	-37.0	1.00	8	4,980	2,390	2,515	2.93	N/A	N/A	0.836	N/A	0.362	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
42.50	19.25	0.82	4.23	clay	-38.0	1.00	19	5,100	2,448	2,573	2.95	N/A	N/A	0.828	N/A	0.359	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
43.50	11.72	0.31	2.60	clayey silt to silty clay	-39.0	1.00	6	5,220	2,506	2,630	3.03	N/A	N/A	0.820	N/A	0.355	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
44.50	39.25	0.80	2.03	sandy silt to clayey silt	-40.0	1.00	16	5,340	2,563	2,688	2.48	2.68	92.81	0.812	0.934	0.352	0.154	0.547	YES	2.8	16.3	808	21.3	N/A	1.146	0.14	0.16
45.50	74.43	1.06	1.42	silty sand to sandy silt	-41.0	1.00	25	5,460	2,621	2,746	2.16	1.58	102.73	0.804	0.911	0.348	0.181	0.631	YES	2.8	24.0	1,200	30.4	N/A	0.071	0.01	0.15
46.50	60.63	1.06	1.75	silty sand to sandy silt	-42.0	1.00	20	5,580	2,678	2,803	2.30	1.93	101.31	0.795	0.913	0.345	0.177	0.625	YES	2.8	19.9	1,172	25.5	N/A	0.143	0.02	0.13
47.50	50.70	0.99	1.95	silty sand to sandy silt	-43.0	1.00	17	5,700	2,736	2,861	2.39	2.28	98.82	0.787	0.915	0.341	0.170	0.608	YES	2.8	16.9	866	22.0	N/A	1.021	0.12	0.01
48.50	33.65	0.76	2.25	sandy silt to clayey silt	-44.0	1.00	13	5,820	2,794	2,918	2.61	N/A	N/A	0.779	N/A	0.338	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
49.50	27.10	0.71	2.62	sandy silt to clayey silt	-45.0	1.00	11	5,940	2,851	2,976	2.74	N/A	N/A	0.771	N/A	0.334	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
50.50	16.50	0.38	2.27	clayey silt to silty clay	-46.0	1.00	8	6,060	2,909	3,034	2.90	N/A	N/A	0.763	N/A	0.331	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
51.50	22.13	0.48	2.15	sandy silt to clayey silt	-47.0	1.00	9	6,180	2,966	3,091	2.78	N/A	N/A	0.755	N/A	0.327	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
52.50	18.19	0.44	2.40	clayey silt to silty clay	-48.0	1.00	9	6,300	3,024	3,149	2.89	N/A	N/A	0.747	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
53.50	29.92	0.64	2.13	sandy silt to clayey silt	-49.0	1.00	12	6,420	3,082	3,206	2.67	N/A	N/A	0.739	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
54.50	78.33	1.26	1.60	silty sand to sandy silt	-50.0	1.00	26	6,540	3,139	3,264	2.21	1.69	105.91	0.730	0.858	0.316	0.190	0.689	YES	2.8	23.2	1,200	29.5	N/A	0.069	0.01	0.00
55.50	49.98	1.19	2.37	sandy silt to clayey silt	-51.0	1.66	33	6,660	3,197	3,322	2.16	1.58	103.47	0.722	0.837	0.313	0.183	0.653	YES	2.8	28.5	1,200	35.8	N/A	0.027	0.00	0.00
56.50	13.42	0.36	2.63	clayey silt to silty clay	-52.0	1.00	7	6,780	3,254	3,379	3.06	N/A	N/A	0.714	N/A	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
57.50	17.62	0.14	0.77	sandy silt to clayey silt	-53.0	1.00	7	6,900	3,312	3,437	2.68	3.82	46.10	0.706	N/A	0.306	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
58.50	10.80	0.10	0.91	sandy silt to clayey silt	-54.0	1.00	4	7,020	3,370	3,494	2.94	N/A	N/A	0.698	N/A	0.302	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
59.50	9.42	0.19	1.93	clayey silt to silty clay	-55.0	1.00	5	7,140	3,427	3,552	3.18	N/A	N/A	0.690	N/A	0.299	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
60.50	10.62	0.28	2.56	silty clay to clay	-56.0	1.00	7	7,260	3,485	3,610	3.19	N/A	N/A	0.682	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
																						max=	1,200				
																						min=	340				
																						avg=	975				

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT038

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	8.40 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	8.40 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	5.40 ft below ground surface
GWT Depth For Design, Zwd =	0.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	27.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	1.98 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	1.98 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_t (in.)	Cumulative Settlement Profile (in.)
0.50	243.24	2.91	1.19	sand	7.4	1.66	81	60	29	60	1.08	1.00	3,356.15	0.999	1.000	0.433	N/A	N/A	NO	N/A	N/A	N/A	136.9	N/A	0.000	0.00	1.98
1.50	85.37	2.17	2.54	sandy silt to clayey silt	6.4	1.00	34	180	86	180	1.84	1.13	466.18	0.997	1.000	0.432	N/A	N/A	NO	N/A	N/A	N/A	74.7	N/A	0.000	0.00	1.98
2.50	47.72	0.58	1.22	silty sand to sandy silt	5.4	1.66	26	300	144	300	1.48	1.00	294.48	0.994	1.000	0.431	N/A	N/A	NO	N/A	N/A	N/A	58.7	N/A	0.000	0.00	1.98
3.50	12.23	0.38	3.11	silty clay to clay	4.4	1.00	8	420	202	420	2.55	3.04	117.14	0.992	1.000	0.430	0.229	0.712	YES	5.0	18.9	1,066	N/A	N/A	0.000	0.00	1.98
4.50	6.79	0.22	3.24	clay	3.4	1.00	7	540	259	540	2.64	N/A	N/A	0.990	N/A	0.429	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.98
5.50	4.83	0.07	1.42	sensitive fine grained	2.4	1.00	2	660	317	654	2.60	3.30	63.46	0.987	1.000	0.428	0.104	0.324	YES	5.0	9.1	266	N/A	N/A	0.000	0.00	1.98
6.50	6.05	0.15	2.45	silty clay to clay	1.4	1.00	4	780	374	711	2.70	N/A	N/A	0.985	N/A	0.427	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.98
7.50	15.80	0.28	1.76	clayey silt to silty clay	0.4	1.66	13	900	432	769	2.13	1.51	84.90	0.983	1.000	0.426	0.137	0.429	YES	2.8	23.9	1,200	N/A	N/A	0.000	0.00	1.98
8.50	7.06	0.16	2.27	silty clay to clay	-0.6	1.00	5	1,020	490	827	2.69	N/A	N/A	0.980	N/A	0.425	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.98
9.50	5.06	0.06	1.19	sensitive fine grained	-1.6	1.00	3	1,140	547	884	2.70	N/A	N/A	0.978	N/A	0.424	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.98
10.50	4.40	0.01	0.23	sensitive fine grained	-2.6	1.00	2	1,260	605	942	2.52	2.88	31.02	0.976	1.000	0.423	0.076	0.239	YES	5.0	8.2	226	N/A	N/A	0.000	0.00	1.98
11.50	10.17	0.03	0.33	sandy silt to clayey silt	-3.6	1.00	4	1,380	662	999	2.35	1.00	17.66	0.973	1.000	0.422	0.065	0.205	YES	2.8	8.6	241	11.9	N/A	2.301	0.28	1.71
12.50	6.63	0.05	0.80	sensitive fine grained	-4.6	1.00	3	1,500	720	1,057	2.60	3.30	47.17	0.971	1.000	0.421	0.089	0.283	YES	5.0	9.6	288	N/A	N/A	0.000	0.00	1.71
13.50	3.99	0.02	0.38	sensitive fine grained	-5.6	1.00	2	1,620	778	1,115	2.71	4.10	33.14	0.969	N/A	0.420	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.71
14.50	3.94	0.01	0.30	sensitive fine grained	-6.6	1.00	2	1,740	835	1,172	2.71	4.10	31.11	0.966	N/A	0.419	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.71
15.50	5.82	0.02	0.26	sensitive fine grained	-7.6	1.00	3	1,860	893	1,230	2.54	2.99	31.90	0.964	1.000	0.418	0.077	0.245	YES	5.0	8.7	248	N/A	N/A	0.000	0.00	1.71
16.50	4.76	0.00	0.00	sensitive fine grained	-8.6	1.00	2	1,980	950	1,287	2.89	5.59	46.42	0.962	N/A	0.417	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.71
17.50	17.18	0.10	0.58	sandy silt to clayey silt	-9.6	1.00	7	2,100	1,008	1,345	2.32	2.01	48.66	0.959	1.000	0.416	0.091	0.291	YES	2.8	11.2	381	15.1	N/A	1.893	0.23	1.48
18.50	85.95	0.45	0.53	sand to silty sand	-10.6	1.00	21	2,220	1,066	1,403	1.69	1.03	121.34	0.957	1.000	0.415	0.246	0.792	YES	1.3	27.0	1,200	29.4	N/A	0.100	0.01	1.47
19.50	149.32	1.24	0.83	sand	-11.6	1.00	30	2,340	1,123	1,460	1.63	1.00	199.25	0.955	1.000	0.414	N/A	N/A	NO	N/A	N/A	N/A	35.0	N/A	0.047	0.01	1.46
20.50	171.04	1.57	0.92	sand	-12.6	1.00	34	2,460	1,181	1,518	1.63	1.00	222.60	0.952	1.000	0.413	N/A	N/A	NO	N/A	N/A	N/A	39.3	N/A	0.007	0.00	1.46
21.50	161.96	1.82	1.12	sand	-13.6	1.00	32	2,580	1,238	1,575	1.72	1.05	216.37	0.950	1.000	0.412	N/A	N/A	NO	N/A	N/A	N/A	36.5	N/A	0.033	0.00	1.46
22.50	135.51	1.28	0.95	sand	-14.6	1.66	45	2,700	1,296	1,633	1.42	1.00	278.72	0.948	1.000	0.411	N/A	N/A	NO	N/A	N/A	N/A	49.7	N/A	0.000	0.00	1.46
23.50	59.26	0.70	1.18	silty sand to sandy silt	-15.6	1.00	20	2,820	1,354	1,691	2.07	1.41	101.32	0.945	1.000	0.410	0.177	0.576	YES	2.8	24.3	1,200	30.8	N/A	0.085	0.01	1.45
24.50	32.63	0.26	0.81	silty sand to sandy silt	-16.6	1.66	18	2,940	1,411	1,748	1.90	1.19	76.41	0.943	1.000	0.409	0.121	0.397	YES	2.8	22.1	1,200	28.1	N/A	0.142	0.02	1.43
25.50	8.30	0.09	1.02	clayey silt to silty clay	-17.6	1.00	4	3,060	1,469	1,806	2.78	N/A	N/A	0.941	N/A	0.408	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.43
26.50	17.70	0.13	0.73	sandy silt to clayey silt	-18.6	1.00	7	3,180	1,526	1,863	2.44	2.48	50.24	0.938	1.000	0.407	0.092	0.301	YES	2.8	10.1	319	13.8	N/A	2.007	0.24	1.19
27.50	13.65	0.11	0.77	sandy silt to clayey silt	-19.6	1.00	5	3,300	1,584	1,921	2.54	2.98	48.46	0.936	1.000	0.406	0.090	0.297	YES	2.8	8.4	233	11.7	N/A	2.335	0.28	0.91
28.50	57.52	0.35	0.61	sand to silty sand	-20.6	1.00	14	3,420	1,642	1,979	1.95	1.24	78.85	0.934	1.000	0.405	0.126	0.414	YES	1.3	15.8	754	17.7	N/A	1.651	0.20	0.71
29.50	85.55	0.84	0.98	sand to silty sand	-21.6	1.00	21	3,540	1,699	2,036	1.94	1.22	113.61	0.931	1.000	0.404	0.216	0.716	YES	1.3	22.5	1,200	24.7	N/A	0.999	0.12	0.59
30.50	178.65	2.17	1.22	sand to silty sand	-22.6	1.00	45	3,660	1,757	2,094	1.77	1.08	206.80	0.926	1.000	0.401	N/A	N/A	NO	N/A	N/A	N/A	48.2	N/A	0.000	0.00	0.59
31.50	202.66	3.12	1.54	sand to silty sand	-23.6	1.00	51	3,780	1,814	2,151	1.82	1.12	237.91	0.918	1.000	0.398	N/A	N/A	NO	N/A	N/A	N/A	53.7	N/A	0.000	0.00	0.59
32.50	117.07	1.38	1.18	sand to silty sand	-24.6	1.00	29	3,900	1,872	2,209	1.90	1.19	143.96	0.909	1.000	0.394	0.357	1.210	YES	1.3	29.2	1,200	31.7	N/A	0.073	0.01	0.58
33.50	112.39	1.30	1.16	sand to silty sand	-25.6	1.00	28	4,020	1,930	2,267	1.91	1.20	137.50	0.901	1.000	0.391	0.322	1.099	YES	1.3	27.7	1,200	30.2	N/A	0.085	0.01	0.57
34.50	108.40	1.33	1.23	sand to silty sand	-26.6	1.00	27	4,140	1,987	2,324	1.95	1.24	134.51	0.893	1.000	0.387	0.306	1.056	YES	1.3	26.5	1,200	28.8	N/A	0.095	0.01	0.56
35.50	142.66	2.15	1.51	sand to silty sand	-27.6	1.00	36	4,260	2,045	2,382	1.93	1.22	171.56	0.885	0.991	0.384	N/A	N/A	NO	N/A	N/A	N/A	36.8	N/A	0.027	0.00	0.56
36.50	80.56	1.77	2.20	silty sand to sandy silt	-28.6	1.66	44	4,380	2,102	2,439	1.91	1.20	156.33	0.877	0.980	0.380	0.435	1.498	NO	N/A	N/A	N/A	53.3	N/A	0.000	0.00	0.56
37.50	13.04	0.22	1.69	clayey silt to silty clay	-29.6	1.00	7	4,500	2,160	2,497	2.83	N/A	N/A	0.869	N/A	0.376	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.56
38.50	10.27	0.07	0.71	sandy silt to clayey silt	-30.6	1.00	4	4,620	2,218	2,555	2.76	4.44	42.21	0.861	N/A	0.373	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.56
39.50	11.22	0.08	0.68	sandy silt to clayey silt	-31.6	1.00	4	4,740	2,275	2,612	2.72	4.15	42.32	0.852	N/A	0.369	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.56
40.50	14.00	0.12	0.87	sandy silt to clayey silt	-32.6	1.00	6	4,860	2,333	2,670	2.68	N/A	N/A	0.844	N/A	0.366	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.56
41.50	18.11	0.37	2.04	clayey silt to silty clay	-33.6	1.00	9	4,980	2,390	2,727	2.77	N/A	N/A	0.836	N/A	0.362	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.56
42.50	21.15	0.65	3.07	clayey silt to silty clay	-34.6	1.00	11	5,100	2,448	2,785	2.83	N/A	N/A	0.828	N/A	0.359	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.56
43.50	20.32	0.70	3.42	clayey silt to silty clay	-35.6	1.00	10	5,220	2,506	2,843	2.88	N/A	N/A	0.820	N/A	0.355	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.56
44.50	16.44	0.48	2.93	clayey silt to silty clay	-36.6	1.00	8	5,340	2,563	2,900	2.93	N/A	N/A	0.812	N/A	0.352	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.56
45.50	71.95	1.03	1.43	silty sand to sandy silt	-37.6	1.00	24	5,460	2,621	2,958	2.17	1.61	101.04	0.804	0.914	0.348	0.176	0.616	YES	2.8	22.5	1,200	28.7	N/A	0.084	0.01	0.55
46.50	98.17	1.21	1.23	sand to silty sand	-38.6	1.00	25	5,580	2,678	3,015	2.03	1.34	114.03	0.795	0.907	0.345	0.218	0.765	YES	1.3	21.3	1,200	23.4	N/A	0.380	0.05	0.50
47.50	129.55	1.24	0.96	sand to silty sand	-39.6	1.00	32	5,700	2,736	3,073	1.87	1.16	128.65	0.787	0.887	0.341	0.278	0.964	YES	1.3	27.5	1,200	29.9	N/A	0.073	0.01	0.49
48.50	191.91	1.00	0.52	sand	-40.6	1.00	38	5,820	2,794	3,131	1.57	1.00	162.38	0.779	0.875	0.338	N/A	N/A	NO	N/A	N/A	N/A	30.7	N/A	0.067	0.01	0.48
49.50	173.66	0.73	0.42	sand	-41.6	1.00	35	5,940	2,851	3,188	1.56	1.00	145.44	0.771	0.870	0.334	0.366	1.272	YES	0.0	27.5	1,200	27.5	N/A	0.088	0.01	0.47
50.50	139.30	0.47	0.34	sand	-42.6	1.00	28	6,060	2,909	3,246	1.60	1.00	115.51	0.763	0.877	0.331	0.223	0.790	YES	0.0	21.9	1,200	21.9	N/A	0.803	0.10	0.38
51.50	182.96	0.61	0.33	sand	-43.6	1.00	37	6,180	2,966	3,303	1.49	1.00	150.23	0.755	0.854	0.327	0.395	1.377	NO	N/A	N/A	N/A	28.5	N/A	0.079	0.01	0.37
52.50	116.86	0.85	0.72	sand	-44.6	1.00	23	6,300	3,024	3,361	1.85	1.14	108.73	0.747	0.877	0.324	0.200	0.721	YES	0.0	18.0	979	18.0	N/A	1.443	0.17	0.19
53.50	98.09	0.49	0.50	sand to silty sand	-45.6	1.66	41	6,420	3,082	3,419	1.53	1.00	130.84	0.739	0.841	0.320	0.288	1.011	YES	1.3	32.4	1,200	35.0	N/A	0.033	0.00	0.19
54.50	18.29	0.34	1.87	sandy silt to clayey silt	-46.6	1.00	7	6,540	3,139	3,476	2.83	N/A	N/A	0.730	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
55.50	14.23	0.21	1.45	sandy silt to clayey silt	-47.6	1.00	6	6,660	3,197	3,534	2.89	N/A	N/A	0.722	N/A	0.313	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
56.50	27.90	0.80	2.85	clayey silt to silty clay	-48.6	1.00	14	6,780	3,254	3,591	2.79	N/A	N/A	0.714	N/A	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
57.50	96.74	1.12	1.15	sand to silty sand	-49.6	1.00	24	6,900	3,312	3,649	2.06	1.38	103.74	0.706	0.852	0.306	0.184	0.683	YES	1.3	19.2	1,106	21.3	N/A	0.367	0.04	0.15
58.50	128.98	0.83	0.64	sand	-50.6	1.00	26	7,020	3,370	3,707	1.80	1.11	110.14	0.698	0.843	0.302	0.204	0.760	YES	0.0	18.9	1,075	18.9	N/A	1.210	0.15	0.00

max=	1,200
min=	226
avg=	888

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT040

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	6.90 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	6.90 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	3.90 ft below ground surface
GWT Depth For Design, Zwd =	0.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	9.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	0.47 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	0.47 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +															RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ_v' (psf)	Effective Vert. Stress (Test) σ_v' (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_c (in.)	Cumulative Settlement Profile (in.)
0.50	13.50	0.25	1.82	clayey silt to silty clay	5.9	1.00	7	60	29	60	2.05	1.37	154.26	0.999	1.000	0.433	0.421	1.299	YES	2.8	14.3	615	N/A	N/A	0.000	0.00	0.47
1.50	11.40	0.48	4.17	clay	4.9	1.00	11	180	86	180	2.53	2.92	159.98	0.997	1.000	0.432	0.461	1.424	NO	N/A	N/A	N/A	N/A	N/A	0.000	0.00	0.47
2.50	6.73	0.38	5.57	clay	3.9	1.00	7	300	144	300	2.66	N/A	N/A	0.994	N/A	0.431	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
3.50	6.17	0.32	5.19	clay	2.9	1.00	6	420	202	420	2.75	N/A	N/A	0.992	N/A	0.430	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
4.50	4.60	0.23	5.02	clay	1.9	1.00	5	540	259	503	2.89	N/A	N/A	0.990	N/A	0.429	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
5.50	4.37	0.22	4.92	clay	0.9	1.00	4	660	317	560	2.96	N/A	N/A	0.987	N/A	0.428	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
6.50	21.60	0.33	1.51	sandy silt to clayey silt	-0.1	1.66	14	780	374	618	1.95	1.24	102.68	0.985	1.000	0.427	0.181	0.565	YES	2.8	27.1	1,200	34.2	N/A	0.057	0.01	0.46
7.50	8.52	0.23	2.75	silty clay to clay	-1.1	1.66	9	900	432	675	2.46	2.58	78.22	0.983	1.000	0.426	0.125	0.390	YES	5.0	21.0	1,200	N/A	N/A	0.000	0.00	0.46
8.50	3.87	0.07	1.86	sensitive fine grained	-2.1	1.00	2	1,020	490	733	2.87	N/A	N/A	0.980	N/A	0.425	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.46
9.50	3.55	0.03	0.97	sensitive fine grained	-3.1	1.00	2	1,140	547	791	2.80	N/A	N/A	0.978	N/A	0.424	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.46
10.50	3.16	0.02	0.65	sensitive fine grained	-4.1	1.00	2	1,260	605	848	2.81	4.90	37.91	0.976	N/A	0.423	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.46
11.50	4.03	0.03	0.72	sensitive fine grained	-5.1	1.00	2	1,380	662	906	2.75	4.40	40.63	0.973	N/A	0.422	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.46
12.50	3.40	0.01	0.30	sensitive fine grained	-6.1	1.00	2	1,500	720	963	2.72	4.18	30.58	0.971	N/A	0.421	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.46
13.50	2.80	0.01	0.31	sensitive fine grained	-7.1	1.00	1	1,620	778	1,021	2.84	5.11	29.07	0.969	N/A	0.420	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.46
14.50	4.75	0.02	0.47	sensitive fine grained	-8.1	1.00	2	1,740	835	1,079	2.69	3.93	35.95	0.966	N/A	0.419	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.46
15.50	3.25	0.01	0.31	sensitive fine grained	-9.1	1.00	2	1,860	893	1,136	2.83	5.02	29.90	0.964	N/A	0.418	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.46
16.50	16.12	0.08	0.50	sandy silt to clayey silt	-10.1	1.00	6	1,980	950	1,194	2.30	1.96	45.80	0.962	1.000	0.417	0.088	0.282	YES	2.8	11.1	379	15.0	N/A	1.897	0.23	0.23
17.50	85.13	1.03	1.22	sand to silty sand	-11.1	1.00	21	2,100	1,008	1,251	1.91	1.20	143.76	0.959	1.000	0.416	0.356	1.144	YES	1.3	28.2	1,200	30.7	N/A	0.088	0.01	0.22
18.50	121.43	2.12	1.74	silty sand to sandy silt	-12.1	1.00	40	2,220	1,066	1,309	1.93	1.21	201.87	0.957	1.000	0.415	N/A	N/A	NO	N/A	N/A	N/A	65.0	N/A	0.000	0.00	0.22
19.50	112.13	1.99	1.77	silty sand to sandy silt	-13.1	1.00	37	2,340	1,123	1,367	1.96	1.25	187.37	0.955	1.000	0.414	N/A	N/A	NO	N/A	N/A	N/A	59.3	N/A	0.000	0.00	0.22
20.50	109.01	1.96	1.80	silty sand to sandy silt	-14.1	1.00	36	2,460	1,181	1,424	1.98	1.28	181.25	0.952	1.000	0.413	N/A	N/A	NO	N/A	N/A	N/A	56.7	N/A	0.000	0.00	0.22
21.50	100.82	2.15	2.14	silty sand to sandy silt	-15.1	1.66	56	2,580	1,238	1,482	1.76	1.08	228.30	0.950	1.000	0.412	N/A	N/A	NO	N/A	N/A	N/A	82.6	N/A	0.000	0.00	0.22
22.50	21.07	0.37	1.75	sandy silt to clayey silt	-16.1	1.66	14	2,700	1,296	1,539	2.22	1.73	74.86	0.948	1.000	0.411	0.119	0.387	YES	2.8	18.7	1,049	24.1	N/A	1.077	0.13	0.09
23.50	8.37	0.08	0.99	clayey silt to silty clay	-17.1	1.00	4	2,820	1,354	1,597	2.74	N/A	N/A	0.945	N/A	0.410	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
24.50	6.07	0.06	0.97	sensitive fine grained	-18.1	1.00	3	2,940	1,411	1,655	2.89	N/A	N/A	0.943	N/A	0.409	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
25.50	5.40	0.06	1.15	sensitive fine grained	-19.1	1.00	3	3,060	1,469	1,712	3.00	N/A	N/A	0.941	N/A	0.408	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
26.50	5.50	0.04	0.70	sensitive fine grained	-20.1	1.00	3	3,180	1,526	1,770	2.90	5.74	38.68	0.938	N/A	0.407	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
27.50	5.63	0.07	1.24	sensitive fine grained	-21.1	1.00	3	3,300	1,584	1,827	3.02	N/A	N/A	0.936	N/A	0.406	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
28.50	7.37	0.12	1.57	clayey silt to silty clay	-22.1	1.00	4	3,420	1,642	1,885	2.96	N/A	N/A	0.934	N/A	0.405	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
29.50	6.33	0.03	0.42	sensitive fine grained	-23.1	1.00	3	3,540	1,699	1,943	2.80	4.76	34.07	0.931	N/A	0.404	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
30.50	9.95	0.10	1.02	clayey silt to silty clay	-24.1	1.00	5	3,660	1,757	2,000	2.76	N/A	N/A	0.926	N/A	0.401	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
31.50	6.61	0.01	0.19	sensitive fine grained	-25.1	1.00	3	3,780	1,814	2,058	2.70	3.99	28.41	0.918	N/A	0.398	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
32.50	9.27	0.08	0.83	clayey silt to silty clay	-26.1	1.00	5	3,900	1,872	2,115	2.78	N/A	N/A	0.909	N/A	0.394	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
33.50	10.87	0.16	1.46	clayey silt to silty clay	-27.1	1.00	5	4,020	1,930	2,173	2.83	N/A	N/A	0.901	N/A	0.391	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
34.50	13.12	0.27	2.05	clayey silt to silty clay	-28.1	1.00	7	4,140	1,987	2,231	2.85	N/A	N/A	0.893	N/A	0.387	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
35.50	18.42	0.48	2.61	clayey silt to silty clay	-29.1	1.00	9	4,260	2,045	2,288	2.78	N/A	N/A	0.885	N/A	0.384	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
36.50	15.97	0.32	1.98	clayey silt to silty clay	-30.1	1.00	8	4,380	2,102	2,346	2.78	N/A	N/A	0.877	N/A	0.380	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
37.50	20.98	0.86	4.08	silty clay to clay	-31.1	1.00	14	4,500	2,160	2,403	2.87	N/A	N/A	0.869	N/A	0.376	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
38.50	55.10	1.24	2.25	sandy silt to clayey silt	-32.1	1.00	22	4,620	2,218	2,461	2.37	2.18	114.10	0.861	0.966	0.373	0.218	0.754	YES	2.8	22.7	1,200	28.8	N/A	0.090	0.01	0.08
39.50	99.28	1.30	1.31	sand to silty sand	-33.1	1.66	41	4,740	2,275	2,519	1.71	1.04	160.58	0.852	0.950	0.369	N/A	N/A	NO	N/A	N/A	N/A	40.9	N/A	0.000	0.00	0.08
40.50	43.88	1.30	2.96	sandy silt to clayey silt	-34.1	1.66	29	4,860	2,333	2,576	2.22	1.70	114.69	0.844	0.943	0.366	0.220	0.758	YES	2.8	28.4	1,200	35.7	N/A	0.034	0.00	0.08
41.50	21.27	0.66	3.08	clayey silt to silty clay	-35.1	1.00	11	4,980	2,390	2,634	2.82	N/A	N/A	0.836	N/A	0.362	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.08
42.50	53.62	0.96	1.79	silty sand to sandy silt	-36.1	1.00	18	5,100	2,448	2,691	2.33	2.04	98.97	0.828	0.942	0.359	0.170	0.596	YES	2.8	18.2	997	23.5	N/A	0.562	0.07	0.01
43.50	31.38	0.89	2.83	sandy silt to clayey silt	-37.1	1.00	13	5,220	2,506	2,749	2.67	N/A	N/A	0.820	N/A	0.355	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
44.50	17.47	0.46	2.63	clayey silt to silty clay	-38.1	1.00	9	5,340	2,563	2,807	2.87	N/A	N/A	0.812	N/A	0.352	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
45.50	15.10	0.30	2.01	clayey silt to silty clay	-39.1	1.00	8	5,460	2,621	2,864	2.87	N/A	N/A	0.804	N/A	0.348	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
46.50	11.02	0.15	1.32	clayey silt to silty clay	-40.1	1.00	6	5,580	2,678	2,922	2.92	N/A	N/A	0.795	N/A	0.345	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
47.50	11.67	0.15	1.25	clayey silt to silty clay	-41.1	1.00	6	5,700	2,736	2,979	2.89	N/A	N/A	0.787	N/A	0.341	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
48.50	10.27	0.13	1.22	clayey silt to silty clay	-42.1	1.00	5	5,820	2,794	3,037	2.95	N/A	N/A	0.779	N/A	0.338	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
49.50	9.60	0.12	1.21	clayey silt to silty clay	-43.1	1.00	5	5,940	2,851	3,095	2.99	N/A	N/A	0.771	N/A	0.334	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
50.50	8.55	0.05	0.60	sensitive fine grained	-44.1	1.00	4	6,060	2,909	3,152	2.92	5.85	37.79	0.763	N/A	0.331	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
51.50	9.15	0.02	0.22	sensitive fine grained	-45.1	1.00	5	6,180	2,966	3,210	2.74	4.28	29.17	0.755	N/A	0.327	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
52.50	9.14	0.15	1.67	clayey silt to silty clay	-46.1	1.00	5	6,300	3,024	3,267	3.10	N/A	N/A	0.747	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
53.50	14.10	0.42	2.98	clayey silt to silty clay	-47.1	1.00	7	6,420	3,082	3,325	3.05	N/A	N/A	0.739	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
54.50	16.10	0.51	3.16	clayey silt to silty clay	-48.1	1.00	8	6,540	3,139	3,383	3.02	N/A	N/A	0.730	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
55.50	15.82	0.46	2.93	clayey silt to silty clay	-49.1	1.00	8	6,660	3,197	3,440	3.01	N/A	N/A	0.722	N/A	0.313	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
56.50	11.37	0.26	2.28	clayey silt to silty clay	-50.1	1.00	6	6,780	3,254	3,498	3.10	N/A	N/A	0.714	N/A	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
57.50	20.52	0.49	2.38	clayey silt to silty clay	-51.1	1.00	10	6,900	3,312	3,555	2.87	N/A	N/A	0.706	N/A	0.306	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
58.50	164.50	1.53	0.93	sand	-52.1	1.00	33	7,020	3,370	3,613	1.82	1.12	141.96	0.698	0.824	0.302	0.346	1.258	YES	0.0	24.5	1,200	24.5	N/A	0.097	0.01	0.00
59.50	375.80	2.01	0.54	gravelly sand to sand	-53.1	1.00	63	7,140	3,427	3,671	1.39	1.00	287.08	0.690	0.806	0.299	N/A	N/A	NO	N/A	N/A	N/A	46.2	N/A	0.000	0.00	0.00

	max=	1,200
	min=	379
	avg=	1,024

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT045

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	9.00 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	9.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$

+++ $FS = (CRR_{7.5}/CSR)\ MSF\ K_\sigma\ K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	6.00 ft below ground surface
GWT Depth For Design, Zwd =	0.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	16.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	0.88 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	0.88 inches	

INPUT SOIL PROFILE (CPT DATA)				
Soil Depth During Test (ft)	Average Cone Tip Resistance q_{t-avg} (tsf)	Average Sleeve Friction f_{s-avg} (tsf)	Average Friction Ratio R_{f-avg} (%)	Soil Behavior Type (Robertson et al., 1983)
0.50	17.12	0.29	1.68	sandy silt to clayey silt
1.50	9.62	0.39	4.06	clay
2.50	5.98	0.35	5.87	clay
3.50	5.32	0.35	6.51	clay
4.50	2.40	0.11	4.65	clay
5.50	2.15	0.06	2.87	clay
6.50	2.32	0.07	2.89	clay
7.50	1.72	0.07	3.86	clay
8.50	24.22	0.13	0.53	silty sand to sandy silt
9.50	19.60	0.20	1.01	sandy silt to clayey silt
10.50	1.71	0.08	4.70	organic material
11.50	1.92	0.05	2.54	clay
12.50	2.70	0.09	3.31	clay
13.50	2.67	0.07	2.45	clay
14.50	1.73	0.03	1.98	sensitive fine grained
15.50	1.62	0.04	2.80	clay
16.50	1.37	0.03	1.92	sensitive fine grained
17.50	2.33	0.05	2.25	sensitive fine grained
18.50	3.18	0.03	0.90	sensitive fine grained
19.50	3.48	0.06	1.74	sensitive fine grained
20.50	29.69	0.18	0.59	silty sand to sandy silt
21.50	49.63	0.36	0.73	silty sand to sandy silt
22.50	9.72	0.19	1.93	clayey silt to silty clay
23.50	5.53	0.14	2.58	clay
24.50	6.88	0.13	1.85	silty clay to clay
25.50	6.08	0.16	2.60	clay
26.50	3.87	0.08	1.98	clay
27.50	4.93	0.12	2.37	clay
28.50	4.60	0.08	1.83	silty clay to clay
29.50	9.32	0.11	1.15	clayey silt to silty clay
30.50	24.22	0.65	2.70	clayey silt to silty clay
31.50	22.70	0.75	3.33	clayey silt to silty clay
32.50	23.72	0.93	3.91	silty clay to clay
33.50	25.67	0.75	2.92	clayey silt to silty clay
34.50	38.37	1.30	3.38	clayey silt to silty clay
35.50	41.48	1.08	2.61	sandy silt to clayey silt
36.50	15.73	0.23	1.46	sandy silt to clayey silt
37.50	17.05	0.31	1.79	sandy silt to clayey silt
38.50	34.87	0.38	1.08	silty sand to sandy silt
39.50	21.35	0.41	1.90	sandy silt to clayey silt
40.50	41.35	0.68	1.64	silty sand to sandy silt
41.50	37.34	0.56	1.50	silty sand to sandy silt
42.50	8.05	0.09	1.08	clayey silt to silty clay
43.50	11.92	0.26	2.15	clayey silt to silty clay
44.50	32.78	0.85	2.58	sandy silt to clayey silt
45.50	35.50	0.55	1.54	silty sand to sandy silt
46.50	11.98	0.22	1.88	clayey silt to silty clay
47.50	99.50	1.20	1.21	sand to silty sand
48.50	16.35	0.49	2.99	clayey silt to silty clay
49.50	7.15	0.14	1.91	silty clay to clay
50.50	6.52	0.15	2.28	silty clay to clay
51.50	6.98	0.23	3.34	clay
52.50	8.57	0.22	2.64	silty clay to clay
53.50	12.23	0.22	1.81	clayey silt to silty clay
54.50	19.78	0.62	3.15	clayey silt to silty clay
55.50	73.55	1.03	1.40	silty sand to sandy silt
56.50	68.25	1.02	1.49	silty sand to sandy silt
57.50	69.22	1.10	1.59	silty sand to sandy silt
58.50	106.67	1.64	1.54	sand to silty sand
59.50	235.33	2.01	0.86	sand

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +																RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ_v' (psf)	Effective Vert. Stress (Test) σ_v' (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r(psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_l (in.)	Cumulative Settlement Profile (in.)
8.0	1.00	7	60	29	60	1.95	1.24	177.56	0.999	1.000	0.433	N/A	N/A	NO	N/A	N/A	N/A	19.0	N/A	1.565	0.19	0.88
7.0	1.00	10	180	86	180	2.57	3.16	146.11	0.997	1.000	0.432	0.370	1.144	YES	5.0	21.3	1,200	N/A	N/A	0.000	0.00	0.88
6.0	1.00	6	300	144	300	2.71	N/A	N/A	0.994	N/A	0.431	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.88
5.0	1.66	9	420	202	420	2.55	3.02	148.47	0.992	1.000	0.430	0.384	1.193	YES	5.0	20.0	1,182	N/A	N/A	0.000	0.00	0.88
4.0	1.00	2	540	259	540	3.10	N/A	N/A	0.990	N/A	0.429	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.88
3.0	1.00	2	660	317	660	3.08	N/A	N/A	0.987	N/A	0.428	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.88
2.0	1.00	2	780	374	749	3.10	N/A	N/A	0.985	N/A	0.427	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.88
1.0	1.00	2	900	432	806	3.35	N/A	N/A	0.983	N/A	0.426	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.88
0.0	1.00	8	1,020	490	864	2.02	1.33	64.88	0.980	1.000	0.425	0.105	0.331	YES	2.8	15.1	687	19.7	N/A	1.490	0.18	0.70
-1.0	1.66	13	1,140	547	922	1.96	1.25	77.59	0.978	1.000	0.424	0.123	0.389	YES	2.8	21.9	1,200	27.9	N/A	0.226	0.03	0.67
-2.0	1.00	2	1,260	605	979	3.53	N/A	N/A	0.976	N/A	0.423	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.67
-3.0	1.00	2	1,380	662	1,037	3.36	N/A	N/A	0.973	N/A	0.422	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.67
-4.0	1.00	3	1,500	720	1,094	3.29	N/A	N/A	0.971	N/A	0.421	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.67
-5.0	1.00	3	1,620	778	1,152	3.26	N/A	N/A	0.969	N/A	0.420	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.67
-6.0	1.00	1	1,740	835	1,210	3.45	N/A	N/A	0.966	N/A	0.419	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.67
-7.0	1.00	2	1,860	893	1,267	3.61	N/A	N/A	0.964	N/A	0.418	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.67
-8.0	1.00	1	1,980	950	1,325	3.71	N/A	N/A	0.962	N/A	0.417	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.67
-9.0	1.00	1	2,100	1,008	1,382	3.41	N/A	N/A	0.959	N/A	0.416	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.67
-10.0	1.00	2	2,220	1,066	1,440	3.07	N/A	N/A	0.957	N/A	0.415	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.67
-11.0	1.00	2	2,340	1,123	1,498	3.19	N/A	N/A	0.955	N/A	0.414	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.67
-12.0	1.00	10	2,460	1,181	1,555	2.14	1.53	58.98	0.952	1.000	0.413	0.099	0.320	YES	2.8	14.0	594	18.5	N/A	1.586	0.19	0.48
-13.0	1.66	27	2,580	1,238	1,613	1.69	1.00	104.44	0.950	1.000	0.412	0.186	0.603	YES	2.8	33.3	1,200	41.6	N/A	0.000	0.00	0.48
-14.0	1.00	5	2,700	1,296	1,670	2.82	N/A	N/A	0.948	N/A	0.411	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-15.0	1.00	6	2,820	1,354	1,728	3.14	N/A	N/A	0.945	N/A	0.410	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-16.0	1.00	5	2,940	1,411	1,786	2.98	N/A	N/A	0.943	N/A	0.409	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-17.0	1.00	6	3,060	1,469	1,843	3.13	N/A	N/A	0.941	N/A	0.408	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-18.0	1.00	4	3,180	1,526	1,901	3.30	N/A	N/A	0.938	N/A	0.407	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-19.0	1.00	5	3,300	1,584	1,958	3.23	N/A	N/A	0.936	N/A	0.406	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-20.0	1.00	3	3,420	1,642	2,016	3.22	N/A	N/A	0.934	N/A	0.405	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-21.0	1.00	5	3,540	1,699	2,074	2.81	N/A	N/A	0.931	N/A	0.404	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-22.0	1.00	12	3,660	1,757	2,131	2.65	N/A	N/A	0.926	N/A	0.401	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-23.0	1.00	11	3,780	1,814	2,189	2.74	N/A	N/A	0.918	N/A	0.398	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-24.0	1.00	16	3,900	1,872	2,246	2.78	N/A	N/A	0.909	N/A	0.394	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-25.0	1.00	13	4,020	1,930	2,304	2.68	N/A	N/A	0.901	N/A	0.391	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-26.0	1.00	19	4,140	1,987	2,362	2.59	3.25	125.24	0.893	1.000	0.387	0.263	0.906	YES	2.8	20.5	1,200	N/A	N/A	0.000	0.00	0.48
-27.0	1.66	27	4,260	2,045	2,419	2.18	1.61	109.25	0.885	0.992	0.384	0.201	0.694	YES	2.8	27.8	1,200	35.0	N/A	0.042	0.01	0.48
-28.0	1.00	6	4,380	2,102	2,477	2.71	N/A	N/A	0.877	N/A	0.380	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-29.0	1.00	7	4,500	2,160	2,534	2.73	N/A	N/A	0.869	N/A	0.376	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-30.0	1.00	12	4,620	2,218	2,592	2.33	2.06	68.37	0.861	0.976	0.373	0.110	0.383	YES	2.8	13.0	511	17.3	N/A	1.642	0.20	0.28
-31.0	1.00	9	4,740	2,275	2,650	2.68	N/A	N/A	0.852	N/A	0.369	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.28
-32.0	1.00	14	4,860	2,333	2,707	2.39	2.26	86.39	0.844	0.961	0.366	0.140	0.491	YES	2.8	14.6	648	19.2	N/A	1.416	0.17	0.11
-33.0	1.66	21	4,980	2,390	2,765	2.09	1.44	81.36	0.836	0.946	0.362	0.130	0.453	YES	2.8	20.3	1,200	26.0	N/A	0.160	0.02	0.09
-34.0	1.00	4	5,100	2,448	2,822	2.99	N/A	N/A	0.828	N/A	0.359	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
-35.0	1.00	6	5,220	2,506	2,880	2.97	N/A	N/A	0.820	N/A	0.355	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
-36.0	1.00	13	5,340	2,563	2,938	2.63	N/A	N/A	0.812	N/A	0.352	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
-37.0	1.66	20	5,460	2,621	2,995	2.14	1.52	78.15	0.804	0.922	0.348	0.124	0.439	YES	2.8	18.8	1,061	24.2	N/A	0.260	0.03	0.06
-38.0	1.00	6	5,580	2,678	3,053	2.96	N/A	N/A	0.795	N/A	0.345	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.06
-39.0	1.66	41	5,700	2,736	3,110	1.71	1.05	147.47	0.787	0.882	0.341	0.378	1.305	NO	N/A	N/A	N/A	37.1	N/A	0.021	0.00	0.06
-40.0	1.66	14	5,820	2,794	3,168	2.63	N/A	N/A	0.779	N/A	0.338	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.06
-41.0	1.00	5	5,940	2,851	3,226	3.23	N/A	N/A	0.771	N/A	0.334	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.06
-42.0	1.00	4	6,060	2,909	3,283	3.33	N/A	N/A	0.763	N/A	0.331	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.06
-43.0	1.00	7	6,180	2,966	3,341	3.40	N/A	N/A	0.755	N/A	0.327	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.06
-44.0	1.00	6	6,300	3,024	3,398	3.24	N/A	N/A	0.747	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.06
-45.0	1.00	6	6,420	3,082	3,456	2.99	N/A	N/A	0.739	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.06
-46.0	1.00	10	6,540	3,139	3,514	2.93	N/A	N/A	0.730	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.06
-47.0	1.00	25	6,660	3,197	3,571	2.20	1.66	96.53	0.722	0.860	0.313	0.164	0.600	YES	2.8	21.1	1,200	27.0	N/A	0.085	0.01	0.05
-48.0	1.00	23	6,780	3,254	3,629	2.24	1.78	95.35	0.714	0.861	0.309	0.161	0.596	YES	2.8	19.7	1,153	25.3	N/A	0.095	0.01	0.03
-49.0	1.00	23	6,900	3,312	3,686	2.26	1.83	98.21	0.706	0.856	0.306	0.168	0.627	YES	2.8	19.8	1,164	25.4	N/A	0.093	0.01	0.02
-50.0	1.00	27	7,020	3,370	3,744	2.11	1.47	120.64	0.698	0.841	0.302	0.243	0.903	YES	1.3	20.8	1,200	22.9	N/A	0.152	0.02	0.00
-51.0	1.00	47	7,140	3,427	3,802	1.68	1.02	184.04	0.690	0.806	0.299	N/A	N/A	NO	N/A	N/A	N/A	34.1	N/A	0.036	0.00	0.00

max=	1,200
min=	511
avg=	1,038

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT048

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	11.00 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	8.00 ft below ground surface
GWT Depth For Design, Zwd =	1.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	11.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	0.45 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	0.45 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_l (in.)	Cumulative Settlement Profile (in.)
0.50	79.50	2.35	2.95	sandy silt to clayey silt	10.0	1.00	32	60	60	60	1.87	1.17	534.77	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	69.9	N/A	N/A	N/A	0.45
1.50	119.95	5.11	4.26	very stiff fine grained (*)	9.0	1.00	120	180	149	180	2.03	1.34	587.21	0.997	1.000	0.251	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	0.000	0.00	0.45
2.50	168.40	5.89	3.50	sandy silt to clayey silt	8.0	1.00	67	300	206	300	1.92	1.21	631.72	0.994	1.000	0.301	N/A	N/A	NO	N/A	N/A	N/A	142.4	N/A	0.000	0.00	0.45
3.50	89.02	5.53	6.22	very stiff fine grained (*)	7.0	1.00	89	420	264	420	2.29	1.90	466.44	0.992	1.000	0.328	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	0.000	0.00	0.45
4.50	122.97	2.78	2.26	silty sand to sandy silt	6.0	1.00	41	540	322	540	1.86	1.15	352.83	0.990	1.000	0.346	N/A	N/A	NO	N/A	N/A	N/A	88.6	N/A	0.000	0.00	0.45
5.50	161.12	2.46	1.53	sand to silty sand	5.0	1.66	67	660	379	660	1.37	1.00	612.65	0.987	1.000	0.357	N/A	N/A	NO	N/A	N/A	N/A	121.3	N/A	0.000	0.00	0.45
6.50	33.18	1.49	4.50	silty clay to clay	4.0	1.00	22	780	437	780	2.48	2.67	189.31	0.985	1.000	0.366	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	0.000	0.00	0.45
7.50	18.23	0.94	5.16	clay	3.0	1.00	18	900	494	900	2.62	N/A	N/A	0.983	N/A	0.372	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.45
8.50	12.40	0.66	5.38	clay	2.0	1.00	12	1,020	552	989	2.77	N/A	N/A	0.980	N/A	0.377	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.45
9.50	30.37	1.02	3.34	clayey silt to silty clay	1.0	1.66	25	1,140	610	1,046	2.15	1.55	141.44	0.978	1.000	0.380	0.343	1.204	YES	2.8	37.6	1,200	N/A	N/A	0.000	0.00	0.45
10.50	12.01	0.45	3.77	clay	0.0	1.00	12	1,260	667	1,104	2.73	N/A	N/A	0.976	N/A	0.383	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.45
11.50	17.03	0.44	2.61	clayey silt to silty clay	-1.0	1.00	9	1,380	725	1,162	2.52	2.89	105.48	0.973	1.000	0.385	0.189	0.655	YES	2.8	14.0	590	N/A	N/A	0.000	0.00	0.45
12.50	33.40	0.59	1.78	sandy silt to clayey silt	-2.0	1.00	13	1,500	782	1,219	2.29	1.90	101.65	0.971	1.000	0.387	0.178	0.612	YES	2.8	19.9	1,176	25.5	N/A	0.283	0.03	0.42
13.50	27.28	0.53	1.94	sandy silt to clayey silt	-3.0	1.66	18	1,620	840	1,277	2.08	1.42	98.85	0.969	1.000	0.389	0.170	0.583	YES	2.8	25.4	1,200	32.1	N/A	0.068	0.01	0.41
14.50	10.33	0.31	3.00	silty clay to clay	-4.0	1.00	7	1,740	898	1,334	2.80	N/A	N/A	0.966	N/A	0.390	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
15.50	5.85	0.20	3.41	clay	-5.0	1.00	6	1,860	955	1,392	3.06	N/A	N/A	0.964	N/A	0.390	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
16.50	5.52	0.15	2.74	clay	-6.0	1.00	6	1,980	1,013	1,450	3.05	N/A	N/A	0.962	N/A	0.391	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
17.50	6.00	0.15	2.56	clay	-7.0	1.00	6	2,100	1,070	1,507	3.02	N/A	N/A	0.959	N/A	0.391	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
18.50	6.38	0.15	2.35	silty clay to clay	-8.0	1.00	4	2,220	1,128	1,565	2.99	N/A	N/A	0.957	N/A	0.392	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
19.50	6.27	0.15	2.35	silty clay to clay	-9.0	1.00	4	2,340	1,186	1,622	3.01	N/A	N/A	0.955	N/A	0.392	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
20.50	6.51	0.13	2.04	silty clay to clay	-10.0	1.00	4	2,460	1,243	1,680	2.98	N/A	N/A	0.952	N/A	0.392	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
21.50	6.97	0.17	2.45	silty clay to clay	-11.0	1.00	5	2,580	1,301	1,738	3.01	N/A	N/A	0.950	N/A	0.392	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
22.50	6.40	0.16	2.56	silty clay to clay	-12.0	1.00	4	2,700	1,358	1,795	3.07	N/A	N/A	0.948	N/A	0.392	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
23.50	7.90	0.24	3.08	clay	-13.0	1.00	8	2,820	1,416	1,853	3.04	N/A	N/A	0.945	N/A	0.392	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
24.50	7.33	0.16	2.17	silty clay to clay	-14.0	1.00	5	2,940	1,474	1,910	3.00	N/A	N/A	0.943	N/A	0.391	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
25.50	7.77	0.12	1.55	clayey silt to silty clay	-15.0	1.00	4	3,060	1,531	1,968	2.91	N/A	N/A	0.941	N/A	0.391	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
26.50	8.82	0.25	2.80	silty clay to clay	-16.0	1.00	6	3,180	1,589	2,026	3.01	N/A	N/A	0.938	N/A	0.391	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
27.50	9.87	0.24	2.47	silty clay to clay	-17.0	1.00	7	3,300	1,646	2,083	2.94	N/A	N/A	0.936	N/A	0.390	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
28.50	11.75	0.24	2.06	clayey silt to silty clay	-18.0	1.00	6	3,420	1,704	2,141	2.84	N/A	N/A	0.934	N/A	0.390	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
29.50	11.68	0.20	1.70	clayey silt to silty clay	-19.0	1.00	6	3,540	1,762	2,198	2.81	N/A	N/A	0.931	N/A	0.389	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
30.50	13.83	0.24	1.73	clayey silt to silty clay	-20.0	1.00	7	3,660	1,819	2,256	2.75	N/A	N/A	0.926	N/A	0.387	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
31.50	14.24	0.38	2.71	clayey silt to silty clay	-21.0	1.00	7	3,780	1,877	2,314	2.86	N/A	N/A	0.918	N/A	0.384	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
32.50	21.87	1.08	4.96	clay	-22.0	1.00	22	3,900	1,934	2,371	2.88	N/A	N/A	0.909	N/A	0.381	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
33.50	25.48	0.69	2.72	clayey silt to silty clay	-23.0	1.00	13	4,020	1,992	2,429	2.67	N/A	N/A	0.901	N/A	0.378	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
34.50	43.57	1.48	3.39	clayey silt to silty clay	-24.0	1.00	22	4,140	2,050	2,486	2.55	3.05	130.56	0.893	0.992	0.375	0.287	1.012	YES	2.8	22.3	1,200	N/A	N/A	0.000	0.00	0.41
35.50	23.07	1.23	5.33	clay	-25.0	1.00	23	4,260	2,107	2,544	2.91	N/A	N/A	0.885	N/A	0.372	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
36.50	28.33	0.77	2.71	sandy silt to clayey silt	-26.0	1.00	11	4,380	2,165	2,602	2.65	N/A	N/A	0.877	N/A	0.369	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
37.50	28.93	0.87	3.01	clayey silt to silty clay	-27.0	1.00	14	4,500	2,222	2,659	2.68	N/A	N/A	0.869	N/A	0.366	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
38.50	59.73	0.99	1.65	silty sand to sandy silt	-28.0	1.66	33	4,620	2,280	2,717	1.94	1.23	114.03	0.861	0.949	0.363	0.218	0.761	YES	2.8	31.1	1,200	38.9	N/A	0.008	0.00	0.41
39.50	22.60	0.58	2.57	clayey silt to silty clay	-29.0	1.00	11	4,740	2,338	2,774	2.74	N/A	N/A	0.852	N/A	0.360	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
40.50	36.63	0.94	2.55	sandy silt to clayey silt	-30.0	1.00	15	4,860	2,395	2,832	2.57	3.15	100.75	0.844	0.954	0.356	0.175	0.625	YES	2.8	15.1	690	19.8	N/A	1.330	0.16	0.25
41.50	22.23	0.73	3.27	clayey silt to silty clay	-31.0	1.00	11	4,980	2,453	2,890	2.83	N/A	N/A	0.836	N/A	0.353	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
42.50	13.85	0.36	2.62	clayey silt to silty clay	-32.0	1.00	7	5,100	2,510	2,947	2.96	N/A	N/A	0.828	N/A	0.350	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
43.50	11.67	0.23	1.97	clayey silt to silty clay	-33.0	1.00	6	5,220	2,568	3,005	2.97	N/A	N/A	0.820	N/A	0.347	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
44.50	11.38	0.32	2.77	silty clay to clay	-34.0	1.00	8	5,340	2,626	3,062	3.07	N/A	N/A	0.812	N/A	0.343	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
45.50	9.10	0.14	1.54	clayey silt to silty clay	-35.0	1.00	5	5,460	2,683	3,120	3.04	N/A	N/A	0.804	N/A	0.340	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
46.50	10.28	0.16	1.51	clayey silt to silty clay	-36.0	1.00	5	5,580	2,741	3,178	2.99	N/A	N/A	0.795	N/A	0.337	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
47.50	12.00	0.28	2.33	clayey silt to silty clay	-37.0	1.00	6	5,700	2,798	3,235	3.03	N/A	N/A	0.787	N/A	0.334	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
48.50	13.30	0.21	1.60	clayey silt to silty clay	-38.0	1.00	7	5,820	2,856	3,293	2.90	N/A	N/A	0.779	N/A	0.330	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
49.50	9.65	0.13	1.30	clayey silt to silty clay	-39.0	1.00	5	5,940	2,914	3,350	3.00	N/A	N/A	0.771	N/A	0.327	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
50.50	11.77	0.21	1.79	clayey silt to silty clay	-40.0	1.00	6	6,060	2,971	3,408	2.99	N/A	N/A	0.763	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
51.50	11.45	0.20	1.70	clayey silt to silty clay	-41.0	1.00	6	6,180	3,029	3,466	3.00	N/A	N/A	0.755	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
52.50	12.07	0.19	1.53	clayey silt to silty clay	-42.0	1.00	6	6,300	3,086	3,523	2.96	N/A	N/A	0.747	N/A	0.317	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
53.50	11.70	0.19	1.63	clayey silt to silty clay	-43.0	1.00	6	6,420	3,144	3,581	3.00	N/A	N/A	0.739	N/A	0.314	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
54.50	12.58	0.19	1.51	clayey silt to silty clay	-44.0	1.00	6	6,540	3,202	3,638	2.95	N/A	N/A	0.730	N/A	0.310	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
55.50	18.40	0.33	1.81	sandy silt to clayey silt	-45.0	1.00	7	6,660	3,259	3,696	2.83	N/A	N/A	0.722	N/A	0.307	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
56.50	44.15	0.87	1.97	sandy silt to clayey silt	-46.0	1.00	18	6,780	3,317	3,754	2.52	2.88	87.15	0.714	0.873	0.304	0.142	0.543	YES	2.8	15.7	744	20.5	N/A	0.498	0.06	0.19
57.50	103.22	1.44	1.39	sand to silty sand	-47.0	1.66	43	6,900	3,374	3,811	1.78	1.09	143.44	0.706	0.811	0.300	0.354	1.278	YES	1.3	32.3	1,200	34.9	N/A	0.031	0.00	0.19
58.50	48.20	0.85	1.75	silty sand to sandy silt	-48.0	1.00	16	7,020	3,432	3,869	2.42	2.41	88.57	0.698	0.871	0.297	0.145	0.566	YES	2.8	14.4	622	18.9	N/A	1.189	0.14	0.05
59.50	54.03	1.09	2.01	silty sand to sandy silt	-49.0	1.00	18	7,140	3,490	3,926	2.42	2.41	98.47	0.690	0.861	0.294	0.169	0.661	YES	2.8	15.7	741	20.4	N/A	0.381	0.05	0.00
60.50	37.43	1.17	3.11	clayey silt to silty clay	-50.0	1.00	19	7,260	3,547	3,984	2.73	N/A	N/A	0.682	N/A	0.290	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
																					max=	1,200					
																					min=	590					
																					avg=	960					

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT050

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	20.00 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$

+++ $FS = (CRR_{7.5}/CSR)\ MSF\ K_\sigma\ K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	17.00 ft below ground surface
GWT Depth For Design, Zwd =	10.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	14.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	0.84 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.02 inches	<--- Dry or Unsaturated Sands
Total:	0.86 inches	

INPUT SOIL PROFILE (CPT DATA)				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)
0.50	104.53	0.23	0.22	sand
1.50	57.47	0.13	0.22	sand to silty sand
2.50	42.85	0.26	0.61	silty sand to sandy silt
3.50	36.18	0.13	0.37	silty sand to sandy silt
4.50	23.82	0.10	0.41	silty sand to sandy silt
5.50	19.15	0.16	0.83	sandy silt to clayey silt
6.50	25.97	0.27	1.05	silty sand to sandy silt
7.50	30.67	0.48	1.58	sandy silt to clayey silt
8.50	124.85	0.89	0.72	sand
9.50	29.12	0.76	2.60	sandy silt to clayey silt
10.50	15.40	0.37	2.43	clayey silt to silty clay
11.50	11.35	0.32	2.82	silty clay to clay
12.50	10.83	0.32	2.97	silty clay to clay
13.50	9.40	0.30	3.19	silty clay to clay
14.50	7.12	0.20	2.82	silty clay to clay
15.50	9.43	0.30	3.15	silty clay to clay
16.50	9.40	0.26	2.74	silty clay to clay
17.50	24.28	0.28	1.14	sandy silt to clayey silt
18.50	8.22	0.22	2.73	silty clay to clay
19.50	6.90	0.21	3.06	clay
20.50	36.31	0.43	1.18	silty sand to sandy silt
21.50	27.67	0.40	1.46	sandy silt to clayey silt
22.50	25.75	0.34	1.32	sandy silt to clayey silt
23.50	6.98	0.15	2.23	silty clay to clay
24.50	6.27	0.06	1.01	sensitive fine grained
25.50	7.67	0.11	1.44	clayey silt to silty clay
26.50	8.15	0.11	1.42	clayey silt to silty clay
27.50	7.30	0.09	1.21	sensitive fine grained
28.50	6.95	0.07	0.95	sensitive fine grained
29.50	7.42	0.08	1.09	sensitive fine grained
30.50	7.92	0.11	1.43	clayey silt to silty clay
31.50	17.09	0.13	0.77	sandy silt to clayey silt
32.50	7.88	0.09	1.08	clayey silt to silty clay
33.50	10.13	0.18	1.78	clayey silt to silty clay
34.50	14.62	0.20	1.35	sandy silt to clayey silt
35.50	14.37	0.37	2.59	clayey silt to silty clay
36.50	14.97	0.46	3.09	clayey silt to silty clay
37.50	47.78	0.57	1.20	silty sand to sandy silt
38.50	12.20	0.37	3.08	silty clay to clay
39.50	10.58	0.29	2.78	silty clay to clay
40.50	10.32	0.23	2.24	clayey silt to silty clay
41.50	37.01	0.68	1.83	sandy silt to clayey silt
42.50	32.33	0.99	3.06	clayey silt to silty clay
43.50	57.98	1.02	1.77	silty sand to sandy silt
44.50	67.35	1.30	1.93	silty sand to sandy silt
45.50	140.32	1.92	1.37	sand to silty sand
46.50	104.55	0.60	0.57	sand
47.50	48.68	0.51	1.05	silty sand to sandy silt
48.50	36.22	0.61	1.70	sandy silt to clayey silt
49.50	49.93	0.75	1.50	silty sand to sandy silt
50.50	37.35	0.65	1.75	sandy silt to clayey silt
51.50	17.12	0.46	2.68	clayey silt to silty clay
52.50	14.99	0.31	2.11	clayey silt to silty clay
53.50	15.17	0.26	1.71	clayey silt to silty clay
54.50	14.72	0.34	2.34	clayey silt to silty clay
55.50	15.32	0.36	2.37	clayey silt to silty clay
56.50	16.47	0.43	2.61	clayey silt to silty clay
57.50	20.08	0.33	1.67	sandy silt to clayey silt
58.50	15.08	0.40	2.68	clayey silt to silty clay
59.50	13.00	0.26	2.02	clayey silt to silty clay
60.50	18.82	0.34	1.83	sandy silt to clayey silt

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +																RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ_v' (psf)	Effective Vert. Stress (Test) σ_v' (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_l (in.)	Cumulative Settlement Profile (in.)
19.0	1.00	21	60	60	60	0.89	1.00	603.52	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	35.5	0.009	0.008	0.00	0.86
18.0	1.00	14	180	180	180	1.31	1.00	191.56	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	28.1	0.017	0.019	0.00	0.86
17.0	1.00	14	300	300	300	1.75	1.07	118.28	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	34.1	0.021	0.018	0.00	0.86
16.0	1.00	12	420	420	420	1.76	1.00	78.96	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	29.6	0.026	0.027	0.00	0.85
15.0	1.00	8	540	540	540	1.99	1.00	45.84	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	21.2	0.033	0.051	0.01	0.85
14.0	1.00	8	660	660	660	2.26	1.82	60.74	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	20.6	N/A	N/A	N/A	0.85
13.0	1.00	9	780	780	780	2.23	1.75	72.79	0.985	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	21.6	0.039	0.059	0.01	0.84
12.0	1.00	12	900	900	900	2.30	1.96	89.50	0.983	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	26.9	N/A	N/A	N/A	0.84
11.0	1.66	41	1,020	1,020	1,020	1.32	1.00	289.46	0.980	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	57.9	0.032	0.000	0.00	0.84
10.0	1.00	12	1,140	1,140	1,140	2.50	2.77	106.76	0.978	N/A	0.203	N/A	N/A	NO	N/A	N/A	N/A	23.5	N/A	N/A	N/A	0.84
9.0	1.00	8	1,260	1,229	1,260	2.67	N/A	N/A	0.976	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
8.0	1.00	8	1,380	1,286	1,380	2.84	N/A	N/A	0.973	N/A	0.217	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
7.0	1.00	7	1,500	1,344	1,500	2.88	N/A	N/A	0.971	N/A	0.225	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
6.0	1.00	6	1,620	1,402	1,620	2.96	N/A	N/A	0.969	N/A	0.233	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
5.0	1.00	5	1,740	1,459	1,740	3.05	N/A	N/A	0.966	N/A	0.240	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
4.0	1.00	6	1,860	1,517	1,860	2.98	N/A	N/A	0.964	N/A	0.246	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
3.0	1.00	6	1,980	1,574	1,980	2.96	N/A	N/A	0.962	N/A	0.252	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
2.0	1.66	16	2,100	1,632	2,069	2.11	1.48	65.77	0.959	1.000	0.257	0.106	0.553	YES	2.8	18.6	1,040	24.0	N/A	0.084	0.01	0.83
1.0	1.00	5	2,220	1,690	2,126	3.03	N/A	N/A	0.957	N/A	0.262	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.83
0.0	1.00	7	2,340	1,747	2,184	3.14	N/A	N/A	0.955	N/A	0.266	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.83
-1.0	1.00	12	2,460	1,805	2,242	2.29	1.93	73.81	0.952	1.000	0.270	0.117	0.580	YES	2.8	14.2	612	18.7	N/A	0.393	0.05	0.78
-2.0	1.00	11	2,580	1,862	2,299	2.45	2.55	73.00	0.950	1.000	0.274	0.116	0.566	YES	2.8	13.1	520	17.4	N/A	1.214	0.15	0.64
-3.0	1.66	17	2,700	1,920	2,357	2.15	1.56	67.90	0.948	1.000	0.277	0.109	0.525	YES	2.8	18.5	1,029	23.9	N/A	0.091	0.01	0.63
-4.0	1.00	5	2,820	1,978	2,414	3.10	N/A	N/A	0.945	N/A	0.280	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
-5.0	1.00	3	2,940	2,035	2,472	2.99	N/A	N/A	0.943	N/A	0.283	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
-6.0	1.00	4	3,060	2,093	2,530	2.98	N/A	N/A	0.941	N/A	0.286	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
-7.0	1.00	4	3,180	2,150	2,587	2.96	N/A	N/A	0.938	N/A	0.289	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
-8.0	1.00	4	3,300	2,208	2,645	2.99	N/A	N/A	0.936	N/A	0.291	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
-9.0	1.00	3	3,420	2,266	2,702	2.97	N/A	N/A	0.934	N/A	0.293	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
-10.0	1.00	4	3,540	2,323	2,760	2.98	N/A	N/A	0.931	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
-11.0	1.00	4	3,660	2,381	2,818	3.02	N/A	N/A	0.926	N/A	0.296	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
-12.0	1.66	11	3,780	2,438	2,875	2.25	1.00	25.62	0.918	0.955	0.296	0.071	0.307	YES	2.8	12.2	453	16.3	N/A	1.596	0.19	0.44
-13.0	1.00	4	3,900	2,496	2,933	2.98	N/A	N/A	0.909	N/A	0.296	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.44
-14.0	1.00	5	4,020	2,554	2,990	2.99	N/A	N/A	0.901	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.44
-15.0	1.00	6	4,140	2,611	3,048	2.78	N/A	N/A	0.893	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.44
-16.0	1.00	7	4,260	2,669	3,106	2.95	N/A	N/A	0.885	N/A	0.294	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.44
-17.0	1.00	7	4,380	2,726	3,163	2.98	N/A	N/A	0.877	N/A	0.293	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.44
-18.0	1.66	26	4,500	2,784	3,221	1.97	1.27	84.92	0.869	0.893	0.292	0.137	0.559	YES	2.8	23.6	1,200	29.9	N/A	0.061	0.01	0.43
-19.0	1.00	8	4,620	2,842	3,278	3.08	N/A	N/A	0.861	N/A	0.291	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
-20.0	1.00	7	4,740	2,899	3,336	3.12	N/A	N/A	0.852	N/A	0.290	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
-21.0	1.00	5	4,860	2,957	3,394	3.08	N/A	N/A	0.844	N/A	0.289	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
-22.0	1.00	15	4,980	3,014	3,451	2.54	2.95	80.37	0.836	0.902	0.287	0.128	0.537	YES	2.8	14.1	598	18.5	N/A	1.150	0.14	0.29
-23.0	1.00	16	5,100	3,072	3,509	2.73	N/A	N/A	0.828	N/A	0.286	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
-24.0	1.00	19	5,220	3,130	3,566	2.34	2.08	96.18	0.820	0.880	0.284	0.163	0.672	YES	2.8	17.3	901	22.4	N/A	0.123	0.01	0.28
-25.0	1.00	22	5,340	3,187	3,624	2.31	1.99	106.33	0.812	0.867	0.283	0.192	0.784	YES	2.8	19.5	1,131	25.0	N/A	0.087	0.01	0.26
-26.0	1.00	35	5,460	3,245	3,682	1.97	1.27	139.73	0.804	0.831	0.281	0.334	1.316	NO	N/A	N/A	N/A	29.6	0.060	0.01	0.26
-27.0	1.66	35	5,580	3,302	3,739	1.54	1.00	134.72	0.795	0.828	0.280	0.307	1.214	YES	0.0	25.3	1,200	25.3	N/A	0.084	0.01	0.25
-28.0	1.00	16	5,700	3,360	3,797	2.28	1.88	70.67	0.787	0.875	0.278	0.113	0.474	YES	2.8	14.6	642	19.1	N/A	0.417	0.05	0.20
-29.0	1.00	14	5,820	3,418	3,854	2.56	3.09	74.92	0.779	0.878	0.276	0.119	0.506	YES	2.8	13.2	529	17.5	N/A	1.214	0.15	0.05
-30.0	1.00	17	5,940	3,475	3,912	2.37	2.18	82.47	0.771	0.867	0.274	0.132	0.558	YES	2.8	14.7	653	19.3	N/A	0.347	0.04	0.01
-31.0	1.66	25	6,060	3,533	3,970	2.20	1.67	77.76	0.763	0.836	0.272	0.124	0.507	YES	2.8	20.4	1,200	26.1	N/A	0.077	0.01	0.00
-32.0	1.00	9	6,180	3,590	4,027	2.98	N/A	N/A	0.755	N/A	0.270	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-33.0	1.00	7	6,300	3,648	4,085	2.98	N/A	N/A	0.747	N/A	0.268	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-34.0	1.00	8	6,420	3,706	4,142	2.93	N/A	N/A	0.739	N/A	0.266	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-35.0	1.00	7	6,540	3,763	4,200	3.03	N/A	N/A	0.730	N/A	0.264	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-36.0	1.00	8	6,660	3,821	4,258	3.02	N/A	N/A	0.722	N/A	0.262	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-37.0	1.00	8	6,780	3,878	4,315	3.02	N/A	N/A	0.714	N/A	0.260	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-38.0	1.00	8	6,900	3,936	4,373	2.83	N/A	N/A	0.706	N/A	0.257	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-39.0	1.00	8	7,020	3,994	4,430	3.07	N/A	N/A	0.698	N/A	0.255	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-40.0	1.00	7	7,140	4,051	4,488	3.07	N/A	N/A	0.690	N/A	0.253	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-41.0	1.00	8	7,260	4,109	4,546	2.90	N/A	N/A	0.682	N/A	0.250	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
																max=	1,200					
																min=	453					
																avg=	836					

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT052

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	12.00 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \longrightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	9.00 ft below ground surface
GWT Depth For Design, Zwd =	2.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	26.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	2.92 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	2.92 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_i (in.)	Cumulative Settlement Profile (in.)
0.50	99.30	0.99	0.99	sand to silty sand	11.0	1.66	41	60	60	60	1.11	1.00	949.25	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	75.7	0.007	0.000	0.00	2.92
1.50	37.35	0.99	2.66	sandy silt to clayey silt	10.0	1.66	25	180	180	180	1.84	1.13	233.71	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	55.5	N/A	N/A	N/A	2.92
2.50	13.08	0.50	3.85	clay	9.0	1.00	13	300	269	300	2.48	2.68	158.13	0.994	1.000	0.231	0.448	2.589	NO	N/A	N/A	N/A	N/A	N/A	0.000	0.00	2.92
3.50	7.10	0.32	4.49	clay	8.0	1.00	7	420	326	420	2.77	N/A	N/A	0.992	N/A	0.265	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
4.50	6.42	0.24	3.69	clay	7.0	1.00	6	540	384	540	2.79	N/A	N/A	0.990	N/A	0.289	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
5.50	9.08	0.28	3.02	silty clay to clay	6.0	1.00	6	660	442	660	2.65	N/A	N/A	0.987	N/A	0.307	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
6.50	6.02	0.22	3.60	clay	5.0	1.00	6	780	499	780	2.88	N/A	N/A	0.985	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
7.50	5.30	0.18	3.42	clay	4.0	1.00	5	900	557	900	2.94	N/A	N/A	0.983	N/A	0.330	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
8.50	5.78	0.19	3.26	clay	3.0	1.00	6	1,020	614	1,020	2.92	N/A	N/A	0.980	N/A	0.338	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
9.50	6.15	0.17	2.76	clay	2.0	1.00	6	1,140	672	1,109	2.88	N/A	N/A	0.978	N/A	0.345	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
10.50	5.63	0.16	2.91	clay	1.0	1.00	6	1,260	730	1,166	2.95	N/A	N/A	0.976	N/A	0.350	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
11.50	5.33	0.26	4.80	clay	0.0	1.00	5	1,380	787	1,224	3.13	N/A	N/A	0.973	N/A	0.355	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
12.50	4.80	0.21	4.39	clay	-1.0	1.00	5	1,500	845	1,282	3.17	N/A	N/A	0.971	N/A	0.359	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
13.50	5.38	0.18	3.30	clay	-2.0	1.00	5	1,620	902	1,339	3.07	N/A	N/A	0.969	N/A	0.362	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
14.50	13.98	0.23	1.61	clayey silt to silty clay	-3.0	1.66	12	1,740	960	1,397	2.30	1.95	65.02	0.966	1.000	0.364	0.106	0.387	YES	2.8	16.7	838	N/A	N/A	0.000	0.00	2.92
15.50	3.95	0.08	1.98	clay	-4.0	1.00	4	1,860	1,018	1,454	3.12	N/A	N/A	0.964	N/A	0.366	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
16.50	3.78	0.06	1.44	sensitive fine grained	-5.0	1.00	2	1,980	1,075	1,512	3.09	N/A	N/A	0.962	N/A	0.368	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
17.50	4.40	0.07	1.61	sensitive fine grained	-6.0	1.00	2	2,100	1,133	1,570	3.06	N/A	N/A	0.959	N/A	0.370	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
18.50	10.05	0.07	0.71	sandy silt to clayey silt	-7.0	1.00	4	2,220	1,190	1,627	2.56	3.09	45.82	0.957	1.000	0.371	0.088	0.317	YES	2.8	7.3	191	10.3	N/A	2.541	0.30	2.61
19.50	12.68	0.07	0.52	sandy silt to clayey silt	-8.0	1.00	5	2,340	1,248	1,685	2.47	2.62	42.03	0.955	1.000	0.372	0.085	0.305	YES	2.8	8.3	231	11.6	N/A	2.343	0.28	2.33
20.50	17.41	0.08	0.47	sandy silt to clayey silt	-9.0	1.66	12	2,460	1,306	1,742	2.04	1.00	35.69	0.952	1.000	0.373	0.080	0.285	YES	2.8	15.2	694	19.8	N/A	1.372	0.16	2.17
21.50	6.22	0.07	1.12	sensitive fine grained	-10.0	1.00	3	2,580	1,363	1,800	2.90	N/A	N/A	0.950	N/A	0.374	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.17
22.50	5.13	0.04	0.74	sensitive fine grained	-11.0	1.00	3	2,700	1,421	1,858	2.92	N/A	N/A	0.948	N/A	0.375	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.17
23.50	6.55	0.08	1.16	sensitive fine grained	-12.0	1.00	3	2,820	1,478	1,915	2.91	N/A	N/A	0.945	N/A	0.375	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.17
24.50	78.00	0.73	0.94	sand to silty sand	-13.0	1.00	20	2,940	1,536	1,973	1.94	1.23	109.15	0.943	1.000	0.375	0.201	0.714	YES	1.3	21.0	1,200	23.1	N/A	1.041	0.12	2.04
25.50	127.10	1.87	1.47	sand to silty sand	-14.0	1.00	32	3,060	1,594	2,030	1.92	1.20	171.45	0.941	1.000	0.376	N/A	N/A	NO	N/A	N/A	N/A	35.6	N/A	0.036	0.00	2.04
26.50	66.67	1.30	1.94	silty sand to sandy silt	-15.0	1.00	22	3,180	1,651	2,088	2.21	1.69	124.08	0.938	1.000	0.376	0.258	0.915	YES	2.8	24.5	1,200	31.1	N/A	0.073	0.01	2.03
27.50	55.60	0.60	1.08	silty sand to sandy silt	-16.0	1.00	19	3,300	1,709	2,146	2.11	1.48	88.87	0.936	1.000	0.376	0.145	0.516	YES	2.8	20.7	1,200	26.5	N/A	0.161	0.02	2.01
28.50	51.23	0.80	1.56	silty sand to sandy silt	-17.0	1.66	28	3,420	1,766	2,203	1.94	1.22	110.46	0.934	1.000	0.376	0.205	0.729	YES	2.8	29.7	1,200	37.3	N/A	0.022	0.00	2.01
29.50	23.58	0.22	0.94	sandy silt to clayey silt	-18.0	1.00	9	3,540	1,824	2,261	2.41	2.37	58.54	0.931	1.000	0.376	0.099	0.350	YES	2.8	11.7	414	15.6	N/A	1.814	0.22	1.79
30.50	50.57	0.30	0.58	sand to silty sand	-19.0	1.00	13	3,660	1,882	2,318	2.02	1.33	69.11	0.926	1.000	0.375	0.111	0.394	YES	1.3	13.1	516	14.8	N/A	1.900	0.23	1.56
31.50	26.97	0.22	0.82	silty sand to sandy silt	-20.0	1.00	9	3,780	1,939	2,376	2.34	2.09	57.33	0.918	1.000	0.372	0.098	0.350	YES	2.8	11.0	373	14.9	N/A	1.889	0.23	1.33
32.50	15.73	0.13	0.81	sandy silt to clayey silt	-21.0	1.00	6	3,900	1,997	2,434	2.56	3.12	49.08	0.909	1.000	0.369	0.091	0.328	YES	2.8	8.5	239	11.8	N/A	2.310	0.28	1.06
33.50	66.23	0.65	0.98	sand to silty sand	-22.0	1.00	17	4,020	2,054	2,491	2.06	1.38	90.39	0.901	0.992	0.367	0.149	0.537	YES	1.3	16.2	791	18.0	N/A	1.545	0.19	0.87
34.50	91.12	0.87	0.95	sand to silty sand	-23.0	1.00	23	4,140	2,112	2,549	1.94	1.23	109.25	0.893	0.982	0.364	0.201	0.724	YES	1.3	21.5	1,200	23.6	N/A	0.621	0.07	0.80
35.50	109.57	1.06	0.96	sand to silty sand	-24.0	1.00	27	4,260	2,170	2,606	1.89	1.18	123.98	0.885	0.971	0.361	0.257	0.922	YES	1.3	25.3	1,200	27.6	N/A	0.096	0.01	0.79
36.50	211.85	2.87	1.36	sand to silty sand	-25.0	1.00	53	4,380	2,227	2,664	1.79	1.10	220.68	0.877	0.958	0.359	N/A	N/A	NO	N/A	N/A	N/A	50.6	N/A	0.000	0.00	0.79
37.50	253.80	3.97	1.56	sand to silty sand	-26.0	1.00	63	4,500	2,285	2,722	1.79	1.10	261.27	0.869	0.948	0.356	N/A	N/A	NO	N/A	N/A	N/A	59.5	N/A	0.000	0.00	0.79
38.50	268.83	4.21	1.57	sand to silty sand	-27.0	1.00	67	4,620	2,342	2,779	1.78	1.09	271.31	0.861	0.939	0.353	N/A	N/A	NO	N/A	N/A	N/A	62.3	N/A	0.000	0.00	0.79
39.50	271.32	4.40	1.62	sand to silty sand	-28.0	1.00	68	4,740	2,400	2,837	1.79	1.10	272.83	0.852	0.930	0.350	N/A	N/A	NO	N/A	N/A	N/A	62.2	N/A	0.000	0.00	0.79
40.50	140.67	2.48	1.76	silty sand to sandy silt	-29.0	1.66	78	4,860	2,458	2,894	1.70	1.04	217.80	0.844	0.921	0.347	N/A	N/A	NO	N/A	N/A	N/A	82.5	N/A	0.000	0.00	0.79
41.50	56.64	0.79	1.40	silty sand to sandy silt	-30.0	1.66	31	4,980	2,515	2,952	1.93	1.22	102.23	0.836	0.917	0.344	0.179	0.637	YES	2.8	28.5	1,200	35.9	N/A	0.030	0.00	0.78
42.50	10.05	0.23	2.23	clayey silt to silty clay	-31.0	1.00	5	5,100	2,573	3,010	3.07	N/A	N/A	0.828	N/A	0.341	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.78
43.50	44.48	0.48	1.07	silty sand to sandy silt	-32.0	1.00	15	5,220	2,630	3,067	2.27	1.87	72.40	0.820	0.931	0.338	0.115	0.423	YES	2.8	14.8	659	19.4	N/A	1.325	0.16	0.62
44.50	57.98	0.58	1.00	silty sand to sandy silt	-33.0	1.00	19	5,340	2,688	3,125	2.16	1.58	78.89	0.812	0.917	0.335	0.126	0.458	YES	2.8	18.3	1,003	23.6	N/A	0.251	0.03	0.59
45.50	30.63	0.43	1.41	sandy silt to clayey silt	-34.0	1.00	12	5,460	2,746	3,182	2.52	2.87	69.25	0.804	0.929	0.332	0.111	0.413	YES	2.8	12.5	473	16.7	N/A	1.647	0.20	0.40
46.50	34.40	0.29	0.83	silty sand to sandy silt	-35.0	1.66	19	5,580	2,803	3,240	2.02	1.33	63.96	0.795	0.907	0.329	0.104	0.383	YES	2.8	17.7	946	22.9	N/A	0.318	0.04	0.36
47.50	11.43	0.22	1.85	clayey silt to silty clay	-36.0	1.00	6	5,700	2,861	3,298	3.00	N/A	N/A	0.787	N/A	0.326	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.36
48.50	10.08	0.15	1.48	clayey silt to silty clay	-37.0	1.00	5	5,820	2,918	3,355	3.02	N/A	N/A	0.779	N/A	0.323	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.36
49.50	26.98	0.33	1.23	sandy silt to clayey silt	-38.0	1.00	11	5,940	2,976	3,413	2.56	3.09	61.97	0.771	0.918	0.320	0.102	0.391	YES	2.8	11.1	374	14.9	N/A	1.855	0.22	0.13
50.50	22.52	0.48	2.11	sandy silt to clayey silt	-39.0	1.00	9	6,060	3,034	3,470	2.77	N/A	N/A	0.763	N/A	0.317	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.13
51.50	23.28	0.45	1.93	sandy silt to clayey silt	-40.0	1.00	9	6,180	3,091	3,528	2.74	N/A	N/A	0.755	N/A	0.314	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.13
52.50	20.74	0.64	3.02	clayey silt to silty clay	-41.0	1.00	10	6,300	3,149	3,586	2.91	N/A	N/A	0.747	N/A	0.311	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.13
53.50	17.70	0.57	3.16	clayey silt to silty clay	-42.0	1.00	9	6,420	3,206	3,643	2.99	N/A	N/A	0.739	N/A	0.308	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.13
54.50	27.90	0.71	2.52	sandy silt to clayey silt	-43.0	1.00	11	6,540	3,264	3,701	2.76	N/A	N/A	0.730	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.13
55.50	48.17	1.06	2.19	sandy silt to clayey silt	-44.0	1.00	19	6,660	3,322	3,758	2.52	2.87	94.47	0.722	0.867	0.301	0.158	0.608	YES	2.8	16.9	858	21.9	N/A	0.198	0.02	0.11
56.50	66.10	0.99	1.50	silty sand to sandy silt	-45.0	1.00	22	6,780	3,379	3,816	2.26	1.84	93.45	0.714	0.855	0.298	0.156	0.597	YES	2.8	18.8	1,054	24.1	N/A	0.098	0.01	0.10
57.50	46.38	1.09	2.34	sandy silt to clayey silt	-46.0	1.00	19	6,900	3,437	3,874	2.56	3.09	95.59	0.706	0.862	0.295	0.161	0.629	YES	2.8	16.1	787	21.0	N/A	0.287	0.03	0.06
58.50	43.50	0.87	2.00	sandy silt to clayey silt	-47.0	1.00	17	7,020	3,494	3,931	2.54	3.01	86.03	0.698	0.863	0.292	0.139	0.550	YES	2.8	15.2	699	19.9	N/A	0.456	0.05	0.01
59.50	36.70	0.96	2.61	sandy silt to clayey silt	-48.0	1.66	24	7,140	3,552	3,989	2.32	2.00	91.16	0.690	0.836	0.288	0.150	0.582	YES	2.8	20.0	1,187	25.7	N/A	0.085	0.01	0.00
60.50	16.43	0.60	3.67	silty clay to clay	-49.0	1.00	11	7,260	3,610	4,046	3.09	N/A	N/A	0.682	N/A	0.285	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
																						max=	1,200				
																						min=	191				
																						avg=	797				

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT054

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	15.30 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	12.30 ft below ground surface
GWT Depth For Design, Zwd =	5.30 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	24.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	2.25 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	2.25 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r(psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_l (in.)	Cumulative Settlement Profile (in.)
0.50	68.05	0.64	0.95	sand to silty sand	14.3	1.00	17	60	60	60	1.48	1.00	392.89	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	32.8	0.010	0.009	0.00	2.25
1.50	74.52	1.04	1.40	silty sand to sandy silt	13.3	1.00	25	180	180	180	1.74	1.06	264.26	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	55.7	0.014	0.000	0.00	2.25
2.50	70.53	0.73	1.04	sand to silty sand	12.3	1.00	18	300	300	300	1.73	1.06	192.71	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	33.9	0.021	0.019	0.00	2.25
3.50	50.92	0.94	1.84	silty sand to sandy silt	11.3	1.66	28	420	420	420	1.75	1.07	196.89	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	62.3	0.020	0.000	0.00	2.25
4.50	17.27	0.59	3.40	silty clay to clay	10.3	1.00	12	540	540	540	2.52	2.88	132.69	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.25
5.50	12.13	0.36	2.97	silty clay to clay	9.3	1.00	8	660	648	660	2.64	N/A	N/A	0.987	N/A	0.209	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.25
6.50	6.58	0.20	2.96	clay	8.3	1.00	7	780	705	780	2.88	N/A	N/A	0.985	N/A	0.227	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.25
7.50	6.63	0.21	3.18	clay	7.3	1.00	7	900	763	900	2.92	N/A	N/A	0.983	N/A	0.241	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.25
8.50	5.25	0.12	2.32	silty clay to clay	6.3	1.00	4	1,020	820	1,020	2.95	N/A	N/A	0.980	N/A	0.254	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.25
9.50	5.53	0.14	2.50	clay	5.3	1.00	6	1,140	878	1,140	2.97	N/A	N/A	0.978	N/A	0.264	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.25
10.50	5.89	0.14	2.43	silty clay to clay	4.3	1.00	4	1,260	936	1,260	2.96	N/A	N/A	0.976	N/A	0.273	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.25
11.50	5.50	0.12	2.24	silty clay to clay	3.3	1.00	4	1,380	993	1,380	2.98	N/A	N/A	0.973	N/A	0.281	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.25
12.50	5.93	0.14	2.27	silty clay to clay	2.3	1.00	4	1,500	1,051	1,488	2.98	N/A	N/A	0.971	N/A	0.288	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.25
13.50	7.47	0.20	2.63	silty clay to clay	1.3	1.00	5	1,620	1,108	1,545	2.94	N/A	N/A	0.969	N/A	0.294	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.25
14.50	6.20	0.19	3.04	clay	0.3	1.00	6	1,740	1,166	1,603	3.06	N/A	N/A	0.966	N/A	0.300	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.25
15.50	14.57	0.20	1.34	sandy silt to clayey silt	-0.7	1.00	6	1,860	1,224	1,660	2.55	3.03	63.82	0.964	1.000	0.305	0.104	0.456	YES	2.8	9.2	270	12.7	N/A	2.182	0.26	1.99
16.50	14.28	0.16	1.13	sandy silt to clayey silt	-1.7	1.66	9	1,980	1,281	1,718	2.27	1.85	54.60	0.962	1.000	0.309	0.095	0.411	YES	2.8	13.0	511	17.2	N/A	1.499	0.18	1.81
17.50	4.67	0.08	1.73	sensitive fine grained	-2.7	1.00	2	2,100	1,339	1,776	3.09	N/A	N/A	0.959	N/A	0.313	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.81
18.50	5.12	0.06	1.24	sensitive fine grained	-3.7	1.00	3	2,220	1,396	1,833	3.00	N/A	N/A	0.957	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.81
19.50	6.02	0.06	0.98	sensitive fine grained	-4.7	1.00	3	2,340	1,454	1,891	2.89	N/A	N/A	0.955	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.81
20.50	5.41	0.04	0.75	sensitive fine grained	-5.7	1.00	3	2,460	1,512	1,948	2.90	5.75	38.38	0.952	N/A	0.322	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.81
21.50	5.78	0.04	0.70	sensitive fine grained	-6.7	1.00	3	2,580	1,569	2,006	2.88	5.48	38.01	0.950	N/A	0.325	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.81
22.50	5.82	0.02	0.38	sensitive fine grained	-7.7	1.00	3	2,700	1,627	2,064	2.79	4.71	32.00	0.948	N/A	0.327	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.81
23.50	5.98	0.03	0.42	sensitive fine grained	-8.7	1.00	3	2,820	1,684	2,121	2.81	4.83	32.89	0.945	N/A	0.329	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.81
24.50	6.35	0.01	0.16	sensitive fine grained	-9.7	1.00	3	2,940	1,742	2,179	2.68	3.82	26.92	0.943	N/A	0.331	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.81
25.50	27.37	0.13	0.48	silty sand to sandy silt	-10.7	1.00	9	3,060	1,800	2,236	2.21	1.70	49.09	0.941	1.000	0.333	0.091	0.365	YES	2.8	11.4	397	15.4	N/A	1.811	0.22	1.59
26.50	73.22	0.65	0.89	sand to silty sand	-11.7	1.00	18	3,180	1,857	2,294	1.98	1.27	96.76	0.938	1.000	0.334	0.164	0.656	YES	1.3	18.4	1,020	20.4	N/A	1.182	0.14	1.45
27.50	107.97	1.06	0.98	sand to silty sand	-12.7	1.00	27	3,300	1,915	2,352	1.88	1.17	128.90	0.936	1.000	0.335	0.279	1.110	YES	1.3	26.2	1,200	28.6	N/A	0.081	0.01	1.44
28.50	218.17	2.48	1.14	sand	-13.7	1.00	44	3,420	1,972	2,409	1.71	1.04	228.89	0.934	1.000	0.337	N/A	N/A	NO	N/A	N/A	N/A	39.8	N/A	0.002	0.00	1.44
29.50	233.58	2.94	1.26	sand	-14.7	1.00	47	3,540	2,030	2,467	1.72	1.05	244.26	0.931	0.994	0.338	N/A	N/A	NO	N/A	N/A	N/A	42.1	N/A	0.000	0.00	1.44
30.50	202.17	2.90	1.43	sand to silty sand	-15.7	1.66	84	3,660	2,088	2,524	1.50	1.00	327.64	0.926	0.983	0.338	N/A	N/A	NO	N/A	N/A	N/A	80.6	N/A	0.000	0.00	1.44
31.50	91.94	1.81	1.97	silty sand to sandy silt	-16.7	1.66	51	3,780	2,145	2,582	1.84	1.14	167.25	0.918	0.972	0.336	N/A	N/A	NO	N/A	N/A	N/A	58.6	N/A	0.000	0.00	1.44
32.50	9.68	0.21	2.13	clayey silt to silty clay	-17.7	1.00	5	3,900	2,203	2,640	3.01	N/A	N/A	0.909	N/A	0.335	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.44
33.50	10.93	0.14	1.25	clayey silt to silty clay	-18.7	1.00	5	4,020	2,260	2,697	2.84	N/A	N/A	0.901	N/A	0.333	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.44
34.50	9.03	0.15	1.64	clayey silt to silty clay	-19.7	1.00	5	4,140	2,318	2,755	2.99	N/A	N/A	0.893	N/A	0.332	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.44
35.50	8.82	0.12	1.34	clayey silt to silty clay	-20.7	1.00	4	4,260	2,376	2,812	2.97	N/A	N/A	0.885	N/A	0.330	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.44
36.50	26.65	0.32	1.20	sandy silt to clayey silt	-21.7	1.00	11	4,380	2,433	2,870	2.50	2.75	63.25	0.877	0.957	0.328	0.104	0.403	YES	2.8	11.7	415	15.7	N/A	1.764	0.21	1.23
37.50	73.80	0.64	0.87	sand to silty sand	-22.7	1.00	18	4,500	2,491	2,928	2.02	1.33	88.17	0.869	0.938	0.326	0.144	0.551	YES	1.3	16.6	831	18.5	N/A	1.394	0.17	1.06
38.50	104.85	1.00	0.96	sand to silty sand	-23.7	1.00	26	4,620	2,548	2,985	1.93	1.22	113.06	0.861	0.919	0.325	0.214	0.810	YES	1.3	22.8	1,200	25.0	N/A	0.116	0.01	1.05
39.50	61.57	1.06	1.72	silty sand to sandy silt	-24.7	1.00	21	4,740	2,606	3,043	2.28	1.88	101.37	0.852	0.922	0.323	0.177	0.675	YES	2.8	19.4	1,127	25.0	N/A	0.111	0.01	1.03
40.50	73.67	0.69	0.94	sand to silty sand	-25.7	1.00	18	4,860	2,664	3,100	2.06	1.38	88.22	0.844	0.921	0.320	0.144	0.551	YES	1.3	16.1	786	18.0	N/A	1.435	0.17	0.86
41.50	90.73	0.89	0.98	sand to silty sand	-26.7	1.66	38	4,980	2,721	3,158	1.69	1.03	132.53	0.836	0.884	0.318	0.296	1.099	YES	1.3	31.2	1,200	33.8	N/A	0.041	0.00	0.85
42.50	20.33	0.52	2.52	clayey silt to silty clay	-27.7	1.00	10	5,100	2,779	3,215	2.82	N/A	N/A	0.828	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.85
43.50	15.63	0.32	2.01	clayey silt to silty clay	-28.7	1.00	8	5,220	2,836	3,273	2.88	N/A	N/A	0.820	N/A	0.314	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.85
44.50	24.57	0.22	0.89	silty sand to sandy silt	-29.7	1.00	8	5,340	2,894	3,331	2.51	2.84	52.96	0.812	0.929	0.312	0.094	0.373	YES	2.8	9.1	268	12.6	N/A	2.191	0.26	0.59
45.50	17.48	0.19	1.06	sandy silt to clayey silt	-30.7	1.00	7	5,460	2,951	3,388	2.70	N/A	N/A	0.804	N/A	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.59
46.50	28.32	0.70	2.45	sandy silt to clayey silt	-31.7	1.00	11	5,580	3,009	3,446	2.72	N/A	N/A	0.795	N/A	0.307	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.59
47.50	69.18	1.01	1.45	silty sand to sandy silt	-32.7	1.00	23	5,700	3,067	3,503	2.22	1.72	96.05	0.787	0.875	0.304	0.162	0.623	YES	2.8	20.2	1,200	25.9	N/A	0.089	0.01	0.58
48.50	127.83	0.72	0.56	sand	-33.7	1.00	26	5,820	3,124	3,561	1.76	1.08	110.23	0.779	0.864	0.302	0.205	0.781	YES	0.0	19.2	1,097	19.2	N/A	1.174	0.14	0.44
49.50	178.62	0.64	0.36	sand	-34.7	1.00	36	5,940	3,182	3,619	1.53	1.00	141.61	0.771	0.836	0.299	0.344	1.282	YES	0.0	26.6	1,200	26.6	N/A	0.083	0.01	0.43
50.50	167.72	0.54	0.32	sand	-35.7	1.00	34	6,060	3,239	3,676	1.54	1.00	131.78	0.763	0.835	0.297	0.293	1.100	YES	0.0	24.7	1,200	24.7	N/A	0.094	0.01	0.42
51.50	140.88	0.55	0.39	sand	-36.7	1.00	28	6,180	3,297	3,734	1.65	1.00	109.73	0.755	0.843	0.294	0.203	0.776	YES	0.0	20.6	1,200	20.6	N/A	0.353	0.04	0.38
52.50	117.41	0.37	0.32	sand	-37.7	1.00	23	6,300	3,355	3,791	1.68	1.00	90.66	0.747	0.852	0.292	0.149	0.582	YES	0.0	17.1	879	17.1	N/A	1.449	0.17	0.20
53.50	124.77	0.52	0.41	sand	-38.7	1.00	25	6,420	3,412	3,849	1.71	1.00	95.52	0.739	0.844	0.289	0.161	0.627	YES	0.0	18.0	974	18.0	N/A	1.264	0.15	0.05
54.50	114.97	1.01	0.88	sand to silty sand	-39.7	1.00	29	6,540	3,470	3,907	1.93	1.22	106.23	0.730	0.829	0.286	0.191	0.740	YES	1.3	21.9	1,200	24.1	N/A	0.094	0.01	0.04
55.50	162.95	1.33	0.82	sand	-40.7	1.00	33	6,660	3,527	3,964	1.79	1.10	135.07	0.722	0.815	0.284	0.309	1.185	YES	0.0	23.1	1,200	23.1	N/A	0.098	0.01	0.03
56.50	184.97	0.80	0.43	sand	-41.7	1.00	37	6,780	3,585	4,022	1.59	1.00	138.15	0.714	0.800	0.281	0.325	1.235	YES	0.0	26.1	1,200	26.1	N/A	0.080	0.01	0.02
57.50	169.50	1.23	0.72	sand	-42.7	1.66	56	6,900	3,643	4,079	1.44	1.00	207.95	0.706	0.787	0.278	N/A	N/A	NO	N/A	N/A	N/A	39.3	N/A	0.004	0.00	0.02
58.50	79.53	1.41	1.77	silty sand to sandy silt	-43.7	1.00	27	7,020	3,700	4,137	2.26	1.83	106.93	0.698	0.820	0.275	0.194	0.770	YES	2.8	21.2	1,200	27.1	N/A	0.072	0.01	0.01
59.50	49.45	0.95	1.93	silty sand to sandy silt	-44.7	1.66	27	7,140	3,758	4,195	2.14	1.53	91.28	0.690	0.814	0.273	0.151	0.601	YES	2.8	21.6	1,200	27.6	N/A	0.069	0.01	0.00
60.50	12.78	0.29	2.29	clayey silt to silty clay	-45.7	1.00	6	7,260	3,815	4,252	3.10	N/A	N/A	0.682	N/A	0.270	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
																						max=	1,200				
																						min=	268				
																						avg=	957				

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT056

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	15.40 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	12.40 ft below ground surface
GWT Depth For Design, Zwd =	5.40 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	14.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	1.20 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.01 inches	<--- Dry or Unsaturated Sands
Total:	1.21 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ_v' (psf)	Effective Vert. Stress (Test) σ_v' (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_i (in.)	Cumulative Settlement Profile (in.)
0.50	32.82	0.11	0.33	silty sand to sandy silt	14.4	1.00	11	60	60	60	1.40	1.00	189.47	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	27.3	0.010	0.012	0.00	1.21
1.50	23.25	0.27	1.15	sandy silt to clayey silt	13.4	1.00	9	180	180	180	2.04	1.35	104.63	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	24.0	N/A	N/A	N/A	1.21
2.50	25.53	0.23	0.89	silty sand to sandy silt	12.4	1.00	9	300	300	300	2.02	1.33	87.89	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	22.4	0.024	0.035	0.00	1.20
3.50	18.52	0.22	1.18	sandy silt to clayey silt	11.4	1.00	7	420	420	420	2.27	1.86	74.98	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	20.1	N/A	N/A	N/A	1.20
4.50	34.65	1.06	3.05	clayey silt to silty clay	10.4	1.00	17	540	540	540	2.37	2.20	146.78	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.20
5.50	23.42	0.79	3.37	clayey silt to silty clay	9.4	1.66	19	660	654	660	2.24	1.78	120.64	0.987	1.000	0.207	0.243	1.566	NO	N/A	N/A	N/A	N/A	N/A	0.000	0.00	1.20
6.50	11.70	0.22	1.91	clayey silt to silty clay	8.4	1.00	6	780	711	780	2.56	3.10	78.67	0.985	1.000	0.225	0.125	0.744	YES	2.8	12.2	448	N/A	N/A	0.000	0.00	1.20
7.50	8.12	0.10	1.23	clayey silt to silty clay	7.4	1.00	4	900	769	900	2.62	N/A	N/A	0.983	N/A	0.239	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.20
8.50	6.65	0.08	1.13	sensitive fine grained	6.4	1.00	3	1,020	827	1,020	2.70	N/A	N/A	0.980	N/A	0.252	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.20
9.50	7.02	0.18	2.61	silty clay to clay	5.4	1.00	5	1,140	884	1,140	2.89	N/A	N/A	0.978	N/A	0.262	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.20
10.50	5.40	0.12	2.26	silty clay to clay	4.4	1.00	4	1,260	942	1,260	2.97	N/A	N/A	0.976	N/A	0.271	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.20
11.50	5.78	0.03	0.49	sensitive fine grained	3.4	1.00	3	1,380	999	1,380	2.66	3.72	36.22	0.973	N/A	0.280	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.20
12.50	5.75	0.02	0.41	sensitive fine grained	2.4	1.00	3	1,500	1,057	1,494	2.65	3.67	34.06	0.971	N/A	0.287	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.20
13.50	9.27	0.19	2.03	clayey silt to silty clay	1.4	1.00	5	1,620	1,115	1,551	2.79	N/A	N/A	0.969	N/A	0.293	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.20
14.50	11.95	0.24	1.98	clayey silt to silty clay	0.4	1.00	6	1,740	1,172	1,609	2.71	N/A	N/A	0.966	N/A	0.298	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.20
15.50	7.88	0.11	1.34	clayey silt to silty clay	-0.6	1.00	4	1,860	1,230	1,667	2.79	N/A	N/A	0.964	N/A	0.303	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.20
16.50	14.50	0.16	1.09	sandy silt to clayey silt	-1.6	1.00	6	1,980	1,287	1,724	2.52	2.87	57.87	0.962	1.000	0.308	0.098	0.425	YES	2.8	9.0	263	12.5	N/A	2.209	0.27	0.94
17.50	30.38	0.29	0.95	silty sand to sandy silt	-2.6	1.66	17	2,100	1,345	1,782	1.95	1.24	76.08	0.959	1.000	0.312	0.121	0.518	YES	2.8	20.6	1,200	26.3	N/A	0.089	0.01	0.93
18.50	9.13	0.09	0.94	clayey silt to silty clay	-3.6	1.00	5	2,220	1,403	1,839	2.70	N/A	N/A	0.957	N/A	0.315	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
19.50	6.02	0.06	0.97	sensitive fine grained	-4.6	1.00	3	2,340	1,460	1,897	2.90	N/A	N/A	0.955	N/A	0.318	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
20.50	6.13	0.03	0.44	sensitive fine grained	-5.6	1.00	3	2,460	1,518	1,955	2.77	4.50	33.89	0.952	N/A	0.321	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
21.50	5.73	0.01	0.17	sensitive fine grained	-6.6	1.00	3	2,580	1,575	2,012	2.70	3.96	27.17	0.950	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
22.50	5.90	0.01	0.17	sensitive fine grained	-7.6	1.00	3	2,700	1,633	2,070	2.69	3.94	27.07	0.948	N/A	0.326	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
23.50	5.80	0.01	0.17	sensitive fine grained	-8.6	1.00	3	2,820	1,691	2,127	2.71	4.10	26.97	0.945	N/A	0.328	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
24.50	7.20	0.01	0.12	sensitive fine grained	-9.6	1.00	4	2,940	1,748	2,185	2.59	3.29	26.24	0.943	1.000	0.330	0.072	0.291	YES	5.0	8.4	236	N/A	N/A	0.000	0.00	0.93
25.50	6.22	0.01	0.16	sensitive fine grained	-10.6	1.00	3	3,060	1,806	2,243	2.70	3.99	26.80	0.941	N/A	0.332	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
26.50	8.27	0.01	0.10	sensitive fine grained	-11.6	1.00	4	3,180	1,863	2,300	2.55	3.02	26.31	0.938	1.000	0.333	0.072	0.288	YES	5.0	8.9	254	N/A	N/A	0.000	0.00	0.93
27.50	37.08	0.09	0.24	sand to silty sand	-12.6	1.00	9	3,300	1,921	2,358	1.99	1.00	37.84	0.936	1.000	0.334	0.082	0.325	YES	1.3	9.9	305	11.4	N/A	2.371	0.28	0.64
28.50	123.80	1.29	1.04	sand to silty sand	-13.6	1.00	31	3,420	1,979	2,415	1.85	1.15	142.99	0.934	1.000	0.336	0.352	1.399	NO	N/A	N/A	N/A	32.0	N/A	0.057	0.01	0.64
29.50	175.17	2.50	1.43	sand to silty sand	-14.6	1.00	44	3,540	2,036	2,473	1.85	1.14	198.55	0.931	0.993	0.337	N/A	N/A	NO	N/A	N/A	N/A	43.8	N/A	0.000	0.00	0.64
30.50	188.88	3.11	1.65	sand to silty sand	-15.6	1.00	47	3,660	2,094	2,531	1.88	1.17	215.68	0.926	0.982	0.337	N/A	N/A	NO	N/A	N/A	N/A	46.5	N/A	0.000	0.00	0.64
31.50	178.76	2.65	1.48	sand to silty sand	-16.6	1.66	74	3,780	2,151	2,588	1.55	1.00	285.37	0.918	0.971	0.335	N/A	N/A	NO	N/A	N/A	N/A	70.7	N/A	0.000	0.00	0.64
32.50	83.45	1.58	1.90	silty sand to sandy silt	-17.6	1.66	46	3,900	2,209	2,646	1.86	1.16	152.17	0.909	0.961	0.334	0.408	1.565	NO	N/A	N/A	N/A	53.1	N/A	0.000	0.00	0.64
33.50	10.73	0.20	1.82	clayey silt to silty clay	-18.6	1.00	5	4,020	2,267	2,703	2.94	N/A	N/A	0.901	N/A	0.333	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.64
34.50	8.05	0.06	0.73	sensitive fine grained	-19.6	1.00	4	4,140	2,324	2,761	2.88	N/A	N/A	0.893	N/A	0.331	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.64
35.50	8.37	0.07	0.76	clayey silt to silty clay	-20.6	1.00	4	4,260	2,382	2,819	2.88	N/A	N/A	0.885	N/A	0.329	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.64
36.50	8.18	0.09	1.03	clayey silt to silty clay	-21.6	1.00	4	4,380	2,439	2,876	2.96	N/A	N/A	0.877	N/A	0.327	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.64
37.50	7.80	0.06	0.79	sensitive fine grained	-22.6	1.00	4	4,500	2,497	2,934	2.94	N/A	N/A	0.869	N/A	0.326	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.64
38.50	13.40	0.25	1.83	clayey silt to silty clay	-23.6	1.00	7	4,620	2,555	2,991	2.89	N/A	N/A	0.861	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.64
39.50	58.43	0.50	0.86	sand to silty sand	-24.6	1.00	15	4,740	2,612	3,049	2.12	1.48	75.91	0.852	0.933	0.322	0.121	0.467	YES	1.3	13.2	523	14.9	N/A	1.859	0.22	0.41
40.50	145.95	1.63	1.11	sand to silty sand	-25.6	1.00	36	4,860	2,670	3,107	1.87	1.16	146.73	0.844	0.891	0.320	0.374	1.390	NO	N/A	N/A	N/A	33.2	N/A	0.046	0.01	0.41
41.50	128.70	1.17	0.91	sand to silty sand	-26.6	1.66	53	4,980	2,727	3,164	1.55	1.00	182.48	0.836	0.883	0.318	N/A	N/A	NO	N/A	N/A	N/A	46.9	N/A	0.000	0.00	0.41
42.50	57.77	0.86	1.49	silty sand to sandy silt	-27.6	1.66	32	5,100	2,785	3,222	1.96	1.25	101.44	0.828	0.883	0.315	0.177	0.661	YES	2.8	27.9	1,200	35.1	N/A	0.032	0.00	0.40
43.50	10.65	0.09	0.82	sandy silt to clayey silt	-28.6	1.00	4	5,220	2,843	3,279	2.85	N/A	N/A	0.820	N/A	0.313	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.40
44.50	9.50	0.06	0.59	sandy silt to clayey silt	-29.6	1.00	4	5,340	2,900	3,337	2.85	5.24	37.68	0.812	N/A	0.311	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.40
45.50	9.58	0.04	0.41	sandy silt to clayey silt	-30.6	1.00	4	5,460	2,958	3,395	2.80	4.75	33.93	0.804	N/A	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.40
46.50	9.27	0.06	0.62	sandy silt to clayey silt	-31.6	1.00	4	5,580	3,015	3,452	2.89	5.56	37.86	0.795	N/A	0.306	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.40
47.50	8.80	0.07	0.72	clayey silt to silty clay	-32.6	1.00	4	5,700	3,073	3,510	2.95	N/A	N/A	0.787	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.40
48.50	11.25	0.14	1.21	clayey silt to silty clay	-33.6	1.00	6	5,820	3,131	3,567	2.94	N/A	N/A	0.779	N/A	0.301	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.40
49.50	10.58	0.12	1.11	clayey silt to silty clay	-34.6	1.00	5	5,940	3,188	3,625	2.96	N/A	N/A	0.771	N/A	0.299	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.40
50.50	8.93	0.09	0.93	clayey silt to silty clay	-35.6	1.00	4	6,060	3,246	3,683	3.02	N/A	N/A	0.763	N/A	0.296	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.40
51.50	9.38	0.13	1.34	clayey silt to silty clay	-36.6	1.00	5	6,180	3,303	3,740	3.08	N/A	N/A	0.755	N/A	0.294	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.40
52.50	9.87	0.18	1.78	clayey silt to silty clay	-37.6	1.00	5	6,300	3,361	3,798	3.12	N/A	N/A	0.747	N/A	0.291	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.40
53.50	17.12	0.35	1.99	clayey silt to silty clay	-38.6	1.00	9	6,420	3,419	3,855	2.91	N/A	N/A	0.739	N/A	0.288	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.40
54.50	41.43	0.64	1.53	silty sand to sandy silt	-39.6	1.00	14	6,540	3,476	3,913	2.49	2.73	74.80	0.730	0.878	0.286	0.119	0.487	YES	2.8	12.7	485	16.8	N/A	1.443	0.17	0.23
55.50	34.18	0.59	1.72	sandy silt to clayey silt	-40.6	1.00	14	6,660	3,534	3,971	2.60	N/A	N/A	0.722	N/A	0.283	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
56.50	45.73	0.59	1.29	silty sand to sandy silt	-41.6	1.00	15	6,780	3,591	4,028	2.37	2.19	74.86	0.714	0.866	0.280	0.119	0.490	YES	2.8	13.5	554	17.9	N/A	1.191	0.14	0.09
57.50	49.22	0.61	1.23	silty sand to sandy silt	-42.6	1.00	16	6,900	3,649	4,086	2.33	2.06	75.14	0.706	0.858	0.278	0.119	0.493	YES	2.8	14.3	616	18.8	N/A	0.477	0.06	0.03
58.50	112.23	0.91	0.81	sand to silty sand	-43.6	1.00	28	7,020	3,707	4,143	1.93	1.22	100.30	0.698	0.815	0.275	0.174	0.688	YES	1.3	20.8	1,200	22.9	N/A	0.096	0.01	0.02
59.50	87.65	1.27	1.45	silty sand to sandy silt	-44.6	1.00	29	7,140	3,764	4,201	2.17	1.61	102.57	0.690	0.808	0.272	0.180	0.715	YES	2.8	23.0	1,200	29.2	N/A	0.060	0.01	0.01
60.50	65.28	0.75	1.15	silty sand to sandy silt	-45.6	1.00	22	7,260	3,822	4,259	2.22	1.72	81.09	0.682	0.829	0.269	0.130	0.532	YES	2.8	17.7	946	22.9	N/A	0.094	0.01	0.00

max=	1,200
min=	236
avg=	674

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT057

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	14.60 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	11.60 ft below ground surface
GWT Depth For Design, Zwd =	4.60 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	24.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	2.80 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	2.80 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ_v' (psf)	Effective Vert. Stress (Test) σ_v' (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_c (in.)	Cumulative Settlement Profile (in.)
0.50	64.60	0.82	1.26	silty sand to sandy silt	13.6	1.00	22	60	60	60	1.60	1.00	372.97	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	48.9	0.008	0.000	0.00	2.80
1.50	44.37	0.60	1.35	silty sand to sandy silt	12.6	1.00	15	180	180	180	1.87	1.17	172.41	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	35.2	0.016	0.014	0.00	2.80
2.50	62.97	0.73	1.16	silty sand to sandy silt	11.6	1.00	21	300	300	300	1.80	1.11	179.71	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	47.8	0.019	0.000	0.00	2.80
3.50	41.70	0.83	2.00	sandy silt to clayey silt	10.6	1.00	17	420	420	420	2.15	1.54	140.37	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	39.0	N/A	N/A	N/A	2.80
4.50	45.55	1.24	2.72	sandy silt to clayey silt	9.6	1.00	18	540	540	540	2.25	1.81	158.58	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	42.2	N/A	N/A	N/A	2.80
5.50	22.92	0.63	2.76	clayey silt to silty clay	8.6	1.00	11	660	604	660	2.49	2.72	113.47	0.987	1.000	0.224	0.216	1.283	YES	2.8	22.3	1,200	N/A	N/A	0.000	0.00	2.80
6.50	13.93	0.18	1.28	sandy silt to clayey silt	7.6	1.00	6	780	661	780	2.48	2.66	64.48	0.985	1.000	0.242	0.105	0.580	YES	2.8	11.7	417	15.7	N/A	1.209	0.15	2.65
7.50	13.87	0.11	0.79	sandy silt to clayey silt	6.6	1.00	6	900	719	900	2.39	2.28	52.70	0.983	1.000	0.256	0.094	0.488	YES	2.8	11.1	374	14.9	N/A	1.649	0.20	2.46
8.50	16.27	0.24	1.50	sandy silt to clayey silt	5.6	1.00	7	1,020	777	1,020	2.49	2.72	70.93	0.980	1.000	0.268	0.113	0.564	YES	2.8	11.9	430	15.9	N/A	1.488	0.18	2.28
9.50	11.02	0.27	2.41	clayey silt to silty clay	4.6	1.00	6	1,140	834	1,140	2.69	N/A	N/A	0.978	N/A	0.278	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.28
10.50	10.70	0.25	2.34	clayey silt to silty clay	3.6	1.00	5	1,260	892	1,260	2.71	N/A	N/A	0.976	N/A	0.287	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.28
11.50	12.87	0.19	1.47	clayey silt to silty clay	2.6	1.00	6	1,380	949	1,380	2.54	3.00	67.46	0.973	1.000	0.294	0.109	0.492	YES	2.8	10.5	342	N/A	N/A	0.000	0.00	2.28
12.50	31.27	0.23	0.75	silty sand to sandy silt	1.6	1.00	17	1,500	1,007	1,444	1.83	1.00	72.96	0.971	1.000	0.301	0.116	0.515	YES	2.8	23.1	1,200	29.4	N/A	0.066	0.01	2.27
13.50	15.30	0.27	1.76	clayey silt to silty clay	0.6	1.00	8	1,620	1,065	1,501	2.56	3.08	75.70	0.969	1.000	0.307	0.120	0.524	YES	2.8	11.6	411	N/A	N/A	0.000	0.00	2.27
14.50	18.33	0.24	1.31	sandy silt to clayey silt	-0.4	1.00	7	1,740	1,122	1,559	2.49	2.69	65.95	0.966	1.000	0.312	0.107	0.457	YES	2.8	11.1	377	15.0	N/A	1.838	0.22	2.05
15.50	21.15	0.44	2.10	sandy silt to clayey silt	-1.4	1.66	14	1,860	1,180	1,617	2.25	1.80	81.89	0.964	1.000	0.316	0.131	0.553	YES	2.8	18.4	1,015	23.7	N/A	0.153	0.02	2.03
16.50	6.48	0.16	2.46	silty clay to clay	-2.4	1.00	4	1,980	1,237	1,674	3.01	N/A	N/A	0.962	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.03
17.50	6.52	0.14	2.14	silty clay to clay	-3.4	1.00	4	2,100	1,295	1,732	2.99	N/A	N/A	0.959	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.03
18.50	18.17	0.14	0.79	sandy silt to clayey silt	-4.4	1.66	12	2,220	1,353	1,789	2.11	1.00	36.58	0.957	1.000	0.327	0.080	0.329	YES	2.8	15.5	728	20.3	N/A	1.162	0.14	1.89
19.50	8.62	0.13	1.48	clayey silt to silty clay	-5.4	1.00	4	2,340	1,410	1,847	2.82	N/A	N/A	0.955	N/A	0.329	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.89
20.50	6.94	0.14	2.06	silty clay to clay	-6.4	1.00	5	2,460	1,468	1,905	3.00	N/A	N/A	0.952	N/A	0.332	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.89
21.50	6.25	0.04	0.67	sensitive fine grained	-7.4	1.00	3	2,580	1,525	1,962	2.83	5.04	38.58	0.950	N/A	0.334	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.89
22.50	6.15	0.03	0.44	sensitive fine grained	-8.4	1.00	3	2,700	1,583	2,020	2.78	4.61	33.82	0.948	N/A	0.336	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.89
23.50	7.32	0.07	0.99	sensitive fine grained	-9.4	1.00	4	2,820	1,641	2,077	2.86	N/A	N/A	0.945	N/A	0.338	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.89
24.50	6.67	0.02	0.35	sensitive fine grained	-10.4	1.00	3	2,940	1,698	2,135	2.73	4.25	32.01	0.943	N/A	0.340	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.89
25.50	7.68	0.04	0.50	sensitive fine grained	-11.4	1.00	4	3,060	1,756	2,193	2.74	4.26	36.11	0.941	N/A	0.341	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.89
26.50	7.38	0.01	0.16	sensitive fine grained	-12.4	1.00	4	3,180	1,813	2,250	2.63	3.48	27.69	0.938	N/A	0.342	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.89
27.50	10.43	0.04	0.40	sandy silt to clayey silt	-13.4	1.00	4	3,300	1,871	2,308	2.59	3.27	35.89	0.936	1.000	0.343	0.080	0.311	YES	2.8	6.7	173	9.7	N/A	2.647	0.32	1.57
28.50	19.40	0.09	0.44	silty sand to sandy silt	-14.4	1.00	6	3,420	1,929	2,365	2.35	1.00	19.76	0.934	1.000	0.344	0.066	0.258	YES	2.8	8.7	249	12.1	N/A	2.265	0.27	1.30
29.50	58.08	0.22	0.38	sand to silty sand	-15.4	1.66	24	3,540	1,986	2,423	1.60	1.00	96.50	0.931	1.000	0.345	0.164	0.632	YES	1.3	23.2	1,200	25.4	N/A	0.148	0.02	1.28
30.50	19.48	0.14	0.72	sandy silt to clayey silt	-16.4	1.00	8	3,660	2,044	2,481	2.46	2.55	49.17	0.926	0.996	0.345	0.091	0.350	YES	2.8	9.8	301	13.4	N/A	2.070	0.25	1.03
31.50	48.89	0.38	0.77	silty sand to sandy silt	-17.4	1.00	16	3,780	2,101	2,538	2.12	1.48	70.72	0.918	0.986	0.343	0.113	0.433	YES	2.8	17.3	900	22.4	N/A	0.875	0.10	0.93
32.50	116.87	1.60	1.37	sand to silty sand	-18.4	1.66	48	3,900	2,159	2,596	1.66	1.01	187.65	0.909	0.970	0.342	N/A	N/A	NO	N/A	N/A	N/A	47.0	N/A	0.000	0.00	0.93
33.50	53.45	1.06	1.99	silty sand to sandy silt	-19.4	1.66	29	4,020	2,217	2,653	2.03	1.33	112.22	0.901	0.962	0.340	0.211	0.798	YES	2.8	28.4	1,200	35.7	N/A	0.031	0.00	0.93
34.50	8.52	0.11	1.33	clayey silt to silty clay	-20.4	1.00	4	4,140	2,274	2,711	2.97	N/A	N/A	0.893	N/A	0.338	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
35.50	8.92	0.10	1.06	clayey silt to silty clay	-21.4	1.00	4	4,260	2,332	2,769	2.91	N/A	N/A	0.885	N/A	0.336	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
36.50	9.33	0.14	1.49	clayey silt to silty clay	-22.4	1.00	5	4,380	2,389	2,826	2.97	N/A	N/A	0.877	N/A	0.334	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
37.50	8.55	0.10	1.18	clayey silt to silty clay	-23.4	1.00	4	4,500	2,447	2,884	2.97	N/A	N/A	0.869	N/A	0.332	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
38.50	8.90	0.14	1.52	clayey silt to silty clay	-24.4	1.00	4	4,620	2,505	2,941	3.02	N/A	N/A	0.861	N/A	0.330	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
39.50	9.65	0.13	1.29	clayey silt to silty clay	-25.4	1.00	5	4,740	2,562	2,999	2.95	N/A	N/A	0.852	N/A	0.328	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
40.50	12.03	0.17	1.37	clayey silt to silty clay	-26.4	1.00	6	4,860	2,620	3,057	2.88	N/A	N/A	0.844	N/A	0.326	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
41.50	15.33	0.20	1.28	sandy silt to clayey silt	-27.4	1.00	6	4,980	2,677	3,114	2.76	N/A	N/A	0.836	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
42.50	14.73	0.24	1.62	clayey silt to silty clay	-28.4	1.00	7	5,100	2,735	3,172	2.84	N/A	N/A	0.828	N/A	0.321	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
43.50	21.02	0.44	2.09	sandy silt to clayey silt	-29.4	1.00	8	5,220	2,793	3,229	2.77	N/A	N/A	0.820	N/A	0.319	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
44.50	20.45	0.46	2.21	sandy silt to clayey silt	-30.4	1.00	8	5,340	2,850	3,287	2.80	N/A	N/A	0.812	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
45.50	20.95	0.57	2.70	clayey silt to silty clay	-31.4	1.00	10	5,460	2,908	3,345	2.85	N/A	N/A	0.804	N/A	0.314	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
46.50	27.90	1.14	4.04	silty clay to clay	-32.4	1.00	19	5,580	2,965	3,402	2.86	N/A	N/A	0.795	N/A	0.311	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
47.50	38.10	1.90	4.95	clay	-33.4	1.00	38	5,700	3,023	3,460	2.81	N/A	N/A	0.787	N/A	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
48.50	41.47	0.94	2.25	sandy silt to clayey silt	-34.4	1.00	17	5,820	3,081	3,517	2.56	3.08	92.48	0.779	0.892	0.306	0.154	0.597	YES	2.8	15.3	708	20.0	N/A	1.073	0.13	0.80
49.50	31.82	0.95	2.96	clayey silt to silty clay	-35.4	1.00	16	5,940	3,138	3,575	2.74	N/A	N/A	0.771	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.80
50.50	39.75	0.93	2.32	sandy silt to clayey silt	-36.4	1.00	16	6,060	3,196	3,633	2.59	3.28	91.81	0.763	0.886	0.301	0.152	0.597	YES	2.8	14.6	644	19.2	N/A	1.168	0.14	0.66
51.50	50.58	1.09	2.15	sandy silt to clayey silt	-37.4	1.00	20	6,180	3,253	3,690	2.45	2.53	100.34	0.755	0.869	0.298	0.174	0.676	YES	2.8	17.7	944	22.9	N/A	0.143	0.02	0.64
52.50	71.21	0.85	1.19	sand to silty sand	-38.4	1.00	18	6,300	3,311	3,748	2.17	1.60	88.54	0.747	0.873	0.295	0.145	0.570	YES	1.3	14.3	621	16.1	N/A	1.626	0.20	0.44
53.50	62.25	1.50	2.41	sandy silt to clayey silt	-39.4	1.00	25	6,420	3,369	3,805	2.42	2.38	114.28	0.739	0.847	0.293	0.219	0.845	YES	2.8	20.9	1,200	26.7	N/A	0.081	0.01	0.43
54.50	176.72	2.76	1.56	sand to silty sand	-40.4	1.66	73	6,540	3,426	3,863	1.64	1.00	222.94	0.730	0.806	0.290	N/A	N/A	NO	N/A	N/A	N/A	57.7	N/A	0.000	0.00	0.43
55.50	68.08	1.61	2.37	sandy silt to clayey silt	-41.4	1.66	45	6,660	3,484	3,921	2.07	1.41	120.18	0.722	0.801	0.287	0.241	0.898	YES	2.8	35.0	1,200	43.6	N/A	0.000	0.00	0.43
56.50	16.08	0.45	2.75	clayey silt to silty clay	-42.4	1.00	8	6,780	3,541	3,978	3.02	N/A	N/A	0.714	N/A	0.284	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
57.50	18.58	0.40	2.14	clayey silt to silty clay	-43.4	1.00	9	6,900	3,599	4,036	2.90	N/A	N/A	0.706	N/A	0.282	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
58.50	26.37	0.43	1.60	sandy silt to clayey silt	-44.4	1.00	11	7,020	3,657	4,093	2.69	N/A	N/A	0.698	N/A	0.279	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
59.50	39.08	0.63	1.60	silty sand to sandy silt	-45.4	1.00	13	7,140	3,714	4,151	2.55	3.01	73.91	0.690	0.870	0.276	0.118	0.495	YES	2.8	11.8	425	15.9	N/A	1.570	0.19	0.25
60.50	30.82	0.36	1.16	silty sand to sandy silt	-46.4	1.00	10	7,260	3,772	4,209	2.57	3.12	59.77	0.682	0.881	0.273	0.100	0.430	YES	2.8	9.9	305	13.5	N/A	2.054	0.25	0.00
																						max=	1,200				
																						min=	173				
																						avg=	690				

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT059

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	18.70 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	15.70 ft below ground surface
GWT Depth For Design, Zwd =	8.70 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	14.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	1.53 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.01 inches	<--- Dry or Unsaturated Sands
Total:	1.54 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ_v' (psf)	Effective Vert. Stress (Test) σ_v' (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_c (in.)	Cumulative Settlement Profile (in.)
0.50	60.80	0.32	0.52	sand to silty sand	17.7	1.00	15	60	60	60	1.31	1.00	351.03	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	29.6	0.010	0.010	0.00	1.54
1.50	58.72	0.39	0.66	sand to silty sand	16.7	1.00	15	180	180	180	1.57	1.00	195.72	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	28.7	0.017	0.019	0.00	1.54
2.50	37.82	0.24	0.62	silty sand to sandy silt	15.7	1.00	13	300	300	300	1.79	1.10	107.70	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	30.7	0.022	0.022	0.00	1.54
3.50	33.95	0.18	0.52	silty sand to sandy silt	14.7	1.00	11	420	420	420	1.85	1.15	85.04	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	28.1	0.027	0.029	0.00	1.53
4.50	37.25	0.71	1.89	sandy silt to clayey silt	13.7	1.00	15	540	540	540	2.20	1.68	120.19	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	35.4	N/A	N/A	N/A	1.53
5.50	26.37	0.63	2.38	sandy silt to clayey silt	12.7	1.00	11	660	660	660	2.42	2.38	109.19	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	26.5	N/A	N/A	N/A	1.53
6.50	17.62	0.19	1.07	sandy silt to clayey silt	11.7	1.00	7	780	780	780	2.38	2.23	62.91	0.985	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	18.5	N/A	N/A	N/A	1.53
7.50	15.18	0.22	1.45	sandy silt to clayey silt	10.7	1.00	6	900	900	900	2.53	2.94	66.61	0.983	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	15.9	N/A	N/A	N/A	1.53
8.50	13.40	0.17	1.27	sandy silt to clayey silt	9.7	1.00	5	1,020	1,020	1,020	2.57	3.17	59.42	0.980	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	14.0	N/A	N/A	N/A	1.53
9.50	18.52	0.09	0.50	sandy silt to clayey silt	8.7	1.00	7	1,140	1,090	1,140	2.27	1.86	46.68	0.978	1.000	0.213	0.089	0.558	YES	2.8	12.6	481	16.8	N/A	0.126	0.02	1.52
10.50	14.87	0.14	0.95	sandy silt to clayey silt	7.7	1.00	6	1,260	1,148	1,260	2.49	2.74	53.70	0.976	1.000	0.223	0.094	0.565	YES	2.8	10.3	328	14.0	N/A	1.457	0.17	1.34
11.50	15.62	0.17	1.09	sandy silt to clayey silt	6.7	1.00	6	1,380	1,205	1,380	2.51	2.84	57.19	0.973	1.000	0.232	0.097	0.561	YES	2.8	10.3	329	14.0	N/A	1.646	0.20	1.15
12.50	28.37	0.37	1.31	sandy silt to clayey silt	5.7	1.00	19	1,500	1,263	1,500	2.04	1.35	79.93	0.971	1.000	0.240	0.127	0.709	YES	2.8	24.5	1,200	31.0	N/A	0.044	0.01	1.14
13.50	8.37	0.12	1.45	clayey silt to silty clay	4.7	1.00	4	1,620	1,320	1,620	2.80	N/A	N/A	0.969	N/A	0.247	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.14
14.50	19.70	0.39	2.00	sandy silt to clayey silt	3.7	1.00	8	1,740	1,378	1,740	2.57	3.13	81.46	0.966	1.000	0.254	0.130	0.685	YES	2.8	11.2	386	15.1	N/A	1.569	0.19	0.95
15.50	22.53	0.37	1.63	sandy silt to clayey silt	2.7	1.66	15	1,860	1,436	1,860	2.20	1.66	73.08	0.964	1.000	0.260	0.116	0.597	YES	2.8	18.3	1,004	23.6	N/A	0.087	0.01	0.94
16.50	8.07	0.18	2.29	silty clay to clay	1.7	1.00	5	1,980	1,493	1,930	2.96	N/A	N/A	0.962	N/A	0.265	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.94
17.50	5.80	0.13	2.22	silty clay to clay	0.7	1.00	4	2,100	1,551	1,988	3.10	N/A	N/A	0.959	N/A	0.270	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.94
18.50	6.63	0.12	1.89	silty clay to clay	-0.3	1.00	4	2,220	1,608	2,045	3.02	N/A	N/A	0.957	N/A	0.275	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.94
19.50	15.90	0.16	1.03	sandy silt to clayey silt	-1.3	1.00	6	2,340	1,666	2,103	2.55	3.01	54.84	0.955	1.000	0.279	0.095	0.456	YES	2.8	9.0	261	12.4	N/A	2.217	0.27	0.68
20.50	9.73	0.13	1.32	clayey silt to silty clay	-2.3	1.00	5	2,460	1,724	2,160	2.80	N/A	N/A	0.952	N/A	0.283	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
21.50	8.10	0.23	2.89	silty clay to clay	-3.3	1.00	5	2,580	1,781	2,218	3.07	N/A	N/A	0.950	N/A	0.286	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
22.50	6.15	0.07	1.13	sensitive fine grained	-4.3	1.00	3	2,700	1,839	2,276	2.99	N/A	N/A	0.948	N/A	0.289	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
23.50	5.75	0.03	0.48	sensitive fine grained	-5.3	1.00	3	2,820	1,896	2,333	2.88	5.48	32.80	0.945	N/A	0.292	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
24.50	7.72	0.08	1.01	sensitive fine grained	-6.3	1.00	4	2,940	1,954	2,391	2.89	N/A	N/A	0.943	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
25.50	7.48	0.07	0.88	sensitive fine grained	-7.3	1.00	4	3,060	2,012	2,448	2.89	N/A	N/A	0.941	N/A	0.298	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
26.50	7.57	0.06	0.80	sensitive fine grained	-8.3	1.00	4	3,180	2,069	2,506	2.87	N/A	N/A	0.938	N/A	0.300	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
27.50	6.80	0.02	0.27	sensitive fine grained	-9.3	1.00	3	3,300	2,127	2,564	2.77	4.49	29.19	0.936	N/A	0.302	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
28.50	7.47	0.06	0.81	sensitive fine grained	-10.3	1.00	4	3,420	2,184	2,621	2.90	N/A	N/A	0.934	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
29.50	6.42	0.01	0.21	sensitive fine grained	-11.3	1.00	3	3,540	2,242	2,679	2.78	4.63	27.24	0.931	N/A	0.306	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
30.50	6.30	0.03	0.51	sensitive fine grained	-12.3	1.00	3	3,660	2,300	2,736	2.92	5.91	33.52	0.926	N/A	0.306	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
31.50	6.13	0.02	0.26	sensitive fine grained	-13.3	1.00	3	3,780	2,357	2,794	2.85	5.22	28.30	0.918	N/A	0.306	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
32.50	7.08	0.01	0.17	sensitive fine grained	-14.3	1.00	4	3,900	2,415	2,852	2.75	4.34	26.66	0.909	N/A	0.305	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
33.50	7.90	0.07	0.87	sensitive fine grained	-15.3	1.00	4	4,020	2,472	2,909	2.94	N/A	N/A	0.901	N/A	0.305	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
34.50	11.10	0.10	0.92	sandy silt to clayey silt	-16.3	1.00	4	4,140	2,530	2,967	2.81	N/A	N/A	0.893	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
35.50	8.95	0.12	1.39	clayey silt to silty clay	-17.3	1.00	4	4,260	2,588	3,024	2.99	N/A	N/A	0.885	N/A	0.303	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
36.50	8.03	0.07	0.90	sensitive fine grained	-18.3	1.00	4	4,380	2,645	3,082	2.96	N/A	N/A	0.877	N/A	0.302	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
37.50	8.92	0.11	1.25	clayey silt to silty clay	-19.3	1.00	4	4,500	2,703	3,140	2.99	N/A	N/A	0.869	N/A	0.301	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
38.50	9.40	0.06	0.66	sandy silt to clayey silt	-20.3	1.00	4	4,620	2,760	3,197	2.85	5.22	38.53	0.861	N/A	0.300	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
39.50	16.47	0.21	1.26	sandy silt to clayey silt	-21.3	1.00	7	4,740	2,818	3,255	2.74	N/A	N/A	0.852	N/A	0.298	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
40.50	15.17	0.24	1.58	sandy silt to clayey silt	-22.3	1.00	6	4,860	2,876	3,312	2.83	N/A	N/A	0.844	N/A	0.297	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
41.50	17.71	0.39	2.19	clayey silt to silty clay	-23.3	1.00	9	4,980	2,933	3,370	2.86	N/A	N/A	0.836	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
42.50	21.82	0.61	2.76	clayey silt to silty clay	-24.3	1.00	11	5,100	2,991	3,428	2.84	N/A	N/A	0.828	N/A	0.294	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
43.50	26.73	1.00	3.71	clayey silt to silty clay	-25.3	1.00	13	5,220	3,048	3,485	2.85	N/A	N/A	0.820	N/A	0.292	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
44.50	20.58	0.59	2.86	clayey silt to silty clay	-26.3	1.00	10	5,340	3,106	3,543	2.88	N/A	N/A	0.812	N/A	0.290	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
45.50	18.78	0.20	1.03	sandy silt to clayey silt	-27.3	1.00	8	5,460	3,164	3,600	2.68	N/A	N/A	0.804	N/A	0.288	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
46.50	20.37	0.61	2.97	clayey silt to silty clay	-28.3	1.00	10	5,580	3,221	3,658	2.91	N/A	N/A	0.795	N/A	0.287	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
47.50	62.70	0.39	0.62	sand to silty sand	-29.3	1.00	16	5,700	3,279	3,716	2.06	1.38	67.67	0.787	0.882	0.285	0.109	0.450	YES	1.3	12.8	498	14.6	N/A	1.868	0.22	0.45
48.50	34.98	0.64	1.84	sandy silt to clayey silt	-30.3	1.00	14	5,820	3,336	3,773	2.59	3.25	77.52	0.779	0.885	0.283	0.123	0.515	YES	2.8	13.0	509	17.2	N/A	1.346	0.16	0.29
49.50	110.05	0.85	0.78	sand to silty sand	-31.3	1.00	28	5,940	3,394	3,831	1.91	1.20	101.04	0.771	0.838	0.281	0.176	0.701	YES	1.3	21.2	1,200	23.3	N/A	0.096	0.01	0.28
50.50	209.07	0.63	0.30	sand	-32.3	1.00	42	6,060	3,452	3,888	1.45	1.00	159.14	0.763	0.804	0.279	0.455	1.751	NO	N/A	N/A	N/A	30.0	N/A	0.057	0.01	0.27
51.50	159.57	0.35	0.22	sand	-33.3	1.00	32	6,180	3,509	3,946	1.50	1.00	120.46	0.755	0.818	0.276	0.243	0.957	YES	0.0	22.7	1,200	22.7	N/A	0.097	0.01	0.26
52.50	152.01	0.45	0.30	sand	-34.3	1.00	30	6,300	3,567	4,004	1.58	1.00	113.83	0.747	0.818	0.274	0.217	0.864	YES	0.0	21.5	1,200	21.5	N/A	0.131	0.02	0.25
53.50	155.73	0.68	0.44	sand	-35.3	1.66	52	6,420	3,624	4,061	1.35	1.00	191.54	0.739	0.788	0.272	N/A	N/A	NO	N/A	N/A	N/A	36.2	N/A	0.021	0.00	0.24
54.50	62.98	0.66	1.05	sand to silty sand	-36.3	1.00	16	6,540	3,682	4,119	2.20	1.67	77.71	0.730	0.859	0.270	0.124	0.525	YES	1.3	12.3	458	14.0	N/A	1.965	0.24	0.01
55.50	94.80	0.92	0.97	sand to silty sand	-37.3	1.66	39	6,660	3,740	4,176	1.73	1.06	121.23	0.722	0.783	0.268	0.246	0.960	YES	1.3	28.5	1,200	31.0	N/A	0.049	0.01	0.00
56.50	24.02	0.30	1.26	sandy silt to clayey silt	-38.3	1.00	10	6,780	3,797	4,234	2.68	N/A	N/A	0.714	N/A	0.265	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
57.50	19.02	0.22	1.16	sandy silt to clayey silt	-39.3	1.00	8	6,900	3,855	4,292	2.77	N/A	N/A	0.706	N/A	0.263	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
58.50	28.63	0.38	1.33	sandy silt to clayey silt	-40.3	1.00	11	7,020	3,912	4,349	2.63	N/A	N/A	0.698	N/A	0.260	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
59.50	26.22	0.33	1.27	sandy silt to clayey silt	-41.3	1.00	10	7,140	3,970	4,407	2.66	N/A	N/A	0.690	N/A	0.258	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
60.50	19.10	0.44	2.28	clayey silt to silty clay	-42.3	1.00	10	7,260	4,028	4,464	2.94	N/A	N/A	0.682	N/A	0.256	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00

max=	1,200
min=	261
avg=	732

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT060

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	14.60 ft
GWT Elev. During Test	-2.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	16.60 ft below ground surface
GWT Depth For Design, Zwd =	4.60 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	12.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	0.52 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	0.52 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_l (in.)	Cumulative Settlement Profile (in.)
0.50	19.68	0.09	0.44	silty sand to sandy silt	13.6	1.00	7	60	60	60	1.66	1.00	113.64	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	18.4	0.012	0.022	0.00	0.52
1.50	39.48	0.28	0.70	silty sand to sandy silt	12.6	1.00	13	180	180	180	1.72	1.05	138.48	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	31.8	0.017	0.016	0.00	0.52
2.50	84.72	0.42	0.50	sand to silty sand	11.6	1.00	21	300	300	300	1.46	1.00	218.74	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	40.2	0.020	0.000	0.00	0.52
3.50	95.70	0.53	0.55	sand to silty sand	10.6	1.00	24	420	420	420	1.50	1.00	208.83	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	45.1	0.023	0.000	0.00	0.52
4.50	108.37	0.84	0.77	sand to silty sand	9.6	1.00	27	540	540	540	1.60	1.00	208.55	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	50.8	0.025	0.000	0.00	0.52
5.50	59.78	0.54	0.90	sand to silty sand	8.6	1.00	15	660	604	660	1.85	1.15	124.94	0.987	1.000	0.224	0.261	1.554	NO	N/A	N/A	N/A	29.1	N/A	0.050	0.01	0.51
6.50	63.75	0.50	0.78	sand to silty sand	7.6	1.00	16	780	661	780	1.81	1.11	123.43	0.985	1.000	0.242	0.255	1.408	NO	N/A	N/A	N/A	29.2	N/A	0.053	0.01	0.51
7.50	55.93	0.65	1.16	silty sand to sandy silt	6.6	1.66	31	900	719	900	1.67	1.02	156.81	0.983	1.000	0.256	0.439	2.288	NO	N/A	N/A	N/A	60.2	N/A	0.000	0.00	0.51
8.50	6.58	0.26	3.88	clay	5.6	1.00	7	1,020	777	1,020	2.98	N/A	N/A	0.980	N/A	0.268	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.51
9.50	6.73	0.14	2.03	silty clay to clay	4.6	1.00	4	1,140	834	1,140	2.83	N/A	N/A	0.978	N/A	0.278	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.51
10.50	19.70	0.59	2.99	clayey silt to silty clay	3.6	1.00	10	1,260	892	1,260	2.57	3.13	112.87	0.976	1.000	0.287	0.214	0.995	YES	2.8	15.2	699	N/A	N/A	0.000	0.00	0.51
11.50	11.53	0.27	2.34	clayey silt to silty clay	2.6	1.00	6	1,380	949	1,380	2.70	N/A	N/A	0.973	N/A	0.294	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.51
12.50	6.02	0.25	4.20	clay	1.6	1.00	6	1,500	1,007	1,500	3.11	N/A	N/A	0.971	N/A	0.301	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.51
13.50	14.68	0.28	1.93	clayey silt to silty clay	0.6	1.00	7	1,620	1,065	1,620	2.60	3.30	77.84	0.969	1.000	0.307	0.124	0.539	YES	2.8	11.0	367	N/A	N/A	0.000	0.00	0.51
14.50	30.67	0.30	0.96	silty sand to sandy silt	-0.4	1.66	17	1,740	1,122	1,740	1.92	1.20	81.60	0.966	1.000	0.312	0.131	0.559	YES	2.8	20.9	1,200	26.8	N/A	0.086	0.01	0.50
15.50	10.13	0.24	2.34	clayey silt to silty clay	-1.4	1.00	5	1,860	1,180	1,860	2.81	N/A	N/A	0.964	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.50
16.50	6.68	0.09	1.27	sensitive fine grained	-2.4	1.00	3	1,980	1,237	1,980	2.85	N/A	N/A	0.962	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.50
17.50	4.78	0.02	0.42	sensitive fine grained	-3.4	1.00	2	2,100	1,295	2,044	2.81	4.90	32.48	0.959	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.50
18.50	4.55	0.02	0.44	sensitive fine grained	-4.4	1.00	2	2,220	1,353	2,101	2.86	5.31	32.41	0.957	N/A	0.327	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.50
19.50	5.38	0.02	0.33	sensitive fine grained	-5.4	1.00	3	2,340	1,410	2,159	2.76	4.45	31.14	0.955	N/A	0.329	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.50
20.50	7.77	0.15	1.89	clayey silt to silty clay	-6.4	1.00	4	2,460	1,468	2,217	2.94	N/A	N/A	0.952	N/A	0.332	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.50
21.50	9.65	0.11	1.05	clayey silt to silty clay	-7.4	1.00	5	2,580	1,525	2,274	2.74	N/A	N/A	0.950	N/A	0.334	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.50
22.50	12.27	0.23	1.80	clayey silt to silty clay	-8.4	1.00	6	2,700	1,583	2,332	2.77	N/A	N/A	0.948	N/A	0.336	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.50
23.50	113.27	0.60	0.53	sand	-9.4	1.00	23	2,820	1,641	2,389	1.67	1.02	127.27	0.945	1.000	0.338	0.272	1.073	YES	0.0	20.7	1,200	20.7	N/A	1.157	0.14	0.36
24.50	99.23	0.63	0.64	sand to silty sand	-10.4	1.00	25	2,940	1,698	2,447	1.77	1.08	116.81	0.943	1.000	0.340	0.228	0.897	YES	1.3	23.8	1,200	26.0	N/A	0.106	0.01	0.34
25.50	68.52	1.31	1.92	silty sand to sandy silt	-11.4	1.00	23	3,060	1,756	2,505	2.21	1.68	122.83	0.941	1.000	0.341	0.252	0.988	YES	2.8	23.2	1,200	29.5	N/A	0.076	0.01	0.33
26.50	41.15	0.75	1.83	sandy silt to clayey silt	-12.4	1.66	27	3,180	1,813	2,562	2.06	1.38	98.86	0.938	1.000	0.342	0.170	0.662	YES	2.8	26.9	1,200	33.9	N/A	0.044	0.01	0.33
27.50	11.00	0.31	2.85	silty clay to clay	-13.4	1.00	7	3,300	1,871	2,620	2.97	N/A	N/A	0.936	N/A	0.343	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.33
28.50	51.33	0.72	1.40	silty sand to sandy silt	-14.4	1.00	17	3,420	1,929	2,677	2.23	1.74	91.02	0.934	1.000	0.344	0.150	0.582	YES	2.8	17.6	933	22.7	N/A	0.589	0.07	0.26
29.50	61.30	0.41	0.66	sand to silty sand	-15.4	1.66	25	3,540	1,986	2,735	1.68	1.00	101.85	0.931	1.000	0.345	0.178	0.689	YES	1.3	23.0	1,200	25.2	N/A	0.156	0.02	0.24
30.50	13.80	0.36	2.59	clayey silt to silty clay	-16.4	1.00	7	3,660	2,044	2,793	2.89	N/A	N/A	0.926	N/A	0.345	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.24
31.50	50.23	0.51	1.02	silty sand to sandy silt	-17.4	1.66	28	3,780	2,101	2,850	1.86	1.16	93.76	0.918	0.982	0.343	0.157	0.598	YES	2.8	26.0	1,200	32.9	N/A	0.052	0.01	0.23
32.50	14.47	0.32	2.20	clayey silt to silty clay	-18.4	1.00	7	3,900	2,159	2,908	2.84	N/A	N/A	0.909	N/A	0.342	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
33.50	61.22	0.32	0.52	sand to silty sand	-19.4	1.66	25	4,020	2,217	2,965	1.66	1.00	96.28	0.901	0.965	0.340	0.163	0.618	YES	1.3	22.1	1,200	24.3	N/A	0.187	0.02	0.21
34.50	16.90	0.27	1.61	sandy silt to clayey silt	-20.4	1.00	7	4,140	2,274	3,023	2.72	N/A	N/A	0.893	N/A	0.338	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
35.50	10.35	0.19	1.89	clayey silt to silty clay	-21.4	1.00	5	4,260	2,332	3,081	2.97	N/A	N/A	0.885	N/A	0.336	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
36.50	10.93	0.28	2.59	silty clay to clay	-22.4	1.00	7	4,380	2,389	3,138	3.03	N/A	N/A	0.877	N/A	0.334	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
37.50	14.53	0.42	2.88	clayey silt to silty clay	-23.4	1.00	7	4,500	2,447	3,196	2.95	N/A	N/A	0.869	N/A	0.332	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
38.50	11.98	0.42	3.54	silty clay to clay	-24.4	1.00	8	4,620	2,505	3,253	3.09	N/A	N/A	0.861	N/A	0.330	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
39.50	9.60	0.33	3.40	clay	-25.4	1.00	10	4,740	2,562	3,311	3.18	N/A	N/A	0.852	N/A	0.328	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
40.50	16.77	0.64	3.82	silty clay to clay	-26.4	1.00	11	4,860	2,620	3,369	2.99	N/A	N/A	0.844	N/A	0.326	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
41.50	13.70	0.35	2.53	clayey silt to silty clay	-27.4	1.00	7	4,980	2,677	3,426	2.97	N/A	N/A	0.836	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
42.50	10.45	0.26	2.46	clayey silt to silty clay	-28.4	1.00	5	5,100	2,735	3,484	3.09	N/A	N/A	0.828	N/A	0.321	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
43.50	10.80	0.26	2.36	clayey silt to silty clay	-29.4	1.00	5	5,220	2,793	3,541	3.07	N/A	N/A	0.820	N/A	0.319	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
44.50	14.23	0.34	2.30	clayey silt to silty clay	-30.4	1.00	7	5,340	2,850	3,599	2.96	N/A	N/A	0.812	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
45.50	10.73	0.31	2.73	silty clay to clay	-31.4	1.00	7	5,460	2,908	3,657	3.14	N/A	N/A	0.804	N/A	0.314	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
46.50	9.87	0.22	2.10	clayey silt to silty clay	-32.4	1.00	5	5,580	2,965	3,714	3.12	N/A	N/A	0.795	N/A	0.311	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
47.50	31.07	0.48	1.50	sandy silt to clayey silt	-33.4	1.00	12	5,700	3,023	3,772	2.56	3.11	70.89	0.787	0.911	0.309	0.113	0.445	YES	2.8	11.8	426	15.9	N/A	1.703	0.20	0.01
48.50	283.85	1.57	0.55	gravelly sand to sand	-34.4	1.00	47	5,820	3,081	3,829	1.47	1.00	228.71	0.779	0.841	0.306	N/A	N/A	NO	N/A	N/A	N/A	34.2	N/A	0.037	0.00	0.00
49.50	578.80	0.00	0.00	gravelly sand to sand	-35.4	1.00	96	5,940	3,138	3,887	2.68	3.85	1,590.87	0.771	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00

max=	1,200
min=	367
avg=	1,002

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT062

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	23.00 ft
GWT Elev. During Test	-2.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	25.00 ft below ground surface
GWT Depth For Design, Zwd =	13.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	11.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	0.77 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.02 inches	<--- Dry or Unsaturated Sands
Total:	0.79 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +															RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r(psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_t (in.)	Cumulative Settlement Profile (in.)
0.50	205.77	1.04	0.51	sand	22.0	1.00	41	60	60	60	1.01	1.00	1,188.00	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	70.0	0.007	0.000	0.00	0.79
1.50	162.27	1.86	1.15	sand to silty sand	21.0	1.00	41	180	180	180	1.48	1.00	540.89	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	74.8	0.013	0.000	0.00	0.79
2.50	189.85	2.20	1.16	sand	20.0	1.00	38	300	300	300	1.50	1.00	490.19	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	64.5	0.017	0.000	0.00	0.79
3.50	213.83	1.53	0.72	sand	19.0	1.00	43	420	420	420	1.34	1.00	466.62	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	72.7	0.019	0.000	0.00	0.79
4.50	219.92	0.89	0.40	sand	18.0	1.00	44	540	540	540	1.18	1.00	423.23	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	74.8	0.022	0.000	0.00	0.79
5.50	172.27	1.00	0.58	sand	17.0	1.00	34	660	660	660	1.40	1.00	299.88	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	58.6	0.026	0.000	0.00	0.79
6.50	98.57	0.99	1.00	sand to silty sand	16.0	1.00	25	780	780	780	1.76	1.08	170.68	0.985	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	43.9	0.031	0.000	0.00	0.79
7.50	60.80	0.56	0.92	sand to silty sand	15.0	1.00	15	900	900	900	1.92	1.21	109.67	0.983	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	26.2	0.039	0.047	0.01	0.78
8.50	55.45	0.39	0.70	sand to silty sand	14.0	1.00	14	1,020	1,020	1,020	1.91	1.20	92.87	0.980	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	22.8	0.043	0.062	0.01	0.77
9.50	35.88	0.58	1.61	silty sand to sandy silt	13.0	1.66	20	1,140	1,140	1,140	1.99	1.28	100.93	0.978	N/A	0.203	N/A	N/A	NO	N/A	N/A	N/A	36.5	0.039	0.032	0.00	0.77
10.50	7.77	0.12	1.52	clayey silt to silty clay	12.0	1.00	4	1,260	1,260	1,260	2.82	N/A	N/A	0.976	N/A	0.203	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
11.50	6.40	0.03	0.39	sensitive fine grained	11.0	1.00	3	1,380	1,380	1,380	2.68	3.89	32.86	0.973	N/A	0.202	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
12.50	8.98	0.05	0.56	sandy silt to clayey silt	10.0	1.66	6	1,500	1,500	1,500	2.36	2.17	37.27	0.971	N/A	0.202	N/A	N/A	NO	N/A	N/A	N/A	13.2	N/A	N/A	N/A	0.77
13.50	3.95	0.02	0.51	sensitive fine grained	9.0	1.00	2	1,620	1,589	1,620	2.98	6.52	30.62	0.969	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
14.50	3.87	0.02	0.43	sensitive fine grained	8.0	1.00	2	1,740	1,646	1,740	2.98	6.55	29.32	0.966	N/A	0.212	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
15.50	3.65	0.01	0.27	sensitive fine grained	7.0	1.00	2	1,860	1,704	1,860	2.96	6.33	26.04	0.964	N/A	0.219	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
16.50	4.45	0.02	0.41	sensitive fine grained	6.0	1.00	2	1,980	1,762	1,980	2.93	6.04	29.54	0.962	N/A	0.225	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
17.50	15.98	0.32	2.03	clayey silt to silty clay	5.0	1.00	8	2,100	1,819	2,100	2.72	N/A	N/A	0.959	N/A	0.230	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
18.50	9.67	0.23	2.38	silty clay to clay	4.0	1.00	6	2,220	1,877	2,220	2.97	N/A	N/A	0.957	N/A	0.235	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
19.50	10.45	0.26	2.48	silty clay to clay	3.0	1.00	7	2,340	1,934	2,340	2.95	N/A	N/A	0.955	N/A	0.240	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
20.50	7.46	0.14	1.88	silty clay to clay	2.0	1.00	5	2,460	1,992	2,460	3.03	N/A	N/A	0.952	N/A	0.245	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
21.50	5.72	0.06	1.03	sensitive fine grained	1.0	1.00	3	2,580	2,050	2,580	3.03	N/A	N/A	0.950	N/A	0.249	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
22.50	8.90	0.14	1.54	clayey silt to silty clay	0.0	1.00	4	2,700	2,107	2,700	2.94	N/A	N/A	0.948	N/A	0.253	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
23.50	10.45	0.06	0.59	sandy silt to clayey silt	-1.0	1.00	4	2,820	2,165	2,820	2.69	3.94	38.82	0.945	N/A	0.256	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
24.50	16.15	0.27	1.68	sandy silt to clayey silt	-2.0	1.00	6	2,940	2,222	2,940	2.73	N/A	N/A	0.943	N/A	0.259	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
25.50	28.30	0.43	1.53	sandy silt to clayey silt	-3.0	1.00	11	3,060	2,280	3,029	2.51	2.81	72.03	0.941	0.971	0.263	0.115	0.566	YES	2.8	12.0	436	16.0	N/A	1.410	0.17	0.60
26.50	20.83	0.68	3.26	clayey silt to silty clay	-4.0	1.00	10	3,180	2,338	3,086	2.82	N/A	N/A	0.938	N/A	0.265	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.60
27.50	78.68	1.08	1.37	silty sand to sandy silt	-5.0	1.00	26	3,300	2,395	3,144	2.11	1.48	106.34	0.936	0.940	0.268	0.192	0.897	YES	2.8	23.7	1,200	30.1	N/A	0.054	0.01	0.60
28.50	188.78	0.56	0.29	sand	-6.0	1.00	38	3,420	2,453	3,202	1.42	1.00	170.47	0.934	0.922	0.271	N/A	N/A	NO	N/A	N/A	N/A	29.8	N/A	0.056	0.01	0.59
29.50	212.07	1.30	0.61	sand	-7.0	1.00	42	3,540	2,510	3,259	1.56	1.00	189.29	0.931	0.913	0.273	N/A	N/A	NO	N/A	N/A	N/A	33.2	N/A	0.038	0.00	0.58
30.50	250.87	0.79	0.32	gravelly sand to sand	-8.0	1.00	42	3,660	2,568	3,317	1.34	1.00	221.39	0.926	0.905	0.274	N/A	N/A	NO	N/A	N/A	N/A	32.5	N/A	0.042	0.01	0.58
31.50	191.36	0.75	0.39	sand	-9.0	1.00	38	3,780	2,626	3,374	1.49	1.00	167.01	0.918	0.897	0.275	N/A	N/A	NO	N/A	N/A	N/A	29.5	N/A	0.059	0.01	0.57
32.50	158.78	0.55	0.34	sand	-10.0	1.66	53	3,900	2,683	3,432	1.24	1.00	226.98	0.909	0.889	0.275	N/A	N/A	NO	N/A	N/A	N/A	40.1	N/A	0.000	0.00	0.57
33.50	52.02	0.53	1.02	silty sand to sandy silt	-11.0	1.00	17	4,020	2,741	3,490	2.21	1.68	74.74	0.901	0.918	0.275	0.119	0.529	YES	2.8	15.9	767	20.8	N/A	0.172	0.02	0.55
34.50	56.05	0.32	0.58	sand to silty sand	-12.0	1.00	14	4,140	2,798	3,547	2.05	1.38	65.17	0.893	0.922	0.275	0.106	0.473	YES	1.3	11.9	426	13.5	N/A	2.050	0.25	0.31
35.50	42.77	0.48	1.12	silty sand to sandy silt	-13.0	1.00	14	4,260	2,856	3,605	2.31	1.98	70.76	0.885	0.917	0.275	0.113	0.503	YES	2.8	13.4	544	17.7	N/A	1.148	0.14	0.17
36.50	45.28	0.62	1.37	silty sand to sandy silt	-14.0	1.00	15	4,380	2,914	3,662	2.34	2.10	78.67	0.877	0.910	0.274	0.125	0.555	YES	2.8	14.0	588	18.4	N/A	1.000	0.12	0.05
37.50	48.08	1.10	2.28	sandy silt to clayey silt	-15.0	1.66	32	4,500	2,971	3,720	2.15	1.55	101.29	0.869	0.866	0.274	0.177	0.746	YES	2.8	26.2	1,200	33.0	N/A	0.039	0.00	0.04
38.50	15.25	0.37	2.46	clayey silt to silty clay	-16.0	1.00	8	4,620	3,029	3,778	2.95	N/A	N/A	0.861	N/A	0.273	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.04
39.50	14.87	0.37	2.48	clayey silt to silty clay	-17.0	1.00	7	4,740	3,086	3,835	2.96	N/A	N/A	0.852	N/A	0.272	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.04
40.50	14.20	0.41	2.88	clayey silt to silty clay	-18.0	1.00	7	4,860	3,144	3,893	3.03	N/A	N/A	0.844	N/A	0.271	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.04
41.50	11.71	0.34	2.92	silty clay to clay	-19.0	1.00	8	4,980	3,202	3,950	3.12	N/A	N/A	0.836	N/A	0.271	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.04
42.50	14.27	0.40	2.82	clayey silt to silty clay	-20.0	1.00	7	5,100	3,259	4,008	3.03	N/A	N/A	0.828	N/A	0.270	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.04
43.50	15.57	0.54	3.51	silty clay to clay	-21.0	1.00	10	5,220	3,317	4,066	3.06	N/A	N/A	0.820	N/A	0.268	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.04
44.50	42.62	0.73	1.71	silty sand to sandy silt	-22.0	1.66	24	5,340	3,374	4,123	2.14	1.53	83.03	0.812	0.853	0.267	0.133	0.568	YES	2.8	19.2	1,100	24.7	N/A	0.083	0.01	0.03
45.50	15.93	0.40	2.52	clayey silt to silty clay	-23.0	1.00	8	5,460	3,432	4,181	2.98	N/A	N/A	0.804	N/A	0.266	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.03
46.50	30.27	0.58	1.93	sandy silt to clayey silt	-24.0	1.00	12	5,580	3,490	4,238	2.66	N/A	N/A	0.795	N/A	0.265	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.03
47.50	113.07	1.47	1.30	sand to silty sand	-25.0	1.00	28	5,700	3,547	4,296	2.05	1.36	115.87	0.787	0.828	0.263	0.225	0.943	YES	1.3	20.6	1,200	22.7	N/A	0.092	0.01	0.02
48.50	180.27	0.98	0.54	sand	-26.0	1.66	60	5,820	3,605	4,354	1.34	1.00	222.32	0.779	0.790	0.262	N/A	N/A	NO	N/A	N/A	N/A	40.5	N/A	0.000	0.00	0.02
49.50	51.97	1.20	2.31	sandy silt to clayey silt	-27.0	1.00	21	5,940	3,662	4,411	2.53	2.92	96.32	0.771	0.844	0.260	0.163	0.706	YES	2.8	16.8	853	21.8	N/A	0.096	0.01	0.01
50.50	36.23	0.96	2.66	sandy silt to clayey silt	-28.0	1.00	14	6,060	3,720	4,469	2.70	N/A	N/A	0.763	N/A	0.259	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
51.50	19.75	0.56	2.86	clayey silt to silty clay	-29.0	1.00	10	6,180	3,778	4,526	2.95	N/A	N/A	0.755	N/A	0.257	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
52.50	16.60	0.35	2.11	clayey silt to silty clay	-30.0	1.00	8	6,300	3,835	4,584	2.95	N/A	N/A	0.747	N/A	0.255	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
53.50	15.45	0.31	2.01	clayey silt to silty clay	-31.0	1.00	8	6,420	3,893	4,642	2.98	N/A	N/A	0.739	N/A	0.253	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
54.50	16.48	0.24	1.47	sandy silt to clayey silt	-32.0	1.00	7	6,540	3,950	4,699	2.88	N/A	N/A	0.730	N/A	0.252	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
55.50	73.55	1.18	1.61	silty sand to sandy silt	-33.0	1.00	25	6,660	4,008	4,757	2.27	1.87	96.99	0.722	0.812	0.250	0.165	0.716	YES	2.8	18.7	1,049	24.1	N/A	0.081	0.01	0.00
56.50	359.00	2.36	0.66	gravelly sand to sand	-34.0	1.00	60	6,780	4,066	4,814	1.49	1.00	251.80	0.714	0.753	0.248	N/A	N/A	NO	N/A	N/A	N/A	38.6	N/A	0.007	0.00	0.00
57.50	471.80	3.13	0.66	gravelly sand to sand	-35.0	1.00	79	6,900	4,123	4,872	1.41	1.00	328.59	0.706	0.749	0.246	N/A	N/A	NO	N/A	N/A	N/A	50.4	N/A	0.000	0.00	0.00

max=	1,200
min=	426
avg=	851

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT063

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	23.20 ft
GWT Elev. During Test	-2.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	25.20 ft below ground surface
GWT Depth For Design, Zwd =	13.20 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	12.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	0.37 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	0.37 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_i (in.)	Cumulative Settlement Profile (in.)
0.50	56.22	0.63	1.12	silty sand to sandy silt	22.2	1.00	19	60	60	60	1.59	1.00	324.57	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	43.2	0.009	0.000	0.00	0.37
1.50	78.40	1.41	1.80	silty sand to sandy silt	21.2	1.00	26	180	180	180	1.81	1.12	291.72	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	58.3	0.014	0.000	0.00	0.37
2.50	47.15	1.11	2.34	sandy silt to clayey silt	20.2	1.00	19	300	300	300	2.11	1.47	179.18	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	43.5	N/A	N/A	N/A	0.37
3.50	59.10	1.31	2.21	sandy silt to clayey silt	19.2	1.00	24	420	420	420	2.07	1.41	181.67	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	53.2	N/A	N/A	N/A	0.37
4.50	90.68	2.68	2.96	sandy silt to clayey silt	18.2	1.00	36	540	540	540	2.09	1.44	251.10	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	79.0	N/A	N/A	N/A	0.37
5.50	50.78	0.71	1.39	silty sand to sandy silt	17.2	1.00	17	660	660	660	2.05	1.37	120.74	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	39.5	0.029	0.022	0.00	0.37
6.50	94.05	1.15	1.22	sand to silty sand	16.2	1.00	39	780	780	780	1.53	1.00	249.36	0.985	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	67.8	0.027	0.000	0.00	0.37
7.50	9.90	0.37	3.72	clay	15.2	1.00	10	900	900	900	2.86	N/A	N/A	0.983	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
8.50	7.13	0.10	1.36	clayey silt to silty clay	14.2	1.00	4	1,020	1,020	1,020	2.77	N/A	N/A	0.980	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
9.50	6.95	0.06	0.82	sensitive fine grained	13.2	1.00	3	1,140	1,140	1,140	2.71	4.08	43.18	0.978	N/A	0.203	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
10.50	5.81	0.05	0.90	sensitive fine grained	12.2	1.00	3	1,260	1,260	1,260	2.84	N/A	N/A	0.976	N/A	0.203	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
11.50	4.42	0.02	0.44	sensitive fine grained	11.2	1.00	2	1,380	1,380	1,380	2.87	5.37	31.34	0.973	N/A	0.202	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
12.50	4.47	0.02	0.37	sensitive fine grained	10.2	1.00	2	1,500	1,500	1,500	2.86	5.36	29.72	0.971	N/A	0.202	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
13.50	4.90	0.03	0.54	sensitive fine grained	9.2	1.00	2	1,620	1,601	1,620	2.90	5.70	33.00	0.969	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
14.50	4.85	0.02	0.41	sensitive fine grained	8.2	1.00	2	1,740	1,659	1,740	2.87	5.46	30.45	0.966	N/A	0.211	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
15.50	4.98	0.02	0.39	sensitive fine grained	7.2	1.00	2	1,860	1,716	1,860	2.87	5.43	30.33	0.964	N/A	0.217	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
16.50	5.38	0.01	0.24	sensitive fine grained	6.2	1.00	3	1,980	1,774	1,980	2.79	4.67	27.53	0.962	N/A	0.223	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
17.50	75.22	1.76	2.34	sandy silt to clayey silt	5.2	1.00	30	2,100	1,832	2,100	2.24	1.78	139.55	0.959	1.000	0.229	0.333	1.941	NO	N/A	N/A	N/A	40.2	N/A	0.000	0.00	0.37
18.50	52.78	1.78	3.37	clayey silt to silty clay	4.2	1.00	44	2,220	1,889	2,220	2.16	1.57	140.90	0.957	1.000	0.234	0.340	1.941	NO	N/A	N/A	N/A	N/A	N/A	0.000	0.00	0.37
19.50	23.03	0.59	2.57	clayey silt to silty clay	3.2	1.00	12	2,340	1,947	2,340	2.67	N/A	N/A	0.955	N/A	0.239	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
20.50	20.53	0.51	2.50	clayey silt to silty clay	2.2	1.00	10	2,460	2,004	2,460	2.71	N/A	N/A	0.952	N/A	0.243	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
21.50	27.05	0.95	3.51	clayey silt to silty clay	1.2	1.00	14	2,580	2,062	2,580	2.72	N/A	N/A	0.950	N/A	0.247	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
22.50	51.63	1.02	1.98	silty sand to sandy silt	0.2	1.00	17	2,700	2,120	2,700	2.34	2.07	103.93	0.948	0.983	0.251	0.184	0.964	YES	2.8	17.6	936	22.8	N/A	0.088	0.01	0.36
23.50	149.02	0.98	0.66	sand	-0.8	1.00	30	2,820	2,177	2,820	1.68	1.02	146.17	0.945	0.969	0.255	0.370	1.880	NO	N/A	N/A	N/A	25.1	N/A	0.077	0.01	0.35
24.50	141.30	0.58	0.41	sand	-1.8	1.00	28	2,940	2,235	2,940	1.58	1.00	133.67	0.943	0.961	0.258	0.302	1.501	NO	N/A	N/A	N/A	23.3	N/A	0.087	0.01	0.34
25.50	152.65	0.57	0.38	sand	-2.8	1.00	31	3,060	2,292	3,041	1.54	1.00	142.58	0.941	0.950	0.261	0.350	1.697	NO	N/A	N/A	N/A	24.8	N/A	0.081	0.01	0.33
26.50	169.92	0.73	0.43	sand	-3.8	1.00	34	3,180	2,350	3,099	1.53	1.00	156.75	0.938	0.939	0.264	0.438	2.079	NO	N/A	N/A	N/A	27.3	N/A	0.068	0.01	0.32
27.50	184.73	0.63	0.34	sand	-4.8	1.00	37	3,300	2,408	3,156	1.45	1.00	168.37	0.936	0.928	0.267	N/A	N/A	NO	N/A	N/A	N/A	29.4	N/A	0.057	0.01	0.32
28.50	149.45	0.45	0.30	sand	-5.8	1.00	30	3,420	2,465	3,214	1.51	1.00	134.61	0.934	0.927	0.269	0.307	1.408	NO	N/A	N/A	N/A	23.6	N/A	0.090	0.01	0.31
29.50	171.27	1.18	0.69	sand	-6.8	1.00	34	3,540	2,523	3,272	1.67	1.02	155.02	0.931	0.914	0.272	0.426	1.913	NO	N/A	N/A	N/A	26.8	N/A	0.073	0.01	0.30
30.50	121.12	0.43	0.36	sand	-7.8	1.00	24	3,660	2,580	3,329	1.64	1.00	106.63	0.926	0.921	0.273	0.193	0.867	YES	0.0	18.8	1,057	18.8	N/A	0.421	0.05	0.25
31.50	75.84	0.56	0.73	sand to silty sand	-8.8	1.00	19	3,780	2,638	3,387	1.98	1.28	84.27	0.918	0.924	0.273	0.136	0.611	YES	1.3	15.9	765	17.8	N/A	1.126	0.14	0.11
32.50	52.93	0.61	1.15	silty sand to sandy silt	-9.8	1.00	18	3,900	2,696	3,444	2.23	1.74	79.17	0.909	0.921	0.274	0.126	0.567	YES	2.8	16.2	798	21.1	N/A	0.147	0.02	0.09
33.50	48.85	0.64	1.31	silty sand to sandy silt	-10.8	1.66	27	4,020	2,753	3,502	1.98	1.28	88.23	0.901	0.897	0.274	0.144	0.629	YES	2.8	23.2	1,200	29.4	N/A	0.059	0.01	0.09
34.50	12.33	0.26	2.12	clayey silt to silty clay	-11.8	1.00	6	4,140	2,811	3,560	2.97	N/A	N/A	0.893	N/A	0.274	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
35.50	12.28	0.33	2.70	clayey silt to silty clay	-12.8	1.00	6	4,260	2,868	3,617	3.04	N/A	N/A	0.885	N/A	0.273	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
36.50	14.52	0.49	3.38	silty clay to clay	-13.8	1.00	10	4,380	2,926	3,675	3.04	N/A	N/A	0.877	N/A	0.273	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
37.50	14.38	0.35	2.44	clayey silt to silty clay	-14.8	1.00	7	4,500	2,984	3,732	2.96	N/A	N/A	0.869	N/A	0.273	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
38.50	14.13	0.34	2.45	clayey silt to silty clay	-15.8	1.00	7	4,620	3,041	3,790	2.98	N/A	N/A	0.861	N/A	0.272	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
39.50	19.23	0.43	2.27	clayey silt to silty clay	-16.8	1.00	10	4,740	3,099	3,848	2.84	N/A	N/A	0.852	N/A	0.271	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
40.50	50.43	0.87	1.73	silty sand to sandy silt	-17.8	1.00	17	4,860	3,156	3,905	2.38	2.24	89.86	0.844	0.888	0.270	0.147	0.646	YES	2.8	14.8	665	19.4	N/A	0.279	0.03	0.05
41.50	196.71	1.68	0.85	sand	-18.8	1.66	65	4,980	3,214	3,963	1.41	1.00	256.93	0.836	0.827	0.269	N/A	N/A	NO	N/A	N/A	N/A	46.3	N/A	0.000	0.00	0.05
42.50	80.42	1.54	1.92	silty sand to sandy silt	-19.8	1.66	44	5,100	3,272	4,020	1.94	1.23	128.32	0.828	0.821	0.268	0.276	1.129	YES	2.8	34.1	1,200	42.6	N/A	0.000	0.00	0.05
43.50	23.93	0.58	2.43	sandy silt to clayey silt	-20.8	1.00	10	5,220	3,329	4,078	2.80	N/A	N/A	0.820	N/A	0.267	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
44.50	170.13	1.48	0.87	sand	-21.8	1.00	34	5,340	3,387	4,136	1.79	1.10	143.49	0.812	0.825	0.266	0.355	1.467	NO	N/A	N/A	N/A	23.7	N/A	0.088	0.01	0.04
45.50	174.05	1.26	0.73	sand	-22.8	1.66	58	5,460	3,444	4,193	1.42	1.00	219.60	0.804	0.805	0.265	N/A	N/A	NO	N/A	N/A	N/A	39.8	N/A	0.001	0.00	0.04
46.50	74.67	1.33	1.79	silty sand to sandy silt	-23.8	1.00	25	5,580	3,502	4,251	2.27	1.87	105.30	0.795	0.841	0.264	0.189	0.802	YES	2.8	19.9	1,172	25.5	N/A	0.078	0.01	0.03
47.50	57.80	0.95	1.64	silty sand to sandy silt	-24.8	1.00	19	5,700	3,560	4,308	2.34	2.09	90.53	0.787	0.855	0.262	0.149	0.648	YES	2.8	15.9	767	20.8	N/A	0.125	0.01	0.02
48.50	58.50	1.94	3.31	sandy silt to clayey silt	-25.8	1.66	39	5,820	3,617	4,366	2.23	1.73	124.71	0.779	0.796	0.261	0.260	1.061	YES	2.8	29.0	1,200	36.5	N/A	0.019	0.00	0.02
49.50	28.33	0.67	2.39	sandy silt to clayey silt	-26.8	1.00	11	5,940	3,675	4,424	2.76	N/A	N/A	0.771	N/A	0.259	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.02
50.50	21.35	0.49	2.30	sandy silt to clayey silt	-27.8	1.00	9	6,060	3,732	4,481	2.86	N/A	N/A	0.763	N/A	0.258	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.02
51.50	20.38	0.40	1.97	sandy silt to clayey silt	-28.8	1.00	8	6,180	3,790	4,539	2.85	N/A	N/A	0.755	N/A	0.256	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.02
52.50	20.34	0.38	1.89	sandy silt to clayey silt	-29.8	1.00	8	6,300	3,848	4,596	2.84	N/A	N/A	0.747	N/A	0.254	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.02
53.50	97.75	1.93	1.98	silty sand to sandy silt	-30.8	1.00	33	6,420	3,905	4,654	2.23	1.75	122.40	0.739	0.793	0.253	0.251	1.050	YES	2.8	24.2	1,200	30.6	N/A	0.048	0.01	0.01
54.50	352.53	1.37	0.39	gravelly sand to sand	-31.8	1.66	97	6,540	3,963	4,712	1.04	1.00	414.67	0.730	0.761	0.251	N/A	N/A	NO	N/A	N/A	N/A	63.4	N/A	0.000	0.00	0.01
55.50	73.55	1.18	1.61	silty sand to sandy silt	-32.8	1.00	25	6,660	4,020	4,769	2.27	1.87	96.92	0.722	0.812	0.249	0.165	0.717	YES	2.8	18.7	1,046	24.1	N/A	0.081	0.01	0.00
56.50	359.00	2.36	0.66	gravelly sand to sand	-33.8	1.00	60	6,780	4,078	4,827	1.49	1.00	251.41	0.714	0.752	0.247	N/A	N/A	NO	N/A	N/A	N/A	38.5	N/A	0.007	0.00	0.00
57.50	471.80	3.13	0.66	gravelly sand to sand	-34.8	1.00	79	6,900	4,136	4,884	1.41	1.00	328.10	0.706	0.748	0.245	N/A	N/A	NO	N/A	N/A	N/A	50.3	N/A	0.000	0.00	0.00

max=	1,200
min=	665
avg=	1,000

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	A-CPT065

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	20.50 ft
GWT Elev. During Test	0.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$

+++ $FS = (CRR_{7.5}/CSR)\ MSF\ K_\sigma\ K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	20.50 ft below ground surface
GWT Depth For Design, Zwd =	10.50 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	14.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	0.90 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.01 inches	<--- Dry or Unsaturated Sands
Total:	0.91 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_t (in.)	Cumulative Settlement Profile (in.)
0.50	26.90	0.57	2.12	sandy silt to clayey silt	19.5	1.00	11	60	60	60	2.01	1.31	203.42	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	27.0	N/A	N/A	N/A	0.91
1.50	55.69	0.49	0.89	sand to silty sand	18.5	1.00	14	180	180	180	1.68	1.02	189.55	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	27.3	0.018	0.020	0.00	0.91
2.50	36.25	0.22	0.61	silty sand to sandy silt	17.5	1.00	12	300	300	300	1.80	1.11	103.89	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	29.7	0.022	0.023	0.00	0.90
3.50	65.50	1.15	1.75	silty sand to sandy silt	16.5	1.00	22	420	420	420	1.97	1.26	180.16	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	49.5	0.022	0.000	0.00	0.90
4.50	84.23	2.30	2.73	sandy silt to clayey silt	15.5	1.66	56	540	540	540	1.78	1.09	292.39	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	118.8	N/A	N/A	N/A	0.90
5.50	33.06	1.10	3.32	clayey silt to silty clay	14.5	1.00	17	660	660	660	2.44	2.50	143.77	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.90
6.50	17.83	0.61	3.41	silty clay to clay	13.5	1.00	12	780	780	780	2.60	N/A	N/A	0.985	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.90
7.50	22.29	0.69	3.11	clayey silt to silty clay	12.5	1.00	11	900	900	900	2.60	3.33	110.54	0.983	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.90
8.50	16.36	0.59	3.63	silty clay to clay	11.5	1.00	11	1,020	1,020	1,020	2.71	N/A	N/A	0.980	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.90
9.50	17.40	0.57	3.25	clayey silt to silty clay	10.5	1.00	9	1,140	1,140	1,140	2.69	N/A	N/A	0.978	N/A	0.203	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.90
10.50	19.30	0.56	2.90	clayey silt to silty clay	9.5	1.00	10	1,260	1,260	1,260	2.65	N/A	N/A	0.976	N/A	0.203	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.90
11.50	15.28	0.46	3.00	clayey silt to silty clay	8.5	1.00	8	1,380	1,318	1,380	2.75	N/A	N/A	0.973	N/A	0.212	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.90
12.50	10.95	0.13	1.22	clayey silt to silty clay	7.5	1.00	5	1,500	1,375	1,500	2.67	N/A	N/A	0.971	N/A	0.220	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.90
13.50	6.66	0.11	1.63	silty clay to clay	6.5	1.00	4	1,620	1,433	1,620	2.94	N/A	N/A	0.969	N/A	0.228	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.90
14.50	15.78	0.22	1.37	sandy silt to clayey silt	5.5	1.00	6	1,740	1,490	1,740	2.58	3.19	62.77	0.966	1.000	0.235	0.103	0.586	YES	2.8	9.6	289	13.1	N/A	2.023	0.24	0.66
15.50	30.86	0.41	1.33	silty sand to sandy silt	4.5	1.00	10	1,860	1,548	1,860	2.35	2.14	74.92	0.964	1.000	0.241	0.119	0.660	YES	2.8	13.5	548	17.8	N/A	0.200	0.02	0.64
16.50	17.25	0.20	1.13	sandy silt to clayey silt	3.5	1.66	11	1,980	1,606	1,980	2.24	1.77	56.31	0.962	1.000	0.247	0.097	0.523	YES	2.8	14.3	616	18.8	N/A	0.170	0.02	0.62
17.50	5.76	0.18	3.04	clay	2.5	1.00	6	2,100	1,663	2,100	3.20	N/A	N/A	0.959	N/A	0.252	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.62
18.50	36.88	0.37	0.99	silty sand to sandy silt	1.5	1.00	12	2,220	1,721	2,220	2.24	1.77	70.25	0.957	1.000	0.257	0.112	0.583	YES	2.8	14.5	632	19.0	N/A	0.198	0.02	0.59
19.50	40.47	0.34	0.85	silty sand to sandy silt	0.5	1.00	13	2,340	1,778	2,340	2.17	1.60	68.77	0.955	1.000	0.261	0.110	0.563	YES	2.8	15.3	705	20.0	N/A	0.163	0.02	0.57
20.50	43.19	0.36	0.84	silty sand to sandy silt	-0.5	1.66	24	2,460	1,836	2,460	1.85	1.14	85.45	0.952	1.000	0.265	0.138	0.694	YES	2.8	24.3	1,200	30.8	N/A	0.050	0.01	0.57
21.50	17.62	0.25	1.40	sandy silt to clayey silt	-1.5	1.66	12	2,580	1,894	2,518	2.31	1.98	59.38	0.950	1.000	0.269	0.099	0.493	YES	2.8	13.2	526	17.5	N/A	1.130	0.14	0.43
22.50	6.42	0.09	1.39	sensitive fine grained	-2.5	1.00	3	2,700	1,951	2,575	3.03	N/A	N/A	0.948	N/A	0.273	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
23.50	6.11	0.10	1.56	sensitive fine grained	-3.5	1.00	3	2,820	2,009	2,633	3.09	N/A	N/A	0.945	N/A	0.276	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
24.50	6.13	0.07	1.20	sensitive fine grained	-4.5	1.00	3	2,940	2,066	2,690	3.04	N/A	N/A	0.943	N/A	0.279	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
25.50	5.71	0.09	1.48	sensitive fine grained	-5.5	1.00	3	3,060	2,124	2,748	3.13	N/A	N/A	0.941	N/A	0.282	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
26.50	5.57	0.08	1.34	sensitive fine grained	-6.5	1.00	3	3,180	2,182	2,806	3.13	N/A	N/A	0.938	N/A	0.284	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
27.50	5.80	0.08	1.29	sensitive fine grained	-7.5	1.00	3	3,300	2,239	2,863	3.12	N/A	N/A	0.936	N/A	0.287	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
28.50	7.64	0.16	2.11	silty clay to clay	-8.5	1.00	5	3,420	2,297	2,921	3.11	N/A	N/A	0.934	N/A	0.289	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
29.50	19.05	0.18	0.93	sandy silt to clayey silt	-9.5	1.66	13	3,540	2,354	2,978	2.24	1.77	51.42	0.931	0.961	0.291	0.093	0.408	YES	2.8	13.1	521	17.4	N/A	1.385	0.17	0.27
30.50	6.72	0.17	2.52	silty clay to clay	-10.5	1.00	4	3,660	2,412	3,036	3.23	N/A	N/A	0.926	N/A	0.292	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
31.50	13.37	0.30	2.22	clayey silt to silty clay	-11.5	1.00	7	3,780	2,470	3,094	2.91	N/A	N/A	0.918	N/A	0.292	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
32.50	12.38	0.32	2.62	clayey silt to silty clay	-12.5	1.00	6	3,900	2,527	3,151	2.99	N/A	N/A	0.909	N/A	0.292	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
33.50	32.07	0.45	1.40	silty sand to sandy silt	-13.5	1.00	11	4,020	2,585	3,209	2.48	2.65	70.18	0.901	0.946	0.292	0.112	0.485	YES	2.8	11.2	385	15.1	N/A	1.780	0.21	0.05
34.50	28.96	1.06	3.65	clayey silt to silty clay	-14.5	1.00	14	4,140	2,642	3,266	2.77	N/A	N/A	0.893	N/A	0.291	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
35.50	36.69	0.95	2.59	sandy silt to clayey silt	-15.5	1.00	15	4,260	2,700	3,324	2.60	N/A	N/A	0.885	N/A	0.290	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
36.50	20.27	0.58	2.87	clayey silt to silty clay	-16.5	1.66	17	4,380	2,758	3,382	2.53	2.94	77.48	0.877	0.917	0.290	0.123	0.521	YES	2.8	15.7	746	N/A	N/A	0.000	0.00	0.05
37.50	7.82	0.21	2.69	silty clay to clay	-17.5	1.00	5	4,500	2,815	3,439	3.23	N/A	N/A	0.869	N/A	0.289	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
38.50	9.09	0.32	3.56	clay	-18.5	1.00	9	4,620	2,873	3,497	3.24	N/A	N/A	0.861	N/A	0.288	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
39.50	10.33	0.32	3.10	silty clay to clay	-19.5	1.00	7	4,740	2,930	3,554	3.16	N/A	N/A	0.852	N/A	0.287	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
40.50	18.55	0.58	3.13	clayey silt to silty clay	-20.5	1.00	9	4,860	2,988	3,612	2.93	N/A	N/A	0.844	N/A	0.286	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
41.50	33.35	0.74	2.23	sandy silt to clayey silt	-21.5	1.00	13	4,980	3,046	3,670	2.63	N/A	N/A	0.836	N/A	0.284	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
42.50	33.73	0.82	2.43	sandy silt to clayey silt	-22.5	1.00	13	5,100	3,103	3,727	2.65	N/A	N/A	0.828	N/A	0.283	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
43.50	105.27	1.54	1.46	sand to silty sand	-23.5	1.00	26	5,220	3,161	3,785	2.08	1.43	119.44	0.820	0.861	0.282	0.238	0.972	YES	1.3	20.5	1,200	22.5	N/A	0.104	0.01	0.04
44.50	184.64	1.29	0.70	sand	-24.5	1.66	61	5,340	3,218	3,842	1.38	1.00	240.99	0.812	0.827	0.280	N/A	N/A	NO	N/A	N/A	N/A	44.1	N/A	0.000	0.00	0.04
45.50	76.78	0.80	1.04	sand to silty sand	-25.5	1.66	32	5,460	3,276	3,900	1.80	1.10	109.68	0.804	0.838	0.279	0.203	0.814	YES	1.3	24.1	1,200	26.4	N/A	0.078	0.01	0.03
46.50	19.24	0.65	3.39	clayey silt to silty clay	-26.5	1.00	10	5,580	3,334	3,958	2.97	N/A	N/A	0.795	N/A	0.277	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.03
47.50	39.81	1.45	3.63	clayey silt to silty clay	-27.5	1.00	20	5,700	3,391	4,015	2.73	N/A	N/A	0.787	N/A	0.275	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.03
48.50	47.75	1.18	2.48	sandy silt to clayey silt	-28.5	1.66	32	5,820	3,449	4,073	2.20	1.67	100.66	0.779	0.825	0.274	0.175	0.704	YES	2.8	25.0	1,200	31.6	N/A	0.047	0.01	0.02
49.50	18.15	0.52	2.85	clayey silt to silty clay	-29.5	1.00	9	5,940	3,506	4,130	2.97	N/A	N/A	0.771	N/A	0.272	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.02
50.50	16.72	0.35	2.07	clayey silt to silty clay	-30.5	1.00	8	6,060	3,564	4,188	2.93	N/A	N/A	0.763	N/A	0.270	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.02
51.50	16.28	0.30	1.83	clayey silt to silty clay	-31.5	1.00	8	6,180	3,622	4,246	2.91	N/A	N/A	0.755	N/A	0.268	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.02
52.50	16.18	0.43	2.65	clayey silt to silty clay	-32.5	1.00	8	6,300	3,679	4,303	3.01	N/A	N/A	0.747	N/A	0.266	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.02
53.50	19.80	0.57	2.89	clayey silt to silty clay	-33.5	1.00	10	6,420	3,737	4,361	2.96	N/A	N/A	0.739	N/A	0.264	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.02
54.50	44.30	1.01	2.28	sandy silt to clayey silt	-34.5	1.00	18	6,540	3,794	4,418	2.59	3.29	90.11	0.730	0.847	0.262	0.148	0.639	YES	2.8	14.7	655	19.3	N/A	0.204	0.02	0.00
55.50	30.03	0.98	3.25	clayey silt to silty clay	-35.5	1.00	15	6,660	3,852	4,476	2.84	N/A	N/A	0.722	N/A	0.260	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
56.50	21.87	0.76	3.46	clayey silt to silty clay	-36.5	1.00	11	6,780	3,910	4,534	2.98	N/A	N/A	0.714	N/A	0.258	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
57.50	15.90	0.41	2.57	clayey silt to silty clay	-37.5	1.00	8	6,900	3,967	4,591	3.04	N/A	N/A	0.706	N/A	0.255	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
58.50	14.87	0.32	2.16	clayey silt to silty clay	-38.5	1.00	7	7,020	4,025	4,649	3.03	N/A	N/A	0.698	N/A	0.253	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
59.50	16.99	0.35	2.08	clayey silt to silty clay	-39.5	1.00	8	7,140	4,082	4,706	2.97	N/A	N/A	0.690	N/A	0.251	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
60.50	30.12	0.61	2.02	sandy silt to clayey silt	-40.5	1.00	12	7,260	4,140	4,764	2.73	N/A	N/A	0.682	N/A	0.249	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00

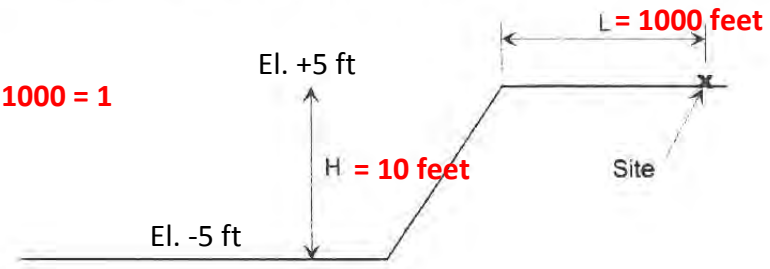
max=	1,200
min=	289
avg=	744

Youd et al. (2002) Procedure for Estimating Lateral Spread Displacements

Free-Face Conditions:

$$\log(D_H) = -16.713 + 1.532M - 1.406\log R^* - 0.012R + 0.592\log W + 0.540\log(T_{15}) + 3.413\log(100 - F_{15}) - 0.795\log(D50_{15} + 0.1mm)$$

D_H = lateral ground displacement, m
M = magnitude (generally M_w). Range is 6-8.
R^* = $Ro + r_{jb}$; $Ro = 10^{(0.89M - 5.64)}$
r_{jb} = closest horizontal distance to surface projection of seismic source (≥ 0.5 km)
W = $100 \cdot H/L$, see figure: Range is $W = 1$ to 20%



W = 100 x 10 / 1000 = 1

			Addition of Terms	
Input Parameters			-16.71	
Magnitude	M:	6.7	10.26	
Distance	R	13	-0.16	
$Ro = 10^{(0.89M - 5.64)}$	Ro:	2	0.00	
$R^* = R + R_o$	R*:	15	-1.66	
Freeface Ratio (%)	W:	1	0.00	
Cumulative Thickness (m)	T15:	6.1	0.42	
Average Fine Contents	F15:	35	6.19	
Mean Grain Size (mm)	D50:	0.1	0.56	
	log (DH):		-1.10	
	DH:		0.08	meter
			0.26	feet
			3	inches

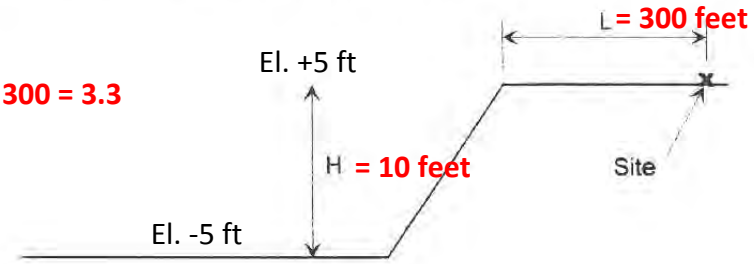
Youd et al. (2002) Procedure for Estimating Lateral Spread Displacements

Free-Face Conditions:

$$\log(D_H) = -16.713 + 1.532M - 1.406\log R^* - 0.012R + 0.592\log W + 0.540\log(T_{15}) + 3.413\log(100 - F_{15}) - 0.795\log(D50_{15} + 0.1mm)$$

D_H = lateral ground displacement, m
M = magnitude (generally M_w). Range is 6-8.
R^* = $Ro + r_{jb}$; $Ro = 10^{(0.89M - 5.64)}$
r_{jb} = closest horizontal distance to surface projection of seismic source (≥ 0.5 km)
W = $100 \cdot H/L$, see figure: Range is W = 1 to 20%

W = 100 x 10 / 300 = 3.3



			Addition of Terms	
Input Parameters			-16.71	
Magnitude	M:	6.7	10.26	
Distance	R	13	-0.16	
$Ro = 10^{(0.89M - 5.64)}$	Ro:	2	0.00	
$R^* = R + R_o$	R*:	15	-1.66	
Freeface Ratio (%)	W:	3.3	0.31	
Cumulative Thickness (m)	T15:	6.1	0.42	
Average Fine Contents	F15:	35	6.19	
Mean Grain Size (mm)	D50:	0.1	0.56	
	log (DH):		-0.79	
	DH:		0.16	meter
			0.53	feet
			6	inches

PLATE E-31

Freefield Lateral Spreading versus Distance from Channel

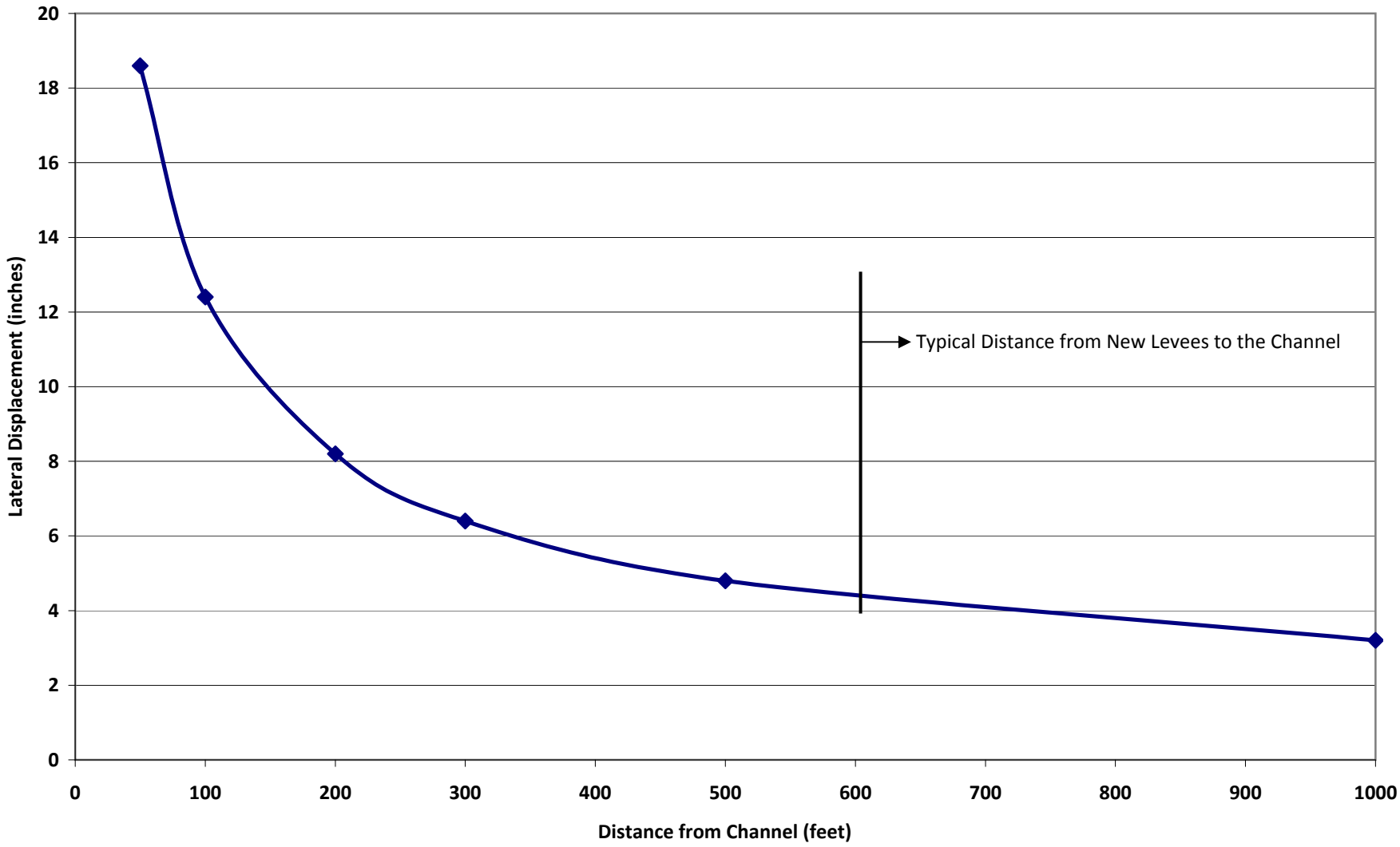


PLATE E-32

APPENDIX F
SEEPAGE

APPENDIX F
SEEPAGE

F.1 Contents

This appendix includes the results calculations of permeability using our field permeability data, as well as the results of the seepage analyses. using the RocScience Program, Slide v.5.

Seepage analyses included estimation of hydraulic gradients for two conservative conditions as follows:

- Steady State Condition at Existing North Area A Levee after Excavation of the New Meander Channel and Prior to Breach
- Steady State Condition at West Area B Existing Levee During a High Water Event

The seepage analyses also show the results of the transient seepage analysis during a week of typical tidal changes, as well as the transient seepage analysis following a 10-day high water flood condition.

A list of the plates presented in this appendix follows:

Plate F-1 and F-2	Permeability Calculations
Plate F-3	Hydraulic Gradient – Steady State Condition at Existing North Area A Levee after Excavation and Prior to Breach
Plate F-4	Hydraulic Gradient – Steady State Condition at West Area B Levee
Plate F-5	Transient Water Level for Tidal Changes over a period of a week
Plate F-6	Typical Tidal Changes in Water Level in Santa Monica Bay Over One Week – Used in Seepage Analyses
Plate F-7 thru F-16	Discharge Flow Analysis for Tidal Changes over a Week
Plate F-17	Transient Water Level for a 10-day Flood Condition
Plate F-17 thru F-29	Discharge Flow Analysis During and After a 10-day Flood

Field Permeability Test Data

Boring A-HSA066

5 foot deep hole
(8 inch diameter hole)

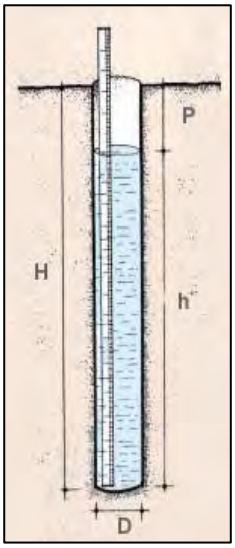
Average Permeability: **K ~= 1.5 x 10^-3 cm/s**

Time (min)	Reading (inches)	Drop in Water (inches)	Height of Water (inches)	Rate of Descent (in/min)	K (in/min)	K (cm/s)
0	0	-14				
0.5	14	0	46	0.00	0.00000	0.00000
1	14	0	46	1.00	0.04396	0.00186
2	15	1	45	1.00	0.04495	0.00190
3	16	2	44	0.00	0.00000	0.00000
4	16	2	44	1.00	0.04598	0.00195
5	17	3	43	0.80	0.03810	0.00161
7.5	19	5	41	1.20	0.06079	0.00257
10	22	8	38	0.60	0.03290	0.00139
15	25	11	35			

10 foot deep hole
(8 inch diameter hole)

Average Permeability: **K ~= 3.2 x 10^-4 cm/s**

Time (min)	Reading (inches)	Drop in Water (inches)	Height of Water (inches)	Rate of Descent (in/min)	K (in/min)	K (cm/s)
0	0	-7				
0.5	7	0	113	2.00	0.03556	0.00151
1	8	1	112	2.00	0.03604	0.00153
2	10	3	110	1.00	0.01826	0.00077
3	11	4	109	1.00	0.01843	0.00078
4	12	5	108	1.00	0.01860	0.00079
5	13	6	107	0.40	0.00751	0.00032
7.5	14	7	106	0.40	0.00758	0.00032
10	15	8	105	0.40	0.00769	0.00033
15	17	10	103			



$$K = (D \div 2) \times \ln (h_1 \div h_2) / 2 (t_2 - t_1)$$

Source: ftp://ftp.fao.org/fi/CDrom/FAO_Training/FAO_Training/General/x6706e/x6706e09.htm

Field Permeability Test Data

Boring A-HSA064

5 foot deep hole
(8 inch diameter hole)

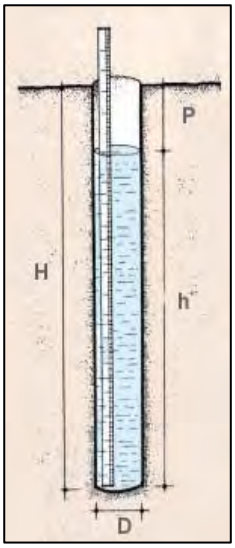
Average Permeability: **K ~= 7.5 x 10^-4 cm/s**

Time (min)	Reading (inches)	Drop in Water (inches)	Height of Water (inches)	Rate of Descent (in/min)	K (in/min)	K (cm/s)
0	0					
0.5	6	0	54	2.00	0.07477	0.00317
1	7	1	53	1.00	0.03810	0.00161
2	8	2	52	1.00	0.03884	0.00164
3	9	3	51	1.00	0.03961	0.00168
4	10	4	50	1.00	0.04041	0.00171
5	11	5	49	0.40	0.01650	0.00070
7.5	12	6	48	0.80	0.03405	0.00144
10	14	8	46	0.40	0.01778	0.00075
15	16	10	44			

10 foot deep hole
(8 inch diameter hole)

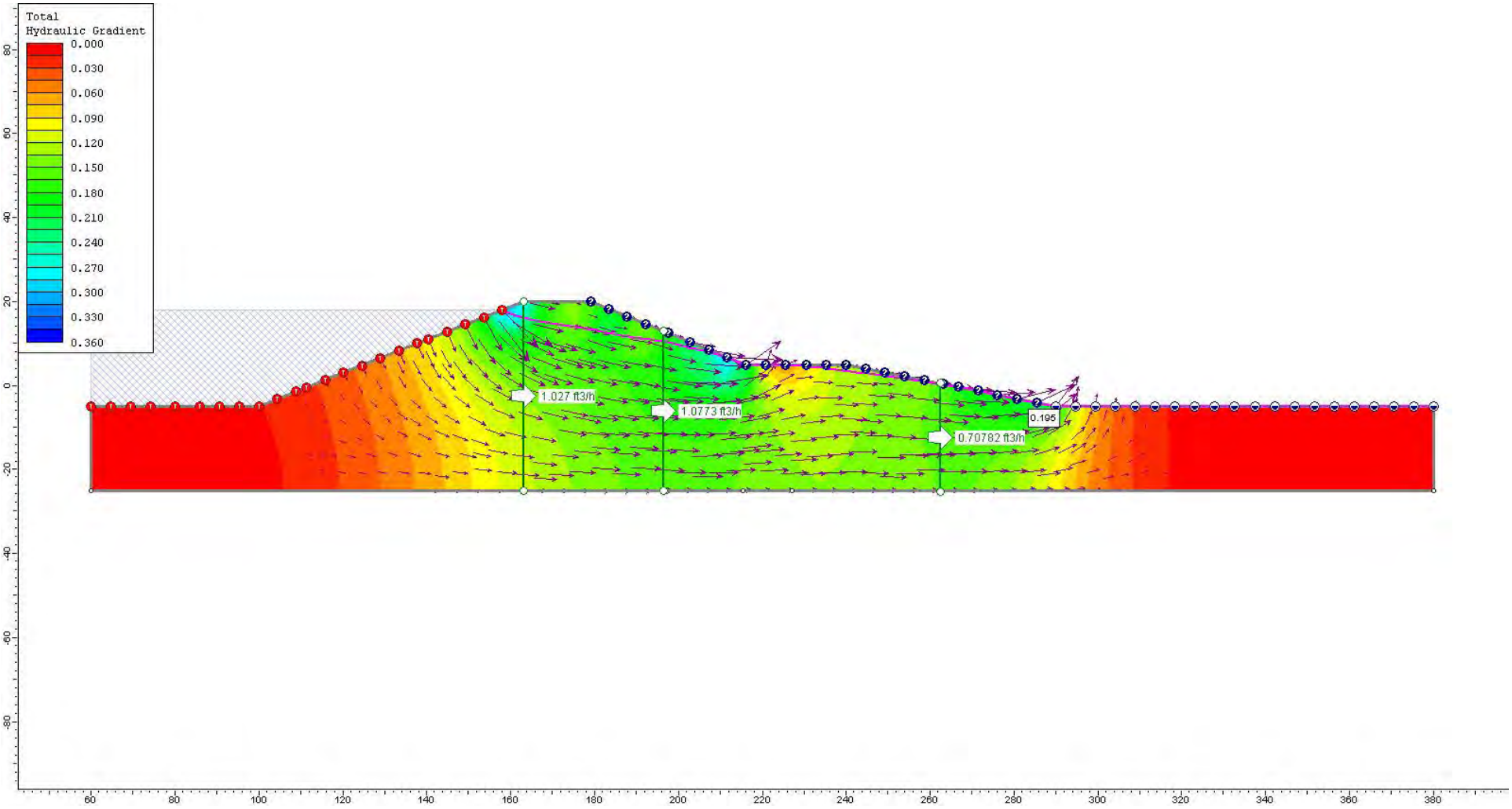
Average Permeability: **K ~= 7.5 x 10^-4 cm/s**

Time (min)	Reading (inches)	Drop in Water (inches)	Height of Water (inches)	Rate of Descent (in/min)	K (in/min)	K (cm/s)
0	0					
0.5	6	0	114	136.00	3.63023	0.15368
1	74	68	46	0.00	0.00000	0.00000
2	74	68	46	0.00	0.00000	0.00000
3	74	68	46	0.00	0.00000	0.00000
4	74	68	46	0.00	0.00000	0.00000
5	74	68	46	0.00	0.00000	0.00000
7.5	74	68	46	0.00	0.00000	0.00000
10	74	68	46	0.40	0.01778	0.00075
15	76	70	44			



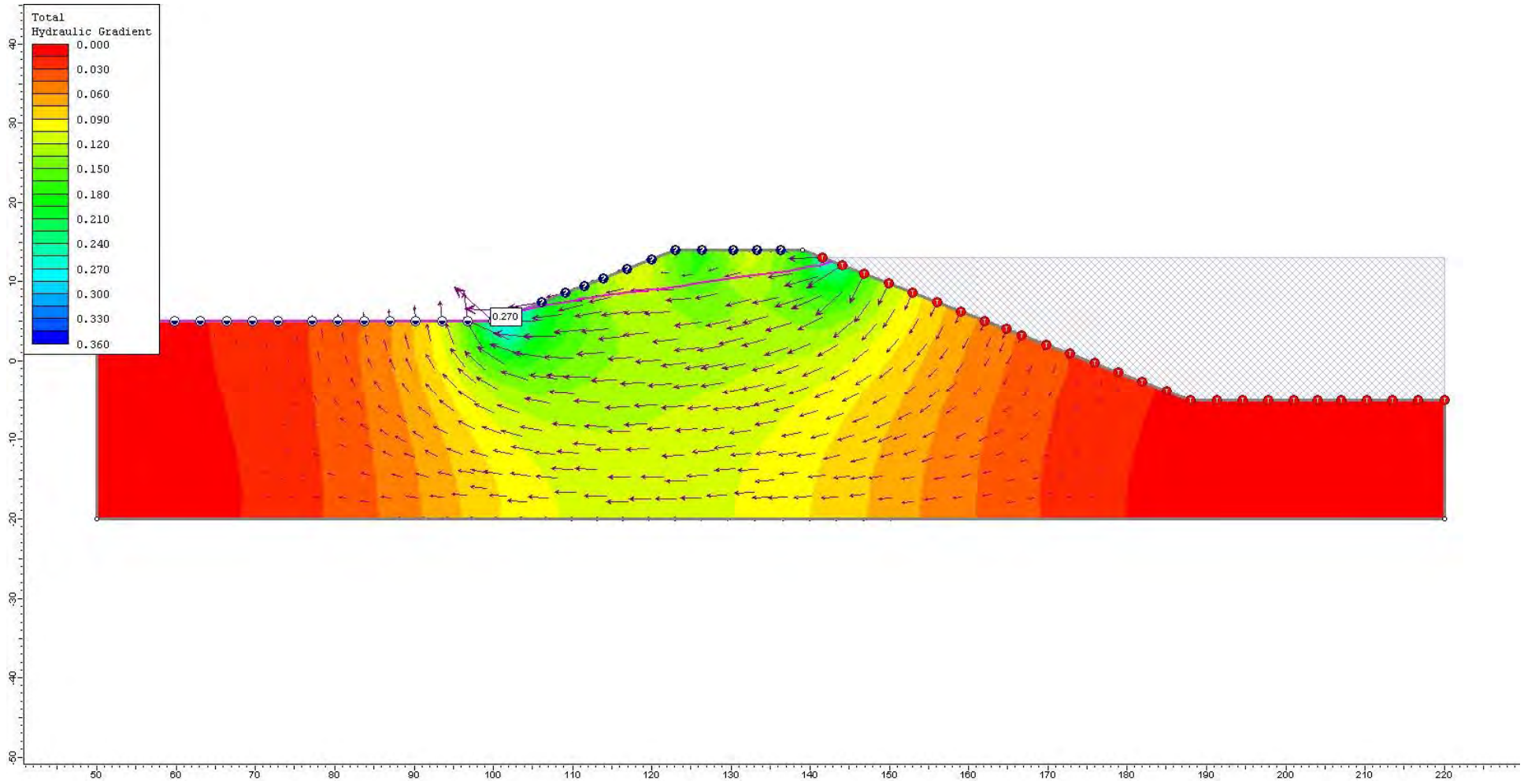
$$K = (D \div 2) \times \ln (h_1 \div h_2) / 2 (t_2 - t_1)$$

Source: ftp://ftp.fao.org/fi/CDrom/FAO_Training/FAO_Training/General/x6706e/x6706e09.htm



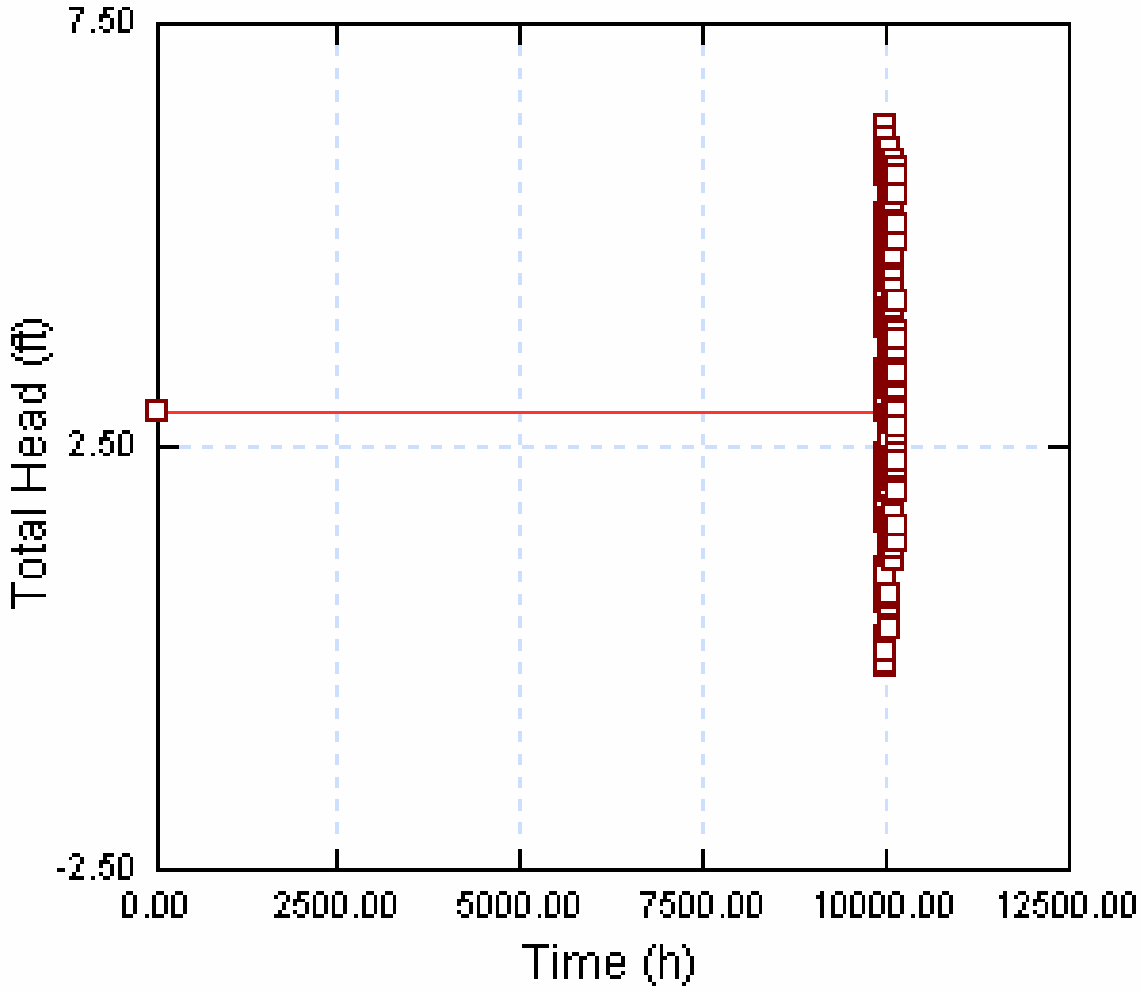
Hydraulic Gradient – Steady State Condition at Existing North Area A Levee after Excavation and Prior to Breach (i=0.195; FS > 5)

PLATE F-3



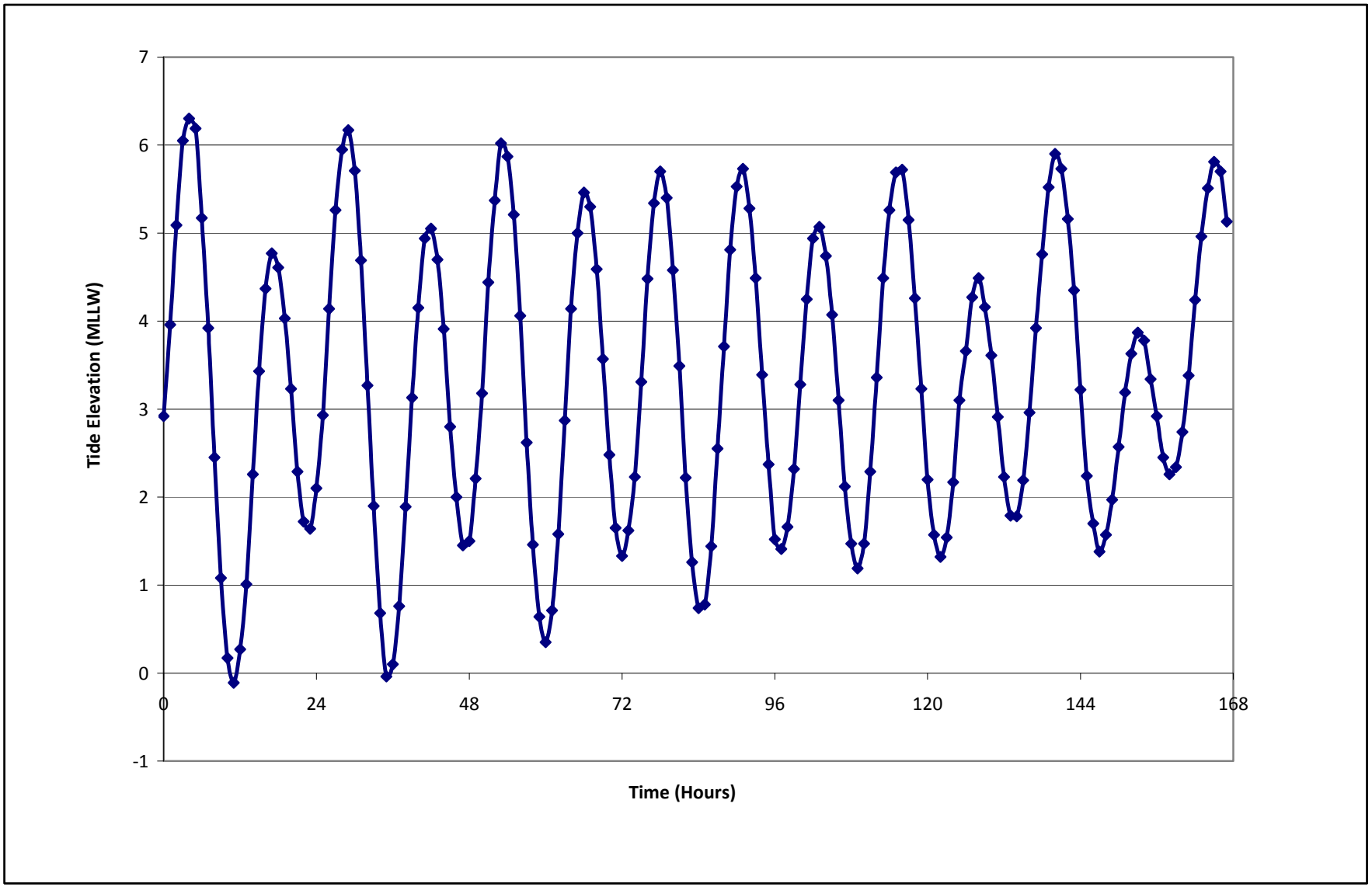
Hydraulic Gradient – Steady State Condition at West Area B Levee (i=0.27; FS > 3.7)

PLATE F-4



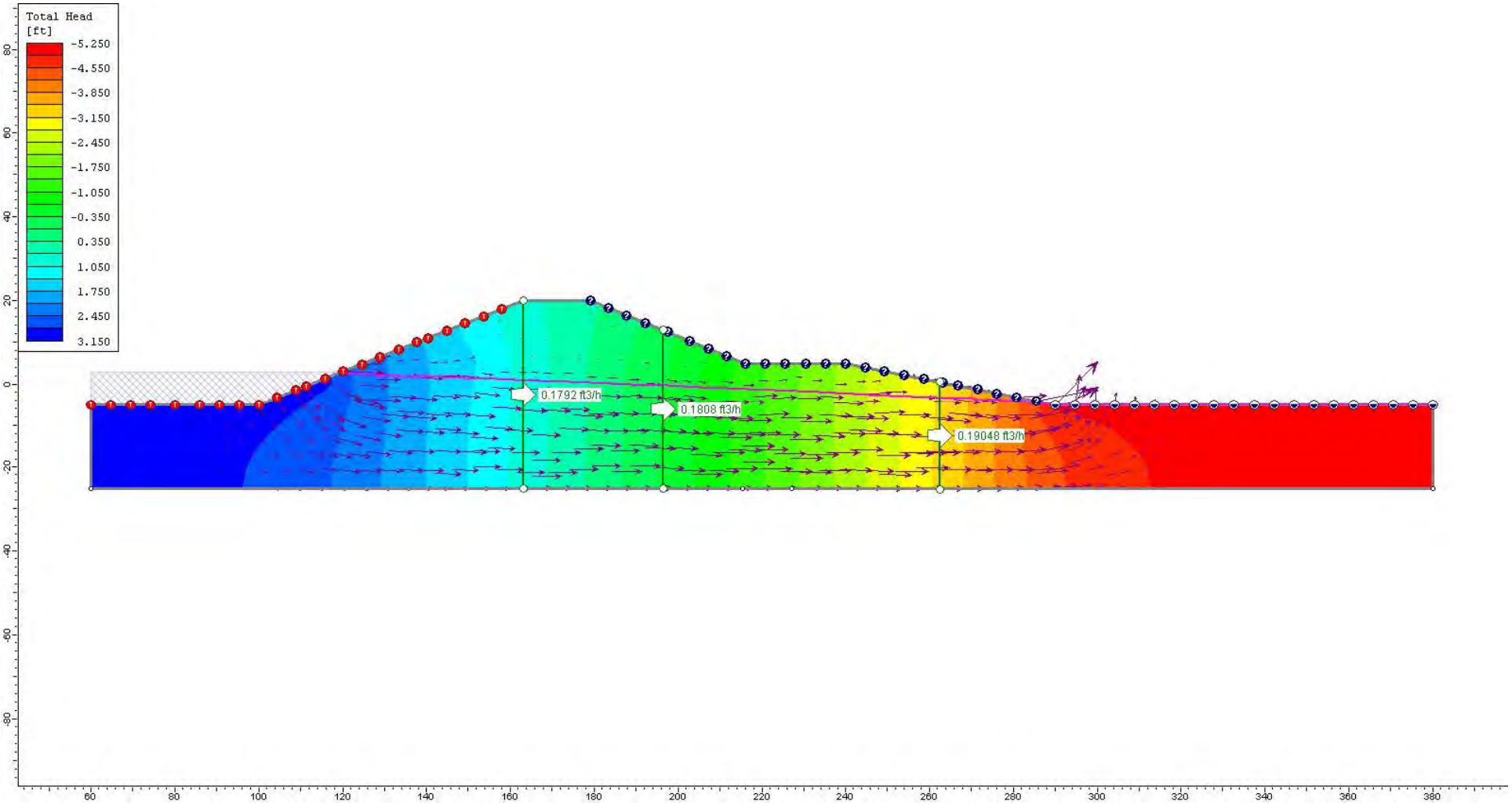
Transient Water Level for Tidal Changed over a Period of One Week

PLATE F-5



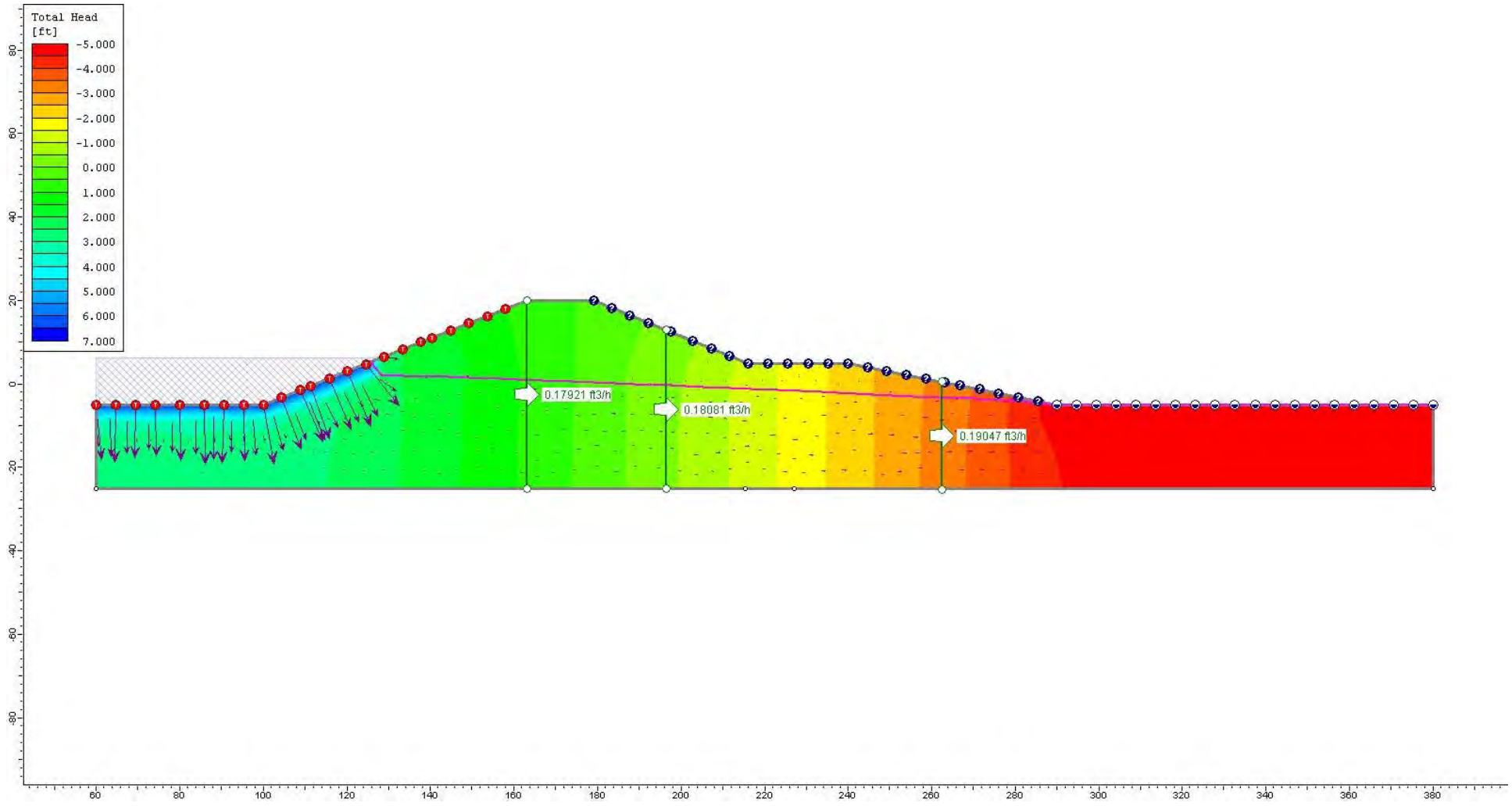
Typical Tidal Changes in Water Level in Santa Monica Bay Over One Week - Used in Seepage Analysis

PLATE F-6

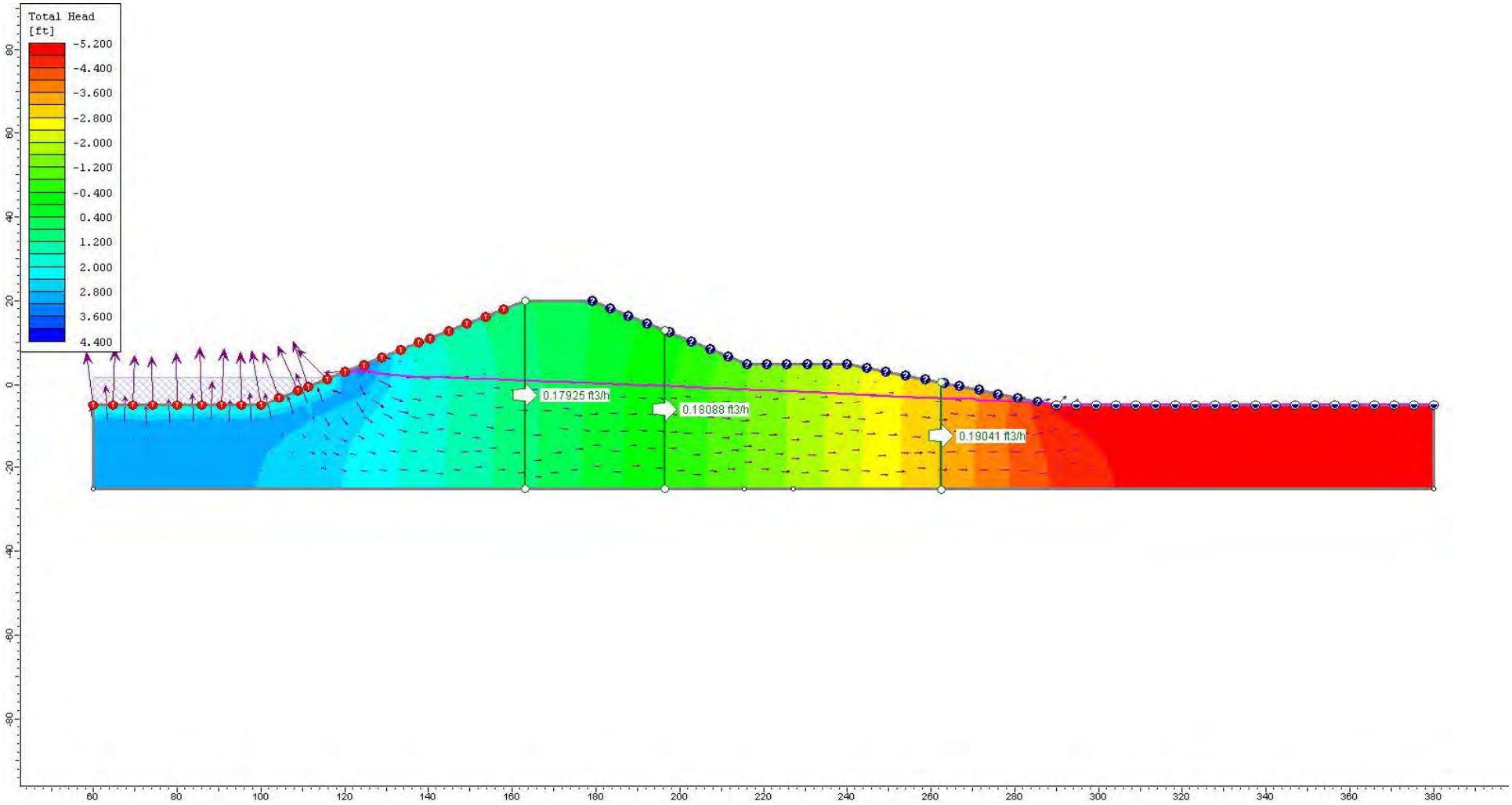


Stage 1 – Steady State at Average Tide Hide Prior to Tidal Fluctuations in the Analysis

PLATE F-7

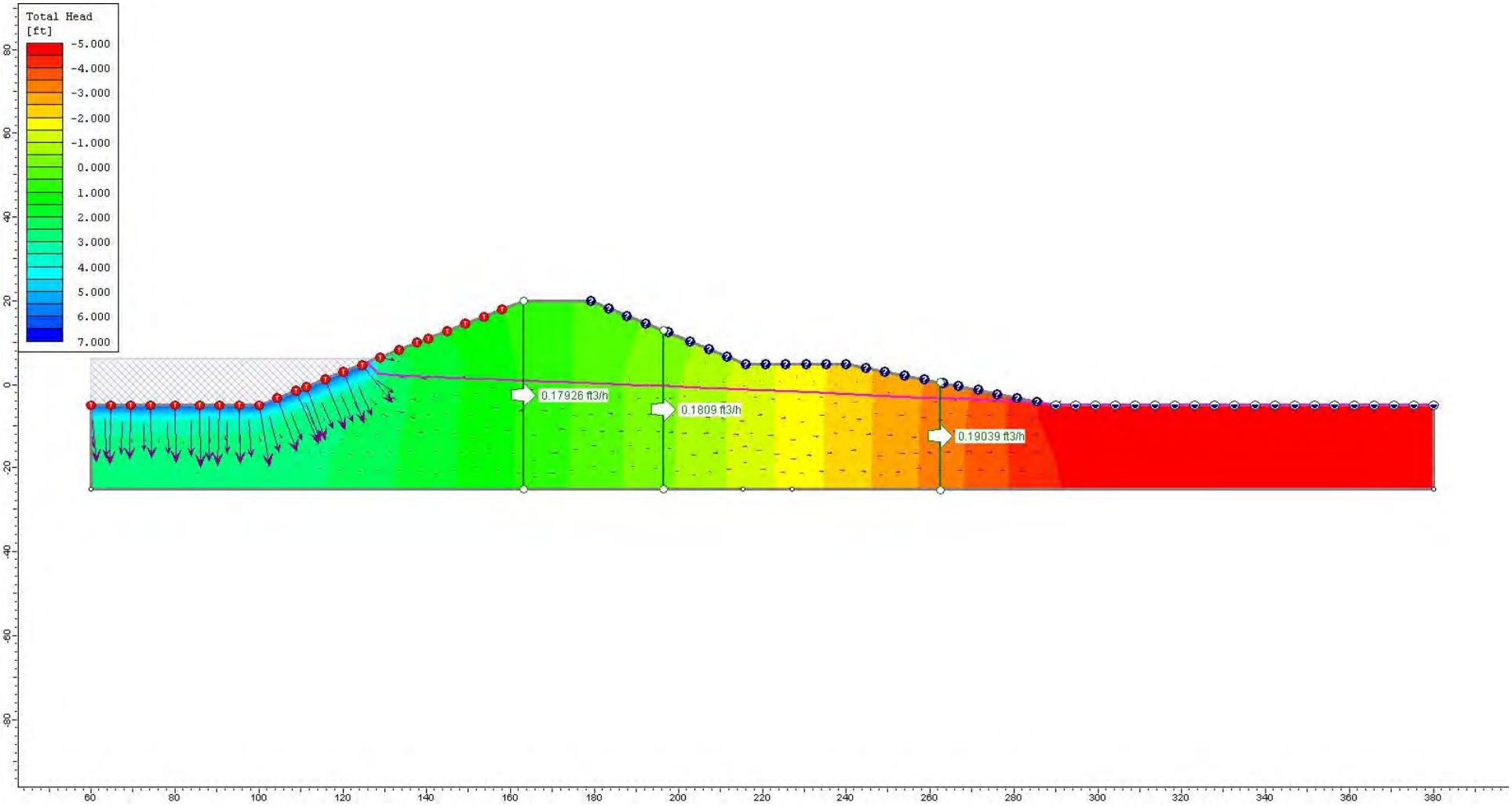


Stage 2 – First Peak – 4th Hour



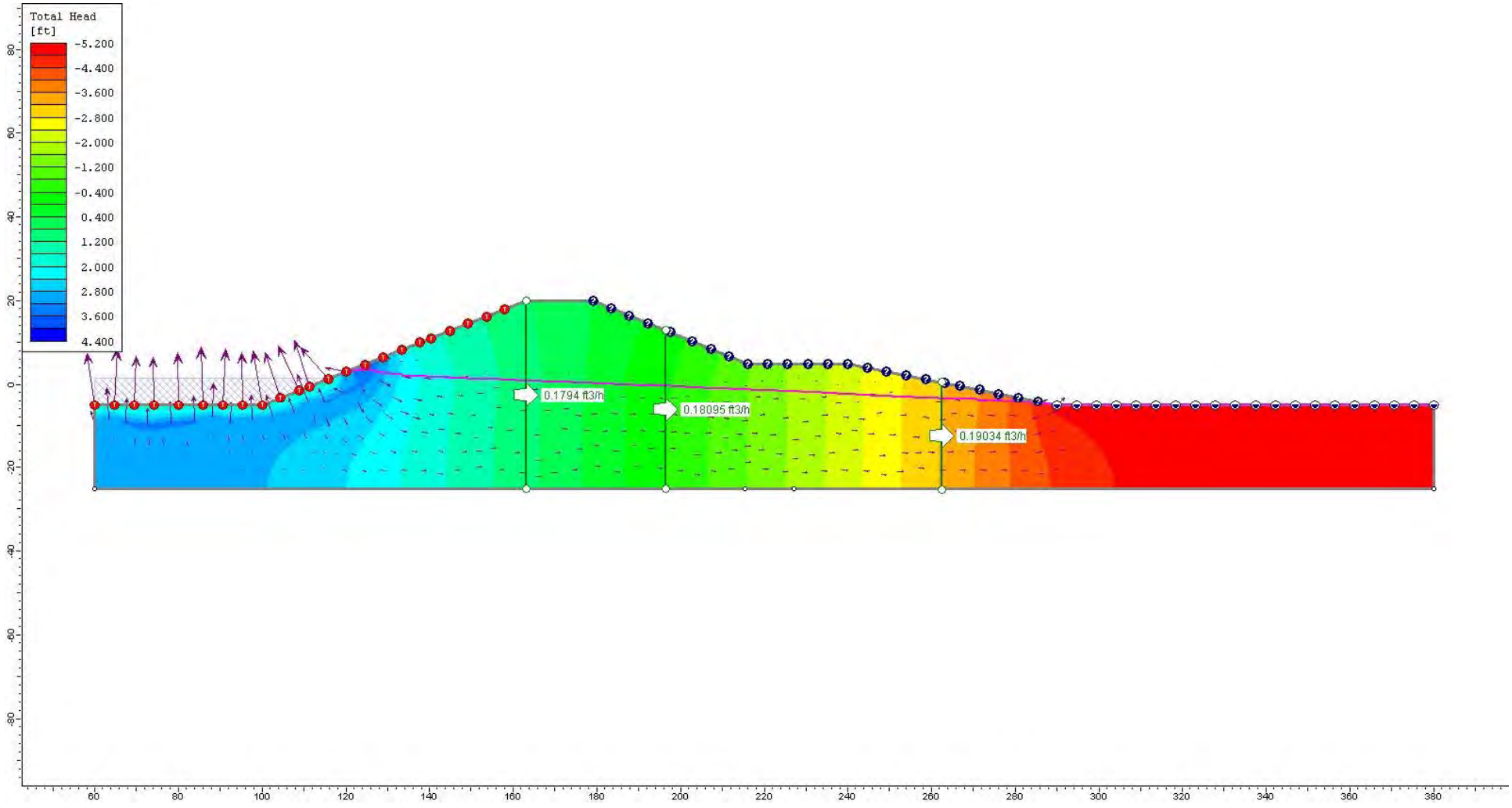
Stage 4 – Second Valley – 23th Hour

PLATE F-9



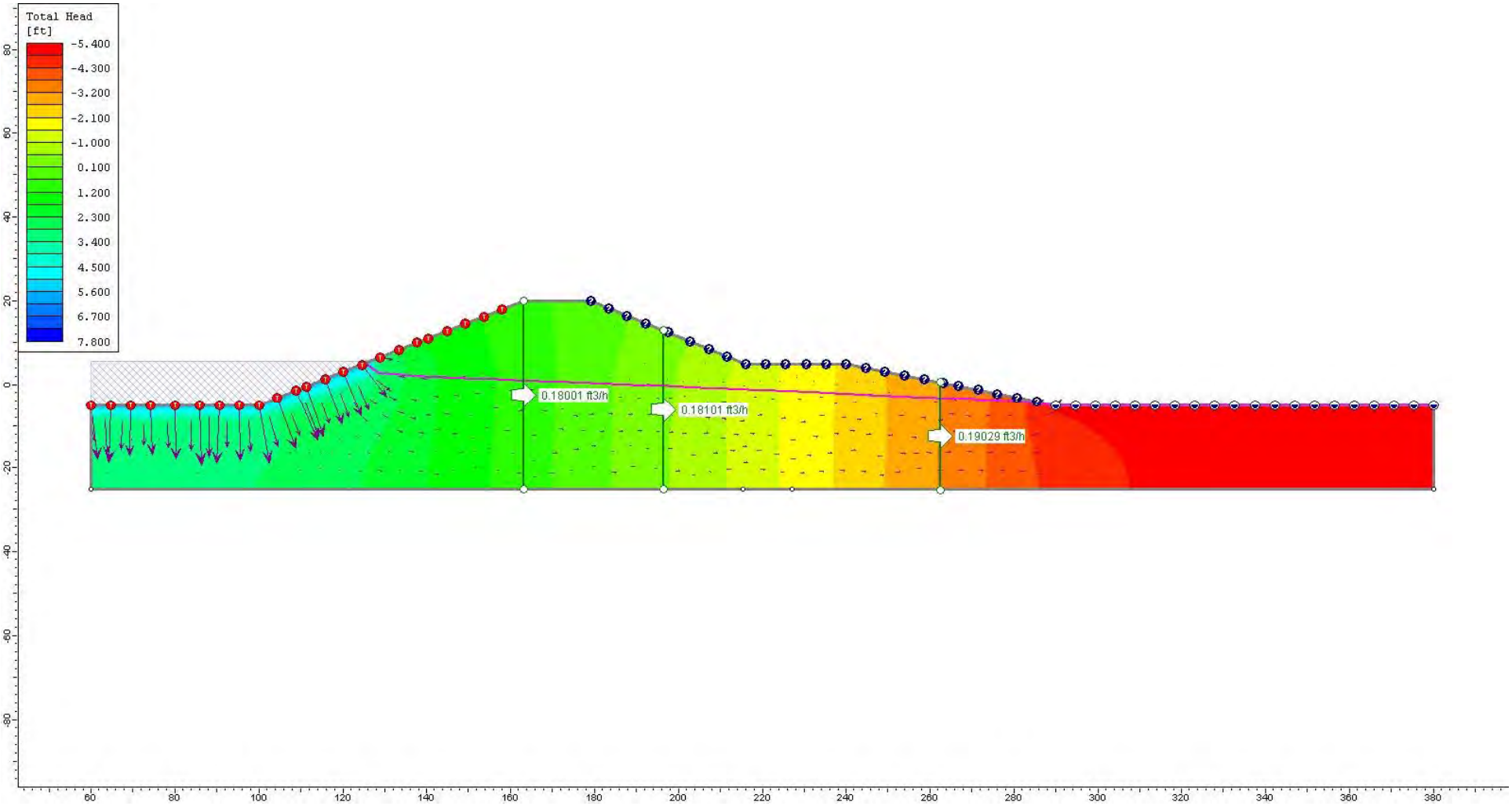
Stage 5 – Third Peak – 29th Hour

PLATE F-10



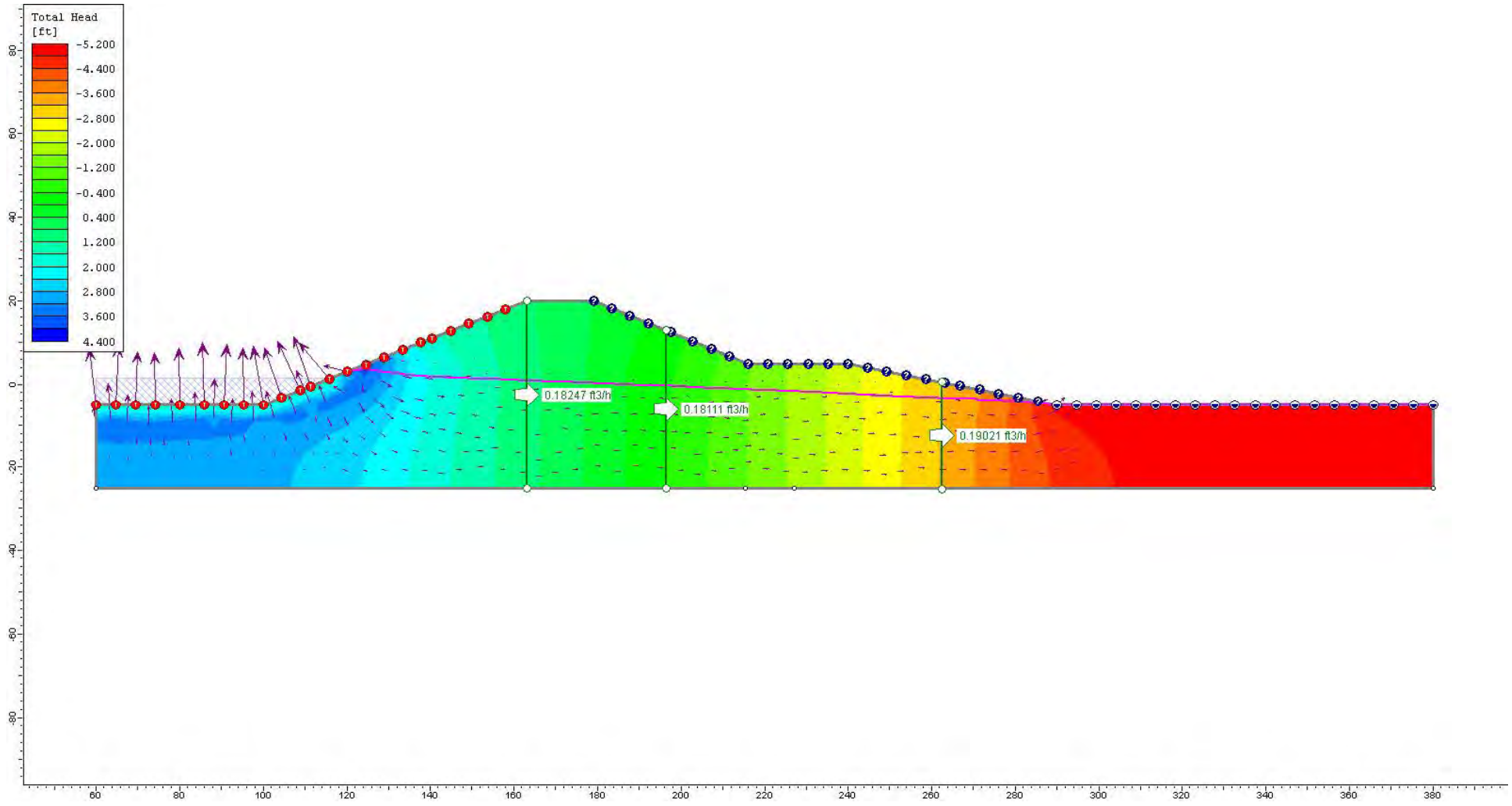
Stage 9 – Fourth Valley – 47th Hour

PLATE F-11



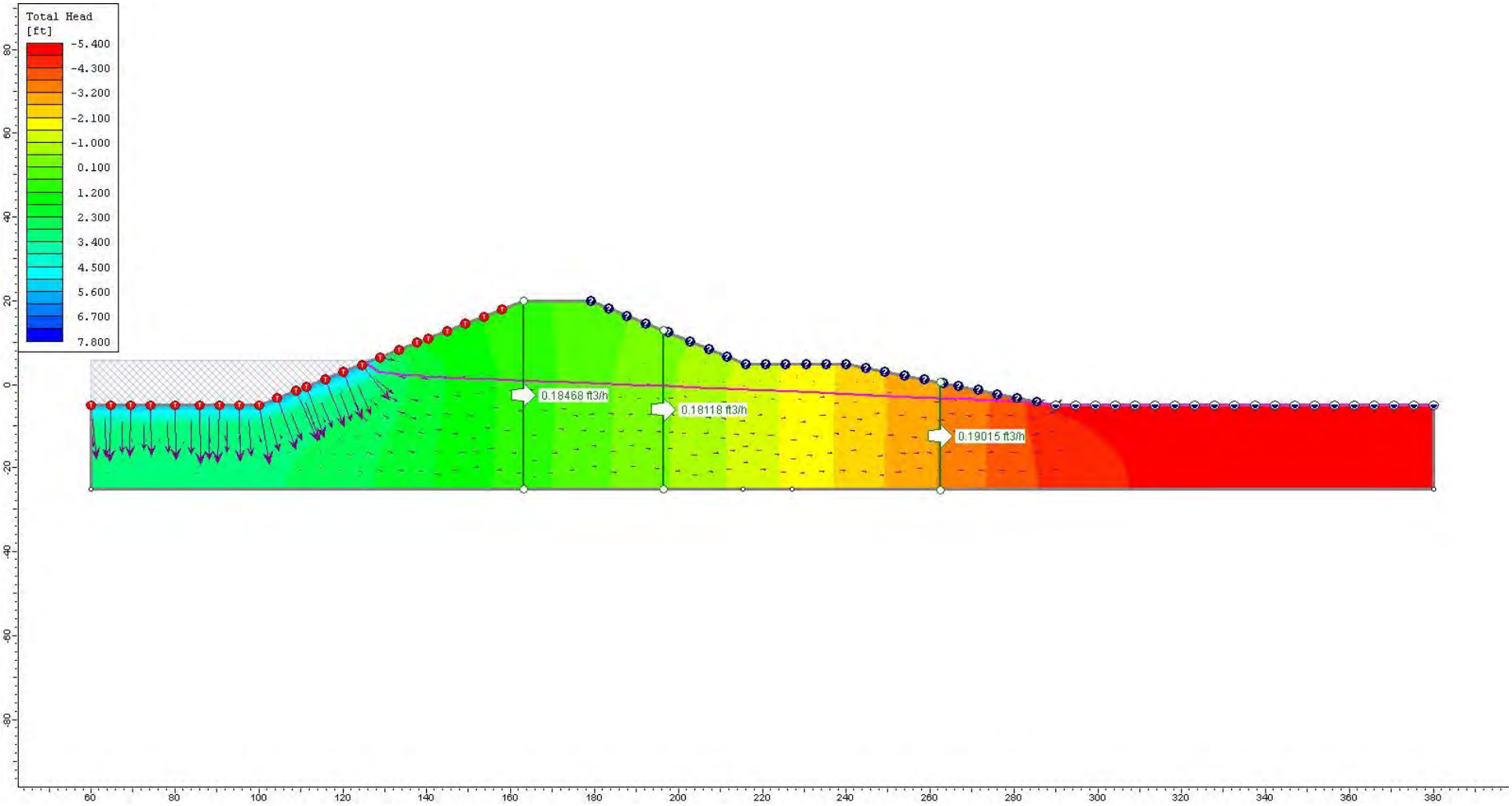
Stage 12 – Sixth Peak – 66th Hour

PLATE F-12



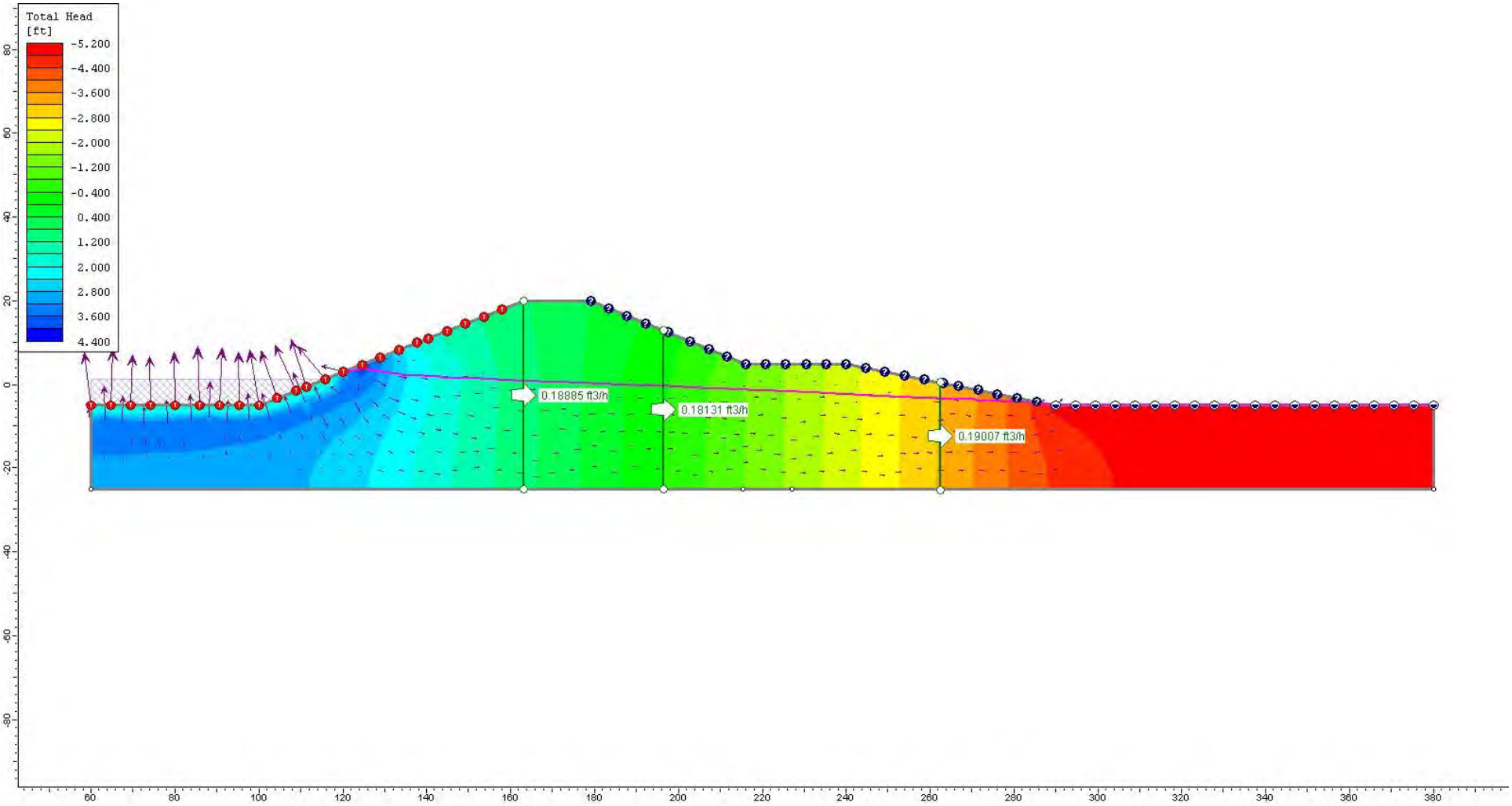
Stage 17 – Sixth Peak – 97th Hour

PLATE F-13



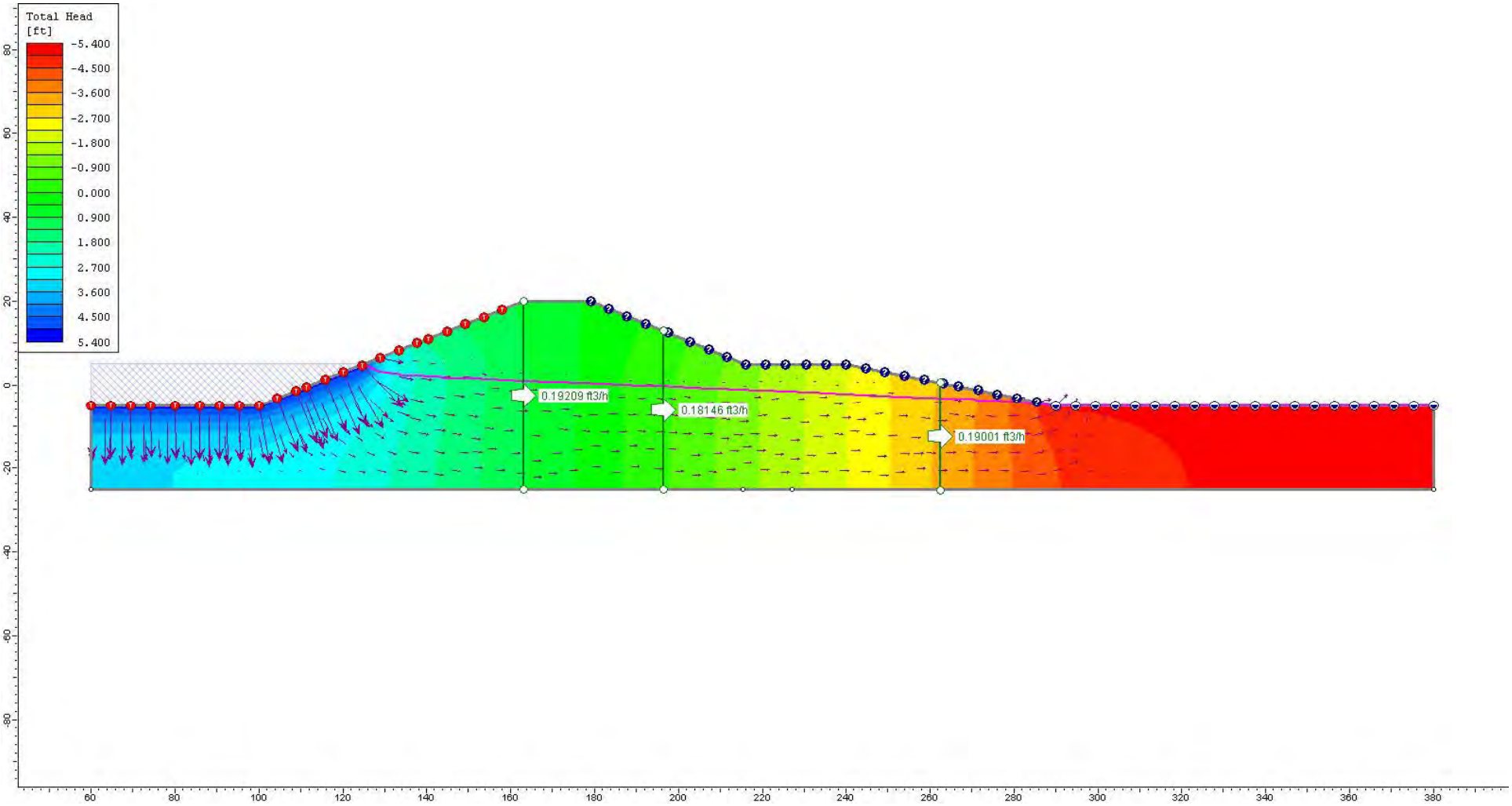
Stage 20 – Tenth Peak – 116th Hour

PLATE F-14



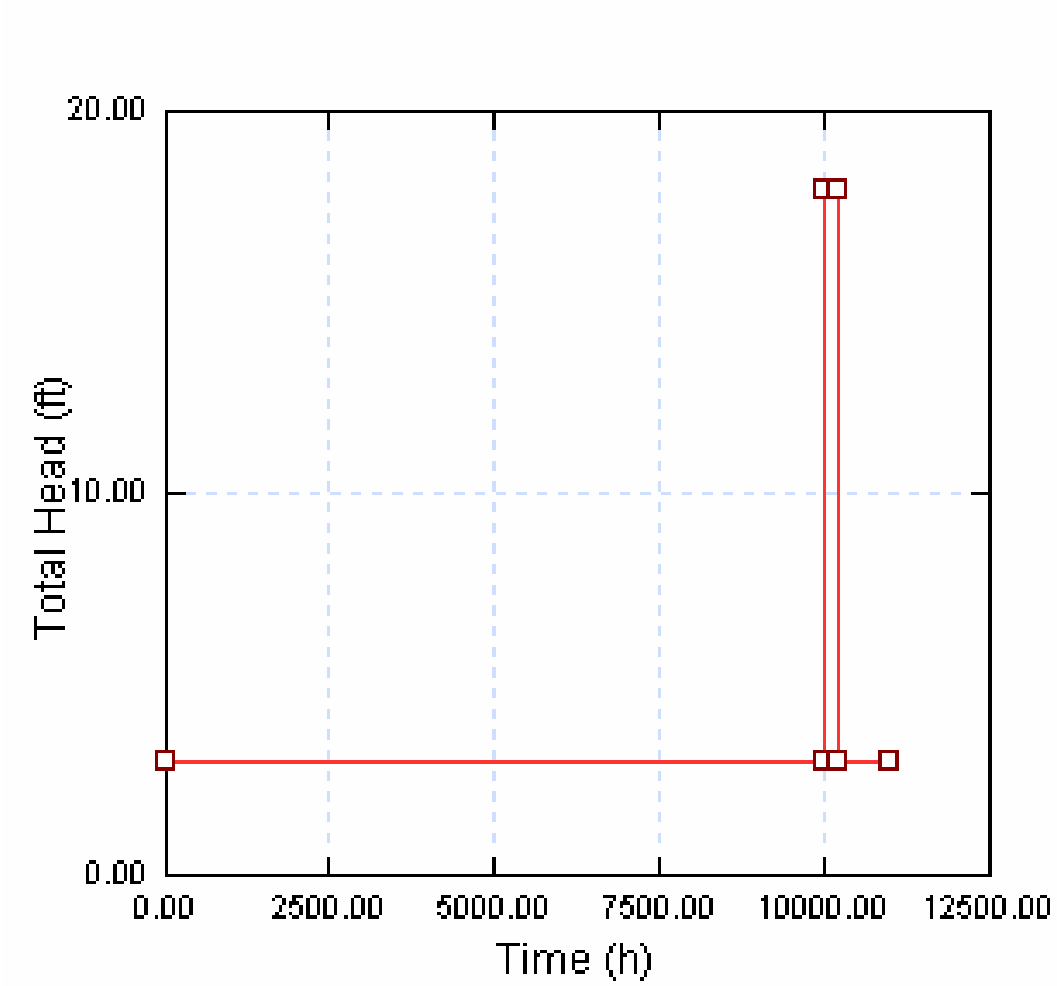
Stage 25 – Twelfth Valley – 147th Hour

PLATE F-15



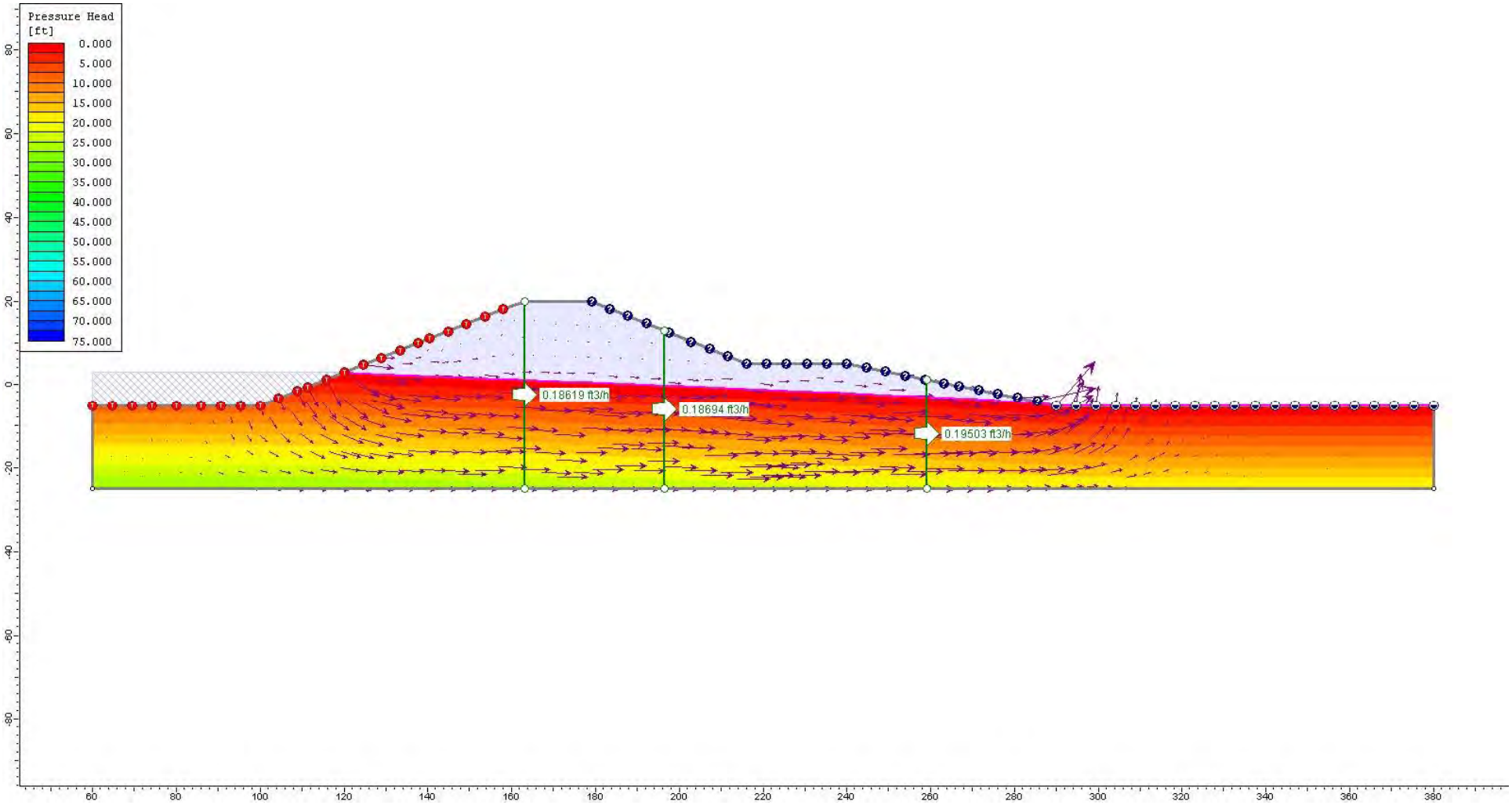
Stage 29 – Fourtheenth Valley – 170th Hour

PLATE F-16



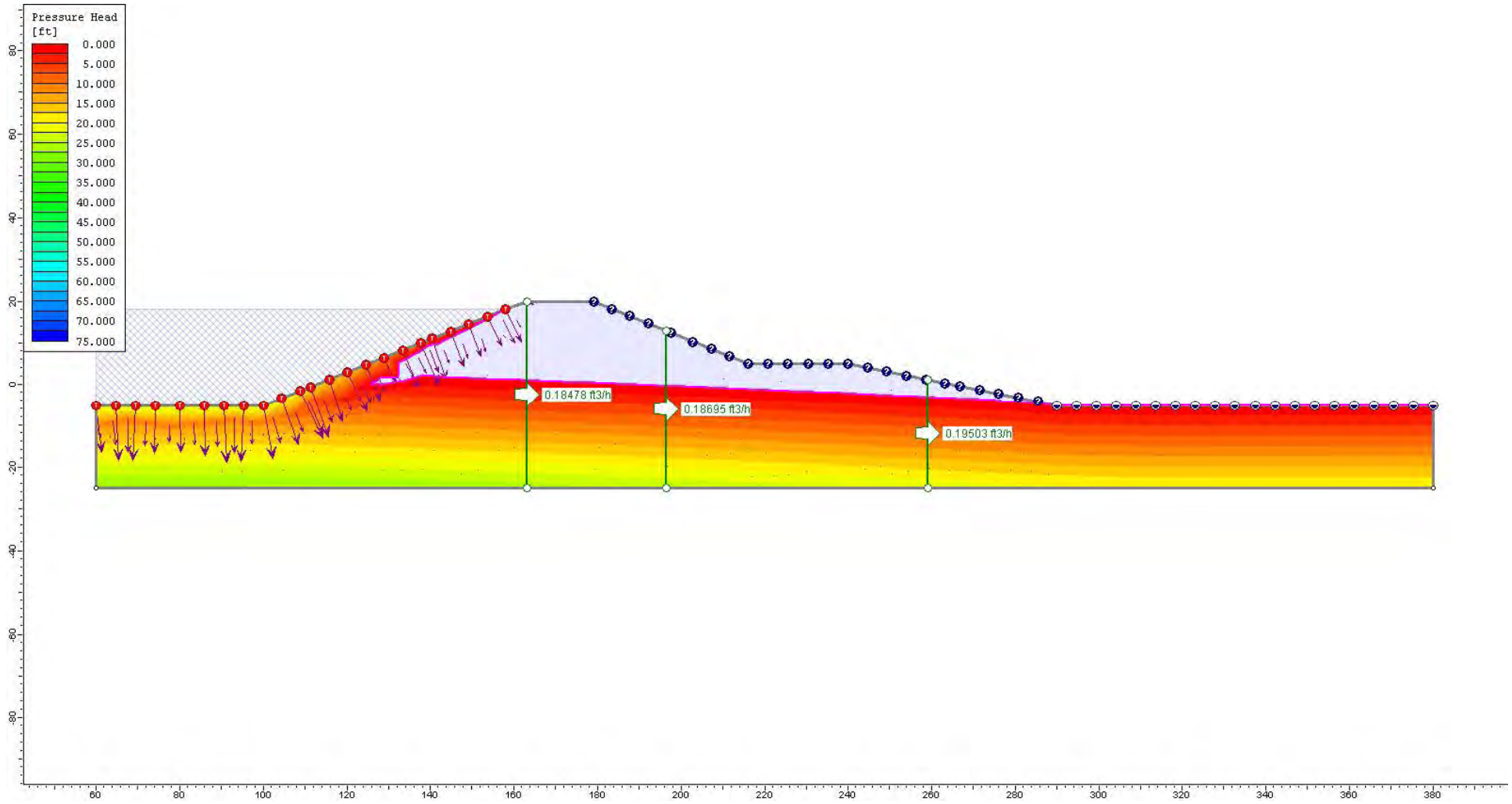
Transient Water Level for a 10 day Flood Condition:
1) Steady State is reached with Water Level at El. +3 feet
2) 10-Day Flood with Water Level at El. +18 feet
3) Water Level droped to El. +3 feet

PLATE F-17



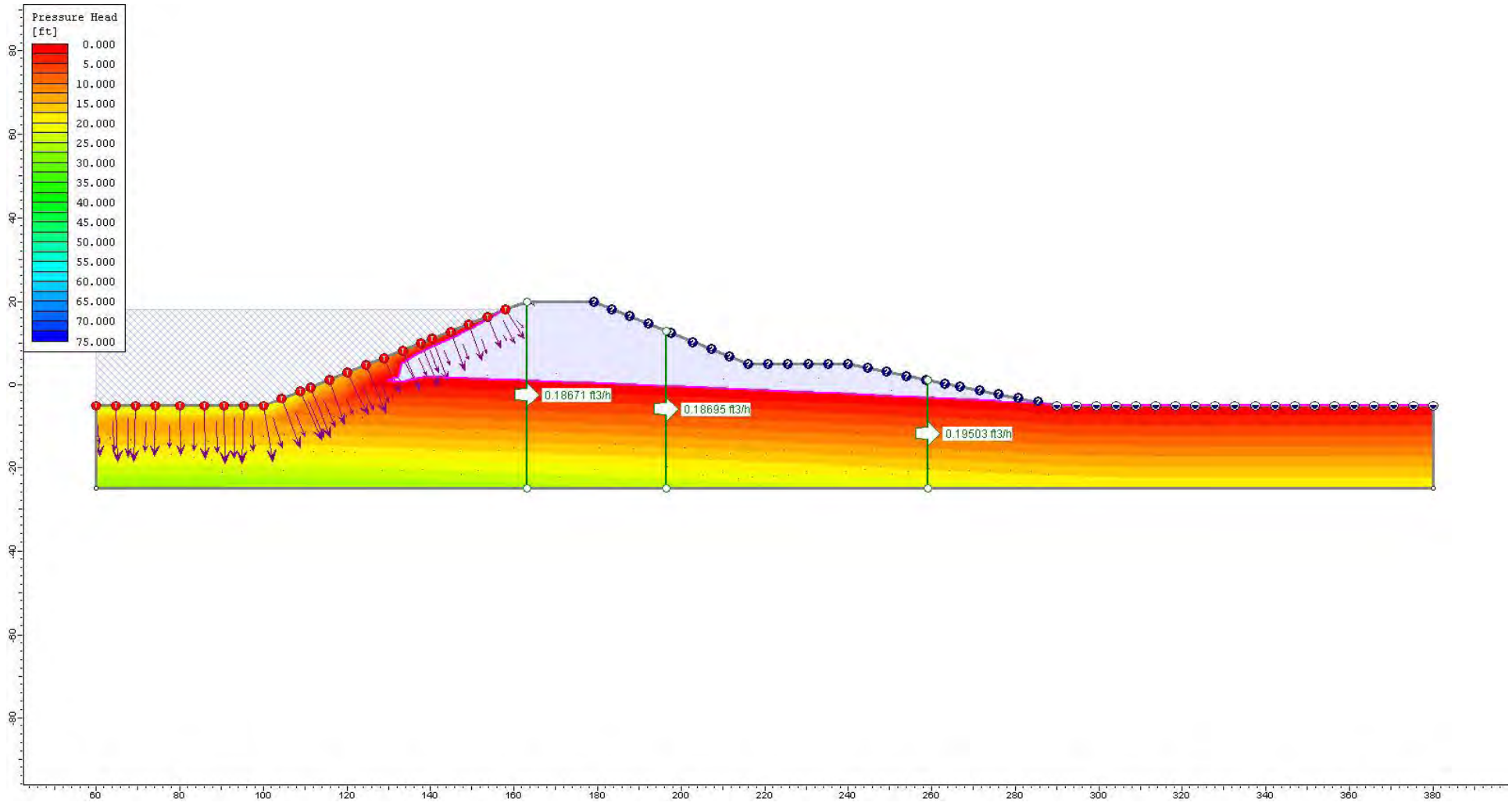
Stage 1 – Steady State Water Levels Prior to Flood

PLATE F-18



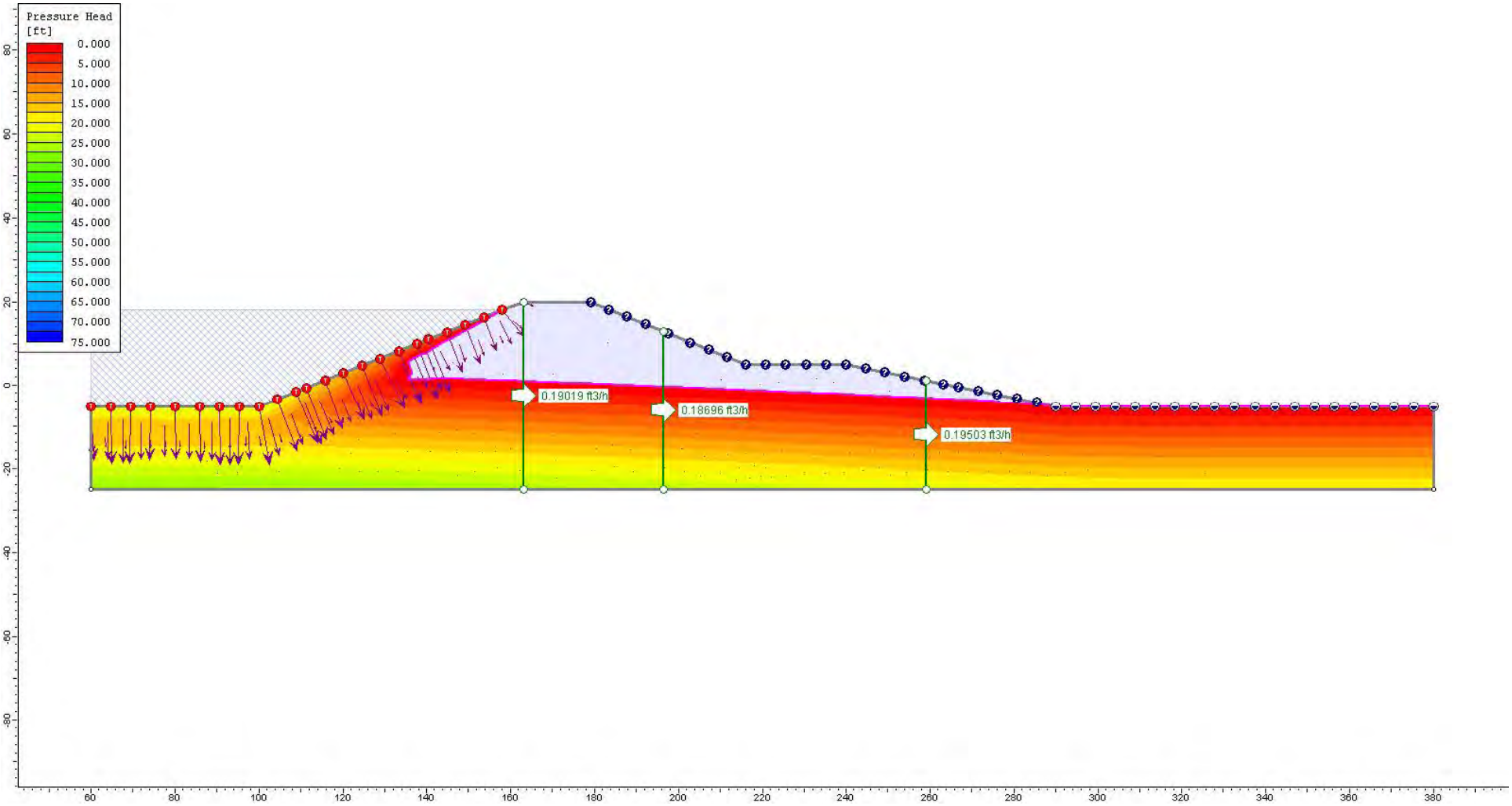
Stage 2 – One hour after the start of the Flood

PLATE F-19



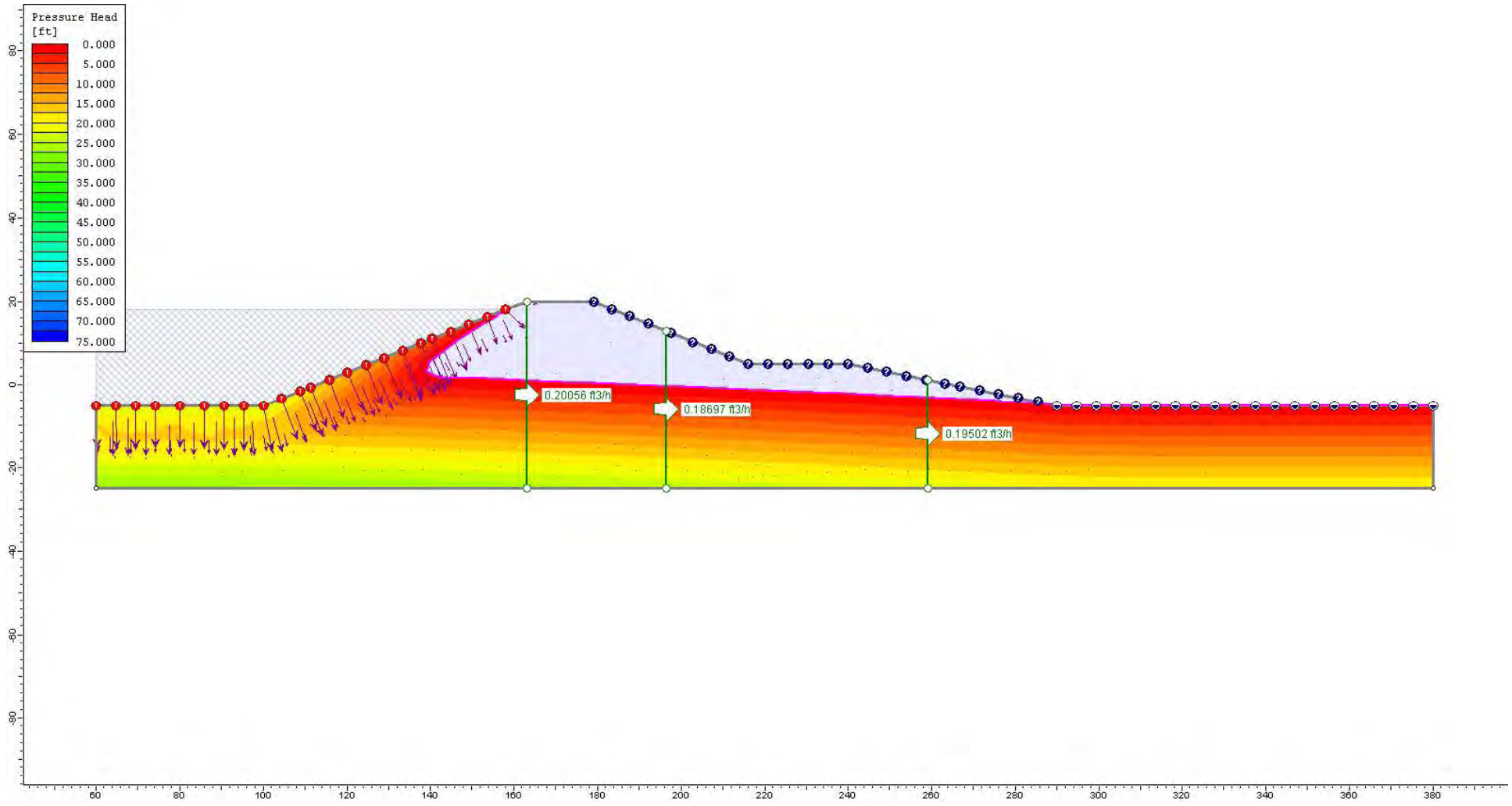
Stage 3 – Two hours after the start of the Flood

PLATE F-20



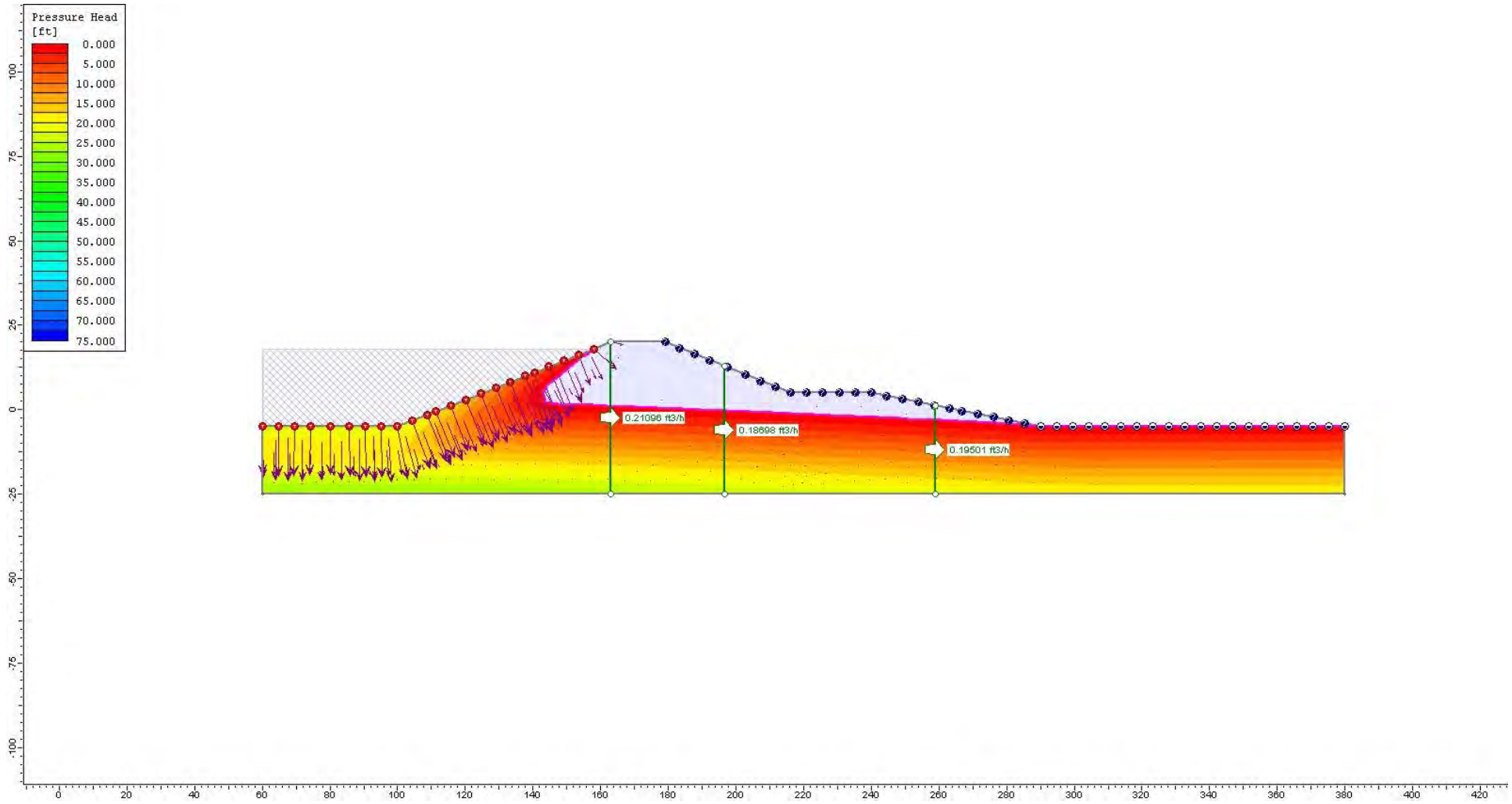
Stage 4 – Four hours after the start of the Flood

PLATE F-21



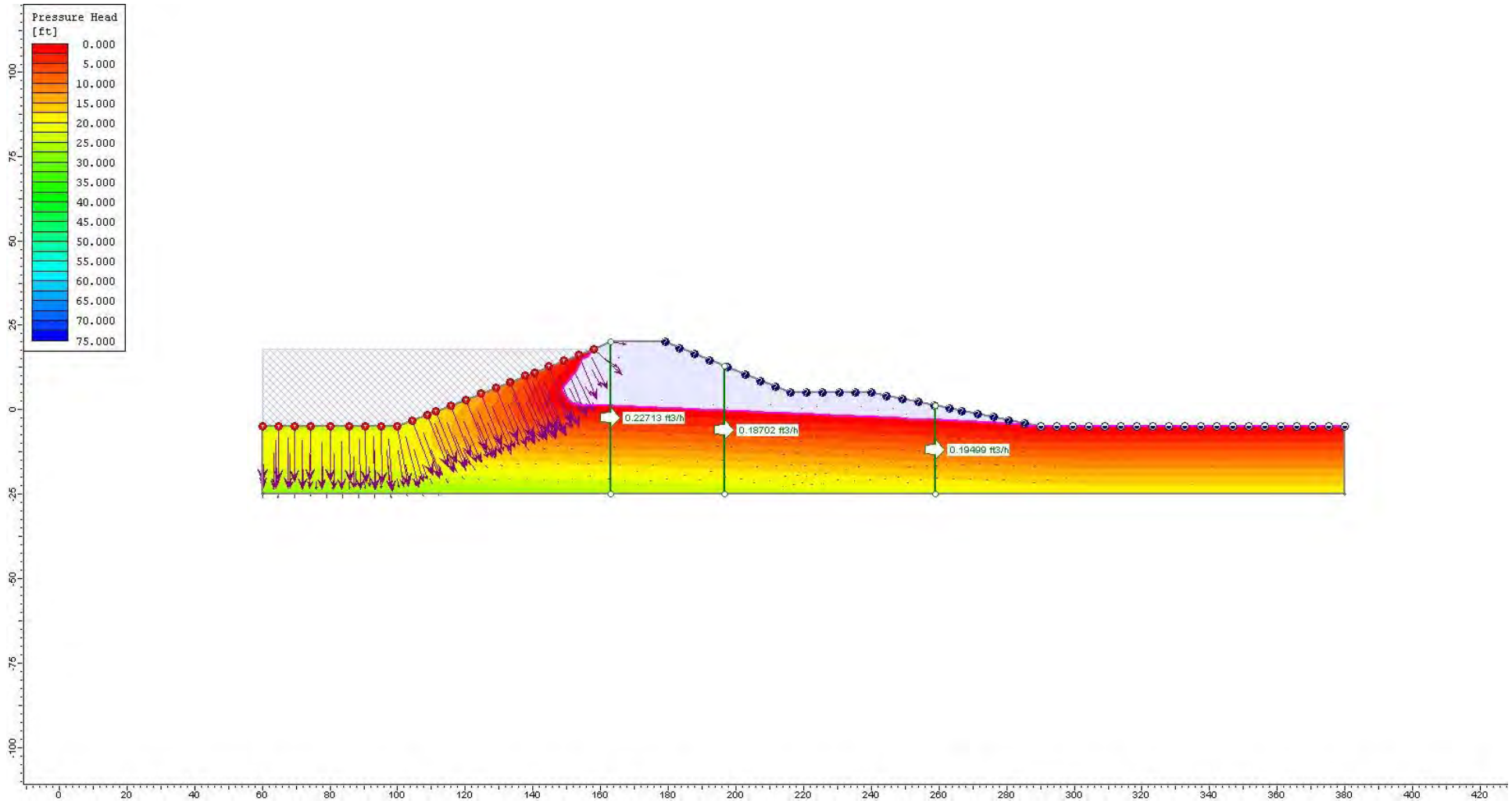
Stage 5 – Eight hours after the start of the Flood

PLATE F-22



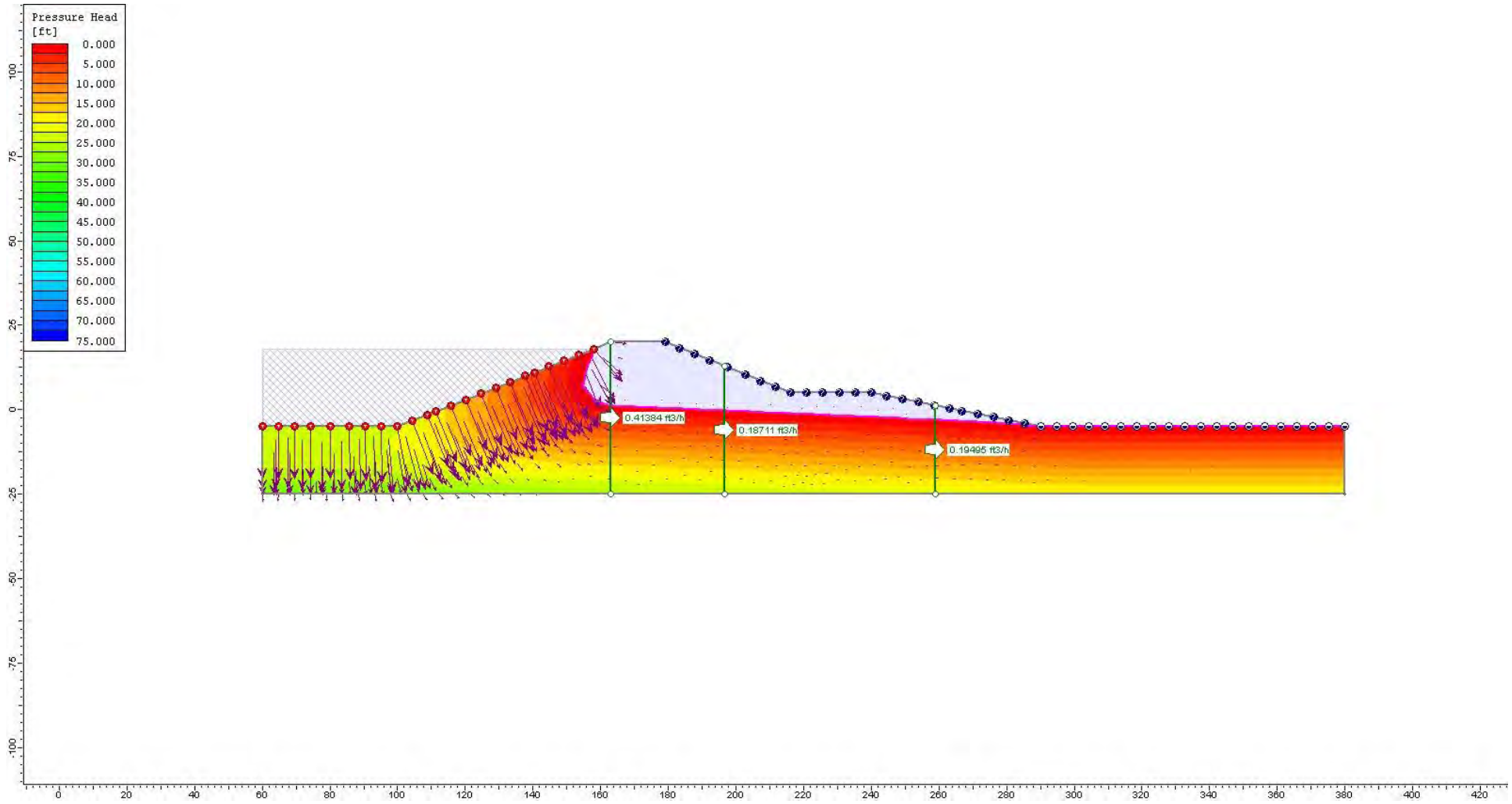
Stage 6 – 12 hours after the start of the Flood

PLATE F-23



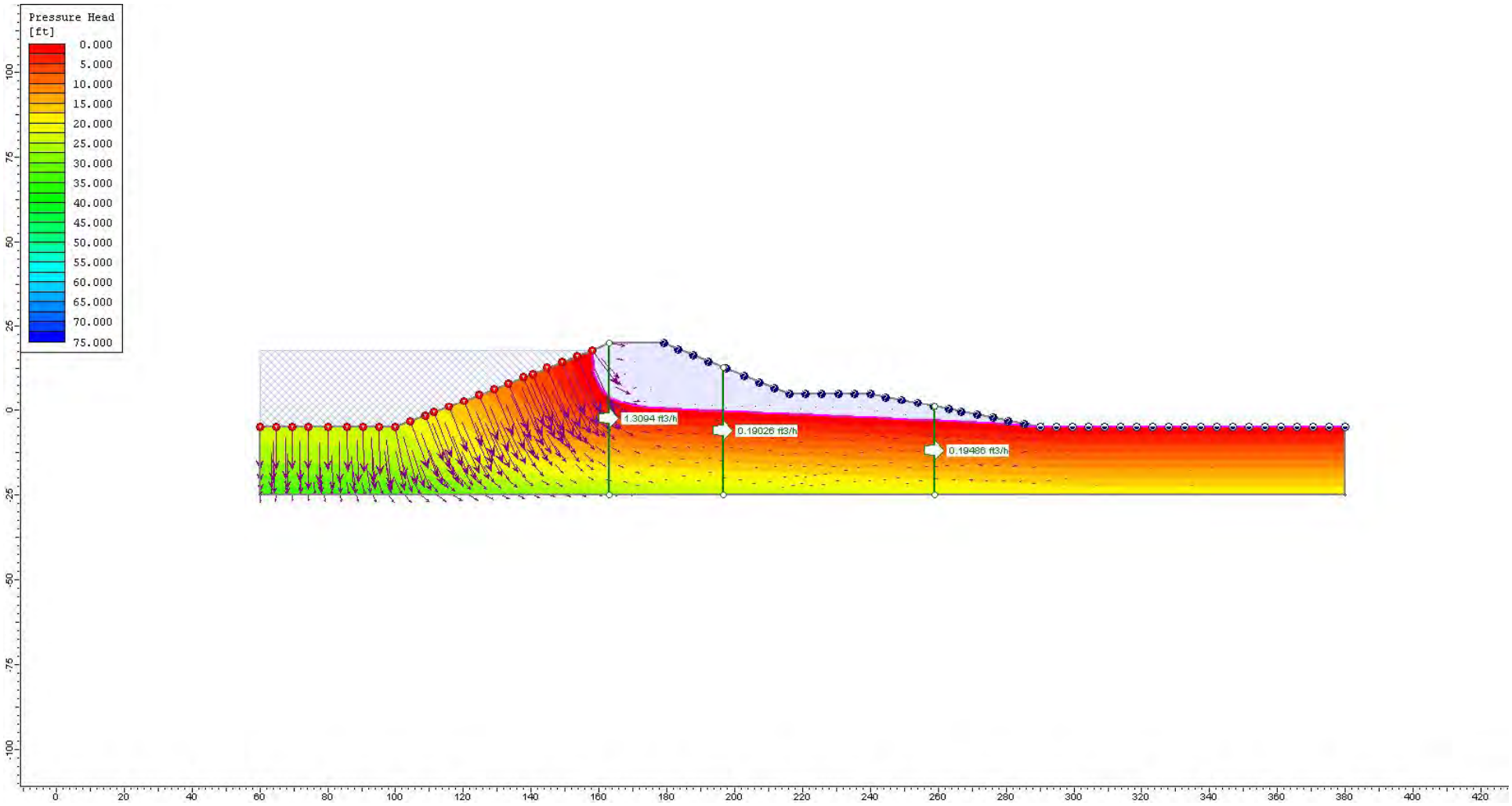
Stage 7 – 24 hours after the start of the Flood

PLATE F-24

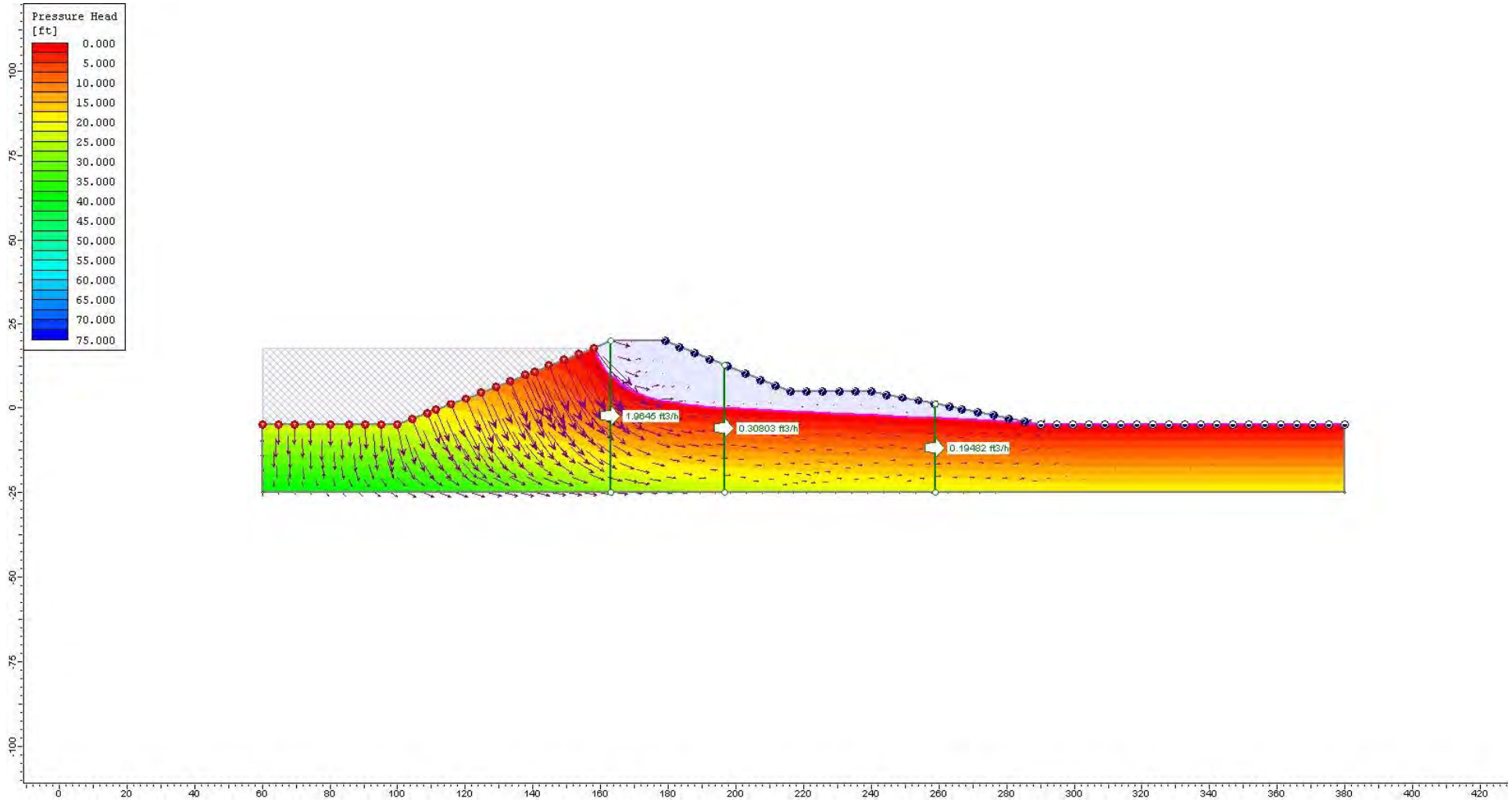


Stage 8 – 48 hours after the start of the Flood

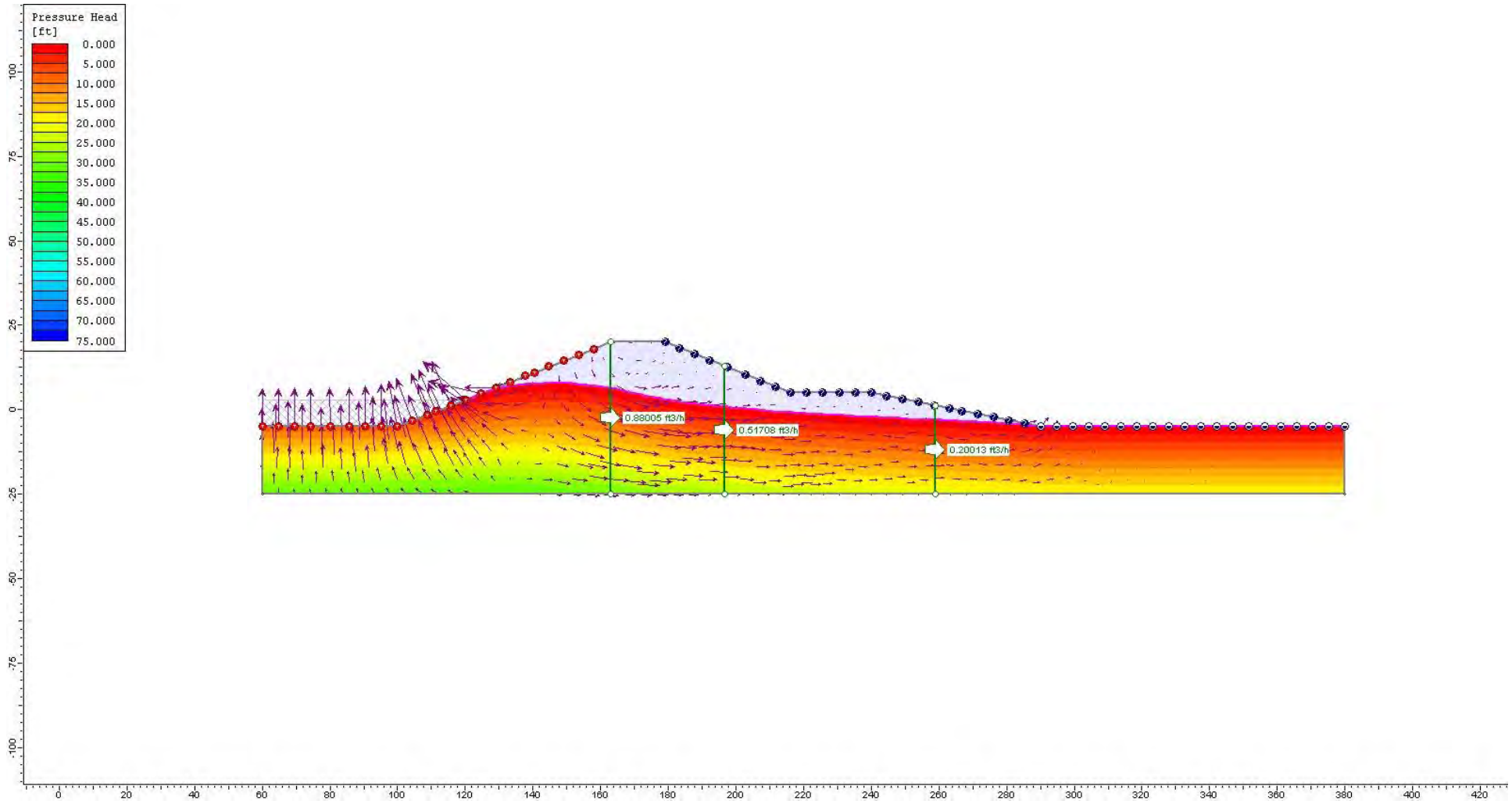
PLATE F-25



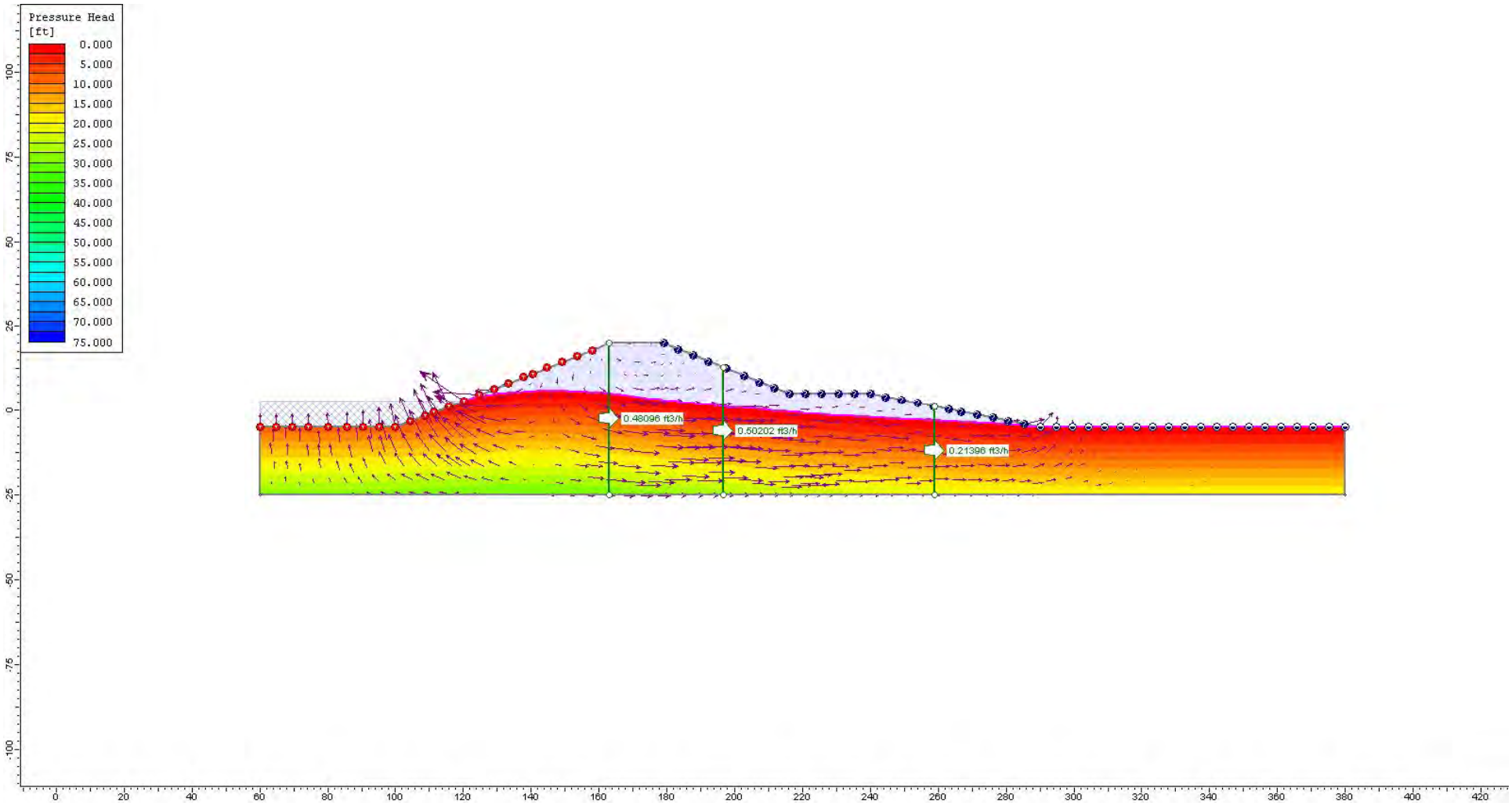
Stage 9 – 4 days after the start of the Flood



Stage 10 – 10 days after the start of the Flood (End of Flood)



Stage 11 – 10 days after the 10-day Flood



Stage 12 – 20 days after the 10-day Flood

APPENDIX G
SLOPE STABILITY

APPENDIX G
SLOPE STABILITY

G.1 Summary of Contents

This appendix includes the following:

- Generalized soil profiles adopted for slope stability analyses of the levees.
- Soil strength parameters criteria, and adopted values for slope stability analyses.
- Strength gain calculations under the West Area B levees using SHANSEP method
- Summary of static analyses for end of construction (short term low water), short term high water, long term high water (steady state) for selected sections, seismic post liquefaction analysis, and analyses for determination of yield acceleration and seismic displacements using Bray and Rathje (1998) method, and potential mitigation measures for reducing seismic displacements for two sections of the existing levees.
- Comparison of FLAC SLOPE results with RocScience Slide v.5 Results
- Analysis results showing the effect of water level fluctuation of seismic deformations of existing levees

G.2 Generalized Soil Profile Tables

Generalized soils profiles shown in Tables G-1 thru G-12 were adopted based on the estimates of soil strength parameters using our boring and CPT and laboratory testing results for the conservative boring/CPT layering within each area.

G.3 Soil Strength Parameters

Soil strength parameter selection criteria are shown graphically in Plates G-7 through G-15. The undrained shear strengths within Areas A and B were selected based on vane shear test results corrected for plasticity index (using Bjerrum, 1972 chart), as well as CPT tip resistances in each area.

Plates G-10 and G-11 show the results of direct shear tests performed on Fill soils in Areas A and B, and also include the conservatively adopted shear strength parameters for Fills soils in all areas. The soil strength for the embankments (levees) was selected to have just slightly higher cohesion than the soil strength parameters for Fill soils, since the soils used for embankments will be primary comprised of Fill soils, but will be well compacted to 90% relative compaction; hence the higher cohesion.

Plates G-12 through G-15 show the profiles of CPTs within different areas, with potentially liquefiable layers/depths highlighted in green, on the CPTs. The adopted extents (depths) of potentially liquefiable layers are also shown within different areas. The post liquefaction residual shear strength values were determined based on

average $(N1)_{60cs}$ of representative liquefiable layers using Seed and Harder (1990) graph, as shown on the Plates.

G.4 Soil Strength Gain (SHANSEP)

The shallow clayey soils underlying portions of West Area B are naturally very soft with undrained shear strengths on the order of 300 psf, under current conditions. However, after placement of the fill these soils will consolidate and gain strength. The strength gain for clayey soils can be determined using the SHANSEP method, as presented in plates G-16 through G-22.

The SHANSEP strength gain analysis for these clayey soils assumed that the soils at a depth of 15 feet and beyond are normally consolidated, and the overconsolidation ratio (OCR) decreases linearly from 2 to 1 from a depth of 5 to 15 feet. The upper 5 feet of the profile were assumed to be Fill soils of different nature and strength parameters.

Assuming normally consolidated clayey soils with a strength of about 300 psf exist at a depth of 15 feet, the shear strength ratio, $(Su/\sigma v')_{NC}$ for normally consolidated was found to be 0.27. After calculating the increase in vertical effective stresses at different locations along the levee cross section as a result of construction of the levee, the final vertical effective stresses were calculated (Plate G-16). The increased shear strength for normally consolidated soils were then determined by multiplying the shear strength ratio, $(Su/\sigma v')_{NC}$ by the final vertical effective stresses, at each location along the levee section (Plate G-17).

A simplified strength layering was then used in levee slope stability analyses for West Area B levees, based on the results of the SHANSEP method.

G.5 Slope Stability Analyses

Static and seismic levee slope stability analyses were performed for different loading conditions at 12 distinct cross sections of both new and portions of the existing levees that remain as part of the project. Additionally, the static stability of portions of the existing north levee that will be breached after/during construction of the new meander channels was analyzed. The analyses were performed in FLAC/Slope V.7. The output plot and the input geometry and layering of each of the analyses are included in this appendix, as shown in Plates G-23 through G-144.

For the portions of the existing levees that will tie in to the new levees and remain as part of the project, the seismic displacements were found to be higher than generally acceptable. Analyses showing possible mitigation measures using ground improvement by Deep Soil Mixing (DSM) are also shown for two of the sections (Sections D-D' and E-E'). Rapid drawdown is not a likely condition, and a viable mode of failure for the Ballona Wetlands levees, and was not included in the levee stability analyses.

G.6 Examples of Comparison of FLAC SLOPE FOS with RocScience Slide

The FOS results from FLAC SLOPE were compared with the results of the RocScience Slide v.5 Slope Stability Program, for a number of Sections and Load Cases. As can be seen from the results shown on Plates G-145 thru G-147, the estimated FOS values from Slide v.5 are agreement with the estimated FOS values from FLAC Slope with variations on the order of 3%, or less. This validates the results of our slope stability analyses.

G.7 Analysis Results Showing the Effect of Water Level Fluctuation of Seismic Deformations of Existing Levees

The effect of changes in water level in the channel on the seismic displacements predicted for the existing levees was investigated for the existing levee located immediately downstream of Lincoln Boulevard (Section E-E') for the following four water levels:

- Case 1 – The water in the channel and in the area outside the channel coincide with the ground surface elevation of +7 feet. This is the design groundwater condition adopted for the previously presented seismic stability analyses of existing levees (Results presented in Plates G-69 and G-70).
- Case 2 – The water in the channel and in the area outside the channel is at Elevation +3 feet. This condition approximately corresponds to the average tidal condition (Plates G-148 and G-149).
- Case 3 – A water level in the channel at Elevation +0 feet (corresponding to low tide) and a groundwater level outside the channel at Elevation +7 feet (Plates G-150 and G-151).
- Case 4 – A water level in the channel of +0 feet and a groundwater level outside the channel at Elevation +3 feet (Plates G-152 and G-153).

The yield accelerations change slightly depending on the variation in water levels; however, estimated seismic displacement for each case is unacceptable. Therefore, mitigations are recommended as described in the text.

A list of the plates presented in this appendix follows:

Plate G-1 and G-6	Soil Profile Tables for Slope Stability
Plate G-7 and G-9	Undrained Shear Strength of Fine Grained Soils
Plate G-10 and G-11	Soil Strength Parameters for Fill Soils
Plate G-12 thru G-15	Liquefied Layers and Residual Strength Values for Difference Areas
Plate G-16 thru G-22	Strength Gain under West Area B Levees using SHANSEP Method
Plates G-23 thru G-33	Static and Seismic/Deformation Analyses – Section A-A'
Plates G-34 thru G-43	Static and Seismic/Deformation Analyses – Section B-B'
Plates G-44 thru G-51	Static and Seismic/Deformation Analyses – Section C-C'
Plates G-52 thru G-62	Static and Seismic/Deformation Analyses and Potential Mitigation Measures – Section D-D'
Plates G-63 thru G-73	Static and Seismic/Deformation Analyses and Potential Mitigation Measures – Section E-E'
Plates G-74 thru G-82	Static and Seismic/Deformation Analyses – Section F-F'
Plates G-83 thru G-93	Static and Seismic/Deformation Analyses - Section G-G'
Plates G-94 thru G-102	Static and Seismic/Deformation Analyses - Section H-H'
Plates G-103 thru G-113	Static and Seismic/Deformation Analyses – Section I-I'
Plates G-114 thru G-122	Static and Seismic/Deformation Analyses – Section J-J'
Plates G-123 thru G-131	Static and Seismic/Deformation Analyses – Section K-K'
Plates G-132 thru G-140	Static and Seismic/Deformation Analyses – Section L-L'
Plates G-141 thru G-144	Static Analyses of Existing North Levee during Meander Channel Excavation
Plates G-145 thru G-147	Comparison of FLAC Slope FOS values with RocScience Slide for a few sections and load cases
Plates G-148 thru G-153	Effect of Water Level Fluctuations on Seismic Deformation of Existing Levees (Section E-E')

Table G-1: East Area A Static Profile

Layer	Total Unit Weight (pcf)	Elevation (feet)		Friction Angle (Degrees)	Cohesion (psf)
		From	To		
Embankment	115	20	10	28	300
Fill	115	10	0	28	250
Soft Clay	115	0	-20	0	500 [1]
Stiff Clay	115	-20	-35	0	1200
Dense Sand	120	-35	-55	35	0

Notes: 1) For drained condition, $\phi = 27$, c = 200 psf

Table G-2: East Area A Seismic Profile

Layer	Total Unit Weight (pcf)	Elevation (feet)		Friction Angle (Degrees)	Cohesion (psf)	Post-Liquefaction Strength (psf)
		From	To			
Embankment	115	20	10	28	300	N/A
Liquefied Fill	115	10	0	N/A	N/A	300
Soft Clay	115	0	-15	0	500 [1]	N/A
Liq Sand	115	-15	-30	N/A	N/A	400
Stiff Clay	115	-30	-35	0	1200	N/A
Dense Sand	120	-35	-55	35	0	N/A

Notes: 1) For drained condition, $\phi = 27$, c = 200 psf

Table G-3: West Area A Static Profile

Layer	Total Unit Weight (pcf)	Elevation (feet)		Friction Angle (Degrees)	Cohesion (psf)
		From	To		
Embankment	115	20	10	28	300
Fill	115	10	0	28	250
Soft Clay	115	0	-25	0	500 [1]
Stiff Clay	115	-25	-52	0	1000
Dense Sand	120	-52	-55	35	0

Notes: 1) For drained condition, $\phi = 27$, c = 200 psf

Table G-4: West Area A Seismic Profile

Layer	Total Unit Weight (pcf)	Elevation (feet)		Friction Angle (Degrees)	Cohesion (psf)	Post-Liquefaction Strength (psf)
		From	To			
Embankment	115	20	10	28	300	N/A
Liquefied Fill	115	10	0	N/A	N/A	300
Soft Clay	115	0	-20	0	500 [1]	N/A
Liq Sand	115	-20	-25	N/A	N/A	400
Stiff Clay	115	-25	-33	0	1000	N/A
Liq Sand 2	115	-33	-45	N/A	N/A	500
Stiff Clay	115	-45	-52	0	1000	N/A
Dense Sand	120	-35	-55	35	0	N/A

Notes: 1) For drained condition, $\phi = 27$, c = 200 psf

Table G-5: East Ballona Creek Static Profile

Layer	Total Unit Weight (pcf)	Elevation (feet)		Friction Angle (Degrees)	Cohesion (psf)
		From	To		
Embankment	115	20	7	28	300
Soft Clay	115	7	-10	0	500 [1]
Stiff Clay	115	-10	-25	0	1000 [1]
Med. Sand	115	-25	-35	33	0
Stiff Clay	115	-35	-45	0	1000 [1]
Dense Sand	120	-45	-55	35	0

Notes: 1) For drained condition, $\phi = 34$, c = 0 psf

Table G-6: East Ballona Creek Seismic Profile

Layer	Total Unit Weight (pcf)	Elevation (feet)		Friction Angle (Degrees)	Cohesion (psf)	Post-Liquefaction Strength (psf)
		From	To			
Embankment	115	20	7	28	300	N/A
Liquefied Sand	115	7	-3	N/A	N/A	300
Soft Clay	115	-3	-10	0	500 [1]	N/A
Stiff Clay	115	-10	-20	0	1000 [1]	N/A
Liq Sand 2	115	-20	-35	N/A	N/A	550
Stiff Clay	115	-35	-45	0	1000 [1]	N/A
Dense Sand	120	-45	-55	35	0	N/A

Notes: 1) For drained condition, $\phi = 34$, c = 0 psf

Table G-7: East Area B Static Profile

Layer	Total Unit Weight (pcf)	Elevation (feet)		Friction Angle (Degrees)	Cohesion (psf)
		From	To		
Embankment	115	20	9	28	300
Fill	115	9	2	28	250
Soft Clay	115	2	-10	0	500 [1]
Med. Sand	115	-10	-15	33	0
Med. Stiff Clay	115	-15	-48	0	600 [1]
Dense Sand	120	-48	-55	35	0

Notes: 1) For drained condition, $\phi = 34$, c = 0 psf

Table G-8: East Area B Seismic Profile

Layer	Total Unit Weight (pcf)	Elevation (feet)		Friction Angle (Degrees)	Cohesion (psf)	Post-Liquefaction Strength (psf)
		From	To			
Embankment	115	20	9	28	300	N/A
Liquefied Fill	115	9	2	N/A	N/A	300
Soft Clay	115	2	-10	0	500 [1]	N/A
Liq Sand	115	-10	-13	N/A	N/A	300
Med Stiff Clay	115	-13	-20	0	600 [1]	N/A
Liq Sand	115	-20	-42	N/A	N/A	300
Med Stiff Clay	115	-42	-48	0	600 [1]	N/A
Dense Sand	120	-48	-55	35	0	N/A

Notes: 1) For drained condition, $\phi = 34$, c = 0 psf

Table G-9: West Area B Static Profile

Layer	Total Unit Weight (pcf)	Elevation (feet)		Friction Angle (Degrees)	Cohesion (psf)
		From	To		
Embankment	115	20	7	28	300
Fill	115	7	2	28	250
Soft Clay	115	2	-12	0	300 [1,2]
Med. Sand	115	-12	-34	33	0
Stiff Clay	115	-34	-43	0	1000 [1]
Med. Sand	115	-43	-48	33	0
Dense Sand	120	-48	-55	35	0

Notes: 1) For drained condition, $\phi = 34$, c = 0 psf

2) Undrained shear strength underneath the levee is higher due levee surcharge

Table G-10: West Area B Seismic Profile

Layer	Total Unit Weight (pcf)	Elevation (feet)		Friction Angle (Degrees)	Cohesion (psf)	Post-Liquefaction Strength (psf)
		From	To			
Embankment	115	20	7	28	300	N/A
Liquefied Fill	115	7	2	N/A	N/A	300
Soft Clay	115	2	-12	0	300 [1,2]	N/A
Liq Sand	115	-12	-34	N/A	N/A	300
Stiff Clay	115	-34	-43	0	1000 [1]	N/A
Liq Sand 2	115	-43	-48	N/A	N/A	500
Dense Sand	120	-48	-55	35	0	N/A

Notes: 1) For drained condition, $\phi = 34$, c = 0 psf

2) Undrained shear strength underneath the levee is higher due levee surcharge

Table G-11: Area C Static Profile

Layer	Total Unit Weight (pcf)	Elevation (feet)		Friction Angle (Degrees)	Cohesion (psf)
		From	To		
Fill	115	20	5	28	250
Soft Clay	115	5	-3	0	500 [1]
Med. Sand	115	-3	-13	33	0
Stiff Clay	115	-13	-33	0	1200
Dense Sand	120	-33	-55	35	0

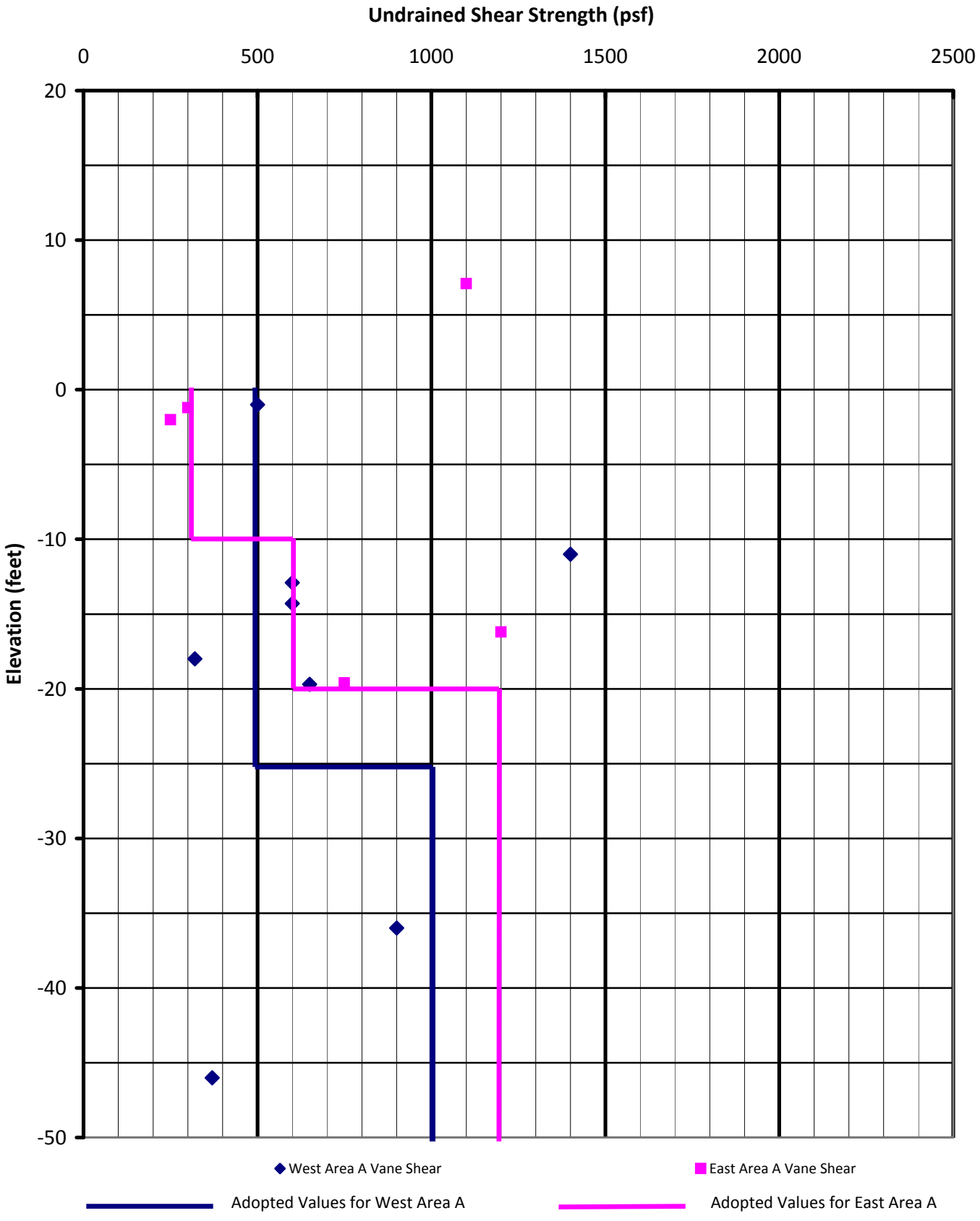
Notes: 1) For drained condition, $\phi = 27$, c = 200 psf

Table G-12: Area C Seismic Profile

Layer	Total Unit Weight (pcf)	Elevation (feet)		Friction Angle (Degrees)	Cohesion (psf)	Post-Liquefaction Strength (psf)
		From	To			
Fill	115	20	5	28	250	N/A
Soft Clay	115	5	-3	0	500 [1]	N/A
Med. Sand	115	-3	-8	33	0	N/A
Liq Sand	115	-8	-13	N/A	N/A	400
Stiff Clay	115	-13	-20	0	1200	N/A
Liq Sand 2	115	-20	-27	N/A	N/A	500
Stiff Clay	115	-27	-33	0	1200	N/A
Dense Sand	120	-33	-55	35	0	N/A

Notes: 1) For drained condition, $\phi = 27$, c = 200 psf

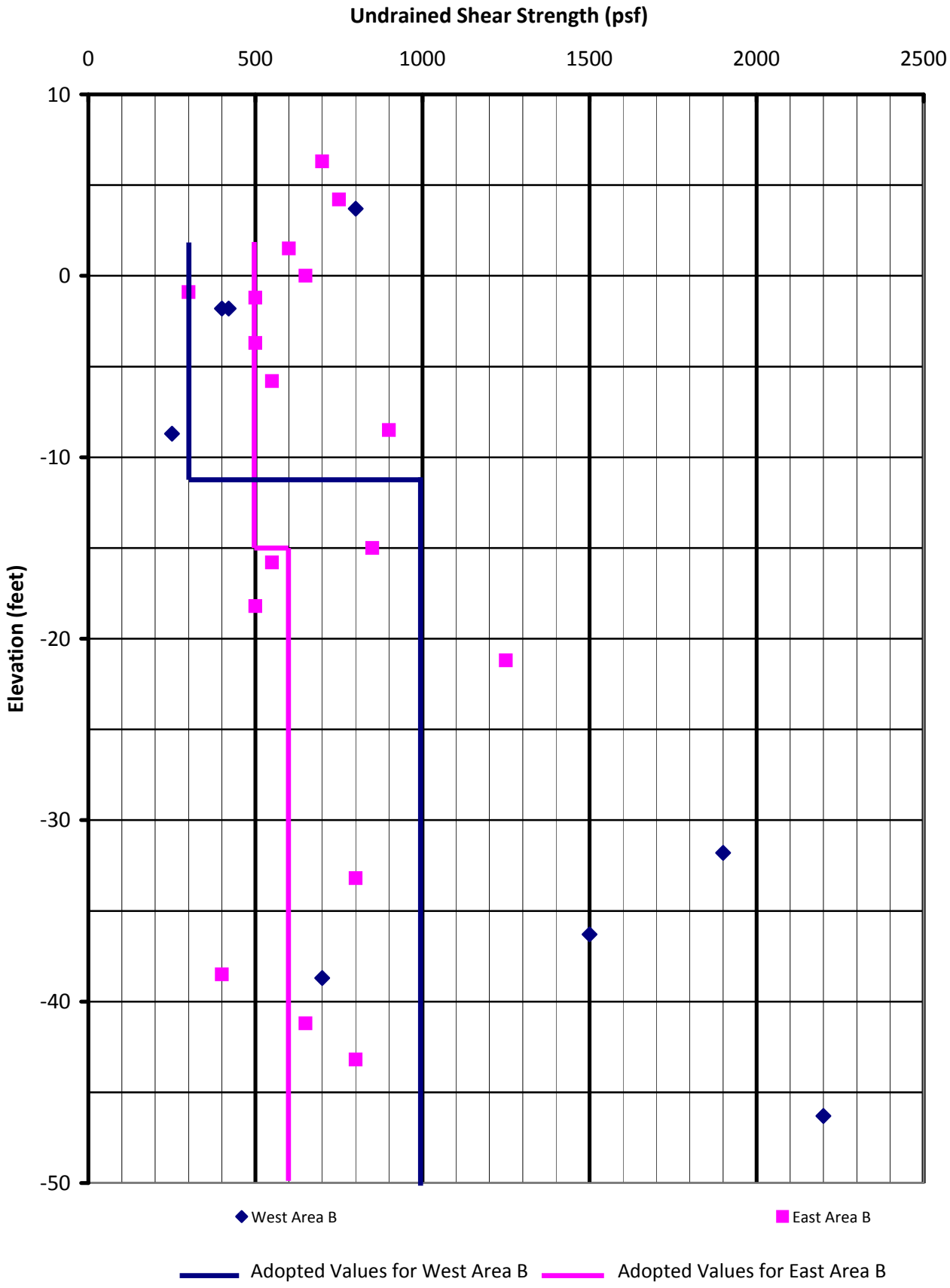
Area A - Undrained Shear Strength



Note: 1) The points shown on the graph are Vane Shear Strength Values adjusted based on Plasticity Index using Bjerrum (1972) Curve.
2) The adopted values consider the results of Lab Vane Shear, as well as estimates of undrained shear strength from CPT data.

PLATE G-7

Area B - Undrained Shear Strength

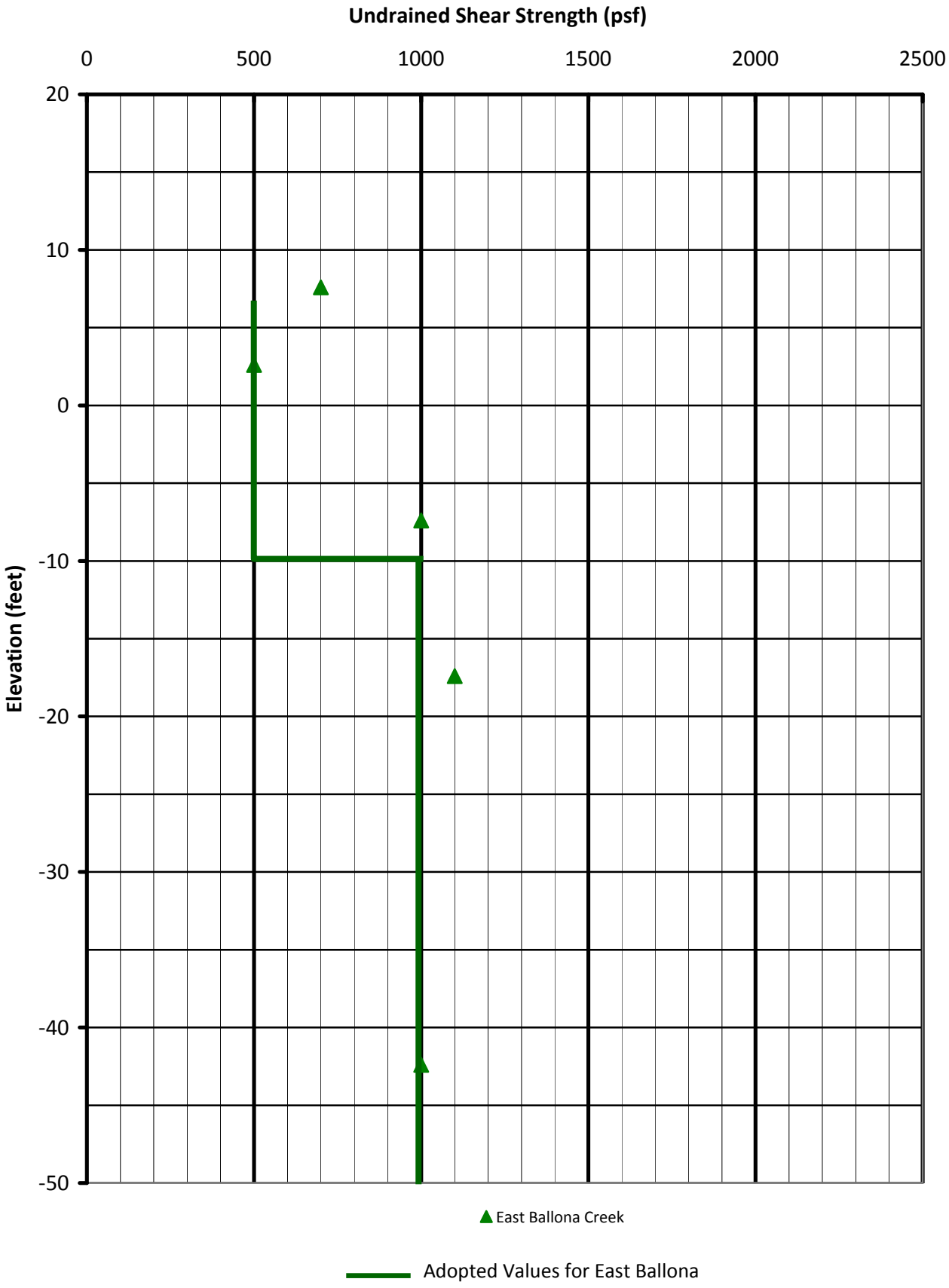


Note: 1) The points shown on the graph are Vane Shear Strength Values adjusted based on Plasticity Index using Bjerrum (1972) Curve.
2) The adopted values consider the results of Lab Vane Shear, as well as estimates of undrained shear strength from CPT data.

B1-1017

PLATE G-8

East Ballona Creek - Undrained Shear Strength



Note: 1) The points shown on the graph are Vane Shear Strength Values adjusted based on Plasticity Index using Bjerrum (1972) Curve.
2) The adopted values consider the results of Lab Vane Shear, as well as estimates of undrained shear strength from CPT data.

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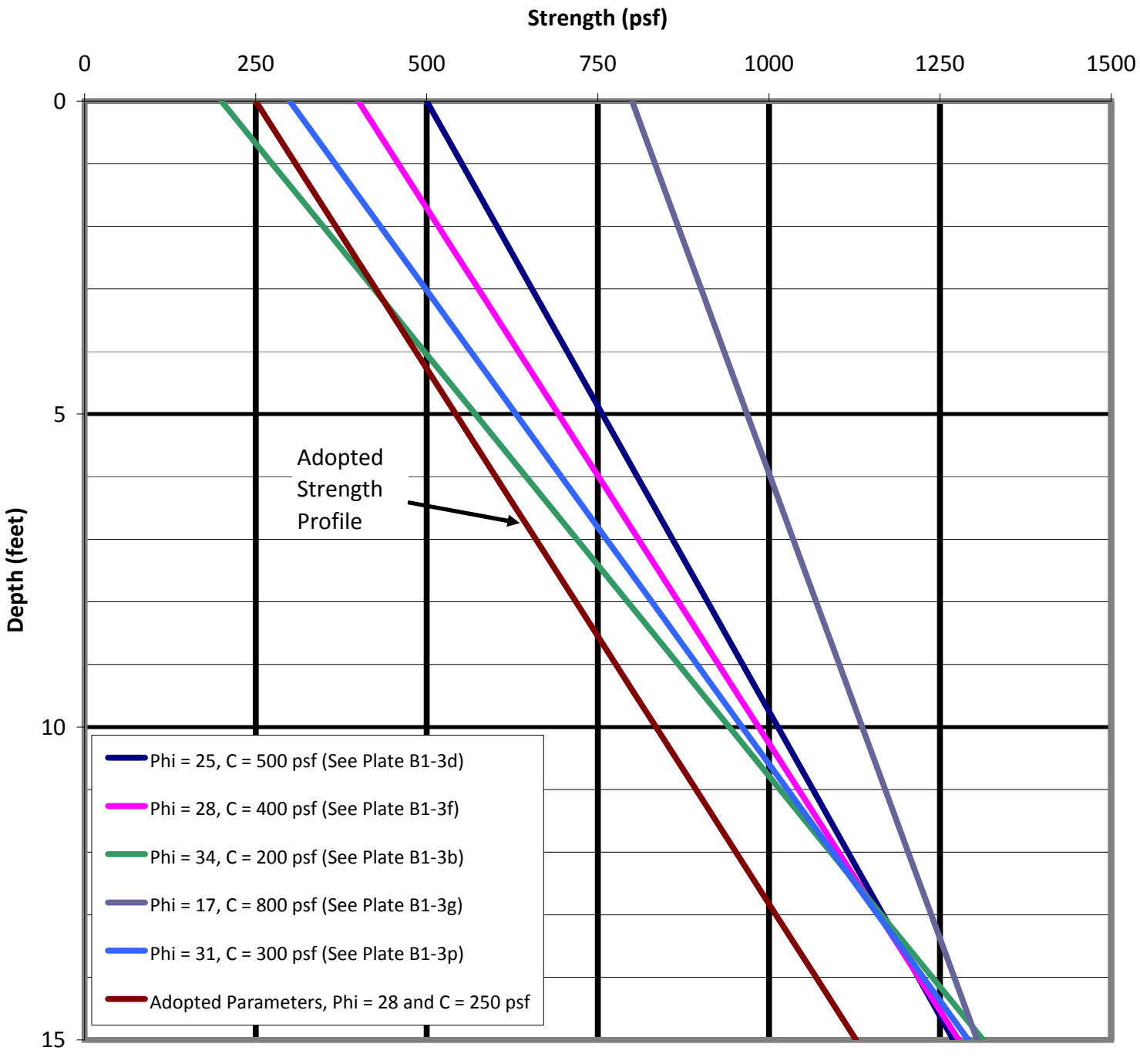
PLATE G-9

Soil Strength Parameters for Fill Soils (Unsaturated)

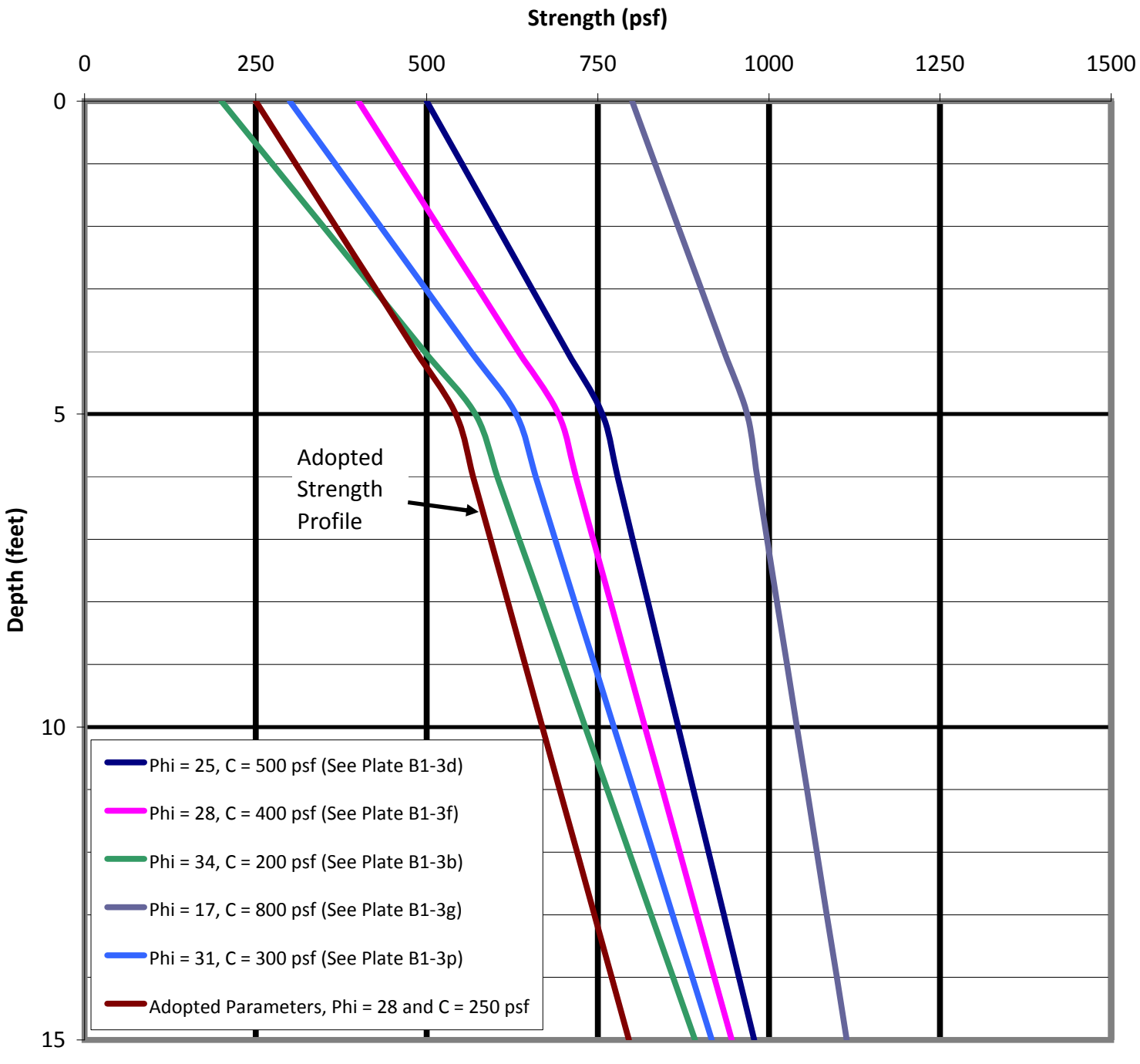


Note: 1) The lines shown are strength profiles versus depth using Parameters found from Direct Shear Tests on Near Surface Fill Soils.

2) The adopted profile is generally conservative, based on a Phi = 28 degrees, and C = 250 psf.

3) The adopted soil parameters for Embankment Soils are Phi = 28 degrees, and C = 300 psf, assuming proper compaction.

Soil Strength Parameters for Fill Soils (Saturated)



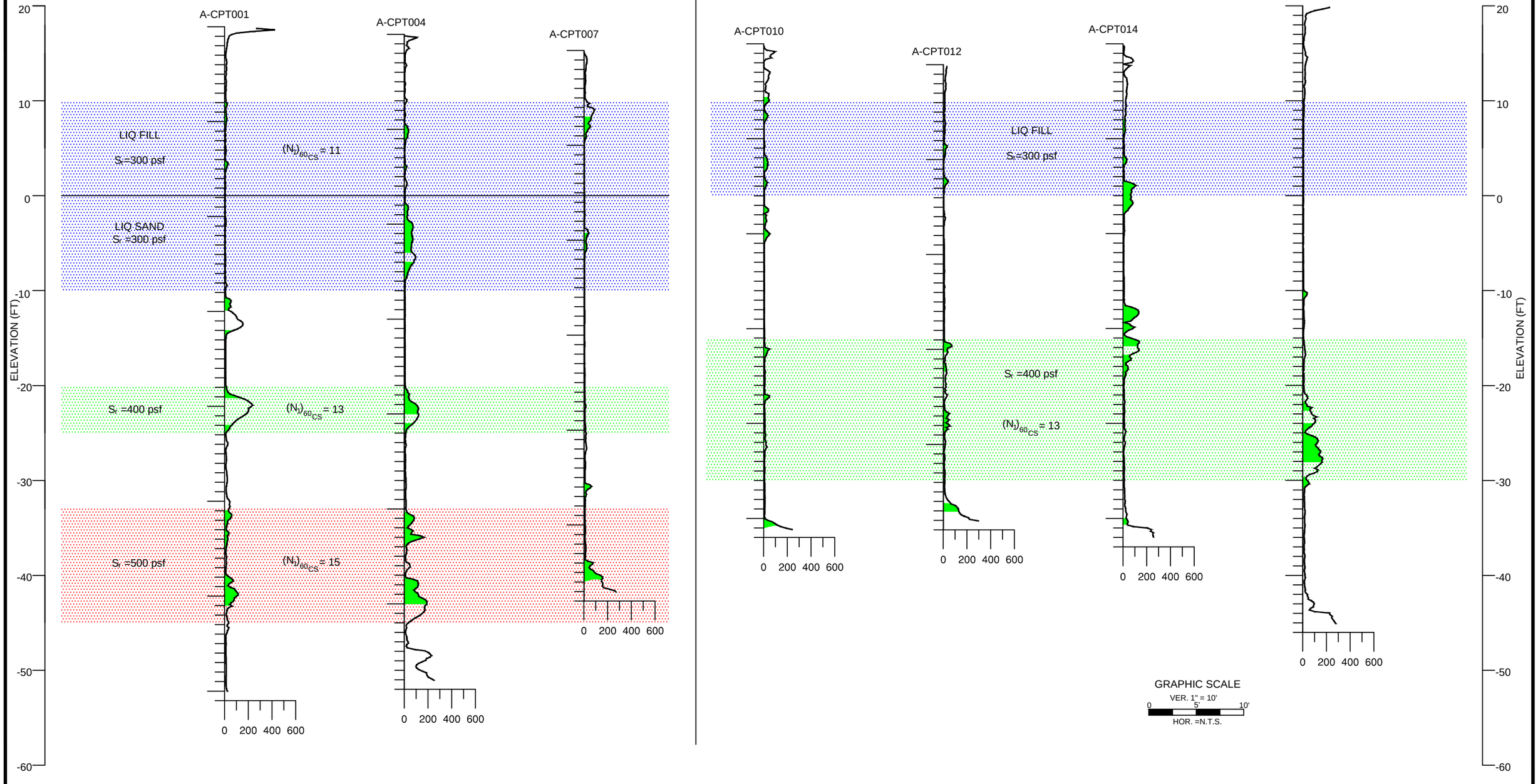
Note: 1) The lines shown are strength profiles versus depth using Parameters found from Direct Shear Tests on Near Surface Fill Soils, and assuming a groundwater depth of 5 feet.

2) The adopted profile is generally conservative, based on a Phi = 28 degrees, and C = 250 psf.

3) The adopted soil parameters for Embankment Soils are Phi = 28 degrees, and C = 300 psf, assuming proper compaction.

WEST AREA A PROFILE

EAST AREA A PROFILE



LEGEND

NOTE

(1) SOME CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/28/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	LIQUEFIED LAYERS ALONG AREA A PERIMETER LEVEE BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION: 3/5/2013	APPROVED BY: P. Kashighandi		
REVISION:	B1-1021		

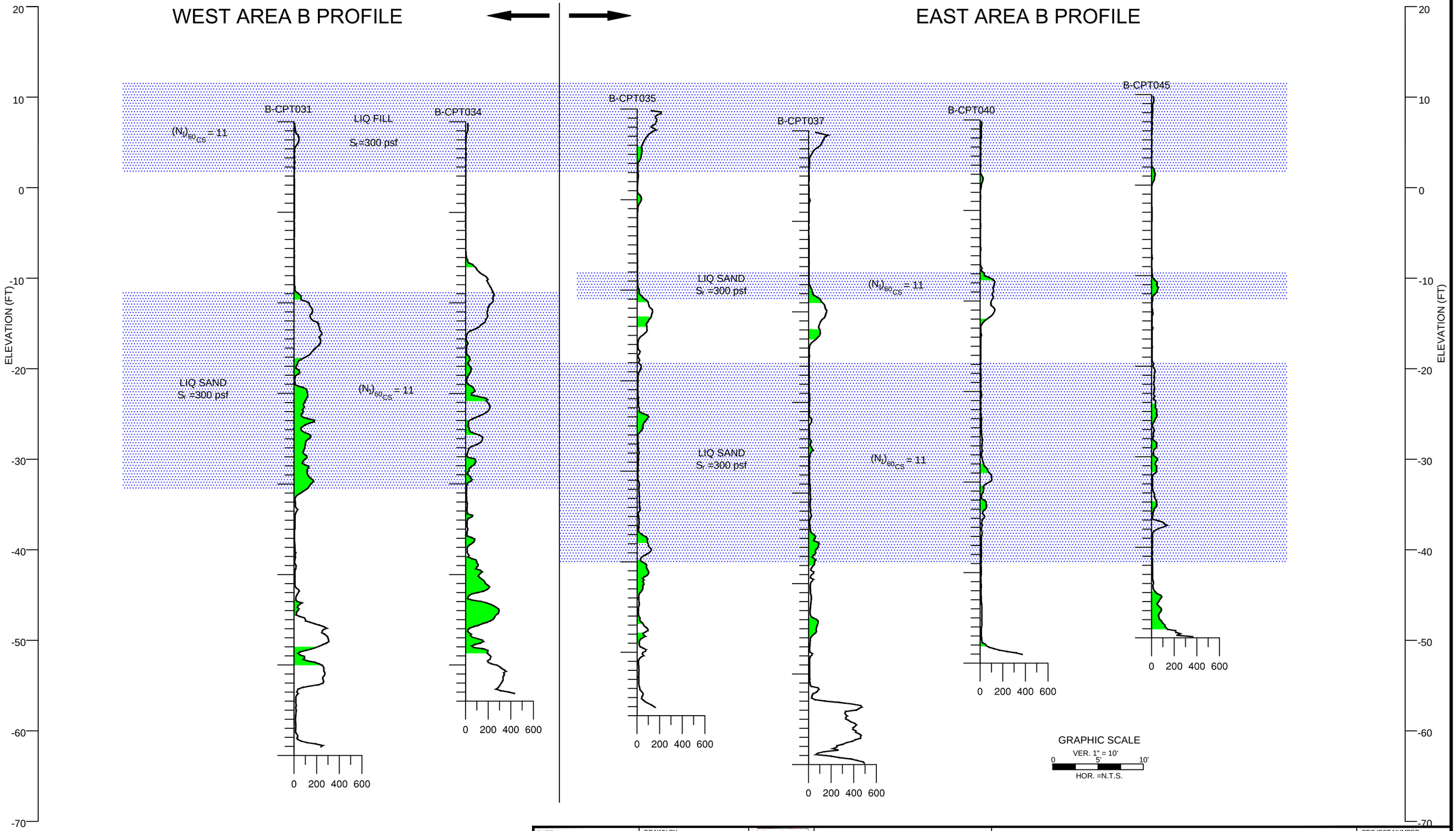
PROJECT NUMBER: L962A

SCALE: AS SHOWN

PLATE NUMBER: G-12

WEST AREA B PROFILE

EAST AREA B PROFILE



LEGEND

NOTE

(1) SOME CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/28/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	LIQUEFIED LAYERS ALONG AREA B PERIMETER LEVEE BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION: 3/5/2013	APPROVED BY: P. Kashighandi		
REVISION:	B1-1022		

PROJECT NUMBER: L962A

SCALE: AS SHOWN

PLATE NUMBER: G-13

EAST BALLONA CREEK CHANNEL

B-CPT052 B-CPT054 B-CPT056 B-CPT057 B-CPT059 A-CPT021 A-CPT022 B-CPT050 A-CPT025

ELEVATION (FT)

20 10 0 -10 -20 -30 -40 -50 -60

0 200 400 600

LIQ SAND
S_r=300 psf

S_r =550 psf

$(N_1)_{60CS} \geq 16$

GRAPHIC SCALE
VER. 1" = 10'
0 5' 10'
HOR. =N.T.S.

LEGEND

NOTE

(1) SOME CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/28/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	LIQUEFIED LAYERS ALONG BALLONA CREEK LEVEE BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION: 3/5/2013	APPROVED BY: P. Kashighandi		PROJECT NUMBER: L962A SCALE: AS SHOWN
REVISION:	B1-1023		PLATE NUMBER: G-14

SOUTH

NORTH

C-CPT062

C-CPT063

C-CPT060

S_r =400 psf

$(N_1)_{60CS}$ = 13

S_r =500 psf

$(N_1)_{60CS}$ = 15

ELEVATION (FT)

30
20
10
0
-10
-20
-30
-40
-50

0 200 400 600

GRAPHIC SCALE

VER. 1" = 10'

0 5' 10'

HOR. =N.T.S.

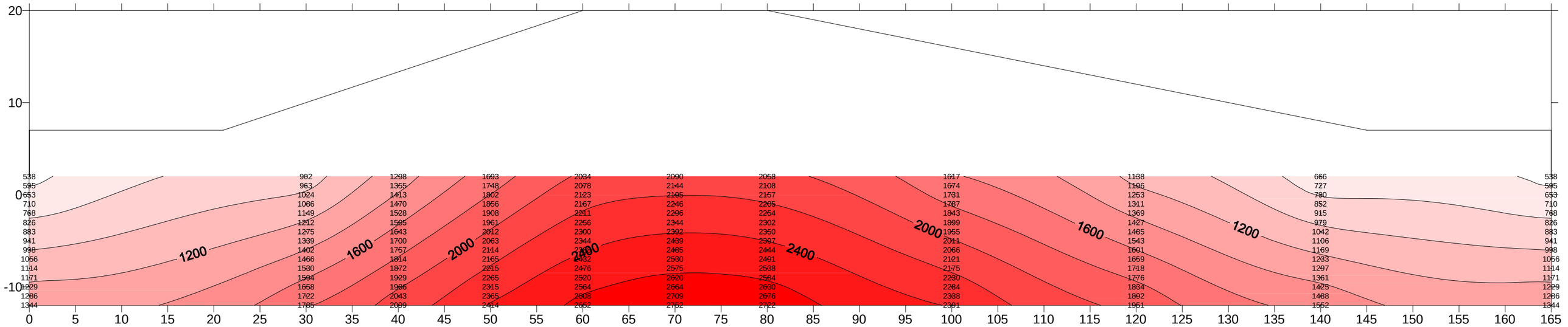
LEGEND

NOTE

(1) SOME CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

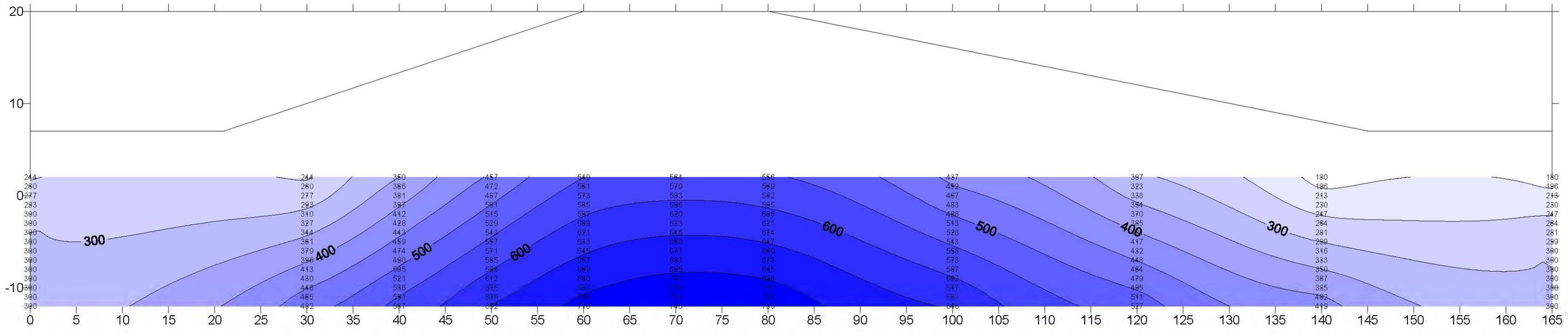
DATE: 2/28/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501
REVISION: 3/5/2013	APPROVED BY: P. Kashighandi	LIQUEFIED LAYERS WITHIN AREA C BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION:	B1-1024	PROJECT NUMBER: L962A SCALE: AS SHOWN FIGURE NUMBER: G-15



Stresses under West Area B Levees

B1-1025

PLATE G-16



SHANSEP assuming Normal Consolidation at 15', with $S_u = 300$ psf

$$\sigma_v' = 4 \times 120 + 11 \times (120 - 62.4) = 1114 \text{ psf}$$

$$\left(\frac{S_u}{\sigma_v'}\right)_{NC} = \left(\frac{300}{1114}\right) = \underline{0.27}$$

Typical Range

$$\left(\frac{S_u}{\sigma_v'}\right) \simeq 0.11 + 0.0037 \overset{40}{\uparrow}(PI) = 0.26$$

$$\left(\frac{S_u}{\sigma_v'}\right) \simeq 0.45 \left(\frac{LL}{100}\right) = 0.45\ (0.7) = 0.32$$

Undrained Shear Strength Gain Due to Surcharging Under West Area B Levees using SHANSEP

B1-1026

PLATE G-17

Center of Embankment

Elev.	Depth	$\sigma v'_{init.}$	OCR	σ p	$\Delta\sigma$	$\sigma v'_{final}$	Su (psf)
7	0	0					Fil
6	1	120					Fil
5	2	240					Fil
4	3	360					Fil
3	4	480					Fil
2	5	538	2.0	1075	1,553	2,090	564
1	6	595	1.9	1131	1,548	2,144	579
0	7	653	1.8	1175	1,543	2,195	593
-1	8	710	1.7	1208	1,536	2,246	606
-2	9	768	1.6	1229	1,528	2,296	620
-3	10	826	1.5	1238	1,518	2,344	633
-4	11	883	1.4	1236	1,508	2,392	646
-5	12	941	1.3	1223	1,498	2,439	658
-6	13	998	1.2	1198	1,486	2,485	671
-7	14	1056	1.1	1162	1,474	2,530	683
-8	15	1114	1.0	1114	1,462	2,575	695
-9	16	1171	1.0	1171	1,449	2,620	707
-10	17	1229	1.0	1229	1,436	2,664	719
-11	18	1286	1.0	1286	1,422	2,709	731
-12	19	1344	1.0	1344	1,408	2,752	743

Dry Side Edge of Crest

Elev.	Depth	$\sigma v'_{init.}$	OCR	σ p	$\Delta\sigma$	$\sigma v'_{final}$	Su (psf)
7	0	0					Fil
6	1	120					Fil
5	2	240					Fil
4	3	360					Fil
3	4	480					Fil
2	5	538	2.0	1075	1,496	2,034	549
1	6	595	1.9	1131	1,483	2,078	561
0	7	653	1.8	1175	1,470	2,123	573
-1	8	710	1.7	1208	1,457	2,167	585
-2	9	768	1.6	1229	1,443	2,211	597
-3	10	826	1.5	1238	1,430	2,256	609
-4	11	883	1.4	1236	1,417	2,300	621
-5	12	941	1.3	1223	1,403	2,344	633
-6	13	998	1.2	1198	1,390	2,388	645
-7	14	1056	1.1	1162	1,376	2,432	657
-8	15	1114	1.0	1114	1,363	2,476	669
-9	16	1171	1.0	1171	1,349	2,520	680
-10	17	1229	1.0	1229	1,335	2,564	692
-11	18	1286	1.0	1286	1,322	2,608	704
-12	19	1344	1.0	1344	1,308	2,652	716

Undrained Shear Strength Gain Due to Surcharging Under West Area B Levees using SHANSEP

Water Side Edge of Crest

Elev.	Depth	$\sigma v'_{init.}$	OCR	σ p	$\Delta\sigma$	$\sigma v'_{final}$	Su (psf)
7	0	0					Fil
6	1	120					Fil
5	2	240					Fil
4	3	360					Fil
3	4	480					Fil
2	5	538	2.0	1075	1,521	2,058	556
1	6	595	1.9	1131	1,512	2,108	569
0	7	653	1.8	1175	1,504	2,157	582
-1	8	710	1.7	1208	1,495	2,205	595
-2	9	768	1.6	1229	1,486	2,254	608
-3	10	826	1.5	1238	1,476	2,302	621
-4	11	883	1.4	1236	1,466	2,350	634
-5	12	941	1.3	1223	1,456	2,397	647
-6	13	998	1.2	1198	1,446	2,444	660
-7	14	1056	1.1	1162	1,435	2,491	673
-8	15	1114	1.0	1114	1,424	2,538	685
-9	16	1171	1.0	1171	1,413	2,584	698
-10	17	1229	1.0	1229	1,402	2,630	710
-11	18	1286	1.0	1286	1,390	2,676	723
-12	19	1344	1.0	1344	1,378	2,722	735

10 foot Dry Side of Crest

Elev.	Depth	$\sigma v'_{init.}$	OCR	σ p	$\Delta\sigma$	$\sigma v'_{final}$	Su (psf)
7	0	0					Fil
6	1	120					Fil
5	2	240					Fil
4	3	360					Fil
3	4	480					Fil
2	5	538	2.0	1075	1,156	1,693	457
1	6	595	1.9	1131	1,153	1,748	472
0	7	653	1.8	1175	1,149	1,802	487
-1	8	710	1.7	1208	1,145	1,856	501
-2	9	768	1.6	1229	1,140	1,908	515
-3	10	826	1.5	1238	1,135	1,961	529
-4	11	883	1.4	1236	1,129	2,012	543
-5	12	941	1.3	1223	1,123	2,063	557
-6	13	998	1.2	1198	1,116	2,114	571
-7	14	1056	1.1	1162	1,109	2,165	585
-8	15	1114	1.0	1114	1,101	2,215	598
-9	16	1171	1.0	1171	1,094	2,265	612
-10	17	1229	1.0	1229	1,086	2,315	625
-11	18	1286	1.0	1286	1,078	2,365	638
-12	19	1344	1.0	1344	1,070	2,414	652

Undrained Shear Strength Gain Due to Surcharging Under West Area B Levees using SHANSEP

20 foot Dry Side of Crest

Elev.	Depth	$\sigma v'_{init.}$	OCR	σ p	$\Delta\sigma$	$\sigma v'_{final}$	Su (psf)
7	0	0					Fil
6	1	120					Fil
5	2	240					Fil
4	3	360					Fil
3	4	480					Fil
2	5	538	2.0	1075	760	1,298	350
1	6	595	1.9	1131	760	1,355	366
0	7	653	1.8	1175	760	1,413	381
-1	8	710	1.7	1208	760	1,470	397
-2	9	768	1.6	1229	760	1,528	412
-3	10	826	1.5	1238	760	1,585	428
-4	11	883	1.4	1236	759	1,643	443
-5	12	941	1.3	1223	759	1,700	459
-6	13	998	1.2	1198	759	1,757	474
-7	14	1056	1.1	1162	758	1,814	490
-8	15	1114	1.0	1114	758	1,872	505
-9	16	1171	1.0	1171	757	1,929	521
-10	17	1229	1.0	1229	757	1,986	536
-11	18	1286	1.0	1286	756	2,043	551
-12	19	1344	1.0	1344	755	2,099	567

30 foot Dry Side of Crest

Elev.	Depth	$\sigma v'_{init.}$	OCR	σ p	$\Delta\sigma$	$\sigma v'_{final}$	Su (psf)
7	0	0					Fil
6	1	120					Fil
5	2	240					Fil
4	3	360					Fil
3	4	480					Fil
2	5	538	2.0	1075	365	902	**244**
1	6	595	1.9	1131	368	963	**260**
0	7	653	1.8	1175	372	1,024	**277**
-1	8	710	1.7	1208	376	1,086	**293**
-2	9	768	1.6	1229	381	1,149	**310**
-3	10	826	1.5	1238	386	1,212	**327**
-4	11	883	1.4	1236	392	1,275	344
-5	12	941	1.3	1223	398	1,339	361
-6	13	998	1.2	1198	404	1,402	379
-7	14	1056	1.1	1162	410	1,466	396
-8	15	1114	1.0	1114	416	1,530	413
-9	16	1171	1.0	1171	423	1,594	430
-10	17	1229	1.0	1229	429	1,658	448
-11	18	1286	1.0	1286	435	1,722	465
-12	19	1344	1.0	1344	441	1,785	482

Note: Bold Su values imply that soils are still overconsolidated.
Strength gain is more than what's shown for overconsolidated depths

Undrained Shear Strength Gain Due to Surcharging Under West Area B Levees using SHANSEP

20 foot Water Side of Crest

Elev.	Depth	$\sigma v'_{init.}$	OCR	σ p	$\Delta\sigma$	$\sigma v'_{final}$	Su (psf)
7	0	0					Fil
6	1	120					Fil
5	2	240					Fil
4	3	360					Fil
3	4	480					Fil
2	5	538	2.0	1075	1,079	1,617	437
1	6	595	1.9	1131	1,079	1,674	452
0	7	653	1.8	1175	1,078	1,731	467
-1	8	710	1.7	1208	1,077	1,787	483
-2	9	768	1.6	1229	1,075	1,843	498
-3	10	826	1.5	1238	1,074	1,899	513
-4	11	883	1.4	1236	1,072	1,955	528
-5	12	941	1.3	1223	1,070	2,011	543
-6	13	998	1.2	1198	1,067	2,066	558
-7	14	1056	1.1	1162	1,065	2,121	573
-8	15	1114	1.0	1114	1,062	2,175	587
-9	16	1171	1.0	1171	1,058	2,230	602
-10	17	1229	1.0	1229	1,055	2,284	617
-11	18	1286	1.0	1286	1,051	2,338	631
-12	19	1344	1.0	1344	1,047	2,391	646

40 foot Water Side of Crest

Elev.	Depth	$\sigma v'_{init.}$	OCR	σ p	$\Delta\sigma$	$\sigma v'_{final}$	Su (psf)
7	0	0					Fil
6	1	120					Fil
5	2	240					Fil
4	3	360					Fil
3	4	480					Fil
2	5	538	2.0	1075	600	1,138	307
1	6	595	1.9	1131	600	1,196	323
0	7	653	1.8	1175	601	1,253	338
-1	8	710	1.7	1208	601	1,311	354
-2	9	768	1.6	1229	601	1,369	370
-3	10	826	1.5	1238	601	1,427	385
-4	11	883	1.4	1236	602	1,485	401
-5	12	941	1.3	1223	602	1,543	417
-6	13	998	1.2	1198	603	1,601	432
-7	14	1056	1.1	1162	603	1,659	448
-8	15	1114	1.0	1114	604	1,718	464
-9	16	1171	1.0	1171	605	1,776	479
-10	17	1229	1.0	1229	605	1,834	495
-11	18	1286	1.0	1286	606	1,892	511
-12	19	1344	1.0	1344	607	1,951	527

Undrained Shear Strength Gain Due to Surcharging Under West Area B Levees using SHANSEP

60 foot Water Side of Crest

Elev.	Depth	$\sigma v'_{init.}$	OCR	σ p	$\Delta\sigma$	$\sigma v'_{final}$	Su (psf)
7	0	0					Fil
6	1	120					Fil
5	2	240					Fil
4	3	360					Fil
3	4	480					Fil
2	5	538	2.0	1075	128	666	**180**
1	6	595	1.9	1131	132	727	**196**
0	7	653	1.8	1175	137	790	**213**
-1	8	710	1.7	1208	142	852	**230**
-2	9	768	1.6	1229	147	915	**247**
-3	10	826	1.5	1238	153	979	**264**
-4	11	883	1.4	1236	159	1,042	**281**
-5	12	941	1.3	1223	165	1,106	**299**
-6	13	998	1.2	1198	171	1,169	**316**
-7	14	1056	1.1	1162	177	1,233	333
-8	15	1114	1.0	1114	183	1,297	350
-9	16	1171	1.0	1171	190	1,361	367
-10	17	1229	1.0	1229	196	1,425	385
-11	18	1286	1.0	1286	202	1,488	402
-12	19	1344	1.0	1344	208	1,552	419

Note: Bold Su values imply that soils are still overconsolidated.
Strength gain is more than what's shown for overconsolidated depths

Undrained Shear Strength Gain Due to Surcharging Under West Area B Levees using SHANSEP

JOB TITLE : Section A-A' - End of Construction

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 11:07

Factor of Safety 3.39

Shear Strain Rate Contours

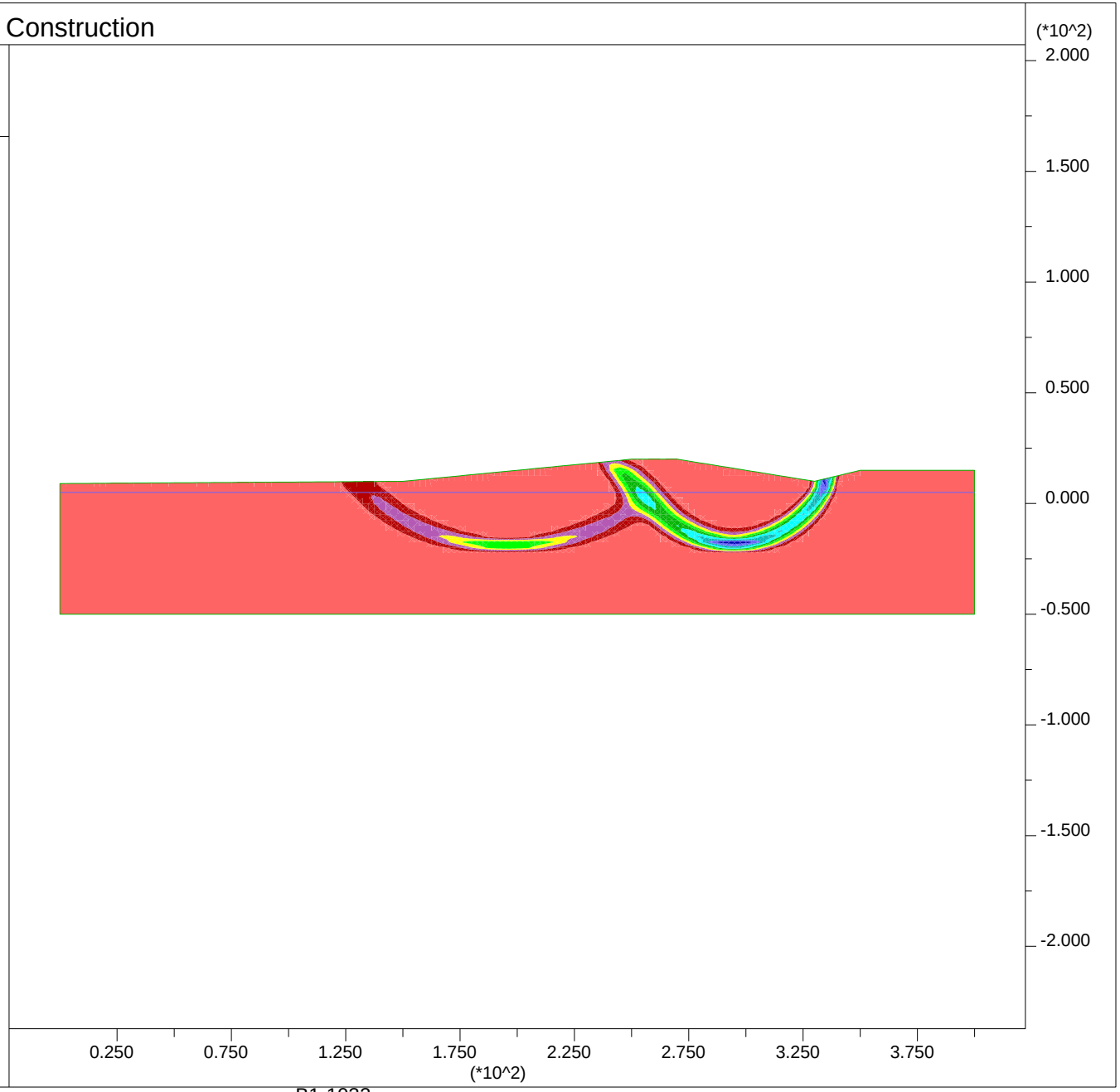
- 5.00E-08
- 1.00E-07
- 1.50E-07
- 2.00E-07
- 2.50E-07
- 3.00E-07
- 3.50E-07
- 4.00E-07
- 4.50E-07

Contour interval= 5.00E-08
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands



B1-1032

PLATE G-23

JOB TITLE : Section A-A' - End of Construction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 11:04

Factor of Safety 3.39

User-defined Groups

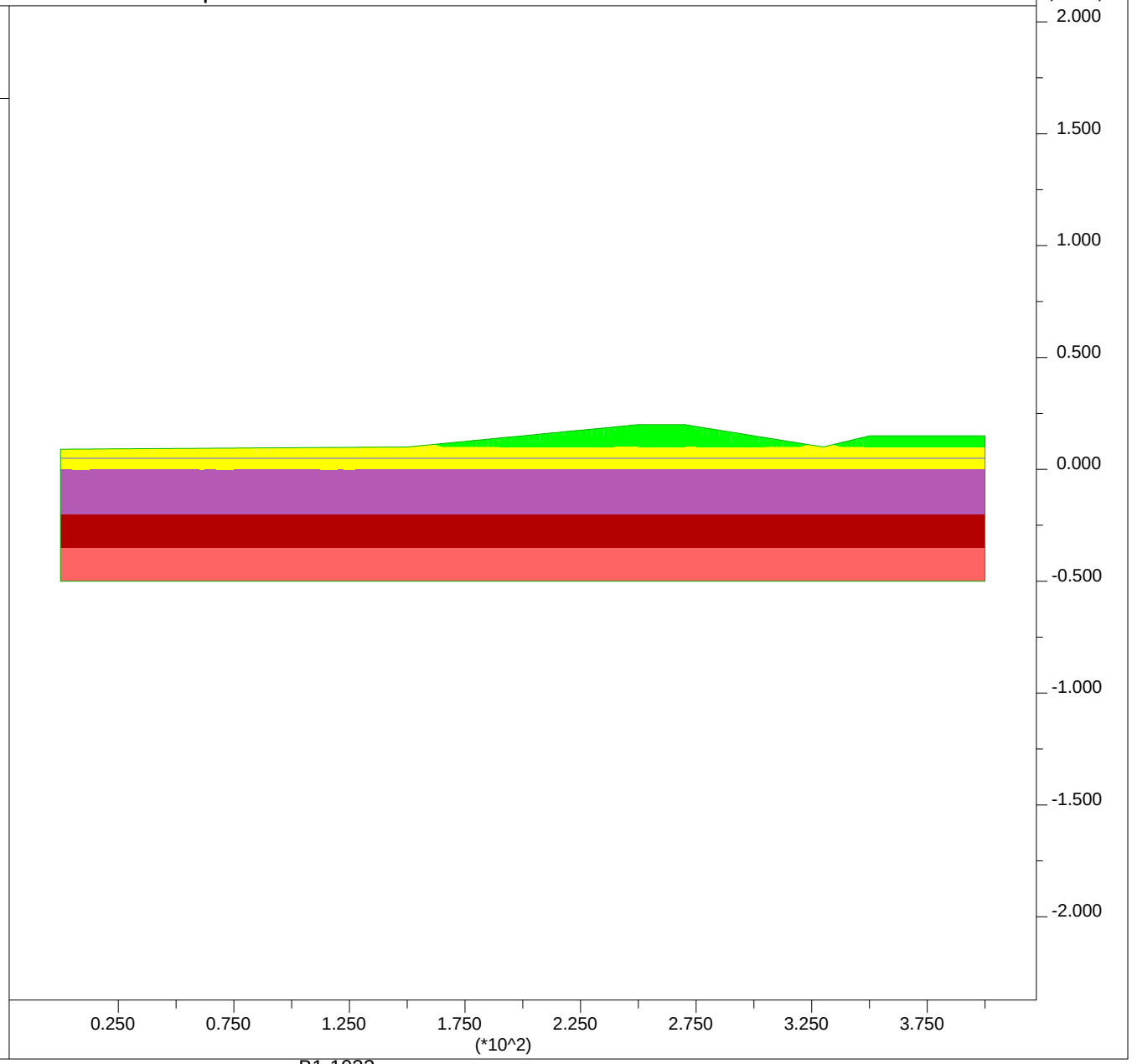
- User:Sand
- 'User:Stiff Clay'
- 'User:Soft Clay'
- User:Fill
- User:Embankment

Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands



B1-1033

PLATE G-24

JOB TITLE : Section A-A' - High Water Short Term

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 11:09

Factor of Safety 3.35

Shear Strain Rate Contours

- 2.50E-07
- 5.00E-07
- 7.50E-07
- 1.00E-06
- 1.25E-06
- 1.50E-06
- 1.75E-06
- 2.00E-06
- 2.25E-06

Contour interval= 2.50E-07
(zero contour omitted)
Boundary plot

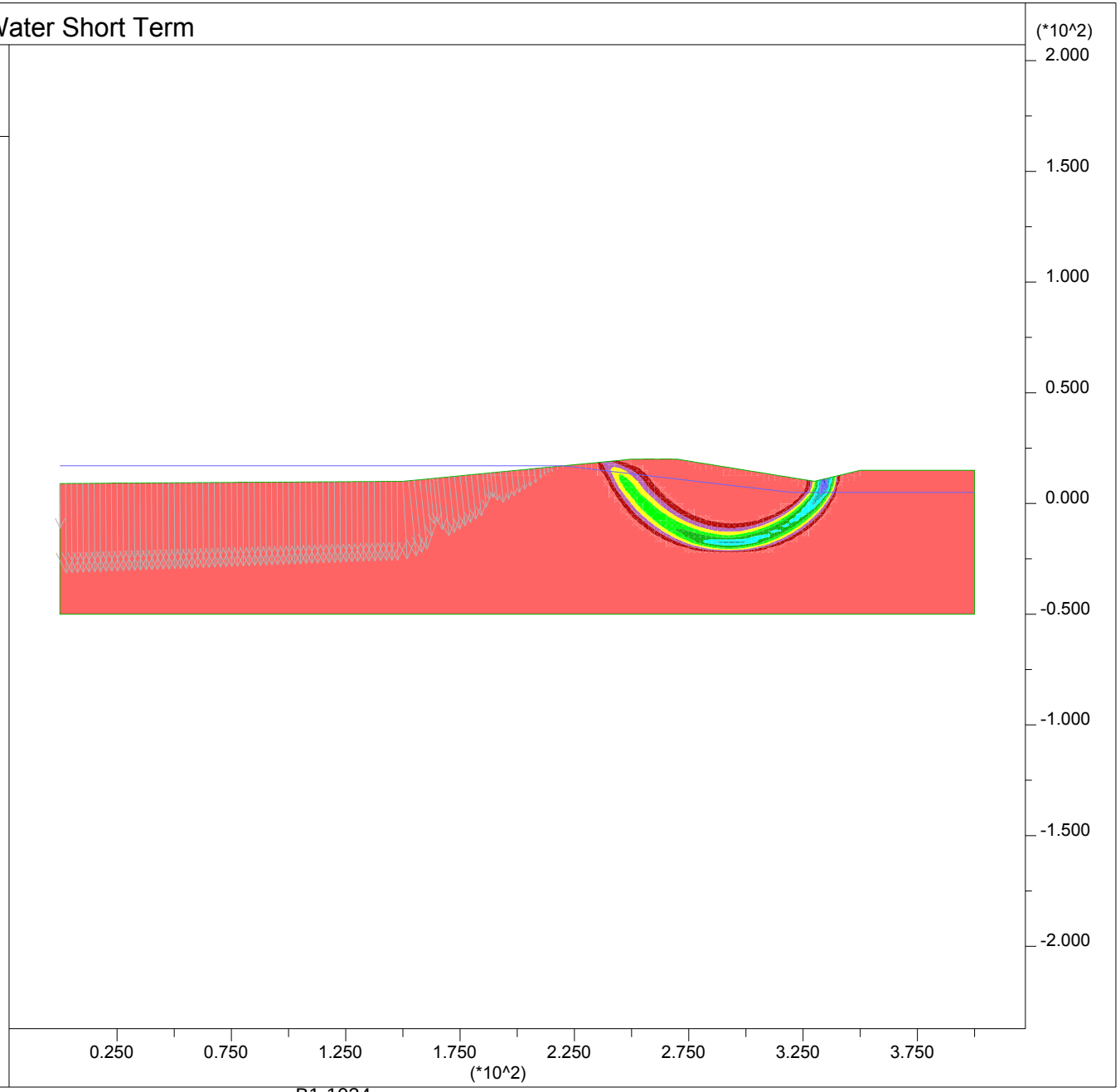
0 1E 2

Water Table

Net Applied Forces

max vector = 1.247E+03

Group Delta Consultants
Ballona Wetlands



B1-1034

PLATE G-25

JOB TITLE : Section A-A' - High Water Short Term - Input

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 11:04

Factor of Safety 3.35

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Soft Clay'
- User:Fill
- User:Embankment

Boundary plot

0 1E 2

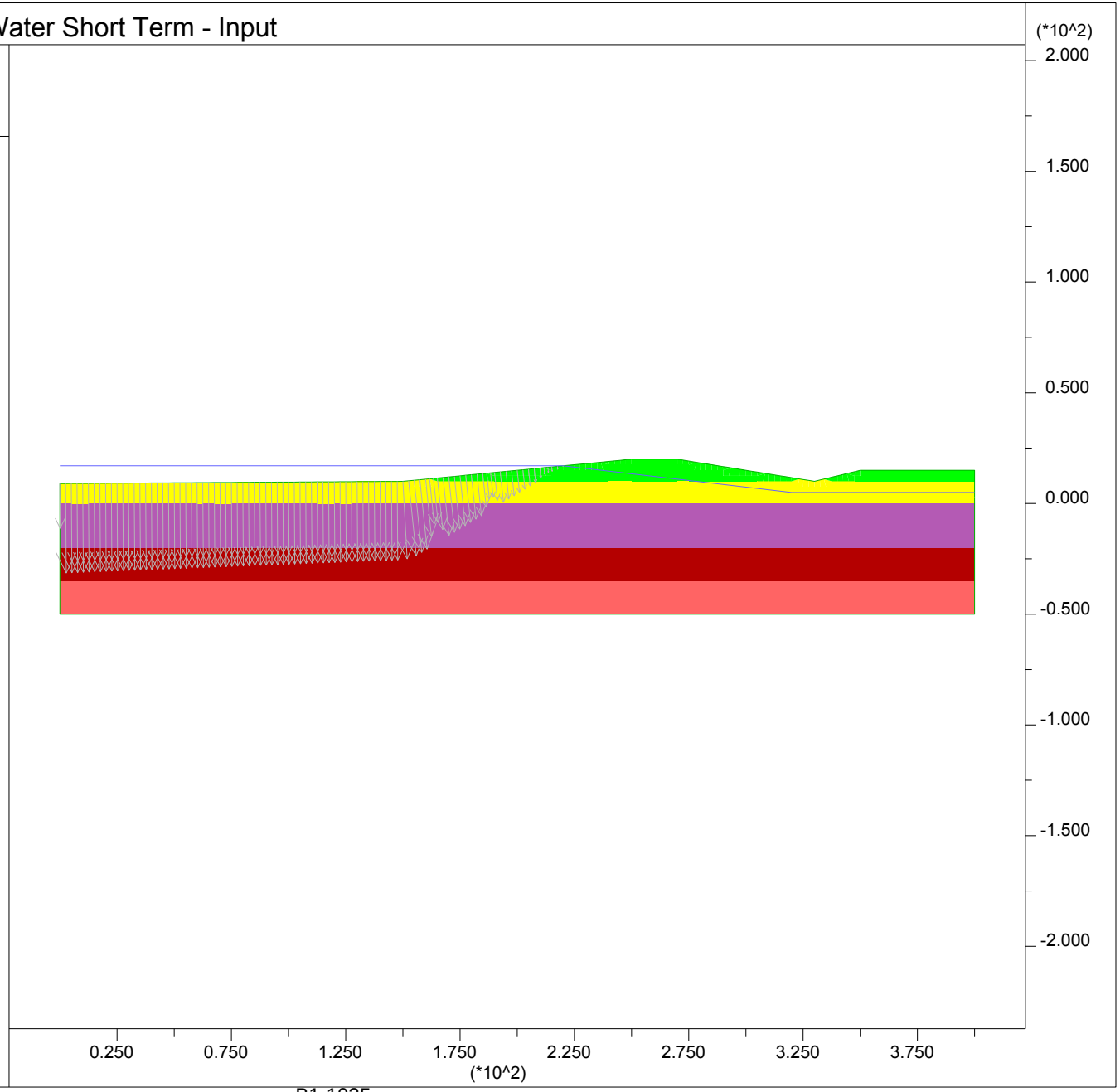
Water Table

Net Applied Forces

max vector = 1.247E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands



B1-1035

PLATE G-26

JOB TITLE : Section A-A' - High Water Long Term (Steady State)

FLAC/SLOPE (Version 7.00)

LEGEND

5-Mar-13 14:14

Factor of Safety 5.21

Shear Strain Rate Contours

- 2.50E-07
- 5.00E-07
- 7.50E-07
- 1.00E-06
- 1.25E-06
- 1.50E-06

Contour interval= 2.50E-07
(zero contour omitted)
Boundary plot

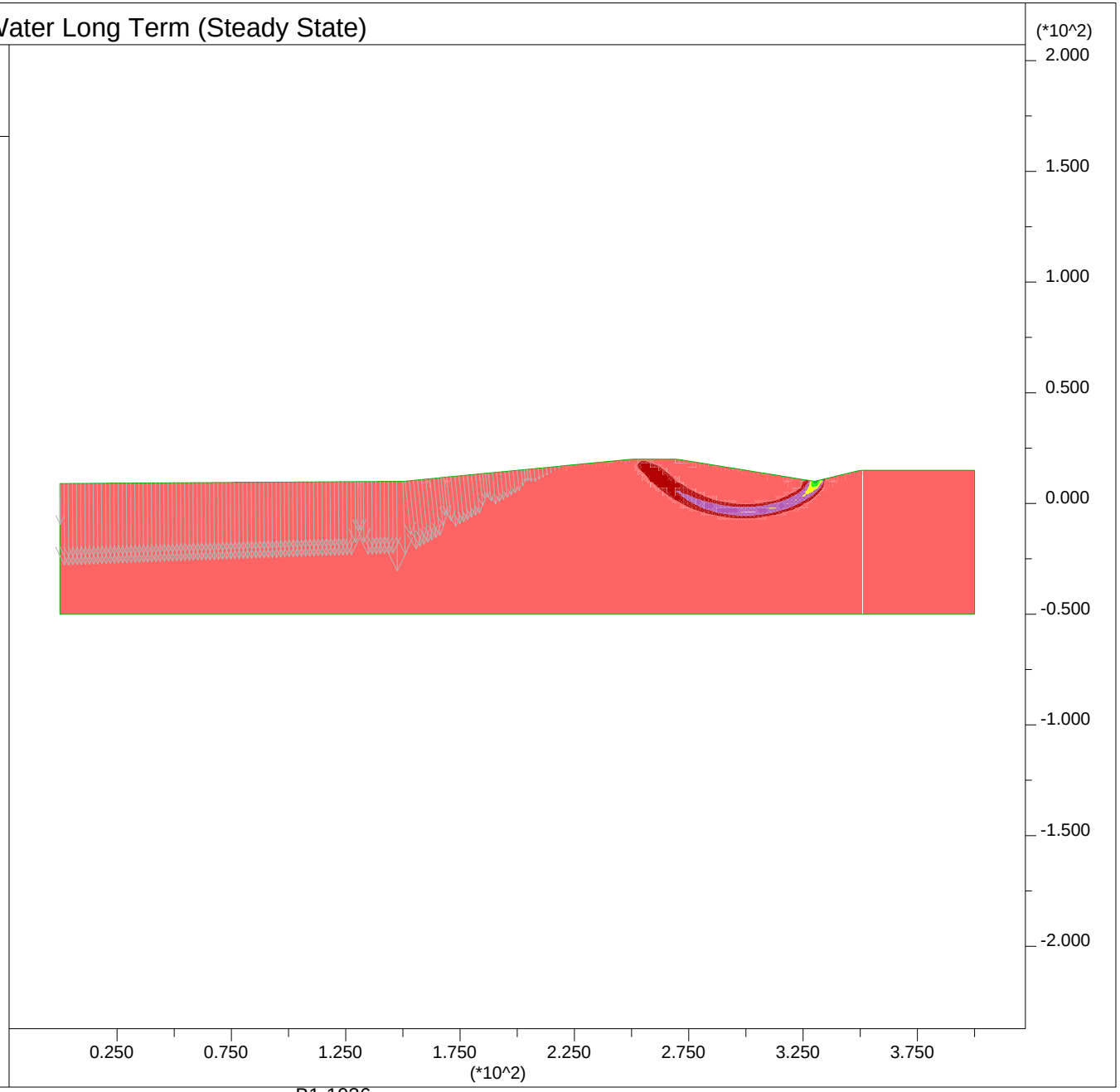
0 1E 2

Net Applied Forces

max vector = 9.947E+02

0 2E 3

Group Delta Consultants
Ballona Wetlands



B1-1036

PLATE G-27

JOB TITLE : Section A-A' - High Water Long Term (Steady State) - Input

FLAC/SLOPE (Version 7.00)

LEGEND

5-Mar-13 14:22

Factor of Safety 5.21

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Soft Clay'
- User:Fill
- User:Embankment

Boundary plot

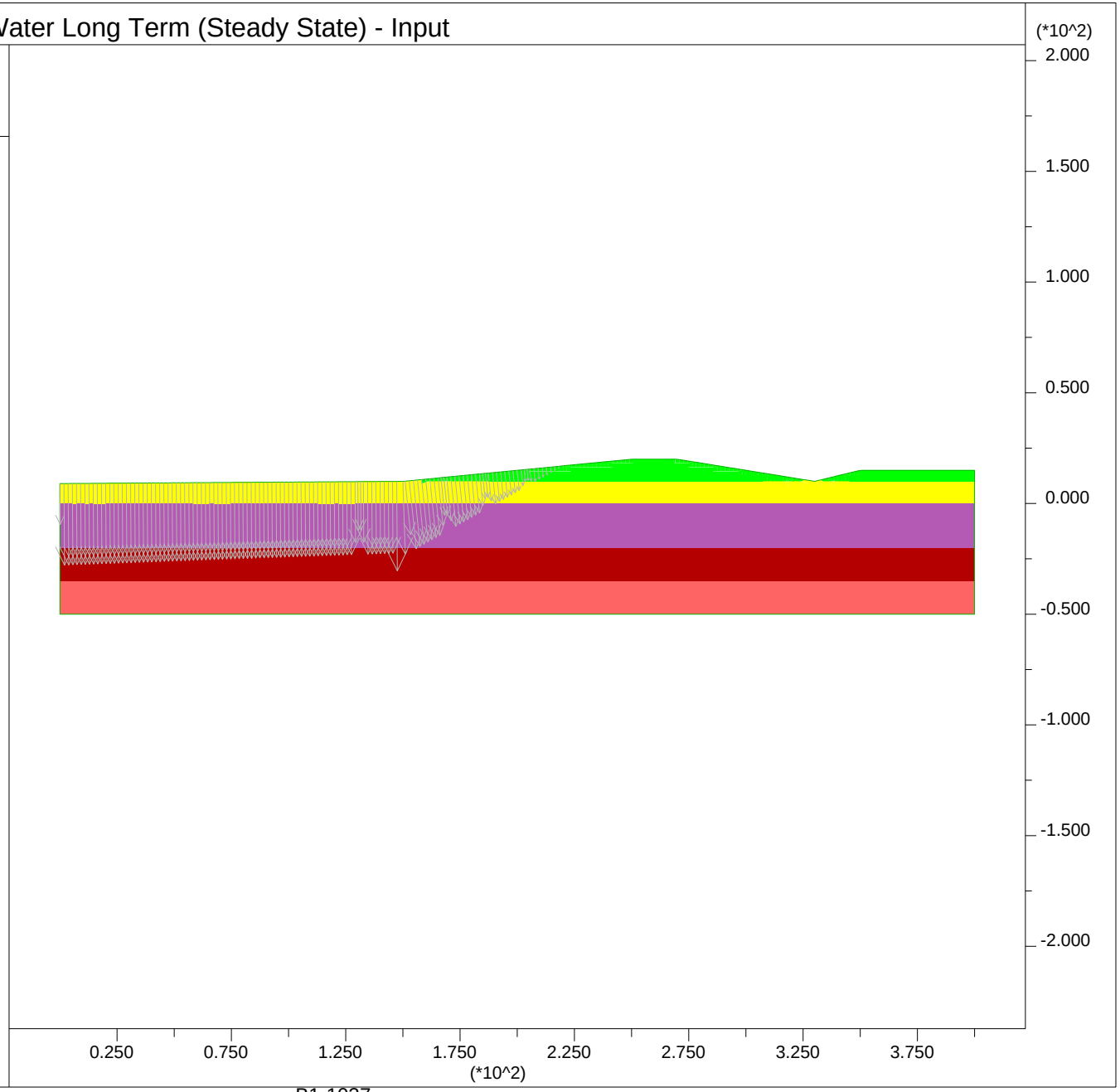
0 1E 2

Net Applied Forces

max vector = 9.947E+02

0 2E 3

Group Delta Consultants
Ballona Wetlands



B1-1037

PLATE G-28

JOB TITLE : Section A-A' - Post Liquefaction

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 13:49

Factor of Safety 2.38

Shear Strain Rate Contours

- 2.00E-07
- 4.00E-07
- 6.00E-07
- 8.00E-07
- 1.00E-06
- 1.20E-06

Contour interval= 2.00E-07
(zero contour omitted)
Boundary plot

0 1E 2

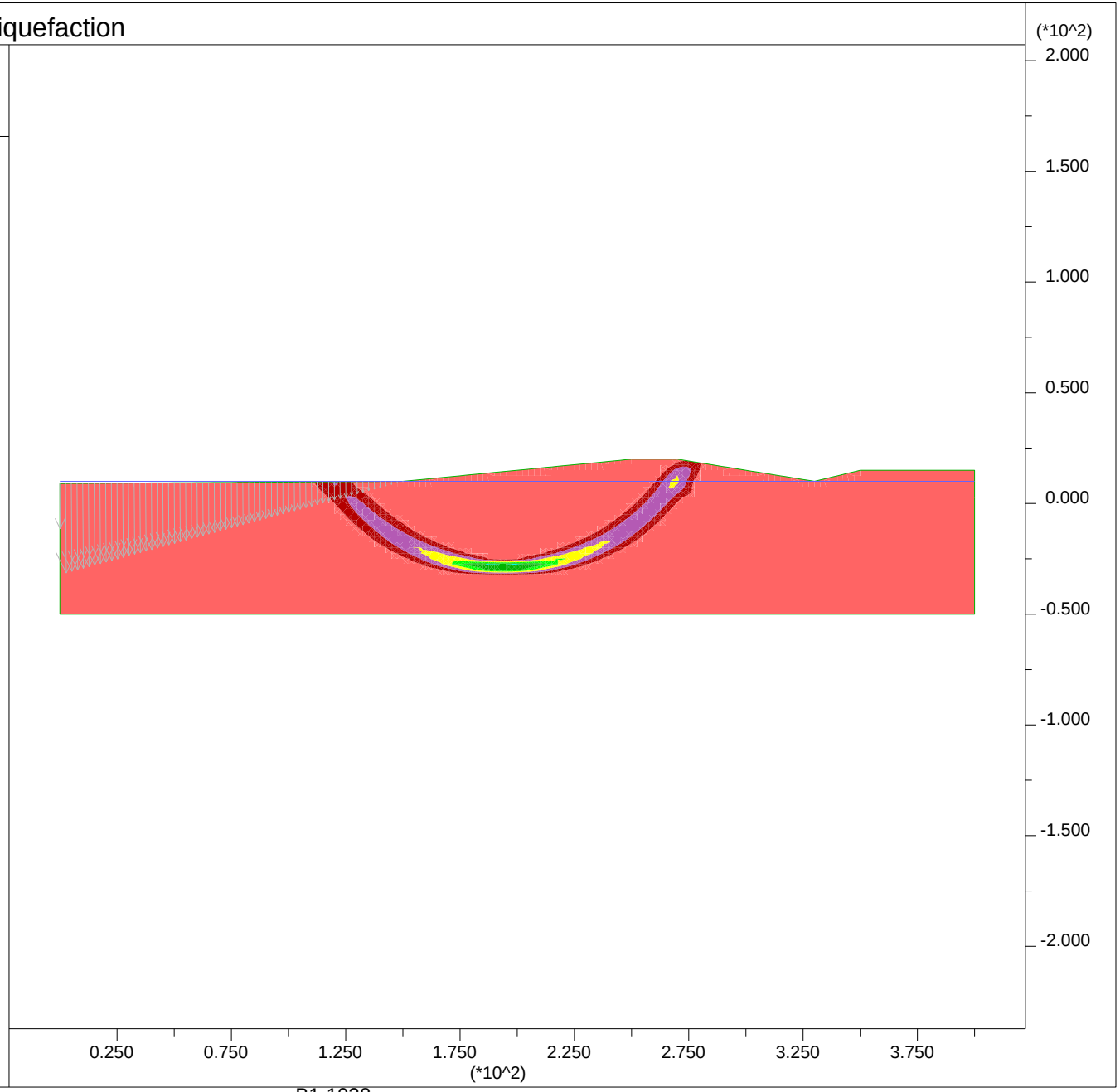
Water Table

Net Applied Forces

max vector = 1.536E+02

0 5E 2

Group Delta Consultants
Ballona Wetlands



B1-1038

PLATE G-29

JOB TITLE : Section A-A' - Post Liquefaction Input

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 13:50

Factor of Safety 2.38

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Liq Sand'
- 'User:Soft Clay'
- 'User:Liq Fill'
- User:Embankment

Boundary plot

0 1E 2

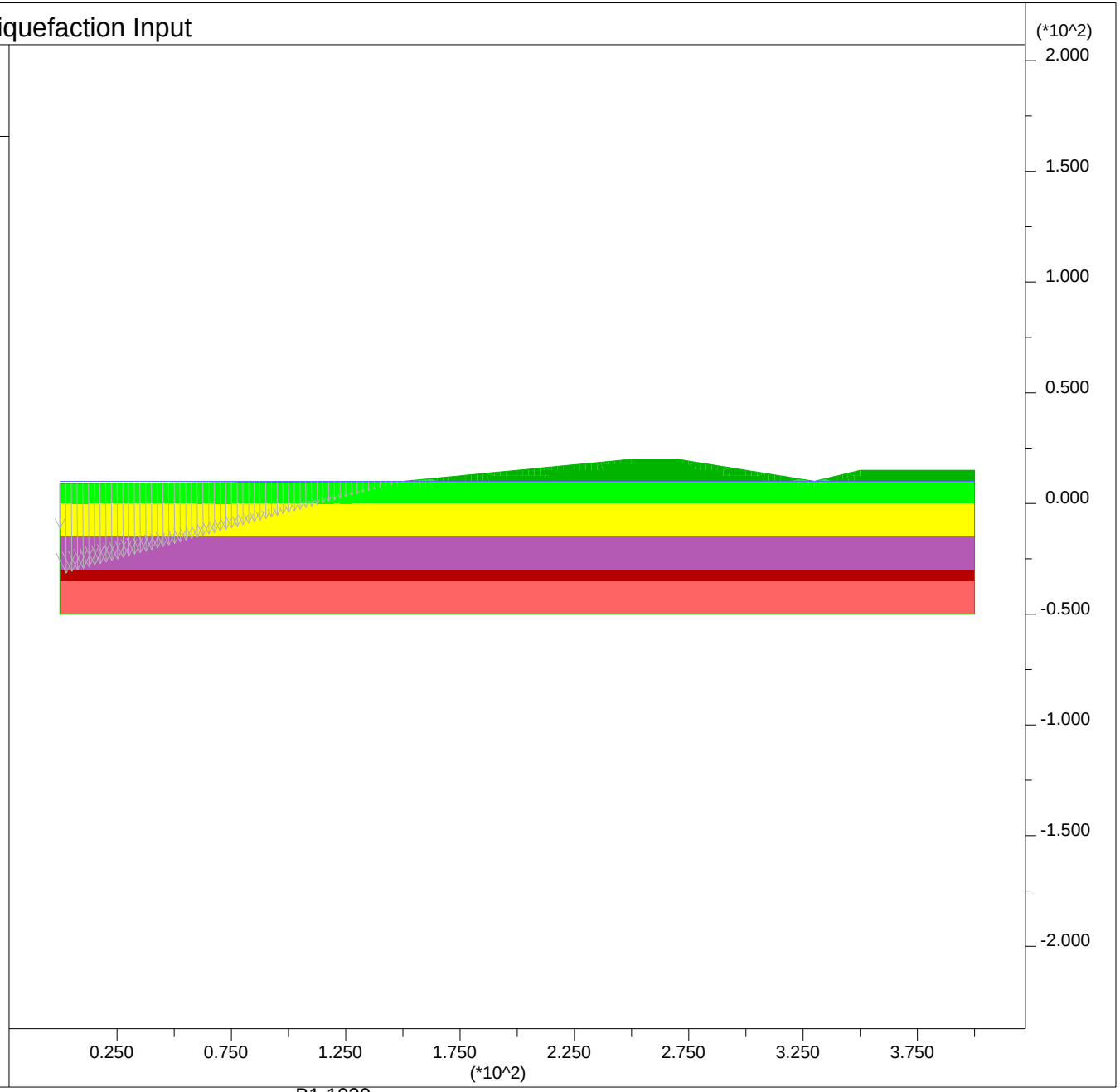
Water Table

Net Applied Forces

max vector = 1.536E+02

0 5E 2

Group Delta Consultants
Ballona Wetlands



B1-1039

PLATE G-30

JOB TITLE : Section A-A' - Ky=0.09

FLAC/SLOPE (Version 7.00)

LEGEND

26-Mar-13 14:07

Factor of Safety 1.03

Shear Strain Rate Contours

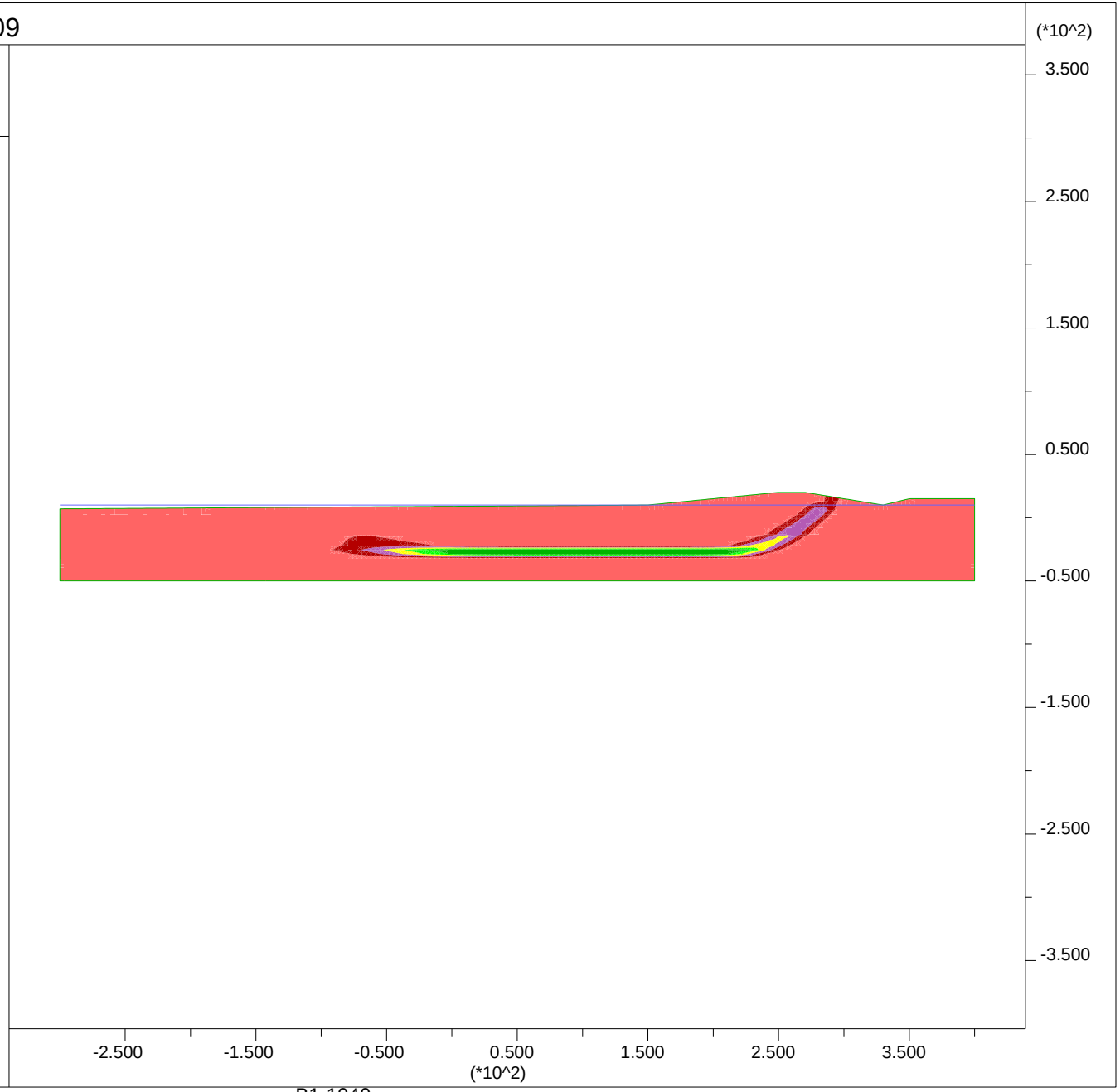
1.00E-06
2.00E-06
3.00E-06
4.00E-06
5.00E-06

Contour interval= 1.00E-06
(zero contour omitted)
Boundary plot

0 2E 2

Water Table

Group Delta Consultants
Ballona Wetlands



B1-1040

PLATE G-31

JOB TITLE : Section A-A' - Ky=0.09 Input

FLAC/SLOPE (Version 7.00)

LEGEND

26-Mar-13 14:07

Factor of Safety 1.03

User-defined Groups

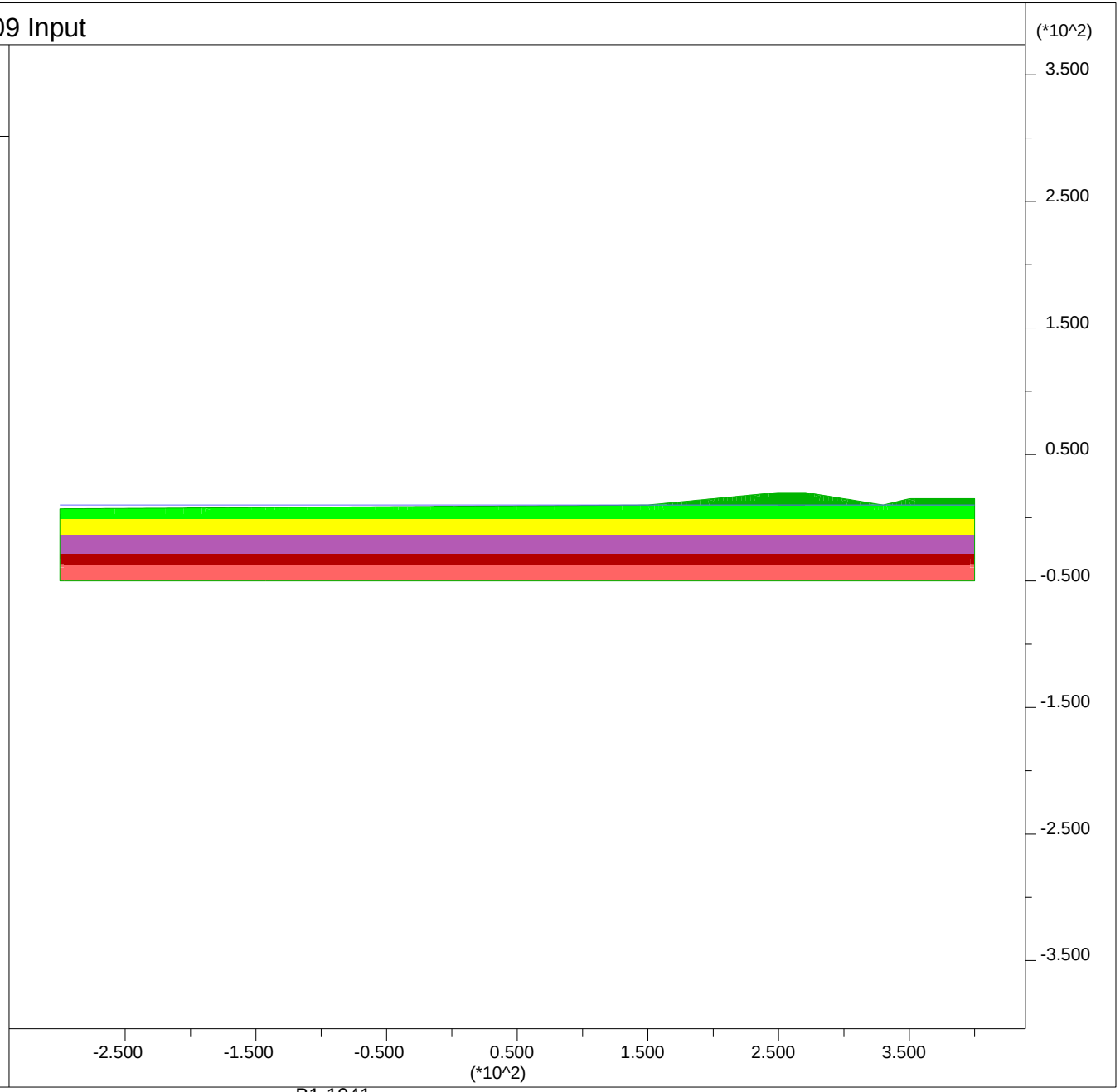
- User:Sand
- 'User:Stiff Clay'
- 'User:Liq Sand'
- 'User:Soft Clay'
- 'User:Liq Fill'
- User:Embankment

Boundary plot

0 2E 2

Water Table

Group Delta Consultants
Ballona Wetlands



B1-1041

PLATE G-32

Newmark Displacements using Bray and Rathje (1998):

Section A-A'

Site Input

PGA,rock =	0.25	g		
M =	6.6			
r =	13	km		
ky =	0.09		32.185	2.89665
Sliding Mass Input				
Vs =	150	m/s	assumed	
Thickness, H =	13.7	m		
	45	ft		

Output

Tm =	0.49	sec				
D5-95 =	10.5	sec				
Ts =	0.37	sec				
NRF =	1.15					
Ts/Tm =	0.75					
kmax/(PGA,rock*NRF)	0.67					
kmax =	0.19					
ky / kmax =	0.47					
Displacement, u =	4	cm	0.1	feet	1.4	inches

JOB TITLE : Section B-B' - End of Construction

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 14:08

Factor of Safety 3.51

Shear Strain Rate Contours

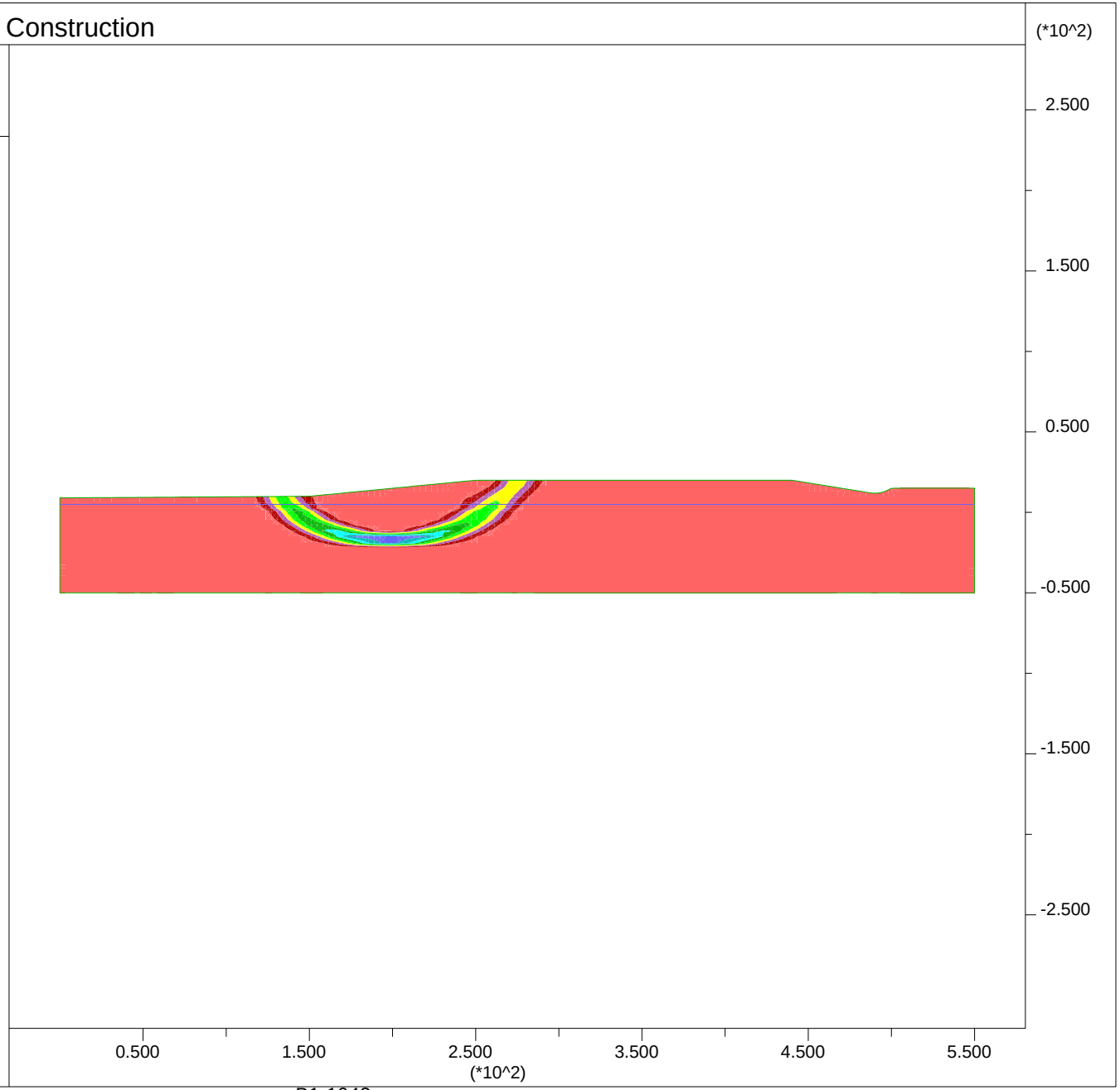
- 5.00E-07
- 1.00E-06
- 1.50E-06
- 2.00E-06
- 2.50E-06
- 3.00E-06
- 3.50E-06
- 4.00E-06

Contour interval= 5.00E-07
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands



B1-1043

PLATE G-34

JOB TITLE : Section B-B' - End of Construction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 14:08

Factor of Safety 3.51

User-defined Groups

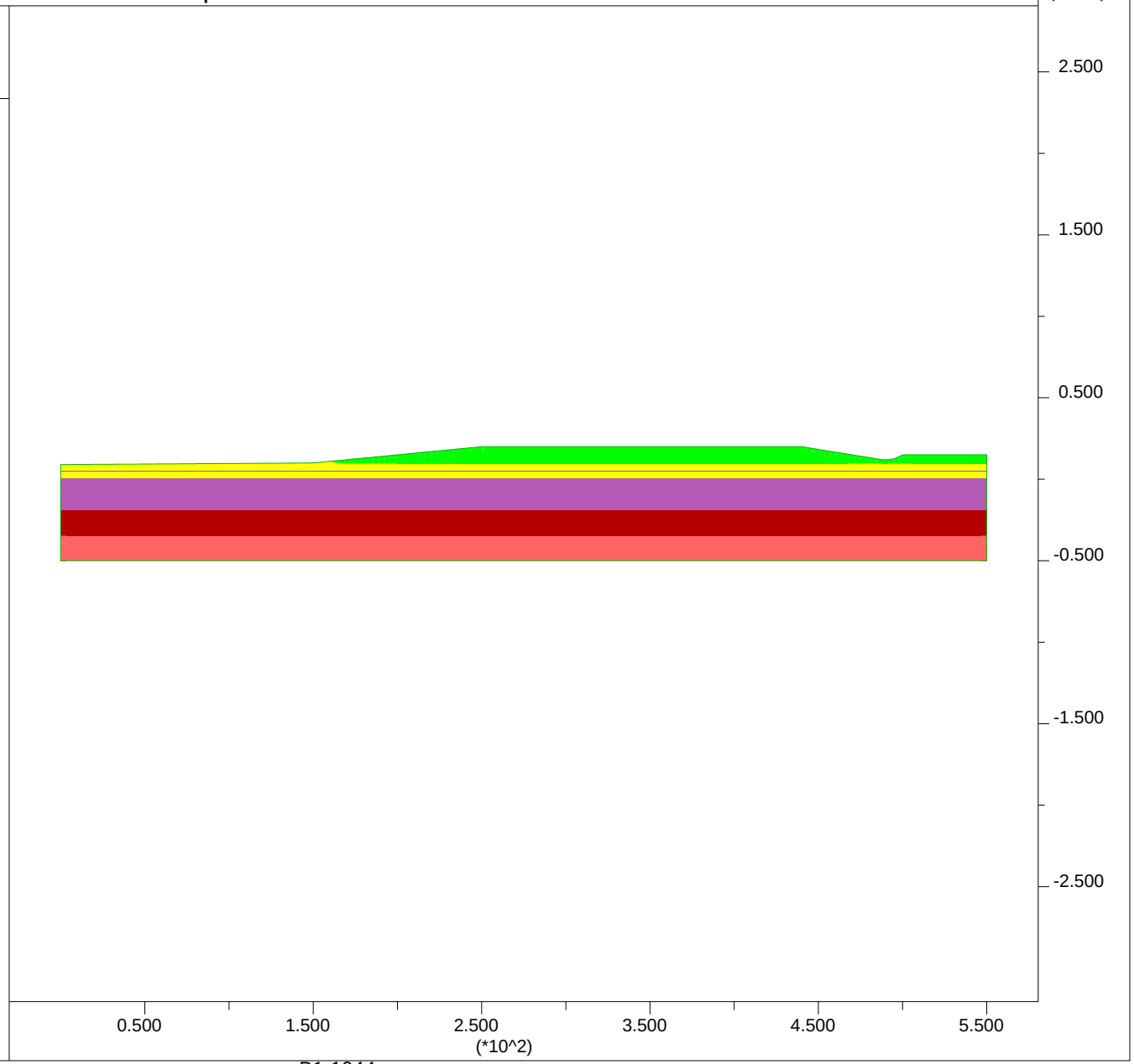
- User:Sand
- 'User:Stiff Clay'
- 'User:Soft Clay'
- User:Fill
- User:Embankment

Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands



B1-1044

PLATE G-35

JOB TITLE : Section B-B' - High Water Short Term

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 14:24

Factor of Safety 4.32

Shear Strain Rate Contours

- 2.50E-06
- 5.00E-06
- 7.50E-06
- 1.00E-05
- 1.25E-05
- 1.50E-05
- 1.75E-05
- 2.00E-05
- 2.25E-05

Contour interval= 2.50E-06
(zero contour omitted)
Boundary plot

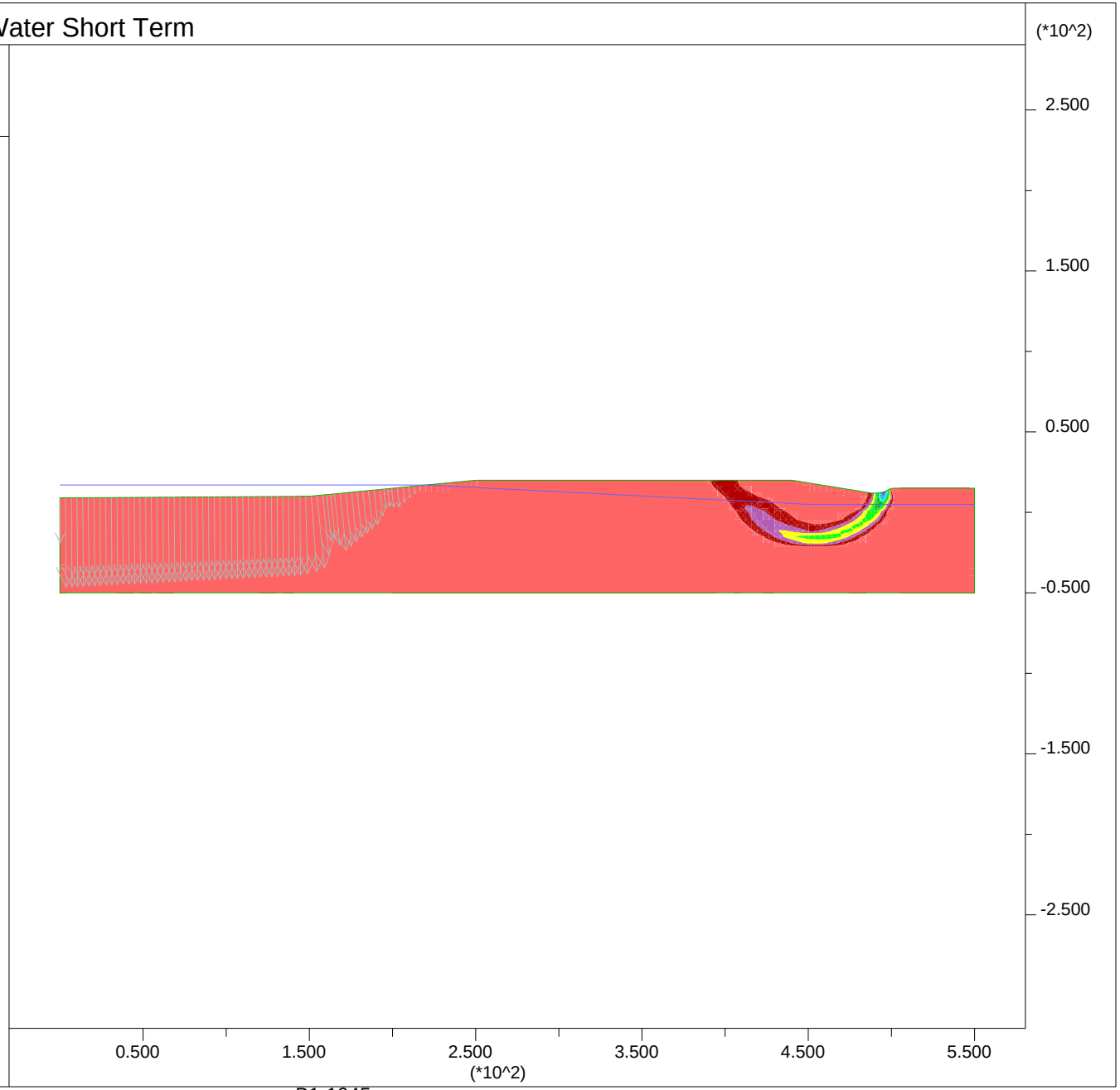
0 1E 2

Water Table

Net Applied Forces

max vector = 1.713E+03

Group Delta Consultants
Ballona Wetlands



B1-1045

PLATE G-36

JOB TITLE : Section B-B' - High Water Short Term - Input

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 14:25

Factor of Safety 4.32

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Soft Clay'
- User:Fill
- User:Embankment

Boundary plot

0 1E 2

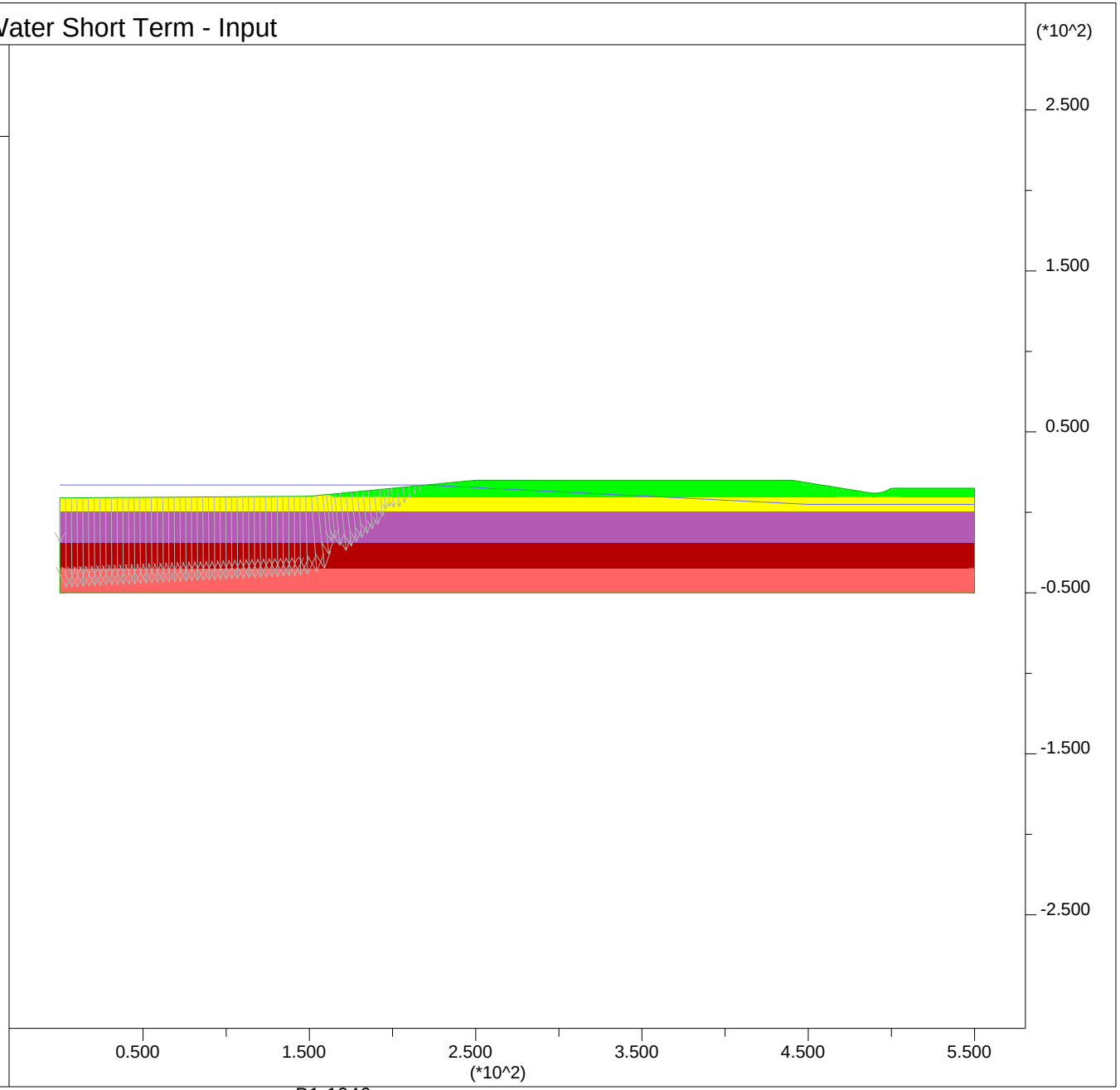
Water Table

Net Applied Forces

max vector = 1.713E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1046

PLATE G-37

JOB TITLE : Section B-B' - Post Liquefaction

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 14:36

Factor of Safety 2.38

Shear Strain Rate Contours

1.00E-06
2.00E-06
3.00E-06
4.00E-06
5.00E-06

Contour interval= 1.00E-06
(zero contour omitted)
Boundary plot

0 1E 2

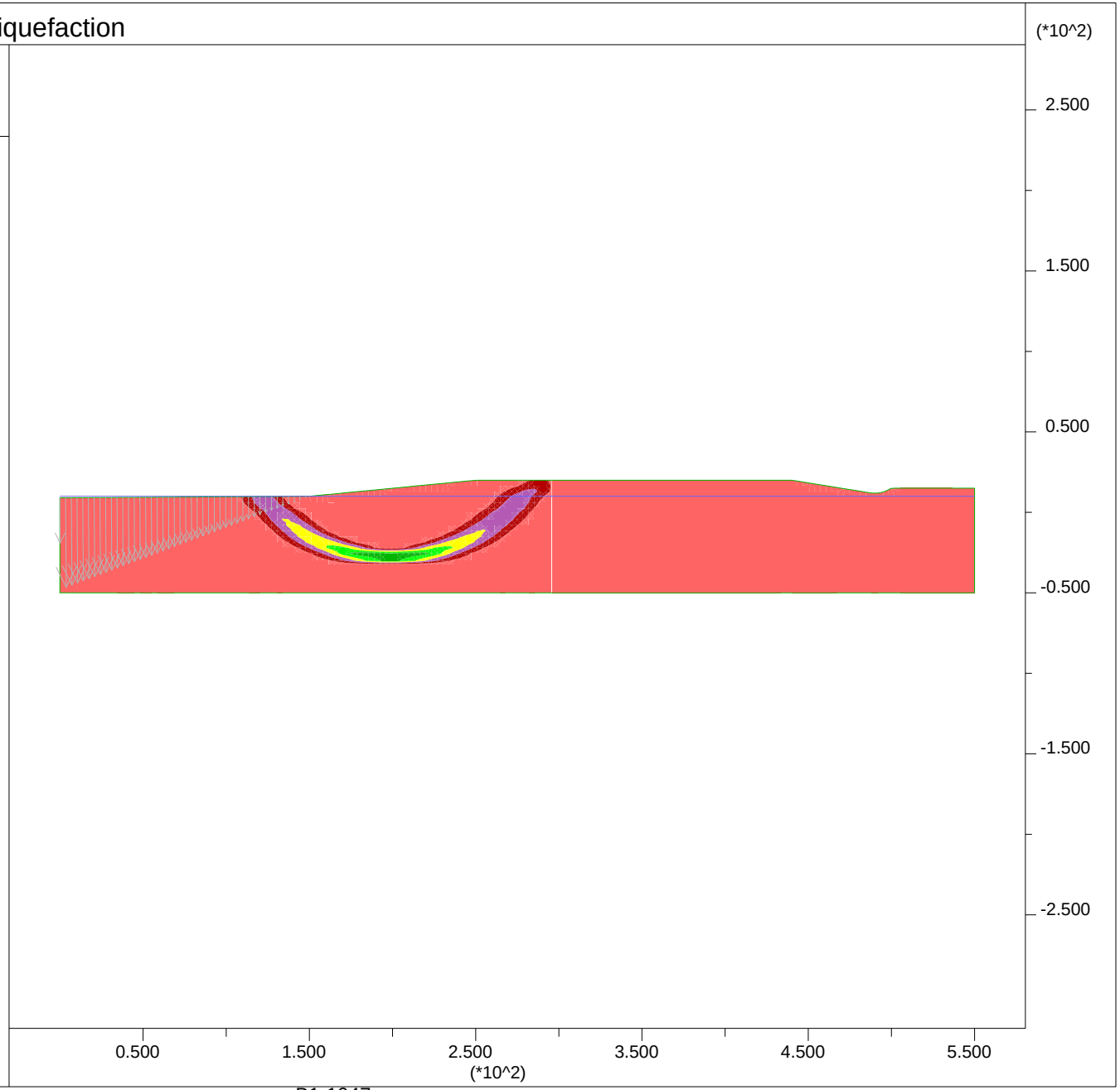
Water Table

Net Applied Forces

max vector = 2.098E+02

0 5E 2

Group Delta Consultants
Ballona Wetlands



B1-1047

PLATE G-38

JOB TITLE : Section B-B' - Post Liquefaction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 14:37

Factor of Safety 2.38

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Liq Sand'
- 'User:Soft Clay'
- 'User:Liq Fill'
- User:Embankment

Boundary plot

0 1E 2

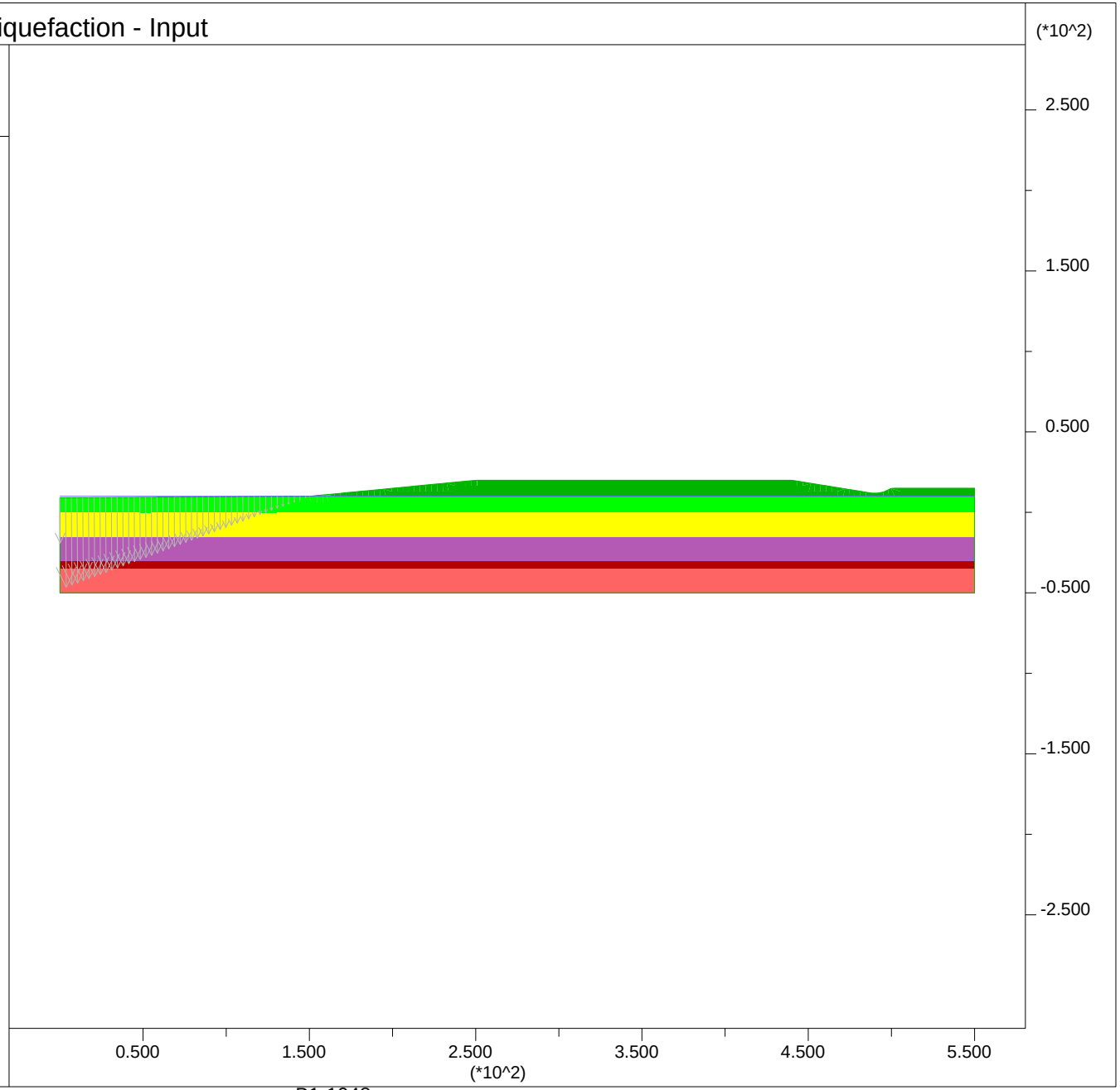
Water Table

Net Applied Forces

max vector = 2.098E+02

0 5E 2

Group Delta Consultants
Ballona Wetlands



B1-1048

PLATE G-39

JOB TITLE : Section B-B' - Ky=0.08

FLAC/SLOPE (Version 7.00)

LEGEND

26-Mar-13 14:11

Factor of Safety 1.01

Shear Strain Rate Contours

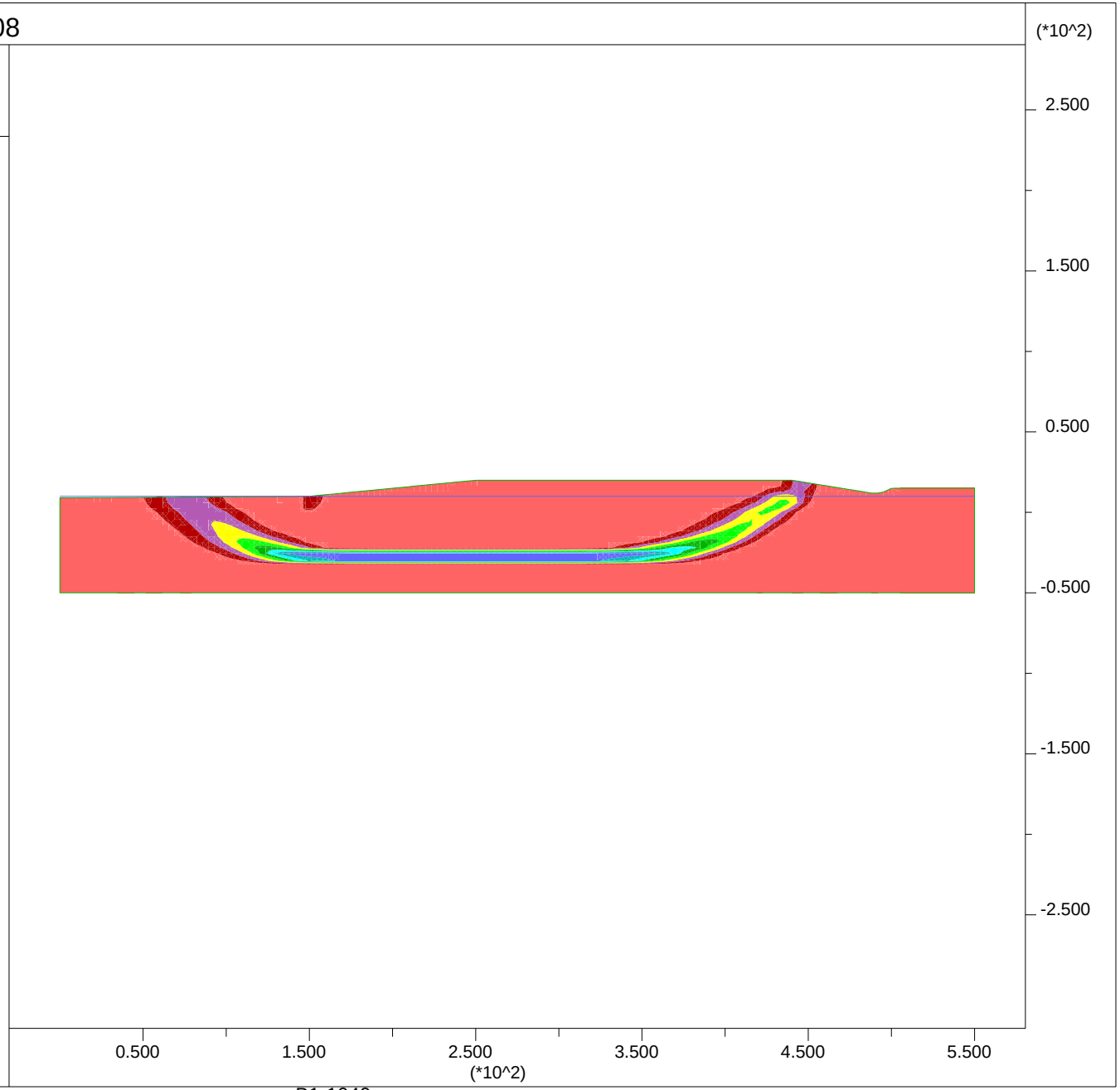
- 2.50E-07
- 5.00E-07
- 7.50E-07
- 1.00E-06
- 1.25E-06
- 1.50E-06
- 1.75E-06
- 2.00E-06

Contour interval= 2.50E-07
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands



B1-1049

PLATE G-40

JOB TITLE : Section B-B' - Ky=0.08 Input

FLAC/SLOPE (Version 7.00)

LEGEND

26-Mar-13 14:12

Factor of Safety 1.01

User-defined Groups

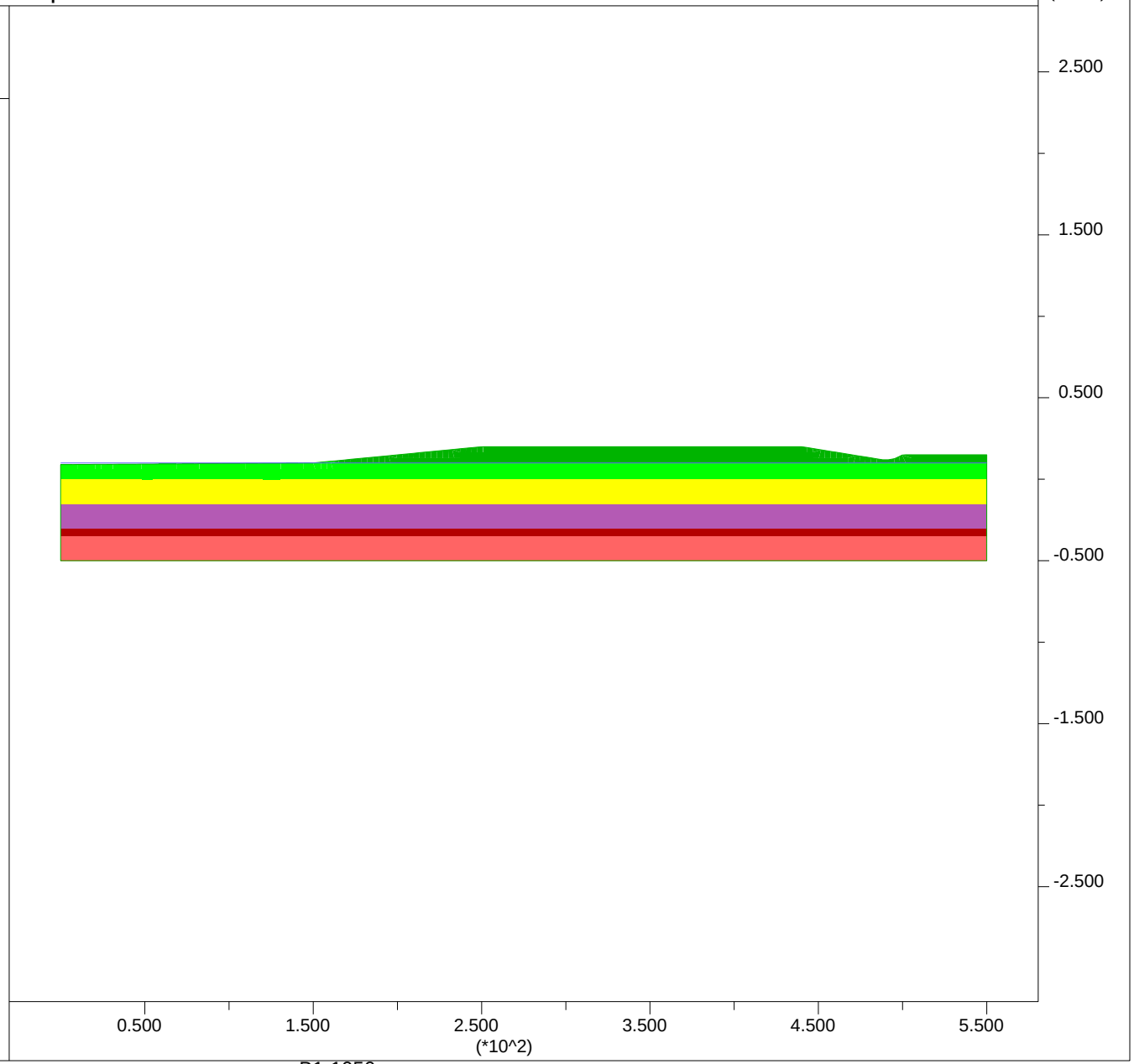
- User:Sand
- 'User:Stiff Clay'
- 'User:Liq Sand'
- 'User:Soft Clay'
- 'User:Liq Fill'
- User:Embankment

Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands



B1-1050

PLATE G-41

Newmark Displacements using Bray and Rathje (1998):

Section B-B'

Site Input

PGA,rock =	0.25	g		
M =	6.6			
r =	13	km		
ky =	0.08		32.185	2.5748
Sliding Mass Input				
Vs =	150	m/s	assumed	
Thickness, H =	15.3	m		
	50	ft		

Output

Tm =	0.49	sec				
D5-95 =	10.5	sec				
Ts =	0.41	sec				
NRF =	1.15					
Ts/Tm =	0.83					
kmax/(PGA,rock*NRF)	0.62					
kmax =	0.18					
ky / kmax =	0.45					
Displacement, u =	4	cm	0.1	feet	1.5	inches

JOB TITLE : Section C-C' -End of Construction

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 16:16

Factor of Safety 3.45

Shear Strain Rate Contours

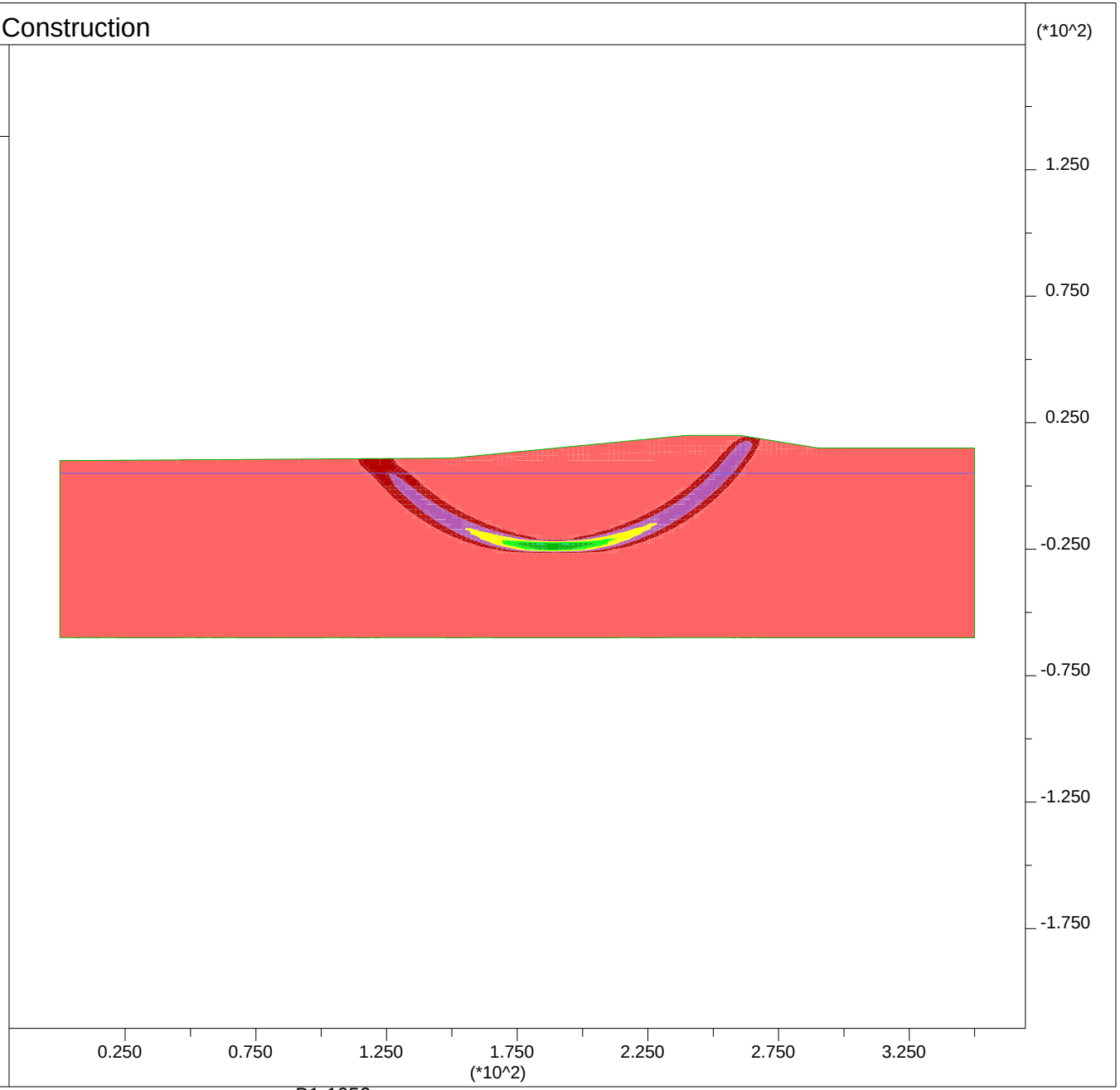
- 2.00E-07
- 4.00E-07
- 6.00E-07
- 8.00E-07
- 1.00E-06
- 1.20E-06

Contour interval= 2.00E-07
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands



B1-1052

PLATE G-43

JOB TITLE : Section C-C' -End of Construction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 16:17

Factor of Safety 3.45

User-defined Groups

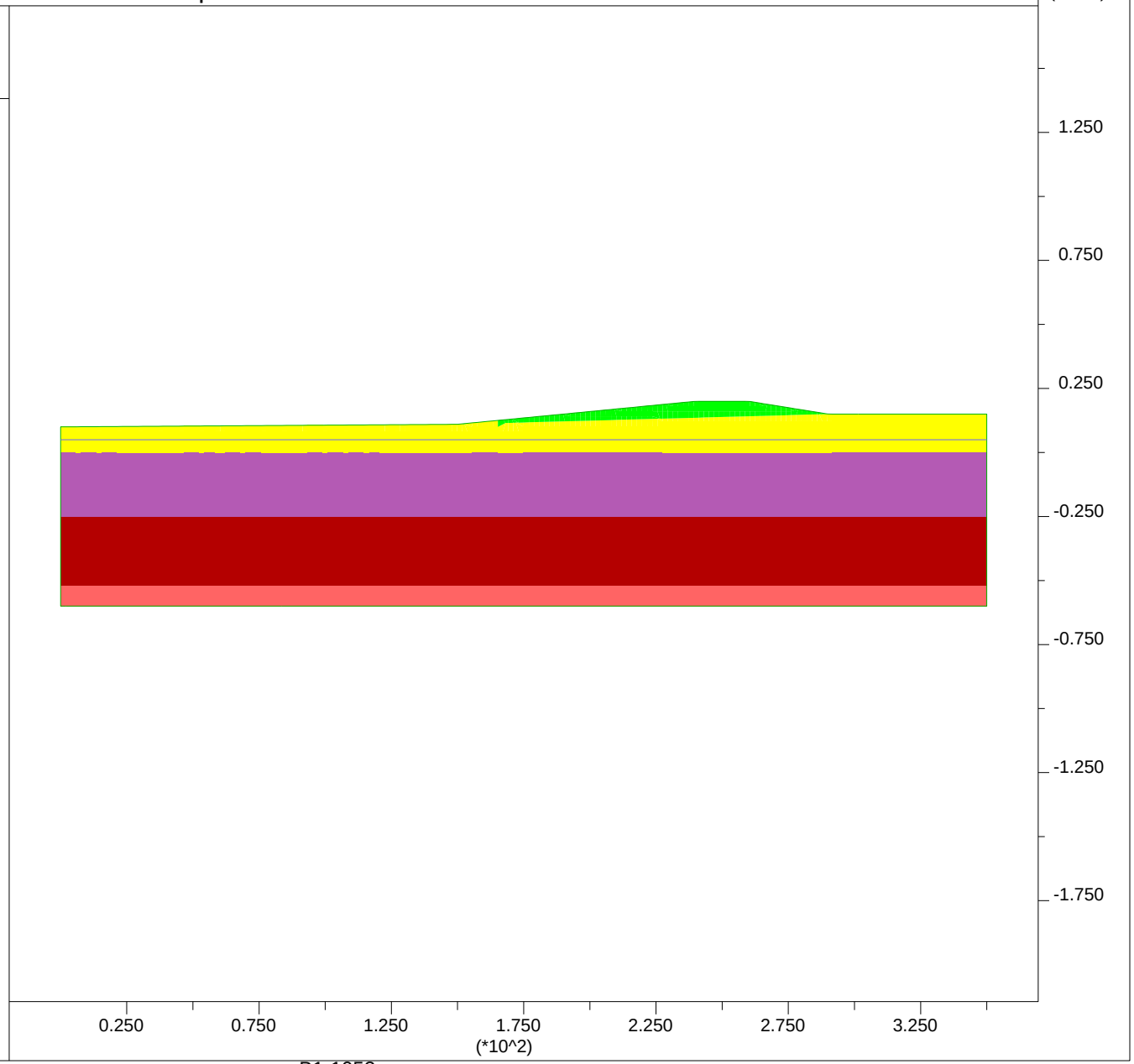
- User:Sand
- 'User:Stiff Clay'
- 'User:Soft Clay'
- User:Fill
- User:Embankment

Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands



B1-1053

PLATE G-44

JOB TITLE : Section C-C' - High Water Short Term

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 17:38

Factor of Safety 5.28

Shear Strain Rate Contours

- 2.50E-08
- 5.00E-08
- 7.50E-08
- 1.00E-07
- 1.25E-07
- 1.50E-07
- 1.75E-07
- 2.00E-07

Contour interval= 2.50E-08
(zero contour omitted)
Boundary plot

0 1E 2

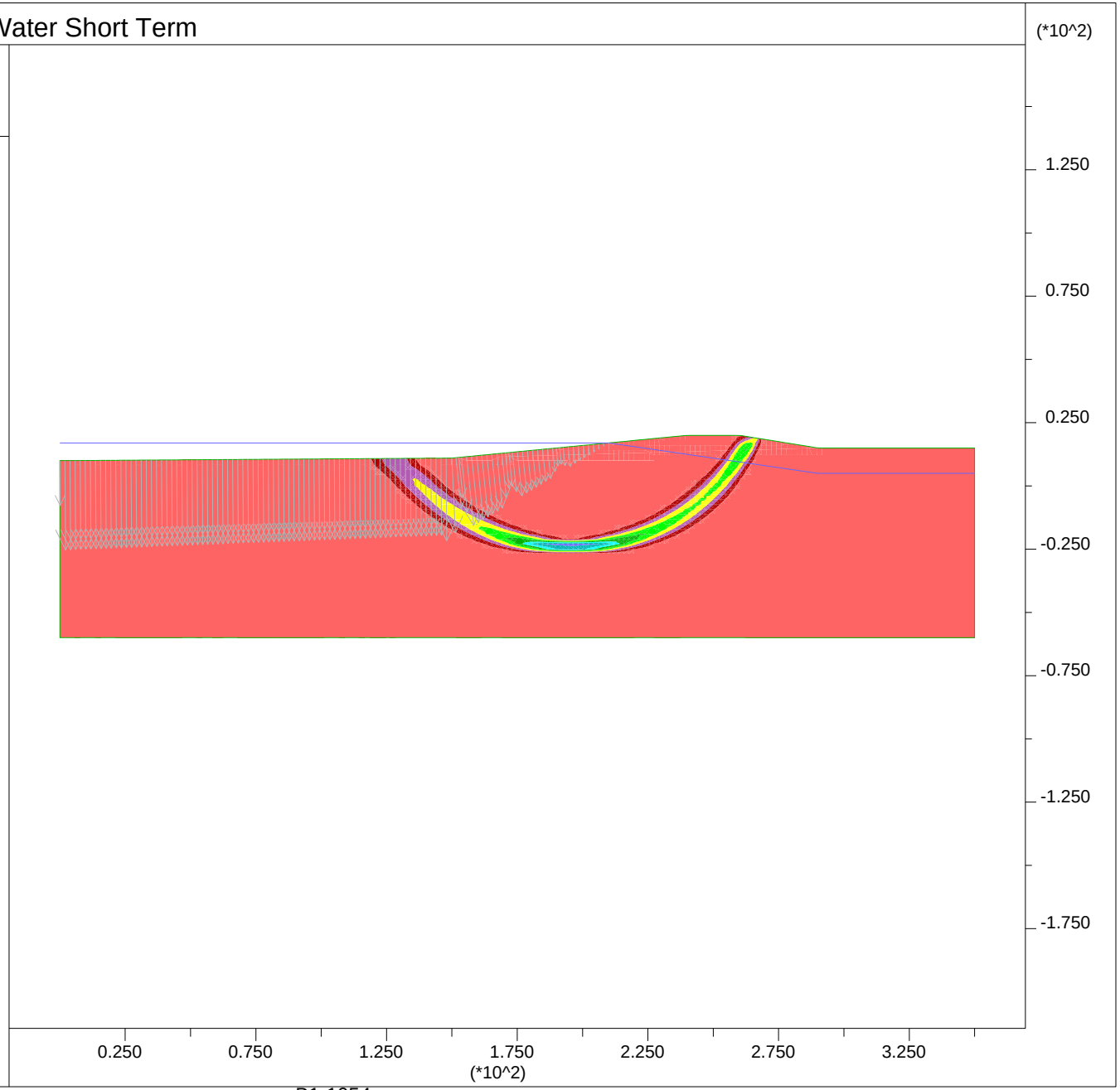
Water Table

Net Applied Forces

max vector = 8.486E+02

0 2E 3

Group Delta Consultants
Ballona Wetlands



B1-1054

PLATE G-45

JOB TITLE : Section C-C' - High Water Short Term - Input

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 17:38

Factor of Safety 5.28

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Soft Clay'
- User:Fill
- User:Embankment

Boundary plot

0 1E 2

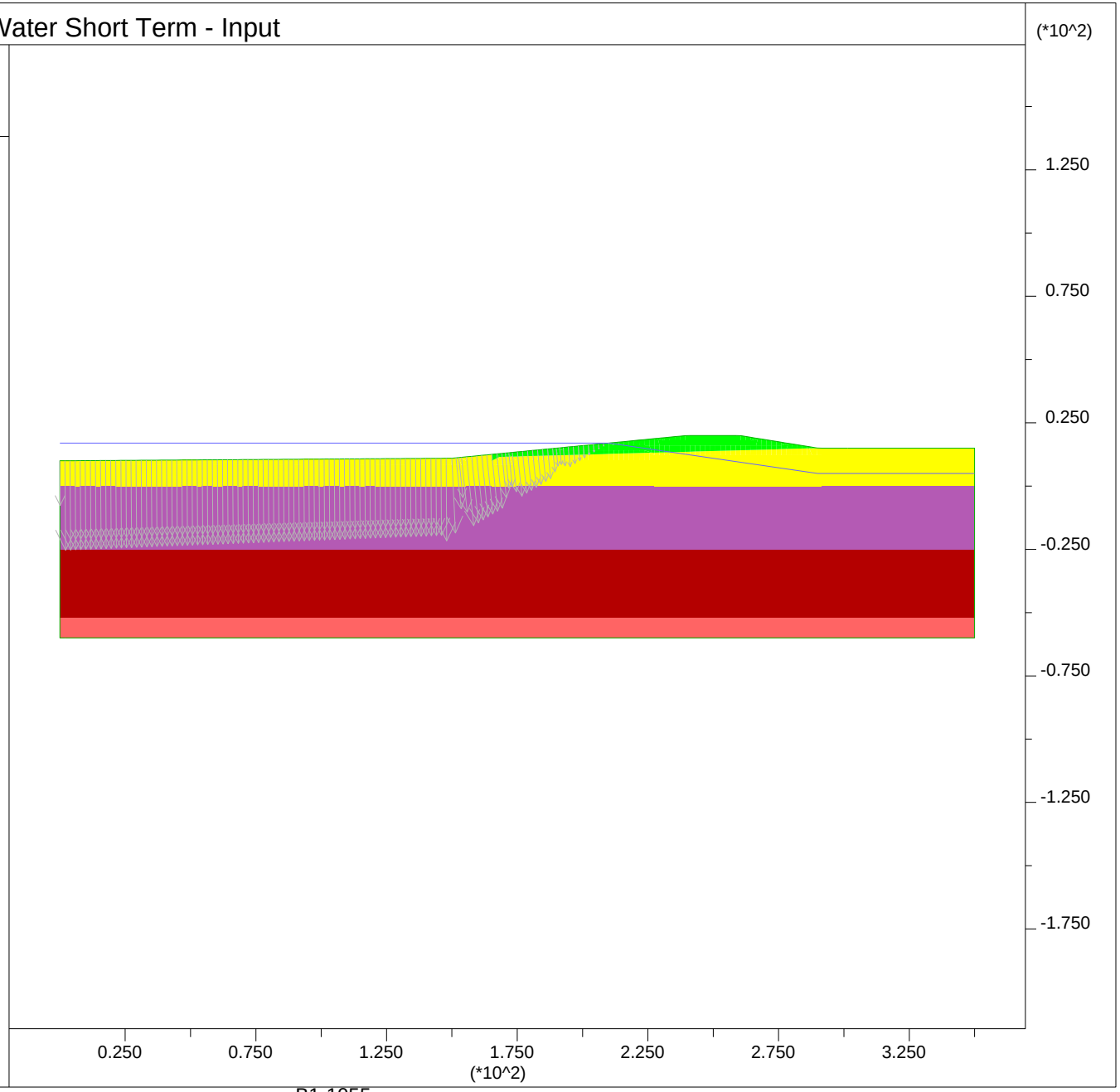
Water Table

Net Applied Forces

max vector = 8.486E+02

0 2E 3

Group Delta Consultants
Ballona Wetlands



B1-1055

PLATE G-46

JOB TITLE : Section C-C' - Post Liquefaction

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 18:09

Factor of Safety 2.42

Shear Strain Rate Contours

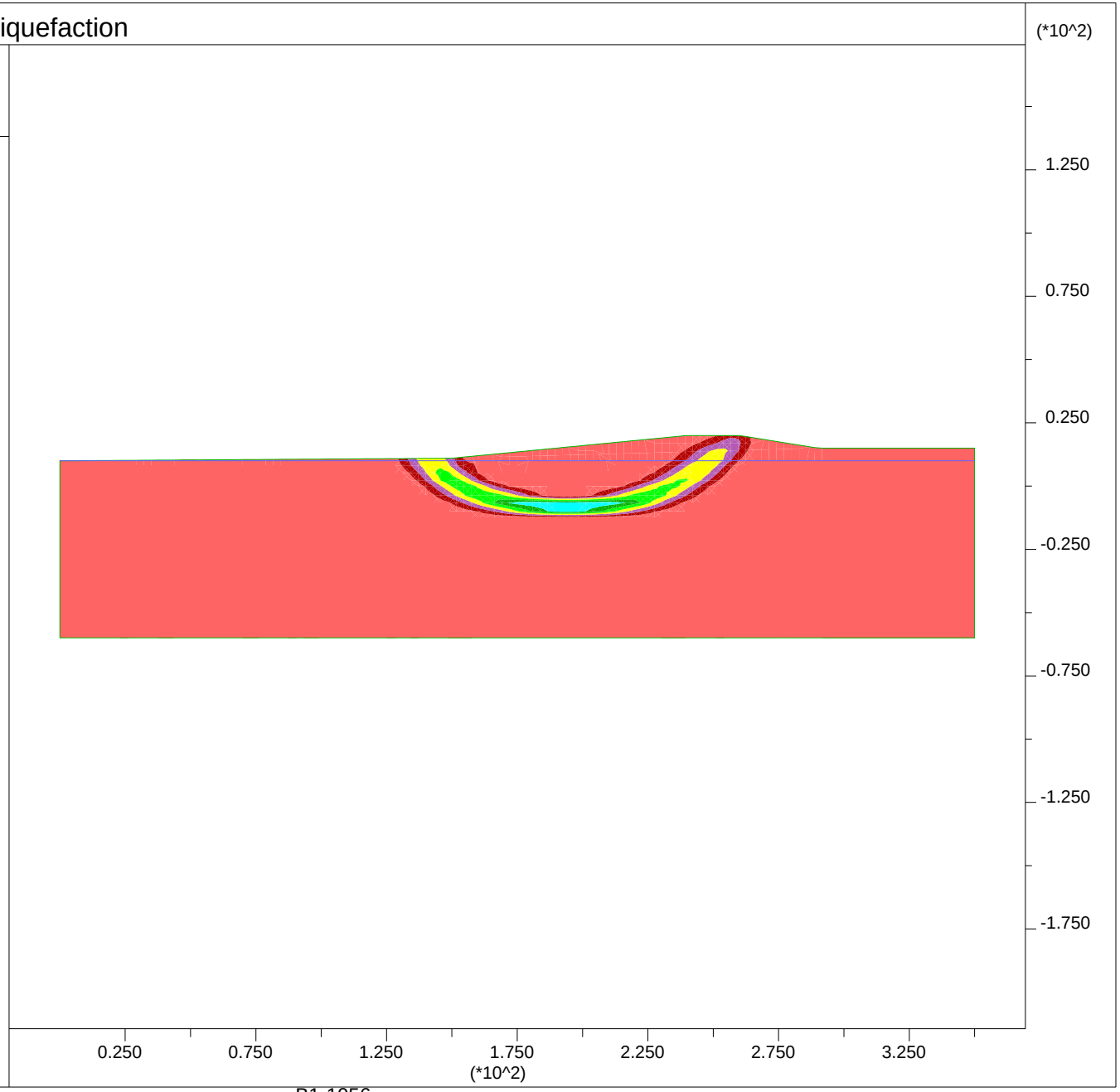
- 2.50E-07
- 5.00E-07
- 7.50E-07
- 1.00E-06
- 1.25E-06
- 1.50E-06

Contour interval= 2.50E-07
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands



B1-1056

PLATE G-47

JOB TITLE : Section C-C' - Post Liquefaction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 18:09

Factor of Safety 2.42

User-defined Groups

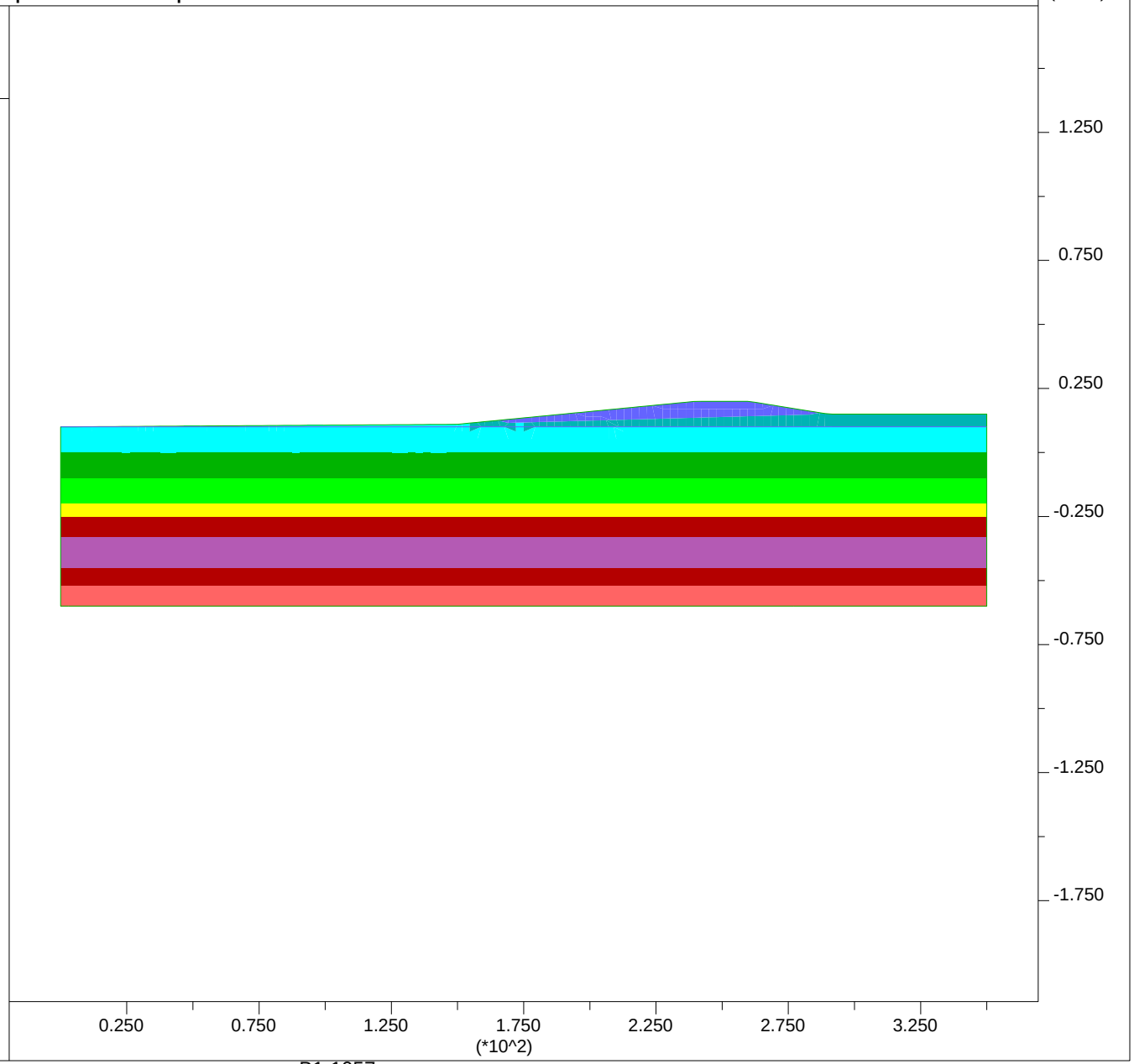
- User:Sand
- 'User:Stiff Clay'
- 'User:Liq Sand Deep'
- 'User:Liq Sand 2'
- 'User:Soft Clay'
- 'User:Liq Sand Shallow'
- 'User:Liq Fill'
- User:Fill
- User:Embankment

Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands



B1-1057

PLATE G-48

JOB TITLE : Section C-C' - Ky=0.1

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 19:11

Factor of Safety 0.99

Shear Strain Rate Contours

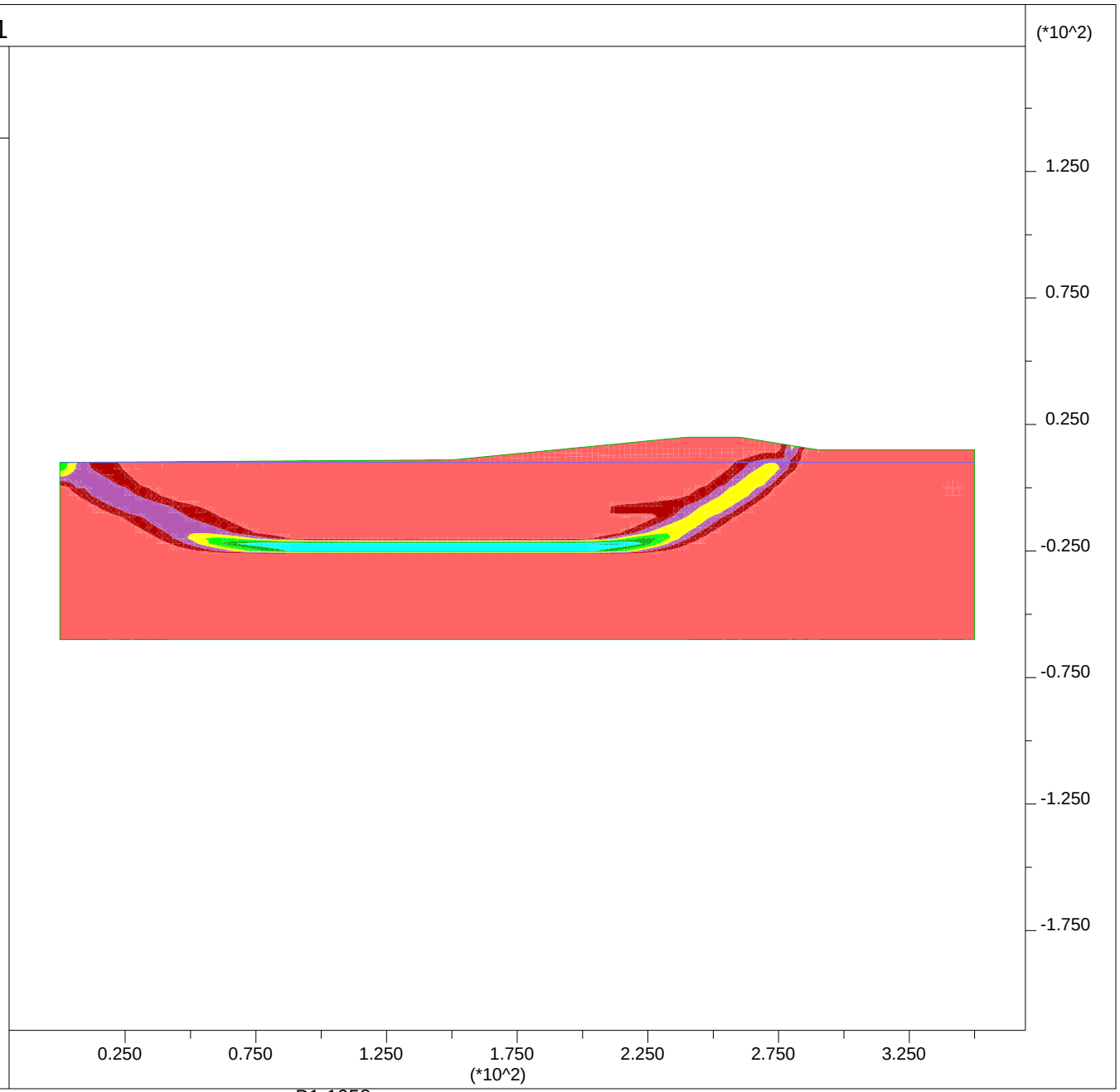
- 2.50E-07
- 5.00E-07
- 7.50E-07
- 1.00E-06
- 1.25E-06
- 1.50E-06
- 1.75E-06

Contour interval= 2.50E-07
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands



B1-1058

PLATE G-49

JOB TITLE : Section C-C' - Ky=0.1 nput

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 19:14

Factor of Safety 0.99

User-defined Groups

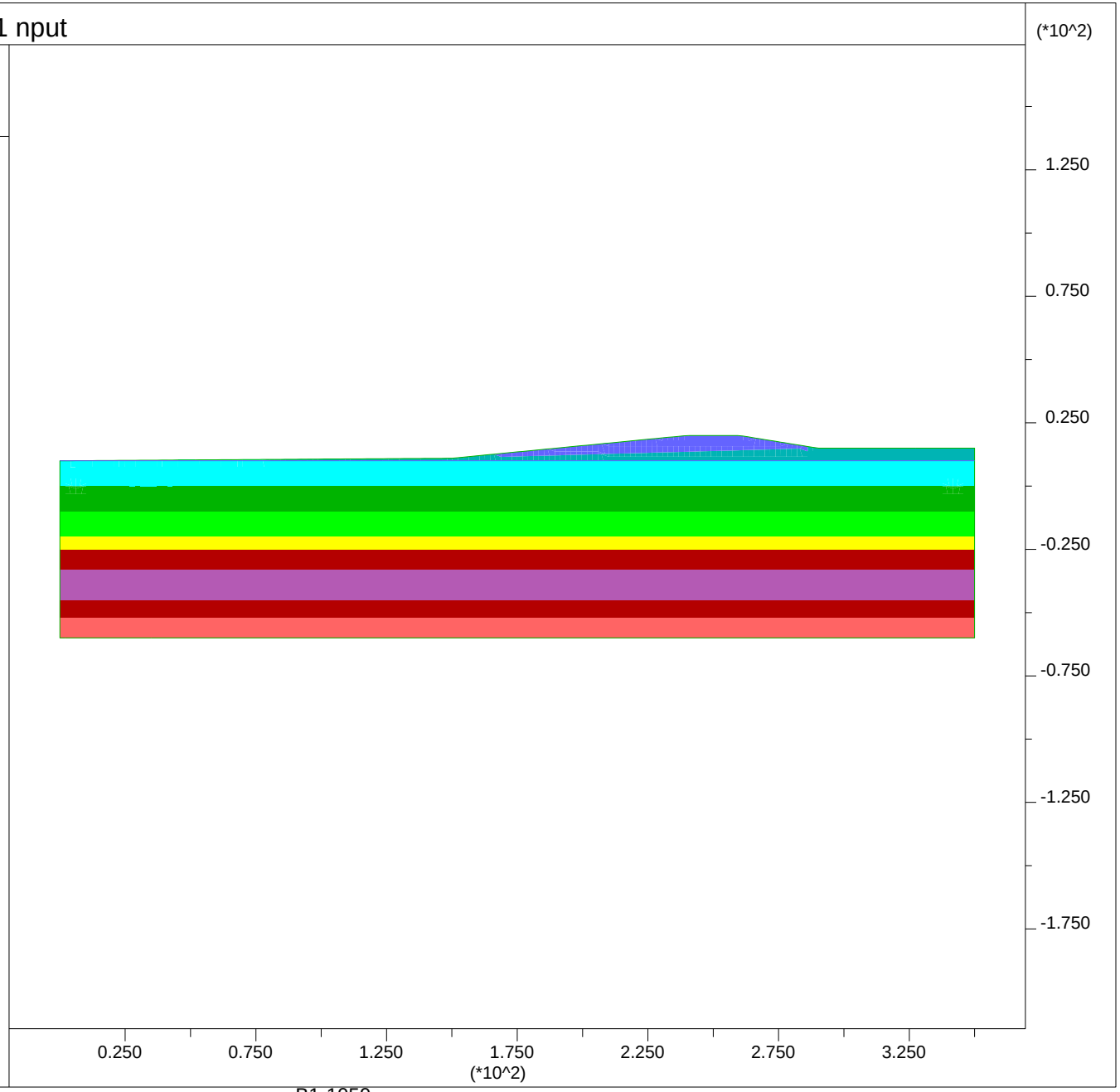
- User:Sand
- 'User:Stiff Clay'
- 'User:Liq Sand Deep'
- 'User:Liq Sand 2'
- 'User:Soft Clay'
- 'User:Liq Sand Shallow'
- 'User:Liq Fill'
- User:Fill
- User:Embankment

Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands



B1-1059

PLATE G-50

Newmark Displacements using Bray and Rathje (1998):

Section C-C'

Site Input

PGA,rock =	0.25	g	
M =	6.6		
r =	13	km	
ky =	0.1		

Sliding Mass Input

Vs =	150	m/s	assumed
Thickness, H =	12.2	m	
	40	ft	

Output

Tm =	0.49	sec				
D5-95 =	10.5	sec				
Ts =	0.33	sec				
NRF =	1.15					
Ts/Tm =	0.67					
kmax/(PGA,rock*NRF)	0.74					
kmax =	0.21					
ky / kmax =	0.47					
Displacement, u =	4	cm	0.1	feet	1.5	inches

JOB TITLE : Section D-D' - End of Construction

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 9:18

Factor of Safety 1.49

Shear Strain Rate Contours

- 1.00E-06
- 2.00E-06
- 3.00E-06
- 4.00E-06
- 5.00E-06
- 6.00E-06
- 7.00E-06
- 8.00E-06

Contour interval= 1.00E-06
(zero contour omitted)
Boundary plot

0 1E 2

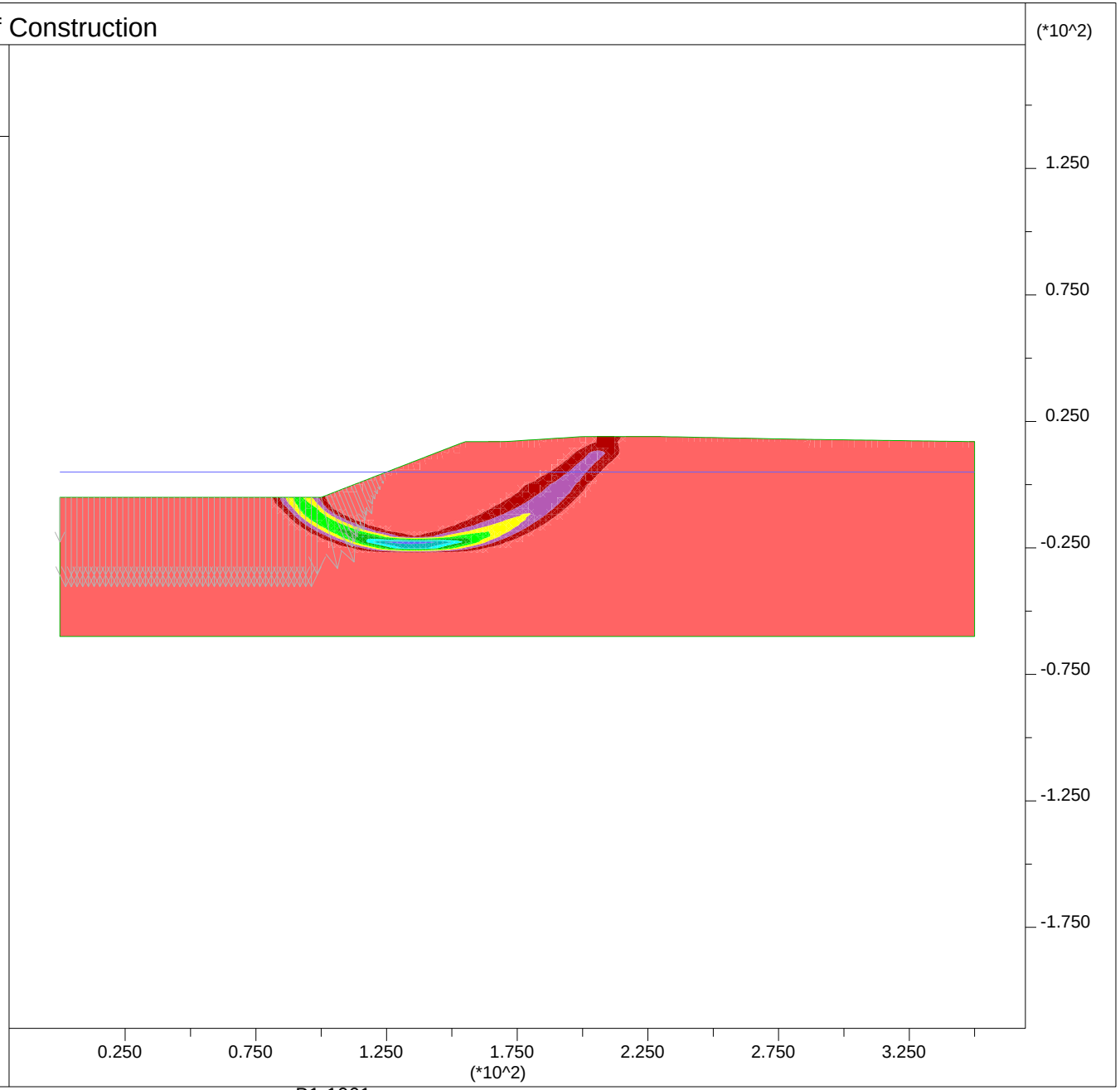
Water Table

Net Applied Forces

max vector = 1.366E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands



B1-1061

PLATE G-52

JOB TITLE : Section D-D' - End of Construction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 9:18

Factor of Safety 1.49

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Soft Clay'
- User:Fill

Boundary plot

0 1E 2

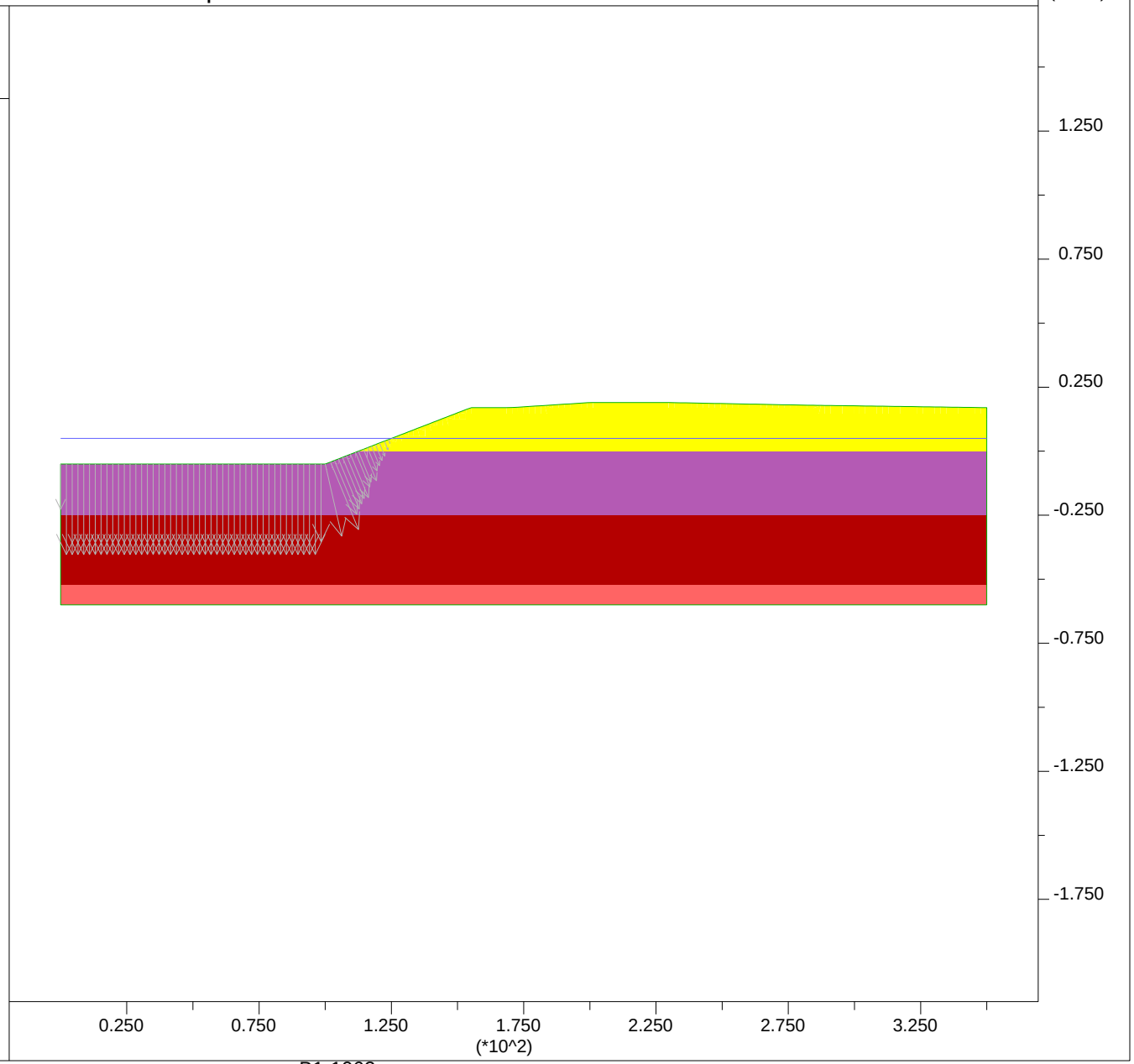
Water Table

Net Applied Forces

max vector = 1.366E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands



B1-1062

PLATE G-53

JOB TITLE : Section D-D' - High Water Short Term

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 9:19

Factor of Safety 2.28

Shear Strain Rate Contours

- 5.00E-07
- 1.00E-06
- 1.50E-06
- 2.00E-06
- 2.50E-06
- 3.00E-06
- 3.50E-06
- 4.00E-06

Contour interval= 5.00E-07
(zero contour omitted)
Boundary plot

0 1E 2

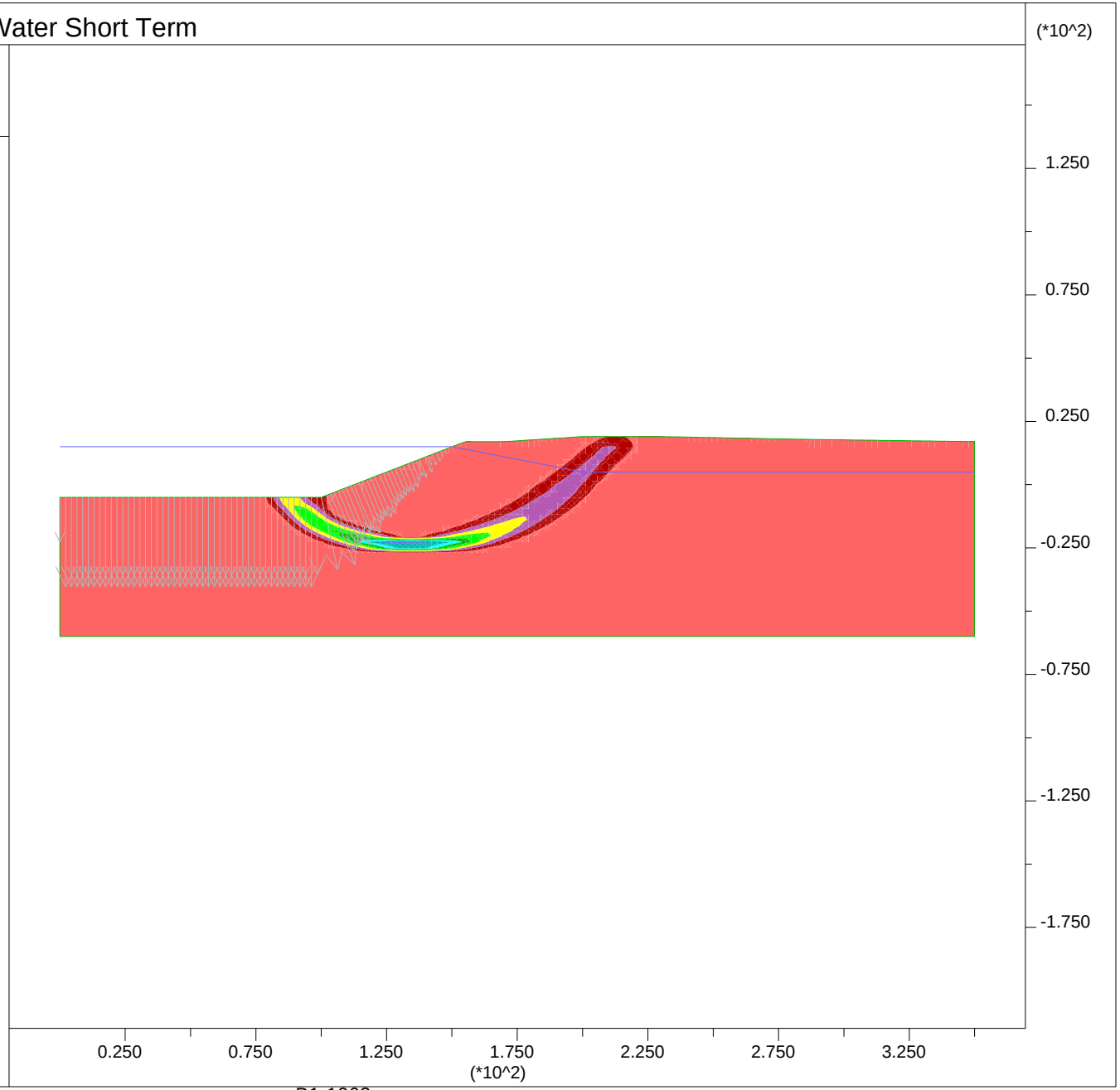
Water Table

Net Applied Forces

max vector = 2.733E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1063

PLATE G-54

JOB TITLE : Section D-D' - High Water Short Term - Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 9:20

Factor of Safety 2.28

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Soft Clay'
- User:Fill

Boundary plot

0 1E 2

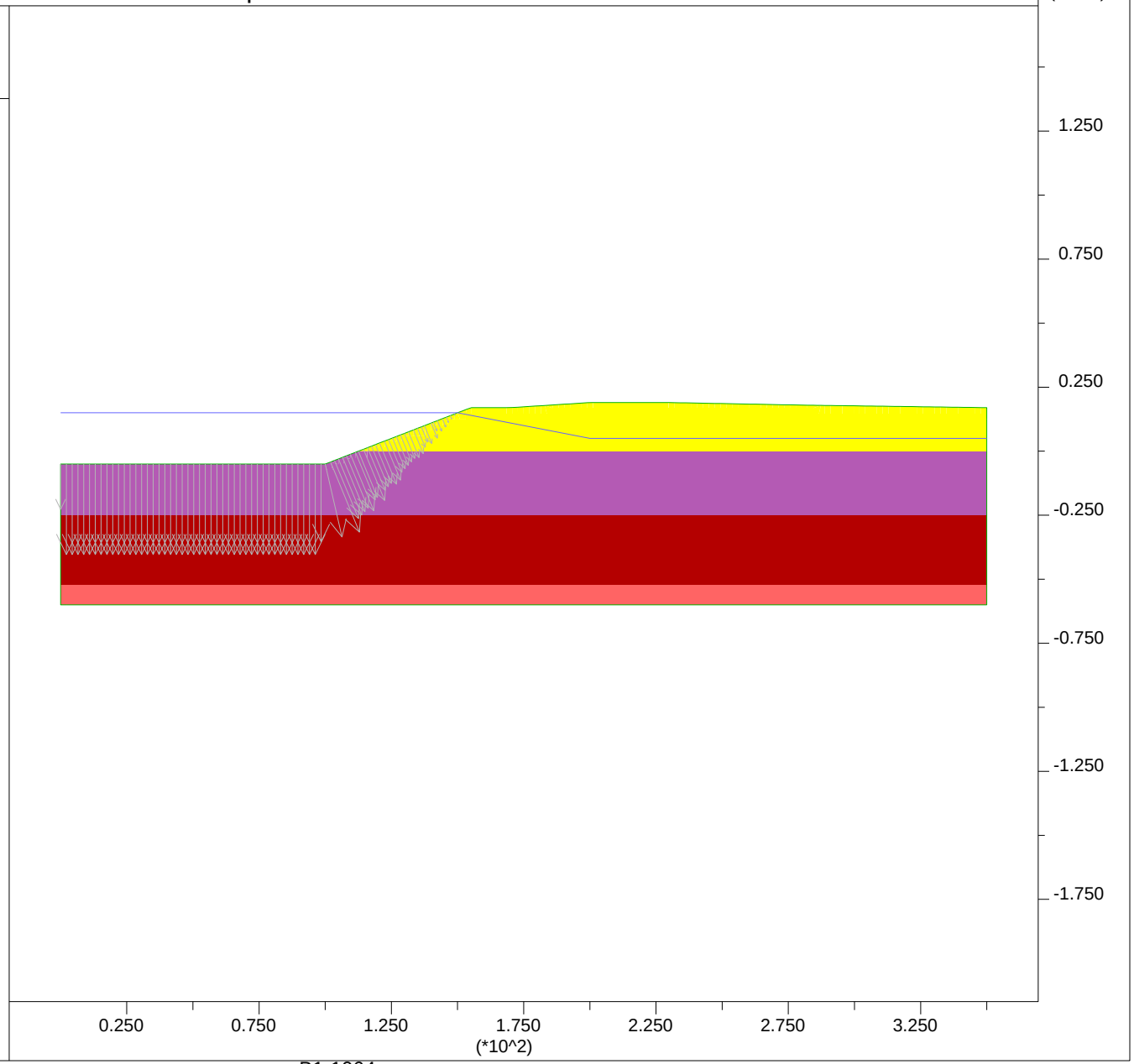
Water Table

Net Applied Forces

max vector = 2.733E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1064

PLATE G-55

JOB TITLE : Section D-D' - Post Liquefaction

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 9:21

Factor of Safety 1.29

Shear Strain Rate Contours

- 2.50E-07
- 5.00E-07
- 7.50E-07
- 1.00E-06
- 1.25E-06
- 1.50E-06
- 1.75E-06
- 2.00E-06

Contour interval= 2.50E-07
(zero contour omitted)
Boundary plot

0 1E 2

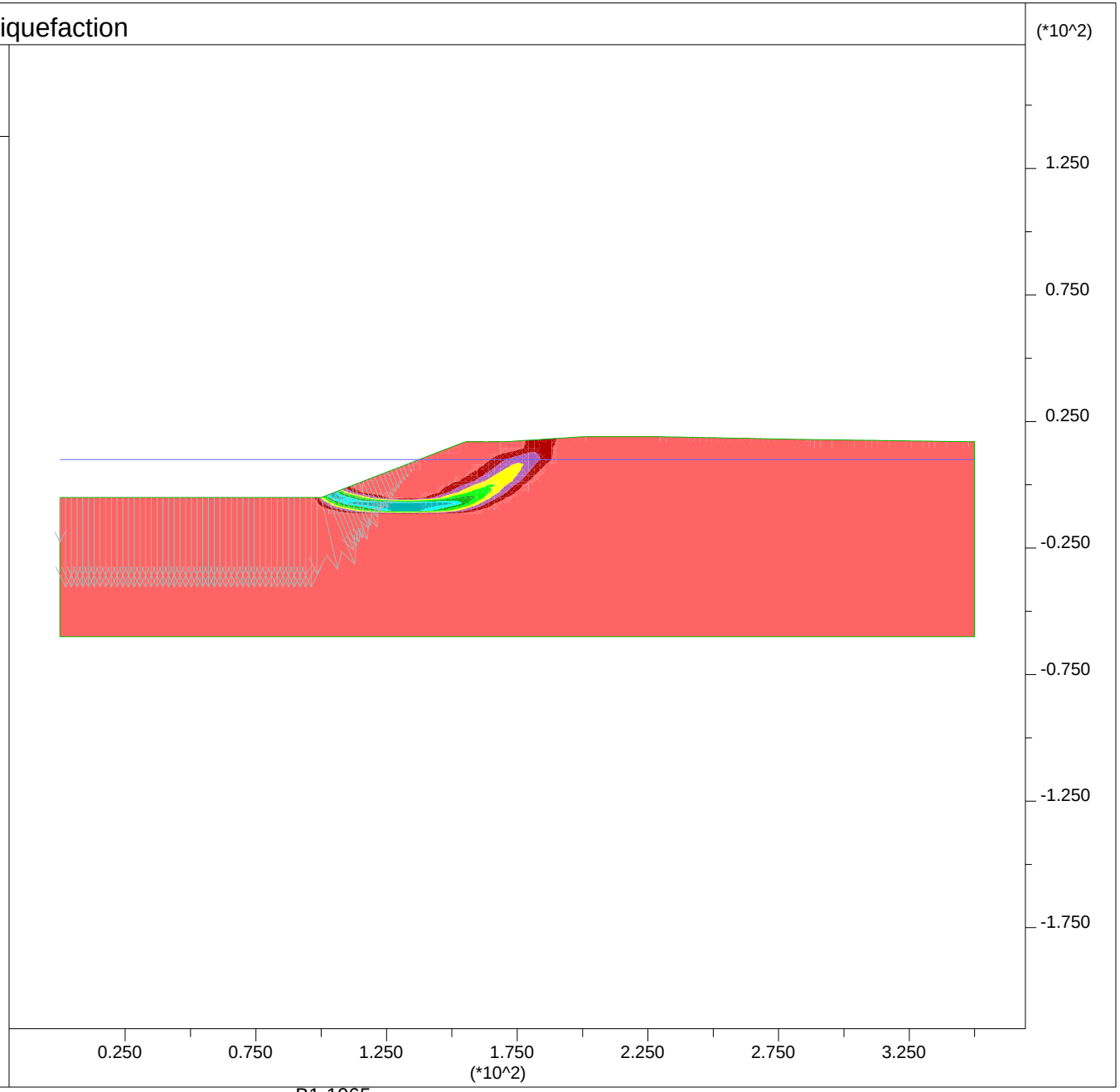
Water Table

Net Applied Forces

max vector = 2.050E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1065

PLATE G-56

JOB TITLE : Section D-D' - Post Liquefaction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 9:22

Factor of Safety 1.29

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Liq Sand Deep'
- 'User:Liq Sand 2'
- 'User:Soft Clay'
- 'User:Liq Sand Shallow'
- User:LiqFill
- User:Fill

Boundary plot

0 1E 2

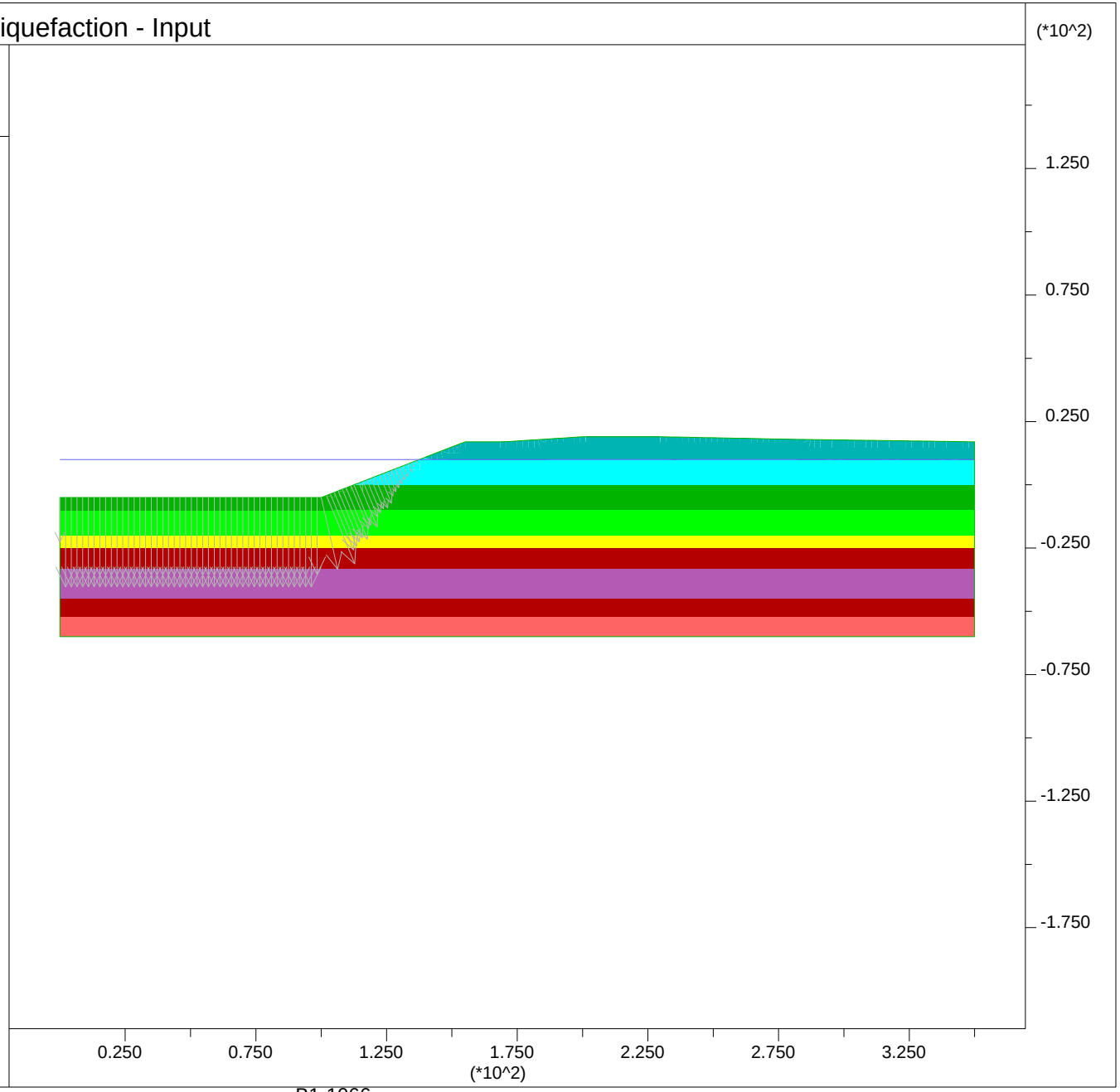
Water Table

Net Applied Forces

max vector = 2.050E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1066

PLATE G-57

JOB TITLE : Section D-D' - Ky=0.05

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 9:25

Factor of Safety 1.00

Shear Strain Rate Contours

- 1.00E-07
- 2.00E-07
- 3.00E-07
- 4.00E-07
- 5.00E-07
- 6.00E-07
- 7.00E-07
- 8.00E-07

Contour interval= 1.00E-07
(zero contour omitted)
Boundary plot

0 1E 2

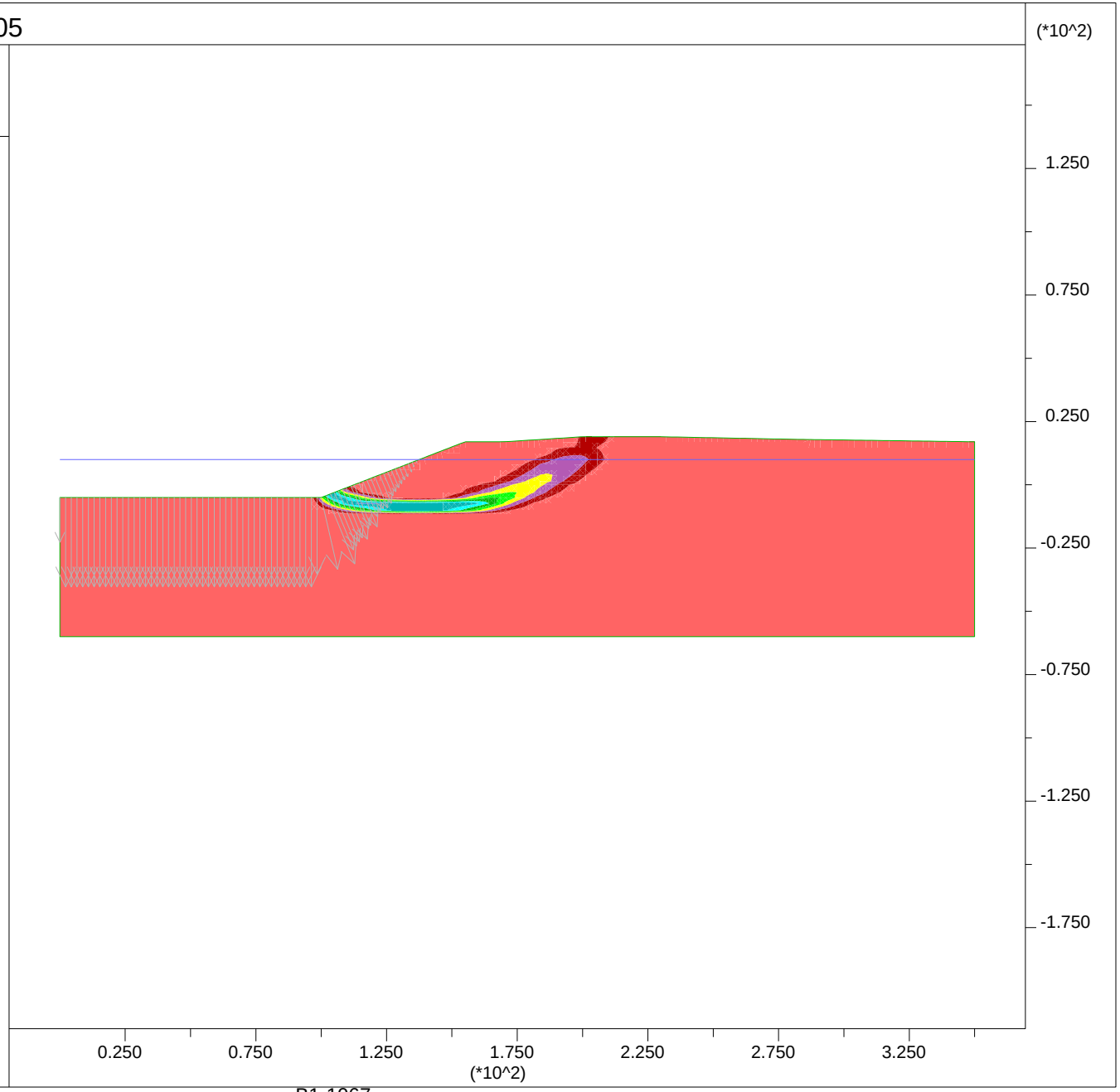
Water Table

Net Applied Forces

max vector = 2.052E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1067

PLATE G-58

JOB TITLE : Section D-D' - Ky=0.05 - Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 9:24

Factor of Safety 1.00

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Liq Sand Deep'
- 'User:Liq Sand 2'
- 'User:Soft Clay'
- 'User:Liq Sand Shallow'
- User:LiqFill
- User:Fill

Boundary plot

0 1E 2

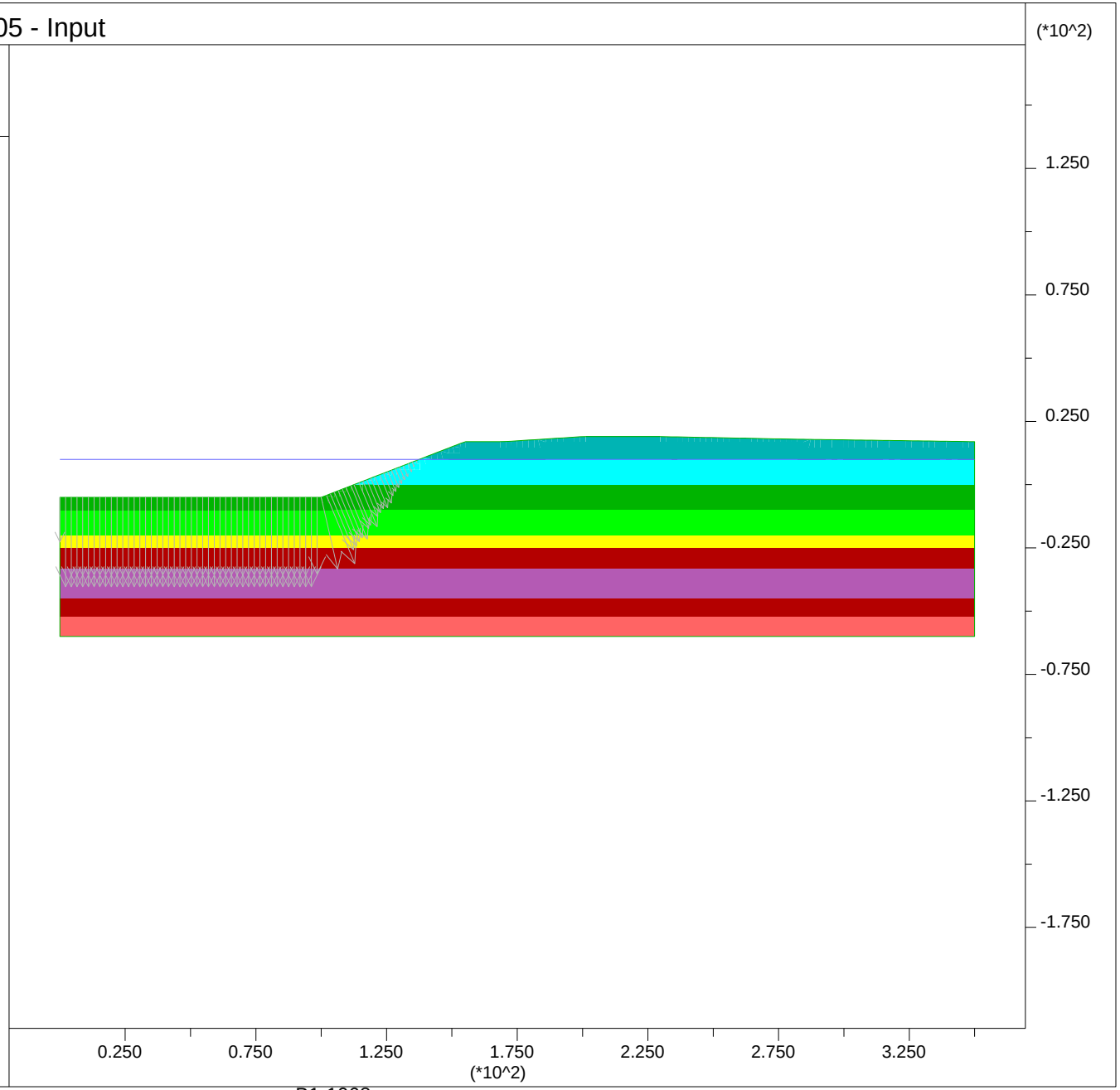
Water Table

Net Applied Forces

max vector = 2.052E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1068

PLATE G-59

Newmark Displacements using Bray and Rathje (1998):

Section D-D'

Site Input

PGA,rock =	0.25	g		
M =	6.6			
r =	13	km		
ky =	0.05		32.185	1.60925
Sliding Mass Input				
Vs =	137	m/s	assumed	
Thickness, H =	8.2	m		
	27	ft		

Output

Tm =	0.49	sec				
D5-95 =	10.5	sec				
Ts =	0.24	sec				
NRF =	1.15					
Ts/Tm =	0.49					
kmax/(PGA,rock*NRF)	0.93					
kmax =	0.27					
ky / kmax =	0.19					
Displacement, u =	47	cm	1.5	feet	18.4	inches

JOB TITLE : Section D-D' - Ground Improvement with DSM (ky=0.07)

FLAC (Version 7.00)

LEGEND

5-Mar-13 17:21
step 33918
-1.944E+01 <x< 3.694E+02
-2.149E+02 <y< 1.739E+02

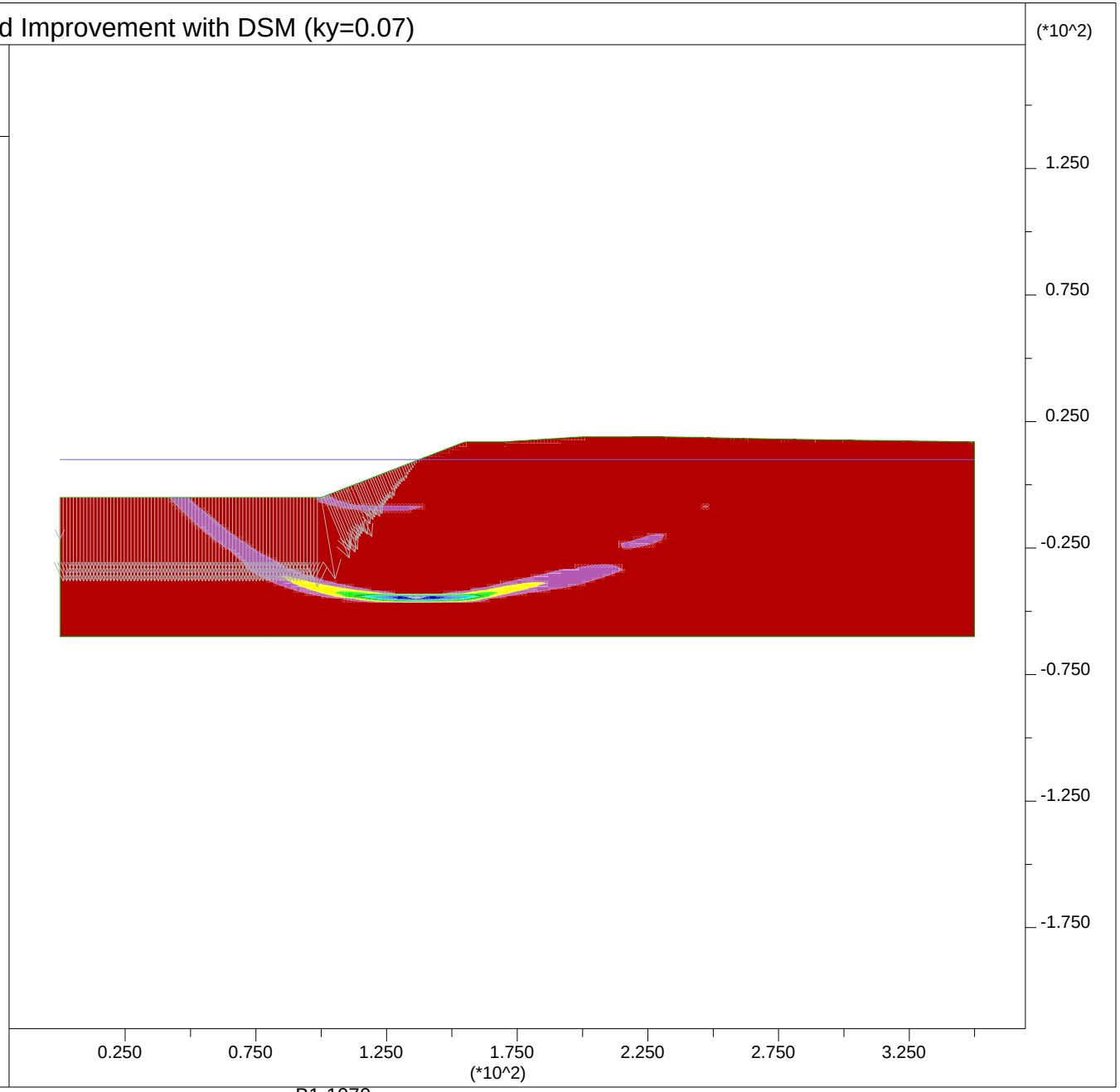
Factor of Safety 0.98

Max. shear strain-rate
0.00E+00
5.00E-07
1.00E-06
1.50E-06
2.00E-06
2.50E-06
3.00E-06
3.50E-06
4.00E-06
4.50E-06

Contour interval= 5.00E-07
Extrap. by averaging
Boundary plot

0 1E 2

Group Delta Consultants
Ballona Wetlands



B1-1070

PLATE G-61

JOB TITLE : Section D-D' - Ground Improvement with DSM (ky=0.07) - Input

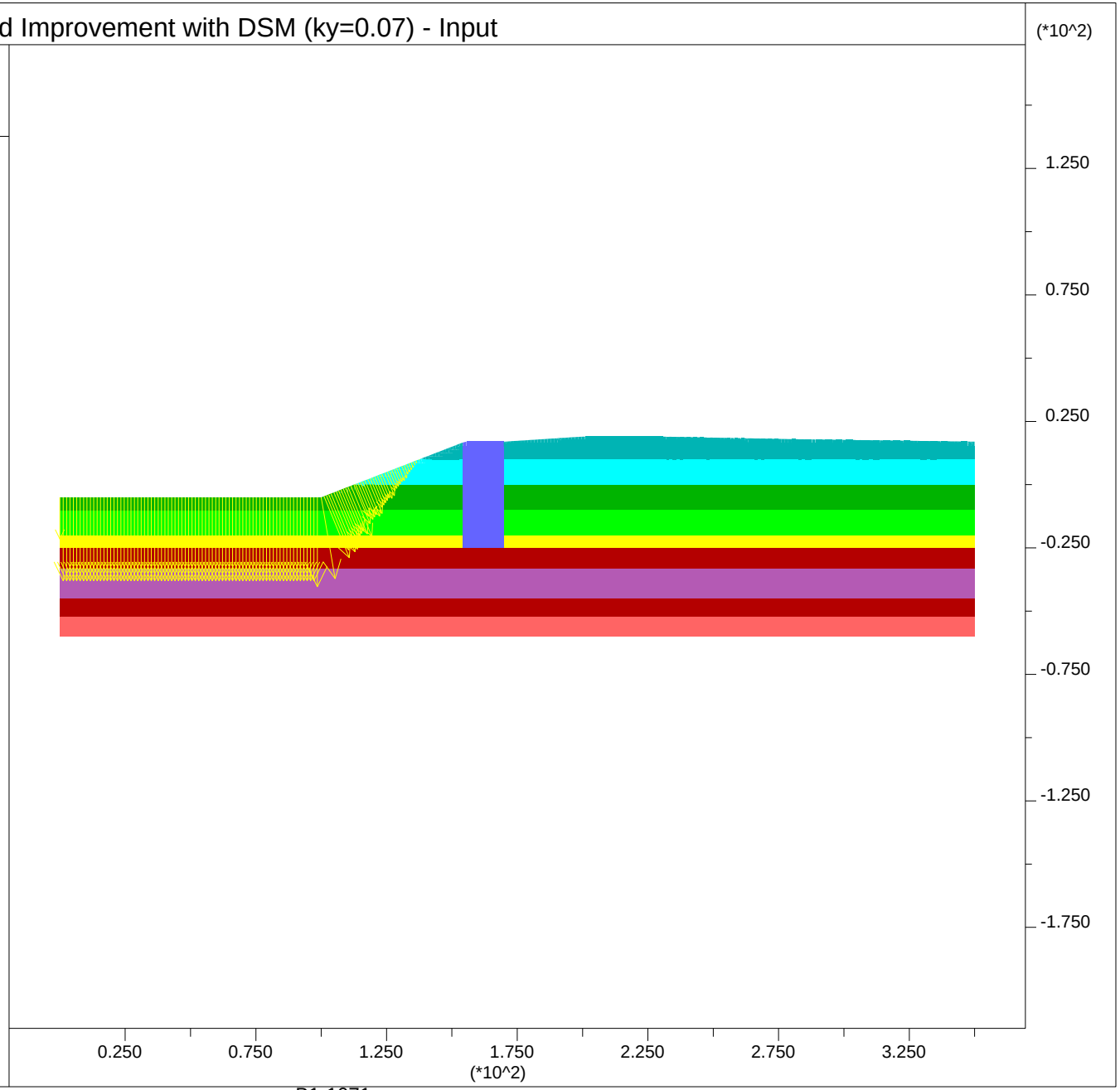
FLAC (Version 7.00)

LEGEND

5-Mar-13 17:20
step 0
-1.944E+01 <x< 3.694E+02
-2.149E+02 <y< 1.739E+02

User-defined Groups
- User:Sand
- 'User:Stiff Clay'
- 'User:Liq Sand Deep'
- 'User:Liq Sand 2'
- 'User:Soft Clay'
- 'User:Liq Sand Shallow'
- User:LiqFill
- User:Fill
- User:DSM

Net Applied Forces
max vector = 1.301E+03
0 2E 3



Group Delta Consultants
Ballona Wetlands

B1-1071

PLATE G-62

JOB TITLE : Section E-E' - End of Construction

FLAC/SLOPE (Version 7.00)

LEGEND

4-Mar-13 17:38

Factor of Safety 1.57

Shear Strain Rate Contours

- 5.00E-07
- 1.00E-06
- 1.50E-06
- 2.00E-06
- 2.50E-06
- 3.00E-06
- 3.50E-06

Contour interval= 5.00E-07
(zero contour omitted)
Boundary plot

0 2E 2

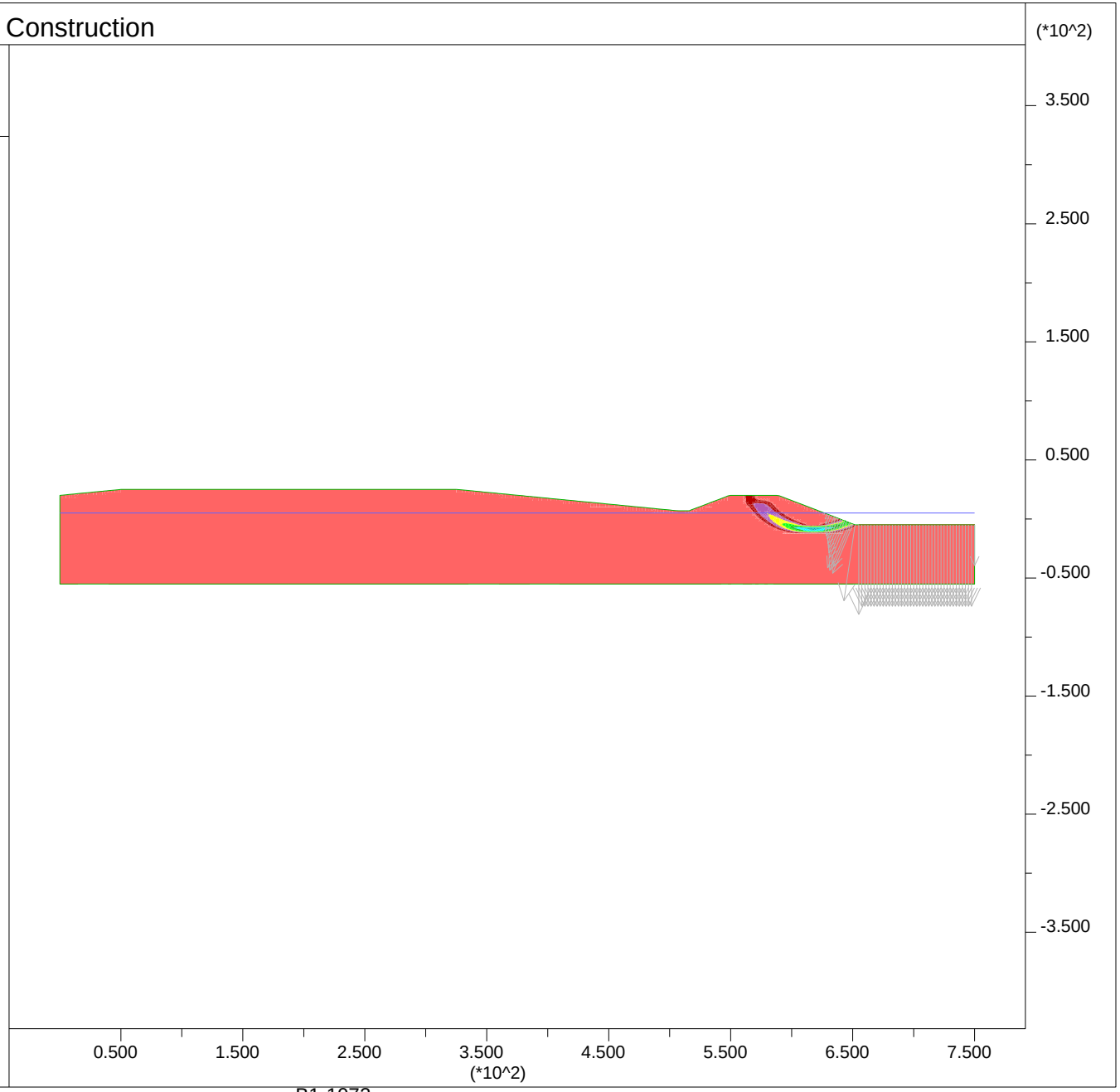
Water Table

Net Applied Forces

max vector = 1.718E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1072

PLATE G-63

JOB TITLE : Section E-E' - End of Construction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

4-Mar-13 17:39

Factor of Safety 1.57

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Med Sand'
- 'User:Soft Clay'
- Fill:Fill
- User:Embankment

Boundary plot

0 2E 2

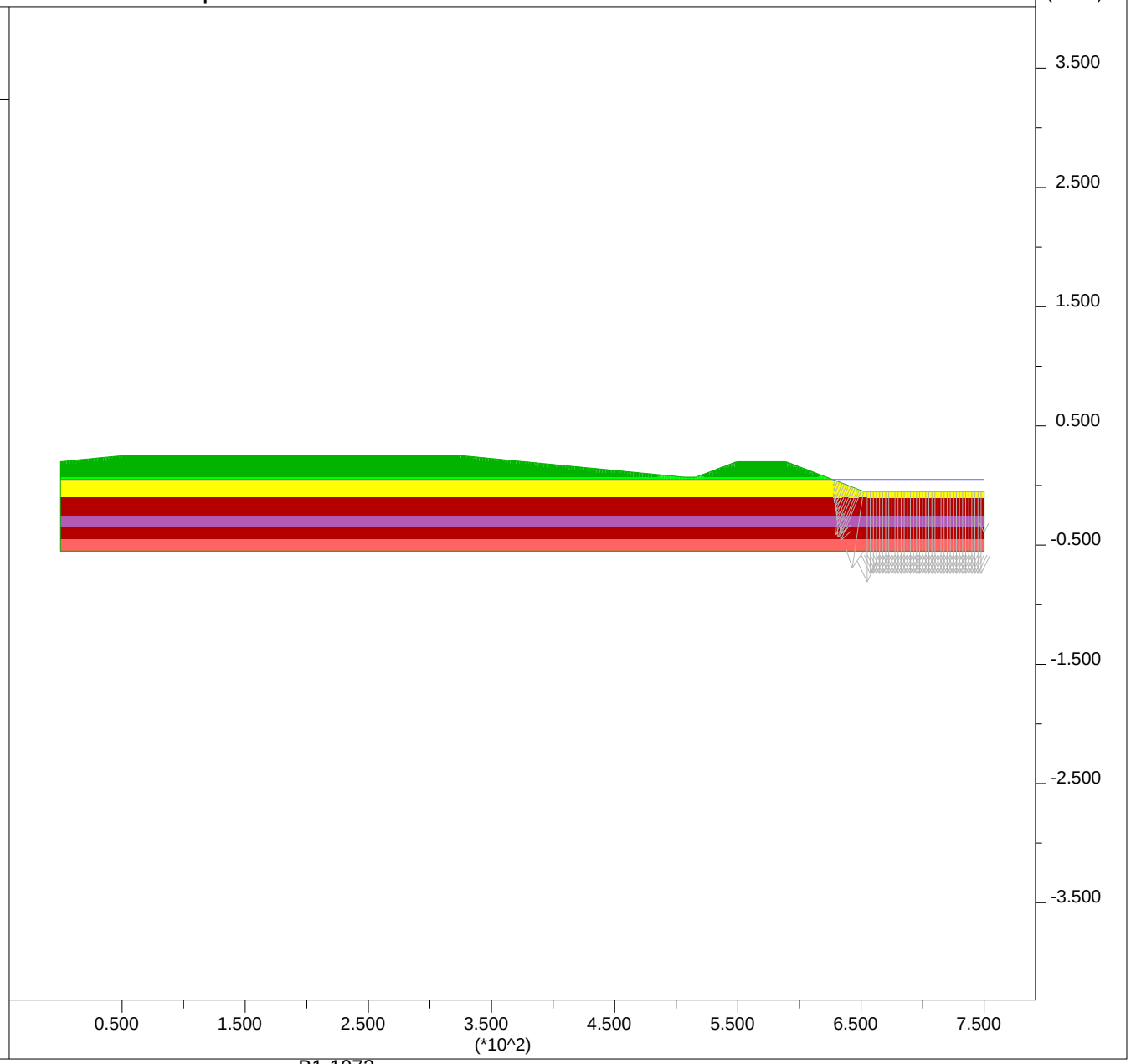
Water Table

Net Applied Forces

max vector = 1.718E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1073

PLATE G-64

JOB TITLE : Section E-E' - High Water Short Term

FLAC/SLOPE (Version 7.00)

LEGEND

4-Mar-13 17:37

Factor of Safety 2.07

Shear Strain Rate Contours

1.00E-06
2.00E-06
3.00E-06
4.00E-06
5.00E-06
6.00E-06
7.00E-06

Contour interval= 1.00E-06
(zero contour omitted)
Boundary plot

0 2E 2

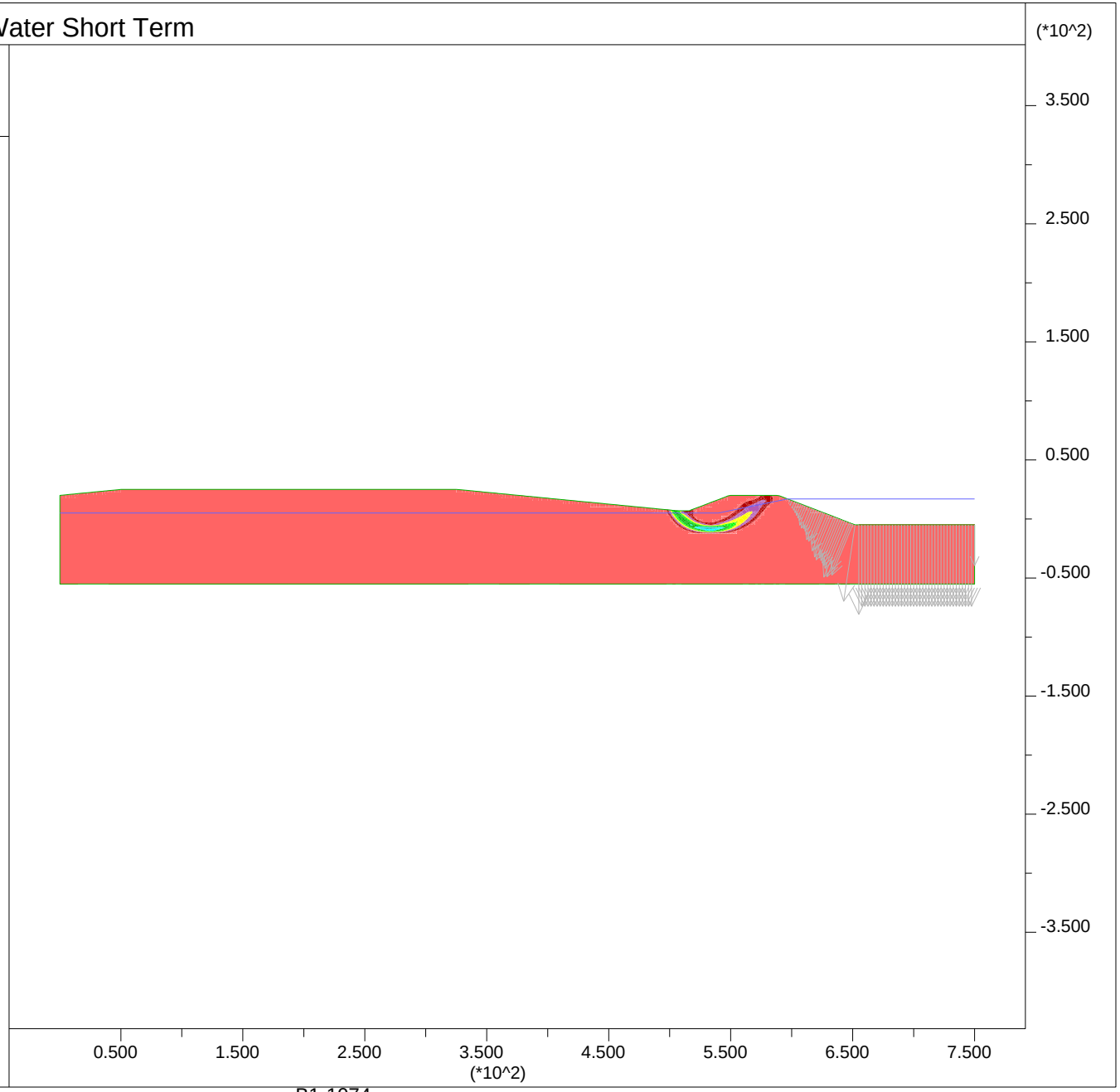
Water Table

Net Applied Forces

max vector = 3.779E+03

0 1E 4

Group Delta Consultants
Ballona Wetlands



B1-1074

PLATE G-65

JOB TITLE : Section E-E' - High Water Short Term - Input

FLAC/SLOPE (Version 7.00)

LEGEND

4-Mar-13 17:37

Factor of Safety 2.07

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Med Sand'
- 'User:Soft Clay'
- Fill:Fill
- User:Embankment

Boundary plot

0 2E 2

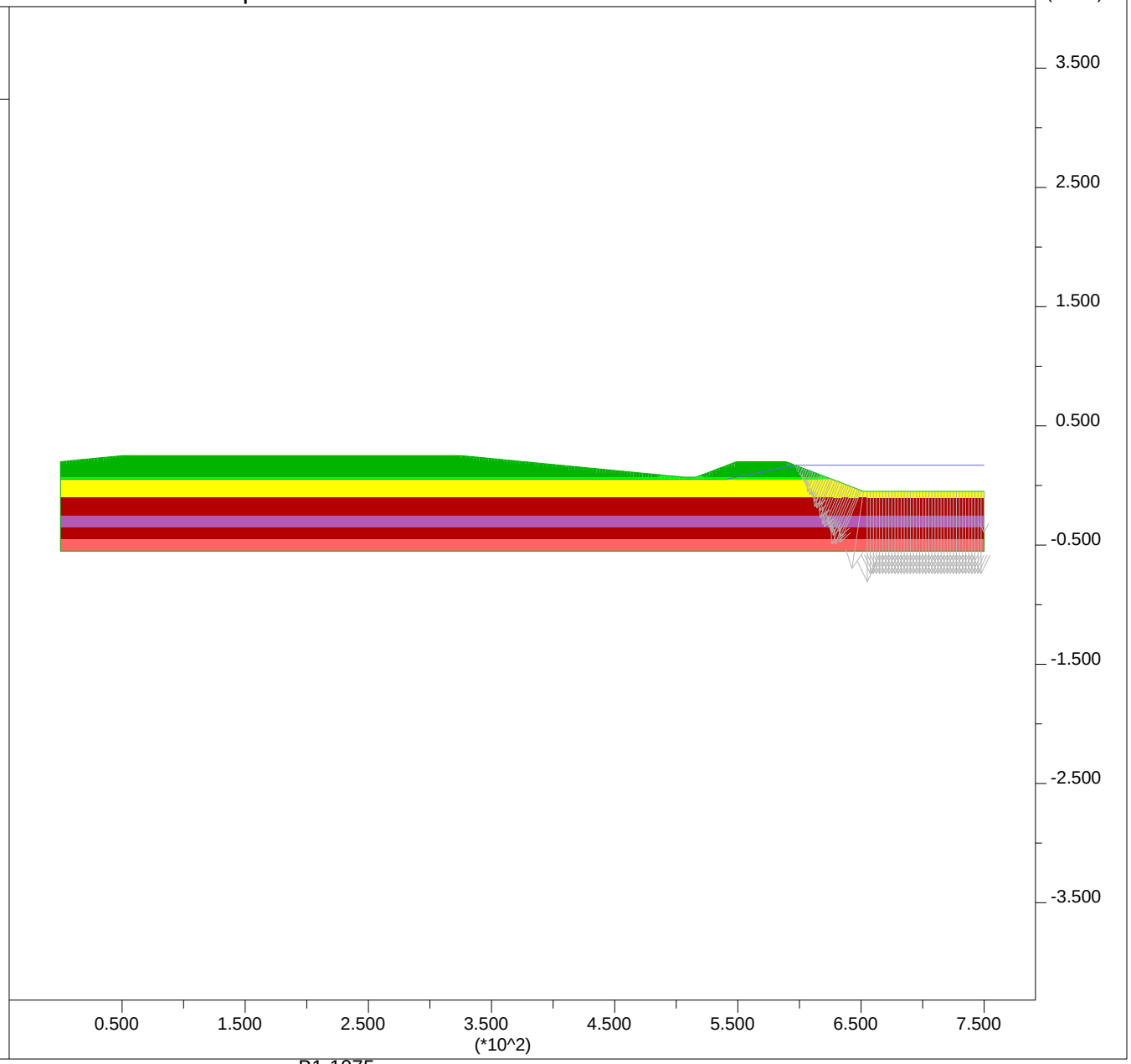
Water Table

Net Applied Forces

max vector = 3.779E+03

0 1E 4

Group Delta Consultants
Ballona Wetlands



B1-1075

PLATE G-66

JOB TITLE : Section E-E' - Post Liquefaction

FLAC/SLOPE (Version 7.00)

LEGEND

4-Mar-13 17:40

Factor of Safety 1.33

Shear Strain Rate Contours

- 2.50E-07
- 5.00E-07
- 7.50E-07
- 1.00E-06
- 1.25E-06
- 1.50E-06
- 1.75E-06
- 2.00E-06

Contour interval= 2.50E-07
(zero contour omitted)
Boundary plot

0 2E 2

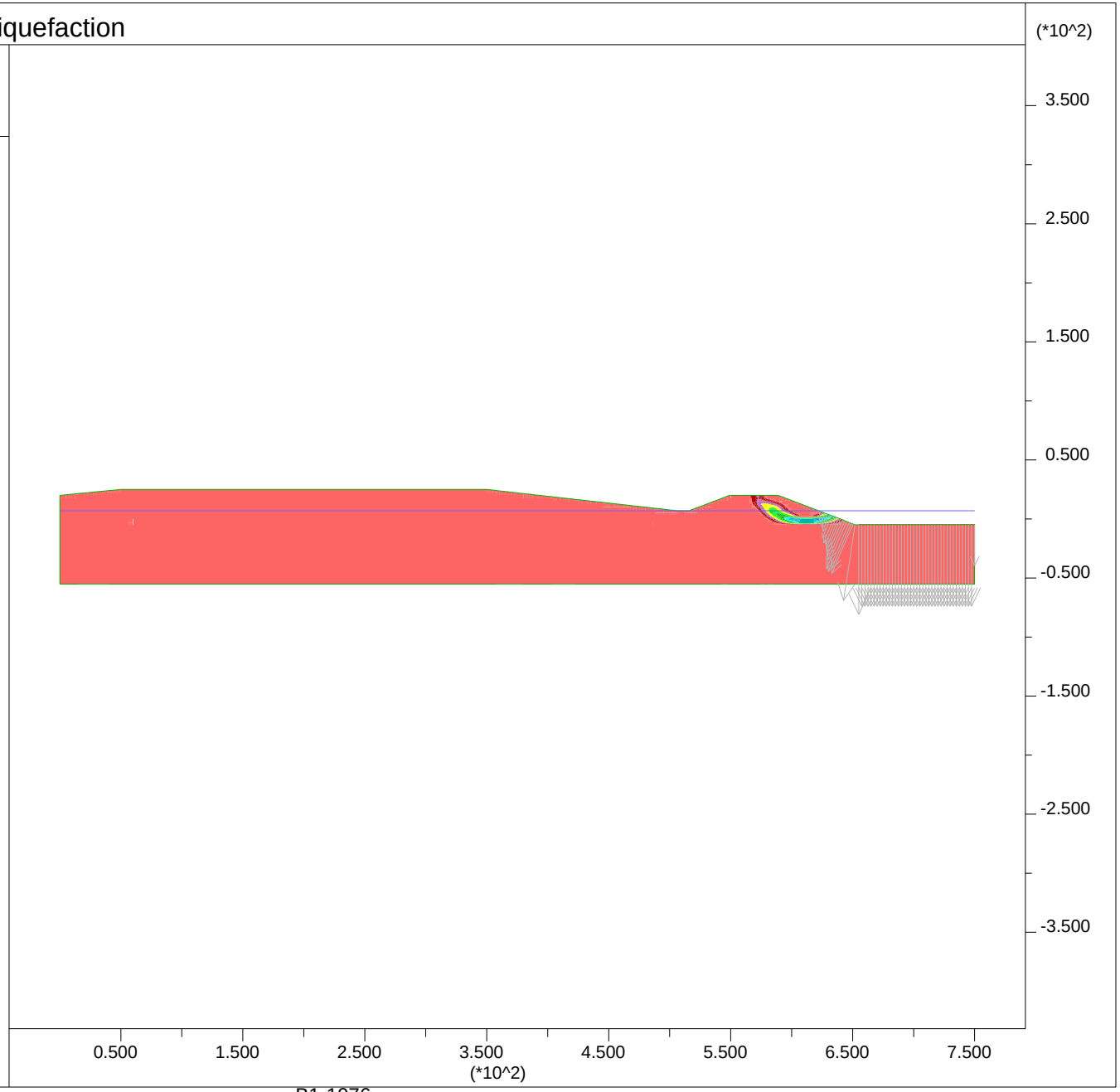
Water Table

Net Applied Forces

max vector = 2.061E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1076

PLATE G-67

JOB TITLE : Section E-E' - Post Liquefaction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

4-Mar-13 17:40

Factor of Safety 1.33

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'Fill:Liq Sand 2'
- 'User:Soft Clay'
- 'Fill:Liq Fill'
- User:Embankment

Boundary plot

0 2E 2

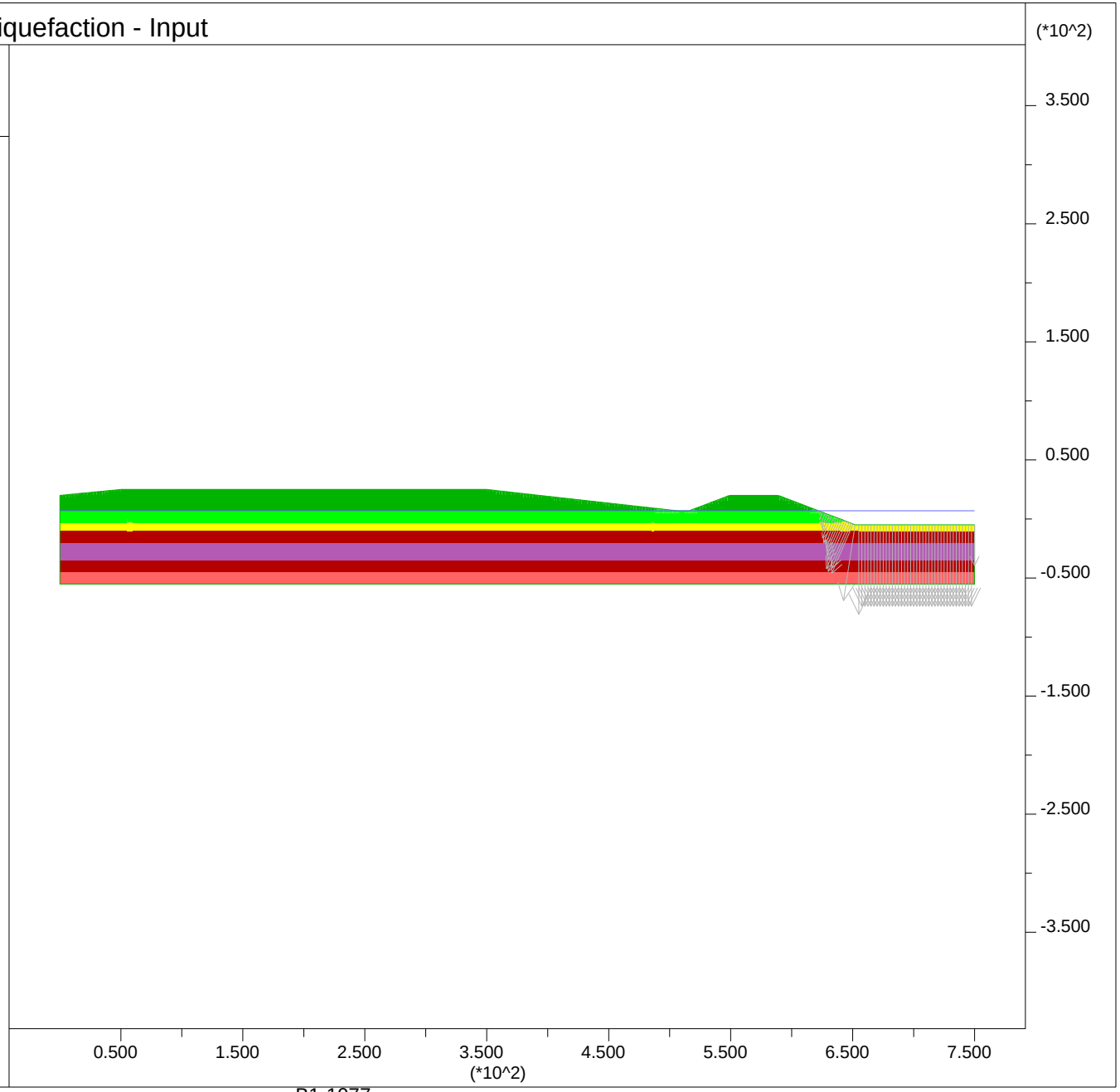
Water Table

Net Applied Forces

max vector = 2.061E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1077

PLATE G-68

JOB TITLE : Section E-E' - Ky=0.08

FLAC/SLOPE (Version 7.00)

LEGEND

4-Mar-13 17:42

Factor of Safety 0.98

Shear Strain Rate Contours

- 5.00E-07
- 1.00E-06
- 1.50E-06
- 2.00E-06
- 2.50E-06
- 3.00E-06
- 3.50E-06
- 4.00E-06

Contour interval= 5.00E-07
(zero contour omitted)
Boundary plot

0 2E 2

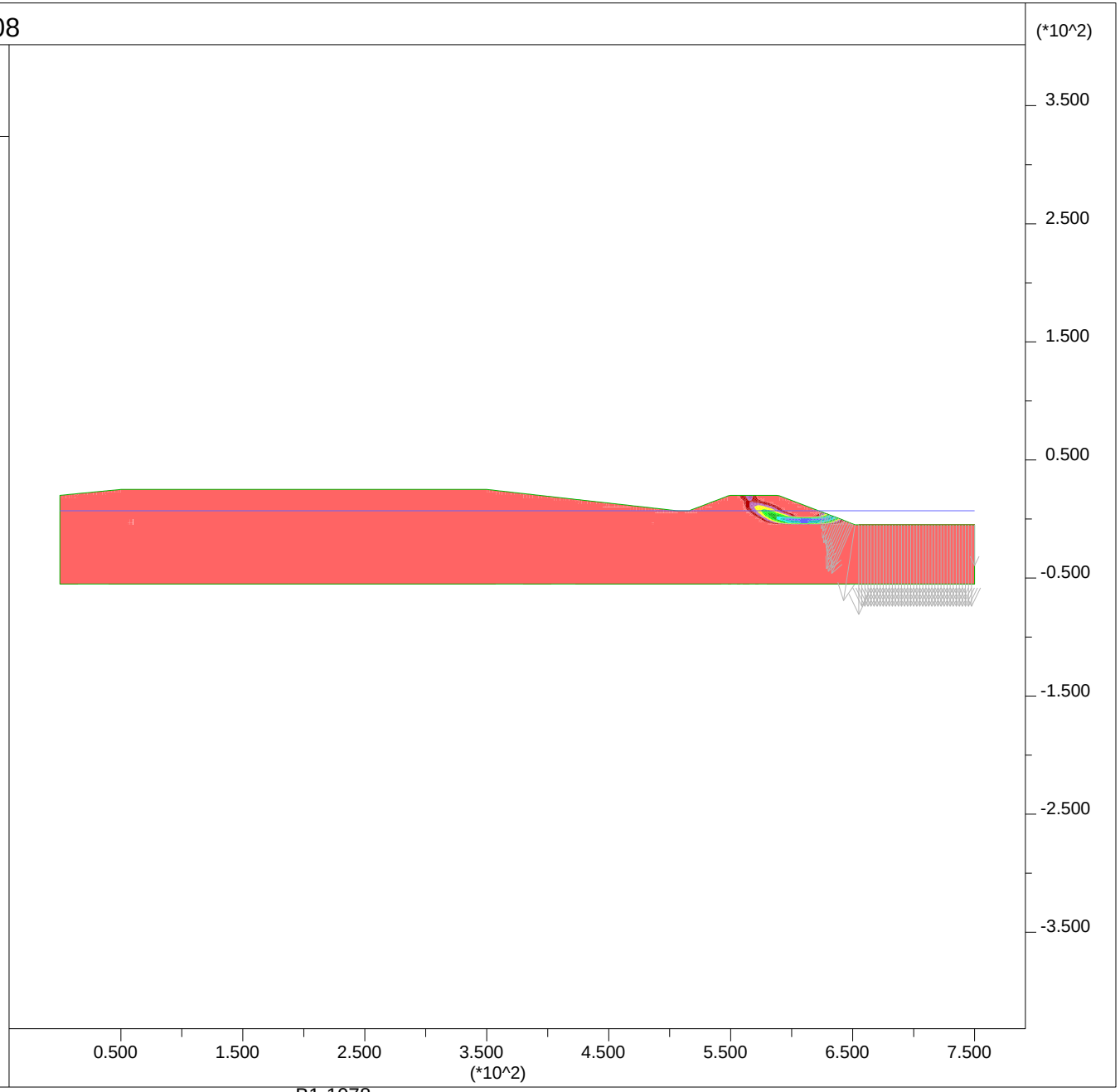
Water Table

Net Applied Forces

max vector = 2.068E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1078

PLATE G-69

JOB TITLE : Section E-E' - Ky=0.08 - Input

FLAC/SLOPE (Version 7.00)

LEGEND

4-Mar-13 17:43

Factor of Safety 0.98

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'Fill:Liq Sand 2'
- 'User:Soft Clay'
- 'Fill:Liq Fill'
- User:Embankment

Boundary plot

0 2E 2

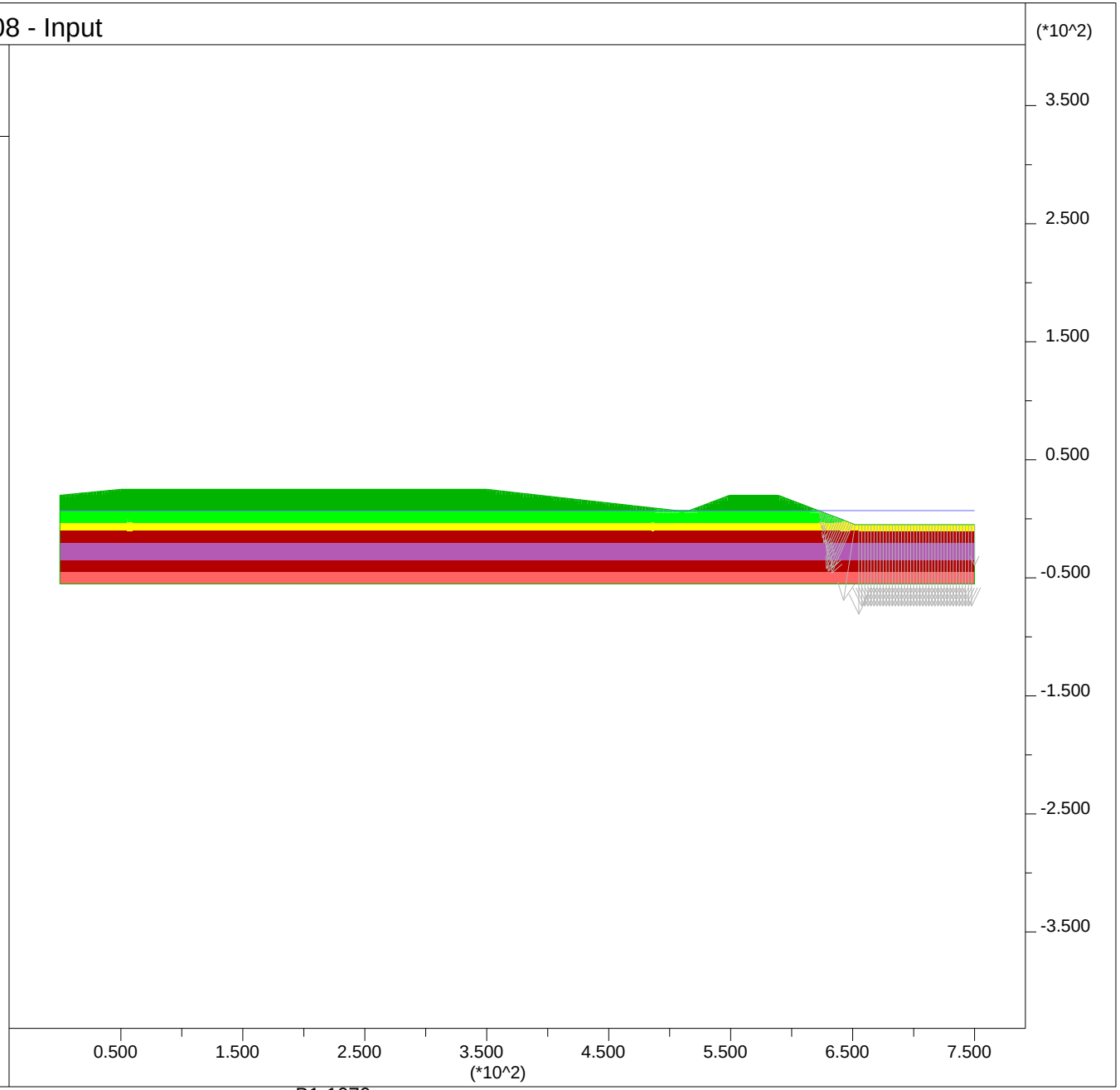
Water Table

Net Applied Forces

max vector = 2.068E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1079

PLATE G-70

Newmark Displacements using Bray and Rathje (1998):

Section E-E'

Site Input

PGA,rock =	0.25	g		
M =	6.6			
r =	13	km		
ky =	0.08		32.185	2.5748
Sliding Mass Input				
Vs =	137	m/s	assumed	
Thickness, H =	6.1	m		
	20	ft		

Output

Tm =	0.49	sec				
D5-95 =	10.5	sec				
Ts =	0.18	sec				
NRF =	1.15					
Ts/Tm =	0.36					
kmax/(PGA,rock*NRF)	1.18					
kmax =	0.34					
ky / kmax =	0.24					
Displacement, u =	40	cm	1.3	feet	15.6	inches

JOB TITLE : Section E-E' - Ground Improvement with DSM (ky=0.08)

FLAC (Version 7.00)

LEGEND

5-Mar-13 17:17
step 13290
-4.167E+01 <x< 7.917E+02
-4.317E+02 <y< 4.017E+02

Factor of Safety 1.00

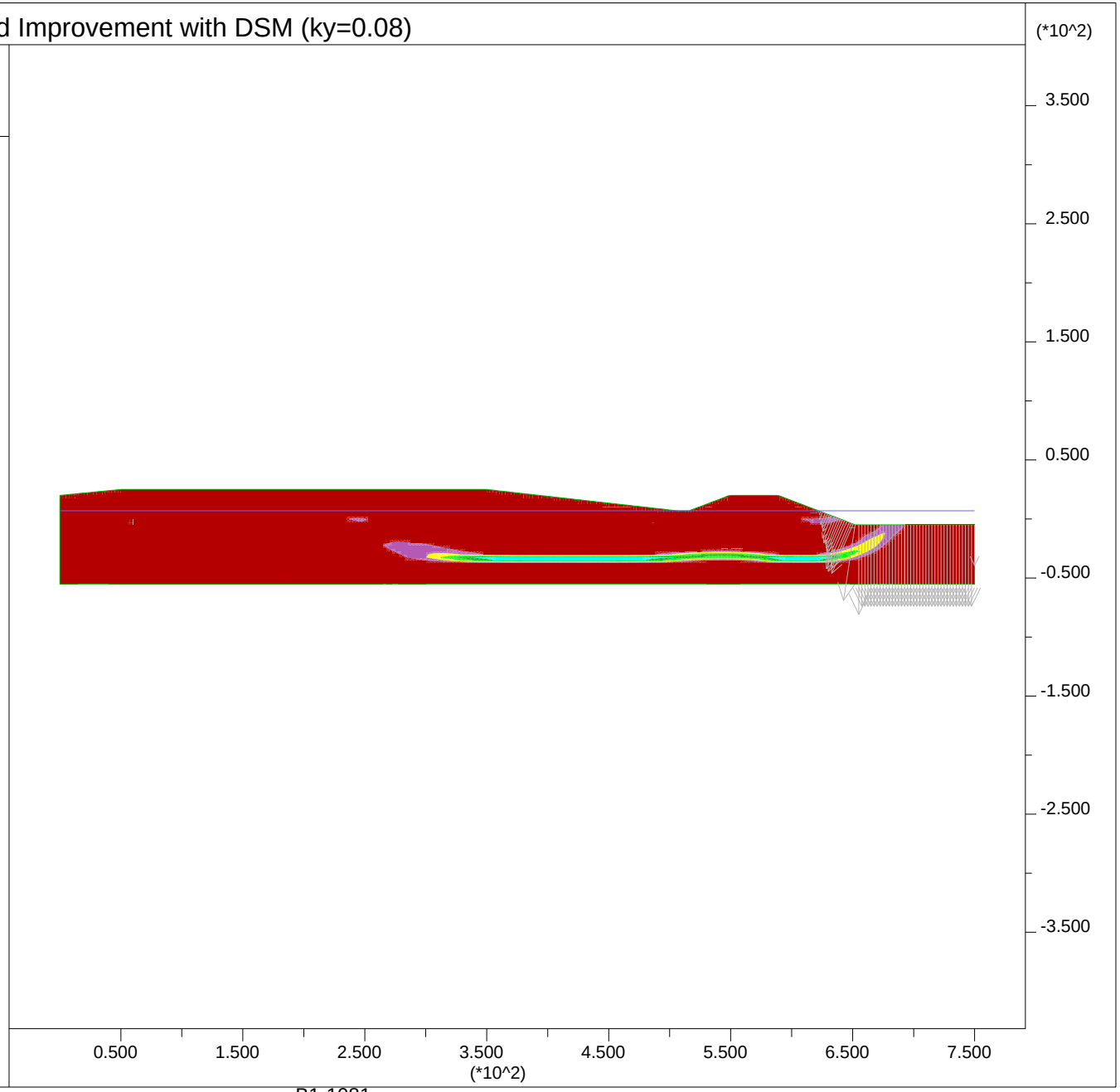
Max. shear strain-rate
0.00E+00
5.00E-07
1.00E-06
1.50E-06
2.00E-06
2.50E-06

Contour interval= 5.00E-07
Extrap. by averaging
Boundary plot
0 2E 2

Water Table

Net Applied Forces
max vector = 2.061E+03
0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1081

PLATE G-72

JOB TITLE : Section E-E' - Ground Improvement with DSM (ky=0.08) - Input

FLAC (Version 7.00)

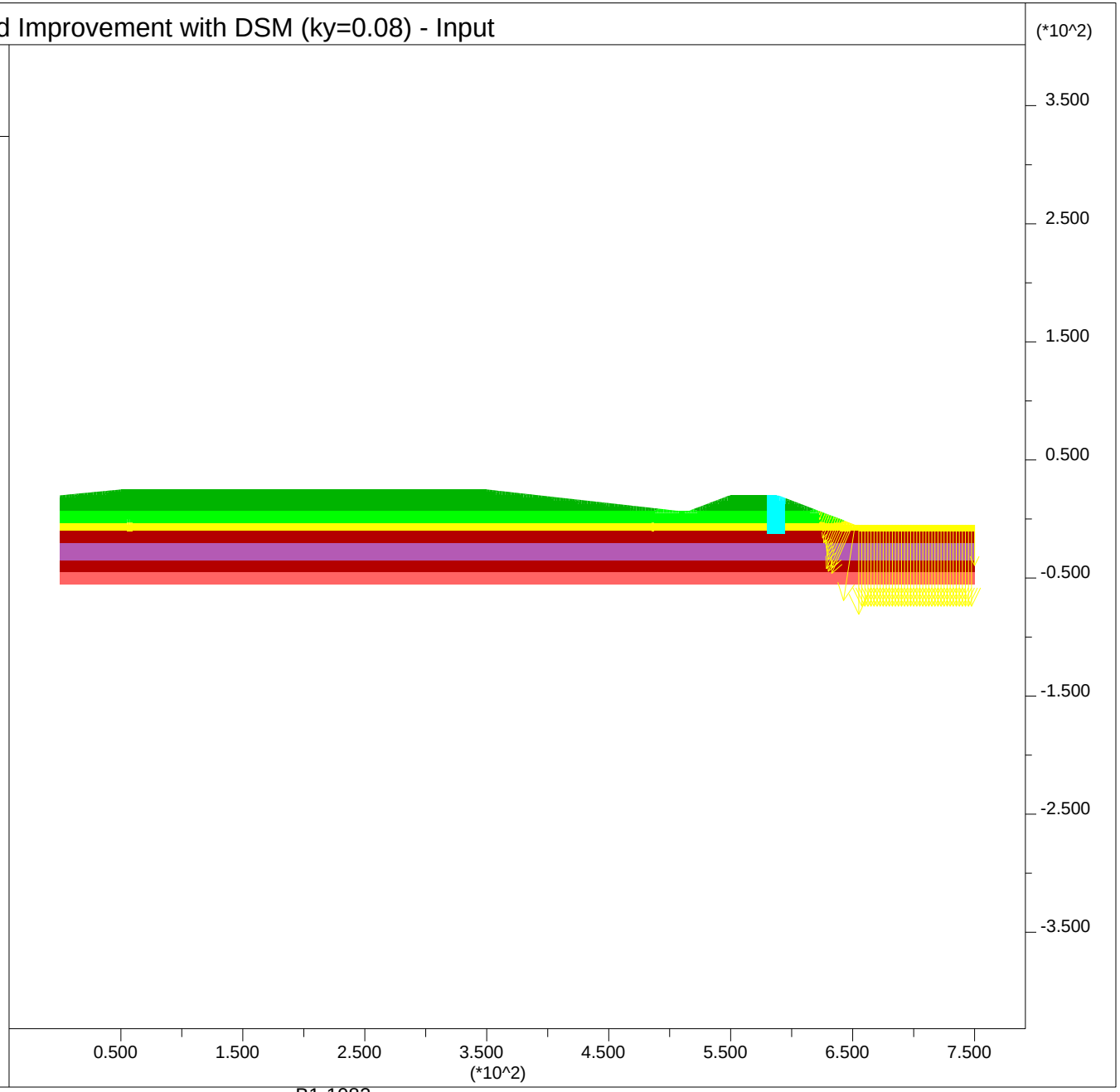
LEGEND

5-Mar-13 17:16
step 13290
-4.167E+01 <x< 7.917E+02
-4.317E+02 <y< 4.017E+02

User-defined Groups
- User:Sand
- 'User:Stiff Clay'
- 'Fill:Liq Sand 2'
- 'User:Soft Clay'
- 'Fill:Liq Fill'
- User:Embankment
- User:DSM

Net Applied Forces
max vector = 2.061E+03
0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1082

PLATE G-73

JOB TITLE : Section F-F' - End of Construction

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 20:06

Factor of Safety 2.19

Shear Strain Rate Contours

1.00E-06
2.00E-06
3.00E-06
4.00E-06
5.00E-06

Contour interval= 1.00E-06
(zero contour omitted)
Boundary plot

0 2E 2

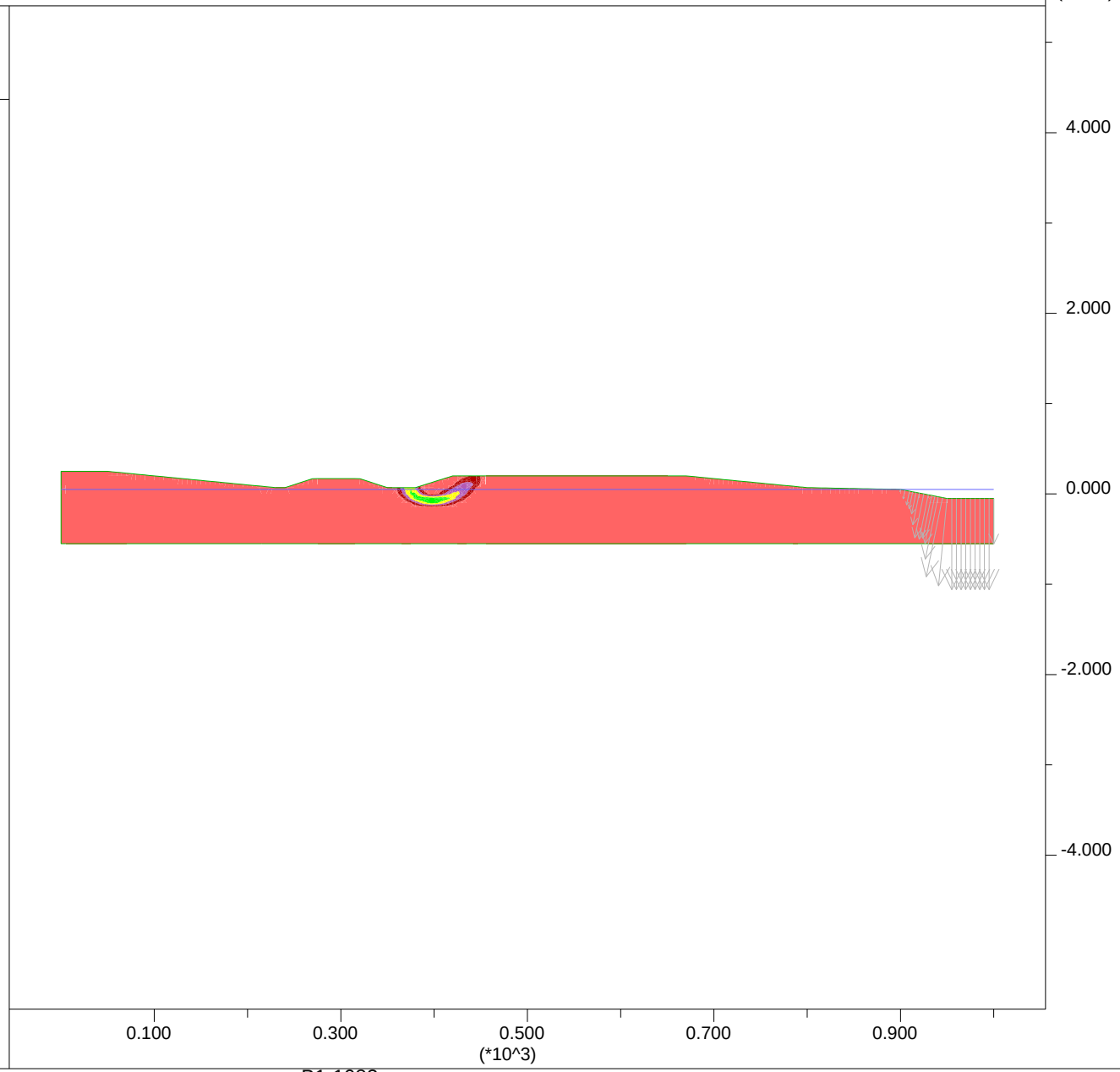
Water Table

Net Applied Forces

max vector = 3.123E+03

0 1E 4

Group Delta Consultants
Torrance, CA



B1-1083

PLATE G-74

JOB TITLE : Section F-F' - End of Construction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 20:05

Factor of Safety 2.19

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Med Sand'
- 'User:Soft Clay'
- User:Embankment
- Fill:Fill

Boundary plot

0 2E 2

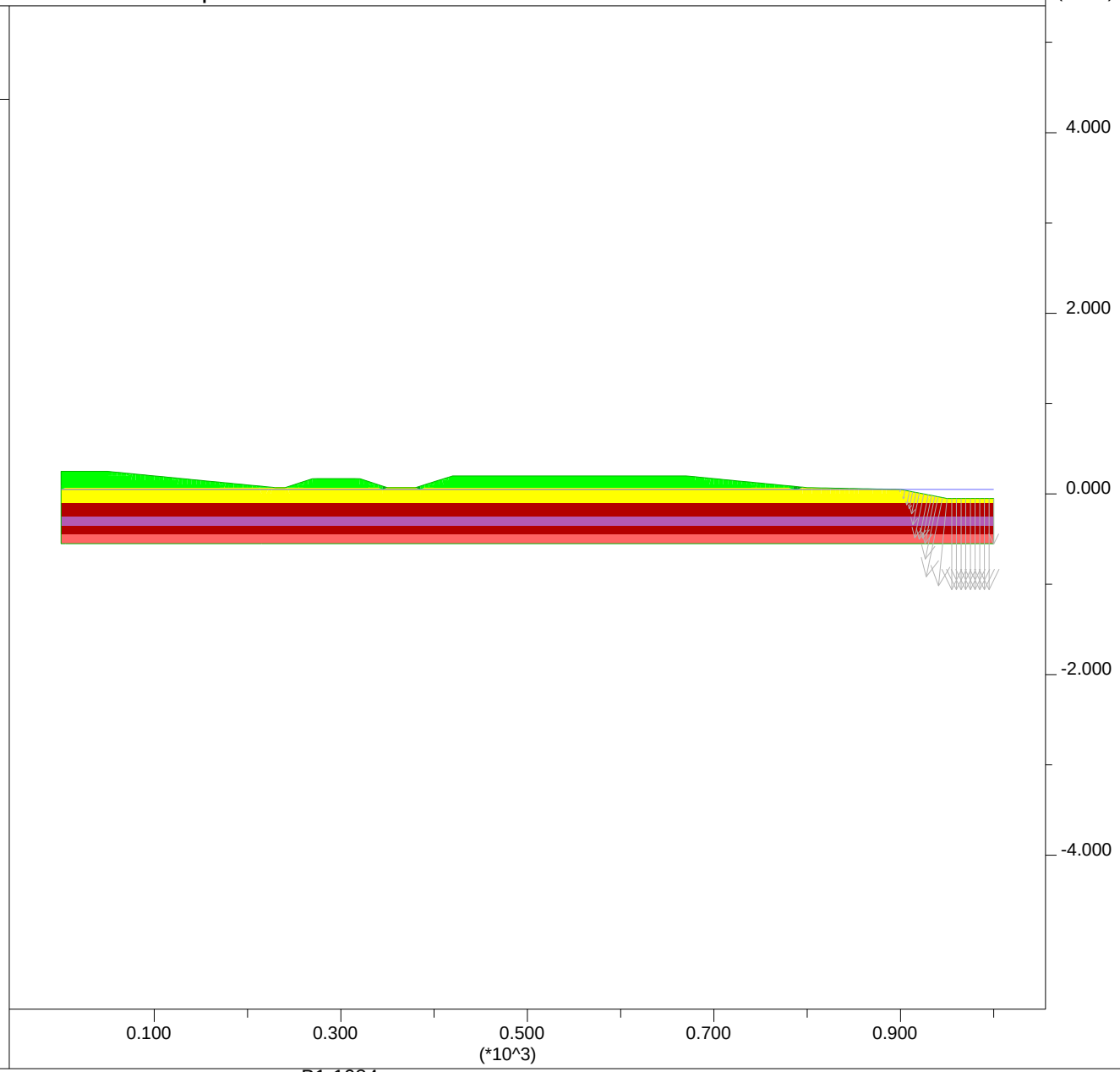
Water Table

Net Applied Forces

max vector = 3.123E+03

0 1E 4

Group Delta Consultants
Torrance, CA



B1-1084

PLATE G-75

JOB TITLE : Section F-F' - High Water Short Term

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 19:52

Factor of Safety 2.19

Shear Strain Rate Contours

- 2.00E-06
- 4.00E-06
- 6.00E-06
- 8.00E-06
- 1.00E-05

Contour interval= 2.00E-06
(zero contour omitted)
Boundary plot

0 2E 2

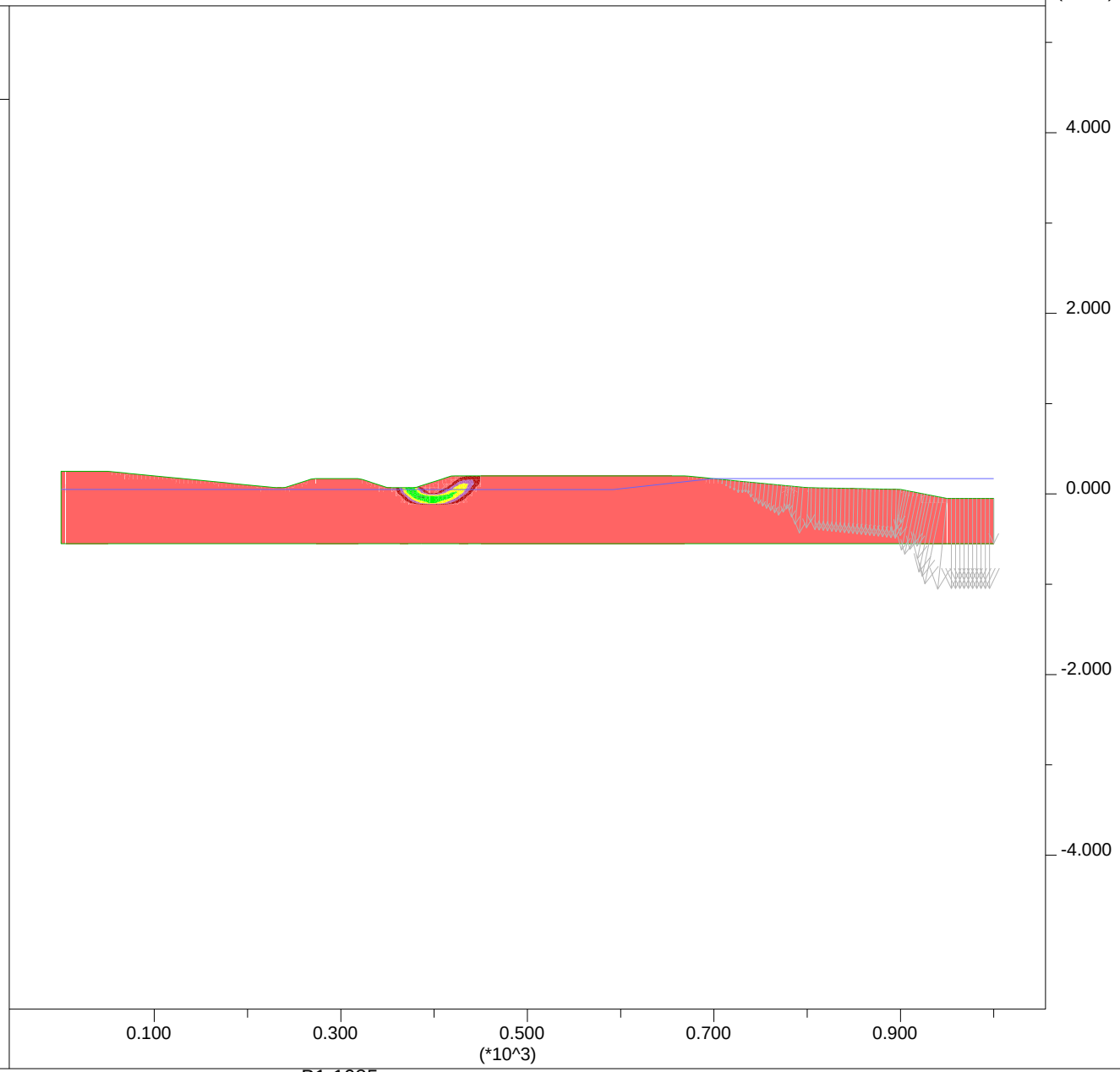
Water Table

Net Applied Forces

max vector = 6.322E+03

0 2E 4

Group Delta Consultants
Torrance, CA



B1-1085

PLATE G-76

JOB TITLE : Section F-F' - High Water Short Term - Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 19:52

Factor of Safety 2.19

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Med Sand'
- 'User:Soft Clay'
- User:Embankment
- Fill:Fill

Boundary plot

0 2E 2

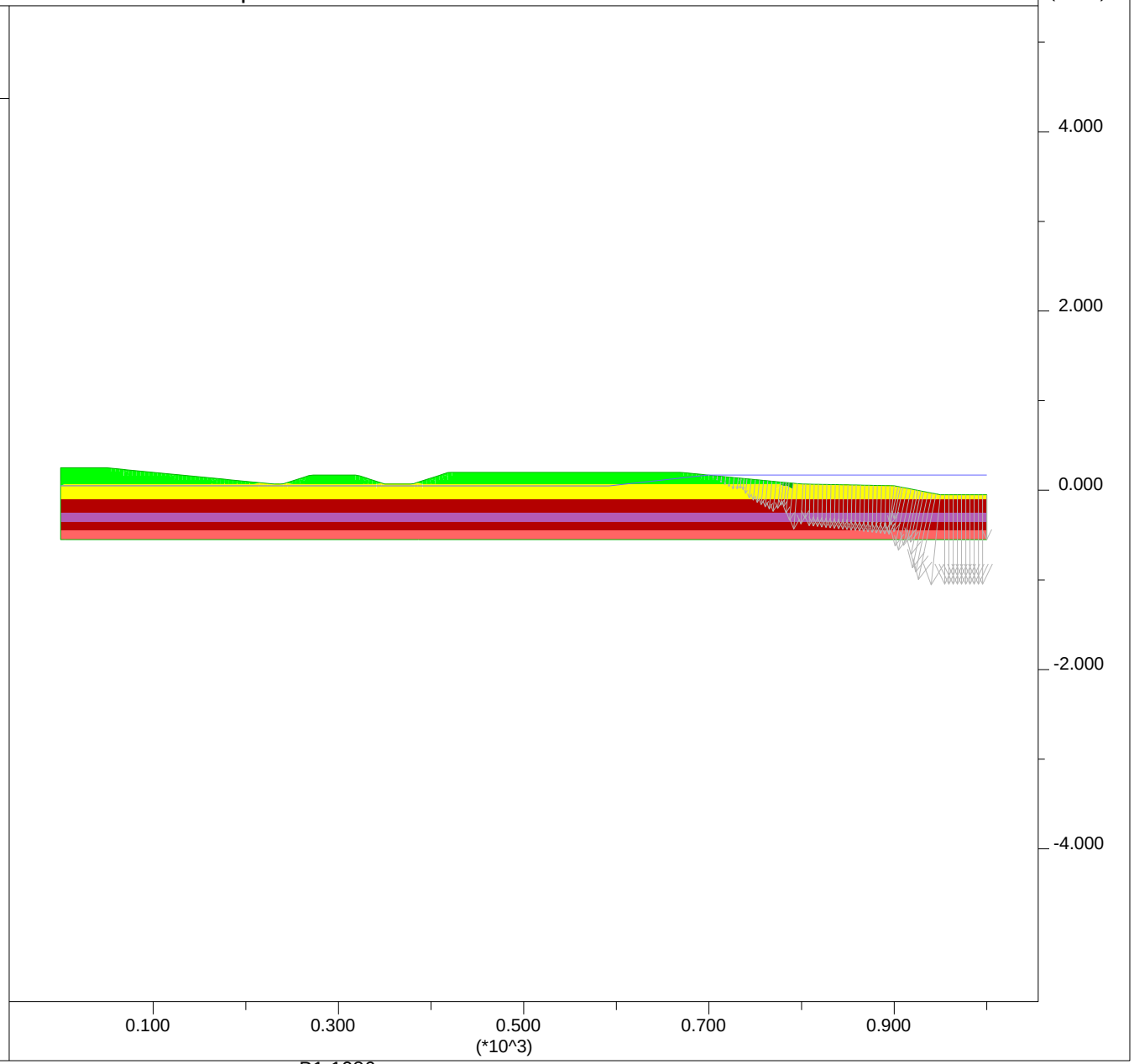
Water Table

Net Applied Forces

max vector = 6.322E+03

0 2E 4

Group Delta Consultants
Torrance, CA



B1-1086

PLATE G-77

JOB TITLE : Section F-F' - Post Liquefaction

FLAC/SLOPE (Version 7.00)

LEGEND

4-Mar-13 17:45

Factor of Safety 1.59

Shear Strain Rate Contours

- 5.00E-07
- 1.00E-06
- 1.50E-06
- 2.00E-06
- 2.50E-06
- 3.00E-06
- 3.50E-06
- 4.00E-06
- 4.50E-06

Contour interval= 5.00E-07
(zero contour omitted)
Boundary plot

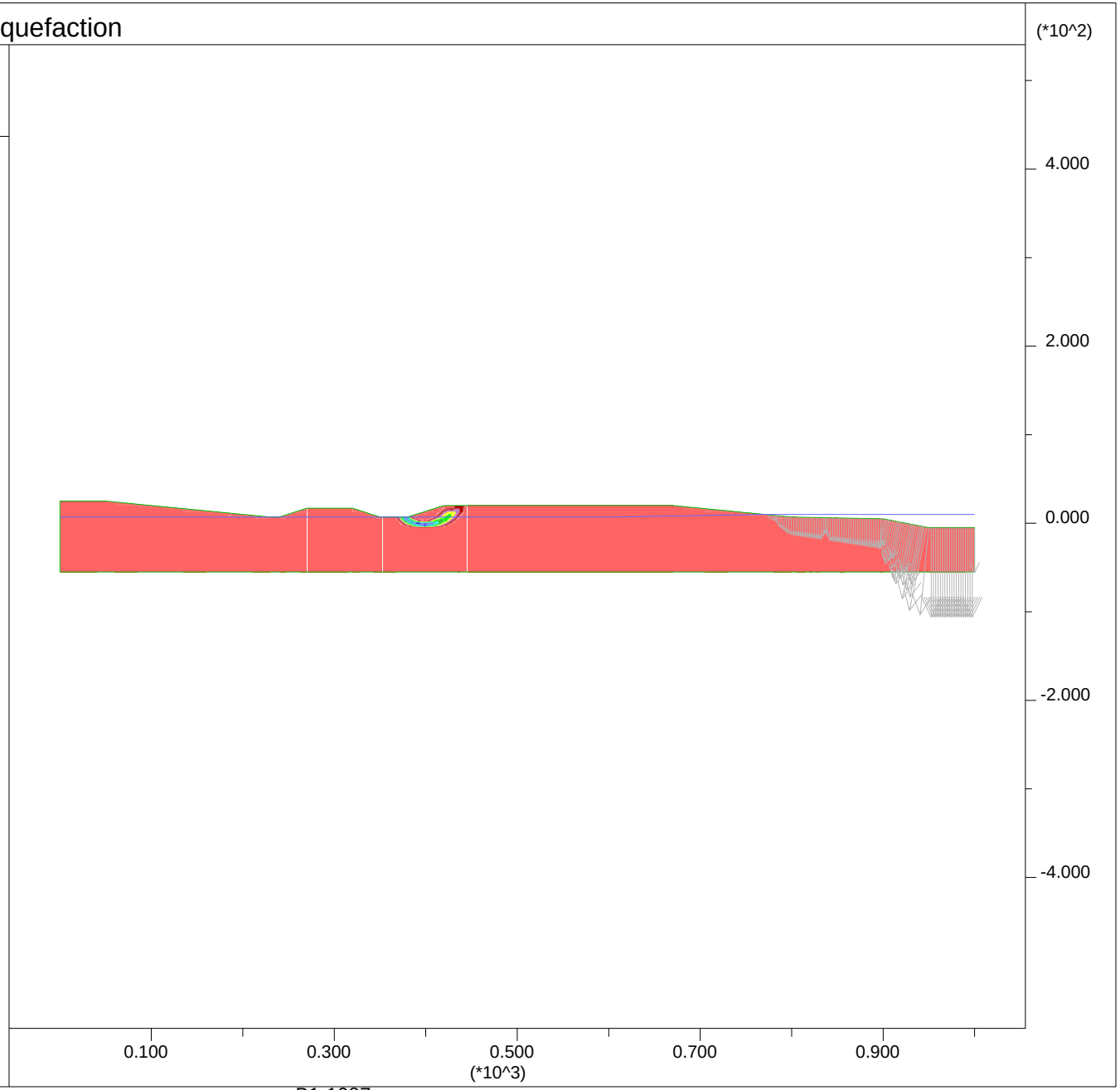
0 2E 2

Water Table

Net Applied Forces

max vector = 2.342E+03

Group Delta Consultants
Ballona Wetlands



B1-1087

PLATE G-78

JOB TITLE : Section F-F' - Post Liquefaction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

4-Mar-13 17:46

Factor of Safety 1.59

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Liq Sand Deep'
- 'User:Soft Clay'
- 'User:Liq Sand'
- User:Embankment

Boundary plot

0 2E 2

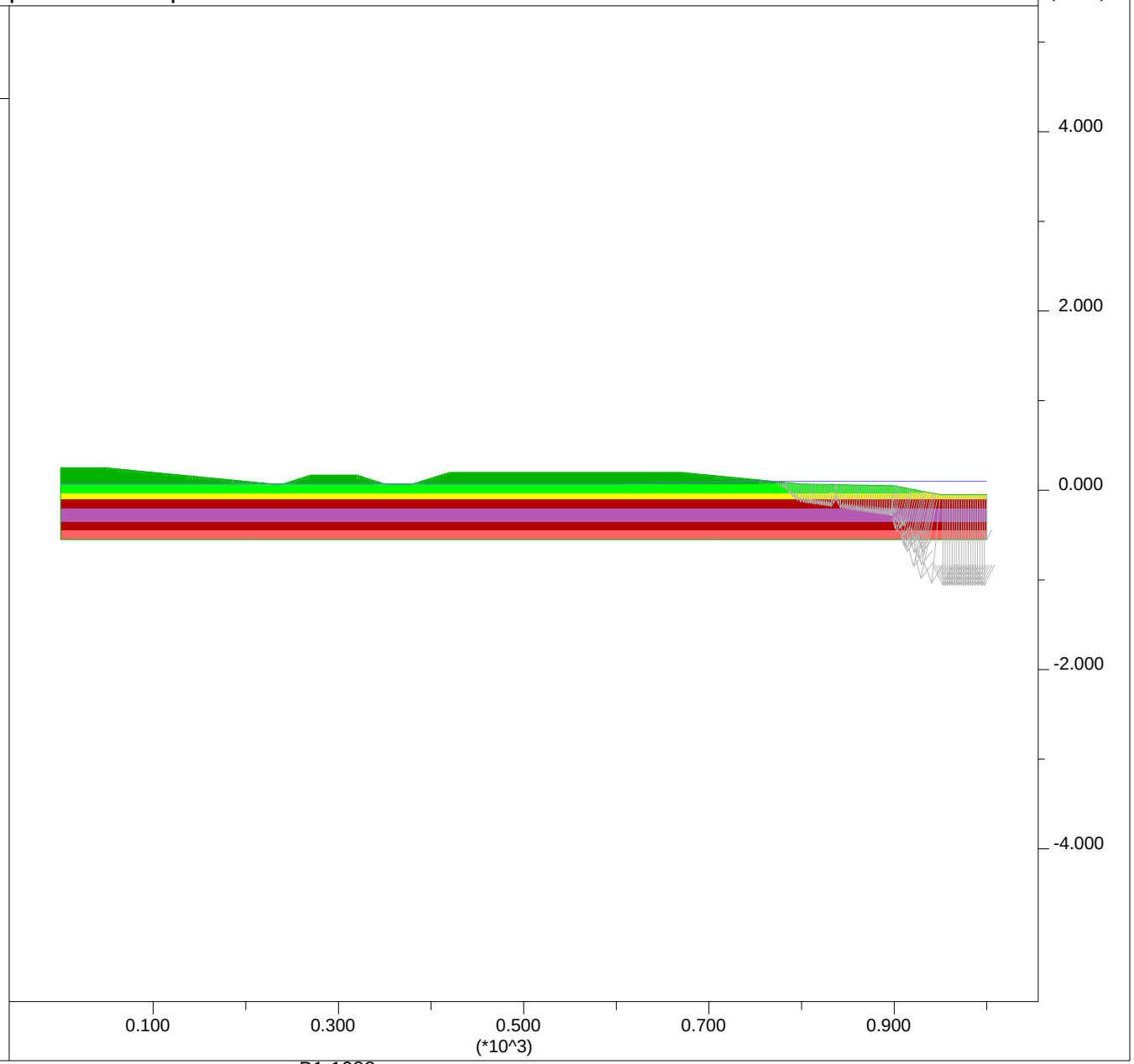
Water Table

Net Applied Forces

max vector = 2.342E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1088

PLATE G-79

JOB TITLE : Section F-F' - Ky=0.10

FLAC/SLOPE (Version 7.00)

LEGEND

4-Mar-13 17:48

Factor of Safety 0.96

Shear Strain Rate Contours

- 1.00E-06
- 2.00E-06
- 3.00E-06
- 4.00E-06
- 5.00E-06
- 6.00E-06

Contour interval= 1.00E-06
(zero contour omitted)
Boundary plot

0 2E 2

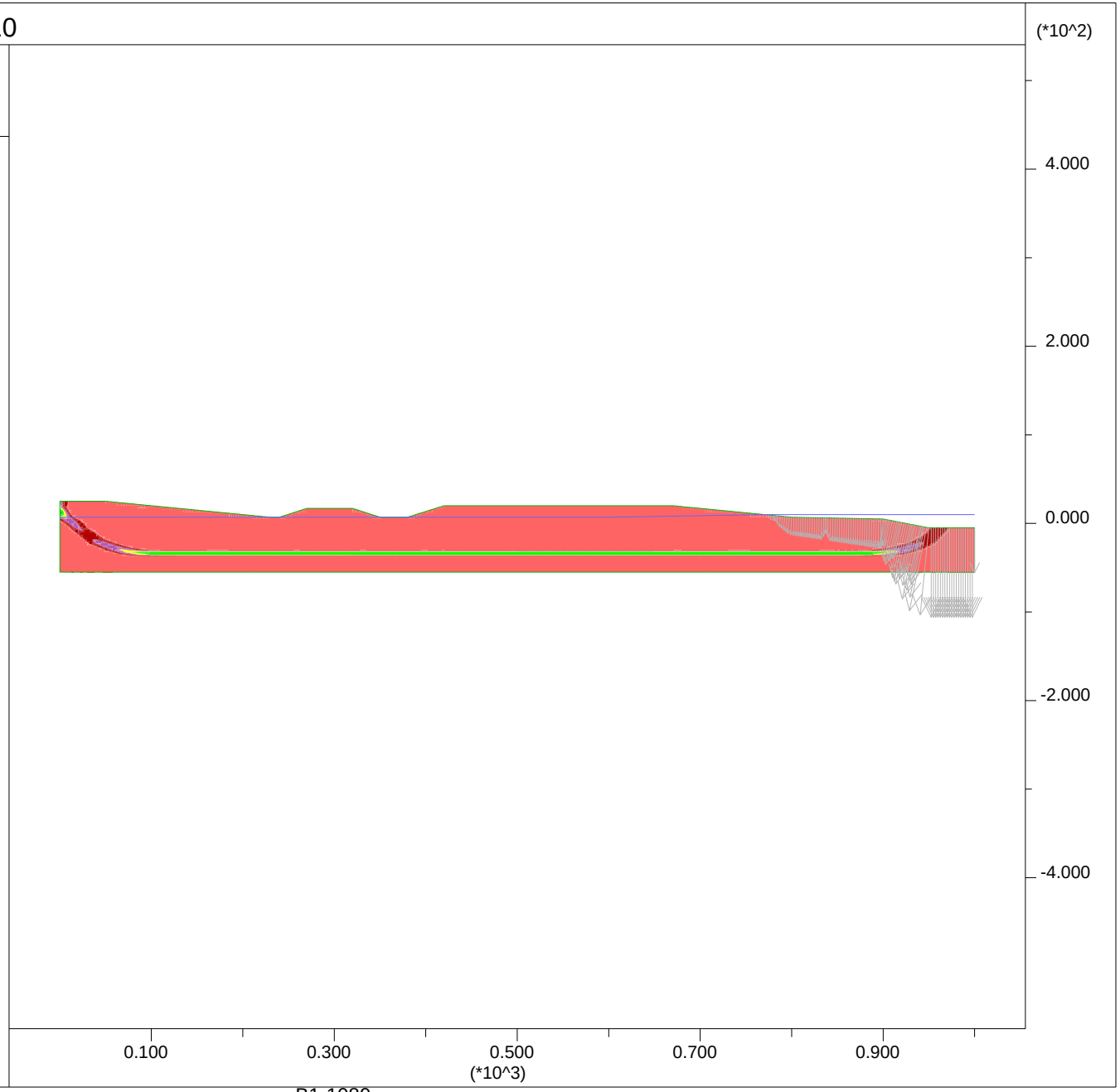
Water Table

Net Applied Forces

max vector = 2.354E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1089

PLATE G-80

JOB TITLE : Section F-F' - Ky=0.10 - Input

FLAC/SLOPE (Version 7.00)

LEGEND

4-Mar-13 17:48

Factor of Safety 0.96

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Liq Sand Deep'
- 'User:Soft Clay'
- 'User:Liq Sand'
- User:Embankment

Boundary plot

0 2E 2

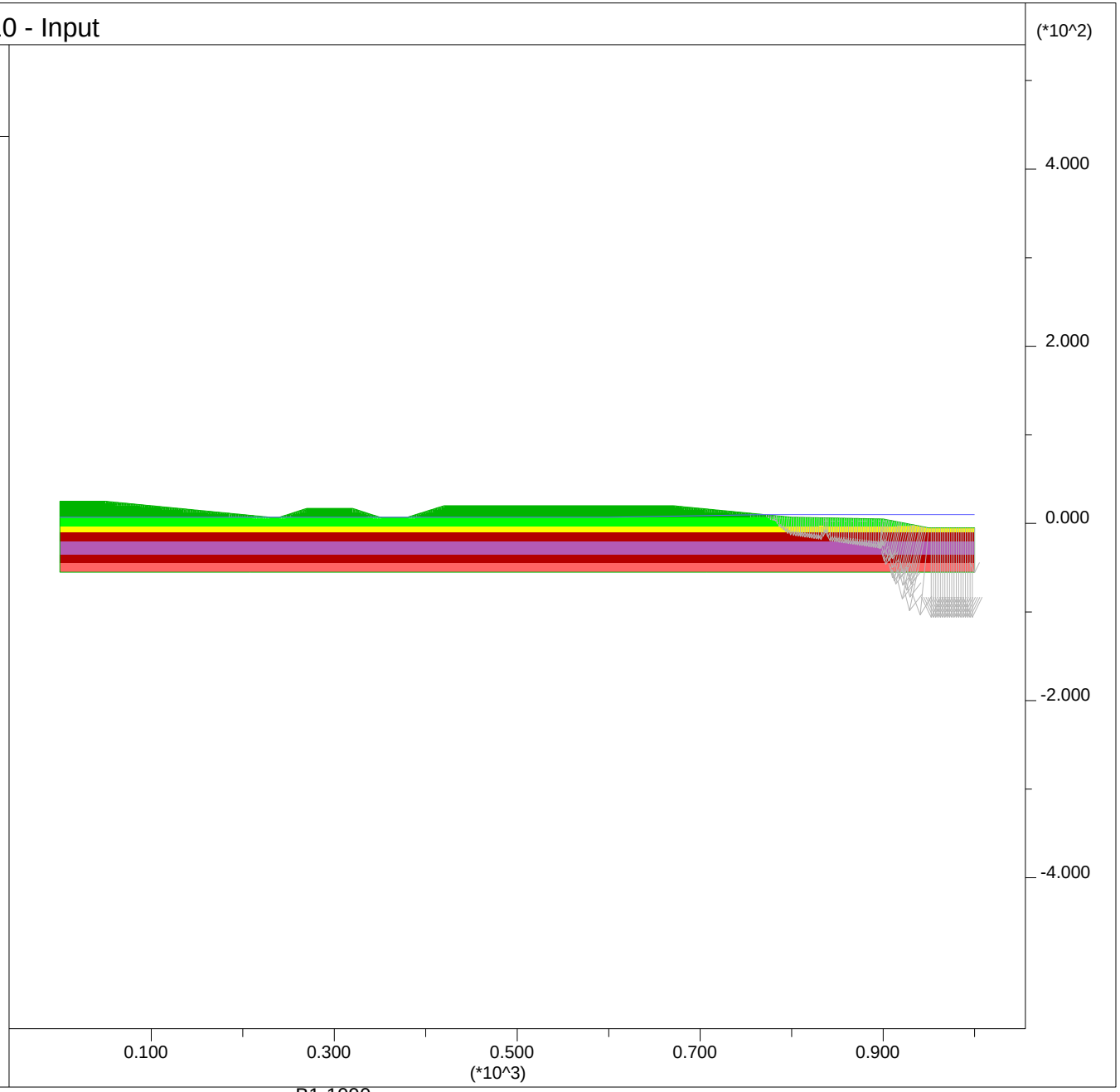
Water Table

Net Applied Forces

max vector = 2.354E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1090

PLATE G-81

Newmark Displacements using Bray and Rathje (1998):

Section F-F'

Site Input

PGA,rock =	0.25	g		
M =	6.6			
r =	13	km		
ky =	0.1		32.185	3.2185
Sliding Mass Input				
Vs =	200	m/s	assumed	
Thickness, H =	16.8	m		
	55	ft		

Output

Tm =	0.49	sec
D5-95 =	10.5	sec
Ts =	0.34	sec
NRF =	1.15	
Ts/Tm =	0.69	
kmax/(PGA,rock*NRF)	0.72	
kmax =	0.21	
ky / kmax =	0.49	

Displacement, u =	3	cm	0.1	feet	1.3	inches

JOB TITLE : Section G-G' - End of Construction

FLAC/SLOPE (Version 7.00)

LEGEND

21-Feb-13 14:43

Factor of Safety 2.55

Shear Strain Rate Contours

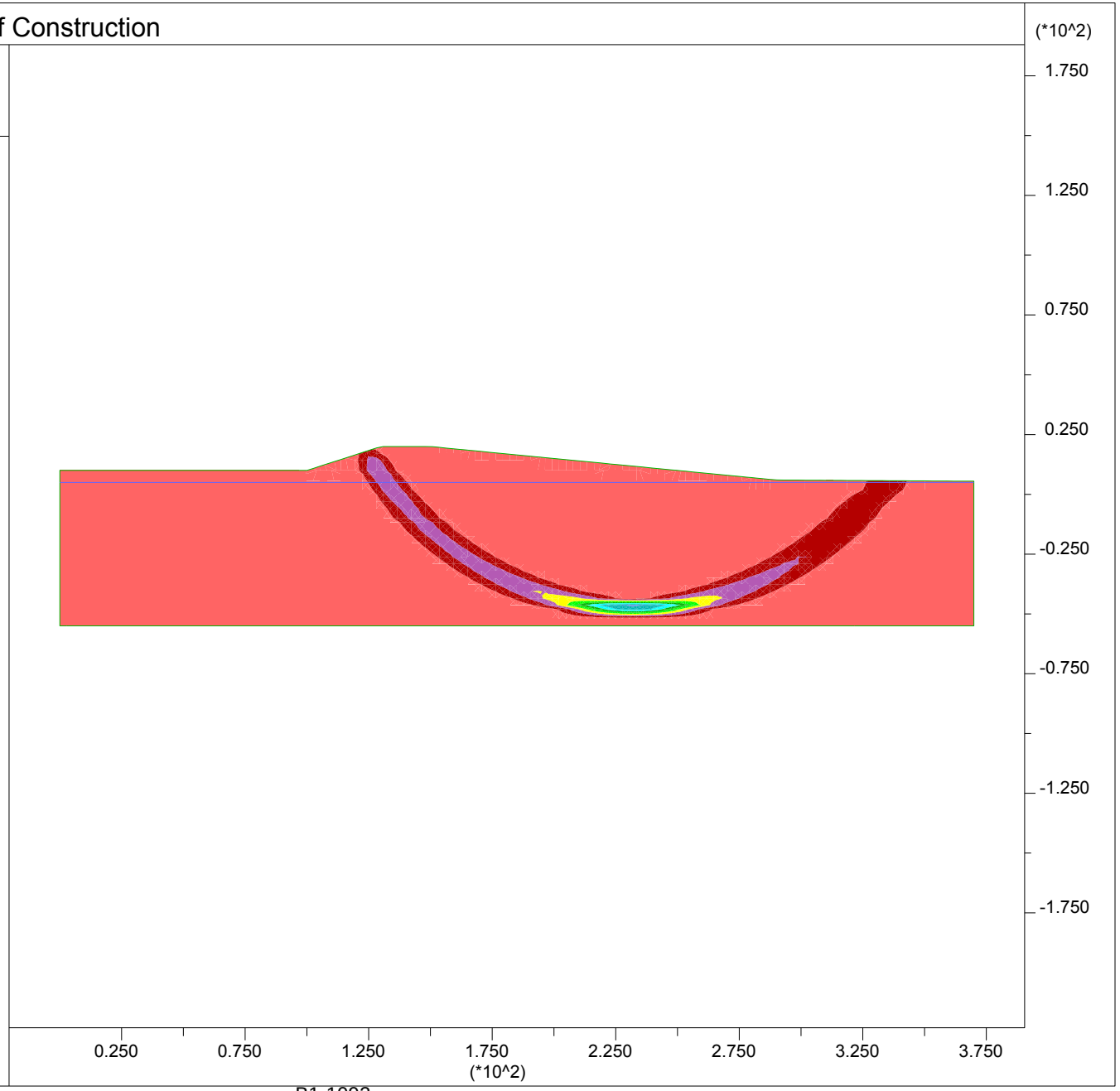
- 2.50E-07
- 5.00E-07
- 7.50E-07
- 1.00E-06
- 1.25E-06
- 1.50E-06
- 1.75E-06
- 2.00E-06

Contour interval= 2.50E-07
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands



B1-1092

PLATE G-83

JOB TITLE : Section G-G' - End of Construction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

21-Feb-13 14:45

Factor of Safety 2.55

User-defined Groups

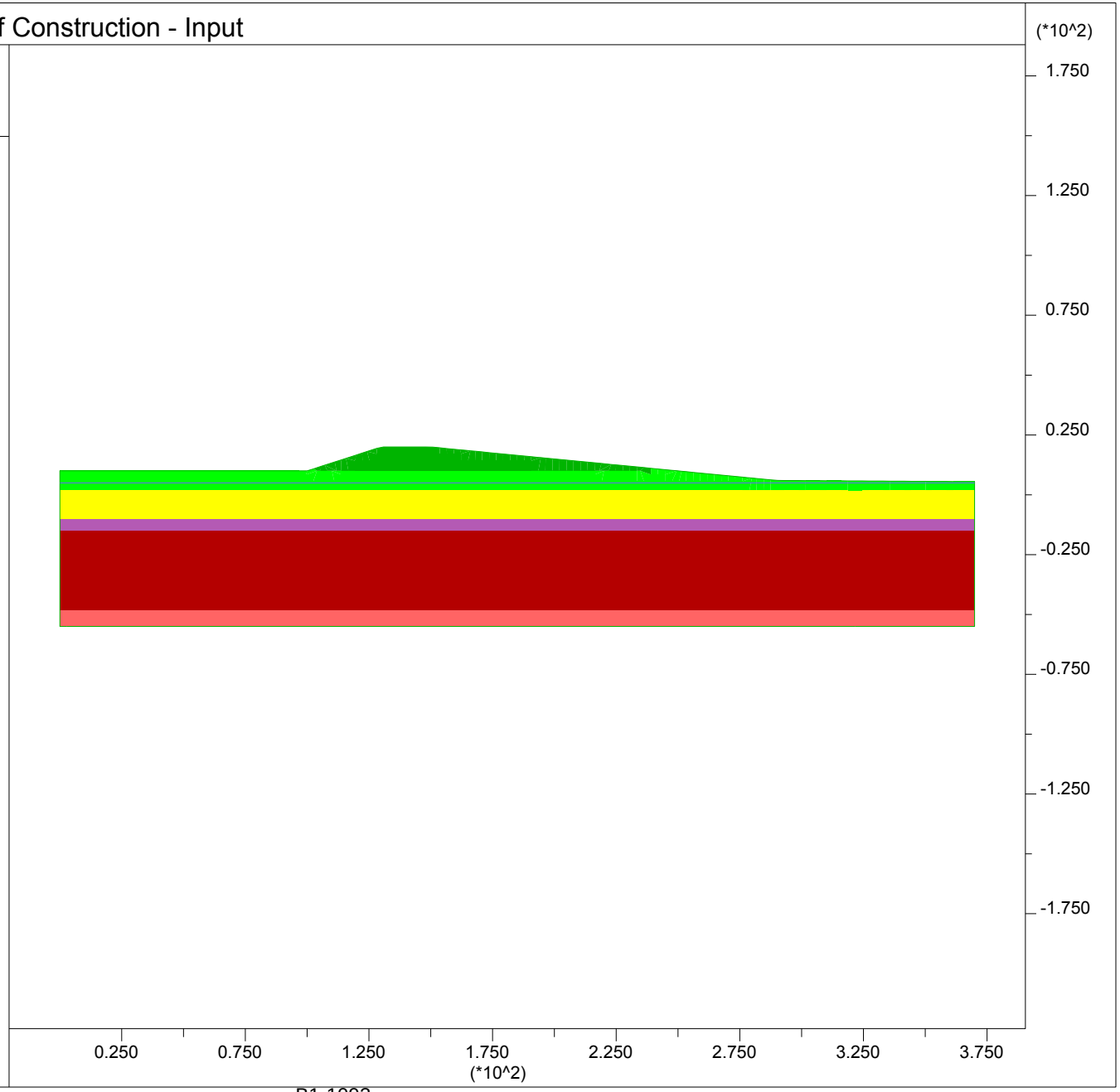
- User:Sand
- 'User:Med Clay'
- 'User:Med Sand'
- 'User:Soft Clay'
- Fill:Fill
- User:Embankment

Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands



B1-1093

PLATE G-84

JOB TITLE : Section G-G' - High Water Short Term

FLAC/SLOPE (Version 7.00)

LEGEND

21-Feb-13 14:42

Factor of Safety 2.73

Shear Strain Rate Contours

- 2.00E-07
- 4.00E-07
- 6.00E-07
- 8.00E-07
- 1.00E-06
- 1.20E-06

Contour interval= 2.00E-07
(zero contour omitted)
Boundary plot

0 1E 2

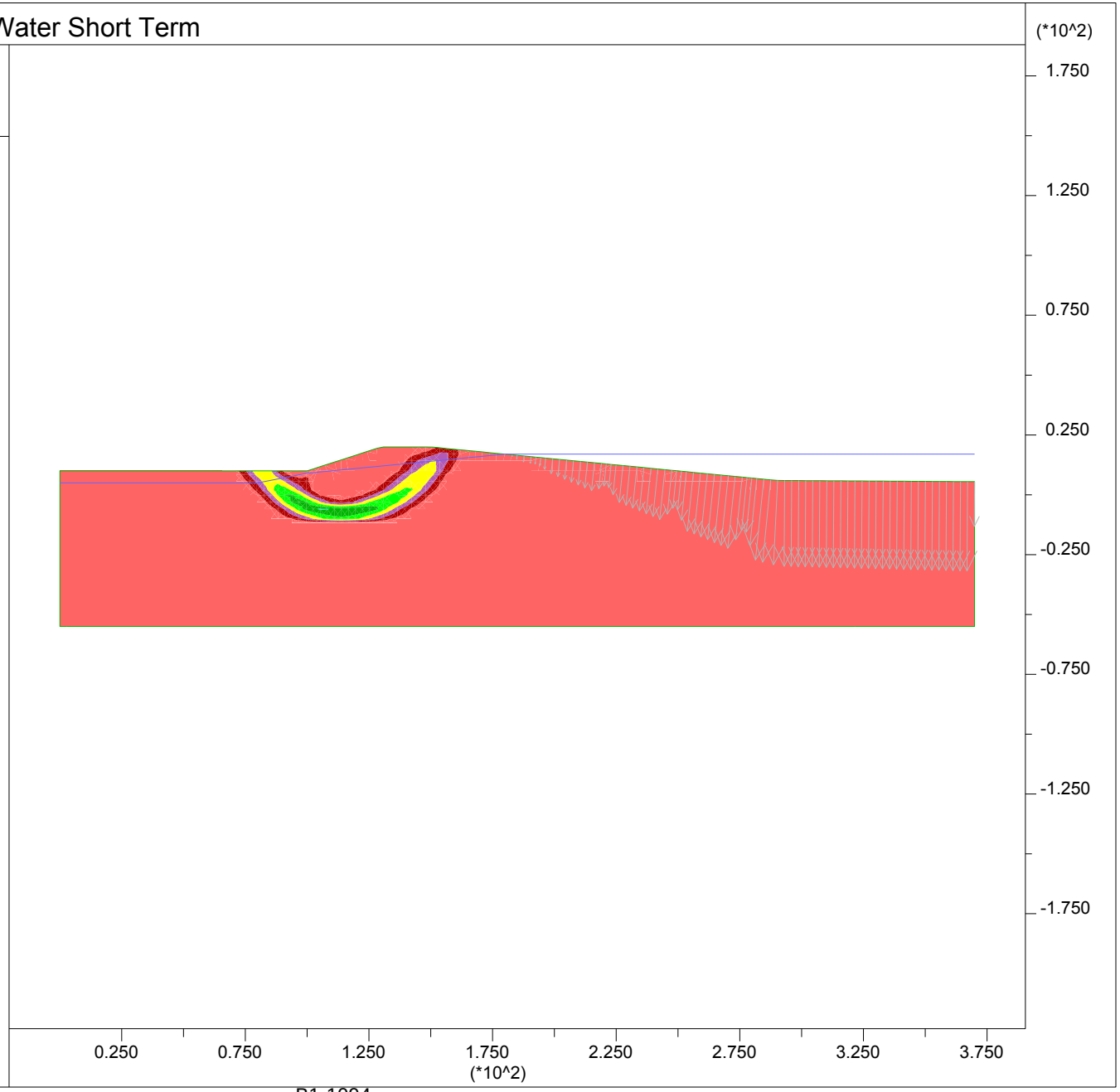
Water Table

Net Applied Forces

max vector = 2.041E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1094

PLATE G-85

JOB TITLE : Section G-G' - High Water Short Term - Input

FLAC/SLOPE (Version 7.00)

LEGEND

21-Feb-13 14:40

Factor of Safety 2.73

User-defined Groups

- User:Sand
- 'User:Med Clay'
- 'User:Med Sand'
- 'User:Soft Clay'
- Fill:Fill
- User:Embankment

Boundary plot

0 1E 2

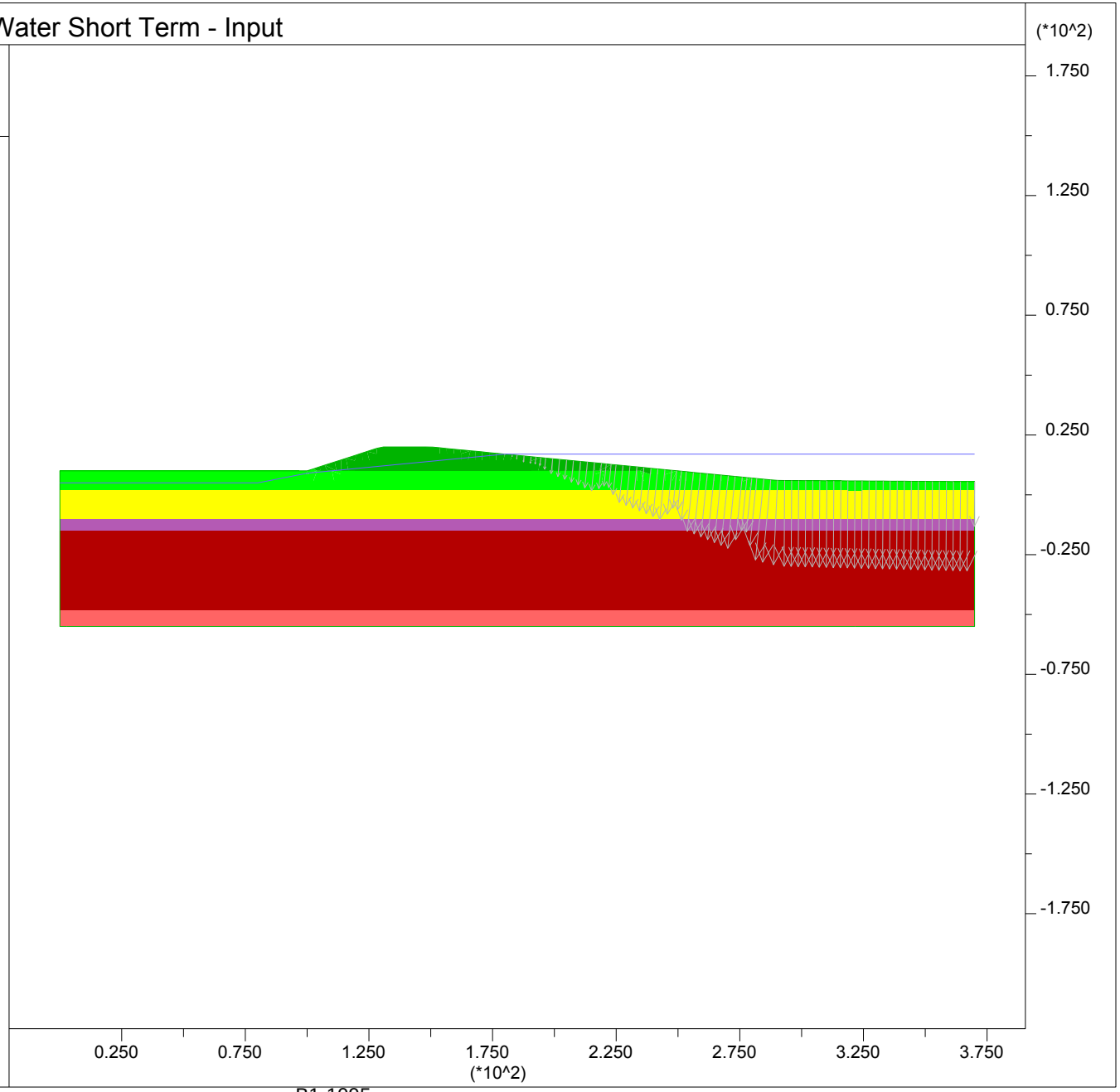
Water Table

Net Applied Forces

max vector = 2.041E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1095

PLATE G-86

JOB TITLE : Section G-G' - High Water Long Term (Steady State)

FLAC/SLOPE (Version 7.00)

LEGEND

5-Mar-13 14:24

Factor of Safety 3.42

Shear Strain Rate Contours

- 2.50E-07
- 5.00E-07
- 7.50E-07
- 1.00E-06
- 1.25E-06
- 1.50E-06

Contour interval= 2.50E-07
(zero contour omitted)
Boundary plot

0 1E 2

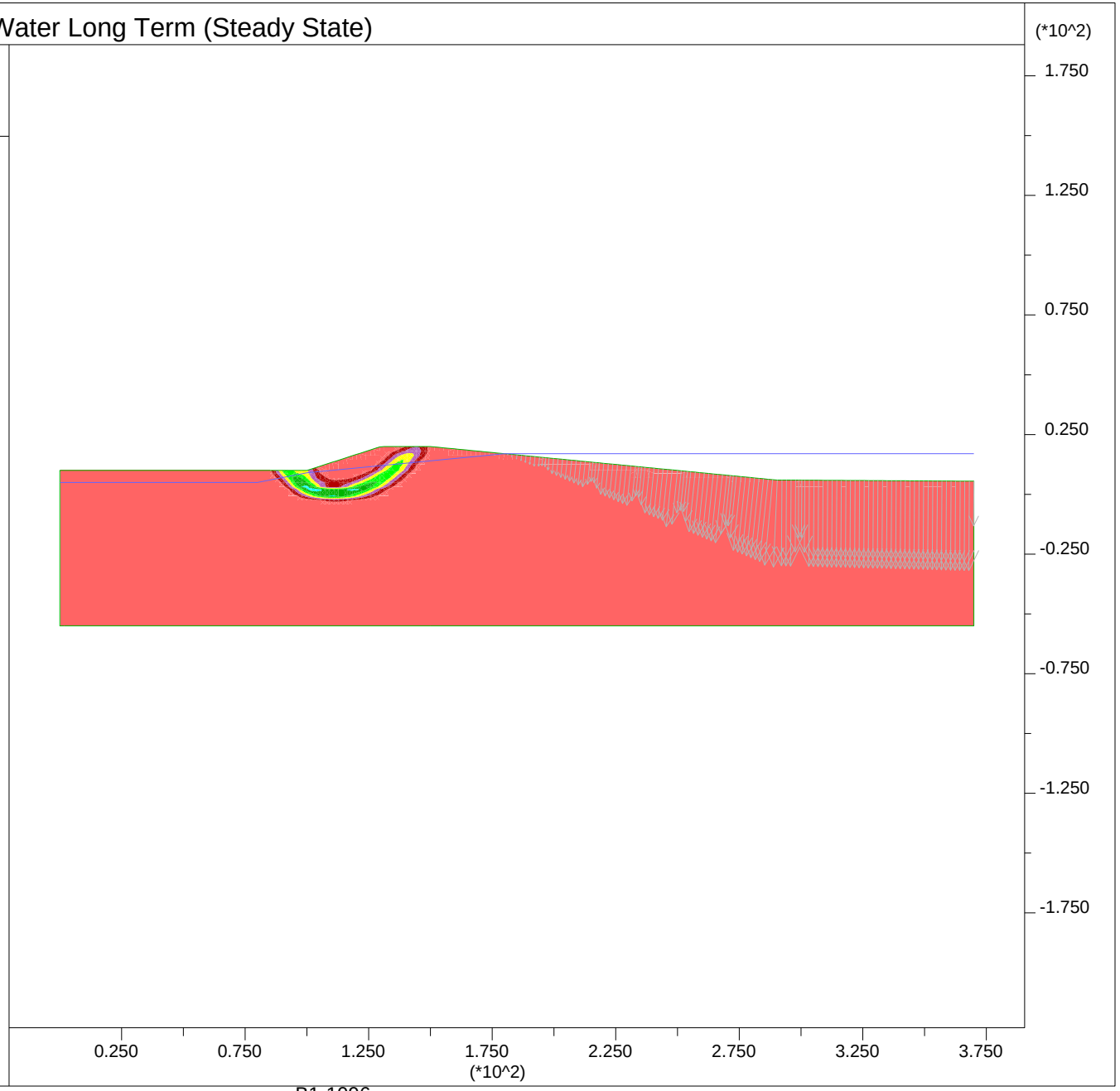
Water Table

Net Applied Forces

max vector = 1.326E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands



B1-1096

PLATE G-87

JOB TITLE : Section G-G' - High Water Long Term (Steady State) - Input

FLAC/SLOPE (Version 7.00)

LEGEND

5-Mar-13 14:24

Factor of Safety 3.42

User-defined Groups

- User:Sand
- 'User:Med Clay'
- 'User:Med Sand'
- 'User:Soft Clay'
- Fill:Fill
- User:Embankment

Boundary plot

0 1E 2

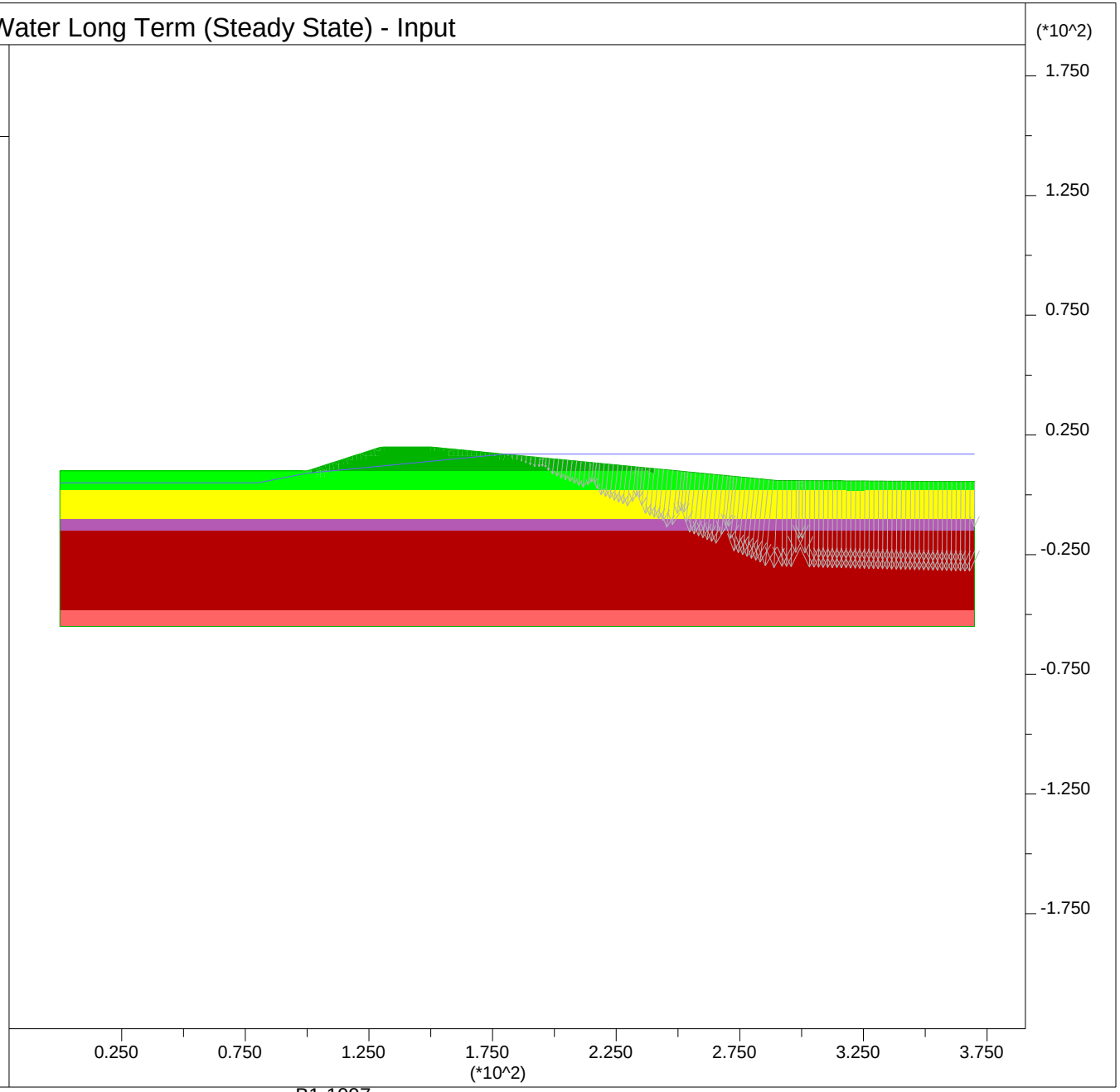
Water Table

Net Applied Forces

max vector = 1.326E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands



B1-1097

PLATE G-88

JOB TITLE : Section G-G' - Post Liquefaction

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 19:01

Factor of Safety 1.79

Shear Strain Rate Contours

- 5.00E-08
- 1.00E-07
- 1.50E-07
- 2.00E-07
- 2.50E-07
- 3.00E-07

Contour interval= 5.00E-08
(zero contour omitted)
Boundary plot

0 1E 2

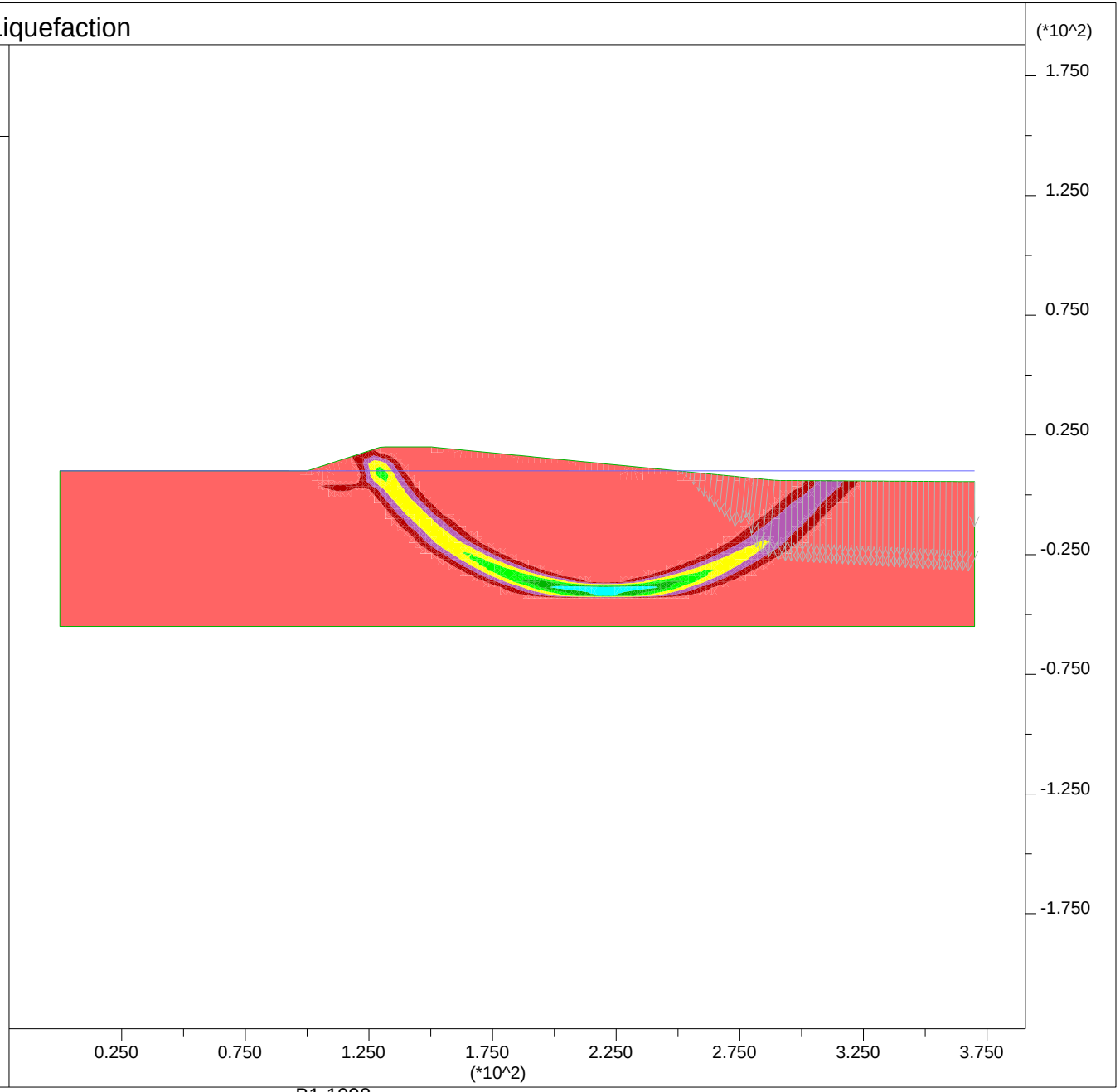
Water Table

Net Applied Forces

max vector = 6.479E+02

0 2E 3

Group Delta Consultants
Torrance, CA



B1-1098

PLATE G-89

JOB TITLE : Section G-G' - Post Liquefaction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 19:01

Factor of Safety 1.79

User-defined Groups

- User:Sand
- 'User:Med Clay'
- 'User:Liq Sand'
- 'User:Soft Clay'
- 'Liq Fill:Liq Fill'
- User:Embankment

Boundary plot

0 1E 2

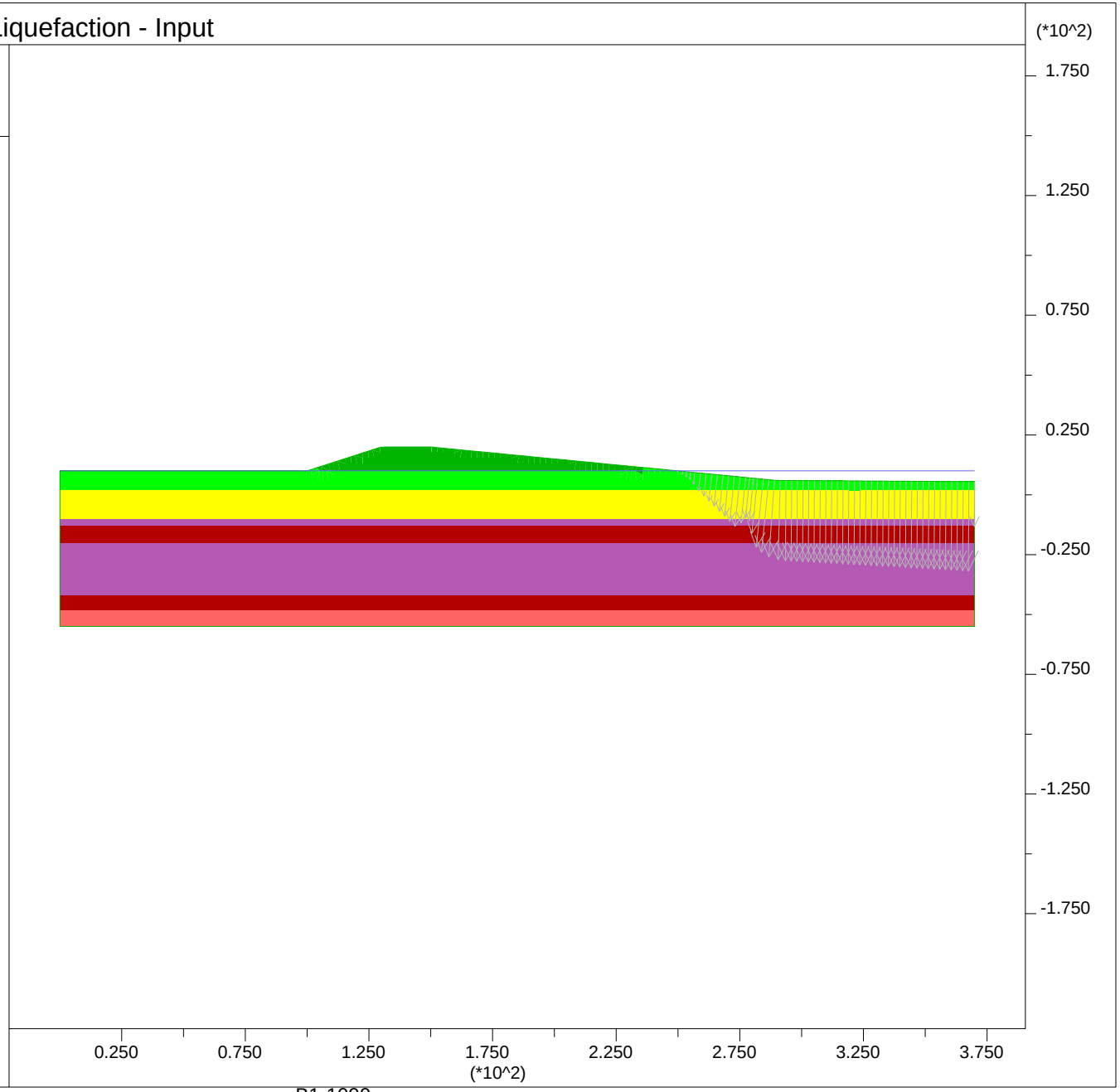
Water Table

Net Applied Forces

max vector = 6.479E+02

0 2E 3

Group Delta Consultants
Torrance, CA



B1-1099

PLATE G-90

JOB TITLE : Section G-G' - Ky=0.05

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 19:26

Factor of Safety 0.98

Shear Strain Rate Contours

- 5.00E-07
- 1.00E-06
- 1.50E-06
- 2.00E-06
- 2.50E-06
- 3.00E-06

Contour interval= 5.00E-07
(zero contour omitted)
Boundary plot

0 2E 2

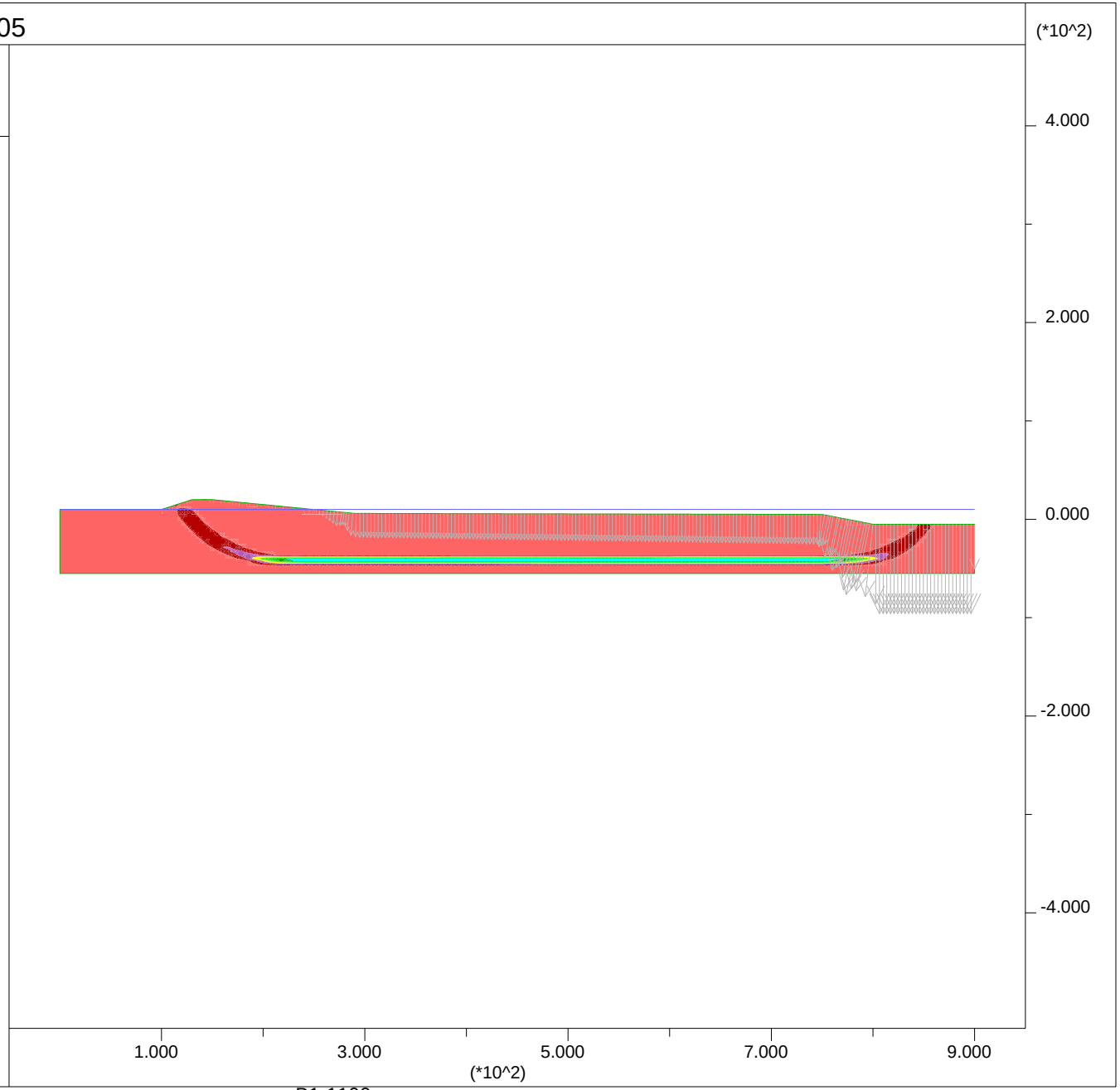
Water Table

Net Applied Forces

max vector = 3.377E+03

0 1E 4

Group Delta Consultants
Torrance, CA



B1-1100

PLATE G-91

JOB TITLE : Section G-G' - Ky=0.05 - Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 19:25

Factor of Safety 0.98

User-defined Groups

- User:Sand
- 'User:Med Clay'
- 'User:Liq Sand'
- 'User:Soft Clay'
- 'Liq Fill:Liq Fill'
- User:Embankment

Boundary plot

0 2E 2

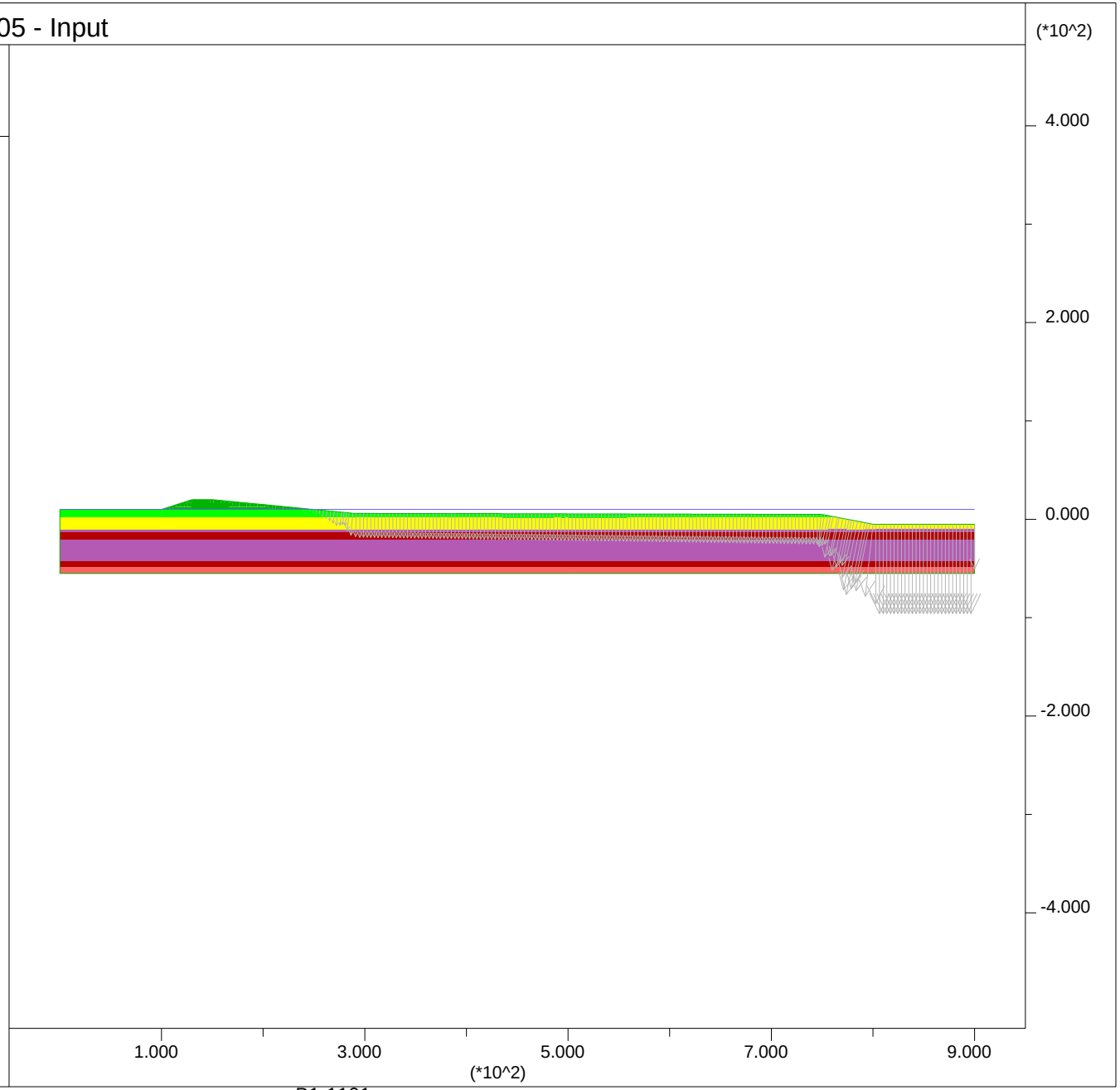
Water Table

Net Applied Forces

max vector = 3.377E+03

0 1E 4

Group Delta Consultants
Torrance, CA



B1-1101

PLATE G-92

Newmark Displacements using Bray and Rathje (1998):

Section G-G'

Site Input

PGA,rock =	0.25	g		
M =	6.6			
r =	13	km		
ky =	0.05		32.185	1.60925
Sliding Mass Input				
Vs =	150	m/s	assumed	
Thickness, H =	18.3	m		
	60	ft		

Output

Tm =	0.49	sec				
D5-95 =	10.5	sec				
Ts =	0.49	sec				
NRF =	1.15					
Ts/Tm =	1.00					
kmax/(PGA,rock*NRF)	0.54					
kmax =	0.15					
ky / kmax =	0.33					
Displacement, u =	9	cm	0.3	feet	3.5	inches

JOB TITLE : Section H-H' - End of Construction - Input

FLAC (Version 7.00)

LEGEND

27-Feb-13 13:52
step 18280
-2.778E+01 <x< 5.278E+02
-2.953E+02 <y< 2.603E+02

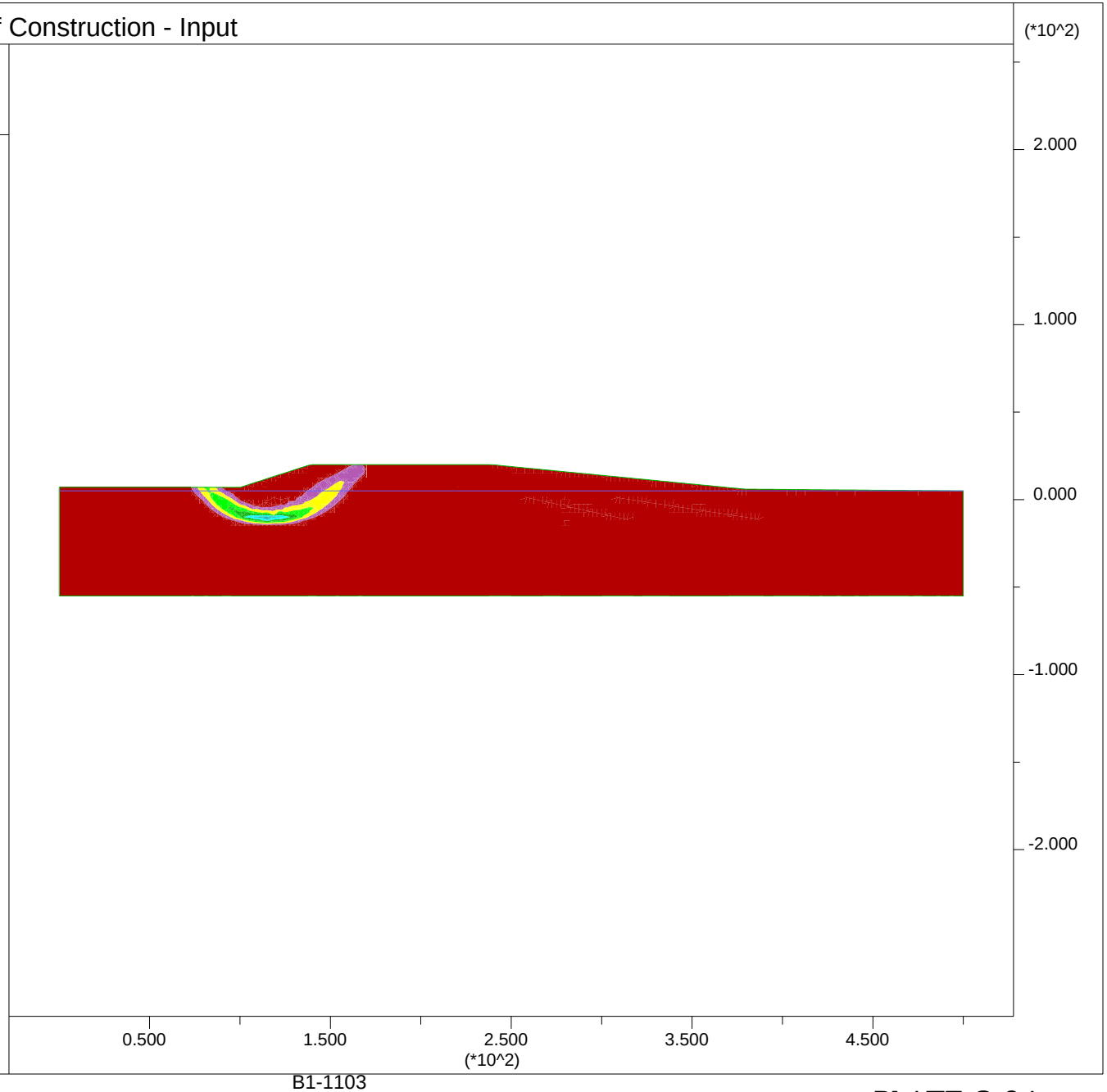
Factor of Safety 1.94

Max. shear strain-rate
0.00E+00
5.00E-07
1.00E-06
1.50E-06
2.00E-06
2.50E-06
3.00E-06
3.50E-06

Contour interval= 5.00E-07
Extrap. by averaging
Boundary plot
0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands



B1-1103

PLATE G-94

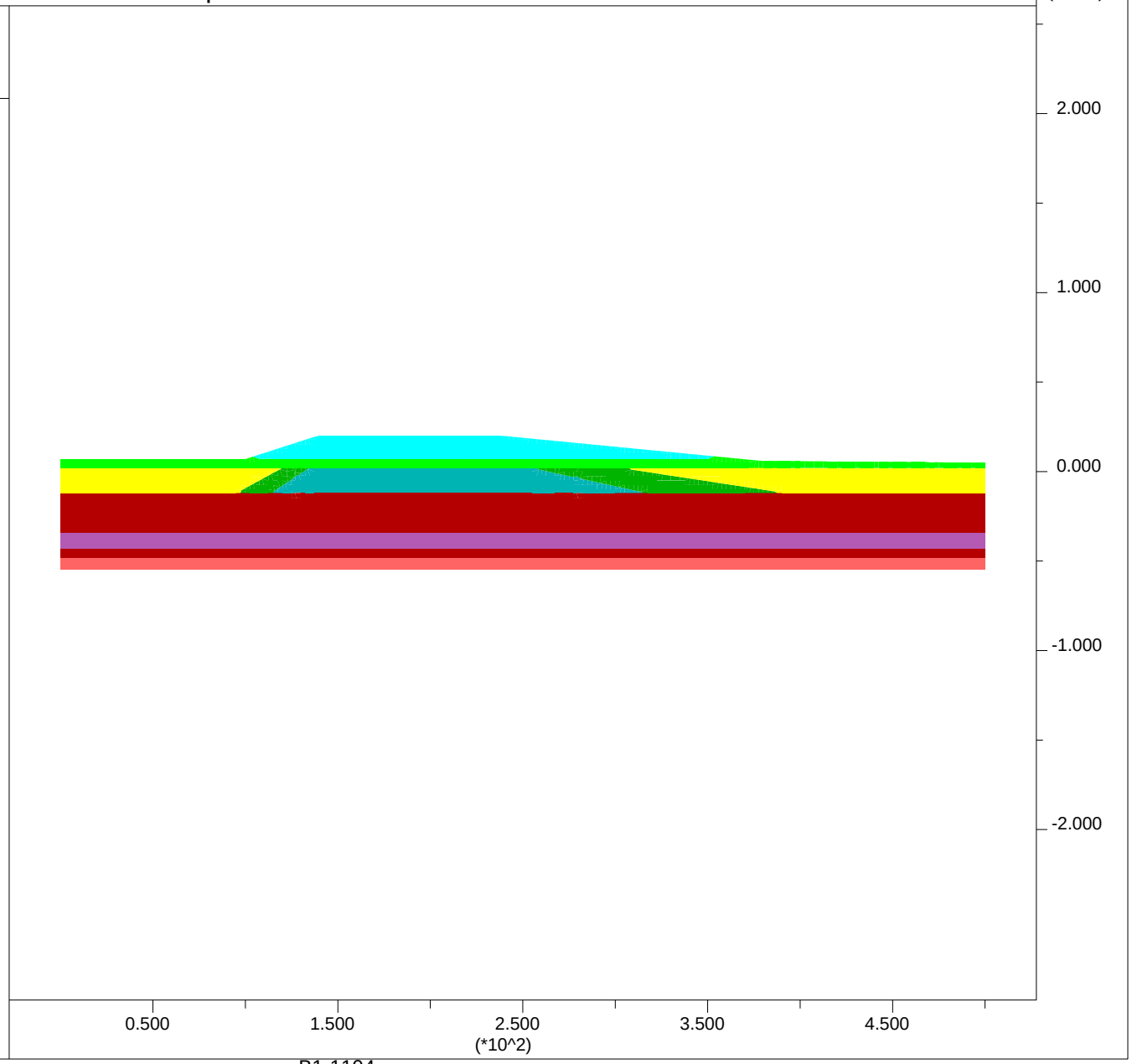
JOB TITLE : Section H-H' - End of Construction - Input

FLAC (Version 7.00)

LEGEND

27-Feb-13 13:49
step 0
-2.778E+01 <x< 5.278E+02
-2.953E+02 <y< 2.603E+02

User-defined Groups
- User:Sand
- 'User:Med Sand'
- 'S:Stiff Clay'
- 'User:V Soft Clay'
- Fill:Fill
- 'User:Clay 400'
- User:Embankment
- 'User:Soft Clay'



Group Delta Consultants
Ballona Wetlands

B1-1104

PLATE G-95

JOB TITLE : Section H-H' - High Water Short Term

FLAC (Version 7.00)

LEGEND

27-Feb-13 19:06
step 20150
-2.778E+01 <x< 5.278E+02
-2.953E+02 <y< 2.603E+02

Factor of Safety 1.87

Max. shear strain-rate
0.00E+00
2.50E-06
5.00E-06
7.50E-06
1.00E-05
1.25E-05

Contour interval= 2.50E-06
Extrap. by averaging
Boundary plot

0 1E 2

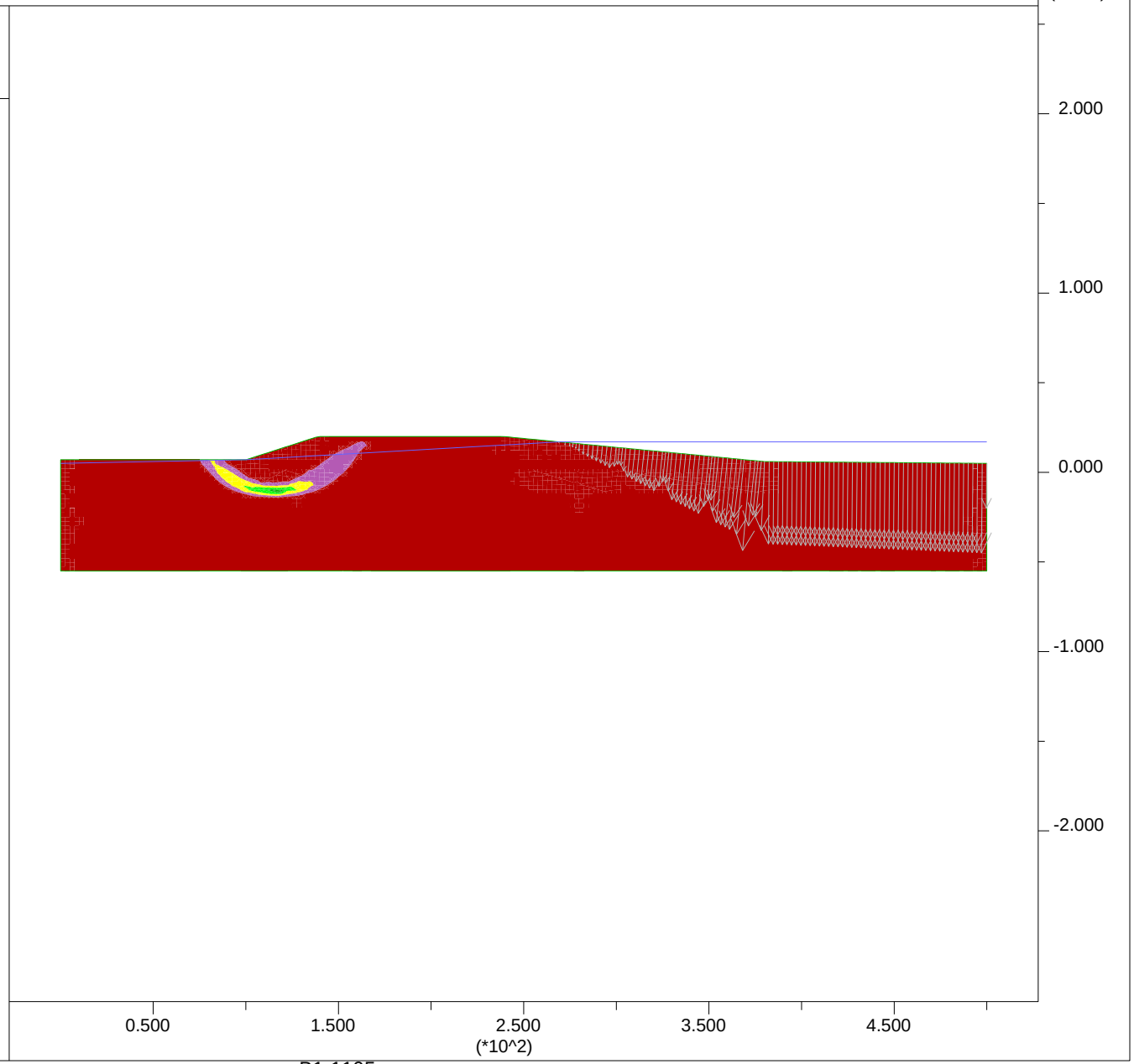
Water Table

Net Applied Forces

max vector = 1.892E+03

0 3E 3

Group Delta Consultants
Ballona Wetlands



B1-1105

PLATE G-96

JOB TITLE : Section H-H' - High Water Short Term - Input

FLAC (Version 7.00)

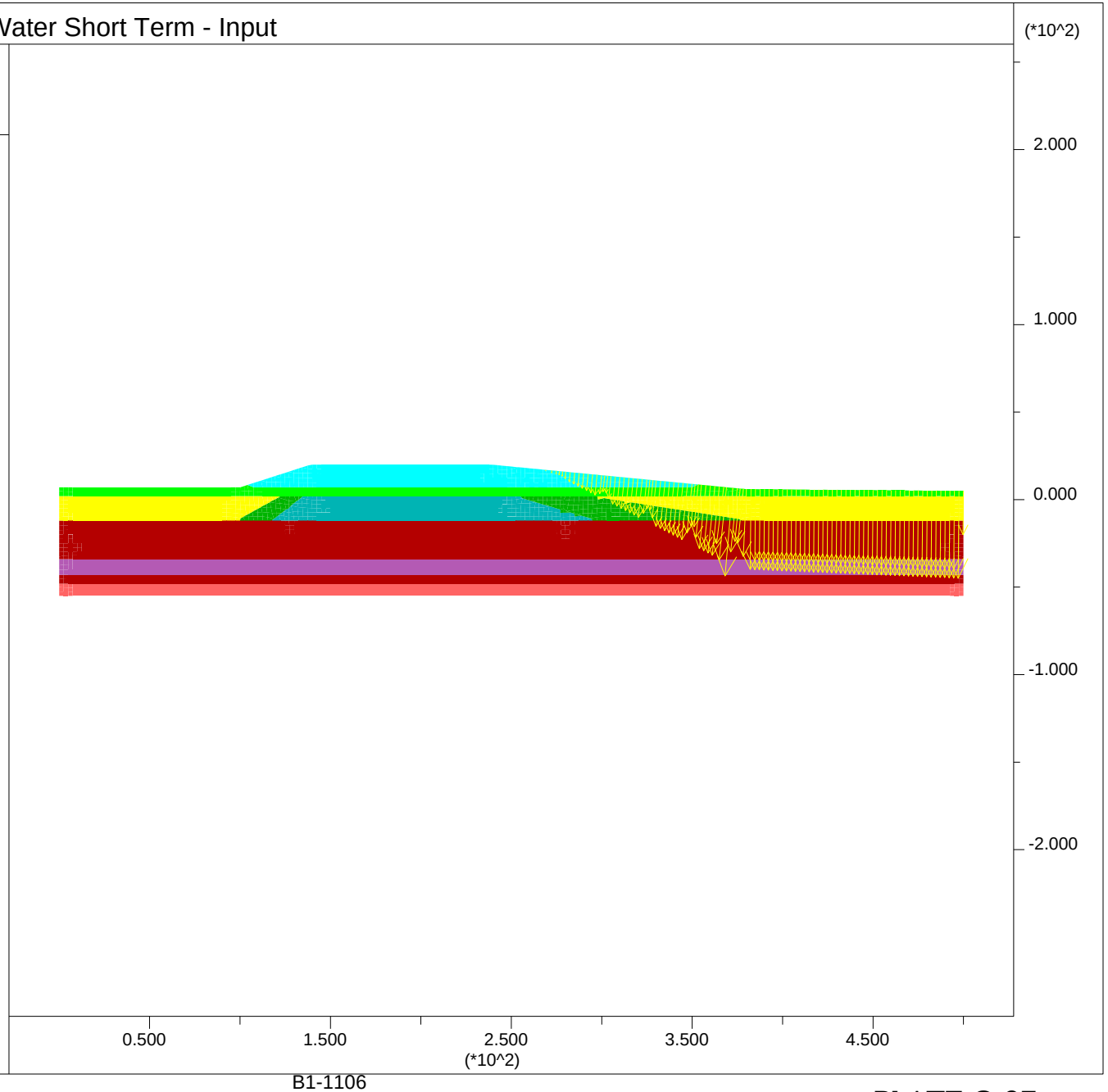
LEGEND

27-Feb-13 19:09
step 20150
-2.778E+01 <x< 5.278E+02
-2.953E+02 <y< 2.603E+02

User-defined Groups
- User:Sand
- 'User:Med Sand'
- 'S:Stiff Clay'
- 'User:V Soft Clay'
- Fill:Fill
- 'User:Clay 400'
- User:Embankment
- 'User:Soft Clay'

Net Applied Forces
max vector = 1.892E+03
0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1106

PLATE G-97

JOB TITLE : Section H-H' - Post Liquefaction

FLAC (Version 7.00)

LEGEND

26-Mar-13 14:19
step 28268
-2.778E+01 <x< 5.278E+02
-2.953E+02 <y< 2.603E+02

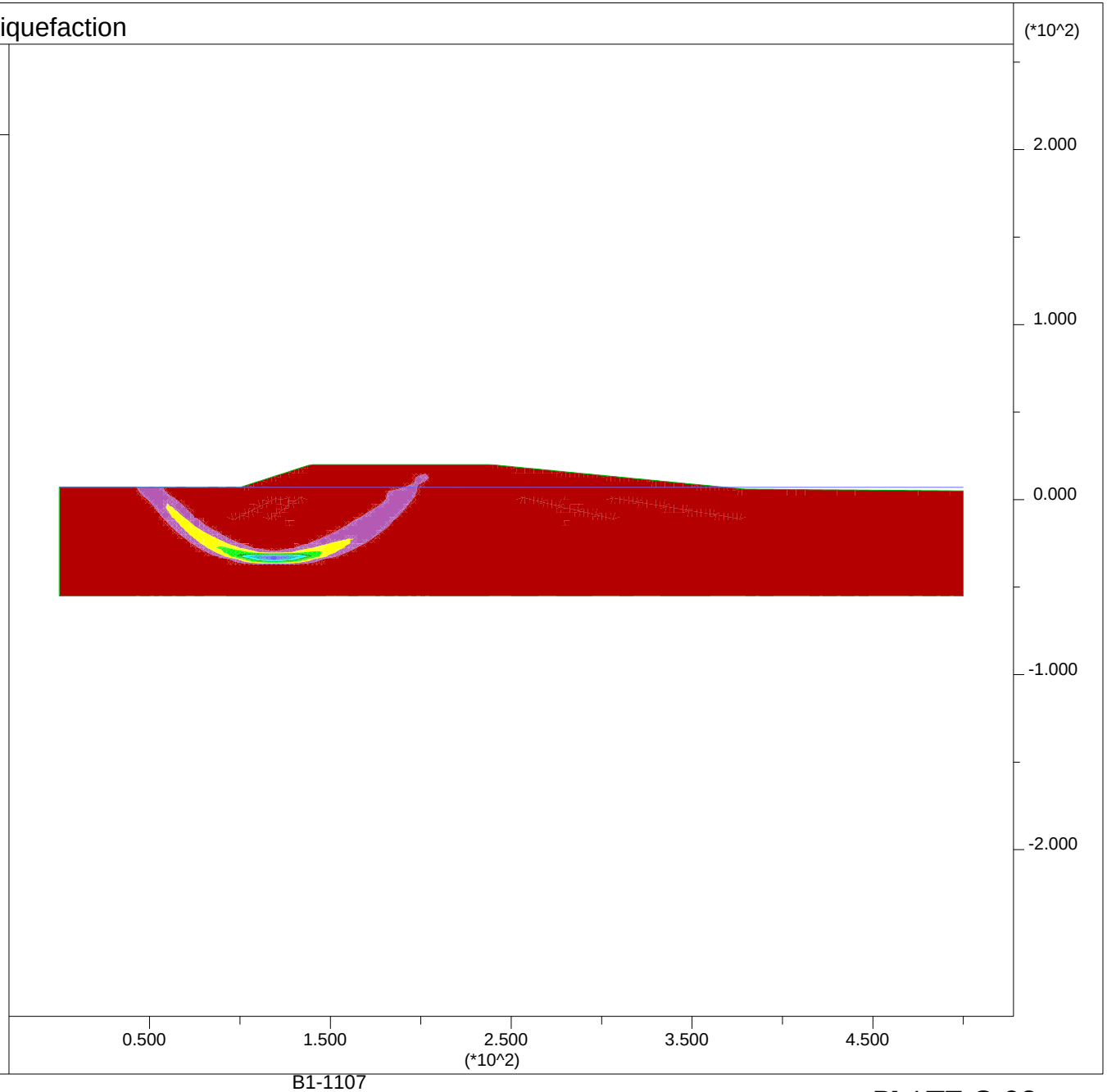
Factor of Safety 1.24

Max. shear strain-rate
0.00E+00
1.00E-06
2.00E-06
3.00E-06
4.00E-06
5.00E-06
6.00E-06
7.00E-06

Contour interval= 1.00E-06
Extrap. by averaging
Boundary plot
0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands



B1-1107

PLATE G-98

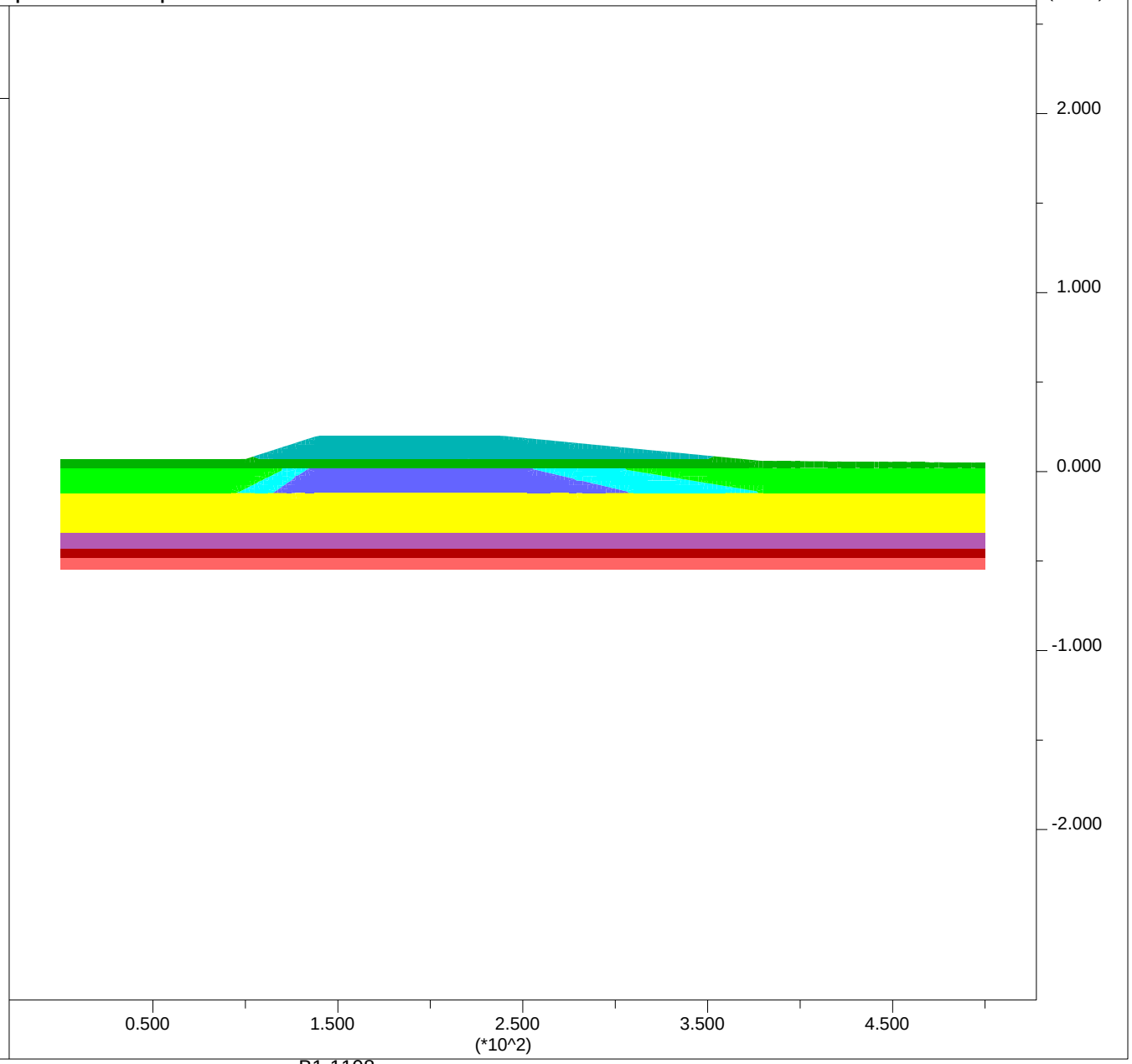
JOB TITLE : Section H-H' - Post Liquefaction Input

FLAC (Version 7.00)

LEGEND

26-Mar-13 14:21
step 28268
-2.778E+01 <x< 5.278E+02
-2.953E+02 <y< 2.603E+02

User-defined Groups
- User:Sand
- 'User:Liq Sand Deep'
- 'S:Stiff Clay'
- 'User:Liq Sand'
- 'User:V Soft Clay'
- 'User:Liq Fill'
- User:Clay400
- User:Embankment
- 'User:Soft Clay'



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Ballona Wetlands

B1-1108

PLATE G-99

JOB TITLE : Section H-H' - Ky=0.04

FLAC (Version 7.00)

LEGEND

26-Mar-13 14:24
step 24768
-2.778E+01 <x< 5.278E+02
-2.953E+02 <y< 2.603E+02

Factor of Safety 0.99

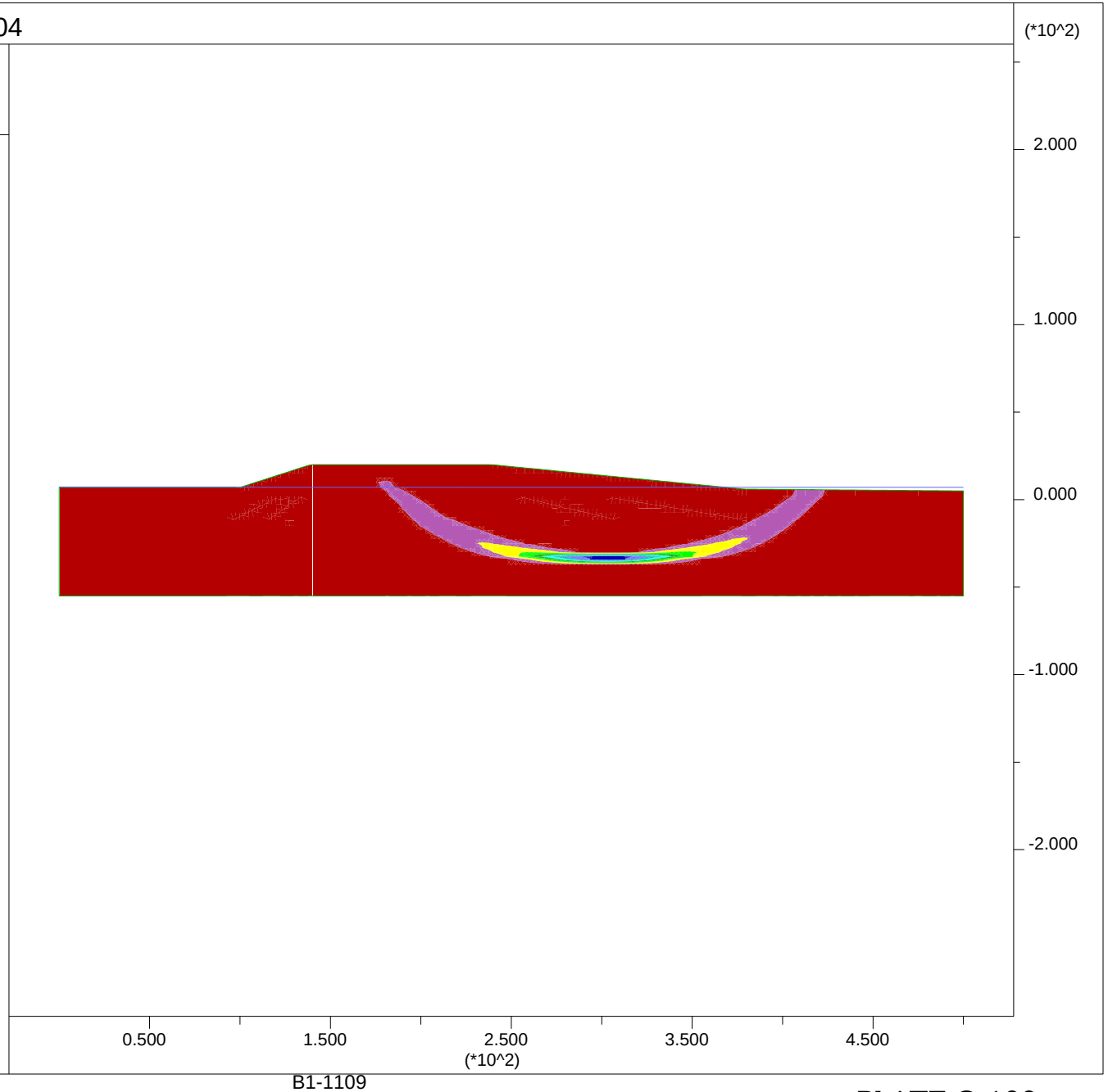
Max. shear strain-rate
0.00E+00
2.50E-08
5.00E-08
7.50E-08
1.00E-07
1.25E-07
1.50E-07
1.75E-07
2.00E-07

Contour interval= 2.50E-08
Extrap. by averaging
Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands



B1-1109

PLATE G-100

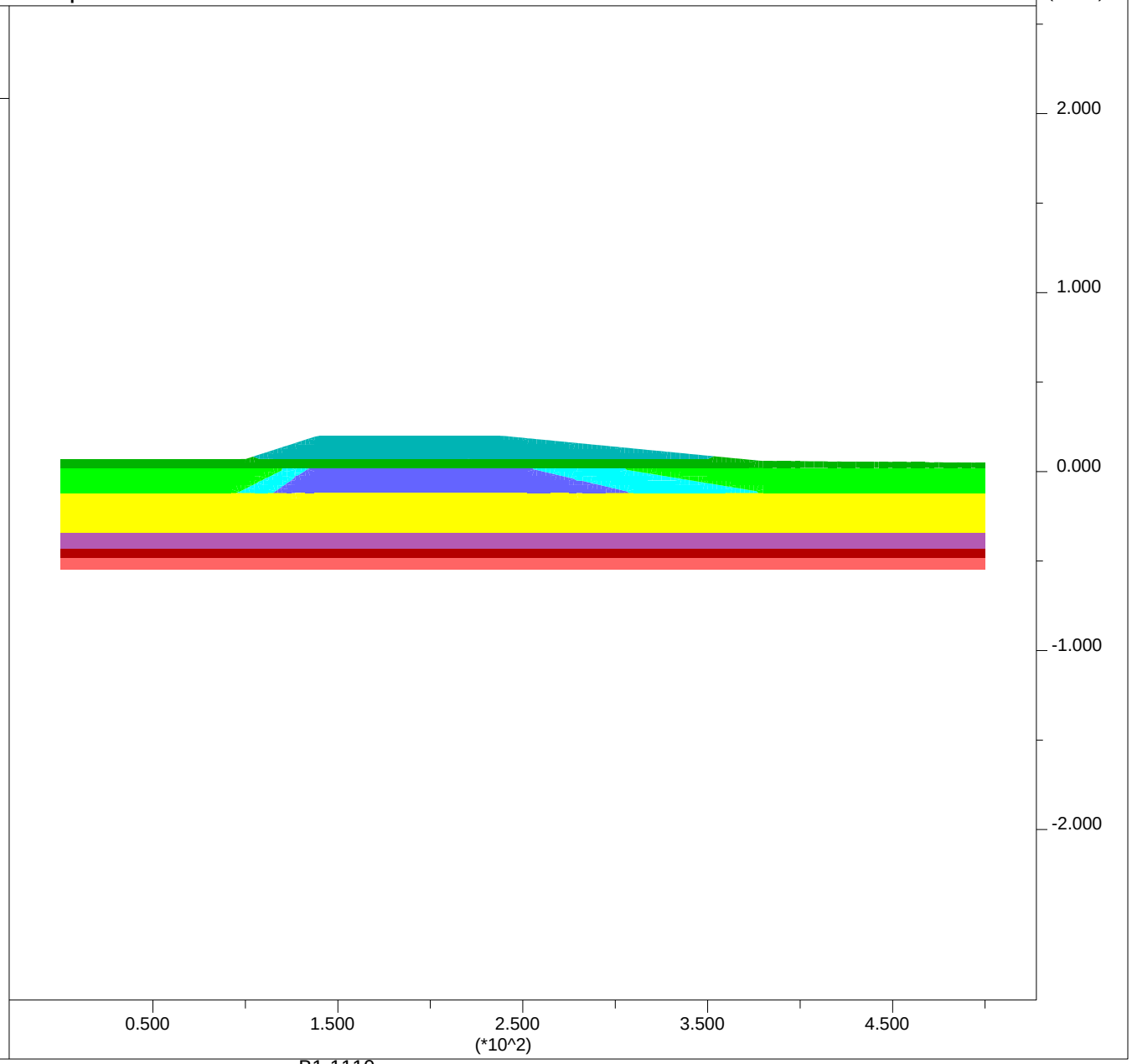
JOB TITLE : Section H-H' - Ky=0.04 - Input

FLAC (Version 7.00)

LEGEND

26-Mar-13 14:22
step 24768
-2.778E+01 <x< 5.278E+02
-2.953E+02 <y< 2.603E+02

User-defined Groups
- User:Sand
- 'User:Liq Sand Deep'
- 'S:Stiff Clay'
- 'User:Liq Sand'
- 'User:V Soft Clay'
- 'User:Liq Fill'
- User:Clay400
- User:Embankment
- 'User:Soft Clay'



Group Delta Consultants
Ballona Wetlands

B1-1110

PLATE G-101

Newmark Displacements using Bray and Rathje (1998):

Section H-H'

Site Input

PGA,rock =	0.25	g		
M =	6.6			
r =	13	km		
ky =	0.04		32.185	1.2874

Sliding Mass Input

Vs =	110	m/s	assumed
Thickness, H =	16.8	m	
	55	ft	

Output

Tm =	0.49	sec				
D5-95 =	10.5	sec				
Ts =	0.61	sec				
NRF =	1.15					
Ts/Tm =	1.25					
kmax/(PGA,rock*NRF)	0.45					
kmax =	0.13					
ky / kmax =	0.31					
Displacement, u =	8	cm	0.3	feet	3.3	inches

PLATE G-102

JOB TITLE : Section I-I' - End of Construction

FLAC (Version 7.00)

LEGEND

27-Feb-13 14:56
step 10281
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

Factor of Safety 1.68

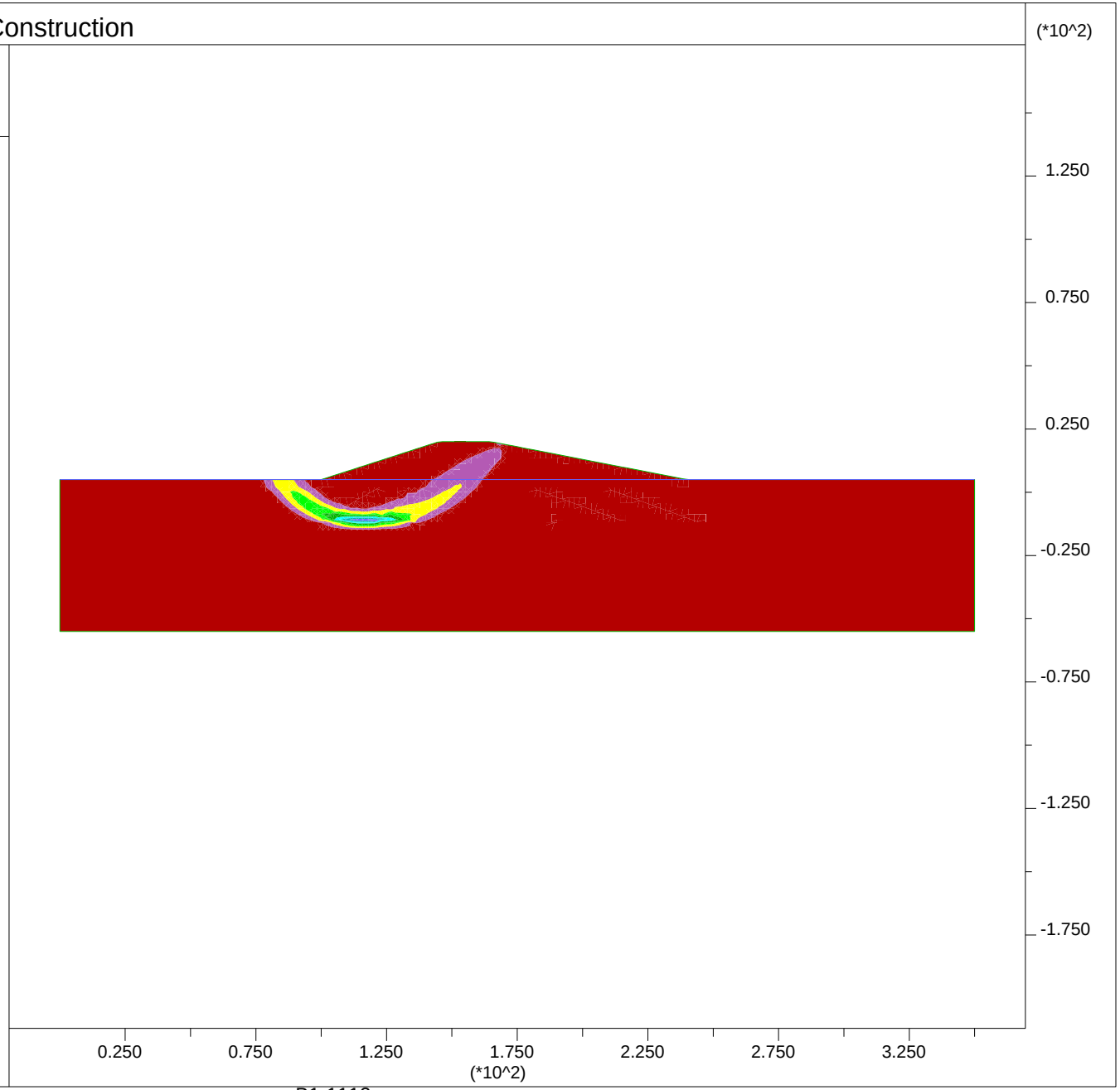
Max. shear strain-rate
0.00E+00
5.00E-07
1.00E-06
1.50E-06
2.00E-06
2.50E-06
3.00E-06
3.50E-06

Contour interval= 5.00E-07
Extrap. by averaging
Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands



B1-1112

PLATE G-103

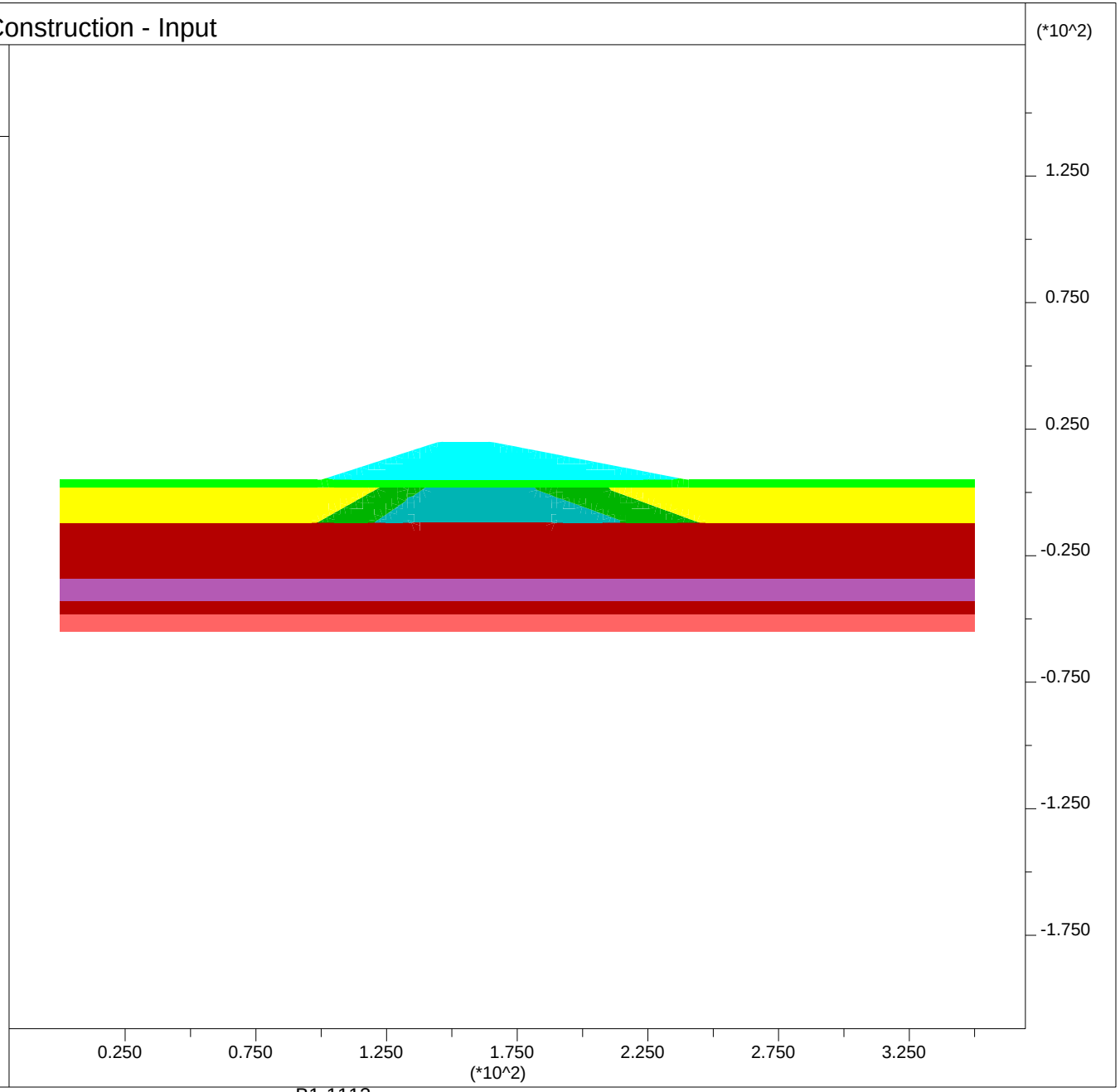
JOB TITLE : Section I-I' - End of Construction - Input

FLAC (Version 7.00)

LEGEND

27-Feb-13 14:57
step 10281
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

User-defined Groups
- User:Sand
- 'User:Med Sand'
- 'S:Stiff Clay'
- 'User:V Soft Clay'
- Fill:Fill
- User:Clay400
- User:Embankment
- 'User:Soft Clay'



Group Delta Consultants
Ballona Wetlands

B1-1113

PLATE G-104

JOB TITLE : Section I-I' - High Water Short Term

FLAC (Version 7.00)

LEGEND

27-Feb-13 14:37
step 21996
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

Factor of Safety 1.61

Max. shear strain-rate
0.00E+00
5.00E-07
1.00E-06
1.50E-06
2.00E-06
2.50E-06

Contour interval= 5.00E-07
Extrap. by averaging
Boundary plot

0 1E 2

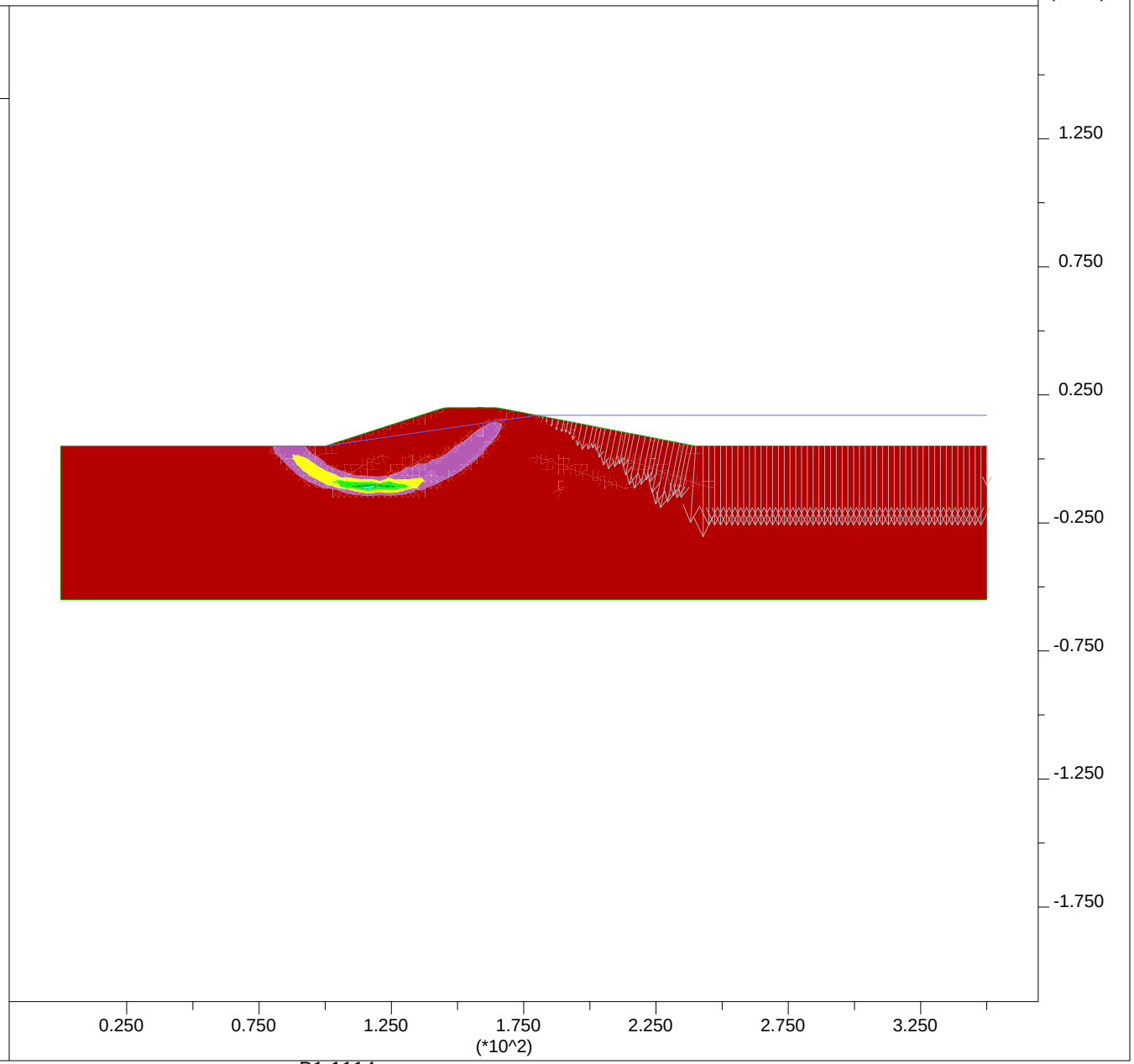
Water Table

Net Applied Forces

max vector = 1.874E+03

0 3E 3

Group Delta Consultants
Ballona Wetlands



B1-1114

PLATE G-105

JOB TITLE : Section I-I' - High Water Short Term - Input

FLAC (Version 7.00)

LEGEND

27-Feb-13 14:38
step 21996
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

User-defined Groups
- User:Sand
- 'User:Med Sand'
- 'S:Stiff Clay'
- 'User:V Soft Clay'
- Fill:Fill
- User:Clay400
- User:Embankment
- 'User:Soft Clay'

Grid plot

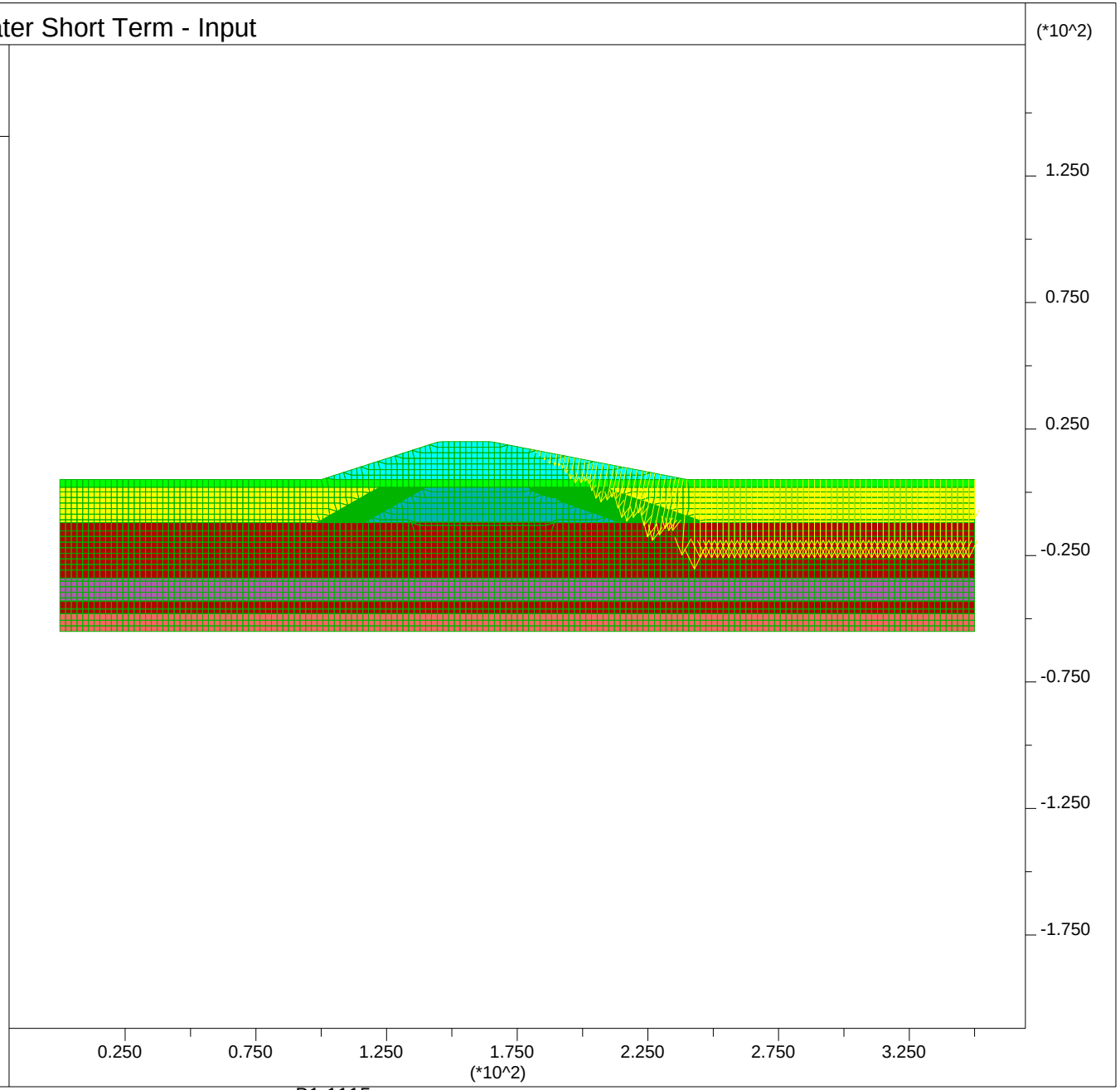
0 1E 2

Net Applied Forces

max vector = 1.874E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1115

PLATE G-106

JOB TITLE : Section I-I' - High Water Long Term (Steady State)

FLAC/SLOPE (Version 7.00)

LEGEND

5-Mar-13 14:26

Factor of Safety 2.29

Shear Strain Rate Contours

- 2.50E-07
- 5.00E-07
- 7.50E-07
- 1.00E-06
- 1.25E-06
- 1.50E-06
- 1.75E-06
- 2.00E-06

Contour interval= 2.50E-07
(zero contour omitted)
Boundary plot

0 1E 2

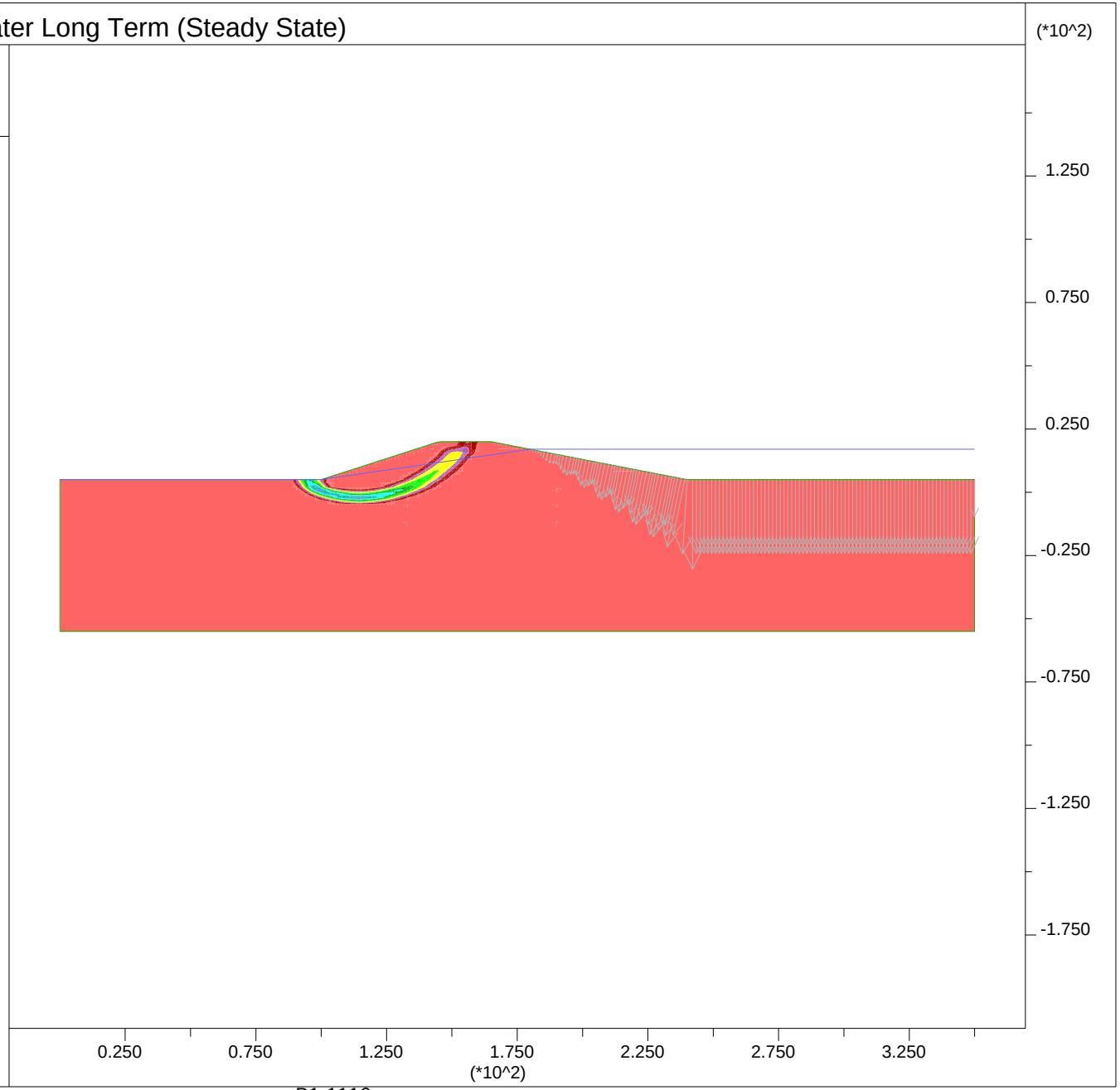
Water Table

Net Applied Forces

max vector = 1.327E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands



B1-1116

PLATE G-107

JOB TITLE : Section I-I' - High Water Long Term (Steady State) - Input

FLAC/SLOPE (Version 7.00)

LEGEND

5-Mar-13 14:27

Factor of Safety 2.29

User-defined Groups

- User:Sand
- 'User:Med Sand'
- 'S:Stiff Clay'
- 'User:Soft Clay'
- Fill:Fill
- User:Embankment

Boundary plot

0 1E 2

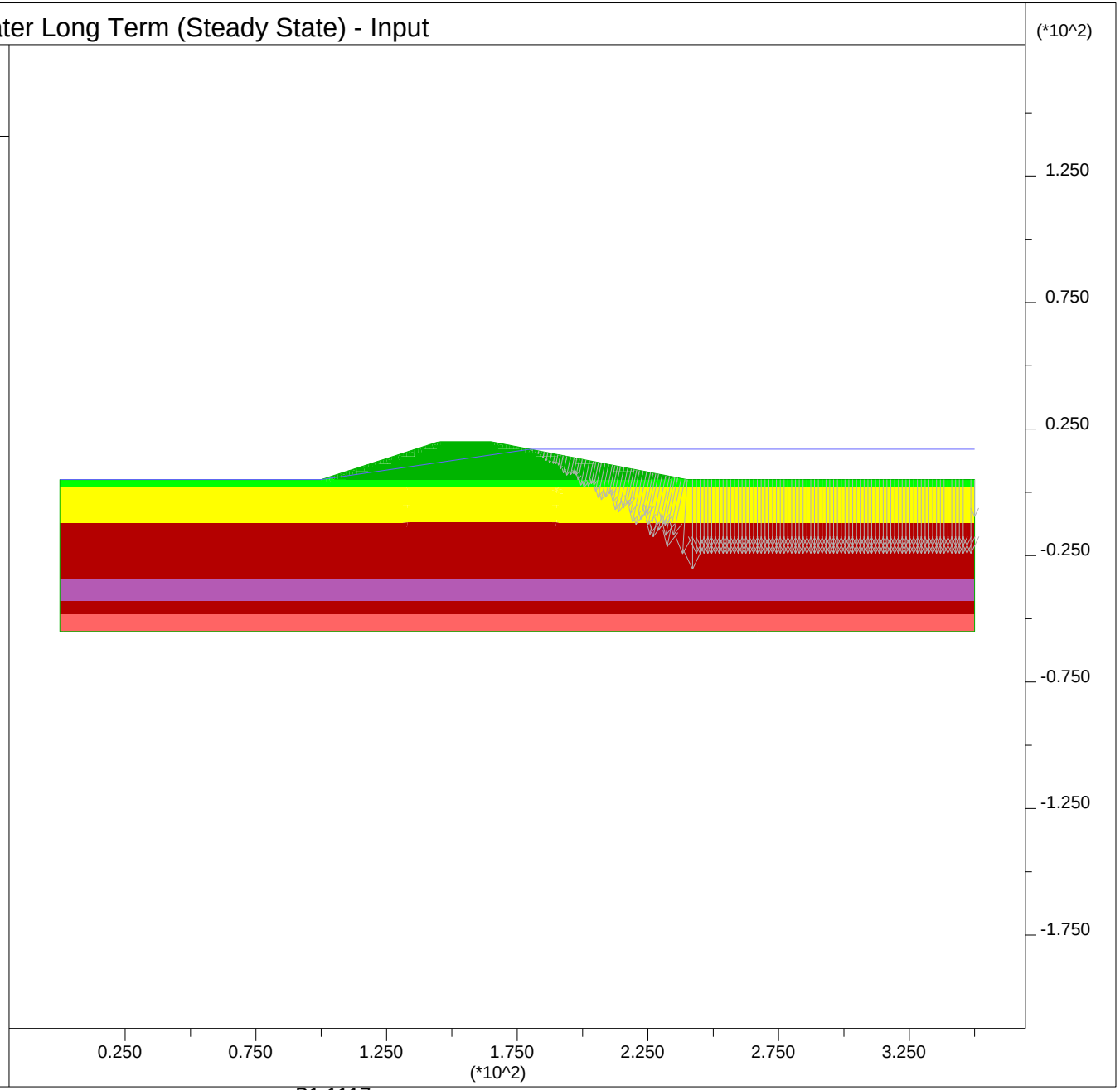
Water Table

Net Applied Forces

max vector = 1.327E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands



B1-1117

PLATE G-108

JOB TITLE : Section I-I' - Post Liquefaction

FLAC (Version 7.00)

LEGEND

27-Feb-13 15:15
step 9213
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

Factor of Safety 1.17

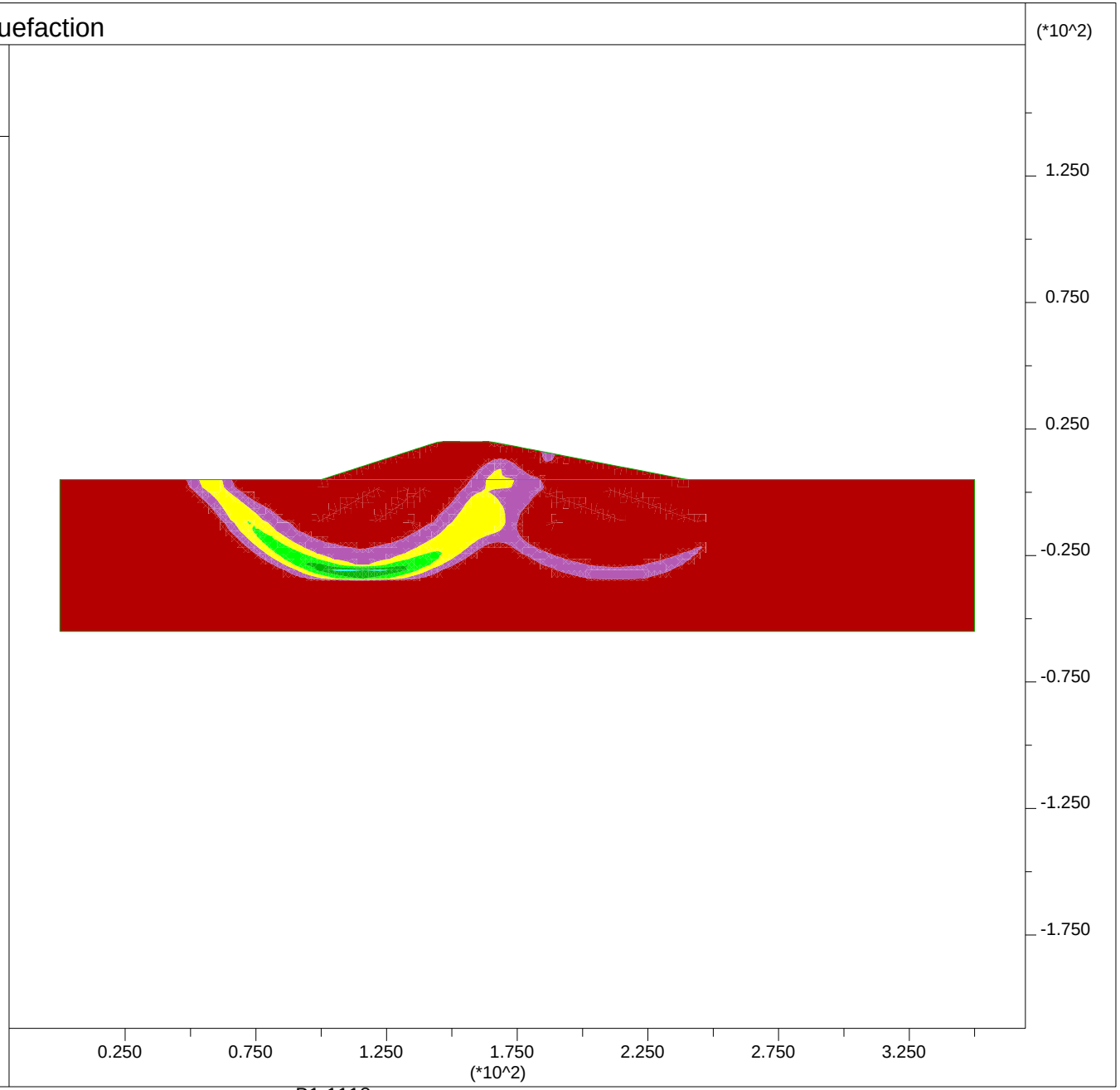
Max. shear strain-rate
0.00E+00
2.00E-07
4.00E-07
6.00E-07
8.00E-07
1.00E-06

Contour interval= 2.00E-07
Extrap. by averaging
Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands



B1-1118

PLATE G-109

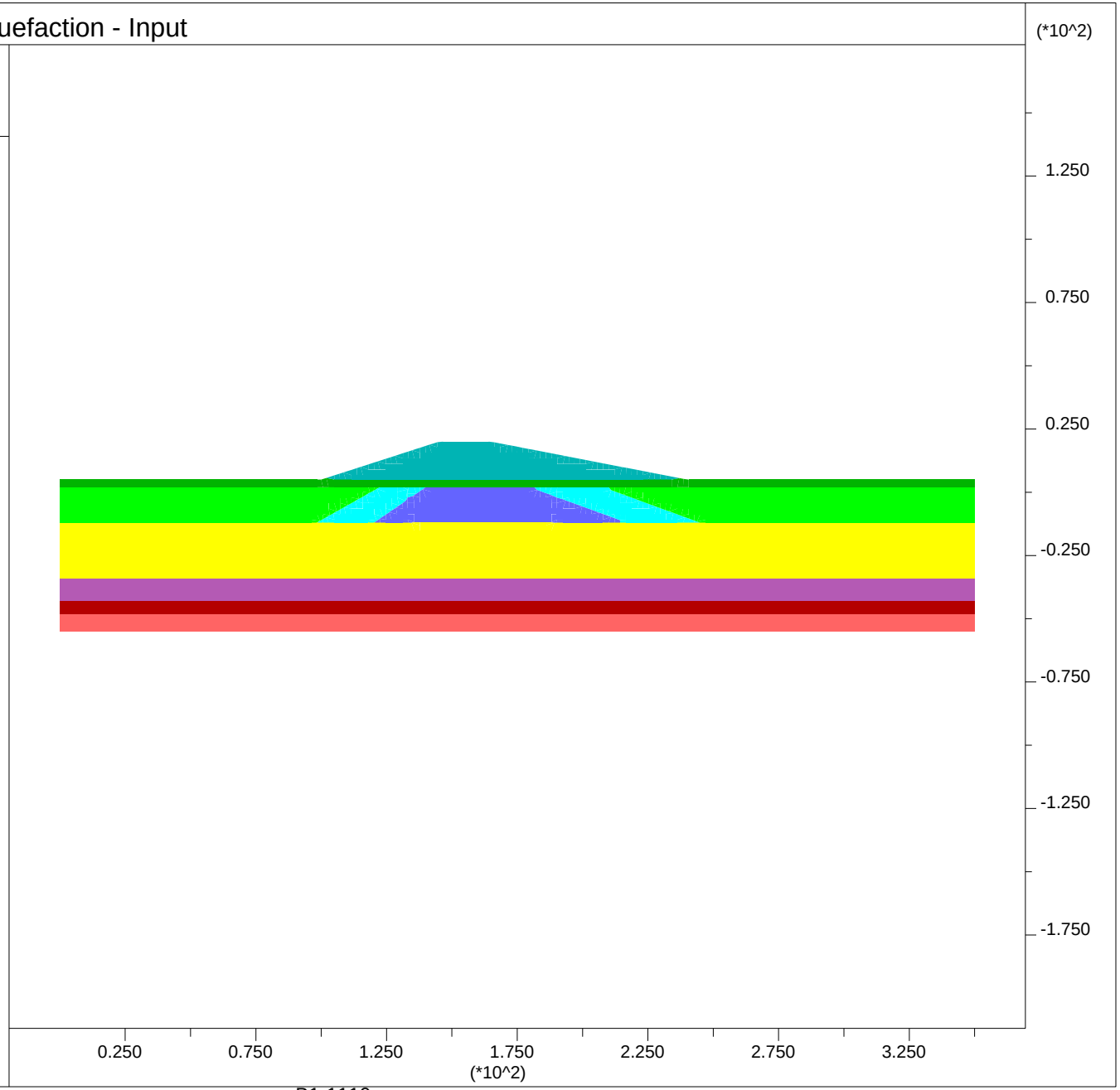
JOB TITLE : Section I-I' - Post Liquefaction - Input

FLAC (Version 7.00)

LEGEND

27-Feb-13 15:17
step 0
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

User-defined Groups
- User:Sand
- User:LiqSandDeep
- 'S:Stiff Clay'
- User:LiqSand
- 'User:V Soft Clay'
- Fill:LiqFill
- User:Clay400
- User:Embankment
- 'User:Soft Clay'



Group Delta Consultants
Ballona Wetlands

B1-1119

PLATE G-110

JOB TITLE : Section I-I' - Ky=0.04

FLAC (Version 7.00)

LEGEND

27-Feb-13 15:23
step 30986
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

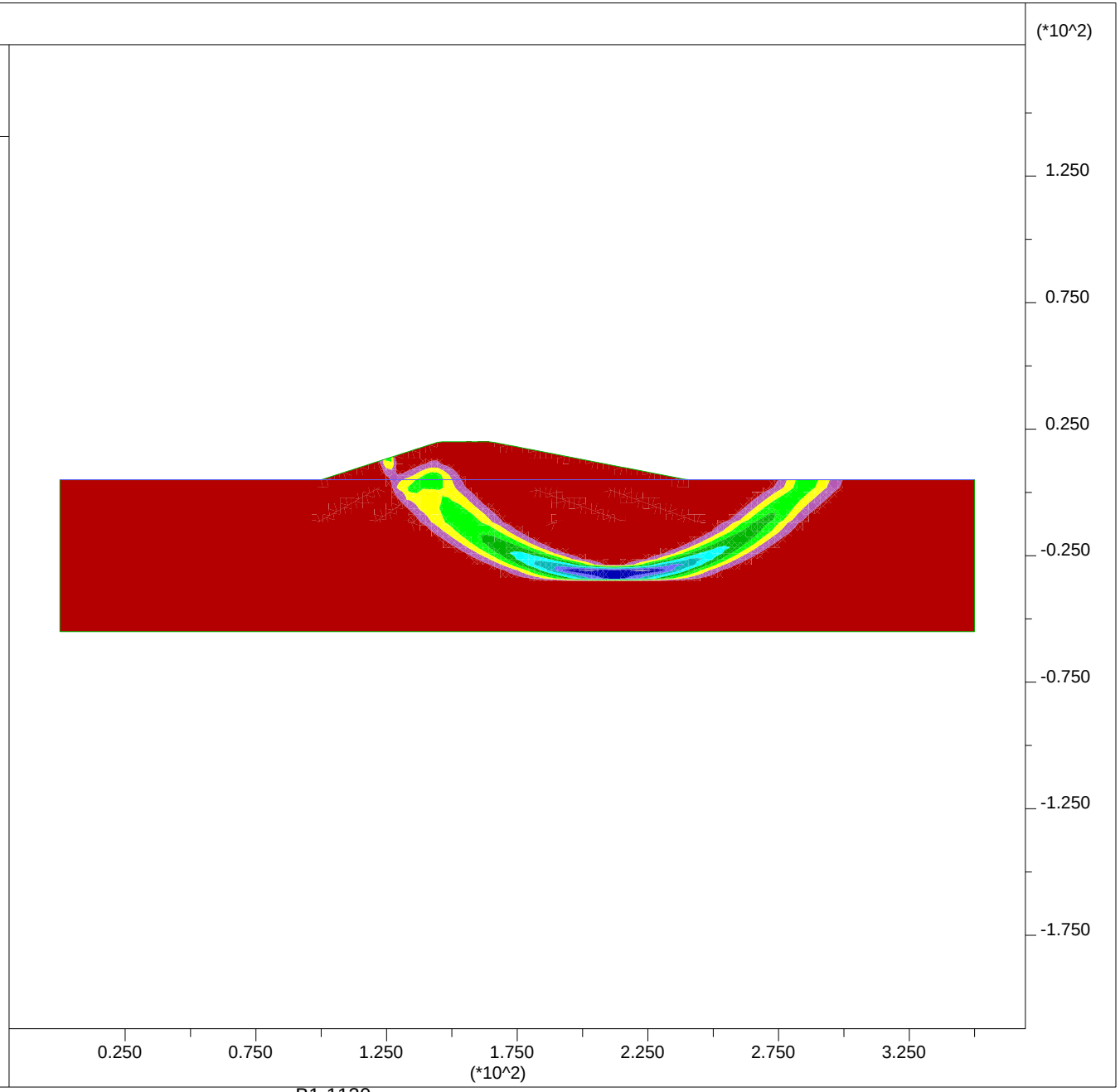
Factor of Safety 1.00

Max. shear strain-rate
0.00E+00
1.00E-07
2.00E-07
3.00E-07
4.00E-07
5.00E-07
6.00E-07
7.00E-07
8.00E-07
9.00E-07

Contour interval= 1.00E-07
Extrap. by averaging
Boundary plot

0 1E 2

Group Delta Consultants
Ballona Wetlands



B1-1120

PLATE G-111

JOB TITLE : Section I-I' - Ky=0.04 - Input

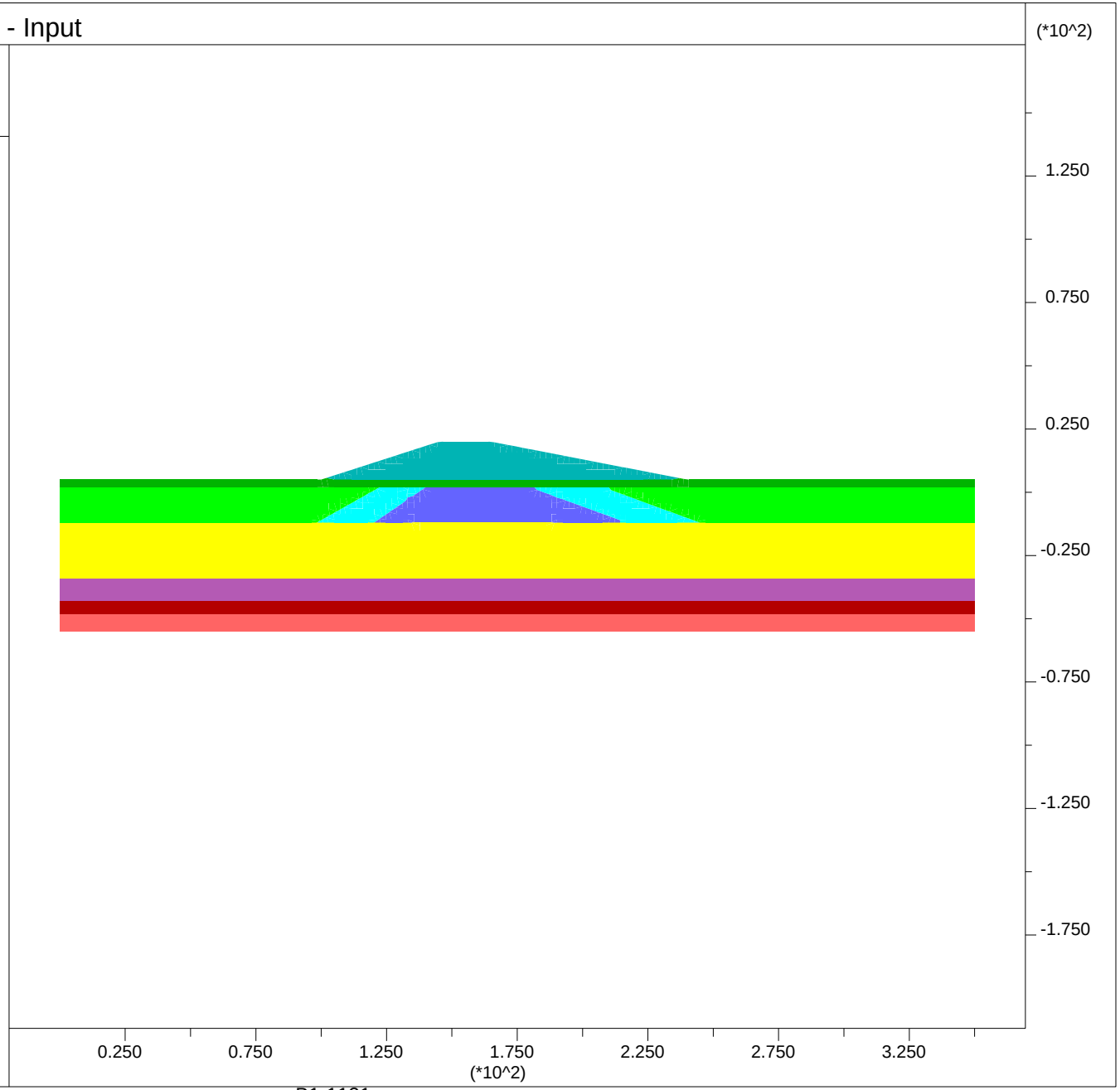
FLAC (Version 7.00)

LEGEND

27-Feb-13 15:25
step 0
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

User-defined Groups
- User:Sand
- User:LiqSandDeep
- 'S:Stiff Clay'
- User:LiqSand
- 'User:V Soft Clay'
- Fill:LiqFill
- User:Clay400
- User:Embankment
- 'User:Soft Clay'

Group Delta Consultants
Ballona Wetlands



B1-1121

PLATE G-112

Newmark Displacements using Bray and Rathje (1998):

Section I-I'

Site Input

PGA,rock =	0.25	g	
M =	6.6		
r =	13	km	
ky =	0.04		

Sliding Mass Input

Vs =	110	m/s	assumed
Thickness, H =	15.3	m	
	50	ft	

Output

Tm =	0.49	sec				
D5-95 =	10.5	sec				
Ts =	0.55	sec				
NRF =	1.15					
Ts/Tm =	1.14					
kmax/(PGA,rock*NRF)	0.48					
kmax =	0.14					
ky / kmax =	0.29					
Displacement, u =	11	cm	0.4	feet	4.3	inches

JOB TITLE : Section J-J' - End of Construction

FLAC (Version 7.00)

LEGEND

27-Feb-13 15:27
step 16426
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

Factor of Safety 2.09

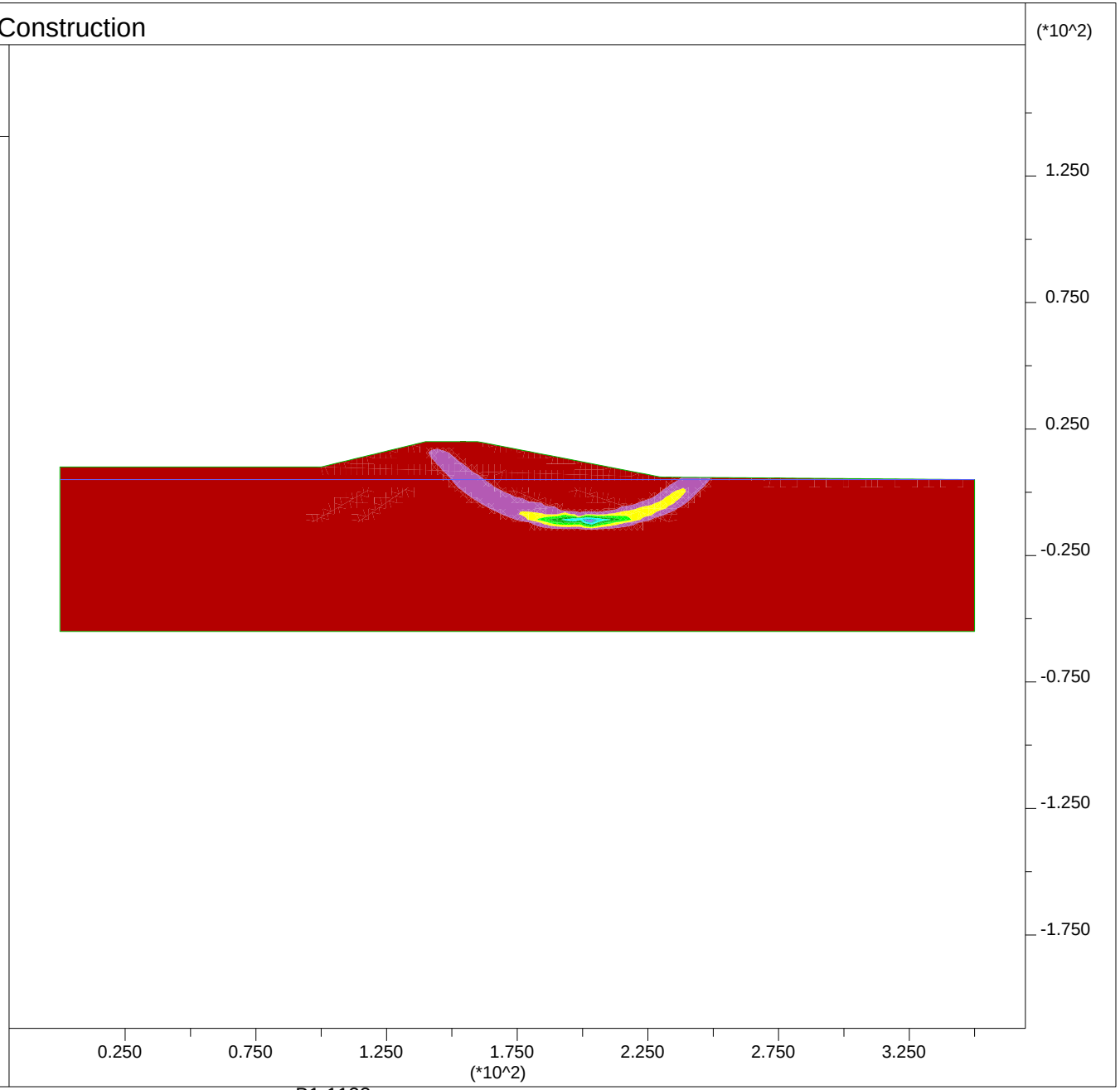
Max. shear strain-rate
0.00E+00
5.00E-07
1.00E-06
1.50E-06
2.00E-06
2.50E-06
3.00E-06
3.50E-06
4.00E-06

Contour interval= 5.00E-07
Extrap. by averaging
Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands



B1-1123

PLATE G-114

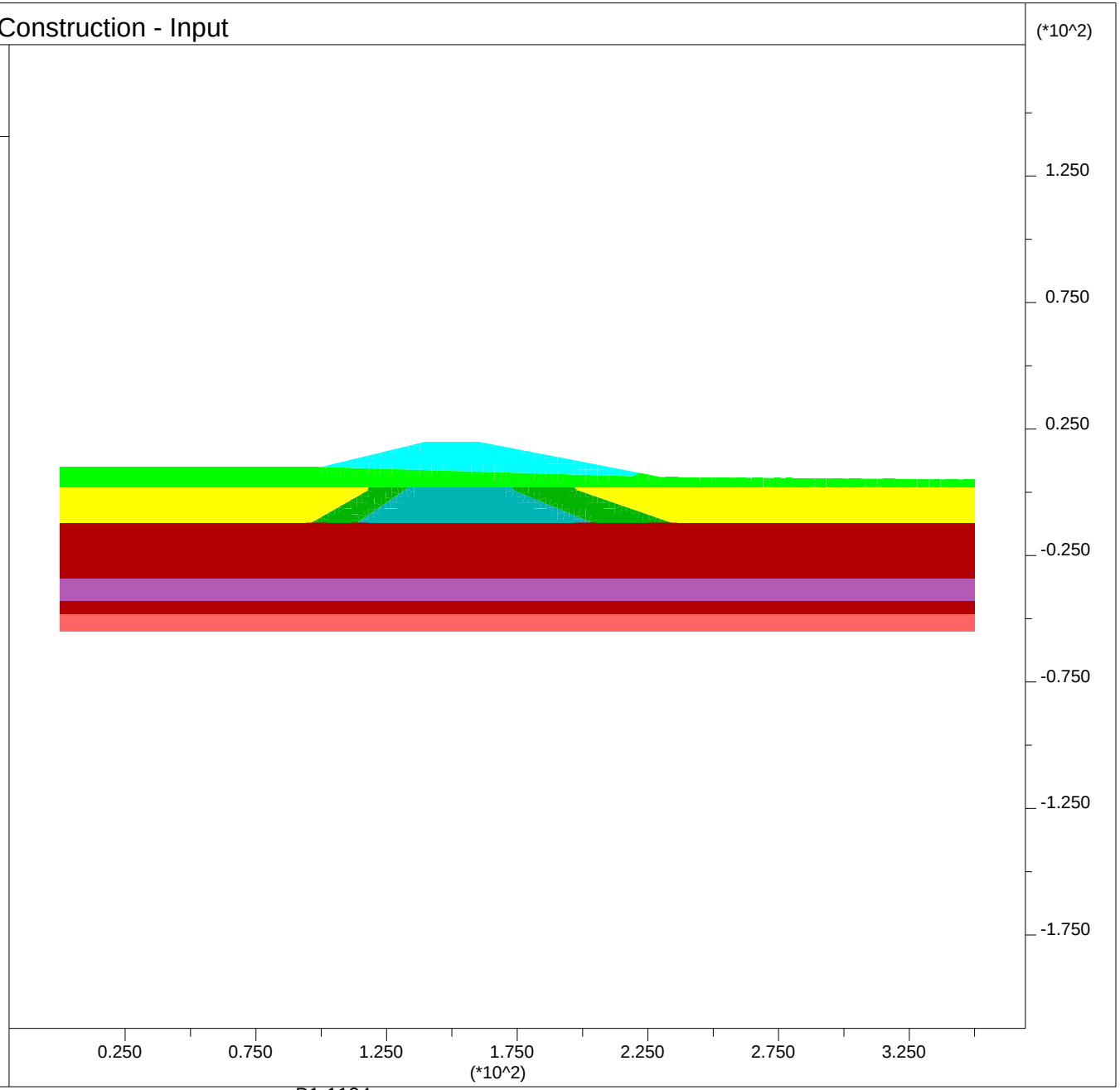
JOB TITLE : Section J-J' - End of Construction - Input

FLAC (Version 7.00)

LEGEND

27-Feb-13 15:30
step 0
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

User-defined Groups
- User:Sand
- 'User:Med Sand'
- 'S:Stiff Clay'
- 'User:V Soft Clay'
- Fill:Fill
- User:Clay400
- User:Embankment
- 'User:Soft Clay'



Group Delta Consultants
Ballona Wetlands

B1-1124

PLATE G-115

JOB TITLE : Section J-J' - High Water Short Term

FLAC (Version 7.00)

LEGEND

27-Feb-13 16:12
step 8130
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

Factor of Safety 2.48

Max. shear strain-rate
0.00E+00
5.00E-07
1.00E-06
1.50E-06
2.00E-06
2.50E-06

Contour interval= 5.00E-07
Extrap. by averaging
Boundary plot

0 1E 2

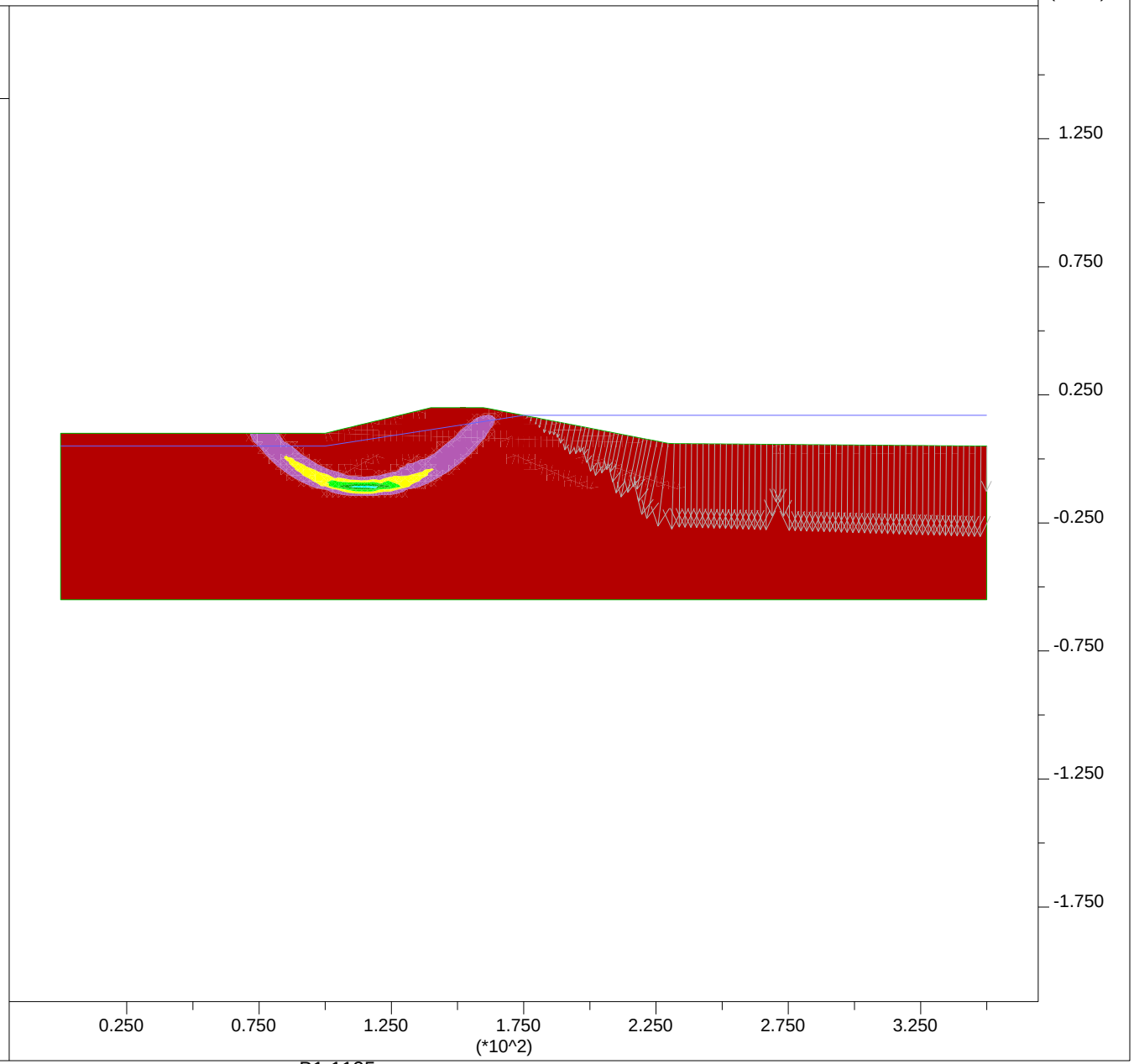
Water Table

Net Applied Forces

max vector = 1.636E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1125

PLATE G-116

JOB TITLE : Section J-J' - High Water Short Term - Input

FLAC (Version 7.00)

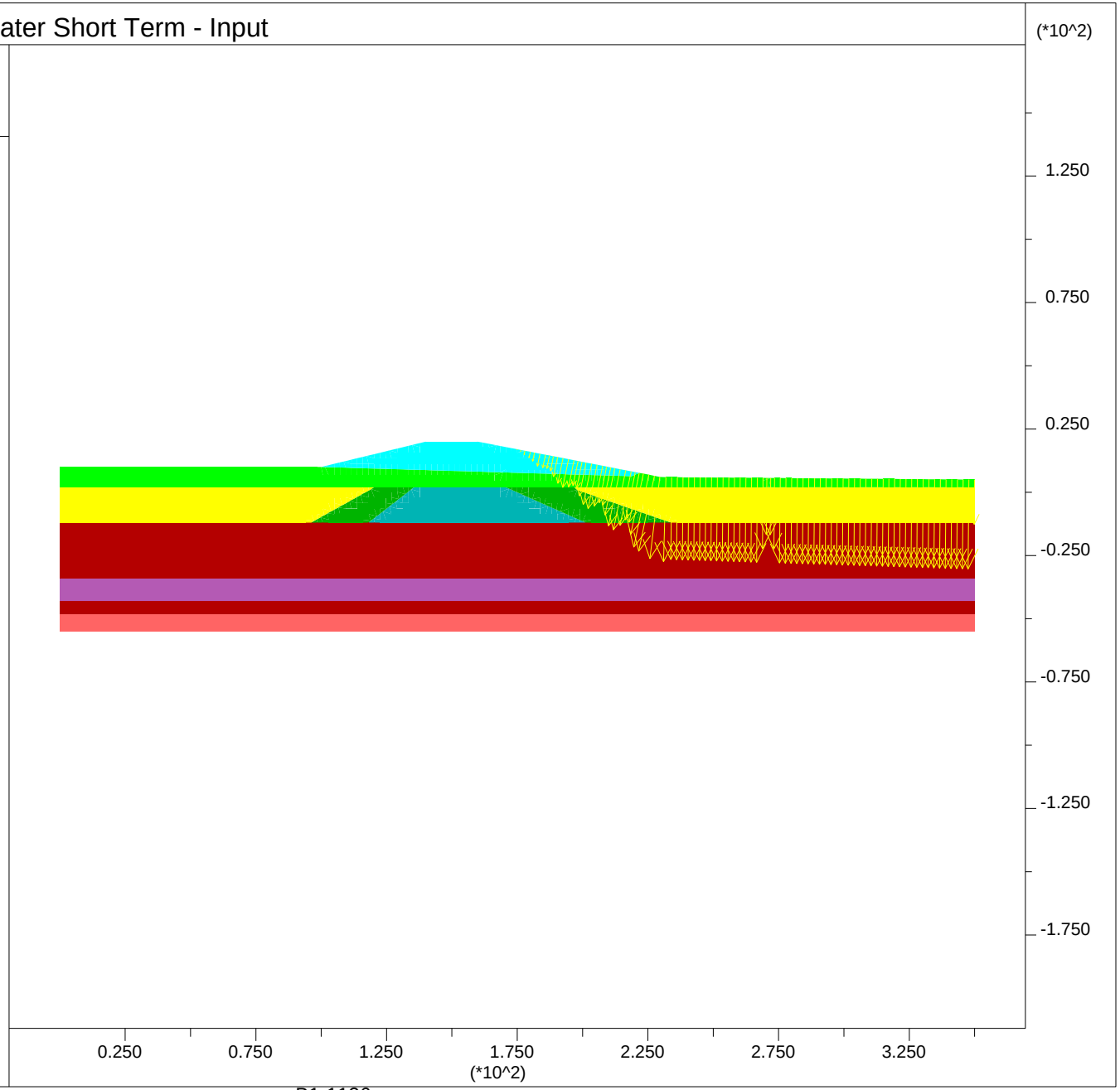
LEGEND

27-Feb-13 15:37
step 1860
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

User-defined Groups
- User:Sand
- 'User:Med Sand'
- 'S:Stiff Clay'
- 'User:V Soft Clay'
- Fill:Fill
- User:Clay400
- User:Embankment
- 'User:Soft Clay'

Net Applied Forces
max vector = 1.636E+03
0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1126

PLATE G-117

JOB TITLE : Section J-J' - Post Liquefaction

FLAC (Version 7.00)

LEGEND

27-Feb-13 15:33
step 19390
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

Factor of Safety 1.47

Max. shear strain-rate
0.00E+00
2.00E-07
4.00E-07
6.00E-07
8.00E-07
1.00E-06

Contour interval= 2.00E-07
Extrap. by averaging
Boundary plot

0 1E 2

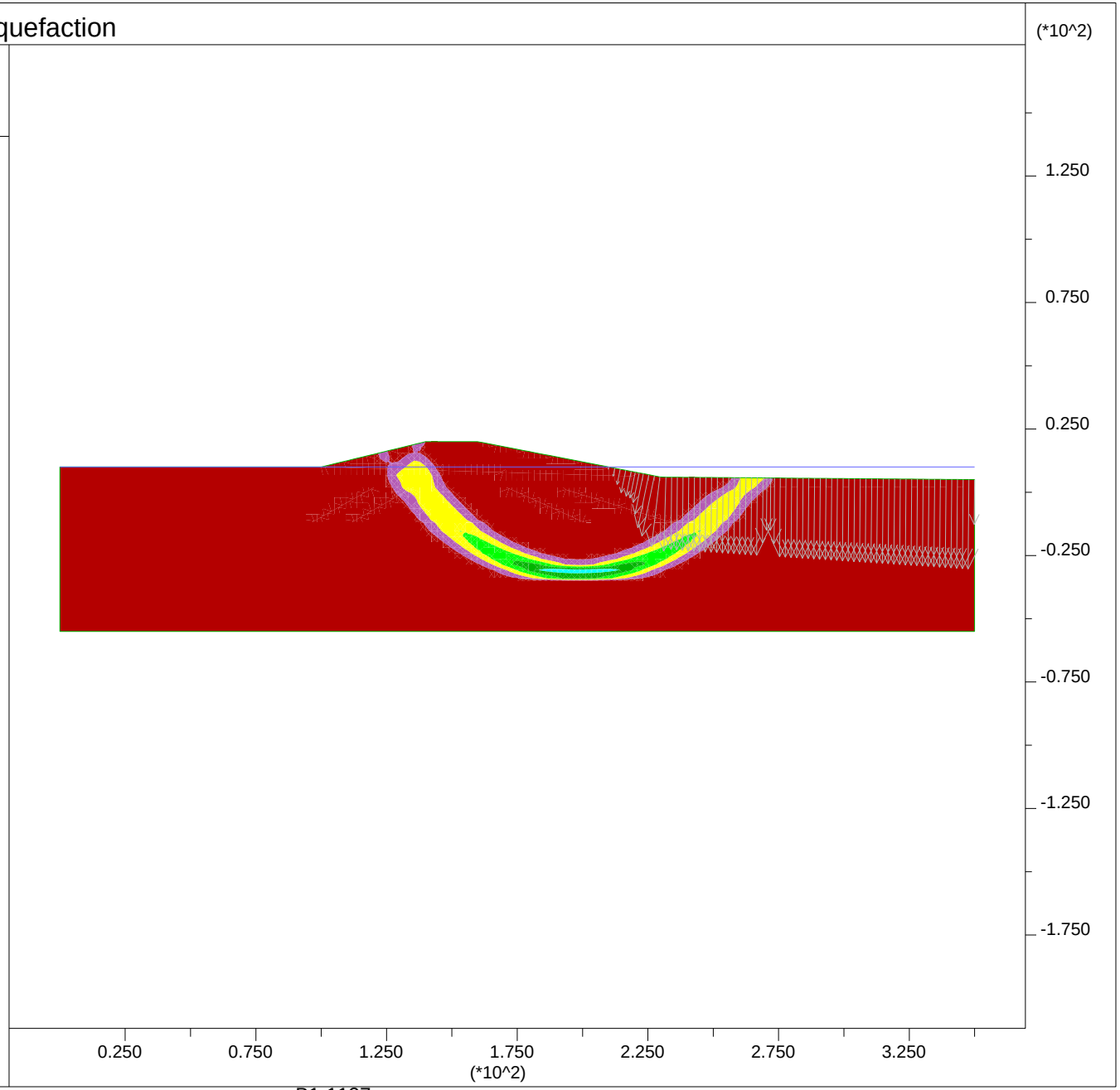
Water Table

Net Applied Forces

max vector = 6.801E+02

0 2E 3

Group Delta Consultants
Ballona Wetlands



B1-1127

PLATE G-118

JOB TITLE : Section J-J' - Post Liquefaction - Input

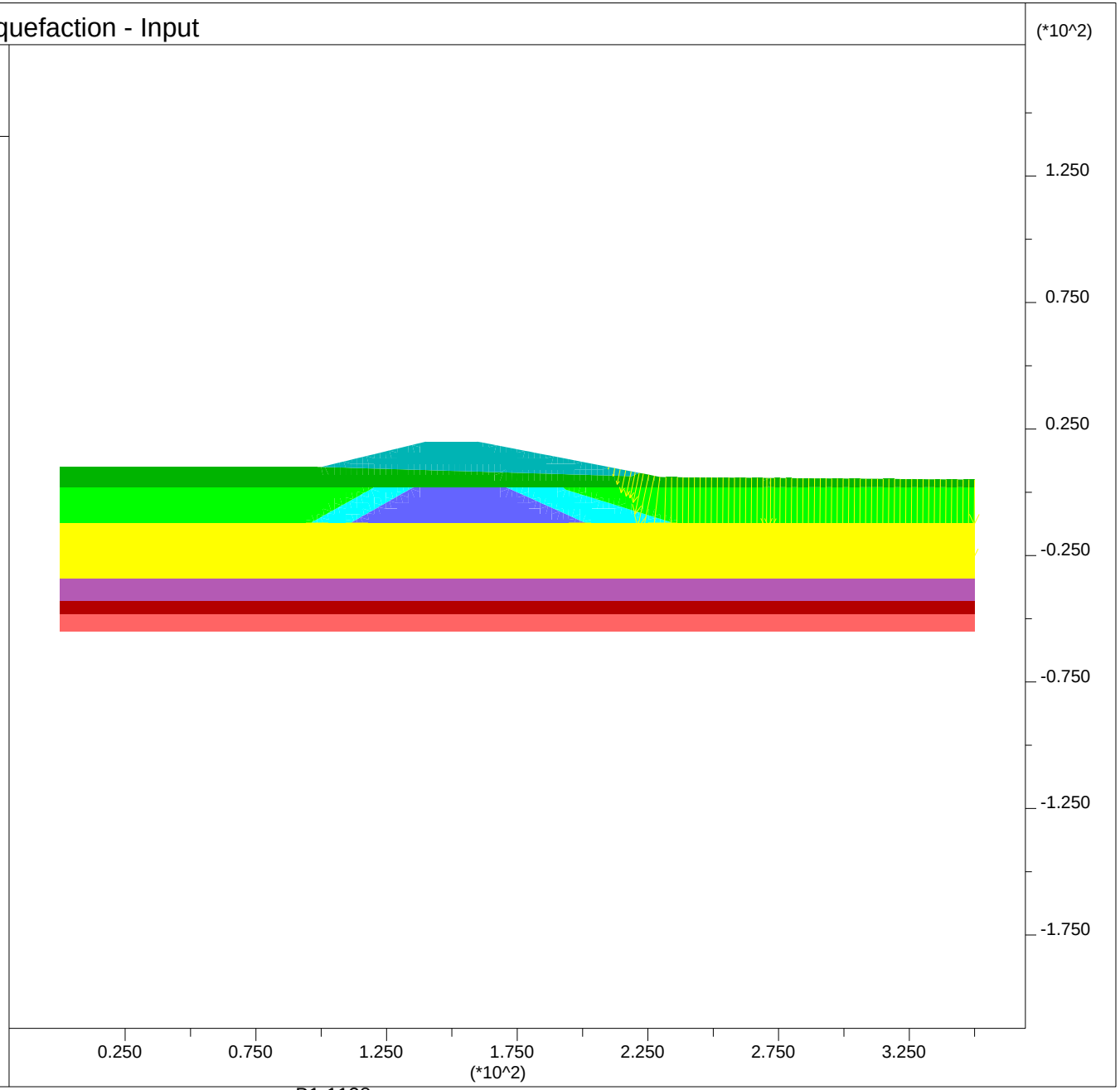
FLAC (Version 7.00)

LEGEND

27-Feb-13 15:34
step 2710
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

User-defined Groups
- User:Sand
- User:LiqSandDeep
- 'S:Stiff Clay'
- User:LiqSand
- 'User:V Soft Clay'
- Fill:LiqFill
- User:Clay400
- User:Embankment
- 'User:Soft Clay'

Net Applied Forces
max vector = 6.801E+02
0 2E 3



Group Delta Consultants
Ballona Wetlands

B1-1128

PLATE G-119

JOB TITLE : Section J-J' - Ky=0.05

FLAC (Version 7.00)

LEGEND

27-Feb-13 15:35
step 27420
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

Factor of Safety 1.01

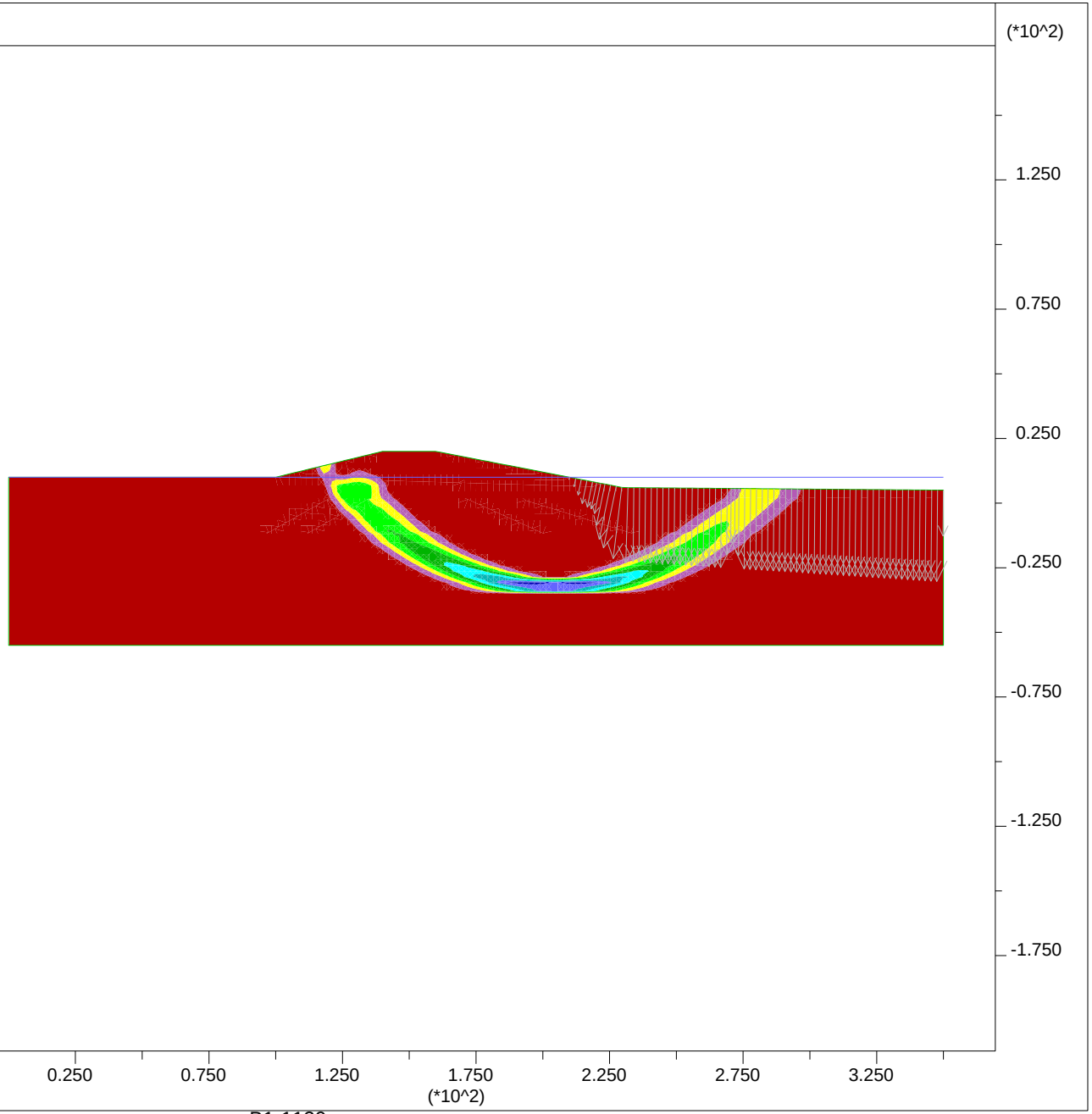
Max. shear strain-rate
0.00E+00
1.00E-07
2.00E-07
3.00E-07
4.00E-07
5.00E-07
6.00E-07
7.00E-07
8.00E-07

Contour interval= 1.00E-07
Extrap. by averaging
Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands



B1-1129

PLATE G-120

JOB TITLE : Section J-J' - Ky=0.05 - Input

FLAC (Version 7.00)

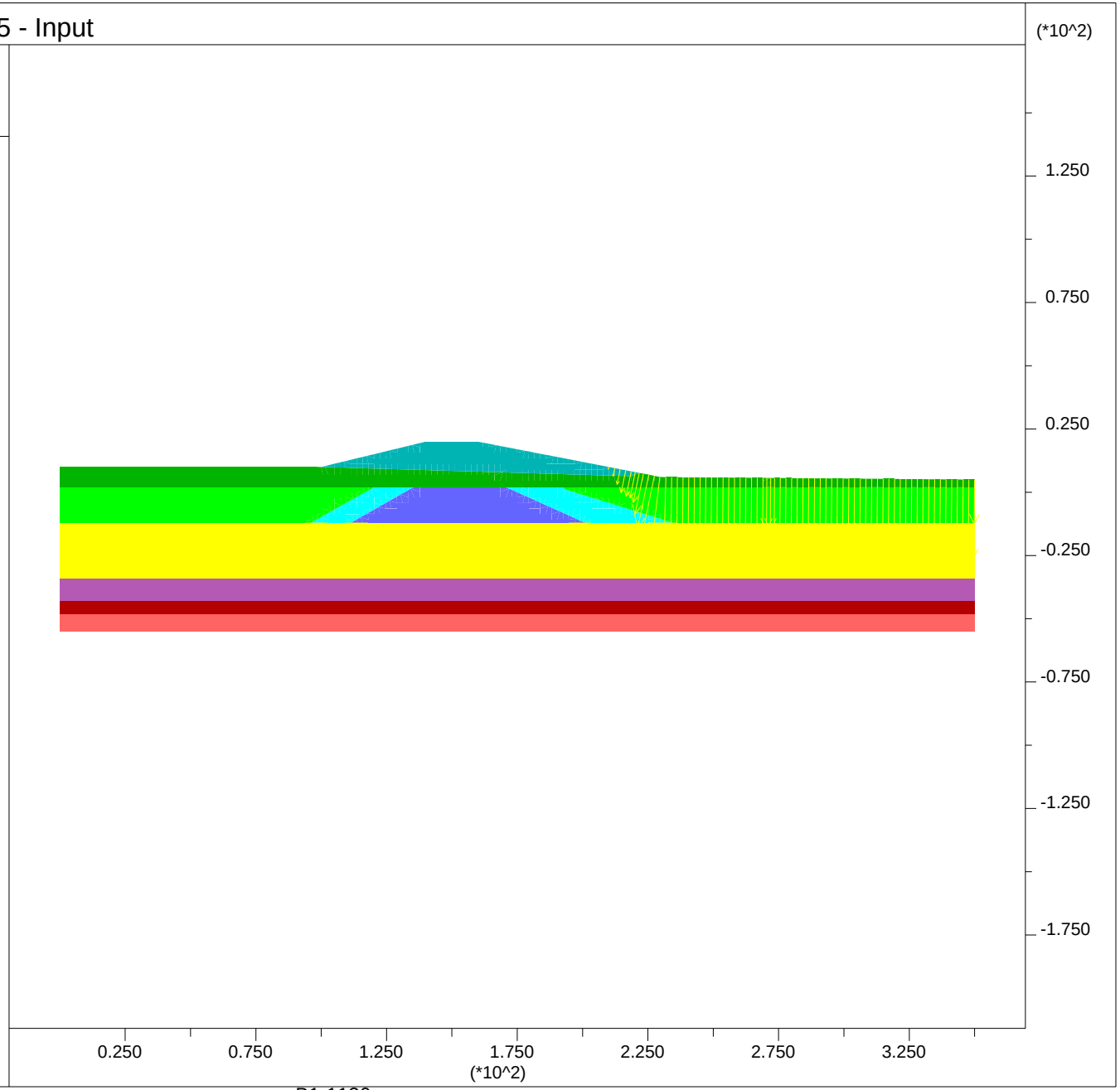
LEGEND

27-Feb-13 15:36
step 27420
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

User-defined Groups
- User:Sand
- User:LiqSandDeep
- 'S:Stiff Clay'
- User:LiqSand
- 'User:V Soft Clay'
- Fill:LiqFill
- User:Clay400
- User:Embankment
- 'User:Soft Clay'

Net Applied Forces
max vector = 6.801E+02
0 2E 3

Group Delta Consultants
Ballona Wetlands



B1-1130

PLATE G-121

Newmark Displacements using Bray and Rathje (1998):

Section J-J'

Site Input

PGA,rock =	0.25	g	
M =	6.6		
r =	13	km	
ky =	0.05		
Sliding Mass Input			
Vs =	110	m/s	assumed
Thickness, H =	15.3	m	
	50	ft	

Output

Tm =	0.49	sec				
D5-95 =	10.5	sec				
Ts =	0.55	sec				
NRF =	1.15					
Ts/Tm =	1.14					
kmax/(PGA,rock*NRF)	0.48					
kmax =	0.14					
ky / kmax =	0.36					
Displacement, u =	6	cm	0.2	feet	2.4	inches

JOB TITLE : Section K-K' - End of Construction

FLAC (Version 7.00)

LEGEND

27-Feb-13 16:15
step 33610
-1.667E+01 <x< 3.167E+02
-1.872E+02 <y< 1.462E+02

Factor of Safety 1.58

Max. shear strain-rate
0.00E+00
2.00E-08
4.00E-08
6.00E-08
8.00E-08
1.00E-07

Contour interval= 2.00E-08
Extrap. by averaging
Boundary plot

0 1E 2

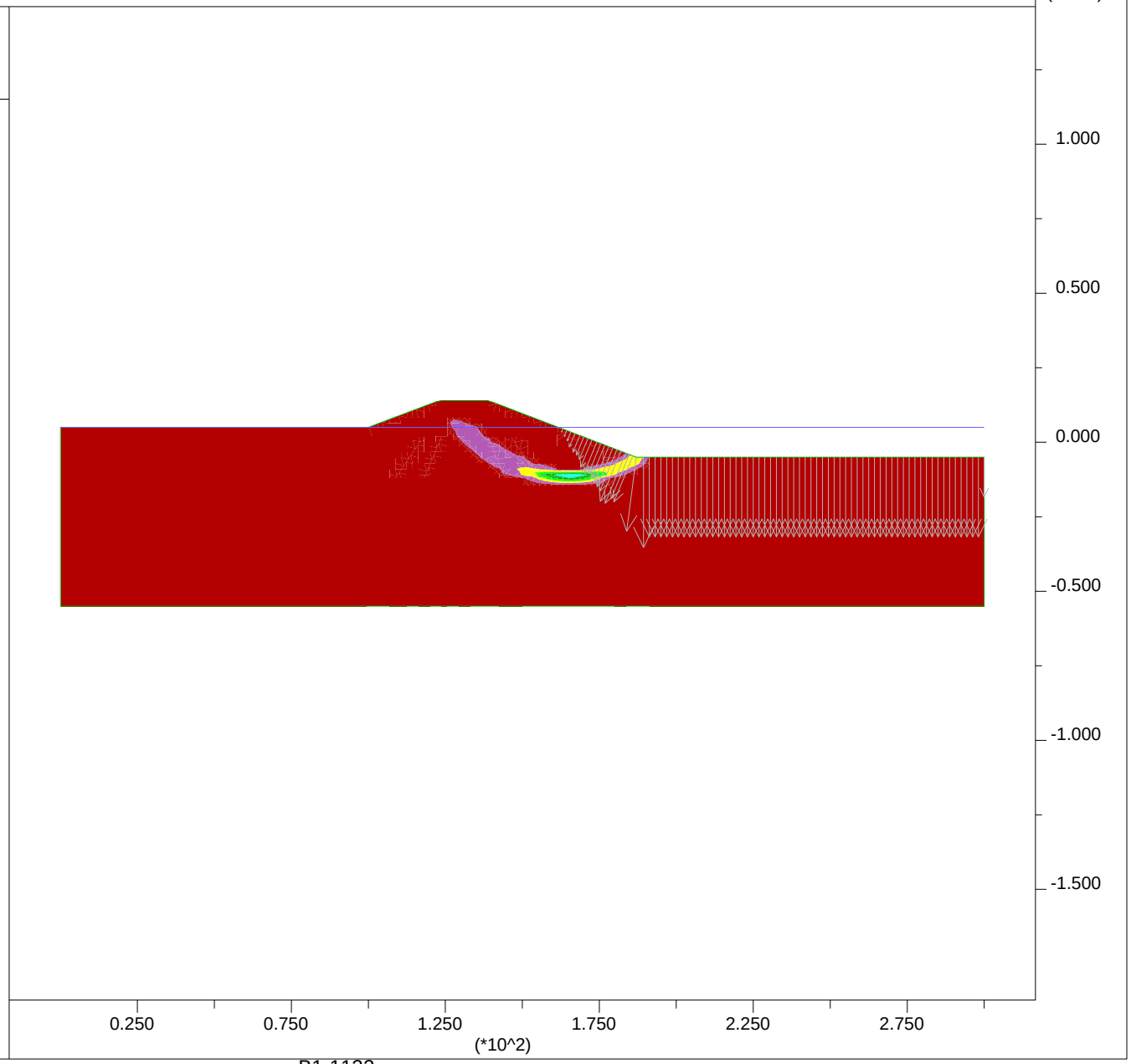
Water Table

Net Applied Forces

max vector = 1.327E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands



B1-1132

PLATE G-123

JOB TITLE : Section K-K' - End of Construction - Input

FLAC (Version 7.00)

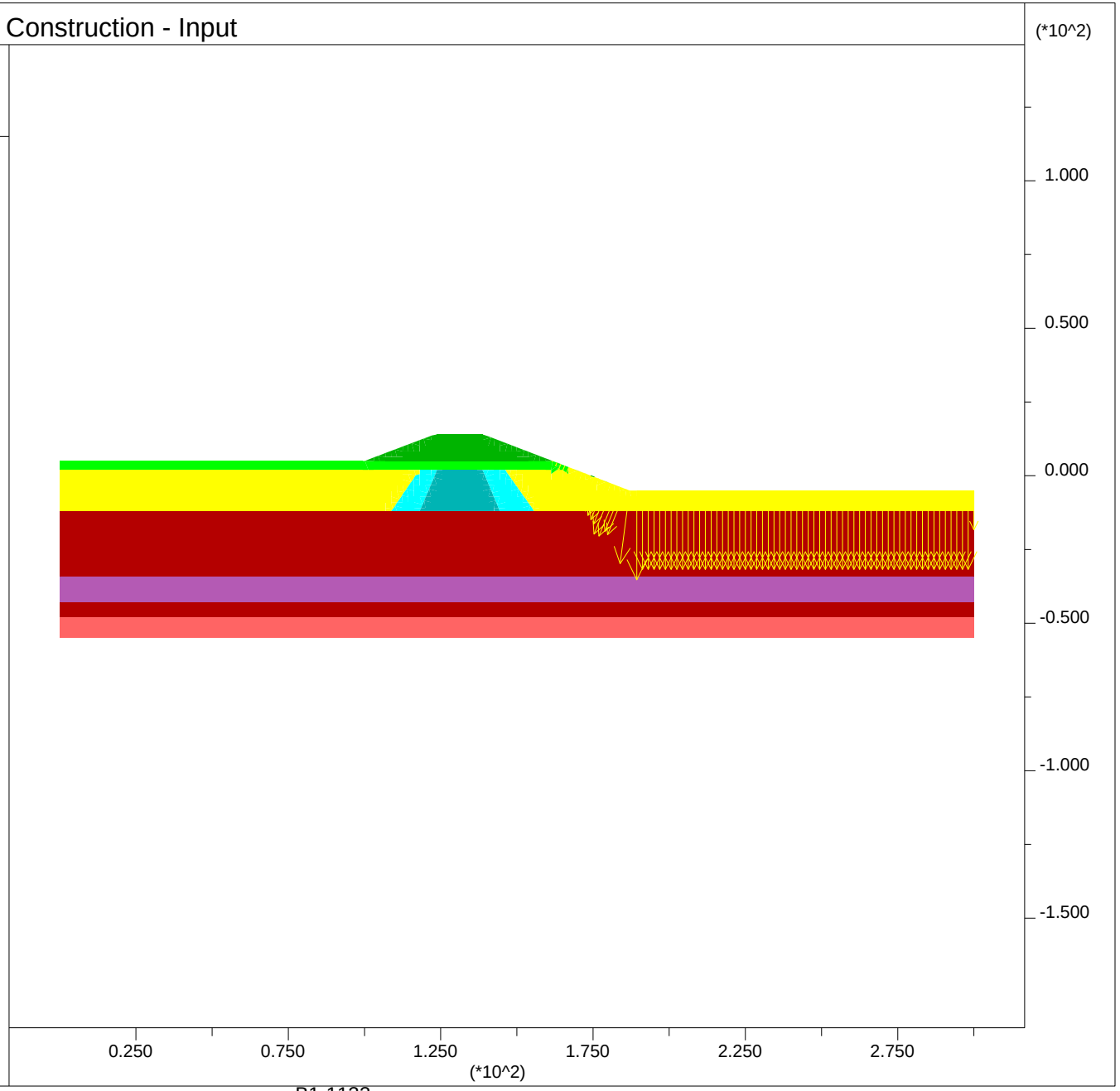
LEGEND

27-Feb-13 16:17
step 670
-1.667E+01 <x< 3.167E+02
-1.872E+02 <y< 1.462E+02

User-defined Groups
- User:Sand
- 'User:Med Sand'
- 'S:Stiff Clay'
- 'User:V Soft Clay'
- Fill:Fill
- User:Embankment
- 'User:Clay 400'
- 'User:Soft Clay'

Net Applied Forces
max vector = 1.327E+03
0 2E 3

Group Delta Consultants
Ballona Wetlands



B1-1133

PLATE G-124

JOB TITLE : Section K-K' - High Water Short Term

FLAC (Version 7.00)

LEGEND

27-Feb-13 17:26
step 41778
-1.667E+01 <x< 3.167E+02
-1.872E+02 <y< 1.462E+02

Factor of Safety 2.13

Max. shear strain-rate
0.00E+00
1.00E-07
2.00E-07
3.00E-07
4.00E-07
5.00E-07
6.00E-07

Contour interval= 1.00E-07
Extrap. by averaging
Boundary plot

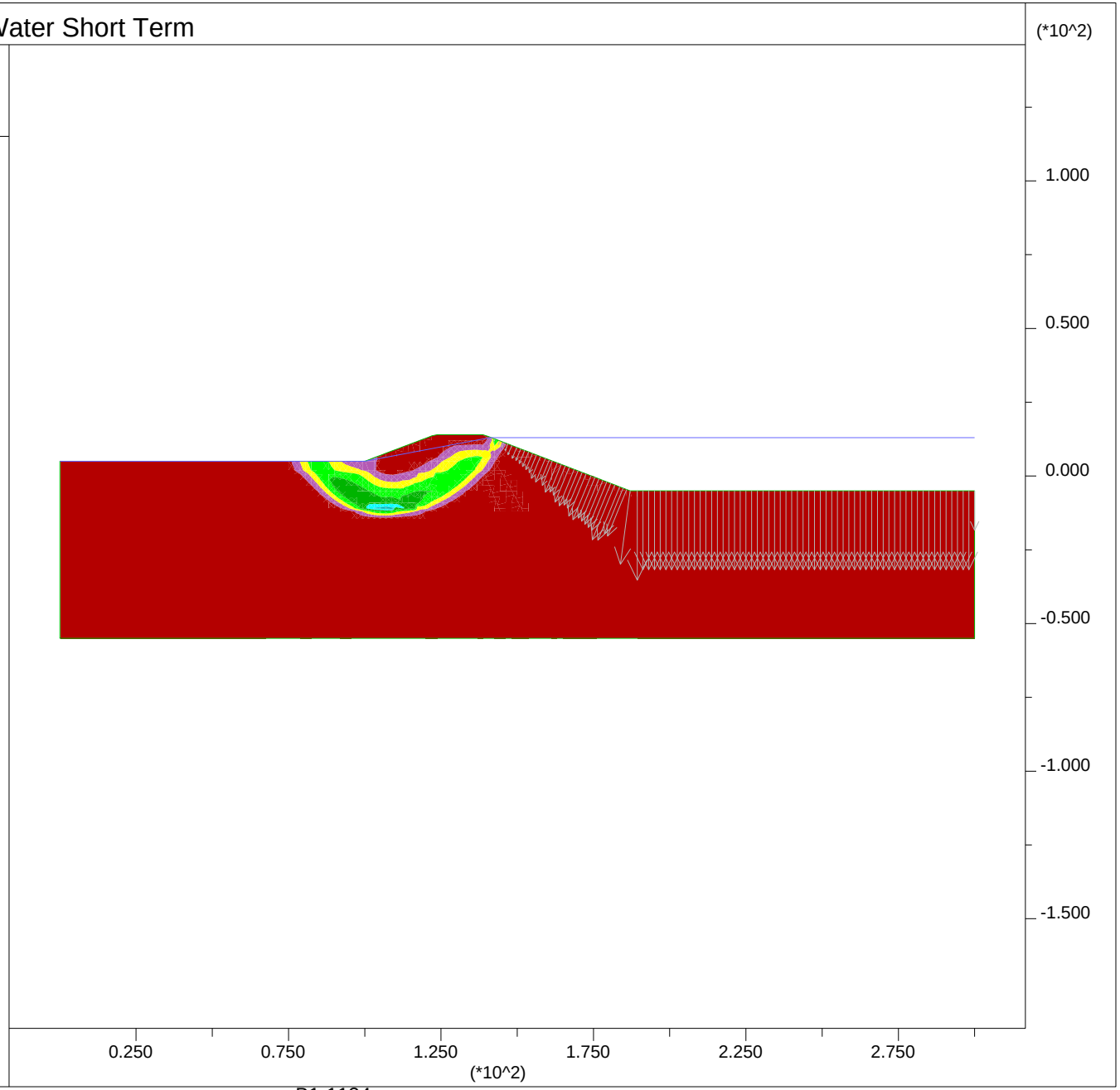
0 1E 2

Water Table

Net Applied Forces

max vector = 2.389E+03

Group Delta Consultants
Ballona Wetlands



B1-1134

PLATE G-125

JOB TITLE : Section K-K' - High Water Short Term - Input

FLAC (Version 7.00)

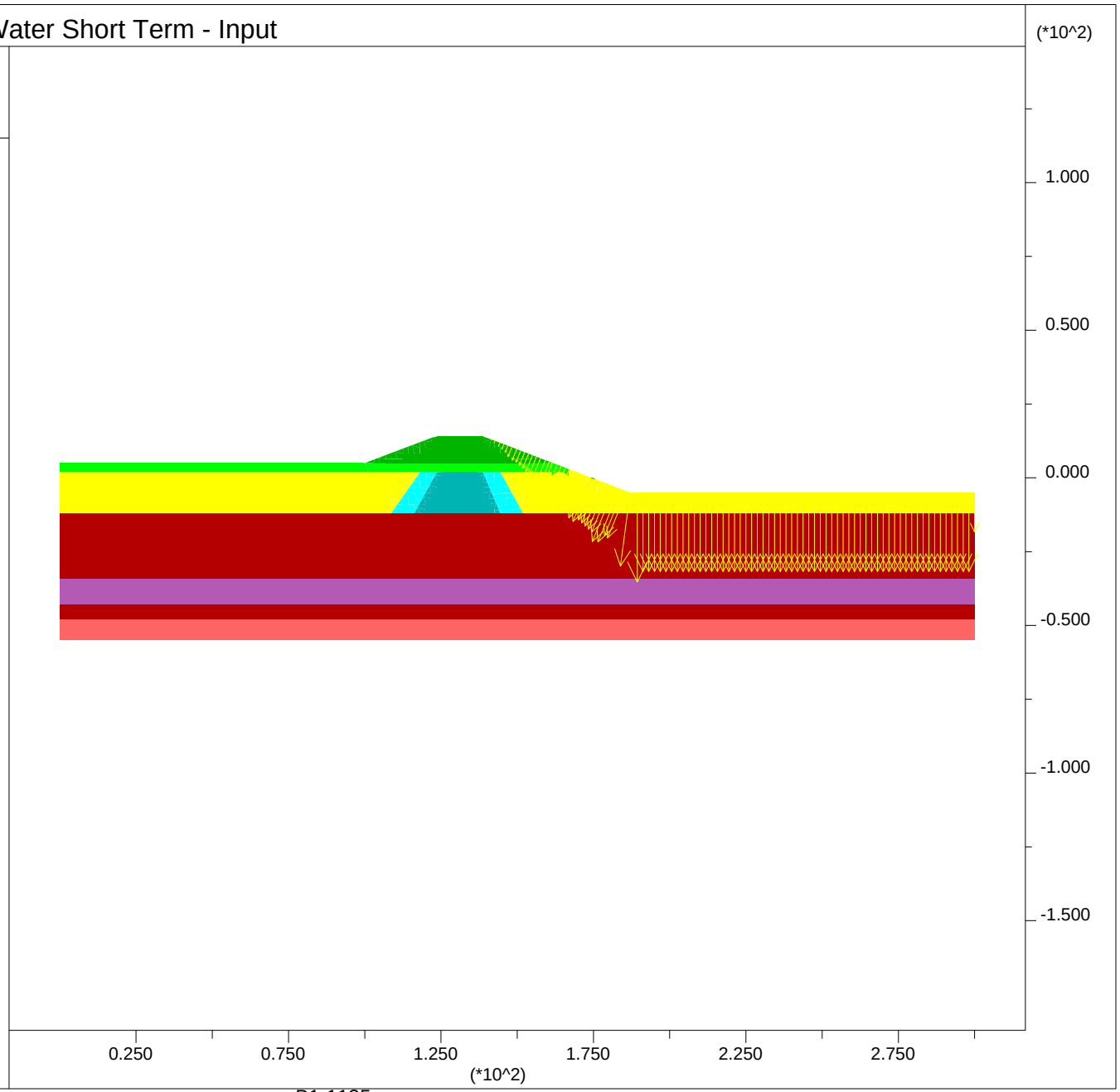
LEGEND

27-Feb-13 16:24
step 0
-1.667E+01 <x< 3.167E+02
-1.872E+02 <y< 1.462E+02

User-defined Groups
- User:Sand
- 'User:Med Sand'
- 'S:Stiff Clay'
- 'User:V Soft Clay'
- Fill:Fill
- User:Embankment
- User:Clay400
- 'User:Soft Clay'

Net Applied Forces
max vector = 2.389E+03
0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1135

PLATE G-126

JOB TITLE : Section K-K' - Post Liquefaction

FLAC (Version 7.00)

LEGEND

27-Feb-13 16:18
step 24366
-1.667E+01 <x< 3.167E+02
-1.872E+02 <y< 1.462E+02

Factor of Safety 1.26

Max. shear strain-rate
0.00E+00
1.00E-07
2.00E-07
3.00E-07
4.00E-07
5.00E-07
6.00E-07

Contour interval= 1.00E-07
Extrap. by averaging
Boundary plot

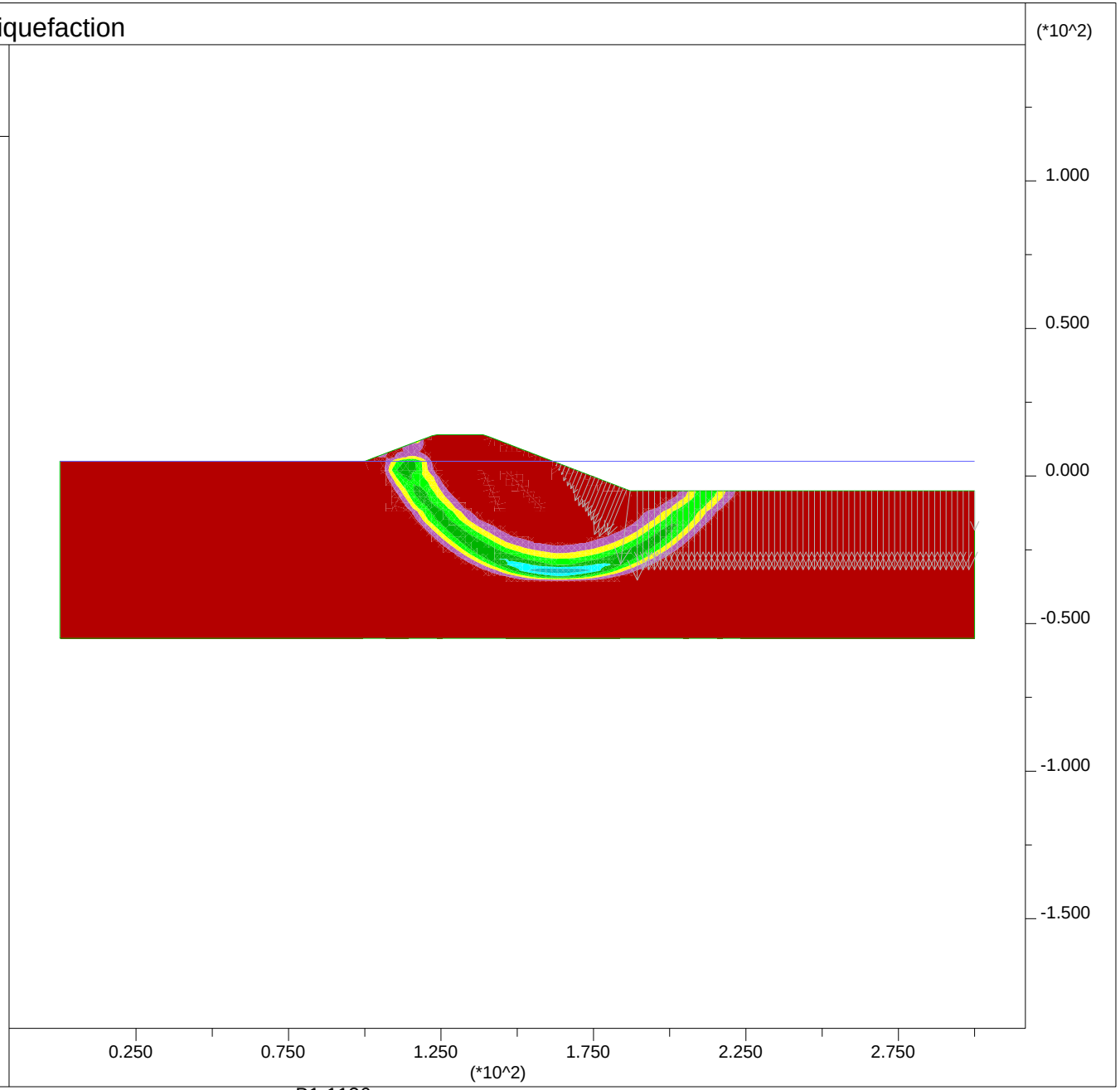
0 1E 2

Water Table

Net Applied Forces

max vector = 1.327E+03

Group Delta Consultants
Ballona Wetlands



B1-1136

PLATE G-127

JOB TITLE : Section K-K' - Post Liquefaction - Input

FLAC (Version 7.00)

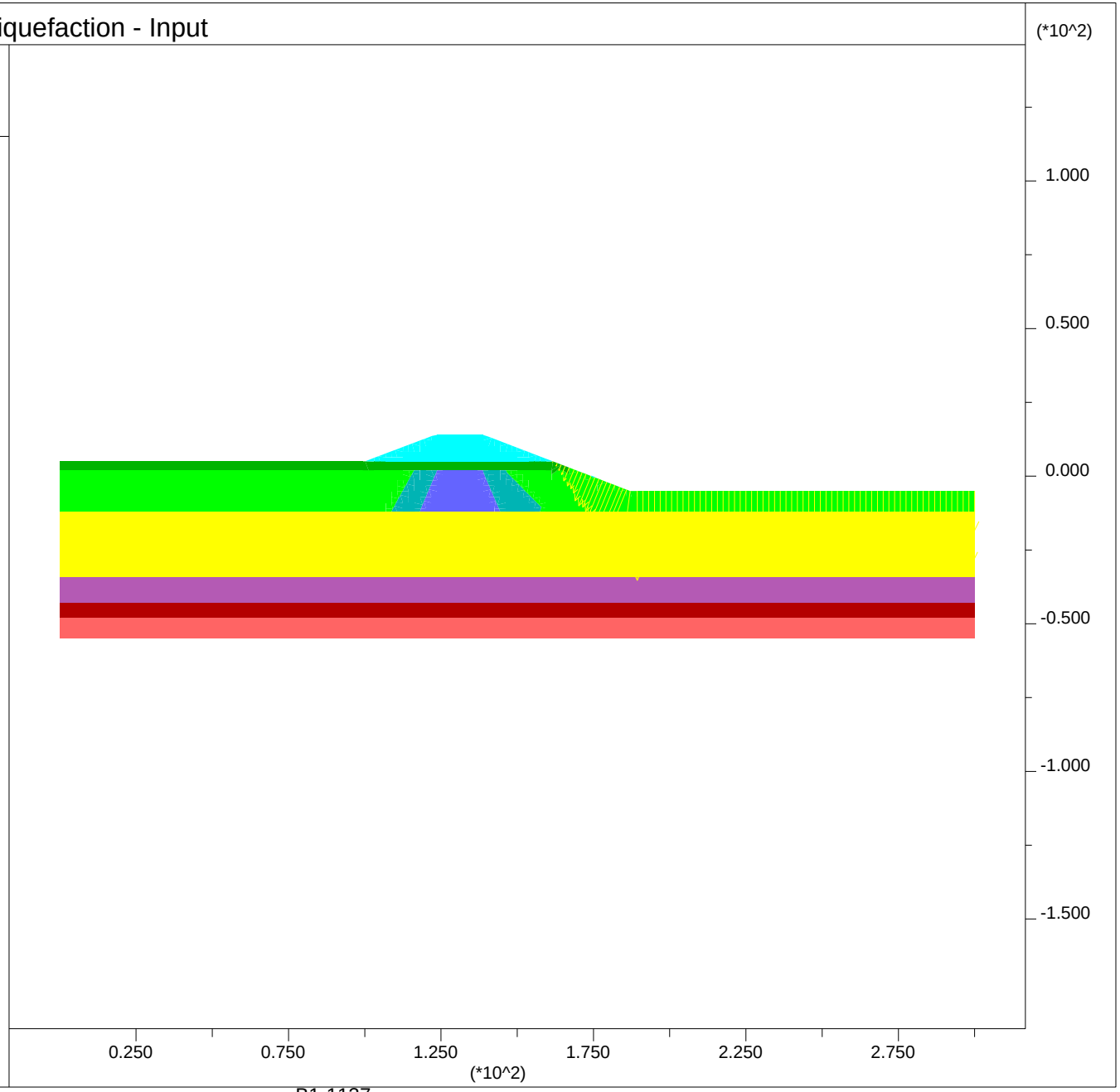
LEGEND

27-Feb-13 16:19
step 550
-1.667E+01 <x< 3.167E+02
-1.872E+02 <y< 1.462E+02

User-defined Groups
- User:Sand
- User:SandLiqDeep
- 'S:Stiff Clay'
- Fill:SandLiq
- 'User:V Soft Clay'
- Fill:FillLiq
- User:Embankment
- User:Clay400
- 'User:Soft Clay'

Net Applied Forces
max vector = 1.327E+03
0 2E 3

Group Delta Consultants
Ballona Wetlands



B1-1137

PLATE G-128

JOB TITLE : Section K-K' - Ky=0.04

FLAC (Version 7.00)

LEGEND

27-Feb-13 16:21
step 34246
-1.667E+01 <x< 3.167E+02
-1.872E+02 <y< 1.462E+02

Factor of Safety 1.01

Max. shear strain-rate
0.00E+00
5.00E-07
1.00E-06
1.50E-06
2.00E-06
2.50E-06

Contour interval= 5.00E-07
Extrap. by averaging
Boundary plot

0 1E 2

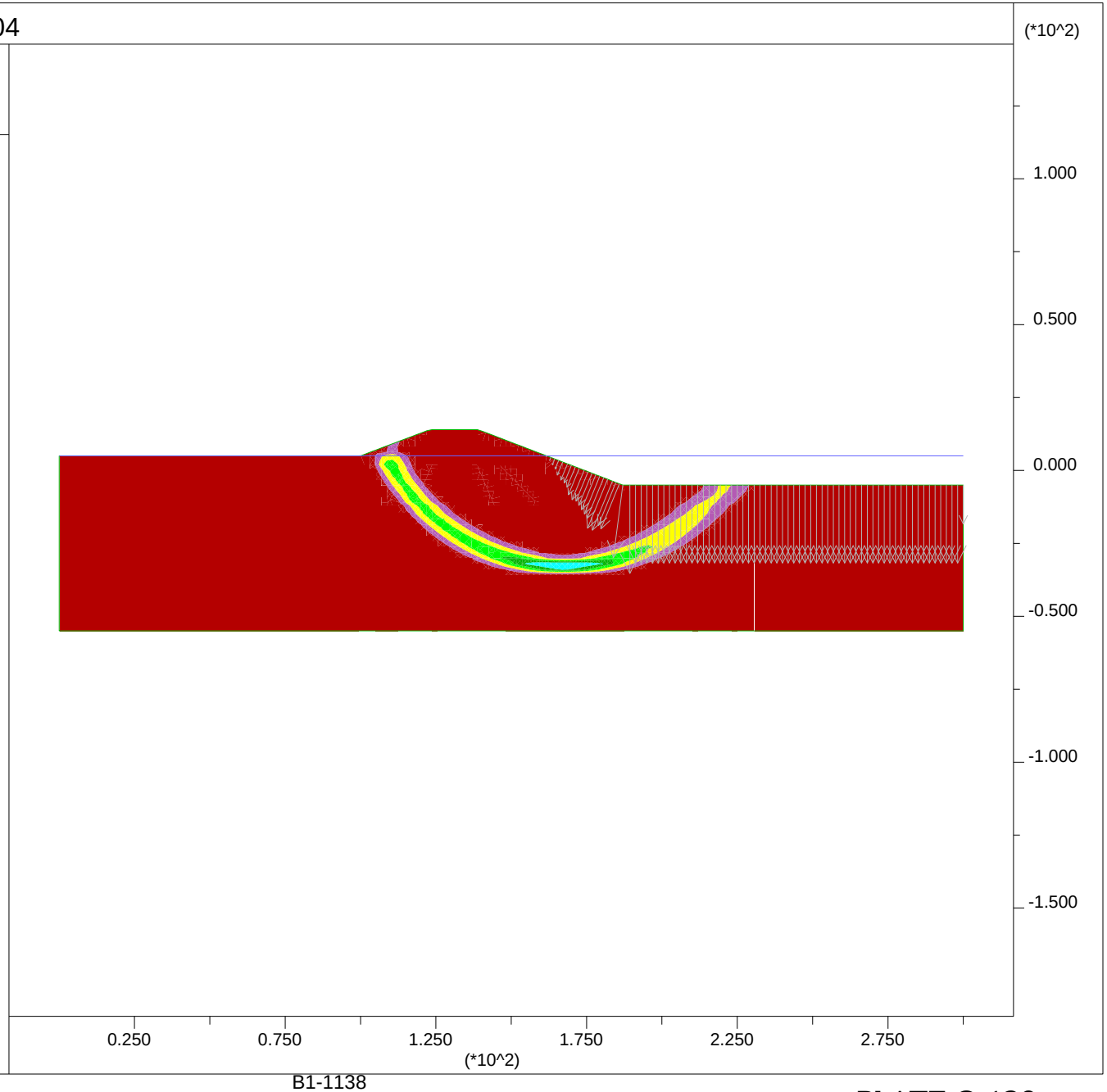
Water Table

Net Applied Forces

max vector = 1.327E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands



B1-1138

PLATE G-129

JOB TITLE : Section K-K' - Ky=0.04 - Input

FLAC (Version 7.00)

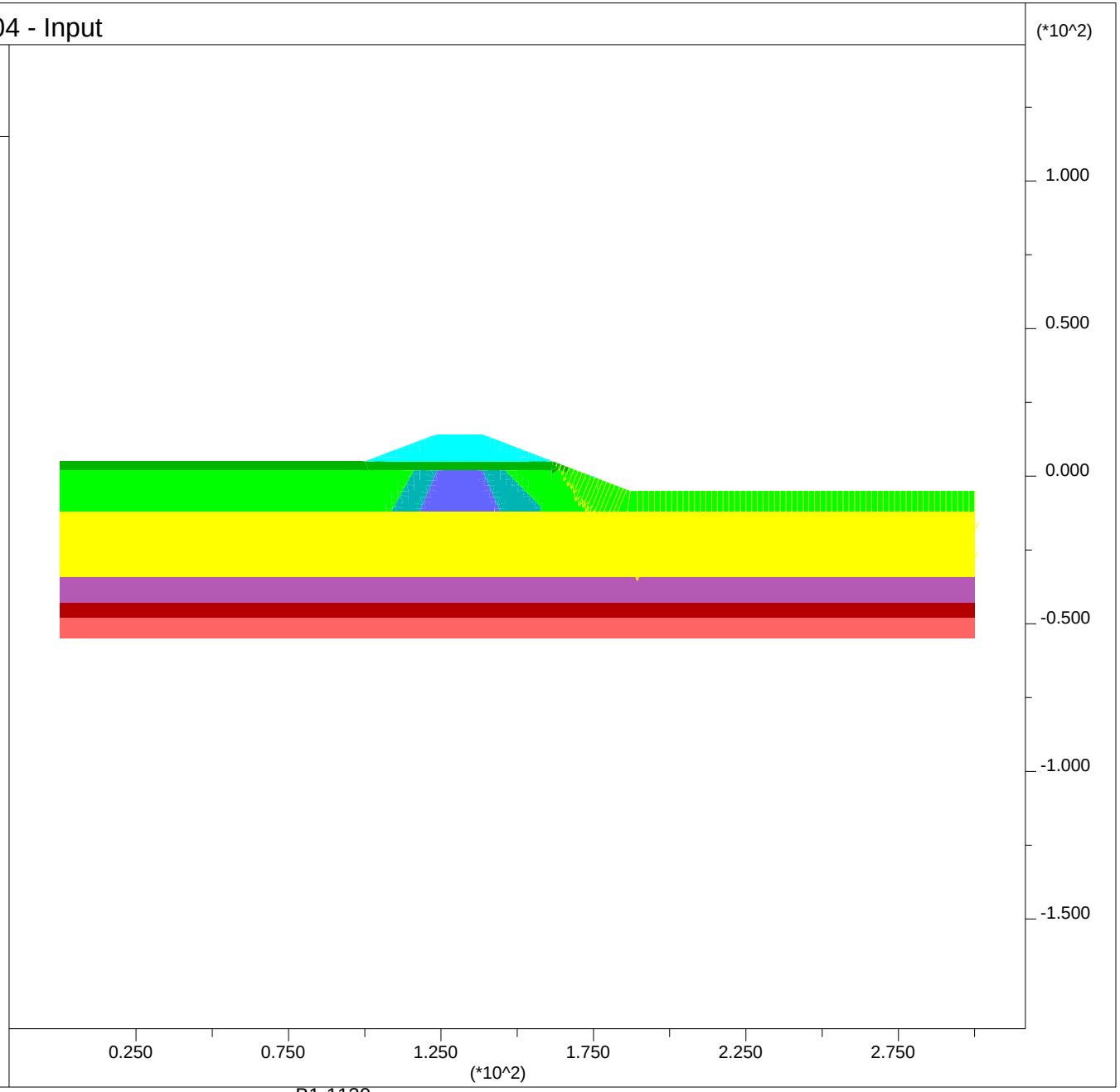
LEGEND

27-Feb-13 16:20
step 550
-1.667E+01 <x< 3.167E+02
-1.872E+02 <y< 1.462E+02

User-defined Groups
- User:Sand
- User:SandLiqDeep
- 'S:Stiff Clay'
- Fill:SandLiq
- 'User:V Soft Clay'
- Fill:FillLiq
- User:Embankment
- User:Clay400
- 'User:Soft Clay'

Net Applied Forces
max vector = 1.327E+03
0 2E 3

Group Delta Consultants
Ballona Wetlands



B1-1139

PLATE G-130

Newmark Displacements using Bray and Rathje (1998):

Section K-K'

Site Input

PGA,rock =	0.25	g		
M =	6.6			
r =	13	km		
ky =	0.04		32.185	1.2874

Sliding Mass Input

Vs =	100	m/s	assumed
Thickness, H =	12.2	m	
	40	ft	

Output

Tm =	0.49	sec				
D5-95 =	10.5	sec				
Ts =	0.49	sec				
NRF =	1.15					
Ts/Tm =	1.00					
kmax/(PGA,rock*NRF)	0.54					
kmax =	0.15					
ky / kmax =	0.26					
Displacement, u =	15	cm	0.5	feet	5.9	inches

JOB TITLE : Section L-L' - End of Construction

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 14:43

Factor of Safety 1.60

Shear Strain Rate Contours

- 5.00E-07
- 1.00E-06
- 1.50E-06
- 2.00E-06
- 2.50E-06

Contour interval= 5.00E-07
(zero contour omitted)
Boundary plot

0 1E 2

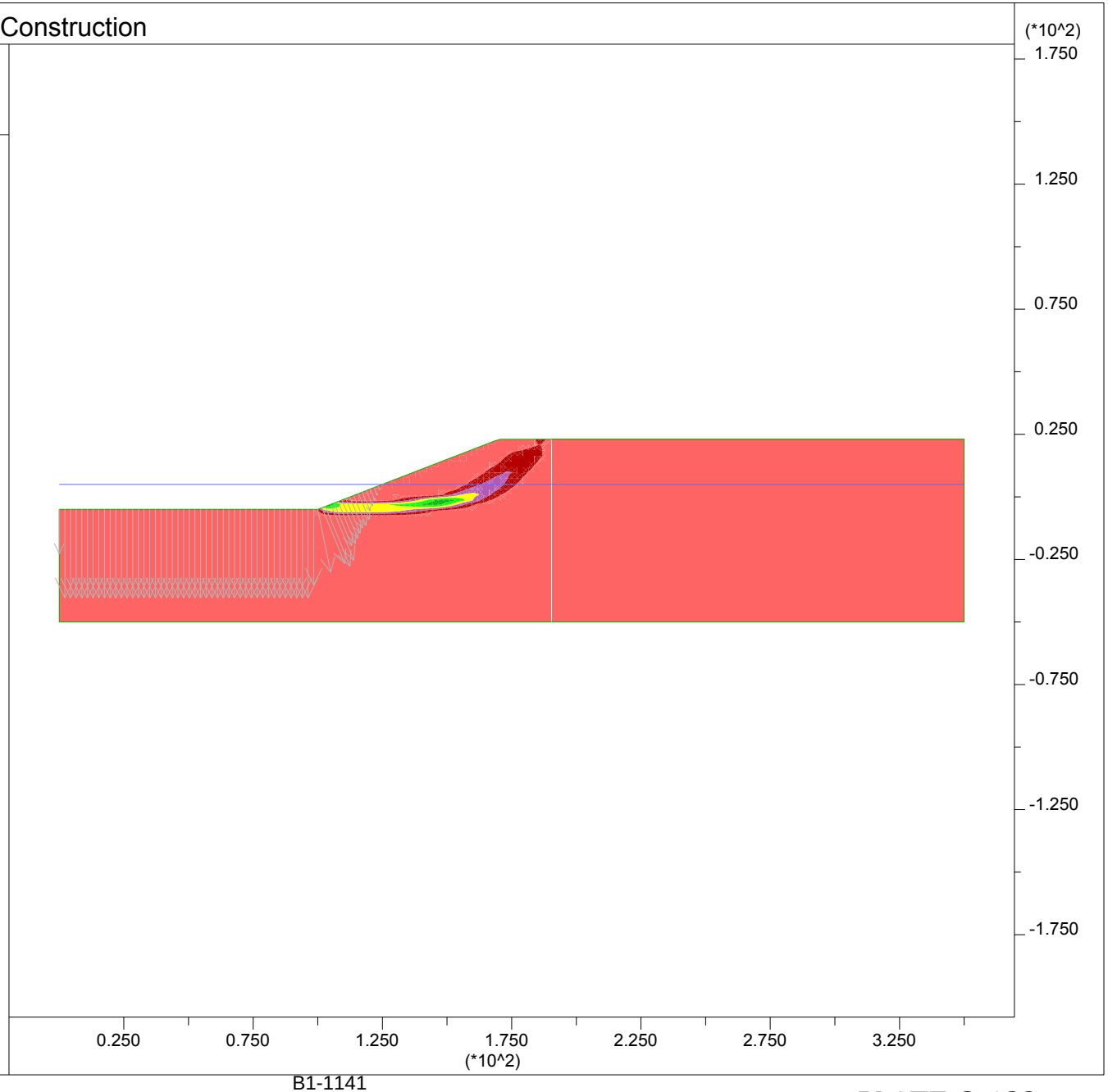
Water Table

Net Applied Forces

max vector = 1.366E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands



B1-1141

PLATE G-132

JOB TITLE : Section L-L' - End of Construction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 14:46

Factor of Safety 1.60

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Med Sand'
- 'User:Soft Clay'
- User:Fill

Boundary plot

0 1E 2

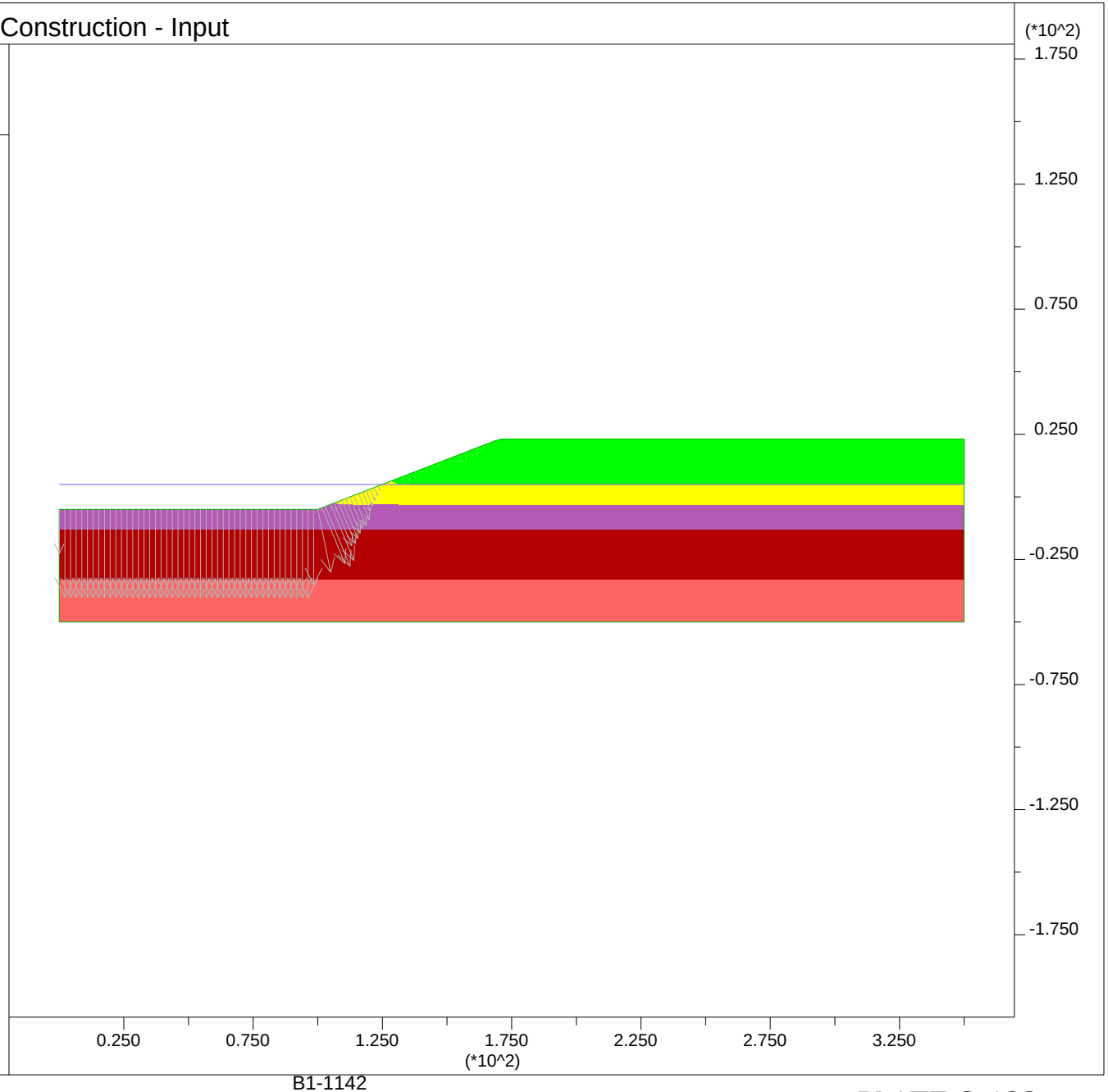
Water Table

Net Applied Forces

max vector = 1.366E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands



B1-1142

PLATE G-133

JOB TITLE : Section L-L' - High Water Short Term

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 14:49

Factor of Safety 2.26

Shear Strain Rate Contours

- 5.00E-07
- 1.00E-06
- 1.50E-06
- 2.00E-06
- 2.50E-06
- 3.00E-06
- 3.50E-06

Contour interval= 5.00E-07
(zero contour omitted)
Boundary plot

0 1E 2

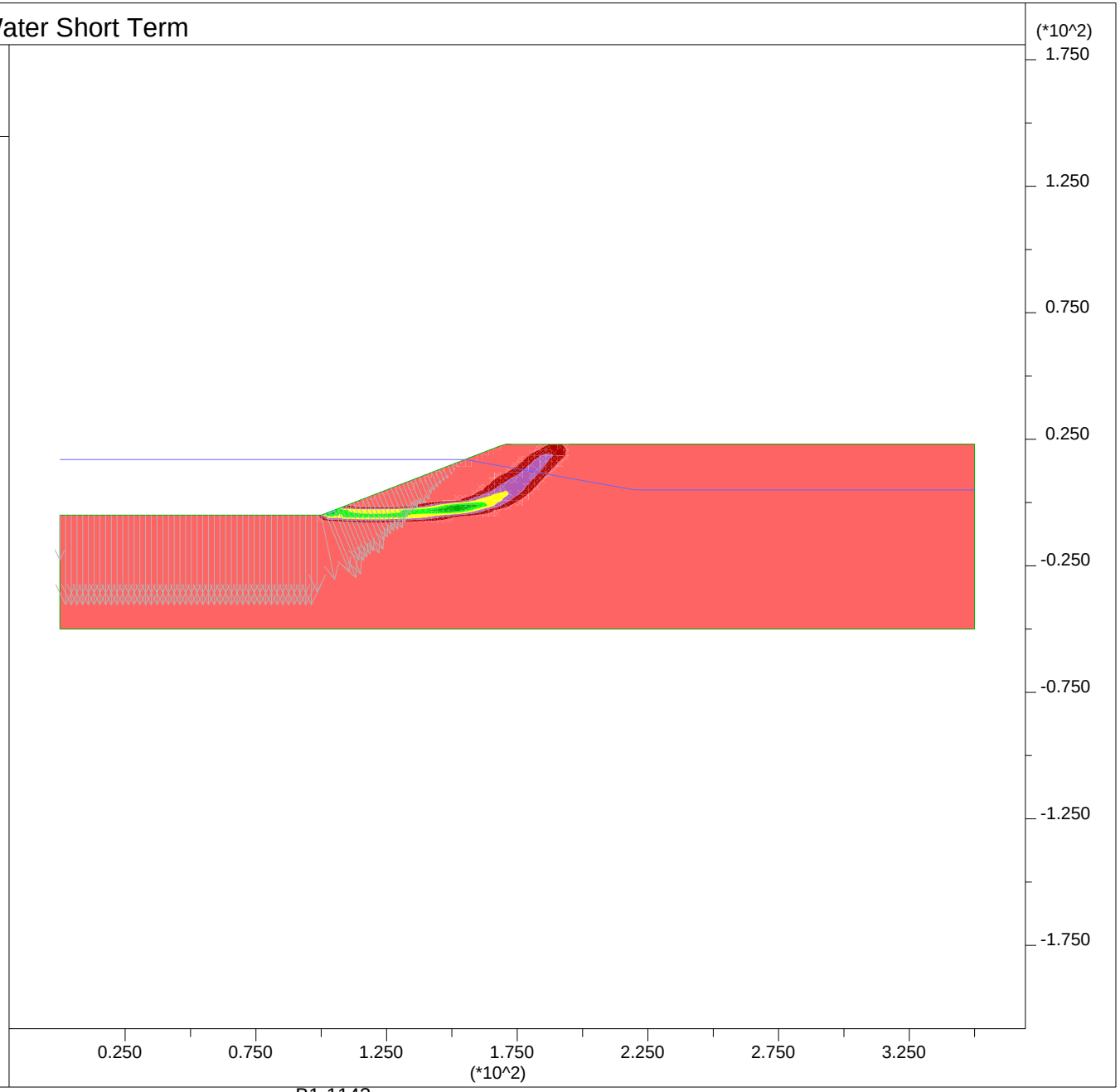
Water Table

Net Applied Forces

max vector = 3.006E+03

0 1E 4

Group Delta Consultants
Ballona Wetlands



B1-1143

PLATE G-134

JOB TITLE : Section L-L' - High Water Short Term - Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 14:48

Factor of Safety 2.26

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Med Sand'
- 'User:Soft Clay'
- User:Fill

Boundary plot

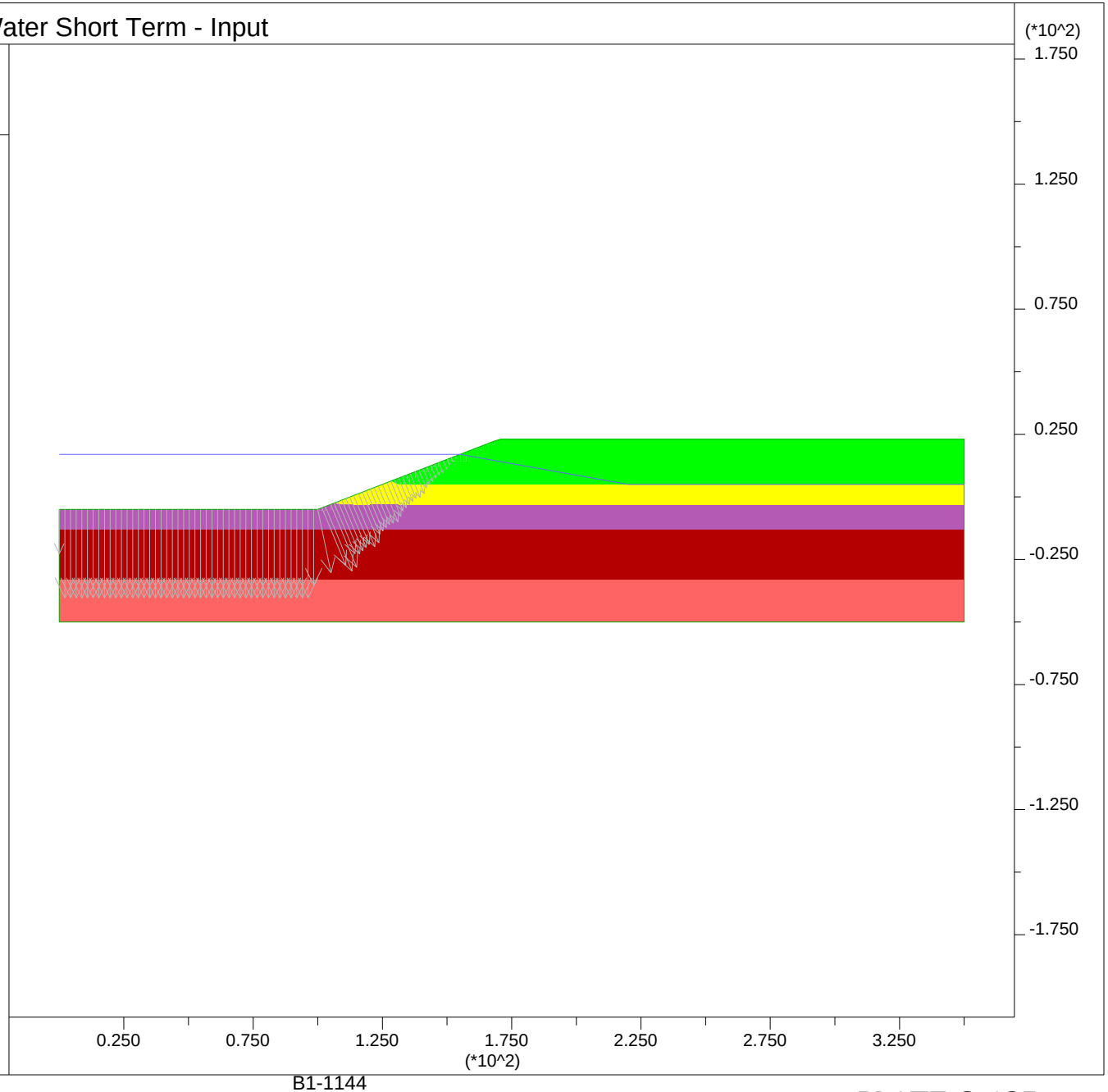
0 1E 2

Water Table

Net Applied Forces

max vector = 3.006E+03

0 1E 4



Group Delta Consultants
Ballona Wetlands

B1-1144

PLATE G-135

JOB TITLE : Section L-L' - Post Liquefaction

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 15:01

Factor of Safety 1.40

Shear Strain Rate Contours

- 5.00E-07
- 1.00E-06
- 1.50E-06
- 2.00E-06
- 2.50E-06
- 3.00E-06
- 3.50E-06

Contour interval= 5.00E-07
(zero contour omitted)
Boundary plot

0 1E 2

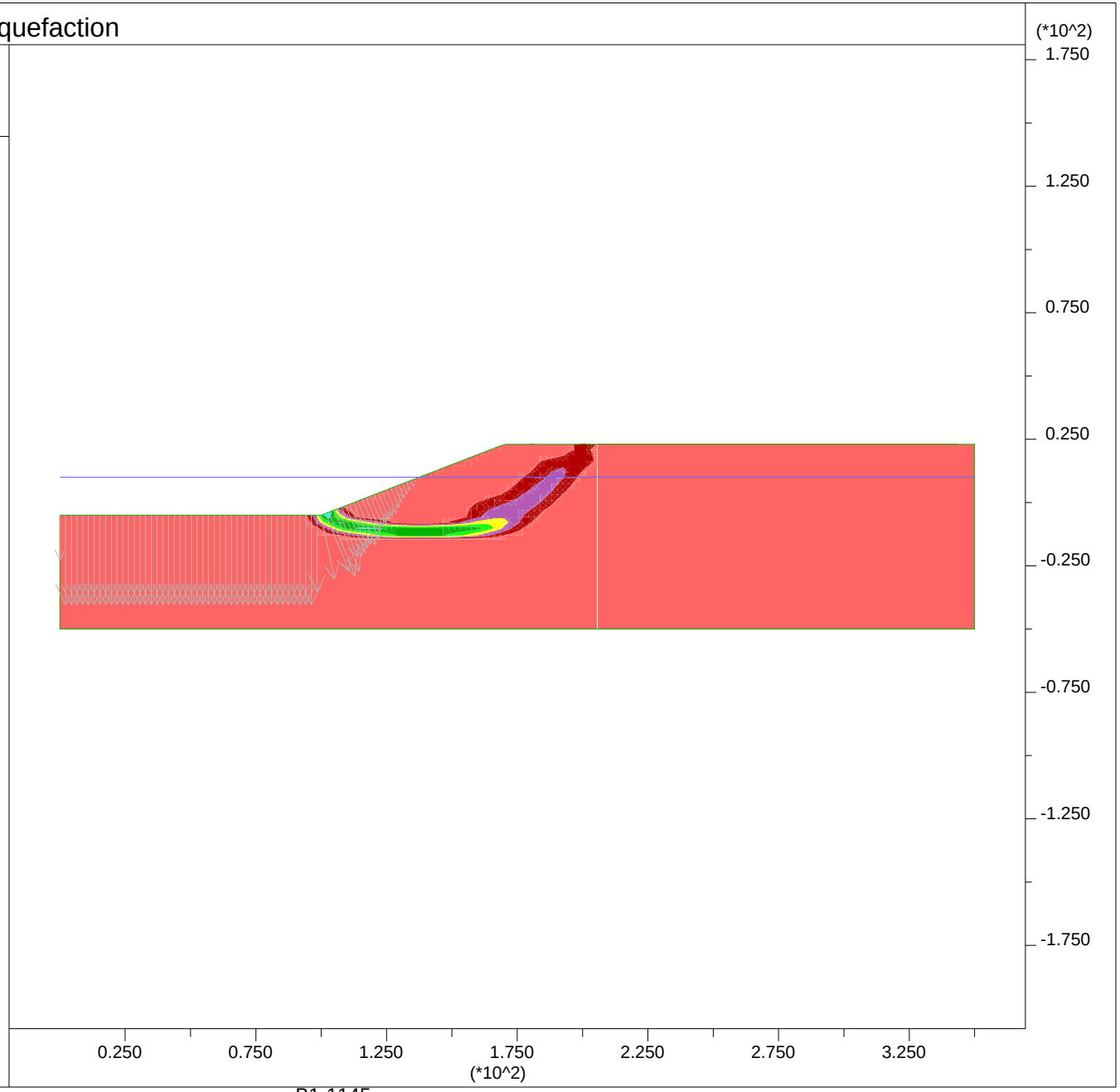
Water Table

Net Applied Forces

max vector = 2.050E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1145

PLATE G-136

JOB TITLE : Section L-L' - Post Liquefaction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 15:03

Factor of Safety 1.40

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Liq Sand 2'
- 'User:Liq Sand'
- 'User:Med Sand'
- 'User:Soft Clay'
- User:Fill

Boundary plot

0 1E 2

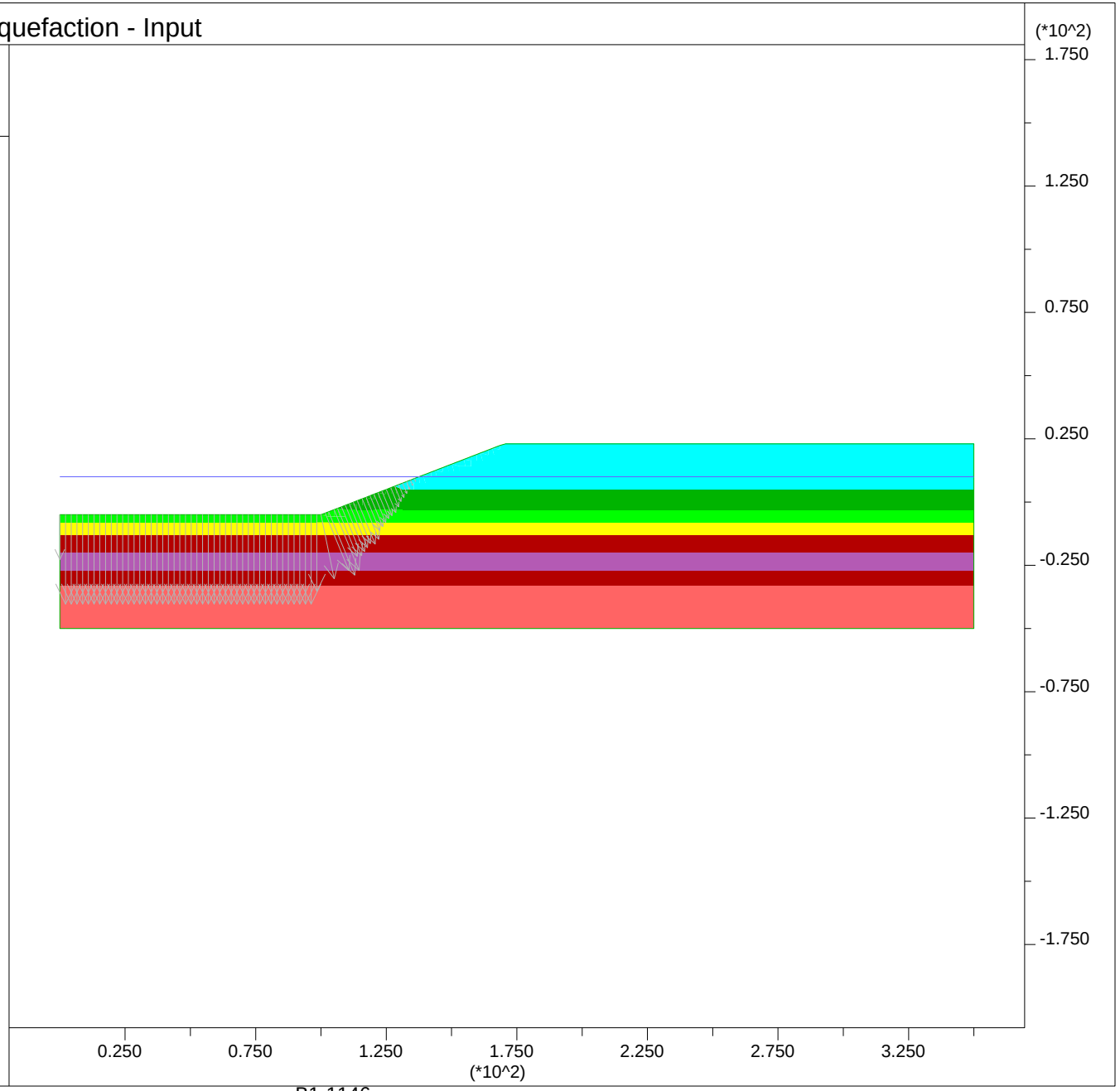
Water Table

Net Applied Forces

max vector = 2.050E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1146

PLATE G-137

JOB TITLE : Section L-L' - Ky=0.08

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 14:53

Factor of Safety 0.99

Shear Strain Rate Contours

- 1.00E-07
- 2.00E-07
- 3.00E-07
- 4.00E-07
- 5.00E-07
- 6.00E-07
- 7.00E-07

Contour interval= 1.00E-07
(zero contour omitted)
Boundary plot

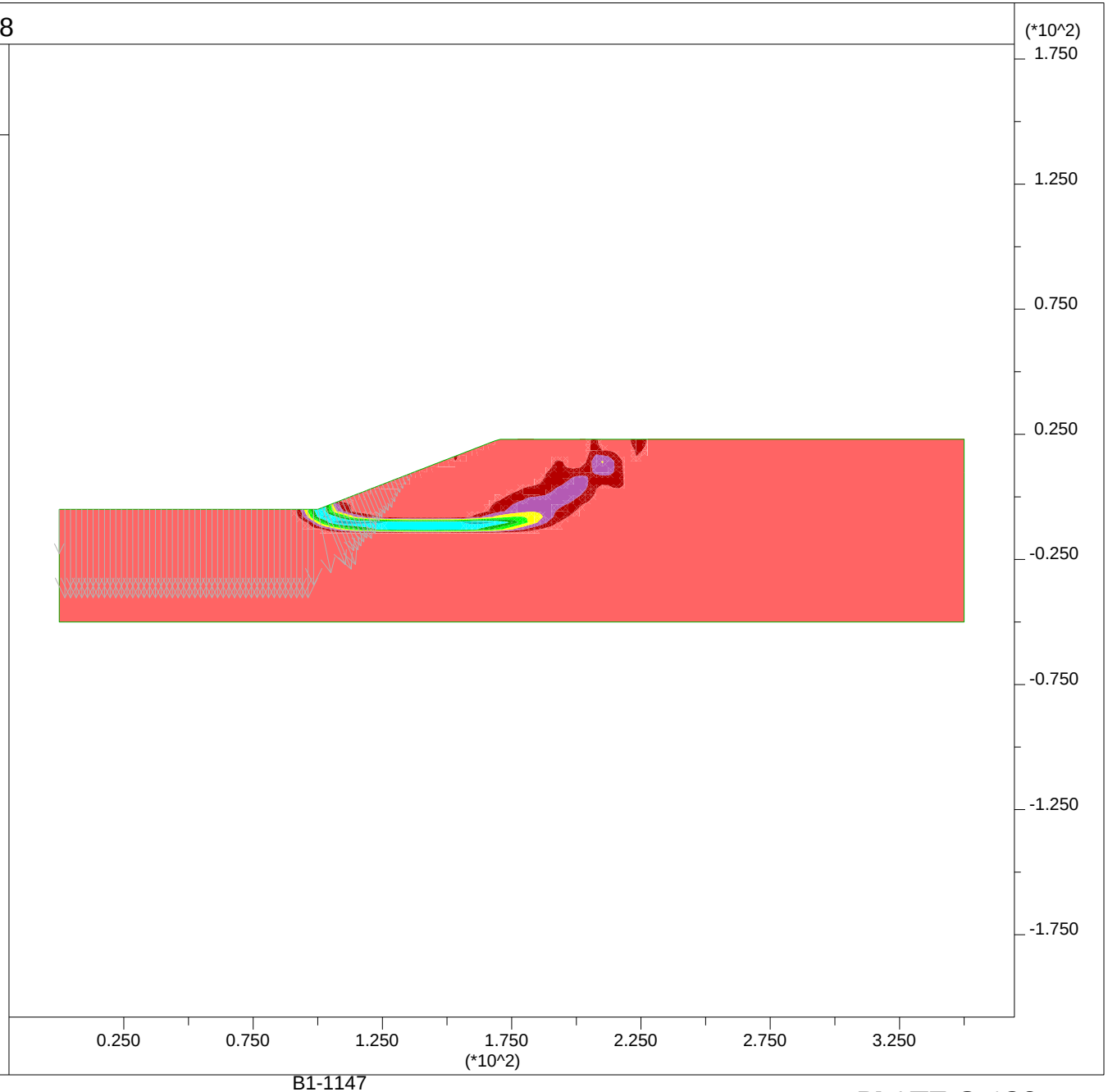
0 1E 2

Net Applied Forces

max vector = 2.056E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1147

PLATE G-138

JOB TITLE : Section L-L' - Ky=0.08 - Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 15:05

Factor of Safety 0.99

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Liq Sand 2'
- 'User:Liq Sand'
- 'User:Med Sand'
- 'User:Soft Clay'
- User:Fill

Boundary plot

0 1E 2

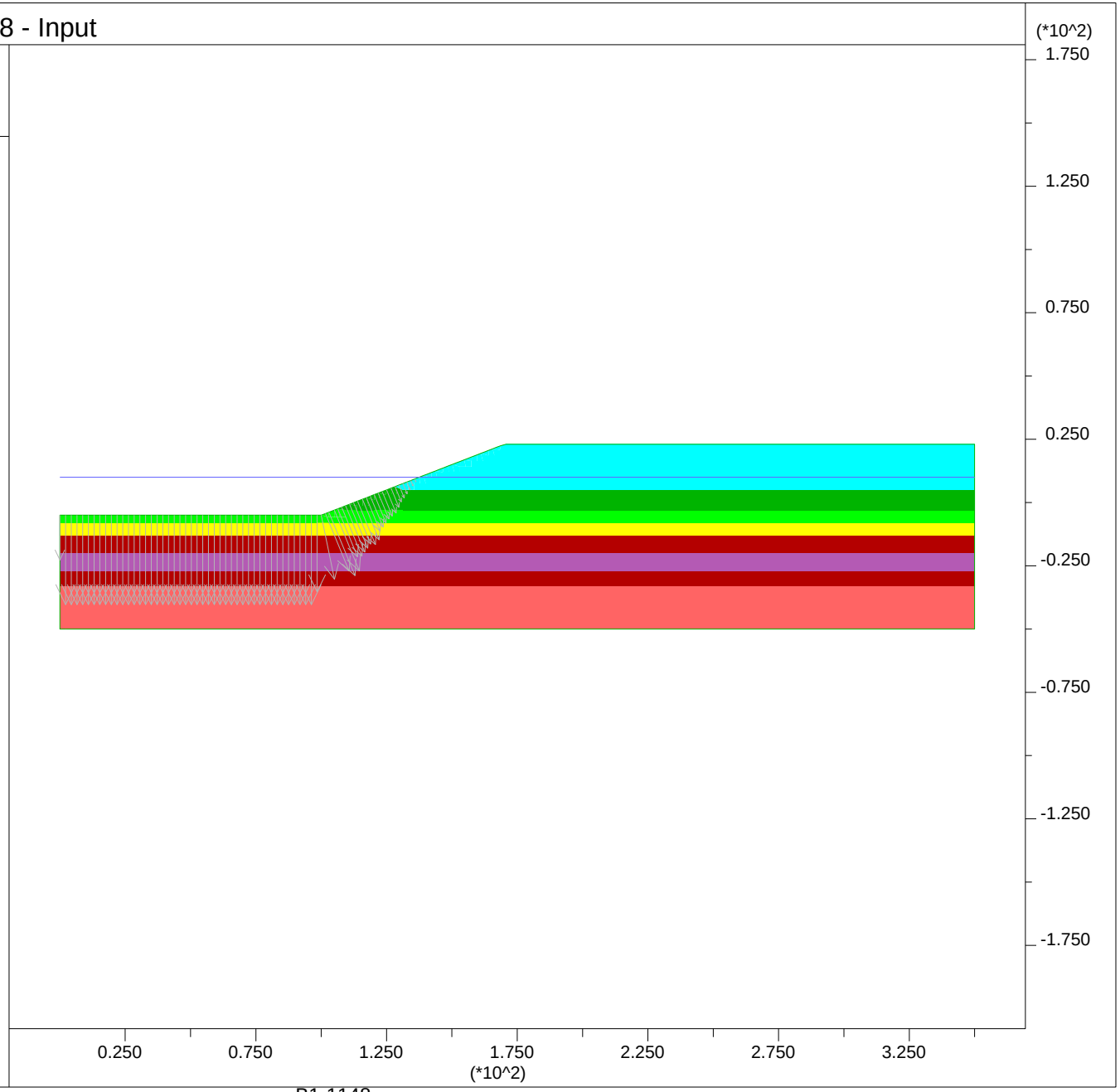
Water Table

Net Applied Forces

max vector = 2.056E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1148

PLATE G-139

Newmark Displacements using Bray and Rathje (1998):

Section L-L'

Site Input

PGA,rock =	0.25	g	
M =	6.6		
r =	13	km	
ky =	0.08		

Sliding Mass Input

Vs =	200	m/s	assumed
Thickness, H =	10.1	m	
	33	ft	

Output

Tm =	0.49	sec				
D5-95 =	10.5	sec				
Ts =	0.20	sec				
NRF =	1.15					
Ts/Tm =	0.41					
kmax/(PGA,rock*NRF)	1.07					
kmax =	0.31					
ky / kmax =	0.26					
Displacement, u =	30	cm	1.0	feet	11.7	inches

JOB TITLE : Existing North Levee during Meander Channel Excavation - 60 foot berm

FLAC/SLOPE (Version 7.00)

LEGEND

5-Mar-13 14:09

Factor of Safety 1.46

Shear Strain Rate Contours

- 2.50E-07
- 5.00E-07
- 7.50E-07
- 1.00E-06
- 1.25E-06
- 1.50E-06
- 1.75E-06
- 2.00E-06

Contour interval= 2.50E-07
(zero contour omitted)
Boundary plot

0 1E 2

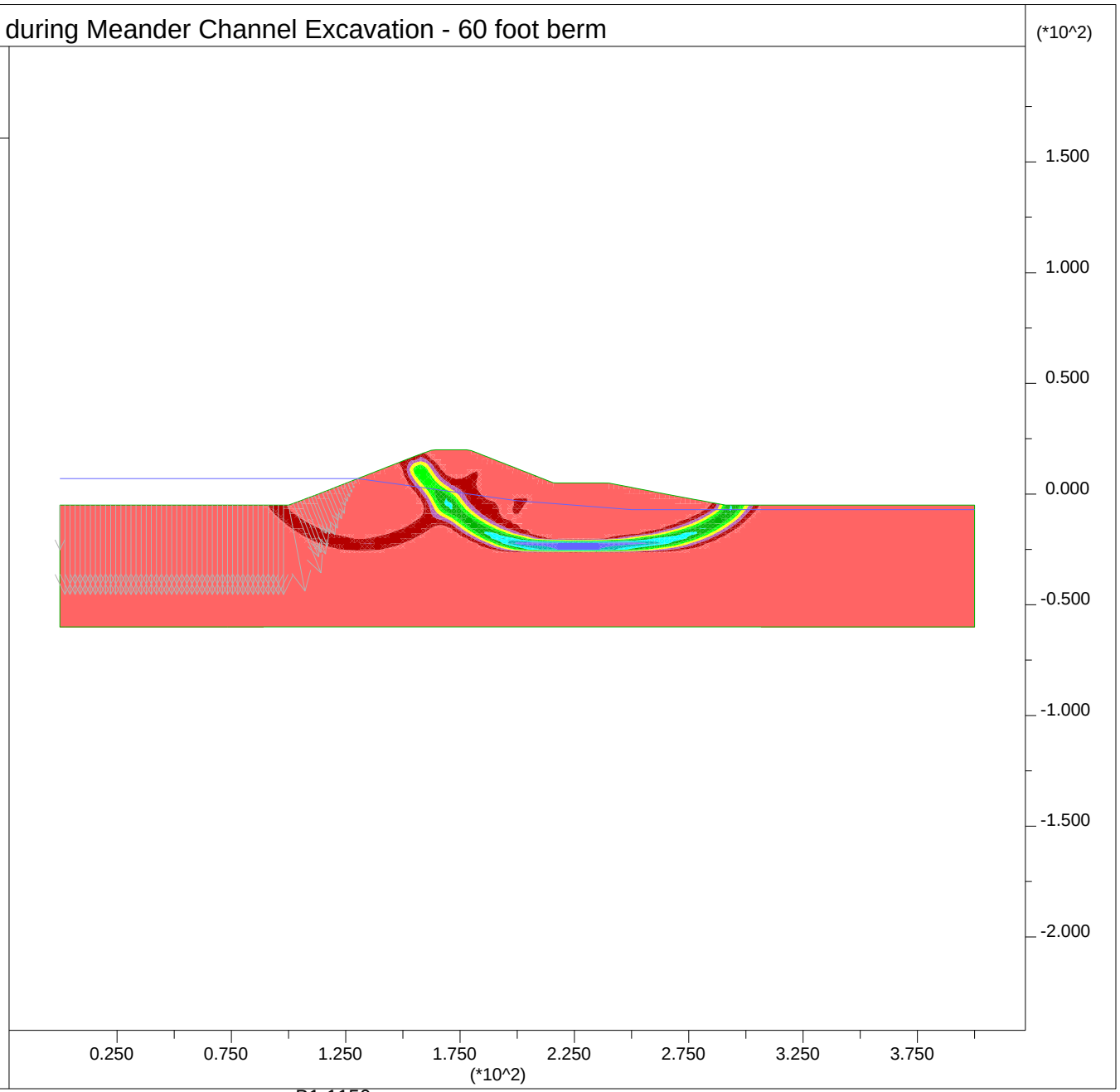
Water Table

Net Applied Forces

max vector = 1.666E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1150

PLATE G-141

JOB TITLE : Existing North Levee during Meander Channel Excavation - 60 foot berm - Inp

FLAC/SLOPE (Version 7.00)

LEGEND

5-Mar-13 14:10

Factor of Safety 1.46

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Soft Clay'
- Fill:Fill

Boundary plot

0 1E 2

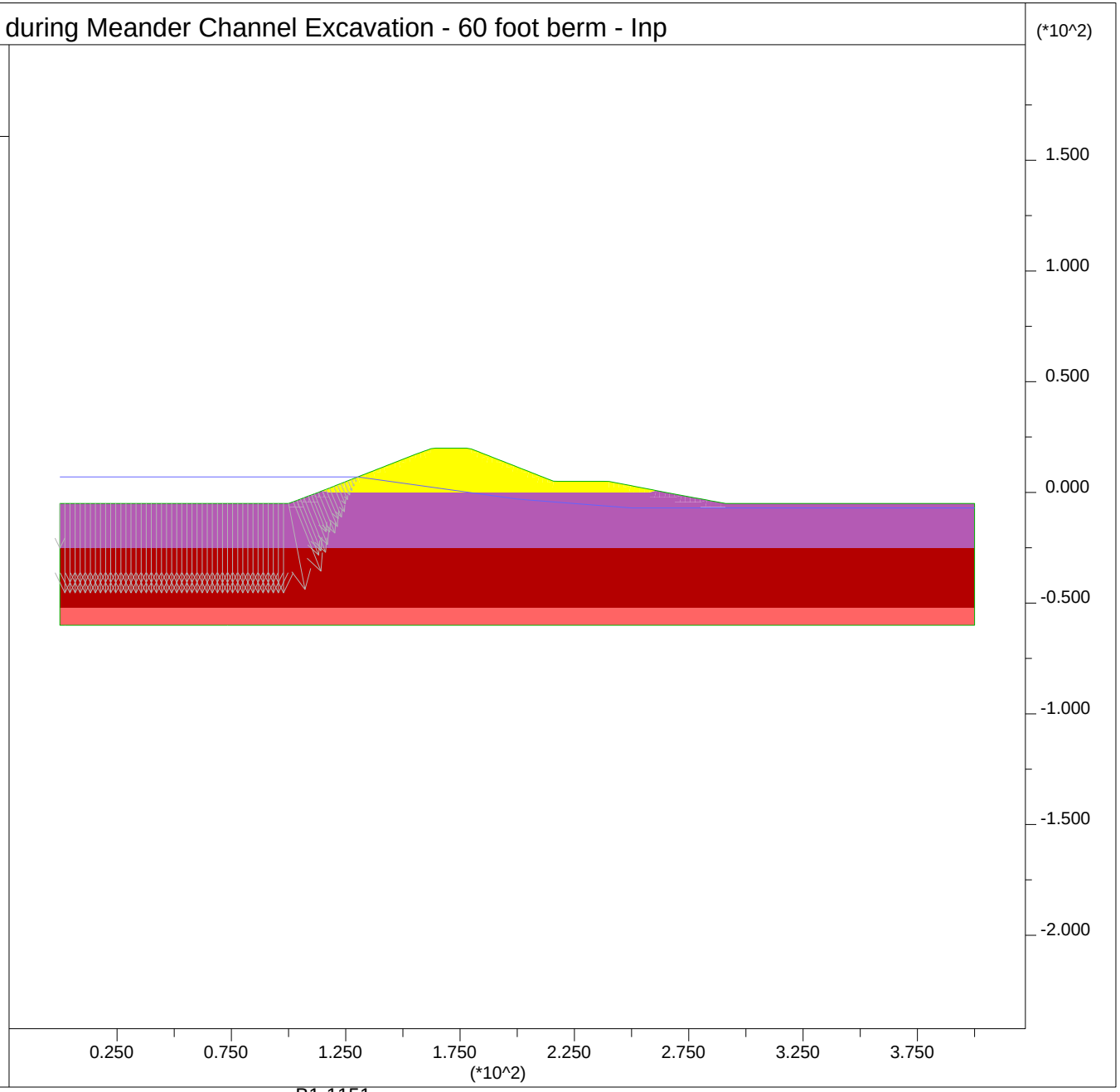
Water Table

Net Applied Forces

max vector = 1.666E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1151

PLATE G-142

JOB TITLE : Existing North Levee during Meander Channel Excavation - 70 foot berm

FLAC/SLOPE (Version 7.00)

LEGEND

5-Mar-13 14:09

Factor of Safety 1.51

Shear Strain Rate Contours

- 5.00E-07
- 1.00E-06
- 1.50E-06
- 2.00E-06
- 2.50E-06

Contour interval= 5.00E-07
(zero contour omitted)
Boundary plot

0 1E 2

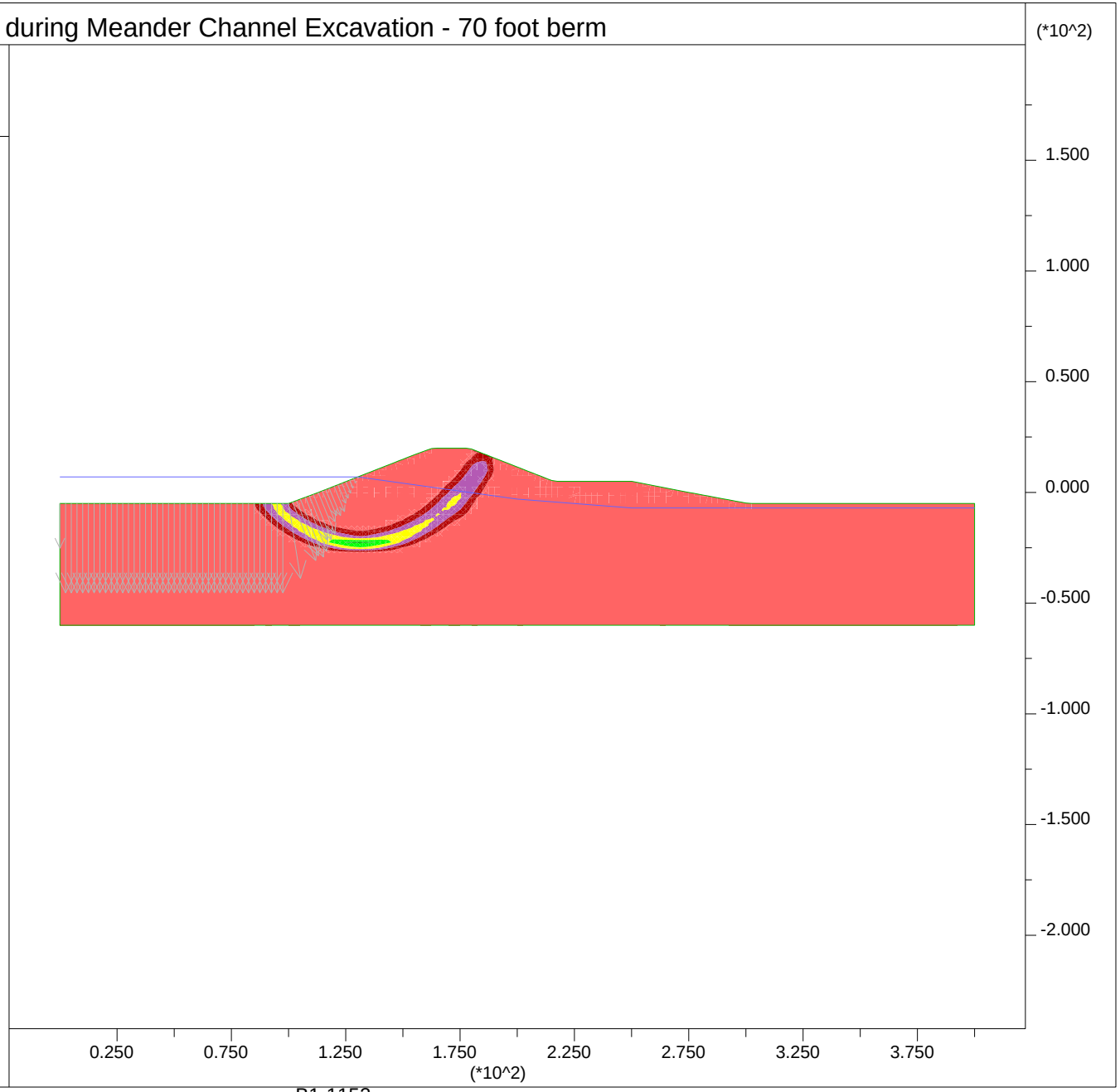
Water Table

Net Applied Forces

max vector = 1.874E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1152

PLATE G-143

JOB TITLE : Existing North Levee during Meander Channel Excavation - 70 foot berm - Inp

FLAC/SLOPE (Version 7.00)

LEGEND

5-Mar-13 14:08

Factor of Safety 1.51

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Soft Clay'
- Fill:Fill

Boundary plot

0 1E 2

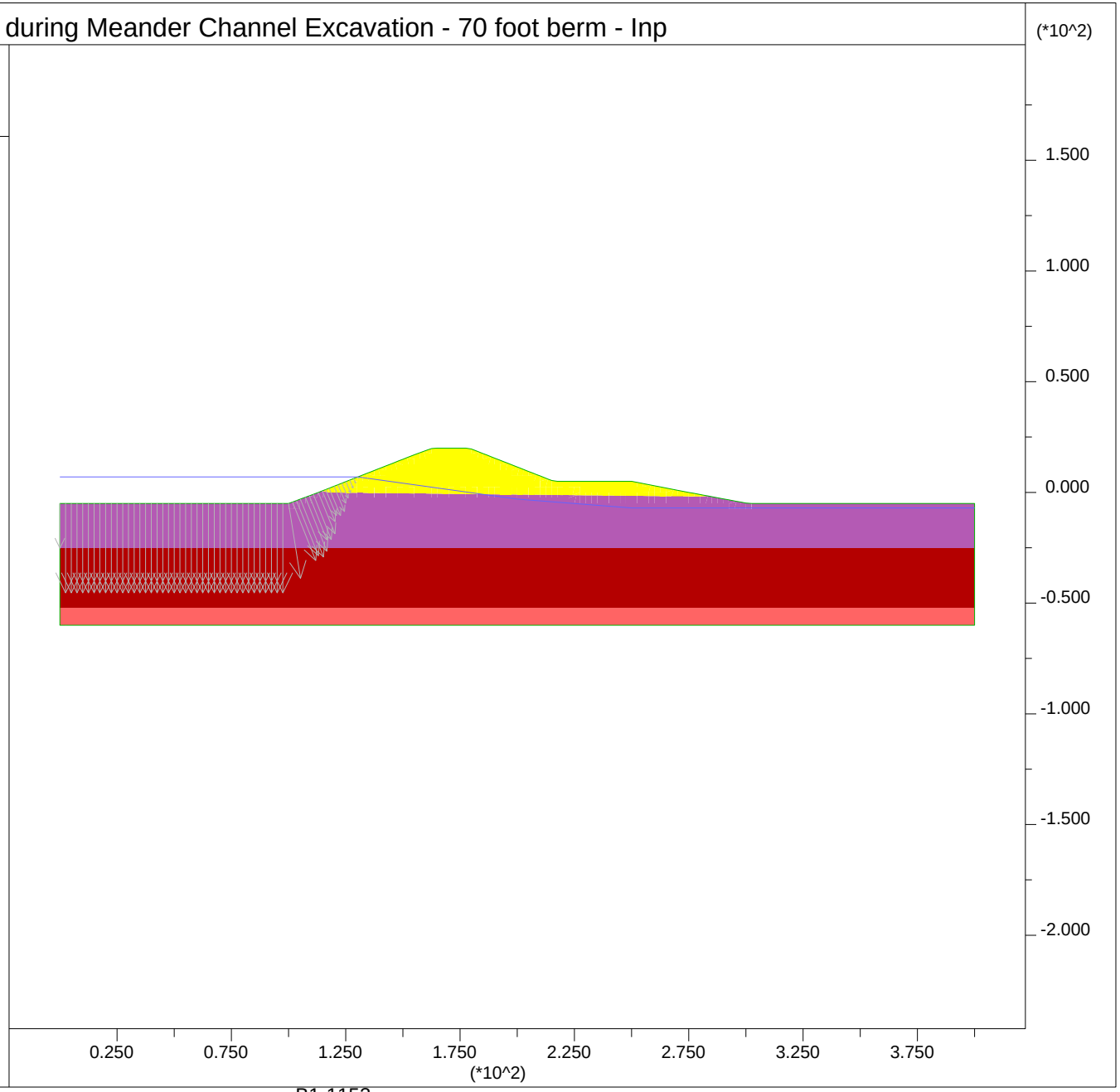
Water Table

Net Applied Forces

max vector = 1.874E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands



B1-1153

PLATE G-144

Section A-A’ – End of Construction

JOB TITLE : Section A-A' - End of Construction

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 11:07

Factor of Safety 3.39

Shear Strain Rate Contours

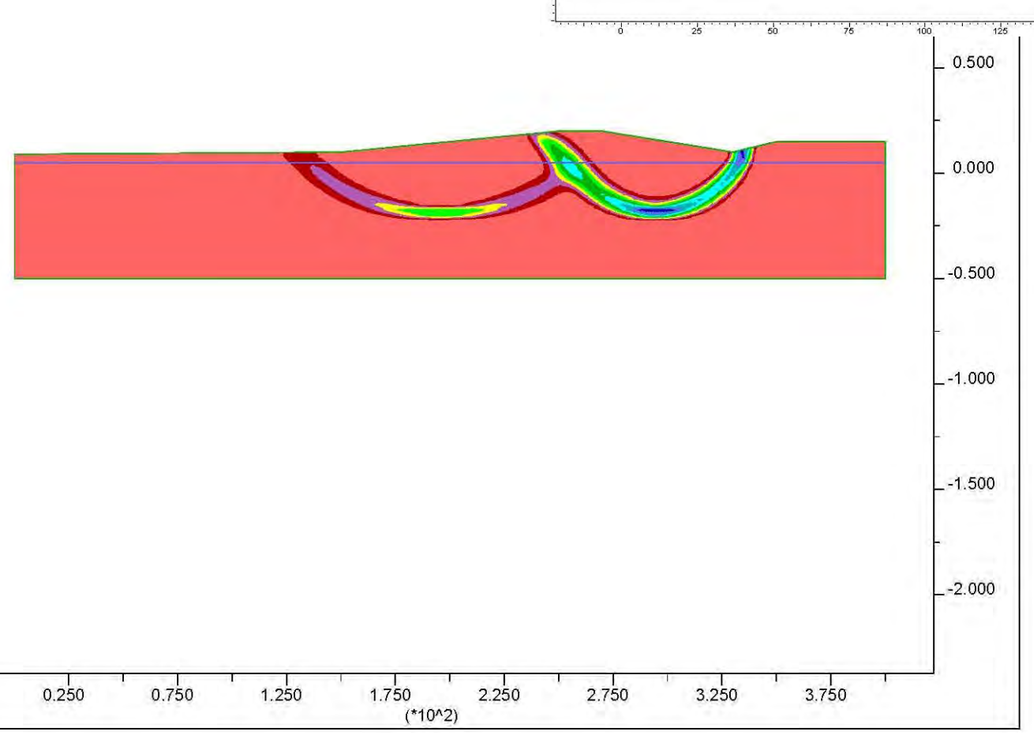
- 5.00E-08
- 1.00E-07
- 1.50E-07
- 2.00E-07
- 2.50E-07
- 3.00E-07
- 3.50E-07
- 4.00E-07
- 4.50E-07

Contour interval= 5.00E-08
(zero contour omitted)
Boundary plot

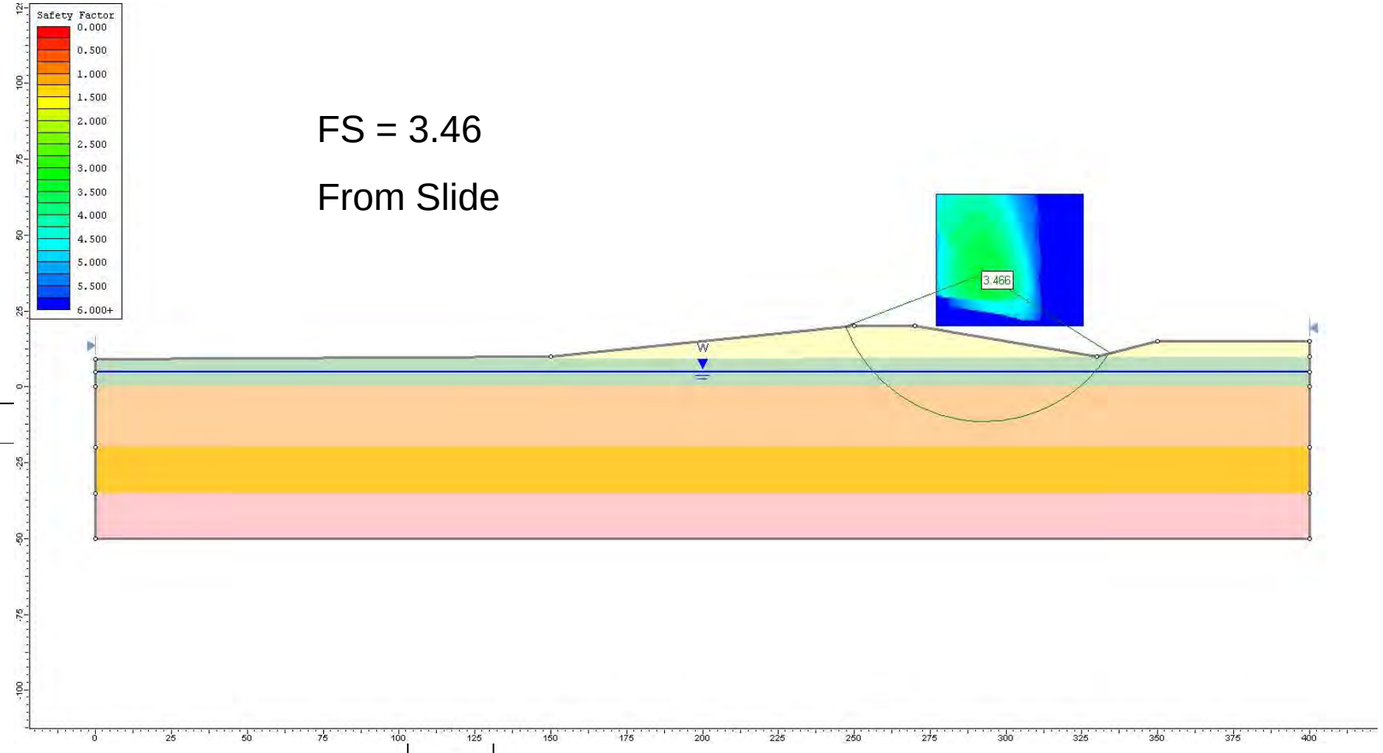
0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands



FS = 3.39
From FLAC SLOPE



FS = 3.46

From Slide

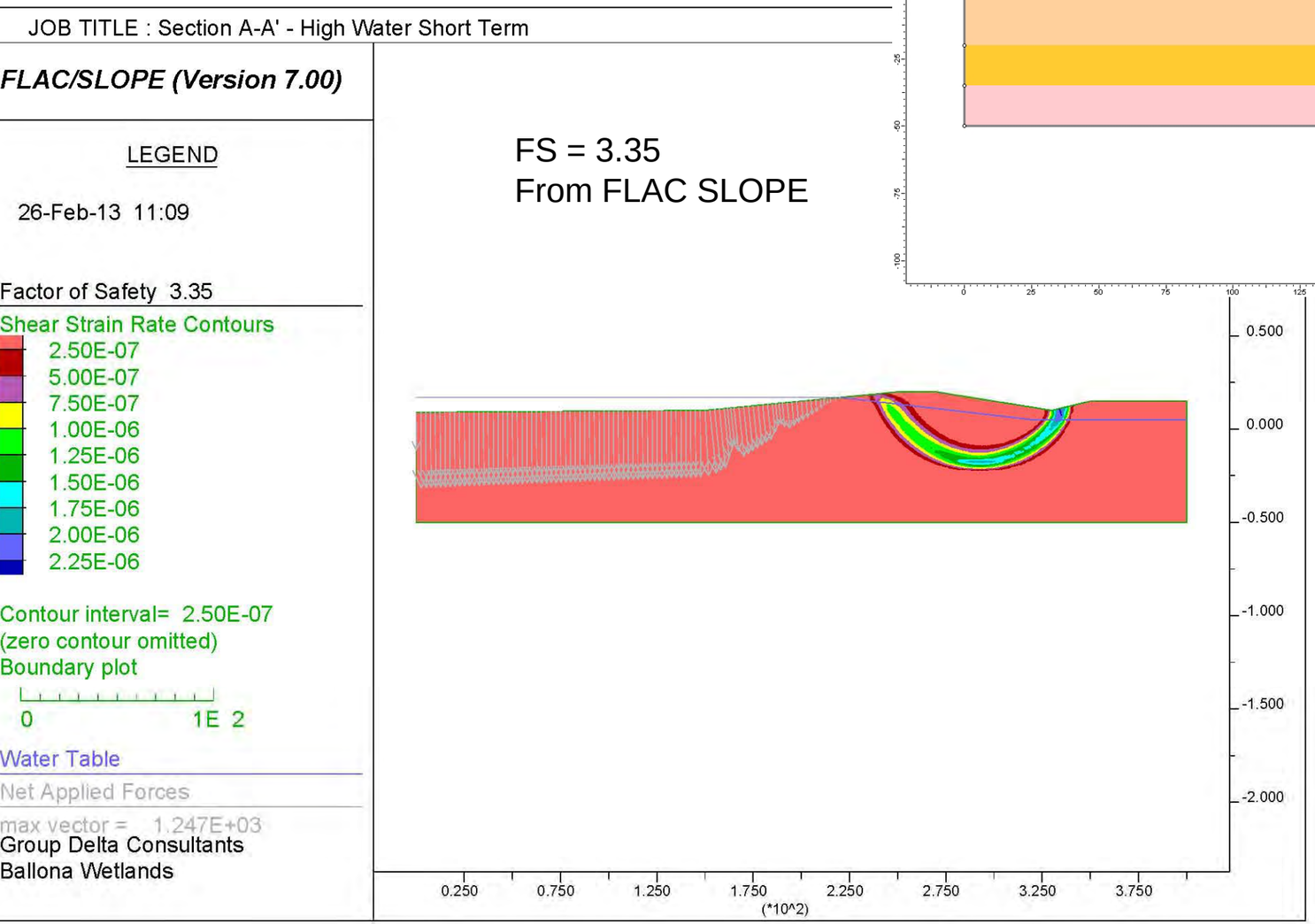
Percent Difference = 2.2%

Comparison of FLAC SLOPE and RocScience Slide Results

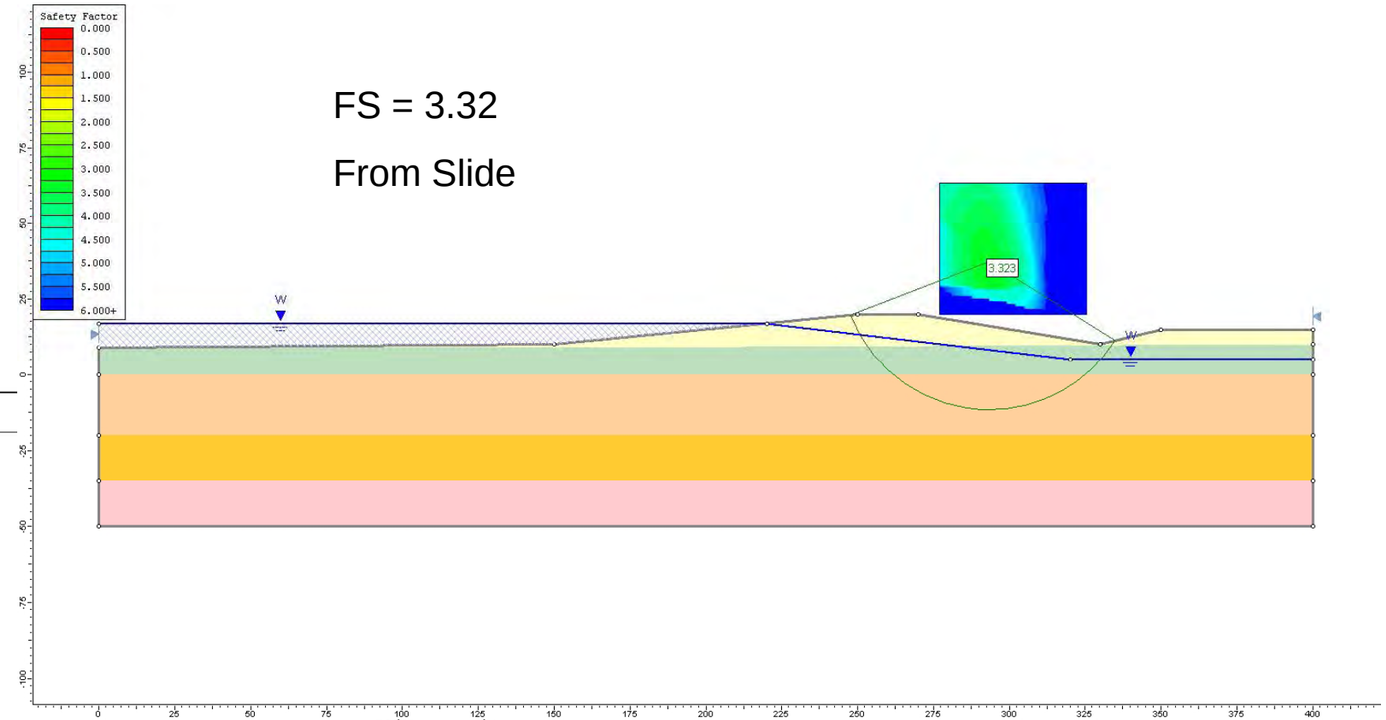
B1-1154

PLATE G-145

Section A-A’ – High Water Short Term



FS = 3.35
From FLAC SLOPE



FS = 3.32

From Slide

Percent Difference = 0.9%

Comparison of FLAC SLOPE and RocScience Slide Results

B1-1155

PLATE G-146

Section G-G’ – Post Liquefaction

JOB TITLE : Section G-G' - Post Liquefaction

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 19:01

Factor of Safety 1.79

Shear Strain Rate Contours
- 5.00E-08
- 1.00E-07
- 1.50E-07
- 2.00E-07
- 2.50E-07
- 3.00E-07

Contour interval= 5.00E-08
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

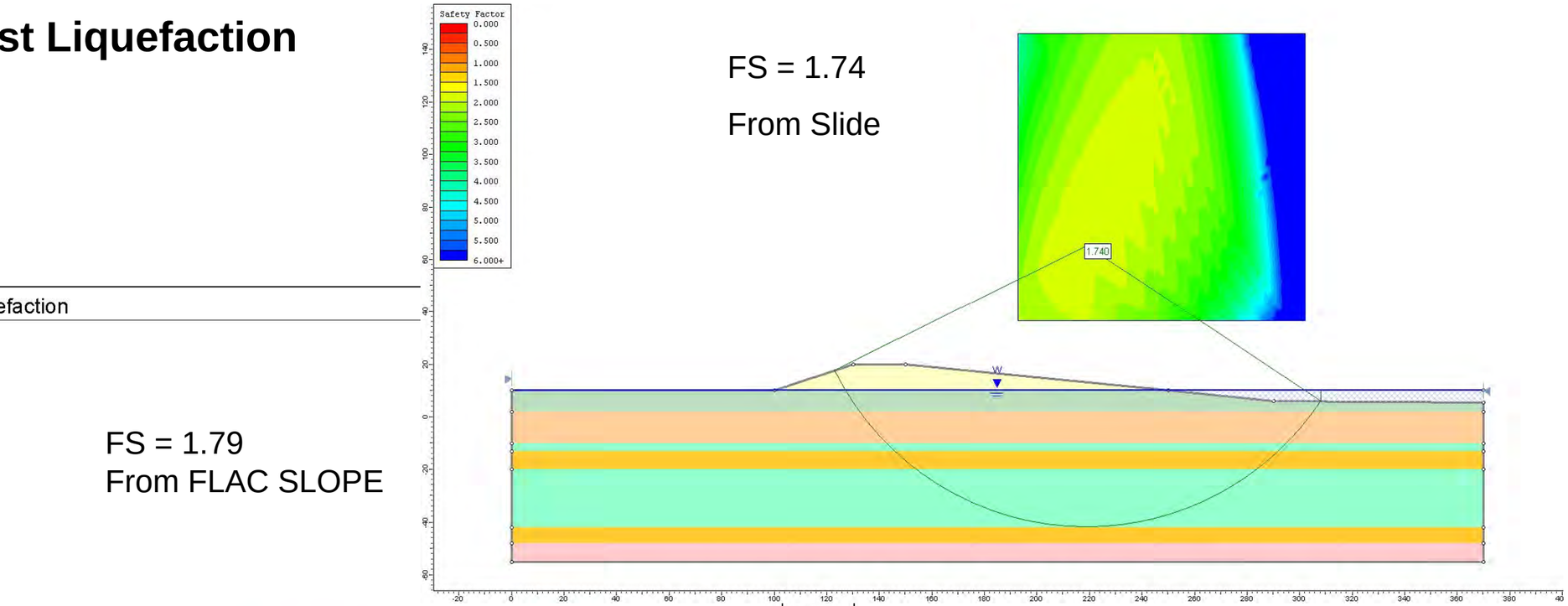
Net Applied Forces

max vector = 6.479E+02

0 2E 3

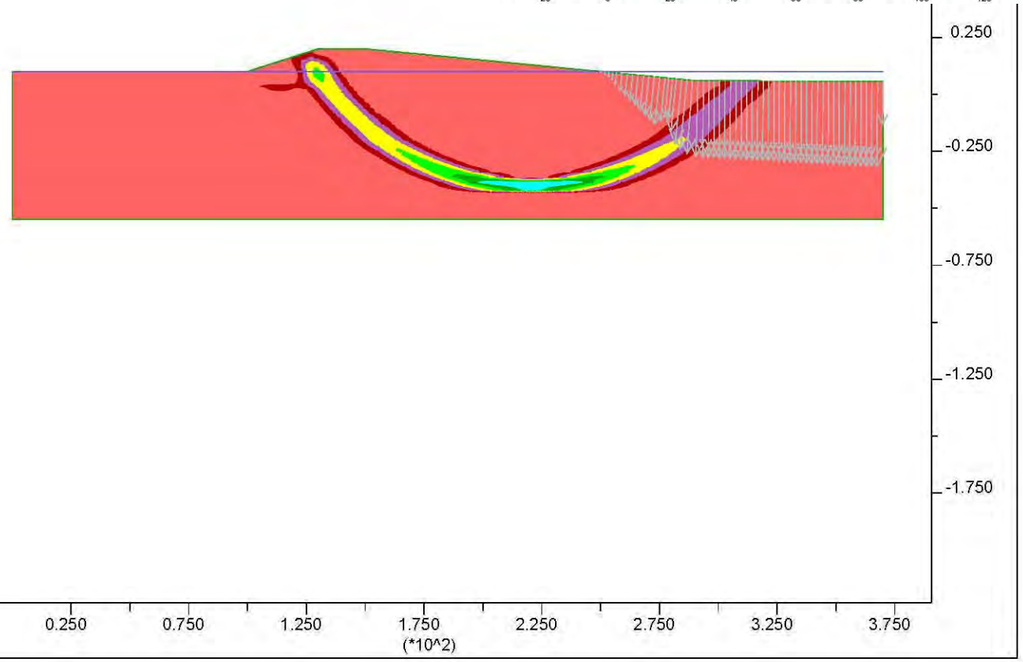
Group Delta Consultants
Torrance, CA

FS = 1.79
From FLAC SLOPE



FS = 1.74

From Slide



Percent Difference = 2.8%

Comparison of FLAC SLOPE and RocScience Slide Results

B1-1156

JOB TITLE : Section E ky =0.06 - Groundwater at El +7, Channel Water at Low Tide El. 0

FLAC/SLOPE (Version 7.00)

LEGEND

27-Mar-13 15:13

Factor of Safety 0.97

Shear Strain Rate Contours

- 5.00E-07
- 1.00E-06
- 1.50E-06
- 2.00E-06
- 2.50E-06
- 3.00E-06
- 3.50E-06
- 4.00E-06

Contour interval= 5.00E-07
(zero contour omitted)
Boundary plot

0 2E 2

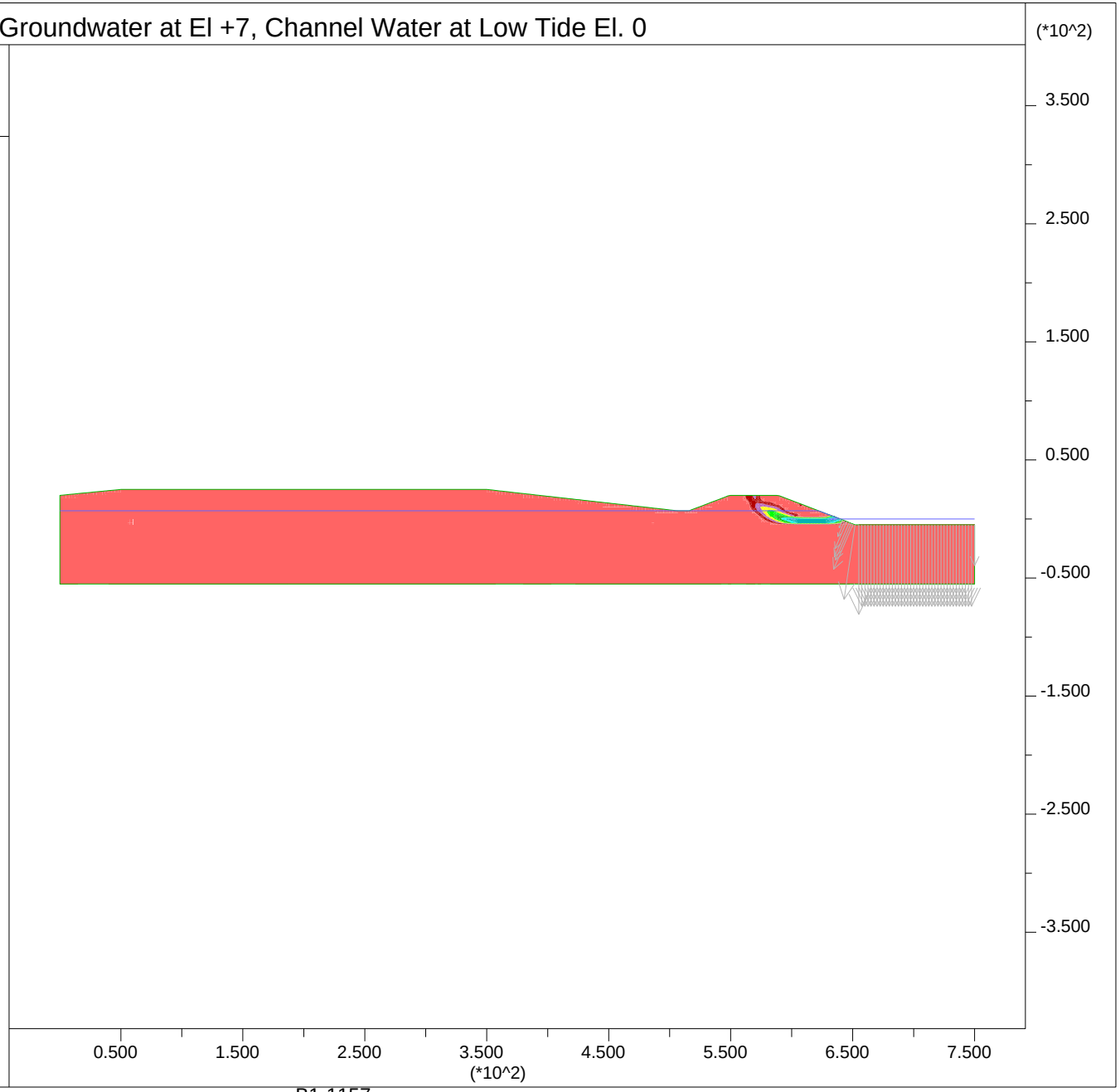
Water Table

Net Applied Forces

max vector = 8.604E+02

0 2E 3

Group Delta Consultants
Ballona Wetlands



B1-1157

PLATE G-148

JOB TITLE : Section E ky =0.06 - GW at El +7, Channel Water at Low Tide El. 0 _ Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Mar-13 15:13

Factor of Safety 0.97

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'Fill:Liq Sand 2'
- 'User:Soft Clay'
- 'Fill:Liq Fill'
- User:Embankment

Boundary plot

0 2E 2

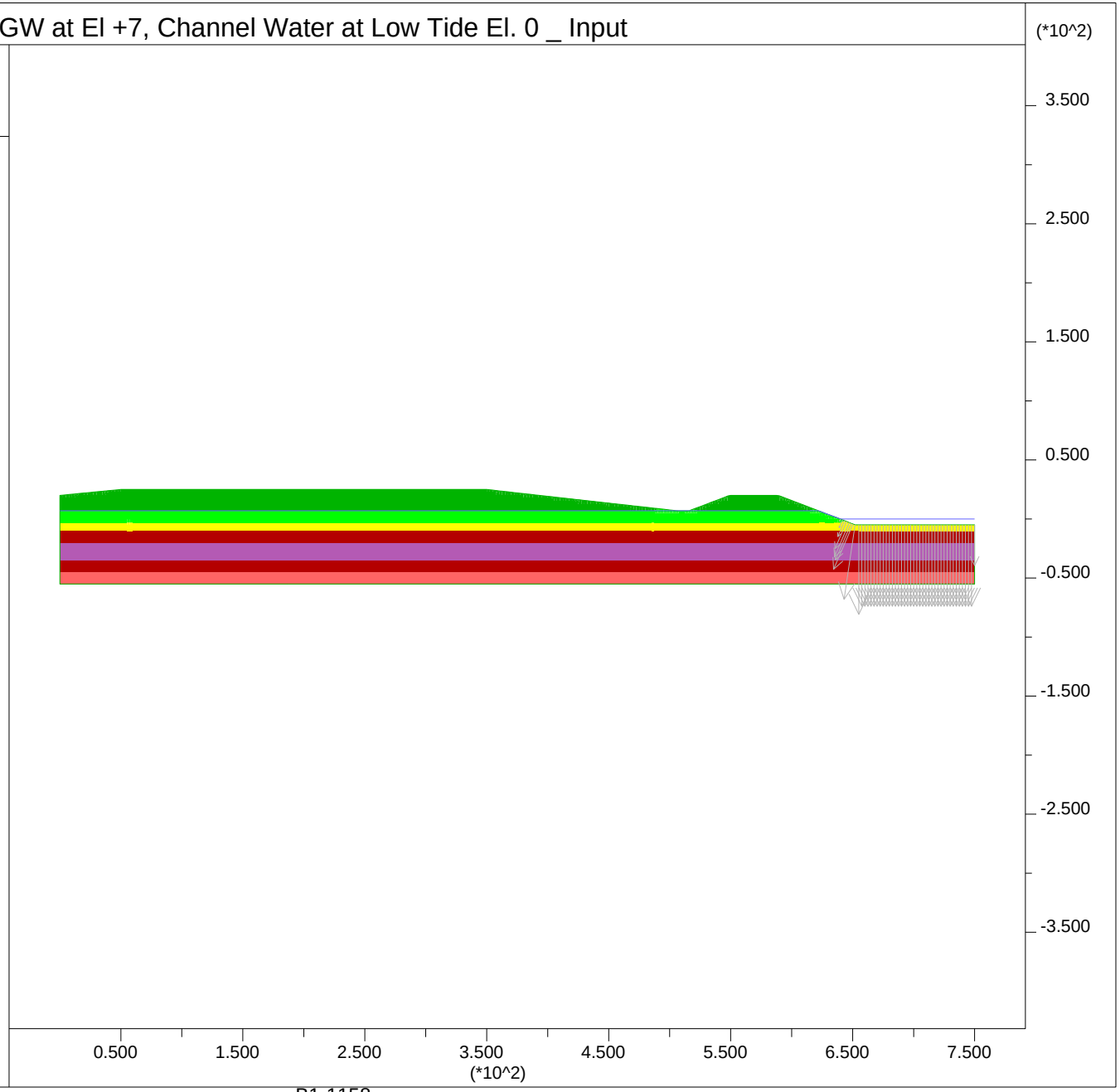
Water Table

Net Applied Forces

max vector = 8.604E+02

0 2E 3

Group Delta Consultants
Ballona Wetlands



B1-1158

PLATE G-149

JOB TITLE : Section E ky =0.08 - Groundwater at El +3, Channel Water at Avg tide El +3

FLAC/SLOPE (Version 7.00)

LEGEND

27-Mar-13 15:19

Factor of Safety 0.99

Shear Strain Rate Contours

- 5.00E-07
- 1.00E-06
- 1.50E-06
- 2.00E-06
- 2.50E-06
- 3.00E-06
- 3.50E-06
- 4.00E-06

Contour interval= 5.00E-07
(zero contour omitted)
Boundary plot

0 2E 2

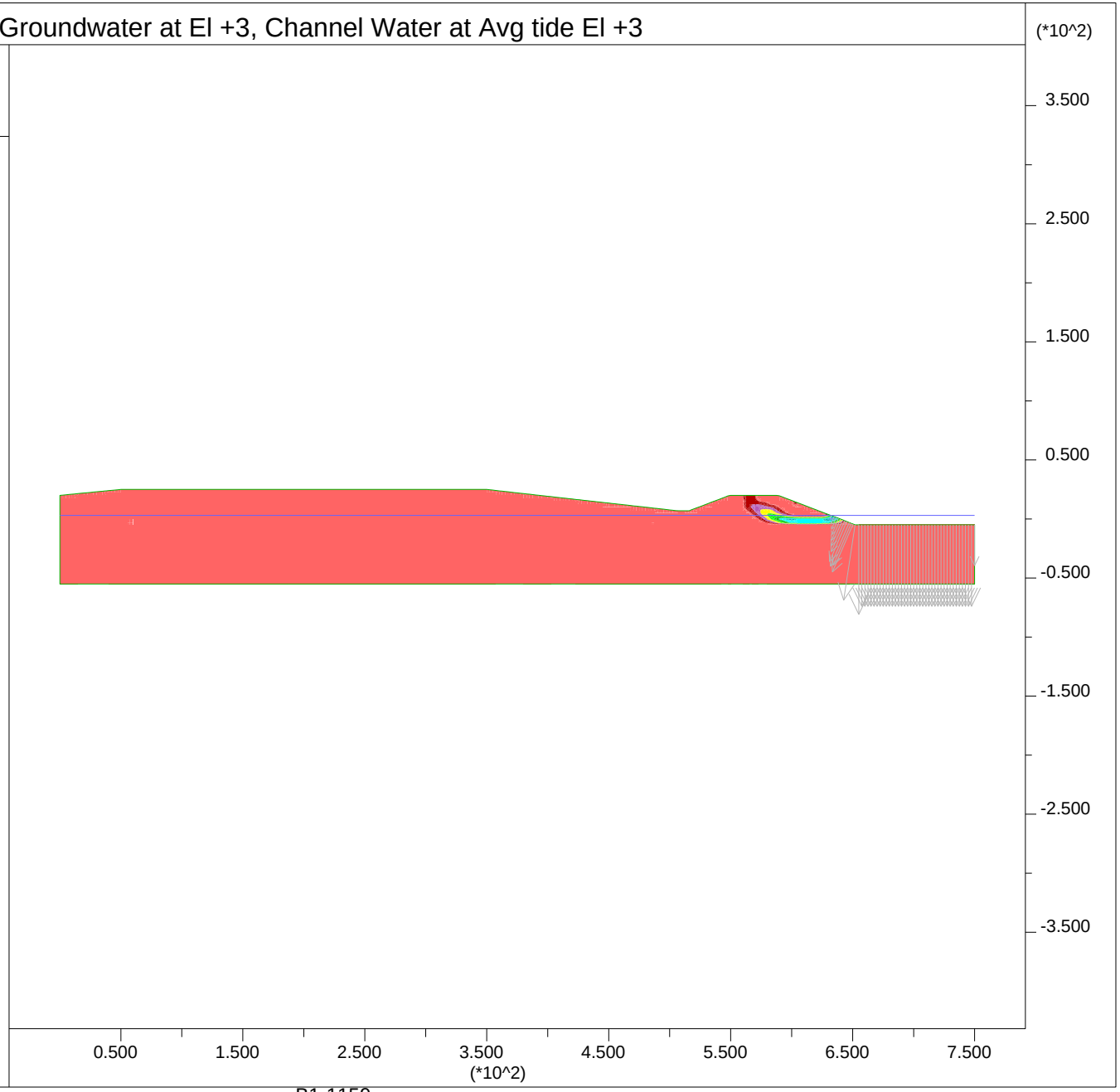
Water Table

Net Applied Forces

max vector = 1.379E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands



B1-1159

PLATE G-150

JOB TITLE : Section E ky =0.08 - GW at El +3, Channel Water at Avg tide El +3 _ Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Mar-13 15:17

Factor of Safety 0.99

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'Fill:Liq Sand 2'
- 'User:Soft Clay'
- 'Fill:Liq Fill'
- User:Embankment

Boundary plot

0 2E 2

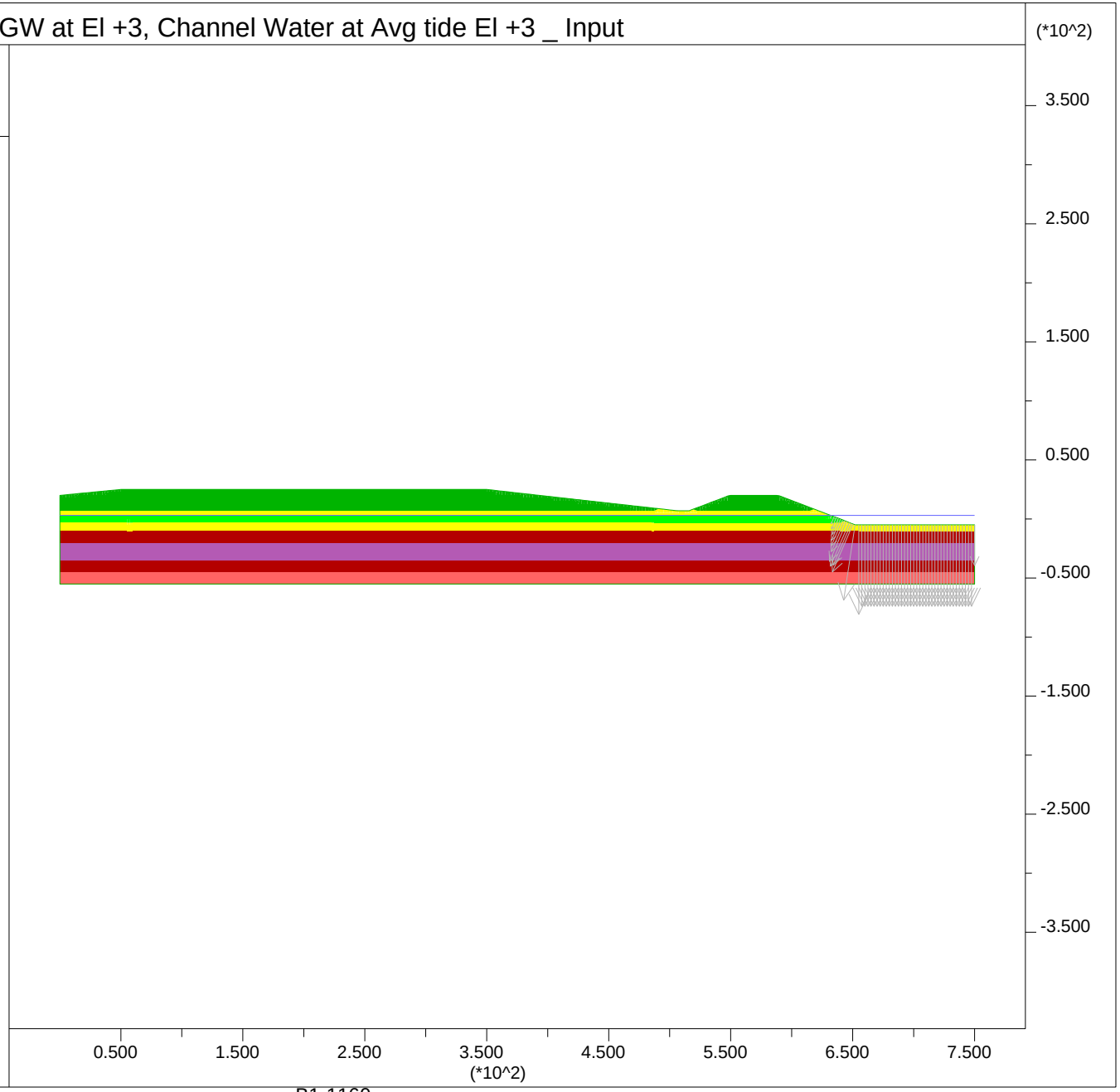
Water Table

Net Applied Forces

max vector = 1.379E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands



B1-1160

PLATE G-151

JOB TITLE : Section E ky =0.07 - Groundwater at El +3, Channel Water at Low Tide El. 0

FLAC/SLOPE (Version 7.00)

LEGEND

27-Mar-13 15:14

Factor of Safety 1.01

Shear Strain Rate Contours

- 2.50E-07
- 5.00E-07
- 7.50E-07
- 1.00E-06
- 1.25E-06

Contour interval= 2.50E-07
(zero contour omitted)
Boundary plot

0 2E 2

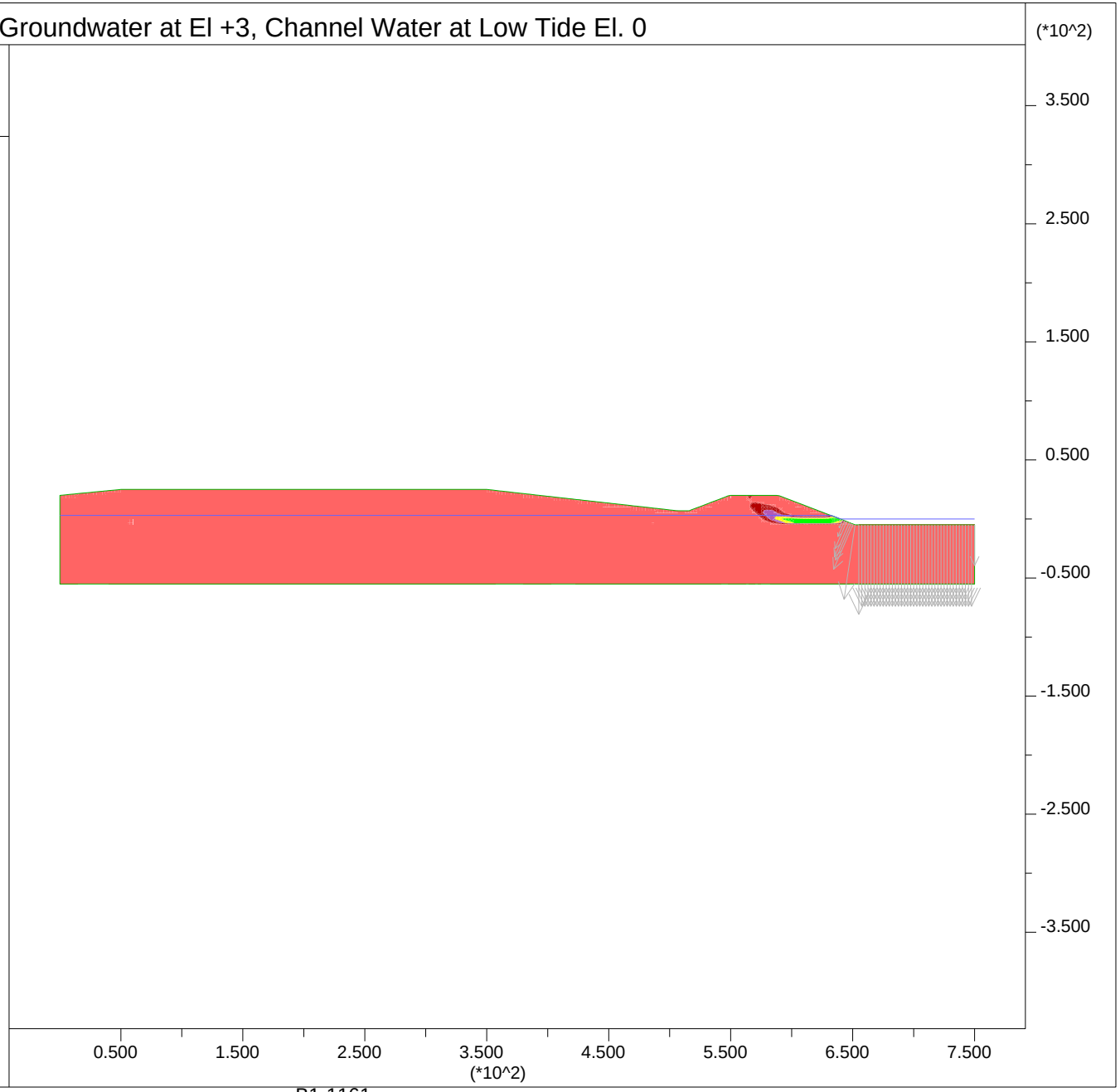
Water Table

Net Applied Forces

max vector = 8.610E+02

0 2E 3

Group Delta Consultants
Ballona Wetlands



B1-1161

PLATE G-152

JOB TITLE : Section E ky =0.07 - GW at El +3, Channel Water at Low Tide El. 0 _ Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Mar-13 15:15

Factor of Safety 1.01

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'Fill:Liq Sand 2'
- 'User:Soft Clay'
- 'Fill:Liq Fill'
- User:Embankment

Boundary plot

0 2E 2

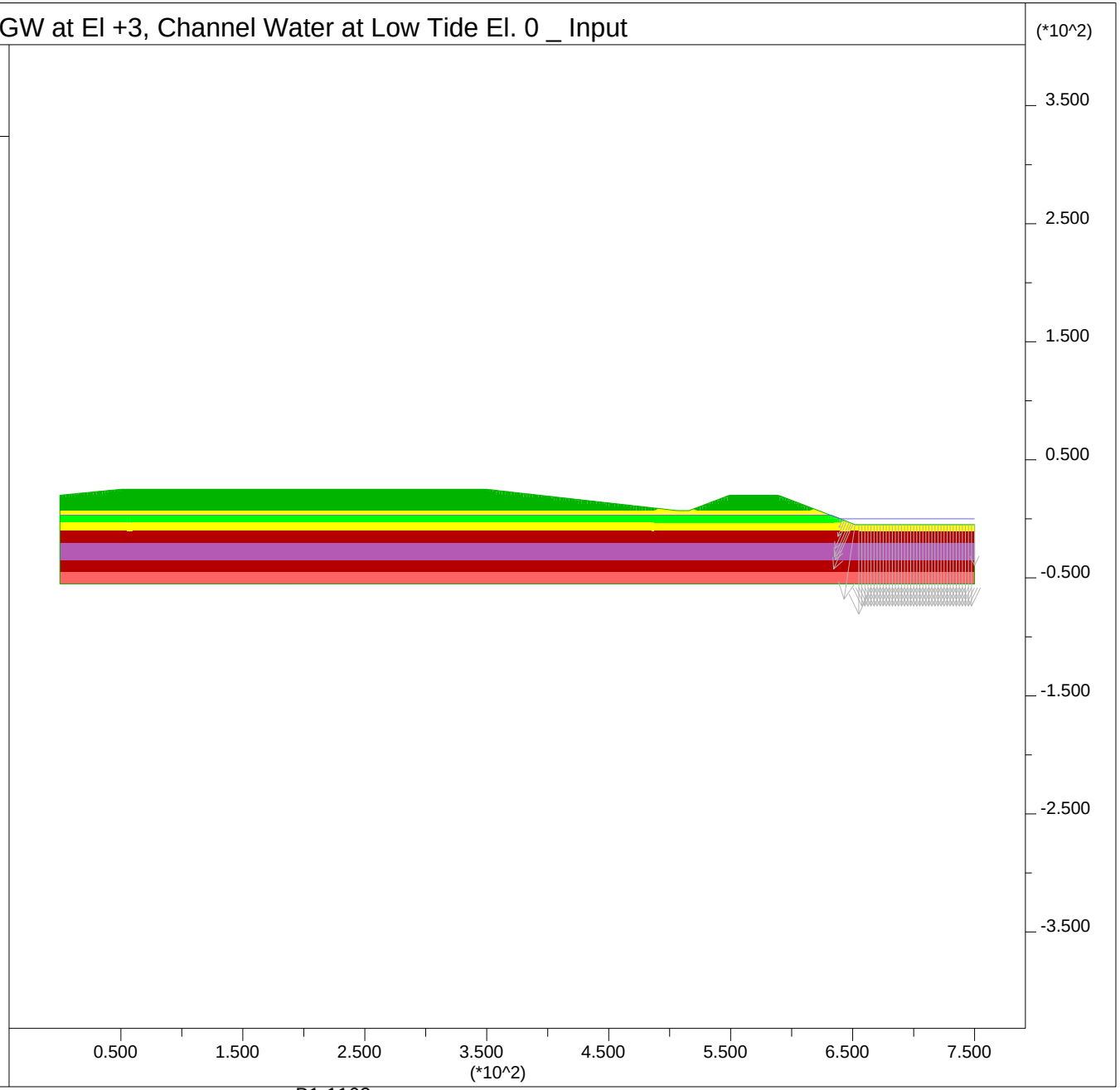
Water Table

Net Applied Forces

max vector = 8.610E+02

0 2E 3

Group Delta Consultants
Ballona Wetlands



B1-1162

PLATE G-153

APPENDIX H
SETTLEMENT

APPENDIX H
SETTLEMENT

H.1 Summary of Contents

This appendix includes the following:

- Cc / $(1+e_o)$ data in Areas A, B, and C, and OCR data within Areas A and B
- Settlements at different locations along different sections of levees
- Settlement bowl beyond dry side toe of levees/embankments
- Examples showing stresses below different portions of levees
- Settlements along different locations below Section I-I' of West Area B levees
- Spreadsheets showing maximum settlement for different Sections of levees
- Consolidation Curves showing P_P and OCR Determination
- Examples of Settlement Monitoring Results at the Adjacent Playa Vista

H.2 Determination of Cc / $(1+e_o)$ and OCR for Settlement Analysis

Plots included in Plates H-1 to H-5 show the values determined from consolidation data for Cc / $(1+e_o)$ in Areas A, B, and C, and OCR in Areas A, and B plotted versus depth. Cc / $(1+e_o)$ is particularly important for settlement analyses at this site, since the clayey soils deeper than about 10 feet are essentially normally consolidated. For this reason, the Cc / $(1+e_o)$ values are companioned with values inferred from correlations with soil moisture content developed from our experience at Playa Vista, as well as a well-known correlation based on the Terzaghi and Peck (1967) relationship. Adopted values for Cc / $(1+e_o)$ and OCR at different depths are also shown for different areas. The adopted OCR values for Area A were also used for Area C. Consolidation test results showing P_P and OCR determination are included in Plates H-26 to H-45.

H.3 Settlements at Different Locations along Sections of Levee

Settlements were determined for different levees sections by estimating the increase in vertical stresses under the embankment at different locations along sections of the levee. Examples of calculation of stresses at different locations below the embankment are included in Plates H-8 and H-9. The stresses were then used to estimate settlement at different locations under the embankments. Estimated settlements at different locations under embankment for section I-I' are exemplified in Plates H-10 through H-18. Maximum estimated settlements are shown for the sections that were analyzed on H-19 through H-25. A summary of settlements at different locations along different sections of the levees that were analyzed is presented on Plate H-6.

H.4 Settlement away from Protected Side Toe of Levees or Embankments

To minimize the settlement impact to utility lines and adjacent structures, the levees/embankments should be offset a minimum distance from roads, utilities, and other essential facilities. Therefore, estimations of settlements were made for

different sections along the levees/embankments at distances of 0, 10, 30, and 50 feet away from the protected side toe, for the sections that were analyzed. The settlement bowl away from the protected side toe is presented graphically on Plate H-7. Impact of settlements to utilities perpendicular to the levee alignment are minimal where the slope of change in settlement over length becomes less than 1/480. This slope is also shown on Plate H-7.

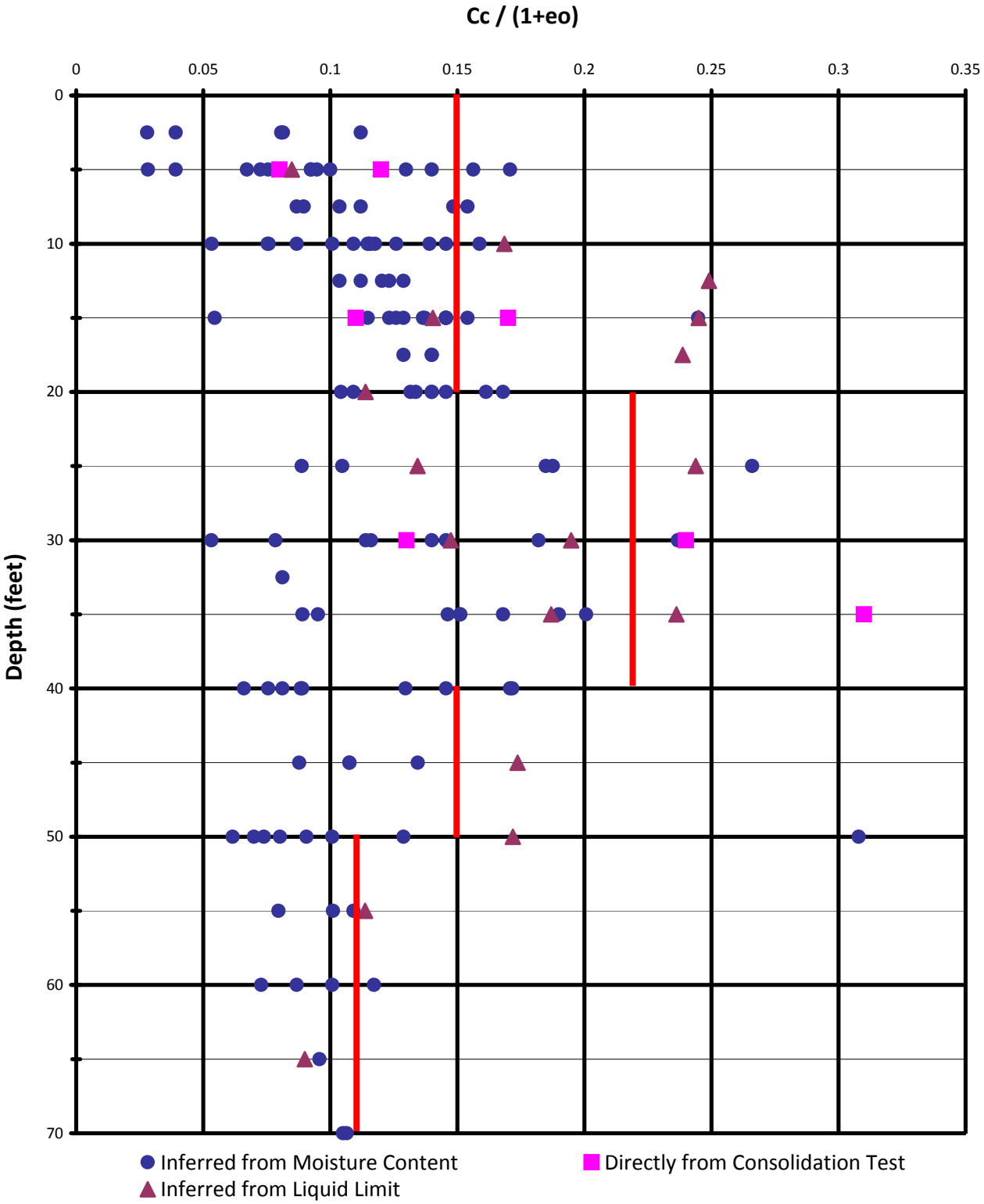
H.5 Rate of Settlement at the Adjacent Playa Vista Development

Examples of settlement monitoring results from our experience at the adjacent Playa Vista Development are included in this appendix. The normalized results (Plate H-47) suggest that 90% consolidation at Lots 1-6 of Area D2 within Playa Vista (located just south of Jefferson Blvd. and about 3,000 feet east of Lincoln Blvd.) occurred within about 100 to 150 days after placement of the full surcharge. Similar time rates of settlements are anticipated at the Ballona Wetlands Restoration Project.

A list of the plates presented in this appendix follows:

Plate H-1 and H-5	Cc / $(1+e_o)$ and OCR Plots showing Consolidation Data, Correlations, and Adopted Values
Plate H-6	Settlements at Different Locations along Different Sections of Levees and Embankments
Plate H-7	Settlement away from Protected Side Toe of Levees or Embankments
Plate H-8 and H-9	Examples of Stresses under the Embankments
Plate H-10 thru H-18	Settlement Spreadsheet Showing Settlement along Different Locations along Section I-I'
Plates H-19 thru H-25	Maximum Levee/Embankment Settlements
Plates H-26 thru H-45	Consolidation Results showing P_p and OCR Estimations
Plates H-46 and H-47	Example of Settlement Monitoring Results at Playa Vista

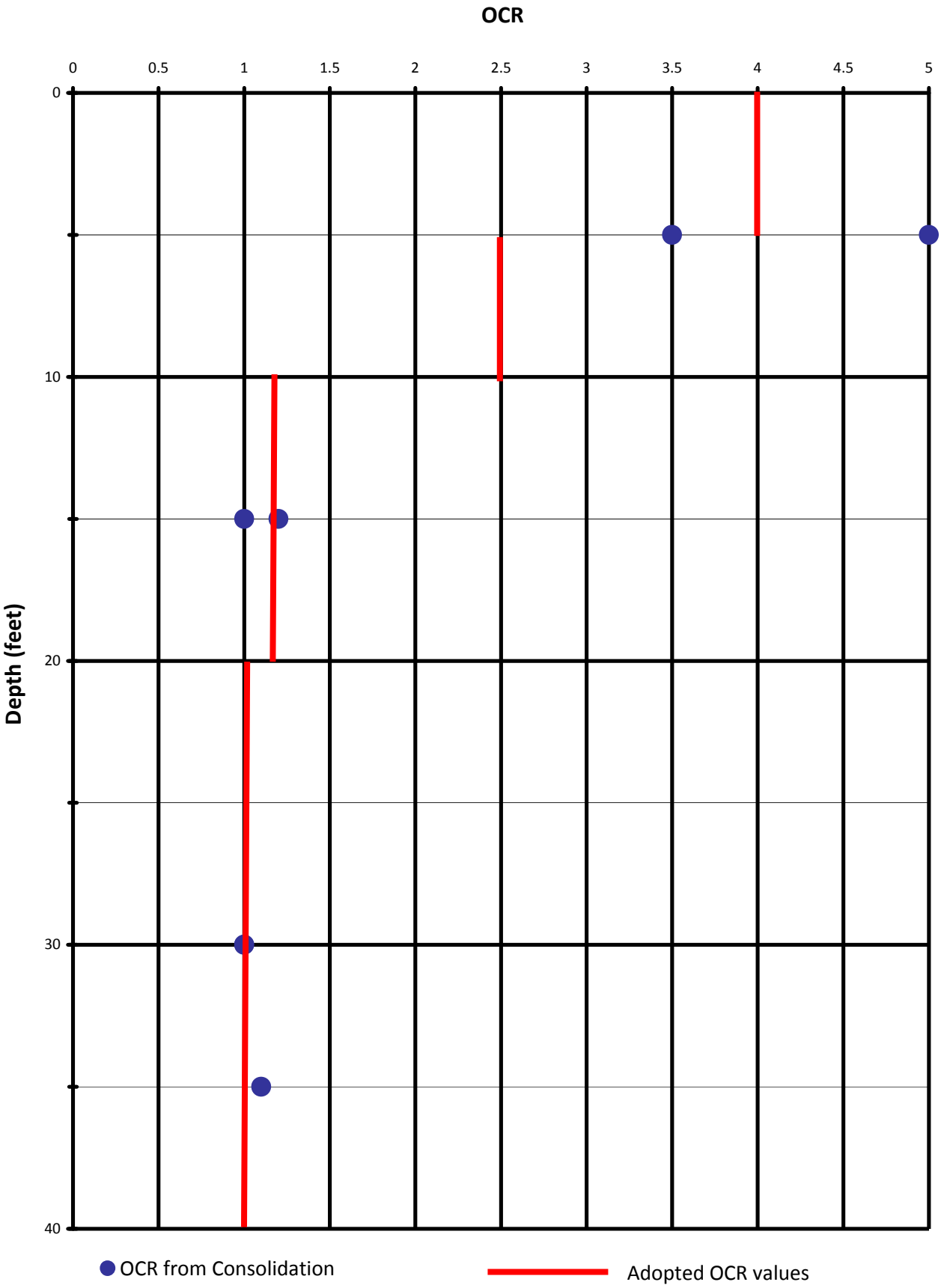
Variation of Cc / (1+e_o) with Depth in Area A



Note: 1) Correlation based on Moisture Content is derived from experience at Playa Vista and Similar Soils:
Cc / (1+eo) = Mc x 0.0028 + 0.0112
2) Correlation based on Liquid Limit is based on Terzaghi and Peck (1967):
Cc / (1+eo) = 0.009 x (LL - 10) / (1+eo)

PLATE H-1

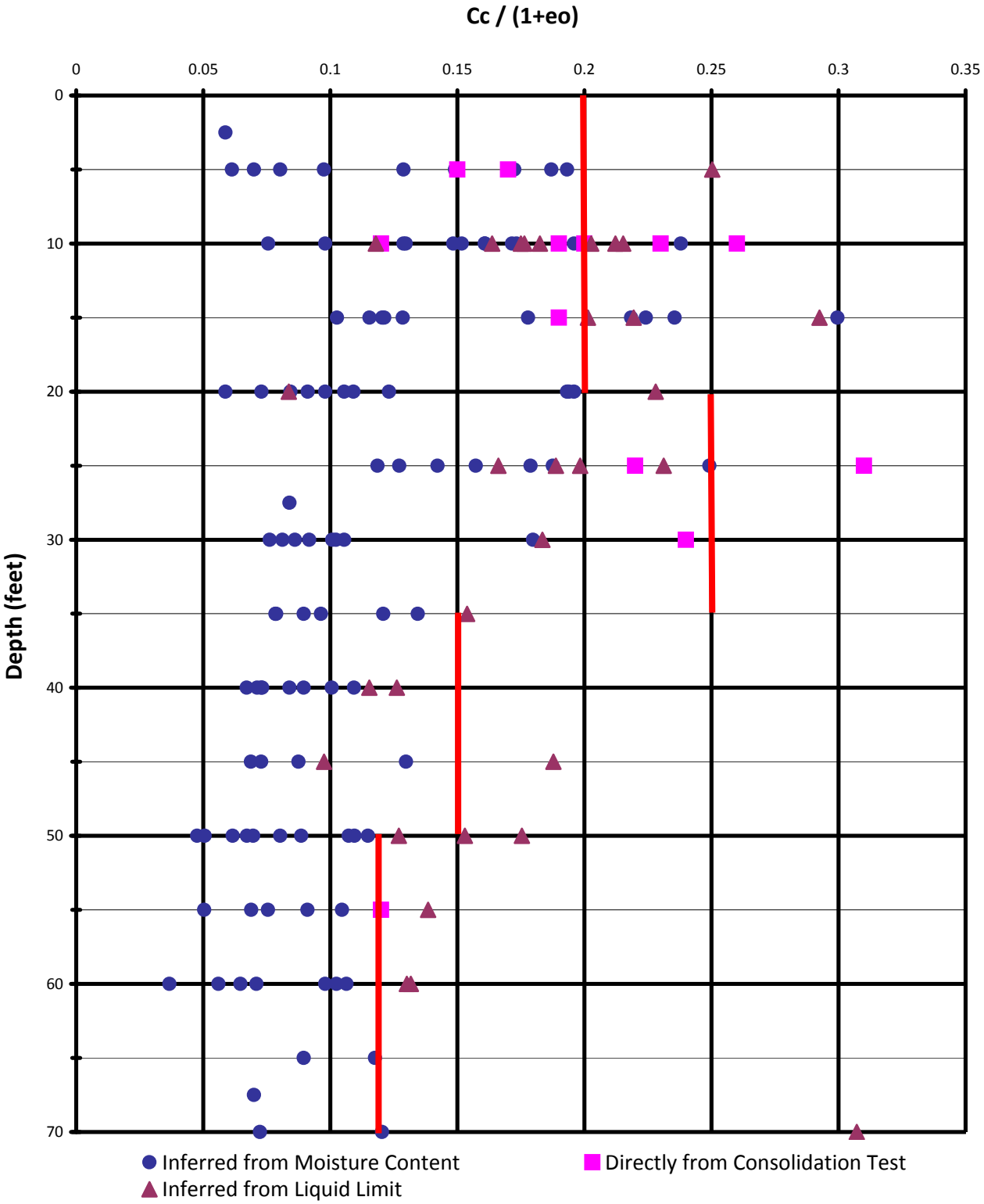
Variation of OCR with Depth in Area A



B1-1167

PLATE H-2

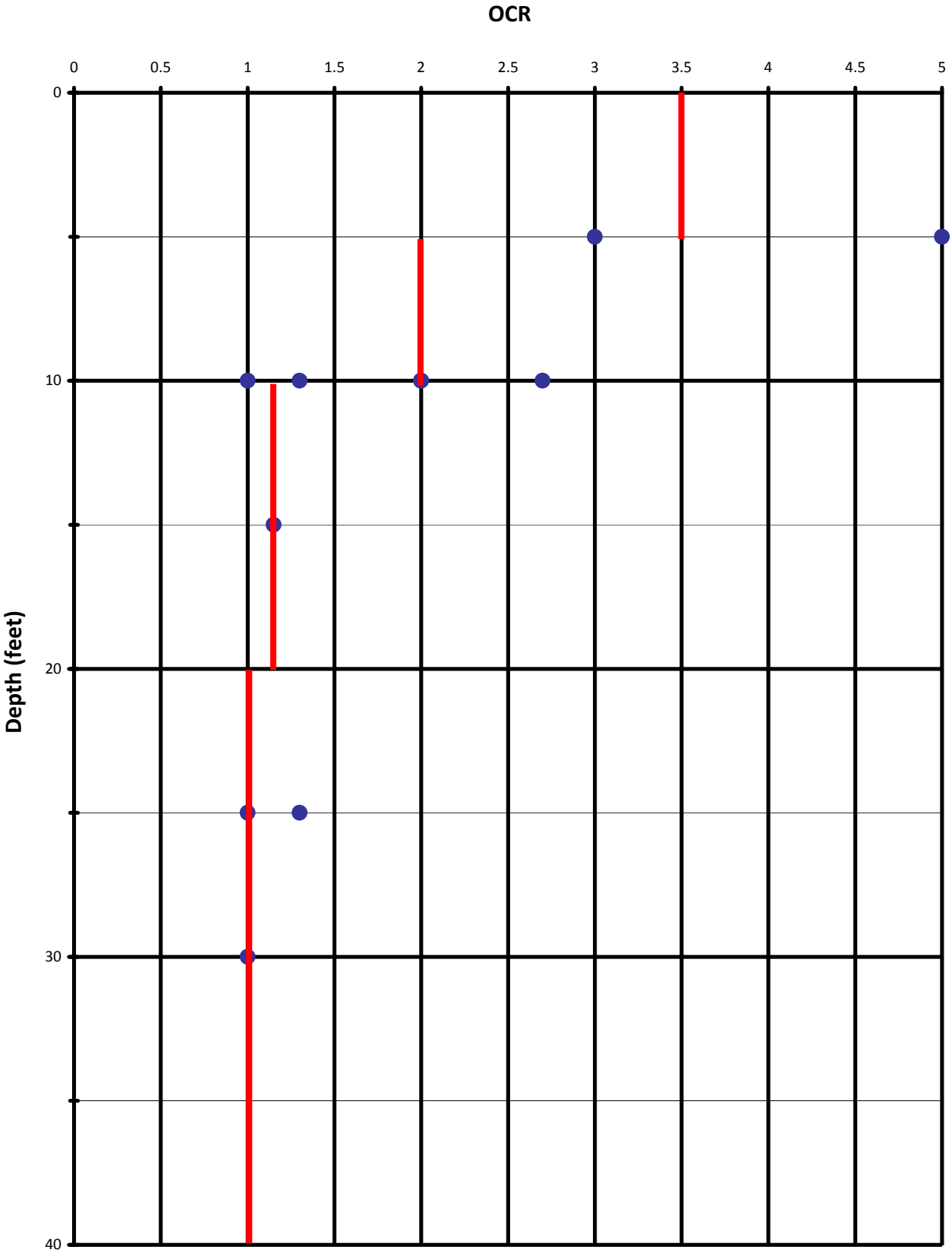
Variation of Cc / (1+e_o) with Depth in Area B



Note: 1) Correlation based on Moisture Content is derived from experience at Playa Vista and Similar Soils:
Cc / (1+eo) = Mc x 0.0028 + 0.0112
2) Correlation based on Liquid Limit is based on Terzaghi and Peck (1967):
Cc / (1+eo) = 0.009 x (LL - 10) / (1+eo)

PLATE H-3

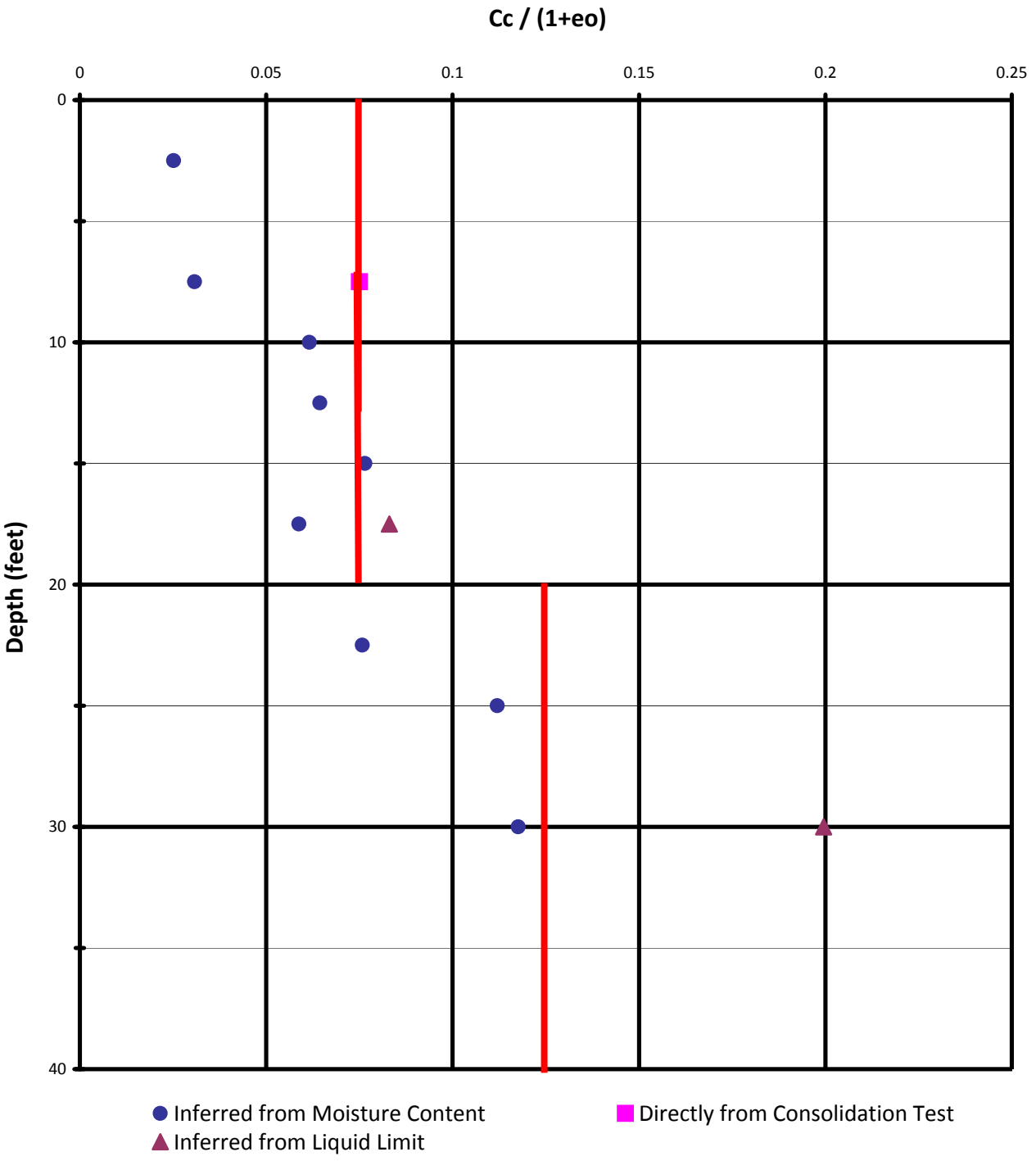
Variation of OCR with Depth in Area B



B1-1169

PLATE H-4

Variation of Cc / (1+e_o) with Depth in Area C

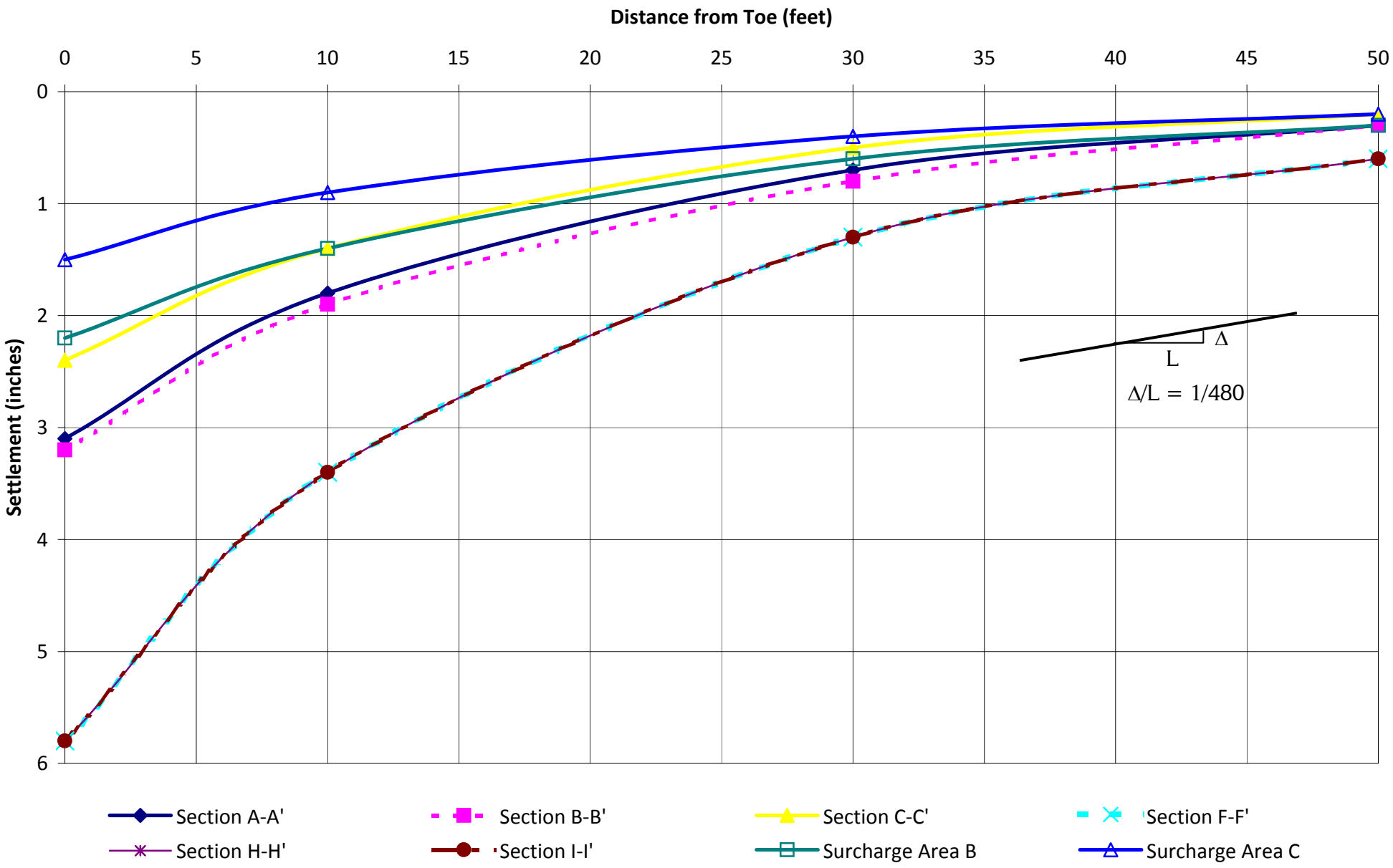


Note: 1) Correlation based on Moisture Content is derived from experience at Playa Vista and Similar Soils:
Cc / (1+eo) = Mc x 0.0028 + 0.0112
2) Correlation based on Liquid Limit is based on Terzaghi and Peck (1967):
Cc / (1+eo) = 0.009 x (LL - 10) / (1+eo)

Area	Section	Approximate Embankment Height (feet)	Settlement (inches)									Max Settlement per foot of Fill (inches)
			Wet Side Toe	1/3 Height of Wet Side Slope	2/3 Height of Wet Side Slope	Wet Side Edge of Crest	Center	Dry Side Edge of Crest	2/3 Height of Dry Side Slope	1/3 Height of Dry Side Slope	Dry Side Toe	
Area A	Section A-A'	10	2.1	7.8	14.3	19	19.1	18.4	13.9	8.2	3.1	1.9
Area B	Section B-B'	10	2.1	7.9	14.6	19.9	21.4	19	14.2	8.3	3.2	2.1
	Section C-C'	5	1	4.2	7.5	9.9	9.9	9.5	7.4	4.6	2.4	2.0
	Section F-F'	14	2.2	11.7	23.1	32	33.4	29	22	13	5.8	2.4
	Section H-H'	14	2.2	11.7	23.1	31.9	32.9	28.9	22	13	5.8	2.4
	Section I-I'	15	2.1	12.3	24.5	32.5	32.1	30.4	23.3	13.6	5.8	2.2
	Surcharge Area B	25	2.2	20.9	38.5	50.7	51.8	50.7	38.5	20.9	2.2	2.1
Area C	Surcharge Area C	30	1.5	13.8	24	30.8	31.6	30.8	24	13.8	1.5	1.1

PLATE H-6

Settlement away from Protected Side Toe



B1-1172

PLATE H-7

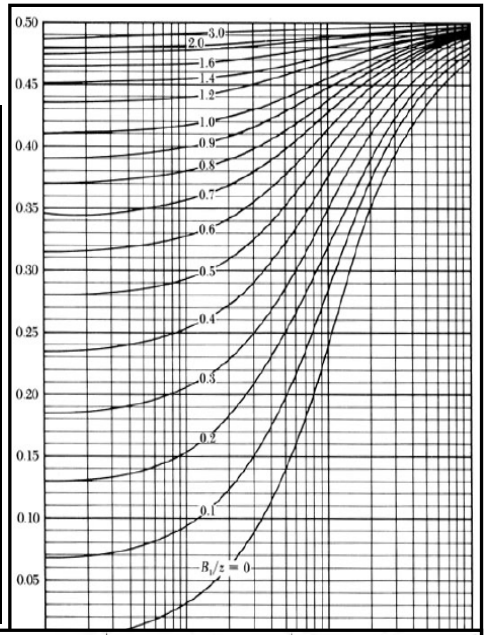
Osterberg, 1957 Chart Stresses Under An Embankemnt

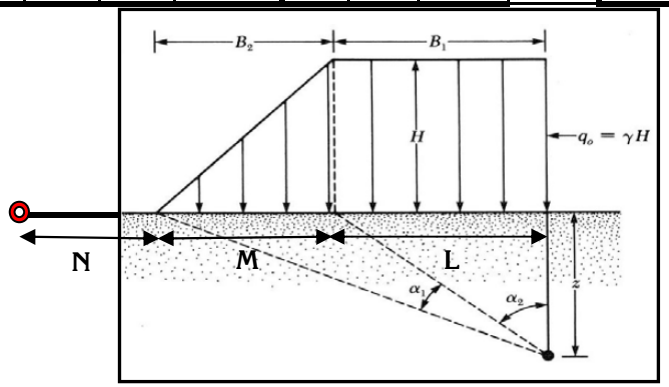
Location: Center of Levee Section I-I'

H:	**Surcharge Height:**	15	feet
q_o:	**Surcharge**	1,800	psf
L:	**Levee Crest Width:**	20	feet
M:	**Dry Side Slope HorizontalDist:**	45	feet
N:	**Distance to Levee Toe:**	NA	feet
O:	**Creek Side Horizontal Slope Dist:**	150	feet

LARGE TRAPEZOID				ADDITIVE TRAPEZOID				SUBTRACTIVE TRAPEZOID			
B1= 10 feet				B1= 10 feet				B1= 0 feet			
B2= 150 feet				B2= 45 feet				B2= 0 feet			
Z	α_2	α_1	σ	Z	α_2	α_1	σ	Z	α_2	α_1	σ
2.5	1.33	0.23	899.81	2.5	1.33	0.20	899	2.5	0.00	0.00	0
7.5	0.93	0.60	895.95	7.5	0.93	0.51	887	7.5	0.00	0.00	0
12.5	0.67	0.82	886.58	12.5	0.67	0.67	858	12.5	0.00	0.00	0
17.5	0.52	0.94	873.59	17.5	0.52	0.74	818	17.5	0.00	0.00	0
22.5	0.42	1.01	858.64	22.5	0.42	0.76	775	22.5	0.00	0.00	0
27.5	0.35	1.05	842.65	27.5	0.35	0.76	731	27.5	0.00	0.00	0
32.5	0.30	1.07	826.12	32.5	0.30	0.74	688	32.5	0.00	0.00	0
37.5	0.26	1.08	809.35	37.5	0.26	0.71	648	37.5	0.00	0.00	0
42.5	0.23	1.08	792.50	42.5	0.23	0.68	610	42.5	0.00	0.00	0
47.5	0.21	1.07	775.70	47.5	0.21	0.65	575	47.5	0.00	0.00	0
52.5	0.19	1.07	759.04	52.5	0.19	0.62	542	52.5	0.00	0.00	0
57.5	0.17	1.05	742.57	57.5	0.17	0.59	513	57.5	0.00	0.00	0
70	0.14	1.02	702.53	70	0.14	0.52	448	70	0.00	0.00	0

$\Delta\sigma$	% Surcharge
1799	99.94
1783	99.05
1744	96.90
1692	93.98
1633	90.75
1574	87.42
1514	84.13
1457	80.95
1402	77.91
1350	75.02
1301	72.30
1255	69.73
1151	63.93





Schematics from Das

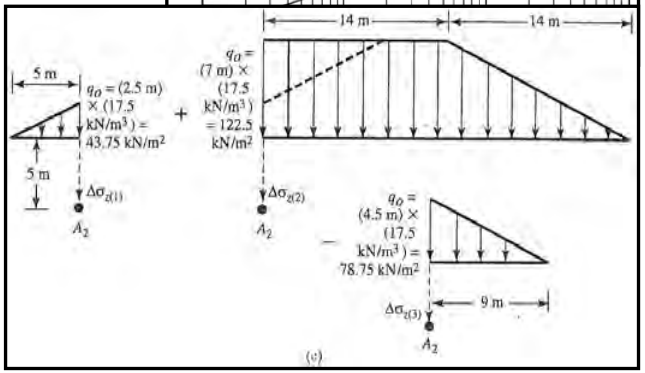


PLATE H-8

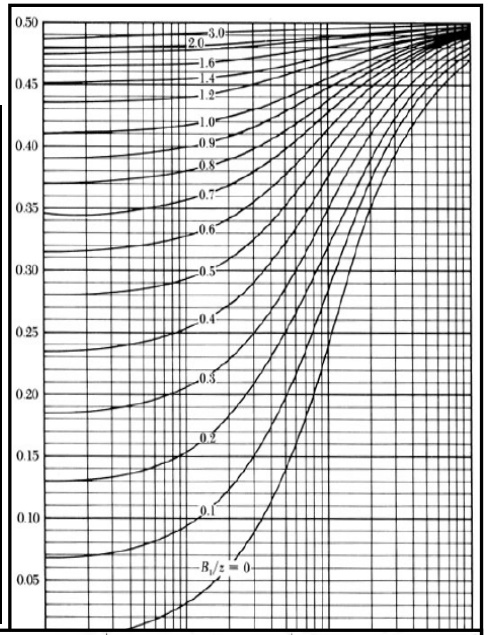
Osterberg, 1957 Chart Stresses Under An Embankemnt

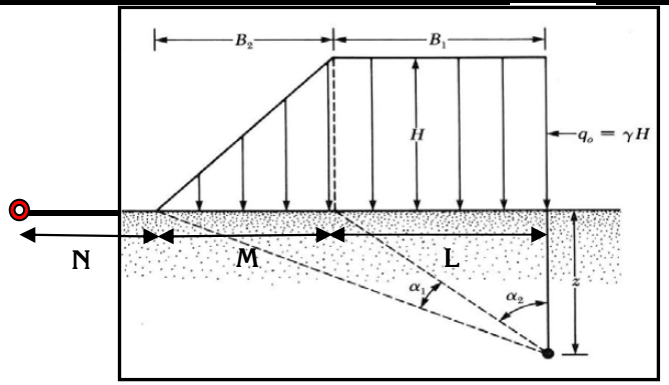
Location: 1/3 of Height - Dry Side Section I-I'

H:	**Surcharge Height:**	15	feet
q_o:	**Surcharge**	1,800	psf
L:	**Levee Crest Width:**	20	feet
M:	**Dry Side Slope HorizontalDist:**	45	feet
N:	**Distance to Levee Toe:**	NA	feet
O:	**Creek Side Horizontal Slope Dist:**	150	feet

LARGE TRAPEZOID				ADDITIVE TRAPEZOID				SUBTRACTIVE TRAPEZOID			
B1= 50 feet				B1= 0 feet				B1= 0 feet			
B2= 150 feet				B2= 15 feet				B2= 30 feet			
Z	α_2	α_1	σ	Z	α_2	α_1	σ	Z	α_2	α_1	σ
2.5	1.52	0.04	899.99	2.5	0.00	1.41	268	2.5	0.00	1.49	568
7.5	1.42	0.11	899.80	7.5	0.00	1.11	211	7.5	0.00	1.33	506
12.5	1.33	0.18	899.10	12.5	0.00	0.88	167	12.5	0.00	1.18	449
17.5	1.23	0.25	897.62	17.5	0.00	0.71	135	17.5	0.00	1.04	398
22.5	1.15	0.31	895.18	22.5	0.00	0.59	112	22.5	0.00	0.93	354
27.5	1.07	0.37	891.65	27.5	0.00	0.50	95	27.5	0.00	0.83	317
32.5	0.99	0.42	887.01	32.5	0.00	0.43	83	32.5	0.00	0.75	285
37.5	0.93	0.46	881.30	37.5	0.00	0.38	73	37.5	0.00	0.67	258
42.5	0.87	0.50	874.59	42.5	0.00	0.34	65	42.5	0.00	0.61	235
47.5	0.81	0.53	866.97	47.5	0.00	0.31	58	47.5	0.00	0.56	215
52.5	0.76	0.55	858.55	52.5	0.00	0.28	53	52.5	0.00	0.52	198
57.5	0.72	0.58	849.44	57.5	0.00	0.26	49	57.5	0.00	0.48	184
70	0.62	0.61	824.34	70	0.00	0.21	40	70	0.00	0.40	155

$\Delta\sigma$	% Surcharge
600	33.34
605	33.60
617	34.29
635	35.26
653	36.29
670	37.25
685	38.05
696	38.68
705	39.14
710	39.46
713	39.63
714	39.69
710	39.44





Schematics from Das

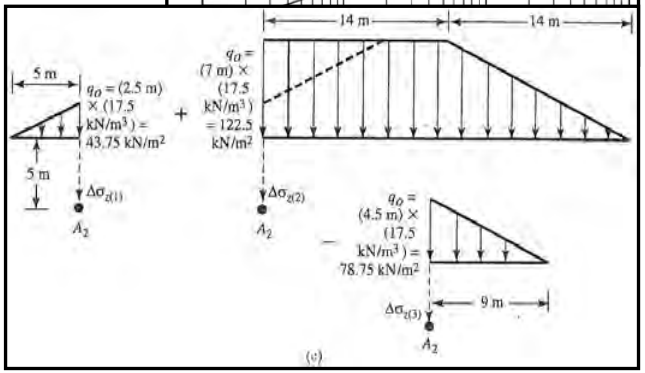


PLATE H-9

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: Wet Side Toe

Loaded	**Load, Q**	1,680	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **2.14** inches 0.15 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	Depth (feet) top	bottom	center	Layer Height (feet)	γ (pcf)	σ'_v (psf)	OCR	σ'_p (psf)	Stress Distribution Δσ (psf)	Compress. Type E or C	E (ksf)	Cr 1+e0	Cc 1+e0	OCR Case	Strain ε (in/in)	Layer Settle (in)	Adjusted Layer Settle (in)
Clay	0	5	2.5	5	120	300	3.5	1,050	10	C		0.025	0.2	1	0.000348	0.02	0.01
Clay	5	10	7.5	5	57.6	744	2	1,488	29	C		0.025	0.2	1	0.000411	0.02	0.02
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	48	C		0.025	0.2	1	0.000489	0.03	0.03
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	66	C		0.025	0.2	1	0.000532	0.03	0.03
Clay	20	25	22.5	5	57.6	1,608	1	1,608	85	C		0.025	0.25	3	0.005575	0.33	0.33
Clay	25	30	27.5	5	57.6	1,896	1	1,896	103	C		0.025	0.25	3	0.005732	0.34	0.34
Clay	30	35	32.5	5	57.6	2,184	1	2,184	120	C		0.025	0.25	3	0.005828	0.35	0.35
Clay	35	40	37.5	5	57.6	2,472	1	2,472	138	C		0.025	0.15	3	0.003529	0.21	0.21
Clay	40	45	42.5	5	57.6	2,760	1	2,760	154	C		0.025	0.15	3	0.003542	0.21	0.21
Clay	45	50	47.5	5	57.6	3,048	1	3,048	170	C		0.025	0.15	3	0.003541	0.21	0.21
Clay	50	55	52.5	5	57.6	3,336	1	3,336	186	C		0.025	0.12	3	0.002822	0.17	0.17
Clay	55	60	57.5	5	57.6	3,624	1	3,624	200	C		0.025	0.12	3	0.002804	0.17	0.17
Sand	60	80	70	20	57.6	4,344	1	4,344	234	E	1200	0.025	0.1	N/A	0.000195	0.05	0.05

TOTAL= **2.14** inches

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: 1/3 of Height - Wet Side - Slope I-I' of Area B

Loaded	**Load, Q**	1,800	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **12.26** inches 0.82 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	**Depth (feet) top**	**bottom**	**center**	**Layer Height (feet)**	**γ (pcf)**	**σ'v (psf)**	**OCR**	**σ'p (psf)**	**Stress Distribution Δσ (psf)**	**Compress. Type E or C**	**E (ksf)**	**Cr 1+e0**	**Cc 1+e0**	**OCR Case**	**Strain ε (in/in)**	**Layer Settle (in)**	**Adjusted Layer Settle (in)**
Clay	0	5	2.5	5	120	300	3.5	1,050	599	C		0.025	0.2	1	0.011915	0.71	0.50
Clay	5	10	7.5	5	57.6	744	2	1,488	597	C		0.025	0.2	1	0.006396	0.38	0.27
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	595	C		0.025	0.2	2	0.025711	1.54	1.54
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	595	C		0.025	0.2	2	0.018445	1.11	1.11
Clay	20	25	22.5	5	57.6	1,608	1	1,608	594	C		0.025	0.25	3	0.034155	2.05	2.05
Clay	25	30	27.5	5	57.6	1,896	1	1,896	595	C		0.025	0.25	3	0.029633	1.78	1.78
Clay	30	35	32.5	5	57.6	2,184	1	2,184	596	C		0.025	0.25	3	0.026202	1.57	1.57
Clay	35	40	37.5	5	57.6	2,472	1	2,472	598	C		0.025	0.15	3	0.014106	0.85	0.85
Clay	40	45	42.5	5	57.6	2,760	1	2,760	599	C		0.025	0.15	3	0.012803	0.77	0.77
Clay	45	50	47.5	5	57.6	3,048	1	3,048	601	C		0.025	0.15	3	0.011728	0.70	0.70
Clay	50	55	52.5	5	57.6	3,336	1	3,336	603	C		0.025	0.12	3	0.008658	0.52	0.52
Clay	55	60	57.5	5	57.6	3,624	1	3,624	604	C		0.025	0.12	3	0.008039	0.48	0.48
Sand	60	80	70	20	57.6	4,344	1	4,344	606	E	1200	0.025	0.1	N/A	0.000505	0.12	0.12

TOTAL= **12.26** inches

PLATE H-11

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: 2/3 of Height - Wet Side - Slope I-I' of Area B

Loaded	**Load, Q**	1,800	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **24.49** inches 1.63 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	Depth (feet) top	bottom	center	Layer Height (feet)	γ (pcf)	σ'_v (psf)	OCR	σ'_p (psf)	Stress Distribution Δσ (psf)	Compress. Type E or C	E (ksf)	Cr 1+e0	Cc 1+e0	OCR Case	Strain ε (in/in)	Layer Settle (in)	Adjusted Layer Settle (in)
Clay	0	5	2.5	5	120	300	3.5	1,050	1200	C		0.025	0.2	2	0.044581	2.67	1.87
Clay	5	10	7.5	5	57.6	744	2	1,488	1200	C		0.025	0.2	2	0.030727	1.84	1.29
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	1198	C		0.025	0.2	2	0.053078	3.18	3.18
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	1195	C		0.025	0.2	2	0.042148	2.53	2.53
Clay	20	25	22.5	5	57.6	1,608	1	1,608	1191	C		0.025	0.25	3	0.06016	3.61	3.61
Clay	25	30	27.5	5	57.6	1,896	1	1,896	1183	C		0.025	0.25	3	0.052659	3.16	3.16
Clay	30	35	32.5	5	57.6	2,184	1	2,184	1174	C		0.025	0.25	3	0.046713	2.80	2.80
Clay	35	40	37.5	5	57.6	2,472	1	2,472	1163	C		0.025	0.15	3	0.025112	1.51	1.51
Clay	40	45	42.5	5	57.6	2,760	1	2,760	1149	C		0.025	0.15	3	0.022674	1.36	1.36
Clay	45	50	47.5	5	57.6	3,048	1	3,048	1134	C		0.025	0.15	3	0.020598	1.24	1.24
Clay	50	55	52.5	5	57.6	3,336	1	3,336	1116	C		0.025	0.12	3	0.015045	0.90	0.90
Clay	55	60	57.5	5	57.6	3,624	1	3,624	1098	C		0.025	0.12	3	0.013792	0.83	0.83
Sand	60	80	70	20	57.6	4,344	1	4,344	1048	E	1200	0.025	0.1	N/A	0.000873	0.21	0.21

TOTAL= **24.49** inches

PLATE H-12

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: Wet Side Edge of Crest - Slope I-I' of Area B

Loaded	**Load, Q**	1,800	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **32.45** inches 2.16 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	Depth (feet) top	bottom	center	Layer Height (feet)	γ (pcf)	σ'_v (psf)	OCR	σ'_p (psf)	Stress Distribution Δσ (psf)	Compress. Type E or C	E (ksf)	Cr 1+e0	Cc 1+e0	OCR Case	Strain ε (in/in)	Layer Settle (in)	Adjusted Layer Settle (in)
Clay	0	5	2.5	5	120	300	3.5	1,050	1790	C		0.025	0.2	2	0.073396	4.40	3.08
Clay	5	10	7.5	5	57.6	744	2	1,488	1768	C		0.025	0.2	2	0.052995	3.18	2.23
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	1737	C		0.025	0.2	2	0.071882	4.31	4.31
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	1699	C		0.025	0.2	2	0.057996	3.48	3.48
Clay	20	25	22.5	5	57.6	1,608	1	1,608	1654	C		0.025	0.25	3	0.076794	4.61	4.61
Clay	25	30	27.5	5	57.6	1,896	1	1,896	1605	C		0.025	0.25	3	0.06658	3.99	3.99
Clay	30	35	32.5	5	57.6	2,184	1	2,184	1554	C		0.025	0.25	3	0.058333	3.50	3.50
Clay	35	40	37.5	5	57.6	2,472	1	2,472	1502	C		0.025	0.15	3	0.030923	1.86	1.86
Clay	40	45	42.5	5	57.6	2,760	1	2,760	1451	C		0.025	0.15	3	0.027514	1.65	1.65
Clay	45	50	47.5	5	57.6	3,048	1	3,048	1401	C		0.025	0.15	3	0.02463	1.48	1.48
Clay	50	55	52.5	5	57.6	3,336	1	3,336	1352	C		0.025	0.12	3	0.017733	1.06	1.06
Clay	55	60	57.5	5	57.6	3,624	1	3,624	1306	C		0.025	0.12	3	0.016035	0.96	0.96
Sand	60	80	70	20	57.6	4,344	1	4,344	1198	E	1200	0.025	0.1	N/A	0.000999	0.24	0.24

TOTAL= **32.45** inches

PLATE H-13

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: Center of Levee - Slope I-I' of Area B

Loaded	**Load, Q**	1,800	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **32.11** inches 2.14 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	**Depth (feet) top**	**bottom**	**center**	**Layer Height (feet)**	**γ (pcf)**	**σ'v (psf)**	**OCR**	**σ'p (psf)**	**Stress Distribution Δσ (psf)**	**Compress. Type E or C**	**E (ksf)**	**Cr 1+e0**	**Cc 1+e0**	**OCR Case**	**Strain ε (in/in)**	**Layer Settle (in)**	**Adjusted Layer Settle (in)**
Clay	0	5	2.5	5	120	300	3.5	1,050	1799	C		0.025	0.2	2	0.073763	4.43	3.10
Clay	5	10	7.5	5	57.6	744	2	1,488	1783	C		0.025	0.2	2	0.053522	3.21	2.25
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	1744	C		0.025	0.2	2	0.072095	4.33	4.33
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	1692	C		0.025	0.2	2	0.057792	3.47	3.47
Clay	20	25	22.5	5	57.6	1,608	1	1,608	1633	C		0.025	0.25	3	0.076113	4.57	4.57
Clay	25	30	27.5	5	57.6	1,896	1	1,896	1574	C		0.025	0.25	3	0.065608	3.94	3.94
Clay	30	35	32.5	5	57.6	2,184	1	2,184	1514	C		0.025	0.25	3	0.057189	3.43	3.43
Clay	35	40	37.5	5	57.6	2,472	1	2,472	1457	C		0.025	0.15	3	0.030186	1.81	1.81
Clay	40	45	42.5	5	57.6	2,760	1	2,760	1402	C		0.025	0.15	3	0.026764	1.61	1.61
Clay	45	50	47.5	5	57.6	3,048	1	3,048	1350	C		0.025	0.15	3	0.023892	1.43	1.43
Clay	50	55	52.5	5	57.6	3,336	1	3,336	1301	C		0.025	0.12	3	0.017165	1.03	1.03
Clay	55	60	57.5	5	57.6	3,624	1	3,624	1255	C		0.025	0.12	3	0.015498	0.93	0.93
Sand	60	80	70	20	57.6	4,344	1	4,344	1151	E	1200	0.025	0.1	N/A	0.000959	0.23	0.23

TOTAL= **32.11** inches

PLATE H-14

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: Dry Side Edge of Crest - Slope I-I' of Area B

Loaded	**Load, Q**	1,800	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **30.40** inches 2.03 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil	**Depth (feet)**			**Layer Height**	**γ**	**σ'v**			**Stress Distribution**	**Compress. Type**	**E**	**Cr**	**Cc**	**OCR**	**Strain**	**Layer**	**Adjusted Layer**
Layer	**top**	**bottom**	**center**	**(feet)**	**(pcf)**	**(psf)**	**OCR**	**σ'p (psf)**	**Δσ (psf)**	**E or C**	**(ksf)**	**1+e0**	**1+e0**	**Case**	**ε (in/in)**	**Settle (in)**	**Settle (in)**
Clay	0	5	2.5	5	120	300	3.5	1,050	1768	C		0.025	0.2	2	0.072471	4.35	3.04
Clay	5	10	7.5	5	57.6	744	2	1,488	1704	C		0.025	0.2	2	0.05077	3.05	2.13
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	1640	C		0.025	0.2	2	0.068766	4.13	4.13
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	1576	C		0.025	0.2	2	0.054381	3.26	3.26
Clay	20	25	22.5	5	57.6	1,608	1	1,608	1513	C		0.025	0.25	3	0.072015	4.32	4.32
Clay	25	30	27.5	5	57.6	1,896	1	1,896	1454	C		0.025	0.25	3	0.061786	3.71	3.71
Clay	30	35	32.5	5	57.6	2,184	1	2,184	1397	C		0.025	0.25	3	0.053682	3.22	3.22
Clay	35	40	37.5	5	57.6	2,472	1	2,472	1344	C		0.025	0.15	3	0.028276	1.70	1.70
Clay	40	45	42.5	5	57.6	2,760	1	2,760	1294	C		0.025	0.15	3	0.025041	1.50	1.50
Clay	45	50	47.5	5	57.6	3,048	1	3,048	1247	C		0.025	0.15	3	0.022344	1.34	1.34
Clay	50	55	52.5	5	57.6	3,336	1	3,336	1204	C		0.025	0.12	3	0.016056	0.96	0.96
Clay	55	60	57.5	5	57.6	3,624	1	3,624	1163	C		0.025	0.12	3	0.014506	0.87	0.87
Sand	60	80	70	20	57.6	4,344	1	4,344	1072	E	1200	0.025	0.1	N/A	0.000894	0.21	0.21

TOTAL= **30.40** inches

PLATE H-15

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: 2/3 of Height - Dry Side - Slope I-I' of Area B

Loaded	**Load, Q**	1,800	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **23.29** inches 1.55 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	**Depth (feet) top**	**bottom**	**center**	**Layer Height (feet)**	**γ (pcf)**	**σ'v (psf)**	**OCR**	**σ'p (psf)**	**Stress Distribution Δσ (psf)**	**Compress. Type E or C**	**E (ksf)**	**Cr 1+e0**	**Cc 1+e0**	**OCR Case**	**Strain ε (in/in)**	**Layer Settle (in)**	**Adjusted Layer Settle (in)**
Clay	0	5	2.5	5	120	300	3.5	1,050	1200	C		0.025	0.2	2	0.044569	2.67	1.87
Clay	5	10	7.5	5	57.6	744	2	1,488	1195	C		0.025	0.2	2	0.030501	1.83	1.28
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	1180	C		0.025	0.2	2	0.052367	3.14	3.14
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	1158	C		0.025	0.2	2	0.040859	2.45	2.45
Clay	20	25	22.5	5	57.6	1,608	1	1,608	1133	C		0.025	0.25	3	0.057896	3.47	3.47
Clay	25	30	27.5	5	57.6	1,896	1	1,896	1106	C		0.025	0.25	3	0.049892	2.99	2.99
Clay	30	35	32.5	5	57.6	2,184	1	2,184	1079	C		0.025	0.25	3	0.043601	2.62	2.62
Clay	35	40	37.5	5	57.6	2,472	1	2,472	1053	C		0.025	0.15	3	0.023123	1.39	1.39
Clay	40	45	42.5	5	57.6	2,760	1	2,760	1028	C		0.025	0.15	3	0.02063	1.24	1.24
Clay	45	50	47.5	5	57.6	3,048	1	3,048	1004	C		0.025	0.15	3	0.018552	1.11	1.11
Clay	50	55	52.5	5	57.6	3,336	1	3,336	981	C		0.025	0.12	3	0.013436	0.81	0.81
Clay	55	60	57.5	5	57.6	3,624	1	3,624	959	C		0.025	0.12	3	0.012234	0.73	0.73
Sand	60	80	70	20	57.6	4,344	1	4,344	907	E	1200	0.025	0.1	N/A	0.000756	0.18	0.18

TOTAL= **23.29** inches

PLATE H-16

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: 1/3 of Height - Dry Side - Slope I-I' of Area B

Loaded	**Load, Q**	1,800	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **13.56** inches 0.90 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	**Depth (feet) top**	**bottom**	**center**	**Layer Height (feet)**	**γ (pcf)**	**σ'v (psf)**	**OCR**	**σ'p (psf)**	**Stress Distribution Δσ (psf)**	**Compress. Type E or C**	**E (ksf)**	**Cr 1+e0**	**Cc 1+e0**	**OCR Case**	**Strain ε (in/in)**	**Layer Settle (in)**	**Adjusted Layer Settle (in)**
Clay	0	5	2.5	5	120	300	3.5	1,050	600	C		0.025	0.2	1	0.011931	0.72	0.50
Clay	5	10	7.5	5	57.6	744	2	1,488	605	C		0.025	0.2	1	0.00646	0.39	0.27
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	617	C		0.025	0.2	2	0.026863	1.61	1.61
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	635	C		0.025	0.2	2	0.020243	1.21	1.21
Clay	20	25	22.5	5	57.6	1,608	1	1,608	653	C		0.025	0.25	3	0.037017	2.22	2.22
Clay	25	30	27.5	5	57.6	1,896	1	1,896	670	C		0.025	0.25	3	0.032872	1.97	1.97
Clay	30	35	32.5	5	57.6	2,184	1	2,184	685	C		0.025	0.25	3	0.029615	1.78	1.78
Clay	35	40	37.5	5	57.6	2,472	1	2,472	696	C		0.025	0.15	3	0.016166	0.97	0.97
Clay	40	45	42.5	5	57.6	2,760	1	2,760	705	C		0.025	0.15	3	0.014812	0.89	0.89
Clay	45	50	47.5	5	57.6	3,048	1	3,048	710	C		0.025	0.15	3	0.013645	0.82	0.82
Clay	50	55	52.5	5	57.6	3,336	1	3,336	713	C		0.025	0.12	3	0.0101	0.61	0.61
Clay	55	60	57.5	5	57.6	3,624	1	3,624	714	C		0.025	0.12	3	0.009378	0.56	0.56
Sand	60	80	70	20	57.6	4,344	1	4,344	710	E	1200	0.025	0.1	N/A	0.000592	0.14	0.14
																TOTAL=	**13.56** inches

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: Dry Side Toe - Slope I-I' of Area B

Loaded	**Load, Q**	1,800	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **5.78** inches 0.39 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	**Depth (feet) top**	**bottom**	**center**	**Layer Height (feet)**	**γ (pcf)**	**σ'v (psf)**	**OCR**	**σ'p (psf)**	**Stress Distribution Δσ (psf)**	**Compress. Type E or C**	**E (ksf)**	**Cr 1+e0**	**Cc 1+e0**	**OCR Case**	**Strain ε (in/in)**	**Layer Settle (in)**	**Adjusted Layer Settle (in)**
Clay	0	5	2.5	5	120	300	3.5	1,050	32	C		0.025	0.2	1	0.001101	0.07	0.05
Clay	5	10	7.5	5	57.6	744	2	1,488	95	C		0.025	0.2	1	0.001299	0.08	0.05
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	155	C		0.025	0.2	1	0.001517	0.09	0.09
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	211	C		0.025	0.2	1	0.001611	0.10	0.10
Clay	20	25	22.5	5	57.6	1,608	1	1,608	263	C		0.025	0.25	3	0.016434	0.99	0.99
Clay	25	30	27.5	5	57.6	1,896	1	1,896	309	C		0.025	0.25	3	0.016403	0.98	0.98
Clay	30	35	32.5	5	57.6	2,184	1	2,184	350	C		0.025	0.25	3	0.016151	0.97	0.97
Clay	35	40	37.5	5	57.6	2,472	1	2,472	386	C		0.025	0.15	3	0.009456	0.57	0.57
Clay	40	45	42.5	5	57.6	2,760	1	2,760	417	C		0.025	0.15	3	0.009169	0.55	0.55
Clay	45	50	47.5	5	57.6	3,048	1	3,048	444	C		0.025	0.15	3	0.008852	0.53	0.53
Clay	50	55	52.5	5	57.6	3,336	1	3,336	466	C		0.025	0.12	3	0.006814	0.41	0.41
Clay	55	60	57.5	5	57.6	3,624	1	3,624	485	C		0.025	0.12	3	0.006543	0.39	0.39
Sand	60	80	70	20	57.6	4,344	1	4,344	518	E	1200	0.025	0.1	N/A	0.000432	0.10	0.10
																TOTAL=	**5.78** inches

PLATE H-18

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: Center of Levee - Slope A-A' of Area A

Loaded	**Load, Q**	1,200	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **19.12** inches 1.91 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	**Depth (feet) top**	**bottom**	**center**	**Layer Height (feet)**	**γ (pcf)**	**σ'v (psf)**	**OCR**	**σ'p (psf)**	**Stress Distribution Δσ (psf)**	**Compress. Type E or C**	**E (ksf)**	**Cr 1+e0**	**Cc 1+e0**	**OCR Case**	**Strain ε (in/in)**	**Layer Settle (in)**	**Adjusted Layer Settle (in)**
Clay	0	5	2.5	5	120	300	4	1,200	1199	C		0.025	0.15	2	0.029558	1.77	1.24
Clay	5	10	7.5	5	57.6	744	2.5	1,860	1189	C		0.025	0.15	2	0.012467	0.75	0.52
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	1165	C		0.025	0.15	2	0.039323	2.36	2.36
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	1132	C		0.025	0.15	2	0.030435	1.83	1.83
Clay	20	25	22.5	5	57.6	1,608	1	1,608	1094	C		0.025	0.22	3	0.049588	2.98	2.98
Clay	25	30	27.5	5	57.6	1,896	1	1,896	1055	C		0.025	0.22	3	0.042259	2.54	2.54
Clay	30	35	32.5	5	57.6	2,184	1	2,184	1015	C		0.025	0.22	3	0.036473	2.19	2.19
Clay	35	40	37.5	5	57.6	2,472	1	2,472	976	C		0.025	0.22	3	0.0318	1.91	1.91
Clay	40	45	42.5	5	57.6	2,760	1	2,760	938	C		0.025	0.15	3	0.019065	1.14	1.14
Clay	45	50	47.5	5	57.6	3,048	1	3,048	902	C		0.025	0.15	3	0.016886	1.01	1.01
Clay	50	55	52.5	5	57.6	3,336	1	3,336	867	C		0.025	0.11	3	0.011036	0.66	0.66
Clay	55	60	57.5	5	57.6	3,624	1	3,624	834	C		0.025	0.11	3	0.009891	0.59	0.59
sand	60	80	70	20	57.6	4,344	1	4,344	757	E	1200	0.025	0.11	N/A	0.000631	0.15	0.15
																TOTAL=	**19.12** inches

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: Center of Levee - Slope B-B' of Area A

Loaded	**Load, Q**	1,200	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **21.43** inches 2.14 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	**Depth (feet) top**	**bottom**	**center**	**Layer Height (feet)**	**γ (pcf)**	**σ'v (psf)**	**OCR**	**σ'p (psf)**	**Stress Distribution Δσ (psf)**	**Compress. Type E or C**	**E (ksf)**	**Cr 1+e0**	**Cc 1+e0**	**OCR Case**	**Strain ε (in/in)**	**Layer Settle (in)**	**Adjusted Layer Settle (in)**
Clay	0	5	2.5	5	120	300	4	1,200	1200	C		0.025	0.15	2	0.029571	1.77	1.24
Clay	5	10	7.5	5	57.6	744	2.5	1,860	1200	C		0.025	0.15	2	0.012818	0.77	0.54
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	1199	C		0.025	0.15	2	0.040338	2.42	2.42
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	1199	C		0.025	0.15	2	0.032191	1.93	1.93
Clay	20	25	22.5	5	57.6	1,608	1	1,608	1197	C		0.025	0.22	3	0.053168	3.19	3.19
Clay	25	30	27.5	5	57.6	1,896	1	1,896	1195	C		0.025	0.22	3	0.046697	2.80	2.80
Clay	30	35	32.5	5	57.6	2,184	1	2,184	1192	C		0.025	0.22	3	0.041612	2.50	2.50
Clay	35	40	37.5	5	57.6	2,472	1	2,472	1188	C		0.025	0.22	3	0.037496	2.25	2.25
Clay	40	45	42.5	5	57.6	2,760	1	2,760	1183	C		0.025	0.15	3	0.02324	1.39	1.39
Clay	45	50	47.5	5	57.6	3,048	1	3,048	1177	C		0.025	0.15	3	0.021275	1.28	1.28
Clay	50	55	52.5	5	57.6	3,336	1	3,336	1170	C		0.025	0.11	3	0.014366	0.86	0.86
Clay	55	60	57.5	5	57.6	3,624	1	3,624	1163	C		0.025	0.11	3	0.013292	0.80	0.80
Sand	60	80	70	20	57.6	4,344	1	4,344	1139	E	1200	0.025	0.11	N/A	0.000949	0.23	0.23

TOTAL= **21.43** inches

PLATE H-20

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: Center of Levee - Slope C-C' of Area A

Loaded	**Load, Q**	600	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **9.93** inches 1.99 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	**Depth (feet) top**	**bottom**	**center**	**Layer Height (feet)**	**γ (pcf)**	**σ'v (psf)**	**OCR**	**σ'p (psf)**	**Stress Distribution Δσ (psf)**	**Compress. Type E or C**	**E (ksf)**	**Cr 1+e0**	**Cc 1+e0**	**OCR Case**	**Strain ε (in/in)**	**Layer Settle (in)**	**Adjusted Layer Settle (in)**
Clay	0	5	2.5	5	120	300	4	1,200	600	C		0.025	0.15	1	0.011924	0.72	0.50
Clay	5	10	7.5	5	57.6	744	2.5	1,860	595	C		0.025	0.15	1	0.006377	0.38	0.27
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	582	C		0.025	0.15	2	0.019255	1.16	1.16
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	566	C		0.025	0.15	2	0.013341	0.80	0.80
Clay	20	25	22.5	5	57.6	1,608	1	1,608	547	C		0.025	0.22	3	0.027976	1.68	1.68
Clay	25	30	27.5	5	57.6	1,896	1	1,896	527	C		0.025	0.22	3	0.023447	1.41	1.41
Clay	30	35	32.5	5	57.6	2,184	1	2,184	508	C		0.025	0.22	3	0.019966	1.20	1.20
Clay	35	40	37.5	5	57.6	2,472	1	2,472	488	C		0.025	0.22	3	0.017217	1.03	1.03
Clay	40	45	42.5	5	57.6	2,760	1	2,760	469	C		0.025	0.15	3	0.010228	0.61	0.61
Clay	45	50	47.5	5	57.6	3,048	1	3,048	451	C		0.025	0.15	3	0.008988	0.54	0.54
Clay	50	55	52.5	5	57.6	3,336	1	3,336	433	C		0.025	0.11	3	0.005836	0.35	0.35
Clay	55	60	57.5	5	57.6	3,624	1	3,624	417	C		0.025	0.11	3	0.005201	0.31	0.31
Sand	60	80	70	20	57.6	4,344	1	4,344	379	E	1200	0.025	0.11	N/A	0.000316	0.08	0.08
																TOTAL=	**9.93** inches

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: Center of Levee - Slope F-F'

Loaded	**Load, Q**	1,680	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **33.44** inches 2.39 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	**Depth (feet) top**	**bottom**	**center**	**Layer Height (feet)**	**γ (pcf)**	**σ'v (psf)**	**OCR**	**σ'p (psf)**	**Stress Distribution Δσ (psf)**	**Compress. Type E or C**	**E (ksf)**	**Cr 1+e0**	**Cc 1+e0**	**OCR Case**	**Strain ε (in/in)**	**Layer Settle (in)**	**Adjusted Layer Settle (in)**
Clay	0	5	2.5	5	120	300	3.5	1,050	1679	C		0.025	0.2	2	0.068659	4.12	2.88
Clay	5	10	7.5	5	57.6	744	2	1,488	1680	C		0.025	0.2	2	0.049899	2.99	2.10
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	1679	C		0.025	0.2	2	0.070048	4.20	4.20
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	1679	C		0.025	0.2	2	0.057421	3.45	3.45
Clay	20	25	22.5	5	57.6	1,608	1	1,608	1678	C		0.025	0.25	3	0.077591	4.66	4.66
Clay	25	30	27.5	5	57.6	1,896	1	1,896	1676	C		0.025	0.25	3	0.068777	4.13	4.13
Clay	30	35	32.5	5	57.6	2,184	1	2,184	1674	C		0.025	0.25	3	0.061778	3.71	3.71
Clay	35	40	37.5	5	57.6	2,472	1	2,472	1671	C		0.025	0.15	3	0.03364	2.02	2.02
Clay	40	45	42.5	5	57.6	2,760	1	2,760	1667	C		0.025	0.15	3	0.030783	1.85	1.85
Clay	45	50	47.5	5	57.6	3,048	1	3,048	1663	C		0.025	0.15	3	0.028359	1.70	1.70
Clay	50	55	52.5	5	57.6	3,336	1	3,336	1657	C		0.025	0.12	3	0.021017	1.26	1.26
Clay	55	60	57.5	5	57.6	3,624	1	3,624	1651	C		0.025	0.12	3	0.01956	1.17	1.17
Sand	60	80	70	20	57.6	4,344	1	4,344	1631	E	1200	0.025	0.1	N/A	0.001359	0.33	0.33

TOTAL= **33.44** inches

PLATE H-22

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: Center of Levee - Slope H-H' of Area B

Loaded	**Load, Q**	1,680	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **32.91** inches 2.35 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	**Depth (feet) top**	**bottom**	**center**	**Layer Height (feet)**	**γ (pcf)**	**σ'v (psf)**	**OCR**	**σ'p (psf)**	**Stress Distribution Δσ (psf)**	**Compress. Type E or C**	**E (ksf)**	**Cr 1+e0**	**Cc 1+e0**	**OCR Case**	**Strain ε (in/in)**	**Layer Settle (in)**	**Adjusted Layer Settle (in)**
Clay	0	5	2.5	5	120	300	3.5	1,050	1680	C		0.025	0.2	2	0.068675	4.12	2.88
Clay	5	10	7.5	5	57.6	744	2	1,488	1679	C		0.025	0.2	2	0.049881	2.99	2.10
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	1677	C		0.025	0.2	2	0.069962	4.20	4.20
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	1672	C		0.025	0.2	2	0.057213	3.43	3.43
Clay	20	25	22.5	5	57.6	1,608	1	1,608	1663	C		0.025	0.25	3	0.077112	4.63	4.63
Clay	25	30	27.5	5	57.6	1,896	1	1,896	1652	C		0.025	0.25	3	0.068023	4.08	4.08
Clay	30	35	32.5	5	57.6	2,184	1	2,184	1636	C		0.025	0.25	3	0.06071	3.64	3.64
Clay	35	40	37.5	5	57.6	2,472	1	2,472	1618	C		0.025	0.15	3	0.032797	1.97	1.97
Clay	40	45	42.5	5	57.6	2,760	1	2,760	1596	C		0.025	0.15	3	0.029733	1.78	1.78
Clay	45	50	47.5	5	57.6	3,048	1	3,048	1573	C		0.025	0.15	3	0.027104	1.63	1.63
Clay	50	55	52.5	5	57.6	3,336	1	3,336	1547	C		0.025	0.12	3	0.019856	1.19	1.19
Clay	55	60	57.5	5	57.6	3,624	1	3,624	1520	C		0.025	0.12	3	0.018254	1.10	1.10
Sand	60	80	70	20	57.6	4,344	1	4,344	1449	E	1200	0.025	0.1	N/A	0.001207	0.29	0.29

TOTAL= **32.91** inches

PLATE H-23

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: Center of Surchage Area B

Loaded	**Load, Q**	3,000	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **51.83** inches 2.07 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil	**Depth (feet)**			**Layer Height**	**γ**	**σ'v**			**Stress Distribution**	**Compress. Type**	**E**	**Cr**	**Cc**	**OCR**	**Strain**	**Layer**	**Adjusted Layer**
Layer	**top**	**bottom**	**center**	**(feet)**	**(pcf)**	**(psf)**	**OCR**	**σ'p (psf)**	**Δσ (psf)**	**E or C**	**(ksf)**	**1+e0**	**1+e0**	**Case**	**ε (in/in)**	**Settle (in)**	**Settle (in)**
Clay	0	5	2.5	5	120	300	3.5	1,050	2999	C		0.025	0.2	2	0.113051	6.78	4.75
Clay	5	10	7.5	5	57.6	744	2	1,488	3000	C		0.025	0.2	2	0.087667	5.26	3.68
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	3000	C		0.025	0.2	2	0.104505	6.27	6.27
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	2999	C		0.025	0.2	2	0.089113	5.35	5.35
Clay	20	25	22.5	5	57.6	1,608	1	1,608	2999	C		0.025	0.25	3	0.114279	6.86	6.86
Clay	25	30	27.5	5	57.6	1,896	1	1,896	2998	C		0.025	0.25	3	0.102956	6.18	6.18
Clay	30	35	32.5	5	57.6	2,184	1	2,184	2997	C		0.025	0.25	3	0.093784	5.63	5.63
Clay	35	40	37.5	5	57.6	2,472	1	2,472	2995	C		0.025	0.15	3	0.051706	3.10	3.10
Clay	40	45	42.5	5	57.6	2,760	1	2,760	2993	C		0.025	0.15	3	0.047846	2.87	2.87
Clay	45	50	47.5	5	57.6	3,048	1	3,048	2990	C		0.025	0.15	3	0.044534	2.67	2.67
Clay	50	55	52.5	5	57.6	3,336	1	3,336	2987	C		0.025	0.12	3	0.033323	2.00	2.00
Clay	55	60	57.5	5	57.6	3,624	1	3,624	2983	C		0.025	0.12	3	0.031299	1.88	1.88
Sand	60	80	70	20	57.6	4,344	1	4,344	2971	E	1200	0.025	0.1	N/A	0.002476	0.59	0.59

TOTAL= **51.83** inches

PLATE H-24

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: Center of Levee - Area C Surcharge

Loaded	**Load, Q**	3,600	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

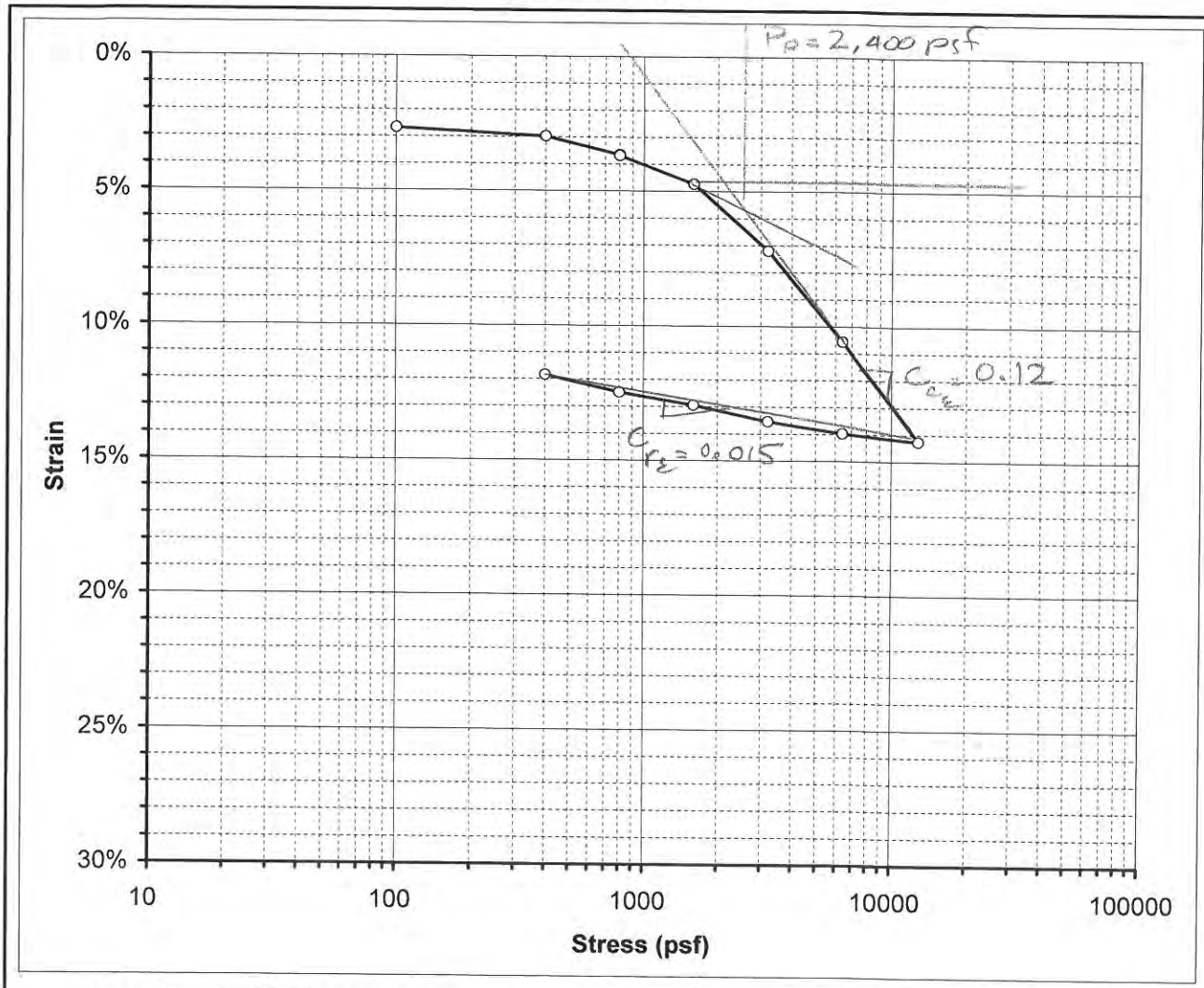
TOTAL= **31.63** inches 1.05 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	**Depth (feet) top**	**bottom**	**center**	**Layer Height (feet)**	**γ (pcf)**	**σ'v (psf)**	**OCR**	**σ'p (psf)**	**Stress Distribution Δσ (psf)**	**Compress. Type E or C**	**E (ksf)**	**Cr 1+e0**	**Cc 1+e0**	**OCR Case**	**Strain ε (in/in)**	**Layer Settle (in)**	**Adjusted Layer Settle (in)**
Clay	0	5	2.5	5	120	300	4	1,200	3599	C		0.025	0.075	2	0.053437	3.21	2.24
Clay	5	10	7.5	5	57.6	744	2.5	1,860	3600	C		0.025	0.075	2	0.037575	2.25	1.58
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	3600	C		0.025	0.075	2	0.044945	2.70	2.70
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	3599	C		0.025	0.075	2	0.03889	2.33	2.33
Clay	20	25	22.5	5	57.6	1,608	1	1,608	3599	C		0.025	0.125	3	0.063784	3.83	3.83
Clay	25	30	27.5	5	57.6	1,896	1	1,896	3598	C		0.025	0.125	3	0.057752	3.47	3.47
Clay	30	35	32.5	5	57.6	2,184	1	2,184	3596	C		0.025	0.125	3	0.052835	3.17	3.17
Clay	35	40	37.5	5	57.6	2,472	1	2,472	3594	C		0.025	0.125	3	0.048732	2.92	2.92
Clay	40	45	42.5	5	57.6	2,760	1	2,760	3591	C		0.025	0.11	3	0.039816	2.39	2.39
Clay	45	50	47.5	5	57.6	3,048	1	3,048	3588	C		0.025	0.11	3	0.03717	2.23	2.23
Clay	50	55	52.5	5	57.6	3,336	1	3,336	3584	C		0.025	0.11	3	0.034859	2.09	2.09
Clay	55	60	57.5	5	57.6	3,624	1	3,624	3580	C		0.025	0.11	3	0.032821	1.97	1.97
sand	60	80	70	20	57.6	4,344	1	4,344	3565	E	1200	0.025	0.11	N/A	0.002971	0.71	0.71

TOTAL= **31.63** inches

PLATE H-25

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-HSA051	Sample Depth	10 ft
Sample No.	R5	USCS	0

BEFORE TEST

Initial Moisture Content:	43.6%	
Initial Dry Unit Wt:	77.5	pcf
Initial Total Unit Wt.:	111.3	pcf
Initial Void Ratio:	1.2466	
Initial Degree of Saturation:	97.5%	

AFTER TEST

Final Moisture Content:	36.8%	
Final Dry Unit Wt:	86.3	pcf
Final Total Unit Wt.:	114.5	pcf
Final Void Ratio:	1.0165	
Final Degree of Saturation:	100.9%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	2.69%	1.1861
400	2.99%	1.1793
800	3.67%	1.1642
800	3.70%	1.1635
1600	4.74%	1.1401
3200	7.22%	1.0845
6400	10.57%	1.0091
12800	14.27%	0.9260
6400	13.98%	0.9326
3200	13.55%	0.9423
1600	12.95%	0.9556
800	12.48%	0.9662
400	11.85%	0.9804

$\sigma_v' = 5 \times 120 + 5 \times 57.6 = 888$

$OCR = \frac{2400}{888} = 2.7$

PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA CONSULTANTS

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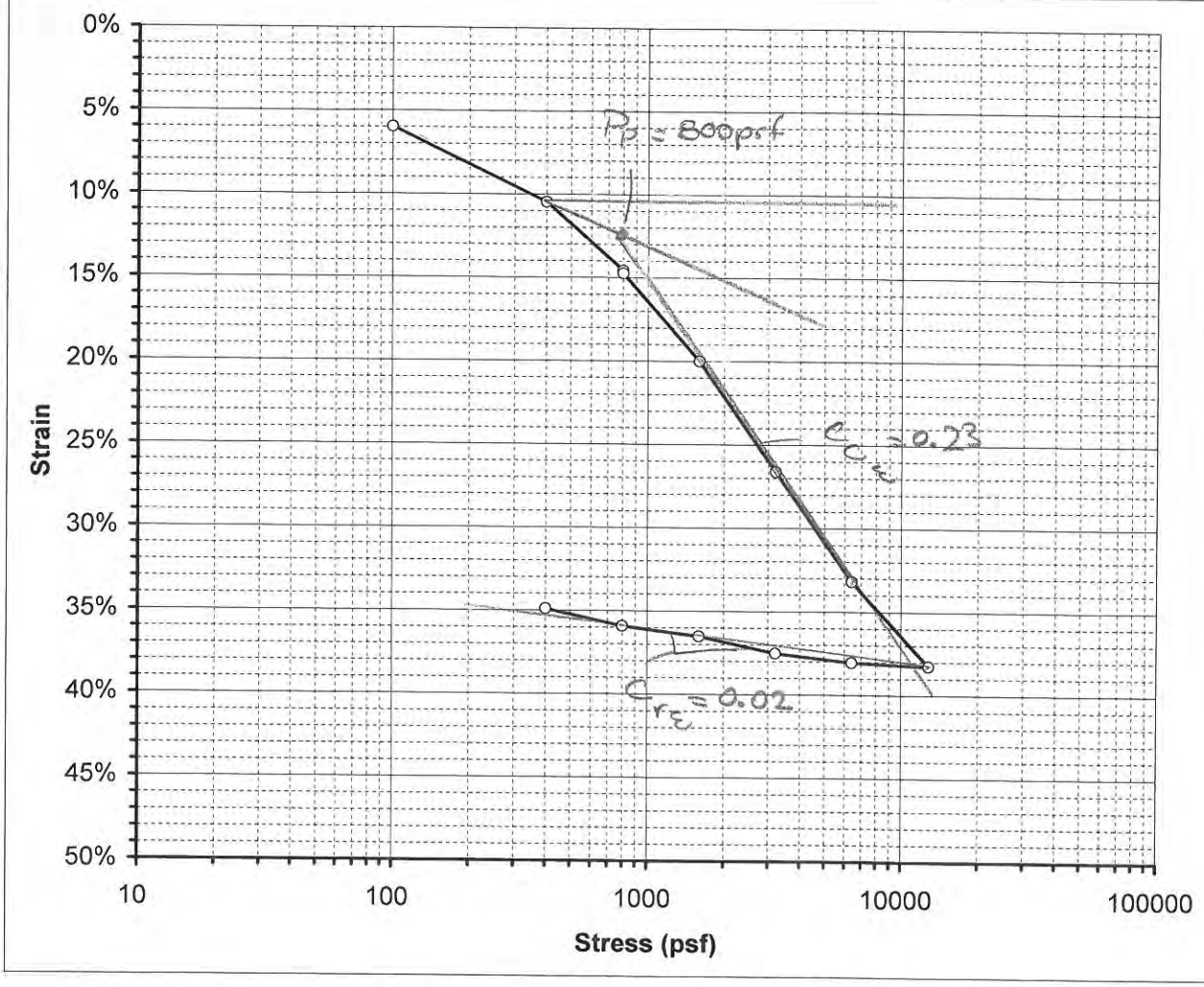
PLATE H-26

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW030	Sample Depth	10
Sample No.	R3	USCS	0

BEFORE TEST

Initial Moisture Content:	107.6%	
Initial Dry Unit Wt:	43.5	pcf
Initial Total Unit Wt.:	90.3	pcf
Initial Void Ratio:	3.0033	
Initial Degree of Saturation:	100.0%	

AFTER TEST

Final Moisture Content:	61.0%	
Final Dry Unit Wt:	64.6	pcf
Final Total Unit Wt.:	152.6	pcf
Final Void Ratio:	1.6946	
Final Degree of Saturation:	100.5%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

$\sigma_v' = 5 \times 120 + 5 \times 57.6 = 888$ psf

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	5.99%	2.7633
400	10.49%	2.5833
800	14.58%	2.4197
800	14.75%	2.4128
1600	20.01%	2.2022
3200	26.63%	1.9373
6400	33.19%	1.6745
12800	38.26%	1.4715
6400	38.06%	1.4795
3200	37.51%	1.5016
1600	36.53%	1.5410
800	35.92%	1.5652
400	34.92%	1.6053

PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

$OCR = \frac{800}{888} \sim 1.0$

FIGURE NO. B-3

GROUP DELTA CONSULTANTS

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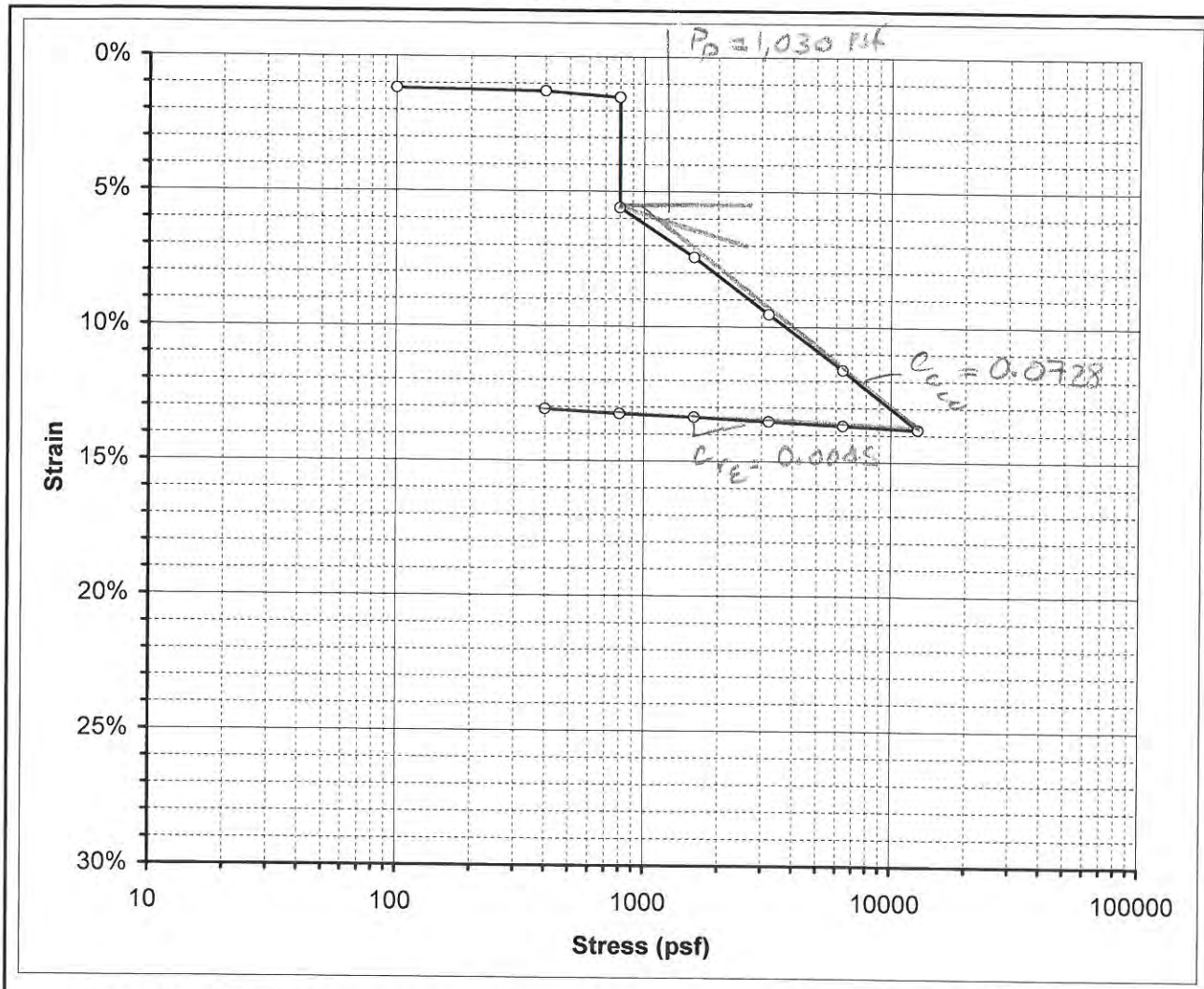
PLATE H-27

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	C-HSA061	Sample Depth	7.5 ft
Sample No.	R3	USCS	0

BEFORE TEST

Initial Moisture Content:	7.2%	
Initial Dry Unit Wt:	88.6	pcf
Initial Total Unit Wt.:	94.9	pcf
Initial Void Ratio:	0.9655	
Initial Degree of Saturation:	20.8%	

AFTER TEST

Final Moisture Content:	20.7%	
Final Dry Unit Wt:	101.4	pcf
Final Total Unit Wt.:	117.1	pcf
Final Void Ratio:	0.7167	
Final Degree of Saturation:	80.7%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.20%	0.9419
400	1.30%	0.9400
800	1.52%	0.9356
800	5.62%	0.8551
1600	7.45%	0.8191
3200	9.55%	0.7778
6400	11.61%	0.7373
12800	13.80%	0.6943
6400	13.67%	0.6968
3200	13.53%	0.6996
1600	13.37%	0.7027
800	13.26%	0.7049
400	13.09%	0.7082

$\sigma_v' = 120 \times 7.5 = 900$ psf OCR = $\frac{1,030}{900} = 1.15$

PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA CONSULTANTS

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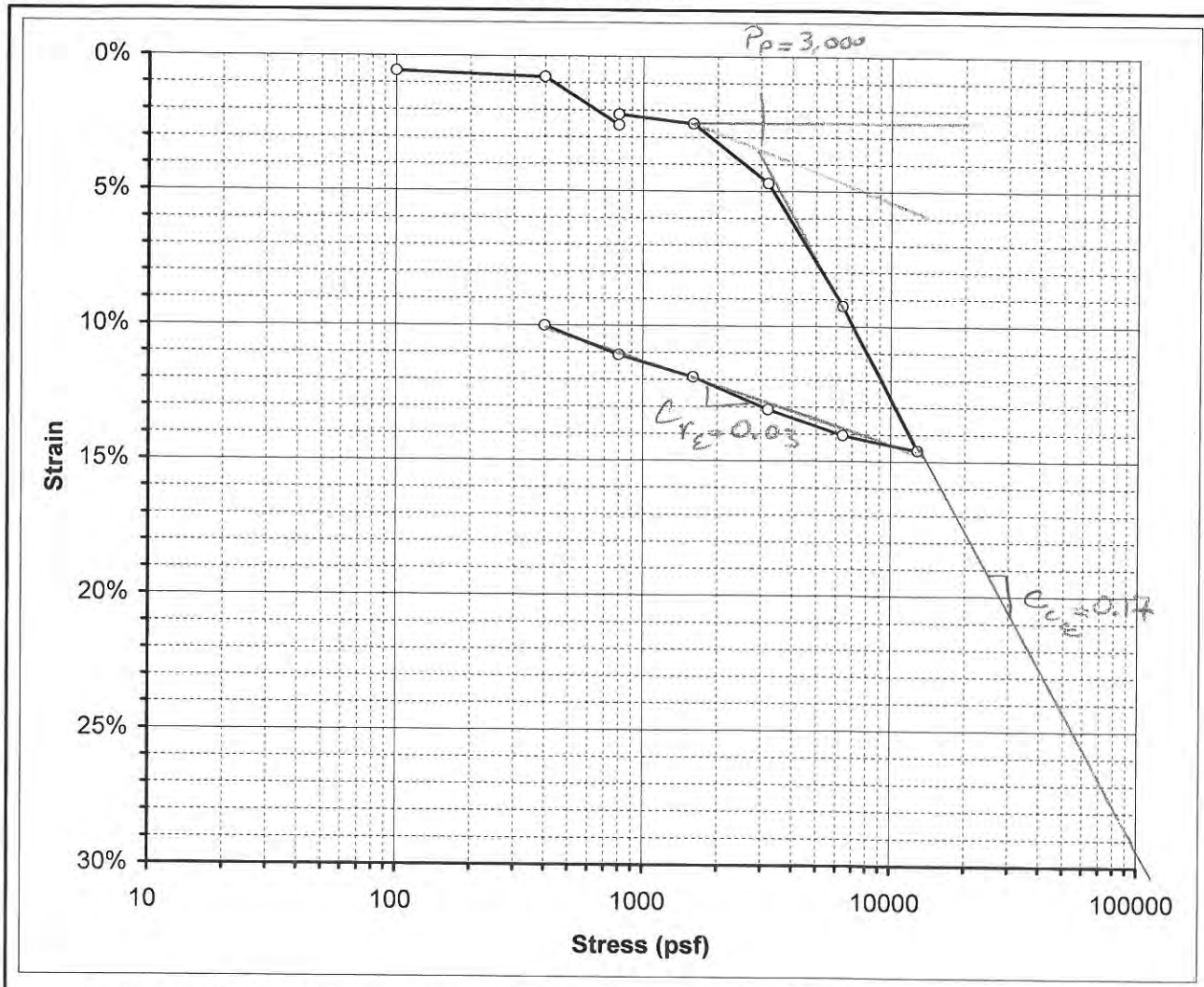
CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-HSA051	Sample Depth	5 ft
Sample No.	R3	USCS	0

BEFORE TEST	Initial Moisture Content:	45.1%	
	Initial Dry Unit Wt:	75.7	pcf
	Initial Total Unit Wt.:	109.9	pcf
	Initial Void Ratio:	1.2998	
	Initial Degree of Saturation:	96.9%	
AFTER TEST	Final Moisture Content:	40.9%	
	Final Dry Unit Wt:	82.5	pcf
	Final Total Unit Wt.:	111.6	pcf
	Final Void Ratio:	1.1111	
	Final Degree of Saturation:	102.6%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	0.57%	1.2867
400	0.78%	1.2819
800	2.58%	1.2406
800	2.17%	1.2498
1600	2.51%	1.2422
3200	4.71%	1.1915
6400	9.26%	1.0869
12800	14.60%	0.9641
6400	14.05%	0.9768
3200	13.11%	0.9984
1600	11.90%	1.0261
800	11.10%	1.0445
400	10.03%	1.0692

$\sigma_v' = 5 \times 120 = 600$ psf $OCR = \frac{3000}{600} \approx 5.0$

PROJECT NUMBER: LA-962A

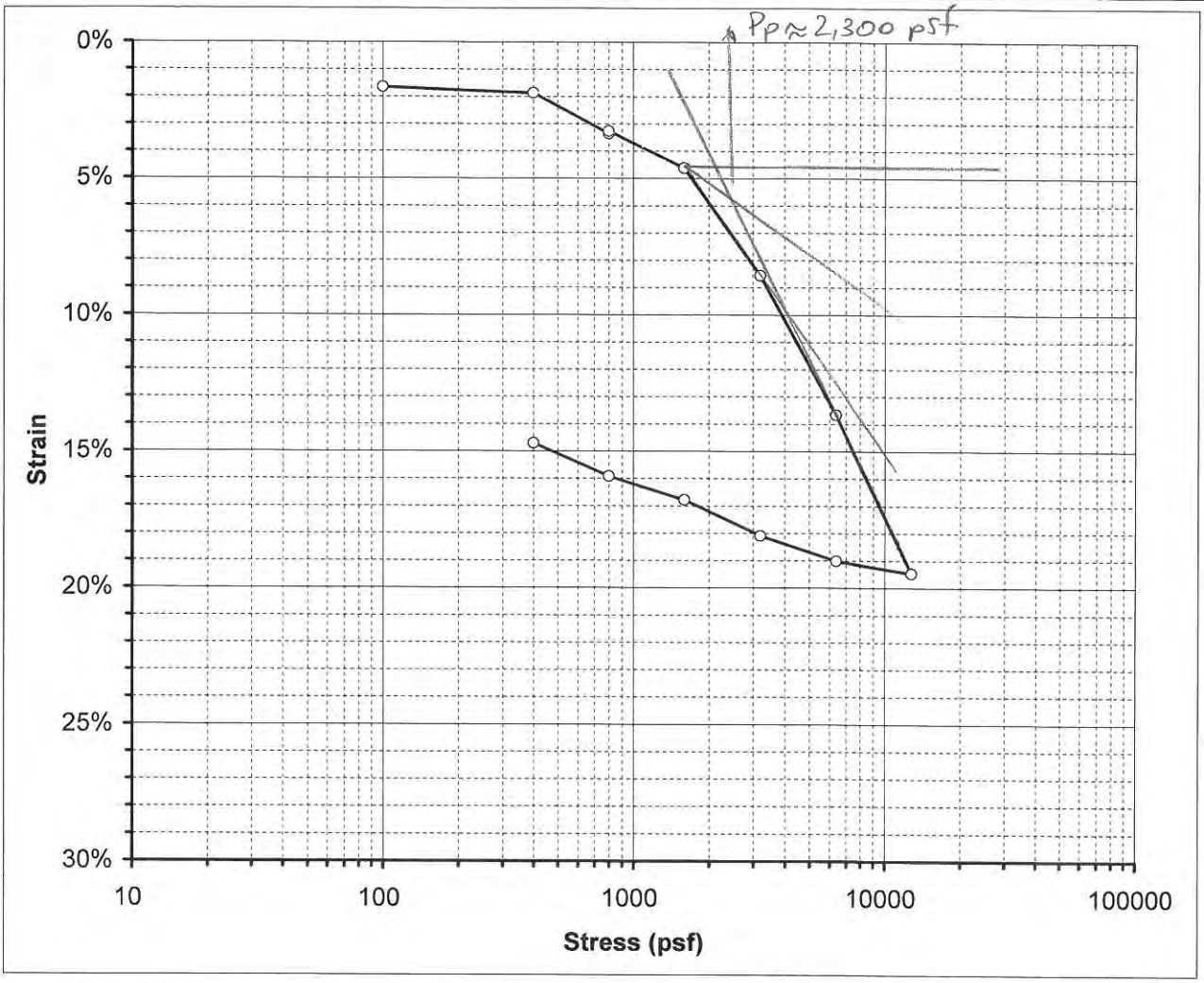
PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA CONSULTANTS

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 11-9-12\B-HSA051 R3@5'_2.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW032	Sample Depth	10
Sample No.	R3A	USCS	CH

BEFORE TEST

Initial Moisture Content:	53.5%	
Initial Dry Unit Wt:	69.4	pcf
Initial Total Unit Wt.:	106.6	pcf
Initial Void Ratio:	1.5080	
Initial Degree of Saturation:	99.1%	

AFTER TEST

Final Moisture Content:	44.0%	
Final Dry Unit Wt:	79.8	pcf
Final Total Unit Wt.:	118.1	pcf
Final Void Ratio:	1.1817	
Final Degree of Saturation:	103.9%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=	71	PL=	28	PI=	43

$\sigma_v' \approx 1{,}200$ psf OCR ~ 2.0

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.65%	1.4667
400	1.87%	1.4612
800	3.35%	1.4239
800	3.26%	1.4262
1600	4.62%	1.3922
3200	8.55%	1.2935
6400	13.65%	1.1656
12800	19.47%	1.0198
6400	19.01%	1.0314
3200	18.09%	1.0543
1600	16.79%	1.0870
800	15.92%	1.1087
400	14.71%	1.1391

PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

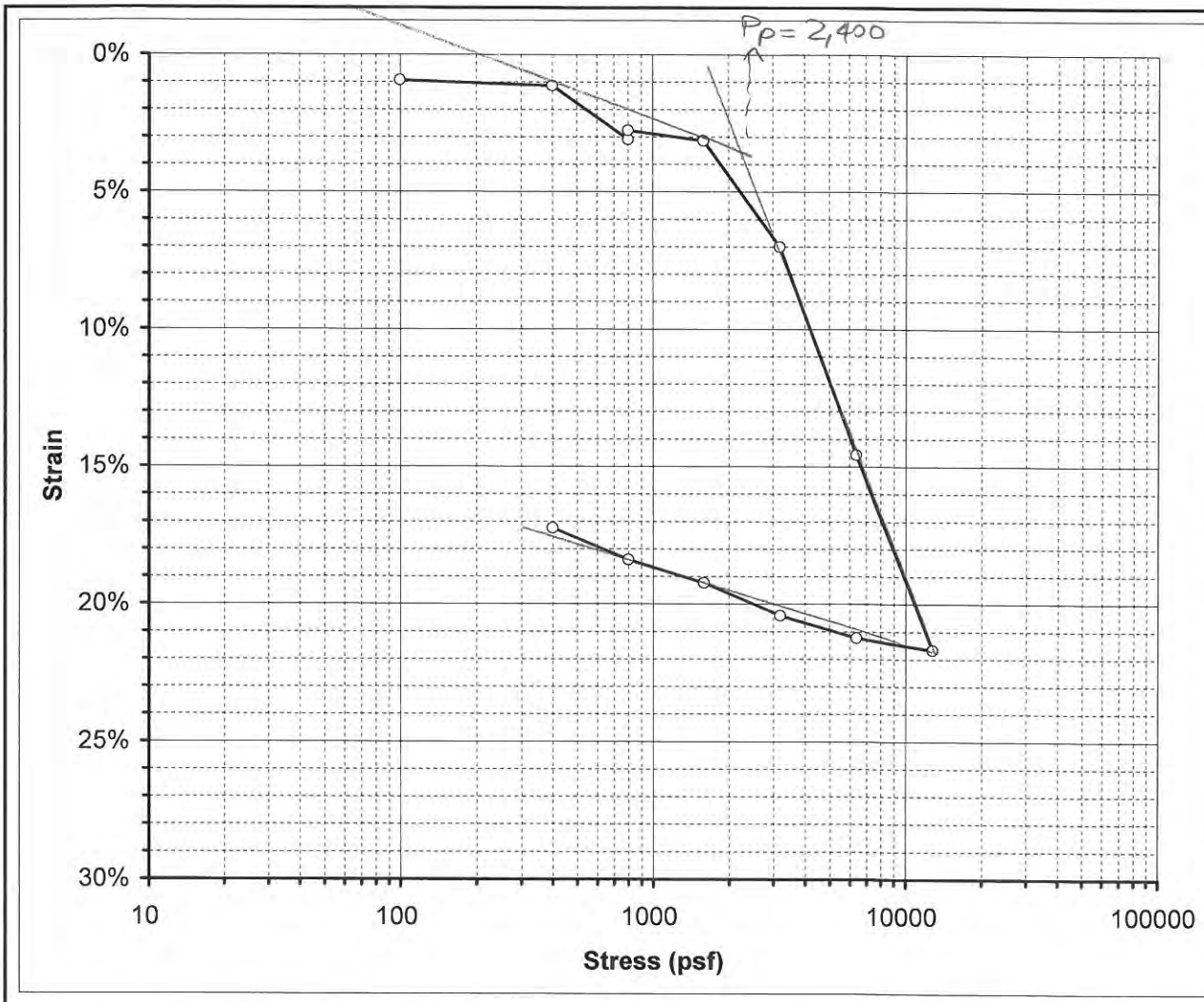
FIGURE NO. B-3

GROUP DELTA

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 9-21-12\Consol B-RW032R3A@10'_2.xls

PLATE H-30

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW036	Sample Depth	30
Sample No.	R6A	USCS	MH

BEFORE TEST

Initial Moisture Content:	58.8%	
Initial Dry Unit Wt:	64.8	pcf
Initial Total Unit Wt.:	102.9	pcf
Initial Void Ratio:	1.6871	
Initial Degree of Saturation:	97.3%	

AFTER TEST

Final Moisture Content:	46.7%	
Final Dry Unit Wt:	76.3	pcf
Final Total Unit Wt.:	121.1	pcf
Final Void Ratio:	1.2809	
Final Degree of Saturation:	101.6%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

$\sigma_v' \approx 2,400$ OCR ~ 1

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	0.93%	1.6619
400	1.13%	1.6568
800	3.10%	1.6039
800	2.75%	1.6131
1600	3.14%	1.6028
3200	7.01%	1.4988
6400	14.56%	1.2958
12800	21.67%	1.1048
6400	21.23%	1.1167
3200	20.41%	1.1386
1600	19.24%	1.1702
800	18.39%	1.1929
400	17.24%	1.2239

PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

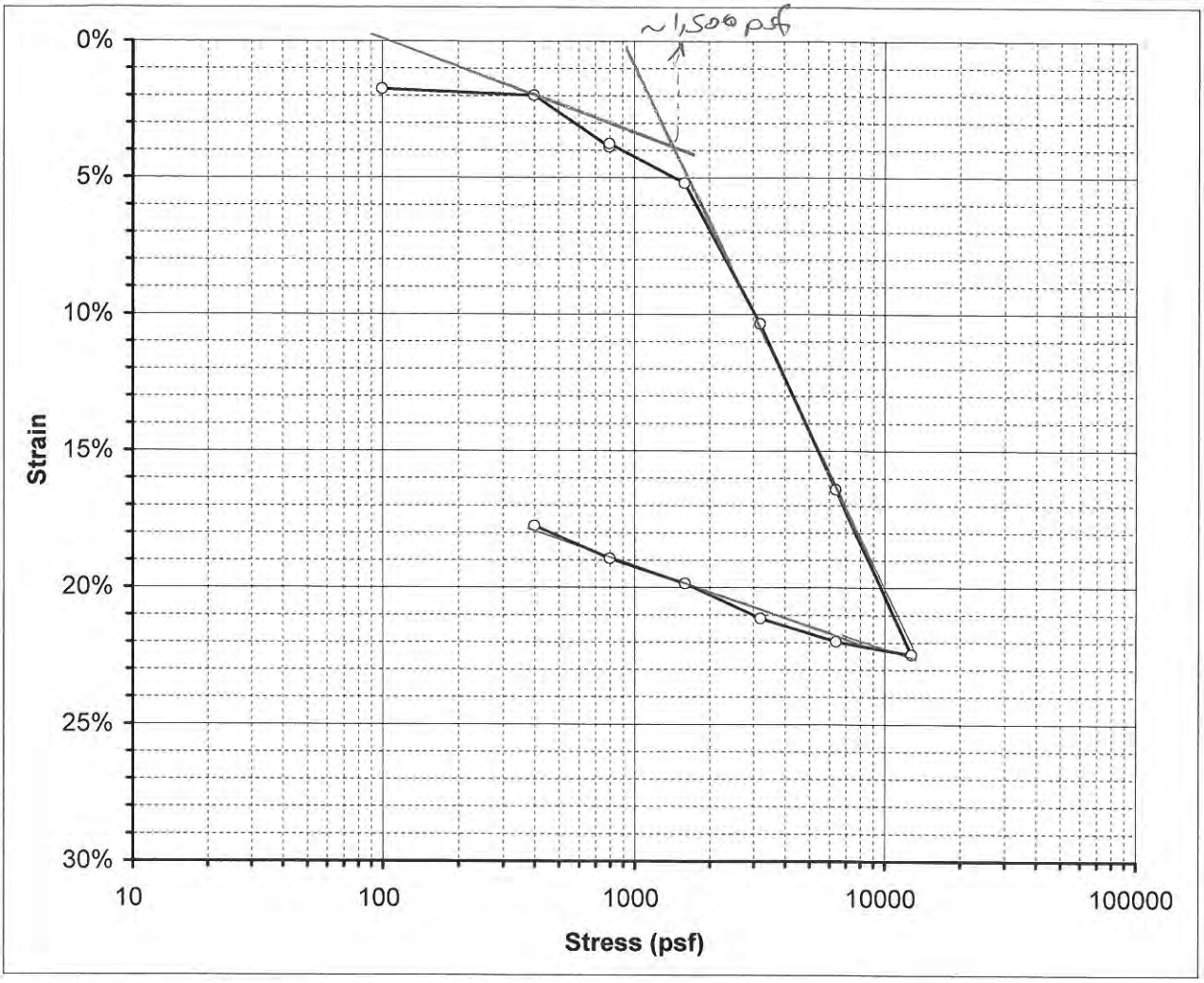
FIGURE NO. B-3

GROUP DELTA CONSULTANTS

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 9-21-12\Consol B-RW036R6A@30'_4.xls

PLATE H-31

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW036	Sample Depth	10
Sample No.	R2A	USCS	CH

BEFORE TEST

Initial Moisture Content:	51.2%	
Initial Dry Unit Wt:	71.3	pcf
Initial Total Unit Wt.:	107.7	pcf
Initial Void Ratio:	1.4431	
Initial Degree of Saturation:	98.9%	

AFTER TEST

Final Moisture Content:	39.0%	
Final Dry Unit Wt:	84.8	pcf
Final Total Unit Wt.:	122.3	pcf
Final Void Ratio:	1.0521	
Final Degree of Saturation:	103.3%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=	60	PL=	28	PI=	32

$\sigma_v' \simeq 1150$ psf OCR ~ 1.3

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.75%	1.4004
400	1.99%	1.3945
800	3.88%	1.3484
800	3.76%	1.3513
1600	5.19%	1.3163
3200	10.35%	1.1902
6400	16.41%	1.0423
12800	22.44%	0.8949
6400	21.97%	0.9064
3200	21.12%	0.9270
1600	19.85%	0.9581
800	18.95%	0.9802
400	17.75%	1.0094

PROJECT NUMBER: LA-962A

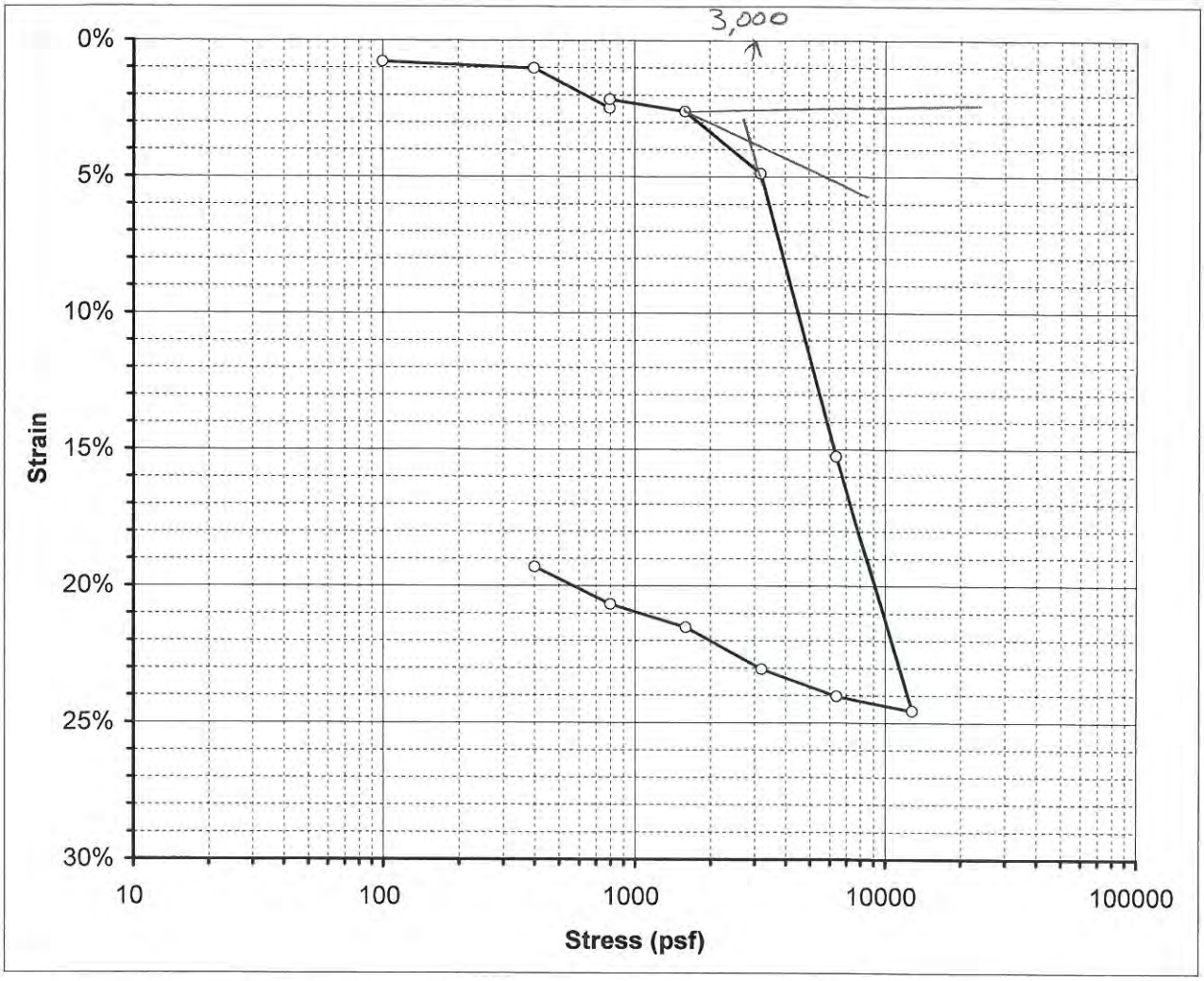
PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 9-21-12\Consol B-RW036R2A@10'_3.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW006	Sample Depth	35 ft
Sample No.	R8A	USCS	MH

BEFORE TEST

Initial Moisture Content:	75.0%	
Initial Dry Unit Wt:	56.1	pcf
Initial Total Unit Wt.:	98.2	pcf
Initial Void Ratio:	2.1032	
Initial Degree of Saturation:	99.5%	

AFTER TEST

Final Moisture Content:	59.2%	
Final Dry Unit Wt:	68.1	pcf
Final Total Unit Wt.:	124.1	pcf
Final Void Ratio:	1.5571	
Final Degree of Saturation:	106.1%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=	64	PL=	33	PI=	31

$\sigma_v' \approx 2650$ OCR ~ 1.1

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	0.78%	2.0790
400	1.02%	2.0716
800	2.48%	2.0263
800	2.16%	2.0362
1600	2.60%	2.0225
3200	4.89%	1.9515
6400	15.25%	1.6300
12800	24.56%	1.3411
6400	24.03%	1.3575
3200	23.04%	1.3882
1600	21.51%	1.4357
800	20.67%	1.4618
400	19.31%	1.5040

PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

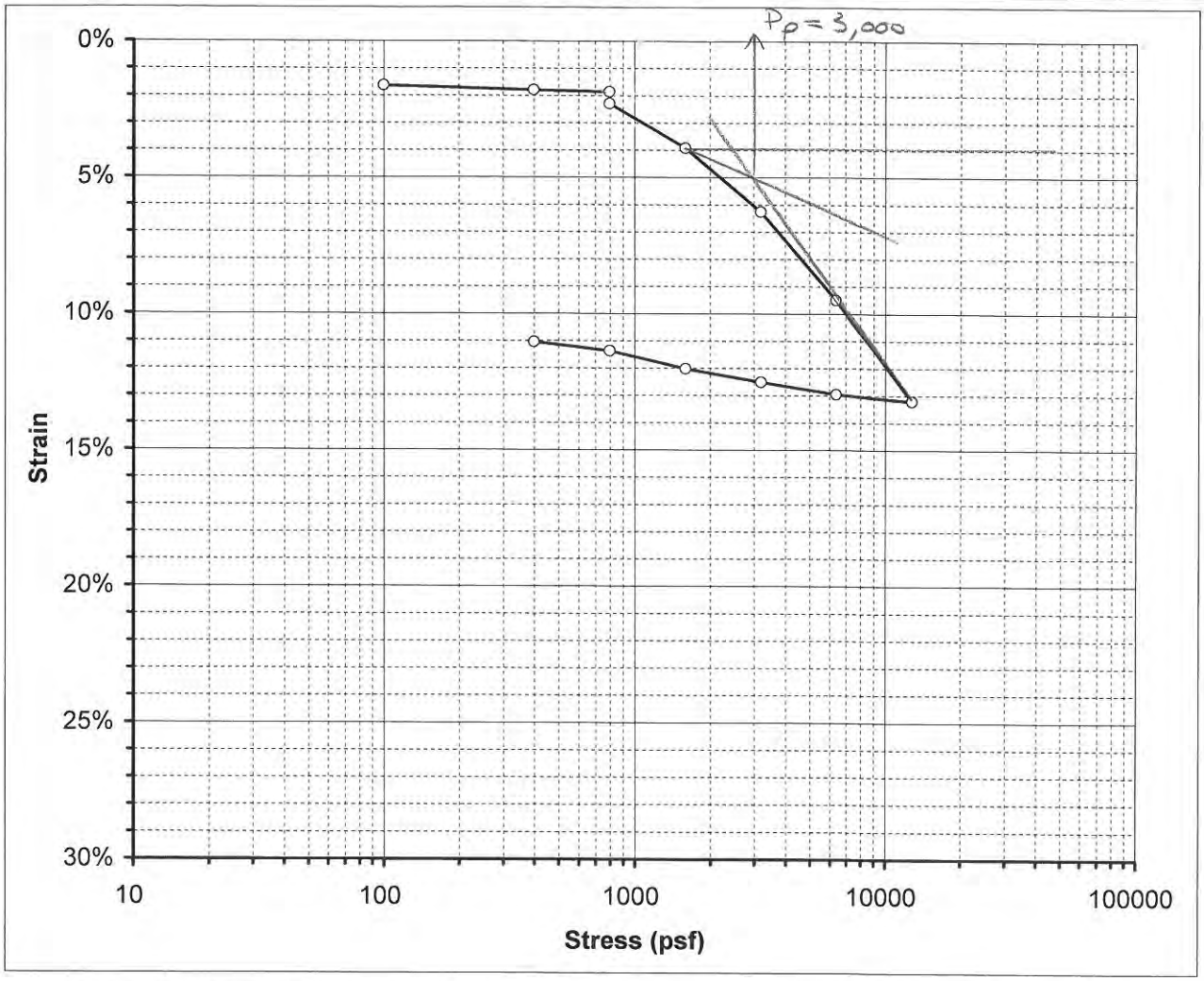
FIGURE NO. B-3

GROUP DELTA CONSULTANTS

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 9-21-12\Consol A-RW006R8A@35'_1.xls

PLATE H-33

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW044	Sample Depth	55 ft
Sample No.	R11	USCS	0

BEFORE TEST

Initial Moisture Content:	33.3%	
Initial Dry Unit Wt:	88.0	pcf
Initial Total Unit Wt.:	117.3	pcf
Initial Void Ratio:	0.9775	
Initial Degree of Saturation:	95.0%	

AFTER TEST

Final Moisture Content:	27.8%	
Final Dry Unit Wt:	98.4	pcf
Final Total Unit Wt.:	114.5	pcf
Final Void Ratio:	0.7692	
Final Degree of Saturation:	100.9%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

$\sigma_v' \approx 3,500$ psf OCR = 1

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.63%	0.9452
400	1.79%	0.9420
800	1.86%	0.9406
800	2.29%	0.9321
1600	3.92%	0.9000
3200	6.26%	0.8536
6400	9.49%	0.7898
12800	13.21%	0.7163
6400	12.96%	0.7213
3200	12.51%	0.7302
1600	12.02%	0.7397
800	11.36%	0.7528
400	11.04%	0.7591

PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

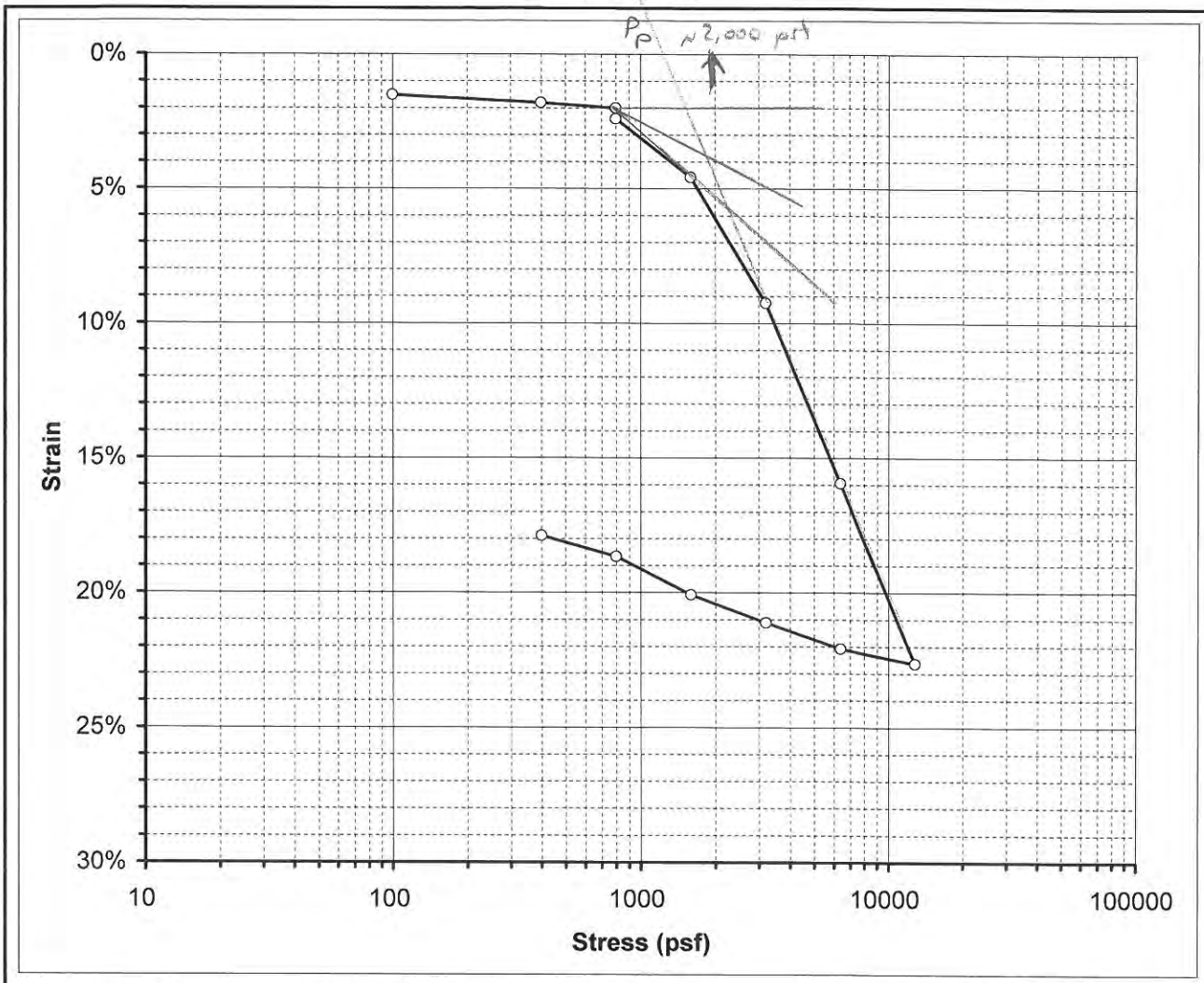
FIGURE NO. B-3

GROUP DELTA

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-3-12\Consol B-RW044R11@55'_4.xls

PLATE H-34

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW041	Sample Depth	25 ft
Sample No.	R6A	USCS	0

BEFORE TEST

Initial Moisture Content:	58.0%	
Initial Dry Unit Wt:	65.2	pcf
Initial Total Unit Wt.:	103.0	pcf
Initial Void Ratio:	1.6717	
Initial Degree of Saturation:	96.8%	

AFTER TEST

Final Moisture Content:	45.4%	
Final Dry Unit Wt:	78.3	pcf
Final Total Unit Wt.:	122.9	pcf
Final Void Ratio:	1.2229	
Final Degree of Saturation:	103.5%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=	64	PL=	33	PI=	31

$\sigma_v' \approx 2{,}100$ psf OCR = 1

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.52%	1.6311
400	1.81%	1.6234
800	2.00%	1.6183
800	2.40%	1.6076
1600	4.57%	1.5496
3200	9.25%	1.4246
6400	15.94%	1.2459
12800	22.63%	1.0671
6400	22.08%	1.0818
3200	21.11%	1.1077
1600	20.08%	1.1353
800	18.67%	1.1729
400	17.89%	1.1938

PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA CONSULTANTS

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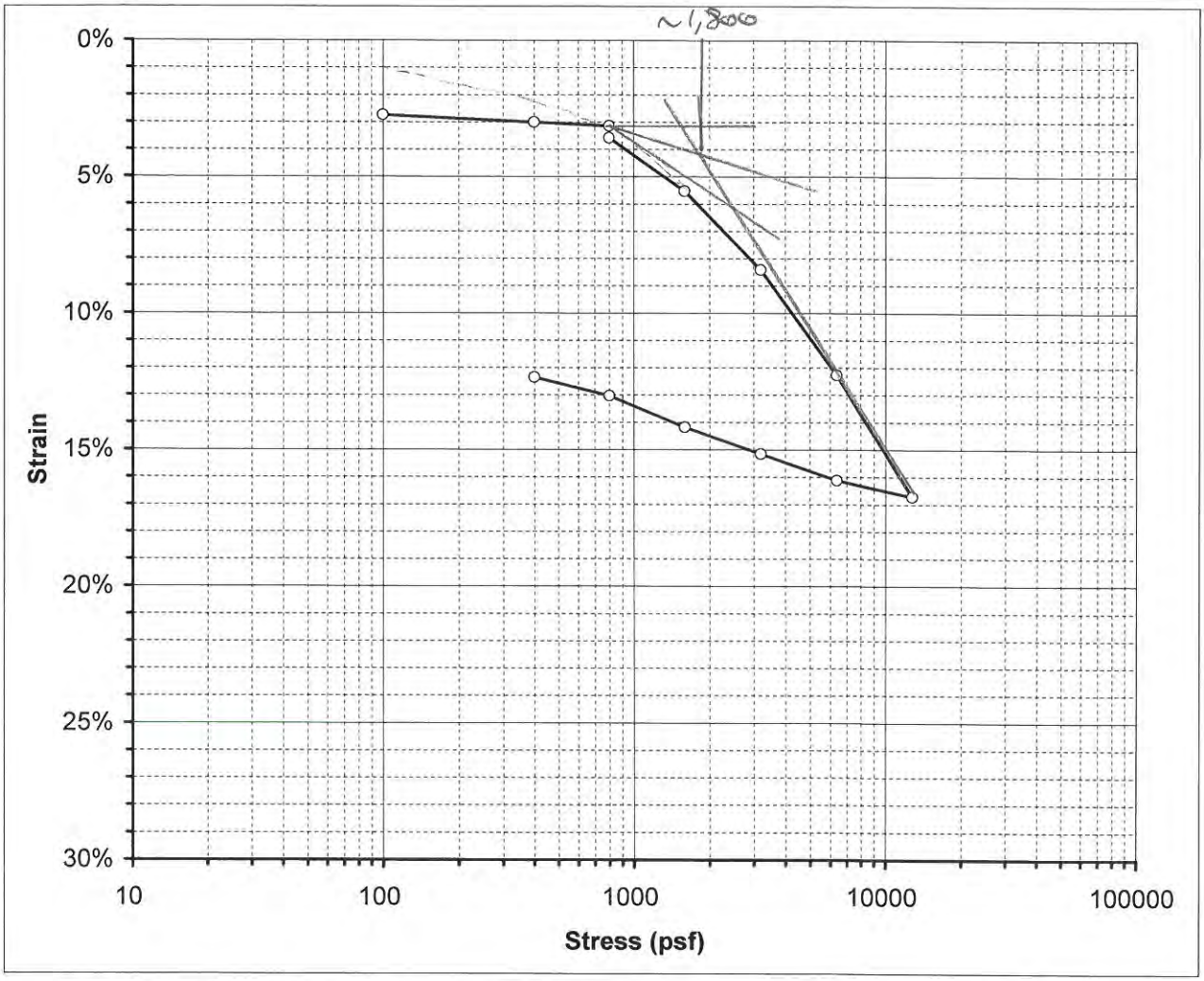
CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW041	Sample Depth	5 ft
Sample No.	R2A	USCS	0

BEFORE TEST

Initial Moisture Content:	47.4%	
Initial Dry Unit Wt:	75.0	pcf
Initial Total Unit Wt.:	110.6	pcf
Initial Void Ratio:	1.3207	
Initial Degree of Saturation:	100.2%	

AFTER TEST

Final Moisture Content:	39.5%	
Final Dry Unit Wt:	84.4	pcf
Final Total Unit Wt.:	115.2	pcf
Final Void Ratio:	1.0622	
Final Degree of Saturation:	103.7%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

$\sigma_v' \approx 600$ psf OCR ~ 3

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	2.73%	1.2573
400	3.00%	1.2510
800	3.13%	1.2480
800	3.58%	1.2376
1600	5.53%	1.1925
3200	8.41%	1.1256
6400	12.26%	1.0361
12800	16.72%	0.9328
6400	16.12%	0.9467
3200	15.16%	0.9690
1600	14.18%	0.9915
800	13.03%	1.0183
400	12.35%	1.0341

PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA CONSULTANTS

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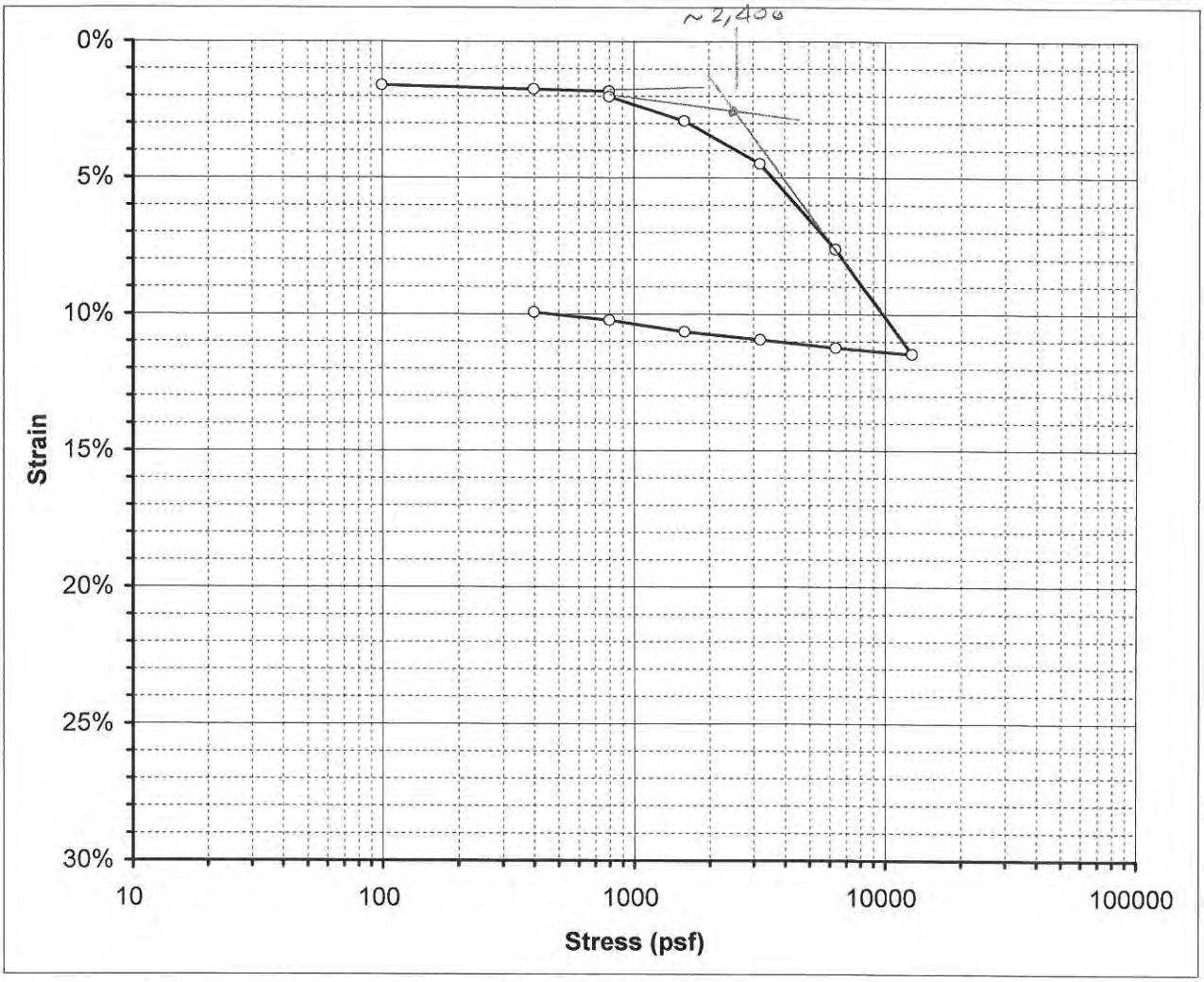
PLATE H-36

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW003	Sample Depth	30 ft
Sample No.	R7A	USCS	0

BEFORE TEST

Initial Moisture Content:	35.6%	
Initial Dry Unit Wt:	85.8	pcf
Initial Total Unit Wt.:	116.3	pcf
Initial Void Ratio:	1.0301	
Initial Degree of Saturation:	96.3%	

AFTER TEST

Final Moisture Content:	30.2%	
Final Dry Unit Wt:	94.4	pcf
Final Total Unit Wt.:	112.8	pcf
Final Void Ratio:	0.8450	
Final Degree of Saturation:	99.6%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

$\sigma_v' \approx 2400$ OCR ~ 1

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.60%	0.9976
400	1.75%	0.9945
800	1.82%	0.9931
800	2.02%	0.9890
1600	2.92%	0.9709
3200	4.49%	0.9390
6400	7.63%	0.8753
12800	11.45%	0.7976
6400	11.23%	0.8021
3200	10.93%	0.8082
1600	10.64%	0.8141
800	10.22%	0.8226
400	9.94%	0.8283

PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

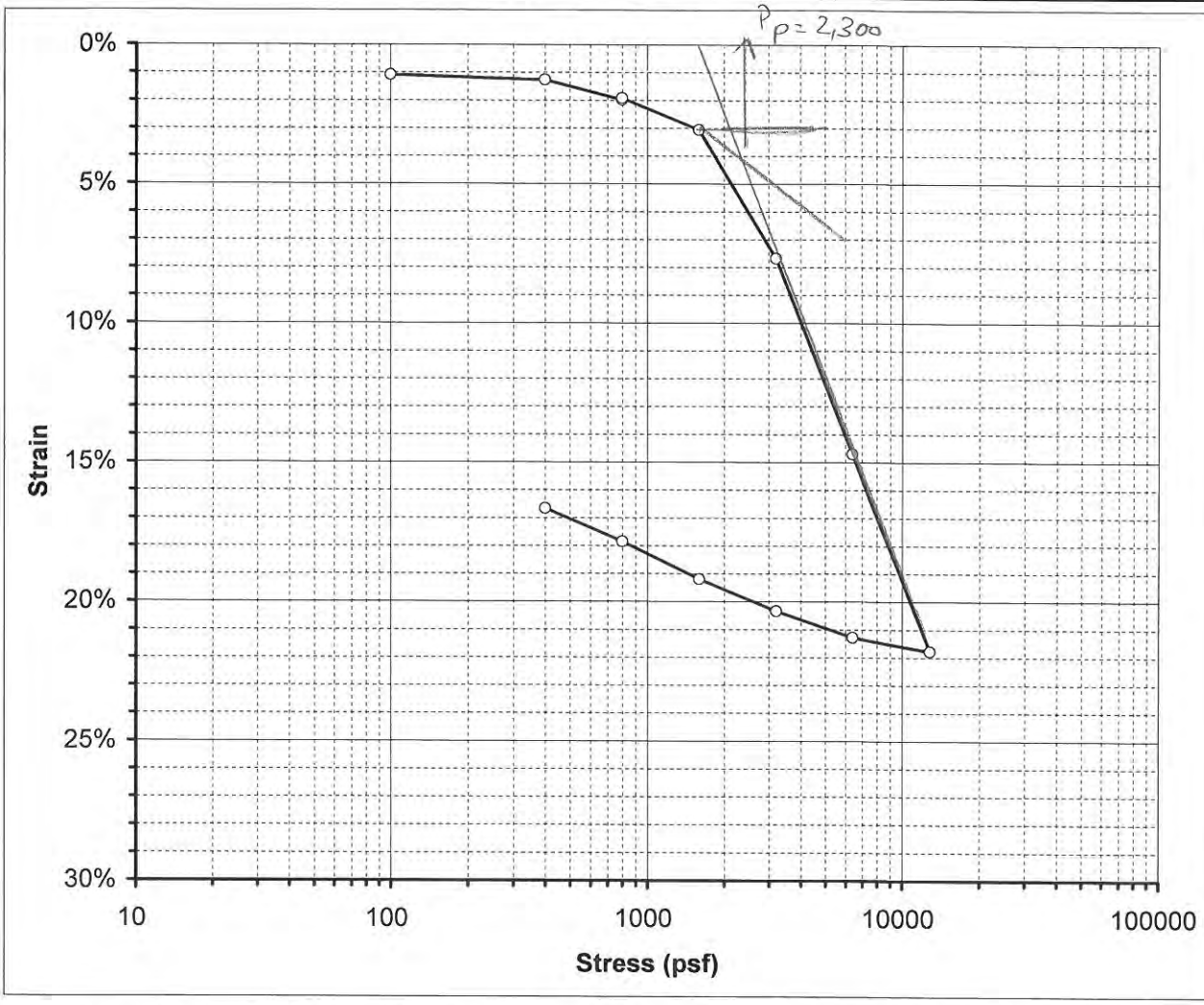
FIGURE NO. B-3

GROUP DELTA

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-3-12\Consol A-RW003R7A@30'_1.xls

PLATE H-37

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW008	Sample Depth	30 ft
Sample No.	R6A	USCS	0

BEFORE TEST	Initial Moisture Content:	62.1%	
	Initial Dry Unit Wt:	63.1	pcf
	Initial Total Unit Wt.:	102.2	pcf
	Initial Void Ratio:	1.7601	
	Initial Degree of Saturation:	98.4%	
AFTER TEST	Final Moisture Content:	49.2%	
	Final Dry Unit Wt:	74.4	pcf
	Final Total Unit Wt.:	120.7	pcf
	Final Void Ratio:	1.3389	
	Final Degree of Saturation:	102.5%	
	Water Added at:	800	psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

$\sigma_v' \sim 2350$ psf OCR ~ 1.0

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.09%	1.7301
400	1.26%	1.7254
800	1.98%	1.7055
800	1.92%	1.7071
1600	3.06%	1.6757
3200	7.68%	1.5482
6400	14.70%	1.3544
12800	21.78%	1.1590
6400	21.28%	1.1728
3200	20.34%	1.1987
1600	19.20%	1.2302
800	17.85%	1.2675
400	16.66%	1.3003

PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

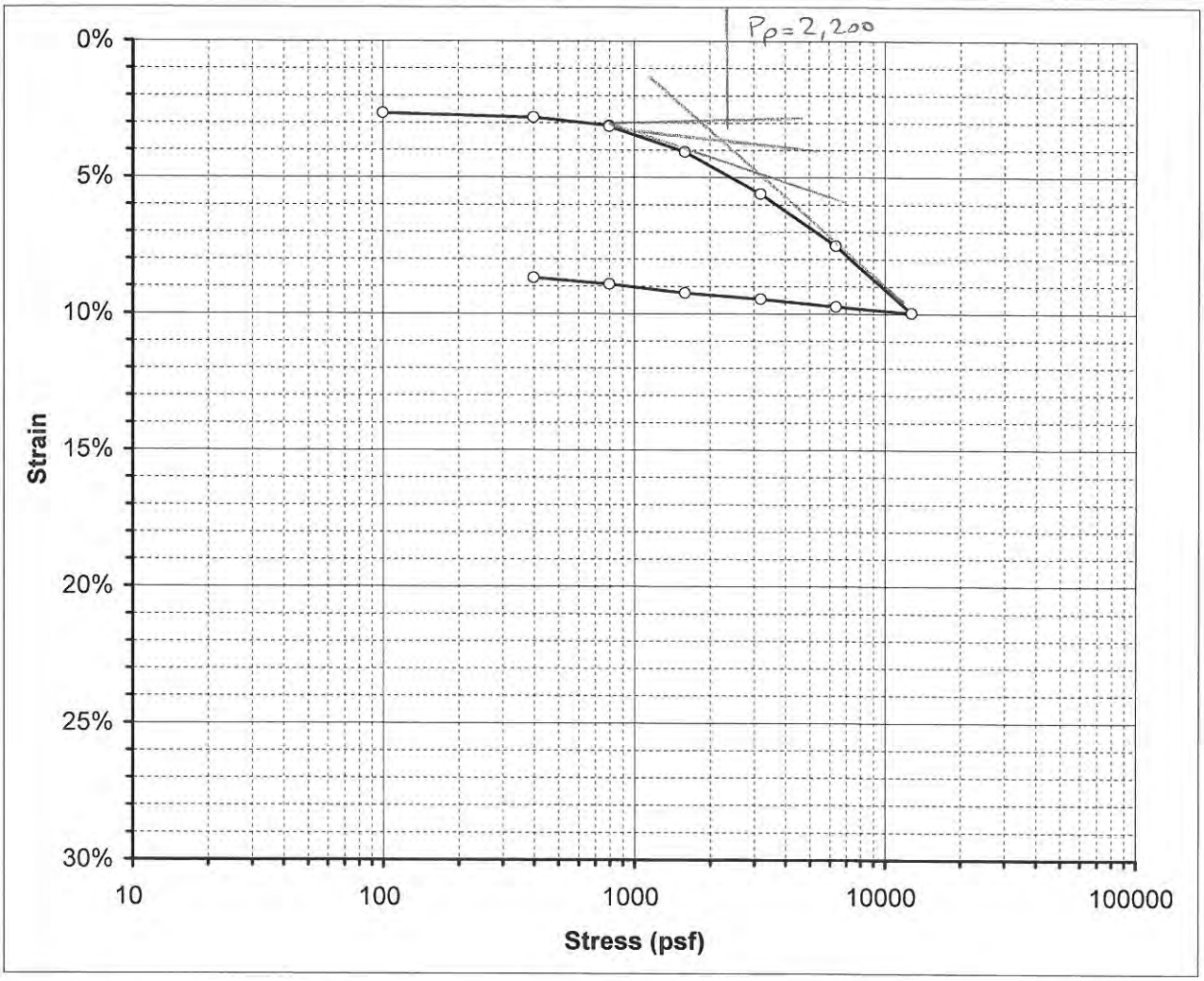
FIGURE NO. B-3

GROUP DELTA CONSULTANTS

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-17-12\Consol A-RW008R6A@30'_1.xls

PLATE H-38

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW011	Sample Depth	5
Sample No.	R2	USCS	0

BEFORE TEST

Initial Moisture Content:	35.2%	
Initial Dry Unit Wt:	86.8	pcf
Initial Total Unit Wt.:	117.3	pcf
Initial Void Ratio:	1.0058	
Initial Degree of Saturation:	97.6%	

AFTER TEST

Final Moisture Content:	29.0%	
Final Dry Unit Wt:	94.1	pcf
Final Total Unit Wt.:	114.3	pcf
Final Void Ratio:	0.8507	
Final Degree of Saturation:	95.0%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

$\sigma_v' \sim 600$ psf OCR ~ 3.5

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	2.65%	0.9526
400	2.80%	0.9495
800	3.10%	0.9435
800	3.13%	0.9429
1600	4.06%	0.9243
3200	5.61%	0.8933
6400	7.52%	0.8550
12800	9.97%	0.8058
6400	9.74%	0.8104
3200	9.46%	0.8159
1600	9.24%	0.8205
800	8.92%	0.8269
400	8.68%	0.8317

PROJECT NUMBER: LA-962A

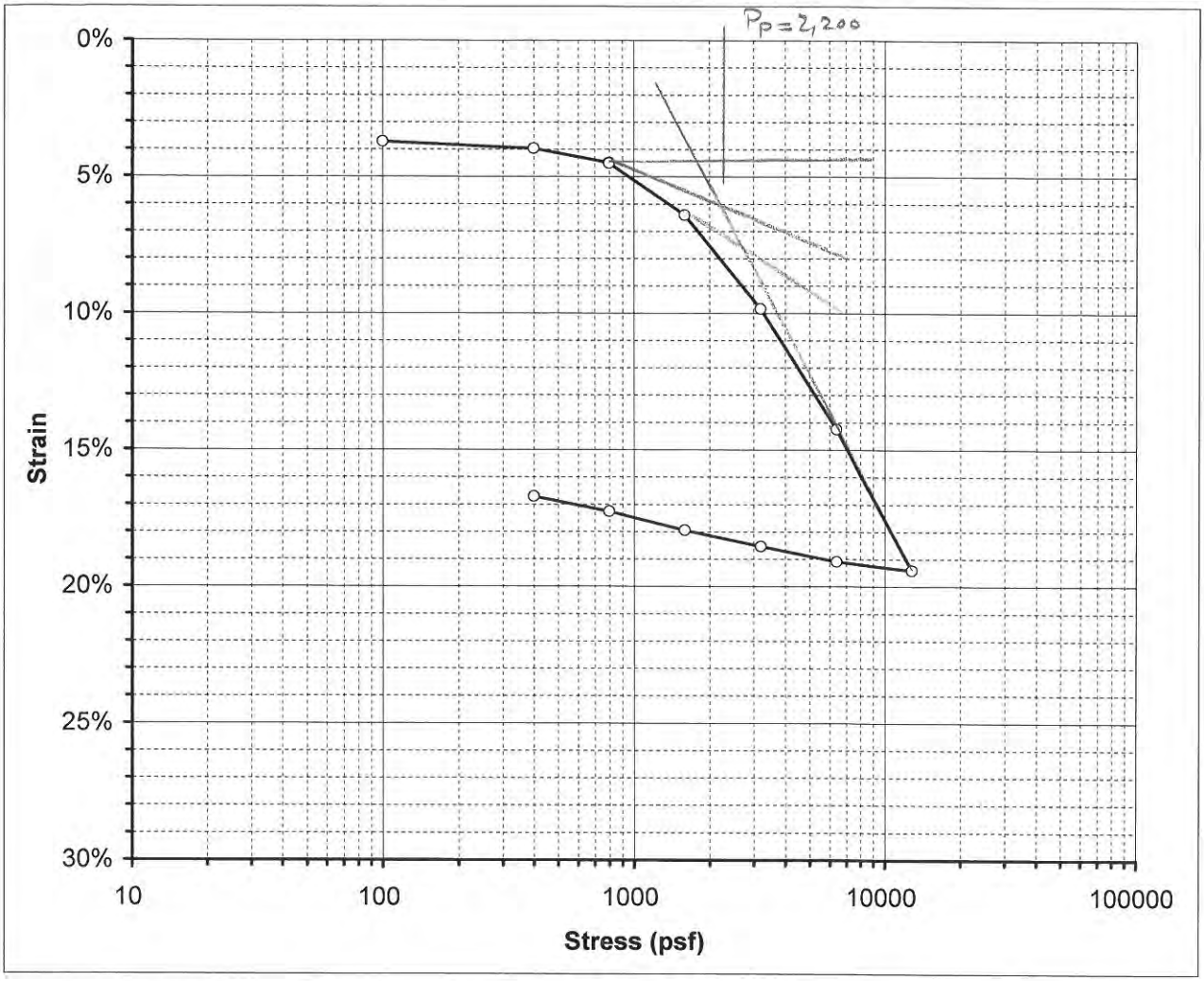
PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-17-12\Consol A-RW011R2@5'_2.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW013	Sample Depth	15
Sample No.	R4	USCS	0

BEFORE TEST

Initial Moisture Content:	50.9%	
Initial Dry Unit Wt:	73.3	pcf
Initial Total Unit Wt.:	110.6	pcf
Initial Void Ratio:	1.3750	
Initial Degree of Saturation:	103.3%	

AFTER TEST

Final Moisture Content:	38.6%	
Final Dry Unit Wt:	86.7	pcf
Final Total Unit Wt.:	123.5	pcf
Final Void Ratio:	1.0076	
Final Degree of Saturation:	106.9%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

$\sigma_v' \sim 1800$ psf OCR ~ 1.2

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	3.71%	1.2868
400	3.97%	1.2807
800	4.49%	1.2684
800	4.51%	1.2679
1600	6.41%	1.2228
3200	9.84%	1.1414
6400	14.24%	1.0367
12800	19.41%	0.9141
6400	19.09%	0.9216
3200	18.53%	0.9349
1600	17.95%	0.9487
800	17.27%	0.9650
400	16.70%	0.9783

PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

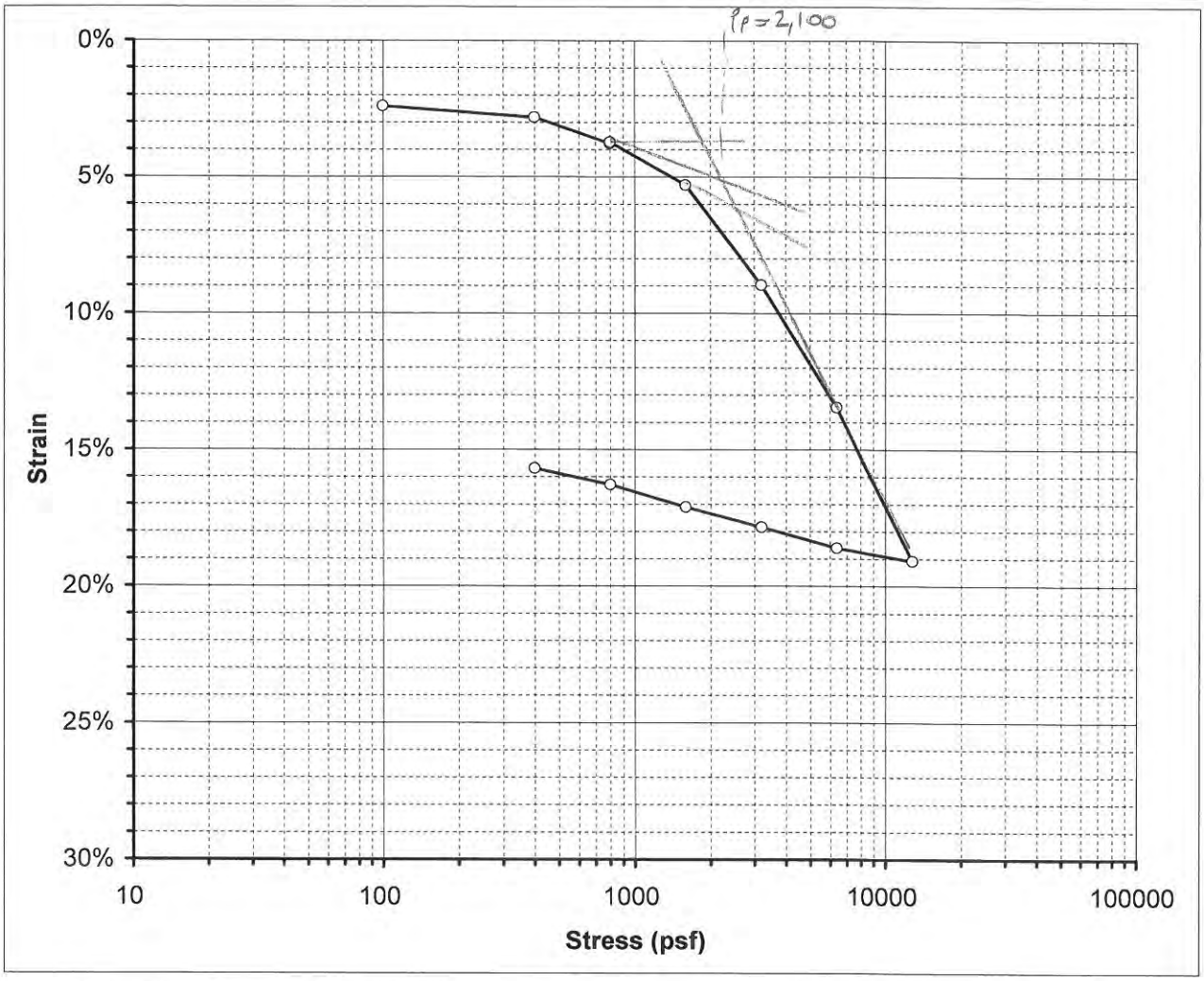
FIGURE NO. B-3

GROUP DELTA CONSULTANTS

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-17-12\Consol A-RW013R4@15'_3.xls

PLATE H-40

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW049	Sample Depth	15
Sample No.	R4A	USCS	0

BEFORE TEST

Initial Moisture Content:	72.7%	
Initial Dry Unit Wt:	56.2	pcf
Initial Total Unit Wt.:	97.1	pcf
Initial Void Ratio:	2.0975	
Initial Degree of Saturation:	96.7%	

AFTER TEST

Final Moisture Content:	59.5%	
Final Dry Unit Wt:	65.9	pcf
Final Total Unit Wt.:	120.1	pcf
Final Void Ratio:	1.6422	
Final Degree of Saturation:	101.0%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

$\sigma_v' = 1800$ psf OCR ~ 1.15

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	2.40%	2.0230
400	2.82%	2.0103
800	3.78%	1.9805
800	3.73%	1.9820
1600	5.30%	1.9333
3200	8.96%	1.8200
6400	13.45%	1.6810
12800	19.08%	1.5065
6400	18.60%	1.5214
3200	17.84%	1.5450
1600	17.10%	1.5677
800	16.28%	1.5931
400	15.69%	1.6114

PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

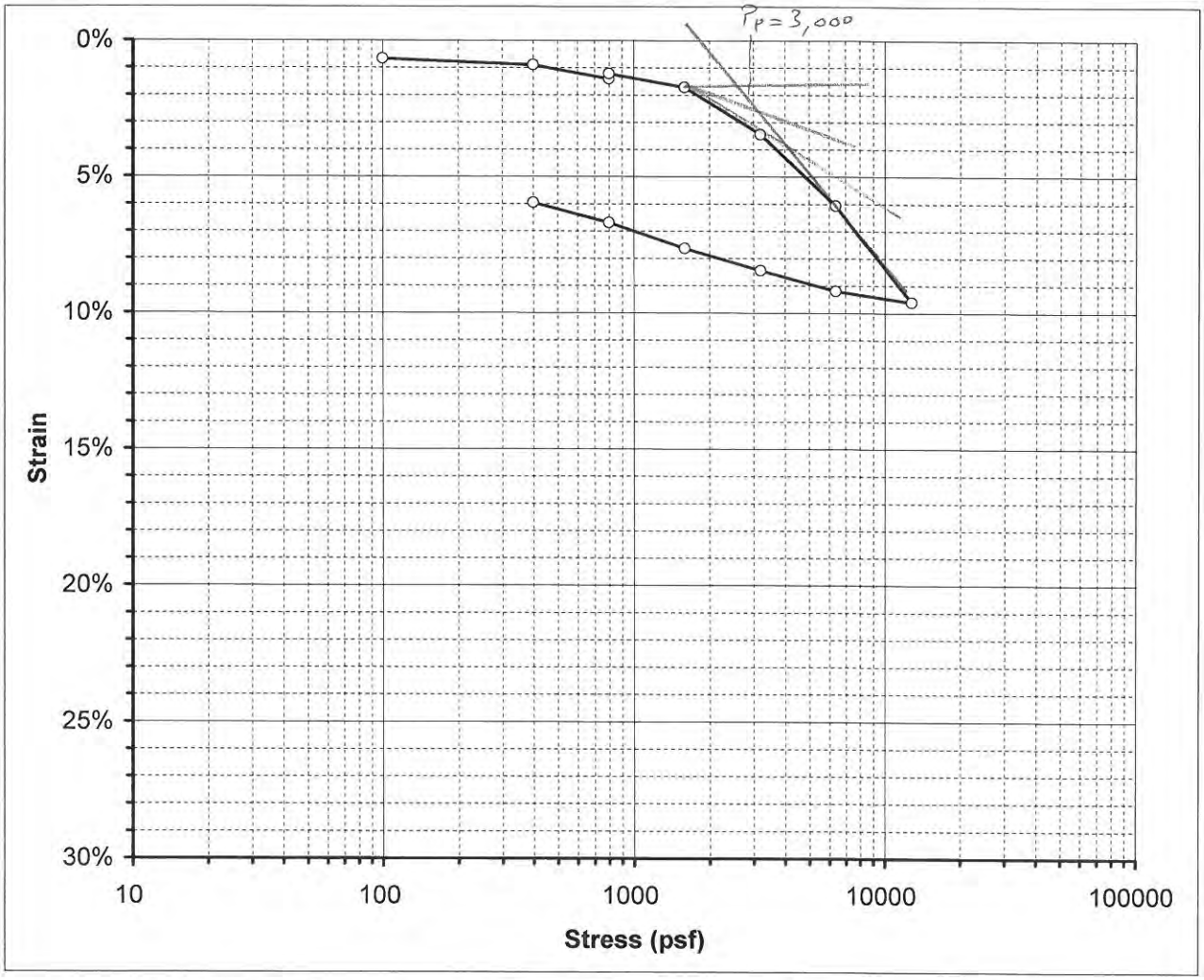
FIGURE NO. B-3

GROUP DELTA

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-17-12\Consol A-RW049R4A@15'_4.xls

PLATE H-41

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW005	Sample Depth	5 ft
Sample No.	R1	USCS	0

BEFORE TEST	Initial Moisture Content:	37.4%	
	Initial Dry Unit Wt:	82.0	pcf
	Initial Total Unit Wt.:	112.7	pcf
	Initial Void Ratio:	1.1234	
	Initial Degree of Saturation:	92.9%	
AFTER TEST	Final Moisture Content:	36.4%	
	Final Dry Unit Wt:	86.5	pcf
	Final Total Unit Wt.:	110.1	pcf
	Final Void Ratio:	1.0129	
	Final Degree of Saturation:	100.2%	
	Water Added at:	800	psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

$\sigma_v' \sim 600$ psf OCR ~ 5.0

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	0.66%	1.1093
400	0.90%	1.1043
800	1.41%	1.0935
800	1.21%	1.0976
1600	1.71%	1.0870
3200	3.45%	1.0501
6400	6.06%	0.9947
12800	9.60%	0.9195
6400	9.19%	0.9281
3200	8.44%	0.9442
1600	7.63%	0.9613
800	6.69%	0.9812
400	5.96%	0.9968

PROJECT NUMBER: LA-962A

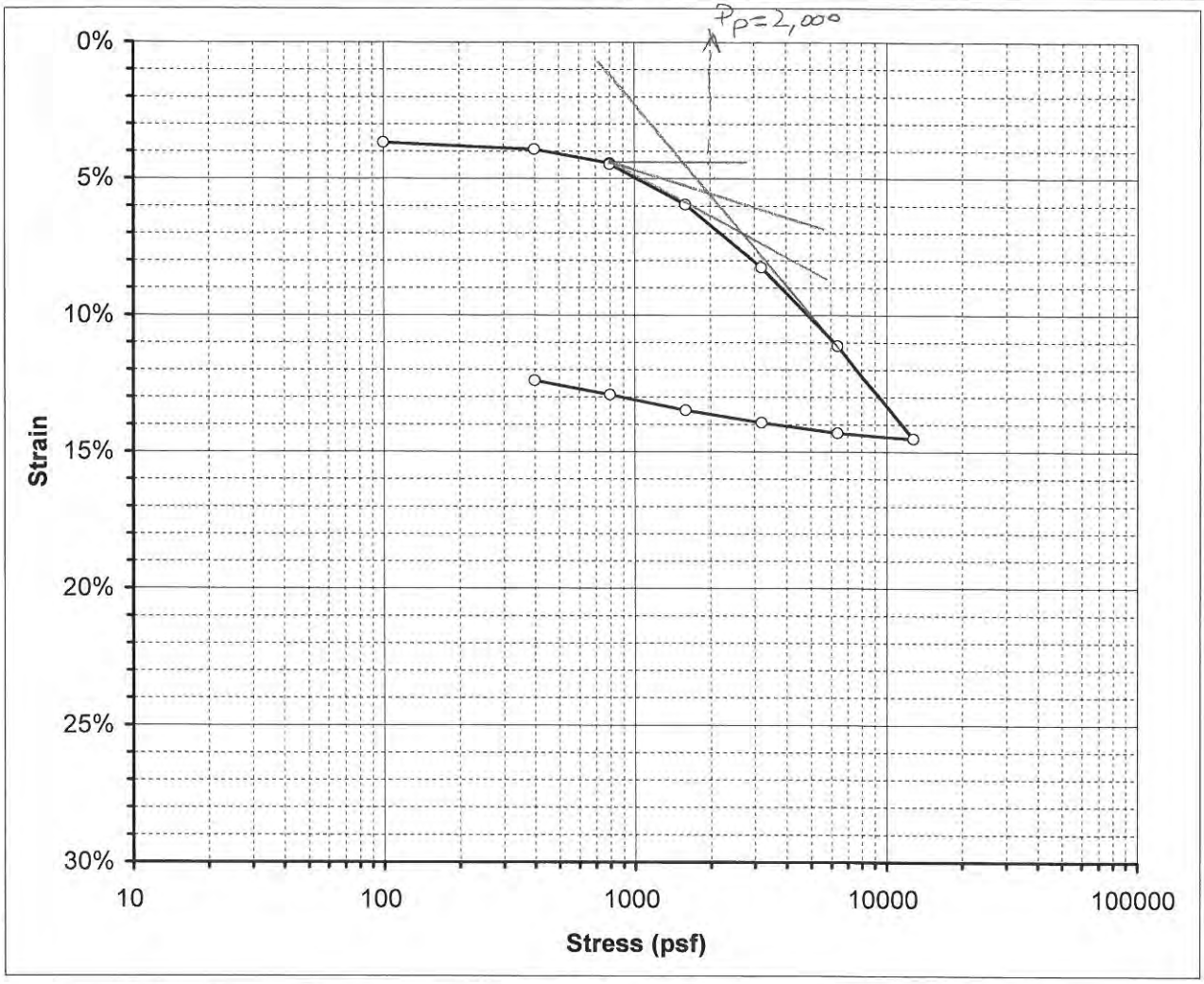
PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA CONSULTANTS

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-30-12\A-RW005 R1@5'_3.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW005	Sample Depth	15 ft
Sample No.	R3	USCS	0

BEFORE TEST	Initial Moisture Content:	43.7%	
	Initial Dry Unit Wt:	77.9	pcf
	Initial Total Unit Wt.:	111.9	pcf
	Initial Void Ratio:	1.2358	
	Initial Degree of Saturation:	98.7%	
AFTER TEST	Final Moisture Content:	35.5%	
	Final Dry Unit Wt:	87.5	pcf
	Final Total Unit Wt.:	115.5	pcf
	Final Void Ratio:	0.9895	
	Final Degree of Saturation:	100.0%	
	Water Added at:	800	psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

$\sigma_v' \approx 1,800$ OCR ~ 1.1

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	3.68%	1.1536
400	3.93%	1.1480
800	4.43%	1.1367
800	4.47%	1.1358
1600	5.95%	1.1028
3200	8.25%	1.0513
6400	11.13%	0.9871
12800	14.52%	0.9111
6400	14.31%	0.9158
3200	13.94%	0.9242
1600	13.48%	0.9345
800	12.91%	0.9471
400	12.39%	0.9588

PROJECT NUMBER: LA-962A

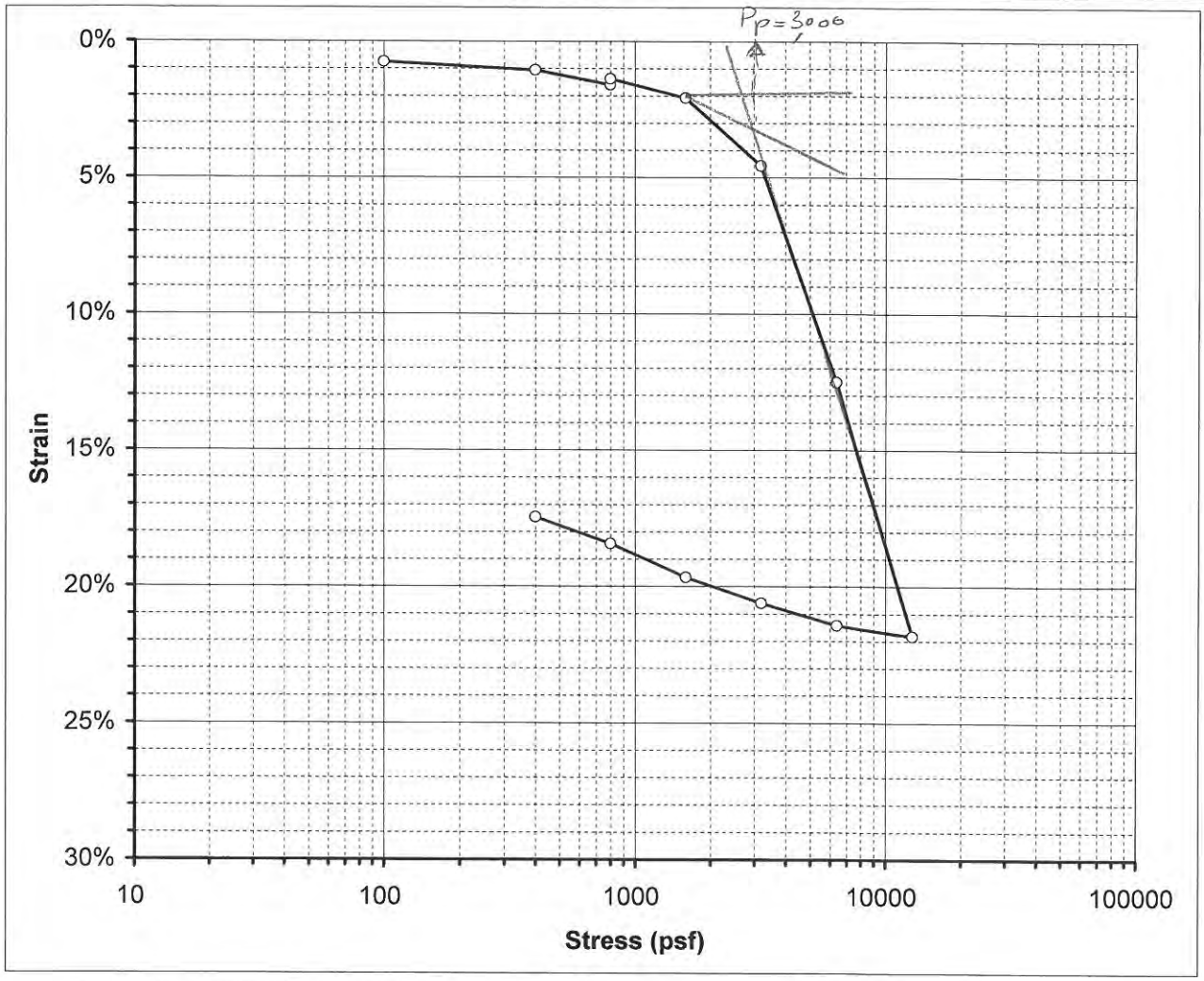
PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-30-12\A-RW005 R3@15'_4.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW049	Sample Depth	25 ft
Sample No.	R6A	USCS	0

BEFORE TEST	Initial Moisture Content:	64.3%	
	Initial Dry Unit Wt:	60.4	pcf
	Initial Total Unit Wt.:	99.2	pcf
	Initial Void Ratio:	1.8822	
	Initial Degree of Saturation:	95.2%	
AFTER TEST	Final Moisture Content:	50.8%	
	Final Dry Unit Wt:	72.4	pcf
	Final Total Unit Wt.:	122.8	pcf
	Final Void Ratio:	1.4048	
	Final Degree of Saturation:	100.8%	
	Water Added at:	800	psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

$\sigma_v' = 2{,}200$ psf OCR ~ 1.3

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	0.75%	1.8605
400	1.05%	1.8518
800	1.59%	1.8362
800	1.37%	1.8426
1600	2.07%	1.8224
3200	4.57%	1.7505
6400	12.51%	1.5217
12800	21.82%	1.2532
6400	21.42%	1.2647
3200	20.60%	1.2884
1600	19.66%	1.3155
800	18.44%	1.3508
400	17.45%	1.3791

PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

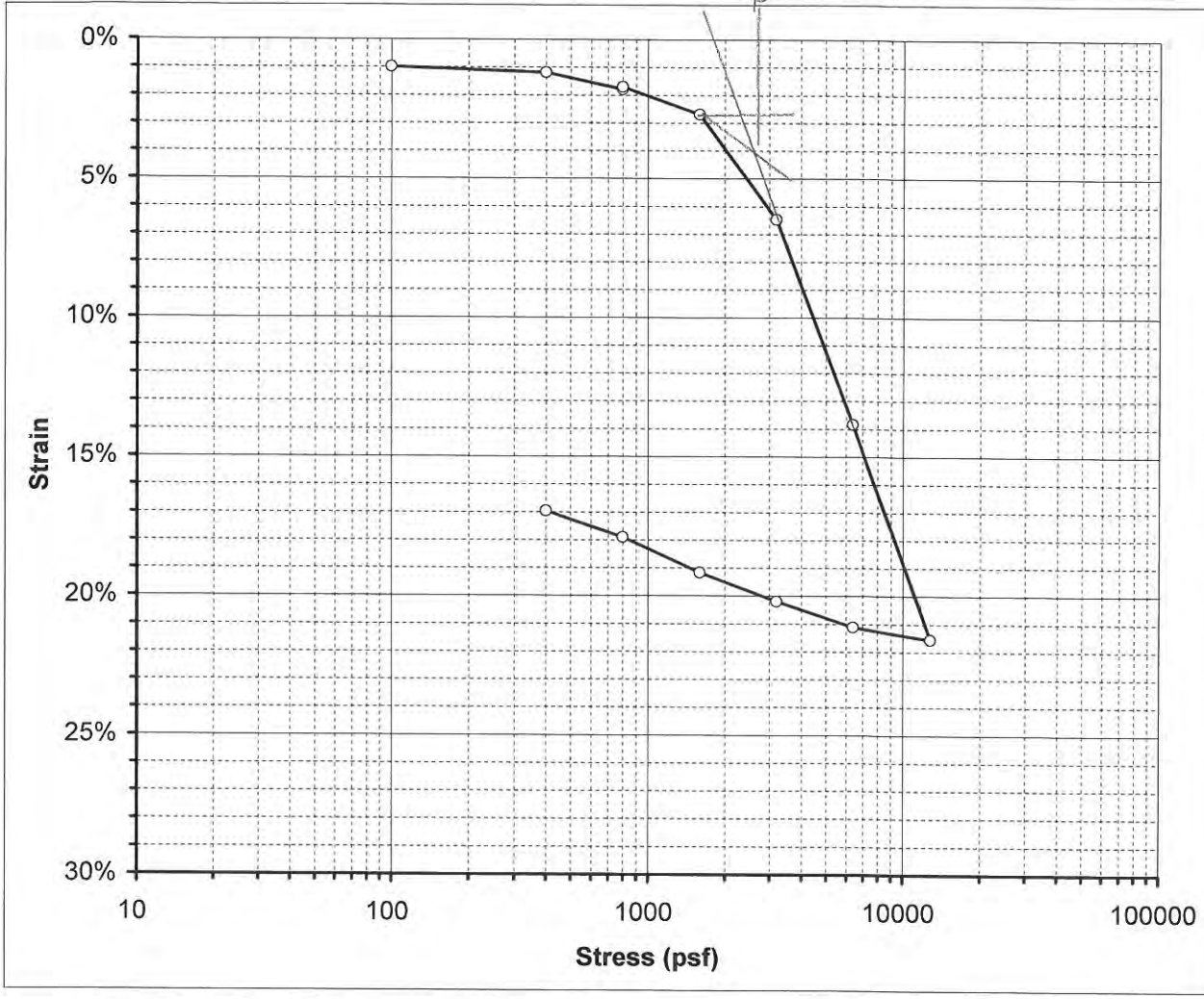
GROUP DELTA

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-30-12\A-RW049 R6A@25'_1.xls

PLATE H-44

CONSOLIDATION TEST RESULTS
ASTM D-2435

$P_c \approx 2,500$ psf



Boring No.	A-RW053	Sample Depth	10 ft
Sample No.	R2A	USCS	0

BEFORE TEST

Initial Moisture Content:	59.5%	
Initial Dry Unit Wt:	63.9	pcf
Initial Total Unit Wt.:	101.8	pcf
Initial Void Ratio:	1.7261	
Initial Degree of Saturation:	96.1%	

AFTER TEST

Final Moisture Content:	47.6%	
Final Dry Unit Wt:	76.2	pcf
Final Total Unit Wt.:	122.1	pcf
Final Void Ratio:	1.2845	
Final Degree of Saturation:	103.4%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

$\sigma_v' \approx 1,200$ OCR ~ 2.0

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	0.98%	1.6993
400	1.19%	1.6937
800	1.79%	1.6773
800	1.71%	1.6795
1600	2.69%	1.6528
3200	6.47%	1.5498
6400	13.84%	1.3488
12800	21.56%	1.1384
6400	21.12%	1.1504
3200	20.20%	1.1755
1600	19.16%	1.2038
800	17.90%	1.2382
400	16.96%	1.2638

PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA CONSULTANTS

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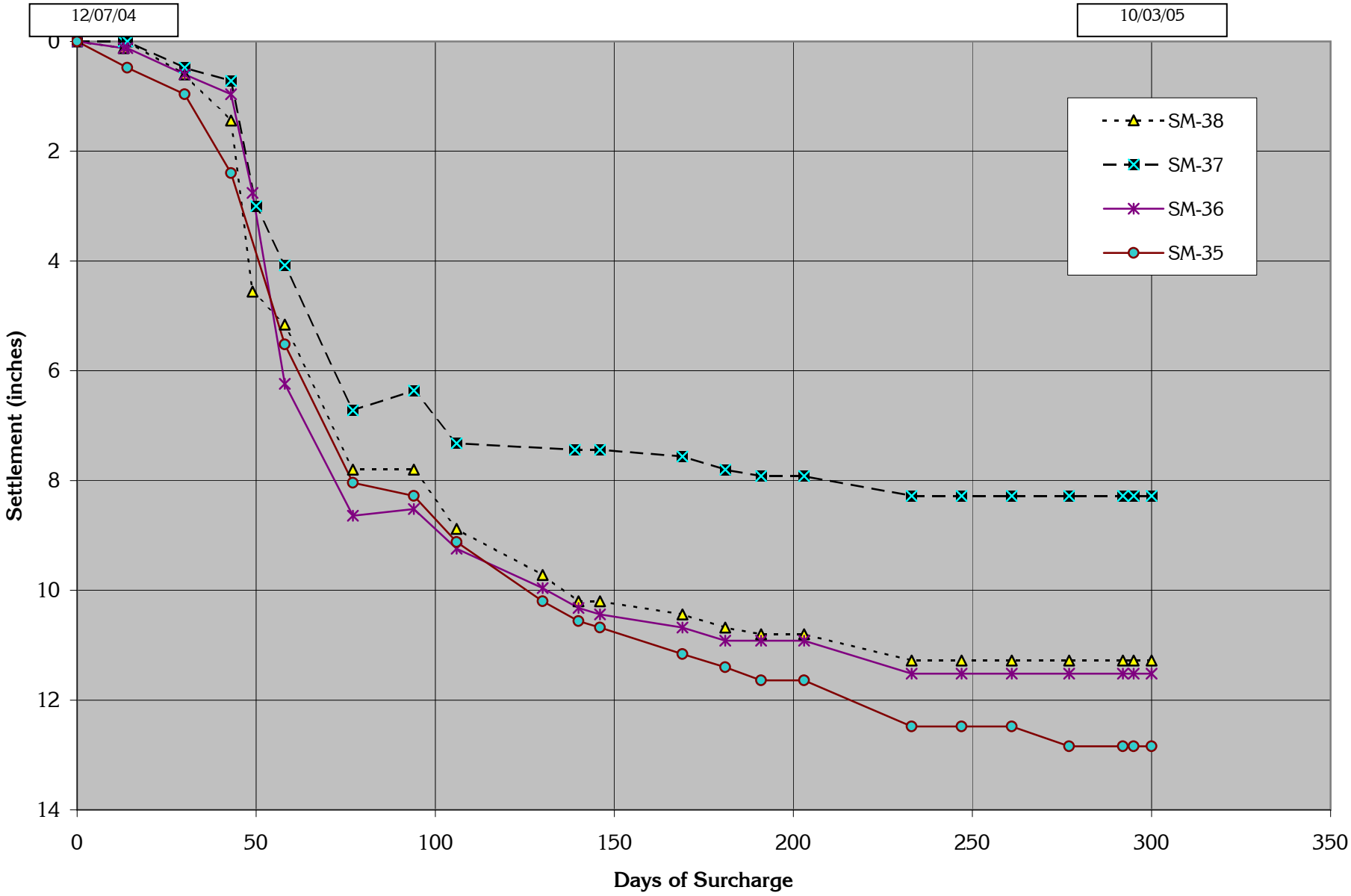
PLATE H-45

Playa Vista Area D2 Surcharge Settlement Lots 1-6



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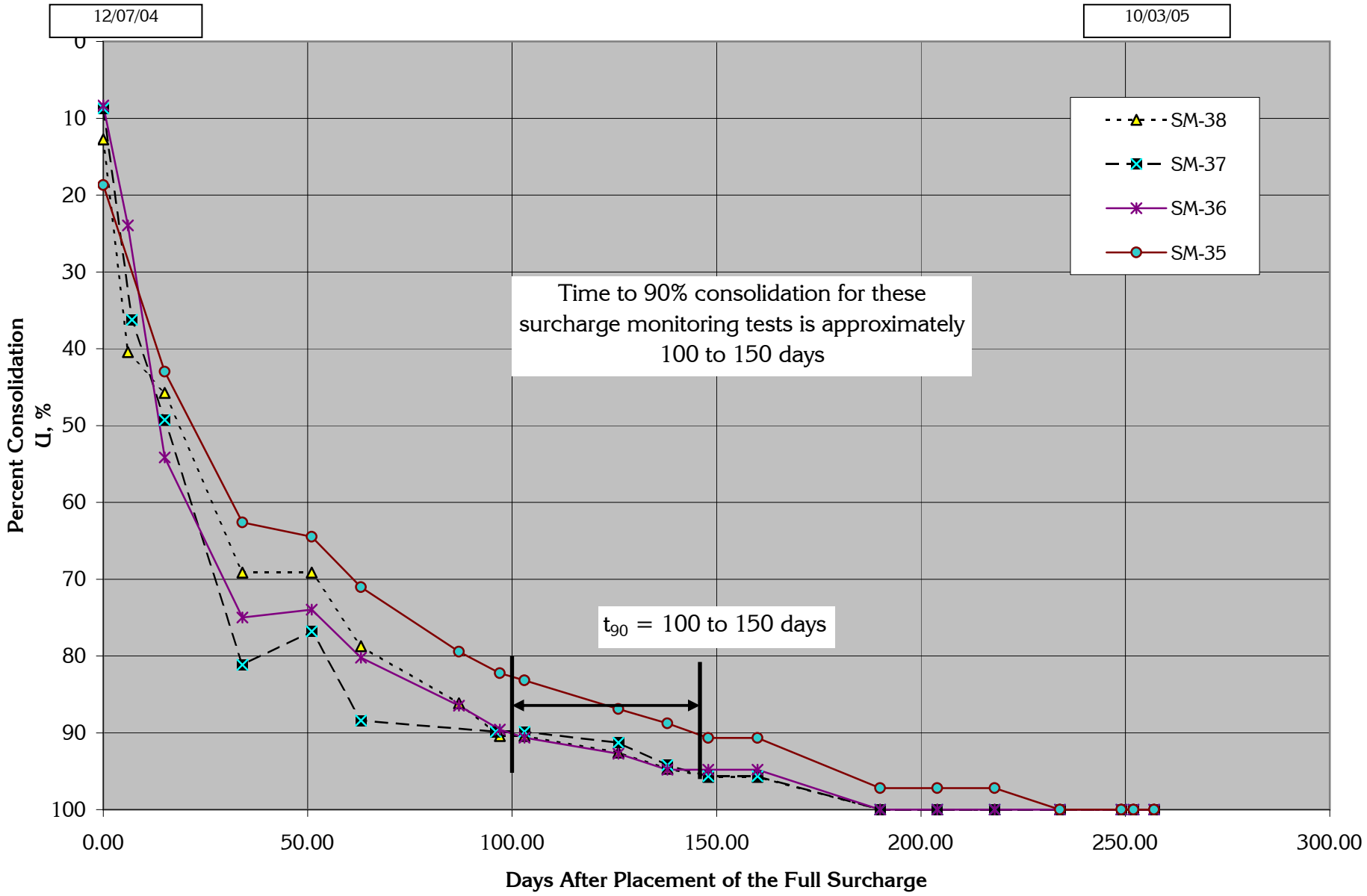
B1-1211

PLATE H-46

Percent Consolidation vs Time



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B1-1212

PLATE H-47

APPENDIX I
EXTENTS OF REMOVAL AND RECOMPACTION UNDER LEVEES

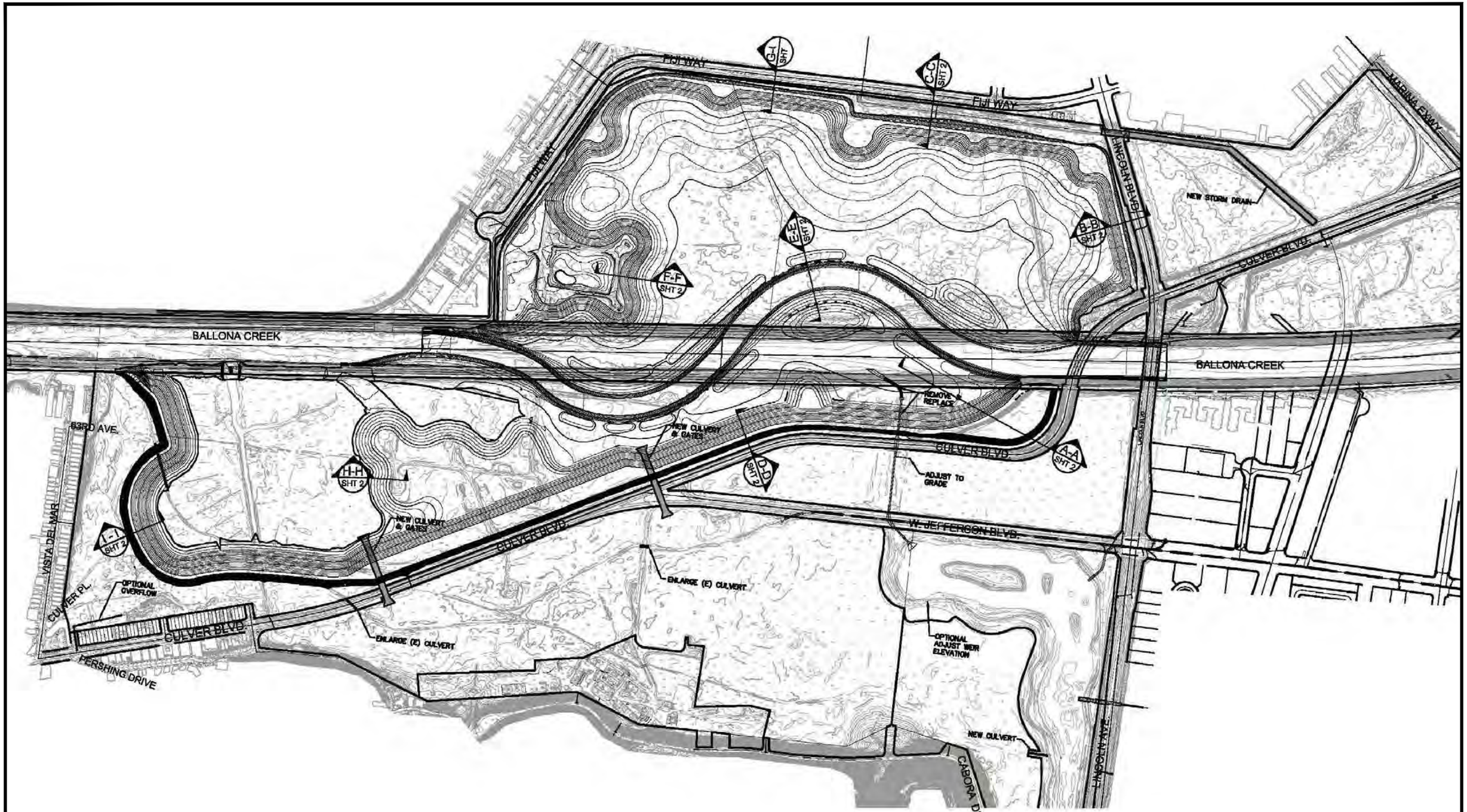
APPENDIX I
EXTENTS OF REMOVAL AND RECOMPACTION UNDER LEVEES

I.1 Contents

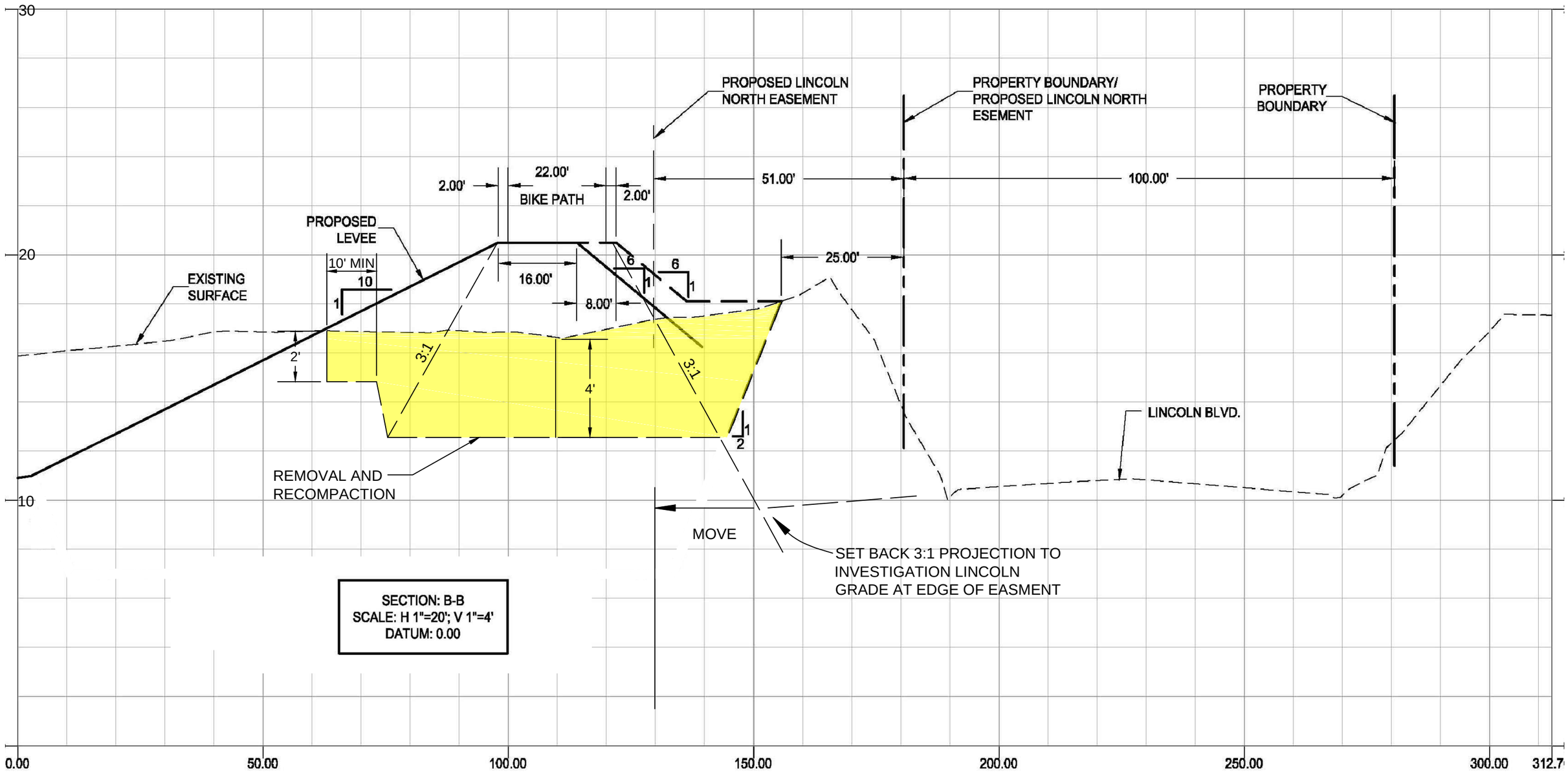
Prior to placement of compacted fill for the new levees, the subgrade soils along the levee alignments should be excavated and recompacted. Under the levee "core" the removals should extend to a minimum depth of 4 feet below the existing grade, while beyond the core, the removals should extend to a minimum depth of 1 feet. The actual limits for removals should be determined by the project geotechnical engineer during construction. The extents of removal and recompaction are shown graphically in this appendix for a number of cross sections.

A list of the plates presented in this appendix follows:

Plate I-1 Ballona Creek Levee Cross Sections Exhibit for Removals
Plate I-2 Extents of Removal and Recompaction (Section B-B)
Plate I-3 Extents of Removal and Recompaction (Sections C-C and D-D)
Plate I-4 Extents of Removal and Recompaction (Sections H-H, I-I and G-G)



DATE: 3/14/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	BALLONA CREEK LEVEE CROSS SECTIONS EXHIBIT FOR REMOVALS BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	PROJECT NUMBER: L962A
REVISION: --	APPROVED BY: P. Kashighandi				SCALE: NO SCALE
REVISION: --	B1-1215				PLATE NUMBER: I-1

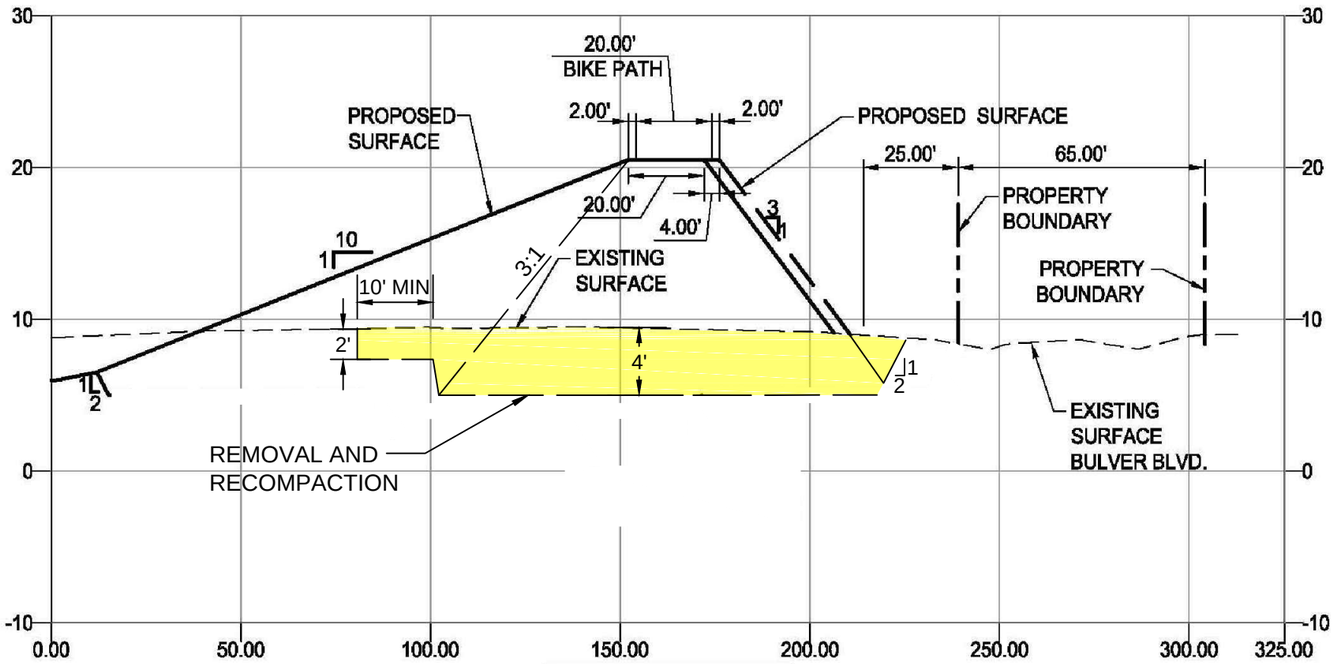


DATE: 6/28/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501
REVISION: --	APPROVED BY: P. Kashighandi		
REVISION: --	B1-1216		

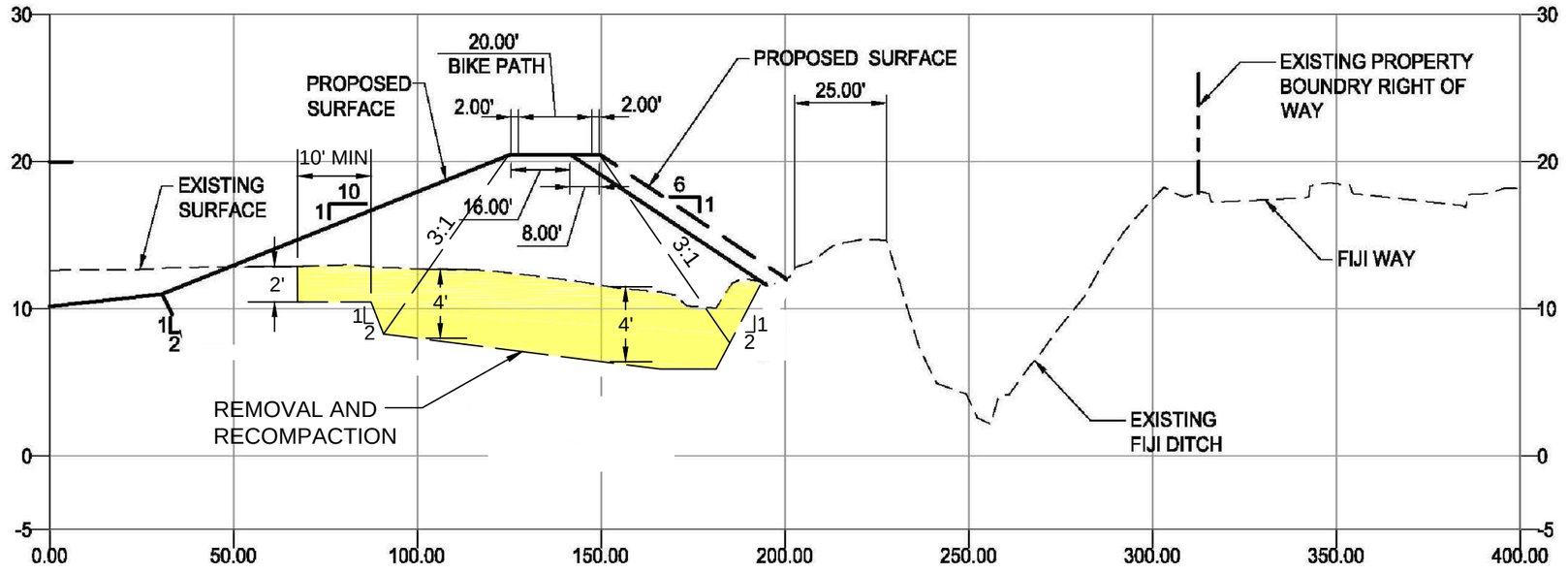
EXTENTS OF REMOVAL AND RECOMPACTION (SECTION B-B)

BALLONA WETLANDS RESTORATION PROJECT
LOS ANGELES, CA

PROJECT NUMBER:	L962A
SCALE:	NO SCALE
PLATE NUMBER:	I-2



SECTION D-D
SCALE: H 1"=40'; V 1"=10'



SECTION C-C
SCALE: H 1"=40'; V 1"=10'

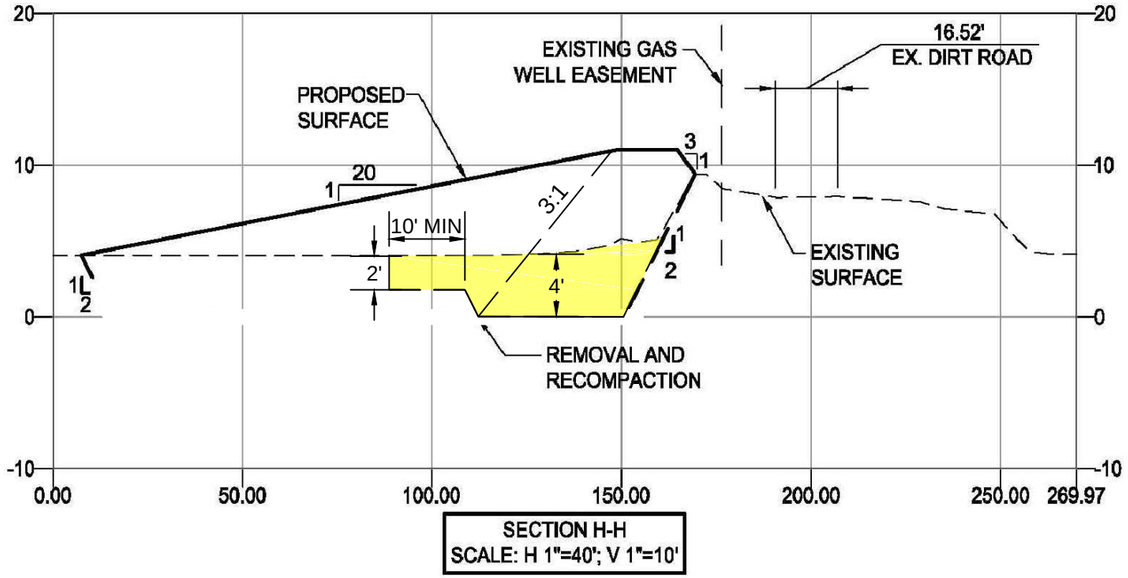
DATE: 6/28/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501
REVISION: --	APPROVED BY: P. Kashighandi		EXTENTS OF REMOVAL AND RECOMPACTION (SECTIONS C-C & D-D) BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION: --	B1-1217		PROJECT NUMBER: L962A SCALE: NO SCALE PLATE NUMBER: I-3

WEST AREA B

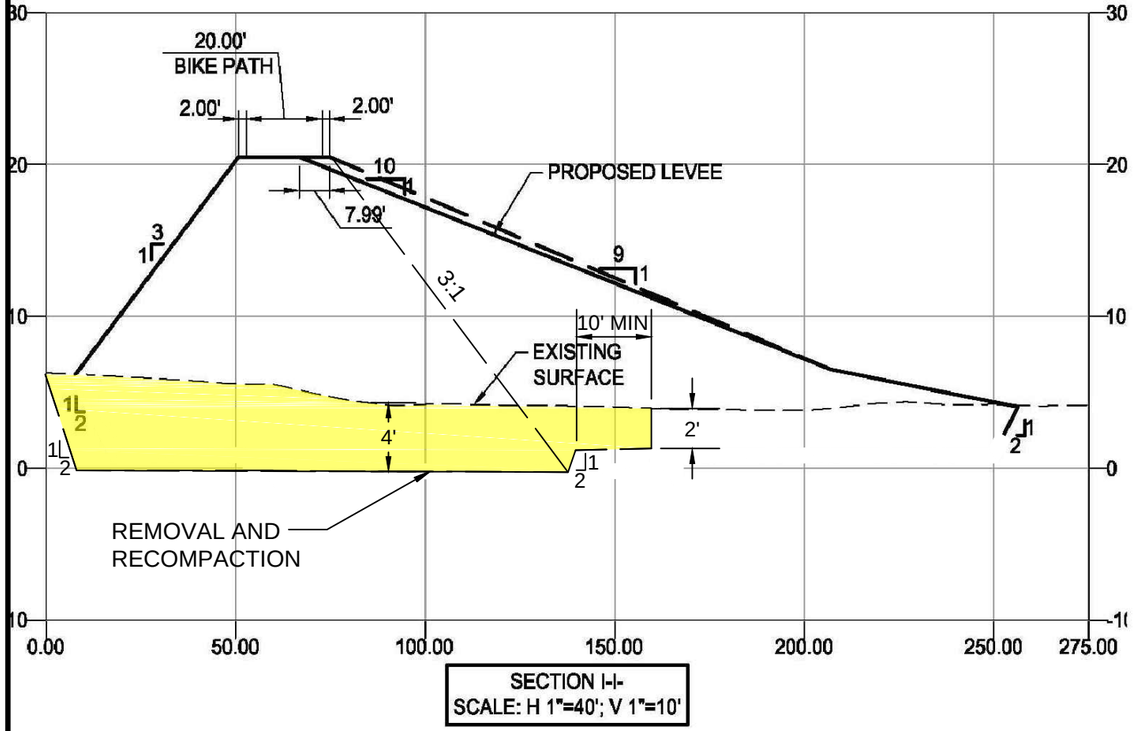
ANTICIPATE DEEPER REMOVALS:

- DE-MUCK AND REMOVE SAND IN CHANNELS AND BACKFILL.

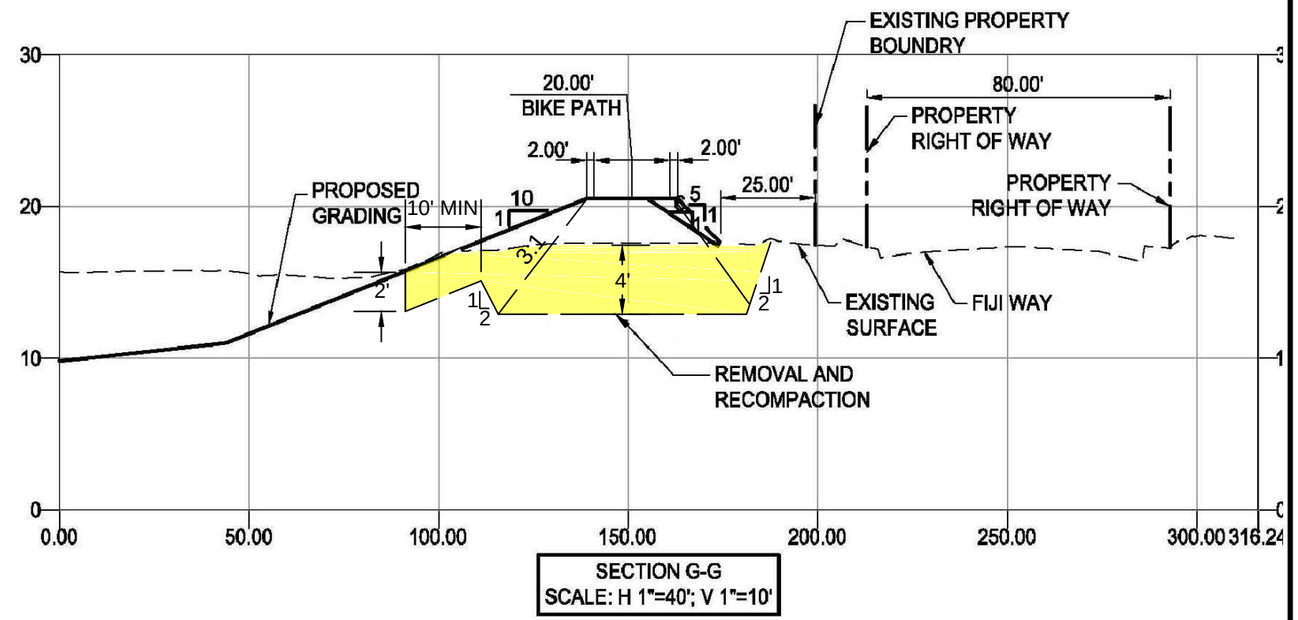
- ENSURE ELIMINATION OF ANY SAND LAGERS UNDER THE LEVEE TO PRTECT AGAINST SEEPAGE.



SECTION H-H
SCALE: H 1"=40'; V 1"=10'



SECTION I-I-
SCALE: H 1"=40'; V 1"=10'



SECTION G-G
SCALE: H 1"=40'; V 1"=10'

DATE: 6/27/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	EXTENTS OF REMOVAL AND RECOMPACTION (SECTIONS H-H, I-I, G-G)	PROJECT NUMBER: L962A
REVISION: --	APPROVED BY: P. Kashighandi			BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	SCALE: NO SCALE
REVISION: --	B1-1218				PLATE NUMBER: I-4

APPENDIX J
AXIAL AND LATERAL CAPACITY OF PILES FOR THE PEDESTRIAN BRIDGE

APPENDIX J
AXIAL AND LATERAL CAPACITY OF PILES FOR THE PEDESTRIAN BRIDGE

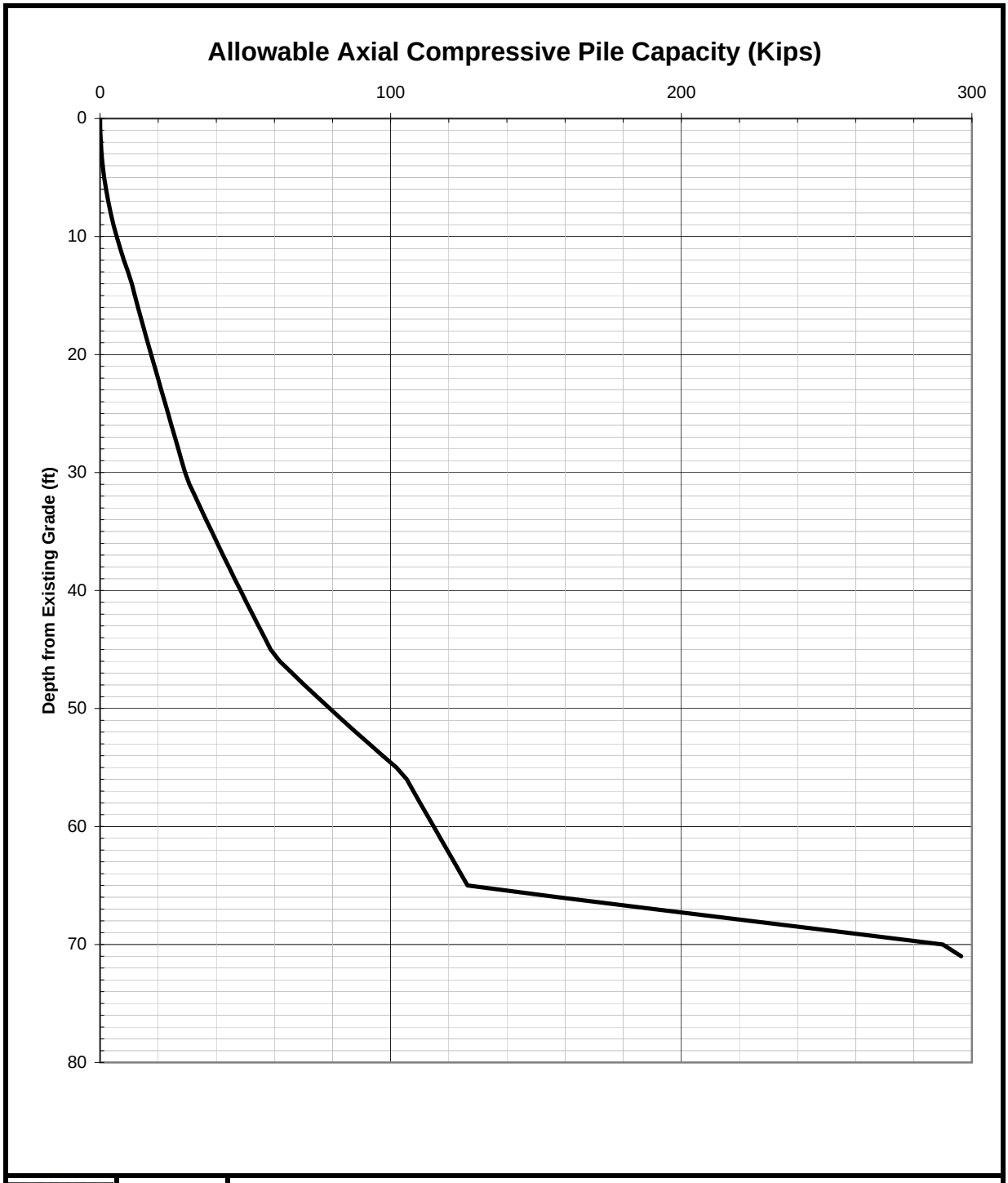
J.1 Contents

A pedestrian bridge is planned to be constructed to the west of the Culver Blvd. as part of the public access plan for the project. Due to large bridge loads, and presence of soft, and liquefiable soils, the bridge should be supported on piles. Pile axial capacity graphs are presented in this appendix for 14-inch square driven piles and 14-inch round Auger Cast Displacement (ACD) Piles. It should be noted that only recommended values presented in the body of the report should be used for the design of the pedestrian bridge. The axial capacity graphs included herein, are solely presented for reference.

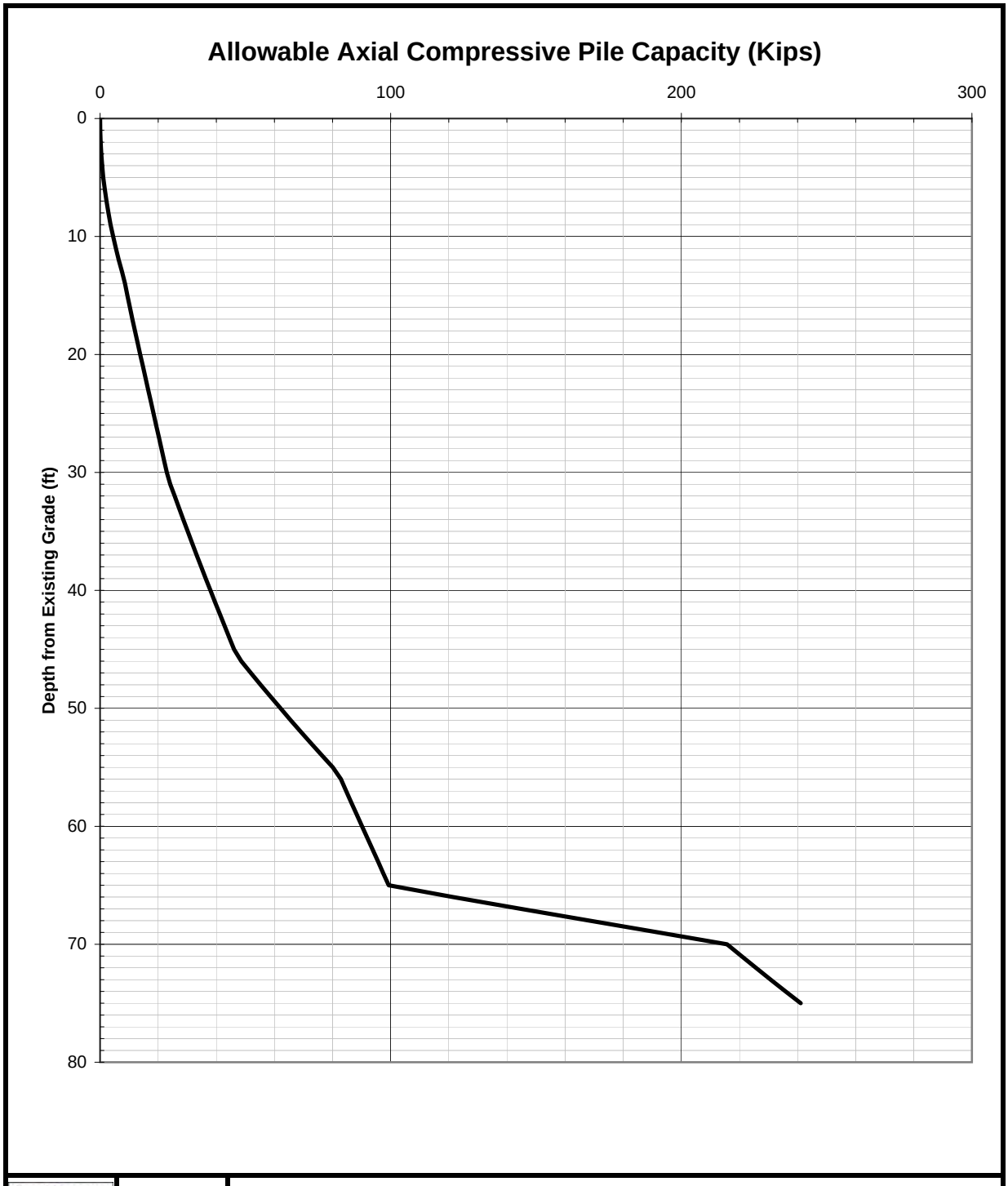
Graphs showing deflections, bending moments, and shear force for the piles under lateral loading are presented for driven and ACD piles for both fixed head and free head conditions.

A list of the plates presented in this appendix follows:

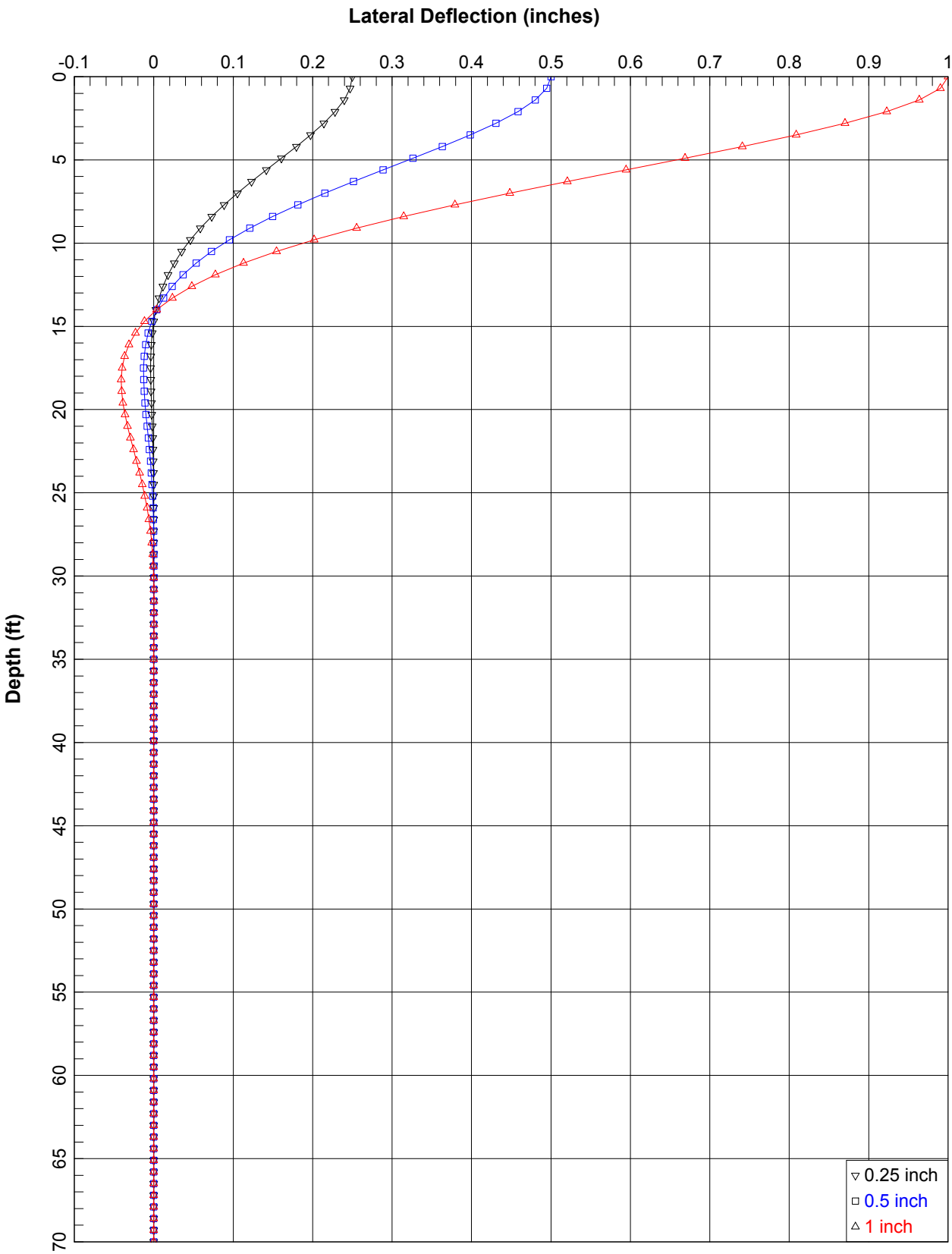
Plate J-1	Axial Capacity of 14-inch Square Driven Piles
Plate J-2	Axial Capacity of 14-inch Round ACD Piles
Plate J-3 thru J-5	Lateral Deflection/Bending Moment/Shear Force graphs for Driven Piles (Fixed Head)
Plate J-6 thru J-8	Lateral Deflection/Bending Moment/Shear Force graphs for ACD Piles (Free Head)
Plate J-9 thru J-11	Lateral Deflection/Bending Moment/Shear Force graphs for Driven Piles (Fixed Head)
Plate J-12 thru J-14	Lateral Deflection/Bending Moment/Shear Force graphs for ACD Piles (Free Head)



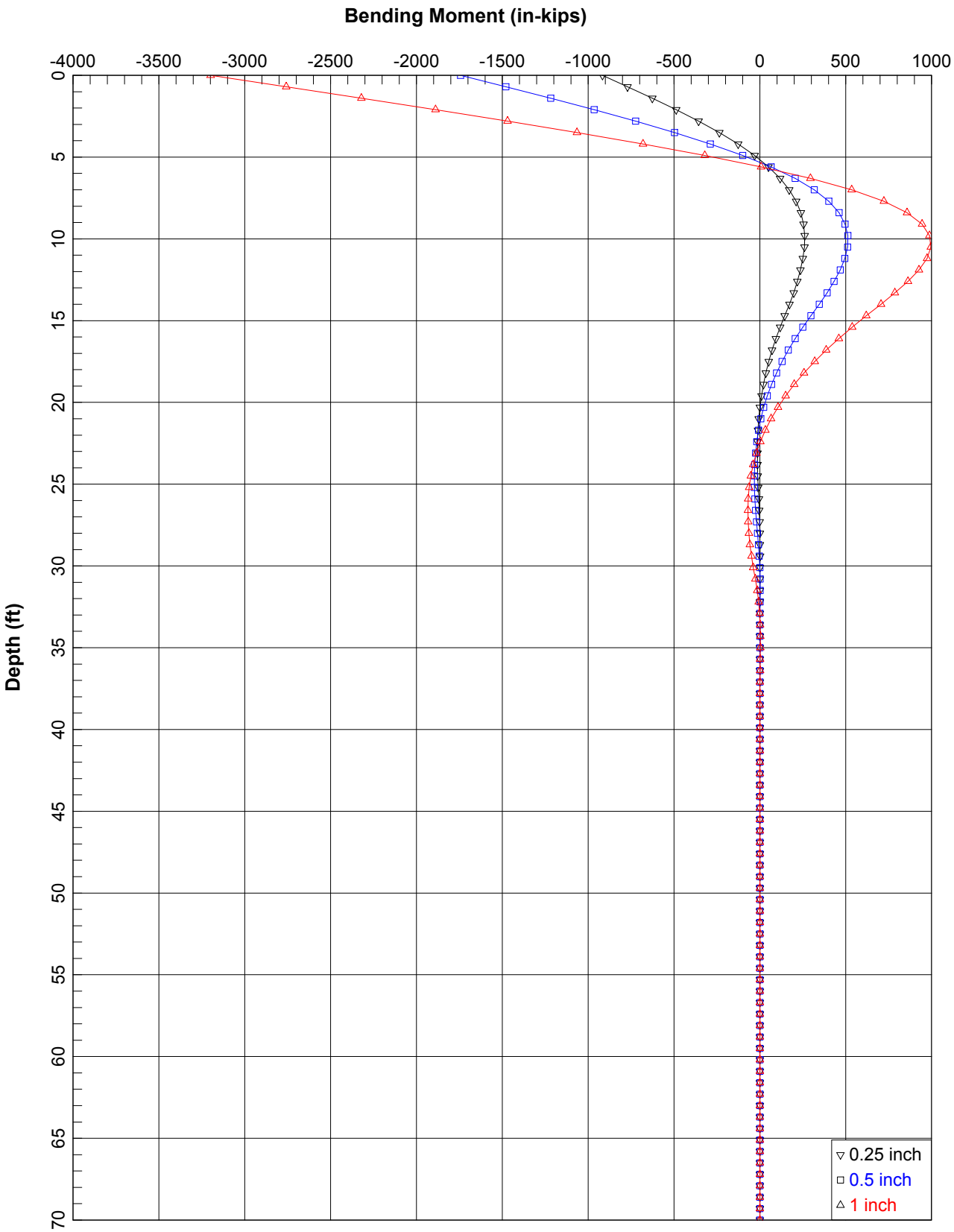
GROUP DELTA CONSULTANTS	Project	L962A - Ballona Creek Wetlands Restoration Project
	Pile Type	14-inch Square Driven Pile
	PLATE:	**J-1**



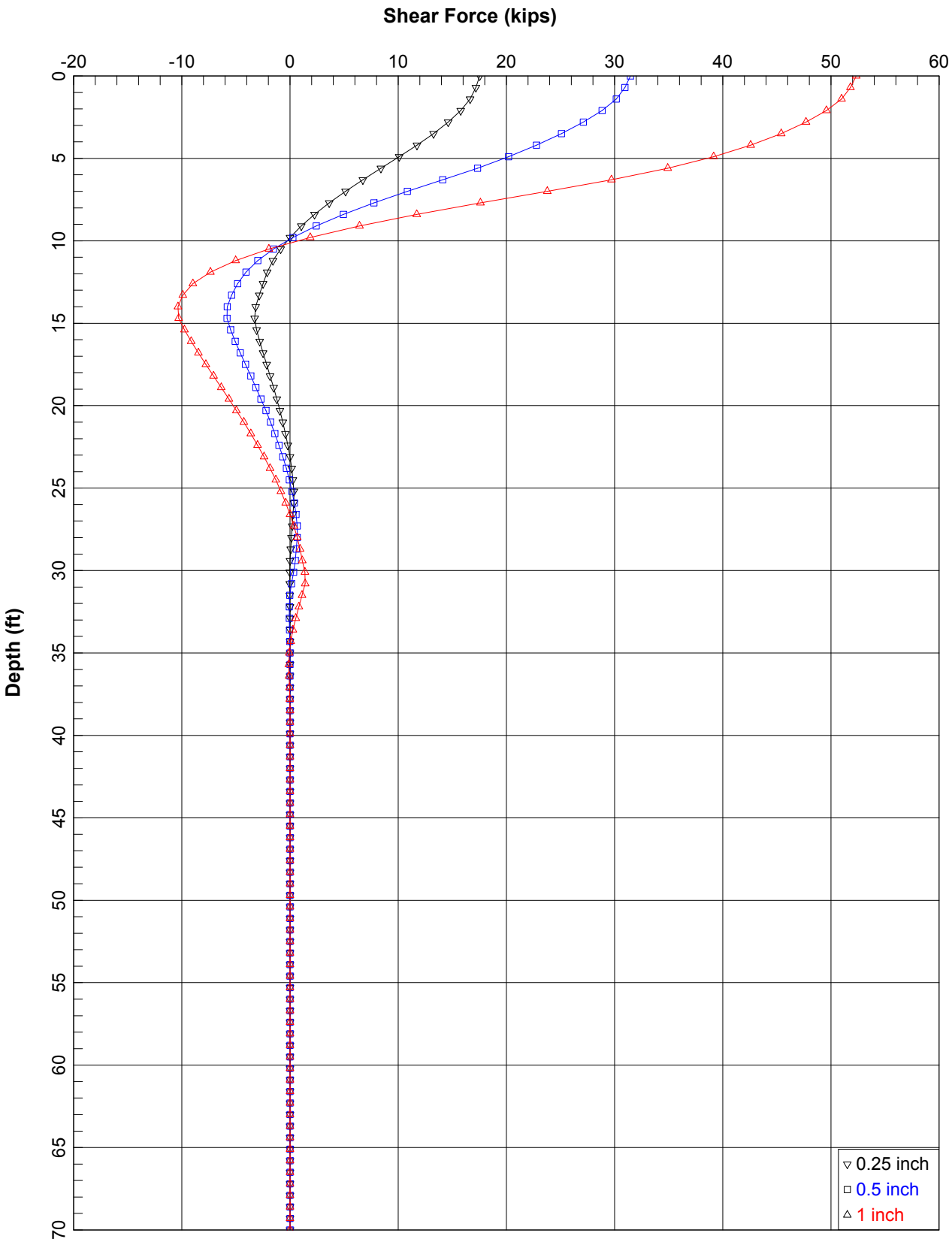
GROUP DELTA CONSULTANTS	Project	L962A - Ballona Creek Wetlands Restoration Project
	Pile Type	14-Diameter Auger Cast Displacement Piles
	PLATE:	**J-2**



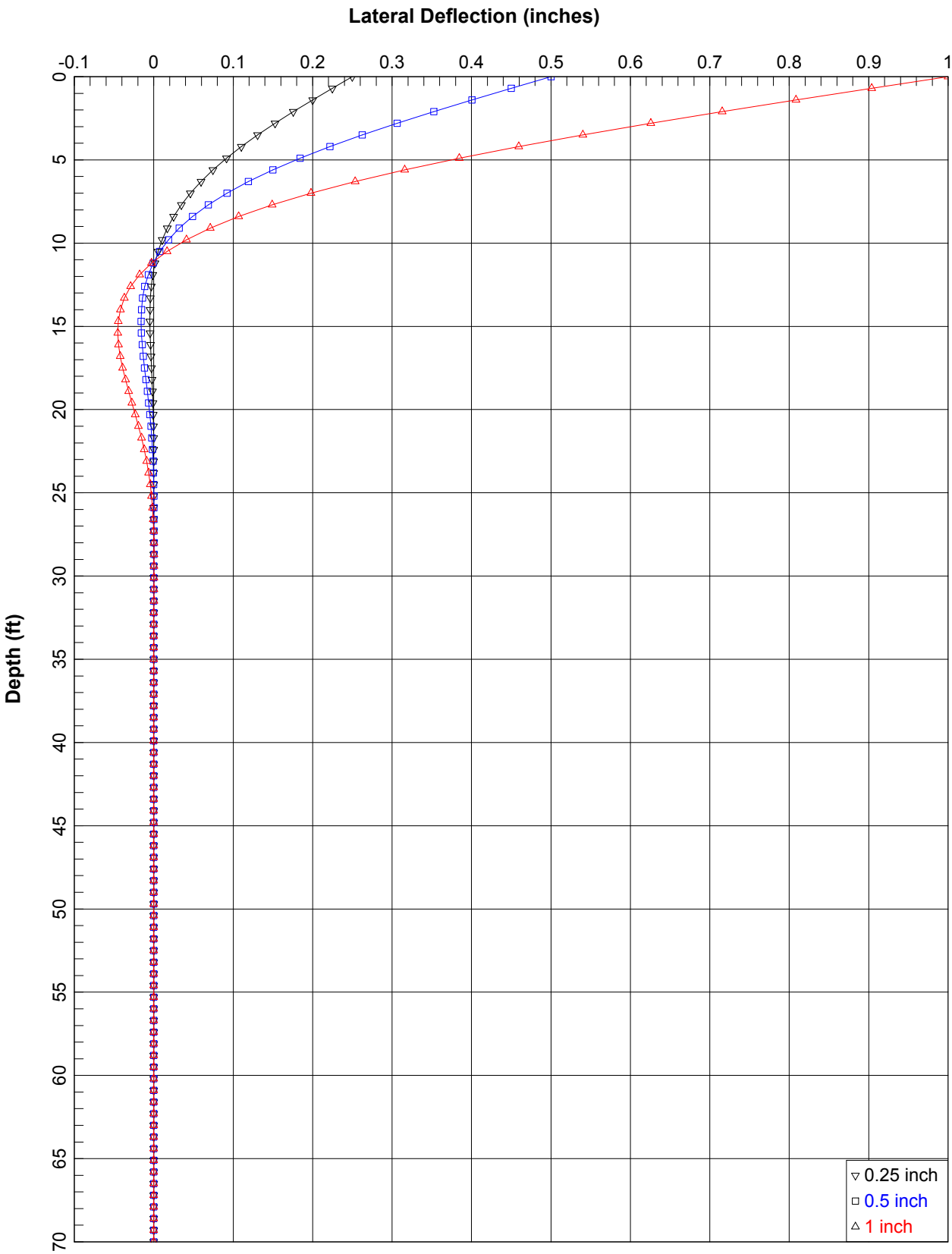
14-inch Square Driven Pile - Fixed Head



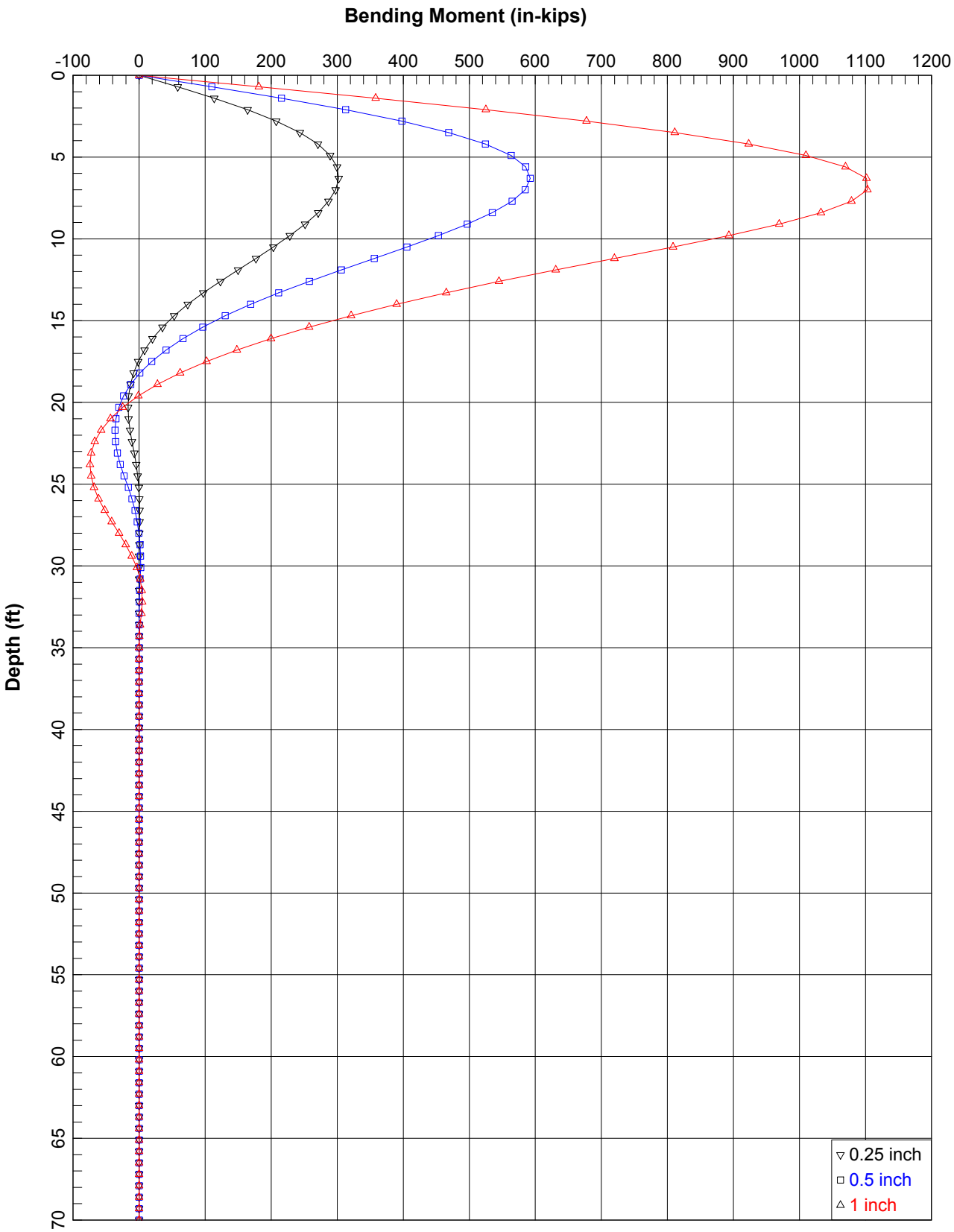
14-inch Square Driven Pile - Fixed Head



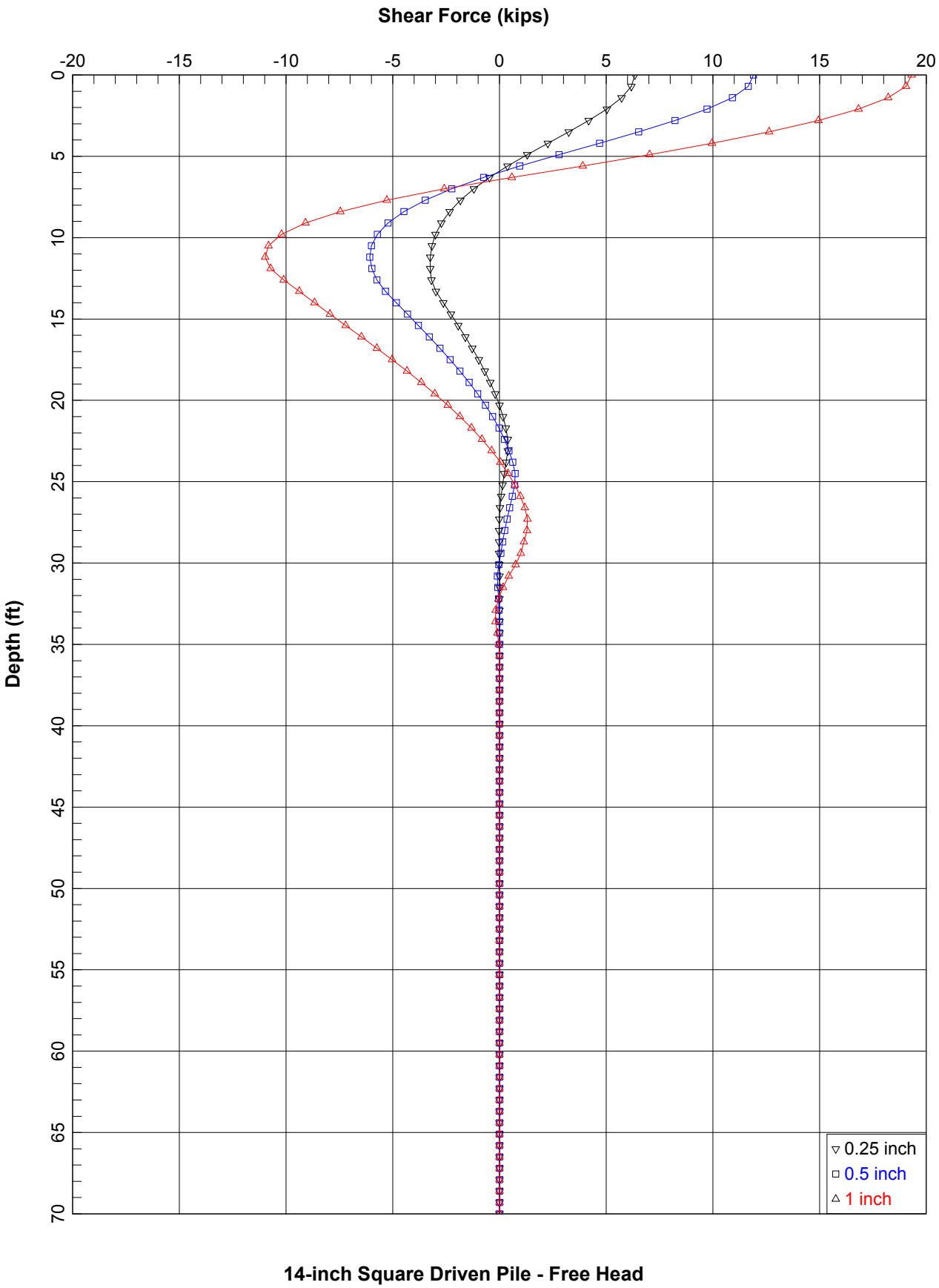
14-inch Square Driven Pile - Fixed Head



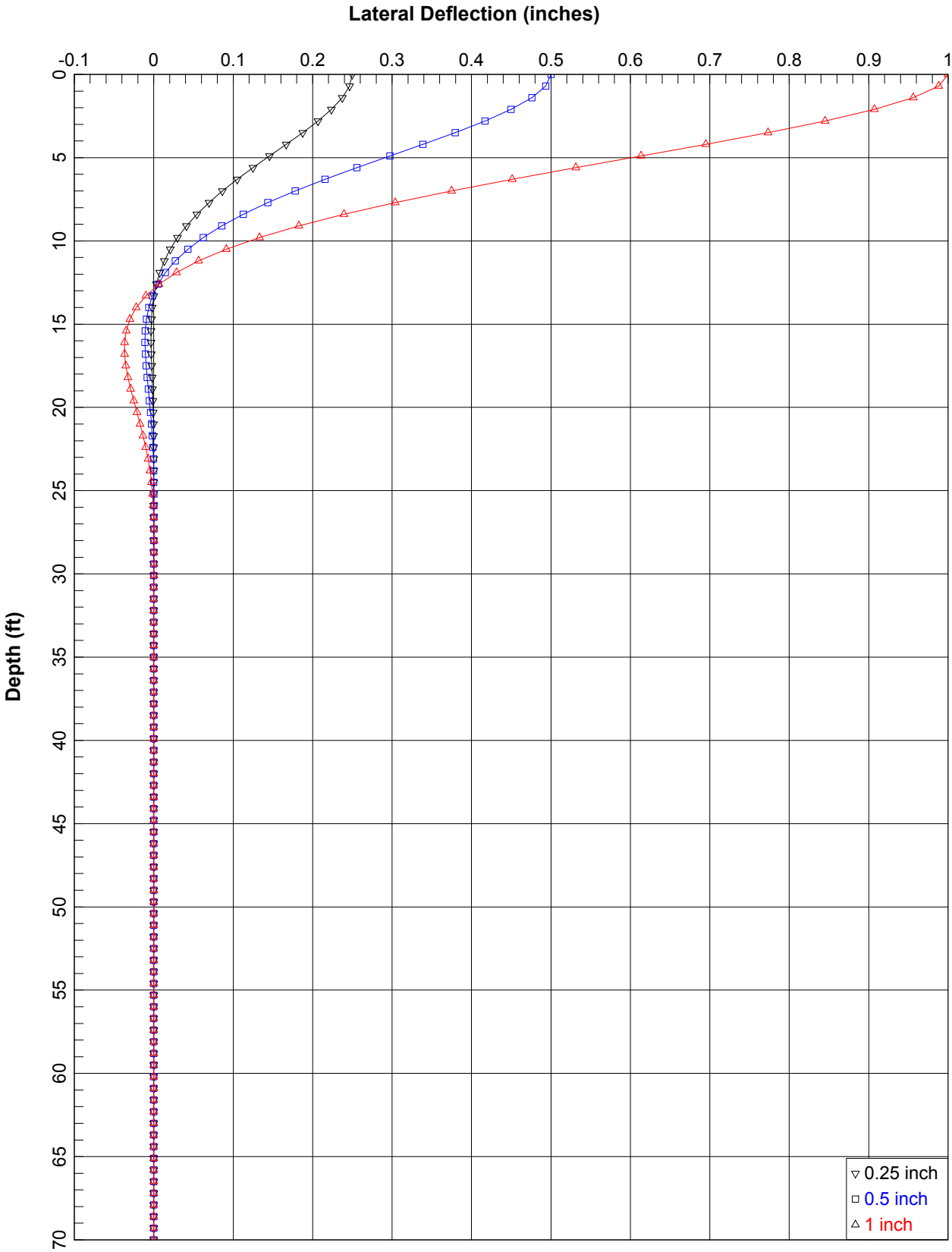
14-inch Square Driven Pile - Free Head



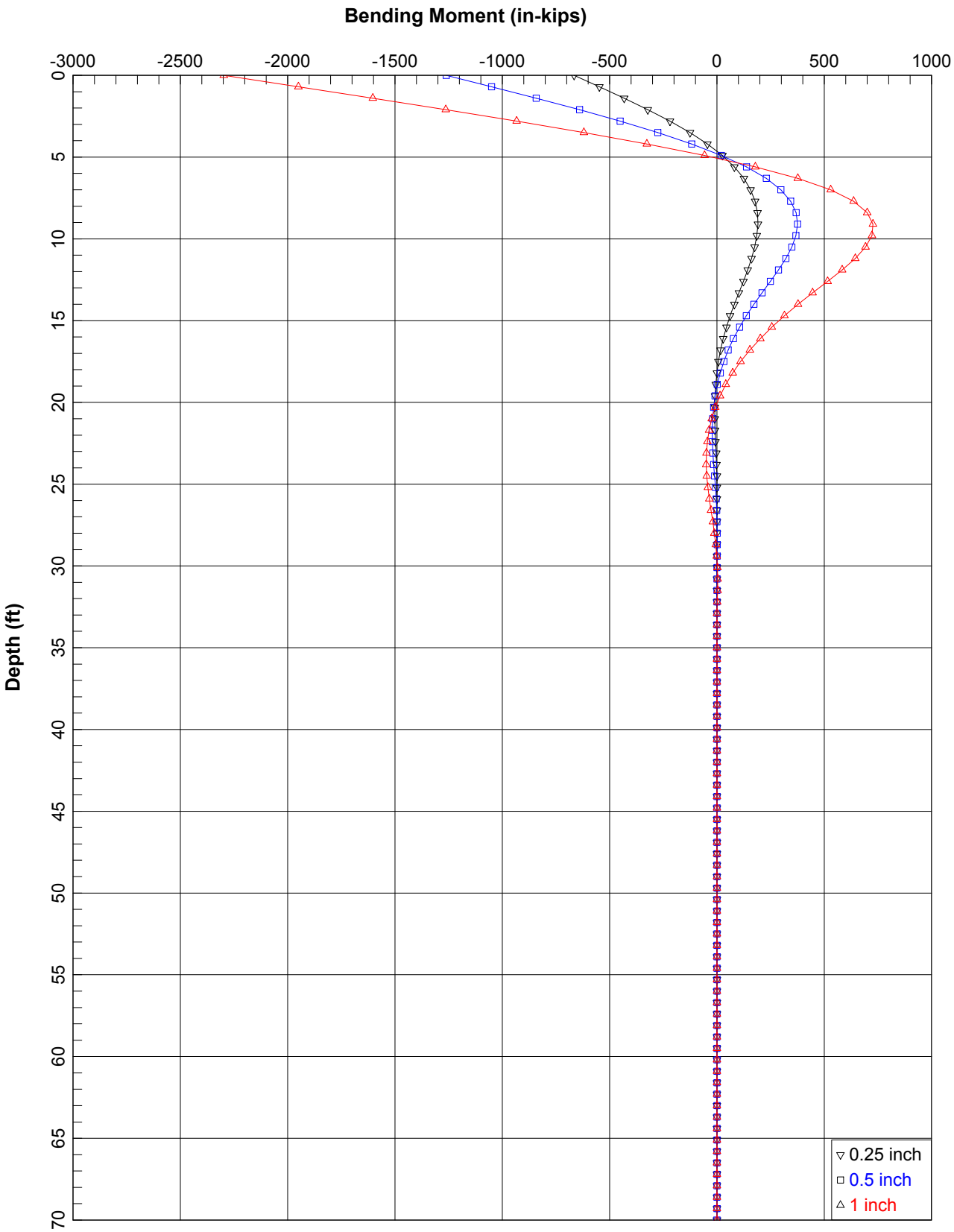
14-inch Square Driven Pile - Free Head



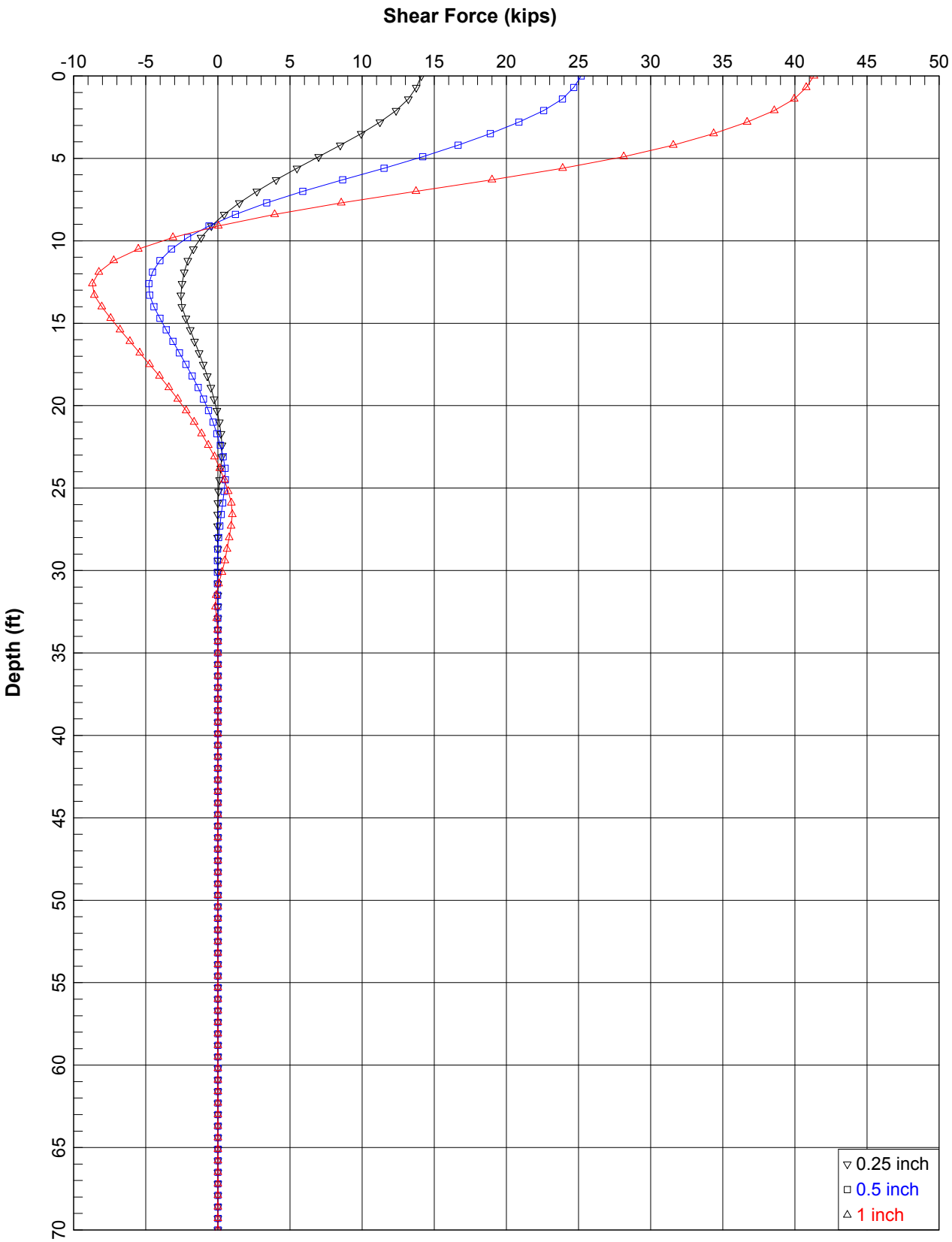
14-inch Square Driven Pile - Free Head



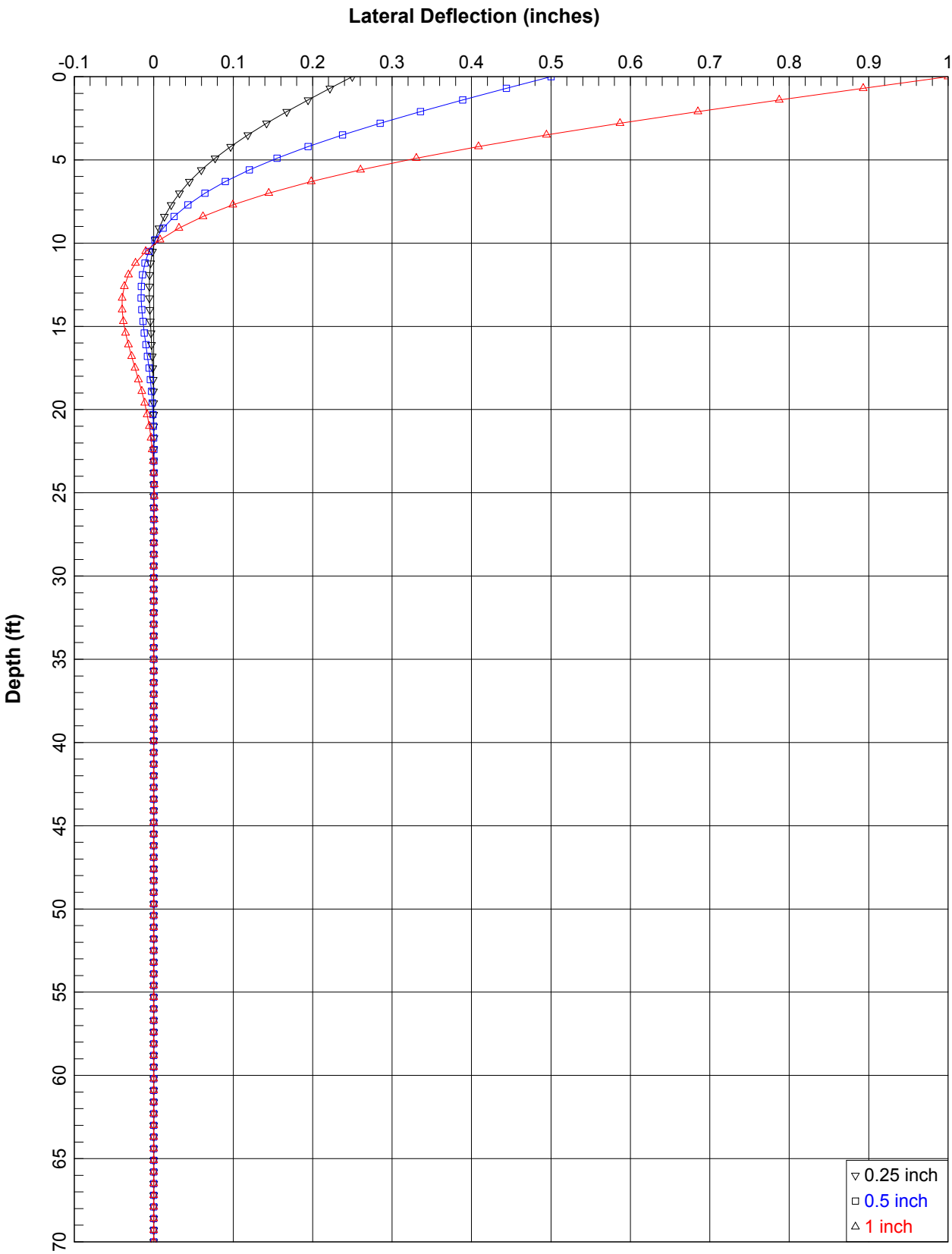
14-inch Round Auger Cast Pile - Fixed Head



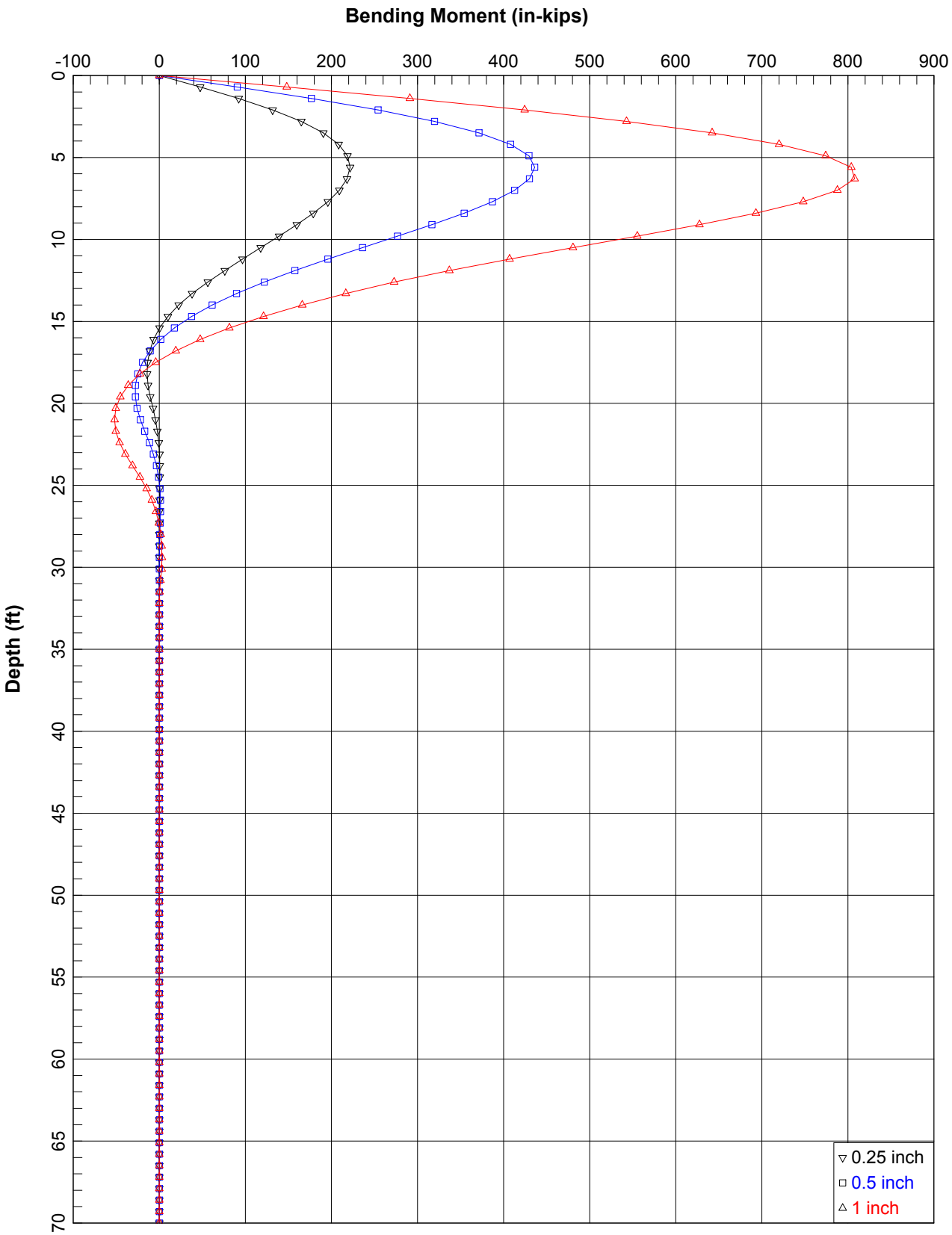
14-inch Round Auger Cast Pile - Fixed Head



14-inch Round Auger Cast Pile - Fixed Head



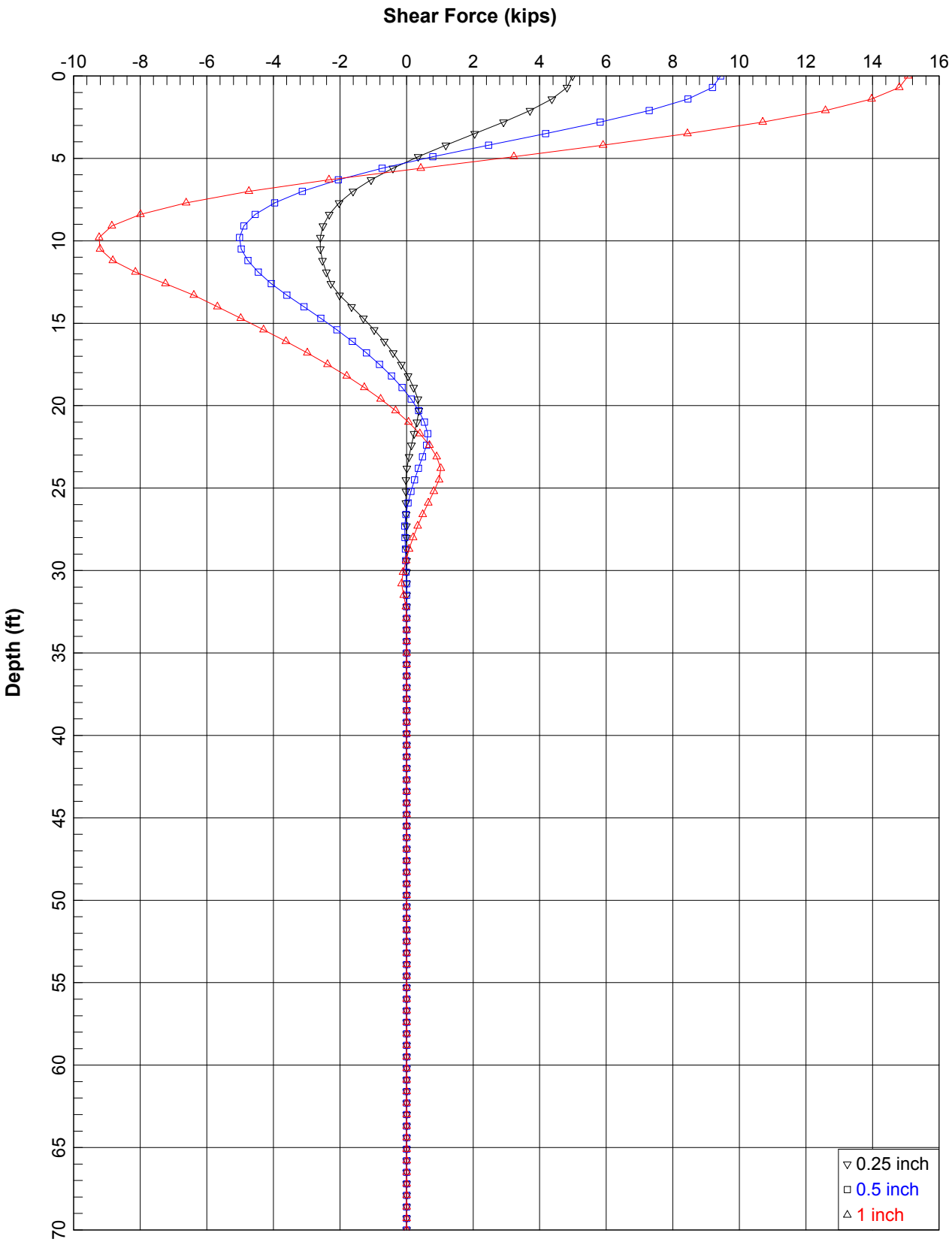
14-inch Round Auger Cast Pile - Free Head



14-inch Round Auger Cast Pile - Free Head

B1-1233

PLATE J-13



14-inch Round Auger Cast Pile - Free Head

Appendix C
Sediment Quality Investigation

BALLONA WETLANDS RESTORATION PROJECT

Sediment Quality Investigation

Prepared for
California State Coastal Conservancy

May 2015

ESA

B1-1236

BALLONA WETLANDS RESTORATION PROJECT

Sediment Quality Investigation

Prepared for
California State Coastal Conservancy

May 2015

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CHAPTER 1
Purpose of the Investigation

The purpose of the sediment characterization program is to assess the sediments within Areas A and B for beneficial use within the proposed Ballona Wetland Restoration Project, located in Los Angeles, California. More specifically, the purpose of the sediment sampling and analytical program was to determine their suitability for use as upland and/or wetland material within the Ballona Wetland Restoration Project. This memo also identifies next steps, including additional investigations to confirm suitability for possible in-ocean placement of excess excavated material. Design specifications for sediment management will be developed during subsequent phases of the design based on the Project EIR/S and regulatory requirements.

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CHAPTER 2
Scope of the Sediment Investigation

The field program for the sediment characterization was conducted from September 24 to 25, 2012 in accordance with the Sampling and Analysis Plan (SAP) (Weston 2012). A summary of the scope of the field and laboratory program is presented in Table 1. Sediment sample selection and boring profile descriptions were led by Weston under contract with ESA, and in coordination with Group Delta Consultants, Inc. (GDC). GDC lead the geotechnical investigation and contracted the driller and analytical laboratory for the sediment characterization program. GDC also provided a geologist to support Weston in the logging of the boreholes. Weston selected the samples for analysis and provided GDC with the prepared samples and chain of custodies for delivery to the analytical laboratory. American Environmental Testing Laboratory in Burbank, CA analyzed the selected sediment samples for the analyses listed in Table 2.

A total of seven direct push borings were completed using the depth and sampling criteria outlined in the SAP (Weston, 2012). The locations of the borings are presented in Figure 1, overlain onto the proposed restoration plan showing the new habitat types. Modifications to the SAP to respond to field conditions and observations are highlighted in the table and summarized as followed:

- **Relocation of Boring on Existing Levee** – Boring A-RW-020 and B-RW-055 were relocated down off the levee and approximately 350 feet from the toe of slope, due the presence of large rip rap. The relocation of these boring was noted in the field and the revised locations were surveyed. The depth of the samples specified in the Work Plan was modified to accommodate for the new existing ground elevation and the anticipated depth of excavation.
- **Modification of Samples Selected for Analysis** – As noted in Table 1, several samples were added for analysis at several boring locations where potential petroleum hydrocarbon contamination was observed and where readings above background were noted from the head space analysis of samples for volatile organic compound (VOC) vapors. Samples were collected where the sediment was observed to have been impacted, and above and below, in order to define the potential extent of contamination. In addition, several designated samples were not analyzed based on field observation that included no evidence of impacted soils near and adjacent to the gas wells.

Samples were transported to the analytical laboratory for chemical testing, and to Nautilus for bio-assay testing. PSOMAS surveyed the locations and ground elevations of the borings. Analytical, bioassay, and survey data have been provided and are summarized in this Technical Report.

TABLE 1
SEDIMENT CHARACTERIZATION PROGRAM – CHEMICAL AND BIOASSAY ANALYSIS OF SELECTED SEDIMENT SAMPLES

Borehole Sites	Sampling Objective	Sample Selection Process	Chemical Analysis	Bioassay Analysis	Samples Collected – ID and Depth
1. Area A and B Boreholes in/near Proposed Channel – A-RW020 – A-HSA018 – B-RW055	Wetland Surface/Foundation Suitability	Proposed Channel Elev.	General Chemistry, Organics, Inorganics (See Table 2)	Acute, 2 Species of Amphipods and 1 species of Polychaete after sample acclimation	Chemistry: A-RW-020-D1 (20'-28'); B-RW-055-D1 (10'-14'), A-HSA-018-D2 (16'-19'), A-HSA- (20'-24') Bioassay: A-RW-020-D1 (20'-28') composited with A-HSA-018-D1 (20'-28'); B-RW-055-D1 (10'-16') composited with B-RW-043- D3 (6.5'-10')
	Wetland Surface Suitability	Change in Material +/-5 ft. within Prop. Channel Elev. (e.g. old marsh mat'l) – if no change – collect 2.5 to 10 ft. below Channel Elev.	(See Table 2)	No bioassay	No change was observed below marsh material. Chemistry and bioassay performed on material located close to the proposed final grades. Samples listed above.
	Use for Upland Placement/ Wetland Grading	Material above the water table – 10 ft interval of similar sediment	(See Table 2)	No bioassay	A-RW-020-C3 (4'-9'), A-RW-020-D3 (12'-16') A-HSA-018-C3 (4'-8'),A-HAS-018-D3 (10'-12') B-RW-055-C1 (0'-3.5'); B-RW-055-C2 (4'-8')
	Use for On-site Grading/ Wetland Surface	Material below the water table – 10 ft interval of similar sediment	(See Table12)	No bioassay	A-RW-020-D2 (16'-19') A-HSA-018-D2 (16'-19')
2. Area A and B Boreholes – Located in Proposed Marsh Habitat & Transition Zone – A-HSA016 – B-RW043	Wetland Surface Suitability	Proposed Wetland Restoration Elev.	(See Table 2)	Acute, 3 Species	Chemistry: A-HSA-016-D1 (10.5'-12'); A-HAS-016-D2 (14'-16'); B-RW-043-D1 (3'-6'); B-RW-043-D2 (6'-6.5'); B-RW-043- D3 (8'-10'); B-RW-043- D5 (10'-16') Bioassay : A-HSA-016- (8'-12'); B-RW-043- D3 (6.5'-10') composited with B-RW-055-D1 (10'-16')
	Use for Upland Placement/wetland Grading	Material above the water table – 10 ft interval of similar sediment	(See Table 2)	No bioassay	A-HSA-016-C1 (0'-6')
	Use for On-site Grading – Wetland Surface	Material below the water table – 10 ft interval of similar sediment	(See Table 2)	No bioassay	A-HSA-016-C2 (6'-10.5') B-RW-043-C1 (0'-3')
3. Areas A Boreholes – Located in Upland Areas – A-HSA067	Use of Material for Upland Placement/Site Grading	Material above the water table – 10 ft interval to straddle proposed excavation depth	(See Table 2)	No bioassay	A-HAS-067-C1 (0'-6')

TABLE 2
LIST OF ANALYTES AND SAMPLES ANALYZED FOR SOIL CHEMISTRY

Samples for Soil Chemistry Analysis	Depth (ft)	Trace Metals	Trace Mercury	Organotins	Polynuclear Aromatic Hydrocarbons	Phthalates	Acid Extractable Compounds	Organochlorine Pesticides & PCBs	Percent solids	pH	Salinity	TOC	Total Sulfides	Dissolved sulfides	TPH diesel	TPH gas	Ammonia as N in Sediment Determination	TRPH in Sediment Determination
In/near proposed channel																		
A-RW-020-D1 (20' –28')	20-28	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
A-RW-020-D2 (16' –19')	16-19	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
A-RW-020-D3 (12'-16')	12-16	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
A-RW-020-C3 (4'-9')	4-9	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
A-HSA018-D2 (16' –19')	16-19	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
A-HSA018-D3 (10' –12')	10-12	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
A-HSA018-D1 (20'-24')	20-24	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
A-HSA018-C3 (4'-8')	4-8	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
B-RW-055-C1 (0' –3.5')	0-3.5	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
B-RW-055-C2 (4' –8')	4-8	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
B-RW-055-D1 (10' –14')	10-14	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
In proposed marsh/trans.																		
A-HSA-016-D1 (10.5'–12')	10.5–12	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
A-HSA-016-D2 (14'–16')	14-16	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
A-HSA-016-C2 (6' -10.5')	6-10.5	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
A-HSA-016-C1 (0' –6')	0-6	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
B-RW-043-C1 (0' –3')	0-3	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
B-RW-043-D1 (3' –6')	3-6	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
B-RW-043-D2 (6' –6.5')	6-6.5	NA	NA	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
B-RW-043-D3 (8'-10')	8-10	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
B-RW-043-D5 (10'-16')	10-16	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Upland																		
A-HSA-067-C1 (0' -6')	0-6	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

NA – not analyzed for these constituents

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J:\1793_Ballona\Fieldwork\SoilSampleLocations.mxd

SOURCE: Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

Ballona Wetlands. D120367

Figure 1

Soil Sample Locations

ESA PWA

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CHAPTER 3
Summary of Results

The results are presented here in four parts. The first part provides a summary of the previous results from the geotechnical investigation of Area A conducted by Weston in 2008 for the Port of Los Angeles. The second part presents the subsurface conditions observed with regard to the type of soils, evidence of impacted sediment, and evidence of original marsh soils. In the third section, the results of the chemical and bioassay testing are summarized. Finally, historic results are presented in the last section.

3.1 Results of 2008 Geotechnical Investigation in Area A

A preliminary geotechnical investigation was completed by Weston under contract with the Port of Los Angeles in 2008. The primary objective of the Preliminary Study was to provide geotechnical and chemical data to characterize approximately 4.5 million cubic yards (cy) of dredge material that has been placed on Area A and which is being considered for removal in support of the Restoration Project. This study was used to determine potential beneficial uses of the dredge material, to identify any special handling or disposal restrictions that may be required based on sediment and leachate chemistry, and to guide any further assessment deemed necessary. The results of the Preliminary Investigation were used to scope the 2012 sediment characterization SAP.

This program included the collection of sediment samples from direct push cores for chemical and geotechnical analysis. The locations of the completed borings are shown in Figure 2 and a summary of constituents above soil screening criteria and sediment quality guidelines are discussed below and presented in Table 3 and Table 4, respectively. The screening criteria that were used to assess the results are summarized in Appendix A. The complete results can be found in the Area A Preliminary Geotechnical Investigation and Beneficial Use Assessment (Weston, 2009).

3.1.1 Comparison to Hazardous Waste Criteria

No chemicals were detected at concentrations greater than the TTLC or greater than 10 times the STLC value. Results of TCLP analyses indicated no analytes above the toxicity characteristic standards USEPA 40 CFR Part 261 values (USEPA, 2006). Therefore, the material was not classified as a hazardous waste and is suitable for upland placement options.

Figure 2. Preliminary Geotechnical Investigation Boring Locations



TABLE 3
SUMMARY OF 2008 SAMPLE RESULTS IN COMPARISON TO HUMAN HEALTH CRITERIA

				Residential Land Use[1]		Commercial/Industrial Land Use Only[1]		S10-060208-6-7	S11-070208-14-15	S11-S15-S28-14-20	S15-080208-15-16	S15-S28-15-16	S17-080208-10-11	S17-S18-10-12	S18-080208-7-8	S21-080208-6-7	S21-S25-6-8
Group	**Analyte**	**Units**	**RL**	**CHHSLs**	**PRG**	**CHHSLs**	**PRG**	**Discrete**	**Discrete**	**Composite**	**Discrete**	**Composite**	**Discrete**	**Composite**	**Discrete**	**Discrete**	**Composite**
Metals	Arsenic (As)	µg/dry g	0.05	0.07	0.39	0.24	1.60	5.129	4.086	4.557	12.61	7.145	3.59	3.816	3.561	9.254	9.218
	Iron (Fe)	µg/dry g	5		23000		100,000	15890	37840	41390	38250	32840	28970	37170	37940	30390	32920
PAHs	Benzo[a]pyrene	ng/dry g	5	38	15	130	210	<5	<5	<5	<5	<5	<5	<5	<5	7.3	6.8

				Residential Land Use[1]		Commercial/Industrial Land Use Only[1]		S23-080208-12-13	S23-S24-S26-21-24	S27-S29-S30-6-8	S29-070208-6-7	S3-11-12-15-16	S4-S10-5-7	S5-060208-15-16	S5-S6-15-16	S5-S6-S9-3-4	S9-060208-3-4
Group	**Analyte**	**Units**	**RL**	**CHHSLs**	**PRG**	**CHHSLs**	**PRG**	**Discrete**	**Composite**	**Composite**	**Discrete**	**Composite**	**Composite**	**Discrete**	**Composite**	**Composite**	**Discrete**
Metals	Arsenic (As)	µg/dry g	0.05	0.07	0.39	0.24	1.60	13.73	4.814	8.977	3.848	7.636	4.666	7.393	3.038	5.73	5.802
	Iron (Fe)	µg/dry g	5		23000		100000	27480	36000	31170	26180	34330	18770	35380	26340	20140	14270
PAHs	Benzo[a]pyrene	ng/dry g	5	38	15	130	210	3.4 J	<5	39.7	<5	6.1	<5	<5	<5	<5	<5

Notes:

J – Below the Reporting Limit (RL) but above the Method Detection Limit (MDL)

Yellow - Concentration exceeds respective soil screening criteria.

[1] California Human Health Screening Levels (CHHSLs) and Preliminary Remediation Goal (PRGs) – see Appendix A for more detailed discussion of these criteria.

TABLE 4
SUMMARY OF 2008 SAMPLE RESULTS IN COMPARISON TO ECOLOGICAL CRITERIA

Group	Analyte	Units	RL	Dredged Material Placement Screening Criteria[1] ER-L	ER-M	S10-060208-6-7 Discrete	S11-070208-14-15 Discrete	S11-S15-S28-14-20 Composite	S15-080208-15-16 Discrete	S15-S28-15-16 Composite	S17-080208-10-11 Discrete	S17-S18-10-12 Composite	S18-080208-7-8 Discrete	S21-080208-6-7 Discrete	S21-S25-6-8 Composite
Metals	Arsenic (As)	µg/dry g	0.05	8.2	70	5.129	4.086	4.557	12.61	7.145	3.59	3.816	3.561	9.254	9.218
	Cadmium (Cd)	µg/dry g	0.05	1.2	9.6	0.262	0.201	1.243	0.836	0.684	0.089	0.595	0.307	0.614	0.57
	Copper (Cu)	µg/dry g	0.05	34	270	11.15	33.62	22.17	39.25	28.84	18.03	28.89	28.99	31.63	35.6
	Lead (Pb)	µg/dry g	0.05	46.7	218	4.742	7.802	4.583	7.924	6.104	3.783	5.758	6.194	24.94	50.72
	Mercury (Hg)	µg/dry g	0.02	0.15	0.71	0.043	0.053	0.055	0.068	0.052	0.041	0.049	0.06	0.303	0.215
	Nickel (Ni)	µg/dry g	0.05	20.9	51.6	14.69	27.15	21.2	25.37	21.42	17.05	24.09	23.61	22.55	23.94
	Silver (Ag)	µg/dry g	0.05	1	3.7	0.04 J	0.035 J	0.072	0.038 J	0.113	0.042 J	0.173	0.052	1.079	1.027
Pesticides	4,4'-DDE	ng/dry g	5	2.2	27	<5	<5	<5	<5	<5	<5	<5	<5	<5	11.6

Group	Analyte	Units	RL	Dredged Material Placcement Screening Criteria[1] ER-L	ER-M	S23-080208-12-13 Discrete	S23-S24-S26-21-24 Composite	S27-S29-S30-6-8 Composite	S29-070208-6-7 Discrete	S3-11-12-15-16 Composite	S4-S10-5-7 Composite	S5-060208-15-16 Discrete	S5-S6-15-16 Composite	S5-S6-S9-3-4 Composite	S9-060208-3-4 Discrete
Metals	Arsenic (As)	µg/dry g	0.05	8.2	70	13.73	4.814	8.977	3.848	7.636	4.666	7.393	3.038	5.73	5.802
	Cadmium (Cd)	µg/dry g	0.05	1.2	9.6	0.67	0.482	0.63	0.257	0.499	0.199	0.175	0.147	0.255	0.208
	Copper (Cu)	µg/dry g	0.05	34	270	25.64	30.61	37.79	20.12	28.08	14.52	27.21	21.25	12.81	9.257
	Lead (Pb)	µg/dry g	0.05	46.7	218	5.361	7.187	31.96	8.573	19.58	4.625	4.742	3.514	6.364	3.383
	Mercury (Hg)	µg/dry g	0.02	0.15	0.71	0.028	0.083	0.189	0.077	0.089	0.065	0.067	0.058	0.046	0.053
	Nickel (Ni)	µg/dry g	0.05	20.9	51.6	26.33	25.27	25.6	19.71	26.05	15.74	20.98	16.44	15.2	13.25
	Silver (Ag)	µg/dry g	0.05	1	3.7	0.105	0.221	0.224	0.129	0.174	0.096	<0.05	0.258	0.138	0.04 J
Pesticides	4,4'-DDE	ng/dry g	5	2.2	27	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5

Notes:
J – Below the Reporting Limit (RL) but above the Method Detection Limit (MDL)

Yellow - Concentration exceeds respective sediment screening criteria.

1 [1] Effects Range-Low (E-RL) and Effects Range Medium (E-RM) are used in dredged material evaluation for Ocean Disposal in combination with the results of bioassay testing and bioaccumulation testing. (Long et al. , 1995). See Appendix A for more detailed discussion of screening criteria

3.1.2 Comparison to Human Health Criteria

The analyzed organic chemicals of concern were PAHs, PCBs, and organochlorine pesticides. With the exception of one soil sample, none of the Area A samples contained concentrations of PAHs, PCBs, or pesticides above the CHHSLs and PRGs soil criteria. The concentration of benzo [a] pyrene at Station 27 was 39.7 µg/kg dry weight, which exceeded the human health screening level (set at 38 µg/kg dry weight) for potential residential land use.

While most of the chemical screening values are below levels of concern for human health, arsenic and iron were measured at ambient concentrations greater than residential CHHSLs and PRGs. The concentrations of arsenic and iron are consistent with natural concentrations in marine sediments. A summary of soil samples that exceeded soil criteria is shown in Table 3.

During the boring and sampling operations, PID readings were taken to identify potential "hot" zones which might contain elevated VOC concentrations. Soil samples from five stations showed elevated PID readings in the field and were subsequently selected for s-VOC and VOC analysis. The results of the laboratory analysis showed that none of the five samples exceeded CHHSLs or PRGs criteria for residential and commercial land use.

Due to the historic and current presence of gasoline production and transportation in Area A, the 20 soil stations were analyzed for total petroleum hydrocarbons (TPHg and TPHd) and benzene, ethylbenzene, toluene, and xylenes (BETX). None of the soil samples had concentrations of TPHg, TPHd or BETX above the Residential Soil Screening Criteria for Groundwater Protection as defined by the California Regional Water Quality Control Board, San Francisco Bay Region. However, during drilling operations at Station 25 and 26, the field engineer noted evidence of soil staining throughout the soil core. These two stations are closest to the compressed natural gas line that runs north-to-south through Area A.

3.1.3 Comparison to Ecological Criteria

Long et al. (1995) developed criteria to evaluate dredged material for ocean disposal, including the Effects Range- Low (ER-L) and Effects Range-Median (ER-M) values (Appendix A). The criteria are helpful in assessing the potential biological impact of elevated constituents of concern.

Concentrations of metals in the sediment samples were compared to ER-L and ER-M values. Several metals slightly exceeded the corresponding ER-L values, including arsenic, cadmium, copper, lead, mercury, nickel, and silver (Table 4). No metals exceeded the corresponding ER-M values, indicating relatively low concentrations.

3.2 Results of 2012 Subsurface Conditions In Areas A and B

Figure 1 presented the boring locations and the profile transects. The borehole profiles for the proposed channel alignment, Area A, and Area B are presented on Figure 3- Figure 5, respectively. The boring profiles include the observed geotechnical observations, field observations and screening, and the results of the comparison of the constituent concentrations to

relevant and applicable criteria/guidelines. The following summary highlights the observed sediment characteristics and the field observations compared to the analytical results:

, respectively. The boring profiles include the observed geotechnical observations, field observations and screening, and the results of the comparison of the constituent concentrations to relevant and applicable criteria/guidelines. The following summary highlights the observed sediment characteristics and the field observations compared to the analytical results:

3.2.1 Area A Proposed Channel Location

Two borings (A-RW020 and A-HSA018) were completed within the proposed channel in Area A (Figure 3). Both of these borings were advanced to below the proposed elevation of the channel into original marsh materials for a total depth of 28 feet below ground surface (bgs). The sediment at these locations is predominantly silty and sandy with low plasticity clays that transition to a high plasticity clay at approximately 14 ft bgs. Above this depth is a lens of more sandy wet clay from 10-14 ft bgs. At approximately 10-14 ft bgs a petroleum odor and dark staining was observed. This potentially impacted sediment is likely limited to an approximately 2-4 foot layer between 10-14 ft bgs. Discrete samples were taken from this layer at 12 to 14 ft bgs in A-RW020 and 10-12 ft in A-HSA018, where the greater petroleum order and staining was observed. Samples were collected for analysis above and below this potentially impacted layer to define the extent of the layer. Head space analysis of samples placed in plastic sealed bags indicated the potentially impacted layers appear to be limited to the sandy clay layer between 10-14 ft bgs. The results of the chemical analysis of these samples indicate TPH was detected at the highest concentrations in A-HSA-018-D3 (10'-12'), and also detected above this sample at lower concentrations in A-HSA-018-D3 (4'-8'). TPH was also detected in A-RW-020-D2 (12'-16'), but not in samples above and below this interval. However, the concentrations of TPH were all below the residential soil screening levels for shallow and deep soils. PAHs, which may include breakdown products of petroleum hydrocarbons, were not detected above the biological or human health criteria in these samples. This layer is above the final excavation depth of the proposed channel that is estimated at 22 ft and 18.5 ft bgs for boring locations A-RW020 and A-HSA018, respectively. The original marsh materials were encountered at approximately 19-20 ft bgs in both borings. Sediment for bioassay testing to assess the suitability of existing materials for wetland surface were collected from depths of 20-28 ft bgs in each boring.

3.2.2 Area A Transition Zone

Two direct push borings (A-HSA016 and A-HSA067) were completed in Area A within transitional habitat zones requiring less excavation (Figure 4). Anticipated excavation depths range from approximately 4 ft bgs at A-HSA067 to 8 ft bgs at A-HSA016. The sediment profile in both of these borings is characterized by sandy silt in the upper 6 ft, transitioning into a more silty clay. The depth of the boring at A-HSA067 was 8 ft bgs or 4 ft below the anticipated excavation depth. A composite sample of the materials from the surface to 6 ft bgs was collected. The results of the analysis indicated total DDT exceeded the most stringent ER-L value, but not the wetland surface criteria developed by the SFRWQCB. A-HSA016 was advanced to 16 ft bgs or 8 ft below anticipated final grades. At 10.5 ft bgs a petroleum odor and staining was observed.

Head space analysis of the sediment from 6-8 ft bgs and from 10.5 to 12 ft bgs, which was placed in a sealed plastic bag, was 0.4 and 0.6 units. The petroleum odor and staining appeared to be limited to 10.5 to 12 ft bgs. The results of the analytical analysis of these samples detected TPH as Heavy Hydrocarbons in the sample from 10.5 ft to 12 ft, but not in samples above and below this depth indicating the impact is limited to this depth. Additionally, the concentrations of TPH were all below the residential soil screening levels for shallow and deep soils. PAHs, which may include breakdown products of petroleum hydrocarbons, were not detected above the biological or human health criteria in these samples.

3.2.3 Area B Channel and Wetland

Two borings were completed in Area B to assess the existing material for use as wetland surface material and beneficial use of excavated materials. B-RW043 was completed in the proposed wetland area with an anticipated excavation depth of 3 ft (Figure 5). B-RW055 was completed in the proposed channel with an anticipated excavation depth of 22.5 ft (Figure 3). B-RW055 was moved off the existing levee due to the potential of encountering boulders and re-located at the toe of the levee. The original marsh materials were encountered in both borings at approximately 10-12 ft bgs. The materials above the original marsh sediments were observed to range from more sandy silts at the surface to silty clays of low and high plasticity. In both borings, a petroleum odor and staining was observed at approximately 6 to 6.5 ft bgs in B-RW043 and less evidently between 4-8 ft bgs in B-RW055. The results of the sample analysis indicated TPH was detected from 0 to 3.5 ft bgs in B-RW055 and B-RW043, but not in the samples below. The concentrations of TPH were, however, all below the residential soil screening levels for shallow and deep soils. PAHs, which may include breakdown products of petroleum hydrocarbons, were not detected above the biological or human health criteria in these samples. Samples for bioassay were collected from the original marsh materials below the potential impacted sediments at depth of 6.5 to 10 ft bgs in B-RW043 and from 10-16 ft bgs in B-RW055. The depth of the samples collected for bioassay were below the anticipated final grade at B-RW043, because of the field observations of potentially impacted sediment, and the potential for over-excavation to the original marsh materials.

3.3 Results of 2012 Sediment Characterization Investigation in Areas A and B

3.3.1 Results of Sediment Characterization Compared to Human Health Criteria/Guidelines

The results of the analytical analysis, compared to relevant California Human Health Screening criteria, are presented in Table 5. Arsenic concentrations are above these criteria in all of the 21 samples that were collected and analyzed. These are similar findings to those in the Area A Geotechnical Investigation conducted in 2008 (Weston, 2009). As reported in the 2008 study, these concentrations are characteristic of marine sediment.

Table 6 presents the results of the TPH analysis and comparison to the Residential Soil Screening Criteria for Groundwater Protection. Although there were multiple detections of TPH as diesel, TPH as Heavy Hydrocarbons, and Total Recoverable Petroleum Hydrocarbons, none of the concentrations were above the residential criteria. Residual concentrations of petroleum products were anticipated in soils within Areas A and B based on the historical uses of the property which was used for oil and gas extraction. Gas production wells remain active on the site. The soils in the areas around the existing gas wells were inspected and only minor surface staining was observed and did not extend below the surface of the soil (area less than one foot squared and only in 3-4 places). Shallow 10 foot boreholes were advanced around the existing well heads, but due to the lack of evidence of sediment impacts, no sampling was collected for analysis.

3.3.2 Results of Sediment Characterization Compared to Ecological Criteria/Guidelines

The summary of results of the Sediment Investigation compared to the ecological criteria is presented in Table 7.

In addition to the ER-L and ER-M criteria, discussed in Section 3.1.3, another measure of potential ecological impacts is the Beneficial Reuse criteria for wetland restoration, developed by the San Francisco Regional Water Quality Control Board (2000) and refined for use outside of San Francisco Bay by Germano & Associates (2004). The Beneficial Reuse criteria have different values for material that will be used as wetland surface (more conservative) and wetland foundation material (less conservative). Appendix A provides more detailed discussion of these screening criteria. The analytical results are compared to the Beneficial Reuse guidelines and historical average concentrations in sediment in the Area B marsh.

Additionally, the TMDL set goals for the estuary that apply to sediments within the tidal zone of Ballona Creek, which would likely apply to the reconfigured channel and tidal wetlands. These goals corresponded to the conservative ER-L values, but were revised based on results of the sediment characterization study conducted as part of the TMDL Reconsideration. The study indicated that the ER-L sediment quality guideline values used as target concentrations for the chemicals listed in the TMDL were inaccurate and highly conservative. The ER-Ls for some metals were below background concentrations typical of estuarine environments. For the organic compounds, ER-Ls were several orders of magnitude below toxicity thresholds for benthic organisms (SCCWRP, 2010). Therefore use of these guidelines for sediment screening purposes may not be applicable for the Ballona Estuary. In the 2013 TMDL Reconsideration, goals for the organic compounds were updated based on recent data in Table 7 includes the updated TMDL goals.

TABLE 5
SUMMARY OF SOIL SAMPLES WITH ANALYTES THAT EXCEED CALIFORNIA HUMAN HEALTH SCREENING LEVELS OR PRELIMINARY REMEDIATION GOALS

Error! Reference source not found.**A: In/near Proposed Channel**

Group	Analyte	Units	PQL	Residential Land Use[1] CHHSLs	Residential Land Use[1] PRG	Commercial/Industrial Land Use Only[1] CHHSLs	Commercial/Industrial Land Use Only[1] PRG	A-RW-020-D1 (20' –28')	A-RW-020-D2 (16' –19')	A-RW-020-D3 (12'-16')	A-RW-020-C3 (4'-9')	A-HSA018-D2 (16' –19')	A-HSA018-D3 (10' –12')	A-HSA018-D1 (20'-24')	A-HSA018-C3 (4'-8')	B-RW-055-C1 (0' –3.5')	B-RW-055-C2 (4' –8')	B-RW-055-D1 (10' –14')
Metals	Arsenic (As)	µg/dry g	0.120	0.07	0.39	0.24	1.60	2.32	1.79	0.953	2.60	0.953	16.6	1.71	5.30	1.88	2.80	1.78

Error! Reference source not found.**B: In Proposed Marsh and Transition Zone**

Group	Analyte	Units	PQL	Residential Land Use[1] CHHSLs	Residential Land Use[1] PRG	Commercial/Industrial Land Use Only[1] CHHSLs	Commercial/Industrial Land Use Only[1] PRG	A-HSA-016-D1 (10.5'–12')	A-HSA-016-D2 (14'–16')	A-HSA-016-C2 (6' -10.5')	A-HSA-016-C1 (0' –6')	B-RW-043-C1 (0' –3')	B-RW-043-D1 (3' –6')	B-RW-043-D3 (8'-10')	B-RW-043-D5 (10'-16')
Metals	Arsenic (As)	µg/dry g	0.120	0.07	0.39	0.24	1.60	2.67	1.77	2.57	2.01	1.91	0.895	1.20	2.01

Error! Reference source not found.**C: Upland**

Group	Analyte	Units	PQL	Residential Land Use[1] CHHSLs	Residential Land Use[1] PRG	Commercial/Industrial Land Use Only[1] CHHSLs	Commercial/Industrial Land Use Only[1] PRG	A-HSA-067-C1 (0' -6')
Metals	Arsenic (As)	µg/dry g	0.120	0.07	0.39	0.24	1.60	2.93

Notes:
J – Below the Reporting Limit (RL) but above the Method Detection Limit (MDL)
Yellow - Concentration exceeds respective soil screening criteria.
1 California Human Health Screening Levels (CHHSLs) and Preliminary Remediation Goal (PRGs) – see Appendix A for more detailed discussion of these criteria

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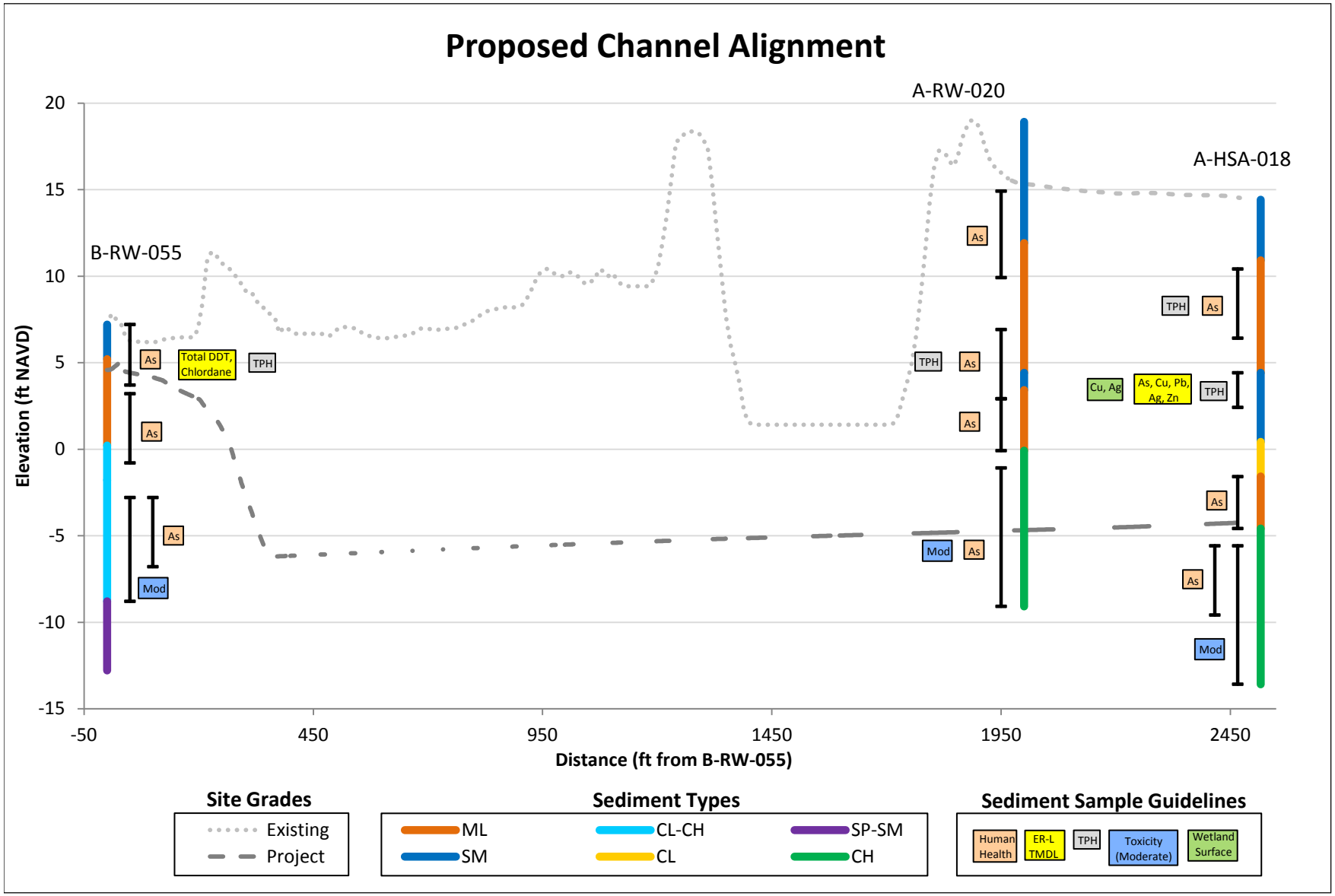
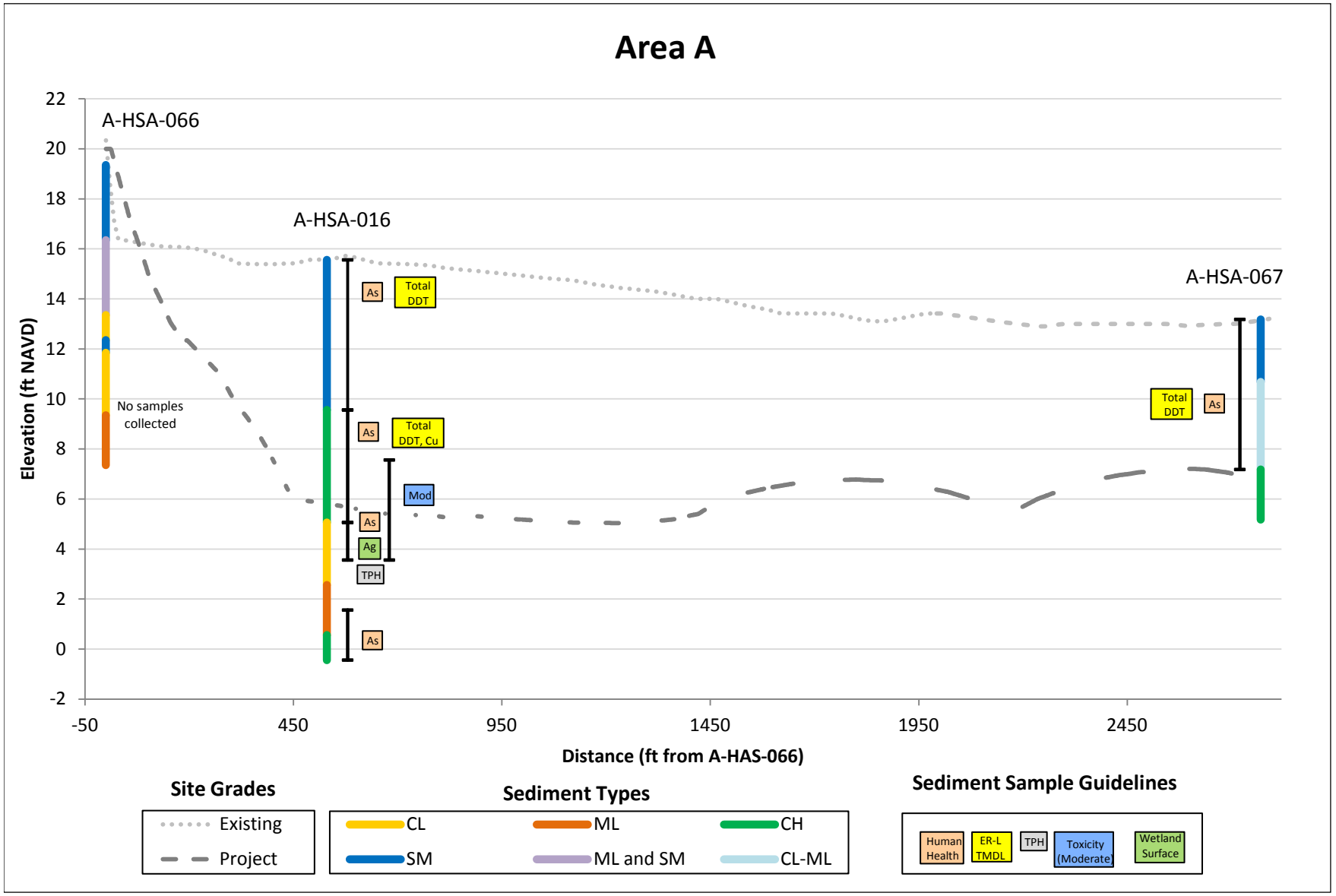


Ballona Wetlands. D120367

Figure 3

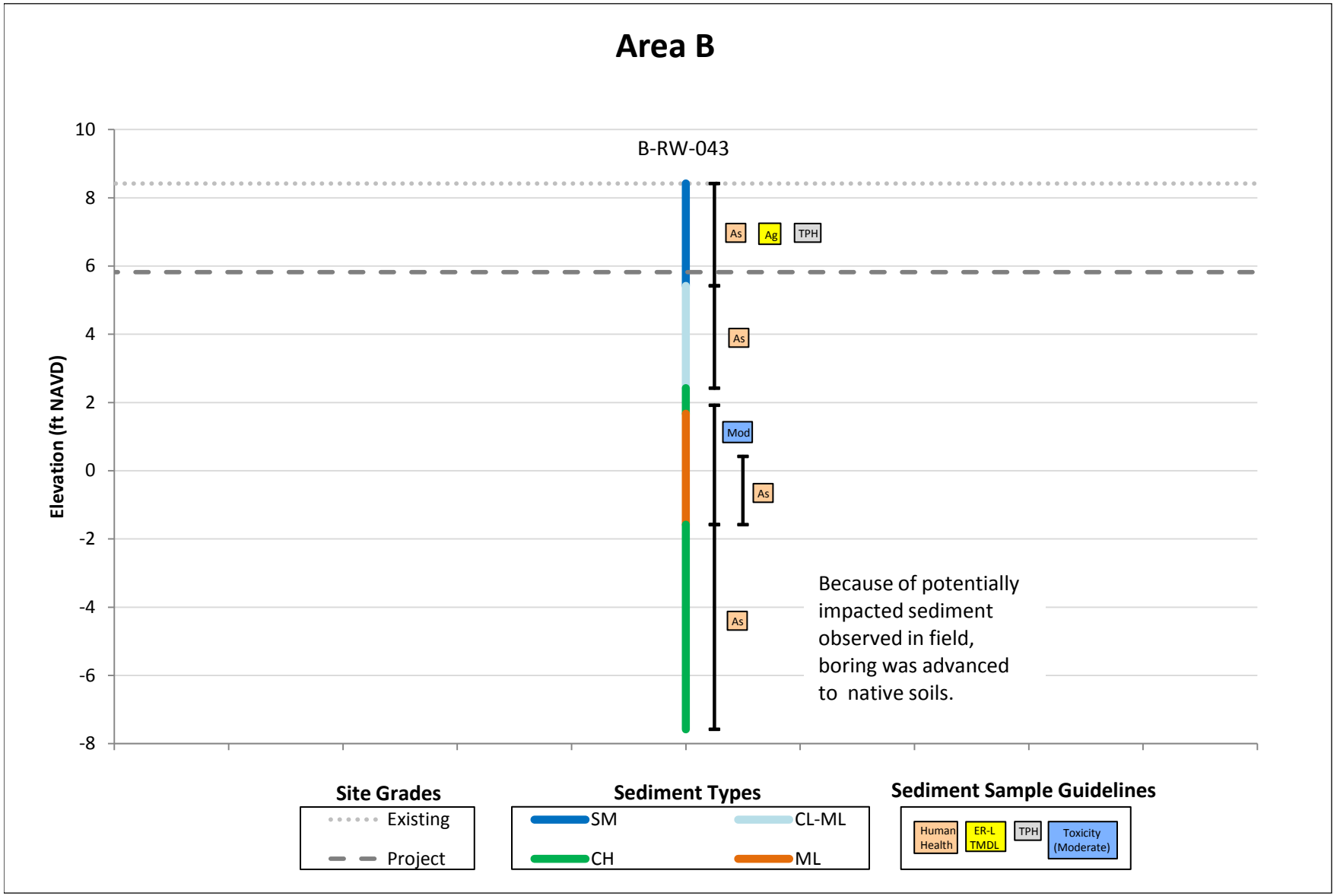
Boring Profiles for Transect
Along Proposed Channel Alignment



Ballona Wetlands. D120367

Figure 4

Boring Profiles for Transect in Area A



Ballona Wetlands. D120367

Figure 5

Boring Profile for Area B

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TABLE 6
SUMMARY OF TPH AND TRPH RESULTS IN SOIL SAMPLES

Table 6A: In/near Proposed Channel

Analyte	Units	PQL	Soil Screening Criteria – Residential (Shallow Soils <3m)**	Soil Screening Criteria – Residential (Deep Soils >3m)**	A-RW-020-D1 (20' –28')	A-RW-020-D2 (16' –19')	A-RW-020-D3 (12'-16')	A-RW-020-C3 (4'-9')	A-HSA018-D2 (16' –19')	A-HSA018-D3 (10' –12')	A-HSA018-D1 (20'-24')	A-HSA018-C3 (4'-8')	B-RW-055-C1 (0' –3.5')	B-RW-055-C2 (4' –8')	B-RW-055-D1 (10' –14')
TPH as Gasoline and Light Hydrocarbons	µg/dry g	1.000	83	83	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
TPH as Diesel	µg/dry g	5.0	83	83	<0.10	<0.10	12.9	<0.10	<0.10	11.1	<0.10	<0.10	<0.10	<0.10	<0.10
TPH as Heavy Hydrocarbons	µg/dry g	5.0	370	5000	<0.10	<0.10	72.8	<0.10	<0.10	149	<0.10	5.26	<0.10	<0.10	<0.10
Total Recoverable Petroleum Hydrocarbons	µg/dry g	5.0			<1.0	<1.0	<1.0	<1.0	<1.0	35.0	<1.0	<1.0	315	<1.0	<1.0

Table 6B: In Proposed Marsh and Transition Zone

Analyte	Units	PQL	Soil Screening Criteria – Residential (Shallow Soils <3m)	Soil Screening Criteria – Residential (Deep Soils >3m)	A-HSA-016-D1 (10.5'–12')	A-HSA-016-D2 (14'–16')	A-HSA-016-C2 (6' -10.5')	A-HSA-016-C1 (0' –6')	B-RW-043-C1 (0' –3')	B-RW-043-D1 (3' –6')	B-RW-043-D2 (6' –6.5')	B-RW-043-D3 (8'-10')	B-RW-043-D5 (10'-16')
TPH as Gasoline and Light Hydrocarbons	µg/dry g	1.000	83	83	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
TPH as Diesel	µg/dry g	5.0	83	83	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
TPH as Heavy Hydrocarbons	µg/dry g	5.0	370	5000	13.0	<0.10	<0.10	<0.10	43.5	<0.10	<0.10	<0.10	<0.10
Total Recoverable Petroleum Hydrocarbons	µg/dry g	5.0			<1.0	<1.0	<1.0	<1.0	130	<1.0	<1.0	<1.0	<1.0

Table 6C: Upland

Analyte	Units	PQL	Soil Screening Criteria – Residential (Shallow Soils <3m)	Soil Screening Criteria – Residential (Deep Soils >3m)	A-HSA-067-C1 (0' -6')
TPH as Gasoline and Light Hydrocarbons	µg/dry g	1.000	83	83	<0.10
TPH as Diesel	µg/dry g	5.0	83	83	<0.10
TPH as Heavy Hydrocarbons	µg/dry g	0.10	370	5000	<0.10
Total Recoverable Petroleum Hydrocarbons	µg/dry g	5.0			<1.0

Notes: ** SFRWCQB, 2007.

J – Below the Reporting Limit (RL) but above the Method Detection Limit (MDL)

Blue - Detections of Constituents Listed.

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The results of the 2012 Sediment Characterization Investigation in Areas A and B are also presented based on the three types of final use/habitat types which were defined in the SAP and which formed the basis for the scope and focus of the investigation. The results are presented for samples collected:

1. in or near the proposed re-aligned channel – Table 7A;
2. in the proposed marsh or transition zones – Table 7B; and,
3. from proposed upland habitat areas –Table 7C.

Material Used for Wetland Surface in Proposed Realigned Channel

The results of the analytical analysis of samples taken at the proposed depth of the re-aligned channel indicate concentration of metals, pesticides, PAHs and PCB are all below the most stringent guidelines including the ER-L values (Young et. al., 1995) and the Beneficial Reuse wetland surface criteria (Germano & Associates, 2004). The concentrations are all well below the historical ranges and averages reported for the existing Area B tidal marsh channel sediments. Historical data on sediment characteristics in the existing Ballona Creek Estuary are discussed in Section 3.5.

A bioassay study was conducted on the samples collected within the anticipated depth of the new marsh surface. Results indicated low to moderate toxicity for one of the marine arthropods, *Eohaustorius estuarius*. These samples contained low concentrations of contaminants and a high percentage of fine sediments, leading to speculation that the toxicity was related to sediment grain size characteristics that were outside of the tolerance range of the toxicity test species (Kendall, 1999 and SCCWRP, Bight'08 Toxicology Lab. Manual). As an additional study to further evaluate the cause of the toxicity result, a toxicity identification evaluation (TIE) study was conducted by the Southern California Coastal Water Research Project (SCCWRP) in 2014 (Greenstein and Bay 2014; included as Appendix C). This TIE study concluded that multiple lines of evidence indicated that nonchemical factors, possibly related to sediment texture, were the most likely cause of toxicity for the sediment (Greenstein and Bay 2014). The result suggests that toxicity was impacted by some physical characteristic, such as clay content. The implication is that the physical sediment properties (e.g., texture, clay content) are not suitable for supporting the marine arthropod, *Eohaustorius estuaries* because this species is adapted to inhabiting environments with sandier sediment. Therefore, the bioassay and TIE results indicate that the fine-grained sediment at Ballona is not likely to support *Eohaustorius estuaries* and that the low concentrations of chemical contaminants are not likely to impact benthic communities.

Material Used for Wetland Surfaces in Areas A and B

The results of the analytical analysis of samples taken at approximately the proposed depth of the new marsh surface indicate the concentration of copper and total DDT are above the ER-L guidelines and similar TMDL goals, but below the Beneficial Reuse wetland surface criteria. Silver concentrations are above the wetland surface guidelines in two samples that could be used for this purpose. The silver and total PCB concentration are within the range of concentration detected in sediment within existing Area B marsh channel sediments, but above the average

concentrations in several samples. The copper concentration that is above the ER-L in sample A-HAS-016-C2 (6'-10.5'), is below the average concentration in the existing Area B marsh. The bioassay results on the samples collected within the anticipated depth of the new marsh surface indicated low to moderate toxicity for one of the marine arthropods, *Eohaustorius estuaries*. As discussed above, the TIE study concluded this is most likely due to sediment texture and not chemical contamination (Greenstein and Bay 2014; Appendix C).

Material Used for Potential On-site Wetland Grading and/or Upland

The results of the analytical analysis of samples taken within the depths that will be excavated and used for either wetland grading or predominantly upland placement, indicate the concentration of silver and total DDT are above the most stringent ER-L guidelines and similar TMDL goals in two of nine and three of nine samples, respectively. These concentrations were below the criteria for wetland surface criteria (Germano & Associates, 2004) with the exception of silver in A-HSA018-D3 (10'-12'). At this borehole location, copper concentrations were also higher than the wetland surface criteria. The silver and total PCB concentration are within the range of concentration detected in sediment within existing Area B marsh channel sediments, but above the average concentrations in two and one of the nine samples, respectively. Arsenic was above the average of Area B marsh sediments in A-HSA018-D3 (10'-12'). This borehole location had the highest and greatest number of constituents above the ER-L values and the only two constituents in all 21 total samples collected in Area A and B that were above the Beneficial Reuse wetland surface criteria. No bioassay testing was performed on this material.

Material Used for Wetland Foundation

The concentrations of constituents in the samples collected from depths that are anticipated to be below the proposed marsh surfaces and serve as wetland foundation material are all below the ER-L values with the exception of silver concentrations in one of eight samples (A-HAS-016-D1 -10.5'-12'). The concentrations for these materials are not above the guidelines for Beneficial Reuse wetland foundation material. The bioassay results on the samples collected within the anticipated depth of wetland foundation material indicated low to moderate toxicity for one of the marine arthropods, *Eohaustorius estuaries*. As discussed above, the TIE study concluded this is most likely due to sediment texture and not chemical contamination (Greenstein and Bay 2014; Appendix C).

Material Used for Potential Off-site Discharge in Marine Waters

The scope of this sediment investigation did not include sediment sampling and analyses for comparison to criteria for off-site discharge in marine waters (e.g., offshore disposal at the LA-2 disposal site). The proposed project includes potential off-site ocean disposal or open water placement (e.g., off-site shallow water habitat creation or either confined aquatic disposal (CAD) or CAD cover). Any material to be used for off-site ocean or open water placement will be tested and assessed in accordance with applicable EPA and USACE guidance as discussed in Section 4.

3.4 Ballona Creek Estuary Sediment Characteristics-Historical Results

Based on the current restoration plan for Ballona Wetlands, areas of the existing Ballona Creek will be filled and covered, while other parts of the channel will remain intact. Therefore, portions of the current sediment within the Ballona Creek Estuary will continue to serve as estuarine habitat. Investigation of the characteristics of these sediments and their suitability for use as wetland surface materials were not part of the field and laboratory sediment characterization

TABLE 7
SUMMARY OF SEDIMENT SAMPLES RESULTS AND COMPARISON TO BENEFICIAL USE GUIDELINES AND AREA B MARSH SEDIMENT QUALITY

Table 7A: Samples in/near Proposed Channel

Group	Analyte	Units	PQL	Dredged Material Screening Criteria[1] ER-L	ER-M	Wetland Benefial Use Guidelines[2] Wetland Surface	Wetland Foundation	Range of Concen. Ballona Area B[3]	Average Concen. Area B[4]	Ballona Estuary TMDL Goals (ER-L)[5]	A-RW-020-C3 (4'-9')	A-RW-020-D3 (12'-16')	A-RW-020-D2 (16' –19')	A-RW-020-D1 (20'-28')	A-HSA018-C3 (4'-8')	A-HSA018-D3 (10' –12')	A-HSA018-D2 (16' –19')	A-HSA018-D1 (20'-24')	B-RW-055-C1 (0' –3.5')	B-RW-055-C2 (4' –8')	B-RW-055-D1 (10' – 14')
Metals	Arsenic (As)	µg/dry g	0.120	8.2	70	40	40	3.7-14.6	8.43		2.60	0.953	1.79	2.32	5.30	**16.6**	0.953	1.71	1.88	2.80	1.78
	Cadmium (Cd)	µg/dry g		1.2	9.6	0.250	0.620	0.49-6.16	2.44	1.2	**0.639**	**0.927**	0.0623	**0.329**	**0.369**	**0.963**	0.101	**0.309**	**0.381**	0.161	**0.46**
	Chromium (Cr)	µg/dry g		81	370	119	320	18-97.2	55.34		16.8	17.3	16.4	18.2	17.2	20.6	20.7	16.2	15.3	15.2	14.1
	Copper (Cu)	µg/dry g	0.030	34	270	50	150	17-440	77.71	34	28.5	14.9	21.9	19.4	26.5	**53.7**	19.5	27.4	22.9	19.3	25.2
	Lead (Pb)	µg/dry g	0.010	46.7	218	200	200	20.8-265	88.16	46.7	7.00	4.74	2.42	4.23	7.64	**58.7**	5.20	6.10	11.2	5.03	6.21
	Mercury (hg)	µg/dry g		0.15	0.71	1.18	1.18	.041-.272	0.16		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Nickel (Ni)	µg/dry g		20.9	51.6	230	230	9.2-39.29	24.78		15.6	15.8	13.1	15.2	15.8	17.8	13.8	13.5	13.9	13.7	18.0
	Silver (Ag)	µg/dry g	0.020	1	3.7	0.28	2.00	0.05-3.77	1.15	1.0	**0.794**	0.164	0.0159 (J)	0.0545	0.110	**1.44**	0.0296	0.0748	**0.285**	0.083	0.0349
	Zinc (Zn)	µg/dry g	0.160	150	410	1200	1200	54.9-1770	285.54	150	67.9	46.0	56.0	41.5	60.8	**187**	60.9	52.2	59.9	45.4	53.3
Pesti-cides & PCBs	Total DDT	ng/dry g	2.0	1.58	46.1	250	250	0-17.1	4.41	1.9*	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**4.27**	<1.0	<1.0
	Total Chlordane	ng/dry g	2.0	0.5	6	69.2	69.2	0-51.4	6.03	1.3*	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**2.42**	<1.0	<1.0
	Total PCB	ng/dry g	2.0	22.7	180	600	600	0-36	10.8	3.2*	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.85 (J)	<1.0	<1.0
	Total PAHs	µg/dry g		4.022	44.79	6.3		0-3.25	0.434	4.022	<0.010	0.1159	<0.010	0.0134	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Bioassay	*Eohaustorius estuaries – 10 day survival*	%						98.6-9.38	79					79				79			69
Potential Beneficial Use (Wetland Surface (WS), Wetland Foundation (WF), Wetland Grading, Upland (WG/UP))											WG/UP	WG/UP	WG/WS	WS	WG/UP	WG/UP	WS	WS/WF	UP/WG	UP/WG	WS/WF

Table 7B: Samples in Proposed Marsh and Transition Zone

Group	Analyte	Units	PQL	Disposal Option Sediment Screening Criteria[1] ER-L	ER-M	Bay Area Recommended Guidelines[2] Wetland Surface	Wetland Foundation	Range of Concen. Ballona Area B[3]	Average Concen. Area B[4]	Ballona Estuary TMDL Goals (ER-L)[5]	A-HSA-016-C1 (0' –6')	A-HSA-016-C2 (6' - 10.5')	A-HSA-016-D1 (10.5'– 12')	A-HSA-016-D2 (14'– 16')	B-RW-043-C1 (0' –3')	B-RW-043-D1 (3' –6')	B-RW-043-D2 (6' –6.5')	B-RW-043-D3 (8'-10')	B-RW-043-D5 (10'-16')
Metals	Arsenic (As)	µg/dry g	0.120	8.2	70	40	40	3.7-14.6	8.43		2.01	2.57	2.67	1.77	1.91	0.895	N/A	1.2	2.01
	Cadmium (Cd)	µg/dry g		1.2	9.6	0.250	0.620	0.49-6.16	2.44	1.2	0.177	**0.537**	**0.779**	0.244	**0.460**	**0.441**	N/A	0.0713	**0.506**
	Chromium (Cr)	µg/dry g		81	370	119	320	18-97.2	55.34		9.75	23.0	19.8	14.1	11.9	13.6	N/A	11.3	15.1
	Copper (Cu)	µg/dry g	0.030	34	270	50	150	17-440	77.71	34	7.3	**35.6**	28.7	24.0	22.6	19.1	N/A	13.5	22.4
	Lead (Pb)	µg/dry g	0.010	46.7	218	200	200	20.8-265	88.16	46.7	2.26	6.84	24.2	4.69	42.6	9.11	N/A	2.52	5.29
	Mercury (hg)	µg/dry g		0.15	0.71	1.18	1.18	.041-.272	0.16		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	N/A	<0.1	<0.1
	Nickel (Ni)	µg/dry g		20.9	51.6	230	230	9.2-39.29	24.78		9.3	19.9	17.2	13.6	9.72	14.8	N/A	9.9	15.0
	Silver (Ag)	µg/dry g	0.020	1	3.7	0.28	2.00	0.05-3.77	1.15	1.0	0.039	0.114	**1.53**	.0174J	**1.25**	0.110	N/A	0.0583	0.103
	Zinc (Zn)	µg/dry g	0.160	150	410	1200	1200	54.9-1770	285.54	150	20.1	55.8	86.1	55.7	1.25	45.9	N/A	45.4	43.9
Pesti-cides & PCBs	Total DDT	ng/dry g	2.0	1.58	46.1	250	250	0-17.1	4.41	1.9*	**3.12**	**18.62**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Total Chlordane	ng/dry g	2.0	0.5	6	69.2	69.2	0-51.4	6.03	1.3*	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Total PCB	ng/dry g	50	22.7	180	600	600	0-36	10.8	3.2*	<25	<25	<25	<25	<25	<25	<25	<25	<25
	Total PAHs	µg/dry g		4.022	44.79	6.3		0-3.25	0.434	4.022	<0.010	<0.010	<0.010	<0.010	0.20	<0.010	<0.010	<0.010	<0.010
Bioassay	*Eohaustorius estuaries – 10 day survival*	%						98.6-9.38	79			86	86					69	
Potential Beneficial Use (Wetland Surface (WS), Wetland Foundation (WF), Wetland Grading, Upland (WG/UP))											WG/UP	WS/WG	WS/WF	WF	WS/WG	WS/WF	WF	WF	WF

Table 7C: Samples from Proposed Upland

Group	Analyte	Units	PQL	Dredged Material Screening Criteria[1] ER-L	ER-M	Wetland Beneficial Use Guidelines[2] Wetland Surface	Wetland Foundation	Range of Concen. Ballona Area B[3]	Average Concen. Area B[4]	Ballona Estuary TMDL Goals (ER-L)[5]	A-HSA-067-C1 (0'–6')
Metals	Arsenic (As)	µg/dry g	0.120	8.2	70	40	40	3.7-14.6	8.43		2.93
	Cadmium (Cd)	µg/dry g		1.2	9.6	0.250	0.620	0.49-6.16	2.44	1.2	**0.374**
	Chromium (Cr)	µg/dry g		81	370	119	320	18-97.2	55.34		21.2
	Copper (Cu)	µg/dry g	0.030	34	270	50	150	17-440	77.71	34	25.7
	Lead (Pb)	µg/dry g	0.010	46.7	218	200	200	20.8-265	88.16	46.7	7.74
	Mercury (hg)	µg/dry g		0.15	0.71	1.18	1.18	.041-.272	0.16		
	Nickel (Ni)	µg/dry g		20.9	51.6	230	230	9.2-39.29	24.78		19.1
	Silver (Ag)	µg/dry g	0.020	1	3.7	0.28	2.00	0.05-3.77	1.15	1.0	0.106
	Zinc (Zn)	µg/dry g	0.160	150	410	1200	1200	54.9-1770	285.54	150	53
Pesti-cides & PCBs	Total DDT	ng/dry g	2.0	1.58	46.1	250	250	0-17.1	4.41	1.58	**31.04**
	Total Chlordane	ng/dry g	2.0	0.5	6	69.2	69.2	0-51.4	6.03	0.5	<0.1
	Total PCB	ng/dry g	50	22.7	180	600	600	0-36	10.8	22.7	<25
	Total PAHs	µg/dry g		4.022	44.79	6.3		0-3.25	0.434	4.022	<0.010
Potential Beneficial Use (Wetland Surface (WS), Wetland Foundation (WF), Wetland Grading, Upland (WG/UP))[6]											WG/UP

Notes:

J – Below the Reporting Limit (RL) but above the Method Detection Limit (MDL)
Yellow - Concentration exceeds the ER-L and/or the TMDL Goals
Green - Concentration exceeds wetland beneficial use guidelines (see footnote 2) for wetland surface criteria
Blue - Concentration exceeds wetland beneficial use guidelines (see footnote 2) for wetland surface and foundation criteria
* Updated with TMDL Reconsideration

Footnotes:

[1] Effects Range-Low (E-RL) and Effects Range Medium (E-RM) are used in dredged material evaluation for Ocean Disposal in combination with the results of bioassay testing and bioaccumulation testing.

[2] Sediment Reuse Criteria for Wetland Restoration – Criteria for assessing sediment for wetland surface and foundation beneficial uses were first developed by the San Francisco Regional Water Quality Control Board (SFCRWQCB, 2000). The guidelines presented are based on revised guidelines based on a Floating Percentile Method for predicting acute amphipod toxicity (Germano & Associates, 2004), and can therefore be applied to application outside of the Bay area. However, these criteria need to be used in combination with site-specific background data (see range and average concentrations for Area B in Table) and bioassay testing results on site sediments.

[3] The range of sediment concentration is based on the results presented in Table 2 in Appendix B from sediment sampling and analysis in Area B for the Ballona Wetlands Ecological Reserve Baseline Assessment Program (Santa Monica Bay Restoration Commission, 2011 and Weston, 2006).

[4] The average concentration is based on historical sediment concentrations for Area B as presented in Table2 in AppendixB.

[5] These are concentration based waste load allocations from the Ballona Estuary Toxics TMDL and based on the E-RL. This TMDL is being re-evaluated. See Appendix A for more discussion of sediment screening criteria. Based on toxicity testing, these guidelines were found to be inaccurate and highly conservative (SCCWRP, 2000).

[6] Potential beneficial use based on elevation of the material from proposed final grades. Wetland surface material is within ±5 ft of proposed final grades. Material above this may be used for wetland grading or upland material. Material 3-5 ft below the proposed final grade is wetland foundation material (WF). If sample is between these depths, dual designated use is shown.

studies conducted as part of the Restoration Design. However, historical data was reviewed to assess suitability and potential sediment quality issues for materials within the Ballona Creek Estuary, which are within the Proposed Project limits. Previous studies, which include chemistry and toxicity testing of sediment within the Ballona Creek Estuary as part of the Bight '03 program, reported that sediments within Ballona Creek Estuary are contaminated and toxic to marine life (LARWQCB &USEPA Region 9, 2005). This prevalence of toxicity led to an Environmental Protection Agency 303(d) listing and the subsequent development of a total maximum daily load (TMDL) for multiple trace organics, metals, and sediment toxicity (LARWQCB &USEPA Region 9, 2005).

In support of the TMDL, a three-year study was conducted to determine the current extent of chemical contamination within the estuary and to identify the likely causes of toxicity. Advanced chemical analysis and toxicity identification evaluation (TIE) methods were used in this study. The results indicated that chemical contamination and toxicity were widespread in the estuary (SCCWRP, 2010). Concentrations of TMDL listed compounds, including DDT, DDE, and chlordane, often exceeded target levels. However, the results of toxicity testing indicated that the concentration of these constituents were 10 to 10000 times below toxicity thresholds either developed in this study or reported in other studies. Sediment concentrations of PAHs and PCBs were also below levels likely to cause direct sediment toxicity. Metals concentrations in field sampled sediment porewater were below California water quality standards for the protection of aquatic life (SCCWRP, 2010).

TIE analyses of whole sediments and porewater found that pyrethroid pesticides were likely the primary source of toxicity within the estuary. Comparison of these pesticides' toxicity thresholds to chemical analysis results confirmed that sufficient pyrethroids were present in the estuary sediments to cause toxicity. Another currently used pesticide, fipronil, was detected in estuary sediments and may also be of concern (SCCWRP, 2010). The issue of synthetic pyrethroids impacts on the sediment in the Ballona Estuary that will remain exposed per the Proposed Project needs to be addressed. Design measures to address this issue may include removal of the sediments to a depth that does not contain concentrations that are toxic and preserves the designated beneficial uses.

Guidelines for sediment quality for the Ballona Estuary are presented in the Toxics Pollutants TMDL developed by the Los Angeles Regional Water Quality Control Board (LARWQCB, 2005). These guidelines are based on the Effects Range-Low (E-RL) criteria. The results of the sediment characterization study as part of the TMDL Reconsideration, indicated the E-RL sediment quality guideline values used as target concentrations for the chemicals listed in the TMDL were found to be inaccurate and highly conservative. The ER-Ls for some metals were below background concentrations typical of estuarine environments. For the organic compounds, ER-Ls were several orders of magnitude below toxicity thresholds for benthic organisms (SCCWRP, 2010). Therefore use of these guidelines for sediment screening purposes may not be applicable for the Ballona Estuary. In the 2013 TMDL Reconsideration, goals for the organic compounds were updated based on recent data. Table 7 includes the updated TMDL goals.

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CHAPTER 4
Ocean Disposal Requirements

On-site sediment that is not used for on-site beneficial use as wetland surface, wetland foundation or upland placement may be designated for alternative placement depending on final cut and fill balance quantities. The suitability of on-site excavated sediment for placement at a designated ocean dredged material disposal site such as LA-2 offshore of San Pedro, would require a Tier III evaluation in accordance with Evaluation of Dredged material Proposed for Discharge in Waters of the U.S. – Testing Manual (ITM; USEPA/USACE 1998, Section 6.7) and Evaluation of Dredged Material Proposed for Ocean Disposal – Testing Manual (OTM; USEPA/USACE 1991) guidelines. Sampling and testing requirements under these protocols include:

- **Sampling Frequency** - The general rule is a minimum of two composite samples will be used for the first 100,000 cubic yards (CY) and one composite sample will be used per subsequent 100,000 CY. However, additional composites or analyses of individual cores may be required if contaminant hot spots are identified.
- **Geotechnical Testing** - Physical analysis should include grain size, specific gravity, and total solids. Atterberg limits are also recommended to estimate strength and settlement characteristics of the sediment.
- **Chemical Testing** - Chemical analysis of bulk sediment should include general chemistry (i.e., ammonia, total sulfides, and total organic carbon [TOC]), trace metals, chlorinated pesticides, PCB Congeners, PAHs, other semivolatile organic compounds (i.e., phenols and phthalates), and organotins.

Similar to the assessment of the suitability of the project's excavated sediment for use as on-site wetland surface and foundation materials, the chemical analyses results may be compared to ER-L and ER-M values. The values are helpful in assessing the potential significance of elevated sediment-associated contaminants of concern, in conjunction with biological analysis. While these screening level values are useful for identifying elevated sediment-associated contaminants, they should not be used to infer causality because of the inherent variability and uncertainty of the approach. As presented previously, the results of chemical analyses of on-site sediment samples indicated concentrations of lead, copper, zinc, silver, and total DDT above the ER-L in several samples. Concentrations were not above the ER-Ms.

The additional biological testing that is required under the ocean disposal guidance includes:

- **Solid Phase Toxicity Testing** - Two solid phase (SP) 10-day acute tests performed on whole sediment are conducted to estimate potential adverse effects of ocean disposed dredged material on benthic organisms. One SP test may be conducted using an amphipod

species. The species should be selected based on grain size tolerance (i.e., *Eohaustorius estuarius* prefer primarily coarse-grained sediment while *Ampelisca abdita* prefer fine-grained sediment) to reduce confounding effects unrelated to contaminants. The polychaete *Neanthes arenaceodentata* may be used.

- **Suspended particulate phase (SPP) Toxicity Testing** – Three suspended particulate phase (SPP) tests are required. SPP tests are conducted to estimate the potential adverse effects of ocean disposed dredged material on organisms that live in the water column. These tests are performed on sediment elutriates, prepared at a ratio of one part sediment and four parts site water in accordance with ITM (USEPA/USACE 1998) and OTM (USEPA/USACE 1991) guidelines. SPP tests may be performed using the mysid shrimp *Americamysis bahia* (formerly *Mysidopsis bahia*), the fish *Menidia beryllina*, and the larvae of a bivalve. The bivalve species may include *Mytilus galloprovincialis*; however, if gravid mussels are not available, an alternate species should be selected in consultation with USEPA and USACE. Both the mysid shrimp and fish SPP tests are 96-hour acute tests, while the *M. galloprovincialis* SPP test is a 48-hour chronic test that measures both survival and development.

- **Bioaccumulation Potential Testing**—The Bioaccumulation Potential (BP) testing consists of a 28-day test performed on whole sediment. The purpose of the BP tests is to estimate the potential of benthic organisms to bioaccumulate contaminants of concern from ocean disposed dredged material. BP tests may be conducted using the bivalve *Macoma nasuta* and the polychaete *Nereis virens*; however, *Nephthys caecoides* may be used as an alternative polychaete species. At test termination, bioaccumulation tissue samples should be submitted for chemical analysis. The tissue analyte list should focus on those chemicals present at levels of concern in sediment (i.e., greater than ER-M values) and based on approval by the Contaminated Sediment Task Force prior to analysis of tissue samples.

The biological testing that has been performed to date on the on-site sediment for assessing suitability for on-site beneficial use has included solid phase toxicity testing. As discussed previously, the result of this toxicity testing indicated a significant difference from the control for one of the three species tested. The differences from the control sample were observed for the *Eohaustorius estuaries,* which is likely the result of the fine-grained nature of the sediment samples as discussed.

Based on the available results, the placement of on-site excavated sediments (not used for on-site wetland restoration and upland habitat) at a designated ocean disposal or open water placement site remains a potential option, if needed. However, the determination of suitability will require further biological testing in accordance with ITM (USEPA/USACE 1998) and OTM (USEPA/USACE 1991) guidelines as outlined above. The additional testing will include running the solid phase toxicity testing using a fine-grained control, and SSP and BP testing as discussed above.

For SPP testing, results are compared to the control. If a median lethal concentration (LC50) or median effective concentration (EC50) can be calculated, a dilution water model should be used to perform a comparison with water quality standards. A short-term fate (STFATE) mixing zone model should be used to determine if LPC requirements will be met; water column concentrations

must not exceed 1 percent of the LC50 or EC50 outside the mixing zone 4 hours after dredged material disposal.

For BP testing, tissue concentrations are compared with applicable U.S. Food and Drug Administration (FDA) action levels, and tissue concentrations of organisms exposed to reference sediment. If tissue concentrations of organisms exposed to test sediment are statistically elevated compared to the organisms exposed to reference sediment, results should be assessed based on the criteria specified in the OTM (USEPA/USACE 1991; e.g., toxicological importance of contaminants, magnitude of exceedance, and propensity to biomagnify).

The biological testing for the evaluation of suitability for on-site beneficial use and ocean disposal was performed using a phased approach to avoid the need for unnecessary testing. Additional testing will be performed as needed in accordance with applicable requirements.

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CHAPTER 5
Conclusions and Recommendations

Based on the sediment characterization results to date for Areas A and B, the following key conclusions and recommendation are presented:

Wetland Surface Materials

The results of the sediment characterization indicate that constituent concentrations in the sediments that are located at depths that are anticipated to serve as wetland surface material are below the Beneficial Reuse guidelines (SFBRWQCB, 2000 and Germano & Associates, 2004) with the exception of silver in two out of the nine samples tested. The concentrations of silver in these two samples are above both the ER-L (and therefore, TMDL) and Beneficial Reuse values. As discussed in Section 3.4, the results of the sediment characterization study conducted as part of the TMDL Reconsideration indicated the ER-L sediment quality guideline values used as target concentrations for the chemicals listed in the TMDL were inaccurate and highly conservative. Therefore use of these guidelines for sediment screening purposes may not be applicable for the Ballona Estuary. Additional investigation may be warranted to demonstrate that these concentrations are within the range of marine sediments, do not demonstrate toxic levels, and fall within the range of the concentrations measured in historical monitoring of the existing Area B tidal marsh.

Per the screening methodology presented in the SAP and shown on Figure 6, samples that have concentrations above the Beneficial Reuse guidelines for wetland surfaces underwent bioassay testing. The results of the bioassay tests on these samples indicate moderate to low toxicity for one of the three species tested. An additional TIE study concluded that multiple lines of evidence indicated that nonchemical factors, possibly related to sediment texture, were the most likely cause of toxicity for the sediment (Greenstein and Bay 2014; Appendix C). As discussed, the toxicity response in this arthropod species is likely due to fine-grained sediments despite the absences of chemical stressors (Kendall, 1999 and SCCWRP, Bight'08 Toxicology Lab Manual, Greenstein and Bay 2014). The results to date indicate that the materials that are anticipated for use as wetland surface and foundation materials are suitable.

Material Used for Wetland Grading and Upland Placement

The results of the sediment characterization indicate that constituent concentrations in the sediments that are located above the proposed restoration elevation that would be used for either wetland final grading or upland placement are below the Beneficial Reuse guidelines for wetland surface (SFBRWQCB, 2000 and Germano & Associates, 2004) with the exception of silver and copper in one sample (A-HAS-018-D3 -10'-12') out of the eight samples tested. The

concentrations of silver and copper in this one sample are above both the ER-L (and therefore TMDL) and Beneficial Reuse values. Concentrations of arsenic, lead, and zinc are also above the ER-Ls in this sample. Total DDT concentrations in three of the eight samples are above the ER-L values. Additional investigation may be warranted to demonstrate that these concentrations are within the range of marine sediments.

Per the screening methodology presented in the SAP and shown on Figure 6, samples that have concentrations above the wetland surface guidelines underwent bioassay testing. The results of the bioassay tests on these samples indicate moderate to low toxicity for one of the three species tested. As discussed, the toxicity response observed is likely due to the fine-grained nature of the sediments. The results indicated no concentrations above the wetland foundation guidelines. Testing of consolidated materials during the restoration phase should be considered prior to placement on-site to verify these results. Material used for wetland grading should undergo testing at a higher frequency compared to soils that will be used for upland placement.

Wetland Foundation Materials

The results of the sediment characterization indicate that sediments that will be used below the wetland surface are below the Beneficial Use guidelines for wetland foundation (SFBRWQCB, 2000 and Germano & Associates, 2004). One of the eight samples collected and analyzed contains silver concentrations above the ER-L value.

Ocean Disposal

Based on the available results, the possible placement of on-site excavated sediments (not used for on-site wetland restoration and upland habitat) at a designated ocean disposal or open water placement site remains a potential alternative if needed. However, the determination of suitability will require further biological testing in accordance with ITM (USEPA/USACE 1998) and OTM (USEPA/USACE 1991) guidelines as outlined in Section 4 above. The additional testing will include running the solid phase toxicity testing using a fine-grained control, and suspended solid phase toxicity and bioaccumulation potential testing.

TABLE 8
SUMMARY OF BIOASSAY RESULTS

Bioassay	Species	Endpoint	Laboratory Control	Thresholds for Toxicity Categories (Bight'08)	A-HSA-016 (8'-12')	B-RW-043- (6.5'-10') B-RW-055- (10'-16') Composite	A-HSA-018-D1(20'-28') A-HAS-020-D1(20'-28') Composite
10-day Solid Phase Test	*Ampelisca abdita* *Marine amphipod*	Mean Survival (%)	95.0		94.0	82.0	91.0
10-day Solid Phase Test	*Neanthes arenaceodentata* *Marine polychacte*	Mean Survival (%)	100		100	96.0	92.0
10-day Solid Phase Test	*Eohaustorius estuaries* *Marine amphipod*	Mean Survival (%)	96.0	90-100 –Nontoxic 82-89 – Low Toxicity 59-81 – Moderate Toxicity <59 High Toxicity	86.0	69.0	79.0
Grain Size Characteristics*					CL Low Plasticity Clay, Silty Clay	CH High Plasticity Clay, Silty Clay	CH High Plasticity Clay, Silty Clay

Notes: * SCCWRP, 2011 Annual Report, Greenstein, D. & Steven Bay

Yellow - Significant difference between Laboratory Control and test.

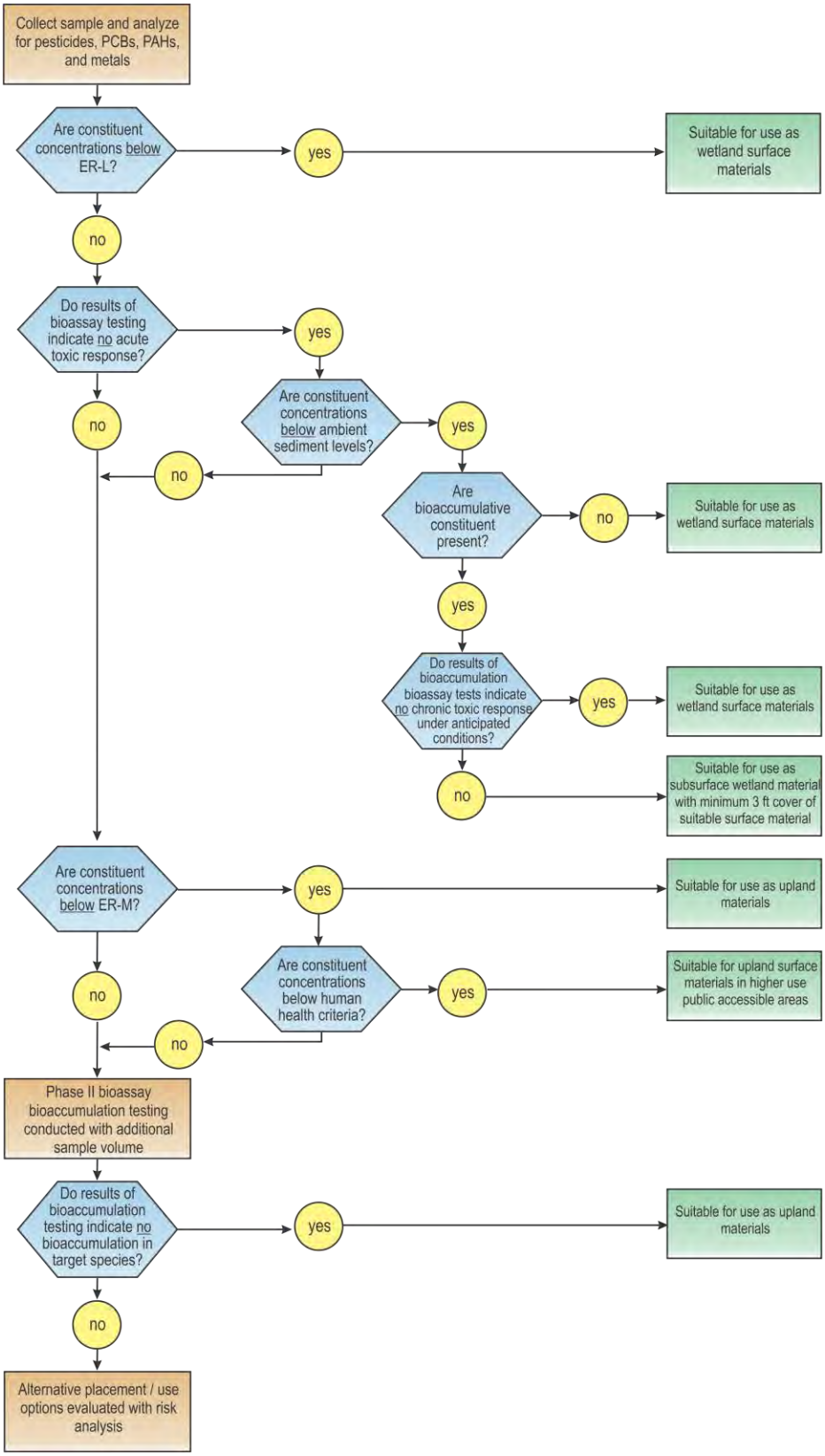

Figure 6. Sediment Beneficial Use Screening Tool

CHAPTER 6
Steps forward

Based on the conclusions and recommendations presented for this sediment characterization study, the following Steps Forward are presented to inform the Environmental Impact Report for the Proposed Ballona Restoration Project:

1. **Suitability of Upland Material** – Materials that are planned for use as upland material shall not possess constituent concentrations above the ER-M. These materials shall also be below the Soil Screening Criteria for shallow and deep soils, where applicable, depending on the depth of the final placement (SFRWCQB, 2007). Materials that are to be used as surface upland materials (top six inches) shall meet the applicable California Human Health Screening Levels (CHHSLs) and Preliminary Remediation Goal (PRGs), or demonstrate that the constituent concentrations are within the typical range of marine sediments and do not exhibit a potential human health risk. For the sediments sampled to date, the only constituent that is above these criteria is arsenic.

   If these materials are not able to be shown suitable for use as surface materials for upland areas based on the CHHSLs, then they shall be covered with a minimum one foot clean layer of soil that shall meet all the above criteria listed for suitability as surface upland materials for both ecological and human health criteria. The top foot of material shall also meet the agronomical requirements for establishing the designated upland habitat. Material below the one foot of clean cover shall still meet the PRGs and Soil Screening Criteria (SFRWCQB, 2007).

2. **Suitability for Potential Marine Discharge** – Any materials that are planned for off-site ocean disposal or open water placement shall be further tested and assessed in accordance with ITM (USEPA/USACE 1998) and OTM (USEPA/USACE 1991) guidelines. The testing results to date do not preclude this alternative, but require further biological testing to meet the applicable guidelines. This additional testing will include running the solid phase toxicity testing using a fine-grained control, and suspended solid phase toxicity and bioaccumulation potential testing. If the material is determined to be suitable for this placement alternative, specific permitting for ocean disposal or open-water placement will be required for the designated site.

3. **Sampling and Analysis Plan** – The methods and frequency for testing excavated sediment for use as the various proposed beneficial uses will be defined in coordination with the permitting agencies in a Sampling and Analysis Plan for any additional sampling performed during the restoration design and/or implementation.

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CHAPTER 7
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APPENDIX A.
Relevant Screening Criteria for Area A Sediments

Analytical results will be compared to relevant soil screening levels, sediment quality guidelines, and hazardous waste criteria to determine suitability of material for specific beneficial uses or placement options. Relevant numeric standards for comparisons include:

- **Ecologically Relevant Screening Criteria**
    - **Effects Range-Low (ER-L) and Effects Range-Median (ER-M) Values**: Effect range values are used in dredged material evaluations for ocean disposal. These values were developed by Long et al. (1995), and are helpful in assessing the potential significance of elevated sediment-associated COCs, in conjunction with biological analyses. Briefly, these values were developed from a large data set where results of both benthic organism effects (e.g., toxicity tests, benthic community effects) and chemical analysis were available for individual samples. To derive these guidelines, the chemical values for paired data demonstrating benthic impairment were sorted in according to ascending chemical concentration. The ER-L was then calculated as the lower tenth percentile of the observed effects concentrations and the ER-M as the 50th percentile of the observed effects concentrations. While these values are useful for identifying elevated sediment-associated contaminants, they should not be used to infer causality because of the inherent variability and uncertainty of the approach. For dredged material evaluations, the ER-L and ER-M sediment quality values are used in conjunction with bioassay testing and are included for comparative purposes only. For certain pesticide compounds (i.e., chlordane and dieldrin) the ER-L and ER-M levels are so low as to make it largely impractical to detect them in typical harbor sediments using routine analytical procedures. Accordingly, having non-detect results that were greater than the ER-L, ER-M, or method detection limits (MDLs) would not require re-analysis. The use of ER-L and ER-M for use as screening criteria for sediments in Area A is appropriate when used as a tiered approach that includes using bioassay results to determine actual toxic effects to the benthic community.
    - **Sediment Reuse Criteria for Wetland Restoration** - These criteria were first developed by the San Francisco Regional Water Quality Control Board (SFBRWQCB) and presented in the Draft Staff Report entitled, *Beneficial Reuse of Dredged Materials: Sediment Screening and Testing Guidelines* dated May 2000. The document was prepared to assist in planning beneficial reuse projects in the Bay Area by establishing general screening guidelines and general sediment testing requirements. The guidelines include specific criteria for reuse of sediments in wetland and upland beneficial uses. The guidelines for the wetland foundation use are based on the Effects-Range Medium (ER-M) concentrations (Long et. al.,

1995). Ambient concentrations in the San Francisco Bay were used to develop the guidelines for re-use of sediments for wetland surface. These guidelines are to be used in combination with bioassay testing to determine suitability of the materials for use in wetland restoration projects (SFBRWQCB, 2000).

Additional ambient sediment chemical and toxicity testing were performed following the Draft Staff Report in 2000. A statistical analysis was performed on the historical and more recent analytical data to develop a statically derived set of recommended sediment chemistry screening guidelines for beneficial reuse. The results of this analysis and recommended guidelines were presented in *An Evaluation of Existing Sediment Screening Guidelines for Wetland Creation/Beneficial Reuse of Dredged Material in the San Francisco Bay Area along with a Proposed Approach for Alternative Guideline Development* (Germano & Associates, 2004) that was funded by the California State Coastal Conservancy. The recommended guidelines presented in the 2004 report are based on the Floating Percentile Method for predicting acute amphipod toxicity. These guidelines presented in the 2004 Germano & Associates report, therefore can be applied to sites outside of the Bay area as they are based on toxicity testing results rather than ambient concentrations in San Francisco Bay. These guidelines are presented in the results summary tables to compare with constituent concentrations in sediment from Area A to assess the suitability of these materials for wetland surface and foundation beneficial uses.

- **Ballona Estuary Total Maximum Daily Loads (TMDL) Guidelines** - These guidelines for the Ballona Estuary are presented in the Toxics Pollutants TMDL developed by the Los Angeles Regional Water Quality Control Board (LARWQCB, 2005). As part of the TMDL Reconsideration, a study on the toxicity of the sediments in the Ballona Creek Estuary was performed by the Southern California Coastal Water Research Project (SCCWRP) and documented in the report on Toxicity Identification Evaluation (TIE) of Sediment in Ballona Creek Estuary (SCCWRP, 2010).

  The TIE testing was performed to determine the cause of the toxicity response in sediments and to compare the TMDL guidelines to actual ambient concentrations in the wetland. The TIE analyses of whole sediments and pore water found that pyrethroid pesticides were the likely primary source of toxicity within the estuary. Comparison of these pesticides' toxicity thresholds to chemical analysis results confirmed that sufficient pyrethroids were present in the estuary sediments to cause toxicity. Concentrations of TMDL listed compounds often exceeded target levels, but there was a poor correlation between these concentrations and toxicity. The Effects Range Low (ER-L) sediment quality guideline values used as target concentrations for the chemicals listed in the TMDL were found to be inaccurate and highly conservative. The ER-Ls for some metals were below background concentrations typical of estuarine environments. For the organic compounds, ER-Ls were several orders of magnitude below toxicity thresholds for benthic organisms. Based on these results, it can be anticipated that the current Toxics TMDL will be revised to reflect that the primary constituents of concern in the estuary are synthetic pyrethroid pesticides, and that the TMDL goals will be modified for the metals and organic compounds currently listed. The use of the TMDL goals based on the ER-L for screening purposes may not be applicable

based on these reported results. The TMDL goals are presented with in the summary results tables for sediment chemistry for information purposes.

- **Bight '08 Toxicity Criteria -** The level of toxicity associated with each sediment sample that underwent toxicity testing was calculated using thresholds established for the SQO program (Bay *et al*. 2009) and presented in the Bight '08 Sediment Toxicity Report (SCCWRP, 2008). The thresholds are specific to each of the toxicity test methods as shown on Table A-1 taken from the Bight '08 Sediment Toxicity Report. Using the thresholds, each sample was classified as Nontoxic, Low Toxicity, Moderate Toxicity, or High Toxicity. Each of these toxicity categories reflects both severity of toxicity and the confidence that the effects are real.

  - **Nontoxic**: Response is not substantially different from that expected in sediments that are uncontaminated and have optimum characteristics for the test species (e.g., control sediments).
  - **Low Toxicity**: A response that is of relatively low magnitude; the response may not be greater than test variability.
  - **Moderate Toxicity**: High confidence that a statistically significant toxic effect is present.
  - **High Toxicity**: High confidence that a toxic effect is present and the magnitude of response includes the strongest effects observed for the test.

TABLE-A-1
THRESHOLDS FOR CALCULATING TOXICITY CATEGORIES.

Test Species/Endpoint	Nontoxic (Percent)	Low Toxicity (Percent of Control)	Moderate Toxicity (Percent of Control)	High Toxicity (Percent of Control)
Eohaustorius estuaries Survival	90 to 100	82 to 89[a]	59 to 81[b]	< 59
Mytilus galloprovincialis Normal	80 to 100	77 to 79[a]	42 to 76[b]	< 42

a If the response is not significantly different from the negative control, then the category becomes Nontoxic.
b If the response is not significantly different from the negative control, then the category becomes Low toxicity.

- **Sediment Quality Objectives (SQOs) -** California's SQOs are described in the *Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality* (SWRCB and CA EPA, 2009). The goals of the SQOs are to determine whether pollutants in sediments are present in quantities that are toxic to benthic organisms and/or will bioaccumulate in marine organisms to levels that may be harmful to humans. The SQOs are based on a multiple lines of evidence (MLOE) approach in which sediment toxicity, sediment chemistry, and benthic community condition are the lines of evidence (LOE). The MLOE approach evaluates the severity of biological effects and the potential for chemically mediated effects to provide a final station level assessment. The use of SQOs require that the site be fully submerged under tidal conditions and assumes establishment of a benthic community. These conditions will not exist until after the restoration in Area A, therefore the use of the SQOs is not applicable. The SQOs ratings cannot be applied without the use of benthic data, and therefore are not applicable at this time

to assess Area A sediments. However, in the absence of clearly defined criteria for evaluating use of sediment in Area A for wetland surface material, chemical and bioassay methods and screening used for SQOs may be used for planning purposes and establishing baseline data as part of multiple screening criteria.

- **Human Health Screening Levels**
  - **California Human Health Screening Levels (CHHSLs)**: Concentrations of 54 hazardous chemicals in soil that the California Environmental Protection Agency (Cal/EPA) considers to be below thresholds of concern for risks to human health based on ingestion, inhalation, and dermal absorption. The CHHSLs were developed by the Office of Environmental Health Hazard Assessment (OEHHA) on behalf of Cal/EPA, and are contained in their report entitled "Human-Exposure-Based Screening Numbers are Developed to Aid Estimation of Cleanup Costs for Contaminated Soil". Any exceedances of the CHHSLs do not indicate that the levels are of concern, but suggest that further evaluation of potential human health concerns may be considered. Residential CHHSLs are recommended for use by the California Department of Toxic Substances Control (DTSC) for human health screening evaluation described in the Preliminary Endangerment Assessment (PEA) Guidance Manual.
  - **Preliminary Remediation Goals (PRGs)**: For contaminants that CHHSLs are not developed, the PRGs are used. The PRGs were developed by USEPA Region IX as a risk-based screening tool for evaluating and cleaning up contaminated sites. The Region IX PRGs were developed prior to the CHHSLs and are similar or slightly less stringent. The values are calculated from current human health toxicity values with standard exposure factors to estimate contaminant concentrations in environmental media (soil, air, and water) that are considered by the Agency to be health protective of human exposures (including sensitive groups), over a lifetime. As with CHHSLs, exceedances do not indicate that the levels present are a human health concern, however, more evaluation may be required.
  - **Soil Screening levels (ESLs):** These screening levels for soils and groundwater were developed by the California Regional Water Quality Control Board, San Francisco Bay Region and are presented in the Interim Final Report, "Screening Criteria for Environmental Concerns at Sites with Contaminated Soil and Groundwater (SFBRWQCB, 2007 – revised May 2008). These screening criteria include ELSs for shallow soils (</- 3m below ground surface (BGS)) and deep soils (>3m BGS), and are further distinguished between sites that are underlain with groundwater that is currently or is a potential drinking water sources and those that are not. These ELSs include criteria for metals, organic compound and petroleum hydrocarbon compounds and constituents. These ESLs are used to screen the sediment samples that contained total petroleum hydrocarbon compounds and constituents.
- **Hazardous Waste Criteria**
  - **Total Threshold Limit Concentration (TTLC) and Soluble Threshold Limit Concentration (STLC)**: TTLC and STLC are used to determine the hazardous waste characterization under California State regulations as outlined in Title 22 of the California Code of Regulations (CCR).Concentrations of contaminants in project soil were compared to TTLC and 10 times the STLC. If concentrations

exceed 10 times the STLC, a Waste Extraction Test (WET) must be performed to estimate the contaminant leachate. If concentrations of contaminants in soil exceed the TTLC or leachate from the WET exceed the STLC, the material is classified as hazardous waste. If a waste is determined to be a hazardous waste, specific regulations and statutes regarding the management, storage, transportation and disposal must be met.

- **Toxicity Characteristic Leaching Procedure (TCLP):** TCLP is the characterization for hazardous waste based on Federal guidelines. TCLP analysis was performed to provide an estimate of the soil contaminant leachate and to determine if this material is classified as hazardous waste or if it is considered suitable for upland placement. Analytes leaching from the soil were compared to USEPA Title 40 Code of Federal Regulations (CFR) Part 261 values (USEPA, 2006).

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APPENDIX B
Additional Result Tables

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TABLE 1
SUMMARY OF GENERAL CHEMISTRY RESULTS IN SOIL SAMPLES

TABLE 1A: IN/NEAR PROPOSED CHANNEL

Analyte	Units	PQL	A-RW-020-D1 (20' –28')	A-RW-020-D2 (16' –19')	A-RW-020-D3 (12'-16')	A-RW-020-C3 (4'-9')	A-HSA018-D2 (16' –19')	A-HSA018-D3 (10' –12')	A-HSA018-D1 (20'-24')	A-HSA018-C3 (4'-8')	B-RW-055-C1 (0' –3.5')	B-RW-055-C2 (4' –8')	B-RW-055-D1 (10' –14')
Salinity	salinity unit	1.0	10.9	8.41	3.63	4.58	4.68	5.30	7.35	4.78	4.66	3.91	5.17
Total Solids	%	1.0	67.5	74.2	70.5	69.1	71.2	70.1	57.0	78.8	83.0	50.9	65.1
pH	pH unit	1.00	7.86	8.01	8.08	7.48	7.97	7.82	7.86	7.80	8.03	8.01	8.05
Ammonia as Nitrogen	µg/dry g	1.00 - 10	35.8	11.0	27.4	31.4	15.3	58.6	35.0	20.1	17.9	8.82	40.0
Total Organic Carbon	µg/dry g	500	8,800	2,700	14,000	9,900	2,300	6,500	28,000	6,600	12,000	1,800	8,600
Sulfides, Acid-Soluble and Acid-Insoluble	µg/dry g	0.50 - 5	5.38	3.92	9.26	5.18	1.10	136	8.22	2.78	3.58	<0.50	14.5
Dissolved Sulfides, Acid-Soluble and Acid-Insoluble	µg/dry g	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50

TABLE 1B: IN PROPOSED MARSH AND TRANSITION ZONE

Analyte	Units	PQL	A-HSA-016-D1 (10.5'–12')	A-HSA-016-D2 (14'–16')	A-HSA-016-C2 (6' -10.5')	A-HSA-016-C1 (0' –6')	B-RW-043-C1 (0' –3')	B-RW-043-D1 (3' –6')	B-RW-043-D2 (6' –6.5')	B-RW-043-D3 (8'-10')	B-RW-043-D5 (10'-16')
Salinity	salinity unit	1.0	6.10	6.71	6.18	2.03	ND	4.71	5.44	5.92	8.57
Total Solids	%	1.0	71.2	72.8	63.1	83.0	81.4	69.8	67.9	75.0	62.8
pH	pH unit	1.00	8.11	7.88	8.07	7.94	8.39	7.93	8.02	7.96	7.84
Ammonia as Nitrogen	µg/dry g	1.00 - 10	53.6	21.8	40.8	10.8	31.8	41.9	54.2	6.96	47.7
Total Organic Carbon	µg/dry g	500	9,200	6,400	10,000	3,600	5,000	14,000	12,000	1,400	12,000
Sulfides, Acid-Soluble and Acid-Insoluble	µg/dry g	0.5 – 5.0	34.4	3.30	13.9	4.88	1.42	5.54	1.46	3.02	4.76
Dissolved Sulfides, Acid-Soluble and Acid-Insoluble	µg/dry g	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50

TABLE 1C: UPLAND

Analyte	Units	PQL	A-HSA-067-C1 (0' -6')
Salinity	salinity unit	1.0	8.79
Total Solids	%	1.00	70.2
pH	pH unit	1.00	7.45
Ammonia as Nitrogen	µg/dry g	1.00	19.9
Total Organic Carbon	µg/dry g	500	8,200
Sulfides, Acid-Soluble and Acid-Insoluble	µg/dry g	0.50	9.02
Dissolved Sulfides, Acid-Soluble and Acid-Insoluble	µg/dry g	0.50	<0.50

TABLE 2
ANALYTICAL RESULTS FOR BALLONA MARSH SEDIMENTS

Parameter	Units	MDL	ERL[1]	ERM[1]	WSC[2]	BWS-1[3]	BWS-3[3]	BWS-4[3]	BWS-5[3]	BWS-8[3]	BWS-9[3]	BWS-10[3]	BWS-11[3]		BW1[4]	BW4[4]	BW5[4]	BW6[4]	BW7[4]	BW8[4]	BW9[4]	BW1[5]	BW4[5]	BW5[5]	BW6[5]	BW7[5]	BW8[5]	Range[6]	Ave.[7]
Toxicity																													
Mean *Eohaustorius estuarius* survival (relative to control)	%					94.79	98.96	91.67	**64.58**	96.88	**34.38**	**60.42**	**9.38**		96.0	87.0	95.0	88.0	94.0	92.0	82.0							98.6-**9.38**	**79**
Sediment Size and TOC																													
Gravel	%					0	0	0	0	0	0	0	0																
Sand	%					51.2	70.2	79.7	22.8	47.4	37	30.5	47.4		48.1	45.6	12.8	24.9	8.4	63.6	20.7								
Silt	%					41.8	24	16.6	51.5	46.6	51.5	57.9	45.1		40.1	44	56.8	50.4	58.2	22.9	49.2								
Clay	%					7.11	5.98	3.73	25.8	6	11.5	11.6	7.47		11.4	10.4	30.4	24.7	32.4	12.3	29.7								
Median size	microns					66	250	360	13	56	40	28	56																
Mean size	microns					110	470	470	5.9	140	60	55	55																
Total Organic Carbon	%	0.001				0.919	0.777	0.372	0.597	1.15	1.04	0.41	4.64																
Metals																													
Arsenic	mg/kg	0.22	8.2	70	40	6.13	3.7	4.26	**12.4**	**10.3**	**8.45**	5.56	**14.6**		4.6	5.67	**10.84**	**10.55**	**12.25**	5.3	**11.78**	0.05	0.31	0.48	0.5	1.18	0.87	3.7-12.25	**8.43**
Cadmium	mg/kg	0.02	1.2	9.6	0.250	**2.39**	**2.12**	**1.83**	**4.5**	**4.66**	**3.67**	**3.32**	**6.16**		0.49	0.74	**1.66**	0.84	**1.27**	1.2	**1.82**	0.02	0.06	0.12	0.05	0.14	0.1	0.49-**6.16**	**2.44**
Chromium	mg/kg	0.1	81	370	119	29.2	21.9	18	70.2	52.1	35.4	33.4	64.3		38.9	60.7	**89.54**	**82.67**	**97.2**	40.15	**96.45**	0	0	0	0.03	0	0.13	18-**97.2**	55.34
Copper	mg/kg	0.18	34	270	50	**35.3**	30.6	17	**60.8**	**82.9**	**48.8**	**39.3**	**440**		**60**	**50.4**	**76.8**	**50.83**	**84.05**	28.7	**60.12**	0.13	0.04	0.11	0.86	0.13	1.21	17-**440**	**77.71**
Lead	mg/kg	0.15	46.7	218	200	46.6	26.9	20.8	**103**	**92.5**	**62.6**	24	**248**		23.1	**59.6**	**105.4**	**65.57**	**104.9**	**74.05**	**265.4**	2.93	12.53	16.3	16.46	4.03	56.47	20.8-**265.5**	**88.16**
Mercury	mg/kg	4E-04	0.15	0.71	1.18	0.122	0.065	0.041	**0.229**	**0.272**	0.143	0.0976	**0.29**		0.07	0.14	**0.2**	0.13	**0.21**	0.14	**0.19**	0	0	0	0	0	0	0.041-**.272**	**0.16**
Nickel	mg/kg	0.2	20.9	51.6	230	16	13.4	9.2	**30.7**	**27.9**	20.5	**21.7**	**38.5**		17.1	**25.9**	**37.44**	**29.11**	**39.29**	13.1	**31.93**	0.47	0.49	0.85	0.21	0.83	0.89	9.2-**39.29**	**24.78**
Silver	mg/kg	0.02	1	3.7	0.280	**1**	0.43	0.27	**3.77**	**1.54**	**1.85**	0.43	0.46		<0.05	0.61	**2.25**	0.5	**2**	0.63	**1.5**	0	0	0	0	0	0	0.05-**3.77**	**1.15**
Zinc	mg/kg	0.21	150	410	1200	**155**	109	54.9	**190**	**330**	**192**	124	**1770**		130.1	**176**	**238.2**	**172.5**	**304.9**	129.7	**206.8**	2.24	1.99	2.21	2.68	0.78	11.74	54.9-**1770**	**285.54**
Selenium	mg/kg	0.35				0.48	0.56	0.55	<0.35	1.61	<0.35	0.42	0.55		0.36	0.63	3.22	2.15	2.27	1.79	0.78							0.35-3.22	1.02
PAHs																													
Total detectable PAHs	mg/kg		4.022	44.79	6.3	0	0	0	0	0	0	0	1.5		.0308	0.333	0.225	3.25	0.215	0.679	0.281							0-3.25	0.434
Pesticides																													
Total detectable DDT	ug/kg		1.58	46.1	250	**3.6**	**17.1**	0	1.2	**7.3**	**5.6**	1	**9.6**		1.5	**3.1**	1.4	**2.7**	**3.3**	**4.2**	**4.6**							0-**17.1**	**4.41**
Total detectable chlordane	ug/kg		0.5	6	69.2	**4.5**	**51.4**	0	**1.2**	**2.4**	**2.7**	**1.2**	**6.7**		<1	**1.5**	**1.2**	<1	**1.1**	**5.9**	**9.7**							0-**51.4**	**6.03**
Pyrethroids																													
Bifenthrin	ug/kg					ND	ND	ND	ND	ND	ND	ND	34J																
PCBs																													
Total detectable PCBs	ug/kg		22.7	180	600	16	**25**	0	0	0	**36**	0	**24**		<1	4.4	11.8	<1	<1	17.2	**24.4**							0-36	10.8
Mean ERM quotient						0.22	0.80	0.07	0.32	0.32	0.26	0.15	0.84																

MDL = Method Detection Limit is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero, as defined in 40 CFR Part 136 Appendix B.
Toxicity results in bold = moderately toxic (per Bight criteria)*
Toxicity results in bold = highly toxic (per Bight criteria)*
Chemistry results in bold = exceeds ERL*
Chemistry results in bold = exceeds ERM*
J - Estimated value

FOOTNOTES:
[1] Effects Range-Low (E-RL) and Effects Range Medium (E-RM)(Long et al. , 1995)*
[2] WSC – Wetland Surface Criteria based on the Sediment Reuse Criteria for Wetland Restoration first developed by the San Francisco Regional Water Quality Control Board (SFBRWQCB)*
[3] Pohl, D. & Hartman, C., Weston Solutions, Inc., July 18, 2006. "Summary of Results from Sediment Sampling in Area B – Ballona Marsh." (Technical Memo to PWA)
[4] The Ballona Wetlands Ecological Reserve Baseline Assessment Program 2010-2011 Final Report, Santa Monica Bay Restoration Commission, June 2012 – Year 2 (2011) data.
[5] The Ballona Wetlands Ecological Reserve Baseline Assessment Program 2010-2011 Final Report, Santa Monica Bay Restoration Commission, June 2012 – Year 1 (2010) data. These results were not used for determining the average and range because the laboratory reports were not presented in the report in order to verify quality control/quality assurance data. These results were also not consistent with the two other sets for data presented in this table for which laboratory reports were available.
[6] Range of results is based on the data presented in the Weston memo dated 2006 and the 2011 data presented in the Santa Monica Bay Restoration Commission Report dated June 2012.
[7] Average of results is based on the data presented in the Weston memo dated 2006 and the 2011 data presented in the Santa Monica Bay Restoration Commission Report dated June 2012.

*See Appendix A for more detailed discussion of screening criteria

APPENDIX C
Toxicity Evaluation of Ballona Wetlands Sediment Cores

Note: As discussed in Section 3.3.2, the following toxicity identification evaluation (TIE) study was conducted by the Southern California Coastal Water Research Project (SCCWRP) in 2014 (Greenstein and Bay). This TIE study concluded that multiple lines of evidence indicated that nonchemical factors, possibly related to sediment texture, were the most likely cause of toxicity for the sediment. The result suggests that toxicity was impacted by some physical characteristic, such as clay content. The implication is that the physical sediment properties (e.g., texture, clay content) are not suitable for supporting the marine arthropod, *Eohaustorius estuaries* because this species is adapted to inhabiting environments with sandier sediment. Therefore, the bioassay and TIE results indicate that the fine-grained sediment at Ballona is not likely to support *Eohaustorius estuaries* and that the low concentrations of chemical contaminants are not likely to impact benthic communities. Results to date indicate that the materials that are anticipated for use as wetland surface and foundation materials are suitable.

Toxicity Evaluation of Ballona Wetlands Sediment Cores

November 7, 2014
Darrin Greenstein and Steven Bay
Southern California Coastal Water Research Project

Introduction

As part of an investigation into the feasibility of restoration of the Ballona Wetlands, subsurface sediment core samples were tested for toxicity to the amphipod *Eohaustorius estuarius* in 2012 (ESA PWA 2013). These core samples were taken at a depth approximate to the projected estuary surface following restoration. These tests indicated low levels of toxicity in a few samples, but the cause of the toxicity could not be determined. These samples contained low concentrations of contaminants and a high percentage of fine sediments, leading to speculation that the toxicity was related to sediment grain size characteristics that were outside of the tolerance range of the toxicity test species.

The goal of the current study was to determine the cause of the sediment toxicity detected in the previous study. Five core locations from the 2012 study were resampled and tested to verify the presence of toxicity. If toxicity was observed, then a sediment toxicity identification evaluation (TIE) would be conducted on one core sample in an effort to identify the cause of the toxicity. The TIE study plan included novel techniques to investigate whether sediment grain size was indeed a causative factor.

Methods

Subsurface sediment samples were collected on December 19 and 20, 2013 by push core using a hollow stem auger rig (Group Delta, Torrance, CA). Samples were taken from three sites in Area A and two sites in Area B (Figure 1). Sediment was collected at depths similar to those taken in 2012 and represented the location of the original grade of the wetland before the addition of fill material. Location and depth records for each sample are shown in Table 1. Multiple cores from each location were composited to provide sufficient sample for testing. Subsamples were stored in precleaned plastic or glass jars for analysis of toxicity/TIEs, contaminants, or grain size characteristics.

The sediment samples were manipulated to make them amenable for toxicity testing. The samples had a very low water content causing them to be difficult to homogenize. A small volume of sea water (20 psu) was slowly mixed into the samples to make them pliable. The volume of water added to the sample from each station was recorded.

The samples were tested for toxicity using the amphipod *Eohaustorius estuarius* and standard USEPA methods (1994) on January 10, 2014. Briefly, 150 ml of homogenized sediment was

added to each 1 L glass canning jar, and 800 ml of 20 psu sea water added above the sediment. For each of the five replicate jars, 20 amphipods were added at the start of the test. A sample of fine sandy sediment from amphipod supply site in Oregon was also included in the test as a control. The exposure was conducted at 15°C, under constant light and with gentle aeration. The only departure from standard methods was that the sediment was added to the jars four days prior to the addition of the animals and 50% of the overlying water was changed daily. This change was made because of the unusual nature of the sediments, having come from a buried, terrestrial source, rather than a marine surface sediment normally tested with this organism. The additional time gave the sediments a chance to better equilibrate with the overlying marine water. At the end of the 10 day exposure period the sediment was passed through a 0.5 mm mesh sieve and the surviving amphipods were enumerated.

The TIE experiment was initiated on February 21, 2014, and was conducted on a single sample that was selected based on the results of the initial screening test. The treatments included in the TIE are listed in Table 2. Treatments 1-9 comprise a typical basic TIE analysis for the purposes of characterizing the principal chemical toxicant type present (USEPA 2007). Each of the typical treatments included a corresponding blank treatment in which the TIE manipulation was carried out on control sediment to verify that the treatment itself was not toxic. Numerous additional treatments were included in this experiment to help determine whether toxicity was related to nonchemical factors, especially sediment texture (i.e., particle grain size and stickiness). These additional treatments consisted primarily of adding clean sediment containing various grain size characteristics, ranging from fine sand (control) to a sediment formulated to approximate the grain size distribution of the test sample (texture reference), to the test sample. The purpose of these additional treatments was to separate out the influence of contaminant dilution and grain size variations on sample toxicity. For all additions of clay, a 1:1 by dry weight mixture of two forms of Bentonite (IBEX200, a calcium ion dominated form and HPM20 a sodium ion dominated form, both from Aardvark Clay and Supplies, Santa Ana, CA) were used. The clays were hydrated with deionized water to form a paste before being mixed with the sediment.

Pore water extracted from the test sediment sample was also tested for toxicity. This test eliminated the physical influence of sediment particles on the test organism. Pore water was extracted from the sediment by centrifugation at 3000 x g for 30 minutes. After centrifugation, 10 ml of the pore water was pipetted into each of five 22 ml glass shell vials. Five *E. estuarius* were added to each vial. The animals were exposed to the pore water for 10 days at 15°C, in darkness and without aeration. At the end of the exposure the number of surviving amphipods was enumerated.

Chemical analysis of sediment from TIE test sample was conducted by Physis (Anaheim, CA). Chlorinated pesticides, PCBs, PAHs were measured using EPA Method 8270D, which includes final analysis by Gas Chromatograph with a Mass Spectrometer (GCMS). Trace metals were analyzed by EPA Method 6020 which includes final analysis by Inductively Coupled Plasma – Mass Spectrometry (ICPMS). Total organic carbon and total nitrogen were analyzed by EPA Method 9060.

Physical characteristics of the test sample and selected TIE treatments were also measured. Sediment particle size was measured using EPA Method 2560D on a laser diffraction particle size analyzer. Atterburg limits to measure sediment plasticity were analyzed by Group Delta (Torrance, CA) using ASTM D-4318.

Results

Results of the initial screening of the five stations indicated that all were toxic to varying degrees (Table 3). The survival ranged from 68 to 22% which represented a higher level of toxicity than was observed in 2012 (86 to 69% survival). Stations B-RW-043 and B-RW-055 exhibited the highest toxicity, with 22% survival in each. It was noted during termination of this test that there was a varying degree of difficulty getting the sediments to pass through a 0.5 mm sieve and that the difficulty seemed to match toxicity; the more difficult the screening, the greater the toxicity. This observation indicated that sediment texture might be playing a role in the observed toxicity.

Based on results of the initial testing, sample B-RW-055 (BW55) was selected for the TIE. Results of the TIE experiment are summarized in Table 4. The control was nontoxic (indicating that the test organisms were of good quality) and the BW55 test sample was still highly toxic, with 15% survival (Table 4). Each treatment is referenced by number to Table 2. Generally, the results for each specific treatment (except for blanks) are compared to that for BW55 (treatment 3) for interpretation. Results of the TIE indicated that none of the TIE treatments specific for chemicals (#4, 6, 8) affected toxicity; this indicates that organic chemicals, metals and ammonia are unlikely to be the cause of toxicity. The addition of fine sand to BW55 did reduce toxicity (#10, 11), while addition of a similar amount of a high silt/clay sediment similar to BW55 in grain size characteristics (#15, 16) did not reduce toxicity; these results are evidence sediment texture is a likely cause of BW55 toxicity.

Pore water from BW55 was tested as an additional line of evidence. No significant toxicity was detected in amphipods exposed to BW55 pore water (Table 5). Contact with dissolved chemicals in the pore water is considered to be a primary route of exposure of sediment-dwelling organisms to sediment contamination. Exposing the animals to the pore water alone removes any effects of sediment particle size that may be contributing to effects in the whole sediment test. Since the pore water was nontoxic, a conclusion that physical characteristics not related to chemical contaminants are the likely cause of the whole sediment toxicity is further supported.

The concentrations for all measured chemical analytes in BW55 were quite low (Tables 6-9). The only chlorinated hydrocarbon that was detectable was p,p'-DDT (Table 6). Only two PCB congeners were detected, the concentrations of both being between the method detection limit and the reporting limit (Table 7). Most PAHs were not detected and those that were had concentrations below 10 µg/kg (Table 8). None of the trace metals usually associated with toxicity were present at concentrations considered to be elevated (Table 9).

The chemical constituents were present at concentrations associated with a low probability of toxicity. All concentrations, except for p,p'-DDT, were below the Effects Range-Low (Long et al. 1995) guidelines, representing a low probability of toxicity to amphipods (Tables 6-9). The concentration of p,p'-DDT in this sample is similar to background levels in unimpacted sediments throughout the region, and is also more than 100 times less than the concentration found to cause toxicity to the toxicity test species used in this study (Greenstein et al. 2014). Evaluation of the chemistry data using methods specified in California Sediment Quality Objectives (SQO) guidance results in a classification category for BW55 of Low Exposure for sediment contaminants. The SQO exposure classification includes four categories: Minimal, Low, Moderate, and High. This classification is based on two sediment quality guidelines, the

Chemical Score Index (CSI) and California Logistic Regression Model (CALRM). The individual CSI and CALRM exposure categories were Moderate and Minimal, respectively.

Measurements of the physical properties of samples, representing a range of toxicity, were conducted. The results indicated the percentage of sediment fines (combination of silt and clay) was greater than 80% for both A-HAS-016 and B-RW-055 (Table 10). Each of these samples had a clay content of about 25% which is considerably higher than what is usually encountered in the marine environment in southern California. The Dana Pt. Reference is a typical example of fine grained marine sediments with fines around 75%, but less than 10% being clay. The total organic carbon content of the wetland core samples was in the range typically observed in the marine environment. The plasticity limits indicated the Ballona samples were in the medium plasticity range (PI 15-30).

The grain size analysis of the dilutions of BW55 with control sediment (treatments #11 and 12) did not yield as high a percentage of sand as was expected based on mass balance calculations (Table 10). This is apparently due to a previously undetected analytical issue related to the combination of very fine clay particles and the fine sand in the mixtures. The analysis method has a bias against the fine sand which is normally sieved out from coarse grained samples and analyzed separately from the silts and clays. Treatment number #12 was reanalyzed with a different sieving method and the percentage of sand was much closer to the expected value. There was not sufficient material available for treatment #11 for reanalysis.

Summary and Conclusions

Multiple lines of evidence with the capability to distinguish between chemical and nonchemical causes of toxicity were evaluated in this TIE. Comparison of these lines of evidence supports a conclusion that nonchemical factors possibly related to sediment texture were the most likely cause of toxicity for sediment from station B-RW-055 (Table 11). Three independent lines of evidence indicate that chemical factors were not a cause of toxicity. First, the three treatments that removed common types of contaminants (# 4, 6, and 8) had no effect on toxicity. Second, dilution of BW55 sediment with different types of reference or control sediments had variable effects on toxicity (e.g., #10, 12, and 15). This result suggests that toxicity was impacted by some physical characteristic, such as clay content, that varied among the treatments. Had the toxicity been related to chemical contamination in BW55, a consistent reduction in toxicity would have been observed in each sample having the same degree of dilution by reference or control sediment. The third line of evidence, lack of pore water toxicity, is also consistent with a nonchemical cause.

Measures of the physical properties of the wetland sediment samples were consistent with observations made during the toxicity test that the sediment was sticky and difficult for the test organisms to burrow through. The BW55 sediment had moderate plasticity and high clay content relative to the Dana Pt. Reference sediment. Unexpected values were obtained from the physical analysis of the texture reference TIE treatment (#13). Both the clay content and plasticity index of this sample were similar to that of treatment 2, although it was expected that these parameters would be higher than treatment 2 and similar to BW55. This may have been

due to a disconnect between the samples analyzed for the TIE and those analyzed for physical parameters There was not a sufficient amount of this sample to both conduct the TIE and measure particle size and Atterburg limits. A second batch of this mixture was created at a later date for the physical property analyses and may not have been representative of what was used in the TIE.

Direct evidence that sediment characteristics associated with clay content may be a cause of toxicity to *E. estuarius* is provided by the results for TIE treatment 13 (texture reference). This sample was composed of nontoxic natural fine-grained sediment from southern California (74% fines) that had been amended with natural clay to produce the same nominal percentage of clay as BW55. This amended sample was highly toxic, while a blank sample consisting of a similar amount of clay added to sand was nontoxic (# 14). Evidence for a sediment texture-related cause of toxicity is further supported by the results for treatments 10 and 11, where a reduction in percentage of clay in BW55 due to the addition of sandy sediment reduced the toxicity of the sample.

The magnitude of effect and specific aspects of sediment texture affecting *E. estuarius* survival is poorly understood. Previous studies by other researchers (unpublished) have reported either no effect or a much lower level of toxicity associated with additions of similar amounts of clay as used in this study. However, these other studies used different types of clay, did not conduct a detailed analysis of sediment physical characteristics, and may have used different methods to prepare the treatments. Additional research is needed to determine which specific characteristics of Ballona Wetlands sediment are responsible for the sediment toxicity measured in recent investigations, but the TIE and chemical analyses conducted in this study indicate that chemical contamination is not responsible. The more likely explanation is that the physical properties of the sediment in the core samples were not compatible with this particular toxicity test species, whose typical habitat is sandy estuarine sediment. Since this amphipod is not indigenous to the Ballona Creek Estuary and is not a species of special status, this incompatibility should not be a cause for concern.

Table 1. Location and depth of core samples taken from the Ballona Wetlands for toxicity testing.

Station	Latitude	Longitude	Depth (Feet below ground surface)
A-HSA-016	33.9720	-118.4425	8-12
A-HSA-018	33.9731	-118.4391	20-28
A-RW-020	33.9715	-118.4398	20-28
B-RW-043	33.9696	-118.4394	6.5-10
B-RW-055	33.9680	-118.4437	10-16

Figure 1. Map of coring stations within the Ballona Estuary.



Table 2. Sediment toxicity identification evaluation (TIE) treatments used on the Ballona Creek Wetland core sample.

#	Treatment or Sample	Description	Purpose	Interpretation
1	Control	Sandy sediment from amphipod collection site	Verification that the test animals are in good health	Mean survival of the amphipods must be greater than 90% for test to be valid. Results for other samples and blanks are compared to this control.
2	Fine sediment control	Silty sediment from a reference location off of Dana Pt.	Verification that finer grained sediments are not causing toxicity	High amphipod survival indicates minimal effect of fine sediments typical of southern California. Results for some treatments are compared to this treatment.
3	B-RW-055 Baseline	Unmodified test sample	Verification that test sample is still toxic following storage	Survival less than 70% of control indicates that sample is highly toxic and a TIE is feasible.
4	Coconut charcoal	Amendment of test sample with coconut charcoal at 15% (w/w)	Reduces bioavailable concentration of organic contaminants	Decrease in toxicity indicates nonpolar organic compounds as likely cause of toxicity.
5	Coconut charcoal blank	Amendment of control sediment with coconut charcoal at 15% (w/w)	QA sample to test for treatment artifacts	Survival similar to the control indicates the charcoal is not toxic.
6	Cation exchange resin	Amendment of test sample with cation exchange resin at 20% (w/w)	Reduces bioavailable concentration of cationic metals (e.g. copper, cadmium, zinc)	Decrease in toxicity indicates cationic metals as likely cause of toxicity.
7	Cation exchange resin blank	Amendment of control sediment with cation exchange resin at 20% (w/w)	QA sample to test for treatment artifacts	Survival similar to the control indicates the resin is not toxic.
8	Zeolite	Amendment of test sample with zeolite at 20% (w/w)	Reduces bioavailable concentration of ammonia	Decrease in toxicity indicates ammonia as likely cause of toxicity.
9	Zeolite blank	Amendment of control sediment with zeolite at 20% (w/w)	QA sample to test for treatment artifacts	Survival similar to the control indicates the zeolite is not toxic.
10	Dilution with control sediment - 20%	Amendment of test sample with control sediment at 20% (w/w)	Test for physical dilution effect of TIE amendments on sample toxicity. Likely to increase grain size characteristics of sample.	Decrease in toxicity similar to that obtained with chemical-specific treatments (charcoal, resin, and zeolite) indicates that those treatments were likely effective due to nonspecific dilution effects rather than binding of toxic substances. Difference in toxicity relative to other dilution treatments indicates sediment texture as a likely cause.

Table 2. Continued.

#	Treatment or Sample	Description	Purpose	Interpretation
11	Dilution with control sediment – 40%	Amendment of test sample with control sediment at 40% (w/w)	Test for effects of physical dilution and sediment texture change on test sample toxicity.	A reduction in toxicity would indicate toxicity caused by either contaminants in the sample or by sediment texture. A difference in toxicity relative to equivalent dilution by the texture reference indicates sediment texture as a likely cause.
12	Dilution with fine sediment control – 20%	Amendment of test sample with fine sediment control at 20% (w/w)	Test for physical dilution effect of TIE amendments on sample toxicity without substantially changing sediment texture.	Decrease in toxicity similar to that obtained with chemical-specific treatments indicates that those treatments were likely effective due to nonspecific dilution effects rather than binding of toxic substances. Difference in toxicity relative to other dilution treatments indicates sediment texture as a likely cause.
13	Texture reference	Mixture of Dana Pt. sediment and bentonite clay to match silt and clay content Ballona test sample.	Simulate sediment texture characteristics of test sample without presence of chemical toxicity	Increase in toxicity relative to control or fine sediment control indicates sediment texture as a likely cause of toxicity.
14	Texture reference blank – 20%	Amendment of control sediment with the texture reference at 20% (w/w)	QA sample to test for treatment artifacts	Survival similar to control indicates lack of chemical toxicity in treatment.
15	Dilution with texture reference – 20%	Amendment of test sample with texture reference sediment at 20% (w/w)	Test for physical dilution effect of TIE amendments on sample toxicity without changing sediment texture.	Decrease in toxicity similar to that obtained with chemical-specific treatments indicates that those treatments were likely effective due to nonspecific dilution effects rather than binding of toxic substances. Difference in toxicity relative to other dilution treatments indicates sediment texture as a likely cause.
16	Dilution with texture reference – 40%	Amendment of test sample with texture reference at 40% (w/w)	Test for effect of physical dilution without texture change on test sample toxicity	A reduction in toxicity indicates toxicity caused by contaminants. A difference in toxicity relative to equivalent dilution using the control sediment indicates texture as a likely cause.

Table 3. Sediment toxicity results for initial screening of core samples.

Sample	Mean Survival	Standard Deviation	Number of Replicates
Control Sediment	99	2.2	5
B-RW-043	22	8.4	5
B-RW-055	22	13.5	5
A-HAS-016	68	15.2	5
A-HAS-018	51	5.5	5
A-RW-020	28	9.7	5

Table 4. Toxicity results summary for toxicity identification evaluation treatments.

#	Treatment or Sample	Mean Survival (%)	Standard Deviation	Number of Replicates
1	Control Sediment	100	0.0	5
2	Fine Sediment Control	92.5	9.6	4
3	B-RW-055 Baseline	15	12.9	4
4	B-RW-055 Coconut Carbon	17.5	5.0	4
5	Coconut Carbon Blank	62.5	9.6	4
6	B-RW-055 Cation Exchange	12.5	12.6	4
7	Cation Exchange Blank	100	0.0	4
8	B-RW-055 Zeolite	12.5	12.6	4
9	Zeolite Blank	100	0.0	4
10	B-RW-055 Dil. Control 20%	35	5.8	4
11	B-RW-055 Dilution Control 40%	52.5	17.1	4
12	B-RW-055 Dil. Fine Sed. Control	15	5.8	4
13	Texture Reference	45	20.8	4
14	Texture Reference Blank	95	5.8	4
15	B-RW-055 Dil. Texture Reference 20%	27.5	5.0	4
16	B-RW-055 Dil. Texture Reference 40%	17.5	17.1	4

Table 5. Toxicity results summary for pore water.

#	Treatment or Sample	Mean Survival (%)	Standard Deviation	Number of Replicates
17	Control water	96	8.9	5
18	B-RW-055 pore water	88	17.9	5

Table 6. Chlorinated pesticide concentrations in sediment from station B-RW-055.

Analyte	Concentration (µg/kg dry wt)	Method Detection Limit	Reporting Limit	Effects Range Low Threshold
2,4'-DDD	ND	1	5	NA
2,4'-DDE	ND	1	5	NA
2,4'-DDT	ND	1	5	NA
4,4'-DDD	ND	1	5	NA
4,4'-DDE	ND	1	5	NA
4,4'-DDT	2.4	1	5	2.2
Aldrin	ND	1	5	NA
BHC-alpha	ND	1	5	NA
BHC-beta	ND	1	5	NA
BHC-delta	ND	1	5	NA
BHC-gamma	ND	1	5	NA
Chlordane-alpha	ND	1	5	NA
Chlordane-gamma	ND	1	5	NA
cis-Nonachlor	ND	1	5	NA
Dieldrin	ND	1	5	NA
Endosulfan sulfate	ND	1	5	NA
Endosulfan-I	ND	1	5	NA
Endosulfan-II	ND	1	5	NA
Endrin	ND	1	5	NA
Endrin aldehyde	ND	1	5	NA
Endrin ketone	ND	1	5	NA
Heptachlor	ND	1	5	NA
Heptachlor epoxide	ND	1	5	NA
Hexachlorobenzene	ND	1	5	NA
Methoxychlor	ND	1	5	NA
Mirex	ND	1	5	NA
Oxychlordane	ND	1	5	NA
Perthane	ND	5	10	NA
trans-Nonachlor	ND	1	5	NA

ND= Not detected
NA= Not available

Table 7. Polychlorinated biphenyl (PCB) congener concentrations in sediment from station B-RW-055.

Analyte	Concentration (µg/kg dry wt)	Method Detection Limit	Reporting Limit	Effects Range Low Threshold
PCB003	ND	1	5	NA
PCB008	ND	1	5	NA
PCB018	ND	1	5	NA
PCB028	ND	1	5	NA
PCB031	ND	1	5	NA
PCB033	ND	1	5	NA
PCB037	ND	1	5	NA
PCB044	ND	1	5	NA
PCB049	ND	1	5	NA
PCB052	ND	1	5	NA
PCB056(060)	ND	1	5	NA
PCB066	ND	1	5	NA
PCB070	ND	1	5	NA
PCB074	ND	1	5	NA
PCB077	ND	1	5	NA
PCB081	ND	1	5	NA
PCB087	ND	1	5	NA
PCB095	ND	1	5	NA
PCB097	ND	1	5	NA
PCB099	ND	1	5	NA
PCB101	ND	1	5	NA
PCB105	ND	1	5	NA
PCB110	ND	1	5	NA
PCB114	ND	1	5	NA
PCB118	ND	1	5	NA
PCB119	ND	1	5	NA
PCB123	ND	1	5	NA
PCB126	ND	1	5	NA
PCB128	ND	1	5	NA
PCB138	2	1	5	NA
PCB141	ND	1	5	NA
PCB149	ND	1	5	NA
PCB151	ND	1	5	NA
PCB153	1.5	1	5	NA
PCB156	ND	1	5	NA
PCB157	ND	1	5	NA
PCB158	ND	1	5	NA
PCB167	ND	1	5	NA
PCB168+132	ND	1	5	NA
PCB169	ND	1	5	NA

Table 7. Continued.

Analyte	Concentration (µg/kg dry wt)	Method Detection Limit	Reporting Limit	Effects Range Low Threshold
PCB170	ND	1	5	NA
PCB174	ND	1	5	NA
PCB177	ND	1	5	NA
PCB180	ND	1	5	NA
PCB183	ND	1	5	NA
PCB187	ND	1	5	NA
PCB189	ND	1	5	NA
PCB194	ND	1	5	NA
PCB195	ND	1	5	NA
PCB199(200)	ND	1	5	NA
PCB201	ND	1	5	NA
PCB206	ND	1	5	NA
PCB209	ND	1	5	NA
Total PCBs	3.5	1	5	22.7

ND= Not detected
NA= Not available

Table 8. Polynuclear aromatic hydrocarbon concentrations in sediment from station B-RW-055.

Analyte	Concentration (µg/kg dry wt)	Method Detection Limit	Reporting Limit	Effects Range Low Threshold
1-Methylnaphthalene	ND	1	5	NA
1-Methylphenanthrene	4.2	1	5	NA
2,3,5-Trimethylnaphthalene	ND	1	5	NA
2,6-Dimethylnaphthalene	ND	1	5	NA
2-Methylnaphthalene	ND	1	5	70
Acenaphthene	ND	1	5	16
Acenaphthylene	ND	1	5	44
Anthracene	ND	1	5	85.3
Benz[a]anthracene	ND	1	5	261
Benzo[a]pyrene	1.2	1	5	430
Benzo[b]fluoranthene	1.2	1	5	NA
Benzo[e]pyrene	1.2	1	5	NA
Benzo[g,h,i]perylene	ND	1	5	NA
Benzo[k]fluoranthene	1.4	1	5	NA
Biphenyl	ND	1	5	NA
Chrysene	2.1	1	5	384
Dibenz[a,h]anthracene	ND	1	5	63.4
Dibenzothiophene	ND	1	5	NA
Fluoranthene	6.2	1	5	600
Fluorene	1.4	1	5	19
Indeno[1,2,3-c,d]pyrene	ND	1	5	NA
Naphthalene	1	1	5	160
Perylene	ND	1	5	NA
Phenanthrene	6.2	1	5	240
Pyrene	7.8	1	5	665

ND= Not detected
NA= Not available

Table 9. Trace metal concentrations in sediment from station B-RW-055.

Analyte	Concentration (mg/kg dry wt)	Method Detection Limit	Reporting Limit	Effects Range Low Threshold
Arsenic (As)	6.204	0.025	0.05	8.2
Cadmium (Cd)	0.913	0.0025	0.005	1.2
Chromium (Cr)	43.083	0.0025	0.005	81
Copper (Cu)	33.519	0.0025	0.005	34
Lead (Pb)	11.928	0.0025	0.005	46.7
Nickel (Ni)	26.02	0.01	0.02	20.9
Selenium (Se)	0.372	0.025	0.05	NA
Silver (Ag)	0.32	0.01	0.02	1
Tin (Sn)	1.56	0.025	0.05	NA
Zinc (Zn)	84.826	0.025	0.05	150

ND= Not detected
NA= Not available

Table 10. Physical attributes of sediment from Ballona Wetlands and TIE samples.

#	Sample	Sand (%)	Silt (%)	Clay (%)	TOC (%)	Plasticity Index
3	B-RW-055	14.3	61.4	24.7	1.57	26
	A-HAS-016	21.4	59.1	19.3	1.83	20
1	Control Sediment	97.6	1.6	0.5	NA	NA
2	Fine Sediment Control	26.1	66.2	7.8	1.04	11
13	Texture Reference	25.2	62.1	12.4	NA	5
10	B-RW-055 Dilution with Control 20%	18.4	57.7	23.7	NA	NA
11	B-RW-055 Dilution with Control 40%	18.8	55.5	26.3	NA	NA
16	B-RW-055 Dilution with Texture Ref. 40%	15.7	60.6	23.2	NA	23

NA= Not analyzed

Table 11. TIE treatment interpretation summary. Treatment numbers refer to Tables 4 and 5. Definitions for stressor type indications: No = results indicate stressor type not likely to influence sample toxicity; Possible = toxicity result is plausible for stressor type but treatment is not specific for that stressor; Yes = results indicate stressor type has a major influence on sample toxicity; na = treatment not informative for this stressor type.

#	Treatment	Toxicity Change	Stressor Type Indicated	
			Chemical	Texture
4	Trace organics removal	No effect	No	Possible
6	Trace metals removal	No effect	No	Possible
8	Ammonia removal	No effect	No	Possible
10	Dilution with control sediment 20%	Decrease	Possible	Yes[1]
11	Dilution with control sediment 40%	Decrease		
15	Dilution with texture reference 20%	Slight decrease	No	Yes[1]
16	Dilution with texture reference 40%	No effect		
12	Dilution with fine sediment control 20%	No effect	No	Possible[1]
13	Texture reference	Increase	na	Yes
18	Pore water	Non toxic	No	Possible

[1] Conclusion based on comparison among results for all dilution treatment types.

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Appendix D
Area B Modeling Memo

ESA

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memorandum

date August 3, 2015 – *updated November 6, 2015*

to Ballona Wetlands Restoration Project Management Team

from Lindsey Sheehan, P.E. and Nick Garrity, P.E.

subject Draft Area B Managed Wetlands Preliminary Design

This memorandum provides the detailed hydrology basis of design for the South and Southeast Area B managed wetlands enhancements, including design criteria for channels, berms, and water control structures as well as hydraulic modeling of existing and project conditions for typical operations and flood scenarios. This memo is an addendum to the September 2015 Preliminary Design Report and the May 2013 Hydraulics and Hydrology Report. This memo provides a discussion of the existing conditions in Section 1, the South and Southeast Area B design features in Section 2, and the model description and results in Section 3. Section 4 notes next steps.

1 Existing Conditions

A brief summary of existing conditions in West, South, and Southeast Area B is included below to provide context for this memo (Figure 1). Other project documents contain more detailed information on existing conditions (e.g., PWA 2006).

1.1 Tidal Connectivity

There are two channels in West Area B that connect to Ballona Creek via culverts through the levee under existing conditions (Figure 1). All of the culverts are equipped with control structures that are designed to limit inflows from Ballona Creek to West Area B. The west channel is connected to the creek with one 36-inch corrugated metal pipe (CMP) which has a one-way flap gate that keeps water from flowing into the marsh (Table 1) from Ballona Creek. The east channel has three 60-inch CMPs, two of which have self-regulating tide gates (SRT gates). The SRT gates are designed to close and prevent inflows when the water surface elevation of Ballona Creek reaches 3.4 ft NAVD, but in practice, they leak and allow water levels to increase in West Area B (LA County 2012). To keep the water levels in the marsh lower than

3.4 ft NAVD, the gates are currently operated to close at 1.4 ft NAVD (LA County 2012). The third CMP has a one-way flap gate intended to keep water from flowing into West Area B.

West Area B is connected to South Area B by three culverts that go under Culver Blvd. A 36-inch reinforced concrete pipe (RCP) connects West Area B to the northern South Area B channel and two 24-inch RCPs connect it to the southern channel (Table 1).

Southeast Area B and South Area B are divided by the Gas Company road, which has three culverts through it. The north channel has two 48-inch CMPs and the south channel has one 48-inch CMP (Table 1).

Southeast Area B also receives overflows from the Freshwater Marsh during storms greater than the mean annual event.

1.2 Existing Topography

The lowest elevations in the vicinity of South and Southeast Area B occur along Culver Blvd, and this is where flooding would occur first during a storm event. In South Area B where Culver Blvd crosses over the existing culvert and channel from West to South Area B, the road drops down and is about even with the surrounding marshplain. For about 300 ft, the middle of the road drops below 7 ft NAVD, with the edges of the road reaching down to below 6.3 ft NAVD. The remainder of Culver Blvd along South Area B is at elevations between 7 to 8 ft NAVD. Where Jefferson Blvd comes off from Culver Blvd, north of Southeast Area B, the road rises to 8 to 9 ft NAVD and then up to 12 ft NAVD when the lanes split. North of the Freshwater Marsh, Jefferson is above 14 ft NAVD. To the south of South and Southeast Area B, the Gas Company is above 7.5 ft NAVD west of the Gas Company Road and above 10 ft NAVD to the east.

The topography is South and Southeast Area B is on the higher end of the range for where salt marsh typically occurs. Generally, pickleweed grows from mean high water (MHW) to the highest high tide level (e.g., Highest Astronomical Tide or HAT). Elevations in South and Southeast Area B are generally conducive to pickleweed marsh (between mean tide level (MTL) and HAT within Ballona Creek), while most of West Area B is lower (between MTL and mean higher high water (MHHW) within Ballona Creek). However, the existing tides are muted by the SRT gates (Section 1.3), so most of the existing habitat does not receive regular tidal inundation. Figure 2 shows how the majority of the area in South and Southeast Area B, of which a portion supports pickleweed, is above the existing high water level, while most of West Area B is much closer to the high water elevation.

1.3 Hydrology and Inundation

West Area B experiences muted tides due to the SRT gates described above. West Area B habitat, which includes a range of marsh habitats, tidal channels, and salt pans, supports the Belding's savannah sparrow and other species. In particular, it has been noted that the current channel layout protects the Belding's savannah sparrow from predators, by limiting access to the marshplain. The muted tidal exchange supports pickleweed at lower elevations than would

be found if the area were fully tidal (Section 1.2). In West Area B, the pickleweed is able to grow down to 3.5 ft NAVD, due to the managed water levels. This is a foot below MHW in Ballona Creek (4.5 ft NAVD), so below the lower end of where pickleweed typically occurs (MHW). The muted tides also support a large salt pan at a lower elevation than would occur under full tidal conditions, due to less frequent flooding of the area.

Tides are further muted in South and Southeast Area B due to the culvert connections with West Area B. The muted tidal flow is limited to the existing ditches in these areas and does not inundate the marshplain. However, South and Southeast Area B do support areas of salt marsh vegetation (e.g. pickleweed). The pickleweed grows up to elevations of about 6.75 ft NAVD, which is approximately 2.9 ft higher than the highest managed tide level allowed by the existing culverts and 1.6 ft higher than mean higher high water (MHHW) in Ballona Creek (5.2 ft NAVD). The majority of pickleweed in South and Southeast Area B is considered non-tidal salt marsh, since it is at elevations above the managed tide range and not supported by tidal flows (The Bay Foundation and WRA 2014).

Although construction of the Freshwater Marsh has reduced storm flows to South and Southeast Area B, the pickleweed is likely still supported by residual soil salinity combined with infrequent inundation by stormwater runoff. Historically, storm drainage from the east flowed into the Centinella Ditch, which ran along the southern portion of South and Southeast Area B. Runoff inundated lower elevation areas in South Area B and the western portion of Southeast Area B during extreme rainfall runoff events (Straw 1987). Now, under existing conditions, the Freshwater Marsh intercepts runoff from the east and discharges low flows to Ballona Creek after providing water quality treatment. However, even with this removal of typical storm flows from the east, the flood modeling performed for this memo indicates that portions of South and Southeast Area B are inundated during extreme rainfall runoff events under existing conditions, which likely supports the pickleweed habitat (Section 3.2.2).

Additionally, groundwater elevation data shows that the pickleweed in South and Southeast Area B is likely not reliant on groundwater for survival. Groundwater data is available from July 1987 from a study by Straw, prior to construction of the Freshwater Marsh and installation of the SRT gates. These data indicate that groundwater levels were about 3 to 4 ft below the central portion of Southeast Area B and that the zone of soil saturation was likely about 2 ft below ground throughout the year over much of Southeast Area B except during years of extreme rainfall (Straw 1987). This information and data suggest that the existing salt marsh vegetation in South and Southeast Area B is likely supported by direct precipitation, limited and infrequent inundation by stormwater runoff, and residual soil salinity, but not groundwater.

2 Preliminary Design

The following section supplements PDR Section 3.6. The Preliminary Design for South and Southeast Area B is based on design objectives intended to achieve the goal of enhancing wetland habitat, while avoiding adverse effects to the surrounding properties. The design objectives for the South and Southeast Area B Managed Wetlands enhancements are as follows:

1. Restore and enhance pickleweed-dominant salt marsh habitat for Belding's savannah sparrow nesting habitat. Pickleweed habitat restoration and enhancement includes removal of invasive vegetation, establishment of pickleweed vegetation, and increased tidal inundation to support pickleweed marsh enhancement and function. Increasing tidal inundation involves installing new culverts under Culver Blvd. and enhancing tidal channels.

2. Restore and enhance tidal channels to convey tidal flows and promote marsh inundation. Enhanced tidal channels are also intended to create foraging habitat and to provide protection from predators for the Belding's savannah sparrow. Channel restoration and enhancement would involve excavating tidal channels in the Area B managed wetlands.

3. Maintain the existing level of flood protection for adjacent areas surrounding the Area B managed wetlands, including Culver and Jefferson Boulevards, the Gas Company, and the Freshwater Marsh storm detention and treatment wetland system for Playa Vista and adjacent areas.

4. Allow for management flexibility and adaptive management, including seasonally closed/non-tidal wetland habitat management to mimic certain wetland habitat conditions present at the site in the 1890s, if desirable.

5. Create a managed wetland system that will be resilient to sea level rise within the management constraints.

As part of the EIR/S process, four alternatives are being evaluated for the Ballona Wetlands Restoration. Chapter 2 of the EIR/S describes these alternatives in detail. This memo describes the preliminary design for Alternative 1 only, but is applicable to the other alternatives as well. For example, restoration under Alternative 2 involves a similar design, but without the final phase of restoration. Alternatives 3 and 4 do not involve significant grading south of Ballona Creek or alteration of the flood control features, so they are not included here.

Alternative 1 would use a phased approach to allow for successful evaluation of biologic (including special-status species), hydrologic, and geomorphic performance of early restoration stages prior to the commencement of further phases. Alternative 1 would involve two phases:

1. Phase 1: enhancement of the existing Area B managed wetlands, restoration of Area A and North Area B, new perimeter flood protection levees, and realignment of the Ballona Creek channel (Figure 3).
2. Phase 2: full tidal restoration of West Area B (Figure 4). Note, only the first phase would occur in Alternative 2.

Phase 1. New culverts with adjustable gates would be installed to connect a tidal channel in North Area B with the channels in Southeast Area B under the Culver Blvd levee (Figure 3, Section 2.1). An overflow weir would be installed in South Area B, before the culverts that go under Culver Blvd to West Area B, which would prevent flow from South Area B to West Area B

under normal tidal conditions. These connections would allow an increased tidal range south of Culver Blvd to improve pickleweed habitat, without affecting Belding's savannah sparrow existing nesting habitat in West Area B. Additionally, during extreme storm events, water from South Area B could flow over the weir to West Area B, which would provide additional storage area.

The SRT gates would allow for continued flexible management in West Area B. Tidal channels would be excavated in South and Southeast Area B to bring in more water, provide foraging habitat for birds, and offer nesting Belding's savannah sparrows protection from predators (Section 2.3). Berms would be constructed to protect the road to the north and the Gas Company to the south from the higher tide levels and storm flows (Section 2.4). An impoundment berm would be constructed to retain freshwater from the Freshwater Marsh in the southeast of Southeast Area B to encourage the development of brackish marsh habitat in this area and allow for brackish marsh management (Section 2.5).

Phase 2. When the Ballona Creek levee is breached and lowered and West Area B becomes fully tidal, the weir between South and West Area B would be removed and new, larger culverts with adjustable gates would be installed to increase flow between the two areas (Figure 4, Sections 2.1 and 2.2).

The project features and the basis for design are further described below.

2.1 Hydraulic Structures

Phase 1. New culverts with adjustable gates would be installed between Ballona Creek and Southeast Area B to allow an increase in water levels in South and Southeast Area B. Existing hydraulic structures under the Gas Company Rd would be replaced to increase flow capacity between South and Southeast Area B. In both locations, four 60-inch diameter pipe culverts or similar structures would be installed at an elevation of -1 ft NAVD. A new weir box would be added to the existing structure between South to West Area B to manage water levels. The weir would be installed in South Area B to prevent tidal waters from entering West Area B, but to allow stormwater to overflow. The weir would be set to an elevation of 7 ft NAVD.

Phase 2. The weir from South to West Area B would be removed, new, larger culverts (four 60-inch diameter culverts or similar) with adjustable tide gates would be installed. The gates would consist of combination slide/flap gates, SRT gates, or other similar gates or valves, however, tide gates are not required to maintain the existing level of flood protection. Hydraulic modeling results shows that flow through open culverts results in an acceptable range of water levels for typical conditions and the design storm event (Section 3.2); however, the addition of tide gates would provide added safety and design redundancy. The gates would also allow for management flexibility, including the option for managing for habitat seasonally closed to Ballona Creek. As sea level rises, the gates would be used to limit water levels in South and Southeast Area B.

2.2 Long-Term Operation of Hydraulic Structures

Because of the hydraulic connection to Ballona Creek, sea level rise will impact water levels south of Culver Boulevard over time. USACE (2011) estimates 59 inches of sea level rise will occur by 2100, under a high emissions scenario. Since there is substantial variability in the sea level rise estimates, water levels south of Culver Boulevard would be managed to adapt to changing water levels over time.

The hydraulic modeling in this memorandum assumes that there will be 59 inches of sea level rise by 2100. The project is designed so that management, including the addition of flap gates or other controls, can be altered easily in response to changing conditions. SRT gates could be used to limit maximum water levels, or flap gates and slide gates could be used to limit flow in and out of these areas. The project scenarios modeled for this memorandum assume that a flap gate would be added to one culvert at each bank of culverts (between South and West Area B and Southeast Area B and Ballona Creek) about every 25 years, so that by 2100 only one culvert would allow flow into South Area B from Ballona Creek and West Area B, while the other culverts would only provide outflow. This reduction in inflow capacity will limit water levels in the marsh in order to maintain flood protection.

2.3 Tidal Channels

Networks of branching, sinuous tidal channels would be excavated in South and Southeast Area B in Phase 1 and connected to Ballona Creek through a culvert through North Area B. The tidal channel network would extend from and drain to Ballona Creek during Phase 1 (Figure 3), with the flexibility to connect the channels through West Area B in Phase 2. The purpose of the tidal channels is to convey tidal flows and sediment to the restored wetlands, providing tidal circulation (inundation and drainage) to support wetland vegetation and functions. Tidal channels are also expected to provide foraging habitat and protection from predators for the Belding's savannah sparrow. See the PDR for further details on channel sizing and placement.

As described in Section 1.2, groundwater is not thought to be supporting the pickleweed habitat in South and Southeast Area B. This means that the existing channels can be deepened, and any flushing of groundwater should not impact the pickleweed habitat.

2.4 Perimeter Berms

Berms would be constructed along the lower portions of Culver Boulevard, Jefferson Boulevard, and the Gas Company to protect these areas from inundation due to the higher water levels in South and Southeast Area B (Figure 4). The berm crest elevation is set to 9 ft NAVD, in order to increase the existing freeboard during the design flood (see Section 3.2.2 for further discussion). The berm would be offset from the road by 30 ft, and have a top width of 8 ft. The berm would have a slope of 3:1 on the outboard side and a slope of 5:1 on the inboard side down to the marsh. With these dimensions, the berm would require approximately 11,300 cy of fill, which is slightly more than quantity cut from the tidal channels (9,400 cy).

2.5 Brackish Marsh Impoundment Berm

A new low berm would be constructed near the Freshwater Marsh to encourage brackish marsh habitat to establish in the eastern portion of Southeast Area B (Figure 4). This berm would include a weir with adjustable risers designed to allow tidal water into the area and delay drainage of the freshwater that flows into Southeast Area B from the Freshwater Marsh. Overtime, the freshwater impoundment is expected to leach salts from the soil and encourage brackish marsh vegetation to colonize. The berm would also provide transitional habitat and, with sea level rise, high tide refugia.

Adaptive management of the brackish marsh areas is expected to be required to encourage brackish marsh habitat development, and the brackish marsh design is therefore intended to provide management flexibility. Further development of the brackish marsh design will focus on designing water control structures that provide management flexibility rather than precise estimates of salinities.

At a height of 6.8 ft NAVD, the berm would impound freshwater and limit tidal inundation without causing backflow into the Freshwater Marsh with the Freshwater Marsh overflow weir set at the lowest weir elevation (6.9 ft NAVD). The berm would limit tidal inundation of the brackish marsh area until about 2050 (assuming 19 in of sea level rise), when it would be regularly overtopped, at which point the berm would no longer limit tidal inundation. The top width of the berm would be 5 ft and slope to the marsh at 10:1 on both sides. The berm would require approximately 350 cy of fill.

The Freshwater Marsh operation would be adjusted to allow more flow into the brackish marsh. Currently, the Freshwater Marsh can hold up to the annual storm (100% chance of recurrence in an average year or the 1 year storm) by lowering water levels during the summer (down to 4.4 ft NAVD) and allowing water to fill up to the lowest weir setting at 6.9 ft NAVD, before it overflows to Southeast Area B (PSOMAS, 2012). For the brackish marsh to receive freshwater every year, the Freshwater Marsh would need to be managed so that at least the 1 year storm (80 ac-ft) flows into Southeast Area B. A new culvert in the northwest of the Freshwater Marsh would be installed so that treated water would flow into Southeast Area B more frequently, rather than flowing out to Ballona Creek.

3 Hydraulic Modeling

Hydraulic modeling was conducted to evaluate water levels under existing and project conditions and to design the berm elevations and hydraulic structure dimensions. The goal of the modeling and design is to maintain or increase the level of flood protection along Culver Boulevard, Jefferson Boulevard, and the Gas Company property, while increasing tidal elevations to achieve the design objectives described in Section 2.

3.1 Model Setup

Three HEC-RAS hydraulic model geometries were used to represent existing conditions, project conditions under Alternative 1, Phase 1 (which would be the same as Alternative 2), and project conditions under Alternative 1, Phase 2.

3.1.1 Model Geometry

The model extent includes the Ballona Creek channel from the Pacific Ocean to just downstream of Centinella Creek (Figure 5). Additionally, the model includes West Area B, South Area B, and Southeast Area B, all modeled as storage areas. The model structures include: Lincoln Blvd, Culver Blvd, and the Pacific Highway bridges, as well as culverts between Ballona Creek and West Area B, between West Area B and South Area B, and between South Area B and Southeast Area B.

3.1.1.1 Topography

A combination of as-built structure data from the USACE model of the Ballona Creek drainage system (USACE 2010) and a digital terrain model (DTM) constructed for the PDR was used to develop existing conditions model geometry for the Ballona Creek system. All elevations are vertically referenced to NAVD88.

3.1.1.2 Storage Areas

West Area B, South Area B, and Southeast Area B were each modeled as individual storage areas for existing conditions, since water surface gradients across the areas are not significant. A stage-storage curve was developed for each area from the topography (Section 3.1.1.1). For Alternative 1, Phase 1 project conditions (Figure 6) model runs, the stage-storage curves that were used for existing conditions were adjusted to account for the tidal channel grading in South and Southeast Area B. For the Alternative 1, Phase 2 project conditions model runs, West Area B was included in the Ballona Creek channel cross-sections and eliminated as a storage area (Figure 7).

3.1.1.3 Structures

Ten culverts were modeled to represent connections between the storage areas and Ballona Creek under existing and project conditions. Table 1 summarizes how each connection was represented in the model geometry.

Under project conditions, the connections between West Area B and Ballona Creek are not modeled since West Area B is included in the channel cross-sections.

3.1.1.4 SRT Calibration

The SRT gates that connect West Area B to Ballona Creek allow water to leak into Area B when they are closed (LA County 2012; Section 1.1). To achieve modeled water levels similar to existing levels in the marsh, the model was run with the SRT gates closing down to a 0.2 ft opening at a rate of 0.2 ft/min when Ballona Creek water levels reach 2.2 ft NAVD. Once channel water levels drop below 2.2 ft NAVD, the gates re-open. Water elevation data from the

marsh and the channel, recorded in December 2011, were used to calibrate the SRT gates in the model. The calibration results are shown in Figure 8.

3.1.2 Hydrology

The flood flow rate modeled for the creek is the design flood of 46,000 cfs (USACE 1999) (see H&H report for additional details). A hydrograph based on model runs from the H&H Report was added just downstream of Centinella Creek and included the flows from Centinella, Sepulveda, and Ballona Creeks. This hydrograph is presented in Figure 9.

Stormwater inflow hydrographs were added to South and Southeast Area B to represent 100-year flows from the Freshwater Marsh (with the Ballona Creek outlet gate closed) and the Westchester Bluffs, respectively (PSOMAS 2012). The peak flow into Southeast Area B from the Freshwater Marsh is 174 cfs and the peak flow into South Area B from Westchester Bluffs is 160 cfs (PSOMAS 2012). Figure 9 presents these hydrographs. The 100-year flows result in a peak volume of 17 ac-ft in Southeast Area B and 34 ac-ft in South Area B (PSOMAS 2012).

3.1.3 Downstream Boundary Conditions

An unsteady tidal signal was used for the downstream boundary of the model. For the typical tides scenarios, a two week tide time series from December 2011 was used, in order to include a spring and neap cycle. For the storm runs, a one-day tide time series from February 2007 was used to represent a spring high tide cycle. The peak tidal water level of 6.22 ft NAVD was timed to occur just before the peak flow in Ballona Creek, when water levels in South and Southeast Area B would be at their highest due to the leaking SRT gates. Figure 9 shows these boundary conditions and the timing of the tides in relation to the flow hydrographs. Note that 7.6 ft NAVD, the downstream water level used to design the flood control channel, was not modeled, but may be in future efforts for the 408 Submittal B.

To represent conditions with sea-level rise for the years 2030, 2050, 2070, and 2100, the tidal signals were raised by 9, 19, 32, and 59 inches respectively per the USACE high emissions scenario (2011). To represent the worst-case storm scenario under sea-level rise conditions for the project, the peak flows were timed to coincide with the end of the neap cycle, when water levels in South and Southeast Area B would be at their highest.

Table 1. Model Culvert Data

		Ballona Creek to West Area B		West Area B to South Area B			South Area B to Southeast Area B			Ballona Creek to Southeast Area B
		West channel	East channel	North channel	South channel		North channel		South channel	
					North	South	North	South		
Existing Conditions	Number of culverts	1	3	1	1	1	1	1	1	
	Invert north (ft NAVD)	-1.28	-1.2							
	Invert south (ft NAVD)	-0.11	-1.2							
	Invert west (ft NAVD)			1.61	0.89	0.9	2.82	3.96	2.55	
	Invert east (ft NAVD)			2.56	0.94	1.08	3.2	3.74	2.23	
	Diameter (ft)	3	5 (FG)	3	2	2	4	4	4	
	Height x Width (ft)		5 x 3.93 (SRTs)							
	Length (ft)	58	50 (SRTs), 46 (FG)	77.3	87.5	89.8	30.8	30.1	41.5	
	Shape	Circular	Square (SRTs), Circular (FG)	Circular	Circular	Circular	Circular	Circular	Circular	
	Chart #	2 - CMP	2 - CMP	1 - RCP	1 - RCP	1 - RCP	2 - CMP	2 - CMP	2 - CMP	
	Scale #	1- Headwall	1- Headwall	1- Sq edge	1- Sq edge	1- Sq edge	1- Headwall	1- Headwall	1- Headwall	
	Entrance Loss Coefficient	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
	Exit Loss Coefficient	1	1	1	1	1	1	1	1	
	Manning's n	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	
	Gates	Flap gate	2 SRTs, 1 Flap gate							
	Gate closing elevation (ft NAVD)		3.4							
Alternative 1, Phase 1	Number of culverts	1	3		1	1	4			4
	Invert north (ft NAVD)	-1.28	-1.2							
	Invert south (ft NAVD)	-0.11	-1.2							
	Invert west (ft NAVD)				0.89	0.9	-1			-1
	Invert east (ft NAVD)				0.94	1.08	-1			-1
	Diameter (ft)	3	5 (FG)		2	2	5			5
	Height x Width (ft)		5 x 3.93 (SRTs)							
	Length (ft)	58	50 (SRTs), 46 (FG)		87.5	89.8	40			40
	Shape	Circular	Square (SRTs), Circular (FG)		Circular	Circular	Circular			Circular
	Chart #	2 - CMP	2 - CMP		1 - RCP	1 - RCP	2 - CMP			2 - CMP
	Scale #	1- Headwall	1- Headwall		1- Sq edge	1- Sq edge	1- Headwall			1- Headwall
	Entrance Loss Coefficient	0.5	0.5		0.5	0.5	0.5			0.5
	Exit Loss Coefficient	1	1		1	1	1			1
	Manning's n	0.024	0.024		0.024	0.024	0.024			0.024
	Gates	Flap gate	2 SRTs, 1 Flap gate		Weir structure					
	Gate closing elevation (ft NAVD)		3.4							
Alternative 1, Phase 2	Number of culverts			4			4			4
	Invert west (ft NAVD)			-1			-1			-1
	Invert east (ft NAVD)			-1			-1			-1
	Diameter (ft)			5			5			5
	Length (ft)			900			300			600
	Shape			Circular			Circular			Circular
	Chart #			2 - CMP			2 - CMP			2 - CMP
	Scale #			1- Headwall			1- Headwall			1- Headwall
	Entrance Loss Coefficient			0.5			0.5			0.5
	Exit Loss Coefficient			1			1			1
	Manning's n			0.024			0.024			0.024
	Gates			Flap gates with SLR over time (0 fg initially, 1 fg at 9”, 2 fg at 19”, 3 fg at 32”,3 fg and 1 slide gate at 59”)						Flap gates with SLR over time (0 fg initially, 1 fg at 9”, 2 fg at 19”, 3 fg at 32”,3 fg and 1 slide gate at 59”)

HEC-RAS can model SRT gates as rectangular culverts, but not circular, so dimensions were chosen to match the culvert area and culvert elevations.

3.1.4 Run Catalog

Sixteen scenarios were run. These included existing and project conditions (Alternative 1, Phase 1 and 2), typical tides and the design storm event, and sea-level rise. provides the run catalog.

Table 2. Model Run Catalog

	Run	Scenario	Hydrology	Downstream Boundary Conditions	Sea-Level Rise
Typical tides	Calibration	Existing	-	Two weeks typical tides	-
	1	Existing	-	Two weeks typical tides	-
	2	Alt 1, Phase 1	-	Two weeks typical tides	-
	3	Alt 1, Phase 2	-	Two weeks typical tides	-
Design Event	4	Existing	Design Event	Spring high tide	-
	5	Alt 1, Phase 1	Design Event	Spring high tide	-
	6	Alt 1, Phase 2	Design Event	Spring high tide	-
Sea Level Rise	7	Existing	-	Two weeks typical tides	9” (high)
	8	Existing	-	Two weeks typical tides	19” (high)
	9	Existing	-	Two weeks typical tides	32” (high)
	10	Existing	-	Two weeks typical tides	59” (high)
	11	Alt 1, Phase 2	-	Two weeks typical tides	9” (high)
	12	Alt 1, Phase 2	-	Two weeks typical tides	19” (high)
	13	Alt 1, Phase 2	-	Two weeks typical tides	32” (high)
	14	Alt 1, Phase 2	-	Two weeks typical tides	59” (high)
Design Event with SLR	15	Existing	Design Event	End of neap tides	59” (high)
	16	Alt 1, Phase 2	Design Event	End of neap tides	59” (high)

3.2 Results and Discussion

Model results are presented in Table 3 and Figures 10-16 and discussed in the following sections.

3.2.1 Typical Tides

Figure 10 shows model results for tidal inundation extent during a low tide and spring high tide in Ballona Creek for existing conditions and Alternative 1 (Phase 1 and Phase 2). Under existing conditions, only the remnant channels in South and Southeast Area B are inundated, due to the muted, managed water levels, which have damped high tide levels. Similarly, West Area B experiences a small extent of inundation as well. Under the proposed operations for Phase 1, the new culverts would allow higher water levels, which would increase inundation in South and Southeast Area B. In Phase 2, water levels would increase even more as the culverts to West Area B are expanded. The eucalyptus grove in South Area B near the Gas Company does not experience any inundation under existing conditions. With Alternative 1, the edge of the grove would be tidally inundated. A berm could be added around the grove to protect it from tidal waters if the inundation is determined to be detrimental.

The elevation-area curves in Figure 11 show inundated acreage under existing, Phase 1, and Phase 2 project conditions. The model results indicate that Phase 1 would inundate an additional 64 acres of marsh in South and Southeast Area B (65 acres total), and Phase 2 would inundate 75 acres.

Figure 12 shows the model results for a typical tidal signal. Under existing conditions, the modeled water level in each area rises with the tide until the water level in Ballona Creek reaches the elevation at which the SRT gates close , and then slowly increases in proportion to the water level in the creek (due to leakage in the SRT gates) until the Creek water levels drops. As the Creek level drops, the areas drain out to the lowest ground surface elevation.

Phase 1 model results show water levels in West Area B would follow the same pattern because the area would be operated the same in Phase 1 as under existing conditions. In South and Southeast Area B model results show some high tide muting despite the increased culvert capacity. With the tidal channel grading, the tidal prism in South and Southeast Area B increases dramatically from 17 ac-ft to 84 ac-ft, and even with the additional and larger culverts, the flow cannot be conveyed quickly enough into the site to raise water levels to the Ballona Creek peak water level before the tide in the Creek starts to drop. This is reflected in the model results, which show peak water level in South and Southeast Area B somewhat lower than the Ballona Creek peak water level.

Under Phase 2, the culvert capacity effectively doubles from Phase 1 (with the removal of the weir from South to West Area B and the new, larger culverts), but model results show the high tide is still slightly muted. However, the muting is not substantial and increasing the culvert dimensions further would offer a decreasing return on investment.

3.2.2 Design Storm Event

During the design storm event under existing conditions, the maximum water level in South and Southeast Area B reaches 5.3 ft NAVD according to model results (Figure 13,). This results in 1.5 ft of freeboard to the low point in Culver Boulevard (6.8 ft NAVD).

In Alternative 1, Phase 1, model results show that the water levels in West Area B are initially lower than under existing conditions because the weir from South to West Area B limits flow. Once the water levels in South Area B overtop the weir (6 ft NAVD), the water levels in West Area B increase and peak to the same level as under existing conditions (4.5 ft NAVD). The weir also limits drainage from South and Southeast Area B. This is reflected in the model results, which show it takes longer (< 1 hour) to drain these areas under Alternative 1, Phase 1 than under existing conditions. Model results show peak water levels in South and Southeast Area B increase to 7.0 and 7.1 ft NAVD respectively under Alternative 1, Phase 1 conditions. However, with the new perimeter berm (9 ft NAVD), freeboard increases to 1.9 ft (Table 3).

In Alternative 1, Phase 2, West Area B would be reconnected to Ballona Creek and the water levels in South and Southeast Area B would increase slightly from Phase 1 according to model results (to 7.3 and 7.4 ft NAVD respectively). The second culvert connection through West Area B allows water to move more quickly into the site, so modeled water levels are higher even before the storm peak

passes. However, model results show that the new berm would provide 1.6 ft of freeboard at the peak water level of 7.3 ft NAVD (Table 3).

Since Ballona Creek flow expands and slows in West Area B under Phase 2 project conditions, model results show water levels at the creek side of the tide gates remain elevated for longer than under existing conditions (Figure 13). This would delay drainage in the areas south of Culver Blvd, but the increased culvert capacity allows water to flow out more quickly (2 hours faster than Phase 1, according to model results).

These results demonstrate that flood hazard is not increased under Alternative 1 relative to existing conditions. The modeled project design assumes open culverts without gates; SRT gates or similar types of automatic gates could be added to the culverts under Phase 2 project conditions if more freeboard and lower water levels are desired or for added safety and design redundancy.

3.2.3 Sea-Level Rise

With sea level rise, inundation is expected to increase over time. Without the project, low tide and high tide inundation will be similar, and habitats will convert to lower elevation habitat types (mid marsh to low marsh or low marsh to mudflat). With the project, the tidal signal can be maintained for a longer time. Figure 14 shows the low and high tide inundation with sea level rise over time.

With 59 inches of sea-level rise by 2100 (USACE 2011), MLLW will rise to 4.7 ft NAVD, which is more than two feet above the current SRT closing elevation. Under typical tidal conditions with sea-level rise (i.e., future without project conditions), this means that the water level in all of the managed areas would continually increase (due to the leakage in the SRT gates) except during spring low tides occurring every two weeks when the water can drain out, as shown in the model results in Figure 15. Under project conditions, modeled water levels still show a tidal signal (as opposed to under existing conditions), because the open culverts allow higher tides and are bigger than under existing conditions, so they provide better drainage. While pickleweed in South and Southeast Area B may not survive until 2100 due to the elevations and the increased duration of inundation in South and Southeast Area B, the vegetation would survive longer than it would without the project.

When the design storm event occurs under sea level rise conditions, water levels south of Culver Boulevard would depend largely on whether the event occurs during a spring or neap tide according to the model results. As shown in Figure 15, the modeled water elevations in South and Southeast Area B due to the tides alone can range from 3.6 to 8.2 ft NAVD under project conditions. The worst-case scenario for project conditions would be if the peak flow hit toward the end of the neap tides, when the water levels would already be at their highest south of Culver Boulevard. The model shows that this would result in water levels up to 8.7 ft NAVD (Figure 16,), with 0.3 ft of freeboard for the berm. Under existing conditions, West Area B provides additional storage, and the SRT gates are operated to close at a lower elevation, so the water levels are 2 feet lower (6.7 ft NAVD) than project conditions; however, the freeboard for Culver Blvd under existing conditions is only 0.1 ft. Model results show that the Project would, therefore, maintain or increase the level of flood protection in the future with up to 59 inches of sea level rise.

Table 3. Area B Water Level Results Summary

		Area B	Existing Conditions (EC)	Alternative 1, Phase 1	Change from EC	Alternative 1, Phase 2	Change from EC
Existing Hydrology	Highest Tide Level	All	3.9	5.7	1.8	6.1	2.2
	Design Storm Peak Water Level	West	4.5	4.5	0.0	-	-
		South	5.3	7.0	1.7	7.3	2.0
		Southeast	5.3	7.1	1.8	7.4	2.1
	Freeboard[1]		1.5	1.9	0.4	1.6	0.1
Sea-Level Rise	Highest Tide Level	All	6.3	-	-	8.2	1.9
	Design Storm Peak Water Level	South	6.7	-	-	8.7	2.0
		Southeast	6.7	-	-	8.7	2.0
	Freeboard[1]		0.1	-	-	0.3	0.2

1. Freeboard is to Culver Blvd low point (6.8 ft NAVD) for Existing Conditions and Phase 1, and to the new berm (9.0 ft NAVD) for Phase 2.

3.3 Summary and Conclusions

For the culvert configuration and operation modeled for this preliminary hydraulic design, high tide levels south of Culver Blvd would be increased by 1.8 ft to 5.7 ft NAVD in Phase 1, and increased by 2.2 ft to 6.1 ft NAVD in Phase 2 under typical tidal conditions (). The proposed new perimeter berm would maintain the existing freeboard above high tide for Culver Boulevard in Phase 2, which is approximately 2.9 ft.

With the proposed structure configuration for Phase 1 project conditions, the water levels in South and Southeast Area B during the design storm would increase by 1.8 ft due to the higher starting tidal water levels. In Phase 2, the modeled peak water levels increase further, due to the extra culverts, which allow more flow into the site before the storm peak. During the design storm, the modeled water levels south of Culver Blvd increase by 2.1 ft, but are still 1.6 ft below the proposed new perimeter berm and therefore maintain the existing freeboard (). Subsequent phases of the design will consider the addition of SRT or similar tide gates and hydraulic controls to limit peak water levels and provide added safety and design redundancy. Culvert sizes and designs will also be refined.

With 59 inches of sea-level rise projected in 2100, the project would increase water levels by 1.9 ft under tidal conditions, and 2 ft during the design storm, according to the model results. However, with the proposed new perimeter berm, freeboard is increased by 0.2 ft during the design storm.

Model results for typical tidal conditions demonstrate that Alternative 1 functions to increase the tide range in South and Southeast Area B, therefore enhancing pickleweed-dominant salt marsh, without increasing the tide range in West Area B under Phase 1, in order to protect existing Belding's savannah sparrow nesting habitat. Model results for design storm conditions demonstrate that flood hazard is not increased under Alternative 1 relative to existing conditions. The model results also demonstrate that the design will be more resilient to sea level rise than existing conditions. Additionally, the design allows for management flexibility and adaptive management, thus achieving all of the design objectives.

4 Next Steps

The South Area B managed wetland enhancement design will be further developed in subsequent phases of the design, including:

- Develop gate configuration design. For the new water control structures in the Culver levee in Phase 2, combination slide and flap gates or SRT gates could be used.
- Develop water management design for the brackish marsh area, including the brackish marsh impoundment water control structure design and operation and modifications to the Freshwater Marsh structures.

5 References

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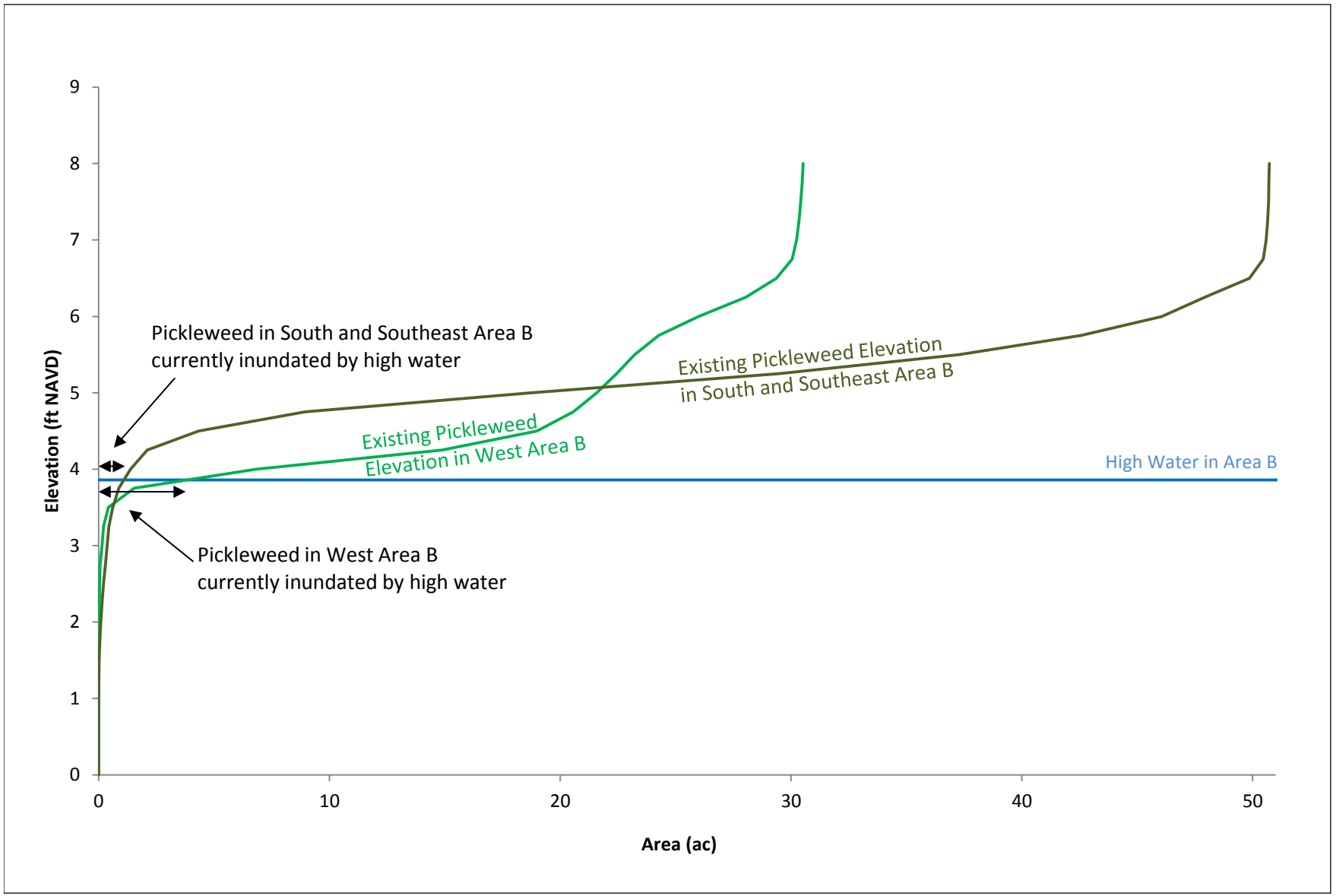
6 List of Preparers

Lindsey Sheehan, P.E.
Nick Garrity, P.E.
Bob Battalio, P.E.
Mark Lindley, P.E.



Ballona Wetlands Restoration Project

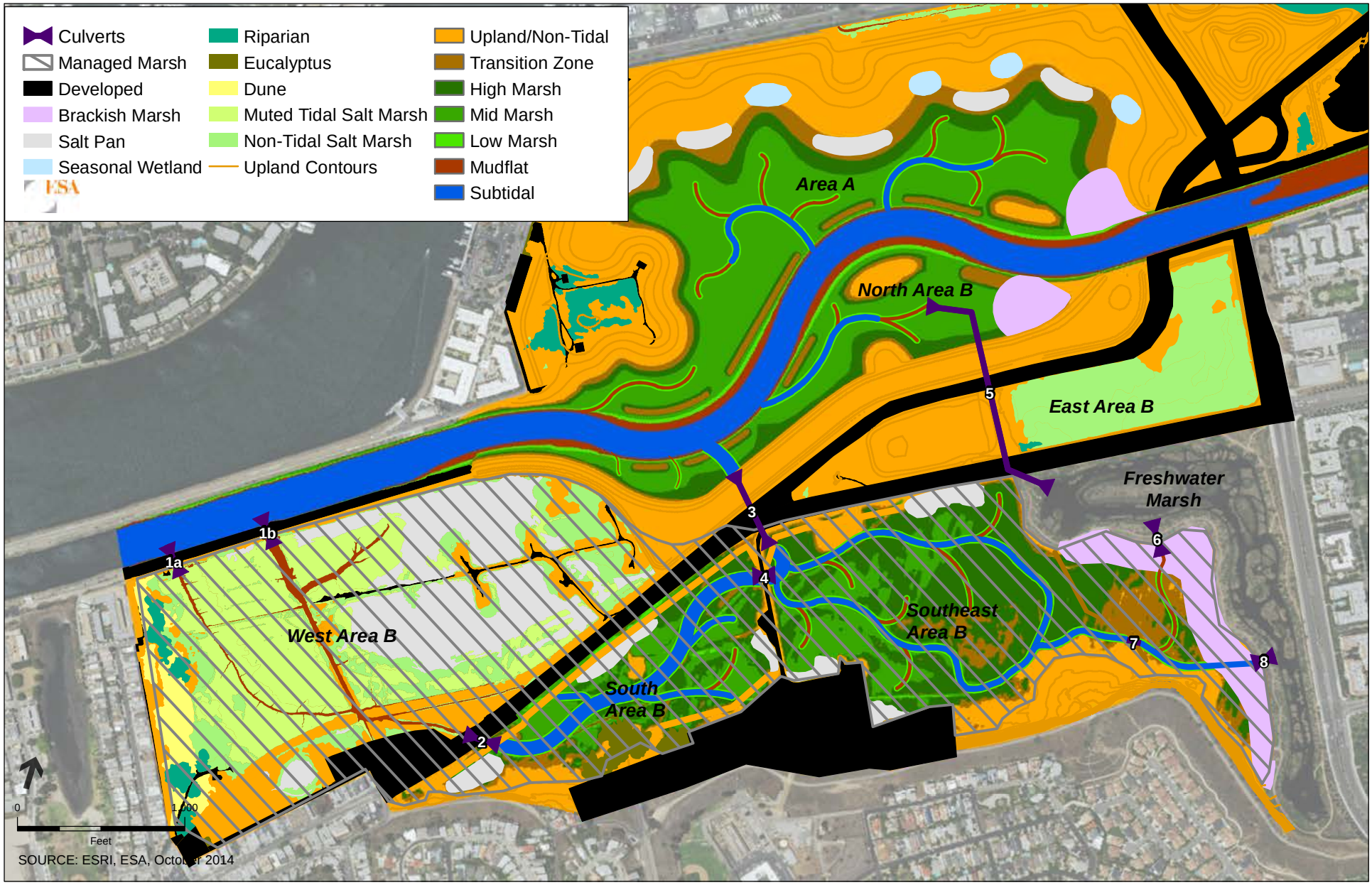
Figure 1
Site Overview



Note: Elevation data from PSOMAS 2013 for PDR. Habitat mapping from the California Department of Fish & Game's (2007) habitat and vegetation mapping.

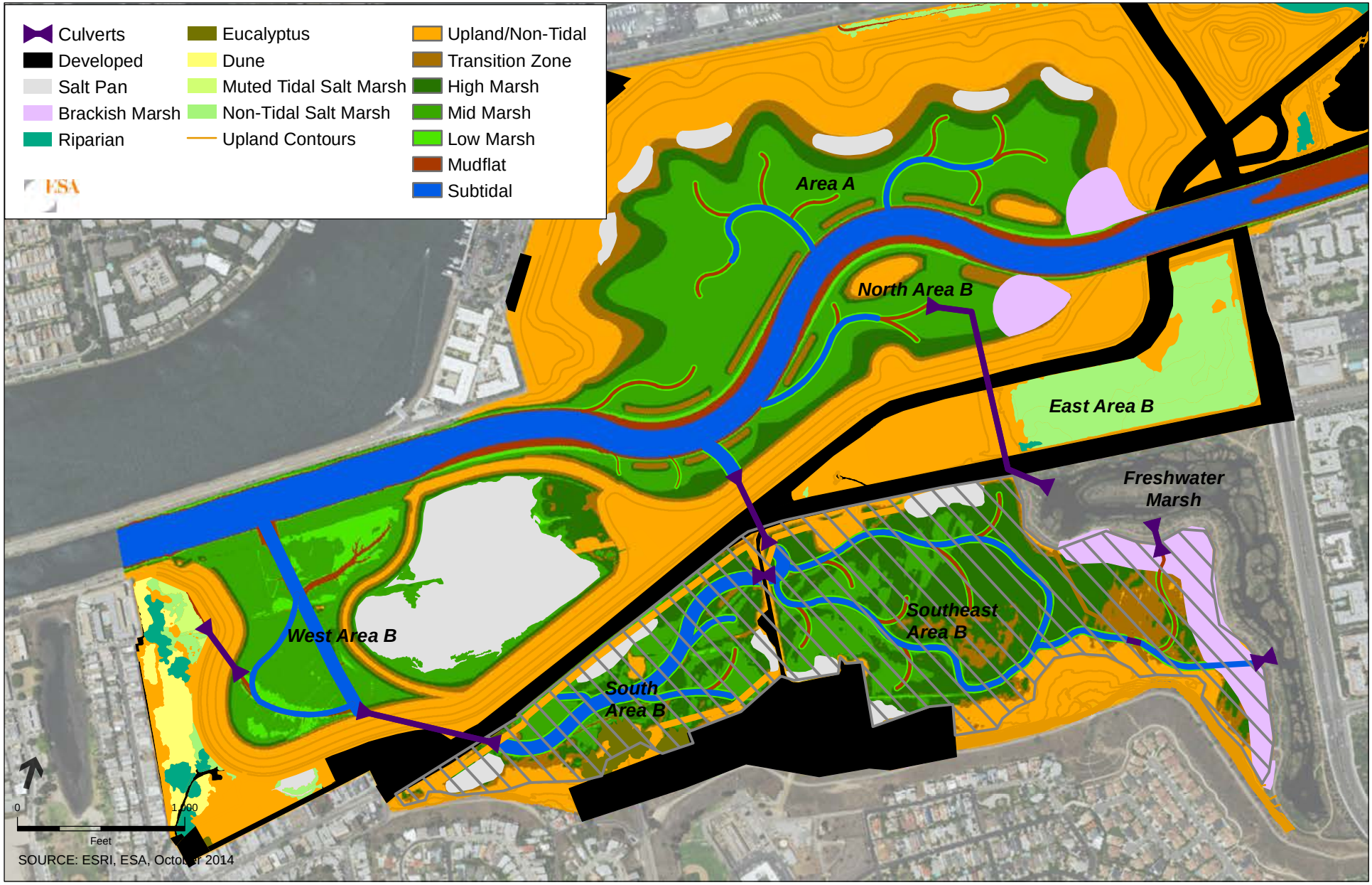
Ballona Wetlands. D120367

Figure 2
Area B
Existing Pickleweed Elevations



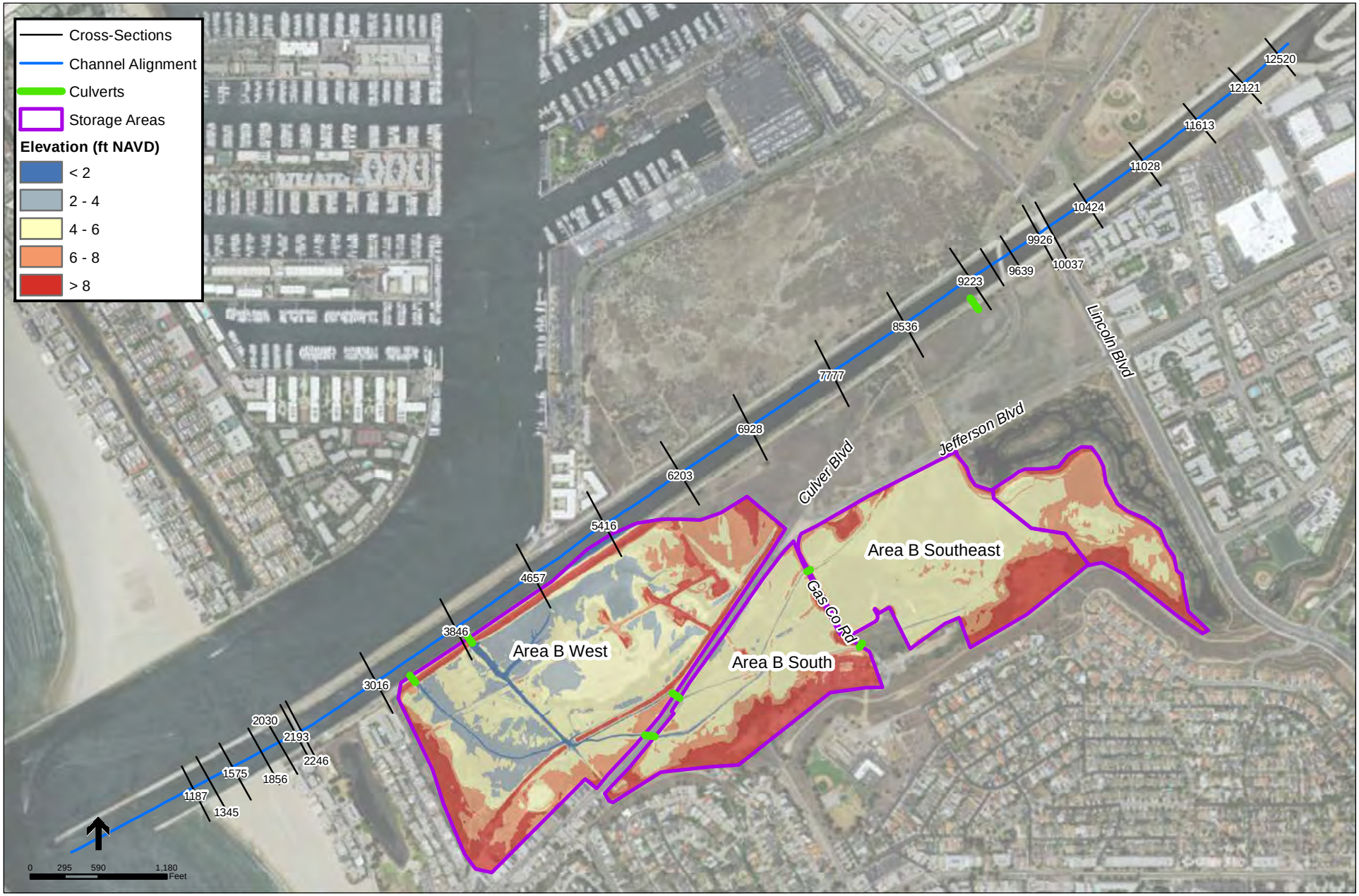
Ballona Wetlands Restoration Project

Figure 3
Alternative 1, Phase 1 Restoration



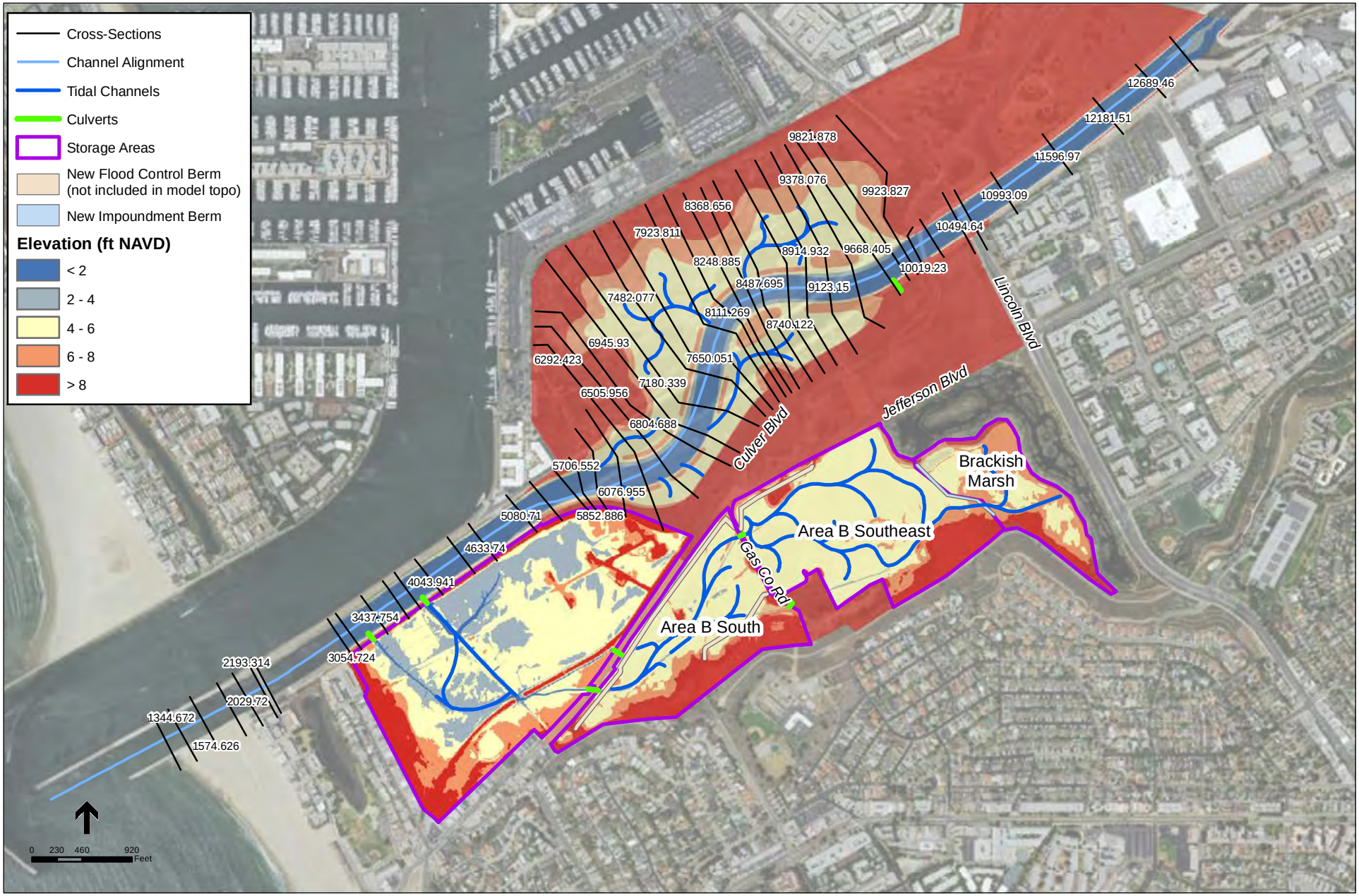
Ballona Wetlands Restoration Project

Figure 4
Alternative 1, Phase 2 Restoration



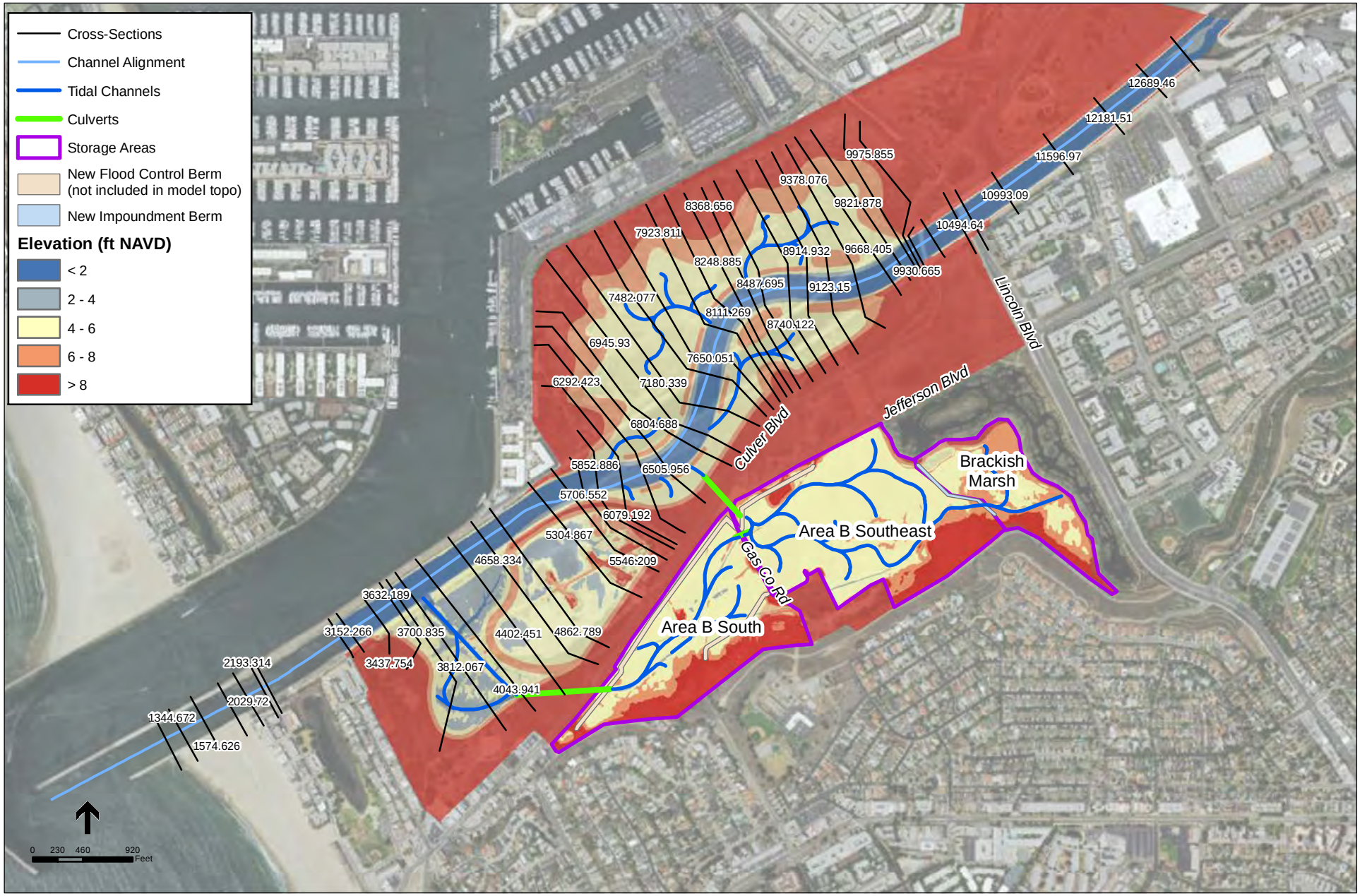
Ballona Wetlands Restoration Project

Figure 5
Existing Conditions Model



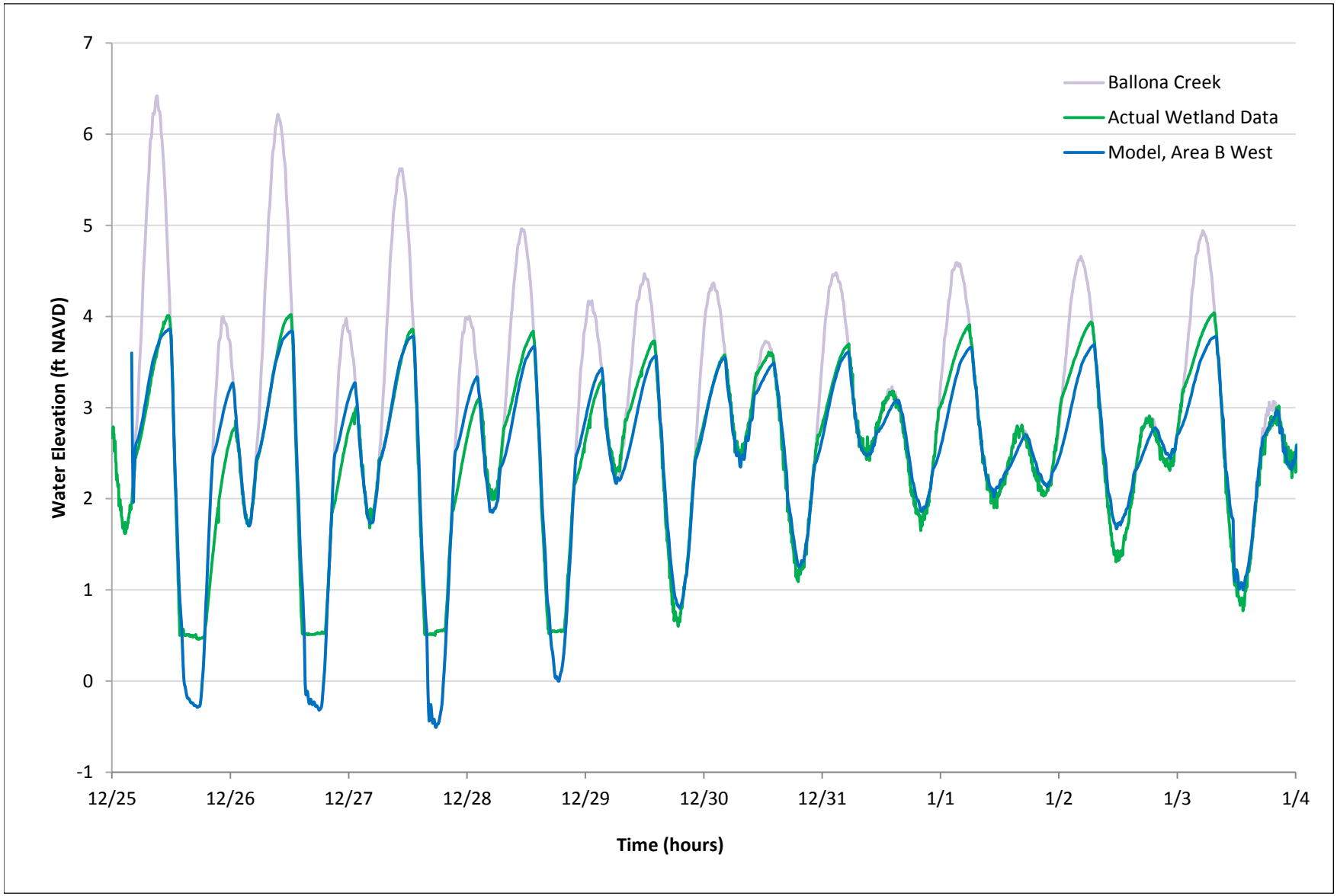
Ballona Wetlands Restoration Project

Figure 6
Alternative 1, Phase 1,
Project Conditions Model



Ballona Wetlands Restoration Project

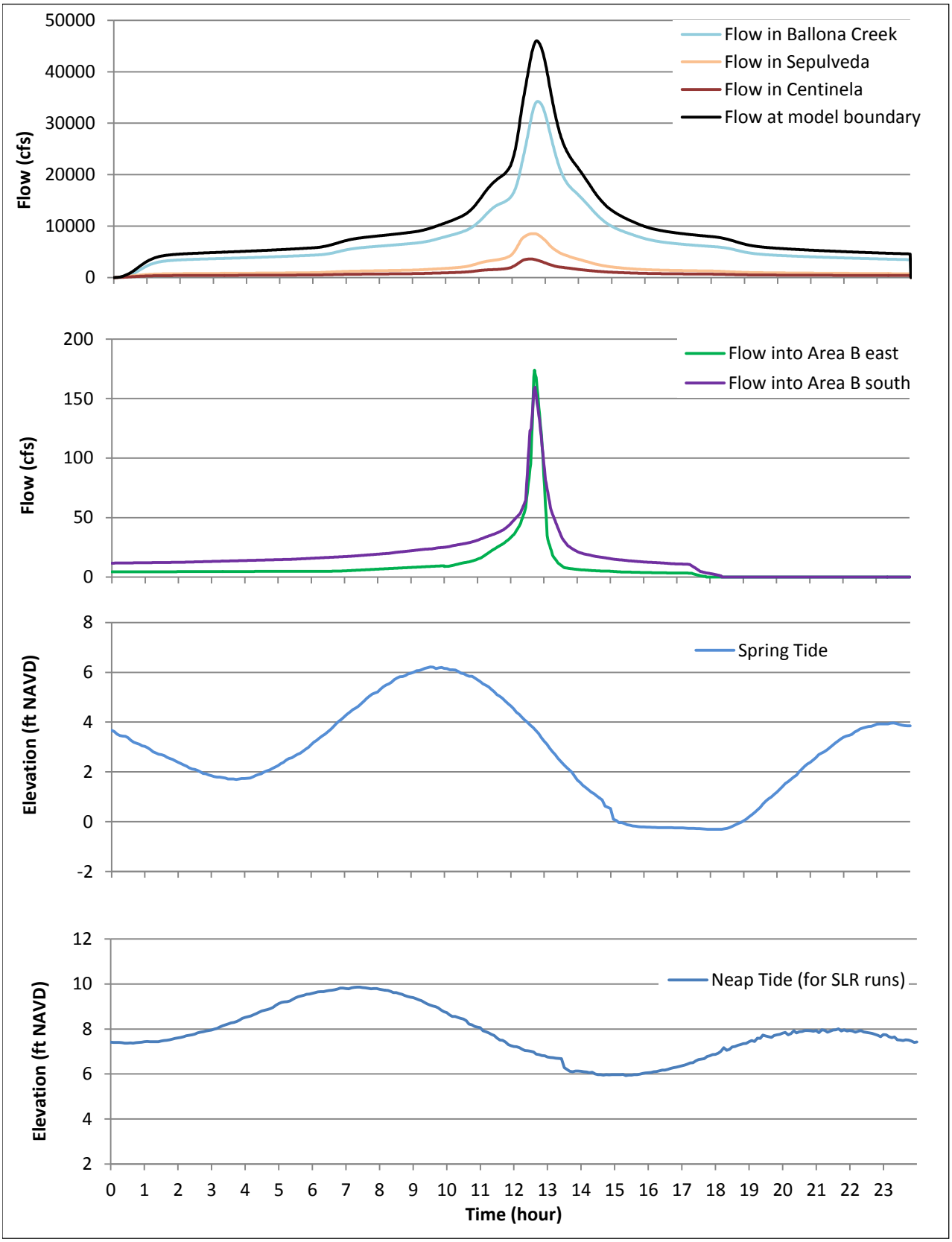
Figure 7
Alternative 1, Phase 2,
Project Conditions Model



Ballona Wetlands. D120367

Note: Ballona Creek water levels taken just outside Area B

Figure 8
Area B
SRT Gates Calibration



Ballona Wetlands Restoration Project

Figure 9
Model Hydrographs and Tidal Signals

SOURCE: Channel hydrographs from USACE HMS model; Area B hydrographs from PSOMAS 2012; Tide data from NOAA at the Santa Monica gage.
NOTES: Channel hydrographs represent the design flood event; Storage area hydrographs represent the Q100.

Low Tide

Spring High Tide

Existing Conditions

Alternative 1, Phase 1

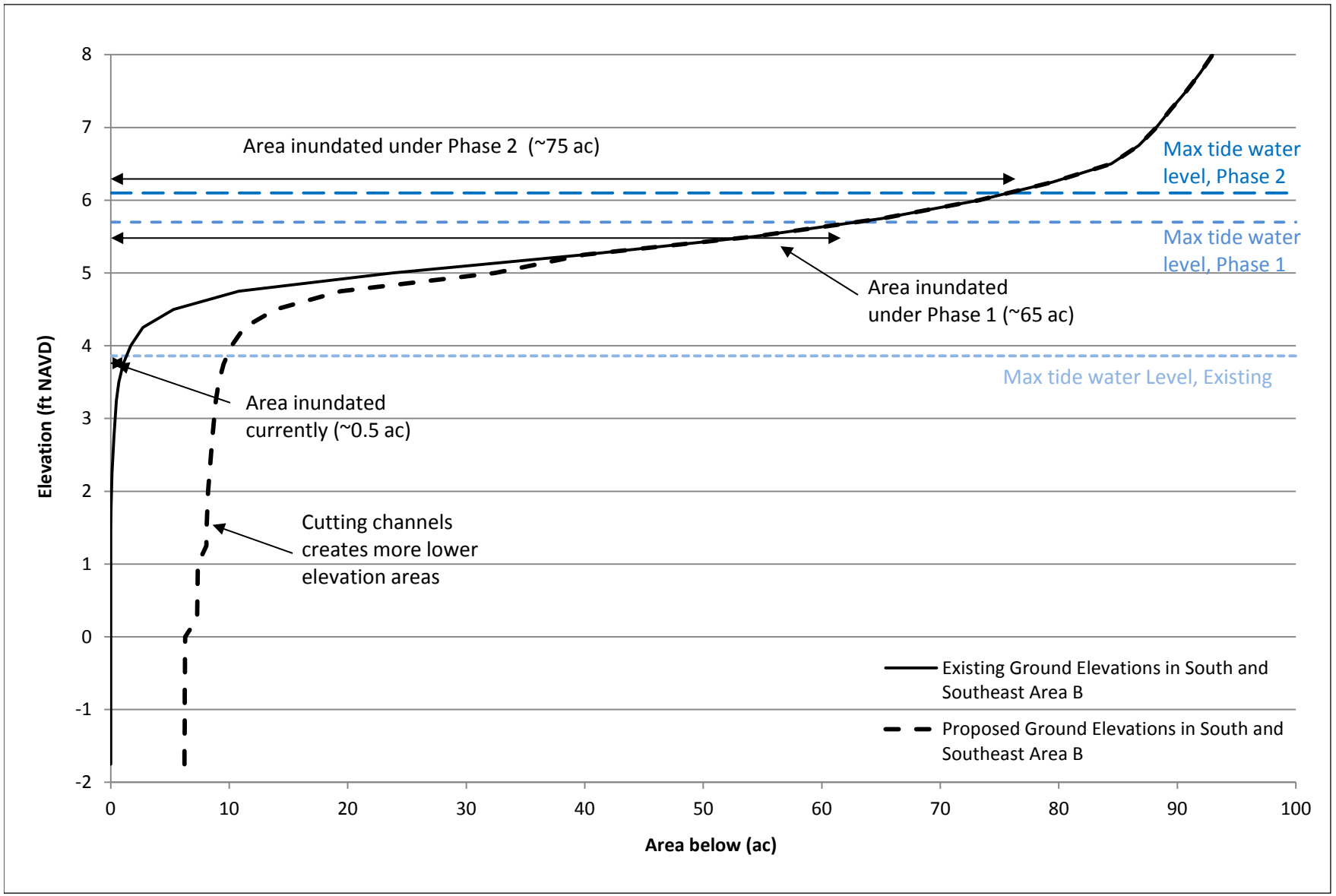
Alternative 1, Phase 2

Upland/Non-Tidal
Transition Zone
High Marsh
Mid Marsh
Low Marsh
Mudflat
Subtidal
Developed
Salt Pan
Non-Tidal Wetland
Muted Tidal Marsh

Spring High Tide

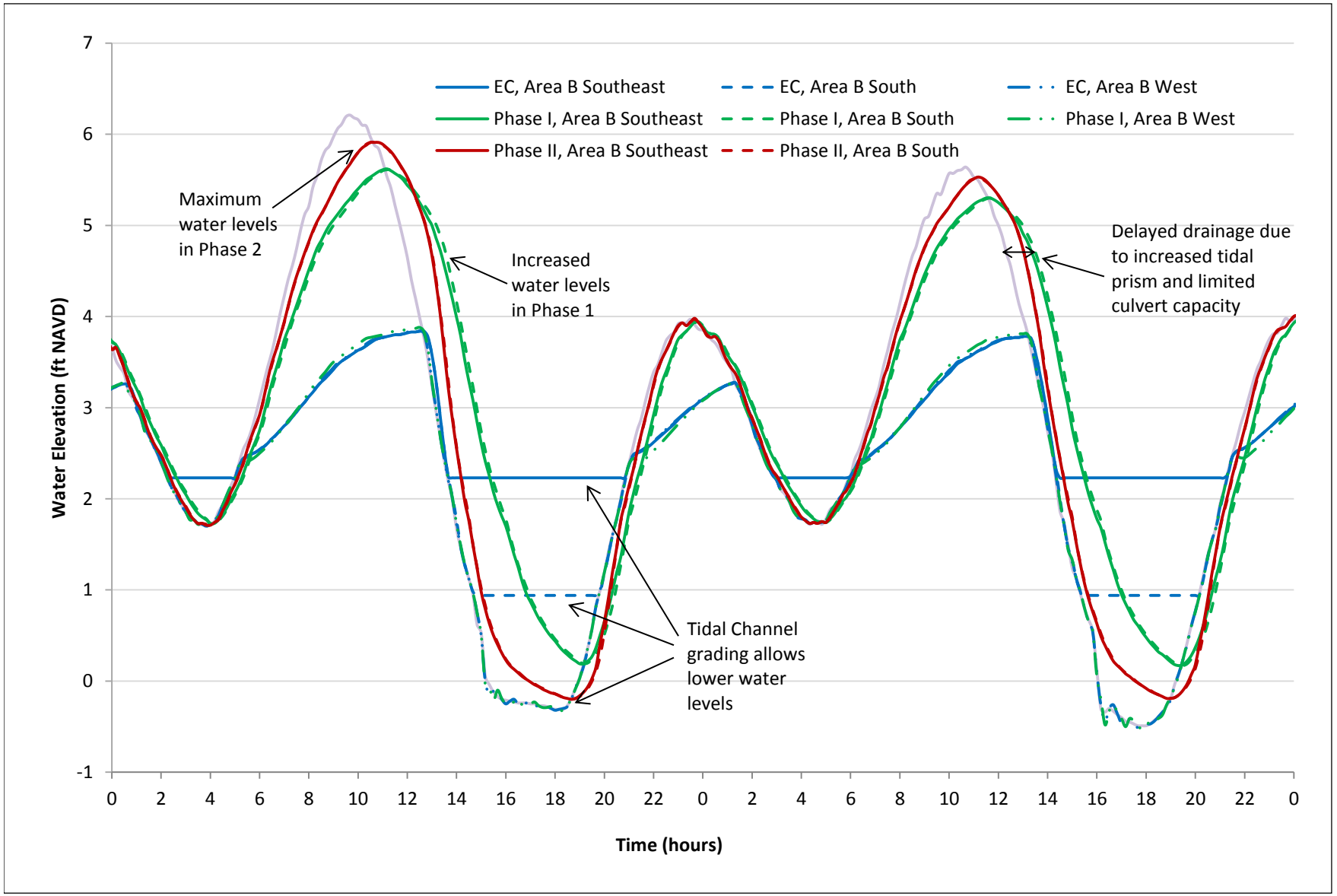
Ballona Wetlands Restoration Project

Figure 10
Increased Inundation Under Alternative 1, Plan View



Ballona Wetlands Restoration Project

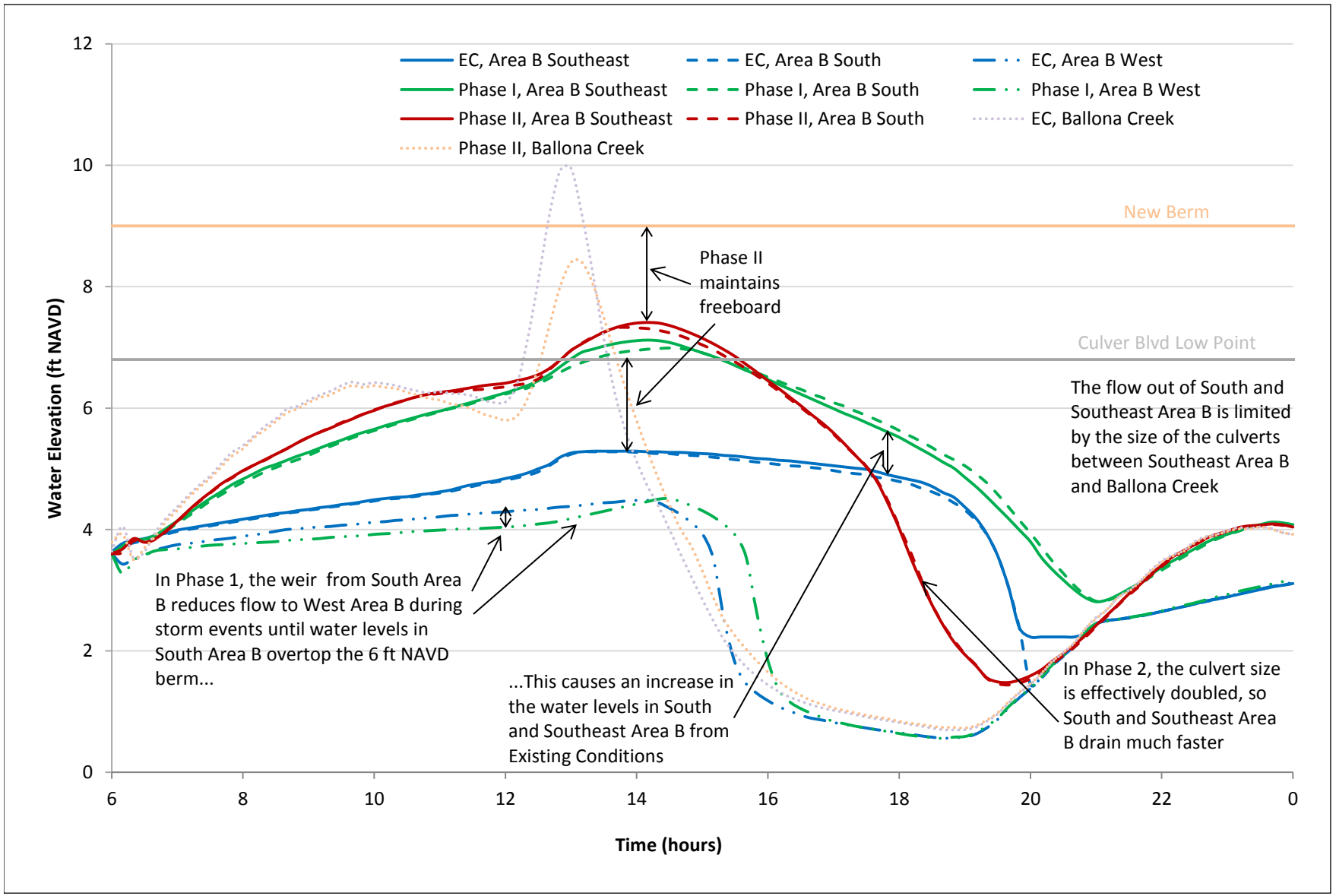
Figure 11
Increased Inundation Under Alternative 1, by Elevation



Ballona Wetlands Restoration Project

Figure 12
Typical Tides Model Results

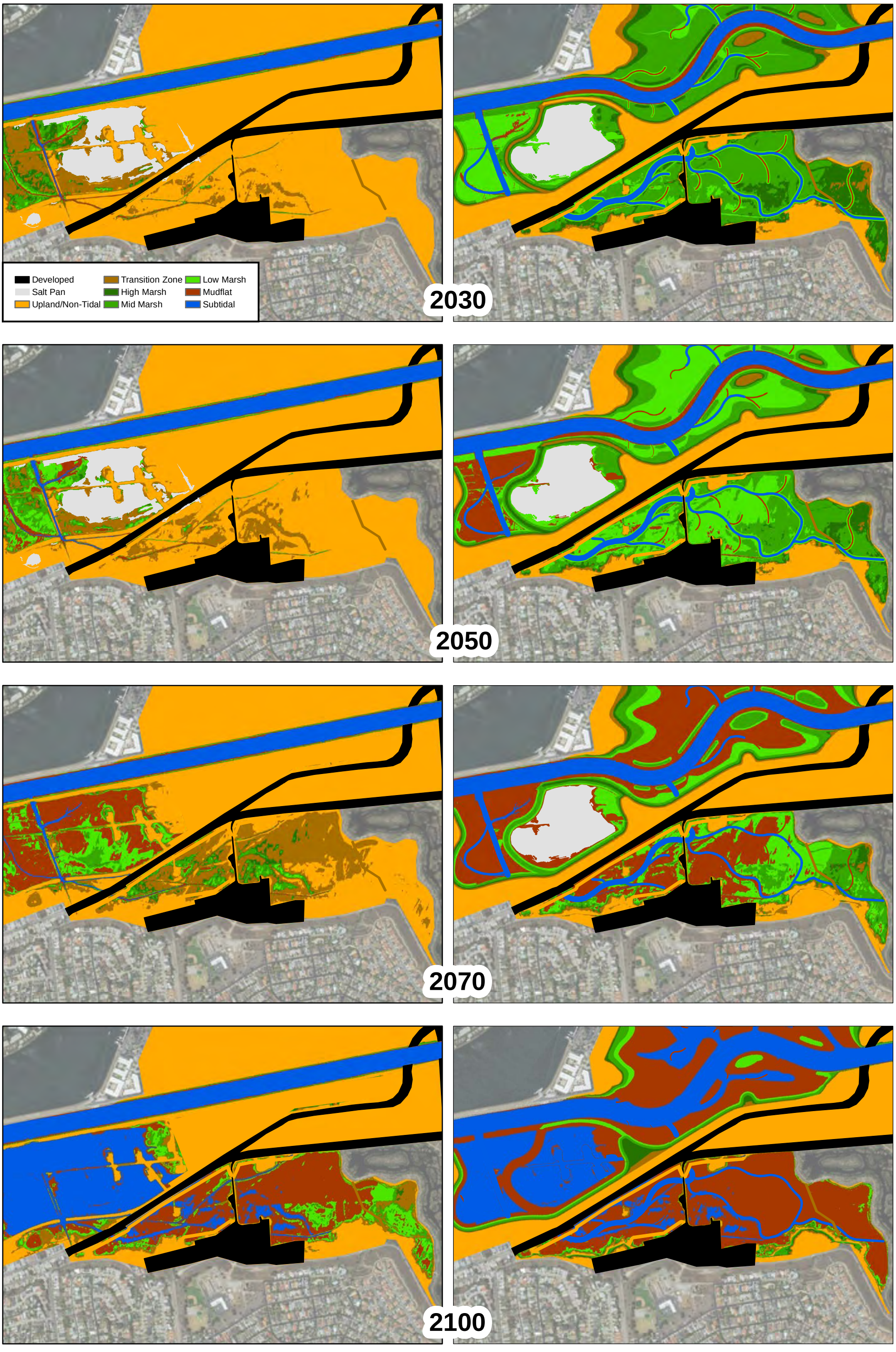
Note: Ballona Creek water levels taken just outside Area B



Ballona Wetlands Restoration Project

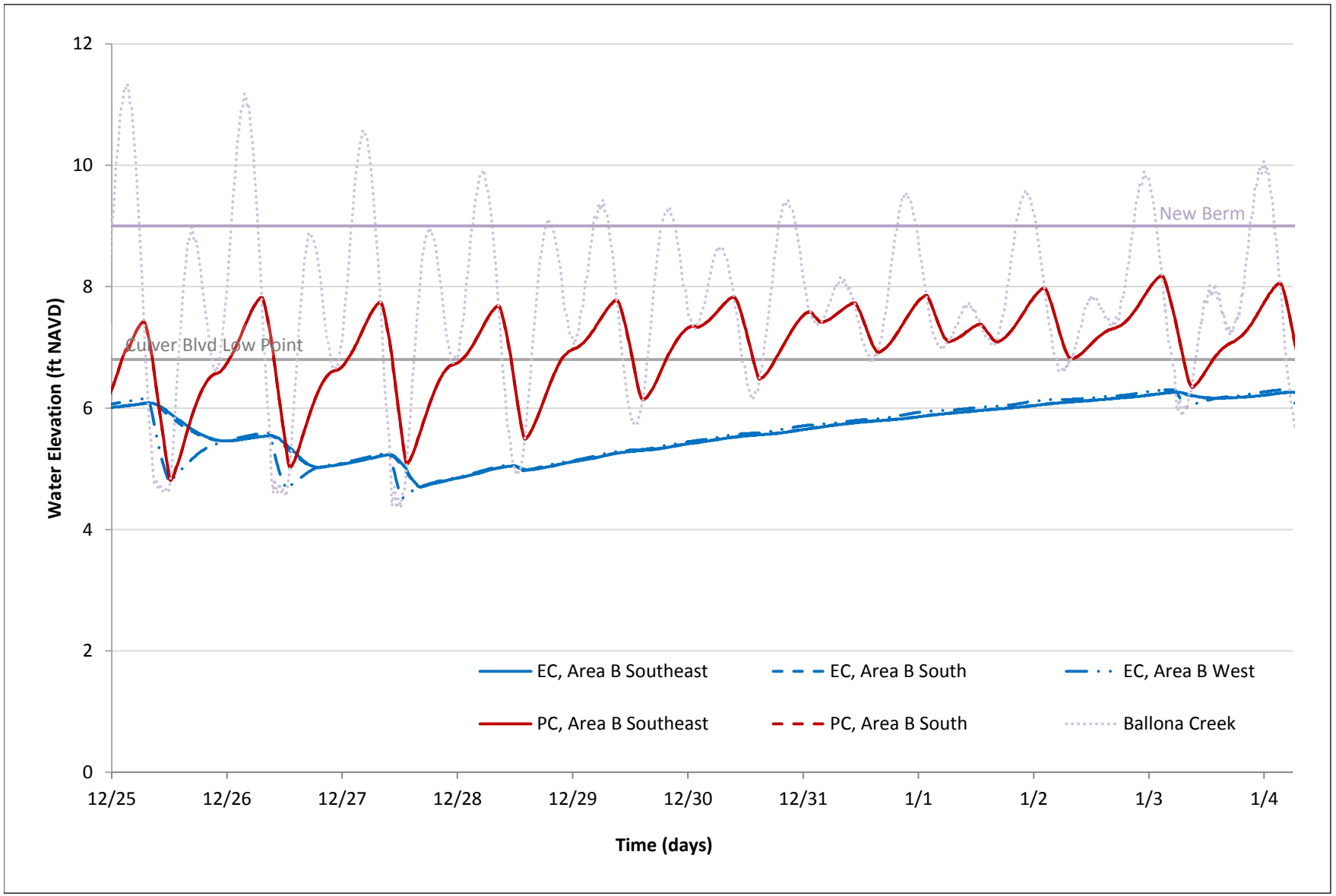
Figure 13
Design Flood Model Results

Note: Ballona Creek water levels taken just outside Area B



Ballona Wetlands Restoration Project

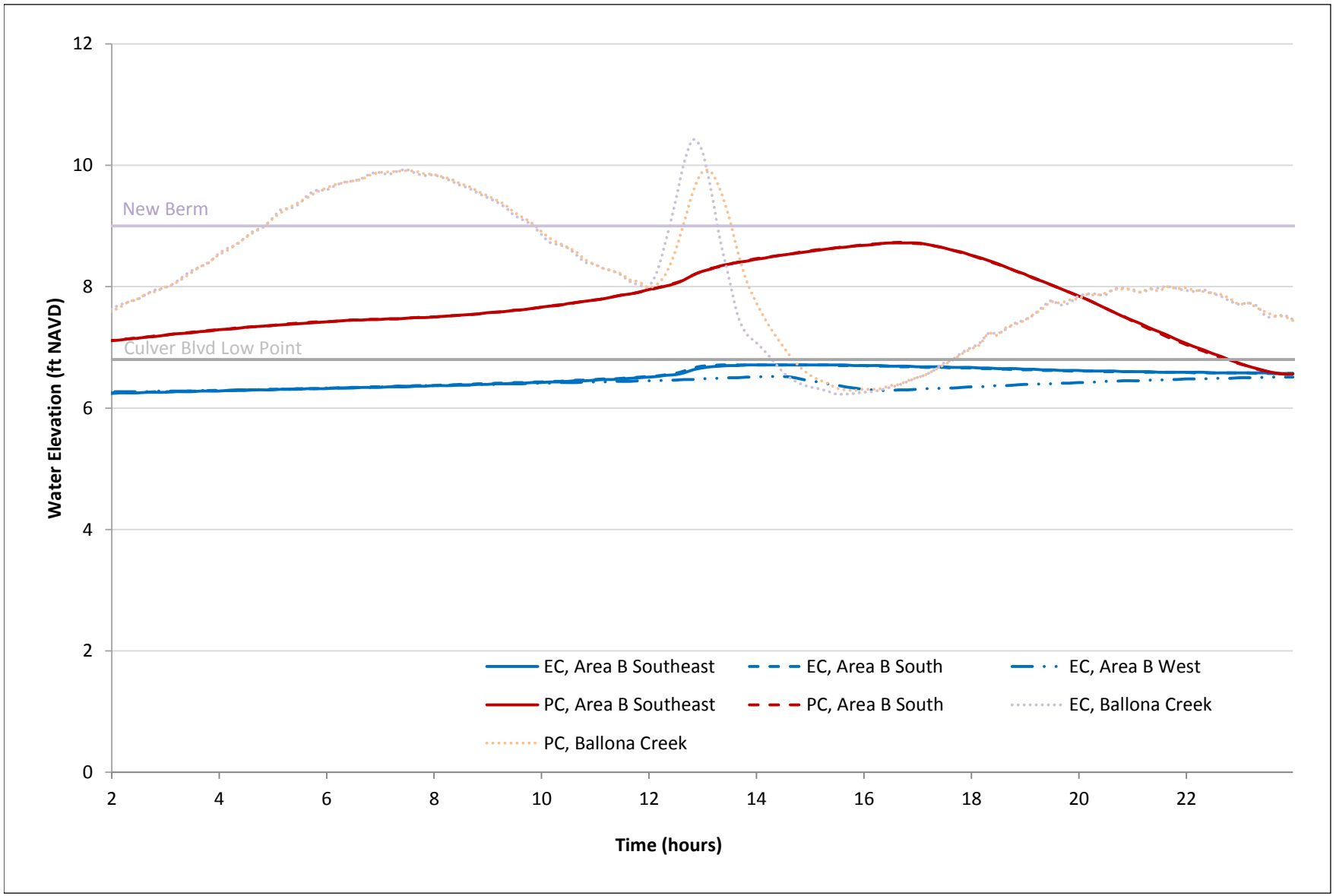
Figure 14
Inundation Under Existing Conditions and Alternative 1 with Sea Level Rise



Ballona Wetlands Restoration Project

Figure 15
Typical Tides with Sea Level Rise Model Results

Note: Ballona Creek water levels taken just outside Area B



Ballona Wetlands Restoration Project

Figure 16
Design Flood with Sea Level Rise Model Results

Note: Ballona Creek water levels taken just outside Area B.

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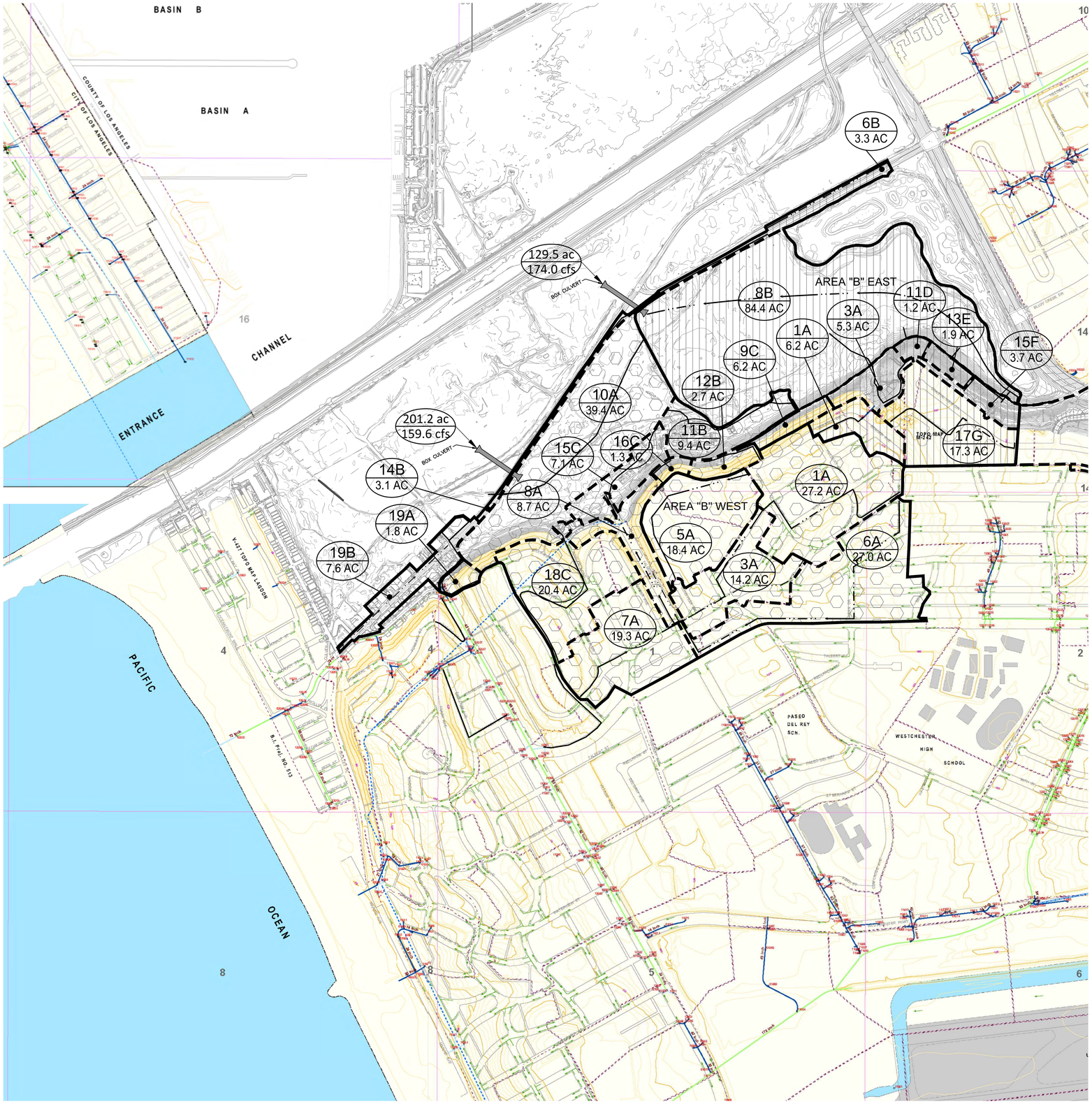
Appendix E
Local Drainage Hydrology

APPENDIX - HYDROLOGY	
Drawing Number	**Exhibit/Report Title**
BR003	Area B Existing and Proposed Hydrology
BR004	Area C Existing Hydrology
BR020	Area D Existing Hydrology
BR022	Area C Proposed Hydrology
BR047	Local Drainage Description



LEGEND

DRAINAGE AREA BOUNDARY	
DRAINAGE SUB-AREA BOUNDARY	
DRAINAGE FLOW PATH	
SUB-AREA DESIGNATION AND ACREAGE	7 / 10.3 AC
STORM FREQUENCY:	100-YR
SOIL TYPE:	010 & 017
AREA "B" WEST	
AREA "B" EAST	

400' 200' 0' 400' 800'
GRAPHIC SCALE
Note: For reduced sized prints, original scale is in inches

B1-1349

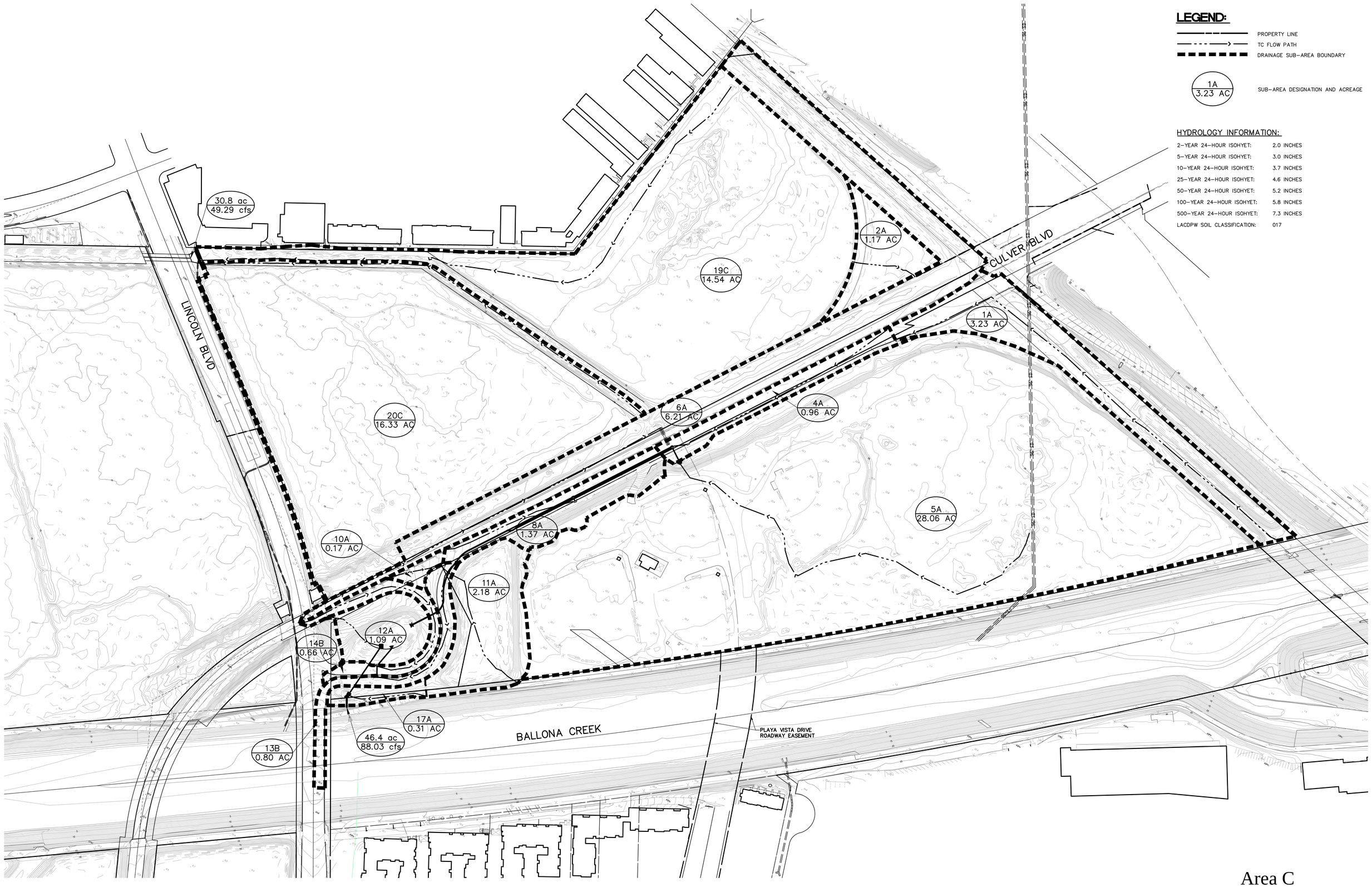
CALIFORNIA COASTAL CONSERVANCY

Area B
Existing & Proposed Conditions Exhibit

PSOMAS

DATE: 10-11-2012 REVISED ON: 03-21-13
JOB No: 1CCC010100

SHEET 1 OF 2
BR003.dwg



LEGEND:

PROPERTY LINE

TC FLOW PATH

DRAINAGE SUB-AREA BOUNDARY

1A
3.23 AC
SUB-AREA DESIGNATION AND ACREAGE

HYDROLOGY INFORMATION:

2-YEAR 24-HOUR ISOHYET:	2.0 INCHES
5-YEAR 24-HOUR ISOHYET:	3.0 INCHES
10-YEAR 24-HOUR ISOHYET:	3.7 INCHES
25-YEAR 24-HOUR ISOHYET:	4.6 INCHES
50-YEAR 24-HOUR ISOHYET:	5.2 INCHES
100-YEAR 24-HOUR ISOHYET:	5.8 INCHES
500-YEAR 24-HOUR ISOHYET:	7.3 INCHES
LACDPW SOIL CLASSIFICATION:	017

CALIFORNIA COASTAL CONSERVANCY

100' 50' 0' 100' 200'
GRAPHIC SCALE
Note: For reduced sized prints, original scale is in inches

B1-1350

Area C
Existing Hydrology
Exhibit

PSOMAS

DATE: 05-21-2012 REVISED ON: 10-16-12
JOB No:1CCC010100

SHEET 1 OF 1
BR004

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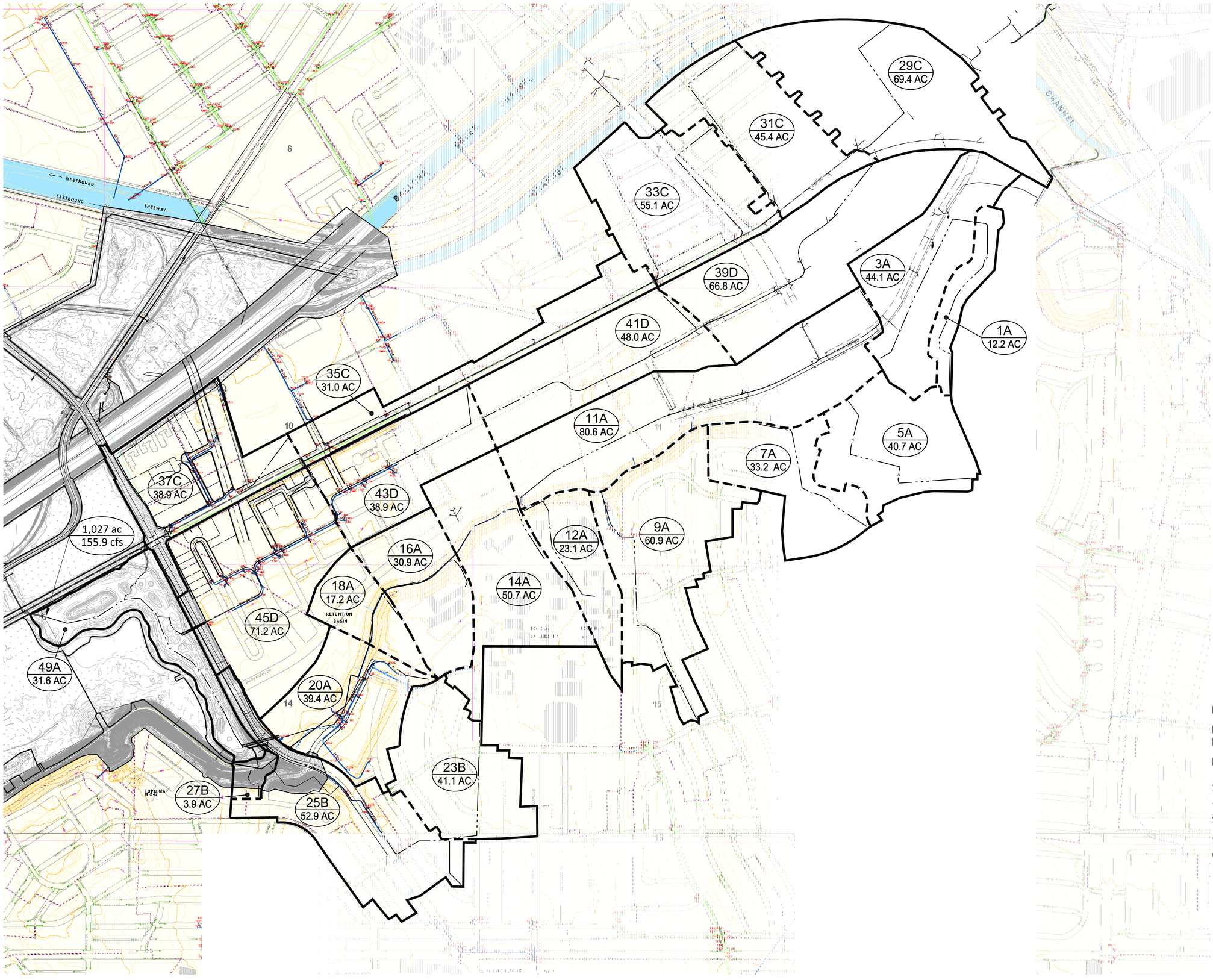

LEGEND

DRAINAGE AREA BOUNDARY

DRAINAGE SUB-AREA BOUNDARY

DRAINAGE FLOW PATH

SUB-AREA DESIGNATION AND ACREAGE — 1A / 12.2 AC

STORM FREQUENCY: 100-YEAR

SOIL TYPES: 10 & 17
(ALL CALCULATIONS ARE BASED ON SOIL TYPE 17)

Area D
Existing Conditions Exhibit

PSOMAS

DATE: 10-30-2012 REVISED ON:
JOB No: 1CCC010100

SHEET 1 OF 1

CALIFORNIA COASTAL CONSERVANCY

400' 200' 0' 400' 800'
GRAPHIC SCALE
Note: For reduced sized prints, original scale is in inches

B1-1351

BR020.dwg

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LEGEND:

PROPERTY LINE

TC FLOW PATH

DRAINAGE SUB-AREA BOUNDARY

1A
3.46 AC

SUB-AREA DESIGNATION AND ACREAGE

HYDROLOGY INFORMATION:

2-YEAR 24-HOUR ISOHYET:	2.0 INCHES
5-YEAR 24-HOUR ISOHYET:	3.0 INCHES
10-YEAR 24-HOUR ISOHYET:	3.7 INCHES
25-YEAR 24-HOUR ISOHYET:	4.6 INCHES
50-YEAR 24-HOUR ISOHYET:	5.2 INCHES
100-YEAR 24-HOUR ISOHYET:	5.8 INCHES
500-YEAR 24-HOUR ISOHYET:	7.3 INCHES
LACDPW SOIL CLASSIFICATION:	017

36.66 ac
58.22 cfs

16C
36.66 AC

1A
3.46 AC

3A
1.58 AC

6A
1.26 AC

4A
30.69 AC

8A
0.28 AC

9A
1.09 AC

11B
0.78 AC

14A
0.73 AC

40.5 ac
67.50 cfs

10B
0.52 AC

SD

PLAYA VISTA DRIVE
ROADWAY EASEMENT

CALIFORNIA COASTAL CONSERVANCY

100' 50' 0' 100' 200'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

B1-1352

Area C
Proposed Hydrology
Exhibit

PSOMAS

DATE: 10-16-2012 REVISED ON:
JOB No:1CCC010100

SHEET 1 OF 1

BR022

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Local Drainage Description

Development of the Ballona Wetlands will impact local drainage facilities that have watersheds tributary to the planned development area. North of the Ballona Channel, local drainage systems and related watersheds are located with Area C that will receive fill materials from Area A. South of Ballona Channel, local drainage systems in Area B will be impacted by the wetland construction and disposal of fill materials.

Design of new drainage facilities in Area C and Area B will require preparation and approval of hydrology reports to define the design flow rates and volumes to be managed through new drainage facilities. Copies of the Tc calculator spreadsheet (A publically available publication from the County of Los Angeles) and the WMS (Watershed Modeling System, version 8.3, by Aquaveo, LLC) hydrology models runs in the existing and proposed conditions are provided for each area. These two programs are used for determining storm water flow rates and volumes per the County of Los Angeles methodology. The 100-year storm event was modeled for each area as our largest storm event for design purposes, as well as the 1-year storm event for the FWM basin capacity. The analysis for each area is discussed below:

Area C

The planned watersheds within Area C will remain similar to current conditions. The watershed area is generally bounded by the project area which is defined by the Marina Freeway at the eastern boundary, existing development on the northern boundary, Lincoln Boulevard to the west, and the Ballona Channel to the south. Existing drainage is generally conveyed to one of two outlet points. The drainage is conveyed toward Culver Boulevard where it is then conveyed either south-west through a series of public storm drains and then outlet into the Ballona Channel or to the north-west corner of the site to a public storm drain. In typical storm events the flow going to the north-west portion of the site is conveyed in a drain within the Lincoln Boulevard right-of-way outletting into the Ballona Creek. In high flow events, overtopping of an existing culvert-weir structure under Lincoln Boulevard occurs, draining into a tidally controlled ditch outletting into Marina del Rey.

The design and placement of fill material will be designed so that existing sub-area drainage patterns will generally be preserved to avoid drainage diversion between areas. Drainage improvements, including pipe and open channel systems, will be designed into the fill placement grading to convey storm water flows to the existing watershed outlet locations. A storm drain pipe will be installed to replace the open ditch across north Area C.

Our preliminary hydrology per the included Tc Calculator and WMS model run indicates that our 100-year storm event has a final routed outfall flow rate of approximately 58 cfs at the Lincoln Blvd outlet and approximately 68 cfs outlet directly into the Ballona Channel. Final hydrology analysis and hydraulic design of drainage facilities will be prepared in accordance with County of Los Angeles and City of Los Angeles standards and policies. Since the Ballona Wetlands project does not propose any hard surface development of lands within Area C, Water Quality and Low Impact Development (LID) basins are not expected to be required.

Development of a visitors or community center will have some, but limited effect on the drainage concept.

Area B

The existing and planned watersheds for Area B will remain similar to the current conditions, however construction of the expanded wetlands and fill placement will impact several drain facilities. The watersheds to these existing drainage systems are significantly larger than Area C and can be broken into three primary watersheds:

- The Playa Vista Development area (Area D) that contributes storm flows through the Jefferson Boulevard Drain, Lincoln Boulevard drains, and the Riparian Corridor / Freshwater Marsh system. Flows from this system are initially stored within the confines of the Freshwater Marsh basin up to the 1-year storm event, then conveyed directly to the Ballona Creek with over-flow of a relief weir into the Brackish Marsh area of eastern Area B.
- The Westchester Bluffs area located south of Area B that contributes flows directly to Area B and to Culver Boulevard west of the junction with Jefferson Boulevard. This watershed is split between the flows outletting into southeast Area B and Southwest Area B, generally delineated by the existing Gas Company road leading from Culver Boulevard to The Gas Company facilities.

The Freshwater Marsh / Riparian Wetlands watershed is indicated on the exhibit and encompasses just over 1,000 acres upstream to the east of Area B. A 1-year storm flow of approximately 156 cfs is calculated with a total storm volume of approximately 80 acre-feet. The design of the Freshwater Marsh is to retain the 1-year storm volume during the average 24-hour storm. The volume contained is determined by the expected duration that the flap gates to the Ballona Creek are closed. The capacity of the Freshwater Marsh is approximately 64 acre-feet measured from an elevation of 4.4 where the water surface is kept during the rainy season months, and 6.9 which is the lowest setting of the overflow weir to the Brackish Marsh. Due to the duration of the storm occurring over two full tidal cycles, the actual storage capacity required is approximately 73.4% of the overall storm volume which is the volume produced during the 12-hour period between tides encompassing the highest volume under the storm hydrograph. 80 x 0.734 = 59 acre-feet which is within the 64 acre-feet available.

A 100-year storm event for the Freshwater Marsh system produces a peak flow rate of approximately 902 cfs and a total storm volume of 318 acre-feet. The 100-year event is reviewed as the criteria for the 408 permit process. The portion of the volume that must be contained south of Culver Boulevard for full tidal action is 318 x 0.734 = 233 acre-feet. The 100-year flow rate and volume for Southwest Area B is 160 cfs and 39.5 acre-feet respectively. This hydrograph has a ratio of volume during its peak 12-hour period of 70.8%. So the volume to contain is 39.5 x 0.708 = 28 acre-feet. The 100-year flow rate and volume for Southeast Area B is 174 cfs and 18.3 acre-feet respectively. This hydrograph has a ratio of volume to its peak 12-hour period of 80.5%. So its containment volume is 18.3 x 0.805 = 15 acre-feet. So the combined volume that must be contained is approximately 276 acre-feet. The available volume capacity without overtopping the existing low point on Culver Boulevard is measured from existing ground level to elevation 6.8. This capacity is approximately 187 acre-feet. Therefore, a berm along

Culver Boulevard must be provided to increase this volume to a minimum of 276 acre-feet. The berm height to accommodate this is approximately one foot plus freeboard.

We also evaluated the hydrology conditions at the very southwesterly corner of Area B to address a localized flooding problem at the intersection of Culver and Nicholson. Per a previous Psomas hydrology report from 1990, the Pershing Drain collects the drainage from the Playa del Rey area south of Culver and routes it toward the ocean in Nicholson, Pershing, and Culver Boulevard. This pipe is undersized and contains an overflow drain that occasionally discharges to the intersection of Culver and Nicholson. The flow rate is not critical to our design, but the volume of overflow of approximately1.8 acre-feet must be addressed since currently it is confined to the street and development areas. We propose to create a detention area behind the businesses to contain this volume. If the maximum depth allowed would be approximately 24", the footprint would be approximately 100' wide by 400' long.

At the existing residential and commercial development area north of Culver Boulevard at Pershing Drive, the Wetlands project will construct a new paved fire access road. The detention area can also be considered a stormwater pretreatment BMP for the pavement runoff design to minimize discharge of pollutants to the main wetlands.

Hydrology analysis and hydraulic design of drainage facilities will be prepared in accordance with County of Los Angeles and City of Los Angeles standards and policies. Since the Ballona Wetlands project does not propose any hard surface development of lands within Area B, Water Quality and Low Impact Development (LID) basins are not expected to be required to treat flows generated from the project areas. Localized water quality measures will be required along the planned levee maintenance roads and paved bike paths.

A large area of the watershed from the Bluffs area is directly tributary to Area B. Most likely, the storm flows from these areas do not currently receive any water quality treatment through normal BMPs. The hydrology analysis will evaluate the storm flow rates and/or volumes that would normally be treated. The Ballona Wetlands project does not propose to provide specific water quality pre-treatment BMPs to treat this runoff since this is an existing condition and not part of a new development that would be obligated to provide treatment control BMPs. And the Wetlands itself is considered a BMP in and of itself.

Storm water flow rates derived for the hydrology analysis will be used for hydraulic design of culverts under Culver Boulevard and Jefferson Boulevard as well as storm drain extensions and outlet structures through the new wetland levee system.

BALLONA CREEK AREA C - Proposed Hydrology Calculations

100-Year TC Calculator Results - Proposed Condition

Subarea	Area (acres)	% imp	Frequency	Soil Type	Length (ft)	Slope (ft/ft)	Isohyet (in.)	Tc-calc. (min.)	Intensity (in./hr)	Cu	Cd	Flowrate (cfs)
1A	3.46	0.2	100	17	1406	0.007	5.8	15	2.06	0.85	0.86	6.13
3A	1.58	0.9	100	17	670	0.002	5.8	11	2.39	0.87	0.9	3.4
4A	30.69	0.2	100	17	1743	0.007	5.8	17	1.95	0.84	0.85	50.87
6A	1.26	0.9	100	17	557	0.018	5.8	7	2.95	0.89	0.9	3.35
8A	0.28	0.9	100	17	175	0.043	5.8	5	3.46	0.91	0.9	0.87
9A	1.09	0.1	100	17	173	0.16	5.8	5	3.46	0.91	0.9	3.39
10B	0.52	0.9	100	17	439	0.022	5.8	6	3.18	0.9	0.9	1.49
11B	0.78	0.9	100	17	735	0.025	5.8	8	2.77	0.88	0.9	1.94
14A	0.73	0.2	100	17	472	0.033	5.8	6	3.18	0.9	0.9	2.09
16C	36.66	0.1	100	17	1500	0.003	5.8	18	1.9	0.83	0.84	58.51

AREA C PROPOSED

AREA C PROPOSED

File name: W:\1CCC010100\ENGR\DESIGN\HYDR\CALCS\100-YR STORM\WMS\PROPOSED\Area C\PrAreaC.lac Run date: Tue Oct 16 11:53:34 2(

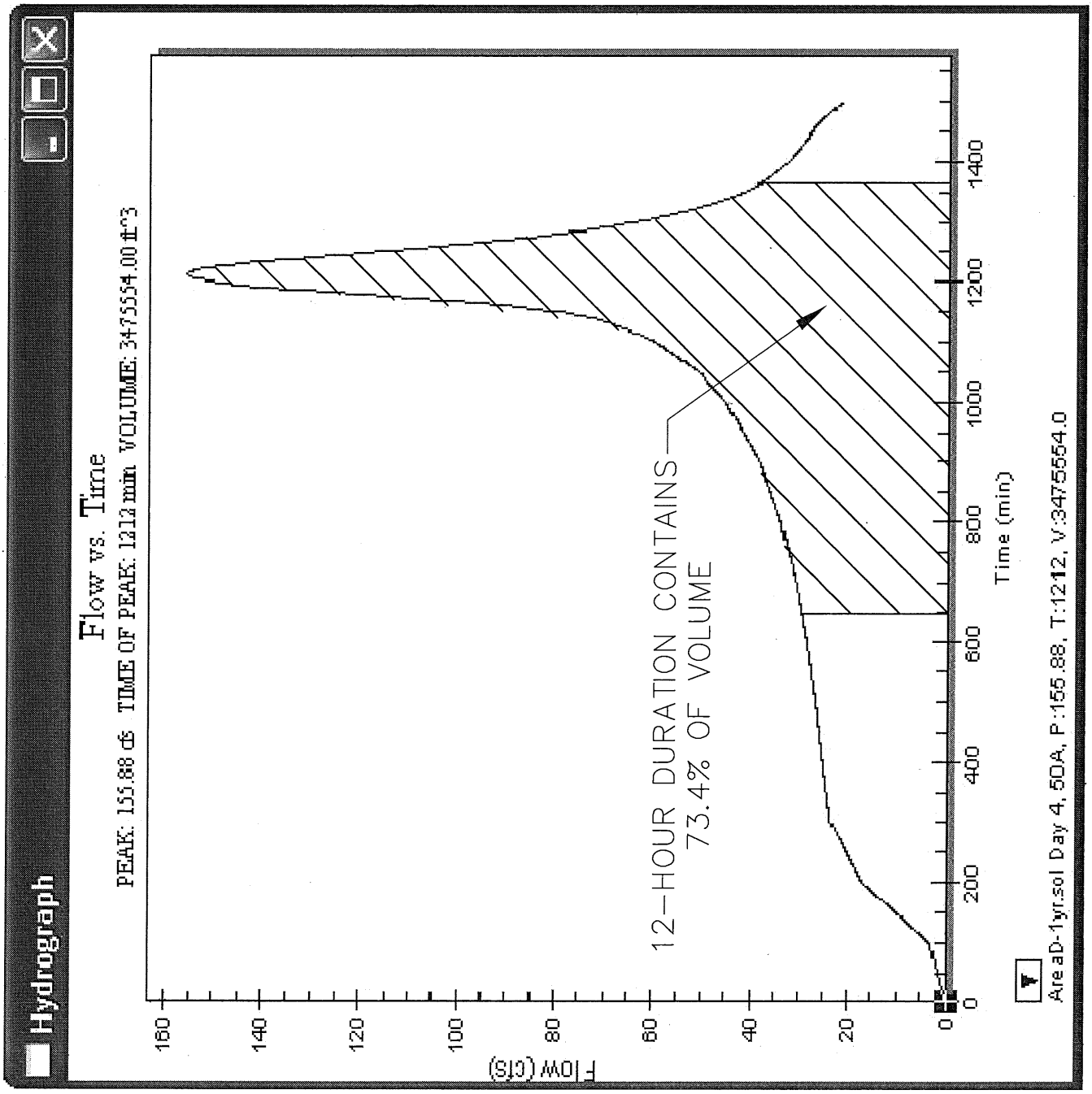
Los Angeles County Flood Control District
Modified Rational Method Hydrology

Storm Day 4 Storm Frequency 1

LOCATION		SUBAREA AREA	SUBAREA Q	TOTAL AREA	TOTAL Q	TOTAL VOLUME	CONV TYPE	CONV LNGTH	CONV SLOPE	CONV SIZE	CONV Z	CONTROL Q	SOIL NAME	TC	RAIN	PCT IMPV
1	1A	3.5	6.19	3.5	6.19	0.639	0	0	0.00000	0.00	0.00	0	17	15	5.80	0.20
1	2A	0.0	0.00	3.5	6.19	0.638	3	671	0.00400	64-6	0.00	0	17	0	5.80	0.00
1	3A	1.6	3.43	5.1	5.84	1.277	0	0	0.00000	0.00	0.00	0	17	11	5.80	0.90
1	4A	30.7	50.69	35.8	56.13	6.874	0	0	0.00000	0.00	0.00	0	17	17	5.80	0.20
1	5A	0.0	0.00	35.8	56.13	6.874	4	323	0.00100	2.00	0.00	0	17	0	5.80	0.00
1	6A	1.3	3.44	37.1	59.47	7.394	0	0	0.00000	0.00	0.00	0	17	7	5.80	0.90
1	7A	0.0	0.00	37.1	59.47	7.393	4	433	0.00100	3.00	0.00	0	17	0	5.80	0.00
1	8A	0.3	0.93	37.4	60.28	7.513	0	0	0.00000	0.00	0.00	0	17	5	5.80	0.90
1	9A	1.1	3.14	38.5	63.24	7.680	0	0	0.00000	0.00	0.00	0	17	6	5.80	0.10
1	9A	0.0	0.00	38.5	63.24	7.677	4	204	0.00100	3.00	0.00	0	17	0	5.80	0.00
1	10B	0.5	1.24	0.5	1.24	0.200	0	0	0.00000	0.00	0.00	0	17	8	5.80	0.90
1	11B	0.8	2.49	1.3	3.73	0.520	0	0	0.00000	0.00	0.00	0	17	5	5.80	0.90
1	12B	0.0	0.00	1.3	3.73	0.519	4	62	0.00600	2.00	0.00	0	17	0	5.80	0.00
1	13AB	1.3	3.68	39.8	65.86	8.197	4	167	0.00110	2.00	0.00	0	17	0	5.80	0.00
1	14A	0.7	2.00	40.5	67.50	8.325	0	0	0.00000	0.00	0.00	0	17	6	5.80	0.20
1	15A	0.0	0.00	40.5	67.50	8.324	4	0	0.00100	5.00	0.00	0	17	0	5.80	0.00
1	16C	36.7	58.22	36.7	58.22	5.552	0	0	0.00000	0.00	0.00	0	17	18	5.80	0.10
1	17C	0.0	0.00	36.7	58.22	5.552	0	0	0.00100	0.00	0.00	0	17	0	5.80	0.00

Normal End of MODRAT

AREA D - 1 YEAR


Hydrograph
Flow vs. Time
PEAK: 155.88 cfs TIME OF PEAK: 1212 min VOLUME: 3475554.00 ft^3
Flow (cfs)
Time (min)
12-HOUR DURATION CONTAINS
73.4% OF VOLUME
Area D-1yr.sol Day 4, SDA, P:155.88, T:1212, V:3475554.0

BALLONA CREEK AREA D - Existing Hydrology Calculations

1-Year Tc Calculation Results - Existing Condition

Subarea	Area (acres)	%imp	Frequency	Soil Type	Length (ft)	Slope (ft/ft)	Isohyet (in.)	Tc-calculated (min.)	Intensity (in./hr)	Cu	Cd	Flow rate (cfs)	Volume (acre-ft)
1A	12.2	0.55	1	17	2,200	0.018	1.6	30	0.41	0.30	0.63	3.15	0.88
3A	44.1	0.42	1	17	1,965	0.051	1.6	30	0.41	0.30	0.55	9.94	2.61
5A	40.7	0.47	1	17	2,130	0.052	1.6	30	0.41	0.30	0.58	9.68	2.61
7A	33.2	0.47	1	17	1,812	0.057	1.6	30	0.41	0.30	0.58	7.89	2.13
9A	60.9	0.55	1	17	2,899	0.030	1.6	30	0.41	0.30	0.63	15.73	4.39
11A	80.6	0.60	1	17	4,764	0.001	1.6	30	0.41	0.30	0.66	21.81	6.22
12A	23.1	0.47	1	17	1,488	0.060	1.6	30	0.41	0.30	0.58	5.49	1.48
14A	50.7	0.53	1	17	1,134	0.066	1.6	26	0.44	0.36	0.65	14.50	3.53
16A	30.9	0.50	1	17	1,173	0.081	1.6	25	0.45	0.37	0.64	8.90	2.08
18A	17.2	0.57	1	17	847	0.106	1.6	18	0.52	0.48	0.72	6.44	1.30
20A	39.4	0.47	1	17	2,023	0.040	1.6	30	0.41	0.30	0.58	9.37	2.53
23B	41.1	0.61	1	17	1,607	0.003	1.6	30	0.41	0.30	0.67	11.28	3.22
25B	52.9	0.68	1	17	3,124	0.033	1.6	30	0.41	0.30	0.71	15.41	4.50
27B	3.9	0.27	1	17	578	0.200	1.6	14	0.59	0.52	0.62	1.43	0.18
29C	69.4	0.57	1	17	1,876	0.020	1.6	30	0.41	0.30	0.64	18.21	5.18
31C	45.4	0.57	1	17	2,372	0.019	1.6	30	0.41	0.30	0.64	11.91	3.39
33C	55.1	0.72	1	17	2,703	0.012	1.6	30	0.41	0.30	0.73	16.49	4.96
35C	31.0	0.91	1	17	4,432	0.001	1.6	30	0.41	0.30	0.85	10.80	3.39
37C	38.9	0.87	1	17	2,055	0.010	1.6	30	0.41	0.30	0.82	13.08	4.10
39D	66.8	0.86	1	17	2,765	0.005	1.6	30	0.41	0.30	0.82	22.46	6.97
41D	48.0	0.86	1	17	3,101	0.004	1.6	30	0.41	0.30	0.82	16.14	5.01
43D	38.9	0.86	1	17	2,085	0.005	1.6	30	0.41	0.30	0.82	13.08	4.06
45D	71.2	0.86	1	17	2,557	0.005	1.6	30	0.41	0.30	0.82	23.94	7.42
49A	31.6	0.10	1	17	3,089	0.001	1.6	30	0.41	0.30	0.36	4.67	0.81
Total	1027.3	-	-	-	-	-	-	-	-	-	-	291.80	82.95

AREA D - 1-YEAR

AREA D - 1-YEAR

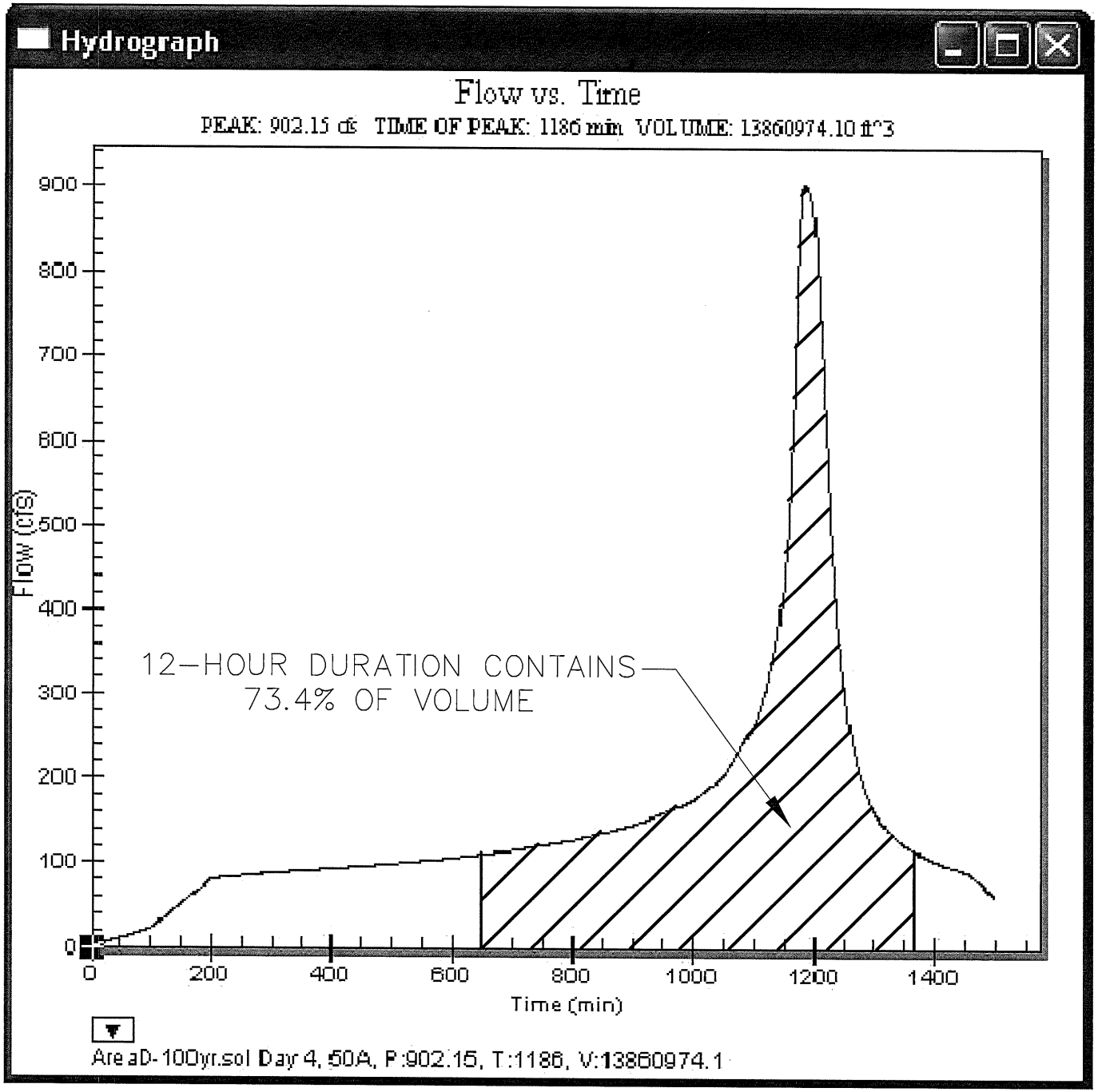
File name: W:\1CCC010100\ENGR\DESIGN\HYDR\CALCS\1-YR STORM\WMS\EXISTING\Area D\AreaD-1yr.lac Run date: Tue Oct 30 16:34:32 201

Los Angeles County Flood Control District
Modified Rational Method Hydrology

Storm Day 4 Storm Frequency 1

LOCATION	SUBAREA AREA	SUBAREA Q	TOTAL AREA	TOTAL Q	TOTAL VOLUME	CONV TYPE	CONV LNGTH	CONV SLOPE	CONV SIZE	CONV Z	CONTROL Q	SOIL NAME	TC	RAIN	PCT IMPV
1 1A	12.2	3.17	12.2	3.17	0.878	0	0	0.00000	0.00	0.00	0	17	30	1.60	0.55
1 2A	0.0	0.00	12.2	3.17	0.878	0	1965	0.05100	0.00	0.00	0	17	0	1.60	0.00
1 3A	44.1	10.04	56.3	13.21	3.463	0	0	0.00000	0.00	0.00	0	17	30	1.60	0.42
1 4A	0.0	0.00	56.3	13.21	3.463	0	793	0.00140	0.00	0.00	0	17	0	1.60	0.00
1 5A	40.7	9.77	97.0	22.98	6.058	0	0	0.00000	0.00	0.00	0	17	30	1.60	0.47
1 6A	0.0	0.00	97.0	22.98	6.049	5	1295	0.00140	5.00	0.00	0	17	0	1.60	0.00
1 7A	33.2	7.97	130.2	27.68	8.166	0	0	0.00000	0.00	0.00	0	17	30	1.60	0.47
1 8A	0.0	0.00	130.2	27.68	8.087	6	1520	0.00140	4.00	0.30	0	17	0	1.60	0.00
1 9A	60.9	15.81	191.1	32.44	12.472	0	0	0.00000	0.00	0.00	0	17	30	1.60	0.55
1 10A	0.0	0.00	191.1	32.44	12.413	6	789	0.00140	5.00	0.30	0	17	0	1.60	0.00
1 11A	80.6	21.92	271.7	46.60	18.632	0	0	0.00000	0.00	0.00	0	17	30	1.60	0.60
1 12A	23.1	5.54	294.8	51.61	20.104	0	0	0.00000	0.00	0.00	0	17	30	1.60	0.47
1 13A	0.0	0.00	294.8	51.61	20.028	5	883	0.00140	6.00	0.00	0	17	0	1.60	0.00
1 14A	50.7	14.36	345.5	62.04	23.590	0	0	0.00000	0.00	0.00	0	17	26	1.60	0.53
1 15A	0.0	0.00	345.5	62.04	23.484	6	907	0.00140	6.00	0.30	0	17	0	1.60	0.00
1 16A	30.9	8.79	376.4	65.13	25.562	0	0	0.00000	0.00	0.00	0	17	25	1.60	0.50
1 17A	0.0	0.00	376.4	65.13	25.479	5	606	0.00140	7.00	0.00	0	17	0	1.60	0.00
1 18A	17.2	6.46	393.6	65.92	26.768	0	0	0.00000	0.00	0.00	0	17	18	1.60	0.57
1 19A	0.0	0.00	393.6	65.92	26.768	0	1651	0.00140	0.00	0.00	0	17	0	1.60	0.00
1 20A	39.4	9.46	433.0	71.89	29.280	0	0	0.00000	0.00	0.00	0	17	30	1.60	0.47
1 21A	0.0	0.00	433.0	71.89	29.249	6	210	0.00140	6.00	0.30	0	17	0	1.60	0.00
1 23B	41.1	11.28	41.1	11.28	3.214	0	0	0.00000	0.00	0.00	0	17	30	1.60	0.61
1 24B	0.0	0.00	41.1	11.28	3.214	4	2518	0.03300	2.50	0.00	0	17	0	1.60	0.00
1 25B	52.9	15.42	94.0	26.03	7.732	0	0	0.00000	0.00	0.00	0	17	30	1.60	0.68
1 26B	0.0	0.00	94.0	26.03	7.731	4	201	0.03300	4.00	0.00	0	17	0	1.60	0.00
1 27B	3.9	1.43	97.9	27.14	7.906	0	0	0.00000	0.00	0.00	0	17	14	1.60	0.27
1 28AB	97.9	27.14	530.9	92.66	36.178	2	2165	0.00100	0.00	0.00	0	17	0	1.60	0.00
1 29C	69.4	18.36	69.4	18.36	5.140	0	0	0.00000	0.00	0.00	0	17	30	1.60	0.57
1 30C	0.0	0.00	69.4	18.36	5.143	4	1082	0.00140	5.50	0.00	0	17	0	1.60	0.00
1 31C	45.4	12.01	114.8	29.08	8.506	0	0	0.00000	0.00	0.00	0	17	30	1.60	0.57
1 32C	0.0	0.00	114.8	29.08	8.485	5	1539	0.00100	5.00	0.00	0	17	0	1.60	0.00
1 33C	55.1	16.61	169.9	40.86	13.417	0	0	0.00000	0.00	0.00	0	17	30	1.60	0.72
1 34C	0.0	0.00	169.9	40.86	13.170	5	4287	0.00100	5.00	0.00	0	17	0	1.60	0.00
1 35C	31.0	10.79	200.9	37.40	16.552	0	0	0.00000	0.00	0.00	0	17	30	1.60	0.91
1 36C	0.0	0.00	200.9	37.40	16.392	5	1921	0.00100	5.00	0.00	0	17	0	1.60	0.00
1 37C	38.9	13.16	239.8	39.14	20.475	0	0	0.00000	0.00	0.00	0	17	30	1.60	0.87
1 38C	0.0	0.00	239.8	39.14	20.328	5	1575	0.00100	5.00	0.00	0	17	0	1.60	0.00
1 39D	66.8	22.43	66.8	22.43	6.944	0	0	0.00000	0.00	0.00	0	17	30	1.60	0.86
1 40D	0.0	0.00	66.8	22.43	6.932	4	2683	0.00100	5.50	0.00	0	17	0	1.60	0.00
1 41D	48.0	16.12	114.8	32.80	11.922	0	0	0.00000	0.00	0.00	0	17	30	1.60	0.86
1 42D	0.0	0.00	114.8	32.80	11.860	4	2086	0.00100	7.50	0.00	0	17	0	1.60	0.00
1 43D	38.9	13.06	153.7	39.37	15.904	0	0	0.00000	0.00	0.00	0	17	30	1.60	0.86
1 44D	0.0	0.00	153.7	39.37	15.798	4	2177	0.00100	8.00	0.00	0	17	0	1.60	0.00
1 45D	71.2	23.90	224.9	52.15	23.199	0	0	0.00000	0.00	0.00	0	17	30	1.60	0.86
1 46D	0.0	0.00	224.9	52.15	23.145	4	945	0.00100	8.00	0.00	0	17	0	1.60	0.00
1 47AC	239.8	38.72	770.7	115.41	56.506	0	0	0.00000	0.00	0.00	0	17	0	1.60	0.00
1 48AD	224.9	51.88	995.6	157.03	78.808	2	923	0.00100	0.00	0.00	0	17	0	1.60	0.00
1 49A	31.6	4.71	1027.2	155.88	79.618	0	0	0.00000	0.00	0.00	0	17	30	1.60	0.10

Reservoir has overflowed!
Error in Reservoir Routing at 1 50A



AREA D - 100-YEAR

BALLONA CREEK AREA D - Existing Hydrology Calculations

100-Year Tc Calculation Results - Existing Condition

Subarea	Area (acres)	%imp	Frequency	Soil Type	Length (ft)	Slope (ft/ft)	Isohyet (in.)	Tc-calculated (min.)	Intensity (in./hr)	Cu	Cd	Flow rate (cfs)	Volume (acre-ft)
1A	12.20	0.55	100	17	2,200	0.018	5.8	17	1.95	0.84	0.87	20.70	3.56
3A	44.10	0.42	100	17	1,965	0.051	5.8	13	2.21	0.85	0.87	84.79	11.17
5A	40.70	0.47	100	17	2,130	0.052	5.8	13	2.21	0.85	0.87	78.25	10.94
7A	33.20	0.47	100	17	1,812	0.057	5.8	12	2.29	0.86	0.88	66.90	8.93
9A	60.90	0.55	100	17	2,899	0.030	5.8	18	1.90	0.83	0.87	100.67	17.78
11A	80.60	0.60	100	17	4,764	0.001	5.8	30	1.49	0.79	0.86	103.28	24.65
12A	23.10	0.47	100	17	1,488	0.060	5.8	10	2.50	0.87	0.88	50.82	6.18
14A	50.70	0.53	100	17	1,134	0.066	5.8	9	2.63	0.88	0.89	118.67	14.45
16A	30.90	0.50	100	17	1,173	0.081	5.8	8	2.77	0.88	0.89	76.18	8.61
18A	17.20	0.57	100	17	847	0.106	5.8	7	2.95	0.89	0.90	45.67	5.18
20A	39.40	0.47	100	17	2,023	0.040	5.8	14	2.13	0.85	0.87	73.01	10.56
23B	41.08	0.61	100	17	1,607	0.003	5.8	19	1.85	0.83	0.87	66.12	12.75
25B	52.94	0.68	100	17	3,124	0.033	5.8	18	1.90	0.83	0.88	88.52	17.52
27B	3.91	0.27	100	17	578	0.200	5.8	5	3.46	0.90	0.90	12.18	0.80
29C	69.40	0.57	100	17	1,876	0.020	5.8	15	2.06	0.85	0.88	125.81	20.71
31C	45.40	0.57	100	17	2,372	0.019	5.8	17	1.95	0.84	0.87	77.02	13.59
33C	55.10	0.72	100	17	2,703	0.012	5.8	20	1.80	0.82	0.88	87.28	18.99
35C	31.00	0.91	100	17	4,432	0.001	5.8	30	1.49	0.79	0.89	41.11	12.47
37C	38.90	0.87	100	17	2,055	0.010	5.8	17	1.95	0.84	0.89	67.51	15.26
39D	66.80	0.86	100	17	2,765	0.005	5.8	24	1.66	0.81	0.89	98.69	25.89
41D	48.00	0.86	100	17	3,101	0.004	5.8	27	1.57	0.80	0.89	67.07	18.60
43D	38.90	0.86	100	17	2,085	0.005	5.8	20	1.80	0.82	0.89	62.32	15.08
45D	71.20	0.86	100	17	2,557	0.005	5.8	23	1.69	0.81	0.89	107.09	27.63
49A	31.64	0.10	100	17	3,089	0.001	5.8	30	1.49	0.79	0.80	37.71	4.78
Total	1027.27	-	-	-	-	-	-	-	-	-	-	1,757.37	326.08

AREA D - 100-YEAR

AREA D - 100-YEAR

File name: W:\1CCC010100\ENGR\DESIGN\HYDR\CALCS\100-YR STORM\WMS\EXISTING\Area D\AreaD-100yr.lac Run date: Tue Oct 30 16:42:03

Los Angeles County Flood Control District
Modified Rational Method Hydrology

Storm Day 4 Storm Frequency 1

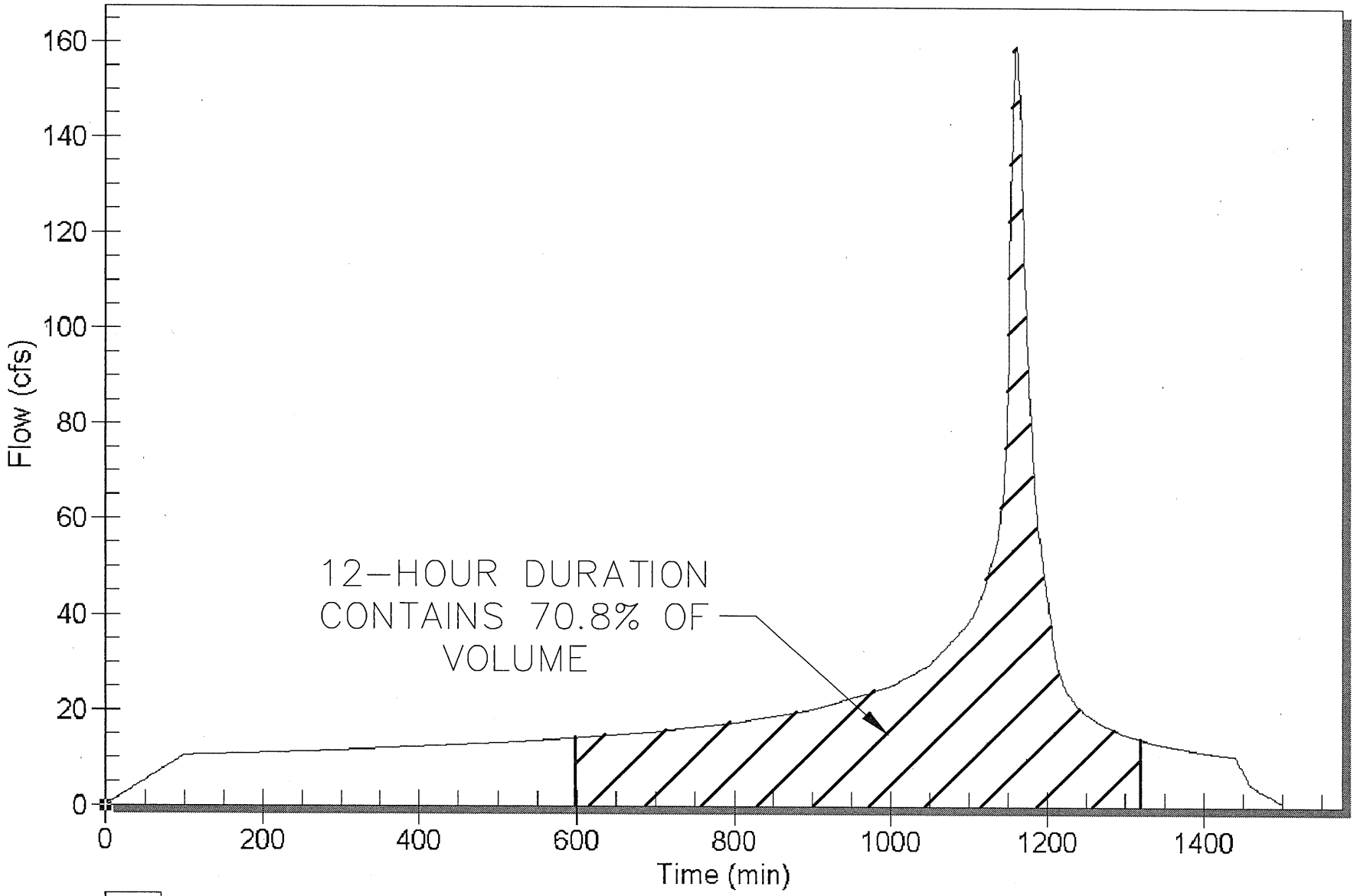
LOCATION	SUBAREA AREA	SUBAREA Q	TOTAL AREA	TOTAL Q	TOTAL VOLUME	CONV TYPE	CONV LNGTH	CONV SLOPE	CONV SIZE	CONV Z	CONTROL Q	SOIL NAME	TC	RAIN	PCT IMPV
1 1A	12.2	20.68	12.2	20.68	3.547	0	0	0.00000	0.00	0.00	0	17	17	5.80	0.55
1 2A	0.0	0.00	12.2	20.68	3.547	0	1965	0.05100	0.00	0.00	0	17	0	5.80	0.00
1 3A	44.1	85.01	56.3	105.69	14.603	0	0	0.00000	0.00	0.00	0	17	13	5.80	0.42
1 4A	0.0	0.00	56.3	105.69	14.603	0	793	0.00140	0.00	0.00	0	17	0	5.80	0.00
1 5A	40.7	78.66	97.0	184.34	25.437	0	0	0.00000	0.00	0.00	0	17	13	5.80	0.47
1 6A	0.0	0.00	97.0	184.34	25.432	5	1295	0.00140	10.00	0.00	0	17	0	5.80	0.00
1 7A	33.2	66.83	130.2	217.47	34.272	0	0	0.00000	0.00	0.00	0	17	12	5.80	0.47
1 8A	0.0	0.00	130.2	217.47	34.108	6	1520	0.00140	9.00	0.30	0	17	0	5.80	0.00
1 9A	60.9	100.23	191.1	254.46	51.810	0	0	0.00000	0.00	0.00	0	17	18	5.80	0.55
1 10A	0.0	0.00	191.1	254.46	51.680	6	789	0.00140	9.00	0.30	0	17	0	5.80	0.00
1 11A	80.6	102.82	271.7	336.38	76.296	0	0	0.00000	0.00	0.00	0	17	30	5.80	0.60
1 12A	23.1	51.11	294.8	344.88	82.449	0	0	0.00000	0.00	0.00	0	17	10	5.80	0.47
1 13A	0.0	0.00	294.8	344.88	82.264	5	883	0.00140	12.00	0.00	0	17	0	5.80	0.00
1 14A	50.7	118.36	345.5	379.09	96.715	0	0	0.00000	0.00	0.00	0	17	9	5.80	0.53
1 15A	0.0	0.00	345.5	379.09	96.471	6	907	0.00140	11.00	0.30	0	17	0	5.80	0.00
1 16A	30.9	76.32	376.4	380.00	104.992	0	0	0.00000	0.00	0.00	0	17	8	5.80	0.50
1 17A	0.0	0.00	376.4	380.00	104.795	5	606	0.00140	13.00	0.00	0	17	0	5.80	0.00
1 18A	17.2	45.39	393.6	384.46	109.912	0	0	0.00000	0.00	0.00	0	17	7	5.80	0.57
1 19A	0.0	0.00	393.6	384.46	109.912	0	1651	0.00140	0.00	0.00	0	17	0	5.80	0.00
1 20A	39.4	73.37	433.0	439.05	120.398	0	0	0.00000	0.00	0.00	0	17	14	5.80	0.47
1 21A	0.0	0.00	433.0	439.05	120.324	6	210	0.00140	11.00	0.30	0	17	0	5.80	0.00
1 23B	41.1	66.14	41.1	66.14	12.708	0	0	0.00000	0.00	0.00	0	17	19	5.80	0.61
1 24B	0.0	0.00	41.1	66.14	12.713	4	2518	0.03300	2.50	0.00	0	17	0	5.80	0.00
1 25B	52.9	87.97	94.0	149.87	30.219	0	0	0.00000	0.00	0.00	0	17	18	5.80	0.68
1 26B	0.0	0.00	94.0	149.87	30.219	4	201	0.03300	4.00	0.00	0	17	0	5.80	0.00
1 27B	3.9	12.15	97.9	153.23	31.017	0	0	0.00000	0.00	0.00	0	17	5	5.80	0.27
1 28AB	97.9	153.23	530.9	585.83	148.923	2	2165	0.00100	0.00	0.00	0	17	0	5.80	0.00
1 29C	69.4	125.59	69.4	125.59	20.617	0	0	0.00000	0.00	0.00	0	17	15	5.80	0.57
1 30C	0.0	0.00	69.4	125.59	20.629	4	1082	0.00140	5.50	0.00	0	17	0	5.80	0.00
1 31C	45.4	77.06	114.8	192.57	34.110	0	0	0.00000	0.00	0.00	0	17	17	5.80	0.57
1 32C	0.0	0.00	114.8	192.57	34.079	5	1539	0.00100	9.00	0.00	0	17	0	5.80	0.00
1 33C	55.1	87.26	169.9	256.30	52.988	0	0	0.00000	0.00	0.00	0	17	20	5.80	0.72
1 34C	0.0	0.00	169.9	256.30	52.450	5	4287	0.00100	10.00	0.00	0	17	0	5.80	0.00
1 35C	31.0	41.13	200.9	244.63	64.889	0	0	0.00000	0.00	0.00	0	17	30	5.80	0.91
1 36C	0.0	0.00	200.9	244.63	64.488	5	1921	0.00100	10.00	0.00	0	17	0	5.80	0.00
1 37C	38.9	67.49	239.8	247.33	79.653	0	0	0.00000	0.00	0.00	0	17	17	5.80	0.87
1 38C	0.0	0.00	239.8	247.33	79.270	5	1575	0.00100	10.00	0.00	0	17	0	5.80	0.00
1 39D	66.8	98.08	66.8	98.08	25.801	0	0	0.00000	0.00	0.00	0	17	24	5.80	0.86
1 40D	0.0	0.00	66.8	98.08	25.805	4	2683	0.00100	5.50	0.00	0	17	0	5.80	0.00
1 41D	48.0	66.58	114.8	146.04	44.335	0	0	0.00000	0.00	0.00	0	17	27	5.80	0.86
1 42D	0.0	0.00	114.8	146.04	44.232	4	2086	0.00100	7.50	0.00	0	17	0	5.80	0.00
1 43D	38.9	62.37	153.7	172.84	59.269	0	0	0.00000	0.00	0.00	0	17	20	5.80	0.86
1 44D	0.0	0.00	153.7	172.84	59.059	4	2177	0.00100	8.00	0.00	0	17	0	5.80	0.00
1 45D	71.2	106.69	224.9	242.59	86.565	0	0	0.00000	0.00	0.00	0	17	23	5.80	0.86
1 46D	0.0	0.00	224.9	242.59	86.455	4	945	0.00100	8.00	0.00	0	17	0	5.80	0.00
1 47AC	239.8	241.43	770.7	697.56	228.193	0	0	0.00000	0.00	0.00	0	17	0	5.80	0.00
1 48AD	224.9	241.41	995.6	906.51	312.831	2	923	0.00100	0.00	0.00	0	17	0	5.80	0.00
1 49A	31.6	37.70	1027.2	902.15	317.596	0	0	0.00000	0.00	0.00	0	17	30	5.80	0.10

Reservoir has overflowed!
Error in Reservoir Routing at 1 50A

Hydrograph

Flow vs. Time

PEAK: 159.56 cfs TIME OF PEAK: 1161 min VOLUME: 1721547.90 ft^3



SouthB-West.sol Day 4, 21A, P:159.56, T:1161, V:1721547.9

100–YEAR STORM EVENT

AREA B - SOUTHWEST - 100-YEAR

BALLONA CREEK AREA B - Existing Hydrology Calculations

100-Year TC Calculator Results – Area B West Existing & Proposed Condition

Subarea	Area (acres)	% imp	Frequency	Soil Type	Length (ft)	Slope (ft/ft)	Isohyet (in.)	Tc-calc. (min.)	Intensity (in./hr)	Cu	Cd	Flowrate (cfs)
1A	27.2	0.42	100	10	1834	0.024	5.61	19	1.79	0.35	0.58	28.24
3A	14.2	0.42	100	10	1423	0.024	5.61	16	1.94	0.38	0.6	16.53
5A	18.4	0.42	100	10	1654	0.022	5.61	18	1.83	0.36	0.59	19.87
6A	27	0.42	100	10	3218	0.024	5.61	28	1.49	0.29	0.55	22.13
7A	19.3	0.42	100	10	1150	0.031	5.61	13	2.14	0.41	0.62	25.61
8A	8.7	0.42	100	10	1366	0.063	5.61	12	2.22	0.43	0.63	12.17
10A	39.4	0.02	100	17	2055	0.001	5.73	29	1.5	0.79	0.79	46.69
11B	9.4	0.91	100	10	1158	0.004	5.61	15	2	0.39	0.85	15.98
12B	2.7	0.1	100	10	651	0.17	5.61	7	2.86	0.53	0.57	4.4
14B	6.1	0.95	100	17	2043	0.001	5.73	26	1.58	0.8	0.9	8.67
15C	7.1	0.91	100	10	774	0.013	5.61	10	2.42	0.47	0.86	14.78
16C	1.3	0.12	100	10	351	0.215	5.61	5	3.35	0.6	0.64	2.79
18C	20.4	0.42	100	10	1334	0.031	5.61	14	2.06	0.4	0.61	25.63

AREA B - SOUTHWEST - 100 YEAR

AREA B - SOUTHWEST - 100 YEAR

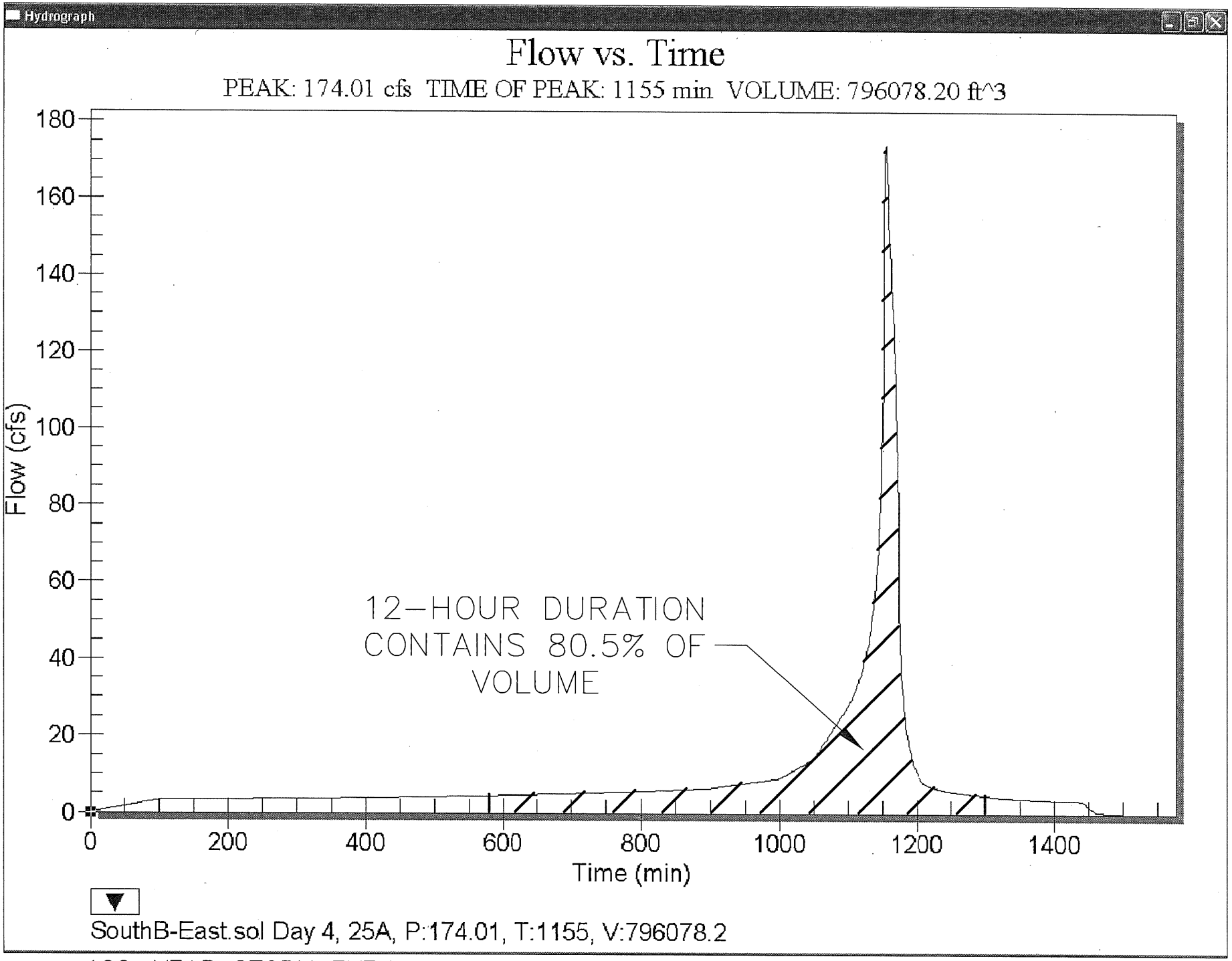
File name: W:\1CCC010100\ENGR\DESIGN\HYDR\CALCS\100-YR STORM\WMS\EXISTING\Area B\South Wetlands Area B West\SouthB-West.lac Ru

Los Angeles County Flood Control District
Modified Rational Method Hydrology

Storm Day 4 Storm Frequency 1

LOCATION		SUBAREA AREA	SUBAREA Q	TOTAL AREA	TOTAL Q	TOTAL VOLUME	CONV TYPE	CONV LNGTH	CONV SLOPE	CONV SIZE	CONV Z	CONTROL Q	SOIL NAME	TC	RAIN	PCT IMPV
1	1A	27.2	28.17	27.2	28.17	5.640	0	0	0.00000	0.00	0.00	0	10	19	5.61	0.42
1	2A	0.0	0.00	27.2	28.17	5.641	3	1834	0.02400	30-6	0.00	0	10	0	5.61	0.00
1	3A	14.2	16.40	41.4	32.81	8.592	0	0	0.00000	0.00	0.00	0	10	16	5.61	0.42
1	4A	0.0	0.00	41.4	32.81	8.589	3	1423	0.02400	30-6	0.00	0	10	0	5.61	0.00
1	5A	18.4	19.71	59.8	39.43	12.407	0	0	0.00000	0.00	0.00	0	10	18	5.61	0.42
1	6A	27.0	21.96	86.8	60.41	17.969	0	0	0.00000	0.00	0.00	0	10	28	5.61	0.42
1	7A	19.3	25.45	106.1	82.91	21.990	0	0	0.00000	0.00	0.00	0	10	13	5.61	0.42
1	8A	8.7	12.08	114.8	94.03	23.804	0	0	0.00000	0.00	0.00	0	10	12	5.61	0.42
1	9A	0.0	0.00	114.8	94.03	23.795	3	1366	0.06260	30-6	0.00	0	10	0	5.61	0.00
1	10A	39.4	17.05	154.2	106.72	26.219	0	0	0.00000	0.00	0.00	0	10	29	5.61	0.02
1	11B	9.4	16.03	9.4	16.03	3.609	0	0	0.00000	0.00	0.00	0	10	15	5.61	0.91
1	12B	2.7	4.36	12.1	20.31	3.866	0	0	0.00000	0.00	0.00	0	10	7	5.61	0.10
1	13B	0.0	0.00	12.1	20.31	3.866	0	116	0.02740	0.00	0.00	0	10	0	5.61	0.00
1	14B	6.1	8.18	18.2	28.36	6.289	0	0	0.00000	0.00	0.00	0	10	26	5.61	0.95
1	15C	7.1	14.77	7.1	14.77	2.729	0	0	0.00000	0.00	0.00	0	10	10	5.61	0.91
1	16C	1.3	2.76	8.4	17.42	2.863	0	0	0.00000	0.00	0.00	0	10	5	5.61	0.12
1	17C	0.0	0.00	8.4	17.42	2.863	0	269	0.01440	0.00	0.00	0	10	0	5.61	0.00
1	18C	20.4	25.67	28.8	42.99	7.109	0	0	0.00000	0.00	0.00	0	10	14	5.61	0.42
1	19AB	18.2	28.36	172.4	128.25	32.508	0	0	0.00000	0.00	0.00	0	10	0	5.61	0.00
1	20AC	28.8	42.99	201.2	159.78	39.615	5	90	0.00100	6.00	0.00	0	10	0	5.61	0.00
1	21A	0.0	0.00	201.2	0.00	0.000	0	100	0.00100	0.00	0.00	0	10	0	5.61	0.00

Normal End of MODRAT



100-YEAR STORM EVENT

AREA B - SOUTHEAST - 100-YEAR

BALLONA CREEK AREA B - Existing Hydrology Calculations

100-Year TC Calculator Results – Area B East Existing & Proposed Condition

Subarea	Area (acres)	% imp	Frequency	Soil Type	Length (ft)	Slope (ft/ft)	Isohyet (in.)	Tc-calc. (min.)	Intensity (in./hr)	Cu	Cd	Flowrate (cfs)
1A	6.2	0.42	100	10	517	0.033	5.73	7	2.92	0.54	0.69	12.49
3A	5.3	0.09	100	10	958	0.1	5.73	11	2.36	0.46	0.5	6.25
6B	3.3	0.95	100	17	1291	0.001	5.73	19	1.83	0.82	0.9	5.44
8B	84.4	0.02	100	17	3063	0.017	5.73	22	1.7	0.81	0.81	116.22
9C	6.2	0.06	100	10	678	0.021	5.73	12	2.27	0.44	0.47	6.61
11D	1.2	0.12	100	10	395	0.242	5.73	5	3.42	0.61	0.64	2.63
13E	1.9	0.11	100	10	406	0.219	5.73	5	3.42	0.61	0.64	4.16
15F	3.7	0.08	100	10	494	0.177	5.73	6	3.14	0.57	0.6	6.97
17G	17.3	0.42	100	10	1478	0.008	5.73	20	1.78	0.35	0.58	17.86

AREA B - SOUTHEAST - 100 YEAR

AREA B - SOUTHEAST - 100-YEAR

File name: W:\1CCC010100\ENGR\DESIGN\HYDR\CALCS\100-YR STORM\WMS\EXISTING\Area B\South Wetlands Area B East\SouthB-East.lac Ru

Los Angeles County Flood Control District
Modified Rational Method Hydrology

Storm Day 4 Storm Frequency 1

LOCATION		SUBAREA AREA	SUBAREA Q	TOTAL AREA	TOTAL Q	TOTAL VOLUME	CONV TYPE	CONV LNGTH	CONV SLOPE	CONV SIZE	CONV Z	CONTROL Q	SOIL NAME	TC	RAIN	PCT IMPV
1	1A	6.2	12.45	6.2	12.45	1.329	0	0	0.00000	0.00	0.00	0	10	7	5.73	0.42
1	2A	0.0	0.00	6.2	12.45	1.328	4	165	0.46330	1.50	0.00	0	10	0	5.73	0.00
1	3A	5.3	6.21	11.5	18.57	1.820	0	0	0.00000	0.00	0.00	0	10	11	5.73	0.09
1	4A	0.0	0.00	11.5	18.57	1.820	0	513	0.08960	0.00	0.00	0	10	0	5.73	0.00
1	6B	3.3	5.40	3.3	5.40	1.351	0	0	0.00000	0.00	0.00	0	17	19	5.73	0.95
1	7B	0.0	0.00	3.3	5.40	1.351	5	604	0.00050	12.00	0.00	0	17	0	5.73	0.00
1	8B	84.4	116.90	87.7	119.59	11.805	0	0	0.00000	0.00	0.00	0	17	22	5.73	0.02
1	9C	6.2	6.54	6.2	6.54	0.506	0	0	0.00000	0.00	0.00	0	10	12	5.73	0.06
1	10C	0.0	0.00	6.2	6.54	0.505	4	102	0.04215	1.50	0.00	0	10	0	5.73	0.00
1	11D	1.2	2.63	1.2	2.63	0.127	0	0	0.00000	0.00	0.00	0	10	5	5.73	0.12
1	12D	0.0	0.00	1.2	2.63	0.044	4	92	0.04510	1.50	0.00	0	10	0	5.73	0.00
1	13E	1.9	4.15	1.9	4.15	0.194	0	0	0.00000	0.00	0.00	0	10	5	5.73	0.11
1	14E	0.0	0.00	1.9	4.15	0.094	4	101	0.04208	1.50	0.00	0	10	0	5.73	0.00
1	15F	3.7	6.90	3.7	6.90	0.335	0	0	0.00000	0.00	0.00	0	10	6	5.73	0.08
1	16F	0.0	0.00	3.7	6.90	0.262	4	153	0.27261	2.50	0.00	0	10	0	5.73	0.00
1	17G	17.3	17.85	17.3	17.85	3.665	0	0	0.00000	0.00	0.00	0	10	20	5.73	0.42
1	18G	0.0	0.00	17.3	17.85	3.665	4	352	0.32950	2.00	0.00	0	10	0	5.73	0.00
1	19AB	87.7	119.59	99.2	137.21	13.626	0	0	0.00000	0.00	0.00	0	10	0	5.73	0.00
1	20AC	6.2	6.53	105.4	143.74	14.131	0	0	0.00000	0.00	0.00	0	10	0	5.73	0.00
1	21AD	1.2	2.58	106.6	146.09	14.174	0	0	0.00000	0.00	0.00	0	10	0	5.73	0.00
1	22AE	1.9	4.07	108.5	149.79	14.268	0	0	0.00000	0.00	0.00	0	10	0	5.73	0.00
1	23AF	3.7	6.81	112.2	156.24	14.530	0	0	0.00000	0.00	0.00	0	10	0	5.73	0.00
1	24AG	17.3	17.83	129.5	174.01	18.195	0	3963	0.01700	0.00	0.00	0	10	0	5.73	0.00
1	25A	0.0	0.00	129.5	0.00	0.000	0	489	0.00100	0.00	0.00	0	10	0	5.73	0.00

Normal End of MODRAT

AREA B - PLAYA DEL REY

A =	170 ac
tc =	18.3 min
Qp =	309 cfs
Qc =	174 cfs

PERSHING STORM DRAIN OVERFLOW TO NORTH WETLAND - 50 YEAR STORM

TIME	BPRR	CLOCK TIME	OVERFLOW HYDROGRAPH 1st Day Q50	2nd Day Q50	3rd Day Q50	4th Day Q50	OVERFLOW VOLUME 1st Day V50	2nd Day V50	3rd Day V50	4th Day V50
-1062	0.00	0	0 cfs	0 cfs	0 cfs	0 cfs				
-60	0.35	1002	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	0.00 af
0	0.37	1062	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	0.00 af
60	0.40	1122	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	0.00 af
70	0.49	1132	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	0.00 af
80	0.65	1142	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	0.00 af
85	0.79	1147	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	0.00 af
88	0.90	1150	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	0.00 af
90	1.01	1152	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	0.00 af
91	1.13	1153	0 cfs	0 cfs	0 cfs	7 cfs	0.00 af	0.00 af	0.00 af	0.00 af
92	1.28	1154	0 cfs	0 cfs	0 cfs	31 cfs	0.00 af	0.00 af	0.00 af	0.03 af
93	1.53	1155	0 cfs	0 cfs	0 cfs	72 cfs	0.00 af	0.00 af	0.00 af	0.10 af
94	1.82	1156	0 cfs	0 cfs	0 cfs	118 cfs	0.00 af	0.00 af	0.00 af	0.23 af
95	1.89	1157	0 cfs	0 cfs	0 cfs	128 cfs	0.00 af	0.00 af	0.00 af	0.40 af
96	1.92	1158	0 cfs	0 cfs	0 cfs	133 cfs	0.00 af	0.00 af	0.00 af	0.58 af
97	1.93	1159	0 cfs	0 cfs	0 cfs	135 cfs	0.00 af	0.00 af	0.00 af	0.77 af
98	1.93	1160	0 cfs	0 cfs	0 cfs	135 cfs	0.00 af	0.00 af	0.00 af	0.95 af
99	1.90	1161	0 cfs	0 cfs	0 cfs	131 cfs	0.00 af	0.00 af	0.00 af	1.14 af
100	1.87	1162	0 cfs	0 cfs	0 cfs	126 cfs	0.00 af	0.00 af	0.00 af	1.31 af
101	1.76	1163	0 cfs	0 cfs	0 cfs	108 cfs	0.00 af	0.00 af	0.00 af	1.47 af
102	1.58	1164	0 cfs	0 cfs	0 cfs	79 cfs	0.00 af	0.00 af	0.00 af	1.60 af
103	1.42	1165	0 cfs	0 cfs	0 cfs	54 cfs	0.00 af	0.00 af	0.00 af	1.69 af
104	1.28	1166	0 cfs	0 cfs	0 cfs	31 cfs	0.00 af	0.00 af	0.00 af	1.75 af
105	1.13	1167	0 cfs	0 cfs	0 cfs	7 cfs	0.00 af	0.00 af	0.00 af	1.78 af
106	1.01	1168	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
107	0.91	1169	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
108	0.83	1170	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
109	0.76	1171	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
110	0.69	1172	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
111	0.64	1173	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
112	0.59	1174	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
113	0.55	1175	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
114	0.50	1176	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
115	0.48	1177	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
116	0.44	1178	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
120	0.36	1182	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
125	0.31	1187	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
130	0.28	1192	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
135	0.24	1197	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
140	0.22	1202	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
145	0.20	1207	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
150	0.19	1212	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
155	0.17	1217	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
160	0.16	1222	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
170	0.16	1232	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
180	0.15	1242	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
190	0.15	1252	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
200	0.15	1262	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
210	0.15	1272	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
220	0.15	1282	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
230	0.15	1292	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
250	0.15	1312	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
260	0.14	1322	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
300	0.14	1362	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af
378	0.00	1440	0 cfs	0 cfs	0 cfs	0 cfs	0.00 af	0.00 af	0.00 af	1.78 af

ELEV = 7.0'

Volumes by Triangulation (Prisms) Wed Oct 17 13:40:43 2012
Existing Surface: \\westla1\projects\1CCC010100\SURVEY\DTM\V-DTM03-AERL-SOUTH.tin
Final Surface: \\westla1\projects\1CCC010100\SURVEY\DTM\V-DTM03-ROAD-LOWP+0.2.tin

Cut volume: 302,418.9 C.F., 11,200.70 C.Y.
Fill volume: 6,495,782.0 C.F., 240,584.52 C.Y.

Area in Cut : 128,145.9 S.F., 2.94 Acres
Area in Fill: 4,020,248.9 S.F., 92.29 Acres
Total inclusion area: 4,148,397.1 S.F., 95.23 Acres

Average Cut Depth: 2.36 feet
Average Fill Depth: 1.62 feet
Cut to Fill ratio: 0.05
Import Volume: 229,383.8 C.Y.
Elevation Change To Reach Balance: -1.493
Volume Change Per .1 ft: 15,364.4 C.Y.

Cut (C.Y.) / Area (acres): 117.61
Fill (C.Y.) / Area (acres): 2526.24

ELEV = 6.8'

Volumes by Triangulation (Prisms) Tue Oct 23 17:55:39 2012
Existing Surface: \\westla1\projects\1CCC010100\SURVEY\DTM\V-DTM03-AERL-SOUTH.tin
Final Surface: \\westla1\projects\1CCC010100\SURVEY\DTM\V-DTM03-ROAD-LOWP_6.8'.tin

Cut volume: 333,665.9 C.F., 12,358.00 C.Y.
Fill volume: 5,697,349.6 C.F., 211,012.95 C.Y.

Area in Cut : 186,898.6 S.F., 4.29 Acres
Area in Fill: 3,961,498.3 S.F., 90.94 Acres
Total inclusion area: 4,148,397.1 S.F., 95.23 Acres

Average Cut Depth: 1.79 feet
Average Fill Depth: 1.44 feet
Cut to Fill ratio: 0.06
Import Volume: 198,654.9 C.Y.
Elevation Change To Reach Balance: -1.293
Volume Change Per .1 ft: 15,364.4 C.Y.

Cut (C.Y.) / Area (acres): 129.78
Fill (C.Y.) / Area (acres): 2215.73

ELEV = 4.0'

Volumes by Triangulation (Prisms) Tue Oct 23 18:16:56 2012
Existing Surface: \\westla1\projects\1CCC010100\SURVEY\DTM\V-DTM03-AERL-SOUTH.tin
Final Surface: \\westla1\projects\1CCC010100\SURVEY\DTM\V-DTM03-SITE-PLANE-ELEV=4.0'.tin

Cut volume: 6,298,254.8 C.F., 233,268.70 C.Y.
Fill volume: 48,426.7 C.F., 1,719.51 C.Y.

Area in Cut : 4,068,852.1 S.F., 93.41 Acres
Area in Fill: 79,545.0 S.F., 1.83 Acres
Total inclusion area: 4,148,397.1 S.F., 95.23 Acres

Average Cut Depth: 1.55 feet
Average Fill Depth: 0.58 feet
Cut to Fill ratio: 135.66
Export Volume: 231,549.2 C.Y.
Elevation Change To Reach Balance: 1.507
Volume Change Per .1 ft: 15,364.4 C.Y.

Cut (C.Y.) / Area (acres): 2449.42
Fill (C.Y.) / Area (acres): 18.06

ELEV = 9.5'

Volumes by Triangulation (Prisms) Tue Oct 23 19:00:30 2012
Existing Surface: \\westla1\projects\1CCC010100\SURVEY\DTM\V-DTM03-AERL-SOUTH.tin
Final Surface: \\westla1\projects\1CCC010100\SURVEY\DTM\V-DTM03-SITE-PLANE-ELEV=9.5'.tin

Cut volume: 72,431.1 C.F., 2,682.63 C.Y.
Fill volume: 17,608,482.1 C.F., 652,166.00 C.Y.

Area in Cut : 98,335.5 S.F., 2.21 Acres
Area in Fill: 4,742,408.2 S.F., 108.87 Acres
Total inclusion area: 4,838,744.9 S.F., 111.08 Acres

Average Cut Depth: 0.75 feet
Average Fill Depth: 3.71 feet
Cut to Fill ratio: 0.00
Import Volume: 649,483.4 C.Y.
Elevation Change To Reach Balance: -3.624
Volume Change Per .1 ft: 17,921.3 C.Y.

Cut (C.Y.) / Area (acres): 24.15
Fill (C.Y.) / Area (acres): 5871.02

AREA B - SOUTH OF CULVER
STORAGE CAPACITY

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Appendix F1
West Area B Levee Options

ESA PWA

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Suite 1100
Los Angeles, CA 90017
562.296.5679 direct
213.599.4300 main

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Suite 900
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www.pwa-ltd.com

Memorandum

date 9/21/2012 Draft

to Diana Hurlbert, Santa Monica Bay Restoration Commission

from Nick Garrity, P.E.

subject *Ballona Wetlands Restoration*
West Area B levee options assessment – Draft for discussion

Introduction

ESA PWA has developed and assessed several conceptual options for providing flood and erosion protection along the site's western boundary and the sand dunes in West Area B. We are providing this assessment for discussion with the PMT and as the basis for the PMT to select a conceptual flood and erosion protection approach. ESA PWA will then develop the preliminary engineering design for the selected approach/levee option.

ESA PWA has coordinated with the restoration design team, including SMBRC, Psomas, and Group Delta, on this assessment. We recommend the option of constructing a new levee for flood and erosion protection and maintenance access along the toe of the existing dunes (Alternative B in this memo). Alternative B would provide engineered erosion protection and avoid construction and geotechnical engineering feasibility issues associated with constructing a levee within the sand dunes. Alternative B would minimize impacts to the existing sand dune habitat, beneficially re-use soil excavated for wetland restoration in Area A, and restore additional dune and transition zone habitat along the slopes of the new levee. A complete assessment of the benefits and tradeoffs of alternative approaches is provided below.

Note that the options in this memo are for the final stage of the project and represent the "ultimate" project to be permitted. The timing/construction phasing will be detailed for the selected option. For the recommended Alternative B, the most efficient means of construction would be to place soil excavated from Area A to build the levee in the first stage of construction; however, staging options will be assessed for the selected option (e.g., to reduce temporary impacts). Potential impacts of the selected option will be analyzed in the environmental review process.

The figures in this memo show approximate conceptual levee alignments and sections developed by ESA PWA for the purpose of estimating and comparing different levee footprints.

The levee would actually be designed and constructed to incorporate restored dune habitat and transitional ecotone habitat along a buried flood protection levee as depicted in the attached Detailed Section and Artistic Rendering of Alternative B (Figures 1 and 2). This would consist of:

- Buried levee core with engineered/compacted fill and slopes (2:1 or 3:1)
- Dune and transitional habitat restoration along and on top of the buried/engineered levee core, with non-engineered fill placement and slopes (varying from 3:1 to 20:1) landscaped as a dune landform (e.g., variable microtopography, mounds, hummocks), sandy surface soils, and dune plantings. Note that the habitat slopes would be refined as appropriate for dune habitat (upper slopes and land-side slope) and wetland transitional habitat (water-side slope) in coordination with team biologists and landscape architects.

Figure 1 shows an artistic rendering of the dune restoration/buried levee concept for Alternative B. Figure 2 shows a detailed section for Alternative B to convey the conceptual design approach. Figure 2 also shows the conceptual levee section used to define the levee footprint/alignments shown in Figure 5. (Note that the conceptual levee alignments and sections shown for Alternatives A – C in Figures 3 – 7 would follow a similar design approach as shown in Figure 2.)

The design for the selected levee option will be refined and detailed during subsequent preliminary design. The levee elevation will also be refined based on hydraulic analyses in progress. The levee elevation used for this assessment represents our "best estimate" based on currently available information. Changes in the levee elevation would change the levee footprints for all options presented in this memo.

Levee Options Assessment

The levee options assessed in Table 1 include:

1. Levee built into the existing dune slope (Alternatives A-1 and A-2) (Figures 3 and 4)
2. Levee along the toe of the existing dunes (recommended Alternative B) (Figure 5)
3. Levee through/around a portion of the existing managed marsh (Alternative C) (Figure 6)
4. Relying on the existing sand dune for flood and erosion protection (prior Conceptual Design) (Figure 8)
5. Flood wall through the dunes

Figures are attached showing plan layouts for Alternatives A, B, and C (Figures 3 – 6), sections for Alternatives A, B, and C (Figure 7); and the plan layout for the prior Conceptual Design (Figure 8). For the recommended Alternative B, a detailed section and artistic rendering (Figures 1 and 2) are also attached to convey better how the levee would actually be designed and look (as discussed above).

Design and construction feasibility considerations. The prior Conceptual Design relied on the existing relic sand dune for flood and erosion protection; however, engineered erosion protection is likely to be required for flood protection approvals. In addition, this approach could introduce impacts to adjacent properties due to increased seepage.

The levee options involving construction within the existing sand dunes and sand soils (Alternatives A-1/2 and a flood wall) have significant design and construction feasibility issues and uncertainties. Engineering a stable levee within the sand soils is likely to involve a significant amount of over-excavation to construct the levee sub-grade. Also, construction in sand soils with

adjacent private development raises significant construction risks. Geotechnical explorations are in progress to confirm the depth of sand within the relic/restored sand dunes and engineering/construction constraints.

Maintenance access. LA County DPW has requested vehicle access around the site for maintenance, including along the west boundary and along other levees. Alternatives A, B, and C provide maintenance vehicle access along the west boundary, while the prior Conceptual Design and the flood wall option do not.

Benefits, tradeoffs, and recommended alternative. Alternatives B and C avoid the design and construction feasibility issues associated with levee construction adjacent to neighboring properties and provide maintenance access. Alternative C would maintain an area of the existing managed marsh behind the levee to maintain the existing connectivity between a portion of the existing marsh and dunes; however, on-going management of the managed marsh would be required (similar to the ongoing maintenance of the existing Ballona Creek structure). Over time, maintenance may not be sustainable with future sea-level rise without the use of pumps.

The recommended Alternative B, with a levee along the toe of the existing dunes, would minimize impacts to the existing dunes, avoid significant design and construction feasibility issues, beneficially re-use fill material, and expand restored dune areas, at the expense of filling approximately 10 acres of existing managed wetland habitat. Estimated habitat impacts are included for all options in Table 1 for comparison.

Note that for the Alternative B levee approach, the toe of the existing dunes would become a depression between the existing dunes and the new levee/habitats. This area could function as a back-dune wetland habitat fed by rainfall-runoff from the adjacent slopes, possibly with an overflow towards the stormwater detention and treatment wetland planned in the southwest corner of Area B. Additional analysis and design of the back-dune wetland habitat would be performed, including consideration of similar reference sites (e.g., historic wetlands between the beach and dunes and other sites to be identified).

Attachments

Figure 1 - Artistic Rendering for Alternative B
Figure 2 - Detailed Section for Alternative B
Figure 3 - Levee Alternative A-1 Plan
Figure 4 - Levee Alternative A-2 Plan
Figure 5 - Levee Alternative B Plan
Figure 6 - Levee Alternative C Plan
Figure 7 - Levee Sections
Figure 8 - Prior Conceptual Design

Table 1. West Area B levee approach options/alternatives assessment - Draft for discussion
ESA PWA, 9/14/2012

Option/Alternative		Intent	Design & construction feasibility issues	Maint-enance access	Benefits	Trade-offs	Footprint (ac)	Estimated habitat impacts (ac)		
								Dune	Other upland	Wetland
A-1	Levee through dunes (10:1 slope)	Build levee along bluff to maximize wetland footprint while providing transitional slope. Requires fill into dunes.	Construction in sand dune adjacent to private property; Will require over-excavation and compaction to stabilize subgrade and build levee; Extent/footprint of construction unknown to achive stability; May have impacts to adjacent property	Y	Minimizes wetland impacts; Maximizes area of restored wetland; Maintains existing connectivity between existing dunes and adjacent restored tidal wetlands	Design & construction feasibility issues with levee construction in sand dune; Increased tidal exchange in adjacent wetland could impact existng freshwater seeps and dune habitat (especially with sea level rise)	11.7	2.2	3.0	6.5
A-2	Levee through dunes (3:1 slope)	Build levee along bluff to maximize wetland footprint. Minimize levee footprint in dunes by using a steeper levee slope.					8.7	0.9	2.6	5.2
B	Levee through wetland along toe of dunes	Minimze dune impact, avoid construction feasibility issues	Requires construction of levee over historic wetland channel; Likely to require over-excavation and sub-grade preparation	Y	Avoids most significant design & construction feasibility issues; Beneficially re-uses fill material; Expands restored dune area; Protects existing dunes from inundation & scour	Fills existing wetland area and part of historic marsh channel; Reduces restored wetland area; Modifies existing wetland/dune connectivity	12.1	0.1	2.2	9.8
C	Levee through wetland	Same as Alt B, plus: Maintain portion of managed marsh connected to dunes	Requires construction of levee over historic wetland channel; Likely to require over-excavation and sub-grade preparation; Requires water control structure to allow for muted tidal action through new levee (similar to existing structure in Ballona Creek levee)	Y	Mantains portion of existing managed marsh connected to dunes; See benefits above	Requires on-going managed marsh O&M (Similar to existing Ballona Creek structure); May require pumps with sea-level rise; Fills existing wetland area; Further reduces restored full tidal wetland area	13.7	0.1	2.0	11.6
	Conceptaul design	Rely on existng dunes for flood and erosion protection	Existing sand dune does not provide engineered erosion protection likley to be required for flood protection approvals; Would require buried rock to protect existing property adjacent to site; Portion of dunes would need to be raised (see A-1/2 & Flood wall issues)	N	Minimizes dune and wetland construction impacts	Does not provide access likley to be required; Would likley require erosion protection (possibly buried rock) to be feasible; Seepage could become an issue for adjacent properties; Increased tidal exchange in adjacent wetland could impact existng freshwater seeps and dune habitat (especially with sea level rise)	NA			
	Flood wall through dunes	Minimize construction footprint	Construction in sand dune adjacent to private property; Extent/footprint of construction required to achive stability and prevent seepage may be extensive	N	Minimizes dune and wetland construction impacts	Does not provide access likley to be required; Increased tidal exchange in adjacent wetland could impact existng freshwater seeps and dune habitat (especially with sea level rise)	NA			

Notes:
Wetland habitat acreage includes estuarine marsh; intertidal channel; salt pan; brackish marsh; and riparian scrub
Other upland habitat acreage includes upland scrub and upland grassland

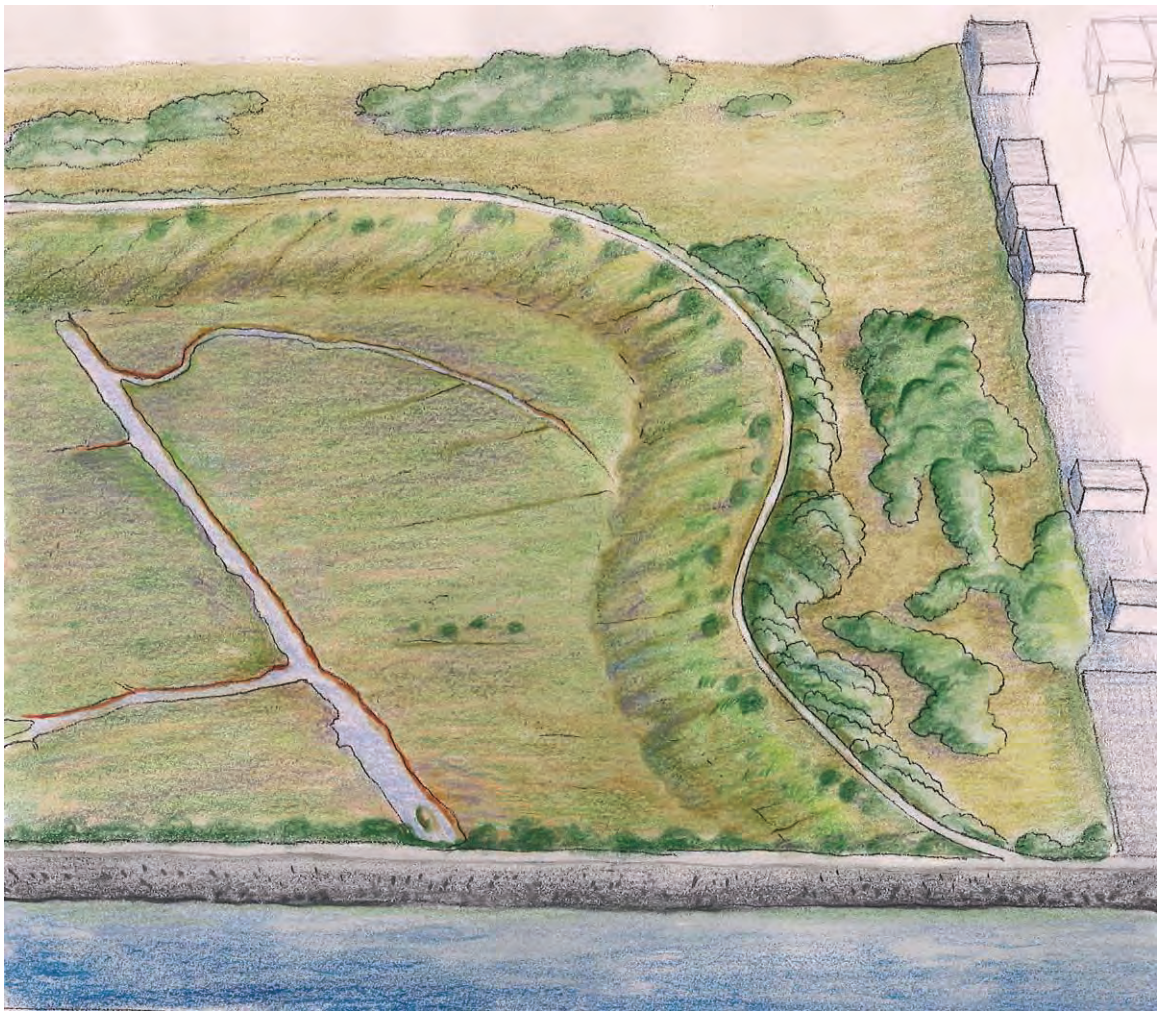

figure 1
Ballona Wetlands Restoration

Artistic Rendering for Alternative B

PWA Ref# D120367.00

ESA PWA

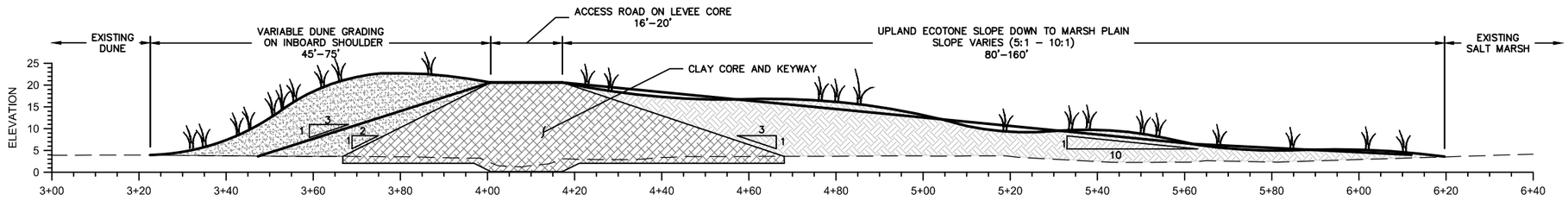

figure 2

Ballona Wetlands Restoration

Detailed Section for Alternative B

ESA PWA

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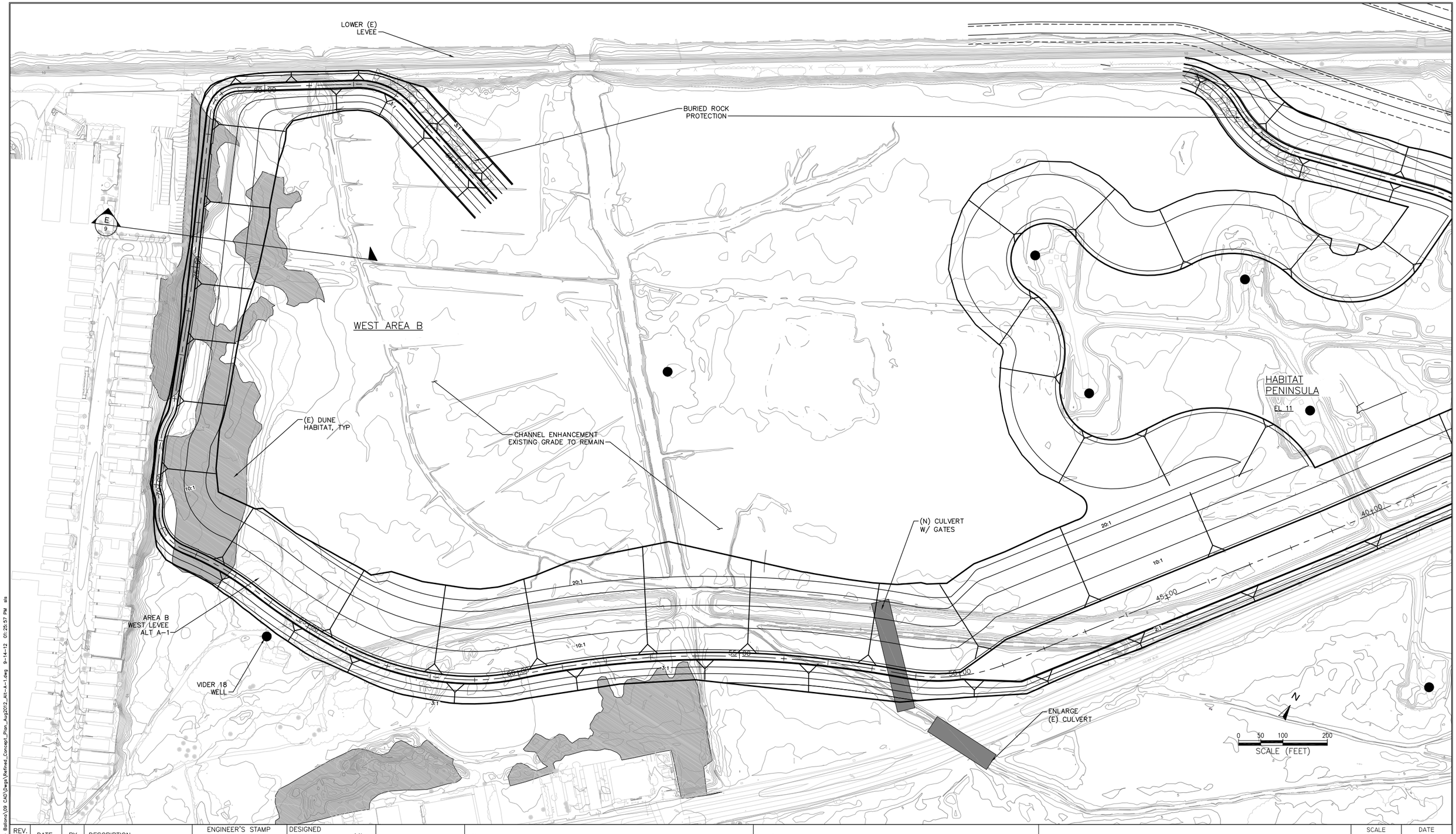

REV. NO.	DATE	BY	DESCRIPTION

ENGINEER'S STAMP

DESIGNED	ML
DRAWN	SLS
CHECKED	BB
PWA JOB NO.	D120367.00

PREPARED FOR:

STATE COASTAL CONSERVANCY

PREPARED BY:

ESA PWA
550 Kearny Street, Suite 900
San Francisco, CA 94108
415.262.2300 phone
415.262.2303 fax
www.pwa-ltd.com

BALLONA WETLANDS RESTORATION
REVISED CONCEPTUAL PLAN
AREA B - LEVEE ALTERNATIVES: A-1

SCALE	DATE
AS SHOWN	9-13-2012

figure 3
Levee Alternative
A-1 Plan

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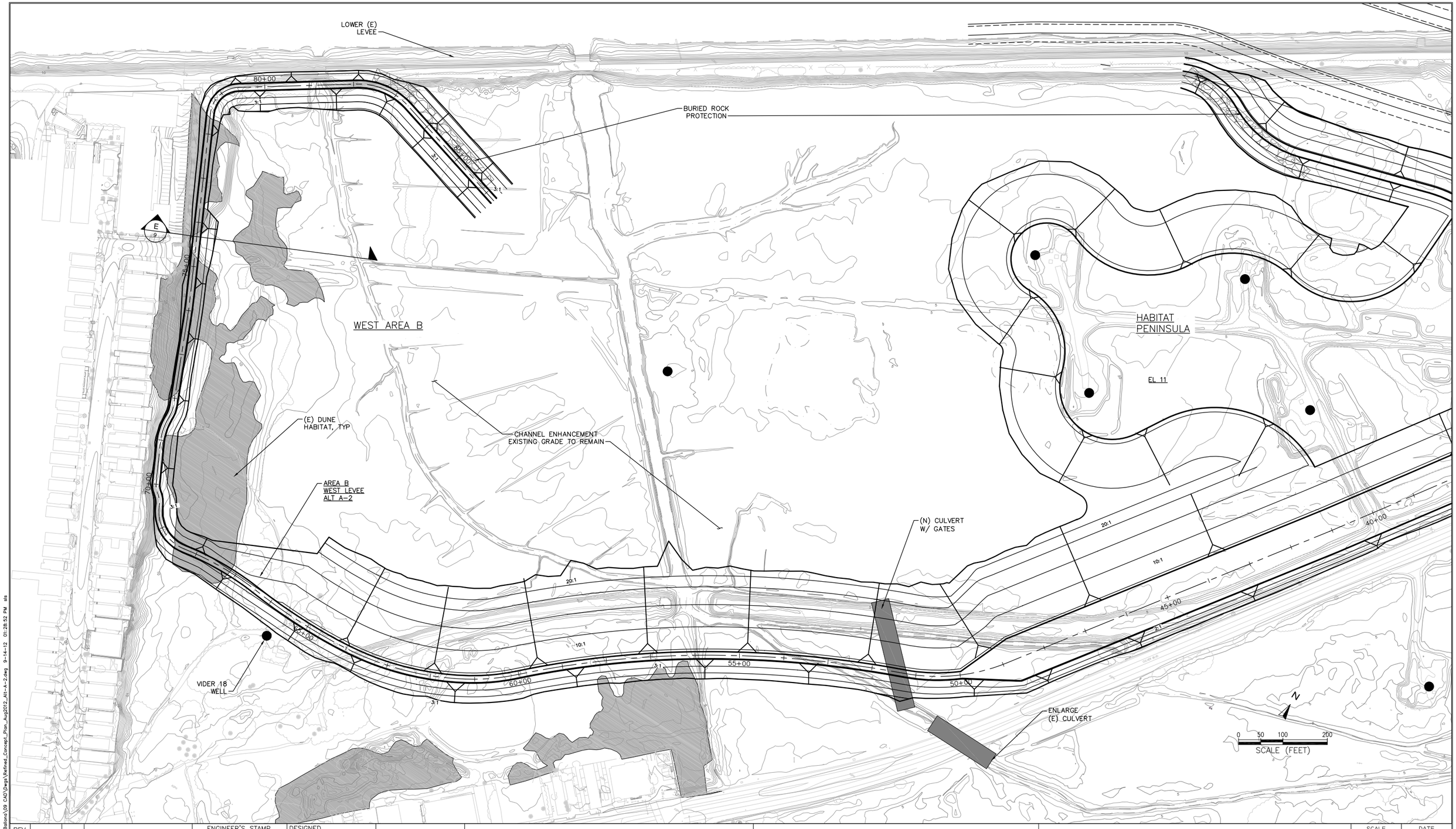

REV. NO.	DATE	BY	DESCRIPTION

ENGINEER'S STAMP

DESIGNED	ML
DRAWN	SLS
CHECKED	BB
PWA JOB NO.	120367.00

PREPARED FOR:

STATE COASTAL CONSERVANCY

PREPARED BY:

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BALLONA WETLANDS RESTORATION
REVISED CONCEPTUAL PLAN
AREA B - LEVEE ALTERNATIVES: A-2

SCALE	DATE
AS SHOWN	9-13-2012

figure 4
Levee Alternative
A-2 Plan

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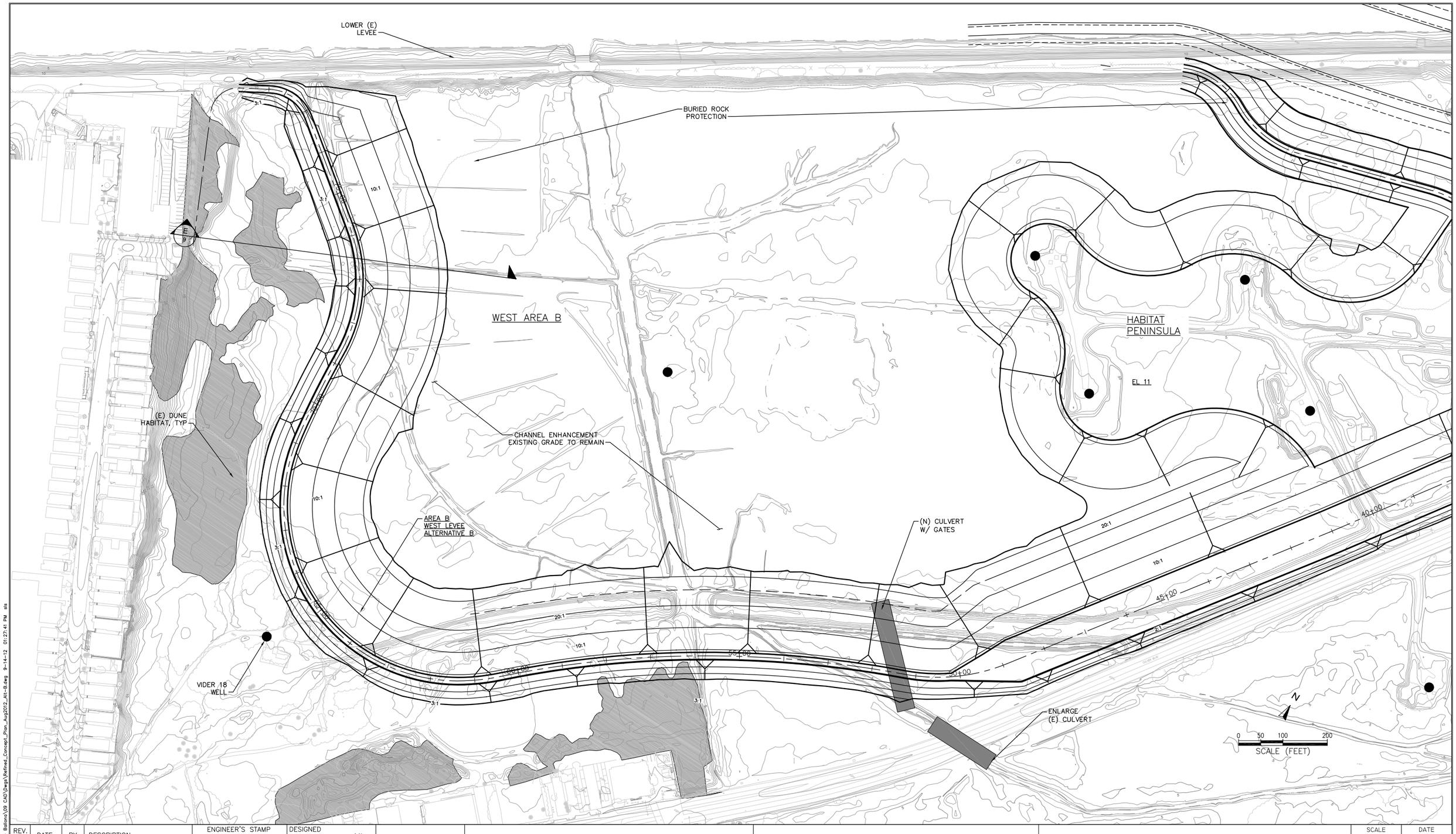

REV. NO.	DATE	BY	DESCRIPTION

ENGINEER'S STAMP

DESIGNED	ML
DRAWN	SLS
CHECKED	BB
PWA JOB NO.	D120367.00

PREPARED FOR:

STATE COASTAL CONSERVANCY

PREPARED BY:

ESA PWA
550 Kearny Street, Suite 900
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BALLONA WETLANDS RESTORATION
REVISED CONCEPTUAL PLAN
AREA B - LEVEE ALTERNATIVES: B

SCALE	DATE
AS SHOWN	9-12-2012

figure 5
Levee Alternative B Plan

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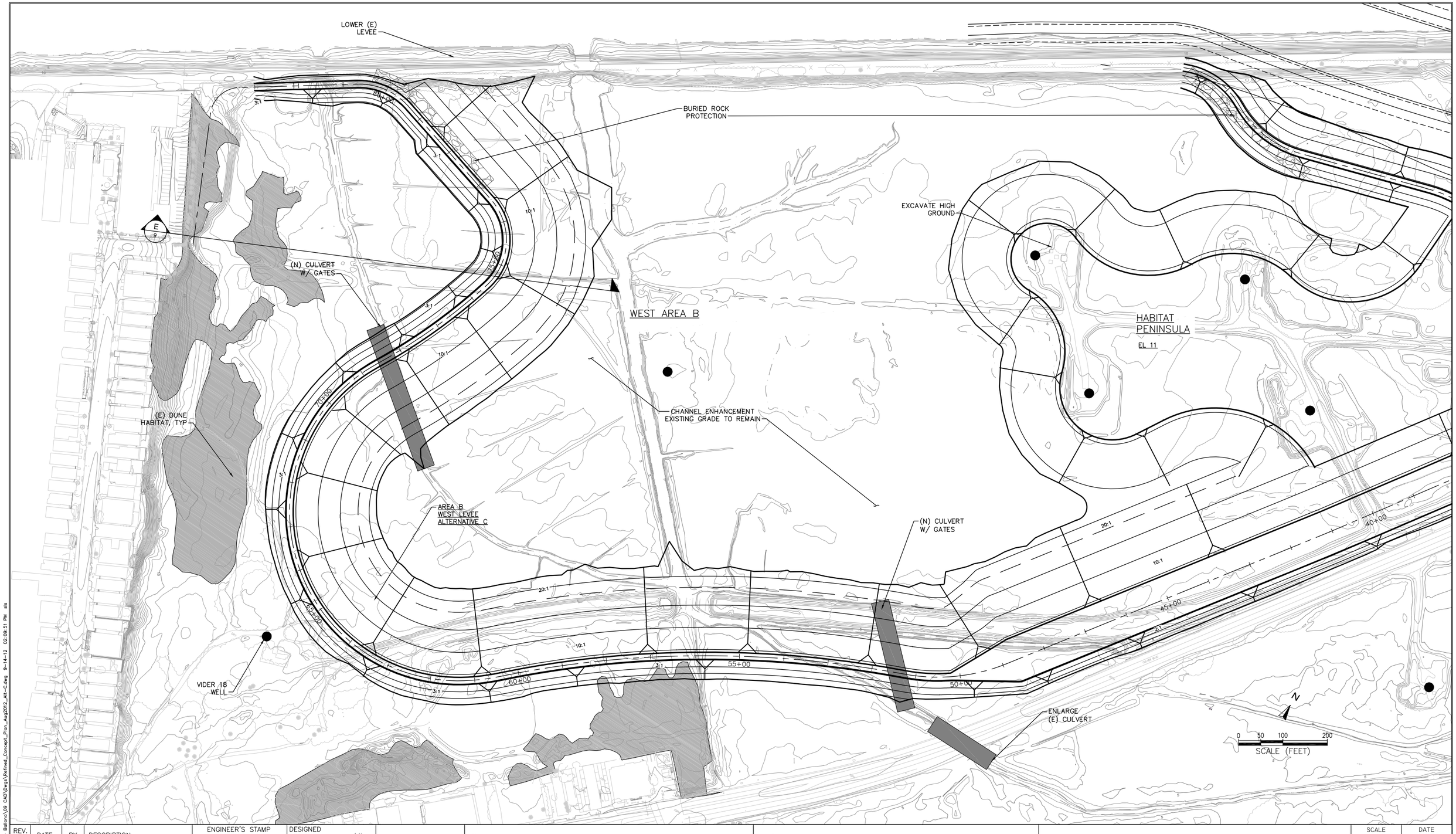

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BALLONA WETLANDS RESTORATION
REVISED CONCEPTUAL PLAN
AREA B - LEVEE ALTERNATIVES: C

SCALE	DATE
AS SHOWN	9-12-2012

figure 6
Levee Alternative C Plan

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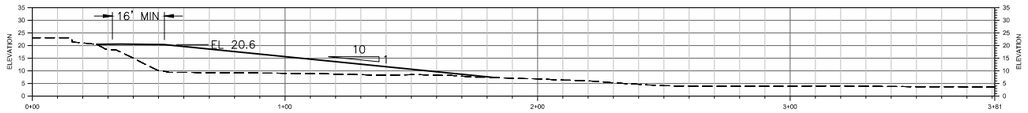
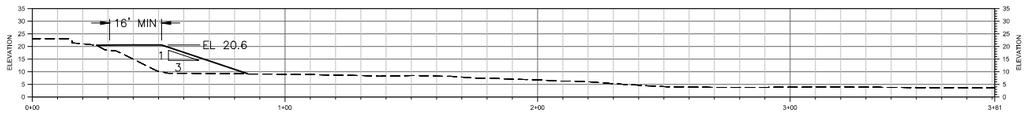
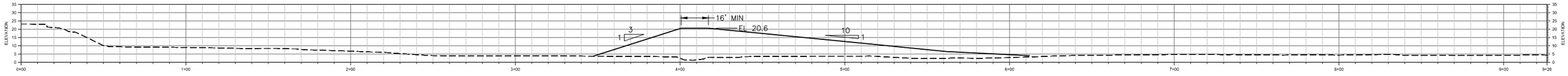


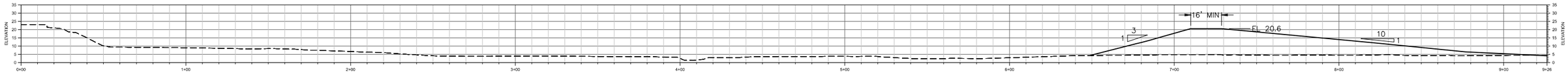
ALT A–1



ALT A–2



ALT B



ALT C

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BALLONA WETLANDS RESTORATION
REVISED CONCEPTUAL PLAN SECTIONS

SCALE	DATE
1" = 30'	9–14–12

figure 7
Levee Sections

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MARINA DEL REY
HARBOR/
ENTRANCE CHANNEL

AREA A

AREA B

AREA C

WEST AREA B

NORTH AREA B

SOUTH AREA B

EAST AREA B

FIJI WAY

FIJI CHANNEL

(E) CULVERT

MARINA FWY. (90)

LINCOLN BLVD

(N) CULVERT

BALLONA CREEK

BURIED ROCK PROTECTION

LOWER (E) JETTY (OPTIONAL)

PROPERTY BOUNDARY (TYP)

LOWER (E) LEVEE

(N) BREACH

EXCAVATE (E) HIGH GROUND

CHANNEL ENHANCEMENT, EXISTING GRADE TO REMAIN

(N) CULVERTS & GATES

HABITAT PENINSULA

CULVER BLVD

ENLARGE (E) CULVERT

(N) ACCESS & STORM DRAINAGE FEATURES

ENLARGE (E) CULVERT, (N) GATES

GAS CO. RD

(N) CULVERTS & GATES

JEFFERSON BLVD

(N) CHANNEL

(N) CULVERT

(E) WEIR

(E) FRESHWATER MARSH

CHANNEL ENHANCEMENT, EXISTING GRADE TO REMAIN

(N) CULVERT & GATE

PROPERTY BOUNDARY

LEGEND

- EXISTING GRADE MAJOR CONTOUR
- EXISTING GRADE MINOR CONTOUR
- DESIGN GRADE MAJOR CONTOUR
- GRADE BREAK (EG. TOE OR TOP OF BANK)

N

0 150 300 600

SCALE (FEET)

NOTES:
1: ALL ELEVATIONS ARE IN NORTH AMERICAN VERTICAL DATUM 1988 (NAVD).
2: DESIGN GRADE CONTOURS REPRESENT APPROXIMATE ROUGH GRADING. DETAILED GRADING NOT SHOWN.

DRAFT
NOT FOR CONSTRUCTION

REV. NO.	DATE	BY	DESCRIPTION

ENGINEER'S STAMP

DESIGNED

DRAWN

CHECKED

PWA JOB NO. 1793.13

PREPARED FOR:

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BALLONA WETLANDS RESTORATION CONCEPTUAL GRADING PLAN

SCALE: AS SHOWN

DATE: 2-28-2012

figure 8
Prior Conceptual Design

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Appendix F2
Levee Protection Memo

LEVEE PROTECTION MEMO

INTRODUCTION

A decision needs to be made regarding levee armoring along Ballona Creek's proposed flood protection levee. This memorandum provides: (1) a summary of selected levee construction, protection, and vegetation management guidelines and (2) real world examples of several levee protection alternatives.

At the Ballona Wetland site, the U.S. Army Corps of Engineers (USACE) is the permitting agency and the L.A. County Flood Control District is currently responsible for maintaining the levees. As such, it is important that these two entities are engaged during the preliminary design process to ensure the project meets their expectations.

DESIGN AND CONSTRUCTION OF LEVEES

The USACE produces guidelines for levee design on projects that they design or certify. The bullet points below come from the Engineering Memorandum 1110-2-1913: Design and Construction of Levees (2000).

- The steepest slope for constructability and riprap stability is 2:1 (H:V). For maintenance activity (i.e. walking, driving mowers and other equipment) a 3:1 (H:V) slope is recommended.
- Minimum road width is 10 to 12 ft, based on the physical capabilities of heavy construction equipment. Levee stability can be increased by flattening slopes and/or adding stability berms, which are based on geotechnical investigations.
- Levee stability can be increased by physical changes to the embankment section, including flattening embankment slopes and adding stability berms (which are more robust than flattening the slope).
- The process of segregating materials and preferentially placing the more impervious materials on the riverside of the embankment improves resistance to infiltration and erosion. This process is time consuming but for large projects can prove to be cost effective.
- Protection of Riverside Slopes: consider erodibility of embankment soils; roughness elements such as vegetation can shield slope from wave attack; very flat slopes can employ less structural protection including grass; assign levee protection according to the erosive forces that each levee portion will face; soil cement may prove economical when haul distances cause riprap to be uneconomical.
- Turnouts (24' wide minimum levee top) should be placed every 2500 ft in straight sections and closer when sight distance is less.

<u>Levee Protection</u>

The proposed levees are set back 200 to over 1000 feet from Ballona Creek. Protecting the new levees from erosion and failure will be based on modeled flow conditions and design guidance from several

sources. We anticipate that for much of the project length flow conditions will indicate that vegetative cover will provide necessary erosion resistance, and that there will be velocity and shear stress hot spots that which will require surface or buried slope protection.

Levee overtopping studies provide insight into levee protection on the landside as well as the waterside. Resistance of levee slopes to overtopping flows is premised on the concept of cumulative work, which accounts for the observation (1) earthen levees can tolerate certain levels of wave overtopping without any soil erosion, (2) earthen levees can survive some duration of increased wave overtopping with allowable erosion, and (3) earthen levees will eventually suffer slope damage if the overtopping level is high and overtopping duration is sufficiently long (USACE, 2011). Work by Hewlett et al. (1987) and wave overtopping studies at Colorado State University (CSU) in 2010 looked at the length of time that different lining materials could resist erosion at various velocities (USACE, 2011).

Figure 1 below shows limiting velocity curves for grass and other ground coverings, including meshes, fabrics, and concrete block systems. Open mats are synthetic mats which are subsequently filled with topsoil. Filled mats are synthetic mats filled with bitumen-bound gravel. Fabrics are considered to be woven geotextiles.

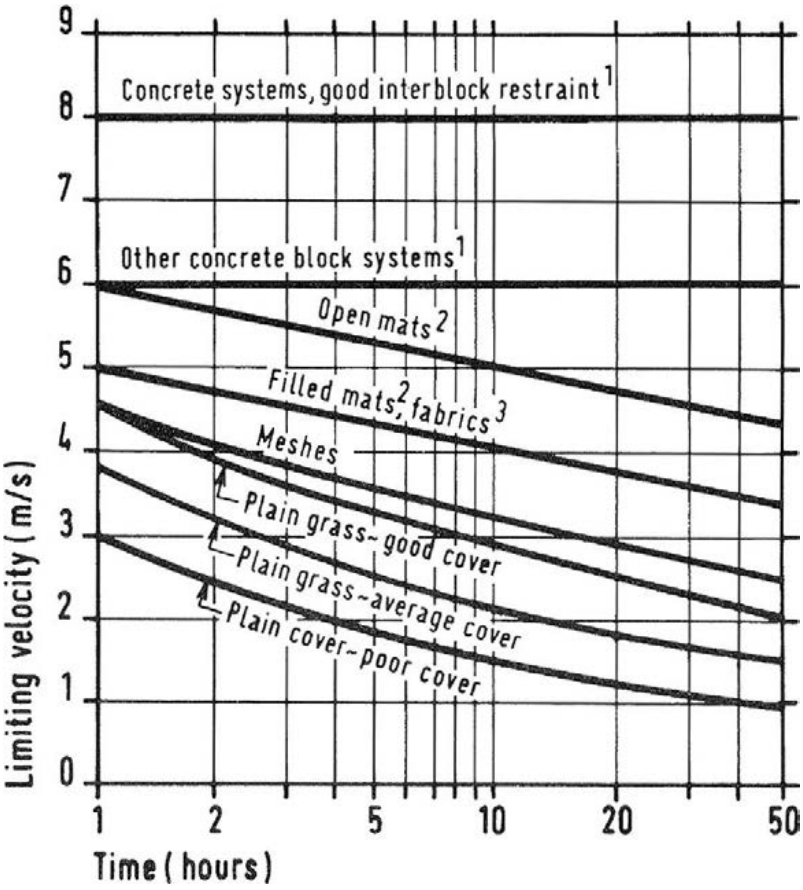


Figure 1. Limiting velocity curves from Hewlett et al. (1987). Note 1 m/s equals about 3.3 fps.

Following hurricane Katrina, the U.S. Army Corps of Engineers developed the Hurricane and Storm Damage Risk Reduction System (HSDRRS) that includes upgraded and new levees in the New Orleans, Louisiana area [1]. This program included extensive testing of grass and turf-reinforcement fabrics for surficial erosion control, including large scale physical model tests. The CSU wave overtopping simulator tested levee slopes built to mimic the geometry and vegetated surface of typical New Orleans levees. The slope length was 28 ft at 3:1, and then transitioned to a 12-ft length at 25:1. The slopes were composed of the same compacted clay soil used in the New Orleans levees. Nine treatments were tested, and the results are presented in the table below: Two grasses, Bermuda and Bahia were tested; turf reinforced mats (TRM) and high-strength turf reinforced mats (HSTRM, also referred to as high-performance turf reinforcement mats, or HPTRM) were placed beneath the turf grass; Bermuda grass with tire ruts; clay mixed with hydrated lime; articulated concrete blocks were placed on top of the clay surface with filter fabric beneath the blocks, and voids filled with 1" crushed rock. In essence the research found that well established grasses can protect levees with overtopping rates of at least 3 cfs/ft without failure. However, theses overtopping rates are higher than the previously published thresholds for steady water (vs. wave pulse) overflows. Prior studies had indicated a design steady flowrate for grass to be about 0.1 cfs/ft. hence a lower design flowrate for grasses is considered less risky. Provisionally, an overtopping rate of 1.0 cfs/ft for bare grasses and 2.0 cfs / ft for grass with HSTRM / HPTRM may be more appropriate for general application.

Table 1 Overtopping rates and resultant erosion for grass covered levees (Thornton et al. 2010).

Levee Slope Surface	Total Time (hrs)	Max. Over. Rate (ft^3/s per ft)	End Result
Bare Clay	1.3	0.2	Severe Erosion
Bermuda Grass	24	4.0	No Damage
Bahia Grass	17	3.0	No Damage
Bermuda w/TRM	9	4.0	No Damage
Bermuda w/HSTRM	9	4.0	No Damage
Bermuda w/Ruts	9	4.0	Minor Erosion
Lime-Stabilized Clay	2	4.0	Severe Erosion
Articulated Concrete Block	3	4.0	Minor Erosion
Dormant Bermuda Grass	3	2.5	Significant Erosion

Traditional hydraulic analyses such as those outlined in USACE River Hydraulics Engineering Manual (1993), can be coupled with published bank stability thresholds for bank treatments to determine acceptable levee bank protection. Fischenich (2001) developed a methodology to select appropriate channel lining materials given a channel's flow regime. Table 2 lists the permissible shear and velocity for several lining materials.

[1] http://www.mvn.usace.army.mil/hps2/hps_background.asp

Table 2. Permissible Shear and Velocity for Selected Lining Materials[1]

Boundary Category	Boundary Type	Permissible Shear Stress (lb/sq ft)	Permissible Velocity (ft/sec)	Citation(s)
Soils	Fine colloidal sand	0.02 - 0.03	1.5	A
	Sandy loam (noncolloidal)	0.03 - 0.04	1.75	A
	Alluvial silt (noncolloidal)	0.045 - 0.05	2	A
	Silty loam (noncolloidal)	0.045 - 0.05	1.75 – 2.25	A
	Firm loam	0.075	2.5	A
	Fine gravels	0.075	2.5	A
	Stiff clay	0.26	3 – 4.5	A, F
	Alluvial silt (colloidal)	0.26	3.75	A
	Graded loam to cobbles	0.38	3.75	A
	Graded silts to cobbles	0.43	4	A
	Shales and hardpan	0.67	6	A
Gravel/Cobble	1-in.	0.33	2.5 – 5	A
	2-in.	0.67	3 – 6	A
	6-in.	2.0	4 – 7.5	A
	12-in.	4.0	5.5 – 12	A
Vegetation	Class A turf	3.7	6 – 8	E, N
	Class B turf	2.1	4 - 7	E, N
	Class C turf	1.0	3.5	E, N
	Long native grasses	1.2 – 1.7	4 – 6	G, H, L, N
	Short native and bunch grass	0.7 - 0.95	3 – 4	G, H, L, N
	Reed plantings	0.1-0.6	N/A	E, N
	Hardwood tree plantings	0.41-2.5	N/A	E, N
Temporary Degradable RECPs	Jute net	0.45	1 – 2.5	E, H, M
	Straw with net	1.5 – 1.65	1 – 3	E, H, M
	Coconut fiber with net	2.25	3 – 4	E, M
	Fiberglass roving	2.00	2.5 – 7	E, H, M
Non-Degradable RECPs	Unvegetated	3.00	5 – 7	E, G, M
	Partially established	4.0-6.0	7.5 – 15	E, G, M
	Fully vegetated	8.00	8 – 21	F, L, M
Riprap	6 – in. d_{50}	2.5	5 – 10	H
	9 – in. d_{50}	3.8	7 – 11	H
	12 – in. d_{50}	5.1	10 – 13	H
	18 – in. d_{50}	7.6	12 – 16	H
	24 – in. d_{50}	10.1	14 – 18	E
Soil Bioengineering	Wattles	0.2 – 1.0	3	C, I, J, N
	Reed fascine	0.6-1.25	5	E
	Coir roll	3 - 5	8	E, M, N
	Vegetated coir mat	4 - 8	9.5	E, M, N
	Live brush mattress (initial)	0.4 – 4.1	4	B, E, I
	Live brush mattress (grown)	3.90-8.2	12	B, C, E, I, N
	Brush layering (initial/grown)	0.4 – 6.25	12	E, I, N
	Live fascine	1.25-3.10	6 – 8	C, E, I, J
	Live willow stakes	2.10-3.10	3 – 10	E, N, O
Hard Surfacing	Gabions	10	14 – 19	D
	Concrete	12.5	>18	H

[1] Ranges of values generally reflect multiple sources of data or different testing conditions.

A. Chang, H.H. (1988).
B. Florineth. (1982)
C. Gerstgraser, C. (1998).
D. Goff, K. (1999).
E. Gray, D.H., and Sotir, R.B. (1996).
F. Julien, P.Y. (1995).
G. Kouwen, N.; Li, R. M.; and Simons, D.B., (1980).
H. Norman, J. N. (1975).
I. Schiechtl, H. M. and R. Stern. (1996).
J. Schoklitsch, A. (1937).
K. Sprague, C.J. (1999).
L. Temple, D.M. (1980).
M. TXDOT (1999)
N. Data from Author (2001)
O. USACE (1997).

VEGETATION ON LEVEES

US Army Corps of Engineers (USACE)

In 2009, the USACE updated their guidelines for vegetation on levees in the wake of Hurricane Katrina (USACE, 2009). It is applicable to all flood control levees where the Corps has the responsibility for design, operation, maintenance, inspection, or certification. The purpose of the guidelines is to provide aesthetic and human value to flood control projects while retaining the structural integrity, functionality, serviceability, and accessibility for flood fighting.

The specific vegetation guidelines for different levee configurations is best seen graphically in Figures 2 through 5. In essence the guidelines state:

- Vegetation on levees is limited to native grass species on levee crown, slopes and within 15 feet of the levee toe, as measured from the centerline of the tree trunk.
- Trees and other woody vegetation are allowed on specially designed planting berms (Figure 4) that keep the vegetation from adversely affecting the performance of the levee core. It is unclear if planting berms are allowed on the riverside.
- Trees and other woody vegetation within the 20-foot right-of-way

There is a possibility for a variance from the policy, though the project has to meet the following two requirements: (1) the variance must be shown to be necessary and the only feasible means to preserve, protect, and enhance natural resources, and (2) the safety, structural integrity, and functionality of the levee is retained as well as accessibility for monitoring, maintenance, and flood-fighting (ER 500-1-1; EP 500-1-1).

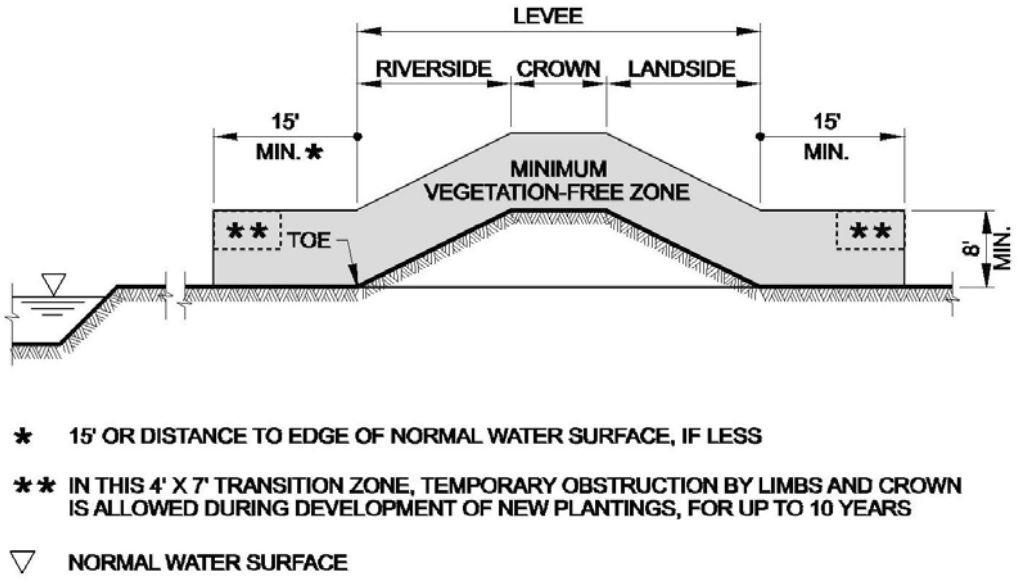


Figure 2 Typical levee cross section, with vegetation-free zone indicated to include the levee itself and extend outward fifteen feet from the leveee toe (note native grasses are allowed in the vegetation-free zone).

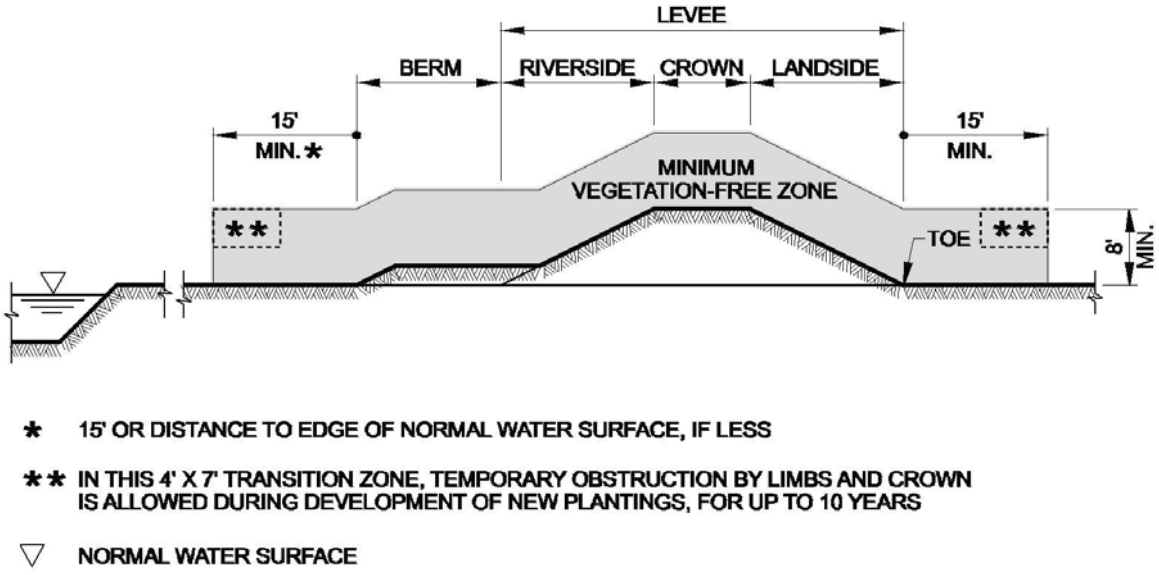
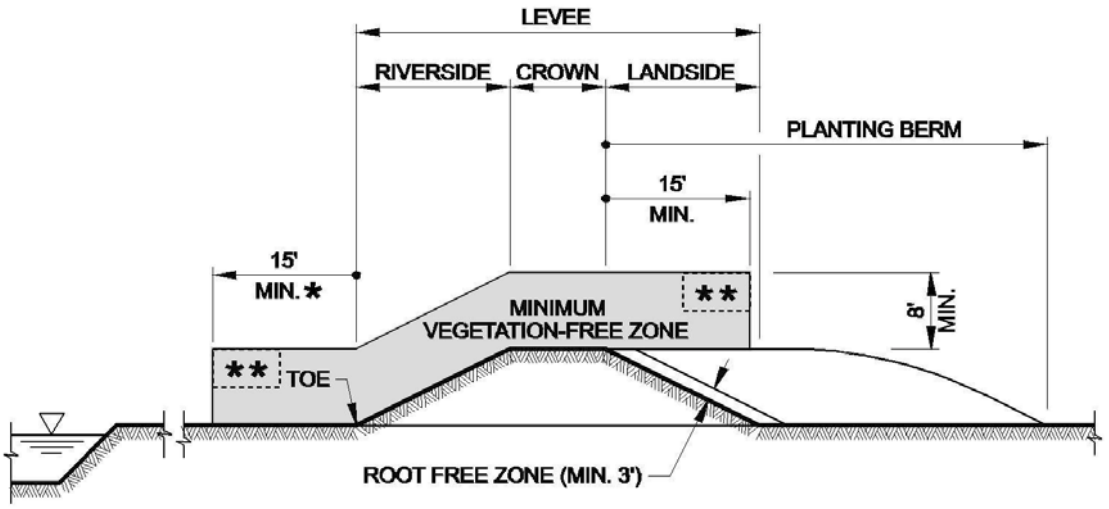


Figure 3 Vegetation-free zone shown when a stability berm is included on the water side. Vegetation only allowed fifteen feet from stability berm.

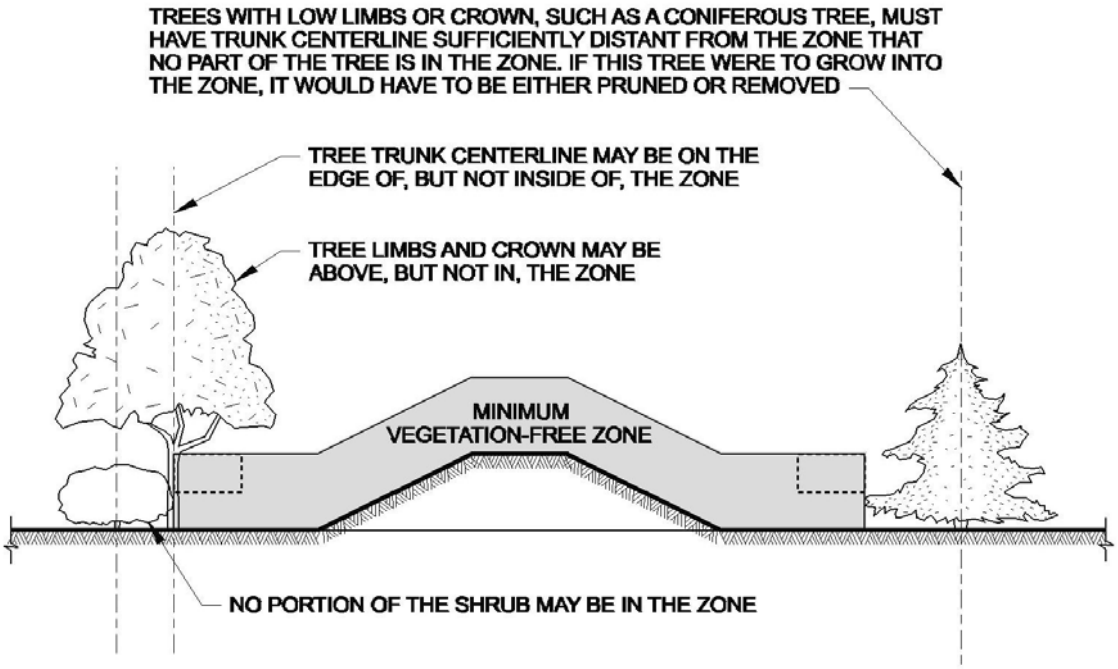


* 15' OR DISTANCE TO EDGE OF NORMAL WATER SURFACE, IF LESS

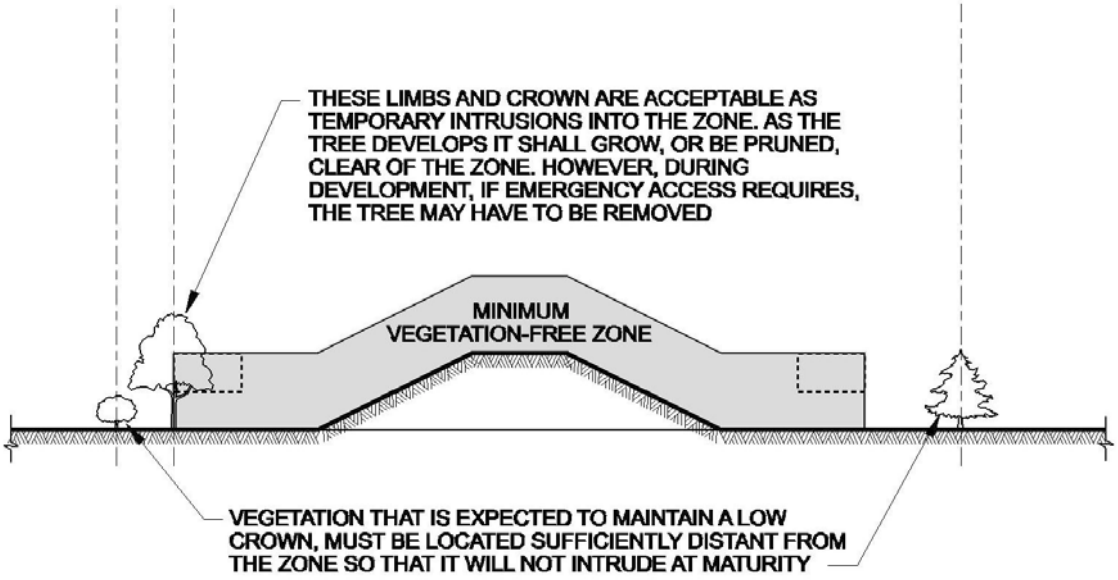
** IN THIS 4' X 7' TRANSITION ZONE, TEMPORARY OBSTRUCTION BY LIMBS AND CROWN IS ALLOWED DURING DEVELOPMENT OF NEW PLANTINGS, FOR UP TO 10 YEARS

▽ NORMAL WATER SURFACE

Figure 4 Vegetation-free zone when planting berm is incorporated on land side. Planting allowed fifteen feet from top of levee, provided the 3-foot root buffer from levee core is observed.



a. MATURE TREES AND SHRUB



b. NEWLY PLANTED TREES AND SHRUB

NOTE: THE MIRROR IMAGE OF THIS FIGURE WOULD BE EQUALLY CORRECT, REGARDLESS OF WHICH SIDE IS THE RIVERSIDE

The guidelines therefore allow native grass cover on levees. Larger vegetation and landscaping are allowed on planting berms on the landward side. It is not clear whether a variance would be required to

include planting berms on the river (water) side. However, we anticipate that the Ballona Project could request a variance based on the restoration goals of the Ballona Project.

Los Angeles County

Los Angeles County has typically used rock, concrete and soil cement armoring of all flood control levees. Soil cement has been used recently to avoid the negatives associated with rock and concrete armoring.

Examples of Biotechnical Levee Armoring

There are several examples of flood control levees that have non-structural levee armoring. Here, we define "non-structural" as biotechnical approaches that incorporate vegetation, engineering fabrics and flat slopes to limit wave and current loadings. The following examples are discussed:

- SAFCA
- Hamilton Wetland Restoration Project
- Louisiana HSTRRS

SAFCA

The Sacramento Area Flood Control Agency (SAFCA) has successfully obtained a vegetation variance from the USACE for 42 miles of existing vegetated levees along the Sacramento and American Rivers. The historic vegetation supports ecological function of the river system and removal would have a questionable net benefit for levee integrity.

The concerns that the USACE has with vegetation on levees are primarily (1) structural (roots may weaken levees and provide a pathway for seepage, overturned trees can initiate bank scour) and (2) maintenance related (visual inspection, access, flood fighting, etc.).

SAFCA demonstrated that the theoretical levee prism (i.e. the minimum levee section needed to meet USACE criteria for resistance to underseepage and rapid drawdown) was maintained in the event of tree overturning and ensuing scour.

The analysis assumed an initial root pit of 4 feet (although a depth of 3 feet is typical). For the levee materials and dimensions, flow conditions and durations examined, the maximum scour hole depth was 18 feet. To meet the variance criteria, SAFCA demonstrated that the scour hole did not intersect the theoretical levee prism.

SAFCA will continue to maintain vegetation so that visual inspections, access and flood fighting are not impaired by existing vegetation (SAFCA, 2010).

Hamilton Wetland Restoration Project

The Hamilton Wetland Restoration Project (HWRP) is a military base closure and ecosystem restoration project being implemented by the US Army Corps of Engineers (San Francisco District) and the State of California[3] . The project includes new levees setback along the site perimeter to allow inundation of the site and development of tidal and seasonal wetlands (Figure HWRP1). The perimeter levees have flat slopes to provide an "ecotone" from tidal wetland to upland while also providing wave and erosion protection and stability berm functions. Figures HWRP2 and HWRP3 show examples of the constructed levees and biotechnical erosion protection to be implemented[4]. The levees were designed for the 100-year hydraulic conditions to prevent flooding of adjacent properties due to overtopping and erosion.

[3] http://www.spn.usace.army.mil/hamilton/

[4] USACE and others, 2008; Basis of Restoration Design for Seasonal and Tidal Wetlands, Hamilton Wetland Restoration Project, December 10, 2008.

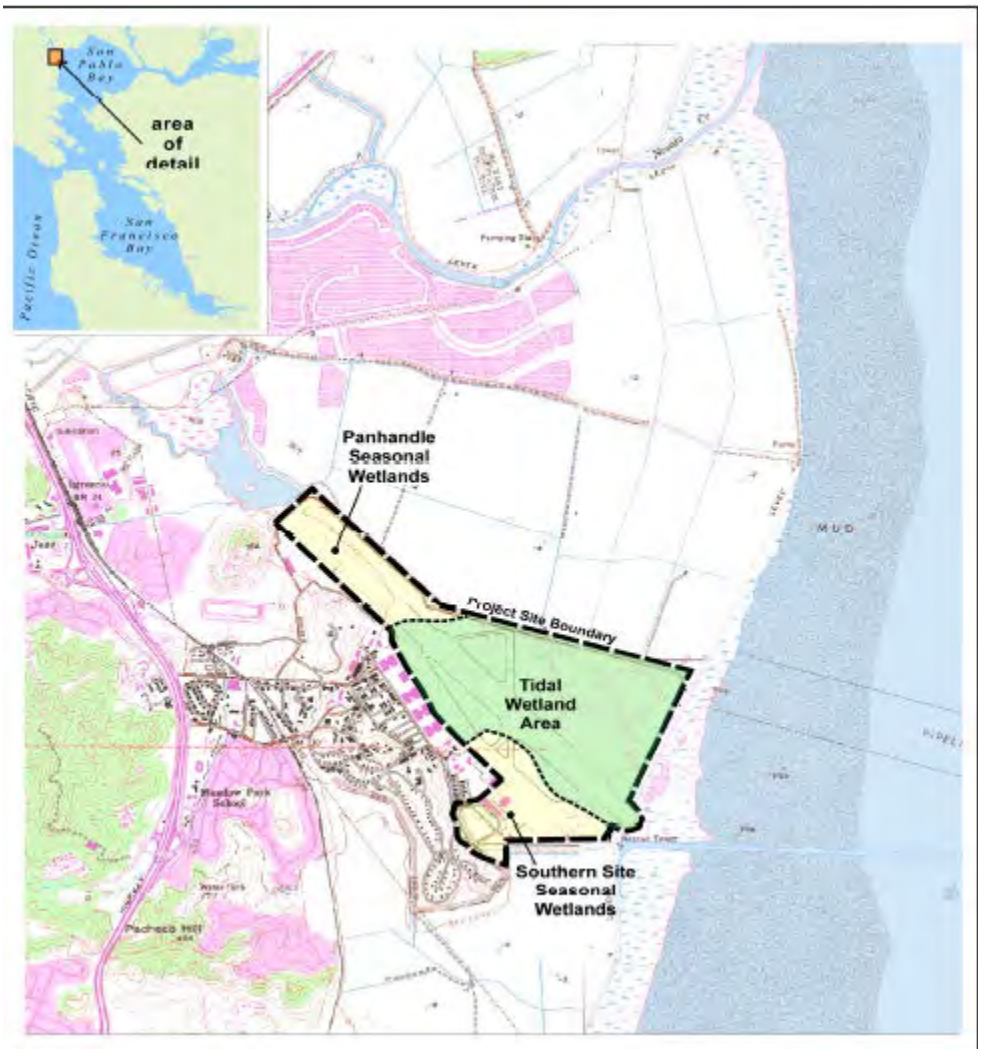


Figure HWRP1: Hamilton Wetland Restoration Project Site Schematic

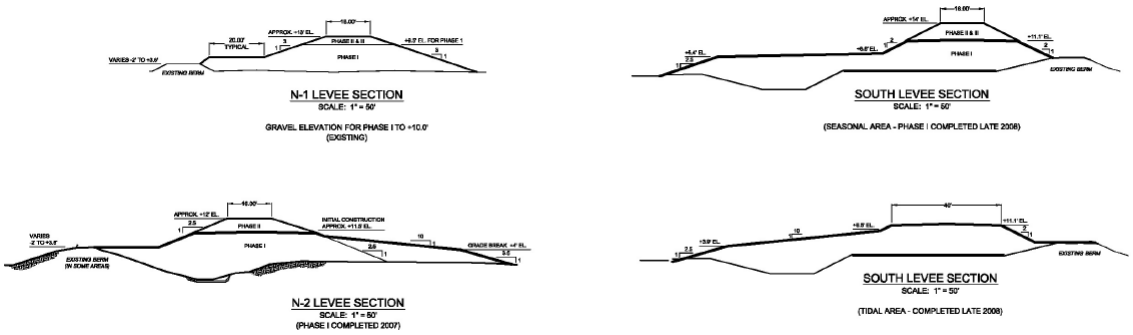


Figure HWRP2: HWRP levee cross-sections. The levees rely on excess soil and vegetation to mitigate erosion and flooding without use of traditional armoring.

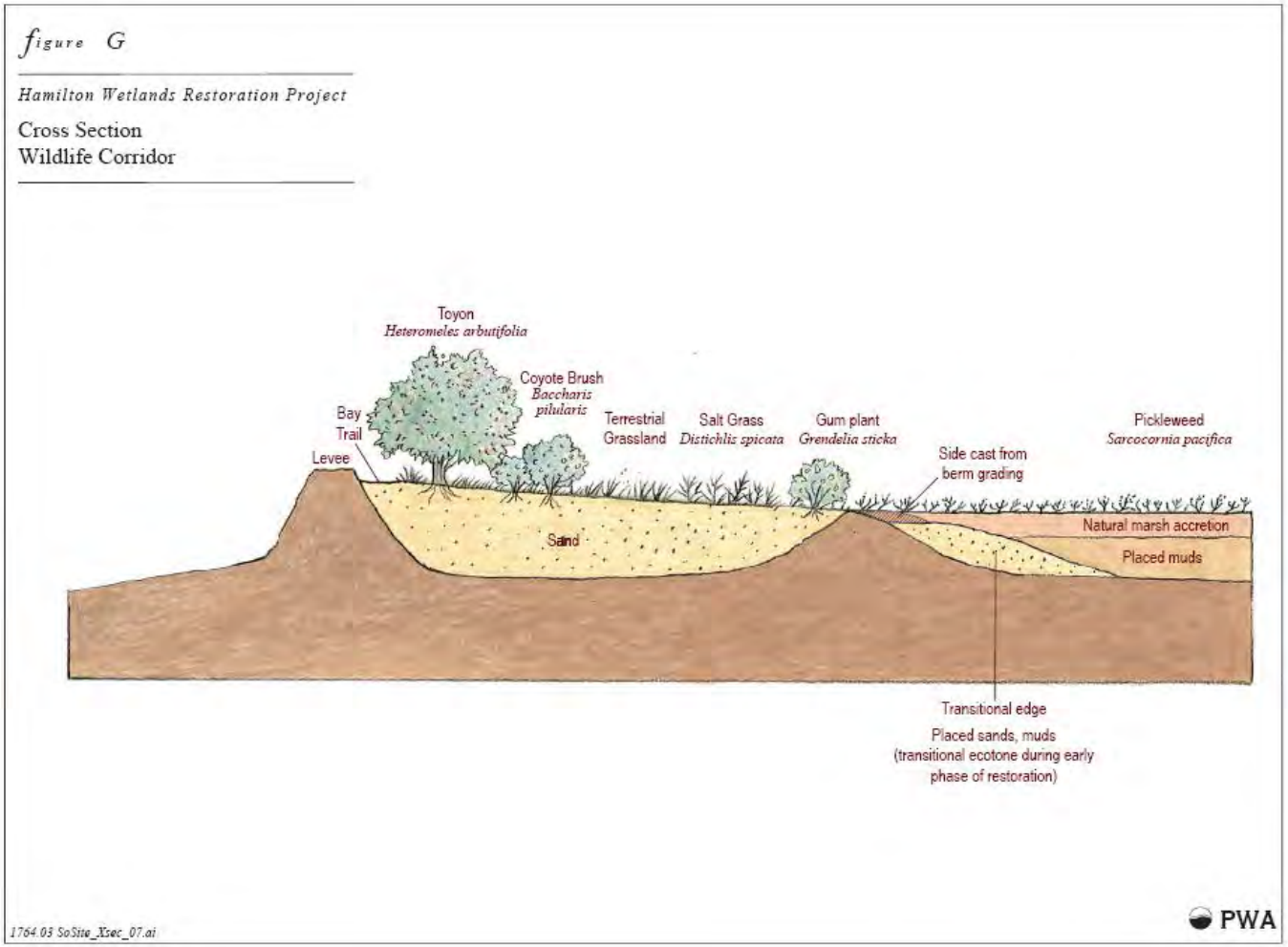


Figure HWRP3: A schematic showing the biotechnical armoring approach being implemented along the Wildlife Corridor of the HWRP. The Wildlife Corridor is on the south side of the site, and the levee provides flood protection to a residential development behind it. The sand and mud have been placed as part of a navigation dredging project (Port of Oakland) to accomplish ecosystem restoration via beneficial reuse of dredged sediments. The earth berm and levee were used to confine dredged material placed via hydraulic slurry.

Louisiana HSTRRS

The Hurricane and Storm Damage Risk Reduction System (HSDRRS) is located in Louisiana and includes five parishes and consists of 350 miles of levees and floodwalls; 73 non-Federal pumping stations; 3 canal closure structures with pumps; and 4 gated outlets.[5] Grass with and without turf reinforcement matting are used to protect the earth levees from erosion in most locations that don't include a flood wall. An example grass covered earth levee is shown in Figure HSDRRS 1.

Figure HSDRRS 2 shows installation of high performance turf reinforcement mat (HPTRP). The USACE has developed criteria for HPTRP for the HSDRRS project[6]. In general, the HPTRP consists of a non-degradeable synthetic fiber matrix capable of supporting dense growth of grass roots thoruhg the material and into the subgrade soil. The HPTRM specified for the HSDRRS is as defined by the Erosion Control Technology Council (ECTC), EPA, Storm Water Technology Fact Sheet, Turf Reinforcement Mats, and FHWA, FP-03,

5 http://www.mvn.usace.army.mil/pd/projectslist/ProjectData/93501/reports/Causeway%20Fact%20Sheet%20(Oct%202011)%20.pdf

6 http://www.mvn.usace.army.mil/hps2/armoring/W912P8-12-SS-0007_HPTRMSourcesSought_REVISION_1.pdf



Figure HRPPS1: Flood control levee with grass erosion protection.



Figure HRPPS2: Flood control levee with high performance turf reinforcement mat being placed prior to grass establishment. (source: http://www.mvn.usace.army.mil/hps2/armoring.asp).

PROPOSED ARMORING

For Ballona, the restoration goals and objectives result in a preference to limit armoring that interferes with ecological function. Rock and concrete-lined slopes degrade ecology. Hence, biotechnical armoring (grasses, turf reinforcement mats and dissipative slopes) will be considered to the extent practicable and acceptable to LA County and the USACE. Where velocities and shear stresses exceed criteria for biotechnical measures, traditional armoring will be used. This traditional armoring is expected to consist of soil cement in areas of low erosion potential. In areas of high erosion potential, rock armor and concrete lining will be used. Where practicable, soil cement and rock armor will be buried under soil and vegetation, with the expectation that the armoring would not be exposed until an extreme event occurs.

Provisionally, the armoring locations are limited to areas of high velocities and likely turbulence due to impinging and accelerating flows during design high flow events. These locations are shown in PDR Figure 6D. The extent of armoring is subject to revision as design progresses.

REFERENCES:

EP 500-1-1-. Emergency Employment of Army and other Resources. Civil Emergency Management Program – Procedures, 30 Sept 2001 (Section 5.8.k and Appendix E).

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Hewlett, H.W.M, L.A. Boorman, and M.E. Bramley. 1987. Design of reinforced grass waterways, CIRIA Report 116, Construction and Industry Research and Information Association, London.

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Appendix G
Final Storm Water Management Plan

PRELIMINARY
STORM WATER MANAGEMENT PLAN

For

BALLONA RESTORATION PROJECT

By

PSOMAS

Dated: July 10, 2015

PURPOSE:

The purpose of this draft report is to outline the storm water management measures that will be implemented during construction to mitigate soils loss and dust control, as well as a description of the permanent project features and benefits proposed. This preliminary report is intended to provide an environmental impact analysis level discussion which will be expanded upon for the final Storm Water Management Plan to be used during project implementation.

This report is organized to discuss these issues in four categories. First, the storm water pollution prevention elements to be implemented during construction. Second, permanent project features and benefits to be provided and maintained in perpetuity. Third, the establishment periods and phasing that may be necessary for full implementation. And fourth, the maintenance and operations that may be necessary. After these four areas are discussed, an additional section that more specifically describes project specific storm water management elements is included.

I. Storm Water Pollution Prevention During Construction:

The overarching intent of storm water management during construction is to manage the construction activities and site conditions to reduce pollutants of concern from migrating from the site. This goes beyond the measures taken related to storm water events and includes daily operations. During implementation of this project, the majority of the construction involves grading of mass volumes of dirt. These activities generate potential soils migration from the site through surface soils movement activities and airborne dust generation. In addition, other activities will be conducted to include construction of structures, hardscape installation, equipment and signage installation, etc. Best Management Practices (BMP's) will be required to mitigate the potential impacts from these activities. BMP's will include the following daily list of activities and features:

- Application of water on dry soil to reduce losses through airborne dust.
- Placement of physical barriers such as straw waddles, silt fences, etc. to reduce loss of surface soil during rain events and daily cleanup operations.
- Installation and operation of Vehicular Staging Areas that includes wheel washes and oil pan drip collection to reduce the introduction of man-made products onto the site.
- Installation of vehicular dust containment measures, such as tarps or enclosures to limit soils and dust migration.
- Installation of local containment devices such as filter fabric or fiber rolls on existing drain inlets on adjacent streets as a secondary measure to further reduce the possibility of soils migration into downstream infrastructure or waterways.

Other BMP measures that will be implemented on a longer term, but still temporary basis, may be necessary. This would primarily be for areas that are graded but must be left in an unfinished condition until final construction is completed. For example, there may be a gap in time between grading of the levee and installation of the maintenance and pedestrian/ bike trail on top of it. Or, for the time between temporary placements of stockpiled soil for future grading fill operations, and its ultimate placement. Where construction phasing or sequencing like this occurs, BMP's may include:

- Application of temporary soil surface coatings, such as applied biodegradable chemicals or fabric.
- Application of temporary vegetation.
- Installation of temporary and removable sheeting material to cover newly graded areas.
- Were unfinished and newly graded areas are located such that rain event runoff might have localized erosion, interim storm water detention and settling areas may be provided.

II. Long Term Storm Water Management Features

The project itself acts as a storm water mitigation feature for the Ballona Watershed. As a wetlands restoration project, this project site will include a storm water cleansing functionality that will help remove constituents of concern through bio-uptake and re-establishment of a viable, sustainable, and natural ecological system. While the project serves this function and benefits the region, there are also many individual local beneficial features. The following lists specific types of permanent storm water management features that will be implemented within the project. More detailed descriptions are provided below:

- Bio-swales will be installed at the toe of all slopes steeper than 10 to 1, and along the non-creek side of the levees. Bio-swales allow the collection of runoff from the adjacent contributing slopes, bio-uptake of constituents in the runoff, and infiltration into the soil of the minor flows collected.
- Grading and installation of pre-treatment basins will be provided. These basins allow storage and controlled discharge of runoff to allow settlement of suspended solids prior to storm water discharge to main water bodies or primary retention areas.
- The project provides full vegetation coverage for bio-uptake of nearly the entire project area.
- For those areas with impervious surfaces, routing of storm water that falls on the impervious surfaces, such as bridges and trails, into vegetated areas will be provided for infiltration and bio-uptake of all localized runoff.

- The existing Fresh Water Marsh is a stormwater treatment BMP for storms events less than the 1-year storm for its upstream developed area. Modifications to the outlet weir will enhance this functionality.

- Erosion mitigation measures will be placed at all storm drainage outlets, on the more erodible portions of the side slopes of the levee, and on areas of pedestrian, bike and vehicular traffic. For the levee and drainage structures, these measures would include strategically located surface and sub-surface armoring. For access ways, the travel way surfaces would include compacted soil, gravel, decomposed granite, asphalt, concrete, or other appropriate surface material depending on the intended use.

III. Establishment Periods, Implementation, and Phasing

Construction will occur over an extended period of time, and in multiple phases and sequences. Temporary erosion control measures will be utilized prior to and during all construction activities, and will be implemented between construction sequences during the life of the project construction. Phasing and sequencing of project elements have been described in other areas of the analysis. Specific sequencing and sub phasing will be determined by the appropriate agencies, design team, and contractor prior to initiation of construction. Flexibility to adjust sub phasing is expected within the perimeters within the impacts and mitigations proposed.

Sufficient time must be allowed to establish the plant palette to the point it is essentially considered self-sustaining. During this establishment period, weekly, monthly, and seasonal evaluation and maintenance will be required.

IV. Operations and Maintenance

Erosion protection measures during construction and establishment periods will be an ongoing effort. After an initial mobilization and installation effort of providing the materials, there will be a constant effort to minimize the amount of erosion and sediment escape from the property. The initial effort will include installation of truck access BMP's including wheel washing areas, silt fencing and slope protection installation around the edge of the property and adjacent to all public roadways and drainage inlets. Installation of silt fencing and other surface erosion protection will not be required within the property except in localized cases. However, dust control measures throughout the property will be required and ongoing.

Ongoing maintenance during grading will include three primary efforts, dust control by deployment of water trucks, maintenance of the perimeter and local structure containment protection, and vehicular access point cleaning operations. Because the soil is generally in a moist or wet condition it is

anticipated that dust control can be accomplish with one water truck and its operator working constantly on a daily basis. However, multiple water trucks may be necessary during peak times and during particularly dry conditions. In addition, on a daily basis another truck and maintenance crew of two people will be utilized to inspect and repair any broken or missing erosion protection equipment or material. Operation of the wheel wash and access areas will require an average of a two person crew at each access location. During transfer of soils between areas, an access control station must be provided in each area. After grading is completed in any particular area, erosion protection will applied to the entire completed area and then inspected and maintained through the plant establishment period. It is anticipated that a crew of four people and one truck will be required for the duration of the plant establishment period.

After the construction and the plant establishment period is complete, the goal is that erosion protection will be accomplished through the natural plant palette in a self-sustaining manner. However, regular inspections and sporadic maintenance is expected.

V. Project Specific Storm Water Management Elements

a. Existing and Proposed Storm Water BMP's

There are a number of existing storm water mitigation features serving the property that will remain or be enhanced as shown on Figures 1 and 2. These include the Fresh Water Marsh, a detention basin in the Culver-Lincoln roadway loop, and a series of depressed areas that act as pre-treatment basins along an old, degraded drainage ditch along the toe of the Westchester Bluffs where a number of low areas exist. The Fresh Water Marsh will remain essentially as is with minor improvements to add additional storage controls. The detention basin in the roadway loop will remain as is. And, the historic drainage ditch will be enhanced with some grading and connectivity for drainage which will reduce the likelihood of erosion.

Proposed BMP's will include bio-swales, pre-treatment basins, discussed below, together with storm drain piping and detention basins. These proposed BMP's are presented on Figures 3 through 6 with details presented on Figures 7 through 13.

b. Bio-Swales

Bio-swales are placed throughout the project in order to serve erosion protection, water quality, and drainage routing functions. Bio-swales will vary in width from approximately three feet to twenty feet, and in depth from a few inches to two feet, Figure 12. Bio-swales will be place at the toes of all slopes greater than a ratio of 10 to 1 horizontal to vertical to collect storm water runoff from the slope face. When the volume of runoff is minor and does not need to be routed to a detention area or conveyance feature, the bio-swale will be sized to contain the volume anticipated for a 100-year storm event. In these cases, the bio-swale may have some minor longitudinal slope but acts more as a detention feature. For Larger volumes and when bio-swales act to convey storm water from the slope to a conveyance, treatment, or storage feature, the bio-swale will be designed to contain the flow and protect against erosion. Longitudinal slope will be very shallow, generally less than one percent. Bio-swales will also

be utilized along the edges of existing roadways outside of public right-of-way to collect storm water runoff from the adjacent roadway. The additional enhancement to these bio-swales will include elements to address the oils and other vehicular fluids expected in this type of runoff. These elements may include a different mix of vegetation and soils composition to allow the breakdown of the expected runoff constituents without long term loss of vegetation or extra maintenance requirements.

c. Pre-Treatment Basins

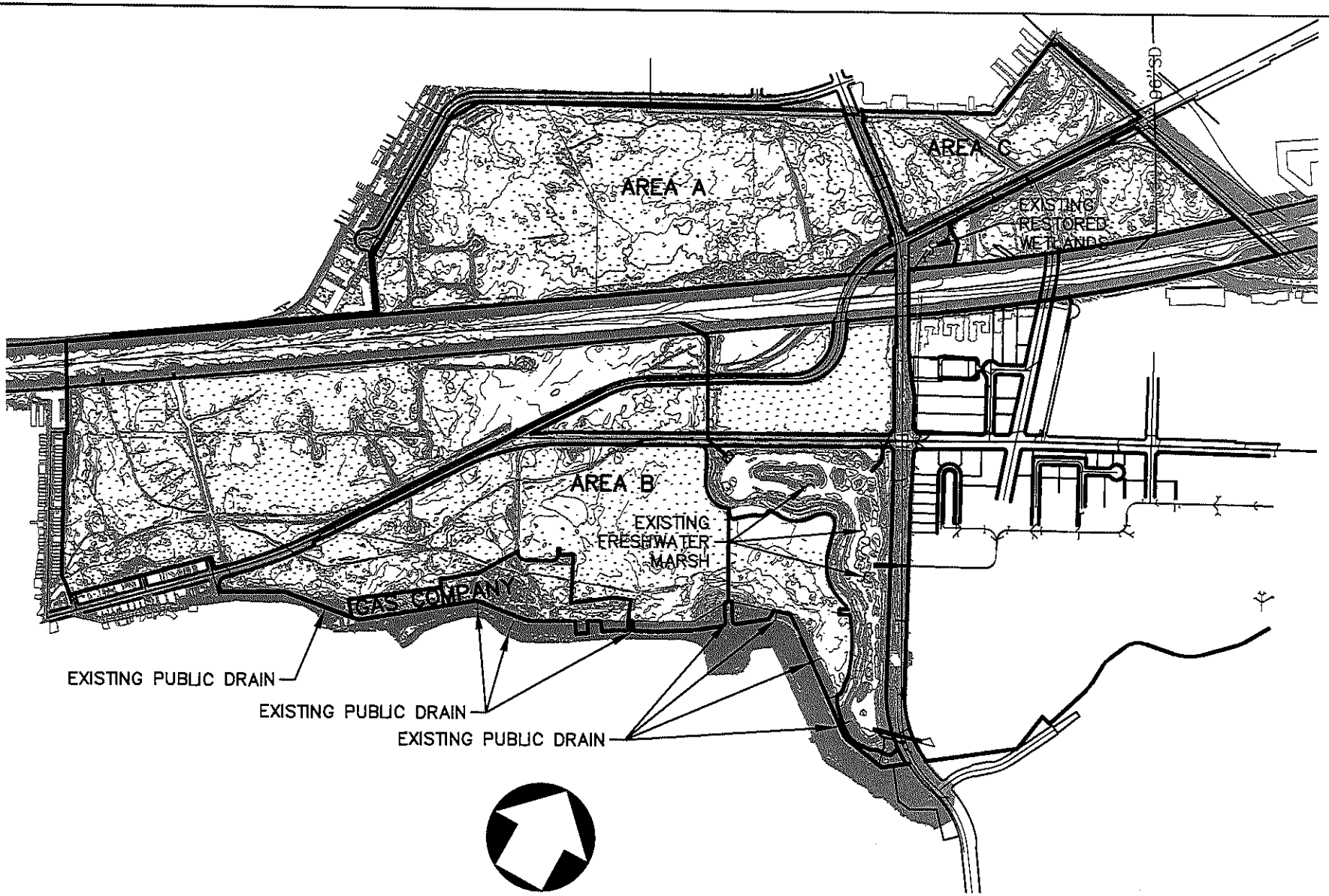
Pre-treatment basins are used throughout the project area where collection of storm water can be impacted by on-site or off-site pollutants and/or sediment runoff. These basins are intended to allow for settlement of suspended solids and reduction of discharge of these solids from the project site. Pre-treatment basins will be provided to mitigate runoff from each localized impervious on-site project feature, and sized and designed to accommodate the pollutants and runoff volume expected. Larger pre-treatment basins for some off-site runoff will also be provided as appropriate. Examples of these include a pre-treatment basin for the Beaches and Harbors parking lot in west Area A, for the existing parking lot on the west edge of Area B (adjacent to Gordon's Market), and for local existing storm drains discharging onto the south edge of Area B along the Westchester Bluffs. In addition, a large pre-treatment basin and detention basin system will be provided at an existing storm drain discharge point in west Area B immediately north of Nicholson Street. For this basin system, in addition to the storm water quality function that all pre-treatment basins provide, this basin system also serves a peak attenuation and volume storage function the 100-year storm event to mitigate an existing flooding situation for the developed properties south and west of the discharge point. Also, another type of pre-treatment basin will be incorporated adjacent to the main channel design to mitigate the minor sediment losses that may be expected from the project uplands areas in Area A where the channel has been realigned. Detention for the Pershing Drain overflow has been calculated at 1.8 acre-feet for the 100-year event. Listing of pre-treatment basins for Area B are shown in Table 1. Volume calculations for the proposed pre-treatment basins are shown in Appendix A with specific detail sheets located in Appendix B.

Basin Number	1 year Storage Volume
3A	0.1386 acre-feet
11D	0.0358 acre-feet
13E	0.0543 acre-feet
15D	0.0922 acre-feet
15C	0.8937 acre-feet
18C	1.3522 acre feet
14B	0.7989 acre feet

Table 1 – Area B Pre-Treatment Basins

d. Re-vegetation Program

A major component of permanent erosion protection and water quality treatment is in the elimination of constituents of concern through bio-uptake. In the natural environment almost all nutrients and heavy metals are used by plants for growth and production. The Ballona Restoration project will provide a natural plant pallet that not only restores habitat, but as a secondary benefit provides water quality treatment through the most natural methodology.



Note: For reduced sized prints, original scale is in inches

CALIFORNIA COASTAL CONSERVANCY

Existing Stormwater BMPs Figure 1

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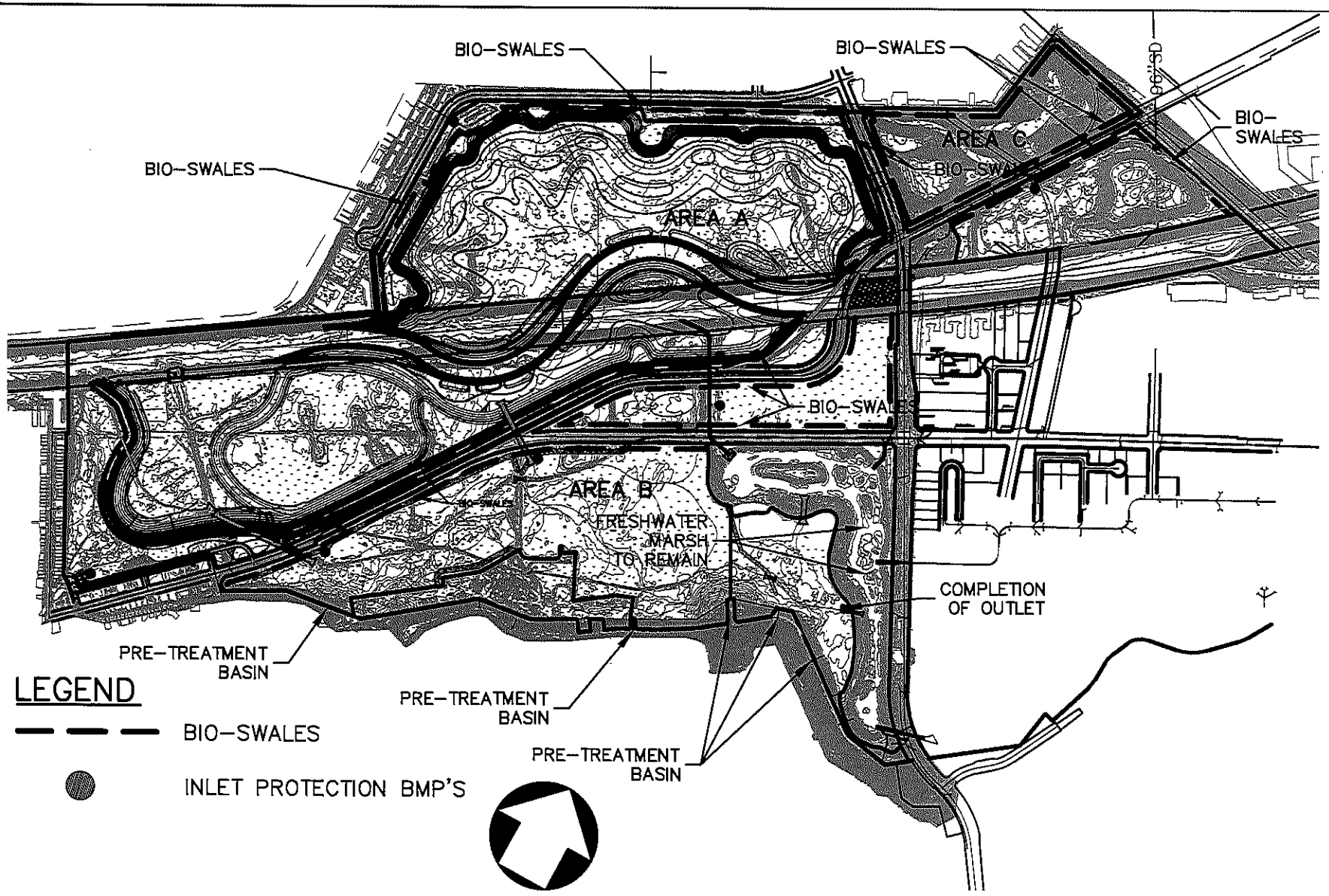

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Proposed Stormwater BMPs Figure 2

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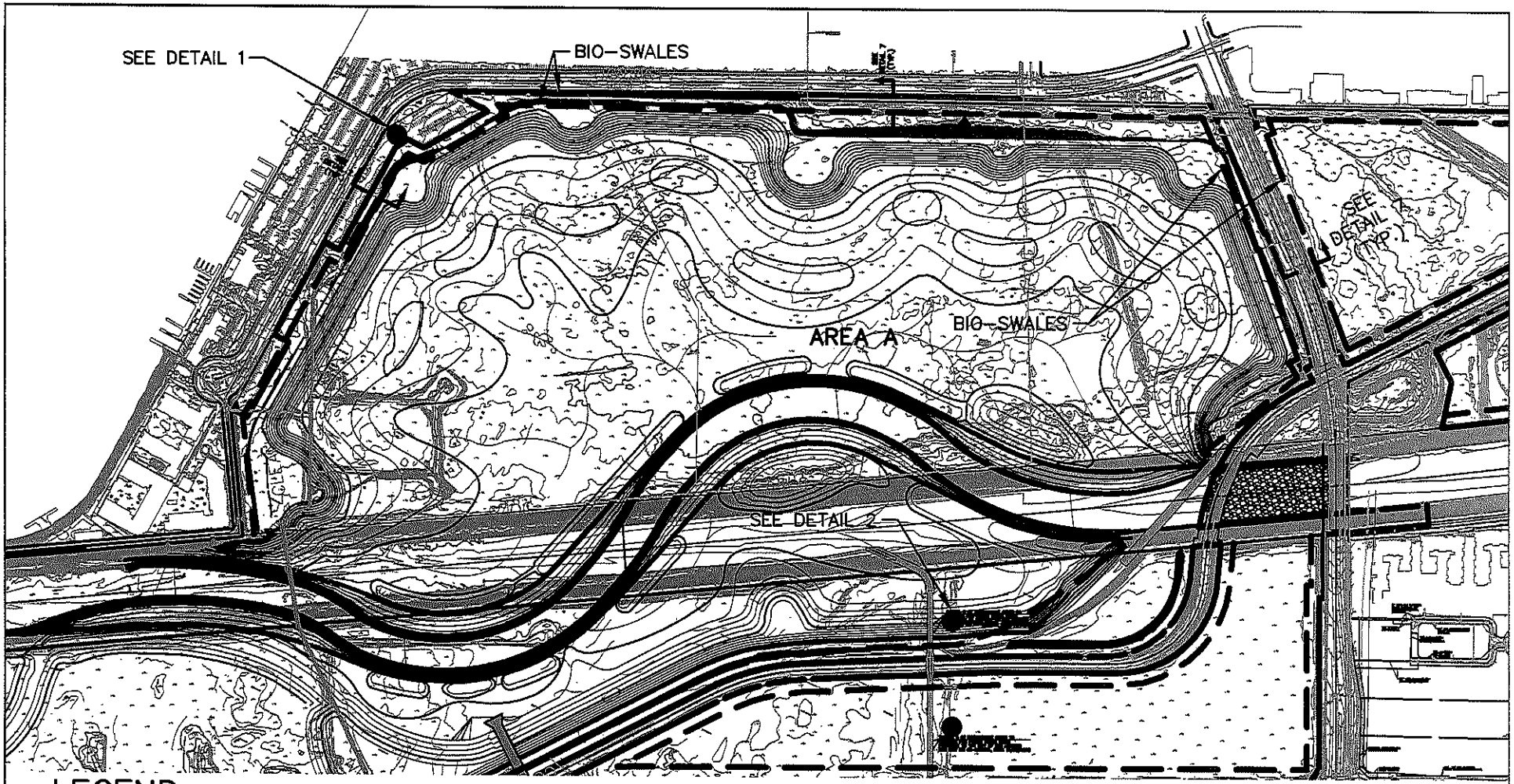

LEGEND

BIO-SWALES

INLET PROTECTION BMP'S

600' 300' 0' 600' 1200'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

Area A Stormwater BMPs Figure 3

CALIFORNIA COASTAL CONSERVANCY

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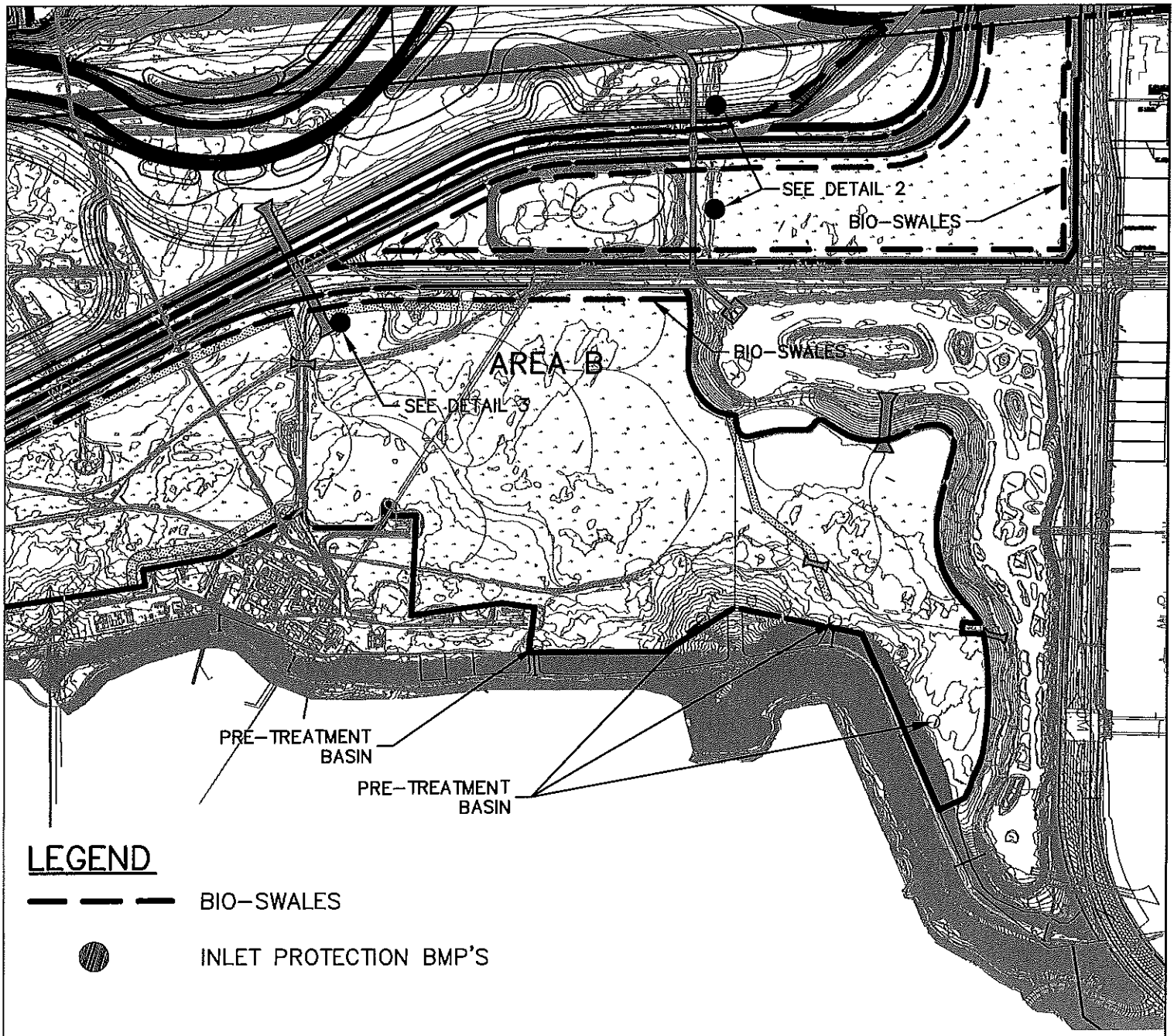

LEGEND

BIO-SWALES

INLET PROTECTION BMP'S

600' 300' 0' 600' 1200'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

Area B-East & B-South Stormwater BMPs Figure 4

CALIFORNIA COASTAL CONSERVANCY

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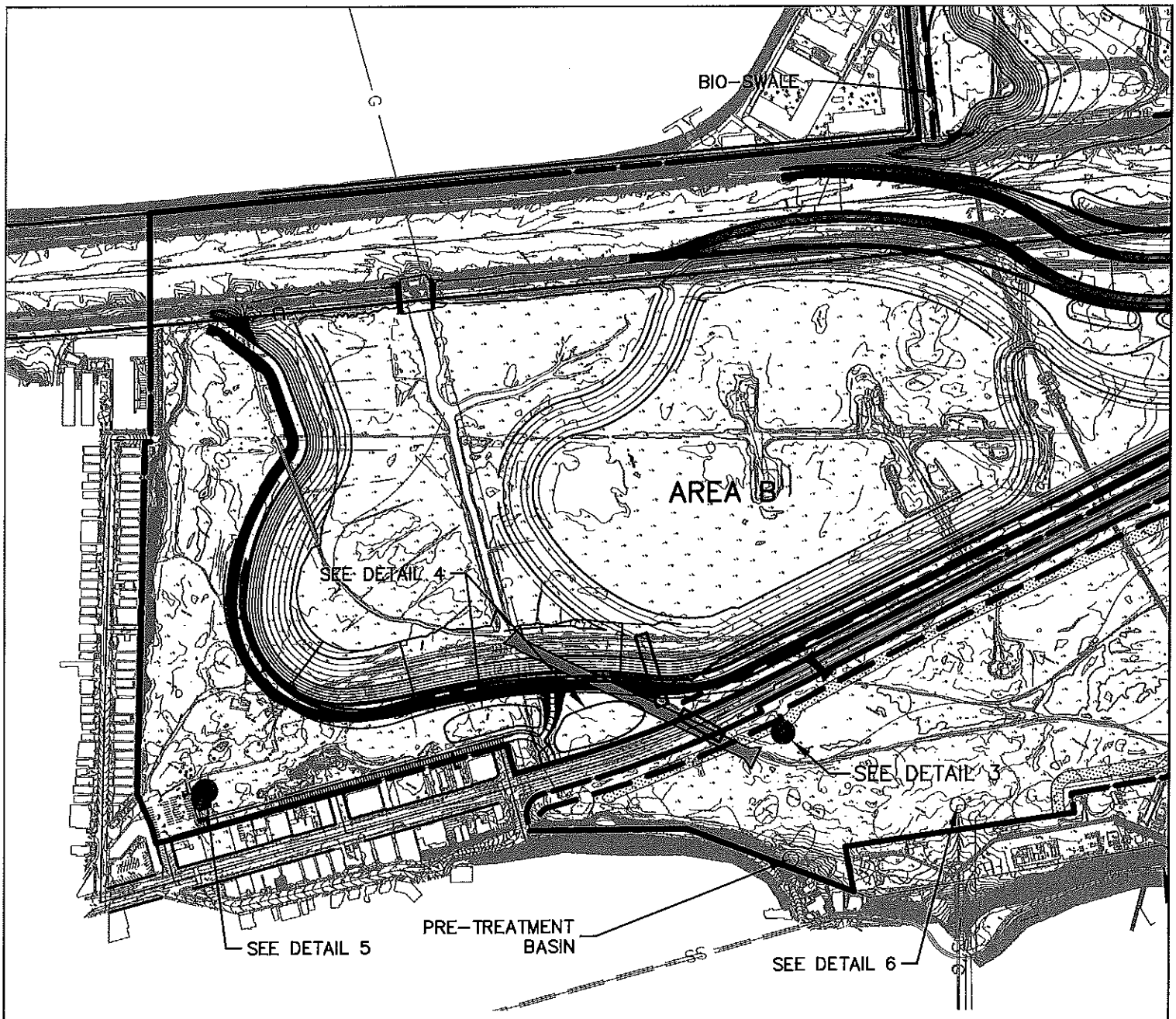

LEGEND

BIO-SWALES

INLET PROTECTION BMP'S

500' 250' 0' 500' 1000'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

Area B-West & B-South Stormwater BMPs Figure 5

CALIFORNIA COASTAL CONSERVANCY

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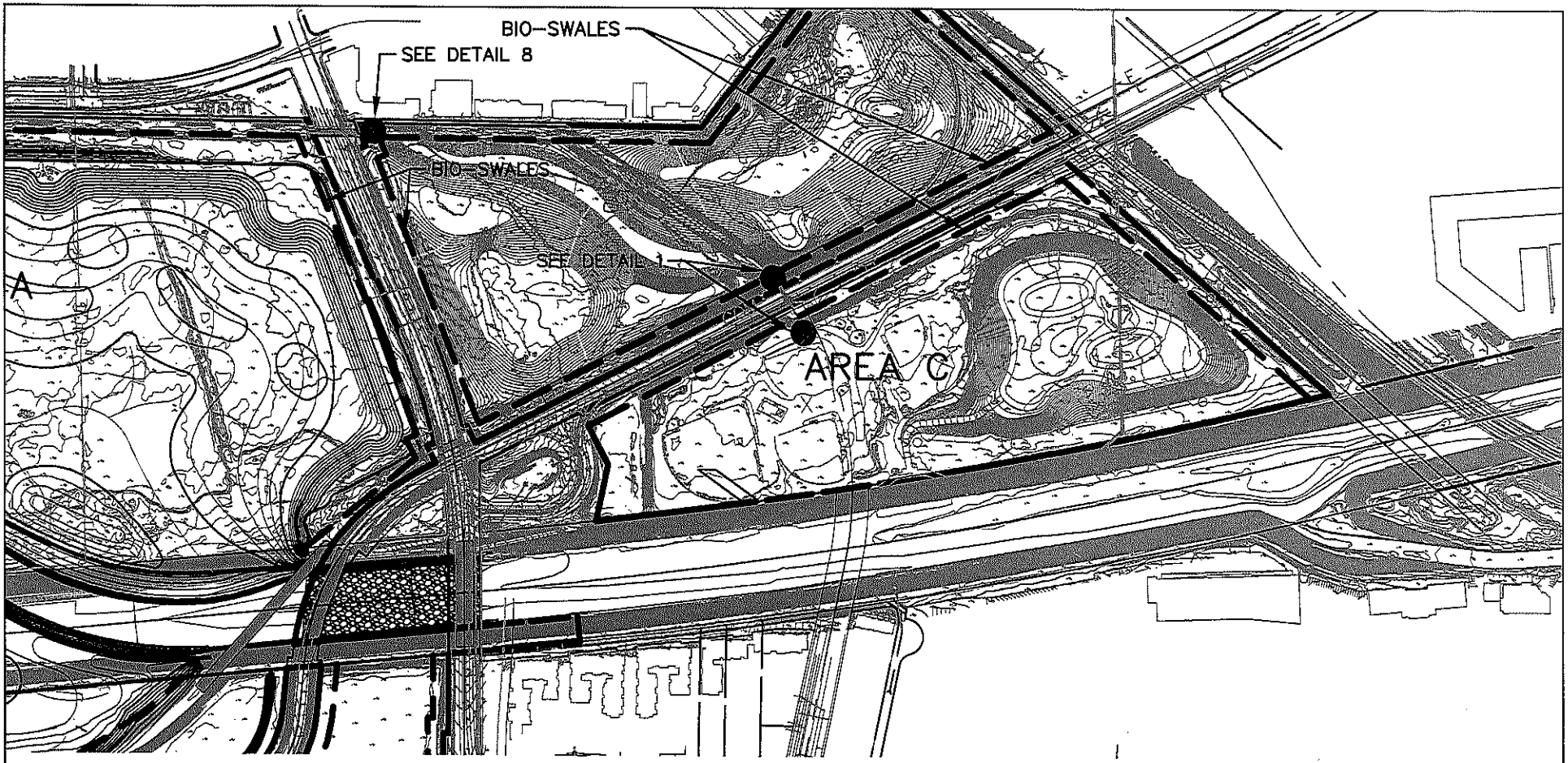

LEGEND

BIO-SWALES

INLET PROTECTION BMP'S

500' 250' 0' 500' 1000'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

Area C

Figure 6

CALIFORNIA COASTAL CONSERVANCY

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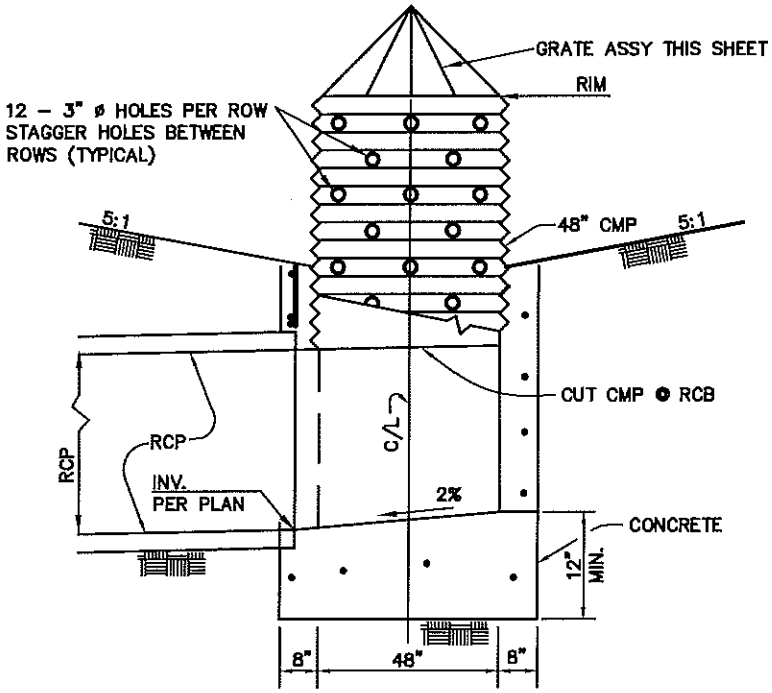

RISER AND OUTLET

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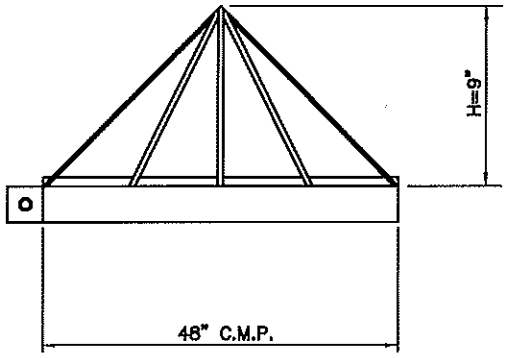

GRATE ASSEMBLY

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EXISTING DEBRIS RISER INLET DETAIL (2)

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Detail Sheet
Figure 7

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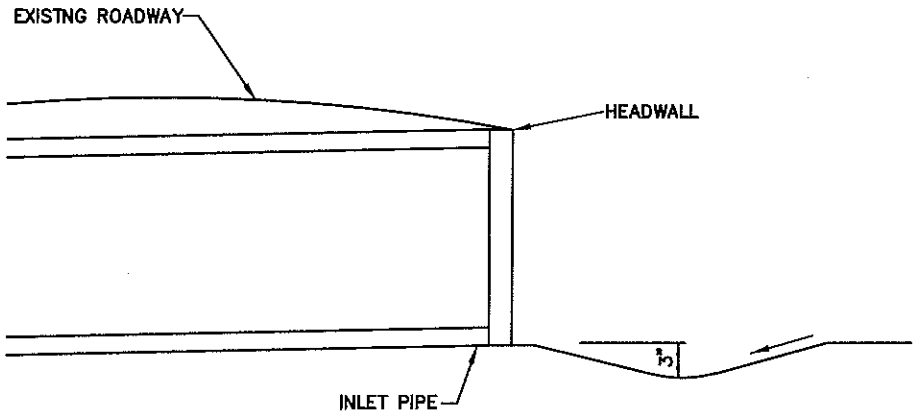
CALIFORNIA COASTAL CONSERVANCY



INLET PIPE CONTROL 3

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Detail Sheet
Figure 8

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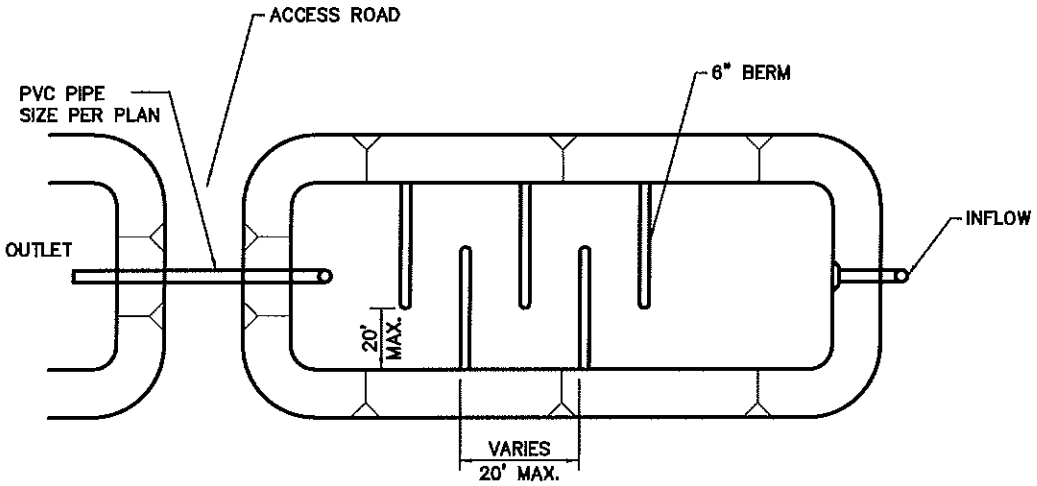
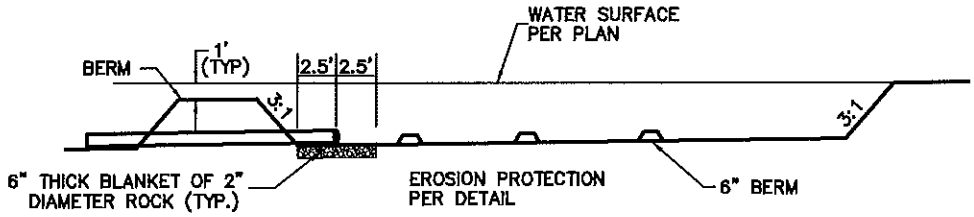


PLAN VIEW



RETENTION BASIN DETAIL 4

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Detail Sheet
Figure 9

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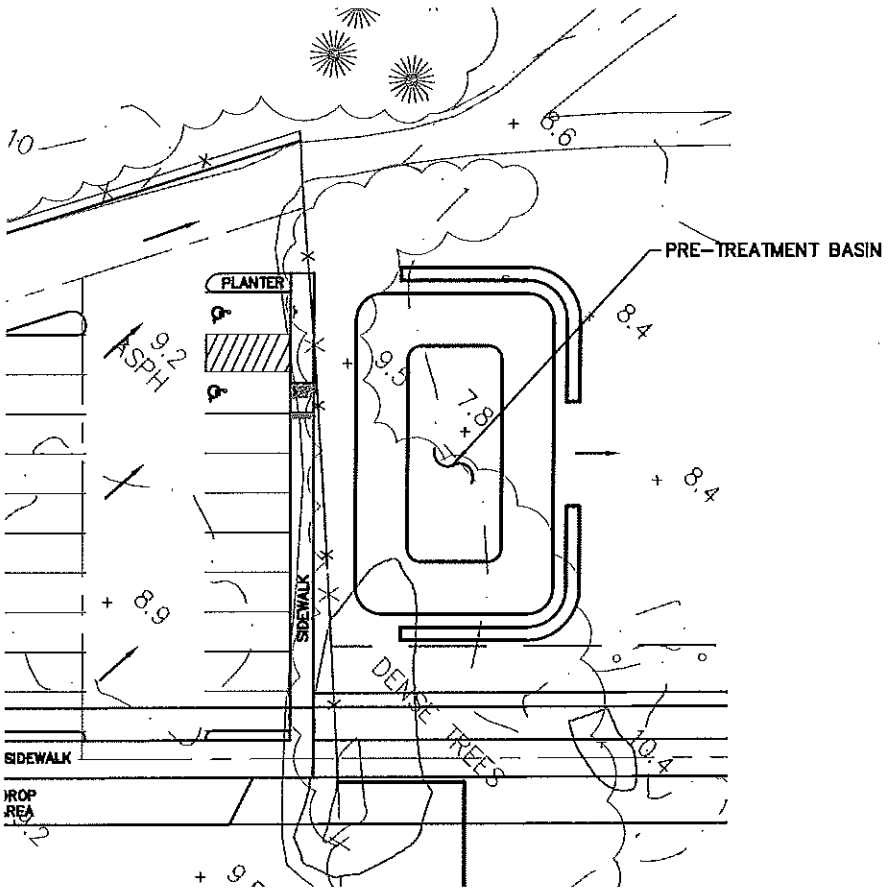

PARKING LOT PRE-TREATMENT BASIN (5)

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Detail Sheet
Figure 10

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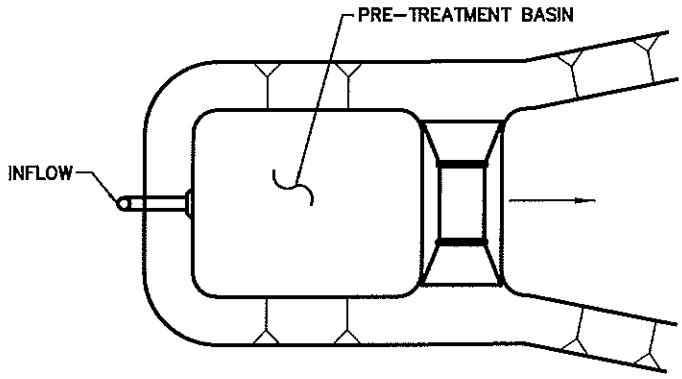
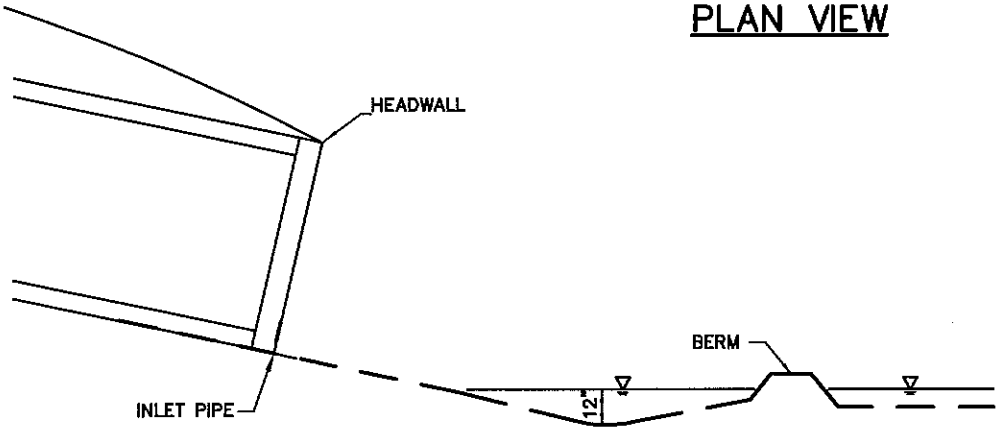


PLAN VIEW



HILLSIDE DR – PRE-TREATMENT BASIN (6)

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Detail Sheet
Figure 11

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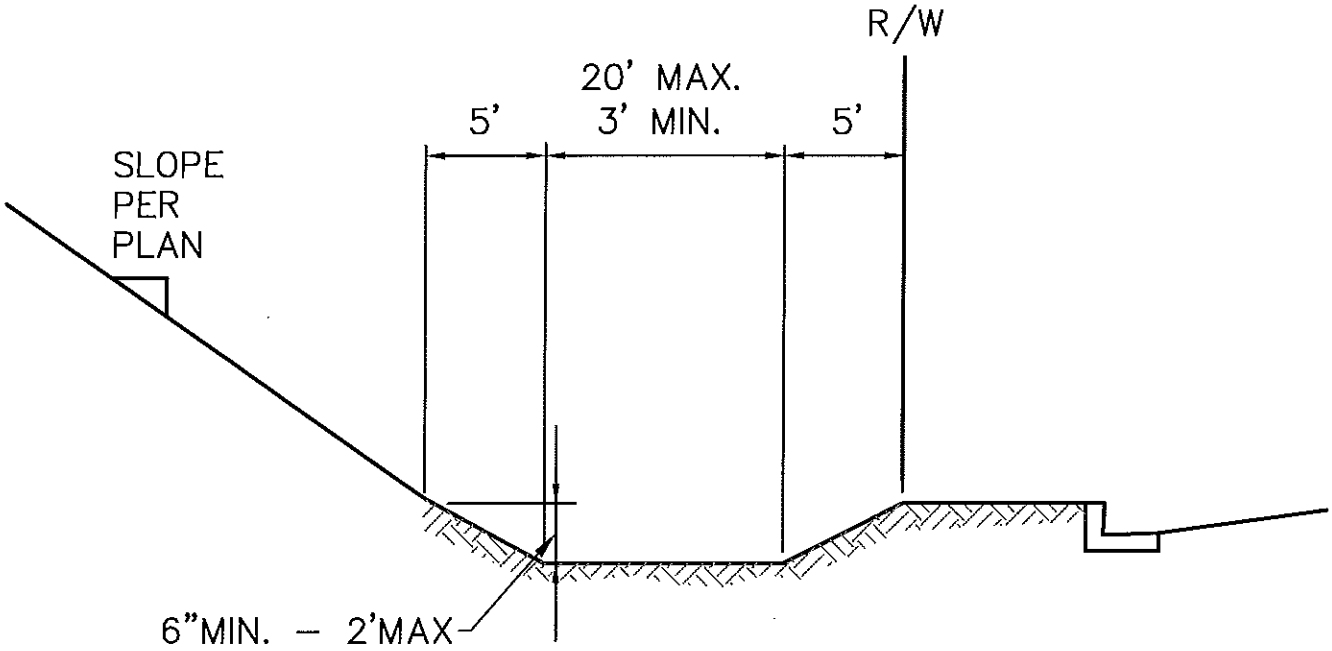
CALIFORNIA COASTAL CONSERVANCY



BIO-SWALE DETAIL (7)

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Figure 12

P S O M A S

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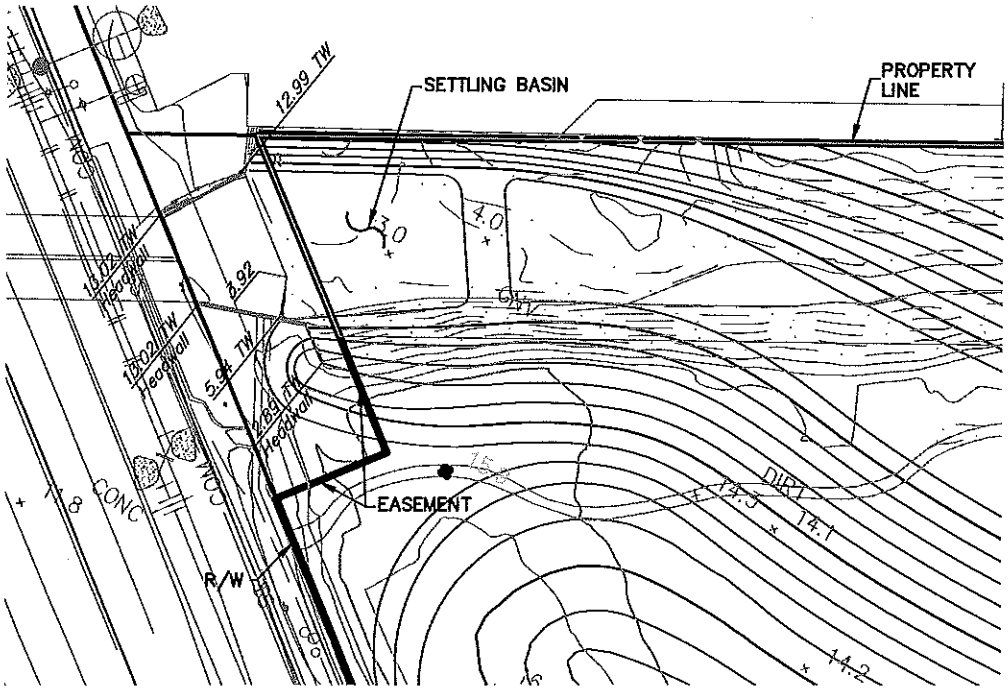
CALIFORNIA COASTAL CONSERVANCY



FIJI DITCH SETTLING BASIN

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Detail Sheet
Figure 13

CALIFORNIA COASTAL CONSERVANCY

PSOMAS

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APPENDIX A

Peak Flow Hydrologic Analysis

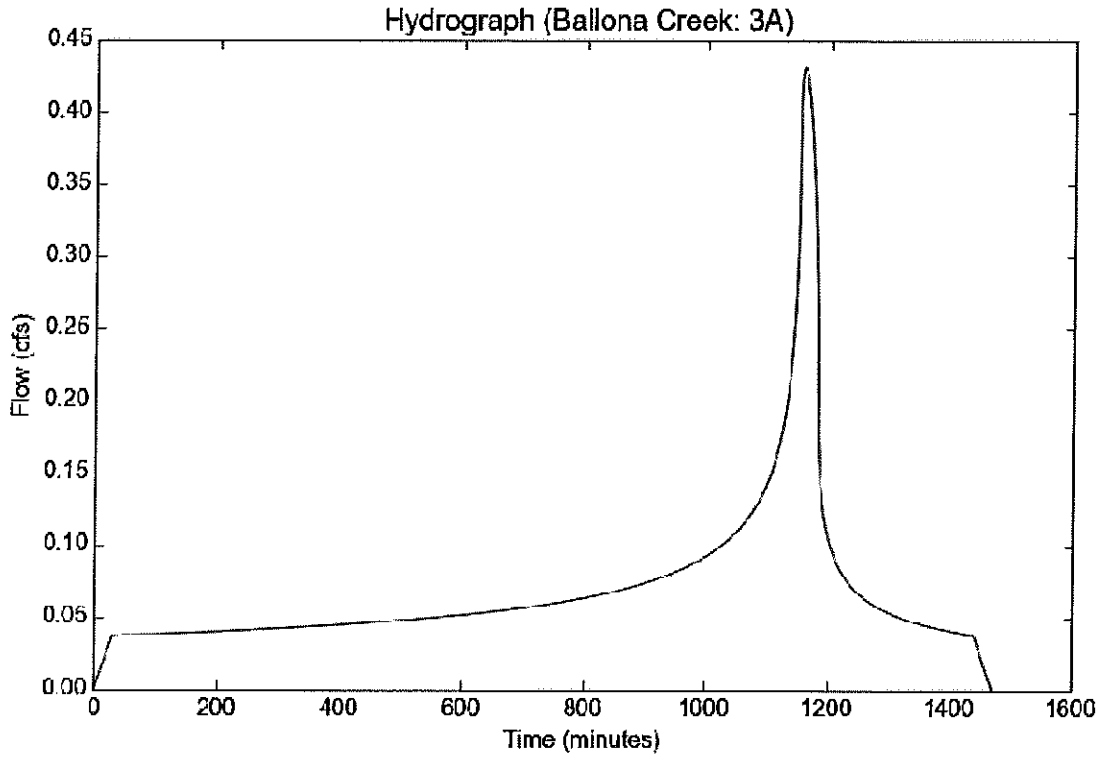
File location: C:/Steve/Psomas Projects/Ballona/Storage Calculations/Ballona Creek - 3A - 1-yr.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Ballona Creek
Subarea ID	3A
Area (ac)	5.3
Flow Path Length (ft)	958.0
Flow Path Slope (vft/hft)	0.1
50-yr Rainfall Depth (in)	6.5
Percent Impervious	0.09
Soil Type	10
Design Storm Frequency	1-yr
Fire Factor	0
LID	False

Output Results

Modeled (1-yr) Rainfall Depth (in)	1.8395
Peak Intensity (in/hr)	0.4728
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.172
Time of Concentration (min)	30.0
Clear Peak Flow Rate (cfs)	0.431
Burned Peak Flow Rate (cfs)	0.431
24-Hr Clear Runoff Volume (ac-ft)	0.1386
24-Hr Clear Runoff Volume (cu-ft)	6036.8668



Peak Flow Hydrologic Analysis

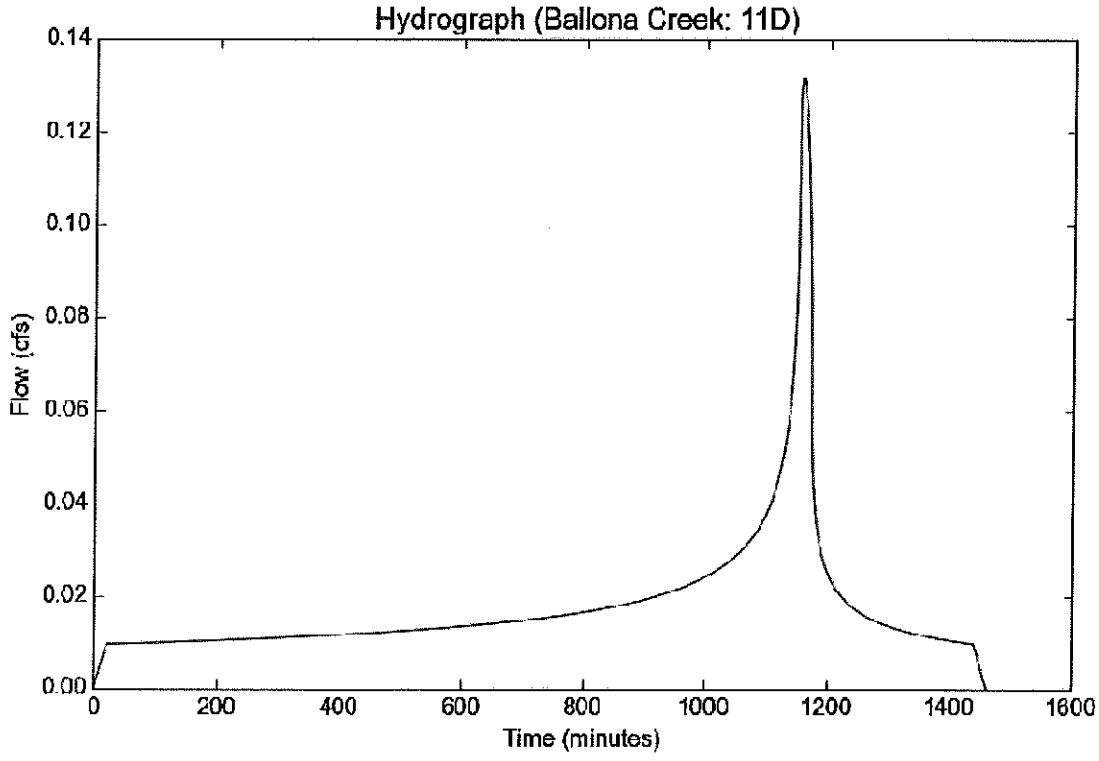
File location: C:/Steve/Psomas Projects/Ballona/Storage Calculations/Ballona Creek - 11D.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Ballona Creek
Subarea ID	11D
Area (ac)	1.2
Flow Path Length (ft)	395.0
Flow Path Slope (vft/hft)	0.242
50-yr Rainfall Depth (in)	6.5
Percent Impervious	0.12
Soil Type	10
Design Storm Frequency	1-yr
Fire Factor	0
LID	False

Output Results

Modeled (1-yr) Rainfall Depth (in)	1.8395
Peak Intensity (in/hr)	0.5591
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.196
Time of Concentration (min)	21.0
Clear Peak Flow Rate (cfs)	0.1315
Burned Peak Flow Rate (cfs)	0.1315
24-Hr Clear Runoff Volume (ac-ft)	0.0358
24-Hr Clear Runoff Volume (cu-ft)	1557.5502



Peak Flow Hydrologic Analysis

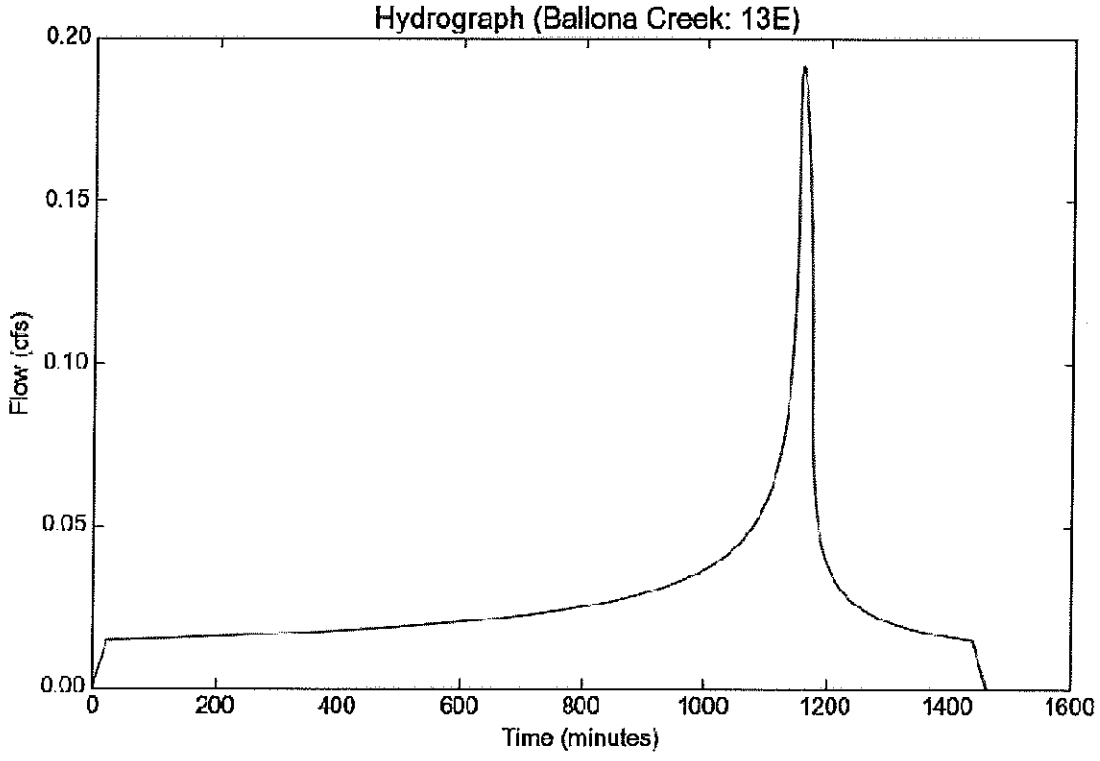
File location: C:/Steve/Psomas Projects/Ballona/Storage Calculations/Ballona Creek - 13E - 1-yr.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Ballona Creek
Subarea ID	13E
Area (ac)	1.9
Flow Path Length (ft)	406.0
Flow Path Slope (vft/hft)	0.219
50-yr Rainfall Depth (in)	6.5
Percent Impervious	0.11
Soil Type	10
Design Storm Frequency	1-yr
Fire Factor	0
LID	False

Output Results

Modeled (1-yr) Rainfall Depth (in)	1.8395
Peak Intensity (in/hr)	0.5357
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.188
Time of Concentration (min)	23.0
Clear Peak Flow Rate (cfs)	0.1913
Burned Peak Flow Rate (cfs)	0.1913
24-Hr Clear Runoff Volume (ac-ft)	0.0543
24-Hr Clear Runoff Volume (cu-ft)	2365.4657



Peak Flow Hydrologic Analysis

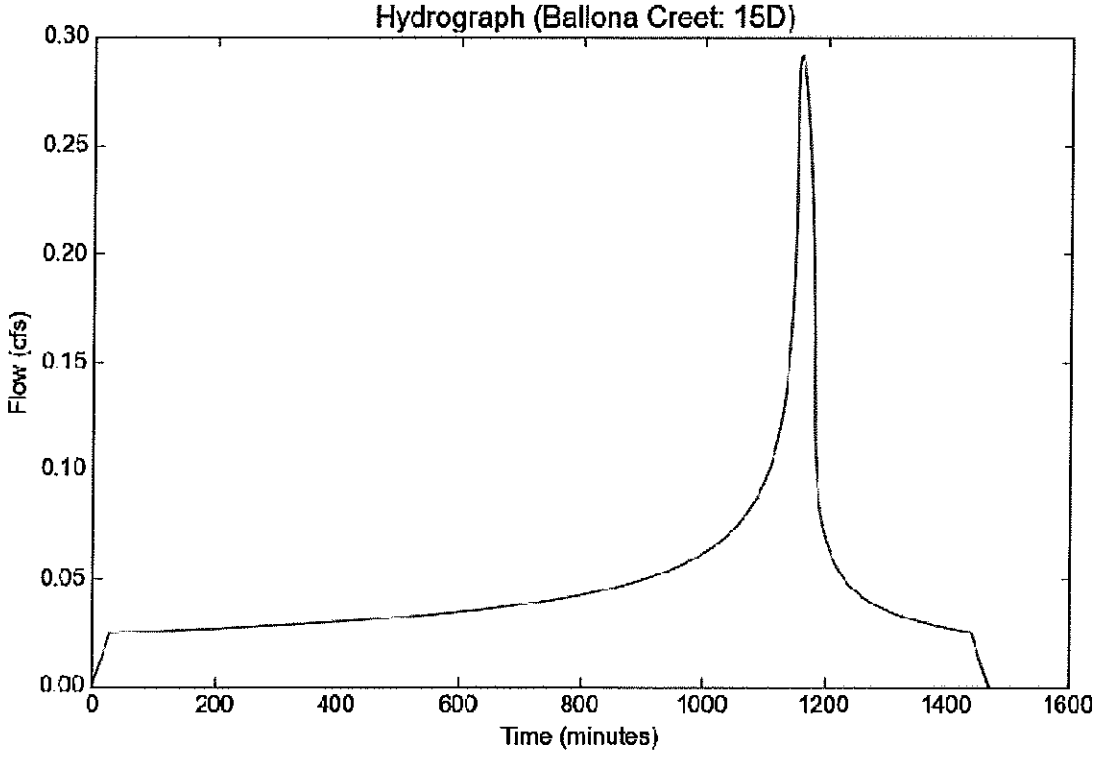
File location: W:/1CCC010100/ENGR/CALCS/Storage Calculations/Ballona Creek - 15D - 1-yr.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Ballona Creet
Subarea ID	15D
Area (ac)	3.7
Flow Path Length (ft)	494.0
Flow Path Slope (vft/hft)	0.177
50-yr Rainfall Depth (in)	6.5
Percent Impervious	0.08
Soil Type	10
Design Storm Frequency	1-yr
Fire Factor	0
LID	False

Output Results

Modeled (1-yr) Rainfall Depth (in)	1.8395
Peak Intensity (in/hr)	0.4804
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.164
Time of Concentration (min)	29.0
Clear Peak Flow Rate (cfs)	0.2915
Burned Peak Flow Rate (cfs)	0.2915
24-Hr Clear Runoff Volume (ac-ft)	0.0922
24-Hr Clear Runoff Volume (cu-ft)	4018.394



Peak Flow Hydrologic Analysis

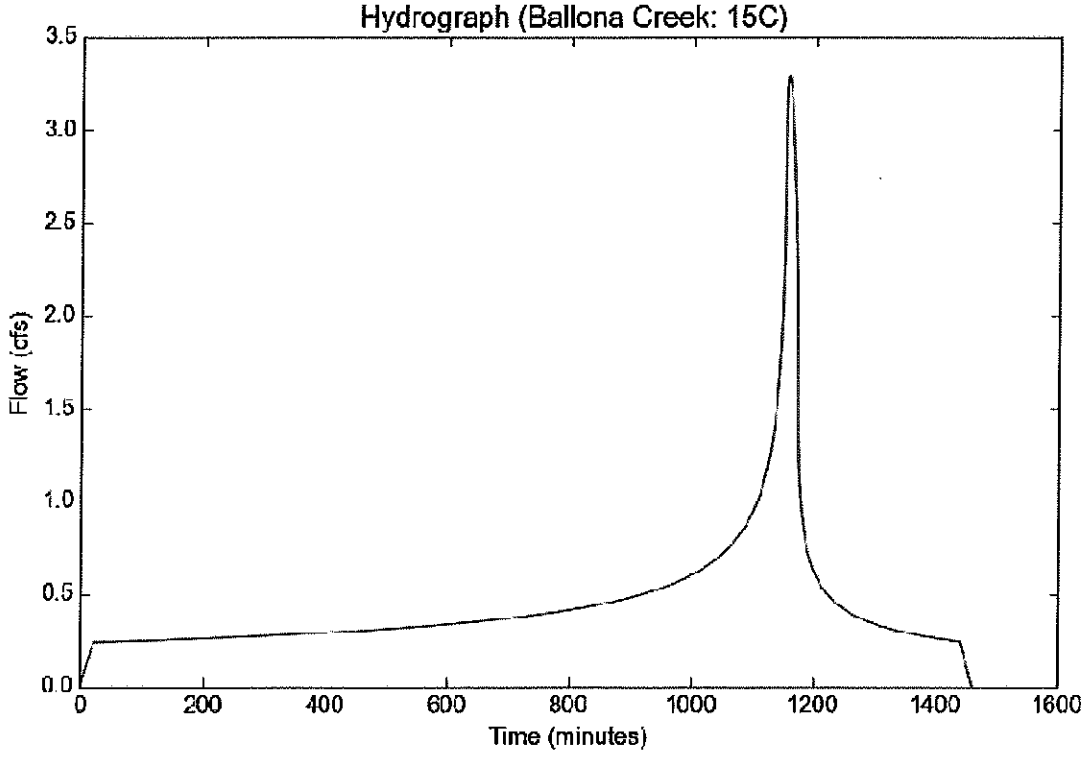
File location: C:/Steve/Psomas Projects/Ballona/Storage Calculations/Ballona Creek - 15C - 1-yr.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Ballona Creek
Subarea ID	15C
Area (ac)	7.1
Flow Path Length (ft)	774.0
Flow Path Slope (vft/hft)	0.013
50-yr Rainfall Depth (in)	6.5
Percent Impervious	0.91
Soil Type	10
Design Storm Frequency	1-yr
Fire Factor	0
LID	False

Output Results

Modeled (1-yr) Rainfall Depth (in)	1.8395
Peak Intensity (in/hr)	0.5591
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.828
Time of Concentration (min)	21.0
Clear Peak Flow Rate (cfs)	3.2867
Burned Peak Flow Rate (cfs)	3.2867
24-Hr Clear Runoff Volume (ac-ft)	0.8937
24-Hr Clear Runoff Volume (cu-ft)	38930.8071



Peak Flow Hydrologic Analysis

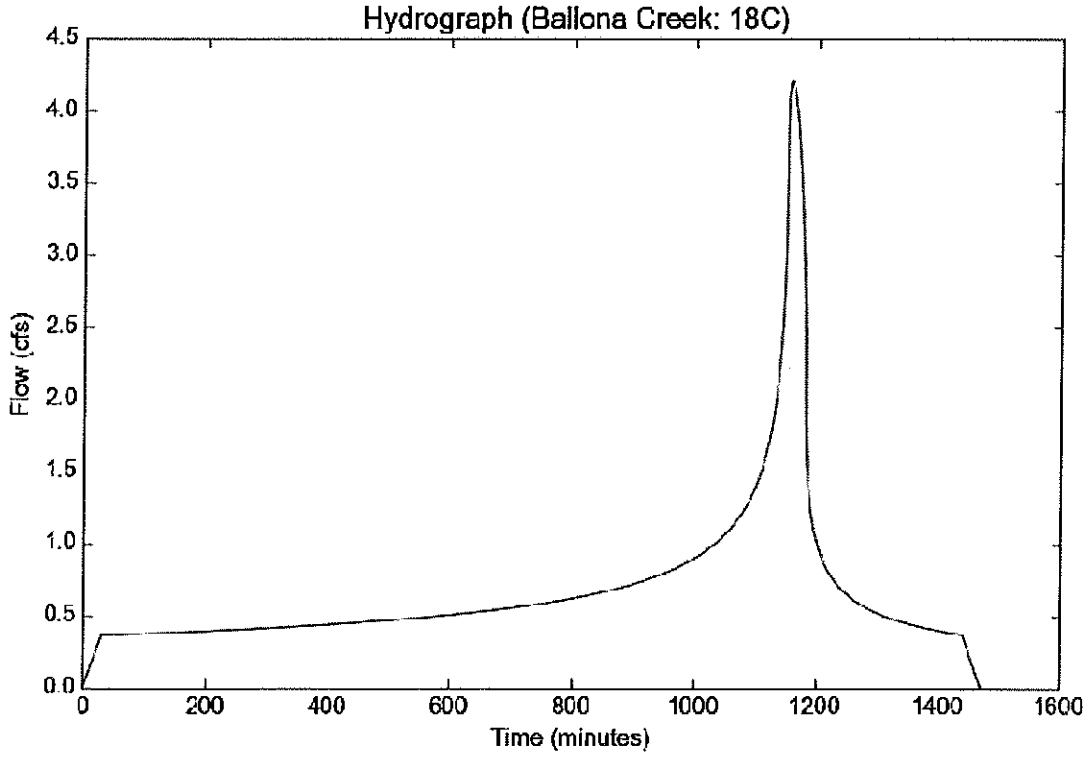
File location: C:/Steve/Psomas Projects/Ballona/Storage Calculations/Ballona Creek - 18C - 1-yr.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Ballona Creek
Subarea ID	18C
Area (ac)	20.4
Flow Path Length (ft)	1334.0
Flow Path Slope (vft/hft)	0.031
50-yr Rainfall Depth (in)	6.5
Percent Impervious	0.42
Soil Type	10
Design Storm Frequency	1-yr
Fire Factor	0
LID	False

Output Results

Modeled (1-yr) Rainfall Depth (in)	1.8395
Peak Intensity (in/hr)	0.4728
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.436
Time of Concentration (min)	30.0
Clear Peak Flow Rate (cfs)	4.2052
Burned Peak Flow Rate (cfs)	4.2052
24-Hr Clear Runoff Volume (ac-ft)	1.3522
24-Hr Clear Runoff Volume (cu-ft)	58901.1719



Peak Flow Hydrologic Analysis

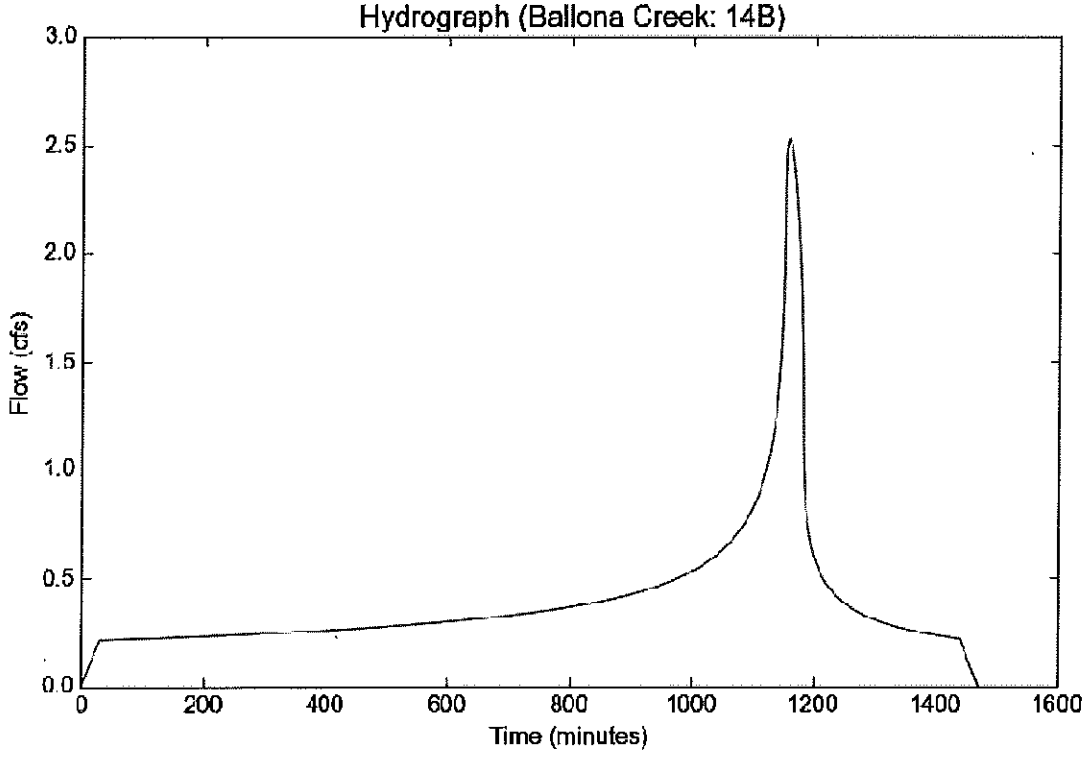
File location: W:/1CCC010100/ENGR/CALCS/Storage Calculations/Ballona Creek - 14B - 1-yr.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

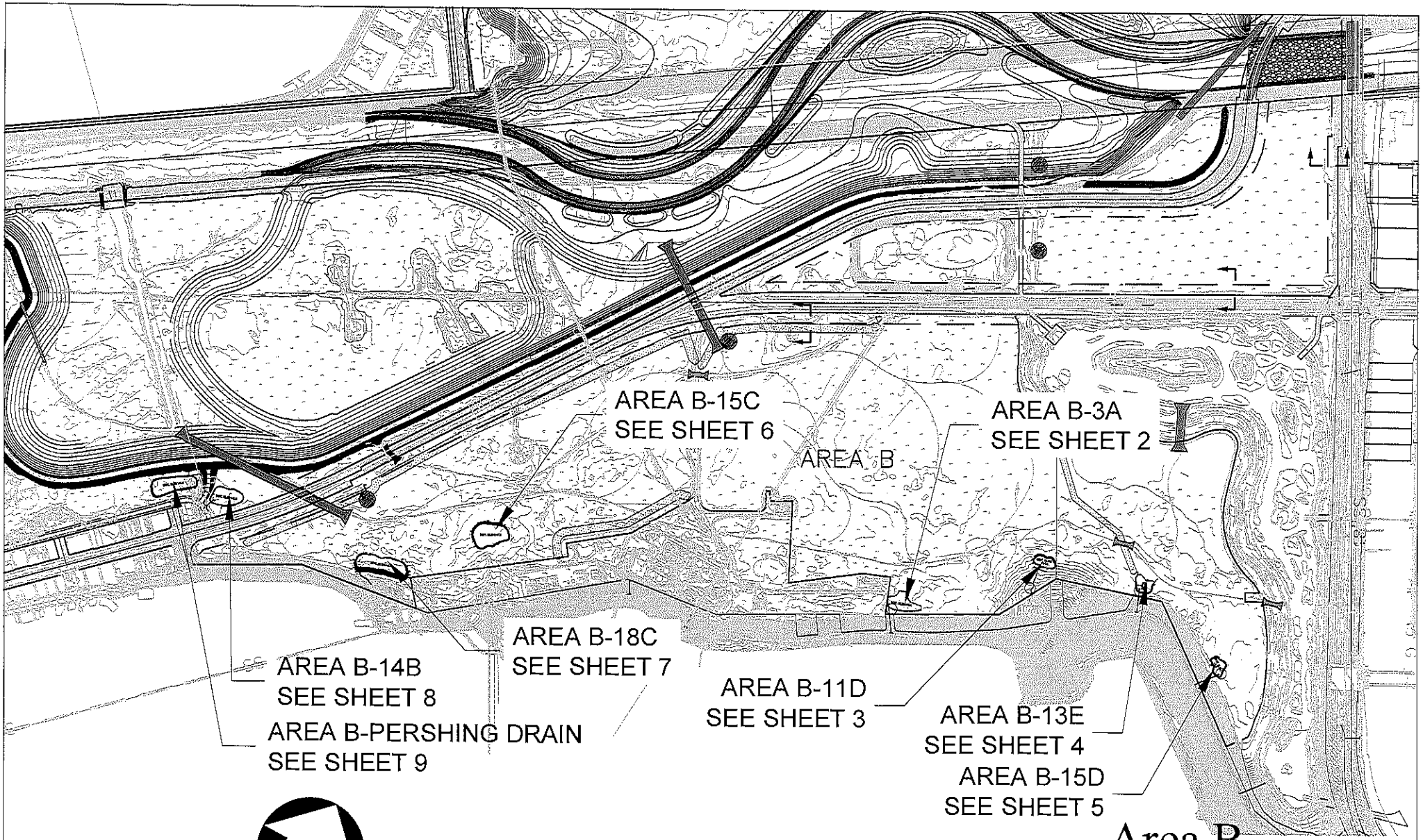
Project Name	Ballona Creek
Subarea ID	14B
Area (ac)	6.1
Flow Path Length (ft)	2043.0
Flow Path Slope (vft/hft)	0.001
50-yr Rainfall Depth (in)	6.5
Percent Impervious	0.95
Soil Type	17
Design Storm Frequency	1-yr
Fire Factor	0
LID	False

Output Results

Modeled (1-yr) Rainfall Depth (in)	1.8395
Peak Intensity (in/hr)	0.4728
Undeveloped Runoff Coefficient (Cu)	0.4151
Developed Runoff Coefficient (Cd)	0.8758
Time of Concentration (min)	30.0
Clear Peak Flow Rate (cfs)	2.5257
Burned Peak Flow Rate (cfs)	2.5257
24-Hr Clear Runoff Volume (ac-ft)	0.7989
24-Hr Clear Runoff Volume (cu-ft)	34798.2985



APPENDIX B



700' 350' 0' 700' 1400'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

Area B Grading Exhibit Index

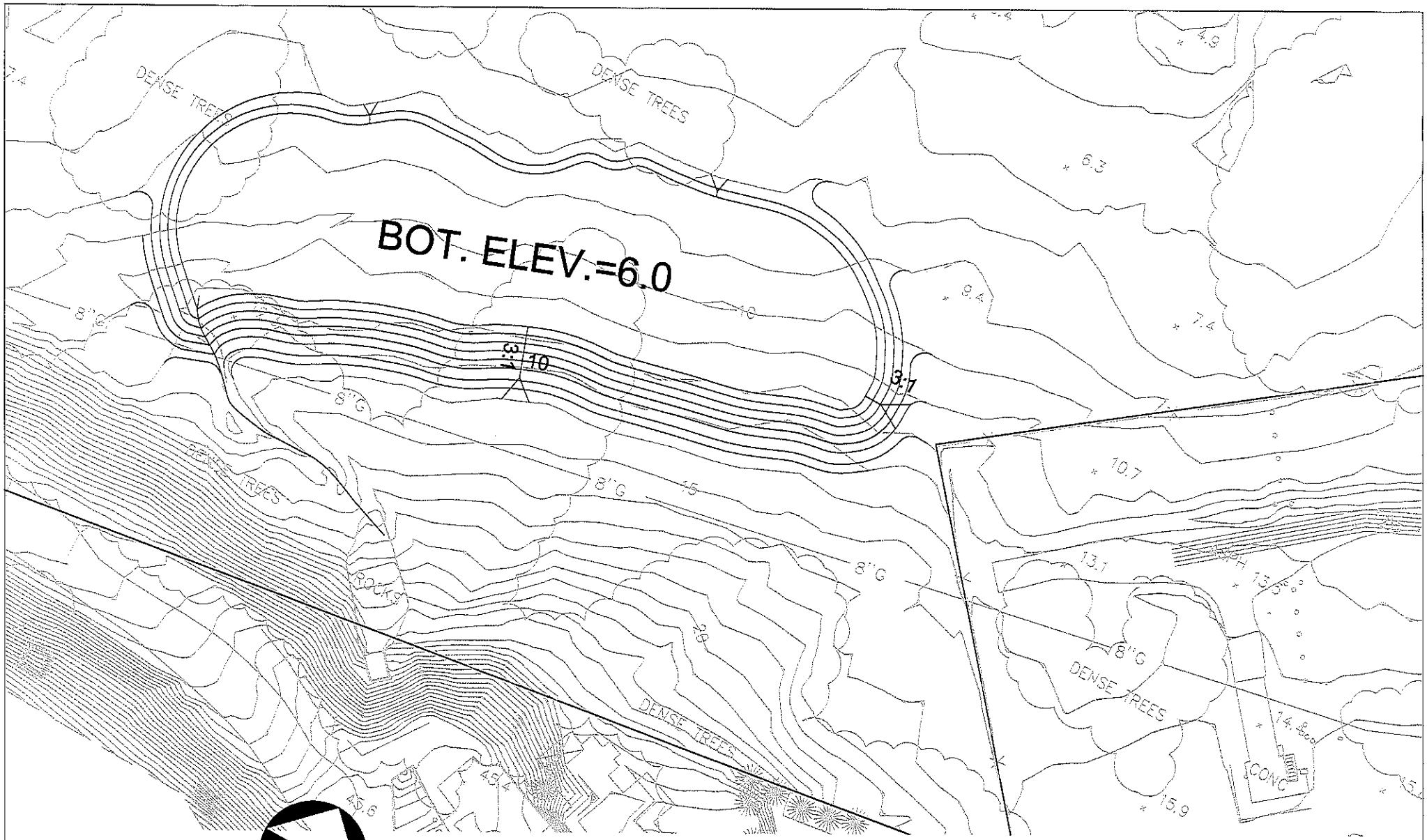
PSOMAS

DATE: 05-21-15 REVISED ON: 06-11-15

JOB No:1CCC010100

CALIFORNIA COASTAL CONSERVANCY

B1-1436



500' 250' 0' 500' 1000'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

Area B-3A Grading Exhibit

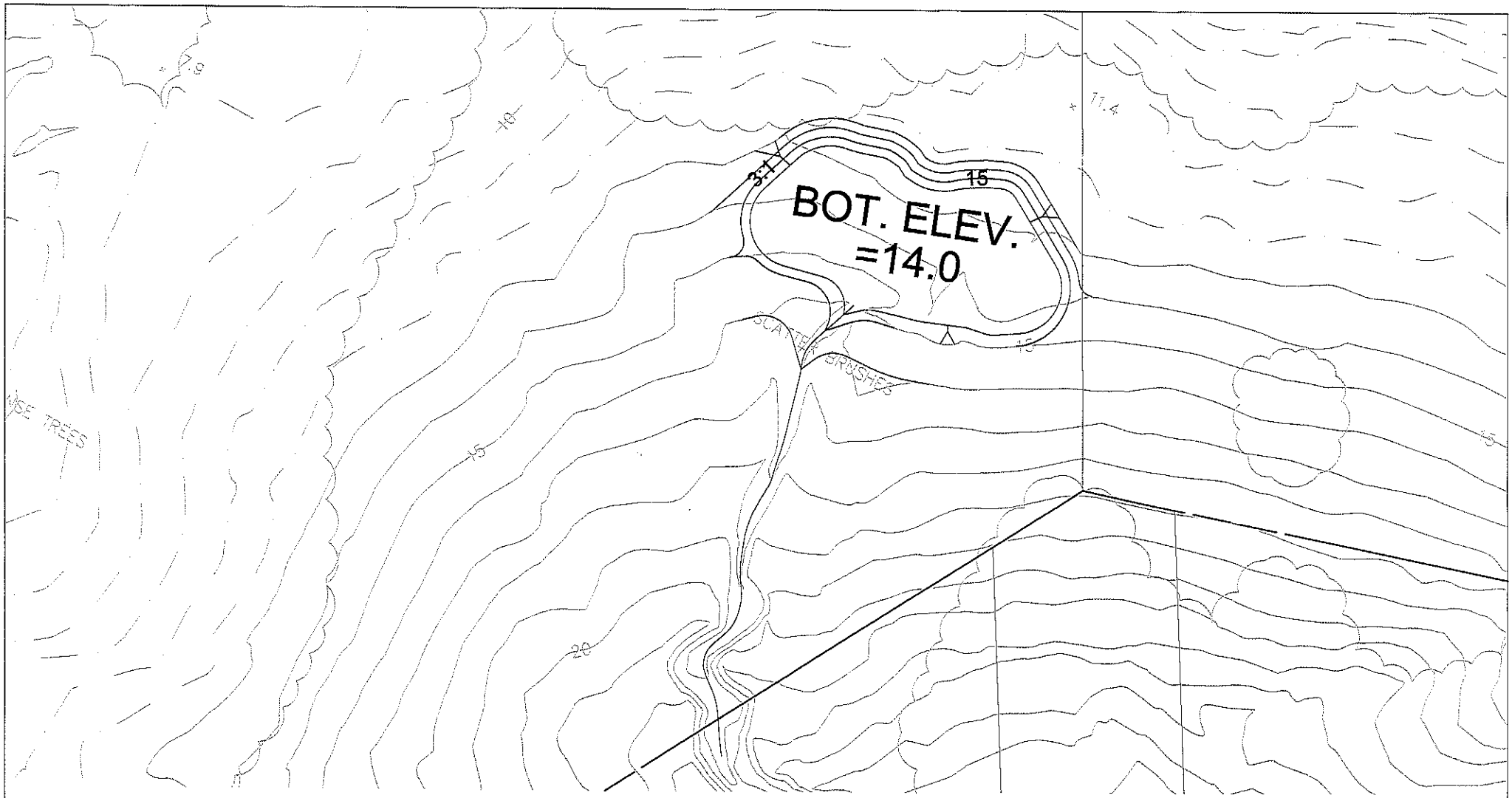
PSOMAS

DATE: 05–21–15 REVISED ON: 06–11–15

JOB No:1CCC010100

SHEET 2 OF 9

CALIFORNIA COASTAL CONSERVANCY



50' 25' 0' 50' 100'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

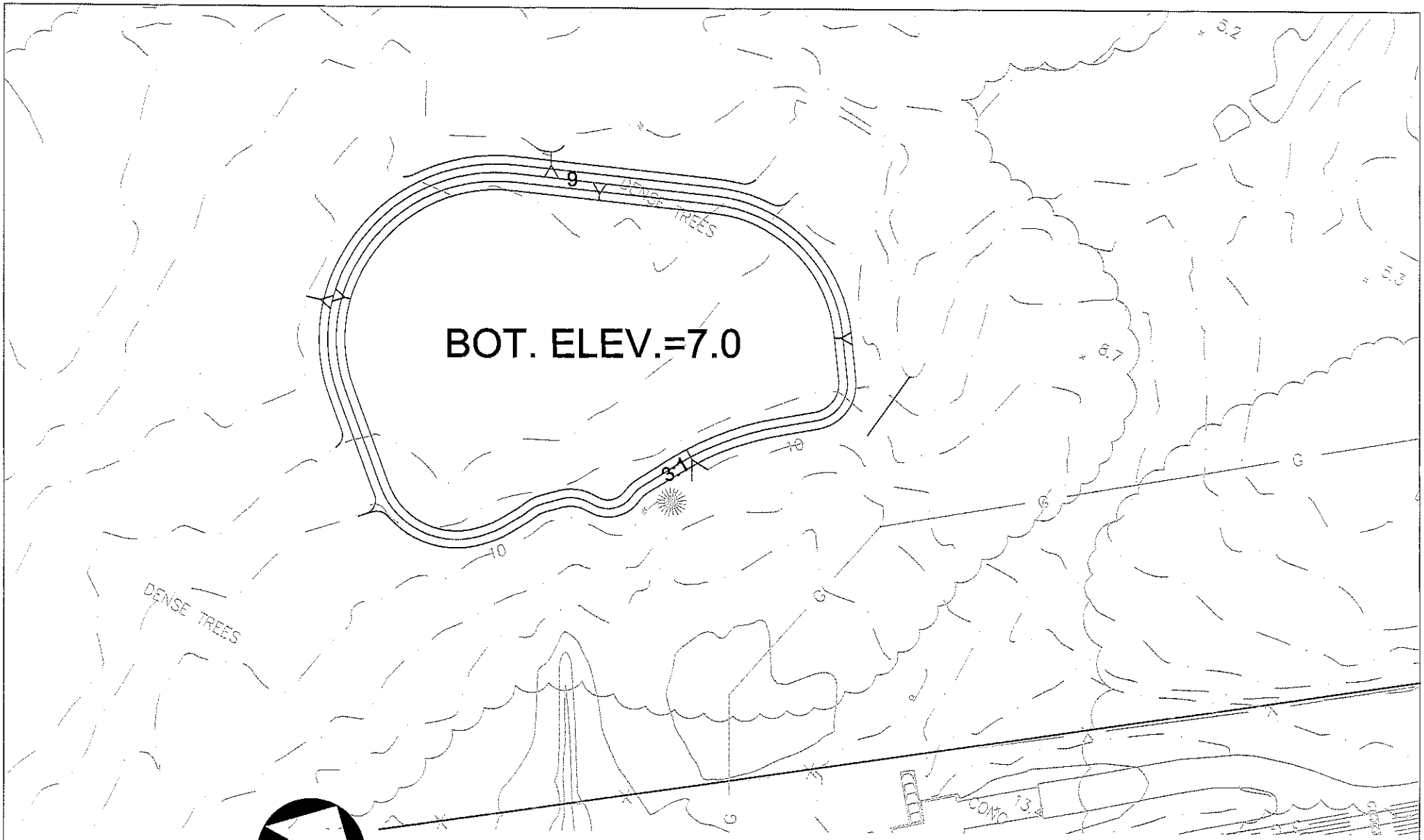
Area B-11D
Grading Exhibit

PSOMAS

DATE: 05–21–15 REVISED ON: 06–11–15
JOB No:1CCC010100

SHEET 3 OF 9

CALIFORNIA COASTAL CONSERVANCY



500' 250' 0' 500' 1000'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

Area B-13E Grading Exhibit

PSOMAS

DATE: 05-21-15 REVISED ON: 06-11-15

JOB No:1CCC010100

SHEET 4 OF 9

CALIFORNIA COASTAL CONSERVANCY



50' 25' 0' 50' 100'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

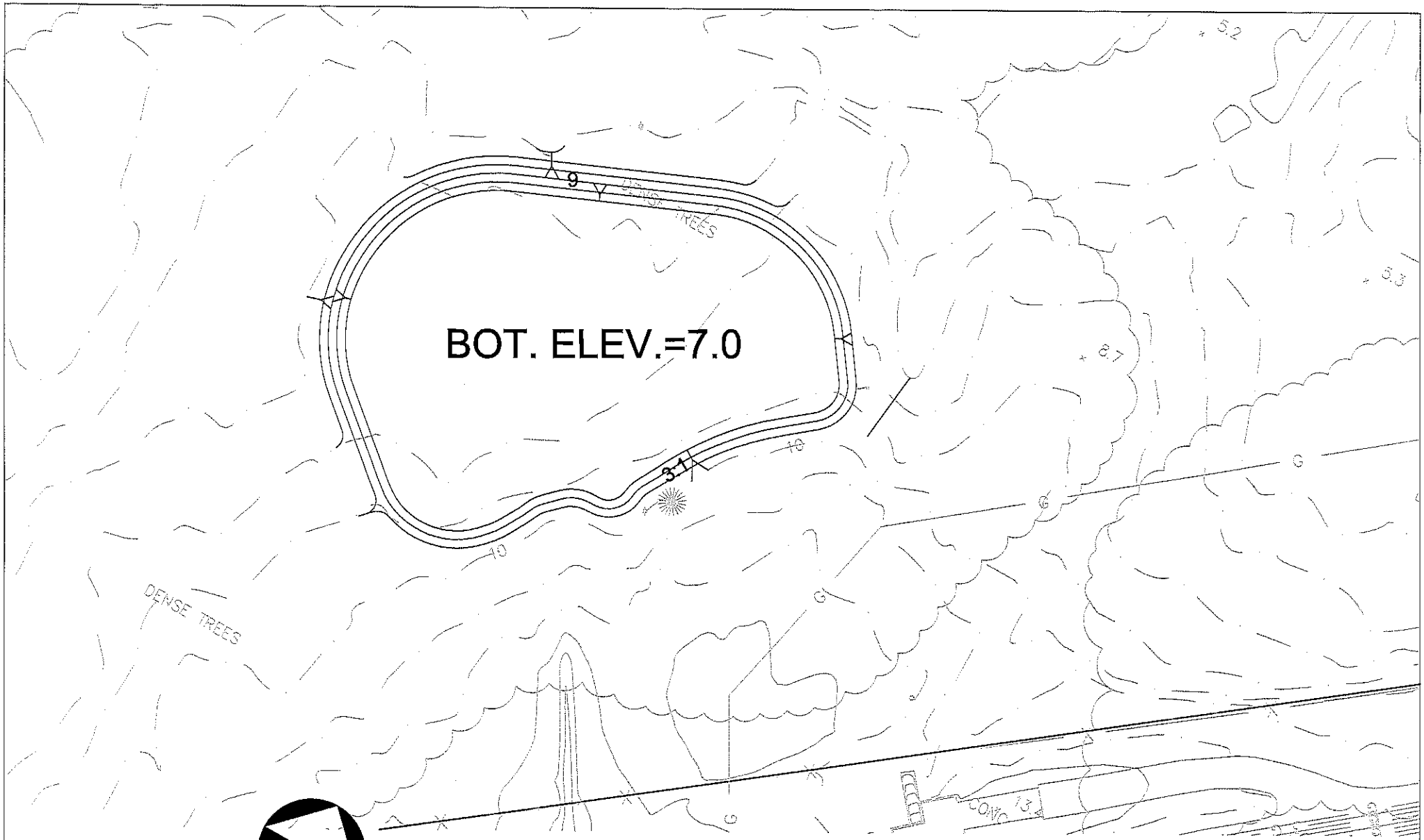
Area B-15D
Grading Exhibit

PSOMAS

DATE: 05-21-15 REVISED ON: 06-11-15
JOB No:1CCC010100

SHEET 5 OF 9

CALIFORNIA COASTAL CONSERVANCY



Note: For reduced sized prints, original scale is in inches

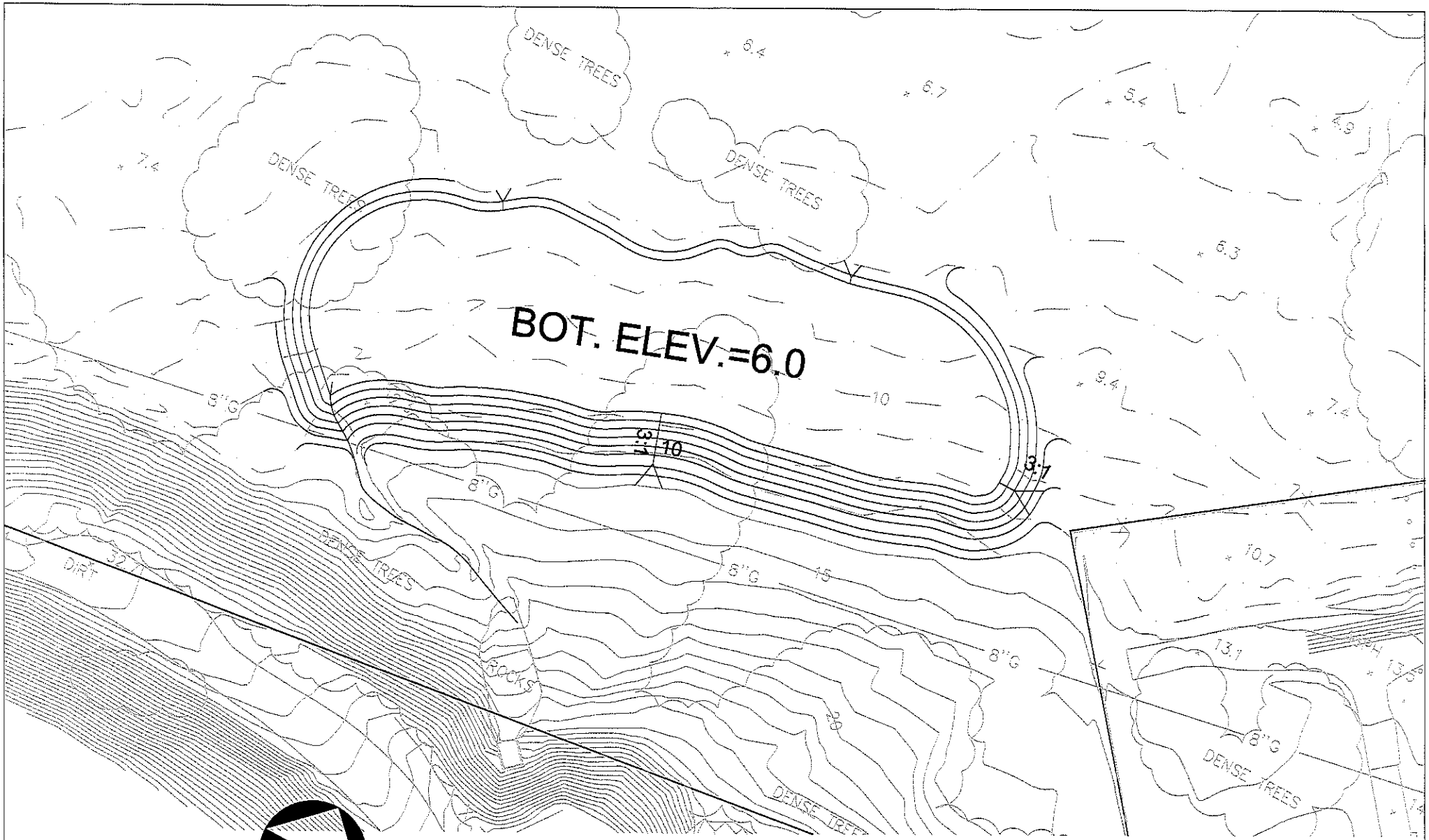
Area B-15C Grading Exhibit

PSOMAS

DATE: 05-21-15 REVISED ON: 06-11-15
JOB No:1CCC010100

SHEET 6 OF 9

CALIFORNIA COASTAL CONSERVANCY



50' 25' 0' 50' 100'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

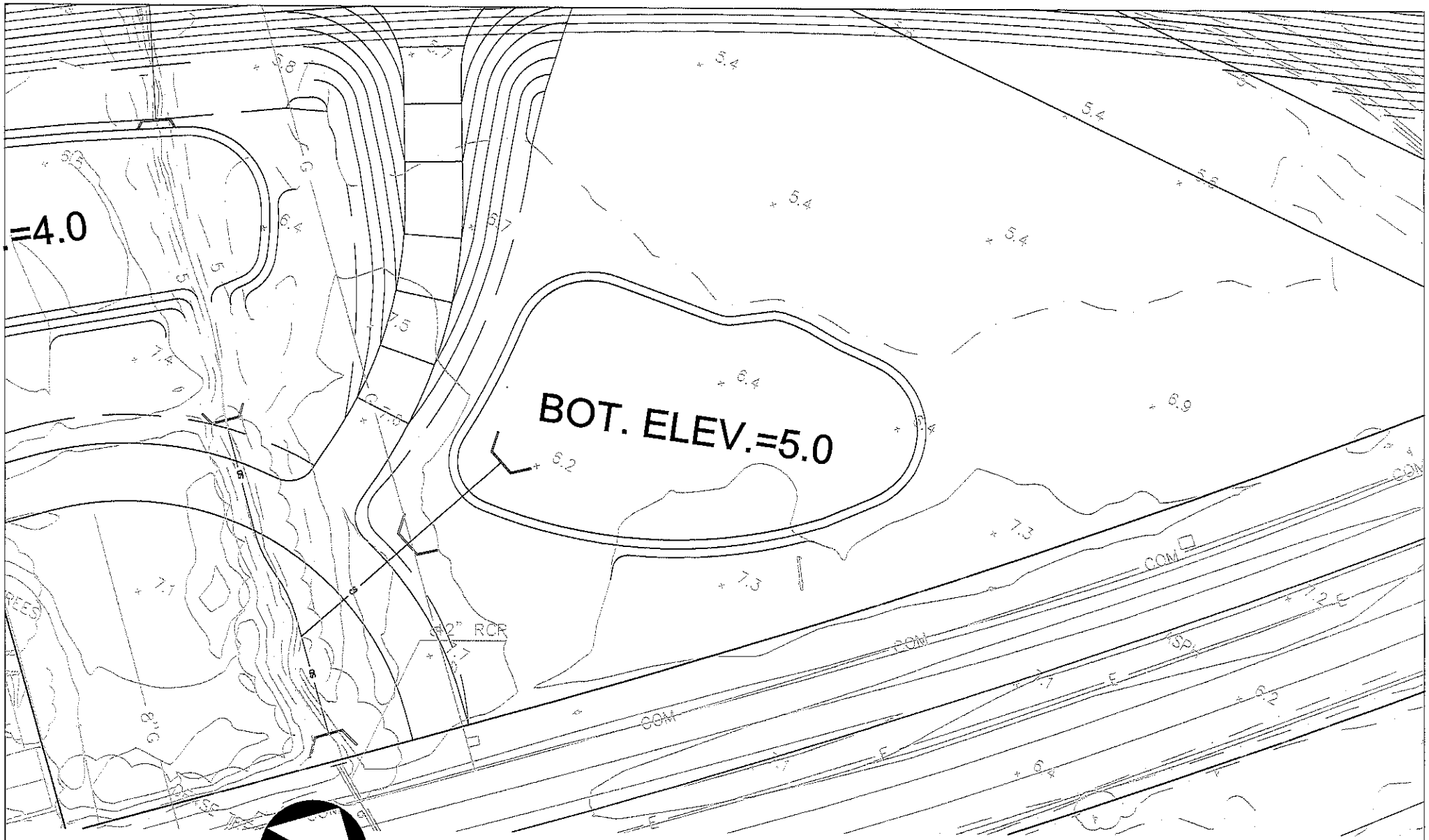
Area B-18C Grading Exhibit

PSOMAS

DATE: 05-21-15 REVISED ON: 06-11-15

JOB No:1CCC010100

CALIFORNIA COASTAL CONSERVANCY



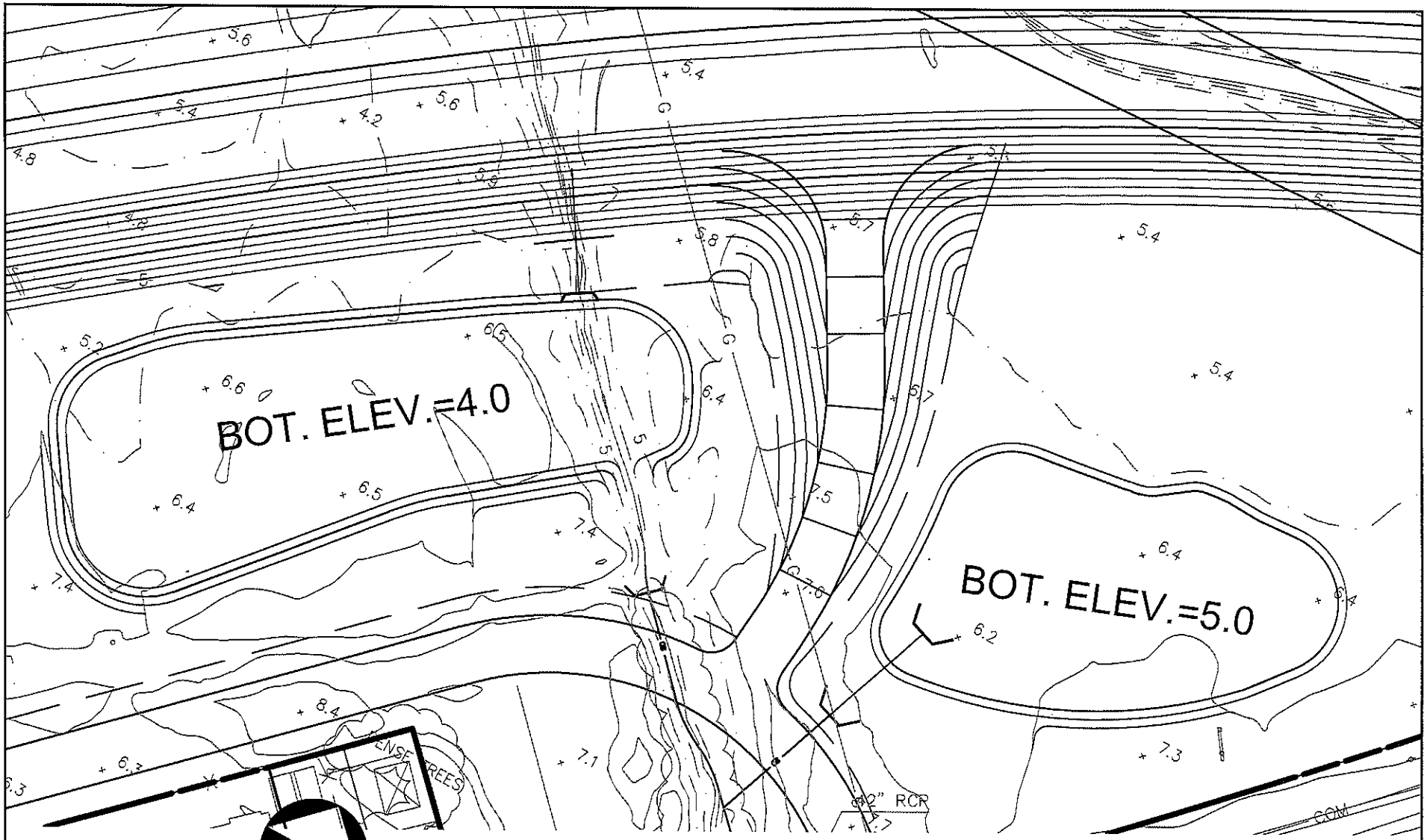
Note: For reduced sized prints, original scale is in inches

Area B-14B Grading Exhibit

PSOMAS

DATE: 05-21-15 REVISED ON: 06-11-15
JOB No:1CCC010100

CALIFORNIA COASTAL CONSERVANCY



Note: For reduced sized prints, original scale is in inches

Area B- Pershing Drain Grading Exhibit

PSOMAS

CALIFORNIA COASTAL CONSERVANCY

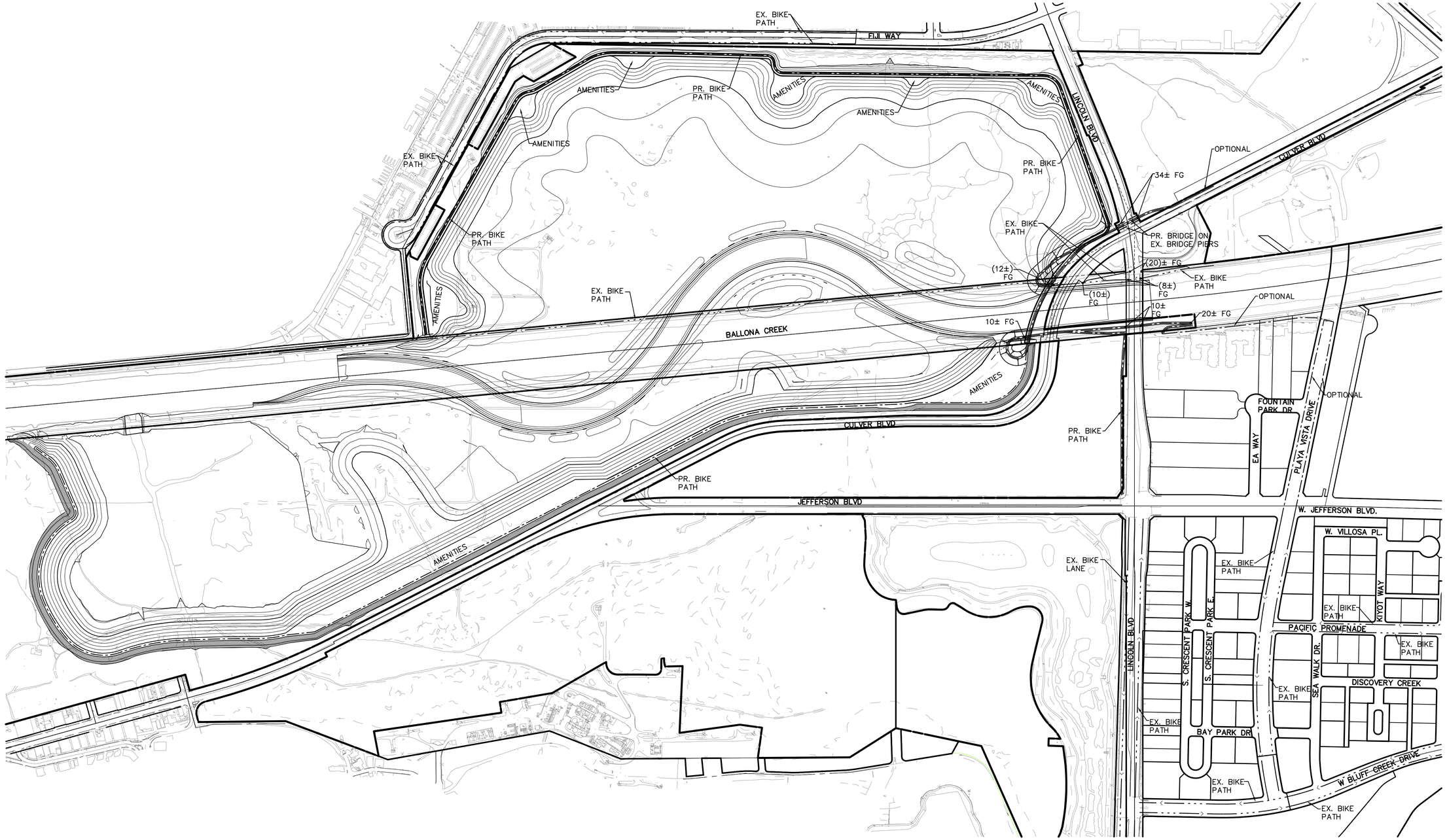
DATE: 05–21–15 REVISED ON: 06–11–15
JOB No:1CCC010100

SHEET 9 OF 9

BR079–08

Appendix H
Bike Path

APPENDIX - BIKE PATH	
Drawing Number	**Exhibit Title**
BR030	Proposed Bike Path Alignments & Amenities Exhibit
BR046	Bike Path Description



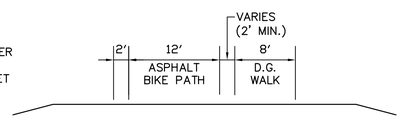
LEGEND

EXISTING BIKE PATH/LANE

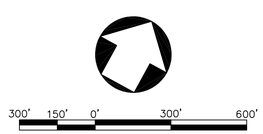
PROPOSED BIKE PATH

NOTES:

1. BIKE PATH WIDTH IS 12 FEET MINIMUM (8 FOOT WITH 2 FOOT SHOULDER ON EITHER SIDE)
2. MINIMUM HEIGHT CLEARANCE FOR BIKE PATH UNDER BRIDGE IS 10 FEET



TYPICAL BRIDGE CROSS-SECTION
NTS



GRAPHIC SCALE
Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

BY _____
SUBDIVISION PLAN CHECKING SECTION DATE

NO.	REVISION	REVISED BY	APPROVED BY	DATE

REGISTERED PROFESSIONAL ENGINEER
MICHAEL J. ORDWAY
No. C48944
Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

T.G.: PAGE

PROPOSED BIKE PATH ALIGNMENTS AND AMENITIES EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

PLANS PREPARED BY:

PSOMAS

555 South Flower Street, Suite 4300
Los Angeles, CA 90071
(213) 223-1400 (213) 223-1444 fax
www.psomas.com

BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 1 OF 1

B1-1447

Plotted - 5/2/2013 4:23:42 PM :: Saved - 5/2/2013 4:23:34 PM :: W:\CCCO10100\ENGR\EXHIB\BR030.dwg ::

BALLONA WETLANDS ECOLOGICAL RESERVE
BIKE PATH DESCRIPTION

The following is a brief description of the existing and proposed bike path through, adjacent to, and near the project.

EXISTING CONDITIONS

There is an existing bike path that runs along the beach southerly of the project. This path crosses over the Ballona Creek at the Pacific Avenue Bridge on the westerly edge of the project. The bike path then heads easterly along the top of the existing northerly levee splitting into two directions at the south-west corner of Area A. In one direction the bike path continues easterly along the levee, under the Culver and Lincoln Boulevard bridges and continues easterly past Area C. The other route splits to the north along the westerly edge of Area A on Marina del Rey property, converting into a bike lane along Fiji Road before heading northerly into Marina del Rey. There are also dead end bike lanes on either side of Lincoln Boulevard south of Jefferson Boulevard. There is also an existing dead end bike lane on either side of Playa Vista Drive (roughly one long block east of Lincoln Boulevard) leading to a series of bike paths within the Playa Vista development east of Area B. And finally, there is a multi-use trail along the westerly edge of Lincoln Boulevard south of Jefferson along the edge of the Fresh Water Marsh.

PROPOSED CONDITIONS RESTORATION

With the elimination of the levees in their current alignment, the bike path along the top of the north levee must be relocated. We are proposing to realign the bike path along the top of the new northerly levee from the south-west corner of Area A, along the edge of Area A, and reconnect to the under-bridge crossing at Culver Boulevard. The existing bike path easterly of this point will remain in its current configuration. This alignment will increases the distance that must be travelled, but relative to the over-all travel length, this increase is modest.

PROPOSED ADDITIONAL CONNECTIVITY

In addition to restoring the existing connection, the project proposes to construct a number of new and missing connections. A new bike and pedestrian bridge will be constructed across the Ballona Creek just west of the existing Culver Boulevard Bridge. This will allow the bike path to be extended from the north side of the Ballona Creek to the south side. The bike path will be continued to the east by routing under this new bridge, as well as the Culver Boulevard Bridge to the westerly edge of Lincoln Boulevard. The path will then turn southerly along the easterly edge of Area B to the intersection of Lincoln and Jefferson Boulevards where it will join the dead end of the existing bike lanes along Lincoln. There are three other potential bike path connections that may be provided. First, the bike path along the south side of the Ballona Creek under Culver Boulevard could be extended under Lincoln Boulevard to connect to the bike lanes on Playa Vista Drive. Second, a bike path could be extended along the new southerly levee into the Playa del Rey area for a future connection to the bike path along the beach. And third, the project will provide a vehicular

access along the north levee connecting to Fiji Road. This connection could also provide another connection point to the existing bike lanes along Fiji.

PROPOSED GEOMETRY

The bike path is proposed in conjunction with a pedestrian trail. The eight foot wide decomposed granite pedestrian trail will be placed toward the water side of the levee with the separate twelve foot wide asphalt bike path away from the water side. The bike path will meet all design criteria of the County except as it transitions to the new bike and pedestrian bridge across the Ballona Creek where the grades and turning radii will be reduced as necessary for the transition.

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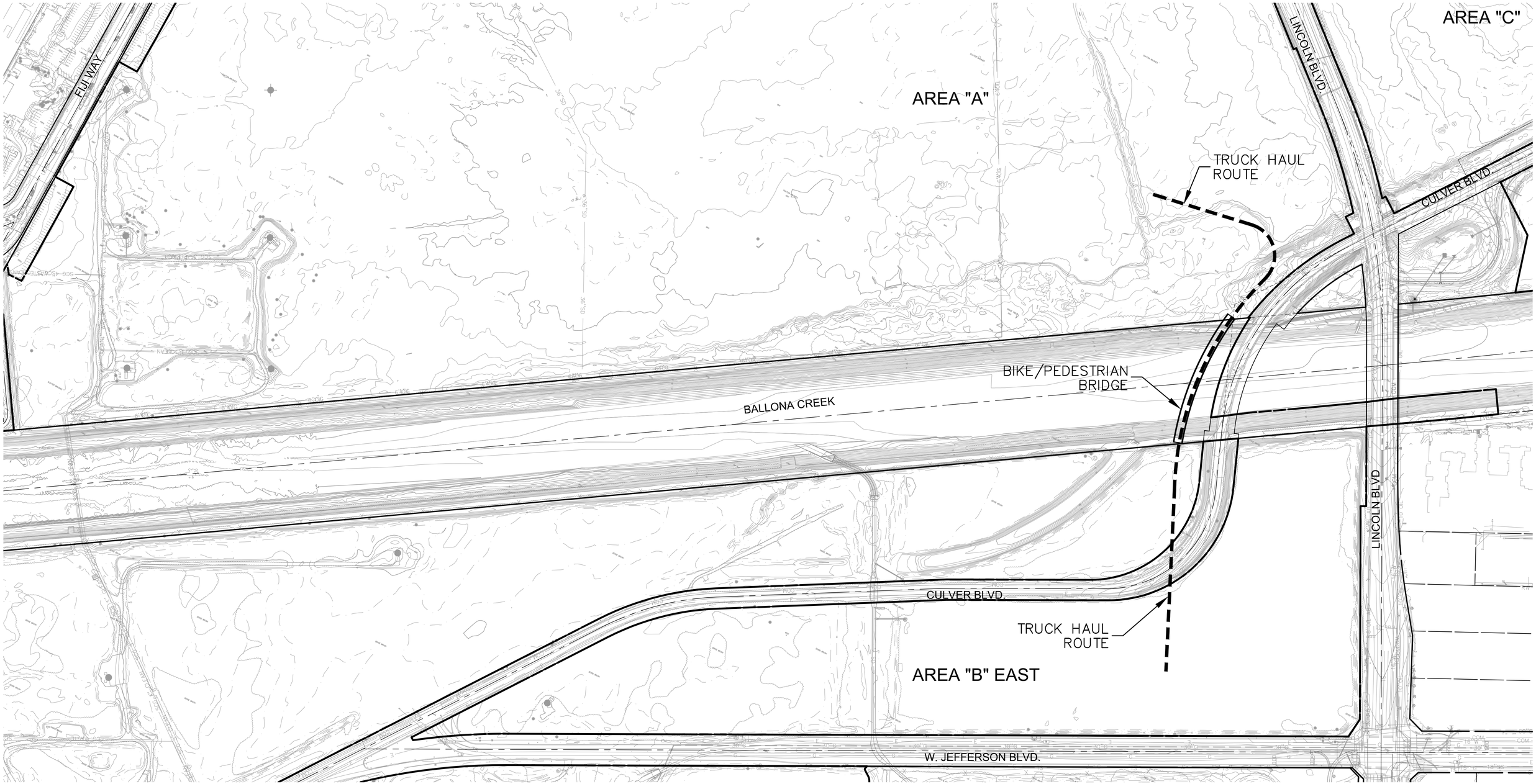
Appendix I
Haul Route

APPENDIX - HAUL ROUTE	
EXHIBIT NUMBER	**EXHIBIT/REPORT TITLE**
BR035-1	Export from Area A to Area B East
BR035-1A	Export from Area A to Area B East
BR035-2	Export from Area A to Area B East
BR035-3	Export from Area A to Area B East
BR035-4	Export from Area A to Area B East
BR035-5	Export from Area A to Area B West
BR035-6	Export from Area A to Area B West
BR035-7	Export from Area A to Area B West
BR035-8	Export from Area A to Area B West
BR035-9	Export from Area A to Area C North
BR035-9A	Export from Area A to Area C North
BR035-9B	Export from Area A to Area C North
BR035-10	Export from Area B East to Area B West
BR035-11	Export from Area B East to Area B West
BR035-12	Export from Area A to Port of LA
BR052	Haul Route Advantages/Disadvantages Spreadsheet
BR053	Haul Route Description



LEGEND

TRUCK HAUL ROUTE

EXPORT FROM AREA "A" TO AREA "B" EAST ACROSS BIKE/PEDESTRIAN BRIDGE & ACROSS CULVER BLVD.

T.G.: PAGE

150' 75' 0' 150' 300'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

BY _____ SUBDIVISION PLAN CHECKING SECTION DATE

NO.	REVISION	REVISED BY	APPROVED BY	DATE

REGISTERED PROFESSIONAL ENGINEER MICHAEL J. ORGMAN No. C48944 Exp. 09-30-14 CIVIL STATE OF CALIFORNIA

PROJECT ENGINEER DATE

HAUL ROUTE EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

PLANS PREPARED BY:

PSOMAS

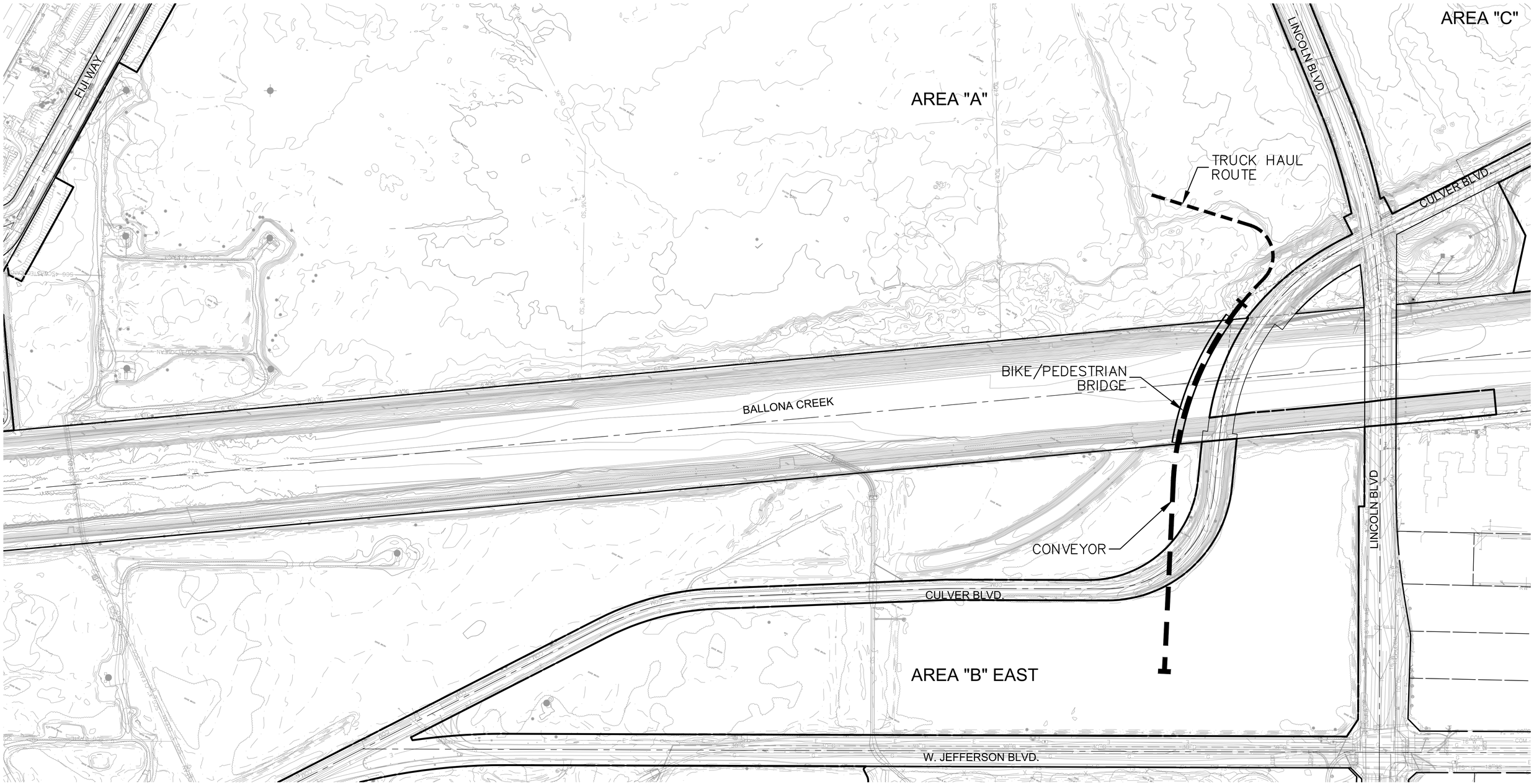
555 South Flower Street, Suite 4400
Los Angeles, CA 90071
(213) 223-1400 (213) 223-1444 fax
www.psomas.com

BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 1 OF 15

B1-1453

Plotted: 5/2/2013 5:14:01 PM :: Saved: 3/28/2013 5:01:27 PM :: W:\LCCD0100\ENGR\EXHIB\Haul Route\BR035-1.dwg ::



LEGEND

TRUCK HAUL ROUTE

CONVEYOR

150' 75' 0' 150' 300'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

BY _____ SUBDIVISION PLAN CHECKING SECTION DATE

NO.	REVISION	REVISED BY	APPROVED BY	DATE

REGISTERED PROFESSIONAL ENGINEER MICHAEL J. ORCHARD No. C48944 Exp. 09-30-14 CIVIL STATE OF CALIFORNIA

PROJECT ENGINEER DATE

EXPORT FROM AREA "A" TO AREA "B" EAST ACROSS CULVER BLVD.

T.G.: PAGE

HAUL ROUTE - CONVEYOR OPTION EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

PLANS PREPARED BY:

PSOMAS

555 South Flower Street, Suite 4400
Los Angeles, CA 90071
(213) 223-1400 (213) 223-1444 fax
www.psomas.com

BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 2 OF 15

B1-1454

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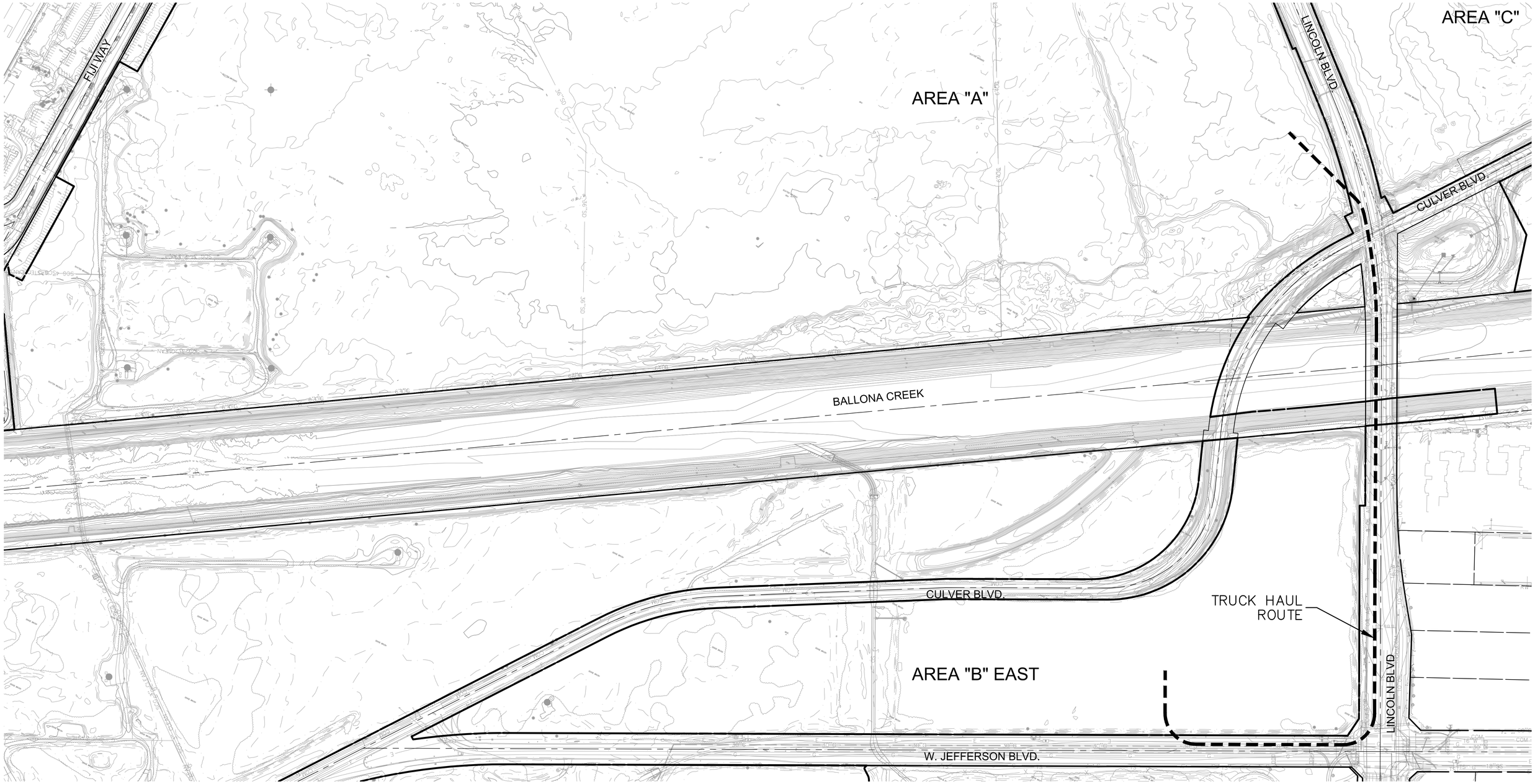

LEGEND

TRUCK HAUL ROUTE

EXPORT FROM AREA "A" TO AREA "B" EAST
USE LINCOLN & JEFFERSON BLVD.

T.G.: PAGE

150' 75' 0' 150' 300'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

BY _____ SUBDIVISION PLAN CHECKING SECTION DATE

NO.	REVISION	REVISED BY	APPROVED BY	DATE

REGISTERED PROFESSIONAL ENGINEER MICHAEL J. OREHM No. C48944 Exp. 09-30-14 CIVIL STATE OF CALIFORNIA

PROJECT ENGINEER DATE

HAUL ROUTE EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

PLANS PREPARED BY:
PSOMAS
555 South Flower Street, Suite 4400
Los Angeles, CA 90071
(213) 223-1400 (213) 223-1444 fax
www.psomas.com

BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 3 OF 15

B1-1455

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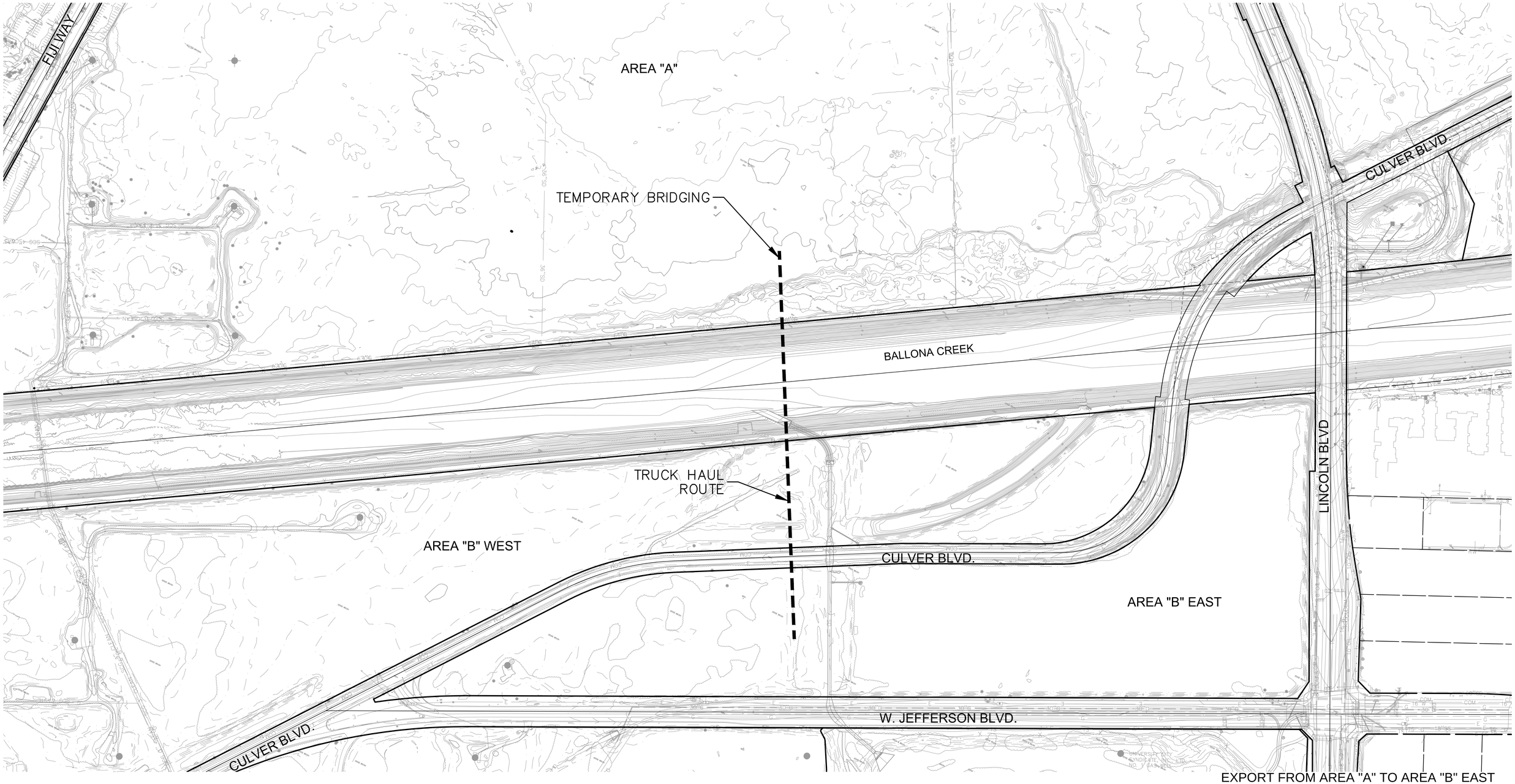

EXPORT FROM AREA "A" TO AREA "B" EAST
TEMPORARY BRIDGE ACROSS BALLONA CREEK
& CULVER BLVD. SURFACE

T.G.: PAGE

LEGEND

— — — — TRUCK HAUL ROUTE

NOTE:
USE TEMPORARY BRIDGE ONLY IF BIKE/PEDESTRIAN BRIDGE IS NOT AVAILABLE

150' 75' 0' 150' 300'
GRAPHIC SCALE
Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION
BY _____ SUBDIVISION PLAN CHECKING SECTION DATE

NO.	REVISION	REVISED BY	APPROVED BY	DATE

REGISTERED PROFESSIONAL ENGINEER
MICHAEL J. CREHAN
No. C48944
Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

HAUL ROUTE
EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

PLANS PREPARED BY:
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555 South Flower Street, Suite 4400
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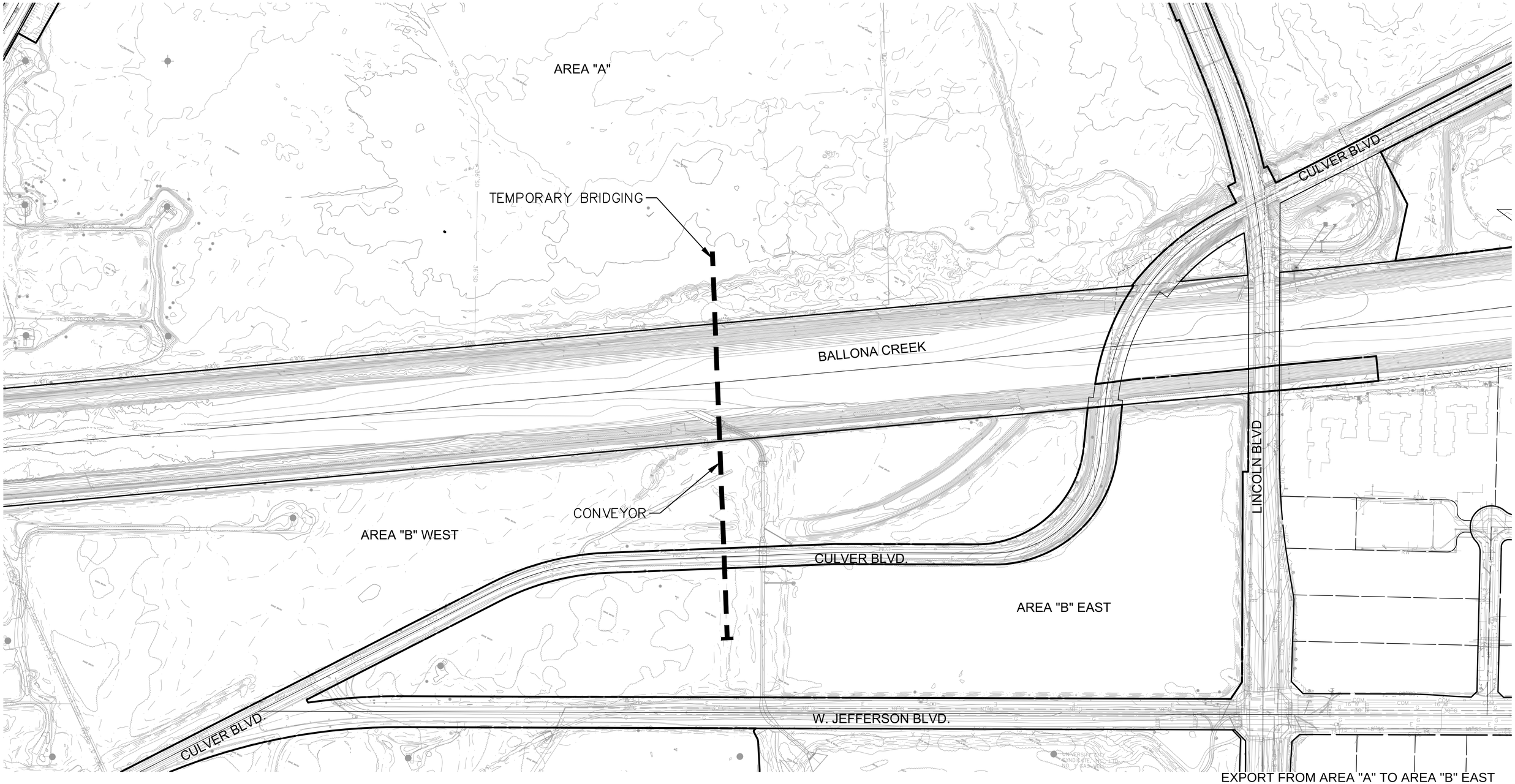
BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 4 OF 15

Plotted – 5/2/2013 5:15:04 PM :: Saved – 3/28/2013 5:09:35 PM :: W:\1CCC010100\ENGR\EXHIB\Haul Route\BR035-3.dwg ::

B1-1456



LEGEND

CONVEYOR

NOTE:
USE TEMPORARY BRIDGE ONLY IF BIKE/PEDESTRIAN BRIDGE IS NOT AVAILABLE

EXPORT FROM AREA "A" TO AREA "B" EAST
TEMPORARY BRIDGE ACROSS BALLONA CREEK
& CONVEYOR ACROSS CULVER BLVD.

T.G.: PAGE

150' 75' 0' 150' 300'
GRAPHIC SCALE
Note: For reduced sized prints, original scale is in inches

NO.	REVISION	REVISED BY	APPROVED BY	DATE

REVIEWED LAND DEVELOPMENT DIVISION

BY _____
SUBDIVISION PLAN CHECKING SECTION DATE

REGISTERED PROFESSIONAL ENGINEER
MICHAEL J. O'BRIEN
No. C48944
Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

HAUL ROUTE - CONVEYOR OPTION EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

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BALLONA WETLANDS ECOLOGICAL RESERVE

B1-1457

Plotted: 5/2/2013 5:15:32 PM :: Saved: 3/26/2013 5:11:36 PM :: W:\1CCCD01050D\ENGR\EXHIB\Haul Route\BR035-4.dwg ::

AREA "A"

AREA "C"

TRUCK HAUL ROUTE

FLUWAY

LINCOLN BLVD.

CULVER BLVD.

BIKE BRIDGE

BALLONA CREEK

CULVER BLVD.

TRUCK HAUL ROUTE

AREA "B" EAST

AREA "B" WEST

W. JEFFERSON BLVD.

TRUCK HAUL ROUTE

LINCOLN BLVD

CULVER BLVD.

LEGEND

TRUCK HAUL ROUTE

EXPORT FROM AREA "A" TO AREA "B" WEST ACROSS BIKE BRIDGE

T.G.: PAGE

200' 100' 0' 200' 400'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

BY _____ SUBDIVISION PLAN CHECKING SECTION DATE

NO.	REVISION	REVISED BY	APPROVED BY	DATE

REGISTERED PROFESSIONAL ENGINEER MICHAEL J. CREVIER No. C48944 Exp. 09-30-14 CIVIL STATE OF CALIFORNIA

PROJECT ENGINEER DATE

HAUL ROUTE EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

PLANS PREPARED BY:

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 6 OF 15

B1-1458

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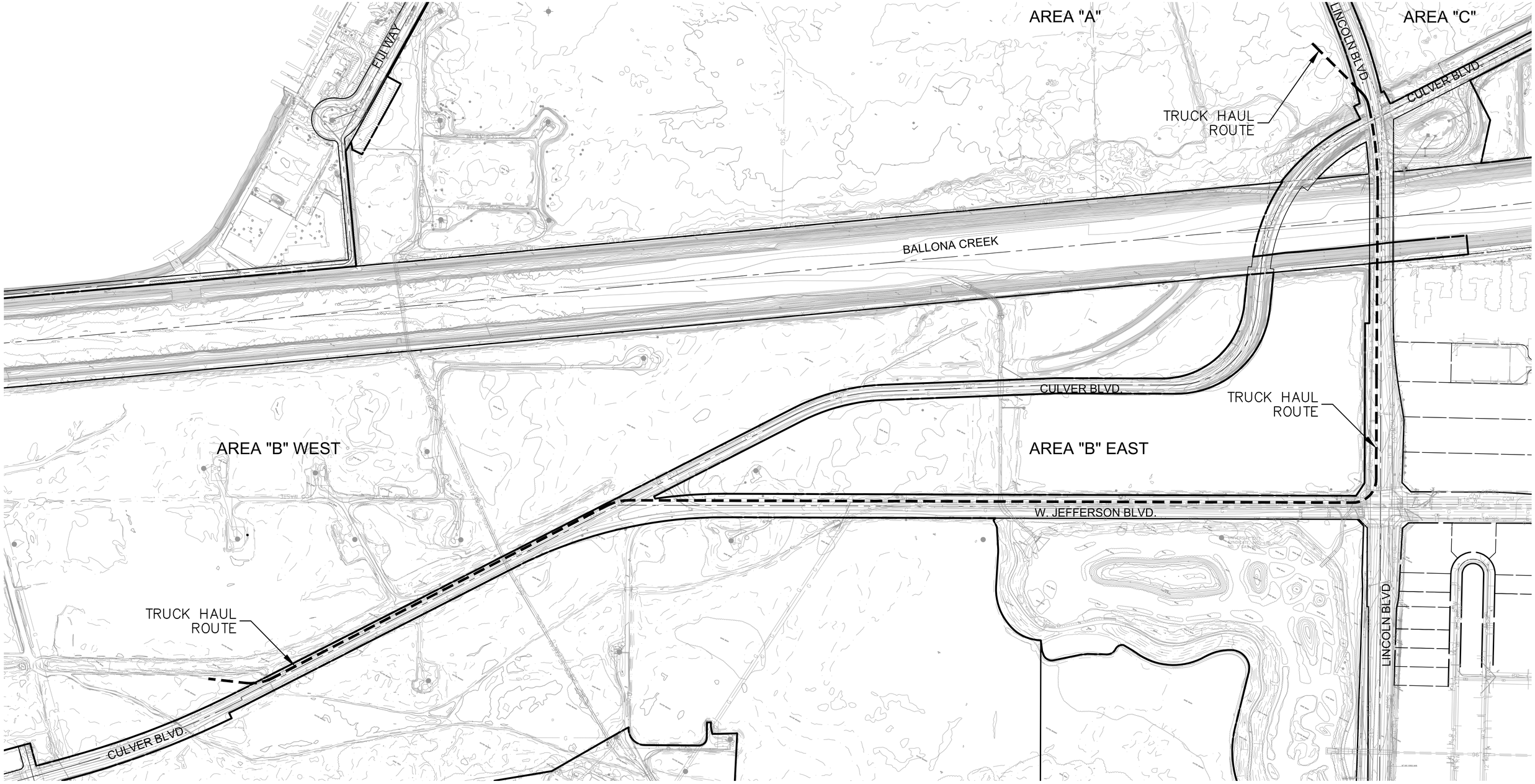

LEGEND

TRUCK HAUL ROUTE

EXPORT FROM AREA "A" TO AREA "B" WEST
USE LINCOLN BLVD, JEFFERSON BLVD. & CULVER BLVD.

T.G.: PAGE

200' 100' 0' 200' 400'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

BY _____

SUBDIVISION PLAN CHECKING SECTION DATE

NO.	REVISION	REVISED BY	APPROVED BY	DATE

REGISTERED PROFESSIONAL ENGINEER
MICHAEL J. CREHAN
No. C48944
Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

HAUL ROUTE EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

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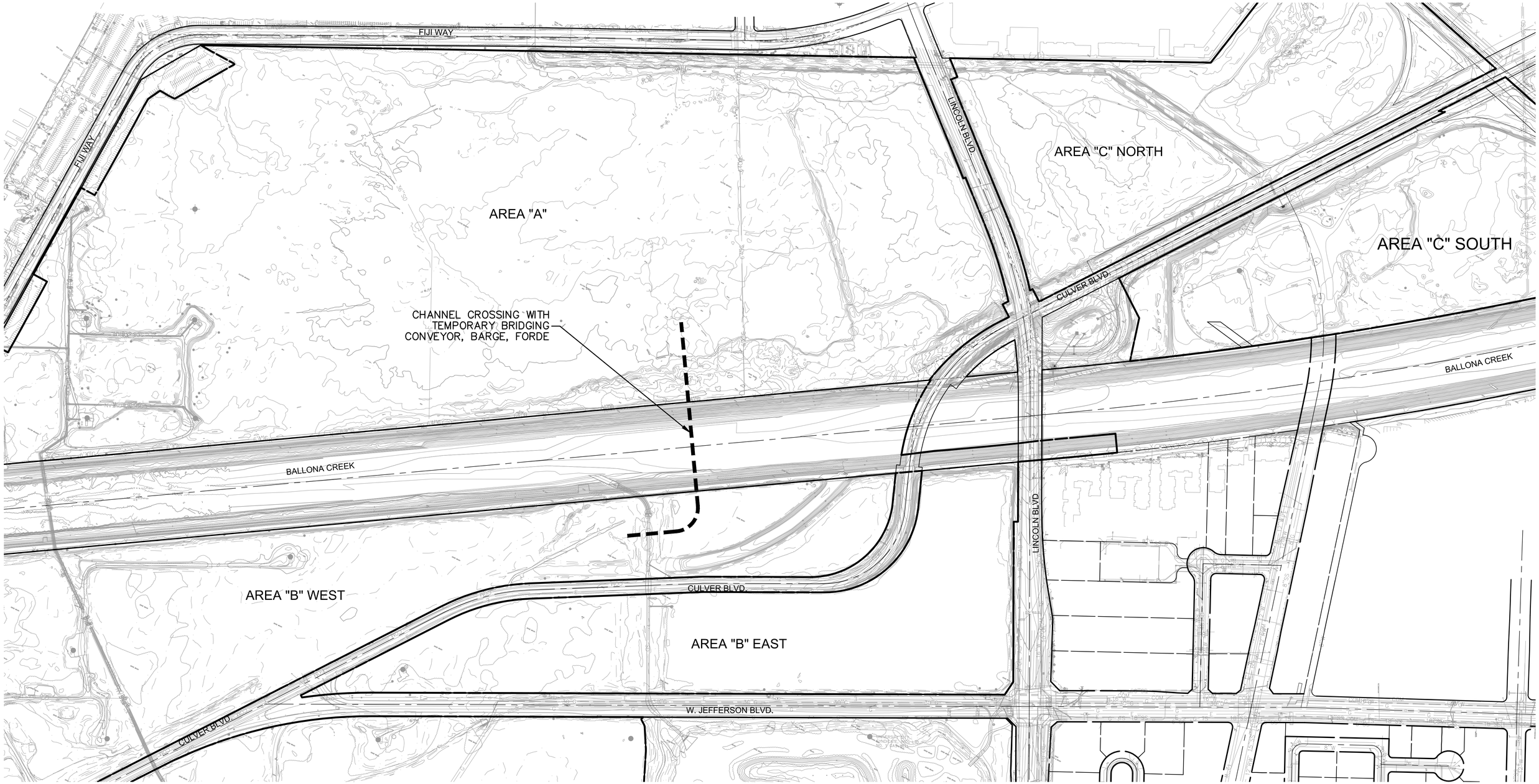
BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 7 OF 15

B1-1459

Plotted: 5/2/2013 5:16:32 PM :: Saved: 3/26/2013 5:13:44 PM :: W:\TCCC010100\ENGR\EXHIB\Haul Route\BR035-6.dwg ::



LEGEND

CONVEYOR

NOTE:
USE TEMPORARY BRIDGE ONLY IF BIKE/PEDESTRIAN BRIDGE IS NOT AVAILABLE

150' 75' 0' 150' 300'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

BY _____

SUBDIVISION PLAN CHECKING SECTION DATE

NO.	REVISION	REVISED BY	APPROVED BY	DATE

REGISTERED PROFESSIONAL ENGINEER
MICHAEL J. CREHAN
No. C48944
Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

EXPORT FROM AREA "A" TO AREA "B" WEST
ACROSS BALLONA CREEK

T.G.: PAGE

HAUL ROUTE - CONVEYOR OPTION EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

PLANS PREPARED BY:

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 8 OF 15

B1-1460

Plotted: 5/2/2013 5:16:48 PM :: Saved: 3/28/2013 5:17:38 PM :: W:\LCCCD10100\ENGR\EXHIB\Haul Route\BR035-7.dwg ::

AREA "A"

TEMPORARY BRIDGING

BALLONA CREEK

TRUCK HAUL ROUTE

CULVER BLVD.

LINCOLN BLVD

AREA "B" WEST

CULVER BLVD.

AREA "B" EAST

W. JEFFERSON BLVD.

CULVER BLVD.

LEGEND

TRUCK HAUL ROUTE

EXPORT FROM AREA "A" TO AREA "B" WEST
TEMPORARY BRIDGE ACROSS BALLONA CREEK

T.G.: PAGE

150' 75' 0' 150' 300'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

BY _____

SUBDIVISION PLAN CHECKING SECTION DATE

NO.	REVISION	REVISED BY	APPROVED BY	DATE

REGISTERED PROFESSIONAL ENGINEER
MICHAEL J. O'HEHIR
No. C48944
Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

HAUL ROUTE EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

PLANS PREPARED BY:

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Los Angeles, CA 90071
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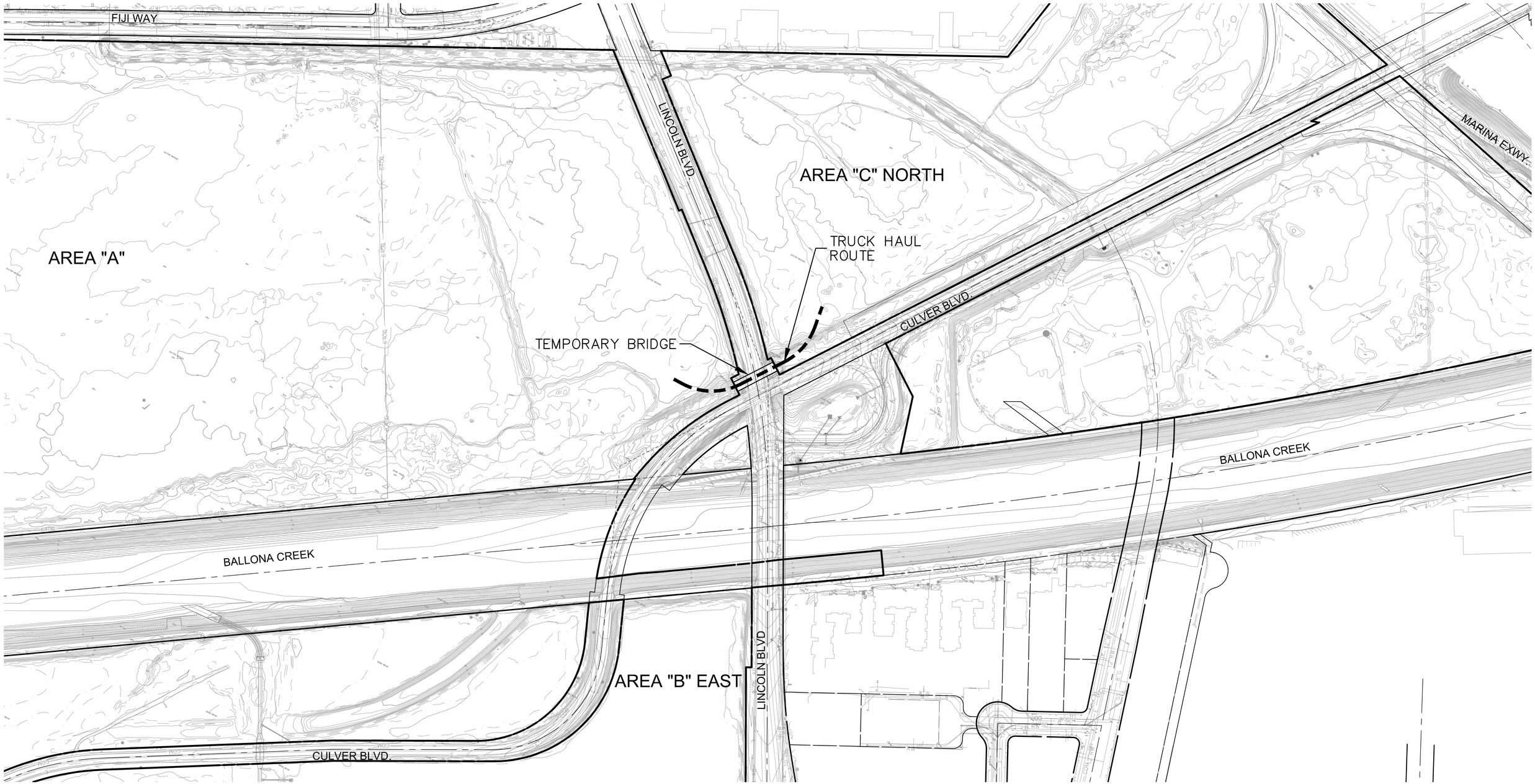
BALLONA WETLANDS ECOLOGICAL RESERVE

B1-1461



LEGEND

TRUCK HAUL ROUTE

EXPORT FROM AREA "A" TO AREA "C" NORTH ACROSS TEMPORARY BRIDGE

T.G.: PAGE

150' 75' 0' 150' 300'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

BY _____ SUBDIVISION PLAN CHECKING SECTION DATE

NO.	REVISION	REVISED BY	APPROVED BY	DATE

REGISTERED PROFESSIONAL ENGINEER MICHAEL J. CREHAN No. C48944 Exp. 09-30-14 CIVIL STATE OF CALIFORNIA

PROJECT ENGINEER DATE

HAUL ROUTE EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

PLANS PREPARED BY:

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 10 OF 15

B1-1462

Plotted: 5/2/2013 5:17:19 PM :: Saved: 3/28/2013 5:22:17 PM :: W:\1CCC01000\ENGR\EXHIB\Haul Route\BR035-9.dwg ::



LEGEND

TRUCK HAUL ROUTE

EXPORT FROM AREA "A" TO AREA "C" NORTH ACROSS LINCOLN BLVD.

T.G.: PAGE

150' 75' 0' 150' 300'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

BY _____ DATE

SUBDIVISION PLAN CHECKING SECTION

NO.	REVISION	REVISED BY	APPROVED BY	DATE

REGISTERED PROFESSIONAL ENGINEER
MICHAEL J. CHEHAK
No. C48944
Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

HAUL ROUTE EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

PLANS PREPARED BY:

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 11 OF 15

B1-1463

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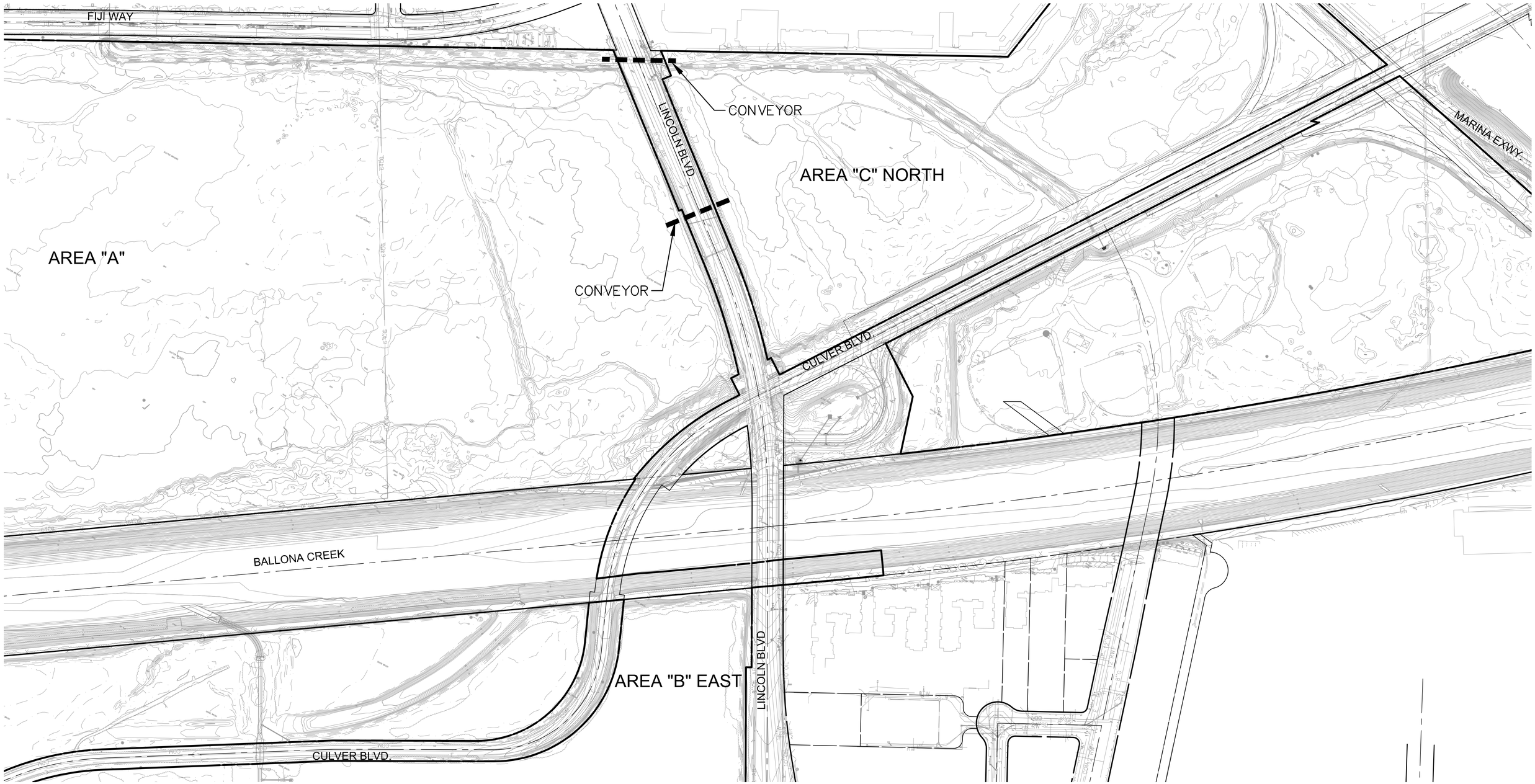

LEGEND

CONVEYOR

EXPORT FROM AREA "A" TO AREA "C" NORTH ACROSS LINCOLN BLVD.

T.G.: PAGE

150' 75' 0' 150' 300'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

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NO.	REVISION	REVISED BY	APPROVED BY	DATE

REGISTERED PROFESSIONAL ENGINEER
MICHAEL J. CHEHAK
No. C48944
Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

HAUL ROUTE - CONVEYOR OPTION EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

PLANS PREPARED BY:

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 12 OF 15

B1-1464

Plotted - 5/2/2013 5:13:27 PM :: Saved - 3/26/2013 5:23:39 PM :: W:\CCC0100100\ENGR\EXHIB\Haul Route\BR035-98.dwg ::

AREA "A"

AREA "C" NORTH

AREA "C" SOUTH

AREA "B" WEST

AREA "B" EAST

LINCOLN BLVD.

CULVER BLVD.

BALLONA CREEK

TRUCK HAUL ROUTE

CULVER BLVD.

LINCOLN BLVD

CULVER BLVD.

W. JEFFERSON BLVD.

LEGEND

TRUCK HAUL ROUTE

EXPORT FROM AREA "B" EAST TO AREA "B" WEST ACROSS CULVER BLVD.

T.G.: PAGE

150' 75' 0' 150' 300'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

BY _____ SUBDIVISION PLAN CHECKING SECTION DATE

NO.	REVISION	REVISED BY	APPROVED BY	DATE

REGISTERED PROFESSIONAL ENGINEER MICHAEL J. CHEHAK No. C48944 Exp. 09-30-14 CIVIL STATE OF CALIFORNIA

PROJECT ENGINEER DATE

HAUL ROUTE EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

PLANS PREPARED BY:

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 13 OF 15

B1-1465

Plotted: 5/2/2013 4:54:18 PM :: Saved: 3/26/2013 5:29:10 PM :: W:\1CCC010100\ENGR\EXHIB\Haul Route\BR035-10.dwg ::

AREA "A"

AREA "C" NORTH

LINCOLN BLVD.

CULVER BLVD.

BALLONA CREEK

CONVEYOR

AREA "B" WEST

CULVER BLVD.

AREA "B" EAST

LINCOLN BLVD

CULVER BLVD.

W. JEFFERSON BLVD.

LEGEND

CONVEYOR

EXPORT FROM AREA "B" EAST TO AREA "B" WEST ACROSS CULVER BLVD.

T.G.: PAGE

150' 75' 0' 150' 300'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

BY _____

SUBDIVISION PLAN CHECKING SECTION DATE

NO.	REVISION	REVISED BY	APPROVED BY	DATE

REGISTERED PROFESSIONAL ENGINEER
MICHAEL J. ORSHAN
No. C48944
Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

HAUL ROUTE - CONVEYOR OPTION EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

PLANS PREPARED BY:

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 14 OF 15

B1-1466

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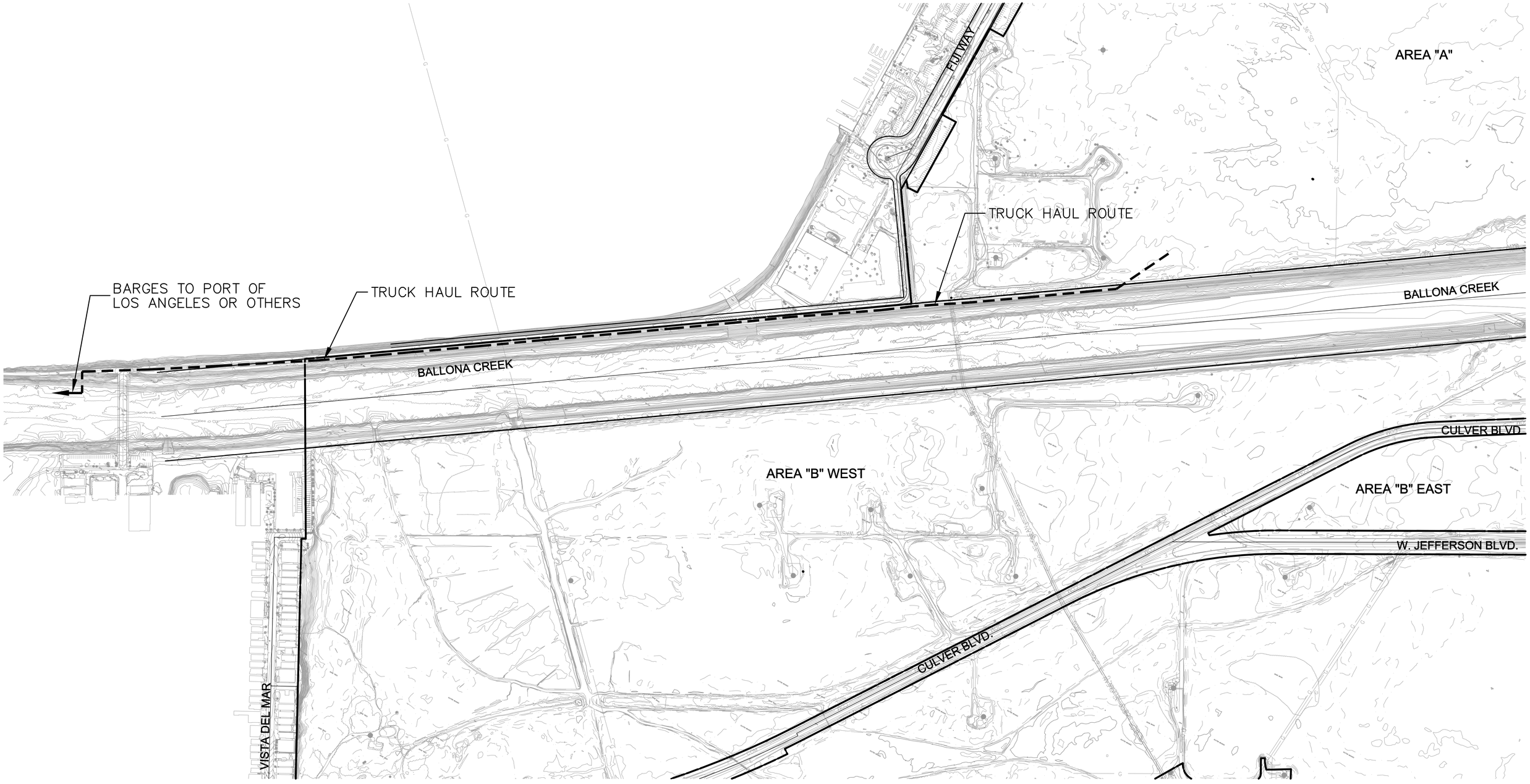
FUTURE
FUTURE
FUTURE

HAUL ROUTE ADVANTAGES/DISADVANTAGES

EXHIBIT NUMBER	EXHIBIT TITLE	DESCRIPTION	ADVANTAGES								DISADVANTAGES										
			Does not require temporary facilities	Bridge used for ongoing O&M activities	No initial construction costs, or relatively small	Provides flexibility in location of crossing	All year operational activity	Minimal impact on existing channel	Earth movement could operate more than 8 hours	Avoids hauling on public roads	Additional bridge cost	Channel support columns larger than necessary	Pontoons removed during storms and wet season	Temporary Costs	Existing bike trail & maintenance road closed	Limited to highway truck type traffic	Reconstruction of Bike Path Required	Increased handling of earth materials	Street cleaning & maintenance activity	Hauling times limited	Larger cost for smaller volume
BR035-1	Export from Area A to Area B East	Across Bike Bridge & Surface of Culver Blvd	X	X			X				X	X				X			X	X	
BR035-1A	Export from Area A to Area B East	Conveyor across Bridge & Culver Blvd				X	X	X	X	X				X				X			X
BR035-2	Export from Area A to Area B East	Across Lincoln Blvd & Jefferson Blvd Surface	X		X	X	X	X								X			X	X	
BR035-3	Export from Area A to Area B East	Temporary Bridging across Ballona Creek & Culver Blvd Surface				X		X					X	X		X			X	X	
BR035-4	Export from Area A to Area B East	Temporary Bridging across Ballona Creek & Conveyor across Culver Blvd				X		X	X	X			X	X				X			X
BR035-5	Export from Area A to Area B West	Across Bike Bridge	X	X			X	X	X	X	X	X									
BR035-6	Export from Area A to Area B West	Use Lincoln Blvd, Jefferson Blvd & Culver Blvd Surface	X		X	X	X	X								X			X	X	
BR035-7	Export from Area A to Area B West	Temporary Bridging across Ballona Creek; Conveyor				X	X	X	X	X			X	X				X			X
BR035-8	Export from Area A to Area B West	Temporary Bridging across Ballona Creek; Surface				X		X	X	X			X	X							
BR035-9	Export from Area A to Area C North	Across Temporary Bridge					X	X	X	X	X			X							
BR035-9A	Export from Area A to Area C North	Across Lincoln Blvd																	X	X	
BR035-9B	Export from Area A to Area C North	Conveyor across Lincoln Blvd							X									X			X
BR035-10	Export from Area B East to Area B West	Across Culver Blvd Surface	X		X	X	X									X			X	X	
BR035-11	Export from Area B East to Area B West	Conveyor Across Culver Blvd				X	X		X	X				X				X			X
BR035-12	Export from Area A to Port of LA	Export from Area A to Port of LA	X		X		X	X	X					X	X		X	X			

Haul Route Options Discussion

We have reviewed various options for transporting soil within the project area. A summary of these options as well as the advantages and disadvantages for each option has been organized into a "haul Routes Exhibit" spreadsheet. The various routes have been grouped to compare options between areas. A description of these options is provided here:

Transporting earth from Area A across Ballona channel to Area B. Approximately 800,000 to 1,000,000 cubic yards of material needs to be transported.

1. Use planned bicycle/trail bridge

   The project proposes to construct a new pedestrian and bicycle bridge across the Ballona channel at the downstream side of the existing Culver Blvd Bridge. This bridge could be increased in size to accommodate dirt transport between Areas A and B

   a. Must construct bridge at beginning of project construction cycle.
   b. Must construct new pedestrian bridge for H20 truck loads.
   c. May transport earth materials in highway rated vehicles
   d. Must provide a bridge width for 2-way traffic.
   e. If scrapers are used for earth material transport, must increase bridge design loads.
   f. Must provide temporary access roads to and from bridge.
   g. Support piles into channel are required to support loads.
   h. Should match pile / foundation spacing to existing Culver Bridge configuration.

2. Use temporary pontoon bridge

   This option involves installing a temporary pontoon bridge across the Ballona Creek waters to be used to transport earth materials.

   a. Would install a pontoon bridge across the wet channel surface.
   b. Pontoon bridge may need to be removed during wet season.
   c. Temporary ramps or access openings may need to be cut into the existing levees on both sides of the channel.
   d. Temporary access openings may need to be sealed during the wet season with riprap.
   e. Access ramps and roads are required on each side of the channel levee.
   f. This option allows deferred costs of building the permanent bridge and would allow the bridge to be less costly.
   g. The bike path would require closure or re-routing.

3. Use temporary modular truss bridge with support columns

This option proposes installation of a temporary truss type bridge across the Ballona Channel to be above the water elevation. The main advantage over a pontoon bridge is that it would not need to be removed during rain events.

a. Construct temporary modular truss bridge from levee to levee.
b. Bridge will require intermediate supports in Ballona Channel
c. Bridge is intended to be used in both dry and wet seasons.
d. Location of crossing should be close to the Culver Bridge and bridge supports should match spacing and location of Culver Bridge supports.
e. Temporary access roadways required at each side of bridge.
f. Bridge would be 20 feet wide minimum for 1-way traffic
g. Preferred width 30 feet for 2-way traffic.
h. A modular truss type bridge would most likely only be adequate for standard highway

4. Conveyor system

Install a conveyor system across Ballona channel to transfer earth materials from one side to the other.

a. Provide loading area and material staging on Area A side
b. Provide spoil area and truck staging on Area B side.
c. Temporary supports required across channel.
d. Temporary electrical service required for conveyor operations.
e. Multiple handling of soils is required.

5. Hauling on public streets

This option would involve loading material on to highway rated vehicles and transporting on existing public roads.

- Identify preferred haul route including points of entry and exit for existing roads.
- Governmental approval for a haul route through City of Los Angeles is required.
- Possibly process CUP through County of Los Angeles because hauling volume exceeds 100,000 c.y.
- Obtain access location approval from Caltrans for access to Lincoln Blvd.
- Obtain access location approval for Jefferson Blvd. entry /exit location.
- Continuous street sweeping will be required.
- Hauling times will probably be limited to avoid peak hour traffic volumes.

Transporting earth from Area A to Area C – north side of Culver. Approximately 300,000 to 400,000 cubic yards of material needs to be transported.

1. Temporary truss bridge at existing Rail crossing abutments.

   A temporary truss bridge may be constructed over Lincoln Boulevard adjacent to and north of the existing Culver Boulevard bridge.

   a. Place a modular steel truss bridge on the existing rail bridge abutments.
   b. Bridge would be a single span over Lincoln Blvd.
   c. Temporary access roads and ramps are required on both sides of Lincoln for access.
   d. Bridge width 20 feet for 1-way traffic or 30 feet for 2-way traffic.
   e. Bridge would be capable of carrying conventional highway trucks.
   f. If scrapers are used for earth material transport, increase bridge design loads.

2. Conveyor System

   Install a conveyor system across Lincoln Boulevard at the same location as the old rail bridge just north of Culver Blvd.

   a. Provide loading area and material staging on Area A side
   b. Provide spoil area and truck staging on Area c side.
   c. Temporary supports truss structure required for Lincoln Blvd crossing.
   d. Temporary electrical service required for conveyor operations.

3. Hauling on public streets

   This option would involve loading material on to highway rated trucks and transporting on existing public roads.

   - Identify preferred haul route including points of entry and exit for existing roads.
   - Process haul route approval through City of Los Angeles.
   - Possibly process CUP through County of Los Angeles because hauling volume exceeds 100,000 c.y.
   - Obtain access location approval from Caltrans for access to Lincoln Blvd.
   - Obtain access location approval for Culver Blvd. entry /exit location.
   - Continuous street sweeping will be required.
   - Hauling times will probably be limited to avoid peak hour traffic volumes.
   - Hauling times will be restricted by peak hour traffic conditions.
   - Special traffic control measures required at entries and exits.

Transporting earth from Area A to Area C – south side of Culver. Approximately 300,000 to 400,000 cubic yards of material needs to be transported.

1. Modify and expand existing bike path crossings – north side Ballona channel under existing bridges.

   This hauling option would use the existing bike trail and maintenance road on the north levee to pass under both Culver Blvd and Lincoln Blvd to access toe Area C south disposal site.

   a. Reconstruct existing bike trail/maintenance road under Culver and Lincoln to lower the road surface sufficiently to provide access clearance for either hauling trucks or scrapers.
   b. Temporary reconstruction of levee slope to widen trail to 20 feet for 1 way traffic.
   c. Hauling would not occur when there is a potential of storm flows.
   d. Temporary encroachments into channel may need to be removed in order to preserve flow capacity
   e. Rebuilding of the bike path may be necessary after construction

2. Public street haul

   This option would involve loading material on to highway rated trucks and transporting on existing public roads.

   a. Identify preferred haul route including points of entry and exit for existing roads.
   b. Process haul route approval through City of Los Angeles.
   c. Possibly process CUP through County of Los Angeles because hauling volume exceeds 100,000 cy.
   d. Obtain access location approval from Caltrans for access to Lincoln Blvd.
   e. Obtain access location approval for Culver Blvd. entry /exit location.
   f. Continuous street sweeping will be required.
   g. Hauling times will probably be limited to avoid peak hour traffic volumes.

3. Use temporary bridge over Lincoln to North of Culver then establish a temporary traffic signal for the road crossing.

   This option would use the temporary bridge installed to transport earth material to Area C – north side and then provide for a controlled intersection crossing of Culver Blvd. at a mid-point between the existing traffic signals at the Marina Freeway ramps and the Lincoln Blvd connector road.

   a. Use the same modular truss bridge and access roads that are discussed for Area C north side access.
   b. Install temporary traffic signal at a mid-point between Marina Freeway ramps and Lincoln Blvd Access road.
   c. Provide street maintenance at road crossing

d. Earth material will be hauled in highway rated trucks.
e. Obtain Haul route approval from City of Los Angeles for Culver Blvd crossing.

4. Continue conveyor from Area C North, or under bridges.

a. Provide loading area and material staging on Area A/ C North side
b. Provide spoil area and truck staging on Area C South side.
c. Temporary supports truss structure required for Culver Blvd crossing.
d. Temporary electrical service required for conveyor operations.
e. Closing bike lane would be required if under the existing bridges.

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Appendix J
Construction Pictures

(a)



(b)



Figure Conveyor; Photographs courtesy of Group Delta. Clockwise from far right:

(a) Conveyor belts carrying different materials to dam site 3+ miles away

(b) Automatic sorting of materials into different belts at the beginning of the conveyor belt

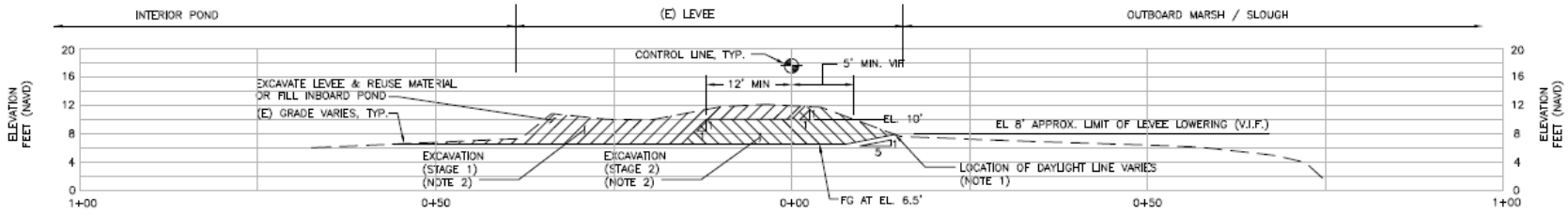
(c), (d) Bridge to protect small road from falling materials out of conveyor belts



(d)



(c)



A 12 3,4

LEVEE LOWERING AT OUTBOARD LEVEE

TYPICAL SECTION

SCALE: 1"=10'



Figure Levee Lowering.

The section drawing shows a 2-phased levee lowering excavation.

The photograph shows the same levee close to the end of Phase 2 construction, with the levee crest lowered to high tide except for a small “check berm” to prevent overtopping. Note: The tidal boundary is on the left, opposite of the drawing.



Figure Breach: Two long-reach excavators and a low ground pressure dozer excavate a breach. Not seen is a third long reach excavator that re-handled the excavated material to spread it further, and additional dozers that helped spread the material. Ideally, the breach is constructed in a few hours, between high tides, including while water flows through. When multiple days or longer are required, flows through or over the breach are controlled to avoid failure of the breach.









Figure Construction Equipment: Clockwise from above: Dragline and Long reach excavator; Clamshell dredge; Rotary ditcher (on trailer); amphibious excavator; long reach excavator on mats.

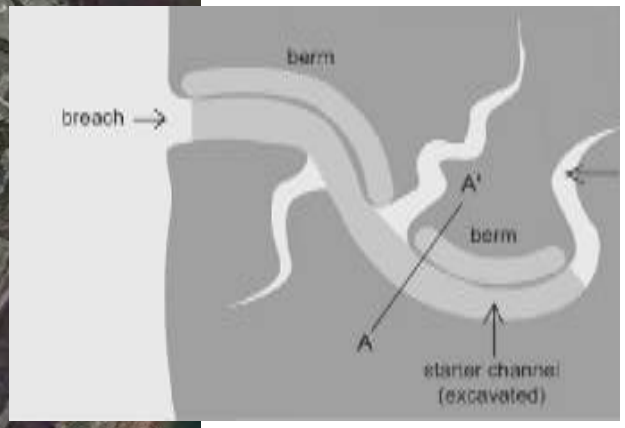




Figure Channel and Berm

(Left) Vegetated areas within newly breached site are berms adjacent to excavated channels and marsh channels and internal levees left in place. Picture taken about 3 years after construction.

(below) Plan and section view of channel and berm earthwork.



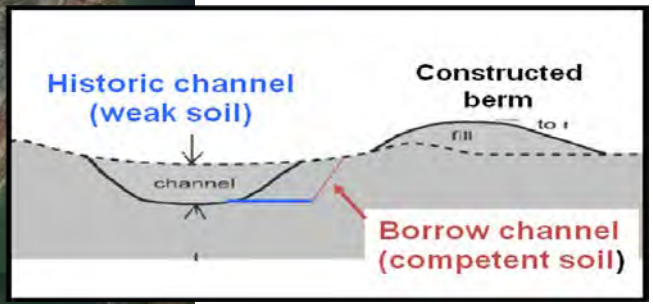
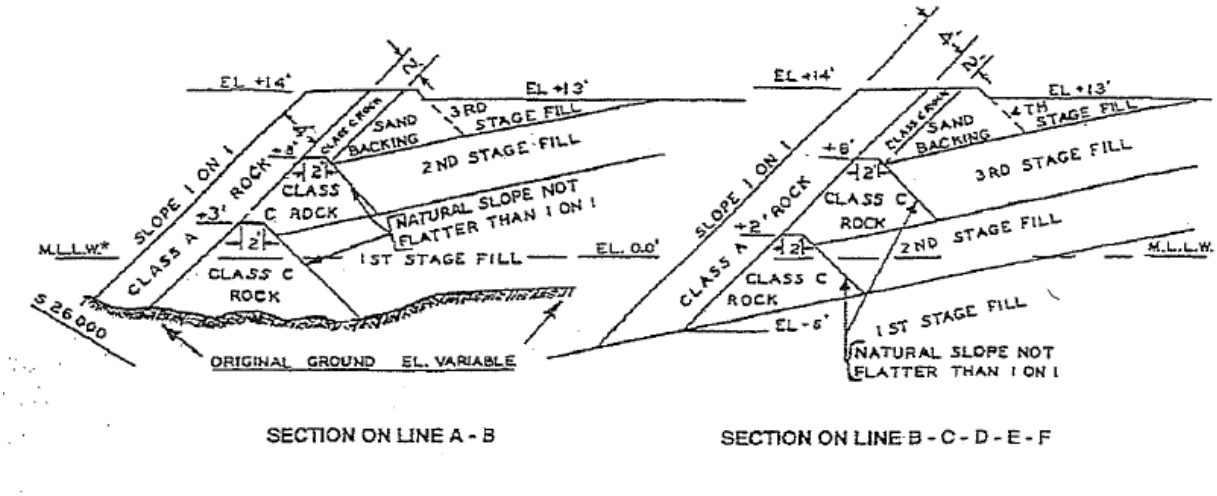




Figure Fill in Water: Pictures of hydraulic fill construction of Treasure Island in San Francisco Bay. Also, cross section showing rubble dike and armor to confine the fill.





SECTION ON LINE A - B

SECTION ON LINE B - C - D - E - F

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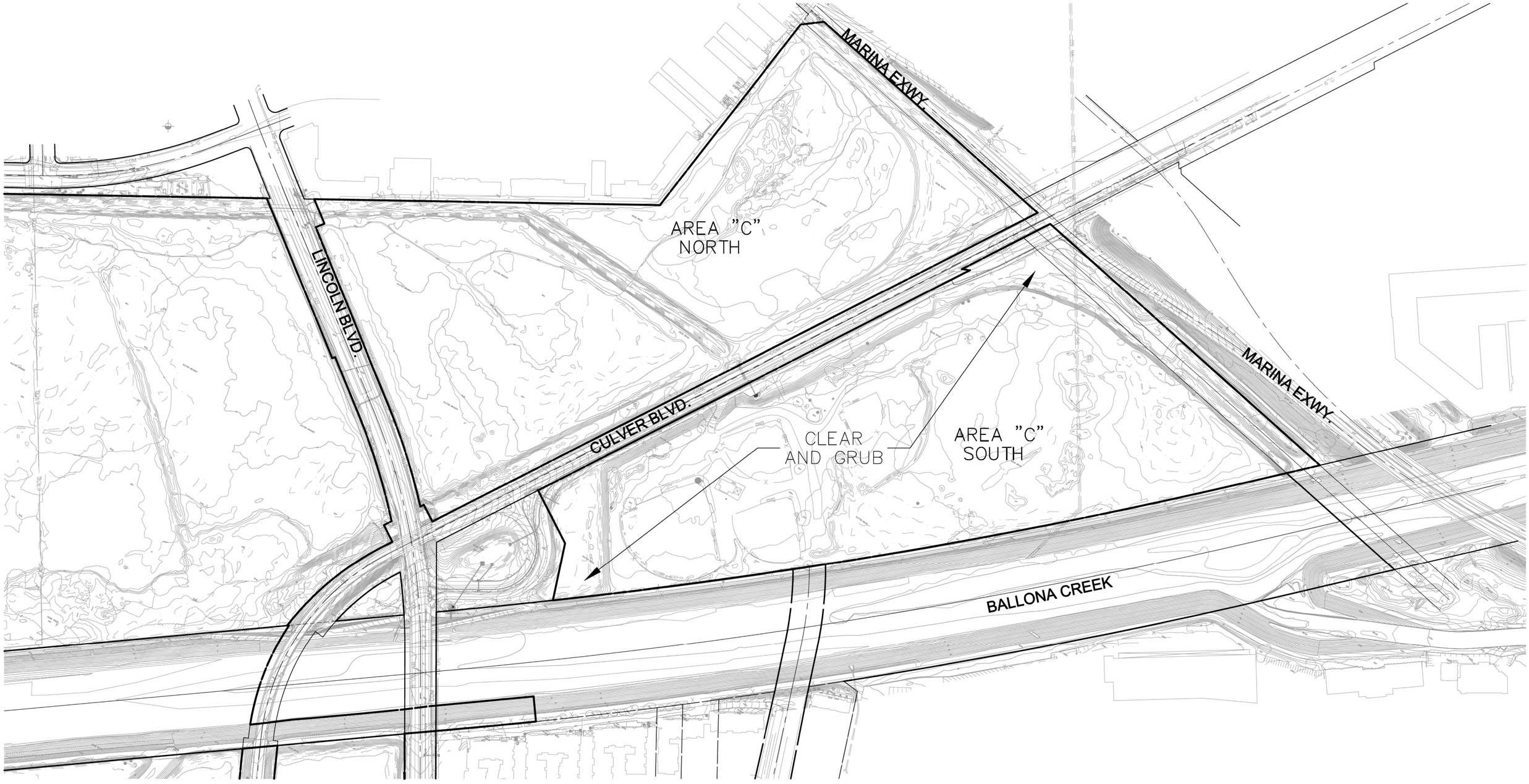
Appendix K
Construction Sequencing

APPENDIX - CONSTRUCTION SEQUENCING

Sequence Number	Title	Description	AREA	Comments
1	Clear and Grub Area "C" South	Clear & Grub - Area C South	C	
2	Area "C" South Grading	Area C South Grading	C	
3	Area "B" Southeast Gas Lines	Remove and relocated existing gas line	B	
4	Area "B" Temporary Storm Drain	Install temporary flexible storm drain pipe	B	
5	Area "B" South Enhancement	Enhancement within area B South including proposed swale	B	
6A	Area "A' Gas Line Removal	Remove existing inactive gas line	A	"A" Designation indicates interim stage if Gas Company facilities not ready
6B	Area "A" Gas Line Removal & Well Abandonment	Remove existing inactive gas line and abandon existing gas wells	A	"B" Designation indicates ultimate design
7	Pedestrian/Bike Bridge	Relocate bike path under proposed bridge and construct pedestrian/bike bridge across channel with connection to bike path under the bridge	A & B	
8	Lincoln Bridge	Build Lincoln Bridge next to Culver Bridge to connect Area A to Area C	**A & C**	Build Lincoln Bridge next to Culver Bridge on existing abutment to connect Area A to Area C
9	Clear and Grub Area "A"	Clear, Grub and Stockpile before Grading Area A	**A**	
10	Excavate Area "A"	Area A excavation starts 70' north of Levee	**A**	Remove existing interfering portions of abandoned 36" RCP
11A	Area "A' Construct North Levee	Grading & construction of levee within Area A, assumes gas wells remain	**A**	
11B	Area "A' Construct North Levee	Grading & construction of levee within Area A, assumes gas will be removed	**A**	
12A	Area "B" North Gas Line Relocation & Well Abandonment	Remove and relocate active gas lines within sleeve; abandon two gas wells and relocate	**B**	Gas Line alignment to be determined in coordination with Southern California Gas Company. Can be conducted earlier, preferably with Sequence 3
12B	Area "B" North Gas Line Relocation & Well Abandonment	Remove and relocate active gas lines within sleeve; abandon all gas wells	**B**	Gas Line alignment to be determined in coordination with Southern California Gas Company. Can be conducted earlier, preferably with Sequence 3
13	Area "B" North Clear & Grub	Clear and Grub Area "B" North	**B**	
14	Area "B" North Over-Excavate and Stockpile	Excavate along Culver - Jefferson to 70 ft. south of levee	**B**	
15	Construct Area "B" Levee	Grading & construction of levee within Area B	**B**	
16	Clear and Grub Area "B" East	Clear, Grub and Stockpile before Grading Area "B" EAST	**B**	
17	Area "B" East Grading	Area B East Grading	**B**	
18	Clear & Grub Area "C" North	Clear & Grub - Area C North	**C**	
19	Area "A" Grading and Export to Area "C" North	Area A Grading and exporting to Area C North	**A & C**	
20	Finish Grading for Uplands Area "C" North	Finish Grading for Uplands on Area C	**C**	
21	Bike Path, Pedestrian Walkway and Amenities	Construct Bike Path, pedestrian walk & amenities along top of levee	**A & B**	
22	Area "B" Box Culverts	Culverts on Culver & Jefferson Blvd and realignment of Fresh Water Marsh outlet	**B**	Two new culverts and realignment of Fresh Water Marsh outlet
23	Area "A" and Area "B" North Excavate and Breach Existing Levees	Excavate and Breach Exist Levees	**A & B**	
24	Area "A" and Area "B" North Block and Fill Existing Levees	Block and Fill Existing Levees	**A & B**	
25	Area "A" and Area "B" North Remove Existing Levees	Removal of Existing Levees	**A & B**	
26	Area "B" West Fire Access Road	Construct the Fire Access Road Area B West	**B**	The majority of this work can be earlier or later as it is a separate operation. The portion of connecting Culver to the levee top must be built with Sequence 20.
27	Area "B" West Grading	Area B West Grading 70 ft south of levee after Area A habitat is established	**B**	
28	Extension of Bike Path along South Levee to Playa Del Rey	Extend the bike path along the top of the South Levee to Playa Del Rey with amenities	**B**	
29	Area "B" West Excavate and Breach Existing Levees	Remove Existing Levee at Ballona Creek and build Levee on Area B West	**B**	
30	Area "B" West Remove Existing Levees	Remove Existing Levee at Ballona Creek and build Levee on Area B West	**B**	
31	Export from Area "B" West to Area "B" East	If required, export excess soil	**B**	
32	Finish Grading For Uplands	Complete Grading - Area B East and construct Optional bike path under Lincoln Blvd bridge	**B**	



CLEAR AND GRUB AREA "C" SOUTH

T.G.: PAGE

200' 100' 0' 200' 400'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

BY _____ DATE

SUBDIVISION PLAN CHECKING SECTION

NO.	REVISION	REVISED BY	APPROVED BY	DATE

REGISTERED PROFESSIONAL ENGINEER
MICHAEL J. OREHAM
No. C48944
Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

CONSTRUCTION SEQUENCING #1
EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 1 OF 32

B1-1485

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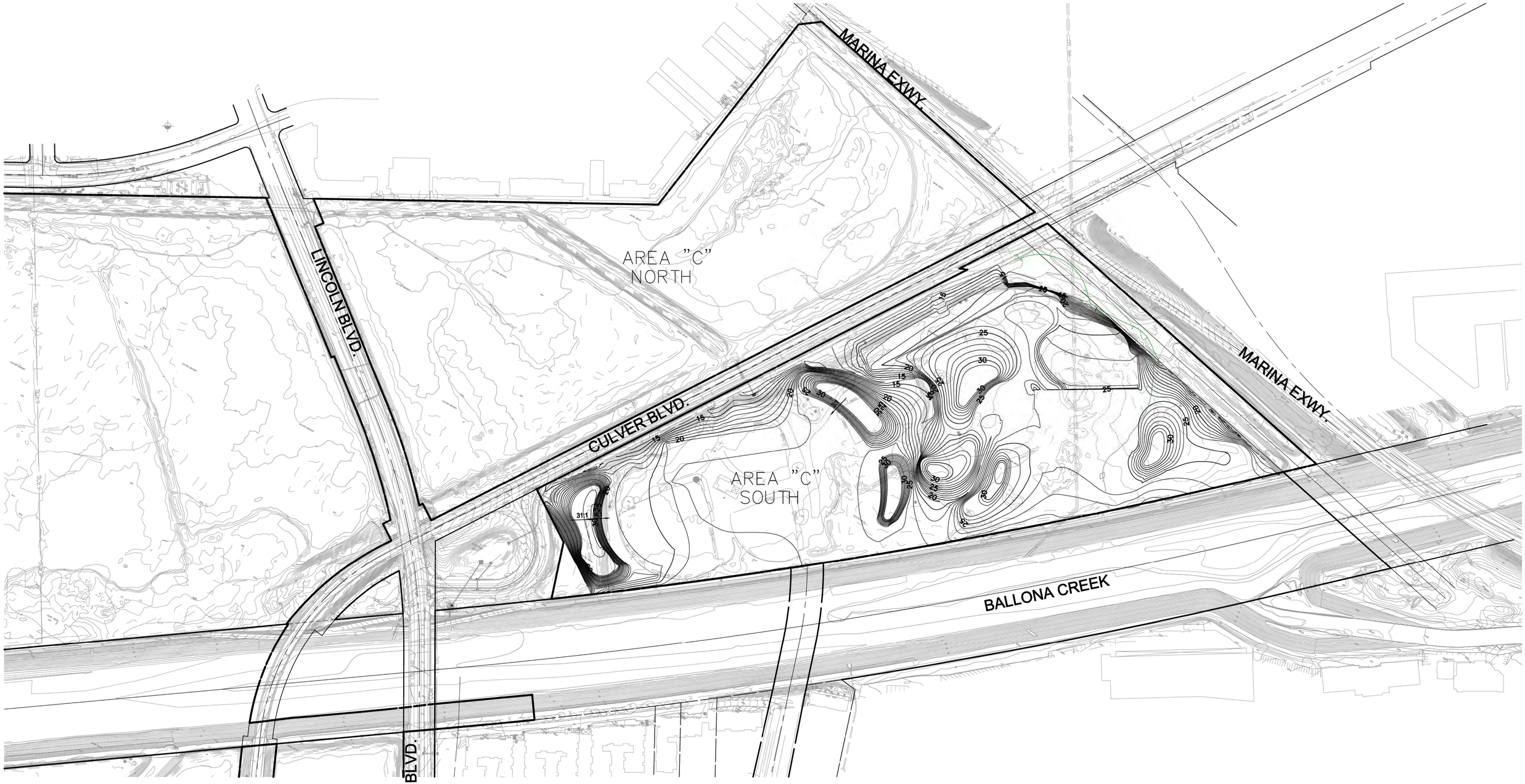

AREA "C" SOUTH GRADING

T.G.: PAGE

CONSTRUCTION SEQUENCING #2 EXHIBIT

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200' 100' 0' 200' 400'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

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BALLONA WETLANDS ECOLOGICAL RESERVE

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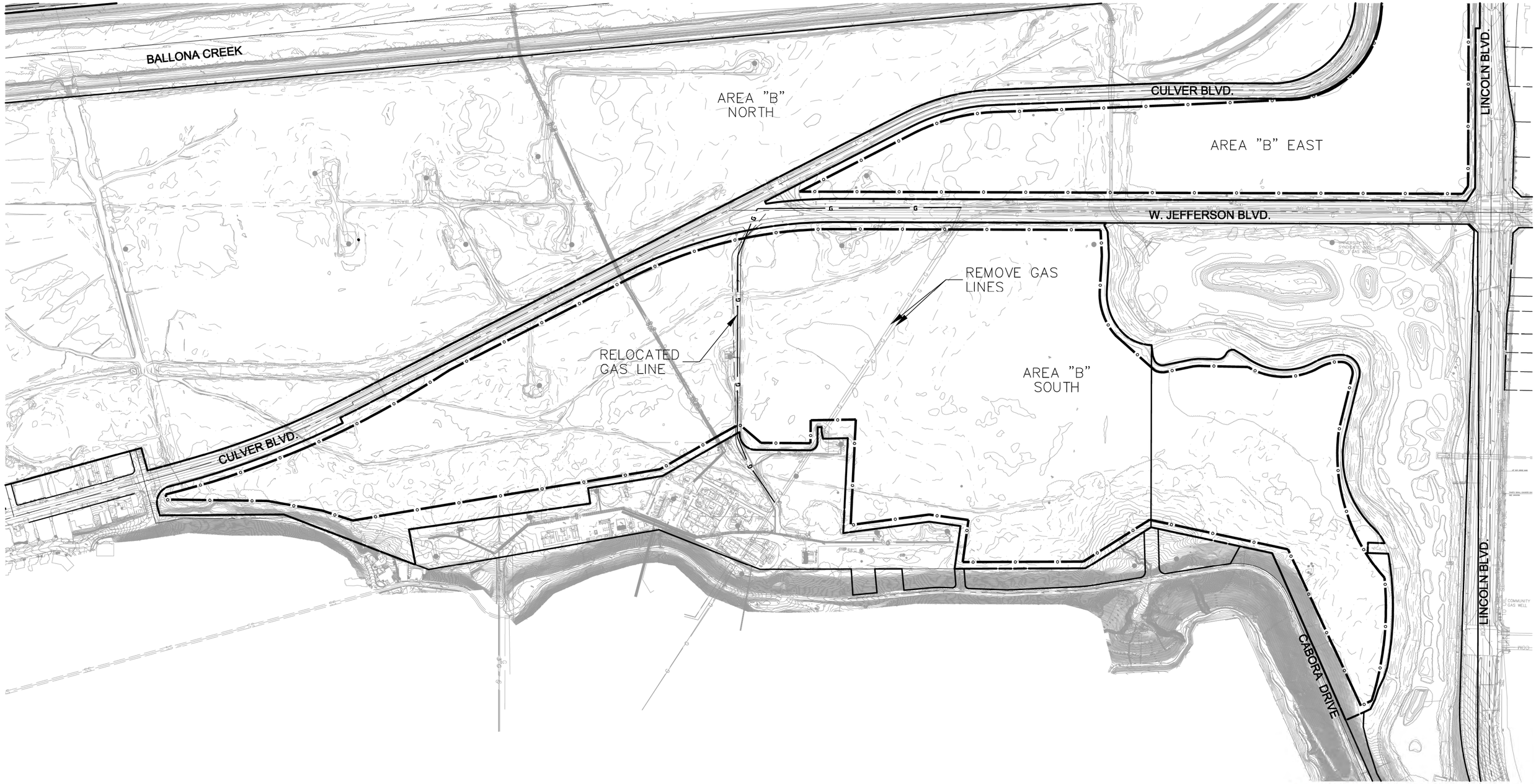

AREA "B" SOUTHEAST
GAS LINES

T.G.: PAGE

LEGEND

- GAS LINE
- PROPOSED SWALE
- LIMITS OF GRADING

200' 100' 0' 200' 400'
GRAPHIC SCALE
Note: For reduced sized prints, original scale is in inches

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Exp. 09-30-14
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STATE OF CALIFORNIA

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CONSTRUCTION SEQUENCING #3
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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 3 OF 32

B1-1487

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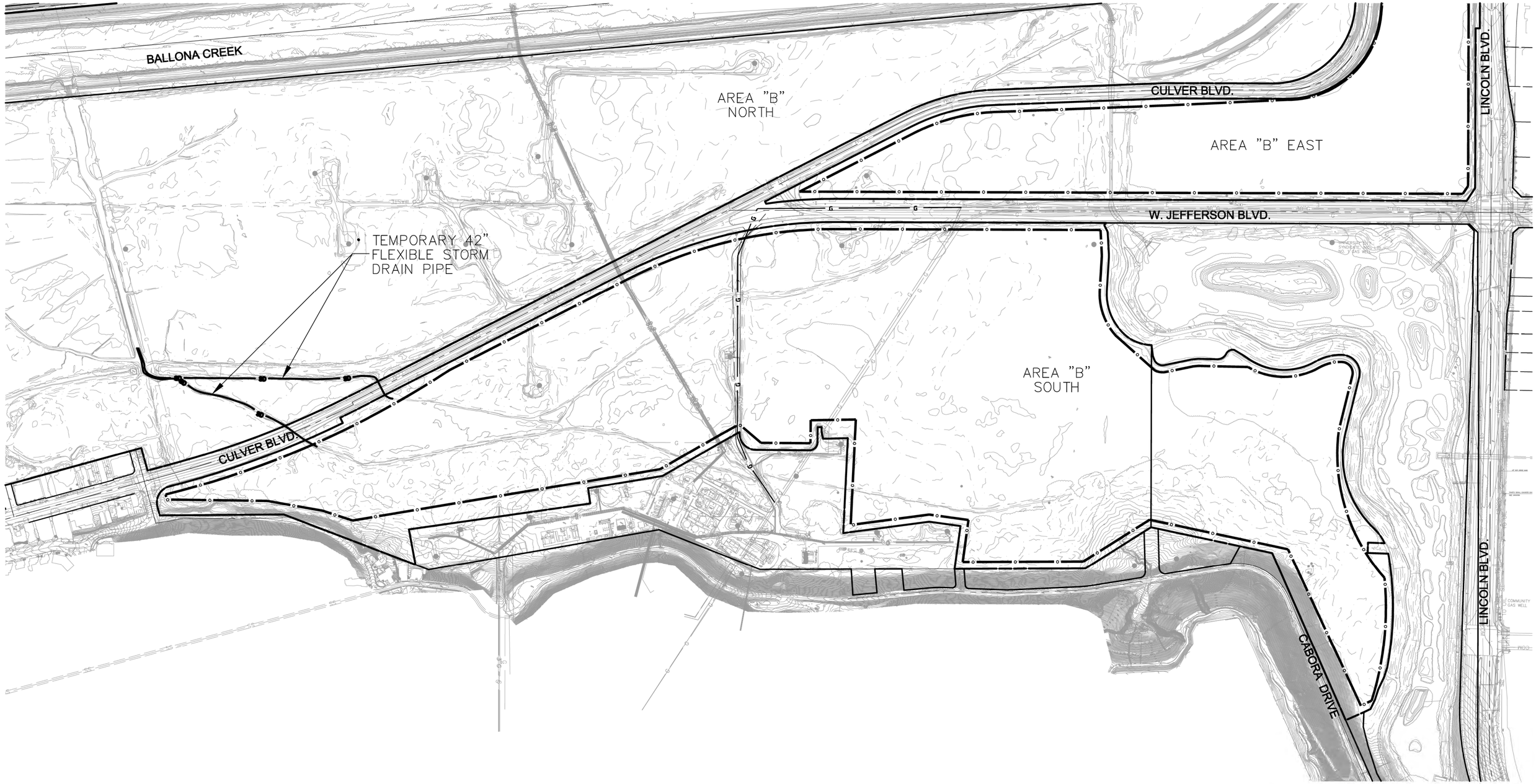

LEGEND

LIMITS OF GRADING

200' 100' 0' 200' 400'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

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PROJECT ENGINEER DATE

AREA "B" TEMPORARY STORM DRAINS

T.G.: PAGE

CONSTRUCTION SEQUENCING #4 EXHIBIT

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 4 OF 32

B1-1488

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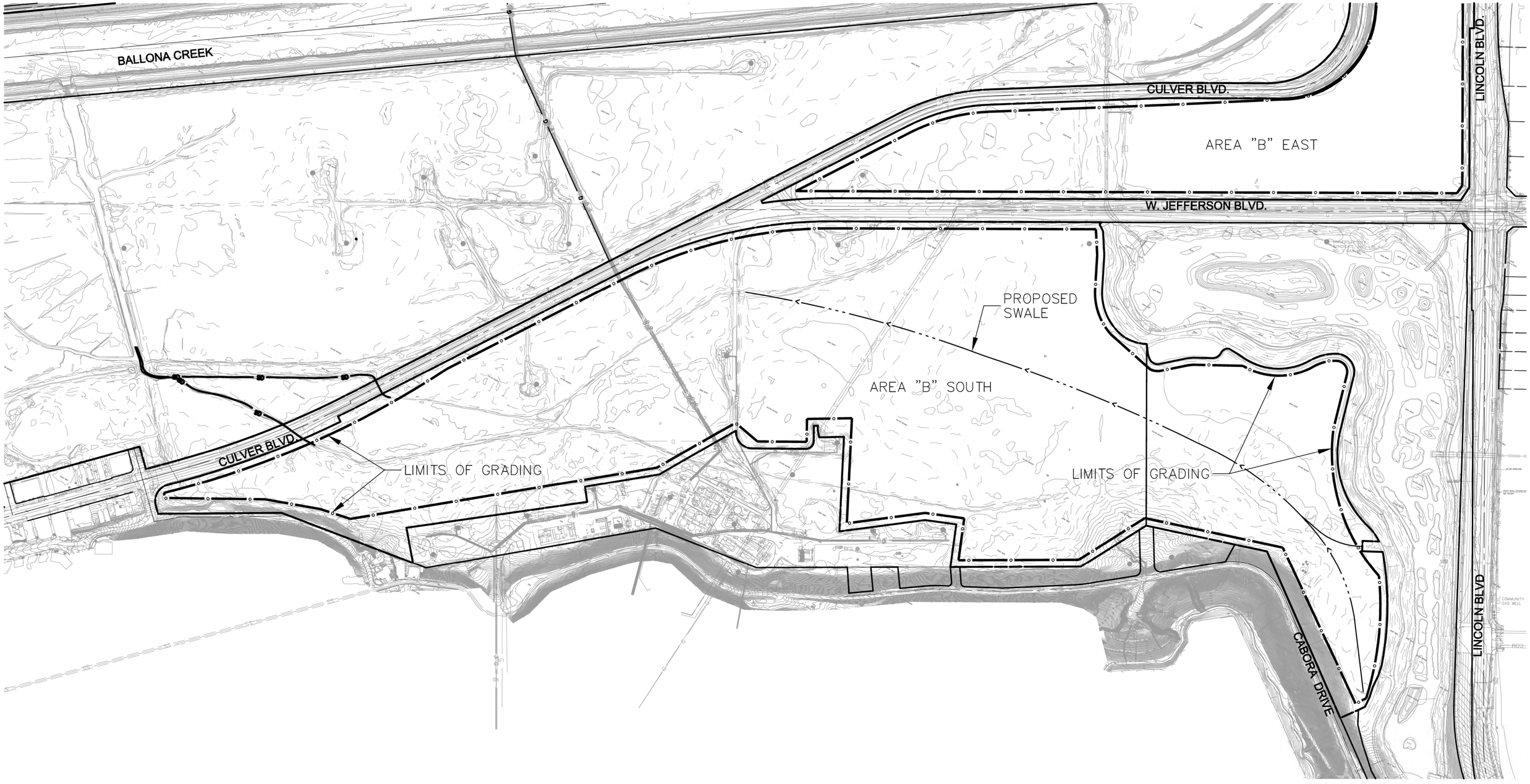

AREA "B" SOUTH ENHANCEMENT

T.G.: PAGE

LEGEND

LIMITS OF GRADING

PROPOSED SWALE

200' 100' 0' 200' 400'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 5 OF 32

B1-1489

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FIJI WAY

FIJI WAY

LINCOLN BLVD.

CUT & CAP EXISTING INACTIVE GAS LINE

REMOVE EXISTING INACTIVE GAS LINE

REMOVE EXISTING INACTIVE GAS LINE

'DEL REY' 17

'DEL REY' 16

'DEL REY' 15

'DEL REY' 14

EXISTING GAS LINES TO REMAIN*

'DEL REY' 19

'DEL REY' 13

BALLONA CREEK

'DEL REY' 12

LINCOLN BLVD.

CULVER BLVD.

LEGEND

G EXISTING GAS LINE

*REMOVED OR RELOCATED IN FUTURE POSSIBLE

WELL ABANDONMENT/RELOCATION:

(1) CANDIDATE FOR ABANDONMENT WELL

(2) ALREADY ABANDONED WELL

(3) CANDIDATE FOR ABANDONMENT AND REPLACEMENT WELL

150' 75' 0' 150' 300'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

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AREA "A" GAS LINE REMOVAL

T.G.: PAGE

CONSTRUCTION SEQUENCING #6A EXHIBIT

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 6A OF 32

B1-1490

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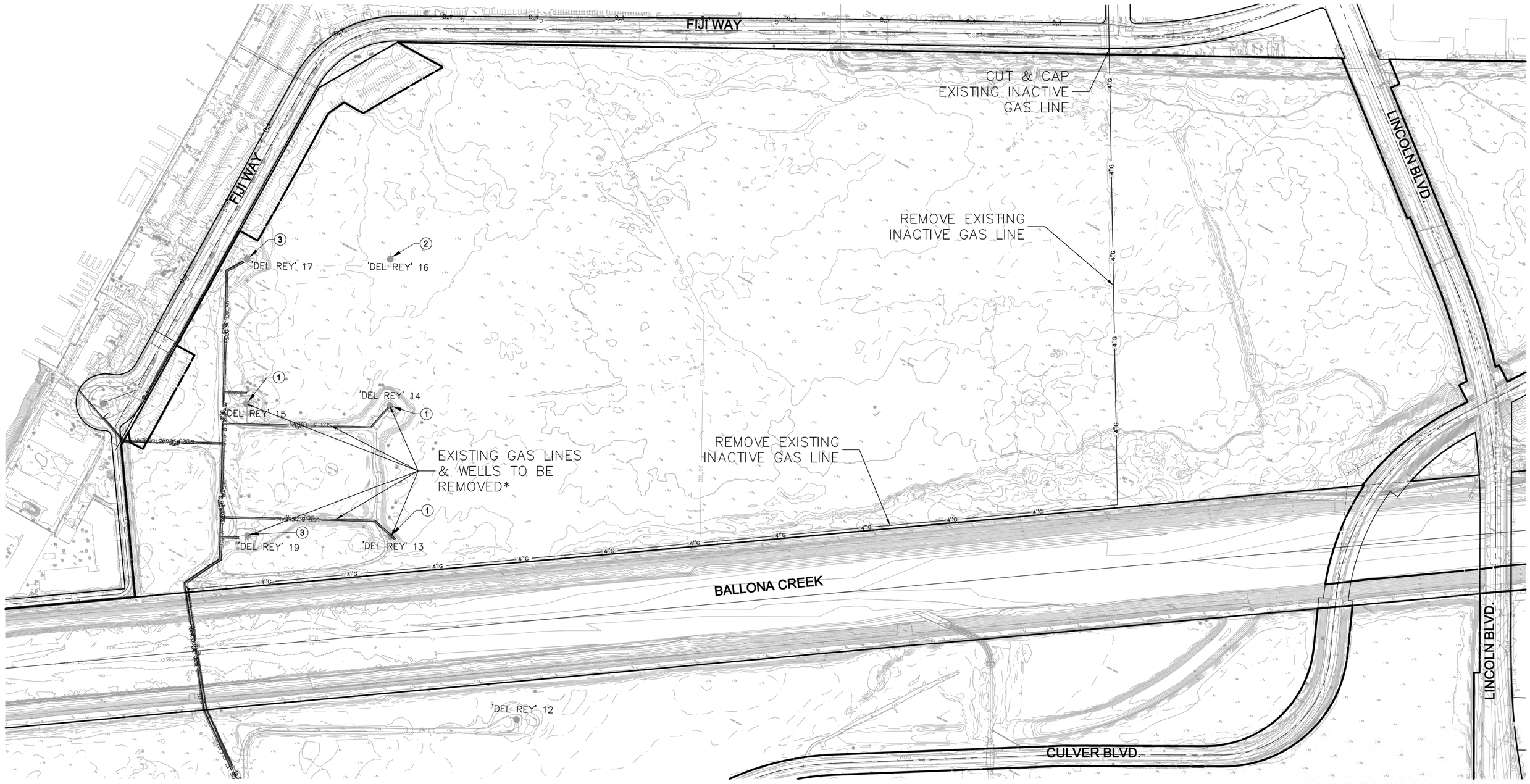

LEGEND

——— G ——— EXISTING GAS LINE

*REMOVAL MAY occur AT THIS STAGE OR LATER

WELL ABANDONMENT/RELOCATION:

(1) CANDIDATE FOR ABANDONMENT WELL

(2) ALREADY ABANDONED WELL

(3) CANDIDATE FOR ABANDONMENT AND REPLACEMENT WELL

150' 75' 0' 150' 300'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

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AREA "A" GAS LINE REMOVAL AND WELL ABANDONMENT

T.G.: PAGE

CONSTRUCTION SEQUENCING #6B EXHIBIT

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 6B OF 32

B1-1491

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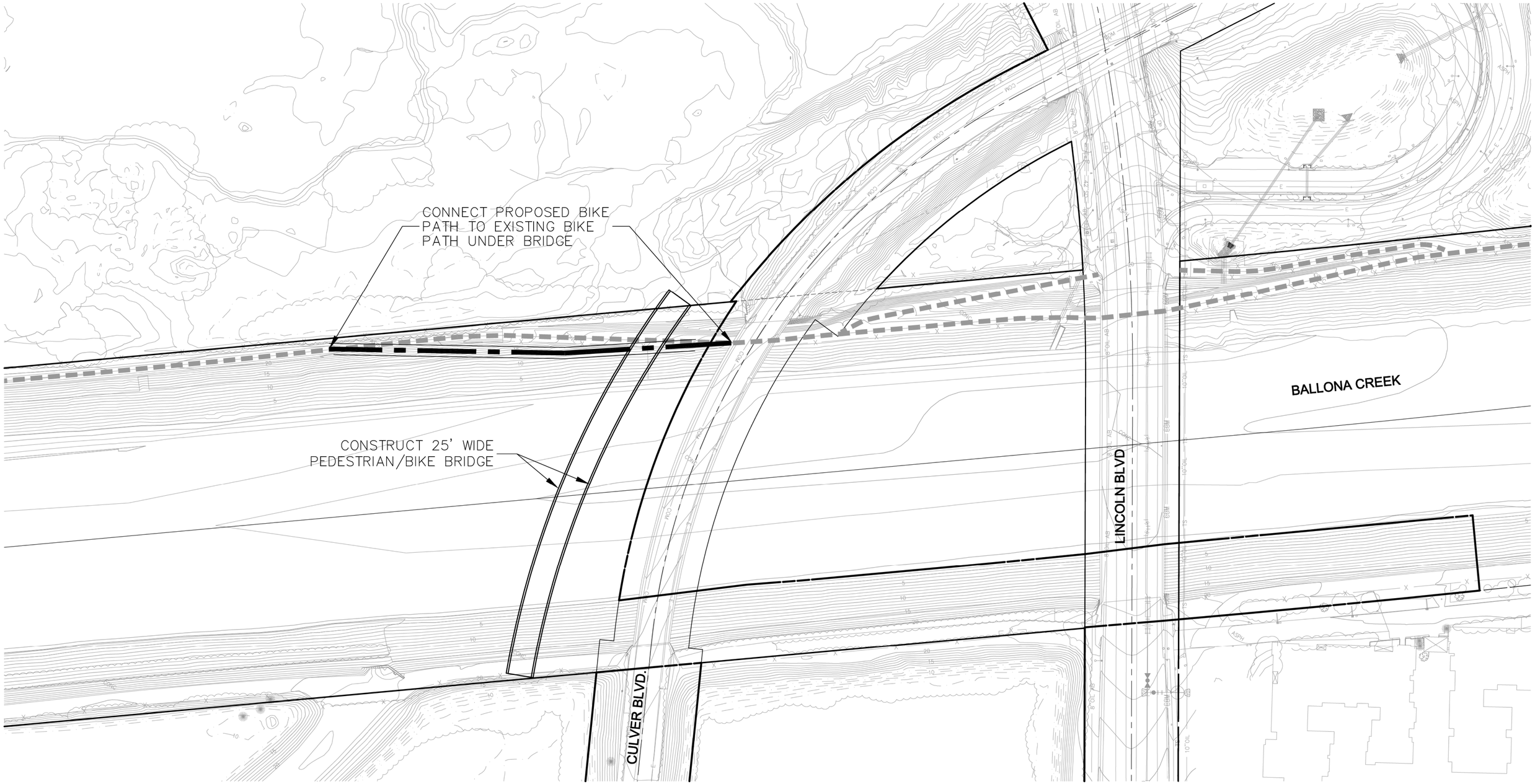

LEGEND

EXISTING BIKE PATH/LANE

PROPOSED PEDESTRIAN/BIKE PATH

50' 25' 0' 50' 100'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

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PROJECT ENGINEER DATE

CONSTRUCTION OF PEDESTRIAN/BIKE BRIDGE TO CONNECT AREA A TO AREA B, WITH BIKE PATH UNDER THE BRIDGE

PEDESTRIAN/BIKE BRIDGE

T.G.: PAGE

CONSTRUCTION SEQUENCING #7 EXHIBIT

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BALLONA WETLANDS ECOLOGICAL RESERVE

B1-1492

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FIJI WAY

MARINA EXWY

LINCOLN BLVD.

CONSTRUCT BRIDGE

CULVER BLVD.

BALLONA CREEK

PEDESTRIAN/BIKE BRIDGE

BALLONA CREEK

LINCOLN BLVD.

CULVER BLVD.

LINCOLN BRIDGE

T.G.: PAGE

150' 75' 0' 150' 300'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

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BY _____

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REGISTERED PROFESSIONAL ENGINEER
MICHAEL J. ORDAZ
No. C48944
Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

CONSTRUCTION SEQUENCING #8
EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 8 OF 32

B1-1493

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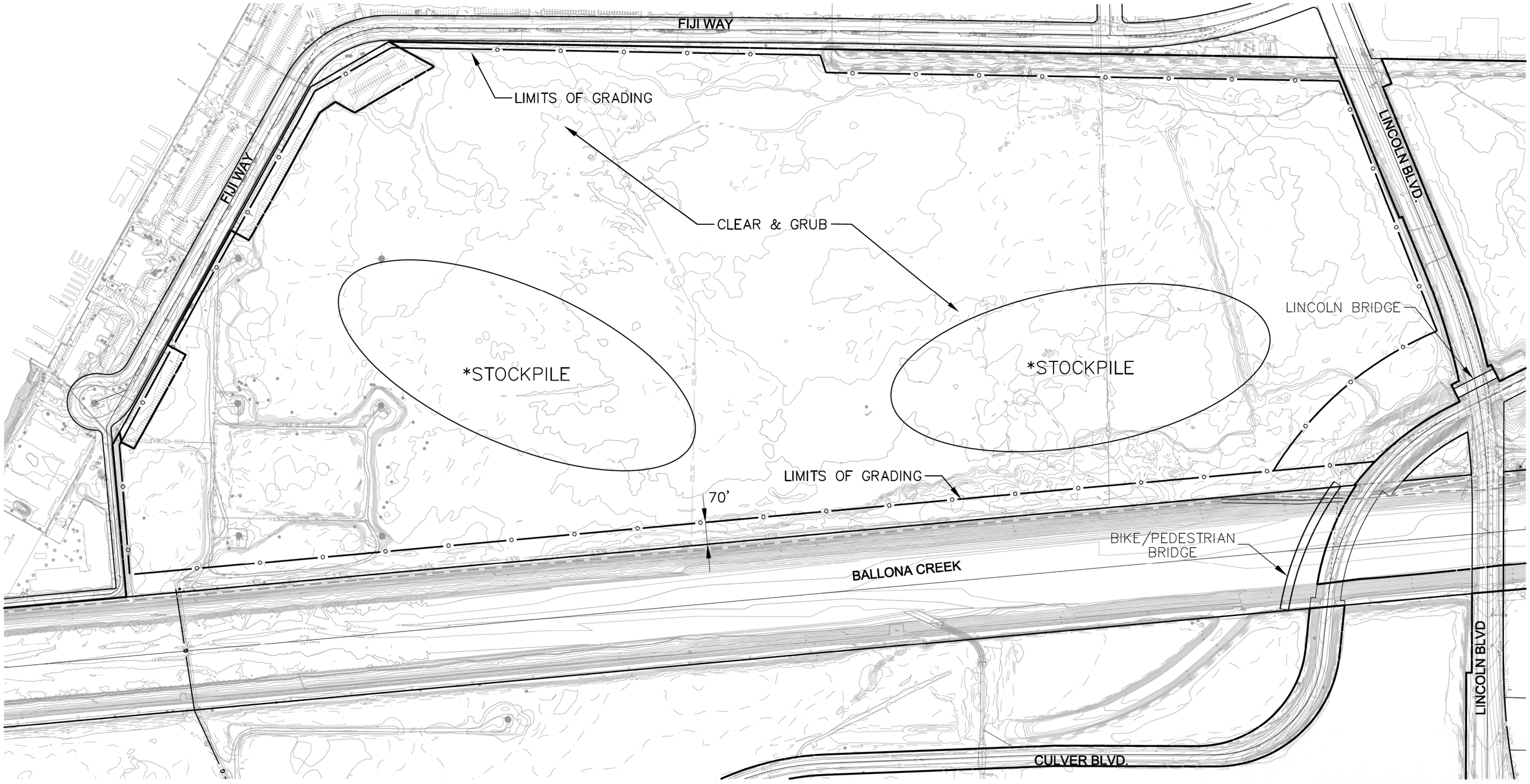

LEGEND

LIMITS OF GRADING

NOTE :

*STOCKPILE LOCATION TO BE DETERMINED, CAN ALSO BE LOCATED WITHIN AREA "C" NORTH

150' 75' 0' 150' 300'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

BY _____ DATE

SUBDIVISION PLAN CHECKING SECTION

NO.	REVISION	REVISED BY	APPROVED BY	DATE

REGISTERED PROFESSIONAL ENGINEER MICHAEL J. OBERMEIER No. C48944 Exp. 09-30-14 CIVIL STATE OF CALIFORNIA

PROJECT ENGINEER DATE

CLEAR AND GRUB AREA "A"

T.G.: PAGE

CONSTRUCTION SEQUENCING #9 EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 9 OF 33

B1-1494

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FIJI WAY

LIMITS OF GRADING

OVER-EXCAVATE

LINCOLN BLVD.

FIJI WAY

EXCAVATING

LINCOLN BRIDGE

LIMITS OF GRADING

70'

BIKE/PEDESTRIAN BRIDGE

BALLONA CREEK

LINCOLN BLVD

CULVER BLVD.

LEGEND

LIMITS OF GRADING

150' 75' 0' 150' 300'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

BY _____ DATE _____

SUBDIVISION PLAN CHECKING SECTION

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REGISTERED PROFESSIONAL ENGINEER MICHAEL J. O'BRIEN No. C48944 Exp. 09-30-14 CIVIL STATE OF CALIFORNIA

PROJECT ENGINEER DATE

EXCAVATE AREA "A" FROM 70 FT. NORTH OF EXISTING BACK OF LEVEE & OVER-EXCAVATE BOTTOM OF LEVEE

EXCAVATE AREA "A"

T.G.: PAGE

CONSTRUCTION SEQUENCING #10 EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 10 OF 33

B1-1495

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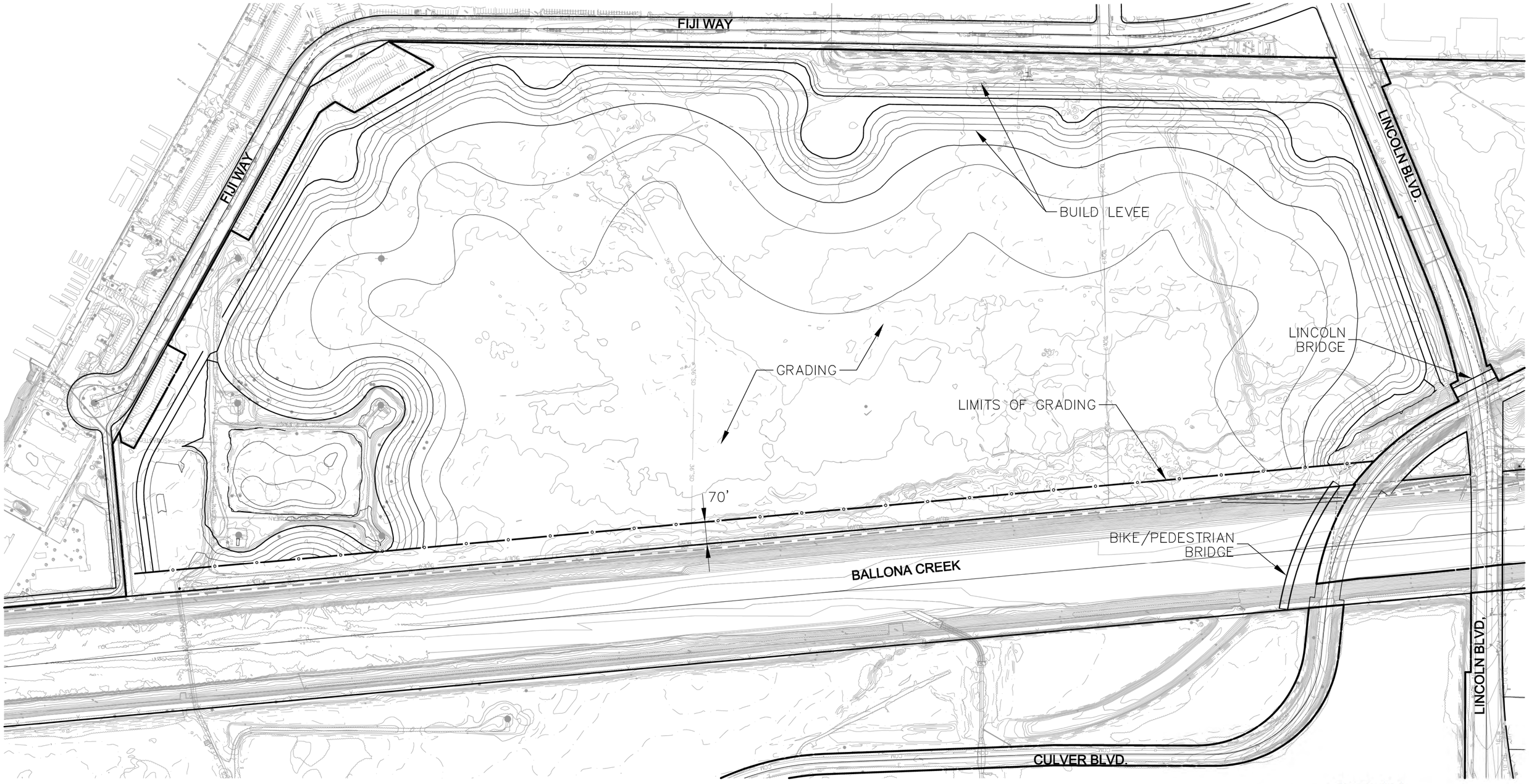

LEGEND

LIMITS OF GRADING

TOE OF SLOPE

NOTE: IF 6A OCCURS AND GAS WELLS ARE TO REMAIN

150' 75' 0' 150' 300'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

BY _____

SUBDIVISION PLAN CHECKING SECTION DATE

NO.	REVISION	REVISED BY	APPROVED BY	DATE

REGISTERED PROFESSIONAL ENGINEER MICHAEL J. OBERMAN No. C48944 Exp. 09-30-14 CIVIL STATE OF CALIFORNIA

PROJECT ENGINEER DATE

AREA "A"
CONSTRUCT NORTH LEVEE

T.G.: PAGE

CONSTRUCTION SEQUENCING #11A
EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

PLANS PREPARED BY:
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Los Angeles, CA 90071
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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 11A OF 32

B1-1496

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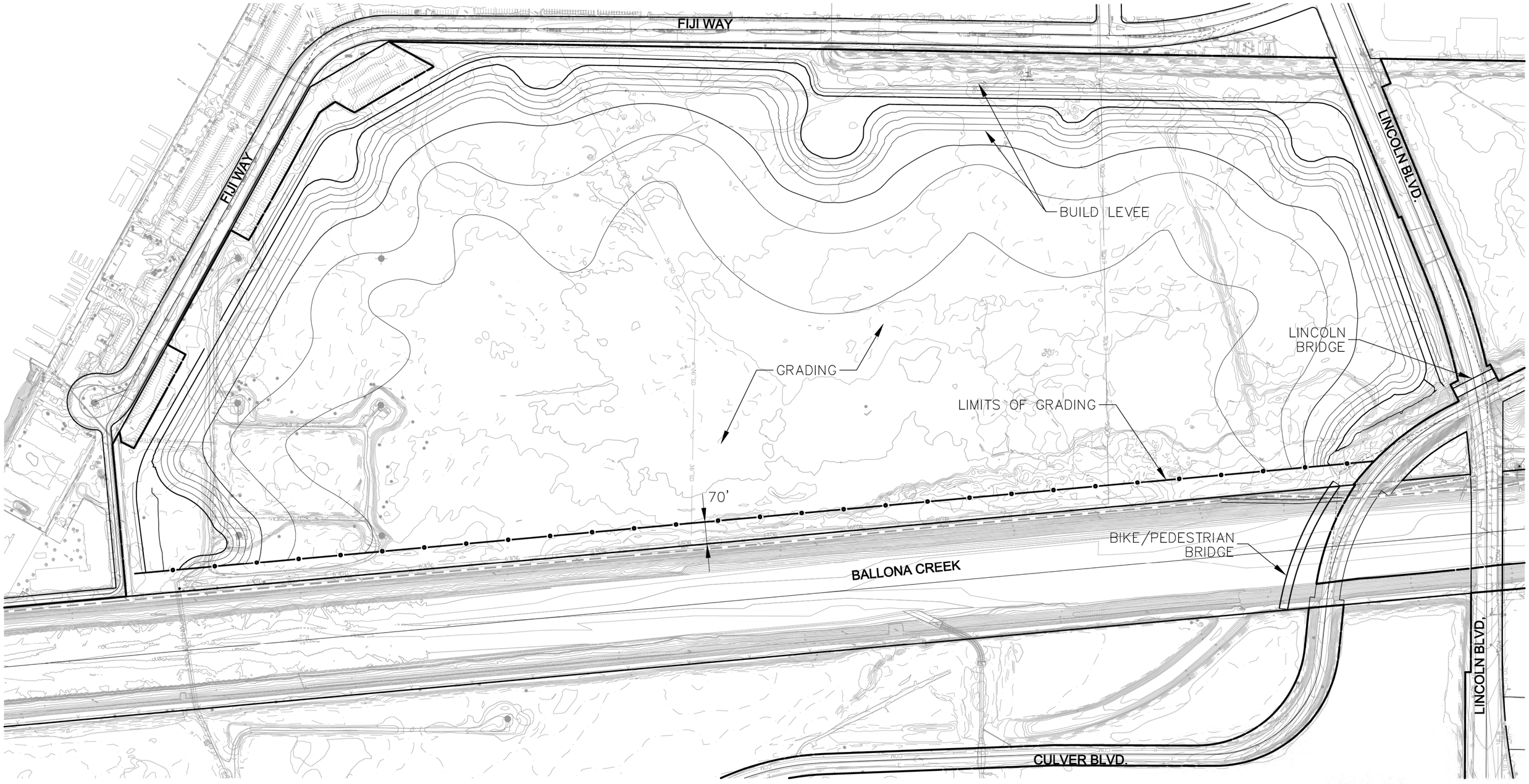

LEGEND

LIMITS OF GRADING

TOE OF SLOPE

NOTE: IF 6B OCCURS AND GAS WELLS ARE REMOVED

150' 75' 0' 150' 300'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

BY _____ DATE

SUBDIVISION PLAN CHECKING SECTION

NO.	REVISION	REVISED BY	APPROVED BY	DATE

REGISTERED PROFESSIONAL ENGINEER
MICHAEL J. OBERMAN
No. C48944
Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

AREA "A"
CONSTRUCT NORTH LEVEE

T.G.: PAGE

CONSTRUCTION SEQUENCING #11B
EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 11B OF 32

B1-1497

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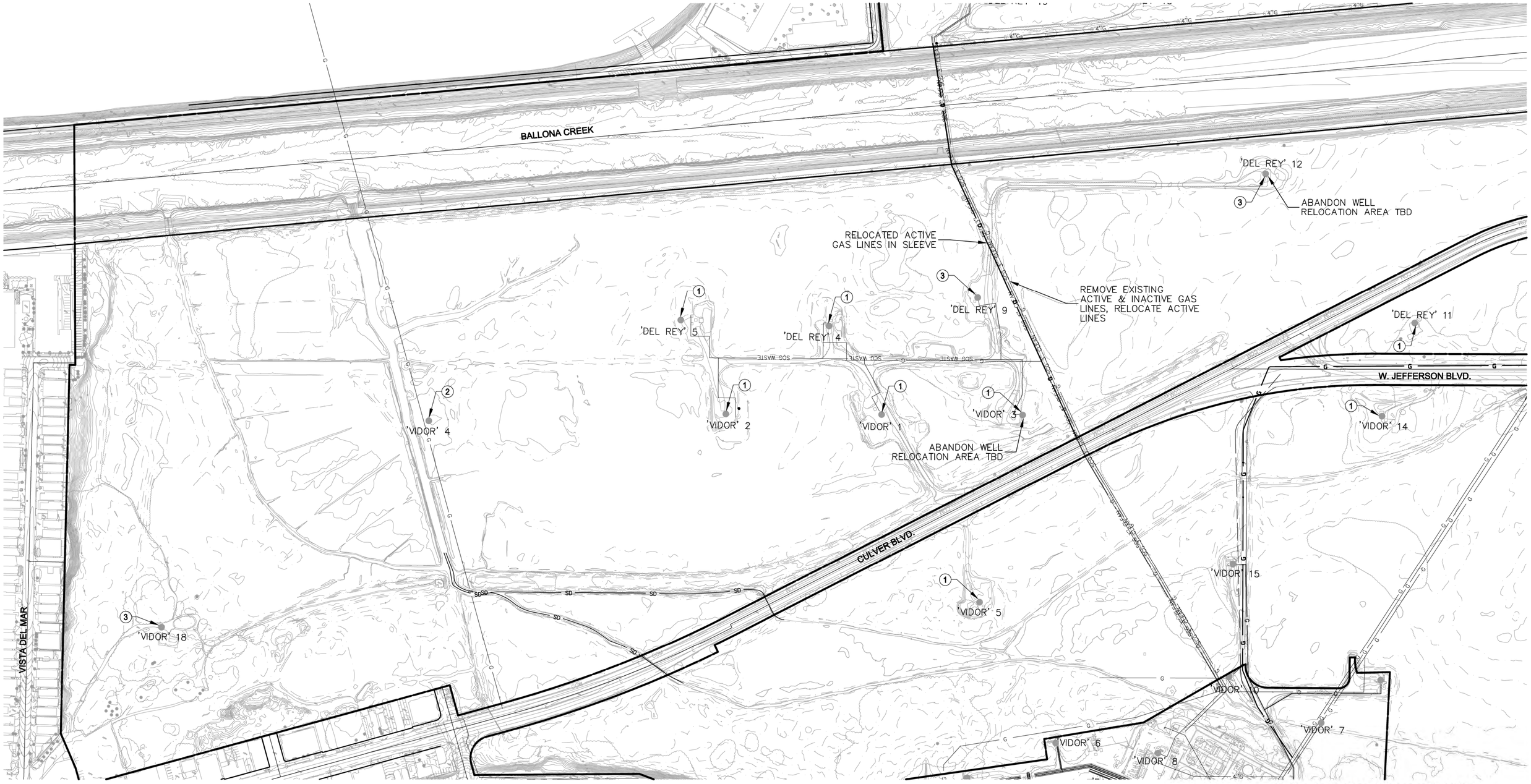

LEGEND

G GAS LINE

G EXISTING GAS LINE

NOTE: ALIGNMENT TO BE DETERMINED.
COORDINATE WITH THE GAS COMPANY

WELL ABANDONMENT/RELOCATION:

(1) CANDIDATE FOR ABANDONMENT WELL

(2) ALREADY ABANDONED WELL

(3) CANDIDATE FOR ABANDONMENT AND REPLACEMENT WELL

150' 75' 0' 150' 300'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

BY _____ DATE

SUBDIVISION PLAN CHECKING SECTION

NO.	REVISION	REVISED BY	APPROVED BY	DATE

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MICHAEL J. O'BRIEN
No. C48944
Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

AREA "B" NORTH GAS LINE RELOCATION AND ABANDON GAS WELLS

T.G.: PAGE

CONSTRUCTION SEQUENCING #12A EXHIBIT

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 12A OF 32

B1-1498

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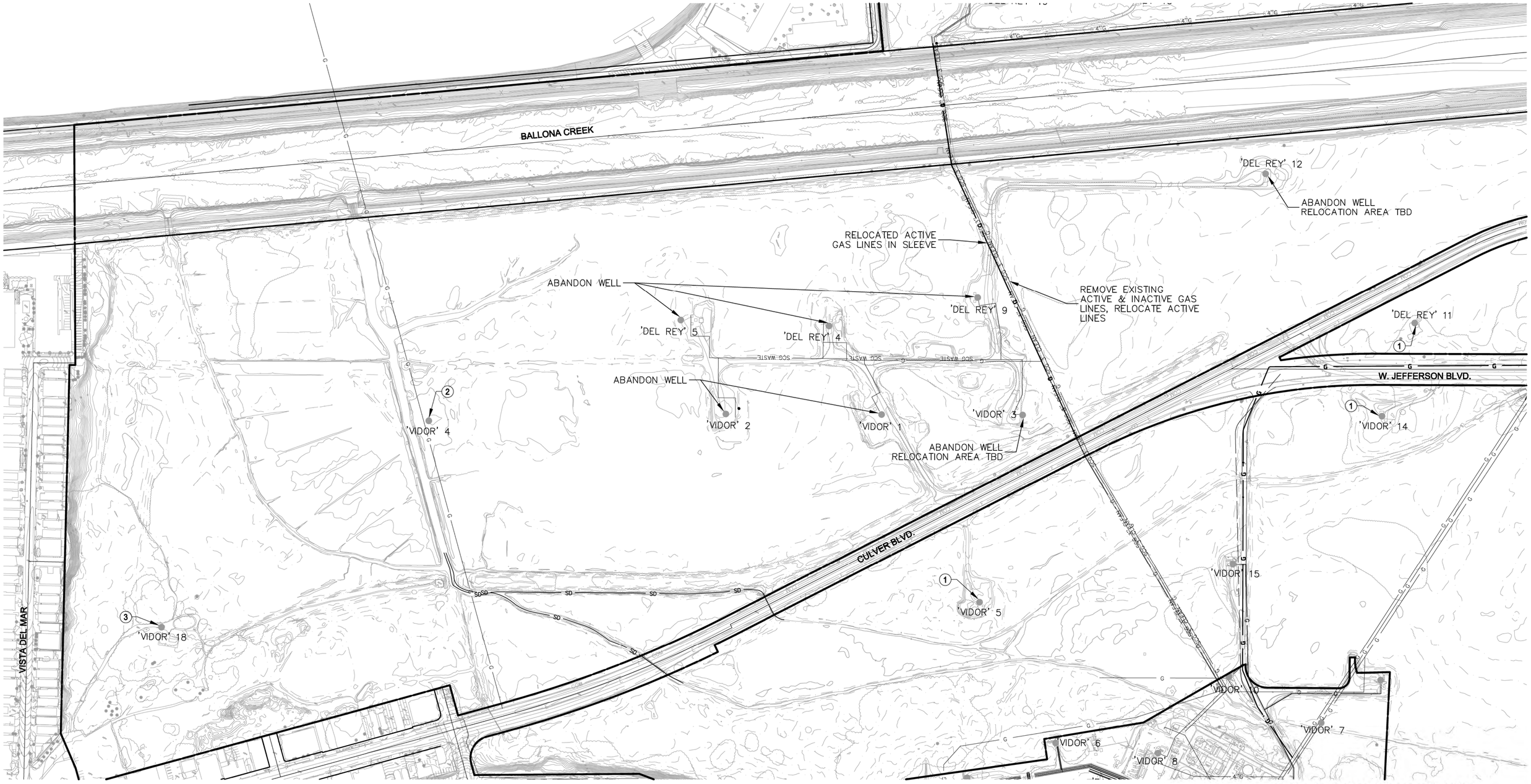

LEGEND

G — GAS LINE

G — EXISTING GAS LINE

NOTE: ALIGNMENT TO BE DETERMINED. COORDINATE WITH THE GAS COMPANY

WELL ABANDONMENT/RELOCATION:

(1) CANDIDATE FOR ABANDONMENT WELL

(2) ALREADY ABANDONED WELL

(3) CANDIDATE FOR ABANDONMENT AND REPLACEMENT WELL

150' 75' 0' 150' 300'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

BY _____ DATE

SUBDIVISION PLAN CHECKING SECTION

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REGISTERED PROFESSIONAL ENGINEER
MICHAEL J. OBERMAN
No. C48944
Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

AREA "B" NORTH GAS LINE RELOCATION AND WELL ABANDONMENT

T.G.: PAGE

CONSTRUCTION SEQUENCING #12B EXHIBIT

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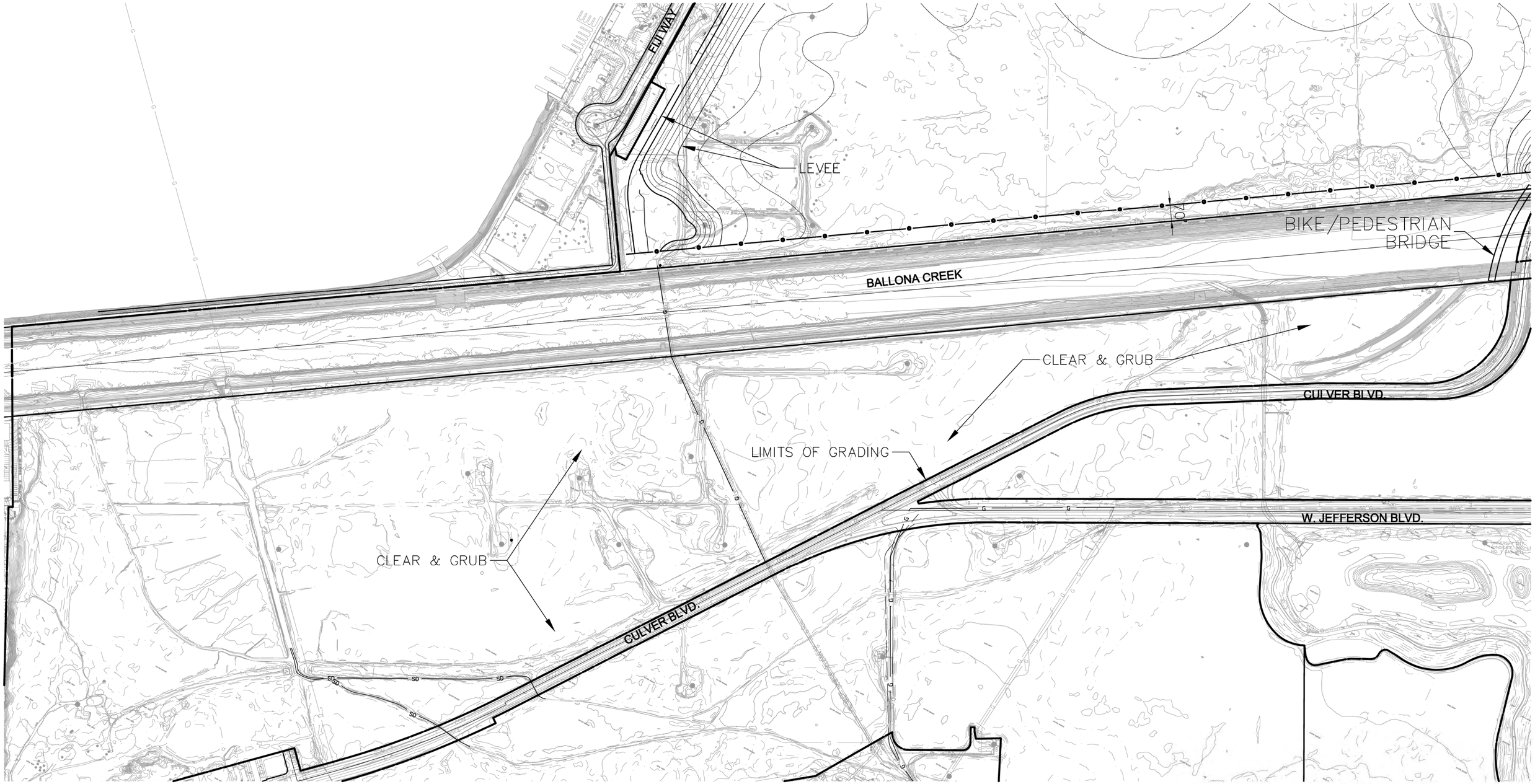
SHEET 12B OF 32

B1-1499

Plotted: 5/2/2013 10:39:18 AM :: Saved: 3/25/2013 3:12:14 PM :: W:\1CCD01010\ENGR\EXHIB\Construction Sequencing\BR02B-12B.dwg ::



AREA "B" NORTH
CLEAN & GRUB

T.G.: PAGE

200' 100' 0' 200' 400'
GRAPHIC SCALE
Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION
BY _____ DATE
SUBDIVISION PLAN CHECKING SECTION

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No. C48944
Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

CONSTRUCTION SEQUENCING #13
EXHIBIT

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 13 OF 32

B1-1500

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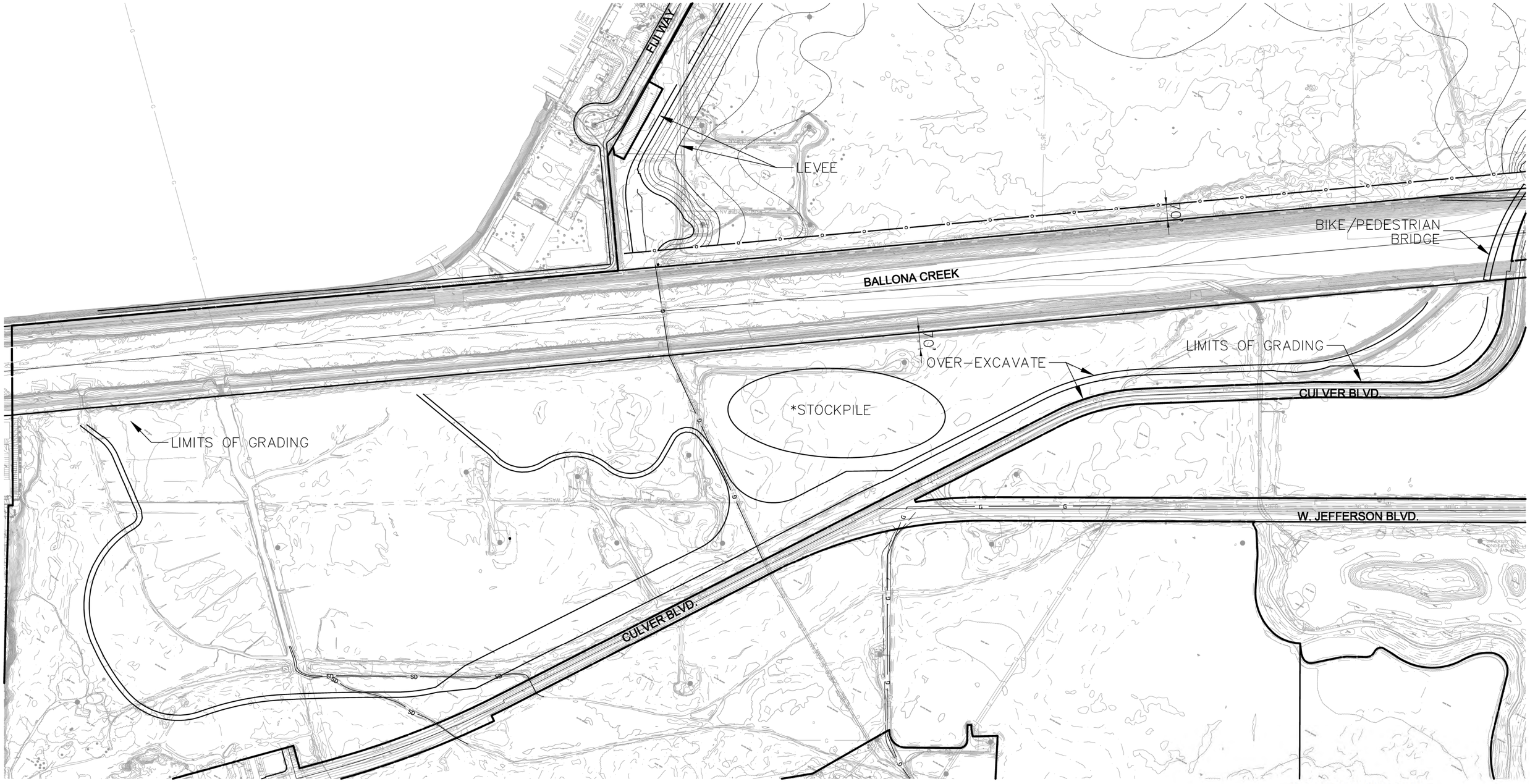

AREA "B" NORTH
OVER-EXCAVATE LEVEE AND STOCKPILE

T.G.: PAGE

LEGEND

——— o ——— LIMITS OF GRADING

NOTE:

*STOCKPILE LOCATION TO BE DETERMINED

200' 100' 0' 200' 400'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

BY _____ SUBDIVISION PLAN CHECKING SECTION DATE

NO.	REVISION	REVISED BY	APPROVED BY	DATE

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PROJECT ENGINEER DATE

CONSTRUCTION SEQUENCING #14
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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 14 OF 32

B1-1501

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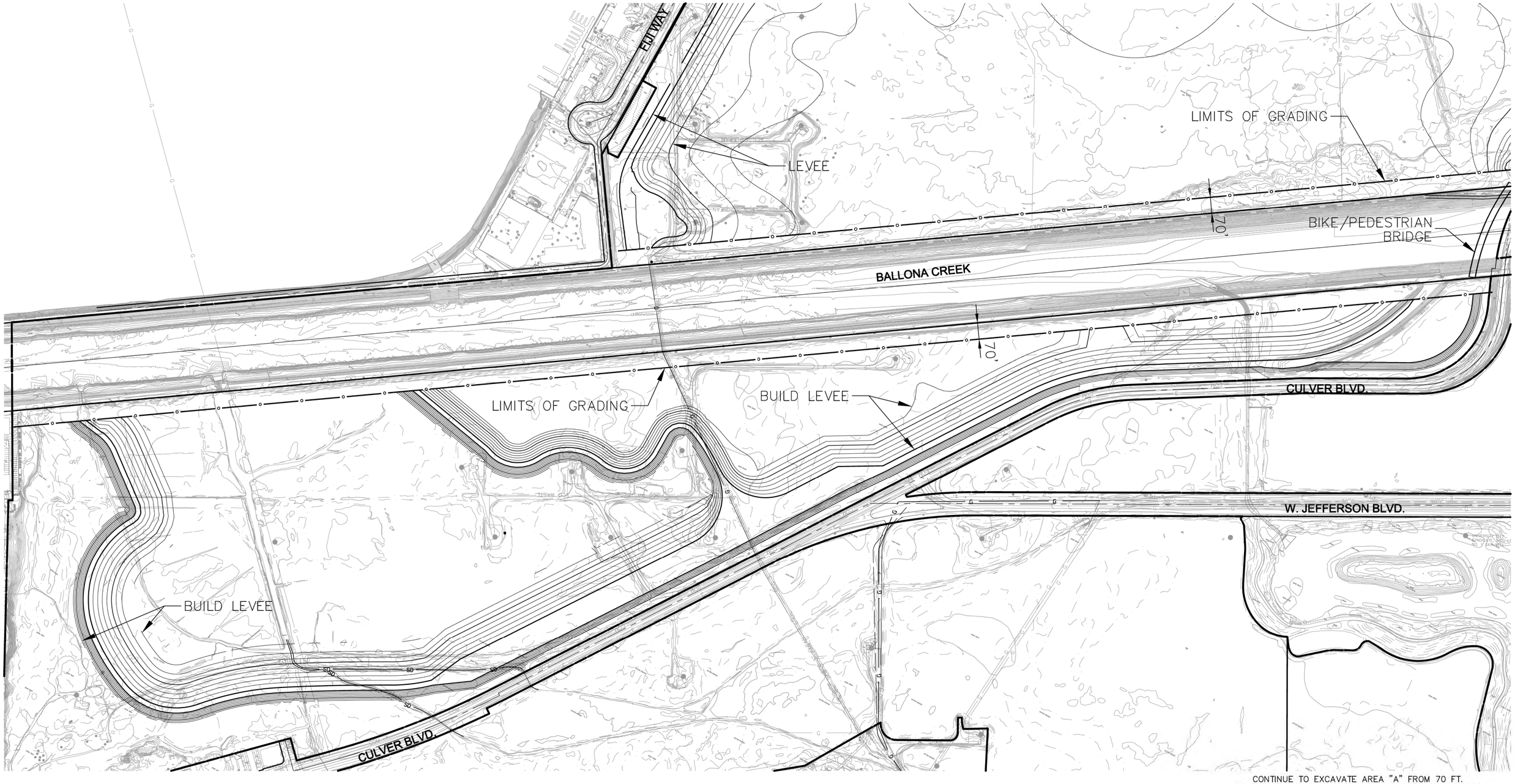

LEGEND

LIMITS OF GRADING

NOTE: IF 12A OCCURS AND WELLS ARE TO REMAIN, GRADING AS SHOWN. IF 12B OCCURS AND WELLS ARE REMOVED, AREA AROUND WELLS MAY BE GRADED.

200' 100' 0' 200' 400'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

BY _____

SUBDIVISION PLAN CHECKING SECTION DATE

CONTINUE TO EXCAVATE AREA "A" FROM 70 FT.
MOVE DIRT ACROSS BIKE BRIDGE & BUILD SOUTH LEVEE

CONSTRUCT AREA "B" LEVEE

T.G.: PAGE

NO.	REVISION	REVISED BY	APPROVED BY	DATE

REGISTERED PROFESSIONAL ENGINEER
MICHAEL J. O'BRIEN
No. C48944
Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

CONSTRUCTION SEQUENCING #15 EXHIBIT

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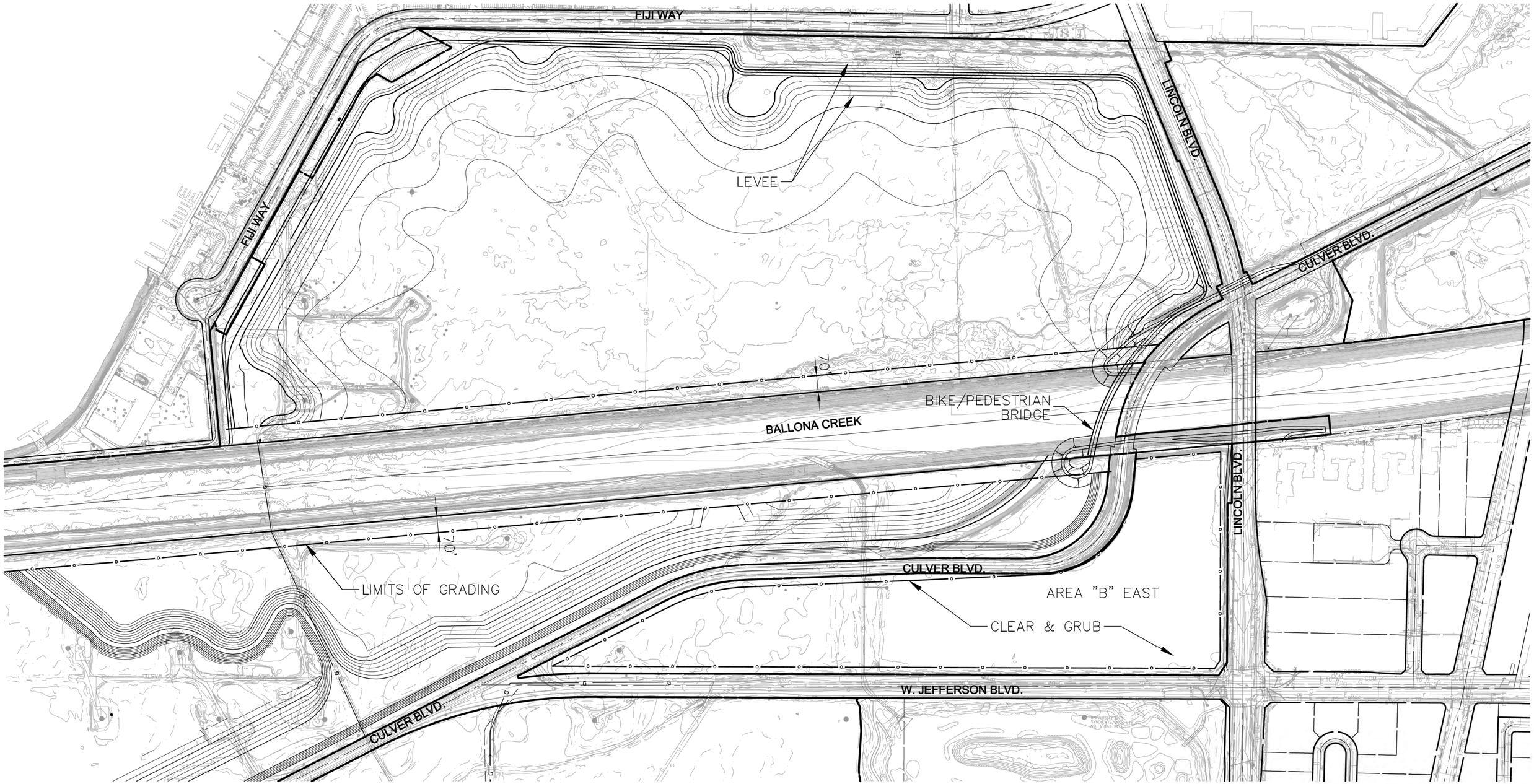

LEGEND

LIMITS OF GRADING

200' 100' 0' 200' 400'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

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MICHAEL J. OBLAND
No. C48944
Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

CLEAR & GRUB AREA "B" EAST

T.G.: PAGE

CONSTRUCTION SEQUENCING #16 EXHIBIT

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SHEET 16 OF 32

B1-1503

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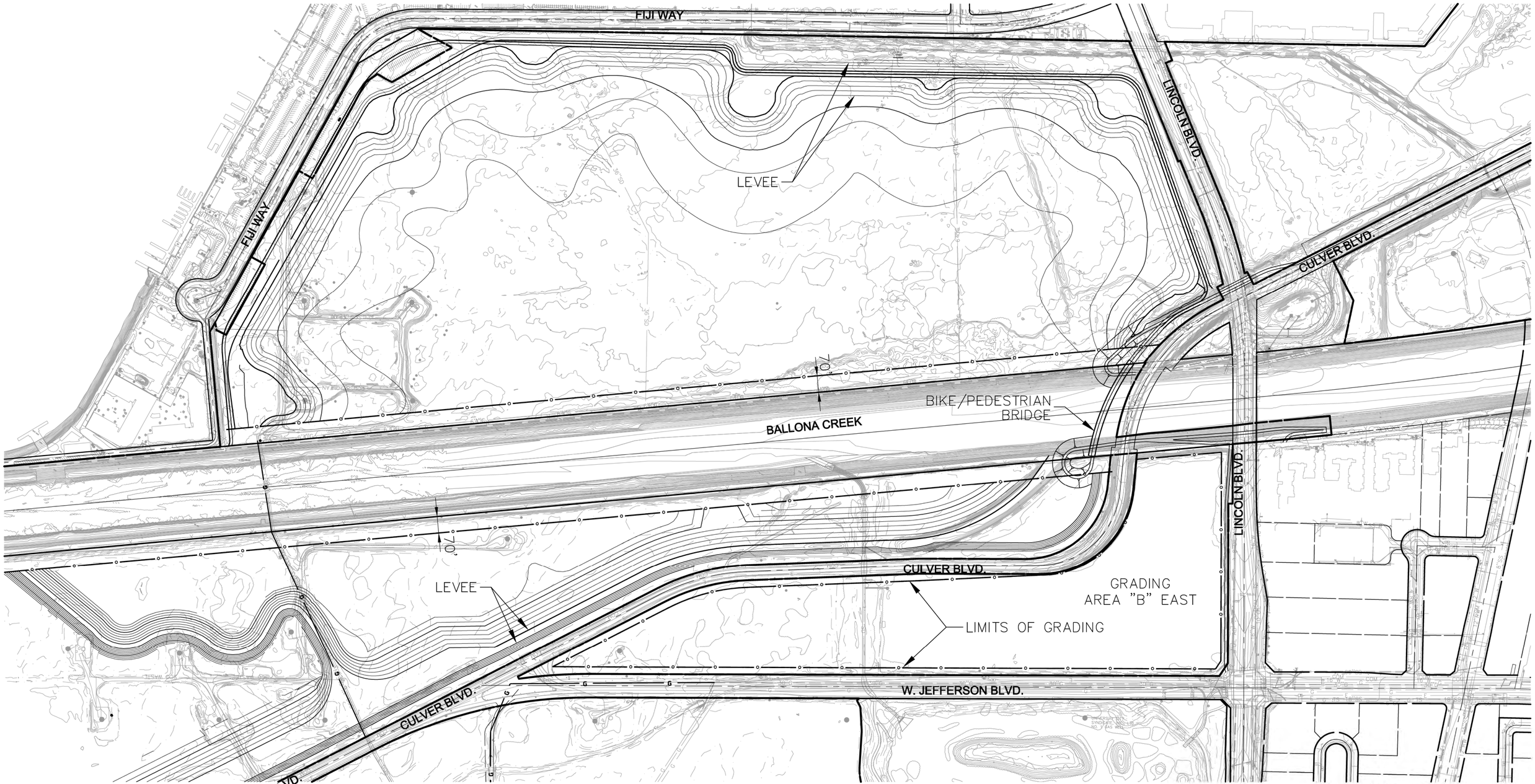

LEGEND

LIMITS OF GRADING

AREA "B" EAST GRADING

T.G.: PAGE

200' 100' 0' 200' 400'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

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PROJECT ENGINEER DATE

CONSTRUCTION SEQUENCING #17
EXHIBIT

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 17 OF 32

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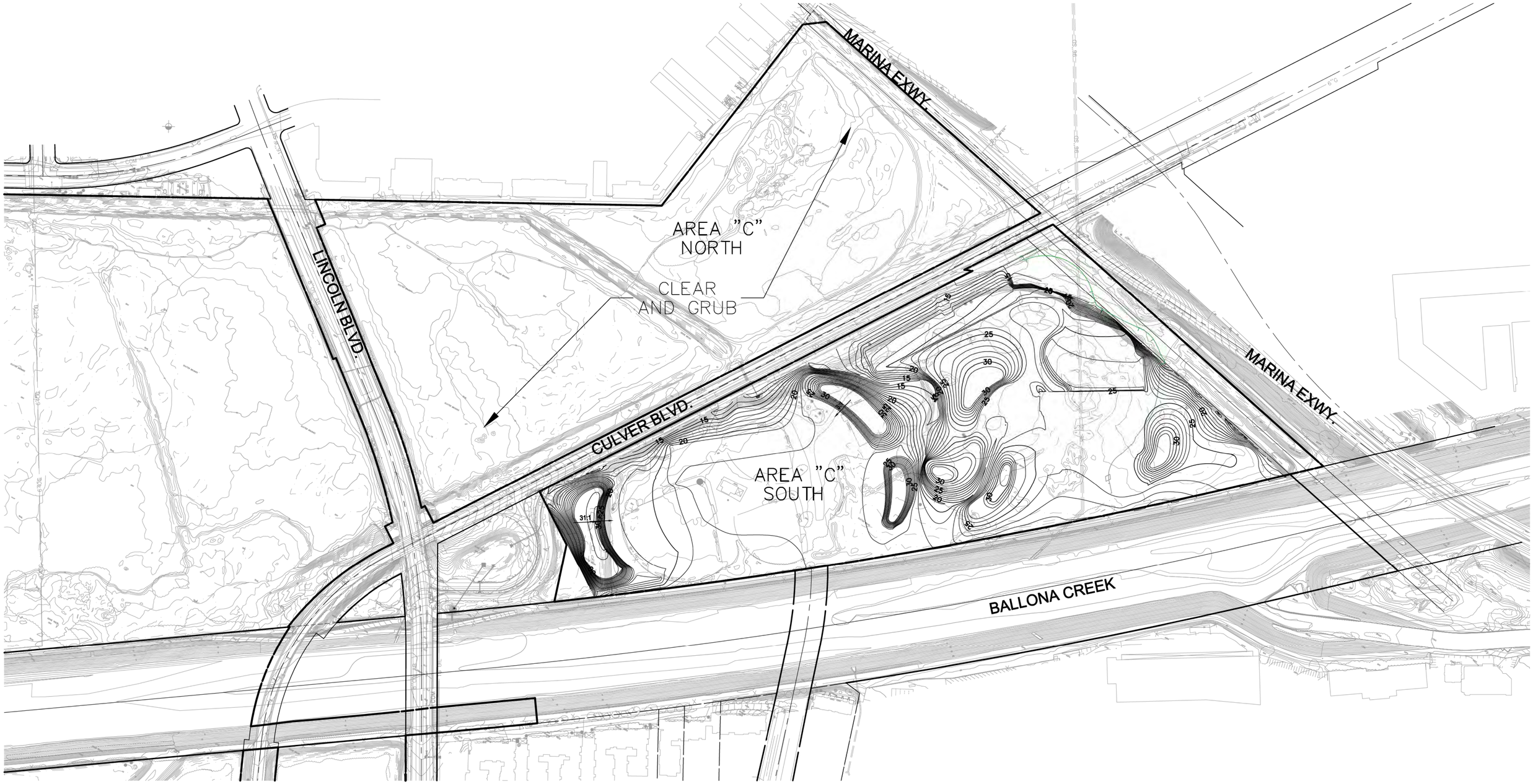

CLEAR AND GRUB AREA "C" NORTH

T.G.: PAGE

200' 100' 0' 200' 400'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

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MICHAEL J. ORDWAY
No. C48944
Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

CONSTRUCTION SEQUENCING #18
EXHIBIT

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SHEET 18 OF 32

B1-1505

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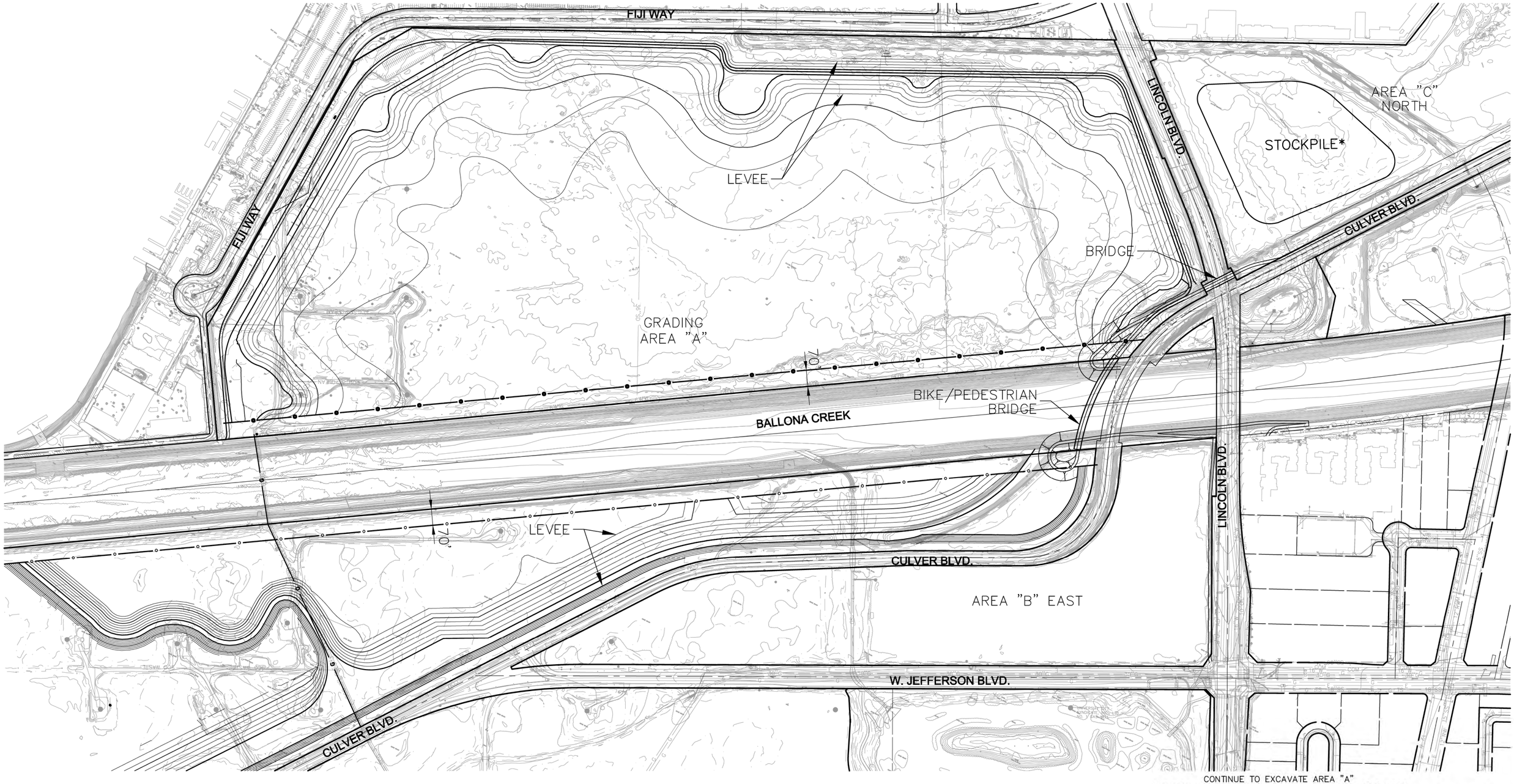

LEGEND

LIMITS OF GRADING

*SPECIFIC GRADING TO BE DETERMINED

CONTINUE TO EXCAVATE AREA "A"
MOVE DIRT ACROSS TEMPORARY BRIDGE TO AREA "C" NORTH

AREA "A" GRADING AND EXPORT TO AREA "C" NORTH

T.G.: PAGE

200' 100' 0' 200' 400'
GRAPHIC SCALE
Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION
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REGISTERED PROFESSIONAL ENGINEER
MICHAEL J. O'BRIEN
No. C48944
Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

CONSTRUCTION SEQUENCING #19
EXHIBIT

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 19 OF 32

B1-1506

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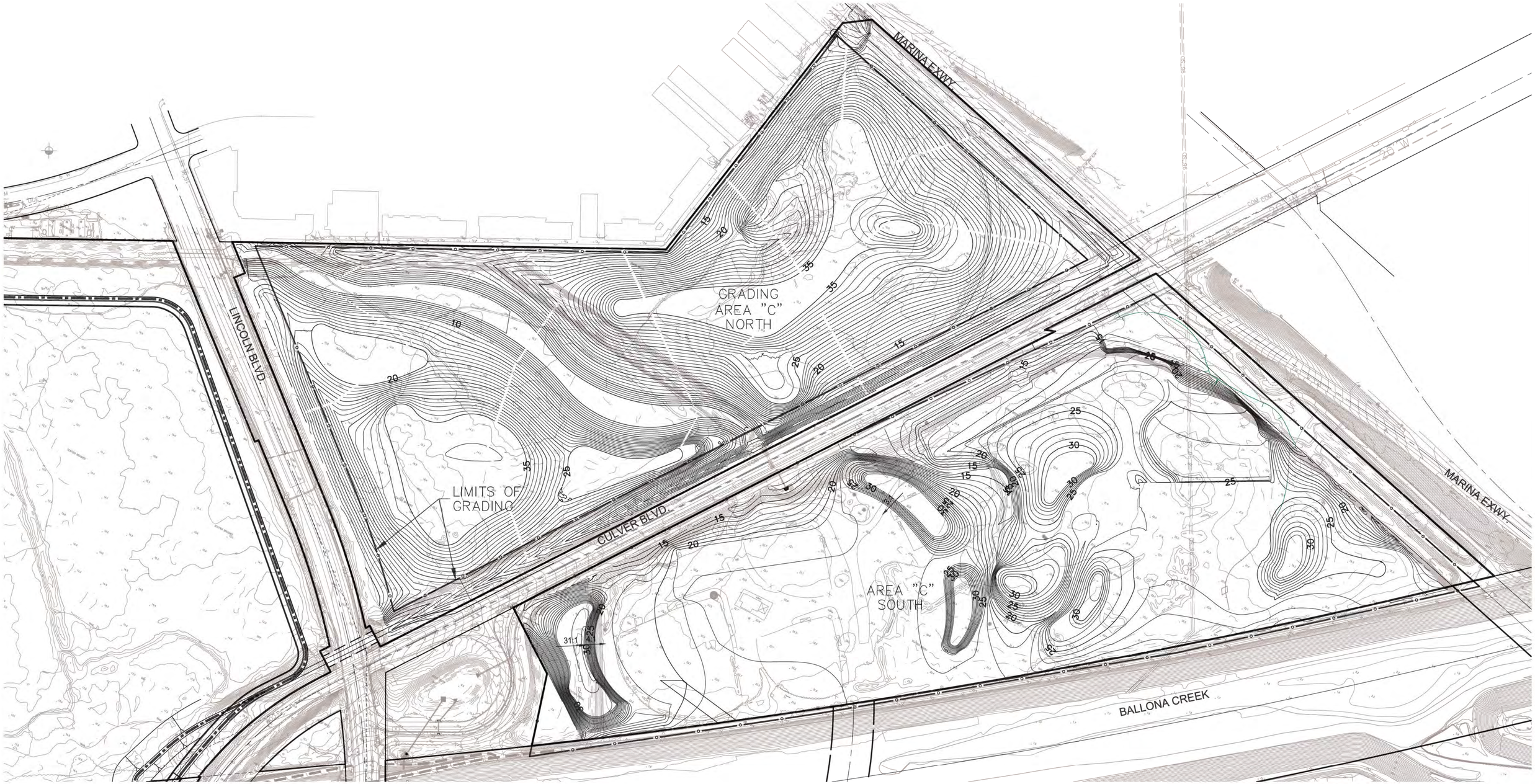

LEGEND

LIMITS OF GRADING

NOTE: GRADING TO BE DETERMINED

120' 60' 0' 120' 240'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

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PROJECT ENGINEER DATE

FINISH GRADING FOR UPLANDS AREA "C" NORTH

T.G.: PAGE

CONSTRUCTION SEQUENCING #20 EXHIBIT

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 20 OF 32

B1-1507

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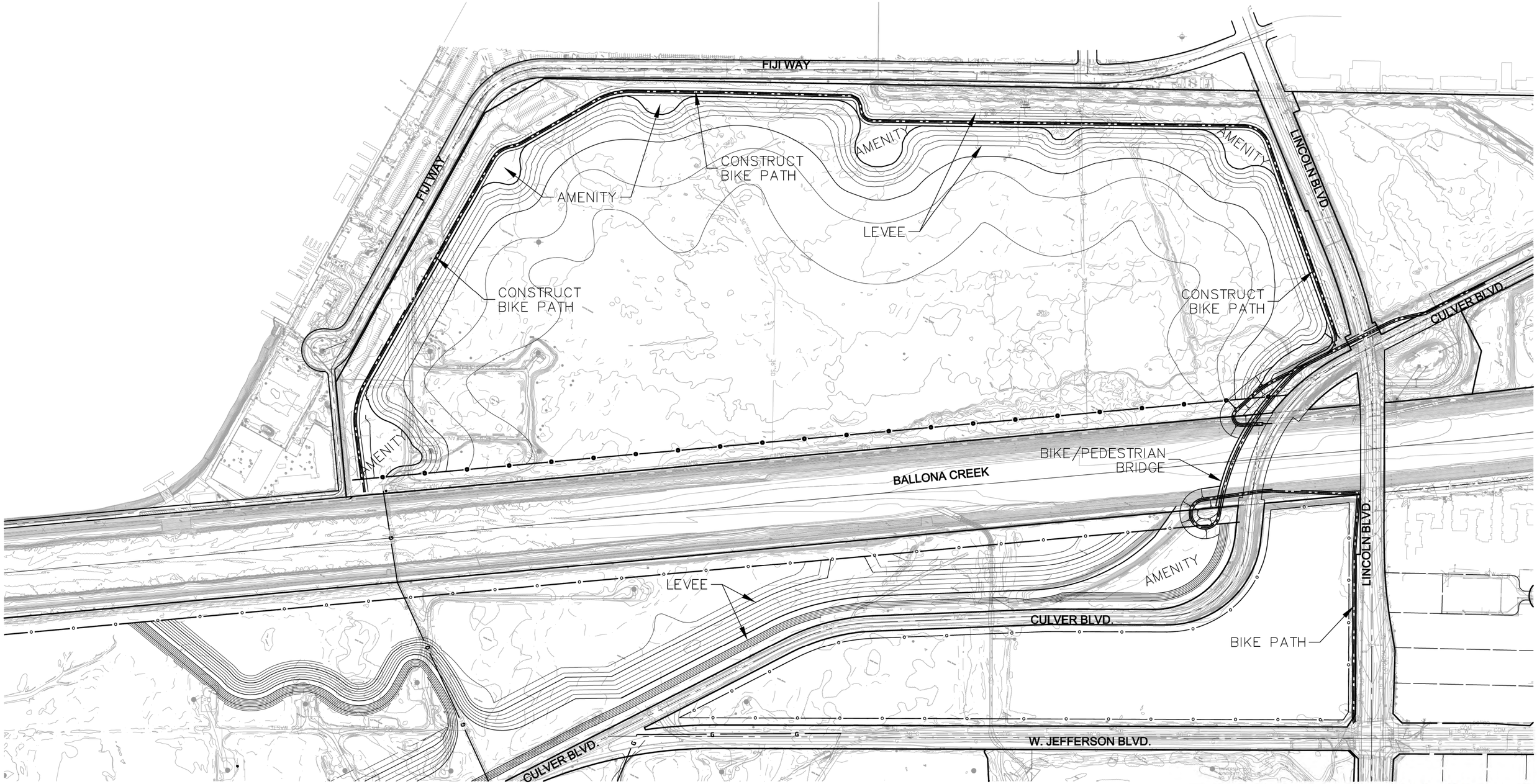

LEGEND

EXISTING BIKE PATH/LANE

PROPOSED BIKE PATH

BIKE PATH, PEDESTRIAN WALK, AND AMENITIES

T.G.: PAGE

200' 100' 0' 200' 400'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

BY _____ DATE

SUBDIVISION PLAN CHECKING SECTION

NO.	REVISION	REVISED BY	APPROVED BY	DATE

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MICHAEL J. OBERMAN
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Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

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CONSTRUCTION SEQUENCING #21
EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 21 OF 32

B1-1508

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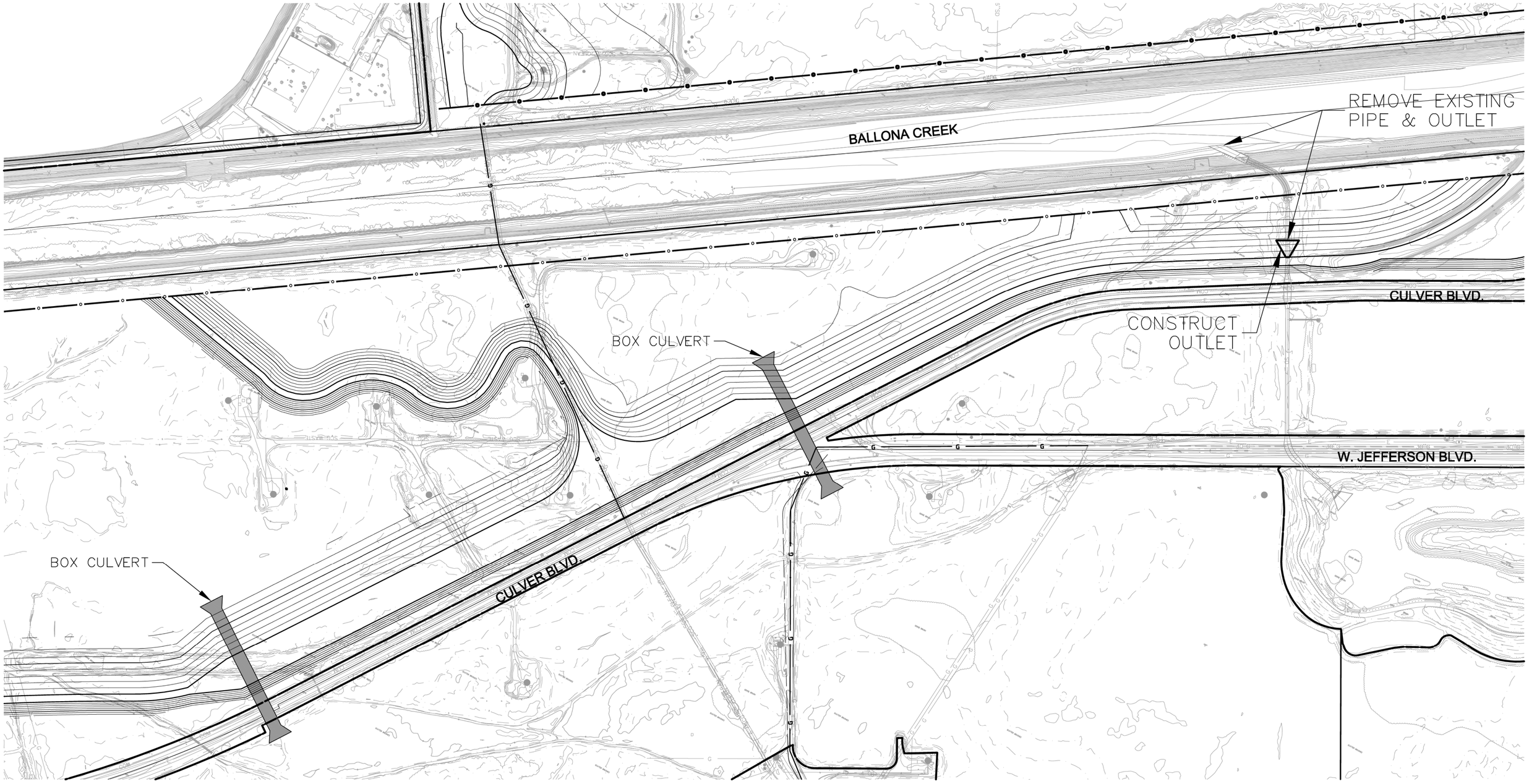

AREA "B"
BOX CULVERTS

T.G.: PAGE

CONSTRUCTION SEQUENCING #22 EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

150' 75' 0' 150' 300'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

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SUBDIVISION PLAN CHECKING SECTION

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Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

PLANS PREPARED BY:

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 22 OF 32

B1-1509

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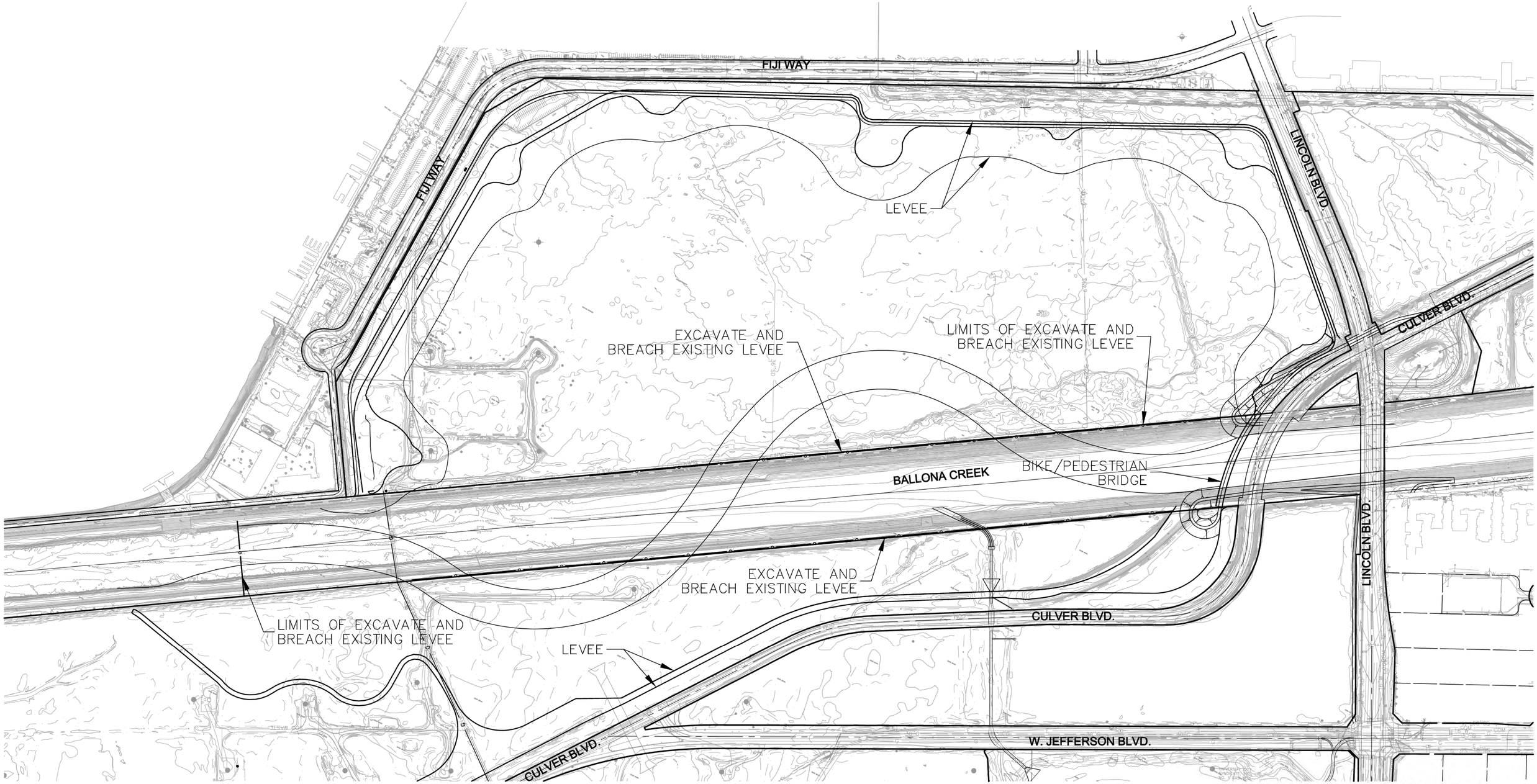

LEGEND

LIMITS OF EXCAVATION

AREA "A AND AREA "B" NORTH
EXCAVATE AND BREACH EXISTING LEVEES

T.G.: PAGE

200' 100' 0' 200' 400'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

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No. C48944
Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

CONSTRUCTION SEQUENCING #23
EXHIBIT

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 23 OF 32

B1-1510

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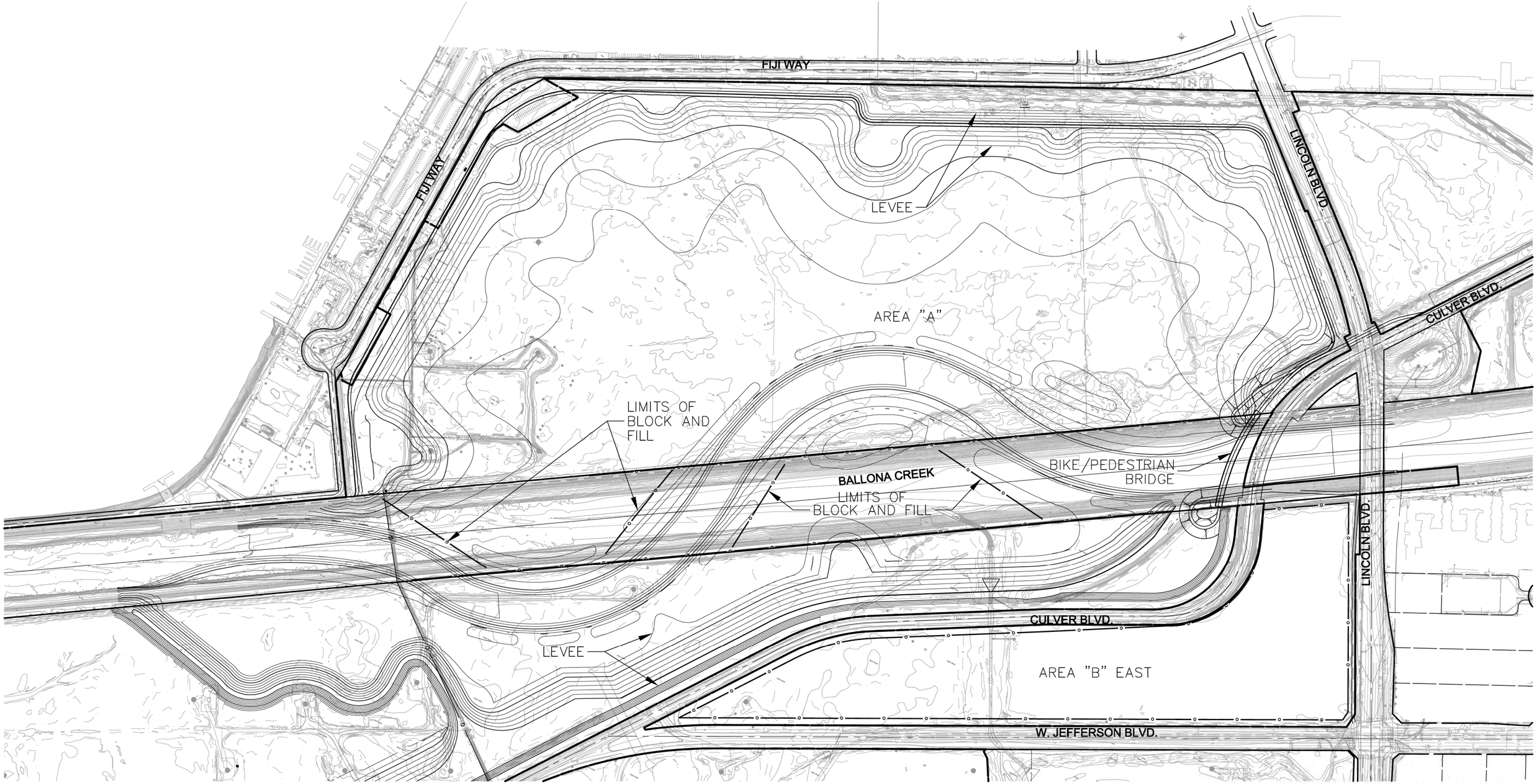

LEGEND

LIMITS OF GRADING

AREA "A" AND AREA "B" NORTH BLOCK AND FILL EXISTING LEVEES

T.G.: PAGE

200' 100' 0' 200' 400'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

BY _____ SUBDIVISION PLAN CHECKING SECTION DATE

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REGISTERED PROFESSIONAL ENGINEER MICHAEL J. OBRIANT No. C48944 Exp. 09-30-14 CIVIL STATE OF CALIFORNIA

PROJECT ENGINEER DATE

CONSTRUCTION SEQUENCING #24 EXHIBIT

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 24 OF 32

B1-1511

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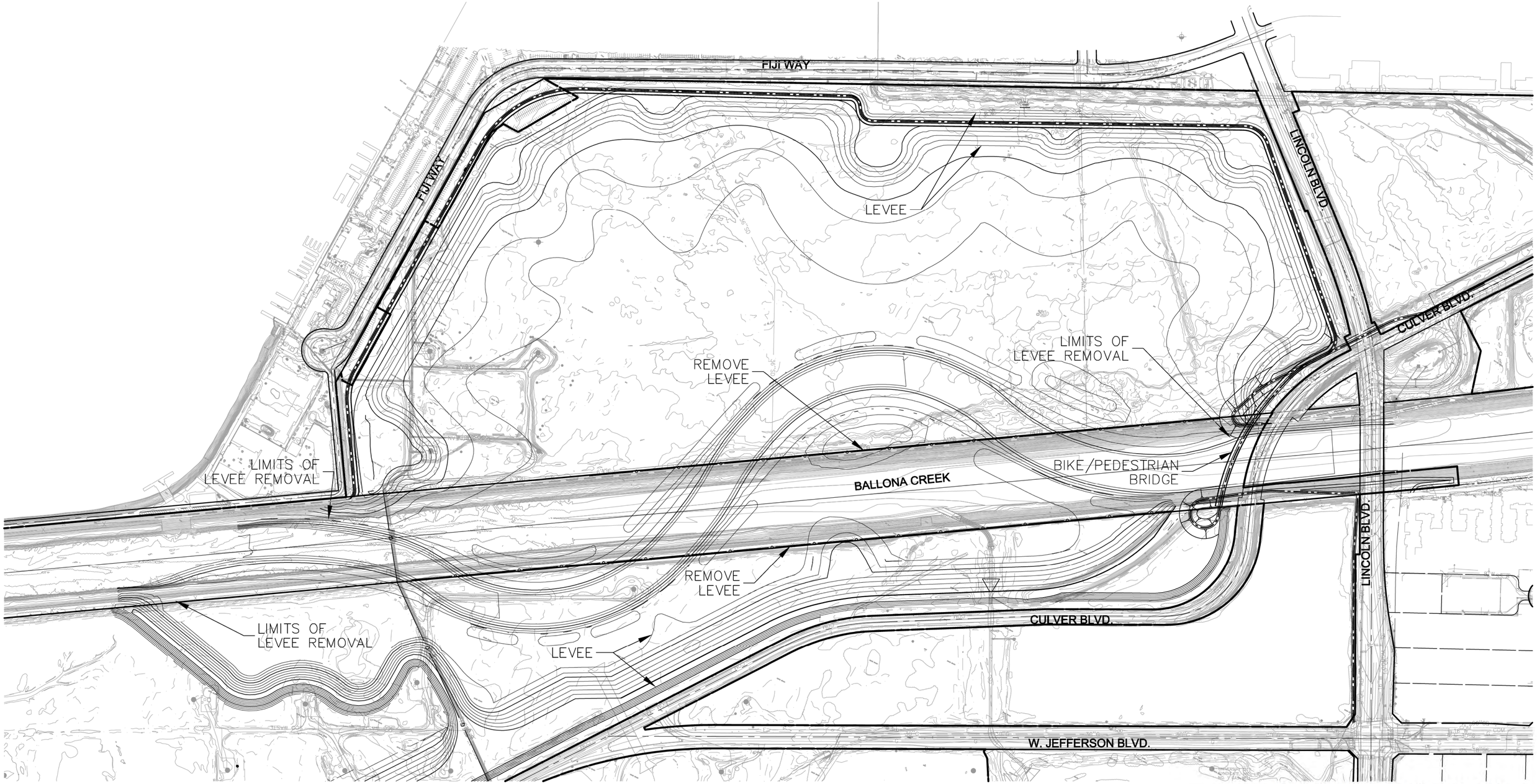

AREA "A" AND AREA "B" NORTH
REMOVE EXISTING LEVEES

T.G.: PAGE

CONSTRUCTION SEQUENCING #25 EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

200' 100' 0' 200' 400'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

BY _____ SUBDIVISION PLAN CHECKING SECTION DATE

NO.	REVISION	REVISED BY	APPROVED BY	DATE

REGISTERED PROFESSIONAL ENGINEER
MICHAEL J. OBRIANT
No. C48944
Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

PLANS PREPARED BY:
PSOMAS
555 South Flower Street, Suite 4300
Los Angeles, CA 90071
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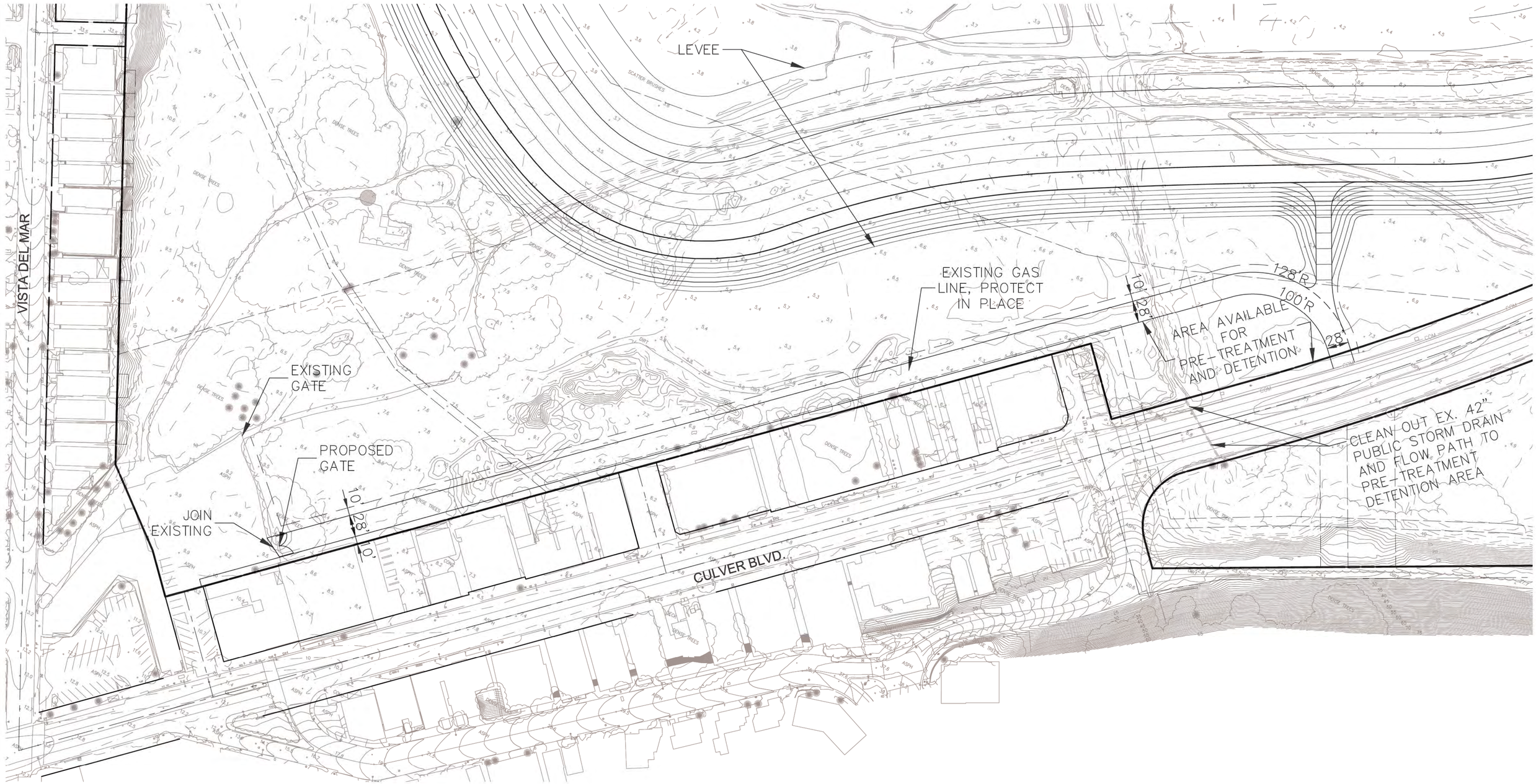
www.psomas.com

BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 25 OF 32

B1-1512

Plotted: 5/2/2013 1:54:04 PM :: Saved: 5/1/2013 1:59:29 PM :: W:\1CCCD10100\ENGR\EXHIB\Construction Sequencing\BR026-25.dwg ::



AREA "B" WEST
FIRE ACCESS ROAD

T.G.: PAGE

CONSTRUCTION SEQUENCING #26 EXHIBIT

60' 30' 0' 60' 120'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

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REGISTERED PROFESSIONAL ENGINEER
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Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 26 OF 32

B1-1513

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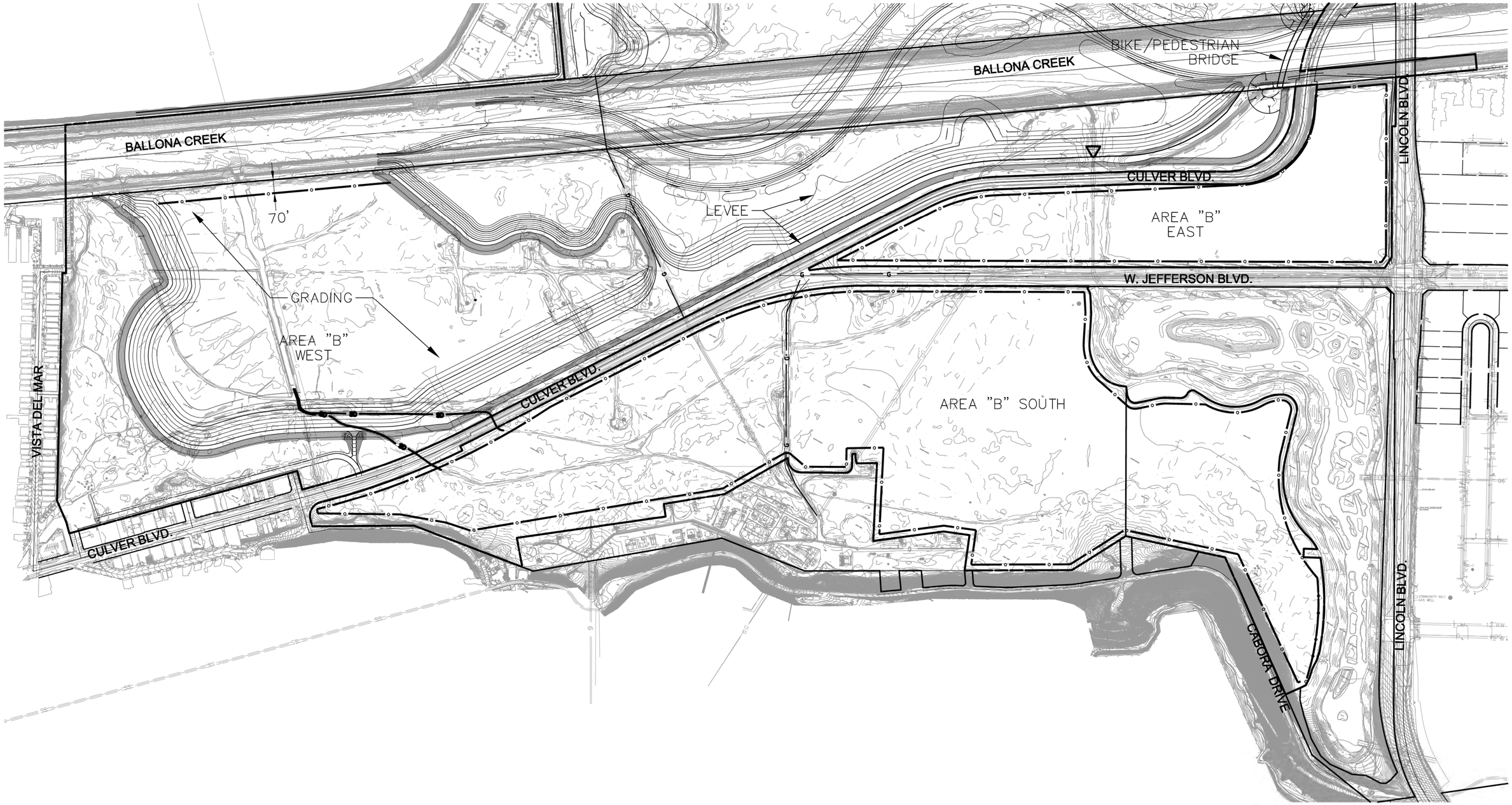

GRADING FOR AREA "B" WEST
AFTER AREA "A" HABITAT IS ESTABLISHED

AREA "B" WEST GRADING

T.G.: PAGE

LEGEND

LIMITS OF GRADING

NOTE: IF 12A OCCURS AND WELLS ARE TO REMAIN, GRADING AS SHOWN. IF 12B OCCURS AND WELLS ARE REMOVED, GRADING AROUND WELLS WILL OCCUR

250' 125' 0' 250' 500'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

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REGISTERED PROFESSIONAL ENGINEER MICHAEL J. O'BRIAN No. C48944 Exp. 09-30-14 CIVIL STATE OF CALIFORNIA

PROJECT ENGINEER DATE

CONSTRUCTION SEQUENCING #27 EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 27 OF 32

B1-1514

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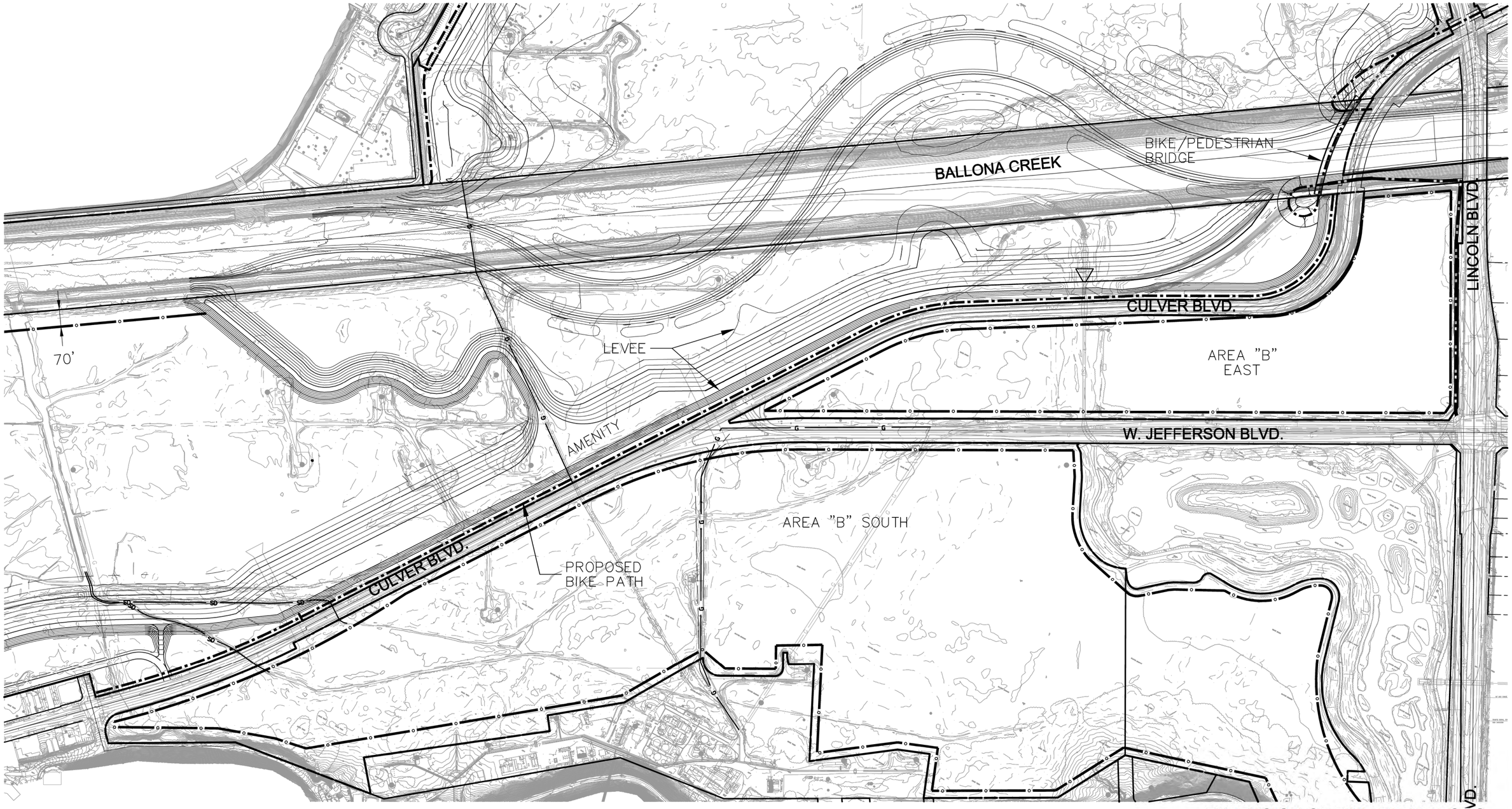

EXTENSION OF BIKE PATH ALONG SOUTH LEVEE TO PLAYA DEL REY

T.G.: PAGE

LEGEND

LIMITS OF GRADING

PROPOSED BIKE PATH

NOTE: BIKE PATH ALONG SOUTH LEVEE IS NEW AND CONNECTS THE EXISTING LEVEE TO PACIFIC AVE BRIDGE AND PLAYA DEL REY STREET SYSTEM AT CULVER AND VISTA DEL MAR

250' 125' 0' 250' 500'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

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PROJECT ENGINEER DATE

CONSTRUCTION SEQUENCING #28 EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 28 OF 32

B1-1515

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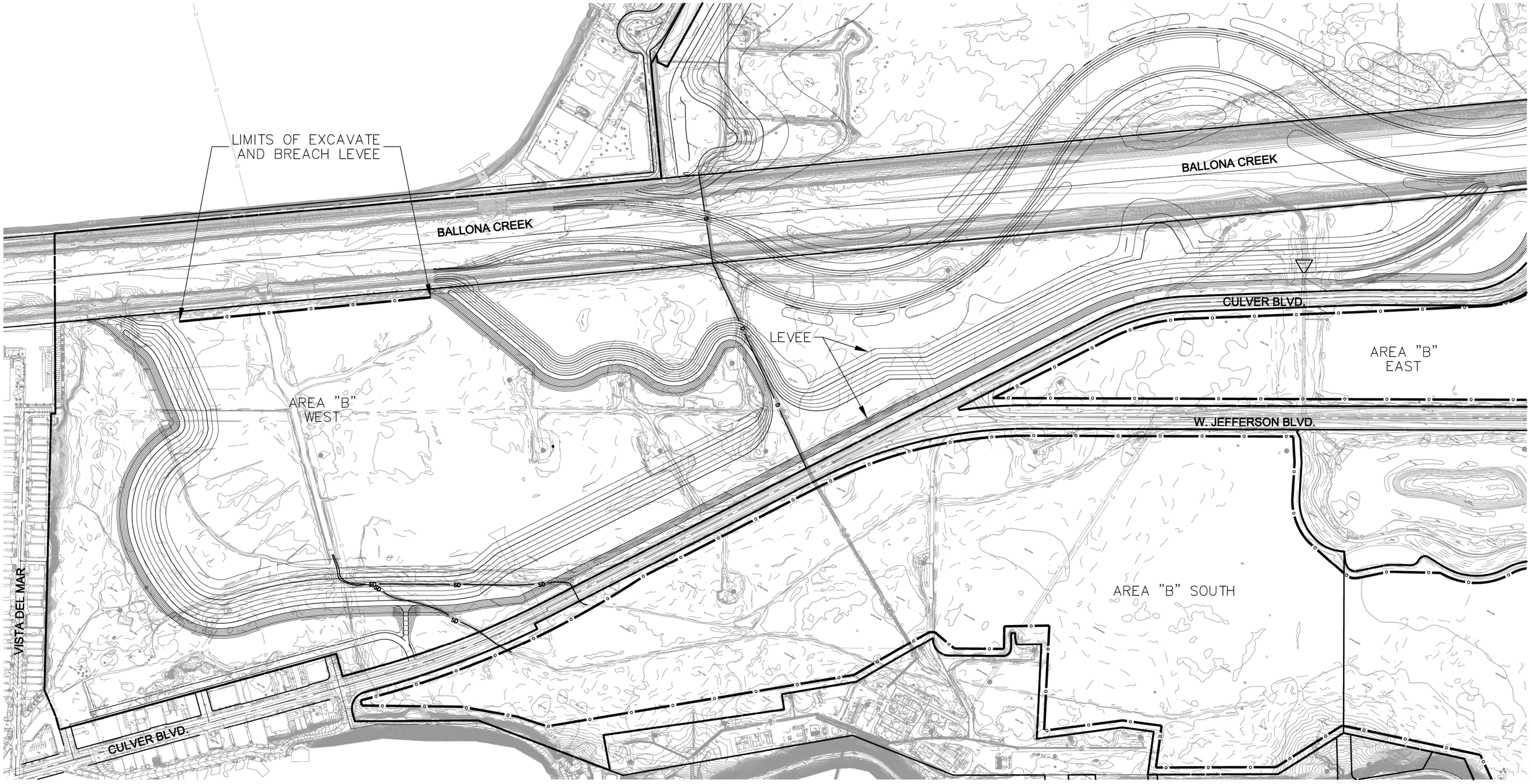

LEGEND

LIMITS OF GRADING

AREA "B" WEST
EXCAVATE AND BREACH EXISTING LEVEES

T.G.: PAGE

200' 100' 0' 200' 400'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

BY _____

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MICHAEL J. CREHAN
No. C48944
Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

CONSTRUCTION SEQUENCING #29
EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 29 OF 32

B1-1516

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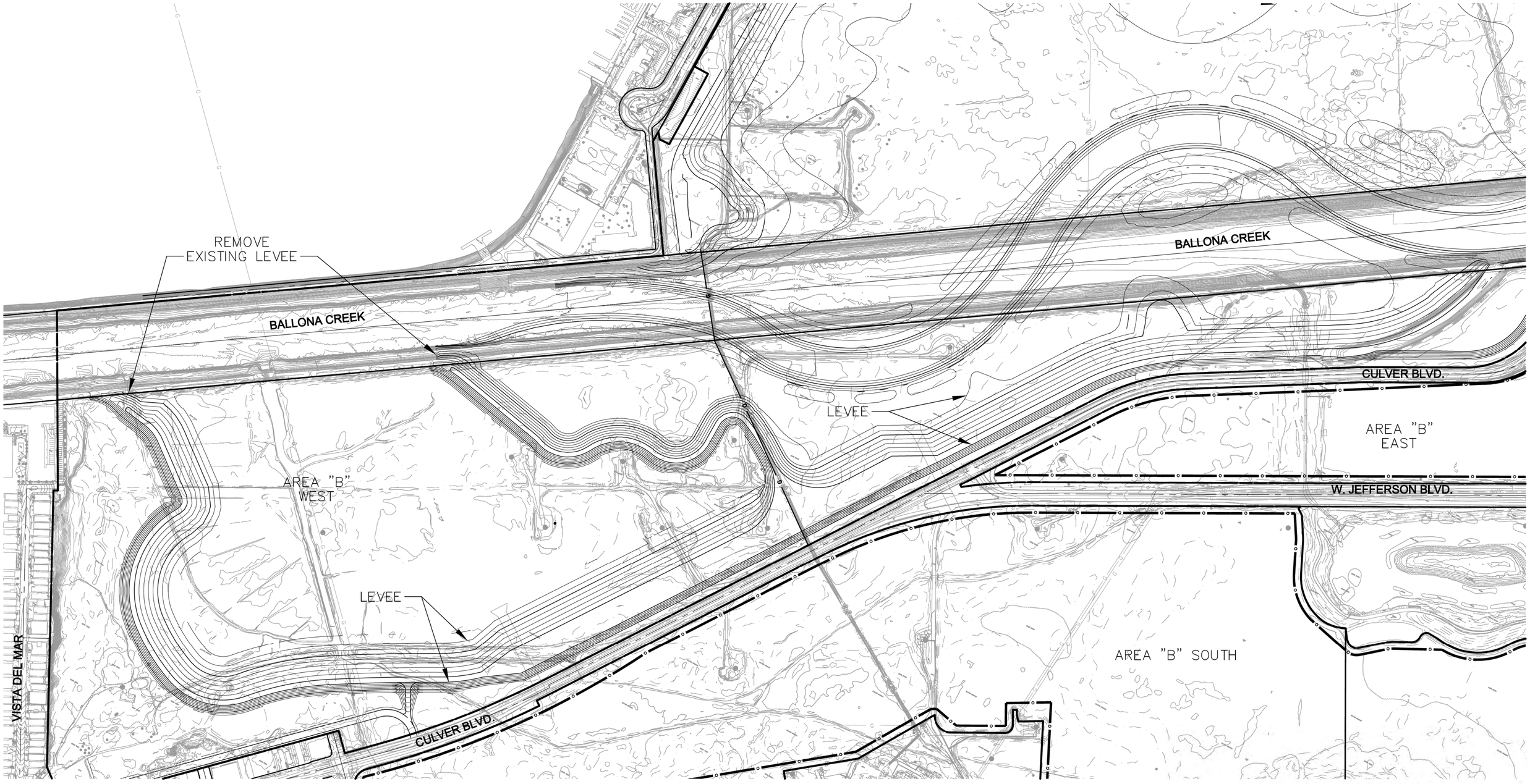

LEGEND

LIMITS OF GRADING

AREA "B" WEST
REMOVE EXISTING LEVEES

T.G.: PAGE

200' 100' 0' 200' 400'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

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PROJECT ENGINEER DATE

CONSTRUCTION SEQUENCING #30
EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 30 OF 32

B1-1517

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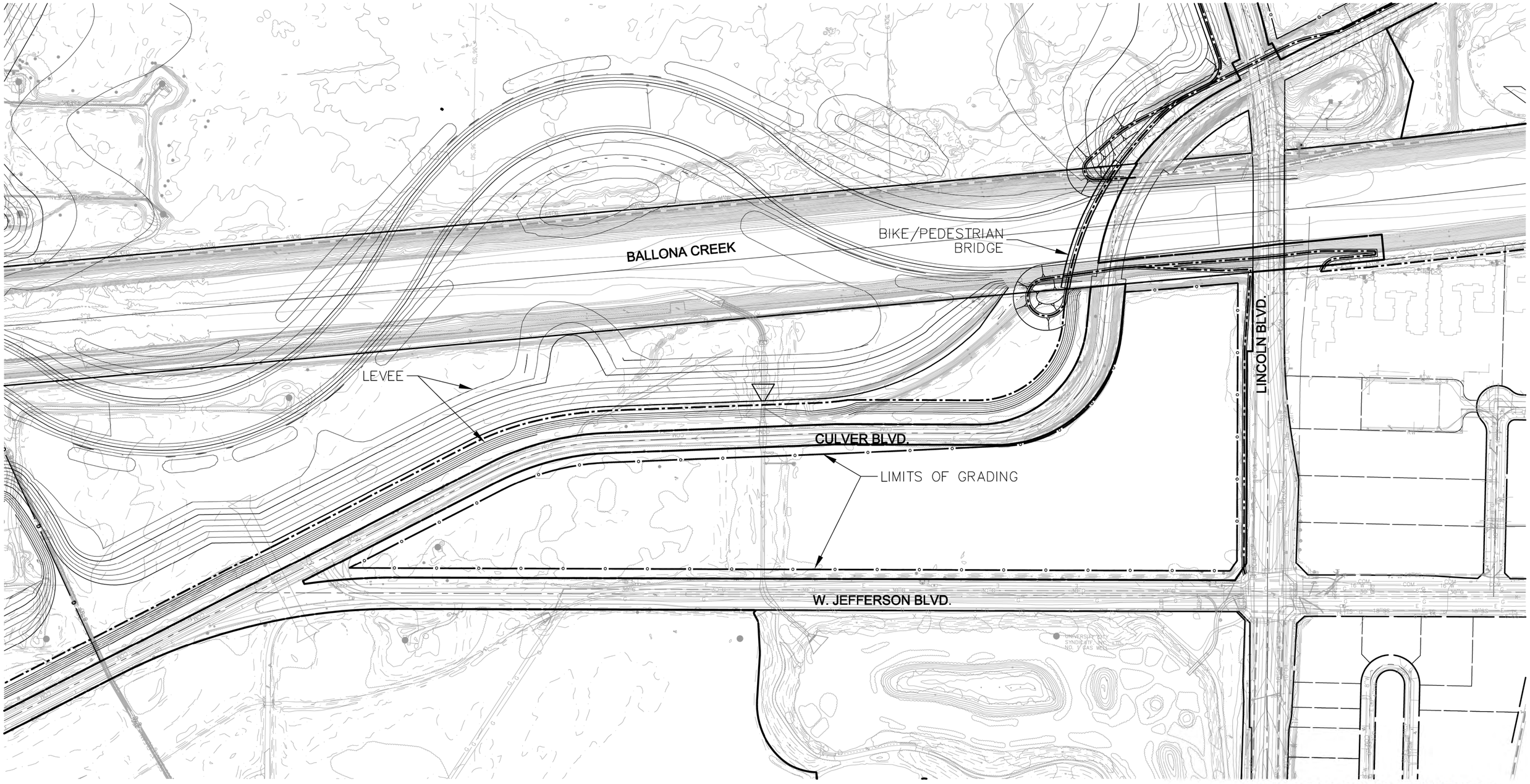

LEGEND

LIMITS OF GRADING

NOTE: IF REQUIRED, EXPORT EXCESS SOIL FROM AREA "B" WEST TO AREA "B" EAST

EXPORT FROM AREA "B" WEST TO AREA "B" EAST

T.G.: PAGE

150' 100' 0' 200' 300'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

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SUBDIVISION PLAN CHECKING SECTION DATE

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PROJECT ENGINEER DATE

CONSTRUCTION SEQUENCING #31 EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 31 OF 32

B1-1518

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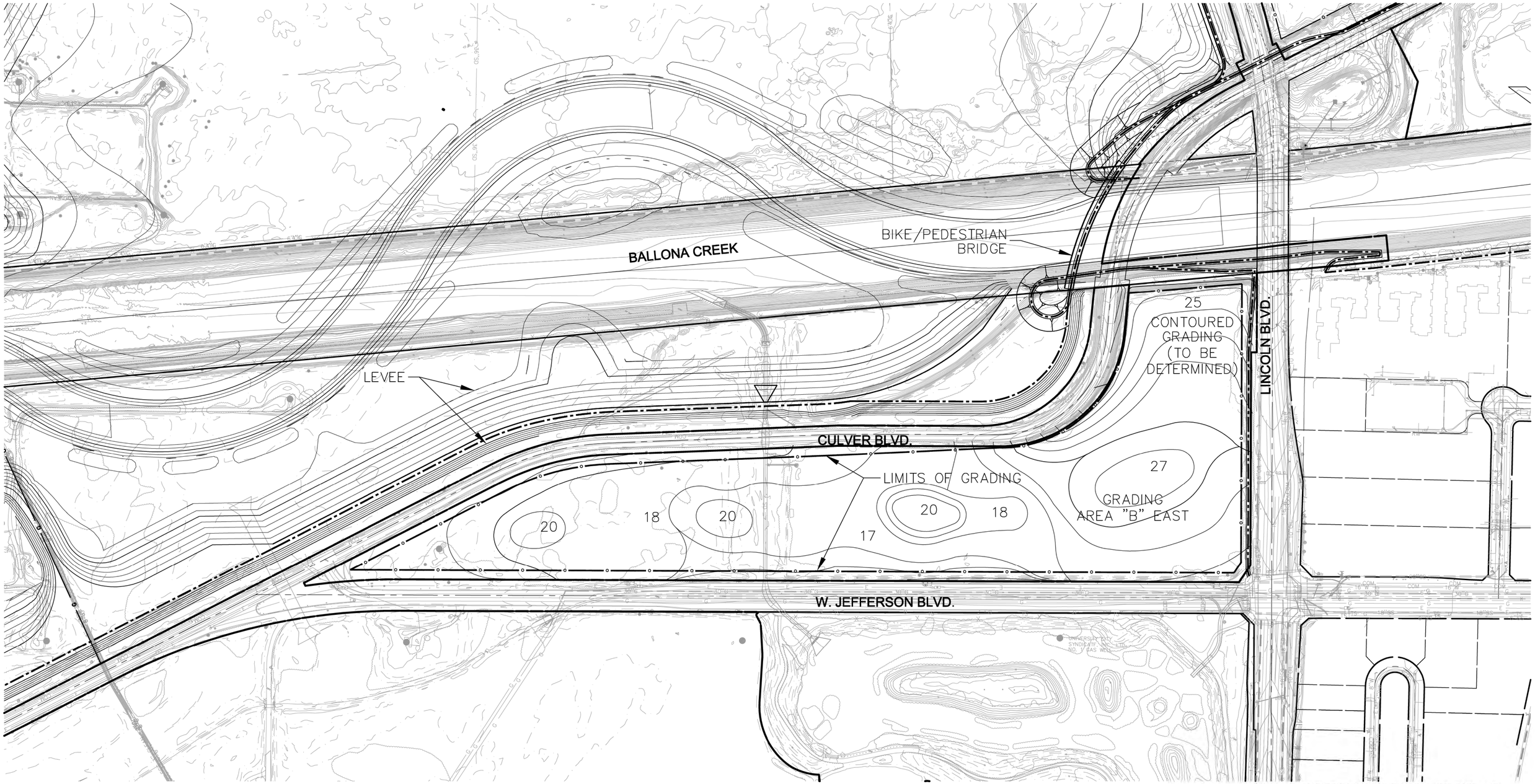

LEGEND

LIMITS OF GRADING

FINISH GRADING FOR UPLANDS ON AREA "B" EAST AND CONSTRUCT OPTIONAL BIKE PATH UNDER LINCOLN BLVD. BRIDGE

FINISH GRADING FOR UPLANDS

T.G.: PAGE

150' 100' 0' 200' 300'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

BY _____ SUBDIVISION PLAN CHECKING SECTION DATE

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CONSTRUCTION SEQUENCING #32 EXHIBIT

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET 32 OF 32

B1-1519

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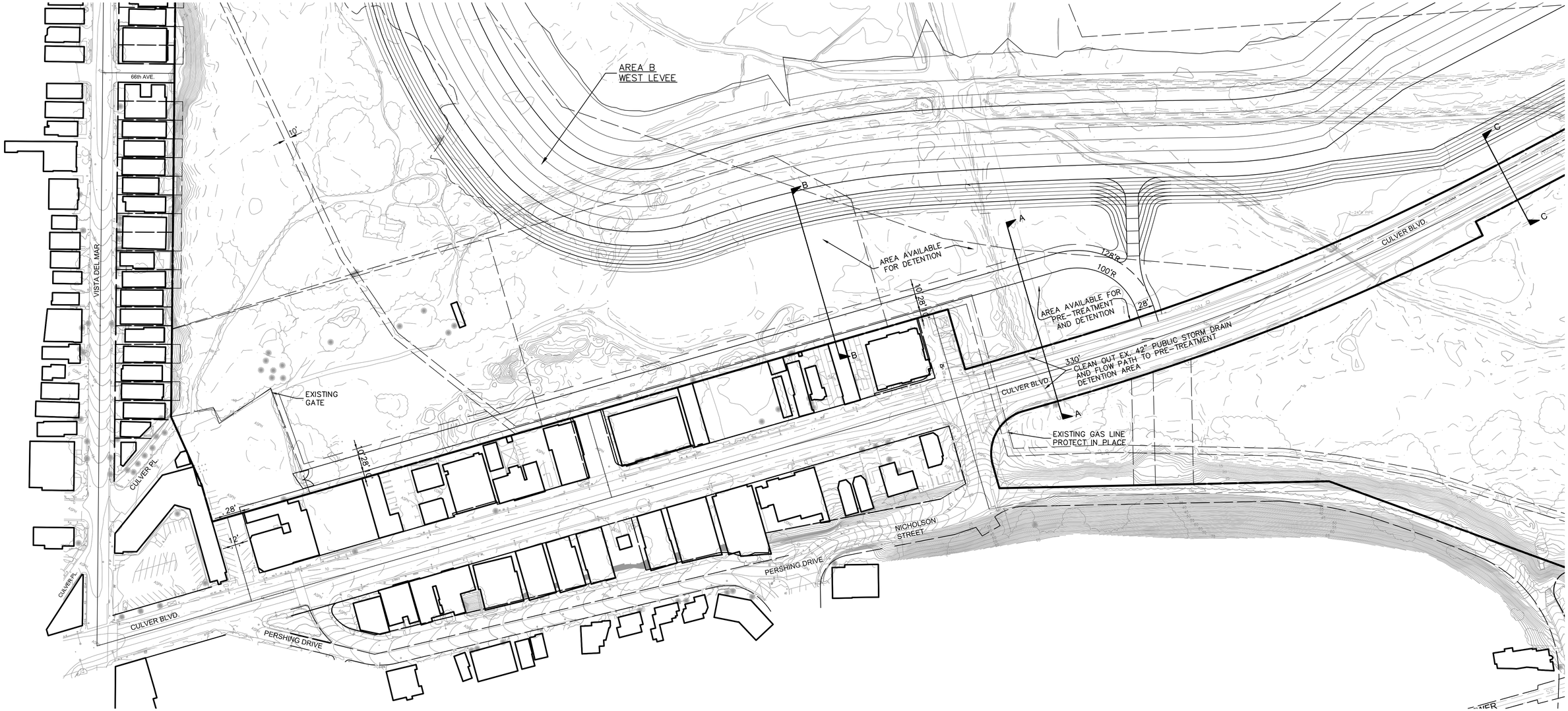
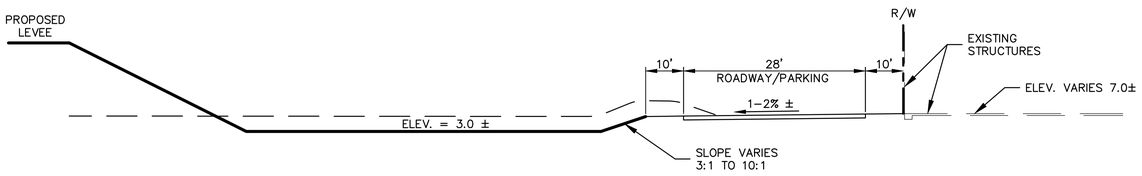
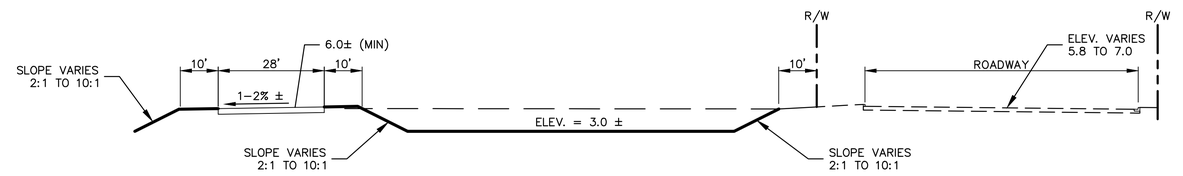
Appendix L
Miscellaneous Civil

APPENDIX - MISCELLANEOUS CIVIL EXHIBITS	
Drawing Number	**Exhibit Title**
BR031	Culver Blvd Stormwater Management & Fire Access Exhibit
BR033	Levee Ends Geometric & Structural Protection Exhibit
BR037	Area C Proposed Grading Exhibit
BR038	Area B Triangle Proposed Grading Exhibit
BR039	Existing Fresh Water Marsh Oulet Structure Exhibit
BR040	Storm Drain Piping Layout Exhibit
BR055	Jurisdictional Boundary Exhibit
BR048	Ballona Water Control Structures Discussion
BR049	Ballona West Area B Water Quality Discussion
BR050	Pedestrian Bridge Structural Narrative
BR051	Ballona Temporary Bridge Structural Narrative

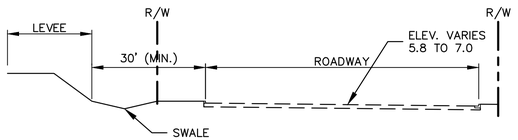




SECTION B-B
NTS



SECTION A-A
NTS



SECTION C-C
NTS

80' 40' 0' 80' 160'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

REVIEWED LAND DEVELOPMENT DIVISION

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No. C48944
Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

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T.G.: PAGE

CULVER BLVD STORMWATER MANAGEMENT AND FIRE ACCESS EXHIBIT

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B1-1523

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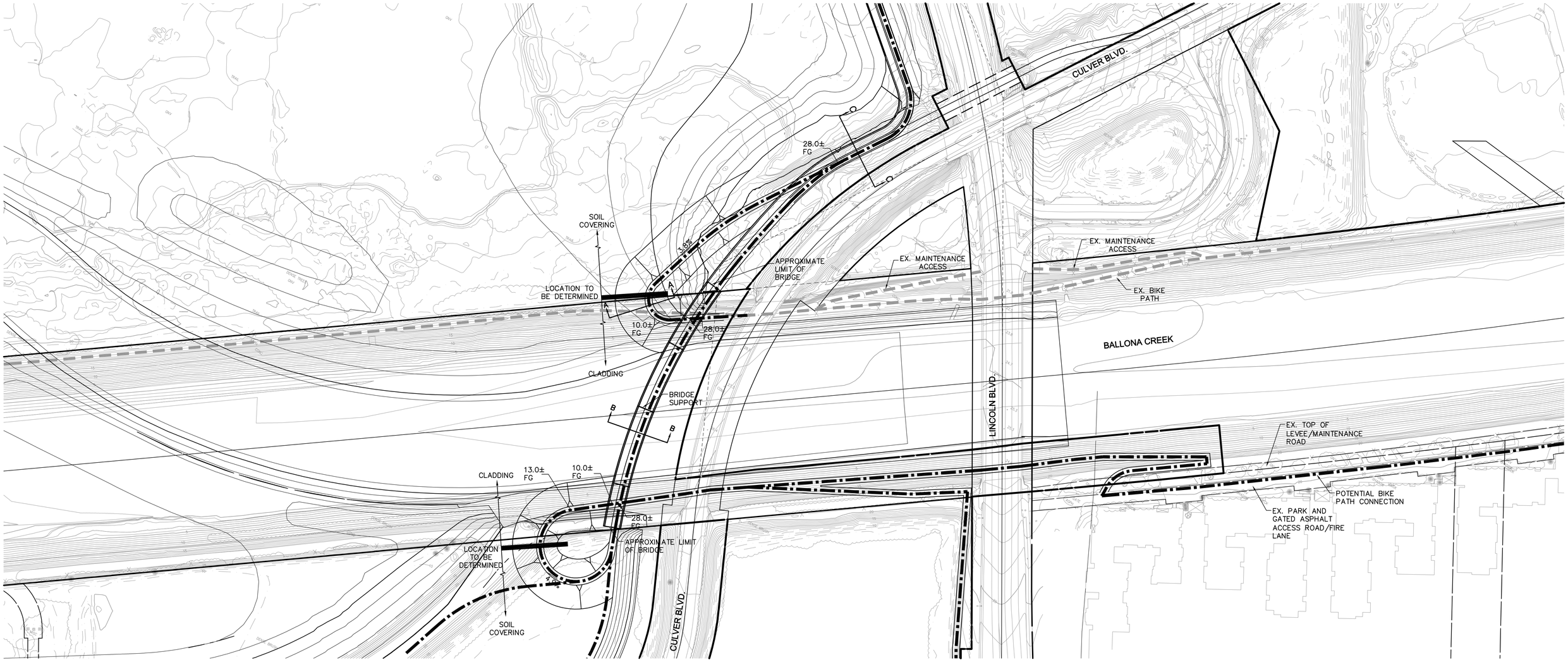
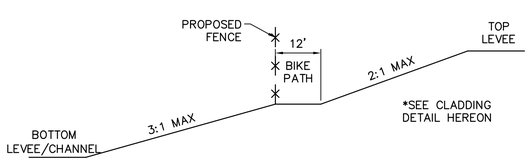
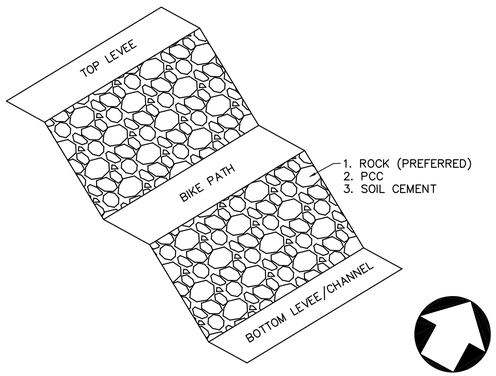


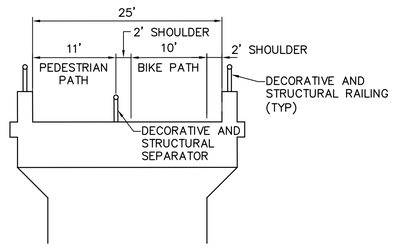
LEGEND

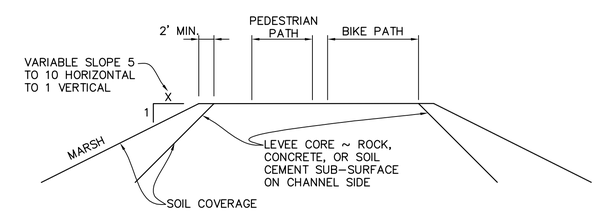
EXISTING BIKE PATH/LANE

PROPOSED BIKE PATH











80' 40' 0' 80' 160'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

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T.G.: PAGE

GEOMETRIC AND STRUCTURAL LEVEE ENDS EXHIBIT

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET OF

B1-1524

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T.G.: PAGE

AREA "C" PROPOSED GRADING EXHIBIT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

120' 60' 0' 120' 240'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

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CIVIL
STATE OF CALIFORNIA

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BALLONA WETLANDS ECOLOGICAL RESERVE

SHEET OF

B1-1525

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T.G.: PAGE

GRAPHIC SCALE
120' 60' 0' 120' 240'
Note: For reduced sized prints, original scale is in inches

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MICHAEL J. ORDWAY
No. C48944
Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

AREA "B" EAST
PROPOSED GRADING

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

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BALLONA WETLANDS ECOLOGICAL RESERVE | SHEET OF

B1-1526

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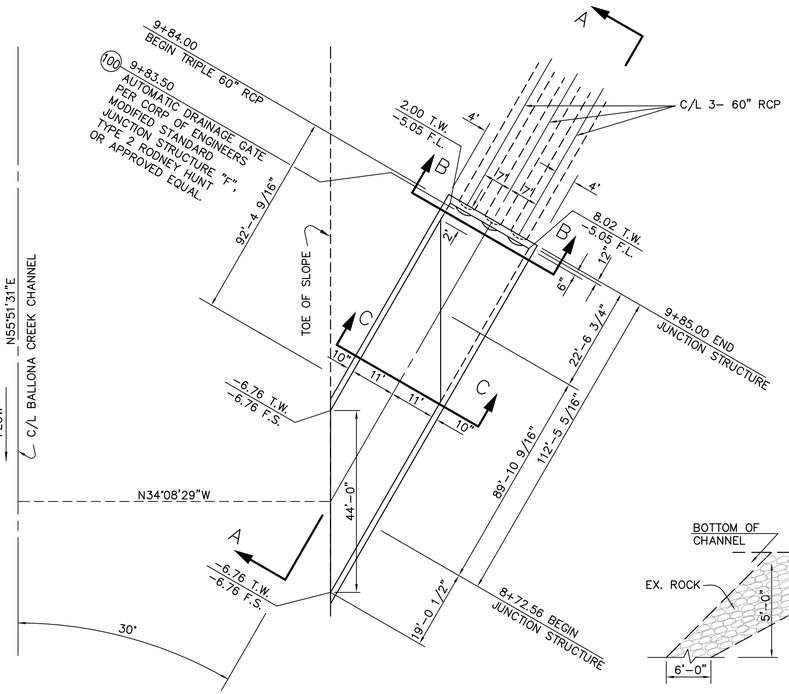

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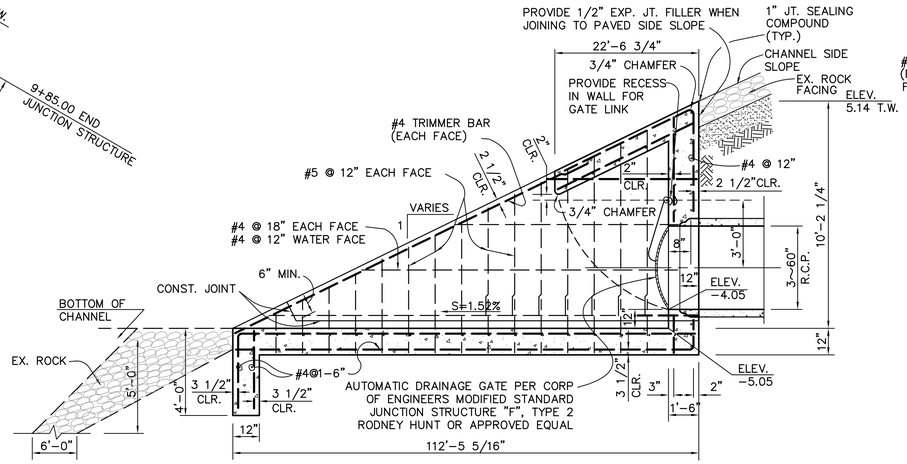

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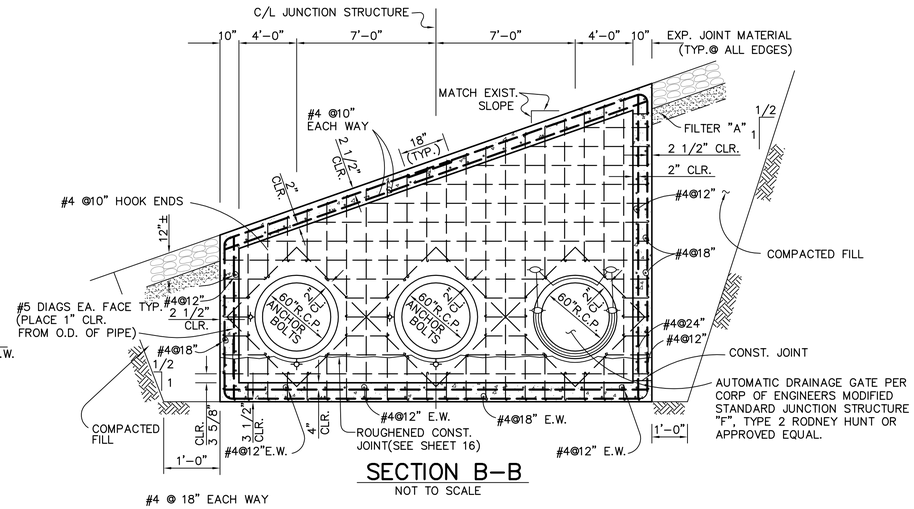

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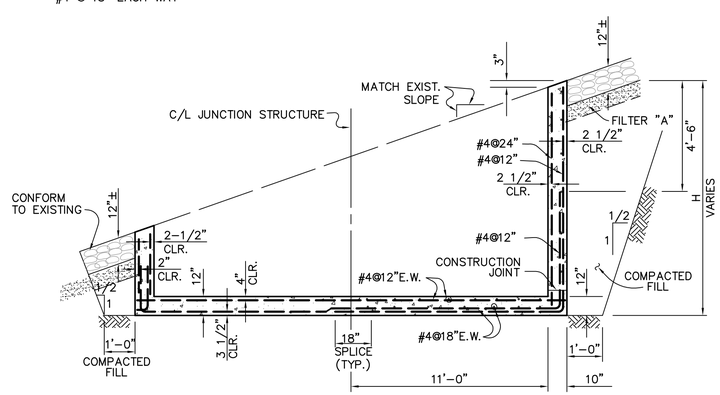

SECTION C–C
NOT TO SCALE

MARINE ENVIRONMENT – USE SPECIAL CONCRETE PER SHEET 14, NOTE 1D.

JUNCTION STRUCTURE (WITH FLAP GATES)

FRESHWATER WETLAND OUTLET DRAIN–CONNECT TO BALLONA CREEK CHANNEL
MODIFIED CORPS OF ENGINEERS
STANDARD JUNCTION STRUCTURE – "F"

NOTES

1. ELEVATIONS BASED ON NGVD
2. THIS STRUCTURAL CONCEPT WILL BE CONSTRUCTED TO REPLACE IN KIND THE FRESHWATER MARSH OUTLET
3. TIDAL GATES WILL BE CONSTRUCTED AS SELF–REGULATING OR ADJUSTABLE

T.G.: PAGE

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No. C48944
Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

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EXISTING FRESHWATER MARSH OUTLET STRUCTURE

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B1-1527

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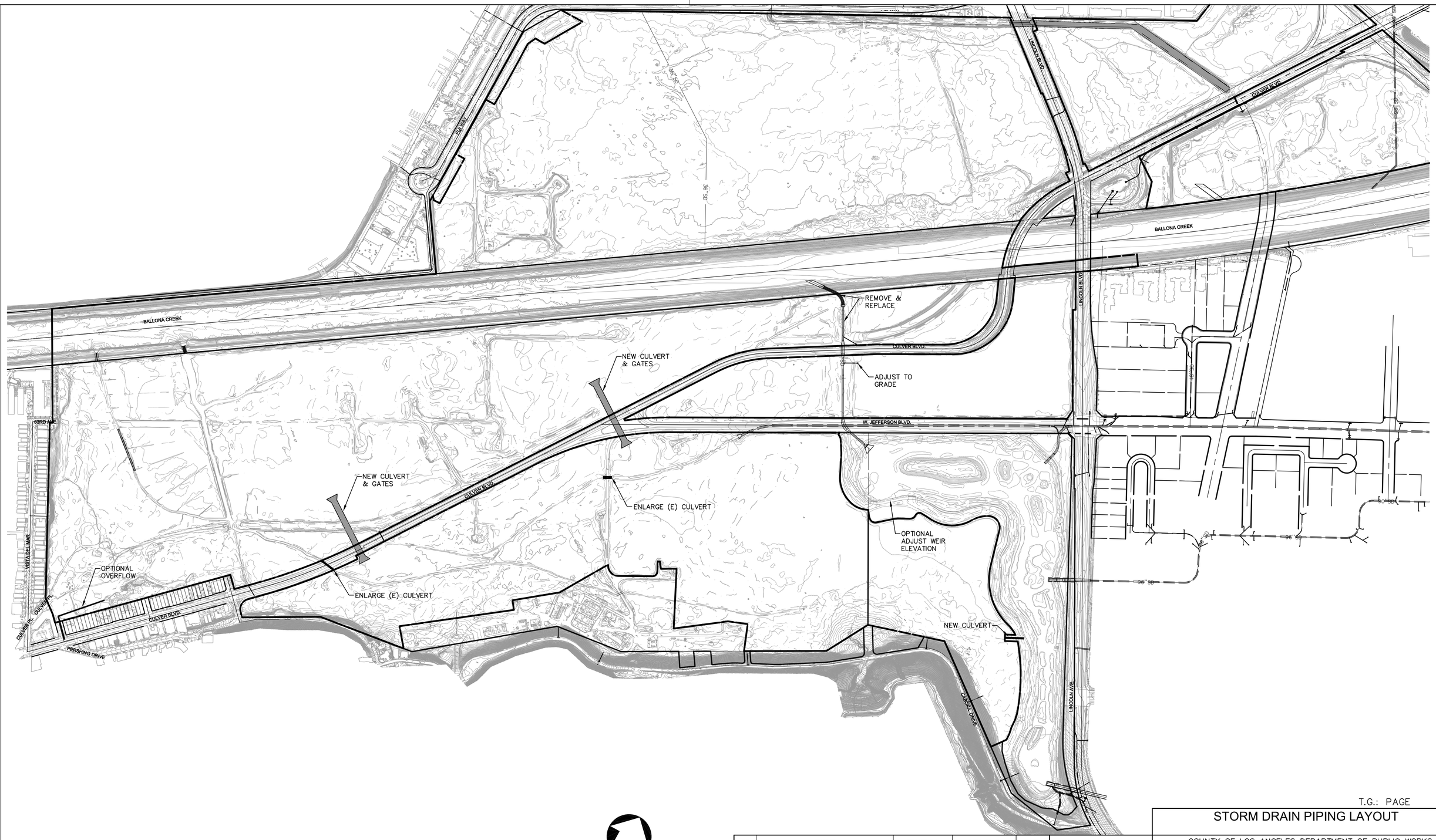

T.G.: PAGE

STORM DRAIN PIPING LAYOUT

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

300' 150' 0' 300' 600'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

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BY _____

SUBDIVISION PLAN CHECKING SECTION DATE

REGISTERED PROFESSIONAL ENGINEER
MICHAEL J. O'BRIEN
No. C48944
Exp. 09-30-14
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

PLANS PREPARED BY:

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BALLONA WETLANDS ECOLOGICAL RESERVE | SHEET OF

B1-1528

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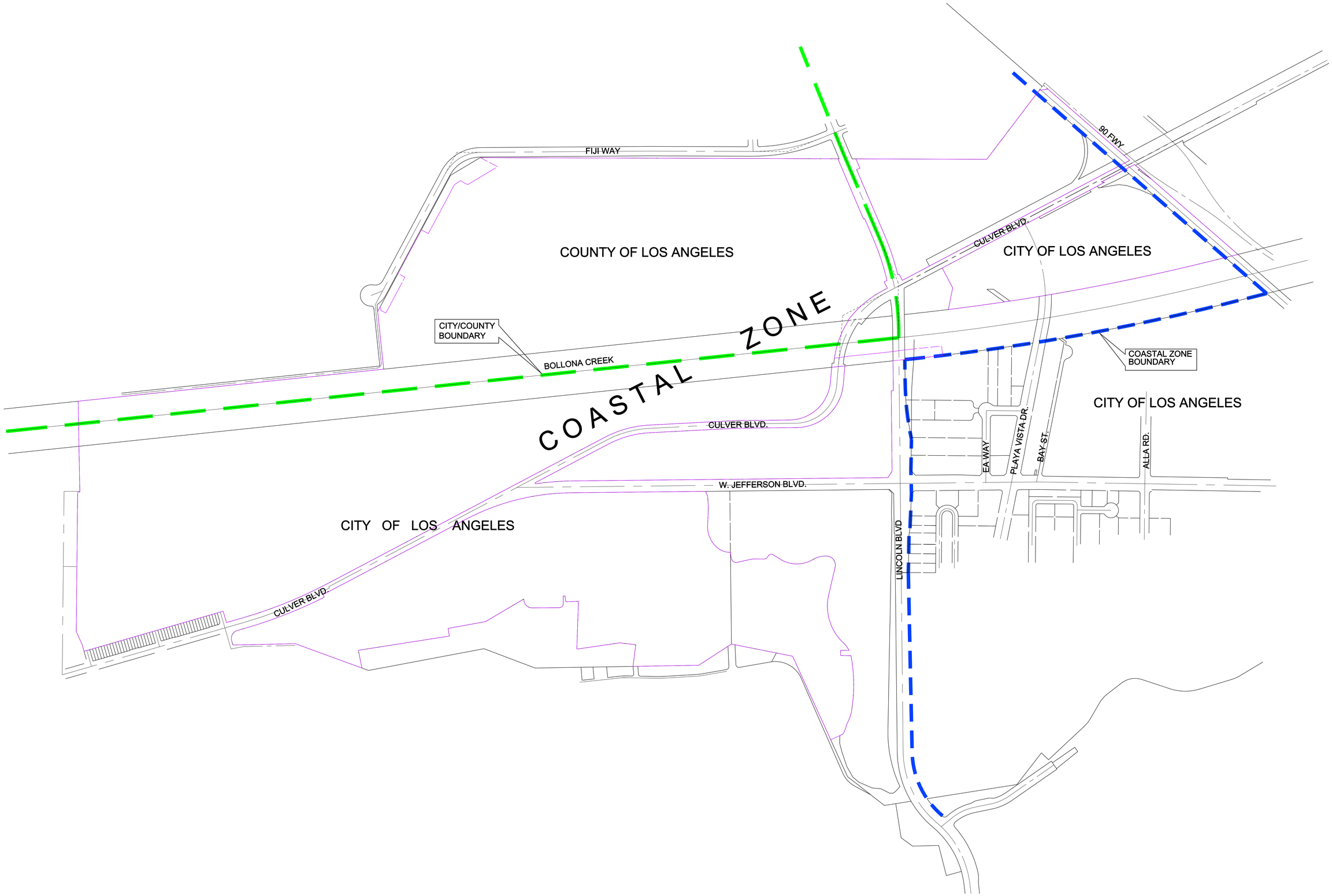

LEGEND

- CITY/COUNTY BOUNDARY
- COASTAL ZONE BOUNDARY
- PROJECT BOUNDARY

CALIFORNIA COASTAL CONSERVANCY

300' 150' 0' 300' 600'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

B1-1529

Jurisdictional Boundary Exhibit

PSOMAS

DATE: 01-31-2013 REVISED ON:
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SHEET 1 OF 1
BR055

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Water Control Structures Description

EXISTING CONDITIONS

There are three existing “Gate” structures within the project boundaries along the Ballona Creek that will be affected by the project. Two are toward the west end of Area B to allow muted and controlled tidal action into the small flow channels within Area B. Close scrutiny of these tide gates is maintained to avoid flooding of very low-lying development areas at the south-west corner of Area B, and of Culver and Jefferson Boulevards. A third gate structure is at the end of the main outlet culvert from the Freshwater Marsh. This structure contains a series of three, 60-inch diameter outlet pipes with flap gates. Tidal action occurs through this structure, but is precluded from entering the Freshwater Marsh by an internal structural weir within the Freshwater Marsh. The flap gates allow storm flows to be conveyed from the Freshwater Marsh to the Ballona Creek for minor storm events, and to close during large storm events for flood protection upstream of the Freshwater Marsh.

PROPOSED CONDITIONS

With the removal of the existing levees, all three of these gate structures will be removed. The area between the new levees will continue to enjoy full tidal action. The project goal is to expand that full tidal action south of the new southerly levee into the remainder of Area B (less the Freshwater Marsh) as much as possible without increasing the risk of flooding. The function of the outlet from the Freshwater Marsh will remain as it is in the existing condition, with construction of a new gate structure that will generally mirror the function and design of the existing structure, simply relocated to the new southerly levee alignment. Two new gate structures will be added through the southerly levee and extend under Culver Boulevard to South Area B to replace the two tidal gates. There are a couple of options for the type of gate used, and a number of geometric configurations to control the amount of tidal action.

The two types are self-regulating tide gates and adjustable gates, either manually or automatically adjusted. Generally self-regulating tide gates, when properly designed and installed, are preferable due to lower cost, maintenance, and reliability. However, adjustable gates can be designed for a wider range of use and could more easily accommodate future sea level rise. There are advantages for each type which will be reviewed with final design.

In order to control flow rates and flooding risk, he sizing and configuration of the gate structure can be configured in a number of ways. The general intent would be to allow greater volumes to pass in one direction than another. For example, we could provide one or two pipes with flap gates to control flow rates and volumes only for rising tides into Area B. And, we could provide three pipes, or larger diameter pipes for receding tides allowing a greater relative volume and flow rate out of Area B. Another example would be to have adjustable gates on both ends of a pipe with different settings for flows to accomplish the same flood protection goal.

West Area B Water Quality Description

EXISTING CONDITIONS

At the southwest corner of Area B is a developed commercial area fronting Culver Boulevard. This development is at a very low elevation in some cases below 6.0. This is a low point of Culver Boulevard and has historically had flooding problems at, and adjacent to, the intersection of Culver Boulevard and Nicholson. There are a number of storm drains in the area with the primary collection drain for flows from the Westchester Bluffs area conveyed westerly of the intersection toward the ocean. This drain is under sized for larger storm flow events. This was recognized and an overflow drain in Nicholson exists to convey the excess overflow to the north outletting on the north side of Culver Boulevard at the intersection. There is a small ditch that routes this overflow runoff into Area B to one of the small tidally influenced ditches in the area. Due to tidal action, the capacity of this overflow ditch and the surrounding area that is available for storm water storage is sometimes exceeded causing flooding of Culver and a few of the adjacent properties.

PROPOSED DRAINAGE CONDITIONS

With the construction of the proposed levees, tidal influence in this area will be eliminated. However storage volume for the excess overflow drainage will also be eliminated. Therefore, replacement storm water storage volume will be provided by creating a low area to approximately elevation 4.0 between the commercial properties and the proposed levee. This storage basin will be sized to accommodate the overflow volume as well as the local drainage in the area. A public storm drain pipe from a downstream drain system can be extended to dewater this area if desired, or storage volume could be provided to fully contain the overflow. This basin will also function as a water quality treatment measure to address the minor increase in pollutant load from the proposed paved fire access road behind the commercial properties, as well as a portion of the runoff from the existing paved area of Culver Boulevard. Other areas of Culver Boulevard further east will drain to a shallow roadway shoulder ditch provided to keep stormwater runoff away from the paved area, as well as provide an infiltration and treatment function for the roadway.

Ballona Wetlands Restoration Project

Pedestrian/Bike Bridge

Structural System

Overview

The proposed pedestrian/bike bridge will have a dual objective. It can be used as a vehicular bridge for H20 loading trucks during construction to facilitate the Earth Transportation and then it will be used as a pedestrian/bike bridge at its final objective. This bridge will span approximately somewhere between 380' & 400', at the location chosen next to the (E) Culver Blvd bridge. See Photo 1. See also preliminary layout by Psomas attached here under Fig. A.



Photo 1. Culver Bridge

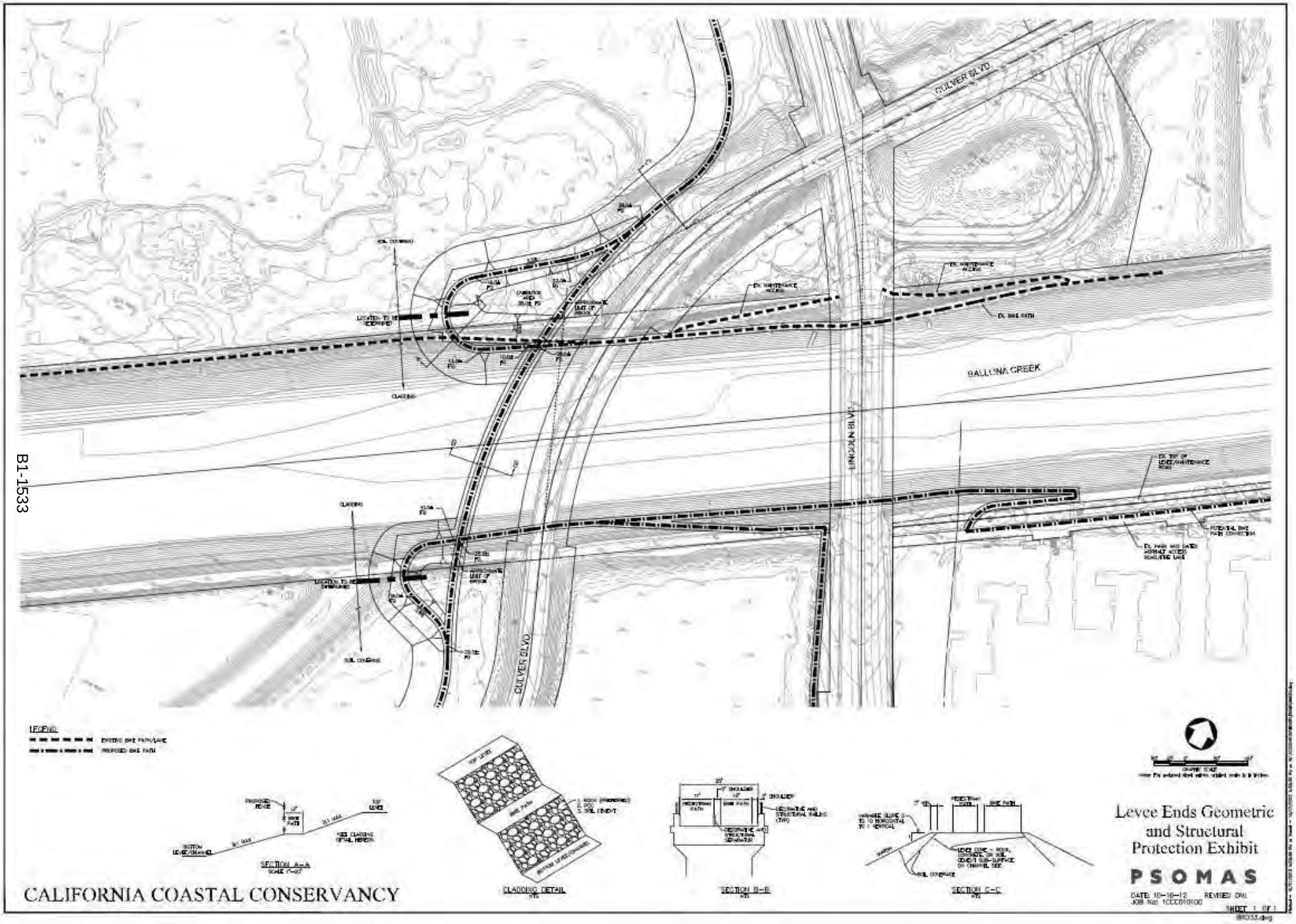


Fig. 1: PRELIMINARY PEDESTRIAN/BIKE BRIDGE

A.1 Description, Proposed Material and Advantages of the Structural System

The proposed structural system for the bridge uses steel for the superstructure and concrete for the foundation piers system.

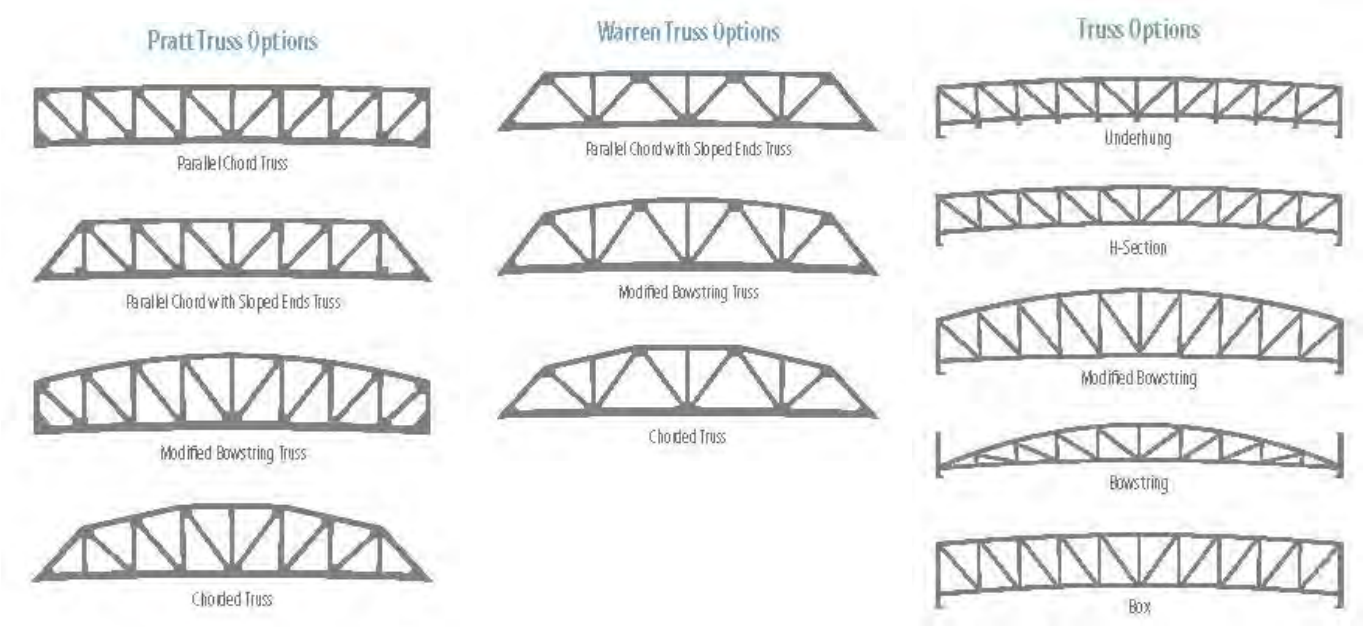
The clear advantage of our structural steel system starts from the weight reduction compared to a purely concrete structural system.

Having to design our structural system for reduced weight will permit us to use also reduced code design forces allowing us to reduce the size of the structural members as well as their foundation, providing a more economical design.

Using structural steel bridges also allows us to play with different configurations to explore the best option from both a structural and aesthetic standpoint.

From the initial geotechnical findings the North & South edges of the Ballona Creek do not seem to be adequate to provide structural support if the bridge is a simple span, therefore there is the need to have interior foundation piers. Our first option is to have a four span bridge.

Some of the possible structural configurations between piers are shown below:



All of the truss options shown above are preferred on Regions of High Seismicity as is a concern at our site.

To illustrate some of the Pedestrian/Bike bridges built based on these configurations, see photos below.













B.1 Design Criteria

Basic Design Criteria shall follow the codes and standards from:

- US Army Corps of Engineers (USACE)
- Los Angeles County Department of Public Works (LA County DPW)

Ballona Wetlands Restoration Project

Temporarily Bridge Across Lincoln Between Areas A & C

Structural System

Overview

Earth movements between areas A & C will be required. A possibility to build a bridge using the (E) concrete piers can be studied. See (E) concrete piers on Photo 2.



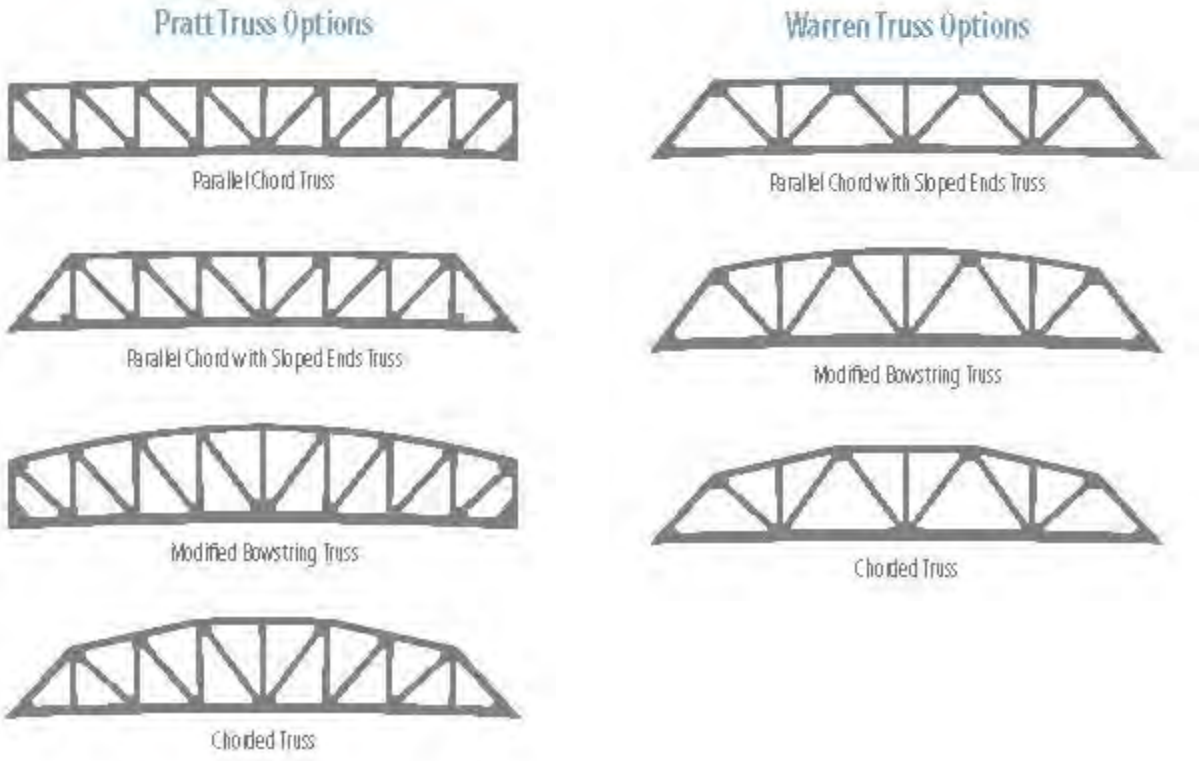
Photo 2: (E) concrete piers between areas A & C.

A.1 Description, Proposed Material and Advantages of the Structural System

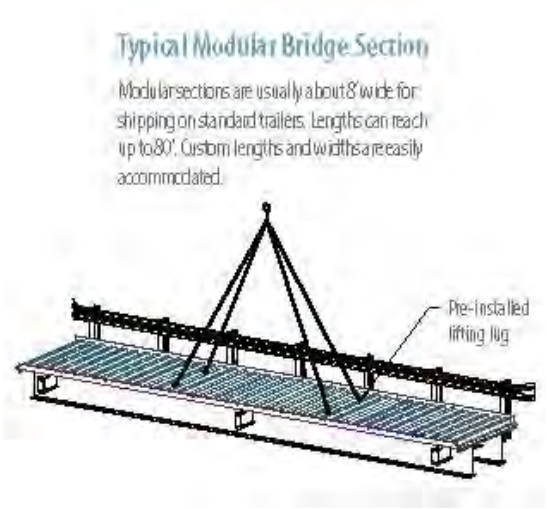
A temporarily bridge across Lincoln and between areas A & C can greatly increase the productivity during construction speeding up the earth movement between areas A & C. This could also contribute to have better logistics & access during construction.

In order to assess this possibility a further structural detailed evaluation of the (E) concrete piers is needed. Based on the findings of this detailed structural evaluation a temporarily bridge with a capacity limited to the capacity of the (E) piers can be build.

Some of the possible structural configurations are shown below:



A temporarily bridge can be a new designed bridge or a prefabricated bridge. See below for some samples:













B.1 Design Criteria

Basic Design Criteria shall follow the codes and standards from:

- US Army Corps of Engineers (USACE)
- Los Angeles County Department of Public Works (LA County DPW)

APPENDIX B2
Stormwater Management Plan

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PRELIMINARY
STORM WATER MANAGEMENT PLAN

For

BALLONA RESTORATION PROJECT

By

PSOMAS

Dated: July 10, 2015

PURPOSE:

The purpose of this draft report is to outline the storm water management measures that will be implemented during construction to mitigate soils loss and dust control, as well as a description of the permanent project features and benefits proposed. This preliminary report is intended to provide an environmental impact analysis level discussion which will be expanded upon for the final Storm Water Management Plan to be used during project implementation.

This report is organized to discuss these issues in four categories. First, the storm water pollution prevention elements to be implemented during construction. Second, permanent project features and benefits to be provided and maintained in perpetuity. Third, the establishment periods and phasing that may be necessary for full implementation. And fourth, the maintenance and operations that may be necessary. After these four areas are discussed, an additional section that more specifically describes project specific storm water management elements is included.

I. Storm Water Pollution Prevention During Construction:

The overarching intent of storm water management during construction is to manage the construction activities and site conditions to reduce pollutants of concern from migrating from the site. This goes beyond the measures taken related to storm water events and includes daily operations. During implementation of this project, the majority of the construction involves grading of mass volumes of dirt. These activities generate potential soils migration from the site through surface soils movement activities and airborne dust generation. In addition, other activities will be conducted to include construction of structures, hardscape installation, equipment and signage installation, etc. Best Management Practices (BMP's) will be required to mitigate the potential impacts from these activities. BMP's will include the following daily list of activities and features:

- Application of water on dry soil to reduce losses through airborne dust.
- Placement of physical barriers such as straw waddles, silt fences, etc. to reduce loss of surface soil during rain events and daily cleanup operations.
- Installation and operation of Vehicular Staging Areas that includes wheel washes and oil pan drip collection to reduce the introduction of man-made products onto the site.
- Installation of vehicular dust containment measures, such as tarps or enclosures to limit soils and dust migration.
- Installation of local containment devices such as filter fabric or fiber rolls on existing drain inlets on adjacent streets as a secondary measure to further reduce the possibility of soils migration into downstream infrastructure or waterways.

Other BMP measures that will be implemented on a longer term, but still temporary basis, may be necessary. This would primarily be for areas that are graded but must be left in an unfinished condition until final construction is completed. For example, there may be a gap in time between grading of the levee and installation of the maintenance and pedestrian/ bike trail on top of it. Or, for the time between temporary placements of stockpiled soil for future grading fill operations, and its ultimate placement. Where construction phasing or sequencing like this occurs, BMP's may include:

- Application of temporary soil surface coatings, such as applied biodegradable chemicals or fabric.
- Application of temporary vegetation.
- Installation of temporary and removable sheeting material to cover newly graded areas.
- Were unfinished and newly graded areas are located such that rain event runoff might have localized erosion, interim storm water detention and settling areas may be provided.

II. Long Term Storm Water Management Features

The project itself acts as a storm water mitigation feature for the Ballona Watershed. As a wetlands restoration project, this project site will include a storm water cleansing functionality that will help remove constituents of concern through bio-uptake and re-establishment of a viable, sustainable, and natural ecological system. While the project serves this function and benefits the region, there are also many individual local beneficial features. The following lists specific types of permanent storm water management features that will be implemented within the project. More detailed descriptions are provided below:

- Bio-swales will be installed at the toe of all slopes steeper than 10 to 1, and along the non-creek side of the levees. Bio-swales allow the collection of runoff from the adjacent contributing slopes, bio-uptake of constituents in the runoff, and infiltration into the soil of the minor flows collected.
- Grading and installation of pre-treatment basins will be provided. These basins allow storage and controlled discharge of runoff to allow settlement of suspended solids prior to storm water discharge to main water bodies or primary retention areas.
- The project provides full vegetation coverage for bio-uptake of nearly the entire project area.
- For those areas with impervious surfaces, routing of storm water that falls on the impervious surfaces, such as bridges and trails, into vegetated areas will be provided for infiltration and bio-uptake of all localized runoff.

- The existing Fresh Water Marsh is a stormwater treatment BMP for storms events less than the 1-year storm for its upstream developed area. Modifications to the outlet weir will enhance this functionality.

- Erosion mitigation measures will be placed at all storm drainage outlets, on the more erodible portions of the side slopes of the levee, and on areas of pedestrian, bike and vehicular traffic. For the levee and drainage structures, these measures would include strategically located surface and sub-surface armoring. For access ways, the travel way surfaces would include compacted soil, gravel, decomposed granite, asphalt, concrete, or other appropriate surface material depending on the intended use.

III. Establishment Periods, Implementation, and Phasing

Construction will occur over an extended period of time, and in multiple phases and sequences. Temporary erosion control measures will be utilized prior to and during all construction activities, and will be implemented between construction sequences during the life of the project construction. Phasing and sequencing of project elements have been described in other areas of the analysis. Specific sequencing and sub phasing will be determined by the appropriate agencies, design team, and contractor prior to initiation of construction. Flexibility to adjust sub phasing is expected within the perimeters within the impacts and mitigations proposed.

Sufficient time must be allowed to establish the plant palette to the point it is essentially considered self-sustaining. During this establishment period, weekly, monthly, and seasonal evaluation and maintenance will be required.

IV. Operations and Maintenance

Erosion protection measures during construction and establishment periods will be an ongoing effort. After an initial mobilization and installation effort of providing the materials, there will be a constant effort to minimize the amount of erosion and sediment escape from the property. The initial effort will include installation of truck access BMP's including wheel washing areas, silt fencing and slope protection installation around the edge of the property and adjacent to all public roadways and drainage inlets. Installation of silt fencing and other surface erosion protection will not be required within the property except in localized cases. However, dust control measures throughout the property will be required and ongoing.

Ongoing maintenance during grading will include three primary efforts, dust control by deployment of water trucks, maintenance of the perimeter and local structure containment protection, and vehicular access point cleaning operations. Because the soil is generally in a moist or wet condition it is

anticipated that dust control can be accomplish with one water truck and its operator working constantly on a daily basis. However, multiple water trucks may be necessary during peak times and during particularly dry conditions. In addition, on a daily basis another truck and maintenance crew of two people will be utilized to inspect and repair any broken or missing erosion protection equipment or material. Operation of the wheel wash and access areas will require an average of a two person crew at each access location. During transfer of soils between areas, an access control station must be provided in each area. After grading is completed in any particular area, erosion protection will applied to the entire completed area and then inspected and maintained through the plant establishment period. It is anticipated that a crew of four people and one truck will be required for the duration of the plant establishment period.

After the construction and the plant establishment period is complete, the goal is that erosion protection will be accomplished through the natural plant palette in a self-sustaining manner. However, regular inspections and sporadic maintenance is expected.

V. Project Specific Storm Water Management Elements

a. Existing and Proposed Storm Water BMP's

There are a number of existing storm water mitigation features serving the property that will remain or be enhanced as shown on Figures 1 and 2. These include the Fresh Water Marsh, a detention basin in the Culver-Lincoln roadway loop, and a series of depressed areas that act as pre-treatment basins along an old, degraded drainage ditch along the toe of the Westchester Bluffs where a number of low areas exist. The Fresh Water Marsh will remain essentially as is with minor improvements to add additional storage controls. The detention basin in the roadway loop will remain as is. And, the historic drainage ditch will be enhanced with some grading and connectivity for drainage which will reduce the likelihood of erosion.

Proposed BMP's will include bio-swales, pre-treatment basins, discussed below, together with storm drain piping and detention basins. These proposed BMP's are presented on Figures 3 through 6 with details presented on Figures 7 through 13.

b. Bio-Swales

Bio-swales are placed throughout the project in order to serve erosion protection, water quality, and drainage routing functions. Bio-swales will vary in width from approximately three feet to twenty feet, and in depth from a few inches to two feet, Figure 12. Bio-swales will be place at the toes of all slopes greater than a ratio of 10 to 1 horizontal to vertical to collect storm water runoff from the slope face. When the volume of runoff is minor and does not need to be routed to a detention area or conveyance feature, the bio-swale will be sized to contain the volume anticipated for a 100-year storm event. In these cases, the bio-swale may have some minor longitudinal slope but acts more as a detention feature. For Larger volumes and when bio-swales act to convey storm water from the slope to a conveyance, treatment, or storage feature, the bio-swale will be designed to contain the flow and protect against erosion. Longitudinal slope will be very shallow, generally less than one percent. Bio-swales will also

be utilized along the edges of existing roadways outside of public right-of-way to collect storm water runoff from the adjacent roadway. The additional enhancement to these bio-swales will include elements to address the oils and other vehicular fluids expected in this type of runoff. These elements may include a different mix of vegetation and soils composition to allow the breakdown of the expected runoff constituents without long term loss of vegetation or extra maintenance requirements.

c. Pre-Treatment Basins

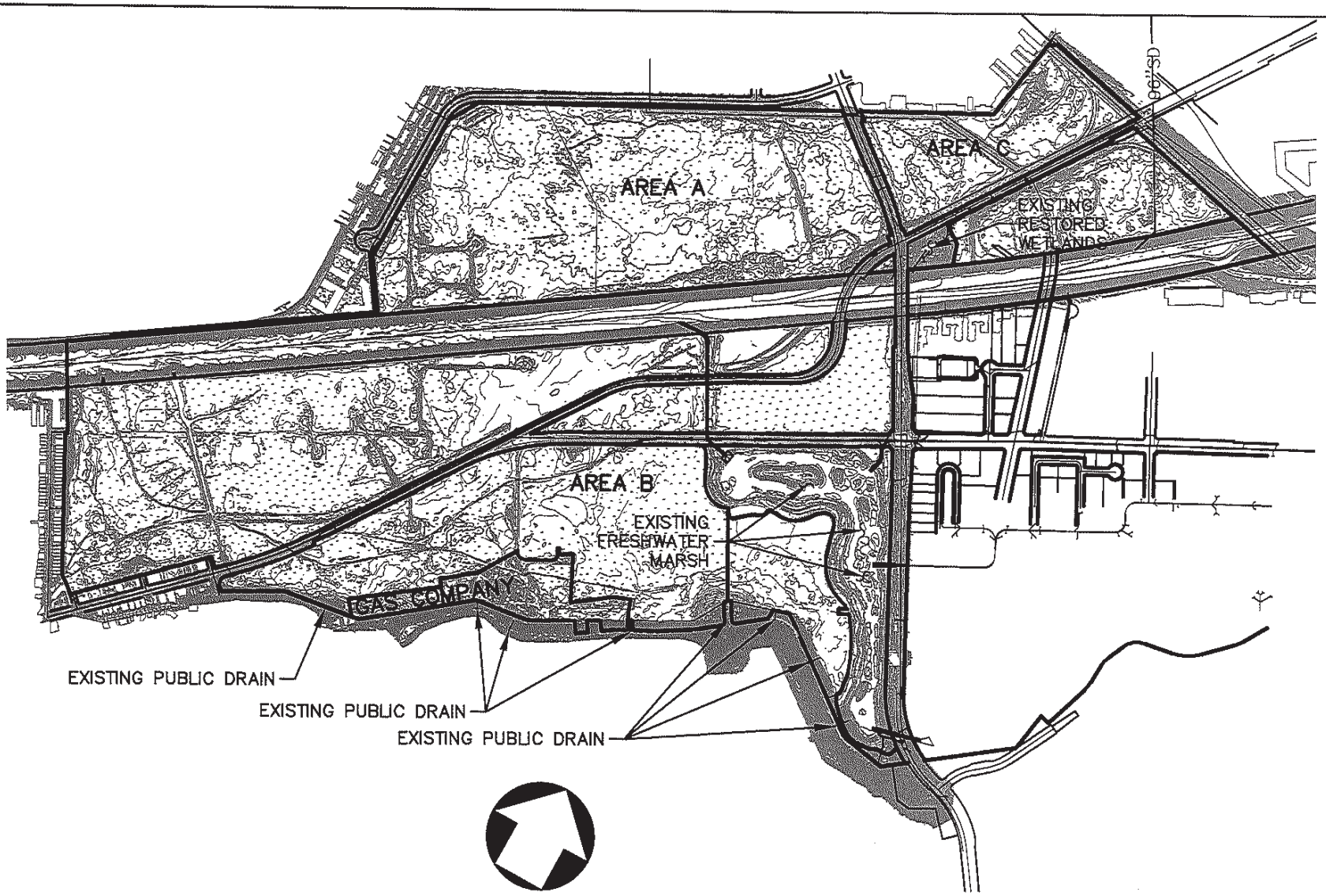
Pre-treatment basins are used throughout the project area where collection of storm water can be impacted by on-site or off-site pollutants and/or sediment runoff. These basins are intended to allow for settlement of suspended solids and reduction of discharge of these solids from the project site. Pre-treatment basins will be provided to mitigate runoff from each localized impervious on-site project feature, and sized and designed to accommodate the pollutants and runoff volume expected. Larger pre-treatment basins for some off-site runoff will also be provided as appropriate. Examples of these include a pre-treatment basin for the Beaches and Harbors parking lot in west Area A, for the existing parking lot on the west edge of Area B (adjacent to Gordon's Market), and for local existing storm drains discharging onto the south edge of Area B along the Westchester Bluffs. In addition, a large pre-treatment basin and detention basin system will be provided at an existing storm drain discharge point in west Area B immediately north of Nicholson Street. For this basin system, in addition to the storm water quality function that all pre-treatment basins provide, this basin system also serves a peak attenuation and volume storage function the 100-year storm event to mitigate an existing flooding situation for the developed properties south and west of the discharge point. Also, another type of pre-treatment basin will be incorporated adjacent to the main channel design to mitigate the minor sediment losses that may be expected from the project uplands areas in Area A where the channel has been realigned. Detention for the Pershing Drain overflow has been calculated at 1.8 acre-feet for the 100-year event. Listing of pre-treatment basins for Area B are shown in Table 1. Volume calculations for the proposed pre-treatment basins are shown in Appendix A with specific detail sheets located in Appendix B.

Basin Number	1 year Storage Volume
3A	0.1386 acre-feet
11D	0.0358 acre-feet
13E	0.0543 acre-feet
15D	0.0922 acre-feet
15C	0.8937 acre-feet
18C	1.3522 acre feet
14B	0.7989 acre feet

Table 1 – Area B Pre-Treatment Basins

d. Re-vegetation Program

A major component of permanent erosion protection and water quality treatment is in the elimination of constituents of concern through bio-uptake. In the natural environment almost all nutrients and heavy metals are used by plants for growth and production. The Ballona Restoration project will provide a natural plant pallet that not only restores habitat, but as a secondary benefit provides water quality treatment through the most natural methodology.



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Existing Stormwater BMPs Figure 1

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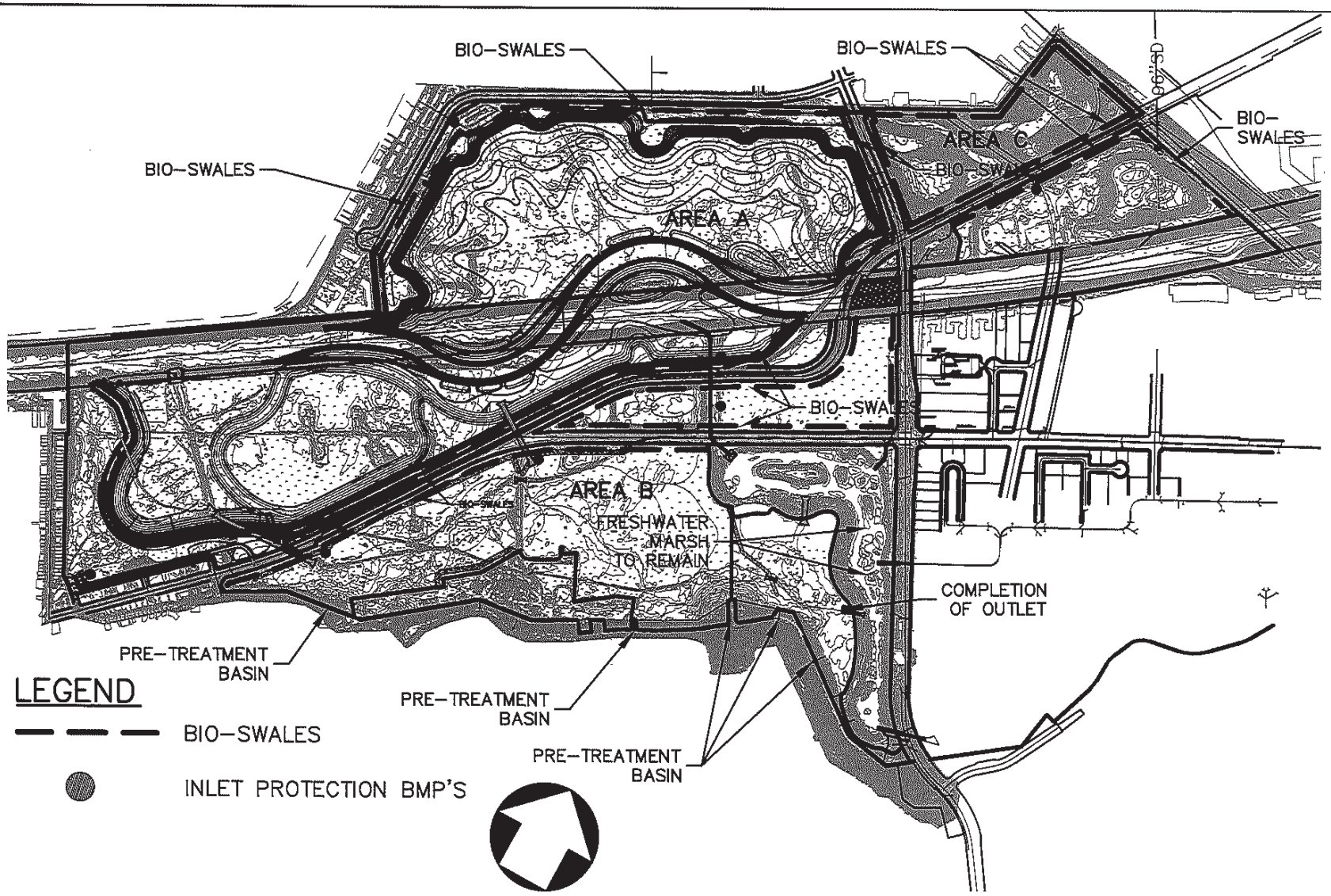

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Proposed Stormwater BMPs Figure 2

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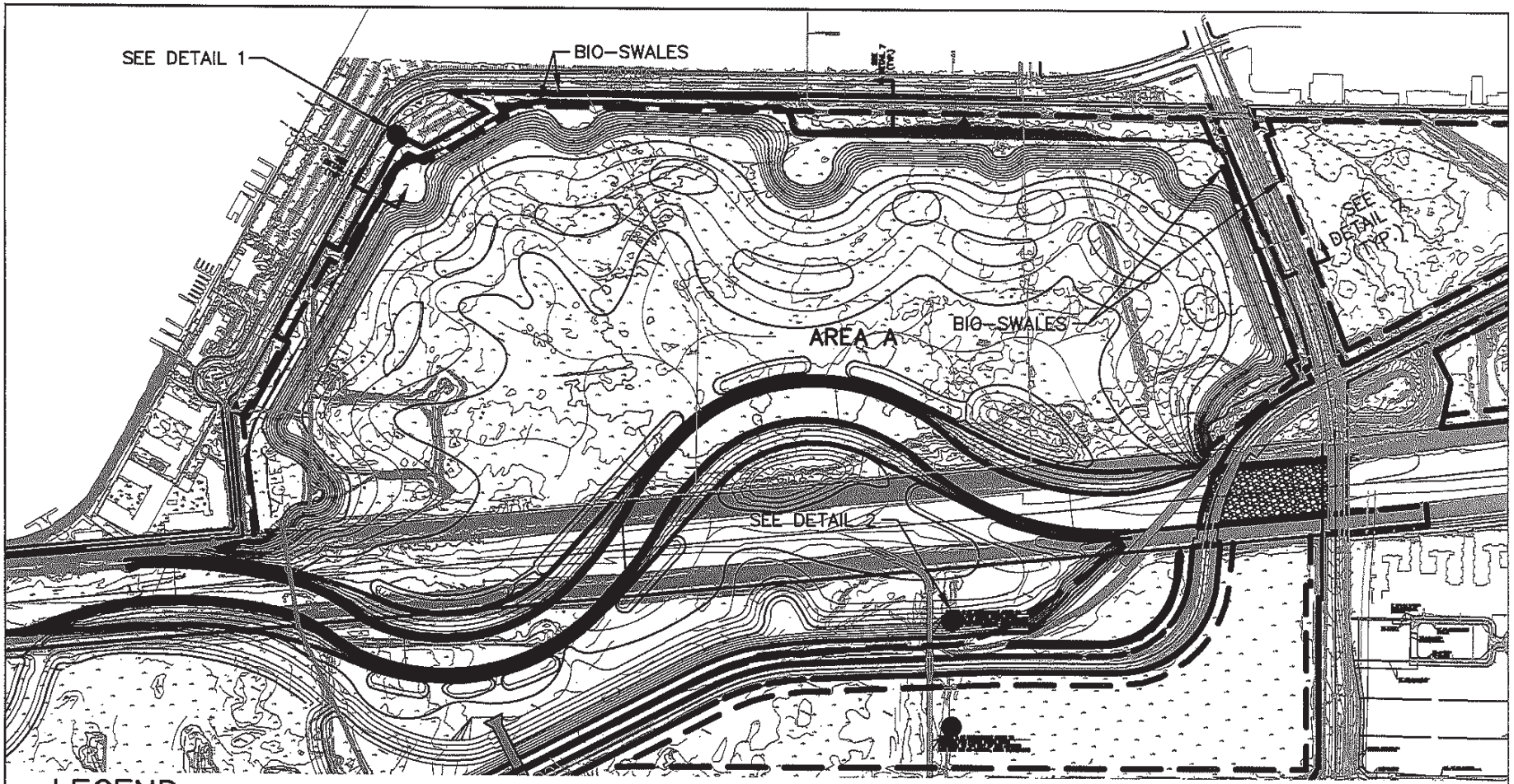

LEGEND

BIO-SWALES

INLET PROTECTION BMP'S

600' 300' 0' 600' 1200'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

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Area A
Stormwater BMPs
Figure 3

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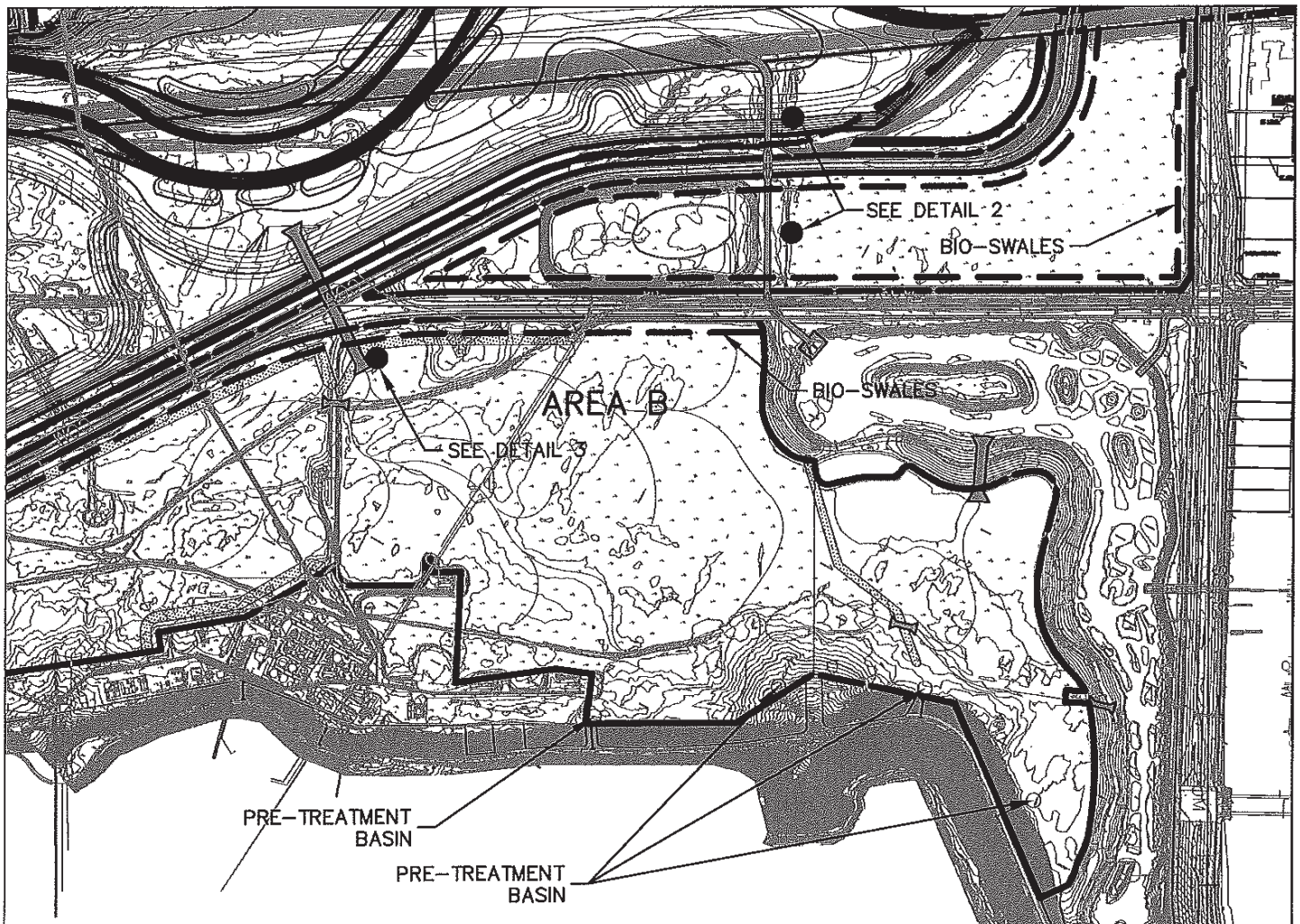

LEGEND

BIO-SWALES

INLET PROTECTION BMP'S

600' 300' 0' 600' 1200'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

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Area B-East & B-South Stormwater BMPs Figure 4

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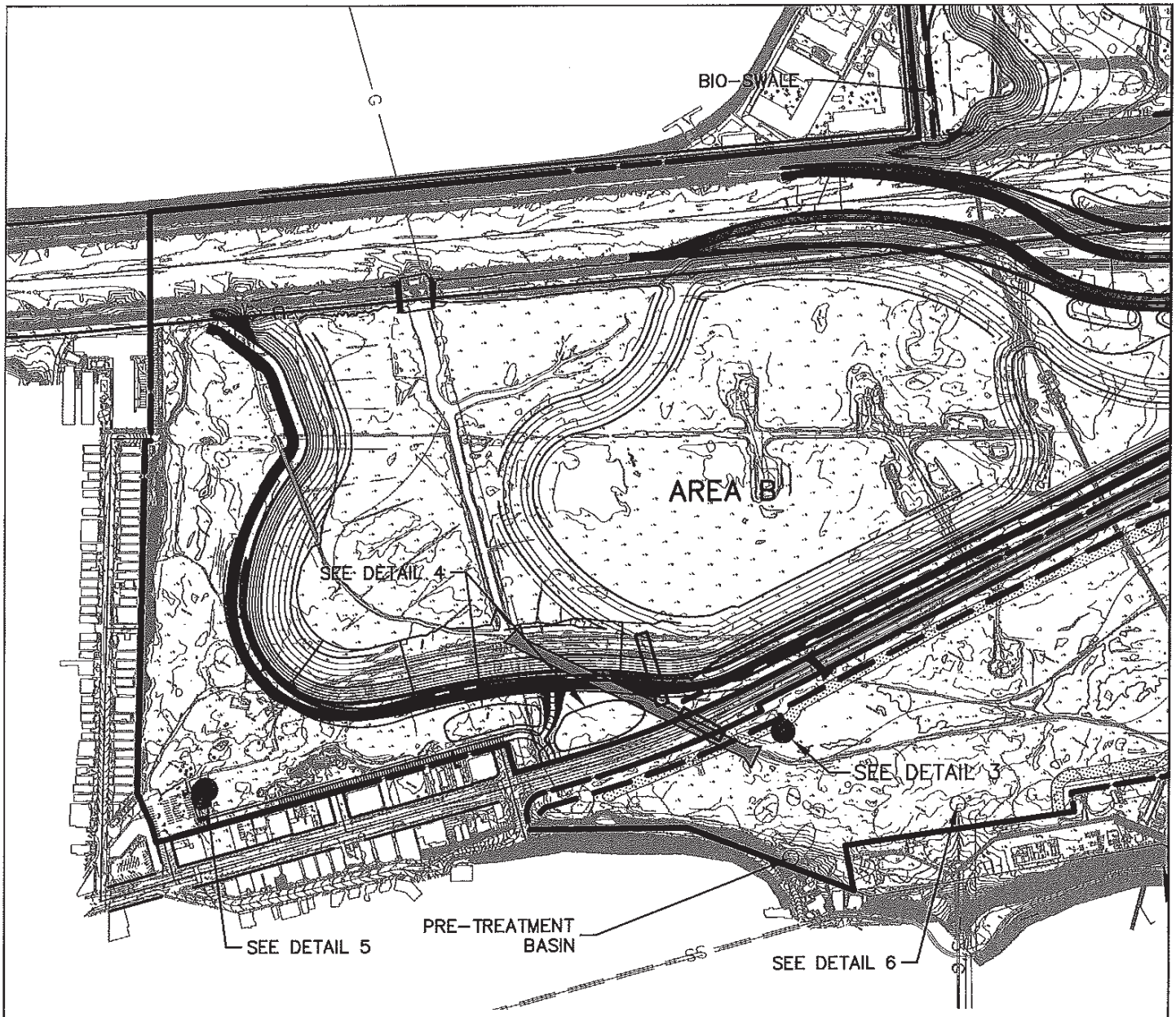

LEGEND

BIO-SWALES

INLET PROTECTION BMP'S

500' 250' 0' 500' 1000'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

CALIFORNIA COASTAL CONSERVANCY

Area B-West & B-South Stormwater BMPs Figure 5

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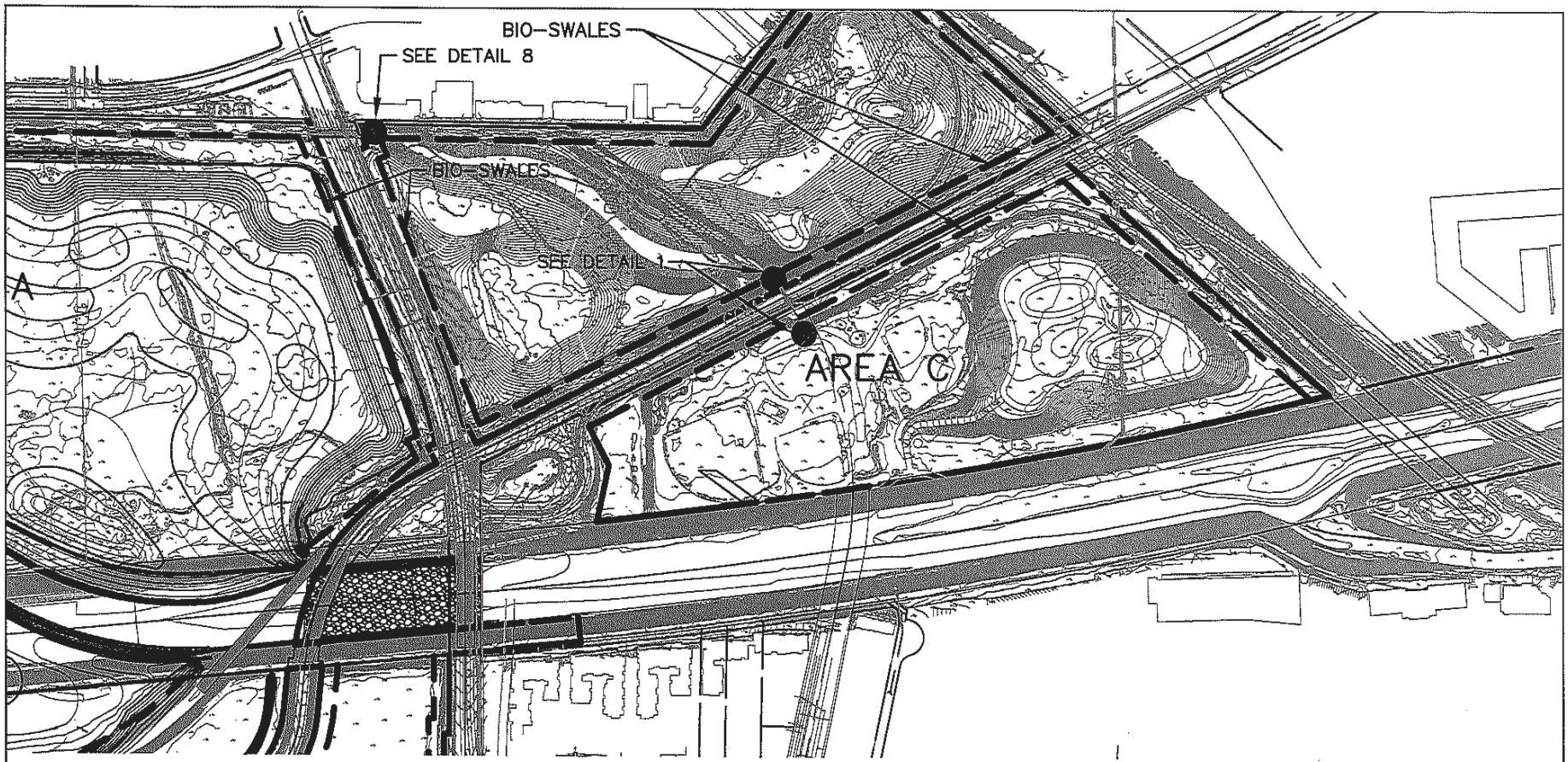

LEGEND

BIO-SWALES

INLET PROTECTION BMP'S

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GRAPHIC SCALE

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Area C

Figure 6

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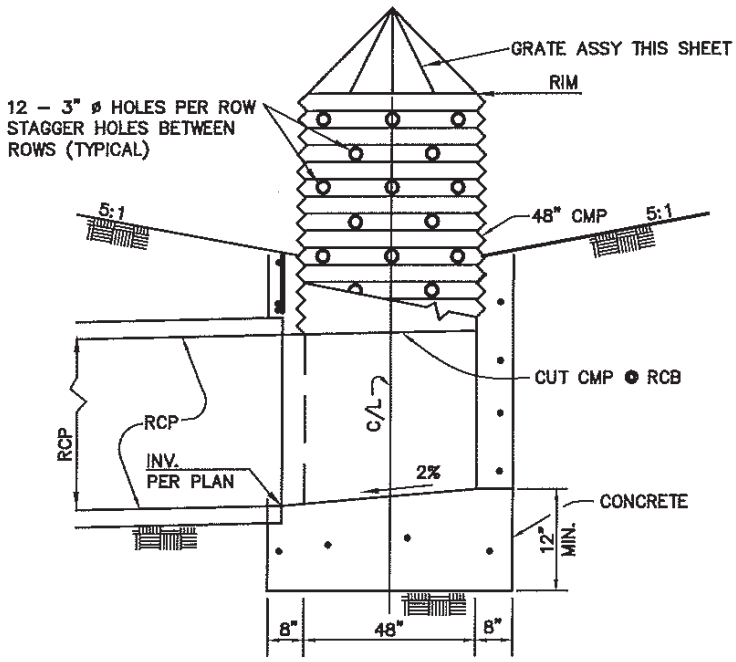

RISER AND OUTLET

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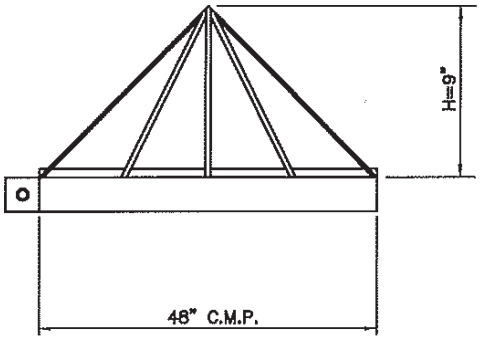

GRATE ASSEMBLY

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EXISTING DEBRIS RISER INLET DETAIL (2)

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Detail Sheet
Figure 7

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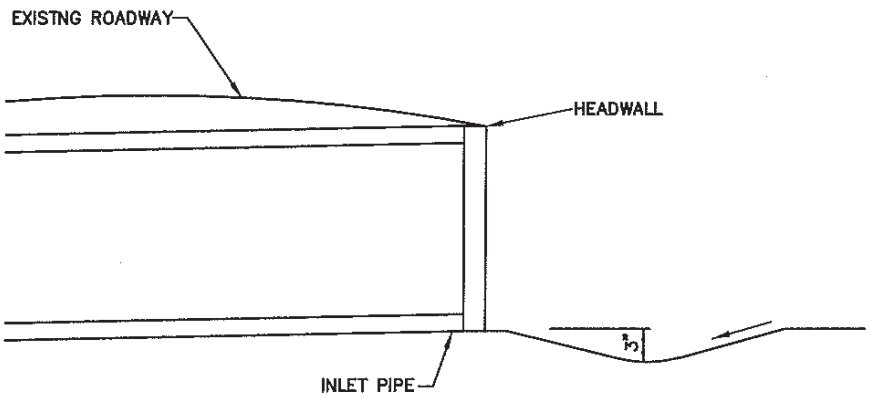

INLET PIPE CONTROL 3

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Detail Sheet
Figure 8

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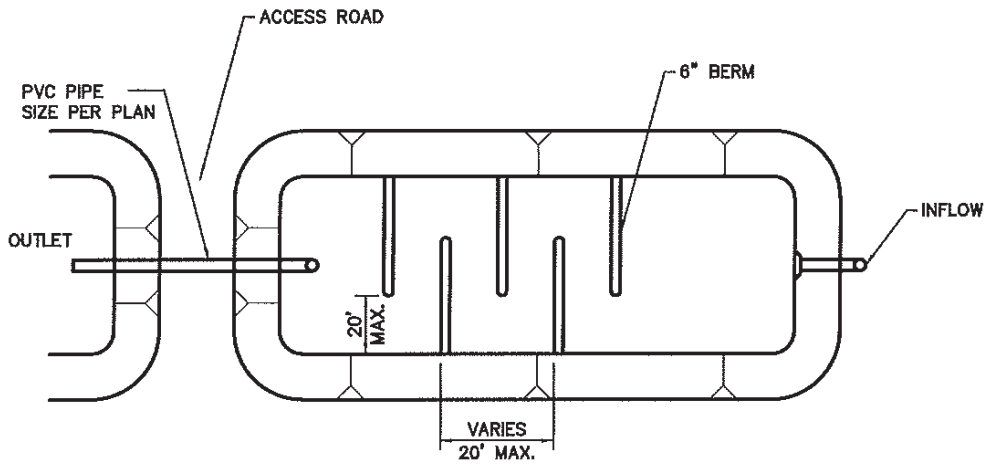
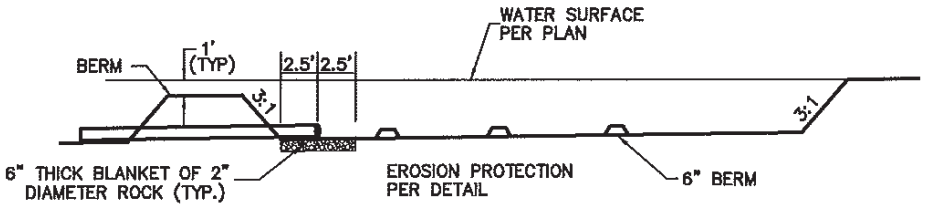


PLAN VIEW



RETENTION BASIN DETAIL 4

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Detail Sheet
Figure 9

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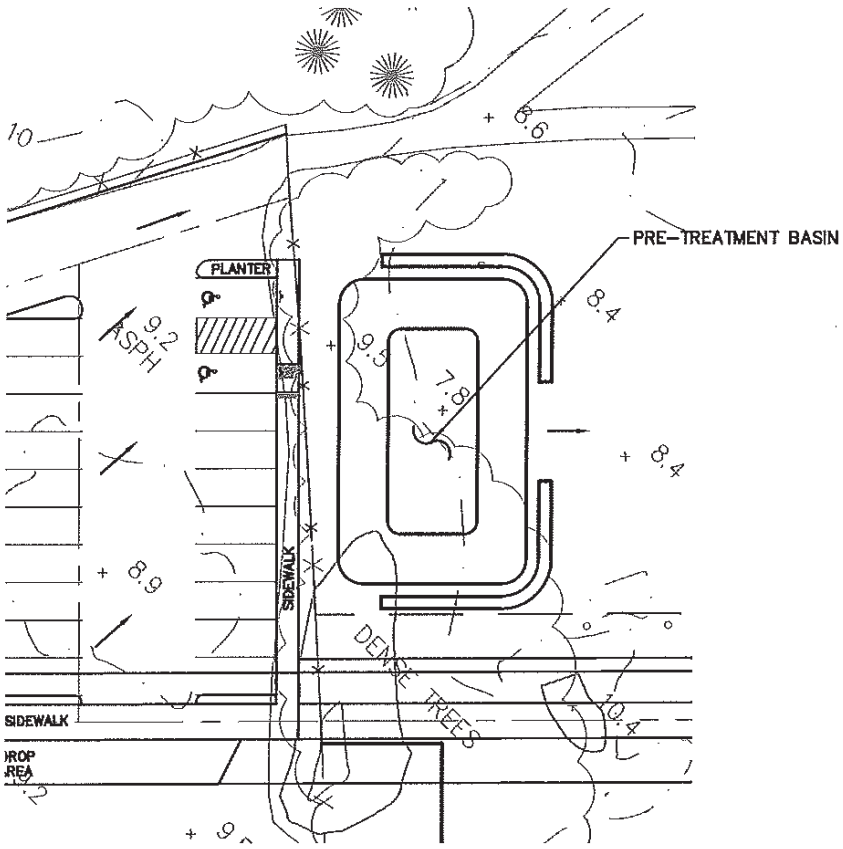
CALIFORNIA COASTAL CONSERVANCY



PARKING LOT PRE-TREATMENT BASIN (5)

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Detail Sheet
Figure 10

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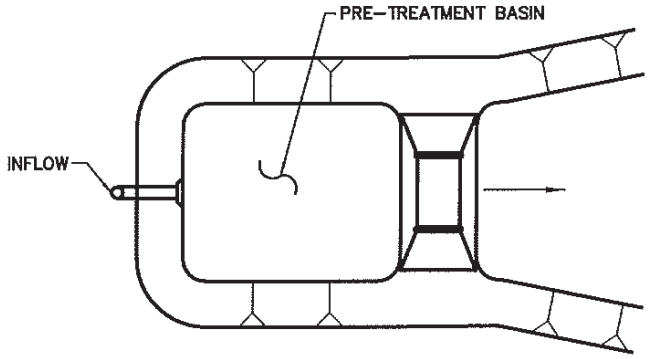
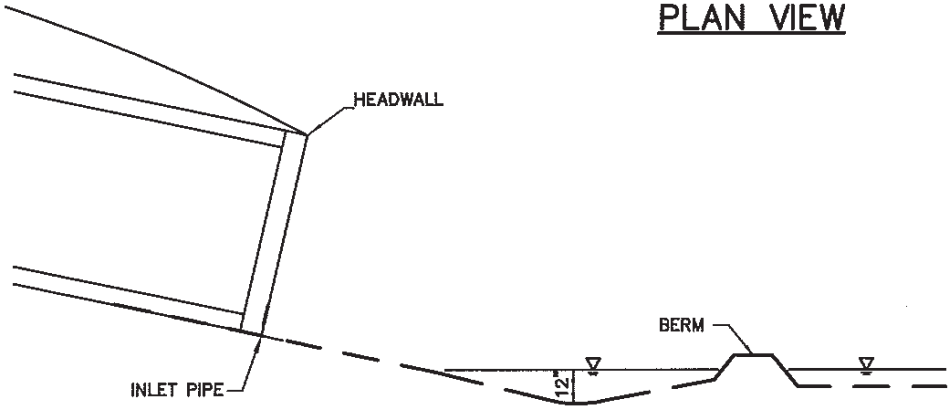
CALIFORNIA COASTAL CONSERVANCY



PLAN VIEW



HILLSIDE DR – PRE-TREATMENT BASIN (6)

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Figure 11

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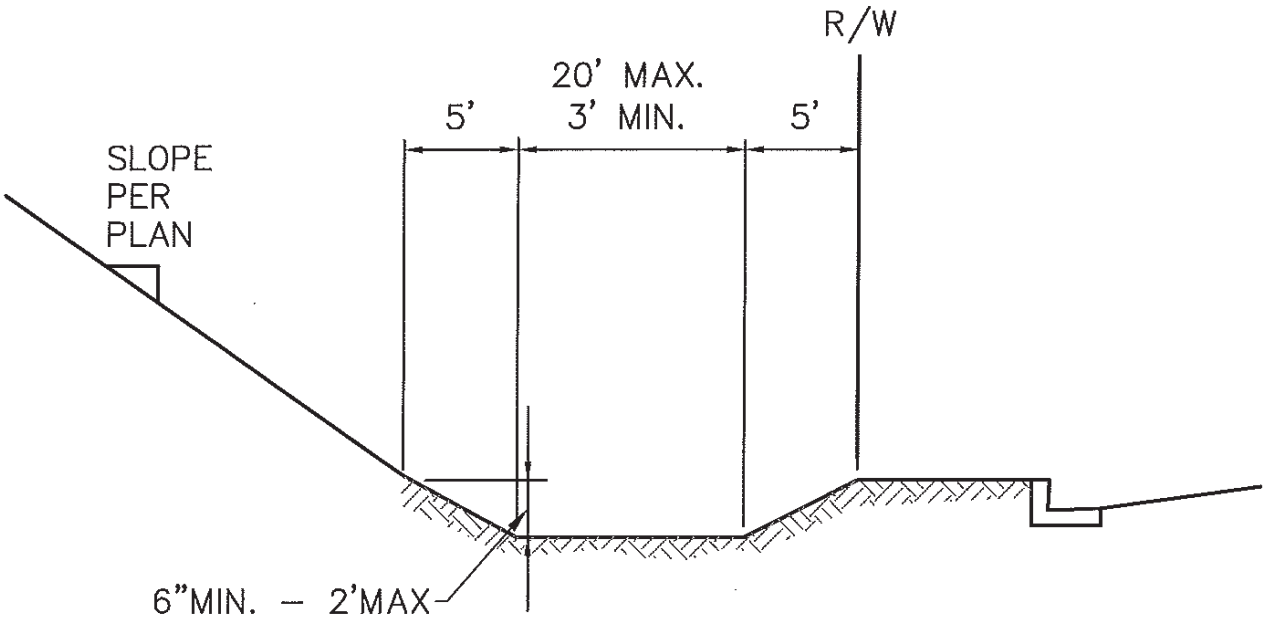
CALIFORNIA COASTAL CONSERVANCY



BIO-SWALE DETAIL (7)

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Figure 12

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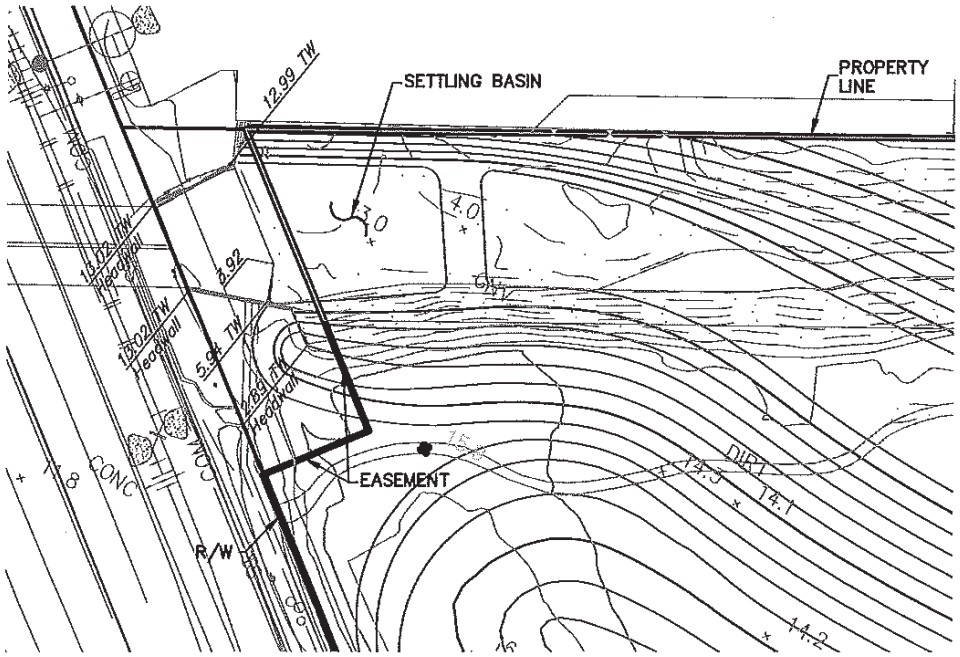
CALIFORNIA COASTAL CONSERVANCY



FIJI DITCH SETTLING BASIN

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8

Detail Sheet
Figure 13

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APPENDIX A

Peak Flow Hydrologic Analysis

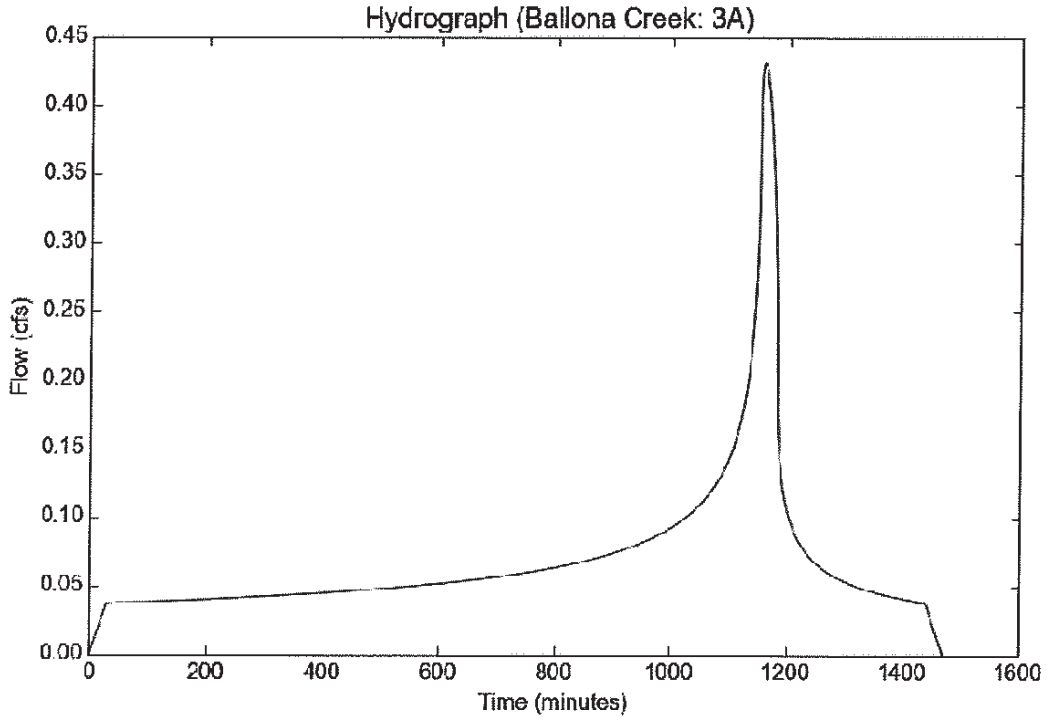
File location: C:/Steve/Psomas Projects/Ballona/Storage Calculations/Ballona Creek - 3A - 1-yr.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Ballona Creek
Subarea ID	3A
Area (ac)	5.3
Flow Path Length (ft)	958.0
Flow Path Slope (vft/hft)	0.1
50-yr Rainfall Depth (in)	6.5
Percent Impervious	0.09
Soil Type	10
Design Storm Frequency	1-yr
Fire Factor	0
LID	False

Output Results

Modeled (1-yr) Rainfall Depth (in)	1.8395
Peak Intensity (in/hr)	0.4728
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.172
Time of Concentration (min)	30.0
Clear Peak Flow Rate (cfs)	0.431
Burned Peak Flow Rate (cfs)	0.431
24-Hr Clear Runoff Volume (ac-ft)	0.1386
24-Hr Clear Runoff Volume (cu-ft)	6036.8668



Peak Flow Hydrologic Analysis

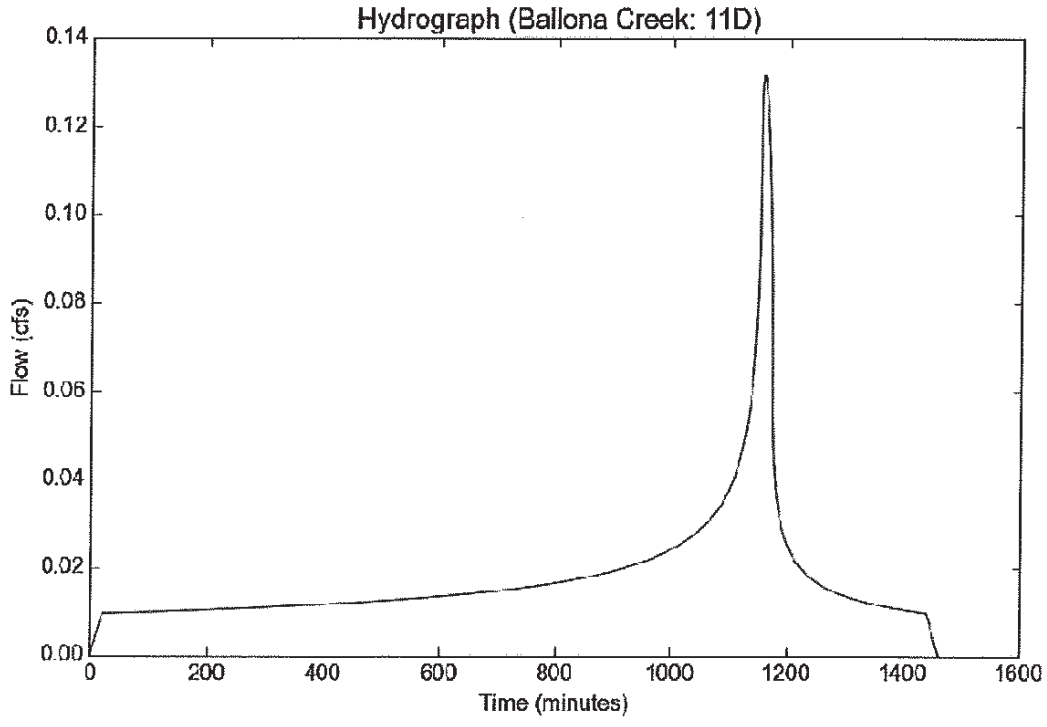
File location: C:/Steve/Psomas Projects/Ballona/Storage Calculations/Ballona Creek - 11D.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Ballona Creek
Subarea ID	11D
Area (ac)	1.2
Flow Path Length (ft)	395.0
Flow Path Slope (vft/hft)	0.242
50-yr Rainfall Depth (in)	6.5
Percent Impervious	0.12
Soil Type	10
Design Storm Frequency	1-yr
Fire Factor	0
LID	False

Output Results

Modeled (1-yr) Rainfall Depth (in)	1.8395
Peak Intensity (in/hr)	0.5591
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.196
Time of Concentration (min)	21.0
Clear Peak Flow Rate (cfs)	0.1315
Burned Peak Flow Rate (cfs)	0.1315
24-Hr Clear Runoff Volume (ac-ft)	0.0358
24-Hr Clear Runoff Volume (cu-ft)	1557.5502



Peak Flow Hydrologic Analysis

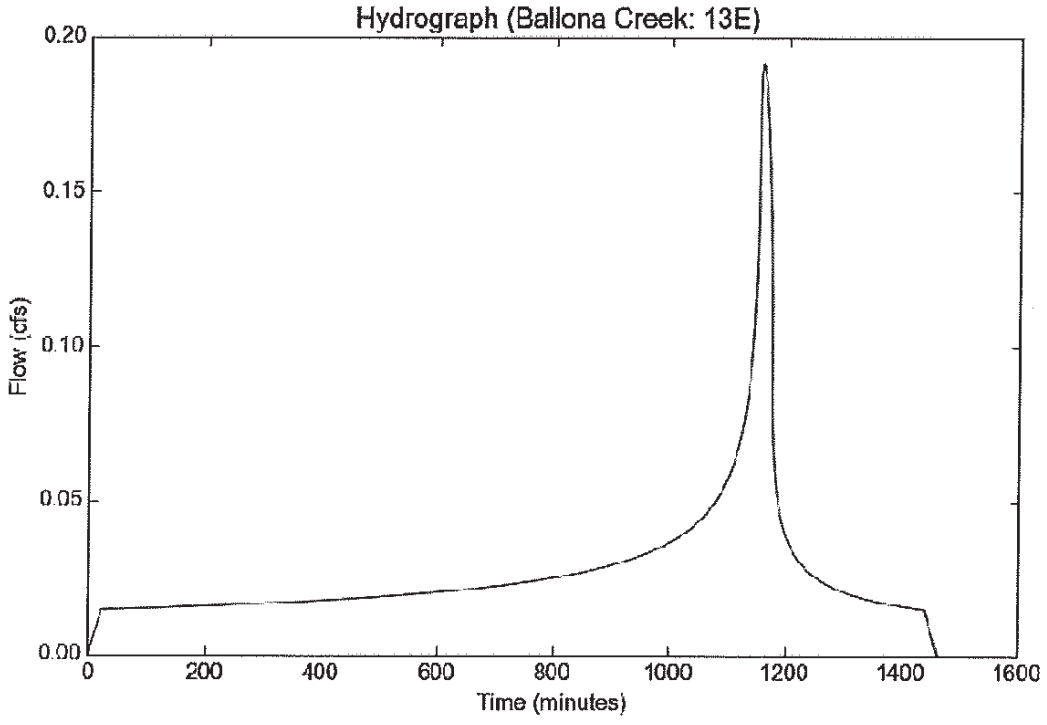
File location: C:/Steve/Psomas Projects/Ballona/Storage Calculations/Ballona Creek - 13E - 1-yr.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Ballona Creek
Subarea ID	13E
Area (ac)	1.9
Flow Path Length (ft)	406.0
Flow Path Slope (vft/hft)	0.219
50-yr Rainfall Depth (in)	6.5
Percent Impervious	0.11
Soil Type	10
Design Storm Frequency	1-yr
Fire Factor	0
LID	False

Output Results

Modeled (1-yr) Rainfall Depth (in)	1.8395
Peak Intensity (in/hr)	0.5357
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.188
Time of Concentration (min)	23.0
Clear Peak Flow Rate (cfs)	0.1913
Burned Peak Flow Rate (cfs)	0.1913
24-Hr Clear Runoff Volume (ac-ft)	0.0543
24-Hr Clear Runoff Volume (cu-ft)	2365.4657



Peak Flow Hydrologic Analysis

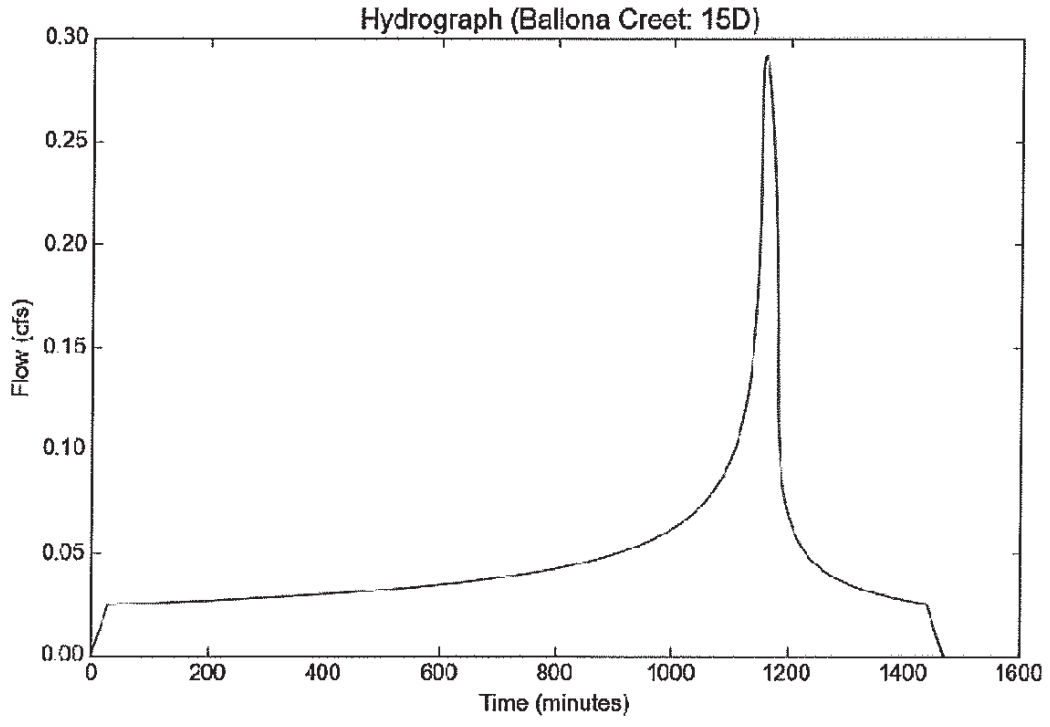
File location: W:/1CCC010100/ENGR/CALCS/Storage Calculations/Ballona Creek - 15D - 1-yr.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Ballona Creet
Subarea ID	15D
Area (ac)	3.7
Flow Path Length (ft)	494.0
Flow Path Slope (vft/hft)	0.177
50-yr Rainfall Depth (in)	6.5
Percent Impervious	0.08
Soil Type	10
Design Storm Frequency	1-yr
Fire Factor	0
LID	False

Output Results

Modeled (1-yr) Rainfall Depth (in)	1.8395
Peak Intensity (in/hr)	0.4804
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.164
Time of Concentration (min)	29.0
Clear Peak Flow Rate (cfs)	0.2915
Burned Peak Flow Rate (cfs)	0.2915
24-Hr Clear Runoff Volume (ac-ft)	0.0922
24-Hr Clear Runoff Volume (cu-ft)	4018.394



Peak Flow Hydrologic Analysis

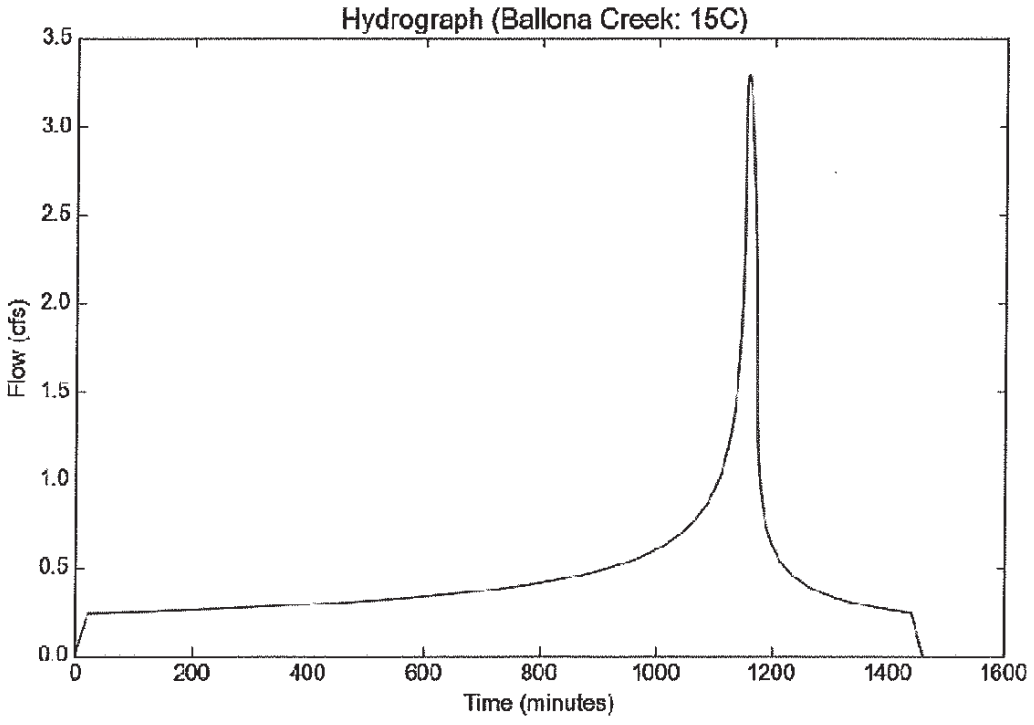
File location: C:/Steve/Psomas Projects/Ballona/Storage Calculations/Ballona Creek - 15C - 1-yr.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Ballona Creek
Subarea ID	15C
Area (ac)	7.1
Flow Path Length (ft)	774.0
Flow Path Slope (vft/hft)	0.013
50-yr Rainfall Depth (in)	6.5
Percent Impervious	0.91
Soil Type	10
Design Storm Frequency	1-yr
Fire Factor	0
LID	False

Output Results

Modeled (1-yr) Rainfall Depth (in)	1.8395
Peak Intensity (in/hr)	0.5591
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.828
Time of Concentration (min)	21.0
Clear Peak Flow Rate (cfs)	3.2867
Burned Peak Flow Rate (cfs)	3.2867
24-Hr Clear Runoff Volume (ac-ft)	0.8937
24-Hr Clear Runoff Volume (cu-ft)	38930.8071



Peak Flow Hydrologic Analysis

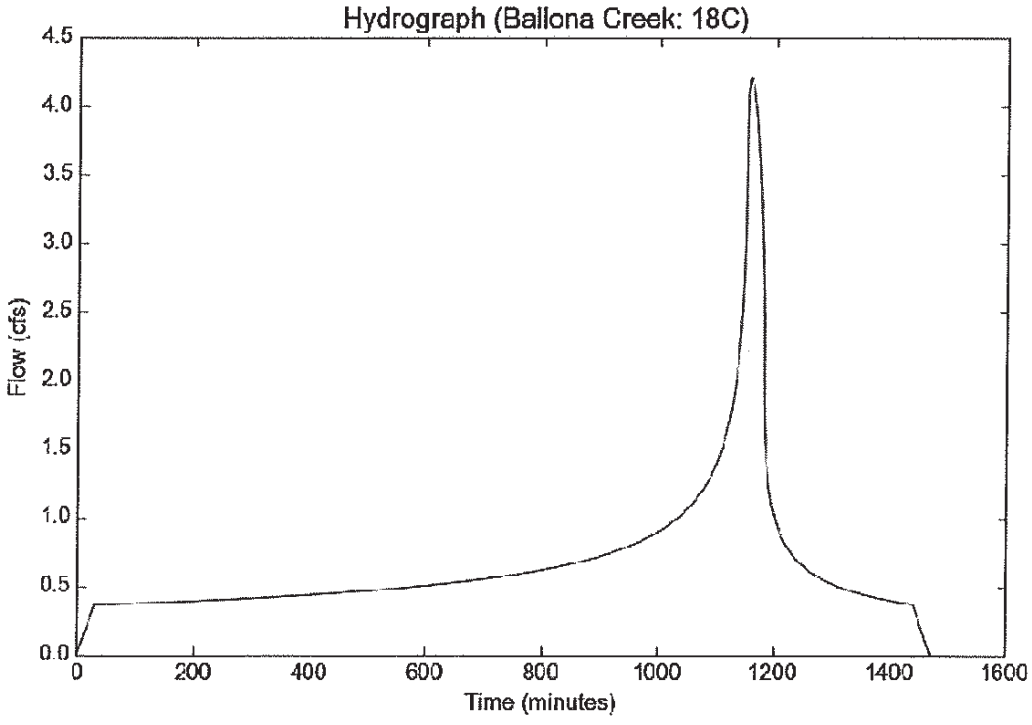
File location: C:/Steve/Psomas Projects/Ballona/Storage Calculations/Ballona Creek - 18C - 1-yr.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Ballona Creek
Subarea ID	18C
Area (ac)	20.4
Flow Path Length (ft)	1334.0
Flow Path Slope (vft/hft)	0.031
50-yr Rainfall Depth (in)	6.5
Percent Impervious	0.42
Soil Type	10
Design Storm Frequency	1-yr
Fire Factor	0
LID	False

Output Results

Modeled (1-yr) Rainfall Depth (in)	1.8395
Peak Intensity (in/hr)	0.4728
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.436
Time of Concentration (min)	30.0
Clear Peak Flow Rate (cfs)	4.2052
Burned Peak Flow Rate (cfs)	4.2052
24-Hr Clear Runoff Volume (ac-ft)	1.3522
24-Hr Clear Runoff Volume (cu-ft)	58901.1719



Peak Flow Hydrologic Analysis

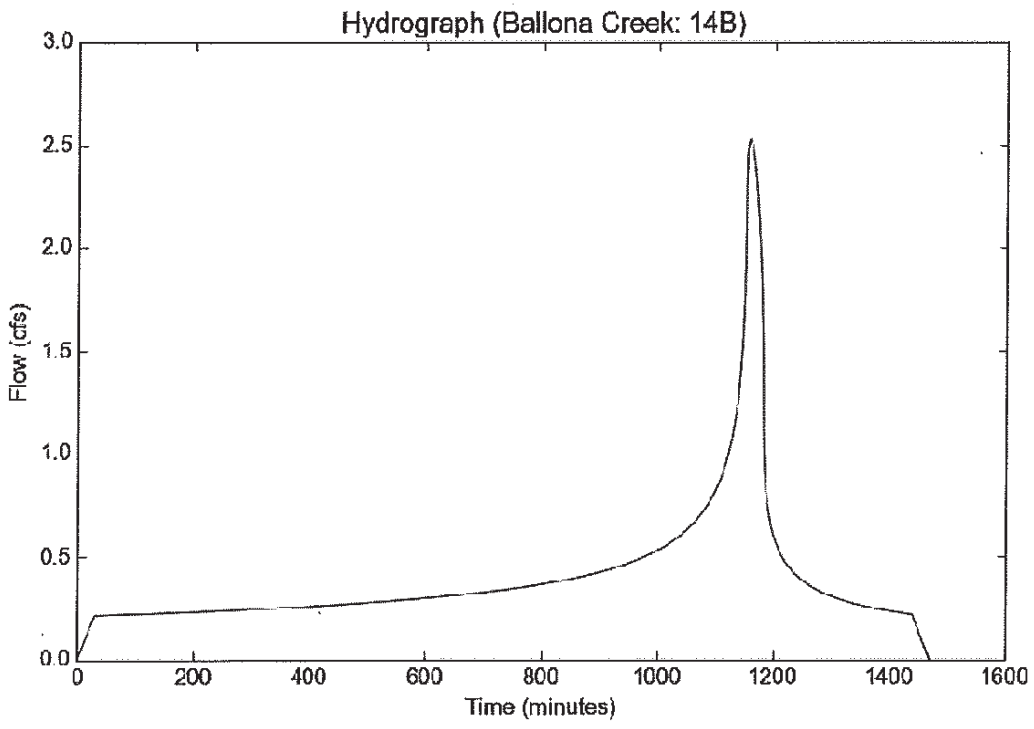
File location: W:/1CCC010100/ENGR/CALCS/Storage Calculations/Ballona Creek - 14B - 1-yr.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

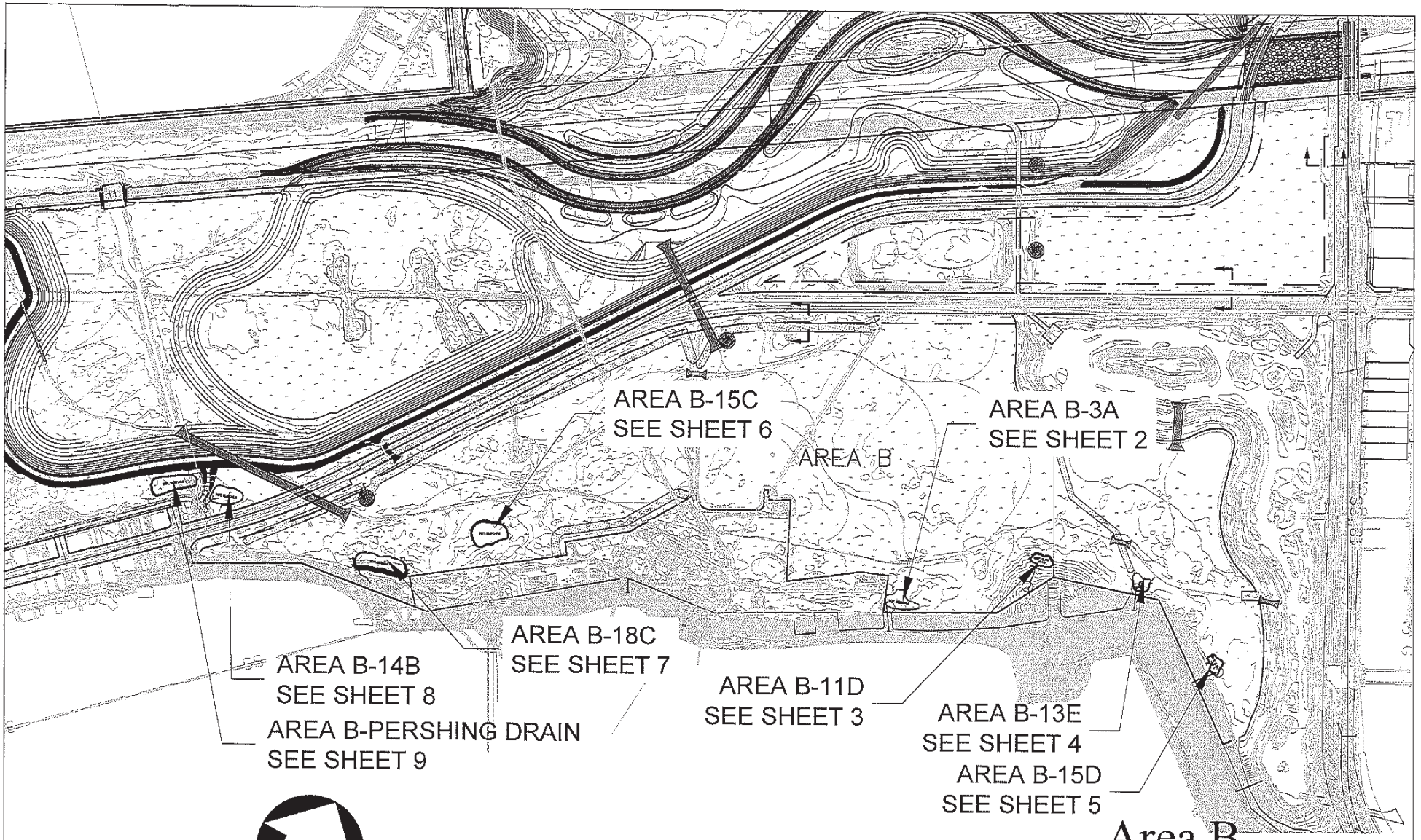
Project Name	Ballona Creek
Subarea ID	14B
Area (ac)	6.1
Flow Path Length (ft)	2043.0
Flow Path Slope (vft/hft)	0.001
50-yr Rainfall Depth (in)	6.5
Percent Impervious	0.95
Soil Type	17
Design Storm Frequency	1-yr
Fire Factor	0
LID	False

Output Results

Modeled (1-yr) Rainfall Depth (in)	1.8395
Peak Intensity (in/hr)	0.4728
Undeveloped Runoff Coefficient (Cu)	0.4151
Developed Runoff Coefficient (Cd)	0.8758
Time of Concentration (min)	30.0
Clear Peak Flow Rate (cfs)	2.5257
Burned Peak Flow Rate (cfs)	2.5257
24-Hr Clear Runoff Volume (ac-ft)	0.7989
24-Hr Clear Runoff Volume (cu-ft)	34798.2985



APPENDIX B



700' 350' 0' 700' 1400'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

Area B Grading Exhibit Index

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DATE: 05-21-15 REVISED ON: 06-11-15

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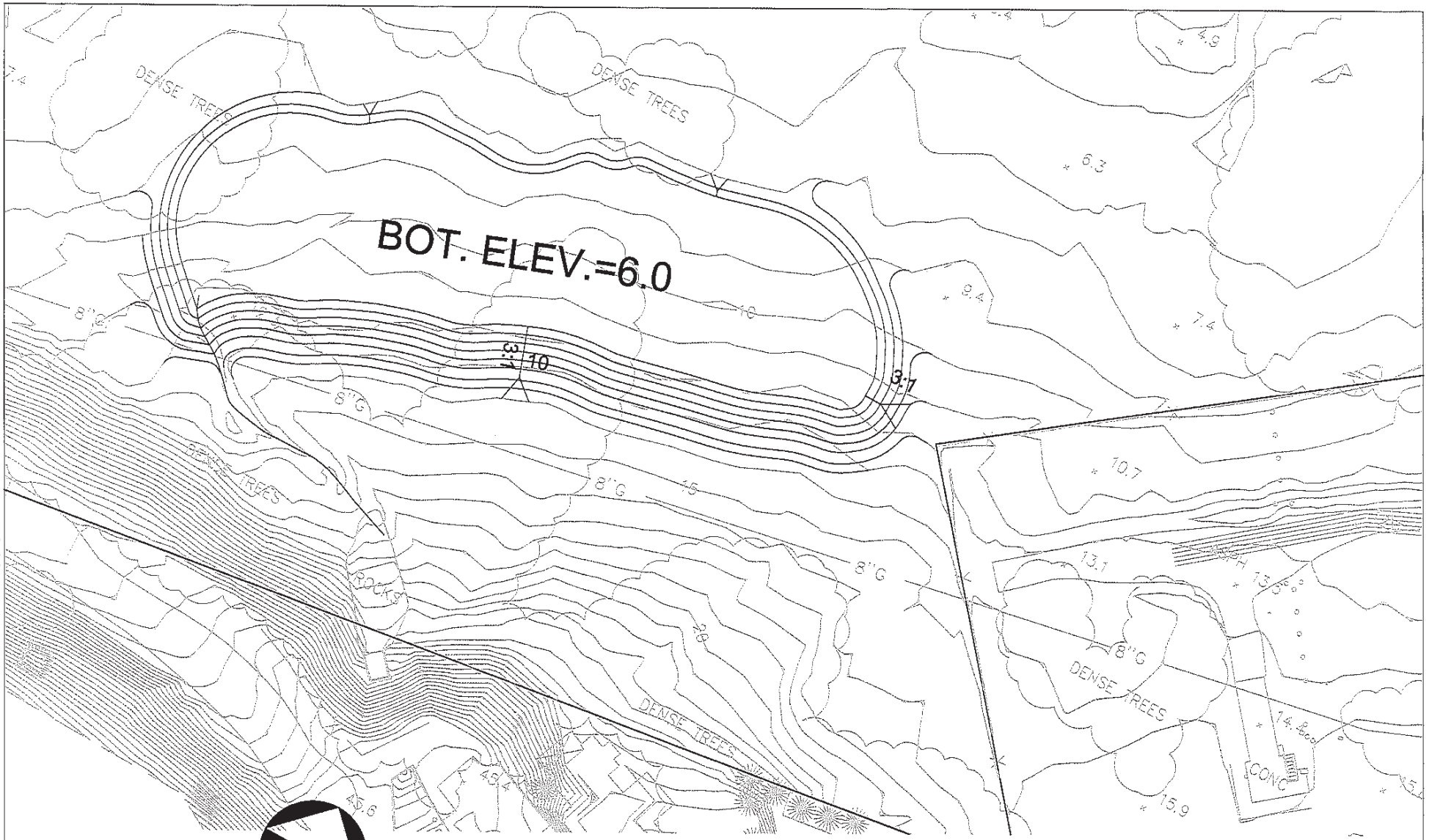
CALIFORNIA COASTAL CONSERVANCY



B2-32

500' 250' 0' 500' 1000'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

CALIFORNIA COASTAL CONSERVANCY

Area B-3A Grading Exhibit

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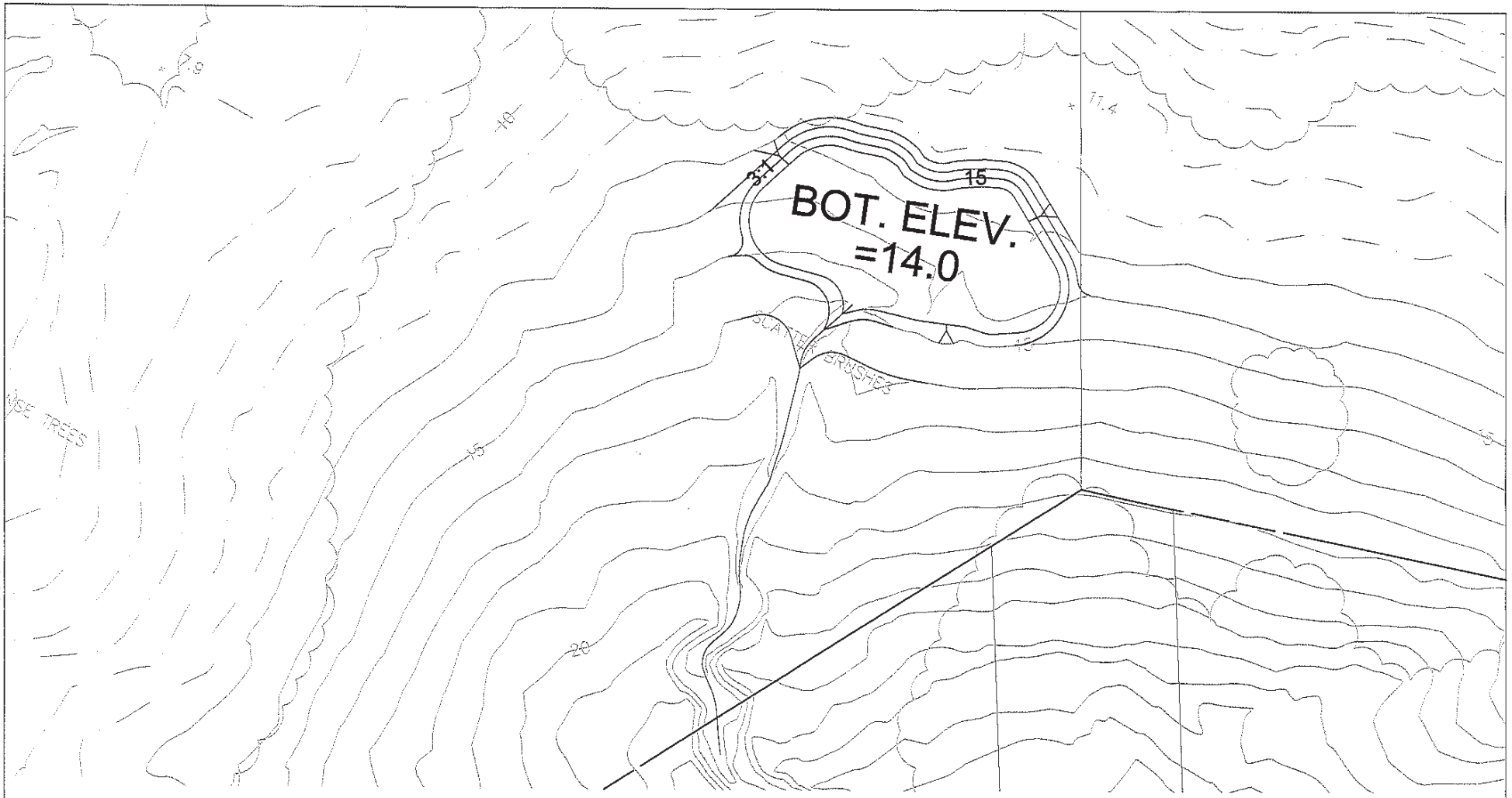

50' 25' 0' 50' 100'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

CALIFORNIA COASTAL CONSERVANCY

Area B-11D Grading Exhibit

PSOMAS

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JOB No:1CCC010100

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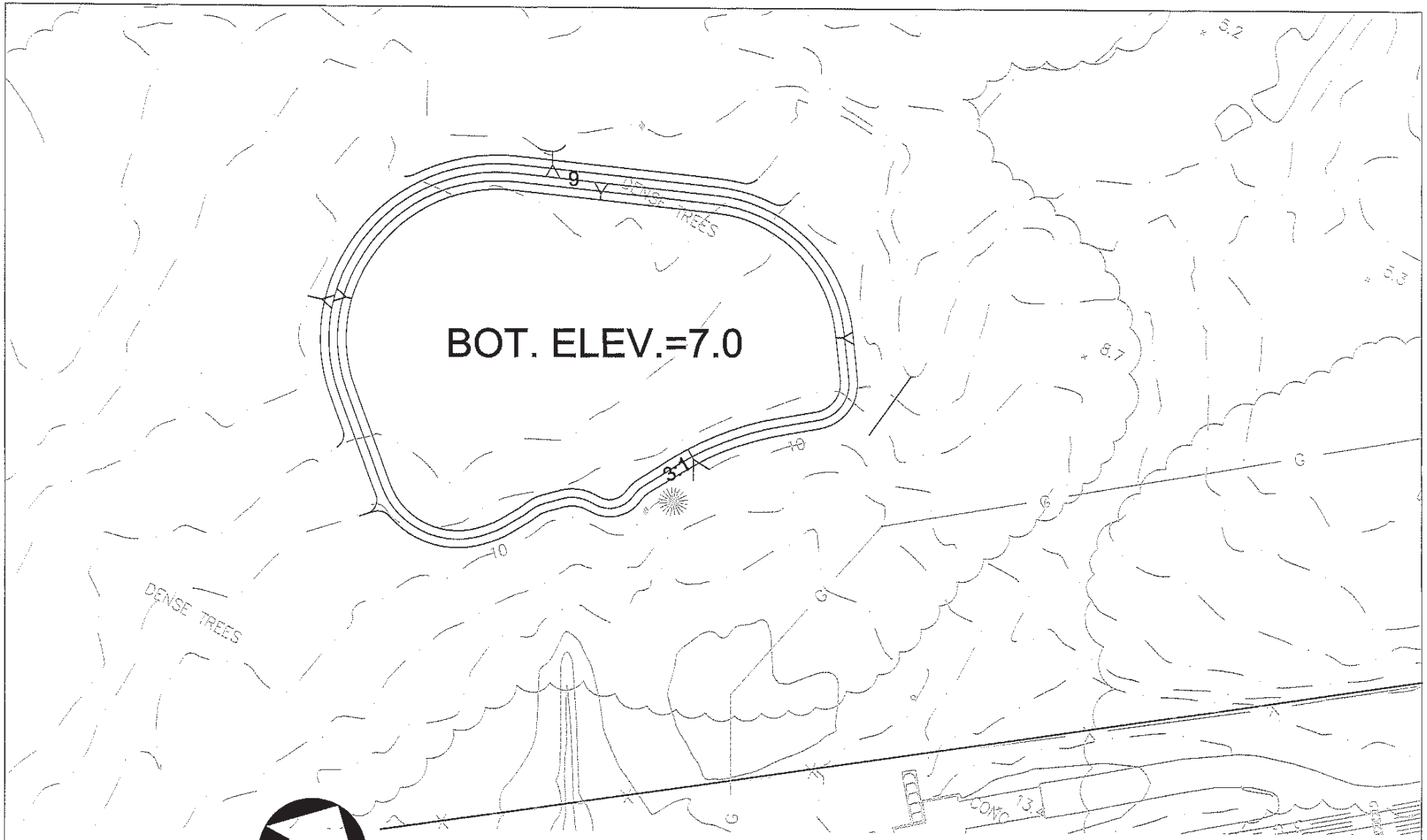
B2-33



Note: For reduced sized prints, original scale is in inches

Area B-13E Grading Exhibit

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CALIFORNIA COASTAL CONSERVANCY


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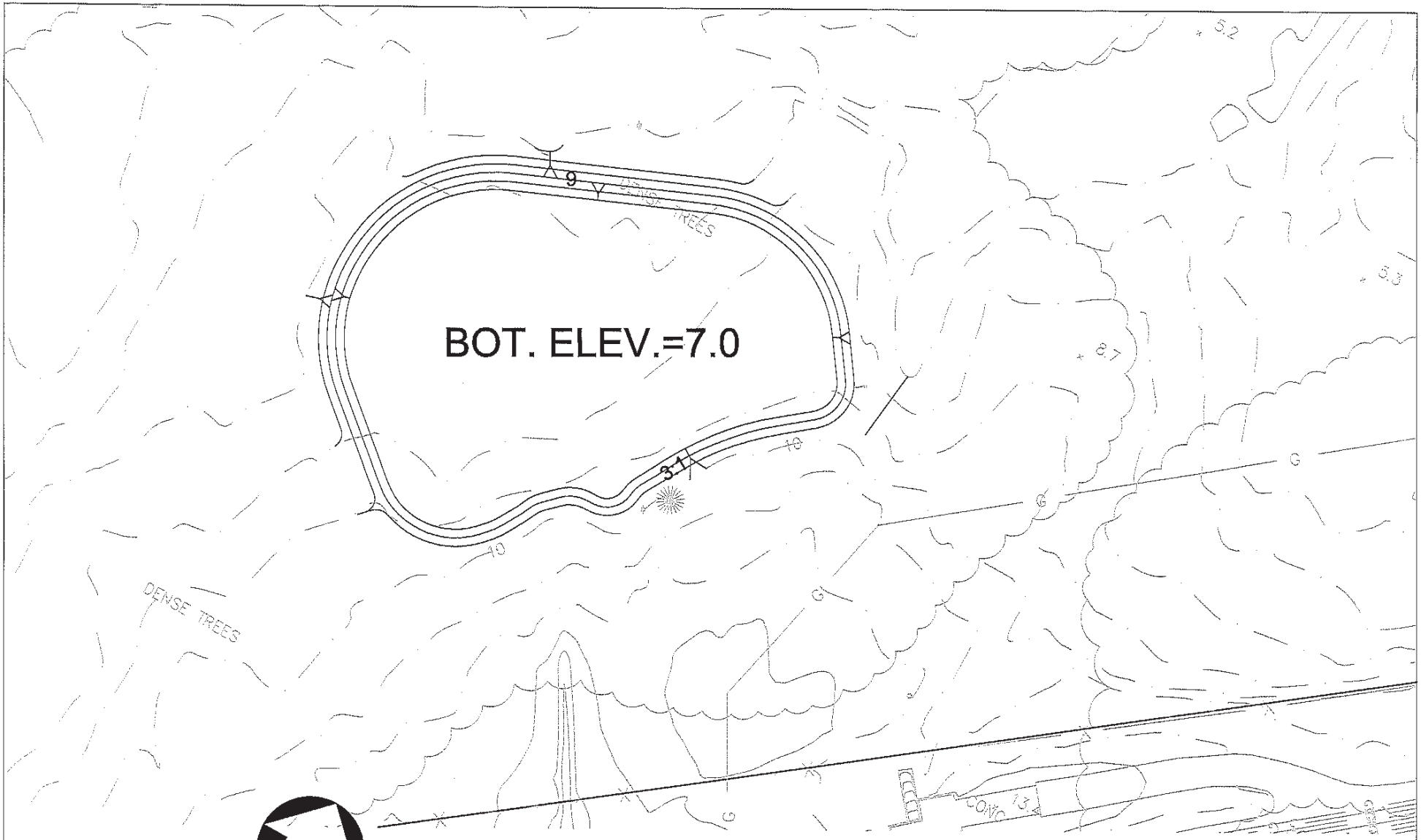

50' 25' 0' 50' 100'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

Area B-15C Grading Exhibit

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DATE: 05-21-15 REVISED ON: 06-11-15

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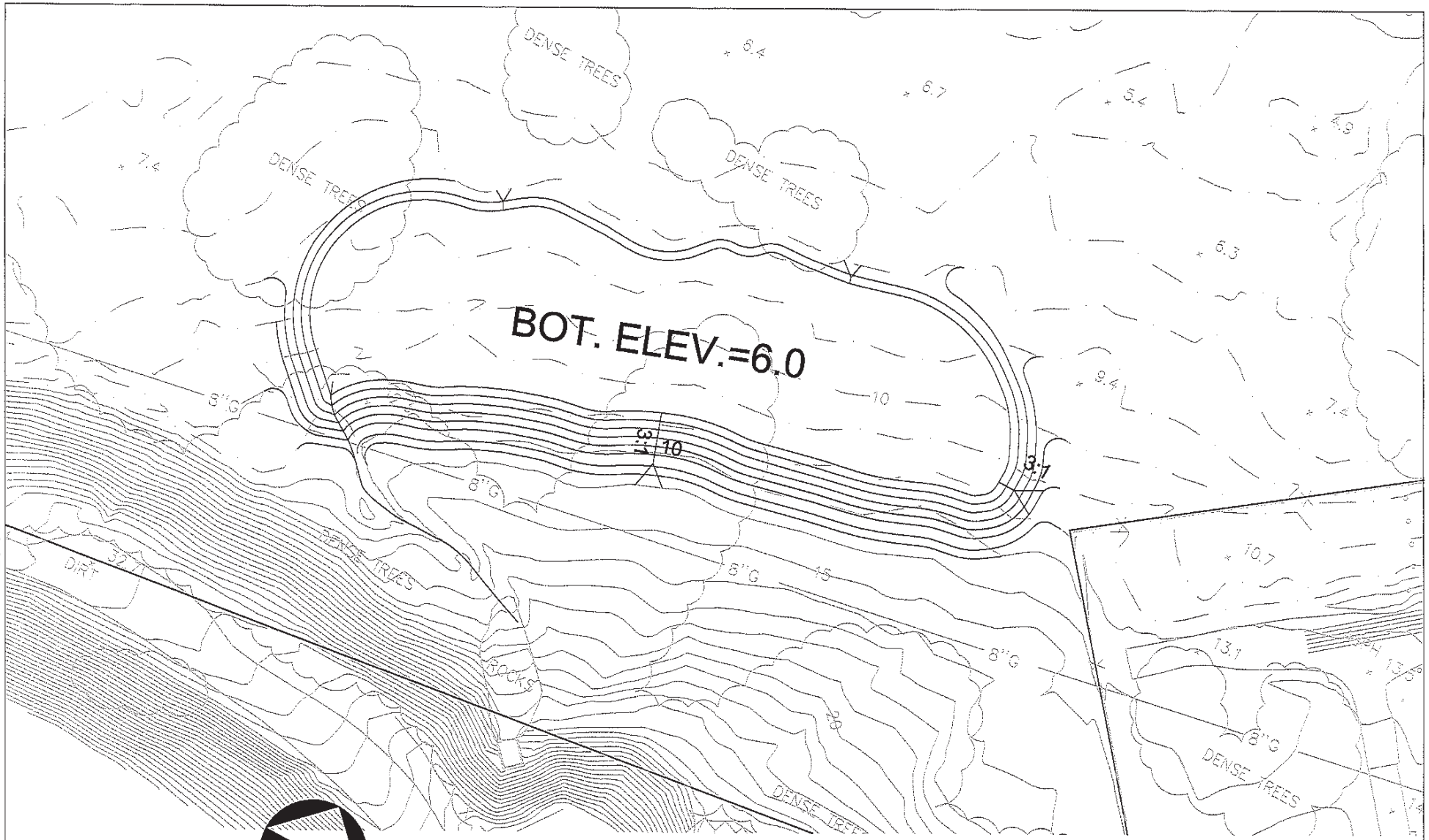
B2-36



50' 25' 0' 50' 100'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

Area B-18C Grading Exhibit

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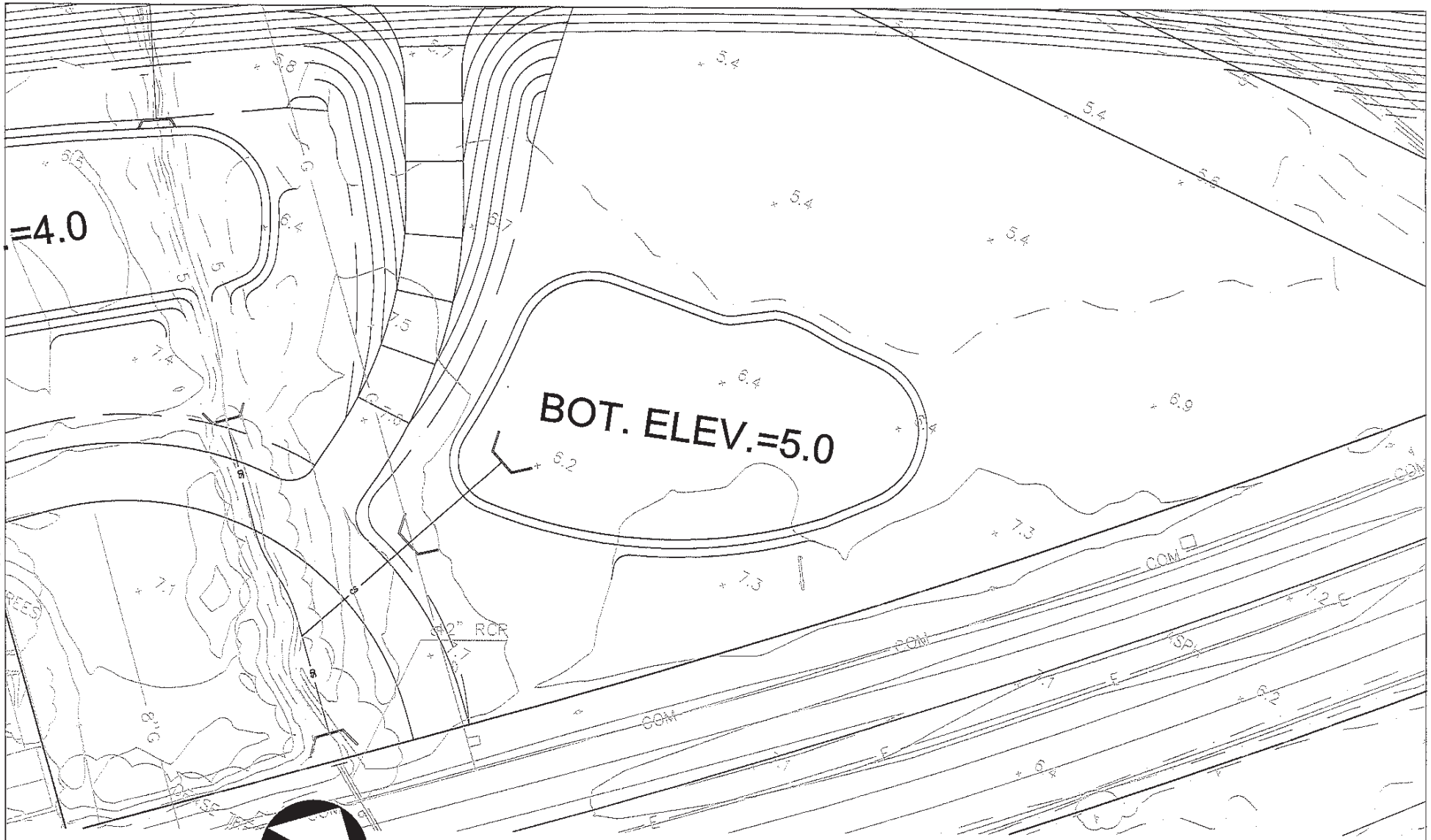
SHEET 7 OF 9



B2-38

Note: For reduced sized prints, original scale is in inches

Area B-14B Grading Exhibit

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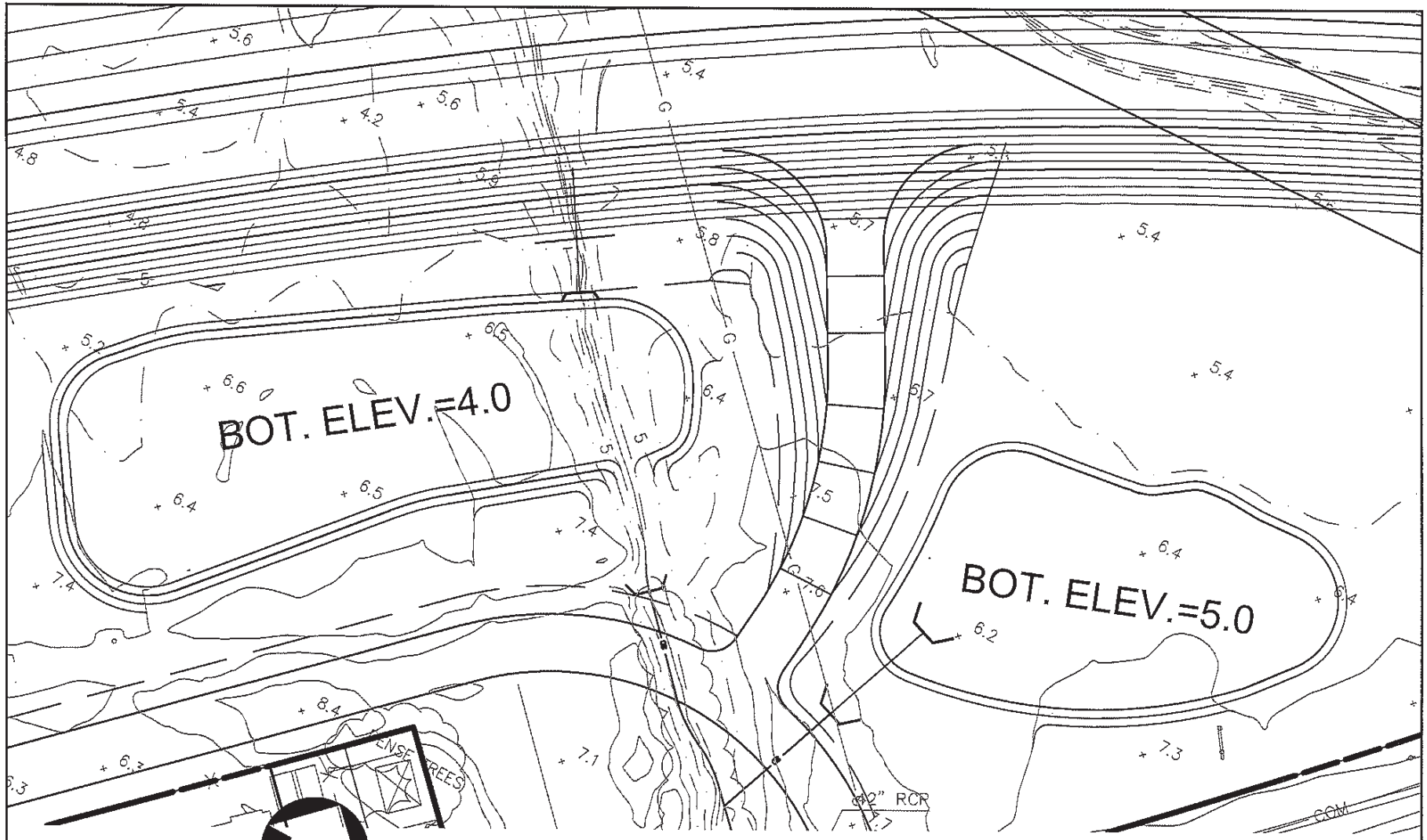
CALIFORNIA COASTAL CONSERVANCY



Note: For reduced sized prints, original scale is in inches

Area B- Pershing Drain Grading Exhibit

CALIFORNIA COASTAL CONSERVANCY

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APPENDIX B3
Conceptual Habitat Restoration and Adaptive Management Plan

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Appendix C. Control Methods for Invasive Plants C-1

Appendix D. Inventory of Basic Best Management Practices D-1

LIST OF ACRONYMS

BWER	Ballona Wetlands Ecological Reserve
CDFG	California Department of Fish and Game (now California Department of Fish and Wildlife)
CDFW	California Department of Fish and Wildlife (formerly California Department of Fish and Game)
CEQA	California Environmental Quality Act
CNPS	California Native Plant Society
Conceptual Plan	Ballona Wetlands Ecological Reserve Conceptual Habitat Restoration and Adaptive Management Plan
Corps	U.S. Army Corps of Engineers
GIS	Geographic Information System
HMMP	Habitat Mitigation and Monitoring Plan
msl	Mean sea level
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
PAR	Property Analysis Record
PMT	Project Management Team
PWA	Phillip Williams and Associates
Reserve	Ballona Wetlands Ecological Reserve
SCC	California State Coastal Conservancy
SLC	California State Lands Commission
SMBRC	Santa Monica Bay Restoration Commission
USFWS	U.S. Fish and Wildlife Service

1.0 INTRODUCTION

This Conceptual Habitat Restoration and Adaptive Management Plan ("Conceptual Plan") presents conceptual guidelines for biological components of habitat restoration within the Ballona Wetlands Ecological Reserve ("BWER" or "Reserve") using principals of adaptive management. The purpose of this document is to provide a conceptual outline of the restoration from a habitat perspective and guide the development of more detailed elements of the restoration such as the final grading plan, the planting/landscape plan, the operations and maintenance plan/long-term management plan, and the habitat mitigation and monitoring plan ("HMMP"). The final design and implementation of the proposed restoration at the BWER will be informed by the biological components presented here as well as the hydrological and geomorphological design components developed by ESA PWA (2011a-d, 2012a-c) and will be refined through the associated California Environmental Quality Act ("CEQA") and National Environmental Policy Act ("NEPA") analysis of alternatives and regulatory agency permitting for the project.

The information presented in this document is based on an extensive body of previous research and planning documents and represents input from a large team of scientists, engineers, conservation planners, and regulators. Where possible, clear direction is given on how activities will proceed; however, in some cases, not enough information is available to make a decision at this point. For these cases, we purposefully use "should" rather than "shall" or "will" to show the intended uncertainty.

The project aims to restore one of the largest remaining tracts of tidal marsh in southern California and is of particular significance considering that coastal wetlands in Los Angeles County have been reduced upward of 96 percent relative to pre-development conditions (PWA et al. 2006). The land, approximately 600 acres (242 hectares) of an original 2,000-acre (809 hectares) tidal marsh in Los Angeles County, is jointly owned by the California Department of Fish and Wildlife ("CDFW"; formerly the California Department of Fish and Game, "CDFG") and the California State Lands Commission ("SLC"). The CDFW, the SLC, the California State Coastal Conservancy ("SCC"), and the Santa Monica Bay Restoration Commission ("SMBRC") are working together to develop the restoration with the following overarching goals:

> *Restore, enhance, and create estuarine habitat and processes in the Ballona Ecosystem to support a natural range of habitat functions, especially as related to estuarine dependent plants and animals.*

Create opportunities for aesthetic, cultural, recreational, research, and educational use of the Ballona ecosystem that are compatible with the environmentally sensitive resources of the area.

The proposed restoration aims to reestablish a once vibrant tidal wetland system, increasing the ecosystem function and flood protection values of this degraded site. The restored wetlands will feature a mosaic of tidal wetland, dune, scrub, and grassland habitats with numerous opportunities for public enjoyment and education.

1.1 Restoration Background

The BWER site consists of approximately 600 acres (242 hectares) of open space in the Marina del Rey area of Los Angeles, in Los Angeles County, California (Figure 1). Of these 600 acres (242 hectares), 540 acres (218 hectares) are owned by the CDFW and 60 acres (24 hectares) are owned by the SLC. The 60 acres (24 hectares) belonging to the SLC was leased to the CDFW and the entire property was named the Ballona Wetlands Ecological Reserve. Funds for the purchase were acquired from Proposition 12 which set aside $300 million for coastal wetland acquisition and restoration in southern California. Funds for the planning and restoration of the property were also provided by Proposition 12. Together, the CDFW, SLC, and SCC are working with stakeholders, scientists, and other agencies to restore the wetlands.

1.2 Restoration Goals and Objectives

Goals developed for the restoration include the following:

Restore, enhance, and create estuarine and associated habitats and processes to support a natural range of habitat structures and functions in the Reserve.

Establish processes and functions within the Reserve to support estuarine habitats by improving tidal circulation into the wetlands to enlarge the amount of area that is tidally inundated, increase tidal prism and excursion, lower residence time of tidal water, ensure a more natural salinity gradient, and create a dynamic interaction between Ballona Creek, Ballona Wetlands, and the Santa Monica Bay.

Create a self-sustaining estuarine system by providing large, contiguous areas of diverse intertidal wetland habitat with wide transition and buffer areas to allow for adaptation to sea level rise, minimize the need for active management, and reduce negative impacts associated with human activities and invasive species.

Figure 1. Location Map

Provide landscape-level functions sustaining the multiple levels of biodiversity associated with estuarine systems by strategically preserving, restoring, enhancing, and developing multiple habitats and incorporating transitional and upland habitat links to the wetlands to support recruitment and the various life stages of a diverse native flora and fauna.

Establish a restored estuarine system that protects and respects cultural and sacred resources, enables cultural use of the site by Native Americans, and provides appropriate interpretive information about prior uses of the site.

Develop and enhance public access, recreation, environmental education, and interpretation opportunities within the Reserve through the development of appropriate visitor facilities and connections to regional and local trail networks.

Protect existing and planned roadways, utilities, and adjacent properties and uses by maintaining or improving flood protection and stormwater management, ensuring consistency with future regional plans, and limiting the need for significant modification to regionally important infrastructure.

Ensure public safety, resources protection, and security while minimizing security and maintenance costs by facilitating adequate law enforcement, providing for safe traffic movement and parking, reducing hazards, and providing appropriate access.

Ecological objectives include creating, restoring, and enhancing wetland and upland habitats in the Reserve to both increase and improve habitat for tidal wetland plant and wildlife species and to improve ecological services such as flood control and water quality improvement. Cultural objectives include protection of Native American cultural resources within the Reserve. Public access objectives include preserving and increasing public access to the Reserve in a manner compatible with sensitive habitats and special-status species. Public education objectives include increasing awareness of the value of wetland systems and increasing public involvement in the protection and restoration of sensitive habitats and the protection of special-status plants and animals. The goals and objectives presented above have been further refined during the development of this Conceptual Plan. These objectives are discussed in more detail in the following sections.

It should be noted that the proposed restoration includes elements of both habitat *restoration* and habitat *creation*. Our understanding of the historical ecology of the Ballona region is largely inferred from historical accounts of the Los Angeles coast (e.g.,

Dark et al. 2011); few hard data exist regarding historical habitat composition or ecosystem function at the BWER. Moreover, development within the Ballona Creek watershed and the associated need for flood control greatly limit the options available for restoration. Some aspects of the restoration plan involve "restoration" in the sense of recovering historical conditions. However, most aspects of the restoration plan involve reestablishment of natural processes and ecological functions and either habitat creation (i.e., creating a particular type of habitat where it previously did not exist) or habitat enhancement (i.e., modification of existing conditions). However, to avoid over-complicating the Conceptual Plan, the term "restoration" is used throughout the text and is meant to encompass all of these elements and not only the re-creation of a historical condition.

1.2.1 Habitat Objectives

The restoration will improve the quality and diversity of native plant communities within the Reserve. An appropriate mix of upland and wetland plant communities will be necessary to maintain or increase numbers of special-status plant species and to maintain or increase use of the Reserve by special-status wildlife species. The specific focus for upland habitats will be on the preservation and enhancement of dunes; however, enhancing grassland and coastal scrub will also be important. The specific focus for wetland habitats will be on increasing and enhancing tidal marsh habitat. Improving freshwater wetlands and riparian habitat will also be addressed. In addition to improving habitat for special-status plant and wildlife species, native plant abundance and diversity will be increased throughout the Reserve.

Impacts from invasive species will be minimized throughout the Reserve. Complete eradication is not achievable, and efforts to control invasive species will be prioritized based on the level of threat posed to sensitive habitats and special-status plant and wildlife species. Preventative measures will be taken to ensure that disturbance during construction does not increase levels of invasive species at the Reserve.

1.2.2 Wildlife Objectives

The restoration will improve overall habitat quality for native wildlife species, with the goal of increasing abundance and diversity of native animals that use the Reserve. The specific focus will be on improving habitat for wildlife species associated with tidal wetland habitat, including birds, fish, and benthic invertebrates. Non-native urban predators will be controlled to allow populations of native wildlife species to expand and occupy newly restored habitat. Similarly, human- and pet-related disturbances will be minimized throughout the Reserve to encourage use by sensitive wildlife species.

1.2.3 Special-Status Species Objectives

The restoration will preserve and enhance habitat for special-status plant and wildlife species that currently occur in or make use of the Reserve. The establishment of additional populations of special-status species will be encouraged. Potential disturbances to sensitive habitats or wildlife species will be reduced through effective design of public access areas, predator management, and other management tools.

1.2.4 Cultural Resource Objectives

To the extent feasible, cultural resources within the Reserve will be avoided by project construction and will be protected. The approach for avoiding and protecting cultural resources will be outlined in the cultural resources report to be prepared for the project.

1.2.5 Public Access, Education, and Involvement Objectives

Levels of public access to the Reserve will be maintained or increased. Public access will be limited to uses compatible with plant and wildlife resources in the Reserve, and special care will be taken to avoid impacts to sensitive habitats or special-status plant and wildlife species. Exclusion from some areas will be necessary to achieve this goal. Opportunities for public awareness and education will be provided through the use of interpretive signs, viewing areas, and other means. To the extent practical, public involvement will be encouraged during the restoration, monitoring, and long-term management of the BWER.

1.2.6 Flood Control and Ecological Service Objectives

The restoration will maintain or increase existing levels of flood protection and water quality improvement functions provided by wetlands in the Reserve. Increasing tidal input to the wetlands as well as increasing the overall acreage of wetlands within the Reserve will increase the capacity of the wetlands to absorb floodwaters. Increasing the acreage and overall quality of wetlands within the Reserve will increase the water quality improvement functions of the wetlands. Improvements to Ballona Creek will help reduce scour and additional sediment loading.

1.3 Purpose of the Conceptual Plan

The purpose of this Conceptual Plan is to provide conceptual guidelines for the long-term restoration and management of the BWER using adaptive management practices to preserve and enhance the ecological and social values of the Reserve. The Conceptual Plan focuses primarily on the biological component of the restoration design and implementation. The geotechnical components of the design and implementation have been addressed in numerous technical documents produced by ESA PWA, Phillip

Williams and Associates ("PWA"), Psomas and Associates, and Group Delta Consultants, Inc. (ESA PWA 2011a-d, 2012a-c; PWA 2008, 2010; PWA et al. 2006). Together, the biological and geotechnical components will be used to guide the overall design and implementation of the restoration. Specifically, this Conceptual Plan serves to:

> *Provide an overview of the Reserve, including its relevant physical, ecological, and biological features and processes, and cultural values.*
>
> *Provide a description of physical structure and biological composition of target habitats which will serve to guide the restoration.*
>
> *Provide the framework for developing a detailed monitoring and adaptive management plan to be implemented at the Reserve.*

The Conceptual Plan provides the framework for achieving the goals and objectives discussed above in Section 1.2. The Conceptual Plan includes an overview of the restoration process which highlights pertinent environmental, ecological, and cultural issues. The Conceptual Plan also includes a monitoring program and adaptive management framework designed to guide the development of a more detailed Monitoring and Adaptive Management Plan.

1.4 Overview of Adaptive Management Practices

The restoration and long-term management of the Reserve will be based on principles of adaptive management. Adaptive management is an iterative process whereby restoration practices are guided by best available technologies and hypothesis testing followed by implementation and monitoring to evaluate results. This approach allows for restoration and management under changing conditions and with uncertainties in the course of habitat development. Adaptive management involves six primary steps: (1) research and planning, (2) design, (3) implementation, (4) monitoring, (5) evaluation, and (6) modification or adaptation. Most importantly, adaptive management is a reflective process in which management actions are continuously monitored and evaluated and necessary changes in management are planned and implemented, followed by continued monitoring and evaluation.

For a more detailed discussion of adaptive management see Atkinson et al. (2004) or Fischenich et al. (2011).

2.0 SUMMARY OF EXISTING CONDITIONS

Existing conditions and baseline ecological data at the BWER have been extensively documented (e.g., PWA et al. 2006; Johnston et al. 2011, 2012). The following sections summarize existing conditions at the BWER to provide context for the restoration and this Conceptual Plan.

2.1 Property Description

2.1.1 Geographical Setting and Site Overview

The Reserve is located in coastal Los Angeles County, California (Figure 1). The site is located northwest of Los Angeles International Airport, near the Marina del Rey area. The Reserve can be accessed by four major roads intersecting or abutting the site: Lincoln Boulevard, Jefferson Boulevard, Fiji Way, and Culver Boulevard. The Reserve is bisected by Ballona Creek and is generally discussed as three areas (A, B, and C; Figure 2). Area A lies north of Ballona Creek, west of Lincoln Boulevard, and south of Fiji Way. Area B lies south of Ballona Creek, west of Lincoln Boulevard, and north of Cabora Drive; the area is bounded on its western side by dunes bordering homes along Vista del Mar. Area C is bounded by Ballona Creek, the Marina Expressway, Lincoln Boulevard, and mixed-use development between the Expressway and Lincoln Boulevard.

The BWER comprises approximately 600 acres (242 hectares) of which 540 acres (218 hectares) are owned by the CDFW and 60 acres (24 hectares) are owned by the SLC. Of the 60 acres (24 hectares) owned by the SLC, 24 acres (10 hectares) , known as the Expanded Wetlands Parcel, are operated by the CDFW and are covered by this Conceptual Plan. The remaining 36 acres of SLC property, known as the Freshwater Marsh, are managed by the Ballona Wetlands Conservancy under a separate conservation easement and are not covered under this plan. Adjacent land use is primarily residential with some commercial development and institutional/government use. Land use adjacent to Area A is dominated by Marina del Rey which is one of the largest small craft harbors in the world and is the source of the majority of the fill material historically placed in Area A.

2.1.2 Cultural Features

A detailed discussion of cultural resources at the BWER is provided in the Existing Conditions Report for the Ballona Wetlands (PWA et al. 2006) and the Archaeological Survey Report (ICF International 2011). Cultural resources at the BWER will be preserved to the extent practicable during the restoration; for Native American resources, this will be done in consultation with the appropriate tribe. Details regarding

Figure 2. Site Overview

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cultural resources at the site and the approach to protecting such resources during the restoration can be found in the Archaeological Survey Report (ICF International 2011).

2.1.3 Existing Infrastructure

Various transportation, utility, and flood control infrastructure elements currently exist on the BWER property. Some of these elements will be left in place or modified as part of the proposed restoration. Other infrastructure elements will need to be removed to accommodate restoration efforts. In addition, new infrastructure will be created such as a visitor center, parking areas, pedestrian paths, lighting, fencing, and related elements. Members of the project management team ("PMT") have met with agencies, businesses, and organizations that have an interest in infrastructural elements within and adjacent to the BWER to discuss future infrastructure plans under the proposed restoration. Detailed descriptions of existing infrastructure can be found in the *Preferred Alternatives Memorandum* (PWA 2010) and the *Existing Conditions Report* (PWA et al. 2006).

2.2 Environmental and Ecological Description

The information provided in the following sections comes from a range of sources including the existing conditions report (PWA et al. 2006), the baseline conditions study (Johnston et al. 2011, 2012), and other sources. This information is intended to provide a contextual background for the other elements of this report.

2.2.1 Regional Climate

Southern California experiences a Mediterranean climate with moderate seasonal temperature fluctuation influenced by the Pacific Ocean and seasonal precipitation occurring predominantly in the winter and spring. The BWER experiences mild year-round temperatures with an average summer temperature of 69 degrees Fahrenheit (21 degrees Celsius) and an average winter temperature of 57 degrees Fahrenheit (14 degrees Celsius), with seasonal coastal fog and an average winter precipitation of 8.26 inches (20.98 centimeters).

2.2.2 Historical Ecology

The historical extent of the Ballona Lagoon is estimated to range from 2,120 acres (858 hectares) (PWA et al. 2006) to 4,288 acres (1735 hectares) (Dark et al. 2011). The Lagoon was part of the larger Ballona Creek watershed which historically covered a large swath of western Los Angeles from the Santa Monica Mountains to the coast (Dark et al. 2011). Natural shifts in the flows of the Los Angeles River and the subsequent channelization of the River in the 1880s resulted in Ballona Lagoon

transitioning from an expansive wetland complex at the terminus of the Los Angeles River watershed to a more discrete wetland associated with the smaller Ballona Creek watershed (Dark et al. 2011; Ambrose and Bear 2012). This shift in the hydrologic regime of the Ballona region was further intensified by subsequent flood control efforts and commercial development in the area up through the early 2000s (Dark et al. 2011; PWA et al. 2006), the most important of these being the installation of flood control structures along Ballona Creek in the 1930s (Ambrose and Bear 2012; PWA et al. 2006).

Identification of dominant historical vegetation and habitats in the BWER is complicated by the lack of systematic surveys in the area prior to development. Focusing on the Ballona Creek watershed from approximately 1850 to 1890, Dark et al. (2011) determined that the BWER area was dominated by (in order from greatest to least extent) alkali meadows, tidal marsh, wet meadows, salt flats, willow thickets, beach and dune habitats, open water, and perennial freshwater ponds, with vernal pools occurring further inland. Species such as cordgrass (*Spartina* spp.), which are typically found in perennially open tidal wetlands (e.g., tidal channels and low marsh habitat), are not found in the older records. However, records indicate that species commonly associated with brackish, freshwater, dune, and salt marsh habitats were present (Dark et al. 2011). Ambrose and Bear (2012) determined that the habitat composition of the BWER shifted from being dominated by salt marsh and mudflats in 1876 to being dominated by grassland, coastal scrub, muted-tidal marsh, and non-tidal marsh habitats as occur today.

Mattoni and Longcore (1997) describe for an extensive Los Angeles coastal prairie extending from Playa Del Rey south to the Palos Verdes penninsula and extending inland to east of Torrance. Although the study focuses on the coastal headlands and does not specifically discuss the Ballona Lagoon, many of the annual prairie and vernal pool plant species they list would likely have occurred in the lowlands around the Ballona Wetlands where soil conditions were likely similar. Mattoni and Longcore developed a plant list for the Los Angeles coastal prairie based on herbaria records and historical literature, and the list shares marked similarities with characteristic southern coastal needlegrass grassland, southern coastal grassland, and pristine California grassland, with the coastal prairie list being differentiated by the presence of vernal pool-associated species. They concluded that the Los Angeles coastal prairie contained extensive vernal pool habitat based on historical topography and herbaria records, historical descriptions including photographs and place names, and identification of physical remnants of pools by the authors.

The lack of specific, systematic surveys of the historical BWER area makes it difficult to determine the historical composition of vegetation in the area. Mattoni and Longcore's list was compiled using herbaria records, historical records including amateur botanical collections and anecdotal accounts, habitat descriptions from early floras of southern California, and consultation with local botanists. However, the authors note that the only available source of quantitative data for the Los Angeles coastal prairie was a photograph taken in 1938 which was then compared to later photographs to measure species frequency and percent cover. Dark et al. (2011) discuss the Ballona Lagoon more specifically, but note that they, like Mattoni and Longcore, utilized a variety of sources including historical maps and surveys in combination with photographs, historical reports, herbaria records, and bird observations to draw their conclusions. Although Dark et al. (2011) provide a list of plants they believe were historically present in the Ballona Wetlands region, they do not draw conclusions as to likely dominant species or associations. Ambrose and Bear (2012) compared topographic maps (t-sheets) generated by a precursor of the National Oceanic and Atmospheric Administration ("NOAA") with a modern survey by the CDFW to determine the change in the extent and composition of habitat types at the Ballona Wetlands from 1876 to 2007; however, they do not discuss vegetation in detail.

The alternative restoration plans for the BWER have been developed with consideration of the historical ecology of the BWER; however, given the lack of detailed knowledge regarding the historical ecology of the area and the major changes that have occurred within the watershed, restoration to historical conditions is not possible. Centuries of surrounding development and other major alterations to the watershed, the flood control requirements of the project, the habitat requirements of special-status wildlife and plant species currently at the site, and the funds available for restoration are all factors that influence the opportunities for restoration at the BWER.

2.2.3 Geology, Soils, and Hydrology

Bedrock geology in the vicinity of the Reserve is characterized by faulting and tectonic activity typical of southern California. The Charnock and Overland faults are the closest faults to the BWER, at 1.3 miles (2.1 kilometers) northwest and 2.5 miles (4 kilometers) northeast, respectively (PWA et al. 2006). Native soils at the BWER are of fluvial and marine origins and include a wide range of particle sizes and textures (PWA et al. 2006). Sand becomes a more prevalent constituent in the upper layers of the soil approaching the ocean-side of the Reserve. Native soils in Areas A and C are overlain at a depth of 0 to 18 feet (0 to 5.5 meters) by sediments dredged during the construction and maintenance of Marina del Rey and Ballona Creek (PWA et al. 2006). Soil testing has revealed high levels of a number of elements of concern throughout the Reserve, but particularly in the salt panne, tidal marsh, and freshwater habitats in the eastern

portion of the Reserve and in illegally dumped fill soils in the northeastern portion of Area B. Elements of concern include boron, selenium, vanadium, zinc, copper, sulfur, and lead (PWA et al. 2006; Johnston et al. 2011). Additional investigations will be necessary to fully document the concentration and distribution of these elements throughout the Reserve and to determine whether remediation will be necessary.

Hydrology at the BWER is influenced by tidal action from Santa Monica Bay as well as groundwater, urban runoff, and stormwater from within the Ballona Creek watershed. Mixed semidiurnal tides bring two high and two low tides of unequal height each day which propagate through the mouth of Ballona Creek and Marina del Rey. Area A receives tidal inflow via a culvert connected to Marina del Rey. Area B receives muted tidal inflow via self-regulating tide-gates in Ballona Creek. The Ballona Creek watershed includes approximately 130 square miles (337 square kilometers) of largely urbanized land. The majority of the Ballona Creek drainage network occurs as storm drains, underground culverts, and concrete channels. Inflow from these sources is particularly important in the Freshwater Marsh located along Lincoln Avenue and in freshwater habitats in Area B. Groundwater from the Ballona Creek watershed is a particularly important source of inflow for the wetlands. Groundwater is present in both confined and unconfined water table aquifers under Area B, with water table levels ranging from 1 foot (0.3 meter) above mean sea level ("msl") to 2.0 feet (0.6 meter) below msl. Areas A and C do not receive major hydrologic input from groundwater discharge, although observations of a perched water table have been made in Area A. Groundwater recharge is largely through infiltration through the soil profile following rainfall and during inundation by surface water.

Descriptions of soils and hydrology for each area of the BWER are presented below. A more detailed accounting can be found in the Existing Conditions Report (PWA et al. 2006).

Area A

Area A has been almost entirely modified from its natural state by the placement of fill and dredged material from numerous projects including construction of the Pacific Electric Railroad levee, platforms created for oil production facilities, and dredging of Marina del Rey and Ballona Creek. The placement of fill material has resulted in wide variation in topography and the distribution of sediments throughout Area A. Fill material ranges in thickness from 9 to 18 feet (2.7 to 5.5 meters) in the western portion of Area A and to 0 feet (0 meters) in the eastern portion, within the Marina Ditch. Fill material is underlain by the original marsh soils comprised of silty clay and clay. Bore data indicate potential subsidence of the original marsh surface due to the placement of fill material, with the original surface ranging from 2 feet (0.6 meter) below msl to 4 feet (1.2 meters) above msl.

Historically the overall elevation was less than 5 feet (1.5 meters) above msl; it now ranges from a low of 9.3 feet (2.8 meters) above msl in an area 600 feet (183 meters) south of the intersection of Admiralty Way and Fiji Way to a high of about 17.4 feet (5.3 meters) above msl at the far western end of the site. Variations in topography and the composition and structure of fill materials have led to varied hydrological regimes throughout Area A. Water infiltrates through the soil profile or flows downslope in areas with steep topography and coarse fill material and tends to collect in low-lying areas with more fine-grained fill material. Surface drainage in Area A either ends up in numerous closed depressions or in Marina Ditch which runs along the northern boundary of the Reserve and is connected to Marina del Rey via culverts under Fiji Way. The majority of Area A drains into the former "stilling basin" in the center of the Area. Water inputs in Area A come from tidal action which is contained in the Marina Ditch and from precipitation. As such, ponding generally only occurs during the wet winter months, and Area A consists largely of upland habitat.

Area B

Area B was not filled as extensively as Areas A and C and retains much of its original topography. The area is bisected by several roads which greatly affect its hydrology and have resulted in four distinct wetland areas: (1) the north wetland located north of Culver Boulevard, south of Ballona Creek, and east of Playa del Rey; (2) the south wetland located north of Del Rey Bluffs, west of the Gas Company road, south of Culver Boulevard, and east of Playa del Rey; (3) the east wetland located north of Del Rey Bluffs, west of the Freshwater Marsh, south of Jefferson Boulevard, and east of the Gas Company road, including the alluvial fan at Hastings Canyon and the lower portions of the Del Rey Bluffs; and (4) the northeast wetland located north of Jefferson Boulevard, south of Ballona Creek, and east of the Gas Company road. Sediments in these areas are mostly fine-grained. The western portion of Area B is richer in sand whereas the eastern portion is rich in silt and clay. Detailed descriptions of the individual wetland areas are provided in the Existing Conditions Report (PWA et al. 2006).

Elevations in Area B range from 2.4 to 5 feet (0.7 to 1.5 meters) above msl and extend to 50 feet (15 meters) above msl along the property line on the southern bluffs. The Del Rey bluffs continue upward to approximately 160 feet (48.8 meters) above msl. Marsh flat elevations range from 0.6 to 1.6 feet (0.2 to 0.5 meters) above msl with channels at 2.2 feet (0.7 meter) below msl. The wetlands in Area B were isolated from the regular tidal influence of Santa Monica Bay when the Ballona Creek levees were constructed in 1932. Currently, a series of flap-gated culverts and self-regulating tide-gates provide for muted tidal influence in Area B. Although tidal channels provide some hydrologic input to a large portion of the wetlands in Area B; the area does not receive normal tidal flushing due to a series of tide gates which connect this area to Ballona Creek. Outflow

of water from the site through the tide gates is unrestricted, but inflow from the channel is partially controlled. These tide gates allow local canals to fill and keep the marsh areas adjacent to Ballona Creek generally wetted. Additional sources of inflow in Area B include precipitation and runoff from surrounding areas.

Area C

Area C received substantial fill during the construction of the Pacific Electric Railroad levee (early 1900s), the dredging of the Marina del Rey (1960s), and more recent highway construction. The largest impact occurred during the dredging for Marina del Rey when hydraulically placed slurry was pumped onto Area C. Marina Ditch is an open channel that runs along a portion of the northwest edge of Area C and then extends diagonally to the southeast across the northern half of Area C. The Marina del Rey dredging process left Area C with a high center sloping down to its perimeter, causing the area to no longer retain water for extended periods of time. Fill materials range from 3.5 to 15 feet (1.1 to 4.6 meters) above msl and consist of sand, silt, and clay with variable amounts of construction-related debris. Bore data indicate that, like Areas A and B, the fill material in Area C is underlain by Holocene alluvium consisting of various layers of sand, silt, and clay.

Current elevations range from 4.6 feet (1.4 meters) above msl in a man-made depression south of Culver Boulevard and east of the on-ramp from east-bound Culver Boulevard to north-bound Lincoln Boulevard, to 25.6 feet (7.8 meters) above msl at several mounds in the southwestern portion of the area. Additional depressions are present in the eastern portion of the site, north of Culver Boulevard, where elevations range from 7.4 to 9.4 feet (2.3 to 2.9 meters) above msl. Elevations of the ditch in the northern portion of the area range from 2.4 to 4.1 feet (0.7 to 1.2 meters) above msl. Aside from these specific areas, the majority of the site sits at elevations ranging from 12 to 20 feet (3.7 to 6.1 meters) above msl.

Direct precipitation, runoff from surrounding areas, and storm drain overflows dominate the hydrology of Area C. Additional flows from Marina Ditch and water backed-up behind tidal flap-gates in Ballona Creek also contribute to the hydrology of the area. However, current hydrologic connectivity between Ballona Creek and Marina Ditch allow for only minimal tidal exchange. Storm drains in the area collect water from off-site properties, and overflows from these storm drains sometimes enter Area C.

2.2.4 Plant Communities and Aquatic Habitats

The Ballona Wetlands contain a wide array of aquatic, wetland, and upland habitats including subtidal and intertidal channels, estuarine marsh, brackish marsh, freshwater

wetland, seasonal wetland, riparian scrub and woodland, salt panne, dune, grassland, and scrub habitats. The CDFW mapped 57 specific plant alliances or mapping units within 16 major habitat types for the Reserve (CDFG 2007). Many plant alliances and mapping units are dominated by one or more non-native species. No alliances or associations are considered rare or endangered; however, one alliance (*Leymus triticoides* Alliance) and one association (*Frankenia salina-Distichlis spicata* Association) are considered vulnerable (S3) in California (Sawyer et al. 2009).

Descriptions of the plant communities and other habitat elements in the three main areas of the Reserve are provided in the following sections. Plant communities and habitat types at the BWER are shown in Figure 3. This figure has been adapted from the mapping conducted by the CDFW and is included here for contextual purposes only—it is not intended for any planning purpose or for analysis of project impacts. In addition, this adapted figure shows all areas dominated by non-native plant species as such, and does not distinguish between dominants.

Area A

Elevations were raised in Area A with the disposal of dredged materials from the construction of the Ballona Creek Channel and Marina del Rey. The topography and salinity of Area A are presumably the cause for the current vegetation zonation present within this area. Internal drainage carries salts leached from old marsh soils from marginal areas at elevations of 15 to 18 feet (4.6 to 5.5 meters) above msl to central areas ranging from 9.3 to 11 feet (2.8 to 3.4 meters) above msl (PWA et al. 2006). One large area of non-tidal salt marsh habitat occurs within the central portion of Area A and consists of intermixed mudflat habitat and hydrophytic vegetation, with a broad transition to upland habitat. The central and northern portions of Area A are dominated by pickleweed species (*Salicornia pacifica* [*S. virginica*], *S. europaea*, and *Arthrocnemum subterminale* [*S. subterminalis*]), big saltbush (*Atriplex lentiformis*), slender-leaf iceplant (*Mesembryanthemum nodiflorum*), annual bluegrass (*Poa annua*), and open, unvegetated bare ground and salt scald areas. The southwestern portion of Area A contains dense patches of alkali heath (*Frankenia salina*).

Many areas are heavily disturbed, largely due to the presence of encampments of homeless people throughout this area. Due in part to the high levels of disturbance in these areas, vegetation is dominated primarily by non-native, invasive species such as mustards (*Brassica* spp., *Hirschfeldia incana*) and crown daisy (*Glebionis coronaria* [Chrysanthemum *coronarium*]). Large patches of sea fig (*Carpobrotus* spp.) with stands of mulefat (*Baccharis salicifolia*) and coyote brush (*B. pilularis*) are also present along the western boundary of Area A.

Area B

Area B is the only area within the Reserve that contains unfilled salt marsh habitat. Dominant plant species in moist habitat types in Area B include bristly ox-tongue (*Helminthotheca echioides* [*Picris e*.]), alkali ryegrass (*Leymus triticoides*), annual bluegrass, brass buttons (*Cotula coronopifolia*), toad rush (*Juncus bufonius*), pickleweed species, salt grass (*Distichlis spicata*), broadleaf cattail (*Typha latifolia*), narrow leaf willow (*Salix exigua*), arroyo willow (*S. lasiolepis*), and Italian rye grass (*Festuca perennis* [*F. perenne*, *Lolium multiflorum*, *L. perenne*). In addition, many patches of coast buckwheat (*Eriogonum parviflorum*) occur along the western boundary of Area B. Some parts of Area B are heavily disturbed and harbor a number of non-native species such as eucalyptus (*Eucalyptus* spp.) in the south central area, pampas grass (*Cortaderia selloana*) in the southeast corner, and sea fig along most of the area south of the slough. Stands of willow (*Salix* spp.), coyotebrush, and acacia (*Acacia* spp.) are present along the western boundary near the levee. Area B currently supports the greatest number of native salt marsh plant species of all the areas (Hendrickson 1991).

Area C

Similar to Area A, Area C has been filled with dredge spoils and other material from various sources. The majority of Area C contains large amounts of trash and other debris and a number of encampments of homeless people. These areas are mostly dominated by non-native species such as acacia and mustards. Dominant vegetation within ditches and wetland areas include bristly ox-tongue, curly dock (*Rumex crispus*), Italian ryegrass, large saltbush, slender-leaf iceplant, and alkali heath. In the northeastern corner of the upper portion of Area C, the wetlands contain patches of bare ground as well as areas dominated by hydrophytic vegetation including large saltbush and pickleweed species. The eastern portion of Marina Ditch is dominated by large saltbush. Two areas of remnant dune habitat were identified within Area C by the CDFW (CDFG 2007). These areas are located adjacent to Culver Boulevard, near Jefferson Boulevard. Four developed baseball fields with associated infrastructure are present in the central portion of the southern part of this area and are primarily devoid of vegetation. Lastly, the drainage ditch located along the northeastern side of the baseball fields is dominated by bristly ox-tongue, curly dock, Italian rye grass, and black mustard (*Brassica nigra*).

Despite the degradation of Area C, it still contains some, albeit small, areas inhabited by native species within depressional areas. Newly established populations of native species such as pickleweed and alkali heath have colonized these depressional areas, and speak toward the resilience of such native species.

Figure 3. Biological Communities

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Ballona Creek

Ballona Creek has been channelized and is currently a lined, trapezoidal creek from its mouth at Santa Monica Bay to the intersection of Venice Boulevard and Pickford Street, approximately 9 miles (14.5 kilometers) upstream. The creek varies in width from 80 to 200 feet (24.4 to 61 meters) and in depth from 19 to 23 feet (5.8 to 7 meters) from the top of the levee. The side slopes are composed of concrete, paving stones, and riprap. The bottom of the creek is only open in the lower, tidally influenced portion, whereas the remaining portions are armored. The vegetation growing along the side slopes consists primarily of ruderal, weedy plant species including bristly ox-tongue, slender-leaf iceplant, and crown daisy. Limited native vegetation including pickleweeds and fleshy jaumea (*Jaumea carnosa*) are present in the western portion of Ballona Creek. Ballona Creek is tidally influenced within the Reserve area.

2.2.5 Floristics

Plant species within the BWER have been well documented throughout the years. Multiple botanical surveys have been conducted within the Reserve for various projects over the past two decades (e.g., Hendrickson 1991; Psomas and Associates 1995; Dorsey and Bergquist 2007; WRA 2011). These studies have included comprehensive floristic inventories and targeted rare plant surveys, as well as transect-based studies aimed at documenting changes in plant communities over time. Johnston et al. (2011) provide a detailed list of the plant species that have been documented at the Reserve. Currently, the BWER contains a mix of upland and wetland habitat types, many of which are dominated by non-native and invasive plant species.

Six special-status plants have been documented from the site: Lewis' evening primrose (*Camissoniopsis lewisii*), Orcutt's pincushion (*Chaenactis glabriuscula* var. *orcuttiana*), South Coast branching phacelia (*Phacelia ramosissima* var. *austrolitoralis*), southern tarplant (*Centromadia parryi* ssp. *australis*), suffrutescent wallflower (*Erysimum suffrutescens*), and woolly seablite (*Suaeda taxifolia*) (WRA 2011). To the extent feasible, occurrences of these species will be preserved during the restoration. If it is not possible to preserve existing occurrences of these species, a mitigation and monitoring plan will be developed to reestablish the impacted species in restored habitat elsewhere in the Reserve.

2.2.6 Animal Species

Animal occurrences at the BWER have been documented in a number of reports and are summarized in both the existing conditions report (PWA et al. 2006) and the baseline study reports (Johnston et al. 2011, 2012). In general, animal communities at the Reserve are composed of common native and non-native species. However, a

number of special-status wildlife species have been documented from the Reserve, although many of these species do not currently occur there. The following sections summarize what is known about the animal communities at the Reserve.

Benthic Invertebrates

Benthic invertebrates provide a reflection of the state of the environment at the transition from water to land and may represent a useful index for the ecological health of an area (Hilty and Merenlender 2000). The presence or absence of certain infaunal taxa within tidal channels can serve as indicators of water quality, anthropogenic stressors to the estuary, and the potential of the estuary to support other trophic levels (Wetlands Recovery Project 2006). Censuses of distribution and abundance have been conducted before and after hydrological modifications within the Reserve to assess the impacts of such projects. Specifically, surveys were conducted before and after the replacement of flapgates (Chambers Group 1996, 1999) and after the installation of the east channel (main) tidegate (City of Los Angeles 2005). Additional benthic surveys of the Reserve include those by Clark (1979), Reish (1980), Ramirez and McLean (1981), Carter (1991), Boland and Zedler (1991), WRA (2004) and Weston Solutions (2005), among others. Benthic invertebrate surveys have primarily focused on Area B; limited surveys have been conducted in Area A, and no surveys have been conducted in Area C.

Benthic invertebrate species observed in one or more surveys are listed in Johnston et al. (2011). Although dominant species were not consistent between reports, the most common species found included: the polychaete worm *Streblospio benedicti* and members of the *Capitella capitata* complex (also polycheates), California hornsnail (*Cerithidea californica*), bent-nosed clam (*Macoma nasuta*), rude barrel-bubble (*Acteocina inculta*), and unidentified oligochaetes. The most commonly represented taxa were annelids, mollusks, and arthropods. Overall, the Reserve has a benthic community dominated by taxa characteristic of southern California coastal wetlands, but with lower species diversity than what might be expect of larger, less disturbed wetlands (Chambers Group 1996). Although no Federal- or State-listed benthic invertebrates have been reported from the Reserve, one species of special concern has been documented. The California brackishwater snail (*Tryonia imitator*) is considered imperiled globally (G2G3) and in California (S2S3) and was reported from Ballona Creek in 1974 (CDFW 2013; NatureServe 2013). The original report was based on the presence of empty shells of this species and there have been no subsequent reports of this species, despite several benthic invertebrate surveys.

Insects

Insects provide a vital link in the food web within a wetland system and are used as indicators for particular species or the overall health of a system (Zedler 2001). The destruction of coastal saltmarsh habitat in southern California has resulted in the decline of the diverse insect communities that rely upon this habitat (Nagano et al. 1981; Mattoni 1991). Invertebrate-based metrics of ecosystem function have centered on taxonomically cataloging the biodiversity of a community (Anderson 2009). In lieu of time-consuming species-level identifications, metrics aimed at describing function or rates may ultimately be better indicators of the current status of a marsh as well as better forecasters of subsequent marsh health (Anderson 2009). These metrics can often be employed rapidly across habitat types, as well as being useful from a management perspective.

The study by Nagano et al. (1981) represents the most comprehensive insect survey of the BWER to date; however, additional surveys include those by Boland and Zedler (1991), Mattoni (1991), Hawks Biological Consulting (1996), and Friends of Ballona Wetlands (2008, 2009, 2010). Insect surveys have primarily focused on Area B, specifically the dune habitats; limited surveys have been conducted in Areas A and C. Insect species observed in one or more surveys are listed in Johnston et al. (2011).

Seven special-status insect species have been observed at the Reserve in recent times: monarch butterfly (*Danaus plexippus*), wandering skipper (*Panoquina errans*), Dorothy's El Segundo dune weevil (*Trigonoscuta dorothea dorothea*), globose dune beetle (*Coelus globosus*), Lange's El Segundo dune weevil (*Onychobaris langei*), Belkin's dune tabanid fly *(Brennania belkini*), and El Segundo blue butterfly (*Euphilotes battoides alluni)*. Special-status insect species observed at the site, or with potential to occur at the site, are discussed in more detail by Johnston et al. (2011) and PWA et al. (2006). To the extent feasible, habitat occupied by these species will be preserved. Most of these species are associated with existing dune habitat at the Reserve and are likely to benefit from on-going restoration efforts in these areas as well as from the potential creation of dune habitat elsewhere in the Reserve.

Fishes

Use of tidal wetlands at the BWER by fish species is arguably one of the most important aspects of the restoration. Defining the fish assemblage of a wetland can be difficult due to the highly mobile nature of the fauna. However, it is this characteristic of mobility that often makes fish some of the first organisms to colonize restored habitats (Zedler 2001). Swift and Franz (1981) were the first to conduct detailed surveys of the fish species within the Ballona area for the "Biota of the Ballona Region" (Schreiber 1981). This was the first study of an upper marsh fish community in southern California and

serves as a good historical reference to past conditions and diversity (PWA et al. 2006). Historically, when the Los Angeles River flooded the wetlands, there would have been a higher ichthyofaunal diversity than currently exists at the BWER, including the possibility of several special concern species that have not been seen during surveys in the past 25 years (PWA et al. 2006). A number of additional fish surveys have been conducted in the tidal channels of the Reserve as well as in Ballona Creek and the adjacent Marina del Rey, including those by Allen (1991), Boland and Zedler (1991), Stoltz (1991), the City of Los Angeles (2005, 2009), Merkel and Associates (2009), and Johnston et al. (2011, 2012). Johnston et al. (2011) provide a detailed list of fish species identified in the open water areas of either Marina del Rey or Ballona Creek and within the tidal channels of the Reserve. No special-status fish species have been documented from the Reserve.

Reptiles and Amphibians

Reptiles and amphibians are an integral part of natural ecosystems (Gibbons et al. 2000; Meyers and Pike 2006). Gibbons et al. (2000) reflect that overall declines in reptile and amphibian populations can be attributed in part to many causes, including, but not limited to, anthropogenic factors, habitat loss, invasive and introduced species, pollution, and disease. Past surveys conducted in Areas A and B have yielded a limited reptile and amphibian species diversity; Area C has not been surveyed for reptiles and amphibians. Throughout the years, there have been several species commonly observed on-site including: Great Basin fence lizard (*Sceloporus occidentalis longipes*), western side-blotched lizard (*Uta stansburiana elegans*), San Diego alligator lizard (*Elgaria multicarinata webbii*), California kingsnake (*Lampropeltis getula californiae*), and San Diego gopher snake (*Pituophis catenifer annectens*) (Dorsey and Bergquist 2007; Hayes and Guyer 1981; Hovore 1991; Impact Sciences 1996; Johnston et al. 2009; Society for the Study of Amphibians and Reptiles 2008). Amphibian diversity at the BWER has historically been limited, consisting of Baja California treefrog (*Pseudacris hypochondriaca hypochondriaca*), California toad (*Bufo boreas halophilus*), and garden slender salamander (*Batrachoseps major major*). These species experienced a major reduction in numbers from the early 1980s to the early 1990s, potentially due to drought conditions in 1991 (Hayes and Guyer 1981; Hovore 1991).

Johnston et al. (2011) list the reptiles and amphibians documented from the Reserve in one or more surveys conducted over the past 25 years. Only one special-status reptile or amphibian species has been documented from the Reserve over the last 25 years: California legless lizard (*Anniella pulchra*). This species is associated with existing dune habitat in the western portion of Area B and is likely to benefit from on-going restoration efforts in this area as well as from the potential creation of dune habitat elsewhere in the Reserve under some proposed project alternatives.

Birds

The avifauna of the Ballona Wetlands has been particularly well-documented, owing to a recent effort to uncover historical bird records and to describe the area's history of landuse change in relation to the extirpation and colonization bird species (summarized in Cooper 2008). Numerous references to Ballona and the "Venice Marshes" (historic, pre-Marina del Rey wetlands which occurred to the north of the present-day BWER) in early ornithological literature (Grinnell 1898; Willet 1912, 1933; Grinnell and Miller 1944), and comprehensive annotated checklists to the birds of the Ballona Wetlands produced at regular intervals (Dock and Schreiber 1981; Corey 1992; Cooper 2006a) have resulted in a record of bird occurrence dating back over 100 years.

Despite the strong historical record, direct comparisons of today's bird community with that of previous eras is made difficult by the lack of systematic observational data. For example, tables of species occurrence by month or season in the public record are sporadic at best. The vast majority of such data is contained in unpublished notes of observers, which have only recently been explored and synthesized (Cooper 2006a, 2006b). The first known published data tables of sightings reflecting regular surveys by observers over set periods of time are from Dock and Schreiber (1981), who performed weekly walking transects of Areas A and B from February 1979 to June 1981. Corey (1992) conducted bi-monthly surveys of open space both east and west of Lincoln Boulevard from April 1990 to April 1991. Neither of these two studies included Ballona Creek, which is an important waterbird site. Only Corey (1992) appears to have investigated the nesting status of bird species, other than anecdotal observations for a select few species by the other authors. Johnston et al. (2011) provide a detailed list of the bird species documented from the Reserve.

Owing to several decades of litigation regarding proposed development on portions of the open space in and around the BWER, the presence of special-status bird species at the site has been repeatedly and thoroughly documented. That said, the actual number of special-status bird species using a given area is difficult to ascertain. Most species are only afforded special-status if engaged in a particular activity, usually breeding. Only two special-status species were confirmed as actually nesting in the BWER proper: least Bell's vireo (*Vireo bellii pusillus*) and Belding's Savannah sparrow (*Passerculus sandwichensis beldingi*). Four additional special-status species are known to breed nearby and visit the Reserve for foraging including: double-crested cormorant (*Phalacrocorax auritus)*, white-tailed kite (*Elanus leucurus*), Cooper's hawk (*Accipiter cooperii*), and California least tern (*Sterna antillarum browni*); these species do not currently breed at the Reserve and thus are not afforded special protections there. Special-status bird species present at the BWER will be protected according to state and federal requirements, and although some temporary loss of habitat may

occur, it is expected that these species will ultimately benefit from restoration activities at the BWER. The population of Belding's Savannah sparrow that currently occupies tidal marsh and salt panne habitats in Area B has been specifically targeted in the restoration planning that has occurred to date, and the extent of restoration activities in Area B (i.e., restoration of the full tidal range in the western portion of Area B) will depend on demonstrated use of restored tidal marsh and salt panne habitats in Area A by this species.

Mammals

The Ballona Wetlands region has suffered a decline in populations of native mammals, a reduction in species ranges, and an increase in introduced species throughout the last century (Friesen et al. 1981). Surveys of the past 29 years throughout the Reserve have yielded a comprehensive mammal diversity of 17 species, three of which are CDFW Species of Special Concern (Friesen et al. 1981; Hovore 1991; Impact Sciences 1996; Erickson 2000; Psomas and Associates 2001; Dorsey and Bergquist 2007; Johnston et al. 2009).

Seven of the species identified in past surveys are considered non-native to the Ballona region: black rat (*Rattus rattus*), domestic cat (*Felis cattus*), domestic dog (*Canis familiaris*), house mouse (*Mus musculus*), Norway rat (*Rattus norvegicus*), red fox (*Vulpes vulpes*), and Virginia opossum (*Didelphis virginiana*). Three of the species identified in past reports are listed as CDFW Species of Special Concern: southern California saltmarsh shrew (*Sorex ornatus salicornicus*), San Diego black-tailed jackrabbit (*Lepus californicus bennetti*), and South Coast marsh vole (*Microtus californicus stephensi*). It is believed that San Diego black-tailed jackrabbit is no longer present at the BWER. In addition, southern California saltmarsh shrew has not been observed at the site since the early 1990s. South Coast marsh vole has been identified from the BWER as recently as 2010 (Johnston et al. 2011), and appropriate measures will be implemented to protect this species during the restoration efforts. Although some temporary loss of habitat may occur, it is expected that this species will ultimately benefit from restoration activities at the BWER.

3.0 RESTORATION DESIGN AND IMPLEMENTATION

The design and implementation elements presented here focus on the biological components of the proposed restoration alternatives. The elements presented here are conceptual in nature and are intended to guide a more detailed level of planning which will be necessary as the restoration effort proceeds. The elements presented here build upon the feasibility studiesand initial impact assessments developed by ESA PWA, the PMT, and other stakeholders. Input from regulatory agencies, interested organizations, and the general public has also been incorporated into the development of this Conceptual Plan. The final design and implementation of the proposed restoration at the BWER will be informed by the biological components presented here as well as the hydrological and geomorphological design components developed by ESA PWA (2011a-d, 2012a-c).

3.1 Target Habitat Composition and Expected Development

The composition of habitats targeted for the restoration at the BWER are primarily based on historical accounts of the habitat previously present at the BWER (Ambrose and Bear 2012; Dark et al. 2011; Mattoni and Longcore 1997; Schreiber 1981) and habitat characterizations provided by Ferren et al. (2008) and Barbour et al. (2007). Given the constraints imposed by the surrounding development, the highly modified nature of the watershed supporting Ballona Creek, existing conditions within the BWER, and projected impacts related to global climate change, re-creation of historical conditions is not possible. Within these constraints, the proposed extent and distribution of habitats in the restored BWER is based on the ecological and biological goals of the restoration (Section 1.2), specifically those related to increasing the total area of tidal wetland habitat and providing high-value habitat for special-status plant and wildlife species.

Physical and biological characteristics of restored habitats within the BWER are expected to develop and evolve over time, particularly given changes expected as a result of global climate change. Restoration will require reliance on natural ecological processes such as sedimentation, erosion, and plant succession. Adaptive management will require an understanding of the expected trajectory of habitat development and the underlying ecological processes involved. The following sections provide an overview of the habitats to be restored at the BWER, including the main ecological drivers of habitat development and a description of the vegetation communities and wildlife populations expected to become established in each habitat.

3.1.1 Tidal Wetland (Tidal Channel, Mudflat, Tidal Marsh)

Tidal action is the primary ecological process responsible for developing and maintaining tidal mudflat and wetland habitats (Kolka and Thompson 2006; Sharitz and Pennings 2006). Wave and tidal action redistribute sediment and determine the topography and evolution of mudflats, marsh, and tidal channels. Tidal inundation, sediment composition, and topography interact to provide the physical conditions that affect the distribution of plant and animal species within a marsh (Mendelssohn and Batzer 2006; Sharitz and Pennings 2006). Tidal marsh plant species vary in their response to the duration and depth of tidal inundation such that each occurs in a unique range of tidal elevations (Zedler et al. 1999). The overlapping distribution of these species is typically simplified and reduced to three marsh vegetation zones in southern California: low, mid-, and high marsh habitats.

Under sediment-limited conditions, tidal marshes typically form by a slow, interactive process of sediment accretion and plant colonization (Kolka and Thompson 2006; Sharitz and Pennings 2006). However, at sites with high sediment loads, the process of tidal marsh development may occur more rapidly (Wallace et al. 2005). As a result of development within the Ballona Creek watershed, sediment loads in Ballona Creek are relatively low, and sediment accretion within restored wetlands at the BWER is expected to be slow. This will necessitate grading of restored tidal marsh and larger channel habitats to near target elevations. Smaller tidal channels are expected to develop over time, and it is expected that all tidal channels will migrate to some degree over the life of the restoration.

Tidal marsh plants can be sensitive to elevated salinity, acidic soil conditions, elevated concentrations of certain naturally occurring elements, and extremes in soil texture. To provide a suitable substrate for marsh vegetation, specifications for marsh soils will be developed and testing of on-site soils will conducted to determine whether there is potential to reuse excavated soils from Areas A and C. Salvage of historic marsh soils buried under dredge spoils placed north of Ballona Creek during creation of the Marina Del Ray harbor may provide a source of suitable marsh soil to use on the marsh surface, although some modification of the soil may be necessary to restore the physical and chemical properties necessary for plant growth.

Because sedimentation rates from the Ballona Creek watershed and from Santa Monica Bay are expected to be low, loss of sediments to the Bay is a potential concern, especially with rising sea levels. Rapid vegetative colonization of low, mid-, and high marsh habitat will be important in reducing the loss of sediments. Planting or seeding of the marsh surface may help speed the colonization process and limit sediment loss. Although a vegetated marsh surface is desirable in terms of reducing sediment loss, some portion of unvegetated mudflat habitat is desired as this provides prime foraging

habitat for many wading and shorebirds and provides valuable habitat for benthic invertebrates.

Re-vegetation will rely on natural establishment as much as possible. Some salt marsh species will colonize areas of sediment accretion where dispersing seeds can become buried in sediment until spring germination. However, plant establishment may be limited where seed is unavailable, sediment erosion is active, or salinity is exceptionally high. Studies conducted as part of the restoration of Tijuana Estuary determined that establishment of most common tidal marsh plant species is improved when the species are planted or seeded; pickleweed was the only tidal marsh species that colonized well on its own (Lindig-Cisneros and Zedler 2002). Some level of active planting or seeding will be necessary throughout the tidal marsh habitat, but it will be especially important in the high marsh zone to provide competition with weeds and to reach the high levels of plant diversity generally found in this portion of tidal marshes. Establishment of species such as alkali heath, saltgrass, and other target species in the high marsh and transition zones will require use of container plantings and irrigation. Establishment of pickleweed in the mid marsh may occur naturally given the proximity of propagules in portions of the BWER and surrounding areas. However, planting stands of other mid-marsh target species will be necessary to encourage species heterogeneity in the mid-marsh. Additional planting may be necessary in locations with high erosion potential such as adjacent to inlets and along tidal channels. Pacific cordgrass (*Spartina foliosa*) is often the dominant plant in the low marsh zone of tidal wetlands in southern California (Zedler et al. 1999) and could recolonize naturally given a nearby seed source. However, Pacific cordgrass does not currently occur at the BWER or in the immediate vicinity, and transplanting from nearby marshes would be necessary to create cordgrass stands at the BWER. Other low marsh species such as salt marsh bird's beak (*Chloropyron maritimum* [*Cordylanthus maritimus*]) should also be considered for establishment at the BWER. The federally endangered subspecies of this plant was successfully established in restored habitat at San Diego Bay where suitable host plants and pollinators were present (Parsons and Zedler 1997).

A significant effort to control invasive plant species will be necessary to ensure establishment of native species in the high marsh and transition zones. Regular tidal inundation and elevated salinity levels in the low and mid-marsh zones will help prevent colonization by non-native ruderal species. However, the decreased frequency of tidal inundation in the high marsh and transition zones makes these areas more susceptible to invasion by non-native ruderal species, particularly after rainfall events which may lower soil salinity (Noe and Zedler 2001a, b). This increased susceptibility to invasion will require greater focus of management activities in these areas to maintain the desired native vegetation.

Target habitat acreages for tidal wetlands will be developed in later stages of the restoration based on input from the project design team and regulatory requirements. The primary targeted species for tidal wetland restoration at the BWER include Pacific cordgrass in the low to mid-marsh zones, pickleweed in the mid-marsh to high-marsh zones, and a combination of Parish's glasswort (*Arthrocnemum subterminale*), shoregrass (*Monanthochloe littoralis*), saltgrass, alkali heath, and coastal gumweed (*Grindelia stricta*) in the high marsh zone (see the potential plant palette provided as Appendix A). Additional species will be considered for establishment in each of the marsh zones to increase native plant diversity within the tidal marsh.

The conflicting dynamics of sedimentation and sediment removal and associated shifts in vegetation should be anticipated in the monitoring and management phases of the restoration. Target acreages for specific wetland habitat and vegetation zones should be flexible, and performance goals should emphasize hydrogeomorphic functionality, vegetative cover, and use by tidal wetland-associated wildlife species.

3.1.2 Brackish Marsh

The Freshwater Marsh will be retained and operated as it is at present under all project alternatives. However, a portion of the outflow from the Freshwater Marsh may be redirected to connect with the channel system in the restored managed tidal wetlands south of Jefferson Boulevard and east of the Gas Company road, creating a brackish marsh transition zone between the Freshwater Marsh and the restored tidal wetlands under some alternatives.

Brackish wetlands are formed in portions of tidal marsh receiving seasonal or perennial input of freshwater (Desmond et al. 2001). In southern California, these areas are generally dominated by California bulrush (*Schoenoplectus californicus*), southern cattail (*Typha domingensis*), ditch grass (*Ruppia maritima*), and spiny rush (*Juncus acutus*) (Desmond et al. 2001). At the BWER, the Freshwater Marsh receives runoff from the adjacent development and the Jefferson Boulevard storm drain. Outflow from the Freshwater Marsh is directed into Ballona Creek via a gated culvert. After the proposed restoration, a portion of the outflow from the Freshwater Marsh will be directed to the restored tidal marsh in the eastern portion of Area B. An area of brackish marsh will develop where outflow from the Freshwater Marsh meets inflow from the restored tidal marsh. The degree and extent of brackish conditions will depend on the amount of freshwater entering the restored tidal marsh at any given time. The flow of water from the Freshwater Marsh will be controlled via the existing overflow weir or via gated culverts installed in the marsh levee. In addition, current project plans call for the installation of a tide gate at the inlet to this portion of Area B, thereby providing a means to regulate the flow of saline tidal water into the brackish marsh area. The ability to control the flow of both freshwater entering from the Freshwater Marsh and saline

water entering from the tidal marsh provides the means to regulate the degree and extent of brackish conditions and to manage this area to promote species diversity and high-quality habitat for brackish marsh-associated species such as tidewater goby (*Eucyclogobius newberryi*), Pacific staghorn sculpin (*Leptocottus armatus*), longjaw mudsucker (*Gillichthys mirabilis*), or topsmelt (*Atherinops affinis*). However, even with the ability to control the flow of water into the marsh—and thereby control salinity levels and other aspects of water chemistry—it will be difficult to predict the extent to which brackish conditions will develop, and it is likely that such conditions will vary from season to season and from year to year.

The brackish marsh, particularly the upper portions of the marsh which will receive less frequent inundation, will be vulnerable to invasion by non-native weed species. As conditions become less saline and tidal inundation becomes less frequent, a greater suite of invasive species will be able to become established. Maintaining more saline conditions by limiting the amount of freshwater entering the brackish marsh may be one way to minimize the potential for invasion of non-native weeds. The use of densely spaced restoration plantings that will fill in quickly and limit the availability of light and nutrients may also help to reduce potential for invasion.

Due to the variable nature of brackish marshes—including large intra- and inter-annual variations in salinity levels (Desmond et al. 2001)—it is difficult to describe a target area or vegetation community for this habitat. Vegetation should include some combination of California bulrush, southern cattail, ditch grass, spiny rush, pickle weed, saltgrass, alkali heath, and other species typical of habitats ranging from freshwater to tidal wetlands (see the potential plant palette provided as Appendix A). Target acreages for brackish marsh should be flexible, as it is likely that the extent of brackish conditions will shift from season to season and year to year. Performance goals should focus on both the composition of the vegetation and the total area of vegetative cover. Plantings will be required in this area and should focus on dominant species characteristic of brackish marshes. It may be desirable to also plant small patches of non-dominant species to increase native plant diversity in the brackish marsh.

3.1.3 Salt Panne

Salt pannes develop in shallow depressions along the upper edges of the high marsh zone. They occur at elevations high enough to receive only occasional high tides. Salt panne depths are shallow enough that they do not collect excessive amounts of rainfall and can dry down between tide events. Salt pannes are often ponded for long periods during the winter and spring months and dry for longer periods during the summer. The input of saline water combined with successive periods of flooding and evaporation creates hypersaline conditions that exclude most plants (Pratolongo et al. 2009). With changes in salinity levels and the duration and frequency of ponding, salt pannes have

the potential to grade into either seasonal wetland or tidal marsh habitats. Two hydrologically distinct forms of salt panne habitat currently occur at the BWER: (1) those that receive water input primarily from spring and other high tides, depending on the levels at which the tide gates are set and (2) those that receive water input from seasonally shallow saline groundwater and stormwater runoff. In both cases, extended periods of evaporation result in the concentration of salts in the upper portion of the soil, resulting in a lack of vegetation over large portions of these habitats. Created salt panne habitat at the BWER will be primarily of the first type, receiving water input primarily from spring and other extreme tides. However, given the presence of saline soils and the likelihood of saline groundwater occurring in many portions of the Reserve, some of areas designed as seasonal wetland habitat may develop high concentrations of salts at the soil surface, thus resulting in the formation of salt panne-like conditions.

It is unclear how long it may take for salinity to reach levels sufficient to exclude most plants, and creation of salt panne habitat at the BWER will benefit from incorporation of high-salinity soils salvaged from existing salt panne habitat that will be lost to tidal wetland restoration or from high-salinity soils excavated from deeper within the soil profile. In addition, it may be desirable to add salt to the pannes to increase salinity levels more rapidly. Given the uncertainty regarding salt panne development and function, a phased approach will be used wherein salt panne design will be tested in Area A, and the results will be carefully evaluated prior to implementation in the other portions of the Reserve.

Target habitat acreages for seasonal wetlands under each project alternative will be developed in later stages of the restoration based on input from the project design team and regulatory requirements. At peak salinity levels, salt panne habitat should exclude the germination and establishment of most plants; however, it is likely that initial post-construction salinity levels may not be high enough to exclude all plants. Moreover, typical tidal marsh plant species such as Parish's glasswort, pickleweed, and saltgrass may become established in a developing salt panne when surface salinities are not yet elevated and then persist as the salt panne develops higher salinity by tapping into lower-salinity water deeper in the soil profile, thereby resisting exclusion by high surface salinities. Weeds with some salt tolerance such as perennial pepperweed (*Lepidium latifolium*) may also become established during the initial years of the restoration when salinity levels are relatively low, and more intensive weed management may be necessary during this time period. As salinity levels rise with each successive dry-down period, plants should be naturally excluded from germinating and establishing within the salt panne habitat, and less weed management will be necessary. Although new plants are likely to be prevented from establishing once salinity levels are sufficiently high, it may be necessary to remove plants which became established when salinity levels were low.

3.1.4 Seasonal Wetland

Seasonal wetlands generally develop in low-lying areas that collect rainfall and other runoff or receive input from seasonally elevated shallow groundwater. These habitats are dependent on ponded conditions that persist for a limited period following the rainy season and which promote the development of hydric soils and hydrophytic vegetation. The duration and depth of ponding is the major determinant of plant community development in seasonal wetlands (Kolka and Thompson 2006). Longer periods and deeper depths of ponding will result in vegetation dominated by wetland-adapted, sometimes perennial species, whereas shorter periods and more shallow depths of ponding may result in vegetation dominated by annual species adapted to fluctuating moisture regimes. At the BWER, soil salinity will also play a major role in determining the plant communities that will develop in seasonal wetlands.

Target habitat acreages for seasonal wetlands will be developed in later stages of the restoration based on input from the project design team and regulatory requirements. Seasonal wetlands will be designed to have a range of inundation depths and durations and will be strategically located throughout the upland and transition habitats throughout the Reserve. The location of these wetlands will be designed to allow for a transition from vernal pool to salt panne habitat in conjunction with expected rates of sea level rise. As sea levels rise, salt panne habitat within the transition zones should undergo natural conversion to tidal marsh habitat and seasonal wetlands located higher in the transition zones and upland habitats will likely undergo conversion to salt panne habitat. This should result in an overall loss of seasonal wetland habitat, but should allow for natural establishment of new tidal marsh and salt panne habitat as sea levels rise.

Historically, seasonal wetlands on coastal terraces in the Ballona region supported a high diversity of freshwater vernal pool plant species (Mattoni and Longcore 1997). The focus of seasonal wetland restoration in areas of low-salinity soils at the Reserve will be on the creation of shallow depressions with appropriate soils for supporting a similar assemblage of southern California vernal pool plant species (see Appendix A). Vernal pools and other seasonal wetlands are formed in two ways: (1) by fine textured low-permeability subsoils which perch shallow groundwater or (2) by seasonal exposure of high water tables through more coarse-grained soils (Zedler 1987; Mitsch and Gosselink 2000; Kolka and Thompson 2006). Investigation of the relationship of topography and soil permeability to surface and subsurface hydrology and salinity at the BWER is necessary to inform the appropriate design of the seasonal wetlands to be created. Analyses will be conducted in existing seasonal wetlands to determine how they function, and theywill also be conducted in the sites proposed for creation of seasonal wetlands to determine what type of seasonal wetlands these areas can support. If the sites selected for seasonal wetland creation contain high water tables,

the created seasonal wetlands will be excavated to an appropriate depth to reach this high water table. If the sites selected for seasonal wetland creation do not contain high water tables, the created seasonal wetlands will be designed with a compacted layer of fine-textured soil which will perch shallow groundwater. Additional topographic and hydrological analyses will be necessary to ensure that seasonal wetlands of this design are fed by an appropriately sized watershed.

3.1.5 Riparian Scrub and Woodland

Riparian habitats are shrub- or tree-dominated areas which develop along the edges of ephemeral, intermittent, or permanent streams or rivers (National Research Council 2002; Mitsch and Gosselink 2000). Habitats within the Reserve which have been classified as *riparian* in the existing conditions report prepared by PWA et al. (2006) may be better described as palustrine scrub or shrub wetlands or palustrine forested wetlands (CDFG 2007) as these features occur not along streams or rivers, but rather adjacent to wetlands or within seasonally ponded areas or areas with shallow water tables. Hydrology is the primary ecological driver for these plant communities, and as such, riparian plant communities within the Reserve are vulnerable to changes in hydrology resulting from grading activities associated with the restoration. In addition, many of the species within these communities may be sensitive to salt, and the restoration of tidal marsh habitat adjacent to these habitats may increase exposure to saline groundwater.

Some portion of the mapped riparian scrub vegetation within the southern and eastern portions of Area B will be lost under most project alternatives to the restored tidal and brackish marsh habitats. However, the eucalyptus grove located in Area B, near the terminus of Falmouth Avenue, will be preserved under all alternatives, as these trees are currently used as roosting habitat for monarch butterfly. The trees will be monitored and managed as needed to maintain suitable habitat conditions for the monarch population and will eventually be replaced with native trees suitable for the site and for monarch roosting. Replacement of the eucalyptus trees will occur in phases according to a replacement plan which will be developed in conjunction with the CDFW. During the interim period, the eucalyptus grove will be prevented from increasing in size or extent. Riparian habitat within Area C is may be lost to upland habitat restoration and construction of the interpretive visitor center and associated facilities planned for this area. The final acreage of riparian habitat to be either preserved and enhanced or created will be determined in later stages of the restoration based on input from the project design team and regulatory requirements. Riparian vegetation not removed during the restoration may be vulnerable to dieback resulting from changes in hydrology or salinity resulting from the creation of tidal wetland habitat immediately adjacent to these areas. Any grading to occur in or around preserved riparian habitat will need to

be undertaken with consideration of the available sources of water for these habitats and should strive to maintain existing levels of water input to prevent large-scale dieback in these areas. Management of riparian areas will focus on the removal of invasive plant species (exclusive of the eucalyptus grove in Area B) and incorporation of appropriate native riparian plants (see Appendix A) to increase diversity and provide appropriate habitat structure for riparian wildlife species.

3.1.6 Dune

Coastal dunes in their natural condition are inherently dynamic systems changing in response to wind and waves (Nordstrom 2008). Plant species typically associated with dune habitat have evolved a variety of reproductive and competitive strategies to adapt to the constant disturbance of accreting and eroding sand (Pickart and Barbour 2007). Dunes within the Reserve are remnants of a once larger dune system and are relatively isolated from the sand source and prevailing winds that are the ecological drivers which would normally shape these systems. Restoring the dunes to a more natural, self-sustaining condition is not possible given the development that has occurred west of the dunes; however, ongoing planting and invasive species control efforts led by Friends of Ballona Wetlands have restored portions of the dunes with native plant species typically found in southern California dune systems. Within these plant communities are several special-status plants (e.g., South Coast branching phacelia) as well as potential host plants for special-status invertebrates (e.g., El Segundo blue butterfly).

The existing dunes occurring in the western and southeastern portions of Area B will remain under some of the project alternatives. Management activities will focus on limiting anthropogenic disturbances, removing non-native species, and encouraging the establishment of both common and rare native dune species. A limited area of dune creation may be undertaken in several additional portions of the Reserve. Similar to existing dune habitat, the created dunes will not be subject to the ecological drivers which would naturally shape these systems. The goal of dune creation should be to provide suitable sand substrate and habitat structure to encourage the development of dune vegetation similar in structure and composition to the vegetation of the existing dunes. Dunes creation should make use of clean sand of similar grain-size to that of the existing dunes. Sand can be sourced from off-shore dredging or from inland quarries. Dredged sand is more likely to be of compatible grain-size and parent material; however, it is also likely to be too saline for most dune plants and will require extensive leaching or capping with 1 to 2 feet (0.3 to 0.6 meter) of inland sourced sand. Inland sourced sand is more likely to be of less compatible grain-size and parent material; however, salinity should not be an issue. The physical structure of created dune habitat should mimic that of existing dunes at the Reserve.

Target vegetation for existing and created dune habitat will be similar in diversity and structure to stabilized back-dune systems in the region, with high diversity and cover of native species, including both woody perennials and herbaceous annuals. During the initial phases of the restoration when plant cover is low, erosion control measures such as the use of sand fencing, hay bales, crimped straw, or jute netting may be necessary to stabilize the sand (Nordstrom 2008). In addition, plantings may benefit from limited application of slow-release fertilizer and supplemental irrigation. It is important that only slow-release fertilizer be used for these applications, as slow-release fertilizer reduces the potential for eutrophication of adjacent waters. In addition, the slow-release fertilizer should be incorporated into the planting holes, rather than being broadcast over large areas—this will ensure that the fertilizer is used by the installed plants rather than by weeds growing between the plantings.

3.1.7 Upland Scrub and Grassland

The primary goal of upland habitat restoration at the BWER is to provide support functions for the larger tidal wetland restoration, including reducing sediment loads to seasonal and tidal wetlands and providing high tide refuge for tidal wetland wildlife. Target habitat acreages for upland scrub and grassland habitats will be developed in later stages of the restoration based on input from the project design team and regulatory requirements. Upland habitats (exclusive of the dunes) should have high plant cover and a diverse composition of native shrubs and herbaceous plants. The composition of this vegetation may be limited by potentially high salinity levels in soils throughout the Reserve. Target vegetation includes grasslands dominated by species such as California barley (*Hordeum brachyantherum* ssp. *californicum*), purple needlegrass (*Stipa* [*Nassella] pulchra*), saltgrass, and alkali ryegrass (*Elymus triticoides*) and scrub dominated by species such as coyote brush, California sagebrush (*Artemisia californica*), mugwort (*Artemisia douglasiana*), big saltbush, lemonade berry (*Rhus integrifolia*), and seacliff buckwheat (*Eriogonum parvifolium*). Additional species will be included in both upland habitat types to increase overall native plant diversity. It should be expected that non-native annual grasses will also form a major component of both grassland and scrub habitats given their prevalence in the seed bank.

If soils used for the creation of upland habitat are highly saline, a 3- to 4-foot cap of clean, non-saline soil may be required to allow for establishment of salt-intolerant species. Even with a cap of non-saline soil, there is potential for saline groundwater to move up through the soil profile and for saline conditions to develop in the root zone. In the event that this becomes an issue at the BWER, a more limited palette of highly salt-tolerant upland plants will be required (see the potential plant palette provided as Appendix A). Given that upland habitat at the BWER will be limited in extent relative to tidal wetland areas, it may be possible for temporary irrigation to be used during the

establishment of upland plantings—this would increase the success rate of upland plant establishment, particularly for native bunchgrasses and woody perennials.

3.2 Overarching Elements of the Restoration

The following sections outline the approach to the overarching elements of the proposed restoration, those elements which are common to most or all habitats, including hydrology, soils, vegetation, and public access. This overview is intended to provide context for the subsequent sections of the Conceptual Plan and to provide guidance for the restoration design where appropriate. Details of the proposed restoration activities for each project alternative are provided by PWA (2010) and ESA PWA (2012a) and are subject to modification based on input from the project design team and regulatory requirements. The restoration will be conducted in phases, with the structure of the latter phases being informed by lessons learned during the first phases, and thus the approach presented here may also be subject to change based on outcomes of the first phases of the restoration.

3.2.1 Hydrology

Any restoration of tidal activity will include the installation of culverts and self-regulating tide gates as well as the creation of tidal channel networks in the restored wetlands. Self-regulating tide gates will allow the full range of tidal activity while maintaining required levels of flood control. Tide gates may be closed during extreme tides or during storm events in Ballona Creek. Restoration of tidal activity will bring saline water into restored tidal wetlands which will become the driving force behind ecological processes in these areas.

3.2.2 Soils

A large volume of soil was placed in Area A during the construction of Marina del Rey. This soil will be excavated under some project alternatives to restore appropriate tidal elevations throughout the BWER. Excavated soil will be re-used on-site to the greatest extent possible.

Appendix B provides a summary of the initial soil analyses conducted at the site as they relate to the establishment of plant communities. Based on these initial analyses, it has been determined that soil salinity may be an issue in the excavated soils, with surface soils containing lower levels of salts and subsurface soils containing salts at levels too high for even the most salt-tolerant plant species. In addition, levels of several essential plant nutrients may be too low to support desired levels of plant growth. Specifically, nitrogen, phosphorus, calcium, and zinc were found to be lower than preferred for the establishment of healthy native plant communities. Given the low levels of these plant nutrients in soils at the site, limited application of fertilizer may be needed. Analyses of

sodium absorption ratios show an imbalance between sodium and soluble calcium and magnesium, which can negatively affect soil structure and water infiltration in soils used outside of a salt marsh setting (e.g., soils used for upland restoration). Incorporation of gypsum combined with extensive leaching may be necessary to reduce sodium levels and improve sodium absorption ratios. Soil texture was shown to range between sand and loam, with most samples being relatively sandy. The more coarsely textured soils (i.e., sandy soils) will have reduced water holding capacity and may not be suitable for establishing plant communities adapted to mesic conditions. The use of soil amendments to increase the water holding capacity of on-site soil or the use of imported soil may be necessary if sufficient amounts of finely textured soils cannot be sourced on-site.

Due to the extensive volume of soil involved in the restoration, the use of soil amendments to alter soil texture or chemistry may be cost-prohibitive. Similarly, importing soil at the scale required for the restoration may also be cost-prohibitive. Given the expense involved in importing soils to the site, including the potential need to export “unusable” soil from the site, every effort will be made to reuse soil on-site. This will require an extensive analysis of soil texture and chemistry throughout both the areas to be excavated and areas of existing salt-adapted and salt-sensitive vegetation—this will provide a detailed understanding of the range of physical and chemical soil conditions across the site, as well as the range of salinities tolerated by existing plant communities at the site. Analyses will be designed to identify the vertical and horizontal distribution of important physical and chemical soil properties; these data will be used to inform the salvage and re-use of excavated soils during the restoration.

Finer textured soils with high organic content will be incorporated into the top 1 to 2 feet (0.3 to 0.6 meter) of mudflat and tidal wetland habitat up to the mean high water line, above which more coarsely textured soils may be incorporated. Highly saline subsoils, as well as highly saline surface soils, will be used for the construction of salt panne habitat. To the extent feasible, highly saline soils will not be used to create upland habitat. However, it is likely that an insufficient amount of non-saline soil will be available on-site for the creation of upland habitat and it will be necessary to use some amount of saline soil for this purpose. Where saline soils are used to create upland habitat, they may need to be amended with gypsum and extensively leached with freshwater and/or covered with a 3- to 4-foot cap of non-saline soil salvaged from elsewhere at the site or imported from off-site. Although there is potential for salts to be wicked up through the soil profile over time, a thick cap of non-saline soil will allow plants to become established and to acclimate to slowly increasing salinity levels. If the use of soil amendments and/or importation of non-saline soil is cost prohibitive, a salt-tolerant plant palette will be required. Appendix A identifies native salt-tolerant plants suitable for including in the restoration design.

3.2.3 Vegetation

Establishment of vegetation in the restored habitats will be based on a combination of natural revegetation and planting or seeding with native plant species appropriate to the hydrologic, soil, and climatic conditions at BWER. Due to the extensive area involved in the restoration and the potential cost involved in the use of potted plants and plugs, natural revegetation and/or seeding will be used whenever possible. Areas receiving regular tidal inundation are ideal for natural revegetation as tidal waters can contain large numbers of propagules for plants suited to tidally influenced habitats—these include low and mid-marsh habitats as well as brackish marsh habitats. Limited installation of potted plant material or plugs may be used in these areas to speed recolonization of the marsh plain, especially in Area A where input of dispersing seed will likely be low due to the low cover of tidal wetland plants currently present in this portion of the BWER. Subsoils and soils excavated from existing marsh or salt panne habitat may lack a suitable seedbank for natural revegetation in uplands; however, if this is the case, these soils will have the advantage of lacking an upland weed seedbank as well. These areas will require seeding with an appropriate mix of native herbaceous plants with supplemental planting of native shrubs. Alternatively, shrubs may be seeded; however, establishment of shrubs from seed is a slow process and better results are likely to be achieved through the use of potted plants. Given the need for sand stabilization in any created dunes, the use of potted plants and plugs is preferred over natural revegetation in this habitat.

Plantings will require careful phasing to ensure that plants are installed at the correct time of year (ideally at the onset of winter rains) and that plantings occur as soon as possible after final grading. This will help ensure successful establishment with minimal need for irrigation, reduce the potential for erosion, and minimize colonization by weedy non-native species. Plantings in high marsh, transition, and upland habitats (including dunes) are likely to require supplemental irrigation during the first two to three years after planting. Supplemental irrigation greatly improves the success of restoration plantings, and the added cost of installing temporary irrigation should be viewed as an investment in the long-term success of the restoration.

A potential plant palette is provided as Appendix A. This list was developed based on the suite of native species documented in the existing conditions and baseline studies reports (PWA et al. 2006; Johnston et al. 2011, 2012) as well as on historical references and plant lists from other coastal wetlands in southern California (Schreiber 1982; Mattoni and Longcore 1997; Sullivan and Noe 2001; Dark et al. 2011; Sawyer et al. 2009). The species included in the list are all native to southern California. Efforts have been made to limit the species on this list to those historically present in the greater Los

Angeles region; however, some species have been included based their ease of propagation and adaptability to a wide range of environmental conditions.

There is potential to salvage some of the existing vegetation for use in restored habitats; however, use of salvaged plant material will require careful timing to ensure plants are removed from existing habitat and replanted during appropriate phenological stages and during appropriate times of year, both of which are species-specific. Salvaging existing vegetation would require an extensive area of land, either on-site or off-site, devoted to propagation and staging. Because the plants being salvaged or propagated would be adapted to the local climate, heated greenhouse facilities may not be necessary; however, other infrastructure would be necessary. Such infrastructure might include shading structures, raised beds, propagation benches, irrigation, fencing, etc. Although the cost of salvaging plant material from the site could be reduced through the use of volunteers, dedicated staff experienced in large-scale plant propagation would be necessary. Alternatively, the stockpiling and maintenance of salvaged plant material can be contracted out to a reputable nursery or a firm specializing in habitat restoration. It is unlikely that all of the plant material needed for the restoration can come from salvaged plant material, and propagation of additional plant material will be necessary. Plant propagation should be accomplished through collection of seeds and cuttings from healthy populations within the Santa Monica Bay watershed. If suitable donor populations cannot be located within this watershed, plant propagules may be sourced from adjacent watersheds; however, efforts should be made to collect plant material from as close to the BWER as possible to maintain the genetic integrity of the regional flora and to ensure that the plants are adapted to the local climate. A large amount of plant material will be required over the lifespan of the restoration, and it will be important to have ample material available during the initial planting and for supplementary planting in subsequent years as habitats develop. Initial plantings should focus on the dominant species desired in each habitat, with supplementary plantings to increase diversity in later stages of the restoration.

A detailed planting plan will be developed for the restoration and will outline protocols for plant sourcing and propagation, necessary infrastructure and staffing for on-site salvage and propagation, requirements for contracted plant salvage and propagation, specifications for soil amendments and irrigation, specifications and a schedule for planting and subsequent management actions, and a weed control plan to ensure successful establishment and long-term maintenance of plant communities at the BWER.

3.2.4 Special-Status Species

A number of special-status plant and wildlife species have been identified at the BWER; these species are listed in Sections 2.2.5 and 2.2.6, respectively. Except for Lewis'

evening primrose and wooly seablite, special-status plant species at the BWER are restricted to the dune habitat in the western portion of Area B (WRA 2011). Lewis' evening primrose occurs in the dune habitat, but also occurs in large numbers in Area C and in smaller numbers in the southeastern portion of Area B (WRA 2011). Wooly seablite occurs along the southwestern edge of Ballona Creek (WRA 2011). Given that work within the dunes in the western portion of Area B will be largely limited to weed removal and planting of appropriate native species, existing special-status species in this area are unlikely to be negatively impacted by restoration activities. Instead, it is likely that restoration activities in the dunes will benefit the special-status plant species present there. It is unclear at this point how restoration activities will affect the occurrences of Lewis' evening primrose outside of the dunes or the occurrences of wooly seablite along Ballona Creek. Occurrences of these species will be protected to the extent feasible. Focused monitoring efforts will be implemented for occurrences of these species that are to be protected, and appropriate management efforts will be undertaken if populations decline significantly. Any impacts to these species will be mitigated on-site through re-establishment of impacted species in restored habitat at the Reserve—this may require collection of seed or other propagules prior to impacting the species. Re-establishment and subsequent monitoring efforts for impacted species will be implemented according to a mitigation and monitoring plan developed in accordance with appropriate local, state, and federal policies or regulations.

Similarly, most special-status insects and the only special-status reptile (California legless lizard) known from the BWER are restricted to the dune habitat in the western portion of Area B. Given the limited extent of proposed restoration activities under the project alternatives in this area, it is unlikely that these species will be negatively impacted by restoration activities. Instead, it is likely that these species will benefit from the on-going restoration activities in this habitat. Focused monitoring efforts will be implemented to ensure that populations of these species either remain at pre-restoration levels or increase in size, and appropriate management efforts will be implemented, as feasible, if populations of these species decline in size.

Although the South Coast marsh vole may experience some temporary loss of habitat during the restoration, it is expected that this species will ultimately benefit from tidal marsh and upland grassland restoration efforts at the BWER. This species will be protected during restoration efforts following protocols approved by the CDFW. Following the completion of restoration efforts, focused monitoring efforts will be implemented for this species to ensure that its population remains at pre-restoration levels or increases in size, and appropriate management efforts will be implemented, as feasible, if the population of this species declines in size.

Given the major grading and other activities planned under some project alternatives in areas occupied by Belding's Savannah sparrow or least Bell's vireo, the restoration has potential to negatively impact these species during project construction. To reduce the potential for negative impacts, appropriate avoidance and minimization measures will be implemented following standard protocols approved by the CDFW. In addition, habitat actively occupied by either of these species will not be impacted until it is demonstrated that these species are making use of restored habitat that was previously unoccupied by the species and that the temporary loss of currently occupied habitat will not have negative impacts on the species. For example, restoration of full the full tidal range in the western portion of Area B—which would require extensive temporary loss and minor permanent loss of tidal marsh and salt panne habitats which are currently occupied by Belding's Savannah sparrow—will not occur until it has been demonstrated that the species is actively using restored tidal marsh and salt panne habitats in Area A and that the temporary and permanent loss of habitat in Area B will not have negative impacts on the species. As with other special-status species, focused monitoring efforts will be implemented to ensure that populations of these species either remain at pre-restoration levels or increase in size, and appropriate management efforts will be implemented if populations of these species decline in size.

In addition to the species discussed above, restored habitats at the BWER have the potential to attract a number of additional special-status plant and wildlife species known to occur in the region. New populations of special-status species will be subject to focused monitoring efforts aimed at identifying trends in population size and habitat use and informing the need for active management of the species or habitats in which they reside. To the extent feasible, monitoring of special-status species will be conducted using established protocols and will be incorporated into existing regional or state monitoring programs for these species.

3.2.5 Invasive Species

A number of non-native, invasive species currently occur at the BWER. Complete eradication of all non-native species in the Reserve is not feasible; however, restoration objectives include the control of those species considered highly or moderately invasive by the California Invasive Plant Council ("Cal-IPC"; 2013); control of such species will be essential for the long-term development and maintenance of desired vegetation communities and high levels of biodiversity. Controlling invasive species will require appropriate pre- and post-construction measures and monitoring to ensure that existing populations of invasive species are handled appropriately and to avoid new introductions of invasive plants. During the pre-construction phase, populations of invasive species should be identified and prioritized for removal. In areas in which soil will be excavated and reused, it may be necessary to remove invasive species prior to

excavation to prevent spreading propagules to other portions of the BWER. For some species which are currently present in high numbers (e.g., pampas grass), a significant amount of biomass will have to be removed. This biomass will require special handling and disposal following appropriate best management practices to prevent spreading the plants to areas outside of the BWER and to prevent reestablishment at the BWER (see Appendix C and Cal-IPC 2012a, b). Depending on the depth of soil to be placed in upland restoration areas and other areas receiving excavated soils, it may be possible to place excavated soils directly over existing populations of invasive plants. Similarly, it may be possible to dispose of removed invasive plant material by burying it under a thick layer of excavated material. The depth at which invasive plant species must be buried to ensure that they will not resprout varies by species, but is on the order of 3 to 10 feet (0.9 to 3 meters). Burying large amounts of plant material at the site may cause issues with subsidence as the plant material decomposes—this subsidence would have to be quantified and incorporated into the project design.

Because it is not possible to remove all invasive plants from the BWER or from surrounding areas, post-restoration monitoring and removal of invasive species must be an on-going process as new infestations are likely to arise over time. Limiting sources of soil disturbance within the BWER, combined with the use of best management practices when soil disturbance is required, will help reduce the potential for new invasions. Control methods for selected invasive species currently at the BWER are presented in Appendix B.

In addition to invasive terrestrial plants, there is potential for establishment of invasive aquatic plant and wildlife species. The potential for introduction of invasive aquatic plants will be limited by high salinity levels in aquatic areas throughout the Reserve. However, there is greater potential for introduction of highly invasive aquatic invertebrates such as the New Zealand mudsnail (*Potamopyrgus antipodarum*). Strict best management practices related to the movement of equipment and materials in and out of the BWER will be required to prevent the introduction of invasive plant and wildlife species. This will be particularly important for equipment and materials that have been used in wetted environments prior to entering the Reserve. A general list of potential best management practices to be employed during the restoration is provided as Appendix C.

3.2.6 Public Access and Infrastructure

A wide range of infrastructural improvements will be necessary to accommodate planned levels of public access. The majority of planning related to public access and infrastructure is beyond the scope of this Conceptual Plan and will be developed in further detail by the project design team; however, some discussion of the location of public access relative to sensitive habitats is appropriate here. Public education and

access to unique habitats is a key goal of the proposed restoration, and as such, it will be important to provide opportunities for public access into the restored habitats. However, public access to these habitats should be limited to well-defined trails and boardwalks. These features should be designed to accommodate natural flows of foot traffic through the BWER—this will help prevent visitors from deviating from the established paths and creating social trails in sensitive habitats. It may be necessary to include wildlife-friendly fencing, plantings of spiny native plants (James and Zedler 2000), or other elements designed to prevent human access to sensitive habitats. Similarly, seasonal closures may be necessary in certain parts of the Reserve to accommodate the life history of sensitive wildlife species (e.g., during the breeding season for some birds) or to prevent damage to trails during the rainy season.

3.3 Restoration Phasing

The complexity of a restoration of this size as well as the presence of sensitive habitats and species necessitates careful staging. The restoration will occur in three phases, each requiring multiple years to complete. Phasing will be designed to allow for evaluation of biologic (including special-status species), hydrologic, and geomorphic performance of early restoration stages and subsequent refinement of the restoration design for later stages. Details of restoration staging can be found in the technical memoranda prepared by ESA PWA with contributions from Psomas and Associates and Group Delta, Inc. (PWA 2010; ESA PWA 2012a). The final staging will require further development to incorporate the biological components of the restoration at appropriate stages and to accommodate changes to the latter stages of the restoration based on the outcome of the first stages. As noted in Section 3.3.4, phasing for many portions of the restoration will be dependent on the demonstrated use of restored habitats by specific special-status species (*e.g.*, Belding's Savannah sparrow) and the determination that restoration activities will not have negative impacts on such species.

3.4 Restoration Approach

As noted previously, the final restoration plan is still in development, several alternatives are being considered, and it is likely that some aspects of the approach will be changed based on funding constraints and regulatory requirements.

3.5 Planning for Climate Change

Numerous public agencies have prepared policies and guidance for addressing issues related to global climate change with particular emphasis on rising sea levels and increases in storms and other extreme weather events (e.g., California Climate Action Team 2010, 2013; SLC 2009; CDFG 2011). Most guidance focuses on adaptive capacity, or the ability of a system to change in response to rising sea levels. Relative

to developed areas, natural habitats such as the Ballona Wetlands generally have an some level of adaptive capacity in that organisms are relatively mobile and habitats can shift, whereas anthropogenic structures such as buildings and roads must be actively protected or relocated. Development adjacent to natural habitats limits this adaptive capacity.

Because our understanding of the potential effects of global climate change is limited, it is difficult to plan the effects that climate change may have, and most planning is aimed at ameliorating the effects of rising sea levels. Bergquist et al. (2012) prepared an extensive analysis of the implications of climate change for the proposed restoration at the BWER. Their analysis indicated that the BWER will be particularly vulnerable to sea level rise due to its low-lying coastal position and that the effects of rising sea levels are likely to outweigh the effects of increased frequency and severity of major storm events.

To accommodate rising sea levels, the proposed restoration alternatives incorporate gentle slopes in tidal wetland and transition habitats with the intent that such gradual slopes will allow tidal marsh habitat to move landward as sea levels rise. As sea levels rise, it is expected that the sequence of tidal marsh, transition, and upland vegetation will shift upslope. This will result in a decrease in upland habitat, but will enhance the ability of tidal marsh habitat and its associated wildlife to persist. This use of broad transitional slopes between wetland and upland habitats is consistent with the State Coastal Conservancy's Climate Change Policy (SCC 2011).

More complex changes in ecological processes are expected with global climate change; however, the extent of our knowledge of climate change and associated adaptation strategies is limited and makes more than generalized predictions impossible. It is likely that a changing climate will result in changes in the distribution of plant and wildlife species as well as the timing of growth and reproduction of these species. The timeframe under which such changes may occur is unclear, as are the implications for the proposed restoration at the BWER. As such, the use of adaptive management strategies will play an important part in managing the BWER in response to climate change. Given the uncertainty in our understanding of the potential effects of climate change, it will be important to be able to address unexpected issues such as deviations in expected habitat development, shifts in the ranges of both native and non-native species, increases in the prevalence of diseases or pest species, and other challenges. The use of an adaptive management approach will allow the land manger to address such challenges and to find solutions consistent with the goals of the restoration.

4.0 MONITORING, PERFORMANCE GOALS, AND ADAPTIVE MANAGEMENT

The monitoring program for the BWER will be designed to evaluate the progress toward achieving restoration goals and to inform the need for adaptive management during the lifespan of the restoration. Because the restoration is not being conducted as mitigation or under mandate from any state or federal judicial body or regulatory agency, the performance goals and associated monitoring may differ from those of standard mitigation projects. That said, many aspects of the restoration will be subject to regulatory oversight, and additional performance goals and associated monitoring requirements may be required by the regulatory agencies. In general, however, performance goals for the restoration will not focus on specific acreages or specific species, but will focus broadly on habitat development, species composition, and, ecosystem function (Short et al. 2000; Zedler and Callaway 2000; Thom et al. 2010). Moreover, the performance goals will be open to revision based on improvements in our understanding of habitat development or species requirements, including lessons learned during the early phases of the restoration or from other similar restoration projects being conducted in the area.

In addition to being broad-based and adaptable, the monitoring program will be of sufficient length to capture long-term trends in habitat development and use by wildlife species—this could be on the order of a decade or longer (Zedler and Callaway 1999). For most variables discussed in this Conceptual Plan, a monitoring period of 10 years is recommended. A 10-year monitoring period was chosen to balance funding limitations with the need to document long-term trends in habitat development. Although a 10-year monitoring period is recommended, it is understood that some aspects of habitat development and function may not be evident within the first 10 years, and for these variables it may be necessary to extend the monitoring period by an additional decade or more.

The goal of monitoring will be to document trends in habitat development and assess progress toward meeting restoration objectives. For cases in which the course of habitat development is relatively uncertain or for monitoring parameters which may be highly variable, it may be useful to assess performance relative to conditions in suitable reference habitats in the region. For more well-understood parameters, the use of absolute performance goals may be sufficient. It should be understood that some level of uncertainty will always be present, and all of the performance goals presented here or those to be developed for the HMMP may require modification based on an improved understanding of habitat development, ecosystem function, or species requirements (Atkinson et al. 2004; Thom et al. 2010; Fischenich et al. 2011). Furthermore, habitat development is an on-going process that is likely to extend well beyond the prescribed monitoring period. Some aspects of the monitoring program will have a definitive end

point (i.e., when performance goals have been reached). However, given the highly modified nature of the watershed supporting the BWER and the constraints imposed by the surrounding development, it is likely that the restored wetlands will never be fully sustainable and will always require periodic maintenance (Callaway and Zedler 2004). As such, some level of monitoring and management will be required indefinitely into the future (e.g., monitoring for invasive species or human disturbance).

Finally, the monitoring program will be designed to be simple, cost-effective, and achievable (Atkinson et al. 2004). Because of the potential length of the monitoring period, monitoring should be designed using standard methods and equipment such that monitoring can be conducted by a range of individuals or organizations, including citizen-scientist volunteers where appropriate, with only minimal training required. Monitoring will focus on the major biotic and abiotic factors that drive habitat development and ecosystem function—in particular, those factors that can be manipulated and managed or those parameters that can be used to gauge habitat development and ecosystem function (Thom et al. 2010). Sampling procedures and analyses of monitoring results will be developed to appropriately reflect the level of accuracy achievable with each sampling procedure and the sample size achievable for each monitoring parameter. The end result of the monitoring program will be a simple, clear picture of habitat development at the BWER in terms that can be understood by scientists, regulators, and laymen alike.

It should be noted that because the restoration plan is still in development, many of the details necessary for developing strict monitoring protocols and performance goals are lacking. For example, it has yet to be determined which habitats will be planted and which will be allowed to revegetate naturally. Habitats that are planted would be expected to develop at a more rapid pace than habitats that are allowed to revegetate naturally. As such, it is difficult to develop strict performance goals related to vegetation establishment. The same is true for other aspects of the restoration that are still in development. The information provided in this Conceptual Plan is intended to guide the development of such details; however, many other factors beyond the scope of this document (e.g., funding) must also be considered. As such, many of the elements treated in the following sections are conditional and are subject to change based on the form of the final restoration plan, input from the CEQA/NEPA analysis, and regulatory requirements.

4.1. Developing the Monitoring and Adaptive Management Program

As noted in the Introduction, the purpose of this Conceptual Plan is to outline the general form of the restoration and guide the development of more detailed elements of the final restoration plan such as the grading plan, the planting/landscape plan, the operations and management plan, and the HMMP. Among these plans is the

development of a more detailed HMMP based on the guidance provided in this Conceptual Plan, the findings of the CEQA/NEPA analysis, regulatory requirements, and the final plan for restoration staging and implementation. The HMMP will build directly from the guidance developed in this Conceptual Plan, with modifications as necessary. The HMMP will include a timeline for the implementation of the monitoring program based on the final plan for staging and implementation. Although a monitoring period of 10 years is recommended here, the final length of the monitoring period will be based on the phasing to be implemented during the restoration. The HMMP will also include a work plan or schedule for long-term monitoring after the site has achieved the performance goals outlined here and in the HMMP. In addition to a detailed monitoring schedule, the HMMP will provide specific protocols for monitoring, including sample design (e.g., number of replicates, locations for sample points, transects, etc.), sampling methods to be implemented, and statistical methods for analyzing the data.

4.1.1 Reference Sites

As noted above, the use of reference sites may be useful for monitoring parameters which are highly variable, such as for biological parameters closely linked to local or regional climates (e.g., plant response to rainfall levels). The use of reference sites may also be useful for habitats for which the course of development is not well understood (e.g., salt panne habitat). The decision to use reference sites as a control for highly variable monitoring parameters or parameters tightly correlated with local weather and climate patterns should be made prior to the initiation of the monitoring program, with significant input from the Scientific Advisory Committee and the CDFW or other managing agency.

The selection of appropriate reference sites is an important component of the monitoring program, as the use of inappropriate reference sites could lead to misinterpretation of habitat development and ecosystem function and could result in a false sense of success or failure. The use of reference sites to gauge the progress of restoration efforts is generally limited by the availability of suitable sites in the region, the similarity of potential reference sites to the restoration site, and the funding available for monitoring (Neckles et al. 2002). The use of tidal wetland reference sites in southern California is further limited by the availability of natural, undisturbed tidal wetlands. Many of the potential reference wetlands in southern California are either highly degraded or are the subject of on-going restoration efforts and may not function in the same way as undisturbed wetlands in the region. Conditions observed at such sites may reflect a rehabilitated condition rather than pre-disturbance conditions (Spencer and Harvey 2012). However, given the highly modified nature of the watershed supporting the BWER and the constraints imposed by the flood control aspects of the project, it is not possible to restore wetlands at the BWER to their pre-

disturbance condition, and a rehabilitated condition may be the most achievable outcome for the restoration. As such, restored reference sites may be appropriate given the general lack of pristine reference sites in the region. In general, any site with remnant or restored wetlands which demonstrate desirable qualities such as high diversity of native species or populations of rare plants or wildlife should be considered as a potential reference site. Despite the general lack of high quality estuarine wetlands and associated habitats in southern California, a number of potential reference sites occur there, including Alamitos Bay in Los Angeles County; Tijuana Estuary, San Dieguito and Poseidon wetlands, and Peñasquitos Lagoon in San Diego County; Upper Newport Bay in Orange County; Mugu Lagoon and Ormond Beach in Ventura County; and Carpinteria Salt Marsh in Santa Barbara County.

A number of authors have put forth recommendations for selecting reference sites (e.g., Short et al. 2000; Neckles et al. 2002; Thom et al. 2010). Horner and Radaeke (1989; *in* Thom et al. 2010) recommend that the following elements be addressed when determining the similarity of potential reference sites to the restoration site:

- Ecological functions
- Climate and hydrology
- Anthropogenic disturbances
- History of and potential for future management actions
- Size, morphology, water depth, wetland zones and their proportions
- Vegetation types
- Soils and non-soil substrates
- Access by fish and wildlife

Short et al. (2000) recommend using principal components analysis ("PCA") to select appropriate reference sites. Their site selection was based primarily on the geomorphological setting and structural components of the wetland type in question. This approach may be feasible for the BWER given the availability of basic data for wetlands in the region. That said, the pool of potential reference sites may be too limited to warrant such an analysis, and it may be more appropriate to select reference sites based on anecdotal or observational evidence of similarity to the BWER.

Given the limited area and degraded condition of tidal wetlands remaining in southern California, it is unlikely that a single "ideal" reference site will be available. Moreover, it is unlikely that any given reference site will have all of the habitat types and other components necessary for the monitoring program at the BWER. As such, separate reference sites or groups of reference sites may be necessary to accommodate all of the monitoring needs at the BWER. Ideally, more than one reference site would be used for each monitoring parameter as this can improve the power of statistical

comparisons (Neckles et al. 2002). In addition, it may be necessary to use different reference sites for each habitat type at the BWER given that many potential reference sites will not contain the full suite of habitat types that are planned for the BWER. However, financial and practical considerations constrain the potential for using multiple reference sites. One way to reduce the cost of monitoring may be the use of data from reference sites which are currently being monitored as part of existing restoration projects. This would require that monitoring parameters and protocols be standardized and that monitoring timeframes be compatible. For example, the ongoing monitoring programs at San Dieguito Wetlands or the South Bay Wetlands in San Diego County could be incorporated into the monitoring program at the BWER. The use of citizen-scientist volunteers may be another way to reduce the cost of monitoring at multiple reference sites.

4.1.2 Monitoring Parameters, Performance Goals, and Adaptive Management

Monitoring Parameters

A wide range of variables have been monitored at wetland restoration sites around the country; however, most authors recommend focusing on variables related to ecological structure and function (Callaway et al. 2001; Neckles et al. 2002; Atkinson et al. 2004; Thom et al. 2010). Ideally, many parameters would be monitored within each habitat at the BWER. In reality, however, most restoration projects, including the restoration of the BWER, have limited funding available for monitoring. Given this constraint, most authors recommend focusing on the core variables affecting habitat development and function and the use of indicators of habitat function such as the development of wetland-associated animal communities (Short et al. 2000). Atkinson et al. (2004) recommend that monitoring variables (1) be relevant to restoration goals and potential management actions, (2) have a strong scientific foundation, (3) be measureable and statistically rigorous, (4) be compatible with existing monitoring and data collection programs, and (5) be easily understood and interpreted.

Extensive lists of potential monitoring variables are provided by Atkinson et al. (2004), Lafferty (2005), Thayer et al. (2005), and Callaway et al. (2001), among others. The monitoring variables presented in the following sections are based on (1) the basic ecological drivers of habitat or community development (or surrogate indicators), (2) the restoration objectives for each habitat (e.g., use by wetland-associated birds), and (3) the variables which are more easily manipulated for management purposes. Within each habitat, there are many potential variables to monitor; the variables chosen for each habitat represent the minimum level of monitoring necessary to gain a basic understanding of the development of biotic communities at the BWER. Given sufficient funding, it may be desirable to include additional variables in the monitoring program. Moreover, additional monitoring variables may be necessary for adaptive management

of specific habitats (Neckles et al. 2002). Such additional variables are outlined the adaptive management sections for each habitat type; however, it is not possible to predict the full range of potential impediments to habitat or community development, and it may be necessary to include additional variables not addressed in this Conceptual Plan.

As noted above, it may be useful to monitor for some variables at both the BWER and at one or more reference sites. If reference sites are used, the monitoring protocols should be standardized such that they are the same for both the reference site and the BWER. To the extent feasible, sample sizes should also be the same. Because of the added expense involved in monitoring at both the BWER and at one or more reference sites, it may be desirable to use reference sites that are currently being monitored by other groups. Data sharing or other means of pooling monitoring resources can reduce the time and effort involved in monitoring, thereby reducing the overall cost of the monitoring program. However, data sharing with other monitoring programs may require some modification to the monitoring program outlined in this Conceptual Plan. To the extent feasible, the final monitoring program should be designed such that the data collected is can be shared with the Southern California Wetlands Recovery Project or other regional monitoring programs.

Performance Goals

The restoration efforts at the BWER differ from many other restoration projects in that the restoration is voluntary and not in response to regulatory requirements. Restoration efforts undertaken as required mitigation are often subject to rigid success criteria aimed at determining the success or failure of the project. In this document, the term “success criteria” has been purposefully replaced with the term “performance goals” to avoid creating the impression of a rigid framework for assessing the project’s performance and preemptively determining the success or failure of the restoration (Zedler 2007; Zedler and Callaway 2000). That said, some aspects of the restoration may be subject to regulatory requirements, and the performance goals presented here are subject to change based on the results of the CEQA/NEPA analysis and regulatory requirements.

Performance goals developed for the monitoring program at BWER are based on the primary ecological drivers of habitat development and function (e.g., frequency of tidal inundation for salt panne habitat), the characteristic expression of such ecological drivers (e.g., lack of vegetation for salt panne habitat), and the primary values of the habitat (e.g., bird foraging for salt panne habitat). In some cases, performance goals are based on a more easily monitored surrogate for one or more of these factors. For example, the use of mud-flat habitat for foraging by wading bird species should be

correlated with the development of a benthic invertebrate community and may serve as a reasonable surrogate for monitoring the benthic invertebrates.

The use of performance goals relative to conditions at reference sites may provide some ability to overcome uncertainties related to habitat development, of which there are many, and to account for stochastic events which may affect plant and animal communities and ecosystem function at a regional scale. The performance goals presented here are based on our understanding of the development of biotic communities and experiences with other restoration projects in southern California.

Adaptive Management

Adaptive management of habitat development in the restored wetland and upland areas will require frequent monitoring during the initial years to identify and correct any problems in the restoration design. However, some trends in habitat development may not become apparent for many years, and long-term monitoring will be necessary. It is not possible to predict the full range of potential restoration outcomes and associated adaptive management scenarios, and as such, the adaptive management triggers and actions presented in the following sections should be treated as a guide only.

Triggers for adaptive management actions should be based on significant deviation from or a lack of progress toward achieving the performance goals outlined for each monitoring parameter coupled with an evaluation of the trajectories of habitat development or directions of change. For many aspects of biotic community development, it may take several years for trends to become apparent, and changes in management should be delayed until sufficient time has elapsed for trends to become apparent. If it is determined that progress toward performance goals is not measurable or that the habitat appears to be progressing toward an alternative state, an evaluation of the causes involved and the trend toward meeting performance goals should be undertaken to determine whether intervention or mid-course corrections are warranted. In some cases, habitat development may be on track to meet long-term performance goals and no actions may be warranted—in these cases, it may be appropriate to modify the performance goals based on new developments in our understanding of the development of biotic communities. In other cases, it may be determined that additional monitoring parameters are necessary to determine the cause of poor performance. Once the causes of poor performance are identified, appropriate changes in management should be investigated and implemented. Any modifications implemented as a result of this process should be subject to quantitative monitoring and analysis specifically designed to evaluate the effectiveness of such modifications or changes in management.

For some aspects of habitat or biotic community development, intervention or mid-course corrections may be minimal in scale. For instance, if invasive species become a problem, increased management efforts or new management techniques may be necessary. However, some aspects of habitat or biotic community development may require more significant changes. For instance, if salt panne or seasonal wetland habitats fail to meet hydrology performance goals, changes to the grade of the site may be necessary. Similarly, if fish die-offs occur due to low dissolved oxygen levels, modification of tidal circulation patterns may be necessary. Any actions requiring grading or other major site alterations should receive increased scrutiny before implementation. If it is determined that such changes will cause unacceptable disturbances to other habitats or animal populations at the BWER, it may be necessary to reevaluate the restoration goals. All decisions related to adaptive management, including changes in management activities, alteration of the site, shifts in target habitats or performance goals, and the rationale for each decision, should be documented in a central location. This is particularly important given that numerous individuals will be responsible overseeing the operation of the Reserve during its lifetime. Recording management decisions in a central location will provide future land managers with an understanding of the actions of previous land managers, thereby providing an improved basis for making future management decisions.

Special-Status Species

As noted in Section 3.3.4, special-status plant and wildlife species will be subject to focused monitoring efforts aimed at identifying trends in population size and habitat use and informing the need for active management of the species or habitats in which they reside. To the extent feasible, monitoring of special-status species will be conducted using established protocols and will be incorporated into existing regional or state monitoring programs for these species. A separate monitoring plan will be developed for each special-status species or group of special-status species. Where possible, monitoring for special-status species will be integrated with regular habitat monitoring; however, for some species it may be necessary to modify monitoring protocols or to adjust the timing of monitoring events to coincide with important life stages of the species in question. All monitoring and management of special-status species will conform to the policies and guidelines set by the CDFW, CNPS, or other agency or organization with jurisdiction over the species or their habitats.

4.1.3 Data Management and Analysis

Numerous authors highlight the importance of scientifically valid sampling and data analysis and the need for good data management (Atkinson et al. 2004; Thom et al. 2010). Good data management includes procedures for quality assurance and quality control and timely reporting of monitoring results (Atkinson et al. 2004). Methods for

quality assurance and quality control will be included in the HMMP and will be consistent with existing CDFW protocols. Similarly, data will be collected and analyzed in a manner that allows the data to be stored in existing databases maintained by the CDFW or other natural resource agencies such as the U.S. Army Corps of Engineers ("Corps"), the U.S. Fish and Wildlife Service ("USFWS"), or the NOAA.

Where appropriate, monitoring data will be analyzed statistically. However, Thom et al. (2010) note that rigorous experimental design which evaluates one or more null hypotheses may not be necessary for documenting the development of biotic communities. They also note that the monitoring implemented for most restoration projects is not conducted with the sample size, replication, or controls necessary for rigorous statistical testing. Although rigorous statistical analyses may be appropriate for some aspects of adaptive management in which management actions are empirically evaluated, in general, simple graphs with error bars or similar analyses may be sufficient to interpret trends in the development of biotic communities (Thom et al. 2010). The use of aerial photographs, permanent ground-based photo-monitoring locations, and Geographic Information Systems ("GIS") analyses are also useful methods for assessing habitat development. The ultimate form of the monitoring program and associated analyses will include some combination of all of the above.

4.2 Tidal Marsh

Monitoring and performance goals for tidal marsh focus on low marsh, mid marsh, and high marsh habitat. Tidal channels and mudflat habitat are treated separately in Sections 4.3 and 4.4, respectively.

The primary ecological driver of tidal wetland habitat development is regular tidal inundation and, related to that, the balance between sediment import and export. The establishment of characteristic tidal marsh vegetation is a relatively good indicator of tidal inundation and marsh plain development and will be the focus of tidal wetland monitoring and performance goals; direct observation of tidal inundation may be needed during the early phases of the restoration when vegetation is sparse and zonation patterns cannot be discerned. Additional monitoring and performance goals will focus on a lack of invasive weeds and the use of tidal marsh habitat by a diversity of birds.

4.2.1. Monitoring

Monitoring of tidal marsh habitat will focus on the establishment of native tidal marsh vegetation, a lack of invasive weeds, and use by bird species. Monitoring for vegetation establishment and invasive weeds should commence at the end of the first growing season following the completion of construction. Although the development of tidal marsh habitat is relatively well understood, it may be useful to base performance goals

on conditions relative to one or more reference sites, particularly for monitoring of bird use. Potential reference sites include the tidal marshes at Tijuana Estuary in San Diego County, Upper Newport Bay in Orange County, Mugu Lagoon in Ventura County, or Carpinteria Salt Marsh in Santa Barbara County, among others.

Vegetation and Invasive Plants

Vegetation monitoring will be conducted in two phases. The first phase will make use of orthorectified aerial imagery to document the total cover of vegetation during the initial phases of vegetation establishment. Aerial images should be taken in late summer, after growth has slowed, and should be taken during a low tide sufficient to expose the entire marsh surface. The goal of this monitoring is to document the location and rate of vegetation establishment during the early phases of the restoration when vegetation is likely to be sparse. Total vegetation cover can be calculated through GIS analysis of the aerial images. Limited ground-truthing may be required to verify patterns observed in the aerial imagery.

The first phase of vegetation monitoring will be conducted every one to two years until it is determined that vegetation is sufficiently dense to allow for efficient ground-based monitoring—this level should be between fifteen and twenty percent cover. Once it is determined that vegetation composition can be efficiently measured on the ground, the second phase of vegetation monitoring will commence and will consist of a quantitative method along transects running from high marsh to low marsh. These transects may be the same as those used for other monitoring parameters to reduce impacts to the marsh and make monitoring more efficient. The monitoring design will be similar to that used for vegetation monitoring elsewhere in the Reserve and will be designed to capture both the composition of vegetation and cover by individual plant species. During the second phase, vegetation will be monitored annually, near the end of the growing season when plants have put on most of their growth but are still identifiable. Vegetation monitoring will continue for the duration of the 10-year monitoring period.

Although it is expected that regular inundation by salt water will limit the potential for invasion of the mid- and low marsh zones, there is potential for non-native, invasive species of sea lavender or statice (*Limonium* spp., other than *L. californicum*) or cordgrass (*Spartina* spp., other than *S. foliosa*) to become established in these regularly inundated marsh zones. Because of the reduced levels of tidal inundation received by the high marsh, there is greater likelihood for invasion of this zone. Monitoring for invasive species will be conducted on an annual (or more frequent) basis, during late spring when annual weeds are in flower or at other appropriate times related to weed life cycles. Monitoring for invasive species will be conducted for the duration of the 10-year monitoring period and is likely to be necessary for the lifespan of the restoration. Monitoring for invasive species will be conducted throughout the entirety of the tidal

marsh habitat and will be aimed at identifying the location and extent of any populations of invasive species listed as “High” or “Moderate” by the Cal-IPC (2013), exclusive of annual grasses. Although it may be helpful for management purposes, it may not be necessary to quantify invasive species populations. Instead, a simple qualitative assessment including the location and approximate extent and severity of the infestation may be sufficient to inform management actions. That said, the effectiveness of management actions should be assessed quantitatively, and this may require baseline quantification of the infestation prior to initiating management actions.

Bird Abundance and Diversity

Monitoring for bird use of tidal marsh habitat will be conducted in conjunction with bird monitoring in other habitats at the BWER and the methods use will be consistent with the methods used elsewhere in the Reserve. Monitoring will be designed to capture (1) the abundance and species richness of birds observed using the tidal marsh habitat and (2) the activities in which the birds were engaged within the tidal marsh habitat (i.e., foraging, nesting, etc.).

Due to the large seasonal variation in bird migration and breeding patterns, monitoring for bird use of tidal marsh habitat will be conducted at intervals throughout the year, with reduced monitoring during the summer breeding period to limit disturbance to breeding birds. Monitoring will be timed to occur during peak periods of bird activity. Because the ecological factors involved in bird use of tidal marsh habitat are based on a complex set of factors extending well beyond the limits of the BWER, this monitoring will be conducted every year during the 10-year monitoring period to capture the full range of variability and to compensate for stochastic events that may affect bird use in any given year. For similar reasons, the use of one or more reference sites will be considered as this will help capture variations in bird use which may be attributable to environmental factors extending beyond the borders of the BWER.

In addition to general bird monitoring, it will be important to conduct species-specific monitoring for Belding’s Savannah sparrow which is known to use existing tidal marsh habitat in Area B. This monitoring will follow established protocol approved by the CDFW (e.g., Zembal and Hoffman 2010). Restoration activities that will disturb habitat within Area B which is currently occupied by Belding’s Savannah sparrow cannot proceed until it is determined that this species is breeding in the restored salt marsh habitat in Area A and that the temporary disturbance of occupied habitat in Area B will not affect the population at the BWER. As such, surveys for Belding’s Savannah sparrow will need to be conducted in both the restored habitat in Area A and the existing habitat in Area B. Following the completion of restoration activities, this species-specific monitoring should continue for as long as the statewide census is in effect. Because of

the sensitivity of this species, performance goals and adaptive management triggers related to this species should be developed by or in close coordination with the CDFW.

4.2.2 Performance Goals

As noted above, performance goals for tidal marsh habitat will be based on (1) establishment of native tidal marsh vegetation, (2) low cover of invasive weeds, and (3) use of tidal wetland habitat by a diverse array of birds.

Vegetation and Invasive Plants

Vegetation performance goals should be based on the establishment and high cover of native tidal marsh plant species and low cover of highly invasive species. Tidal marsh vegetation will be established through a combination of natural recruitment and plantings, and as such, the performance of tidal marsh vegetation is likely to be highly variable, particularly in the first several years of the restoration. Variation is also likely to occur within the low, mid- and high marsh zones due to the variable use of natural revegetation versus planting in these different zones. The performance goals outlined below are presented for the habitat as a whole; however, given the likely variability of plant performance in the initial years and between marsh zones, it may be appropriate to develop and apply these goals to the three marsh zones independently.

Table 1. Tidal Marsh Vegetation and Invasive Plant Performance Goals

Monitoring Year	Performance Goals
1 – 3	**A.** Canopy cover may be low, but native salt marsh species should show signs of establishment and spread. **B.** Cover of invasive species listed as “High” or “Moderate” by the Cal-IPC, exclusive of annual grasses, should remain low.
4 – 7	**A.** Canopy cover of native salt marsh species should be relatively high, approaching 75% or greater by the end of Year 7, and should show signs of significant natural recruitment. **B.** Vegetation should include a mix of native species, although one or two native species may dominate. **C.** Cover of invasive species listed as “High” or “Moderate” by the Cal-IPC, exclusive of annual grasses, should remain low.

Table 1. Tidal Marsh Vegetation and Invasive Plant Performance Goals

Monitoring Year	Performance Goals
8 – 10	**A.** Canopy cover of native salt marsh species should be nearly complete. **B.** Vegetation should include a mix of native species, although one or two native species may dominate. **C.** Cover of invasive species listed as "High" or "Moderate" by the Cal-IPC, exclusive of annual grasses, should remain low.

Bird Abundance and Diversity

Performance goals for bird use of restored tidal marsh habitat will be based on high abundance and species richness of tidal marsh-associated birds observed using tidal marsh habitat for foraging, nesting, etc. Because of the large number of factors involved in the use of a site by birds, it may be useful to assess bird use of tidal marsh habitat at the BWER relative to bird use of tidal marsh habitat at one or more suitable reference sites.

Table 2. Tidal Marsh Bird Performance Goals

Monitoring Year	Performance Goals
1 – 3	**A.** A variety of tidal-marsh associated bird species should be observed foraging in the restored tidal marsh, although the diversity and abundance of birds may be lower than observed prior to the restoration.
4 – 7	**A.** Species richness and abundance of tidal marsh-associated birds should each be within pre-restoration levels and should be increasing with each successive year. **B.** Birds should be observed both foraging and demonstrating territorial behavior within the restored tidal marsh habitat.

Table 2. Tidal Marsh Bird Performance Goals

Monitoring Year	Performance Goals
8 – 10	**A.** Species richness and abundance of tidal marsh-associated birds should each be greater than pre-restoration levels; however, annual increases may slow relative to increases observed in Years 4 – 7. **B.** Birds should be observed both foraging and demonstrating territorial behavior within the restored tidal marsh habitat. **C.** Successful breeding should be documented for at least some tidal marsh-associated bird species.

4.2.3 Adaptive Management

The primary ecological factor involved in the development of tidal marsh vegetation is hydrology—regular inundation by tidal waters (Sharitz and Pennings 2006). Additional factors involved in the establishment of tidal marsh vegetation include sediment characteristics (e.g., soil texture, pH, nutrient levels, organic matter content, soil contaminants, etc.), rates of erosion or sedimentation, and the availability of plant propagules. The development of tidal marsh bird communities is primarily related to vegetation composition and structure, the availability of suitable food sources such as seeds, benthic invertebrates, or fish, and the presence of bird predators (Keddy 2010).

Performance goals for tidal wetland habitat focus on the development of appropriate vegetation and use by birds. Because restoration in each zone of the tidal marsh will rely on some combination of planting, seeding, and natural revegetation, differences are expected in the trajectory of vegetation development within each zone. Marsh zones which are planted should be expected to develop quicker than zones which rely on natural revegetation. For marsh zones which are planted, trends in the development of vegetation should be apparent within three to five years. For marsh zones which rely on natural revegetation, trends in the development of vegetation may take five or more years to become apparent. Use of the tidal marsh areas by bird species is expected to occur immediately following the restoration of tidal action and to evolve over time in conjunction with the development of tidal marsh vegetation. As such, trends in the use of tidal marsh habitat by birds should be apparent within three to five years following the restoration of tidal activity.

If tidal marsh vegetation does not demonstrate a suitable trajectory toward achieving performance goals within the expected timeframe for trends in vegetation development to become apparent, an assessment of overall trends in vegetation development will be

conducted to determine whether additional studies or changes in management are warranted. If it is determined that the development of tidal marsh vegetation is on track to meet long-term performance goals, modification of performance goals based on an improved understanding of habitat development may be the most appropriate course of action. However, if it is determined that the development of marsh vegetation is not on track to meet long-term performance goals, the causes of this lack of progress toward meeting performance will be identified and potential solutions will be investigated. Potential causes for a lack of progress toward meeting performance goals are likely to be related to soil physical or chemical properties or hydrological regime, and these should be the first targets for study. Potential corrective actions may include additional planting of tidal marsh species to increase the rate of vegetation establishment, the introduction of soil amendments to alter soil physical or chemical properties, or the addition of temporary irrigation or modifications to the tidal regime to improve plant growth or hinder the establishment of invasive species. If invasive species become a problem, management actions such as physical removal or chemical control may be necessary.

If it is determined that bird use of tidal marsh habitat does not demonstrate a suitable trajectory toward achieving performance goals within the expected timeframe for trends to become apparent, an assessment of overall trends in bird use will be conducted to determine whether trends are specific to the BWER or occur at a regional scale. If it is determined that the poor performance is specific to the BWER, additional studies or changes in management may be warranted. Potential causes for a lack of progress toward meeting performance goals are likely to be related to vegetation composition or structure, the absence of suitable food sources, or the presence of bird predators. Potential corrective actions may include modifications to the management of vegetation, soil properties, or tidal regimes to create appropriate habitat structure for birds or to promote increased use of tidal marsh habitat by benthic invertebrates or fish species. Predator management may also be required and is discussed in further detail in Section 4.12.4.

4.3 Subtidal and Intertidal Channels

The extent of subtidal and intertidal channels will be determined primarily by the initial design and will be modified over time based on the rate of tidal flow entering the wetlands from Ballona Creek. Tidal channels are expected to evolve to some degree over time based on sediment loads, storm events, etc. Although some migration and contraction or expansion of tidal channels is expected and desired, excessive movement and contraction or expansion could negatively affect the flood control aspects of the project or the development of tidal marsh habitat. Monitoring and performance goals will be based on the location, width, and depth of tidal channels

relative to the originally designed specifications and the expected development of tidal channels.

In addition to providing some level of flood control protection, tidal channels provide the connection between the open ocean, Ballona Creek, and tidal marsh habitat at the BWER. These tidal channels will be the primary route through which the introduction of benthic invertebrates, fish, and other aquatic organisms will occur. Colonization of mudflat habitat by benthic invertebrates will provide some evidence of this biological function of the tidal channels. A diverse array of fish species and functional guilds in tidal channels will provide an indication of aquatic habitat quality in the tidally influenced portions of the Reserve. In addition to measurements of tidal channel structure, biological monitoring parameters and performance goals will focus on use of tidal channels by fish. Given the high seasonal and annual variability in fish populations, the use of one or more suitable reference sites may be useful for this monitoring parameter. Potential reference sites include the tidal wetlands at Tijuana Estuary in San Diego County, Mugu Lagoon in Ventura County, or Carpinteria Salt Marsh in Santa Barbara County, among others.

4.3.1 Monitoring

Channel Morphology

Monitoring for channel morphology should include both analyses of aerial images to document changes in the extent and location of tidal channels and ground-based monitoring to document changes in channel width or depth. Monitoring should occur after the rainy season, when major storms are no longer expected and annual changes in tidal channel morphology are likely to be slower. Aerial images should be analyzed using GIS software to document any changes in the extent and location of tidal channels. Ground-based monitoring should consist of measurements of channel depth and width and the location of the banks at a variety of locations near and far from the channel openings at Ballona Creek. Monitoring will be conducted annually during the 10-year monitoring period; it may be useful to qualitatively monitor changes in channel morphology following major storms, in addition to the annual monitoring. Although the proposed restoration has been designed to avoid accumulation of sediments at the tidal openings to Ballona Creek and at tide gates servicing the managed tidal areas, there is potential for unforeseen changes in sediment loads or related factors to cause long-term accumulation of sediments in these areas. As such, some level of monitoring may be necessary for the lifespan of the restoration.

Fish Abundance and Diversity

In addition to physical parameters, monitoring of tidal channels will also document the abundance and species richness of fish species found in tidal channels at the BWER. Fish monitoring will be conducted annually, during the summer months when fish abundance and diversity are at their peak. Monitoring will occur at high tide and will occur in each major tidal channel servicing the tidal marsh areas. Monitoring will make use of a variety of sampling methods designed to document the full range of fish diversity at the BWER—these methods may include the use of otter trawls, bag seines, gill nets, enclosures, and other methods. The goal of monitoring will be to capture the diversity and abundance of fish species within each guild expected to be present at the BWER, including demersal fish, pelagic fish, and burrow-inhabiting fish.

Water Quality

Dissolved oxygen will be monitored using a data logging device capable of capturing continuous water quality data or by similar methods. Sampling will occur in a wide range of locations within the tidal channel network to gain a clear picture of dissolved oxygen dynamics. Monitoring for dissolved oxygen levels will be conducted for the duration of the 10-year monitoring period as this monitoring will provide useful data on circulation patterns and residence time, data that will be important for adaptive management.

4.3.2 Performance Goals

Channel Morphology

Performance goals for subtidal and intertidal channels focus on excessive sedimentation, large-scale erosion, and major changes in channel geomorphology. The performance goals presented below assume that changes in channel geomorphology will be greater during the initial phases of the restoration, but will stabilize as vegetation colonizes the marsh plain and rates of sedimentation and erosion reach a balance.

Table 3. Tidal Channel Morphology Performance Goals

Monitoring Year	Performance Goals
1 – 3	**A.** Changes in channel extent or location should be within acceptable design limits. **B.** Erosion and scouring within the main channels may be significant in the first years, but should be within acceptable design limits. **C.** Sedimentation within the main channels and at tide gates and openings to Ballona Creek should be within acceptable design limits.
4 – 7	**A.** Changes in channel extent or location should be within acceptable design limits and should be greatly reduced from rates or extents of change observed during the first years. **B.** Erosion and scouring within the main channels should be significantly reduced from rates observed in the first years. **C.** Sedimentation within the main channels and at tide gates and openings to Ballona Creek should be reduced from rates observed in the first years and should be within acceptable design limits.
8 – 10	**A.** Changes in channel extent or location should be within acceptable design limits and should be negligible. **B.** Erosion and scouring should be minimal throughout the marsh plain. **C.** Sedimentation within the main channels and at tide gates and openings to Ballona Creek should be minimal and should be within acceptable design limits.

Fish Abundance and Diversity

Performance goals for fish abundance and diversity are be based on the development of a relatively stable and diverse native fish population. Because of the large number of variables involved in fish population dynamics, many of which may occur outside of the BWER, it may be appropriate to assess use of the site by fish species relative to pre-restoration levels of fish diversity. Alternatively, one or more reference sites may also be used to assess fish use of tidal channels at the BWER.

Table 4. Tidal Channel Fish Performance Goals

Monitoring Year	Performance Goals
1 – 3	**A.** Species richness and abundance of fish should each be within or approaching pre-restoration levels. **B.** No major fish die-offs should occur.
4 – 7	**A.** Species richness and abundance of fish should each be the same as or greater than pre-restoration levels. **B.** Changes in species richness and abundance of fish should show signs of stabilizing. **C.** No major fish die-offs should occur.
8 – 10	**A.** Species richness and abundance of fish should each exceed pre-restoration levels. **B.** Species richness and abundance of fish should be relatively stable. **C.** No major fish die-offs should occur.

Water Quality

Because dissolved oxygen levels are not expected to evolve over time in the same way vegetation might, a static performance goal is recommended for this monitoring parameter. However, given the expected high daily and seasonal variation in dissolved oxygen levels, in may be useful to develop performance goals relative to the range of dissolved oxygen levels observed at one or more suitable reference sites.

Table 5. Tidal Channel Water Quality Performance Goals

Monitoring Year	Performance Goals
Applicable to All Years	Dissolved oxygen levels should remain within healthy levels for fish and other aquatic organisms; levels should not drop below 2 parts per million for extended periods.

4.3.3 Adaptive Management

The main purpose of subtidal and intertidal channel restoration at Ballona is to provide sufficient tidal flow for the development of high-quality tidal wetland habitat. A secondary function is to provide habitat for wildlife species associated with shallow and deepwater habitats. The structure and function of tidal channels at the BWER will be

most influenced by the design process, with additional development based on changes in the tidal prism due to sedimentation or erosion. The development of appropriate animal communities within tidal channels is primarily related to habitat structure, sediment characteristics, water quality, and the availability of food sources. Monitoring and performance goals focus on major changes in channel location or morphology, the development of a diverse fish community, and healthy dissolved oxygen levels. It is expected that the desired function of tidal channels should be achieved immediately following the restoration of tidal activity. Most of the changes in tidal channel morphology are expected to occur within the first year or two, with less extensive changes occurring in subsequent years based on rates of erosion and sedimentation, the occurrence of major storm events, and the rate of vegetation establishment along channel margins, among other factors. Similarly, desired water quality levels (as measured by dissolved oxygen levels) are expected to be achieved through the design process, and as such, problems should be evident within the first one to two years following restoration of tidal activity. Fish use of tidal channels is also expected to occur immediately following the restoration of tidal activity, with subsequent changes in abundance and community composition as habitat structure (e.g., channel morphology or establishment of macroalgae) and food availability evolve within the tidal channels.

If subtidal or intertidal channels show a lack of progress toward meeting performance goals for channel morphology, water quality, or fish use within the first two to three years, an assessment of overall trends will be conducted to determine whether adaptive management is warranted. Potential causes of poor performance in terms of channel morphology and water quality are most likely to be related to tidal prism and the associated rates of tidal velocity, circulation, and residence time. In terms of water quality, problems may also be related to contamination issues in Santa Monica Bay or upstream of the Reserve, contamination from stormwater runoff from developed areas surrounding the Reserve, or sediment contamination within the Reserve. Additional studies may be required to identify problems with tidal circulation or potential sources of water or sediment contamination. If it is determined that changes in management are necessary, potential actions include modification of the tidal inlet or channel morphology to alter tidal prism or circulation patterns or remediation efforts to improve sediment or water quality.

If fish populations within the tidal channels fail to meet performance goals within the first two to three years, an assessment of overall trends will be conducted to determine whether the lack of progress in meeting performance goals is specific to the BWER or is related to a regional condition. If it is determined that the lack of progress in meeting performance goals is specific to the BWER, additional studies should be conducted to determine whether the lack of progress is a result of misguided performance goals or due to habitat conditions within the BWER. If new information suggests that

performance goals may be deficient, appropriate modifications will be made. However, if there is no evidence to suggest that performance criteria are deficient, studies will be undertaken to determine the cause of the lack of progress in meeting performance goals. Potential causes include problems with tidal channel design which may affect tidal circulation patterns, water quality, or habitat structure. Other problems may be related to contamination issues or poor development of tidal marsh habitat which will affect the availability of food sources for fish. Potential corrective actions include changes to the channel design, modification of tidal regimes where possible (e.g., in the managed tidal portions of Area B), remedial actions to address water or sediment contamination, or modification of vegetation structure or composition.

As with other habitats and monitoring variables, adaptive management triggers for tidal channels are primarily based on significant deviation from the expected trajectory of biotic community development (i.e., significant deviation from the performance goals). However, for fish use of tidal channels, additional triggers may include abnormal declines in fish populations, evidence of a fish die-off, or large increases in non-native fish species.

4.4 Mudflat Habitat

Monitoring for mudflat habitat will focus on the establishment of a diverse macroinvertebrate population and use of mudflat habitat by wading birds. Because the colonization and use of mudflat habitat by wildlife species is subject to a wide range of unpredictable ecological factors, the use of reference sites may be useful for wildlife monitoring parameters. Potential mudflat reference sites include the tidal wetlands at Tijuana Estuary in San Diego County, Upper Newport Bay in Orange County, Mugu Lagoon in Ventura County, or Carpinteria Salt Marsh in Santa Barbara County, among others.

4.4.1 Monitoring

Macroinvertebrate Abundance and Diversity

To reduce the level of effort involved, monitoring for macroinvertebrate colonization will be conducted at the level of order, suborder, or genus (depending on available funding). Monitoring will be designed to capture the overall abundance (or biomass) and order, suborder, or genus diversity of macroinvertebrates greater than 0.1 inche (3 millimeters) in size—although smaller size classes are often used, this greatly increases the level of effort and cost involved in sampling. This can be accomplished through the use of a suitable number of sediment cores from which macroinvertebrates can be sifted, identified to the level of order, sub-order, or genus, and quantified. Quantification may consist of either counts of individuals or measurements of biomass. Monitoring will

begin following one full year after the reestablishment of tidal activity and will be conducted annually for the duration of the 10-year monitoring period.

Identification of macroinvertebrates can be a time consuming process (Callaway et al. 2001), and depending on the funding available for monitoring, it may be necessary to investigate alternative monitoring approaches to assess the health of the macroinvertebrate population at the BWER. One potential alternative includes the use of indicator or umbrella species to assess the overall health of the macroinvertebrate population.

Bird Abundance and Diversity

Monitoring of bird use will be conducted in conjunction with bird monitoring in other habitats at the BWER and will be consistent with the methods used elsewhere in the Reserve. Monitoring will be designed to capture the abundance and species richness of birds observed using the mudflat habitat. Unlike bird use in other habitats, it is expected that bird use of mudflat habitat will be limited to foraging, and thus, there is not a need to capture the activities in which the birds were engaged while using mudflat habitat. Due to the large seasonal variation in bird migration and breeding patterns, monitoring for bird use of mudflat habitat will be conducted at intervals throughout the year. Monitoring will be timed to occur during peak periods of bird activity; in the case of mudflat habitat, this would be at low tide. Because the ecological factors involved in bird use of mudflat habitat are based on a complex set of factors extending well beyond the limits of the BWER, this monitoring will be conducted every year during the first ten years of the monitoring period to capture the full range of variability and to compensate for stochastic events which may affect bird use in any given year. As noted above, it may be useful to also monitor bird use of mudflat habitat at suitable reference sites and to assess conditions at the BWER relative to conditions at the reference sites.

4.4.2 Performance Goals

Macroinvertebrate Abundance and Diversity

Given the complex set of factors involved with macroinvertebrate colonization of mudflat habitat, the performance goals presented here are based on a steady increase in macroinvertebrate abundance and taxonomic richness (at the level of order, suborder, or genus). It is expected that colonization of mudflat habitat will occur within the first year following the restoration of tidal activity; however, it may take a number of years for the macroinvertebrate community to reach pre-restoration levels of diversity and abundance. It may take several additional years for macroinvertebrate diversity and abundance to exceed pre-restoration levels.

Table 6. Mudflat Macroinvertebrate Performance Goals

Monitoring Year	Performance Goals*
1 – 3	**A.** Macroinvertebrate order diversity should be near pre-restoration levels within one to two years following restoration of tidal activity. **B.** Macroinvertebrate abundance or biomass (by order) may be significantly lower than pre-restoration levels but should show a steady increase during the first years following restoration of tidal activity.
4 – 7	**A.** Macroinvertebrate order diversity should be at or above pre-restoration levels. **B.** Macroinvertebrate abundance or biomass (by order) should be at or near pre-restoration levels and should show a steady increase.
8 – 10	**A.** Macroinvertebrate order diversity should exceed pre-restoration levels. **B.** Macroinvertebrate abundance or biomass (by order) should exceed pre-restoration levels.

* Based on sampling of macroinvertebrates greater than 0.1 inch (3 millimeters) in size.

Bird Abundance and Diversity

As noted above, the performance goals for bird use of mudflat habitat are based on the abundance and species richness of birds observed using mudflat habitat. Use of mudflat habitat by birds is likely to be closely linked to colonization of the habitat by macroinvertebrates. As such, the performance goals presented here should be considered in relationship to the observed rates of macroinvertebrate colonization.

Table 7. Mudflat Bird Performance Goals

Monitoring Year	Performance Goals
1 – 3	**A.** A variety of wading and other mudflat-associated bird species should be observed foraging in mudflat habitat, although species richness may be lower than observed prior to the restoration. **B.** The abundance of wading and other mudflat-associated bird species should show a steady increase in conjunction with the development of the macroinvertebrate community.

Table 7. Mudflat Bird Performance Goals

Monitoring Year	Performance Goals
4 – 7	**A.** The species richness of wading and other mudflat-associated birds observed foraging in mudflat habitat should be within pre-restoration levels. **B.** The abundance of wading and other mudflat-associated bird species should observed foraging in mudflat habitat should be within pre-restoration levels.
8 – 10	**A.** The species richness of wading and other mudflat-associated birds observed foraging in mudflat habitat should exceed pre-restoration levels. **B.** The abundance of wading and other mudflat-associated bird species should exceed pre-restoration levels.

4.4.3 Adaptive Management

The primary goal of mudflat restoration at the BWER is to provide foraging habitat for wading birds. Monitoring parameters and performance goals are based on the total area of mudflat remaining in an unvegetated state or being colonized by seaweeds and other macroalgae, colonization by macroinvertebrates, and the use of mudflat habitat by wading birds for foraging. The area of mudflat habitat remaining unvegetated or being colonized by seaweeds will primarily be determined by design elevations and should not change significantly over time. It is assumed that bird species will begin using mudflat habitat immediately following restoration of tidal activity, with subsequent changes in abundance and species composition as the mudflat is colonized by macroinvertebrates. Macroinvertebrate colonization is also expected to occur relatively rapidly following restoration of tidal activity. It is expected that trends in bird use of mudflat habitat will be evident within three to five years following restoration of tidal activity and trends in macroinvertebrate colonization should be evident within five years.

If it is determined that bird use or macroinvertebrate colonization of mudflat habitat does not demonstrate a suitable trajectory toward achieving performance goals within the expected timeframe for trends to become apparent, an assessment of overall trends in bird use will be conducted to determine whether trends are specific to the BWER or occur at a regional scale. If it is determined that the lack of progress in meeting performance goals is specific to the BWER, additional studies or corrective actions may be warranted. Potential causes for a lack of progress in meeting performance goals for birds are likely to be related to low rates of macroinvertebrate colonization or the

presence of bird predators. Potential corrective actions for improving bird performance include changes aimed at increasing rates of macroinvertebrate colonization or initiation of predator management. Potential causes of poor performance for macroinvertebrates may include incompatible sediment composition, sediment contamination, or excessive foraging by birds during the early stages of colonization. Although modifying sediment composition of the mudflat habitat may not be practicable, remedial actions to reduce sediment contamination and actions to reduce foraging pressure from birds may be possible.

4.5 Brackish Marsh

Brackish marsh habitat is formed in portions of tidal marsh receiving seasonal or perennial input of freshwater (Desmond et al. 2001). These habitats represent a transition zone between freshwater and saline conditions, and as such, are characterized by an overlapping mix of species adapted either freshwater or saline conditions, as well as a suite of species unique to brackish conditions. Given the high variability among brackish marshes, developing detailed performance goals is not practical. As such, the monitoring and performance goals presented below include only basic metrics of habitat performance.

4.5.1 Monitoring

Brackish marshes are highly variable in terms of hydrology, salinity, vegetation, and wildlife use. The brackish marsh should be treated as a transition zone similar to the upland-wetland transition zone in the sense that it may be difficult to determine the boundary between the brackish marsh and the adjacent habitats and to define a target plant community (see note on monitoring for transition zones in Section 4.11). It is expected that the extent of the brackish marsh “transition zone” may fluctuate from season to season and year to year. Although the primary ecological factors responsible for the development of brackish marsh include hydrology and salinity, these two factors are likely too variable both within and among brackish marshes to be of use in the monitoring program. Colonization of brackish marsh habitat by specific plant or wildlife species is also highly variable. Given this high variability, monitoring in brackish marsh habitat will focus primarily on vegetative cover and a lack of highly invasive weeds.

<u>Vegetation and Invasive Plants</u>

Vegetation monitoring will be designed to capture the cover of vegetation and the presence and extent of invasive weeds within areas considered brackish. Because the area of brackish marsh will change from year to year, it will not be possible set quantitative goals for vegetation cover—instead, monitoring in this habitat will focus on a qualitative assessment of vegetation establishment and a lack of highly invasive

weeds. Monitoring for establishment of brackish marsh vegetation will be conducted on an annual basis during the entire 10-year monitoring period.

4.5.2 Performance Goals

Vegetation and Invasive Plants

Vegetation performance goals for brackish marsh should be based on a lack of highly invasive weeds and the establishment of vegetative cover. Given that the area of brackish marsh will vary from year to year, it will be difficult to quantify the percent cover of brackish marsh vegetation. As such, performance goals for vegetation in this habitat are qualitative in nature and have been designed to assess the establishment of vegetation or, conversely, the absence of unvegetated areas. Performance goals are also based on low cover of invasive weeds.

Table 8. Brackish Marsh Vegetation and Invasive Plant Performance Goals

Monitoring Year	Performance Goals
1 – 3	**A.** Canopy cover may be low, but vegetation should show signs of establishment and spread. **B.** Cover of invasive species listed as "High" or "Moderate" by the Cal-IPC, exclusive of annual grasses, should remain low.
4 – 7	**A.** Canopy cover should be relatively high, approaching 75% or greater by the end of Year 7, and should show signs of significant natural recruitment. **B.** Cover of invasive species listed as "High" or "Moderate" by the Cal-IPC, exclusive of annual grasses, should remain low.
8 – 10	**A.** Canopy cover should be nearly complete. **B.** Cover of invasive species listed as "High" or "Moderate" by the Cal-IPC, exclusive of annual grasses, should remain low.

4.5.3 Adaptive Management

The primary ecological factors involved in the development of brackish marsh habitat are related to hydrology and the relative proportions of fresh and saline water entering the system (Desmond et al. 2001). Because brackish marsh represents a fluctuating transition zone between fresh and saline environments, it is difficult to define a target biological community for this habitat. As such, performance goals are aimed at general factors such as the development of vegetative cover and the occurrence of invasive plants. As with tidal marsh habitat, it is expected that trends in the development of

vegetation should be apparent within three to five years following the restoration of tidal activity.

If brackish marsh vegetation does not demonstrate a satisfactory trend toward meeting performance goals within the first three to five years, an assessment of the causes will be undertaken. Potential causes of poor vegetation establishment are likely to be related to physical or chemical properties of the sediment, including sediment contamination, or deficiencies in the tidal regime. Potential corrective management actions may include additional planting or seeding, the addition of supplementary irrigation or slow-release fertilizers, or remedial actions to reduce sediment contamination or to improve other aspects of sediment quality.

4.6 Salt Panne

Salt pannes are characterized by irregular or seasonal water fluxes—including from both freshwater inputs such as rainfall or groundwater and saline inputs such as tidal inundation during extreme high tides—followed by prolonged dry-down periods which concentrate salts in the soil surface horizons at levels of up to 200 parts per thousand (Vivian-Smith 2001). The resulting habitat is a salt-crusted depression largely devoid of vegetation in the center and often fringed by halophytic plant species along the margins (Sharitz and Pennings 2006). Existing salt panne habitat at the BWER is valued primarily for its use by birds. Created salt panne habitat will also have the potential to host rare species of tiger beetles such as the western mudflat tiger beetle (*Cicindela trifasciata sigmoidea*) which has been previously documented from Area B (PWA et al. 2006).

Performance goals for restored salt panne habitat focus on (1) the primary ecological drivers of salt panne habitat development: hydrology and salinity, (2) the characteristic expression of these ecological drivers: lack of vegetation, and (3) the primary value of salt panne habitat: use by birds for foraging. In terms of bird use, performance goals do not focus on specific species or other taxonomic groups, but instead focus on bird guilds or other broad functional groups of birds such as shorebirds or wading birds. Monitoring for these parameters is relatively simple and can be easily repeated over long time periods and by a variety of individuals or organizations, including volunteers.

As noted in the salt panne habitat description in Section 3.2.3 of this report, two types of salt panne habitat currently occur at the BWER, those fed by irregular tidal inundation by extreme high tides and those fed by shallow groundwater or stormwater runoff. Salt panne creation at the BWER is focused on the former type; however, there is potential for the latter type to develop in areas designed as seasonal wetland habitat. The monitoring and performance goals presented here are aimed at the salt panne habitat designed to receive irregular inundation by extreme high tides. However, it should be

recognized that salt panne habitat that unexpectedly forms in areas originally designed as seasonal wetland habitat or in other portions of the Reserve may provide valuable wildlife habitat and should be considered an asset to the overall restoration, not a failure in the creation of seasonal wetlands.

4.6.1 Monitoring

Monitoring for restored salt panne habitat will focus on (1) hydroperiod and salinity, (2) vegetative cover (or lack thereof), and (3) habitat use by guilds or other functional groups of birds. Monitoring will commence after the first full growing season following the completion of construction and will occur for a period of at least 10 years. As noted previously, salt panne habitat may develop in areas not explicitly designed as salt panne habitat—if this occurs, salt panne monitoring should be expanded to include these areas. Because our knowledge of salt panne development is limited, it may be useful to monitor for hydrology, salinity, and bird use at both the BWER and at one or more reference sites containing functioning salt panne habitat such as at Upper Newport Bay in Orange County or Peñasquitos Lagoon in San Diego County. Other potential salt panne reference sites include Point Mugu in Ventura County or the San Dieguito and Poseidon wetlands in San Diego County; however, these sites contain constructed salt panne habitat, and it is unclear whether these salt pannes function similar to naturally occurring salt pannes in the region. During the initial phases of the restoration in Area A, monitoring for these parameters may also be conducted in the existing salt panne habitat in Area B. Monitoring both at reference sites and in existing salt panne habitat at the BWER may provide a better understanding of how salt panne habitat functions within the region as well as useful data to guide adaptive management decisions.

<u>Hydrology and Salinity</u>

The goal of hydrology and salinity monitoring is to determine whether created salt panne habitat receives the frequency and duration of tidal inundation necessary to reach hypersaline conditions. Monitoring for hydrology can be done relatively inexpensively using water level data loggers (however, if salt panne habitat is constructed using a clay layer to reduce percolation, care should be taken not to penetrate the clay layer and cause drainage). Use of such equipment can provide continuous, high-precision monitoring and allows for an understanding of hydrological patterns at multiple time scales. Alternatively, this monitoring can be accomplished by monthly (or more frequent) monitoring using staff gauges or other manual methods. In addition to providing fine-scale data, the use of data logging equipment would require fewer visits to salt panne habitat and reduced disturbance in this habitat. However, there may be security issues involved in leaving scientific equipment at the site. The use of staff gauges would require less up-front cost in terms of equipment and reduced

potential for equipment loss or damage; however, this method would require more visits and disturbance to the site and would provide only limited insight into seasonal patterns of inundation frequency and duration. That said, the expense involved in monitoring staff gauges may be reduced by employing volunteers for this task. If staff gauges are used, monitoring should occur following extreme tides and heavy rainfall events and at appropriate intervals thereafter to determine the duration of inundation following such events. The appropriate interval for monitoring following such events will depend on the size of the event (i.e., height of the tide or amount of rainfall) and the rates of percolation, evaporation, and transpiration (assuming the presence of vegetation) unique to each panne. As such, the most appropriate interval for hydrology monitoring should be based on observations of the depth and duration of inundation made during the first year following the restoration of tidal activity.

Soil salinity can be measured by taking soil cores from within the potential plant rooting zone (to a depth of approximately 4 to 6 inches [10 to 15 centimeters]) along a transect from the edge of the salt panne to the lowest point in the center of the salt panne. Collecting soil cores along an elevation gradient from the edge of the salt panne to the center will provide a detailed understanding of salinity patterns as they relate to inundation depths as inferred by elevation within the salt panne (i.e., lower elevations are assumed to have greater depth and duration of inundation). Soil cores can be either analyzed in-house or sent to a soil testing laboratory for analysis using standard protocols for determining soil salinity. Soils cores should be analyzed for salinity in 1- to 2-centimeter intervals as salinity levels can vary dramatically within the soil profile and will differentially affect plants based on their salt-tolerance and rooting depth.

To avoid excessive disturbance in these sensitive habitats, monitoring for soil salinity will be conducted once annually, when the pannes are dry. This will be done toward the end of the dry season, when salt concentrations are expected to be at their highest (Pratolongo et al. 2009). However, if salt panne soil salinity is to be compared to salinity levels from reference salt pannes, sampling should occur at the same time of year to ensure that results are comparable. Using randomly positioned transects may help reduce impacts associated with sampling along a permanent transect year after year. Given the potential for large variations in soil salinity due to rainfall levels, it may be useful to monitor precipitation at both the BWER and one or more reference sites and to incorporate rainfall into the analysis of soil salinity. Comparing rainfall levels between both years and sites will allow for an analysis of salinity levels weighted by rainfall which may be a better indicator of habitat function than salinity levels alone.

Modifications to this monitoring scheme may be necessary if salt panne habitat is not developing as expected. For instance, if weeds or other unwanted vegetation become established within the salt pannes, it may be necessary to monitor salinity levels during

the growing season (as opposed to the peak of the dry season) to determine what conditions are like when the plants are germinating or actively growing.

Vegetation and Invasive Species

The goal of vegetation monitoring in created salt panne habitat is to (1) determine whether vegetation within the salt panne habitat is expanding, receding, or remaining stable and (2) identify the presence of invasive plant species that may require control.

Monitoring of vegetative cover within salt panne habitat can be combined with vegetation monitoring in other habitats at Ballona and is easily accomplished through GIS analysis of vegetation data collected on the ground. Such monitoring would consist of delineating the area of unvegetated salt panne habitat using a handheld GPS device with sub-meter accuracy and subsequent GIS analysis to calculate the total area of unvegetated salt panne habitat relative to the as-built area of the salt panne habitat. During this vegetation monitoring, the plant species present along the fringes or within the salt panne habitat will be documented and the presence of non-native weeds will be noted. Although species composition and the presence of non-native weeds will not be monitored quantitatively, an understanding of which plant species are encroaching on or establishing within the salt panne habitat will help inform management of these areas. Monitoring of vegetative cover may also be accomplished through GIS analysis of aerial imagery; however, this method would still require on-the-ground monitoring to determine the species composition of any developing vegetation. This on-the-ground monitoring could be combined with hydrology monitoring or annual soil salinity monitoring. The methods chosen for determining the total cover of vegetation will be consistent with the methods used for determining vegetative cover in other habitats within the Reserve.

Monitoring for vegetative cover and the composition of encroaching vegetation will commence following the first full growing season after construction has been completed and will occur in mid- to late summer, after plant growth has slowed but when plants are still identifiable. If aerial imagery is used to determine the total cover of vegetation, the images should be taken during the mid- to late summer for the same reason. Vegetation monitoring will be conducted annually for the first five years following the restoration of tidal activity and thereafter at Year 7 and Year 10, assuming vegetation is on track to meet final performance goals.

Bird Abundance and Diversity

The goal of bird monitoring is to determine whether salt panne habitat will support a diversity of bird species. However, a distinction should be made between the *ability* of created salt panne habitat to support desired levels of bird use and the *actual use* of salt panne habitat by such species. Patterned use of the existing salt panne habitat in Area

B may limit bird use of created salt panne habitat in Area A without being indicative of the suitability of the created salt panne habitat to support birds. This is a particularly important point to consider given that the salt panne habitat planned for Area A consists of many small, scattered salt pannes whereas the existing salt panne habitat in Area B consists of one large, contiguous area. Because of the greater area and reduced perimeter to area ratio of salt panne habitat in Area B, birds may favor this habitat over the smaller areas of salt panne habitat to be created in Area A. If bird use of the created salt panne habitat in Area A is determined to be inadequate, it may be necessary to monitor invertebrate populations or other indicators of the habitat's *ability* to support the desired diversity and abundance of birds.

Monitoring for bird use of salt panne habitat can be conducted in conjunction with bird monitoring in other habitats at the BWER and will be consistent with the methods used for bird monitoring in other habitats throughout the Reserve. Monitoring will be designed to capture (1) the abundance and diversity of bird species observed using the salt panne habitat and (2) the activities in which the birds were engaged within the salt panne habitat (i.e., foraging, resting, etc.).

Due to the large seasonal variation in bird migration and breeding patterns, monitoring for bird use of salt panne habitat will be conducted at intervals throughout the year, with reduced monitoring during the summer breeding period to limit disturbance to breeding birds. Monitoring will be timed to occur during peak periods of bird activity and should occur when the salt panne habitat is inundated or when invertebrates are active at the surface of the salt pannes, as these are the times when birds are most likely to use salt panne habitat for foraging. Because the ecological factors involved in bird use of salt panne habitat are based on a complex set of factors extending well beyond the limits of the BWER, this monitoring will be conducted every year during the first ten years of the monitoring period to capture the full range of variability and to compensate for stochastic events which may affect bird use in any given year.

4.6.2 Performance Goals

As noted above, performance goals for created salt panne habitat are based on (1) hydrology, (2) soil salinity, (3) lack of vegetative cover and invasive weeds, and (4) bird use. The first three parameters are relatively easy to measure and are potentially subject to manipulation, whereas the fourth parameter is less easily measured and may not be subject to manipulation. As such, the first three parameters should be the primary factors used to determine successful development of the created salt panne habitat. As noted above, bird use of salt panne habitat is not well understood and may not be within the control of the BWER land manager. As such, creating strict performance goals for bird use of created salt panne habitat at BWER is not recommended. Bird use of salt panne habitat should be used to determine the general

quality of the salt panne habitat created (e.g., high bird use would indicate high habitat quality and vice versa). If it is determined that the salt panne habitat created is of low habitat quality for birds, additional studies and adaptive management actions may be appropriate.

Hydrology and Salinity

Hydrology performance goals for salt panne habitat are be based on the frequency of inundation and the duration of subsequent ponding which should occur at sufficient frequency and duration to create hypersaline conditions within the salt panne habitat. Because hydrologic conditions are not expected to change substantially over time in the same way vegetation communities might develop, the hydrology performance goals presented in Table 10 are the same for each year of the 10-year monitoring period. Because salt panne habitat will receive some proportion of its hydrologic input from rainfall, the assessment of hydrology performance goals should take into account annual and seasonal variation in rainfall levels.

Performance goals for soil salinity should be based on the levels required to preclude vegetation. The goals presented below assume that salt panne habitat will be created using saline soils or by the addition of salt, and that salinity levels will be high from the outset. If non-saline soils are used and/or salt is not added, performance goals will require modification based on the expected rate of habitat development. Ultimately, the desired outcome is for salinity levels to be within the range of levels found within the rooting zone (top 15 centimeters of the soil profile) in functioning salt panne habitat in Area B or from salt panne habitat at one or more reference sites.

Table 9. Salt Panne Hydrology and Salinity Performance Goals

Monitoring Year	Performance Goals
Applicable to All Years	**A.** The frequency of inundation and duration of ponding should be within the range documented from salt panne habitat in Area B or from one or more reference sites. **B.** Soil salinity levels in created salt panne habitat should be on a trajectory toward levels observed in salt panne habitat in Area B or from one or more reference sites.

Vegetation and Invasive Species

Performance goals for vegetation cover should be based on a steady trend toward attaining non-vegetated, periodically-ponded areas due to hypersaline conditions. It is expected that some vegetation may become established along the fringes and within

the salt panne habitat during the initial phases of the salt panne development when salinities are lower. It is expected that establishment of new plants will be deterred as salinities rise; however, plants that become established during the early years of salt panne development and that are able to tap into deeper, less saline groundwater, may be able to resist increasing salinity levels at the soil surface and may require physical removal. Given these expected trends, performance goals should be based on a sustained decline in vegetative cover and the assumption that some level of active vegetation management may be necessary, especially during the early years of salt panne development when salinities are lower. The ultimate performance goal should be based on a sustained lack of vegetation in a majority of the area originally designed as salt panne habitat. However, this number should also take into account the development of salt panne habitat in areas not originally designed as salt panne habitat; this will account for salt panne habitat that is lost to sea level rise and a corresponding increase in salt panne habitat resulting from the conversion of seasonal wetland habitat in the transition zones, also due to sea level rise.

In addition to the vegetation cover performance goals, invasive weeds designated by the Cal-IPC (2013) as “High” or “Moderate” (exclusive of annual grass species) should remain at low levels. This performance goal is exclusive of non-native annual grass species which are difficult to control and are a dominant member of most herbaceous vegetation communities in California.

Table 10. Salt Panne Vegetation and Invasive Plant Performance Goals

Monitoring Year	Performance Goals
1 – 5	**A.** A majority of the area originally designed as salt panne habitat should remain unvegetated. Plants that establish during the early years may require physical removal; however, new plants should be prevented from becoming established as salinities rise. **B.** Cover of invasive weeds rated as “High” or “Moderate” by the Cal-IPC, exclusive of annual grass species, should remain low.
6 – 10	**A.** A majority of the area originally designed as salt panne habitat should remain unvegetated. Plants that became established during the early years should no longer be present within the salt panne habitat, and new plants should not become established. **B.** Cover of invasive weeds rated as “High” or “Moderate” by the Cal-IPC, exclusive of annual grass species, should remain low.

Bird Abundance and Diversity

Performance goals for bird use of created salt panne habitat are be based on the abundance and species richness of birds observed using salt panne habitat. It may be useful to base the assessment on conditions relative to suitable reference salt pannes. Bird use of specific habitats is dependent on a wide range of variables, including patterned use of existing habitat and the area to perimeter ratio of certain habitats. As such, the performance goals presented here should be used to evaluate the general quality of created salt panne habitat and to inform the need for corrective management actions to improve habitat quality for birds. As noted in Section 4.6.1, patterned use of salt panne habitat in Area B, as well as the larger area of salt panne habitat in Area B, may limit bird use of smaller salt pannes to be constructed in Area A—this may not necessarily reflect the *ability* of constructed salt panne habitat to support high levels of bird use. If bird use of created salt panne habitat is low, it may be appropriate to develop performance goals based on the *ability* of the habitat to support birds as measured using invertebrate levels or another appropriate surrogate of habitat quality.

Table 11. Salt Panne Bird Performance Goals

Monitoring Year	Performance Goals
1 – 3	A variety of bird species should be observed foraging in the salt panne habitat, although the diversity and abundance of birds may be lower than observed prior to the restoration.
4 – 7	Species richness and abundance of birds observed using salt panne habitat should each be within pre-restoration levels and should be increasing with each successive year.
8 – 10	Species richness and abundance of birds observed using salt panne habitat should each be greater than pre-restoration levels; however, annual increases may slow relative to increases observed in Years 4-7.

4.6.3 Adaptive Management

The primary ecological factor involved in the development of salt panne habitat is hydrology, including the frequency and duration of inundation and the salinity of inundating waters. The primary goal of salt panne restoration at Ballona is to provide high quality foraging and/or resting habitat for bird species associated with salt panne habitat. Performance goals for salt panne habitat are based on aspects of hydrology, soil salinity, vegetation composition and cover, and use by birds for foraging. It is

expected that trends in salt panne development may take five or more years to become apparent. Because bird use of salt panne habitat is expected to evolve in conjunction with the development of this habitat, it may take a similar amount of time for trends in bird use to become apparent.

Potential corrective management actions related to the development of salt panne habitat include addition of salt to rapidly increase salinity levels, modifications to salt panne hydrology (through adjustments in grading) to alter inundation frequency and duration, and management of vegetation in the early years of habitat development when salinity levels are low. Other potential management actions may be possible depending on the cause of poor performance. The assessment of salt panne performance should take into consideration the potential for habitat conversion to tidal marsh as a result of sea level rise. This transition is likely to occur over a period of several decades or more. The potential for wetland type conversion due to sea level rise combined with a general lack of knowledge regarding salt panne development makes the monitoring of this habitat type the most nebulous of all of the habitats at the BWER. As such, great care and consideration should be given to any potential management actions related to this habitat.

If the frequency and duration of tidal inundation in the restored salt panne habitat is not sufficient to create hypersaline conditions (i.e., within the range of the same parameters in Area B or at reference sites), an evaluation of habitat development trends will be conducted prior to any modifications related to hydrology. If performance goals for salinity levels and vegetation are being achieved, modifications to salt panne hydrology may not be necessary. However, if the salt pannes demonstrate a lack of progress in meeting performance goals for salinity levels and vegetation, modification of salt panne hydrology may be warranted. In this case, salt panne topography should be assessed in relationship to tidal inundation and appropriate modifications should be made. Because modifications to salt panne hydrology could require the use of heavy equipment which has the potential to cause significant disturbance to other habitats, such management actions will not be undertaken without significant consideration.

If trends in salinity levels are not within the appropriate range identified in the performance goals, an evaluation of trends in salinity levels will be conducted prior to taking any management actions. If salinity levels are sufficiently high to exclude the establishment of vegetation, no management actions may be necessary—instead, adjustments to the performance goals may be warranted based on new information which improves our understanding of salt panne development. If, however, salinity levels are low and do not exclude vegetation, options for increasing salinity will be investigated. The most likely management actions would be to add salt to the salt panne soils or to modify salt panne hydrology through changes in topography.

In the event that trends in vegetation development (or lack thereof) do not demonstrate suitable progress toward meeting performance goals, an evaluation of vegetation trends will be conducted prior to implementing any management actions. If vegetative cover remains low, no management actions may be necessary—instead, adjustments to the performance goals may be warranted based on new information which improves our understanding of salt panne habitat development. However, if it is determined that vegetation within the salt panne habitat is not on a suitable trajectory to meet the goals of the salt panne restoration, the causes of this poor performance will be investigated. These investigations should focus primarily on seasonal and annual variations in hydrology and salinity. Once the cause of poor vegetation performance is identified, appropriate management actions will be developed. If hydrology and salinity are determined to be on appropriate trajectories for salt panne development, vegetation management in the form of hand removal may be the most appropriate management action. If, however, hydrology and salinity are determined to not be on target, modifications related to these parameters may be the most appropriate management action.

If bird use of salt panne habitat does not demonstrate suitable progress toward meeting performance goals, a thorough analysis of the causes of this poor performance will be conducted prior to implementing any corrective management actions. If it is determined that salt panne hydrology, salinity, and vegetation are all within an acceptable range (e.g., within the range of the same variables in other functioning salt panne habitat), additional factors will be analyzed. Potential factors to be analyzed include those related to food sources (e.g., invertebrate populations), predation by cats and other urban predators, or competition from other birds, particularly aggressive non-native birds. Once the potential cause of poor bird performance is determined, appropriate corrective management actions will be developed.

4.7 Seasonal Wetlands

Within the context of the larger tidal wetland restoration at the BWER, the goal of including seasonal wetlands is to increase the diversity of non-tidal wetland habitat available for wildlife use. The primary ecological driver of seasonal wetland development is hydrology, and this will be the focus of monitoring and performance criteria for this habitat type. Additionally, seasonal wetlands will be monitored for the presence of invasive weeds.

4.7.1 Monitoring

Hydrology

Monitoring will be conducted to determine the presence of wetland hydrology. Hydrological monitoring can be accomplished through visual observations of inundation made on a weekly basis during the rainy season. Monitoring will be designed to capture the number of pools inundated, the approximate percentage of area inundated within each pool, and the duration of inundation. As pools dry down, the duration of soil saturation will also be documented. Hydrological monitoring will occur on an annual basis for the full 10-year monitoring period to account for natural variation in rainfall levels and other factors affecting seasonal wetland hydrology.

Vegetation and Invasive Plants

Monitoring will be conducted to determine the presence and extent of invasive weeds listed by the Cal-IPC (2013) as “High” or “Moderate”, exclusive of non-native annual grasses. This should consist of visual observations of invasive weeds and an estimate of total cover within the seasonal wetlands. Monitoring for invasive weeds will be conducted twice per year (or more frequently) during the entire 10-year monitoring period, once near the beginning of the growing season and during the annual vegetation monitoring toward the end of the growing season (or more frequently). Because it will not be possible to eliminate all propagule sources for non-native weeds which occur outside of the BWER, some level of monitoring for invasive weeds will be required for the lifespan of the restoration.

4.7.2 Performance Goals

Hydrology

Hydrology performance goals for seasonal wetlands are be based on the number of pools inundated during each rainy season and the length of inundation or soil saturation. However, because seasonal wetland hydrology will be driven by rainfall, performance goals will be linked with annual rainfall levels. Thus, the performance goals presented here will generally be applied only to years of normal or greater rainfall as determined by the use of local rainfall data and Natural Resources Conservation Service (“NRCS”) WETS tables (NRCS 1997; Sprecher and Warne 2000). Due to this variation in annual rainfall levels, it is likely that not all pools will fill every year, and the ultimate goal should be to have prolonged (i.e., two consecutive weeks or longer) inundation in a majority of all seasonal wetlands—with the remaining seasonal wetlands containing saturated soils for at least two consecutive weeks—in years with normal and greater rainfall.

Table 12. Seasonal Wetland Hydrology Performance Goals

Monitoring Year	Performance Goals
Applicable to All Years	During years of normal or greater rainfall, the majority of seasonal wetlands should be inundated for at least two consecutive weeks during the rainy season; these should generally be the same pools each year. The remaining seasonal wetlands should contain saturated soils for at least two consecutive weeks during the rainy season; these should generally be the same pools each year.

Vegetation and Invasive Plants

The performance goals presented here focus on the cover of invasive species, exclusive of non-native annual grasses, and the presence of wetland-adapted species (both native and non-native). It is expected that seasonal wetland habitats will contain a high percentage of non-native herbaceous species and, given the ample supply of weed seed sources in the surrounding areas, it is unlikely that these species will ever be fully eradicated. As such, the performance goals are be aimed at depleting the available seed bank, reducing cover of invasive weeds to a minimal level, and encouraging establishment of wetland-adapted species.

Table 13. Seasonal Wetland Vegetation and Invasive Plant Performance Goals

Monitoring Year	Performance Goals
Applicable to All Years	A. Cover of invasive species listed as “High” or “Moderate” by the Cal-IPC, exclusive of annual grasses, should remain low. B. The majority of plant cover, both native and non-native, should be composed of wetland-adapted species listed as facultative (“FAC”) or wetter on the National Wetland Plant List (Lichvar 2012).

4.7.3 Adaptive Management

The goal of seasonal wetland habitat restoration at Ballona is to increase the diversity of non-tidal wetland habitat available for wildlife use. Monitoring parameters and performance goals focus on wetland hydrology and a lack of highly invasive plant species. If it is determined that performance goals are not being met, overall trends in habitat development will be examined to determine whether corrective management actions are warranted. If trends are on track to meet long-term performance goals, no

corrective management actions may be warranted and modification of the interim performance goals based on an improved understanding of seasonal wetland habitat development may be the most appropriate course of action. However, if it is determined that corrective management actions are appropriate, these may include alterations to hydrology through grading or modification of substrate characteristics (e.g., soil texture or compaction rates), more intensive weed management, or planting of appropriate native species.

4.8 Riparian Scrub and Woodland

Limited areas of riparian habitat currently exist at the BWER, and riparian habitat restoration is not a primary focus of the overall restoration effort. Some areas of existing riparian habitat will be preserved; however, a portion of existing low-quality riparian habitat may be converted to other habitat types. Riparian habitat restoration, monitoring parameters, performance goals, and management will focus primarily on sustaining high cover of riparian-associated species and low cover of highly invasive plant species. The goal of preserving the eucalyptus grove is to maintain the trees as viable roosting habitat for monarch butterfly and to prevent the spread of eucalyptus to other portions of the BWER. Long-term management of the eucalyptus grove will focus on eventually replacing the trees with native species suitable for monarch roosting.

In general, high diversity of riparian-associated plant species is the desired outcome of riparian habitat restoration; however, it is expected that establishing a diverse understory within the eucalyptus grove will be exceedingly difficult give the large amounts of litter deposited by these trees as well as allelopathic compounds potentially exuded into the soil. In addition, some native riparian species such as arroyo willow (*Salix lasiolepis*) tend to form dense, monotypic thickets, and although these areas may be low in plant diversity, they provide valuable habitat for riparian-associated wildlife species. Given the difficulty of maintaining a diverse understory in the eucalyptus grove and the tendency of riparian vegetation (i.e., willows) to form dense, monotypic stands, no specific performance goals for native plant composition, other than for invasive weeds, are included here. Instead, performance goals focus on attaining high levels of plant cover and low levels of invasive species (excluding the eucalyptus).

4.8.1 Monitoring

Monitoring of riparian habitats will focus on total canopy cover and composition, including the presence of invasive plant species listed as “High” or “Moderate” by the Cal-IPC (2013), exclusive of eucalyptus trees and non-native annual grasses. This monitoring will be quantitative in nature, with estimates of total cover by species and canopy layer. In addition, the location and extent of invasive weed populations will be documented. Monitoring for vegetation cover and composition will occur annually for

the entire 10-year monitoring period. As with other habitats, it may be useful to monitor for invasive weeds twice annually (or more frequently), once near the beginning of the growing season and again during the annual vegetation monitoring to be conducted in mid- to late summer (or more frequently). In addition to the vegetation monitoring, the eucalyptus grove will be assessed for tree health by a qualified arborist every two to three years. These assessments will consist of general observations of tree health and recommendations for management actions, with the ultimate goal of replacing the trees with suitable native species. In addition, the overwintering monarch population will be quantitatively monitored on an annual basis to provide an estimate of the size of the overwintering population.

4.8.2 Performance Goals

Performance goals for riparian habitat restoration focus on maintaining the eucalyptus grove in healthy condition, providing viable roosting habitat for the overwintering monarch population, and maintaining high cover of riparian-associated species (outside of the eucalyptus grove) and low cover of invasive species listed as "High" or "Moderate" by the Cal-IPC (2013), exclusive of eucalyptus and non-native annual grasses.

Table 14. Riparian Vegetation and Invasive Plant Performance Goals

Monitoring Year	Performance Goals
1 – 3	**A.** Canopy cover of riparian-associated species (outside of areas occupied by eucalyptus trees) may be low, but vegetation should show signs of establishment and spread. Areas not occupied by eucalyptus trees should show signs of natural vegetation recruitment or should be planted with appropriate native species. **B.** Cover of invasive species listed as "High" or "Moderate" by the Cal-IPC, exclusive of the eucalyptus trees and non-native annual grasses, should remain low. Eucalyptus trees should not be allowed to expand beyond the baseline population size.
4 – 7	**A.** Canopy cover of riparian-associated species (outside of areas occupied by eucalyptus trees) should be relatively high, approaching 75% or greater by the end of Year 7 and should show signs of establishment and spread. **B.** Cover of invasive species listed as "High" or "Moderate" by the Cal-IPC, exclusive of the eucalyptus trees and non-native annual grasses, should remain low. Eucalyptus trees should not be allowed to expand beyond the baseline population size.

Table 14. Riparian Vegetation and Invasive Plant Performance Goals

Monitoring Year	Performance Goals
8 – 10	**A.** Canopy cover of riparian-associated species (outside of areas occupied by eucalyptus trees) should be nearly complete. **B.** Cover of invasive species listed as "High" or "Moderate" by the Cal-IPC, exclusive of the eucalyptus trees and non-native annual grasses, should remain low. Eucalyptus trees should not be allowed to expand beyond the baseline population size.

4.8.3 Adaptive Management

The goal of riparian habitat restoration at the BWER is to preserve existing riparian vegetation where possible, including maintaining and eventually replacing the eucalyptus grove in Area B, encouraging establishment and expansion of native riparian species, and maintaining low cover of invasive species in these areas. It is unclear at this point what restoration activities will occur in or adjacent to areas currently identified as riparian habitat; however, it is assumed that these restoration activities will be focused on planting or natural recruitment of appropriate riparian-associated native species and removal of any highly invasive species. It is expected that trends in vegetation establishment will be apparent within two to three years following the completion of initial restoration activities.

Management for riparian habitat will focus on attaining near complete cover of riparian-associated species and low levels of invasive species. In addition, the eucalyptus grove will be managed as needed to maintain the overwintering monarch population at existing or improved levels, but to prevent the spread of eucalyptus beyond its current extent and to eventually replace the eucalyptus with appropriate native species. In areas not occupied by eucalyptus trees, canopy cover will ideally consist of a combination of herbaceous plants, shrubs, and small trees. However, as noted above, some native riparian-associated species such as arroyo willow tend to form dense, monotypic stands with little to no understory vegetation—such stands provide valuable habitat for wildlife and are desirable despite having low plant diversity. In addition, it is expected that establishing understory vegetation in areas occupied by eucalyptus will be exceedingly difficult given the large amount of leaf litter, bark, and other debris dropped by these species—as such, no goals have been established for understory vegetation cover in these areas, and management should be focused on establishing native trees to replace the eucalyptus and preventing the spread of the eucalyptus and the establishment of other aggressive invaders.

Potential causes of poor vegetation establishment in areas not occupied by eucalyptus are likely to be related to water availability and physical and chemical properties of the soil. If it is determined that vegetation establishment does not demonstrate suitable progress toward meeting performance goals, studies will be conducted to determine the cause of the poor performance. Potential management actions include additional plantings, addition of temporary irrigation (if not already present), addition of slow-release fertilizers, or the addition of other soil amendments to alter soil physical or chemical properties. If it is determined that soil salinity is a cause of poor vegetation establishment, it may be necessary to modify the planting palette to include more salt-tolerant species.

As noted previously, the eucalyptus grove in Area B is being kept as roosting habitat for monarch butterflies. Although eucalyptus trees are tolerant of a wide range of soil and moisture conditions, there is potential for restoration activities to affect the growth of these trees, and it may be necessary to actively manage the trees to maintain the grove as viable roosting habitat for the monarchs. Any management will be conducted under the advisement of a certified arborist or a monarch expert, as appropriate. Large reductions in the size of the overwintering monarch population will be assessed against historical data from the site and observations of other regional (or wider-scale) trends in monarch population size to determine whether the drop in numbers is specific to the BWER or attributable to regional climate or other wide-scale factors. If the trends appear to be specific to the BWER, a monarch expert will be consulted to determine the potential causes and most appropriate management actions. Long-term management of the eucalyptus grove will focus on replacement of the trees with native trees suitable for monarch roosting.

4.9 Dune

Existing dune habitat at the BWER is composed of relict, stabilized dunes. Despite lacking many of the natural processes present in active dune systems, the dunes at the Reserve provide valuable habitat for a number of sensitive plant and wildlife species and are of great public interest. The goal of dune restoration at the BWER is to mimic conditions within the more stabilized (i.e., backdune) portions of a dune system such as the one at Ormond Beach in Ventura County. Given their removal from the active dune forming processes that occur in foredune habitat, conditions within the more stabilized portions of the dunes at Ormond Beach represent the range of conditions most likely to be achieved at the BWER. Performance goals are be based on the diversity of native dune-associated plant species present (see the potential planting palette included as Appendix A for a list of native plant species typically associated with dunes), total area of vegetation cover, and the absence of highly invasive species. Management actions will focus on maintaining the desired plant community cover and composition, reducing

existing levels of invasive weeds, and preventing the establishment of new populations of invasive weeds. Currently, it is unclear whether new dune habitat will be created in addition to the existing dune habitat in the western portion of Area B and the southwestern portion of Area C. If new dune habitat is created, it may be necessary to create a revised set of monitoring protocols and performance goals to account for the different stages of development between the existing and created dune habitat.

4.9.1 Monitoring

Vegetation and Invasive Plants

The composition and cover of vegetation is the dominant characteristic feature of stabilized dune systems and will be the primary focus of monitoring. Monitoring will focus on measurements of plant species richness and cover and on the presence and extent of invasive plant species. General vegetation monitoring for dune habitat will be conducted on an annual basis during entire 10-year monitoring period. Monitoring will be conducted toward the end of the growing season after perennial plants have put on most of their annual growth. As with other habitats, it may be useful to monitor for invasive weeds twice annually (or more frequently), once near the beginning of the growing season and again during the annual vegetation monitoring to be conducted in mid- to late summer (or more frequently). Monitoring will be quantitative and will be conducted using a random sampling strategy or fixed transects. The monitoring scheme to be implemented will be similar to the vegetation monitoring conducted elsewhere in the Reserve. Monitoring will be designed to quantify (1) species richness, (2) vegetative cover, and (3) the presence and extent of invasive weeds. In conjunction with general quantitative vegetation monitoring, the entire extent of dune habitat will be qualitatively surveyed and the location and extent of invasive species rated as “High” or “Moderate” by the Cal-IPC, exclusive of annual grasses, will be documented on maps or aerial imagery. These data will be used to prioritize weed control efforts.

4.9.2 Performance Goals

Performance goals for dune habitat will be based on the diversity of native dune-associated plant species, the total area of vegetation cover, and the cover of invasive species. As noted above, if new dune habitat is to be created, it may be necessary to create a separate set of performance goals for the newly created dune habitat to account for differences in seral stages between created and existing dune habitat. Performance goals for any new dune habitat should be based on developing plant community composition and cover similar to that of the backdune habitat at Ormond Beach or another suitable reference dune system and on maintaining low cover of invasive species.

Table 15. Dune Vegetation and Invasive Plant Performance Goals

Monitoring Year	Performance Goals*
1 – 3	**A.** Total plant cover should be similar to that of other stabilized dunes in the region. Some portion of the dunes should remain unvegetated. **B.** The diversity of native dune-associated plant species should be similar to that of other stabilized dunes in the region. **C.** Existing populations of invasive species listed as "High" or "Moderate" by the Cal-IPC, exclusive of non-native annual grasses, should be significantly reduced during the early years of the restoration. Newly developed populations should not be allowed to become established.
4 – 7	**A.** Total plant cover should be similar to that of other stabilized dunes in the region. Some portion of the dunes should remain unvegetated. **B.** The diversity of native dune-associated plant species should be the same as or greater than that of other stabilized dunes in the region. **C.** Existing populations of invasive species listed as "High" or "Moderate" by the Cal-IPC, exclusive of non-native annual grasses, should be reduced to and maintained at minimal levels. Newly developed populations should not be allowed to become established.
8 – 10	**A.** Total plant cover should be similar to that of other stabilized dunes in the region. **B.** The diversity of native dune-associated plant species should exceed that of other stabilized dunes in the region. **C.** All populations of invasive species listed as "High" or "Moderate" by the Cal-IPC, exclusive of non-native annual grasses, should be reduced to and maintained at minimal levels.

* Performance goals presented here are based on restoration of existing dune habitat. If dune habitat is created, it may be necessary to create a separate set of performance goals specific to the created dune habitat.

4.9.3 Adaptive Management

The focus of dune restoration at the BWER is to provide habitat for unique plant and animal species, and given that these dune systems will lack the natural processes found

in active dune systems, the focus of performance goals will be on the development of appropriate dune vegetation. Because much of the existing dune vegetation will be preserved, it is expected that restoration activities will focus on the removal of invasive species and subsequent planting of appropriate native plants. It is expected that trends in vegetation response to management activities will become apparent within two to three years following weed removal or planting.

If vegetation does not appear to be on a suitable trajectory toward meeting performance goals within two to three years following management activities, an assessment of long-term vegetation trends will be conducted to determine whether changes in management activities are warranted or whether performance goals should be modified based on an improved understanding of dune habitat development. If it is determined that trends in vegetation development are not on track to meet long-term performance goals, corrective management actions may be warranted, and an investigation into the causes of poor plant performance will be conducted. Potential corrective management actions may include the addition of slow-release fertilizer or other soil amendments, application of irrigation, more intensive weed management, or the use of sand stabilizing techniques such as installing sand fencing. Additional corrective management actions might include experimental seeding or planting techniques, trials to determine the best species for use in the dune restoration, or experimental methods of weed removal. Any such corrective management actions will be accompanied by monitoring designed to quantify and assess the outcomes.

4.10 Upland Scrub and Grassland

Within the context of the overall wetland restoration at the BWER, the goal of upland scrub and grassland habitat restoration is to create high-quality upland habitat to support tidal wetland functions. The primary support functions desired from upland habitat include (1) reducing overland flow rates, sediment loads, and contaminants for waters entering wetland habitat, (2) providing high quality nesting and high tide refuge areas for wildlife species, and (3) providing transition zones for sea level transgression. Monitoring and performance goals will focus on aspects related to the first two functions. The third function, providing transition zones for sea level transgression, will be achieved through the design process and should not require monitoring.

4.10.1 Monitoring

Monitoring of upland scrub and grassland habitats will include (1) measurements of total plant cover and plant diversity, (2) the location and cover of highly invasive species (i.e., Cal-IPC “High” or “Moderate” lists, exclusive of non-native annual grasses), and (3) use by a diversity of bird species for nesting, foraging, and other activities.

Vegetation and Invasive Plants

Vegetation monitoring will be conducted using a quantitative method (e.g., estimates of percent cover using quadrats) similar to that used to monitor vegetation elsewhere in the BWER. Monitoring will be designed to capture both the composition of vegetation and cover by individual plant species. Vegetation monitoring will commence near the end of the first full growing season following planting and will be conducted annually for the entire 10-year monitoring period. During annual vegetation monitoring, the location and extent of highly invasive weeds (i.e., plants on the Cal-IPC "High" or "Moderate" lists, exclusive of non-native annual grasses) will be documented on maps or aerial imagery. Whereas vegetation monitoring will be conducted over a limited area using a quantitative method, monitoring for invasive weeds will be conducted at a qualitative level, but will be conducted over the entire area of upland habitat. It may be useful to monitor for invasive weeds twice per year (or more frequently), once near the beginning of the growing season and again during the annual vegetation monitoring toward the end of the growing season (or more frequently). Because it will not be possible to eliminate propagule sources for non-native weeds which occur outside of the BWER, monitoring for invasive weeds will likely be required for the lifespan of the restoration.

Bird Abundance and Diversity

Monitoring for bird use of upland habitat will be conducted in conjunction with bird monitoring in other habitats at the BWER and will be consistent with the methods used elsewhere in the Reserve. Monitoring will be designed to capture (1) the abundance and species richness of birds observed using the upland habitat and (2) the activities in which the birds were engaged within the upland habitat (i.e., foraging, nesting, etc.).

Due to the large seasonal variation in bird migration and breeding patterns, monitoring for bird use of upland and transition habitats will be conducted at intervals throughout the year, with reduced monitoring during the summer breeding period to limit disturbance to breeding birds. Monitoring will be timed to occur during peak periods of bird activity. Because the ecological factors involved in bird use of upland habitat are based on a complex set of factors extending well beyond the limits of the BWER, this monitoring will be conducted every year during the 10-year monitoring period to capture the full range of variability and to compensate for stochastic events which may affect bird use in any given year.

4.10.2 Performance Goals

Performance goals for upland scrub and grassland habitats focus on (1) high cover and species richness of native plant species, (2) low cover of invasive plant species, and (3) use by a diversity of bird species.

Vegetation and Invasive Plants

Vegetation performance criteria presented here are aimed at documenting a steady increase in plant cover to meet the upland restoration objectives of providing erosion control, reducing overland flow rates and sediment and contaminant loads, and providing high quality habitat for use by wildlife species. The performance goals focus on the establishment of vegetative cover and a lack of highly invasive species. It is expected that upland habitats will contain a high percentage of non-native herbaceous species and, given the ample supply of weed seed sources in the surrounding areas, it is unlikely that these species will ever be fully controlled.

Table 16. Upland Scrub and Grassland Vegetation and Invasive Plant Performance Goals

Monitoring Year	Performance Goals
1 – 3	**A.** Canopy cover may be low, but vegetation should show signs of establishment and spread. **B.** Cover of invasive species listed as "High" or "Moderate" by the Cal-IPC, exclusive of annual grasses, should remain low.
4 – 7	**A.** Canopy cover should be relatively high, approaching 75% or greater by the end of Year 7, and should show signs of significant natural recruitment. **B.** Cover of invasive species listed as "High" or "Moderate" by the Cal-IPC, exclusive of annual grasses, should remain low.
8 – 10	**A.** Canopy cover should be nearly complete by the end of Year 10. **B.** Cover of invasive species listed as "High" or "Moderate" by the Cal-IPC, exclusive of annual grasses, should remain low.

Bird Abundance and Diversity

It is expected that many bird species will use upland scrub and grassland habitat, and although the primary wetland support function of the upland habitat is to provide high tide refuge for tidal marsh species, providing high quality habitat for non-aquatic birds is also an important function. The performance goals presented below are aimed at the presence of birds associated tidal marsh habitat as well as the presence of other birds using the habitat for foraging, roosting, and nesting—these birds may or may not be typically associated with tidal marsh habitat.

Table 17. Upland Scrub and Grassland Bird Performance Goals

Monitoring Year	Performance Goals
1 – 3	**A.** A variety of bird species should be observed foraging in the restored uplands, although the diversity and abundance of birds may be lower than observed prior to the restoration.
4 – 7	**A.** Species richness and abundance of birds should each be within pre-restoration levels and should be increasing with each successive year. **B.** Birds should be observed both foraging and demonstrating territorial behavior within the restored upland habitat.
8 – 10	**A.** Species richness and abundance of birds should each be greater than pre-restoration levels; however, annual increases may slow relative to increases observed in Years 4 – 7. **B.** Birds should be observed both foraging and demonstrating territorial behavior within the restored upland habitat.

4.10.3 Adaptive Management

The goal of upland habitat restoration at the BWER is to create high-quality habitat with support functions for tidal wetland habitat including reducing overland flow rates and sediment and contaminant loads, providing habitat for nesting and high tide refuge areas for wildlife species, and providing transition zones for sea level transgression. The primary focus of monitoring and performance goals for upland habitat is on the establishment of appropriate vegetation and use by wildlife species. It is expected that trends in the establishment of upland vegetation will be apparent within two to three years following planting or seeding. It is expected that trends in bird use may take somewhat longer to become apparent, on the order of three to five years.

If it is determined that trends in vegetation establishment or use by bird species are not on track to meet performance goals within the expected timeframe for trends to become apparent, an assessment of the overall trends in habitat development and use by wildlife will be conducted to determine whether the poor performance is specific to the BWER or occurs at a regional scale. If it is determined that the lack of progress toward meeting performance goals is specific to the BWER, the performance goals will be reevaluated in light of any improvements in our understanding of upland habitat development. If it is determined that the performance is not related to a deficiency in the performance goals, studies will be undertaken to determine the cause of the poor performance.

In terms of vegetation establishment, a lack of progress toward meeting performance goals is likely to be related to soil physical or chemical properties or moisture levels. Potential corrective management actions include additional plantings, installation of temporary irrigation (if not already present), addition of slow-release fertilizers, or addition of soil amendments to alter soil physical or chemical properties. Initial investigations indicate that salinity may be an issue in upland habitats. If it is determined that soil salinity is a cause of poor vegetation establishment, it may be necessary to modify the planting palette to include more salt-tolerant species (see the potential planting palette included as Appendix A). In terms of bird use of upland habitat, potential causes for a lack of progress toward meeting performance goals is likely to be related to vegetation composition or structure, the absence of suitable food sources, the presence of bird predators, or competition from non-native birds. Potential corrective management actions may include modifications vegetation structure or composition or management of predators or competing non-native birds.

4.11 Transition Zones

Although the habitats shown in Figure 4 are depicted with sharp boundaries between the adjacent habitats, in reality, each habitat will have a transition zone between it and the adjacent habitat. In some cases, these transition zones will be relatively narrow, such as the transition zone between tidal channels and tidal marsh habitat or the transition zone between seasonal wetland and upland grassland habitats. However, other transition zones are likely to be more broad, such as the transition zone between the high marsh and upland grassland and scrub habitats. In general, these transition zones will not be treated separately from their adjacent habitats, with one exception being the brackish marsh which represents a transition zone between saline and freshwater habitats. That said, it may be difficult to apply some performance goals to the transition zones, and in those cases, performance goals will be applied judiciously. In general, the focus of monitoring and assessments of performance in transition zones will be based on high levels of plant cover (if appropriate), low levels of invasive species, and low levels of problematic erosion or other disturbances.

4.12 Reserve-Wide Monitoring Elements

In addition to the habitat-specific monitoring parameters, a number of more general parameters will need to be monitored throughout the entire preserve. These parameters include erosion, public access, infrastructural conditions, litter, invasive species, and urban predators. Reserve-wide monitoring for these variables is discussed in the following sections. It may be most efficient to combine this monitoring with other elements of the monitoring program. Combining monitoring tasks will also help reduce disturbance to sensitive habitats or species at the BWER.

4.12.1 Erosion

Although erosion is likely to be more prevalent in certain habitats, it will be important to monitor for erosion throughout the BWER. Goals for erosion control will focus on preventing erosion and correcting any problematic erosion problems that do occur. Monitoring for erosion will occur on an annual basis, with particular emphasis during the rainy season. Monitoring will occur (1) within one month prior to the onset of seasonal rains and (2) on a monthly to bi-monthly basis following the onset of seasonal rains during the first several years of the restoration. The purpose of monitoring prior to the onset of seasonal rains is to document maintenance needs for existing erosion control measures as well as the need for any additional erosion control measures prior to the onset of the rainy season when erosion is expected to be greatest. The timing of this monitoring should be such that the land manager has sufficient time to perform maintenance or install additional controls prior to the onset of winter rains. The purpose of monthly monitoring during the rainy season is to document any areas of erosion and to identify the need for maintenance or additional control measures. Although these measures are useful for short-term erosion control during construction and the initial phases of vegetation establishment, long-term erosion control measures should be focused on the establishment of vegetative cover. Once vegetation communities have filled in sufficiently to reduce the potential for erosion, the frequency of monitoring may be reduced, but will occur no less than once per year during the entire 10-year monitoring period.

4.12.2 Public Access, Infrastructure, Litter

Public access at the BWER will be limited to roads, pedestrian trails, and designated public access areas such as picnic sites or wildlife viewing areas. Trash cans and recycling bins will be available throughout the BWER, and trash and other human debris will not be present in natural habitats. In addition, a trash boom will be installed within aquatic habitat to prevent the movement of trash to Ballona Creek. The surface of walkways and trails will be maintained in good, dry condition. Areas that flood or become muddy during the rainy season will be subject to seasonal closure or will be redesigned to prevent flooding. Trails will be free of large debris, and fencing and signage will be maintained in good condition. Social trails will not be present in any part of the Reserve. Given the relative ease of access to upland habitat relative to wetland habitat, human disturbance is likely to be a greater problem in upland habitat and will require regular monitoring and control.

Monitoring for these parameters may be qualitative in nature, but will occur over the full extent of the BWER, with particular focus in the upland areas and areas immediately adjacent to trails and other public access areas. During monitoring for human disturbance, the presence and extent of social trails, trash, and other debris will be

documented on maps or aerial imagery. The condition of fencing, signage, and lighting will also be noted.

4.12.3 Invasive Species

Although monitoring for invasive plants is included in the monitoring program for individual habitats, it is included here to ensure that monitoring occurs throughout the Reserve. Monitoring for effectiveness of invasive weed control efforts will be conducted at least twice annually during the initial 10-year monitoring period, once near the beginning of the growing season and again during early to mid-summer. More frequent monitoring may desirable given sufficient funds. Thereafter, monitoring will be conducted indefinitely into the future, at intervals to be determined based on data collected during the initial 10 years of monitoring. It is likely that uplands and freshwater habitats will require greater management for invasive weeds than will tidal wetland and salt panne habitats, and monitoring should be conducted more frequently in these habitats. Monitoring may be qualitative in nature and should document the location and approximate size of populations of invasive weeds listed by the Cal-IPC as “Moderate” or “High”, exclusive of grasses and the eucalyptus grove in Area B. Although complete eradication is unlikely for many species, the goal of weed control efforts at the Reserve should be to minimize impacts from invasive species. Existing populations of highly invasive species will be controlled, to the extent feasible. New populations will be prevented from becoming established.

In addition to monitoring for invasive weeds, it may also be necessary to monitor for invasive wildlife species such as New Zealand mudsnail or American bullfrog (*Lithobates catesbeianus*). Although these species are not known to occur at the Reserve, there is potential for them to be introduced to the site. If these or other invasive wildlife species are observed at the site, a monitoring and eradication plan will be developed consistent with CDFW policies regarding such species.

4.12.4 Urban Predator Management

Given the urban setting in which the Reserve occurs, urban predators such as feral cats and raccoons are likely to pose significant threats to native wildlife in the Reserve. The presence of such urban predators may prevent the establishment of populations of wildlife species and will require control if wildlife performance goals are to be achieved. An urban predator monitoring and management plan will be developed in coordination with the CDFW. This plan will identify key areas for monitoring, trigger levels for management, and appropriate control methods. The plan will be administered by the CDFW or an appropriately licensed firm specializing in predator management.

4.12.5 Vector Control

Project proponents will work with the Los Angeles West County Vector Control District to ensure that vector concerns are addressed within the BWER. Any measures required to address vector concerns will be addressed in final plans.

4.13 Reporting

Timely reporting is a critical component of any monitoring and adaptive management program (Atkinson et al. 2004). Annual monitoring methods and results should be detailed in a report to be prepared for the SCC, the CDFW, the Corps, the Regional Water Quality Control Boards, and other interested parties. The exact content and formatting for monitoring reports will be informed by the CEQA/NEPA analysis and the regulatory permitting process. The annual monitoring report will present an analysis and discussion of the data collected over the previous year and will incorporate data and trends from previous years to create a complete picture of post-restoration habitat development. The analysis presented will be rigorous and detailed; however, the report should be written such that it can be understood by all parties involved in the restoration, whether they be technical experts or the general public.

In addition to the annual report, it may be necessary to produce brief monitoring memoranda for issues requiring rapid management decisions such as newly documented populations of invasive species, areas of severe erosion, or signs of human disturbance in sensitive habitats. The form of these brief reports will be developed in conjunction with the development of the HMMP.

4.14 Revisions to the Management Plan

Given the uncertainty involved in the development of many habitats at the Reserve, it may be necessary to modify the monitoring approach and performance goals presented here or those to be developed for the HMMP. Any modifications or additions to the monitoring approach or performance goals, or to the adaptive management program presented above will be supported by data collected at the BWER or the reference sites or from advances in our understanding of coastal habitat restoration. The triggers and process for implementing revisions to the management plan will be developed in coordination with the project design team and the CDFW and in conjunction with the development of the HMMP.

5.0 INFRASTRUCTURE PLANNING AND MANAGEMENT

The restoration and the long-term management of the BWER will require modifications to existing infrastructure and the addition of new infrastructure. The following sections outline the infrastructural requirements of both the restoration and the long-term management of the Reserve. This information is not intended to serve as a detailed analysis of the infrastructural requirements, but rather is intended to inform the development of a Property Analysis Record ("PAR") and an Operations and Maintenance Plan for the BWER. The PAR will be used to determine the funding required to conduct all of the proposed activities required for restoration, establishment, and long-term management.

5.1 Required Infrastructure for Restoration

A number of infrastructural elements may be required at the BWER in support of habitat restoration efforts. If on-site plant salvage and propagation is to occur, greenhouses and related facilities will be required. Multiple greenhouses may be required to provide space for the variety of plants needed for the restoration. Because of the infrastructural requirements for on-site plant salvage and propagation, it may be more cost-effective to outsource this work to a reputable native plant nursery or habitat restoration firm with plant propagation facilities. Temporary irrigation will be required in upland areas, transition zones, high marsh, and dune habitats where supplemental water will aid in the establishment of restoration plantings. Throughout the restoration, temporary staging areas will be required for plant and soil handling and other restoration-related tasks. In addition, temporary roads or travel ways will be required to transport restoration materials and equipment around the BWER; depending on the type of equipment to be used, these roads may require a surface treatment such as compacted gravel or geotextile fabric. It is likely that additional restoration-related infrastructural needs will be identified as the details of the restoration plan are developed.

5.2 Required Infrastructure for Long-Term Operations and Maintenance

5.2.1 Visitor Center

An interpretive visitor center is currently planned for development in Area C. The visitor center will serve as the public's main gateway to the BWER, providing educational resources on the functions and values of restored habitats and the importance of tidal wetland preservation. Plans for the visitor center are being developed by the project design team. Although the details of the visitor center have yet to be determined, it is clear that basic infrastructural elements will be necessary, including utilities, parking areas, pathways, fencing, and signage. Details on these elements will be provided in the project description for the visitor center.

5.2.2 Reserve Operations and Maintenance

The BWER will require long-term management and maintenance to ensure the success of restored habitats. Some of the major infrastructure required will likely include:

- Trails
- Gates
- Fencing
- Signage
- Interpretive panels
- Vehicles
- Maintenance workshop
- Machinery and hand tools

Other infrastructure, including a greenhouse to propagate plant material, may be required for successful operations and maintenance of the BWER and should be identified in the development of a long-term Operations and Maintenance Plan. The Operations and Maintenance Plan should provide detailed information on the planning, timing, and execution of yearly and periodic Reserve management tasks. The Plan should identify both up-front and on-going management tasks and the estimated costs of all tasks.

Following the preparation of a long-term Operations and Management Plan, a PAR will be performed to determine the financial requirements for managing and maintaining the BWER. All of the required management and maintenance needs of the Reserve identified in the Operations and Maintenance Plan will be analyzed in the PAR to determine the full cost of implementation.

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APPENDIX A

POTENTIAL PLANT PALETTE

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Appendix A. Potential plant palette for wetland and upland restoration areas in BWER. Plant nomenclature follows Baldwin et al. (2012).

Scientific Name	Common Name	Life form	Conservation Status*	Salt Marsh	Mud flat	Low Marsh	Mid Marsh	High Marsh	Salt Pan	Low Transition	High Transition	Upland	Grass	Scrub	Dune	Seasonal Wetland	Freshwater / Brackish	Salt Tolerant	Landscape Suitable	Historically at BWER
Abronia latifolia	Sand verbena	Perennial forb										x			x					
Abronia maritima	Red sand verbena	Perennial forb	Rank 4								x	x			x			x		x
Abronia umbellata	Pink sand verbena	Perennial forb									x	x			x			x		x
Abronia villosa	Villose abronia	Annual herb										x			x			x		x
Acer macrophyllum	Big leaf maple	Tree										x	x						x	
Acer negundo	Boxelder	Tree										x					x		x	
Achillea millefolium	Common yarrow	Perennial forb									x	x	x	x					x	
Acmispon americanus	Spanish clover	Annual herb																		x
Acmispon argophyllus	Silver birds foot trefoil	Perennial herb										x	x	x						
Acmispon argyraeus	Canyon birdsfoot trefoil	Perennial herb										x	x	x						
Acmispon brachycarpus	Short podded lotus	Annual herb										x	x	x	x					
Acmispon dendroideus	Island broom	Shrub										x	x	x						
Acmispon glaber	Deerweed	Perennial shrub									x	x	x	x	x			x		x
Acmispon maritimus	Coastal lotus	Annual herb										x		x						
Acmispon strigosus	Strigose lotus	Annual herb										x	x	x	x					x
Adenostoma fasciculatum	Chamise	Perennial shrub										x								x
Agrostis exarata	Spike redtop	Perennial herb															x			
Alnus rhombifolia	White alder	Tree															x		x	
Amaranthus californicus	California amaranth	Annual herb															x			x
Amblyopappus pusillus	Dwarf coastweed	Annual herb																x		

Scientific Name	Common Name	Life form	Conservation Status*	Salt Marsh	Mud flat	Low Marsh	Mid Marsh	High Marsh	Salt Pan	Low Transition	High Transition	Upland	Grass	Scrub	Dune	Seasonal Wetland	Freshwater / Brackish	Salt Tolerant	Landscape Suitable	Historically at BWER
Ambrosia acanthicarpa	Annual bursage	Annual herb										x	x	x						x
Ambrosia chamissonis	Beach bur-sage	Perennial herb										x			x					x
Ambrosia psilostachya	Western ragweed	Perennial forb										x	x		x		x			x
Ammannia robusta	Grand redstem	Annual herb															x			
Amsinckia spectabilis	Seaside fiddleneck	Annual herb													x			x		
Anemopsis californica	Yerba mansa	Perennial herb																	x	x
Arenaria paludicola	Marsh sandwort	Perennial herb	FE, SE, Rank 1B	x		x	x	x									x	x	x	
Artemisia californica	California sage brush	Evergreen shrub										x		x	x			x	x	x
Artemisia douglasiana	Douglas' mugwort	Perennial forb									x									x
Artemisia dracunculus	Wild tarragon	Perennial forb										x		x	x				x	x
Artemisia palmeri	San Diego sage	Shrub	Rank 4									x	x	x				x		
Arthrocnemum subterminale	Parish's pickleweed	Perennial forb		x			x	x										x		x
Asclepias fascicularis	Narrow leaf milkweed	Perennial forb										x	x				x		x	
Astragalus pycnostachyus	Marsh milk vetch	Perennial herb		x														x		
Astragalus pycnostachyus var. lanosissimus	Ventura marsh milk vetch	Perennial forb	FE, SE, Rank 1B	x				x	x	x							x	x		
Astragalus tener	Alkali milk vetch	Annual herb									x	x	x		x	x	x	x		
Astragalus tener var. titi	Coastal dunes milk vetch	Annual forb	FE, SE, Rank 1B						x	x	x			x	x		x	x		
Astragalus trichopodus	Milk vetch	Perennial forb											x					x		x
Atriplex californica	California saltbush	Perennial								x	x							x		x

Scientific Name	Common Name	Life form	Conservation Status*	Salt Marsh	Mud flat	Low Marsh	Mid Marsh	High Marsh	Salt Pan	Low Transition	High Transition	Upland	Grass	Scrub	Dune	Seasonal Wetland	Freshwater / Brackish	Salt Tolerant	Landscape Suitable	Historically at BWER
		forb																		
Atriplex canescens	Fourwing saltbush	Perennial shrub												x				x		
Atriplex lentiformis	Large saltbush	Evergreen shrub									x	x	x	x				x		x
Atriplex pacifica	Pacific saltbush	Annual forb	Rank 1B											x	x					
Atriplex parryi	Parry'ss saltbush	Shrub										x		x		x	x	x	x	
Atriplex patula	Spear saltbush	Annual forb						x		x								x		x
Atriplex watsonii	Watson's saltbush	Perennial forb						x		x	x							x		
Baccharis glutinosa	Saltmarsh baccharis	Perennial forb								x								x		
Baccharis pilularis	Coyote brush	Evergreen shrub									x	x		x	x					x
Baccharis salicifolia	Mule fat	Evergreen shrub												x		x		x		x
Baccharis sarothroides	Broom baccharis	Perennial shrub												x				x		
Batis maritima	Saltwort	Evergreen shrub		x			x	x	x	x								x		
Bistorta bistortoides	American bistort	Perennial forb														x	x			
Bolboschoenus maritimus	Alkali bulrush	Perennial graminoid		x	x	x										x	x			x
Bolboschoenus maritimus subsp. paludosus	Saltmarsh bulrush	Perennial graminoid														x	x	x		
Bolboschoenus robustus	Robust bulrush	Perennial graminoid		x				x			x						x	x		x
Brickellia californica	California brickelbush	Perennial forb									x			x				x		x
Bromus arizonicus	Arizona brome	Annual graminoid										x	x							
Bromus carinatus	California brome	Annual graminoid																x		x
Bromus grandis	Tall brome	Perennial herb										x	x	x						
Bromus maritimus	Maritime brome	Perennial herb										x	x		x					

Scientific Name	Common Name	Life form	Conservation Status*	Salt Marsh	Mud flat	Low Marsh	Mid Marsh	High Marsh	Salt Pan	Low Transition	High Transition	Upland	Grass	Scrub	Dune	Seasonal Wetland	Freshwater / Brackish	Salt Tolerant	Landscape Suitable	Historically at BWER
Calystegia macrostegia	Southern California morning glory	Perennial vine										x		x	x					x
Calystegia sepium	Hedge bindweed	Perennial herb		x												x	x	x		
Calystegia soldanella	Beach morning glory	Perennial herb										x		x	x					
Camissoniopsis bistorta	California sun cup	Annual herb										x		x	x					x
Camissoniopsis cheiranthifolia	Beach evening primrose	Perennial forb										x	x	x	x			x		x
Camissoniopsis cheiranthifolia subsp. suffruticosa	Shrubby beach primrose	Perennial herb										x	x		x				x	x
Camissoniopsis lewisii	Lewis' evening primrose	Annual forb	Rank 3									x			x					x
Camissoniopsis micrantha	Spencer primrose	Annual herb										x	x		x				x	x
Carex barbarae	Santa Barbara sedge	Perennial graminoid									x	x	x	x		x		x	x	
Carex praegracilis	Clustered field sedge	Perennial graminoid															X		x	x
Carex spissa	San Diego sedge	Perennial graminoid															X		x	
Caulanthus lasiophyllus	California mustard	Annual herb										x	x	x						x
Centromadia parryi ssp. australis	Southern tarplant	Annual forb	Rank 1B									x	x	x		x		x	x	x
Chaenactis glabriuscula	Common yellow pincushion	Annual forb										x	x	x	x					x
Chaenactis glabriuscula var. glabriuscula	Common yellow pincushion	Annual forb										x	x	x	x					x
Chaenactis glabriuscula var. orcuttiana	Orcutt's yellow pincushion	Annual forb	Rank 1B									x	x	x	x					x
Chamerion angustifolium	Fireweed	Perennial forb										x		x			x			
Chenopodium berlandieri	Pitseed goosefoot	Annual forb										x							x	x
Chloropyron maritimum	Salt-marsh bird's beak	Annual herb		x								x			x			x		x
Chloropyron	Salt-marsh bird's beak	Annual	FE,	x								x			x			x		

Scientific Name	Common Name	Life form	Conservation Status*	Salt Marsh	Mud flat	Low Marsh	Mid Marsh	High Marsh	Salt Pan	Low Transition	High Transition	Upland	Grass	Scrub	Dune	Seasonal Wetland	Freshwater / Brackish	Salt Tolerant	Landscape Suitable	Historically at BWER
maritimum ssp. maritimum		herb	SE, Rank 1B																	
Clarkia purpurea	Winecup Clarkia	Annual herb										x	x	x						
Clematis ligusticifolia	Western white clematis	Vine / perennial forb										x					x			x
Corethrogyne filaginifolia	Common sandaster	Perennial forb										x		x	x					x
Cornus glabrata	Brown twig dogwood	Tree/ shrub										x	x				x			
Cornus sericea	American dogwood	Shrub															x		x	
Cornus sericea ssp. sericea	Creek dogwood	Shrub															x		x	
Crassula aquatica	Aquatic pygmyweed	Annual forb										x	x				x			
Crassula connata	Sand pygmyweed	Annual forb										x	x	x	x		x			x
Cressa truxillensis	Spreading alkali weed	Perennial forb		x			x	x					x			x		x		x
Croton californicus	California croton	Perennial forb									x	x	x	x	x			x		x
Croton setiger	Dove weed	Annual forb										x	x	x						
Cryptantha intermedia	Clearwater cryptantha	Annual forb										x		x						x
Cucurbita foetidissima	Missouri gourd	Vine / perennial forb										x	x	x	x					x
Cuscuta californica	California dodder	Parasitic vine										x	x	x						x
Cuscuta campestris	Field dodder	Parasitic vine										x	x	x	x					x
Cuscuta indecora	Large-seeded dodder	Parasitic vine										x	x			x	x			x
Cuscuta salina	Saltmarsh dodder	Parasitic vine		x			x	x		x										x
Cylindropuntia prolifera	Coastal cholla cactus	Succulent shrub										x		x						
Cyperus eragrostis	Tall flatsedge	Perennial forb										x					x			x
Cyperus erythrorhizos	Red rooted cyperus	Annual forb															x			

Scientific Name	Common Name	Life form	Conservation Status*	Salt Marsh	Mud flat	Low Marsh	Mid Marsh	High Marsh	Salt Pan	Low Transition	High Transition	Upland	Grass	Scrub	Dune	Seasonal Wetland	Freshwater / Brackish	Salt Tolerant	Landscape Suitable	Historically at BWER
Cyperus esculentus	Yellow nutgrass	Perennial forb										x					x			x
Cyperus laevigatus	Smooth cyperus	Perennial forb										x		x			x			
Cyperus niger	Black cyperus	Perennial forb										x		x			x			
Cyperus parishii	Parish's flatsedge	Perennial forb										x		x			x			
Cyperus squarrosus	Awned cyperus	Annual forb															x			
Datura wrightii	Jimsonweed	Perennial forb										x	x	x						x
Deinandra fasciculata	Clustered tarweed	Annual forb										x	x	x						x
Deinandra kelloggii	Kellog's tarweed	Annual forb										x	x							
Deinandra paniculata	Paniculate tarplant	Annual forb	Rank 4									x	x	x					x	x
Dichondra occidentalis	Western dichondra	Perennial forb	Rank 4									x	x	x						x
Distichlis littoralis	Shore grass	Perennial graminoid		x				x	x									x		
Distichlis spicata	Spiked saltgrass	Perennial graminoid		x			x	x		x								x		x
Dudleya caespitosa	Sand lettuce	Perennial succulent										x	x	x	x				x	
Dudleya lanceolata	Southern California dudleya	Perennial succulent										x		x						
Dudleya palmeri	Palmer's dudleya	Perennial succulent										x		x						
Dudleya pulverulenta	Chalk dudleya	Perennial succulent										x		x					x	
Dudleya virens	Bright green dudleya	Perennial succulent										x		x						
Eleocharis coloradoensis	Rush	Perennial graminoid		x			x	x		x	x					x	x	x	x	
Eleocharis macrostachya	Longstem spike-rush	Perennial graminoid		x			x	x		x	x						x	x		x
Eleocharis montevidensis	Montevideo spike-rush	Perennial graminoid															x			x
Elymus condensatus	Giant rye grass	Perennial graminoid										x	x	x					x	x
Elymus triticoides	Creeping wild rye	Perennial									x	x	x			x		x		

Scientific Name	Common Name	Life form	Conservation Status*	Salt Marsh	Mud flat	Low Marsh	Mid Marsh	High Marsh	Salt Pan	Low Transition	High Transition	Upland	Grass	Scrub	Dune	Seasonal Wetland	Freshwater / Brackish	Salt Tolerant	Landscape Suitable	Historically at BWER
		graminoid																		
Encelia californica	California brittlebush	Shrub										x	x	x	x				x	x
Encelia farinosa	Brittlebush	Shrub										x		x						
Epilobium brachycarpum	Annual fireweed	Annual forb										x	x							
Epilobium campestre	Smooth boisduvalia	Annual forb										x	x	x			x			
Epilobium canum	California fuschia	Perennial forb										x		x						
Epilobium ciliatum	Fringed willow herb	Perennial forb										x	x	x			x			x
Epilobium densiflorum	Dense flowered spike primrose	Annual forb										x	x	x						
Epipactis gigantea	Stream orchid	Perennial forb															x			
Equisetum telmateia ssp. braunii	Giant horsetail	Fern															x			
Ericameria arborescens	Golden fleece	Shrub										x		x					x	
Ericameria ericoides	California goldenbush	Shrub										x		x	x			x		x
Ericameria palmeri	Palmer's goldenweed	Shrub										x		x						
Ericameria pinifolia	Pine bush	Shrub										x		x						x
Erigeron canadensis	Canadian horseweed	Annual herb										x								x
Eriodictyon trichocalyx	Yerba santa	Shrub										x		x					x	
Eriogonum cinereum	Coast ashyleaf buckwheat	Shrub										x		x	x				x	
Eriogonum elongatum	Longstem buckwheat	Perennial forb										x		x						
Eriogonum fasciculatum	California buckwheat	Shrub												x	x					x
Eriogonum giganteum	St. Catherine's lace	Shrub										x		x						
Eriogonum gracile	Slender buckwheat	Annual graminoid										x	x	x						x
Eriogonum gracillimum	Rose and white buckwheat	Annual forb										x	x	x						
Eriogonum grande	Island buckwheat	Perennial forb										x		x						

Scientific Name	Common Name	Life form	Conservation Status*	Salt Marsh	Mud flat	Low Marsh	Mid Marsh	High Marsh	Salt Pan	Low Transition	High Transition	Upland	Grass	Scrub	Dune	Seasonal Wetland	Freshwater / Brackish	Salt Tolerant	Landscape Suitable	Historically at BWER
Eriogonum nudum	Nude buckwheat	Shrub										x	x	x						
Eriogonum parvifolium	Dune buckwheat	Shrub										x		x	x				x	x
Eriogonum viridescens	Bright green buckwheat	Annual forb										x	x	x						
Eriophyllum confertiflorum	Golden yarrow	Shrub										x		x					x	
Eryngium aristulatum	California eryngo	Perennial herb														x				
Erysimum capitatum var. capitatum	Sand dune wallflower	Perennial herb										x		x	x					
Erysimum suffrutescens	Suffrutescent wallflower	Perennial forb	Rank 4									x			x					x
Eschscholzia californica	California poppy	Annual/perennial herb										x			x			x	x	x
Euphorbia albomarginata	Rattlesnake weed	Perennial forb										x	x	x						x
Euphorbia crenulata	Chinese caps	Annual/perennial herb										x	x	x						
Euphorbia melanadenia	Spurge	Perennial forb										x								
Euphorbia polycarpa	Small-seeded spurge	Perennial forb										x		x						x
Euphorbia serpens	Creeping spurge	Annual forb															x			
Euthamia occidentalis	Western goldenrod	Perennial forb		x				x		x								x		
Festuca californica	California fescue	Perennial herb										x	x							
Festuca microstachys	Small fescue	Annual herb										x	x	x				x		
Festuca octoflora	Sixweeks grass	Perennial graminoid										x	x							
Festuca rubra	Red fescue	Perennial graminoid										x	x							
Frangula californica	California coffeeberry	Shrub										x								
Frankenia salina	Alkali heath	Perennial forb		x			x	x	x	x	x							x		x
Fraxinus velutina	Velvet Arizona ash	Tree										x								x
Galium angustifolium	Narrow-leaved bedstraw	Perennial herb																		x

Scientific Name	Common Name	Life form	Conservation Status*	Salt Marsh	Mud flat	Low Marsh	Mid Marsh	High Marsh	Salt Pan	Low Transition	High Transition	Upland	Grass	Scrub	Dune	Seasonal Wetland	Freshwater / Brackish	Salt Tolerant	Landscape Suitable	Historically at BWER
Gambelia speciosa	Island snapdragon	Shrub										x		x					x	
Gnaphalium palustre	Western marsh cudweed	Annual herb										x	x			x	x			x
Grindelia camporum	Common gum plant	Perennial herb											x							x
Grindelia hirsutula	Gumweed	Perennial herb												x						
Grindelia stricta	Coastal gumweed	Perennial herb		x																
Hazardia squarrosa	Saw-toothed hazardia	Perennial shrub											x	x				x		
Helianthus annuus	Common annual sunflower	Annual herb										x	x	x					x	x
Heliotropium curassavicum	Seaside heliotrope	Perennial forb		x				x	x	x								x		x
Hesperoyucca whipplei	Whipple's yucca	Shrub										x		x						
Heteromeles arbutifolia	Toyon	Evergreen shrub											x	x						x
Heterotheca grandiflora	Telegraph weed	Annual/perennial forb										x		x						x
Heterotheca sessiliflora	Golden aster	Annual/perennial forb										x	x	x						
Heterotheca villosa	Villous golden-aste	Perennial forb										x		x			x			x
Hoffmannseggia glauca	Waxy hoffmannseggia	Perennial forb														x		x		x
Hordeum brachyantherum	Meadow barley	Perennial graminoid									x	x	x			x	x	x		
Hordeum brachyantherum ssp. californicum	California barley	Perennial graminoid										x	x	x		x	x			
Hordeum depressum	Alkali barley	Annual graminoid								x	x	x	x			x		x		x
Hordeum intercedens	Bobtail barley	Annual graminoid	Rank 3									x	x			x	x			
Hordeum jubatum	Fox tail barley	Perennial graminoid										x				x	x			
Hypericum anagalloides	Tinker's penny	Annual/perennial herb														x	x	x		
Isocoma menziesii	White flowered	Shrub										x			x					x

Scientific Name	Common Name	Life form	Conservation Status*	Salt Marsh	Mud flat	Low Marsh	Mid Marsh	High Marsh	Salt Pan	Low Transition	High Transition	Upland	Grass	Scrub	Dune	Seasonal Wetland	Freshwater / Brackish	Salt Tolerant	Landscape Suitable	Historically at BWER
	goldenbush																			
Isocoma menziesii var. vernonioides	Coastal goldenbush	Shrub									x	x	x	x	x	x	x	x		
Isolepis cernua	Low bulrush	Annual graminoid					x									x		x		
Isomeris arborea	Bladder pod	Perennial shrub										x		x				x		
Iva axillaris	Poverty weed	Perennial forb		x					x		x	x	x					x		
Jaumea carnosa	Fleshy jaumea	Perennial forb		x	x	x	x										x	x		x
Juglans californica	California black walnut	Tree	Rank 4									x								
Juncus acutus	Spiny rush	Perennial graminoid		x	x	x	x									x	x	x		x
Juncus acutus ssp. leopoldii	Spiny rush	Perennial graminoid	Rank 4							x						x	x	x		x
Juncus ambiguus	Saline toad rush	Perennial graminoid														x	x			
Juncus balticus	Baltic rush	Perennial graminoid		x	x	x	x			x						x	x	x		x
Juncus bufonius	Common toad-rush	Annual graminoid						x	x	x						x	x	x		x
Juncus bufonius var. *occidentalis*	Western toad rush	Perennial graminoid														x	x			x
Juncus effusus	Common bog rush	Perennial graminoid		x		x	x	x		x	x					x	x	x		
Juncus macrophyllus	Longleaf rush	Perennial graminoid														x	x			
Juncus mexicanus	Mexican rush	Perennial graminoid		x	x	x	x	x		x						x	x	x	x	x
Juncus patens	Common rush	Perennial graminoid														x	x	x	x	
Juncus textilis	Basket rush	Perennial graminoid										x		x					x	
Juncus xiphioides	Iris leaved rush	Perennial graminoid														x	x		x	
Laennecia coulteri	Coulter's horseweed	Annual herb														x	x	x		x
Lasthenia glabrata	Yellow ray goldfields	Annual herb									x	x				x		x	x	

Scientific Name	Common Name	Life form	Conservation Status*	Salt Marsh	Mud flat	Low Marsh	Mid Marsh	High Marsh	Salt Pan	Low Transition	High Transition	Upland	Grass	Scrub	Dune	Seasonal Wetland	Freshwater / Brackish	Salt Tolerant	Landscape Suitable	Historically at BWER
Lasthenia glabrata var. coulteri	Coulter's goldfields	Annual forb							x							x				
Layia platyglossa	Common tidy tips	Annual forb										x	x	x		x			x	
Lepidium virginicum ssp. menziesii	Robinson's pepper grass	Annual forb										x	x	x						x
Leptochloa fusca ssp. uninervia	Mexican sprangle top											x	x	x		x				x
Leptosyne gigantea	Giant coreopsis	Shrub										x		x						
Lilium humboldtii	Humboldt's lily	Perennial herb										x		x					x	
Limonium californicum	Sea lavender	Perennial forb		x			x	x		x	x	x				x	x	x		x
Lupinus arboreus	Coastal bush lupine	Shrub										x		x	x				x	
Lupinus bicolor	Bicolored lupine	Annual/perennial herb																x	x	x
Lupinus chamissonis	Coastal bush lupine	Evergreen shrub										x		x	x				x	x
Lupinus excubitus var. hallii	Hall's bush lupine	Shrub										x		x					x	x
Lupinus latifolius	Broadleaf lupine	Perennial herb															x		x	
Lupinus longifolius	Longleaf bush lupine	Shrub										x		x					x	x
Lupinus succulentus	Arroyo lupine	Annual herb										x	x						x	x
Lupinus truncatus	Truncate-leaved lupine	Annual herb										x	x	x					x	x
Lycium californicum	California boxthorn	Shrub								x	x	x		x				x		
Malacothamnus fasciculatus	Bushmallow	Shrub										x		x				x		x
Malacothrix saxatilis	Cliff aster	Perennial forb										x		x	x					x
Malosma laurina	Laurel sumac	Tree / shrub										x		x						x
Malvella leprosa	Alkali mallow	Perennial forb										x	x	x		x	x			x
Melica imperfecta	Small-flowered melic grass	Perennial graminoid										x	x	x						x
Mimulus aurantiacus	Sticky monkeyflower	Shrub										x	x	x					x	

Scientific Name	Common Name	Life form	Conservation Status*	Salt Marsh	Mud flat	Low Marsh	Mid Marsh	High Marsh	Salt Pan	Low Transition	High Transition	Upland	Grass	Scrub	Dune	Seasonal Wetland	Freshwater / Brackish	Salt Tolerant	Landscape Suitable	Historically at BWER
Mimulus cardinalis	Scarlet monkeyflower	Perennial herb														x	x		x	
Mimulus guttatus	Common yellow monkeyflower	Annual/perennial herb														x	x		x	
Mimulus latidens	Broad toothed monkeyflower	Annual herb										x	x			x	x		x	
Mimulus moschatus	Musk monkeyflower	Perennial herb														x	x		x	
Mimulus pilosus	Downy monkeyflower	Annual herb										x					x		x	
Muhlenbergia rigens	Deergrass	Perennial herb										x	x						x	
Nemophila maculata	Five spot	Annual forb										x	x							
Nemophila menziesii	Baby blue eyes	Seasonal wildflower										x	x	x					x	
Nemophila pedunculata	Meadowfoot nemophilia	Annual forb										x	x			x	x			
Oenothera elata	Hooker's evening primrose	Perennial forb										x	x		x	x	x	x		
Oenothera elata ssp. hirsutissima	Hairy evening primrose	Perennial forb														x	x			x
Oenothera elata ssp. hookeri	Common evening primrose	Perennial forb										x		x	x	x	x			x
Opuntia basilaris	Beavertail cactus	Succulent shrub										x		x					x	
Opuntia littoralis	Coastal prickly pear	Succulent shrub										x		x					x	x
Paspalum distichum	Knot grass	Perennial herb					x	x		x		x	x			x	x	x		
Penstemon centranthifolius	Scarlet bugler	Perennial forb										x								
Penstemon heterophyllus	Foothill penstemon	Perennial forb										x								
Penstemon spectabilis	Showy penstemon	Perennial forb										x							x	
Persicaria hydropiperoides	Water pepper	Perennial forb														x	x			
Persicaria lapathifolia	Willow weed	Annual forb										x	x	x		x	x			x
Persicaria punctata	Dotted smartweed	Perennial forb														x	x			

Scientific Name	Common Name	Life form	Conservation Status*	Salt Marsh	Mud flat	Low Marsh	Mid Marsh	High Marsh	Salt Pan	Low Transition	High Transition	Upland	Grass	Scrub	Dune	Seasonal Wetland	Freshwater / Brackish	Salt Tolerant	Landscape Suitable	Historically at BWER
Petunia parviflora	Wild petunia	Annual forb										x	x			x	x			x
Phacelia brachyloba	Short lobed phacelia	Annual forb										x		x						
Phacelia cicutaria	Caterpillar phacelia	Annual forb										x	x	x						
Phacelia distans	Common phacelia	Annual forb										x	x							
Phacelia douglasii	Douglas' phacelia	Annual forb										x	x	x						
Phacelia fremontii	Fremont's phacelia	Annual forb										x	x	x						
Phacelia minor	California bluebell	Annual forb										x		x						
Phacelia ramosissima	Branching phacelia	Perennial forb									x	x	x	x	x			x		x
Phacelia stellaris	Star phacelia	Annual forb	Rank 1B									x		x	x					
Phyla lanceolata	Lance leaf lippia	Perennial forb									x	x	x			x	x			
Phyla nodiflora	Common lippia	Perennial forb														x	x		x	
Plantago erecta	Foothill plantain	Annual forb										x	x	x						
Plantago subnuda	Tall coastal plantain	Perennial herb														x	x			
Platanus racemosa	Western sycamore	Deciduous tree										x		x		x				
Pluchea odorata	Marsh fleabane	Perennial forb						x		x								x		
Poa secunda	Pine bluegrass	Perennial herb										x	x							
Populus fremontii	Fremont cottonwood	Deciduous tree												x		x				x
Potentilla anserina subsp. pacifica	Silverweed	Perennial forb						x		x	x							x		
Prunus ilicifolia ssp. ilicifolia	Holly-leaf cherry	Tree/ shrub										x		x					x	
Pseudognaphalium beneolens	Cudweed	Perennial forb										x	x	x	x					x
Pseudognaphalium biolettii	Two-color rabbit-tobacco	Perennial herb										x	x	x	x					
Pseudognaphalium californicum	Ladies' tobacco	Annual/perennial herb										x	x	x						x
Pseudognaphalium	Wright's cudweed	Perennial										x			x					x

Scientific Name	Common Name	Life form	Conservation Status*	Salt Marsh	Mud flat	Low Marsh	Mid Marsh	High Marsh	Salt Pan	Low Transition	High Transition	Upland	Grass	Scrub	Dune	Seasonal Wetland	Freshwater / Brackish	Salt Tolerant	Landscape Suitable	Historically at BWER
microcephalum		herb																		
Pseudognaphalium ramosissimum	Pink cudweed	Biennial herb										x	x	x	x					x
Pseudognaphalium stramineum	Cottonbatting plant	Perennial herb										x	x	x	x					x
Quercus agrifolia	Coast live oak	Tree										x								x
Quercus berberidifolia	Scrub oak	Tree										x		x						
Rhamnus ilicifolia	Hollyleaf redberry	Shrub										x		x					x	
Rhus aromatica	Skunkbush	Shrub										x								
Rhus integrifolia	Lemonade berry	Shrub										x		x					x	
Rhus ovata	Sugar bush	Shrub																		x
Ribes aureum	Golden currant	Shrub										x							x	
Ribes californicum	California gooseberry	Shrub										x							x	
Ribes malvaceum	Chaparral currant	Shrub										x		x					x	x
Ribes speciosum	Fuchsia flowering gooseberry	Shrub										x							x	
Rosa californica	California wild rose	Shrub									x	x	x	x				x	x	x
Rubus ursinus	California blackberry	Vine										x								
Rumex californicus	California dock	Perennial herb														x	x	x		
Rumex crassus	Willow leaved dock	Perennial herb										x			x		x			
Rumex fueginus	Golden dock	Annual/perennial herb														x	x	x		x
Rumex persicarioides	Dock	Annual/perennial herb						x				x			x			x		
Rumex salicifolius	Willow dock	Perennial herb								x		x	x			x		x		x
Ruppia cirrhosa	Spiral ditch grass	Perennial herb			x												x	x		
Ruppia maritima	Ditch grass	Perennial herb			x												x	x		x
Sagittaria montevidensis	Giant arrowhead	Perennial herb															x			
Sagittaria	Montevideo	Perennial															x			x

Scientific Name	Common Name	Life form	Conservation Status*	Salt Marsh	Mud flat	Low Marsh	Mid Marsh	High Marsh	Salt Pan	Low Transition	High Transition	Upland	Grass	Scrub	Dune	Seasonal Wetland	Freshwater / Brackish	Salt Tolerant	Landscape Suitable	Historically at BWER
montevidensis subsp. calycina	arrowhead	herb																		
Salicornia bigelovii	Annual pickleweed	Annual forb		x			x	x	x									x		
Salicornia depressa	Virginia glasswort	Annual herb		x												x		x		
Salicornia pacifica	Common pickleweed	Perennial forb		x			x	x										x		x
Salix exigua	Narrow-leaved willow	Deciduous shrub										x				x				
Salix gooddingii	Black willow	Tree															x			x
Salix laevigata	Red willow	Tree															x	x		x
Salix lasiolepis	Arroyo willow	Deciduous shrub														x				x
Salix melanopsis	Dusky willow	Tree / shrub															x			
Salvia apiana	White sage	Perennial shrub										x		x				x	x	
Salvia leucophylla	Purple sage	Shrub										x		x					x	
Salvia mellifera	Black sage	Perennial shrub										x		x				x	x	
Salvia spathacea	Hummingbird sage	Perennial herb										x					x	x	x	
Sambucus nigra	Black elderberry	Deciduous shrub												x		x			x	
Sambucus nigra subsp. caerulea	Blue elderberry	Shrub										x							x	
Sambucus nigra subsp. canadensis	Blue elderberry	Shrub										x							x	
Schoenoplectus acutus	Hard stem bulrush	Perennial herb		x	x	x										x	x			
Schoenoplectus americanus	Chairmaker's bulrush	Perennial herb														x	x			x
Schoenoplectus californicus	California tule	Perennial graminoid		x	x	x										x	x	x		x
Scirpus californicus	California bulrush	Perennial herb		x							x						x	x		
Sesuvium verrucosum	Western sea-purslane	Perennial herb										x	x	x		x	x			x
Setaria parviflora	Bristlegrass	Perennial										x	x	x						x

Scientific Name	Common Name	Life form	Conservation Status*	Salt Marsh	Mud flat	Low Marsh	Mid Marsh	High Marsh	Salt Pan	Low Transition	High Transition	Upland	Grass	Scrub	Dune	Seasonal Wetland	Freshwater / Brackish	Salt Tolerant	Landscape Suitable	Historically at BWER
		graminoid																		
Silene laciniata	Mexican silene	Perennial forb										x		x						
Sisyrinchium bellum	Western blue-eyed grass	Perennial graminoid										x	x						x	
Solanum americanum	American black nightshade	Annual/perennial forb															x			x
Solanum douglasii	Douglas's nightshade	Perennial forb										x		x	x	x	x			x
Solanum umbelliferum	Blue witch	Shrub										x	x	x						
Solanum xanti	Nightshade	Shrub / perennial forb										x		x						x
Solidago velutina subsp. californica	California goldenrod	Perennial herb									x	x	x	x						x
Spartina foliosa	Cordgrass	Perennial graminoid		x	x	x												x		
Spergularia macrotheca	Sticky sand spurry	Perennial herb		x				x		x		x		x			x			x
Spergularia marina	Salt marsh sand spurry	Perennial herb		x				x		x					x		x			x
Stephanomeria exigua	Small wire lettuce	Annual forb										x		x						x
Stephanomeria virgata	Tall stephanomeria	Annual forb										x	x	x						x
Stipa cernua	Nodding needlegrass	Perennial graminoid										x	x	x						x
Stipa coronata	Crested needlegrass	Perennial graminoid										x	x	x						
Stipa lepida	Foothill needle grass	Perennial graminoid										x	x	x						
Stipa pulchra	Purple needle grass	Perennial graminoid										x	x	x					x	
Suaeda calceoliformis	Horned sea blite	Annual herb														x		x		x
Suaeda californica	California sea blite	Shrub		x													x	x		
Suaeda esteroa	Estuary sea-blite	Perennial forb		x			x	x										x		x
Suaeda nigra	Seepweed	Perennial forb								x	x					x		x		

Scientific Name	Common Name	Life form	Conservation Status*	Salt Marsh	Mud flat	Low Marsh	Mid Marsh	High Marsh	Salt Pan	Low Transition	High Transition	Upland	Grass	Scrub	Dune	Seasonal Wetland	Freshwater / Brackish	Salt Tolerant	Landscape Suitable	Historically at BWER
Suaeda taxifolia	Woolly seablite	Evergreen shrub		x				x	x	x		x	x		x	x		x		x
Symphoricarpos albus	Common snowberry	Shrub										x							x	
Symphoricarpos mollis	Trailing snowberry	Shrub										x							x	
Symphyotrichum subulatum	Annual saltmarsh aster	Annual herb		x				x										x		
Thalictrum fendleri var. polycarpum	Fendler's meadow rue	Perennial forb										x							x	
Trichostema lanatum	Woolly bluecurls	Shrub										x		x					x	
Triglochin concinna	Arrow grass	Perennial herb		x	x	x	x	x									x	x		
Triglochin maritima	Seaside arrow grass	Perennial forb		x	x	x	x	x									x	x		
Typha domingensis	Southern cattail	Perennial herb		x	x	x											x			x
Typha latifolia	Common cattail	Perennial forb															x			x
Urtica dioica ssp. holosericea	Hoary nettle	Perennial forb										x	x	x		x	x			x
Verbena bracteata	Bigbract verbena	Annual/perennial forb										x	x			x	x			
Verbena lasiostachys	Common verbena	Perennial forb										x	x			x	x			x
Verbena lasiostachys subsp. lasiostachys	Western vervain	Perennial forb														x	x			
Verbena lasiostachys subsp. scabrida	Robust vervain	Perennial forb										x				x	x			
Verbena scabra	Rough vervain	Perennial forb										x	x	x		x	x			
Woodwardia fimbriata	Giant chain fern	Fern											x			x	x			
Xanthium spinosum	Spiny cocklebur	Annual forb														x	x			x
Xanthium strumarium	Rough cocklebur	Annual forb														x	x			x

*Key to Conservation Status:

FE	Federal endangered	Rank 1B	California Rare Plant Rank 1B: Plants rare, threatened, or endangered in California and elsewhere
SE	State endangered	Rank 3	California Rare Plant Rank 3: Plants about which we need more information—a review list
		Rank 4	California Rare Plant Rank 4: Plants of limited distribution—a watch list

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APPENDIX B

RESULTS OF INITIAL SOIL ANALYSES

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APPENDIX C

INVASIVE PLANT CONTROL METHODS

Appendix C. Control methods for selected invasive plant species at the Reserve (adapted from DiTomaso and Healy 2007a, b).

Acacia (*Acacia cyclops*, *A. longifolia*, *A. retinodes*). Acacia is a woody shrub or tree that is resistant to many herbicides. The most effective method of control for acacia is manual removal of aboveground vegetation; sprouts from the cut stump must be removed until the root system dies. Seedlings must be pulled until the seed bank is exhausted, at least three years.

Giant reed (*Arundo donax*). Manual removal of giant reed is ineffective. Systemic herbicide, such as glyphosate, should be applied to mature plants in late summer to early fall. It is also possible to use the 'cut stump' method on giant reed canes during the spring and summer. Giant reed can resprout through both vegetative and root material; if plants are controlled using the 'cut stump' method, all plant material should be collected and disposed of offsite.

Black mustard (*Brassica nigra*). Black mustard is an annual species that spreads exclusively by seed. Repeated mowing before the plant forms mature seeds can be an effective control method. This species makes a great deal of seed which can survive up to 11 years; continued monitoring and maintenance is recommended for at least 11 years after initial treatment.

Sea-fig (*Carpobrotus chilensis*). Sea-fig is a succulent perennial. The species is shallow-rooted, making hand weeding an effective control method. The species will resprout from vegetative fragments left in contact with the ground, so all material should be collected and disposed of offsite. This species produces viable seed, and vegetative fragments can remain unseen in the soil; continued monitoring and maintenance is recommended for at least three years.

Poison hemlock (*Conium maculatum*). Poison hemlock is an annual species with a deep taproot. Repeated mowing before the plant sets seed (late summer to early fall) can be an effective method of control. This species thrives in recently disturbed soil; caution should be taken to minimize soil disturbances. The seed can remain viable for up to three years; monitoring and maintenance is recommended for at least three years.

Pampas grass (*Cortaderia selloana*). Pampas grass can be killed by cutting the plant below the crown. This is most easily done with a chainsaw or ax. This species thrives in recently disturbed soil, and caution should be taken to minimize soil disturbances.

Red gum (*Eucalyptus camaldulensis*). Red gum is a long-lived tree that can easily resprout after cutting. Mature trees should be cut down or girdled and treated with glyphosate or similar systemic herbicide. Herbicide should be applied to the exposed

sapwood to reduce the number of sprouts from the root network. Young trees can be removed by hand. The root network and seeds can remain viable for up to three years; monitoring and maintenance is recommended for at least three years.

Terracina spurge (*Euphorbia terracina*). Terracina spurge is a perennial species that is very difficult to control. It is resistant to most chemical herbicides and is not affected by mowing (underground parts can persist in the soil for up to eight years). A combination of chemical and manual control methods should be used over the course of at least eight years to ensure all the remaining plants and below ground parts are eliminated.

Sweet fennel (*Foeniculum vulgare*). Sweet fennel is a perennial species with a deep taproot. Because it is perennial mowing is not an effective means of control. Fall burning followed by herbicide treatment of new foliage has been shown to control larger stands, although the process can take up to two years. This species thrives in recently disturbed soil, and caution should be taken to minimize soil disturbances. The seed can remain viable for up to three years; monitoring and maintenance is recommended for at least three years.

Crown daisy (*Glebionis coronaria* [*Chrysanthemum coronarium*]). This species is an annual plant which spreads exclusively by seed. Repeated mowing before the plant forms mature seeds can be an effective control method.

Canary ivy (*Hedera canariensis*). Canary ivy is shallow rooted, making hand weeding an effective control method. The species will resprout from vegetative fragments left in contact with the ground, so all material should be collected and disposed of offsite. This species produces viable seed, and vegetative fragments can remain unseen in the soil; continued monitoring and maintenance is recommended for at least three years.

Summer mustard (*Hirschfeldia incana*). Summer mustard is an annual species that spreads exclusively by seed. Repeated mowing before the plant forms mature seeds can be an effective control method. This species makes a great deal of seed which can live up to 11 years; continued monitoring and maintenance is recommended for at least 11 years after initial treatment.

Ngaio tree (*Myoporum laetum*). Ngaio tree is a large shrub or small tree that readily resprouts after cutting. Mature trees should be cut down or girdled and treated with glyphosate or similar systemic herbicide. Herbicides should be applied to the exposed sapwood to reduce the number of sprouts from the root network. Young trees can be removed by hand. The root network and seeds can remain viable for up to three years; monitoring and maintenance is recommended for at least three years.

Tree tobacco (*Nicotiana glauca*). Tree tobacco is a short-lived shrub or small tree. Manual removal of mature plants and seedlings is an effective control method.

Phoenix date palm (*Phoenix canariensis*). Phoenix date palm is a long-lived tree. Manual removal of mature plants and seedlings is an effective control method. This species thrives in recently disturbed soil; caution should be taken to minimize soil disturbances.

Aleppo pine (*Pinus halepensis*). Aleppo pine is a long-lived conifer. Manual removal of mature plants and seedlings is an effective control method for this species.

Castor bean (*Ricinus communis*). Castor bean is a perennial species that can occur as an herbaceous plant or small woody shrub. Manual removal or systemic herbicide application can be effective means of control of this plant. The removal of a larger plant often encourages increased seed germination; care should be taken to maintain the area where any larger tree was removed.

Tumbleweed (*Salsola tragus*). Tumbleweed is an annual herb that spreads by seed. One of the most effective methods of control for tumbleweed is to cut the young plants immediately above the cotyledons. Treatment it must be timed to ensure plants are not able to produce viable seed. Seeds remain viable for up to two years; maintenance and monitoring should be continued for up to two years.

Brazilian peppertree (*Schinus terebinthifolius*). Brazilian peppertree is a woody shrub. Roots of the Brazilian peppertree will readily resprout. Mature trees should be cut down or girdled and treated with glyphosate or similar systemic herbicide. Herbicides should be applied to the exposed sapwood to reduce the number of sprouts from the root network. Young trees can be removed by hand. The root network and seeds can remain viable for up to three years; monitoring and maintenance is recommended for at least three years.

Saltcedar (*Tamarix ramosissima*). Saltcedar is a woody shrub to small tree. Cut stumps will readily resprout; mature trees should be cut down or girdled and treated with glyphosate or similar systemic herbicide. Herbicides should be applied to the exposed sapwood to reduce the number of sprouts from the root network. Young trees can be removed by hand. Seeds remain viable for only five weeks, but mature plants produce many seeds. Seedlings should be pulled as soon as they are found to prevent further infestation.

APPENDIX D

INVENTORY OF BASIC BEST MANAGEMENT PRACTICES

Appendix D. Inventory of Basic Best Management Practices.

The following Best Management Practices are recommended for implementation during the restoration at the BWER. The list presented below primarily addresses measures designed to protect water quality. The list is intended to serve as a guide only and is not intended to be an exhaustive list of all best management practices to be implemented. Additional best management practices may be appropriate and/or may be required by the regulatory agencies. For additional best management practices see Cal-IPC (2012a, b), Environmental Protection Agency (2000), and Caltrans (2003), among others.

- The construction, staging, and access areas should be clearly marked with orange plastic, or similar, fencing and no work should be conducted outside of this area.

- A qualified biologist should train all project staff regarding habitat sensitivity, identification of listed species, and required best management practices before the start of construction. The training should cover the general measures being implemented to conserve the species as they relate to the project, penalties for noncompliance, and species ecology with key identifying features. A factsheet or other supporting materials containing this information should be prepared and distributed to all project staff. Upon completion of training, employees should sign a form stating that they attended the training and understand all of the conservation and protection measures. The training should be conducted in languages other than English, as appropriate, for workers who do not speak or understand English.

- A Spill Prevention and Control Plan should be developed for work within and adjacent to the aquatic habitats. The Spill Prevention and Control Plan should contain measures to prevent and control potential spills of hazardous materials associated with mechanical equipment (e.g., oil, gas, hydraulics, etc.), as well as measures to minimize contact with the stream bed, such as the use of work pads. The plan and materials necessary to implement it should be accessible on-site.

- All fueling, maintenance, and staging of equipment and vehicles should occur away from wetlands and outside of active stream channels, above the top of the bank.

- Heavy equipment should be checked daily for leaks. Equipment with leaks should not be used until leaks are fixed.

- Any leaks, drips, or spills should be immediately controlled to prevent entry into waterways, ditches, or other tributaries to waterways.

- At a pre-construction meeting, all workers should be informed of the importance of preventing accidental spills and the procedure, protocol, and required measures to be followed if an accidental spill or construction site discharge enters waterways, ditches, or other tributaries to waterways.

- All workers should ensure that food scraps, paper wrappers, food containers, cans, bottles, and other trash from the project area are deposited in covered or closed trash containers. The trash containers should not be left open and unattended overnight.

- If water is present in streams or channels during construction, water diversion should be implemented following procedures approved by the USFWS and the RWQCB and should be constructed using clean and contained material such as sandbags filled with gravel and wrapped in plastic, an inflatable coffer dam system, or similar materials.

- Tightly woven fiber netting, straw, or similar material should be used for erosion control after completion of construction activities and/or before the onset of a rain event. The material used should be designed to avoid trapping of wildlife species which might be present in the project area during or after construction. Plastic monofilament matting should not be used for erosion control.

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APPENDIX B4
Construction Equipment and Sequencing

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Overview

The purpose of this workbook is to identify assumptions for construction of the Ballona Wetlands Project. The assumptions will be used to support the air quality, greenhouse gas, and transportation analyses. The workbook includes three primary tabs, which are denoted in dark blue. The light blue tabs summarize the construction sequences for Alternatives 1a through 6.

Instructions for Review

The first five tables were used to provide the construction assumptions. Below is a brief description of each table.

1) Construction Master (Alt 1): This table summarizes the construction sequence for Alternative 1 (columns A through D) and identifies the requested construction data (columns E through O).
2) Equipment Ref: Since many of the actions are similar (e.g., "remove trash"), it is anticipated that the same (or similar) equipment and personnel assumptions can be used for multiple actions. The Equipment
3) Soil Export: This table summarizes the options for exporting excess soil offsite.

The first table identify the construction sequences for Alternative 1. Differences relative to Alternative 1 are identified in the last three tables. Construction assumptions developed for Alternative 1 will be used to evaluate sequences that are the same as Alternative 1 (unless otherwise instructed).

Construction Master (Alt 1)

Sequence	Area	Title	Actions	Start Date	Working Days	Overlap	Equipment Reference	Notes/ Assumptions
		PHASE 1						
1	B	Area "B" Southeast Gas Lines	1a. Remove and relocate existing gas line	1/2/2017	20	A	4	Assumed start date. Schedule shift as required after EIR certification and governmental approvals..
2	B	Area "B" South Enhancement	2a. Create swale (10,000 CY wet cut)	1/2/2017	40	A	1	Independent Seqence which may occur any time during the project schedule .
3	A	Area "A' Gas Line Removal	3a. Remove existing inactive gas line	1/2/2017	10	A	4	
			3b. Cut and cap gas line at Fiji Way	1/2/2017	1	A	4	
4	A & B	Pedestrian/Bike Bridge	4a. Construct temporary & portion of final re-routed trail to existing trail	4/17/2017	40	A, B, C	7	2nd step, start after rainy season
			4b. Construct new pedestrian/bike bridge over Ballona Creek	1/2/2017	130	A, B, C	8	1st step, start on south side
			4c. Reroute Ballona Creek Bike Trail under Culver Blvd Bridge	7/4/2017	5	A, B, C	7	Final step weekend after the 4th of July
5	A & C	Lincoln Bridge	5a. Build Lincoln Bridge next to Culver Bridge to connect Area A to Area C North	7/4/2017	65	A, B, C	9	Note, if assuming new bridge NOT using existing foundations, Use Equip 8 and 130 days duration
6	A	Clear, Grub, and Stockpile Area "A"	6a. Remove vegetation from Area A (54,400 CY dry cut)	7/4/2017	10	C	10	
			6b. Remove trash	7/4/2017	20	C	10	
			6c. Stockpile	7/4/2017	20	C	10	
7	A	Excavate Area "A"	7a. Remove 36" concrete pipe near center of Area A	7/4/2017	5	C	4	
			7b. Excavate old fill from Area A (1,134,200 CY wet cut and 54,400 dry cut, see note)	7/4/2017	555	C	11	This cut is the 2.05M CY, less cuts accounted for in other sequences. Assume dry max move is 10k cy/day; wet max move is 4k cy/day; wet soil spread over 4 of 20 acre for 5 days is limiting issue.
			7c. Dig below (over excavate) future levees (25,200 CY dry cut)	7/4/2017	5	C	11	Within Seq 7b
8	A	Area "A' Construct North Levee	8a. Grade and construct new levee around Area A (125,300 CY fill)	7/4/2017	35	C	12	Within Seq 7b
			8b. Protect Del Ray 13, 14, 15, 17, and 19	1/2/2017	n/a	n/a	n/a	
9	B & Property 1	Area "B" North Gas Line Relocation & Well Abandonment	9a. Drill new well at SoCal Gas Plant to replace Del Ray 12	1/2/2017	50	D	5	
			9b. Abandon and plug Del Ray 12	4/3/2017	90	D	6	
			9c. Remove/relocate existing pipelines	7/4/2017	10	D	4	
10	B	Area "B" North Clear & Grub	10a. Remove vegetation from Area B North and interim levee (25,000 CY wet cut)	7/4/2017	10	E	10	
			10b. Remove trash	7/4/2017	50	E	10	
11	B	Area "B" North Over-Excavate and Stockpile	11a. Excavate Area B North (56,700 CY wet cut)	7/4/2017	25	E	11	
			11b. Dig below (over excavate) future levees (11,400k CY wet cut)	7/4/2017	5	E	11	
12	B	Construct Area "B" Levee	12a. Construct Area B levees (437,000 CY fill = total import from Area A = 546,000 CY)	8/14/2017	165	E	12	Uses dry or dried out dirt from Area A, imported over new Ballona bridge. Area A exported dirt placed here first. Time is within 555 days from Seq 7, but extra equipment added during this time.
13	B	Clear, Grub, and Stockpile Area "B" East	13a. Remove vegetation in Area B East (4,600 CY wet cut)	2/5/2018	5	E	1	
			13b. Stockpile and prepare for fill	2/5/2018	5	E	10	
14	B	Area "B" East Stockpile Grading	14a. Grade Area B east and import from Area A (80,000 CY import from Area A)	2/12/2018	25	E	11	Uses dry or dried out dirt from Area A, imported over new Ballona bridge. Area A exported dirt placed here second. Time is within 555 days from Seq 7, but extra equipment added during this time.
15	C	Clear & Grub Area "C" North & South	15a. Protect baseball fields and structures.	1/2/2017	n/a	n/a	n/a	
			15b. Clear vegetation from Area C North (56,000 CY dry cut) & South (15,000 CY dry cut)	4/2/2018	10	C, E	10	
			15c. Re-align and replace Marina ditch (45,000 CY wet cut)	4/23/2018	15	C, E	11	
16	A & C	Area "A" Grading and Export to Area "C" North & South	16a. Excavate Area A and export to C South (300,000 CY total)	5/21/2018	75	C, E	11	Uses dry or dried out dirt from Area A, imported over new Lincoln bridge and across Culver Blvd. Area A exported dirt placed here third. Time is within 555 days from Seq 7, but extra equipment added during this time.
			16b. Excavate Area A and export to C North (720,000 CY ultimate total; 420,000 CY to C North)	9/3/2018	110	C, E	11	Uses dry or dried out dirt from Area A, imported over new Lincoln bridge. Area A exported dirt placed here fourth. Time is within 555 days from Seq 7, but extra equipment added during this time.
17	C	Finish Grading for Uplands Area "C" South	17a. Finish grading Area C South	6/3/2019	15	C, E	13	
			17b. Re-establish upland vegetation	6/24/2019	5	C, E	14	
18	B	Area "B" New and Reconstructed Culverts	18a. Install culverts under Culver/Jefferson Blvd, Gas Co Rd, and FWM berm; modify existing culvert under west end of Culver Blvd.	1/7/2019	130	F	1	
			18b. Remove existing FWM pipes and outlets	7/8/2019	15	F	1	
			18c. Construct new FWM outlet and spillway	7/29/2019	40	F	1	

Color	Description
	Could start sooner if desired, not later
	Work must start and finish in non-rainy season
	Cannot start until habitat establishment period complete. Work in Non-rainy season
	Independent effort, can start any time after this start date.

Sequence	Area	Title	Actions	Start Date	Working Days	Overlap	Equipment Reference	Notes/ Assumptions
19	A & B	Area "A" and Area "B" North Excavate and Breach Existing Levees	19a. Excavate Ballona Creek Channel in Areas A and B North (277,800 CY cut)	4/15/2019	130	G	11	Total time allowed during non-rainy season - 4/15 to 10/15
20	A & B	Area "A" and Area "B" North Block and Fill Existing Channels	20a. Install temporary pipe	4/15/2019	10	G	4	Time assumed within Seq 19
			20b. Temporary block then fill existing Ballona Creek (258,500 CY fill from Seq 19)	4/15/2019	60	G	11	Time assumed within Seq 19
21	A & B	Area "A" and Area "B" North Remove Existing Levees	21a. Lower and breach existing Ballona Creek levee (383,400 CY) - Export to Area C North, quantities included in Sequence 16, ultimate.	7/8/2019	120	G	11	Time assumed within Seq 19
22	B	Area "B" West Fire Access Road	22a. Construct maintenance and fire road in Area B West	10/14/2019	20	H	7	
			22b. Reconstruct Area B parking lot	10/14/2019	20	I	7	
23	A & B	Bike Path, Pedestrian Walkway and Amenities	23a. Construct bike and ped trails on levees	10/14/2019	65	J	7	
			23b. Construct County Parking Structure Foundation	10/14/2019	60	K	2	Independent sequence anytime after Seq 8a. Is complete
			23c. Construct County Parking Structure	10/14/2019	120	K	3	Independent sequence anytime after Seq 8a. Is complete
24	A	Export	24a. Export final excess dirt quantity (Assume up to 110,000 CY)	10/14/2019	35	C, E	15	See separate tab for export
		PHASE 2						
		Area A Gas Well Removal and Restoration						
25	A & Property 1	Gas Well Abandonment	25a. Drill new well at SoCal Gas Plant to replace Del Ray 19	1/2/2017	50	L	5	Assumes one crew working sequencially. Multiple crews could cut time down.
			25b. Abandon and plug Del Ray 13, 14, 15, 17, 18, and 19	3/13/2017	225	L	6	Assumes one crew working sequencially. Multiple crews could cut time down.
			25c. Remove existing gas lines serving removed wells	1/22/2018	10	L	4	
26	A	Area A around Wells Clear & Grub	26a. Remove vegetation around wells (2,000 CY)	1/22/2018	5	M	1	
27	A	Area A around Wells Grading and Export to West Area B	27a. Excavate Area A and Export to West Area B (208,000 CY)	1/22/2018	5	M	11	
28	A	Finish Grading For Uplands	28a. Finish grading around wells	2/12/2018	10	M	1	
			28b. Re-establish upland vegetation	2/26/2018	5	M	14	
		Area B wells						
29	B	Area B Abandon Wells	29a. Drill new well at SoCal Gas Plant to replace Del Rey 9 and Vidor 18	1/2/2017	50	N	5	Assumes one crew working sequencially. Multiple crews could cut time down.
			29b. Abandon and plug Vidor 1, 2, 3, 5, 14, 18 and Del Rey 4, 5, 9, 11	3/13/2017	225	N	6	Assumes one crew working sequencially. Multiple crews could cut time down.
			29c. Remove existing pipelines	11/13/2017	10	N	4	
30	B	Area B around Wells Clear & Grub	30a. Remove vegetation around wells (2,000 CY)	11/27/2017	5	O	1	
31	B	Finish Grading For Uplands	31a. Finish grading around wells	12/4/2017	10	O	1	
			31b. Re-establish upland vegetation	12/18/2017	5	O	14	
		Area B West						
32	B	Area "B" West Clear & Grub	32a. Remove vegetation in Area B West (76,000 CY)	4/17/2023	10	P	10	
33	B	Area "B" West Grading and Levee Extention	33a. Install temporary flexible storm drain	5/1/2023	10	P	1	
			33b. Dig below (over excavate) levees (10,800k CY wet cut)	5/1/2023	10	P	12	
			33c. Grade Area B West channels, construct salt pan berm, and construct levee with import from stockpile from Area B North and East at 248,000 CY (31,200 + 216,800 CY (291,800 less 49,000 and 26,000))	5/15/2023	75	P	12	
34	B	Area "B" West Excavate and Breach Existing Levees	34a. Breach existing levee in Area B West and place in Stability berms (75,000 CY wet = 26,000 + 49,000)	4/15/2023	130	P	11	Time allowed during non-rainy season = 130 Days, Time expected = 30
35	B	Finish Bike Path, Pedestrian Walkway and Amenities	35a. Construct maintenance and fire access road and bike path on new levee.	8/14/2023	20	Q	7	
36	B	Finish Grading For Uplands	36a. Finish grading Area B East	9/4/2023	10	Q	13	
			36b. Re-establish upland vegetation	9/18/2023	5	Q	14	

Equipment Reference

Reference #	Action(s)	Equipment Type	Number per day	Hours per day	Employees per day
1	2a, 13a, 18a, 18b, 18c, 26a, 28a, 30a, 31a, 33a	Grader	2	8	26
		Truck	12	8	
		Loader	4	8	
		Backhoe	2	8	
		Generator Set	1	8	
2	23b	Grader	4	8	24
		Truck	10	8	
		Loader	4	8	
		Backhoe	1	8	
		Drill Rig	1	8	
		Generator Set	2	8	
3	23c	Truck	12	8	40
		Backhoe	1	8	
		Crane	1	8	
		Loader	4	8	
		Generator Set	2	8	
4	1a, 3a, 3b, 7a, 9c, 20a, 25c, 29c	Backhoe	1	8	8
		Truck	4	8	
		Loader	1	8	
		Grader	1	8	
5	9a, 25a, 29a	Drill Rig	1	24	70
		Generator Set	6	24	
		Truck	20	24	
		Forklift	1	24	
		Backhoe	1	24	
		Crane	2	24	
6	9b, 25b, 29b	Drill Rig	1	12	17
		Truck	17	12	
		Generator Set	1	12	
7	4a, 4c, 22a, 22b, 23a, 35a	Backhoe	2	8	15
		Truck	10	8	
		Loader	4	8	
		Grader	1	8	
8	4b (5a?)	Drill Rig	1	8	50
		Crane	2	8	
		Generator Set	4	8	
		Truck	30	8	
		Forklift	2	8	
		Backhoe	2	8	
		Grader	1	8	
9	5a	Drill Rig	1	8	30
		Crane	2	8	
		Generator Set	3	8	
		Truck	16	8	
		Forklift	2	8	
10	6a, 6b, 6c, 10a, 10b, 13b, 15b, 32a	Grader	4	8	35
		Truck	20	8	
		Loader	8	8	
		Backhoe	2	8	
		Generator Set	1	8	
11	7b, 7c, 11a, 11b, 14a, 15c, 16a, 16b, 19a, 20b, 21a, 27a, 34a	Grader	6	8	80
		Truck	50	8	
		Loader	6	8	
		Backhoe	6	8	
12	8a, 12a, 33b, 33c	Grader	6	8	90
		Truck	60	8	
		Loader	6	8	
		Backhoe	6	8	
		Drill Rig	1	8	
		Generator Set	2	8	
13	17a, 36a	Grader	4	8	10
		Truck	240	8	
14	17b, 28b, 31b,	Truck	10	8	16
15	24a	Loader	2	8	122
		Truck	120	8	

Soil Export, Alternative 1

After grading operations are complete, there may be up to 110,000 c.y. of excess soil that might be exported outside the project boundary for disposal. Export will occur during **Sequence 24.**

		Haul Trucks			Crane			Tugs (to pull barges)			
Option	Description	Trips/day	Miles/trip	Total Trips	Number	Hours	Days	Number	Miles/trip	Hours/trip	Trips/tug
Off-Shore Disposal	Soil transported to temporary local staging areas along Ballona Creek (truck)	670	1	7,330	0	0	0	0	0	0	0
	Soil loaded on barge (crane)	0	0	0	1	8	31	0	0	0	0
	Soil barged up to 55 miles to the US EPA Los Angeles ocean disposal site off San Pedro (LA-2, 30 miles) or the Newport Bay ocean disposal site off Newport Beach (LA 3, 55 miles) (30 barge trips)	0	0	0	0	0	0	1	110	12	31
Port of Los Angeles (barge)	Soil transported to temporary local staging areas along Ballona Creek (truck)	670	1	7,330	0	0	0	0	0	0	0
	Soil loaded on barge (crane)	0	0	0	1	8	31	0	0	0	0
	Soil barged 30 miles from the shoreline of Port (30 barge trips)	0	0	0	0	0	0	1	30	8	31
Port of Los Angeles (truck)	Soil transported to temporary local staging areas along Ballona Creek (truck)	670	1	7,330	0	0	0	0	0	0	0
	Soil loaded on barge (crane)	0	0	0	1	8	31	0	0	0	0
	Soil barged 33 miles from the shoreline of Port (30 barge trips)	0	0	0	0	0	0	1	30	8	31
	Soil trucked to facilities in Los Angeles County, Orange County, Riverside County, and Ventura County	240	30.7-245	7,330	0	0	0	0	0	0	0
Landfill	Soil trucked to facilities in Los Angeles County, Orange County, Riverside County, and Ventura County	240	30-79.3	7,330	0	0	0	0	0	0	0

Soil Export, Alternative 2

After grading operations are complete, there may be up to 10,000 c.y. of excess soil that might be exported outside the project boundary for disposal. Export will occur during **Sequence 24.**

		Haul Trucks			Crane			Tugs (to pull barges)			
Option	Description	Trips/day	Miles/trip	Total Trips	Number	Hours	Days	Number	Miles/trip	Hours/trip	Trips/tug
Off-Shore Disposal	Soil transported to temporary local staging areas along Ballona Creek (truck)	670	1	670	0	0	0	0	0	0	0
	Soil loaded on barge (crane)	0	0	0	1	8	1	0	0	0	0
	Soil barged up to 55 miles to the US EPA Los Angeles ocean disposal site off San Pedro (LA-2, 30 miles) or the Newport Bay ocean disposal site off Newport Beach (LA 3, 55 miles) (150 barge trips)	0	0	0	0	0	0	1	110	12	1
Port of Los Angeles (barge)	Soil transported to temporary local staging areas along Ballona Creek (truck)	670	1	670	0	0	0	0	0	0	0
	Soil loaded on barge (crane)	0	0	0	1	8	1	0	0	0	0
	Soil barged 30 miles from the shoreline of Port (150 barge trips)	0	0	0	0	0	0	1	30	8	1
Port of Los Angeles (truck)	Soil transported to temporary local staging areas along Ballona Creek (truck)	670	1	670	0	0	0	0	0	0	0
	Soil loaded on barge (crane)	0	0	0	1	8	1	0	0	0	0
	Soil barged 33 miles from the shoreline of Port (150 barge trips)	0	0	0	0	0	0	1	30	8	1
	Soil trucked to facilities in Los Angeles County, Orange County, Riverside County, and Ventura County	240	30.7-245	670	0	0	0	0	0	0	0
Landfill	Soil trucked to facilities in Los Angeles County, Orange County, Riverside County, and Ventura County	240	30-79.3	670	0	0	0	0	0	0	0

Soil Export, Alternative 3

After grading operations are complete, there may be up to 1,226,000 c.y. of excess soil that might be exported outside the project boundary for disposal. Export will occur during **Sequence 24.**

NOTE: MATCHES FULL EXPORT

		Haul Trucks			Crane			Tugs (to pull barges)			
Option	Description	Trips/day	Miles/trip	Total Trips	Number	Hours	Days	Number	Miles/trip	Hours/trip	Trips/tug
Off-Shore Disposal	Soil transported to temporary local staging areas along Ballona Creek (truck)	670	1	81,730	0	0	0	0	0	0	0
	Soil loaded on barge (crane)	0	0	0	3	8	110	0	0	0	0
	Soil barged up to 55 miles to the US EPA Los Angeles ocean disposal site off San Pedro (LA-2, 30 miles) or the Newport Bay ocean disposal site off Newport Beach (LA 3, 55 miles) (330 barge trips)	0	0	0	0	0	0	3	110	12	110
Port of Los Angeles (barge)	Soil transported to temporary local staging areas along Ballona Creek (truck)	670	1	81,730	0	0	0	0	0	0	0
	Soil loaded on barge (crane)	0	0	0	3	8	110	0	0	0	0
	Soil barged 30 miles from the shoreline of Port (330 barge trips)	0	0	0	0	0	0	3	30	8	110
Port of Los Angeles (truck)	Soil transported to temporary local staging areas along Ballona Creek (truck)	670	1	81,730	0	0	0	0	0	0	0
	Soil loaded on barge (crane)	0	0	0	3	8	110	0	0	0	0
	Soil barged 33 miles from the shoreline of Port (330 barge trips)	0	0	0	0	0	0	3	30	8	110
	Soil trucked to facilities in Los Angeles County, Orange County, Riverside County, and Ventura County	240	30.7-245	81,730	0	0	0	0	0	0	0
Landfill	Soil trucked to facilities in Los Angeles County, Orange County, Riverside County, and Ventura County	240	30-79.3	81,730	0	0	0	0	0	0	0

Construction, Alternative 2

Sequence	Area	Title	Actions	Same as Alt 1?	Schedule Adjustment ?	Equipment Adjustment ?
		PHASE 1				
1	B	Area "B" Southeast Gas Lines	1a. Remove and relocate existing gas line	Y		
2	B	Area "B" South Enhancement	2a. Create swale (10,000 CY wet cut)	Y		
3	A	Area "A' Gas Line Removal	3a. Remove existing inactive gas line	Y		
			3b. Cut and cap gas line at Fiji Way	Y		
25	A & Property 1	Gas Well Abandonment	25a. Drill new well at SoCal Gas Plant to replace Del Ray 19	Y		
			25b. Abandon and plug Del Ray 13, 14, 15, 17, 18, and 19	Y		
			25c. Remove existing gas lines serving removed wells	Y		
26	A	Area A around Wells Clear & Grub	26a. Remove vegetation around wells (2,000 CY)	Y		
27	A	Area A around Wells Grading and Export to West Area B	27a. Excavate Area A and Export to West Area B (208,000 CY)	Y		
28	A	Finish Grading For Uplands	28a. Finish grading around wells	Y		
			28b. Re-establish upland vegetation	Y		
29	B	Area B Abandon Wells	29a. Drill new well at SoCal Gas Plant to replace Del Rey 9 and Vidor 18	Y		
			29b. Abandon and plug Vidor 1, 2, 3, 5, 14, 18 and Del Rey 4, 5, 9, 11	Y		
			29c. Remove existing pipelines	Y		
30	B	Area B around Wells Clear & Grub	30a. Remove vegetation around wells (2,000 CY)	Y		
31	B	Finish Grading For Uplands	31a. Finish grading around wells	Y		
			31b. Re-establish upland vegetation	Y		
4	A & B	Pedestrian/Bike Bridge	4a. Construct temporary & portion of final re-routed trail to existing trail	Y		
			4b. Construct new pedestrian/bike bridge over Ballona Creek	Y		
			4c. Reroute Ballona Creek Bike Trail under Culver Blvd Bridge	Y		
5	A & C	Lincoln Bridge	5a. Build Lincoln Bridge next to Culver Bridge to connect Area A to Area C North	Y		
6	A	Clear, Grub, and Stockpile Area "A"	6a. Remove vegetation from Area A (54,400 CY dry cut)	Y		
			6b. Remove trash	Y		
			6c. Stockpile	Y		
7	A	Excavate Area "A"	7a. Remove 36" concrete pipe near center of Area A	Y		
			7b. Excavate old fill from Area A (1,384,000 CY wet cut, see note)	Y		
			7c. Dig below (over excavate) future levees (30,000 CY dry cut)	Y		
8	A	Area "A' Construct North Levee	8a. Grade and construct new levee around Area A (125,300 CY fill)	Y		
9	B & Property 1	Area "B" North Gas Line Relocation & Well Abandonment	9a. Drill new well at SoCal Gas Plant to replace Del Ray 12	Y		
			9b. Abandon and plug Del Rey 12	Y		
			9c. Remove/relocate existing pipelines	Y		
10	B	Area "B" North Clear & Grub	10a. Remove vegetation from Area B North and Area B West (25,000 CY wet cut)	Y		
			10b. Remove trash	Y		
11	B	Area "B" North Over-Excavate and Stockpile	11a. Excavate Area B North (56,700 CY wet cut)	Y		
			11b. Dig below (over excavate) future levees (3,000 CY wet cut)	N		
12	B	Construct Area "B" Levee	12a. Construct Area B levees (266,200 CY = total import from Area A = 332,800 CY)	Y		
13	B	Clear, Grub, and Stockpile Area "B" East	13a. Remove vegetation in Area B East stockpile area (4,600 CY wet cut)	Y		
			13b. Stockpile and prepare for fill	Y		
14	B	Area "B" East Grading	14a. Grade Area B east and import from Area A (324,000 CY import from Area A)	N	Increase from 20 to 85 days	
15	C	Clear & Grub Area "C" North & South	15a. **Demo** baseball fields and structures.	N	Add 15 Days	
			15b. Clear vegetation from Area C North (56,000 CY dry cut) & South (**51,000** CY dry cut)	N	Increase from 15 to 25 days	
			15c. Re-align and replace Marina ditch (45,000 CY wet cut)	Y		
16	A & C	Area "A" Grading and Export to Area "C" North & South	16a. Excavate Area A and export to C South (**540,000** CY total)	N	Increase from 75 to 135 days	
			16b. Excavate Area A and export to C North (**500,000** CY ultimate total; **183,000** CY at this sequence until levee is breached)	N	Decrease from 110 to 50 days	
17	C	Finish Grading for Uplands Area "C" South	17a. **Reconstruct ballfields and structures and detailed grading in** Area C South	N	Increase from 15 to 65 days	Use 7
			17b. Re-establish upland vegetation	Y		
18	B	Area "B" New and Reconstructed Culverts	18a. Install culverts under Culver/Jefferson Blvd, Gas Co Rd., and FWM berm; modify existing culvert under west end of Culver Blvd.	Y		
			18b. Remove existing FWM pipes and outlets	Y		
			18c. Construct new FWM outlet and spillway	Y		
19	A & B	Area "A" and Area "B" North Excavate and Breach Existing Levees	19a. Excavate Ballona Creek Channel in Areas A and B North (277,800 CY cut)	Y		
20	A & B	Area "A" and Area "B" North Block and Fill Existing Levees	20a. Install temporary pipe	Y		
			20b. Temporary block then fill existing Ballona Creek (269,100 CY fill from Seq 19)	Y		
21	A & B	Area "A" and Area "B" North Remove Existing Levees	21a. Lower and breach existing Ballona Creek levee (383,400 CY) - Export to Area C North, quantities included in Sequence 16, ultimate.	Y		
22	B	Area "B" West Fire Access Road	22a. Construct maintenance and fire road in Area B West	Y		
			22b. Reconstruct Area B parking lot	Y		

Sequence	Area	Title	Actions	Same as Alt 1?	Schedule Adjustment ?	Equipment Adjustment ?
23	A & B	Bike Path, Pedestrian Walkway and Amenities	23a. Construct bike and ped trails on levees	Y		
			23b. Construct County Parking Structure Foundation	Y		
			23c. Construct County Parking Structure	Y		
24	A	Export	24a. Export final excess dirt quantity (Assume 10,000 CY)	N	Decrease from 35 to 3 days	

Construction, Alternative 3

Sequence	Area	Title	Actions	Same as Alt 1?	Schedule Adjustment ?	Schedule Adjustment ?
1	B	Area "B" Southeast Gas Lines	1a. Remove and relocate existing gas line	Y		
2	B	Area "B" South Enhancement	2a. Create stormwater detention/treatment swale/wetland (10,000 CY wet cut)	Y		
3	A	Area "A' Gas Line Removal	3a. Remove existing inactive gas line	Y		
			3b. Cut and cap gas line at Fiji Way	Y		
25	A & Property 1	Gas Well Abandonment	32a. Drill new well at SoCal Gas Plant to replace Del Rey 17 and 19	Y		
			32b. Abandon and plug Del Rey 13, 14, 15, 17, 18 and 19	Y		
			32c. Remove existing gas lines serving removed wells	Y		
			31a. Finish grading around wells	N		
9	B & Property 1	Area "B" North Gas Line Relocation & Well Abandonment	31b. Re-establish upland vegetation	N		
			9c. Remove existing pipelines	Y		
29	B	Area B Abandon Wells	29b. Abandon and plug Vidor 1, 2, 3, 5, 14, 18 and Del Rey 4, 5, 9, 11	Y		
			29b. Remove existing pipelines	Y		
30	B	Area B around Wells Clear & Grub	30a. Remove vegetation around wells (2,000 CY)	Y		
31	B	Finish Grading and Habitat Establishment	31a. Finish grading around wells	Y		
			31b. Establish vegetation	Y		
6	A	Clear, Grub, and Stockpile Area "A"	6a. Remove vegetation from Area A (54,400 CY dry cut)	Y		
			6b. Remove trash	Y		
			6c. Stockpile	Y		
7	A	Excavate Area "A"	7a. Remove 36" concrete pipe near center of Area A	Y		
			7b. Excavate old fill from Area A (999,700CY wet cut, see note)	Y	Decrease from 555 to 400 days	
			7c. Dig below (over excavate) future levees (30,000 CY dry cut)	Y		
8	A	Area "A' Construct North Levee	8. Grade and construct new levee around Area A (125,300 CY fill)	Y		
19	A	Area "A" Excavate New Channel	19a. Excavate Ballona Creek Channel in Area A (190,900 CY cut)	N	Decrease from 130 to 55 days	
16	A & C	Area "A" Grading and Export **Off-Site**	16a. Excavate Area A and export **Off-Site (1,230,000 CY Total; Split into Seq 's 16 (859k), 19/20**	N	Increase from 75 to 340 days	
			(195k), 21 (166k), and 24 (10k))	N	Deleted	
17	C	**Remove invasives** for Uplands Area "C" **North &** South	17a. **Remove invasives** Area C **North &** South	N	Increase from 15 to 45 days	Use 14
			17b. Re-establish upland vegetation	Y		
23	A & B	Bike Path, Pedestrian Walkway and Amenities	23a. Construct bike and ped trails on levees	Y		
			23b. Construct County Parking Structure Foundation	Y		
			23c. Construct County Parking Structure	Y		
xx	**A**	**Area "A" Excavate New Channel**	**Install culverts in existing north Ballona Creek levee**	**N**	**ADDED LINE, 20 days**	**Use 1**
24	A	Export	24a. Export final excess dirt quantity (Assume 1,230,000 CY, per line 16a.)	N	See 16a	

Construction, Alternative 4

Sequence	Area	Title	Actions
NEW	A, B, C	Restoration	Invasive species removal and volunteer-based restoration

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APPENDIX B5
Preliminary Operation and Maintenance Plan

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Ballona Wetlands Ecological Reserve

Preliminary Operations and Maintenance Plan

January 2017

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BALLONA WETLANDS RESTORATION PROJECT

PRELIMINARY OPERATIONS AND MAINTENANCE PLAN

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LIST OF ACRONYMS

BMPs	Best Management Practices
Ballona Reserve	Ballona Wetlands Ecological Reserve
Cal-IPC	California Invasive Plant Council
CCC	California Conservation Corps
CDFG	California Department of Fish and Game (now California Department of Fish and Wildlife)
CDFW	California Department of Fish and Wildlife (formerly California Department of Fish and Game)
CESA	California Endangered Species Act
CEQA	California Environmental Quality Act
CHRAMP	Ballona Wetlands Ecological Reserve Conceptual Habitat Restoration and Adaptive Management Plan
CNPS	California Native Plant Society
Corps	U.S. Army Corps of Engineers
GIS	Geographic Information System
HMMP	Habitat Mitigation and Monitoring Plan
LA County	Los Angeles County
LACFCD	Los Angeles County Department of Public Works-Flood Control District
MSL	Mean sea level
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
O&M Plan	Operations and Maintenance Plan
PAR	Property Analysis Record
PMT	Project Management Team
PWA	Phillip Williams and Associates
Reserve	Ballona Wetlands Ecological Reserve
SCC	California State Coastal Conservancy
SLC	California State Lands Commission
SMBRC	Santa Monica Bay Restoration Commission
SRT Gate	Self-Regulating Tide Gate
USFWS	U.S. Fish and Wildlife Service

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1.0 OPERATIONS AND MAINTENANCE PLAN

1.1 Introduction and Purpose

The intent of the Ballona Wetlands Restoration Project is to restore, enhance, and establish native coastal wetland and upland habitats within the Ballona Reserve, while maintaining a flood protection system that is sustained by natural processes and requires minimal operations and maintenance activities. The restored Ballona Creek channel has been designed to minimize maintenance; however, significant maintenance may be required for the channel. The purpose of this document is to describe the activities required for the ongoing operation and maintenance of the Ballona Wetlands Ecological Reserve (Ballona Reserve), which would include, but would not necessarily be limited to, site monitoring and management (e.g., trash and debris removal; channel, levee, and water control structure maintenance; habitat and vegetation maintenance; vector control; maintenance of public trails, lookouts, and points of entry; access to public parking lots; maintenance of the ballfields), other ongoing or routine maintenance (e.g., safety patrols, maintenance of emergency access routes), and staffing and personnel needs. This Preliminary Operations and Maintenance Plan (Preliminary O&M Plan) has been developed to describe the anticipated short- and long-term management and maintenance activities that would be required to achieve the following key objectives:

1. Maintain the same or greater flow-carrying capacity as the original Ballona Creek channel design approved in accordance with existing U.S. Army Corps of Engineers (Corps) requirements as determined through Section 14 of the Rivers and Harbors Act of 1899 and codified in 33 U.S.C. §408 (commonly referred to as "Section 408");
2. Maintain a diversity of functional restored wetland and upland habitats; and
3. Provide public access and safety.

This Preliminary O&M Plan has been developed to ensure that anticipated O&M activities that could result in physical environmental impacts are included as part of the restoration project and are evaluated in the Ballona Wetlands Restoration Project Environmental Impact Statement (EIS)/Environmental Impact Report (EIR). A summary of this Plan is provided in Chapter 2, *Description of Alternatives*, of the EIS/EIR. This Preliminary O&M Plan should not be interpreted as any sort of regulatory approval by the California Department of Fish and Wildlife (CDFW), or otherwise binding on CDFW related to the issuance of a regulatory approval in the future.

As part of the Section 408 permit process, which will occur following conclusion of the environmental review process, a Final O&M Plan will be jointly developed by the Los Angeles County Department of Public Works-Flood Control District (LACFCD), CDFW, and any other responsible parties (e.g., Los Angeles County Department of Beaches and Harbors, Los Angeles County Sheriff's Department, City of Los Angeles Fire Department, and Ballona Wetlands Conservancy). The Final O&M Plan will identify all operations and maintenance responsibilities, providing more detail than contained in this Preliminary O&M Plan; however, it is anticipated that this Preliminary O&M Plan will form the basis of the Final O&M Plan.

1.2 Operation and Maintenance Responsibilities

CDFW manages and maintains primary ownership of the Ballona Reserve (with a smaller interest owned by the California State Lands Commission [CSLC]). The Corps, in cooperation with the LACFCD, constructed the Ballona Creek channel and levees within the Ballona Reserve as part of the Los Angeles County Drainage Area (LACDA) project. On behalf of the LACFCD, the LACDPW operates and maintains LACDA project features for the section of the Ballona Creek channel upstream of Lincoln Boulevard to the Ballona Creek outlet, including LACDA project features within the Ballona Reserve. While the primary responsibilities for the management and maintenance of the Ballona Reserve fall under the responsibility

of CDFW and LACFCD, other responsible parties may be involved, including, but not necessarily limited to, Los Angeles County Department of Beaches and Harbors, Los Angeles County Sheriff's Department, City of Los Angeles Fire Department, and Ballona Wetlands Conservancy. This document identifies an agency responsible for completion of specific O&M activities, but that agency may choose a qualified contractor to complete the activity under its supervision.

The main responsibilities of the Preliminary O&M Plan for the Ballona Reserve fall into three general categories: flood and stormwater facility inspection and maintenance; habitat restoration monitoring and maintenance; and public access, public services, and general maintenance.

Flood and stormwater management will primarily be the responsibility of the LACFCD and Ballona Reserve staff. LACFCD is responsible for maintaining and inspecting the LACDA project facilities within the Ballona Reserve, including the Ballona Creek channel and related infrastructure, which includes, but is not limited to, trash booms, flood risk management levees, levee access roads and fencing, channels, self-regulating tide flap gates, and culverts. Drainage structures and other flood management or stormwater related infrastructure that is needed only for habitat purposes will be the responsibility of Ballona Reserve staff. Drainage structures needed to maintain the integrity of roads and associated infrastructure would be the responsibility of the owner of the road.

Habitat restoration monitoring and maintenance activities will be the responsibility of CDFW or a qualified contractor working under the direction of CDFW. In addition, CDFW will coordinate at its discretion with NGOs to conduct restoration and maintenance activities.

Operation and maintenance of public access, public services, and general maintenance primarily will be the responsibility of LACDPW and Ballona Reserve staff. The LACDPW is responsible for maintaining the bike paths on the flood risk management levees. Both LACDPW and Ballona Reserve staff will be responsible for maintaining and inspecting the bike paths located on the flood risk management levees and portions of the pedestrians paths. Ballona Reserve staff will be responsible for the remaining pedestrian paths, public provided services, and the overall general maintenance of the areas that are accessible to the public, which includes, but is not limited to, pedestrian paths and boardwalks, sitting and viewing areas, interpretative signage, and entrances and exits to the Ballona Reserve.

This Preliminary O&M Plan is adaptive and the responsibilities and activities included in this document are subject to change, as needed, and as further described in Section 2.0, *Future Revisions to Preliminary Operations and Maintenance Plan*, and after agreement from the entities involved.

1.3 Operations and Maintenance Tasks/Activities

Existing and future O&M tasks are discussed below for: flood and stormwater facility inspection and maintenance; habitat restoration monitoring and maintenance; and public access, public services, and general maintenance. Future O&M tasks are described for Alternative 1 – Full Tidal Restoration/Proposed Action first, followed by descriptions for Alternative 2 – Restored Partial Sinuous Creek and Alternative 3 – Levee Culverts and Oxbow. Future O&M tasks for Alternative 4 – No Project would be the same as under existing conditions.

Flood and Stormwater Facility Inspection and Maintenance

Flood risk and stormwater management may include modifications to LACDA project structures within the Ballona Reserve by removing all or portions of the existing levees and the concrete-lined channel in favor of constructing new flood risk management levees, restoring the wetland floodplain, constructing

new water-control structures (such as culverts, weirs, and tide gates, and associated access roads) and/or erosion protection features, and modifications to existing operations and maintenance requirements.

The existing LACDA project structures and facilities are continuously maintained in such a manner and operated at such times and for such periods as necessary to obtain the maximum flood protection benefits (33 CFR §208.10). The LACFCD currently operates and maintains these structures and facilities within the Ballona Reserve consistent with the Corps' Operation, Maintenance, Repair, Replacement, and Rehabilitation Manual for the Los Angeles County Drainage Area (the "OMRR&R") (Corps 1999). Table 1 lists current LACFCD maintenance activities (P. Holland, Los Angeles County Department of Public Works, pers. comm.) and identifies which activities are anticipated to be continued as part of the Ballona Wetlands Restoration Project.

Ballona Creek Channel and Levees

Existing

The Ballona Creek flood risk management channel and levees were constructed in 1939 by the Corps (Corps 1999).

LACDPW, on behalf of LACFCD, currently performs maintenance of the existing flood risk management channel. The channels and levees have not been modified since 1976. The anticipated design life for these levees is approximately 50 years. The existing levee slopes are armored with a mix of rock, rubble, and concrete. As the levees continue to age and show signs of deterioration and weed infestation, it is the responsibility of LACFCD to perform repairs to the hardscape surfaces, as well as manage vegetation. In addition to monitoring for erosion along the levees, changes in channel bathymetry are monitored and repaired, as needed, to provide proper hydraulic performance.

Future – Alternative 1

Ballona Creek Channel - Flood Conveyance Capacity

LACFCD would continue to perform existing maintenance activities for Ballona Creek channel following restoration. While the restored Ballona Creek channel will be designed to minimize maintenance requirements, a monitoring and as-needed maintenance program would be developed for the channel.

The level of channel erosion and deposition during storm flow events is anticipated to be acceptable for the restoration and flood management. The levee heights are designed to meet flood criteria with a reduced channel cross-section (i.e., reduction in the design channel cross-section due to deposition). Due to the existing limited amount of sediment coming from the watershed, the channel is not expected to reach this reduced cross-section. However, this reduced channel cross-section will define a minimum allowable cross-section and maintenance limits for the channel. The channel cross-section will be monitored on a prescribed schedule (e.g., every five years) and after significant storm events and compared to the minimum allowable channel cross-section to confirm that the cross-section and flood performance is within the predetermined maintenance limit. Only if the channel cross-section were to reach the minimum cross-section (the smallest cross-section that still maintains flood protection, see EIS/EIR Appendix F10) through unforeseen circumstances would channel maintenance (e.g., dredging) be required. Any major debris or blockage of the channel that may negatively affect flood risk protection or restoration performance would need to be removed; however, this is not anticipated.

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Table 1. Existing and Future LACFCD O&M Activities

Current LA County O&M Activities	Anticipated Continuation of Existing O&M Activities	Note
1. Clean channel invert	Yes	See Below
2. Clean trash net	Yes	No change anticipated
3. Inspect and lock gates	Yes	Some new access gate locations will be operated by on-site Ballona Reserve staff
4. Inspect and service flap gates	Yes	Existing West Area B flap gates to remain in Phase 1 of Alternative 1, Alternative 2, and Alternative 3; new structures and gates in North Area B in Alternative 1 and 2 and in West Area B in Alternative 1.
5. Inspect and service sub-drains	Yes	For existing sub-drains to remain within Project Area
6. Maintenance and repair of fence and gates	Yes	Some new fence and gate locations
7. Maintenance and repair of weep holes	Yes	Four existing levees and weep holes to remain
8. Midge control	TBD	If needed, midge control responsibilities may be shared between LACFCD and Ballona Reserve management due to the potential increased populations of midges in wetlands versus flood channels.
9. Operation and maintenance of tidal gates	Yes	Existing West Area B SRT gates to remain in Phase 1 of Alternative 1, Alternative 2, and Alternative 3; new structures and gates.
10. Pre-emergent nuisance plant control	Yes	The responsibility of nuisance plant control will depend on the location of the nuisance plants. Nuisance plants in the flood risk management infrastructure (e.g., walkways, bike paths, culverts, etc.) will be managed by LACFCD, with prior approval of the Land Manager; nuisance plants in the Ballona Reserve restoration areas will be managed by the Ballona Reserve.
11. Spill response	Yes	Spill response will be the responsibility of the location where the spill occurred and spreads. If a spill affects the Ballona Reserve restored habitats, it will be the responsibility of Ballona Reserve on-site staff and management. Spills that affect the channels will be the responsibility of LACFCD. Responsibilities for spills that overlap in both areas will be shared between Ballona Reserve management/ on-site staff and LACFCD.
12. Nuisance plant removal	Yes	The responsibility of nuisance plant control will depend on the location of the nuisance plants. Nuisance plants in the flood risk management infrastructure (e.g., walkways, bike paths, culverts, etc.) will be managed by LACFCD, with the prior approval of the Land Manager; nuisance plants in the Ballona Reserve restoration areas will be managed by the Ballona Reserve.

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Table 1. Existing and Future LACFCD O&M Activities (continued)

Current LA County O&M Activities	Anticipated Continuation of Existing O&M Activities	Note
13. Trash/debris	Yes	The responsibility of trash/debris control will depend on the location of the trash and debris. Trash/debris in the creek and associated flood risk management infrastructure (i.e. walkways, bike paths, culverts, etc.) will be managed by LACFCD, with prior approval of the Land Manager; trash/debris in the Ballona Reserve restoration areas will be managed by the Ballona Reserve.
14. Existing bike path repair and management	Yes	Maintenance of the bike path following existing LACFCD channels will be the responsibility of the LACFCD.
15. Vegetation Management	TBD	The responsibility of vegetation management would depend on the location. Vegetation management on the levees, if required, will be the responsibility of LACFCD, with prior approval of the Land Manager; vegetation management in the Ballona Reserve restoration areas (i.e. fuel management etc.) will be managed by the Ballona Reserve.

TBD = to be determined in coordination with Los Angeles County

For purposes of estimating potential maintenance requirements related to sedimentation, up to 4 feet of uniform deposition along the new channel alignment would be allowed before channel maintenance would be required. This amount of sedimentation is estimated to take at least 50 years to accumulate in the channel and would require removal of approximately 125,000 CY of material. If this channel maintenance threshold were reached, LACFCD would perform the required maintenance using floating mechanical or hydraulic dredge equipment. Dredge equipment would be transported to the site by truck or barge via Marina del Rey Harbor or the Ballona Creek channel to the Pacific Avenue Bridge. Dredge equipment would be assembled in the channel. The channel would be dredged to the design dimensions of the channel. Dredged material either would be beneficially used within the wetlands (e.g., to raise sub-tidal and intertidal mudflat areas and create additional vegetated wetland habitat) or would be disposed of off-site. Land and marine-based off-haul options would be similar to options described for Project construction. However, soil excavation and disposal volumes for maintenance activities would be less than Project construction volumes. Any off-haul activities for maintenance therefore would have a shorter duration than for construction activities. Sediment testing would be performed prior to channel maintenance and any soil requiring special management measures would be handled and disposed of according to regulations. Table 2 below summarizes details related to maintenance of the channel capacity.

Table 2. Ballona Creek Conveyance Capacity Summary

Quantity	Area Affected	Dredging Equipment	On-site Reuse Equipment	Off-site Disposal Equipment	Frequency
125,000 CY	21 acres dredging and 6 acres access along channel	Hydraulic dredge, floating barge with long-reach excavator	Low ground pressure track truck and track long reach excavator, mats for access	Low ground pressure track truck, haul and dump truck	50 years

Ballona Creek Channel - Bank Protection

In locations where armoring would be installed along the banks of the Ballona Creek channel to limit erosion, scour protection would be inspected and maintained as needed. Level 1 armoring (consisting of buried rock revetment) and Level 3 armoring (consisting of vegetated channel banks) are proposed within the realigned reach of Ballona Creek. The Level 1 buried rock revetment would be designed to withstand velocities and shear stresses as if it were exposed and thus scour or erosion at the revetment that would expose bedding or cause undercutting is not anticipated. In the event that the buried armoring was exposed after a storm, natural processes would be allowed to rebury/revegetate those areas (e.g., vegetation recruitment in remaining soils, encouraging deposition) and no maintenance would be required. Level 3 vegetated channel banks are located in areas of the channel where the consequences of erosion would not impact infrastructure and thus the impacts are low. Erosion of Level 3 vegetated armoring would be considered a manifestation of natural processes in the restoration area and would be allowed to evolve/revegetate with no maintenance required.

Perimeter Levees - General

The levees themselves will be maintained following Corps policy and guidance letter on the periodic inspection procedures for the Levee Safety Program (Corps 2008) maintenance requirements. The levees are expected to require limited maintenance, and they would be inspected annually and after significant storm events. Maintenance would include, but not be limited to: periodic repaving of the bike path and walking trail; replacement or repair of fencing that may be installed; replacement or repair of any overlook or educational equipment placed along the walking trail; trash collection and graffiti removal; and habitat care, including removal of invasive species from the levees. These activities may include public education and involvement programs. Minor erosion best management practices (BMPs) may be necessary periodically.

CDFW would be responsible for replacement or repair of any overlook or educational equipment placed along the walking trail, and for any graffiti removal required for these elements.

Perimeter Levees -Vegetation

Planting along levee alignments implements tiered approach to applying the Corps' Guidelines for Landscape Planting and Vegetation at Levees (ETL 1110-2-583, April 2014). The proposed planting plans strike a balance between use of upland grasses in a vegetation free zone along the levee core and a vegetation management zone with grasses and small, shallow rooted shrubs between the vegetation free zone and the areas dedicated to upland and transitional habitat.

- Vegetation Free Zone – This zone follows Corps guidance providing a zone of perennial upland grasses along the levee core that would be mowed to facilitate inspection of the levee core. The Vegetation Free Zone would extend 15 feet beyond the toe of the levee core along the steeper land side of the levee. Along the creek side of the levee, where existing grades would be raised to create broad, flat transitional slopes ranging from 10H:1V to 20H:1V and flatter to support the habitat objectives of the project, the Vegetation Free Zone would extend 15 feet beyond the levee core.
- Vegetation Maintenance Zone – This zone provides an area of upland grasses and small shallow rooted shrubs that may be mowed as needed to facilitate inspections or selective removal of shrubs that could impact the integrity of the levee core. The Vegetation Management Zone would extend to 15 feet beyond the toe of the buried levee core on the water side of the levee. In this zone, the levee core would be buried by 8 to 10 feet of soil to support the habitat objectives of the Project. The intent would be that mowing or select vegetation removal would not be regularly needed, but would be included in Project permits to facilitate any maintenance and inspections should issues arise. The planting list within the Vegetation Management Zone would add low

shrubs with small root balls that are limited to 2-3 feet in depth to the perennial grasses included in the Vegetation Free Zone. A root-free zone of at least 3 feet would be maintained above the levee core.

- Habitat Zone – The Habitat Zone is located 15 feet from the levee core toe. In areas of higher levee fill (i.e., West Area B) this zone would incorporate 6 to 10 feet of soil above the levee toe at slopes of 10-20H:1V. This zone would support the full range of habitat plantings included in the upland and transitional habitat mix. Within the Habitat Zone, regular inspection is not anticipated.

Perimeter Levees – Scour Protection

In locations where armoring would be installed to limit erosion, the scour protection would be inspected and maintained as-needed. Three levels of armoring are proposed along the perimeter levees: Level 1 and Level 2 would consist of buried rock revetment; Level 4 would consist of vegetation only. A short reach of Level 1 armoring between the Culver and Lincoln Boulevard bridges would consist of surface rock revetment/concrete. Inspection and maintenance of this section of channel bank protection would continue as under existing conditions. The Level 1 and Level 2 buried rock revetment would be designed to withstand velocities and shear stresses as if it were exposed and thus scour or erosion at the revetment that would expose bedding or cause undercutting is not anticipated. In the event that the buried armoring becomes exposed after a storm, natural processes would be allowed to rebury/revegetate those areas (e.g., vegetation recruitment in remaining soils, encouraging deposition) and no maintenance would be required. Inspection and maintenance of Level 4 armoring is as described under Perimeter Levees –Vegetation.

Ballona Creek - Water Level Monitoring

Water levels will be monitored in the restored Ballona Creek channel and in the Area B managed marsh as they currently are in the existing channel and West Area B wetlands. In addition, Ballona Creek channel flows will be monitored at the Lincoln Boulevard bridge (or upstream), as they are being monitored for project baseline conditions data collection.

Future – Alternatives 2 and 3

Maintenance of Ballona Creek Channel and Levees under Alternative 2 would be the same as described under Alternative 1.

Maintenance of Ballona Creek Channel and Levees under Alternative 3 would be the same as the existing conditions.

Water Control Structures

Existing

The existing West Area B self-regulating tide gates (SRT gates) were installed in 2003 as a Corps 1135 project,[1] and are operated and maintained by LACFCD. LACFCD inspects and maintains the tide gates, including removal of debris/obstructions from the gates. The gates are checked on a weekly basis, and obstruction removal typically occurs twice per year. The gates are inspected and serviced annually. O&M

[1] Section 1135 of the Water Resources Development Act of 1986, as amended, provides the authority to modify existing Corps projects to restore the environment and construct new projects to restore areas degraded by Corps projects. A project is accepted for construction after a detailed investigation shows it is technically feasible, environmentally acceptable, and provides cost effective environmental benefits. Each project must be complete within itself, not a part of a larger project. The maximum federal expenditure per project is $5 million, which includes both planning and construction costs.

of the existing tide gates would continue until the structure is removed and the levee is breached (e.g., in Phase 2 of Alternative 1).

Future – Alternative 1

A number of new slide or tide gates will be installed to connect South and Southeast Area B to West and North Area B (and in turn the Ballona Creek channel), to maintain operation of the Freshwater Marsh, and to connect South and Southeast Area B. Inspection of the new water control structures will be the same as described for the existing gates. The gates will be checked on a weekly basis with obstruction removal occurring as needed. The gates will be inspected and serviced annually. Gates may be adjusted seasonally for habitat management purposes at the discretion of the Ballona Reserve Manager.

Due to the exposure conditions at the Project site, the new gates (like the existing ones) are likely to require replacement every 10 years. Replacement of the gates would be done using a crane and gates would be delivered to the Project site using a flatbed truck. Access to each water control structure would be along the paths/access routes along the perimeter levee. Connector channels between the water control structures and Ballona Creek may require sediment removal during the first 10 years post-construction. For purposes of estimating potential maintenance requirements related to sedimentation in the connector channels, up to 6 inches of sedimentation was assumed to deposit in the channels per maintenance event. Sediment removal would be accomplished using a low ground pressure (LGP) excavator and material would be removed from the Project site using a LGP track truck. A temporary access route, 35-feet wide, would be created using mats along one side of channel to provide equipment access. Access into the Project site would be from the perimeter levees. Table 3 below provides a summary of activities related to maintenance of water control structures and connecting channels.

Future – Alternatives 2 and 3

Maintenance of water control structures under Alternative 2 would be similar to description under Alternative 1, but with the following exceptions. Under Alternative 2, West Area B would not be improved. The existing West Area B gates connecting West Area B to Ballona Creek would remain and would continue to be maintained as under the existing conditions.

Maintenance of water control structures under Alternative 3 would be similar to the existing conditions, but also would include the addition of two new banks of culverts and gates connecting Area A to Ballona Creek. The existing West Area B gates connecting West Area B to Ballona Creek would remain and would continue to be maintained as under the existing conditions. Twelve new gates would be installed between Area A and Ballona Creek. Maintenance and replacement of these gates would be completed at the same frequency and using the same equipment and approach as described under Alternative 1.

South and Southeast Area B Flood Risk Management Berms

Existing

The berm features do not exist in the baseline (pre-Project) condition.

Future – Alternative 1

Berms would be constructed along lower perimeter elevations of South and Southeast Area B and tied into areas of high ground to maintain the existing level of flood risk protection (e.g., around the SoCalGas facility and along Culver Boulevard and Jefferson Boulevard). Maintenance of the berms would be focused on erosion protection.

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Table 3. Alternative 1 Water Control Structure Summary

Location	Activity	Frequency	Equipment	Quantity	Area Affected
Wetland to West Area B	Replace gate	Once every 10 years for life of project	Crane	1 gate	N/A
South Area B to West Area B	Replace gates	Once every 10 years for life of project	Crane	5 gates	N/A
	Connector channel to Ballona Creek sediment removal	Years 1-5: 2 times per year Years 6-10: 1 time per year	LGP excavator, LGP track trucks, mats to provide access along channel	Years 1-5: 560 CY per year Years 6-10: 280 CY per year	2.3 acres within channel 1 acre adjacent to channel for access
Southeast Area B to North Area B	Replace gates	Once every 10 years for life of project	Crane	5 gates	N/A
	Connector channel to Ballona Creek sediment removal	Years 1-5: 2 times per year Years 6-10: 1 time per year	LGP excavator, LGP track trucks, mats to provide access along channel	Years 1-5: 130 CY per year Years 6-10: 65 CY per year	0.5 acres within channel 0.2 acre adjacent to channel for access
Freshwater Marsh to North Area B	Connector channel to Ballona Creek sediment removal	Years 1-5: 2 times per year Years 6-10: 1 time per year	LGP excavator, LGP track trucks, mats to provide access along channel	Years 1-5: 240 CY per year Years 6-10: 120 CY per year	1 acre within channel 1 acre adjacent to channel for access
Gas Company Road	Replace gates	Once every 10 years for life of project	Crane	5 gates	N/A

Monitoring for erosion will occur during the rainy season. Monitoring will occur approximately one month prior to the expected onset of seasonal rains on a monthly to bi-monthly basis following the onset of seasonal rains during the first several years of the restoration. The timing of monitoring will allow the Ballona Reserve Manager sufficient time to perform maintenance or install additional controls prior to the onset of winter rains. The purpose of monthly monitoring during the rainy season is to document any areas of erosion and to identify the need for maintenance or additional control measures. Although these measures are useful for short-term erosion control during construction and the initial phases of vegetation establishment, long-term erosion control measures will be focused on the establishment of vegetative cover. Once vegetation communities have become sufficiently established to reduce the potential for erosion, the frequency of monitoring may be reduced, but will occur no less than once per year during the entire 10-year monitoring period. If significant erosion is observed, measures may be taken to correct the erosion issue such as re-grading or installation of more durable surface scour protection measures.

Future – Alternatives 2 and 3

Maintenance of flood risk management berms under Alternative 2 will be the same as described under Alternative 1.

Alternative 3 does not include flood risk management berms and, thus, no additional maintenance will be needed.

Freshwater Marsh and Associated Drainage Structures

Existing

The Freshwater Marsh was completed in 2009 and is operated and maintained by the Ballona Wetlands Conservancy, a non-profit State of California established agency funded by the Playa Vista development. Operations for the Freshwater Marsh consist primarily of controlling the water surface elevation to provide detention of smaller storm events balanced with adequate freshwater availability for health of the ecosystem. Maintenance includes trash, weed, and vector control, as well as structural maintenance for the drainage and access structures and features. Monitoring of the health of the Freshwater Marsh is accomplished through regular testing and inspection of inflows and outflows as prescribed by permits issued by the Corps and the Regional Water Quality Control Board and annual reporting. The Ballona Wetlands Conservancy has a separate operation and maintenance manual, and a stipulated documentation and reporting process that allows the Freshwater Marsh to be operated and maintained in perpetuity with minimal maintenance costs.

The Freshwater Marsh is outside the Project area, but has multiple inlet and outlet structures that connect to the Ballona Reserve. All of these structures are under the primary jurisdiction of the LACFCD, but are operated, inspected, and maintained by the Ballona Wetlands Conservancy.

Future – Alternative 1

Three outlet structures will be modified by the Project. The greatest modification will be due to the removal and relocation of the Ballona Creek levee. When the south levee is relocated along Culver Boulevard, an existing outlet structure and set of three flap gates will be relocated to the new levee location. The second modification is the completion of a relatively small outlet pipe (24-inch diameter) extending from an existing valve structure, which will allow direct freshwater release into Area B-South irrespective of storm events. The third modification, the existing overflow weir structure, may be modified to adjust a variable overflow elevation control system. After construction, the relocated structure, flap gates, pipes, and weir will continue to be operated and maintained by the Ballona Wetlands Conservancy. Replacement of the gates would be accomplished using the same approaches as summarized under the Water Control Structures section above. Details are provided in the table below.

Table 4. Alternative 1 Freshwater Marsh Summary

Location	Activity	Frequency	Equipment	Quantity	Area Affected
Freshwater Marsh to North Area B	Replace gates	Once every 10 years for life of Project	Crane	3 gates	N/A

Future – Alternatives 2 and 3

Maintenance of the Freshwater Marsh and associated drainage structures under Alternative 2 will be the same as described under Alternative 1.

Maintenance of the Freshwater Marsh and associated drainage structures under Alternative 2 will be the same as described under the existing condition.

Stormwater Management Features

Existing

The stormwater bio-swales and pre-treatment basins do not exist in the baseline (pre-Project) condition.

Future – Alternative 1

Stormwater management features requiring maintenance include bio-swales and pre-treatment basins. Information in this section is based on descriptions provided in a technical memorandum by Psomas (Psomas 2016)

Bio-swales

Maintenance of bio-swales is expected to be limited to non-native vegetation removal. Non-native plant removal would include work with hand tools such as shovels, rakes, hatchets, wheel barrows, and small trucks for hauling of equipment and spoils. The trucks would remain at the nearest access path or road with removal of spoils conveyed to them.

It is expected that these efforts would occur once a year for the lifespan of the Project. Two to four people could be expected to provide this annual maintenance in two to five days. The expected volumes of non-native plant species to be removed would vary but should be minor. The area impacted also would be minor, limited to within the bioswales, the footprint of which will be finalized during design.

Pre-Treatment Basins

Maintenance of pre-treatment basins will include non-native vegetation removal, minor structural repair, and sediment removal.

Non-native vegetation removal in the pre-treatment basins would utilize the same equipment and methods as described above under bio-swales and would occur at the same frequency. Impact areas for removal and access for each basin would be the same as described in under sediment removal in Table 5 below.

Minor structural repair would include repair of storm drain pipes, headwalls, and berms associated with the stormwater management features. Minor chipping or cracking of the concrete structures (storm drain pipe and headwalls) would be repaired with small batches of concrete or mortar that is hauled in with either a portable mixer or in a five gallon bucket and applied to the local repair area. Minor berm distress (rills and other erosion level distress) would be repaired with shovels and hand tamps. Trucks for hauling hand tools and personnel would remain at the nearest access path or road. It is expected that these efforts would occur once a year for the lifespan of the Project.

The pre-treatment retention/detention basins are designed to capture stormwater runoff from upstream tributary areas and allow the silts and other debris carried by the runoff to settle within the basins prior to infiltration and/or discharge into the Ballona wetlands. This “storage” must be maintained for proper functioning. The basins have been sized to intercept the 5-year storm event while the minimum storm event to provide appropriate pre-treatment is a 2-year storm. The basin sizing for a 5-year storm will allow room for sediment and debris build up without initially impacting functionality. Therefore, the pre-treatment basins can be allowed to fill approximately 40% before major maintenance is necessary. Sediment removal quantities for each basin based on this design criterion are included in Table 5 below.

A formal inspection related to storage volume and accumulation volume will be conducted annually. Permanent markers and volume indicators (concrete posts or similar) will be placed in the basin for ease of the visual inspection estimate. Removal of sediment is estimated to be required once every 50 years for the life of the Project. When removal sediment is required, the maintenance effort will consist of excavating the accumulated silts and debris with a lightweight backhoe, dump truck, and assorted hand tools from the basin to return it to the original design size and depth. This effort is estimated to require four to six people and be completed in one to three weeks. The excavated material can either be used elsewhere where erosion may have occurred (if testing indicates the material deems it suitable for re-use), or can be trucked to an acceptable disposal site. Because the backhoe and trucks must directly access each

basin to be excavated, a defined ingress/egress route will be established to limit the vehicular impact. Repair of the ingress/egress path and replanting of stripped areas in the basin will be required after the effort is completed. Details related to basin area and access are summarized in Table 5.

Table 5. Stormwater Pre-Treatment Basins Sediment Removal Summary

Basin	Activity	Frequency	Equipment	Quantity (cubic yards)	Area Affected (square feet)
Southeast Area B					
3A	Sediment Removal	Once every 50 years for the life of Project	Backhoe, flatbed truck, dump truck, grading roller	190 CY	Basin: 11,171 SF Access: 535 SF
11D	Same as above			50 CY	Basin: 7,750 SF Access : 3,990 SF
13E	Same as above			80 CY	Basin: 6,945 SF Access : 3,170 SF
15D	Same as above			130 CY	Basin: 5,427 SF Access: 1,545 SF
West Area B					
14B-Pershing Drain	Same as above			1,030 CY	Basin: 30,900 SF Access: 482 SF
South Area B					
15C	Same as above			1,190 CY	Basin: 18,060 SF Access : 1,205 SF
18C	Same as above			1,820 CY	Basin: 29,810 SF Access: 485 SF
Area A					
Parking Structure	Same as above			860 CY	Basin: 14,810 SF Access: 1,512 SF
North Area C					
Fiji Ditch	Same as above			TBD	Basin: 1,700 SF Access: NA

Future – Alternatives 2 and 3

Maintenance of stormwater management features under Alternative 2 would be similar to description under Alternative 1, but with the following exceptions. Under Alternative 2, West Area B would not be improved and thus, the sediment removal activities associated with Basin 14B-Pershing Drive would not be needed.

Maintenance of stormwater management features under Alternative 3 would be similar to description under Alternative 1, but with the following exceptions. Under Alternative 3, only Area A would be improved and thus, only the sediment removal activities associate with the Parking Structure Basin would be included.

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Trash Boom

Existing

LACFCD operates and maintains an existing trash boom system (or trash net) between the Culver Boulevard and Lincoln Boulevard bridges, which catches trash and debris carried downstream by Ballona Creek flows, primarily during storm events. LACFCD provided the following information on existing trash boom O&M. LACFCD inspects the trash net weekly and removes trash from the net as necessary.

Description

- Three booms – 75 feet connected to 50 feet connected to 75 feet all have 10-inch diameter booms and 18-inch skirts.

Maintenance Routines

- The trash boom is inspected weekly for debris, and the net is cleaned if necessary.
- After every rain event, the net is monitored and repairs are made, as needed.
- Debris is collected during daylight hours only, on an outgoing tide, and only during the week unless there is a storm that has recently passed, and trash was present on the last working day of the week.
- If necessary, a supervisor checks the net on weekends and calls a crew to clean the net.

Amount of Trash Collected

Year	Tons	Trash Removal Days
2006	38	43
2007	44	43
2008	46	24
2009	27	12
2010	21	18
2011	23	20
2012	22	13 (through November 28)

The Project allows for continued O&M of the existing trash net; no changes to trash net O&M are anticipated.

Vector Control Protocols

Existing

Vector control activities have not occurred within the Project area over the last several years due to drought conditions. In previous years, the Los Angeles County West Vector Control District (LACWVCD) has applied larvicides in South Area B, and likely other wet areas of the Ballona Reserve. LACFCD currently controls insect vectors, including midges and mosquitos, along existing flood risk management channels within Los Angeles County, including Ballona Creek. For example, the LACDPW sought and thereafter received State Water Resources Control Board continuous coverage (effective July 1, 2014) under General Permit Water Quality Order No. 2011-0002-DWQ, Statewide General National Pollutant Discharge Elimination System (NPDES) for Aquatic Vector Control Applications, to apply an insecticide called Bactimos PT to Ballona Creek channel sections outside the Project area

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between the months of April and October each year to keep midge populations below nuisance levels. The active ingredient in the insecticide applied for is *Bacillus thuringiensis, israelis* (BTI), a microbial larvicide that targets mosquitos, aquatic midge larvae, and closely-related insects such as black flies.

Future

Wetlands are known to increase populations of insect vectors, such as midges and mosquitos, to levels much higher than those seen in flood risk management channels, but not necessarily in saltwater wetlands. Therefore, vector control methods within the restored wetland complexes may or may not need to increase in frequency and/or amount to augment the existing vector control methods already in place by the LACFCD. Also, the restored and enhanced tidal wetlands would be designed to provide daily tidal flushing to support tidal wetland functions, which would also discourage vector breeding; however, it is possible that vector control within certain areas of the restored wetland complexes may need to increase in frequency and/or amount. Future vector control activities within the Ballona Reserve would be coordinated between LACFCD, LACWVCD, and CDFW. If pesticide application is determined to be necessary, the least toxic available control will be used. Based on best available information, it is anticipated that Bactimos PT or another insecticide that has BTI as an active ingredient will be used in strict accordance with a pesticide application plan that is substantially similar to the Pesticide Application Plan (PAP) for Ballona Creek and Centinela Creek Vector Control Program prepared by LACDPW, dated July 3, 2014, and submitted in support of its 2014 NPDES General Permit for Vector Control Application pursuant to Water Quality Order No. 2011-0002-DWQ.

If vector control is determined necessary to control mosquitoes and/or midges, Bactimos PT will be applied uniformly over the entire surface area of the waterbody. If complete surface coverage is not possible, then applications will be concentrated at least within 2 meters of the perimeter in <1 meter deep water. Bactimos PT will be applied using conventional ground application equipment such as hand or motorized spreaders or backpack blowers. Although actual use may vary depending on vector abundance and compliance with application directions, the expected application rate is 25 pounds per acre. Applications will be timed carefully to coincide with periods in the lifecycle when larvae are actively feeding, i.e., in the warmer periods of April and October each year.

LACFCD

Habitat Restoration, Monitoring, and Maintenance

All habitat restoration activities will be coordinated by the CDFW and conducted by local NGOs or contracted staff in the Ballona Reserve.

Existing

Existing O&M activities related to habitat management include, but are not necessarily limited to, the following:

- Restore native habitats through hand planting and hydrological improvements
- At the discretion and approval of the CDFW, control and limit the spread of exotic non-native and/or invasive species (floral and faunal) that threaten to dominate the landscape and outcompete native species, which serves to restore the integrity of intact, native communities
- Conduct ongoing floral and faunal surveys
- Identify and remove or circumvent any barriers to wildlife movement
- Maintain and restore habitat continuity between upland and wetland habitats

- Restore ecological function to disturbed areas adjacent to continuous habitat
- Install wildlife housing and nesting platforms

Future

Revegetation

Portions of the restored site will be planted (e.g., upland, transition zone, high marsh, and low marsh), while other marsh areas may rely on natural recruitment of salt marsh vegetation (e.g., mid marsh). The Ballona Reserve Conceptual Habitat Restoration and Adaptive Management Plan (CHRAMP) (Appendix A) includes a revegetation plan, including monitoring and maintenance, as well as a plant palette. Vegetation maintenance, irrigation, and weeding may be required for certain habitats (e.g., for transition and upland habitat plantings).

Establishment of vegetation in the restored habitats will be based on a combination of natural revegetation and planting or seeding with native plant species appropriate to the hydrologic, soil, and climatic conditions at Ballona Reserve. Due to the extensive area involved in the restoration and the potential cost involved in the use of potted plants and plugs, natural revegetation and/or seeding will be used whenever possible. Areas receiving regular tidal inundation are ideal for natural revegetation as tidal waters can contain large numbers of propagules for plants suited to tidally influenced habitats—these include low and mid-marsh habitats, as well as brackish marsh habitats. Limited installation of potted plant material or plugs may be used in these areas to speed recolonization of the marsh plain, especially in Area A where input of dispersing seed will likely be low due to the low cover of tidal wetland plants currently present in this portion of the Ballona Reserve. Subsoils and soils excavated from existing marsh or salt pan habitat may lack a suitable seed bank for natural revegetation in uplands; however, if this is the case, these soils will have the advantage of lacking an upland weed seed bank as well. These areas will require seeding with an appropriate mix of native herbaceous plants with supplemental planting of native shrubs. Alternatively, shrubs may be seeded; however, establishment of shrubs from seed is a slow process and better results are likely to be achieved with potted plants. Given the need for sand stabilization in the created dunes, the use of potted plants and plugs is preferred over natural revegetation in this habitat.

Plantings will require careful phasing to ensure that plants are installed at the correct time of year (ideally at the onset of winter rains) and that plantings occur as soon as possible after final grading. This will help ensure successful establishment with minimal need for irrigation, reduce the potential for erosion, and minimize colonization by weedy non-native species. Plantings in high marsh, transition, and upland habitats (including dunes) are likely to require supplemental irrigation during the first two to three years after planting. Depending on rainfall and soil moisture levels, temporary above-ground irrigation may be used in the high marsh or transition areas. If rainfall is below average or is considered inadequate to establish high marsh and transition zone vegetation, or to improve plant survival or establishment, an irrigation system consisting of a pressurized main line with hose bibs for manual watering or an automated overhead spray system would be used. The irrigation system would be located above the tidal zone to allow for plant establishment in this environment and would be connected to existing domestic and recycled water mains.

As previously mentioned, a potential plant palette is provided in the CHRAMP, which is included as Appendix A of this Plan. This list was developed based on the suite of native species documented in the existing conditions and baseline studies reports (PWA et al. 2006; Johnston et al. 2011, 2012), as well as on historical references and plant lists from other coastal wetlands in southern California (Schreiber 1981; Mattoni and Longcore 1997; Sullivan and Noe 2001; Dark et al. 2011; Sawyer et al. 2009). The species included in the list are all native to southern California. Efforts have been made to limit the species on this list to those historically present in the greater Los Angeles region; however, some species have been

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included based on their ease of propagation, adaptability to a wide range of environmental conditions, and ability to host special-status or other desired species.

There is potential to salvage some existing vegetation for use in the restored habitats; however, use of salvaged plant material will require careful timing to ensure that plants are removed from existing habitats and replanted during appropriate phenological stages and during appropriate times of year, both of which are species-specific. Salvaging existing vegetation would require an extensive area of land, on-site or off-site, devoted to propagation and staging. Because the plants being salvaged or propagated would be adapted to the local climate, heated greenhouse facilities may not be necessary; however, other infrastructure would be necessary. Such infrastructure might include shading structures, raised beds, propagation benches, irrigation, fencing, etc. Although the cost of salvaging plant material from the site could be reduced with volunteers, dedicated staff experienced in large-scale plant propagation would be necessary. Alternatively, the stockpiling and maintenance of salvaged plant material can be contracted out to a reputable nursery or a firm specializing in habitat restoration. It is unlikely that all of the plant material needed for the restoration can come from salvaged plant material, and propagation of additional plant material will be necessary. Plant propagation should be accomplished through collection of seeds and cuttings from healthy populations within the Santa Monica Bay watershed. If suitable donor populations cannot be located within this watershed, plant propagules may be sourced from adjacent watersheds; however, efforts should be made to collect plant material from as close to the Ballona Reserve as possible to maintain the genetic integrity of the regional flora and to ensure that the plants are adapted to the local climate. A large amount of plant material will be required over the lifespan of the restoration and it will be important to have ample material available during the initial planting and for supplementary planting in subsequent years as habitats develop. Initial plantings should focus on the dominant species desired in each habitat, with supplementary plantings to increase diversity in later stages of the restoration.

A Detailed Planting Plan will be developed for the restoration efforts and will outline specific protocols for plant sourcing and propagation, necessary infrastructure and staffing for on-site salvage and propagation, requirements for contracted plant salvage and propagation, specifications for soil amendments and irrigation, specifications and a schedule for planting and subsequent management actions, and a weed control plan to ensure successful establishment and long-term maintenance of plant communities at the Ballona Reserve. The Plan will be prepared and administered by the CDFW or a qualified contractor working under the direction of CDFW.

Urban Predator Management

Given the urban setting surrounding the Ballona Reserve, urban predators such as feral cats and raccoons are likely to pose significant threats to native wildlife within the Ballona Reserve. The presence of such urban predators may prevent the establishment of populations of wildlife species and may require control to achieve wildlife performance goals. An Urban Predator Monitoring and Management Plan will be developed in coordination with the CDFW. This plan will identify key areas for monitoring, trigger levels for management, and appropriate control methods. The Plan will be prepared and administered by the CDFW or a qualified contractor working under the direction of CDFW.

Erosion Protection

Erosion protection of manufactured slopes will be necessary in certain areas or conditions, primarily upland habitat restoration areas such as the upland fill in Area C North and Area B (between Culver, Lincoln, and Jefferson Boulevards). During and immediately after construction, erosion protection measures will be used to reduce escape of sediment from the Project site related to construction activities. The potential for maintenance related to long-term erosion (not related to the Ballona Creek or a drainage structure) is increased as the slope of the land increases. Slopes with a horizontal to vertical ratio steeper

than 5:1 will be regularly inspected. Preventive measures may include revegetation or installation of localized short-term protection, such as biodegradable netting. If significant erosion is observed, measures may be taken to correct the erosion issue such as re-grading or installation of more durable surface scour protection measures.

Monitoring for erosion will occur during the rainy season. Monitoring will occur approximately one month prior to the expected onset of seasonal rains on a monthly to bi-monthly basis following the onset of seasonal rains during the first several years of the restoration. The timing of monitoring will allow the Ballona Reserve Manager sufficient time to perform maintenance or install additional controls prior to the onset of winter rains. The purpose of monthly monitoring during the rainy season is to document any areas of erosion and to identify the need for maintenance or additional control measures. Although these measures are useful for short-term erosion control during construction and the initial phases of vegetation establishment, long-term erosion control measures will be focused on the establishment of vegetative cover. Once vegetation communities have become sufficiently established to reduce the potential for erosion, the frequency of monitoring may be reduced, but will occur no less than once per year during the entire 10-year monitoring period.

Post-Restoration Monitoring

Habitat Monitoring. A wide variety of monitoring activities will occur in the Ballona Reserve following habitat restoration, which will vary based on habitat type. The habitats that will be monitored include tidal marsh, subtidal and intertidal channels, mudflat habitat, brackish marsh, salt pan, seasonal wetlands, riparian scrub and woodland, dune, upland scrub and grassland, and transition zones. Monitoring for some habitats will be more general and encompass the entire Ballona Reserve (ex: transition zones), while other habitats may require a greater level of detail in monitoring due to the complexity of the habitat and the wide variety of species it supports, such as salt pan and subtidal and intertidal channels. Habitat monitoring activities will be the responsibility of the CDFW or a qualified contractor working under the direction of CDFW. O&M activities/monitoring efforts are presented in in Table 6.

Invasive Species Management. Vegetation monitoring will be conducted to determine the presence and extent of invasive weeds and the establishment of native species in the restored areas. Plantings will be monitored for general health and vigor and evidence of any disease or wildlife browsing. Dead plants will be replaced, as needed, to establish the target plant communities. Mulch will be replenished in the planting basins, as required, and foliage protection cages will be maintained during the establishment period. Temporary irrigation systems also will be maintained and repaired as required.

Invasive weeds of concern are those listed by the California Invasive Plant Council (Cal-IPC; Cal-IPC 2013) as “High” or “Moderate,” exclusive of non-native annual grasses and the eucalyptus grove in Area B. On-site removal of invasive species would occur, and other non-native species also shall be removed if they are inhibiting the establishment and development of native plant species. Monitoring will consist of visual observations of invasive weeds and an estimate of total cover within the seasonal wetlands. Monitoring for invasive weeds will be conducted twice per year (or more frequently) during the entire 10-year monitoring period, once near the beginning of the growing season and during the annual vegetation monitoring toward the end of the growing season (or more frequently). Because it will not be possible to eliminate all propagule sources for non-native weeds that occur outside of the Ballona Reserve, some level of monitoring for invasive weeds will be required for the lifespan of the restoration.

Upland and freshwater habitats will require greater management for invasive weeds than will tidal wetland and salt pan habitats. Although complete eradication is unlikely for many species, the goal of weed control efforts at the Ballona Reserve is to minimize impacts from invasive species. Existing populations of highly invasive species will be controlled, to the extent feasible, and every effort will be made to prevent new populations from becoming established. Some of the existing non-native, invasive

Table 6. O&M Activities/Monitoring Efforts

O&M Activities/ Monitoring Efforts	Tidal Marsh	Subtidal and Intertidal Channels	Mudflat Habitat	Brackish Marsh	Salt Pan	Seasonal Wetlands	Riparian Scrub and Woodland	Dune	Upland Scrub and Grassland	Transition Zones	Reserve-wide Monitoring Elements
Bird Abundance and Diversity Monitoring	X		X		X				X		
Channel Morphology Monitoring		X									
Erosion Monitoring	X	X	X	X	X	X	X	X	X	X	X
Fish Abundance and Diversity Monitoring		X									
Hydrology and/or Salinity Monitoring					X	X					
Macroinvertebrate Abundance and Diversity			X								
Monitoring Canopy Cover and Determining Habitat Suitability for Monarch Butterfly							X				
Public Access, Infrastructure, Litter	X	X	X	X	X	X	X	X	X	X	X
Urban Predator Management	X	X	X	X	X	X	X	X	X	X	X
Vector Control	X	X	X	X	X	X	X	X	X	X	X
Vegetation and Invasive Plants	X	X	X	X	X	X	X	X	X	X	X
Water Quality		X									

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plant species classified as “High” or “Moderate” by the Cal-IPC within the Ballona Reserve include black mustard (*Brassica nigra*), short podded mustard (*Hirschfeldia incana*), crown daisy (*Glebionis coronaria*), sea fig (*Carpobrotus* spp.), and pampas grass (*Cortaderia selloana*).

Weed removal methods contained in the Cal-IPC Weed Workers Manual[2] and website and at the U.S. Department of Agriculture website (http://plants.usda.gov/java/noxiousDriver) will be followed. Hand removal is the preferred method of removing weed species; accordingly, weed removal will occur using manual methods to the maximum extent possible. Hand removal or the use of small handheld equipment (such as a Weed Wrench or a chainsaw) will be used in areas where the associated ground disturbance will not adversely affect sensitive wildlife species. For some species, particularly woody species or large-biomass species (e.g., pampasgrass [*Cortaderia jubata*]), mowers, chainsaws, or other handheld equipment may be used.

Weeds will be removed before the species sets seed. When this is not feasible, seed heads will be removed from plants prior to removing the stems and roots. Seed heads of invasive species will be placed in plastic trash bags and removed from the project site for proper disposal. Plant materials will be removed entirely and disposed of carefully, including stems and all root fragments, to prevent regeneration or spread. In general, removal will be performed during the late winter or early spring when soils are moist enough to remove entire plants without breaking the roots.

If hand removal methods are found to be ineffective or the problem is too widespread for hand removal to be practical, chemical controls may be implemented, as described below. Herbicides may be used in conjunction with physical removal methods for species that are known to be difficult to control. An Herbicide Treatment Plan will be prepared for each treated weed species, including such information as the type of herbicide to be used, application rates, and timing of treatment. The Herbicide Treatment Plan will be prepared by the CDFW or a qualified contract prior to herbicide application. In all cases, herbicides would be used only to the extent necessary to support native plant establishment and limit adverse effects to sensitive species and habitats. For sites within 100 feet of a wetland or stream, the project will use herbicides approved by the Environmental Protection Agency (EPA) for use near wetlands and streams. Herbicides will not be used when rain is predicted within 24 hours after application, and herbicide application shall not resume again until 72 hours after rain. During nesting season, appropriate measures will be taken to avoid disruption of nests.

In addition to monitoring for invasive weeds, it may also be necessary to monitor for invasive wildlife species, such as New Zealand mudsnail (*Potamopyrgus antipodarum*) or American bullfrog (*Lithobates catesbeianus*). Although these species are not known to occur at the Ballona Reserve, there is potential for them to be introduced to the site. If these or other invasive wildlife species are observed at the site, a Monitoring and Eradication Plan will be developed consistent with CDFW policies regarding such species. The Plan will be prepared and administered by the CDFW or a qualified contractor working under the direction of CDFW.

[2] The Watershed Project and California Invasive Plant Council, 2004. Weed Workers’ Handbook, A Guide to Techniques for Removing Bay Area Invasive Plants. [http://www.cal-ipc.org/ip/management/wwh/pdf/18601.pdf].

Public Access, Public Services, and General Maintenance

Existing

Existing O&M activities related to public access, public services, and general maintenance include, but are not necessarily limited to, the following:

- Develop interpretive trails within the Ballona Reserve within West Area B, for use by the general public and schools, working with local schools, teachers, students and volunteers;
- Design and install interpretive signs and other displays within the Ballona Reserve;
- Close or re-route existing trails for adaptive management/resource protection, at the discretion of the Ballona Reserve manager, using natural barriers such as boulders and logs, and restore native habitat;
- Conduct periodic reviews of public uses in the Ballona Reserve and assess the need for modifications to the public use program, the need for additional trails, and/or closure of some trails;
- Maintain trails as necessary for passage, public safety and resource protection by trimming vegetation, controlling erosion, and removing weeds;
- Vegetation mowing, or other forms of removal, to provide for fuel modification or a buffer between the open space and nearby existing facilities;
- Patrol the Ballona Reserve to enforce regulations that prohibit unauthorized uses;
- Use signage and written notifications to foster cooperation. Issue citations and/or pursue legal action when voluntary cooperation cannot be obtained;
- Reduce impacts from maintenance of utility easements where they disrupt ecological functions by minimizing size and/or frequency of impact, and/or other methods;
- Remove any potentially hazardous materials;
- Fence repair and installation as needed, at the discretion of the Ballona Reserve Manager;
- Notify, evict, and cleanup trespasser debris as needed, at the discretion of the Ballona Reserve Manager;
- Prune vegetation and/or take other corrective measures where needed to discourage illegal camping and other uses of the Ballona Reserve;
- Minor grading to restore topography after misuse and illegal trespasser activity (e.g., camp establishment, BMX track construction); and
- Stage equipment container(s) and management trailer within the Ballona Reserve for ongoing reserve management and maintenance.

Table 7, Other Current and Ongoing Routine Operation and Maintenance Activities, lists other routine current and ongoing O&M activities that would continue with implementation of the Project.

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Table 7. Other Current and Ongoing Routine Operation and Maintenance Activities

Ongoing O&M Activities	O&M Activity Frequency	Notes
Inspect and lock gates	Daily	To be performed by the County at existing and new gate locations.
Maintenance and repair of fence and gates	Monthly or as needed	To be performed as needed for existing and new fence and gate locations by on-site Ballona Reserve staff except for levee-related fences and gates, which would be the responsibility of the LACFCD.
Trail maintenance	Weekly or as needed	To be performed by CDFW as needed for existing and new trails except for levee access roads and related accessways, the maintenance of which would be the County's responsibility.
Bicycle path maintenance	Weekly or as needed	Sweeping and maintenance of path surface to be conducted as needed by the County.
Access road maintenance	Approximately every 5 years or as needed	Pavement management and resurfacing to be conducted as needed by the LACFCD or the County.

SOURCES: P. Holland, Los Angeles County Department of Public Works. Personal Communication; R. Brody, California Department of Fish and Wildlife, 2014. Personal Communication.

Future

Public Access

Public access at the Ballona Reserve will be limited to roads, pedestrian trails, and designated public access areas such as picnic sites or wildlife viewing areas. The surface of walkways and trails will be maintained in good, dry condition. Areas that flood during the rainy season will be subject to seasonal closure or will be redesigned to prevent flooding. Trails will be free of large debris, and fencing and signage will be maintained in good condition.

Public access areas will include split-rail fencing, decomposed granite trails, and padlocks for fenced areas. Gravel or another ADA compliant material will be needed over the entire trail to ensure the trails are ADA compliant. Additionally, in the design phase of the public access areas, elevated walkways and piers will be considered to account for potential changes in sea level rise. This will prevent permanent or periodic flooding and wave action that could periodically cause damage and restrict access to the public access areas.

Social trails[3] and/or other non-official routes will not be allowed in any part of the Ballona Reserve. Given the relative ease of access to upland habitat relative to wetland habitat, human disturbance is likely to be a greater problem in upland habitat and will require regular monitoring and control. During monitoring for human disturbance, the presence and extent of social trails, trash, and other debris will be documented on maps or aerial imagery. Monitoring will occur over the full extent of the Ballona Reserve, with particular focus in the upland areas and areas immediately adjacent to trails and other public access areas. The condition of fencing, signage, and lighting also will be noted.

Hours of operation for public use of the West Culver Parking Lot and the existing parking lot and new parking structure in Area A would be from dawn to dusk. Parking would be locked after hours. The West Culver Parking Lot currently is unlocked, and CDFW and the City of Los Angeles Police Department

[3] A "social trail" is a path developed by erosion caused by animal or human footfall. The path usually represents the shortest or most easily navigated route between the origin and destination.

periodically check for vehicles that are parked overnight. This lot would be locked after dusk as part of future operations, during which the Los Angeles County Department of Beaches and Harbors would assume the responsibilities currently exercised by CDFW.

All maintenance activities for the ballfields would continue to be undertaken in conformance with the use agreement between the Culver-Marina Little League and CDFW.

Public Services - Trash

Trash and other human debris will not be allowed in natural habitats. Trashcans and recycling bins will be available throughout the publicly accessible areas of the Ballona Reserve and will be regularly emptied by a trash-collection agency contracted by the CDFW. Volunteers also will continue to clean up trash. Trash removal would occur as needed within the restored wetlands for some trash that is not caught upstream at the existing trash net either by LACFCD or CDFW. LACFCD would remove trash along the levees and CDFW would remove trash within the restored wetlands.

In addition, all workers should ensure that food scraps, paper wrappers, food containers, cans, bottles, and other trash from the project area are deposited in covered or closed trash containers. The trash containers should not be left open and unattended overnight.

Public Services – Public Safety

To ensure public safety, a public safety officer may be hired by CDFW to monitor the site for trails or other public access features that should be closed or re-routed due to the presence of hazardous conditions; to ensure that emergency access routes are unrestricted and available for use; to coordinate with the Los Angeles County Sherriff's Department if illegal or dangerous activities are witnessed or suspected; and to enforce regulations that prohibit unauthorized uses.

Summary of Preliminary Operations and Maintenance Activities

The intent of the Ballona Wetlands Restoration Project is to restore a wetland and creek habitat and flood protection system that is sustained by natural processes and requires minimal operations and maintenance activities. The restored Ballona Creek channel is intended to have no substantial maintenance requirements. The levees are intended to have no substantial maintenance requirements, with only periodic repaving of bike paths and walking trails, fence repair, trash collection, and similar upkeep necessary. In locations where armoring is installed to limit erosion, the scour protection would be inspected and maintained as needed maintenance; however, maintenance is not anticipated to be needed. Flap gates will need regular inspection and maintenance to ensure proper operation. Gates eventually may need to be replaced when they are significantly damaged or reach the end of their useful life. Inspection of other water control structures will also occur periodically, but problems are unlikely except in the very long term. Gates may be adjusted seasonally for habitat management. Portions of the restored site will be planted, while other marsh areas may rely on natural recruitment of vegetation. The revegetation plan will include monitoring and maintenance. Vegetation maintenance, irrigation, and weeding may be required for certain habitats. A long-term Final O&M Plan will be established among the CDFW, the LACFCD, and other responsible parties to identify all operations and maintenance responsibilities for the new channel and levees, water control structures, habitat and vegetation, flood risk management, and other components of the project as part of the Section 408 permit process.

Tables 8a, 8b, and 8c and summarize the specific O&M tasks and activities discussed in this document. Potential environmental impacts of the tasks and activities identified in this Preliminary Operation and Maintenance Plan are evaluated in the EIS/EIR for the Project.

Table 8a. Summary of Operation and Maintenance Activities – Flood and Stormwater Monitoring and Management

Category	Ballona Reserve Location/Element	Task	Documentation or Reporting Requirement and Permit Acquisition	Frequency and Timing	Duration	Estimated Hours Required	Estimated Annual Cost
Flood and Stormwater Facility Management - Inspection	**Channel Inspection**	Levee elevation survey	TBD	As-needed if determined to be necessary	As-needed if determined to be necessary	TBD	TBD
		Levee inspection	TBD	Annual and after significant storm events	Life of project	TBD	TBD
		Scour protection inspection	TBD	Annual and after significant storm events	Life of project	TBD	TBD
		Channel cross-section survey	TBD	Once a year every five years and after significant storm events	Life of project	TBD	TBD
		Channel inspection	TBD	Annual and after significant storm events	Life of project	TBD	TBD
	Culver Levee water control structures	Structure inspection	TBD	Monthly	Life of project	TBD	TBD
	Road and perimeter drainage structures	Structure and pavement surface inspection, erosion inspection	TBD	Monthly	Life of project	TBD	TBD
	Water level monitoring	Channel and Area B managed wetland water level monitoring	TBD	Continuous	Life of project	TBD	TBD
	Flow monitoring	Creek discharge monitoring at Culver Blvd. bridge / upstream	TBD	Continuous during storm season	Life of project	TBD	TBD
	Data Analysis and Reporting	Analyze data, compare to established maintenance thresholds, authorize established maintenance measures	TBD	Annual	Life of project	TBD	TBD
Flood and Stormwater Facility Management - Operations	**Existing West Area B SRT gate operations**	Continue ongoing inspection, gate service, and maintenance (e.g., debris removal)	TBD	As-needed	Interim Phase	TBD	TBD
	New Culver Levee water control structures operations	Perform any established seasonal adjustments to water control structures; perform any annual adjustments identified through data analysis and reporting	TBD	Seasonal and annual or as-needed	Life of project	TBD	TBD
	Trash boom	Continue ongoing O&M	TBD	Weekly	Life of project	TBD	TBD
Flood and Stormwater Facility Management - As-needed Maintenance	**Channel Inspection**	Perform levee repairs as-needed / identified through inspection and monitoring data analysis and reporting	TBD	As-needed	Life of project	TBD	TBD
		Repair scour protection structures as-needed / identified through inspection and monitoring data analysis and reporting	TBD	As-needed	Life of project	TBD	TBD
		Perform channel excavation / dredging as-needed / identified through inspection and monitoring data analysis and reporting	TBD	Once every 50 years	Life of project	TBD	TBD
	Culver Levee water control structures	Repair Culver Levee water control structures as-needed / identified through inspection and monitoring data analysis and reporting/ Replace every 10 years	TBD	Repair as-needed Replacement every 10 years	Life of project	TBD	TBD
	Road and perimeter drainage structures	Repair/replace structures, remove silt, repair erosion protection, roadway resurfacing as needed / identified through inspection and monitoring data analysis and reporting	TBD	As-needed, and regular pavement resurfacing program	Life of project	TBD	TBD

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Table 8b. Summary of Operation and Maintenance Activities – Habitat Restoration, Monitoring, and Maintenance

Category	Ballona Reserve Location/Element	Task	Documentation or Reporting Requirement and Permit Acquisition	Frequency and Timing	Duration	Estimated Hours Required	Estimated Annual Cost
Habitat Restoration, Monitoring, and Maintenance - Restoration Implementation	**N/A**	Implement restoration according to restoration design, CHRAMP, HMMP, CEQA documents, regulatory permits, etc.	HMMP	Ongoing (year round)	Duration of restoration and monitoring period	TBD	TBD
Habitat Restoration, Monitoring, and Maintenance - Post-Restoration Reserve Management	**N/A**	Oversee management of Ballona Reserve post-restoration to ensure it corresponds with the restoration goals laid out in the CHRAMP.	HMMP	Annually (year round)	Continue indefinitely	TBD	TBD
Habitat Restoration, Monitoring, and Maintenance - Habitat Monitoring	**All Habitats**	Collect high-resolution, orthorectified aerial imagery of site	HMMP	Annually (late summer at low tide)	A minimum of ten years, beginning at the end of the first growing season following the completion of construction activities.	TBD	TBD
		Monitor known populations of special-status plants. Populations will be monitored for density, cover, size, and number of individuals present.	HMMP; CEQA	Annually (timing depends on phenology of species in question)	Monitoring will occur for at least 10 years.	TBD	TBD
		Monitor for invasive weed establishment throughout the Ballona Reserve, with specific focus on the restoration areas.	HMMP	Annually or more frequently based on the species phenology; generally will occur in late spring, but may vary.	Continue indefinitely	TBD	TBD
		Assess effectiveness of weed control activities following the weed monitoring activities.	HMMP; HMP	Annually; timing varies based on timing of control efforts and phenology of species in question.	Continue indefinitely	TBD	TBD
		Monitor BMPs and excessive or problematic habitat erosion. This will be conducted via a walk through survey and will photographically document eroded areas.	HMMP	Semi-annually in spring and fall; additional monitoring should be conducted after heavy storms.	Continue indefinitely	TBD	TBD
		Monitor for litter, social trails, and other signs of human disturbance in natural habitats and restoration areas. A walk-through survey will be conducted as part of routine monitoring.	HMMP	Annually	Continue indefinitely	TBD	TBD
		Monitor for non-native urban predators (e.g., domestic cats).	HMMP	Annually; year-round.	Continue indefinitely	TBD	TBD
Habitat Restoration, Monitoring, and Maintenance - Habitat Monitoring	**Tidal Marsh**	Monitor vegetation establishment, composition, and cover.	HMMP	Annually, at end of growing season and at low tide.	A minimum of ten years, beginning at the end of the first growing season following the completion of construction activities.	TBD	TBD
		Monitor bird abundance, diversity, and activities (e.g., foraging, resting, breeding).	CEQA	Annually; timing will vary based on phenology (e.g., migration, breeding, overwintering).	Monitoring will occur for at least 10 years.	TBD	TBD
		Monitor Belding's Savannah sparrow.	CESA; CEQA	Annually; during annual state-wide census	Monitoring will occur for at least 10 years or as long as state-wide census is in effect.	TBD	TBD

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Table 8b. Summary of Operation and Maintenance Activities – Habitat Restoration, Monitoring, and Maintenance (continued)

Category	Ballona Reserve Location/Element	Task	Documentation or Reporting Requirement and Permit Acquisition	Frequency and Timing	Duration	Estimated Hours Required	Estimated Annual Cost
Habitat Restoration, Monitoring, and Maintenance - Habitat Monitoring	**Subtidal and Intertidal Channels**	Monitor channel location and extent.	HMMP	Annually; assessment can occur anytime and is based on aerial imagery collected in late summer.	A minimum of ten years, beginning at the end of the first growing season following the completion of construction activities.	TBD	TBD
		Ground-based monitoring of in-channel geomorphology including measurements of channel depth, width, and the location of banks at a variety of locations near and far from the channel openings.	HMMP	Annually after the rainy season; additional monitoring may occur immediately following large storm events.	A minimum of ten years, beginning at the end of the first growing season following the completion of construction activities.	TBD	TBD
		Ground based monitoring of sedimentation rates (esp. inboard of tide gates, culverts, etc.).	HMMP	Semi-annually in spring and fall; additional monitoring may be conducted after heavy storms.	Continue indefinitely	TBD	TBD
		Monitor sedimentation levels at openings to Ballona Creek and inboard of tide gates, culverts, etc.	HMMP	Semi-annually in spring and fall; additional monitoring may be conducted after heavy storms.	Continue indefinitely	TBD	TBD
		Monitor fish abundance, species richness, and diversity each major in tidal channel.	CEQA	Annually during summer when fish abundance and diversity is at its peak. Monitoring will occur at high tide.	Monitoring will occur for at least 10 years.	TBD	TBD
		Monitor water quality.	401	Annually (continuous if using data loggers or at intervals; TBD if assessing manually)	Monitoring will occur for at least 10 years.	TBD	TBD
Habitat Restoration, Monitoring, and Maintenance - Habitat Monitoring	**Mudflats**	Monitor macroinvertebrate abundance and diversity of benthic invertebrates.		Annually (summer?), ad determined by project biologist	Monitoring will begin following one full year after the reestablishment of tidal activity and will be conducted annually for the duration of the 10-year monitoring period.	TBD	TBD
		Monitor bird abundance, diversity, and activities (e.g., foraging, resting, breeding).		Annually; timing will vary based on phenology (e.g., migration, breeding, overwintering), but always at low tide.	Duration of 10-year monitoring period.	TBD	TBD
Habitat Restoration, Monitoring, and Maintenance - Habitat Monitoring	**Brackish Marsh**	Qualitative assessment of vegetation establishment and a lack of highly invasive weeds.		Annually in late summer.	A minimum of ten years, beginning at the end of the first growing season following the completion of construction activities.	TBD	TBD
Habitat Restoration, Monitoring, and Maintenance - Habitat Monitoring	**Salt Pan**	Monitor hydrologic changes including fluctuations in water height throughout the year.		Annually, if needed; continuous if using data loggers or monthly (or more frequently) if using staff gauges or other manual methods.	A minimum of ten years, beginning of tidal year following construction activities.	TBD	TBD
		Monitor soil salinity.		Annually at the end of dry season/before onset of winter rains.	A minimum of ten years, beginning of tidal year following construction activities.	TBD	TBD
		Monitor vegetation establishment, composition, and cover.		Annually from years 1 to 5, then once in year 7 and year 10, assuming vegetation is approaching the expected performance standards. Monitoring should occur in mid to late summer.	A minimum of ten years, beginning of tidal year following construction activities.	TBD	TBD

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Table 8b. Summary of Operation and Maintenance Activities – Habitat Restoration, Monitoring, and Maintenance (continued)

Category	Ballona Reserve Location/Element	Task	Documentation or Reporting Requirement and Permit Acquisition	Frequency and Timing	Duration	Estimated Hours Required	Estimated Annual Cost
		Monitor bird abundance, diversity, and activities (e.g., foraging, resting, breeding).		Annually; timing will vary based on phenology (e.g., migration, breeding, overwintering); always at low tide.	A minimum of ten years, beginning of tidal year following construction activities.	TBD	TBD
Habitat Restoration, Monitoring, and Maintenance - Habitat Monitoring	**Seasonal Wetlands**	Monitor hydrology.		Annually; weekly basis during the rainy season.	A minimum of ten years, beginning at the end of the first growing season following the completion of construction activities.	TBD	TBD
		Monitor vegetation establishment, composition, and cover.		Annually; near end of growing season.	A minimum of ten years, beginning at the end of the first growing season following the completion of construction activities.	TBD	TBD
Habitat Restoration, Monitoring, and Maintenance - Habitat Monitoring	**Riparian Scrub and Woodland**	Monitor vegetation establishment, composition, and cover.		Annually; mid- to late summer.	A minimum of ten years, beginning at the end of the first growing season following the completion of construction activities.	TBD	TBD
		Monitor eucalyptus tree health and success of efforts to replace with native tree species.		Every 2 to 3 years in mid- to late summer.	A minimum of ten years, beginning at the end of the first growing season following the completion of construction activities.	TBD	TBD
		Qualitative assessment of overwintering monarch population on eucalyptus and changes associated with replacement of eucalyptus with native species.		Annually; winter.	Continue indefinitely or as long as the species is listed by CDFW.	TBD	TBD
Habitat Restoration, Monitoring, and Maintenance - Habitat Monitoring	**Dunes**	Quantitative monitoring of vegetation establishment, composition, and cover.		Annually in late summer.	A minimum of ten years, beginning at the end of the first growing season following the completion of construction activities.	TBD	TBD
Habitat Restoration, Monitoring, and Maintenance - Habitat Monitoring	**Upland Scrub and Grassland**	Quantitative monitoring of vegetation establishment, composition, and cover.		Annually in mid- to late-summer.	A minimum of ten years, beginning at the end of the first growing season following the completion of construction activities.	TBD	TBD
		Monitor bird abundance, diversity, and activities (e.g., foraging, resting, breeding).		Annually; timing will vary based on phenology (e.g., migration, breeding, overwintering)	A minimum of ten years, beginning at the end of the first growing season following the completion of construction activities.	TBD	TBD
Habitat Restoration, Monitoring, and Maintenance - Habitat Maintenance	**All Habitats**	Remove invasive plants.		Annually or more frequently based on the phenology of the species targeted for control.	Continue indefinitely	TBD	TBD
		Install additional plantings according to CHRAMP and HMMP.		Annually, as needed based on vegetation monitoring results. Vegetation should be installed at onset of winter rains.	Until plantings are on a clear trajectory to achieve restoration goals.	TBD	TBD
		Operate irrigation system		As needed during growing season.	As needed during initial 2 to 3 years of plant establishment	TBD	TBD

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Table 8b. Summary of Operation and Maintenance Activities – Habitat Restoration, Monitoring, and Maintenance (continued)

Category	Ballona Reserve Location/Element	Task	Documentation or Reporting Requirement and Permit Acquisition	Frequency and Timing	Duration	Estimated Hours Required	Estimated Annual Cost
		Inspect irrigation system		Annually, prior to onset of growing season.	For the lifespan of the irrigation system.	TBD	TBD
		Implement predator control program.		Annually; year-round.	Continue indefinitely	TBD	TBD
		Implement adaptive management actions		Annually (varies)	Continue indefinitely	TBD	TBD
		Remove trash and other debris		Annually to semi-annually.	Continue indefinitely	TBD	TBD
Habitat Restoration, Monitoring, and Maintenance - Data Analysis and Habitat Restoration, Monitoring, and Maintenance – Reporting	**All Habitats**	Compile and input data into database		Annually (TBD)	Continue indefinitely	TBD	TBD
		Analyze data and prepare annual monitoring and maintenance report		Annually (TBD)	Continue indefinitely	TBD	TBD
		Prepare annual work plan		Annually (TBD)	Continue indefinitely	TBD	TBD

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Table 8c. Summary of Operation and Maintenance Activities – Public Access, Public Services, and General Maintenance

Category	Ballona Reserve Location/Element	Task	Documentation or Reporting Requirement and Permit Acquisition	Frequency and Timing	Duration	Estimated Hours Required	Estimated Annual Cost
Public Access, Public Services, and General Maintenance - Public Access	**Roads, Sidewalks, Trails**	Inspect roads, sidewalks, and trails for damage or maintenance issues	TBD	Annually or more frequently	Continue indefinitely	TBD	TBD
Public Access, Public Services, and General Maintenance - Public Access	**Signage**	Inspect signs (including kiosks and interpretive panels) for damage, theft, or other maintenance issues	TBD	Annually or more frequently	Continue indefinitely	TBD	TBD
Public Access, Public Services, and General Maintenance - Public Access		Inspect public areas daily (e.g., lobby, restrooms, interpretive areas, outdoor meeting areas, etc.)	TBD	Annually; daily	Continue indefinitely	TBD	TBD
Public Access, Public Services, and General Maintenance - General Maintenance	**Greenhouse Facilities**	Inspect greenhouse facilities (e.g., heating, ventilation, irrigation, benches, other equipment)	TBD	Annually or more frequently, in conjunction with irrigation inspection (?)	TBD	TBD	TBD
Public Access, Public Services, and General Maintenance - Public Access	**Bike Paths**	TBD	TBD	TBD	TBD	TBD	TBD
Public Access, Public Services, and General Maintenance - Public Access		Conduct repairs to bike paths	TBD	Annually (as needed)	Continue indefinitely	TBD	TBD
Public Access, Public Services, and General Maintenance - Public Access	**Roads, Sidewalks, Trails**	Conduct repairs to roads, sidewalks, and trails	TBD	Annually (as needed)	Continue indefinitely	TBD	TBD
Public Access, Public Services, and General Maintenance - Public Access	**Signage**	Replace or repair signage (including kiosks and interpretive panels)	TBD	Annually (as needed)	Continue indefinitely	TBD	TBD
Public Access, Public Services, and General Maintenance - Public Access		Maintain public areas (e.g., lobby, restrooms, interpretive areas, outdoor meeting areas, etc.)	TBD	Annually, Daily	Continue indefinitely	TBD	TBD
Public Access, Public Services, and General Maintenance - General Maintenance	**Greenhouse Facilities**	Conduct repairs to greenhouse facilities (e.g., heating, ventilation, irrigation, benches, other equipment)	TBD	Annually (as needed)	TBD	TBD	TBD
Public Access, Public Services, and General Maintenance – Public Services	**Entire Ballona Reserve**	Enforce all applicable rules/laws, ensure public safety	TBD	Annually (as needed)	Continue indefinitely	TBD	TBD

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1.4 Estimated Operations and Maintenance Costs and Funding Sources

Estimated Costs

The preliminary estimated costs provided in Section 2.1.1 of the Draft EIS/EIR will be refined before this Preliminary Operation and Maintenance Plan is finalized. High cost, long life, capital equipment (e.g., bridges, levees, tide gates, culverts, and roads) have life spans of 50 to 100 years or longer, barring damage from disasters, unlawful acts, or faulty materials. They require very little major maintenance activities, but their continued viability requires routine inspection and preventative maintenance and they may ultimately be replaced or reinforced. The ultimate replacement/reinforcement will have a high cost and will likely create localized disturbance to the ecosystem. A separate permitting process may be required for these items. These items are likely maintained by the County for public safety. Smaller cost items (e.g., parking lots, walkways, lighting, and fencing) have varying costs, but will likely be maintained by CDFW. Different groups may also be responsible for maintenance and activities will be categorized depending on the urgency for maintenance and replacement. Daily maintenance (e.g., changing light bulbs, cleaning toilets, replacing hand tools, weeding of some areas) may have public involvement, but will require staffing appropriate to the need.

Assets and Capital Equipment

- Tide gates
- Culverts
- Roads (pavement, gutters, culverts, shoulders)
- Bridges
- Parking areas
- Sidewalks
- Trails (decomposed granite trails, including drainage crossings)
- Trash containers, liners, and a large dumpster
- Modular pre-fabricated trailer office space with a septic tank
- Split-rail fencing and padlocks
- Fence repair equipment (e.g. bolt cutters and splicers)
- Cage traps
- Provisions for kiosks, signage, benches, and Trex trails
- Staging areas
- Lighting
- Boardwalks
- Greenhouse facilities
- Workshop/garage for tractor and other machinery
- Tractor (or other equipment for levee maintenance or other)
- Other large machinery (e.g., tractor attachments, shop tools)
- Infrastructure/Habitat maintenance tools (e.g., drills, saws, post drivers, shovels, etc.)
- Restrooms
- Monitoring equipment (binoculars, cameras, spotting scope, tripod, and cell phones).
- Vehicles
- Gator All-Terrain Vehicle outfitted with a 150 gallon Intellispray
- Mower
- Backpack sprayers
- Office equipment (e.g. computers, copiers, file cabinets, etc.)
- Irrigation system (temporary for habitat restoration)

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Operations and Maintenance

- Administration (restoration oversight, Ballona Reserve management, monitoring/maintenance coordination, report coordination, permit/agency coordination, etc.)
- Permitting and approvals (including mitigation)
- Habitat monitoring (conducted by project team or design team/professionals)
- Habitat maintenance
- Data analysis and reporting
- Infrastructure monitoring
- Infrastructure operations (e.g., tide gate adjustments)
- Infrastructure maintenance
- Law enforcement

Funding Sources

- CDFW
- SCC
- LACFCD (regional flood risk management function)
- LACDPW (bikeway components)
- Others (e.g., Friends of Ballona, Los Angeles Parks)

2.0 FUTURE REVISIONS TO PRELIMINARY OPERATIONS AND MAINTENANCE PLAN

This Preliminary O&M Plan details predicted operation and maintenance needs within the Ballona Reserve. However, as with most biological systems, restoration activities are changing environments, which can present additional issues that must be addressed (e.g., seasonal and annual fluctuations in precipitation, temperature, weed introduction, and other biotic factors) to create a successful restored ecosystem. Therefore, this Preliminary O&M Plan is written to allow adaptation and account for unpredicted future needs. Some of the revisions to the O&M Plan may be minor in nature and decided solely by on-site CDFW staff and management, while other revisions may include major changes to infrastructure and management. All revisions (minor or major) will be subject to applicable environmental reviewvrequire4ment.

2.1 Minor Revisions

Minor revisions to the O&M Plan could include adaptive management of restorations, including replanting failed plantings, increasing or decreasing initial irrigation (if employed), tide gate and culvert replacement without a change in location, weed management, trespasser violations and vandalism, and other adaptations to restoration habitats. Minor revisions also could include changes to who (which state or local entity) is responsible for implementing particular operation and maintenance tasks. These types of minor revisions will require informal decisions and discussion and documentation of the changes.

2.2 Major Revision

Major revisions to the O&M Plan could include activities such as levee replacement, changes to the restoration plan and location of restored areas, and other large-scale activities. Major revisions would require detailed discussion with all affected agencies and analysis of proposed changes by scientific experts to determine the necessity for the revision, as well as to ensure the major revision follows CDFW requirements, regulatory procedures, and environmental compliance and permit requirements.

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APPENDIX B6
Mitigation Monitoring and Reporting Program

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PRELIMINARY MITIGATION MONITORING AND REPORTING PROGRAM

for the

BALLONA WETLANDS RESTORATION PROJECT

prepared by the

California Department of Fish and Wildlife
as lead agency under the
California Environmental Quality Act

State Clearinghouse No. 2012071090

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1. Introduction

This document describes a preliminary mitigation, monitoring, and reporting program (MMRP) proposed by the California Department of Fish and Wildlife (CDFW) as the lead agency under the California Environmental Quality Act (CEQA, Pub. Res. Code §§21000 et seq.) and its implementing guidelines (CEQA Guidelines, 14 Cal. Code Regs. §15000 et seq.) for the Ballona Wetlands Restoration Project (Project). The purpose of the MMRP is to ensure the effective implementation of the mitigation measures recommended in the joint Environmental Impact Statement/Environmental Impact Report (EIS/EIR) prepared for the Project by CDFW as the CEQA lead agency and by the U.S. Army Corps of Engineers (Corps) as the lead agency under the National Environmental Policy Act (NEPA, 42 U.S.C. § 4321 et seq.). CDFW proposes a large-scale restoration of the Ballona Wetlands Ecological Reserve (Ballona Reserve) that would entail restoring, enhancing, and establishing native coastal wetland and upland habitats within the Ballona Reserve. To implement the proposal, CDFW is working with the Los Angeles County Department of Public Works-Flood Control District (LACFCD) to modify Los Angeles County Drainage Area (LACDA) project features (including the Ballona Creek channel and levee system) within the Ballona Reserve.

If and when the Project is approved by CDFW and the Corps, this preliminary MMRP would be refined, further developed, or supplemented as needed to identify the final, approved mitigation measures. Once finalized, the MMRP would serve as a self-contained general reference for the Mitigation, Monitoring, and Reporting Program adopted for the Project.

Current versions as of the publication of the Draft EIS/EIR of all mitigation measures identified in the Draft EIS/EIR are presented in Table 1, which is provided at the end of this MMRP.

2. Monitoring Requirements and Purpose

One of CEQA's fundamental purposes is to reduce potential significant adverse impacts when it is feasible to do so (Pub. Res. Code §§21002, 21002.1). To implement this requirement, a CEQA lead agency must adopt mitigation measures that are fully enforceable through permit conditions, agreements, or other measures (Pub. Res. Code §21081.6(b); CEQA Guidelines §15091(d)) and adopt an MMRP to ensure that the measures actually will be implemented as a condition of project approval, and not merely adopted and then neglected (*Environmental Council of Sacramento v. City of Sacramento* (2006) 142Cal. App. 4th 1018, 1035; *Federation of Hillside and Canyon Associations v. City of Los Angeles* (2000) 83Cal. App. 4th 1252, 1261).

This preliminary MMRP has been prepared in accordance with CEQA and the CEQA Guidelines. The measures presented below to avoid or mitigate the Project's potential significant adverse environmental impacts would be fully enforceable following final approval of the MMRP.

This preliminary MMRP: (a) describes all feasible mitigation measures recommended for the Project in the Draft EIS/EIR; (b) identifies the applicable "Monitoring Agency" for each mitigation measure, (c) establishes and describes the requisite implementing actions, and (d) provides an administrative procedure for the acceptance of each mitigation measure by

including a column for the future listing of the approval/clearance date for each mitigation measure.

3. CDFW's Mitigation Authority

CDFW's authority to adopt mitigation measures to avoid or reduce potential significant adverse impacts is based on its regulatory authority under the California Fish and Game Code, including the Lake and Streambed Alteration Agreement sections (Fish and Game Code §§1603, 1605) and the California Endangered Species Act (Fish and Game Code §2081). CEQA does not provide independent legal authority for CDFW to impose or otherwise require the implementation of feasible mitigation measures for impacts that fall outside CDFW's regulatory/permitting jurisdiction (Pub. Res. Code §21004). The mitigation of those impacts may be imposed only by another agency with pertinent regulatory authority. To ensure enforcement of all non-biological resource related mitigation measures identified in the final MMRP, CDFW has made an enforceable commitment to implement all mitigation measures identified in the final MMRP to the Corps as a condition of the federal approvals required from the Corps to implement the Project.

4. General Monitoring Procedures

Mitigation Monitor

Many of the monitoring procedures will be conducted during the restoration phase of the Project. CDFW and the mitigation monitor are responsible for integrating the mitigation monitoring procedures into the restoration process and, insofar as the mitigation measures relate to modifications to the LACDA project facilities within the Ballona Reserve, with the LACFCD. To oversee the monitoring procedures and to ensure success, the mitigation monitor assigned to restoration activities must be on site during the activities that have the potential to create a significant environmental impact. The mitigation monitor is responsible for ensuring that all procedures specified in the MMRP are followed.

Restoration/Construction Personnel

A key feature contributing to the success of mitigation monitoring will be obtaining the full cooperation of restoration personnel and supervisors. Many of the mitigation measures require action on the part of the restoration supervisors or crews for successful implementation. To ensure success, the following actions, detailed in specific mitigation measures included in the MMRP, will be taken:

- Procedures to be followed by companies hired to do the work will be written into contracts between CDFW and any contractors. Procedures to be followed by crews will be written into a separate agreement that all on-site personnel will be asked to sign, denoting agreement.

- One or more meetings will be held before the start of work to inform and train all on-site personnel about the requirements of the MMRP.

- A written summary of mitigation monitoring procedures will be provided to supervisors of on-site workers for all mitigation measures requiring their attention.

General Reporting Procedures

Site visits and specified monitoring procedures performed by other individuals will be reported to the mitigation monitor assigned to the restoration activities. A monitoring record form will be submitted to the mitigation monitor by the individual conducting the visit or procedure so that details of the visit can be recorded and progress tracked by the mitigation monitor. A checklist will be developed and maintained by the mitigation monitor to track all procedures required for each mitigation measure and to ensure that the timing specified for the procedures is adhered to. The mitigation monitor will note any problems that may occur and take appropriate action to rectify the problems. CDFW or the mitigation monitor shall prepare written quarterly reports of the Project, which shall include progress of Project implementation, resulting impacts, mitigation measures implemented, and all other noteworthy elements of the Project. Quarterly reports shall be required as long as mitigation measures are applicable.

Public Access to Records

The public is allowed access to records and reports used to track the monitoring program. Monitoring records and reports will be made available for public inspection by CDFW upon request. CDFW will develop a filing and tracking system.

Condition Effectiveness Review

In order to fulfill its statutory mandates to mitigate or avoid significant effects on the environment and to design a MMRP to ensure compliance during Project implementation (14 Cal. Code Regs. §21081.6):

- CDFW may conduct a comprehensive review of conditions which are not effectively mitigating impacts at any time it deems appropriate; and

- If CDFW determines that any conditions are not adequately mitigating significant environmental impacts caused by the Project, or that recent proven technological advances could provide more effective mitigation, then CDFW may impose additional or different reasonable conditions to effectively mitigate these impacts.

TABLE 1
MITIGATION MONITORING AND REPORTING PROGRAM FOR THE BALLONA WETLANDS RESTORATION PROJECT

Mitigation Measure	Monitoring Agency	Monitoring/Reporting Requirements	Approval/Acceptance Dates
Aesthetics			
Mitigation Measure AE-4a: *Construction Lighting*. Construction contractors shall ensure that all temporary construction lighting shall be designed and installed to be fully shielded (full cutoff) and to minimize glare and obtrusive light by limiting outdoor lighting that is misdirected, excessive, or unnecessary. Construction lighting shall be oriented away from nearby land use areas that are not being affected by construction.			
Mitigation Measure AE-4b: *Lighting Plan.* Prior to implementing any changes to the existing parking areas, a lighting plan shall be developed and implemented that requires all exterior lighting to be directed downward and focused away from adjacent sensitive uses and habitats to encourage way-finding and provide security and safety for individuals walking to and from parking areas.			
Air Quality			
Mitigation Measure AQ-1: *Odor Management Plan.* In order to reduce odors from the decomposition of organic materials during excavation and stockpiling activities, contractors shall submit and implement, for and upon CDFW approval, an odor management plan to limit hydrogen sulfide levels to 10 parts per billion at the site perimeter. This concentration is below the state 1-hour standard of 30 parts per billion. The plan shall be reviewed and approved by the CDFW and include the following elements: a) Monitoring and recording of hydrogen sulfide at the perimeter of the Ballona Reserve to ensure compliance and implementation of the plan. Monitoring shall occur periodically during the days when fill in Area A is being removed. Monitoring shall occur along the perimeter with the closest off-site receptors in addition to the perimeter that is most directly downwind from the removal activities; b) Procurement and local storage of an oxidizer that can be applied in liquid form to treat stock piles of sediment or particularly odorous excavation areas; however, the use of such an oxidizer shall be approved by the CDFW, in advance, to ensure that it would not be harmful to aquatic organisms or cause long-term adverse effects in the aquatic environment (Ventana 2010); and posting of signage at entrances to the Ballona Reserve (including at the Fiji Way entrance to the CDFW trailer, the Culver Boulevard entrance to the baseball fields, and the West Culver Parking Lot) listing the contact information for odor complaints			
Biological Resources			

TABLE 1 (Continued)
MITIGATION MONITORING AND REPORTING PROGRAM FOR THE BALLONA WETLANDS RESTORATION PROJECT

Mitigation Measure	Monitoring Agency	Monitoring/Reporting Requirements	Approval/Acceptance Dates
Cultural Resources			
Mitigation Measure CR-1: *Archaeological Monitoring*. A Cultural Resources Monitoring Plan (CRMP) shall be developed and implemented for the Project. The CRMP also would be a component of a Historical Properties Treatment Plan (HPTP), per Section 106 of the NHPA, should the PA or MOA prepared for the project require an HPTP. A Secretary of the Interior Qualified archaeologist shall be retained to oversee preparation of the CRMP/HPTP, construction monitoring, and preparation of a final monitoring report. The qualified archaeologist shall develop the CRMP/HPTP based on Project design plans, the results of the archaeological and geoarchaeological studies prepared for the Project (Douglas et al. 2015; Lockwood 2015; Vader and Bever 2016), input from Native American representatives, and any other relevant information. The CRMP/HPTP shall provide measures for cultural resources construction worker sensitivity training; delineation of sensitive areas; archaeological and Native American monitoring; assessment and treatment of unanticipated discovery of archaeological resources and human remains; notification protocols; procedures for Native American coordination and input; weekly, monthly, and final reporting; and curation of cultural materials recovered during monitoring. The CRMP/HPHP shall be developed in coordination with CDFW, the Corps, and appropriate Native American representatives. The CRMP/HPHP shall specify the roles and responsibilities of involved parties, and also shall specify the location, duration and timing of monitoring, which minimally shall occur in areas of high or moderate sensitivity, and from the time of initial ground disturbance (which could include grading, vegetation removal, brush clearance, excavation, and other activities) until a depth at which the potential to encounter buried archaeological deposits is greatly reduced. These sensitive areas will include, minimally, archaeological sites CA-LAN-54 and CA-LAN-3784H (including a suitable buffer of at least 100 feet), and areas identified as highly sensitive in the geoarchaeological study. These areas shall be identified in maps to guide monitoring. The CRMP/HPTP shall outline procedures for determining when/where monitoring may be reduced or discontinued in consultation among CDFW, the Corps (in cases of an HPTP), qualified archaeologist, and appropriate Native American representatives. The CRMP/HPTP shall stipulate that archaeological monitoring shall be conducted by an archaeological monitor familiar with the types of resources that could be encountered and that the archaeological monitor shall keep daily logs detailing the types of activities and soils observed, and any discoveries. Monitors shall be empowered to halt and re-direct ground disturbing activities in the event of a discovery until it has been assessed for significance and treatment implemented, if necessary. The CRMP/HPTP shall state that avoidance or preservation in place shall be the preferred means of mitigating impacts to historical resources and unique archaeological resources but will provide procedures to follow should avoidance be infeasible (see Mitigation Measure CR-3).			
Mitigation Measure CR-2: *Native American Monitoring***.** CDFW shall retain a Native American monitor who is traditionally and culturally affiliated with the Project site to carry out the monitoring as required by the CRMP/HPTP in CR-1. The monitor shall also be empowered to halt and re-direct work in the event of a discovery until it has been assessed for significance and treatment implemented,			

TABLE 1 (Continued)
MITIGATION MONITORING AND REPORTING PROGRAM FOR THE BALLONA WETLANDS RESTORATION PROJECT

Mitigation Measure	Monitoring Agency	Monitoring/Reporting Requirements	Approval/Acceptance Dates
Cultural Resources (cont.)			
Mitigation Measure CR-3: *Treatment of Unanticipated Discoveries*. The CRMP/HPTP developed as part of Mitigation Measure CR-1 shall include protocols for the assessment and treatment of any unanticipated discoveries of archaeological resources during Project implementation, including procedures for assessing the significance of the resources according to the National Register and California Register. To accomplish this, the unanticipated discoveries component of the CRMP/HPTP will contain: 1. A research design to be used to guide the evaluation of cultural resources, including a regional cultural setting, appropriate regional research questions, and field methods for the testing and evaluation of cultural resources. 2. Prescribed actions to be taken in the event that unanticipated cultural resources are discovered during construction, or known resources are impacted in an unanticipated manner, consistent with Mitigation Measure CR-1, including (but not limited to): a. Notification procedures b. Establishment of buffers for resources that will be avoided Documentation of resources on DPR forms c. Inspection of the resource(s) by a qualified archaeologist d. Evaluation of the resource for listing in the California Register and National Register, or as a unique archaeological resource under CEQA, and as a contributor to the BLAD e. Monitoring of construction in the vicinity of the resource per Mitigation Measures CR-1 and CR-2 3. Treatment protocols for significant cultural resources that cannot be avoided, to be developed in consultation with CDFW, the Corps, the SHPO and appropriate Native American representatives, may include but not be limited to: a. Data recovery excavation, with preparation of an attendant data recovery plan b. Surface artifact collection c. Further site documentation, including photography, collection of oral histories, preparation of a scholarly work, or some form of public awareness or interpretation d. Special studies where sufficient data exists, including but not limited to radiocarbon dating, residue analysis, sourcing and other materials analysis e. Historical research, as appropriate, with the aim to target the recovery of important scientific or other data contained in the portion of the significant resource to be impacted by the project f. A report documenting the methods and results of the treatment of the resource			

TABLE 1 (Continued)
MITIGATION MONITORING AND REPORTING PROGRAM FOR THE BALLONA WETLANDS RESTORATION PROJECT

Mitigation Measure	Monitoring Agency	Monitoring/Reporting Requirements	Approval/Acceptance Dates
Cultural Resources (cont.)			
Mitigation Measure CR-4: *Compliance with Secretary of Interior's Standards***.** CDFW shall retain a Secretary of the Interior qualified architectural historian to ensure compliance with the Secretary of the Interior's Standards regarding the re-use of the Pacific Electric Railroad Bridge Abutments. The architectural historian shall prepare a character-defining features memorandum that outlines the characteristics of the bridge that convey its significance and that must be retained. In addition, the architectural historian shall provide guidance on the types of bridge spans that would be consistent with the Standards. The architectural historian shall review and approve the preliminary and final bridge design plans to confirm that it conforms to the Standards. The architectural historian shall also monitor construction of the new bridge span to ensure that the Project does not inadvertently damage or alter the character-defining features of the bridge abutments. Further, post-restoration plans for maintenance and repair of the bridge will need to be developed with input from an architectural historian and in accordance with the Standards to ensure that post-restoration use of the bridge will not impact the resource.			
Mitigation Measure CR-5: *Paleontological Resources Impact Mitigation Plan*. A Paleontological Resources Impact Mitigation Plan (PRIMP) shall be prepared prior to the start of restoration. The PRIMP shall be developed by a qualified paleontologist (defined as a paleontologist meeting the SVP Standards). The PRIMP shall identify areas where depth of excavation will extend into areas that are considered moderately to highly sensitive for paleontological resources, based on the final grading plans. Paleontological resource requirements shall be incorporated as a note on the grading plan cover sheet. The PRIMP shall include, but not be limited to: 1) During excavations in areas underlain by geologic units identified as having moderate to high paleontological sensitivity per the SVP guidelines and likely to contain paleontologic resources, a qualified vertebrate paleontologist, shall direct the paleontological monitoring. Areas of concern include all previously undisturbed paleontologically sensitive sediments of the fossiliferous San Pedro Sand (Qsp) and excavations beyond a depth of five feet into Quaternary alluvium (Qa). As shown in Table 3.5-1, Quaternary alluvium (Qa) underlies most areas of the project. San Pedro Sand (Qsp) underlies portions of South and Southeast Area B. Specific areas that will require monitoring will be developed in the PRMP based on the most current design plans. If no significant fossils are found, then, after an adequate amount of time, which the SVP (2010) considers to be 50% of the monitoring duration, the frequency of monitoring may be adjusted at the discretion of the qualified paleontologist. 2) Paleontological monitors shall be equipped to salvage fossils as unearthed to avoid construction delays, collect necessary paleontological data, and to remove samples of sediments likely to contain the remains of small fossil invertebrates and vertebrates. If it is determined by the qualified paleontologist that appropriate sediments are present that may yield significant microvertebrates, a test sample should be collected per the SVP (2010) guidelines. If scientifically significant microvertebrates are recovered from the test sample, the PRIMP shall direct the qualified paleontologist or paleontological monitor to collect and screen a standard sample per the SVP (2010) guidelines. Monitors shall be empowered to temporarily halt or divert equipment to allow removal of abundant or large specimens.			

TABLE 1 (Continued)
MITIGATION MONITORING AND REPORTING PROGRAM FOR THE BALLONA WETLANDS RESTORATION PROJECT

Mitigation Measure	Monitoring Agency	Monitoring/Reporting Requirements	Approval/Acceptance Dates
Cultural Resources (cont.)			
3) The PRIMP shall stipulate that the preparation of recovered specimens shall be conducted to a point of identification and permanent preservation, including washing of sediments to recover small invertebrates and vertebrates. Preparation and stabilization of all recovered fossils are essential in order to fully mitigate adverse impacts to the resources. 4) The PRIMP shall specify that the identification and curation of specimens into an established museum repository with permanent retrievable paleontologic storage. These procedures are also essential steps in effective paleontological mitigation and CEQA compliance. The paleontologist should have a written repository agreement in hand prior to the initiation of mitigation activities. Mitigation of adverse impacts to significant paleontologic resources is not complete until such curation into an established museum repository has been fully completed and documented. 5) The PRIMP shall detail the preparation of a report of findings with an appended itemized inventory of specimens. The report and inventory, when submitted to the appropriate Lead Agency along with confirmation of the curation of recovered specimens into an established, accredited museum repository, would signify completion of the PRIMP to mitigate impacts to paleontologic resources. Included in the report will be recommendations for post-restoration management protocols that might be necessary to reduce indirect impacts following project completion. These could include management requirements for restricting access to significant paleontological resources through a combination of law enforcement, protective enclosures, land access restrictions, or other means. The final PRIMP shall be submitted to and approved by the CDFW and the Corps prior to commencement of grading in the Ballona Reserve. The qualified paleontologist also shall contribute to any construction worker cultural resources sensitivity training, either in person or via a module provided to the qualified archaeologist			
Mitigation Measure CR-6: *Discovery of Human Remains*. If human remains are encountered, the construction contractor shall immediately halt work in the vicinity (within 100 feet) of the find, notify CDFW and the Corps of the find, and unless CDFW decides to initiate contact, the construction contractor shall contact the Los Angeles County Coroner in accordance with Public Resources Code Section 5097.98 and Health and Safety Code Section 7050.5. If the County Coroner determines that the remains are Native American, the NAHC will be notified in accordance with Health and Safety Code Section 7050.5(c), and Public Resources Code Section 5097.98 (as amended by AB 2641). The NAHC will designate a Most Likely Descendant (MLD) for the remains per Public Resources Code Section 5097.98. Until the CDFW has conferred with the MLD and determined an appropriate course of action for protection, avoidance, or removal and disposition of the remains, CDFW and the Corps shall ensure that the immediate vicinity where the discovery occurred is not disturbed by further activity, is adequately protected according to generally accepted cultural or archaeological standards or practices, and that further activities take into account the possibility of multiple burials.			

TABLE 1 (Continued)
MITIGATION MONITORING AND REPORTING PROGRAM FOR THE BALLONA WETLANDS RESTORATION PROJECT

Mitigation Measure	Monitoring Agency	Monitoring/Reporting Requirements	Approval/Acceptance Dates
Geology, Seismicity, and Soils			
Mitigation Measure GEO-1b: ***Geotechnical Recommendations.*** As a condition of approval, CDFW shall require that all the recommendations made in the July 1, 2013 Geotechnical Investigation Report for the Ballona Restoration Project by Group Delta Consultants, including revisions in response to Corps comments, are incorporated as part of Project designs. Recommendations that are applicable to earthwork, site preparation, levee design, and foundation design that were prepared for the project shall be incorporated in the Project. The final seismic considerations as well as recommendations for all other identified geotechnical hazards (including but not limited to expansive soils) for the site shall be in accordance with all current design requirements of the most recent California Building Code and any current Corps' standards. All recommendations and plans for all improvements proposed as part of the project shall be submitted to and approved of by the County and the Corps prior to the commencement of any ground breaking activities			
Mitigation Measure GEO-1c: *Geotechnical Investigation and Report.* As a condition to allowing the Los Angeles County Department of Beaches and Harbors to enter the reserve and construct the parking structure, CDFW shall require that entity, prior to proceeding with such construction to: 1) Commission a site-specific, design level geotechnical investigation for the proposed parking structure prepared by a registered geotechnical engineer. The investigation shall comply with all applicable state and local building code requirements and: a) Include an analysis of the expected ground motions at the site from known active faults using methodologies in accordance with the California Building Code; b) Determine and implement structural design requirements as prescribed by the most current version of the California Building Code, including applicable County amendments, to ensure that structures can withstand ground accelerations expected from known active faults; c) Determine the final design parameters for walls, foundations, foundation slabs, utilities, roadways, parking lots, sidewalks, and other surrounding related improvements in order to comply with the most current version of the California Building Code; 2) Ensure that project plans and specifications for foundation design, earthwork, and site preparation shall incorporate all of the recommendations contained in the site specific investigation. 3) Ensure that the project structural engineer shall review the site specific recommendations, provide any additional necessary amendments to meet Building Code requirements, and incorporate all applicable recommendations from the investigation in the structural design plans and shall ensure that all structural plans for the project meet current California Building Code requirements. 4) Ensure that the approval agency review all project plans for grading, foundations, structural, infrastructure and all other relevant construction permits to ensure compliance with the applicable geotechnical investigation and other applicable Code requirements. If expansive soils are present, the technical investigation shall provide recommendations to either remove or treat the expansive soils in accordance with current California Building Code Requirements and any local County amendments.			

TABLE 1 (Continued)
MITIGATION MONITORING AND REPORTING PROGRAM FOR THE BALLONA WETLANDS RESTORATION PROJECT

Mitigation Measure	Monitoring Agency	Monitoring/Reporting Requirements	Approval/Acceptance Dates
Geology, Seismicity, and Soils			
Mitigation Measure GEO-4: *Corrosive Soil Testing*. Any native or other fill soils that contact concrete or metal foundation elements of structures constructed under the Project shall be tested for corrosivity. Those soils, as determined by laboratory analysis and reviewed by a California licensed geotechnical engineer, that exceed acceptable thresholds of corrosivity shall be managed in accordance with recommendations of a qualified geotechnical engineer or corrosion engineer. Engineering recommendations could include soil reconditioning through mixing with non-corrosive soils, replacement of the corrosive soils in the vicinity of the foundation, or corrosion reducing systems for exposed metal such as "sacrificial anodes." In addition, the contractor shall use Type II cement for all concrete and steel foundation work to further reduce the potential for degradation of concrete through corrosion			
Hydrology and Water Quality			
Mitigation Measure WQ-1a-i: *Monitoring and Adaptive Management Plan (MAMP)*. A Monitoring and Adaptive Management Plan (MAMP) (Appendix F11 of the EIS/EIR) shall be prepared and implemented. The MAMP shall provide a framework for the assessment of the Project and watershed using the TMDL targets as assessment metrics. The MAMP shall use both Project monitoring, the sediment and water quality data gathered from the TMDL monitoring conducted by the Permittees (designated parties listed in the Ballona Creek and Ballona Creek Estuary TMDLs who are under a state-wide or LARWQCB NPDES MS4 Stormwater Permit), and monitoring conducted by the Corps in the Marina del Rey harbor entrance channel to determine if impairment conditions exist and provide protocols for any further measures to meet TMDLs and dredging requirements. The assessment of the effectiveness of the Project features and watershed measures (conducted by the Permittees) shall be determined through comparisons to the SQOs and fish tissue targets. If the SQO analysis indicated an impaired or likely impaired condition, then further source and delineation monitoring shall be conducted. Depending on the source of the impairment, reparative measures shall be implemented by the Project proponents, Permittees, or in cooperation with parties as outlined in the MAMP framework to reduce the impacts to sediment to below the SQOs and fish tissue targets. SQOs shall be the regulatory target used to protect against negative biological impacts and are considered the performance standard to identify negative impacts. In the event that sediment quality impairments are found to be a result of the project, the sediment shall be excavated and disposed of off-site or buried beneath uncontaminated material on-site. If sediment quality impairments in the Marina del Rey harbor entrance channel are found to be a result of the project, CDFW shall coordinate with the Corps to develop a mutually agreed upon course of action, which could include participating in reparative measures proportional to the amount of increased impairment due to the project. Additionally, the MAMP shall monitor and address any changes in sediment deposition in the entrance of Marina del Rey after project implementation is complete. The plan shall use bathymetric data collected by the Corps to determine if deposition has increased substantially after construction of the project. In the event that substantial deposition is identified, CDFW shall coordinate with the Corps to develop a mutually agreed upon course of action, which could include participating in dredging proportional to the amount of increased deposition due to the project. Dredged material shall be disposed of back in the marsh by spraying a slurry of sediment in a thin layer across the marshplain or disposed of on- or off-site by other means in accordance with necessary permits or other approvals. The MAMP would ensure that any increases to deposition would be monitored and addressed in order to maintain boat access to the Marina consistent with historic dredging efforts.			

TABLE 1 (Continued)
MITIGATION MONITORING AND REPORTING PROGRAM FOR THE BALLONA WETLANDS RESTORATION PROJECT

Mitigation Measure	Monitoring Agency	Monitoring/Reporting Requirements	Approval/Acceptance Dates
Hydrology and Water Quality (cont.)			
The MAMP would also monitor water levels in South and Southeast Area B to determine operation of the culverts in order to prevent flooding. Over time, flap gates would be installed on the culverts as part of Alternative 1 to limit the flow into South and Southeast Area B. Initial modeling indicated that adding a flap gate every 25 years would maintain the current level of flood protection, but the MAMP would ensure that water levels were monitored so that flap gates could be added as needed to maintain an acceptable level of flood risk			
Mitigation Measure WQ-1a-ii: *Sampling and Analysis Plan (SAP)*. A SAP shall be prepared and implemented prior to commencement of construction to identify any levels of constituents that may have been missed in previous sampling efforts. The results of the sediment sampling shall determine which materials shall be used as wetland surfaces (highest quality), as wetland foundation, or buried in the uplands (lowest quality) in accordance with the ER-Ls and ER-Ms developed by Long et al. (1995). The SAP shall also include, without limitation: a) In addition to the sampling and analysis of soil as identified in the SAP, soil and groundwater samples shall also be collected from any excavations that encounter groundwater. The soil samples shall be collected at or just below the static water level to sample soil that may have been affected by contaminated groundwater migrating from offsite properties. Each soil sample shall be labeled with a unique sample identification number, placed in to plastic bags in coolers with ice packs, along with the appropriate chain of custody documentation, and delivered to the analytical testing laboratory within the required testing method holding times. b) All soil samples collected for the analyses described below shall be collected into Teflon-lined metal or plastic tubes and sealed to minimize the loss of volatile compounds. The groundwater samples shall be collected into glass bottles with Teflon-lined lids and the appropriate preservatives to seal in and preserve volatile compounds, if any. Each sample shall be labeled with a unique sample identification number, placed in to plastic bags in coolers with ice packs, along with the appropriate chain of custody documentation, and delivered to the analytical testing laboratory within the required testing method holding times. c) All soil and groundwater samples shall be analyzed for petroleum hydrocarbons using US EPA Test Method 8015 or equivalent, including a silica gel cleanup (USEPA Test Method 3630C or equivalent) to remove naturally occurring polar non-petroleum hydrocarbons that could interfere with the analyses. d) All soil and groundwater samples shall be analyzed for VOCs using USEPA Test Method 8260 or equivalent (at a minimum, the test methods shall be capable of detecting PCE). e) Following receipt of laboratory results of the chemical testing, soil or groundwater material that exceeds the reuse screening levels, CHHSLs, or PRGs and cannot be reused on site shall be transported by a DTSC-licensed hazardous waste hauler and disposed of at an offsite disposal facility licensed to receive the contaminated soil and groundwater. Alternative disposal options, such as onsite burial, shall be considered for soil and groundwater found not to contain contaminates or having concentrations below the regulatory thresholds.			

TABLE 1 (Continued)
MITIGATION MONITORING AND REPORTING PROGRAM FOR THE BALLONA WETLANDS RESTORATION PROJECT

Mitigation Measure	Monitoring Agency	Monitoring/Reporting Requirements	Approval/Acceptance Dates
Noise			
Mitigation Measure NOI-1-i: The construction contractor(s) shall locate stationary noise sources as far as possible from noise-sensitive uses, to the extent feasible, and ensure that they are muffled and enclosed within temporary sheds, incorporate insulation barriers, or other measures to the extent feasible			
Mitigation Measure NOI-1-ii: All mobile off-road construction equipment operating at the Project site shall be equipped with properly operating mufflers.			
Mitigation Measure NOI-1-iii: Restoration-phase activities shall, to the extent feasible, be scheduled so as to avoid operating several pieces of heavy diesel-powered equipment simultaneously, which causes high noise levels.			
Mitigation Measure NOI-1-iv: Temporary barriers such as plywood structures or flexible sound control curtains at least 8 feet in height shall be erected, to the extent feasible, around the perimeter of the active work area to minimize the amount of noise on the surrounding sensitive receptors during noise-generating restoration activities.			
Mitigation Measure NOI-1-v: Project-related noise levels at the property line of the multi-family residential buildings located west of Area A and north of West Area B in the County of Los Angeles shall undergo spot check monitoring with a sound level meter that meets the requirements identified in Chapter 12.08 (Noise Control) of the County of Los Angeles Municipal Code to ensure that noise levels from the Project's implementation activities would not exceed 80 dBA at multi-family residences during active work hours. Where noise levels exceeding 80 dBA are detected, the construction contractor must be notified immediately and corrective actions must be implemented to reduce the noise levels to below 80 dBA. These corrective actions may include, but are not limited to, the erection of a noise barrier along the boundary of the Project site or the reduction in the amount of construction equipment operating concurrently to meet the County's noise standards for mobile equipment.			
Mitigation Measure NOI-1-vi: All construction staging areas during site restoration activities shall be located to maximize the distance between staging areas and occupied residential structures.			
Mitigation Measure NOI-1-vii: Two weeks prior to the commencement of restoration activities within Area A; North, East, Southeast, South, or West Area B; North or South Area C; or the SoCalGas Property, notification must be provided to all existing off-site residential uses located directly adjacent to the active work area that discloses the general work schedule, including the various types of activities and equipment that would be occurring throughout the duration of the construction period.			
Mitigation Measure NOI-1-viii: Signs shall be posted at the Project site that include permitted work days and hours, a contact number for the job site, and a contact number with the appropriate CDFW enforcement officers.			

TABLE 1 (Continued)
MITIGATION MONITORING AND REPORTING PROGRAM FOR THE BALLONA WETLANDS RESTORATION PROJECT

Mitigation Measure	Monitoring Agency	Monitoring/Reporting Requirements	Approval/Acceptance Dates
Noise (cont.)			
Mitigation Measure NOI-1-ix: All Project noise-generating activities occurring in Area A shall be limited to the hours of 7:00 a.m. to 7:00 p.m. from Monday through Saturday and prohibited on Sundays or holidays as permitted under the County of Los Angeles Municipal Code, and all Project noise-generating activities occurring in Areas B and C and on the SoCalGas Property shall be limited to the hours of 7:00 a.m. to 9:00 p.m. from Monday through Friday, 8:00 a.m. to 6 p.m. on any Saturday or national holiday, and prohibited on Sundays as permitted under the City of Los Angeles Municipal Code, unless otherwise authorized or exempted under each of the respective municipal codes.			
Mitigation Measure NOI-2: The operation of construction equipment at the Project site that generates high levels of vibration, such as large bulldozers, loaded trucks, and drill rigs, shall be prohibited within 100 feet of existing residential structures in both the County of Los Angeles and City of Los Angeles during restoration activities. Instead, small rubber-tired bulldozers, which generate vibration levels as low as 0.003 at 25 feet, shall be used within these areas during site preparation, grading, and excavation operations to ensure that vibration levels experienced at the off-site receptors would not be perceptible.			
Transportation and Traffic			
Mitigation Measure TRANS-1a: *Construction Traffic Management Plan.* The construction contractor(s) shall prepare a construction traffic management plan for each phase of the Project at the time of final design, prior to commencement of construction. This Plan would address details related to haul routes, dust control, noise control and City and County regulations. The construction management plan ensures that the construction activities and workers follow the City regulations and provides details of activities planned on-site. The Plan shall be developed on the basis of detailed design plans for the approved project, and shall include, but not necessarily be limited to, the elements listed below: a) Develop circulation and detour plans to minimize impacts on local streets. Haul routes that minimize truck traffic on local roadways and residential streets shall be used. As necessary, warning lights, signage and/or flaggers shall be used to guide vehicles through the construction work areas. b) Control and monitor construction vehicle movements by enforcing standard construction specifications through periodic on-site inspections. c) Install traffic control devices where traffic conditions warrant, as specified in the applicable jurisdiction's standards (e.g., the California Manual of Uniform Traffic Controls for Construction and Maintenance Work Zones). d) Schedule truck trips outside of peak morning and evening commute hours to minimize adverse impacts on traffic flow (i.e., if agencies with jurisdiction over the affected roads identify highly congested roadway segments during their review of the encroachment permit applications). e) Post detour signs along affected roadways to notify motorists of alternative routes. f) Perform construction that crosses on-street and off street bikeways, sidewalks, and other walkways in a manner that allows for safe access for bicyclists and pedestrians. Alternatively, provide safe detours to reroute affected bicycle/pedestrian traffic.			

TABLE 1 (Continued)
MITIGATION MONITORING AND REPORTING PROGRAM FOR THE BALLONA WETLANDS RESTORATION PROJECT

Mitigation Measure	Monitoring Agency	Monitoring/Reporting Requirements	Approval/Acceptance Dates
Transportation and Traffic (cont.)			
g) At least two weeks prior to construction, post signage along all potentially affected roadways, recreational trails, bicycle routes, and pedestrian pathways, to warn motorists, bicyclists, and pedestrians of construction activities. The signs shall include information regarding the nature of construction activities, duration, and detour routes. Signage shall be composed of or encased in weatherproof material and posted in conspicuous locations for the duration of the closure period. At the end of the closure period, the contractors shall retrieve all notice materials.			
h) Construction activities shall be scheduled to minimize impacts during heavy recreational use periods (e.g., weekends and holidays).			
i) Implement a public information program to notify motorists, bicyclists, nearby residents, and adjacent businesses of the impending construction activities (e.g., media coverage, email notices, websites, etc.). Notices of the location(s) and timing of road closures shall be published in local newspapers and on available websites to allow motorists to select alternative routes.			
j) Store all equipment and materials in designated contractor staging areas.			
k) Maintain alternate one-way traffic flow past the construction zones where possible.			
l) Install detour signs to direct traffic to alternative routes around the closed road segment if alternate one-way traffic flow cannot be maintained past the construction zone.			
m) Limit lane closures during peak hours.			
n) Restore roads and streets to normal operation by covering trenches with steel plates outside of normal work hours or when work is not in progress.			
o) Comply with roadside safety protocols to reduce the risk of accidents. Provide “Road Work Ahead” warning signs and speed control (including signs informing drivers of state-legislated double fines for speed infractions in a construction zone) to achieve required speed reductions for safe traffic flow through the work zone. Train construction personnel to apply appropriate safety measures as described in the traffic control and safety assurance plan.			
p) Maintain access for emergency vehicles at all times. Coordinate with facility owners or administrators of sensitive land uses such as police and fire stations, transit stations, hospitals, and schools. Provide advance notification to local police, fire, and emergency service providers of the timing, location, and duration of construction activities that could affect the movement of emergency vehicles on area roadways.			
q) Avoid truck trips through designated school zones during the school drop-off and pickup hours to the extent feasible.			
r) Provide flaggers in school areas at street crossings to manage traffic flow and maintain traffic safety during the school drop-off and pickup hours on days when pipeline installation would occur in designated school zones.			
s) Coordinate with the local transit providers to enable temporary bus routes or bus stops relocations within work zones as necessary. For example, access for Santa Monica Big Blue Bus Line 3 would be maintained at all times through the construction zone on Lincoln Boulevard during bridge construction.			

TABLE 1 (Continued)
MITIGATION MONITORING AND REPORTING PROGRAM FOR THE BALLONA WETLANDS RESTORATION PROJECT

Mitigation Measure	Monitoring Agency	Monitoring/Reporting Requirements	Approval/Acceptance Dates
Energy Conservation			
Mitigation Measure EC-2a: The parking garage operator shall use appropriate lighting levels for safety (estimated to be 1-2 foot candles) and shall use energy-efficient fixtures (e.g., LED or other lighting that provides efficiency comparable to or better than 55-watt induction lamps, which draw 58 watts per fixture).			
Mitigation Measure EC-2b: Parking garage operators shall turn off unneeded lights in the garage during the daytime in areas where ambient light is sufficient. Lights in emergency exit pathways shall remain on at all times for safety.			
Mitigation Measure EC-2c: If fans are installed to disperse exhaust fumes in the parking garage, a demand-control ventilation (DCV) system shall be installed rather than an "on/off" system. The DCV system shall continuously operate fans at less than 3% of the full-speed power draw and only increase the air flow when prompted by a sensor.			

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APPENDIX B7
Ballona Wetlands Inundation Memo

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ESA

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memorandum

date September 28, 2015

to

from Lindsey Sheehan, P.E

subject DRAFT- Ballona Wetlands Habitat Elevations Inundation Analysis

Introduction

Salt marsh and intertidal habitats establish within zones corresponding to tidal inundation (Adams 1963, Earle and Kershaw 1989). Tides and tidal inundation at Ballona are therefore important processes affecting the habitats. The proposed alternatives in the EIR/S include three different tidal conditions: existing managed, post-restoration managed, and fully tidal. Under existing conditions, the wetlands in West and South Area B experience managed tides due to the SRT gates between West Area B and Ballona Creek. The tides behind the SRT gates are muted (i.e. high tides in the managed marsh are lower than high tides in Ballona Creek). In Alternatives 1 and 2, the area south of Culver Boulevard would experience post-restoration managed tidal conditions. The new culverts would allow a larger tidal range, but the tides would still be slightly muted post-restoration, and managed over time with sea level rise. In Area A for all of the alternatives, North Area B for Alternatives 1 and 2, and West Area B for Alternative 1, tides would not be limited- these areas would experience fully tidal conditions. Table 1 summarizes the different tidal conditions for each alternative and area.

Table 1. Tidal Influence by Area and Alternative

	Area A	North Area B	South Area B	West Area B
Existing Conditions				
	-	-	Existing Managed Tidal	Existing Managed Tidal
Alternative 1				
Phase 1	Fully Tidal	Fully Tidal	Post-Restoration Managed Tidal	Existing Managed Tidal
Phase 2	Fully Tidal	Fully Tidal	Post-Restoration Managed Tidal	Fully Tidal
Alternative 2				
Phase 1	Fully Tidal	Fully Tidal	Post-Restoration Managed Tidal	Existing Managed Tidal
Alternative 3				
Phase 1	Fully Tidal	-	Existing Managed Tidal	Existing Managed Tidal
Alternative 4				
Phase 1	-	-	Existing Managed Tidal	Existing Managed Tidal

Methods to Determine Habitat Elevations

Three methods were used to determine habitat elevations for each tidal condition. Habitat elevation data from the literature was used to develop initial habitat ranges. This data was then compared to data from the San Dieguito Lagoon as a reference site. Lastly, these elevations were compared to extreme tide levels and storm events data to examine the frequency of inundation for upper elevation habitats.

Using data from the literature, ESA determined habitat elevations for fully tidal conditions with input from WRA. ESA then calculated the corresponding percent of time that each habitat was inundated using NOAA's verified Tides and Currents data at Santa Monica. To establish habitat elevations for existing managed conditions, ESA analyzed water level data measured from within the existing managed wetland (collected by LA County) and determined the managed water levels that correspond to the same percent inundation as the fully tidal habitat elevations. ESA also analyzed modeled water levels for post-restoration managed conditions to establish post-restoration managed habitat elevations with the same percent inundation as the full tidal habitat elevations. Table 2 presents the elevations and percent inundation for each habitat.

Table 2. Habitats by Percent Inundation

Habitat Transitions	% Inundation[1]	Habitat Elevations under Fully Tidal Conditions[1] (ft NAVD)	Habitat Elevations under Managed Tidal Conditions[2] (ft NAVD)	Habitat Elevation under Post-Restoration Managed Tidal Conditions[3] (ft NAVD)
Upland/Transition Zone	~3yr tidal inundation	7.3	4.3	6.5
Transition Zone/High Marsh	1%	6.3	3.6	5.8
High Marsh/Mid Marsh	5%	5.4	3.3	5.0
Mid Marsh/Low Marsh	26%	3.8	2.7	3.8
Low Marsh/Mudflat	51%	2.7	2.1	2.8
Mudflat/Subtidal	MLLW	-0.2	-0.2	-0.2

1. ESA determined habitat elevations from the literature (with input from WRA) and calculated the corresponding percent inundation based on the Santa Monica predicted tides (NOAA Tides and Currents). ESA used these elevations to calculate the percent inundation based on the verified measured tides.
2. Managed tidal habitats were calculated using water level data from Los Angeles County, recorded within the managed marsh.
3. Post-restoration managed tidal habitats were calculated using modeled water levels within South Area B (ESA, 2015)

The habitat elevations were compared to elevations of pickleweed and cordgrass at San Dieguito Lagoon in San Diego County. At San Dieguito, average pickleweed elevations (± one standard deviation) ranged from 4.5-5.6 ft NAVD, which falls in the mid to high marsh categories. Average cordgrass elevations at San Dieguito (± one standard deviation) occurred from 3.5 to 3.9 ft NAVD, which falls in the low to mid marsh categories.

The habitat elevations were also compared to extreme tide levels and storm events. The extreme tidal water level analysis used two different extreme distributions, the GEV and Gumbell. Table 3 presents the range of water levels by return period.

Table 3. Extreme Tide Levels

Return Period (years)	Still Water Level (ft NAVD)
1	7.1
5	7.3 - 7.4
10	7.4 - 7.5
20	7.5 - 7.6
50	7.7 - 7.8
100	7.8 - 7.9

Rainfall-runoff storm events in Ballona Creek were modeled to evaluate the flood risk under project conditions in the Ballona Wetlands Hydraulics and Hydrology Report (ESA PWA 2013). Water levels from this modeling are provided in Table 4 with the corresponding storm event recurrence.

Table 4. Flood Water Levels

	Water Level (ft NAVD)		
Event	Upstream, Station 10207	Mid-Site, Station 6292	Downstream, Station 3055
500-yr	15.98	14.01	10.44
200-yr	14.95	12.95	9.43
150-yr	14.62	12.57	9.15
100-yr	14.09	11.96	8.76
50-yr	13.26	11.02	8.05
25-yr	12.16	9.85	7.24
10-yr	11.32	8.98	6.73
5-yr	10.37	8.05	6.25
2-yr	8.75	6.69	5.69

Future Habitat Elevations Under Sea Level Rise

Future habitat elevations were estimated using the USACE NRC-III sea level rise curve (high range; Table 5). To determine the future habitat elevations for the fully tidal conditions, the sea level rise for each year was applied to the habitat elevations shown in Table 2 (Table 6 through Table 9). To determine the habitat elevations for managed and post-restoration managed tidal conditions, water levels from the South Area B modeling analysis were used (ESA 2015).

The habitat elevations described above were applied to the existing and proposed topography to develop maps of habitat change over time with sea level rise. Figures 1-4 show habitat change for Alternative 1 and Figures 5-8 shows habitat change for Alternative 4 (existing conditions).

Table 5. USACE NRC-III Sea Level Rise Estimates

Year	High Sea Level Rise from 1992 (in)	Sea Level Rise from 1992 Range (in)
2030	9	4-9
2050	19	7-19
2070	32	12-32
2100	59	20-59

Although sea level rise is typically described as a range of values for a specific year, it can also be described as an amount of sea level rise that will occur over a certain timeframe. For example, even if emissions begin to track on the lower end of the USACE sea level rise estimates, 59 inches of sea level rise will still occur, just at a date later than 2100. So it could either be said that 7-19 inches of sea level rise will occur by 2050, or that 19 inches of sea level rise will occur sometime between 2050 and 2100. Tables 6 through 9 present habitat elevations for each of the points along the USACE high sea level rise curve, with the corresponding time frame for when this is expected to occur included in the title for each table.

Table 6. Habitat Elevations with 9-in of Sea Level Rise (2030 – 2060)

Habitat Transitions	Habitat Elevations under Fully Tidal Conditions (ft NAVD)	Habitat Elevations under Managed Tidal Conditions (ft NAVD)	Habitat Elevation under Post-Restoration Managed Tidal Conditions (ft NAVD)
Upland/Transition Zone	8.05	4.70	7.05
Transition Zone/High Marsh	7.05	4.00	6.35
High Marsh/Mid Marsh	6.16	3.89	5.64
Mid Marsh/Low Marsh	4.52	3.60	4.58
Low Marsh/Mudflat	3.43	3.22	3.54
Mudflat/Subtidal	0.55	0.55	0.55

Table 7. Habitat Elevations with 19-in of Sea Level Rise (2050 – 2100)

Habitat Transitions	Habitat Elevations under Fully Tidal Conditions (ft NAVD)	Habitat Elevations under Managed Tidal Conditions (ft NAVD)	Habitat Elevation under Post-Restoration Managed Tidal Conditions (ft NAVD)
Upland/Transition Zone	8.88	4.88	7.3
Transition Zone/High Marsh	7.88	4.18	6.6
High Marsh/Mid Marsh	6.99	4.13	6.1
Mid Marsh/Low Marsh	5.35	3.99	5.2
Low Marsh/Mudflat	4.26	3.78	4.4
Mudflat/Subtidal	1.38	1.38	1.4

Table 8. Habitat Elevations with 32-in of Sea Level Rise (2070 – 2135)

Habitat Transitions	Habitat Elevations under Fully Tidal Conditions (ft NAVD)	Habitat Elevations under Managed Tidal Conditions (ft NAVD)	Habitat Elevation under Post-Restoration Managed Tidal Conditions (ft NAVD)
Upland/Transition Zone	9.97	5.57	7.2
Transition Zone/High Marsh	8.97	4.87	6.5
High Marsh/Mid Marsh	8.08	4.75	6.3
Mid Marsh/Low Marsh	6.44	4.42	5.7
Low Marsh/Mudflat	5.35	4.15	5.2
Mudflat/Subtidal	2.47	2.47	2.5

Table 9. Habitat Elevations with 59-in of Sea Level Rise (2100 – 2195)

Habitat Transitions	Habitat Elevations under Fully Tidal Conditions (ft NAVD)	Habitat Elevations under Managed Tidal Conditions (ft NAVD)	Habitat Elevation under Post-Restoration Managed Tidal Conditions (ft NAVD)
Upland/Transition Zone	12.22	6.96	8.3
Transition Zone/High Marsh	11.22	6.26	7.6
High Marsh/Mid Marsh	10.33	6.23	7.40
Mid Marsh/Low Marsh	8.69	6.04	7.08
Low Marsh/Mudflat	7.60	5.64	6.63
Mudflat/Subtidal	4.72	4.72	4.72

Salt Pan Habitat Under Sea Level Rise

To evaluate the sustainability of the salt pan habitat in West Area B, it was assumed that once the salt pan topography (or surrounding berm, in Alternative 1) drops into the mid marsh elevation, the salt pan would be inundated frequently enough that salt pans would convert to marsh (or mudflat in the case of Alternative 1, where the salt pan would be preserved by a berm until the berm reaches mid marsh elevation). This assumption is based on the fact that salt pans typically occur within high marsh areas of tidal wetlands that are infrequently inundated, but not in mid marsh areas that are inundated daily. Under existing conditions (and Alternatives 2 and 3), the salt pan would convert to marsh before 2050. This process appears to be occurring at present in the northern portion of the existing salt pan through the formation of tidal channels extending into the salt pan, which appear to be increasing tidal inundation, leaching salt from the soil, and allowing pickleweed vegetation to establish. With the berm in Alternative 1, the salt pan would convert before 2070, extending the life of the salt pan habitat by approximately 10 years.

Assessment of Habitat Change with Sea Level Rise

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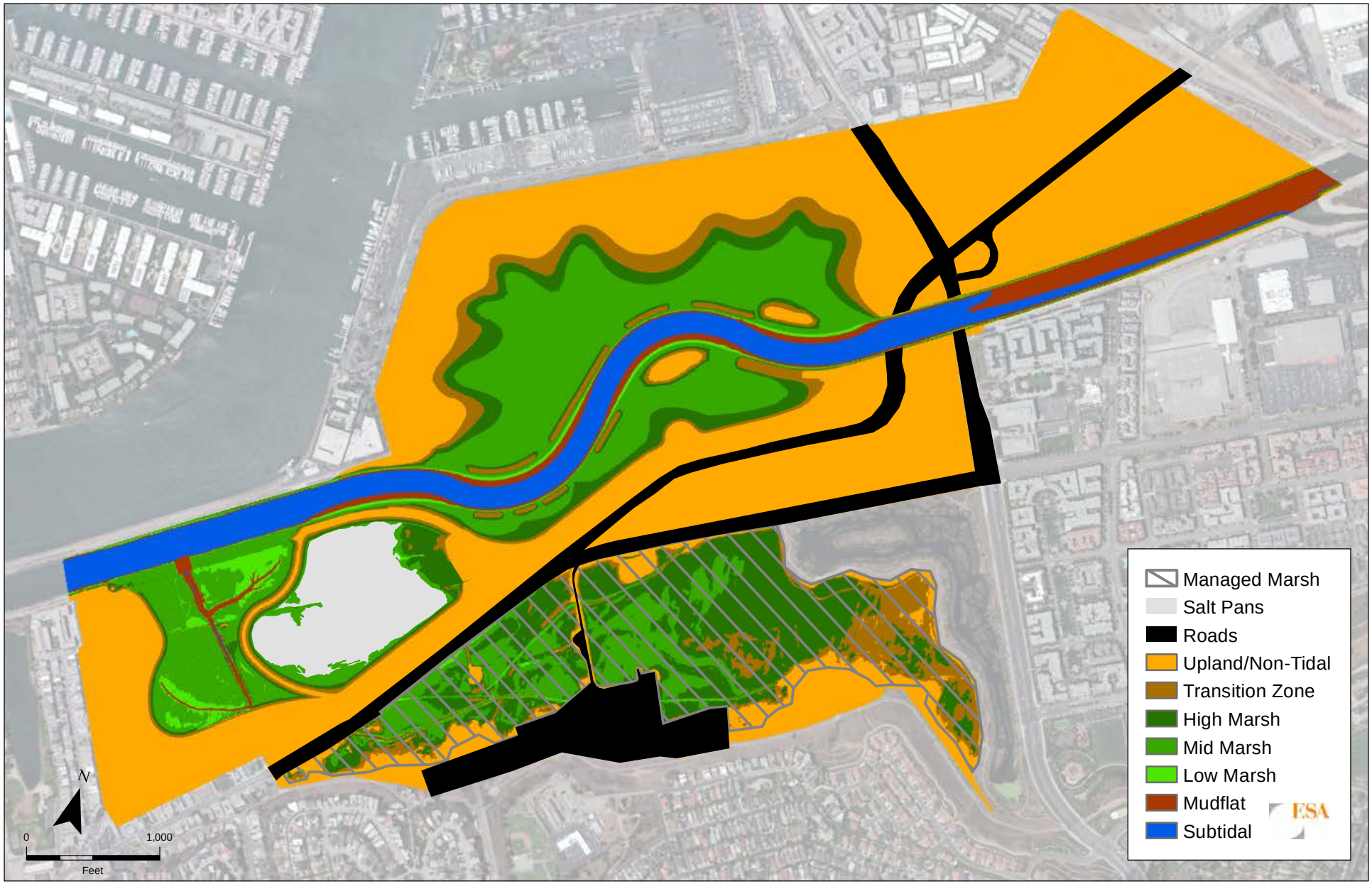
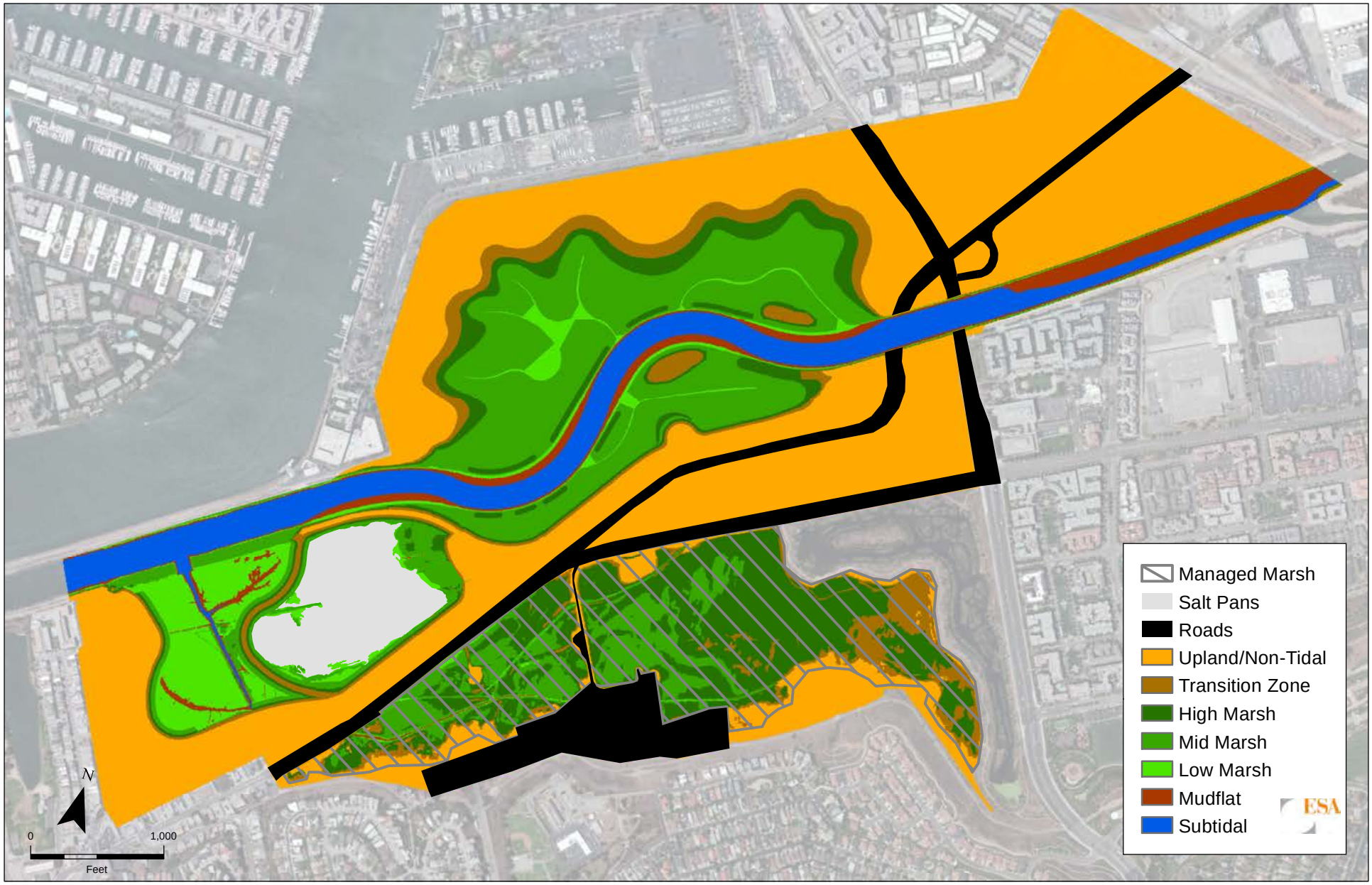


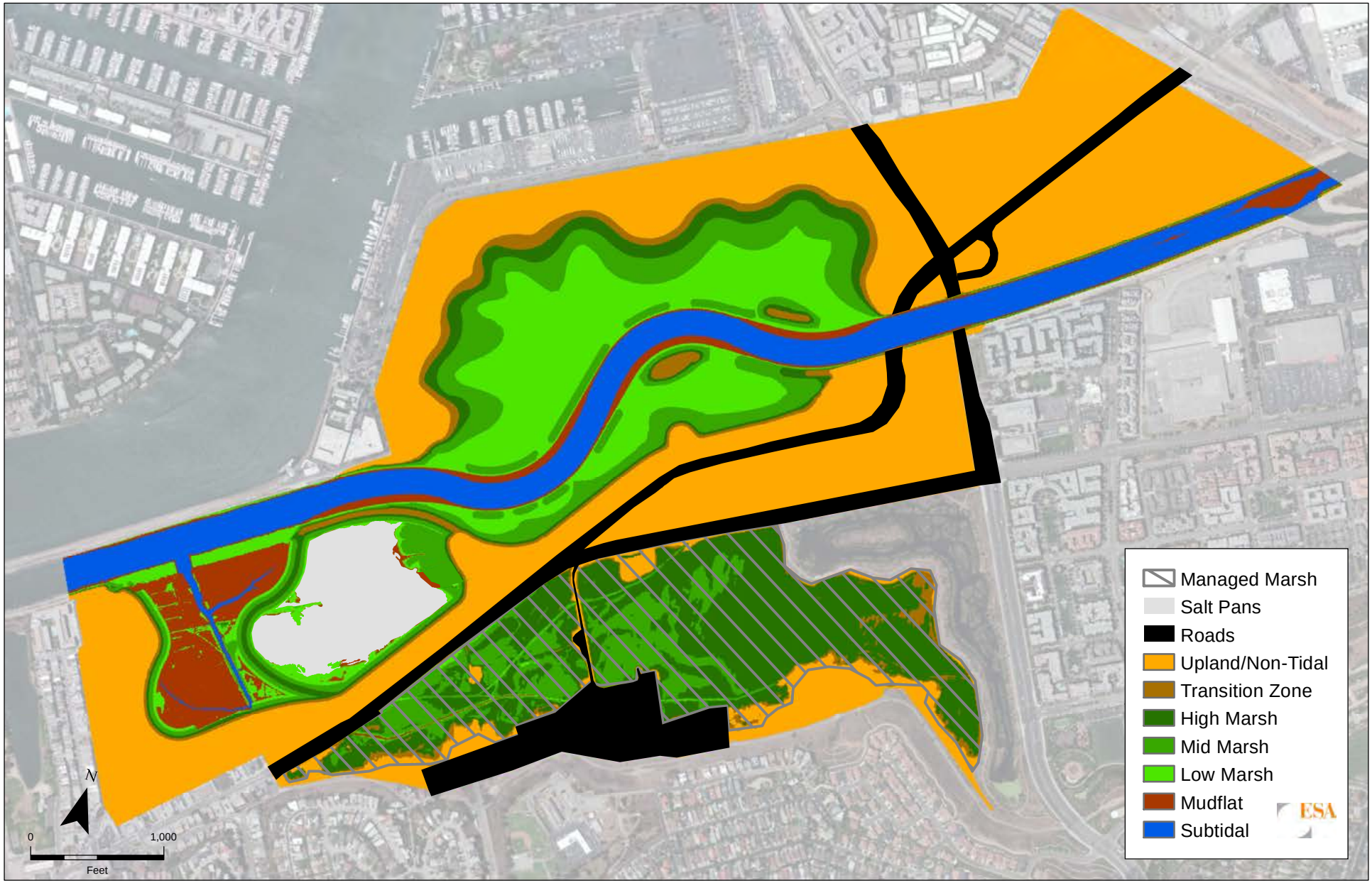
Ballona Wetlands Restoration Project

Figure 1
Alt 1, Now



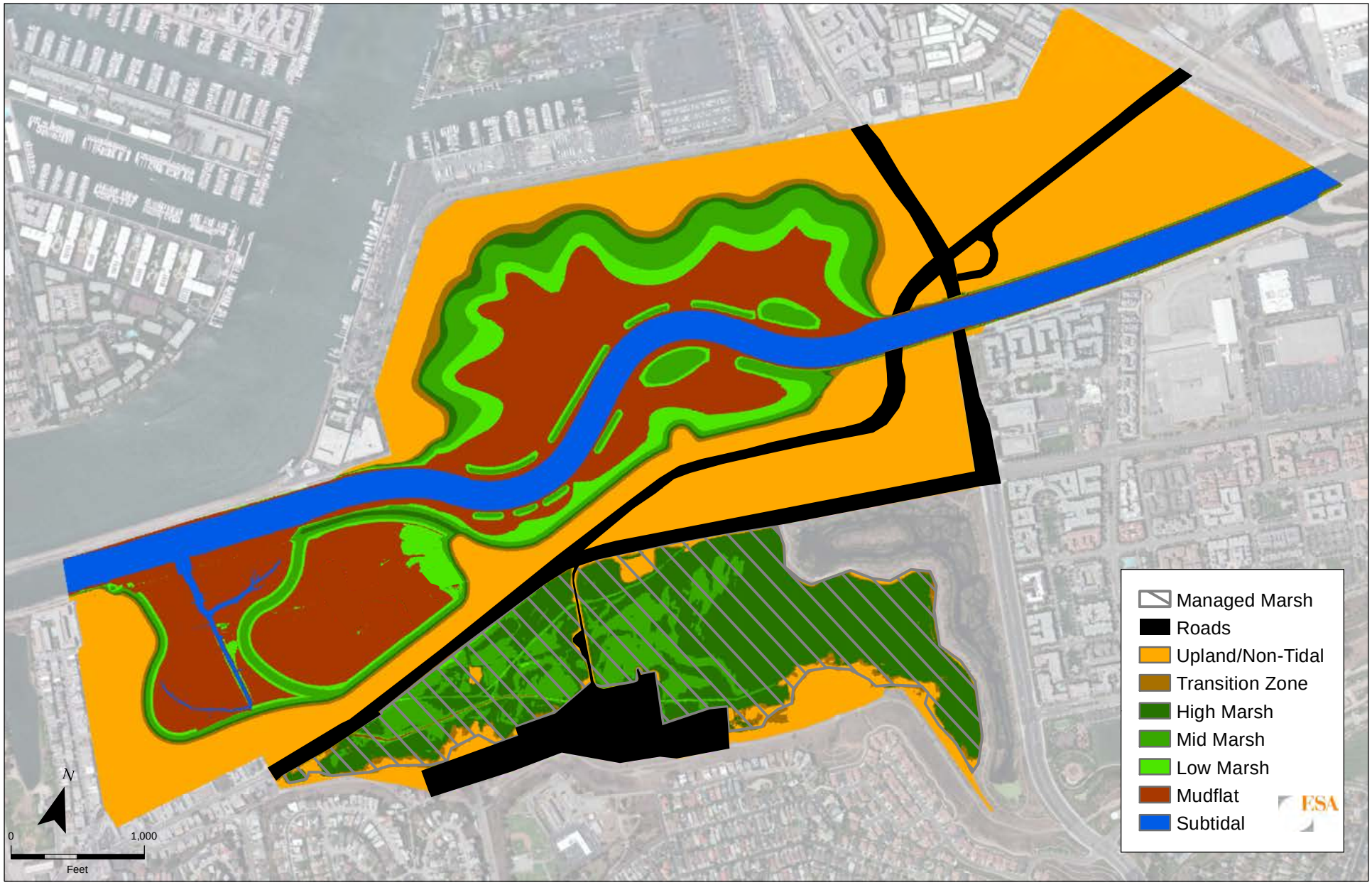
Ballona Wetlands Restoration Project

Figure 2
Alt 1, 2030



Ballona Wetlands Restoration Project

Figure 3
Alt 1, 2050



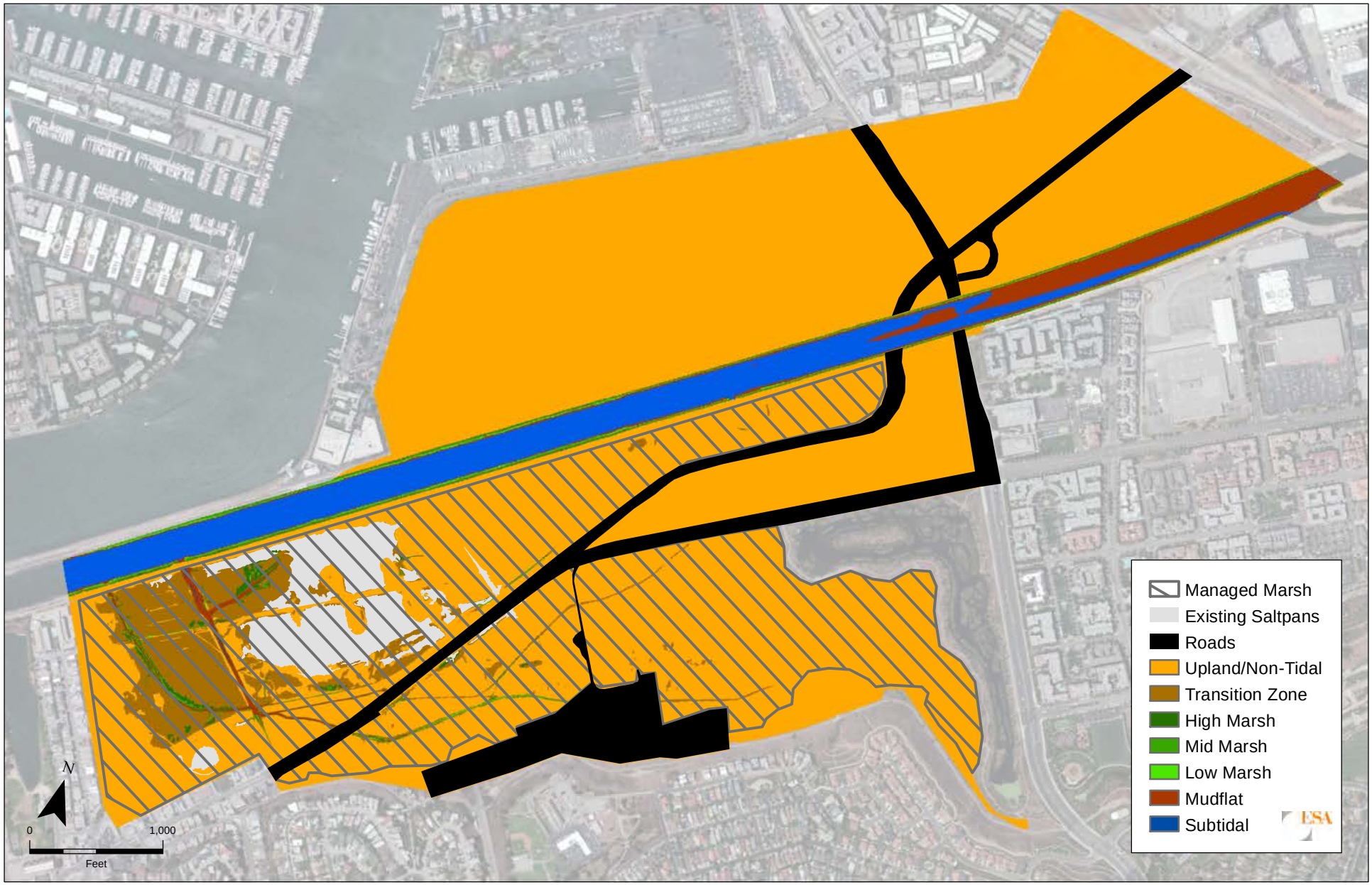
Ballona Wetlands Restoration Project

Figure 4
Alt 1, 2070



Ballona Wetlands Restoration Project

Figure 5
Alt 1, 2100



Ballona Wetlands Restoration Project

Figure 6
Alt 4 (No project), Now



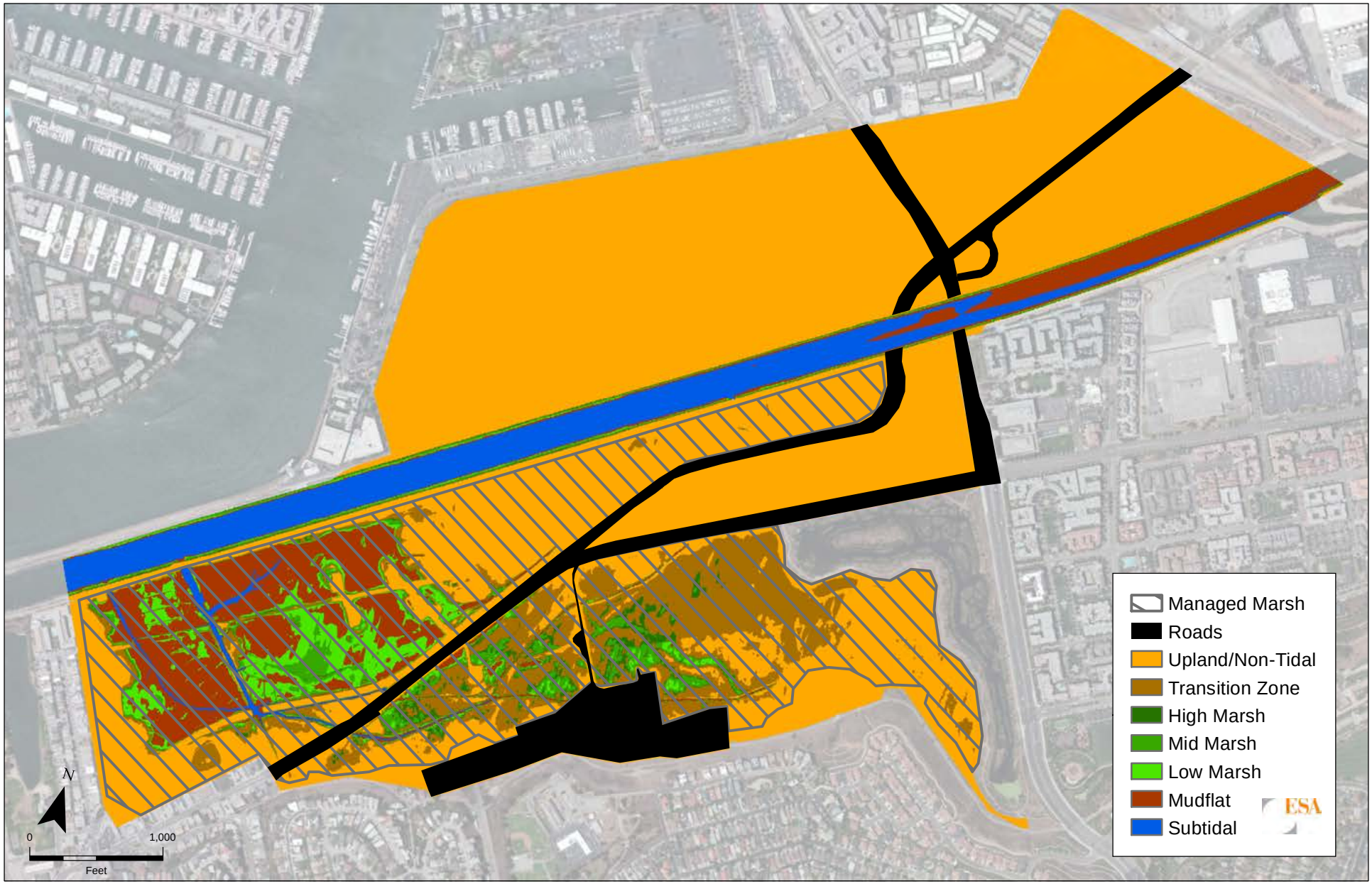
Ballona Wetlands Restoration Project

Figure 7
Alt 4 (No project), 2030



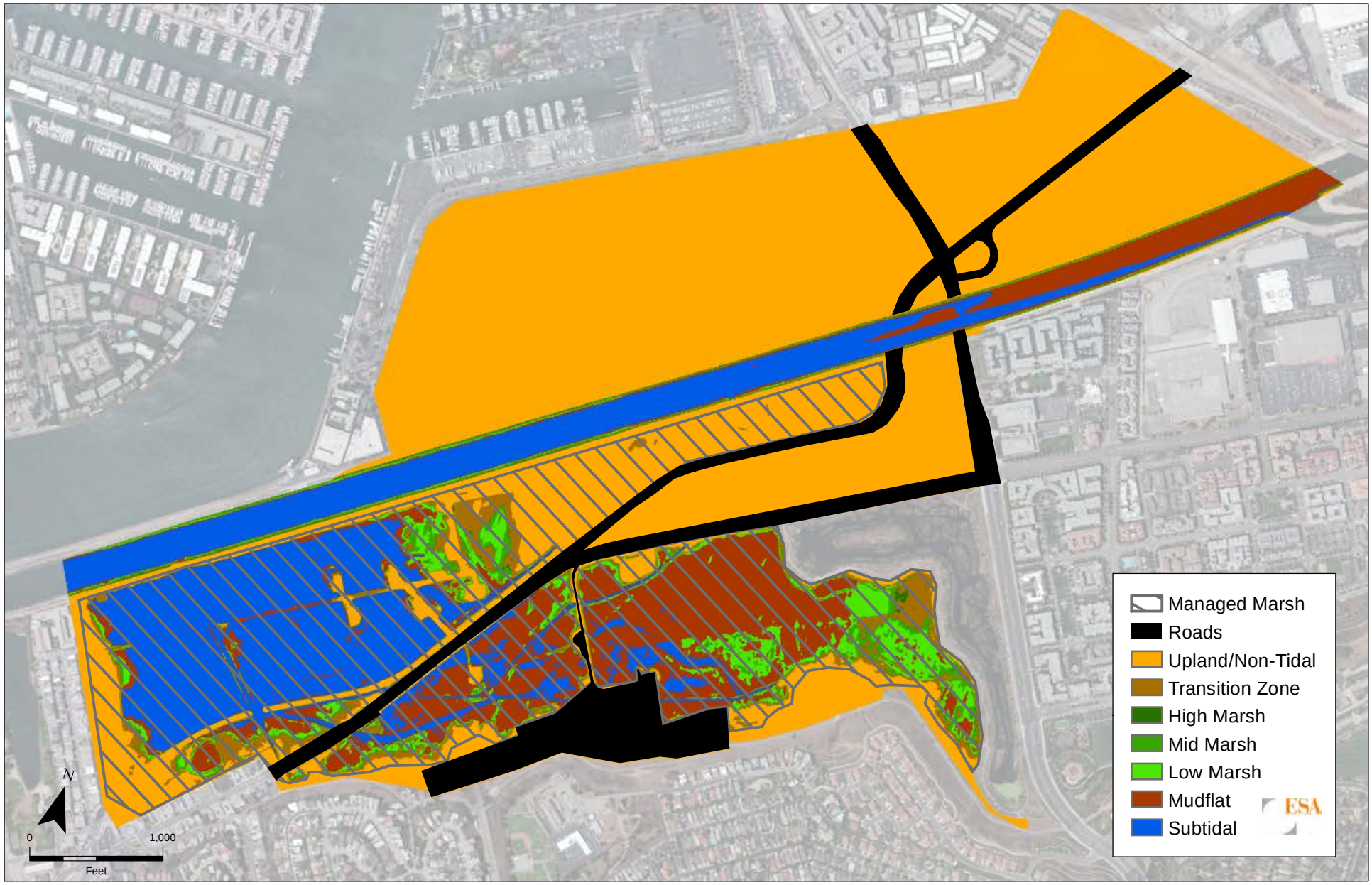
Ballona Wetlands Restoration Project

Figure 8
Alt 4 (No project), 2050



Ballona Wetlands Restoration Project

Figure 9
Alt 4 (No project), 2070



Ballona Wetlands Restoration Project

Figure 10
Alt 4 (No project), 2100

APPENDIX B8
Ballona Wetland Feasibility Report

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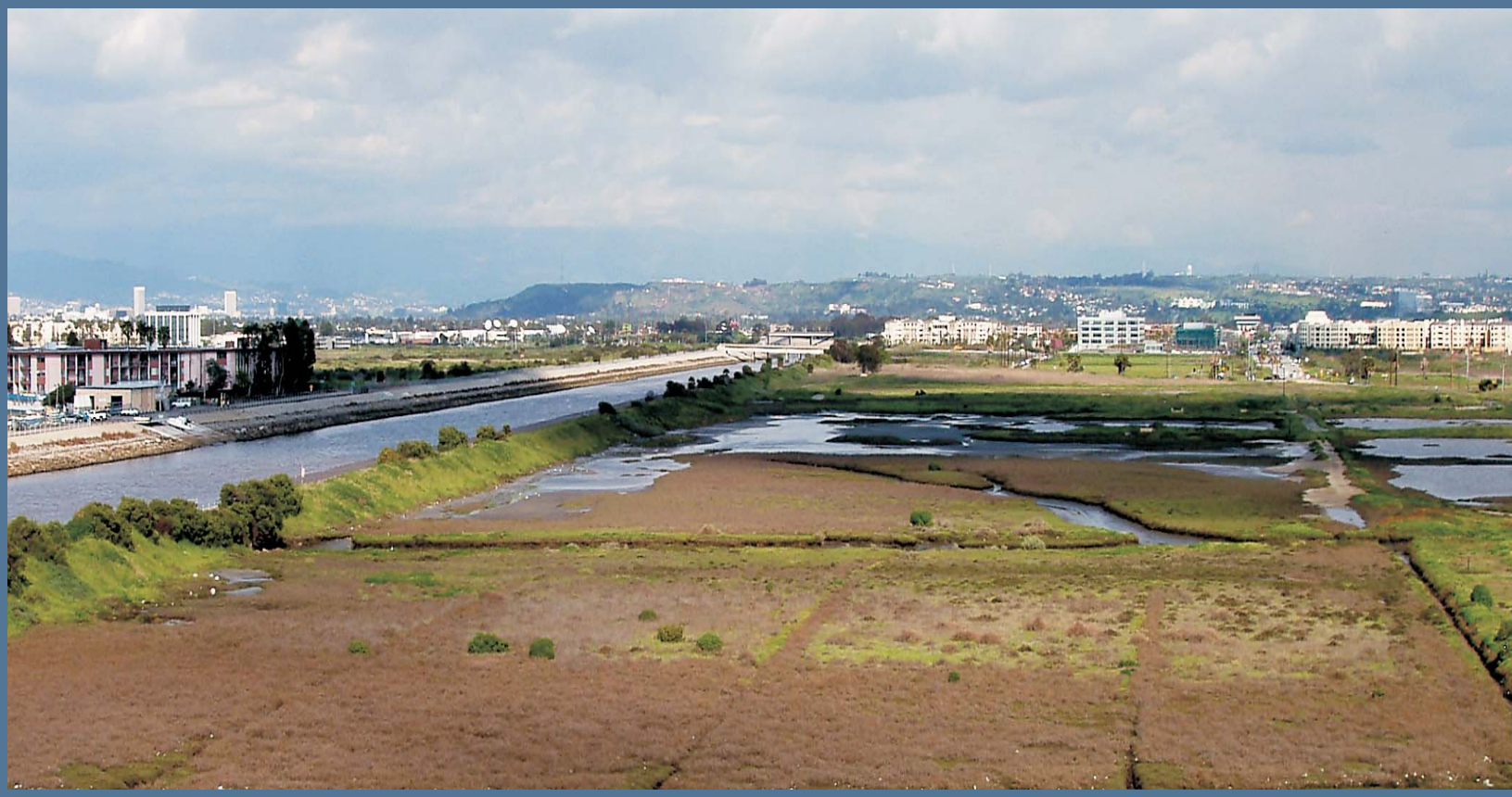
September 2008

Ballona Wetland Feasibility Report

Prepared For *California State Coastal Conservancy*



Prepared By

Philip Williams & Associates, Ltd.

with

EDAW,
Nordby Biological Consulting,
Tierra Environmental, and
Weston Solutions

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Ballona Wetlands Restoration
Feasibility Report

Prepared for

California State Coastal Conservancy

Prepared by

Santa Monica Bay Restoration Commission
Philip Williams & Associates, Ltd.

with

EDAW
Nordby Biological Consulting
Tierra Environmental
Weston Solutions

September 2008

PWA REF. # 1793.00

Services provided pursuant to this Agreement are intended solely for the use and benefit of the California State Coastal Conservancy.

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1. INTRODUCTION

In 2004, the State of California took title to 600-acres of the remaining Ballona Wetlands in Los Angeles (Figure 1-1). The property is owned by two state agencies, the Department of Fish and Game (DFG) and the State Lands Commission. The State Coastal Conservancy (Conservancy) has funding for planning and restoring the property. Together, the three agencies are working with stakeholders, scientists and other agencies to develop a plan to restore this extraordinary resource. The Conservancy is providing funds for the planning effort and manages the work plan, budget, and schedule. DFG would be the applicant for any permits needed for the restoration project and the lead agency for purposes of CEQA. A restoration plan would be developed for all of the lands owned by the state. Planning is being conducted within the landscape and watershed context, incorporating adjacent and ecologically related resources.

This document characterizes the differences between five preliminary alternatives for the Ballona Wetlands Restoration Plan developed and refined by the Project Management Team (PMT), with the advice of the Ballona Wetlands Working Group, Science Advisory Committee, Agency Advisory Committee, and the consultant team. The aim is to provide a consistent set of information for each alternative using measures of change developed from the project's Goals and Objectives (Appendix A). These measures of change provide the ability to objectively determine how each alternative moves towards a specific project objective from the existing baseline conditions. The PMT would use this information to screen out infeasible or undesirable alternatives from advancing to the EIS/EIR process.

While the report is structured around five alternatives, they are discussed for each subarea within the Ballona Wetlands when appropriate, allowing the preferred alternative(s) to be developed from a combination of alternatives from different subareas. Area A refers to the portion of the Ballona Wetlands north of Ballona Creek to the west of Lincoln Boulevard. Area B refers to the portion south of Ballona Creek. Area C refers to the area north of Ballona Creek and east of Lincoln Boulevard.

Chapter 2 of the report provides an overview of the five alternatives, highlighting the changes from the existing conditions of the site, as well as the habitat restoration and public access objectives accomplished by each alternative. The alternatives encompass a reasonable range of options for restoring estuarine habitat within each of the different subareas (see Appendix B for habitat descriptions). These options include:

- Enhance existing habitat with minimal grading
- Muted tidal wetland restoration within existing constraints
- Full tidal wetland restoration, supporting all associated habitat types, and requiring significant site alteration

- Full tidal wetland and subtidal habitat restoration, providing a connection between these habitats with the project site, and requiring significant site alteration.
- Realignment of Ballona Creek, allowing interaction between the creek and wetland, and providing much more habitat and functional connectivity; and, requiring significant site alteration.

For each habitat restoration alternative, a public access alternative has been developed which includes trails, gateway entrances, overlooks and pullouts.

Chapter 3 applies information from existing sources, in particular the Existing Conditions Report and hydrodynamic modeling (Appendix C), to compare the potential effects of the restoration alternatives based on the measures of change. The main themes of the feasibility assessment are:

- Habitat Acreages
- Quality of Habitat
- Habitat Connectivity (Regional and Local)
- Biodiversity
- Hydrology (Tidal Circulation and Flood Protection)
- Sediment and Water Quality
- Sustainability
- Public Access, Recreation and Safety
- Phasing and Relative Costs

These themes are based on the goals and objectives for the project. Each theme is discussed in terms of how different site conditions might improve or effect desired characteristics of the theme. The evaluation is summarized in a Chapter 4 which describes the main characteristics of each alternative. The information provided in this section can then be used as an objective basis to determine how each of the alternatives accomplishes these project objectives. A summary is provided that compares the alternatives to each other based on a list of common, favorable characteristics. This summary also describes some of the trade-offs between the different approaches to restoration. A ranking of each alternative on a scale from 1 to 5 is given. These rankings are based on the best judgment of the Project Management Team, with input from the Science and Agency Advisory Committees.

1.1 SECTION 1 FIGURES



figure 1-1

Ballona Wetlands Restoration

Project Area

Proj. # 1793

PWA

2. DESCRIPTION OF ALTERNATIVES

2.1 ALTERNATIVE 1 - ENHANCE EXISTING HABITAT WITH MINIMAL GRADING

Alternative 1 (Figure 2-1) proposes minimal change relative to the existing conditions of the site. As such, this alternative emphasizes enhancement of existing upland habitats, in particular coastal sage scrub (CSS) and native grassland habitats, over creation or restoration of coastal wetland habitats. Alternative 1 would convert an area of freshwater marsh in the southeast portion of Area B to muted tidal marsh by replacing the existing Freshwater marsh culvert with a daylighted tidal channel that connects to Ballona Creek. This would provide one additional source of tidal influence to the project area. Existing tide gates would be modified to increase the muted tidal waters entering the southwest portion of Area B. Alternative 1 proposes little change to existing infrastructure such that the project area would remain fragmented and isolated by roads, Ballona Creek, berms and levees. Existing dune habitat, the constructed freshwater marsh and recreational facilities in Area C would be retained.

Area A would be managed to include seasonal wetland habitat, tidal low marsh and channel, transition zone and enhanced upland. The existing tidal connection to Berth H in Marina del Rey would not be changed.

Area B would remain similar to existing conditions with the following exceptions:

1. A small triangle of land located south of Culver Boulevard and west of proposed muted mid-marsh habitat that is currently mapped as non-tidal salt marsh/brackish marsh would be converted to CSS and transitional habitats.
2. The closing elevation of the tide gates that allow limited tidal influence in this area would be increased to admit lower high tides into the area. This would expand the area of muted tidal marsh.

Area C includes the highest elevations of the project area. Under Alternative 1, little excavation of this area is proposed. Instead, existing recreational facilities would be retained and enhanced CSS and native grassland habitat, and a small treatment wetland would be constructed.

In terms of Public Access (Figure 2-2), Area A would have a loop trail on the existing Gas Company access road, and a larger loop trail would provide access to the seasonal wetland area via a boardwalk. Gateway entrances, overlooks and a formal parking/staging area would be developed. For Area B, public access would include periphery trails, along Cabora Drive, and pedestrian crossings for a fully integrated trail network. Gateway entrances, overlooks and formal parking would be provided. Linkages between the east and west portions of Area B would be provided by two pedestrian crossings on Culver Boulevard. A pedestrian bridge located near the historic rail crossing would link Area B to Area A. Public access features in Area C would

include two loop trails originating from the gateway entrances at La Villa Marina and near the Little League fields. A parking area would continue to be located at the Little League fields.

2.2 ALTERNATIVE 2 - A SMALLER AREA TIDAL WETLAND RESTORATION

Alternative 2 (Figure 2-3) includes a departure from existing conditions through excavation of fill to create fully tidal channels, low marsh, and mid-high salt marsh. Alternative 2 would also convert an area of freshwater marsh in the southeast portion of Area B to muted tidal marsh by replacing the existing Freshwater Marsh culvert with a daylighted tidal channel that connects to Ballona Creek. This would provide one additional source of tidal influence to the project area. Existing connections would be modified by adjusting the setting of the existing tide gates to increase the muted tidal waters entering the southwest portion of Area B. The connection under Dock 52 to Marina del Rey would be enhanced, creating a full tidal marsh in Area A. Alternative 2 proposes little change to existing infrastructure such that the project area would remain fragmented and isolated by roads, Ballona Creek, and berms and levees. Existing dune habitat, constructed freshwater marsh and recreational facilities would be retained.

Area A would be modified to include fully tidal channels, low and mid-high marsh, and associated transition zone habitats. This would be accomplished by increasing the tidal connection under Dock 52 to create an open culvert with a cross-sectional area of 100 ft^2. The remainder of Area A would be converted to enhanced CSS and native grassland habitat.

The southeast portion of Area B (Area B southeast) would be modified to include fully tidal channels, low and mid-high marsh, and associated transition zone habitats. In Area B southwest, the degree of tidal influence would be increased through modification of the existing tide gates. A new culvert with a cross-section of 100 ft^2 would provide a new fully tidal connection to Area B southwest. Like Alternative 1, a small triangle of land located south of Culver Boulevard that is currently mapped as non-tidal salt marsh/brackish marsh would be converted to CSS and transition zone habitats

Alternative 2 would create a small, deeper extension of Fiji Ditch in Area C beneath Lincoln Boulevard resulting in an incremental increase in fully tidal channel, low and mid-high marsh habitats and transition zone habitat beyond that proposed in Alternative 1. The recreational facilities, CSS and native grassland habitat would be retained and small areas of seasonal wetland and treatment wetlands created.

In Area A, a loop trail on the existing Gas Company Road, and a perimeter trail, around the new wetlands, connecting the gateway entrance along Fiji Way to the Ballona Creek Bicycle trail along the north levee would be developed (Figure 2-4). Boardwalk spur trails at the Fiji Way and Fisherman's Village gateway entrances would provide access to overlooks. Public access features in Area B would be similar to Alternative 1. Public access features in Area C would include two loop trails originating from the gateway entrances at La Villa Marina and near the Little League

fields. A parking area would continue to be located at the Little League fields. An overlook would be located near the seasonal wetland area.

2.3 ALTERNATIVE 3 - A LARGER AREA TIDAL WETLAND RESTORATION

Alternative 3 (Figure 2-5) would create additional estuarine habitat relative to Alternative 2 resulting in further increases in fully tidal channel, low marsh and mid-high marsh habitats and associated transition zone habitat. Culver Boulevard, Jefferson Boulevard and the Gas Company road in Area B would be improved by raising the roads on levees or piles; these would provide greater hydraulic connectivity through larger culverts or between piles. Portions of the project area would remain fragmented and isolated by Ballona Creek and Jefferson Boulevard. Existing dune habitat, constructed freshwater marsh and recreational facilities would be retained.

Area A would be modified to include fully tidal channels, low marsh and mid-high marsh and associated transition zone habitats. This would be accomplished by increasing the tidal connection under Dock 52 to create an open culvert with a cross-sectional area of 160 ft^2. The remainder of Area A would be converted to enhanced CSS and native grassland habitat.

In Area B, Alternative 3 would increase the degree of tidal influence in the southwest wetland by replacing the SRT with a 100 foot wide breach. The alternative also includes extension of existing fully tidal channels and raising Culver Boulevard on pilings or levees and removal of the berm south of Culver Boulevard. Most available area would be converted to fully tidal habitats and transition zone habitat. The southeast wetland would be connected as in Alternative 2.

Alternative 3 would create a small, deeper extension of Fiji Ditch in Area C and excavation of a small tidal marsh resulting in an incremental increase in fully tidal channel habitat and an increase in transition zone habitat beyond that proposed in Alternative 2. The recreational facilities, CSS and native grassland habitat would be retained and two small areas of seasonal wetland would be created.

Key provisions for public access (Figure 2-6) in Area A are a looping perimeter trail along the banks of the restored wetland. This trail links gateway entrances along Fiji Way to those along the north levee. Gateway entrances would be located at the existing parking area near Fisherman's Village, along Fiji Way, and two along the Ballona Creek Bicycle Path. Boardwalk spur trails at the Fisherman's Village and Fiji Way gateway entrances would provide access to overlooks. These overlooks would provide both an easily accessible viewing point and a key location for interpretive and educational signage. A formal parking/staging area would be developed at the gateway entrance near Fisherman's Village. In Area B, roadside vehicular pullouts would be provided along Culver and Lincoln Boulevards. A link between the east and west portions of Area B would be provided by a pedestrian crossing located on Culver Blvd. A pedestrian bridge located near the historic rail crossing would link Area B to Area A. Formal parking areas would be located at the gateway entrance behind Gordon's Market and along Jefferson Blvd at the Freshwater Marsh. Public access features in Area C would include two loop

trails originating from the gateway entrances at La Villa Marina and near the Little League fields. A parking area would continue to be located at the Little League fields. Overlooks would be located at viewing points for the seasonal wetland area near the Little League fields and north of Culver Blvd at the restored estuarine wetland area.

2.4 ALTERNATIVE 4 - A LARGE AREA TIDAL WETLAND RESTORATION WITH SUBTIDAL COMPONENT

Alternative 4 (Figure 2-7) resembles Alternative 3 with the exception of a larger connection with Marina del Rey and creation of shallow subtidal and intertidal habitats in Area A. This increased excavation would create a shallow subtidal basin and increased intertidal mudflats, while shifting the excavation to the northwest edge of Area A would allow for the creation of a more diverse marsh plain. Culver Boulevard and the levee system south of Culver Boulevard would be improved by raising the road on piles or a levee, these would provide greater hydraulic connectivity through larger culverts or between piles. Portions of the project area would remain fragmented and isolated by Ballona Creek and Jefferson Boulevard. Existing dune habitat, constructed freshwater marsh and recreational facilities would be retained.

Area A would be modified to include a shallow subtidal embayment, tidal channels, intertidal mudflat, low salt marsh, mid-high marsh and associated transition zone habitats. This would be accomplished by increasing the tidal connection under Dock 52 to create an open culvert with a cross-sectional area of 500 ft^2. A narrow, linear strip adjacent to Ballona Creek would be converted to enhanced CSS habitat.

In Area A there would be a loop trail on the existing Gas Company Road, and a perimeter trail along the southern edge of the restored estuarine wetland, portions of which would be boardwalk (Figure 2-8). Gateway entrances would be located at the existing parking area near Fisherman's Village and along the Ballona Creek Bicycle Path. The loop and perimeter trails would link the gateway entrance near Fisherman's Village to the Ballona Creek trail located along the north levee and the two gateway entrances along Ballona Creek. Overlooks would be located near the Fisherman's Village gateway entrance and along the perimeter trail. A formal parking/staging area would be developed at the gateway entrance near Fisherman's Village. Public access features in Area B and C would be the same as Alternative 2.

2.5 ALTERNATIVE 5 - A REALIGNMENT OF BALLONA CREEK

Alternative 5 (Figure 2-9) proposes the greatest amount of change to the project area, including the greatest degree of fully tidal wetland creation. The most obvious change would be the removal of the Ballona Creek flood control channel levees and creation of a sinuous natural creek and associated tidal basins through the site. The site would be interconnected across all areas, with shallow subtidal and mudflats grading through all marsh habitats to higher wetland-upland transition habitat. The channel would be free to migrate across the tidal floodplain, limited where necessary by buried rock protection. The existing Ballona Creek channel would be filled where

necessary. The intersection of Culver and Jefferson Boulevards would be moved westward, closer to Lincoln. Culver and Lincoln Boulevard would be raised on pilings above the fully tidal marshlands. The gas/oil monitoring facilities in Area A and recreational facilities in Area C would be minimized and converted to fully-tidal channel, low, and. mid-high marsh, transition zone and enhanced CSS. The constructed freshwater marsh and existing dunes would be retained.

Phasing would be an important aspect of this alternative. Phase 1 would lower the levees and surface elevations and excavate the main channel in Area A; Phase 2 would extend the channel into Area B; Phase 3 would extend the channel into Area C following the raising of Lincoln Boulevard.

Areas A, B and C would be modified to include the reengineered fully-tidal Ballona Creek, two shallow tidal ponds, tidal channels, low salt marsh, mid-high marsh and associated transition zone habitats. The northern breakwater of Ballona Creek would be lowered to allow flood flows to spill into Marina Del Rey. Buried rock protection would be provided along the south east edge to prevent the channel meandering too far west. A narrow, linear strip in the north and west portions of the area would be converted to enhanced CSS habitat.

A perimeter trail would be constructed along Fiji Way and gateway entrances located at the existing parking area near Fisherman's Village and along Fiji Way (Figure 2-10). A boardwalk containing an overlook would link the two gateway entrances as well as overlooks located at both gateway entrances. A vehicular pullout would be located along Culver Blvd and would also provide an overlook. Linkages within Area A would be provided through two pedestrian crossings located along Lincoln Blvd. A formal parking/staging area would be developed at the gateway entrance near Fisherman's Village. Area B gateway entrances would be located behind Gordon's Market, along the southern bank of Ballona Creek, along Lincoln Blvd, and along Jefferson Blvd at the entrance to the Freshwater Marsh. Boardwalk spur trails leading to overlooks would be located along the Freshwater Marsh Trail and at a vehicular pullout along Culver Blvd. Overlooks would also be located at the existing Boy Scout Overlook Platform, at the gateway entrance along the south levee, and along the Cabora Drive trail at Pershing Drive. Linkages throughout Area B would be provided by three pedestrian crossings located on Culver Blvd. An upland area along Lincoln Boulevard provides for a possible visitor center location. Formal parking areas would be located at the gateway entrance behind Gordon's Market, at the visitor center, and along Jefferson Blvd at the Freshwater Marsh.

Public access features in Area C would include a perimeter trail from the La Villa Marina gateway entrance to the Lincoln Blvd pedestrian crossing to Area A. Regional trail connectivity would be preserved by connecting the Ballona Creek Bicycle Trail (previously located on the north levee) to a dual pedestrian and bicycle trail along the southern boundary of Area C. This trail would continue both to the north along Lincoln Blvd and to the south along Culver Blvd. Since both roads would be improved within this restoration alternative, improved bicycle lanes would facilitate this regional connectional. A pedestrian bridge would cross Ballona Creek

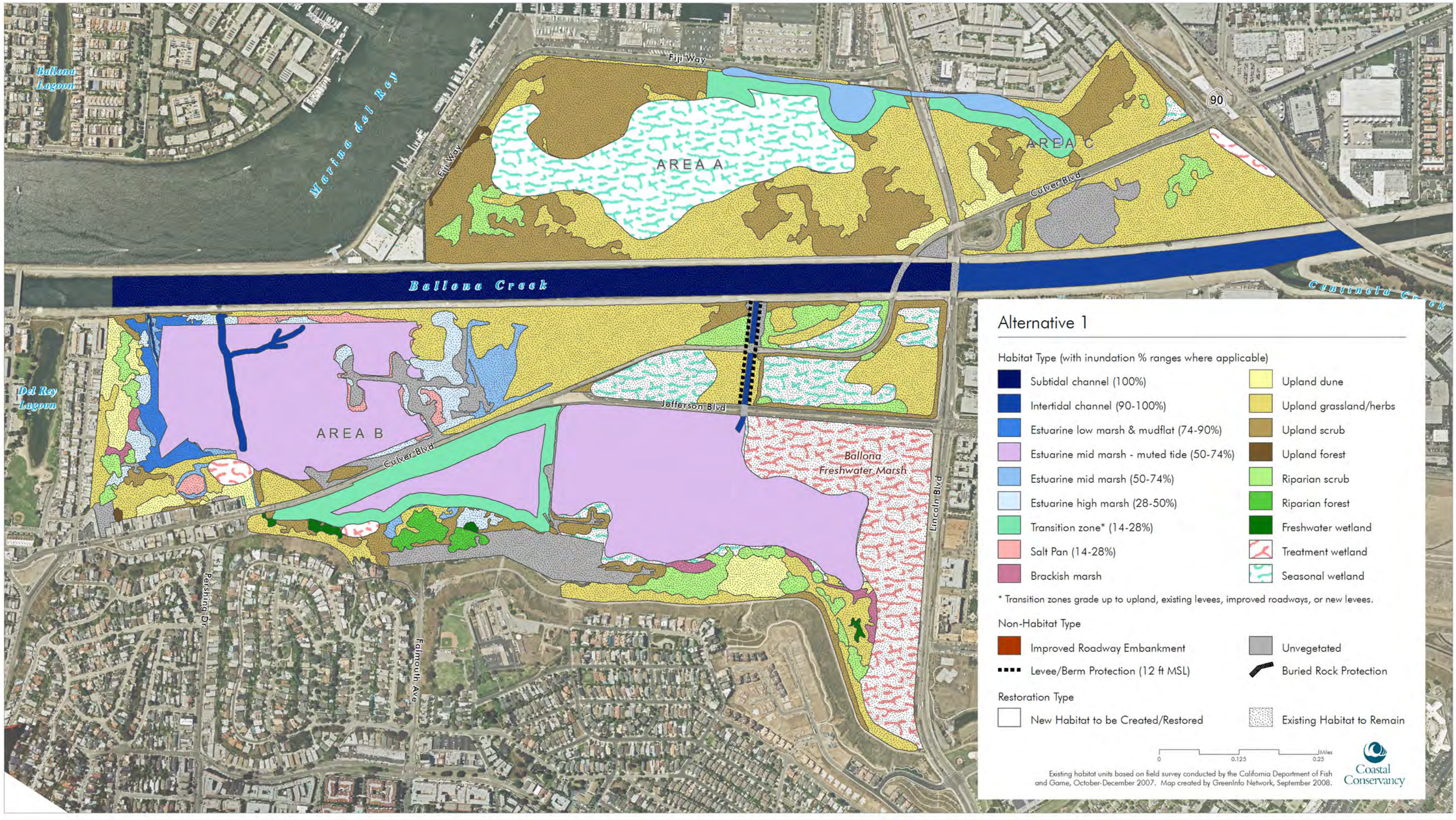
connecting this new trail alignment to the existing Ballona Creek Bicycle Trail. An overlook would be located at the La Villa Marina gateway entrance.

2.6 SECTION 2 FIGURES

Ballona Wetlands
Restoration Project

FIGURE 2-1

Alternative 1 - Habitat Restoration



Alternative 1

Habitat Type (with inundation % ranges where applicable)

- Subtidal channel (100%)
- Intertidal channel (90-100%)
- Estuarine low marsh & mudflat (74-90%)
- Estuarine mid marsh - muted tide (50-74%)
- Estuarine mid marsh (50-74%)
- Estuarine high marsh (28-50%)
- Transition zone* (14-28%)
- Salt Pan (14-28%)
- Brackish marsh
- Upland dune
- Upland grassland/herbs
- Upland scrub
- Upland forest
- Riparian scrub
- Riparian forest
- Freshwater wetland
- Treatment wetland
- Seasonal wetland

* Transition zones grade up to upland, existing levees, improved roadways, or new levees.

Non-Habitat Type

- Improved Roadway Embankment
- Levee/Berm Protection (12 ft MSL)
- Unvegetated
- Buried Rock Protection

Restoration Type

- New Habitat to be Created/Restored
- Existing Habitat to Remain

0 0.125 0.25 Miles

Existing habitat units based on field survey conducted by the California Department of Fish and Game, October-December 2007. Map created by GreenInfo Network, September 2008.

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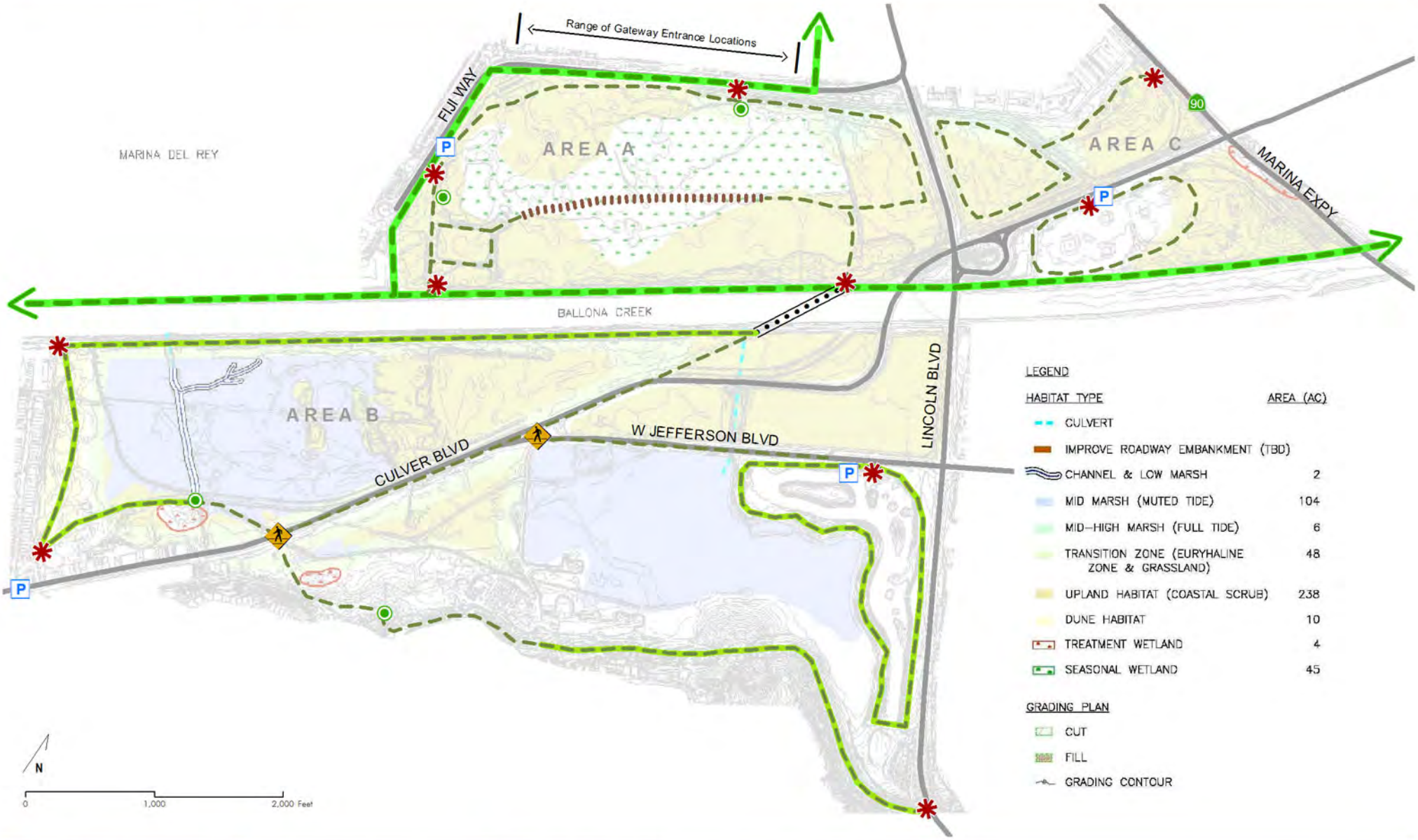
Ballona Wetlands
Restoration Project

FIGURE 2-2

Alternative 1 - Public Access



Gateway Entrance
Overlook
Parking Area
Pedestrian Crossing
Pedestrian Bridge
Boardwalk
Existing Regional Trail
Proposed Regional Trail
Existing Trail Network
Proposed Trail Network

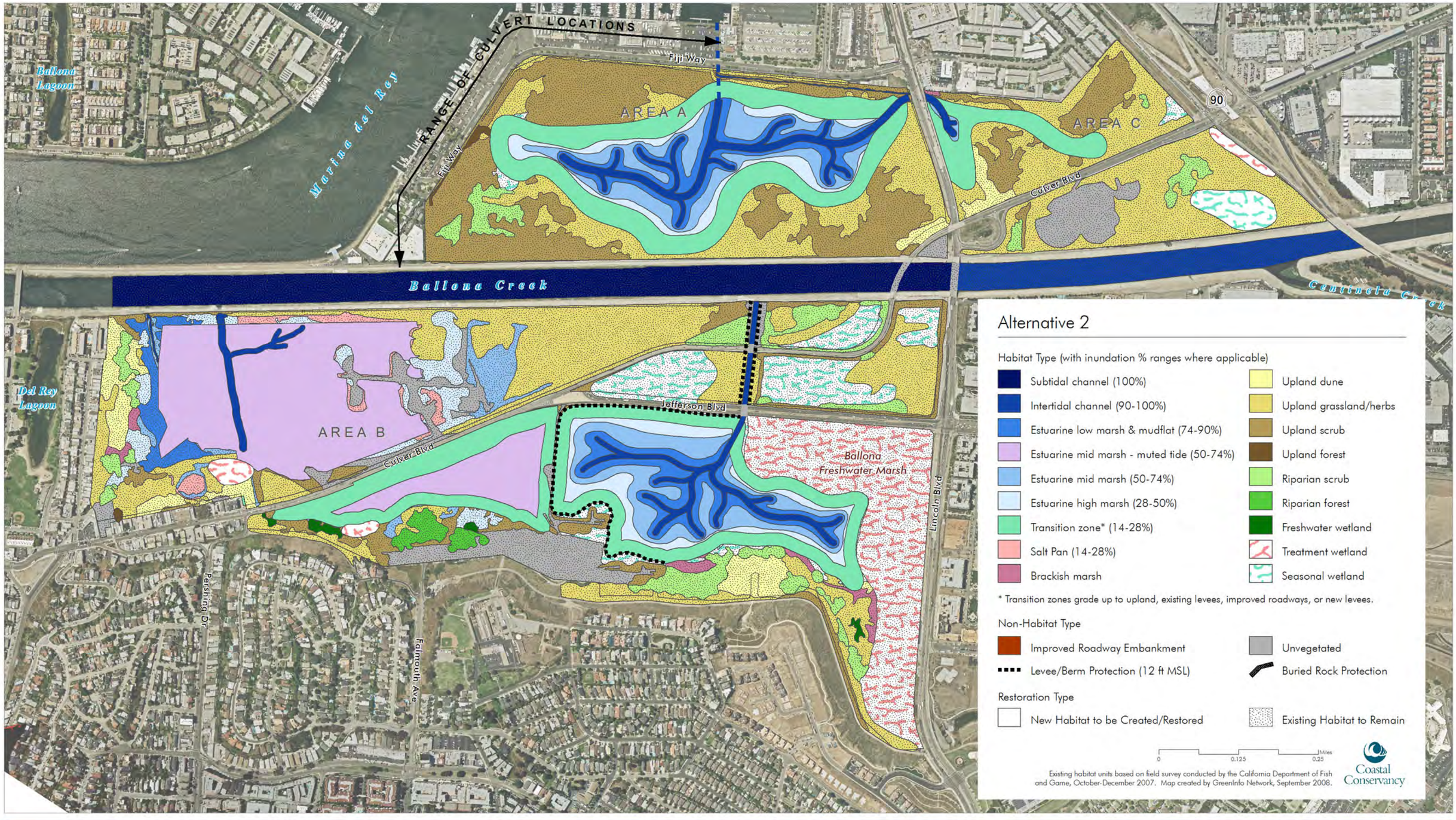
Coastal Conservancy

Habitat concepts created by Philip Williams and Associates (PWA) and EDAW. Map created by GreenInfo Network and EDAW, September, 2008.

Ballona Wetlands
Restoration Project

FIGURE 2-3

Alternative 2 - Habitat Restoration



Alternative 2

Habitat Type (with inundation % ranges where applicable)

- Subtidal channel (100%)
- Intertidal channel (90-100%)
- Estuarine low marsh & mudflat (74-90%)
- Estuarine mid marsh - muted tide (50-74%)
- Estuarine mid marsh (50-74%)
- Estuarine high marsh (28-50%)
- Transition zone* (14-28%)
- Salt Pan (14-28%)
- Brackish marsh
- Upland dune
- Upland grassland/herbs
- Upland scrub
- Upland forest
- Riparian scrub
- Riparian forest
- Freshwater wetland
- Treatment wetland
- Seasonal wetland

* Transition zones grade up to upland, existing levees, improved roadways, or new levees.

Non-Habitat Type

- Improved Roadway Embankment
- Levee/Berm Protection (12 ft MSL)
- Unvegetated
- Buried Rock Protection

Restoration Type

- New Habitat to be Created/Restored
- Existing Habitat to Remain

0 0.125 0.25 Miles

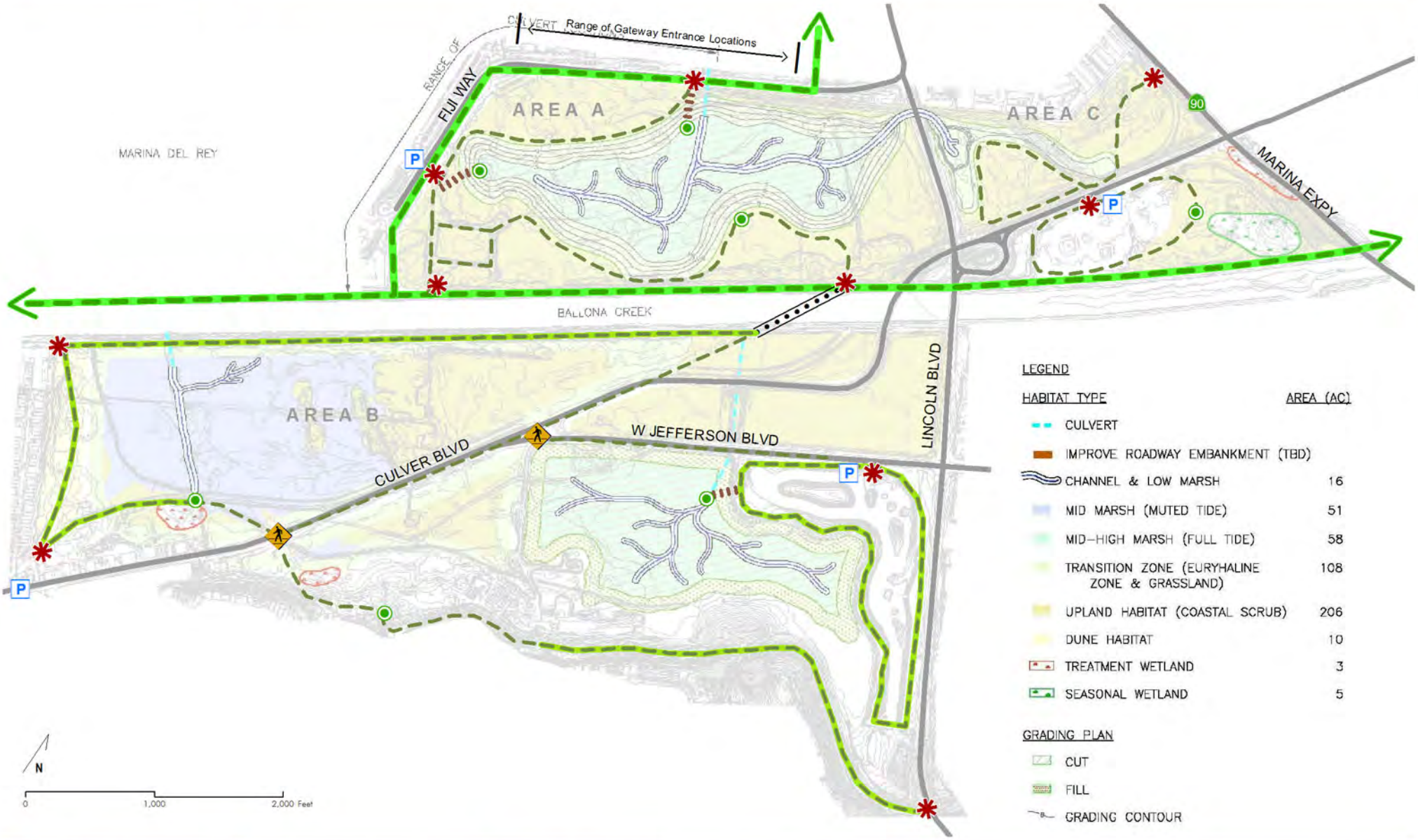
Existing habitat units based on field survey conducted by the California Department of Fish and Game, October-December 2007. Map created by GreenInfo Network, September 2008.

Coastal Conservancy

Ballona Wetlands
Restoration Project

FIGURE 2-4

Alternative 2 - Public Access



LEGEND

HABITAT TYPE	AREA (AC)
CULVERT	
IMPROVE ROADWAY EMBANKMENT (TBD)	
CHANNEL & LOW MARSH	16
MID MARSH (MUTED TIDE)	51
MID-HIGH MARSH (FULL TIDE)	58
TRANSITION ZONE (EURYHALINE ZONE & GRASSLAND)	108
UPLAND HABITAT (COASTAL SCRUB)	206
DUNE HABITAT	10
TREATMENT WETLAND	3
SEASONAL WETLAND	5

GRADING PLAN

- CUT
- FILL
- GRADING CONTOUR

- Gateway Entrance
- Overlook
- P Parking Area
- Pedestrian Crossing
- Pedestrian Bridge
- Boardwalk
- Existing Regional Trail
- Proposed Regional Trail
- Existing Trail Network
- Proposed Trail Network

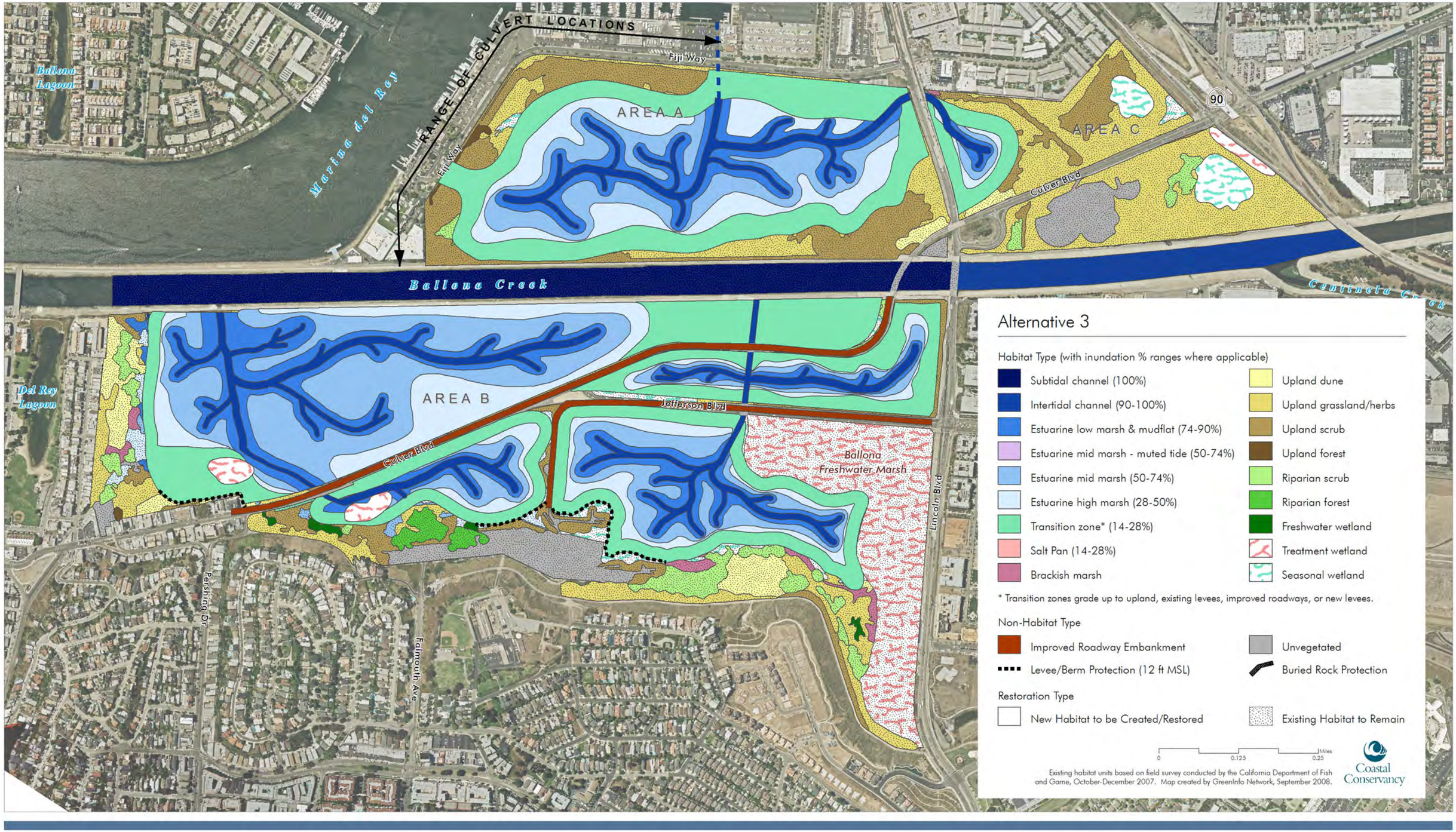
Coastal Conservancy

Habitat concepts created by Philip Williams and Associates (PWA) and EDAW. Map created by GreenInfo Network and EDAW, June, 2008.

Ballona Wetlands
Restoration Project

FIGURE 2-5

Alternative 3 - Habitat Restoration



Alternative 3

Habitat Type (with inundation % ranges where applicable)

- Subtidal channel (100%)
- Intertidal channel (90-100%)
- Estuarine low marsh & mudflat (74-90%)
- Estuarine mid marsh - muted tide (50-74%)
- Estuarine mid marsh (50-74%)
- Estuarine high marsh (28-50%)
- Transition zone* (14-28%)
- Salt Pan (14-28%)
- Brackish marsh
- Upland dune
- Upland grassland/herbs
- Upland scrub
- Upland forest
- Riparian scrub
- Riparian forest
- Freshwater wetland
- Treatment wetland
- Seasonal wetland

* Transition zones grade up to upland, existing levees, improved roadways, or new levees.

Non-Habitat Type

- Improved Roadway Embankment
- Levee/Berm Protection (12 ft MSL)
- Unvegetated
- Buried Rock Protection

Restoration Type

- New Habitat to be Created/Restored
- Existing Habitat to Remain

0 0.125 0.25 Miles

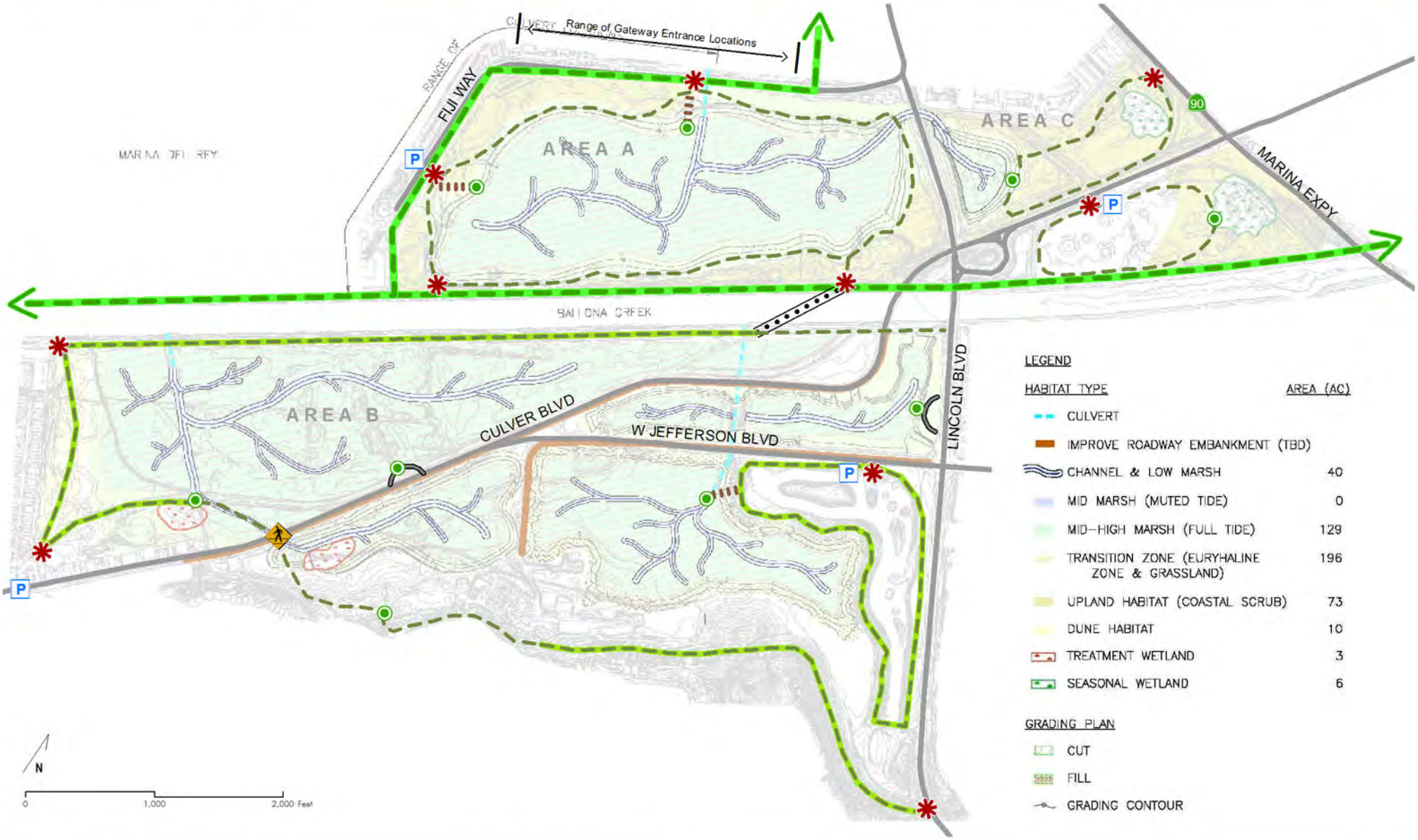
Existing habitat units based on field survey conducted by the California Department of Fish and Game, October-December 2007. Map created by GreenInfo Network, September 2008.

Coastal Conservancy

Ballona Wetlands
Restoration Project

FIGURE 2-6

Alternative 3 - Public Access



LEGEND

HABITAT TYPE	AREA (AC)
CULVERT	
IMPROVE ROADWAY EMBANKMENT (TBD)	
CHANNEL & LOW MARSH	40
MID MARSH (MUTED TIDE)	0
MID-HIGH MARSH (FULL TIDE)	129
TRANSITION ZONE (EURYHALINE ZONE & GRASSLAND)	196
UPLAND HABITAT (COASTAL SCRUB)	73
DUNE HABITAT	10
TREATMENT WETLAND	3
SEASONAL WETLAND	6

GRADING PLAN

- CUT
- FILL
- GRADING CONTOUR

- Gateway Entrance
- Overlook
- Parking Area
- Pedestrian Crossing
- Pedestrian Bridge
- Boardwalk
- Existing Regional Trail
- Proposed Regional Trail
- Existing Trail Network
- Proposed Trail Network
- Vehicular Pullout

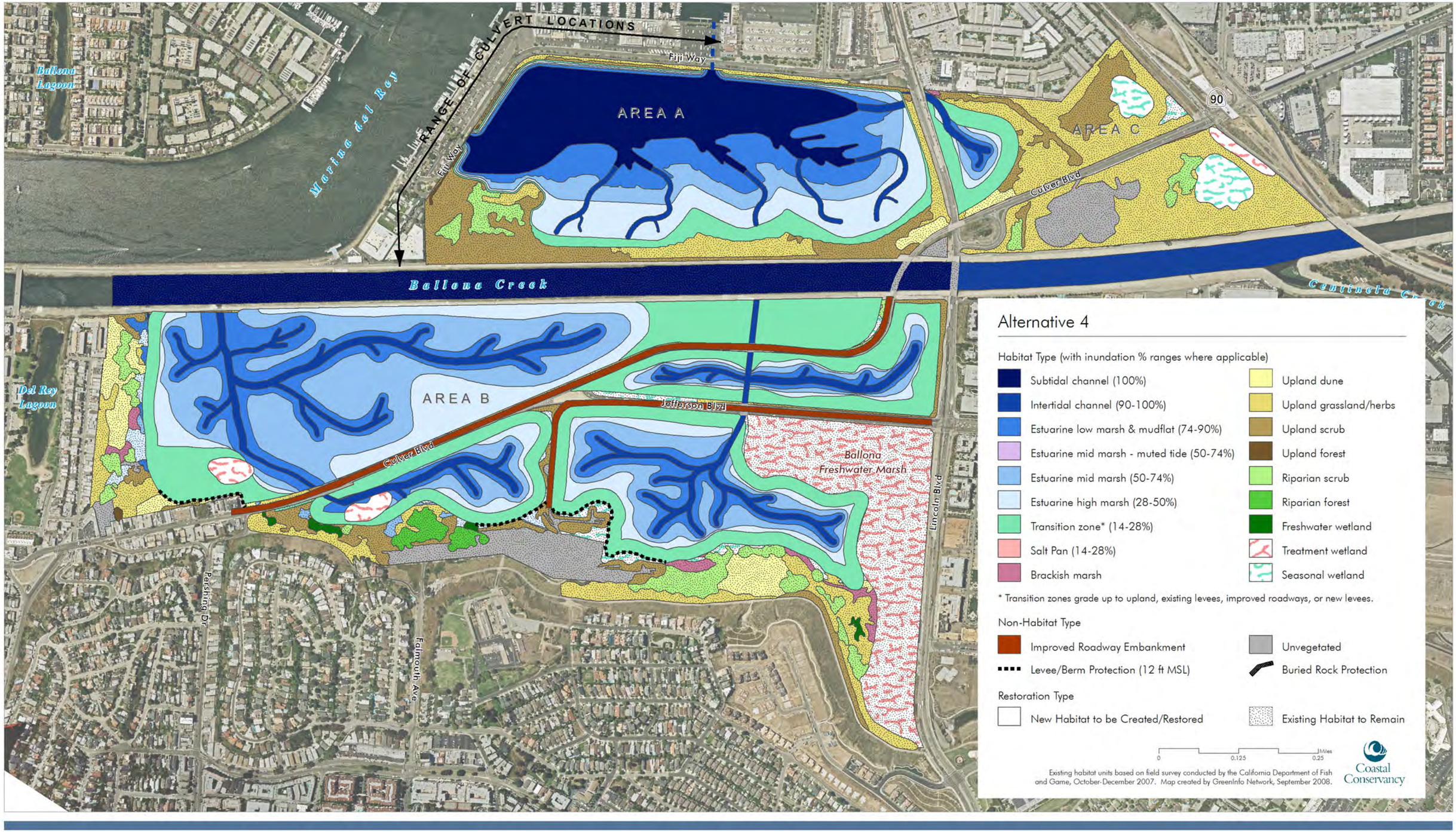
Coastal Conservancy

Habitat concepts created by Philip Williams and Associates (PWA) and EDAW. Map created by GreenInfo Network and EDAW, June, 2008.

Ballona Wetlands
Restoration Project

FIGURE 2-7

Alternative 4 - Habitat Restoration



Alternative 4

Habitat Type (with inundation % ranges where applicable)

- Subtidal channel (100%)
- Intertidal channel (90-100%)
- Estuarine low marsh & mudflat (74-90%)
- Estuarine mid marsh - muted tide (50-74%)
- Estuarine mid marsh (50-74%)
- Estuarine high marsh (28-50%)
- Transition zone* (14-28%)
- Salt Pan (14-28%)
- Brackish marsh
- Upland dune
- Upland grassland/herbs
- Upland scrub
- Upland forest
- Riparian scrub
- Riparian forest
- Freshwater wetland
- Treatment wetland
- Seasonal wetland

* Transition zones grade up to upland, existing levees, improved roadways, or new levees.

Non-Habitat Type

- Improved Roadway Embankment
- Levee/Berm Protection (12 ft MSL)
- Unvegetated
- Buried Rock Protection

Restoration Type

- New Habitat to be Created/Restored
- Existing Habitat to Remain

0 0.125 0.25 Miles

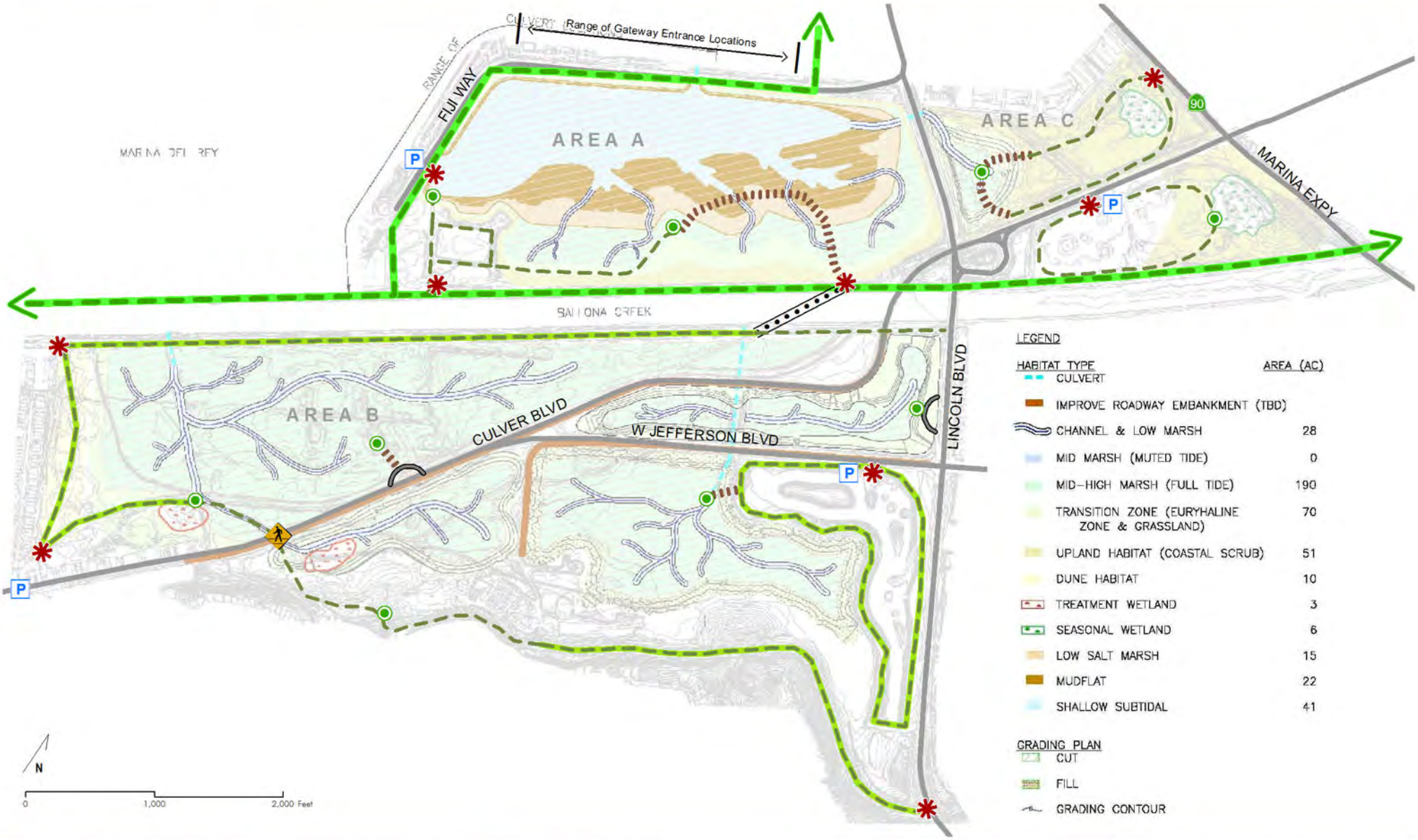
Existing habitat units based on field survey conducted by the California Department of Fish and Game, October-December 2007. Map created by GreenInfo Network, September 2008.

Coastal Conservancy

Ballona Wetlands
Restoration Project

FIGURE 2-8

Alternative 4 - Public Access



LEGEND

HABITAT TYPE	AREA (AC)
CULVERT	
IMPROVE ROADWAY EMBANKMENT (TBD)	
CHANNEL & LOW MARSH	28
MID MARSH (MUTED TIDE)	0
MID-HIGH MARSH (FULL TIDE)	190
TRANSITION ZONE (EURYHALINE ZONE & GRASSLAND)	70
UPLAND HABITAT (COASTAL SCRUB)	51
DUNE HABITAT	10
TREATMENT WETLAND	3
SEASONAL WETLAND	6
LOW SALT MARSH	15
MUDFLAT	22
SHALLOW SUBTIDAL	41

GRADING PLAN
- CUT
- FILL
- GRADING CONTOUR

- Gateway Entrance
- Overlook
- Parking Area
- Pedestrian Crossing
- Pedestrian Bridge
- Boardwalk
- Existing Regional Trail
- Proposed Regional Trail
- Existing Trail Network
- Proposed Trail Network
- Vehicular Pullout

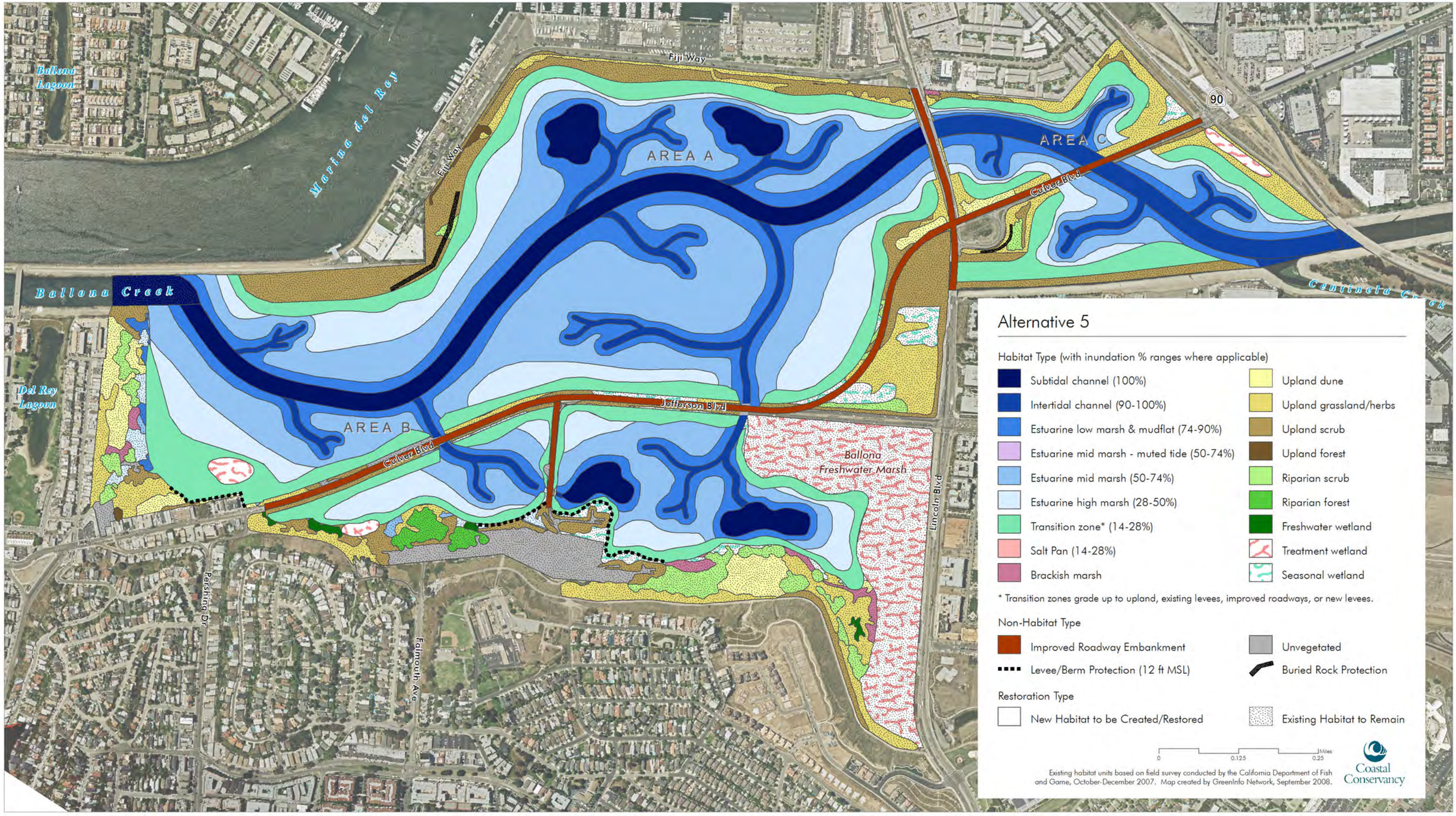
Coastal Conservancy

Habitat concepts created by Philip Williams and Associates (PWA) and EDAW. Map created by GreenInfo Network and EDAW, June, 2008.

Ballona Wetlands
Restoration Project

FIGURE 2-9

Alternative 5 - Habitat Restoration



Alternative 5

Habitat Type (with inundation % ranges where applicable)

- Subtidal channel (100%)
- Intertidal channel (90-100%)
- Estuarine low marsh & mudflat (74-90%)
- Estuarine mid marsh - muted tide (50-74%)
- Estuarine mid marsh (50-74%)
- Estuarine high marsh (28-50%)
- Transition zone* (14-28%)
- Salt Pan (14-28%)
- Brackish marsh
- Upland dune
- Upland grassland/herbs
- Upland scrub
- Upland forest
- Riparian scrub
- Riparian forest
- Freshwater wetland
- Treatment wetland
- Seasonal wetland

* Transition zones grade up to upland, existing levees, improved roadways, or new levees.

Non-Habitat Type

- Improved Roadway Embankment
- Levee/Berm Protection (12 ft MSL)
- Unvegetated
- Buried Rock Protection

Restoration Type

- New Habitat to be Created/Restored
- Existing Habitat to Remain

0 0.125 0.25 Miles

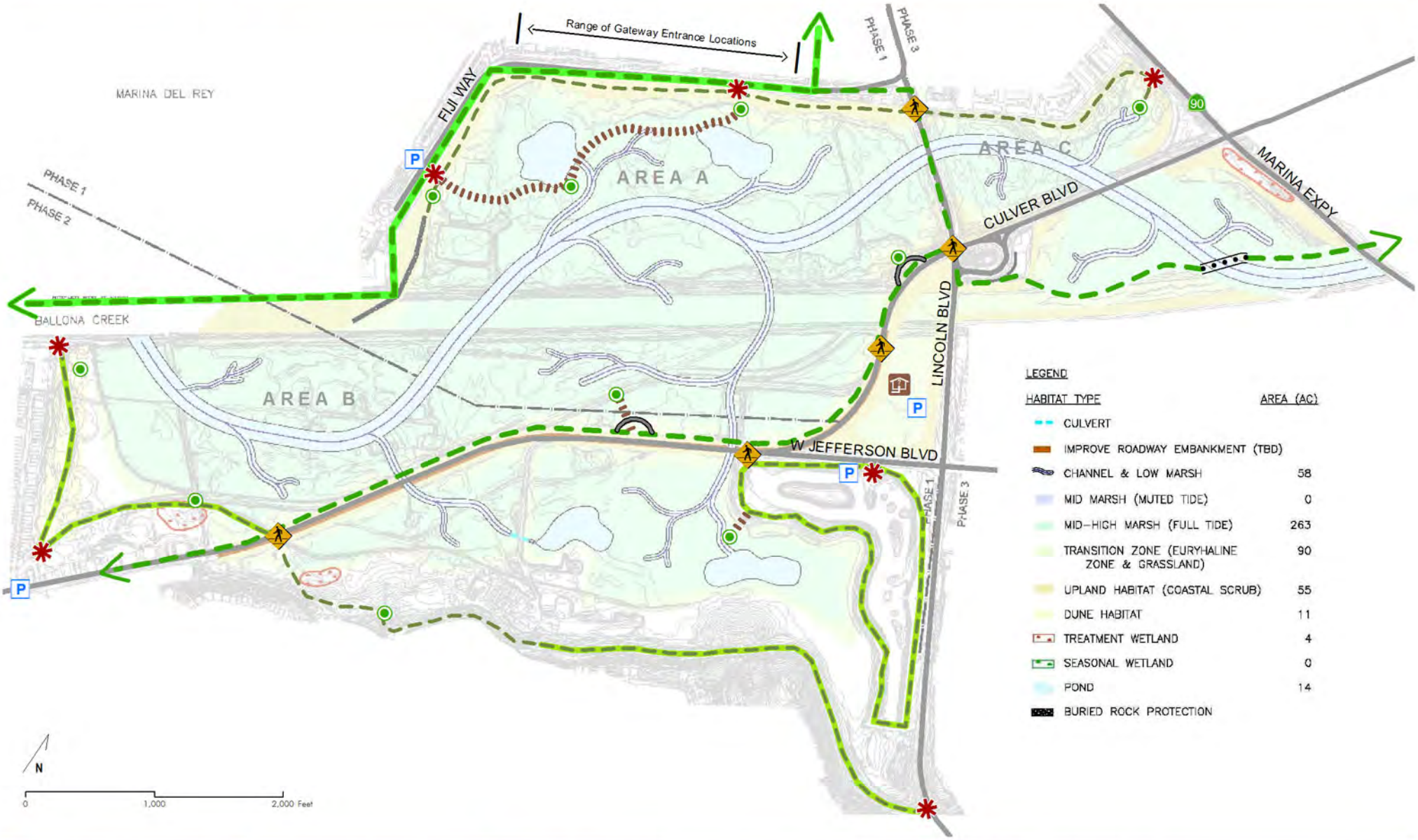
Existing habitat units based on field survey conducted by the California Department of Fish and Game, October-December 2007. Map created by GreenInfo Network, September 2008.

Coastal Conservancy

Ballona Wetlands
Restoration Project

FIGURE 2-10

Alternative 5 - Public Access



LEGEND

HABITAT TYPE	AREA (AC)
CULVERT	
IMPROVE ROADWAY EMBANKMENT (TBD)	
CHANNEL & LOW MARSH	58
MID MARSH (MUTED TIDE)	0
MID-HIGH MARSH (FULL TIDE)	263
TRANSITION ZONE (EURYHALINE ZONE & GRASSLAND)	90
UPLAND HABITAT (COASTAL SCRUB)	55
DUNE HABITAT	11
TREATMENT WETLAND	4
SEASONAL WETLAND	0
POND	14
BURIED ROCK PROTECTION	

- Gateway Entrance
- Overlook
- Parking Area
- Pedestrian Crossing
- Pedestrian Bridge
- Boardwalk
- Existing Regional Trail
- Proposed Regional Trail
- Existing Trail Network
- Proposed Trail Network
- Vehicular Pullout
- Visitor Center

Coastal Conservancy

Habitat concepts created by Philip Williams and Associates (PWA) and EDAW. Map created by GreenInfo Network and EDAW, June, 2008.

3. MEASURES OF CHANGE

3.1 HABITAT

The Ballona Wetlands historically covered over 2000-acres and likely included a mix of fluvial, tidal, deltaic and dune habitat types. Today this wetland has been reduced to less than 170 acres within the project area and the hydrology of the watershed has been severely altered by extensive development. Remnant areas of the historic wetland complex include Del Rey Lagoon, Ballona Lagoon, Grand Canal, Oxford lagoon, Marina Del Rey, and the Venice Canals. Given the significant alteration, restoring Ballona Wetlands to its historic condition is infeasible; however, the opportunity to recreate a vibrant wetland system would still require consideration of the mix of habitat types that would benefit the ecological functioning.

This section provides a brief description of the different habitat types that would be restored under each of the alternatives (for more detail see Appendix B). A number of broad habitat types are identified in the alternatives: shallow subtidal and open water habitats, intertidal channels and mudflat habitats; low, mid and high marsh and salt pan habitats; wetland-upland transition habitat; brackish marsh; seasonal wetland habitat; freshwater marsh and riparian scrub habitats; and coastal dune, coastal sage scrub and native grassland habitats. Estuarine intertidal wetland habitat includes shallow subtidal, intertidal channels, mudflats, and low, middle and high marsh, salt pan, and transition zone habitats. Each component is necessary to recreate the Ballona Ecosystem and without each component the estuarine wetlands within the system would not function properly. Some components are currently absent from Ballona, and may be important additions in the restoration of Ballona Wetlands.

Tidal Wetlands

Given the estuarine location of the site, the degree of tidal inundation would be a major factor in influencing the habitat type. The period, depth, and frequency of inundation by tidal water are dependent upon the tidal range, density of soil, degree of slope, and ground elevation.

Shallow subtidal habitats include channels, embayments, basins and other features, which at extreme low water do not drain with the outgoing tides. This estuarine water regime results in permanently flooded habitats and permanent open water bodies. These habitats are generally considered truly aquatic systems and are adjacent to and downslope from tidal estuarine wetlands. Estuaries with extensive subtidal habitat areas often support extensive intertidal low marsh and mudflat habitats, providing refugia for fish during low tides, and feeding opportunities for wetland birds.

Intertidal channels and creeks play a critical role in salt marshes as they convey tidal waters and associated nutrients and dissolved gases. They also support a complex assemblage of plants and

animals. Estuarine channels and creeks are subjected to a wide variety of environmental conditions. Typically, tidal flushing is greatest at the tidal inlet and decreases with distance from the inlet. This general gradient, in turn influences, water movement, salinity, temperature, nutrients, and dissolved gases. These environmental factors influence the species composition, distribution, and population dynamics of the channel fauna.

Intertidal mudflats are situated low in the intertidal zone, between subtidal open water and vegetated salt marsh (low marsh), at the open water edge and along channel banks. Mudflats are inundated and exposed during most tide cycles. Mudflat habitat support invertebrate population and provides valuable foraging habitat, particularly for shorebirds.

Intertidal salt marsh ranges from low marsh, dominated by California cordgrass (*Spartina foliosa*), to a diverse mosaic of species that comprises the mid-marsh, to very high marsh species that transition to upland. Salt marsh vegetation changes gradually with elevation. Nearly every species has its peak occurrence at its unique elevational band and the vegetation forms a continuum rather than a set of zones. However, the presence of shrub-like succulents at the uppermost elevations and tall cordgrass at the lowest elevations helps to delineate low to high marsh.

Low salt marsh is regularly inundated by tides and is dominated by California cordgrass that forms dense monotypic stands. At its lower elevation, cordgrass intergrades with mudflat habitat; at its upper elevation it intergrades with a mosaic of mid-marsh species. This highly productive species decomposes to form the base of the detrital food chain that supports many lower order estuarine consumers. Many of the animals of the low marsh are adapted to periods of frequent inundation.

Intermediate elevations within the salt marsh are inundated irregularly by tides but at a greater frequency than are higher elevations. As a result, the plant species that inhabit this elevation are adapted to highly saline soil conditions due to long periods of exposure. The animals of the mid-marsh are abundant and diverse. Food is abundant in the form of algae and the epifaunal invertebrates and insects that feed on algae. In addition, when flooded by the tides, fish move into the marsh plain to forage on these abundant invertebrates. Several bird species such as the Beldings' savannah sparrow and light footed clapper rail also forage in this zone.

High marsh habitats are also irregularly to intermittently inundated by tidal water and generally range from saline to hypersaline conditions. The vegetation varies depending on the density of the soil (i.e. ratio of clay to sand), which often is correlated with salinity.

Salt pans form in the high marsh where drainage is poor. These higher elevation areas along the upland edge are only inundated during the highest spring tides and typically have no tidal channels. As a result, ponded areas are formed that become hypersaline as water evaporates, thereby inhibiting vegetation establishment. These salt pans provide habitat diversity and have habitat value for foraging and refugia.

The wetland transitional zone represents that area where the halophytic (salt-tolerant) and hydrophytic salt marsh vegetation overlaps with upland communities. Scrub-shrub plant species of the transition zone overlap with the highest of the salt marsh species. The animals at the higher elevations of the transition zone are primarily terrestrial species. The transitional zone may also include nontidal palustrine habitats both salt influenced and non-saline types. Seeps from perched water tables on deltas and the toe of slopes and along dune transitions often support a variety of palustrine emergent and scrub-shrub types. Seasonal wetlands also occur in this area, especially in low-gradient deltaic deposits and may include salt pans. Transitional zones provide refugia during extreme weather or tides, as well as foraging opportunities. These areas also support a unique set of plant species, which may only occur or coexist in the habitat conditions provided in these transition zones.

Muted tidal habitats are created by the installation of gate structures and flow restrictions, which typically reduce tidal flows and the tide range compared to a fully tidal wetland. Muted tidal wetlands may support subtidal, mudflat, and vegetated wetland habitats. Hydraulic control structures have proven to severely limit fish passage, decrease tidal flushing, and restrict the diversity of habitat of a restored tidal wetland. A muted tidal system typically limits the creation of upper marsh and transitional habitat.

Additional habitats, which either occur on the site or are included in the alternatives consist of, brackish marsh, seasonal wetlands, freshwater and riparian habitat, and upland habitats, including coastal dune, coastal sage scrub and native grassland habitats. Some of these additional habitats are important to the restoration of the tidal wetland system; they may provide buffers from human disturbances, refugia during extreme weather or tides, or complementary habitats. These habitat types may also be significantly impacted in the region due to limited range along the coast.

Brackish conditions, with intermediate salinities, occur where freshwater mixes with seawater. This phenomenon is less frequent in southern California where many estuaries are less influenced by runoff from rainfall than in more northerly latitudes. Local influence from seeps and springs and seasonally impounded stream and river-mouths can produce brackish environments that support emergent vegetation and aquatic bed species.

Non-tidal Wetlands

Seasonal wetlands are non-tidal wetlands and transitional habitats that are flooded to varying degrees by seasonal rainfall and runoff. If there are sufficient salts in the soil, the seasonal wetland may support plant species more typical of coastal salt marsh. If the soils do not contain salts, the seasonal wetlands may support freshwater marsh species and a mixture of weedy opportunists. “Vernal pools” and seasonal saline wetlands in transition zones can occur on alluvial and deltaic deposits adjacent to estuarine habitats and are known to support special-status plants and invertebrate animals. A majority of the existing seasonal wetlands at Ballona occur on saline dredge spoils from the excavation of Marina del Rey. These habitats only support common

intertidal plant species in a severely degraded state, and provide little habitat for wildlife. Some of the alternatives include the creation of seasonal wetlands in areas that do not support salt marsh plant species; in these areas freshwater seasonal wetlands may be created that could support vernal pool habitat.

Riparian scrub and woodland occurs in small groves or in riverine corridors that drain into estuaries. As with other riparian habitats, riparian scrub supports a diverse assemblage of wildlife species, especially passerine bird species. Mammal assemblages are similar to those found in freshwater marsh habitats as the two often intergrade. In an undisturbed estuarine system, wouldow scrub habitat would generally occur upstream of tidal influence as wouldows are very sensitive to salt. Like freshwater marsh, this habitat is dependent upon a constant source of freshwater.

Uplands

Most of the peripheral uplands of estuaries have been disturbed in southern California. Historically, upland communities of the systems were likely comprised of coastal dunes, scrub, or grasslands, and woodlands in some cases.

Dune habitat represents a form of transition zone between the land and the sea and includes Coastal Dune Scrub and Dune Herb vegetation. Coastal dune habitats have been largely lost due to development in southern California. Prior to development, plants stabilized the loose sand, and the dunes were thereby anchored. Following human disturbance, many of the native plants were eliminated and exotics, such as sour-fig (*Carporotus edulis*) and sea rocket (*Cakile maritima*) invaded or were planted.

Coastal sage scrub can be described as low, soft to woody shrubs and subshrubs that occur in a variety of situations and are characterized by a variety of dominant plant species. Coastal Sage Scrub is now generally rare along the coast. This vegetation community is typically dominated by coastal sagebrush (*Artemisia californica*) and California buckwheat (*Eriogonum fasciculatum*), together with laurel sumac (*Malosma laurina*), white sage (*Salvia apiana*) and others. Other forms of upland coastal scrub include, for example, Delta Scrub and Baccharis Scrub, which can be transitional to wetland scrub types. A variety of terrestrial animals, including amphibians, reptiles, mammals and birds are supported by coastal scrub habitat.

Native grasslands were a common upland vegetation associated with estuarine ecosystems in southern California. Existing conditions within coastal ecosystems often include extensive areas of non-native annual grassland and forblands generally dominated by introduced species. The function and importance of perennial and annual grasslands, however, are often similar for the support of small mammals and the raptors that prey upon them.

The proposed creation of treatment wetlands provide a means of cleaning contaminated water before it enters the wetlands. Treatment wetlands require periodic maintenance, including

harvesting of wetland plants and removal of sediments as they accumulate contaminants. Thus, treatment wetlands are not considered valuable for their structure, but for their function.

3.1.1 Habitat Acreages

Each of the alternatives would make changes to the existing distribution of habitats. In some places there would be enhancement of the existing habitat, either by management or by increasing tidal inundation (for the case of muted tidal areas). In some places, there would also be replacement of existing habitat by a different habitat type, which would generally involve the regrading of the existing ground elevation and introduction of tidal flows.

For each alternative the area for each habitat type was calculated. Where the alternative did not change the existing habitat then that habitat was assumed to remain. Where a muted tidal regime has been proposed, the distribution of low, mid and high marsh has been defined by the specified tidal inundation regime.

Table 3-2 shows the acreage of each habitat type by subarea and alternative. Table 3-3 show the area of habitat type by alternative. Totals are given for estuarine, freshwater/riparian and upland habitats. These show the shift in emphasis from upland and muted tidal habitat, in the existing situation, to increasing proportion of fully tidal estuarine habitat. Alternatives 3, 4 and 5 each create over 450 acres of estuarine habitat. Included in Table 3-3 is the acreage of shallow subtidal habitat adjacent to mudflat habitat for each alternative. As noted earlier, extensive dredging and development along the southern California coastline has reduced the amount of functional subtidal habitat adjacent to mudflats and wetlands. Alternatives 4 and 5 are the only alternatives that create subtidal habitat adjacent to mudflats, each with over 40 acres.

3.1.2 Quality of Habitat

Each of the proposed restoration alternatives implies varied degrees of improvement over the current existing conditions. Alternative 1, for example, proposes minimal grading and creation of wetland habitats; however, it offers enhancement of existing uplands and seasonal wetlands, resulting in an increase in the quality of the existing habitats (CSS and palustrine wetlands on fill). For the purposes of this document, quality of habitat is described based on a variety of factors: the regional "rarity" of each habitat; the characteristics of habitat patches; the connectivity between habitats both within the project site and with adjacent complimentary habitats; the relationship to adjacent developed areas; and the degree of transition from wetland to upland habitats.

3.1.2.1 Regional Rarity

One important factor in prioritizing habitats for restoration is to identify those habitats that are rare in the region. This includes habitat types that have been lost due to development as well as habitats that require a specific combination of natural processes so that they can only be created

in a few, specific places. Regional rarity, which may be considered both in terms of local (Santa Monica Bay or Los Angeles County) or regional (Southern California coast) extent of habitats, can be used to aide in this selection.

Estuarine Wetlands

Due to the dredging of wetlands and the expansion of harbors, subtidal habitat is not regionally rare; but it is often severely degraded. Shallow subtidal habitat connected to functioning wetland habitat is rare.

Estuarine wetlands, including vegetated tidal marsh, intertidal channels, mudflats and salt pans, are a regionally rare habitat that can only be restored in very specific locations. The Ballona Wetlands has long been identified as a significant regional opportunity for estuarine wetland restoration. The Southern California Wetlands Recovery Project, identifies tidal wetland restoration as a key priority in their Regional Strategy. The Regional Strategy states tidal wetlands can only be established within a small elevation range and a compatible geologic setting, and the region's rugged topography and extensive development restricts opportunities for restoration of tidal wetlands in Southern California. The project site represents the only opportunity to restore a large tidal wetland in Santa Monica Bay, and fills a large gap in the chain of wetlands along the Southern California coast.

Transitional zones provide a rare habitat due to the unique conditions created as tidal wetlands convert to uplands with increasing elevation. These habitats are regionally rare and have been significantly impacted as tidal wetlands have been lost.

Brackish marsh habitat is found at the transition of freshwater and intertidal marsh. These habitats are regionally rare and have been significantly impacted as tidal wetlands have been lost.

Non-tidal Wetlands

The seasonal wetlands in Ballona are on saline dredge spoils and are not a naturally occurring habitat type. However, seasonal wetlands may be created that could support vernal pool habitat of much more significant value. Vernal pool habitat has been nearly extirpated from Los Angeles County. These unique habitats support plant and wildlife species that rarely occur elsewhere.

Freshwater marsh and riparian scrub/woodland have also been severely degraded throughout southern California. These habitats require a consistent surface or subsurface freshwater input. While there are additional sites in the region to restore riparian and freshwater habitat, few occur in the vicinity of the Ballona Wetlands.

Upland Habitats

Coastal dunes habitats once stretched from Torrance to Santa Monica. Some of the small remaining patches are currently being restored along the south bay. Dune habitats are also rare in the sense that they require sandy substrate and specific physical processes (wind) to be maintained. Given impacts of the development surrounding the project area, there are limited opportunities to restore functioning dune systems and there may be better opportunities for coastal dune restoration adjacent to the coast.

Coastal sage scrub habitat is considered sensitive by the CDFG, but it is much more common in southern California than coastal wetland habitats. The bluffs immediately adjacent to the site and the nearby Baldwin Hills provide significant areas for potential restoration of coastal sage scrub.

Grassland habitats provide essential foraging habitat, and much of this habitat has been lost or severely impacted along the southern California coast. Restoration of upper marsh and transitional zones may provide equivalent foraging opportunities.

3.1.2.2 Habitat Patch Characteristics

The number, size and shape of habitat patches can determine the long-term stability of the created ecosystem. Restoration plans that incorporate numerous, small patches of different habitats are less likely to be self-sustaining in the long term due to edge effects. Edge effects may include colonization by invasive exotic plant species and/or competition with dominant plant species from other nearby created native habitats. Edge effects may also be reduced in habitat patches of similar area with smaller perimeters (edges). Small patches are also more susceptible to disease as fewer individual plants or clones may equate to reduced genetic diversity. Additionally, specialized pollinators may not be supported by small habitat patches. In general, larger more genetically diverse patches are more likely to survive in the long term without active management.

Edge to area ratio and edge to area index for each alternative is presented in Table 3-4. Patches have been defined by combining together all connected estuarine habitats. Edge to area ratio is simply the ratio of perimeter length to habitat patch size. Alternatives with larger patch sizes would have a lower edge to area ratio. Edge to Area Index is the ratio of the shape's edge-to-area ratio compared to the edge-to-area ratio for a circle of the same total area. The lower the index the closer patch shape is to a circle; the shape that maximizes area and minimizes edge length.

3.1.2.3 Connectivity Between Habitat Patches

Habitat connectivity includes the connection between similar habitats, as well as the connection between complementary habitats. The degree of habitat connectivity within each restoration alternative is an important factor to determine the quality of habitat which may result. Connectivity of similar habitats allows for local migration of plant and animal species providing

alternative sites for these species when conditions of one site or patch become unsuitable, i.e., during drought. While bird and insect species may be able to migrate across roads and waterways, terrestrial animals, such as reptiles, amphibians and mammals, are prevented or discouraged from by these barriers. Tidal exchange is an important component of connectivity in a wetland system. Tidal exchange provides diurnal replenishment of gases and nutrients; conveys pelagic eggs and larvae of marine organisms, and distributes floating propagules of salt marsh and other plant species. Connectivity of wetland and to transitional or upland habitat is also important to the quality of a restored wetland, allowing migration terrestrial species to migrate to dry areas during high tides. Thus, habitat connectivity can be measured on at least three scales within a restoration project: 1) connectivity of similar habitats within the project area, 2) hydraulic connectivity between wetland/estuarine habitats and the ocean, and 3) connectivity between wetland habitats and the uplands or transition zones.

Roads or levees can affect the connectivity within the project area. They bisect habitat areas, restrict movement of species, increase the area of disturbed habitat and force channels through culverts. Alternatives 1 through 4 contain 3 miles of roads and 3.8 miles of levees, while Alternative 5 has 2.2 miles of roads and no levees within the project area.

3.1.2.4 Relationship to Adjacent Developed Areas

Transition zones affect the species diversity and function of both the intertidal wetland and the adjacent upland. This habitat supports a unique assemblage of both plants and animals that may not exist in either the adjacent upland or wetland. Thus, the inclusion of transitional habitats in restoration projects is highly desirable. Table 1 gives the areas of transitional habitat for each alternative. The approximate slopes for transitional habitats in the alternatives is about 1:50 to 1:100.

In addition to a wetland-upland transition zone, buffer areas are important for various wetland functions, such as area for transgression, sediment filtration or retention, pollution retention, habitat and food web support, and flood protection. These would improve the quality of the wetland habitat.

Typically, southern California wetlands are bounded by homes, roads and levees that create abrupt, narrow transitions from wetland to upland. This adjacency does not allow animal species the refugia needed during some tides and introduces human disturbances to the wetlands. For example, during extreme high tides, species like light-footed clapper rail are subjected to predation by cats as they are forced from their preferred low marsh habitat into adjacent uplands. In some cases, adjacent developed areas provide habitat for desirable species. For example, non-native cedar trees located to the north of the Area A provide nesting habitat for a small colony of great blue herons. These herons may forage in the wetland and upland habitats of Ballona, but it is the adjacent habitat that serves as the rookery.

3.1.3 Connectivity

Connectivity may be measured in terms of geographical position of the restored wetland relative to other similar or complimentary habitats, locally and regionally.

3.1.3.1 Connectivity Within the Greater Ballona Ecosystem

Within the greater Ballona system there exist areas of complimentary habitat. These include Del Rey Lagoon, Grand Canal, El Segundo Dunes, Oxford Lagoon, adjacent bluff areas, nearshore and beach habitat, Ballona Creek and Marina del Rey jetties and breakwater, and the Pacific Ocean. Some of these sites are hydraulically connected and support a limited wetland component; those that are not provide upland habitat primarily for avian and insect species.

Connectivity within the greater Ballona ecosystem can be accomplished, via improved hydraulic connection, for fish and other aquatic species and for wetland and upland plants. This allows exchange of nutrients gases; transportation of eggs, larvae, juveniles and adult aquatic organisms; provides habitat for avian species and a pathway for water-dispersed seed. Connection by air is possible for flying insects and birds, as well as wind-dispersed seeds. The ability to access similar habitats within the greater system provides refugia for animal species during times of environmental instability; provides greater genetic variation and a greater potential foraging area.

3.1.3.2 Regional Connectivity to Other Southern California Wetlands

A further measure of connectivity is the position of the restored wetland to other wetlands in southern California, such as Mugu Lagoon and Upper Newport Bay. Such connectivity applies primarily to avian and fish species. It may also apply to aquatic plankton and nekton and plant propagules, as these are transported tidally. Certain habitats, such as mudflat, may be created in order to facilitate the connectivity between these wetland systems by providing a string of mudflats along the southern Californian coast.

3.1.4 Tables

Table 3-1. Tidal Habitat Types with Elevation Limits and Inundation Regime
(Based upon Ferren et al, 2007)

Habitat Type	Lower	Upper	Lower	Upper
	NAVD ft	NAVD ft	% time tide exceeds	% time tide exceeds
Subtidal	-5.0	-3.0	100%	100%
Intertidal Channel /Mudflat	-3.0	1.0	100%	90%
Salt pan	4.5	5.5	28%	14%
Low Marsh	1.0	2.5	90%	74%
Mid Marsh	2.5	3.5	74%	50%
High Marsh	3.5	4.5	50%	28%
Transition Zone	4.5	5.5	28%	14%

Table 3-2. Acreage of each habitat type by area and alternative

Habitat Type	Existing					Alternative 1					Alternative 2					Alternative 3					Alternative 4					Alternative 5	
	Area A	Area B	Area C	Ballona Creek	Total	Area A	Area B	Area C	Ballona Creek	Total	Area A	Area B	Area C	Ballona Creek	Total	Area A	Area B	Area C	Ballona Creek	Total	Area A	Area B	Area C	Ballona Creek	Total	All Areas	Total
TOTAL Existing	**137.6**	**347.5**	**71.4**	**74.0**	**630.5**	**137.6**	**347.5**	**71.4**	**74.0**	**630.5**	**137.6**	**347.5**	**71.4**	**74.0**	**630.5**	**137.6**	**347.5**	**71.4**	**74.0**	**630.5**	**137.6**	**347.5**	**71.4**	**74.0**	**630.5**	**137.6**	**630.5**
TOTAL for Alternative						**137.7**	**334.7**	**71.8**	**74.0**	**618.1**	**139.8**	**335.4**	**71.7**	**74.0**	**620.9**	**141.4**	**357.3**	**71.5**	**74.0**	**644.2**	**141.4**	**356.7**	**71.5**	**74.0**	**643.5**	**632.4**	**632.4**
Subtidal				74.0	**74.0**				74.0	**74.0**				74.0	**74.0**				74.0	**74.0**	41.4			74.0	**115.4**	48.6	**48.6**
Intertidal Channel /Mudflat		1.7			**1.7**	0.3	10.2			**10.4**	2.9	8.7	0.1		**11.7**	5.6	14.5	0.3		**20.4**	25.7	14.5	0.3		**40.6**	26.2	**26.2**
Salt pan		22.4			**22.4**					**0.0**					**0.0**					**0.0**					**0.0**		**0.0**
Muted Low Marsh		8.5			**8.5**		64.7			**64.7**		37.0			**37.0**					**0.0**					**0.0**		**0.0**
Muted Mid Marsh		17.6			**17.6**		34.3			**34.3**		19.6			**19.6**					**0.0**					**0.0**		**0.0**
Muted High Marsh		40.6			**40.6**		17.8			**17.8**		10.2			**10.2**					**0.0**					**0.0**		**0.0**
Fully Tidal Low Marsh					**0.0**	1.3				**1.3**	14.7	14.2	0.4		**29.3**	27.8	72.5	1.6		**102.0**	13.5	72.5	1.6		**87.6**	131.0	**131.0**
Fully Tidal Mid Marsh					**0.0**	0.8				**0.8**	9.5	9.2	0.2		**19.0**	18.1	47.1	1.1		**66.3**	10.3	47.1	1.1		**58.4**	85.2	**85.2**
Fully Tidal High Marsh					**0.0**	0.8				**0.8**	9.5	9.2	0.2		**19.0**	18.1	47.1	1.1		**66.3**	10.3	47.1	1.1		**58.4**	85.2	**85.2**
Transition Zone					**0.0**	5.7	26.1			**31.9**	28.9	44.4	7.7		**81.1**	38.4	79.2	5.9		**123.5**	10.0	79.2	5.9		**95.2**	96.1	**96.1**
Brackish Marsh		3.0	0.1		**3.1**		2.6	0.1		**2.7**		2.6			**2.6**		2.6			**2.6**		2.6			**2.6**	2.6	**2.6**
TOTAL Estuarine	**0.0**	**93.8**	**0.1**	**74.0**	**167.9**	**8.9**	**155.6**	**0.1**	**74.0**	**238.7**	**65.6**	**155.2**	**8.6**	**74.0**	**303.5**	**108.0**	**263.0**	**10.0**	**74.0**	**455.0**	**111.2**	**263.0**	**10.0**	**74.0**	**458.2**	**474.8**	**474.8**
Fresh Water Marsh		1.1			**1.1**		1.0			**1.0**		1.0			**1.0**		1.0			**1.0**		1.0			**1.0**	1.0	**1.0**
Seasonal Wetland	10.9	74.2	0.6		**85.7**	10.9	2.5	0.6		**14.0**		2.5	4.0		**6.5**		2.5	5.8		**8.3**		2.5	5.8		**8.3**	2.5	**2.5**
Riparian Scrub	3.2	15.1	3.3		**21.6**		5.1	1.7		**6.7**		5.1	0.5		**5.6**		5.1	0.5		**5.6**		5.1	0.5		**5.6**	5.6	**5.6**
Riparian Woodland		2.9			**2.9**		2.9			**2.9**		2.9			**2.9**		2.9			**2.9**		2.9			**2.9**	2.9	**2.9**
TOTAL Freshwater/Riparian	**14.1**	**93.3**	**3.9**	**0.0**	**111.3**	**10.9**	**11.5**	**2.2**	**0.0**	**24.6**	**0.0**	**11.5**	**4.6**	**0.0**	**16.0**	**0.0**	**11.4**	**6.3**	**0.0**	**17.7**	**0.0**	**11.4**	**6.3**	**0.0**	**17.7**	**11.9**	**11.9**
Grassland/Herbaceous	64.0	62.7	49.7		**176.4**		13.3	30.0		**43.4**		13.3	7.3		**20.7**		13.2	7.3		**20.5**		13.2	7.3		**20.5**	13.5	**13.5**
Coastal Scrub	58.9	26.0	8.9		**93.9**	117.2	91.7	30.6		**239.5**	73.5	92.9	44.4		**210.9**	32.9	7.3	41.1		**81.3**	29.7	7.3	41.1		**78.1**	69.8	**69.8**
Coastal Dunes		9.9	2.1		**12.0**		8.3	2.1		**10.4**		8.3			**8.3**		8.3			**8.3**		8.3			**8.3**	8.3	**8.3**
Forest/Woodland	0.6	0.2			**0.7**		0.1			**0.1**		0.1			**0.1**		0.1			**0.1**		0.1			**0.1**	0.1	**0.1**
TOTAL Upland	**123.5**	**98.8**	**60.7**	**0.0**	**283.0**	**117.2**	**113.5**	**62.7**	**0.0**	**293.4**	**73.5**	**114.7**	**51.8**	**0.0**	**240.0**	**32.9**	**28.9**	**48.4**	**0.0**	**110.2**	**29.7**	**28.9**	**48.4**	**0.0**	**107.0**	**91.7**	**91.7**
Unvegetated/Paved		10.9			**10.9**	0.7	0.7			**1.4**	0.7	0.7			**1.4**	0.6	0.7			**1.2**	0.6				**0.6**	0.7	**0.7**
Ballfields			6.7		**6.7**			6.7		**6.7**			6.7		**6.7**			6.7		**6.7**			6.7		**6.7**		**0.0**
Gas Company		10.9			**10.9**		13.6			**13.6**		13.6			**13.6**		13.6			**13.6**		13.6			**13.6**	13.6	**13.6**
The Freshwater Marsh		39.8			**39.8**		39.8			**39.8**		39.8			**39.8**		39.8			**39.8**		39.8			**39.8**	39.8	**39.8**
TOTAL Other areas	**0.0**	**61.6**	**6.7**	**0.0**	**68.3**	**0.7**	**54.1**	**6.7**	**0.0**	**61.5**	**0.7**	**54.1**	**6.7**	**0.0**	**61.5**	**0.6**	**54.0**	**6.7**	**0.0**	**61.3**	**0.6**	**53.4**	**6.7**	**0.0**	**60.6**	**54.0**	**54.0**

Table 3-3. Summary of Habitat Acreages

Habitat Type	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Subtidal	74.0	74.0	74.0	115.4 (41.4†)	48.6 (48.6†)
Intertidal Channel And Mudflats	10.4	11.7	20.4	40.6	26.2
Low Marsh	66.0 (64.7††)	66.3 (37.0††)	102.0	87.6	131.0
Mid Marsh	35.1 (34.3††)	38.6 (19.6††)	66.3	58.4	85.2
High Marsh	18.6 (17.8††)	29.2 (10.2††)	66.3	58.4	85.2
Transitional Habitat	31.9	81.1	123.5	95.2	96.1
Brackish Marsh	2.7	2.6	2.6	2.6	2.6
Total Estuarine	**238.7**	**303.5**	**455.0**	**458.2**	**474.8**
Freshwater/Riparian	10.6	9.5	9.5	9.5	9.5
Seasonal Wetland	14.0*	6.5	8.3	8.3	2.5
Upland	293.4	240.0	110.2	107.0	91.7
Unvegetated	8.1	8.1	7.9	7.3	0.7

† Area of shallow subtidal habitat adjacent to mudflats
†† Area of muted tidal
* Habitat created on saline soils

Table 3-4. Edge/Area indices for Estuarine Wetland Habitats

Alternative	Edge to Area Ratio (ft/ac)	Edge to Area Index*
ALT1	218.3918	4.4645
ALT2	243.0364	4.7857
ALT3	193.1576	4.6057
ALT4	178.0851	4.4550
ALT5	111.3358	2.8696

* Edge to Area Index is the ratio of the shape's edge-to-area ratio compared to the edge-to-area ratio for a circle of the same total area.

3.2 BIODIVERSITY

Habitat restoration provides opportunities for the preservation of the region's plant and animal species as well as the opportunity for the recovery of lost or declining biodiversity. The biological communities of coastal southern California have experienced a decline in species richness, or diversity, as a result of loss of over 90% of their wetland habitat following urban and agricultural development. Declining biodiversity includes plant and animal species that are listed as threatened or endangered, many of which are associated with wetland habitats. Restoration of Ballona wetlands offers the opportunity to create refuges for these species and habitats for other species to recover locally and potentially act as a "seed" source for other nearby wetland systems. Because a major goal of this restoration project is to restore estuarine habitats and processes, diversity of species supported by estuarine habitats would be of particular interest. Therefore, for the purpose of this document, biodiversity is discussed in terms of the sustainable richness of representative interdependent native estuarine habitats along with their associated and expected species biodiversity. The diversity of species dependent upon other habitat types (eg. freshwater wetland or coastal dune habitats) included in the alternatives is also noted.

The five restoration alternatives for Ballona range from preservation and enhancement of large areas of upland habitat with limited wetland habitat to restoration and creation of large areas of wetlands with less upland habitat. Upland-dominated restoration should increase the biodiversity of the existing upland habitats. This would primarily benefit woody vascular plants and associated animals at the expense of opportunities to increase diversity of wetland plant and animal groups. Wetland-dominated restoration would benefit non-vascular aquatic plants, vascular plants, aquatic invertebrates, aquatic vertebrates, terrestrial invertebrates and terrestrial vertebrates.

Biodiversity is discussed at the level of large taxonomic groups. Some specific examples are given; however, not all species that may be supported by each of the restoration alternatives are discussed. For the purposes of this document, taxonomic groups are defined as vascular and nonvascular plants; terrestrial invertebrates (insects); terrestrial vertebrates (birds, herpetofuana, mammals); aquatic invertebrates (infauna and epifauna); and aquatic vertebrates (fish).

Estuarine Wetlands

Maximizing shallow subtidal habitat would benefit the biodiversity of the system especially for birds and fishes. Non-vascular plants (e.g., phytoplankton) would presumably be most functional in the upper water column where light penetration is greatest and thus would not necessarily benefit from deeper water. Similarly, vascular plants, insects, benthic invertebrates, herpetofuana and small mammals would not directly benefit from deeper salt water.

Fishes, primarily those associated with the nearshore ocean habitat, would be supported by deeper waters with a connection to the open coast. Such species as Queenfish (*Seriphus politus*), white croaker (*Genyonemus lineatus*), northen anchovy (*Engraulis mordax*) that inhabit the mid- to

upper water column would increase the biodiversity of the system as would demersal species such as California halibut and shovel-nose guitarfish (*Rhinobatos productus*).

Gulls and terns, including California least tern and such species as double-crested cormorant (*Phalacrocorax auritus*) and brown pelican (*Pelicanus occidentalis*) would be supported by increased fish diversity and abundance. Osprey (*Pandion haliaetus*) may also forage for fish in the subtidal areas.

As more tidal wetland habitat is included in an alternative, additional taxonomic groups are supported. Creation of channel, low and mid-high marsh would support non-vascular aquatic plants, vascular plants, aquatic invertebrates, aquatic vertebrates, terrestrial invertebrates and terrestrial vertebrates.

Non-vascular plants include phytoplankton, micro-algae, and macro-algae, that are found in the channels and marsh habitats. Salt marsh micro-algae are dominated by diatoms. Macro-algae include green algae and blue-green algae. Tidal influence, light penetration and nutrients are factors that can limit salt marsh algal populations.

Vascular plants that inhabit a typical Southern California tidal salt marsh include the perennials Pacific cordgrass (*Spartina foliosa*), common pickleweed (*Sarcocornia pacifica*) and fleshy jaumea (*Jaumea carnosa*), as well as annual pickleweed (*Salicornia bigelovii*). They occur in narrow elevation zones determined by the frequency of tidal inundation, salinity, duration of saturated soil, and temperature. These plants, along with non-vascular algae, contribute to the complex food web that supports the high productivity of coastal wetlands. The detritus of vascular and non-vascular plants provides food for aquatic invertebrates, including both infauna (organisms that live within the sediment) and epifauna (those that live on the surface of the sediment).

Common infauna associated with mud or sand bottoms of channel and low marsh habitats include polychaete worms and filter-feeding bivalves, such as California jackknife clam (*Tagelus californica*), littleneck clam (*Prototheca staminea*) and bent-nose clam (*Macoma nasuta*). Common epifuana of channels include detritivores, such as California horn snail (*Cerethidia californica*), bubble snail (*Bulla gouldiana*), and *Nassarius* sp., and omnivores such as lined shore crab (*Pachygrapsus crassipes*) and yellow shore crab (*Hemigrapsus oregonensis*).

Restoring intertidal mudflat area would increase the biodiversity of benthic infauna, including polychaetes, which in turn would support a higher diversity of wading birds. Perhaps the most conspicuous animals of the intertidal mudflats are the shorebirds that feed and rest there during low tide. Many of their invertebrate prey items are widely distributed, from the subtidal channels to the lower limit of the salt marsh. Wading shorebirds, such as western sandpiper (*Calidris mauri*), semipalmated sandpiper (*C. pusilla*) and dowitchers (*Limnodromus* spp.) would be expected to forage on the mudflats during their migration.

Cordgrass associated with low marsh habitat provides structure, and possibly food, for insect species, such as the larvae of *Incertella* and *Cricotopus* species, the beetle *Coleomegilla fuscilabris* and the plant hopper (*Prokelesia* sp.). The longjaw mudsucker (*Gillichthys mirabilis*) forages in the low and mid-high marsh, especially along creek banks during high tides. Mid-high marsh habitat provides food and structure for California horn snails, amphipods, and snails of the genus *Assiminea*. Water boatmen (*Trichocorixia* spp.) feed on algae in pools and in turn provide food for California killifish (*Fundulus parvipinnis*) that feed in the marsh during high tides

The wetland-dominated restoration alternatives would create/restore large blocks of habitat that would be connected via channels and tidal flows. These large blocks of habitat would be more sustainable in the long-term as they would be less susceptible to edge effects of invasive species. They would also be less susceptible to human disturbance, as many areas would be inaccessible.

Creation of channels and mudflats provides habitat for breeding and foraging for estuarine fishes. Some, such as gobies (Gobiidae), complete their life cycle in southern California estuaries, attaching their eggs to the burrows of commensal invertebrates. Other common wetland fish species, such as topsmelt (*Atherinops affinis*), attach their eggs to filamentous algal mats that also shelter their larvae and post-larvae. Species such as California halibut spawn offshore but spend the first few years of life in protected coastal waters. Still others, such as striped mullet (*Mugil cephalus*) live their lives in protected inshore habitat but spawn offshore. In general, the channels and low marsh habitats of southern California coastal wetlands act as nursery grounds for coastal fisheries.

Larger aquatic benthic invertebrates, such as snails and crabs, as well as fish, are preyed upon by a number of bird groups, including herons and egrets, wading birds and terns and gulls. Southern California coastal wetlands support dozens of species and many thousands of individual birds that migrate along the Pacific flyway. Herons, egrets, gulls, terns, shorebirds, ducks, geese, coots, gallinules and rails occur in southern California wetlands throughout most of the year. Most of these birds appear to prefer intertidal flats to salt marsh habitats for foraging and other activities. However, marsh habitats contribute to the support of birds by: providing food (either directly or indirectly), cover from predators, and structure for nesting and roosting. Birds of the low marsh include rails, such as Virginia rail (*Rallus limicola*), sora (*Porzana carolina*), and the endangered light-footed clapper rail (*Rallus longirostris levipes*).

Common bird species of the mid-high marsh include wading species such as willet (*Catoptrophorus semipalmatus*), marbled godwit (*Limosa fedoa*), long-billed curlew (*Numenius americanus*) and great blue heron (*Ardea herodias*). These species prey upon fishes and aquatic invertebrates and, in the case of herons, upland terrestrial animals such as small mammals and herpetofauna.

Terns and gulls observed in southern California coastal wetlands occur primarily in intertidal flats and on the adjacent beaches; however, some taxa do utilize salt marsh habitats. Western gull (*Larus occidentalis*) and ring-billed gull (*Larus delawarensis*) forage and roost in intertidal salt

marsh habitats while the endangered California least tern (*Sterna antillarum browni*) forages in intertidal channels. Forster's tern (*Sterna forsteri*) and elegant tern (*S. elegans*) can use a variety of wetland habitats, including salt marsh. Most of the bird groups, with exception of a few small species, forage and roost in southern California wetlands but breed elsewhere.

The mid-high marsh provides structure for some nesting birds, including the state endangered Belding's Savannah sparrow (*Passerculus sandwichensis beldingi*). This small songbird builds its nest low to the ground under marsh vegetation, such as pickleweed. Belding's Savannah sparrows forage on insects, often at the interface of marsh and channel.

Small mammals associated with southern California tidal wetlands include the western salt marsh harvest mouse (*Reithrodontomys megalotis limicola*) and meadow mouse (*Microtus californicus stephensi*). Harvest mice are granivorous, while meadow mice are primarily herbivorous. While little is known about their diets, neither feeds on pickleweed, the most common vascular plant species at Ballona.

Both upland-dominated and intermediate tidal restoration alternatives preserve areas that are currently muted-tidal wetlands. Muted-tidal wetlands provide functions similar to fully-tidal wetlands, but reduced in terms of biodiversity. For example, muted tidal channels may have similar species composition and densities of phytoplankton and benthic micro-algae but may support fewer salt marsh vascular plant species than do fully tidal channels. Similarly, fewer fish species might occur in muted tidal systems. With less tidal influence, muted tidal areas would be susceptible to periodic fresh water inflows. Conversely, during neap tides, muted tidal systems may be subjected to prolonged drying and increased salinity, unless they impounded water continuously, in which case, they would not support vascular plants. Thus, muted tidal systems are likely to be less sustainable than fully tidal systems.

Creation of wetland habitats allows for creation of transitional habitats, which would increase the regional diversity of vascular plants and terrestrial vertebrates. Examples of transition zone vascular plants include boxthorn *(Lycium californicum)*, bush seepweed *(Suaeda nigra)*, coast golden bush (*Isocoma menziesii*), and Parish's glasswort (*Arthrocnemum subterminale*). These overlap with the highest elevation salt marsh species including, for example, saltgrass, alkali weed *(Cressa truxillensis)*, and shoregrass *(Monanthochloe littoralis)*. Boxthorn is a common perch for birds and various small mammals and herpetofauna burrow beneath it or use it for shade.

The transition zone of southern California wetlands, such as Carpenteria salt marsh, have a euryhaline zone that fluctuates between wet season low salinities and dry season hypersaline conditions. The habitat is characterized by winter annual plant species such as salt marsh daisy (*Lasthenia glabrata* ssp. *coulteri*), salt marsh sand-spurry (*Spergularia marina*), toad rush (*Juncus bufonius*), and hutchinsia (*Hutchinsia procumbens*), which tolerate the fluctuating salinities by growing in the wet season.

The animals of the higher elevations of the transition zone are primarily terrestrial species. These include various snakes, lizards, small mammals and birds. Herpetofauna may include California kingsnake *(Lampropeltis getulus californiae)*, San Diego gopher snake *(Pituophus melanoleucus annectens)* and side-blotched lizard *(Uta stansburiana)*. Common mammals of the shrub-dominated transition zone include western harvest mouse, deer mouse *(Peromyscus maniculatus)*, pocket gopher (*Thomomys* sp.*)*, and California ground squirrel *(Spermophilus beechyi)*. The small mammals are preyed upon by a variety of birds including northern harrier *(Circus cyaneus)* and white-tailed kite *(Elaneus caeruleus)*. Ground-nesting bees that pollinate salt marsh bird's-beak (*Cordylanthus maritimus* spp. *maritimus*) live above the high tide in this habitat.

Non-tidal Wetlands

It is anticipated that brackish marsh would develop in areas where fresh water marsh and salt marsh intergrade. This habitat supports many of the taxa associated with both of those habitats, although species that cannot tolerate either extreme are likely to be absent. Brackish water marsh habitat has a range of conditions from briefly fresh to briefly hypersaline and would provide a small increase in the biodiversity of the wetlands. For example, *Juncus acutus* is regionally rare and can thrive where soil is at least briefly brackish; tall tules can provide critical cover for rails during high tide.

Seasonal wetlands would support regional biodiversity of non-vascular and vascular plant species, herpetofauna, birds and small mammals. However, much of the existing seasonal wetlands are on saline fill soils that would not support biodiversity. Vascular plants that might be supported include common pickleweed (*Sarcocornia pacifica = Salicornia virginica*), alkali weed (*Cressa truxellensis*), and alkali heath (*Frankenia salina*). Smaller areas of freshwater seasonal wetlands would provide breeding grounds for toad and frog species, such as Pacific chorus frog (*Pseudacris regilla*) and California tree frog (*Hyla cadaverina*). Ponded water provides nesting and foraging habitat for American avocet (*Recurvirostra americana*), black-necked stilt (*Himantopus mexicanus*) and killdeer. Small mammals common to upland habitats could also use seasonal wetlands.

Creation of vernal pool habitat has been proposed as part of upland-dominated restoration schemes. Vernal pools are regionally rare habitats, and adding water-holding depressions would increase the biodiversity of the Ballona ecosystem. Vernal pools are formed over impervious substrates, such as a soil with a subsurface clay layer that impounds seasonal rainfall. Such topography and soils are lacking from Ballona upland areas. Creation of vernal pools would benefit primarily non-vascular and vascular plants, aquatic invertebrates, and herpetofauna, although small mammals and birds may also benefit. Non-vascular species that inhabit vernal pools include diverse phytoplankton, green and blue-green micro-algae, and occasional macro-algae. These are food sources for a number of invertebrates, including fairy shrimp (*Branchinecta* spp.), several species of which are listed as endangered. Many of the vascular plants associated with vernal pools are unique in their adaptations to water levels that fluctuate widely over short periods of time. These range from fairly common species, such as isoetes (*Isoetes* spp.) to the

endangered San Diego mesa mint (*Pogogyne abramsii*). Herpetofauna, such as discussed above, would benefit from vernal pools, although survival through metamorphosis depends on the amount of rainfall and the duration of impoundment.

Created vernal pools, especially those requiring importation of clay to line the pools so they would hold water for the appropriate duration, would not only be difficult build but subject to invasion by unwanted species once wetted. Imported soils often contain plant propagules, such as non-native grasses, that could invade the proposed restoration. Furthermore, small vernal pools would be subject to edge effects. Pools that dry early in the growing season of vernal pool vascular plants would be subject to invasion by non-desirable species, such as non-native grasses.

Fresh water marsh and riparian habitats would, in some way, provide support to all of the taxonomic groups. Detritus from vascular plants, such as cattail (*Typha* spp.) and bulrushes (*Scirpus* spp.), and a variety of non-vascular algae would provide food for aquatic invertebrates, including gastropods, copepods, amphipods and decapods, and insects, such as beetles (Coleoptera), flies (Diptera) and true bugs (Hemiptera). These taxa provide food for passerine birds, such as blackbirds (*Agelaius* spp.), wrens (*Cistothorus* spp.), rails (*Rallus* ssp.) and waterfowl; fishes, primarily non-native species; herpetofauna, including Pacific chorus frog and California tree frog, and snakes, such as two-striped garter snake (*Thamnophis couchi hammondi*); and small mammals. Larger mammals, such as raccoon (*Procyon lotor*), may forage directly on invertebrates and fish.

Treatment wetlands could support similar species as fresh water marsh habitat. However, these areas would require active management and removal of sediments, contaminants, and invasive plants, all of which would limit their value for biodiversity support.

Upland Habitats

Existing disturbed uplands would be preserved and their biota enhanced through the removal of exotic plant species and planting of native coastal sage scrub and native grassland species. Coastal sage scrub habitat (CSS) would be enhanced through planting of species such as coastal sagebrush (*Artemisia californica*), California buckwheat (*Eriogonum fasciculatum*), deerweed (*Lotus scoparius*), sage species (*Salvia* spp.) and lemonadeberry (*Rhus integrifolia*). Planting of these vascular plant species would, in turn, provide nesting and foraging habitat for a number of migratory and non-migratory terrestrial passerine bird species, including the federally-listed threatened coastal California gnatcatcher (*Pilioptila californica californica*), towhees (*Pipilo* spp), wrens (*Troglodyte*s spp.), and finches (*Cardeulis* spp.). Many of these passerine birds rely on insects and seeds for food. CSS enhanced by more diverse flowering plants would support insects that provide forage for the above birds. Enhanced CSS would also support insect pollinators, including bees and flies. The diversity of other insects, such as butterflies and moths, would be enhanced by providing plant species that serve as larval foods and adult nectaring plants.

Native grassland habitat would be created from disturbed upland habitat through the removal of exotics and planting with a variety of native grasses and annual forbs. Examples include purple needlegrass (*Nassela pulchra*), nodding needlegrass (*N. cernua*), bluegrass (native *Poa* spp.) goldenstar (*Bloomeria* spp.), brodiaea (*Brodiaea* spp.), clarkia (*Clarki*a spp.) and valley tassels (*Castilleja attenuata*). Populations of these vascular plant species would enhance nesting and foraging habitat for passerine birds such as western meadowlark (*Sternella neglecta*) and grasshopper sparrow (*Ammodramus savannarum*), and also wading birds such as killdeer (*Charadrius vociferous*) and owls, including burrowing owl (*Athene cunicularia*). Grasslands are important foraging grounds for raptors including red-tailed hawk (*Buteo jamaicensis*) and white-tailed kite (*Elanus leucurus*). Like coastal sage scrub, this upland habitat would increase the diversity of flowering plants which, in turn, would support a variety of insects.

A number amphibians and reptiles occur in upland habitats, including Gilbert's skink (*Eumeces gilberti rubricaudatus*), western toad (*Bufo boreas*), spadefoot toad (*Scaphiphus hammnodi*), western fence lizard (*Sceloporus occidentalis*), side-blotch lizard (*Uta stansburiana*), rosy boa (*Charina trivirgata roseofusca*), gopher snake (*Pituophis catinefer*), horned lizard (*Phrynosoma coronatum*) and various species of rattle snake (*Crotalus* sp.). Enhancement of the existing habitat would increase foraging and breeding habitat for these and other herpetofauna.

Upland habitats also support numerous small mammals. Examples include shrews (*Sorex* sp.), deer mice (*Peromyscus* spp.), voles (*Microtus* sp.), rabbits (*Sylvilagus* spp.), and skunks (*Mephitis mephitis*). These small mammals are preyed upon by larger upland mammals, such as coyote (*Canis latrans*) and grey fox (*Urocyon* sp.), and birds of prey, such as red-tailed hawk and northern harrier (*Circus cyaneus*).

The existing disturbed upland habitats at Ballona are dominated by non-native vascular plant species, such as crown daisy (*Chrysanthemum coronarium*), mustard (*Brassic*a spp.), wild radish, fennel, castor bean, pampas grass and brazillan pepper tree. Seeds of many of these and other invasive plants are wind dispersed and off-site sources are numerous. Non-native animal species, such as Virginia opossum (*Didelphis virginianus*) and house mouse (*Mus mus*) are also common. Non-native animals that are adapted to humans are also likely to disperse into created upland habitats, competing for food with native species. Additionally, upland predators, including red fox and feral cats, can significantly affect birds nesting in the wetland as well as small mammals. Because restored upland habitats are highly susceptible to invasion by non-native plants and animals, their sustainability is constrained by the urban landscape.

All alternatives include the preservation and enhancement of coastal dune habitat at Ballona. Similar to CSS and native grassland, coastal dunes would support flowering vascular plants, such as lupines (*Lupinus* sp.), which would support and benefit from insect pollinators and provide larval and adult food sources. Coastal dune habitats provide habitat for reptiles, including horned lizard (*Phrynosoma* spp.) and California silvery legless lizard (*Anniella pulchra pulchra*). Passerine birds and small mammals could forage on seeds produced by vascular plants.

3.3 HYDROLOGY

The hydrology of each of the alternatives would have a significant impact on the functioning of the habitats. The depth and period of tidal inundations is a major influence on the type of habitats that would each alternative would support. The flow of water would erode, deposit and transport sediment. The period of time water stays on the wetlands and the amount it mixes with water from other water bodies would affect water quality. The hydrology of each alternative also affects the flood protection for existing infrastructure surrounding the wetlands. Hydrology is one of the main processes that link both the different project areas with each other and with Ballona Creek and Marina del Rey. The hydrology of the site would be sensitive to climate change and sea level rise in particular; the sustainability of the alternatives is discussed in Section 3.5.

Each restoration alternative proposed for the project has varying degrees of tidal inundation in terms of area and tidal range. Alternative 1 has minimal grading and most of the tidally inundated areas have a muted tidal range in portions of Area B. Alternative 2 and 3, by contrast, have fully tidal wetlands covering significant portions of Areas A and B. Alternative 4 has a large subtidal component connected to Marina del Rey. Alternative 5 has the greatest hydraulic connectivity with the main channel and between the restoration areas, due to the removal of levees. The degree of tidal inundation has a fundamental impact on the vertical and horizontal distribution of habitat types that would be supported.

The degree of tidal inundation inside the wetlands would also change the way the wetlands interact with Ballona Creek and Marina Del Rey. Larger, fully tidal wetlands would have larger tidal prisms which would have a greater impact on the surrounding water bodies, in particular on the amount of mixing. The location of the tidal connections is also important; a location inside Basin H, with its smaller tidal prism, would have a greater local effect on mixing than one connected to the main channel of Marina del Rey, which has a very large tidal prism.

3.3.1 Muted Tidal System versus Full Tidal System

A fully tidal wetland at Ballona would experience a tidal range equivalent to the oceanic tide in Santa Monica Bay. Mean Lower Low Water (MLLW, the long term average of the lowest tide each day) is -0.21 ft NAVD, Mean Higher High Water (MHHW, the long term average of the highest tide each day) is 5.29 ft NAVD and the diurnal tidal range (MHHW-MLLW) is 5.49 feet. The land area between the upper and lower limits of tidal range is the total area of intertidal habitat.

A muted tidal wetland experiences a more limited tidal range than a fully tidal wetland. Existing muted tidal wetlands at Ballona have Self-Regulating Tide gates (SRT), which close when the water surface elevation reaches a set height. Muted tidal systems would tend to compress the vertical range of wetland habitat types and would cause intertidal habitats to be created at lower elevations. Connections through culverts, open breaches and removal of levees are intended to allow the full oceanic tide to enter the site.

Inundation regime is the percentage of time that a given water level is exceeded during a Neap-Spring tidal cycle. It a useful parameter for characterizing the tidal inundation at a particular location with a specific elevation. The inundation regime for the unrestricted tidal system in the Santa Monica Bay is shown in Table 3-3; for example 2 ft NAVD is exceeded for 80% of the time and 4 ft NAVD for 38% of the time.

The inundation regime in some of the alternatives can be modified by setting the closure of the SRT in Area B at different elevations, which limits the maximum tidal elevation but maintains the rate of rise and fall of the tide. The inundation regimes were estimated for three SRT closure elevations using hydraulic modeling. The existing gate is set to close at 3.6 ft NAVD. Two additional closure elevations were modeled at 4.9 ft NAVD and 6.6 ft NAVD.

Table 3-3 shows how the inundation regime varies with different closure elevations. The inundation regime for lower elevations stays roughly the same between gate settings (e.g. 2 ft NAVD is exceeded about 77% of the time in all cases, which is comparable to the 80% for Santa Monica Bay). The effect of the muting is more pronounced at higher elevations (e.g. 4 ft NAVD is exceeded 38% of the time in Santa Monica Bay, but only 6% with a gate that closes at 4.9 ft NAVD). The inundation regime for intermediate closure elevations can be estimated by interpolation.

The vertical zonation of intertidal habitats can be estimated from the inundation regime. Different species would favor being inundated for different frequencies. For instance, high marshes are inundated approximately 28 to 50% of the time, while for low marsh the range of frequencies are 74 to 90%. Table 3-4 shows the inundation regime for intertidal habitats and the corresponding elevations for the oceanic tide in Santa Monica Bay (based on Ferren *et al*, 2007 in Appendix B). Each of the marsh habitat types covers a vertical range of about one foot.

Habitat zonations for the muted tidal regimes have been derived by determining the muted tidal elevation that has the same inundation regime as the open ocean. Table 3-4 shows the expected habitat distribution for different closure elevations for the SRT. Muting can also be achieved by undersized culverts that constrict the flow. These change the rate at which the tide rises in the site such that maximum elevation would not be the same on each tide. However, undersized culverts cause problems of erosion, backwater effects, and drainage.

For muted tidal systems the elevation range for the intertidal habitats is compressed which in turn limits the areal extent of these habitats compared to fully tidal alternatives. The zonation for intermediate closure elevations can be estimated by interpolation. This compression is most significant for the highest zones of the marsh (e.g. high marsh, transition zone). For instance, with the existing SRT closure elevation of 3.6 ft NAVD, mid marsh has the same vertical range as in a fully tidal system (1 foot) but occurs 0.3 feet lower. However, for the same SRT setting, the high marsh has a much reduced vertical range of 0.3 ft (between elevations 3.2 -3.5 ft NAVD).

In summary:

- varying the SRT closure elevation would mute the inundation regime in a predictable manner in Area B;
- vertical zonation of habitat would be compressed, particular at higher elevations, by muting of the tidal inundation;
- habitat area would be limited by the reduced vertical range of habitats.

3.3.2 Tidal Prism

The tidal prism is the volume of water entering the wetland on each tide. The tidal prism is a function of the topography and the tidal range of the site. For example, Alternatives 2 to 5 include substantial grading which would increase the volume of tidal water entering the site on each tide. If the tidal range is muted, the tidal prism would be reduced. The tidal prism was evaluated for each restoration area and for each of the main water connecting water bodies (Basin H, Marina Del Rey and Ballona Creek).

The tidal prism is important both within and outside the wetland:

- the tidal prism would influence the channel geometry and channel network properties.
- the tidal prism would influence the source of tidal water (as it affects the excursion length) and the residence time.

Table 3-5 shows the tidal prism of Ballona Creek in relation to the southwest wetland of Area B. In this case the main variable is the type of connection, either a SRT (Alt 1) or open breach (Alt 3). The muted tidal wetland has a tidal prism of about 30 ac-ft. Replacing muted tidal wetlands in Area B with fully tidal wetlands (Alt 3), connected to the creek by a breach, adds about 150 ac-ft to the existing tidal prism. One effect of increasing the tidal prism of Ballona Creek would be to increase the potential for scour at the mouth, in the vicinity of the jetty heads. Increased scour at the mouth has both positive and negative implications. It may reduce the need for dredging of Ballona Creek, improving the flood conveyance of the channel; however, it may also remobilize contaminated sediment that has settled at the mouth and there is the potential for undermining the breakwater as the channel readjusts to the larger tidal prism.

Table 3-6 shows the variation of tidal prism in relation to the southwest wetland of Area B. For a muted tidal wetland in this area the tidal prism is about 15 ac-ft. A tidal wetland created in this area in Alternatives 2 to 4 has a tidal prism of about 30 ac-ft.

Table 3-7 shows the variation of tidal prism for Area A. For those alternatives that connect to Marina del Rey, the tidal prism across the mouth of Basin H was used as a measure as this allows the effect of restoring the wetland tidal prism on Basin H water quality to be assessed. The larger the combined tidal prism, the greater the turnover of water in Basin H. The existing tidal prism of Basin H is about 12 acre-feet. A 38 acre wetland in Area A (Alt 2) increases the tidal prism by

about 25 ac-ft, a 73 acre wetland (Alt 3) adds about 46 ac-ft, and the large subtidal pond and wetland in Alternative 4 adds about 330 ac-ft. The same alternatives connected to Marina del Rey at Via Venetia do not have a significant effect on the overall tidal prism as the tidal prism of Marina del Rey is so large.

Alternative 5 has the largest tidal prism of all of the alternatives at 600 ac-ft. This is nearly three times the existing tidal prism and it is expected that tidal flow velocities through the mouth of Ballona Creek would increase.

In summary:

- in the southwest wetland of Area B, an open breach and full tide would have a tidal prism about 100 ac-ft greater than a muted tidal option;
- southeast wetland would have a tidal prism of about 30 ac-ft;
- a tidal connection from Area A at Dock 52 has a large impact on the circulation of Basin H, but no alternative has a tidal prism sufficiently large to impact the much larger Marina del Rey channel.
- Alternative 5 has the largest tidal prism at 600 ac-ft.

3.3.3 Connections

The nature of the connection between open water and the wetland would greatly influence tidal conditions within the wetland. Four types of connections are present in at least one of the five alternatives:

- open (non-gated) culverts,
- gated culverts (e.g. self-regulating tide gate (SRT) and flood gates)
- open breach, and
- complete levee removal

The large pipes which penetrate levees to convey water between Ballona Creek and the inundated areas are referred to as culverts. Conveyance through a culvert is limited by its dimensions, particularly its cross-sectional area. Flow through culverts can be controlled by different types of gates that prevent flow through the culvert. SRT include a mechanism to close itself when water levels reach a specified elevation. Manual flood gates can be closed manually as dictated by conditions. Gated culverts can be used to prevent contaminants entering the site from Ballona Creek or Marina del Rey or to reduce peak flood elevations. The SRT has an advantage of being adaptable so that the desired water surface elevation within the site may be controlled.

The second type of connection through a levee is a breach. Breaches would be sized to the same width and depth as the connecting marsh channel and would have no top boundary. Breaches would therefore convey water with negligible restriction during normal tides and much more effectively during flood conditions. Breaches may be combined with lowering of the levee to

about marsh plain elevation, thereby allowing higher tides to enter the site. This would mimic the flood routing of natural overmarsh tides and restore the hydraulic connection between the creek and the marsh plain. Controlling regular tidal flows or flood events is not possible with either a breach or levee removal.

The capacity of connections would vary. The SRT and culvert would have fixed capacity dependent upon their physical dimensions. A breach, depending on the nature of the material in which it is excavated, may be able to erode wider or deeper. Sizing levee breaches and connecting channels to the predicted tidal prism is generally necessary to limit how much the channel and breach erode. Tidal exchange and sediment supply to a wetland would be limited if the levee breaches or channels are undersized compared to the tidal prism. As the breaches or slough channels erode in response to the large tidal prism, tidal exchange and sediment supply would increase. Levee removal provides the most complete connection for water exchange and sediment supply between wetlands and the tidal source.

The location of the connections would have an impact on the evolution of the wetland, in particular the channel network. The alternatives have been developed to maximize opportunities for creating a single unified channel network within each marsh unit rather than multiple smaller networks, each with their own connection to open water. Using two connections for a hydrologic unit may increase the circulation in subtidal areas if there is sufficient head difference between the two entrances; this would be most effective in Alternative 4, which has a large open water area. For intertidal channels, flow may occur preferentially through only one of the entrances. Ideally, each marsh unit should be large enough to sustain its own network, containing a range of channel sizes and habitat. The southwest wetlands in Area B have the only remnant channel system that could be rejuvenated.

The use of structures as part of the connection, while increasing control, does have a number of issues:

- Gates and trash grilles, common on such structures, can impede the movement of sediment, seeds, fish and fish larvae. These restrictions would not be present with breaches.
- Culverts and gates generally have a smaller cross-section than natural channels and flow velocities within the structures would generally be higher. Scour would therefore be expected in the vicinity of the structure, especially in the channels leading into the wetlands.
- The potential for blockage is greater for gates and culverts, compared to an open breach, due to the smaller size of the opening and the presence of moving parts.
- Failure of a gate in the open position, due to trapping of debris or the failure of the control mechanism, may allow increase the potential for flooding. Failure of a gate in the closed position could delay drainage of tidal habitats.

3.3.4 Channel Network

Vegetated wetlands are typically drained by a complex network of dendritic and sinuous tidal channels. A dendritic sinuous tidal channel network is expected to provide better habitat and support a wider range of wetland functions than linear channels. For examples, channel bends provide sheltered foraging habitat for birds. Each tidal channel within the channel network drains and fills an area of marsh or "tidal watershed." Marsh drainage areas in natural marshes are distinguished by very subtle changes in marsh plain elevation and inundation patterns. The channel size adjusts to the flow to and from the marsh drainage area (i.e., the tidal prism of the marsh drainage area). Tidal channels may scour or fill in with sediment (shoal) in response to changes in the tidal prism and/or sediment dynamics.

In a natural system, as mudflats accrete to intertidal elevations, mudflat tidal channels form and become fixed as vegetation establishes and the marsh plain develops. Within this channel network, the tidal channel geometry at any given point is mainly dictated by the tidal prism of the watershed upstream. If the channel geometry is too small for the tidal prism, current speeds would increase and erode a larger channel. If the channel geometry is too large for the tidal prism, current speeds would decrease, allowing sedimentation to decrease the channel geometry.

Much of the natural channel system in Ballona Wetlands has been lost and a new channel networks would be constructed in tidal marsh restoration areas using the same tidal prism channel geometry relations found in natural channels. Larger tidal channels may be graded by excavating channels with dimensions that closely mimic channels in natural tidal marshes. The smallest channels may only be partially excavated, allowing these channels to develop over time through channel scour. Channel dimensions would be sized relative to the tidal prism of the marsh drainage area. Table 3-8 shows the channel network characteristics expected for each alternative, including tidal prism, channel length and order of channels. The method of calculation is described in Appendix C.

Channel networks constructed within the Ballona restoration are expected to be relatively stable, with limited potential for channel scour or shoaling. Tidal habitat would be restored by excavating fill and grading the site to elevations suitable for high, mid, and low marsh plain; mudflat; and subtidal habitat. The restored marsh plain would be graded with gentle slopes from the channel edge to upland areas to allow for the transgression of tidal habitats with sea level rise (see Section 3.5.1 below). Sedimentation rates within restored marsh areas are expected to be slow due to low sediment supply from the urbanized Ballona Creek watershed. The tidal prism of the restored marsh is therefore not expected to change rapidly after construction. The constructed tidal prism and channel dimensions are expected to maintain a relatively stable equilibrium condition. Also, as the restored marsh would be graded to higher marsh elevations, the tidal prism would be less than for lower elevation tidal areas. The potential for channels to form through channel scour is therefore expected to be low.

The presence of roads and levees within the site somewhat constrain the channel pattern as flow through this infrastructure must be routed through culverts. These culverts would set both the location and capacity of the channel at that place, reducing the ability of the channels to evolve over time. The culverts should be oversized in anticipation of larger tidal prisms in the future to increase the sustainability of the wetlands.

Permanent ponds in the marsh plain may be constructed to increase the amount of subtidal habitat. These would be connected to the channel network. These ponds would be shallow, well-defined, persistent depressions, 1 to 2 ft deep, that contain about 0.5 ft of standing water at all stages of the tide. They would receive tidal inflow on most tides.

3.3.5 Residence Time

Residence time is an estimate of how long water would remain in a flooded area before it is replaced by water from outside the wetland. A shorter residence time indicates a faster rate of turnover of the water. For this study, the residence time is estimated as the fraction of volume exchanged each tidal period, calculated by dividing the total volume in the flooded area by the tidal prism.

The residence time would depend on the proportion of tidal prism to total (subtidal plus intertidal) volume. Intertidal areas with an open connection to the ocean would have a residence time equal to the average tidal period because they dry out each tide. In areas with a large subtidal volume relative to intertidal volume (such as in Area A in Alternative 4), the residence time can be as long as several tidal periods. Short residence times indicate rapid and continuous exchange with the ocean water, with positive effects, for example, on exchange of gases, nutrients, fish larvae, sedimentation and water quality. Longer residence times indicate delayed exchange with the ocean.

The method for estimating residence time is an average for the entire flooded area and range of tides. Actual residence time would vary across the site. For example, residence times would be longer for regions of the flooded areas which are far from the exchange outlet or during periods of reduced tidal prism, such as neap tides. Similarly, actual residence times would be shorter for regions of the flooded areas which are close to the exchange outlet or during periods of increased tidal prism, such as spring tides.

3.3.6 Excursion Length

Excursion length is an estimate of the distance traveled by water during a tidal period. It is analogous to dropping a buoy in the water and measuring how far the buoy travels during a single tide. Excursion length provides an indication of the spatial extent of water movement within the tidal timeframe. As a first approximation, the water within an excursion length of a particular location is the source of inflowing water, the destination for departing water, and the volume of

water that would most rapidly mix with that location's water. Water within an excursion length can be categorized as hydraulically well-connected to that location.

A major influence on excursion length is the addition of intertidal area upstream of a location which increases the flow of water past that location. In accordance with increasing flow, current speeds and hence, excursion length, also increase. Alternatives with the largest intertidal area would yield the largest excursion lengths.

Water in Ballona Creek, at the western side of the project area, exchanges with Santa Monica Bay on each tide. In contrast, water at the eastern side of the project area remains in Ballona Creek for more than a single tide. The different outlets from Area B are just a bit further than an excursion length of each other, indicating that water that exits one flooded area would typically take at least two typical tidal cycles to enter into another flooded area. The outlets from Area A to Marina del Rey and the outlets from Area B to Ballona Creek are separated by approximately three times the excursion distance and pass through a portion of Santa Monica Bay. This indicates that Area A and Area B are not well connected by Alternatives 1-4. Only Alternative 5 would closely connect Area A and Area B.

3.3.7 Flooding

Increasing tidal inundation within the Ballona wetlands may also affect the potential for flooding. Potential changes to the flood hazard as a result of the alternatives were evaluated.

Flood hazard was considered to arise from two sources – stormwater discharge from the Ballona Creek watershed and elevated ocean water levels in Santa Monica Bay. The watershed of Marina del Rey is small and its stormwater contribution is not considered a significant flood hazard. Flood events are typically characterized by their likelihood of occurrence, where the likelihood is expressed as a return interval. For this study, the selected stormwater discharge event has a return interval of 50 years or a 2% chance of occurring in any one year. The hydrograph of this 50-year stormwater discharge, which relates the rate at which water enters Ballona Creek as a function of time, was developed by the U. S. Army Corps of Engineers (2008). This hydrograph was developed by combining: (1) modeling of the transformation of rainfall into runoff and (2) frequency analysis of past discharge events.

The second source of flood hazard, elevated ocean water levels, arises from meteorological events acting at the regional or global scale. Regional meteorological events which elevate water levels include low atmospheric pressure associated with storm systems and wind setup. El Niño is the global meteorological event which leads to elevated ocean water levels along the entire western coastline. Since a detailed frequency analysis of elevated ocean water levels has not yet been conducted, this study relied upon an event selection approach to identify typical increases in ocean water level. Water levels at the Port of Los Angeles during 12 large storm events increased an average of 1.1 ft above expected water levels (USACE Hydrology Report).

These sources of water, stormwater discharge and elevated ocean water levels, interact with the ground surface elevation to determine the depth and spatial extent of flooding. Because of the existing levees which bound Ballona Creek, flooding is also a function of hydraulic connection. By adding tidal connections, the restoration alternatives alter the potential for flooding while decreasing the peak water levels within Ballona Creek. Within the flooded areas, flood exposure increases because of additional conveyance through the new tidal connections. However, the exposure within these flooded areas can be managed to acceptable levels by configuring the tidal connections and/or the flood hazard to infrastructure can be mitigated by structural means. The input of flood waters into the flooded areas acts to reduce the flood hazard within Ballona Creek itself. Because the flooded areas provide additional storage for flood waters, flood peak water levels along Ballona Creek, downstream of the tidal connection, are reduced.

Infrastructure that is exposed to flood hazard as a result of its location within or adjacent to the project area can be protected in several ways. The infrastructure itself can be raised above peak flood levels. For instance, roadways which cross the project site could be raised on structures or earthwork to elevate them above anticipated flood levels. Flood risk for infrastructure adjacent to the project area can be mitigated by constructing new levees or improving existing levees to constrain the flooded area extent.

Alternatives 1 and 2, which have muted tidal systems, have flood peaks at or below the closure elevation. If the rate at which the water level rises is rapid then the gate may close when elevations within the site are lower. For those alternatives that allow a full tide, flood peaks in the wetland channels are generally about a foot lower than in Ballona Creek. For instance, with the 50-year storm, Ballona Creek has a flood elevation of about 8.9 ft NAVD; for the same storm conditions the southeast wetland in Area B records 7.1 ft NAVD, and the southwest marsh was 7.6 ft NAVD.

Flood peaks also lower along Ballona Creek. At the seaward end of the channel, the existing peak flood elevation is predicted to be 8.9 ft NAVD. Predictions under Alternatives 1 and 2 have similar elevations as existing conditions. Alternatives 3 and 4 exhibit a 0.5 ft reduction in peak levels because of storage in the restored wetlands. Alternative 5 has slightly less of a reduction of 0.3 ft, due in part to the channel configuration and roughness of the vegetated floodplain.

3.3.8 Tables

Table 3-3. Inundation Regime of the SRT Gates in Area B, Showing Percentage of Time Tidal Water at or Above a Given Elevation

Elevation	% of time tides at or above given elevation				
ft NAVD	Santa Monica Bay (open ocean)	SRT closes at 3.6 ft NAVD	SRT closes at 4.9 ft NAVD	SRT closes at 6.6 ft NAVD	
7.5	0%				Inundation muted
7.0	1%				
6.5	4%				
6.0	8%				
5.5	14%			0%	
5.0	19%			4%	
4.5	28%		0%	16%	
4.0	38%	0%	6%	29%	
3.5	51%	23%	42%	44%	
3.0	65%	56%	58%	57%	
2.5	74%	69%	72%	70%	
2.0	80%	76%	78%	77%	Inundation similar
1.5	85%	82%	83%	82%	
1.0	90%	87%	88%	87%	
0.5	95%	100%	91%	91%	
0.0	98%	100%	97%	97%	
-0.25	100%	100%	100%	100%	

Note: all these examples use the existing 39 ft^2 culvert; with the gate set to close at 6.6ft NAVD the tide range is damped due to the lack of capacity of the culvert.

Table 3-4. Habitat Zonation in Terms of Inundation Regime and Elevation for Full and Muted Tidal Regimes

Habitat type	Inundation regime	Elevation range, ft NAVD			
	%r	Santa Monica Bay (open ocean)	SRT closes at 3.6 ft NAVD	SRT closes at 4.9 ft NAVD	SRT closes at 6.6 ft NAVD
Salt pan	14-28%	4.5-5.5	3.5-3.6	3.8-3.9	4.0-4.6
Transition Zone	14-28%	4.5-5.5	3.5-3.6	3.8-3.9	4.0-4.6
High Marsh	28-50%	3.5-4.5	3.2-3.5	3.3-3.8	3.3-4.0
Mid Marsh	50-74%	2.5-3.5	2.2-3.2	2.4-3.3	2.2-3.3
Low Marsh	74-90%	1.0-2.5	0.7-2.2	0.7-2.4	0.7-2.2
Intertidal Channel /Mudflat	90-100%	-3.0-1.0	-0.1-0.7	-0.1-0.7	-0.1-0.7
Subtidal	100%	-5.0- -3.0			

Table 3-5. Variation of Tidal Prism for Area B Southwest Wetland

	Ballona Creek tidal prism,
	ac-ft
Ballona Creek only	235
Alt 1 and 2 Area B SRT	267
Alt 3 and 4 Area B breached	386

Table 3-6. Variation of Tidal Prism for Area B Southeast Wetland

	Ballona Creek tidal prism,
	ac-ft
Ballona Creek only	235
Alt 1 Area B add muted tidal HW and tp	250
Alt 2, 3, 4 Area B fully tidal	390

Table 3-7. Variation of Tidal Prism for Area A

	Basin H tidal prism,
	ac-ft
Existing	9
Alt 2 Area A	36
Alt 3 Area A	69
Alt 4 Area A subtidal	345

Table 3-8. Channel Network Characteristics

Alt	Area	Channel length, ft			Order, no. of channels				
		Subtidal	Intertidal	Total	1	2	3	4	5
2	Area B East	1,530	13,730	15,260	43	12	4	1	
	Area A and C	1,820	14,730	16,550	43	12	4	1	
	Total	**3,350**	**28,460**	**31,810**	**86**	**24**	**8**	**2**	**0**
3	Area B East	1,530	20,270	21,800	67	20	6	1	
	Area B West	8,010	42,070	50,080	150	43	12	4	1
	Area A and C	4,770	27,030	31,800	150	43	12	4	1
	Total	**14,310**	**89,370**	**103,680**	**367**	**106**	**30**	**9**	**2**
4	Area B East	1,530	20,270	21,800	67	20	6	1	
	Area B West	8,010	42,070	50,080	150	43	12	4	1
	Area A (5 sub watersheds)	0	10,850	10,850	60	20	5		
	Total	**9,540**	**73,190**	**82,730**	**277**	**83**	**23**	**5**	**1**
5	**Total**	**17,810**	**164,650**	**182,460**	**678**	**198**	**58**	**14**	**2**

3.4 SEDIMENT AND WATER QUALITY

Water and sediment quality are key to the proper functioning of wetland systems. Contaminants associated with poor sediment and water quality can have an effect on the health of wetland plant and animal communities and to the long-term sustainability of any restoration efforts. Accumulated contaminants may also pose a human health risk. A healthy wetland depends on the continuing flow of non-impacted tidal waters and sediment into and out of the restored areas.

Contaminants that have been detected in the water column in Ballona Creek above the water quality criteria include copper, lead, zinc, bacteria indicators, polyaromatic hydrocarbons (PAHs), and several pesticides. These contaminants are generally associated with urban runoff that may contain heavy metals, PAHs and pesticides. These constituents generally are adsorbed to, and carried by, fine-grained soils (clays) and organic materials. These materials then settle out when the water flow velocity decreases such as in a wetland. Continuous flushing through adequate circulation and channel flows would reduce the accumulation of impacted sediments; in a muted tidal system there may be periods of high water slack where increased sedimentation may occur.

Evaluation of sediments in both the Ballona tidal prism and in Marina del Rey has indicated benthic impacts and in some cases toxicity responses to aquatic organism. As indicated by the toxicity testing and benthic studies, these constituents may have negative impacts to the benthic and aquatic organisms within the wetland. Certain metals such as selenium and mercury can bio-accumulate in the wetland environment and are carried up the food-chain. Organic compounds such as PAHs and pesticides such as DDT can also bio-accumulate in organisms in the wetlands resulting in a long-term impact.

Through the Total Maximum Daily Load program, pollutant load reduction is required to reduce these impacts to the benthic and aquatic communities. TMDL implementation is, however, in its initial phases which include developing an implementation plan and identifying source of pollutants. Due to the challenges of reducing pollutant loads from highly urbanized watersheds, improvements in water quality and significant reduction in potential impacts may take twenty years or more. Therefore, alternative for the wetland restoration need to consider the potential impacts from storm flows within this projected timeframe.

Water quality in Ballona Creek may improve as a result of efforts to meet TMDL targets. The need for restricted wet weather flows would diminish compared to the importance of water quality within the wetlands achieved through adequate circulation and residence time that would require less restriction of flow in and out of the wetland

Alternatives are compared by evaluating the sediment and water quality issues associated with different sources of tidal and fresh water flows, which include Ballona Creek, tidal waters and urban storm water runoff. These issues form the criteria for which the alternatives can be assessed to assure a healthy and sustainable wetland.

3.4.1 Ballona Creek Flows

Historical and current water quality data indicate that dry weather flows from Ballona Creek exceed water quality objectives for bacteria indicators, metals, and other constituents. Dry weather flows may result in pollutant loading to the restored areas. Any alternative that increases the connection of the creek to the wetlands, through larger culverts and breaches, may increase this loading.

Storm water flows frequently exceed water quality objectives for bacteria, metals, PAHs, and pesticides in Ballona Creek. Alternatives that allow for the use of flood gates can prevent the inflow of contaminated storm water into the wetlands and reduce pollutant loading. Restricted connections, for example culverts, may reduce inflow from the Creek but would also restrict drainage leading to ponding of polluted waters on the wetlands. Unrestricted storm flows from Ballona Creek, through larger breaches and levee removal, would allow the greatest exchange of water between the Creek and wetlands. Compared to muted tidal systems this would maximize the area exposed to pollutants but this may be mitigated by the improved circulation and flushing of the system.

3.4.2 Tidal Water from Ballona Estuary and Marina del Rey

In general the oceanic water quality is better than in Ballona Creek or Marina Del Rey. In Ballona Creek the tidal influence extends up to Centinela Creek and water quality reduces further away from the ocean as a result of less mixing (a function of tide and fresh water flow). Water in Marina del Rey also exceeds the water quality objectives for bacteria indicators, metals and other constituents. However, the magnitude and frequency of these exceedances are lower in comparison to Ballona Creek. The main channel of Marina del Rey has better water quality than the back basins due to greater circulation, proximity to the ocean, and less direct input from urban runoff.

Accessing the cleaner oceanic water is dependent upon the location of the tidal connection and the excursion length of the waters in the wetlands. Alternatives that have inlets or breaches closer to the ocean would provide water of higher quality to the restored areas. Alternatives that have greater excursion lengths, through larger tidal prisms, would draw from more distant, higher quality waters. Water quality within the wetlands, compared with the muted tidal systems, would also be improved by adequate circulation and lower residence time.

3.4.3 Suspended Sediment Loading

Suspended sediment and organic matter in urban runoff attract and provide the mechanism to transport constituents such as heavy metals (copper, lead, zinc), bacteria, pesticides, PAHs and other organic compounds to receiving waters. These sediments then settle out as velocity decreases when storm flows meet tidal waters or enter into the wetlands.

Historical and current data indicate long term accumulation of these constituents in sediments in Ballona estuary and at the tide gates into Area B; sediment testing has indicated toxic effects on aquatic organisms. Suspended sediments from Ballona Creek and from local resuspension during storms, may continue to enter the wetlands and impact sediment quality.

Marina del Rey also has impacted sediments in the main channel and in several of the back basins. The sources of the impacted sediments may include the Ballona estuary, resuspension of coastal sediments during storms, storm water discharges directly into Marina del Rey and human activities within the Marina.

Alternatives that restrict flows into the wetlands during and, for a period, after storm events may reduce the supply of sediment to the wetlands but increase the potential for settling of finer material due to longer slack periods. In the long term, restricted flow and import of sediment would limit sediment cycling. This may further reduce the already limited sediment supply from the urbanized watershed.

Other storm water inflows are at the ends of Falmouth and Pershing Drives and along Lincoln Boulevard and Marina Freeway. Continued loading of these constituents into the existing wetland areas has resulted in localized impacts to sediment. All the alternatives include storm water treatment wetlands to reduce the pollutant loading. Treatment wetlands can be effective in removing heavy metals, sediment and organic compounds that adsorb to fine-grain soil particles and organic matter. The effectiveness of these systems depends on the retention time that flows entering the wetlands and the maintenance of the plants and sediments. These wetlands may only be able to reduce loads from a portion of storm water flows due to the constraints of size, through flow, and number of inflow locations.

3.4.4 Sediment Impacts

Within the project area there are contaminated soils in the creek and wetland channels. Grading of the site for an alternative may make these contaminants bioavailable. All the alternatives would alter the local flow patterns within the wetlands, either by altering the path or velocity of the flow. As a result there would be localized accretion and erosion of the existing sediment as the channels adapt to the new flow regime. This may result in the mobilization of contaminated soils which may be deposited within the site or transported out to the Creek or Marina del Rey.

Culverts and other constrictions should be sized to reduce the flow velocity below that for significant erosion. Alternatives may also include structures that reduce the velocity at locations of high flow.

3.5 SUSTAINABILITY AND MAINTENANCE

All natural systems have a certain amount of variation or trends that occur over different time scales. In a tidal wetland, these variations may include floods or droughts over the short term or

changes in climate over the long term. These variations can cause stress to the system, which may be anticipated and accommodated within the design of a restoration project. Climate change, for example, would affect not only sea level but also temperature and precipitation.

In addition to long term changes, there would also be individual events that would stress the system. Variations in timing and frequency of storms are difficult to predict, as is the accidental release of contaminants. The uncertainty in the timing and magnitude of these stressors makes the operation and maintenance (O&M) of the system to unexpected changes important.

3.5.1 Long-term Sustainability - Sensitivity to Climate Change

Long-term sustainability of the restored wetlands is evaluated as the sensitivity to climate change and other long-term trends, including sea level rise and also changing rainfall patterns and sediment supply within the watershed.

Tidal wetlands exist within a very narrow vertical range, set primarily by the tidal frame. A small change in the tidal frame due to sea level rise would result in movement of the vertical distribution of tidal habitats. The response of tidal wetland to sea level rise depends primarily on:

1. sediment supply to the wetland and the associated rate of wetland accretion, and
2. the availability of space for the transgression of wetland habitats to higher elevations.

If sediment is readily available, vertical accretion may keep pace with sea level rise and the spatial distribution of tidal habitats may not change significantly. If sediment supply is low, as in Ballona Creek, accretion rates may be slower than sea level rise and habitats would transgress landward. In Alternatives 2, 3, 4 and 5, tidal wetlands would be graded to elevations that support the desired vegetation, as it is assumed accretion rates would be slow.

As sea level rises, habitats that are higher in the tidal frame would be converted to habitats that are lower in the tidal frame (e.g., high marsh is converted to low marsh, low marsh is converted to mudflat, and mudflat is converted to open water). If the transitional zone has a shallow slope, higher tide levels due to sea level rise would inundate transitional and upland habitats and convert these areas to high marsh. The space provided by shallow upland slopes allows tidal habitat to transgress up the slope with sea level rise, thereby maintaining similar acreages of habitat. If the transitional slope is steep, higher elevation habitat acreages would decrease as open water and lower elevation habitats transgress landward.

The tidal wetland habitats in Alternatives 2, 3, 4 and 5 include broad transitional slopes (1:50 to 1:70) that allow habitat transgression and can accommodate 2 to 3 feet of sea level rise. These shallow slopes would also provide valuable interim transitional habitat and act as a buffer from the surrounding urban activity. Where space is constrained and shallow slopes are not feasible, particularly where wetlands are located close to levees or roads, the transgression process would still occur but the higher elevation marsh habitat would be compressed against the slope of the

levee into a narrow horizontal band. There may be loss of some wetland in the future due to the steep transitional slopes in these locations.

Alternatives 1 and 2, which include culverts or gates, allow some control of the water surface elevation. In these alternatives, a muted tidal regime would be implemented that limits the maximum water surface elevation. The result would likely be a vertical and horizontal compression of the higher elevation habitats (high marsh and transition zones). The culverts and gates would be designed to accommodate expected sea level rise.

Current assessments of climate change in California do not indicate a clear trend or significant change in precipitation patterns. Higher temperatures are expected to cause a significant shift from snow to rain in the mountains, but coastal California is relatively unaffected by snow. Significant changes in precipitation and streamflow in coastal watersheds are therefore not currently predicted. There is the potential for decreased precipitation and more severe droughts. Small changes in water balance for sensitive habitats, such as seasonal wetlands and brackish marsh, may result in temporary or permanent changes in the salinity regime of these areas. Those areas that are already fully tidal wetlands may not be directly affected but they may still be influenced by changes in occasional freshwater inputs. In this respect, wetland areas connected to Ballona Creek and its watershed would be more sensitive than those connected to Marina del Rey.

3.5.2 Operations and Maintenance (O&M)

The alternatives require varying levels of ongoing operations and maintenance (O&M). Fully tidal wetlands in Alternatives 3, 4, and 5 would be designed to be self-maintaining and are expected to require little O&M. Muted tidal wetlands in Alternatives 2 and 3 would require regular and ongoing O&M of tide gates.

In addition to routine O&M for typical conditions, there would always be unforeseen or difficult to predict events – a large flood, the accidental release of a pollutant, the failure of a mechanical structure. Ideally the alternatives should be flexible enough to accommodate such unknowns and allow the opportunity for intervention. The muted tidal wetlands in Alternatives 1 and 2 provide the ability to occasionally close off the wetlands from its main tidal source, which could prevent high flows or contaminants from entering the site. A flood or tide gate may be added to a culvert with relative ease; however, it is much more difficult to close off the breaches and lowered levees in Alternatives 3, 4, and 5 from Ballona Creek. On the landward side, preventing flows from entering the site is more difficult due to the number of potential inflows and the difficulty of rerouting the flows to the ocean. For fully tidal wetlands in Alternatives 3, 4, and 5, the breaches may allow better flushing of contaminants entering from either the creek or adjacent land.

If controls are used as part of the management of the alternative, planning should include system response if the control fails. For instance, if a tide gate fails to operate then the impact it would have on the wetlands would differ depending on whether it failed open or shut, at high or low

water. Ideally the tide gate should not be the only protection against excessive water levels, there should be redundant measures such as additional ebb culvert barrels and landward levees.

Another consideration is the reversibility of an alternative. All alternatives would have an adaptive management plan in which it may be desirable to manipulate conditions. Changing the operation of an existing gate has less risk than changing the tidal inundation by removing a section of the levee. If conditions change and the system does not respond as required then the ability to revert to the former state may be desirable. Another example may be the enhancement of existing uplands, where changes envisioned in Alternative 1 and 2 are mainly related to management rather than structural changes and could more easily be reversed.

3.5.3 Vectors

Mosquitoes occur in wetland ecosystems where certain species can be vectors for viral diseases such as forms of encephalitis and more recently West Nile Virus. Understanding the life cycles and habitat requirements of the species that can be disease vectors is important in their control. Mosquitoes breed in standing water. Mosquitoes rarely occur in significant numbers in areas of tidal wetlands that are regularly inundated and drained over the tide cycle. Problems can occur in areas of tidal wetlands that are not well drained, such as ponds and pans that are infrequently or seasonally inundated, densely vegetated areas that pond water between tides, or locations where tidal drainage has been interrupted. Maintenance (e.g., spraying) may be required to address vector issues for poorly drained areas of tidal marsh.

For muted tidal wetlands, the designs should provide the ability to drain areas of standing water when required. This could be accomplished by operating gated culverts to drain the wetland on an occasional basis. Open areas of standing water should be large enough to allow wind waves to disturb the surface and dense vegetation around the edges should be avoided.

Additionally, wide buffers between wetlands and residential areas can reduce the likelihood of vector issues. The design of the alternatives should provide access points for mosquito surveillance and control.

3.5.4 Invasives

Biological invasions by exotics represent one of the most serious threats to ecosystem integrity and functioning. Invaders can detrimentally alter habitats, eat native species, and act as disease agents. Millions of dollars are spent annually in combating exotic plant pests just within southern California. Managing exotic species is complicated, as invaders are living organisms that can adapt to their new environments and have diverse, cascading effects. Invasive species may become established in restored upland and wetland habitats, requiring costly removal and maintenance efforts.

Salt marshes in southern California have been relatively free from invasions of wetland plants. Some localized exceptions include a mangrove (*Avicennia marina*) intentionally introduced into Mission Bay, San Diego, a sea lavender (*Limonium ramosissimum provinciale*) in Carpinteria salt marsh in Santa Barbara and *Tamarix* which has invaded the high marsh at Tijuana Estuary in San Diego County.

Upland area in southern California have some particularly troublesome plant invaders including giant reed (*Arundo donax*), which forms dense stands in riparian, brackish and fresh water wetlands, and salt cedar (*Tamarix* spp.), which have invaded riparian habitats, uplands, transition zones and high salt marsh. The major invaders at Ballona include , wattle (*Acacia* spp.), myoporum (*Myoporum laetum*), Russian thistle (*Salsola tragus*) mustard (*Brassica* spp.), garland daisy (*Chrysanthemum coronarium*), wild radish (*Raphanus sativus*), castor bean (*Ricinis communis*), pampas grass (*Cortaderia jubata*), fennel (Foeniculum *vulgare*), brazillian pepper tree (*Schinus terebinthifolia*), slender fan pam (*Washingtonia robusta*), non-native spurge (*Euphorbia* spp.), multiple varieties of ice plant (*Aizoaceae*) and non-native grasses have invaded disturbed upland areas and continues to spread.

Important vertebrate invaders that may affect restoration efforts include cowbirds, which are nest parasites that affect the endangered Least Bell's Vireo, and predatory red fox and house cats. These primarily upland invaders can also enter the wetland areas, impacting the native species. Estuarine and marine invaders include the clam-smothering mussel (*Muscalista senhousia*) and the carnivorous yellowfin goby (*Acanthogobius flavimanus*), the "killer" alga *Caulerpa taxifolia*, the salt-marsh destroying crustacean *Sphaeroma quoyanum*, and the mud-flat invading cordgrass *Spartina alterniflora.*

Alternatives with greater area of upland habitats would have greater impacts from invasive species and provide more opportunities for them to impact the adjacent wetland habitats. Alternatives 3, 4 and 5 provide the greatest area of contiguous wetland habitat (see Table 3-3), while Alternative 5 provides a significantly smaller edge to area ratio (Table 3-4).

3.6 PUBLIC ACCESS, RECREATION AND SAFETY

The goal of the public access plan is to provide "enhanced access to and within the Ballona Ecosystem consistent with ecosystem preservation and restoration values in a safe, consistent, coherent and functional manner," as per project objectives in the Ballona Wetland Restoration Plan Goals and Objectives (Appendix A). Public access features would be developed in concert with habitat restoration efforts to ensure maximum resource protection while providing a valuable recreational experience for the community. Providing public access and interpretive features about habitat restoration in turn provides increased public education, awareness, and support of local biological and physical resources present within the Ballona Wetlands. Providing strategically-placed public access features and limiting the intensity and duration of recreational use at the Ballona Wetlands would reduce impacts to the wetlands and enhance opportunities to involve the public in restoration and monitoring efforts.

The proposed public access and recreation features include a system of trails and overlooks, gateway entrances, interpretive stations, pedestrian bridges, bicycle parking, parking areas, boardwalks, vehicular pullouts, and visitor center. These would provide a diversity of public access and recreation opportunities for a wide range of users. The goal for the future design of these features would be to integrate all aspects of the project into a coherent system of restoration and public access that provides a clear sense of place within the context of the Ballona Wetlands and surrounding landscape.

The California Fish and Game Commission has designated the majority of the project area as a State Ecological Reserve. The purpose of the designation is to provide protection for rare, threatened or endangered native species. Public entry and recreational use of ecological reserves is subject to general rules and regulations to ensure that recreation is compatible with the primary purpose of resource protection.

In order to protect natural resources on the site and limit impact to wetland areas, a controlled and appropriate level of access to the Ecological Reserve would be provided as part of restoration. The public access strategy would focus on managing and concentrating recreation use within the site. The restoration and public access design would accommodate an appropriate level of fishing, boating, walking, and other activities consistent with the Ecological Reserve designation and ecosystem restoration values:

- **Walking**. Currently, access to the Ecological Reserve for walking or hiking is authorized on a case-by-case basis, and the site is not yet open to the general public. However, there is a public trail and self-guided interpretive tour located along the perimeter of the Freshwater Marsh. Walking or hiking would likely be the predominant recreational use of the site.

- **Biking**. Several local and regional bicycle routes are located near the Ballona Wetlands. No formal off-road or trail bicycle paths exist within the wetlands. The Ecological Reserve designation permits biking only on the designated bicycle path located on the north bank of Ballona Creek. Bicycle use is not permitted within the Ecological Reserve or Freshwater Marsh area.

- **Fishing**. Fishing currently occurs on both sides of Ballona Creek and from the downstream pedestrian bridge. The Ecological Reserve designation permits fishing with barbless hooks from the shoreline of Ballona Creek or from boats within the Ballona Creek channel. Fishing within the wetland area is restricted and by permit only.

- **Boating**. The Ballona Creek channel is currently used for both motorized and non-motorized boating. The University of California Los Angeles and Loyola Marymount University rowing teams use the Ballona Creek channel for crew practice. The Ecological Reserve designation permits boating within the Ballona Creek channel. Boating within the wetland area, however, is restricted and by permit only.

- **Other Recreational Uses**. Playa Vista Little League currently plays baseball on three fields located within the Ecological Reserve (Area C).

Public access and recreation features would provide a variety of settings, including access to the estuarine environment and retreat from urbanized areas, and would provide recreation opportunities for a variety of visitors. Access would be designed to be as barrier-free as possible to provide access for visitors of varying abilities and to comply with the Americans with Disabilities Act. In some locations, trails may be designed to accommodate vehicular use in order to provide access for security or maintenance. Raised boardwalks would be strategically located to maximize interpretive and educational opportunities related to the site and ongoing restoration activities. Exact trail locations and characteristics would be further developed when the preferred alternative is identified.

Table 3-9 details the number, length and location of public access features.

The Ballona Wetlands are also an important crossroad within the regional trail network. Both the coastal South Bay Bicycle Trail and the Ballona Creek Bicycle Trail run along the boundary of the site. Running north/south, the South Bay Bicycle Trail is a 22-mile paved trail that runs from Will Rogers State Beach in the north to Torrance County Beach in the south. Running east/west, the Ballona Creek Bicycle Trail runs along the south boundary of Area A and concludes in Culver City. The project is an opportunity to increase regional connectivity by developing an integrated trail network within the project site that connects to the surrounding regional trail network. The Alternatives would both preserve and enhance regional connectivity through connections of loop trails within the project area to the regional network. These connections would provide regional and local trail users with a range of opportunities and destinations.

Providing public access and interpretive features regarding habitat restoration in turn provide increased public education, awareness, and support of local biological and physical resources present within the Ballona Wetlands. Interpretive stations would be developed at strategic locations such as at gateway entrances, overlooks, or along the trail network within the project area. Educational signage and interpretive panels would facilitate a greater understanding and appreciation of the landscape. A potential visitor center and other opportunities for outdoor education and interpretation would provide a rich diversity of public access and recreation opportunities for a wide range of users. The goal for the future design of these features would be to integrate all aspects of the project into a coherent system of restoration and public access that provides a clear sense of place within the context of the Ballona Wetlands and surrounding landscape.

The prehistoric resources within and near the Ballona project area, including LAN-54, contain human remains and other materials that are of extremely high heritage value and sensitivity to the contemporary Gabrielino/Tongva Native American groups. Efforts to enhance cultural awareness of these resources and Native American lifeways in general should therefore be closely

coordinated with the California Native American Heritage Commission and those groups identified as having specific concerns for the Ballona area.

As outlined in the Ballona Wetland Early Action Plan, interpretive panels would highlight habitat characteristics and diversity, watershed history, and Native American site usage through clear, consistent and attractive displays (Conservancy 2007). Overlooks or viewing platforms would be located at vista points where important features of the landscape can be viewed and/or opportunities for wildlife viewing and birding exist. Associated interpretive information would be provided at these facilities based on the opportunities provided at the facility sites.

Public access within Ballona Wetland would be developed in a manner that is "safe, consistent, coherent and functional" for the safety of the public, long-term management, and maintenance of the site. The separation of incompatible uses, such as bikers and walkers or bikers and cars is important for public safety and security in the area. The Ballona Wetlands are located in a densely population area surrounded by busy roads and popular regional bike paths. The Ecological Reserve designation provides clear guidance on allowable recreational uses within the site.

The most common unauthorized uses within the project area are BMX biking, dog walking, homeless encampments, dumping, and off-trail walking. Unauthorized use of the site can have an adverse impact on the landscape. Therefore, controlling these uses is critical to successful habitat restoration. Wetland restoration would inherently preclude access to portions of the site by creating deepwater and wetland habitat.

Lincoln Boulevard, Jefferson Boulevard, and Culver Boulevard, as well as street ends to the west and north, provide site access for automobiles. Current on-site parking includes an unimproved lot behind Gordon's Market in Area B, paved on-street parking along Jefferson Boulevard at the Freshwater Marsh, and a paved parking lot at the Little League baseball fields in Area C. Safe traffic access would be provided by designating parking areas, creating roadside pullouts to provide formalized automobile access and viewing locations, and discouraging unauthorized roadside parking.

3.6.1 Tables

Table 3-9. Public Access Features Comparison

Public Access & Recreational Features	Alternative 1 (length/ number)	Alternative 2 (length/ number)	Alternative 3 (length/ number)	Alternative 4 (length/ number)	Alternative 5 (length/ number)
Trails					
Area A: Trails	8,800 feet	8,000 feet	9,450 feet	3,550 feet	4,450 feet
Area B: Trails	29,600 feet	29,600 feet	27,000 feet	27,000 feet	16,200 feet
Area C: Trails	7,200 feet	6,700 feet	7,150 feet	6,550 feet	2,250 feet
Boardwalks	1,900 feet	1,450 feet	1,350 feet	3,650 feet	3,850 feet
Access Points & Overlooks					
Gateway Entrances	11	11	11	10	7
Overlooks	4	6	9	9	10
Parking and Pullouts					
Formal Parking Areas	4	4	4	4	4
Vehicular Pullouts	0	0	2	2	2
Pedestrian Crossings					
Pedestrian Creek Bridge Crossing	1	1	1	1	1
Pedestrian Road Crossing	2	2	1	1	5

3.7 PHASING AND COSTS

This section describes the probable construction costs for the five selected alternatives as described in Chapter 2. In determining an opinion of probable construction costs appropriate to conceptual level design, several assumptions were required. These assumptions included:

- construction methods
- unit costs
- project sequencing and phasing
- permitting
- property acquisition

Table 3-10 is included to illustrate the level of accuracy and amount of contingency which is typically included in cost estimation for construction projects at various levels of design. This table is from the Cost Estimate Classification System, developed by the Association for the Advancement of Cost Estimating (AACE, 1997). As shown in the table, a particularly wide range in accuracy is assumed inherent for project design at the conceptual level. In addition, contingency is a large percentage of the estimated project costs, decreasing as the level of design is increased.

The "estimates of probable costs" are summarized in Table 3-11. Appendix D contains detailed cost estimates for each alternative by area and supporting information. It is important to note that these are large scale construction projects and that the alternatives involve significant intervention, and hence would require further detailed analysis and engineering design that would likely lead to additional refinements. Consequently, at this conceptual design phase, a cost contingency of 35% is included. We anticipate that actual construction costs could be reduced significantly through more detailed engineering. This is particularly true of the unit costs identified for fill placement; if a major fill element is included in the project, there is an opportunity to develop a construction methodology with a lower cost. Also, land costs are not included. At this stage, it is anticipated that all construction can be accomplished on publicly-owned land, and land and easement purchase costs are therefore not included. Also, costs associated with environmental restrictions of construction including timing and phasing are not explicitly treated.

These estimates are subject to refinement and revisions as the design is developed in future stages of the project. The cost tables summarize the cost of construction, and do not include estimated project costs for additional studies, permitting, detailed design, construction observation, monitoring and ongoing maintenance. Estimated costs are presented in 2008 dollars, and would need to be adjusted to account for price escalation for implementation in future years. This opinion of probable construction costs is based on: PWA's prior experience, prices from similar projects, and consultation with contractors and others involved in comparable projects.

Note these estimates of probable construction costs and the actual costs at the time of construction may vary. The cost of construction would be impacted by the availability of construction equipment and crews and fluctuation of supply prices at the time the work is bid. PWA makes no warranty, expressed or implied, as to the accuracy of such opinions as compared to bids or actual costs.

3.7.1 Notes on Cost Estimate Assumptions

Quantities were estimated conservatively (high). For the grading of the subtidal, mudflats and marsh plain, it is assumed the grading was to the desired elevation and volumes were calculated using the "average end area method." For channels, it is assumed that only the largest channels (order 3, 4 and 5) would be excavated, and that these channels would be excavated to their modeled, equilibrium dimensions. Quantities of material used in levees were increased to account for settlement.

Appendix D (Table D-2) includes the unit costs and assumptions used in the cost estimate. The cost of excavation is the most expensive item in Alternatives 2 to 5. The cost used for excavation is $15/CY, which may be high. The use of scrapers or other efficient construction methods may have a lower unit cost. However, in this case, over-excavation and/or ripping of the soil may be required to give a suitable substrate for wetland restoration. This additional work would increase costs. Therefore, lower unit costs are not recommended for use in the cost estimate without further analysis of engineering and constructability considerations.

Onsite trucking and placement of excavated material is included as a separate item in the cost estimate. The cost estimate assumes that as much material as possible is reused within the same area to construct levees. Even so, each alternative generates more material than can be reused on site. There is no requirement to move material from one area to another, with the exception of Alternative 1. In Alternative 1, material excavated in Area A would be trucked to Area B and used as fill for levee construction along the daylighted culvert. It is assumed that the excess quantity from each area will be placed on site in stockpiles, at least until the material is disposed of off site. Table 3-12 lists the volume of excess material to be stockpiled (Appendix D, Table D-4 includes a rough calculation of possible stockpile areas).

Options for disposal may include:

Option 1 / 2. Remove sediment, barge sediment to the Port of Los Angeles (POLA), and unload dredged material at POLA (Option 1) or dispose material at a confined disposal facility (CDF) at POLA (Option 2).

Option 3. Remove sediment, barge sediment to POLA, and truck to landfill for beneficial use as landfill cover.

Option 4. Remove sediment, barge sediment to POLA, and dispose contaminated material at a hazardous waste landfill. The level and extent of on-site contamination is presently unknown.

Option 5. Remove sediment, barge sediment offshore, and dispose sediment offshore (Offshore Disposal).

Option 6. Remove sediment and dispose sediment on a nearby beach (Beach Disposal).

POLA identified and evaluated disposal Options 1 to 4. A preliminary draft cost estimate table prepared for POLA by Weston (Weston, undated) for these options was provided. There are uncertainties associated with the preliminary draft table and conceptual-level cost estimates. Disposal costs were not estimated for this report. The POLA/Weston cost estimate information was used to estimate the costs for Options 1 to 3. Mobilization (8%) and a 35% contingency were added to the disposal cost estimates for consistency with the estimates in this report and to account for uncertainties. Cost estimates for Option 4 are not included because information on contamination is not currently available.

For offshore disposal (Option 5) and beach disposal (Option 6), a range of costs is included in the estimate. On the lower end of the range, the costs for offshore disposal (Option 5) and beach disposal (Option 6) may be as low as the costs for disposal at POLA (Option 1 / 2). The upper end of the range for offshore disposal (Option 5) may be as high as the unit cost for dredging and offshore disposal at Upper Newport Bay provided by the SCC (G. Gauthier, SCC, pers. comm.) This unit cost is $28 per cubic meter for dredging and disposal about three to five miles offshore (S. Brodeur, County of Orange, pers. comm.). For beach disposal (Option 6), the upper end of the unit cost may be about $10/CY higher than the costs for Option 1 / 2. The cost estimates for disposal options should be updated at the next opportunity. Table 3-13 summarizes the disposal option cost estimates for each alternative.

3.7.2 Phasing

Areas A and C and Area B are not hydraulically connected in Alternatives 1 to 4 and so their construction may be phased in either order. In addition, it would be possible to construct Area A prior to Area C in each of these alternatives. Since each area generates more than enough material to construct levees, there is no need to stockpile material for use in later phases.

Alternative 5 is shown as being constructed in three phases (see Figure 2-9). A breakdown of the cost estimate between phases is included in Table 3-11. Excavation of Area A and removal of the Ballona Creek levees downstream of Lincoln Boulevard would occur first. This would require the construction of a temporary levee across the northern part of Area B and adjacent to Culver Drive. This temporary levee would increase the costs of phasing Alternative 5 compared to the cost estimated for Alternative 5 without phasing. The second phase would consist of restoring the remaining portion of Area B once the first phase habitat had been successfully established. Finally, Area C would be restored in the third phase. The advantage of phasing would be to

spread costs over a longer period of time and take advantage of the timing of other projects, such as the widening of Lincoln Boulevard. The project could be stopped at the end of any of the phases and still leave a functioning system.

3.7.3 Tables

Table 3-10. Levels of Cost Estimate Accuracy and Contingency for Different Levels of Design

Design Completion Level	Cost Estimate Accuracy	Contingency
Conceptual (order of magnitude costs)	-30% to +50%	35–50%
Preliminary (30%)	-15% to +30%	20-25%
40 to 70% complete	-15% to +30%	15-20%
70 to 100% complete	-5% to +15%	10-15%

Table 3-11. Summary of Engineer's Estimates[1] for Alternatives 1 to 5 (cost in Millions of Dollars)

Alternative	Area A	Area B	Area C	Total
1	$4.0	$2.6	--	**$6.6**
2	$42.6	$16.0	$3.3	**$61.8**
3	$69.3	$55.5	$5.2	**$130.0**
4	$108.4	$55.5	$5.2	**$169.0**
5	$99.8	$59.0	$50.4	**$209.3**
	Phase 1	**Phase 2**	**Phase 3**	
5 [2]	$110.4	$48.8	$50.5	$209.7

Notes:

1 - Estimated construction costs include a 35% contingency

2 - The cost estimate for phasing Alternative 5 is higher due to the construction of a temporary levee

Table 3-12. Estimated Volumes of Excess Material to Be Stockpiled.

	Stockpile Volume (ac-ft)			
	Area A	**Area B**	**Area C**	**Total**
Alternative 1	50	-	-	**50**
Alternative 2	590	120	60	**770**
Alternative 3	1,040	600	90	**1,730**
Alternative 4	1,700	600	90	**2,390**
Alternative 5	1,650	760	840	**3,250**
	Phase 1	**Phase 2**	**Phase 3**	
Alternative 5	1,790	570	830	**3,190**

Table 3-13. Summary of Estimated Costs[1] for Disposal Options. Costs in Millions of Dollars

							Alt 5 with Phasing [2]		
		Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Phase 1	Phase 2	Phase 3	Total [2]
On-Site Work		**$6.6**	**$61.8**	**$130.0**	**$169.0**	**$209.3**	$110.4	$48.8	$50.5	**$209.7**
Disposal Volume (CY)		**86,400**	**1,241,440**	**2,789,580**	**3,853,140**	**5,231,600**	2,889,960	923,500	1,344,600	**5,158,060**
Off-Site Disposal Options										
Option 1 / 2	**Unload Dredged Material at POLA / Disposal at CDF at POLA**	**$1.3**	**$19.1**	**$43.0**	**$59.4**	**$81.0**	$44.5	$14.2	$20.7	**$81.0**
Option 3	**Beneficial Use - Landfill Cover**	**$4.2**	**$59.7**	**$134.1**	**$185.2**	**$252.6**	$138.9	$44.4	$64.6	**$252.6**
Option 4	**Disposal at Hazardous Waste Landfill [3]**									
Option 5	**Offshore Disposal (low end of range)**	**$1.3**	**$19.1**	**$43.0**	**$59.4**	**$81.0**	$44.5	$14.2	$20.7	**$81.0**
	Offshore Disposal (high end of range)	**$3.6**	**$51.0**	**$114.6**	**$158.3**	**$216.**	$118.7	$37.9	$55.2	**$216.0**
Option 6	**Beach Disposal (low end of range)**	**$1.3**	**$19.1**	**$43.0**	**$59.4**	**$81.0**	$44.5	$14.2	$20.7	**$81.0**
	Beach Disposal (high end of range)	**$2.7**	**$38.3**	**$86.0**	**$118.7**	**$162.**	$89.1	$28.5	$41.4	**$162.0**

Notes

1 - Estimated construction costs include a 35% contingency

2 - The cost estimate for phasing Alternative 5 is higher due to the construction of a temporary levee

3 - Estimate not included for Beneficial Use - Landfill Cover, contamintant report pending

4. SUMMARY

1. The project goal is to create functional estuarine habitat, including shallow subtidal, mudflats, fully tidal wetlands, salt pan and transitional habitats. Extensive enhancement of muted tidal wetlands or upland habitat, such as coastal sage scrub, grassland and saline seasonal marsh, does not achieve the project goal. However, upland habitat may provide some support for functioning estuarine habitat. Alternatives 3, 4 and 5 create the largest areas of fully tidal estuarine habitat while Alternatives 1 and 2 have larger areas of upland and muted tidal habitat. As discussed in Section 3.1, tidal estuarine habitats would benefit vascular and non-vascular plants, small mammals, a diverse community of aquatic invertebrates and many bird species known to utilize other southern California wetlands. Alternatives 4 and 5 create large areas of shallow subtidal habitat adjacent to mudflat. This would provide spawning and nursery habitat for pelagic and demersal fish species; these may disperse to the adjacent nearshore habitat and to other regional wetlands.

2. Transitional habitats, between tidal wetlands and upland, support a unique assemblage of vascular plant species and provide additional support for terrestrial species such as snakes, lizards, small mammals and birds. Transitional habitats also provide refuge for wildlife during periods of high water, serve as buffers against human activity, and allow for transgression of wetland habitats with rising sea levels. Alternatives 3, 4 and 5 provide the widest and largest area of transitional habitat. Muted tidal systems, as in Alternatives 1 and 2, have a reduced tidal range and therefore a compressed vertical range of habitats, limiting the area of transitional habitat that can be created.

3. Upland areas would support populations of vascular plants and provide foraging and nesting habitat for a number of bird species. Upland areas would also provide breeding and foraging habitat for insect pollinators, butterflies and moths, birds, herpetofauna and some mammals. All alternatives provide some upland habitat; however, there is a trade-off between the acreage of estuarine habitat and upland habitat. Alternatives 1 and 2 have the most upland habitat and the least change to the existing habitat mix. Freshwater seasonal wetlands, including vernal pool habitat, would benefit specific vascular and non-vascular plants, aquatic invertebrates and herpetofauna uniquely adapted to this environment, Alternatives 2, 3 and 4 create vernal pools.

4. Alternatives with larger, contiguous, areas of wetland habitat are more likely to sustain populations of associated species. Alternatives 3, 4 and 5 have larger areas of contiguous wetlands with fewer roads, wider transitions and more channels. These alternatives would have a higher quality of wetland habitat because they would be more remote from noise, lights, cars, and other human impacts. Alternatives with larger areas of contiguous wetland would also have fewer impacts from, and require less active management for, invasive plant and animal species.

5. Fully tidal systems allow for greater tidal circulation and reduced residence time. This would lead to a more rapid exchange of water with the ocean, and positive effects on exchange of gases, nutrients, fish larvae, sedimentation and improved water quality. Alternatives 1 and 2 have large areas of muted tidal wetland; Alternatives 3, 4 and 5 create fully tidal wetlands. The large intertidal areas of Alternative 2, 3 and 5 would have the shortest residence times, completely draining on most tidal cycles. Alternative 4 has a substantial subtidal volume, which would flush over several tidal cycles.

6. A complex tidal channel system allows water, sediment and nutrients to reach all parts of the wetland and provides diverse habitats. The complexity of the channel network depends on the area of the wetland and its tidal prism. Alternatives 3, 4 and 5 have large tidal prisms and would support an extensive and complex channel network with a large range of channels sizes.

7. The higher quality sources of tidal water are the ocean and Marina del Rey. The ability to bring this water into the wetlands would depend on the location of the tidal connection and the tidal excursion length. Alternatives 2, 3 and 4 improve tidal connections between Area A and higher quality water in Marina del Rey; this would also benefit habitat connectivity for fish species. All alternatives have some connection to Ballona Creek, which has poorer water quality. Longer excursion lengths increase the mixing of water on each tidal cycle, improving water quality. Alternatives 3, 4 and 5, with the largest tidal prism, have excursion lengths extending to the ocean.

8. The form of the tidal connection would affect the connectivity and function of habitat by influencing the movement of sediment, seeds, gases, nutrients, fish and fish larvae. Tide gates in Alternatives 1 and 2 would control water surface elevations within the wetlands but would limit connectivity with Ballona Creek and Marina del Rey, reducing diversity, and limiting primary productivity. Gates can also control pollutant loading, especially during storm events, although muted tidal systems would have a longer residence time allowing greater settling of pollutants. Gates would require regular maintenance and management as failure could impact habitat and cause flooding. Fixed structures, such as gates and culverts, need to accommodate both scour and sea level rise in their design.

Breaches in Alternatives 3 and 4 allow for full tidal range, movement of larger fish and greater seed dispersal. Open breaches would allow greater tidal circulation, reduced residence times and would be able to adapt to rising sea levels. Levee removal in Alternative 5 has the advantages of breaches and increases the interaction between the wetlands and the Creek - creating gradients of inundation and salinity across the site, letting the morphology evolve and allowing for periodic disturbance by flooding and scouring.

9. All of the alternatives would maintain the existing level of flood protection. Alternatives 1 and 2 have muted tidal systems, which would maintain the existing flood levels. These

alternatives rely on tide gates. Alternatives 3, 4 and 5 can accommodate higher flood levels by the construction of new levees and provide additional flood storage, reducing peak flood elevations.

10. All the alternatives would include principles of adaptive management in their Operation and Maintenance strategy. Alternative 1 has little change from the present situation and the risk associated with implementation is low. The restoration of wetlands in Alternative 2, 3 and 4 could be undertaken in distinct hydrologic areas which would allow for adaptive management and experimentation. Alternative 5 restores a large, contiguous area of habitat connecting a number of existing hydrologic units with Ballona Creek. This alternative makes the greatest change to the site, would be the hardest to reverse and consequently has the most risk. This risk may be mitigated to an extent by phasing the implementation.

The following tables have been developed from the above summary. They indicate favorable characteristics in terms of habitat, hydrology and public access. Check marks indicate which alternatives have these characteristics and the number of check marks indicates the relative degree. The number in brackets refers to the relevant summary paragraph above.

4.1 TABLES

Table 4-1. Summary of Habitat Characteristics

	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Large areas of fully tidal estuarine habitat (1)		√	√√	√√√	√√√
Large areas of mudflat (1)			√	√√	√√
Large areas of shallow subtidal habitat, adjacent to mudflats (1)				√√	√√
Extensive channel network (6)	√	√	√√	√√	√√√
Wide transitional habitat (2)		√	√√	√√	√√
Large areas of enhanced upland habitats (3)	√√	√√	√	√	
Allows for dynamic interaction between Ballona Creek and the Wetlands					√
Larger and more hydraulic connections between wetland habitats, Ballona Creek and the ocean (5, 7, 8)		√	√√	√√	√√√
Hydraulic connection to Marina del Rey (7)		√	√	√√	
Fewer culverts and tide gates; more breaches and levee removal (7, 8)			√	√	√√
Larger contiguous areas of estuarine habitat with fewer roads and more channels (4)			√	√	√√

Table 4-2. Summary of Hydrology, Sediment and Water Quality Characteristics

	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Full tidal range (1)		√	√√	√√√	√√√
Large channel network (6)		√	√√	√√	√√√
Daylights culverts, creates breaches (8)	√	√	√√	√√	√√
Large tidal prism (5, 7)		√	√√	√√√	√√√√
Short residence time (5)		√√	√√	√	√√√
Long excursion length (7)		√	√√	√√√	√√√
Control of flows by gates (8)	√	√			
Maintains existing flood levels (9)	√	√			
Increase in flood storage (9)			√√	√√√	√√√
Stormwater wetlands	√	√	√	√	√
Hydraulic connection to Marina del Rey (7)		√	√	√√	

4.2 RANKING OF ALTERNATIVES

Ranking is based upon the ability of each alternative to meet the project goals: the creation of functioning estuarine habitats, tidal circulation, connectivity of habitat areas, ability to address sediment and water quality, sustainability and maintenance. The alternatives are ranked from 1 to 5, with 1 being the highest rank.

In order to protect natural resources on the site and limit impact to wetland areas, a controlled and appropriate level of access to the Ecological Reserve would be provided as part of restoration. The alternatives are not ranked according to public access; each alternative can be modified to accommodate varying degrees of access as described in the feasibility analysis.

Alternative 1 – Rank 5

Alternative 1 is ranked the lowest because this alternative:

- does not achieve the project goals of creating a functional estuarine habitat;
- maintains existing upland habitat and does not provide fully tidal habitat;
- does not address existing problems of invasive species, limited buffers, poor tidal circulation, poor connectivity between habitat areas, and supports only a limited number of targeted wetland species;
- has upland areas that would require continuous management for a muted tidal system, invasive species and human impacts; and
- accommodates sea level rise through tidal muting.

Alternative 2 – Rank 4

Alternative 2 is ranked 4th because this alternative:

- creates fully tidal areas with better connections to Marina Del Rey although existing muted tidal areas remain;
- maintains significant upland areas;
- does not take advantage of whole site;
- does not address existing problems of invasive species, limited buffers, tidal circulation restricted by levees, poor connectivity between habitat areas;
- has upland areas that would require continuous management for a muted tidal system, invasive species and human impacts; and
- accommodates sea level rise through tidal muting.

Alternative 3 – Rank 3

Alternative 3 is ranked 3rd because this alternative:

- creates fully tidal areas across the whole site;

- creates complex channel networks;
- improves tidal circulation with breaches and larger connection to Marina del Rey water;
- creates large contiguous areas of habitat and large buffer areas;
- has poor connectivity between habitat areas across the site; and
- accommodates sea level rise through transgression.

Alternative 4 – Rank 2

Alternative 4 is ranked 2rd because this alternative:

- creates fully tidal areas across the whole site;
- creates complex channel networks;
- improves tidal circulation with breaches and larger connection to Marina del Rey water;
- creates large contiguous areas of habitat and large buffer areas;
- has poor connectivity between habitat areas across the site;
- includes subtidal habitat adjacent to wetlands using Marina Del Rey water ;
- has longer residence time in subtidal areas; and
- accommodates sea level rise through transgression.

Alternative 5 – Rank 1

Alternative 5 is ranked the highest because this alternative:

- is the most likely to create a functional estuarine habitat as per the project goals;
- creates the largest complex channel network;
- improves tidal circulation through a direct connection to Ballona Creek;
- has the largest tidal prism, lowest residence time, and greatest tidal excursion;
- creates the largest contiguous area of wetland;
- has the greatest connectivity across the site;
- allows interaction between the wetlands and the Creek;
- restores gradients in salinity and inundation;
- allows periodic disturbance by flooding and scouring; and
- accommodates sea level rise through transgression.

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APPENDIX A.
GOALS AND OBJECTIVES, OPPORTUNITIES AND CONSTRAINTS

Appendix A

Ballona Wetlands Restoration Plan
Goals and Objectives,
Opportunities & Constraints

The purpose of this document is to identify key characteristics of the project area that present opportunities for achieving the restoration planning goals and objectives as well as those that may limit (or place constraints on) the achievement of those goals and objectives. The ideas listed below tend to be generalized, this document is an effort to take information about the existing conditions of the area and assess what that information tells us about achieving the project's goals and objectives.

This table does not evaluate the relative importance of specific opportunities or constraints and there are internal inconsistencies among the opportunities and constraints identified. Inherent in some of the opportunities are preferences, priorities and approaches to wetland restoration and because of these differences, some conflict with one another. The purpose of this document is not to resolve these potential conflicts, but rather to be sure there is a common understanding of the project area's potential for achieving the fullest range of goals.

Goal 1: Ecosystem Restoration: Restore, enhance, and create estuarine habitat and processes in the Ballona Ecosystem to support a natural range of habitat and functions, especially as related to estuarine dependent plants and animals.

Sub-goal 1. Habitat: Preserve, restore, enhance, and create a variety of functional wetland, estuarine and other habitats representative of the Ballona Ecosystem.

Objectives:

a. *Support existing and future habitat based on identified regional needs*

b. *Create spatial connectivity within the site*

c. *Create appropriate edge habitat and connectivity to adjacent areas of the Ballona Ecosystem*

d. *Provide landscape-level function at a regional scale addressing habitat/landscape patches, corridors, connectivity and mosaics landscapes. Provide habitat for migratory birds, fish nurseries, etc.*

Opportunities	Constraints
Preserve, restore, enhance, and create multiple habitats historically associated with both the Ballona Wetlands and the region.	Because the size of the site is limited, it may not be possible to incorporate large enough patches of all historic habitat types to ensure their viability.
Restore and create fully tidal wetland habitat	Habitats are fragmented by the existing roads, infrastructure and surrounding development
Preserve and enhance seasonal ponding areas	Existing habitats on site could be displaced by future enhancement, such as the restoration of tidal inundation
Create regional habitat linkages and corridors	Site has been filled, existing soil types may not be appropriate for reestablishment of all historic habitats
Incorporate adjacent upland habitats along with transitional habitats linking wetlands and uplands.	
Restore diverse habitats based upon gradients of elevation, hydroperiod and salinity	

Sub-goal 2. Biodiversity: Preserve and increase the native biodiversity of the Ballona Ecosystem. Identify and protect multiple levels of diversity (e.g. species, habitats, biogeographic provinces and trophic structure).

Objectives:

a. *Increase diversity and populations of rare and endangered plant and animal species.*

b. *Establish and maintain diverse native plant communities, including vascular plants, algae, and diatoms.*

c. *Support a diverse complement of species including: birds, fish, amphibians, reptiles, native aquatic and terrestrial invertebrates.*

Opportunities	Constraints
Restore biodiversity historically associated with the region, including common, rare and locally extirpated species.	Implementation of restoration efforts will entail impacts to existing species to some degree and may need to be mitigated in some way
Strategically design habitat to ensure recruitment and survival of targeted species	Site may too small and isolated to support some species
Restore microhabitats that support various life stages of species	May become a biological sink as a result of invaders, predators or other impacts
	Restricted tidal connection could limit the species of fish that can be established

Sub-goal 3. Physical/Chemical Processes: Maintain and establish physical and chemical processes consistent with the restoration goals.

Objectives:

a. *Improve tidal circulation and enlarge the amount of area that is tidally inundated.*

b. *Manage surface and subsurface freshwater inflows to support desired on-site habitats.*

c. *Establish and maintain a sediment transport regime that supports the desired wetland functions.*

d. *Re-establish a dynamic range of hydrologic conditions (intensity and duration) to support natural ecosystem processes.*

e. *Establish and maintain biogeochemical processes representative of natural wetland ecosystems.*

Opportunities	Constraints
Increase tidal flow into the site	Flood conveyance in Ballona Creek Channel needs to be maintained
Improve tidal connectivity within the site by enlarging existing channels and culverts, and creating new channel networks	Existing tidal connections are insufficient to create and maintain a significant area of natural tidal wetland
Improve management of tide gates to create a muted tidal system with long-term management of water levels	Elevations are too high, fill disposal will be difficult
Change the roads and berms to improve habitat connections, reduce flood hazards and accommodate sea-level rise	Existing infrastructure may limit hydrologic connections within the site
Include distributary channels in the bluff deltas for coarse sediment distribution where feasible	Urban watershed negatively impacts sediment supply, water quality and hydrograph of potential freshwater sources
Restore a more natural tidal slough system linking freshwater areas to tidal marsh	Natural channel formation may be limited due to lack of tidal scour, high elevations, soil type and absence of antecedent channel network
Enhance historic Centinela Creek in Area B by increasing freshwater flows.	Limited supply of fine sediments to the site may limit march evolution over time
Reduce current flooding problems around the project area	Low-lying properties around the periphery of the site may need to be protected from flooding
Daylight outlet culvert of the Freshwater Marsh	The upstream reach of Centinela Creek has been diverted.

Physical/Chemical Processes, continued

Opportunities	Constraints
Modify Ballona Creek levees by realignment or changing the form of the bank	
Coordinate the management of tide gates in the Ballona Ecosystem (Del Rey Lagoon, Ballona Lagoon & Ballona Wetlands)	

Sub-goal 4. Sustainability: Facilitate the conservation and restoration of natural resources in a manner that maintains and improves the ecological integrity, function, diversity and productivity for future generations.

Objectives:

a. *Accommodate potential sea level rise for transitional habitat provide appropriate elevations to accommodate habitat shifts*
b. *Use self-sustaining, low maintenance systems where possible*
c. *Minimize future adverse effects of nuisance species, including non-native, invasive species, feral predators and disease vectors.*
d. *Protect the wetlands from adverse impacts caused by contaminants in influent water or sediment.*
e. *Plan for the longterm management of the site*

Opportunities	Constraints
Accommodate rising sea level by using site slope to allow habitat migration	Future development of surrounding areas
Provide sufficient tidal flow to maintain channel system	Maintenance and management resources have not been identified
Incorporate principles of adaptive management in restoration design to phase implementation and test different methods	Some sources of water and sediment to the site may be contaminated, those contaminants may accumulate in the restoration area
Utilize (or employ) existing organizations to maintain and implement stewardship activities at the site	Accumulation of contaminants or pollutants on the site: including trash and aerial deposition
Use low maintenance processes to improve water quality of urban runoff entering the wetlands	Site vulnerable to invasive species, onsite and from local area
Design site to minimize the impacts of streetlights, traffic noise and other urban characteristics on habitat values	Rising sea level may inundate low lying areas
Reduce management costs associated with tide gates	Infrastructure, such as gas facilities, needs to be maintained

Goal 2: Social and Socioeconomic Values: Create opportunities for aesthetic, cultural, recreation, research and educational use of the Ballona Ecosystem that are compatible with the environmentally sensitive resources of the area.

Sub-goal 1. Public Access: Design enhanced access to and within the Ballona Ecosystem consistent with ecosystem preservation and restoration values in a safe, consistent, coherent and functional manner.

Objectives:

a. *Develop gateway entrances that attract, welcome and inform ecosystem visitors.*

b. *Phase-out inappropriate or uncontrolled access points.*

c. *Create public outreach, education and interpretive opportunities for visitors, organizations and institutions.*

d. *Develop appropriate signage that enhances visitor understanding of wetland restoration efforts; increase public awareness of local biological and physical resources present within Ballona Wetlands.*

e. *Develop overlooks and connections accessible to pedestrian, bike and bus users and provide the appropriate signage to facilitate such access.*

f. *Provide potential opportunities for the public to participate in restoration and monitoring efforts.*

Opportunities	Constraints
Develop parking areas and designated entry points for the public on currently disturbed or developed areas.	Informal access points and associated unauthorized and uncontrolled uses
Develop interpretative components to educate the public on the values of wetland functions and habitat, build on existing educational programs	Public access areas reduce the area available for restoration
Design access with buffers between people and sensitive habitat areas	
Install facilities to serve visitors of the site	
Improve overlook points. For example, potential to use sediment material onsite to create high points	
Install consistent signage	

Public Access, continued

Opportunities	Constraints
Provide access that serves people with disabilities	
Incorporate educational and stewardship activities into the Little League program	

Sub-goal 2. Cultural Access and Preservation: Initiate formal and informal consultation with representatives of the Gabrielino/Tongva Tribal Council to develop guidelines that contribute to the preservation of sacred and cultural sites.

Opportunities	Constraints
Provide access for cultural use of the site by native people	Protection of cultural resources on site may constrain site design
Preserve cultural resources onsite	
Educate the public regarding archaeological and historic resources	

Sub-goal 3. Recreational Use: Design site to accommodate an appropriate level of fishing, boating, walking, and other activities consistent with the Ecological Reserve Designation and ecosystem restoration values.

Objectives:

a. *Provide public trails and viewing areas around the perimeter of the wetlands with interpretive displays at selected locations.*

b. *Concentrate potentially incompatible human activities in non-sensitive areas*

Opportunities	Constraints
Develop a recreational plan compatible with the Ecological Reserve designation	Existing unauthorized uses, such as BMX use and dog walking, may be incompatible with Ecological Reserve designation
Integrate existing trails, features and disturbed areas into the designated trail network.	
Integrate trail network with local and regional trails, bikeways and transportation systems	

Sub-goal 4. Public Safety and Security: Design public access so that the wetlands are a safe place to visit.

Objectives:

a. *Design access to minimize maintenance costs*

b. *Provide access points at locations responsive to the needs of law enforcement.*

c. *Create and maintain access points in a manner that minimizes safety concerns and hazards.*

Opportunities	Constraints
Provide for a safe visitor experience through site design	Major roadways cross the site, fast moving traffic, limited places for parking
Consolidate Gas Company facilities, separate from habitat areas and public access	Poorly secured site, hard to control all unauthorized access in an urban setting
Improve traffic-related safety concerns through crosswalks, walkways and safe parking areas	Unknown extent of methane or other potentially harmful substances
Improve emergency access to the site	Need to protect public health by limiting disease vectors (such as mosquitos)

APPENDIX B.
HABITAT DESCRIPTIONS FOR RESTORATION ALTERNATIVES

Draft

BALLONA WETLAND RESTORATION PROJECT: HABITAT DESCRIPTIONS FOR RESTORATION ALTERNATIVES

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I. INTRODUCTION

The Ballona Wetlands Restoration Project seeks to restore ecosystem structure, function, and processes at Ballona Wetlands, in particular those related to the support of biodiversity. A method of organizing biological diversity information for the Ballona Wetland Restoration Project is to group plants and animals by the "habitat" in which they are most likely to be sustained under improved conditions. One measure of progress toward achieving habitat restoration goals, therefore, is a determination of whether or not these targeted organisms are supported by the manipulated habitats to a measurable and acceptable level of sustained occurrence. Performance criteria can be established to measure establishment of species populations in these habitats. Physical parameters of the environmental also can be monitored and compared against data from reference sites or expected conditions to determine if the restored areas are performing within a range of anticipated values.

The following are generalized groups of habitats (organized by category and type) with information regarding characteristics such as structural feature, ecosystem function, and landscape process as well as dominant or characteristic plant species, characteristic animal species, and presumed extirpated or rare or endangered species that could be candidates for translocation and recovery experiments or goals within the Ballona Ecosystem.

The categories and subcategories of habitats are arranged from estuarine deepwater habitats and wetlands to palustrine wetlands, followed by uplands within the Ballona Ecosystem and within the estuarine category from subtidal (deepwater) and intertidal open water and non-vegetated types of habitats to vegetated types, generally going from lower elevation and hence more frequently flooded types to less frequently flooded types, an important distinction when assessing habitat characteristics. Habitat restoration design as it relates to the potential for significant sea level rise due to global climate change is an important consideration for the Ballona Wetland Restoration Science Advisory Committee during the evaluation of restoration alternatives for the Ballona Ecosystem.

II. LIST OF HABITAT CATEGORIES AND TYPES

Habitat Category I – Estuarine Open Water: Non-vegetated Habitats and Flooded Substrates:

1. Deepwater Habitats (mud and sand substrates) – Open Water Subtidal Conditions

2. Deepwater Subtidal and Wetland Intertidal Channels (cobble/gravel and riprap substrates) – Open Water Subtidal, Intertidal, and High Tide Conditions

3. Intertidal Wetland Habitats (sand and mud substrates) – Intertidal and High Tide Conditions

Habitat Category II - Estuarine Non-vegetated Intertidal Wetland Habitats

4. Intertidal Margins, Beds, Banks, and Benches (mud and sand substrates) - Low Tide Conditions

5. Intertidal Channels (cobble/gravel and riprap substrates) - Low Tide Condition

6. Mudflats

7. Hyperhaline Salt Flats

Habitat Category III - Estuarine Vegetated Wetlands:

8. Aquatic Bed Wetlands

9. Cordgrass (Low) Marsh

10. Marsh Plain (Middle Marsh)

11. High Marsh (clay/mud or sand/loam substrates)

12. High Marsh Transition Zone (including Euryhaline and Hyperhaline Habitats)

13. Brackish Marsh (an associated Open Water Habitat)

Habitat Category IV - Palustrine Nontidal Wetlands:

14. Transitional Emergent Wetlands (delta distributaries and margins of estuaries)

15. Freshwater Marsh

16. Seasonal Palustrine Wetlands (including Haline Vernal Wetlands)

17. Palustrine Scrub/Shrub Wetland (= DFG "Riparian Scrub")

18. Palustrine Forested Wetland (= DFG "Riparian Woodland"?)

Habitat Category V - Upland Habitats:

19. Grasslands (= DFG Non-native Herbaceous Vegetation)

20. Coastal Scrub (including Coastal Bluff Scrub)

21. Coastal Dune Scrub and Dune Herbs (including Foredunes)

22. Forests, Woodlands, Groves, and Tree Rows (including DFG "Eucalyptus Grove")

III. HABITAT DESCRIPTIONS

Habitat Category I – Estuarine Open Water: Non-vegetated Habitats and Flooded Substrates:

In the estuarine system, deepwater habitats are characterized by the subtidal water regime and wetlands are characterized by various non-storm-influenced intertidal water regimes including irregularly exposed, regularly flooded, and irregularly flooded regimes.

1. Deepwater Habitats (mud and sand substrates) – Open Water Subtidal Conditions

Narrative (refer to other open water habitats for additional information): Subtidal deepwater habitats include channels, bays, basins, and other features, which at extreme low water do not drain with the outgoing tides. The subtidal estuarine water regime results in permanently flooded habitats and permanent bodies of open water. These habitats are generally considered truly aquatic systems and are adjacent to and down-slope from tidal estuarine wetlands. Estuaries with extensive deepwater habitat areas often support adjacent areas of intertidal mudflat and low marsh wetland habitats.

The "plants" of channels and creeks, both intertidal and subtidal, are generally nonvascular taxa, but under brackish conditions may include various aquatic bed and emergent vascular species. The non-vascular plants include phytoplankton (e.g., diatoms) and macroalgae, which, along with the detritus from decomposed Cordgrass (*Spartina foliosa*), are often direct links in the estuarine food chain (i.e., are directly consumed by higher order consumers). Benthic invertebrates are the most visible consumers of detritus, algae and plankton. Crabs and snails graze on detritus and macroalgae, while bivalve mollusks filter feed on phytoplankton. Polychaete worms inhabit the fine sediments of tidal creeks, while fish exploit the water column and substrate surface.

Fish use of subtidal habitats can be categorized by various functional groups or guilds including, for example, (1) adult and juvenile marine fish, such as Leopard Sharks (*Triakis semifasciata*), Grey Smoothhounds (*Mustelus californicus),* and Stripped Mullet (*Mugil cephalus*) that enter estuaries with incoming tides to forage in estuaries, (2) adult marine fish such as Round Rays that feed and mate in estuaries; (3) marine fish such as California Halibut (*Paralichthys californicus*) that use flooded estuarine habitats especially channels as nursery habitat for young-of-the-year juvenile populations; (4) estuarine restricted fish such as Long-jawed Mudsuckers (*Gillichthys mirabilis*) that spend their entire life cycle in estuaries; (5) estuarine fish such as Tidewater Gobies (*Eucyclobius newberryi*) that are restricted to particular types of estuaries with brackish

water but that survive under marine conditions during floods and return to estuaries under reduced runoff conditions; (6) anadromous fish such a Steelhead Trout (*Oncorhynchus mykiss*) that live under marine conditions as adults but enter estuaries to spawn either in estuaries or in rivers and streams on adjacent watersheds. In general most estuaries do not support all of the fish guilds, but collectively, southern California estuaries as a whole provide functions for each guild.

Estuarine open water habitats such as those provided by permanently flooded conditions are important foraging areas for birds from other habitats. Of note is the endangered California Least Tern (*Sterna antillarum browni*), which breeds on sandy habitats adjacent to marine and estuarine wetlands and forages on small fish, primarily Top Smelt *(Atherinops affinis)* and Northern Anchovy *(Engraulis mordax)* in the relatively shallow water of estuaries. Shallow water habitat also is important for foraging by wading birds [e.g., Snowy and Great Egrets (*Egretta thula, Casmerodias albus*) and Green, Black-crown Night, and Great Blue Herons (*Butorides virescens, Nycticorax nycticorax, Ardea herodias*], wading shore birds [e.g., Willet (*Catoptrophorus semipalmatus*)], diving birds including grebes, mergansers, and many ducks. The endangered Brown Pelican (*Pelecanus occidentalis*) is a frequent forager in estuarine open water habitats such as those provided by permanently, semi-permanently flooded, and intertidal water regimes. Open waters also provide low-tide refuges for species that move on to the mudflat and marsh plain during high tide.

Structural features: bays, lagoons, channels.

Deepwater habitats: Estuarine Unconsolidated Bottom and Rocky Bottom, and Estuarine Streambed Deepwater Habitats.

Physical processes: estuarine hydrology including tidal hydraulics; fluvial hydrology in river and creek mouth estuaries; marine and shoreline processes associated with estuary mouth dynamics; sediment transport; biogeochemistry.

Water regime/hydrology: subtidal, permanently flooded (i.e., deepwater habitats).

Salinity: haline to mixohaline.

Dominant/characteristic plant(s): diatoms, algae.

Associated plant(s): *Zostera marina*, *Potamogeton pectinatus*, *Ruppia maritima*, *Ruppia chirrosa* in various types of Estuarine Aquatic Bed Deepwater Habitat.

Characteristic animals: perhaps over 35 species of fish depending on type of estuary and guild of fishes present; suites of benthic and epibenthic invertebrates including various mollusks, crustaceans, worms, etc.; wading birds; dabbling and diving waterfowl; foraging Osprey.

Ecosystem functions: maintenance of biodiversity; habitat for rare, endangered, and special interest species; resident and migratory bird resting and foraging habitat, source populations of marsh-plain fish species (e.g., California Killifish, Long-jaw Mudsuckers); nutrient removal (denitrification at anoxic-soil/oxic-water interface; also P removal with sediment deposition); maintain predictable environment by maintaining hydrological connectivity and reducing extremes of drought (hypersalinity) and/or freshwater flooding (hyposalinity).

Recovery opportunities: foraging habitat for California Least Tern (*Sterna antillarum browni*), California Brown Pelican (*Pelicanus occidentalis californicus*), and Osprey (*Pandion haliaetus*); flat fish nursery habitat including California Halibut (*Paralichthys californicus*), Starry Flounder (*Platichthys stellatus*), and Diamond Turbot (*Hypsopsetta guttulata*).

Management Issues: water quality.

2. Deepwater Subtidal and Wetland Intertidal Channels (cobble/gravel and riprap substrates) – Open Water Subtidal, Intertidal, and High Tide Conditions

Narrative (refer to other open water habitats for additional information): Estuarine channels and creeks play a critical role in salt marshes as they convey tidal waters and associated nutrients and dissolved gases. They also support a complex assemblage of plants and animals, and are particularly diverse when cobble beds provide surfaces for attachment by some invertebrates (e.g., mussels, oysters, barnacles, and limpets) and protective habitats for others (e.g., crabs, gobies). This substrate differences separates this habitat type (#2) from type #3 (sand and mud substrates).

Estuarine channels and creeks are subjected to a wide variety of environmental conditions including fluctuations in salinity and depth of tidal inundation. Typically, tidal flushing is greatest at the tidal inlet and decreases with distance from the inlet. This general gradient, in turn influences, water movement, salinity, temperature, nutrients, and dissolved gases. These environmental factors influence the species composition, distribution, and population dynamics of the channel fauna.

Structural features: marine cobble deltas, cobble channel beds and bars, riprap.

Deepwater Habitats and Wetlands: Estuarine Streambed and Unconsolidated Shore and Bottom (cobble/gravel) Wetlands and Estuarine Rocky Shore and Rocky Bottom (boulder) Wetlands and Estuarine Deepwater Habitats.

Physical processes: estuarine hydrology including tidal hydraulics; fluvial hydrology in river and creek mouth estuaries; marine and shoreline processes associated with estuary mouth dynamics; sediment transport; biogeochemistry.

Water regime/hydrology: subtidal, permanently flooded (i.e., deepwater habitats); intertidal irregularly exposed, regularly flooded, irregularly flooded.

Salinity: haline and mixohaline.

Dominant/characteristic plant(s): micro-algae (e.g., diatoms, cyanobacteria); macro-algae (e.g., *Ulva* and *Enteromorpha*).

Associated plant(s): none.

Characteristic animals: oysters; mussels; crustaceans including Shore, Mud, and Fiddler Crabs; possibly over 70 species of invertebrates in cobble beds; wading birds; dabbling and diving waterfowl; foraging Osprey. Many estuarine fish species also use these channels depending on the type of estuary and habitat.

Ecosystem functions: maintenance of biodiversity; habitat for rare, endangered, and special interest species; biofiltration (e.g., bivalve filtration from mussels, oysters, etc.), nutrient cycling/biogeochemistry; N and P removal as above; carbon removal by shell forming mollusks.

Recovery opportunities: *Ostreola conchaphila* (native oyster) on cobble-gravel and other hard substrates; foraging habitat for California Least Tern, California Brown Pelican, and Osprey.

Management issues: water quality including sedimentation; loss of habitat due to dredging in some estuaries; expansion of habitat in other estuaries due to ongoing accretion of marine deltas.

3. Intertidal Wetland Habitats (sand and mud substrates) – Intertidal and High Tide Conditions

Narrative (refer to other open water habitats for additional information): Intertidal channels and creeks play a critical role in salt marshes as they convey tidal waters and associated nutrients and dissolved gases. They also support a complex assemblage of plants and animals. Estuarine channels and creeks are subjected to a wide variety of environmental conditions. Typically, tidal flushing is greatest at the tidal inlet and decreases with distance from the inlet. This general gradient, in turn influences, water movement, salinity, temperature, nutrients, and dissolved gases. These environmental factors influence the species composition, distribution, and population dynamics of the channel fauna.

Structural features: intertidal channels, creeks, basins, banks, benches, marsh plain, as well as margins of deepwater habitats in bays, lagoons and subtidal channels, natural creek levees and back-levee depressions (pools).

Wetlands: Estuarine Unconsolidated Bottom, Unconsolidated Shore, Streambed, Aquatic Bed, and Emergent wetlands.

Physical processes: estuarine hydrology including tidal hydraulics; fluvial processes in tidal river and stream channels; marine and shoreline processes in estuary mouths; sediment transport; biogeochemistry.

Water regime/hydrology: intertidal – semi-permanently flooded, irregularly exposed, regularly flooded, irregularly flooded.

Salinity: haline or mixohaline.

Dominant/characteristic plant(s): diatoms.

Associated plant(s): none or *Spartina foliosa* and *Sarcocornia pacifica* (*Salicornia virginica*), and other species as appropriate on flooded habitat margins and the marsh plain; channel banks provide substrate for germination of *Ulva* spp. spores, which then grow into blades that break free and become highly productive floating mats.

Characteristic animals: perhaps over 35 species of fish depending on type of estuary and habitat; suite of benthic and epibenthic invertebrates including Ce*rithidea californica* (California Horn Snail) and various clam genera including *Tagelus, Macoma, Protothaca*; wading birds including egrets and herons; dabbling and diving waterfowl; and foraging Osprey.

Ecosystem functions: maintenance of biodiversity; habitat for rare, endangered, and special interest species; resident and migratory bird resting and foraging habitat, source populations of marsh-plain fish species (e.g., killifish, mudsuckers); nutrient cycling/biogeochemistry; N and P removal.

Recovery opportunities: flat fish habitat including California Halibut, Starry Flounder, and Diamond Turbot; foraging habitat for California Least Tern, Brown Pelican, and Osprey.

Management issues: water quality including sedimentation; loss of habitat due to dredging in some estuaries; expansion of habitat in other estuaries due to ongoing accretion of marine deltas.

Habitat Category II
Estuarine Non-vegetated Intertidal Wetland Habitats

4. Intertidal Margins, Beds, Banks, and Benches (mud and sand substrates) - Low Tide Conditions

Narrative: Within the intertidal wetland portion of estuaries and in addition to mudflat features for those estuaries that support flats, other non-vegetated structures, including channel beds, banks and benches, often occur that can have similar functions to mudflats exposed at low tide conditions. These structures are group together here when lacking aquatic bed or emergent wetland vegetation cover.

Structural features: bay and lagoon margins and beds, bottoms, banks, and benches of estuarine channels and creeks.

Wetlands: Estuarine Streambed, Unconsolidated Shore, and Unconsolidated Bottom Wetlands.

Physical Processes: estuarine hydrology including tidal hydraulics; biogeochemistry.

Water regime/hydrology: irregularly exposed, regularly flooded.

Salinity: haline and mixohaline.

Dominant/characteristic plant(s): diatoms.

Associated plant(s): none or *Spartina foliosa*, *Sarcocornia pacifica* (*Salicornia virginica*) on margins; channel banks provide substrate for germination of *Ulva* spp. spores, which then grow into blades that break free and become highly productive floating mats.

Characteristic animals: suite of benthic and epibenthic invertebrates including Ce*rithidea californica* (California Horn Snail) and various clam genera including *Tagelus, Macoma, Protothaca*; wading and shore birds (foraging); polychaetes; oligochaetes.

Ecosystem functions: maintenance of biodiversity; habitat for rare, endangered, and special interest species; biofiltration, food chain support and nutrient cycling, N and P removal, C removal by bivalves.

Recovery opportunities: channel bench and similar habitat for Fiddler Crabs (*Uca crenulata*).

Management issues: water quality and sedimentation issues.

5. Intertidal Channels (cobble/gravel and riprap substrates) - Low Tide Conditions

Narrative: Estuarine channels and creeks play a critical role in salt marshes as they convey tidal waters and associated nutrients and dissolved gases. They also support a complex assemblage of plants and animals, and are particularly diverse when cobble beds provide surfaces for attachment by some invertebrates (e.g., mussels, oysters, barnacles, and limpets) and protective habitats for others (e.g., crabs, gobies). Estuarine channels and creeks are subjected to a wide variety of environmental conditions including fluctuations in salinity and depth of tidal inundation. Typically, tidal flushing is greatest at the tidal inlet and decreases with distance from the inlet. This general gradient, in turn influences, water movement, salinity, temperature, nutrients, and dissolved gases. These environmental factors influence the species composition, distribution, and population dynamics of the channel fauna.

Structural features: marine cobble deltas, cobble channel beds and bars, riprap.

Wetlands: Estuarine Unconsolidated Shore and Bottom (cobble/gravel) and Estuarine Rocky Shore and Rocky Bottom (boulder).

Physical processes: estuarine hydrology including tidal hydraulics; fluvial hydrology in river and creek mouth estuaries; marine and shoreline processes associated with estuary mouth dynamics; biogeochemistry.

Water regime/hydrology: intertidal irregularly exposed, regularly flooded, irregularly flooded.

Salinity: haline and mixohaline.

Dominant/characteristic plant(s): micro-algae (diatoms, cyanobacteria); macro-algae.

Associated plant(s): none.

Characteristic animals: oysters and mussels (hard substrates) crustaceans including Shore, Mud, and Fiddler Crabs; possibly over 70 species of invertebrates in cobble beds.

Ecosystem functions: maintenance of biodiversity; habitat for rare, endangered, and special interest species; low tide resting habitat for resident and migratory

birds and foraging habitat for shorebirds and clapper rail; biofiltration (by bivalves), nutrient cycling/biogeochemistry; food chain support.

Recovery opportunities: *Ostreola conchaphila* (native oyster), shore bird feeding habitat.

Management issues: water quality including sedimentation**.**

6. Mudflats

Narrative: Extensive mudflats generally occur in estuaries that have gradually sloping shorelines and are sufficiently large enough to support a extensive open water and low marsh habitats or that are flooded for long periods due to closure of the estuary mouth or reduced tidal flow, presenting development of a vegetated marsh plain. Many estuaries that lack extensive mudflat habitat support functions for shore bird foraging and maintenance of invertebrate biodiversity because tidal channel beds and banks that are exposed at low tide provide similar habitat areas.

Structural features: down slope from low marsh and the marsh plain.

Wetlands: Estuarine Unconsolidated Shore and Unconsolidated Bottom Wetlands, and Estuarine Aquatic Bed Wetland (Irregularly Exposed).

Physical processes: extended periods of inundation prevent vascular plant growth.

Water regime/hydrology: regularly (daily) flooded by high tides.

Salinity: haline.

Dominant/characteristic plant(s): micro-algae, especially diatoms (over 100 species identified at some estuaries in s. CA).

Associated plant(s): at lowest tides, Eelgrass (*Zostera marina*) may be exposed (Estuarine Aquatic Bed Wetland, Irregularly Exposed) if present in estuary; macroalgae (e.g., *Ulva* spp.).

Characteristic animals: invertebrates: crabs, shrimp, clams, etc. (some are listed above regarding intertidal creeks] and shorebirds.

Ecosystem functions: maintenance of biodiversity; habitat for rare, endangered, and special interest species; nitrogen fixation by microalgae, sediment accumulation (and P removal), nutrient cycling, denitrification, invertebrate habitat, shorebird foraging.

Recovery opportunities: shorebird feeding habitat.

Management issues: mudflat is a very limited in most southern California estuaries. Sedimentation elevates the mudflat to levels that can support vascular plants; once vascular plants are established, the habitat is less suitable for shorebird feeding.

7. Hyperhaline Salt Flats

Narrative: Whereas intertidal mudflats occur at low elevations, permanently hypersaline salt flats are an important part of continuum from upland to low marsh. Salt flats but generally form only when the elevational gradient of the marsh plain is sufficient low for this evaporate zone to form at the higher levels of infrequent tidal inundation. As with restoration of all tide influenced habitats, establishment of hyperhaline salt flat and adjacent euryhaline marsh habitats require careful consideration of elevation, frequency and duration of inundation, and substrate texture. Salt flats alternate between flooded and drought conditions, which prevent most plants from occurring or from developing closed canopies if they are present. The open flat, with an occasional subshrub (e.g., *Arthrocnemum* (*Salicornia*) *subterminale*), offers certain shore birds a rare habitat that allows both feeding and refuge from predators.

Structural features: shallow depressions of upper marsh plain, banks, upper tidal deltas

Wetlands: Estuarine Unconsolidated Shore (Irregularly Flooded)

Physical processes: Estuarine processes including tidal hydraulics; geochemical processes including formation of evaporate deposits; salt concentration so that soils prevent invasion by exotic plants.

Water regime/hydrology: irregularly flooded by tides; < 25% of high tide.

Salinity: hyperhaline - 200 g/L or more in dry season.

Dominant/characteristic plant(s): none; scattered *Arthrocnemum subterminale.*

Associated plant(s): none.

Characteristic animals: Staphylinid beetles; shorebirds use these areas as refugia.

Ecosystem functions: maintenance of biodiversity; habitat for rare, endangered, and special interest species; resting and foraging areas for migratory birds, especially during high tides when other habitats are inundated.

Recovery opportunities: Tiger beetles (?); Elegant Tern (*Sterna elegans*) roosting habitat.

Management issues: Naturally occurring salt flat habitats, such as along the margins of estuarine deltas, were often some of the first areas filled in and developed in southern California estuaries. The Ballona Ecosystem supports habitat on dredge spoil in areas that were previously lower elevation habitats on the marsh plain. Preservation of salt plat habitat and functions may require relocation of the habitat if existing conditions are altered as part of a restoration plan.

Habitat Category III
Estuarine vegetated wetlands:

8. Aquatic Bed Wetlands

Narrative: This habitat category as described herein includes a number of different types depending on the structure of the habitat and the dominant organism, such as algae, bluegreen algae, vascular plants, etc. For example, nutrient-rich, estuarine channels are likely to be dominated by floating *Enteromorpha intestinalis* whereas nutrient-rich, exposed mud flats may be characterized by *Enteromorpha clathrata*. Lagoons, channels, and flooded marsh depressions with haline salinities may support dense, submersed colonies of *Ruppia maritima*, whereas similar areas that are mixohaline are likely to be characterized by *Ruppia cirrhosa* and other vascular aquatic-bed species.

Structural features: depressions in marsh plain, intertidal and subtidal channels, lagoons, and bays; haline vernal wetlands.

Wetlands: Estuarine Aquatic Bed Algal; Estuarine Aquatic Bed Rooted Vascular.

Physical processes: Estuarine processes including hydraulics.

Water regime/hydrology: variable depending on class of wetland and type of estuarine system; includes permanently flooded, semi-permanently flooded; intermittently exposed, regularly flooded, irregularly flooded.

Salinity: haline; mixo-haline.

Dominant/characteristic plant(s): Algae – various species represented including Enteromorpha, *Ulva*, *Porphyra*, etc, but many examples are not large enough or provide a dense enough cover to warrant distinction as a wetland type; Rooted vascular plants – various species depending on conditions, including *Ruppia maritima* (haline or euryhaline) and *Potamogeton pectinatus*, *Ruppia cirrhosa*, and *Zannichellia palustris* (mixohaline). Floating vascular plants – e.g., *Lemna gibba* (mixohaline).

Associated plant(s): as noted above or various emergent species in adjacent wetlands.

Characteristic animals: food and habitat for aquatic invertebrate species and for small fish species, including Tidewater Goby (*Eucyclogobius newberryi*) under mixohaline conditions.

Ecosystem functions: maintenance of biodiversity; habitat for rare, endangered, and special interest species; food chain support for waterfowl such as dabbling ducks; bio-assimilation of nutrient pollution; nutrient cycling/biogeochemistry; N and P removal.

Recovery opportunities: Mixohaline (i.e., brackish) environments that support *Ruppia cirrhosa* are frequently habitat for populations of Tidewater Goby (*Eucyclogobius newberryi)*, a federal endangered and state fish of concern.

Management issues: water quality.

9. Cordgrass (Low) Marsh

Narrative: Low salt marsh is regularly and daily inundated by tides and is dominated by California Cordgrass (*Spartina foliosa*) that forms dense monotypic stands, primarily along channel edges and adjacent to mudflats. At its lower elevation, cordgrass intergrades with mudflat habitat; at its upper elevation it intergrades with a mosaic of mid-marsh species. California Cordgrass is a highly productive species. It decomposes to form the base of the detrital food chain that supports many lower order estuarine consumers. The tall canopy provides cover for birds such as Curlew and Pintail Duck, which forage during migration.

Many of the animals of the low marsh are adapted to periods of frequent inundation. These include California horn snail, Lined Shore Crab *(Pachygrapsus crassipes)*, Yellow Shore Crab *(Hemigrapsus oregonensis)*, and Fiddler Crab *(Uca crenulata)*. The best-studied animal of the low marsh is the federal and state-endangered Light-footed Clapper Rail (*Rallus longirostrus levipes*). This species generally nests in the cordgrass that grows in the low marsh and feeds on fishes and crustaceans in adjacent tidal creeks. It also nests in pickleweed on the marsh plain and in bulrushes in brackish marsh vegetation.

Structural features: lower edge of the marsh plain, tidal channel margins

Wetlands: Estuarine Emergent Persistent Wetland (Regularly Flooded)

Physical processes: Estuarine processes including tidal hydraulics; sediment accumulation.

Water regime/hydrology: regular (daily) flooding by tides

Salinity: hypersaline and saline to brackish

Dominant/characteristic plant(s): *Spartina foliosa;* also patches of *Batis maritima.*

Associated plant(s): *Salicornia bigelovii.*

Characteristic animals: *Pachygrapsus crassipes; Hemigrapsus oregonensis; Uca crenulata;* California Horn Snail (*Cerithidea californica).*

Ecosystem functions: maintenance of biodiversity; habitat for rare, endangered, and special interest species; sediment accumulation and reduced erosion along channel edges; nutrient cycling/biogeochemistry; N and P removal; C sequestration; high rates of primary productivity and food web support; invertebrate habitat; fish habitat when flooded by tide water.

Recovery opportunities: *Spartina foliosa* (where it previously existed or to compensate for areas where its population is declining); Light-footed Clapper Rail (Fed. & State endangered bird).

Management issues: potential impacts from native and introduced predators of marsh nesting birds (Light-footed Clapper Rail); excessive sedimentation.

10. Marsh Plain (Middle Marsh)

Narrative: Intermediate elevations within the salt marsh are inundated irregularly by tides but at a greater frequency than are higher elevations. As a result, the plant species that inhabit this elevation are adapted to occasional prolonged inundation. The dominant plant is Pickleweed [*Sarcocornia pacifica* (*Salicornia virginica*)] a perennial with the broadest elevation range of all salt marsh species. Other common mid-marsh species include Saltwort (*Batis maritima*), Arrow-grass (*Triglochin concinnum*), Estero Sea-blite (*Suaeda esteroa*), and Jaumea (*Jaumea carnosa*). An important feature of the marsh plain is its topographic heterogeneity, which includes creeks, creek banks, levees, and shallow depressions. The creeks provide habitat for Longjaw Mudsucker (*Gillichthys mirabilis*);

creek levees tend to support more plant species than the plain (e.g., Estero Sea-blite is especially abundant near creeks), and the shallow depressions (5-10 cm) tend to reduce biomass of perennial pickleweed. When this dominant is subdued, the annual pickleweed (*Salicornia bigelovii*) can establish and persist. Deeper depressions (≥10 cm) retain tidal water and become feeding oases for the California Killifish (*Fungulus parvipinnus*); shallow depressions develop algal growths that support dense populations of invertebrates that are suitable prey for fish.

The animals of the mid-marsh are abundant and diverse. Food is abundant in the form of algae and vascular plant detritus. Animals that feed directly on algae include Ephydrid flies, amphipods, and snails such as the Olive Snail (*Melampus olivaceus*) in marsh vegetation and California Horn Snail (*Cerithidea californica*) in open flats and channels. A variety of birds forage in the mid-marsh, especially during higher tides when mudflats are under water, including Willet *(Catotrophorus semipalmatus)*, Marbled Godwit *(Limosa fedoa)*, Long-billed Curlew *(Numenius americanus)*, Great Blue Heron *(Ardea herodias)*, and Great Egret *(Ardea alba)*. The state endangered Belding's Savannah Sparrow *(Passerculus sandwichensis beldingii)* inhabits the marsh plain where it prefers to nest in pickleweed in mid and high marsh conditions.

Structural features: mid-marsh plain, rivulets, tidal pools, creek-side levees and back-levee depressions.

Wetlands: Estuarine Emergent Persistent Wetland (Irregularly Flooded).

Physical processes: estuarine processes including tidal hydraulics and maintenance of sediment and elevation.

Water regime/hydrology: irregularly flooded by tides (ca. 50% of high tides).

Salinity: saline to hypersaline.

Dominant/characteristic plant(s): *Sarcocornia pacifica* (*Salicornia virginica*).

Associated plant(s): *Frankenia salina, Jaumea carnosa, Distichlis spicata, Suaeda esteroa, Triglochin concinna.*

Characteristic animals: *Fundulus parvipinnis* (California Killifish); *Melampus* olivaceus; polychaetes; oligochaetes.

Ecosystem functions: plant diversity support (the mash plain is potentially diverse in native halophytes), habitat for rare, endangered, and special interest species; insect support, nutrient cycling/biogeochemistry; N and P removal; primary productivity and detrital food web support.

Recovery opportunities: Belding's Savannah Sparrow (State endangered bird); Long-billed Curlew (*Numenius americanus*); Estero Seep-weed (*Suaeda esteroa*); Northern Harrier (*Circus cyaneus*).

Management issues: sedimentation (increase in elevation and loss of shallow depressions that form pools and create feeding oases, or erosion (decrease in elevation); potential impacts to marsh nesting birds (Belding's Savannah Sparrow).

11. High Marsh (clay/mud or sand/loam substrates)

Narrative: High marsh habitats are irregularly to intermittently inundated by tidal water and generally range from saline to hypersaline conditions. Plants that comprise the high marsh include the Parish's Glasswort [*Arthrocnemum subterminale* (*Salicornia subterminalis*)], Shoregrass (*Monanthochloe littoralis),* Alkali Heath (*Frankenia salina*), and Sea Lavender *(Limonium californicum).* The vegetation varies depending on the drainage and density of the soil (i.e., ratio of clay to sand), which often is correlated with salinity. Vegetation in dense, hypersaline (salinity greater than seawater) or euryhaline (fluctuating salinity, seasonal hypersalinity) is quite different than loose, sandy soils. The endangered Salt Marsh Bird's Beak *(Cordylanthus maritimus* spp. *maritimus)* occurs in high marsh and is more abundant in sandy soils. Likely the open canopies of sandy areas allow seeds to germinate after rainfall while also offering roots for this hemiparasite to parasitize. High marsh vegetation provides habitat for Belding's Savannah Sparrow, staphylinid beetles, the snail *Assiminea transluscens,* and other estuarine restricted species.

Structural features: upper marsh plain, slopes of berms and banks; upper tidal deltas.

Wetlands: Estuarine Emergent Persistent Wetland (Irregularly Flooded).

Physical processes: Estuarine processes including tidal hydraulics; also Aeolian-influenced processes if adjacent to dune systems, or fluvial-influenced if on a delta.

Water regime/hydrology: Irregularly flooded by tides (< 50% of high tides.

Salinity: saline, hyperhaline, euryhaline.

Dominant/characteristic plant(s): *Arthrocnemum subterminale*; *Monanthochloe littoralis.*

Associated plant(s): *Sarcocornia pacifica, Limonium californicum, Distichlis spicata, Spergularia macrotheca, Atriplex watsonii, Frankenia salina*

Characteristic animals: *Asiminea transluscens* (snail); Belding's Savannah Sparrow; Cottontail; Ground Squirrels.

Ecosystem functions: maintenance of biodiversity; habitat for rare, endangered, and special interest species; high tide refuge for Light-footed Clapper Rail and Belding's Savannah Sparrow.

Recovery opportunities: Light-footed Clapper Rail (Fed. & State endangered bird); Belding's Savannah Sparrow (State endangered bird); Northern harrier (*Circus cyaneus*) foraging habitat; *Cordylanthus maritimus* ssp. *maritimus* (Fed. & State endangered plant)

Management issues: Loss of historic habitat due to filling and development. Vulnerable to invasion by many introduced invasive plant species including introduced species of *Limonium* (Sea Lavender), are less likely to invade lower elevations habitats, and introduced grass species such as Rabbit's Foot Grass (*Polypogon monspeliensis*), Sicklegrass (*Parapholis incurva*), Italian Ryegrass (*Lolium multiflorum*) because it is rarely tidal and can have very low salinities at least seasonally.

12. High Marsh Transition Zone (including Euryhaline and Hyperhaline Habitats)

Narrative: The transition zone represents that area where the halophytic and hydrophytic salt marsh vegetation overlaps with upland communities. Storm-surge high tides may flood habitats transitional to upland habitats, including various palustrine wetlands adjacent to high marsh estuarine wetlands; however, they are generally considered to be located beyond the limits of estuarine wetlands, but within the more broadly defined "estuarine" ecosystem (e.g., the Ballona Ecosystem). At relatively undisturbed southern California estuaries, examples of Estuarine Scrub Shrub Wetland may occur in the transition zone and may include Boxthorn *(Lycium californicum)*, Bush Seepweed *(Suaeda nigra)*, Coast Golden Bush (*Isocoma menziesii*), Parish's Glasswort (*Arthrocnemum subterminale*), and Quail Bush (*Atriplex lentiformis*). These overlap with the highest elevation salt marsh species including, for example, Saltgrass *(Distichlis spicata)*, Alkali Weed *(Cressa truxillensis)*, and Shoregrass *(Monanthochloe littoralis)*. *Lycium* is a common perch for birds and various small mammals burrow under it. The fact that it is deciduous shrub that greens up whenever there is water available makes it an indicator of sewage spills or other off-season sources of water.

The animals of the higher elevations of the transition zone are primarily terrestrial species. Those associated with shrubby uplands such as portions of the transition zone include, for example, various species of snakes, lizards, small mammals and birds. Herpetofauna may include California Kingsnake *(Lampropeltis getulus californiae)*, San

Diego Gopher Snake *(Pituophus melanoleucus annectens)* and side-blotched lizard *(Uta stansburiana)*. Common mammals of the shrub-dominated uplands include Western Harvest Mouse *(Reithrodontomys megalotis)*, Deer Mouse *(Peromyscus maniculatus)*, Pocket Gopher (*Thomomys* sp.), Opossum *(Didelphis virginianus)*, Striped Skunk (*Mephitis mephitis)*, and California Ground Squirrel *(Spermophilus beechyi)*. The small mammals are preyed upon by a variety of birds including Short-eared Owl *(Asio flammeus)*, Northern Harrier *(Circus cyaneus)*, and White-tailed Kite *(Elaneus caeruleus)*. Ground-nesting bees that pollinate Salt Marsh Bird's-Beak (*Cordylanthus maritimus* spp. *maritimus*) live above the high tide in this habitat. Boxthorn (*Lycium californicum*) offers a tall perch site for various birds, and its thorns can deter human intrusion.

One of the more interesting habitats is the euryhaline zone with fluctuating salinities between wet season low salinities and dry season hypersaline conditions. The habitat is characterized by winter annual plant species such as Salt Marsh Daisy (*Lasthenia glabrata* ssp. *coulteri*), Salt Marsh Sand-sperry (*Spergularia marina*), Toad Rush (*Juncus bufonius*), and Hutchinsia (*Hutchinsia procumbens*), which are adapted to the fluctuating salinities. The euryhaline zone is generally located upslope from hyperhaline salt flats and down-slope from nontidal palustrine wetland or grassland habitats and is perhaps the habitat most representative of Mediterranean climate estuarine wetlands.

The transition zone may also include nontidal palustrine habitats both salt influenced and non-saline types. Seeps from perched water tables on deltas and the toe of slopes and along dune transitions often support a variety of palustrine emergent and scrub-shrub types. Characteristic non-saline or slightly brackish species may include shrubs such as Mule Fat (*Baccharis salicifolia*) and herbaceous species such as spiny-rush (*Juncus acutus*), Willow-Dock (*Rumex salicifolia)*, and Alkali Ryegrass (*Leymus triticoides*). Seasonal palustrine wetlands also occur in this area, especially in low-gradient deltaic deposits and may include salt-influenced types supporting a variety of native annual species such as Alkali Barley (*Hordeum depressum*). Belding's Savannah Sparrows use the taller shrubs of this habitat during the non-nesting season.

Structural features: alluvial plain, upper deltas, banks.

Wetlands: Estuarine Emergent Persistent and Nonpersistent Wetland (Irregularly Flooded); Estuarine Scrub Shrub Wetland (Broadleaved Deciduous and Evergreen).

Physical processes: estuarine processes including tidal hydraulics; fluvial-influenced if on a delta; geochemical processes including formation of evaporate deposits.

Water regime/hydrology: (irregularly flooded by tides; i.e., < 20% of tides); and adjacent storm-tide influenced wetlands, palustrine wetlands, and uplands.

Salinity: fluctuating from mixohaline and saline to hyperhaline (more saline than sea water) and euryhaline (fluctuating salinity) and upslope to potentially non-haline.

Dominant/characteristic plant(s): *Arthrocnemum subterminale, Monanthochloe littoralis, Lycium californicum.*

Associated plant(s): winter annuals including *Spergularia marina, Juncus bufonius, Hordeum depressum, Lasthenia glabrata* ssp. *coulteri, Hutchinsia procumbens.*

Characteristic animals: (see animals discussed above regarding the high marsh habitat).

Ecosystem functions: maintenance of biodiversity; habitat for rare, endangered, and special interest species; foraging areas for upland animals; resting areas for migratory birds; high tide refuge for Light-footed Clapper Rail; pollination support.

Recovery opportunities: *Lasthenia glabrata coulteri* (CNPS rare); *Hutchinsia procumbens* (locally extirpated); Tiger beetles (?); Northern Harrier (*Circus cyaneus*) foraging areas.

Management issues: Loss of historic habitat due to filling and development. Vulnerable to colonization by many introduced invasive plant species. This transitional habitat [and the high marsh as noted above] is highly susceptible to invasive species such as Rabbit's Foot Grass (*Polypogon monspeliensis*), Sicklegrass (*Parapholis incurva*), Italian Ryegrass (*Lolium multiflorum*), and other grasses because it is rarely tidal and can have very low salinities at least seasonally, especially during unusually wet winters and in areas that receive substantial anthropogenic freshwater inputs.

13. Brackish Marsh (and associated Open Water Habitat)

Narrative: Sites where freshwater mixes with saline seawater produce brackish conditions with intermediate salinities. This phenomenon is less frequent in southern California where many estuaries are less influenced by runoff from rainfall than in more northerly latitudes. In southern California, brackish sites vary seasonally, with dilution during the wet season and concentration of salts during the dry season. Local influence from seeps and springs and seasonally impounded stream and river-mouths can produce brackish environments that support emergent vegetation characterized, for example, by Prairie Bulrush [*Bolboschoenus* (*Scirpus*) *maritimus*], and Southern Cattail (*Typha domingensis*), and aquatic bed species including (*Potamogeton pectinatus)* and Ditchgrass (*Ruppia* spp.). The biggest difference in plant composition between brackish

and salt marshes is often at the lower elevations in the marsh -- higher elevation areas of Mediterranean-climate brackish marshes tend to be similar to the mid-marsh plain or high marsh habitats of salt marshes. Tidewater Goby (*Eucyclogobius newberryi),* a Federal listed endangered species, occurs in systems or habitats within systems characterized by brackish water conditions.

Structural features: channels, depressions, basins, seeps and springs.

Wetlands: Estuarine Emergent Persistent and Nonpersistent Wetland (Semi-permanently Flooded); estuarine Aquatic Bed Wetland (Floating and Rooted Vascular; Algal).

Physical processes: Estuarine processes including tidal hydraulics; also fluvial-influenced if associated with a river channel and artesian-influenced if associated with seeps or springs from groundwater.

Water regime/hydrology: Tidally influenced with a wide range of tidal inundation frequencies depending on elevation and distance from the tidal inlet; seasonal dilution from surface water (runoff).

Salinity: brackish (mixohaline).

Dominant/characteristic plant(s): Prairie Bulrush [*Bolboschoenus* (*Scirpus*) *maritimus*]*;* California Bulrush, Tule [*Schoenoplectus* (*Scirpus*) *californicus*]; American Bulrush [*Schoenoplectus* (*Scirpus*) *americanus*]; Southern Cattail (*Typha domingensis*).

Associated plant(s): Salt Marsh Bulrush [*Bolboschoenus* (*Scirpus*) *robustus*] (unknown from Ballona?); Spiny Rush (*Juncus acutus*).

Characteristic animals: rails; bittern; wrens, Redwing Blackbird.

Ecosystem functions: maintenance of biodiversity; habitat for rare, endangered, and special interest species; biofiltration of freshwater runoff; nutrient cycling/biogeochemistry; N and P removal; C sequestration; sediment accumulation; very high rates of primary productivity in the lower portions of brackish and freshwater marsh areas; food web support.

Recovery opportunities: Light-footed Clapper Rail (Fed. & State endangered); Tidewater Goby (threatened); Brackish Water Snail (*Tyonia imitator*).

Management issues: Influence of stormwater runoff on formation of and impacts to brackish marshes; water quality; excessive sedimentation from upstream disturbances.

Habitat Category IV
Palustrine Nontidal Wetlands:

14. Transitional Emergent Wetlands (delta distributaries and margins of estuaries)

Narrative: The toe of slopes along estuary margins often provide opportunities for the formation of fresh or brackish water seeps and springs, including examples with well-developed dune fields containing freshwater lenses, deltas of rivers with shallow aquifers, and alluvial fans with artesian wells. These features can be the sites of estuarine brackish marshes and palustrine freshwater marshes. They also can support the development of palustrine emergent wetlands that are transitional in nature and similar to habitat type No 12 – High Marsh Transition Zone, but are distinctly palustrine and adjacent to estuarine habitats within coastal ecosystems.

Structural features: margins of dunes, deltas, banks, bluffs, alluvial fans and plains.

Wetlands: Palustrine Emergent Persistent Wetland.

Physical processes: Fluvial and/or groundwater hydrology.

Water regime/hydrology: (Permanently?), seasonally, temporarily, or intermittently saturated; temporarily or intermittently flooded.

Salinity: Freshwater to euryhaline. Due to brackish nature of water, salt spray, or rare storm-tide influences, or even concentration of salts by plants, soil salinity may increase during dry periods and may include formation of surface precipitates.

Dominant/characteristic Plant(s): Alkali Ryegrass (*Leymus triticoides*); Saltgrass (*Distichlis spicata*); Western Goldenrod (*Euthamia occidentalis*); Salt Marsh Baccharis (*Baccharis douglasii*).

Associated plant(s): Alkali Barley (*Hordeum depressum);* Seaside Heliotope (*Heliotropium curassavicum);* Coast Golden Bush (*Isocoma menziesii);* Western Sea-Purslane (*Sesuvium verrucosum);* Common Sedge (*Carex praegracilis*); Yerba Mansa (*Anemopsis californica*); Baltic Rush (*Juncus balticus*); Small-leaved (Petunia parvifolia); Sticky Conyza (*Conyza coulteri*).

Characteristic animals: small mammals including voles, harvest mice, field mice, gophers; herpetofauna.

Ecosystem functions: maintenance of biodiversity; habitat for rare, endangered, and special interest species; hydrology (seasonally saturated, temporarily flooded).

Recovery opportunities: foraging habitat for White-tailed Kite and other raptors; potential habitat for Ventura Marsh Milk-vetch (*Astragalus pycnostachys* var. *lanosissimus* - Fed and State listed endangered plant); Wandering Skipper (butterfly); Southern Salt Marsh Shrew (*Sorex ornatus salicornicus*).

Management issues: invasion by Giant reed (*Arundo donax*) and Myoporum (*Myoporum laetum*).

15. Freshwater Marsh

Narrative: Freshwater marshes occur in saturated, organic rich or sometime mineral soils. The dominant plants are generally emergent monocots such as cattails (*Typha* spp.) and bulrushes [e.g., *Schoenoplectus (Scirpus) californicus*], although aquatic-bed species, such as pondweeds (*Potamegeton* spp.), may also be common. Redwing Blackbirds (*Agelaius phoeniceus*) and Marsh Wrens (*Cistithorus palustris*) commonly breed in the tall, dense vegetation. Common mammals include Raccoon (*Procyon lotor*), Striped Skunk and Opossum. Freshwater marsh habitat may also support the Light-footed Clapper Rail, although this is not considered optimal breeding or foraging habitat. These marshes may provide refugia for rails and other bird species during extreme high tides and rive floods. Creation and maintenance of freshwater marsh habitat is dependent upon a continual source of freshwater. Some coastal wetland restoration plans have incorporated freshwater and brackish marshes due to historical evidence of springs adjacent to intertidal areas

Structural features: river and stream channels; ponds; seeps and springs

Wetlands: Riverine Nonpersistent Emergent Wetland; Palustrine Emergent Persistent Wetland (Permanently or Semi-permanently Flooded, Irregularly Exposed).

Physical processes: Fluvial and/or groundwater.

Water regime/hydrology: Permanently flooded; intermittently flooded; seasonally flooded; permanently and seasonally saturated.

Salinity: fresh water to slightly brackish (groundwater conditions).

Dominant/characteristic Plant(s): Broadleaved Cattail (*Typha latifolia*); Bur-reed (*Sparganium eurycarpum*); California Bulrush (*Schoenoplectus californicus*); Southern Cattail (*Typha domingensis*).

Associated plant(s) - Representative: Basket Rush (*Juncus textilis*); Spiny Rush (*Juncus acutus*); Spike-rush (*Eleocharis spp*.), Hooker's Evening Primrose (*Oenothera elata* ssp. *hookeri*); Horsetails – Common Scouring Rush (*Equisetum hyemale* ssp. *affine*), Smooth Scouring Rush (*E. levigatum*), Giant Horsetail (*E. telmateia*); Western Goldenrod (*Euthamia occidentalis*); Willow Dock (*Rumex salicifolius* vars. *crassus*); Willow Herb (*Epilobium ciliatum* ssp. *ciliatum*); Yerba Mansa (*Anemopsis californica*); American Bulrush (*Schoenoplectus americanus*); Three-square Bulrush (*Schoenoplectus pungens*); Cinquefoil (*Potentilla anserina*); Monkey-flower (*Mimulus guttatus*).

Characteristic animals: Western Pond Turtle, Red-legged Frog; rails, waterfowl, Red-winged Blackbird (*Agelaius phoeniceus*); many passerine birds.

Ecosystem functions: maintenance of biodiversity; habitat for rare, endangered, and special interest species; nutrient cycling/biogeochemistry; N and P removal; C sequestration; sediment accumulation; high rates of primary productivity; habitat for breeding birds.

Recovery opportunities: Western Pond Turtle (*Clemmys marmorata*); California Red-Legged Frog (*Rana aurora draytonii*); Light-footed Clapper Rail and other rail species known to use freshwater marshes adjacent to estuaries in southern California; Least Bittern (*Ixobrychus exilis*); Northern Harrier (*Circus cyaneus*); Spiny Rush (*Juncus acutus*).

Management issues: excessive sedimentation; subject to shrub invasion (e.g., willow invasion). Sites that are less frequently flooded can have substantial problems with non-native grasses such as Rabbitsfoot Grass. Also, Giant Reed and Pampas Grass are large perennial grasses that can be problematic.

16. Seasonal Palustrine Wetlands (including Haline Vernal Wetlands)

Narrative: Seasonal wetlands are non-tidal wetlands and transitional habitats that are flooded to varying degrees by seasonal rainfall and runoff. If there are sufficient salts in the soil, the seasonal wetland may support plant species more typical of coastal salt marsh, such as Pickleweed [*Sarcocornia pacifica* (*Salicornia virginica*)], Saltgrass (*Distichlis spicata*), and Alkali Weed (*Cressa truxillensis*). If the soils do not contain salts or alkaline substances, the seasonal wetlands may support freshwater marsh species and a mixture of weedy opportunists. "Vernal pools" and saline vernal wetlands of transition zones can occur on alluvial and deltaic deposits adjacent to estuarine habitats and are known to support special concern plants and invertebrate animals (e.g., fairy shrimp species).

Seasonal wetlands can be important to a number of bird species that feed on the insects, algae and aquatic invertebrates that develop in these temporary habitats. Amphibians, such as western toad (*Bufo boreas*) and Pacific Tree Frog (*Pseudacris regilla*) have been noted to breed in this habitat. These areas also attract mammals, such as Coyote, Raccoon, Striped Skunk and Opossum. In areas where water pools deeply enough, waterfowl species such as Mallard (*Anas platyrhynchos*), Cinnamon Teal (*Anas cyanoptera*) and American Coot (*Fulica Americana*) have been observed. Seasonal wetlands may also used by shorebirds such as Killdeer (*Charadrius vociferus*) and Black-necked Stilts (*Himantopus mexicanus*).

Structural features: depressions in deltas and fill deposits often associated with other palustrine wetlands adjacent to estuarine wetlands

Wetlands: Palustrine Emergent Wetland, persistent and non-persistent types, seasonally flooded and generally euryhaline

Physical processes: natural examples influenced by fluvial and coastal (storm) processes and anthropogenic effects from disturbances including infilling, dredging, grading, etc.

Water regime/hydrology: Seasonally flooded

Salinity: Fresh water or euryhaline (low salinity when flooded and higher salinity when dry)

Dominant/characteristic Plant(s): Haline vernal wetland examples – Alkali Barley (*Hordeum depressum*); Pickleweed (*Sarcocornia pacifica*); Salt Marsh Daisy (*Lasthenia glabrata* ssp. *coulteri*); Salt Marsh Sand-Sperry (*Spergularia marina*); Toad Rush (*Juncus bufonius* ssp. *halophilus*?). Freshwater examples – Meadow Barley (*Hordeum brachyantherum* ssp. *brachyantherum).*

Associated plant(s): Alkali Mallow (*Malvella leprosa*); Alkali Weed (*Cressa truxillensis*); Sea-Purslane (*Sesuvium verrucosum*); Horned Sea-blite (*Suaeda calceoliformis*); Seaside Heliotrope (*Heliotropium curassavicum*); Slim Aster (*Symphyotrichum subulatum*); Sticky Conyza (*Conyza coulteri*).

Characteristic animals: planktonic (e.g., rotifers, crustaceans including copepods, cladocerans) and macroscopic (e.g., aquatic insect larvae) invertebrates.

Ecosystem functions: maintenance of biodiversity; habitat for rare, endangered, and special interest species; shorebird foraging habitat.

Recovery opportunities: Silver Scale (*Atriplex argentea* var. *mohavensis*) (extirpated?); Hutchinsia (*Hutchinsia procumbens*) (extirpated?); Southern Tarweed (*Centromadia*. *parryi* ssp. *australis*); fairy shrimp species?

Management issues: impacts (e.g., cover and thatch) from introduced annual weeds including Brass Buttons (*Cotula coronopifolia*), Mediterranean Barley (*Hordeum marinum*), Italian Ryegrass (*Lolium multiflorum*), Rabbitsfoot Grass (*Polypogon monspeliensis*), and Sicklegrass (*Parapholis incurva*).

17. Palustrine Scrub/Shrub Wetland (= DFG "Riparian Scrub")

Narrative: Willow scrub is characterized by dense broad-leafed, winter-deciduous riparian thickets dominated by several willow shrub and tree species (*Salix* spp.). Riparian trees also may occur with the association and may include, for example, scattered Fremont's Cottonwood (*Populus fremontii*), and Western Sycamore (*Platanus racemosa*). Riparian woodland also may occur in small groves or in riverine corridors that drain into estuaries. As with other riparian habitats, riparian scrub supports a diverse assemblage of wildlife species, especially passerine bird species. The endangered Least Bell's Vireo (*Vireo bellii pusillus*) and Southwestern Willow Flycatcher (*Epidonax traillii extimus*) as well as other sensitive species, such as Yellow Warbler (*Dendroica petechia brewsteri*) and Yellow-breasted Chat (*Icteria virens*) all depend on riparian woodlands for breeding. Mammal assemblages are similar to those found in freshwater marsh habitats as the two often intergrade. In an undisturbed estuarine system, willow scrub habitat would generally occur upstream of tidal influence as willows are very sensitive to salt. Like freshwater marsh, this habitat is dependent upon a constant source of freshwater.

Structural features: bluff and dune seeps or spring, floodplains.

Wetlands: Palustrine Scrub/Shrub Wetland (Broadleaved Deciduous and Evergreen).

Physical processes: fluvial and/or groundwater hydrology; sediment transport.

Water regime/hydrology: seasonally and permanently saturated; temporarily flooded; phreatophytic.

Salinity: fresh water.

Dominant/characteristic Plant(s): Arroyo Willow (*Salix lasiolepis*); Mule Fat (*Baccharis salicifolia*); Sandbar Willow (*Salix exigua*).

Associated plant(s): Basket Rush (*Juncus textlis*); California Rose (*Rosa californica*); Coyote Brush (*Baccharis pilularis*); Salt Marsh Baccharis (*Baccharis douglasii*); American Dogwood (*Cornus sericea* ssp. *occidentalis*)?; Hoary Nettle (*Urtica dioica* ssp. *holosericea*).

Characteristic animals: resident and migratory passerine birds, such as Common Yellowthroat (*Geothlypis trichas*) and Blue grosbeack (*Guiraca caerulea*), and those listed herein (habitat no. 18); herpetofauna and mammals of various guilds.

Ecosystem functions: maintenance of biodiversity; habitat for rare, endangered, and special interest species; refuges for estuarine wildlife species and wildlife corridors linking upland sites with coastal wetlands.

Recovery opportunities: Least Bell's Vireo (*Vireo bellii pusillus*) and Southwestern Willow Flycatcher (*Epidonax traillii extimus*) as well as other sensitive species, such as Yellow Warbler (*Dendroica petechia brewsteri*) and Yellow-breasted Chat (*Icteria virens*).

Management issues: Impacts from invasive plant species including Giant reed (*Arundo donax*), Pampas Grass (*Cortaderia selloana*); Myoporum (*Myoporum laetum*).

18. Palustrine Forested Wetland (= DFG "Riparian Woodland"?)

Narrative: Palustrine Forested Wetland as discussed herein is generally characterized by isolated stands of trees or tall shrubs that occur at seeps, toe-of-slopes, ponded areas, along streams and rivers, and at other sites with shallow water tables. Arroyo Willow (*Salix lasiolepis*) is the most common representative but other native species such as additional willow species, Black Cottonwood (*Populus balsamifera* ssp. *trichocarpa*), and Western Sycamore (*Platanus racemosa*) are also represented. Riparian corridors along streams and rivers are no longer well developed due to impacts from urbanization, but portions of the original drainage of Centinela Creek still support riparian vegetation. In the riparian setting, trees in upland and wetland habitats may be included in mapped examples of this vegetation where the distinction among hydric (i.e., wetland), mesic, and xeric (i.e., upland) types of riparian vegetation are often not distinguished. A number of exotic species also may be represented including Myoporum (*Myoporum laetum*) and various species of *Eucalyptus*, especially Blue Gum (*Eucalyptus globulus*).

Structural features: bluff seeps, floodplains, margins of dunes and dune swales.

Wetlands: Palustrine Forested Broadleaved Deciduous Wetland.

Physical processes: fluvial and/or groundwater hydrology; sediment transport.

Water regime/hydrology: permanently, seasonally, temporarily, or intermittently flooded; permanently, seasonally saturated; phreatophytic.

Salinity: freshwater.

Dominant/characteristic Plant(s): Black Cottonwood (*Populus balsamifera* ssp. *trichocarpa*); Western Sycamore (*Platanus racemosa*); Arroyo (*Salix lasiolepis*).

Associated plant(s): Blue Elderberry (*Sambucus mexicana*); Coast Live Oak (*Quercus agrifolia*); White Alder (*Alnus rhombifolia*); Red Willow (*Salix laevigata*); Shining Willow (*Salix lucida* ssp. *lasiandra*); Black Willow (*Salix goodingii*); California Walnut (*Juglans californica*); various riparian shrubs and vine species and herbaceous plants including Stinging Nettle (*Urtica dioica* ssp,. *holosericea*).

Characteristic animals: Passerine birds including resident and migratory birds such as those sensitive species listed below; herpetofauna; shelter and corridor for mammals including raccoon, skunk, and coyote.

Ecosystem functions: maintenance of biodiversity; habitat for rare, endangered, and special interest species; breeding bird habitat.

Recovery opportunities: Southwestern Willow Flycatcher (*Empidomax trallii extimus*); Least Bell's Vireo (*Vireo belli pusillus*); Western Yellow Warbler (*Dendroica petechia brewsteri*); Yellow-breasted Chat (*Icteria virens*).

Management issues: vulnerable to invasion by Giant Reed (*Arundo donax*) and various exotic vines (e.g. Cape Ivy), shrubs (Tamarisk), and tree species (e.g., *Eucalytus* spp.); restore connectivity of stands when appropriate and feasible.

Habitat Category V
Upland Habitats:

19. Grasslands (= DFG Non-native Herbaceous Vegetation)

Narrative: Grasslands are illustrated on historic maps of the Ballona region and are likely to have occurred on alluvial deposits on the periphery of the coastal wetland ecosystem, mixed with various forms of coastal scrub. DFG recently used the designation "non-native herbaceous" for the category of vegetation that represents the existing conditions of "grassland", "meadow", or "prairie" vegetation within the Ballona Ecosystem. In a restored state, the vegetation could include native grass species and a diverse number of native herbaceous and sub-shrub species as noted above, with small

colonies and scattered individuals of coastal scrub species to provide perches and shelter for animals that characterize grassland and adjacent scrub and wetland habitats.

Structural features: upland alluvial deposits, graded spoil deposits,

Physical processes: potentially a fire-maintained community.

Dominant/characteristic Plant(s): in an upland context - California Barley (*Hordeum brachyantherum* ssp. *californicum*); Purple Needlegrass (*Nassella pulchra*); Salt Grass (*Distichlis spicata*); Alkali Ryegrass (*Leymus triticoides*).

Associated plant(s): Alkali Heath (*Frankenia salina*); Coast Golden Bush (*Isocoma menziesii*); Common Tarweed (*Dienandra fasciculata*); Telegraph Weed (*Heterotheca grandiflora*); Deerweed (*Lotus scoparius*), Spanish Clover (*Lotus purshianus*), Owl's Clover (*Castilleja exerta*); White Cudweed (*Gnaphalium canescens*); Common Verbena (*Verbena lasiostachys*); California Poppy (*Eschschulzia californica*); Pitseed Goosefoot (*Chenopodium berlandieri*); Arroyo Lupine (*Lupinus succulentus*); Bicolor Lupine (*Lupinus bicolor* var. *microphyllus*); Fascicled Milkweed (*Asclepias fasciculata*); Bush Aster (*Lessingia filaginifolia*); Fiddleneck (*Amsinckia menziesii*); Western Ragweed (*Ambrosia psilostachya*); Gum Plant (*Grindelia robusta*); California Goldenrod (*Solidago californica*); Popcorn Flower (*Cryptantha inermedia*); Miniature Sun Cup (*Camissonia micrantha*); Rattlesnake Weed (*Euphorbia albomarginata*); Pygmy Stonecrop (*Crassula connata*).

Characteristic animals: resident and migratory grassland bird species including Horned Lark; herpetofauna including lizards and snakes, such as California King Snake and Gopher Snake; and small mammals including voles, mice, shrews, and moles.

Ecosystem functions: maintenance of biodiversity; habitat for rare, endangered, and special interest species; host plants for butterfly larvae including the Wandering Skipper Monarch (*Danaus plexippus*) butterflies; habitat for native small mammals; foraging habitat for raptors such as White-tailed Kite and Northern Harrier and egrets (Great Egret) and herons (Great Blue Heron).

Recovery opportunities: South Coast Marsh Vole (*Microtus californicus stephensi*); San Diego Black-tailed Jackrabbit (*Lepus californicus bennettii*); California Horned Lark (*Eremophila alpestris*); White-tailed Kite (*Elanus caeruleus*); Northern Harrier (*Circus cyaneus*).

Management issues: Maintenance of grassland habitat to prevent it becoming coastal scrub (using fire, grazing, or mowing techniques?); control of invasive plant species.

20. Coastal Scrub (including Coastal Bluff Scrub)

Narrative: The general category "coastal scrub" includes a number of shrub-dominated plant communities in the context of a variety of land forms. Coyote Brush and California Sage Brush form colonies on alluvial and disturbed soils and can occur within the context of grassland and other herbaceous vegetation. Upland delta scrub can be quite rich in shrub species and occurs in alluvium adjacent to wetland forms of delta scrub often dominated by Mulefat (*Baccharis salicifolia*). Coastal Bluff Scrub is limited to coastal bluffs where salt tolerant species including Wooly Sea-Blite (*Suaeda taxifolia*) and Quail Bush (*Atriplex lentiformis*) are characteristic but occurs in different forms depending on proximity to salt spray. Within the bluff community, sparsely-vegetated areas or areas with low vegetation also can support a wide variety of herbaceous species, some of which are also associated with coastal dunes. Coastal Dune Scrub is treated separately herein. No Maritime Chaparral occurs in the Ballona Ecosystem.

Other forms of upland coastal scrub include, for example, Delta Scrub and Baccharis Scrub, which can be transitional to wetland scrub types.

A variety of terrestrial animals, including amphibians, reptiles, mammals and birds are supported by coastal scrub habitat. For instance, Coastal Sage Scrub is the preferred breeding habitat of the coastal California Gnatcatcher (*Pilioptila californica californica*).

Structural features: alluvial deposits, berms and banks; coastal bluffs.

Physical processes: fluvial, erosional, (and anthropogenic).

Dominant/characteristic Plant(s): Coyote Brush (*Baccharis pilularis*); California Sagebrush (*Artemisia californica*); *Mugwort (Artemisia douglasiana***);** Quail Bush (*Atriplex lentiformis*); Douglas' Nightshade (*Solanum douglasii*); Lemonade Berry (*Rhus integrifolia*); Seacliff or Dune Buckwheat (*Eriogonum parvifolium*).

Associated plant(s): Laurel Sumac (*Malosma laurina*); Cliff Aster (*Malacothris saxatilis*); Deerweed (*Lotus scoparius*); Black Sage (*Salvia mellifera*); Wild Morning-glory (*Calystegia macrostegia*); Melic Grass (*Melica imperfecta*); Foothill Needlegrass (*Nassella lepida*); California Brome (*Bromus carinatus*); Mock Heather (*Ericameria ericoides*); Bladderpod (*Isomeris arboreus)*; Elderberry (*Sambucus mexicanus*); Wild Cucumber (*Marah macrocarpus*); Giant Ryegrass (*Leymus condenstatus*); California Encelia (*Encelia californica*); Suffrutescent Wallflower (*Erysimum insulare* ssp *suffrutescens*); Coastal Prickly Pear (*Opuntia littoralis*); California Buckwheat (*Eriogonum fasciculaum*); Milk Vetch (*Astragalus trichopodus*); Branching Phacelia (*Phacelia ramosissima* var.

austrolittoralis); Bush Mallow (*Malacothamnus fasciculatus*); Lewis' Evening Primrose (*Camissonia lewisii*); Toyon (*Heteromeles arbutifolia*); Chaparral Nightshade (*Solanus xanti*); Wooly Sea-blite (*Suaeda taxifolia*).

Characteristic animals: Loggerhead Shrike (Lanius ludovicianus) perching; California Gnat Catcher (*Polioptila californica californica*) endangered; resident and migratory passerine birds including Luzuli Bunting (*Passerina amoena*) and Blue Grosbeak (*Guiraca caerulea*); small mammals.

Ecosystem functions: maintenance of biodiversity; habitat for rare, endangered, and special interest species; breeding bird habitat; refuge for resident estuarine birds.

Recovery opportunities: Pacific Pocket Mouse (*Perognathus longimembris pacificus*); Loggerhead Shrike (*Lanius ludovicianus*) perching; California Gnat Catcher (*Polioptila californica californica*) breeding habitat; Suffrutescent Wallflower (*Erysimum insulare* ssp. *suffrutescens*); Lewis' Evening Primrose (*Camissonia lewisii*); Coastal Dunes Milkvetch (*Astragalis tener* var. *titi*).

Management issues: plan for connectivity among sites; invasive species such as Pampas Grass.

21. Coastal Dune Scrub and Dune Herbs (including Foredunes)

Narrative: Dune habitat represents a form of transition zone between the land and the sea and includes Coastal Dune Scrub and Dune Herb vegetation. Coastal dune habitats have been largely lost due to development in southern California. Prior to development, plant species such as dune lupine (*Lupinus chamissonis*), Mock Heather (*Ericameria ericoides*), dune primrose *(Camissonia cheiranthifolia)*, sand verbena *(Abronia maritima)* and dune ragweed *(Ambrosia chamissonis)* stabilized the loose sand, and the dunes where thereby anchored. Following human disturbance, many of the native plants were eliminated and exotics, such as sour-fig *(Carporotus edulis)* and sea rocket *(Cakile maritima)* invaded or were planted.

Dunes are important habitats for several species of rare insects including Globose Dune Beetle *(Coelus globosus)*, the Sandy Beach Tiger Beetle *(Coelus hiticollis gravida)*, and Sand Dune Tiger Beetle *(C. latesignata latesignata)*. The San Diego Horned Lizard and Silvery Legless Lizard *(Anniella pulchra pulchra)* were once common; the later still occurs within the Ballona Ecosystem. The endangered California Least Tern *(Sterna antillarum browni)* and Western Snowy Plover *(Charadrius alexandrinus nivosus)* are associated with dune habitat but generally nest in the upper beach environment, which is no longer connected to the dunes.

Structural features: coastal dunes

Physical processes: aeolian transport and deposition of sands; storm influenced.

Dominant/characteristic Plant(s): Dune Lupine **(***Lupinus chamissonis*); Dune Buckwheat **(***Eriogonum parvifolium***)**; Beach Bur (*Ambrosia chamissonis*); Beach Evening Primerose (*Camissonia cheiranthifolia*); Common Sand Verbena (*Abronia umbellata*).

Associated plant(s): California Croton (*Croton californicus*), Tall Stephanomeria (*Stephanomeria virgata*), Mock Heather (*Ericameria ericoides*), Yellow Pincushion (*Chaenactis glabriuscula*), California Sun Cup (*Camissonia bistorta*), Lewis' Evening Primrose (*Camissonia lewisii*), Miniature Sun Cup (*Camissonia micrantha*), Coastal Dunes Milkvetch (*Astragalis tener* var. *titi*).

Characteristic animals: Silvery Legless Lizard (*Anniella pulchra pulchra*); Globose Dune Beetle (*Coelus globosus*); Ciliated Dune Beetle.

Ecosystem functions: maintenance of biodiversity; habitat for rare, endangered, and special interest species; source of freshwater seeps along interface with salt marsh habitat.

Recovery or protection opportunities: Silvery Legless Lizard (*Anniella pulchra pulchra*); El Segundo Blue Butterfly (*Euphilotes battoides allyni*); Dorothy's El Segunda Dune Weevil (*Trigonoscuta dorothea dorothea*); Globose Dune Beetle (*Coelus globosus*); Lande's El Segundo Dune Weevil (*Onychobaris langei*); Suffrutescent Wallflower (*Erysimum insulare* ssp. *suffutescens*); Beach Spectaclepod (*Dithyrea maritima*), Lewis' Evening Primrose (*Camissonia lewisii*)

Management issues: Remnant dunes are disjunct from coastal processes that formed them hence no natural disturbance regime, and beach related habitats are missing from the complex. Vulnerable to introduced invasive plant species.

22. Forests, woodlands, groves, and tree rows (including DFG "Eucalyptus Grove")

Narrative: Oak woodlands, characterized by Coast Live Oak (*Quercus agrifolia*), are characteristic along slopes, bluffs, and banks adjacent to various estuaries in southern California but may not have been located within or in proximity to the Ballona Ecosystem. Nonetheless, Coast Live Oaks may have been in the more xeric portions of riparian forests that included stands of Western Sycamore (*Platanus racemosa*). Current conditions include a number of groves and stands of planted or naturalized, largely exotic trees (e.g., Blue Gum, *Eucalyptus globulus*) within the Ballona Ecosystem. Some of these sites have important ecosystem functions such as nesting areas for great Blue Herons,

whereas others (e.g., Myoporum and Acacia) may be less important depending on the site and role in the ecosystem.

Structural features: cultivated areas; roadsides; yards; banks and bluffs.

Physical processes:

Dominant/characteristic Plant(s): *Eucalyptus* spp.; Myoporum (*Myoporum laetum*).

Associated plant(s): numerous species of planted and naturalized trees including Acacia (*Acacia baileyana*); California Walnut (*Juglans californica*); Peruvian and Brazilian Pepper Trees (*Schinus molle* and *S. terebinthifolia*); Canary Island Date Palm (*Phoenix canariensis*); Slender Fan Palm (*Washingtonia robusta*); Carob (*Ceratonia siliquia*); Sweet Gum (*Liquidambar styraciflua*); Olive (*Olea europea*); Velvet Ash (*Fraxinus velutina*); Fremont Cottonwood (*Populus fremontii*); Chinese Elm (*Ulmus parvifolia*).

Characteristic animals: resident and migratory passerine birds; roosting and possibly nesting raptors; roosting and nesting herons.

Ecosystem functions: habitat for rare, endangered, and special interest species; perches for raptors.

Recovery opportunities: Preservation/expansion of Great Blue Heron rookery; potential for Monarch Butterfly over-wintering habitat in groves of Blue Gum (*Eucalyptus globulus*).

Management issues: Monarch Butterflies use exotic Eucalyptus trees as winter roosts. Need to retain butterfly habitat (if Eucalyptus trees are targeted as butterfly habitat at Ballona), while not encouraging spread of exotic tree species.

APPENDIX C.
HYDRODYNAMIC MODELING

APPENDIX C – NUMERICAL MODELING OF BALLONA WETLAND RESTORATION ALTERNATIVES TECHNICAL APPENDIX

Hydrodynamic modeling was conducted in support of the development and evaluation of restoration alternatives for the Ballona Wetlands Restoration Project. The Environmental Fluid Dynamics Code (EFDC) hydrodynamic model was selected because of its capacity to model the relevant physical processes, its compliance with regulatory standards, and its availability in the public domain at no cost.

This appendix documents the development, calibration, and alternative implementation of the EFDC model. It also provides supporting documentation for specific model results discussed in the Feasibility Report. This appendix is not a stand-alone report and should be reviewed in conjunction with Section 3.3 (Hydrology) of the Feasibility Report.

Because the EFDC model uses metric units, some of the model results in this appendix are presented using metric units. However, the discussion in the Feasibility Report uses English units to follow local convention. As a result, this appendix presents some results in metric units and some in English units.

Sections C-1 and C-2 were prepared as stand-alone memos. Section C-1 discusses the EFDC model development and calibration. Section C-2 discusses the representation of marsh channel networks within the model. Section C-3 shows overview plots of model bathymetry for each alternative. Section C-4 provides supporting documentation for model results discussed in Section 3.3 (Hydrology) of the Feasibility Study.

C-1. LOWER BALLONA CREEK MODELING – EFDC MODEL DEVELOPMENT AND CALIBRATION

1. INTRODUCTION

This section presents the calibration process for the Environmental Fluid Dynamics Code (EFDC) hydrodynamic model developed for the Ballona Creek Wetland Restoration Project. The EFDC model was configured such that predicted water levels accurately replicate observed water levels from a two-week calibration period. Typically, predicted water levels agree to within 5 cm of the observed water levels. Having calibrated the EFDC model, it is ready to characterize the hydrologic response of the proposed restoration actions for feasibility assessment purposes.

This section includes details of the model development and calibration. The section on model development describes the EFDC model in general and summarizes how the model was configured to represent the Lower Ballona Wetland system. The section on calibration describes the calibration approach and compares model predictions and field observations.

2. MODEL DEVELOPMENT

The EFDC model was chosen to simulate the Lower Ballona Wetland system after discussion between the Project Management Team, the Science Advisory Committee and the LA District, Corps of Engineers. Benefits of this model include its capacity to model the relevant physical processes, its compliance with regulatory standards, and its availability in the public domain at no cost.

After briefly describing EFDC's general characteristics, this section describes the application of the model to the Lower Ballona Wetland system, including the model's domain, boundary conditions, initial conditions and model execution. The linked Lower Ballona Wetland system includes lower Ballona Creek; Ballona Wetland Restoration Areas A, B, and C; Marina Del Rey; Del Rey Lagoon; Ballona Lagoon; the Grand Canal; and a portion of Santa Monica Bay. The uncertainties with respect to the model predictions are discussed.

2.1. MODEL DESCRIPTION

EFDC is a numerical model designed for simulating flows in open water systems. The model was originally developed at the Virginia Institute of Marine Science and receives continuing support from the U.S. EPA. A complete description of the model assumptions, governing equations and approximations, including the space discretization, time integration, and numerical solution methods is presented in Hamrick (1992). Tetra Tech (2002) provides guidance in using the model as well as references to successful applications of EFDC for a variety of tidally-influenced systems.

The physical processes represented in the model include important aspects of the Lower Ballona Wetland system:

- unsteady tidal flow,

- boundary wetting and drying, and
- hydraulic control structures.

EFDC solves the physical equations for fluid flow on a staggered, finite-difference grid. The modeling domain is defined by a curvilinear flexible mesh, enabling the grid to follow dominant terrain features. At present, the model has been configured to predict two-dimensional (2D) depth-averaged flow. Although not implemented for this study, the model can be extended to simulate three-dimensional (3D) flows and the transport of salt, sediment, and/or contaminants.

2.2. MODEL DOMAIN

The model domain defines the portion of the physical environment that is included in the model. Its extent should include the system's relevant components and processes between these components. Additionally, the boundaries of the system should be sufficiently far from the region of interest such that boundary conditions do not overly constrain flow in the region of interest. When constructing the model's horizontal grid that defines the domain, these factors must be balanced against model execution time. The vertical component of the model domain is defined by the system's bathymetry. Further information about the physical setting within the model domain can be found in PWA (2006).

2.2.1. Model extent

The model domain extends from where Ballona Creek passes under Sawtelle Boulevard to Santa Monica Bay, as shown in Figure 1. The upstream boundary is beyond the range of tidal influence and coincides with a discharge monitoring station. Placing the downstream boundary within Santa Monica Bay provides ample distance and tidal volume between the specified tidal boundary condition and the region of interest. Between the upstream and downstream boundaries, the model domain includes:

- lower Ballona Creek;
- Ballona Wetland Restoration Areas A, B and C;
- Marina Del Rey, including Oxford Basin;
- Del Rey Lagoon;
- Ballona Lagoon, including the Grand Canal downstream of Washington Boulevard; and
- a portion of Santa Monica Bay roughly 1.3 km by 2.5 km.

2.2.2. Horizontal grid generation

EFDC employs a curvilinear orthogonal grid to represent the physical domain. The grid is analogous to a rubber sheet of graph paper. Its curvilinear aspect allows the grid to be stretched and transformed so that it aligns with the major topographic features of the model domain. However, orthogonality requirements dictate that the grid maintains nearly perpendicular intersections at cell boundaries.

The grid generation tools available within the EFDC modeling environment are somewhat limited in their functionality. Instead, DELFT3D's grid generation software (WL | Delft Hydraulics, 2006b) was used to create the grid. DELFT3D's graphical user interface provides robust tools for grid orthogonalization,

manipulation, and merging. After creating the grid with the DELFT3D software, the grid files were converted to EFDC format using MatLab programs. The grid cell sizes average 10 m across in most of the model domain, resulting in approximately 42,000 active cells within the domain.

2.2.3. Bathymetry

The bathymetry, or spatial map of surface elevations, is represented in the model as a single elevation value at the center of each grid cell. Multiple sources of bathymetric data were compiled to cover the entire model domain. The sources of bathymetry data for each region are listed below:

- *Ballona Creek:* Channel centerline elevations and width from the channel's design drawings (Los Angeles County Flood Control District, 1959).
- *Ballona Wetland Areas A, B and C*: Ground surface elevations from the R.J. Lung & Associates aerial survey in April 1998, supplemented with spot elevations, marsh channel cross sections, and culvert invert elevations collected by PWA in 2006.
- *Marina Del Rey*: Elevations in the main stem of the marina from unpublished USACE dredging surveys in March 2006 and elevations in the mooring basins extrapolated from the adjacent main channel elevations.
- *Del Rey Lagoon:* Spot elevations from bathymetric survey drawings (City of Los Angeles, 2003) interpolated across the lagoon.
- *Ballona Lagoon and the Grand Canal*: Elevations from cross section surveys (Coastal Frontiers Corporation, 1989) and Ballona Lagoon Enhancement Project design drawings (City of Los Angeles, 1997).
- *Santa Monica Bay*: Bathymetric survey data from the National Oceanic and Atmospheric Administration (1997).

All elevation data were converted to the same horizontal datum (UTM Zone 10N) and vertical datum (NAVD88) using Corpscon software (U.S. Army Corps of Engineers, 2004). The data sets were then imported into the DELFT3D bathymetry generation software (WL | Delft Hydraulics, 2006a) and smoothly interpolated at the boundaries between data sets. The compiled bathymetric surface was converted into EFDC-specific input files using the EFDC_Explorer graphical user interface (Criag, 2004). To refine features such as wetland channels and elevated road bed that have widths on the order of the 10 m grid cell size, a MatLab program was used to inscribe these features into the bathymetry. This procedure ensures that these features are hydraulically contiguous, but yields a stair-step appearance as the features traverse diagonally across the grid. The compiled bathymetry for the model extent is shown in Figure 1. Figure 2 displays a portion of the bathymetry within the western portion of Area B that includes wetland channels and road bed. This figure demonstrates the implementation of these features as contiguous sets of grid cells.

2.3. BOUNDARY AND INITIAL CONDITIONS

Boundary and initial conditions describe the external forcing applied to the model and starting values for the predicted variables, respectively. Boundary conditions consist of:

- the tidal boundary within Santa Monica Bay,
- the freshwater inflows from the Ballona Creek watershed,
- culvert discharges, and
- bed roughness.

Initial conditions must be specified for the water surface elevation and velocity field when the model begins a simulation.

2.3.1. Tidal boundary

Comparison between the NOAA continuous tide gauge station at the Port of Los Angeles (Station ID 9410660) and water surface measurements in Ballona Creek collected by Nearshore and Wetland Surveys (2006) show good agreement with minimal amplitude differences or phase lag. For example, observations in Ballona Creek (Nearshore and Wetland Surveys, 2006) and at the Port of Los Angeles are shown in Figure 3. Because of the agreement between the two data sets, the Port of Los Angeles water surface elevation data was applied as the open tidal boundary condition at the model's western edge in Santa Monica Bay. This tide station is well established and it can provide boundary condition data for a wide range of time periods. The northern and southern boundaries of the model grid in Santa Monica Bay are linked by a periodic boundary condition. This type of boundary condition minimizes the influence of these boundaries on model results.

2.3.2. Freshwater inflow

The primary freshwater inflow into the Lower Ballona system comes from Ballona Creek itself. The upstream model boundary coincides with the County of Los Angeles, Department of Public Work's discharge station at Sawtelle Blvd (Station ID F38C-R). Observations from this station were used as a discharge boundary condition into the model.

2.3.3. Culvert and gate discharges

Culverts and gates regulate flow into and out of the Area B wetland, Fiji Ditch, Del Rey Lagoon, and Ballona Lagoon. Culvert flow is represented in the model as water-level-dependent discharge between a pair of grid cells. Discharges through all but one culvert are implemented in the EFDC model through an input file that specifies the discharge as a function of the difference in water levels at the ends of each culvert.

A slightly more complex specification was used for the gate that conveys water from Ballona Creek to the Area B wetland. Flow through this gate is governed by a self-regulating tide gate that closes automatically once the water level in Ballona Creek reaches a predetermined level. For this culvert, the discharge was

modeled as a function of both the upstream and downstream water levels and the discharge was set to zero when the upstream water level in Ballona Creek equal or exceeds the water level which triggers gate closure.

Observed water levels within the Area B wetland (Nearshore and Wetland Surveys, 2006) slowly increase even after the self-regulating tide gate has closed. This increase may result from leakage through either of the tide gates and/or seepage from the headlands to the south of the wetland. The exact source remains a point of discussion. To replicate these slowly increasing water levels, a constant discharge of 0.16 m^3/s was added as a source to the wetland. This rate was estimated from the observed rate of water level increase after the self-regulating tide gate has closed (Figure 5) and the area of inundated wetland during higher high water. If future investigation clarifies and quantifies the source of this water level increase, it can be more explicitly included in the model.

2.3.4. Bed roughness

Bed roughness relates the flow velocity to the frictional loss of momentum as the flow moves over the bed. EFDC parameterizes the bed friction's effect on flow through a roughness height, z_0, based on the assumption of a logarithmic velocity profile. A typical, constant z_0 value of 0.002 m was applied across the entire domain (Blumberg and Mellor, 1987). Sensitivity analysis of water levels to variations in z_0 confirms that water levels are relatively insensitive to this parameter.

2.3.5. Initial conditions

Model start times were selected to coincide with slack tide when current speeds can be initialized to zero. Initial water levels throughout the model domain were set to a uniform value equal to the open boundary condition. The model was spun up for four days of simulation time to remove initial transients from the model results and enable water levels and velocities to equilibrate to the prescribed boundary conditions.

2.4. MODEL EXECUTION

For the model configuration described above, model testing indicates that stable and accurate predictions are achieved with a time step of two seconds. With this time step, simulations execute on a 3.6 GHz PC workstation at speeds approximately eight times faster than real time.

2.5. MODEL UNCERTAINTY

EFDC is a widely used modeling tool for estuarine simulations and has been validated in numerous studies (Tetra Tech, 2002). However, numerical models inherently rely on approximations that introduce sources of uncertainty in the model results. Uncertainties may be present both spatially and temporally, and may result from a variety of factors, including:

- physical characteristics of the model domain,
- specification of boundary conditions, or
- limitations in the model's numerical formulation.

For the specific application of a hydrodynamic model of the Lower Ballona system, it is important to assess the modeling uncertainties and assumptions made in applying the model to understand the extent to which these uncertainties affect model predictions.

The largest uncertainties affecting model performance for the Lower Ballona model are the accuracy and resolution of available bathymetry and the grid resolution used in the model to resolve this bathymetry. To the extent possible, the model has made use of the most recent and best available bathymetric data and datum conversion tools (Section 2.2.3). However, when the bathymetric data is sampled onto the model grid, additional filtering of the bathymetric data occurs which limits the capacity of the model to resolve small-scale bathymetric features. The grid resolution for the model was selected to be as fine as possible, subject to the computation time restraints. The nominal grid cell size of 10 m prevents the model from accurately resolving the bathymetry in the smallest channels. However, since the volume of these small channels represents a small fraction of the overall domain, their exclusion is not likely to significantly alter the model's predictions.

The model solves the 2D depth-averaged approximation of the hydrodynamic flow equations. The use of 2D simulations significantly reduces the computational time required for the model simulations but also introduces additional model uncertainty in the hydrodynamic predictions. This uncertainty is constrained because the wetland's shallow depths and limited freshwater inputs minimize the impact of 3D flow effects.

Model uncertainties are also introduced through the specification of boundary conditions and model parameterizations, such as bed roughness. Additionally, any field data used either to force the model or to calibrate the model has some associated uncertainty due to instrument calibration and errors, instrument location, field corrections, and data noise.

3. MODEL CALIBRATION

The model was calibrated to observed water levels, primarily by adjustment of culverts and gate discharge rates. As presently calibrated, the model predicts water levels to within 5 cm of observations for nearly all of the calibration period. The sections below describe the calibration approach, summarize the observation data, compare predicted and observed water levels, and outline future refinements to the model.

3.1. CALIBRATION APPROACH

Calibrating a model involves adjusting model parameters or model formulation in order to match model predictions and field observations at known locations. Initially, the calibration process can verify that each of the specified model inputs and boundary conditions are working properly. Subsequent iterations of the calibration process enhance agreement between model predictions and observations. The model is run for a known set of input conditions, and its output is compared to a known set of observations. The discrepancies between the model predictions and the observation data help determine which aspects of the

model are not adequately capturing the physical processes. This may lead to adjusting some model parameters to improve agreement between predictions and observations.

Adjustments to model parameters are made until the model's response to the specified inputs replicates the field measurements as closely as possible. The goal of the calibration process is to identify the areas and processes of highest interest, and maximize the model's predictive capability in those areas, while ensuring reasonable behavior in the rest of the model predictions.

The model was calibrated to optimize agreement between observations and predictions of water levels. Calibration to water levels indicates that the model is correctly predicting the volumes of water that are exchanged between each region of the model. Calibration of Ballona Creek water levels required no adjustments to model parameters beyond the model setup described above in Section 0. To calibrate water levels at the other four observation stations, all of which are upstream of culverts, a coefficient scaling the discharge through the culverts was adjusted. Comparison between this calibrated discharge and the discharge estimated by the U.S. Geological Survey Culvert Analysis Program (CAP; Fulford, 1998) exhibit good agreement.

3.2. OBSERVATION DATA

The water level observations used for calibration were collected by PWA and Nearshore and Wetland Surveys (2006) in July and August, 2006. A representative spring-neap cycle from July 5 to July 20 was selected from this observation record as the calibration period to simulate. The five locations at which water levels were observed are shown in Figure 1. In addition to water levels in Ballona Creek, which is directly exposed to the tidal action, the other four stations are located in regions where the tidal flows are controlled by flow through gates and culverts.

3.3. WATER LEVEL COMPARISON

Time series of predicted water levels at five stations and the corresponding observed water levels are plotted in Figure 4 to Figure 8. For most of the two-week simulation period, these time series demonstrate agreement within 5 cm between the model predictions and observations. Differences larger than 5 cm between predictions and observations are typically caused by mechanisms beyond the scope of the model that are insignificant in comparison to the changes expected from restoration. Explanation for these larger differences between observations and predictions are discussed below:

- During several of the lowest tides in the middle of the simulation period, the observations bottom out at constant values that are above the predicted values (Figure 4 to Figure 7). This is because the instruments were mounted such that water levels during these lowest tides fell below their sensors and exposed the sensors to the atmosphere during these periods.
- As discussed above in Section 2.3.3, an unknown water source causes water levels to rise in the Area B wetland after the tide gates between Ballona Creek and the wetland close. The observed water levels consist of a rapidly rising section while the tide gate is open and then a slowly rising section once the tide gate closes (Figure 5). In the absence of data, the unknown source was modeled as a constant discharge to the wetland. This approximation of the source is sufficient to

reproduce the typical rising water levels during high tides. However, the source's actual discharge rate probably varies in time, causing the differences between the observed and the modeled water levels.

- In Fiji Ditch (Figure 6), high frequency oscillations in the water level observations are consistent with the 6 to 8 second water level oscillations observed visually during instrument installation. It is hypothesized that these water level oscillations result from ocean swell that propagates through the marina and culvert. The model does not include the physical processes which create this type of water level oscillation since this process does not transport significant amounts of water.
- Below 0.25 m NAVD, predicted water levels in Del Rey Lagoon fall more rapidly than observed water levels (Figure 7). This difference may be the result of the representation of the lagoon's bathymetry in the model, which was created by interpolation from relatively few spot elevations. Since the predictions at all other times and locations otherwise demonstrate good agreement with the observed water levels and the lagoon is only a small feature located outside the project area, the current implementation is sufficient for assessment of the restoration alternatives. If specific questions regarding circulation within the lagoon are of interest, the model's representation of the lagoon's bathymetry should be improved.
- The tide gates regulating flow into Ballona Lagoon (Figure 8) are manually adjusted to restrict flow during spring tides, e.g. from July 7 to July 14. This operational practice prevents flooding upstream of the gates. Since records of the actual gate settings are not maintained (Mariposa Landscaping, personal communication), no attempt was made to model the Lagoon's water levels during this period. Hence, during the spring tides, the predicted water level continues to span nearly the full range of water levels in Ballona Creek while the observed water level within Ballona Lagoon was muted.

3.4. FUTURE WORK

Although the model is sufficiently calibrated to provide a feasibility assessment of the proposed restoration alternatives, additional calibration should be conducted for future stages of alternative design or evaluation of more complex processes, such as sediment transport or water quality. These additional steps include:

- Calibration to observed current velocity data
- Calibration to observed salinity data
- Validation to water levels during high Ballona Creek discharge

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5. FIGURES

Figure 1 Model Bathymetry, Full Extent

Figure 2 Model Bathymetry, Area B Wetland

Figure 3 Port of Los Angeles and Ballona Creek Observed Water Levels

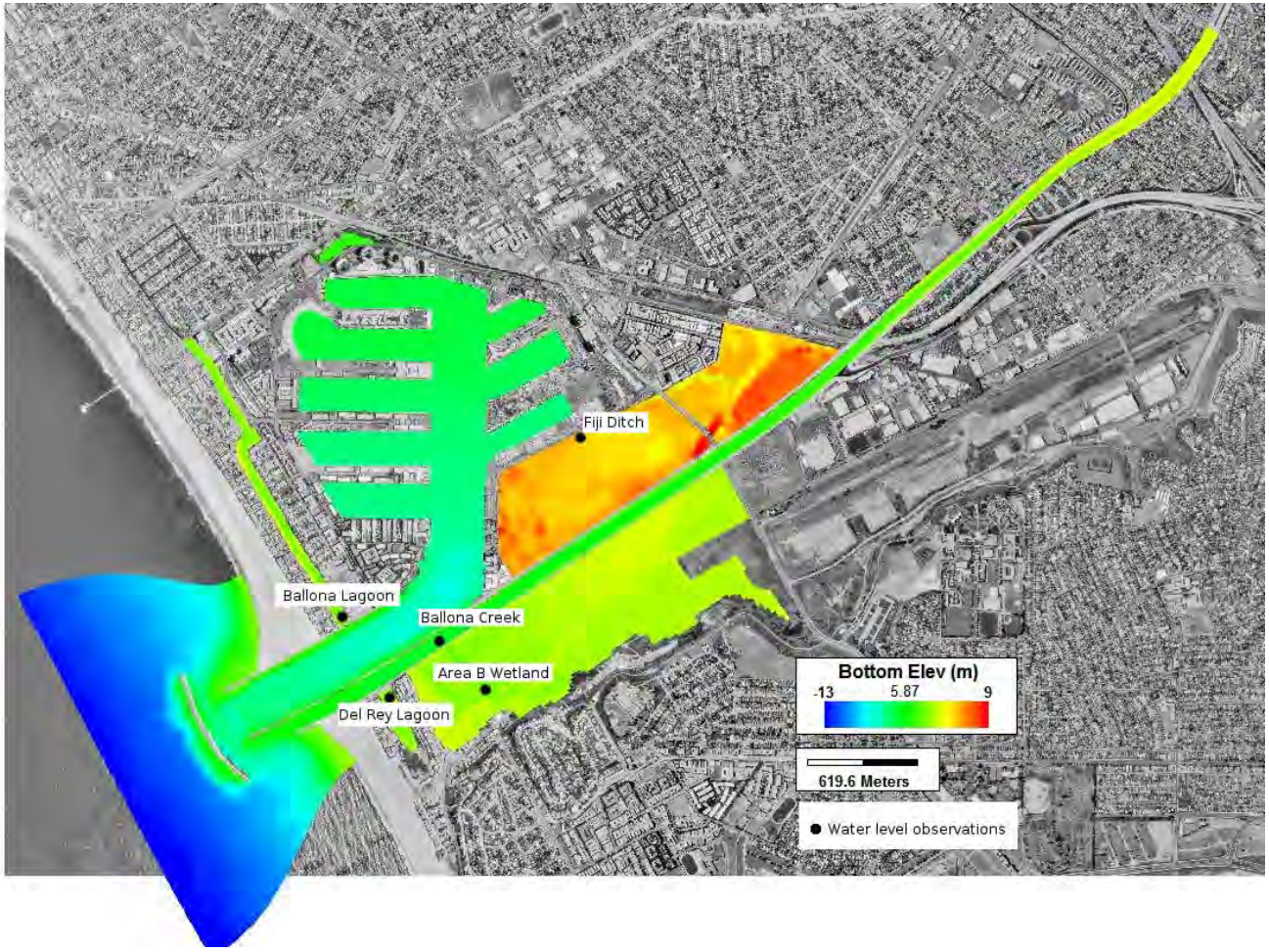
Figure 4 Predicted vs. Observed Water levels, 2006 – Ballona Creek

Figure 5 Predicted vs. Observed Water levels, 2006 –Area B Wetland

Figure 6 Predicted vs. Observed Water levels, 2006 – Fiji Ditch

Figure 7 Predicted vs. Observed Water levels, 2006 – Del Rey Lagoon

Figure 8 Predicted vs. Observed Water levels, 2006 –Ballona Lagoon



Source: R.J. Lung & Associates aerial survey (1998) and PWA (2006) channel cross sections

figure 1
Lower Ballona Modeling

Model Bathymetry, Full Extent

PWA Ref# 1793.01

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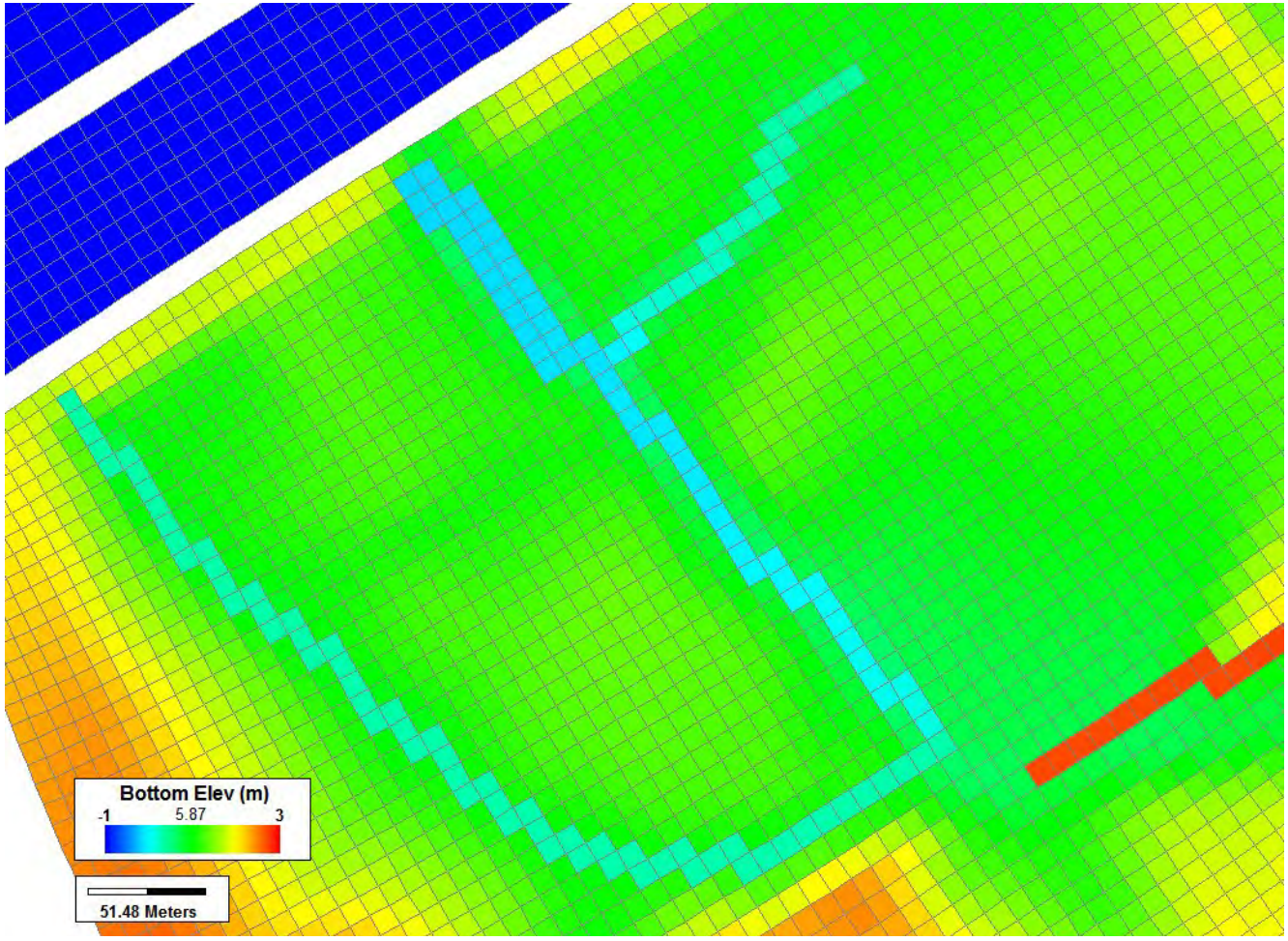

Source: R.J. Lung & Associates aerial survey (1998) and PWA (2006) channel cross sections

figure 2
Lower Ballona Modeling

Model Bathymetry, Area B Wetland

PWA Ref# 1793.01

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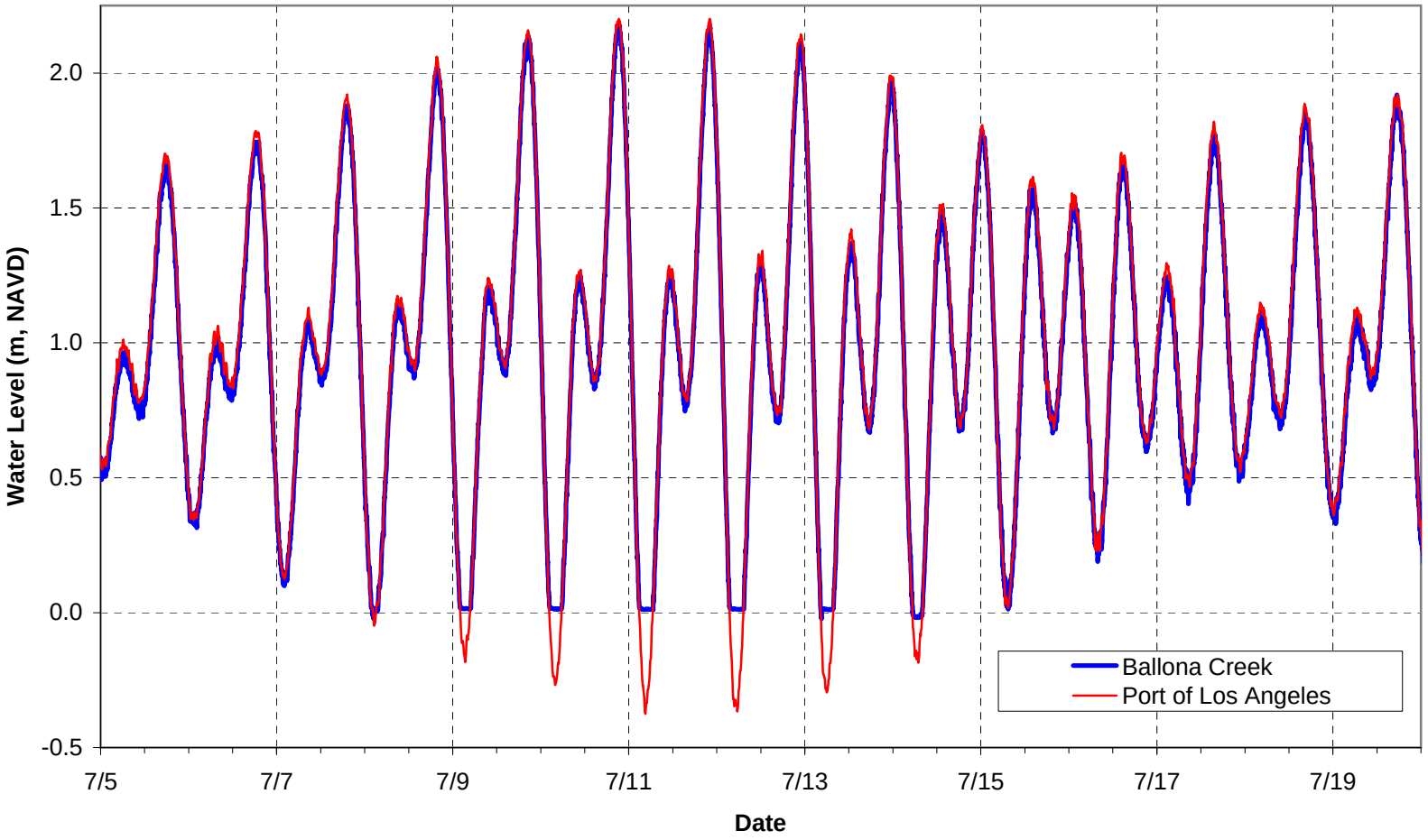

Source: NOAA (Station ID 9410660) and Nearshore and Wetland Surveys (2006)

figure 3

Lower Ballona Modeling

Port of Los Angeles and Ballona Creek Observed Water Levels

PWA

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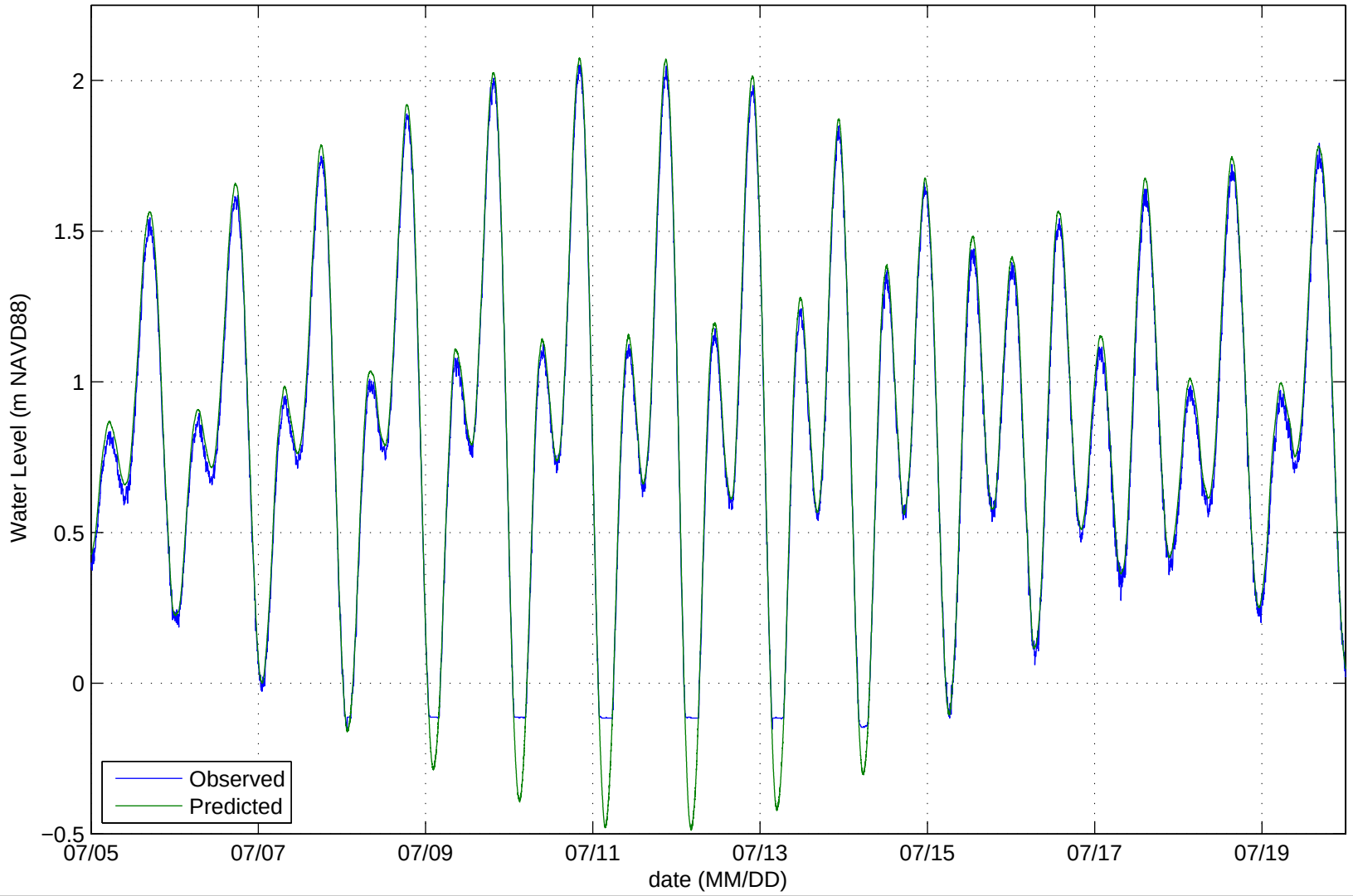

Source: USACE field observations and EFDC model predictions

Figure 4
Lower Ballona Modeling

Predicted vs. Observed Water levels, 2006 – Ballona Creek

PWA Ref# 1793.1

PWA

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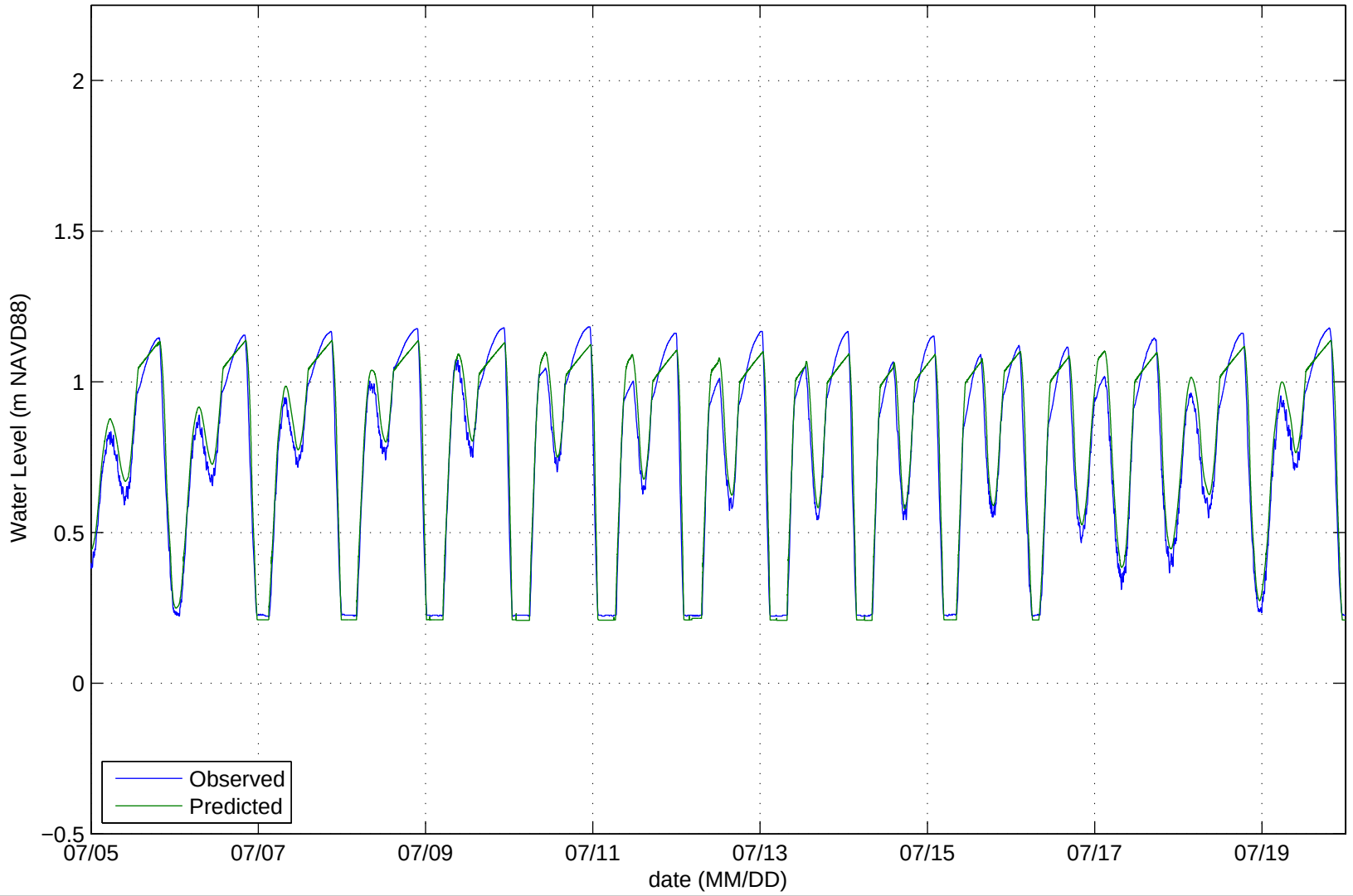

Source: USACE field observations and EFDC model predictions

Figure 5
Lower Ballona Modeling

Predicted vs. Observed Water levels, 2006 – Area B Wetland

PWA Ref# 1793.1

PWA

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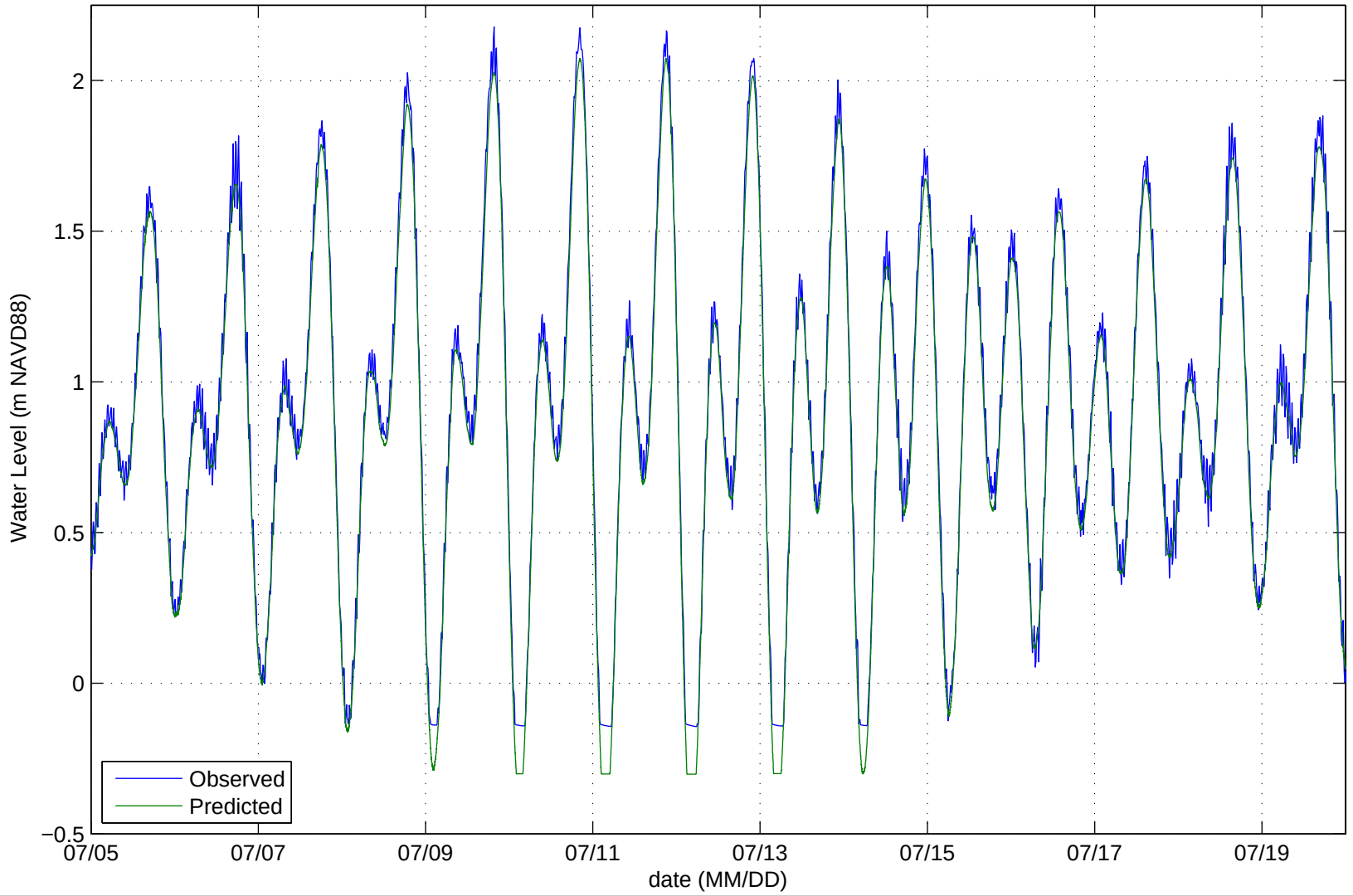

Source: PWA field observations and EFDC model predictions

Figure 6
Lower Ballona Modeling

Predicted vs. Observed Water levels, 2006 – Fiji Ditch

PWA Ref# 1793.1

PWA

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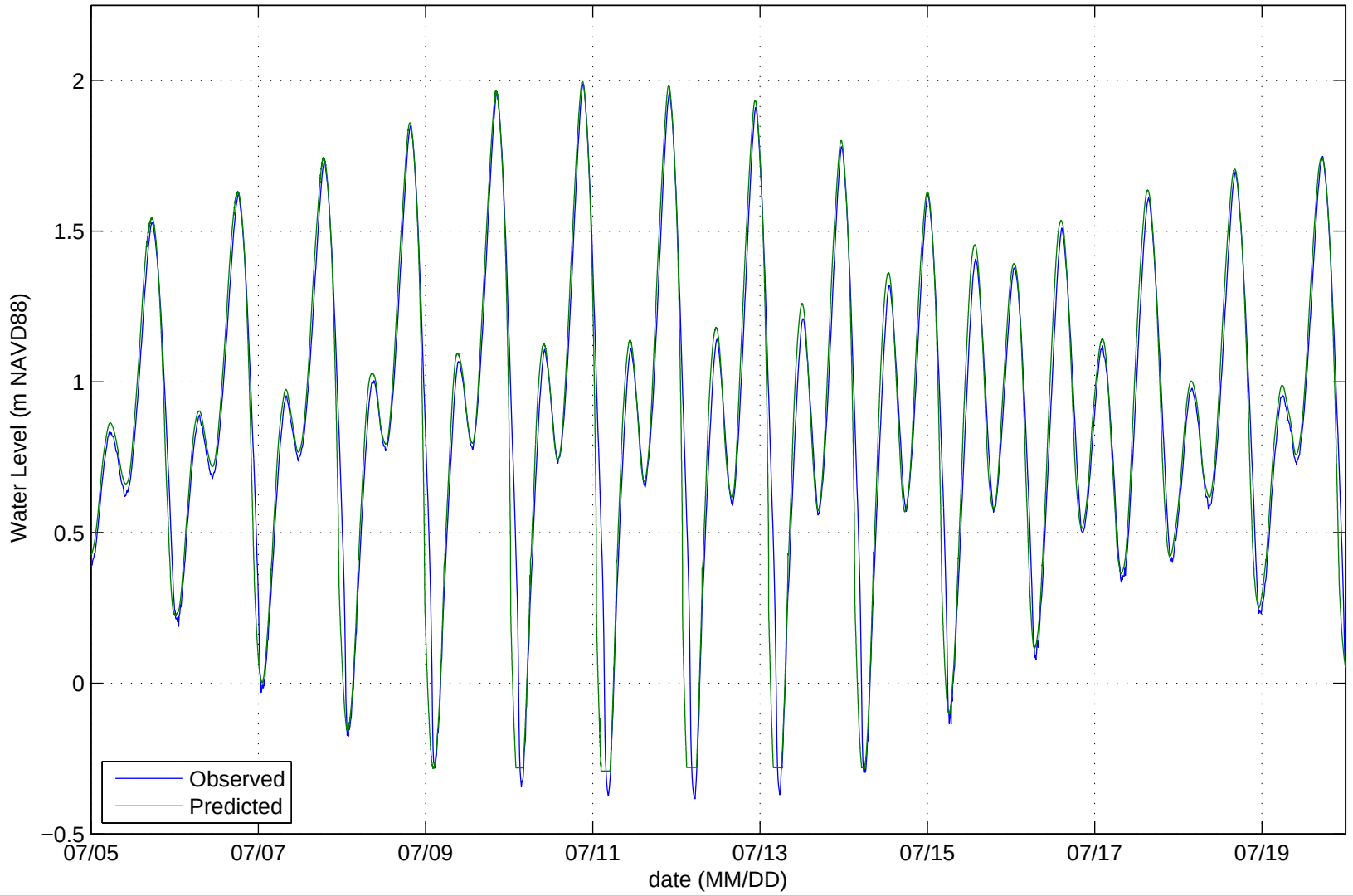

Source: PWA field observations and EFDC model predictions

Figure 7
Lower Ballona Modeling

Predicted vs. Observed Water levels, 2006 – Del Rey Lagoon

PWA Ref# 1793.1

PWA

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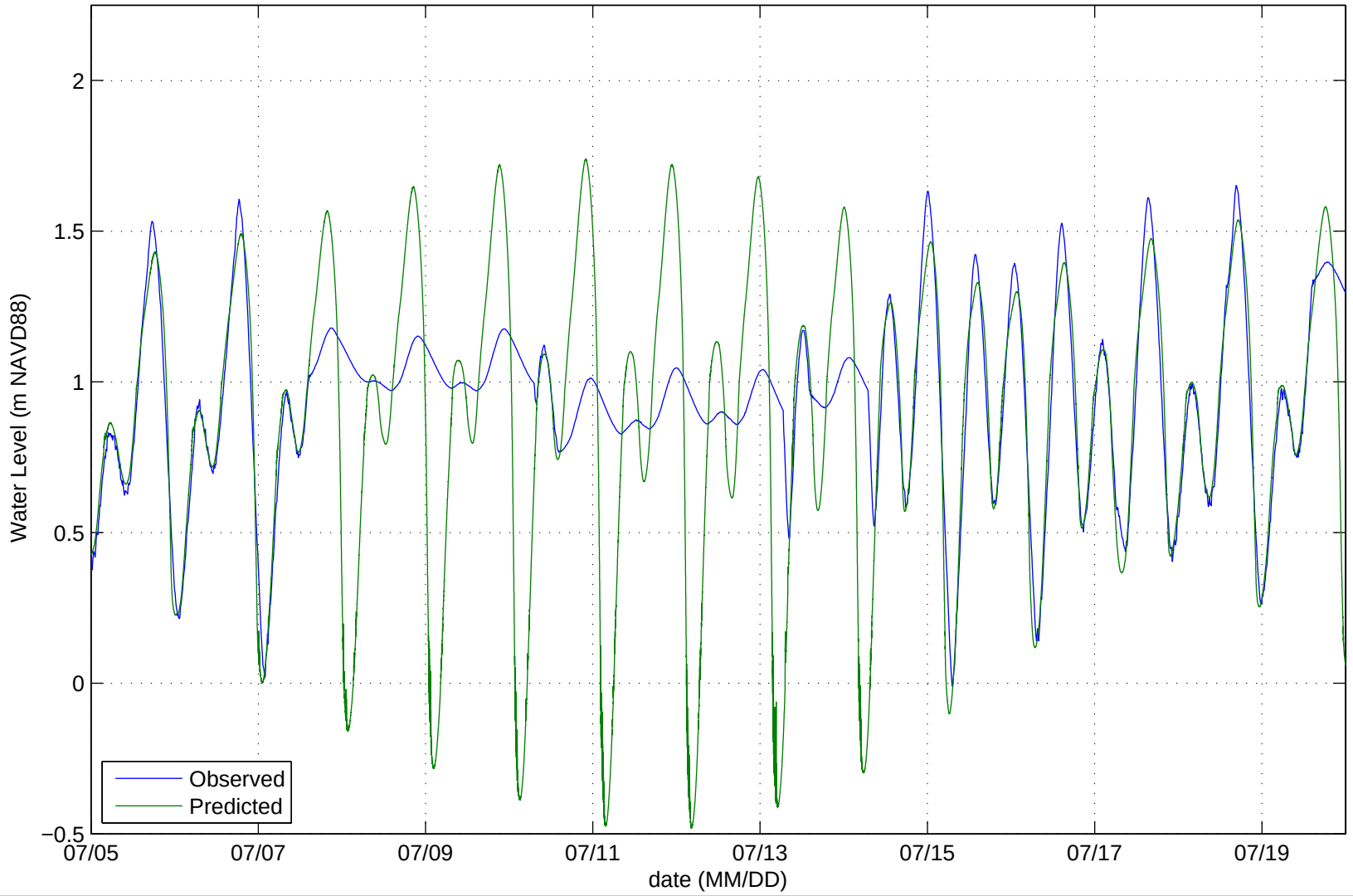

Source: PWA field observations and EFDC model predictions

Figure 8
Lower Ballona Modeling

Predicted vs. Observed Water levels, 2006 – Ballona Lagoon

PWA Ref# 1793.1

PWA

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C-2. MARSH CHANNEL REPRESENTATION IN LOWER BALLONA EFDC MODEL

1. INTRODUCTION

This section outlines the methodology implemented to represent tidal channel morphology and layout in the Lower Ballona Wetlands EFDC numerical model. The purpose of the numerical model is not to model fine scale hydrodynamics or velocities in the tidal channels (existing or future), but to describe the hydraulic characteristics and flushing of each restoration parcel. The procedure is based on the methods presented in the "Design Guidelines for Tidal Channels in Coastal Wetlands," prepared by PWA in January 1995 for the U.S. Army Corps of Engineers. The guidelines present empirical relationships between morphologic characteristics of marsh channels (channel top width, depth, and cross sectional area) and diurnal tidal prism. Characteristics of marsh morphometry (channel order, length, sinuosity, drainage density, etc.) are also tabulated. The tidal prism dataset includes sites from San Diego Bay (Chula Vista) and San Francisco Bay (Novato, Corte Madera, and Newark Slough). The marsh morphometry dataset includes a more extensive analysis of sites from southern California, north San Francisco Bay, and south San Francisco Bay.

The approach taken to implement the appropriate channel characteristics in the model was to first determine what the detailed tidal channel characteristics would be, and then to aggregate these for inclusion into the model, given the grid cell size limitations. A general outline of the procedure is presented below:

1. Approximate channel order, length, and number of channels based on channel morphometry relationships with marsh area (Section 2).
2. Approximate channel geometry (width and thalweg depth) based on tidal prism using hydraulic geometry relationships (Section 3).
3. Aggregate channel morphology and morphometry for inclusion into the model (Section 4).

2. CHANNEL MORPHOMETRY

Marsh morphometry refers to the plan view features of tidal marshes, such as channel length, sinuosity, channel order, and density of channels. The general outline presented in the Design Guidelines is reproduced below:

1. Determine the order of the drainage system that can be accommodated within the site based on the marsh area.
2. Calculate the total channel length based on an assumed drainage density (typically 0.01-0.02 ft/ft^2).
3. Estimate the number of channels of each order.
4. Partition the length among the different order channels.

The results for Area B East Wetland are presented below as an example of the methodology and assumptions used in the analysis.

1. For a given marsh area of approximately 35 acres, Figure 7.1-4 of the design guidelines was used to select a maximum channel order of 4 for the parcel.
2. Drainage densities at numerous California marshes tend to fall between 0.01-0.02 ft/ft^2. A drainage density of 0.01 ft/ft^2 was selected to minimize construction costs and allow for natural evolution of the site. From this drainage density, a total length of channels of 15,250 ft was determined.
3. The number of channels of each order was determined assuming a bifurcation ratio of 3.5. This ratio predicts 1 fourth-order channel, 4 third-order channels, 12 second-order channels, and 43 first-order channels, although not all orders can be represented in the model due to grid cell size limitations.
4. Table 7-6 and Figure 7.3-1 of the Design Guidelines give typical channel distributions for California marshes. The following distribution of channel length was assumed for the 4th through 1st order channels: 10%, 15%, 30%, and 45%. The total length of channels was used with the channel order distributions to determine the length of each order channel.

3. HYDRAULIC GEOMETRY

The term hydraulic geometry refers the empirical relationships between channel discharge and channel geometry. The hydraulic geometry relationships presented in the Design Guidelines relate diurnal tidal prism with channel width, depth, and cross sectional area. A predicted tidal prism of 25 acre-ft was determined to represent the diurnal tidal prism for the 35-acre Area B East Wetland parcel using Figure 5.2-1. The top width and depth of the 4th order channel were determined assuming this tidal prism. For the lower order channels, the total tidal prism was distributed incrementally based on the bifurcation ratio, after subtracting out the intertidal storage volume of the next higher order channel. The partitioned tidal prism was used in the hydraulic geometry relationships for each channel order.

4. IMPLEMENTATION OF CHANNEL MORPHOLOGY IN MODEL BATHYMETRY

For each channel order, the predicted top width was compared to the grid cell size of the EFDC model grid, nominally equal to 9 m (29.5 ft). The predicted top widths of the 3rd and 4th order channels were 28 ft and 54 ft, roughly equivalent to one and two cell widths, respectively. The model tidal prism was calculated as the total intertidal channel storage volume for a diurnal tide range of 5.49 ft (LA tide gage, #9410660). The resulting tidal prism was 19 acre-ft, 24% less than the predicted tidal prism of 25 acre-ft. This is due to the lack of first and second order channels in the model. To account for the remaining 6 acre-ft, 4 of the 12 second-order channels were implemented at a width of one grid cell. The number of grid cells for each channel order was determined by dividing the length per channel by the nominal grid size. An idealized channel layout was then overlaid on the existing topography grid based on the widths, depths, and lengths determined from the Design Guidelines. The bed elevation of the highest-order channel is constant along its length. Along-channel bed elevations of lower-order channels were linearly interpolated from the channel junction to the channel end (i.e., from the predicted elevation of the higher-order channel to the predicted elevation of the lower-order channel). Elevations of the future marshplain (non-channel regions within the wetland footprint) were set at MHHW (1.61 m NAVD).

The channel layout was adjusted iteratively to correctly reproduce the expected future tidal prism for the marsh restoration parcel. The model tidal prism was confirmed by comparing the total intertidal channel storage volume to the predicted diurnal tidal prism for the given marsh area. Future model refinement could be to develop a more detailed bathymetry grid in the region of tidal channels.

C-3. LOWER BALLONA EFDC MODEL – ALTERNATIVES BATHYMETRY

Sections C-1 and C-2 above describe the model development and calibration procedures. Figure 9 through Figure 14 show the model bathymetries for each alternative.

Figures

Figure 9. Existing Conditions (No Action) Bathymetry

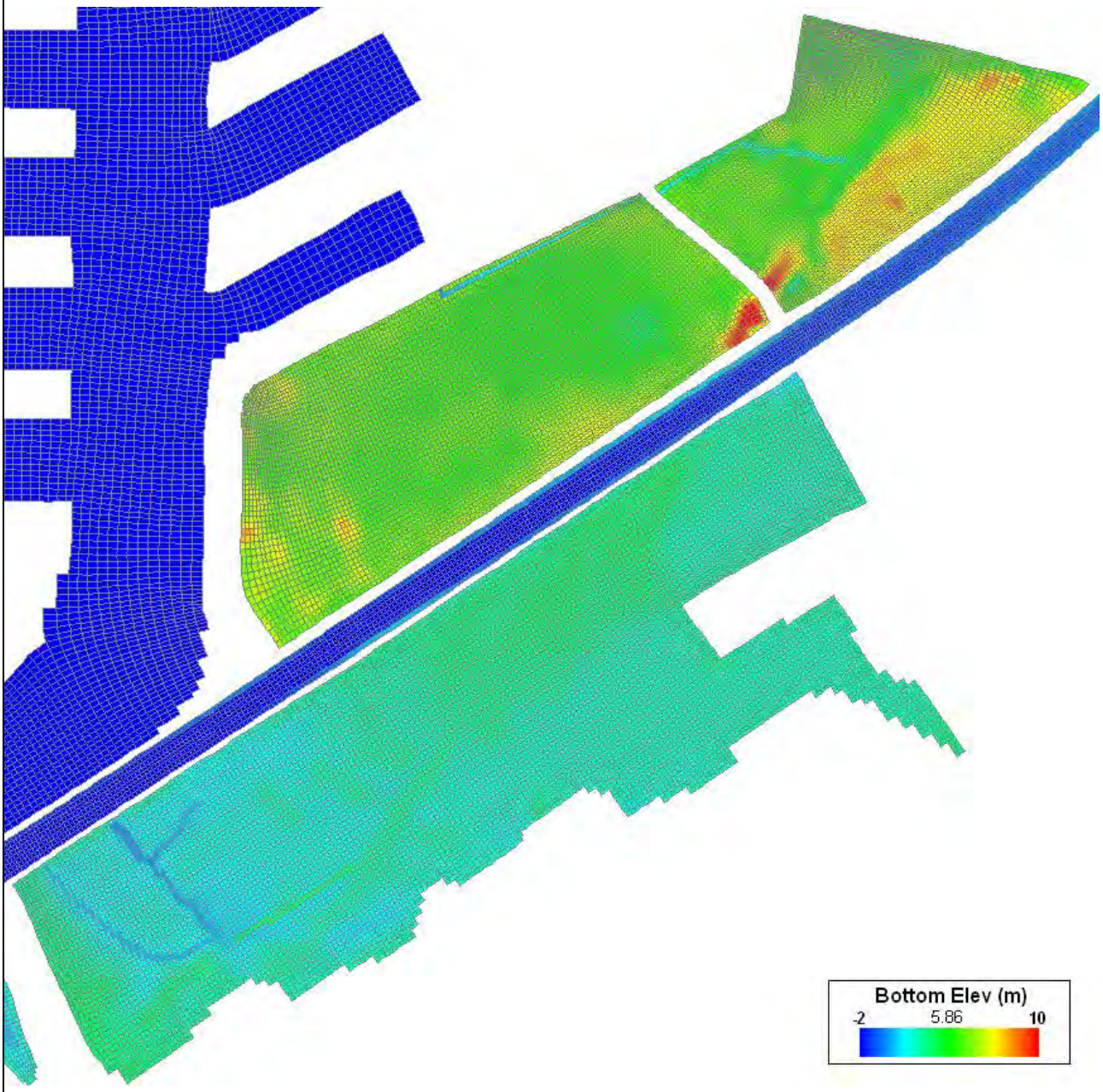
Figure 10. Alternative 1 – Muted Tidal Bathymetry

Figure 11. Alternative 2 – Partial Tidal Bathymetry

Figure 12. Alternative 3 – Full Tidal Bathymetry

Figure 13. Alternative 4 – Area A Subtidal Bathymetry

Figure 14. Alternative 5 – New Creek Bathymetry



Source: EFDC model setup.
Notes: Bottom elevations shown in meters NAVD.

figure 9
Ballona Wetlands Restoration Project

Existing Conditions (No Action) Bathymetry

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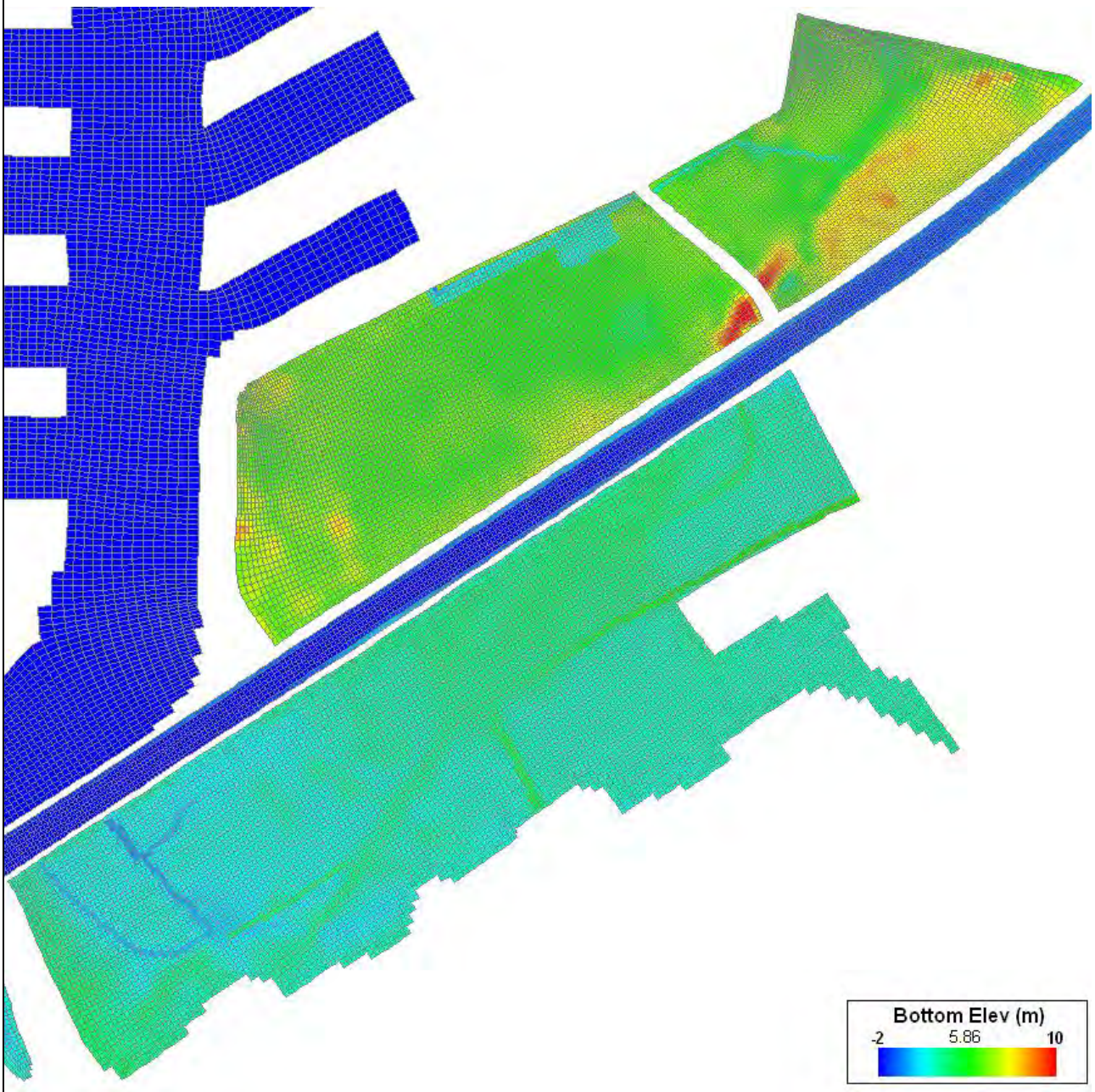


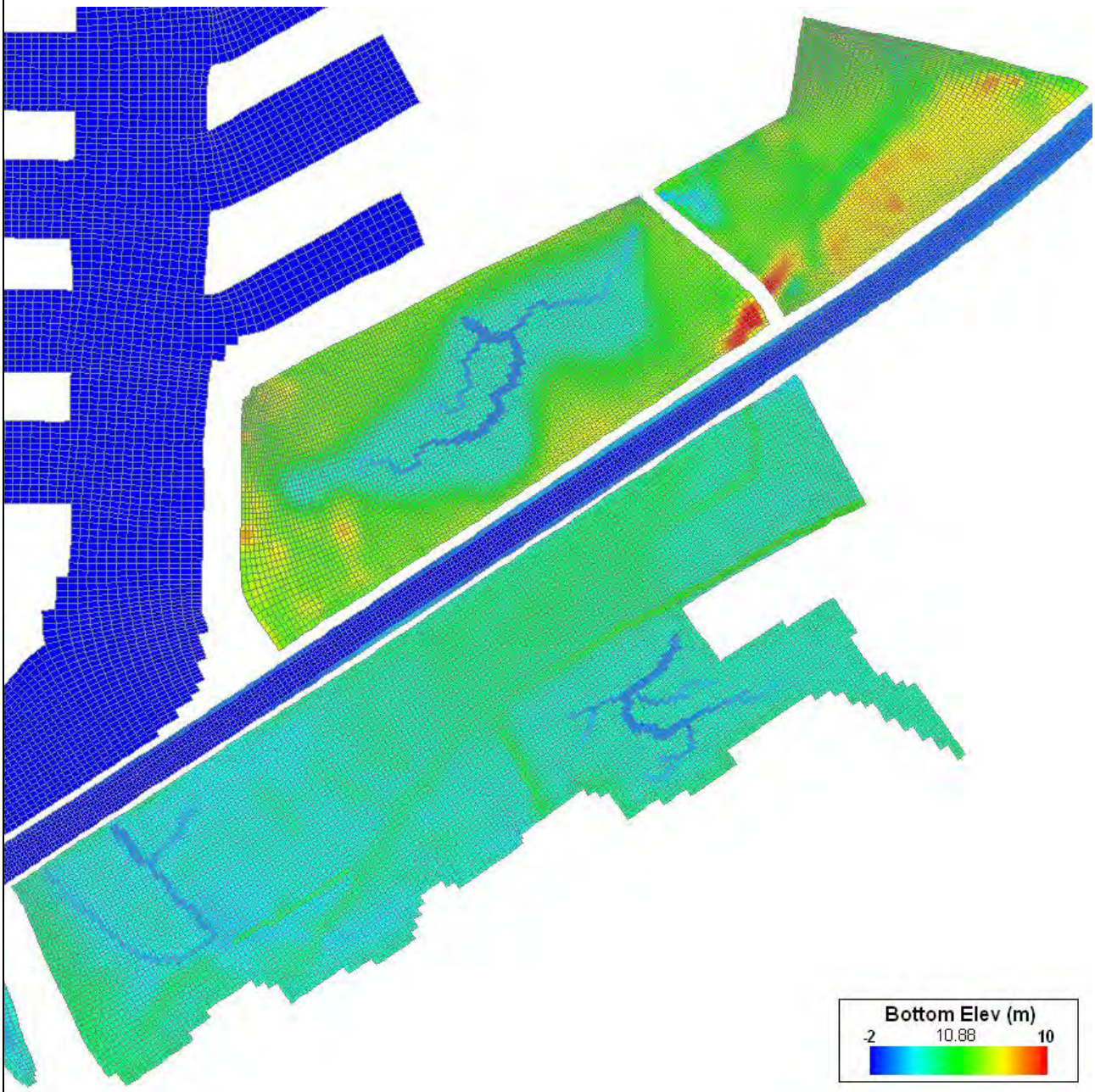
Source: EFDC model setup.
Notes: Bottom elevations shown in meters NAVD.

figure 10
Ballona Wetlands Restoration Project

Alt 1 – Muted Tidal Bathymetry

PWA Ref# 1793

PWA



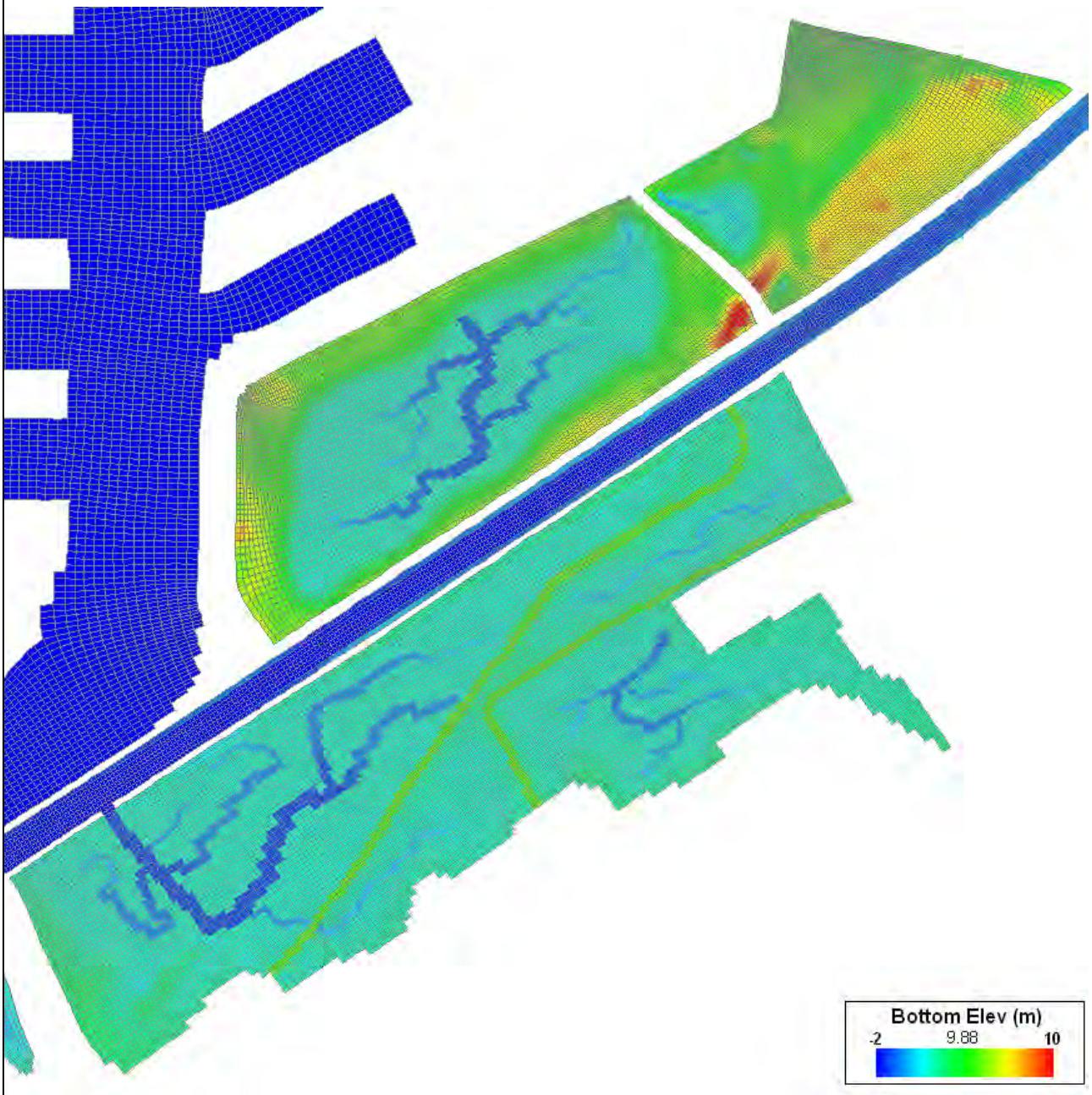
Source: EFDC model setup.
Notes: Bottom elevations shown in meters NAVD.

figure 11
Ballona Wetlands Restoration Project

Alt 2 – Partial Tidal Bathymetry

PWA Ref# 1793

PWA



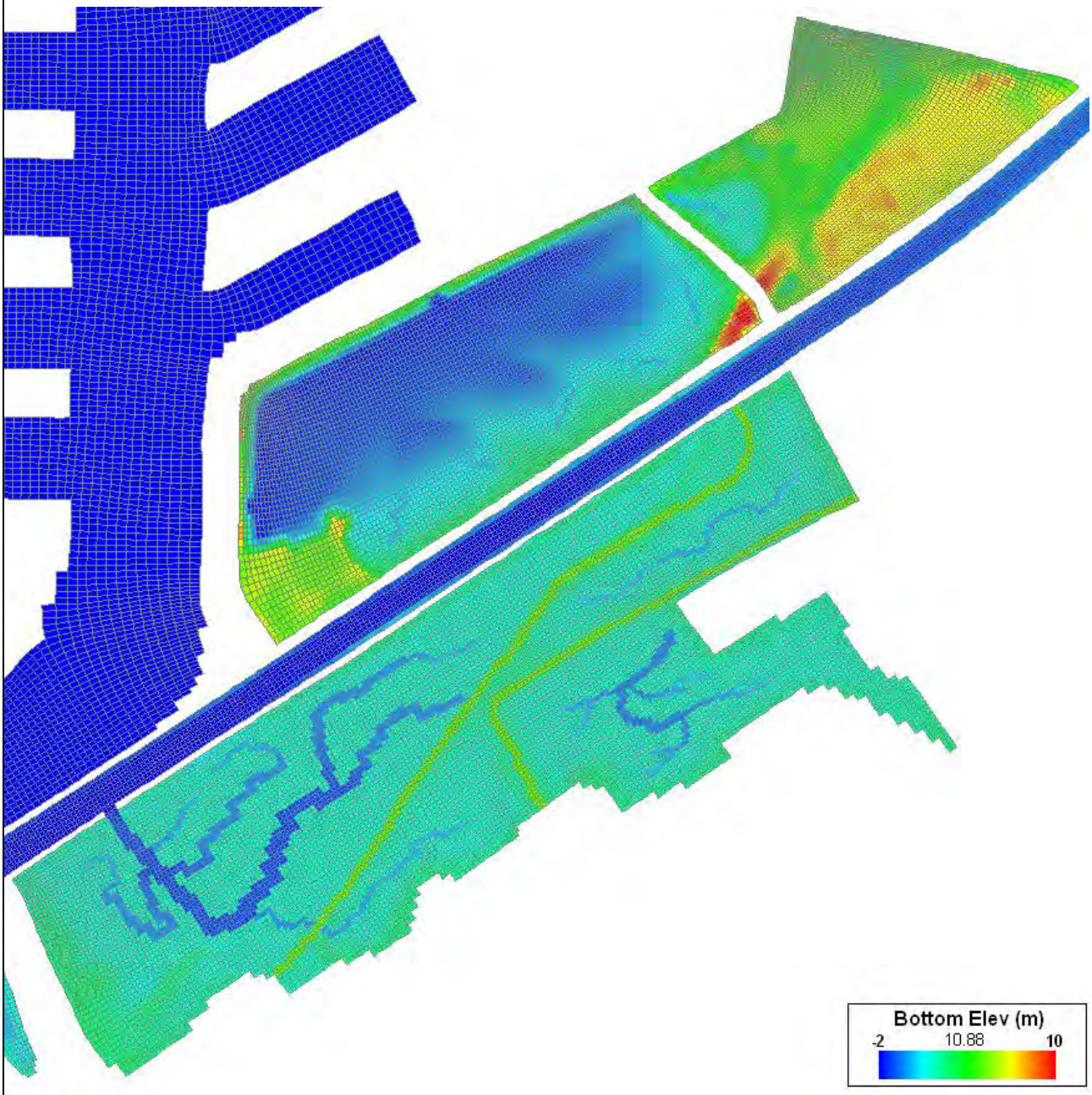
Source: EFDC model setup.
Notes: Bottom elevations shown in meters NAVD.

figure 12
Ballona Wetlands Restoration Project

Alt 3 – Full Tidal Bathymetry

PWA Ref# 1793

PWA



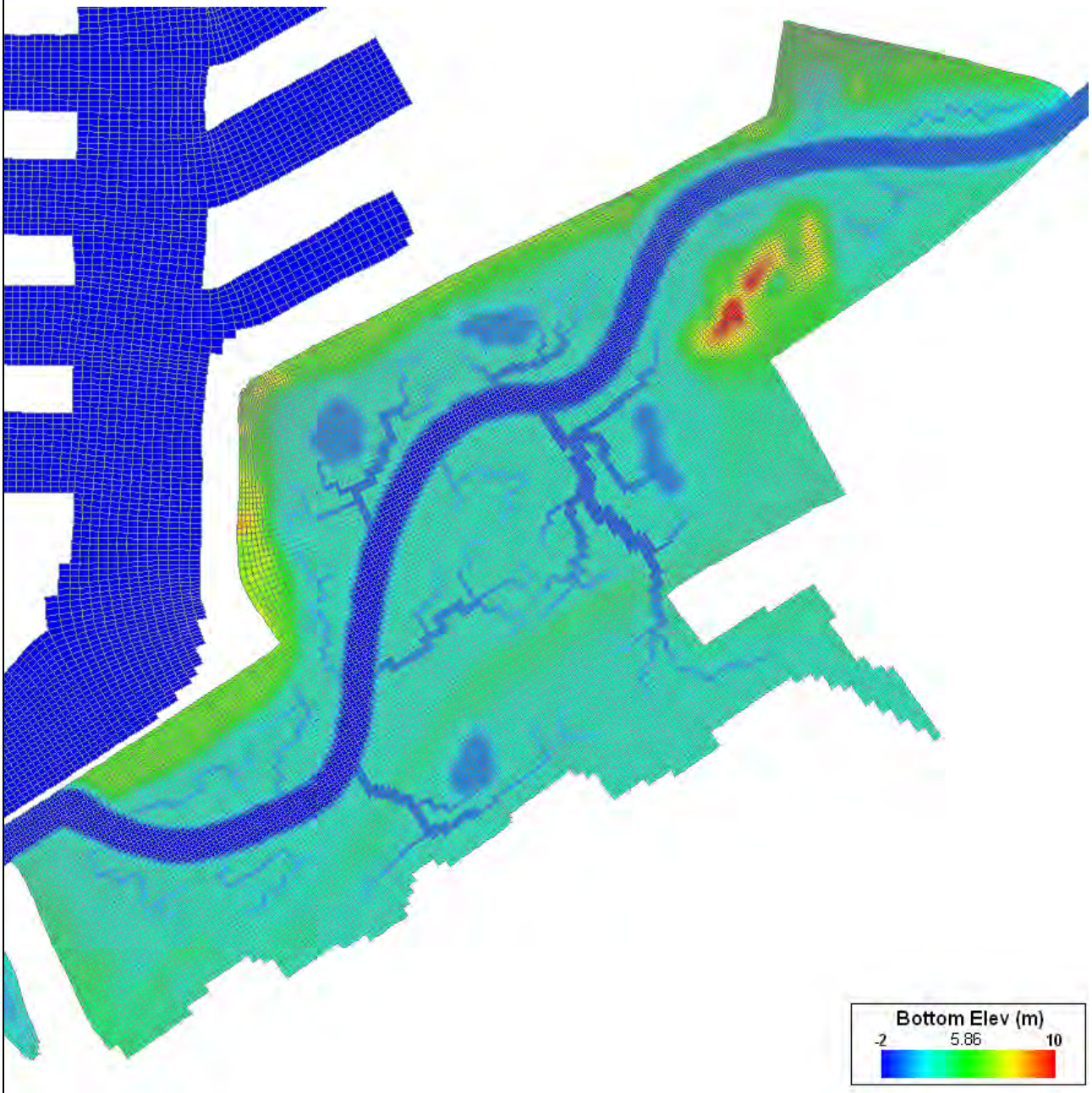
Source: EFDC model setup.
Notes: Bottom elevations shown in meters NAVD.

figure 13
Ballona Wetlands Restoration Project

Alt 4 – Area A Subtidal Bathymetry

PWA Ref# 1793

PWA



Source: EFDC model setup.
Notes: Bottom elevations shown in meters NAVD.

figure 14
Ballona Wetlands Restoration Project

Alt 5 – New Creek Bathymetry

PWA Ref# 1793

PWA

C-4. SUPPORTING DOCUMENTATION FOR SECTION 3.3 HYDROLOGY

Section 3.3 of the Lower Ballona Creek Restoration Feasibility Study discusses the expected hydrology for each proposed alternative. The text and figures below provide supporting documentation for the specific model results discussed in the report as well as related model results not explicitly discussed in the Feasibility Study. The section numbers below correspond to the relevant subsections of Section 3.3 (Hydrology).

Section 3.3.1 - Muted Tidal System versus Full Tidal System

Inundation regime is the percentage of time that a given water level is exceeded during a neap-spring tidal cycle. It is a useful parameter for characterizing the tidal inundation at a particular location with a specific elevation. The inundation frequency curves corresponding to Table 3-7 are shown in Figure 15.

Section 3.3.2 - Tidal prism

Tidal prism is the volume of water passing through a channel cross section on each tide (ebb or flood). Tidal prism was evaluated for each restoration area at four cross sections: (1) mouth of Ballona Creek, (2) mouth of Marina Del Rey, (3) Basin H entrance, and (4) Marina del Rey above Basin H. Tidal prism was estimated by integrating the discharge time series at each cross section for each tide (flood or ebb). The mean tidal prism of all floods and all ebbs was estimated for all runs that spanned the full spring-neap cycle. The results are shown in Table 1.

Section 3.3.3 – Connections

Area B southwest wetland SRT and culvert connection

Figure 16 shows a sample water level comparison for the culvert sizing and SRT optimization for the Area B southwest wetland. Two culvert geometries are tested: (1) 2 x 5 ft culverts and (2) 3 x 5 ft culverts. Three elevations are tested for the SRT: 3.6 ft, 4.9 ft, and 6.6 ft NAVD. Increasing the culvert area increases the tide range within the wetland and improves drainage from the wetland to Ballona Creek. The effect of the SRT in limiting high water within the site is seen once the Ballona Creek water levels reach the closure elevation.

Area B southeast wetland, Area A small marsh, Area A large marsh, Area A subtidal

Figure 17 illustrates the procedure adopted to size the culvert connections to each wetland. The number of culverts was increased until the tide range within the wetland approximately matched that of Ballona Creek. As can be seen in Figure 17, once the number of culverts increases beyond six 5-ft culverts, there are very small incremental gains in tide range for relatively large increases in culvert cross sectional area. The same procedure was followed to size the culverts for the small and large marshes and subtidal portion of Area A, shown in Figure 18, Figure 19, and Figure 20, respectively.

Area B southwest breach

The Area B breach was sized with a similar objective to the culvert sizing described above. The breach was sized to allow full conveyance of the tidal signal to the wetland (i.e. no tidal damping or muting). A sample water level comparison is shown in Figure 21.

Section 3.3.4 - Channel Network

Section 3.3.4 of the Feasibility Report discusses the expected channel network characteristics for each alternative. See Appendix C-2 (Marsh channel representation in Lower Ballona EFDC model) for a more detailed explanation of the methodology used to develop the channel networks.

Section 3.3.6 - Excursion Length

Section 3.3.6 of the Feasibility Report provides a qualitative discussion of tidal excursion lengths and implications for hydraulic connectivity and mixing in Ballona Creek. Excursion length was examined at the same cross sections locations as for the tidal prism analysis: (1) mouth of Ballona Creek, (2) mouth of Marina del Rey, and (3) Entrance to Basin H. For this application, excursion length was calculated by integrating the velocity time series over each tidal cycle to obtain the tidal excursion for each flood or ebb tide. The median tidal excursion lengths for flood and ebb were then tabulated for each model run. The results are shown in Table 2.

Section 3.3.7 – Flooding

50-yr hydrograph

The Ballona Creek Ecosystem Restoration Feasibility Study Hydrology Appendix (USACE 2008) presents results of a flood frequency analysis and rainfall-runoff model for the Ballona Creek watershed. A discharge-frequency relationship for Ballona Creek at Sawtelle Boulevard for the period 1928-2005 was developed to predict the hydrograph for the 50-yr discharge event (Figure 22). Ballona Creek hydrographs for the 50-year event were provided to PWA by the USACE. PWA then used these hydrographs to estimate the discharge from Sepulveda Channel and from Centinela Channel. These estimates were used as boundary conditions for the model.

50-yr flood water levels

The restoration alternatives were evaluated under flood conditions by using the EFDC model to predict water levels resulting from the 50-yr flood. The predicted peak water levels near the SRT for existing conditions (Figure 23) compare well with the USACE predictions at the same location. Overall changes to the system under Alternative 1 and Alternative 2 are minimal, resulting in nearly identical water level predictions in Ballona Creek as for Existing Conditions (Figure 24, Figure 25). Because of flow through the culverts is limited, water levels within the southeast wetlands peak at lower values than within Ballona Creek and also take longer to drain off with the falling flood water levels (Figure 25). Alternative 3's peak water levels in Ballona Creek were lower than the Existing Conditions peak because the large expanse of wetlands in this alternative provides storage for the flood waters (Figure 26). For floods under Alternatives 1-3, predicted water levels in Area A are not altered since these wetlands are not connected to Ballona Creek. Therefore, Alternative 4, which is identical to Alternative 3 except for the subtidal region of Area A, was not modeled with flood conditions. For Alternative 5, water levels

were assessed both upstream near Area C and at the SRT. While the upstream water levels are higher as a consequence of the channel and water surface slope, Alternative 5's upstream water levels are below that of existing conditions (Figure 27). This suggests that flood hazard is unlikely to increase with restoration.

Storm Surge Analysis

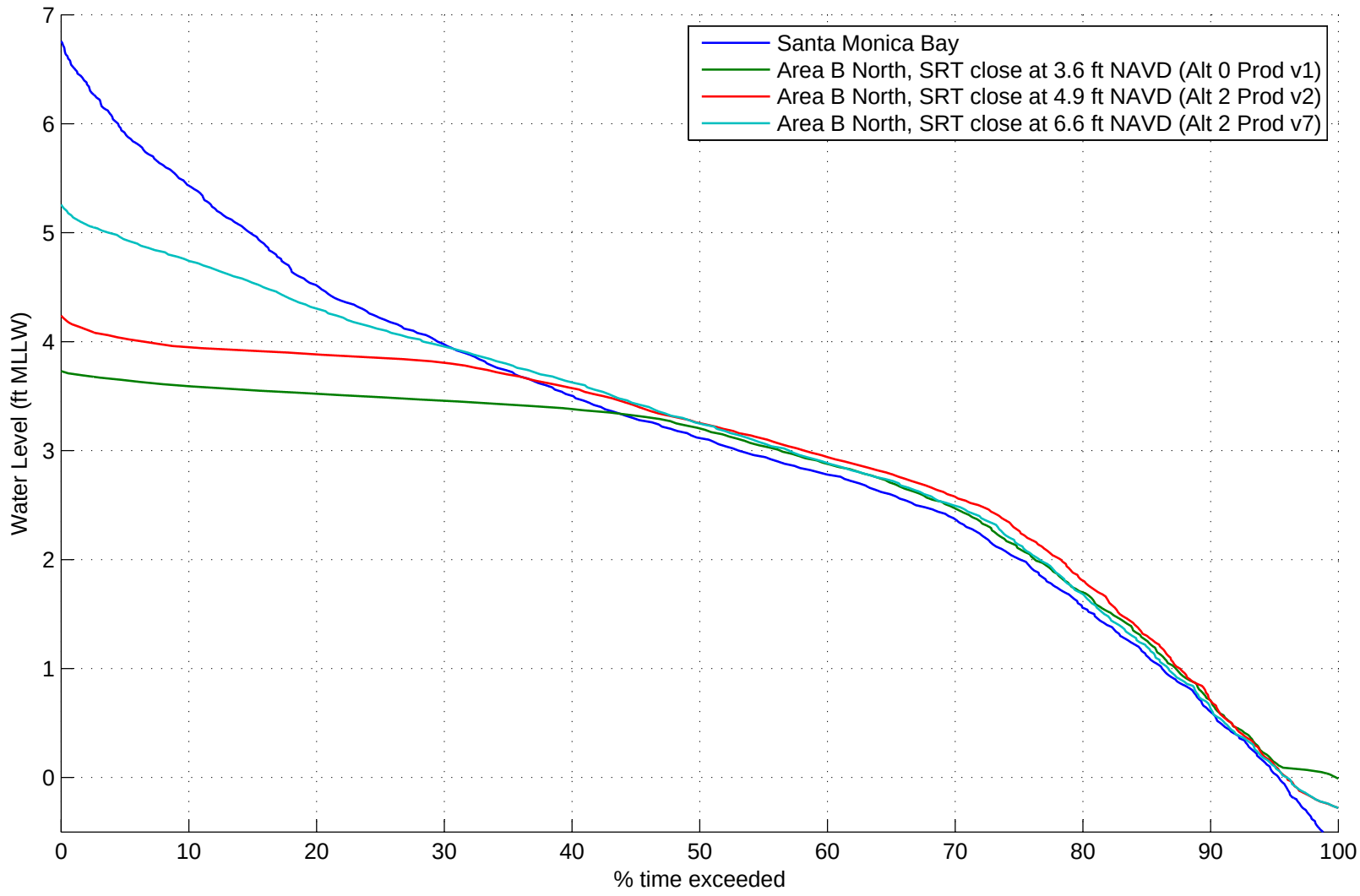
Water levels at the Port of Los Angeles were examined using an event selection approach to identify typical storm surge events (super-elevation of water levels above astronomical tides). Events were selected based on events identified in the Ballona Creek Ecosystem Restoration Feasibility Study Hydrology Appendix (USACE 2008), since coastal storms often exhibit high precipitation and storm surge. Typical surges ranged from 0.5 to 1.5 ft above astronomical tides, with a maximum of 1.65 ft during the 1997-1998 El Niño winter. Storm surge events lasted approximately 3-7 days. Table 3 shows a summary of the event-based analysis.

Additional Model Runs

Additional model runs were conducted for each alternative to inform the culvert sizing, SRT closure elevations, and other aspects of the model setup. The full run catalog is shown in Table 4.

Figures

Figure 15. Annual inundation frequency, Area B southwest SRT
Figure 16. Culvert sizing and SRT optimization, Area B southwest
Figure 17. Culvert sizing, Area B southeast
Figure 18. Culvert sizing, Area A small marsh
Figure 19. Culvert sizing, Area A large marsh
Figure 20. Culvert sizing, Area A subtidal
Figure 21. Culvert sizing, Area B southwest breach
Figure 22. Ballona Creek 50-yr hydrograph at Sawtelle Boulevard
Figure 23. Existing Conditions: Water Levels, 50-yr Flood
Figure 24. Alt. 1: Water Levels, 50-yr Flood
Figure 25. Alt. 2: Water Levels, 50-yr Flood
Figure 26. Alt. 3: Water Levels, 50-yr Flood
Figure 27. Alt. 5: Water Levels, 50-yr Flood



Source: EFDC model predictions

Figure 15
Lower Ballona Wetlands

Inundation frequency, Area B southwest SRT

PWA Ref# 1793.1

PWA

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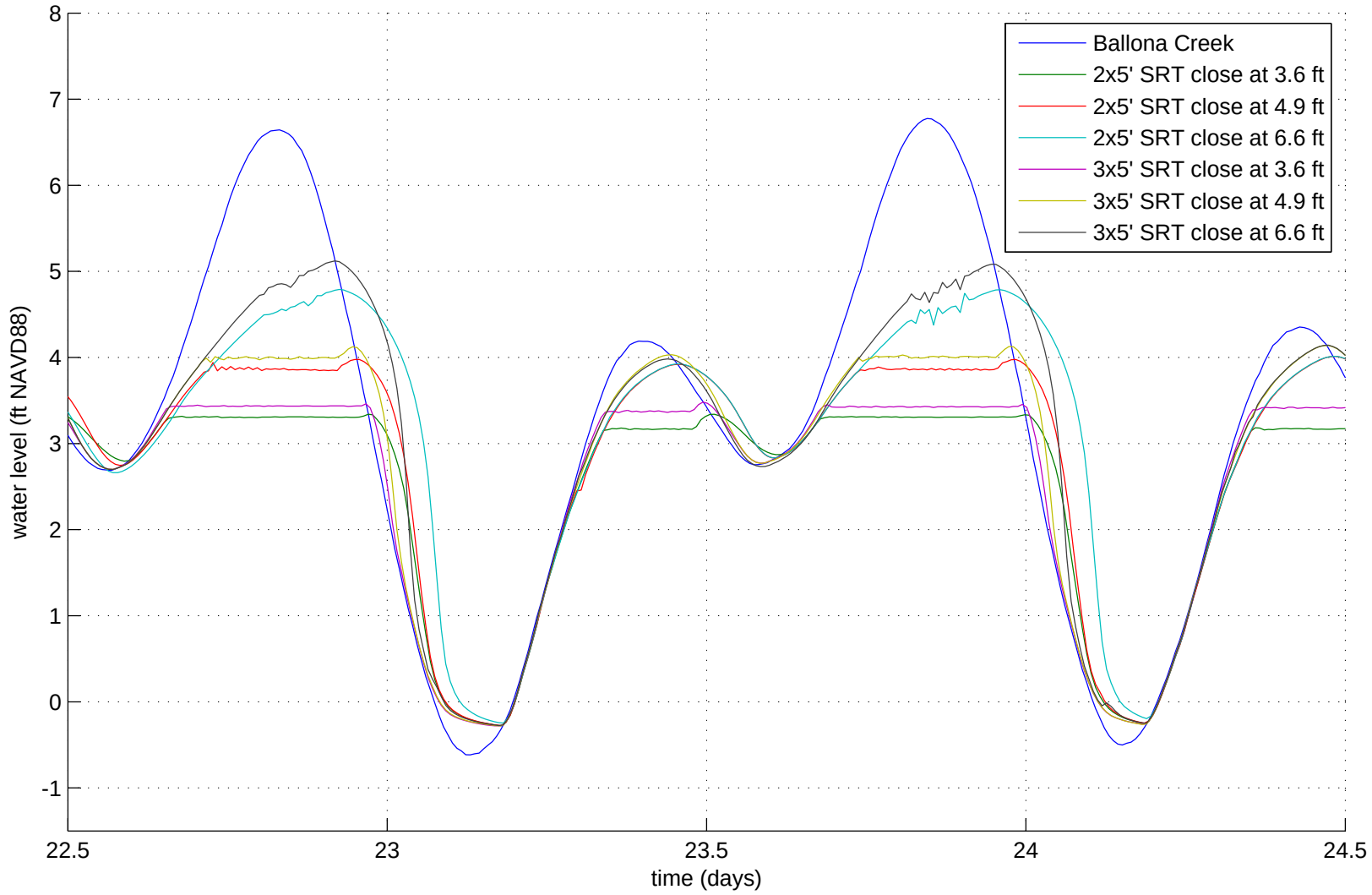

Source: EFDC model predictions

Figure 16
Lower Ballona Wetlands

Culvert sizing and SRT optimization, Area B southwest

PWA Ref# 1793.1

PWA

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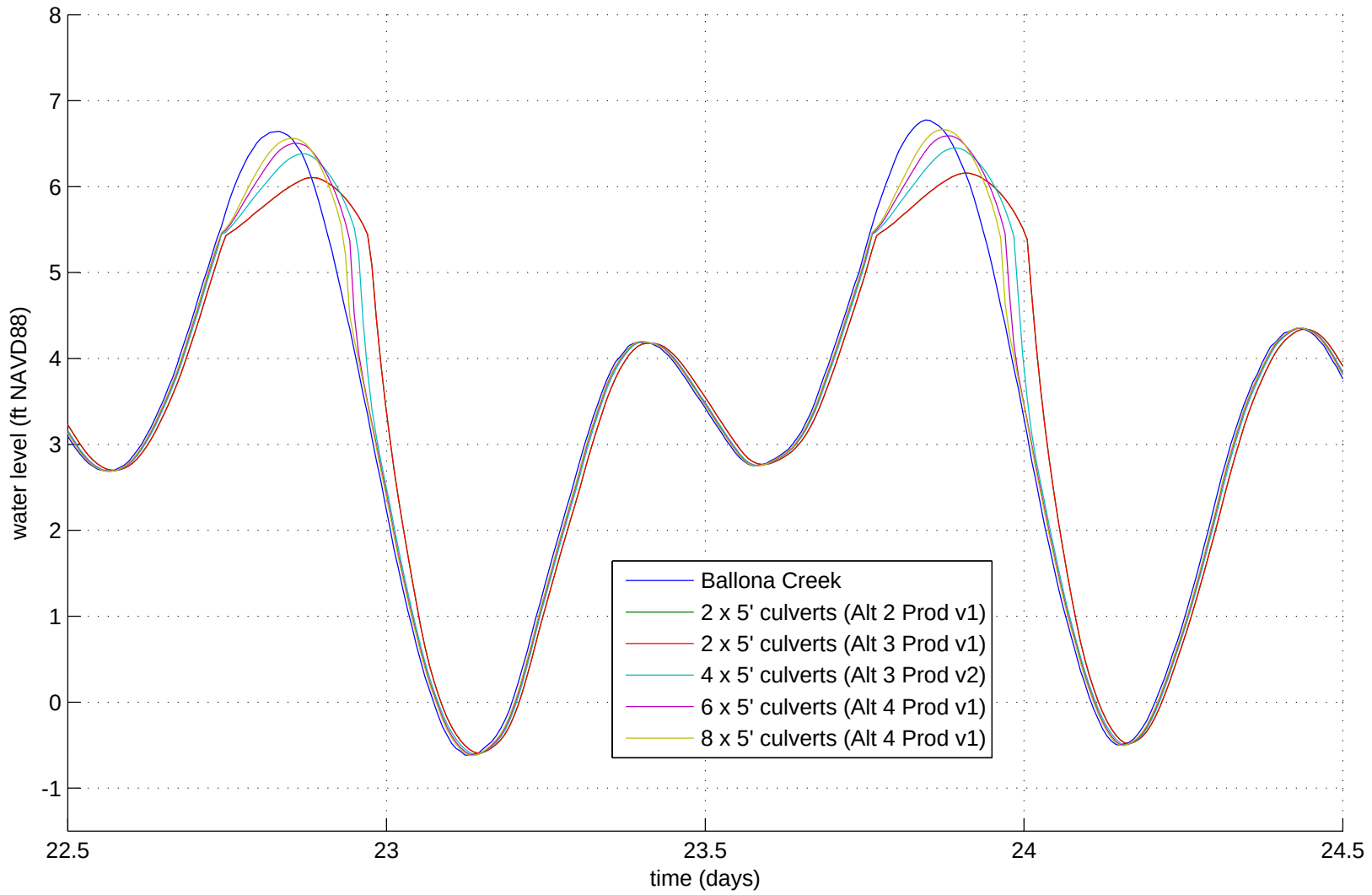

Source: EFDC model predictions

Figure 17
Lower Ballona Wetlands

Culvert Sizing, Area B SE Marsh

PWA Ref# 1793.1

PWA

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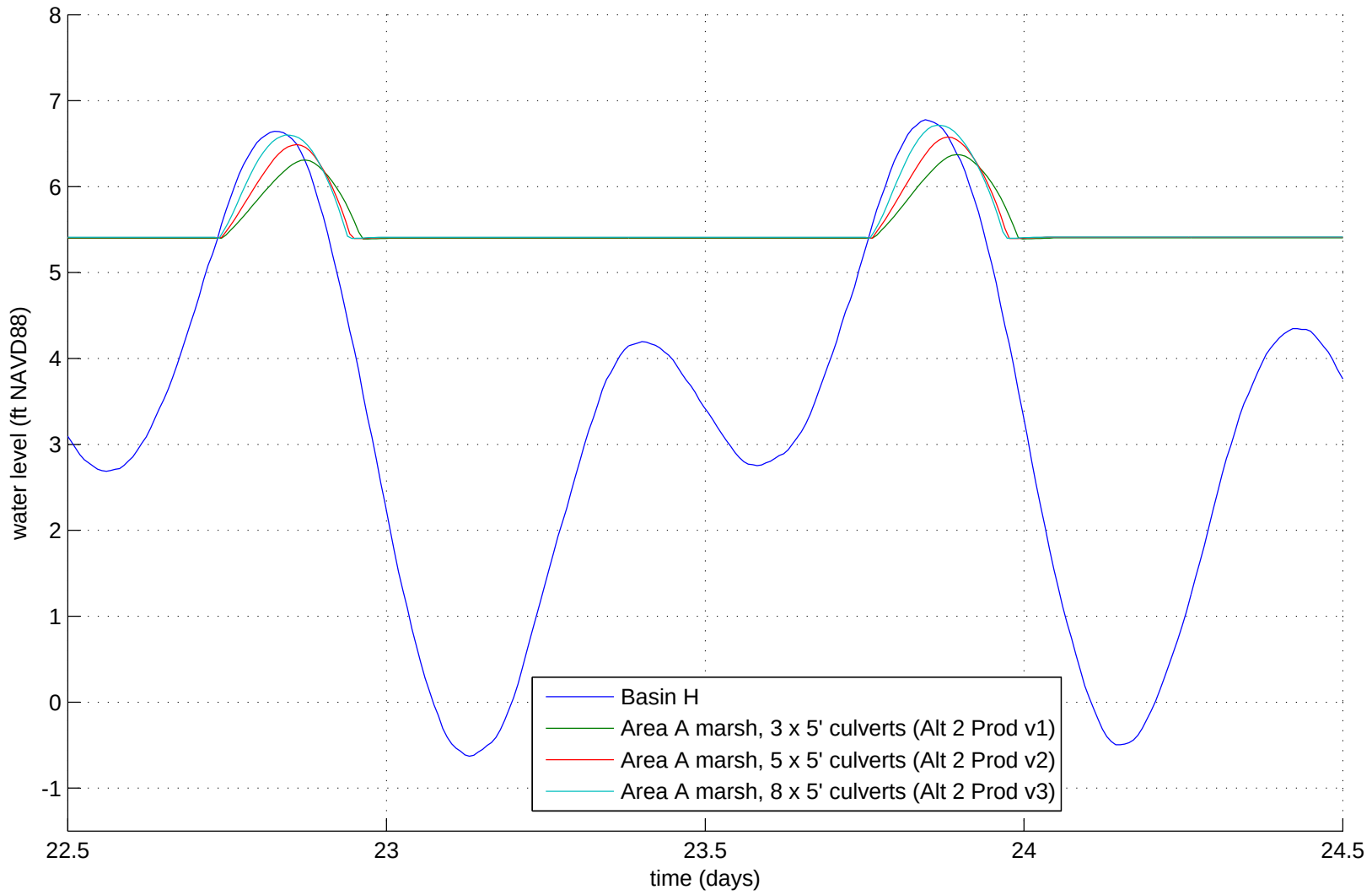

Source: EFDC model predictions

Figure 18
Lower Ballona Wetlands

Culvert Sizing, Area A Small Marsh

PWA Ref# 1793.1

PWA

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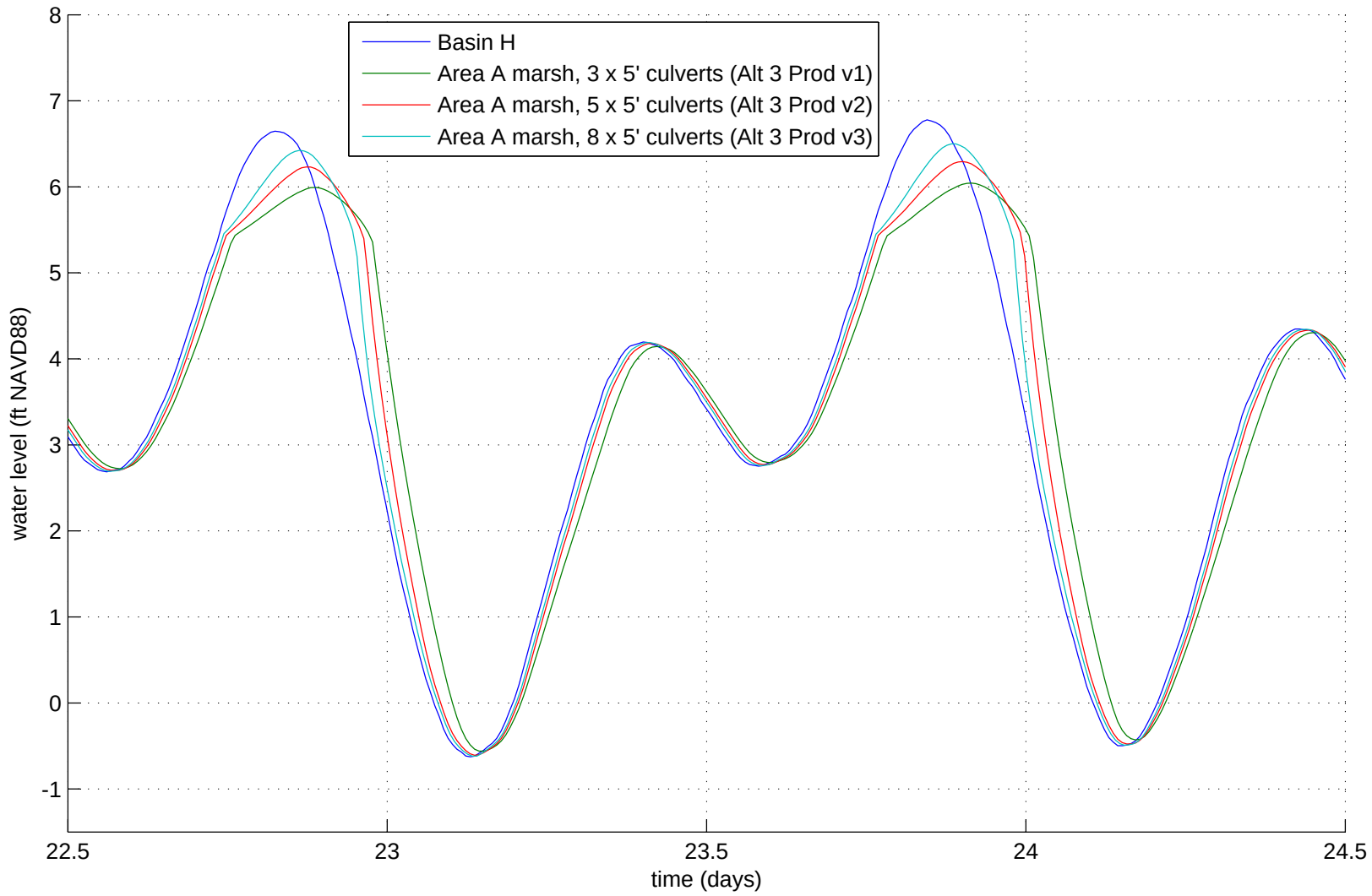

Source: EFDC model predictions

Figure 19
Lower Ballona Wetlands

Culvert Sizing, Area A Large Marsh

PWA Ref# 1793.1

PWA

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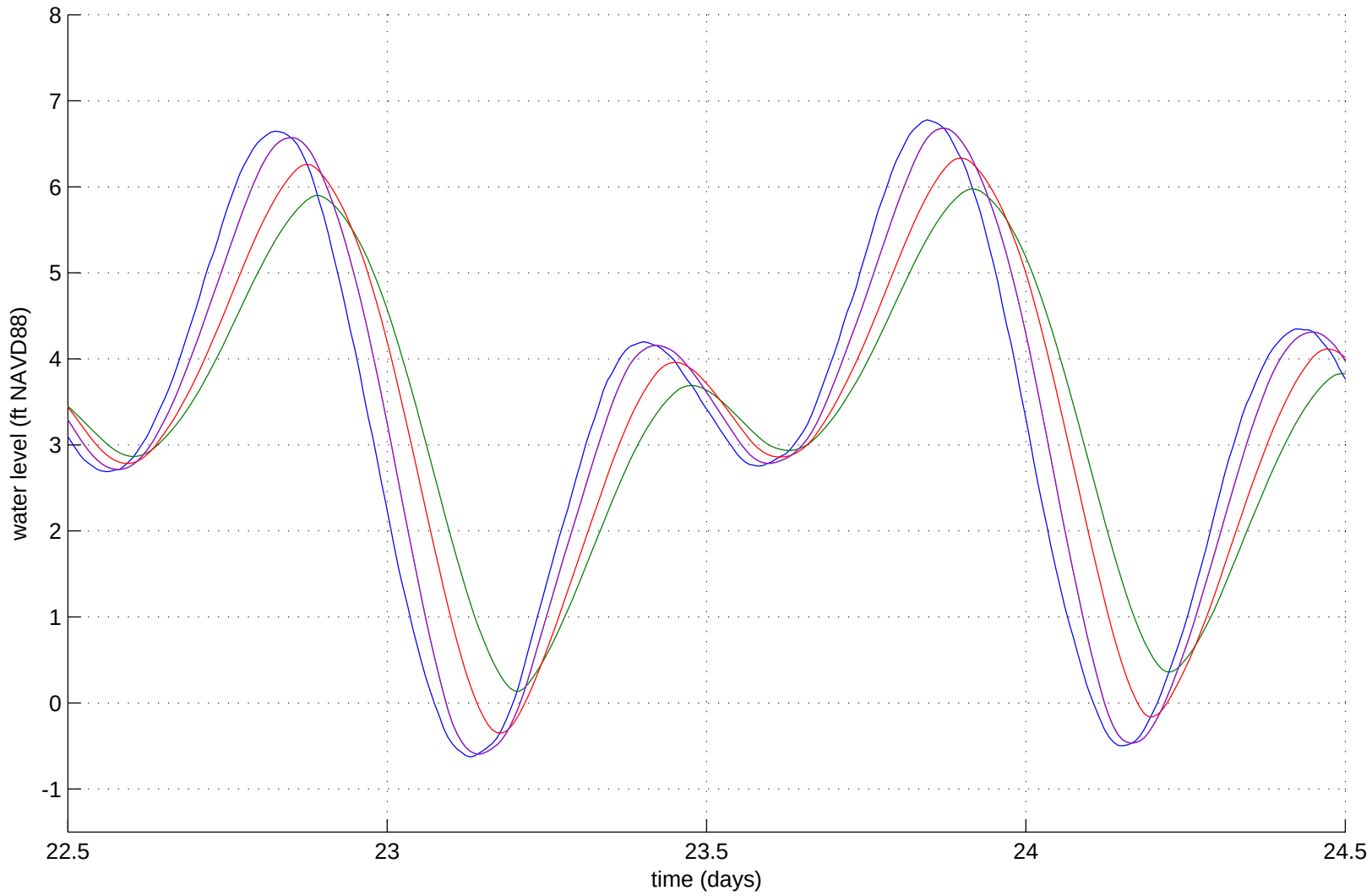


Source: EFDC model predictions

- Basin H
- Area A subtidal, 8 x 5' culverts (Alt 4 Prod v1)
- Area A subtidal, 12 x 5' culverts (Alt 4 Prod v2)
- Area A subtidal, 2x(12 x 5') culverts (Alt 4 Prod v5)
- Area A subtidal, 2x(12 x 5') culverts @ Via Venetia (Alt 4 Prod v6)

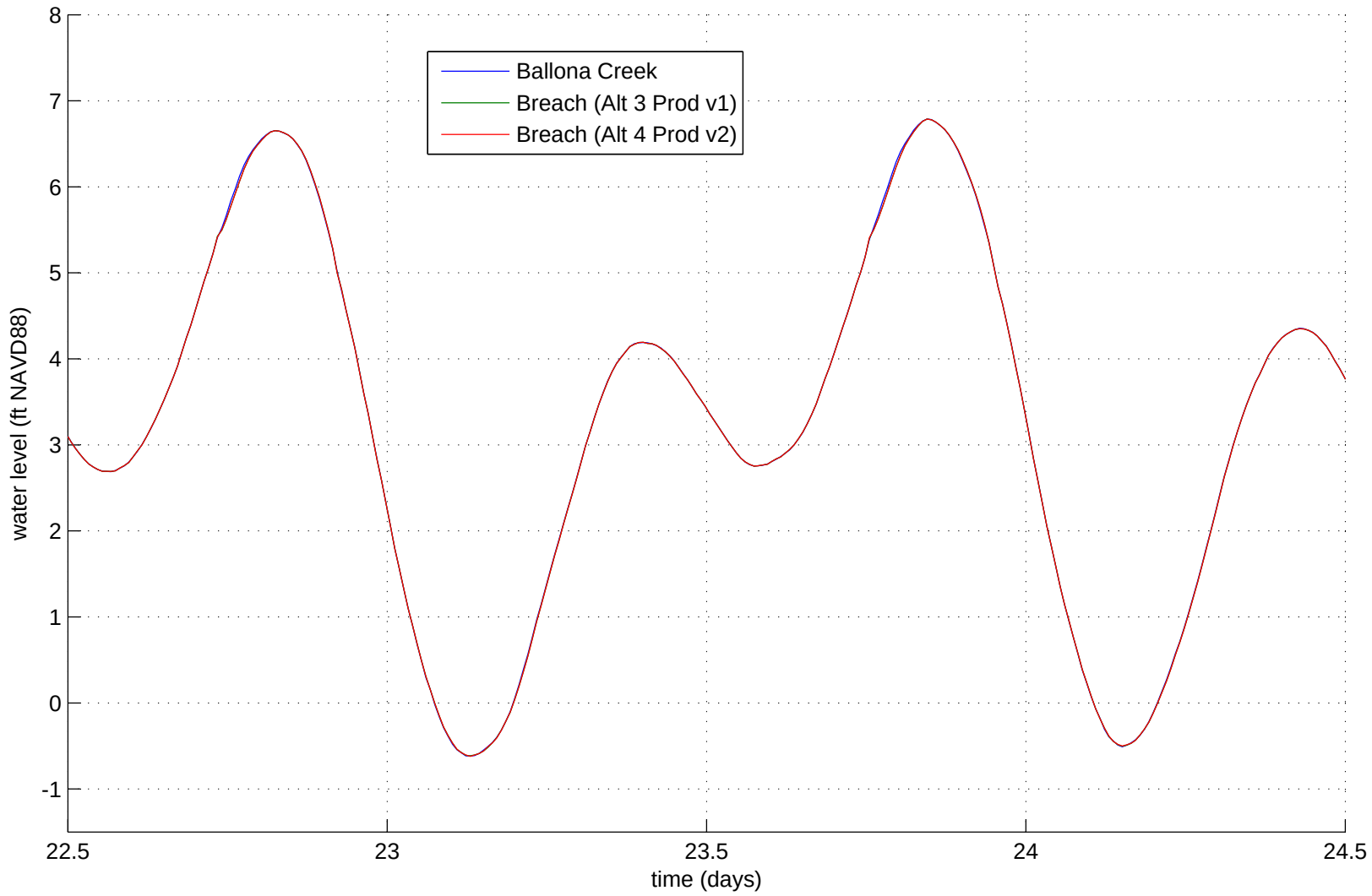
Figure 20
Lower Ballona Wetlands

Culvert Sizing, Area A Subtidal

PWA Ref# 1793.1

PWA

C:\m.brennan\Projects\1793_Ballona\Modeling\Alternatives\Analysis\Culvert sizing\compare_culverts_AreaA_subtidal.m



Source: EFDC model predictions

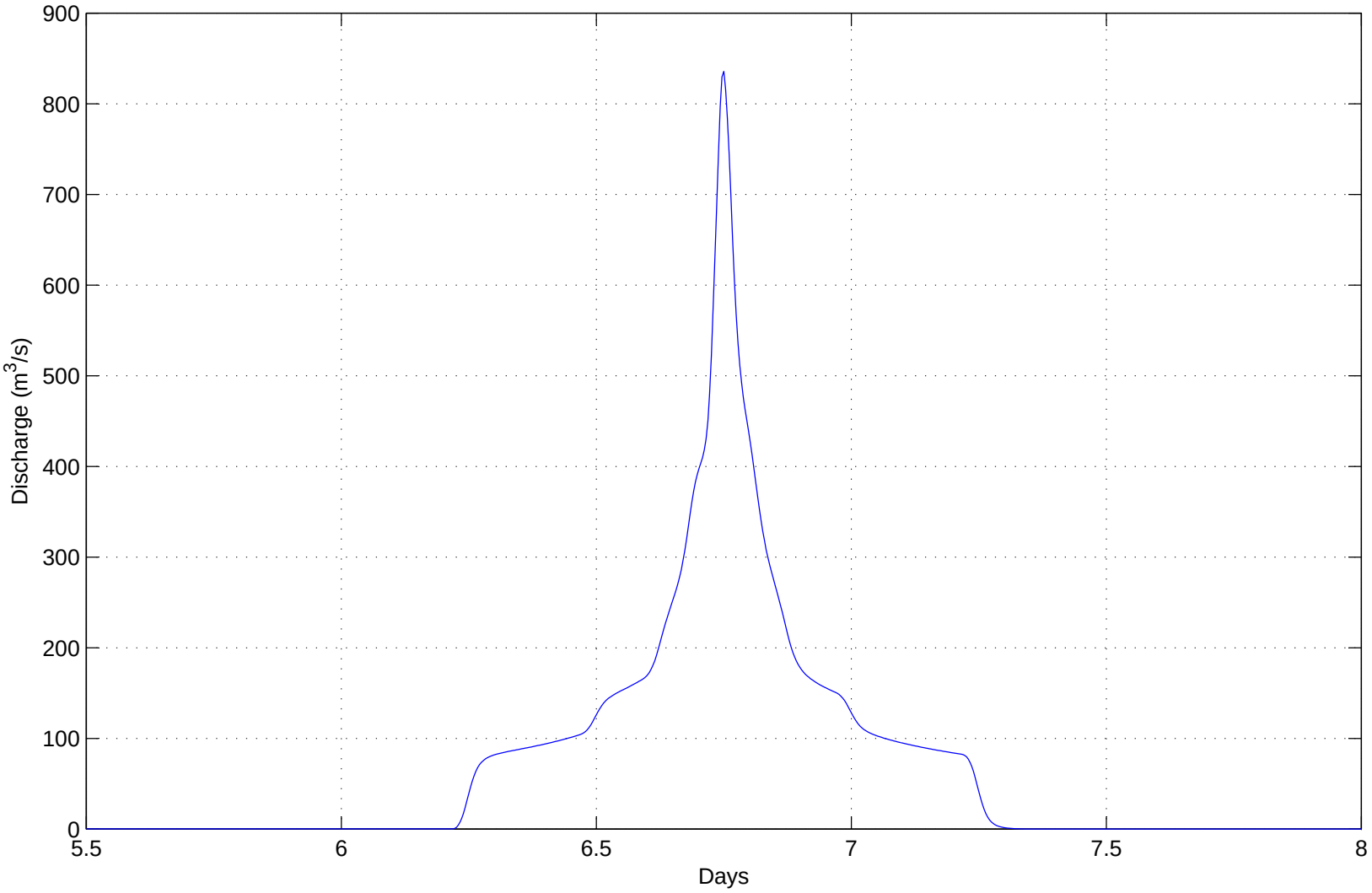
Figure 21
Lower Ballona Wetlands

Culvert Sizing, Area B Southwest Breach

PWA Ref# 1793.1

PWA

C:\m.brennan\Projects\1793_Ballona\Modeling\Alternatives\Analysis\Culvert sizing\compare_culverts_AreaB_north_breach.m



Source: Ballona Creek Ecosystem Restoration Feasibility Study Hydrology Appendix F3 - Without Project Hydrologic Analysis. January 2008. U.S. Army Corps of Engineers, South Pacific Division, Los Angeles District

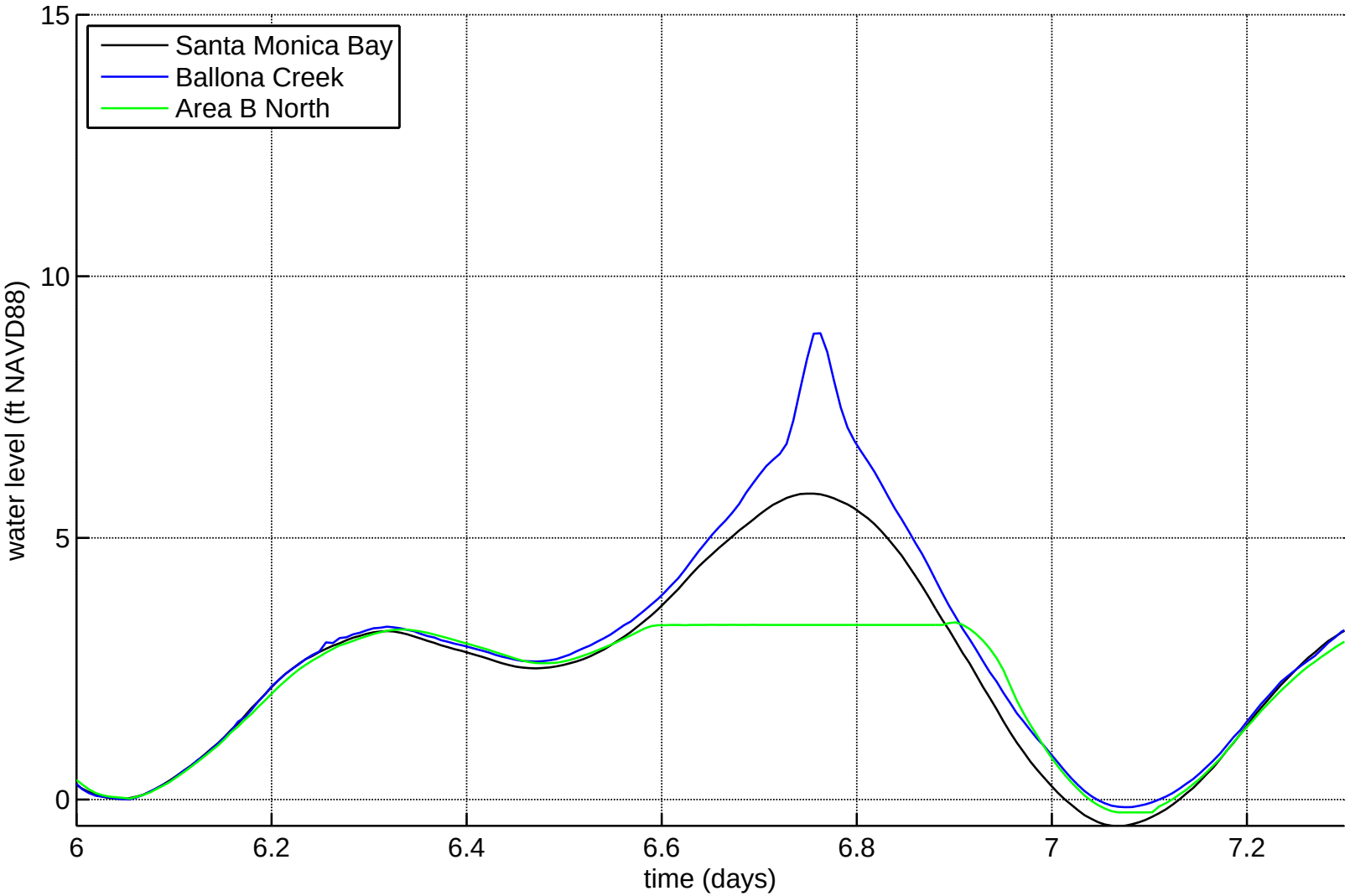
Figure 22
Ballona Wetlands Restoration Project

Ballona Creek 50-yr hydrograph at Sawtelle Blvd

PWA Ref# 1793

PWA

J:\1793_Ballona_Wetlands\1793.01_Modeling\Reporting\Modeling appendix\Flooding\plot_50yr_hydrograph.m



Source: EFDC model predictions

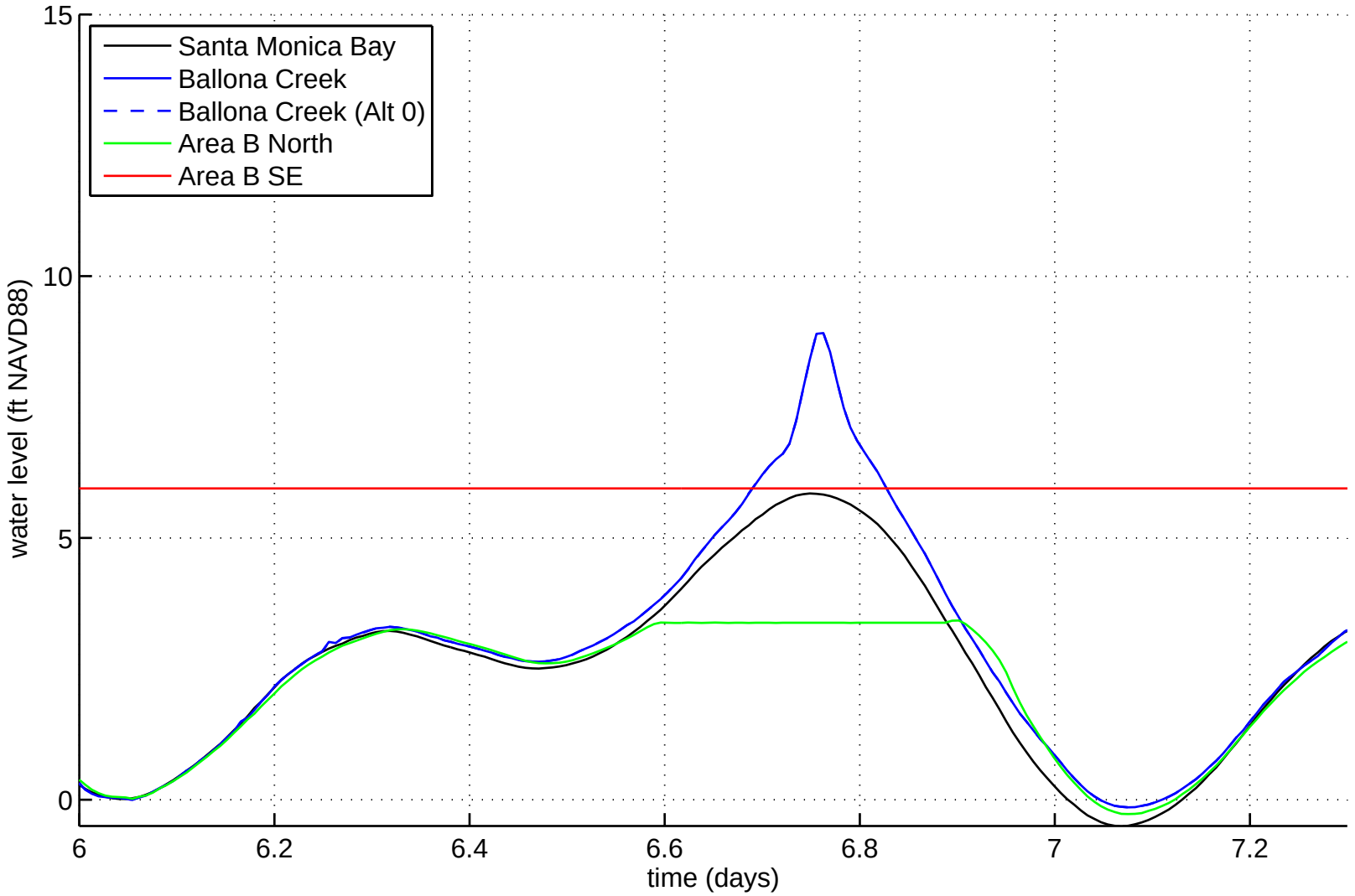
Figure 23
Lower Ballona Wetlands

Existing Conditions: Water Levels, 50-yr Flood

PWA Ref# 1793.1

PWA

C:\m.brennan\Projects\1793_Ballona\Modeling\Alternatives\Analysis\Flooding\plot_alt0_flood.m



Source: EFDC model predictions

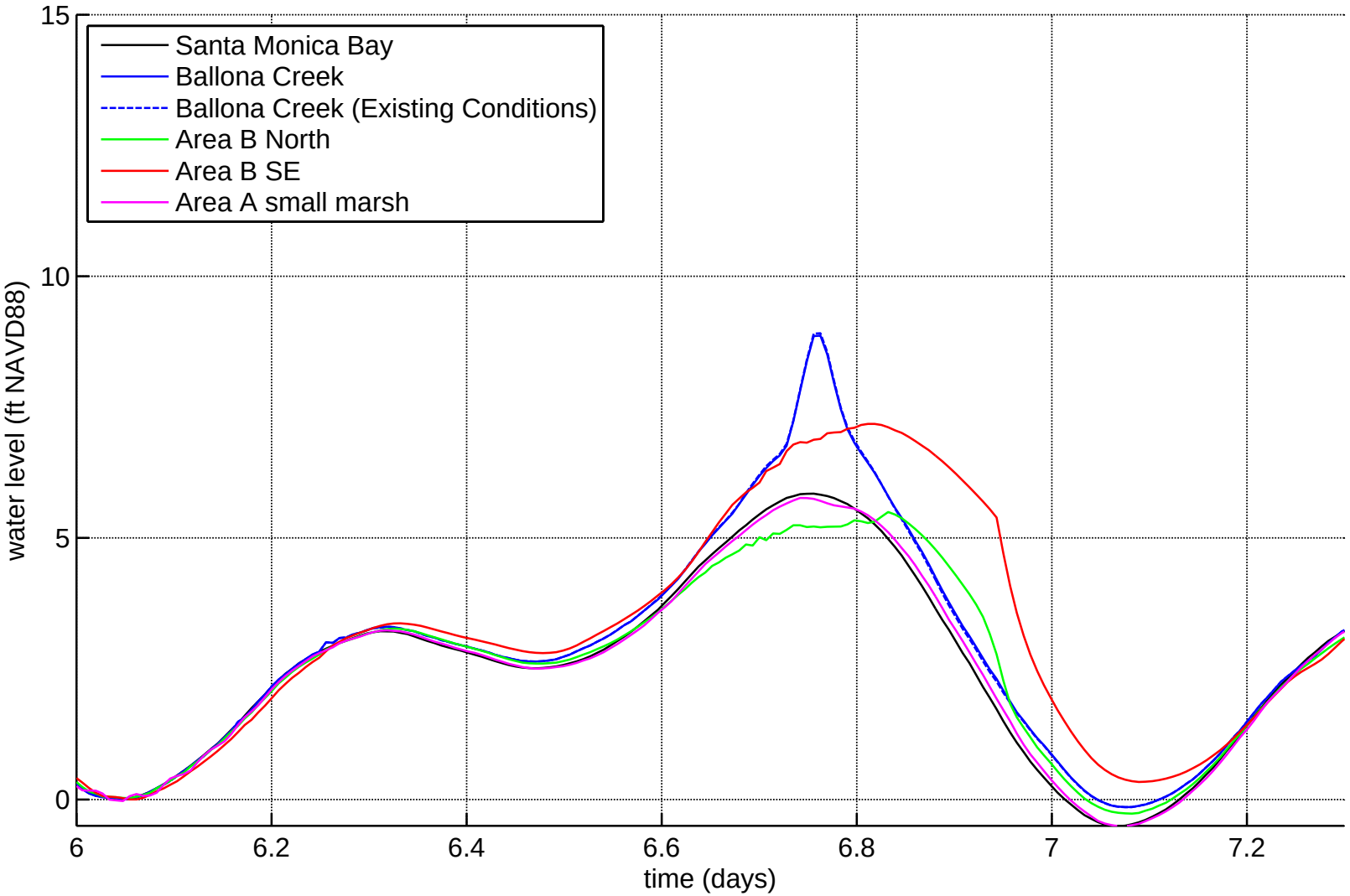
Figure 24
Lower Ballona Wetlands

Alt. 1: Water Levels, 50−yr Flood

PWA Ref# 1793.1

PWA

C:\m.brennan\Projects\1793_Ballona\Modeling\Alternatives\Analysis\Flooding\plot_alt1_flood.m



Source: EFDC model predictions

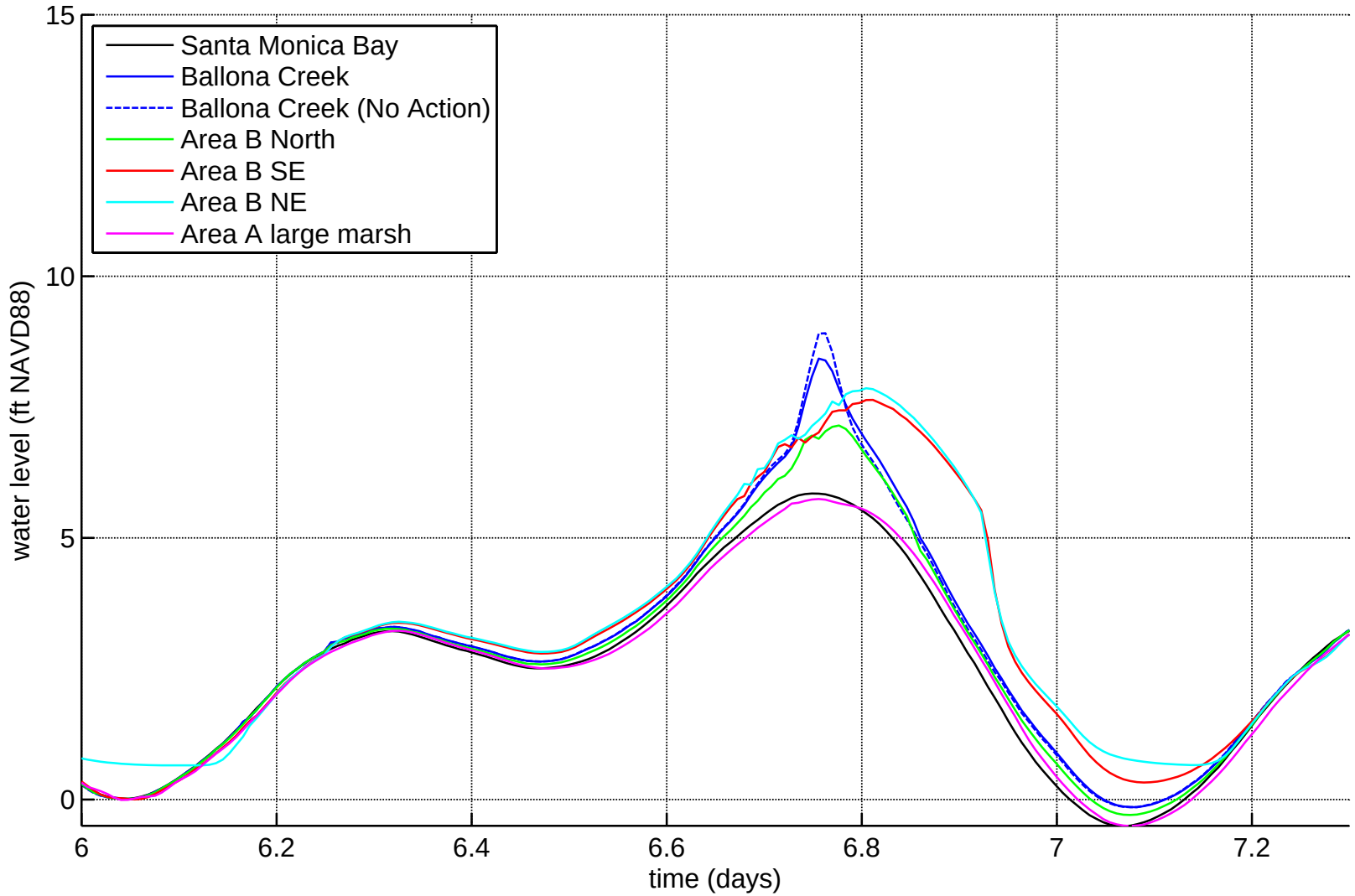
Figure 25
Lower Ballona Wetlands

Alt. 2: Water Levels, 50-yr Flood

PWA Ref# 1793.1

PWA

C:\m.brennan\Projects\1793_Ballona\Modeling\Alternatives\Analysis\Flooding\plot_alt2_flood.m



Source: EFDC model predictions

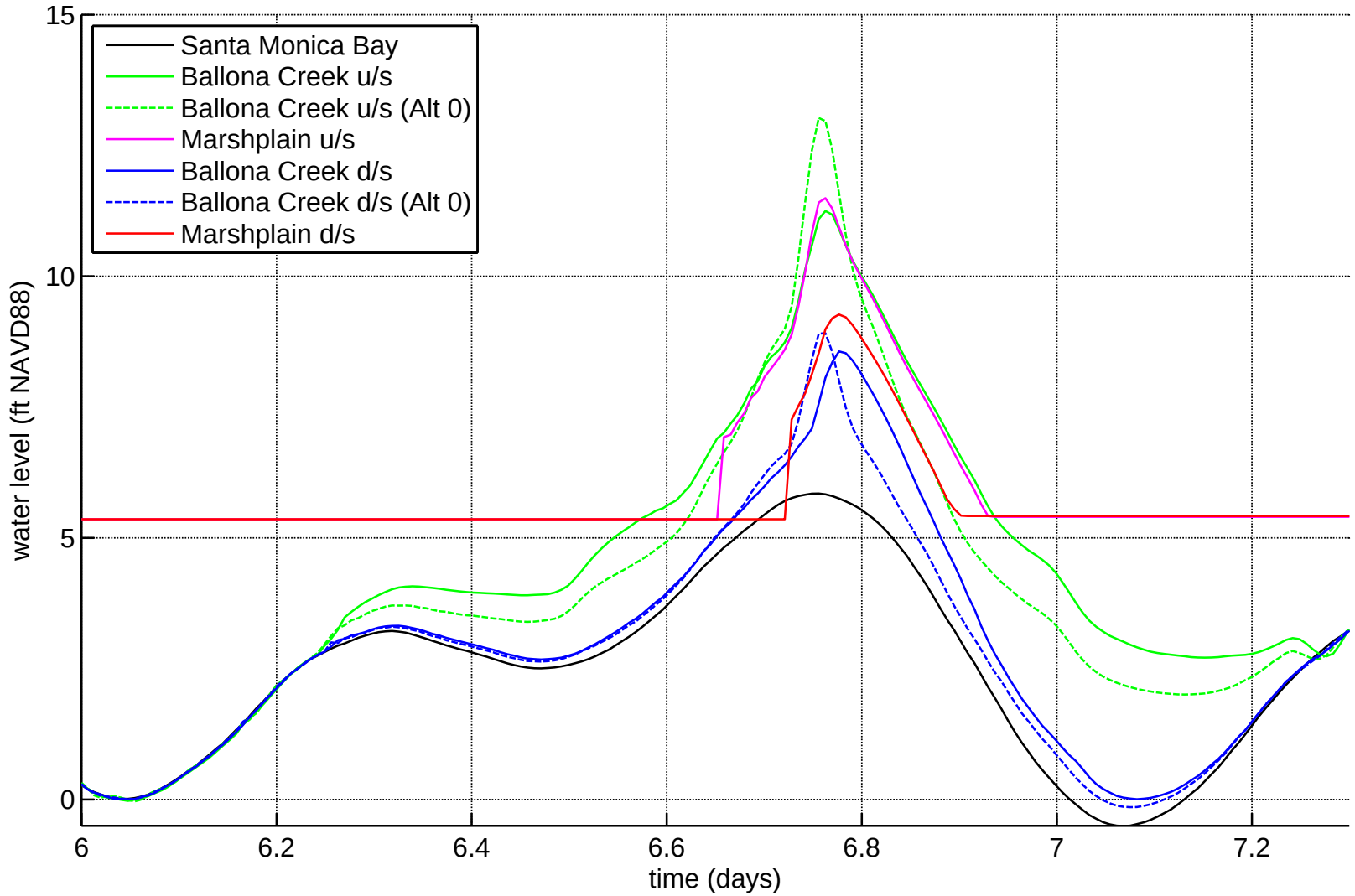
Figure 26
Lower Ballona Wetlands

Alt. 3: Water Levels, 50-yr Flood

PWA Ref# 1793.1

PWA

C:\m.brennan\Projects\1793_Ballona\Modeling\Alternatives\Analysis\Flooding\plot_alt3_flood_2.m



Source: EFDC model predictions

Figure 27
Lower Ballona Wetlands

Alt. 5: Water Levels, 50-yr Flood

PWA Ref# 1793.1

PWA

C:\m.brennan\Projects\1793_Ballona\Modeling\Alternatives\Analysis\Flooding\plot_alt5_flood.m

Table 1. Modeled Tidal Prism at Selected Cross Sections
1793.01 Ballona Wetlands Restoration Project
Tidal prism in ac-ft

	Mouth of Ballona Creek		Mouth of Marina del Rey		Entrance to Basin H		Marina del Rey above Basin H	
Model Run*	mean flood	mean ebb	mean flood	mean ebb	mean flood	mean ebb	mean flood	mean ebb
Alt 0 Prod v1	231	-243	1291	-1400	9	-10	382	-350
Alt 1 Prod v1	235	-279	1402	-1287	12	-14	364	-416
Alt 2 Prod v1	267	-314	1384	-1343	31	-35	376	-432
Alt 2 Prod v2	274	-306	1348	-1383	36	-44	382	-440
Alt 2 Prod v3	277	-405	1221	-1418	48	-53	464	-529
Alt 2 Prod v7	284	-331	1281	-1385	43	-47	394	-424
Alt 3 Prod v1	386	-416	1404	-1362	54	-55	388	-431
Alt 3 Prod v2	390	-419	1409	-1367	60	-68	382	-409
Alt 3 Prod v4	396	-427	1477	-1438	69	-70	380	-456
Alt 4 Prod v1	391	-421	1625	-1488	294	-298	376	-448
Alt 4 Prod v2	392	-421	1701	-1651	345	-348	414	-448
Alt 4 Prod v5	392	-421	1765	-1714	381	-371	461	-466
Alt 4 Prod v6	392	-421	1764	-1713	10	-10	509	-516
Alt 5 Prod v1	599	-627	1400	-1284	11	-12	381	-409

* See run catalog for more detailed description of model setup for each run.

Table 2. Median tidal excursions lengths

1793.01 Ballona Wetlands Restoration Project

	Ballona Creek		Marina del Rey		Basin H Entrance	
Model Run*	flood (mi)	ebb (mi)	flood (mi)	ebb (mi)	flood (mi)	ebb (mi)
Alt 0 - No action\Prod v1	0.63	-0.71	0.75	-0.52	0.01	-0.01
Alt 1 - Muted tidal\Prod v1	0.64	-0.72	0.67	-0.57	0.01	-0.02
Alt 2 - Partial tidal\Prod v1	0.69	-0.76	0.69	-0.58	0.04	-0.03
Alt 2 - Partial tidal\Prod v2	0.71	-0.82	0.69	-0.58	0.06	-0.02
Alt 2 - Partial tidal\Prod v7	0.79	-0.83	0.69	-0.58	0.04	-0.02
Alt 3 - Full tidal\Prod v1	1.03	-0.95	0.70	-0.59	0.07	-0.05
Alt 3 - Full tidal\Prod v2	1.03	-0.95	0.70	-0.59	0.12	-0.04
Alt 3 - Full tidal\Prod v4	1.03	-0.95	0.70	-0.59	0.11	-0.04
Alt 4 - Area A subtidal\Prod v1	1.03	-0.95	0.78	-0.65	0.37	-0.10
Alt 4 - Area A subtidal\Prod v2	1.03	-0.95	0.81	-0.69	0.41	-0.18
Alt 4 - Area A subtidal\Prod v5	1.03	-0.95	0.85	-0.72	0.47	-0.20
Alt 4 - Area A subtidal\Prod v6	1.03	-0.95	0.84	-0.72	0.01	-0.01
Alt 5 - New creek\Prod v1	1.52	-1.43	0.67	-0.57	0.01	-0.02

* See run catalog for more detailed description of model setup for each run.

Note: mi = miles

Table 3. Storm Surge Event-based Analysis for Ballona Creek Mouth
1793.01 Ballona Wetlands Modeling
J. Vandever (PWA)
Date: April 10, 2008

Event*	Description	Storm Dates	Peak Surge (ft)**	Date/Time***	Approx. Duration (days)****
1	Series of winter storms tracked eastward from North Pacific	27 February - 3 March 1938	0.76	3/2/38 15:40	3
2	Winter storm, combination of warm Pacific cyclone and cold coastal storm	21-23 January 1943	1.35	1/22/43 21:10	3.5
3a	Low-latitude north Pacific cyclone	3-4 March 1943	0.54	3/3/43 18:00	2.5
3b			0.75	2/22/43 20:00	4
4	Combination of cold low pressure system moving down coast and subtropical cyclone	19-21 November 1967	0.64	11/21/67 19:10	4
5a	Series of unusually intense low latitude Pacific storms	18-26 January 1969	0.86	1/21/69 5:00	4.5
5b	Series of unusually intense low latitude Pacific storms	18-26 January 1969	0.80	1/25/69 7:00	5.5
6	Pacific cyclone cold front	3-4 December 1974	-	-	-
7	Persistent series of warm, subtropical Pacific storms from SW	5-13 February 1978	1.58	2/10/78 1:30	6
8	Persistent series of warm, subtropical Pacific storms from SW	27 February - 5 March 1978	1.32	3/1/78 2:00	7
9a	1982-83 El Nino Winter	1982-83 Winter	1.64	3/2/83 1:20	7
9b	1982-83 El Nino Winter		1.23	2/2/83 15:30	7
10	High storm event in SF Bay	3 December 1983	-	-	-
11	1997-1998 El Nino Winter	1997-98 Winter	1.65	2/3/1998 9:30	3

Average Surge	**1.1**

* Events were selected based on the COE Ballona Creek Ecosystem Study Appendix F3 Hydrology.
* Peak surge determined from the max residual between observed and predicted water level at NOAA Station #9410660 Los Angeles
** Dates and times are given in local standard time (LST)
*** Approximate storm durations were determined by visually examining the residual time series for each event

Table 4. Ballona Wetlands Modeling Run Catalog					
Restoration alternatives	**Run name**	**Status P=planned S=setup R=running C=complete A=analyzed**	**Tide or Flood**	**Run period, days**	**Project area configuration**
No Action					
	Calibration v1	C	Tide	0.1-19.1	Area B N: Existing SRT (2x5' culverts)
	Alt 0 - Prod v1	C	Tide	10.88-28.88	Area B N: Existing SRT (2x5' culverts)
	Alt 0 - Prod fld v6	C	Flood	5.86-7.36	Area B N: Existing SRT (2x5' culverts)
Alt 1- Muted tidal					
	Alt 1 - Prod v1	A	Tide	10.88-28.88	Area B N: Existing SRT (2x5' culverts, cutoff at 1.1 m NAVD) Area B SE: 2x5' culverts, cutoff at 2 m NAVD
	Alt 1 - Prod v2	A	Tide	10.88-21.1	Area B N: Modified SRT (4x5' culverts, cutoff at 1.5 m NAVD) Area B SE: 4x5' culverts, cutoff at 2.25 m NAVD
	Alt 1 - Prod fld v2	R	Flood	5.28-6.78	Area B N: Existing SRT (2x5' culverts, cutoff at 1.1 m NAVD) Area B SE: 2x5' culverts, cutoff at 2 m NAVD
	Alt 1 - Prod fld v3	R	Flood	5.86-7.36	Area B N: Existing SRT (2x5' culverts, cutoff at 1.1 m NAVD) Area B SE: 2x5' culverts, cutoff at 2 m NAVD
Alt 2 - Partial tidal					
	Alt 2 - Prod v1	A	Tide	10.88-28.88	Area B N: Existing SRT (2x5' culverts, cutoff at 1.1 m NAVD) Area B SE: 2x5' culverts Area A: 3x5' culverts, Dock 52
	Alt 2 - Prod v2	A	Tide	10.88-28.88	Area B N: Modified SRT (2x5' culverts, cutoff at 1.5 m NAVD) Area B SE: 2x5' culverts Area A: 5x5' culverts, Dock 52
	Alt 2 - Prod v3	A	Tide	21.8-24.8	Area B N: Modified SRT (2x5' culverts, cutoff at 2.0 m NAVD) Area B SE: 2x5' culverts Area A: 8x5' culverts, Dock 52
	Alt 2 - Prod v4	A	Tide	21.8-24.8	Area B N: Modified SRT (3x5' culverts, cutoff at 2.0 m NAVD) Area B SE: 2x5' culverts Area A: 8x5' culverts, Dock 52
	Alt 2 - Prod v5	A	Tide	21.8-24.8	Area B N: Modified SRT (3x5' culverts, cutoff at 1.5 m NAVD) Area B SE: 2x5' culverts Area A: 8x5' culverts, Dock 52
	Alt 2 - Prod v6	A	Tide	21.8-24.7	Area B N: Modified SRT (3x5' culverts, cutoff at 1.1 m NAVD) Area B SE: 2x5' culverts Area A: 8x5' culverts, Dock 52
	Alt 2 - Prod v7	A	Tide	10.88-28.88	Area B N: Modified SRT (3x5' culverts, cutoff at 2.0 m NAVD) Area B SE: 2x5' culverts Area A: 8x5' culverts, Dock 52
	Alt 2 - Prod fld v2	C	Flood	5.28-6.78	Area B N: Modified SRT (2x5' culverts, cutoff at 2.0 m NAVD) Area B SE: 2x5' culverts Area A: 8x5' culverts, Dock 52
	Alt 2 - Prod fld v3	C	Flood	5.86-7.36	Area B N: Modified SRT (2x5' culverts, cutoff at 2.0 m NAVD) Area B SE: 2x5' culverts Area A: 8x5' culverts, Dock 52
Alt 3 - Fully tidal					
	Alt 3 - Prod v1	A	Tide	10.88-28.88	Area B N: Breach to Creek Area B NE: 2x5' culverts Area B SE: 2x5' culverts Area A: 3x5' culverts, Dock 52
	Alt 3 - Prod v2	A	Tide	10.88-28.88	Area B N: Breach to Creek Area B NE: 2x5' culverts Area B SE: 4x5' culverts Area A: 5x5' culverts, Dock 52
	Alt 3 - Prod v3	A	Tide	21.8-24.7	Area B N: Breach to Creek Area B NE: 2x5' culverts Area B SE: 4x5' culverts Area A: 8x5' culverts, Dock 52
	Alt 3 - Prod v4	A	Tide	9.88-28.88	Area B N: Breach to Creek Area B NE: 2x5' culverts Area B SE: 4x5' culverts Area A: 8x5' culverts, Dock 52
	Alt 3 - Prod fld v4	C	Flood	5.86-7.36	Area B N: Breach to Creek Area B NE: 2x5' culverts Area B SE: 2x5' culverts Area A: 3x5' culverts, Dock 52

Alt 4 - Subtidal					
	Alt 4 - Prod v1	A	Tide	10.88-28.88	Area B N: Breach to Creek Area B NE: 2x5' culverts Area B SE: 6x5' culverts Area A: 8x5' culverts, Dock 52
	Alt 4 - Prod v2	A	Tide	10.88-28.88	Area B N: Breach to Creek Area B NE: 2x5' culverts Area B SE: 8x5' culverts Area A: 12x5' culverts, Dock 52
	Alt 4 - Prod v3	A	Tide	10.88-11.2	Area B N: Breach to Creek Area B NE: 2x5' culverts Area B SE: 8x5' culverts Area A: 8*(12x5' culverts), Dock 52
	Alt 4 - Prod v4	A	Tide	10.88-11.2	Area B N: Breach to Creek Area B NE: 2x5' culverts Area B SE: 8x5' culverts Area A: 4*(12x5' culverts), Dock 52
	Alt 4 - Prod v5	A	Tide	10.88-28.88	Area B N: Breach to Creek Area B NE: 2x5' culverts Area B SE: 8x5' culverts Area A: 2*(12x5' culverts), Dock 52
	Alt 4 - Prod v6	C	Tide	10.88-28.88	Area B N: Breach to Creek Area B NE: 2x5' culverts Area B SE: 8x5' culverts Area A: 2*(12x5' culverts), Via Venetia
Alt 5 - New creek					
	Alt 5 - Prod v1	C	Tide	10.88-28.88	Phase 3
	Alt 5 - Prod fld v4	P	Flood	5.86-7.36	Phase 3
SLR / Storm surge					

APPENDIX D.
DETAILED COST ESTIMATES AND SUPPORTING INFORMATION

Table D-1. Summary of Engineer's Estimates[1] for Alternatives 1 to 5. Costs in Millions of Dollars

Alternative	Area A	Area B	Area C	Total
1	$4.0	$2.6	--	**$6.6**
2	$42.6	$16.0	$3.3	**$61.8**
3	$69.3	$55.5	$5.2	**$130.0**
4	$108.4	$55.5	$5.2	**$169.0**
5	$99.8	$59.0	$50.4	**$209.3**
	Phase 1	**Phase 2**	**Phase 3**	
5 [2]	$110.4	$48.8	$50.5	**$209.7**

Notes

1 - Estimated construction costs include a 35% contingency

2 - The cost estimate for phasing Alternative 5 is higher due to the construction of a temporary levee

Table D-2. Estimated Volumes of Excess Material to Be Stockpiled and Rough Calcuation of Possible Stockpile Areas and Number of Truck Loads.

	Stockpile Volume (CY)				Stockpile Volume (ac-ft)				5-ft High Stockpile Areas (ac) [1]				10-ft High Stockpile Areas (ac) [1]				No. Truck Loads [2]
	Area A	**Area B**	**Area C**	**Total**	**Area A**	**Area B**	**Area C**	**Total**	**Area A**	**Area B**	**Area C**	**Total**	**Area A**	**Area B**	**Area C**	**Total**	**Total**
Alternative 1	86,400	-	-	86,400	50	-	-	**50**	11	-	-	**11**	6	-	-	**6**	**8,640**
Alternative 2	955,900	196,040	89,500	1,241,440	590	120	60	**770**	120	25	13	**158**	62	14	7	**83**	**124,144**
Alternative 3	1,684,880	963,700	141,000	2,789,580	1,040	600	90	**1,730**	211	122	19	**352**	108	63	10	**182**	**278,958**
Alternative 4	2,748,440	963,700	141,000	3,853,140	1,700	600	90	**2,390**	344	122	19	**485**	176	63	10	**249**	**385,314**
Alternative 5	2,665,700	1,218,100	1,347,800	5,231,600	1,650	760	840	**3,250**	334	155	171	**659**	170	80	88	**338**	**523,160**
	Phase 1	**Phase 2**	**Phase 3**		**Phase 1**	**Phase 2**	**Phase 3**		**Phase 1**	**Phase 2**	**Phase 3**		**Phase 1**	**Phase 2**	**Phase 3**		
Alternative 5	2,889,960	923,500	1,344,600	5,158,060	1,790	570	830	**3,190**	362	116	169	**647**	185	60	87	**332**	**515,806**

Notes

1- Assumes circular stockpile with 5:1 (h:v) side slopes. Area calculation uses insitu volume and does not account for losses, bulking, or compaction.

2- Assumes 10 CY per truck load as an order of magnitude index

Table D-3. Summary of Estimated Costs[1] for Disposal Options. Costs in Millions of Dollars

		Alt 1				Alt 2				Alt 3				Alt 4				Alt 5				Alt 5 with Phasing [2]			
		Area A	Area B	Area C	Total	Area A	Area B	Area C	Total	Area A	Area B	Area C	Total	Area A	Area B	Area C	Total	Area A	Area B	Area C	Total	Phase 1	Phase 2	Phase 3	Total [2]
On-Site Work		$4.0	$2.6	--	**$6.6**	$42.6	$16.0	$3.3	**$61.8**	$69.3	$55.5	$5.2	**$130.0**	$108.4	$55.5	$5.2	**$169.0**	$99.8	$59.0	$50.4	**$209.3**	$110.4	$48.8	$50.5	**$209.7**
Disposal Volume (CY)		86,400	0	0	**86,400**	955,900	196,040	89,500	**1,241,440**	1,684,880	963,700	141,000	**2,789,580**	2,748,440	963,700	141,000	**3,853,140**	2,665,700	1,218,100	1,347,800	**5,231,600**	2,889,960	923,500	1,344,600	**5,158,060**
Off-Site Disposal Options																									
Option 1 / 2	**Unload Dredged Material at POLA / Disposal at CDF at POLA**	$1.3	--	--	**$1.3**	$14.7	$3.0	$1.4	**$19.1**	$26.0	$14.8	$2.2	**$43.0**	$42.3	$14.8	$2.2	**$59.4**	$41.1	$18.8	$20.8	**$81.0**	$44.5	$14.2	$20.7	**$81.0**
Option 3	**Beneficial Use - Landfill Cover**	$4.2	--	--	**$4.2**	$45.9	$9.4	$4.3	**$59.7**	$81.0	$46.3	$6.8	**$134.1**	$132.1	$46.3	$6.8	**$185.2**	$128.1	$58.5	$64.8	**$252.6**	$138.9	$44.4	$64.6	**$252.6**
Option 4	**Disposal at Hazardous Waste Landfill [3]**																								
Option 5	**Offshore Disposal (low end of range)**	$1.3	--	--	**$1.3**	$14.7	$3.0	$1.4	**$19.1**	$26.0	$14.8	$2.2	**$43.0**	$42.3	$14.8	$2.2	**$59.4**	$41.1	$18.8	$20.8	**$81.0**	$44.5	$14.2	$20.7	**$81.0**
	Offshore Disposal (high end of range)	$3.6	--	--	**$3.6**	$39.3	$8.1	$3.7	**$51.0**	$69.2	$39.6	$5.8	**$114.6**	$112.9	$39.6	$5.8	**$158.3**	$109.5	$50.0	$55.4	**$216.0**	$118.7	$37.9	$55.2	**$216.0**
Option 6	**Beach Disposal (low end of range)**	$1.3	--	--	**$1.3**	$14.7	$3.0	$1.4	**$19.1**	$26.0	$14.8	$2.2	**$43.0**	$42.3	$14.8	$2.2	**$59.4**	$41.1	$18.8	$20.8	**$81.0**	$44.5	$14.2	$20.7	**$81.0**
	Beach Disposal (high end of range)	$2.7	--	--	**$2.7**	$29.5	$6.0	$2.8	**$38.3**	$51.9	$29.7	$4.3	**$86.0**	$84.7	$29.7	$4.3	**$118.7**	$82.1	$37.5	$41.5	**$162.0**	$89.1	$28.5	$41.4	**$162.0**
Grand Totals for Disposal Options																									
Option 1 / 2	**Unload Dredged Material at POLA / Disposal at CDF at POLA**	$5.4	--	--	**$5.4**	$57.3	$19.0	$4.7	**$81.0**	$95.3	$70.4	$7.4	**$173.0**	$150.7	$70.4	$7.4	**$228.4**	$140.9	$77.8	$71.2	**$290.3**	$155.0	$63.1	$71.2	**$290.7**
Option 3	**Beneficial Use - Landfill Cover**	$8.2	--	--	**$8.2**	$88.5	$25.4	$7.6	**$121.5**	$150.3	$101.8	$12.0	**$264.1**	$240.4	$101.8	$12.0	**$354.2**	$227.9	$117.6	$115.2	**$461.9**	$249.3	$93.2	$115.1	**$462.3**
Option 4	**Disposal at Hazardous Waste Landfill [3]**																								
Option 5	**Offshore Disposal (low end of range)**	$5.4	--	--	**$5.4**	$57.3	$19.0	$4.7	**$81.0**	$95.3	$70.4	$7.4	**$173.0**	$150.7	$70.4	$7.4	**$228.4**	$140.9	$77.8	$71.2	**$290.3**	$155.0	$63.1	$71.2	**$290.7**
	Offshore Disposal (high end of range)	$7.6	--	--	**$7.6**	$81.9	$24.0	$7.0	**$112.9**	$138.6	$95.1	$11.0	**$244.6**	$221.3	$95.1	$11.0	**$327.4**	$209.3	$109.1	$105.8	**$425.2**	$229.2	$86.8	$105.7	**$425.7**
Option 6	**Beach Disposal (low end of range)**	$5.4	--	--	**$5.4**	$57.3	$19.0	$4.7	**$81.0**	$95.3	$70.4	$7.4	**$173.0**	$150.7	$70.4	$7.4	**$228.4**	$140.9	$77.8	$71.2	**$290.3**	$155.0	$63.1	$71.2	**$290.7**
	Beach Disposal (high end of range)	$6.7	--	--	**$6.7**	$72.1	$22.0	$6.0	**$100.1**	$121.3	$85.2	$9.5	**$216.0**	$193.1	$85.2	$9.5	**$287.8**	$181.9	$96.6	$92.0	**$371.2**	$199.5	$77.3	$91.9	**$371.7**

Notes

1 - Estimated construction costs include a 35% contingency

2 - The cost estimate for phasing Alternative 5 is higher due to the construction of a temporary levee

3 - Estimate not included for Beneficial Use - Landfill Cover, contamintant report pending

Table D-4. Summary of Unit Costs and Cost Estimate Assuptions

Item	Description	Unit	Unit Cost	Notes
	Unit Costs			
	Mobilization			
1	Mobilization	LS		8% of subtotal used as a typical value. This value may be high.
	Demolition			
2	Demo culvert, daylight channel	LF	$1,000	
	Excavation	CY		Excavation of material only. Transportation included in Item 9.
3	Excavate to Marshplain	CY	$15	Excavate material from existing grade to marshplain elevation.
4	New Ballona Creek	CY	$15	Excavate material to create new Ballona Creek channel.
5	Channels Order 5	CY	$15	Excavate material to create large channels
6	Channels Order 4	CY	$15	Excavate material to create medium channels
7	Channels Order 3	CY	$15	Excavate material to create small channels
8	Breach	CY	$15	Excavate material to create breach
	Transportation	CY		Transportation of excavated material only. Placement of material in stockpile included in Item 12.
9	Onsite trucking	CY	$5	Truck transportation of excavated material to locations of fill and stockpile in each sub-area. Does not include transportation between sub-areas.
	New Levees	CY		
10	Levee Fill - no road	CY	$10	Levee construction using earth fill from material excavated onsite in each sub-area
11	Levee Fill - with road	CY	$17	Levee construction per above and paved roadway.
	Stockpile	CY		
12	Place material at stockpile	CY	$5	Placement of excavated material in excess of fill material in a stockpile in each sub-area. Excavation (Items 3-8) and transporation (Item 9) included separately.
	Levee Lowering and Ballona Creek Fill			
13	Levee Lowering	CY	$5	Excavation of earth material from existing levees along Ballona Creek. Removal and salvage of rip rap included in Item 15.
14	Ballona Creek Fill	CY	$5	Fill placement in existing Ballona Creek channel by sidecasting excavated material from levee lowering to fill Ballona Creek and using some excavated material (Items 2-8)
15	Salvage Rip Rap	CY	$10	Removal of rip-rap from existing levees
16	Buried rock protection	CY	$20	Assumes half the salvaged volume is used for protection and remainder is taken off-site for use by contractor
	Water Control Structures			
17	Culvert	SF	$2,010	New culvert
18	Tide Gate	LS	$100,000	New tide gate for culvert
	Subtotal			
	Contingency			35% contingency included for concept-level cost estimate.
	Total			
	Disposal Options - Cost Estimates from POLA / Weston and SCC			
1 / 2	**Unload Dredged Material at POLA / Disposal at CDF at POLA**			
	Mobilization	LS		8% of subtotal used as a typical value. This value may be high.
	Sediment Removal	CY	$3	From POLA / Weston
	Barge Sediment (approx. 30 NM)	CY	$4.50	From POLA / Weston
	Unload Dredged Material (hydraulic unloader) or Disposal at CDF	CY	$3	From POLA / Weston
	Subtotal			
	Contingency			35% contingency included for concept-level cost estimate.
	Total for Option 1			
3	**Beneficial Use - Landfill Cover**			
	Mobilization	LS		8% of subtotal used as a typical value. This value may be high.
	Sediment Removal	CY	$3	From POLA / Weston
	Barge Sediment (approx. 30 NM)	CY	$5	From POLA / Weston
	Stockpiling & Staging Material at POLA	CY	$1	From POLA / Weston
	Truck Material to Site (100 mi at $0.20/cy)	CY	$20	From POLA / Weston
	Placement, grading, compaction at Site	CY	$4.25	From POLA / Weston
	Subtotal			
	Contingency			35% contingency included for concept-level cost estimate.
	Total for Option 2			
4	**Disposal at Hazardous Waste Landfill - estimate not included, contamintant report pending**			
5	**Offshore Disposal** [1]			
	Mobilization	LS		8% of subtotal used as a typical value. This value may be high.
	Sediment Removal and Offshore Disposal (approx. 3 mi offshore)	CY	$28	Based on $28 per cubic meter cost from Upper Newport Bay project for dredging and disposal about three miles offshore provide by SCC
	Subtotal			
	Contingency			35% contingency included for concept-level cost estimate.
	Total for Option 3			
6	**Beach Disposal** [1]			
	Mobilization	LS		
	Sediment Removal and Beach Disposal	CY	$21	Based on cost for Option 1 / 2 with additional $10/CY premium for beach disposal
	Subtotal			
	Contingency			
	Total for Option 4			

Notes

1 - For Options 5 and 6, costs may range from the cost for Option 1 / 2 (lower end) up to the costs listed for Options 5 and 6 (upper end)

Alternative 1 Area A

Item	Description	Quantity	Unit	Unit Cost	Total Cost
	Mobilization				**$240,000**
1	Mobilization	1	LS	$240,000	$240,000
	Demolition				**$0**
2	Demo culvert, daylight chan	0	LF	$1,000	$0
	Excavation	**109,500**	CY		**$1,642,500**
3	Excavate to Marshplain	109,500	CY	$15	$1,642,500
4	New Ballona Creek	0	CY	$15	$0
5	Channels Order 5	0	CY	$15	$0
6	Channels Order 4	0	CY	$15	$0
7	Channels Order 3	0	CY	$15	$0
8	Breach	0	CY	$15	$0
	Transportation	**109,500**	CY		**$547,500**
9	Onsite trucking	109,500	CY	$5	$547,500
	New Levees	**0**	CY		**$0**
10	Levee Fill - no road	0	CY	$10	$0
11	Levee Fill - with road	0	CY	$17	$0
	Stockpile	**86,400**	CY		**$547,500**
12	Place material at stockpile	109,500	CY	$5	$547,500
	Levee Lowering and Ballona Creek Fill				**$0**
13	Levee Lowering	0	CY	$5	$0
14	Ballona Creek Fill	0	CY	$5	$0
15	Salvage Rip Rap	0	CY	$10	$0
16	Buried rock protection	0	CY	$20	$0
	Water Control Structures				**$0**
17	Culvert	0	SF	$2,010	$0
18	Tide Gate	0	LS	$100,000	$0
	Subtotal				**$2,977,500**
	Contingency	35%			**$1,042,200**
	Total				**$4,019,700**

Disposal Options - Cost Estimates from POLA / Weston and SCC

1 / 2	**Unload Dredged Material at POLA / Disposal at CDF at POLA**				
	Mobilization	1	LS	$79,000	$79,000
	Sediment Removal	86,400	CY	$3	$259,200
	Barge Sediment (approx. 30 NM)	86,400	CY	$4.50	$388,800
	Unload Dredged Material (hydraulic unloader) or Disposal at CDF	86,400	CY	$3	$259,200
	Subtotal				**$986,200**
	Contingency	35%			**$345,200**
	Total for Option 1				**$1,331,400**
3	**Beneficial Use - Landfill Cover**				
	Mobilization	1	LS	$247,000	$247,000
	Sediment Removal	86,400	CY	$3	$259,200
	Barge Sediment (approx. 30 NM)	86,400	CY	$4.50	$388,800
	Stockpiling & Staging Material at POLA	86,400	CY	$1	$86,400
	Truck Material to Site (100 mi at $0.20/cy)	86,400	CY	$20	$1,728,000
	Placement, grading, compaction at Site	86,400	CY	$4.25	$367,200
	Subtotal				**$3,076,600**
	Contingency	35%			**$1,076,900**
	Total for Option 2				**$4,153,500**
4	**Disposal at Hazardous Waste Landfill - estimate not included, contamintant report pending**				
5	**Offshore Disposal [1]**				
	Mobilization	1	LS	$211,000	$211,000
	Sediment Removal and Offshore Disposal (approx. 3 mi offshore)	86,400	CY	$28	$2,419,200
	Subtotal				**$2,630,200**
	Contingency	35%			**$920,600**
	Total for Option 3				**$3,550,800**
6	**Beach Disposal [1]**				
	Mobilization	1	LS	$158,000	$158,000
	Sediment Removal and Beach Disposal	86,400	CY	$21	$1,814,400
	Subtotal				**$1,972,400**
	Contingency	35%			**$690,300**
	Total for Option 4				**$2,662,700**

Grand Totals with Disposal Options

1 / 2	**Disposal at POLA**	**$5,351,100**
3	**Upland Disposal**	**$8,173,200**
5	**Offshore Disposal [1]**	**$7,570,500**
6	**Beach Disposal [1]**	**$6,682,400**

Notes

1 - For Options 5 and 6, costs may range from the cost for Option 1 / 2 (lower end) up to the costs listed for Options 5 and 6 (upper end)

Alternative 1 Area B

Item	Description	Quantity	Unit	Unit Cost	Total Cost
	Mobilization				**$160,000**
1	Mobilization	1	LS	$160,000	$160,000
	Demolition				**$1,400,000**
2	Demo culvert, daylight chan	1,400	LF	$1,000	$1,400,000
	Excavation	**0**	CY		**$0**
3	Excavate to Marshplain	0	CY	$15	$0
4	New Ballona Creek	0	CY	$15	$0
5	Channels Order 5	0	CY	$15	$0
6	Channels Order 4	0	CY	$15	$0
7	Channels Order 3	0	CY	$15	$0
8	Breach	0	CY	$15	$0
	Transportation	**23,100**	CY		**$115,500**
9	Onsite trucking	23,100	CY	$5	$115,500
	New Levees	**23,100**	CY		**$231,000**
10	Levee Fill - no road	23,100	CY	$10	$231,000
11	Levee Fill - with road	0	CY	$17	$0
	Stockpile	**0**	CY		**$0**
12	Place material at stockpile	0	CY	$5	$0
	Levee Lowering and Ballona Creek Fill				**$0**
13	Levee Lowering	0	CY	$5	$0
14	Ballona Creek Fill	0	CY	$5	$0
15	Salvage Rip Rap	0	CY	$10	$0
16	Buried rock protection	0	CY	$20	$0
	Water Control Structures				**$0**
17	Culvert	0	SF	$2,010	$0
18	Tide Gate	0	LS	$100,000	$0
	Subtotal				**$1,906,500**
	Contingency	35%			**$667,300**
	Total				**$2,573,800**

Disposal Options - Cost Estimates from POLA / Weston and SCC

1 / 2	**Unload Dredged Material at POLA / Disposal at CDF at POLA**				
	Mobilization	1	LS	$0	$0
	Sediment Removal	0	CY	$3	$0
	Barge Sediment (approx. 30 NM)	0	CY	$4.50	$0
	Unload Dredged Material (hydraulic unloader) or Disposal at CDF	0	CY	$3	$0
	Subtotal				**$0**
	Contingency	35%			**$0**
	Total for Option 1				**$0**
3	**Beneficial Use - Landfill Cover**				
	Mobilization	1	LS	$0	$0
	Sediment Removal	0	CY	$3	$0
	Barge Sediment (approx. 30 NM)	0	CY	$4.50	$0
	Stockpiling & Staging Material at POLA	0	CY	$1	$0
	Truck Material to Site (100 mi at $0.20/cy)	0	CY	$20	$0
	Placement, grading, compaction at Site	0	CY	$4.25	$0
	Subtotal				**$0**
	Contingency	35%			**$0**
	Total for Option 2				**$0**
4	**Disposal at Hazardous Waste Landfill - estimate not included, contamintant report pending**				
5	**Offshore Disposal [1]**				
	Mobilization	1	LS	$0	$0
	Sediment Removal and Offshore Disposal (approx. 3 mi offshore)	0	CY	$28	$0
	Subtotal				**$0**
	Contingency	35%			**$0**
	Total for Option 3				**$0**
6	**Beach Disposal [1]**				
	Mobilization	1	LS	$0	$0
	Sediment Removal and Beach Disposal	0	CY	$21	$0
	Subtotal				**$0**
	Contingency	35%			**$0**
	Total for Option 4				**$0**

Grand Totals with Disposal Options

1 / 2	**Disposal at POLA**	**$2,573,800**
3	**Upland Disposal**	**$2,573,800**
5	**Offshore Disposal [1]**	**$2,573,800**
6	**Beach Disposal [1]**	**$2,573,800**

Notes

1 - For Options 5 and 6, costs may range from the cost for Option 1 / 2 (lower end) up to the costs listed for Options 5 and 6 (upper end)

Alternative 2 Area A

Item	Description	Quantity	Unit	Unit Cost	Total Cost
	Mobilization				**$2,530,000**
1	Mobilization	1	LS	$2,530,000	$2,530,000
	Demolition				**$0**
2	Demo culvert, daylight chan	0	LF	$1,000	$0
	Excavation	**955,900**	CY		**$14,338,500**
3	Excavate to Marshplain	951,700	CY	$15	$14,275,500
4	New Ballona Creek	0	CY	$15	$0
5	Channels Order 5	0	CY	$15	$0
6	Channels Order 4	2,430	CY	$15	$36,450
7	Channels Order 3	1,770	CY	$15	$26,550
8	Breach	0	CY	$15	$0
	Transportation	**955,900**	CY		**$4,779,500**
9	Onsite trucking	955,900	CY	$5	$4,779,500
	New Levees	**0**	CY		**$0**
10	Levee Fill - no road	0	CY	$10	$0
11	Levee Fill - with road	0	CY	$17	$0
	Stockpile	**955,900**	CY		**$4,779,500**
12	Place material at stockpile	955,900	CY	$5	$4,779,500
	Levee Lowering and Ballona Creek Fill				**$0**
13	Levee Lowering	0	CY	$5	$0
14	Ballona Creek Fill	0	CY	$5	$0
15	Salvage Rip Rap	0	CY	$10	$0
16	Buried rock protection	0	CY	$20	$0
	Water Control Structures				**$5,125,000**
17	Culvert	2,500	SF	$2,010	$5,025,000
18	Tide Gate	1	LS	$100,000	$100,000
	Subtotal				**$31,552,500**
	Contingency	35%			**$11,043,400**
	Total				**$42,595,900**

Disposal Options - Cost Estimates from POLA / Weston and SCC

1 / 2	**Unload Dredged Material at POLA / Disposal at CDF at POLA**				
	Mobilization	1	LS	$873,000	$873,000
	Sediment Removal	955,900	CY	$3	$2,867,700
	Barge Sediment (approx. 30 NM)	955,900	CY	$4.50	$4,301,550
	Unload Dredged Material (hydraulic unloader) or Disposal at CDF	955,900	CY	$3	$2,867,700
	Subtotal				**$10,909,950**
	Contingency	35%			**$3,818,500**
	Total for Option 1				**$14,728,450**
3	**Beneficial Use - Landfill Cover**				
	Mobilization	1	LS	$2,723,000	$2,723,000
	Sediment Removal	955,900	CY	$3	$2,867,700
	Barge Sediment (approx. 30 NM)	955,900	CY	$4.50	$4,301,550
	Stockpiling & Staging Material at POLA	955,900	CY	$1	$955,900
	Truck Material to Site (100 mi at $0.20/cy)	955,900	CY	$20	$19,118,000
	Placement, grading, compaction at Site	955,900	CY	$4.25	$4,062,575
	Subtotal				**$34,028,725**
	Contingency	35%			**$11,910,100**
	Total for Option 2				**$45,938,825**
4	**Disposal at Hazardous Waste Landfill - estimate not included, contamintant report pending**				
5	**Offshore Disposal [1]**				
	Mobilization	1	LS	$2,328,000	$2,328,000
	Sediment Removal and Offshore Disposal (approx. 3 mi offshore)	955,900	CY	$28	$26,765,200
	Subtotal				**$29,093,200**
	Contingency	35%			**$10,182,700**
	Total for Option 3				**$39,275,900**
6	**Beach Disposal [1]**				
	Mobilization	1	LS	$1,746,000	$1,746,000
	Sediment Removal and Beach Disposal	955,900	CY	$21	$20,073,900
	Subtotal				**$21,819,900**
	Contingency	35%			**$7,637,000**
	Total for Option 4				**$29,456,900**

Grand Totals with Disposal Options

1 / 2	**Disposal at POLA**	**$57,324,350**
3	**Upland Disposal**	**$88,534,725**
5	**Offshore Disposal [1]**	**$81,871,800**
6	**Beach Disposal [1]**	**$72,052,800**

Notes

1 - For Options 5 and 6, costs may range from the cost for Option 1 / 2 (lower end) up to the costs listed for Options 5 and 6 (upper end)

Alternative 2 Area B

Item	Description	Quantity	Unit	Unit Cost	Total Cost
	Mobilization				**$950,000**
1	Mobilization	1	LS	$950,000	$950,000
	Demolition				**$1,400,000**
2	Demo culvert, daylight chan	1,400	LF	$1,000	$1,400,000
	Excavation	**277,970**	CY		**$4,169,550**
3	Excavate to Marshplain	274,400	CY	$15	$4,116,000
4	New Ballona Creek	0	CY	$15	$0
5	Channels Order 5	0	CY	$15	$0
6	Channels Order 4	2,040	CY	$15	$30,600
7	Channels Order 3	1,530	CY	$15	$22,950
8	Breach	0	CY	$15	$0
	Transportation	**277,970**	CY		**$1,389,850**
9	Onsite trucking	277,970	CY	$5	$1,389,850
	New Levees	**81,930**	CY		**$819,300**
10	Levee Fill - no road	81,930	CY	$10	$819,300
11	Levee Fill - with road	0	CY	$17	$0
	Stockpile	**196,040**	CY		**$980,200**
12	Place material at stockpile	196,040	CY	$5	$980,200
	Levee Lowering and Ballona Creek Fill				**$0**
13	Levee Lowering	0	CY	$5	$0
14	Ballona Creek Fill	0	CY	$5	$0
15	Salvage Rip Rap	0	CY	$10	$0
16	Buried rock protection	0	CY	$20	$0
	Water Control Structures				**$2,110,000**
17	Culvert	1,000	SF	$2,010	$2,010,000
18	Tide Gate	1	LS	$100,000	$100,000
	Subtotal				**$11,818,900**
	Contingency	35%			**$4,136,700**
	Total				**$15,955,600**

Disposal Options - Cost Estimates from POLA / Weston and SCC

1 / 2	**Unload Dredged Material at POLA / Disposal at CDF at POLA**				
	Mobilization	1	LS	$179,000	$179,000
	Sediment Removal	196,040	CY	$3	$588,120
	Barge Sediment (approx. 30 NM)	196,040	CY	$4.50	$882,180
	Unload Dredged Material (hydraulic unloader) or Disposal at CDF	196,040	CY	$3	$588,120
	Subtotal				**$2,237,420**
	Contingency	35%			**$783,100**
	Total for Option 1				**$3,020,520**
3	**Beneficial Use - Landfill Cover**				
	Mobilization	1	LS	$559,000	$559,000
	Sediment Removal	196,040	CY	$3	$588,120
	Barge Sediment (approx. 30 NM)	196,040	CY	$4.50	$882,180
	Stockpiling & Staging Material at POLA	196,040	CY	$1	$196,040
	Truck Material to Site (100 mi at $0.20/cy)	196,040	CY	$20	$3,920,800
	Placement, grading, compaction at Site	196,040	CY	$4.25	$833,170
	Subtotal				**$6,979,310**
	Contingency	35%			**$2,442,800**
	Total for Option 2				**$9,422,110**
4	**Disposal at Hazardous Waste Landfill - estimate not included, contamintant report pending**				
5	**Offshore Disposal [1]**				
	Mobilization	1	LS	$478,000	$478,000
	Sediment Removal and Offshore Disposal (approx. 3 mi offshore)	196,040	CY	$28	$5,489,120
	Subtotal				**$5,967,120**
	Contingency	35%			**$2,088,500**
	Total for Option 3				**$8,055,620**
6	**Beach Disposal [1]**				
	Mobilization	1	LS	$358,000	$358,000
	Sediment Removal and Beach Disposal	196,040	CY	$21	$4,116,840
	Subtotal				**$4,474,840**
	Contingency	35%			**$1,566,200**
	Total for Option 4				**$6,041,040**

Grand Totals with Disposal Options

1 / 2	**Disposal at POLA**	**$18,976,120**
3	**Upland Disposal**	**$25,377,710**
5	**Offshore Disposal [1]**	**$24,011,220**
6	**Beach Disposal [1]**	**$21,996,640**

Notes

1 - For Options 5 and 6, costs may range from the cost for Option 1 / 2 (lower end) up to the costs listed for Options 5 and 6 (upper end)

Alternative 2 Area C

Item	Description	Quantity	Unit	Unit Cost	Total Cost
	Mobilization				**$200,000**
1	Mobilization	1	LS	$200,000	$200,000
	Demolition				**$0**
2	Demo culvert, daylight chan	0	LF	$1,000	$0
	Excavation	**89,500**	CY		**$1,342,500**
3	Excavate to Marshplain	89,500	CY	$15	$1,342,500
4	New Ballona Creek	0	CY	$15	$0
5	Channels Order 5	0	CY	$15	$0
6	Channels Order 4	0	CY	$15	$0
7	Channels Order 3	0	CY	$15	$0
8	Breach	0	CY	$15	$0
	Transportation	**89,500**	CY		**$447,500**
9	Onsite trucking	89,500	CY	$5	$447,500
	New Levees	**0**	CY		**$0**
10	Levee Fill - no road	0	CY	$10	$0
11	Levee Fill - with road	0	CY	$17	$0
	Stockpile	**89,500**	CY		**$447,500**
12	Place material at stockpile	89,500	CY	$5	$447,500
	Levee Lowering and Ballona Creek Fill				**$0**
13	Levee Lowering	0	CY	$5	$0
14	Ballona Creek Fill	0	CY	$5	$0
15	Salvage Rip Rap	0	CY	$10	$0
16	Buried rock protection	0	CY	$20	$0
	Water Control Structures				**$0**
17	Culvert	0	SF	$2,010	$0
18	Tide Gate	0	LS	$100,000	$0
	Subtotal				**$2,437,500**
	Contingency	35%			**$853,200**
	Total				**$3,290,700**

Disposal Options - Cost Estimates from POLA / Weston and SCC

1 / 2	**Unload Dredged Material at POLA / Disposal at CDF at POLA**				
	Mobilization	1	LS	$82,000	$82,000
	Sediment Removal	89,500	CY	$3	$268,500
	Barge Sediment (approx. 30 NM)	89,500	CY	$4.50	$402,750
	Unload Dredged Material (hydraulic unloader) or Disposal at CDF	89,500	CY	$3	$268,500
	Subtotal				**$1,021,750**
	Contingency	35%			**$357,700**
	Total for Option 1				**$1,379,450**
3	**Beneficial Use - Landfill Cover**				
	Mobilization	1	LS	$255,000	$255,000
	Sediment Removal	89,500	CY	$3	$268,500
	Barge Sediment (approx. 30 NM)	89,500	CY	$4.50	$402,750
	Stockpiling & Staging Material at POLA	89,500	CY	$1	$89,500
	Truck Material to Site (100 mi at $0.20/cy)	89,500	CY	$20	$1,790,000
	Placement, grading, compaction at Site	89,500	CY	$4.25	$380,375
	Subtotal				**$3,186,125**
	Contingency	35%			**$1,115,200**
	Total for Option 2				**$4,301,325**
4	**Disposal at Hazardous Waste Landfill - estimate not included, contamintant report pending**				
5	**Offshore Disposal [1]**				
	Mobilization	1	LS	$218,000	$218,000
	Sediment Removal and Offshore Disposal (approx. 3 mi offshore)	89,500	CY	$28	$2,506,000
	Subtotal				**$2,724,000**
	Contingency	35%			**$953,400**
	Total for Option 3				**$3,677,400**
6	**Beach Disposal [1]**				
	Mobilization	1	LS	$164,000	$164,000
	Sediment Removal and Beach Disposal	89,500	CY	$21	$1,879,500
	Subtotal				**$2,043,500**
	Contingency	35%			**$715,200**
	Total for Option 4				**$2,758,700**

Grand Totals with Disposal Options

1 / 2	**Disposal at POLA**	**$4,670,150**
3	**Upland Disposal**	**$7,592,025**
5	**Offshore Disposal [1]**	**$6,968,100**
6	**Beach Disposal [1]**	**$6,049,400**

Notes

1 - For Options 5 and 6, costs may range from the cost for Option 1 / 2 (lower end) up to the costs listed for Options 5 and 6 (upper end)

Alternative 3 Area A

Item	Description	Quantity	Unit	Unit Cost	Total Cost
	Mobilization				**$4,110,000**
1	Mobilization	1	LS	$4,110,000	$4,110,000
	Demolition				**$0**
2	Demo culvert, daylight chan	0	LF	$1,000	$0
	Excavation	**1,684,880**	CY		**$25,273,200**
3	Excavate to Marshplain	1,673,700	CY	$15	$25,105,500
4	New Ballona Creek	0	CY	$15	$0
5	Channels Order 5	3,540	CY	$15	$53,100
6	Channels Order 4	4,240	CY	$15	$63,600
7	Channels Order 3	3,400	CY	$15	$51,000
8	Breach	0	CY	$15	$0
	Transportation	**1,684,880**	CY		**$8,424,400**
9	Onsite trucking	1,684,880	CY	$5	$8,424,400
	New Levees	**0**	CY		**$0**
10	Levee Fill - no road	0	CY	$10	$0
11	Levee Fill - with road	0	CY	$17	$0
	Stockpile	**1,684,880**	CY		**$8,424,400**
12	Stockpile	1,684,880	CY	$5	$8,424,400
	Levee Lowering and Ballona Creek Fill				**$0**
13	Levee Lowering	0	CY	$5	$0
14	Ballona Creek Fill	0	CY	$5	$0
15	Salvage Rip Rap	0	CY	$10	$0
16	Buried rock protection	0	CY	$20	$0
	Water Control Structures				**$5,125,000**
17	Culvert	2,500	SF	$2,010	$5,025,000
18	Tide Gate	1	LS	$100,000	$100,000
	Subtotal				**$51,357,000**
	Contingency	35%			**$17,975,000**
	Total				**$69,332,000**

Disposal Options - Cost Estimates from POLA / Weston and SCC

1 / 2	**Unload Dredged Material at POLA / Disposal at CDF at POLA**				
	Mobilization	1	LS	$1,539,000	$1,539,000
	Sediment Removal	1,684,880	CY	$3	$5,054,640
	Barge Sediment (approx. 30 NM)	1,684,880	CY	$4.50	$7,581,960
	Unload Dredged Material (hydraulic unloader) or Disposal at CDF	1,684,880	CY	$3	$5,054,640
	Subtotal				**$19,230,240**
	Contingency	35%			**$6,730,600**
	Total for Option 1				**$25,960,840**
3	**Beneficial Use - Landfill Cover**				
	Mobilization	1	LS	$4,799,000	$4,799,000
	Sediment Removal	1,684,880	CY	$3	$5,054,640
	Barge Sediment (approx. 30 NM)	1,684,880	CY	$4.50	$7,581,960
	Stockpiling & Staging Material at POLA	1,684,880	CY	$1	$1,684,880
	Truck Material to Site (100 mi at $0.20/cy)	1,684,880	CY	$20	$33,697,600
	Placement, grading, compaction at Site	1,684,880	CY	$4.25	$7,160,740
	Subtotal				**$59,978,820**
	Contingency	35%			**$20,992,600**
	Total for Option 2				**$80,971,420**
4	**Disposal at Hazardous Waste Landfill - estimate not included, contamintant report pending**				
5	**Offshore Disposal [1]**				
	Mobilization	1	LS	$4,103,000	$4,103,000
	Sediment Removal and Offshore Disposal (approx. 3 mi offshore)	1,684,880	CY	$28	$47,176,640
	Subtotal				**$51,279,640**
	Contingency	35%			**$17,947,900**
	Total for Option 3				**$69,227,540**
6	**Beach Disposal [1]**				
	Mobilization	1	LS	$3,077,000	$3,077,000
	Sediment Removal and Beach Disposal	1,684,880	CY	$21	$35,382,480
	Subtotal				**$38,459,480**
	Contingency	35%			**$13,460,800**
	Total for Option 4				**$51,920,280**

Grand Totals with Disposal Options

1 / 2	**Disposal at POLA**	**$95,292,840**
3	**Upland Disposal**	**$150,303,420**
5	**Offshore Disposal [1]**	**$138,559,540**
6	**Beach Disposal [1]**	**$121,252,280**

Notes

1 - For Options 5 and 6, costs may range from the cost for Option 1 / 2 (lower end) up to the costs listed for Options 5 and 6 (upper end)

Alternative 3 Area B

Item	Description	Quantity	Unit	Unit Cost	Total Cost
	Mobilization				**$3,290,000**
1	Mobilization	1	LS	$3,290,000	$3,290,000
	Demolition				**$1,400,000**
2	Demo culvert, daylight chan	1,400	LF	$1,000	$1,400,000
	Excavation	**1,259,910**	CY		**$18,898,650**
3	Excavate to Marshplain	1,229,400	CY	$15	$18,441,000
4	New Ballona Creek	0	CY	$15	$0
5	Channels Order 5	5,560	CY	$15	$83,400
6	Channels Order 4	9,390	CY	$15	$140,850
7	Channels Order 3	8,180	CY	$15	$122,700
8	Breach	7,380	CY	$15	$110,700
	Transportation	**1,252,530**	CY		**$6,262,650**
9	Onsite trucking	1,252,530	CY	$5	$6,262,650
	New Levees	**288,830**	CY		**$4,336,600**
10	Levee Fill - no road	81,930	CY	$10	$819,300
11	Levee Fill - with road	206,900	CY	$17	$3,517,300
	Stockpile	**963,700**	CY		**$4,818,500**
12	Stockpile	963,700	CY	$5	$4,818,500
	Levee Lowering and Ballona Creek Fill				**$0**
13	Levee Lowering	0	CY	$5	$0
14	Ballona Creek Fill	0	CY	$5	$0
15	Salvage Rip Rap	0	CY	$10	$0
16	Buried rock protection	0	CY	$20	$0
	Water Control Structures				**$2,110,000**
17	Culvert	1,000	SF	$2,010	$2,010,000
18	Tide Gate	1	LS	$100,000	$100,000
	Subtotal				**$41,116,400**
	Contingency	35%			**$14,390,800**
	Total				**$55,507,200**

Disposal Options - Cost Estimates from POLA / Weston and SCC

1 / 2	**Unload Dredged Material at POLA / Disposal at CDF at POLA**				
	Mobilization	1	LS	$880,000	$880,000
	Sediment Removal	963,700	CY	$3	$2,891,100
	Barge Sediment (approx. 30 NM)	963,700	CY	$4.50	$4,336,650
	Unload Dredged Material (hydraulic unloader) or Disposal at CDF	963,700	CY	$3	$2,891,100
	Subtotal				**$10,998,850**
	Contingency	35%			**$3,849,600**
	Total for Option 1				**$14,848,450**
3	**Beneficial Use - Landfill Cover**				
	Mobilization	1	LS	$2,745,000	$2,745,000
	Sediment Removal	963,700	CY	$3	$2,891,100
	Barge Sediment (approx. 30 NM)	963,700	CY	$4.50	$4,336,650
	Stockpiling & Staging Material at POLA	963,700	CY	$1	$963,700
	Truck Material to Site (100 mi at $0.20/cy)	963,700	CY	$20	$19,274,000
	Placement, grading, compaction at Site	963,700	CY	$4.25	$4,095,725
	Subtotal				**$34,306,175**
	Contingency	35%			**$12,007,200**
	Total for Option 2				**$46,313,375**
4	**Disposal at Hazardous Waste Landfill - estimate not included, contamintant report pending**				
5	**Offshore Disposal [1]**				
	Mobilization	1	LS	$2,347,000	$2,347,000
	Sediment Removal and Offshore Disposal (approx. 3 mi offshore)	963,700	CY	$28	$26,983,600
	Subtotal				**$29,330,600**
	Contingency	35%			**$10,265,800**
	Total for Option 3				**$39,596,400**
6	**Beach Disposal [1]**				
	Mobilization	1	LS	$1,760,000	$1,760,000
	Sediment Removal and Beach Disposal	963,700	CY	$21	$20,237,700
	Subtotal				**$21,997,700**
	Contingency	35%			**$7,699,200**
	Total for Option 4				**$29,696,900**

Grand Totals with Disposal Options

1 / 2	**Disposal at POLA**	**$70,355,650**
3	**Upland Disposal**	**$101,820,575**
5	**Offshore Disposal [1]**	**$95,103,600**
6	**Beach Disposal [1]**	**$85,204,100**

Notes

1 - For Options 5 and 6, costs may range from the cost for Option 1 / 2 (lower end) up to the costs listed for Options 5 and 6 (upper end)

Alternative 3 Area C

Item	Description	Quantity	Unit	Unit Cost	Total Cost
	Mobilization				**$310,000**
1	Mobilization	1	LS	$310,000	$310,000
	Demolition				**$0**
2	Demo culvert, daylight ch	0	LF	$1,000	$0
	Excavation	**141,000**	CY		**$2,115,000**
3	Excavate to Marshplain	141,000	CY	$15	$2,115,000
4	New Ballona Creek	0	CY	$15	$0
5	Channels Order 5	0	CY	$15	$0
6	Channels Order 4	0	CY	$15	$0
7	Channels Order 3	0	CY	$15	$0
8	Breach	0	CY	$15	$0
	Transportation	**141,000**	CY		**$705,000**
9	Onsite trucking	141,000	CY	$5	$705,000
	New Levees	**0**	CY		**$0**
10	Levee Fill - no road	0	CY	$10	$0
11	Levee Fill - with road	0	CY	$17	$0
	Stockpile	**141,000**	CY		**$705,000**
12	Stockpile	141,000	CY	$5	$705,000
	Levee Lowering and Ballona Creek Fill				**$0**
13	Levee Lowering	0	CY	$5	$0
14	Ballona Creek Fill	0	CY	$5	$0
15	Salvage Rip Rap	0	CY	$10	$0
16	Buried rock protection	0	CY	$20	$0
	Water Control Structures				**$0**
17	Culvert	0	SF	$2,010	$0
18	Tide Gate	0	LS	$100,000	$0
	Subtotal				**$3,835,000**
	Contingency	35%			**$1,342,300**
	Total				**$5,177,300**

Disposal Options - Cost Estimates from POLA / Weston and SCC

1 / 2	**Unload Dredged Material at POLA / Disposal at CDF at POLA**				
	Mobilization	1	LS	$129,000	$129,000
	Sediment Removal	141,000	CY	$3	$423,000
	Barge Sediment (approx. 30 NM)	141,000	CY	$4.50	$634,500
	Unload Dredged Material (hydraulic unloader) or Disposal at CDF	141,000	CY	$3	$423,000
	Subtotal				**$1,609,500**
	Contingency	35%			**$563,400**
	Total for Option 1				**$2,172,900**
3	**Beneficial Use - Landfill Cover**				
	Mobilization	1	LS	$402,000	$402,000
	Sediment Removal	141,000	CY	$3	$423,000
	Barge Sediment (approx. 30 NM)	141,000	CY	$4.50	$634,500
	Stockpiling & Staging Material at POLA	141,000	CY	$1	$141,000
	Truck Material to Site (100 mi at $0.20/cy)	141,000	CY	$20	$2,820,000
	Placement, grading, compaction at Site	141,000	CY	$4.25	$599,250
	Subtotal				**$5,019,750**
	Contingency	35%			**$1,757,000**
	Total for Option 2				**$6,776,750**
4	**Disposal at Hazardous Waste Landfill - estimate not included, contamintant report pending**				
5	**Offshore Disposal [1]**				
	Mobilization	1	LS	$344,000	$344,000
	Sediment Removal and Offshore Disposal (approx. 3 mi offshore)	141,000	CY	$28	$3,948,000
	Subtotal				**$4,292,000**
	Contingency	35%			**$1,502,200**
	Total for Option 3				**$5,794,200**
6	**Beach Disposal [1]**				
	Mobilization	1	LS	$258,000	$258,000
	Sediment Removal and Beach Disposal	141,000	CY	$21	$2,961,000
	Subtotal				**$3,219,000**
	Contingency	35%			**$1,126,700**
	Total for Option 4				**$4,345,700**

Grand Totals with Disposal Options

1 / 2	**Disposal at POLA**	**$7,350,200**
3	**Upland Disposal**	**$11,954,050**
5	**Offshore Disposal [1]**	**$10,971,500**
6	**Beach Disposal [1]**	**$9,523,000**

Notes

1 - For Options 5 and 6, costs may range from the cost for Option 1 / 2 (lower end) up to the costs listed for Options 5 and 6 (upper end)

Alternative 4 Area A

Item	Description	Quantity	Unit	Unit Cost	Total Cost
	Mobilization				**$6,430,000**
1	Mobilization	1	LS	$6,430,000	$6,430,000
	Demolition				**$0**
2	Demo culvert, daylight chan	0	LF	$1,000	$0
	Excavation	**2,748,440**	CY		**$41,226,600**
3	Excavate to Marshplain	2,748,000	CY	$15	$41,220,000
4	New Ballona Creek	0	CY	$15	$0
5	Channels Order 5	0	CY	$15	$0
6	Channels Order 4	0	CY	$15	$0
7	Channels Order 3	440	CY	$15	$6,600
8	Breach	0	CY	$15	$0
	Transportation	**2,748,440**	CY		**$13,742,200**
9	Onsite trucking	2,748,440	CY	$5	$13,742,200
	New Levees	**0**	CY		**$0**
10	Levee Fill - no road	0	CY	$10	$0
11	Levee Fill - with road	0	CY	$17	$0
	Stockpile	**2,748,440**	CY		**$13,742,200**
12	Stockpile	2,748,440	CY	$5	$13,742,200
	Levee Lowering and Ballona Creek Fill				**$0**
13	Levee Lowering	0	CY	$5	$0
14	Ballona Creek Fill	0	CY	$5	$0
15	Salvage Rip Rap	0	CY	$10	$0
16	Buried rock protection	0	CY	$20	$0
	Water Control Structures				**$5,125,000**
17	Culvert	2,500	SF	$2,010	$5,025,000
18	Tide Gate	1	LS	$100,000	$100,000
	Subtotal				**$80,266,000**
	Contingency	35%			**$28,093,100**
	Total				**$108,359,100**

Disposal Options - Cost Estimates from POLA / Weston and SCC

1 / 2	**Unload Dredged Material at POLA / Disposal at CDF at POLA**				
	Mobilization	1	LS	$2,510,000	$2,510,000
	Sediment Removal	2,748,440	CY	$3	$8,245,320
	Barge Sediment (approx. 30 NM)	2,748,440	CY	$4.50	$12,367,980
	Unload Dredged Material (hydraulic unloader) or Disposal at CDF	2,748,440	CY	$3	$8,245,320
	Subtotal				**$31,368,620**
	Contingency	35%			**$10,979,100**
	Total for Option 1				**$42,347,720**
3	**Beneficial Use - Landfill Cover**				
	Mobilization	1	LS	$7,828,000	$7,828,000
	Sediment Removal	2,748,440	CY	$3	$8,245,320
	Barge Sediment (approx. 30 NM)	2,748,440	CY	$4.50	$12,367,980
	Stockpiling & Staging Material at POLA	2,748,440	CY	$1	$2,748,440
	Truck Material to Site (100 mi at $0.20/cy)	2,748,440	CY	$20	$54,968,800
	Placement, grading, compaction at Site	2,748,440	CY	$4.25	$11,680,870
	Subtotal				**$97,839,410**
	Contingency	35%			**$34,243,800**
	Total for Option 2				**$132,083,210**
4	**Disposal at Hazardous Waste Landfill - estimate not included, contamintant report pending**				
5	**Offshore Disposal [1]**				
	Mobilization	1	LS	$6,692,000	$6,692,000
	Sediment Removal and Offshore Disposal (approx. 3 mi offshore)	2,748,440	CY	$28	$76,956,320
	Subtotal				**$83,648,320**
	Contingency	35%			**$29,277,000**
	Total for Option 3				**$112,925,320**
6	**Beach Disposal [1]**				
	Mobilization	1	LS	$5,019,000	$5,019,000
	Sediment Removal and Beach Disposal	2,748,440	CY	$21	$57,717,240
	Subtotal				**$62,736,240**
	Contingency	35%			**$21,957,700**
	Total for Option 4				**$84,693,940**

Grand Totals with Disposal Options

1 / 2	**Disposal at POLA**	**$150,706,820**
3	**Upland Disposal**	**$240,442,310**
5	**Offshore Disposal [1]**	**$221,284,420**
6	**Beach Disposal [1]**	**$193,053,040**

Notes

1 - For Options 5 and 6, costs may range from the cost for Option 1 / 2 (lower end) up to the costs listed for Options 5 and 6 (upper end)

Alternative 4 Area B

Item	Description	Quantity	Unit	Unit Cost	Total Cost
	Mobilization				**$3,290,000**
1	Mobilization	1	LS	$3,290,000	$3,290,000
	Demolition				**$1,400,000**
2	Demo culvert, daylight chan	1,400	LF	$1,000	$1,400,000
	Excavation	**1,259,910**	CY		**$18,898,650**
3	Excavate to Marshplain	1,229,400	CY	$15	$18,441,000
4	New Ballona Creek	0	CY	$15	$0
5	Channels Order 5	5,560	CY	$15	$83,400
6	Channels Order 4	9,390	CY	$15	$140,850
7	Channels Order 3	8,180	CY	$15	$122,700
8	Breach	7,380	CY	$15	$110,700
	Transportation	**1,252,530**	CY		**$6,262,650**
9	Onsite trucking	1,252,530	CY	$5	$6,262,650
	New Levees	**288,830**	CY		**$4,336,600**
10	Levee Fill - no road	81,930	CY	$10	$819,300
11	Levee Fill - with road	206,900	CY	$17	$3,517,300
	Stockpile	**963,700**	CY		**$4,818,500**
12	Stockpile	963,700	CY	$5	$4,818,500
	Levee Lowering and Ballona Creek Fill				**$0**
13	Levee Lowering	0	CY	$5	$0
14	Ballona Creek Fill	0	CY	$5	$0
15	Salvage Rip Rap	0	CY	$10	$0
16	Buried rock protection	0	CY	$20	$0
	Water Control Structures				**$2,110,000**
17	Culvert	1,000	SF	$2,010	$2,010,000
18	Tide Gate	1	LS	$100,000	$100,000
	Subtotal				**$41,116,400**
	Contingency	35%			**$14,390,800**
	Total				**$55,507,200**

Disposal Options - Cost Estimates from POLA / Weston and SCC

1 / 2	**Unload Dredged Material at POLA / Disposal at CDF at POLA**				
	Mobilization	1	LS	$880,000	$880,000
	Sediment Removal	963,700	CY	$3	$2,891,100
	Barge Sediment (approx. 30 NM)	963,700	CY	$4.50	$4,336,650
	Unload Dredged Material (hydraulic unloader) or Disposal at CDF	963,700	CY	$3	$2,891,100
	Subtotal				**$10,998,850**
	Contingency	35%			**$3,849,600**
	Total for Option 1				**$14,848,450**
3	**Beneficial Use - Landfill Cover**				
	Mobilization	1	LS	$2,745,000	$2,745,000
	Sediment Removal	963,700	CY	$3	$2,891,100
	Barge Sediment (approx. 30 NM)	963,700	CY	$4.50	$4,336,650
	Stockpiling & Staging Material at POLA	963,700	CY	$1	$963,700
	Truck Material to Site (100 mi at $0.20/cy)	963,700	CY	$20	$19,274,000
	Placement, grading, compaction at Site	963,700	CY	$4.25	$4,095,725
	Subtotal				**$34,306,175**
	Contingency	35%			**$12,007,200**
	Total for Option 2				**$46,313,375**
4	**Disposal at Hazardous Waste Landfill - estimate not included, contamintant report pending**				
5	**Offshore Disposal [1]**				
	Mobilization	1	LS	$2,347,000	$2,347,000
	Sediment Removal and Offshore Disposal (approx. 3 mi offshore)	963,700	CY	$28	$26,983,600
	Subtotal				**$29,330,600**
	Contingency	35%			**$10,265,800**
	Total for Option 3				**$39,596,400**
6	**Beach Disposal [1]**				
	Mobilization	1	LS	$1,760,000	$1,760,000
	Sediment Removal and Beach Disposal	963,700	CY	$21	$20,237,700
	Subtotal				**$21,997,700**
	Contingency	35%			**$7,699,200**
	Total for Option 4				**$29,696,900**

Grand Totals with Disposal Options

1 / 2	**Disposal at POLA**	**$70,355,650**
3	**Upland Disposal**	**$101,820,575**
5	**Offshore Disposal [1]**	**$95,103,600**
6	**Beach Disposal [1]**	**$85,204,100**

Notes

1 - For Options 5 and 6, costs may range from the cost for Option 1 / 2 (lower end) up to the costs listed for Options 5 and 6 (upper end)

Alternative 4 Area C

Item	Description	Quantity	Unit	Unit Cost	Total Cost
	Mobilization				**$310,000**
1	Mobilization	1	LS	$310,000	$310,000
	Demolition				**$0**
2	Demo culvert, daylight cl	0	LF	$1,000	$0
	Excavation	**141,000**	CY		**$2,115,000**
3	Excavate to Marshplain	141,000	CY	$15	$2,115,000
4	New Ballona Creek	0	CY	$15	$0
5	Channels Order 5	0	CY	$15	$0
6	Channels Order 4	0	CY	$15	$0
7	Channels Order 3	0	CY	$15	$0
8	Breach	0	CY	$15	$0
	Transportation	**141,000**	CY		**$705,000**
9	Onsite trucking	141,000	CY	$5	$705,000
	New Levees	**0**	CY		**$0**
10	Levee Fill - no road	0	CY	$10	$0
11	Levee Fill - with road	0	CY	$17	$0
	Stockpile	**141,000**	CY		**$705,000**
12	Stockpile	141,000	CY	$5	$705,000
	Levee Lowering and Ballona Creek Fill				**$0**
13	Levee Lowering	0	CY	$5	$0
14	Ballona Creek Fill	0	CY	$5	$0
15	Salvage Rip Rap	0	CY	$10	$0
16	Buried rock protection	0	CY	$20	$0
	Water Control Structures				**$0**
17	Culvert	0	SF	$2,010	$0
18	Tide Gate	0	LS	$100,000	$0
	Subtotal				**$3,835,000**
	Contingency	35%			**$1,342,300**
	Total				**$5,177,300**

Disposal Options - Cost Estimates from POLA / Weston and SCC

1 / 2	**Unload Dredged Material at POLA / Disposal at CDF at POLA**				
	Mobilization	1	LS	$129,000	$129,000
	Sediment Removal	141,000	CY	$3	$423,000
	Barge Sediment (approx. 30 NM)	141,000	CY	$4.50	$634,500
	Material (hydraulic unloader) or Disposal at CDF	141,000	CY	$3	$423,000
	Subtotal				**$1,609,500**
	Contingency	35%			**$563,400**
	Total for Option 1				**$2,172,900**
3	**Beneficial Use - Landfill Cover**				
	Mobilization	1	LS	$402,000	$402,000
	Sediment Removal	141,000	CY	$3	$423,000
	Barge Sediment (approx. 30 NM)	141,000	CY	$4.50	$634,500
	Stockpiling & Staging Material at POLA	141,000	CY	$1	$141,000
	Truck Material to Site (100 mi at $0.20/cy)	141,000	CY	$20	$2,820,000
	Placement, grading, compaction at Site	141,000	CY	$4.25	$599,250
	Subtotal				**$5,019,750**
	Contingency	35%			**$1,757,000**
	Total for Option 2				**$6,776,750**
4	**Disposal at Hazardous Waste Landfill - estimate not included, contamintant report pending**				
5	**Offshore Disposal [1]**				
	Mobilization	1	LS	$344,000	$344,000
	Sediment Removal and Offshore Disposal (approx. 3 mi offshore)	141,000	CY	$28	$3,948,000
	Subtotal				**$4,292,000**
	Contingency	35%			**$1,502,200**
	Total for Option 3				**$5,794,200**
6	**Beach Disposal [1]**				
	Mobilization	1	LS	$258,000	$258,000
	Sediment Removal and Beach Disposal	141,000	CY	$21	$2,961,000
	Subtotal				**$3,219,000**
	Contingency	35%			**$1,126,700**
	Total for Option 4				**$4,345,700**

Grand Totals with Disposal Options

1 / 2	**Disposal at POLA**	**$7,350,200**
3	**Upland Disposal**	**$11,954,050**
5	**Offshore Disposal [1]**	**$10,971,500**
6	**Beach Disposal [1]**	**$9,523,000**

Notes

1 - For Options 5 and 6, costs may range from the cost for Option 1 / 2 (lower end) up to the costs listed for Options 5 and 6 (upper end)

Alternative 5 Area A

Item	Description	Quantity	Unit	Unit Cost	Total Cost
	Mobilization				**$5,920,000**
1	Mobilization	1	LS	$5,920,000	$5,920,000
	Demolition				**$0**
2	Demo culvert, daylight chan	0	LF	$1,000	$0
	Excavation	**2,674,100**	CY		**$40,111,500**
3	Excavate to Marshplain	2,649,400	CY	$15	$39,741,000
4	New Ballona Creek	16,500	CY	$15	$247,500
5	Channels Order 5	1,200	CY	$15	$18,000
6	Channels Order 4	3,300	CY	$15	$49,500
7	Channels Order 3	3,700	CY	$15	$55,500
8	Breach	0	CY	$15	$0
	Transportation	**2,674,100**	CY		**$13,370,500**
9	Onsite trucking	2,674,100	CY	$5	$13,370,500
	New Levees	**0**	CY		**$0**
10	Levee Fill - no road	0	CY	$10	$0
11	Levee Fill - with road	0	CY	$17	$0
	Stockpile	**2,665,700**	CY		**$13,328,500**
12	Stockpile	2,665,700	CY	$5	$13,328,500
	Levee Lowering and Ballona Creek Fill				**$1,189,400**
13	Levee Lowering	85,700	CY	$5	$428,500
14	Ballona Creek Fill	94,100	CY	$5	$470,500
15	Salvage Rip Rap	14,520	CY	$10	$145,200
16	Buried rock protection	7,260	CY	$20	$145,200
	Water Control Structures				**$0**
17	Culvert	0	SF	$2,010	$0
18	Tide Gate	0	LS	$100,000	$0
	Subtotal				**$73,919,900**
	Contingency	35%			**$25,872,000**
	Total				**$99,791,900**

Disposal Options - Cost Estimates from POLA / Weston and SCC

1 / 2	**Unload Dredged Material at POLA / Disposal at CDF at POLA**				
	Mobilization	1	LS	$2,434,000	$2,434,000
	Sediment Removal	2,665,700	CY	$3	$7,997,100
	Barge Sediment (approx. 30 NM)	2,665,700	CY	$4.50	$11,995,650
	Unload Dredged Material (hydraulic unloader) or Disposal at CDF	2,665,700	CY	$3	$7,997,100
	Subtotal				**$30,423,850**
	Contingency	35%			**$10,648,400**
	Total for Option 1				**$41,072,250**
3	**Beneficial Use - Landfill Cover**				
	Mobilization	1	LS	$7,592,000	$7,592,000
	Sediment Removal	2,665,700	CY	$3	$7,997,100
	Barge Sediment (approx. 30 NM)	2,665,700	CY	$4.50	$11,995,650
	Stockpiling & Staging Material at POLA	2,665,700	CY	$1	$2,665,700
	Truck Material to Site (100 mi at $0.20/cy)	2,665,700	CY	$20	$53,314,000
	Placement, grading, compaction at Site	2,665,700	CY	$4.25	$11,329,225
	Subtotal				**$94,893,675**
	Contingency	35%			**$33,212,800**
	Total for Option 2				**$128,106,475**
4	**Disposal at Hazardous Waste Landfill - estimate not included, contamintant report pending**				
5	**Offshore Disposal [1]**				
	Mobilization	1	LS	$6,491,000	$6,491,000
	Sediment Removal and Offshore Disposal (approx. 3 mi offshore)	2,665,700	CY	$28	$74,639,600
	Subtotal				**$81,130,600**
	Contingency	35%			**$28,395,800**
	Total for Option 3				**$109,526,400**
6	**Beach Disposal [1]**				
	Mobilization	1	LS	$4,868,000	$4,868,000
	Sediment Removal and Beach Disposal	2,665,700	CY	$21	$55,979,700
	Subtotal				**$60,847,700**
	Contingency	35%			**$21,296,700**
	Total for Option 4				**$82,144,400**

Grand Totals with Disposal Options

1 / 2	**Disposal at POLA**	**$140,864,150**
3	**Upland Disposal**	**$227,898,375**
5	**Offshore Disposal [1]**	**$209,318,300**
6	**Beach Disposal [1]**	**$181,936,300**

Notes

1 - For Options 5 and 6, costs may range from the cost for Option 1 / 2 (lower end) up to the costs listed for Options 5 and 6 (upper end)

Alternative 5 Area B

Item	Description	Quantity	Unit	Unit Cost	Total Cost
	Mobilization				**$3,500,000**
1	Mobilization	1	LS	$3,500,000	$3,500,000
	Demolition				**$0**
2	Demo culvert, daylight chan	0	LF	$1,000	$0
	Excavation	**1,440,000**	CY		**$21,600,000**
3	Excavate to Marshplain	1,398,600	CY	$15	$20,979,000
4	New Ballona Creek	27,700	CY	$15	$415,500
5	Channels Order 5	2,000	CY	$15	$30,000
6	Channels Order 4	5,500	CY	$15	$82,500
7	Channels Order 3	6,200	CY	$15	$93,000
8	Breach	0	CY	$15	$0
	Transportation	**1,440,000**	CY		**$7,200,000**
9	Onsite trucking	1,440,000	CY	$5	$7,200,000
	New Levees	**209,300**	CY		**$3,558,100**
10	Levee Fill - no road	0	CY	$10	$0
11	Levee Fill - with road	209,300	CY	$17	$3,558,100
	Stockpile	**1,218,100**	CY		**$6,090,500**
12	Stockpile	1,218,100	CY	$5	$6,090,500
	Levee Lowering and Ballona Creek Fill				**$1,783,600**
13	Levee Lowering	128,500	CY	$5	$642,500
14	Ballona Creek Fill	141,100	CY	$5	$705,500
15	Salvage Rip Rap	21,780	CY	$10	$217,800
16	Buried rock protection	10,890	CY	$20	$217,800
	Water Control Structures				**$0**
17	Culvert	0	SF	$2,010	$0
18	Tide Gate	0	LS	$100,000	$0
	Subtotal				**$43,732,200**
	Contingency	35%			**$15,306,300**
	Total				**$59,038,500**

Disposal Options - Cost Estimates from POLA / Weston and SCC

1 / 2	**Unload Dredged Material at POLA / Disposal at CDF at POLA**				
	Mobilization	1	LS	$1,113,000	$1,113,000
	Sediment Removal	1,218,100	CY	$3	$3,654,300
	Barge Sediment (approx. 30 NM)	1,218,100	CY	$4.50	$5,481,450
	Unload Dredged Material (hydraulic unloader) or Disposal at CDF	1,218,100	CY	$3	$3,654,300
	Subtotal				**$13,903,050**
	Contingency	35%			**$4,866,100**
	Total for Option 1				**$18,769,150**
3	**Beneficial Use - Landfill Cover**				
	Mobilization	1	LS	$3,469,000	$3,469,000
	Sediment Removal	1,218,100	CY	$3	$3,654,300
	Barge Sediment (approx. 30 NM)	1,218,100	CY	$4.50	$5,481,450
	Stockpiling & Staging Material at POLA	1,218,100	CY	$1	$1,218,100
	Truck Material to Site (100 mi at $0.20/cy)	1,218,100	CY	$20	$24,362,000
	Placement, grading, compaction at Site	1,218,100	CY	$4.25	$5,176,925
	Subtotal				**$43,361,775**
	Contingency	35%			**$15,176,700**
	Total for Option 2				**$58,538,475**
4	**Disposal at Hazardous Waste Landfill - estimate not included, contamintant report pending**				
5	**Offshore Disposal [1]**				
	Mobilization	1	LS	$2,966,000	$2,966,000
	Sediment Removal and Offshore Disposal (approx. 3 mi offshore)	1,218,100	CY	$28	$34,106,800
	Subtotal				**$37,072,800**
	Contingency	35%			**$12,975,500**
	Total for Option 3				**$50,048,300**
6	**Beach Disposal [1]**				
	Mobilization	1	LS	$2,225,000	$2,225,000
	Sediment Removal and Beach Disposal	1,218,100	CY	$21	$25,580,100
	Subtotal				**$27,805,100**
	Contingency	35%			**$9,731,800**
	Total for Option 4				**$37,536,900**

Grand Totals with Disposal Options

1 / 2	**Disposal at POLA**	**$77,807,650**
3	**Upland Disposal**	**$117,576,975**
5	**Offshore Disposal [1]**	**$109,086,800**
6	**Beach Disposal [1]**	**$96,575,400**

Notes

1 - For Options 5 and 6, costs may range from the cost for Option 1 / 2 (lower end) up to the costs listed for Options 5 and 6 (upper end)

Alternative 5 Area C

Item	Description	Quantity	Unit	Unit Cost	Total Cost
	Mobilization				**$2,990,000**
1	Mobilization	1	LS	$2,990,000	$2,990,000
	Demolition				**$0**
2	Demo culvert, daylight chan	0	LF	$1,000	$0
	Excavation	**1,352,000**	CY		**$20,280,000**
3	Excavate to Marshplain	1,324,700	CY	$15	$19,870,500
4	New Ballona Creek	21,800	CY	$15	$327,000
5	Channels Order 5	800	CY	$15	$12,000
6	Channels Order 4	2,200	CY	$15	$33,000
7	Channels Order 3	2,500	CY	$15	$37,500
8	Breach	0	CY	$15	$0
	Transportation	**1,352,000**	CY		**$6,760,000**
9	Onsite trucking	1,352,000	CY	$5	$6,760,000
	New Levees	**0**	CY		**$0**
10	Levee Fill - no road	0	CY	$10	$0
11	Levee Fill - with road	0	CY	$17	$0
	Stockpile	**1,347,800**	CY		**$6,739,000**
12	Stockpile	1,347,800	CY	$5	$6,739,000
	Levee Lowering and Ballona Creek Fill				**$595,200**
13	Levee Lowering	42,900	CY	$5	$214,500
14	Ballona Creek Fill	47,100	CY	$5	$235,500
15	Salvage Rip Rap	7,260	CY	$10	$72,600
16	Buried rock protection	3,630	CY	$20	$72,600
	Water Control Structures				**$0**
17	Culvert	0	SF	$2,010	$0
18	Tide Gate	0	LS	$100,000	$0
	Subtotal				**$37,364,200**
	Contingency	35%			**$13,077,500**
	Total				**$50,441,700**

Disposal Options - Cost Estimates from POLA / Weston and SCC

1 / 2	**Unload Dredged Material at POLA / Disposal at CDF at POLA**				
	Mobilization	1	LS	$1,231,000	$1,231,000
	Sediment Removal	1,347,800	CY	$3	$4,043,400
	Barge Sediment (approx. 30 NM)	1,347,800	CY	$4.50	$6,065,100
	Unload Dredged Material (hydraulic unloader) or Disposal at CDF	1,347,800	CY	$3	$4,043,400
	Subtotal				**$15,382,900**
	Contingency	35%			**$5,384,100**
	Total for Option 1				**$20,767,000**
3	**Beneficial Use - Landfill Cover**				
	Mobilization	1	LS	$3,839,000	$3,839,000
	Sediment Removal	1,347,800	CY	$3	$4,043,400
	Barge Sediment (approx. 30 NM)	1,347,800	CY	$4.50	$6,065,100
	Stockpiling & Staging Material at POLA	1,347,800	CY	$1	$1,347,800
	Truck Material to Site (100 mi at $0.20/cy)	1,347,800	CY	$20	$26,956,000
	Placement, grading, compaction at Site	1,347,800	CY	$4.25	$5,728,150
	Subtotal				**$47,979,450**
	Contingency	35%			**$16,792,900**
	Total for Option 2				**$64,772,350**
4	**Disposal at Hazardous Waste Landfill - estimate not included, contamintant report pending**				
5	**Offshore Disposal [1]**				
	Mobilization	1	LS	$3,282,000	$3,282,000
	Sediment Removal and Offshore Disposal (approx. 3 mi offshore)	1,347,800	CY	$28	$37,738,400
	Subtotal				**$41,020,400**
	Contingency	35%			**$14,357,200**
	Total for Option 3				**$55,377,600**
6	**Beach Disposal [1]**				
	Mobilization	1	LS	$2,462,000	$2,462,000
	Sediment Removal and Beach Disposal	1,347,800	CY	$21	$28,303,800
	Subtotal				**$30,765,800**
	Contingency	35%			**$10,768,000**
	Total for Option 4				**$41,533,800**

Grand Totals with Disposal Options

1 / 2	**Disposal at POLA**	**$71,208,700**
3	**Upland Disposal**	**$115,214,050**
5	**Offshore Disposal [1]**	**$105,819,300**
6	**Beach Disposal [1]**	**$91,975,500**

Notes

1 - For Options 5 and 6, costs may range from the cost for Option 1 / 2 (lower end) up to the costs listed for Options 5 and 6 (upper end)

Alternative 5 Phase 1

Item	Description	Quantity	Unit	Unit Cost	Total Cost
	Mobilization				**$6,550,000**
1	Mobilization	1	LS	$6,550,000	$6,550,000
	Demolition				**$0**
2	Demo culvert, daylight chan	0	LF	$1,000	$0
	Excavation	**2,924,300**	CY		**$43,864,500**
3	Excavate to Marshplain	2,882,500	CY	$15	$43,237,500
4	New Ballona Creek	31,400	CY	$15	$471,000
5	Channels Order 5	1,500	CY	$15	$22,500
6	Channels Order 4	4,200	CY	$15	$63,000
7	Channels Order 3	4,700	CY	$15	$70,500
8	Breach	0	CY	$15	$0
	Transportation	**2,924,300**	CY		**$14,621,500**
9	Onsite trucking	2,924,300	CY	$5	$14,621,500
	New Levees	**49,240**	CY		**$492,400**
10	Levee Fill - no road	49,240	CY	$10	$492,400
11	Levee Fill - with road	0	CY	$17	$0
	Stockpile	**2,889,960**	CY		**$14,449,800**
12	Stockpile	2,889,960	CY	$5	$14,449,800
	Levee Lowering and Ballona Creek Fill				**$1,828,500**
13	Levee Lowering	163,100	CY	$5	$815,500
14	Ballona Creek Fill	148,200	CY	$5	$741,000
15	Salvage Rip Rap	27,200	CY	$10	$272,000
16	Buried rock protection	0	CY	$20	$0
	Water Control Structures				**$0**
17	Culvert	0	SF	$2,010	$0
18	Tide Gate	0	LS	$100,000	$0
	Subtotal				**$81,806,700**
	Contingency	35%			**$28,632,400**
	Total				**$110,439,100**

Disposal Options - Cost Estimates from POLA / Weston and SCC

1 / 2	**Unload Dredged Material at POLA / Disposal at CDF at POLA**				
	Mobilization	1	LS	$2,639,000	$2,639,000
	Sediment Removal	2,889,960	CY	$3	$8,669,880
	Barge Sediment (approx. 30 NM)	2,889,960	CY	$4.50	$13,004,820
	Unload Dredged Material (hydraulic unloader) or Disposal at CDF	2,889,960	CY	$3	$8,669,880
	Subtotal				**$32,983,580**
	Contingency	35%			**$11,544,300**
	Total for Option 1				**$44,527,880**
3	**Beneficial Use - Landfill Cover**				
	Mobilization	1	LS	$8,231,000	$8,231,000
	Sediment Removal	2,889,960	CY	$3	$8,669,880
	Barge Sediment (approx. 30 NM)	2,889,960	CY	$4.50	$13,004,820
	Stockpiling & Staging Material at POLA	2,889,960	CY	$1	$2,889,960
	Truck Material to Site (100 mi at $0.20/cy)	2,889,960	CY	$20	$57,799,200
	Placement, grading, compaction at Site	2,889,960	CY	$4.25	$12,282,330
	Subtotal				**$102,877,190**
	Contingency	35%			**$36,007,100**
	Total for Option 2				**$138,884,290**
4	**Disposal at Hazardous Waste Landfill - estimate not included, contamintant report pending**				
5	**Offshore Disposal [1]**				
	Mobilization	1	LS	$7,037,000	$7,037,000
	Sediment Removal and Offshore Disposal (approx. 3 mi offshore)	2,889,960	CY	$28	$80,918,880
	Subtotal				**$87,955,880**
	Contingency	35%			**$30,784,600**
	Total for Option 3				**$118,740,480**
6	**Beach Disposal [1]**				
	Mobilization	1	LS	$5,278,000	$5,278,000
	Sediment Removal and Beach Disposal	2,889,960	CY	$21	$60,689,160
	Subtotal				**$65,967,160**
	Contingency	35%			**$23,088,500**
	Total for Option 4				**$89,055,660**

Grand Totals with Disposal Options

1 / 2	**Disposal at POLA**	**$154,966,980**
3	**Upland Disposal**	**$249,323,390**
5	**Offshore Disposal [1]**	**$229,179,580**
6	**Beach Disposal [1]**	**$199,494,760**

Notes

1 - For Options 5 and 6, costs may range from the cost for Option 1 / 2 (lower end) up to the costs listed for Options 5 and 6 (upper end)

Alternative 5 Phase 2

Item	Description	Quantity	Unit	Unit Cost	Total Cost
	Mobilization				**$2,900,000**
1	Mobilization	1	LS	$2,900,000	$2,900,000
	Demolition				**$0**
2	Demo culvert, daylight chan	0	LF	$1,000	$0
	Excavation	**1,192,500**	CY		**$17,887,500**
3	Excavate to Marshplain	1,165,500	CY	$15	$17,482,500
4	New Ballona Creek	15,500	CY	$15	$232,500
5	Channels Order 5	1,700	CY	$15	$25,500
6	Channels Order 4	4,600	CY	$15	$69,000
7	Channels Order 3	5,200	CY	$15	$78,000
8	Breach	0	CY	$15	$0
	Transportation	**1,192,500**	CY		**$5,962,500**
9	Onsite trucking	1,192,500	CY	$5	$5,962,500
	New Levees	**209,300**	CY		**$3,558,100**
10	Levee Fill - no road	0	CY	$10	$0
11	Levee Fill - with road	209,300	CY	$17	$3,558,100
	Stockpile	**923,500**	CY		**$4,617,500**
12	Stockpile	923,500	CY	$5	$4,617,500
	Levee Lowering and Ballona Creek Fill				**$1,253,500**
13	Levee Lowering	51,000	CY	$5	$255,000
14	Ballona Creek Fill	110,700	CY	$5	$553,500
15	Salvage Rip Rap	8,200	CY	$10	$82,000
16	Buried rock protection	18,150	CY	$20	$363,000
	Water Control Structures				**$0**
17	Culvert	0	SF	$2,010	$0
18	Tide Gate	0	LS	$100,000	$0
	Subtotal				**$36,179,100**
	Contingency	35%			**$12,662,700**
	Total				**$48,841,800**

Disposal Options - Cost Estimates from POLA / Weston and SCC

1 / 2	**Unload Dredged Material at POLA / Disposal at CDF at POLA**				
	Mobilization	1	LS	$844,000	$844,000
	Sediment Removal	923,500	CY	$3	$2,770,500
	Barge Sediment (approx. 30 NM)	923,500	CY	$4.50	$4,155,750
	Unload Dredged Material (hydraulic unloader) or Disposal at CDF	923,500	CY	$3	$2,770,500
	Subtotal				**$10,540,750**
	Contingency	35%			**$3,689,300**
	Total for Option 1				**$14,230,050**
3	**Beneficial Use - Landfill Cover**				
	Mobilization	1	LS	$2,630,000	$2,630,000
	Sediment Removal	923,500	CY	$3	$2,770,500
	Barge Sediment (approx. 30 NM)	923,500	CY	$4.50	$4,155,750
	Stockpiling & Staging Material at POLA	923,500	CY	$1	$923,500
	Truck Material to Site (100 mi at $0.20/cy)	923,500	CY	$20	$18,470,000
	Placement, grading, compaction at Site	923,500	CY	$4.25	$3,924,880
	Subtotal				**$32,874,630**
	Contingency	35%			**$11,506,200**
	Total for Option 2				**$44,380,830**
4	**Disposal at Hazardous Waste Landfill - estimate not included, contamintant report pending**				
5	**Offshore Disposal [1]**				
	Mobilization	1	LS	$2,249,000	$2,249,000
	Sediment Removal and Offshore Disposal (approx. 3 mi offshore)	923,500	CY	$28	$25,858,000
	Subtotal				**$28,107,000**
	Contingency	35%			**$9,837,500**
	Total for Option 3				**$37,944,500**
6	**Beach Disposal [1]**				
	Mobilization	1	LS	$1,687,000	$1,687,000
	Sediment Removal and Beach Disposal	923,500	CY	$21	$19,393,500
	Subtotal				**$21,080,500**
	Contingency	35%			**$7,378,200**
	Total for Option 4				**$28,458,700**

Grand Totals with Disposal Options

1 / 2	**Disposal at POLA**	**$63,071,850**
3	**Upland Disposal**	**$93,222,630**
5	**Offshore Disposal [1]**	**$86,786,300**
6	**Beach Disposal [1]**	**$77,300,500**

Notes

1 - For Options 5 and 6, costs may range from the cost for Option 1 / 2 (lower end) up to the costs listed for Options 5 and 6 (upper end)

Alternative 5 Phase 3

Item	Description	Quantity	Unit	Unit Cost	Total Cost
	Mobilization				**$2,990,000**
1	Mobilization	1	LS	$2,990,000	$2,990,000
	Demolition				**$0**
2	Demo culvert, daylight chan	0	LF	$1,000	$0
	Excavation	**1,352,000**	CY		**$20,280,000**
3	Excavate to Marshplain	1,324,700	CY	$15	$19,870,500
4	New Ballona Creek	21,800	CY	$15	$327,000
5	Channels Order 5	800	CY	$15	$12,000
6	Channels Order 4	2,200	CY	$15	$33,000
7	Channels Order 3	2,500	CY	$15	$37,500
8	Breach	0	CY	$15	$0
	Transportation	**1,352,000**	CY		**$6,760,000**
9	Onsite trucking	1,352,000	CY	$5	$6,760,000
	New Levees	**0**	CY		**$0**
10	Levee Fill - no road	0	CY	$10	$0
11	Levee Fill - with road	0	CY	$17	$0
	Stockpile	**1,344,600**	CY		**$6,723,000**
12	Stockpile	1,344,600	CY	$5	$6,723,000
	Levee Lowering and Ballona Creek Fill				**$620,200**
13	Levee Lowering	42,900	CY	$5	$214,500
14	Ballona Creek Fill	50,300	CY	$5	$251,500
15	Salvage Rip Rap	8,160	CY	$10	$81,600
16	Buried rock protection	3,630	CY	$20	$72,600
	Water Control Structures				**$0**
17	Culvert	0	SF	$2,010	$0
18	Tide Gate	0	LS	$100,000	$0
	Subtotal				**$37,373,200**
	Contingency	35%			**$13,080,700**
	Total				**$50,453,900**

Disposal Options - Cost Estimates from POLA / Weston and SCC

1 / 2	**Unload Dredged Material at POLA / Disposal at CDF at POLA**				
	Mobilization	1	LS	$1,228,000	$1,228,000
	Sediment Removal	1,344,600	CY	$3	$4,033,800
	Barge Sediment (approx. 30 NM)	1,344,600	CY	$4.50	$6,050,700
	Unload Dredged Material (hydraulic unloader) or Disposal at CDF	1,344,600	CY	$3	$4,033,800
	Subtotal				**$15,346,300**
	Contingency	35%			**$5,371,300**
	Total for Option 1				**$20,717,600**
3	**Beneficial Use - Landfill Cover**				
	Mobilization	1	LS	$3,830,000	$3,830,000
	Sediment Removal	1,344,600	CY	$3	$4,033,800
	Barge Sediment (approx. 30 NM)	1,344,600	CY	$4.50	$6,050,700
	Stockpiling & Staging Material at POLA	1,344,600	CY	$1	$1,344,600
	Truck Material to Site (100 mi at $0.20/cy)	1,344,600	CY	$20	$26,892,000
	Placement, grading, compaction at Site	1,344,600	CY	$4.25	$5,714,550
	Subtotal				**$47,865,650**
	Contingency	35%			**$16,753,000**
	Total for Option 2				**$64,618,650**
4	**Disposal at Hazardous Waste Landfill - estimate not included, contamintant report pending**				
5	**Offshore Disposal [1]**				
	Mobilization	1	LS	$3,274,000	$3,274,000
	Sediment Removal and Offshore Disposal (approx. 3 mi offshore)	1,344,600	CY	$28	$37,648,800
	Subtotal				**$40,922,800**
	Contingency	35%			**$14,323,000**
	Total for Option 3				**$55,245,800**
6	**Beach Disposal [1]**				
	Mobilization	1	LS	$2,456,000	$2,456,000
	Sediment Removal and Beach Disposal	1,344,600	CY	$21	$28,236,600
	Subtotal				**$30,692,600**
	Contingency	35%			**$10,742,400**
	Total for Option 4				**$41,435,000**

Grand Totals with Disposal Options

1 / 2	**Disposal at POLA**	**$71,171,500**
3	**Upland Disposal**	**$115,072,550**
5	**Offshore Disposal [1]**	**$105,699,700**
6	**Beach Disposal [1]**	**$91,888,900**

Notes

1 - For Options 5 and 6, costs may range from the cost for Option 1 / 2 (lower end) up to the costs listed for Options 5 and 6 (upper end)

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APPENDIX B9
Restoration Projects Cost Comparison

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Appendix B9, Comparative Costs of Alternatives Considered

Table 1. Summary Comparing Restoration Costs Per Acre

Project	*Total Cost*	*Cost Per Restored Acre*
Ballona Wetlands Restoration Project - Alternative 1	$ 182,822,316	$ 908,208
Ballona Wetlands Restoration Project - Alternative 2	$ 144,765,227	$ 974,194
Ballona Wetlands Restoration Project - Alternative 3	$ 135,443,230	$ 2,574,966
Breuner Marsh Restoration Project	$ 14,425,248.00	$ 87,959
San Elijo Lagoon Restoration Project	$ 58,976,218.00	$ 393,175
Malibu Lagoon Restoration and Enhancement	$ 4,094,487	$ 240,852
San Dieguito Wetlands Restoration Project	$ 84,804,784	$ 526,738

Table 1a. Calculation of Per-Acre Costs - Ballona Wetlands Restoration Project Alternatives

	Ballona Wetlands Restoration Project				
Task	***Alternative 1- Phase 1***	***Alternative 1- Phase 2***	***Alternative 1 Total***	***Alternative 2***	***Alternative 3***
Mobilization & Demobilization	$ 7,100,000	$ 4,300,000	$ 11,400,000	$ 7,100,000	$ 4,300,000
Demolition and Removal	$ 467,500	$ 555,000	$ 1,022,500	$ 718,500	$ 105,000
Earthwork (Cut and Fill)	$ 62,969,500	$ 16,502,400	$ 79,471,900	$ 67,203,500	$ 29,575,000
Offsite hauling	$ 1,211,770	$ -	$ 1,211,770	$ 110,350	$ 55,466,700
Levee Transitions to existing levees	$ 549,750	$ 137,438	$ 687,188	$ 549,750	$ 274,875
Erosion Control Structures	$ 11,213,717	$ 7,433,333	$ 18,647,050	$ 10,934,967	$ -
Water Control Structures	$ 6,740,222	$ 2,760,000	$ 9,500,222	$ 6,740,222	$ 11,185,383
Public Access	$ 22,991,400	$ 1,704,000	$ 24,695,400	$ 22,933,000	$ 9,069,000
Planting	$ 2,756,060	$ 959,840	$ 3,715,900	$ 3,147,400	$ 2,093,400
Monitoring	$ 1,200,000	$ 800,000	$ 2,000,000	$ 1,200,000	$ 800,000
Total	$ 117,199,919	$ 35,152,011	$ 152,351,930	$ 120,637,689	$ 112,869,358
Contingency	$ 23,439,984	$ 7,030,402	$ 30,470,386	$ 24,127,538	$ 22,573,872
Total Cost	$ 140,639,903	$ 42,182,413	$ 182,822,316	$ 144,765,227	$ 135,443,230
Acres to be restored	138.2	63.1	201.3	148.6	52.6
Total Cost per Restored Acre	***$ 1,017,655***	***$ 668,501***	***$ 908,208***	***$ 974,194***	***$ 2,574,966***

Table 1b. Calculation of Per-Acre Costs - Breuner Marsh

Project Summary: Breuner Marsh Restoration Project

On behalf of a long list of project partners, the US EPA describes the Breuner Marsh Restoration Project as folows: "This project will create, restore and enhance 164 acres of wetlands and uplands habitat at Breuner Marsh along th Point Pinole Regional Shoreline in Richmond. The restored area will be a self-sustaining tidal wetlands area with adjacent seasonal wetlands and coastal prairie habitats, and will provide a key link in the Bay Trail system. The project is designed to accommodate a sea level rise of 55 inches by the year 2100 and includes uplands in order for the wetlands to be able to transgress inland. Site preparation has already begun and the project is estimated to be completed in 2016." (US EPA 2016)

Task	*Year*	*Cost*	*Cost in 2017 Dollars*
Preconstruction	2015	$ 1,400,000	$ 1,425,612
Construction Management, Engineering/Design	2015	$ 2,600,000	$ 2,647,565
Phase I	2014	$ 2,500,000	$ 2,548,757
Phase II	2015	$ 1,700,000	$ 1,731,100
Phase III	2016	$ 5,000,000	$ 5,053,920
Monitoring	2015	$ 1,000,000	$ 1,018,294
Total Cost			***$ 14,425,248***
Acres to be Restored			***164***
Total Cost Per Restored Acre			***$ 87,959***

Notes

1. Land acquisition costs are not included.
2. Preconstruction costs include planning, environmental compliance and permitting.
3. Phase I tasks include hazardous soil removal, site preparation, grading, portion of tidal wetland/seasonal wetland construction.
4. Phase II tasks include a portion of tidal wetland/seasonal wetland construction, and portion of public access improvements, bathrooms, etc.
5. Phase III tasks include remaining work, including public access improvements, boardwalk and trail construction, etc.

References

California Coastal Conservancy, 2016a. Wetlands Costs Worksheet Breuner Marsh. November 14, 2016.

U.S. EPA, 2016. Breuner Marsh Restoration Project [https://www.epa.gov/sfbay-delta/breuner-marsh-restoration-project]. Updated May 31, 2016.

Table 1c. Calculation of Per-Acre Costs - San Elijo Lagoon Restoration Project

Project Summary

The San Elijo Lagoon Restoration Project has two components: the restoration of San Elijo Lagoon and the disposal or reuse of materials excavated as part of that restoration. The project would restore ecological functions in San Elijo Lagoon within the San Elijo Lagoon Ecological Reserve, which is located in the City of Encinitas, San Diego County, California. The restoration area comprises approximately 960 acres primarily within the Reserve, including the lagoon. (U.S. Army Corps of Engineers and County of San Diego Department of Parks and Recreation 2016). Project activities include dredging an over-dredge pit, channels, placing beach fill, placing offshore fill, constructing habitat areas, constructing pedestrian bridges, placing rock revetment, planting and irrigation.

Task	*Year*	*Cost*	*Cost in 2017 Dollars*	
Mobilization	2016	$ 7,114,500	$ 7,191,223	
Site preparation (grubbing, invasives removal, etc.)	2016	$ 8,328,000	$ 8,417,810	
Relocation of utilities	Not applicable			
Grading and earthwork and dredging	2016	$ 30,632,500	$ 30,962,843	Includes Dredging, Filling, Traffic Control, QC/QA, SWPPP
Construction of structures	2016	$ 8,455,000	$ 8,546,179	Includes Drainage RSP, Ped Bridges
Irrigation installation	2016	$ 1,010,000	$ 1,020,892	
Planting Maintenance (during monitoring period)	2016	$ 2,807,000	$ 2,837,271	
Monitoring (including reporting)	Not available			
Total Cost			***$ 58,976,218***	
Acres to be Restored			***150***	
Total Cost Per Restored Acre			***$ 393,175***	

Notes

References

California Coastal Conservancy, 2016b. Wetlands Costs Worksheet San Elijo. November 14, 2016.

U.S. Army Corps of Engineers and County of San Diego Department of Parks and Recreation, 2016. San Elijo Lagoon Restoration Project Environmental Impact Report / Environmental Impact Statement. SCH# 2011111013 [https://www.sanelijo.org/sites/sanelijo.org/files/Publications/San%20Elijo%20Lagoon%20Restoration%20Project%20EIR.pdf] February 2016.

Table 1d. Calculation of Per-Acre Costs - Malibu Lagoon Restoration and Enhancement

Project Summary

The restoration and enhancement of the Malibu Lagoon (approximately 17 acres of estuarine wetlands) will include activities relating to the following: water management, habitat management, access, and monitoring to facilitate implementation of the monitoring program and subsequent environmental review and permitting. (Moffatt & Nichol 2005) More specifically, restoration will include recontouring the western lagoon, demolishing three bridges, removing inappropriate vegetation, replanting with native species appropriate for the site, and the construction of interpretive landscape.

Task	*Year*	*Cost*	*Cost in 2017 Dollars*
Mobilization	2012	$ 205,000	$ 215,499
Site preparation (grubbing, invasives removal, etc.)	2012	$ 680,000	$ 714,827
Relocation of utilities	Not applicable		
Grading and earthwork	2012	$ 900,000	$ 946,095
Construction of structures	2012	$ 887,000	$ 932,429
Irrigation installation	2012	$ 228,000	$ 239,677
Planting Maintenance (included in monitoring estimate)	Spring 2013-Spring 2018		
Monitoring (including reporting)	Spring 2013-Spring 2018	$ 450,000	$ 473,047
Project Management and Inspection		$ 545,000	$ 572,913
Total Cost			***$ 4,094,487***
Acres to be Restored			***17***
Total Cost Per Restored Acre			***$ 240,852***

Notes

References

California Coastal Conservancy, 2016c. Wetlands Costs Worksheet Malibu Lagoon. November 4, 2016.

Moffatt & Nichol, 2005. Final Malibu Lagoon Restoration and Enhancement Plan. [http://www.parks.ca.gov/pages/980/files/000%20appendix%20a%20-%20malibu%20lagoon%20restoration%20and%20enhancement%20plan.pdf] June 17, 2005.

Table 1e. Calculation of Per-Acre Costs - San Dieguito Wetlands Restoration Project

Project Summary

The San Dieguito Wetlands Restoration has been described as "intended to offset impacts to fish eggs and larvae attributed to the San Onofre Nuclear Generating Station (SONGS) once-through ocean cooling water system operation. The project restored 161 acres of degraded historical wetlands adjacent to the San Dieguito River between El Camino Real and the Del Mar beach.... A key requirement of the restoration is keeping the tidal inlet at the river mouth in an essentially open condition indefinitely." (Southern California Edison 2016).

Task	*Year*	*Cost*	*Cost in 2017 Dollars*
Phase 1: Early conceptual planning, siting studies, land acquisition	1997-1998	$ 7,400,000	$ 7,479,802
Phase 2: Preliminary design and engineering, CEQA documentation, litigation	1999-2003	$ 8,200,000	$ 8,288,429
Phase 3: Final engineering, permitting	2004-2006	$ 8,000,000	$ 8,086,273
Phase 4: Construction and Mitigation	2007-2012	$ 50,000,000	$ 50,539,204
Phase 5: Post-Construction Maintenance, Monitoring and Reporting	2012-2015	$ 10,300,000	$ 10,411,076
Total Cost			***$ 84,804,784***
Acres to be Restored			***161***
Total Cost per Acre			***$ 526,738***

Notes

1. Each year since 1997 includes approximately $1 M in Coastal Commission independent oversight and monitoring, per the 1997 Coastal Development Permit for SONGS Marine Mitigation.
2. Each year since 2009 includes approximately $300 K in JPA public access element maintenance.
3. Dollars have been adjusted from 2016 (the year reported) to 2017 to account for inflation and for purposes of comparison.

References

Southern California Edison, 2016. San Dieguito Wetlands Restoration Project, Summary of Costs/Phases. April 20, 2016.

Southern California Edison, 2005. San Dieguito Wetlands Restoration Project Final Restoration Plan. [http://marinemitigation.msi.ucsb.edu/documents/wetland/sce_reports/san_dieguito-lagoon-final-restoration-plan_112005.pdf] November 2005.

Table 1a. Calculation of Per-Acre Costs - Ballona Wetlands Restoration Project Alternatives

Table 1f. Calculation of Per-Acre Costs - Ballona Wetlands Restoration Project Alternatives With Raised Roads
Ballona Wetlands Restoration Project

Task	*Alternative 1*	*Alternative 2*	*Alternative 3*	*Alt. 1 with Raised Roads*	*Alt. 2 with Raised Roads*	*Alt. 3 with Raised Roads*
Mobilization & Demobilization	$ 11,400,000	$ 7,100,000	$ 4,300,000			
Demolition and Removal	$ 1,022,500	$ 718,500	$ 105,000			
Earthwork (Cut and Fill)	$ 79,471,900	$ 67,203,500	$ 29,575,000			
Offsite hauling	$ 1,211,770	$ 110,350	$ 55,466,700			
Levee Transitions to existing levees	$ 687,188	$ 549,750	$ 274,875			
Erosion Control Structures	$ 18,647,050	$ 10,934,967	$ -	(See Alt 1)	(See Alt 2)	(See Alt 3)
Water Control Structures	$ 9,500,222	$ 6,740,222	$ 11,185,383			
Public Access	$ 24,695,400	$ 22,933,000	$ 9,069,000			
Planting	$ 3,715,900	$ 3,147,400	$ 2,093,400			
Monitoring	$ 2,000,000	$ 1,200,000	$ 800,000			
Total	$ 152,351,930	$ 120,637,689	$ 112,869,358			
Contingency	$ 30,470,386	$ 24,127,538	$ 22,573,872			
Subtotal Cost (without Road Raising)	$ 182,822,316	$ 144,765,227	$ 135,443,230	$ 182,822,316	$ 144,765,227	$ 135,443,230
Additional Cost - Road Raising Option 1	$ -	$ -	$ -	$ 200,000,000	$ 200,000,000	$ 200,000,000
Additional Cost - Road Raising Option 2	$ -	$ -	$ -	$ 143,000,000	$ 143,000,000	$ 143,000,000
Additional Cost - Road Raising (Average of Options 1 and 2)	$ -	$ -	$ -	$ 171,500,000	$ 171,500,000	$ 171,500,000
Total acres to be restored (w/o Raised Roads)	201.3	148.6	52.6	201.3	148.6	52.6
Total acres to be Restored (with Raised Roads)	0	0	0	208.3	155.6	59.6
Total Cost per Restored Acre (with Raised Roads-Option 1)	***$ 908,208***	***$ 974,194***	***$ 2,574,966***	***$ 1,837,841***	***$ 2,215,715***	***$ 5,628,242***
Total Cost per Restored Acre (with Raised Roads-Option 2)				***$ 1,564,197***	***$ 1,849,391***	***$ 4,671,866***
Total Cost per Restored Acre (with Raised Roads-Options Averaged)				***$ 1,701,019***	***$ 2,032,553***	***$ 5,150,054***
Percent increase relative to Alternative without Raised Roads				***53%***	***48%***	***50%***

Table 1f. Land Acquisition Costs

Street Address		Type	Building (SF)	Lot (SF)	List Price	Date	$/SF (lot)
14 Mast Street	Marina del Rey	"low rise"	6,261	3,135	$ 4,995,000	6/14/2017	$ 1,593
318 Culver Blvd/333 Pershing	Playa del Rey	Retail/Residential	7,601	5,529	$ 5,000,000	6/14/2017	$ 904
165 Culver Blvd	Playa del Rey	Office	2,692		$ 3,400,000	6/14/2017	Not Available
6836 Esplanade	Playa del Rey	Multi-family		43,560	$ 1,600,000	6/14/2017	$ 37
100 Montreal Street	Playa del Rey	Multi-family	1,872	2,552	$ 1,500,000	6/14/2017	$ 588
7321 Vista del Mar	Playa del Rey	Single-family		4,210	$ 1,195,000	6/14/2017	$ 284
					Average $/SF		***$ 681***

References

Loopnet, 2017. [http://www.loopnet.com/for-sale/2/?bb=sqx4gvq7mNzku9sL] Accessed June 14, 2017.

APPENDIX B10
Conceptual Cost Analysis to Raise Culver and Jefferson Boulevards

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TECHNICAL MEMO

From: Michael J. Crehan, P.E., Psomas
Date: May 12, 2017
RE: Option to Raise Culver and Jefferson Boulevards in Area B – Conceptual Cost Analysis

PURPOSE:

This memo documents the analysis to estimate the rough order of magnitude cost to raise Culver Boulevard and Jefferson Boulevard onto a causeway west of Lincoln within the ownership limits such that the roadway will be above any potential flooding or tidal water surface elevation.

I. REQUIRED ROADWAY WIDTHS:

Per the City of Los Angeles Mobility Plan the street widths are required to be:

Street:	Classification:	Roadway Width:	Right-of-Way Width:
Jefferson	Boulevard II	80'	110'
Culver	Modified Avenue III	46' Street	72'

(Note, the "Modification" has not been defined, so this is the listed standard)

The existing roadways are:

Street:	Roadway Width:	Right-of-Way Width:
Jefferson	Varies from 50' to 80'	100'
Culver	Varies from 30' to 50'	65'

(Note, there as a section of one-way road at the transition from Culver to Jefferson east-bound where there is an 18' wide paved roadway and a much widened right-of-way)

The difference between Street width and R/W width is intended for sidewalks on each side. While the City's street classifications would normally call for the State to dedicate land for additional street R/W, at meetings with the Los Angeles Department of Transportation, they indicated that no formal request for such dedication should be expected. Therefore, the existing right-of-way width is the ultimate right-of-way width.

II. CAUSEWAY DESCRIPTION:

Two possible causeway widths were reviewed. First, a roadway cross-section on the causeway to match the existing roadway width was reviewed. This would match the pavement lane widths and vehicular transitions which would maintain current vehicular traffic conditions, but not include vehicular shoulders, sidewalks, or bicycle lanes. Second, a more typical roadway cross section on the causeway to provide the same traffic lane conditions, but also include shoulder/bicycle lanes, and a sidewalk on one side within the existing right-of-way. This option would have a minimum 40' wide roadway width and a 6' wide sidewalk on both sides.

The causeway would essentially be an elevated bridge structure on pilings with the causeway above any flooding potential, possibly up to the top of the levee at approximately elevation 20. Whether at elevation 20 or lower will have little impact on the cost of the structure. The top of the causeway would include a roadway section for vehicular/bicycle traffic, and sidewalk and guardrail on each side. Lighting would typically be required, but may not due to the adjacent habitat area. Cost for a public street lighting system is included. There will also be a major graded transition at three locations (Lincoln/Jefferson, Culver south of the Ballona Channel, and Culver/Nicholson), and minor graded transitions at the Gas Company access roads and the new access points needed to drive onto the levee for maintenance.

III. CONSTRUCTION/COST ISSUES AND RISKS:

Staging – Construction staging would occur in a minimum of two phases in order to build the causeway while maintaining traffic flows during construction. Half of the causeway would be built per phase. For the narrower Culver Blvd sections, this will require expanding a temporary paving section on one side to move two way traffic to that half of the right-of-way while the causeway is built on the other half of the right-of-way. Sub-phasing would be needed at transitions and access points.

Existing Overhead Power Lines – With the raising of the causeway above the existing roadway elevations, the separation from the roadway to the wires on the overhead electrical poles may not meet safety requirements. If this is the case, these poles would need to be replaced with taller poles. If the wider causeway is constructed, the existing overhead power lines would be required to be relocated. If the poles have to be relocated, a significant additional cost above the costs noted below would be required. This cost range is estimated in the $3,000,000 to $4,000,000 per mile per pole line, or an additional five to six million dollars.

Jurisdiction – Both Culver and Jefferson are public roadways under the jurisdiction of the City of Los Angeles. Therefore, they must be built for, and inspected by, the City of Los Angeles for their acceptance.

IV. ROUGH ORDER OF MAGNITUDE COST FOR MAJOR ITEMS:

Item	Quantity	Unit Cost	Cost
Option 1 (Full causeway width)			
Transition Grade/Pave	40,000 sf	$15	$ 1,000,000
Causeway Deck	640,000 sf	$200	$128,000,000
Piles (Note – Assumed 5 pile rows on Jefferson, 4 on Culver, at 40' spacing per row)	900 each	$15,000	$ 14,000,000
Temporary Pavement (15' widening for 5,500 lf)	82,500 sf	$10	$ 1,000,000
Traffic Signal & Interconnect	1 each	Lump Sum	$ 1,000,000
Street Lights	90 each	$10,000	$ 1,000,000
Miscellaneous (Traffic control, erosion protection, misc. bridge equipment)	1 each	Lump Sum	$ 2,000,000
Sub-total			$148,000,000
Design/CM/Monitoring (6%)			$ 8,000,000
Inspection/Fees (15%)			$ 22,000,000
Contingencies (15%)			$ 22,000,000
		TOTAL	**$200,000,000**
Option 2 (Minimum causeway width)			
Transition Grade/Pave	36,000 sf	$15	$ 1,000,000
Causeway Deck (Assumes 40' roadway and sidewalk on one side, widened at intersections)	4,300,000 sf	$200	$ 86,000,000
Piles (Assumed 4 pile rows at 40' spacing per row)	840 each	$15,000	$ 13,000,000
Temporary Pavement (15' widening for 5,500 lf)	82,500 sf	$10	$ 1,000,000
Traffic Signal & Interconnect	1 each	Lump Sum	$ 1,000,000

Street Lights	90 each	$10,000	$ 1,000,000
Miscellaneous (Traffic control, erosion protection, misc. bridge equipment)	1 each	Lump Sum	$ 2,000,000
Sub-total			$105,000,000
Design/CM/Monitoring (6%)			$ 6,000,000
Inspection/Fees (15%)			$ 16,000,000
Contingencies (15%)			$ 16,000,000
		TOTAL	**$143,000,000**

V. COST REFERENCES:

Costs for bridge deck and piles are the more significant items driving the overall cost. Other costs are relatively incidental.

Bridge – Caltrans "Comparative Bridge Costs" has a wide range of unit costs per square foot (sf). $200 per sf was chosen as an approximate average of costs listed.

Piles – Drilled piles must be used due to proximity to a 230 kV underground transmission line, and safer installation next to an active roadway. Drilled piles are generally more expensive than driven piles. Pile costs can range significantly. A unit cost of $15,000 was used.

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
STRUCTURE DESIGN - OFFICE OF STRUCTURE OFFICE ENGINEER

COMPARATIVE BRIDGE COSTS

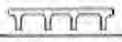
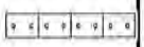
JANUARY 2016

The following tabular data provides some **general guidelines** for structure type selection and its relative cost. These costs should be used only for **preliminary estimates** until more detailed information is developed. The following factors must be taken into account when determining a price within the cost range:

Factors for Lower End of Cost Range	Factors for Higher End of Cost Range
Short Spans, Low Structure Height, No Environmental Constraints, Large Project, No Aesthetic Issues, Dry Conditions, No Bridge Skew	Long Spans, High Structure Height, Environmental Constraints, Small Project, Aesthetic Issues, Wet Conditions (cofferdams required), Skewed Bridges
Urban Location	Remote Location
Seat Abutment	Cantilever Abutment
Spread Footing	Pile Footing (Large Diameter Piling)
No Stage Construction	2-Stage Construction

Factors that will increase the price from 25% - 150% over the high end of the cost range

Structures with more than 2 construction stages	Unique substructure construction
Widenings less than 15 Ft.	

STRUCTURAL SECTION	(STR. DEPTH / MAX SPAN) SIMPLE	(STR. DEPTH / MAX SPAN) CONTINUOUS	COMMON SPAN RANGE (feet)	* COST RANGE (price/sqft)	REMARKS
RC SLAB 	0.06	0.045	16 - 44	120-400	CAST-IN -PLACE CONCRETE BRIDGES ACCOUNT FOR APPROXIMATELY 65% OF BRIDGES BUILT ON CALIFORNIA STATE HIGHWAYS
RC T-BEAM 	0.07	0.065	40 - 60	115-260	
RC BOX 	0.06	0.055	50 - 120	160-250	
CIP/PS SLAB 	0.03	0.03	40 - 65	120-250	
CIP/PS BOX 	0.045	0.04	100 - 250	110-350	
PC/PS SLAB 	0.03 (+3" AC)	0.03 (+3" AC)	20 - 50	270 - 500	NO FALSEWORK REQUIRED
PC/PS T, TT, ⊥	0.06 (+3" AC)	0.055 (+3" AC)	30 - 120	No Current Cost Data	
BULB TEE GIRDER	0.05	0.045	90 - 145	120 - 300	
WIDE FLANGE GIRDER	0.045	0.04	90 - 180	140 -250	
PC/PS I 	0.055	0.05	50 - 120	150 - 400	
PC/PS BOX 	0.06	0.045	120 - 200	125 - 280	
STRUCT STEEL I GIRDER 	0.045	0.04	60 - 300	250 - 500	NO FALSEWORK REQUIRED

NOTE: Removal of a box girder structure costs from $10 - $20 per square foot.

* "Price/SQFT" is calculated using "Bridge Costs Only" as defined by the Federal Highway Administration. The "Bridge Cost Only" is the sum of the "Superstructure" and "Substructure" bridge items, listed in Chapter 11 of the Bridge Design Aids Manual, multiplied by the bid item price. The "Superstructure" and "Substructure" bridge items do not include items such as: time related overhead, mobilization, bridge removal, approach slabs, slope paving, soundwalls, or retaining walls.

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APPENDIX C

Air Quality and Greenhouse Gas Emissions

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Criteria Pollutant and Greenhouse Gas Emission Calculations

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Off-Road Construction Emissions during Alternative 1

TABLE 1
ALTERNATIVE 1 EQUIPMENT LIST

OFFROAD Equipment Type	Horsepower	Load Factor
Backhoe	98	0.5
Crane	226	0.29
Drill Rig	206	0.5
Forklift	89	0.2
Generator Set	84	0.74
Grader	175	0.41
Loader	200	0.36
Note: Equipment horse power and load factors were obtained from CalEEMod User's Guide, Appendix D, 2013.		

TABLE 2
ALTERNATIVE 1 UNMITIGATED CONSTRUCTION EMISSIONS FACTORS

Equipment	Model Year	Unmitigated Emission Factors (g/bhp-hr)							
		ROG	CO	NOX	SOX	PM10	PM2.5	CO2	CH4
Bore/Drill Rigs	2017	0.1735	1.1021	2.5215	0.0048	0.0725	0.0667	494.1381	0.1514
Bore/Drill Rigs	2018	0.1545	1.07328	2.15308	0.0048	0.0608	0.056	484.5605	0.1509
Bore/Drill Rigs	2019	0.1434	1.06058	1.8943	0.0048	0.0537	0.0494	475.7896	0.1505
Bore/Drill Rigs	2023	0.1104	1.04309	1.04653	0.0049	0.0339	0.0312	469.7058	0.1519
Cranes	2017	0.5606	2.38452	6.65526	0.0049	0.2967	0.273	499.3721	0.153
Cranes	2018	0.4831	2.13445	5.77298	0.0049	0.2499	0.2299	491.4069	0.153
Cranes	2019	0.4266	1.94079	5.0842	0.0049	0.2155	0.1983	483.4616	0.153
Cranes	2023	0.2974	1.55262	3.22938	0.0049	0.1349	0.1241	472.9738	0.153
Forklifts	2017	0.6719	3.97881	5.81772	0.0049	0.48	0.4416	497.7245	0.1525
Forklifts	2018	0.5674	3.85819	5.0153	0.0049	0.4002	0.3682	489.8657	0.1525
Forklifts	2019	0.5095	3.80391	4.54965	0.0049	0.3525	0.3243	482.0069	0.1525
Forklifts	2023	0.3266	3.64655	3.0569	0.0049	0.1889	0.1738	471.5285	0.1525
Generator Sets	2017	0.356	2.931	3.347	0.006	0.151	0.151	568.299	0.032
Generator Sets	2018	0.319	2.93	2.989	0.006	0.133	0.133	568.299	0.028
Generator Sets	2019	0.29	2.929	2.669	0.006	0.118	0.118	568.299	0.026
Generator Sets	2023	0.211	2.927	1.635	0.006	0.071	0.071	568.299	0.019
Graders	2017	0.7571	3.84518	7.66265	0.0049	0.4304	0.396	506.7478	0.1553
Graders	2018	0.6614	3.70957	6.60465	0.0049	0.3713	0.3416	497.3767	0.1548
Graders	2019	0.6088	3.65586	6.01354	0.0049	0.3365	0.3096	489.0419	0.1547
Graders	2023	0.3898	3.45006	3.54785	0.0049	0.1953	0.1797	478.4629	0.1547
Rubber Tired Loaders	2017	0.3727	1.4172	4.75473	0.0048	0.162	0.149	495.9499	0.152
Rubber Tired Loaders	2018	0.3335	1.34644	4.13133	0.0048	0.1401	0.1289	487.9023	0.1519
Rubber Tired Loaders	2019	0.3094	1.30248	3.74452	0.0048	0.1255	0.1155	480.0997	0.1519
Rubber Tired Loaders	2023	0.2099	1.17136	2.05963	0.0049	0.069	0.0635	469.824	0.152
Tractors/Loaders/Backhoes	2017	0.5005	3.7818	4.8087	0.0049	0.3616	0.3327	502.7952	0.1541
Tractors/Loaders/Backhoes	2018	0.4204	3.69155	4.15444	0.0049	0.2943	0.2708	494.1237	0.1538
Tractors/Loaders/Backhoes	2019	0.3678	3.63777	3.69257	0.0049	0.2465	0.2268	485.8548	0.1537
Tractors/Loaders/Backhoes	2023	0.2391	3.52504	2.42607	0.0049	0.1198	0.1102	476.4307	0.1541

Source: CalEEMod User's Guide, Appendix D, Table 3.4, 2013.

TABLE 3
ALTERNATIVE 1 MITIGATED CONSTRUCTION EMISSIONS FACTORS

Equipment	Tier 4 Emission Factors (g/bhp-hr)							
	ROG	CO	NOX	SOX	PM10	PM2.5	CO2	CH4
Bore/Drill Rigs Composite	0.0600	2.2	0.26	-	0.008	0.008	-	-
Cranes Composite	0.0600	2.2	0.26	-	0.008	0.008	-	-
Forklifts Composite	0.0600	3.7	0.26	-	0.008	0.008	-	-
Generator Sets Composite	0.0600	3.7	0.26	-	0.008	0.008	-	-
Graders Composite	0.0600	2.2	0.26	-	0.008	0.008	-	-
Rubber Tired Loaders Composite	0.0600	2.2	0.26	-	0.008	0.008	-	-
Tractors/Loaders/Backhoes Composite	0.0600	3.7	0.26	-	0.008	0.008	-	-

Source: CalEEMod User's Guide, Appendix D, Table 3.5, 2013.

TABLE 4
ALTERNATIVE 1 UNMITIGATED CONSTRUCTION EMISSIONS BY ACTION ITEM

Actions	Unmitigated Emission (lbs/day)							
	ROG	CO	NOX	SOX	PM10	PM2.5	CO2	CH4
1a. Remove and relocate existing gas line	1.86	9.93	19.89	0.02	1.06	0.98	1,705.58	0.52
2a. Create swale (10,000 CY wet cut)	5.06	26.68	55.53	0.05	2.70	2.50	5,293.77	1.47
3a. Remove existing inactive gas line	1.86	9.93	19.89	0.02	1.06	0.98	1,705.58	0.52
3b. Cut and cap gas line at Fiji Way	1.86	9.93	19.89	0.02	1.06	0.98	1,705.58	0.52
4b. Construct new pedestrian/bike bridge over Ballona Creek	5.42	34.27	56.31	0.06	2.95	2.77	6,367.09	1.33
9a. Drill new well at SoCal Gas Plant to replace Del Ray 12	13.79	93.94	143.89	0.20	6.82	6.52	19,143.36	3.06
25a. Drill new well at SoCal Gas Plant to replace Del Ray 19	13.79	93.94	143.89	0.20	6.82	6.52	19,143.36	3.06
29a. Drill new well at SoCal Gas Plant to replace Del Rey 9 and Vidor 18	13.79	93.94	143.89	0.20	6.82	6.52	19,143.36	3.06
29b. Abandon and plug Vidor 1, 2, 3, 5, 14, 18 and Del Rey 4, 5, 9, 11	1.06	7.82	12.37	0.02	0.45	0.43	2,281.04	0.47
9b. Abandon and plug Del Ray 12	1.06	7.82	12.37	0.02	0.45	0.43	2,281.04	0.47
4a. Construct temporary & portion of final re-routed trail to existing trail	3.72	18.60	42.16	0.04	1.99	1.83	4,029.47	1.23
4c. Reroute Ballona Creek Bike Trail under Culver Blvd Bridge	3.72	18.60	42.16	0.04	1.99	1.83	4,029.47	1.23
5a. Build Lincoln Bridge next to Culver Bridge to connect Area A to Area C North	3.20	19.65	34.63	0.04	1.62	1.53	4,233.75	0.83
6a. Remove vegetation from Area A (54,400 CY dry cut)	8.87	43.61	99.07	0.09	4.61	4.26	9,095.45	2.63
6b. Remove trash	8.87	43.61	99.07	0.09	4.61	4.26	9,095.45	2.63
6c. Stockpile	8.87	43.61	99.07	0.09	4.61	4.26	9,095.45	2.63
7a. Remove 36" concrete pipe near center of Area A	1.86	9.93	19.89	0.02	1.06	0.98	1,705.58	0.52
7c. Dig below (over excavate) future levees (25,200 CY dry cut)	11.18	59.60	119.34	0.10	6.38	5.87	10,233.46	3.14
8a. Grade and construct new levee around Area A (125,300 CY fill)	5.42	34.27	56.31	0.06	2.95	2.77	6,367.09	1.33
9c. Remove/relocate existing pipelines	1.86	9.93	19.89	0.02	1.06	0.98	1,705.58	0.52
10a. Remove vegetation from Area B North and interim levee (25,000 CY wet cut)	8.87	43.61	99.07	0.09	4.61	4.26	9,095.45	2.63
10b. Remove trash	8.87	43.61	99.07	0.09	4.61	4.26	9,095.45	2.63
11a. Excavate Area B North (56,700 CY wet cut)	11.18	59.60	119.34	0.10	6.38	5.87	10,233.46	3.14
11b. Dig below (over excavate) future levees (11,400k CY wet cut)	11.18	59.60	119.34	0.10	6.38	5.87	10,233.46	3.14
29c. Remove existing pipelines	1.86	9.93	19.89	0.02	1.06	0.98	1,705.58	0.52

TABLE 4 (Continued)
ALTERNATIVE 1 UNMITIGATED CONSTRUCTION EMISSIONS BY ACTION ITEM

Actions	Unmitigated Emission (lbs/day)							
	ROG	CO	NOX	SOX	PM10	PM2.5	CO2	CH4
30a. Remove vegetation around wells (2,000 CY)	5.06	26.68	55.53	0.05	2.70	2.50	5,293.77	1.47
31a. Finish grading around wells	5.06	26.68	55.53	0.05	2.70	2.50	5,293.77	1.47
12a. Construct Area B levees (452,800 CY fill = total import from Area A = 566,000 CY)	12.28	68.03	131.26	0.12	6.84	6.32	12,377.19	3.48
7b. Excavate old fill from Area A (1,134,200 CY wet cut and 54,400 dry cut, see note)	11.18	59.60	119.34	0.10	6.38	5.87	10,233.46	3.14
26a. Remove vegetation around wells (2,000 CY)	4.44	25.82	48.16	0.05	2.31	2.13	5,214.18	1.46
27a. Excavate Area A and Export to West Area B (208,000 CY)	9.74	57.57	103.17	0.10	5.41	4.98	10,056.03	3.13
13a. Remove vegetation in Area B East (4,600 CY wet cut)	4.44	25.82	48.16	0.05	2.31	2.13	5,214.18	1.46
13b. Stockpile and prepare for fill	7.81	42.05	85.86	0.09	3.96	3.65	8,951.28	2.62
14a. Grade Area B east and import from Area A (80,000 CY import from Area A)	9.74	57.57	103.17	0.10	5.41	4.98	10,056.03	3.13
28a. Finish grading around wells	4.44	25.82	48.16	0.05	2.31	2.13	5,214.18	1.46
28b. Re-establish upland vegetation	4.44	25.82	48.16	0.05	2.31	2.13	5,214.18	1.46
15b. Clear vegetation from Area C North (56,000 CY dry cut) & South (15,000 CY dry cut)	7.81	42.05	85.86	0.09	3.96	3.65	8,951.28	2.62
15c. Re-align and replace Marina ditch (45,000 CY wet cut)	9.74	57.57	103.17	0.10	5.41	4.98	10,056.03	3.13
16a. Excavate Area A and export to C South (300,000 CY total)	9.74	57.57	103.17	0.10	5.41	4.98	10,056.03	3.13
16b. Excavate Area A and export to C North (720,000 CY ultimate total; 420,000 CY to C North)	9.74	57.57	103.17	0.10	5.41	4.98	10,056.03	3.13
18a. Install culverts under Culver/Jefferson Blvd, Gas Co Rd, and FWM berm; modify existing culvert under west end of Culver Blvd.	4.07	25.37	43.55	0.05	2.04	1.89	5,139.16	1.46
19a. Excavate Ballona Creek Channel in Areas A and B North (277,800 CY cut)	8.89	56.54	93.34	0.10	4.79	4.41	9,890.42	3.13
20a. Install temporary pipe	1.48	9.42	15.56	0.02	0.80	0.73	1,648.40	0.52
20b. Temporary block then fill existing Ballona Creek (269,100 CY fill from Seq 19)	8.89	56.54	93.34	0.10	4.79	4.41	9,890.42	3.13
17a. Finish grading Area C South	3.08	18.51	30.44	0.02	1.70	1.57	2,475.44	0.78
18b. Remove existing FWM pipes and outlets	4.07	25.37	43.55	0.05	2.04	1.89	5,139.16	1.46
21a. Remove old Ballona Creek levee (424,400CY) and excavate new channel meanders - Export to Area C North, quantities included in Sequence 16, ultimate.	8.89	56.54	93.34	0.10	4.79	4.41	9,890.42	3.13
18c. Construct new FWM outlet and spillway	4.07	25.37	43.55	0.05	2.04	1.89	5,139.16	1.46
22a. Construct maintenance and fire road in Area B West	2.98	17.53	33.01	0.04	1.49	1.37	3,897.27	1.23
22b. Reconstruct Area B parking lot	2.98	17.53	33.01	0.04	1.49	1.37	3,897.27	1.23
23a. Construct bike and ped trails on levees	2.98	17.53	33.01	0.04	1.49	1.37	3,897.27	1.23

TABLE 4 (Continued)
ALTERNATIVE 1 UNMITIGATED CONSTRUCTION EMISSIONS BY ACTION ITEM

Actions	Unmitigated Emission (lbs/day)							
	ROG	CO	NOX	SOX	PM10	PM2.5	CO2	CH4
23b. Construct County Parking Structure Foundation	5.87	36.61	61.94	0.08	2.91	2.70	7,444.36	2.02
23c. Construct County Parking Structure	3.02	18.43	33.94	0.05	1.36	1.27	4,663.44	1.14
24a. Export final excess dirt quantity (Assume up to 110,000 CY)	0.79	3.31	9.51	0.01	0.32	0.29	1,219.32	0.39
34a. Breach existing levee in Area B West and place in Stability berms (75,000 CY wet = 26,000 + 49,000)	5.80	53.40	55.21	0.10	2.63	2.42	9,682.94	3.13
32a. Remove vegetation in Area B West (76,000 CY)	4.75	38.66	44.87	0.09	1.97	1.82	8,641.30	2.61
33a. Install temporary flexible storm drain	2.70	23.98	25.43	0.05	1.13	1.05	5,043.91	1.45
33b. Dig below (over excavate) levees (10,800k CY wet cut)	6.46	61.71	60.70	0.12	2.85	2.63	11,782.28	3.45
33c. Grade Area B West channels, construct salt pan berm, and construct levee with import from stockpile from Area B North and East at 248,000 CY (31,200 + 216,800 CY (291,800 less 49,000 and 26,000))	6.46	61.71	60.70	0.12	2.85	2.63	11,782.28	3.45
35a. Construct maintenance and fire access road and bike path on new levee.	1.97	16.41	19.14	0.04	0.80	0.74	3,815.40	1.23
36a. Finish grading Area B East	1.97	17.46	17.96	0.02	0.99	0.91	2,421.89	0.78

TABLE 5
ALTERNATIVE 1 MITIGATED CONSTRUCTION EMISSIONS BY ACTION ITEM

Actions	Mitigated Emission (lbs/day)							
	ROG	CO	NOX	SOX	PM10	PM2.5	CO2	CH4
1a. Remove and relocate existing gas line	0.20	9.93	0.88	0.02	0.03	0.03	1,705.58	0.52
2a. Create swale (10,000 CY wet cut)	0.63	26.68	2.71	0.05	0.08	0.08	5,293.77	1.47
3a. Remove existing inactive gas line	0.20	9.93	0.88	0.02	0.03	0.03	1,705.58	0.52
3b. Cut and cap gas line at Fiji Way	0.20	9.93	0.88	0.02	0.03	0.03	1,705.58	0.52
4b. Construct new pedestrian/bike bridge over Ballona Creek	0.73	34.27	3.16	0.06	0.10	0.10	6,367.09	1.33
9a. Drill new well at SoCal Gas Plant to replace Del Ray 12	2.14	93.94	9.27	0.20	0.29	0.29	19,143.36	3.06
25a. Drill new well at SoCal Gas Plant to replace Del Ray 19	2.14	93.94	9.27	0.20	0.29	0.29	19,143.36	3.06
29a. Drill new well at SoCal Gas Plant to replace Del Rey 9 and Vidor 18	2.14	93.94	9.27	0.20	0.29	0.29	19,143.36	3.06
29b. Abandon and plug Vidor 1, 2, 3, 5, 14, 18 and Del Rey 4, 5, 9, 11	0.26	7.82	1.14	0.02	0.03	0.03	2,281.04	0.47
9b. Abandon and plug Del Ray 12	0.26	7.82	1.14	0.02	0.03	0.03	2,281.04	0.47
4a. Construct temporary & portion of final re-routed trail to existing trail	0.48	18.60	2.10	0.04	0.06	0.06	4,029.47	1.23
4c. Reroute Ballona Creek Bike Trail under Culver Blvd Bridge	0.48	18.60	2.10	0.04	0.06	0.06	4,029.47	1.23
5a. Build Lincoln Bridge next to Culver Bridge to connect Area A to Area C North	0.48	19.65	2.09	0.04	0.06	0.06	4,233.75	0.83
6a. Remove vegetation from Area A (54,400 CY dry cut)	1.08	43.61	4.69	0.09	0.14	0.14	9,095.45	2.63
6b. Remove trash	1.08	43.61	4.69	0.09	0.14	0.14	9,095.45	2.63
6c. Stockpile	1.08	43.61	4.69	0.09	0.14	0.14	9,095.45	2.63
7a. Remove 36" concrete pipe near center of Area A	0.20	9.93	0.88	0.02	0.03	0.03	1,705.58	0.52
7c. Dig below (over excavate) future levees (25,200 CY dry cut)	1.22	59.60	5.30	0.10	0.16	0.16	10,233.46	3.14
8a. Grade and construct new levee around Area A (125,300 CY fill)	0.73	34.27	3.16	0.06	0.10	0.10	6,367.09	1.33
9c. Remove/relocate existing pipelines	0.20	9.93	0.88	0.02	0.03	0.03	1,705.58	0.52
10a. Remove vegetation from Area B North and interim levee (25,000 CY wet cut)	1.08	43.61	4.69	0.09	0.14	0.14	9,095.45	2.63
10b. Remove trash	1.08	43.61	4.69	0.09	0.14	0.14	9,095.45	2.63
11a. Excavate Area B North (56,700 CY wet cut)	1.22	59.60	5.30	0.10	0.16	0.16	10,233.46	3.14
11b. Dig below (over excavate) future levees (11,400k CY wet cut)	1.22	59.60	5.30	0.10	0.16	0.16	10,233.46	3.14
29c. Remove existing pipelines	0.20	9.93	0.88	0.02	0.03	0.03	1,705.58	0.52
30a. Remove vegetation around wells (2,000 CY)	0.63	26.68	2.71	0.05	0.08	0.08	5,293.77	1.47
31a. Finish grading around wells	0.63	26.68	2.71	0.05	0.08	0.08	5,293.77	1.47

TABLE 5 (Continued)
ALTERNATIVE 1 MITIGATED CONSTRUCTION EMISSIONS BY ACTION ITEM

Actions	Mitigated Emission (lbs/day)							
	ROG	CO	NOX	SOX	PM10	PM2.5	CO2	CH4
7b. Excavate old fill from Area A (1,134,200 CY wet cut and 54,400 dry cut, see note)	1.22	59.60	5.30	0.10	0.16	0.16	10,233.46	3.14
7b. Excavate old fill from Area A (1,134,200 CY wet cut and 54,400 dry cut, see note)	1.22	59.60	5.30	0.10	0.16	0.16	10,233.46	3.14
12a. Construct Area B levees (452,800 CY fill = total import from Area A = 566,000 CY)	1.46	68.03	6.35	0.12	0.20	0.20	12,377.19	3.48
26a. Remove vegetation around wells (2,000 CY)	0.63	25.82	2.71	0.05	0.08	0.08	5,214.18	1.46
27a. Excavate Area A and Export to West Area B (208,000 CY)	1.22	57.57	5.30	0.10	0.16	0.16	10,056.03	3.13
13a. Remove vegetation in Area B East (4,600 CY wet cut)	0.63	25.82	2.71	0.05	0.08	0.08	5,214.18	1.46
13b. Stockpile and prepare for fill	1.08	42.05	4.69	0.09	0.14	0.14	8,951.28	2.62
14a. Grade Area B east and import from Area A (80,000 CY import from Area A)	1.22	57.57	5.30	0.10	0.16	0.16	10,056.03	3.13
28a. Finish grading around wells	0.63	25.82	2.71	0.05	0.08	0.08	5,214.18	1.46
28b. Re-establish upland vegetation	0.63	25.82	2.71	0.05	0.08	0.08	5,214.18	1.46
15b. Clear vegetation from Area C North (56,000 CY dry cut) & South (15,000 CY dry cut)	1.08	42.05	4.69	0.09	0.14	0.14	8,951.28	2.62
15c. Re-align and replace Marina ditch (45,000 CY wet cut)	1.22	57.57	5.30	0.10	0.16	0.16	10,056.03	3.13
16a. Excavate Area A and export to C South (300,000 CY total)	1.22	57.57	5.30	0.10	0.16	0.16	10,056.03	3.13
16b. Excavate Area A and export to C North (720,000 CY ultimate total; 420,000 CY to C North)	1.22	57.57	5.30	0.10	0.16	0.16	10,056.03	3.13
18a. Install culverts under Culver/Jefferson Blvd, Gas Co Rd, and FWM berm; modify existing culvert under west end of Culver Blvd.	0.63	25.37	2.71	0.05	0.08	0.08	5,139.16	1.46
19a. Excavate Ballona Creek Channel in Areas A and B North (277,800 CY cut)	1.22	56.54	5.30	0.10	0.16	0.16	9,890.42	3.13
20a. Install temporary pipe	0.20	9.42	0.88	0.02	0.03	0.03	1,648.40	0.52
20b. Temporary block then fill existing Ballona Creek (269,100 CY fill from Seq 19)	1.22	56.54	5.30	0.10	0.16	0.16	9,890.42	3.13
17a. Finish grading Area C South	0.30	18.51	1.32	0.02	0.04	0.04	2,475.44	0.78
18b. Remove existing FWM pipes and outlets	0.63	25.37	2.71	0.05	0.08	0.08	5,139.16	1.46
21a. Remove old Ballona Creek levee (424,400CY) and excavate new channel meanders - Export to Area C North, quantities included in Sequence 16, ultimate.	1.22	56.54	5.30	0.10	0.16	0.16	9,890.42	3.13
18c. Construct new FWM outlet and spillway	0.63	25.37	2.71	0.05	0.08	0.08	5,139.16	1.46
22a. Construct maintenance and fire road in Area B West	0.48	17.53	2.10	0.04	0.06	0.06	3,897.27	1.23
22b. Reconstruct Area B parking lot	0.48	17.53	2.10	0.04	0.06	0.06	3,897.27	1.23
23a. Construct bike and ped trails on levees	0.48	17.53	2.10	0.04	0.06	0.06	3,897.27	1.23
23b. Construct County Parking Structure Foundation	0.90	36.61	3.90	0.08	0.12	0.12	7,444.36	2.02
23c. Construct County Parking Structure	0.56	18.43	2.42	0.05	0.07	0.07	4,663.44	1.14

TABLE 5 (Continued)
ALTERNATIVE 1 MITIGATED CONSTRUCTION EMISSIONS BY ACTION ITEM

Actions	Mitigated Emission (lbs/day)							
	ROG	CO	NOX	SOX	PM10	PM2.5	CO2	CH4
24a. Export final excess dirt quantity (Assume up to 110,000 CY)	0.15	3.31	0.66	0.01	0.02	0.02	1,219.32	0.39
34a. Breach existing levee in Area B West and place in Stability berms (75,000 CY wet = 26,000 + 49,000)	1.22	53.40	5.30	0.10	0.16	0.16	9,682.94	3.13
32a. Remove vegetation in Area B West (76,000 CY)	1.08	38.66	4.69	0.09	0.14	0.14	8,641.30	2.61
33a. Install temporary flexible storm drain	0.63	23.98	2.71	0.05	0.08	0.08	5,043.91	1.45
33b. Dig below (over excavate) levees (10,800k CY wet cut)	1.46	61.71	6.35	0.12	0.20	0.20	11,782.28	3.45
33c. Grade Area B West channels, construct salt pan berm, and construct levee with import from stockpile from Area B North and East at 248,000 CY (31,200 + 216,800 CY (291,800 less 49,000 and 26,000))	1.46	61.71	6.35	0.12	0.20	0.20	11,782.28	3.45
35a. Construct maintenance and fire access road and bike path on new levee.	0.48	16.41	2.10	0.04	0.06	0.06	3,815.40	1.23
36a. Finish grading Area B East	0.30	17.46	1.32	0.02	0.04	0.04	2,421.89	0.78

Off-Road Construction Emissions during Alternative 2

TABLE 6
ALTERNATIVE 2 EQUIPMENT LIST

OFFROAD Equipment Type	Horsepower	Load Factor
Backhoe	98	0.5
Crane	226	0.29
Drill Rig	206	0.5
Forklift	89	0.2
Generator Set	84	0.74
Grader	175	0.41
Loader	200	0.36
Note: Equipment horse power and load factors were obtained from CalEEMod User's Guide, Appendix D, 2013.		

TABLE 7
ALTERNATIVE 2 UNMITIGATED CONSTRUCTION EMISSIONS FACTORS

Equipment	Model Year	Unmitigated Emission Factors (g/bhp-hr)							
		ROG	CO	NOX	SOX	PM10	PM2.5	CO2	CH4
Bore/Drill Rigs	2017	0.1735	1.1021	2.5215	0.0048	0.0725	0.0667	494.1381	0.1514
Bore/Drill Rigs	2018	0.1545	1.07328	2.15308	0.0048	0.0608	0.056	484.5605	0.1509
Bore/Drill Rigs	2019	0.1434	1.06058	1.8943	0.0048	0.0537	0.0494	475.7896	0.1505
Bore/Drill Rigs	2023	0.1104	1.04309	1.04653	0.0049	0.0339	0.0312	469.7058	0.1519
Cranes	2017	0.5606	2.38452	6.65526	0.0049	0.2967	0.273	499.3721	0.153
Cranes	2018	0.4831	2.13445	5.77298	0.0049	0.2499	0.2299	491.4069	0.153
Cranes	2019	0.4266	1.94079	5.0842	0.0049	0.2155	0.1983	483.4616	0.153
Cranes	2023	0.2974	1.55262	3.22938	0.0049	0.1349	0.1241	472.9738	0.153
Forklifts	2017	0.6719	3.97881	5.81772	0.0049	0.48	0.4416	497.7245	0.1525
Forklifts	2018	0.5674	3.85819	5.0153	0.0049	0.4002	0.3682	489.8657	0.1525
Forklifts	2019	0.5095	3.80391	4.54965	0.0049	0.3525	0.3243	482.0069	0.1525
Forklifts	2023	0.3266	3.64655	3.0569	0.0049	0.1889	0.1738	471.5285	0.1525
Generator Sets	2017	0.356	2.931	3.347	0.006	0.151	0.151	568.299	0.032
Generator Sets	2018	0.319	2.93	2.989	0.006	0.133	0.133	568.299	0.028
Generator Sets	2019	0.29	2.929	2.669	0.006	0.118	0.118	568.299	0.026
Generator Sets	2023	0.211	2.927	1.635	0.006	0.071	0.071	568.299	0.019
Graders	2017	0.7571	3.84518	7.66265	0.0049	0.4304	0.396	506.7478	0.1553
Graders	2018	0.6614	3.70957	6.60465	0.0049	0.3713	0.3416	497.3767	0.1548
Graders	2019	0.6088	3.65586	6.01354	0.0049	0.3365	0.3096	489.0419	0.1547
Graders	2023	0.3898	3.45006	3.54785	0.0049	0.1953	0.1797	478.4629	0.1547
Rubber Tired Loaders	2017	0.3727	1.4172	4.75473	0.0048	0.162	0.149	495.9499	0.152
Rubber Tired Loaders	2018	0.3335	1.34644	4.13133	0.0048	0.1401	0.1289	487.9023	0.1519
Rubber Tired Loaders	2019	0.3094	1.30248	3.74452	0.0048	0.1255	0.1155	480.0997	0.1519
Rubber Tired Loaders	2023	0.2099	1.17136	2.05963	0.0049	0.069	0.0635	469.824	0.152
Tractors/Loaders/Backhoes	2017	0.5005	3.7818	4.8087	0.0049	0.3616	0.3327	502.7952	0.1541

TABLE 7 (Continued)
ALTERNATIVE 2 UNMITIGATED CONSTRUCTION EMISSIONS FACTORS

Equipment	Model Year	Unmitigated Emission Factors (g/bhp-hr)							
		ROG	CO	NOX	SOX	PM10	PM2.5	CO2	CH4
Tractors/Loaders/Backhoes	2018	0.4204	3.69155	4.15444	0.0049	0.2943	0.2708	494.1237	0.1538
Tractors/Loaders/Backhoes	2019	0.3678	3.63777	3.69257	0.0049	0.2465	0.2268	485.8548	0.1537
Tractors/Loaders/Backhoes	2023	0.2391	3.52504	2.42607	0.0049	0.1198	0.1102	476.4307	0.1541

Source: CalEEMod User's Guide, Appendix D, Table 3.4, 2013.

TABLE 8
ALTERNATIVE 2 MITIGATED CONSTRUCTION EMISSIONS FACTORS

Equipment	Tier 4 Emission Factors (g/bhp-hr)							
	ROG	CO	NOX	SOX	PM10	PM2.5	CO2	CH4
Bore/Drill Rigs Composite	0.0600	2.2	0.26	-	0.008	0.008	-	-
Cranes Composite	0.0600	2.2	0.26	-	0.008	0.008	-	-
Forklifts Composite	0.0600	3.7	0.26	-	0.008	0.008	-	-
Generator Sets Composite	0.0600	3.7	0.26	-	0.008	0.008	-	-
Graders Composite	0.0600	2.2	0.26	-	0.008	0.008	-	-
Rubber Tired Loaders Composite	0.0600	2.2	0.26	-	0.008	0.008	-	-
Tractors/Loaders/Backhoes Composite	0.0600	3.7	0.26	-	0.008	0.008	-	-

Source: CalEEMod User's Guide, Appendix D, Table 3.5, 2013.

TABLE 9
ALTERNATIVE 2 UNMITIGATED CONSTRUCTION EMISSIONS BY ACTION ITEM

Actions	Unmitigated Emission (lbs/day)							
	ROG	CO	NOX	SOX	PM10	PM2.5	CO2	CH4
1a. Remove and relocate existing gas line	1.86	9.93	19.89	0.02	1.06	0.98	1,705.58	0.52
2a. Create swale (10,000 CY wet cut)	5.06	26.68	55.53	0.05	2.70	2.50	5,293.77	1.47
3a. Remove existing inactive gas line	1.86	9.93	19.89	0.02	1.06	0.98	1,705.58	0.52
3b. Cut and cap gas line at Fiji Way	1.86	9.93	19.89	0.02	1.06	0.98	1,705.58	0.52
4b. Construct new pedestrian/bike bridge over Ballona Creek	5.42	34.27	56.31	0.06	2.95	2.77	6,367.09	1.33
9a. Drill new well at SoCal Gas Plant to replace Del Ray 12	13.79	93.94	143.89	0.20	6.82	6.52	19,143.36	3.06
9b. Abandon and plug Del Ray 12	1.06	7.82	12.37	0.02	0.45	0.43	2,281.04	0.47
4a. Construct temporary & portion of final re-routed trail to existing trail	3.72	18.60	42.16	0.04	1.99	1.83	4,029.47	1.23
4c. Reroute Ballona Creek Bike Trail under Culver Blvd Bridge	3.72	18.60	42.16	0.04	1.99	1.83	4,029.47	1.23
5a. Build Lincoln Bridge next to Culver Bridge to connect Area A to Area C North	3.20	19.65	34.63	0.04	1.62	1.53	4,233.75	0.83
6a. Remove vegetation from Area A (54,400 CY dry cut)	8.87	43.61	99.07	0.09	4.61	4.26	9,095.45	2.63
6b. Remove trash	8.87	43.61	99.07	0.09	4.61	4.26	9,095.45	2.63
6c. Stockpile	8.87	43.61	99.07	0.09	4.61	4.26	9,095.45	2.63
7a. Remove 36" concrete pipe near center of Area A	1.86	9.93	19.89	0.02	1.06	0.98	1,705.58	0.52
7c. Dig below (over excavate) future levees (25,200 CY dry cut)	11.18	59.60	119.34	0.10	6.38	5.87	10,233.46	3.14
8a. Grade and construct new levee around Area A (125,300 CY fill)	5.42	34.27	56.31	0.06	2.95	2.77	6,367.09	1.33
9c. Remove/relocate existing pipelines	1.86	9.93	19.89	0.02	1.06	0.98	1,705.58	0.52
10a. Remove vegetation from Area B North and interim levee (25,000 CY wet cut)	8.87	43.61	99.07	0.09	4.61	4.26	9,095.45	2.63
10b. Remove trash	8.87	43.61	99.07	0.09	4.61	4.26	9,095.45	2.63
11a. Excavate Area B North (56,700 CY wet cut)	11.18	59.60	119.34	0.10	6.38	5.87	10,233.46	3.14
11b. Dig below (over excavate) future levees (11,400k CY wet cut)	11.18	59.60	119.34	0.10	6.38	5.87	10,233.46	3.14
12a. Construct Area B levees (452,800 CY fill = total import from Area A = 566,000 CY)	12.28	68.03	131.26	0.12	6.84	6.32	12,377.19	3.48
7b. Excavate old fill from Area A (1,134,200 CY wet cut and 54,400 dry cut, see note)	11.18	59.60	119.34	0.10	6.38	5.87	10,233.46	3.14
12a. Construct Area B levees (452,800 CY fill = total import from Area A = 566,000 CY)	12.28	68.03	131.26	0.12	6.84	6.32	12,377.19	3.48
26a. Remove vegetation around wells (2,000 CY)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27a. Excavate Area A and Export to West Area B (208,000 CY)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13a. Remove vegetation in Area B East (4,600 CY wet cut)	4.44	25.82	48.16	0.05	2.31	2.13	5,214.18	1.46

TABLE 9 (Continued)
ALTERNATIVE 2 UNMITIGATED CONSTRUCTION EMISSIONS BY ACTION ITEM

Actions	Unmitigated Emission (lbs/day)							
	ROG	CO	NOX	SOX	PM10	PM2.5	CO2	CH4
13b. Stockpile and prepare for fill	7.81	42.05	85.86	0.09	3.96	3.65	8,951.28	2.62
14a. Grade Area B east and import from Area A (80,000 CY import from Area A)	9.74	57.57	103.17	0.10	5.41	4.98	10,056.03	3.13
15b. Clear vegetation from Area C North (56,000 CY dry cut) & South (15,000 CY dry cut)	7.81	42.05	85.86	0.09	3.96	3.65	8,951.28	2.62
15c. Re-align and replace Marina ditch (45,000 CY wet cut)	9.74	57.57	103.17	0.10	5.41	4.98	10,056.03	3.13
16a. Excavate Area A and export to C South (300,000 CY total)	9.74	57.57	103.17	0.10	5.41	4.98	10,056.03	3.13
16b. Excavate Area A and export to C North (720,000 CY ultimate total; 420,000 CY to C North)	9.74	57.57	103.17	0.10	5.41	4.98	10,056.03	3.13
18a. Install culverts under Culver/Jefferson Blvd, Gas Co Rd, and FWM berm; modify existing culvert under west end of Culver Blvd.	4.07	25.37	43.55	0.05	2.04	1.89	5,139.16	1.46
19a. Excavate Ballona Creek Channel in Areas A and B North (277,800 CY cut)	8.89	56.54	93.34	0.10	4.79	4.41	9,890.42	3.13
20a. Install temporary pipe	1.48	9.42	15.56	0.02	0.80	0.73	1,648.40	0.52
20b. Temporary block then fill existing Ballona Creek (269,100 CY fill from Seq 19)	8.89	56.54	93.34	0.10	4.79	4.41	9,890.42	3.13
17a. Finish grading Area C South	3.08	18.51	30.44	0.02	1.70	1.57	2,475.44	0.78
18b. Remove existing FWM pipes and outlets	4.07	25.37	43.55	0.05	2.04	1.89	5,139.16	1.46
21a. Remove old Ballona Creek levee (424,400CY) and excavate new channel meanders - Export to Area C North, quantities included in Sequence 16, ultimate.	8.89	56.54	93.34	0.10	4.79	4.41	9,890.42	3.13
18c. Construct new FWM outlet and spillway	4.07	25.37	43.55	0.05	2.04	1.89	5,139.16	1.46
22a. Construct maintenance and fire road in Area B West	2.98	17.53	33.01	0.04	1.49	1.37	3,897.27	1.23
22b. Reconstruct Area B parking lot	2.98	17.53	33.01	0.04	1.49	1.37	3,897.27	1.23
23a. Construct bike and ped trails on levees	2.98	17.53	33.01	0.04	1.49	1.37	3,897.27	1.23
23b. Construct County Parking Structure Foundation	5.87	36.61	61.94	0.08	2.91	2.70	7,444.36	2.02
23c. Construct County Parking Structure	3.02	18.43	33.94	0.05	1.36	1.27	4,663.44	1.14
24a. Export final excess dirt quantity (Assume up to 110,000 CY)	0.79	3.31	9.51	0.01	0.32	0.29	1,219.32	0.39

TABLE 10
ALTERNATIVE 2 MITIGATED CONSTRUCTION EMISSIONS BY ACTION ITEM

Actions	Mitigated Emission (lbs/day)							
	ROG	CO	NOX	SOX	PM10	PM2.5	CO2	CH4
1a. Remove and relocate existing gas line	0.20	9.93	0.88	0.02	0.03	0.03	1,705.58	0.52
2a. Create swale (10,000 CY wet cut)	0.63	26.68	2.71	0.05	0.08	0.08	5,293.77	1.47
3a. Remove existing inactive gas line	0.20	9.93	0.88	0.02	0.03	0.03	1,705.58	0.52
3b. Cut and cap gas line at Fiji Way	0.20	9.93	0.88	0.02	0.03	0.03	1,705.58	0.52
4b. Construct new pedestrian/bike bridge over Ballona Creek	0.73	34.27	3.16	0.06	0.10	0.10	6,367.09	1.33
9a. Drill new well at SoCal Gas Plant to replace Del Ray 12	2.14	93.94	9.27	0.20	0.29	0.29	19,143.36	3.06
9b. Abandon and plug Del Ray 12	0.26	7.82	1.14	0.02	0.03	0.03	2,281.04	0.47
4a. Construct temporary & portion of final re-routed trail to existing trail	0.48	18.60	2.10	0.04	0.06	0.06	4,029.47	1.23
4c. Reroute Ballona Creek Bike Trail under Culver Blvd Bridge	0.48	18.60	2.10	0.04	0.06	0.06	4,029.47	1.23
5a. Build Lincoln Bridge next to Culver Bridge to connect Area A to Area C North	0.48	19.65	2.09	0.04	0.06	0.06	4,233.75	0.83
6a. Remove vegetation from Area A (54,400 CY dry cut)	1.08	43.61	4.69	0.09	0.14	0.14	9,095.45	2.63
6b. Remove trash	1.08	43.61	4.69	0.09	0.14	0.14	9,095.45	2.63
6c. Stockpile	1.08	43.61	4.69	0.09	0.14	0.14	9,095.45	2.63
7a. Remove 36" concrete pipe near center of Area A	0.20	9.93	0.88	0.02	0.03	0.03	1,705.58	0.52
7c. Dig below (over excavate) future levees (25,200 CY dry cut)	1.22	59.60	5.30	0.10	0.16	0.16	10,233.46	3.14
8a. Grade and construct new levee around Area A (125,300 CY fill)	0.73	34.27	3.16	0.06	0.10	0.10	6,367.09	1.33
9c. Remove/relocate existing pipelines	0.20	9.93	0.88	0.02	0.03	0.03	1,705.58	0.52
10a. Remove vegetation from Area B North and interim levee (25,000 CY wet cut)	1.08	43.61	4.69	0.09	0.14	0.14	9,095.45	2.63
10b. Remove trash	1.08	43.61	4.69	0.09	0.14	0.14	9,095.45	2.63
11a. Excavate Area B North (56,700 CY wet cut)	1.22	59.60	5.30	0.10	0.16	0.16	10,233.46	3.14
11b. Dig below (over excavate) future levees (11,400k CY wet cut)	1.22	59.60	5.30	0.10	0.16	0.16	10,233.46	3.14
12a. Construct Area B levees (452,800 CY fill = total import from Area A = 566,000 CY)	1.46	68.03	6.35	0.12	0.20	0.20	12,377.19	3.48
7b. Excavate old fill from Area A (1,134,200 CY wet cut and 54,400 dry cut, see note)	1.22	59.60	5.30	0.10	0.16	0.16	10,233.46	3.14
13a. Remove vegetation in Area B East (4,600 CY wet cut)	0.63	25.82	2.71	0.05	0.08	0.08	5,214.18	1.46
13b. Stockpile and prepare for fill	1.08	42.05	4.69	0.09	0.14	0.14	8,951.28	2.62
14a. Grade Area B east and import from Area A (80,000 CY import from Area A)	1.22	57.57	5.30	0.10	0.16	0.16	10,056.03	3.13
15b. Clear vegetation from Area C North (56,000 CY dry cut) & South (15,000 CY dry cut)	1.08	42.05	4.69	0.09	0.14	0.14	8,951.28	2.62

TABLE 10 (Continued)
ALTERNATIVE 2 MITIGATED CONSTRUCTION EMISSIONS BY ACTION ITEM

Actions	Mitigated Emission (lbs/day)							
	ROG	CO	NOX	SOX	PM10	PM2.5	CO2	CH4
15c. Re-align and replace Marina ditch (45,000 CY wet cut)	1.22	57.57	5.30	0.10	0.16	0.16	10,056.03	3.13
16a. Excavate Area A and export to C South (300,000 CY total)	1.22	57.57	5.30	0.10	0.16	0.16	10,056.03	3.13
16b. Excavate Area A and export to C North (720,000 CY ultimate total; 420,000 CY to C North)	1.22	57.57	5.30	0.10	0.16	0.16	10,056.03	3.13
18a. Install culverts under Culver/Jefferson Blvd, Gas Co Rd, and FWM berm; modify existing culvert under west end of Culver Blvd.	0.63	25.37	2.71	0.05	0.08	0.08	5,139.16	1.46
19a. Excavate Ballona Creek Channel in Areas A and B North (277,800 CY cut)	1.22	56.54	5.30	0.10	0.16	0.16	9,890.42	3.13
20a. Install temporary pipe	0.20	9.42	0.88	0.02	0.03	0.03	1,648.40	0.52
20b. Temporary block then fill existing Ballona Creek (269,100 CY fill from Seq 19)	1.22	56.54	5.30	0.10	0.16	0.16	9,890.42	3.13
17a. Finish grading Area C South	0.30	18.51	1.32	0.02	0.04	0.04	2,475.44	0.78
18b. Remove existing FWM pipes and outlets	0.63	25.37	2.71	0.05	0.08	0.08	5,139.16	1.46
21a. Remove old Ballona Creek levee (424,400CY) and excavate new channel meanders - Export to Area C North, quantities included in Sequence 16, ultimate.	1.22	56.54	5.30	0.10	0.16	0.16	9,890.42	3.13
18c. Construct new FWM outlet and spillway	0.63	25.37	2.71	0.05	0.08	0.08	5,139.16	1.46
22a. Construct maintenance and fire road in Area B West	0.48	17.53	2.10	0.04	0.06	0.06	3,897.27	1.23
22b. Reconstruct Area B parking lot	0.48	17.53	2.10	0.04	0.06	0.06	3,897.27	1.23
23a. Construct bike and ped trails on levees	0.48	17.53	2.10	0.04	0.06	0.06	3,897.27	1.23
23b. Construct County Parking Structure Foundation	0.90	36.61	3.90	0.08	0.12	0.12	7,444.36	2.02
23c. Construct County Parking Structure	0.56	18.43	2.42	0.05	0.07	0.07	4,663.44	1.14
24a. Export final excess dirt quantity (Assume up to 110,000 CY)	0.15	3.31	0.66	0.01	0.02	0.02	1,219.32	0.39

Off-Road Construction Emissions during Alternative 3

TABLE 11
ALTERNATIVE 3 EQUIPMENT LIST

OFFROAD Equipment Type	Horsepower	Load Factor
Backhoe	98	0.5
Crane	226	0.29
Drill Rig	206	0.5
Forklift	89	0.2
Generator Set	84	0.74
Grader	175	0.41
Loader	200	0.36
Note: Equipment horse power and load factors were obtained from CalEEMod User's Guide, Appendix D, 2013.		

TABLE 12
ALTERNATIVE 3 UNMITIGATED CONSTRUCTION EMISSIONS FACTORS

Equipment	Model Year	Unmitigated Emission Factors (g/bhp-hr)							
		ROG	CO	NOX	SOX	PM10	PM2.5	CO2	CH4
Bore/Drill Rigs	2017	0.1735	1.1021	2.5215	0.0048	0.0725	0.0667	494.1381	0.1514
Bore/Drill Rigs	2018	0.1545	1.07328	2.15308	0.0048	0.0608	0.056	484.5605	0.1509
Bore/Drill Rigs	2019	0.1434	1.06058	1.8943	0.0048	0.0537	0.0494	475.7896	0.1505
Bore/Drill Rigs	2023	0.1104	1.04309	1.04653	0.0049	0.0339	0.0312	469.7058	0.1519
Cranes	2017	0.5606	2.38452	6.65526	0.0049	0.2967	0.273	499.3721	0.153
Cranes	2018	0.4831	2.13445	5.77298	0.0049	0.2499	0.2299	491.4069	0.153
Cranes	2019	0.4266	1.94079	5.0842	0.0049	0.2155	0.1983	483.4616	0.153
Cranes	2023	0.2974	1.55262	3.22938	0.0049	0.1349	0.1241	472.9738	0.153
Forklifts	2017	0.6719	3.97881	5.81772	0.0049	0.48	0.4416	497.7245	0.1525
Forklifts	2018	0.5674	3.85819	5.0153	0.0049	0.4002	0.3682	489.8657	0.1525
Forklifts	2019	0.5095	3.80391	4.54965	0.0049	0.3525	0.3243	482.0069	0.1525
Forklifts	2023	0.3266	3.64655	3.0569	0.0049	0.1889	0.1738	471.5285	0.1525
Generator Sets	2017	0.356	2.931	3.347	0.006	0.151	0.151	568.299	0.032
Generator Sets	2018	0.319	2.93	2.989	0.006	0.133	0.133	568.299	0.028
Generator Sets	2019	0.29	2.929	2.669	0.006	0.118	0.118	568.299	0.026
Generator Sets	2023	0.211	2.927	1.635	0.006	0.071	0.071	568.299	0.019
Graders	2017	0.7571	3.84518	7.66265	0.0049	0.4304	0.396	506.7478	0.1553
Graders	2018	0.6614	3.70957	6.60465	0.0049	0.3713	0.3416	497.3767	0.1548
Graders	2019	0.6088	3.65586	6.01354	0.0049	0.3365	0.3096	489.0419	0.1547
Graders	2023	0.3898	3.45006	3.54785	0.0049	0.1953	0.1797	478.4629	0.1547
Rubber Tired Loaders	2017	0.3727	1.4172	4.75473	0.0048	0.162	0.149	495.9499	0.152
Rubber Tired Loaders	2018	0.3335	1.34644	4.13133	0.0048	0.1401	0.1289	487.9023	0.1519
Rubber Tired Loaders	2019	0.3094	1.30248	3.74452	0.0048	0.1255	0.1155	480.0997	0.1519
Rubber Tired Loaders	2023	0.2099	1.17136	2.05963	0.0049	0.069	0.0635	469.824	0.152
Tractors/Loaders/Backhoes	2017	0.5005	3.7818	4.8087	0.0049	0.3616	0.3327	502.7952	0.1541
Tractors/Loaders/Backhoes	2018	0.4204	3.69155	4.15444	0.0049	0.2943	0.2708	494.1237	0.1538
Tractors/Loaders/Backhoes	2019	0.3678	3.63777	3.69257	0.0049	0.2465	0.2268	485.8548	0.1537
Tractors/Loaders/Backhoes	2023	0.2391	3.52504	2.42607	0.0049	0.1198	0.1102	476.4307	0.1541

Source: CalEEMod User's Guide, Appendix D, Table 3.4, 2013.

TABLE 13
ALTERNATIVE 3 MITIGATED CONSTRUCTION EMISSIONS FACTORS

Equipment	Tier 4 Emission Factors (g/bhp-hr)							
	ROG	CO	NOX	SOX	PM10	PM2.5	CO2	CH4
Bore/Drill Rigs Composite	0.0600	2.2	0.26	-	0.008	0.008	-	-
Cranes Composite	0.0600	2.2	0.26	-	0.008	0.008	-	-
Forklifts Composite	0.0600	3.7	0.26	-	0.008	0.008	-	-
Generator Sets Composite	0.0600	3.7	0.26	-	0.008	0.008	-	-
Graders Composite	0.0600	2.2	0.26	-	0.008	0.008	-	-
Rubber Tired Loaders Composite	0.0600	2.2	0.26	-	0.008	0.008	-	-
Tractors/Loaders/Backhoes Composite	0.0600	3.7	0.26	-	0.008	0.008	-	-

Source: CalEEMod User's Guide, Appendix D, Table 3.5, 2013.

TABLE 14
ALTERNATIVE 3 UNMITIGATED CONSTRUCTION EMISSIONS BY ACTION ITEM

Actions	Mitigated Emission (lbs/day)							
	ROG	CO	NOX	SOX	PM10	PM2.5	CO2	CH4
1a. Remove and relocate existing gas line	1.86	9.93	19.89	0.02	1.06	0.98	1,705.58	0.52
2a. Create swale (10,000 CY wet cut)	5.06	26.68	55.53	0.05	2.70	2.50	5,293.77	1.47
3a. Remove existing inactive gas line	1.86	9.93	19.89	0.02	1.06	0.98	1,705.58	0.52
3b. Cut and cap gas line at Fiji Way	1.86	9.93	19.89	0.02	1.06	0.98	1,705.58	0.52
9a. Drill new well at SoCal Gas Plant to replace Del Ray 12	13.79	93.94	143.89	0.20	6.82	6.52	19,143.36	3.06
25a. Drill new well at SoCal Gas Plant to replace Del Ray 19	13.79	93.94	143.89	0.20	6.82	6.52	19,143.36	3.06
29a. Drill new well at SoCal Gas Plant to replace Del Rey 9 and Vidor 18	13.79	93.94	143.89	0.20	6.82	6.52	19,143.36	3.06
9b. Abandon and plug Del Ray 12	1.06	7.82	12.37	0.02	0.45	0.43	2,281.04	0.47
6a. Remove vegetation from Area A (54,400 CY dry cut)	8.87	43.61	99.07	0.09	4.61	4.26	9,095.45	2.63
6b. Remove trash	8.87	43.61	99.07	0.09	4.61	4.26	9,095.45	2.63
6c. Stockpile	8.87	43.61	99.07	0.09	4.61	4.26	9,095.45	2.63
7a. Remove 36" concrete pipe near center of Area A	1.86	9.93	19.89	0.02	1.06	0.98	1,705.58	0.52
7c. Dig below (over excavate) future levees (25,200 CY dry cut)	11.18	59.60	119.34	0.10	6.38	5.87	10,233.46	3.14
8a. Grade and construct new levee around Area A (125,300 CY fill)	5.42	34.27	56.31	0.06	2.95	2.77	6,367.09	1.33
9c. Remove/relocate existing pipelines	1.86	9.93	19.89	0.02	1.06	0.98	1,705.58	0.52
7b. Excavate old fill from Area A (1,134,200 CY wet cut and 54,400 dry cut, see note)	11.18	59.60	119.34	0.10	6.38	5.87	10,233.46	3.14
7b. Excavate old fill from Area A (1,134,200 CY wet cut and 54,400 dry cut, see note)	11.18	59.60	119.34	0.10	6.38	5.87	10,233.46	3.14
16a. Excavate Area A and export to C South (300,000 CY total)	9.74	57.57	103.17	0.10	5.41	4.98	10,056.03	3.13
19a. Excavate Ballona Creek Channel in Areas A and B North (277,800 CY cut)	8.89	56.54	93.34	0.10	4.79	4.41	9,890.42	3.13
17a. Finish grading Area C South	3.08	18.51	30.44	0.02	1.70	1.57	2,475.44	0.78
23a. Construct bike and ped trails on levees	2.98	17.53	33.01	0.04	1.49	1.37	3,897.27	1.23
23b. Construct County Parking Structure Foundation	5.87	36.61	61.94	0.08	2.91	2.70	7,444.36	2.02
23c. Construct County Parking Structure	3.02	18.43	33.94	0.05	1.36	1.27	4,663.44	1.14
24a. Export final excess dirt quantity (Assume up to 110,000 CY)	0.79	3.31	9.51	0.01	0.32	0.29	1,219.32	0.39

TABLE 15
ALTERNATIVE 3 MITIGATED CONSTRUCTION EMISSIONS BY ACTION ITEM

Actions	Mitigated Emission (lbs/day)							
	ROG	CO	NOX	SOX	PM10	PM2.5	CO2	CH4
1a. Remove and relocate existing gas line	0.20	9.93	0.88	0.02	0.03	0.03	1,705.58	0.52
2a. Create swale (10,000 CY wet cut)	0.63	26.68	2.71	0.05	0.08	0.08	5,293.77	1.47
3a. Remove existing inactive gas line	0.20	9.93	0.88	0.02	0.03	0.03	1,705.58	0.52
3b. Cut and cap gas line at Fiji Way	0.20	9.93	0.88	0.02	0.03	0.03	1,705.58	0.52
4b. Construct new pedestrian/bike bridge over Ballona Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9a. Drill new well at SoCal Gas Plant to replace Del Ray 12	2.14	93.94	9.27	0.20	0.29	0.29	19,143.36	3.06
25a. Drill new well at SoCal Gas Plant to replace Del Ray 19	2.14	93.94	9.27	0.20	0.29	0.29	19,143.36	3.06
29a. Drill new well at SoCal Gas Plant to replace Del Rey 9 and Vidor 18	2.14	93.94	9.27	0.20	0.29	0.29	19,143.36	3.06
29b. Abandon and plug Vidor 1, 2, 3, 5, 14, 18 and Del Rey 4, 5, 9, 11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9b. Abandon and plug Del Ray 12	0.26	7.82	1.14	0.02	0.03	0.03	2,281.04	0.47
6a. Remove vegetation from Area A (54,400 CY dry cut)	1.08	43.61	4.69	0.09	0.14	0.14	9,095.45	2.63
6b. Remove trash	1.08	43.61	4.69	0.09	0.14	0.14	9,095.45	2.63
6c. Stockpile	1.08	43.61	4.69	0.09	0.14	0.14	9,095.45	2.63
7a. Remove 36" concrete pipe near center of Area A	0.20	9.93	0.88	0.02	0.03	0.03	1,705.58	0.52
7c. Dig below (over excavate) future levees (25,200 CY dry cut)	1.22	59.60	5.30	0.10	0.16	0.16	10,233.46	3.14
8a. Grade and construct new levee around Area A (125,300 CY fill)	0.73	34.27	3.16	0.06	0.10	0.10	6,367.09	1.33
9c. Remove/relocate existing pipelines	0.20	9.93	0.88	0.02	0.03	0.03	1,705.58	0.52
7b. Excavate old fill from Area A (1,134,200 CY wet cut and 54,400 dry cut, see note)	1.22	59.60	5.30	0.10	0.16	0.16	10,233.46	3.14
16a. Excavate Area A and export to C South (300,000 CY total)	1.22	57.57	5.30	0.10	0.16	0.16	10,056.03	3.13
19a. Excavate Ballona Creek Channel in Areas A and B North (277,800 CY cut)	1.22	56.54	5.30	0.10	0.16	0.16	9,890.42	3.13
17a. Finish grading Area C South	0.30	18.51	1.32	0.02	0.04	0.04	2,475.44	0.78
23a. Construct bike and ped trails on levees	0.48	17.53	2.10	0.04	0.06	0.06	3,897.27	1.23
23b. Construct County Parking Structure Foundation	0.90	36.61	3.90	0.08	0.12	0.12	7,444.36	2.02
23c. Construct County Parking Structure	0.56	18.43	2.42	0.05	0.07	0.07	4,663.44	1.14
24a. Export final excess dirt quantity (Assume up to 110,000 CY)	0.15	3.31	0.66	0.01	0.02	0.02	1,219.32	0.39

Parking Structure Construction - Application of Arch Coatings

South Coast Air Basin, Summer

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
Parking Lot	43.00	Space	0.39	17,200.00	0
Unenclosed Parking Structure	302.00	Space	0.80	120,800.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	31
Climate Zone	13			**Operational Year**	2023
Utility Company	Southern California Edison				
CO2 Intensity (lb/MWhr)	630.89	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics –

Land Use - Based on project specific information

Construction Phase - Only want architectural coating emissions and paving ROG emissions associated with the construction of the parking structure and parking lot paving other construction Equipment emissions determined outside of CalEEMod

Table Name	Column Name	Default Value	New Value
tblConstructionPhase	NumDays	10.00	66.00
tblConstructionPhase	NumDays	10.00	15.00
tblConstructionPhase	PhaseEndDate	1/21/2020	11/8/2019
tblConstructionPhase	PhaseStartDate	1/1/2020	10/21/2019
tblLandUse	LotAcreage	2.72	0.80
tblProjectCharacteristics	OperationalYear	2014	2023

2.0 Emissions Summary

2.1 Overall Construction (Maximum Daily Emission)

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2019	43.9030	10.9831	11.8474	0.0198	0.2794	0.6473	0.9267	0.0741	0.6067	0.6808	0.0000	1,851.9362	1,851.9362	0.4410	0.0000	1,861.1973
Total	**43.9030**	**10.9831**	**11.8474**	**0.0198**	**0.2794**	**0.6473**	**0.9267**	**0.0741**	**0.6067**	**0.6808**	**0.0000**	**1,851.9362**	**1,851.9362**	**0.4410**	**0.0000**	**1,861.1973**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2019	43.9030	10.9831	11.8474	0.0198	0.2794	0.6473	0.9267	0.0741	0.6067	0.6808	0.0000	1,851.9362	1,851.9362	0.4410	0.0000	1,861.1973
Total	**43.9030**	**10.9831**	**11.8474**	**0.0198**	**0.2794**	**0.6473**	**0.9267**	**0.0741**	**0.6067**	**0.6808**	**0.0000**	**1,851.9362**	**1,851.9362**	**0.4410**	**0.0000**	**1,861.1973**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	3.5059	3.2000e-004	0.0352	0.0000		1.3000e-004	1.3000e-004		1.3000e-004	1.3000e-004		0.0755	0.0755	2.0000e-004		0.0797
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Total	**3.5059**	**3.2000e-004**	**0.0352**	**0.0000**	**0.0000**	**1.3000e-004**	**1.3000e-004**	**0.0000**	**1.3000e-004**	**1.3000e-004**		**0.0755**	**0.0755**	**2.0000e-004**	**0.0000**	**0.0797**

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	3.5059	3.2000e-004	0.0352	0.0000		1.3000e-004	1.3000e-004		1.3000e-004	1.3000e-004		0.0755	0.0755	2.0000e-004		0.0797
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Total	**3.5059**	**3.2000e-004**	**0.0352**	**0.0000**	**0.0000**	**1.3000e-004**	**1.3000e-004**	**0.0000**	**1.3000e-004**	**1.3000e-004**		**0.0755**	**0.0755**	**2.0000e-004**	**0.0000**	**0.0797**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Architectural Coating	Architectural Coating	10/1/2019	12/31/2019	5	66	
2	Paving	Paving	10/21/2019	11/8/2019	5	15	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 0

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 181,974; Non-Residential Outdoor: 60,658 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Architectural Coating	Air Compressors	1	6.00	78	0.48
Paving	Cement and Mortar Mixers	1	6.00	9	0.56
Paving	Pavers	1	6.00	125	0.42
Paving	Paving Equipment	1	8.00	130	0.36
Paving	Rollers	1	7.00	80	0.38
Paving	Tractors/Loaders/Backhoes	1	8.00	97	0.37

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Architectural Coating	1	12.00	0.00	0.00	14.70	6.90	20.00	LD_Mix	HDT_Mix	HHDT
Paving	5	13.00	0.00	0.00	14.70	6.90	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

3.2 Architectural Coating – 2019

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Archit. Coating	42.5985					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Off-Road	0.2664	1.8354	1.8413	2.9700e-003		0.1288	0.1288		0.1288	0.1288		281.4481	281.4481	0.0238		281.9473
Total	**42.8649**	**1.8354**	**1.8413**	**2.9700e-003**		**0.1288**	**0.1288**		**0.1288**	**0.1288**		**281.4481**	**281.4481**	**0.0238**		**281.9473**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0373	0.0470	0.5882	1.6900e-003	0.1341	1.0300e-003	0.1352	0.0356	9.6000e-004	0.0365		127.1672	127.1672	5.8700e-003		127.2904
Total	**0.0373**	**0.0470**	**0.5882**	**1.6900e-003**	**0.1341**	**1.0300e-003**	**0.1352**	**0.0356**	**9.6000e-004**	**0.0365**		**127.1672**	**127.1672**	**5.8700e-003**		**127.2904**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Archit. Coating	42.5985					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Off-Road	0.2664	1.8354	1.8413	2.9700e-003		0.1288	0.1288		0.1288	0.1288	0.0000	281.4481	281.4481	0.0238		281.9473
Total	**42.8649**	**1.8354**	**1.8413**	**2.9700e-003**		**0.1288**	**0.1288**		**0.1288**	**0.1288**	**0.0000**	**281.4481**	**281.4481**	**0.0238**		**281.9473**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0373	0.0470	0.5882	1.6900e-003	0.1341	1.0300e-003	0.1352	0.0356	9.6000e-004	0.0365		127.1672	127.1672	5.8700e-003		127.2904
Total	**0.0373**	**0.0470**	**0.5882**	**1.6900e-003**	**0.1341**	**1.0300e-003**	**0.1352**	**0.0356**	**9.6000e-004**	**0.0365**		**127.1672**	**127.1672**	**5.8700e-003**		**127.2904**

3.3 Paving – 2019

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	0.8923	9.0499	8.7806	0.0133		0.5164	0.5164		0.4759	0.4759		1,305.5566	1,305.5566	0.4050		1,314.0618
Paving	0.0681					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Total	**0.9604**	**9.0499**	**8.7806**	**0.0133**		**0.5164**	**0.5164**		**0.4759**	**0.4759**		**1,305.5566**	**1,305.5566**	**0.4050**		**1,314.0618**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0404	0.0509	0.6373	1.8400e-003	0.1453	1.1200e-003	0.1464	0.0385	1.0400e-003	0.0396		137.7644	137.7644	6.3600e-003		137.8979
Total	**0.0404**	**0.0509**	**0.6373**	**1.8400e-003**	**0.1453**	**1.1200e-003**	**0.1464**	**0.0385**	**1.0400e-003**	**0.0396**		**137.7644**	**137.7644**	**6.3600e-003**		**137.8979**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	0.8923	9.0499	8.7806	0.0133		0.5164	0.5164		0.4759	0.4759	0.0000	1,305.5566	1,305.5566	0.4050		1,314.0618
Paving	0.0681					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Total	**0.9604**	**9.0499**	**8.7806**	**0.0133**		**0.5164**	**0.5164**		**0.4759**	**0.4759**	**0.0000**	**1,305.5566**	**1,305.5566**	**0.4050**		**1,314.0618**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0404	0.0509	0.6373	1.8400e-003	0.1453	1.1200e-003	0.1464	0.0385	1.0400e-003	0.0396		137.7644	137.7644	6.3600e-003		137.8979
Total	**0.0404**	**0.0509**	**0.6373**	**1.8400e-003**	**0.1453**	**1.1200e-003**	**0.1464**	**0.0385**	**1.0400e-003**	**0.0396**		**137.7644**	**137.7644**	**6.3600e-003**		**137.8979**

4.0 Operational Detail – Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Parking Lot	0.00	0.00	0.00		
Unenclosed Parking Structure	0.00	0.00	0.00		
Total	0.00	0.00	0.00		

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
Parking Lot	16.60	8.40	6.90	0.00	0.00	0.00	0	0	0
Unenclosed Parking Structure	16.60	8.40	6.90	0.00	0.00	0.00	0	0	0

LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
0.503640	0.059862	0.182421	0.141149	0.043488	0.006857	0.016394	0.034533	0.001981	0.002521	0.004259	0.000566	0.002330

5.0 Energy Detail

4.4 Fleet Mix

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
NaturalGas Mitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
NaturalGas Unmitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000

5.2 Energy by Land Use - Natural Gas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
Unenclosed Parking Structure	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Parking Lot	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
Unenclosed Parking Structure	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Parking Lot	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	3.5059	3.2000e-004	0.0352	0.0000		1.3000e-004	1.3000e-004		1.3000e-004	1.3000e-004		0.0755	0.0755	2.0000e-004		0.0797
Unmitigated	3.5059	3.2000e-004	0.0352	0.0000		1.3000e-004	1.3000e-004		1.3000e-004	1.3000e-004		0.0755	0.0755	2.0000e-004		0.0797

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	0.7703					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	2.7324					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Landscaping	3.2600e-003	3.2000e-004	0.0352	0.0000		1.3000e-004	1.3000e-004		1.3000e-004	1.3000e-004		0.0755	0.0755	2.0000e-004		0.0797
Total	**3.5059**	**3.2000e-004**	**0.0352**	**0.0000**		**1.3000e-004**	**1.3000e-004**		**1.3000e-004**	**1.3000e-004**		**0.0755**	**0.0755**	**2.0000e-004**		**0.0797**

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	0.7703					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	2.7324					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Landscaping	3.2600e-003	3.2000e-004	0.0352	0.0000		1.3000e-004	1.3000e-004		1.3000e-004	1.3000e-004		0.0755	0.0755	2.0000e-004		0.0797
Total	**3.5059**	**3.2000e-004**	**0.0352**	**0.0000**		**1.3000e-004**	**1.3000e-004**		**1.3000e-004**	**1.3000e-004**		**0.0755**	**0.0755**	**2.0000e-004**		**0.0797**

7.0 Water Detail

7.1 Mitigation Measures Water

8.0 Waste Detail

8.1 Mitigation Measures Waste

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Vegetation

Grading Fugitive Dust Emissions during Alternatives 1, 2 and 3

$$EF_{PM15} = 0.051 \times (S)^{2.0}, \text{ and } EF_{PM10} = EF_{PM15} \times F_{PM10}$$
$$EF_{TSP} = 0.04 \times (S)^{2.5}, \text{ and } EF_{PM2.5} = EF_{TSP} \times F_{PM2.5}$$

Where:

EF = emission factor (lb/VMT)
S = mean vehicle speed (mph). The AP-42 default value is 7.1 mph.
$F_{PM2.5}$ = $PM_{2.5}$ scaling factor. The AP-42 default value is 0.031.
F_{PM10} = PM_{10} scaling factor. The AP-42 default value is 0.6.

$$E = EF \times VMT, \text{ and}$$
$$VMT = As / Wb \times 43{,}560(sqft / acre) / 5{,}280(ft / mile)$$

Where:

E: emissions (lb)
EF: emission factor (lb/VMT)
VMT: vehicle miles traveled (mile)
A_S: the acreage of the grading site (acre)
W_b: Blade width of the grading equipment. The program uses a default blade width of 12 ft based on Caterpillar's 140 Motor Grader.[7]

Equipment Type	Acres/8hr-day
Crawler Tractors	0.5
Graders	0.5
Rubber Tired Dozers	0.5
Scrapers	1

Source: CalEEMod, Appendix A

TABLE 16
ALTERNATIVE 1 - 3 ON-SITE GRADING ASSUMPTIONS

Assumptions			
Parameter	**Value**	**Units**	**Reference**
Fpm2.5	0.031	-	AP-42 default
FPM10	0.6	-	AP-42 default
S - Mean Vehicle speed	7.1	mph	AP-42 default
As- Acres per day	6	a/d	CalEEMod Appendix A
Wb	12	ft	CalEEMod Appendix A

TABLE 17
ALTERNATIVE 1 - 3 ON-SITE GRADING EMISSIONS (POUNDS PER DAY)

Category	F (PM10)	F (PM2.5)	EF (PM15)	EF (TSP)	EF (PM10)	EF (2.5)	VMT	Pm10 Emissions	PM2.5 Emissions
Alternative 1, 2 & 3									
Grading	0.6	0.031	2.57091	5.372864	1.542546	0.166559	4.125	6.4	0.7

On-Road Criteria Emissions during Alternatives 1, 2 and 3

TABLE 18
ALTERNATIVE 1 - 3 ONROAD EMISSION FACTORS

Running Emissions						g/mi				
Veh Class	ROG	CO	NOx	CO2	PM10	PM2.5	SOx	CH4	Tire & Brake Wear PM10	Tire & Brake Wear PM2.5
LDA										
2017	0.018588	0.854138	0.062278	274.0034	0.001529	0.00141438	0.002747	0.006156	0.04475	0.01775
2018	0.01492	0.752626	0.054283	265.5478	0.001496	0.00138223	0.002661	0.005412	0.04475	0.01775
2019	0.012171	0.671513	0.047745	256.4536	0.00147	0.0013577	0.002569	0.0048	0.04475	0.01775
2023	0.00785	0.491893	0.031639	218.9987	0.001304	0.00120227	0.002192	0.003114	0.04475	0.01775
HHDT										
2017	0.115779	0.895885	2.488663	1029.657	0.10263	0.09818611	0.009896	0.01107	0.14234	0.05886
2018	0.098577	0.741123	2.159946	1027.937	0.087227	0.08344956	0.009875	0.009258	0.14234	0.05886
2019	0.081035	0.608762	1.812461	1025.163	0.073145	0.06997675	0.009844	0.007569	0.14234	0.05886
2023	0.014607	0.187222	0.280815	1011.855	0.002375	0.00226842	0.009707	0.002246	0.14234	0.05886

Source: EMFAC 2014

Running Emissions						lbs/mi				
Veh Class	ROG	CO	NOx	CO2	PM10	PM2.5	SOx	CH4	Tire & Brake Wear PM10	Tire & Brake Wear PM2.5
LDA										
2017	3.3E-05	1.7E-03	1.2E-04	5.9E-01	3.3E-06	3.0E-06	5.9E-06	1.2E-05	9.9E-05	3.9E-05
2018	2.7E-05	1.5E-03	1.1E-04	5.7E-01	3.2E-06	3.0E-06	5.7E-06	1.1E-05	9.9E-05	3.9E-05
2019	1.7E-05	1.1E-03	7.0E-05	4.8E-01	2.9E-06	2.7E-06	4.8E-06	6.9E-06	9.9E-05	3.9E-05
2023	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
HHDT										
2017	2.6E-04	2.0E-03	5.5E-03	2.3E+00	2.3E-04	2.2E-04	2.2E-05	2.4E-05	3.1E-04	1.3E-04
2018	2.2E-04	1.6E-03	4.8E-03	2.3E+00	1.9E-04	1.8E-04	2.2E-05	2.0E-05	3.1E-04	1.3E-04
2019	1.8E-04	1.3E-03	4.0E-03	2.3E+00	1.6E-04	1.5E-04	2.2E-05	1.7E-05	3.1E-04	1.3E-04
2023	3.2E-05	4.1E-04	6.2E-04	2.2E+00	5.2E-06	5.0E-06	2.1E-05	5.0E-06	3.1E-04	1.3E-04

Source: EMFAC 2014

TABLE 19
ALTERNATIVE 1 - 3 OFFSITE VMT ESTIMATES

Heavy Truck/Work Trip Data						
Category	**Round Trips**	**Annual Round Trips**	**Vehicle Type**	**Trip length (miles)**	**Daily VMT**	**Annual VMT**
Alternative 1 & 2						
Haul trips	480	124,800	HHDT	19	9,120	2,371,200
Worker Trips	809	210,340	LDA/LDT	15	11,892	3,091,998
Alternative 3						
Haul trips	480	124,800	HHDT	19	9,120	2,371,200
Worker Trips	371	96,460	LDA/LDT	15	5,454	1,417,962

TABLE 20
ALTERNATIVE 1 - 3 ONSITE VMT ESTIMATES

Heavy Truck/Work Trip Data						
Category	**Daily Trips**	**Annual Round Trips**	**Vehicle Type**	**Trip length (miles)**	**Daily VMT**	**Annual VMT**
Alternative 1 & 2						
Haul trips	480	124,800	HHDT	1	343	89,275
Worker Trips	809	210,340	LDA/LDT	1	579	150,465
Alternative 3						
Haul trips	480	124,800	HHDT	1	343	89,275
Worker Trips	371	96,460	LDA/LDT	1	265	69,002

TABLE 21
ALTERNATIVE 1 - 3 OFFSITE ONROAD EMISSION ESTIMTES (POUNDS PER DAY)

Category	lbs/day									
	ROG	CO	NOx	CO2	PM10	PM2.5	SOx	CH4	Tire & Brake Wear PM10	Tire & Brake Wear PM2.5
Alternative 1 & 2										
Haul trips										
2017	2.33	18.01	50.04	20702.42	2.06	1.97	0.20	0.22	2.86	1.18
2018	1.98	14.90	43.43	20667.84	1.75	1.68	0.20	0.19	2.86	1.18
2019	1.63	12.24	36.44	20612.07	1.47	1.41	0.20	0.15	2.86	1.18
2023	0.29	3.76	5.65	20344.48	0.05	0.05	0.20	0.05	2.86	1.18
Worker Trips										
2017	0.39	19.73	1.42	6962.13	0.04	0.04	0.07	0.14	1.17	0.47
2018	0.32	17.61	1.25	6723.70	0.04	0.04	0.07	0.13	1.17	0.47
2019	0.21	12.90	0.83	5741.71	0.03	0.03	0.06	0.08	1.17	0.47
2023	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Alternative 3										
Haul trips										
2017	2.33	18.01	50.04	20702.42	2.06	1.97	0.20	0.22	2.86	1.18
2018	1.98	14.90	43.43	20667.84	1.75	1.68	0.20	0.19	2.86	1.18
2019	1.63	12.24	36.44	20612.07	1.47	1.41	0.20	0.15	2.86	1.18
2023	0.29	3.76	5.65	20344.48	0.05	0.05	0.20	0.05	2.86	1.18
Worker Trips										
2017	0.18	9.05	0.65	3192.77	0.02	0.02	0.03	0.07	0.54	0.21
2018	0.15	8.07	0.57	3083.43	0.02	0.02	0.03	0.06	0.54	0.21
2019	0.09	5.91	0.38	2633.09	0.02	0.01	0.03	0.04	0.54	0.21
2023	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 22
ALTERNATIVE 1 - 3 OFFSITE ONROAD EMISSION ESTIAMTES (METRIC TONS PER YEAR)

	MT/year									
Category	**ROG**	**CO**	**NOx**	**CO2**	**PM10**	**PM2.5**	**SOx**	**CH4**	**Tire & Brake Wear PM10**	**Tire & Brake Wear PM2.5**
Alternative 1 & 2										
Haul trips										
2017	0.30	2.34	6.50	2691.31	0.27	0.26	0.03	0.03	0.37	0.15
2018	0.26	1.94	5.65	2686.82	0.23	0.22	0.03	0.02	0.37	0.15
2019	0.21	1.59	4.74	2679.57	0.19	0.18	0.03	0.02	0.37	0.15
2023	0.04	0.49	0.73	2644.78	0.01	0.01	0.03	0.01	0.37	0.15
Worker Trips										
2017	0.05	2.57	0.19	905.08	0.01	0.00	0.01	0.02	0.15	0.06
2018	0.04	2.29	0.16	874.08	0.01	0.00	0.01	0.02	0.15	0.06
2019	0.03	1.68	0.11	746.42	0.00	0.00	0.01	0.01	0.15	0.06
2023	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Alternative 3										
Haul trips										
2017	0.30	2.34	6.50	2691.31	0.27	0.26	0.03	0.03	0.37	0.15
2018	0.26	1.94	5.65	2686.82	0.23	0.22	0.03	0.02	0.37	0.15
2019	0.21	1.59	4.74	2679.57	0.19	0.18	0.03	0.02	0.37	0.15
2023	0.04	0.49	0.73	2644.78	0.01	0.01	0.03	0.01	0.37	0.15
Worker Trips										
2017	0.02	1.18	0.08	415.06	0.00	0.00	0.00	0.01	0.07	0.03
2018	0.02	1.05	0.07	400.85	0.00	0.00	0.00	0.01	0.07	0.03
2019	0.01	0.77	0.05	342.30	0.00	0.00	0.00	0.00	0.07	0.03
2023	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 23
ALTERNATIVE 1 - 3 ONSITE ONROAD EMISSION ESTIMTES (POUNDS PER DAY)

	lbs/day									
Category	**ROG**	**CO**	**NOx**	**CO2**	**PM10**	**PM2.5**	**SOx**	**CH4**	**Tire & Brake Wear PM10**	**Tire & Brake Wear PM2.5**
Alternative 1 & 2										
Haul trips										
2017	0.09	0.68	1.88	779.44	0.08	0.07	0.01	0.01	0.11	0.04
2018	0.07	0.56	1.64	778.13	0.07	0.06	0.01	0.01	0.11	0.04
2019	0.06	0.46	1.37	776.03	0.06	0.05	0.01	0.01	0.11	0.04
2023	0.01	0.14	0.21	765.96	0.00	0.00	0.01	0.00	0.11	0.04
Worker Trips										
2017	0.02	0.96	0.07	338.80	0.00	0.00	0.00	0.01	0.06	0.02
2018	0.02	0.86	0.06	327.19	0.00	0.00	0.00	0.01	0.06	0.02
2019	0.01	0.63	0.04	279.41	0.00	0.00	0.00	0.00	0.06	0.02
2023	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Alternative 3										
Haul trips										
2017	0.09	0.68	1.88	779.44	0.08	0.07	0.01	0.01	0.11	0.04
2018	0.07	0.56	1.64	778.13	0.07	0.06	0.01	0.01	0.11	0.04
2019	0.06	0.46	1.37	776.03	0.06	0.05	0.01	0.01	0.11	0.04
2023	0.01	0.14	0.21	765.96	0.00	0.00	0.01	0.00	0.11	0.04
Worker Trips										
2017	0.01	0.44	0.03	155.37	0.00	0.00	0.00	0.00	0.03	0.01
2018	0.01	0.39	0.03	150.05	0.00	0.00	0.00	0.00	0.03	0.01
2019	0.00	0.29	0.02	128.13	0.00	0.00	0.00	0.00	0.03	0.01
2023	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 24
ALTERNATIVE 1 - 3 ONSITE ONROAD EMISSION ESTIAMTES (METRIC TONS PER YEAR)

	MT/year									
Category	ROG	CO	NOx	CO2	PM10	PM2.5	SOx	CH4	Tire & Brake Wear PM10	Tire & Brake Wear PM2.5
Alternative 1 & 2										
Haul trips										
2017	0.01	0.09	0.24	101.33	0.01	0.01	0.00	0.00	0.01	0.01
2018	0.01	0.07	0.21	101.16	0.01	0.01	0.00	0.00	0.01	0.01
2019	0.01	0.06	0.18	100.88	0.01	0.01	0.00	0.00	0.01	0.01
2023	0.00	0.02	0.03	99.57	0.00	0.00	0.00	0.00	0.01	0.01
Worker Trips										
2017	0.00	0.12	0.01	44.04	0.00	0.00	0.00	0.00	0.01	0.00
2018	0.00	0.11	0.01	42.54	0.00	0.00	0.00	0.00	0.01	0.00
2019	0.00	0.08	0.01	36.32	0.00	0.00	0.00	0.00	0.01	0.00
2023	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Alternative 3										
Haul trips										
2017	0.01	0.09	0.24	101.33	0.01	0.01	0.00	0.00	0.01	0.01
2018	0.01	0.07	0.21	101.16	0.01	0.01	0.00	0.00	0.01	0.01
2019	0.01	0.06	0.18	100.88	0.01	0.01	0.00	0.00	0.01	0.01
2023	0.00	0.02	0.03	99.57	0.00	0.00	0.00	0.00	0.01	0.01
Worker Trips										
2017	0.00	0.06	0.00	20.20	0.00	0.00	0.00	0.00	0.00	0.00
2018	0.00	0.05	0.00	19.51	0.00	0.00	0.00	0.00	0.00	0.00
2019	0.00	0.04	0.00	16.66	0.00	0.00	0.00	0.00	0.00	0.00
2023	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Alternative 1 Construction Annual GHG Emissions

TABLE 25
ALTERNATIVE 1 CONSTRUCTION ANNUAL GHG EMISSIONS FOR YEAR 2017

Category	CO2	CH4	CO2e
Off-road Emissions	4,251	25	4,275
On-road Emissions	3,742	0	3,742
Amortized over 30 years			267

TABLE 26
ALTERNATIVE 1 CONSTRUCTION ANNUAL GHG EMISSIONS FOR YEAR 2018

Category	CO2	CH4	CO2e
Off-road Emissions	2,632	20	2,652
On-road Emissions	3,705	1	3,706
Amortized over 30 years			212

TABLE 27
ALTERNATIVE 1 CONSTRUCTION ANNUAL GHG EMISSIONS FOR YEAR 2019

Category	CO2	CH4	CO2e
Off-road Emissions	3,401	26	3,427
On-road Emissions	3,563	1	3,564
Amortized over 30 years			233

TABLE 28
ALTERNATIVE 1 CONSTRUCTION ANNUAL GHG EMISSIONS FOR YEAR 2023

Category	CO2	CH4	CO2e
Off-road Emissions	1,133	9	1,142
On-road Emissions	2,744	1	2,745
Amortized over 30 years			130

Alternative 2 Construction Annual GHG Emissions

TABLE 29
ALTERNATIVE 2 CONSTRUCTION ANNUAL GHG EMISSIONS FOR YEAR 2017

Category	CO2	CH4	CO2e
Off-road Emissions	3,106	20	3,126
On-road Emissions	3,742	0	3,742
Amortized over 30 years			229

TABLE 30
ALTERNATIVE 2 CONSTRUCTION ANNUAL GHG EMISSIONS FOR YEAR 2018

Category	CO2	CH4	CO2e
Off-road Emissions	2,562	19	2,581
On-road Emissions	3,705	1	3,706
Amortized over 30 years			210

TABLE 31
ALTERNATIVE 2 CONSTRUCTION ANNUAL GHG EMISSIONS FOR YEAR 2019

Category	CO2	CH4	CO2e
Off-road Emissions	3,401	26	3,427
On-road Emissions	3,563	1	3,564
Amortized over 30 years			233

Alternative 3 Construction Annual GHG Emissions

TABLE 32
ALTERNATIVE 3 CONSTRUCTION ANNUAL GHG EMISSIONS FOR YEAR 2017

Category	CO2	CH4	CO2e
Off-road Emissions	2,451	13	2,465
On-road Emissions	3,228	0	3,228
Amortized over 30 years			190

TABLE 33
ALTERNATIVE 3 CONSTRUCTION ANNUAL GHG EMISSIONS FOR YEAR 2018

Category	CO2	CH4	CO2e
Off-road Emissions	1,549	12	1,561
On-road Emissions	3,208	0	3,208
Amortized over 30 years			159

TABLE 34
ALTERNATIVE 3 CONSTRUCTION ANNUAL GHG EMISSIONS FOR YEAR 2019

Category	CO2	CH4	CO2e
Off-road Emissions	1,967	15	1,981
On-road Emissions	3,139	0	3,139
Amortized over 30 years			171

Operational Criteria Pollutant Emissions

Ballona EIR

South Coast AQMD Air District, Summer

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
City Park	574.10	Acre	574.10	25,007,796.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	31
Climate Zone	13			**Operational Year**	2035
Utility Company	Southern California Edison				
CO2 Intensity (lb/MWhr)	630.89	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use -

Construction Phase - Assumed O&M activities requiring off-road equipment would occure 55 days out of the year.

Off-road Equipment - Assumed one

Off-road Equipment - Assumed O&M off-road equipment

Off-road Equipment - Assumed O&M off-road equipment

Off-road Equipment - Assumed O&M off-road equipment

Off-road Equipment - Assumed O&M off-road equipment

Off-road Equipment - Assumed O&M off-road equipment

Off-road Equipment - Assumed O&M off-road equipment

Off-road Equipment - Assumed O&M off-road equipment

Off-road Equipment - Assumed O&M off-road equipment

Trips and VMT - Provided by project engineer

Table Name	Column Name	Default Value	New Value
tblConstructionPhase	PhaseEndDate	9/20/2017	9/20/2018
tblConstructionPhase	PhaseEndDate	12/6/2018	3/19/2019
tblConstructionPhase	PhaseEndDate	6/4/2019	3/18/2020
tblConstructionPhase	PhaseEndDate	6/3/2020	3/19/2021
tblConstructionPhase	PhaseEndDate	6/4/2021	3/18/2022
tblConstructionPhase	PhaseEndDate	6/3/2022	3/17/2023
tblConstructionPhase	PhaseEndDate	6/2/2023	3/19/2035
tblConstructionPhase	PhaseStartDate	7/6/2017	7/6/2018
tblConstructionPhase	PhaseStartDate	9/21/2018	1/2/2019
tblConstructionPhase	PhaseStartDate	3/20/2019	1/2/2020
tblConstructionPhase	PhaseStartDate	3/19/2020	1/2/2021
tblConstructionPhase	PhaseStartDate	3/20/2021	1/2/2022
tblConstructionPhase	PhaseStartDate	3/19/2022	1/2/2023
tblConstructionPhase	PhaseStartDate	3/18/2023	1/2/2035
tblProjectCharacteristics	OperationalYear	2014	2035
tblTripsAndVMT	WorkerTripNumber	10.00	390.00
tblTripsAndVMT	WorkerTripNumber	10.00	390.00
tblTripsAndVMT	WorkerTripNumber	10.00	390.00
tblTripsAndVMT	WorkerTripNumber	10.00	390.00
tblTripsAndVMT	WorkerTripNumber	10.00	390.00
tblTripsAndVMT	WorkerTripNumber	10.00	390.00
tblTripsAndVMT	WorkerTripNumber	10.00	390.00
tblTripsAndVMT	WorkerTripNumber	10.00	390.00

2.0 Emissions Summary

2.1 Overall Construction (Maximum Daily Emission)

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2017	3.0394	19.9420	31.2994	0.0737	4.3593	0.9022	5.2615	1.1561	0.8301	1.9862	0.0000	6,351.1491	6,351.1491	0.7987	0.0000	6,367.9208
2018	2.6946	17.3676	28.9052	0.0737	4.3593	0.7608	5.1201	1.1561	0.7001	1.8562	0.0000	6,153.8339	6,153.8339	0.7824	0.0000	6,170.2642
2019	2.4622	15.6673	27.0405	0.0735	4.3593	0.6629	5.0221	1.1561	0.6101	1.7662	0.0000	5,960.8089	5,960.8089	0.7693	0.0000	5,976.9632
2020	2.2909	14.2742	25.6067	0.0735	4.3593	0.5865	4.9458	1.1561	0.5399	1.6960	0.0000	5,753.2601	5,753.2601	0.7590	0.0000	5,769.1986
2021	2.1243	12.6934	24.4364	0.0737	4.3593	0.5095	4.8688	1.1561	0.4690	1.6251	0.0000	5,692.6464	5,692.6464	0.7514	0.0000	5,708.4252
2022	1.9208	10.5265	23.2783	0.0737	4.3593	0.4125	4.7718	1.1561	0.3797	1.5358	0.0000	5,629.7988	5,629.7988	0.7445	0.0000	5,645.4336
2023	1.7994	9.4478	22.3284	0.0737	4.3593	0.3592	4.7185	1.1561	0.3307	1.4868	0.0000	5,571.5952	5,571.5952	0.7382	0.0000	5,587.0968
2035	1.3838	3.7592	17.5169	0.0782	4.3593	0.0973	4.4565	1.1561	0.0948	1.2509	0.0000	5,633.1772	5,633.1772	0.1931	0.0000	5,637.2323
Total	**17.7154**	**103.6780**	**200.4117**	**0.5936**	**34.8742**	**4.2909**	**39.1651**	**9.2488**	**3.9544**	**13.2032**	**0.0000**	**46,746.2695**	**46,746.2695**	**5.5364**	**0.0000**	**46,862.5348**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2017	3.0394	19.9420	31.2994	0.0737	4.3593	0.9022	5.2615	1.1561	0.8301	1.9862	0.0000	6,351.1491	6,351.1491	0.7987	0.0000	6,367.9208
2018	2.6946	17.3676	28.9052	0.0737	4.3593	0.7608	5.1201	1.1561	0.7001	1.8562	0.0000	6,153.8339	6,153.8339	0.7824	0.0000	6,170.2642
2019	2.4622	15.6673	27.0405	0.0735	4.3593	0.6629	5.0221	1.1561	0.6101	1.7662	0.0000	5,960.8089	5,960.8089	0.7693	0.0000	5,976.9632
2020	2.2909	14.2742	25.6067	0.0735	4.3593	0.5865	4.9458	1.1561	0.5399	1.6960	0.0000	5,753.2601	5,753.2601	0.7590	0.0000	5,769.1986
2021	2.1243	12.6934	24.4364	0.0737	4.3593	0.5095	4.8688	1.1561	0.4690	1.6251	0.0000	5,692.6464	5,692.6464	0.7514	0.0000	5,708.4252
2022	1.9208	10.5265	23.2783	0.0737	4.3593	0.4125	4.7718	1.1561	0.3797	1.5358	0.0000	5,629.7988	5,629.7988	0.7445	0.0000	5,645.4336
2023	1.7994	9.4478	22.3284	0.0737	4.3593	0.3592	4.7185	1.1561	0.3307	1.4868	0.0000	5,571.5952	5,571.5952	0.7382	0.0000	5,587.0968
2035	1.3838	3.7592	17.5169	0.0782	4.3593	0.0973	4.4565	1.1561	0.0948	1.2509	0.0000	5,633.1772	5,633.1772	0.1931	0.0000	5,637.2323
Total	**17.7154**	**103.6780**	**200.4117**	**0.5936**	**34.8742**	**4.2909**	**39.1651**	**9.2488**	**3.9544**	**13.2032**	**0.0000**	**46,746.2695**	**46,746.2695**	**5.5364**	**0.0000**	**46,862.5348**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	653.9421	5.2000e-004	0.0583	0.0000		2.1000e-004	2.1000e-004		2.1000e-004	2.1000e-004		0.1256	0.1256	3.2000e-004		0.1324
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	1.7404	4.0560	18.9631	0.0873	5.5838	0.1182	5.7020	1.4931	0.1090	1.6021		6,229.9010	6,229.9010	0.1566		6,233.1905
Total	**655.6825**	**4.0565**	**19.0214**	**0.0873**	**5.5838**	**0.1184**	**5.7022**	**1.4931**	**0.1092**	**1.6023**		**6,230.0266**	**6,230.0266**	**0.1570**	**0.0000**	**6,233.3229**

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	653.9421	5.2000e-004	0.0583	0.0000		2.1000e-004	2.1000e-004		2.1000e-004	2.1000e-004		0.1256	0.1256	3.2000e-004		0.1324
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	1.7404	4.0560	18.9631	0.0873	5.5838	0.1182	5.7020	1.4931	0.1090	1.6021		6,229.9010	6,229.9010	0.1566		6,233.1905
Total	**655.6825**	**4.0565**	**19.0214**	**0.0873**	**5.5838**	**0.1184**	**5.7022**	**1.4931**	**0.1092**	**1.6023**		**6,230.0266**	**6,230.0266**	**0.1570**	**0.0000**	**6,233.3229**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	O&M Activities 2017	Trenching	4/20/2017	7/5/2017	5	55	
2	O&M Activities 2018	Trenching	7/6/2018	9/20/2018	5	55	
3	O&M Activities 2019	Trenching	1/2/2019	3/19/2019	5	55	
4	O&M Activities 2020	Trenching	1/2/2020	3/18/2020	5	55	
5	O&M Activities 2021	Trenching	1/2/2021	3/19/2021	5	55	
6	O&M Activities 2022	Trenching	1/2/2022	3/18/2022	5	55	
7	O&M Activities 2023	Trenching	1/2/2023	3/17/2023	5	55	
8	O&M Activities 2035	Trenching	1/2/2035	3/19/2035	5	55	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 0

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 0; Non-Residential Outdoor: 0 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
O&M Activities 2017	Rubber Tired Loaders	2	8.00	199	0.36
O&M Activities 2017	Tractors/Loaders/Backhoes	2	8.00	97	0.37
O&M Activities 2018	Rubber Tired Loaders	2	8.00	199	0.36
O&M Activities 2018	Tractors/Loaders/Backhoes	2	8.00	97	0.37
O&M Activities 2019	Rubber Tired Loaders	2	8.00	199	0.36
O&M Activities 2019	Tractors/Loaders/Backhoes	2	8.00	97	0.37
O&M Activities 2020	Rubber Tired Loaders	2	8.00	199	0.36
O&M Activities 2020	Tractors/Loaders/Backhoes	2	8.00	97	0.37
O&M Activities 2021	Rubber Tired Loaders	2	8.00	199	0.36
O&M Activities 2021	Tractors/Loaders/Backhoes	2	8.00	97	0.37
O&M Activities 2022	Rubber Tired Loaders	2	8.00	199	0.36
O&M Activities 2022	Tractors/Loaders/Backhoes	2	8.00	97	0.37
O&M Activities 2023	Rubber Tired Loaders	2	8.00	199	0.36
O&M Activities 2023	Tractors/Loaders/Backhoes	2	8.00	97	0.37
O&M Activities 2035	Rubber Tired Loaders	2	8.00	199	0.36
O&M Activities 2035	Tractors/Loaders/Backhoes	2	8.00	97	0.37

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
O&M Activities 2017	4	390.00	0.00	0.00	14.70	6.90	20.00	LD_Mix	HDT_Mix	HHDT
O&M Activities 2018	4	390.00	0.00	0.00	14.70	6.90	20.00	LD_Mix	HDT_Mix	HHDT
O&M Activities 2019	4	390.00	0.00	0.00	14.70	6.90	20.00	LD_Mix	HDT_Mix	HHDT
O&M Activities 2020	4	390.00	0.00	0.00	14.70	6.90	20.00	LD_Mix	HDT_Mix	HHDT
O&M Activities 2021	4	390.00	0.00	0.00	14.70	6.90	20.00	LD_Mix	HDT_Mix	HHDT
O&M Activities 2022	4	390.00	0.00	0.00	14.70	6.90	20.00	LD_Mix	HDT_Mix	HHDT
O&M Activities 2023	4	390.00	0.00	0.00	14.70	6.90	20.00	LD_Mix	HDT_Mix	HHDT
O&M Activities 2035	4	390.00	0.00	0.00	14.70	6.90	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

3.2 O&M Activities 2017 – 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	1.5754	18.1031	8.3690	0.0185		0.8672	0.8672		0.7978	0.7978		1,889.8084	1,889.8084	0.5790		1,901.9681
Total	**1.5754**	**18.1031**	**8.3690**	**0.0185**		**0.8672**	**0.8672**		**0.7978**	**0.7978**		**1,889.8084**	**1,889.8084**	**0.5790**		**1,901.9681**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	1.4640	1.8390	22.9304	0.0552	4.3593	0.0351	4.3943	1.1561	0.0323	1.1884		4,461.3407	4,461.3407	0.2196		4,465.9526
Total	**1.4640**	**1.8390**	**22.9304**	**0.0552**	**4.3593**	**0.0351**	**4.3943**	**1.1561**	**0.0323**	**1.1884**		**4,461.3407**	**4,461.3407**	**0.2196**		**4,465.9526**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	1.5754	18.1031	8.3690	0.0185		0.8672	0.8672		0.7978	0.7978	0.0000	1,889.8084	1,889.8084	0.5790		1,901.9681
Total	**1.5754**	**18.1031**	**8.3690**	**0.0185**		**0.8672**	**0.8672**		**0.7978**	**0.7978**	**0.0000**	**1,889.8084**	**1,889.8084**	**0.5790**		**1,901.9681**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	1.4640	1.8390	22.9304	0.0552	4.3593	0.0351	4.3943	1.1561	0.0323	1.1884		4,461.3407	4,461.3407	0.2196		4,465.9526
Total	**1.4640**	**1.8390**	**22.9304**	**0.0552**	**4.3593**	**0.0351**	**4.3943**	**1.1561**	**0.0323**	**1.1884**		**4,461.3407**	**4,461.3407**	**0.2196**		**4,465.9526**

3.3 O&M Activities 2018 – 2018

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	1.3749	15.6994	8.0759	0.0185		0.7267	0.7267		0.6685	0.6685		1,858.4941	1,858.4941	0.5786		1,870.6442
Total	**1.3749**	**15.6994**	**8.0759**	**0.0185**		**0.7267**	**0.7267**		**0.6685**	**0.6685**		**1,858.4941**	**1,858.4941**	**0.5786**		**1,870.6442**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	1.3197	1.6681	20.8293	0.0552	4.3593	0.0341	4.3934	1.1561	0.0316	1.1877		4,295.3398	4,295.3398	0.2038		4,299.6200
Total	**1.3197**	**1.6681**	**20.8293**	**0.0552**	**4.3593**	**0.0341**	**4.3934**	**1.1561**	**0.0316**	**1.1877**		**4,295.3398**	**4,295.3398**	**0.2038**		**4,299.6200**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	1.3749	15.6994	8.0759	0.0185		0.7267	0.7267		0.6685	0.6685	0.0000	1,858.4941	1,858.4941	0.5786		1,870.6442
Total	**1.3749**	**15.6994**	**8.0759**	**0.0185**		**0.7267**	**0.7267**		**0.6685**	**0.6685**	**0.0000**	**1,858.4941**	**1,858.4941**	**0.5786**		**1,870.6442**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	1.3197	1.6681	20.8293	0.0552	4.3593	0.0341	4.3934	1.1561	0.0316	1.1877		4,295.3398	4,295.3398	0.2038		4,299.6200
Total	**1.3197**	**1.6681**	**20.8293**	**0.0552**	**4.3593**	**0.0341**	**4.3934**	**1.1561**	**0.0316**	**1.1877**		**4,295.3398**	**4,295.3398**	**0.2038**		**4,299.6200**

3.4 O&M Activities 2019 - 2019

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	1.2474	14.1372	7.8968	0.0185		0.6293	0.6293		0.5790	0.5790		1,828.3084	1,828.3084	0.5785		1,840.4560
Total	**1.2474**	**14.1372**	**7.8968**	**0.0185**		**0.6293**	**0.6293**		**0.5790**	**0.5790**		**1,828.3084**	**1,828.3084**	**0.5785**		**1,840.4560**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	1.2148	1.5301	19.1437	0.0551	4.3593	0.0335	4.3928	1.1561	0.0311	1.1872		4,132.5005	4,132.5005	0.1908		4,136.5072
Total	**1.2148**	**1.5301**	**19.1437**	**0.0551**	**4.3593**	**0.0335**	**4.3928**	**1.1561**	**0.0311**	**1.1872**		**4,132.5005**	**4,132.5005**	**0.1908**		**4,136.5072**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	1.2474	14.1372	7.8968	0.0185		0.6293	0.6293		0.5790	0.5790	0.0000	1,828.3084	1,828.3084	0.5785		1,840.4560
Total	**1.2474**	**14.1372**	**7.8968**	**0.0185**		**0.6293**	**0.6293**		**0.5790**	**0.5790**	**0.0000**	**1,828.3084**	**1,828.3084**	**0.5785**		**1,840.4560**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	1.2148	1.5301	19.1437	0.0551	4.3593	0.0335	4.3928	1.1561	0.0311	1.1872		4,132.5005	4,132.5005	0.1908		4,136.5072
Total	**1.2148**	**1.5301**	**19.1437**	**0.0551**	**4.3593**	**0.0335**	**4.3928**	**1.1561**	**0.0311**	**1.1872**		**4,132.5005**	**4,132.5005**	**0.1908**		**4,136.5072**

3.5 O&M Activities 2020 – 2020

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	1.1524	12.8557	7.7658	0.0185		0.5532	0.5532		0.5090	0.5090		1,788.0082	1,788.0082	0.5783		1,800.1520
Total	**1.1524**	**12.8557**	**7.7658**	**0.0185**		**0.5532**	**0.5532**		**0.5090**	**0.5090**		**1,788.0082**	**1,788.0082**	**0.5783**		**1,800.1520**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	1.1524	12.8557	7.7658	0.0185		0.5532	0.5532		0.5090	0.5090		1,788.0082	1,788.0082	0.5783		1,800.1520
Total	**1.1524**	**12.8557**	**7.7658**	**0.0185**		**0.5532**	**0.5532**		**0.5090**	**0.5090**		**1,788.0082**	**1,788.0082**	**0.5783**		**1,800.1520**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	1.1384	1.4185	17.8409	0.0551	4.3593	0.0333	4.3926	1.1561	0.0309	1.1870		3,965.2519	3,965.2519	0.1807		3,969.0466
Total	**1.1384**	**1.4185**	**17.8409**	**0.0551**	**4.3593**	**0.0333**	**4.3926**	**1.1561**	**0.0309**	**1.1870**		**3,965.2519**	**3,965.2519**	**0.1807**		**3,969.0466**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	1.1524	12.8557	7.7658	0.0185		0.5532	0.5532		0.5090	0.5090	0.0000	1,788.0082	1,788.0082	0.5783		1,800.1520
Total	**1.1524**	**12.8557**	**7.7658**	**0.0185**		**0.5532**	**0.5532**		**0.5090**	**0.5090**	**0.0000**	**1,788.0082**	**1,788.0082**	**0.5783**		**1,800.1520**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	1.1384	1.4185	17.8409	0.0551	4.3593	0.0333	4.3926	1.1561	0.0309	1.1870		3,965.2519	3,965.2519	0.1807		3,969.0466
Total	**1.1384**	**1.4185**	**17.8409**	**0.0551**	**4.3593**	**0.0333**	**4.3926**	**1.1561**	**0.0309**	**1.1870**		**3,965.2519**	**3,965.2519**	**0.1807**		**3,969.0466**

3.6 O&M Activities 2021 – 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	1.0470	11.3669	7.6548	0.0185		0.4762	0.4762		0.4381	0.4381		1,788.4013	1,788.4013	0.5784		1,800.5478
Total	**1.0470**	**11.3669**	**7.6548**	**0.0185**		**0.4762**	**0.4762**		**0.4381**	**0.4381**		**1,788.4013**	**1,788.4013**	**0.5784**		**1,800.5478**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	1.0773	1.3266	16.7815	0.0552	4.3593	0.0334	4.3926	1.1561	0.0309	1.1870		3,904.2451	3,904.2451	0.1730		3,907.8774
Total	**1.0773**	**1.3266**	**16.7815**	**0.0552**	**4.3593**	**0.0334**	**4.3926**	**1.1561**	**0.0309**	**1.1870**		**3,904.2451**	**3,904.2451**	**0.1730**		**3,907.8774**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	1.0470	11.3669	7.6548	0.0185		0.4762	0.4762		0.4381	0.4381	0.0000	1,788.4013	1,788.4013	0.5784		1,800.5478
Total	**1.0470**	**11.3669**	**7.6548**	**0.0185**		**0.4762**	**0.4762**		**0.4381**	**0.4381**	**0.0000**	**1,788.4013**	**1,788.4013**	**0.5784**		**1,800.5478**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	1.0773	1.3266	16.7815	0.0552	4.3593	0.0334	4.3926	1.1561	0.0309	1.1870		3,904.2451	3,904.2451	0.1730		3,907.8774
Total	**1.0773**	**1.3266**	**16.7815**	**0.0552**	**4.3593**	**0.0334**	**4.3926**	**1.1561**	**0.0309**	**1.1870**		**3,904.2451**	**3,904.2451**	**0.1730**		**3,907.8774**

3.7 O&M Activities 2022 - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	0.9007	9.2820	7.4780	0.0185		0.3792	0.3792		0.3488	0.3488		1,789.9380	1,789.9380	0.5789		1,802.0949
Total	**0.9007**	**9.2820**	**7.4780**	**0.0185**		**0.3792**	**0.3792**		**0.3488**	**0.3488**		**1,789.9380**	**1,789.9380**	**0.5789**		**1,802.0949**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	1.0201	1.2445	15.8003	0.0552	4.3593	0.0333	4.3926	1.1561	0.0309	1.1870		3,839.8608	3,839.8608	0.1656		3,843.3387
Total	**1.0201**	**1.2445**	**15.8003**	**0.0552**	**4.3593**	**0.0333**	**4.3926**	**1.1561**	**0.0309**	**1.1870**		**3,839.8608**	**3,839.8608**	**0.1656**		**3,843.3387**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	0.9007	9.2820	7.4780	0.0185		0.3792	0.3792		0.3488	0.3488	0.0000	1,789.9380	1,789.9380	0.5789		1,802.0949
Total	**0.9007**	**9.2820**	**7.4780**	**0.0185**		**0.3792**	**0.3792**		**0.3488**	**0.3488**	**0.0000**	**1,789.9380**	**1,789.9380**	**0.5789**		**1,802.0949**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	1.0201	1.2445	15.8003	0.0552	4.3593	0.0333	4.3926	1.1561	0.0309	1.1870		3,839.8608	3,839.8608	0.1656		3,843.3387
Total	**1.0201**	**1.2445**	**15.8003**	**0.0552**	**4.3593**	**0.0333**	**4.3926**	**1.1561**	**0.0309**	**1.1870**		**3,839.8608**	**3,839.8608**	**0.1656**		**3,843.3387**

3.8 O&M Activities 2023 - 2023

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	0.8331	8.2761	7.4227	0.0185		0.3259	0.3259		0.2998	0.2998		1,790.4108	1,790.4108	0.5791		1,802.5709
Total	**0.8331**	**8.2761**	**7.4227**	**0.0185**		**0.3259**	**0.3259**		**0.2998**	**0.2998**		**1,790.4108**	**1,790.4108**	**0.5791**		**1,802.5709**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.9663	1.1717	14.9057	0.0552	4.3593	0.0333	4.3926	1.1561	0.0309	1.1870		3,781.1844	3,781.1844	0.1591		3,784.5259
Total	**0.9663**	**1.1717**	**14.9057**	**0.0552**	**4.3593**	**0.0333**	**4.3926**	**1.1561**	**0.0309**	**1.1870**		**3,781.1844**	**3,781.1844**	**0.1591**		**3,784.5259**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	0.8331	8.2761	7.4227	0.0185		0.3259	0.3259		0.2998	0.2998	0.0000	1,790.4108	1,790.4108	0.5791		1,802.5709
Total	**0.8331**	**8.2761**	**7.4227**	**0.0185**		**0.3259**	**0.3259**		**0.2998**	**0.2998**	**0.0000**	**1,790.4108**	**1,790.4108**	**0.5791**		**1,802.5709**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.9663	1.1717	14.9057	0.0552	4.3593	0.0333	4.3926	1.1561	0.0309	1.1870		3,781.1844	3,781.1844	0.1591		3,784.5259
Total	**0.9663**	**1.1717**	**14.9057**	**0.0552**	**4.3593**	**0.0333**	**4.3926**	**1.1561**	**0.0309**	**1.1870**		**3,781.1844**	**3,781.1844**	**0.1591**		**3,784.5259**

3.9 O&M Activities 2035 - 2035

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	0.8093	3.0223	7.5410	0.0228		0.0632	0.0632		0.0632	0.0632		2,155.5633	2,155.5633	0.0721		2,157.0769
Total	**0.8093**	**3.0223**	**7.5410**	**0.0228**		**0.0632**	**0.0632**		**0.0632**	**0.0632**		**2,155.5633**	**2,155.5633**	**0.0721**		**2,157.0769**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.5745	0.7369	9.9759	0.0555	4.3593	0.0340	4.3933	1.1561	0.0316	1.1877		3,477.6139	3,477.6139	0.1210		3,480.1554
Total	**0.5745**	**0.7369**	**9.9759**	**0.0555**	**4.3593**	**0.0340**	**4.3933**	**1.1561**	**0.0316**	**1.1877**		**3,477.6139**	**3,477.6139**	**0.1210**		**3,480.1554**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	0.8093	3.0223	7.5410	0.0228		0.0632	0.0632		0.0632	0.0632	0.0000	2,155.5633	2,155.5633	0.0721		2,157.0769
Total	**0.8093**	**3.0223**	**7.5410**	**0.0228**		**0.0632**	**0.0632**		**0.0632**	**0.0632**	**0.0000**	**2,155.5633**	**2,155.5633**	**0.0721**		**2,157.0769**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.5745	0.7369	9.9759	0.0555	4.3593	0.0340	4.3933	1.1561	0.0316	1.1877		3,477.6139	3,477.6139	0.1210		3,480.1554
Total	**0.5745**	**0.7369**	**9.9759**	**0.0555**	**4.3593**	**0.0340**	**4.3933**	**1.1561**	**0.0316**	**1.1877**		**3,477.6139**	**3,477.6139**	**0.1210**		**3,480.1554**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	1.7404	4.0560	18.9631	0.0873	5.5838	0.1182	5.7020	1.4931	0.1090	1.6021		6,229.9010	6,229.9010	0.1566		6,233.1905
Unmitigated	1.7404	4.0560	18.9631	0.0873	5.5838	0.1182	5.7020	1.4931	0.1090	1.6021		6,229.9010	6,229.9010	0.1566		6,233.1905

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
City Park	912.82	912.82	912.82	2,626,673	2,626,673
Total	912.82	912.82	912.82	2,626,673	2,626,673

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
City Park	16.60	8.40	6.90	33.00	48.00	19.00	66	28	6

LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
0.474926	0.062601	0.188601	0.146937	0.045783	0.007301	0.017304	0.043806	0.002178	0.002600	0.003891	0.000533	0.003539

5.0 Energy Detail

4.4 Fleet Mix

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
NaturalGas Mitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
NaturalGas Unmitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
City Park	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
City Park	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	653.9421	5.2000e-004	0.0583	0.0000		2.1000e-004	2.1000e-004		2.1000e-004	2.1000e-004		0.1256	0.1256	3.2000e-004		0.1324
Unmitigated	653.9421	5.2000e-004	0.0583	0.0000		2.1000e-004	2.1000e-004		2.1000e-004	2.1000e-004		0.1256	0.1256	3.2000e-004		0.1324

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	158.7824					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	495.1544					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Landscaping	5.3300e-003	5.2000e-004	0.0583	0.0000		2.1000e-004	2.1000e-004		2.1000e-004	2.1000e-004		0.1256	0.1256	3.2000e-004		0.1324
Total	**653.9421**	**5.2000e-004**	**0.0583**	**0.0000**		**2.1000e-004**	**2.1000e-004**		**2.1000e-004**	**2.1000e-004**		**0.1256**	**0.1256**	**3.2000e-004**		**0.1324**

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	158.7824					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	495.1544					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Landscaping	5.3300e-003	5.2000e-004	0.0583	0.0000		2.1000e-004	2.1000e-004		2.1000e-004	2.1000e-004		0.1256	0.1256	3.2000e-004		0.1324
Total	**653.9421**	**5.2000e-004**	**0.0583**	**0.0000**		**2.1000e-004**	**2.1000e-004**		**2.1000e-004**	**2.1000e-004**		**0.1256**	**0.1256**	**3.2000e-004**		**0.1324**

7.0 Water Detail

7.1 Mitigation Measures Water

8.0 Waste Detail

8.1 Mitigation Measures Waste

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Vegetation

Operational Annual GHG Emissions

Ballona EIR

South Coast AQMD Air District, Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
City Park	574.10	Acre	574.10	25,007,796.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	31
Climate Zone	13			**Operational Year**	2035
Utility Company	Southern California Edison				
CO2 Intensity (lb/MWhr)	630.89	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use -

Construction Phase - Assumed O&M activities requiring off-road equipment would occure 55 days out of the year.

Off-road Equipment - Assumed one

Off-road Equipment - Assumed O&M off-road equipment

Off-road Equipment - Assumed O&M off-road equipment

Off-road Equipment - Assumed O&M off-road equipment

Off-road Equipment - Assumed O&M off-road equipment

Off-road Equipment - Assumed O&M off-road equipment

Off-road Equipment - Assumed O&M off-road equipment

Off-road Equipment - Assumed O&M off-road equipment

Off-road Equipment - Assumed O&M off-road equipment

Trips and VMT - Provided by project engineer

Table Name	Column Name	Default Value	New Value
tblConstructionPhase	PhaseEndDate	9/20/2017	9/20/2018
tblConstructionPhase	PhaseEndDate	12/6/2018	3/19/2019
tblConstructionPhase	PhaseEndDate	6/4/2019	3/18/2020
tblConstructionPhase	PhaseEndDate	6/3/2020	3/19/2021
tblConstructionPhase	PhaseEndDate	6/4/2021	3/18/2022
tblConstructionPhase	PhaseEndDate	6/3/2022	3/17/2023
tblConstructionPhase	PhaseEndDate	6/2/2023	3/19/2035
tblConstructionPhase	PhaseStartDate	7/6/2017	7/6/2018
tblConstructionPhase	PhaseStartDate	9/21/2018	1/2/2019
tblConstructionPhase	PhaseStartDate	3/20/2019	1/2/2020
tblConstructionPhase	PhaseStartDate	3/19/2020	1/2/2021
tblConstructionPhase	PhaseStartDate	3/20/2021	1/2/2022
tblConstructionPhase	PhaseStartDate	3/19/2022	1/2/2023
tblConstructionPhase	PhaseStartDate	3/18/2023	1/2/2035
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	0.00	2.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	0.00	2.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	0.00	2.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	0.00	2.00

tblOffRoadEquipment	OffRoadEquipmentUnitAmount	0.00	2.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	0.00	2.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	0.00	2.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	0.00	2.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	0.00	2.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	0.00	2.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	0.00	2.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	0.00	2.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	0.00	2.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	0.00	2.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	0.00	2.00
tblOffRoadEquipment	PhaseName		O&M Activities 2017
tblOffRoadEquipment	PhaseName		O&M Activities 2018
tblOffRoadEquipment	PhaseName		O&M Activities 2019
tblOffRoadEquipment	PhaseName		O&M Activities 2020
tblOffRoadEquipment	PhaseName		O&M Activities 2021
tblOffRoadEquipment	PhaseName		O&M Activities 2022
tblOffRoadEquipment	PhaseName		O&M Activities 2023
tblOffRoadEquipment	PhaseName		O&M Activities 2035
tblOffRoadEquipment	PhaseName		O&M Activities 2017
tblOffRoadEquipment	PhaseName		O&M Activities 2018
tblOffRoadEquipment	PhaseName		O&M Activities 2019
tblOffRoadEquipment	PhaseName		O&M Activities 2020
tblOffRoadEquipment	PhaseName		O&M Activities 2021

tblOffRoadEquipment	PhaseName		O&M Activities 2022
tblOffRoadEquipment	PhaseName		O&M Activities 2023
tblOffRoadEquipment	PhaseName		O&M Activities 2035
tblProjectCharacteristics	OperationalYear	2014	2035
tblTripsAndVMT	WorkerTripNumber	10.00	390.00
tblTripsAndVMT	WorkerTripNumber	10.00	390.00
tblTripsAndVMT	WorkerTripNumber	10.00	390.00
tblTripsAndVMT	WorkerTripNumber	10.00	390.00
tblTripsAndVMT	WorkerTripNumber	10.00	390.00
tblTripsAndVMT	WorkerTripNumber	10.00	390.00
tblTripsAndVMT	WorkerTripNumber	10.00	390.00
tblTripsAndVMT	WorkerTripNumber	10.00	390.00

2.0 Emissions Summary

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2017	0.0819	0.5550	0.8236	1.9500e-003	0.1177	0.0248	0.1425	0.0313	0.0228	0.0541	0.0000	153.1532	153.1532	0.0199	0.0000	153.5716
2018	0.0725	0.4836	0.7595	1.9500e-003	0.1177	0.0209	0.1386	0.0313	0.0193	0.0505	0.0000	148.4153	148.4153	0.0195	0.0000	148.8252

2019	0.0661	0.4363	0.7099	1.9500e-003	0.1177	0.0182	0.1359	0.0313	0.0168	0.0480	0.0000	143.7785	143.7785	0.0192	0.0000	144.1815
2020	0.0615	0.3976	0.6721	1.9500e-003	0.1177	0.0161	0.1338	0.0313	0.0149	0.0461	0.0000	138.7855	138.7855	0.0189	0.0000	139.1832
2021	0.0570	0.3538	0.6412	1.9500e-003	0.1177	0.0140	0.1317	0.0313	0.0129	0.0442	0.0000	137.3323	137.3323	0.0187	0.0000	137.7259
2022	0.0515	0.2939	0.6106	1.9500e-003	0.1177	0.0113	0.1290	0.0313	0.0104	0.0417	0.0000	135.8303	135.8303	0.0186	0.0000	136.2203
2023	0.0482	0.2640	0.5855	1.9500e-003	0.1177	9.8800e-003	0.1276	0.0313	9.0900e-003	0.0403	0.0000	134.4371	134.4371	0.0184	0.0000	134.8238
2035	0.0373	0.1059	0.4593	2.0700e-003	0.1177	2.6700e-003	0.1203	0.0313	2.6100e-003	0.0339	0.0000	136.2125	136.2125	4.8200e-003	0.0000	136.3137
Total	**0.4760**	**2.8900**	**5.2616**	**0.0157**	**0.9414**	**0.1180**	**1.0594**	**0.2500**	**0.1088**	**0.3588**	**0.0000**	**1,127.9447**	**1,127.9447**	**0.1381**	**0.0000**	**1,130.8452**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2017	0.0819	0.5550	0.8236	1.9500e-003	0.1177	0.0248	0.1425	0.0313	0.0228	0.0541	0.0000	153.1531	153.1531	0.0199	0.0000	153.5715
2018	0.0725	0.4836	0.7595	1.9500e-003	0.1177	0.0209	0.1386	0.0313	0.0193	0.0505	0.0000	148.4152	148.4152	0.0195	0.0000	148.8251
2019	0.0661	0.4363	0.7099	1.9500e-003	0.1177	0.0182	0.1359	0.0313	0.0168	0.0480	0.0000	143.7785	143.7785	0.0192	0.0000	144.1815
2020	0.0615	0.3976	0.6721	1.9500e-003	0.1177	0.0161	0.1338	0.0313	0.0149	0.0461	0.0000	138.7855	138.7855	0.0189	0.0000	139.1831
2021	0.0570	0.3538	0.6412	1.9500e-003	0.1177	0.0140	0.1317	0.0313	0.0129	0.0442	0.0000	137.3322	137.3322	0.0187	0.0000	137.7258
2022	0.0515	0.2939	0.6105	1.9500e-003	0.1177	0.0113	0.1290	0.0313	0.0104	0.0417	0.0000	135.8302	135.8302	0.0186	0.0000	136.2203
2023	0.0482	0.2640	0.5855	1.9500e-003	0.1177	9.8800e-003	0.1276	0.0313	9.0900e-003	0.0403	0.0000	134.4370	134.4370	0.0184	0.0000	134.8238
2035	0.0373	0.1059	0.4593	2.0700e-003	0.1177	2.6700e-003	0.1203	0.0313	2.6100e-003	0.0339	0.0000	136.2125	136.2125	4.8200e-003	0.0000	136.3136
Total	**0.4760**	**2.8900**	**5.2616**	**0.0157**	**0.9414**	**0.1180**	**1.0594**	**0.2500**	**0.1088**	**0.3588**	**0.0000**	**1,127.9442**	**1,127.9442**	**0.1381**	**0.0000**	**1,130.8448**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	119.3441	7.0000e-005	7.2900e-003	0.0000		3.0000e-005	3.0000e-005		3.0000e-005	3.0000e-005	0.0000	0.0143	0.0143	4.0000e-005	0.0000	0.0150
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.3096	0.7848	3.5063	0.0153	0.9978	0.0215	1.0193	0.2672	0.0199	0.2871	0.0000	992.2784	992.2784	0.0259	0.0000	992.8215
Waste						0.0000	0.0000		0.0000	0.0000	10.0217	0.0000	10.0217	0.5923	0.0000	22.4592
Water						0.0000	0.0000		0.0000	0.0000	0.0000	2,174.7445	2,174.7445	0.1000	0.0207	2,183.2554
Total	**119.6538**	**0.7849**	**3.5136**	**0.0153**	**0.9978**	**0.0215**	**1.0194**	**0.2672**	**0.0199**	**0.2871**	**10.0217**	**3,167.0371**	**3,177.0588**	**0.7181**	**0.0207**	**3,198.5511**

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	119.3441	7.0000e-005	7.2900e-003	0.0000		3.0000e-005	3.0000e-005		3.0000e-005	3.0000e-005	0.0000	0.0143	0.0143	4.0000e-005	0.0000	0.0150
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.3096	0.7848	3.5063	0.0153	0.9978	0.0215	1.0193	0.2672	0.0199	0.2871	0.0000	992.2784	992.2784	0.0259	0.0000	992.8215
Waste						0.0000	0.0000		0.0000	0.0000	10.0217	0.0000	10.0217	0.5923	0.0000	22.4592
Water						0.0000	0.0000		0.0000	0.0000	0.0000	2,174.7445	2,174.7445	0.1000	0.0207	2,183.2554
Total	**119.6538**	**0.7849**	**3.5136**	**0.0153**	**0.9978**	**0.0215**	**1.0194**	**0.2672**	**0.0199**	**0.2871**	**10.0217**	**3,167.0371**	**3,177.0588**	**0.7181**	**0.0207**	**3,198.5511**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	O&M Activities 2017	Trenching	4/20/2017	7/5/2017	5	55	
2	O&M Activities 2018	Trenching	7/6/2018	9/20/2018	5	55	
3	O&M Activities 2019	Trenching	1/2/2019	3/19/2019	5	55	
4	O&M Activities 2020	Trenching	1/2/2020	3/18/2020	5	55	
5	O&M Activities 2021	Trenching	1/2/2021	3/19/2021	5	55	
6	O&M Activities 2022	Trenching	1/2/2022	3/18/2022	5	55	
7	O&M Activities 2023	Trenching	1/2/2023	3/17/2023	5	55	
8	O&M Activities 2035	Trenching	1/2/2035	3/19/2035	5	55	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 0

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 0; Non-Residential Outdoor: 0 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
O&M Activities 2017	Rubber Tired Loaders	2	8.00	199	0.36
O&M Activities 2017	Tractors/Loaders/Backhoes	2	8.00	97	0.37
O&M Activities 2018	Rubber Tired Loaders	2	8.00	199	0.36
O&M Activities 2018	Tractors/Loaders/Backhoes	2	8.00	97	0.37
O&M Activities 2019	Rubber Tired Loaders	2	8.00	199	0.36

O&M Activities 2019	Tractors/Loaders/Backhoes	2	8.00	97	0.37
O&M Activities 2020	Rubber Tired Loaders	2	8.00	199	0.36
O&M Activities 2020	Tractors/Loaders/Backhoes	2	8.00	97	0.37
O&M Activities 2021	Rubber Tired Loaders	2	8.00	199	0.36
O&M Activities 2021	Tractors/Loaders/Backhoes	2	8.00	97	0.37
O&M Activities 2022	Rubber Tired Loaders	2	8.00	199	0.36
O&M Activities 2022	Tractors/Loaders/Backhoes	2	8.00	97	0.37
O&M Activities 2023	Rubber Tired Loaders	2	8.00	199	0.36
O&M Activities 2023	Tractors/Loaders/Backhoes	2	8.00	97	0.37
O&M Activities 2035	Rubber Tired Loaders	2	8.00	199	0.36
O&M Activities 2035	Tractors/Loaders/Backhoes	2	8.00	97	0.37

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
O&M Activities 2017	4	390.00	0.00	0.00	14.70	6.90	20.00	LD_Mix	HDT_Mix	HHDT
O&M Activities 2018	4	390.00	0.00	0.00	14.70	6.90	20.00	LD_Mix	HDT_Mix	HHDT
O&M Activities 2019	4	390.00	0.00	0.00	14.70	6.90	20.00	LD_Mix	HDT_Mix	HHDT
O&M Activities 2020	4	390.00	0.00	0.00	14.70	6.90	20.00	LD_Mix	HDT_Mix	HHDT
O&M Activities 2021	4	390.00	0.00	0.00	14.70	6.90	20.00	LD_Mix	HDT_Mix	HHDT
O&M Activities 2022	4	390.00	0.00	0.00	14.70	6.90	20.00	LD_Mix	HDT_Mix	HHDT
O&M Activities 2023	4	390.00	0.00	0.00	14.70	6.90	20.00	LD_Mix	HDT_Mix	HHDT
O&M Activities 2035	4	390.00	0.00	0.00	14.70	6.90	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

3.2 O&M Activities 2017 - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0433	0.4978	0.2302	5.1000e-004		0.0239	0.0239		0.0219	0.0219	0.0000	47.1462	47.1462	0.0145	0.0000	47.4495
Total	**0.0433**	**0.4978**	**0.2302**	**5.1000e-004**		**0.0239**	**0.0239**		**0.0219**	**0.0219**	**0.0000**	**47.1462**	**47.1462**	**0.0145**	**0.0000**	**47.4495**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0386	0.0572	0.5935	1.4500e-003	0.1177	9.6000e-004	0.1186	0.0313	8.9000e-004	0.0321	0.0000	106.0070	106.0070	5.4800e-003	0.0000	106.1221
Total	**0.0386**	**0.0572**	**0.5935**	**1.4500e-003**	**0.1177**	**9.6000e-004**	**0.1186**	**0.0313**	**8.9000e-004**	**0.0321**	**0.0000**	**106.0070**	**106.0070**	**5.4800e-003**	**0.0000**	**106.1221**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0433	0.4978	0.2302	5.1000e-004		0.0239	0.0239		0.0219	0.0219	0.0000	47.1461	47.1461	0.0145	0.0000	47.4495
Total	**0.0433**	**0.4978**	**0.2302**	**5.1000e-004**		**0.0239**	**0.0239**		**0.0219**	**0.0219**	**0.0000**	**47.1461**	**47.1461**	**0.0145**	**0.0000**	**47.4495**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0386	0.0572	0.5935	1.4500e-003	0.1177	9.6000e-004	0.1186	0.0313	8.9000e-004	0.0321	0.0000	106.0070	106.0070	5.4800e-003	0.0000	106.1221
Total	**0.0386**	**0.0572**	**0.5935**	**1.4500e-003**	**0.1177**	**9.6000e-004**	**0.1186**	**0.0313**	**8.9000e-004**	**0.0321**	**0.0000**	**106.0070**	**106.0070**	**5.4800e-003**	**0.0000**	**106.1221**

3.3 O&M Activities 2018 - 2018

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0378	0.4317	0.2221	5.1000e-004		0.0200	0.0200		0.0184	0.0184	0.0000	46.3649	46.3649	0.0144	0.0000	46.6681
Total	**0.0378**	**0.4317**	**0.2221**	**5.1000e-004**		**0.0200**	**0.0200**		**0.0184**	**0.0184**	**0.0000**	**46.3649**	**46.3649**	**0.0144**	**0.0000**	**46.6681**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0347	0.0519	0.5374	1.4400e-003	0.1177	9.4000e-004	0.1186	0.0313	8.7000e-004	0.0321	0.0000	102.0504	102.0504	5.0800e-003	0.0000	102.1571
Total	**0.0347**	**0.0519**	**0.5374**	**1.4400e-003**	**0.1177**	**9.4000e-004**	**0.1186**	**0.0313**	**8.7000e-004**	**0.0321**	**0.0000**	**102.0504**	**102.0504**	**5.0800e-003**	**0.0000**	**102.1571**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0378	0.4317	0.2221	5.1000e-004		0.0200	0.0200		0.0184	0.0184	0.0000	46.3649	46.3649	0.0144	0.0000	46.6680
Total	**0.0378**	**0.4317**	**0.2221**	**5.1000e-004**		**0.0200**	**0.0200**		**0.0184**	**0.0184**	**0.0000**	**46.3649**	**46.3649**	**0.0144**	**0.0000**	**46.6680**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0347	0.0519	0.5374	1.4400e-003	0.1177	9.4000e-004	0.1186	0.0313	8.7000e-004	0.0321	0.0000	102.0504	102.0504	5.0800e-003	0.0000	102.1571
Total	**0.0347**	**0.0519**	**0.5374**	**1.4400e-003**	**0.1177**	**9.4000e-004**	**0.1186**	**0.0313**	**8.7000e-004**	**0.0321**	**0.0000**	**102.0504**	**102.0504**	**5.0800e-003**	**0.0000**	**102.1571**

3.4 O&M Activities 2019 - 2019

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0343	0.3888	0.2172	5.1000e-004		0.0173	0.0173		0.0159	0.0159	0.0000	45.6119	45.6119	0.0144	0.0000	45.9149
Total	**0.0343**	**0.3888**	**0.2172**	**5.1000e-004**		**0.0173**	**0.0173**		**0.0159**	**0.0159**	**0.0000**	**45.6119**	**45.6119**	**0.0144**	**0.0000**	**45.9149**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0318	0.0476	0.4928	1.4400e-003	0.1177	9.2000e-004	0.1186	0.0313	8.5000e-004	0.0321	0.0000	98.1667	98.1667	4.7600e-003	0.0000	98.2666
Total	**0.0318**	**0.0476**	**0.4928**	**1.4400e-003**	**0.1177**	**9.2000e-004**	**0.1186**	**0.0313**	**8.5000e-004**	**0.0321**	**0.0000**	**98.1667**	**98.1667**	**4.7600e-003**	**0.0000**	**98.2666**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0343	0.3888	0.2172	5.1000e-004		0.0173	0.0173		0.0159	0.0159	0.0000	45.6118	45.6118	0.0144	0.0000	45.9149
Total	**0.0343**	**0.3888**	**0.2172**	**5.1000e-004**		**0.0173**	**0.0173**		**0.0159**	**0.0159**	**0.0000**	**45.6118**	**45.6118**	**0.0144**	**0.0000**	**45.9149**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0318	0.0476	0.4928	1.4400e-003	0.1177	9.2000e-004	0.1186	0.0313	8.5000e-004	0.0321	0.0000	98.1667	98.1667	4.7600e-003	0.0000	98.2666
Total	**0.0318**	**0.0476**	**0.4928**	**1.4400e-003**	**0.1177**	**9.2000e-004**	**0.1186**	**0.0313**	**8.5000e-004**	**0.0321**	**0.0000**	**98.1667**	**98.1667**	**4.7600e-003**	**0.0000**	**98.2666**

3.5 O&M Activities 2020 - 2020

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0317	0.3535	0.2136	5.1000e-004		0.0152	0.0152		0.0140	0.0140	0.0000	44.6065	44.6065	0.0144	0.0000	44.9094
Total	**0.0317**	**0.3535**	**0.2136**	**5.1000e-004**		**0.0152**	**0.0152**		**0.0140**	**0.0140**	**0.0000**	**44.6065**	**44.6065**	**0.0144**	**0.0000**	**44.9094**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0298	0.0441	0.4585	1.4400e-003	0.1177	9.2000e-004	0.1186	0.0313	8.5000e-004	0.0321	0.0000	94.1791	94.1791	4.5100e-003	0.0000	94.2737
Total	**0.0298**	**0.0441**	**0.4585**	**1.4400e-003**	**0.1177**	**9.2000e-004**	**0.1186**	**0.0313**	**8.5000e-004**	**0.0321**	**0.0000**	**94.1791**	**94.1791**	**4.5100e-003**	**0.0000**	**94.2737**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0317	0.3535	0.2136	5.1000e-004		0.0152	0.0152		0.0140	0.0140	0.0000	44.6064	44.6064	0.0144	0.0000	44.9094
Total	**0.0317**	**0.3535**	**0.2136**	**5.1000e-004**		**0.0152**	**0.0152**		**0.0140**	**0.0140**	**0.0000**	**44.6064**	**44.6064**	**0.0144**	**0.0000**	**44.9094**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0298	0.0441	0.4585	1.4400e-003	0.1177	9.2000e-004	0.1186	0.0313	8.5000e-004	0.0321	0.0000	94.1791	94.1791	4.5100e-003	0.0000	94.2737
Total	**0.0298**	**0.0441**	**0.4585**	**1.4400e-003**	**0.1177**	**9.2000e-004**	**0.1186**	**0.0313**	**8.5000e-004**	**0.0321**	**0.0000**	**94.1791**	**94.1791**	**4.5100e-003**	**0.0000**	**94.2737**

3.6 O&M Activities 2021 - 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0288	0.3126	0.2105	5.1000e-004		0.0131	0.0131		0.0121	0.0121	0.0000	44.6163	44.6163	0.0144	0.0000	44.9193
Total	**0.0288**	**0.3126**	**0.2105**	**5.1000e-004**		**0.0131**	**0.0131**		**0.0121**	**0.0121**	**0.0000**	**44.6163**	**44.6163**	**0.0144**	**0.0000**	**44.9193**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0282	0.0412	0.4307	1.4400e-003	0.1177	9.2000e-004	0.1186	0.0313	8.5000e-004	0.0321	0.0000	92.7160	92.7160	4.3200e-003	0.0000	92.8066
Total	**0.0282**	**0.0412**	**0.4307**	**1.4400e-003**	**0.1177**	**9.2000e-004**	**0.1186**	**0.0313**	**8.5000e-004**	**0.0321**	**0.0000**	**92.7160**	**92.7160**	**4.3200e-003**	**0.0000**	**92.8066**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0288	0.3126	0.2105	5.1000e-004		0.0131	0.0131		0.0121	0.0121	0.0000	44.6162	44.6162	0.0144	0.0000	44.9193
Total	**0.0288**	**0.3126**	**0.2105**	**5.1000e-004**		**0.0131**	**0.0131**		**0.0121**	**0.0121**	**0.0000**	**44.6162**	**44.6162**	**0.0144**	**0.0000**	**44.9193**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0282	0.0412	0.4307	1.4400e-003	0.1177	9.2000e-004	0.1186	0.0313	8.5000e-004	0.0321	0.0000	92.7160	92.7160	4.3200e-003	0.0000	92.8066
Total	**0.0282**	**0.0412**	**0.4307**	**1.4400e-003**	**0.1177**	**9.2000e-004**	**0.1186**	**0.0313**	**8.5000e-004**	**0.0321**	**0.0000**	**92.7160**	**92.7160**	**4.3200e-003**	**0.0000**	**92.8066**

3.7 O&M Activities 2022 - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0248	0.2553	0.2056	5.1000e-004		0.0104	0.0104		9.5900e-003	9.5900e-003	0.0000	44.6546	44.6546	0.0144	0.0000	44.9579
Total	**0.0248**	**0.2553**	**0.2056**	**5.1000e-004**		**0.0104**	**0.0104**		**9.5900e-003**	**9.5900e-003**	**0.0000**	**44.6546**	**44.6546**	**0.0144**	**0.0000**	**44.9579**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0267	0.0386	0.4049	1.4400e-003	0.1177	9.2000e-004	0.1186	0.0313	8.5000e-004	0.0321	0.0000	91.1757	91.1757	4.1300e-003	0.0000	91.2624
Total	**0.0267**	**0.0386**	**0.4049**	**1.4400e-003**	**0.1177**	**9.2000e-004**	**0.1186**	**0.0313**	**8.5000e-004**	**0.0321**	**0.0000**	**91.1757**	**91.1757**	**4.1300e-003**	**0.0000**	**91.2624**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0248	0.2553	0.2056	5.1000e-004		0.0104	0.0104		9.5900e-003	9.5900e-003	0.0000	44.6546	44.6546	0.0144	0.0000	44.9579
Total	**0.0248**	**0.2553**	**0.2056**	**5.1000e-004**		**0.0104**	**0.0104**		**9.5900e-003**	**9.5900e-003**	**0.0000**	**44.6546**	**44.6546**	**0.0144**	**0.0000**	**44.9579**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0267	0.0386	0.4049	1.4400e-003	0.1177	9.2000e-004	0.1186	0.0313	8.5000e-004	0.0321	0.0000	91.1757	91.1757	4.1300e-003	0.0000	91.2624
Total	**0.0267**	**0.0386**	**0.4049**	**1.4400e-003**	**0.1177**	**9.2000e-004**	**0.1186**	**0.0313**	**8.5000e-004**	**0.0321**	**0.0000**	**91.1757**	**91.1757**	**4.1300e-003**	**0.0000**	**91.2624**

3.8 O&M Activities 2023 - 2023

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0229	0.2276	0.2041	5.1000e-004		8.9600e-003	8.9600e-003		8.2500e-003	8.2500e-003	0.0000	44.6664	44.6664	0.0145	0.0000	44.9698
Total	**0.0229**	**0.2276**	**0.2041**	**5.1000e-004**		**8.9600e-003**	**8.9600e-003**		**8.2500e-003**	**8.2500e-003**	**0.0000**	**44.6664**	**44.6664**	**0.0145**	**0.0000**	**44.9698**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0253	0.0364	0.3814	1.4400e-003	0.1177	9.2000e-004	0.1186	0.0313	8.5000e-004	0.0321	0.0000	89.7707	89.7707	3.9700e-003	0.0000	89.8540
Total	**0.0253**	**0.0364**	**0.3814**	**1.4400e-003**	**0.1177**	**9.2000e-004**	**0.1186**	**0.0313**	**8.5000e-004**	**0.0321**	**0.0000**	**89.7707**	**89.7707**	**3.9700e-003**	**0.0000**	**89.8540**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0229	0.2276	0.2041	5.1000e-004		8.9600e-003	8.9600e-003		8.2500e-003	8.2500e-003	0.0000	44.6664	44.6664	0.0145	0.0000	44.9697
Total	**0.0229**	**0.2276**	**0.2041**	**5.1000e-004**		**8.9600e-003**	**8.9600e-003**		**8.2500e-003**	**8.2500e-003**	**0.0000**	**44.6664**	**44.6664**	**0.0145**	**0.0000**	**44.9697**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0253	0.0364	0.3814	1.4400e-003	0.1177	9.2000e-004	0.1186	0.0313	8.5000e-004	0.0321	0.0000	89.7707	89.7707	3.9700e-003	0.0000	89.8540
Total	**0.0253**	**0.0364**	**0.3814**	**1.4400e-003**	**0.1177**	**9.2000e-004**	**0.1186**	**0.0313**	**8.5000e-004**	**0.0321**	**0.0000**	**89.7707**	**89.7707**	**3.9700e-003**	**0.0000**	**89.8540**

3.9 O&M Activities 2035 - 2035

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0223	0.0831	0.2074	6.3000e-004		1.7400e-003	1.7400e-003		1.7400e-003	1.7400e-003	0.0000	53.7761	53.7761	1.8000e-003	0.0000	53.8139
Total	**0.0223**	**0.0831**	**0.2074**	**6.3000e-004**		**1.7400e-003**	**1.7400e-003**		**1.7400e-003**	**1.7400e-003**	**0.0000**	**53.7761**	**53.7761**	**1.8000e-003**	**0.0000**	**53.8139**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0151	0.0228	0.2519	1.4500e-003	0.1177	9.4000e-004	0.1186	0.0313	8.7000e-004	0.0321	0.0000	82.4365	82.4365	3.0200e-003	0.0000	82.4999
Total	**0.0151**	**0.0228**	**0.2519**	**1.4500e-003**	**0.1177**	**9.4000e-004**	**0.1186**	**0.0313**	**8.7000e-004**	**0.0321**	**0.0000**	**82.4365**	**82.4365**	**3.0200e-003**	**0.0000**	**82.4999**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0223	0.0831	0.2074	6.3000e-004		1.7400e-003	1.7400e-003		1.7400e-003	1.7400e-003	0.0000	53.7760	53.7760	1.8000e-003	0.0000	53.8138
Total	**0.0223**	**0.0831**	**0.2074**	**6.3000e-004**		**1.7400e-003**	**1.7400e-003**		**1.7400e-003**	**1.7400e-003**	**0.0000**	**53.7760**	**53.7760**	**1.8000e-003**	**0.0000**	**53.8138**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0151	0.0228	0.2519	1.4500e-003	0.1177	9.4000e-004	0.1186	0.0313	8.7000e-004	0.0321	0.0000	82.4365	82.4365	3.0200e-003	0.0000	82.4999
Total	**0.0151**	**0.0228**	**0.2519**	**1.4500e-003**	**0.1177**	**9.4000e-004**	**0.1186**	**0.0313**	**8.7000e-004**	**0.0321**	**0.0000**	**82.4365**	**82.4365**	**3.0200e-003**	**0.0000**	**82.4999**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	0.3096	0.7848	3.5063	0.0153	0.9978	0.0215	1.0193	0.2672	0.0199	0.2871	0.0000	992.2784	992.2784	0.0259	0.0000	992.8215
Unmitigated	0.3096	0.7848	3.5063	0.0153	0.9978	0.0215	1.0193	0.2672	0.0199	0.2871	0.0000	992.2784	992.2784	0.0259	0.0000	992.8215

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
City Park	912.82	912.82	912.82	2,626,673	2,626,673
Total	912.82	912.82	912.82	2,626,673	2,626,673

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
City Park	16.60	8.40	6.90	33.00	48.00	19.00	66	28	6

LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
0.474926	0.062601	0.188601	0.146937	0.045783	0.007301	0.017304	0.043806	0.002178	0.002600	0.003891	0.000533	0.003539

5.0 Energy Detail

4.4 Fleet Mix

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Electricity Mitigated						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Electricity Unmitigated						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NaturalGas Mitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NaturalGas Unmitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
City Park	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
City Park	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

5.3 Energy by Land Use - Electricity

Unmitigated

	Electricity Use		Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	tons/yr	MT/yr			
City Park	0		0.0000	0.0000	0.0000	0.0000
Total			**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated

	Electricity Use		Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	tons/yr	MT/yr			
City Park	0		0.0000	0.0000	0.0000	0.0000
Total			**0.0000**	**0.0000**	**0.0000**	**0.0000**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	119.3441	7.0000e-005	7.2900e-003	0.0000		3.0000e-005	3.0000e-005		3.0000e-005	3.0000e-005	0.0000	0.0143	0.0143	4.0000e-005	0.0000	0.0150
Unmitigated	119.3441	7.0000e-005	7.2900e-003	0.0000		3.0000e-005	3.0000e-005		3.0000e-005	3.0000e-005	0.0000	0.0143	0.0143	4.0000e-005	0.0000	0.0150

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	28.9778					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	90.3657					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	6.7000e-004	7.0000e-005	7.2900e-003	0.0000		3.0000e-005	3.0000e-005		3.0000e-005	3.0000e-005	0.0000	0.0143	0.0143	4.0000e-005	0.0000	0.0150
Total	**119.3441**	**7.0000e-005**	**7.2900e-003**	**0.0000**		**3.0000e-005**	**3.0000e-005**		**3.0000e-005**	**3.0000e-005**	**0.0000**	**0.0143**	**0.0143**	**4.0000e-005**	**0.0000**	**0.0150**

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	28.9778					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	90.3657					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	6.7000e-004	7.0000e-005	7.2900e-003	0.0000		3.0000e-005	3.0000e-005		3.0000e-005	3.0000e-005	0.0000	0.0143	0.0143	4.0000e-005	0.0000	0.0150
Total	**119.3441**	**7.0000e-005**	**7.2900e-003**	**0.0000**		**3.0000e-005**	**3.0000e-005**		**3.0000e-005**	**3.0000e-005**	**0.0000**	**0.0143**	**0.0143**	**4.0000e-005**	**0.0000**	**0.0150**

7.0 Water Detail

7.1 Mitigation Measures Water

		Total CO2	CH4	N2O	CO2e
Category	tons/yr	MT/yr			
Mitigated		2,174.7445	0.1000	0.0207	2,183.2554
Unmitigated		2,174.7445	0.1000	0.0207	2,183.2554

7.2 Water by Land Use

Unmitigated

	Indoor/Outdoor Use		Total CO2	CH4	N2O	CO2e
Land Use	Mgal	tons/yr	MT/yr			
City Park	0 / 684.029		2,174.7445	0.1000	0.0207	2,183.2554
Total			**2,174.7445**	**0.1000**	**0.0207**	**2,183.2554**

Mitigated

	Indoor/Outdoor Use		Total CO2	CH4	N2O	CO2e
Land Use	Mgal	tons/yr	MT/yr			
City Park	0 / 684.029		2,174.7445	0.1000	0.0207	2,183.2554
Total			**2,174.7445**	**0.1000**	**0.0207**	**2,183.2554**

8.0 Waste Detail

8.1 Mitigation Measures Waste

Category/Year

		Total CO2	CH4	N2O	CO2e
	tons/yr	MT/yr			
Mitigated		10.0217	0.5923	0.0000	22.4592
Unmitigated		10.0217	0.5923	0.0000	22.4592

8.2 Waste by Land Use

Unmitigated

	Waste Disposed		Total CO2	CH4	N2O	CO2e
Land Use	tons	tons/yr	MT/yr			
City Park	49.37		10.0217	0.5923	0.0000	22.4592
Total			**10.0217**	**0.5923**	**0.0000**	**22.4592**

Mitigated

	Waste Disposed		Total CO2	CH4	N2O	CO2e
Land Use	tons	tons/yr	MT/yr			
City Park	49.37		10.0217	0.5923	0.0000	22.4592
Total			**10.0217**	**0.5923**	**0.0000**	**22.4592**

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Vegetation

APPENDIX D
Biological Resources

D1. Botanical Survey Summary

D2. Vegetation Alliance and Association Acreages by Habitat Type

D3. Study Area Plant List by Survey Effort

D4. Benthic Invertebrate Studies

D5. Biological Resources Existing Conditions

D6. Terrestrial Invertebrate Studies

D7. Summary of Fish Studies

D8. Summary of Reptile and Amphibian Studies

D9. Summary of Bird Studies

D10. Summary of Mammal Studies

D11. Special-Status Plants

D12. Special-Status Wildlife

D13. Species Accounts

D14. Ballona Creek Wetlands Ecological Reserve Preliminary Delineation of Wetlands and Non-Wetland Waters

D15. Jurisdictional Delineation Report, Potential Well Sites, Playa del Rey Storage Facility

D16. Patterns of Vehicle-Based Vertebrate Mortality in the Ballona Wetlands Ecological Reserve, Los Angeles, CA

D17. Biological Assessment

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APPENDIX D1
Botanical Survey Summary

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Appendix D1

Summary of Botanical Studies in the Study Area

The following summarizes the botanical studies conducted in the study area between 1981 and 2013.

Gustafson 1981

Gustafson conducted one of the earliest full taxonomic floristic surveys of Areas A and B of the Reserve, with the identified plants deposited in the Los Angeles County Natural History Museum. No mapping or transects were completed at this time, but some rough cover estimates were made. Gustafson found a total of 235 plant species, 130 of which were introduced or naturalized, and 105 of which were indigenous to California. Weedy introduced components covered approximately 40% of the area under investigation (Areas A and B). Approximately 15% of the 40% nonnative vegetation cover was attributed to iceplant species (Johnston et al. 2011).

Henrickson 1991

Triggered by the Playa Vista Project, James Henrickson, PhD. conducted a botanical resources survey of the Reserve in April to October 1990. The entire limits of Areas A, B, and C (and D, which is no longer part of the Reserve) were traveled on foot with a detailed account of all plant species present along with community associations observed. Each of these areas is quite diverse in habitat type and species composition. Three special-status plant species were observed in Area B: woolly seablite (*Suaeda taxifolia*), Lewis' evening primrose (*Camissoniopsis lewisii*), and suffrutescent wallflower (*Erysimum insulare* ssp. *suffrutescens*). Populations of woolly seablite, a typical salt marsh species, were observed in areas classified as tidal pickleweed flats but were restricted to the upland margins of the Ballona Creek channel. Lewis' evening primrose and suffrutescent wallflower were also observed in Area B but were concentrated in areas classified as sand dunes and flats habitat, which are remnants of the extensive dune system that bordered the Santa Monica Bay. These species were not found in any other region of the Reserve. Of all the remaining plant species documented, none were considered special-status (WRA 2011).

Psomas 1995

A follow up of Henrickson's 1991 survey was conducted in April to mid-October 1995, led by Dr. Edith Read of Psomas and Associates and field support staff provided by Impact Sciences. Presence or absence of the special-status species reported by Henrickson were confirmed during the 1995 walking surveys and any additional special-status species observed along with any notable differences in vegetation communities were documented. Prior to any field work commencing,

Psomas and Associates compiled a list of plant species of potential concern from the California Natural Diversity Database (CNDDB), the California Native Plant Society's Inventory of Rare and Endangered Vascular Plants (CNPS), and Henrickson's 1991 survey. On account of the extensive nature of Henrickson's survey and the detailed species list obtained, it was justified that the 1995 studies would solely focus on the flowering and fruiting periods of the sensitive species. If possible, reference populations for targeted species in the southern coastal California area were visited to confirm accurate survey timing for each species (WRA 2011).

Results of the Psomas Study concluded that two of the same sensitive species mapped by Henrickson (1991), Lewis' evening primrose and suffrutescent wallflower, were still present on site. In addition, southern tarplant (*Centromadia parryi* ssp. *australis*) was also observed for the first time. Woolly seablite was documented as an observed special-status species by Henrickson; however, no mention of this species was found within the Psomas Study (WRA 2011).

Populations of Lewis' evening primrose were recorded in Areas B and C, which coincide with documented observations made by Henrickson (1991). No individuals of this species were observed elsewhere within the Reserve. It is estimated that the total population size in Area B was approximately 5,000 individuals and Area C contained approximately 6,000 individuals. All observed individuals were found to occur on sandy soils, in areas away from dense grasses and weeds. This species was found to commonly co-occur with California sun cup (*Camissoniopsis bistorta*), a species that holds no sensitivity status. Due to the close relationship of these species and their nearly identical morphology, it is believed by Dr. Read that hybrids between these two species are possible in areas where they co-occur, which she believed could lead to potential mis-identification. Because of this potential hybridization between species, individuals mapped during the Psomas Study may have been hybrids and therefore results of this study were unable to determine whether this species had expanded or declined (WRA 2011).

The Henrickson study documented suffrutescent wallflower as occurring in the dune habitats of Area B and its continued existence was confirmed by the Psomas 1995 surveys with approximately 10 individuals observed. It was not indicated by Henrickson as to how many individuals were present during his surveys, so it is unclear as to this populations' progression. Results of the Psomas study reported that the expansion of this species appeared to be hindered by increasing densities of ripgut brome (*Bromus diandrus*) (WRA 2011).

Southern tarplant was not observed by Henrickson but was recorded during the Psomas surveys in areas east of the baseball fields of Area C. Specific morphological characteristics, such as black anthers and prickly, sticky foliage make this species easily identifiable from other species in this genus. Extensive surveys were conducted during the 1995 surveys for this species to avoid overlooking individuals that occur within dense stands of common tarplant (*Deinandra fasciculata* [*Hemizonia fasciculata*]). All individuals, except for one, of this species were found to occur in compacted, clay soil in shallow depressions and openings in dense stands of curly dock (*Rumex crispus*) and horseweed (*Conyza canadensis*). The population of southern tarplant in Area C is the only known population in the region of Marina del Rey. The nearest population outside of the Ballona Wetlands is in Harbor Regional Park, approximately 10 miles south. Botanists involved with the Psomas Study visited this population prior to field surveys to confirm proper timing of surveys. This population was found to be extant (WRA 2011).

Vegetation communities reported in the Psomas study matched the communities discussed by Henrickson in 1991 except for two areas in Area B where pickleweed saltmarsh areas and freshwater marsh habitat along Jefferson had since expanded (WRA 2011).

WRA 2002

As part of ongoing restoration at the Reserve, the dune habitat in the western end of Area B was monitored in 2002 by Michael Josselyn and Becky Miller of WRA, Inc. (WRA). The purpose of this monitoring effort was to provide all interested parties with an update of the Ballona Dunes post restoration activities and also to provide a baseline for which all future restoration could be measured against. All vegetation in the sand dune habitat was assessed during the 2002 study by walking homogenous stands of plant communities with an advanced global positioning system (GPS) backpack unit. Multiple species, both native and nonnative, were recorded within this area. Many of the dominant plant species observed in the dune areas on the western edge of Area B during the WRA 2002 study coincided with species observed during focused rare plant surveys conducted in 2010 and 2011, such as dune lupine (*Lupinus chamissonis*), sand verbena (*Abronia* sp.), and coast buckwheat. The area east of the dunes in Area B, made up of coastal salt marsh habitat, continued to be dominated by species indicative of this habitat such as pickleweed, alkali heath, salt grass, and saltbush (*Atriplex lentiformis*) during the WRA 2002 study. These same species were observed again during protocol-level rare plant surveys conducted in 2010 and 2011 (WRA 2011).

Results of 2002 vegetation survey did not report any observations of suffrutescent wallflower, though past surveys (Henrickson 1991 and Psomas 1995) have confirmed presence of this species in Area B. Furthermore, some sun cup species (*Camissoniopsis* spp. [*Camissonia* spp.]) were observed; however, they were not identified to species so it is unclear whether any of these species observed were considered rare (e.g., Lewis' evening primrose). Though no special-status species were observed during these 2002 surveys, results of this survey are still useful in providing an updated species account of this area (WRA 2011).

CLAEMD Study 2004/2005

Upon completion of the installation of two self-regulating tide gates and a one-way flap gate in March 2003 in Area B, between Ballona Creek and the Reserve, it was determined by agencies involved in the flap gate installation process (U.S. Army Corps of Engineers [USACE], National Marine Fisheries Service, City staff, Kathy Keane Biological Consulting, and MEC Analytical Systems/Weston Solutions) that vegetation surveys were necessary to assess any change in pickleweed stands with respect to increased inundation. Expert assistance was obtained from Dr. Philippa Drennan of Loyola Marymount University (LMU) for taxonomic and protocol quality assurance. Methods for vegetation surveying consisted of the establishment of 10 permanent transects at various locations. Eight transects were located at various distances (3-meter, 5-meter, 9-meter, and 18-meter) parallel to their closest channel while the remaining two transects were located somewhat equidistant between and perpendicular to the two main channels of Area B. Eight of the 10 transects were specifically positioned to capture any changes in vegetation percent cover, canopy height, and soil chemistry as a result of increased inundation. The remaining two transects, those set at equidistance from the two main channels, functioned as controls. 0.25 square meter (m^2) quadrats at 5-meter intervals along transects were used to assess vegetation. Tallest plant shoot measurements and identification of all species within the quadrat were recorded. This process was repeated for each transect (WRA 2011).

Though the majority of the results of the CLAEMD Study were not intended to provide floristic survey data, they do provide data on presence, but not absence, of species within the western portion of Area B. Populations of seablite were observed on site; however, it is unclear as to whether these stands are of those of the special-status species (woolly seablite). In addition, coast buckwheat was observed within the Reserve. Due to the nature of the survey, no exact locations of seablite or coast buckwheat were reported in the CLAEMD Study. It is assumed that exact species locations are available from actual hard copy field data collected during transect surveys (WRA 2011).

LA City 2005

In 2004, the City of Los Angeles (LA City) conducted a post-construction biological survey of vegetation for the USACE after the installation of two self-regulating tide gates (SRTs) and a one-way flap gate between Ballona Creek and the BWER (LA City 2005). Ten 30-meter permanent vegetation transects were established in the salt marsh in the western portion of Area B. Transects were located adjacent and parallel to the tidal channels at 3, 5, 9, 18, and 30 meter distances (two at each distance). The LA City survey team used a 0.25 m^2 (0.5 meter x 0.5 meter) quadrat sampling method spaced every five meters, for a total of six quadrats per transect (Johnston et al. 2011).

LA City found nine plant species during their fall 2004 surveys, with most of the transects dominated by Salicornia virginica (pickleweed) or fleshy jaumea (*Jaumea carnosa*). In addition, the majority of the nonnative plant cover comprised A. semibaccata and rabbitfoot grass (*Polypogon monspeliensis*), with foxtail chess (*Bromus madritensis* spp. *rubens*) occurring in one quadrat (Johnston et al. 2011).

CDFG 2007

The California Department of Fish and Game (CDFG; now California Department of Fish and Wildlife) conducted a site-wide assessment of the major vegetation alliances and habitats to correlate with state-wide data. Plant community type (i.e., alliance-level) surveys were conducted by Todd Keeler-Wolf (CDFG), following the "Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities" (CDFG 2009). The Reserve was divided into 16 habitat groups. The generalized habitat categories were based on characteristics such as structural feature, ecosystem function, and landscape process as well as dominant or characteristic plant species, characteristic animal species, and presumed extirpated or rare or endangered species (Johnston et al. 2011).

BOLD Study 2007

As part of an agreement between the Playa Vista landowners and the Friends at Ballona Wetlands, an 8-acre parcel located in the southwest corner of Area B was designated as the site for an outdoor learning laboratory, referred to as the Ballona Outdoor Learning and Discovery (BOLD) area (BOLD 2007). An assessment of the BOLD area, which included soil and groundwater characteristics, hydrology assessments, wetland delineation, biota present, and cultural resources, was necessary in order to proceed with permitting activities and ultimately begin construction. The above assessment required a detailed account of all plant species observed on site which included plant species identification and mapping of plant communities present. Expert assistance was provided by Dr. Philippa Drennan of LMU who also assisted in the CLAEMD Study 2004/2005. A first broad assessment of the area found it to be dominated by mostly nonnative, invasive species such as sea-

fig (*Carpobrotus edulis*). Lower elevations in the northwest corner of the BOLD parcel were dominated by pickleweed with small amounts of salt grass present, an indication that this particular area currently receives sufficient tidal flushing to support coastal wetland vegetation (WRA 2011).

The following is a description of the methods employed for the BOLD Study 2007:

> Site visits were conducted in March through June 2005. The entire area to be assessed included the full 8-acre BOLD parcel along with an additional 100-foot radius to the north and east. In order to prepare a vascular plant checklist for the BOLD area, all vascular plant taxa within the BOLD and BOLD-adjacent areas were identified and, where possible, collected during site visits on the following dates: 10 March 2005, 5 April 2005, 19April 2005, 26 April 2005, 10 May 2005, 1 June 2005, 8 June 2005, 17 June 2005, and 22June 2005.

Vegetation surveying was accomplished by establishing transect lines, 30 meters long, at 21 sites within the BOLD area that showed spatial and/or vegetation differences. An additional site was sampled in the dunes area at the western edge of the Reserve. The percentage of species cover within 0.25 m^2 quadrats and positioned at 5-meter intervals along each transect was used to characterize the dominant species for each vegetation type. Transect sampling was conducted on 24 June 2005 and 27 June 2005 (WRA 2011).

Results of the above vegetation surveys concluded that there were 134 total species present within the BOLD area. Of these 134 species found, 85 were considered nonnative (BOLD 2007). None of the potentially occurring special-status species were found to occur within the BOLD parcel. Stands of coast buckwheat were, however, found to occur within this area, though exact location was not specified (WRA 2011).

San Gabriel Rivers Watershed Council 2007

Nonnative plant mapping surveys were conducted for four species by J. Casanova of the Los Angeles and San Gabriel Rivers Watershed Council, with assistance from the California State Coastal Conservancy. The four species were pampas grass (*Cortaderia selloana*), Geraldton carnation weed (*Euphorbia terracina*), Canary Island palm (*Phoenix canariensis*), and Washington fan palm (*Washingtonia robusta*) (Johnston et al. 2011).

Johnston et al. 2011 and 2012

Plant species observed were documented by the team conducting vegetation transect surveys throughout all areas of the Reserve during 2009–2010 and 2010–2011; however, these surveys were not floristic in nature and sampled each habitat type using quadrats along pre-determined transects (WRA 2011).

WRA 2011

Prior to surveys in 2010 and 2011, WRA and ICF International (ICF) assessed the CNPS, U.S. Fish and Wildlife Service (USFWS), and the CNDDB lists to determine the habitat preferences for special-status species recorded in the vicinity of the Reserve and determined that 30 special-status plant species have the potential to occur within the Reserve. July 2010 surveys coincided with peak blooming periods for 11 potentially occurring special-status plant species; October 2010 coincided with peak blooming periods for 6 special-status plant species; and April 2011 coincided with peak blooming periods for 13 special-status plant species. In addition, WRA staff spoke with

knowledgeable botanists from the Rancho Santa Ana Botanic Garden who are familiar with these species and visited reference populations of species, as possible, to determine the likelihood of presence of sensitive plant species in the project area prior to surveys (WRA 2011).

WRA conducted focused, rare plant surveys to update all previously conducted floristic, protocol-level surveys for the 30 potential special-status plant species with potential to occur within the Reserve during July. WRA also conducted floristic, protocol-level surveys in October and April. All three surveys were conducted by walking transects or traversing areas with suitable habitat throughout the site. Per CDFG 2009 guidelines, rainfall data was collected for Santa Monica, California, the nearest rainfall gauge. Rainfall data for this region indicated that precipitation was within the normal range for 2010 and is slightly above the average for 2011 (WRA 2011).

Approximately 15 individuals of suffrutescent wallflower (*Erysimum insulare* ssp. *suffrutescens*, CNPS List 4), 85 individuals of woolly seablite (*Suaeda taxifolia*, CNPS List 4) were observed within the Reserve in July and October 2010. Approximately 12,300 individuals of Lewis' evening primrose (*Camissoniopsis lewisii*, CNPS List 3), 350 individuals of Orcutt's pincushion (*Chaenactis glabriuscula* var. *orcuttiana*, CNPS List 1B), approximately 600 individuals of South Coast branching phacelia (*Phacelia ramosissima* var. *austrolitoralis*, CNPS List 4), and an additional 14 individuals, for a total of 29 individuals, of suffrutescent wallflower were observed within the Reserve in April 2011. No other special-status plant species were observed in the Reserve. In addition, approximately 0.24 acre of coast buckwheat (*Eriogonum parviflorum*), habitat for Quino checkerspot (*Euphydryas editha quino*) and/or El Segundo blue (*Euphilotes battoides alluni*) butterflies, was mapped on the site (WRA 2011).

The Bay Foundation 2013

In 2013, biologists from the Bay Foundation updated the categorization and mapping of the major vegetation alliances and habitats on the Reserve. This information had not been updated since last performed by the California Department of Fish and Wildlife in 2007. The field work for the update was conducted between May and October 2013 in accordance with methods created by the Vegetation and Classification Mapping Program with supplemental information derived from monitoring surveys conducted between 2009 and 2013 throughout the Reserve (Johnston et al. 2011, 2012). Habitat categories were classified on an individual basis based on geo-referenced polygons classifying dominant vegetation community and physical characteristics such as soil and hydrology. When applicable, categories are "crosswalked" from alliance and association types in accordance with the Manual of California Vegetation (Sawyer 2009) and from previous site surveys. Additional habitat categories were identified to accurately reflect current site conditions (i.e., nonnative habitats).

APPENDIX D2
Vegetation Alliance and Association Acreages by Habitat Type

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Appendix D2

Vegetation Alliance and Association Acreages by Habitat Type

The following provides a list of the vegetation alliances and associations found on the study site, summarizes the habitat type(s) these vegetation alliances and associations are found in, and provides existing acreage of each. It should be noted that portions of the study site not covered in The Bay Foundation vegetation mapping included the Marina del Rey Property and two of the seven potential well relocation sites on the southern end of the SoCalGas Property. In addition, no lands adjacent to the study site were mapped at this level.

Table D2-1. Vegetation Alliance and Association Acreages by Habitat Type.

		Category 1		Category 2							Category 3		Category 4								Category 5		
Vegetation Type	**Nativity**	**Subtidal**	**Intertidal**	**Tidal Wetland**	**Non-tidal Salt Marsh**	**Ruderal Marsh**	**Brackish Marsh**	**Brackish Scrub**	**Salt Pan**	**Riparian Scrub and Woodland**	**Iceplant Wetland**	**Pampas Grass**	**Dune**	**Non-native Dune**	**Disturbed Hard-pack**	**Annual / Ruderal Grassland**	**Non-native "Tall" Herbaceous**	**Iceplant Stand**	**Upland Scrub**	**Non-native Tree**	**Eucalyptus Grove**	**Developed**	**Acres**	**Total Polygons**
Acacia spp. mu	**nn**																			1.70			**1.7**	**15**
Acmispon glaber - Croton Californicus mu	**n**												3.62										**3.6**	**4**
Acmispon glaber alliance	**n**												1.08										**1.1**	**1**
Ambrosia psilostachya alliance	**n**												0.14										**0.1**	**1**
Anemopsis californica alliance	**n**						0.10																**0.1**	**1**
Artemesia californica alliance	**n**												0.66						1.43				**2.1**	**4**
Arthrocnemum subterminale alliance	**n**			1.02	0.56																		**1.6**	**6**
Arundo donax stand	**nn**																0.38						**0.4**	**7**
Atriplex lentiformis alliance	**n**							10.56															**10.6**	**18**
Atriplex prostrata stand	**nn**					0.04																	**0.0**	**1**
Atriplex semibaccata mu	**nn**					0.04																	**0.0**	**1**
Avena fatua - mixed herb association	**nn**															2.87							**2.9**	**1**
Baccharis pilularis - annual grass/ herb association	**c**																0.87		2.06				**2.9**	**7**
Baccharis pilularis - Artemesia californica association	**n**																		20.07				**20.1**	**5**
Baccharis pilularis - Baccharis salicifolia mu	**n**																		0.22				**0.2**	**2**
Baccharis pilularis - Carpobrotus edulis mu	**c**																	0.26					**0.3**	**3**
Baccharis pilularis - Glebionis coronaria mu	**c**																0.10						**0.1**	**1**
Baccharis pilularis - Isocoma menziesii - annual grass mu	**c**															0.95							**0.9**	**1**
Baccharis pilularis - Malosma laurina mu	**n**																		0.89				**0.9**	**1**
Baccharis pilularis alliance	**n**																		14.47				**14.5**	**14**
Baccharis salicifolia - annual grass mu	**c**									0.12													**0.1**	**2**
Baccharis salicifolia - Helminotheca echioides mu	**c**					0.19																	**0.2**	**2**

		Category 1		Category 2							Category 3		Category 4									Category 5		
Vegetation Type	**Nativity**	**Subtidal**	**Intertidal**	**Tidal Wetland**	**Non-tidal Salt Marsh**	**Ruderal Marsh**	**Brackish Marsh**	**Brackish Scrub**	**Salt Pan**	**Riparian Scrub and Woodland**	**Iceplant Wetland**	**Pampas Grass**	**Dune**	**Non-native Dune**	**Disturbed Hard-pack**	**Annual / Ruderal Grassland**	**Non-native "Tall" Herbaceous**	**Iceplant Stand**	**Upland Scrub**	**Non-native Tree**	**Eucalyptus Grove**	**Developed**	**Acres**	**Total Polygons**
Baccharis salicifolia alliance	**n**									5.84							0.02		0.20				**6.1**	**14**
Bassia hyssopifolia - Spergularia macrotheca - annual grass mu	**nn**					1.05																	**1.0**	**1**
Bassia hyssopifolia mu	**nn**					0.16								0.08			0.37						**0.6**	**4**
Bolboschoenus maritimus alliance	**n**						0.80																**0.8**	**2**
Bolboschoenus spp. - Malvella leprosa mu	**n**						0.48																**0.5**	**1**
Brassica nigra - Euphorbia terracina mu	**nn**																0.36						**0.4**	**2**
Brassica nigra - Gleibonis coronaria mu	**nn**																15.68						**15.7**	**6**
Brassica nigra - Ricinus communis mu	**nn**																0.33						**0.3**	**1**
Brassica nigra - Salsola tragus mu	**nn**																0.21						**0.2**	**1**
Brassica nigra stand	**nn**														0.91		65.67						**66.6**	**22**
Bromus spp. stand	**nn**															0.03							**0.0**	**1**
Bromus diandrus - Avena spp. stand	**nn**													0.82									**0.8**	**1**
Bromus diandrus - Frankenia salina mu	**c**					0.05																	**0.1**	**1**
Bromus diandrus - mixed herb stand	**nn**													4.17		2.39							**6.6**	**14**
Bromus madritensis stand	**nn**															0.11							**0.1**	**1**
Bromus spp. - mixed herb stand	**nn**															3.75							**3.7**	**4**
Bromus spp. stand	**nn**													0.03		3.49							**3.5**	**11**
California annual grassland mu	**nn**															0.80							**0.8**	**1**
Carpobrotus edulis - Acacia sp. mu	**nn**																	0.21					**0.2**	**1**
Carpobrotus edulis - Baccharis pilularis - Glebionis coronaria mu	**c**																1.90		2.24				**4.1**	**3**
Carpobrotus edulis - Distichlis littoralis mu	**c**										0.72							0.05					**0.8**	**6**
Carpobrotus edulis - Glebionis coronaria mu	**nn**																1.01						**1.0**	**1**
Carpobrotus edulis - mixed herb mu	**nn**																	0.89					**0.9**	**5**
Carpobrotus edulis stand	**nn**										1.21			0.66				26.32					**28.2**	**97**

		Category 1		Category 2							Category 3		Category 4									Category 5		
Vegetation Type	**Nativity**	**Subtidal**	**Intertidal**	**Tidal Wetland**	**Non-tidal Salt Marsh**	**Ruderal Marsh**	**Brackish Marsh**	**Brackish Scrub**	**Salt Pan**	**Riparian Scrub and Woodland**	**Iceplant Wetland**	**Pampas Grass**	**Dune**	**Non-native Dune**	**Disturbed Hard-pack**	**Annual / Ruderal Grassland**	**Non-native "Tall" Herbaceous**	**Iceplant Stand**	**Upland Scrub**	**Non-native Tree**	**Eucalyptus Grove**	**Developed**	**Acres**	**Total Polygons**
Centaurea diluta stand	**nn**																0.85						**0.8**	**2**
Clematis lingusticifolia mu	**n**									0.21													**0.2**	**1**
Cortaderia selloana - Salicornia pacifica mu	**c**											0.08											**0.1**	**1**
Cortaderia selloana stand	**nn**											5.71											**5.7**	**23**
Cressa truxillensis - annual grass mu	**c**					8.47																	**8.5**	**9**
Cressa truxillensis - Distichlis littoralis alliance	**n**				1.40																		**1.4**	**7**
Cressa truxillensis - Festuca perennis - Helminotheca echioides mu	**c**					1.27																	**1.3**	**1**
Cressa truxillensis - Festuca perennis mu	**c**					0.71																	**0.7**	**1**
Cressa truxillensis - mixed herb mu	**c**					0.26																	**0.3**	**1**
Cressa truxillensis mu	**n**			0.24	7.69	0.40																	**8.3**	**28**
Croton californicus mu	**n**												0.24										**0.2**	**1**
Deinandra fasciculata - ruderal herbaceous mu	**c**																0.17						**0.2**	**1**
Distichlis littoralis - annual grass association	**c**					1.77																	**1.8**	**5**
Distichlis littoralis - Bassia hyssopifolia mu	**c**					0.06																	**0.1**	**1**
Distichlis littoralis - Bromus diandrus association	**c**					0.87																	**0.9**	**2**
Distichlis littoralis - Heliotropium curassavicum mu	**n**				0.58																		**0.6**	**1**
Distichlis littoralis - Jaumea carnosa association	**n**			0.05																			**0.1**	**1**
Distichlis littoralis - mixed herb mu	**c**					0.32																	**0.3**	**2**
Distichlis littoralis - Salicornia pacifica association	**n**			0.10	0.30																		**0.4**	**3**
Distichlis littoralis alliance	**n**			0.18	3.40								0.46										**4.0**	**20**
Elymus triticoides alliance	**n**				0.03		0.07						0.24										**0.3**	**3**

		Category 1		Category 2							Category 3		Category 4								Category 5		
Vegetation Type	**Nativity**	**Subtidal**	**Intertidal**	**Tidal Wetland**	**Non-tidal Salt Marsh**	**Ruderal Marsh**	**Brackish Marsh**	**Brackish Scrub**	**Salt Pan**	**Riparian Scrub and Woodland**	**Iceplant Wetland**	**Pampas Grass**	**Dune**	**Non-native Dune**	**Disturbed Hard-pack**	**Annual / Ruderal Grassland**	**Non-native "Tall" Herbaceous**	**Iceplant Stand**	**Upland Scrub**	**Non-native Tree**	**Eucalyptus Grove**	**Developed**	**Acres**	**Total Polygons**
Encelia californica - Artemesia californica association	**n**												0.89										**0.9**	**1**
Eriogonum parvifolium - Heterotheca grandifora mu	**n**												0.09										**0.1**	**1**
Eriogonum parvifolium mu	**n**												0.25										**0.2**	**2**
Erodium spp. - annual grass mu	**nn**															0.12							**0.1**	**1**
Eucalyptus spp. stand	**nn**																				3.40		**3.4**	**5**
Euphorbia terracina - Glebionis coronaria - annual grass mu	**nn**																0.31						**0.3**	**1**
Euphorbia terracina mu	**nn**														0.45		7.01	0.01					**7.5**	**27**
Euthamia occidentalis mu	**n**						1.03																**1.0**	**7**
Exotic landscaping mu	**nn**																			2.65			**2.7**	**3**
Frankenia salina - annual grass mu	**c**					1.02																	**1.0**	**4**
Frankenia salina - Brassica nigra mu	**c**					1.61																	**1.6**	**3**
Frankenia salina - Carpobrotus edulis mu	**c**										0.03												**0.0**	**1**
Frankenia salina - Cressa Truxillensis mu	**n**					0.04																	**0.0**	**1**
Frankenia salina - Distichlis littoralis association	**n**				0.28	0.60																	**0.9**	**4**
Frankenia salina alliance	**n**				0.79	0.01																	**0.8**	**17**
Glebionis coronaria - annual grass mu	**nn**																12.23						**12.2**	**1**
Glebionis coronaria mu	**nn**																7.83					0.20	**8.0**	**14**
Gleibionis coronaria - annual grass mu	**nn**																0.49						**0.5**	**1**
Helminotheca echioides - annual grass mu	**nn**					2.75																	**2.7**	**2**
Helminotheca echioides - Cressa truxillensis mu	**c**					0.19																	**0.2**	**1**
Helminotheca echioides - Distichlis littoralis mu	**c**					0.18																	**0.2**	**3**
Helminotheca echioides - Malvella leprosa mu	**c**					0.71																	**0.7**	**2**

		Category 1		Category 2							Category 3		Category 4								Category 5		
Vegetation Type	**Nativity**	**Subtidal**	**Intertidal**	**Tidal Wetland**	**Non-tidal Salt Marsh**	**Ruderal Marsh**	**Brackish Marsh**	**Brackish Scrub**	**Salt Pan**	**Riparian Scrub and Woodland**	**Iceplant Wetland**	**Pampas Grass**	**Dune**	**Non-native Dune**	**Disturbed Hard-pack**	**Annual / Ruderal Grassland**	**Non-native "Tall" Herbaceous**	**Iceplant Stand**	**Upland Scrub**	**Non-native Tree**	**Eucalyptus Grove**	**Developed**	**Acres**	**Total Polygons**
Helminotheca echioides mu	**nn**					0.85																	**0.9**	**5**
Heterotheca grandiflora - Artemesia douglasiana - annual grass mu	**c**															0.13							**0.1**	**1**
Heterotheca grandiflora mu	**n**														0.11								**0.1**	**1**
Isocoma menziesii alliance	**n**																		0.14				**0.1**	**2**
Jaumea carnosa mu	**n**			0.40							0.09												**0.5**	**11**
Juncus mexicanus alliance	**n**						0.11																**0.1**	**2**
Lupinus chamissonis - Ericameria ericoides alliance	**n**												0.04										**0.0**	**1**
Lupinus chamissonis association	**n**												2.79										**2.8**	**4**
Malephora crocea stand	**nn**																	0.02					**0.0**	**1**
Malosma laurina alliance	**n**																		0.08				**0.1**	**1**
Malvella leprosa - annual grass mu	**c**					1.99																	**2.0**	**1**
Malvella leprosa mu	**n**				1.35																		**1.3**	**4**
Myoporum laetum stand	**nn**																			0.60			**0.6**	**2**
Opuntia microdasys mu	**nn**																		0.02				**0.0**	**1**
Palm spp. mu	**nn**																			0.31			**0.3**	**4**
Phacelia ramossisima mu	**n**												0.11										**0.1**	**1**
Psuedognaphalium canescens mu	**n**														0.45								**0.4**	**1**
Psuedognaphalium sp. - Heterotheca grandiflora - Erodium spp. mu	**c**														1.09								**1.1**	**1**
Psuedognaphalium sp. - Heterotheca grandiflora mu	**n**														1.04								**1.0**	**1**
Raphanus sativus stand	**nn**																2.32						**2.3**	**5**
Rhus integrifolia alliance	**n**																		0.06				**0.1**	**1**
Ricinus communis - Raphanus sativus mu	**nn**																0.13						**0.1**	**1**
Ricinus communis mu	**nn**																0.46						**0.5**	**3**
Ruderal herbaceous mu	**nn**													8.58	0.92		40.57					0.25	**50.4**	**31**

		Category 1		Category 2							Category 3		Category 4									Category 5		
Vegetation Type	**Nativity**	**Subtidal**	**Intertidal**	**Tidal Wetland**	**Non-tidal Salt Marsh**	**Ruderal Marsh**	**Brackish Marsh**	**Brackish Scrub**	**Salt Pan**	**Riparian Scrub and Woodland**	**Iceplant Wetland**	**Pampas Grass**	**Dune**	**Non-native Dune**	**Disturbed Hard-pack**	**Annual / Ruderal Grassland**	**Non-native "Tall" Herbaceous**	**Iceplant Stand**	**Upland Scrub**	**Non-native Tree**	**Eucalyptus Grove**	**Developed**	**Acres**	**Total Polygons**
Salicornia pacifica - annual grass association	**c**					6.71																	**6.7**	**7**
Salicornia pacifica - Arthrocnemum subterminale - annual grass mu	**c**					0.90																	**0.9**	**1**
Salicornia pacifica - Arthrocnemum subterminale association	**n**			0.03	7.52	2.37																	**9.9**	**10**
Salicornia pacifica - Brassica nigra association	**c**					2.77																	**2.8**	**2**
Salicornia pacifica - Cressa truxillensis mu	**n**			0.17	8.47																		**8.6**	**7**
Salicornia pacifica - Distichlis littoralis association	**n**			0.89	1.47																		**2.4**	**11**
Salicornia pacifica - Frankenia salina - Distichlis littoralis mu	**n**				0.02																		**0.0**	**1**
Salicornia pacifica - Frankenia salina association	**n**			0.04	1.29																		**1.3**	**4**
Salicornia pacifica - Jaumea carnosa - Distichlis littoralis association	**n**			1.79																			**1.8**	**9**
Salicornia pacifica - Jaumea carnosa association	**n**			2.95																			**2.9**	**13**
Salicornia pacifica - Malvella leprosa mu	**n**				0.18																		**0.2**	**2**
Salicornia pacifica - mesembryanthemum nodiflorum mu	**c**					0.39																	**0.4**	**1**
Salicornia pacifica - mixed herb mu	**c**					0.30																	**0.3**	**3**
Salicornia pacifica - Schoenoplectus spp. mu	**n**						0.35																**0.3**	**1**
Salicornia pacifica - Symphyotrichum subulatum mu	**n**				0.74																		**0.7**	**1**
Salicornia pacifica alliance	**n**			10.37	49.54	0.39																	**60.3**	**62**
Salix exigua - Baccharis salicifolia mu	**n**									0.12													**0.1**	**1**
Salix exigua alliance	**n**									0.32													**0.3**	**2**
Salix lasiolepsis alliance	**n**									8.84													**8.8**	**16**

		Category 1		Category 2							Category 3		Category 4									Category 5		
Vegetation Type	**Nativity**	**Subtidal**	**Intertidal**	**Tidal Wetland**	**Non-tidal Salt Marsh**	**Ruderal Marsh**	**Brackish Marsh**	**Brackish Scrub**	**Salt Pan**	**Riparian Scrub and Woodland**	**Iceplant Wetland**	**Pampas Grass**	**Dune**	**Non-native Dune**	**Disturbed Hard-pack**	**Annual / Ruderal Grassland**	**Non-native "Tall" Herbaceous**	**Iceplant Stand**	**Upland Scrub**	**Non-native Tree**	**Eucalyptus Grove**	**Developed**	**Acres**	**Total Polygons**
Schinus molle association	**nn**																			0.03			**0.0**	**1**
Schinus sp. - Myoporum laetum stand	**nn**																			0.03			**0.0**	**1**
Schinus terebinthifolius - mixed palm - mixed herb mu	**nn**																			0.24			**0.2**	**1**
Schoenoplectus (S. americanus, Bulboschoenus maritimus, B. robustus) mu	**n**						0.50																**0.5**	**3**
Schoenoplectus americanus alliance	**n**						0.17																**0.2**	**1**
Schoenoplectus californicus alliance	**n**						0.16																**0.2**	**2**
Schoenoplectus spp. - Distichlis littoralis mu	**n**						0.03																**0.0**	**1**
Schoenoplectus spp. - Malvella leprosa mu	**n**						2.08																**2.1**	**1**
Suaeda taxifolia mu	**n**				0.05																		**0.0**	**1**
Typha spp. - Cortaderia selloana mu	**c**					0.10																	**0.1**	**1**
Typha spp. alliance	**n**						0.43																**0.4**	**2**
Unvegetated	**----**						0.21						0.03										**0.2**	**2**
Unvegetated (development)	**----**																					62.31	**62.3**	**13**
Unvegetated (dirt road)	**----**																					2.35	**2.3**	**8**
Unvegetated (open water)	**----**	53.69																					**53.7**	**1**
Unvegetated (salt scald)	**----**								22.81													0.02	**22.8**	**14**
Unvegetated (tidal channel)	**----**		3.49																				**3.5**	**3**
Total Acres	**----**	**53.7**	**3.5**	**18.2**	**85.6**	**39.5**	**6.5**	**10.6**	**22.8**	**15.5**	**2.0**	**5.8**	**10.7**	**14.3**	**5.0**	**14.6**	**159.2**	**27.8**	**41.9**	**5.6**	**3.4**	**65.1**	**611.3**	**811**

Note: Within nativity column, n = native, nn = nonnative, and c = co-dominant native and nonnatives.
Source: Reproduced from The Bay Foundation 2013

APPENDIX D3
Study Area Plant List by Survey Effort

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Appendix D3

Study Area Plant List

Scientific Name	Common Name	Family	Native/ Non-native	(1) 1979	(2) 1981	(3) 1991	(4) 1992	(5) 2001	(6) 2002	(7) 2005	(8) 2010	(9) 2011	(10) 2011
------	palm tree	Arecaceae	n-n								x	x	
Abronia umbellata	common sand verbena	Nyctaginaceae	n	x	x	x	x	x	x				x
Abronia villosa	villose abronia	Nyctaginaceae	n							x			
Acacia dealbata	silver wattle mimosa	Fabaceae	n-n		x				x				
Acacia decurrens	green wattle	Fabaceae	n-n										x
Acacia longifolia	long-leaved acacia	Fabaceae	n-n			x			x				x
Acacia neriifolia (*)	Mattle (Oleander wattle)	Fabaceae	n-n						x				
Acacia sp.	acacia	Fabaceae	n-n			x		x	x	x	x	x	
Acmispon americanus var, *americanus*	Spanish clover	Fabaceae	n		x	x	x		x				
Acmispon glaber (=*Lotus scoparius*)	deerweed	Fabaceae	n	x	x	x	x	x	x	x	x	x	x
Acmispon sp. (=*Lotus* sp.)	lotus	Fabaceae									x		
Acmispon strigosus	strigose lotus	Fabaceae	n		x	x	x		x				
Acroptilon repens	Russian knapweed	Asteraceae	n-n		x	x			x			x	x
Adenostoma fasciculatum	common chamise	Rosaceae	n	x					x				
Agave americana	century plant	Agavaceae	n-n			x			x				x
Agave attenuata (*)	swan's neck agave (fox tail agave)	Agavaceae (Liliaceae)	n-n						x				
Agave sp.	agave	Agavaceae	n-n					x					

Scientific Name	Common Name	Family	Native/ Non-native	(1) 1979	(2) 1981	(3) 1991	(4) 1992	(5) 2001	(6) 2002	(7) 2005	(8) 2010	(9) 2011	(10) 2011
Agrostis stolonifera	stoloniferous creeping bentgrass	Poaceae	n-n		x				x				x
Albizia lophantha	plume albizia	Fabaceae	n-n		x	x			x				
Aloe vera (*)	medicinal aloe	Asphodelacae (=Liliaceae)	n-n			x			x				
Amaranthus albus	tumbleweed amaranthus	Amaranthaceae	n-n		x	x			x				
Amaranthus californicus	California amaranthus	Amaranthaceae	n		x		x		x				x
Amaranthus deflexus	low pigweed	Amaranthaceae	n-n		x				x				
Amaranthus rudis	waterhemp	Amaranthaceae	n-n			x			x				
Ambrosia acanthicarpa	annual bursage	Asteraceae	n		x	x	x		x				
Ambrosia chamissonis	Chamisso's bur-sage	Asteraceae	n		x	x	x		x		x	x	x
Ambrosia psilostachya	western ragweed	Asteraceae	n		x	x	x	x	x	x	x	x	x
Ammania sp. (*)	red stem	Lythraceae	n						x				
Amsinckia menziesii	fiddleneck	Boraginaceae	n										x
Anagallis arvensis	scarlet pimpernel	Myrsinaceae	n-n	x		x		x	x	x	x	x	
Anemopsis californica	yerba mansa	Saururaceae	n		x	x	x		x		x	x	x
Apium graveolens	garden celery	Apiaceae	n-n		x			x	x	x		x	x
Aptenia cordifolia	baby sun rose	Aizoaceae	n-n		x				x				x
Artemisia californica	California sage brush	Asteraceae	n	x			x	x	x	x	x	x	x
Artemisia douglasiana	Douglas' mugwort	Asteraceae	n	x	x	x	x	x	x	x			x
Artemisia dracunculus	wild tarragon	Asteraceae	n		x	x	x		x				x
Artemisia sp.	mugwort	Asteraceae	--									x	
Arthrocnemum subterminale (=*Salicornia subterminalus*)	Parish's pickleweed	Chenopodiaceae	n	x		x	x	x	x	x(t)	x	x	x
Arundo donax	giant river reed	Poaceae	n-n		x	x		x	x	x	x	x	x
Asclepias fasciculatus	narrow leaf milkweed	Apocynaceae	n										x

Scientific Name	Common Name	Family	Native/ Non-native	(1) 1979	(2) 1981	(3) 1991	(4) 1992	(5) 2001	(6) 2002	(7) 2005	(8) 2010	(9) 2011	(10) 2011
Astragalus trichopodus	milk vetch	Fabaceae	n			x			x				
Atriplex lentiformis	big saltbush	Chenopodiaceae	n			x	x		x		x	x	x
Atriplex patula	spear saltbush	Chenopodiaceae	n	x			x						x
Atriplex prostrata (=*Atriplex triangularis*)	fat hen	Chenopodiaceae	n-n	x		x	x	x	x	x(t)	x	x	x
Atriplex rosea	tumbling oracle	Chenopodiaceae	n-n			x			x				
Atriplex semibaccata	Australian saltbush	Chenopodiaceae	n-n	x		x	x	x	x	x(t)	x	x	x
Atriplex sp.	atriplex	Chenopodiaceae	--									x	
Avena barbata	slender wild oat	Poaceae	n-n			x		x	x	x(t)			x
Avena fatua	common wild oat	Poaceae	n-n			x		x	x	x	x	x	x
Avena sp.	oat	Poaceae	n-n	x								x	
Baccharis pilularis	coyote brush	Asteraceae	n	x	x	x	x		x		x	x	x
Baccharis pilularis var. *consanguinea* (*)	pigeon foot	Asteraceae	n				x						
Baccharis salicifolia	mule fat	Asteraceae	n	x		x		x	x	x	x	x	x
Bassia hyssopifolia	five-hooked bassia	Chenopodiaceae	n-n		x	x			x		x	x	x
Batis maritima	salt wort	Bataceae	n										x
Bauhinia variegata	orchid tree	Fabaceae	n-n			x			x				
Beta vulgaris	beet	Chenopodiaceae	n-n										x
Bolboschoenus maritimus	Olney's bulrush	Cyperaceae	n										x
Bolboschoenus robustus	robust bulrush	Cyperaceae	n	x	x	x	x		x				
Brassica nigra	black mustard	Brassicaceae	n-n	x		x			x	x	x	x	x
Brassica rapa	common yellow mustard	Brassicaceae	n-n			x			x			x	x
Brassica sp.	mustard	Brassicaceae	--									x	
Brickellia californica	California brickellbush	Asteraceae	n			x			x				x
Bromus carinatus	brome grass	Poaceae	n-n								x	x	
Bromus catharticus	rescue-grass	Poaceae	n-n			x			x				x

Scientific Name	Common Name	Family	Native/ Non-native	(1) 1979	(2) 1981	(3) 1991	(4) 1992	(5) 2001	(6) 2002	(7) 2005	(8) 2010	(9) 2011	(10) 2011
Bromus diandrus	ripgut chess	Poaceae	n-n			x		x	x	x	x	x	x
Bromus hordeaceus	soft cheatgrass	Poaceae	n-n			x		x	x	x			x
Bromus madritensis ssp. *rubens*	foxtail chess	Poaceae	n-n					x	x	x(t)	x	x	x
Bromus marginatus	large mountain brome	Poaceae	n				x						
Bromus spp.	brome grass	Poaceae	n-n	x								x	
Cakile maritima	maritime sea-rocket	Brassicaceae	n-n			x			x				x
Callistemon citrinus	crimson bottle brush	Myrtaceae	n-n										x
Calystegia macrostegia	southern California morning glory	Convolvulaceae	n					x		x			
Calystegia macrostegia ssp. *cyclostegia*	southern California morning glory	Convolvulaceae	n		x	x	x		x				
Camissonia sp.	sun cup	Onagraceae	n			x			x				
Camissonia strigulosa	Sandy soil sun cup	Onagraceae											x
Camissoniopsis bistorta (=*Camissonia bistorta*)	California sun cup	Onagraceae	n	x	x	x	x	x	x	x			x
Camissoniopsis cheiranthifolia (=Camissonia cheiranthifolia)	beach evening primrose	Onagraceae	n	x	x	x			x	x			
Camissoniopsis cheiranthifolia ssp. suffruticosa (=*Camissonia cheiranthifolia* ssp. *suffruticosa*)	beach suncup	Onagraceae	n	x			x	x					x
Camissoniopsis lewisii (=*Camissonia lewisii*)	Lewis' evening primrose	Onagraceae	n			x			x				x
Camissoniopsis micrantha (=*Camissonia micrantha*)	Miniature sun cup (Spencer primrose)	Onagraceae	n		x	x	x		x				x

Scientific Name	Common Name	Family	Native/ Non-native	(1) 1979	(2) 1981	(3) 1991	(4) 1992	(5) 2001	(6) 2002	(7) 2005	(8) 2010	(9) 2011	(10) 2011
Camissoniopsis sp.	sun cup	Onagraceae	n								x	x	
Carduus pycnocephalus	Italian thistle	Asteraceae	n-n										x
Carex praegracilis	clustered field sedge	Cyperaceae	n		x		x	x	x	x			
Carpobrotus chilensis	sea-fig iceplant	Aizoaceae	n-n	x				x	x	x			
Carpobrotus edulis	hottentot-fig	Aizoaceae	n-n	x	x	x		x	x	x	x	x	x
Casuraina glauca	grey sheoak	Casuarinaceae	n-n										x
Centaurea melitensis	tocalote	Asteraceae	n-n		x	x		x	x	x	x	x	x
Centromadia parryi ssp. *a ustralis*	southern tarplant	Asteraceae	n						x				
Ceratonia siliqua (*)	St. John's bread	Fabaceae	n-n		x	x			x				
Chaenactis glabriuscula	yellow chaenactis	Asteraceae	n		x	x	x	x	x	x			
Chaenactis glabriuscula var. *orcuttiana*	Orcutt's pincushion	Asteraceae	n										x
Chenopodium album	lambs-quarters	Chenopodiaceae											x
Chenopodium berlandieri	pitseed goosefoot	Chenopodiaceae	n			x			x				
Chenopodium murale	nettle-leaved goosefoot	Chenopodiaceae	n-n			x			x				
Chenopodium sp.	goosefoot (chenopodium)	Chenopodiaceae	n	x			x	x	x	x			
Chondrilla juncea	rush chondrilla	Asteracea	n-n		x								
Chrysanthemum sp.	daisy (chrysanthemum)	Asteraceae	n-n	x	x	x							
Cichorium intybus	common chickory	Asteraceae	n-n		x	x			x				x
Ciclospermum leptophyllum	marsh parsley	Apiaceae	n-n		x				x				
Cirsium vulgare	bull thistle	Asteraceae	n-n		x	x			x				x
Citrullus lanatus (*) (=*Citrullus colocynthis* var. *lanatus*)	watermelon	Cucurbitaceae	n-n		x	x			x				

Scientific Name	Common Name	Family	Native/ Non-native	(1) 1979	(2) 1981	(3) 1991	(4) 1992	(5) 2001	(6) 2002	(7) 2005	(8) 2010	(9) 2011	(10) 2011
Clematis ligusticifolia	western white clematis	Ranunculaceae	n				x						
Conium maculatum	poison hemlock	Apiaceae	n-n		x				x				x
Convolvulus arvensis	field convolvulus	Convolvulaceae	n-n		x	x		x	x	x			x
Corethrogyne filaginifolia (=*Corethrogyne filaginifolia* var. *filaginifolia*; *Lessingia filaginifolia* var. *filaginifolia*)	common sand aster	Asteraceae	n		x		x		x				x
Cortaderia jubata	purple pampas grass	Poaceae	n-n							x			
Cortaderia selloana	silver pampas grass	Poaceae	n-n	x		x			x		x	x	x
Cotula australis	Australian cotula	Asteraceae	n-n						x				
Cotula coronopifolia	common brass buttons	Asteraceae	n-n	x	x	x			x				x
Cotula sp.	brass-buttons	Asteraceae	n-n					x		x			
Crassula argentea	jade plant	Crassulaceae	n-n										x
Crassula connata	sand pygmyweed	Crassulaceae	n		x	x	x		x				x
Crassula ovata	silver jade plant	Crassulaceae	n-n		x	x		x	x	x(t)			
Cressa truxillensis	spreading alkali weed	Convolvulaceae	n	x	x	x	x	x	x	x(t)	x	x	x
Croton californicus	California croton	Euphorbiaceae	n		x	x	x	x	x	x	x	x	x
Cryptantha intermedia	clearwater cryptantha	Boraginaceae	n			x	x		x				x
Cucurbita foetidissima	Calabazilla (foetid gourd)	Cucurbitaceae	n		x	x	x		x				
Hesperocyparis glabra (Cupressus arizonica) [a] (**)	Smooth cypress	Cupressaceae	n-n			x			x				x
Cuscuta californica	California Dodder	Convolvulaceae	n		x	x	x	x	x	x			
Cuscuta campestris	field dodder	Convolvulaceae	n		x		x		x				
Cuscuta indecora var. *indecora*	large-seeded dodder	Convolvulaceae	n			x			x				

Scientific Name	Common Name	Family	Native/ Non-native	(1) 1979	(2) 1981	(3) 1991	(4) 1992	(5) 2001	(6) 2002	(7) 2005	(8) 2010	(9) 2011	(10) 2011
Cuscuta sp.	dodder	Convolvulaceae	n			x			x		x	x	x
Cynodon dactylon	Bermuda grass (creeping-cynodon)	Poaceae	n-n			x		x	x	x			x
Cyperus eragrostis	tall flatsedge (eragrostoid cyperus)	Cyperaceae	n		x	x	x		x				x
Cyperus esculentus	chufa flat-sedge	Cyperaceae	n		x	x			x				
Cyperus involucratus	umbrella papyrus	Cyperaceae	n-n		x	x			x				
Datura wrightii	Western jimson weed (Wright's datura)	Solanaceae	n		x	x	x	x	x	x			x
Daucus pusilus	rattlesnake weed	Apiaceae	n-n										x
Deinandra fasciculata	fascicled tarplant	Asteraceae	n		x		x		x				X
Deinandra paniculata	paniculate tarplant (San Diego tarplant)	Asteraceae	n			x			x				
Delosperma litorale	seaside delosperma	Aizoaceae	n-n		x				x				
Dichondra occidentalis	western dichondra	Convolvulaceae	n			x			x				
Digitaria sp.	digitaria	Poaceae	n-n			x			x				
Distichlis littoralis (=*Monanthochloe littoralis*)	shore grass	Poaceae	n			x			x				
Distichlis spicata	spiked saltgrass	Poaceae	n	x		x	x	x	x	x(t)	x	x	x
Dysphania ambrosioides (=*Chenopodium ambrosioides*)	Mexican tea	Chenopodiaceae				x			x				x
Dysphania botrys	Jerusalem-oak goosefoot	Chenopodiaceae	n-n			x			x				
Dysphania pumilio	clammy goosefoot	Chenopodiaceae	n-n						x				
Echinochloa crus-galli	common barnyard-grass	Poaceae	n-n			x			x				
Ehrharta erecta	upright veldtgrass	Poaceae	n-n			x			x				x

Scientific Name	Common Name	Family	Native/ Non-native	(1) 1979	(2) 1981	(3) 1991	(4) 1992	(5) 2001	(6) 2002	(7) 2005	(8) 2010	(9) 2011	(10) 2011
Eleocharis macrostachya	longstem spike-rush	Cyperaceae	n		x	x	x		x				x
Eleocharis montevidensis	Montevideo spike- rush	Cyperaceae	n		x		x		x				
Elymus condensatus (=*Leymus condensatus*)	giant rye grass	Poaceae	n			x			x				
Elymus triticoides (=*Leymus triticoides*)	creeping wild rye	Poaceae	n									x	x
Encelia californica	California encelia	Asteraceae	n					x		x		x	x
Epilobium ciliatum	ciliate willow-herb	Onagraceae	n			x			x				
Ericameria ericoides	Californian goldenbush	Asteraceae	n		x		x		x		x	x	
Ericameria pinifolia	pine goldenbush	Asteraceae	n			x			x				x
Erigeron bonariensis (=*Conyza bonariensis*)	flax leaf horseweed (Buenos Aires conyza)	Asteraceae	n-n		x	x		x	x	x			
Erigeron canadensis (=*Conyza canadensis*)	Canadian horseweed	Asteraceae	n		x	x			x		x	x	x
Eriogonum fasciculatum	California wild buckwheat	Polygonaceae	n			x	x	x	x	x			x
Eriogonum gracile	slender woolly eriogonum	Polygonaceae	n				x						
Eriogonum parvifolium	seacliff wild buckwheat	Polygonaceae	n			x	x	x	x	x	x	x	x
Eriogonum sp.	buckwheat	Polygonaceae	--								x		
Eriophyllum confertiflorum	golden yarrow	Asteraceae	n										x
Erodium botrys	long-beaked filaree	Geraniaceae	n-n		x	x		x	x	x(t)			x
Erodium cicutarium	red-stemmed filaree	Geraniaceae	n-n	x	x	x			x		x		x
Erodium moschatum	whitestem filaree	Geraniaceae	n-n										x
Erodium spp.	filaree	Geraniaceae	n-n								x	x	
Erysimum suffrutescens (=*Erysimum insulare* ssp. *suffrutescens*)	suffrutescent wallflower	Brassicaceae	n	x		x	x		x				x

Scientific Name	Common Name	Family	Native/ Non-native	(1) 1979	(2) 1981	(3) 1991	(4) 1992	(5) 2001	(6) 2002	(7) 2005	(8) 2010	(9) 2011	(10) 2011
Eschscholzia californica	California poppy	Papaveraceae	n			x		x	x	x			x
Eucalyptus camaldulensis	red gum	Myrtaceae	n-n		x	x			x				x
Eucalyptus globulus	blue gum	Myrtaceae	n-n			x			x				x
Eucalyptus sp.	eucalyptus	Myrtaceae	n-n	x							x	x	
Eucalyptus tereticornis	forest red gum	Myrtaceae	n-n		x				x				
Eucalyptus viminalis	manna gum	Myrtaceae	n-n		x				x				
Euphorbia albomarginata (=*Chamaesyce albomarginata*)	rattlesnake sandmat	Euphorbiaceae	n		x		x		x				x
Euphorbia maculata (=*Chamaesyce maculata*)	common spotted spurge	Euphorbiaceae	n-n		x	x			x				x
Euphorbia peplus	pretty spurge	Euphorbiaceae	n-n		x	x			x				x
Euphorbia polycarpa (=*Chamaesyce polycarpa*)	small-seeded spurge	Euphorbiaceae	n		x		x		x				
Euphorbia serpens (=*Chamaesyce serpens*)	Matted spurge (serpent euphorbia)	Euphorbiaceae	n-n		x	x	x		x				
Euphorbia sp. (=*Chamaesyce* sp.)	spurge (chamaesyce)	Euphorbiaceae	--								x	x	
Euphorbia terracina	terracina spurge	Euphorbiaceae	n-n								x	x	x
Euphorbia virgate (=*Euphorbia esula*)	leafy spurge	Euphorbiaceae	n-n			x			x				x
Euryops pectinatus (*)	euryops daisy	Asteraceae	n-n			x			x				
Euthamia occidentalis	western goldenrod	Asteraceae	n		x	x	x				x	x	x
Extriplex californica (=*Atriplex californica*)	California saltbush	Chenopodiaceae	n			x	x		x				x
Festuca arundinacea	reed fescue	Poaceae	n-n			x			x				
Festuca myuros (=*Vulpia myuros* var. *hirsute*, var. *myuros*)	rat-tailed fescue	Poaceae	n-n				x	x	x	x			x

Scientific Name	Common Name	Family	Native/ Non-native	(1) 1979	(2) 1981	(3) 1991	(4) 1992	(5) 2001	(6) 2002	(7) 2005	(8) 2010	(9) 2011	(10) 2011
Festuca perennis (=*Lolium multiflorum, Lolium perenne*)	Italian rye-grass	Poaceae	n-n			x		x	x	x	x	x	x
Ficus carica	common fig	Moraceae	n-n			x			x				x
Foeniculum vulgare	common fennel	Apiaceae	n-n	x	x	x		x	x	x	x	x	x
Frankenia salina	alkali frankenia	Frankeniaceae	n	x	x	x	x	x	x	x(t)	x	x	x
Fraxinus velutina	velvet arizona ash	Oleaceae	n		x		x		x				x
Galium angustifolium	narrow-leaved bedstraw	Rubiaceae	n		x		x		x				
Gazania linearis	hardy gazania	Asteraceae	n-n			x			x				
Gazania scaposa (*)	African daisy	Asteraceae	n-n		x				x				
Geranium molle	dove's-foot geranium	Geraniaceae	n-n										x
Glebionis coronaria	garland chrysanthemum	Asteraceae	n-n					x	x	x(t)	x	x	x
Gnaphalium palustre	Western marsh cudweed	Asteraceae	n								x		
Grindelia camporum	field gumplant (Great Valley grindelia)	Asteraceae	n		x	x	x		x				x
Guillenia lasiophylla	California mustard	Brassicaceae	n				x	x		x			
Hainardia cylindrica	barbgrass (thin tail)	Poaceae	n-n										x
Hedera canariensis	Canary ivy	Araliaceae	n-n			x			x				
Hedera helix	English ivy	Araliaceae	n-n										x
Hedypnois cretica	Crete hedypnois	Asteraceae	n-n		x				x				x
Helianthus annuus	common annual sunflower	Asteraceae	n		x	x	x		x				
Heliotropium curassavicum	salt heliotrope	Boraginaceae	n			x	x	x	x	x	x	x	x
Helminthotheca echioides (=*Picris echioides*)	bristly ox-tongue	Asteraceae	n-n	x	x	x							x

Scientific Name	Common Name	Family	Native/ Non-native	(1) 1979	(2) 1981	(3) 1991	(4) 1992	(5) 2001	(6) 2002	(7) 2005	(8) 2010	(9) 2011	(10) 2011
Heteromeles arbutifolia	toyon	Rosaceae	n			x			x				x
Heterotheca grandiflora	telegraph weed	Asteraceae	n		x	x	x	x	x	x	x	x	x
Heterotheca villosa	villous golden-aste	Asteraceae	n			x			x				x
Hirschfeldia incana	field mustard	Brassicaceae	n-n			x			x				x
Hoffmannseggia glauca	waxy hoffmannseggia	Fabaceae	n			x			x				
Hordeum brachyantherum	meadow barley	Poaceae											x
Hordeum depressum	dwarf barley	Poaceae	n								x	x	
Hordeum murinum ssp. *leporinum*	mouse barley	Poaceae	n			x			x		x	x	x
Hordeum sp.	barley	Poaceae	n-n	x									
Hypochaeris glabra	smooth cat's-ear	Asteraceae	n-n			x	x	x	x	x			x
Hypochaeris radicata	rough cat's-ear	Asteraceae	n-n										x
Iris sp.	iris	Iridaceae	n-n										x
Isocoma menziesii var. *vernioides*	coastal goldenbush	Asteraceae	n										x
Iva axillaris	poverty weed	Asteraceae	n										x
Jaumea carnosa	fleshy juamea	Asteraceae	n		x	x	x		x	x(t)	x	x	x
Juglans regia	English walnut	Juglandaceae	n-n			x			x				
Juncus balticus	Baltic rush	Juncaceae	n			x	x		x				x
Juncus bufonius	common toad-rush	Juncaceae	n			x	x	x	x	x			x
Juncus bufonius var. *occidentalis*	common toad-rush	Juncaceae	n			x			x				
Juncus mexicanus	Mexican rush	Juncaceae	n			x			x		x	x	x
Juncus sp.	rush wire-grass	Juncaceae	n	x							x	x	
Juniperus chinensis	Hollywood juniper	Cupressaceae	n-n										x
Lactuca eucra (*)		Asteraceae	n-n			x			x				
Lactuca serriola	prickly lettuce	Asteraceae	n-n		x	x	x	x	x	x	x		x

Scientific Name	Common Name	Family	Native/ Non-native	(1) 1979	(2) 1981	(3) 1991	(4) 1992	(5) 2001	(6) 2002	(7) 2005	(8) 2010	(9) 2011	(10) 2011
Lactuca virosa	wild lettuce	Asteraceae	n-n			x	x	x	x	x			
Laennecia coulteri (=*Conyza coulteri*)	Coulter's horseweed	Asteraceae	n		x				x				
Lamarckia aurea	goldentop	Poaceae	n-n			x			x				
Lamium amplexicaule	henbit	Lamiaceae	n-n										x
Lantana camara	orange-flowered lantana	Verbenaceae	n-n			x			x				
Lasthenia californica ssp. *californica*	California goldfields	Asteraceae	n										x
Lepidium latifolium	broad-leaved peppergrass	Brassicaceae	n-n			x			x				x
Lepidium virginicum (=*Lepidium virginicum* var. *pubescens*)	tall peppergrass	Brassicaceae	n			x	x		x				x
Leptochloa uninervia	Mexican sprangle top	Poaceae	n			x	x		x				
Liquidambar styraciflua	sweet gum	Altingiaceae (Hamamelidaceae)	n-n			x			x				x
Lobularia maritima	sweet alyssum	Brassicaceae	n-n	x		x			x				x
Logfia sp. (=*Filago* sp.)	filago	Asteraceae	--			x			x				
Luma apiculata	temu	Myrtaceae	n-n			x			x				
Lupinus bicolor	bicolored lupine	Fabaceae	n		x	x	x		x				x
Lupinus chamissonis	coastal bush lupine	Fabaceae	n	x	x	x	x	x	x	x	x	x	x
Lupinus excubitus var. *hallii*	grape soda lupine	Fabaceae	n		x		x		x				
Lupinus longifolius	longleaf bush lupine	Fabaceae	n			x			x				
Lupinus succulentus	arroyo lupine	Fabaceae	n		x	x	x		x				x
Lupinus truncatus	truncate-leaved lupine	Fabaceae	n		x		x		x				
Lycium californicum	California boxthorn	Solanaceae	n							x			

Scientific Name	Common Name	Family	Native/ Non-native	(1) 1979	(2) 1981	(3) 1991	(4) 1992	(5) 2001	(6) 2002	(7) 2005	(8) 2010	(9) 2011	(10) 2011
Lycium ferocissimum	African boxthorn	Solanaceae	n-n		x	x			x				x
Lycopersicon esculentum	common tomato	Solanaceae	n-n		x				x				
Lythrum hyssopifolia	hyssop loosestrife	Lythraceae	n-n		x	x			x				x
Malacothamnus fasciculatus	chaparral bush-mallow	Malvaceae	n		x		x		x				
Malacothrix saxatilis	cliff aster	Asteraceae	n		x	x	x		x				x
Malephora crocea	red-flowered iceplant	Aizoaceae	n-n		x	x			x				x
Malosma laurina	laurel sumac	Anacardiaceae	n	x	x	x	x		x	x			x
Malva nicaeensis	bull mallow	Malvaceae	n-n		x	x			x				x
Malva parviflora	cheeseweed mallow	Malvaceae	n-n		x	x		x	x	x	x		x
Malvella leprosa	alkali mallow	Malvaceae	n		x	x	x		x		x	x	x
Marah macrocarpus	wild cucumber	Cucurbitaceae	n										x
Marrubium vulgare	horehound	Lamiaceae	n-n	x	x	x			x		x	x	x
Matricaria discoidea (=*Matricaria matricarioides*; *Chamomilla suaveolens*)	pineapple weed	Asteraceae	n-n		x	x			x				x
Medicago lupulina	black burclover (black medicago)	Fabaceae	n-n								x		
Medicago polymorpha	California burclover	Fabaceae	n-n	x	x	x		x	x	x	x		x
Melaleuca citrine	crimson bottlebrush	Myrtaceae	n-n									x	
Melaleuca sp.	melaleuca	Myrtaceae	--									x	
Melica imperfecta	coast range onion grass (imperfect melic)	Poaceae	n			x	x		x				x
Melilotus albus	white sweetclover	Fabaceae	n-n		x	x			x				x
Melilotus indicus	indian sweetclover (sourclover)	Fabaceae	n-n	x	x	x		x	x	x(t)	x	x	x
Melilotus limensis (*)		Fabaceae	n-n		x								

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Mesembryanthemum crystallinum	crystalline iceplant	Aizoaceae	n-n			x		x	x	x(t)	x		x
Mesembryanthemum nodiflorum	slender leaf iceplant	Aizoaceae	n-n	x	x	x			x		x	x	x
Mimulus aurantiacus var. *puniceus*	red bush monkeyflower	Phrymaceaee	n										x
Morus albus	white mulberry	Moraceae	n-n			x			x				x
Myoporum laetum	Ngaio tree (myoporum)	Schrophulariaceae (=Myoporaceae)	n-n	x	x	x		x	x	x	x	x	x
Narcissus tazetta	paper white narcissus	Amaryllidaceae	n-n		x				x				
Nemophila menziesii	baby blue eyes	Hydrophyllaceae	n										x
Nerium oleander	oleander	Apocynaceae	n-n			x			x				x
Nicotiana glauca	tree tobacco	Solanaceae	n-n	x	x	x		x	x	x	x	x	x
Oenothera elata ssp. *hirsutissima*	hairy evening primrose	Onagraceae	n				x						
Oenothera elata ssp. *hookeri*	Hooter's evening primrose	Onagraceae	n		x	x			x				
Olea europaea	olive	Oleaceae	n-n			x			x				x
Opuntia ficus-indica	mission cactus	Cactaceae	n-n			x			x				x
Opuntia littoralis	coastal prickly pear	Cactaceae	n			x			x				x
Osteospermum fruticosum	African daisy	Asteraceae	n-n		x				x				x
Oxalis pes-caprae	Bermuda buttercup	Oxalidaceae	n-n	x	x	x			x				x
Parapholis incurva	sickle grass	Poaceae	n-n	x				x	x	x(t)	x	x	x
Paspalum dilatatum	Dallis grass	Poaceae	n-n			x			x				x
Pelargonium zonale	garden geranium	Geraniaceae	n-n			x			x				x
Peritome arborea (=*Isomeris arborea*)	bladderpod	Cleomaceae (Capparaceae)	n										x
Persicaria lapathifolia	willow weed	Polygonaceae	n			x	x	x	x	x			
Petunia parviflora	wild petunia	Solanaceae	n			x			x				

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Phacelia ramosissima	branching phacelia	Boraginaceae	n		x	x				x	x		x
Phacelia ramosissima var. *austrolitoralis*[b]	branching phacelia	Boraginaceae	n				x		x		x	x	
Phalaris aquatica	Canary grass	Poaceae	n-n									x	
Phalaris minor	little seed canary grass	Poaceae	n-n										x
Phalaris paradoxa	hood Canary grass	Poaceae	n-n										
Phaseolus limensis (*)	marge lima bean	Fabaceae	n-n						x				
Phoenix canariensis	Canary Island date palm	Arecaceae	n-n		x	x		x	x	x			x
Phoenix dactylifera	date palm	Arecaceae	n-n			x		x	x	x			
Pinus aff. canariensis	Canary Island pine	Pinaceae	n-n										x
Pinus muricata	Bishop pine	Pinaceae	n										x
Plantago lanceolata	English plantain	Plantaginaceae	n-n		x	x		x	x	x			x
Plantago major	common plantain	Plantaginaceae	n-n		x	x		x	x	x			x
Plantago sp.	plantain (rib grass)	Plantaginaceae	--									x	
Plantanus racemosa	western sycamore	Platanaceae	n										x
Poa annua	annual bluegrass	Poaceae	n-n			x			x				
Podocarpus macrophylla (*)	kusamaki (yew podocarpus)	Podocarpaceae	n-n			x			x				
Polycarpon tetraphyllum	four-leaved allseed	Caryophyllaceae	n-n			x			x				x
Polygonum aviculare ssp. *depressum* (=*Polygonum arenastrum*)	common knotweed	Polygonaceae	n-n			x		x	x	x			x
Polypogon monspeliensis	rabbit's foot grass	Poaceae	n-n			x		x	x	x(t)	x	x	x
Polypogon viridis (=*Agrostis semiverticillata*)	water beardgrass	Poaceae	n			x			x				

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Populus fremontii	Fremont cottonwood	Salicaceae	n	x	x	x	x	x	x	x			x
Prunus persica	peach	Rosaceae	n-n			x			x				
Prunus sp.	apricot	Rosaceae	n-n			x			x				
Pseudognaphalium beneolens	fragrant everlasting cudweed	Asteraceae	n		x	x	x		x				x
Pseudognaphalium bioletti (=*Gnaphalium bicolor*)	twocolor cudweed	Asteraceae	n		x	x	x	x	x	x			
Pseudognaphalium californicum (=*Gnaphalium californicum*)	California cudweed	Asteraceae	n			x	x	x	x	x			x
Pseudognaphalium microcephalum	small-headed white everlasting	Asteraceae	n		x		x		x				
Pseudognaphalium ramosissimum (=*Gnaphalium ramosissimum*)	pink cudweed	Asteraceae	n		x		x		x				
Pseudognaphalium sp. (=*Gnaphalium* sp.)	cudweed	Asteraceae	n	x					x		x		
Pseudognaphalium spp.	false cudweed	Asteraceae	--								x	x	
Pseudognaphalium stramineum (=*Gnaphalium stramineum*)	Chilean cudweed	Asteraceae	n		x	x			x				
Pyracantha sp.	firethorn	Rosaceae	n-n			x			x				
Pyrus communis	pear	Rosaceae	n-n										x
Quercus agrifolia	coast live oak	Fagaceae	n			x			x				
Quercus virginiana (*)	southern live oak	Fagaceae	n-n						x				
Raphanus sativus	wild radish	Brassicaceae	n-n	x		x	x	x	x	x	x	x	x

Scientific Name	Common Name	Family	Native/ Non-native	(1) 1979	(2) 1981	(3) 1991	(4) 1992	(5) 2001	(6) 2002	(7) 2005	(8) 2010	(9) 2011	(10) 2011
Rhus integrifolia	lemonade berry	Anacardiaceae	n		x		x		x	x			x
Rhus ovata	sugar bush	Anacardiaceae	n	x				x	x	x			x
Ribes malvaceum	chaparral currant	Grossulariaceae	n	x	x		x		x				
Ricinus communis	castor bean	Euphorbiaceae	n-n	x	x	x		x	x	x	x	x	x
Robinia pseudoacacia	black locust	Fabaceae	n-n										x
Rosa californica	California rose	Rosaceae	n			x			x				x
Rumex crispus	curly dock	Polygonaceae	n-n	x		x		x	x	x	x	x	x
Rumex fueginus	golden dock	Polygonaceae	n				x						
Rumex pulcher	fiddle dock	Polygonaceae	n-n										x
Rumex salicifolius	willow dock	Polygonaceae	n			x	x	x	x	x			x
Rumex sp.	dock	Polygonaceae	?								x	x	
Ruppia maritima	ditch grass	Ruppiaceae	n		x		x		x				
Sagittaria montevidensis ssp. *calycina*	Montevideo arrowhead	Alismataceae	n		x		x		x				
Salicornia pacifica (=*Salicornia virginica*)	common pickleweed	Chenopodiaceae	n	x		x	x	x	x	x(t)	x	x	x
Salix exigua	narrow-leaved willow	Salicaceae	n			x			x				x
Salix gooddingii	black willow	Salicaceae	n						x				
Salix laevigata	red willow	Salicaceae	n	x	x	x	x	x	x	x			
Salix lasiolepis	arroyo willow	Salicaceae	n		x	x	x	x	x	x	x		x
Salix sp.	willow	Salicaceae	n								x	x	
Salsola sp.	Russian thistle	Chenopodiaceae	n-n									x	
Salsola tragus	Russian thistle	Chenopodiaceae	n-n			x	x	x	x	x(t)			x
Sambucus nigra ssp. *caerulea*	blue elderberry	Adoxaceae	n			x			x				x
Schinus molle	Peruvian pepper tree	Anacardiaceae	n-n		x	x			x				x
Schinus terebinthifolius	Brazilian pepper tree	Anacardiaceae	n-n			x		x	x	x	x	x	x
Schismus barbatus	Mediterranean grass	Poaceae	n-n			x			x				x

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Schoenoplectus americanus	Olney bulrush	Cyperaceae	n		x	x	x		x				
Schoenoplectus californicus	California bulrush	Cyperaceae	n		x	x	x		x				x
Scirpus sp.	bulrush	Cyperaceae	--								x	x	
Senecio vulgaris	common groundsel	Asteraceae	n-n		x				x				x
Sesuvium verrucosum	western sea-purslane	Aizoaceae	n	x			x		x				
Setaria parviflora (=*Setaria gracilis*)	bristlegrass	Poaceae	n			x			x				
Silene gallica	small-flowered catchfly	Caryophyllaceae	n-n										x
Silybum marianum	milk thistle	Asteraceae	n-n		x	x			x			x	x
Sinapis alba	white mustard	Brassicaceae	n-n										x
Sisymbrium altissimum	tumble-mustard	Brassicaceae	n-n			x			x				
Sisymbrium irio	London rocket	Brassicaceae	n-n			x			x				x
Solanum americanum	small-flowered nightshade	Solanaceae	n			x			x				x
Solanum douglasii	Douglas's nightshade	Solanaceae	n		x	x	x	x	x	x			
Solanum nigrum	black nightshade	Solanaceae	n-n		x	x			x				x
Solanum physalifolium var. *nitidibaccatum* (=*Solanum sarrachoides*)	hairy nightshade	Solanaceae	n-n		x				x				
Solanum xanti	chaparral nightshade	Solanaceae	n	x		x			x				
Solidago velutina ssp. *californica*	California goldenrod	Asteraceae	n			x			x				
Sonchus arvensis	field sowthistle	Asteraceae	n-n								X		
Sonchus asper ssp. *asper*	prickly sow thistle	Asteraceae	n-n		x	x	x	x	x	x(t)			x
Sonchus oleraceus	common sow thistle	Asteraceae	n-n	x	x	x			x		x		x
Sonchus spp.	sow thistle	Asteraceae	--								x	x	

Scientific Name	Common Name	Family	Native/ Non-native	(1) 1979	(2) 1981	(3) 1991	(4) 1992	(5) 2001	(6) 2002	(7) 2005	(8) 2010	(9) 2011	(10) 2011
Sorghum halepense	Johnson's grass	Poaceae	n-n			x			x				
Sorghum nutans (*)	Indian grass	Poaceae	n-n			x			x				
Spartium junceum	Spanish broom	Fabaceae	n-n			x			x				
Spergularia bocconi	Boccone's sandspurrey	Caryophyllaceae	n-n			x	x	x	x				
Spergularia macrotheca	salt marsh sand spurry	Caryophyllaceae	n	x			x						
Spergularia marina	hairy sand spurry	Caryophyllaceae	n	x		x	x		x				x
Spergularia rubra	red sandspurry	Caryophyllaceae	n-n										x
Spergularia villosa	sand spurrey	Caryophyllaceae	n-n			x			x				
Stenotaphrum secundatum	St. Augustine grass	Poaceae	n-n			x			x				
Stephanomeria exigua	small wire lettuce	Asteraceae	n		x		x		x				
Stephanomeria sp.	wire lettuce (milk aster)	Asteraceae	n					x		x			
Stephanomeria virgata	rod wire lettuce (tall stephanomeria)	Asteraceae	n		x	x	x		x				x
Stipa cernua (=*Nassella cernua*)	nodding needlegrass	Poaceae	n			x			x				x
Stipa miliacea (=*Piptatherum miliaceum*)	smilo grass	Poaceae	n-n			x			x				x
Suaeda calceoliformis	horned sea blite	Chenopodiaceae	n		x		x		x				
Suaeda sp.	sea-blite	Chenopodiaceae	n	x				x	x	x			
Suaeda taxifolia	woolly sea-blite	Chenopodiaceae	n			x			x				x
Symphytotrichum subulatum var. *parviflorum* (**) (=*Aster subulatus* var. *ligulatus*)	Short flower annual saltmarsh aster (annual water aster)	Asteraceae	n		x	x	x		x				
Taraxacum officinale	dandelion	Asteraceae	n-n			x			x				x

Scientific Name	Common Name	Family	Native/ Non-native	(1) 1979	(2) 1981	(3) 1991	(4) 1992	(5) 2001	(6) 2002	(7) 2005	(8) 2010	(9) 2011	(10) 2011
Tetragonia tetragonoiodes	New Zealand spinach	Aizoaceae	n-n		x	x							x
Tribulus terrestris	puncture vine	Zygophyllaceae	n-n						x				
Triglochin maritima	seaside arrow grass	Juncaginaceae	n										x
Tropaeolum majus	garden nasturtium	Tropaeolaceae	n					x		x		x	
Typha angustifolia	narrow leaf cattail	Typhaceae	n-n										x
Typha domingensis	southern cattail	Typhaceae	n				x		x				x
Typha latifolia	broad-leaved cattail	Typhaceae	n				x		x	x			
Typha sp.	cattail	Typhaceae	n						x			x	
Ulmus parvifolia	Chinese elm	Ulmaceae	n-n						x				x
Ulmus sp.	elm	Ulmaceae	n-n						x				
Urtica dioica ssp. *holosericea*	hoary nettle	Urticaceae	n				x		x				x
Urtica urens	dwarf nettle	Urticaceae	n-n						x				x
Verbascum virgatum	wand mullein	Scrophulariaceae	n-n						x				
Verbena lasiostachys	common verbena	Verbenaceae	n				x		x				
Washingtonia robusta	slender fan palm	Arecaceae	n-n						x	x			x
Washingtonia sp.	fan palm	Arecaceae	n-n						x				
Xanthium sp.	cocklebur	Asteraceae	n	x					x				
Xanthium spinosum	spiny cocklebur	Asteraceae	n						x				
Xanthium strumarium	rough cocklebur	Asteraceae	n				x	x	x	x		x	x
Yucca gloriosa (*)	Spanish dagger	Agavaceae (Liliaceae)	n-n						x				
Yucca sp.	yucca	Agavaceae (Liliaceae)	--									x	

Sources (1) through (7) as reported by Johnston et al. (2011) in Appendix C.1.

(1) *Clark, J. 1979. "*Ballona Vegetation Survey.*"* In: *Ballona Wetlands Study: Part 3.* University of California, Los Angeles. School of Architecture and Planning.

(2) Gustafson, R. 1981. "The Vegetation of Ballona." In *The Biota of the Ballona Region*, Los Angeles County, edited by R.W. Schreiber, BO1- BO29. Los Angeles: Los Angeles County Natural History Museum Foundation.
(3) Henrickson, J. 1991. "DRAFT Botanical Resources of Playa Vista." Prepared for Maguire Thomas Partners.
(4) Altschul, J. and Homburg, J. 1992. "Life in the Ballona." Adapted from Gustafson, R. 1981. *The Vegetation of Ballona*. (unpublished)
(5) MEC Analytical Systems. 2001. "Biological Study of Ballona Wetlands, Los Angeles County, California." Prepared for U.S. Army Corps of Engineers, Los Angeles District.
(6) Read, E. 2002. Playa Vista Master Species list. (unpublished)
(7) City of Los Angeles. 2005. "Ballona Wetlands Vegetation." Prepared for US Army Corps of Engineers.
(Note: x(t) = on transects)

Sources (8) through (10) are as follows:

(8) Johnston, K.K., E. Del Giudice-Tuttle, I.D. Medel, S. Bergquist, D.S. Cooper, J. Dorsey, and S. Anderson. 2011. The Ballona Wetlands Ecological Reserve Baseline Assessment Program: 2009–2010 Final Report. Santa Monica Bay Restoration Commission. Prepared for the California State Coastal Conservancy, Los Angeles, California.
(9) Johnston, K.K., E. Del Giudice-Tuttle, I.D. Medel, C.J. Piechowski, D.S. Cooper, J. Dorsey, and S. Anderson. 2012. The Ballona Wetlands Ecological Reserve Baseline Assessment Program: 2010–2011 Final Report. Santa Monica Bay Restoration Commission. Prepared for the California State Coastal Conservancy, Los Angeles, California.
(10) WRA, Inc. 2011. Protocol Rare Plant Surveys: 2010–2011 Ballona Wetlands Ecological Reserve Marina del Rey, Los Angeles County, California

Note:

a = Flora of North America reports *Cupressus arizonica* having widely modified cultivars throughout the south west (*Flora of North America Volume 2*. Ed: Flora of North America Editorial Committee. 1993. Oxford University Press, Inc.). *Cupressus arizonica* has been misidentified as the common ornamental form of Arizona cypress planted throughout the world. *Hesperocyparis glabra (Cupressus arizonica* var. *glabra)* is the correct taxon from which most, if not all, plantings of the former Arizona cypress complex are derived. (Adams et al. 2010. Geographic variation in the leaf essential oils of *Hesperocyparis arizonica* and *H. glabra.* Phytologia 92: 366–387).

b = Recent taxonomic descriptions do not recognize varieties of *Phacelia ramosissima*; however, *Phacelia ramosissima* var. *austrolitoralis* is currently recognized by CNPS as a rare plant (CNPS 3.2).

(*) = unpublished, invalidly published, illegitimate, or rejected name for taxon native to CA or not found on Jepson interchange.

(**) = taxonomic or nomenclatural synonym for taxon not occurring in CA (erroneous reports, misapplication of names, misidentifications, other exclusions.

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APPENDIX D4
Benthic Invertebrate Studies

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Appendix D4

Summary of Benthic Invertebrate Studies in the Study Area (1980 to 2011)

The following summarizes the results of benthic invertebrate studies performed in the study area between 1980 and 2011. Table D4-1 provides a summary of the benthic invertebrate studies conducted in the study area. This table is then followed by a summary of the survey results.

Table D4-1. Summary of Benthic Invertebrate Surveys and Reports in the Study Area (modified from PWA 2006a to include later studies reported by Johnston et al. 2011, 2012)

Year	Author	Geographic Extent	Description
1980	Reish	Area B	General marine biology study of Playa Vista
1981	Ramirez	Area B	Mollusk survey for *Biota of the Ballona Region*
1991	Boland and Zedler	Area B	Fish and invertebrate research sponsored by the National Audubon Society
1991	Carter	Areas A, B, C, and D*	Noninsect invertebrate survey for Playa Vista EIR
1996	Chambers Group	Areas A and B	Benthic infauna survey for Impact Sciences
1999	Chambers Group	Areas A and B	Benthic infauna survey for Impact Sciences
2000	Glen Lukos Associates	Areas A, B, and C	Habitat assessment for Riverside and San Diego Fairy Shrimp for Playa Vista Project
2001	MEC-Weston	Area B	Vegetation, fish, bird, and benthic infauna study, provided monitoring data for USACE 1135 (LA City 2005)
2003	MEC-Weston	Area B	Vegetation, fish, bird, and benthic infauna study, provided monitoring data for USACE 1135 (LA City 2005)
2003	Wetlands Research Associates	Area B	Benthic infauna survey
2005	MEC-Weston	Area B	Vegetation, fish, bird, and benthic infauna study, provided monitoring data for USACE 1135 (LA City 2005)
2005	Dorsey	Area B	BOLD report
2009-2010	Johnston et al.	Area A and B	Year 1 Baseline Assessment Program
2010-2011	Johnston et al.	Area A and B	Year 2 Baseline Assessment Program

* = Area D, located east of Lincoln Boulevard, was considered part of the Ballona Wetlands until the late 1990s, when a residential development project was constructed there.

Reish (1980)

Reish conducted what is considered by some to be a definitive study of the benthic invertebrates of the Reserve. From previous reports evaluated by Reish, a combined total of 15 taxa were found. From the four seasons (August and November 1979 and April and June 1980) during which Reish sampled, 63 taxa were identified. The number of taxa found at each station increased as distance from the mouth of the tide channel decreased. The lowest number of taxa was recorded in April 1980. The highest number of taxa was found in June 1980. Reish found that Area B was dominated by a few species typical of Southern California coastal wetlands. *Streblospio benedicti* was the most abundant species and was present at all stations. *Capitella capitata*, *Polydora nuchalis*, and unidentified oligochaetes were the next most abundant species (Johnston et al. 2011). Figure D4-1 depicts sample locations and Figure D4-2 summarizes results.



Figure D4-1 depicts benthic infauna sampling stations from studies conducted between 1980 and 2005 (Reish 1980; Ramirez 1981; Boland and Zedler 1991; Chambers 1996, 1999; WRA 2004; MEC 2005). Yellow bars represent the flap gate (A) and tide gate locations (B), respectively. Chambers A is in the Fiji Ditch of Area A. (Reproduced from Johnston et al. 2011)



Figure D4-2 summarizes densities (number of benthic infauna individuals/m^2) from studies conducted between 1980 and 2007 (Reish 1980; Chambers 1996 and 1999; Dorsey 2007). A and B represent the flap gate and tide gate locations, respectively. Chambers A is in the Fiji Ditch of Area A. (Reproduced from Johnston et al. 2011).

Ramirez (1981)

Ramirez conducted monthly sampling of marine mollusks in the Reserve between August 1980 and May 1981 and identified 19 mollusk taxa. The highest species richness (14 species) was recorded nearest to the mouth of the tide channel. Ramirez recorded the presence of *Macoma nasuta, Protothaca staminea, Assiminea californica*, and *Melampus olivaceus* at all stations (Johnston et al. 2011). Figure D4-1 depicts sample locations.

Boland and Zedler (1991)

In April, July, and October of 1990, the Pacific Estuarine Research Laboratory of San Diego State University surveyed six stations (Boland and Zedler 1991). A total of 11 taxa were identified. Boland and Zedler also found that species richness was lowest at the stations furthest from the tide gates (Johnston et al. 2011). Figure D4-1 depicts sample locations.

Carter (1991)

Carter conducted quarterly surveys of noninsect invertebrates in Areas A, B, C, and D that focused on epifauna. The study's aim was to define species composition and relative distribution over the course of one year. The study found a total of 30 taxa, with the most common including: *M. nasuta,*

Tagelus subteres, Bulla gouldiana, Uca crenulata, Pachygrapsus crassipes, and *Capitella capitata. C. capitata* are known to invade disturbed habitats and are indicators of pollution, when found occurring in large populations in an ecosystem that is otherwise species poor. Cerithidea californica was the most abundant species found in the saline channels (Johnston et al. 2011).

Chambers Group (1996 and 1999)

The Chambers Group sampled seven sites in Ballona Creek, Marina del Rey, and Areas A and B in 1996 and 1999 to compile a census of the benthic invertebrate communities of the Reserve. A total of 23 taxa were identified. Annelids, arthropods, and mollusks were the predominant organismal groups. Oligochaetes were the most numerous taxa found at all but two sample stations. Densities of benthic invertebrates samples ranged from 6,089 individuals /m^2 to 95,550 individuals/m^2. The highest densities of benthic invertebrates were recorded at the Area B stations closest to the tide gates. They concluded that the Reserve had a benthic community dominated by taxa characteristic of Southern California coastal wetlands, but that the species diversity was lower than that of larger, less disturbed wetlands (Johnston et al. 2011).

In 1998, the Chambers Group returned to sample the same eight stations in Areas A and B to assess benthic invertebrate communities after the replacement of the easternmost tidal flap gates. They found that densities of benthic invertebrates were lower at all stations, while distribution trends remained generally the same. Densities of oligochaetes were also reduced (Johnston et al. 2011). Figure D4-1 depicts sample locations and Figure D4-2 summarizes results.

Glen Lukos Associates (2000)

Areas A, B, and C were evaluated for habitat suitable for both the Riverside and the San Diego fairy shrimp, although the habitat assessment did not include either wet- or dry-season sampling. Wherever substantial ponding was observed during the May 2000 assessments, the water was measured for specific conductance and visual observations of any aquatic invertebrates and vegetation were collected. No ponds in Areas A, B, or C were determined to be capable of supporting either type of fairy shrimp due to high salinities or inadequate length or depth of ponding, and thus, both the Riverside fairy shrimp and the San Diego fairy shrimp were determined to be absent from the project area (Glen Lukos Associates 2000).

MEC-Weston (2001, 2003, and 2005)

The United States Army Corps of Engineers (USACE) installed a self-regulating tide gate, in March 2003. In support of the tide gate project, MEC-Weston conducted benthic invertebrate surveys in Area B in 2001, 2003, and 2005 (Johnston et al. 2011). Figure D4-1 depicts sample locations.

WRA (2003)

In 2003, a survey was conducted for benthic infauna in the tide channels of Area B before and after the installation of the USACE self-regulating tide gates to assess the benthic invertebrate population. The trend observed at all stations was an overall increase in the number of benthic invertebrates as distance from the tide gate increased. Additionally, WRA found that all stations had an increased number of benthic invertebrates in the September (before) sampling than in the February (after) sampling, with the exception of amphipods (Johnston et al. 2011).

Dorsey (2007)

In 2005, benthic invertebrate surveys were conducted at two stations in the tidal channels of Area B as part of the Ballona Outdoor Learning and Discovery (BOLD) Report. Samples were collected at two stations during April and August 2005. The most abundant macrofauna was *C. californica*, with 311 individuals/m^2, followed by the sea anemone (*Diadumene* sp.) with 1.3 individuals/m^2. Sixteen taxa of infauna were identified. The most abundant taxa were: Monocorophium insidiosum, *A. inculta, C. capitata, P. nucalis,* and *S. benedicti*. Species abundance was higher in the April samples (17,429 individuals/m^2 and 4,388 individuals/m^2) than in the August samples (4,054 individuals/m^2 and 2,946 individuals/m^2) (Johnston et al. 2011). Figure D4-3 depicts sample locations.

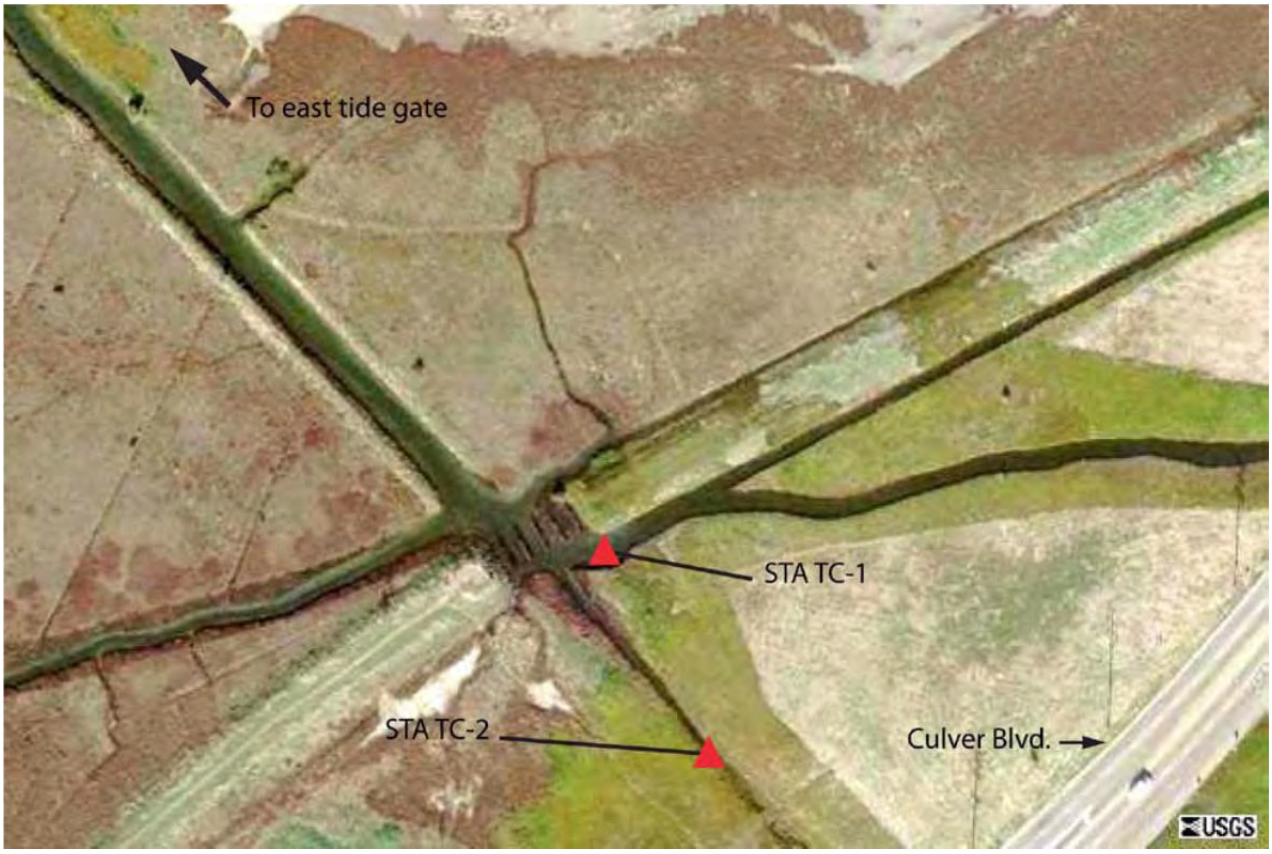

Figure D4-3 depicts BOLD benthic invertebrate sampling stations. (Reproduced from Johnston et al. 2011).

Merkel & Associates (2009)

While conducting fish surveys in late summer 2009, Merkel & Associates collected a numbers of invertebrates from Ballona Creek. Collected invertebrate species in order of decreasing relative abundance: Pacific calico scallop (*Argopecten ventricosus*), Navanax nudibranch (*Navanax inermis*), Asian mussel (*Musculista senhousia*), Gould's bubble snail (*Bulla gouldiana*), Cancer crab (*Cancer* sp.), green shore crab (*Hemigrapsus oregonensis*), and kelp crab (*Pugettia producta*). One individual of each of the following invertebrates was also captured in trawls: clam (*Chione* sp.), Pacific batwing seaslug (*Gastropteron pacificum*), Mediterranean mussel (*Mytilus galloprovincialis*), and tuberculate pear crab (*Pyromaia tuberculata*). No invertebrates were captured at the Fiji Ditch, although California hornsnail (*Cerithidea californica*) was observed. Invertebrates captured in the tide channel sites include: green shore crab, California horn snail, Mediterranean mussel, clam, Pacific calico scallop, common slipper limpet (*Crepidula fornicate*), eggcockle (*Laevicardium* sp.), and Asian mussel (Johnston et al. 2011).

Johnston et al. (2009-2010)

Between 2009 and 2010, Johnston et al. conducted benthic invertebrate surveys for the Baseline Assessment Program (BAP) on the Reserve (Johnston et al 2011). Infauna results showed the group of organisms that consistently had the highest proportion of the samples at each station was gastropods, dominated by California hornsnail, when all samples for each station were combined. The California hornsnail density included both live and dead individuals. The groups that were the next highest proportion of the samples were mollusks and gammarids. The sample station closest to the tide gate in the main channel, had the highest proportion of mollusks compared to the other stations. Invertebrate density, when averaged for all cores and all organisms combined, increased with increased distance from the tide gates (with the exception of one station which had low overall abundances during both sampling periods). The sample station furthest from the tide gate had the highest average number of individuals/m^2 in both October 2009 (55,640 individuals/m^2) and April 2010 (74,223 individuals/m^2) when averaged for all cores, whereas Boland and Zedler (1991) recorded densities of zero in the southern wetland channels of Area B. Contrasted to Reish (1980) with an average of 229,406 individuals/m^2 at a particular station in June, the BAP survey at the same location average of 22,914 individuals/m^2 in April 2010 and 39,186 individuals/m^2 in October 2009. The lowest average density was recorded at a station in Area A with 2,968 individuals/m^2 when averaged for all cores combined. Epifauna results showed the average number of California hornsnail were similar across all transects in June 2010. In September, only Transect 1 had a higher value than that of June. Both Transects 2 and 3 had lower numbers of California hornsnail in September. Targeted surveys for mimic tryonia (*Tryonia imitator*), a nonlisted special-status species, were not conducted during the first year of the BAP. No special-status species were observed visually at the sampling stations nor were they found in any of the samples (Johnston et al. 2011). Figure D4-4 and Figure D4-5 shows areas sampled for this study.



Figure D4-4 depicts BAP benthic invertebrate sampling stations. Yellow bars represent the flap gate (A) and tide gate (B) locations, respectively (reproduced from Johnston et al. 2011). BW1 and BW2 are in the Fiji Ditch of Area A.



Figure D4-5 shows the location of *C. californica* sampling transects (reproduced from Johnston et al. 2011). Transects 1 through 3 are represented as blue lines, and Transect 4, represented as an orange line, was added during the second survey period.

Johnston et al. (2010–2011)

Between 2010 and 2011, Johnston et al. (2012) conducted benthic invertebrate surveys for the BAP on the Reserve (Johnston et al. 2011). Infauna results showed 42 taxa were identified in small and large cores in April of the second baseline assessment year. *Monocorophium insidiosum, Grandidierella japonica, Capitella capitata Cmplx, Acteocina inculta, Oligochaeta,* and *Streblospio benedicti* were the most common species found in order of greatest to lowest density of individuals/m^2. The phylum with the highest total percentage of organisms in the large core samples was Mollusca. Five species from three phyla accounted for 69.4% of the density of organisms for the large core samples. There were a total of 20 species identified in the large core samples across all stations surveyed. *A. inculta* accounted for 30.6% of the total average density of organisms across stations for large care samples. *Cirriformia* sp. and *M. insidiosum* accounted for the next highest percentages of the large core samples (18.4% and 10.2% respectively). The phylum Arthropoda had the highest percentage of organisms in the small cores samples. Seven species from three phyla accounted for 93.3% of the density of organisms for the small core samples. There were a total of 36 species identified in the small cores samples across all stations surveyed. *M. insidiosum* accounted for 48.3% of the total average density of organisms across all small core stations. *G. japonica* and *C. capitata Cmplx* accounted for the next highest percentage of the small core samples (15.1% and 7.5%, respectively). The small cores samples had an average density of organisms of 54,862.9 individuals/m^2. Epifauna results showed the average number of California hornsnail across all transects was lower in winter and fall (January 267.2 individuals/m^2 and September 239.0

individuals/m^2) than in spring and summer (March 422.8 individuals/m^2 and June 387.0 individuals/m^2). The average number of California hornsnail was found to be highest in the March survey on all transects except one which recorded a higher number during September (58.4 individuals/m^2). For data comparison between both baseline years, the average number of California hornsnail was roughly three times higher in 2010 (June and September combined) at Transect 1 (86.8 individuals/m^2) and Transect 2 (55.6 individuals/m^2), whereas Transect 3 had a slightly higher average number of California hornsnail in 2011 (43.6 individuals/m^2). Targeted surveys for mimic tryonia were not conducted during the second year of the BAP. No special-status species were observed visually at the sampling stations nor were they found in any of the samples (Johnston et al. 2012). Figure D4-4 and Figure D4-5 shows areas sampled for this study.

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APPENDIX D5
Biological Resources Existing Conditions

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Biological Resources Existing Conditions Tables

TABLE D5-1
SUMMARY OF BENTHIC INVERTEBRATE ORGANISMS FOUND ON THE STUDY SITE

Phylum	Class	Order	Family	Species*	MEC (2005)	BAP (2011)
Annelida	Clitellata	—	—	*Oligochaeta*	X	X
Annelida	Polychaeta	—	Capitellidae	*Capitella capitata Cmplx*	X	X
Annelida	Polychaeta	—	Capitellidae	*Notomastus* sp	X	
Annelida	Polychaeta	—	Capitellidae	*Notomastus* sp HYP3	X	
Annelida	Polychaeta	—	Capitellidae	*Notomastus hemipodus*	X	
Annelida	Polychaeta	—	Orbiniidae	*Scoloplos acmeceps*		X
Annelida	Polychaeta	—	—	*Euclymeninae*	X	
Annelida	Polychaeta	Aciculata	Eunicidae	*Marphysa* sp		X
Annelida	Polychaeta	Aciculata	Nereididae	*Neanthes acuminata Cmplx*		X
Annelida	Polychaeta	Aciculata	Nereididae	*Nereididae*		X
Annelida	Polychaeta	Aciculata	Syllidae	*Exogone lourei*		X
Annelida	Polychaeta	Aciculata	Syllidae	*Exogone sp*	X	X
Annelida	Polychaeta	Canalipalpata	Cirratulidae	*Cirratulidae*		X
Annelida	Polychaeta	Canalipalpata	Cirratulidae	*Cirriformia sp*		X
Annelida	Polychaeta	Canalipalpata	Sabellidae	*Fabricinuda limnicola*	X	X
Annelida	Polychaeta	Canalipalpata	Spionidae	*Polydora nuchalis*	X	X
Annelida	Polychaeta	Canalipalpata	Spionidae	*Spionidae*	X	X
Annelida	Polychaeta	Canalipalpata	Spionidae	*Streblospio benedicti*	X	X
Annelida	Polychaeta	Phyllodocida	Glyceridae	*Hemipodus borealis*	X	
Annelida	Polychaeta	Spionida	Spionidae	*Polydora sp*	X	
Arthropoda	Insecta	Diptera	—	fly larvae		X
Arthropoda	Malacostraca	Amphipoda	Ampithoidae	*Ampithoe lacertosa*		X
Arthropoda	Malacostraca	Amphipoda	Ampithoidae	*Ampithoe plumulosa*		X
Arthropoda	Malacostraca	Amphipoda	Ampithoidae	*Ampithoe sp*		X
Arthropoda	Malacostraca	Amphipoda	Ampithoidae	*Ampithoe valida*	X	X
Arthropoda	Malacostraca	Amphipoda	Aoridae	*Grandidierella japonica*	X	X
Arthropoda	Malacostraca	Amphipoda	Corophiidae	*Monocorophium insidiosum*	X	X
Arthropoda	Malacostraca	Amphipoda	Corophiidae	*Monocorophium sp*		X
Arthropoda	Malacostraca	Amphipoda	Hyalellidae	*Allorchestes angusta*		X
Arthropoda	Malacostraca	Amphipoda	Hyalidae	*Protohyale frequens*		X
Arthropoda	Malacostraca	Amphipoda	Pontogeneiidae	*Tethygeneia opata*	X	
Arthropoda	Malacostraca	Amphipoda	Corophiidae	*Monocorophium acherusicum*	X	

TABLE D5-1 (Continued)
SUMMARY OF BENTHIC INVERTEBRATE ORGANISMS FOUND ON THE STUDY SITE

Phylum	Class	Order	Family	Species*	MEC (2005)	BAP (2011)
Arthropoda	Malacostraca	Isopoda	Sphaeromatidae	*Dynamenella dilatata*	X	
Arthropoda	Malacostraca	Isopoda	Sphaeromatidae	*Sphaeromatidae*		X
Arthropoda	Malacostraca	Tanaidacea	Paratanaoidea incertae sedis	*Tanaopsis cadieni*	X	
Arthropoda	Maxillopoda	Poecilostomatoida	Sapphirinidae	*Edwardsia sp*	X	
Arthropoda	Ostracoda	Podocopida	—	*Podocopida*		X
Cnidaria	Anthozoa	—	—	*Anthozoa*	X	
Cnidaria	Anthozoa	Actiniaria	Actiniidae	*Anthopleura artemisia*	X	
Cnidaria	Anthozoa	Actiniaria	Diadumenidae	*Diadumene sp*		X
Cnidaria	Anthozoa	Actiniaria	Edwardsiidae	*Drillactis sp*	X	X
Cnidaria	Anthozoa	Actiniaria	—	*Athenaria*		X
Cnidaria	Anthozoa	Actiniaria	—	*Edwardsiidae*	X	
Cnidaria	Hydrozoa	Leptothecata	—	*Campanulariidae*	X	
Mollusca	Gastropoda	Cephalaspidea	Clyichnidae	*Acteocina harpa*	X	
Mollusca	Gastropoda	Opisthobranchia	Aglajidae	*Melanochlamys diomedea*		X
Mollusca	Gastropoda	Opisthobranchia	Cylichnidae	*Acteocina inculta*	X	X
Mollusca	Gastropoda	Sorbeoconcha	Potamididae	*Cerithidea californica*		X
Mollusca	Pelecypoda	Mytilida	Mytilidae	*Adula* sp *BW1*	X	
Mollusca	Pelecypoda	Mytilida	Mytilidae	*Mytilidae, juv*		X
Mollusca	Pelecypoda	Mytilida	Mytilidae	*Mytilus californianus*	X	
Mollusca	Pelecypoda	Tellinidae	Tellina	*Tellina cadieni*	X	
Mollusca	Pelecypoda	Venerida	Semelidae	*Theora lubrica*	X	
Mollusca	Pelecypoda	Venerida	Tellinidae	*Macoma secta*	X	
Mollusca	Pelecypoda	Venerida	Tellinidae	*Macoma nasuta*	X	
Mollusca	Pelecypoda	Venerida	Veneridae	*Protothaca staminea*	X	
Mollusca	Pelecypoda	Venerida	Solecurtidae	*Tagelus affinis*	X	
Mollusca	Pelecypoda	Venerida	Solenidae	*Solen rostriformis*		X
Mollusca	Pelecypoda	Venerida	Veneridae	*Chione californiensis*		X
Mollusca	Pelecypoda	Venerida	Veneridae	*Leukoma laciniata*		X
Mollusca	Pelecypoda	Venerida	Veneridae	*Protothaca laciniata*	X	
Mollusca	Pelecypoda	Venerida	Veneridae	*Tellina meropsis*		X
Mollusca	Pelecypoda	Venerida	Veneridae	*Venerupis phillipinarum*	X	X
Nematoda	—	—	—	*Nematoda*	X	
Nemertea	—	—	—	*Nemertea*		X
Nemertea	—	—	—	*Nemertea*		X
Nemertea	Anopla	—	Lineidae	*Lineus sp*	X	
Nemertea	Anopla	Paleonemertea	—	*Paleonemertea*	X	X
Nemertea	Anopla	Paleonemertea	Carinomidae	*Carinoma mutabilis*		X
Nemertea	Enopla	Hoplonemertea	Emplectonematidae	*Paranemertes californica*	X	X
Platyhelminthes	Rhabditophora	Seriata	Monocelididae	*Monocelididae*	X	
Sipuncula	—	—	—	*Sipuncula*	X	
Unknown	—	—	—	unknown (insect)		X

SOURCE: Johnston et al. 2012[1] (modified from Johnston et al. 2012[2])

1 Johnston et al. 2012
2 Johnston et al. 2012

TABLE D5-2
BUTTERFLY SPECIES OBSERVED IN THE SALT MARSH OF AREA B, RIPARIAN AND FRESHWATER MARSH HABITATS DURING SURVEYS BY THE FRIENDS OF BALLONA WETLANDS

Common Name	Species Name	2008	2009	2010	2011
Acmon Blue	*Plebejus acmon*	X	X	X	X*(freshwater)
American Lady	*Vanessa virginiensis*				X*(freshwater)
Anise Swallowtail	*Papilio zelicaon*			X	
Blue sp (unknown)	—			X	X
Cabbage White	*Pieris rapae*	X	X	X	X
Checkered White	*Pontia protodice*	X	X	X	
Cloudless Sulphur	*Phoebis sennae*	X			
Common Buckeye	*Junonia coenia*	X		X	X
Eufala Skipper	*Lerodea eufala*	X	X	X	X
Fiery Skipper	*Hylephila phyleus*	X		X	X
Gray Hairstreak	*Srtymon melinus*	X		X	X
Lady sp	—				X
Gulf Fritillary	*Argraulis vanillae*			X*(freshwater)	
Marine Blue	*Leptotes marina*	X	X	X	X
Monarch	*Danaus plexippus*				X*(freshwater)
Mourning Cloak	*Nymphalis antiopa*			X*(riparian)	X*(freshwater)
Orange Sulphur	*Colias euytheme*	X			
Queen	*Danaus gilippus*	X			
Red Admiral	*Vanessa atalanta*				X
Sachem Skipper	*Atalopedes campestris*			X	
Sandhill Skipper	*Polites sabuleti*			X	X
Skipper sp	—		X	X	X
Umber Skipper	*Poanes melane*	X		X	X
Wandering Skipper	*Panoquina errans*			X	X
West Coast Lady	*Vanessa anabella*			X	
Western Pygmy-blue	*Brephidium exilis*	X	X	X	X
Western Swallowtail	*Papilio rutulus*			X* (riparian, cabora, freshwater, triangle)	X
White Checkered Skipper	*Pyrgus albescens*			X*(freshwater)	
White sp	—			X	

SOURCE: Johnston et al. 2012[3] (reproduced from Johnston et al. 2012[4])

[3] Johnston et al. 2012
[4] Johnston et al. 2012

TABLE D5-3
FISH SPECIES IN THE TIDE CHANNELS OF THE RESERVE

Common Name	Scientific Name	1981[a]	1991[b]	1996[c]	2001[d]	2004[e]	2005[f]	2009[g]	2009–2011[h]
Arrow goby	*Clevelandia ios*	X	X	X	X		X	X	X
Black perch	*Embiotoca jacksoni*	X							
California halibut	*Paralichthys californicus*	X							
California killifish	*Fundulus parvipinnis*	X	X	X	X	X	X	X	X
Cheekspot goby	*Ilypnus gilberti*	X		X	X			X	
CIQ goby	*Clevlandia/Ilypnus/ Quietula complex*							X	
Diamond turbot	*Hypsopsetta guttulata*	X				X			X
Longjaw mudsucker	*Gillichthys mirabilis*	X	X	X	X		X	X	X
Pacific staghorn sculpin	*Leptocottus armatus*	X	X	X	X				X
Queenfish	*Seriphus politus*	X							
Round stingray	*Urobatis halleri*								X
Sailfin molly*	*Poecilia latipinna*	X	X	X		X	X		
Shadow goby	*Quietula y-cauda*	X		X					
Shiner perch	*Cymatogaster aggregate*	X							
Striped mullet	*Mugil cephalus*	X	X					X	X
Topsmelt	*Atherinops affinis*	X	X	X	X		X	X	X
Western mosquitofish*	*Gambusia affinis*	X	X	X	X	X	X	X	X
Yellowfin goby*	*Acanthogobius flavimanus*	X	X						

NOTES:

X = present during survey
* nonnative species

[a] Swift and Frantz (Area B of Reserve sampled)
[b] Boland and Zedler, and Stolz (Area B of Reserve sampled)
[c] Haglund et al. (Area B of Reserve sampled)
[d] MEC-Weston (Area B of Reserve sampled)
[e] MEC-Weston (Area B of Reserve sampled)
[f] LA City (Area B of Reserve sampled)
[g] Merkel & Associates (Fiji Ditch and Area B of Reserve sampled)
[h] Johnston et al. (combined 2011 and 2012 survey results for Fiji Ditch and Area B of Reserve)

SOURCE: Modified from Johnston et al. 2011 to include results from Johnston et al. 2011 and 2012[5]

[5] Modified from Johnston et al. 2011 to include results from Johnston et al. 2011 and 2012

TABLE D5-4
FISH SPECIES IDENTIFIED FROM MARINA DEL REY AND/OR BALLONA CREEK

Common Name	Scientific Name	1991[a]	1996[b]	2005[c]	2009[d]	2009–2011[e]
Arrow goby	*Clevelandia ios*	X	X	X		X
Barred sand bass	*Paralabrax nebulifer*	X	X			
Bat ray	*Myliobatis californica*	X	X			X
Bay pipefish	*Syngnathus leptorhynchus*				X	
Black croaker	*Cheilotrema saturnum*				X	
California barracuda	*Sphyraena argentea*	X	X			
California clingfish	*Gobiesox rhessodon*	X				
California corbina	*Menticirrhus undulatus*		X			
California halibut	*Paralichthys californicus*	X	X	X	X	X
California killifish	*Fundulus parvipinnis*				X	X
California needlefish	*Strongylura exilis*	X	X			
California lizardfish	*Synodus lucioceps*					X
California tonguefish	*Symphurus atricauda*	X	X			
Cheekspot goby	*Ilypnus gilberti*	X	X			
CIQ goby (unknown)	*Clevlandia/Ilypnus/Quietula complex*				X	
Diamond turbot	*Hypsopsetta guttulata*	X	X		X	X
Fantail sole	*Xystreurys liolepis*		X		X	
Giant kelpfish	*Heterostichus rostratus*	X				X
Hornyhead turbot	*Pleuronichthys verticalis*	X			X	
Jacksmelt	*Atherinopsis californiensis*		X			
Kelp bass	*Paralabrax clanthratus*	X				X
Longjaw mudsucker	*Gillichthys mirabilis*	X	X	X		
Mussel blenny	*Hypsoblennius jenkinsi*	X	X			
Northern anchovy	*Engraulis mordax*	X	X			
Opaleye	*Girella nigricans*		X			
Pacific sardine	*Sardinops sagax*	X	X			
Pacific staghorn sculpin	*Leptocottus armatus*	X			X	
Queenfish	*Seriphus politus*	X	X		X	
Round stingray	*Urobatis halleri*	X			X	
Sailfin molly*	*Poecilia latipinna*			X		
Salema	*Xenistius californiensis*	X	X		X	
Sargo	*Anisotremus davidsoni*		X		X	
Shadow goby	*Quietula y-cauda*		X			
Shiner perch	*Cymatogaster aggregata*	X	X		X	
Shovelnose guitarfish	*Rhinobatis productus*				X	
Specklefin midshipman	*Porichthys myriaster*		X			X
Spotted kelpfish	*Gibbonsia elegans*	X	X			
Spotted sand bass	*Paralabrax maculatofasciatus*		X			
Spotted turbot	*Pleuronichthys ritteri*	X	X			
Striped kelpfish	*Gibbonsia metzi*				X	
Striped mullet	*Mugil cephalus*				X	X

TABLE D5-4 (Continued)
FISH SPECIES IDENTIFIED FROM MARINA DEL REY AND/OR BALLONA CREEK

Common Name	Scientific Name	1991[a]	1996[b]	2005[c]	2009[d]	2009–2011[e]
Topsmelt	*Atherinops affinis*	X	X	X	X	
Western mosquitofish*	*Gambusia affinis*			X		
White croaker	*Genyonemus lineatus*	X	X			
White seabass	*Atractoscion nobilis*	X	X			
White seaperch	*Phanerodon furcatus*		X			
Yellowfin croaker	*Umbrina roncador*		X		X	
Yellowfin goby*	*Acanthogobius flavimanus*	X				
Zebra perch	*Hermosilla azurea*		X			

NOTES:

X = present during survey
* nonnative species

[a] Allen (both Marina del Rey and Ballona Creek sampled)
[b] Haglund et al. (both Marina del Rey and Ballona Creek sampled)
[c] LA City (Marina del Rey not sampled)
[d] Merkel & Associates (Marina del Rey not sampled)
[e] Johnston et al. (combined 2011 and 2012 survey results within Ballona Creek; Marina del Rey not sampled)

SOURCE: Modified from Johnston et al. 2011 to include results from Johnston et al. 2011 and 2012.

TABLE D5-5
REPTILE AND AMPHIBIAN SPECIES IN THE STUDY AREA

Common Name	Scientific Name	1981[a]	1991[b]	1996[c]	2007[d]	2009[e]	2009–2011[f]	FWM[g]
American bullfrog*	*Rana catesbeiana*							X
Baja California treefrog	*Pseudacris hypochondriaca hypochondriaca*	X		X	X		X	X
California kingsnake	*Lampropeltis getula californiae*	X	X	X			X	X
California toad	*Bufo boreas halophilus*	X		X				X
Garden slender salamander	*Batrachoseps major major*	X	X				X	
Great Basin fence lizard	*Sceloporus occidentalis*	X	X	X	X	X	X	X
Red-eared slider*	*Trachemys scripta elegans*							X
San Bernardino ring-necked snake	*Diadophis punctatus modestus*						X	
San Diego alligator lizard	*Elgaria multicarinata webbii*	X	X	X	X	X	X	
San Diego gopher snake	*Pituophis catenifer annectens*	X	X	X	X	X	X	X
Southern California legless lizard (=Silvery legless lizard)	*Anniella stebbinsi* (=*Anniella pulchra pulchra*)	X	X		X		X	
Southern Pacific rattlesnake	*Crotalus oreganus helleri*						X	
Western side-blotched lizard	*Uta stansburiana elegans*	X	X	X	X	X	X	

NOTES:

X = species present
* Introduced species

[a] Hayes and Guyer—Areas A and B of the Reserve (as reported in PWA 2006a)
[b] Frank Hovore and Associates—Areas A and B of the Reserve (as reported in PWA 2006a)
[c] Impact Sciences, Inc.—Areas A and B of the Reserve (as reported in PWA 2006a)
[d] Sustaita et al.—Area B of the Reserve (as reported in PWA 2006a)
[e] Johnston et al.—Area B of the Reserve for Early Action Plant (EAP)
[f] Johnston et al.—Areas A, B, and C of the Reserve for Baseline Assessment Program (BAP)
[g] Species reported in the area of the adjacent freshwater marsh between 2009 and 2011 (Johnston et al. 2011, 2012)

TABLE D5-6
BIRD SPECIES DOCUMENTED IN THE STUDY AREA

Common Name	Scientific Name	Ballona Valley Status Designationc	Source		
			SMBRC[a]	FWM[b]	Cooper[c]
Acorn Woodpecker	*Melanerpes formicivorus*	Vagrant (casual on the coast)		X*	X
Allen's Hummingbird	*Selasphorus sasin*	Common perennial resident and nester	X[2]	X (2006–2010)	X
American Avocet	*Recurvirostra americana*	Currently an occasional transient		X	X
American Bittern	*Botarus lentiginosus*	Mostly extirpated as a winter resident; however, recent wintering documented at FWM (freshwater marsh)	X	X*	X
American Coot	*Fulica americana*	Reestablished; now a common breeding perennial resident at FWM; transient and winter resident elsewhere	X[1b]	X (2003–2010)	X
American Crow	*Corvus brachyrhynchos*	Common perennial resident	X[1a]	X	X
American Goldfinch	*Spinus tristis*	Extirpated as breeder; now an irregularly uncommon transient and winter visitor	X[1b]	X (2010)	X
American Kestrel	*Falco sparverius*	Fairly common resident	X[2]	X	X
American Pipit	*Anthus rubescens*	Fairly common winter resident	X	X	X
American Robin	*Turdus migratorius*	Occasional winter and irregular visitor to Westchester	X	X	X
American Tree Sparrow	*Spizella arborea*	Vagrant		X*	X
American White Pelican	*Pelecanus erythrorhynchos*	Rare winter visitor and transient		X*	X
American Wigeon	*Anas americana*	Common winter resident and fall transient	X	X	X
Anna's Hummingbird	*Calypte anna*	Common permanent resident in all terrestrial habitats	X[1a]	X (2006–2010)	X
Ash-throated Flycatcher	*Myiarchus cinerascens*	Fairly common transient in both spring and fall	X	X	X
Baird's Sandpiper	*Calidris bairdii*	Probably a rare early fall transient	X	X*	X
Bank Swallow	*Riparia riparia*	Occasional transient; may be most common in early fall		X*	X
Barn Owl	*Tyto alba*	Rare (at least rarely recorded) perennial visitor	X	X*	X
Barn Swallow	*Hirundo rustica*	Common transient and summer resident; uncommon in winter	X[1a]	X (2003–2010)	X
Belted Kingfisher	*Megaceryle alcyon*	Uncommon transient and winter visitor to all aquatic habitats	X	X	X
Bewick's Wren	*Thryomanes bewickii*	Irregular and occasional fall transient and rare winter visitor	X	X*	X
Black Oystercatcher	*Haematopus bachmani*	Uncommon resident	X		X
Black Phoebe	*Sayornis nigricans*	Common perennial resident in all habitats	X[1b]	X (2003–2010)	X

TABLE D5-6 (Continued)
BIRD SPECIES DOCUMENTED IN THE STUDY AREA

Common Name	Scientific Name	Ballona Valley Status Designationc	Source		
			SMBRC[a]	FWM[b]	Cooper[c]
Black Skimmer	*Rynchops niger*	Currently an irregularly uncommon mid-winter and spring visitor; rare at other times of year			X
Black Swift	*Cypseloides niger*	Probably a rare and irregular transient		X*	X
Black Turnstone	*Arenaria melanocephala*	Common transient and winter resident on jetties, breakwaters, and beach	X		X
Black-and-white Warbler	*Mniotilta varia*	—	X		
Black-bellied Plover	*Pluvialis squatarola*	Common nonbreeding resident, particularly in fall and winter	X	X	X
Black-crowned Night-Heron	*Nycticorax nycticorax*	Recent colonizer as a breeder; fairly common perennial resident	X[1b]	X	X
Black-headed Grosbeak	*Pheucticus melanocephalus*	Extirpated as breeder; now a fairly common transient; rare (irregular?) summer resident	X	X	X
Black-necked Stilt	*Himantopus mexicanus*	Reestablished as a common perennial resident and localized breeder away from the coast	X[1b]	X ('03,'07,'08, attempt '09,'10)	X
Blackpoll Warbler	*Setophaga striata*	Rare fall transient		X*	X
Black-throated Gray Warbler	*Setophaga nigrescens*	Uncommon transient and winter resident; more common in Westchester	X	X	X
Black-throated Sparrow	*Amphispiza bilineata*	Vagrant			X
Blue Grosbeak	*Passerina caerulea*	Uncommon transient; rare summer resident	X	X	X
Blue-gray Gnatcatcher	*Polioptila caerulea*	Common fall transient and fairly common winter resident	X	X	X
Blue-winged Teal	*Anas discors*	Uncommon perennial visitor	X	X	X
Bobolink	*Dolichonyx oryzivorus*	Rare transient	X	X*	X
Bonaparte's Gull	*Chroicocephalus ridibundus*	Currently an irregular common winter visitor and spring transient; rare in summer and fall	X	X	X
Brandt's Cormorant	*Phalacrocorax penicillatus*	Probably fairly common winder resident on breakwaters	X		X
Brant	*Branta bernicla*	Occasional spring transient; casual summer/ winter	X	X*	X
Brewer's Blackbird	*Euphagus cyanocephalus*	Uncommon and localized resident, more common in winter	X		X
Brewer's Sparrow	*Spizella breweri*	Probably a rare transient		X*	X
Brown Pelican	*Pelecanus occidentalis*	Abundant late summer, fall and winter resident	X	X*	X
Brown-headed Cowbird	*Molothrus ater*	Uncommon transient and summer visitor; rare in winter	X[2]	X (2007, 2010)	X
Bufflehead	*Bucephala albeola*	Common winter resident	X	X	X
Bullock's Oriole	*Icterus bullockii*	Uncommon summer resident and spring transient, rare in fall and winter	X[1a]	X	X

TABLE D5-6 (Continued)
BIRD SPECIES DOCUMENTED IN THE STUDY AREA

Common Name	Scientific Name	Ballona Valley Status Designationc	Source		
			SMBRC[a]	FWM[b]	Cooper[c]
Burrowing Owl	*Athene cunicularia*	Rare fall and winter visitor	X		X
Bushtit	*Psaltriparus minimus*	Common perennial resident	X[1a]	X (2006–2010)	X
Cackling Goose	*Branta hutchinsii*	Vagrant		X*	X
California Gnatcatcher	*Polioptila californica*	Extirpated; however, a couple individuals observed in Reserve in 2010-2011.	X		
California Gull	*Larus californicus*	Common winter resident and fall transient; fairly common spring transient; uncommon summer lingerer	X	X	X
California Quail	*Callipepla californica*	Extirpated as a breeding perennial resident		X*	X
California Thrasher	*Toxostoma redivivum*	Once considered extirpated, individual(s) detected in Ballona wetlands	X	X*	X
California Towhee	*Melozone crissalis*	Fairly common perennial resident in areas of scrub	X[1a]	X (2009–2010)	X
Canada Goose	*Branta canadensis*	Established breeding at FWM	X[1b]	X (2006–2010)	X
Canvasback	*Aythya valisineria*	Extirpated as winter resident		X	X
Caspian Tern	*Hydroprogne caspia*	Common spring transient, fairly common nonbreeding visitor in summer, and uncommon during fall and winter	X[3]	X	X
Cassin's Vireo	*Vireo cassinii*	Occasional spring transient; rare in fall		X	X
Cassin's Kingbird	*Tyrannus vociferans*	Uncommon resident; local breeder	X[2]	X	X
Cattle Egret	*Bubulcus ibis*	Occasional winter visitor and transient	X	X*	X
Cedar Waxwing	*Bombycilla cedrorum*	Uncommon and localized winter visitor and transient		X*	X
Chestnut-sided Warbler	*Setophaga pensylvanica*	Rare fall transient		X*	X
Chipping Sparrow	*Spizella passerina*	Uncommon transient	X	X	X
Cinnamon Teal	*Anas cyanoptera*	Extirpated as a breeder; winter resident	X[1b]	X (2008–2010)	X
Clark's Grebe	*Aechmophorus clarkii*	Probably an occasional winter visitor			X
Clay-colored Sparrow	*Spizella pallida*	Probably a rare fall transient		X*	X
Cliff Swallow	*Petrochelidon pyrrhonota*	Common spring transient and summer resident; uncommon fall transient	X	X	X
Common Gallinule (=Common Moorhen)	*Gallinula galeata* (=*Gallinula chloropus*)	Reestablished as an uncommon transient and winter visitor at FWM; recent breeding at FWM confirmed		X (2008–2010)	X
Common Goldeneye	*Bucephala clangula*	Occasional winter visitor and early spring transient		X	X

TABLE D5-6 (Continued)
BIRD SPECIES DOCUMENTED IN THE STUDY AREA

Common Name	Scientific Name	Ballona Valley Status Designationc	Source		
			SMBRC[a]	FWM[b]	Cooper[c]
Common Loon	*Gavia immer*	Fairly common winter resident and spring transient		X*	X
Common Poorwill	*Phalaenoptilus nuttallii*	Casual transient	X		X
Common Raven	*Corvus corax*	Fairly common perennial resident	X[1a]	X	X
Common Yellowthroat	*Geothlypis trichas*	Common perennial resident	X[1a]	X (2003–2010)	X
Cooper's Hawk	*Accipiter cooperii*	Fairly common fall transient and winter visitor; uncommon summer resident; local breeder in residential areas	X[1b]	X	X
Dark-eyed Junco ("Oregon")	*Junco hyemalis*	Uncommon winter resident	X	X*	X
Double-crested Cormorant	*Phalacrocorax auritus*	Common winter resident; breeding at Marina del Rey	X[1b]	X	X
Downy Woodpecker	*Picoides pubescens*	Occasional perennial visitor	X[3]	X	X
Dunlin	*Calidris alpina*	Uncommon winter visitor and spring transient	X	X*	X
Dusky Flycatcher	*Empidonax oberholseri*	Occasional transient	X	X	X
Eared Grebe	*Podiceps nigricollis*	Fairly common winter resident and transient	X	X	X
Eastern Phoebe	*Sayornis phoebe*	Individual at FWM (Cooper 2009)		X*	X
Elegant Tern	*Thalasseus elegans*	Common spring, summer and fall resident to the immediate coast and lower Ballona Creek	X	X*	X
Eurasian Collared-dove	*Streptopelia decaocto*	Currently a vagrant, but increasing regionally	X	X*	X
European Starling (Introduced)	*Sturnus vulgaris*	Common perennial resident, most numerous in summer and fall	X[1b]	X (2010)	X
Ferruginous Hawk	*Buteo regalis*	Casual winter visitor		X*	X
Forster's Tern	*Sterna forsteri*	Uncommon to fairly common perennial visitor along immediate coast	X	X	X
Fox Sparrow	*Passerella iliaca*	Uncommon (and localized) winter resident and occasional transient	X	X	X
Gadwall	*Anas strepera*	Winter resident; uncommon through summer	X[2]	X (2005–2010)	X
Glaucous-winged Gull	*Larus glaucescens*	Fairly common winter resident (generally seen near coast and along Ballona Creek)	X	X	X
Golden-crowned Kinglet	*Regulus satrapa*	Vagrant			X
Golden-crowned Sparrow	*Zonotrichia atricapilla*	Fairly common winter resident in native scrub	X	X	X
Grasshopper Sparrow	*Ammodramus savannarum*	Vagrant	X		X
Gray Flycatcher	*Empidonax wrightii*	Occasional transient and casual winter visitor		X*	X

TABLE D5-6 (Continued)
BIRD SPECIES DOCUMENTED IN THE STUDY AREA

Common Name	Scientific Name	Ballona Valley Status Designationc	Source		
			SMBRC[a]	FWM[b]	Cooper[c]
Great Blue Heron	*Ardea herodias*	Common breeding resident	X[1b]	X	X
Great Egret	*Ardea alba*	Fairly common transient and winter resident; uncommon summer resident	X[1b]	X	X
Great Horned Owl	*Bubo virginianus*	Rare perennial resident	X[1a]		X
Greater Scaup	*Aythya marila*	Uncommon winter resident; casual in summer		X	X
Greater White-fronted Goose*	*Anser albifrons*	Rare transient and winter visitor		X	X
Greater Yellowlegs	*Tringa melanoleuca*	Fairly common transient and winter resident	X	X	X
Great-tailed Grackle	*Quiscalus mexicanus*	Common in winter, spring, and summer; occasional in fall	X[3]	X (2003–2010)	X
Green Heron	*Butorides virescens*	Reestablished breeder; uncommon perennial resident	X	X (2005, 2008–2010)	X
Green-winged Teal	*Anas crecca*	Common fall transient and winter resident	X	X	X
Hammond's Flycatcher	*Empidonax hammondii*	Occasional spring transient throughout; probably rare fall transient	X	X	X
Heermann's Gull	*Larus heermanni*	Common in summer, fall and winter along immediate coast; uncommon in late winter and spring	X		X
Hermit Thrush	*Catharus guttatus*	Uncommon winter resident	X	X	X
Hermit Warbler	*Setophaga occidentalis*	Uncommon mid-spring transient, casual in fall and winter		X	X
Herring Gull	*Larus argentatus*	Uncommon winter visitor	X	X	X
Hooded Merganser	*Lophodytes cucullatus*	Occasional and irregular late fall and winter visitor		X	X
Hooded Oriole	*Icterus cucullatus*	Common spring and early summer resident	X[2]	X	X
Horned Grebe	*Podiceps auritus*	Uncommon winter resident		X*	X
House Finch	*Carpodacus mexicanus*	Common perennial resident	X[1a]	X (2006–2010)	X
House Sparrow (Introduced)	*Passer domesticus*	Common perennial resident	X[1a]	X	X
House Wren	*Troglodytes aedon*	Common fall transient, fairly common through winter; recent spring records	X[3]	X	X
Indigo Bunting	*Passerina cyanea*	Probably a casual transient and summer visitor			X
Killdeer	*Charadrius vociferus*	Common perennial resident	X[1a]	X (2004–2010)	X
Lark Sparrow	*Chondestes grammacus*	Occasional fall transient; rare in late winter and spring		X*	X
Lazuli Bunting	*Passerina amoena*	Uncommon transient; casual into summer	X	X	X

TABLE D5-6 (Continued)
BIRD SPECIES DOCUMENTED IN THE STUDY AREA

Common Name	Scientific Name	Ballona Valley Status Designationc	Source		
			SMBRC[a]	FWM[b]	Cooper[c]
Least Bell's Vireo	*Vireo bellii pusillus*	Confirmed breeding in riparian habitat on Reserve and FWM	X[1a]	X* (2010)	X
Least Bittern	*Ixobrychus exilis*	Rare and localized perennial visitor or resident; breeding at FWM		X (2005–2010)	X
Least Sandpiper	*Calidris minutilla*	Common transient and uncommon winter visitor	X	X	X
Least Tern	*Sternula antillarum*	Fairly common summer resident, with a large breeding colony on Venice Beach and forage widely	X[1b]	X	X
Lesser Goldfinch	*Spinus psaltria*	Fairly common perennial resident in residential Westchester; uncommon transient and winter visitor on the immediate coast	X[1a]	X (2006–2010)	X
Lesser Nighthawk	*Chordeiles acutipennis*	Rare transient		X*	X
Lesser Scaup	*Aythya affinis*	Common winter resident; casual in summer	X	X	X
Lesser Yellowlegs	*Tringa flavipes*	Rare transient and winter visitor		X*	X
Lincoln's Sparrow	*Melospiza lincolnii*	Common transient and fairly common winter resident	X	X	X
Little Blue Heron	*Egretta caerulea*	Vagrant		X*	X
Loggerhead Shrike	*Lanius ludovicianus*	Extirpated as a breeder; now an uncommon summer, fall and winter resident	X	X	X
Long-billed Curlew	*Numenius americanus*	Currently an occasional transient	X	X*	X
Long-billed Dowitcher	*Limnodromus scolopaceus*	Common winter resident and transient	X	X	X
Long-tailed Duck	*Clangula hyemalis*	Occasional winter visitor and rare spring transient in salt water			X
MacGillivray's Warbler	*Geothlypis tolmiei*	Occasional transient		X	X
Mallard	*Anas platyrhynchos*	Common perennial resident	X[1a]	X (2003–2010)	X
Mandarin Duck (Introduced)	*Aix galericulata*	—	X	X	
Marbled Godwit	*Limosa fedoa*	Common transient and winter resident on immediate coast	X	X*	X
Marsh Wren	*Cistothorus palustris*	Fairly common fall transient and winter resident	X	X	X
Merlin	*Falco columbarius*	Uncommon transient and winter visitor	X	X	X
Mew Gull	*Larus canus*	Uncommon winter visitor	X	X	X
Mourning Dove	*Zenaida macroura*	Common perennial resident	X[1a]	X (2003–2010)	X
Mute Swan (Introduced)	*Cygnus olor*	—		X*	
Nashville Warbler	*Oreothypis ruficapilla*	Fairly common spring and uncommon fall migrant	X	X	X

TABLE D5-6 (Continued)
BIRD SPECIES DOCUMENTED IN THE STUDY AREA

Common Name	Scientific Name	Ballona Valley Status Designationc	Source		
			SMBRC[a]	FWM[b]	Cooper[c]
Northern Flicker	*Colaptes auratus*	Common fall and early spring transient; fairly common through winter; extirpated as a breeder	X	X	X
Northern Harrier	*Circus cyaneus*	Extirpated as a breeding perennial resident; now occasional fall/winter visitor w/ few overwintering	X	X	X
Northern Mockingbird	*Mimus polyglottos*	Common perennial resident	X[1a]	X (2006–2010)	X
Northern Parula	*Setophaga americana*	Single male reported (Cooper 2009)		X*	X
Northern Pintail	*Anas acuta*	Uncommon in migration and winter		X	X
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	Common spring transient; fairly common summer resident and early fall transient; casual in winter	X[1a]	X	X
Northern Shoveler	*Anas clypeata*	Common in fall and winter at FWM; uncommon to rare elsewhere	X	X	X
Northern Waterthrush	*Parkesia noveboracensis*	Rare transient		X*	X
Nutmeg Mannikin (Introduced)	*Lonchura punctulata*	Three individuals reported (Cooper 2008)		X	X
Nuttall's Woodpecker	*Picoides nuttallii*	Occasional fall and winter visitor; uncommon year round in residential Westchester	X	X*	X
Olive-sided Flycatcher	*Contopus cooperi*	Occasional transient		X	X
Orange Bishop (Introduced)	*Euplectes franciscanus*	Currently a fairly common spring, summer and fall resident within a small area near the FWM; occasional elsewhere	X[2]	X	X
Orange-crowned Warbler	*Oreothlypis celata*	Common transient and uncommon winter resident	X[2]	X (suspected 2010)	X
Osprey	*Pandion haliaetus*	Uncommon fall transient; rare visitor at all times of the year	X	X	X
Pacific Loon	*Gavia pacifica*	Uncommon winter resident and spring transient		X*	X
Pacific-slope Flycatcher	*Empidonax difficilis*	Fairly common transient; potential breeder	X	X	X
Palm Warbler	*Setophaga palmarum*	Occasional late fall transient; rare winter visitor and spring transient	X	X*	X
Pectoral Sandpiper	*Calidris melanotos*	Probably a rare fall transient		X*	X
Peregrine Falcon	*Falco peregrinus*	Uncommon transient and winter visitor; since 2003 singles have been present mid-summer through winter	X	X	X
Phainopepla	*Phainopepla nitens*	Casual transient		X*	X
Pied-billed Grebe	*Podilymbus podiceps*	Colonized as a breeder	X[1b]	X (2003–2010)	X

TABLE D5-6 (Continued)
BIRD SPECIES DOCUMENTED IN THE STUDY AREA

Common Name	Scientific Name	Ballona Valley Status Designationc	Source		
			SMBRC[a]	FWM[b]	Cooper[c]
Prothonotary Warbler	*Protonotaria citrea*	Vagrant (Cooper 2008)		X*	X
Purple Martin	*Progne subis*	Probably a rare transient	X	X*	X
Red Knot	*Calidris canutus*	Occasional fall transient and winter visitor; rare in spring			X
Red-breasted Merganser	*Mergus serrator*	Fairly common winter resident and rare transient; casual in summer	X	X*	X
Red-breasted Nuthatch	*Sitta canadensis*	Probably a rare, irregular fall and winter visitor during "invasion years"			X
Redhead	*Aythya americana*	Uncommon in fall and winter		X	X
Red-necked Phalarope	*Phalaropus lobatus*	Uncommon early fall and spring; most common in August		X	X
Red-shouldered Hawk	*Buteo lineatus*	Occasional transient and winter visitor	X	X	X
Red-tailed Hawk	*Buteo jamaicensis*	Common and conspicuous resident	X[1a]	X	X
Red-throated Loon	*Gavia stellata*	Uncommon spring transient	X	X*	X
Red-throated Pipit	*Anthus cervinus*	Vagrant		X*	X
Red-winged Blackbird	*Agelaius phoeniceus*	Common spring, summer and winter resident; breeding	X[2]	X (2003–2010)	X
Ring-billed Gull	*Larus delawarensis*	Common winter resident and fall transient; fairly common spring transient; uncommon summer lingerer	X	X	X
Ring-necked Duck	*Aythya collaris*	Uncommon		X	X
Rock Pigeon (Introduced)	*Columba livia*	Common perennial resident throughout	X[1b]	X	X
Royal Tern	*Thalasseus maximus*	Uncommon fall, winter and spring visitor to immediate coast and lower Ballona Creek	X		X
Ruby-crowned Kinglet	*Regulus calendula*	Fairly common winter resident	X	X	X
Ruddy Duck	*Oxyura jamaicensis*	Fairly common breeding resident	X[1b]	X (2003–2010)	X
Ruddy Turnstone	*Arenaria interpres*	Common transient and winter resident on jetties, break water, and beach	X		X
Rufous Hummingbird	*Selasphorus rufus*	Rare (or rarely-identified) spring transient and casual winter visitor		X*	X
Sage Thrasher	*Oreoscoptes montanus*	Probably a rare fall transient		X*	X
Sanderling	*Calidris alba*	Common transient and winter resident; generally found on the wet sand of beach	X	X*	X
Savannah Sparrow ("Belding's")	*Passerculus sandwichensis beldingi*	Fairly common perennial resident almost exclusively in and adjacent to *Salicornia*-dominated wetlands	X[1a]		X

TABLE D5-6 (Continued)
BIRD SPECIES DOCUMENTED IN THE STUDY AREA

Common Name	Scientific Name	Ballona Valley Status Designationc	Source		
			SMBRC[a]	FWM[b]	Cooper[c]
Savannah Sparrow ("Large-billed")	*Passerculus sandwichensis rostratus*	Rare and highly localized fall and winter visitor; found at Ballona Creek jetty			X
Savannah Sparrow (other ssp)	*Passerculus sandwichensis ssp*	Common transient and winter resident	X	X	X
Say's Phoebe	*Sayornis saya*	Common fall transient and winter resident; rare through summer	X[1b]	X	X
Semipalmated Plover	*Charadrius semipalmatus*	Probably a rare fall transient	X	X	X
Sharp-shinned Hawk	*Accipiter striatus*	Uncommon winter resident	X	X	X
Short-billed Dowitcher	*Limnodromus griseus*	Fairly common transient		X	X
Short-eared Owl	*Asio flammeus*	Currently a casual transient		X*	X
Snow Goose	*Chen caerulescens*	Casual winter visitor and transient; extirpated as a winter resident			X
Snowy Egret	*Egretta thula*	Fairly common perennial resident	X[1b]	X	X
Solitary Sandpiper	*Tringa solitaria*	Probably an occasional fall transient	X	X*	X
Song Sparrow	*Melospiza melodia*	Common perennial resident in riparian and emergent marsh vegetation and Westchester Bluffs; uncommon transient and winter visitor	X[1a]	X (2003–2010)	X
Sora	*Porzana carolina*	Reestablished as a fairly common transient and winter resident at FWM	X	X	X
Spotted Sandpiper	*Actitis macularius*	Fairly common transient and uncommon winter visitor	X	X	X
Spotted Towhee	*Pipilo maculatus*	Uncommon and localized transient and winter visitor; occasional in spring and summer	X	X*	X
Surf Scoter	*Melanitta perspicillata*	Common winter resident and spring transient; casual in summer	X		X
Surfbird	*Aphriza virgata*	Fairly common spring transient and winter resident on jetties and breakwater	X		X
Swainson's Thrush	*Catharus ustulatus*	Probably an occasional late spring transient	X	X	X
Swamp Sparrow	*Melospiza georgiana*	Occasional winter visitor and transient		X*	X
Thayer's Gull	*Larus thayeri*	Uncommon winter visitor	X		X
Townsend's Warbler	*Setophaga townsendi*	Fairly common spring and uncommon fall transient and winter resident;	X	X	X
Tree Swallow	*Tachycineta bicolor*	Fairly common transient and uncommon winter visitor; local breeder	X[1a]	X (2004–2010)	X
Tricolored Blackbird	*Agelaius tricolor*	Aside from regular wintering flock in vicinity of Westchester Park, only a casual visitor		X*	X
Tropical Kingbird	*Tyrannus melancholicus*	Probably a casual fall visitor		X*	X
Tundra Swan	*Cygnus columbianus*	Vagrant		X*	X

TABLE D5-6 (Continued)
BIRD SPECIES DOCUMENTED IN THE STUDY AREA

Common Name	Scientific Name	Ballona Valley Status Designationc	Source		
			SMBRC[a]	FWM[b]	Cooper[c]
Turkey Vulture	*Cathartes aura*	Uncommon transient	X	X	X
Vaux's Swift	*Chaetura vauxi*	Uncommon transient; occurring both in spring and fall; occasionally in large numbers	X	X	X
Vermilion Flycatcher	*Pyrocephalus rubinus*	Vagrant	X	X	X
Vesper Sparrow	*Pooecetes gramineus*	Occasional fall transient	X	X*	X
Violet-green Swallow	*Tachycineta thalassina*	Rare spring transient	X	X	X
Virginia Rail	*Rallus limicola*	Reestablished as an uncommon transient and rare winter visitor at FWM; more recently breeding confirmed at FWM	X	X (2009–2010)	X
Virginia's Warbler	*Oreothypis virginiae*	Rare fall transient		X	X
Wandering Tattler	*Tringa incana*	Uncommon winter visitor and transient, but present in small numbers practically year round	X		X
Warbling Vireo	*Vireo gilvus*	Fairly common spring transient, less common in fall		X	X
Western Grebe	*Aechmophorus occidentalis*	Common winter resident; rare in summer	X	X	
Western Gull	*Larus occidentalis*	Common summer, fall and winter resident in all aquatic habitats; fairly common in spring	X	X	X
Western Kingbird	*Tyrannus verticalis*	Common transient in both spring and fall; local breeder	X	X	X
Western Meadowlark	*Sturnella neglecta*	Common (but probably declining) winter resident, uncommon through summer	X[2]	X	X
Western Sandpiper	*Calidris mauri*	Common transient and uncommon winter visitor	X	X	X
Western Scrub-Jay	*Aphelocoma californica*	Fairly common perennial resident	X		X
Western Tanager	*Piranga ludoviciana*	Fairly common transient; casual winter visitor		X	X
Western Wood-Pewee	*Contopus sordidulus*	Occasional transient	X	X	X
Whimbrel	*Numenius phaeopus*	Common nonbreeding resident in saltwater habitats, with small numbers lingering through June along beach	X	X	X
White-crowned Sparrow	*Zonotrichia leucophrys*	Common winter resident and rare spring transient	X	X	X
White-faced Ibis	*Plegadis chihi*	Uncommon fall transient; occasional in spring	X	X	X
White-tailed Kite	*Elanus leucurus*	Fairly common nonbreeding resident from mid-summer to mid-winter; casual in spring	X[1b]	X	X
White-throated Sparrow	*Zonotrichia albicollis*	Probably a rare fall transient and winter visitor		X*	X
White-throated Swift	*Aeronautes saxatalis*	Irregularly common winter visitor; occasional at best in late summer and fall	X[3]	X	X
White-winged Dove	*Zenaida asiatica*	Rare fall transient		X*	X

TABLE D5-6 (Continued)
BIRD SPECIES DOCUMENTED IN THE STUDY AREA

Common Name	Scientific Name	Ballona Valley Status Designationc	Source		
			SMBRC[a]	FWM[b]	Cooper[c]
Willet	*Tringa semipalmata*	Common nonbreeding resident, primarily in saltwater habitats	X	X	X
Willow Flycatcher	*Empidonax traillii*	Fairly common transient	X	X	X
Wilson's Phalarope	*Phalaropus tricolor*	Uncommon and irregular early fall transient; rare spring transient		X	X
Wilson's Snipe	*Gallinago delicata*	Uncommon transient and winter resident in both fresh and salt marsh; most frequently seen in winter	X	X	X
Wilson's Warbler	*Cardellina pusilla*	Common spring and uncommon fall transient; rare winter visitor	X	X	X
Wood Duck	*Aix sponsa*	Rare visitor		X*	
Wrentit	*Chamaea fasciata*	Once considered extirpated, individual(s) recently detected in Ballona wetland	X		X
Yellow Warbler	*Setophaga petechia*	Common transient both in spring and fall; occasionally into early winter	X	X	X
Yellow-breasted Chat	*Icteria virens*	Rare transient; extirpated as a breeder	X	X	X
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	Extirpated as a winter resident; now fairly common spring and rare fall transient at FWM		X	X
Yellow-rumped (Audubon) Warbler	*Setophaga coronata* ssp *auduboni*	Common winter resident and transient	X	X	X
Yellow-rumped (Myrtle) Warbler	*Setophaga coronata* ssp *coronata*	Uncommon winter visitor	X	X	X

NOTES: Species listed above include: "Common" (expected on every visit in season and hard to miss); "Fairly common" (expected in smaller numbers at proper season in ideal habitat); "Uncommon" (seen in season in small numbers, but somewhat unpredictable and often missed); "Occasional" (occurs annually, but typically in very low numbers so not regularly detected; and "Rare" (less than annual, but with an established pattern of occurrence, either seasonally). Unless reported by Johnston et al. (2011, 2012) and/or Read and Strecker (2010) or a Los Angeles County sensitive bird survey, species not included above include: "Casual" (irregular and never expected, with records every 10 years or so); "Vagrant" (one or two records total; unlikely to occur again); and "Extirpated" (species, or seasonal populations, that once occurred locally but no longer do).

[a] Santa Monica Bay Restoration Commission (Johnston et al. 2011, 2012). Superscript codes for this column refer to the following breeding categories (highest potential of breeding reported during the two survey periods used in table above):

- **Category 1a:** Nesting confirmed
- **Category 1b:** Breeding activity observed during survey, but actual nesting was adjacent to Reserve/lower Ballona Creek.
- **Category 2:** Potential breeding activity observed at Reserve/lower Ballona Creek during survey; e.g., paired and/or territorial birds during breeding season in suitable habitat, or family groups (including young capable of flight) appearing mid-season.
- **Category 3:** Sporadic occurrence of adult birds during breeding season, but with no direct evidence of breeding on or adjacent to site. This category is reserved for species known to breed in region, and not for over-summering, obviously nonbreeding individuals (including certain waterfowl, shorebirds) that might linger or pass through during spring/summer.

[b] Freshwater marsh (Read, E. and Strecker E. 2010). Unusual species observed in the Ballona freshwater marsh are marked with an asterisk (*).

[c] Dan Cooper (Cooper 2006: *Annotated Checklist of Birds of Ballona Valley, Los Angeles County, California*; and Cooper 2006, 2007, 2008, 2009: Addendums to Checklist).

TABLE D5-7
MAMMAL SPECIES DOCUMENTED AS OCCURRING IN THE STUDY AREA

Common Name	Scientific Name	Reference	Report Year
Black Rat	*Rattus rattus*	Impact Sciences	1996
Botta's pocket gopher	*Thomomys bottae*	Zedler Impact Sciences Psomas Johnston et al. Johnston et al.	1965 1996 2001 2011 2012
California Ground Squirrel	*Spermophilus beecheyi*	Zedler Psomas Johnston et al. Johnston et al.	1965 2001 2011 2012
Coyote	*Canis latrans*	E. Read email Johnston et al. Johnston et al.	2005 2011 2012
Desert Cottontail	*Sylvilagus audubonii*	Zedler Impact Sciences Johnston et al. Johnston et al.	1965 1996 2011 2012
Domestic Cat	*Felis cattus*	Zedler Impact Sciences Johnston et al. Johnston et al.	1965 1996 2011 2012
Domestic Dog	*Canis familiaris*	Friesen et al. Impact Sciences Johnston et al. Johnston et al.	1981 1996 2011 2012
Eastern Fox Squirrel	*Sciurus niger*	Johnston et al. Johnston et al.	2011 2012
Gray Fox	*Urocyon cinereoargenteus californicus*	Zedler	1965
House Mouse	*Mus musculus*	Zedler Friesen et al. Hovore Impact Sciences Psomas Johnston et al.	1965 1981 1991 1996 2001 2011
Norway Rat	*Rattus norvegicus*	Friesen et al. Impact Sciences	1981 1996
Raccoon	*Procyon lotor psora*	Friesen et al. Hovore Johnston et al. Johnston et al.	1981 1991 2011 2012
Rat Species	*Rattus sp*	Johnston et al. Johnston et al.	2011 2012
Red Fox	*Vulpes vulpes*	Hovore Impact Sciences	1991 1996
Southern California Salt Marsh Shrew	*Sorex ornatus salicornicus*	Zedler Friesen et al. Hovore	1965 1981 1991
San Diego Black-tailed Jackrabbit	*Lepus californicus bennetti*	Zedler Friesen et al.	1965 1981

TABLE D5-7 (Continued)
MAMMAL SPECIES DOCUMENTED AS OCCURRING IN THE STUDY AREA

Common Name	Scientific Name	Reference	Report Year
South Coast Marsh Vole	*Microtus californicus stephensi*	Zedler Friesen et al. Hovore Impact Sciences Psomas Johnston et al. Johnston et al.	1965 1981 1991 1996 2001 2011 2012
Striped Skunk	*Mephitis mephitis*	Zedler Impact Sciences Johnston et al. Johnston et al.	1965 1996 2011 2012
Virginia Opossum	*Didelphis virginiana*	Friesen et al. Hovore Impact Sciences Johnston et al. Johnston et al.	1981 1991 1996 2011 2012
Western Harvest Mouse	*Reithrodontomys megalotis*	Zedler Hovore Impact Sciences Psomas Johnston et al. Johnston et al.	1965 1991 1996 2001 2011 2012

SOURCE: Modified from PWA 2006a to include an earlier study reported by Zedler, J. B. 1982 and Johnston et al. 2011, 2012 survey results.[6]

[6] Modified from PWA 2006a to include an earlier study reported by Zedler, J. B. 1982 and Johnston et al. 2011, 2012 survey results

TABLE D5-8
SPECIAL-STATUS NATURAL VEGETATION COMMUNITIES ON THE STUDY SITE

CNDDB (2014)	=	WRA (2015)	CDFW (Sawyer et al. 2009)	State Ranking	Subset Acres	Total Acres
South Mud Intertidal	=	Mudflat	N/A	S3.2	N/A	3.39
Southern Coastal Salt Marsh	=	Muted-Tidal Wetland and Subset of Non-Tidal Wetland (includes areas dominated or co-dominated by pickleweed)	N/A	S2.1	17.21	18.23
			Arthrocnemum subterminale alliance[a]	S2	1.02	
Coastal brackish marsh	=	Brackish marsh	N/A	S2.1	5.37	6.51
			Anemopsis californica alliance[a]	S2?	0.10	
			Bolboschoenus maritimus alliance[a]	S3	0.80	
			Elymus (=Leymus) triticoides alliance[a]	S3	0.07	
			Schoenoplectus americanus alliance[a]	S3	0.17	
		Nontidal Saltmarsh	Arthrocnemum subterminale alliance[a]	S2	0.56	1.38
			Elymus (=Leymus) triticoides alliance[a]	S3	0.03	
			Frankenia salina alliance[a]	S3	0.79	
		Ruderal Marsh	Frankenia salina alliance[a]	S3	N/A	0.01
Mule fat scrub	=	Subsets of Riparian Scrub and Woodland	Baccharis salicifolia—annual grass	S4	0.12	5.96
			Baccharis salicifolia alliance		5.84	
Southern Riparian Scrub	=	Subsets of Riparian Scrub and Woodland	Salix exigua—Baccharis salicifolia	S3.2	0.12	0.44
			Salix exigua alliance		0.32	
Southern Willow Scrub	=	Subset of Willow Thickets (includes area along former stream channel)	Salix lasiolepsis alliance	S2.1	N/A	8.84
Riversidean Upland Sage Scrub	=	Upland Scrub	N/A	S3.1	41.85	41.91
			Rhus integrifolia alliance[a]	S3	0.06	
Southern Dune Scrub	=	Stabilized Dune	N/A	S1.1	6.69	10.65
			Encelia californica—Artemisia californica association[a]	S3	0.89	
			Elymus (=Leymus) triticoides alliance[a]	S3	0.24	
			Lupinus chamissonis—Ericameria ericoides alliance[a]	S3	0.04	
			Lupinus chamissonis association[a]	S3	2.79	
Total					***85.08***	***97.32***

NOTES: The CNDDB uses the same ranking methodology originally developed by The Nature Conservancy and now maintained and recently revised by NatureServe. The *state rank* (S-rank) refers to the imperilment status only within California's state boundaries. It is a reflection of the overall status of an element through its state range. The state rank represent a letter + number score that reflects a combination of *Rarity*, *Threat*, and *Trend* factors, with weighting being heavier on *Rarity* than the other two.

S1 Critically Imperiled: Critically imperiled in the state because of extreme rarity (often five or fewer populations) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state.
S2 Imperiled: Imperiled in the state because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the state.
S3 Vulnerable: Vulnerable in the state due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation from the state.
S4 Apparently Secure: Uncommon but not rare in the state; some cause for long-term concern due to declines or other factors.
S5 Secure: Common, widespread, and abundant in the state.
SH All sites are historical; the element has not been seen for at least 20 years, but suitable habitat still exists.
SX All sites are extirpated.

Uncertainty about the rank of an element is expressed in two major ways:
- By expressing the ranks as a range of values: e.g., S2S3 means the rank is somewhere between S2 and S3.
- By adding a ? to the rank: e.g., S2? This represents more certainty than S2S3, but less certainty than S2.

[a] CDFW 2010: Special-Status Natural Vegetation Community.

SOURCE: ICF International, 2014.

TABLE D5-9
SUMMARY OF GLA HABITAT ASSESSMENT FOR RIVERSIDE AND SAN DIEGO FAIRY SHRIMP

	Riverside Fairy Shrimp			San Diego Fairy Shrimp	
	Ponding depth at least 12 inches	**Ponding Duration at least 60 days**	**Specific Conductance of less than 1,000 µMhos**	**Ponding duration at least 16 Day**	**Specific Conductance of less than 1,000 µMhos**
Requisite	Requisite(s) Not Present			Requisite(s) Not Present	
Area A					
A-1	X	X	X		X
A-2	X	X	X		X
A-3			X		X
A-4	X	X	X		X
A-5 to A-11	X	X	X		X
A-12	X	X	X		X
A-13			X		X
A-14			X		X
Area B					
B-1	X	X	X		X
B-2	X	X	X		X
B-3	X	X	X		X
B-4	X	X	X		X
B-5		X	X		X
B-6	X	X	X		X
B-7	X	X	X		X
B-8	X	X	X		X
B-9	X	X	X		X
B-10*	N/A	N/A	X	N/A	X
Area C					
C-1		X	X		X
C-2		X	X		X

NOTES:

µMhos = micromhos per centimeter

* B-10 receives nearly constant nuisance flows from development and remains wet for most of the year, meaning the depression is unsuitable for either species due to the long-term wetness.

SOURCE: Summarized by ICF International based on Glen Lukos Associates 2000 habitat assessment for Riverside and San Diego fairy shrimp.

TABLE D5-10
RESULTS OF SURVEYS FOR BELDING'S SAVANNAH SPARROW AT PLAYA VISTA, 1977 TO 2010

Study Year(s)	# Pairs Area B	# Pairs Area A	Surveys Conducted By
1977	37 pairs	No data	Massey 1977
1979	21	18	Dock and Schreiber 1981
1980	18	10	Dock and Schreiber 1981
1981	13	10-13	Dock and Schreiber 1981
1982–1985	No data	No data	—
1986	32	No data	Zembal et al. 1988
1987	30	5	Massey 1987
1988	No data	No data	—
1989	31	0	White 1989
1990	11-12	0	Corey and Massey 1990
1991	1 to 30 throughout the year	0 breeding; up to 7 Oct. to Feb.	Corey 1991
1992–1993	No data	No data	—
1994	10	0	Lockhart 1994
1995	21	0	Keane Biological Consulting 1996
1996	37	0	John Konecny, USFWS
1997	No surveys	No surveys	No surveys
1998	12 to 13	0	Keane Biological Consulting 1998
1999	No surveys	No surveys	—
2000	No surveys	No surveys	—
2001	13 to 15	0	Keane Biological Consulting 2001
2002	No surveys	No surveys	—
2003	No surveys	No surveys	Keane Biological Consulting 2004
2004	12	No surveys	Keane Biological Consulting 2004b
2005	11	No surveys	Keane Biological Consulting 2005
2007	12	No Surveys	Keane Biological Consulting 2007
2008	14	No Surveys	Keane Biological Consulting 2008
2009	22	No Survey	Keane Biological Consulting 2009
2010	20 territories	No territories, but two birds noted	Cooper 2010

SOURCE: PWA 2006[7] and Cooper 2010[8](reproduced from PWA 2006[9]; modified to include KBC 2009[10] and Cooper 2010[11])

7 PWA 2006
8 Cooper 2010
9 PWA 2006
10 KBC 2009
11 Cooper 2010

TABLE D5-11
HISTORY OF CALIFORNIA LEAST TERN NESTING IN THE VICINITY OF BALLONA WETLANDS, 1973–2014

Study Year(s)	Nesting Location	Number of Nesting Pairs	Number of Fledglings
1973–1976	Salt flats Area B	10–22	not recorded
1977	Venice Beach	35	30+
1977	Beethoven Street Fill	3	None
1978	Salt flats Area B	25–30	30
1978	Venice Beach	60–75	75
1979	Salt flats Area B	18–25	25
1979	Venice Beach	80–95	140
1980	Salt flats Area B	+	0
1980	Venice Beach	150–165	240
1981	Salt flats Area B	16	0
1981	Venice Beach	140–160	195
1982–1996	Salt flats Area B	0	0
1982–2005	Venice Beach[a]	82 to over 300	60 to over 300
2007	Venice Beach	449–453	414–440
2008	Venice Beach	460–698	296 in second nesting attempt (100% failure due to American crow predation of the first nesting attempt)
2009	Venice Beach	295	100% failure due to American crow predation
2010	Venice Beach	148–164	100% failure due to American crow predation
2011	Venice Beach	14–21	100% failure due to American crow predation
2014	Salt flats Area B	9	100% failure due to American crow predation
2014	Venice Beach	9+	9+

NOTE:
[a] One pair of least terns nested at Area B in 2001, but the nest was unsuccessful (KBC 2001[12])

SOURCE: PWA 2006[13] and Marschalek 007-2011[14] (modified from PWA 2006[15] to include Marschalek 2007–2011[16]); Richard Brody, pers. Comm. 2014

12 KBC 2001
13 PWA 2006
14 Marschalek 007-2011
15 PWA 2006
16 Marschalek 2007–2011

APPENDIX D6
Terrestrial Invertebrate Studies

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Summary of Terrestrial Invertebrate Studies in the Study Area (1981 to 2011)

The following summarizes the results of terrestrial invertebrate studies performed in the study area between 1981 and 2013. Table D6-1 provides a summary of the benthic invertebrate studies conducted in the study area. This table is then followed by a summary of the survey results.

Table D6-1. Summary of Terrestrial Invertebrate Studies in the Study Area (modified from PWA 2006a to include later studies reported by Johnston et al. 2011, 2012 and Psomos 2013).

Year	Author	Geographic Extent	Description
1981	Nagano et al.	Areas A and B	Baseline report on insects and related terrestrial arthropods for The Biota of the Ballona Region
1991	Boland and Zedler	Area B	Fish and invertebrate research sponsored by the National Audubon Society
1991	Mattoni	Area B	Terrestrial arthropod survey for Playa Vista Environmental Impact Report (EIR)
1996	Hawks Biological Consulting	Areas A, B, C and D*	Sensitive insect survey for Impact Sciences
2000	Sapphos Environmental Inc	Area B	Survey of El Segundo blue butterfly for Psomas and USFWS
2007	Arnold 2007	Area B	Habitat assessment for special-status species
2008	Friends of Ballona	Area B	Walking butterfly surveys
2009	Friends of Ballona	Area B	Walking butterfly surveys
2010	Friends of Ballona	Area B	Walking butterfly surveys
2009-2010	Johnston et al. 2011	Areas A, B, C	Year 1 Baseline Assessment Program
2011	Friends of Ballona	Area B	Walking butterfly surveys
2011	Cooper 2011	Area B	Incidental observation
2010-2011	Johnston et al. 2011	Areas A, B, C	Year 2 Baseline Assessment Program
2013	Psomos	Area B	Survey of El Segundo blue butterfly

* = Area D, located east of Lincoln Boulevard, was considered part of the Ballona Wetlands until the late 1990s, when a residential development project was constructed there. Thus, Area D is not currently part of the Ballona Wetlands evaluated for the Conceptual Restoration Plan.

Nagano et al. (1981)

Nagano et al. conducted the most comprehensive terrestrial invertebrate survey of the Reserve to date. The goal of the survey was to collect and catalogue the terrestrial invertebrates of the Reserve. The survey methods included nets, traps, soil sifting and berlese funnels. The greatest arthropod diversity was in the sand dunes of Area B. The brackish and freshwater marshes were extensively sampled, but less diverse. The coastal sage and bluff habitats were not sampled (Johnston et al. 2011).

Mattoni (1991)

Mattoni conducted surveys in Area B, tracing a continuous survey transect through all the habitat types present. Observed butterflies, dayflying moths, dragonflies, beeflies, robber flies, other large flies and obvious bee and wasp species were recorded. In addition, pitfall traps and targeted surveys (for certain tiger beetles and several flies) were used. Species distribution was found to be highly nonrandom (Johnston et al. 2011). Figure D6-1 depicts sample areas for this study.

Boland and Zedler (1991)

Boland and Zedler conducted terrestrial invertebrate surveys of Area B from March through November 1990 as part of a broad ecology study sponsored by the National Audubon Society. The terrestrial invertebrates were sampled using pan traps. Five habitats were surveyed for terrestrial invertebrates: western salt marshes, central salt marshes, eastern salt marshes, salt pans, and old agricultural fields. The contents of the traps were identified to family. Large invertebrates were sampled using circular quadrats, and large animals (primarily snails) were counted. Pitfall traps were found to be dominated by amphipods, spiders, and insects (*Collembola, Diptera, Homoptera*, and *Hymenoptera*), with higher numbers of invertebrates found in the wet pickleweed sites than in the dry pickleweed sites. The nonnative milk snail (*Otala lacteal*) was common throughout the study area, reaching a peak density of approximately one individual/m^2 (Johnston et al. 2011). Figure D6-1 depicts sample areas for this study.

Hawks Biological Consulting (HBC) (1996)

Hawks Biological Consulting (HBC) conducted special interest insect species and habitat surveys in Areas A, B, C, and D, though they focused their efforts in the dune habitat of Area B with 20 pitfall traps. Additional field survey techniques included: walks (collection and observation), beating sheets, sweep nets, and an aspirator. Sixteen insect orders were collected from Areas A, B, and C. HBC also found three unlisted species of interest: the western mudflat tiger beetle (*Cicindela trifasciata sigmoidea*), two undescribed species of Jerusalem cricket (*Stenopelmatus* new species), and one undescribed species of sand roach (*Arenivage* new species) (Johnston et al. 2011). Figure D6-1 depicts sample areas for this study.

Sapphos Environmental Inc. (2000)

Sapphos Environmental Inc. assessed habitats for the El Segundo blue butterfly (*Euphilotes battoides allyni*) in October and November 2000 by walking belt-transects to identify areas that could support native coastal dune vegetation. No suitable habitat for the El Segundo blue butterfly was identified in Areas A, C, and D while a portion of Area B [identified as suitable habitat by the United States Fish and Wildlife Service (USFWS 1998 and 2008)] was confirmed as suitable by Sapphos Environmental Inc (Johnston et al. 2011).



Figure D6-1 depicts survey sites from previous reports: Boland and Zedler 1991 (blue), Mattoni 1991 (green), and HBC 1996 (pink) (reproduced from Johnston et al. 2011).

Arnold (2007)

Walking surveys were conducted in the Ballona Outdoor Learning and Discovery (BOLD) southwestern portion of Area B to assess habitat suitability for special status species. The survey concluded that the wandering skipper and mudflat tiger beetle have the greatest likelihood of using the BOLD project area. A single adult wandering skipper was observed at the BOLD site, along with small cabbage white butterfly larva *(Pieris rapae*), buckeye butterfly (*Junonia coenia*), Argentine ant, honey bee (*Apis mellifera*), and an unidentified species of ground-nesting bee. The cabbage white butterfly, Argentine ant, and honey bee are nonnative species (Johnston et al. 2011).

The Friend of Ballona Wetlands (2008-2011)

Walking surveys for butterflies conducted by the Friends of Ballona Wetlands (FBW) found 13 species in 2008, seven species in 2009, 18 species in 2010, and 15 species in 2011 in the salt marsh in the western portion of Area B in July of each year; four additional species were found in habitats adjacent to the salt marsh. The FBW recorded the presence of one of the special status butterflies, the wandering skipper (Johnston et al. 2011).

Johnston et al. (2009-2010)

Between 2009 and 2010, Johnston et al. conducted terrestrial invertebrate surveys for the Baseline Assessment Program (BAP) on the Reserve. The objective for the first year of the BAP invertebrate assessment was to extrapolate aerial arthropod productivity (as biomass) using length-fresh weight regressions for each habitat. Results showed the brackish marsh habitat had the lowest average total aerial arthropod productivity at 3.50 ± 0.59 mg/m^2/day). The high salt marsh had approximately twice the productivity of the brackish marsh, at 7.14 ± 1.37 mg/m2/day, but approximately half of the total average productivity of the low salt marsh, mid salt marsh, and salt pan habitats (14.9 ± 3.96, 14.9 ± 3.07, and 14.7 ± 4.12 mg/m^2/day, respectively), which all expressed similar productivity results. The upland grassland had the highest aerial arthropod productivity and the highest level of variability between transects at 29.0 ± 11.1 mg/m^2/day. In addition to the aerial arthropod surveys, ancillary observations of the nonnative milk snail (*Otala lacteal*) were common throughout the Reserve, especially on nonnative and upland vegetation. The snail was not surveyed quantitatively but was noted during sampling events. Finally, several terrestrial invertebrates were observed as incidental catch during the herpetofauna pitfall surveys. Individuals of the beetles (Order: Coleoptera) and other invertebrates were not collected at this time, and therefore were not taxonomically identified to species or retained as voucher specimens. No special status species were identified on the aerial arthropod surveys; however, species-level taxonomic classifications were not conducted for the purposes of these surveys. Monarch butterfly presence was confirmed on 11 October 2010 during tree surveys in Area B, south of Culver Boulevard. Additionally, ancillary observations of the wandering skipper were visually confirmed in the lower marsh habitat of western Area B during vegetation surveys. Figure D6-2 depicts sample areas for this study.

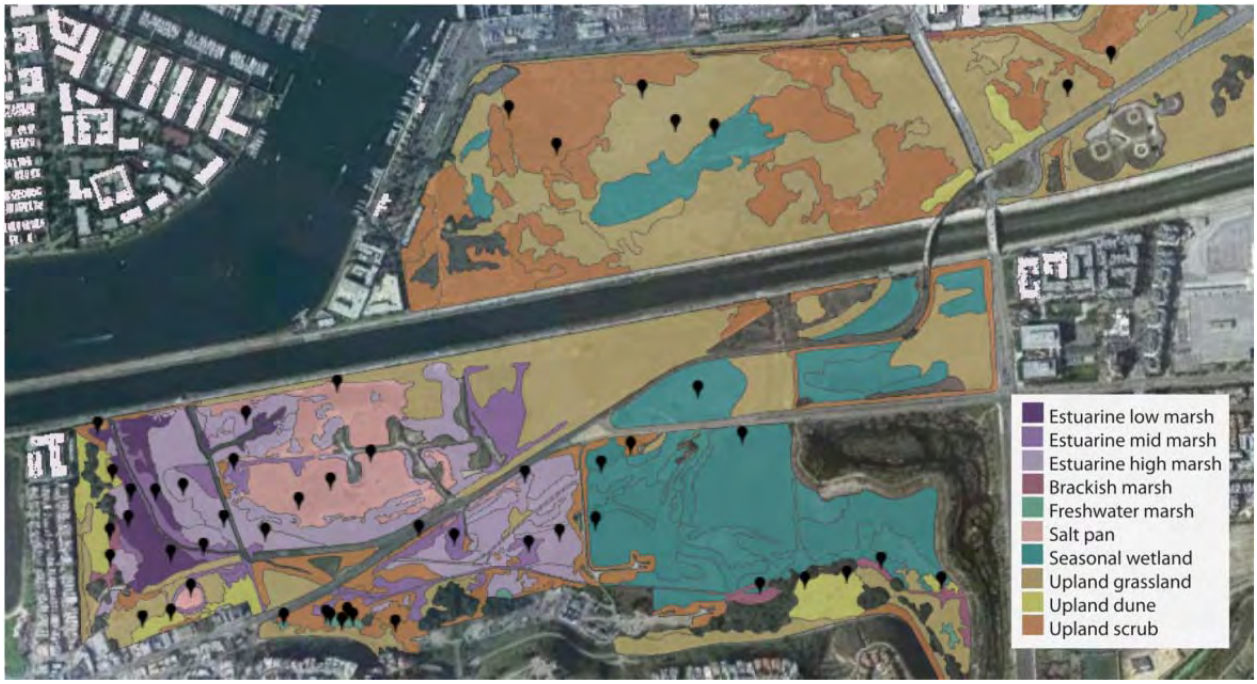

Figure D6-2 depicts BAP insect transects throughout the Reserve by habitat type (reproduced from Johnston et al. 2011). Please note that the habitat types presented here are associated with mapping and habitat categorizations developed in 2007 (CDFW 2007) and are only presented here as the backdrop for survey locations.

Cooper (2011)

Approximately 30 individuals of the federally endangered El Segundo Blue Butterfly, Euphilotes battoides allyni, were observed on 19 July 2011 while conducting bird surveys (D. Cooper, Cooper Ecological, pers. comm. 2011). The individuals were observed in the western dune habitat on dune buckwheat, *Eriogonum parvifolium*, which was planted as part of the Friends of Ballona Wetlands dune restoration project. The last sighting of the El Segundo blue butterfly in the area was an anecdotal observation in 1986 of one male in Playa Del Rey (Johnston et al. 2011).

Johnston et al. (2010-2011)

Between 2010 and 2011, Johnston et al. conducted terrestrial invertebrate surveys for the BAP on the Reserve. The objective for the second Baseline year of the BAP invertebrate assessment was to extrapolate aerial arthropod productivity (as biomass) using length-fresh weight regressions for each habitat and to note observations of special status species. Results showed the salt pan habitat had the lowest average aerial arthropod productivity (mean ± standard error) at 5.18 ± 2.03 $mg/m^2/day$. The seasonal wetland had the highest average total aerial arthropod productivity and the highest level of variability between transects at 59.95 ± 23.91 $mg/m^2/day$. These results suggest that the seasonal wetland and freshwater marsh habitats had higher relative proportions of larger invertebrate size classes during the second baseline year in the seasons they were assessed. In addition to the aerial arthropod surveys, ancillary observations of the nonnative milk snail (*Otala lacteal*) were common throughout the Reserve, especially on nonnative and upland vegetation. The snail was not surveyed quantitatively but was noted during sampling events. The low marsh, mid marsh, and high marsh habitats were sampled during the same time periods in both years, so productivity can be compared across years. The mid marsh habitat had the highest difference in relative aerial arthropod invertebrate productivity between both baseline years. Both the low and mid marsh habitat types had higher invertebrate productivity in the first baseline year; the high marsh had slightly higher average invertebrate productivity in the second baseline year. No special status species were identified in the aerial arthropod surveys; however, species-level taxonomic classifications were not conducted. Ancillary observations of the wandering skipper (*Panoquina errans*) and monarch butterfly (*Danaus plexippus*) were visually confirmed in the marsh habitats of western Area B during vegetation surveys (Johnston et al. 2012). Figure D6-2 depicts sample areas for this study.

Psomas (2013)

The El Segundo Blue butterfly (*Euphilotes battoides allyni*) (ESB) was determined to be present at the Reserve as a result of presence/absence surveys. Surveys were conducted during the 2013 flight season. A total of 199 butterflies were observed as a result of presence/absence surveys along an established survey route. During the survey period the numbers of adult male and female ESB observed ranged from 0 to 65 on any given survey date. Adults were estimated to emerge the week of June 16 and peak the week of July 7. By August 27 no ESB were observed.

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APPENDIX D7
Summary of Fish Studies

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Appendix D7

Summary of Fish Studies in the Study Area (1981 to 2011)

The following summarizes the results of fish studies performed in the study area between 1981 and 2013. Table D7-1 provides a summary of the fish studies conducted in the study area. This table is then followed by a summary of the survey results.

Table D7-1. Summary of the Fish Studies in the Study Area (modified from PWA 2006a to include later studies reported by Johnston et al. 2011, 2012)

Year	Author	Geographic Extent	Description
1981	Swift and Frantz	Area B	Fish survey for Biota of the Ballona Region report
1991	Allen	Ballona Creek and Low Marina Del Rey	Fish survey for Playa Vista EIR
1991	Boland and Zedler	Area B	Fish and invertebrate research sponsored by the National Audubon Society
1991	Soltz	Area B	Fish survey for Playa Vista EIR
1993	Swift et al.	Southern California	Journal article. 'The status and distribution of the freshwater fishes of Southern California'. Bulletin of the Southern California Academy of Sciences
1996	Haglund et al.	Area B, Ballona Creek, Marina Del Rey	Fish survey performed for Impact Sciences
2001	MEC-Weston	Area B	Vegetation, fish, birds, and benthic infauna study, provided monitoring data for USACE 1135
2003	MEC-Weston	Area B	Vegetation, fish, birds, and benthic infauna study, provided monitoring data for USACE 1135
2004	MEC-Weston	Area B	Vegetation, fish, and bird study, provided monitoring data for USACE 1135
2005	LA City	Area B	Fish and macroinvertebrates in the Reserve
2009	Merkel and Associates	Area B, Fiji Ditch, Ballona Creek	Study of the fish species in the lower Ballona Creek area for a US Army Corps of Engineers Feasibility Report
2009-2010	Johnston et al. (2011)	Area B, Fiji Ditch, Ballona Creek	Baseline fish surveys
2010-2011	Johnston et al. (2012)	Area B, Fiji Ditch, Ballona Creek	Baseline fish surveys

Swift and Frantz (1981)

In 1981, Swift and Frantz conducted the first detailed study of the Ballona Wetlands fish community. This was the first ever study of an upper marsh fish community in Southern California and serves as a baseline for future marshes, as well as providing a wealth of information about likely conditions in the past. Prior to modifications of the region, when the Los Angeles River emptied into the Ballona Wetlands during flood events, the fish assemblage would have included all the species known to have inhabited the River. Most of these species are currently absent from the project area and have been since the 1950s. The course of the Los Angeles River has been maintained to the south and away from Ballona Creek since 1884 (PWA 2006a).

Allen (1991), Boland and Zedler (1991), Stolz (1991), and Haglund et al. (1996)

In 1991 and 1996, several fish surveys of the Ballona Wetlands, Ballona Creek, and the adjacent Marina del Rey were conducted (Johnston et al. 2011).

MEC-Weston (2001, 2003, and 2004)

The channels within Area B of the Reserve were sampled in July of 2004 to provide data on fish populations using the wetlands after implementation of the USACE 1135 project, which was a restoration of the tide-gates to increase tidal flushing of Area B. Prior to the tide-gate restoration project, baseline conditions were documented in 2001. The same methods used during the 2001 baseline study were implemented during four seasonal post-restoration surveys in 2003. The July 2004 was intended to provide further information on the development of fish populations under post-restoration conditions.

Fish were sampled at eight stations in Ballona Wetlands on July 15, 2004. The stations were located as close as practicable to the sampling stations established during the 2001 baseline study and the 2003 post-restoration study previously used by MEC-Weston (2001, 2004). The 2004 survey was scheduled to coincide with neap tidal conditions in order to avoid extremes in water depth and current velocity. Fish were collected using a standard beach seine. Two replicate hauls, spaced approximately 10 yards apart, were taken at each station (Johnston et al. 2011).

LA City (2005)

In September 2005, the City of Los Angeles surveyed fish and macroinvertebrates in the Reserve at eight stations within the tide channels and compared their results to surveys conducted in 2001, 2003, and 2004 by MEC-Weston. They found six species; the most abundant was the non-native western mosquitofish (2,719 individuals). California killifish (*Fundulus parvipinnis*) was the second most abundant (721 individuals), and the combination of the two species represented 91% of the total catch. The other species collected, in order of decreasing abundance, were topsmelt (*Atherinops affinis*), longjaw mudsucker (*Gillichthys mirabilis*), arrow goby (*Clevelandia ios*), and sailfin molly. The sailfin molly is also a non-native species, and was found in the upper channel stations only. Overall, fish diversity was slightly lower than previous survey years, and fish abundance roughly reflected the survey abundances of 2003, but not 2004 (Johnston et al. 2011). Figure D7-1 depicts sample locations for this study.



Figure D7-1 depicts City of Los Angeles fish survey stations in 2005 (reproduced from Johnston et al. 2011).

Merkel & Associates (2009)

Merkel & Associates conducted a study of the fish species in the lower Ballona Creek area for a U.S. Army Corps of Engineers Feasibility Report. They included surveys in Ballona Creek, the tide channels of Area B, and the first reported surveys from within the Fiji Ditch. They conducted daytime surveys in August, nighttime surveys in October, and both day and night surveys in early December (Johnston et al. 2011). Figure D7-2 depicts sample locations for this study.



Figure D7-2 depicts Merkel and Associates 2009 fish survey stations (reproduced from Johnston et al. 2011).

Johnston et al. (2009–2010)

Surveys were conducted three times during the Baseline Year: September 2009, April 2010, and June 2010. When possible, survey events occurred at least 72 hours after the last storm or rainfall event that produced more than 0.5 inch of rain. Surveys were conducted at three sites: Ballona Creek, Fiji Ditch, and the tidally influenced channels of the western portion of Area B. Three permanent survey stations were positioned in the Fiji Ditch, and three in the tidal. Five survey stations were positioned within Ballona Creek, using 250-meter trawling transects along the length of the Creek. During the September surveys, three methods (i.e. beach seines, minnow traps, and shrimp/otter trawls) were employed at various stations. After the first round of surveys in September 2009, it was determined that minnow traps were not an effective method to evaluate a high species richness, as they only caught California killifish and longjaw mudsuckers, which were adequately represented using the beach seine method. Beach seines were found to be effective for benthic and demersal fish as well as pelagic fish. For each event, fish were surveyed during an incoming, semidiurnal spring tide once during the day and once again at night to provide a comparison of diurnal versus nocturnal fish activity and abundance. Fishing was conducted with a minimum of 12 hours between survey times at each station (Johnston et al. 2011). Figure D7-3 depicts sample locations for this study.



Figure D7-3 shows fish survey stations for Johnston et al. studies between 2009 and 2011. Red lines indicate individual stations (reproduced from Johnston et al. 2011).

Johnston et al. (2010–2011)

Beach seine surveys were conducted three times during the second Baseline Year: September 2010, April 2011, and June 2011. Shrimp trawls in Ballona Creek were conducted twice, once in July and once in September 2011. No minnow traps were used for fish surveys in the second baseline year. When possible, survey events occurred at least 72 hours after the last storm or rainfall event that produced more than 0.5 inch of rain to ensure there were no significant reductions in salinity. For each event, fish were surveyed during an incoming, semidiurnal spring tide once during the day and once again at night to provide a comparison of diurnal versus nocturnal fish activity and abundance. Surveys were conducted at the same stations as the first Baseline year (Johnston et al. 2012). Figure D7-3 depicts sample locations for this study.

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APPENDIX D8
Summary of Reptile and Amphibian Studies

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Appendix D8

Summary of Reptile and Amphibian Studies in the Study Area

The following summarizes the results of reptile and amphibian studies performed in the study area between 1981 and 2011. Table D8-1 provides a summary of the reptile and amphibian studies conducted in the study site. This table is then followed by a summary of the survey results.

Table D8-1. Summary of Benthic Invertebrate Surveys and Reports in the Study Area (modified from PWA 2006a to include later studies reported by Johnston et al. 2011, 2012)

Year	Author	Geographic Extent	Description
1981	Hayes and Guyer	Areas A and B	Herpetofauna survey for Biota of the Ballona Region report
1991	Frank Hovore and Associates	Areas A and B	Amphibian, reptile, and mammal survey for Playa Vista EIR
1996	Impact Sciences, Inc.	Areas A and B	Amphibian and reptile survey
2007	Sustaita et al.	Area B	Herpetofauna surveys conducted on the BOLD project site
2009	Johnston et al.	Area B	Herpetofauna and mammal surveys conducted for the Early Action Plan (EAP)
2009-2010	Johnston et al.	Areas A, B, and C	Year 1 Baseline Assessment Program
2010-2011	Johnston et al.	Areas A, B, and C	Year 2 Baseline Assessment Program

Hayes and Guyer (1981), Frank Hovore and Associates (1991), and Impact Sciences, Inc. (1996)

Reptile and amphibian surveys conducted between 1981 and 1996 in the study area documented a total of nine species (Johnston et al. 2011).

Sustaita et al. (2007)

The Ballona Outdoor Learning & Discovery (BOLD) Report summarized findings from two herpetofauna surveys conducted on the BOLD project site using over 180 trapping nights in the southwestern portion of Area B, near Gordon's lot entranceway. The surveys were conducted in spring and late summer of 2005. Herpetofauna were classed as either common or uncommon (Johnston et al. 2011). Figure D8-1 depicts sample locations for this study.

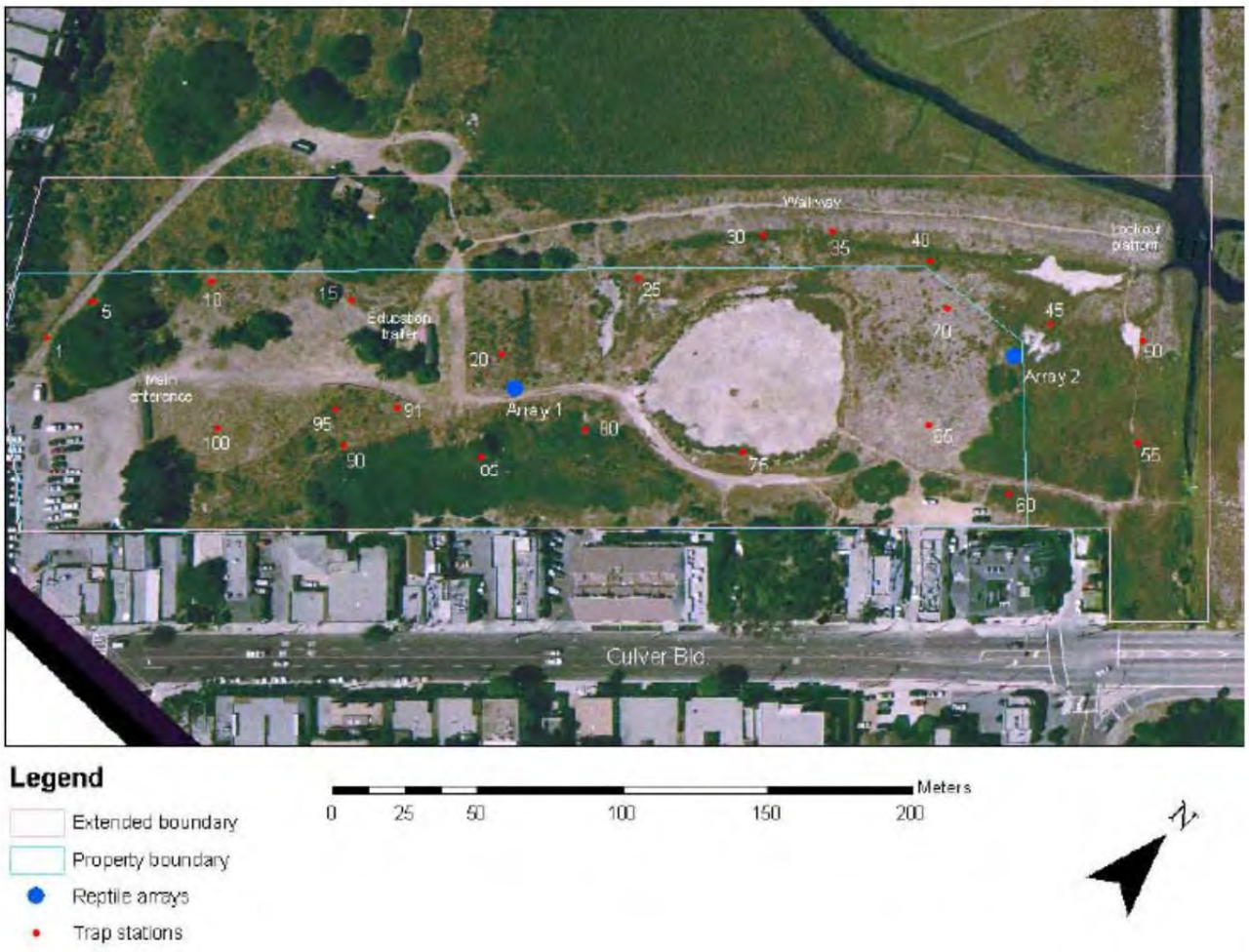

Figure D8-1 depicts the BOLD site boundaries and survey locations (reproduced from Johnston et al. 2011).

Johnston et al. (2009)

For the Reserve's Early Action Plan (EAP), Johnston et al. conducted a survey for herpetofauna in the portion of Area B located directly adjacent to Gordon's lot. Surveys conducted during June 2009 utilized pitfall trap and driftnet arrays as well as comprehensive area searches (Johnston et al. 2011). Figure D8-2 depicts sample locations for this study.



Figure D8-2 depicts survey locations for herpetofauna and mammal surveys within EAP project site. Note: pitfall and driftnet arrays are in blue; green lines indicate mammal transects (reproduced from Johnston et al. 2011).

Johnston et al. (2011)

Herpetofauna surveys were conducted in three habitat types: seasonal wetland, upland grassland, and upland scrub. Surveys were conducted during three seasons (early fall, spring, and early summer) of the Baseline year (September 2009 to September 2010). Early fall surveys occurred from 2 November to 12 November 2010; spring surveys occurred from 30 March to 12 April 2010; early summer surveys occurred from 24 June to 5 July 2010. Pitfall traps and driftnet fence arrays were used in several of the major habitat types. Herpetofauna surveys occurred for ten consecutive days and nights, when possible. Additionally, site-wide searches involving board and cover flipping, and targeted surveys for the California legless lizard, were conducted (Johnston et al. 2011). Figure D8-3 depicts sample locations for this study.

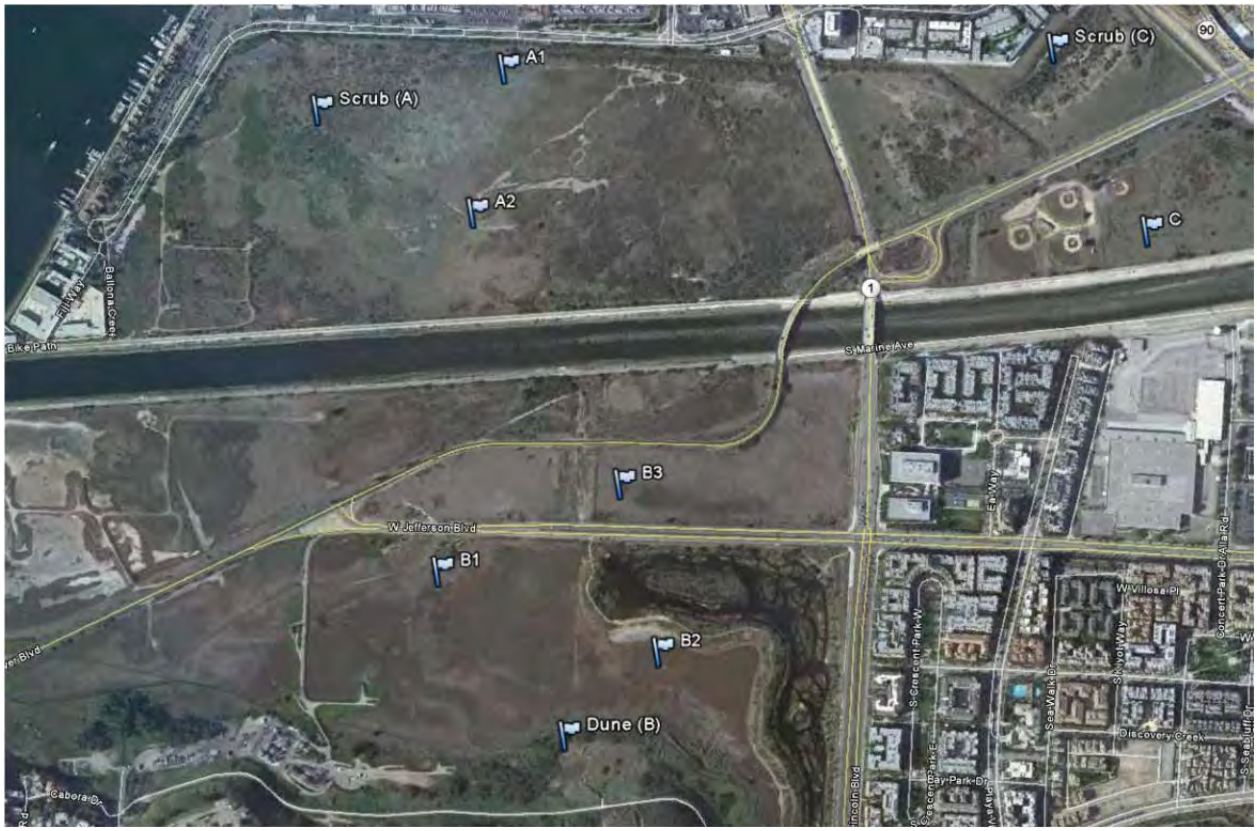

Figure D8-3 depicts survey locations for herpetofauna surveys for BAP (reproduced from Johnston et al. 2011).

The Ballona freshwater marsh, located immediately adjacent to the Reserve, is regularly surveyed for purposes of measuring biological performance criteria. Detected herpetofauna species within the Ballona freshwater marsh are communicated to the BAP team (Johnston et al. 2011).

Johnston et al. (2012)

Nineteen arrays with approximately 10 boards per array were placed in the three Areas of Ballona (190 total boards). Two of the arrays in Area A were placed in upland grassland habitat, and one array was placed in upland scrub habitat. Five arrays in Area B were placed in upland dune habitat, two in high marsh, one in grassland, and three in transition areas between habitats. Four arrays in Area C were placed in grassland, and one array was placed in dune habitat. Boards were preferentially placed greater than 5 meters apart to ensure proper coverage of the location. Boards were checked on a weekly basis during the fall season (October to December 2010) and again in the spring season (February to May 2011). Surveys were preferentially conducted two days after a rain event to achieve optimal soil moisture (Johnston et al. 2012). Figure D8-3 depicts sample locations for this study.

The Ballona freshwater marsh, located immediately adjacent to the Reserve, is regularly surveyed for purposes of measuring biological performance criteria Detected herpetofauna species within the freshwater marsh are communicated to the BAP team (Johnston et al. 2012).

APPENDIX D9
Summary of Bird Studies

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Appendix D9

Summary of Bird Studies in the Study Area

A summary of the bird studies conducted in the study area between 1898 and 2015 is provided in Table D9-1.

Table D9-1. Summary of the Bird Studies in the Study Area (modified from PWA 2006a to include later studies reported by Johnston et al. 2011 and 2012 as well as other available reports)

Year	Author	Geographic Extent	Description
1898	Grinnell	References to Ballona Region	Birds of the Pacific Slope of Los Angeles County
1912	Willet	References to Ballona Region	Birds of the Pacific Slope of Southern California
1933	Willet	References to Ballona Region	Revised List of the Birds of Southwestern California
1943	von Bloaker	El Segundo and Playa del Rey	The Fauna and Flora of the El Segundo Sand Dunes: Birds of El Segundo and Playa del Rey
1944	Grinnell and Miller	References to Ballona Region	The Distribution of the Birds of California
1981	Dock and Schriber	Ballona Region	The Birds of Ballona
1987	Massey, B.W.	Ballona Wetlands	Census of Belding's Savannah Sparrow
1989	Massey, B.W.	Ballona Wetlands	Counts of Belding's savannah sparrows
1992	Corey	Ballona Wetland	Bird survey of Ballona Wetland, Playa del Rey, California (1990-1991)
1996	Keane Biological Consulting	Areas A, B, and C	Bird surveys as part of environmental documentation for the proposed Playa Vista development
1996	National Audubon Society	Ballona Creek, Ballona Lagoon, and the western portion of the North Wetland of Area B	Dan Kahane, Art Pickus, and Richard Barth conducted weekly surveys from 1993 to 1998
1997	Hamilton	Area B	Bird surveys in riparian habitat
1998	Almdale	Ballona Lagoon	Birds of Ballona Lagoon
1998	Keane Biological Consulting	Areas A, B and C	Bird surveys as part of environmental documentation for the proposed Playa Vista development

Year	Author	Geographic Extent	Description
2001	Keane Biological Consulting	Areas A, B and C	Bird surveys as part of environmental documentation for the proposed Playa Vista development
2001	Keane Biological Consulting	Portion of Area B	Bird surveys conducted to provide baseline information for the evaluation of a tide-gate modification project by the USACE
2003	Keane Biological Consulting	Freshwater Marsh	Breeding bird survey results
2004	Keane Biological Consulting	Portion of Area B	Follow-up surveys to assess changes in the Belding's savannah sparrow population as a result of increased tidal inundation
2004	Cooper	Freshwater Marsh	2004 Breeding bird survey at Playa Vista
2005	Keane Biological Consulting	Portion of Area B	Follow-up surveys to assess changes in the Belding's savannah sparrow population as a result of increased tidal inundation
2005	Cooper	Freshwater Marsh	2004-05 winter bird survey at Playa Vista, Playa
2005	Froke	Marina del Rey	Report on the Marina del Rey Heronry
2006	Keane Biological Consulting	Portion of Area B	Follow-up surveys to assess changes in the Belding's savannah sparrow population as a result of increased tidal inundation
2006	Cooper	Ballona Valley	Annotated Checklist of Birds of Ballona Valley (based on notes from local bird experts dating back to 1970)
2007	Keane Biological Consulting	Portion of Area B	Follow-up surveys to assess changes in the Belding's savannah sparrow population as a result of increased tidal inundation
2007	Cooper	Area B	Birds of the BOLD Project Site
2008	Cooper	Ballona Wetlands and Freshwater Marsh	Identifies species whose future reestablishment may be used to evaluate restoration success
2008	Keane Biological Consulting	Portion of Area B	Follow-up surveys to assess changes in the Belding's savannah sparrow population as a result of increased tidal inundation
2009	Keane Biological Consulting	Portion of Area B	Follow-up surveys to assess changes in the Belding's savannah sparrow population as a result of increased tidal inundation
2003 – 2010	Read and Strecker	Ballona Freshwater Marsh	Ballona Freshwater Wetlands Annual Report of Monitoring, Operation, and Maintenance
2009-2010	Johnston et al.	Area A,B, and C	Year 1 Baseline Assessment Program
2010	Cooper	Areas A, B, C	Survey for Belding's Savannah Sparrow
2010-2011	Johnston et al.	Area A,B, and C	Year 2 Baseline Assessment Program
2010	Cooper	Area B	Survey for Least Bell's Vireo

Year	Author	Geographic Extent	Description
2011	Ryan Ecological Consulting	Area A and B	Survey for Light-Footed Clapper Rail
2011	Cooper	Area A and C	Survey for Coastal California Gnatcatcher
2011	Hamilton	Marina del Rey	Surveys for nesting herons, egrets, and cormorants (i.e., colonial waterbirds0 throughout Marina del Rey.
2015	Cooper, D. S.	Area B	Memo: Rapid-assessment survey of nesting Belding's Savannah Sparrow

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APPENDIX D10
Summary of Mammal Studies

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Appendix D10

Summary of Mammal Studies in the Study Area

Table D10-1 provides a summary of the mammal studies conducted in the Study area between the 1960s and 2015.

Table D10-1. Summary of the Mammal Studies in the Study Area (modified from PWA 2006a to include an earlier study reported by Zedler, J. B. 1982 and later studies reported by Johnston et al. 2011, 2012).

Year	Author	Geographic Extent	Description
Early 1960s	Zelder, J. B. 1982	Ballona Creek Marshes	Zeldler summarizes Coulombe, H. N. (1965), which is an ecological study of a southern California salt marsh rodent fauna at Mugu Lagoon and Ballona Creek Marshes.
1981	Friesen et al.	Area A and B	Mammal survey for Biota of the Ballona Region report
1991	Frank Hovore and Associates	Areas A, B, and C	Amphibian, reptile, and mammal survey for Playa Vista EIR
1996	Impact Sciences	Areas A, B, and C	Mammal survey
2000	Erickson	Area B	Survey for sensitive species of small mammal for Playa Capital Co.
2001	Psomas and Associates	Area B	Sensitive Species Assessment and Surveys for Playa Vista, Phase One
2007	Sustaita et al.	Area B	Ballona Outdoor Learning and Discovery (BOLD) Report
2009	Johnston et al.	Area B	Herpetofauna and mammal surveys for the Early Action Plan (EAP)
2009-2010	Johnston et al.	Areas A, B, and C	Year 1 Baseline Assessment Program
2010-2011	Johnston et al.	Areas A, B, and C	Year 2 Baseline Assessment Program
2015	Molioo, T.	Freshwater marsh, southern Eucalyptus grove, Area B	Memorandum: chiropteran fauna surveys summary

Zedler, J. B. (1982)

Zedler, J.B. summarizes a mammal study conducted in the 1960s (Coulombe, H. N. 1965. An ecological study of a Southern California salt marsh rodent fauna. M. S. Thesis, Univ. Calif. Los Angeles). Coulombe's study entails an extensive trapping in the early 1960s of Mugu Lagoon and

Ballona Creek marshes. Detected mammals included western harvest mouse, south coast marsh vole, saltmarsh shrew, house mouse, Botta's pocket gopher, San Diego black-tailed jackrabbit, and desert cottontail on Ballona wetlands and described California ground squirrel, striped skunk, gray fox, and domestic cat as occurring "nearby."

Friesen et al. (1981), Frank Hovore and Associates (1991), Impact Sciences (1996), Erickson (2000), and Psomas and Associates (2001)

Mammal surveys used a variety of mammal sampling methods, including: Sherman live traps, pitfall traps, scent station monitoring, track station monitoring, and observational site searches (Johnston et al. 2011).

Three species of bat were also evaluated for potential occurrence. None were detected within the project area in 2000 or 1981, although no specialized survey methods were used to determine presence or absence. Other sensitive-species of bat that may have occurred historically include California leaf-nosed bat (Macrotus californicus californicus), pallid bat (Antrozous pallidus pacificus), and western mastiff bat (Eumops perotis californicus). A bat survey was performed by Impact Sciences in 1996 which included examination of potential bat roost sites for guano, staining, and other indications of bats, as well as use of a hand-held bat detector. No evidence of bats in Areas A, B, or C was uncovered, although a high frequency echo-location was picked up in an adjacent area (Johnston et al. 2011).

It has also been speculated that at some point in the past, the edges of the marsh may have been used by marine mammals. Several species of cetaceans have been observed to occasionally come ashore for short periods or stand along the beaches adjacent to the wetlands (Johnston et al. 2011).

Sustaita et al. (2007)

Two mammal surveys were conducted on the Ballona Outdoor Learning & Discovery (BOLD) project site in the southwestern portion of Area B near the Culver Gateway during 400 trapping nights; one in spring and one in late summer of 2005 (Johnston et al. 2011). Figure D10-1 depicts the sample locations for this study.

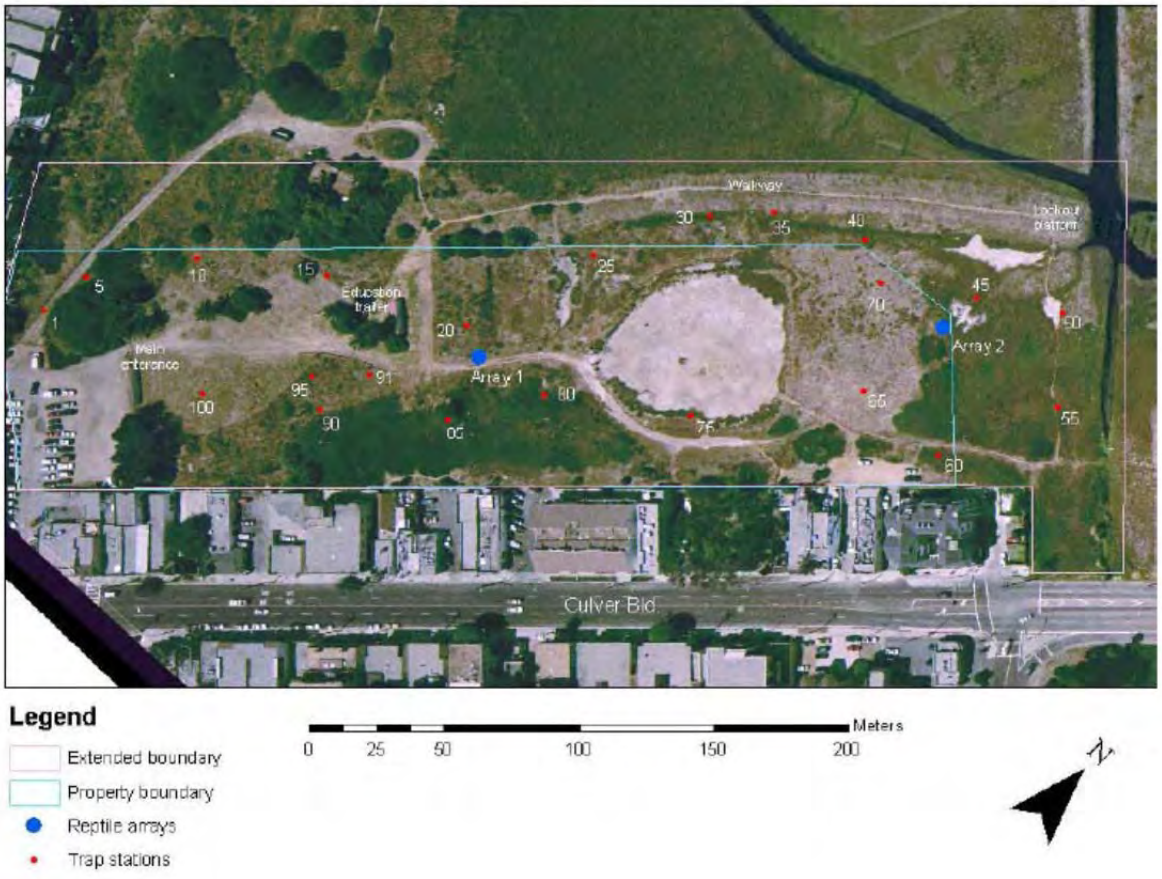

Figure D10-1 depicts the BOLD site boundaries and survey locations (reproduced from Johnston et al. 2011).

Johnston et al. (2009)

Johnston et al. surveyed for mammals in the southwestern portion of Area B directly adjacent to the Culver Gateway, within the Early Action Plan (EAP) designated area. Sampling was conducted over three nights from June 1 to June 4, 2009 (Johnston et al. 2011). Figure D10-2 depicts the sample locations for this study.



Figure D10-2 depicts survey locations for herpetofauna and mammal surveys within EAP project site. Note: pitfall and driftnet arrays are in blue; green lines indicate mammal transects (reproduced from Johnston et al. 2011).

Johnston et al. (2009–2010)

The Baseline Assessment Program surveyed small mammals throughout the Reserve using baited Sherman live traps deployed in both array and transect forms. Sampling was conducted during fall 2009 and early summer 2010 of the Baseline year. During the fall sampling event, arrays were placed throughout the site. During the summer, targeted transects were located throughout the upland scrub habitats (Johnston et al. 2011). Figure D10-3 depicts the sample locations for this study.

Medium and large mammal sampling was conducted using baited Scout Guard camera stations. A total of 12 "Critter Cam" stations were spread throughout the site between February and September 2010. Five Critter Cam stations were in Area A, five were in Area B, and two were in Area C (Johnston et al. 2011). Figure D10-4 depicts the camera location for this study.



Figure D10-3 depicts mammal survey locations within the Reserve. Note: Green boxes indicate mammal arrays; red lines indicate 100 m transects (reproduced from Johnston et al. 2011).

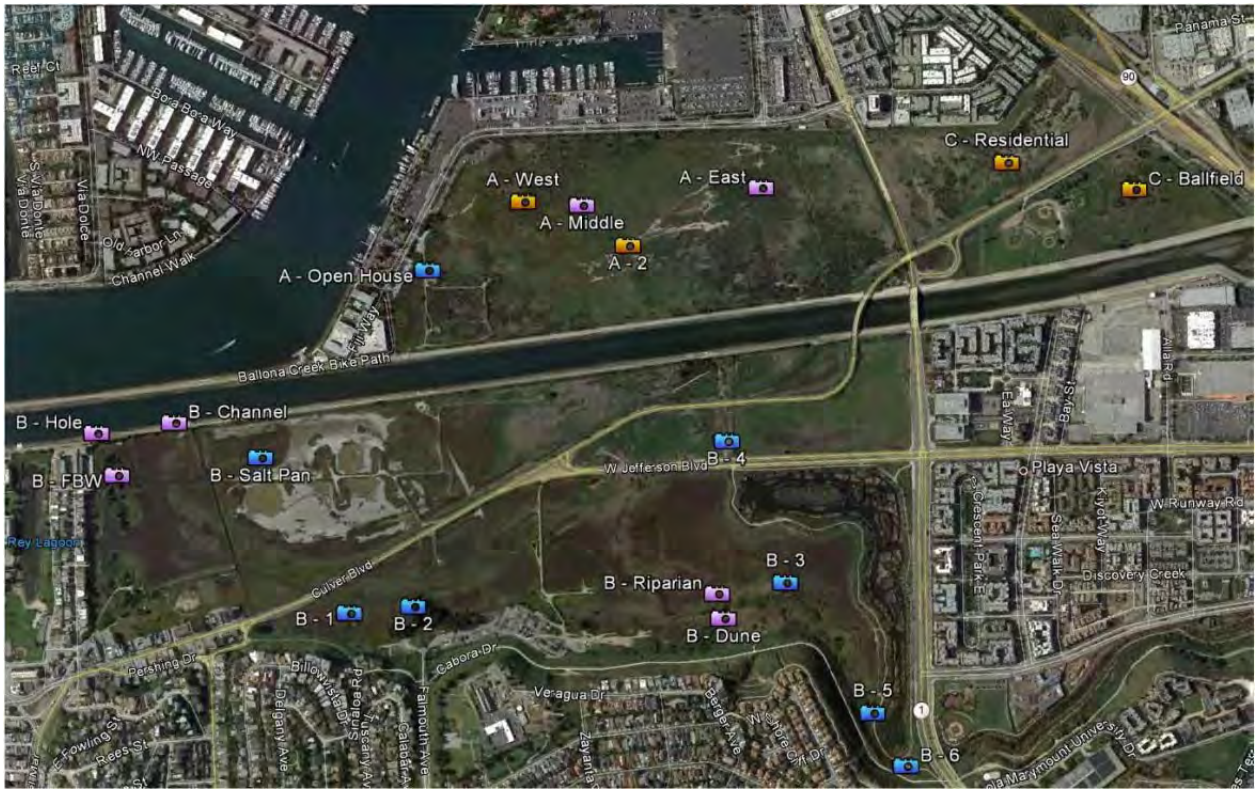

Figure D10-4 depicts camera stations throughout the Reserve for the first Baseline year (pink), second Baseline year (blue), and stations monitored both years (gold) (reproduced from Johnston et al. 2012).

Johnston et al. (2010–2011)

The Baseline Assessment Program surveyed small mammals in the salt marsh habitats of Area B using baited Sherman live traps deployed as seven transects of approximately 100 meters each with 10 to 15 meters between traps, based on habitat type and terrain, for a total of 360 trap nights. Transects occurred in vegetation dominated by pickleweed, saltgrass, and some nonnative grasses. Five were deployed in the marsh habitats north of Culver Blvd and two were deployed south of Culver and west of the Gas Company Road. Surveys were conducted during late August and early September, 2011, primarily to assess the presence of the South Coast marsh vole (*Microtus californicus stephensi*), a California Species of Special Concern that was identified in surveys during the first baseline year (Johnston et al. 2012). Figure D10-5 depicts the sample locations for this study.



Figure D10-5 depicts seven small mammal transect locations within the Reserve next to the tide gates (left) and the Gas Company Road (right) (reproduced from Johnston et al. 2012).

Medium and large mammal sampling was conducted using baited Scout Guard camera stations. Twelve Critter Cam stations were spread throughout the site during the second Baseline year for a total deployment of 631 days. Three Critter Cam stations were in Area A, seven were in Area B, and two were in Area C (Johnston et al. 2012). Figure D10-4 depicts the camera location for this study.

Surveys to assess vertebrate mortality (roadkill) along roadways bisecting the Reserve were conducted semi-monthly throughout the second baseline year. Each individual was identified to the lowest possible taxon along three transects, ranging from "unidentifiable" in broad size classes to species-level data (Johnston et al. 2012). Figure D10-6 depicts survey routes for this study.



Figure D10-6 depicts vertebrate mortality survey transects bisecting and adjacent to the Reserve (reproduced from Johnston et al. 2012).

Molioo, T. (2015)

Chiropteran fauna surveys were conducted within the Ballona Wetlands Ecological Reserve in Fall 2014. Three survey locations were examined for suitable habitat of resident and migratory chiropteran species. Survey locations were surveyed with the utilization of non-invasive acoustic monitoring devices that detect and record echolocation calls in flight and an ultrasonic SM3 detector deployed for six nights total to determine if chiropteran species were present during the studies. Results suggest that due to a relatively high level of bat activity on the Reserve, resident bats occur on the Reserve. Four species were detected during the surveys: silver-haired bat (*Lasionycteris noctivagans*), hoary bat (*Lasiurus cinereus*), Yuma myotis (*Myotis yumanensis*), and Mexican free-tailed bat (*Tadarida brasiliensis*). Results of the study suggest that bat occupancy, particularly maternity roosts, will need to be considered prior to any disturbance or removal of roosting habitat in native and non-native trees, and riparian scrub habitat in areas such as the freshwater marsh, eucalyptus grove, and West Area B. to avoid direct impacts to bats.

APPENDIX D11
Special-Status Plants

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Appendix D11

Occurrence Determination: Special-Status Plants

Table D11-1. Occurrence Determination: Special-Status Plant Species.

Scientific Name	Common Name	Status	Habitat Requirements	Occurrence Determination
Abronia maritima	Red sand-verbena	CRPR 4.2 S3?	Coastal dunes. Elevation range: 0 – 325 feet. Blooms: February – November (CNPS 2014).	**Presumed Absent**. Historically present in the study area; the study area contains restored coastal dune habitat that that is potential habitat for this species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in 2010 and 2011, did not observe this species.
Aphanisma blitoides	Aphanisma	CRPR 1B.2 S3	Coastal bluff scrub, coastal dunes, coastal scrub. Typically located on bluffs and slopes near the ocean on sandy or clay soils. Elevation range: 1 – 990 feet. Blooms: March – June. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Present in the project region but not known from the study area; the study area contains restored coastal dune and coastal scrub habitat, but not the drier, steeper bluffs that provide suitable microsite conditions for the species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in April 2011, did not observe this species.
Arenaria paludicola	Marsh sandwort	FE SE CRPR 1B.1 S1	Marshes and swamps. Typically located in dense mats of emergent marsh vegetation. Elevation range: 485 – 3965 feet. Blooms: May – August. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Present in the project region but not known from the study area; closely associated with freshwater wetland habitat, which is not present in the study area; multiple surveys of the study area conducted since 1979, including focused rare plant surveys in July 2010, did not observe this species.

Scientific Name	Common Name	Status	Habitat Requirements	Occurrence Determination
Astragalus brauntonii	Braunton's milk-vetch	FE, CRPR 1B.1 S2	Closed-cone coniferous forest, chaparral, coastal scrub, valley and foothill grassland. Often in recent burns or disturbed areas on gravelly clay soils overlying granite or limestone. Elevation range: 10 – 2075 feet. Blooms: January – August. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Present in the project region but not known from the study area; primarily a chaparral species, and the habitats in the study area do not provide suitable microsite conditions for the species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in July 2010 and April 2011, did not observe this species.
Astragalus pycnostachyus var. *lanosissimus*	Ventura marsh milk-vetch	FE SE CRPR 1B.1 S1	Coastal salt marsh, coastal dune, coastal scrub. Typically located within reach of high tide protected by barrier beaches and near seeps on sandy bluffs. Elevation range: 1 – 115 feet. Blooms: June – October. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Historically present in the study area; the study area contains dune and grassland habitat adjacent to wetlands that that is potential habitat for this species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in July and October 2010, did not observe this species.
Astragalus tener var. *titi*	Coastal dunes milk-vetch	FE SE CRPR 1B.1 S1	Coastal prairie. Located on moist, sandy depressions within coastal prairie. Elevation range: 1 – 165 feet. Blooms: March – May. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Historically present in the project region but not known from the study area; primarily a coastal prairie species, which did not occur in the study area; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in April 2011, did not observe this species.
Atriplex pacifica	South Coast saltscale	CRPR 1B.2 S2	Coastal scrub, coastal bluff scrub, playas, chenopod scrub. Located on alkali soils. Elevation range: 0 – 460 feet. Blooms: March – October. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Historically present in the project region but not known from the study area; the study area contains restored coastal dune and coastal scrub habitat, but not the drier, steeper bluffs that provide suitable microsite conditions for the species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in 2010 and 2011, did not observe this species.
Atriplex parishii	Parish's brittlescale	CRPR 1B.1 S1	Alkali meadows, vernal pools, chenopod scrub, playas. Typically located on alkali flats with finely textured soils. Elevation range: 80 – 6160 feet. Blooms: June – October. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Historically present in the project region but not known from the study area; suitable habitat does not occur in the study area; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in July and October 2010, did not observe this species.
Atriplex serenana var. davidsonii	Davidson's saltscale	CRPR 1B.2 S2?	Coastal bluff scrub, coastal scrub. Located on alkaline soils. Elevation range: 30 – 650 feet. Blooms: April – October. (CNPS 2014)	**Presumed Absent**. Historically present in the project region but not known from the study area; the study area contains coastal scrub habitat, but not the drier, steeper bluffs that provide suitable microsite conditions for the species; multiple surveys of the study area

Scientific Name	Common Name	Status	Habitat Requirements	Occurrence Determination
				conducted since 1979, including floristic rare plant surveys in 2010 and 2011, did not observe this species.
Calandrinia breweri	Brewer's calandrinia	CRPR 4.2 S3.2?	Chaparral, coastal scrub. Located on sandy or loamy soils, often in disturbed areas. Elevation range: 30 – 3695 feet. Blooms: March – June. (CNPS 2014)	**Presumed Absent**. Present in the project region but not known from the study area; primarily a chaparral species, and the habitats in the study area do not provide suitable microsite conditions for the species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in April 2011, did not observe this species.
Calochortus catalinae	Catalina mariposa lily	CRPR 4.2 S3.2	Found in chaparral, cismontane woodland, coastal scrub, and valley and foothill woodland. Elevation range: 15- 700 meters. Blooming period: February- June. (CNPS 2014)	**Presumed Absent**. Present in the project region but not known from the study area; primarily a chaparral species, and the habitats in the study area do not provide suitable microsite conditions for the species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in April 2011, did not observe this species.
Calochortus clavatus var. *gracilis*	Slender mariposa lily	CRPR 1B.2 S2	This is a perennial herb that typically blooms from March to June and occurs in chaparral, coastal scrub, and valley and foothill grassland communities. It is found in shaded foothill canyons that range from (about 360 to1000 meters) 1180 to 3280 feet. It is limited in distribution to Los Angeles County. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Present in the project region, but the study area is outside of the species' range; primarily a chaparral species, and the habitats in the study area do not provide suitable microsite conditions for the species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in April 2011, did not observe this species.
Calochortus plummerae	Plummer's mariposa lily	CRPR 4.2 S4	Coastal scrub, chaparral, valley and foothill grassland, cismontane woodland, lower montane coniferous forest. Located on rocky and sandy sites derived from granitic or alluvial material; often occurs following fires. Elevation range: 320 – 5510 feet. Blooms: May – July. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Present in the project region, but the study area is outside of the species' range; primarily a chaparral species, and the habitats in the study area do not provide suitable microsite conditions for the species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in 2010 and 2011, did not observe this species.
Calystegia peirsonii	Peirson's morning-glory	CRPR 4.2 S3.2	This perennial herb typically blooms in May or June, and is found in chaparral, chenopod scrub, cismontane woodlands, coastal scrubs, valley and foothill grassland, and even lower elevation conifer forests at (30 to 1500 meters) elevation 98 to 4920 feet. It is typically restricted to rocky slopes (Hickman 1993), and is known only from Los Angeles County. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Present in the project region, but the study area is outside of the species' range; primarily a chaparral species, and the habitats in the study area do not provide suitable microsite conditions for the species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in 2010 and 2011, did not observe this species.

Scientific Name	Common Name	Status	Habitat Requirements	Occurrence Determination
Calystegia binghamiae	Santa Barbara morning-glory	CRPR 1B.1 S1	Marshes and swamps and riparian scrub. Historically associated with wetland and marshy places, but possibly in drier situations as well. Possibly located on silty loam and alkaline. Elevation range: 0 – 65 feet. Blooms: April – May. (CNPS 2014)	**Presumed Absent**. Present in the project region but not known from the study area; closely associated with freshwater wetland habitat, which is not present in the study area; multiple surveys of the study area conducted since 1979, including focused rare plant surveys in April 2011, did not observe this species.
Camissoniopsis lewisii (=*Camissonia lewisii*)	Lewis's evening primrose	CRPR 3 S1S3	Coastal bluff scrub, cismontane woodland, coastal dunes, coastal scrub, valley and foothill grassland on sandy or clay soils. Elevation range: 0 – 975 feet. Blooms: March – May, sometimes June. (CNPS 2014)	**Confirmed Present**. First observed in the study area in 1889; several populations were mapped on the study area in Areas A, B, and C during focused rare plant surveys in 2011.
Centromadia parryi subsp. *australis*	Southern tarplant	CRPR 1B.1 S2	Marshes and swamps margins, valley and foothill grassland. Often located on disturbed sites near the coast on alkali soils. Elevation range: 0 – 1385 feet. Blooms: May – November. (CNDDB 2014; CNPS 2014)	**Presumed Present**. First observed in the study area in 1890, and most recently reported in 1995 to occur east of the Area C ball fields (PWA 2006). Although rare plant surveys in 2010 and 2011 did not detect this species in the Project area, the study area contains grassland and other upland habitat that may support this species.
Cercocarpus betuloides var. *blancheae*	Island Mountain-mahogany	CRPR 4.3 S3.3	Found in closed-cone coniferous forest and chaparral habitat. Elevation range: 30-600 meters Blooming period: February – May. (CNPS 2014)	**Confirmed Absent**. Present in the project region, but the study area is outside of the species' range; primarily a chaparral species, and the habitats in the study area do not provide suitable microsite conditions for the species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in 2010 and 2011, did not observe this species.
Chaenactis glabriuscula var. *orcuttiana*	Orcutt's pincushion	CRPR 1B.1 S1	Coastal bluff scrub, coastal dunes. Located on sandy soils. Elevation range: 0 – 330 feet. Blooms: January – August. (CNPS 2014)	**Confirmed Present**. First documented from Ballona wetlands in 1979, although there are records from Playa del Rey from as early as 1918; mapped in the study area in Area B during focused rare plant surveys in 2011.
Chenopodium littoreum	coastal goosefoot	CRPR 1B.2 S2	Coastal dunes. Elevation range: 30 – 95 feet. Blooms: April – August. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Historically present in the study area; the study area contains restored coastal dune habitat that that is potential habitat for this species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in 2010 and 2011, did not observe this species.
Chloropyron maritimum subsp. *maritimum*	Salt marsh bird's-beak	FE SE CRPR 1B.2	Coastal dune, marsh & swamp, coastal salt marsh, wetland. Located on the higher zones of salt marshes. Elevation range: 0 – 100 feet. Blooms: May – October. (CNDDB 2014;	**Presumed Absent**. Known historically from a 1901 collection from the study area; tidal wetlands (Marsh Plain) in Areas A and B are potential habitat for this

Scientific Name	Common Name	Status	Habitat Requirements	Occurrence Determination
(=Cordylanthus maritimus ssp. *maritimus)*		S1	CNPS 2014)	species; occurrence considered to be extirpated, based on surveys at Ballona wetlands in 1980, 1982 and 1983; floristic rare plant surveys in July and October 2010 did not observe this species.
Chorizanthe parryi var. *fernandina*	San Fernando Valley spineflower	FC SE CRPR 1B.1 S1	Coastal scrub, valley and foothill grassland. Located on sandy soils. Elevation range: 490 – 4000 feet. Blooms: April – July.	**Presumed Absent**. Known historically from a 1901 collection from the study area but considered to be extirpated; annual grassland and upland scrub on the study site are potential habitat for this species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in July 2010 and April 2011, did not observe this species.
Cistanthe maritima (=*Calandrinia maritime*)	Seaside cistanthe	CRPR 4.2 S3.2	Coastal bluff scrub, coastal scrub, valley and foothill grassland. Located on sea bluffs and sandy sites. Elevation range: 15- 975 feet. Blooms: February - August. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Historically present in the project region but not known from the study area; the study area contains coastal scrub habitat, but not the drier, steeper bluffs that provide suitable microsite conditions for the species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in July 2010 and April 2011, did not observe this species.
Convolvulus simulans	Small-flowered morning-glory	CRPR 4.2 S3.2	Chaparral, coastal scrub, valley and foothill grassland. Located in openings on wet clay soils and serpentine seeps. Elevation range: 95 – 2275 feet. Blooms: March – July. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Present in the project region, but not known from the study area; primarily a chaparral species, and the habitats in the study area do not provide suitable microsite conditions for the species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in July 2010 and April 2011, did not observe this species.
Deinandra minthornii	Santa Susana tarplant	Rare CRPR 1B.2 S2.2	This deciduous shrub can be found at elevations from (280 to 760 meters) 919 to 2493 feet in rocky chaparral and coastal scrub communities of Ventura and Los Angeles counties. The typical blooming period is July to November. (CNPS 2014)	**Confirmed Absent**. Present in the project region, but the study area is outside of the species' range; primarily a chaparral species, and the habitats in the study area do not provide suitable microsite conditions for the species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in 2010 and 2011, did not observe this species.
Deinandra paniculata	Paniculate tarplant	CRPR 4.2 S3.2	Coastal scrub, valley and foothill grassland, vernal pools. Typically located on vernally mesic sites. Sometimes in vernal pools or on mima mounds near them. Elevation range: 80 – 3055 feet. Blooms: April – November. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Not reported from the project region; the study area is outside of the species' range; typical habitat for this species does not occur in the study area; floristic rare plant surveys in 2010 and 2011 did not observe this species in the study area. Surveys in 1991 and 2002 reporting the species to be present in

Scientific Name	Common Name	Status	Habitat Requirements	Occurrence Determination
				the study site appear to be based on misidentified fascicled tarplant, which is common in the project region and known to occur in the study area.
Dichondra occidentalis	Western dichondra	CRPR 4.2 S3.2	Chaparral, cismontane woodland, valley and foothill grassland, coastal scrub. Located on sandy loam, clay, and rocky soils. Elevation range: 160 – 1625 feet. Blooms: January – July. (CNDDB 2014; CNPS 2014)	**Presumed Present**. Known to occur in the project region (Santa Monica Mountains); the study area contains coastal scrub habitat that may be suitable habitat for this species; surveys of the study area in 1991 and 2002 reported the species to be present, although focused rare plant surveys in July 2010 and April 2011 did not observe this species in the study area.
Dithyrea maritima	Beach spectaclepod	ST CRPR 1B.1 S2.1	Coastal dunes, coastal scrub. Located at sea shores on sand dunes and sandy places near the shore. Elevation range: 10 - 165 feet. Blooms: March – May.	**Presumed Absent**. Known historically from the study area and last observed in the project region in 1934; dune and nonnative dune habitats in Area B are potential habitat for this species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in April 2011, did not observe this species.
Dudleya cymosa subsp. *ovatifolia*	Santa Monica dudleya	FT CRPR 1B.2 S1	Chaparral, coastal scrub. Located in canyons on sedimentary conglomerates on primarily north-facing slopes. Elevation range: 485 – 5430 feet. Blooms: March – June. (CNDDB 2014; CNPS 2014)	**Confirmed Absent**. Present in the project region, but the study area is outside of the species' range; occurs on rock outcrops, which do not occur in the study area; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in July 2010 did not observe this species.
Dudleya multicaulis	Many-stemmed dudleya	CRPR 1B.2 S2	Chaparral, coastal scrub, valley and foothill grassland. Located in heavy, often clay soils or grassy slopes. Elevation range: 45 – 2560 feet. Blooms: April – July. (CNDDB 2014; CNPS 2014)	**Confirmed Absent**. Present in the project region, but the study area is outside of the species' range; occurs on clay soils and sandstone outcrops, which do not occur in the study area; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in July 2010 and April 2011 did not observe this species.
Dudleya virens subsp. *insularis*	Island green dudleya	CRPR 1B.2 S2.2	Coastal bluff scrub, coastal scrub. Located on rocky sites. Elevation range: 15 – 975 feet. Blooms: April – June. (CNDDB 2014; CNPS 2014)	**Confirmed Absent**. Present in the project region but not known from the study area; the study area contains restored coastal scrub habitat, but not the drier, steeper bluffs and rock outcrops that provide suitable microsite conditions for the species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in July 2010 and April 2011, did not observe this species.

Scientific Name	Common Name	Status	Habitat Requirements	Occurrence Determination
Erysimum suffrutescens (=*Erysimum insulare* subsp. *suffrutescens*)	Suffrutescent wallflower	CRPR 4.2 S3.2	Coastal bluff scrub, coastal scrub, valley and foothill grassland. Located on coastal dunes and bluffs. Elevation range: 0 – 490 feet. Blooms: January – July. (CNDDB 2014; CNPS 2014)	**Confirmed Present**. First observed in the project region in the late 1800s and often observed in the region in subsequent years; observed during multiple surveys of the study area conducted since 1979; several populations were mapped on the study area in Areas A, B, and C during focused rare plant surveys in 2011.
Helianthus nuttallii subsp. *parishii*	Los Angeles sunflower	CRPR 1A SH	Coastal salt and freshwater marshes and swamps. Elevation range: 30 – 5445 feet. Blooms: August – October. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Known historically in the project region but not known from the study area; wetlands in the study area may be potential habitat for the species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in July and October 2010, did not observe this species.
Hordeum intercedens	Vernal barley	CRPR 3.2 S3S4	Coastal dunes, coastal scrub, valley and foothill grassland, vernal pools. Located on saline flats and depressions. Elevation range: 15 – 3240 feet. Blooms: March – June. (CNPS 2014)	**Presumed Absent**. Historically present in the study area but not observed since 1901; although primarily found in alkali grasslands and vernal pools, the margins of salt pan habitat in the study area may be potential habitat for the species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in April 2011, did not observe this species.
Horkelia cuneata subsp. *puberula*	Mesa horkelia	CRPR 1B.1 S2.1	Chaparral, cismontane woodland, coastal scrub. Located on sandy or gravelly sites. Elevation range: 225 – 2,625 feet. Blooms: February – September. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Present in the project region, but the study area is outside of the species' range; primarily a chaparral species, and the habitats in the study area do not provide suitable microsite conditions for the species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in July 2010 and April 2011, did not observe this species.
Juglans californica	Southern California black walnut	CRPR 4.2 S3.2	This deciduous tree blooms from March to August in alluvial soils of cismontane woodland, chaparral, coastal scrub, between 164 to 2,952 feet elevation. Known from Los Angeles, Orange, Riverside, Santa Barbara, San Bernardino, San Diego, and Ventura counties. (CNPS 2014)	**Confirmed Absent**. Present in the project region, but the study area is outside of the species' range; primarily a woodland or chaparral species, and the habitats in the study area do not provide suitable microsite conditions for the species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in July 2010 and April 2011, did not observe this species.
Juncus acutus subsp. *leopoldii*	Southwestern spiny rush	CRPR 4.2 S3.2	Coastal dunes, meadows and seeps, coastal salt marshes. Located on mesic, alkaline seeps, and coastal salt. Elevation range: 10 – 2925 feet. Blooms: May – June. (CNPS 2014)	**Presumed Absent**. Known historically in the project region but not known from the study area; wetlands in the study area may provide suitable habitat for the species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in July

Scientific Name	Common Name	Status	Habitat Requirements	Occurrence Determination
				2010, did not observe this species.
Lasthenia glabrata subsp. *coulteri*	Coulter's goldfields	CRPR 1B.1 S2.1	Coastal salt marshes, playas, valley and foothill grassland, vernal pools. Typically located on alkaline soils in playas, sinks, and grasslands. Elevation range: 1 – 3955 feet. Blooms: February – June. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Historically present in the study area but not observed since 1934; wetlands in the study area may provide suitable habitat for the species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in April 2011, did not observe this species.
Leptosyne maritima	sea dahlia	CRPR 2B.2 S2.2	Found in coastal bluff scrub and coastal scrub habitat. Located on a variety of soil types, including sandstone. Elevation range: 5-150 meters. Blooming period: March-May. (CNDDB 2014; CNPS 2014)	**Presumed Absent.** Does not occur in the project region; study area is outside of the species' range; the study area contains coastal scrub habitat, but not the drier, steeper bluffs that provide suitable microsite conditions for the species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in 2010 and 2011, did not observe this species.
Monardella hypoleuca subsp. h*ypoleuca*	White-veined monardella	CRPR 1B.3 S2S3	Found in chaparral and cismontane woodland. Located on dry slopes. Elevation range: 50-1525 meters. Blooming period: April- December. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Present in the project region, but the study area is outside of the species' range; no habitats on site suitable for the species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in 2010 and 2011, did not observe this species.
Mucronea californica	California spineflower	CRPR 4.2 S3	Chaparral, cismontane woodland, coastal dunes, coastal scrub, valley and foothill grassland. Located on sandy soils. Elevation range: 0 – 4550 feet. Blooms: March – August. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Known historically in or near the study area until 1934; restored coastal dune and coastal scrub habitat underlain by sandy substrate may provide habitat for this species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in 2010 and 2011, did not observe this species.
Nama stenocarpum	Mud nama	CRPR 2B.2 S1S2	Marshes and swamps. Located on lake shores, streams banks, and intermittently wet areas. Elevation range: 15 – 1620 feet. Blooms: January – July. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Known historically in the project region (last seen in 1924) but not known from the study area; ruderal and brackish marsh margins may provide potential habitat for this species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in July 2010 and April 2011, did not observe this species.
Nasturtium gambelii	Gambel's watercress	FE ST CRPR 1B.1 S1	Brackish and freshwater marshes and swamps. Located on lake and stream margins at or immediately above the water line. Elevation range: 15 – 1075 feet. Blooms: April – October. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Known historically in the project region (last seen in 1904) but not known from the study area; closely associated with freshwater wetland habitat, which is not present in the study area; multiple

Scientific Name	Common Name	Status	Habitat Requirements	Occurrence Determination
				surveys of the study area conducted since 1979, including focused rare plant surveys in July 2010, did not observe this species.
Navarretia fossalis	Spreading navarretia	FT CRPR 1B.1 S1	Vernal pools, chenopod scrub, marshes, swamps, and playas. Located on hardpan soils in swales, depressions, and pools. Elevation range: 95 – 4225 feet. April – June. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Known historically in the project region (last seen in 1906) but not known from the study area; no potential habitat for this species in the study area; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in April 2011, did not observe this species.
Navarretia prostrata	Prostrate navarretia	CRPR 1B.1 S2	Found in mesic conditions within coastal scrub, meadows and seeps, valley and foothill grassland (alkaline), and vernal pools. Elevation range: 45 – 2270 feet. Blooms: April – July. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Known historically from coastal plains in the project region (last seen in 1944) but not known from the study area; no potential habitat for this species in the study area; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in April 2011, did not observe this species.
Nemacaulis denudata var. *denudata*	coastal wooly-heads	CRPR 1B.2 S2.2	Coastal dunes. Elevation range: 0 – 325 feet. Blooms: April – September. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Not known to occur in the project region or study area, although the study site is within the species' range; the study area contains restored coastal dune habitat that that is potential habitat for this species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in July 2010 and April 2011, did not observe this species.
Orcuttia californica	California Orcutt grass	FE SE CRPR 1B.1 S1	Vernal pools. Elevation range: 45 – 2145 feet. Blooms: April – August. (CNPS 2014)	**Presumed Absent**. Known historically from coastal plains in the project region (last seen in 1946) but not known from the study area; no potential habitat for this species in the study area; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in July 2010 and April 2011, did not observe this species.
Pentachaeta lyonii	Lyon's pentachaeta	FE SE CRPR 1B.1 S2	Chaparral, valley and foothill grassland. Located on the edges of openings at the ecotone between chaparral and grassland. Elevation range: 95 – 2050 feet. Blooms: March – August. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Known historically in the project region (last seen in 1884) but not known from the study area; no potential habitat for this species in the study area; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in July 2010 and April 2011, did not observe this species.

Scientific Name	Common Name	Status	Habitat Requirements	Occurrence Determination
Phacelia hubbyi	Hubby's phacelia	CRPR 4.2 S3.2	Found in gravelly, rocky, talus soil in chaparral, coastal scrub, and valley and foothill grassland habitat. Elevation range: 0 – 3,280 feet. Blooming period: April - July. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Known in the project region from the Palos Verdes Hills and the Santa Monica Mountains but not known from the study area; no potential habitat for this species in the study area; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in July 2010 and April 2011, did not observe this species.
Phacelia ramosissima var. *austrolitoralis*	South coast branching phacelia	CRPR 3.2 S3.2	Chaparral, coastal dunes, coastal scrub, coastal salt marshes. Located on sandy, sometimes rocky soils. Elevation range: 20 – 975 feet. Blooms: March – August. (CNPS 2014)	**Confirmed Present**. First recorded from the study area in 1901, this species has been observed in the study area on multiple occasions, including focused rare plant surveys in July, October, and April 2011.
Phacelia stellaris	Brand's star phacelia	CRPR 1B.1 S1	Coastal scrub, coastal dunes. Located in open areas. Elevation range: 1 – 1300 feet. Blooms: March – June. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Known historically in or near the study area until 1932; restored coastal dune and coastal scrub habitat underlain by sandy substrate may be suitable habitat for this species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in April 2011, did not observe this species.
Potentilla multijuga	Ballona cinquefoil	CRPR 1A SX	Perennial herb found in brackish meadows and seeps. Elevation range: 0 – 10 feet. Blooms: June – August. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. This species is known from only a single location. It was originally collected on the flats of Ballona (now called Venice) in the 1890. No further observations of the species were made, and it is presumed to be extinct. Multiple surveys of the study area conducted since 1979, including focused rare plant surveys in July 2010, did not observe this species.
Pseudognaphalium leucocephalum	White rabbit-tobacco	CRPR 2B.2 S3.2	Riparian woodland, cismontane woodland, coastal scrub, chaparral. Elevation range: 0 – 6,825 feet. Blooms: July – December. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Known historically in the project region until 1907; the study area is outside of the species' range; coastal scrub habitat in the study area may be suitable habitat for the species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in July and October 2010, did not observe this species.
Quercus dumosa	Nuttall's scrub oak	CRPR 1B.1 S2	This evergreen shrub blooms from February to August at elevations from 49 to 1,312 feet. It inhabits sandy soils and clay loam in coastal scrub, chaparral, and closed-cone coniferous forests. It can be found along the coasts of Santa Barbara, Orange, and San Diego counties. (CNPS 2014)	**Confirmed absent**. Not known to occur in the project region or study area; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in July 2010 and April 2011, did not observe this species.

Scientific Name	Common Name	Status	Habitat Requirements	Occurrence Determination
Sidalcea neomexicana	Salt spring checkerbloom	CRPR 2B.2 S2S3	Alkali playas, brackish marshes, chaparral, coastal scrub, lower montane coniferous forest, Mojavean Desert scrub. Located on alkali springs and marshes. Elevation range: 45 – 4,960 feet. Blooms: March – June. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Known historically in the project region from a single collection in 1890; the study area is outside of the species' range; brackish marsh in the study area may be suitable habitat for the species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in July 2010 and April 2011, did not observe this species.
Suaeda esteroa	Estuary seablite	CRPR 1B.2 S2	Coastal salt marshes and swamps. Located on clay, silt, and sand substrates. Elevation range: 0 – 15 feet. Blooms: May – January. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Not known to occur in the project region or the study area; marshes in the study area may be suitable habitat for the species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in July and October 2010 did not observe this species.
Suaeda taxifolia	Wooly seablite	CRPR 4.2 S2S3	Coastal bluff scrub, coastal dunes, margins of coastal salt marshes. Elevation range: 0- 165 feet. Blooms: January – December. (CNDDB 2014; CNPS 2014)	**Confirmed Present**. The species is known to occur in the study area from multiple collections made from Playa del Rey and Ballona wetlands between 1901 and 1981. Coastal salt marsh and coastal dunes in the study area are habitat for this species habitat. Focused rare plant surveys in April, July, and October 2011 located this species in Area B.
Symphyotrichum (=Aster) defoliatum	San Bernardino Aster	CRPR 1B.2 S2	Meadows and seeps, marshes and swamps, coastal scrub, cismontane woodland, lower montane coniferous forest, grassland. Located in mesic grassland near ditches, streams, and springs. Elevation range: 5 – 6,630 feet. Blooms: July – November. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Known historically in the project region (last seen in 1930) but not known from the study area; coastal scrub and grasslands habitats in the study area do not provide suitable habitat for this species; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in July and October 2010 did not observe this species.
Symphyotrichum (=Aster) greatae	Greata's aster	CRPR 1B.3 S2.3	Chaparral, cismontane woodland. Located in mesic canyons. Elevation range: 975 – 6535 feet. Blooms: June – October. (CNDDB 2014; CNPS 2014)	**Presumed Absent**. Known historically in the project region (last seen in 1932) but not known from the study area; no chaparral or woodland habitat present in the study area; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in July and October 2010 did not observe this species.

Scientific Name	Common Name	Status	Habitat Requirements	Occurrence Determination
Thelypteris puberula var. *sonorensis*	Sonoran maiden fern	CRPR 2B.2 S2.2?	This rhizomatous perennial herb inhabits seeps and streams in meadows, from southern California south to Sonora, Mexico, and east to Arizona. Within California it is known from Santa Barbara, Los Angeles, Riverside, and San Bernardino counties, at elevations from about 164 to 2,001 feet. This fern is rare to uncommon in California, but more common outside of the state. (CNPS 2014)	**Presumed Absent**. Not known to occur in the project region or study area; no suitable habitat present in the study area; multiple surveys of the study area conducted since 1979, including floristic rare plant surveys in July 2010 and April 2011, did not observe this species.

Shading
Species not expected to occur in the study area because the study area is outside of the species range and/or no suitable habitat is present in the study area.

Confirmed Present
A qualified biologist or other reliable source has confirmed the presence of the species. Depending on the species and other information available, it may or may not be possible to determine, without further studies, what portions of the study area are currently in use.

Presumed Present
The study area is known to be within the range of the species, and contains potentially suitable habitat. Although no individuals or diagnostic sign were detected during the most recent fieldwork by a qualified observer (2010-2011), the species has been reported to occur in the study area within the last 30 years.

Presumed Absent
The species is not known to occur in the study area or has only been observed there historically (>30 years ago). Potentially suitable habitat may or not be present. No individuals or diagnostic sign were detected by a qualified observer within the last 30 years.

Confirmed Absent
Confirmed to be absent by qualified observer. This category applies to woody trees and shrubs that can be readily observed at any time of year.

NOTES:
Federal
FE = Endangered
FT = Threatened
FC = Candidate
State
SE = Endangered
ST = Threatened
CSC = Species of Special Concern
CFP = Fully Protected Species
Rare = Listed as rare under the California Native Plant Protection

CRPR – California Rare Plant Rank
1A. Presumed extinct in California
1B. Rare or Endangered in California and elsewhere
2A. Presumed extinct in California, extant and more common elsewhere
2B. Rare or Endangered in California, more common elsewhere
3. Plants for which we need more information - Review list
4. Plants of limited distribution - Watch list
Threat Ranks
.1 - Seriously endangered in California
.2 – Fairly endangered in California
.3 – Not very endangered in California

Note: The California Natural Diversity Database (CNDDB) uses the same ranking methodology originally developed by The Nature Conservancy and now maintained and recently revised by NatureServe. The state rank (S-rank) refers to the imperilment status only within California's state boundaries. It is a reflection of the overall status of an element through its state range. The state rank represent a letter + number score that reflects a combination of Rarity, Threat, and Trend factors, with weighting being heavier on Rarity than the other two.

S1 = Critically Imperiled - Critically imperiled in the state because of extreme rarity (often 5 or fewer populations) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state.

S2 = Imperiled - Imperiled in the state because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the state.
S3 = Vulnerable - Vulnerable in the state due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation from the state.
S4 = Apparently Secure - Uncommon but not rare in the state; some cause for long-term concern due to declines or other factors.
S5 = Secure - Common, widespread, and abundant in the state.
SH = All sites are historical; the element has not been seen for at least 20 years, but suitable habitat still exists.
SX = All sites are extirpated.
Uncertainty about the rank of an element is expressed in two major ways:

- By expressing the ranks as a range of values: e.g., S2S3 means the rank is somewhere between S2 and S3.
- By adding a ? to the rank: e.g., S2? This represents more certainty than S2S3, but less certainty than S2.

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APPENDIX D12
Special-Status Wildlife

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Appendix D12-Special-status Species Occurrence Tables

Benthic and Terrestrial Invertebrates

Fish

Reptiles and Amphibians

Birds

Mammals

Special-status Benthic and Terrestrial Invertebrates

Common Name	Scientific Name	Status	Habitat Requirements	Likelihood of Occurrence
Belkin's Dune Tabanid Fly	*Brennania belkini*	S1S2	Found in exposed sandy substrates within southern foredune and southern dune scrub plant communities. Adults fly from late May to early July and breed only on coastal sand dunes (CNDDB 2014).	**Low potential**. Sand dunes are present south of Ballona Creek and east of Vista Del Mar Road. One adult was collected on the sand dunes and larvae were collected below the soil surface in 1980. No flies have been detected since the 1980's. (CNDDB 2014)
Busck's Gallmoth	*Carolella busckana*	SH	Type location for this species from El Segundo sand dunes. (CNDDB 2014)	**Less than reasonable**. Terrestrial invertebrate surveys did not detect this species. Last detection was in 1938 and 1939. Possibly extirpated in Los Angeles County. (CNDDB 2014)
Dorothy's El Segundo Dune Weevil	*Trigonoscuta dorothea dorothea*	S1	Distributed only along coastal southern California from Point Dume to Point Fermin and is associated with southern dune scrub plant community.	**Moderate potential**. Detected in 1995, 1996, and 2001 terrestrial invertebrate surveys is the dune system immediately west of Area B (CNDDB 2014). Not detected in 2009 and 2011 terrestrial invertebrate surveys. Dune scrub vegetation is present in Area B.
El Segundo Blue Butterfly	*Euphilotes battoides allyni*	FE S1	Historically ranged over the entire Los Angeles/El Segundo Dunes and the northwestern Palos Verdes Peninsula in southwestern LA County. Currently distributed on three remnant habitats within its former range supporting coastal sand dunes with coast buckwheat (*Eriogonum parvifolium*). All life stages depend on sea cliff buckwheat (*Eriogonum parvifolium*) and possibly loose sand.	**Confirmed Present**. Approximately 30 individuals were observed on 19 July 2011. Psomos (2013) reported 199 butterflies during presence/absence surveys. The individuals were observed in Area B's dune habitat on coast buckwheat, *Eriogonum parvifolium*, which was planted as part of the Friends of Ballona Wetlands dune restoration project.
El Segundo Flower-loving Fly	*Rhaphiomidas terminatus terminatus*	S1	Areas containing sandy substrates with a sparse cover of perennial shrubs and other vegetation constitute the primary habitat requirement for *Rhaphiomidas* flies. This subspecies was believed extinct since its last sighting in 1965; however, in 2001 a small colony was found on the upper Malaga sand dune in Los Angeles County, California (CNDDB 2014).	**Less than reasonable**. Not detected in previous terrestrial invertebrate surveys. Last documented observation was in 2001 in Redondo Beach quad (CNDDB 2014).
Gertsch's Socalchemmis Spider	*Socalchemmis gertschi*	S1	Found in sage scrub, chaparral, oak woodland, coniferous forest, generally in rocky outcrops or talus slopes (moveable rocks with spaces or cracks) in non-arid climates.	**Less than reasonable**. Not detected in previous terrestrial invertebrate surveys. Previously detected in Topanga Canyon in 1997 and in Brentwood in 1952. (CNDDB 2014)

Common Name	Scientific Name	Status	Habitat Requirements	Likelihood of Occurrence
Globose Dune Beetle	*Coelus globosus*	S1	Inhabitant of coastal sand dune habitat, typically foredunes and sand hummocks, from Bodega Head in Sonoma County, south to Ensenada, Mexico.	**Moderate Potential**. Detected in dunes in Area B in 1996 and 2001 (CNDDB 2014). Although this species was not detected in recent terrestrial invertebrate surveys (Johnston et al. 2011 and 2012), coastal sand dune habitat still present on the Reserve.
Henne's Eucosman Moth	*Eucosma hennei*	S1	Endemic to the Los Angeles/El Segundo Dunes in Los Angeles County. Species has been collected from and identified at the dunes in 1984.Larvae are stem and root borers of *Phacelia ramosissim.* (CNDDB 2014)	**Low Potential**. Last detection in 1984 in El Segundo dunes (CNDDB). No detected in previous terrestrial invertebrate surveys in the Project area; however, host plant present on the Project site.
Lange's El Segundo Dune Weevil	*Onychobaris langei*	S1	Occurs in southern foredune and southern dune scrub plant communities. Possible food plant is an evening primrose (*Oenothera* sp.) (CNDDB 2014).	**Moderate potential**. Detected in 1981, 1991, and 2001 terrestrial invertebrate surveys in the dune system immediately west of Area B. Although evening primrose species were not detected in floristic surveys after 2002, dune scrub vegetation remains present in Area B.
mimic tryonia (=California brackishwater snail)	*Tryonia imitator*	S2S3	Inhabits coastal lagoons, estuaries and salt marshes, from Sonoma County south to San Diego County (CNDDB 2014).	**Less than reasonable**. This species was reported from Ballona Creek in 1974. The original report was based on the presence of empty shells of this species and there have been no subsequent reports of this species, despite several benthic invertebrate surveys (CNDDB 2014; WRA 2013).
Monarch Butterfly	*Danaus plexippus*	S3	Winter roost sites extend along the coast from northern Mendocino to Baja California, Mexico. Roosts located in wind-protected tree groves (e.g., eucalyptus, Monterey pine, and cypress). (CNDDB 2014)	**Confirmed Present**. Detected in marsh habitats of western Area B during vegetation surveys. Monarchs detected in October 2010 monarch surveys. Eucalyptus stands on the Reserve considered wintering sites.
Palos Verdes Blue Butterfly	*Glaucopsyche lygdamus palosverdesensis*	FE S1	Restricted to the cool, fog-shrouded, seaward side of Palos Verdes Hills, Los Angeles County. Larval host Southern California milkvetch *(Astragalus trichopodus* ssp. *locnhus)* which is typically found on clay soils on rocky slopes. Butterflies feed on milkvetch and deerweed.	**Less than reasonable**. Historical sightings in the CNDDB search include 2001 at Malaga Cove (approx. 10 miles to the south). Other sightings in CNDDB from 1980's considered possibly extirpated (CNDDB 2014). Not detected in previous terrestrial invertebrate surveys in the Project area.
Quino Checkerspot Butterfly	*Euphydryas editha quino*	FE S1	Habitat is characterized by patchy shrub or small tree landscapes with openings of several meters, between large plants or a landscape of open swales alternating with dense patches of shrubs. Egg deposition has been documented on erect or dwarf plantain (*Plantago erecta*), Patagonian plantain (*Plantago patagonica*), and white snapdragon (*Anterrhinum coulterianum*).	**Confirmed absent**. Host plant not present. Quino has been extirpated from Los Angeles County (CNDDB 2014). Not detected in previous terrestrial invertebrate surveys.

Common Name	Scientific Name	Status	Habitat Requirements	Likelihood of Occurrence
Riverside Fairy Shrimp	*Streptocephalus woottoni*	FE S1	Found in shallow depressions containing a clay hard pan soil layer. Discontinuously distributed along coastal southern California and northern Baja California. The species was found at Los Angeles International Airport (USFWS 2009b).	**Low potential**. No vernal pools present on the site. Previous studies determined that because of high salinities and inadequate depth and/or duration of ponding that the Project site did not support suitable habitat.
San Diego Fairy Shrimp	*Branchinecta sandiegonensis*	FE S1	Species found in deep vernal pools, road cuts, and depressions that retain water through the warm weather of late April and May. Distribution is limited to discrete localities from Los Angeles County (LAX), Orange County, Riverside, and San Diego Counties south to Baja California.	**Low potential**. No vernal pools present on the site. Previous studies determined that because of high salinities and inadequate depth and/or duration of ponding that the Project site did not support suitable habitat.
Sandy Beach (= Hairy Necked) Tiger Beetle	*Cicindela hirticollis gravida*	S1	Inhabits clean, dry, light-colored sand in the upper zone of the beach dunes, usually close to non-brackish water. Occurs along the coast of California from San Francisco Bay to northern Mexico. (CNDDB 2014)	**Less than reasonable**. Playa Del Ray, the beach west of the study area and south of Ballona Creek is a historical location for the species. According to CNDDB, last recoded sighting was in 1907 and the species is believed to be extirpated (CNDDB 2014).
Santa Monica shieldback Katydid	*Aglaothorax longipennis*	S1S2	Occurs nocturnally on chaparral and canyon stream bottom vegetation and also on introduced ice plant (*Mesembryantheum* sp.). Only one population is known and it was identified at the mouth of Big Rock Canyon in 1975. (CNDDB 2014)	**Less than reasonable**. Previous survey efforts did not detect the species. The only known population occurs in the Santa Monica mountains and was detected in 1975 and preferred habitat is not present in the Project area.
Senile Tiger Beetle	*Cicindela senilis frosti*	S1	Found in the middle to upper parts of salt marshes. The beetle has a bimodal flight period in early spring and late fall. (CNDDB 2014)	**Less than reasonable**. Not detected in previous terrestrial invertebrate surveys. Documented historical location is Manhattan Beach (1979). This species is believed to be extirpated from Los Angeles County-Manhattan Beach (CNDDB 2014).
Wandering (= saltmarsh) Skipper	*Panoquina errans*	S1	Distributed along a narrow coastal strip from Santa Barbara and Ventura to San Diego County. Often associated with host plant, saltgrass (*Distichlis spicata*) (CNDDB 20140.	**Confirmed present**. Detected in marsh habitats of western Area B during vegetation surveys. Detected in 2010 and 2011 in the salt marsh of Area B. Detected in Areas A and B during 1981, 1991, 1995, and 2001 surveys (CNDDB 2014). Host plant present during floristic surveys from 1991-2011.
Western S-banded Tiger Beetle	*Cicindela trifasciata sigmoidea*	SNR	Salty coastal habitats including salt marshes, tidal flats, beaches.	**Low potential**. Detected during sensitive insect survey (1996) and insect and related terrestrial arthropod survey (1981). Potential suitable habitat occurs on the Reserve.
Western Tidal Flat Tiger Beetle	*Cicindela gabbii*	S1	Found in salty coastal habitats including salt marshes, tidal flats, beaches. Species burrows in or uses soil.	**Low potential**. Potential suitable habitat occurs on the Reserve.

Shading Species which has less than reasonable potential for occurrence and impact.
Confirmed Present A qualified biologist or other reliable source has confirmed the presence of the species and there is no specific evidence that the species has subsequently become absent. Depending on the species and other information available, it may or may not be possible to determine, without further studies, what portions of the study area are currently in use.
High Potential The study area is known to be within the range of the species, and contains potential habitat with a high likelihood of occupancy. Although no individuals or diagnostic sign were detected during current fieldwork by a qualified observer, the species is likely to be present to some degree given the best available information. Depending upon regulatory status, local rarity, public interest, extent of habitat on the study area, and the nature of potential project impacts, a substantial basis may exist for either conducting focused surveys for the species or for assuming presence.
Moderate Potential The study area is within the range of the species, and contains potentially appropriate habitat. Neither individuals nor diagnostic sign were detected. It is nevertheless reasonable that some individuals may have been overlooked. The best available information on the species with regard to the study area is either very uncertain, or may be equally weighted for and against occurrence. Depending upon local and special legal status, extent of habitat, and the nature and sensitivity of the project, focused surveys for the species may be warranted or presence may be assumed.
Low Potential Occurrence of the species is reasonable but Less than reasonable because of some combination of facts. For example, 1) the study area was the subject of unsuccessful searches conducted under relevant and reasonable circumstances, 2) potential habitat present is marginal or minimal in extent, 3) the best available information suggests the species is absent from the study area, and/or 4) available information sheds no clear light on the species likelihood on the study area, but it is known to be rare at best in the vicinity. Neither the species nor any indication of its presence was detected. Although individuals may have been missed, it is Less than reasonable that substantial populations are present. Further evaluation should usually not be required for individual species except, in most cases, for biologically threatened or endangered species. Note however, that where several non-listed species hold this status, a higher likelihood of occurrence for "one or more" will generally hold. This is due both to the increased number of species and the fact that an array of possibilities often correlates with greater site biodiversity and lower relevant (but not readily detected) disturbance levels.
Less than reasonable Although occurrence may be remotely possible, the likelihood of occurrence is less than that required for any potentially applicable regulatory threshold. Further, the likelihood of meaningful value of the site to any population(s) of this taxon is less than reasonable. The species may or may not include the study area within its current, general range. However, no appropriate, or adequately extensive, or effectively connected habitat is present. Neither the species nor any indication of its presence was detected. In some cases this likelihood may indicate that based on the best available information, the study area has a very high probability of being outside of the species' current range. In all of the above cases, the species may not be definitively ruled out but is strongly believed to be absent based on professional evaluation of all available evidence. In some cases, the species may occur on rare occasions and in low numbers, but with no more than brief, incidental use of the study area. That is, the site is also judged to lack any important function for the species. Certainly there are no substantial populations directly utilizing the study area at any time of year. Further evaluation should not normally be required
Confirmed Absent Confirmed to be absent on the study area as a formal and/or practical matter. Most often, this is a determination based on negative results of a focused survey for the species conducted in appropriate habitat at appropriate time(s) of year, using biologically sound methods and qualified personnel. In the remaining cases, it may be based on a simple study area examination, for species and study area contexts where it is easily determined that the species is absent; for example, a tidal marsh insect and a dry mountainside study area, or a disturbance-intolerant chaparral shrub where the study area is a long-standing, degraded grassland far from chaparral. The relevant fieldwork was also in all cases conducted within a time frame sufficiently recent to conclude that the species remains absent, based on study area

conditions and the species' known ecology. In most cases a specific, established survey protocol and/or guidelines have been followed.

NOTES:

Federal

FE = Endangered
FT = Threatened
FC = Candidate

State

SE = Endangered
ST = Threatened
CSC = Species of Special Concern
CFP = Fully Protected Species
WL= California Watchlist (formerly a Species of Special Concern; limited protection)

Note: The California Natural Diversity Database (CNDDB) uses the same ranking methodology originally developed by The Nature Conservancy and now maintained and recently revised by NatureServe. The *state rank* (S-rank) refers to the imperilment status only within California's state boundaries. It is a reflection of the overall status of an element through its state range. The state rank represent a letter + number score that reflects a combination of Rarity, Threat, and Trend factors, with weighting being heavier on Rarity than the other two.

S1 = Critically Imperiled - Critically imperiled in the state because of extreme rarity (often 5 or fewer populations) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state.

S2 = Imperiled - Imperiled in the state because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the state.

S3 = Vulnerable - Vulnerable in the state due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation from the state.

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S5 = Secure - Common, widespread, and abundant in the state.

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SX = All sites are extirpated.

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SNR = Unranked

Special-status Fish Species

Scientific Name	Common Name	Status	Habitat Requirements	Likelihood of Occurrence
Catostomus santaanae	Santa Ana sucker	FT CSC S1	As a freshwater fish, this species occurs in watersheds draining the San Gabriel and San Bernardino Mountains of southern California. Most abundant in unpolluted, clear water that is less than 72F, but can tolerate warmer water temperatures and turbid water conditions. Prefer gravel, cobble and cobble with sand substrates and riffle, runs and pools with riparian vegetation that provides shade and cover.	**Less than reasonable.** The lack of suitable freshwater conditions and absence of the species during past surveys suggests this species is not present. The Santa Ana sucker has been historically documented in the Los Angeles River so may have occurred in the distant past.
Eucyclogobius newberryi	Tidewater Goby	FE CSC S2S3	Found primarily in waters of coastal lagoons, estuaries, and marshes, and historically ranged from mouth of the Smith River, Del Norte County to northern San Diego County. The species is benthic in nature, living at the bottom of shallow brackish bodies of water, such as lagoons and in lower stream reaches where the water is fairly still but not stagnant. Prefer water with high dissolved oxygen levels and salinities less than 10 parts per thousand (ppt).	**Less than reasonable.** The species may have occurred historically; however, the species has not been detected during numerous studies over the last several decades.
Gasterosteus aculeatus williamsoni	Unarmored Threespine Stickleback	FE SE CFP S1	As a freshwater fish, this species is found in slow-moving or standing water with aquatic vegetation. Can be found in the shallow edges of streams in areas with dense vegetation.	**Less than reasonable.** The lack of suitable freshwater conditions and absence of the species during past surveys suggests this species is not present. There is no historic record of occurrence of this species near the study site.
Gila orcutti	Arroyo Chub	CSC S2	This freshwater fish inhabits sandy and muddy bottoms in flowing pools and runs of headwaters creeks and small to medium rivers. Often found in intermittent streams.	**Less than reasonable.** The lack of suitable freshwater conditions and absence of the species during past surveys suggests this species is not present. There is no historic record of occurrence of this species near the study site.

Scientific Name	Common Name	Status	Habitat Requirements	Likelihood of Occurrence
Oncorhynchus mykiss irideus	Southern California Steelhead	FE CSC S2	Migrate into fresh water streams when sandbars breach during winter and spring rains. Occur in coastal streams with water temperatures < 15°C. Need cool, clear water with in-stream cover. Spawn in tributaries to large rivers or streams directly connected to the ocean. Spawning habitat consists of gravel substrates free of excessive silt. Thrive when dissolved oxygen concentration is at least 7 parts per million. In streams, deep low-velocity pools are important wintering habitats. They have been extirpated from at least 11 southern California streams: San Luis Rey River, San Mateo Creek, Santa Margarita River, Rincon Creek, Maria Ygnacio River, Los Angeles River, San Gabriel River, Santa Ana River, San Onofre Creek, San Juan Creek, San Diego River, and Sweetwater River.	**Low Potential.** Although individuals have been periodically observed in Ballona Creek (Johnston et al. 2011), this creek and its tributaries are urbanized and provide no spawning conditions.
Rhinichthys osculus	Santa Ana Speckled Dace	CSC S1	Inhabits rocky riffles, runs and pools of headwaters, creeks and small to medium rivers.	**Less than reasonable.** The lack of suitable freshwater conditions and absence of the species during past surveys suggests this species is not present. There is no historic record of occurrence of this species near the study site.
Siphateles bicolor mohavensis	Mohave Tui Chub	FE SE CFP S1	Deep pools or shallow outflow streams of mineralized, alkaline waters. Formerly in mainstream Mohave River; now in lakes and mineral spring pools. Dominant plants in habitat include ditchgrass, bulrush, cattail, rush, and saltgrass). Capable of surviving low oxygen (1 mg oxygen/L) and high alkaline (pH 9-10) environments.	**Less than reasonable.** Suitable conditions for this species not present in the Project area. There is no historic record of occurrence of this species near the study site.

Shading Species which has less than reasonable potential for occurrence and impact.
Confirmed Present A qualified biologist or other reliable source has confirmed the presence of the species and there is no specific evidence that the species has subsequently become absent. Depending on the species and other information available, it may or may not be possible to determine, without further studies, what portions of the study area are currently in use.
High Potential The study area is known to be within the range of the species, and contains potential habitat with a high likelihood of occupancy. Although no individuals or diagnostic sign were detected during current fieldwork by a qualified observer, the species is likely to be present to some degree given the best available information. Depending upon regulatory status, local rarity, public interest, extent of habitat on the study area, and the nature of potential project impacts, a substantial basis may exist for either conducting focused surveys for the species or for assuming presence.
Moderate Potential The study area is within the range of the species, and contains potentially appropriate habitat. Neither individuals nor diagnostic sign were detected. It is nevertheless reasonable that some individuals may have been overlooked. The best available information on the species with regard to the study area is either very uncertain, or may be equally weighted for and against occurrence. Depending upon local and special legal status, extent of habitat, and the nature and sensitivity of the project, focused surveys for the species may be warranted or presence may be assumed.
Low Potential Occurrence of the species is reasonable but Less than reasonable because of some combination of facts. For example, 1) the study area was the subject of unsuccessful searches conducted under relevant and reasonable circumstances, 2) potential habitat present is marginal or minimal in extent, 3) the best available information suggests the species is absent from the study area, and/or 4) available information sheds no clear light on the species likelihood on the study area, but it is known to be rare at best in the vicinity. Neither the species nor any indication of its presence was detected. Although individuals may have been missed, it is Less than reasonable that substantial populations are present. Further evaluation should usually not be required for individual species except, in most cases, for biologically threatened or endangered species. Note however, that where several non-listed species hold this status, a higher likelihood of occurrence for "one or more" will generally hold. This is due both to the increased number of species and the fact that an array of possibilities often correlates with greater site biodiversity and lower relevant (but not readily detected) disturbance levels.
Less than reasonable Although occurrence may be remotely possible, the likelihood of occurrence is less than that required for any potentially applicable regulatory threshold. Further, the likelihood of meaningful value of the site to any population(s) of this taxon is less than reasonable. The species may or may not include the study area within its current, general range. However, no appropriate, or adequately extensive, or effectively connected habitat is present. Neither the species nor any indication of its presence was detected. In some cases this likelihood may indicate that based on the best available information, the study area has a very high probability of being outside of the species' current range. In all of the above cases, the species may not be definitively ruled out but is strongly believed to be absent based on professional evaluation of all available evidence. In some cases, the species may occur on rare occasions and in low numbers, but with no more than brief, incidental use of the study area. That is, the site is also judged to lack any important function for the species. Certainly there are no substantial populations directly utilizing the study area at any time of year. Further evaluation should not normally be required
Confirmed Absent Confirmed to be absent on the study area as a formal and/or practical matter. Most often, this is a determination based on negative results of a focused survey for the species conducted in appropriate habitat at appropriate time(s) of year, using biologically sound methods and qualified personnel. In the remaining cases, it may be based on a simple study area examination, for species and study area contexts where it is easily determined that the species is absent; for example, a tidal marsh insect and a dry mountainside study area, or a disturbance-intolerant chaparral shrub where the study area is a long-standing, degraded grassland far from chaparral. The relevant fieldwork was also in all cases conducted within a time frame sufficiently recent to conclude that the species remains absent, based on study area conditions and the species' known ecology. In most cases a specific, established survey protocol and/or guidelines have been followed.

NOTES:

Federal

FE = Endangered

FT = Threatened

FC = Candidate

State

SE = Endangered

ST = Threatened

CSC = Species of Special Concern

CFP = Fully Protected Species

WL= California Watchlist (formerly a Species of Special Concern; limited protection)

Note: The California Natural Diversity Database (CNDDB) uses the same ranking methodology originally developed by The Nature Conservancy and now maintained and recently revised by NatureServe. The *state rank* (S-rank) refers to the imperilment status only within California's state boundaries. It is a reflection of the overall status of an element through its state range. The state rank represent a letter + number score that reflects a combination of Rarity, Threat, and Trend factors, with weighting being heavier on Rarity than the other two.

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Special-status Reptiles and Amphibian Species

Scientific Name	Common Name	Status	Habitat Requirements	Likelihood of Occurrence
Amphibians				
Spea hammondii	Western Spadefoot Toad	CSC S3	Prefers open areas with sandy or gravelly soils, in a variety of habitats including mixed woodlands, grasslands, coastal sage scrub, chaparral, sandy washes, lowlands, river floodplains, alluvial fans, playas, alkali flats, foothills, and mountains. Pools which do not contain bullfrogs, fish, or crayfish are necessary for breeding. The known elevational range is from sea level to about 4,472 feet. Although they spend the great majority of their life outside water, they require temporary rain pools with water temperatures between 48° and 86° f. lasting upwards of 3 weeks. Vernal pools are occasionally occupied, but species must have access to friable soils for estivation during the dry season.	**Low potential.** Potentially suitable freshwater pools are limited on the Project site; however, other conditions such sandy soils, coastal sage scrub, and playas are present. This species has not been detected during any of the numerous studies conducted in the Project area over the past several decades.
Anaxyrus californicus	Arroyo Toad	FE CSC S2S3	Inhabits washes, arroyos, sandy river banks, riparian areas with willows, sycamores, oaks, cottonwoods. Specialized habitat needs, including exposed sandy stream sides with stable terraces for burrowing with scattered vegetation for shelter, and areas of quiet water or pools free of predatory fishes with sandy or gravel bottoms without silt for breeding. Adults typically breed in overflow pools adjacent to the inflow channel of third or greater-order predator-free streams. Adult estivation sites are typically in stream terraces or uplands with friable soils, usually near active use areas but potentially more than 1 kilometer away. Young toads require moderately vegetated sandbars.	**Confirmed absent.** No potentially suitable conditions found on the Project site. This species has not been detected during any of the numerous studies conducted in the Project area over the past several decades.

Scientific Name	Common Name	Status	Habitat Requirements	Likelihood of Occurrence
Rana draytonii	California Red-legged Frog	FT CSC S2S3	Occurs very locally on the western slopes of the Sierra Nevada and the coastal foothills the length of the state, up to about 4,920 feet. Inhabit pools of streams, marshes, and ponds. Adults feed on a wide variety of aquatic prey, and will move up to a mile through riparian communities under wet conditions, such as rainfall. They prefer shorelines with extensive vegetation, and are vulnerable to the introduction of exotic competitors.	**Confirmed absent.** No potentially suitable conditions found on the Project site. This species has not been detected during any of the numerous studies conducted in the Project area over the past several decades.
Reptiles				
Anniella stebbinsi (=*Anniella pulchra pulchra*)	Southern California legless lizard (=Silvery legless lizard)	CSC S3	Occurs in moist warm loose soil with plant cover; sparsely vegetated areas of beach dunes, chaparral, pine-oak woodlands, desert scrub, sandy washes, and stream terraces with sycamores, cottonwoods, or oaks. Leaf litter under trees and bushes in sunny areas and dunes stabilized with bush lupine and mock heather often indicate suitable habitat. Found under surface objects such as rocks, boards, driftwood, and logs. Sometimes found in suburban gardens in Southern California. Soil characteristics, as well as requirements for soil moisture and relatively cool microclimates (about 93° f. maximum) limit distribution.	**Confirmed present.** In 2013, the scientific community accepted the division of the existing one species of legless lizard into five species based on the five lineages (Papenfuss and Parham 2013), naming four new species and giving a new common name to the species now known as *Anniella pulchra*. The species that occurs in Southern California and is regularly observed on the Project site in Area B is now named Southern California Legless Lizard (*Anniella stebbinsi*).
Aspidoscelis tigris stejnegeri	Coastal Whiptail	S2S3	Habitats include disturbed coastal sage scrub-chaparral mix and cleared areas of chaparral with a sandy/rocky substrate.	**Low potential.** Potentially suitable conditions present; however, the species has not been detected during any of the numerous studies conducted in the Project area over the past several decades.
Diadophis punctatus modestus	San Bernardino Ringneck Snake	S2?	Elevation range for the species as a whole is from sea level to about 7000 feet (2100 m). Prefers moist, open, rocky areas within valley-foothill, mixed chaparral, and annual grassland habitats where it preys on salamanders, frogs, lizards, snakes, and earthworms.	**Confirmed present.** Observed in central Area B during year 2 Baseline Assessment Program (Johnston et al. 2012).

Scientific Name	Common Name	Status	Habitat Requirements	Likelihood of Occurrence
Phrynosoma blainvillii	Coast Horned Lizard	CSC S3S4	Found in a wide variety of vegetation communities, from grasslands and shrublands to woodlands, including coniferous forests. Critical factors are the presence of loose soils with a high sand fraction; an abundance of native ants or other insects, especially harvester ants (*Pogonomyrmex* spp.); and the availability of both sunny basking spots and dense cover for refuge.	**Low potential.** Limited potential to occur in Area B, as one of its key elements is sandy soils. However, it also prefers an abundance of native ant species and the region is dominated with Argentine ants, The native red ant *Pogonomyrmex*ant is still common on the dunes and elsewhere in sandy soils. Documented CNDDB observations are greater than five miles away predominantly near Santa Monica mountains.
Emys marmorata	Western Pond Turtle	CSC S3	Found in ponds, lakes, rivers, streams, creeks, marshes, and irrigation ditches, with abundant vegetation, and either rocky or muddy bottoms, in woodland, forest, and grassland. In streams, prefers pools to shallower areas. Logs, rocks, cattail mats, and exposed banks are required for basking. May enter brackish water and even seawater.	**Less than reasonable.** Not detected in previous surveys from 1981-2011 or in any published survey efforts. Last documented observation on CNDDB was in 1941 in the saltmarsh of Ballona Creek (CNDDB 2014). It is likely that this species inhabited the original freshwater marsh system, but is likely extirpated.
Thamnophis hammondi	Two-striped Garter Snake	CSC S2	Generally found around pools, creeks, cattle tanks, and other water sources, often in rocky areas, in oak woodland, chaparral, brushland, and coniferous forest. They will also inhabit large riverbeds if riparian vegetation is available, and even occur in artificial impoundments if both aquatic vegetation and suitable prey items are present.	**Low potential.** This species has never been observed in previous surveys from 1981-2011. Potentially suitable habitat on the Project site is marginal at best.
Thamnophis sirtalis ssp.	South Coast Garter Snake	CSC S1S2	Endemic to coastal southern California from the Santa Clara River valley south to northern San Diego County. Maximum known elevation is about 2,270 feet. Restricted to marsh and upland habitats near permanent water with good strips of riparian vegetation where adequate prey and refuge can be found.	**Low potential.** It is likely that this species inhabited the original freshwater marsh system. Not detected in previous surveys from 1981-2011 or in any published survey efforts. Last detection was in 2010 in Topanga quad.

Shading
Species which has less than reasonable potential for occurrence and impact.

Confirmed Present
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High Potential
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diagnostic sign were detected during current fieldwork by a qualified observer, the species is likely to be present to some degree given the best available information. Depending upon regulatory status, local rarity, public interest, extent of habitat on the study area, and the nature of potential project impacts, a substantial basis may exist for either conducting focused surveys for the species or for assuming presence.
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SE = Endangered
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Special-status Bird Species

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
American Bittern	*Botaurus lentiginosus*	LAC(Part I) SBBW S3	Breeds in wetlands across most of the United States and Canada. Prefer dense beds of cattails and rushes in freshwater and brackish portions of estuaries. Winters from the southern United States southward into Mexico and the Caribbean. Primarily a winter visitant and uncommon along the coast, but can remain casually through summer.	**Less than reasonable** as breeder. **Moderate potential** as a forager as this species is reestablished as wintering at the adjacent Ballona freshwater marsh.
American Pipit	*Anthus rubescens*	SBBW	Breeds in arctic and alpine tundra. In migration and winter uses coastal beaches and marshes, stubble fields, recently plowed fields, mudflats, and river courses.	**Less than reasonable** as breeder. **Moderate potential** as a forager as this is a fairly common winter resident.
American White Pelican	*Pelecanus erythrorhynchos*	(Nesting colony) CSC SBBW S1	Primarily a transient through southern California, wintering only in small numbers at limited locations. It breeds in California only at a few far northern colony sites (mainly Siskiyou and Modoc counties). They are very rare at any season over open ocean. Winters uncommonly and locally. Occasional non-breeding individuals will summer on larger lakes and reservoirs.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is a rare winter visitor and transient.
Ashy Storm-petrel	*Oceanodroma homochroa*	(Nesting colony) CSC ABC:WLBCC BCC SBBW S2	Occurs year-round in offshore waters of the continental slope (200-2,000 m deep) from Cape Mendocino to northern Baja California, Mexico. Spends most of its time at sea, coming to land only to reproduce. Nests in natural cavities and sea caves, mainly talus but also larger rock.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is a vagrant.
Bald Eagle	*Haliaeetus leucocephalus*	(Nesting and wintering) Fed. Delisted SE CFP BCC LAC(Part II) SBBW S2	It eats mainly fish and carrion, and formerly nested locally along the coast of southern California. It is now a very localized winter resident and rare migrant, with only very rare breeding efforts in coastal southern California (e.g., Lake Skinner, Riverside County).	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is a vagrant.

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
Bank Swallow	*Riparia riparia*	(Nesting) ST LAC(Part II) SBBW S2S3	This species historically bred interruptedly along the entire coast of California, as well as in the Central Valley and Great Basin portions of the state. Currently the species breeds only in northern California, primarily in the Sacramento Valley and far northeastern portions of the state, with a few colonies in coastal counties from Monterey through Del Norte County. This species is uncommon to fairly common migrants in spring and fall at the Salton Sea in Riverside and Imperial counties and at other large lakes and wetlands in desert regions. They are rare migrants elsewhere in California.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is an occasional transient.
Belding's Savannah Sparrow	*Passerculus sandwichensis beldingi*	SE LAC(Part II) SBBW S3	Locally common non-migratory resident of coastal saltmarsh. It is an obligate breeder in middle elevation saltmarsh, nearly always characterized by pickleweed (*Salicornia* spp.), either in tidal situations or non-tidal alkaline flats nearby. Although the majority of its subsistence stems from the saltmarsh and closely adjacent mudflat, individuals, particularly post-breeding birds, can be found foraging in a wide variety of habitats including upper marsh, adjacent ruderal and ornamental vegetation, open beach and mudflat, and even dirt and gravel parking lots.	**Confirmed present** as a breeder and forager. Currently breeds in pickleweed saltmarsh habitat in the northwestern portion of Area B. Nested in Area A through the mid-1980's, but only marginal nesting habitat present in Area A. Forages in Areas A and B.
Bell's Sage Sparrow	*Amphispiza belli belli*	WL ABC:WLBCC BCC LAC(WL) SBBW S2?	Typically found in chaparral, sagebrush, and other open habitat with shrubs. A casual transient along the coast of southern California.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is not reported as occurring in Ballona Valley
Belted Kingfisher	*Megaceryle alcyon*	(Breeding) LAC(Part I)	Though widespread throughout North America and readily seen during the winter in Los Angeles County, this species is seldom encountered along our local rivers during the breeding season. Because they require earthen riverbanks in which to excavate nest burrows and appear to prefer nest sites that are within close proximity to foraging sites.	**Less than reasonable** for nesting. **Moderate potential** as a forager as this species is an uncommon transient and winter visitor.

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
Black Oystercatcher	*Haematopus bachmani*	(Nesting) BCC S2	A permanent resident on rocky shores of marine habitats along almost the entire California coast, and on adjacent islands. Undisturbed, rocky coastlines required for feeding. Availability of foraging habitats depends on tidal cycle and ocean swell conditions.	**Less than reasonable** for nesting (although breeding confirmed on outer jetties, this is well beyond potential Project influences) **Less than reasonable** as a forager since this species is in small numbers on the outer jetties and the free-standing breakwater of Playa del Rey and rarely seen along lower Ballona Creek.
Black Skimmer	*Rynchops niger*	(Nesting colony) CSC ABC:WLBCC BCC LAC(Part II) SBBW S1S3	Forage for small fish and possibly crustaceans in calm shallows of harbors, lagoons, bays, estuaries, ponds, and river channels. In winter, flocks commonly roost on urban beaches well above the tide line or on mud flats in estuaries. Beach sites that are habitually used by skimmers are often associated with estuaries or protected harbors and are near the mouths of rivers or other drainage channels.	**Less than reasonable** for nesting. **Moderate potential** as a forager as this species is an irregularly uncommon mid-winter and spring visitor.
Black Storm-petrel	*Oceanodroma melania*	CSC SBBW S1	Nests in burrows, natural cavities, or rock crevices on islands. Presumably monogamous. Common to abundant post-breeding summer visitor in waters from Monterey Bay south during April to October, sometimes into January.	**Less than reasonable** for nesting. **Less than reasonable** as a forager as this species is a vagrant.
Black Swift	*Cypseloides niger*	(Nesting) CSC ABC:WLBCC BCC LAC(Part II) S2	Breeding distribution is very patchy, from southern Alaska southward through Costa Rica and Caribbean islands. Winter distribution is unknown, but presumed to be South America. In southern California the species is a rare breeder and migrant (May to early June; late Aug. through September). It breeds at mountain waterfalls in steep canyons at elevations from 1,800 to 6,400 feet (550 to 1950 m), with six known sites in the San Gabriel, San Bernardino, and San Jacinto mountains.	**Less than reasonable** for nesting. **Less than reasonable** as a forager as this species is probably a rare and irregular transient.

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
Black Tern	*Chlidonias niger*	(Nesting colony) CSC SBBW S2	A marsh-breeding bird, the Black Tern nests in freshwater wetlands in Eastern Washington, mostly east of the Okanogan and Columbia Rivers. For nesting, it requires habitat with extensive, cover-providing, vegetation as well as open water. During migration, it uses large lakes and coastlines. In winter, it can be found along productive marine coastlines, lagoons and estuaries, especially off the Pacific Coast of Panama.	**Less than reasonable** for nesting. **Less than reasonable** as a forager as this species is a casual fall transient and extirpated as a non-breeding summer resident.
Black-bellied Plover	*Pluvialis squatarola*	SBBW	Nests in Arctic lowlands on dry tundra. Winters on coastal beaches and estuaries. May use flooded pasture and agricultural land.	**Less than reasonable** for nesting. **High potential** as forager as this species is a common non-breeding resident. This species is most numerous in fall and winter, but at least a few are present every month of the year.
Black-headed Grosbeak	*Pheucticus melanocephalus*	(Breeding) LAC(WL)	Breed in complex habitats with a diversity of plants and ready access to water. They avoid monotonous stretches of unbroken dry chaparral, desert, grassland, or dense coniferous forests, but inhabit edges where those habitats are disturbed or meet others. During migration they tend to seek out shrubs and trees rich in berries.	**Less than reasonable** for nesting as this species is considered extirpated as a breeder. **High potential** as forager as this species is a fairly common transient and rare (irregular?) summer resident.
Black-throated Sparrow	*Amphispiza bilineata*	LAC(WL)	Typically found in deserts with cactus, mesquite, and creosote bush, and also sagebrush; partial to rocky places. Breeds from northeastern California, southwestern Wyoming, and southeastern Colorado southward. Winters north to desert regions of southern United States.	**Less than reasonable** for nesting. **Less than reasonable** as a forager as this species is a vagrant.
Blue Grosbeak	*Passerina caerulea*	SBBW	Found along forest edge, fields, power-line cuts, riparian areas, hedgerows, and other areas with medium-sized trees and low shrub density. Nests irregularly in very small numbers in willow and mulefat thickets on the floor of the Ballona Valley.	**Less than reasonable** for nesting. **Moderate potential** as forager as this species is an uncommon transient and rare summer resident and spring transients.

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
Bonaparte's Gull	*Larus philadelphia*	SBBW	Breeds around lakes and marshes in boreal forest. Winters along lakes, rivers, marshes, bays, and beaches along coasts. Local concentrations generally appear in November, although small numbers trickle through in fall (mainly seen offshore).	**Less than reasonable** for nesting in riparian habitat. **Moderate potential** as forager as this species is an irregularly common winter visitor and spring transient; rare in summer and fall (several thousand typically winter in Ballona Valley, but are absent some winters).
Brant	*Branta bernicla*	(Winter and staging) CSC LAC(Part II) SBBW S2?	An abundant small goose of the ocean shores, the Brant breeds in the high Arctic tundra and winters along both coasts. The species is a very locally common winter visitant along the coast.	**Less than reasonable** as breeder. **Moderate potential** as a forager as this species is an occasional spring transient and casual in summer and winter.
Brewer's Sparrow	*Spizella breweri*	(Nesting) ABC:WLBCC BCC LAC(WL) S3	Typically found in sagebrush and alpine meadows. Breeds in northern Rocky Mountains of Yukon and British Columbia, and in Great Basin south to southern California and New Mexico. Winters in southwestern states. Absent from Pacific Coast.	**Less than reasonable** for nesting. **Less than reasonable** as a forager as this species is a rare transient.
Burrowing Owl	*Athene cunicularia*	(Burrow sites and some wintering sites) CSC BCC LAC(Part II) SBBW S2	Level, open, dry, heavily grazed or low grassland or desert vegetation with available burrows. In coastal Southern California, a substantial fraction of Burrowing Owls are found in microhabitats highly altered by humans, including flood control and irrigation basins, dikes, banks, abandoned fields surrounded by agriculture, and road cuts and margins. Several factors in combination probably explain the species' distribution on local scales: vegetation density, availability of suitable prey, availability of burrows or suitable soil, and disturbance.	**Low potential** as breeder as this species is has not been observed during the breading season in the Project area for decades. **Moderate potential** as a forager as this species is a rare fall and winter visitor, but has been reported in Area A fairly regularly since 2005.

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
California Black Rail	*Laterallus jamaicensis coturniculus*	ST CFP ABC:WLBCC BCC SBBW S1	Tidal salt marshes associated with heavy growth of tule and pickleweed; also occurs in brackish marshes or freshwater marshes at low elevations. Primarily restricted to the San Francisco Bay, with smaller numbers in wetlands from the Salton Sea area to Arizona. This species has essentially disappeared from coastal wetlands in coastal southern and central California, although small populations have recently been discovered about 100 miles south of the U.S. border in northwestern Baja California.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is deemed extirpated from the region.
California Brown Pelican	*Pelecanus occidentalis californicus*	(Nesting colony/ communal roosts) Fed/State Delisted CFP SBBW S1S2	This widely known pelican is the largest bird occurring regularly along our shorelines, with a wingspan of about 7 feet (about 2.1 meters). Foraging along the coast, in brackish lagoons, and up to 100 miles (160 kilometers) out to sea, it is not found inland except at the Salton Sea in Imperial and Riverside counties, locally in small numbers along the Colorado River, and occasionally following prey for short distances up larger rivers coastally. Nests on offshore islands.	**Less than reasonable** as breeder. **Moderate potential** as a forager as this species is abundant late summer and fall and winter resident. Hundreds of pelicans roost on the Playa del Rey breakwater and large numbers throughout Marina del Rey, Ballona Creek, and Ballona Lagoon. Low usage of Ballona Wetland channels for foraging due to shallowness.
California Gnatcatcher	*Polioptila californica californica*	FT CSC ABC:WLBCC LAC(Part II) SBBW S2	Generally prefers open sage scrub with California sagebrush (*Artemisia californica*) as a dominant or co-dominant species. Nest placement typically in areas with less than 40 percent slope gradient. Monogamous pairs tend to stay in the same locale. Both parents build nest, incubate, and care for young.	**Less than reasonable** for nesting as the species does not occur in the Project area at this time. **Low potential** as a forager as this species is does not occur in the Project area at this time. A couple individuals briefly used Project site in 2010-2011. Very limited potentially suitable habitat on the Project site. Scrub vegetation near Ballona freshwater marsh and Westchester Bluffs represent potentially suitable habitat adjacent to the Project site.

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
California Gull	*Larus californicus*	(Nesting colony) WL S2	This medium-sized gull breeds in large colonies east of the Sierra Nevada mountains and in San Francisco Bay, and is one of about a dozen species of "seagulls" that winter in and migrate through coastal southern California. Concentrations occur along major rivers, lakes, open landfills, and at parks with duck ponds.	**Less than reasonable** as breeder. **High potential** as a forager as this species is a common winter residents and fall transient; fairly common spring transient, and uncommon summer lingerer.
California Horned Lark	*Eremophila alpestris actia*	WL LAC(Part I) SBBW S3	Breeds throughout coastal California and the San Joaquin Valley. This small bird breeds in bare and short-grass areas in open grassland, desert washes, wetland edges, above tree line in mountains, along dirt roads and other disturbed areas, and even in recently burned areas. It is well-adapted to certain types of human disturbance, such as agriculture and cattle grazing, though it cannot tolerate intensive activity at the nest site, which is located directly on the ground.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is considered extirpated as a perennial resident and now a casual fall transient.
California Least Tern	*Sternula antillarum browni*	(Nesting colony) FE SE CFP ABC:WLBCC LAC(Part II) SBBW S2S3	Nests on sandy upper ocean beaches, open barren sites, and occasionally uses mudflats. Forages on adjacent surf line, estuaries, or the open ocean. Colonies are located near the ocean shoreline (within 0.5 miles [about 800 meters]), typically on nearly flat, loose sandy substrates with lightly scattered short vegetation and debris, although some colonies have been located on hard-packed surfaces, even unused asphalt. Colony sites must provide access to the shoreline for juveniles, and must be relatively free of predators or the colony may abandon breeding efforts before completion.	**Less than reasonable** as breeder as the species has not nested successfully on the Project site since the 1970's and last documented attempt in 2001 failed. A large breeding colony (up to 200-300 pairs) within fenced-off "tern preserve" is located on Venice Beach just north of Ballona Creek mouth. **High potential** as a forager as this species is a fairly common summer resident, fishing offshore, along lower Ballona Creek., along tidal channels within the Project site, at Ballona Lagoon, and at the Ballona freshwater marsh.
California Quail	*Callipepla californica*	SBBW	California Quail are characteristic birds of coastal sagebrush, chaparral, foothills, and high desert of California and the northwestern United States.	**Less than reasonable** as breeder . **Less than reasonable** for foraging since considered extirpated as a breeding perennial resident.

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
California Towhee	*Melozone crissalis*	LAC(WL)	Found in dense chaparral scrub that lines coastal slopes and foothills of California and southern Oregon. They also occur along streams and canyon bottoms adjacent to desert slopes, where they live amid manzanita, buckthorn, madrone, foothill pines, and a variety of oaks. As cities and suburbs sprang up in California, towhees moved right in to shrubby backyards and city parks.	**Confirmed present** as a breeder and forager as this species is a fairly common perennial resident in areas supporting scrub.
Caspian Tern	*Hydroprogne caspia*	(Nesting colony) BCC LAC(Part 1) S4	The largest tern, with the exception of Antarctica, this species occurs on all continents, breeding and/or wintering along coastlines and inland along rivers, lakes, and marshes. In North America, it breeds at scattered localities along the Pacific, Atlantic, and Gulf Coasts, and inland in the western interior, Prairie Provinces of Canada, and along the Great Lakes. It generally nests in colonies. Flat rocky islands, beaches, and sandy shores, sparsely vegetated and littered with driftwood, are typical breeding habitat for this species. Its nests range from mere scrapes in sand or gravel to clam shell or vegetation lined depressions with elaborately built-up rims that contain mollusk shells or crayfish appendages.	**Less than reasonable** as breeder. **Moderate potential** as a forager as this species is a common spring transient, fairly common non-breeding visitor in the summer and uncommon during the fall and winter. Dozens of Caspian Terns roost with other gull and tern species along the beach just south of Ballona Creek and on exposed mud within Ballona Creek during low tides.
Cassin's Auklet	*Ptychoramphus aleuticus*	(Nesting colony) CSC BCC SBBW S2S4	The breeding habitat is remarkably diverse, but nesting always occurs on offshore islands. Cassin's Auklets may nest on cliffs, flat grassy plains, slopes, or even in caves. Outside of the breeding season, the species is found at sea. Fairly common year-round in marine pelagic waters off California. Seen less regularly in fall and winter, especially in September and October.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is probably a rare winter visitor; one summer record. This species is probably regular offshore in very small numbers during winter storms.
Clark's Marsh Wren	*Cistothorus palustris clarkae*	CSC LAC(Part II) SBBW S2S3	Restricted to freshwater and brackish marshes dominated by bulrushes or cattails. Clark's Marsh Wren has a narrow distribution along the coast of southern California from the Los Angeles basin south to the Mexican border. Within this range, it is quite localized, though sometimes numerous. In winter (late Sep–early Apr), this resident subspecies is outnumbered in its range by Marsh Wrens of the migrant subspecies *C. p. pulverius*.	**Less than reasonable** as breeder. **Low potential** as a forager as a few individuals of this subspecies has been reported in the Ballona freshwater marsh during the winter.

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
Common Gallinule (=Common Moorhen)	*Gallinula galeata* (=*Gallinula chloropus*)	SBBW	Breeds principally in permanently flooded, nontidal, deep marshes and slightly brackish or freshwater tidal marshes, where robust emergent grasslike plants about 1–4 m tall are interspersed with pools and channels that have floating-leaved and submerged plants, or with mudflats.	**Low potential** as breeder on the Project site; however, confirmed breeding on adjacent Ballona freshwater marsh. **Moderate potential** as a forager as the species is reestablished as an uncommon transient and recently breeding at the adjacent Ballona freshwater marsh.
Common Loon	*Gavia immer*	(Nesting) CSC S1	Breeds on quiet, remote freshwater lakes of the northern U.S. and Canada. From September to May, fairly common in estuarine and subtidal marine habitats along entire coast, and uncommon on large, deep lakes in valleys and foothills throughout state. Common migrant along coast, including offshore, in November and May.	**Less than reasonable** as breeder. **Moderate potential** as a forager as this species is fairly common winter resident and spring transient on salt water. Regular in very small numbers in summer and fall.
Common Poorwill	*Phalaenoptilus nuttallii*	LAC(WL)	In California, breeds in pinyon-juniper woodland, brushy slopes, chaparral, desert washes and hillsides, and sagebrush and shadscale flats; mainly in Upper Sonoran Life Zone to about 2,100 m.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is a casual transient.
Cooper's Hawk	*Accipiter cooperii*	(Nesting) WL S3	This medium sized hawk specializing in hunting small birds in closed quarters. This species is now a locally common breeder throughout the Los Angeles Basin in residential and even urban habitats if tall trees are present.	**High potential** as breeder as this species is a known local breeder, particularly in the residential areas. **Confirmed present** as a forager as this species is fairly common fall transient and winter visitor and uncommon summer resident and local breeder in residential areas.
Craveri's Murrelet	*Synthliboramphus craveri*	SBBW	This resident of warm, coastal waters only comes to shore during the breeding season, when it seeks out small arid coastal islands. A ground-nester, it requires rocky, vegetated coastal areas, where it builds its nest along cliffs, in crevices, or hidden among dense shrubs. Following the breeding season, the birds move out to sea for the autumn and winter months.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is a vagrant.

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
Double-crested Cormorant	*Phalacrocorax auritus*	(Nesting colony) WL S3	Common inhabitants of seacoasts and inland waters, rarely observed out of sight of land. Cormorants are gregarious birds, often nesting in large numbers at diverse sites—on the ground on islands free from predators, in trees, or on various artificial structures. These colonies are conspicuous, not only because of the visible whitewash but also, downwind, because of the powerful reek of guano and rotting fish. In the U.S. and Canada, it is the only cormorant to occur in large numbers in the interior as well as on the coasts, and it is more frequently cited than the others as conflicting with human interests in fisheries. In California, most individuals nest coastally, especially from Cape Mendocino northward, and in lakes and marshes of Siskiyou, Modoc, and Lassen Cos.; small numbers in San Francisco Bay, Central Valley, and lower Colorado River; declining numbers on Salton Sea; and very locally elsewhere.	**Low potential** as breeder as this species was reported to have successfully nested in Marina del Rey in a cypress tree at the coast guard station. **High potential** as a forager as this species is a common winter resident. This species becomes scarcer through spring and into summer, though a handful are generally present year round, often along Ballona Creek.
Eared Grebe	*Podiceps nigricollis*	(Breeding) LAC(Part I)	Found at marshy lakes and ponds and open bays and ocean in winter. Breeds from British Columbia, southern Manitoba, and Dakotas south to California and New Mexico. Winters on Pacific, Gulf, and Atlantic (rare) coasts, occasionally on open water in interior Southwest and Texas. Also in Eurasia.	**Less than reasonable** as breeder. **High potential** as a forager as this species is a fairly common winter resident and transient. Small numbers linger through the spring, but are rare by mid-summer.
Elegant Tern	*Thalasseus elegans*	(Nesting colony) WL ABC:WLBCC LAC(Part I) SBBW S1	Only 5 colonies: 3 on coastal California; 2 insular in Gulf of California; all somewhat isolated, semitropical, and generally low, flat, and sandy, with little vegetation. (1) San Diego Bay, CA. (2) Bolsa Chica Ecological Reserve, Orange Co., CA: (3) Isla Montague, Gulf of California. (4) Isla Rasa, Gulf of California. (5) Los Angeles Harbor. Forages in bay-estuarine habitat, but rarely in fresh water.	**Less than reasonable** as breeder. **High potential** as a forager as this species is a common spring, summer and fall resident (both pre- and post-breeding) to the immediate coast and lower Ballona Creek. Roost by the hundreds on the saltpan of the Ballona Wetlands and on the sandy beach just south of the mouth of Ballona Creek in spring and late summer.

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
Ferruginous Hawk	*Buteo regalis*	(wintering) WL BCC LAC(Part I) SBBW S3S4	This large relative of the common red-tailed hawk is primarily a winter visitor to California, with the bulk of its breeding range in the Great Basin to the east. Small numbers breed in the northeast corner of the state. Ferruginous hawks feed on a variety of prey, but mostly small mammals, hunting in open country from low perches.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is a casual winter visitor.
Fork-tailed Storm-petrel	*Oceanodroma furcata*	(Nesting colony) CSC SBBW S1	Breed on offshore rocks and islands that are largely free of mammalian predators. Birds nest primarily in natural crevices but also in earthen burrows dug by themselves or other species. Uncommon, sporadic late fall-early spring visitor on open ocean along the entire coast; occasionally in bays and harbors, particularly after storms.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is a vagrant.
Fulvous Whistling-duck	*Dendrocygna bicolor*	CSC LAC(Part II) SBBW S1	Species is migratory in northern portions of their range, but elsewhere they exhibit only local movements. Individuals feed almost exclusively on seeds, especially seeds of native moist-soil plants, which may be abundant in flooded ricefields. The species makes only limited use of undisturbed, nonagricultural habitats for nesting in the United States.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is considered extirpated.
Golden-crowned Kinglet	*Regulus satrapa*	LAC(WL)	This species breeds south through the local mountains at the highest elevations, and appears in fall and winter in adjacent foothill areas south into the Mojave Desert, irregularly along the coastal slope.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is a vagrant.
Grasshopper Sparrow	*Ammodramus savannarum*	(Nesting) CSC LAC(Part II) SBBW S2	A grassland bird, this species appears to prefer areas with significant grass cover and a few scattered shrubs for perching. They don't use habitats with dense shrub cover or sites that have been over-grazed. During migration and winter, they will use many types of open fields.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is a vagrant.

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
Gray Flycatcher	*Empidonax wrightii*	(Breeding) LAC(Part I)	A fairly common summer resident at about 1700-2500 m (5500-8000 ft) in sagebrush and bitterbrush habitats east of Cascade-Sierra crest from the Oregon border south to Inyo, Grapevine and Panamint Mts., Inyo Co. Also breeds locally on desert slopes of southern Sierra Nevada and San Bernardino Mts., and probably on Clark Mt., San Bernardino Co. Preferred nesting habitat is extensive stands of large sagebrush, but also breeds where there is a mixture of brush, ponderosa pine, pinyon pine, juniper, and other woody plants. Uncommon spring (May) and fall (September) transient in scrub and woodland habitats throughout the Great Basin and southeastern deserts, and along the Colorado River.	**Less than reasonable** as breeder. **Low potential** as a forager as this species is an occasional transient and casual winter visitor.
Greater Sandhill Crane	*Grus canadensis tabida*	(Nesting and wintering) ST CFP LAC(Part II) SBBW S2	Sandhill cranes winter in Texas, California, Arizona, New Mexico and Mexico. In the early spring, the cranes begin the migration to their breeding grounds. Throughout the spring, the cranes can be seen resting and feeding along rivers and wetlands throughout the Great Plains and Pacific Northwest. During the late spring, summer and early fall, sandhill cranes can be seen at their breeding grounds. Some breed in Minnesota, Wisconsin and Michigan. Others breed in Oregon, Idaho and Alaska. Three subpopulations of sandhill cranes are non-migratory and found in Mississippi, Florida, and Cuba.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is considered extirpated.
Greater White-fronted Goose	*Anser albifrons*	LAC(Part I)	Breeding across the tundra from Nunavut to Siberia, across Russia, and in Greenland, this species has one of the largest ranges of any species of goose in the world. In North America, however, it is common only west of the Mississippi River, where it is found in large flocks in wetlands and croplands. Winters in agricultural fields, marshes, bays, and lakes.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is a rare transient and winter visitor.
Harlequin Duck	*Histrionicus histrionicus*	(Nesting) CSC SBBW S2	Rare to very uncommon from October to early April in marine waters along rocky coast from San Luis Obispo Co. north, with stragglers remaining through the summer. Usually nests along shores of shallow, swift rivers with plentiful aquatic invertebrates	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is a vagrant.

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
Hermit Thrush	*Catharus guttatus*	(Breeding) LAC(WL)	Occurs in coniferous and mixed forests; deciduous woodlands and thickets on migration and in winter. Breeds from central Alaska east to Newfoundland and south to southern California, northern New Mexico, Wisconsin, and Virginia. Winters from Washington and southern New England southward.	**Less than reasonable** as breeder. **Low potential** as a forager as this species is an uncommon winter resident on floor of Ballona Valley (more common in Westchester).
Hermit Warbler	*Setophaga occidentalis*	(Nesting) ABC:WLBCC LAC(WL) S3?	Breeds in coniferous forests of the Coast, Cascade, and Sierra Nevada mountain ranges of southern Washington, Oregon, and central and northern California. It usually builds its nest saddled on limbs well above ground and concealed by branches. Most individuals migrate along the Coast, Cascade, and Sierra Nevada mountain ranges, wintering in the pine-oak and pine forests of the mountains of Mexico and Guatemala, where it forages in mixed-species flocks.	**Less than reasonable** as breeder. **Low potential** as a forager as this species is an uncommon mid-spring transient, casual in fall and winter and is rare on Ballona Valley floor.
Indigo Bunting	*Passerina cyanea*	LAC(WL)	A small migratory species that breeds in eastern North America and winters primarily in Mexico and Central America, as well as in the Caribbean and sparingly in southern Florida.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is probably a casual transient and summer visitor.
Large-billed Savannah Sparrow	*Passerculus sandwichensis rostratus*	(Wintering) CSC LAC(WL) SBBW S2?	Breeding habitat is limited to open, low salt marsh vegetation, including grasses (*Spartina, Distichlis)*, pickleweed (*Salicornia* spp.), and iodine bush (*Allenrolfea* spp.), around the mouth of the Colorado River and adjacent coastlines of the uppermost Gulf of California; less typical breeding habitat is Frankenia-dominated scrub on the inland borders of beaches. Almost entirely restricted to shorelines within its California nonbreeding range. Accounts of wintering birds in coastal southern California from days of former abundance emphasized use of salt marshes, beaches, kelp wracks, wharves, docks, and city streets.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is a rare and highly localized fall and winter visitor. One or two have been present along the jetties in fall and early winter nearly annually. The Ballona Creek jetty is currently the only site in Los Angeles County that consistently supports this species.
Laughing Gull	*Leucophaeus atricilla*	(Nesting colony) WL SH	Primarily coastal gulls and are only rarely found far inland. Typically detected in saltmarshes, in mangroves, or on agricultural fields or landfills near the coast. They nest in saltmarshes, on islands including artificial ones created from dredge spoils, and on sandy beaches	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is a vagrant.

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
Least Bell's Vireo	*Vireo bellii pusillus*	(Nesting) FE SE ABC:WLBCC BCC LAC(Part II) SBBW S2	Nesting elevation ranges from below sea level to at least 4,100 feet. The subspecies winters in southern Baja California . Least Bell's Vireos select dense vegetation low in riparian zones for nesting.	**Confirmed present** as breeder and forager. In 2010 documented successful breeding along the southeastern corner of the Reserve (Area B) and adjacent Ballona freshwater marsh.
Least Bittern	*Ixobrychus exilis*	(Nesting) CSC BCC LAC(Part II) SBBW S1	This cryptic little bird, the smallest heron in the world, inhabits a variety of dense emergent wetlands, especially favoring extensive bulrush, but also occurring in cattail and even salt cedar when inundated or along the immediate edge of waterways. Both fresh, brackish, and occasionally salt water are used in coastal southern California. Principal food is said to be small fish, but it also takes crustaceans, amphibians, small mammals, and arthropods. It is rare and local in coastal southern California during the breeding season, and is even more rarely found in winter due to an uncertain combination of migration, increased secretiveness, and/or decreased vocalization.	**Low potential** as breeder on the Project site; however, reported as breeding on the adjacent Ballona freshwater marsh. **Low potential** as a forager as this species is reestablished as a rare and localized perennial visitor or resident, but essentially confined to the Ballona freshwater marsh.
Lesser Nighthawk	*Chordeiles acutipennis*	LAC(Part I)	This nighthawk still breeds (or summers) along the Santa Clara River and tributaries (e.g., Bouquet Canyon), Big Tujunga Wash (upstream of Hansen Dam), San Gabriel River (upstream of Santa Fe Dam), and San Antonio Wash (upstream of Arrow Highway). This species is a characteristic nesting species of Riversidean alluvial fan scrub. Now a scarce and local breeder at the outlying edges of the Los Angeles Basin, the migration of this bird tracks well inland in southern California, though small numbers regularly reach the coast, mainly in fall.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is a rare transient observed at the Ballona freshwater marsh.

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
Light-footed Clapper Rail	*Rallus longirostris levipes*	FE SE CFP ABC:WLBCC LAC(Part II) SBBW S1	This subspecies of the large and widespread Clapper Rail is restricted to the lower elevations of coastal marshes with active tidal flow and dense pickleweed and/or cordgrass thickets from Hueneme, Ventura County (formerly to Santa Barbara County) south to Bahia de San Quintin, Baja California, Mexico. No substantial seasonal movements occur, although rare individuals wander away from known breeding locales.	**Confirmed absent** as breeder and forager (Ryan 2011)
Lincoln's Sparrow	*Melospiza lincolnii*	LAC(Part I)	This sparrow nests only in damp mountain meadows that support tall grasses, sedge, and corn lilies interspersed with low growing shrubs such as willow.	**Less than reasonable** as breeder. **Moderate potential** as a forager as this species is a common transient and fairly common winter resident.
Loggerhead Shrike	*Lanius ludovicianus*	(Nesting) CSC BCC LAC(Wintering-Part I) LAC(Breeding-Part II) SBBW S4	It forages in open country of many types (including non-intensive agricultural areas) and nests in small trees and large shrubs, often at the edges of such open areas. Like most birds of prey, this species generally occur in low densities. The species is widely distributed in southern California, with some seasonal movements evident.	**Low potential** as breeder. **High potential** as a forager as this species is an uncommon summer, fall and winter resident.
Long-billed Curlew	*Numenius americanus*	(Nesting) WL ABC:WLBCC BCC LAC(Wintering-Part I) SBBW S2	Breeds in open country from southeastern British Columbia eastward to central Nebraska, and southward to northeastern California and New Mexico. Winters from central California and coastal Texas southward through Mexico. Transients and wintering birds frequent coastal estuaries, agricultural fields, and less commonly sandy beaches.	**Less than reasonable** as breeder. **Low potential** as a forager as this species is only detected during migration. Extirpated as a winter resident; now an occasional transient.

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
Long-eared Owl	*Asio otus*	(Nesting) CSC LAC(Wintering-Part I) LAC(Breeding-Part II) SBBW S3	Nests in conifer, oak, riparian, pinyon-juniper, and desert woodlands that are either open or are adjacent to grasslands, meadows, or shrublands. In southern California, long-eared owl breeds and roosts in riparian and oak forests, and hunts small mammals at night in adjacent open habitats.	**Less than reasonable** as breeder. **Less than reasonable** as forager as this species is a vagrant and has not been recorded in the Project area since the early 1980's (PWA 2006).
Lucy's Warbler	*Oreothlypis luciae*	(Nesting) CSC ABC:WLBCC BCC SBBW S2S3	Neotropical migrant that breeds in the southwestern United States and winters in western Mexico. This species nests almost entirely in the hot lower Sonoran desert of the southwestern United States and northwestern Mexico. It occupies the driest habitat of the 4 southwestern lowland-breeding warblers and has been called the "mesquite warbler" and "desert warbler".	**Less than reasonable** as breeder. **Less than reasonable** as forager as this species is a vagrant.
MacGillivray's Warbler	*Geothlypis tolmiei*	(Breeding) LAC(WL)	This long-distance neotropical migrant breeds at low to moderate elevations along the Rocky and Sierra mountains from the Northwest Territories and southeastern Alaska south to northeastern Mexico. Breeding populations throughout much of the United States can best be described as remote and disjunct, located in mountain ranges isolated by large regions of arid, sagebrush steppe, prairie grasslands, salt deserts, agricultural floodplains and livestock grazing.	**Less than reasonable** as breeder. **Low potential** as forager as this species is an occasional transient.
Marbled Murrelet	*Brachyramphus marmoratus*	(Nesting) FT SE ABC:WLBCC SBBW S1	This small seabird nests in trees in coastal, older forests throughout most of its range in North America and Asia. In summer, forages primarily in bays, inlets, fjords (rarely in protected harbors), and open ocean within 5 km of shore (Alaska 50 km). Usually in widely dispersed concentrations: singles or pairs of birds. Seems to prefer shallow water, usually <60 m deep, but known to forage in water up to 400 m deep in fjords and 300 km offshore, generally in areas with underwater sills, shelf edges, or strong tidal currents.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is a rare winter visitor to salt water and casual in late summer; seen at the deeper water at the mouth of Marina del Rey harbor.

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
Merlin	*Falco columbarius*	(Wintering) WL S3	This is a medium-small falcon which breeds only to the north and east of California and winters here sparsely. Like larger falcons such as peregrine falcon, merlins specialize in hunting birds in open country, especially wetlands and extensive grasslands next to trees.	**Less than reasonable** as breeder. **Moderate potential** as a forager as this species is an uncommon transient and winter visitor throughout Ballona Valley and adjacent residential areas.
Mountain Plover	*Charadrius montanus*	(Wintering) Proposed FT CSC ABC:WLBCC BCC LAC(Part II) SBBW S2?	The species breeds on the Great Plains from New Mexico up to extreme southern Canada, and winters from California's Central Valley across northern Mexico to southern Texas. Small numbers are present in winter in the valleys of coastal southern California. The most commonly utilized winter habitat in California is freshly cultivated croplands, but based on habitat studies, heavily grazed native rangelands and, especially, natural alkali flats are the preferred habitats.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is considered extirpated from Ballona Valley.
Nashville Warbler	*Nashville Warbler*	(Breeding) LAC(WL)	A small, sprightly songbird of second-growth forests, this species breeds in both north-central North America and an isolated portion of the mountainous Pacific Northwest. It nests on the ground and feeds almost exclusively on insects.	**Less than reasonable** as breeder. **High potential** as a forager as this species is a fairly common spring and uncommon fall migrant. Frequently encountered in Westchester, this species occurs mainly during large waves of more common migrant warblers
Northern Harrier	*Circus cyaneus*	(Nesting) CSC LAC(Breeding-Part II) LAC(Wintering-WL) SBBW S3	This is a medium-small, lightly built bird of prey which hunts low to the ground mostly in open country, nesting on the ground. Prey diversity is high, though small mammals are most commonly taken. This is the only North American hawk that locates much of its prey by hearing as it quarters low over the vegetation. It was formerly a fairly common breeder in much of coastal southern California, but now is nearly extirpated in this role due to loss of native open habitats, especially marshes. It remains fairly common in open country with low human disturbance during migration and in winter.	**Less than reasonable** as breeder. **High potential** as a forager as this species is an occasional fall and winter visitor and is frequently observed foraging on the Reserve, particularly in the winter.

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
Olive-sided Flycatcher	*Contopus cooperi*	(Nesting) CSC ABC:WLBCC BCC LAC(Part II) SBBW S4	Breeding habitat for this species is primarily late-successional conifer forests with open canopies. Breeding locales range from sea level to timberline but usually are at mid to high elevations (3018–6988 ft). These flycatchers are mostly associated with edges, openings, and natural and human-created clearings in otherwise relatively dense forests, but they also occupy semi open forests.	**Less than reasonable** as breeder. **Low potential** as a forager as this species is an occasional transient.
Osprey	*Pandion haliaetus*	(Nesting) WL S3	This large, distinctive hawk is highly adapted to a diet consisting almost entirely of fish. One of the most widespread bird species in the world, it was formerly a common and widespread breeder in southern California, but no longer breeds regularly in California anywhere south of the northern San Francisco Bay.	**Less than reasonable** as breeder. **High potential** as a forager as this species is an uncommon fall transient; rare visitor at all other times of year.
Pacific Golden-Plover	*Pluvialis fulva*	SBBW	Preferred wintering habitat seems to be large expanses of flat, damp ground near the coast with very short herbaceous vegetation. Breeds on Arctic tundra, especially in vegetation in low areas with few rocks. Winters in cultivated fields, pastures, salt marshes, airports, parks, lawns, golf courses, and clearings in wooded areas. On migration found in prairie, pastures, tilled farmland, golf courses, airports, mudflats, shorelines, and beaches.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species was previously a fall transient and winter resident to the Reserve, but is currently extirpated.
Peregrine Falcon	*Falco peregrinus*	(Nesting) Fed/State Delisted CFP BCC SBBW S2	This species catch medium-sized birds in the air with swift, spectacular dives, called stoops. In cities they are masterful at catching pigeons. Elsewhere they feed especially on shorebirds and ducks. Often perching or nesting on skyscrapers, water towers, cliffs, power pylons, and other tall structures. Peregrines can be seen all over North America, but they are more common along coasts.	**Less than reasonable** as breeder. **Moderate potential** as a forager as this species is an uncommon transient and winter visitor. Frequently observed foraging on the Reserve.

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
Prairie Falcon	*Falco mexicanus*	(Nesting) WL BCC LAC(Breeding-Part I) LAC(Wintering-WL) SBBW S3	A larger relative of the Merlin, the Prairie Falcon breeds primarily on cliffs in desert and semi-desert areas with low human disturbance, feeding on quail and other birds. It is nearly extirpated from coastal southern California as a breeder, occurring mainly as a sparse winter visitor throughout.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is casual in fall and (formerly) winter.
Purple Martin	*Progne subis*	(Nesting) CSC LAC(Part II) SBBW S3	This largest North American member of the swallow family frequents a variety of open or semi-open habitats, especially near water, and open woodland, as well as park-like settings within towns and farms. This martin is widespread across North America, from Canada to Mexico, and breeds from fairly high elevations in mountains to lowlands. They have declined from locally common in coastal southern California to nearly extirpated, with most of the few, small colonies that remain in mid-elevation forested mountain habitats.	**Less than reasonable** as breeder. **Low potential** as a forager as this species is probably a rare transient.
Red Knot	*Calidris canutus*	SBBW	Breeds in drier tundra areas, such as sparsely vegetated hillsides. Outside of breeding season, it is found primarily in intertidal, marine habitats, especially near coastal inlets, estuaries, and bays. Typically observed in small numbers with other shorebirds.	**Less than reasonable** as breeder. **Moderate potential** as a forager as this species is an occasional fall transient and winter visitor; rare in spring. Seen roosting with Black-bellied Plovers on flooded saltpans of the Reserve.
Red-breasted Nuthatch	*Sitta canadensis*	(Breeding) LAC(WL)	Occurs mainly in coniferous forests of spruce, fir, pine, hemlock, larch, and western red cedar. Eastern populations use more deciduous woods, including aspen, birch, poplar, oak, maple, and basswood. During irruptive winters, nuthatches may use habitats such as orchards, scrub, parks, plantations, and shade trees. This species is irregularly present in fall, winter and spring in groves of planted pines throughout the Los Angeles Basin.	**Less than reasonable** as breeder. **Low potential** as a forager as this species is probably a rare, irregular fall and winter visitor during “invasion years”.

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
Redhead	*Aythya americana*	(Nesting) CSC LAC(Part II) SBBW S3?	This diving duck, restricted to North America, breeds widely throughout the Prairie Pothole Region of the United States and Canada. It also nests in dense concentrations in marshes of the western United States. In contrast to its extensive breeding distribution, the Redhead in winter is concentrated mostly in coastal areas along the Gulf of Mexico, with hundreds of thousands of birds traditionally found in the Laguna Madre of Texas and the Laguna Madre of Tamaulipas, Mexico.	**Less than reasonable** as breeder. **High potential** as a forager as this species, once extirpated, is now reestablished as a winter resident and is now uncommon in fall and winter.
Rhinoceros Auklet	*Cerorhinca monocerata*	(Nesting colony) WL S3	Found both in coastal habitats and far from land. They often feed close to shore, especially where tidal currents near islands create upwellings and concentrations of food. Flocks may over-night in protected bays and forage farther out to sea during the day. Nesting islands have grass, shrubs or trees, with enough soil for the birds to burrow. Nests are typically located on slopes from which the birds can take flight easily.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species probably a rare winter visitor and is much more common several miles offshore.
Royal Tern	*Thalasseus maximus*	LAC(Part I) SBBW	Fairly common, but localized winter visitor to offshore waters and coast of southern California, north to Santa Barbara County. While foraging, frequents pelagic waters well offshore, but also flies along beach lines, coastal estuaries, and lagoons. Usually nests on sandy beaches or dredging spoils. Prerequisites for colonies are isolation from land predators, good visibility, and nearby shallows for feeding. Ideal locations are at, or near, inlets between bays and oceans. Often nests near other species such as gulls, terns, or skimmers. Less commonly inshore while foraging. Roosts on tidal flats and beaches.	**Less than reasonable** for nesting. **Moderate potential** for foraging as this species is an uncommon fall, winter and spring visitor to immediate coast and lower Ballona Creek.
Ruby-crowned Kinglet	*Regulus calendula*	(Breeding) LAC(WL)	During migration and winter, this species occupies a variety of habitats and is often recognized by its constant wing-flicking. As a breeder, it inhabits spruce-fir forests of the northern and mountainous western United States and Canada. Its nest is hidden, often near the trunk and up to 30 meters above the ground.	**Less than reasonable** for nesting. **High potential** for foraging as this species is a fairly common winter resident.

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
Scripps's (=Xantus's) Murrelet	*Synthliboramphus scrippsi (=Synthliboramphus hypoleucus)*	(Nesting colony) Federal Candidate ST ABC:WLBCC BCC S3	Scripps's (formerly Xantus's) Murrelet, along with the closely related Craveri's Murrelet, is one of the southernmost species in the Alcidae, a family that is predominantly northern in distribution. This small black and white seabird has a relatively limited breeding distribution on offshore islands from southern California to central Baja California, Mexico. Postbreeding dispersal is largely to the north, as far as is known. Llarge numbers of birds spend the late summer and fall over the outer continental shelf off central California, and small numbers occasionally occur in similar habitats north to Washington and southern British Columbia.	**Less than reasonable** for nesting. **Less than reasonable** for foraging as this species is a vagrant (regular well offshore).
Sharp-shinned Hawk	*Accipiter striatus*	(Nesting) WL S3	This small raptor specializes in hunting small birds, primarily in thickets, woodlands and forests. This small raptor is as frequently seen in residential neighborhoods as in native habitat, and unlike Merlin or American Kestrel, often perches in low, concealed spots (esp. willow clumps), waiting for small birds.	**Less than reasonable** as breeder. **Moderate potential** as a forager as this species is an uncommon winter resident.
Short-eared Owl	*Asio flammeus*	(Nesting) CSC ABC:WLBCC LAC(Part I) SBBW S3	This owl was once a locally uncommon breeder and a fairly common winter visitor and migrant in southern California. It is now apparently extirpated from the region as a breeder and only locally rare at other times. It is a medium-sized owl, hunting at all times of day and night primarily for small rodents. It is a ground-nester in marshes and open fields of native, or at least undisturbed, vegetation with limited predators,	**Less than reasonable** as breeder. **Low potential** as a forager as this species is currently a casual transient. One reported on the Reserve in 2006, 2008, and in 2009 as a road-kill.
Snow Goose	*Chen caerulescens*	LAC(Part I)	This medium-sized goose is one of the most abundant species of waterfowl in the world, breeding in large, often dense colonies north of the tree line from extreme northeastern Russia (Wrangel Island), along the coast and islands of arctic and subarctic North America to northwestern Greenland. During migration and on the wintering grounds, they often congregate in very large flocks.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is a casual winter visitor and transient (extirpated as a winter resident)

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
Sora	*Porzana carolina*	(Breeding) LAC(Part I)	The most abundant and widely distributed North American rail, the Sora breeds and winters primarily in freshwater marshes dominated by emergent vegetation, but it also occurs in brackish coastal marshes during migration. It is more often heard than seen.	**Less than reasonable** as breeder. **Moderate potential** as a forager as this species is reestablished as a fairly common transient and winter resident at Ballona freshwater marsh (extirpated as a breeding perennial resident).
Spotted Sandpiper	*Actitis macularius*	(Breeding) LAC(WL)	The most widespread-breeding sandpiper in North America, this species is found east-west across the continent and north-south from the southern edge of the Arctic to the southern states. This species has colonized this broad range by capitalizing on generalist habits; i.e., individuals feed on a great variety of animal matter and occupy almost all habitats near water, everything from the shorelines of wild rivers and lakes to urban and agricultural ponds and pools. Migrate singly or in small groups to their wintering grounds, which extend from the extreme southern United States to southern South America.	**Less than reasonable** as breeder. **Moderate potential** as a forager as this species is a fairly common transient and uncommon winter visitor.
Summer Tanager	*Piranga rubra*	(Nesting) CSC LAC(Part II) SBBW S2	An uncommon (formerly common) summer resident and breeder in desert riparian habitat along lower Colorado River; also occurs very locally elsewhere in southern California deserts. Found in additional desert and other localities in migration. Breeds in mature, desert riparian habitat dominated by cottonwoods and willows.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is a probably a casual transient and winter visitor.
Swainson's Hawk	*Buteo swainsoni*	(Nesting) ST ABC:WLBCC BCC LAC(Part II) SBBW S2	This slim relative of the common red-tailed hawk nests today primarily in low-intensity agricultural areas of the western United States, migrating through Central America to Argentina and Brazil each fall and spring.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is rarely recorded along the coast.

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
Swainson's Thrush	*Catharus ustulatus*	LAC(Breeding-Part I) SBBW	Nearctic-Neotropical migrant that breeds as far north as Alaska and northern Canada and winters primarily in South America. One of the most characteristic birds of montane fir forests over much of its range, Swainson's Thrush fills a different niche in coastal California, where it inhabits riparian woodlands.	**Less than reasonable** as breeder. **Low potential** as a forager as this species is probably an occasional late spring transient on floor of Ballona Valley (uncommon in Westchester) and rare in fall.
Tricolored Blackbird	*Agelaius tricolor*	(Nesting colony) CSC ABC:WLBCC BCC LAC(Part II) SBBW S2	Range is restricted to the Central Valley and surrounding foothills, throughout coastal and some inland localities in southern California, and scattered sites in Oregon, western Nevada, central Washington, and western coastal Baja California. Breed in dense colonies and may travel several kilometers to secure food for their nestlings; males defend small territories within colonies and mate with 1 to 4 females. They are itinerant breeders, nesting more than once at different locations during the breeding season.	**Less than reasonable** as breeder. Nearest historical nesting miles inland near Torrance. **Low potential** as a forager as this species, with the exception of a regular wintering flock of several dozen birds in the vicinity of Westchester Park, is a casual visitor to the Ballona Valley.
Tufted Puffin	*Fratercula cirrhata*	(Nesting colony) CSC SBBW S2	Puffins breed on offshore rocks and islands or, rarely, steep mainland cliffs that are largely free of mammalian predators and human disturbance. They nest either in earthen burrows or rock crevices, usually on steep slopes, cliffs, or cliff tops. Crevices are used mostly when suitable soil for burrowing is unavailable; they are the primary nest sites in central and southern California.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is a vagrant.
Turkey Vulture	*Cathartes aura*	(Breeding) LAC(Part I)	As a carrion eater, the species needs a large area for foraging, but the foraging areas do not necessarily need to be suitable for nesting. For western populations, nesting birds require remote, rocky locations with caves, cliff ledges, and piles of large boulders.	**Less than reasonable** as breeder. **Moderate potential** as a forager as this species is extirpated as a winter resident; now an uncommon transient.
Vaux's Swift	*Chaetura vauxi*	(Nesting) CSC SBBW S3	Occurs rarely and irregularly in winter in southern California. Requires trees, snags, chimneys, or smokestacks with large hollows or cavities for nighttime roosting. Roost sites are found in a variety of forested and urban environments. They are fairly common as spring and fall migrants in southern California.	**Less than reasonable** as breeder. **Moderate potential** as a forager as this species is an uncommon transient, occurring both in spring and fall, and occasionally in large numbers, especially on overcast days.

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
Vermilion Flycatcher	*Pyrocephalus rubinus*	(Nesting) CSC SBBW S2S3	A rare, local, yearlong resident along the Colorado River, especially in vicinity of Blythe, Riverside Co. Nesters inhabit cottonwood, willow, mesquite, and other vegetation in desert riparian habitat adjacent to irrigated fields, irrigation ditches, pastures and other open, mesic areas in isolated patches throughout central southern California.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is a vagrant.
Vesper Sparrow	*Pooecetes gramineus*	LAC(Part I)	A ground-dwelling species, it prefers dry grass fields, with some shrubs or similar structure, and is found in open habitats, including old fields, shrubsteppe, grasslands, and cultivated crop fields. In many areas the species responds quickly to changes in habitat; it is often the first species to occupy reclaimed mine sites and will abandon old farm fields as they return to forest.	**Less than reasonable** as breeder. **Low potential** as a forager as this species is an occasional fall transient.
Virginia Rail	*Rallus limicola*	LAC(Part I)	Secretive freshwater marsh bird that is more often heard than seen. A habitat generalist, this species probes mudflats and shallow water with its long, slightly decurved bill searching for invertebrates, small fish, and the occasional seed. Vagrancy and generalist habits allow it to exploit a highly ephemeral niche.	**Moderate potential** as breeder (recently breeding confirmed at Ballona freshwater marsh). **High potential** as a forager as this species was once considered extirpated, but is now reestablished as an uncommon transient and rare winter visitor.
Virginia's Warbler	*Oreothlypis virginiae*	(Nesting) WL ABC:WLBCC BCC S2S3	A rare to uncommon, very local, summer resident along the eastern slope of southern Sierra Nevada and in several desert ranges. Breeds in arid, shrubby, mixed conifer, pinyon-juniper, montane chaparral, and possibly montane riparian habitats from about 2200-2800 m (7000-9000 ft). A rare fall migrant (late August-late September) in brushy habitats along the coast from Los Angeles Co. south, and a very rare spring and fall transient in wooded habitats in deserts.	**Less than reasonable** as breeder. **Low potential** as a forager as this species is a rare fall transient.

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
Western Meadowlark	*Sturnella neglecta*	LAC(Part I) SBBW	A common resident throughout most of the state, except in higher mountains. Occurs in herbaceous and cropland habitats with sufficient ground cover for concealment. Where such habitats form understory open wooded and brushy habitats also used. Among cultivated crops, particularly favors alfalfa. Feeds in open, grassy areas, gleaning food from ground or low plants; also turns over objects and probes in soft earth. Requires relatively dense, grassy habitat with vegetation tall enough to provide cover, along with a few low perches. Scattered trees and shrubs may be present, but not required.	**Confirmed present** as breeder. **Confirmed present** as a forager as this species is common winter resident, uncommon through summer. A minute breeding population (up to 3 pairs) persists on the Reserve.
Western Snowy Plover	*Charadrius alexandrinus nivosus*	(Nesting) FT CSC ABC:WLBCC BCC LAC(Part II) SBBW S2	Breeds primarily above the high tide line on coastal beaches, sand spits, dune-backed beaches, sparsely-vegetated dunes, beaches at creek and river mouths, and salt pans at lagoons and estuaries. In winter, found on beaches used for nesting and other beaches, in manmade salt ponds and on estuarine sand and mud flats.	**Less than reasonable** as breeder (Extirpated as a breeding perennial resident). **Low potential** as a forager as this species is a now an occasional transient and rare winter visitor.
Western Wood-Pewee	*Contopus sordidulus*	(Breeding) LAC(WL)	An inhabitant of open forest, forest edge, and riparian zones, this species is a widespread breeder in many of western North America's forested habitats. Its generalized foraging behavior and nest site selection reflect its common occurrence. This species is primarily a sit-and-wait predator, sallying from open perches and usually returning to the same or a nearby perch in pursuit of flying insects, especially flies, ants, bees, wasps, and beetles.	**Less than reasonable** as breeder. **Low potential** as a forager as this species is an occasional transient.
Western Yellow-billed Cuckoo	*Coccyzus americanus occidentalis*	(Nesting) Federal Candidate SE BCC LAC(Part II) SBBW S1	This Neotropical migrant is a relative of the roadrunner and an inhabitant of extensive riparian forests. It formerly occurred from southwestern British Columbia south to the highlands of northern Mexico and the Yucatan Peninsula, wintering in South America. It has declined from a fairly common, local breeder in much of California sixty years ago, to virtual extirpation, with only a handful of tiny populations remaining in all of California today.	**Less than reasonable** as breeder. **Less than reasonable** as a forager as this species is a vagrant.

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
White-faced Ibis	*Plegadis chihi*	(Nesting colony) WL LAC(Part I) SBBW S1	Most southern California counties now have a few known nesting colonies. Breeding occurs in extensive, undisturbed marshes with emergent vegetation (e.g., bulrush or cattails, especially when mixed with scattered woody vegetation such as willows or tamarisk. Habitat for foraging and migration is varied, including flooded fields, marshes, estuaries, reservoirs, mudflats, and other open wetland areas.	**Less than reasonable** as breeder. **Low potential** as a forager as this species is now extirpated as a winter resident; but an uncommon fall transient (late Aug. – early Dec.) and occasional in spring.
White-tailed Kite	*Elanus leucurus*	(Nesting) CFP LAC(Part II) SBBW S3	Hunts in open country. It is found across most of California west of the Sierra Nevada and deserts, from north of the San Francisco Bay south into northern Baja California, Mexico. Separate populations also occur from southern Texas across lowland Mexico, and in southern Florida. This is a strongly lowland species, apparently rare anywhere in California above 2000 feet (610 m), though there are records of wanderers to over 10,000 feet (3050 m). Nests are flimsy, often not lasting to the next breeding season, and are located low in trees and large shrubs near foraging areas in savannahs and at edges between open habitat and woodland or forest areas.	**Less than reasonable** as breeder. **Confirmed present** as a forager as this species is a fairly common non-breeding resident from mid-summer to mid-winter and casual in spring. Two to three kites are expected at the Reserve from mid-summer (late June or July) through mid-winter (January), when they apparently vacate the area to breed elsewhere.
Willow flycatcher (other ssp.)	*Empidonax trailii*	(Nesting) SE ABC:WLBCC BCC LAC(Part II) SBBW S1S2	A broadly distributed species, breeding interruptedly across much of the United States and Canada. In California it is nearly restricted to the Sierra Nevada Mountains and a few populations scattered through southern California. Several subspecies are recognized. Southern California is within the range of the subspecies *E.t. extimus* (southwestern willow flycatcher) – *see the account below for more*. During migration, southern California is host to other subspecies of willow flycatcher passing between breeding areas farther north (Sierra Nevada north to Canada) and their winter range farther south (Central America). These migrants of other subspecies are found in a wide variety of habitats, and are uncommon to fairly common in spring and fall.	**Less than reasonable** as breeder. **Moderate present** as a forager during migration.

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
Willow Flycatcher ("Southwestern")	*Empidonax traillii extimus*	(Nesting) FE SE ABC:WLBCC LAC(Part II) S1	Occurs in riparian habitats along rivers, streams, or other wetlands, where dense growths of willows, Baccharis spp., Arrowweed, buttonbush, tamarisk, Russian olive or other plants are present, often with a scattered overstory of cottonwood, etc. Throughout the range of *E.t. extimus*, these riparian habitats tend to be rare, widely separated, small and/or linear locales, separated by vast expanses of arid lands. Nests in thickets of trees and shrubs approximately 4 - 7 meters (13 - 23 feet) or more in height, with dense foliage from approximately 0 - 4 meters (13 feet) above ground, and often a high canopy cover percentage. Following modern changes in riparian plant communities, *E.t. extimus* still nests in native vegetation where available, but has been known to nest in thickets dominated by tamarisk and Russian olive. Virtually always nests near surface water or saturated soil	**Less than reasonable** as breeder as only a relatively small amount of marginal riparian habitat is supported on the Project site. **Less than reasonable** as a forager as this species is likely only to occur as a vagrant.
Wilson's Phalarope	*Phalaropus tricolor*	SBBW	Found mostly on fresh water, but during migration they can also be found in small numbers on salt water. They breed in shallow, prairie wetlands in the northern US and southern Canada. During migration, they inhabit shallow ponds, flooded fields, and sometimes mudflats. Winter on large, shallow ponds and saline lakes in southern South America.	**Less than reasonable** as breeder. **Low present** as a forager as this species is an uncommon and irregular early fall transient and rare spring transient.
Wilson's Warbler	*Cardellina pusilla*	(Breeding) LAC(Part I)	Lowland breeding populations in the west favor riparian woodlands with shrubby understory. Montane-breeding population of this warbler occupy riparian areas dominated by low willows and other shrubs, often within steep ravines on north-facing slopes.	**Less than reasonable** as breeder as there is no evidence of breeding in the valley. **High potential** as a forager since this species and Yellow Warbler are among the most common passerine migrants in the Ballona area in spring.

Common Name	Scientific Name	Status[A]	Habitat Requirements/Regional Trends	Likelihood of Occurrence[B]
Wood Stork	*Mycteria americana*	CSC S2?	The only stork and the largest wading bird that breeds in the United States, the Wood Stork is a distinctive wetland bird found primarily in the Southeast. This species is a tactile feeder, capturing food by feel. In south Florida, extensive wetlands and high concentrations of prey due to evaporative drawdowns during the dry season have historically supported large breeding colonies of this species. Current breeding range in U.S. limited to Florida, Georgia, and S. Carolina. Pair of wild storks has bred at San Diego Wild Animal Park, San Diego, CA. Regular postbreeding visitor to southern end of Salton Sea and adjacent portions of Imperial Valley of s. California (common), and Colorado River valley of s. California and Arizona (uncommon).	**Less than reasonable** as breeder. **Less than reasonable** as a forager since this species is a vagrant.
Yellow Warbler	*Dendroica petechia brewsteri*	(Nesting) CSC BCC LAC(Part II) SBBW S2	Generally occupy riparian vegetation in close proximity to water along streams and in wet meadows. Throughout their range, they are found in willows and cottonwoods and in California they are found in numerous other species of riparian shrubs or trees, varying by biogeographic region.	**Less than reasonable** as breeder. **High potential** as a forager since this species is a common transient both in spring and fall; occasional into early winter. During migration, this warbler is common in willow thickets as well as in tall ornamental trees, especially if flowering.
Yellow-breasted Chat	*Icteria virens*	(Nesting) CSC LAC(Part II) SBBW S3	Nesting habitat is usually restricted to the narrow border of streams, creeks, sloughs, and rivers and seldom forms extensive tracts. Blackberry, wild grape, willow, and other plants that form dense thickets and tangles are frequently selected as nesting strata.	**Less than reasonable** as breeder (extirpated as a breeder from Ballona Valley). **Low potential** as a forager since this species is a rare transient (detected in Ballona freshwater marsh).
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	(Nesting) CSC LAC(Part II) SBBW S3S4	Most numerous in prairie wetlands, is a conspicuous breeding bird in deep-water, emergent wetlands throughout nonforested regions of western North America. Highly social, these large-bodied blackbirds are polygynous, nesting on grouped territories. Postbreeding birds eat mostly grains, often forming large flocks that forage in uplands and roost in wetlands. Flocks migrate to the southern United States and Mexico for the winter.	**Less than reasonable** as breeder (extirpated as a breeder from Ballona Valley). **Low potential** as a forager since this species is extirpated as a winter resident; now a fairly common spring and rare fall transient at Ballona freshwater marsh.

Shading = Species which has less than reasonable potential for occurrence and impact.

(A) Regulatory/Regional/Local Status

Federal

FE = Federal Endangered
FT = Federal Threatened
FC = Candidate
BCC = USFWS Bird Species of Conservation Concern

State

SE = State Endangered
ST = State Threatened
CSC = California Species of Special Concern
CFP = California Fully Protected Species
WL = California Department of Fish and Wildlife Watch List (The birds on this Watch List are 1) not on the current Special Concern list but were on previous lists and they have not been state listed under CESA; 2) were previously state or federally listed and now are on neither list; or 3) are on the list of "Fully Protected" species.).

Local

LAC= Los Angeles County Bird Species of Special Concern (may include species categorized as "Part 1", "Part 2", or "Watchlist"- Los Angeles County Sensitive Bird Species Working Group 2009)
SBBW = Special-status Bird Species of the Ballona Wetlands. Cooper, D.S. 2005.
Important note by Cooper, D.S.: The information is based on dozens of sources compiled by the author since 2003, including the unpublished field notes of Kimball Garrett, Art Pickus, Robert Shanman, and many others; the Los Angeles Audubon Society newsletter "The Western Tanager"; the "Southern California" section of North American Birds/Audubon Field Notes; historical publications (e.g. von Bloeker 1943); consulting reports (prepared by Keane Biological Consultants, among others), and 3000+ combined field hours (since 2003) of a network of c. 10 birders active in the Ballona Valley on a daily basis.

Other

ABC:WLBCC = American Bird Conservancy: United States Watchlist of Birds of Conservation Concern

NatureServe

The California Natural Diversity Database (CNDDB) uses the same ranking methodology originally developed by The Nature Conservancy and now maintained and recently revised by NatureServe. The *state rank* (S-rank) refers to the imperilment status only within California's state boundaries. It is a reflection of the overall status of an element through its state range. The state rank represent a letter + number score that reflects a combination of Rarity, Threat, and Trend factors, with weighting being heavier on Rarity than the other two.

S1 = Critically Imperiled - Critically imperiled in the state because of extreme rarity (often 5 or fewer populations) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state.
S2 = Imperiled - Imperiled in the state because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the state.
S3 = Vulnerable - Vulnerable in the state due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation from the state.
S4 **=** Apparently Secure - Uncommon but not rare in the state; some cause for long-term concern due to declines or other factors.

S5 = Secure - Common, widespread, and abundant in the state.
SH = All sites are historical; the element has not been seen for at least 20 years, but suitable habitat still exists.
SX = All sites are extirpated.
Uncertainty about the rank of an element is expressed in two major ways:

- By expressing the ranks as a range of values: e.g., S2S3 means the rank is somewhere between S2 and S3.
- By adding a ? to the rank: e.g., S2? This represents more certainty than S2S3, but less certainty than S2.

(B) Potential of Occurrence Definitions

Confirmed Present	High Potential	Moderate Potential	Low Potential	Less than reasonable	Confirmed Absent
A qualified biologist or other reliable source has confirmed the presence of the species and there is no specific evidence that the species has subsequently become absent. Depending on the species and other information available, it may or may not be possible to determine, without further studies, what portions of the study area are currently in use.	The study area is known to be within the range of the species, and contains potential habitat with a high likelihood of occupancy. Although no individuals or diagnostic sign were detected during current fieldwork by a qualified observer, the species is likely to be present to some degree given the best available information. Depending upon regulatory status, local rarity, public interest, extent of habitat on the study area, and the nature of potential project impacts, a substantial basis may exist for either conducting focused surveys for the species or for assuming presence.	The study area is within the range of the species, and contains potentially appropriate habitat. Neither individuals nor diagnostic sign were detected. It is nevertheless reasonable that some individuals may have been overlooked. The best available information on the species with regard to the study area is either very uncertain, or may be equally weighted for and against occurrence. Depending upon local and special legal status, extent of habitat, and the nature and sensitivity of the project, focused surveys for the species may be warranted or presence may be assumed.	Occurrence of the species is reasonable but Less than reasonable because of some combination of facts. For example, 1) the study area was the subject of unsuccessful searches conducted under relevant and reasonable circumstances, 2) potential habitat present is marginal or minimal in extent, 3) the best available information suggests the species is absent from the study area, and/or 4) available information sheds no clear light on the species likelihood on the study area, but it is known to be rare at best in the vicinity. Neither the species nor any indication of its presence was detected. Although individuals may have been missed, it is Less than reasonable that substantial populations are present. Further	Although occurrence may be remotely possible, the likelihood of occurrence is less than that required for any potentially applicable regulatory threshold. Further, the likelihood of meaningful value of the site to any population(s) of this taxon is less than reasonable. The species may or may not include the study area within its current, general range. However, no appropriate, or adequately extensive, or effectively connected habitat is present. Neither the species nor any indication of its presence was detected. In some cases this likelihood may indicate that based on the best available information, the study area has a very high probability of being outside of the species' current range. In all of the above cases, the	Confirmed to be absent on the study area as a formal and/or practical matter. Most often, this is a determination based on negative results of a focused survey for the species conducted in appropriate habitat at appropriate time(s) of year, using biologically sound methods and qualified personnel. In the remaining cases, it may be based on a simple study area examination, for species and study area contexts where it is easily determined that the species is absent; for example, a tidal marsh insect and a dry mountainside study area, or a disturbance-intolerant chaparral shrub where the study area is a long-standing, degraded grassland far from chaparral. The relevant fieldwork was also in all cases

			evaluation should usually not be required for individual species except, in most cases, for biologically threatened or endangered species. Note however, that where several non-listed species hold this status, a higher likelihood of occurrence for "one or more" will generally hold. This is due both to the increased number of species and the fact that an array of possibilities often correlates with greater site biodiversity and lower relevant (but not readily detected) disturbance levels.	species may not be definitively ruled out but is strongly believed to be absent based on professional evaluation of all available evidence. In some cases, the species may occur on rare occasions and in low numbers, but with no more than brief, incidental use of the study area. That is, the site is also judged to lack any important function for the species. Certainly there are no substantial populations directly utilizing the study area at any time of year. Further evaluation should not normally be required.	conducted within a time frame sufficiently recent to conclude that the species remains absent, based on study area conditions and the species' known ecology. In most cases a specific, established survey protocol and/or guidelines have been followed.

Special-status Mammal Species

Common Name	Scientific Name	Status	Habitat Requirements	Likelihood of Occurrence
American badger	*Taxidea taxus*	CSC S4	Commonly found in treeless areas including tallgrass and shortgrass prairies, grass-dominated meadows and fields within forested habitats, and shrub-steppe communities.	**Less than reasonable**. Not reported in any survey efforts. CNDDB records are not dated, but show the closest occurrence greater than nine miles away. Urbanized setting would likely preclude the species.
Big free-tailed bat	*Nyctinomops macrotis*	CSC S2	In Southern California, found in low-lying arid areas. Need high cliffs or rocky outcrops for roosting sites. Feeds principally on large moths.	**Low potential**. Roosting sites are lacking in the Project area; however, the species may occur in a foraging role.
California leaf-nosed bat	*Macrotus californicus*	CSC S2S3	This insectivorous bat is a maneuverable, low-flying forager that gleans and feeds on the ground and in the air. Roosts are in deep tunnels or caves, occasionally in buildings or bridges. It was formerly found throughout southern California, but is apparently now confined to lowland Sonoran Desert habitat below 900 m. It forages in desert wash vegetation within one to three miles of roosting sites. Historical habitats utilized in coastal areas appear to be poorly known.	**Low potential**. Roosting sites are lacking in the Project area; however, the species may occur in a foraging role.
Hoary bat	*Lasiurus cinereus*	S4?	The hoary bat is the most widespread North American bat. May be found at any location in California, although distribution patchy in southeastern deserts. This common, solitary species winters along the coast and in southern California, breeding inland and north of the winter range. Habitats suitable for bearing young include all woodlands and forests with medium to large-size trees and dense foliage. Hoary bats have been recorded from sea level to 4125 m (13,200 ft). During migration in southern California, males are found in foothills, deserts and mountains; females in lowlands and coastal valleys.	**Low potential**. Potentially suitable foraging and day roosting habitat are present within the Project area.
Pacific pocket mouse	*Perognathus longimembris pacificus*	FE CSC S1	It is an obligate resident of fine-grained sandy soils of Coastal Strand, Coastal Dunes, River and Marine Alluvium, and Coastal Sage Scrub in close proximity to the ocean, and has never been collected more than 2 miles (about 3 kilometers) from the coast or above 600 feet (about 180 meters) elevation. It appears that occurrences are closely associated with loose or friable soils that permit burrowing.	**Less than reasonable**. No detection in survey efforts from 1981-2011. The study area contains suitable habitat; however, the last noted detection detections was in 1938.

Common Name	Scientific Name	Status	Habitat Requirements	Likelihood of Occurrence
Pallid bat	*Antrozous pallidus*	CSC S3	This bat species is widely distributed in the southwestern United States and northern Mexico. They are locally common across most of California except in the far northwest and in higher portions of the Sierra Nevada. Habitats utilized include a wide variety of grasslands, shrublands, woodlands, and forests, including mixed conifer forest. They appear to be most common in open, dry, rocky lowlands. Roosts are in caves, mines, as well as crevices in rocks, buildings and trees. This is a colonial species that forages low over open ground, often picking up beetles and other species of prey off the ground.	**Low potential**. Potentially suitable foraging and day roosting habitat are present within the Project area.
Pocketed free-tailed bat	*Nyctinomops femorosaccus*	CSC S2S3	Occurs in a variety of arid areas in Southern California, including pine-juniper woodlands, desert scrub, palm oasis, desert wash, desert riparian. Prefers rocky areas with high cliffs for roosting.	**Low potential**. Roosting sites are lacking in the Project area; however, the species may occur in a foraging role.
San Diego black-tailed jackrabbit	*Lepus californicus bennetti*	CSC S3?	This subspecies is distributed along the coastal slope from around Point Conception south into Baja California. It requires extensive open spaces, such as grasslands or open sage scrub, usually in fairly level situations. It is generally not found in chaparral or woodland habitats. The presence of substantial available cover, either dense grasses or shrubs, appears to be important for day roosts and is often adjacent to more open foraging areas.	**Less than reasonable**. In the early 1990's there was a population at the Los Angeles airport. Detected in 1981 surveys in Areas A and B, however mammal surveys after 1981 report no detections of the species.
Silver-haired bat	*Lasionycteris noctivagans*	S3S4	Coastal and montane forests from the Oregon border south along the coast to San Francisco Bay, and along the Sierra Nevada and Great Basin region to Inyo Co. It also occurs in southern California from Ventura and San Bernardino, south to Mexico and on some of the Channel Islands. During spring and fall migrations this species may be found anywhere in California. Summer habitats include coastal and montane coniferous forests, valley foothill woodlands, pinyon-juniper woodlands, and valley foothill and montane riparian habitats. Summer range is generally below 2750 m (9000 ft). Roosts in hollow trees, snags, buildings, rock crevices, caves, and under bark. Primarily a forest dweller, feeding over streams, ponds, and open brushy areas.	**Low potential**. Roosting sites are lacking in the Project area; however, the species may occur in a foraging role.

Common Name	Scientific Name	Status	Habitat Requirements	Likelihood of Occurrence
South coast marsh vole	*Microtus californicus stephensi*	CSC S1S2	Occurs in the area of tidal marshes in Los Angeles, Orange, and southern Ventura Counties.	**Confirmed present**. Captured during small mammal surveys in marsh habitats containing saltgrass (*Distichlis spicata*). Recorded in Areas A and B in 1981, 1991, 1996, and 2001. Captured only in Area B in 2010. Visually detected in salt marsh habitat in Area B in 2011.
Southern California saltmarsh shrew	*Sorex ornatus salicornicus*	CSC S1	Occurs in coastal marshes in Los Angeles, Orange and Ventura counties. Based on other studies of shrews, may require dense ground cover, nesting sites above mean high tide and free from inundation.	**Moderate potential**. Last captured on the Reserve Area B in 1991. Although recent trapping efforts on the Reserve have not yielded additional captures; suitable habitat remains present.
Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	Candidate as State Threatened (=CSC) S2S3	Occurs throughout the drier portions of California. It is non-migratory, and hibernates from approximately October through April. They take a variety of prey, but primarily larger insects, especially moths. Known roost sites have been in caves, lava tubes, mines, tunnels, buildings and other man-made structures. Foraging habitats include coniferous forests and pinyon-juniper woodlands, deciduous riparian woodlands, and desert lands.	**Low potential**. Roosting sites are lacking in the study area; however, the species may occur in a foraging role.
Western mastiff bat	*Eumops perotis californicus*	CSC S3?	Primarily a cliff dwelling species, where maternity colonies of 30 to several hundred (typically fewer than 100) roost generally under exfoliating rock slabs (e.g. granite, sandstone or columnar basalt). It has also been found in similarly crevices in large boulders and buildings. Roosts are generally high above the ground, usually allowing a clear vertical drop of at least 9.8 feet below the entrance for flight. Forages in broad open areas.	**Low potential**. Roosting sites are lacking in the Project area; however, the species may occur in a foraging role.
Western yellow bat	*Lasiurus xanthinus*	CSC S3	Some populations may be migratory, although some individuals appear to be present year-round. Species probably do not hibernate. Associated with water features in open grassy areas and scrub, as well as canyon and riparian situations. Thought to be noncolonial. Individuals usually roost in trees, hanging from the underside of a leaf and are commonly found in the southwestern U.S. roosting in the skirt of dead fronds in both native and non-native palm trees.	**Moderate potential**. Palm trees and other trees on and adjacent to the Project site may provide roosting sites. May also occur in a foraging role

Shading Species which has less than reasonable potential for occurrence and impact.
Confirmed Present A qualified biologist or other reliable source has confirmed the presence of the species and there is no specific evidence that the species has subsequently become absent. Depending on the species and other information available, it may or may not be possible to determine, without further studies, what portions of the study area are currently in use.
High Potential The study area is known to be within the range of the species, and contains potential habitat with a high likelihood of occupancy. Although no individuals or diagnostic sign were detected during current fieldwork by a qualified observer, the species is likely to be present to some degree given the best available information. Depending upon regulatory status, local rarity, public interest, extent of habitat on the study area, and the nature of potential project impacts, a substantial basis may exist for either conducting focused surveys for the species or for assuming presence.
Moderate Potential The study area is within the range of the species, and contains potentially appropriate habitat. Neither individuals nor diagnostic sign were detected. It is nevertheless reasonable that some individuals may have been overlooked. The best available information on the species with regard to the study area is either very uncertain, or may be equally weighted for and against occurrence. Depending upon local and special legal status, extent of habitat, and the nature and sensitivity of the project, focused surveys for the species may be warranted or presence may be assumed.
Low Potential Occurrence of the species is reasonable but Less than reasonable because of some combination of facts. For example, 1) the study area was the subject of unsuccessful searches conducted under relevant and reasonable circumstances, 2) potential habitat present is marginal or minimal in extent, 3) the best available information suggests the species is absent from the study area, and/or 4) available information sheds no clear light on the species likelihood on the study area, but it is known to be rare at best in the vicinity. Neither the species nor any indication of its presence was detected. Although individuals may have been missed, it is Less than reasonable that substantial populations are present. Further evaluation should usually not be required for individual species except, in most cases, for biologically threatened or endangered species. Note however, that where several non-listed species hold this status, a higher likelihood of occurrence for "one or more" will generally hold. This is due both to the increased number of species and the fact that an array of possibilities often correlates with greater site biodiversity and lower relevant (but not readily detected) disturbance levels.
Less than reasonable Although occurrence may be remotely possible, the likelihood of occurrence is less than that required for any potentially applicable regulatory threshold. Further, the likelihood of meaningful value of the site to any population(s) of this taxon is less than reasonable. The species may or may not include the study area within its current, general range. However, no appropriate, or adequately extensive, or effectively connected habitat is present. Neither the species nor any indication of its presence was detected. In some cases this likelihood may indicate that based on the best available information, the study area has a very high probability of being outside of the species' current range. In all of the above cases, the species may not be definitively ruled out but is strongly believed to be absent based on professional evaluation of all available evidence. In some cases, the species may occur on rare occasions and in low numbers, but with no more than brief, incidental use of the study area. That is, the site is also judged to lack any important function for the species. Certainly there are no substantial populations directly utilizing the study area at any time of year. Further evaluation should not normally be required
Confirmed Absent Confirmed to be absent on the study area as a formal and/or practical matter. Most often, this is a determination based on negative results of a focused survey for the species conducted in appropriate habitat at appropriate time(s) of year, using biologically sound methods and qualified personnel. In the remaining cases, it may be based on a simple study area examination, for species and study area contexts where it is easily determined that the species is absent; for example, a tidal marsh insect and a dry mountainside study area, or a disturbance-intolerant chaparral shrub where the study area is a long-standing, degraded grassland far from chaparral. The relevant fieldwork was also in all cases conducted within a time frame sufficiently recent to conclude that the species remains absent, based on study area

conditions and the species' known ecology. In most cases a specific, established survey protocol and/or guidelines have been followed.

NOTES:

Federal

FE = Endangered

FT = Threatened

FC = Candidate

State

SE = Endangered

ST = Threatened

CSC = Species of Special Concern

CFP = Fully Protected Species

WL= California Watchlist (formerly a Species of Special Concern; limited protection

Note: The California Natural Diversity Database (CNDDB) uses the same ranking methodology originally developed by The Nature Conservancy and now maintained and recently revised by NatureServe. The *state rank* (S-rank) refers to the imperilment status only within California's state boundaries. It is a reflection of the overall status of an element through its state range. The state rank represent a letter + number score that reflects a combination of Rarity, Threat, and Trend factors, with weighting being heavier on Rarity than the other two.

S1 = Critically Imperiled - Critically imperiled in the state because of extreme rarity (often 5 or fewer populations) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state.

S2 = Imperiled - Imperiled in the state because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the state.

S3 = Vulnerable - Vulnerable in the state due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation from the state.

S4 = Apparently Secure - Uncommon but not rare in the state; some cause for long-term concern due to declines or other factors.

S5 = Secure - Common, widespread, and abundant in the state.

SH = All sites are historical; the element has not been seen for at least 20 years, but suitable habitat still exists.

SX = All sites are extirpated.

Uncertainty about the rank of an element is expressed in two major ways:

- By expressing the ranks as a range of values: e.g., S2S3 means the rank is somewhere between S2 and S3.
- By adding a ? to the rank: e.g., S2? This represents more certainty than S2S3, but less certainty than S2.

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APPENDIX D13
Species Accounts

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Appendix D13 Species Discussions

State and Federally Listed Special-Status Plants

Beach spectaclepod (*Dithyrea maritima*): State listed as Threatened; CRPR List 1B.1. Beach spectaclepod is a perennial forb in the mustard family (Brassicaceae) that blooms from March to May. It typically occurs on seashores on sand dunes and sandy places near the shore in coastal dune and coastal scrub habitats at elevations ranging from 10 to 165 feet (CNDDB 2014[1]; CNPS 2014[2]). Observed associated species include sand verbenas (*Abronia* spp), beach primrose (*Camissoniopsis cheiranthifolia*), Trask's milk-vetch (*Astragalus traskiae*), coastal goldenbush (*Isocoma menziesii*), silver beach weed (*Ambrosia chamissonis*), iceplant, sea rocket (*Cakile maritima*), silver bird's-foot trefoil (*Lotus argophyllus*), silver bush lupine (*Lupinus albifrons*), and wire lettuce (*Stephanomeria virgata*)(CNDDB 2014[3]).

This species is known from seventeen USGS 7.5-minute quadrangles in Los Angeles, Santa Barbara, San Luis Obispo, and Ventura counties; however, it is presumed to be extirpated from 4 of the seventeen quadrangles (CNPS 2014[4]). There are four CNDDB (2014[5]) records in the project region, based on ten collection records in the Consortium of California Herbaria (CCH) (2014[6]) and CNPS file information. The nearest documented occurrence to the study site, based on a collection made in April 1903 from Playa del Rey, is less than 1 mile from the Reserve (CNDDB 2014[7]). The most recently documented observation of the species in the region was in April 1932 at El Segundo, approximately 4 miles south of the study site (CCH 2014[8]; CNDDB 2014[9]). Dune and nonnative dune habitats in Area B are potential habitat for this species. However, this species was not observed during the April 2011 rare plant survey (WRA 2011[10]) or during any other earlier surveys; therefore, it is presumed to be absent from the study area.

Coastal dunes milk-vetch (*Astragalus tener* var *titi*): Federally listed as Endangered; State listed as Endangered; CRPR List 1B.2. Coastal dunes milk-vetch is an annual herb in the pea family (Fabaceae) that blooms from March to May. Although the habitat requirements for coastal dunes milkvetch is poorly known, it is currently known from coastal prairie habitat (USFWS

1 CNDDB 2014
2 CNPS 2014
3 CNDDB 2014
4 CNPS 2014
5 CNDDB 2014
6 Consortium of California Herbaria 2014
7 CNDDB 2014
8 CCH 2014
9 CNDDB 2014
10 WRA 2011

2009a[11]) at elevations ranging from 1 to 165 feet (CNPS 2014[12]; CNDDB 2014[13]). Observed associated species include grasses, sedges (*Carex* spp), sea fig (*Carpobrotus edulis*), varied lupine (*Lupinus variicolor*), cut leaf plantain (*Plantago coronopus*), and Pacific Grove clover (*Trifolium polyodon*) (CNDDB 2014[14]).

This species is known from six USGS 7.5-minute quadrangles in Los Angeles, Monterey, and San Diego counties; however, it is believed to be extirpated in Los Angeles County (CNPS 2014[15]). There are two CNDDB (2014[16]) records in the project region, based on three collections from Los Angeles County (CCH 2014[17]). The nearest documented occurrence was a collection made in April 1903 at Hyde Park, approximately 3 miles east of the study site (CNDDB 2014[18]). The most recently documented observation of the species in the region was in 1930 near Santa Monica, approximately 4 miles northwest of the study site (CCH 2014[19]; CNDDB 2014[20]). Coastal prairie habitat does not occur in the Reserve, although this habitat historically extended from the Ballona Bluffs south to Palos Verdes (Mattoni and Longcore 1997[21]). This species was not observed during the April 2011 rare plant surveys (WRA 2011[22]) or during any other earlier surveys; therefore, it is presumed to be absent from the study area.

Salt marsh bird's-beak (*Chloropyron maritimum* ssp *maritimum*): State and Federally listed as Endangered; CRPR List 1B.2. Salt marsh bird's beak is an annual herb in the figwort family (Scrophulariaceae) that blooms from May to October. It typically occurs inin higher zones of coastal salt marsh habitats at elevations ranging from 0 to 100 feet (USFWS 2009b[23]; CNPS 2014[24]). Observed associated species include salt grass (*Distichlis spicata*), sea lavender (*Limonium californicum*), salt marsh dodder (*Cuscuta salina*), alkali weed (*Cressa truxillensis*), saltwort (*Batis maritima*), fleshy jaumea, and pickleweed (CNDDB 2014[25]).

This species is known from sixteen USGS 7.5-minute quadrangles in Los Angeles, Orange, Santa Barbara, San Bernardino, San Diego, San Luis Obispo, and Ventura counties; however it is believed to be extirpated from 3 of the 16 quadrangles (CNPS 2014[26]). There are three known occurrences in Los Angeles County, including one occurrence in the project region (CNDDB 2014[27]), based on six collections of the species (CCH 2014[28]). The nearest occurrence to the Reserve is in Santa Monica, based on a collection made in 1888 (CNDDB 2014[29]). A 1901

11 USFWS 2009a
12 CNPS 2014
13 CNDDB 2014
14 CNDDB 2014
15 CNPS 2014
16 CNDDB 2014
17 CCH 2014
18 CNDDB 2014
19 CCH 2014
20 CNDDB 2014
21 Mattoni and Longcore 1997
22 WRA 2011
23 USFWS 2009b
24 CNPS 2014
25 CNDDB 2014
26 CNPS 2014
27 CNDDB 2014
28 CCH 2014
29 CNDDB 2014

collection from Ballona Harbor is also attributed to the Santa Monica occurrence (USFWS 2009b[30]), although this collection is not cited in the CNDDB record (CNDDB 2014[31]). Tidal wetlands (Marsh Plain) in Area A and Area B are potential habitat for this species. However, the U.S. Fish and Wildlife Service (USFWS) (1984[32]) concluded that this occurrence was extirpated, based on surveys at Ballona wetlands in 1980, 1982, and 1983 that were unsuccessful in locating the species. The species was not observed during any subsequent surveys in the study area, including the rare plant surveys conducted in July and October 2010 (WRA 2011[33]). Therefore, salt marsh bird's-beak is presumed to be absent from the study area.

San Fernando Valley spineflower (*Chorizanthe parryi* var *fernandina*): State listed as Endangered and Federal Candidate; CRPR List 1B.1. San Fernando Valley spineflower is an annual herb in the buckwheat family (Polygonaceae) that blooms from April to July. It typically occurs on sandy soils in coastal scrub, and in valley and foothill grassland habitats at elevations ranging from 490 to 4,000 feet (CNPS 2014[34]). Observed associated species include California sage brush, California buckwheat *(Eriogonum fasciculatum*),), longstem buckwheat (*Eriogonum elongatum*), slender buckwheat (*E. gracile*), purple sage (*Salvia leucophylla*), goldenbush (*Ericameria* spp), four o'clock species (*Mirabilis* sp), and Madrid brome (*Bromus madritensis*) (CNDDB 2014[35]).

This species is known from fourteen USGS 7.5-minute quadrangles in Los Angeles and Ventura counties; however, it is believed to be extirpated from 9 of the 14 quadrangles, and from Orange County (CNPS 2014[36]). There are nineteen occurrence records from Los Angeles County, based on thirty-nine specimen collections, but only one occurrence is recorded in the project region (CNDDB 2014[37]; CCH 2014[38]). The nearest documented occurrence is from April 1901 at Ballona Harbor, less than 1 mile north of the study site, however, this occurrence is considered to be possibly extirpated (CNDDB 2014[39]).

The most recent occurrences reported from Los Angeles County are from August 2011 at the Newhall Ranch, approximately 30 miles north of the study site (CCH 2014[40]). Annual grassland and upland scrub are potential habitat for this species on the study site. This species was not observed during the July 2010 or April 2011 rare plant surveys (WRA 2011[41]) or during any other earlier surveys; therefore, it is presumed to be absent from the study area.

Ventura Marsh milk-vetch (*Astragalus pycnostachyus* var *lanosissimus*): Federally listed as Endangered; State listed as Endangered; CRPR List 1B.1. Ventura Marsh milk-vetch is a perennial herb in the pea family (Fabaceae) that blooms from June to October. It typically occurs near sandy bluff seeps, behind barrier beaches, and near high tide zones, in coastal dune, coastal

30 USFWS 2009b
31 CNDDB 2014
32 USFWS (1984
33 WRA 2011
34 CNPS 2014
35 CNDDB 2014
36 CNPS 2014
37 CNDDB 2014
38 CCH 2014
39 CNDDB 2014
40 CCH 2014
41 WRA 2011

scrub, and coastal salt marsh habitats at elevations ranging from 0 to 115 feet (CNPS 2014[42]; CNDDB 2014[43]). Observed associated species include coyote brush, mulefat, arroyo willow (*Salix lasiolepis*), sea fig, lollypop tree, and rabbit's-foot grass (CNDDB 2014[44]).

This species is reported from five USGS 7.5-minute quadrangles in Los Angeles, Orange, and Ventura counties; however, it is believed to be extirpated from both Los Angeles and Orange counties (CNPS 2014[45]). There are two CNDDB (2014[46]) records in the study region, based on eight collections from Los Angeles County (CCH 2014[47]). The nearest and most recent CNDDB (2014[48]) or CCH (2014[49]) documented occurrence is from July 1951 within the historic Ballona wetlands. Another occurrence at Santa Monica was last observed in 1900 (CNDDB 2014[50]; CCH 2014[51]). No other recent occurrences within the study region have been documented for this species. The only extant occurrence for Ventura Marsh milk-vetch is at Mandalay Beach in Ventura County, an area outside of the study region. Potential habitat for this species is present in dune and grassland habitat adjacent to wetlands. This species was not observed during the July or October 2010 surveys (WRA 2011[52]) or during any other earlier surveys; therefore, it is presumed to be absent from the study area.

Non-listed Special-Status Plants

Red Sand-verbena (*Abronia maritima*): CRPR 4.2. Red sand-verbena is a perennial herb in the four o'clock family (Nyctaginaceae) that blooms from February to October. It grows on coastal dunes below 328 feet (CNPS 2014[53]).

This species is known from at least thirty-two USGS 7.5-minute quadrangles and is distributed from San Luis Obispo County to San Diego County, including the Channel Islands. The CNDDB does not provide records of List 4 species; however, there are seventy specimen records of red sand-verbena from Los Angeles County, including multiple collections made between Santa Monica and Manhattan Beach (CCH 2014[54]). The species was initially documented in Ballona Harbor in 1901 and in Playa del Rey in 1902, and it was most recently documented in El Segundo in 2011 (CCH 2014[55]). Dune and nonnative dune habitats in Area B are potential habitat for this species. Both common sand-verbena and villose sand-verbena have been reported from the study site. However, red sand-verbena was not observed during the 2010 and 2011 rare

42 CNPS 2014
43 CNDDB 2014
44 CNDDB 2014
45 CNPS 2014
46 CNDDB 2014
47 CCH 2014
48 CNDDB 2014
49 CCH 2014
50 CNDDB 2014
51 CCH 2014
52 WRA 2011
53 CNPS 2014
54 CCH 2014
55 CCH 2014

plant surveys (WRA 2011[56]) or during any other earlier surveys; therefore, it is presumed to be absent from the study area.

Coastal Goosefoot (*Chenopodium littoreum*): CRPR 1B.2. Coastal goosefoot is an annual herb in the goosefoot family (Chenopodiaceae) that blooms from April to August. It grows on coastal dunes at elevations below 130 feet (CNPS 2014[57]). Reported associated species include coyote brush, California sage brush, California goldenbush (*Ericameria ericoides*), coastal bush lupine (*Lupinus arboreus*), California croton, common sand verbena, and lance-leaved dudleya (*Dudleya lanceolate*) (CNDDB 2014[58]).

This species is known from five USGS 7.5-minute quadrangles in Los Angeles, Santa Barbara, and San Luis Obispo counties (CNPS 2014[59]). There is a single occurrence in the project region, based on a 1904 collection from Playa del Rey (CNDDB 2014[60]; CCH 2014[61]). This occurrence is reported to be extirpated (CNDDB 2014[62]). The species was not observed during the 2010 and 2011 rare plant surveys (WRA 2011[63]) or during any other earlier surveys; therefore, it is presumed to be absent from the study area.

Los Angeles Sunflower (*Helianthus nuttallii* ssp *parishii*): CRPR 1A. Los Angeles sunflower is a perennial herb in the sunflower family (Asteraceae) that bloomed from August to October. It grows in coastal salt marsh and freshwater marshes at elevations between 15 and 5,500 feet (CNPS 2014[64]). Observed associated species are unreported.

This species is known from nine USGS 7.5-minute quadrangles in Los Angeles, Orange, and San Bernardino counties (CNPS 2014[65]). The species has not been observed since 1937 and is considered to be extinct (CNDDB 2014[66]; CNPS 2014[67]). There is one record of the species from the project region, and none from the study area. The occurrence from the project region was extirpated in 1903 (CNDDB 2014[68]). Marsh habitat in the study area is potential habitat for the species. The species was not observed during the 2010 and 2011 rare plant surveys (CNDDB 2014[69]). Marsh habitat in the study area is potential habitat for the species. The species was not observed during the 2010 and 2011 rare plant surveys (WRA 2011[70]) or during any other earlier surveys; therefore, it is presumed to be absent from the study area.

56 WRA 2011
57 CNPS 2014
58 CNDDB 2014
59 CNPS 2014
60 CNDDB 2014
61 CCH 2014
62 CNDDB 2014
63 WRA 2011
64 CNPS 2014
65 CNPS 2014
66 CNDDB 2014
67 CNPS 2014
68 CNDDB 2014
69 CNDDB 2014
70 WRA 2011

Vernal Barley (*Hordeum intercedens*): CRPR 3.2. Vernal barley is an annual herb in the grass family (Poaceae) that blooms from March to June. It grows in coastal dunes, coastal scrub, and grassland habitats, typically in saline flats, depressions and vernal pools (CNPS 2014[71]).

The species is known from the south coast ranges and southwestern California, although an accurate record of its occurrence in the counties and USGS 7.5-minute quadrangles has been limited by misidentification of this species as low barley (*Horteum depressum*), a more common species (CNPS 2014[72]). The CNDDB does not provide records of List 4 species; however, there are two historical records of the species from the project region, including a 1901 collection from Ballona Harbor (CCH 2014[73]). Although primarily found in alkali grasslands and vernal pools, the margins of salt pan habitat in the study area may be potential habitat for the species. The species was not observed during the 2010 and 2011 rare plant surveys (WRA 2011[74]) or during any other earlier surveys; therefore, it is presumed to be absent from the study area.

Southwestern Spiny Rush (*Juncus acutus* ssp *leopoldii*): CRPR 4.2. Southwestern spiny rush is a rhizomatous perennial herb in the rush family (Juncaceae) that blooms from June to August. It grows in alkali seeps in coastal dunes and meadows and in coastal salt marsh (CNPS 2014[75]). Wetlands in the study area may provide suitable habitat for the species.

This species is known from twenty-seven USGS 7.5-minute quadrangles in San Luis Obispo, Santa Barbara, Ventura, Los Angeles, Orange, and San Diego counties (CNPS 2014[76]). The CNDDB does not provide records of List 4 species; however, there are twenty-five specimen records from Los Angeles County, including four historical records from the project region (CCH 2014[77]). There are no records of the species from the study area. The species was not observed during the 2010 and 2011 rare plant surveys (WRA 2011[78]) or during any other earlier surveys; therefore, it is presumed to be absent from the study area.

Coulter's Goldfields (*Lasthenia glabrata* ssp *coulteri*): CRPR 1B.1. Coulter's goldfields is an annual herb in the sunflower family (Asteraceae) that blooms in April and May. It grows in vernal pools and on the margins of playa and coastal salt marsh, below 4,000 feet elevation (CNPS 2014[79]). Reported associated species include saltgrass, barley species, pickleweed species, alkali weed, alkali heath, bush seepweed, and saltscale species (CNDDB 2014[80]).

This species is known from sixty-seven USGS 7.5-minute quadrangles, primarily in southwestern California; it is presumed to be extirpated in 14 of the quadrangles (CNPS 2014[81]). There are five historical records in the project region (CNDDB 2014[82]; CCH 2014[83]). It was

71 CNPS 2014
72 CNPS 2014
73 CCH 2014
74 WRA 2011
75 CNPS 2014
76 CNPS 2014
77 CCH 2014
78 WRA 2011
79 CNPS 2014
80 CNDDB 2014
81 CNPS 2014
82 CNDDB 2014
83 CCH 2014

historically known to occur in Ballona Marsh, where it was last observed in 1934 and is believed to be extirpated (CNDDB 2014[84]). Wetlands in the study area appear to remain suitable habitat for the species. The species was not observed during the April 2011 rare plant surveys (WRA 2011[85]) or during any other earlier surveys; therefore, it is presumed to be absent from the study area.

California Spineflower (*Mucronea californica*): CRPR 4.2. California spineflower is an annual herb in the buckwheat family (Polygonaceae) that blooms from March to August. It grows in sandy soils in chaparral, woodland, coastal dunes, coastal scrub, and grassland habitats below 4,600 feet elevation (CNPS 2014[86]). Coastal dunes, coastal scrub, and grassland habitats in the study area are suitable habitat for this species.

This species is known from at least nine USGS 7.5-minute quadrangles, ranging from Kern and Monterey counties south to Riverside and San Diego counties (CNPS 2014[87]). There are multiple collection records from the project area. The species was historically collected at Ballona Marshes in 1899 and Playa del Rey in 1902; the most recent collections near the study area are from El Segundo in 1988 (CCH 2014[88]). The species was not observed during the April 2011 rare plant surveys (WRA 2011[89]) or during any other earlier surveys; therefore, it is presumed to be absent from the study area.

Mud Nama (*Nama stenocarpa*): CRPR 2B.2. Mud nama is an annual herb in the borage family (Boraginaceae) that blooms between March and October. It grows on lake shores, river banks, and intermittently wet areas of marshes, at elevations between 15 and 1,640 feet (CNPS 2014[90]). Reported associated species include purple redstem, annual salt marsh aster, common cocklebur, alkali mallow, common verbena, hyssop loosestrife, toad rush, and western marsh cudweed (CNDDB 2014[91]). Wetlands in the study area appear to be suitable habitat for this species. This species is known from at least eighteen USGS 7.5-minute quadrangles in Kings, Los Angeles, Orange, Riverside, Imperial, and San Diego counties; it is considered to be extirpated from three quadrangles and from Los Angeles and Imperial counties (CNPS 2014[92]). There are two historical records from the project region, where it was last observed in 1924 (CCH 2014[93]; CNDDB 2014[94]). There are no records of the species from the study area. The species was not observed during the 2010 and 2011 rare plant surveys (WRA 2011[95]) or during any other earlier surveys; therefore, it is presumed to be absent from the study area.

Brand's star phacelia (*Phacelia stellaris*): CNPS List 1B.1. Brand's star phacelia is an annual forb in the waterleaf family (Hydrophyllaceae) that blooms from March to June. It typically occurs in open areas in coastal dune and coastal scrub habitat at elevations ranging from 1 to

84 CNDDB 2014
85 WRA 2011
86 CNPS 2014
87 CNPS 2014
88 CCH 2014
89 WRA 2011
90 CNPS 2014
91 CNDDB 2014
92 CNPS 2014
93 CCH 2014
94 CNDDB 2014
95 WRA 2011

1,300 feet (CNDDB 2014[96]; CNPS 2014[97]). Observed associated species include pink sand verbena (*Abronia umbellata*), red sand verbena (*Abronia maritima*), beach primrose, silver beach weed, cottonheads (*Nemacaulis denudata*), California croton (*Croton californica*), and pygmy weed (*Crassula connata*) (CNDDB 2014[98]).

This species is known from eight USGS 7.5-minute quadrangles in Los Angeles and San Diego counties; however, it is presumed extirpated from five of the eight quadrangles (CNPS 2014[99]). There are three CNDDB (2014[100]) records in the project region and eight CCH (2014[101]) records from Los Angeles County. The nearest documented occurrence was based on a collection made in 1909 at Playa del Rey, within 1 mile of the study site (CNDDB 2014[102]). The most recently documented observation of the species in the region was in March 1932 at El Segundo, approximately 4 miles south of the study site (CCH 2014[103]; CNDDB 2014[104]). Dune and nonnative dune habitats in Area B are potential habitat for this species. However, this species was not observed during the April 2011 rare plant survey or during any other earlier surveys; therefore, it is presumed to be absent from the study area.

Ballona Cinquefoil (*Potentilla multijuga*): CRPR 1A. Ballona cinquefoil was a perennial herb in the rose family (Rosaceae) that bloomed from April to July. It grew in brackish meadows (CNDDB 2014[105]).

This species is known from only a single occurrence. It was originally collected in the 1890s at the Ballona wetlands (CNDDB 2014[106]; CCH 2014[107]). The species has not been observed since that time and is believed to be extinct. Habitat in the study area may no longer be suitable for the species. This species was not observed during the 2010 or 2011 rare plant surveys or during any other earlier surveys; therefore, it is presumed to be absent from the study area.

Estuary Seablite (*Suaeda esteroa*): CRPR 1B.2. Estuary seablite is a perennial herb in the goosefoot family (Chenopodiaceae) that is occasionally annual or persisting as a subshrub. It blooms from May to October. Habitat for the species is coastal salt marsh, at elevations below 15 feet (CNPS 2014[108]). Suitable habitat for the species is present in the study area.

This species is known from fifteen USGS 7.5-minute quadrangles in Santa Barbara, Ventura, Los Angeles, Orange, and San Diego counties; however, it is presumed extirpated from one of the quadrangles (CNPS 2014[109]). Although there are no records of the species from the project region, the study site is within the range of estuary seablite, and several collections are known

96 CNDDB 2014
97 CNPS 2014
98 CNDDB 2014
99 CNPS 2014
100 CNDDB 2014
101 CCH 2014
102 CNDDB 2014
103 CCH 2014
104 CNDDB 2014
105 CNDDB 2014
106 CNDDB 2014
107 CCH 2014
108 CNPS 2014
109 CNPS 2014

from Long Beach and Seal Beach (CNDDB 2014[110]; CCH 2014[111]). This species was not observed during the 2010 or 2011 rare plant surveys or during any other earlier surveys; therefore, it is presumed to be absent from the study area.

[110] CNDDB 2014
[111] CCH 2014

Special-Status Invertebrates

Riverside fairy shrimp (*Streptocephalus woottoni*): Federally listed as Endangered; State Rank= S1 Riverside fairy shrimp require vernal pool habitat to grow and reproduce. Their life cycle requires periods of inundation as well as dry periods. Suitable habitats for growth and persistence of Riverside fairy shrimp include areas that generally pond for two to eight months and dry down for a period during the late spring to summer months. Habitats include natural and created pools (usually greater than 12 inches (30 centimeters [cm]) deep) that support these longer inundation periods; some of these habitats are artificial pools (cattle watering holes and road embankments) that have been modified or deepened with berms. Artificial depressions, often associated with degraded vernal pool habitat, are capable of functioning as habitat and can support vernal pool species, including Riverside fairy shrimp. Suitable habitat for the Riverside fairy shrimp's normal growth and behavior requires an underlying soil series (typically clay soil inclusions with a subsurface claypan or hardpan component), which forms an impermeable layer that sustains appropriate inundation periods (water percolates slowly once filled) and provides necessary physiological requirements including, but not limited to, appropriate water temperature and water chemistry (mineral) regimes, a natural prey base, foraging opportunities, and areas for predator avoidance. Vernal pool habitat typically exhibits a range of conditions but remains within the physiological tolerance of the species. The general ranges of conditions include, but are not limited to: dilute, freshwater pools with low levels of total dissolved solids (low ion levels [sodium ion concentrations generally below 70 millimoles per liter (mmol/l)], low alkalinity levels [lower than 80 to 1,000 milligrams per liter (mg/l)], and a range of pH levels from slightly acidic to neutral [typically in range of 6.4–7.1]) (Federal Register 2012[112]). Area A, Area B, and Area C were evaluated by Glen Lukos Associates (GLA) in 2000 for habitat suitable for Riverside fairy shrimp, although the habitat assessment did not include either wet- or dry-season sampling (PWA 2006[113]). Wherever substantial ponding was observed during the May 2000 assessments, the water was measured for specific conductance and visual observations of any aquatic invertebrates and vegetation were collected. No ponds in Area A, Area B, or Area C were determined to be capable of supporting Riverside fairy shrimp due to high salinities or inadequate length or depth of ponding and, therefore, Riverside fairy shrimp was determined to be absent from the study area (GLA 2000[114]). Appendix 3.4N Table 3.4-9, Summary of GLA Habitat Assessment for Riverside and San Diego Fairy Shrimp (*Branchinecta sandiegonensis*), summarizes the results of the GLA habitat assessment for Riverside fairy shrimp.

[112] Federal Register 2012
[113] PWA 2006
[114] GLA 2000

San Diego fairy shrimp (*Branchinecta sandiegonensis*): Federally listed as Endangered; State Rank= S1 San Diego fairy shrimp require vernal pool habitat to grow and reproduce. Their life cycle requires periods of inundation as well as dry periods. The San Diego fairy shrimp is most often found in vernal pools or vernal pool complexes that have the appropriate temperature, water chemistry, depth, and duration. More specifically, San Diego fairy shrimp are found in vernal and ephemeral wetlands that range in ponding duration from seven days to two months and that range in depth from less than 2 inches (5 cm) to over 12 inches (30 cm). For the appropriate conditions to occur, the following factors are necessary: associated hydrology that provides water to fill the pools, and any soil type with a claypan or hardpan component that forms an impermeable layer and provides space for individual and population growth and normal behavior. Vernal pool hydrology (i.e., seasonal filling and drying of vernal pools) is an essential feature that governs the life cycle of the San Diego fairy shrimp; proper timing, duration, and depth of these hydrological processes is necessary for cyst hatching and successful reproduction of San Diego fairy shrimp. Temperature, water chemistry, and length of time vernal pools are inundated with water are factors that play an important role in the distribution and temporal appearance of the San Diego fairy shrimp. San Diego fairy shrimp hatch and reproduce in water at temperatures that range from 41 to 68°F (5 to 20 degrees Celsius [°C]), and do not hatch at temperatures greater than 77°F (25°C). This limitation keeps San Diego fairy shrimp from hatching during the summer months if the vernal pools were to fill with water. Also, San Diego fairy shrimp do not survive well in temperatures below 41°F (5°C). San Diego fairy shrimp typically inhabit dilute, freshwater pools with low levels of total dissolved solids (low ion levels [sodium concentrations below 60 mmol/l], low alkalinity levels [lower than 80 to 1,000 mg/l], and a range of pH levels from neutral to alkaline [8.0 to 10.3]) (Federal Register 2007[115]).

Area A, Area B, and Area C were evaluated by GLA in 2000 for habitat suitable for San Diego fairy shrimp, although the habitat assessment did not include either wet- or dry-season sampling (PWA 2006[116]). Wherever substantial ponding was observed during the May 2000 assessments, the water was measured for specific conductance and visual observations of any aquatic invertebrates and vegetation were collected. No ponds in Area A, Area B, or Area C were determined to be capable of supporting San Diego fairy shrimp due to high salinities or inadequate length or depth of ponding and, therefore, San Diego fairy shrimp was determined to be absent from the project area (GLA 2000[117]). Appendix 3.4N Table 3.4-9, Summary of GLA Habitat Assessment for Riverside and San Diego Fairy Shrimp, summarizes the results of the GLA habitat assessment for San Diego fairy shrimp.

[115] Federal Register 2007
[116] PWA 2006
[117] GLA 2000

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APPENDIX D14
Ballona Creek Wetlands Ecological Reserve Preliminary Delineation of Wetlands and Non-Wetland Waters

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Ballona Creek Wetlands Ecological Reserve Preliminary Delineation of Wetlands and Non-Wetland Waters

LOS ANGELES COUNTY,CALIFORNIA

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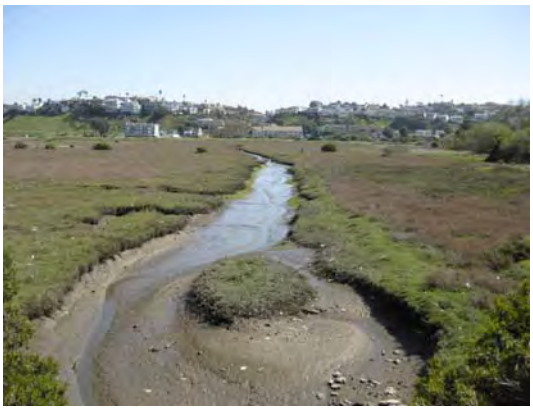



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1.0 INTRODUCTION

1.1 Study Background

The Ballona Wetlands site (Study Area) consists of approximately 605 acres of open space in the City of Playa Vista, Los Angeles County, California (Figure 1). The Study Area is bounded on all sides by urban development; Ballona Creek bisects the Study Area. Urban and industrial development, including the creation of Marina Del Rey, has altered the wetlands on-site from their natural state. Due to the straightening of tidal channels, development of oil and gas fields, and filling of wetlands with dredged materials, the value of wetlands in the Study Area have been progressively degraded. The State Coastal Conservancy, the California Department of Fish and Game (CDFG), and the State Lands Commission (SLC) are working with various stakeholders to develop a restoration plan for the Ballona Wetlands. The Ballona Wetlands area was delineated several times prior to the delineation conducted by WRA, Inc. (WRA) in 2010. Previous delineations of the Study Area include, Sanders (1987), Straw (1987), Newling and Theriot (1988), Sanders (1989) and Sanders (2000). WRA delineated the Ballona Wetlands Study Area at the request of the State Coastal Conservancy in an effort to update the current total of wetland and non-wetland water habitat present. This report presents the results of this delineation.

Between March 22 and 24, 2010, WRA conducted a routine delineation of waters in the Study Area to determine the presence of potential wetlands and non-wetland waters subject to federal jurisdiction under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act (RHA), as well as wetlands, non-wetland waters, and riparian habitat subject to state jurisdiction under the California Coastal Act (CCA), the Coastal Zone Management Act (CZMA), and Sections 1600-1616 of California Fish and Game Code. Although not delineated for this report, wetlands on the site are also subject to state jurisdiction under the Regional Water Quality Control Board through the Porter-Cologne Water Quality Control Act.

1.2 Regulatory Background

Section 404 of the Clean Water Act

Section 404 of the Clean Water Act gives the United States Environmental Protection Agency (EPA) and the United States Army Corps of Engineers (Corps) regulatory and permitting authority regarding discharge of dredged or fill material into “navigable waters of the United States [U.S.]”. Section 502(7) of the Clean Water Act defines navigable waters as “waters of the United States, including territorial seas.” Section 328 of Chapter 33 in the Code of Federal Regulations (CFR) defines the term “waters of the United States” as it applies to the jurisdictional limits of the authority of the Corps under the Clean Water Act. A summary of this definition of “waters of the U.S.” in 33 CFR 328.3 includes (1) waters used for commerce; (2) interstate waters and wetlands; (3) “other waters” such as intrastate lakes, rivers, streams, and wetlands; (4) impoundments of waters; (5) tributaries to the above waters; (6) territorial seas; and (7) wetlands adjacent to waters. Therefore, for the purposes of determining Corps jurisdiction under the Clean Water Act, “navigable waters” as defined in the Clean Water Act are the same as “waters of the U.S.” defined in the CFR, above. The limits of Corps jurisdiction under Section 404 as given in 33 CFR Section 328.4 are as follows: (a) *Territorial seas:* three nautical miles in a seaward direction from the baseline; (b) *Tidal waters of the U.S.:* high tide line or to the limit of adjacent non-tidal waters; and (c) *Non-tidal waters of the U.S.:* ordinary high water mark or to the limit of adjacent wetlands.

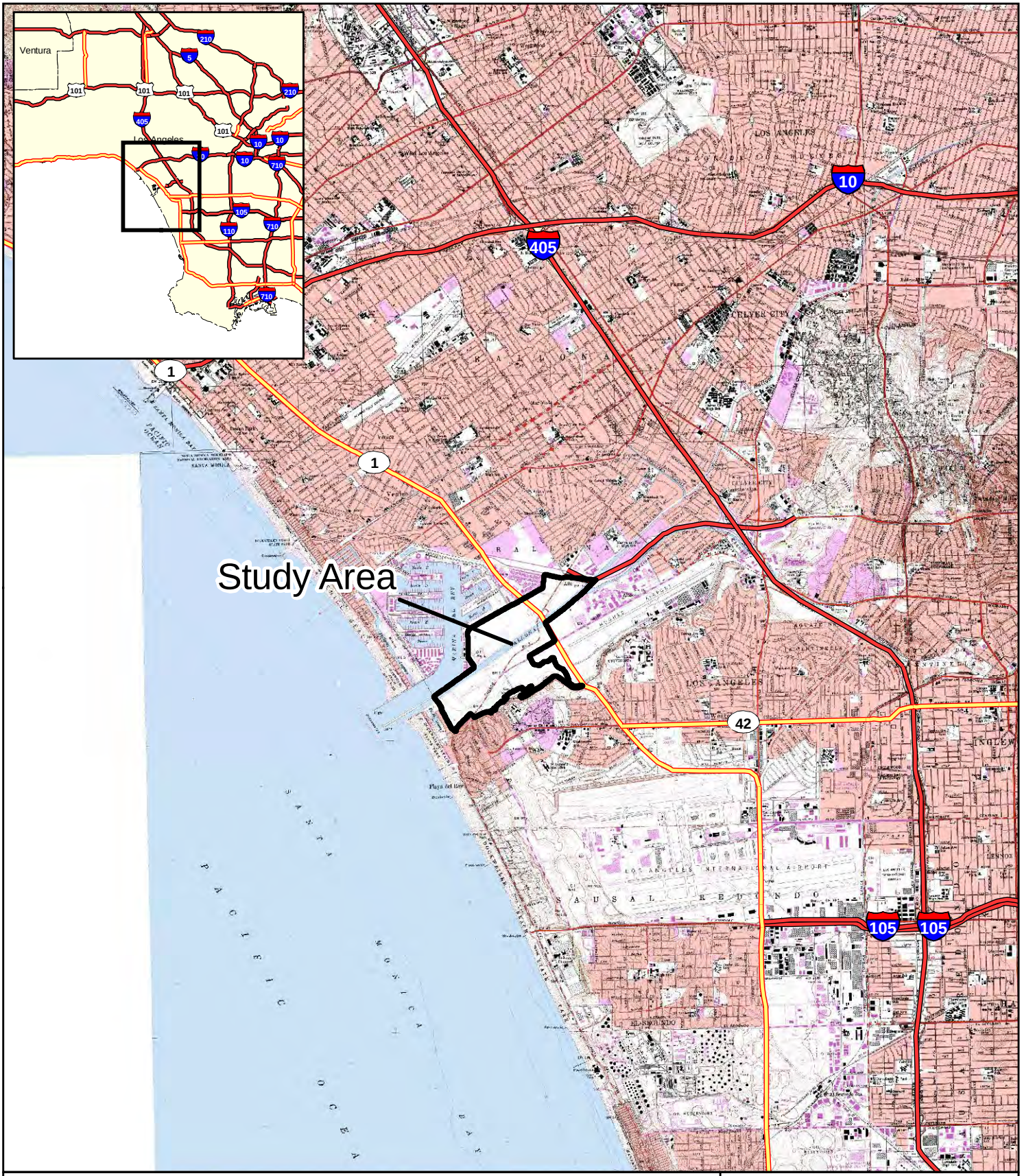

Figure 1. Location Map

Ballona Wetlands Restoration
Los Angeles County, CA

wra
ENVIRONMENTAL CONSULTANTS

Date: April 2010
Map By: Sundaran Gillespie
Filepath:I:\Acad2000\00000\00016-3\gis\Arcmap\Location Map.mxd

Section 10 of the Rivers and Harbors Act

Section 10 of the Rivers and Harbors Act gives the Corps regulatory and permitting authority over any work in, over, or under “navigable waters of the U.S.” (see definition above). Activities regulated by the Corps under Section 10 include the construction of any structure in or over any navigable water of the United States, the excavation/dredging or deposition of material in these waters, or any obstruction or alteration to a navigable water. Structure or work outside the limits defined for navigable waters of the U.S. require a Section 10 permit if the structure or work affects the course, location, condition, or capacity of the water body. Section 10 and Section 404 do overlap in some activities involving wetlands and non-wetland waters. Permits for activities regulated under both are processed simultaneously by the Corps.

California Coastal Act (CCA) and Coastal Zone Management Act (CZMA)

Wetlands found in the "coastal zone" are regulated under the CCA 1976 and the federal CZMA, and are within jurisdiction of the California Coastal Commission (CCC). Under the CCA, wetlands are defined as land within the coastal zone which may be covered periodically or permanently with shallow water and include saltwater marshes, freshwater marshes, open or closed brackish water marshes, swamps, mudflats, and fens (Pub. Res. Code Section 30121). The CCC uses definitions similar to the federal government in defining wetland habitat.

In the California coastal zone, the CCC, with the assistance of the CDFG, is responsible for determining the presence of wetlands subject to regulation under the CCA. The local government also has a direct role in the identification and delineation process in areas with a certified local coastal program (LCP). Areas B and C, including adjacent sections of the Ballona Creek channel, are covered under the Playa Vista Specific Plan. This plan is intended to constitute the LCP for the portion of Ballona Wetlands located within the City of Los Angeles. Area A is part of Los Angeles County and was proposed to be included in the Marina Del Rey LCP; however, Area A was removed from the Marina Del Rey LCP prior to its certification and is currently not covered under a certified LCP.

For wetland development projects requiring Corps review, the applicant may, in some cases, need to obtain two delineation approvals: one for the coastal development permit and another for the Corps Section 404 permit.

Sections 1600-1616 of California Fish and Game Code

Streams and lakes, as habitat for fish and wildlife species, are subject to jurisdiction by CDFG under Sections 1600-1616 of California Fish and Game Code. Alterations to or work within or adjacent to streambeds or lakes generally require a 1602 Lake and Streambed Alteration Agreement. The term stream, which includes creeks and rivers, is defined in the California Code of Regulations (CCR) as follows: “a body of water that flows at least periodically or intermittently through a bed or channel having banks and supports fish or other aquatic life. This includes watercourses having a surface or subsurface flow that supports or has supported riparian vegetation” (14 CCR 1.72). In addition, the term stream can include ephemeral streams, dry washes, watercourses with subsurface flows, canals, aqueducts, irrigation ditches, and other means of water conveyance if they support aquatic life, riparian vegetation, or stream-dependent terrestrial wildlife (CDFG ESD 1994). Riparian is defined as, “on, or pertaining to, the banks of a stream;” therefore, riparian vegetation is defined as, “vegetation which occurs in and/or adjacent to a stream and is dependent on, and occurs because of, the stream itself” (CDFG ESD 1994) or other vegetation as defined by CDFG scientists (Rick Mayfield, pers.

comm. February 16, 2011). Removal of riparian vegetation also requires a Section 1602 Lake and Streambed Alteration Agreement from CDFG.

2.0 SUMMARY OF POTENTIAL JURISDICTIONAL AREAS

Appendix A depicts the extent of Corps jurisdiction within the Study Area based on a formal wetland delineation conducted by WRA in March 2010 and revised in July 2010 after a site visit with the Corps (with Aaron Allen and Spencer MacNeil, of the Corps). Appendix B depicts the extent of CCC jurisdiction delineated by WRA during the same site visit. The CCC map of waters was revised in September 2010 after a site visit with the CCC (Al Padilla and Jonna Engel of the CCC) and has since been approved by the CCC (Jonna Engel, pers. comm. March 29, 2011). Appendix C depicts the map of CDFG jurisdictional habitat, which was revised during the October site visit with CDFG (Dave Lawhead and Rick Mayfield of the CDFG) and has since been approved (Rick Mayfield, pers. comm. February 16, 2011). The acreage of potential Section 404, Section 10, CCA, and CDFG jurisdictional areas is summarized in Tables 1 through 3 below.

Table 1. Summary of Potential Corps Jurisdictional Areas Within the Study Area

Habitat Type	Size (acres)	"Potentially Isolated" Areas (acres)	**Potential Jurisdictional Waters of the U.S. (acres)**
Section 404 Wetlands	**153.2**	0	**153.2**
Section 404/10 Non-Wetland Waters	**83.0**	0	**83.0**
TOTAL	**236.2**	**0**	**236.2**

Table 2. Summary of Potential CCC Jurisdictional Areas within the Study Area

Habitat Type	**Potential Jurisdictional Wetlands (acres)**
CCC Wetlands	**278.5**
Vegetated Wetlands	195.5
Open Water	83.0
TOTAL	**278.5**

Table 3. Summary of Potential CDFG Jurisdictional Areas within the Study Area

Habitat Type	**Potential Jurisdictional Wetlands (acres)**
CDFG Streams, Lakes and Riparian Habitat	**150.0**

3.0 METHODS

Prior to conducting the 2010 field surveys, reference materials were reviewed, including results of previous wetland delineations of the Study Area with specific emphasis on Sanders 1987 and 2000, the Web Soil Survey of Los Angeles County (United States Department of Agriculture [USDA] 2010a), the United States Geologic Survey (USGS) 7.5-minute Venice quadrangle (USGS 1981), and aerial photos of the site.

A focused evaluation of indicators of wetlands and non-wetland waters was performed in the Study Area in March, 2010. The methods used in this study to delineate jurisdictional wetlands and non-wetland waters are based on the *U.S. Army Corps of Engineers Wetlands Delineation Manual* ("Corps Manual"; Environmental Laboratory 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region* ("Arid West Supplement"; Corps 2008a). The routine method for wetland delineation described in the Corps Manual was used to identify areas potentially subject to Corps Section 404 jurisdiction (three-parameter) and CCC jurisdiction (one-parameter) within the Study Area. Methods for delineating waters and riparian habitat potentially subject to CDFG jurisdiction were determined with CDFG staff scientists during a visit to the Study Area (pers. com. with Dave Lawhead and Rick Mayfield during the October 2010 site visit). A general description of the Study Area, including plant communities present, topography, and land use was also generated during the delineation visits. The methods for evaluating the presence of potential Corps jurisdictional wetlands and other waters of the U.S. employed during the site visit are described in sections 3.1 and 3.2. The methods for evaluating the presence of wetlands potentially under CCC jurisdiction are described in section 3.3, and methods for determining CDFG jurisdictional features is described in section 3.4.

For the purposes of this delineation, the minimum mapping unit used to delineate a wetland or upland island within a wetland was 10 feet by 10 feet; any individual wetland or upland island which constituted less than this minimum area was not mapped as a distinct feature.

According to the "Wetlands that Periodically Lack Indicators of Wetland Hydrology" section of the Arid West Supplement (Corps 2008a), 30-year WETS tables' data (Natural Resource Conservation Service [NRCS] 2009) can be used to make a determination as to whether the site meets the definition of typical climactic or hydrological conditions. Using data from WETS station CA5114, located near the Los Angeles Airport, it was determined that the normal annual rainfall for this area totals 13.20 inches, with a 30% chance that the rainfall will be greater than 15.64 inches and a 30% chance that the rainfall will be less than 9.34 inches. According to California Irrigation Management Information System (CIMIS) data provided by the Department of Water Resources Office of Water Use Efficiency (2010), the precipitation recorded in the vicinity of the Study Area (near Santa Monica, California, located north of the Study Area)

totaled 14.59 inches during the 2009 to 2010 rainfall period (October to May each year). Therefore, rainfall during this period and prior to the field work conducted for this delineation was within the normal range for the area.

Delineations conducted by Sanders in 1987 and 2000 also followed the Corps routine method for delineating a wetland; however, all wetlands mapped during these surveys were classified into four categories of "waters of the United States" which included perennial waterbodies, wetlands, mudflats, and "other waters." As stated in the 2000 Sanders delineation report:

> *"Perennial waterbodies were defined as permanently inundated areas lacking rooted emergent vegetation. Wetlands were defined as areas having hydric soils, wetland hydrology, and 10 percent or greater aerial cover of hydrophytic vegetation. Mudflats were defined as areas having hydric soil conditions and wetland hydrologic conditions, but less than 10 percent areal cover by hydrophytic vegetation. 'Other waters' were defined as unvegetated areas that may temporarily or seasonally pond water, but are located in landscape positions that would not normally lead to an interpretation of mudflats."*

Delineation of such features during the 1987 and the 2000 delineations simply involved the application of the definitions stated above. In addition, they used topography to aid in the delineation of perennial waterbodies, mudflats, and "other waters." Topography was used in the sense that each of these categories generally occur at lower landscape positions than wetlands and exhibit less than 10 percent aerial plant cover (Sanders 2000).

Several additional factors were also considered in the determination of wetlands and non-wetland waters for the 2000 delineation. Results of previous wetland delineations, including Sanders (1987), Straw (1987), Newling and Theriot (1988), Sanders (1989), and the District's 1989 (Areas A, B, and C) wetland determination letter were consulted. Observed vegetation and hydrologic indicators were interpreted by analyzing rainfall data from 1987-1998 and comparing these data with the resulting hydrologic conditions (Sanders 2000). Finally, field observations from 1998 were considered in relation to "normal circumstances" as defined in the Corps regulations/memoranda and with regards to "normal environmental conditions". Of particular interest for "normal circumstances" was determining whether or not changes in vegetation and hydrology were induced by a change in physical site features. Similarly, weather patterns were reviewed to determine if any significant change in long-term climatic conditions had occurred which may have affected the conditions encountered at the time of the site visit.

Slight differences in methodology, changes in the physical and environmental conditions between field visits, and differences in the study area boundaries used are all factors which make it difficult to compare the results of this delineation report with previous delineation reports. A discussion of how the differences in methodology between the delineation presented here and delineations from previous years may have affected the comparison of results from each report is included in the Results section, below.

3.1 Potential Section 404 Waters of the U.S.

3.1.1 Wetlands

The Study Area was evaluated for the presence or absence of indicators of the three wetland parameters described in the Corps Manual (Environmental Laboratory 1987) and Arid West Supplement (Corps 2008a).

Section 328.3 of the CFR defines wetlands as:

> *"Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."*
>
> Environmental Protection Agency, 40 CFR 230.3 and CE, 33 CFR 328.3 (b)

The three parameters used to delineate wetlands are the presence of: (1) hydrophytic vegetation, (2) wetland hydrology, and (3) hydric soils. According to the Corps Manual, for areas not considered "problem areas" or situations that are not "atypical situations":

> *"....[E]vidence of a minimum of one positive wetland indicator from each parameter (hydrology, soil, and vegetation) must be found in order to make a positive wetland determination."*

Data on vegetation, hydrology, and soils collected at sample points during the delineation site visit was reported on Arid West Supplement data forms. We preliminarily used the CDFG Natural Community mapping of the Study Area to determine wetland boundaries (PWA 2006). Once an area was determined to be a potential jurisdictional wetland, the boundaries previously mapped by the CDFG were checked for accuracy to the existing conditions based upon hydric vegetation, hydric soils, and wetland hydrology; if the boundaries were not correct, the boundaries were delineated using GPS equipment and mapped on a topographic map. Areas of potential jurisdictional wetlands and non-wetland waters were measured digitally using ArcGIS software. Indicators described in the Arid West Supplement were used to make wetland determinations at each sample point in the Study Area and are summarized below.

<u>Vegetation</u>

Plant species identified on the Study Area were assigned a wetland status according to the U.S. Fish and Wildlife Service list of plant species that occur in wetlands (Reed 1988). This wetland classification system is based on the expected frequency of occurrence in wetlands as follows:

OBL	Always found in wetlands	>99% frequency
FACW(±)	Usually found in wetlands	67-99%
FAC	Equal in wetland or non-wetlands	34-66%
FACU	Usually found in non-wetlands	1-33%
UPL/NL	Upland/Not listed (upland)	<1%

The presence of hydrophytic vegetation was then determined based on indicator tests described in the Arid West Supplement. The Arid West Supplement requires that a three-step process be conducted to determine if hydrophytic vegetation is present. The procedure first requires the delineator to apply the "50/20 rule" (Indicator 1; Dominance Test) described in the manual. To apply the "50/20 rule", dominant species are chosen independently from each stratum of the community. Dominant species are determined for each vegetation stratum from a sampling plot of an appropriate size surrounding the sample point. Dominants are the most abundant species that individually or collectively account for more than 50 percent of the total vegetative cover in the stratum, plus any other species that, by itself, accounts for at least 20 percent of the total vegetative cover. If greater than 50 percent of the dominant species has an OBL, FACW, or FAC status, ignoring + and - qualifiers, the sample point meets the hydrophytic vegetation criterion.

If the sample point fails Indicator 1 and both hydric soils and wetland hydrology are not present, then the sample point does not meet the hydrophytic vegetation criterion, unless the site is a problematic wetland situation. However, if the sample point fails Indicator 1, but hydric soils and wetland hydrology are both present, the delineator must apply Indicator 2.

Indicator 2 is known as the Prevalence Index. The prevalence index is a weighted average of the wetland indicator status for all plant species within the sampling plot. Each indicator status is given a numeric code (OBL = 1, FACW = 2, FAC = 3, FACU = 4, and UPL = 5). Indicator 2 requires the delineator to estimate the percent cover of each species in every stratum of the community and sum the cover estimates for any species that is present in more than one stratum. The delineator must then organize all species into groups according to their wetland indicator status and calculate the Prevalence Index using the following formula, where A equals total percent cover:

$$PI = \frac{A_{OBL} + 2A_{FACW} + 3A_{FAC} + 4A_{FACU} + 5A_{UPL}}{A_{OBL} + A_{FACW} + A_{FAC} + A_{FACU} + A_{UPL}}$$

The Prevalence Index will yield a number between 1 and 5. If the Prevalence Index is equal to or less than 3, the sample point meets the hydrophytic vegetation criterion. However, if the community fails Indicator 2, the delineator must proceed to Indicator 3.

Indicator 3 is known as Morphological Adaptations. If more than 50 percent of the individuals of a FACU species have morphological adaptations for life in wetlands, that species is considered to be a hydrophyte and its indicator status should be reassigned to FAC. If such observations are made, the delineator must recalculate Indicators 1 and 2 using a FAC indicator status for this species. The sample point meets the hydrophytic vegetation criterion if either test is satisfied.

Hydrology

The Corps jurisdictional wetland hydrology criterion is satisfied if an area is inundated or saturated for a period sufficient to create anoxic soil conditions during the growing season (a minimum of 14 consecutive days in the Arid West region). Evidence of wetland hydrology can include primary indicators, such as visible inundation or saturation, drift deposits, oxidized root channels, and salt crusts, or secondary indicators such as the FAC-neutral test, presence of a shallow aquitard, or crayfish burrows. The Arid West Supplement contains 16 primary hydrology indicators and 10 secondary hydrology indicators. Only one primary indicator is required to meet the wetland hydrology criterion; however, if secondary indicators are used, at least two secondary indicators must be present to conclude that an area has wetland hydrology. The presence or absence of the primary or secondary indicators described in the Arid West Supplement was utilized to determine if sample points within the Study Area met the wetland hydrology criterion.

Due to the variable climate of the region, special consideration of the total amount of precipitation received must be given when determining whether the area exhibits wetland hydrology. During years of above normal precipitation, survey areas may falsely exhibit surface indicators such as watermarks, drift lines, or sediment deposits. These same areas during normal or below normal rainfall years may fail to exhibit these same indicators (Sanders 2000).

Reliance solely on the above mentioned indicators may lead to mistaken conclusions regarding the hydrology of site. For the purpose of this delineation, precipitation data for the area was reviewed prior to 2010 surveys as stated in section 3.0 above.

In addition to precipitation data, several other factors were considered in determining whether indicators of wetland hydrology were present in an effort to avoid making false determinations. Such factors include:

1. Presence/absence of oxidized root channels associated with living roots. Any oxidized rhizospheres associated with living roots, observed within 12 inches of the soil surface, was a positive indicator of wetland hydrology. Absence of such features was an indication that the site lacked wetland hydrology.

2. Historical rainfall patterns. Heavy rainfall years can often cause flooding in non-wetland areas thereby producing surface and subsurface indicators of wetland hydrology. Since the majority of the years are not categorized as extreme rainfall, relying solely on surface and subsurface indicators during these times would yield false indicators of wetland hydrology. Therefore, for the purpose of this delineation, the presence of surface indicators of wetland hydrology alone were not considered to be sufficient to make a determination as to whether wetland hydrology was present.

3. Changes in the sources of water available to a sampling location. Changes in the source(s) of water available to a given area were considered. If observed changes in the landscape were observed to have occurred since 2000, the effects of such changes on any potentially affected sampling location were identified; and

4. Water table observations for previous delineations. Water table levels in open boreholes dug at each sampling location were used in deciding which areas had wetland hydrology at the time of the 2010, 2000, and 1987 delineations. These 1987 water table observations were considered to be the most relevant data available for determining the hydrology of an area and were given greater weight in the 2000 Sanders delineation than the presence of surface indicators of wetland hydrology (Sanders 2000). For the present delineation, rainfall during and prior to the field work conducted was within the normal range for the area. Therefore, the present study used hydrology results from the 2000 delineation and collected additional hydrologic data to either a) support the conclusions of the 2000 report, or b) expand the areas determined to have wetland hydrology where strong indicators were present.

Soils

The NRCS defines a hydric soil as follows:

> *"A hydric soil is a soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part."*
>
> Federal Register July 13, 1994,
> U.S. Department of Agriculture, NRCS

Soils formed over long periods of time under wetland (anaerobic) conditions often possess characteristics that indicate they meet the definition of hydric soils. Hydric soils can have a hydrogen sulfide (rotten egg) odor, low chroma matrix color, generally designated 0, 1, or 2,

used to identify them as hydric, presence of redox concentrations, gleyed or depleted matrix, or high organic matter content.

The Arid West Supplement provides a list of 23 of these hydric soil indicators which are known to occur in the Arid West region. Soil samples were collected and described according to the methodology provided in the Arid West Supplement. Soil chroma and values were determined by utilizing a standard Munsell soil color chart (GretagMacbeth 2000).

Hydric soils were determined to be present if any of the soil samples met one or more of the 23 hydric soil indicators described in the Arid West Supplement.

The Los Angeles Area Soil Survey (USDA 2010a) indicates that the Study Area has one native soil type: Delhi - Urban Land - Beaches. The soil description from the soil survey for this soil type is described in detail below. This soil is not on the hydric soils list for Los Angeles County (USDA 2010b). Although this soil type has been mapped in the Study Area, substantial amounts of fill material have been deposited on the native soils since the soil was last surveyed and it is unlikely that any native soils were encountered during the delineation field work conducted in March 2010.

Delhi - Urban Land - Beaches. The Delhi series consists of very deep, somewhat excessively drained soils. The soils formed in wind-modified material weathered from granitic rock sources. Delhi soils are found on floodplains, alluvial fans, and terraces. Delhi soils are on 0 to 15 percent slopes at elevations of 25 to 1,400 feet. When moist, the C horizon color is brown (10YR 5/3). A typical profile consists of sand, fine sand, loamy fine sand or loamy sand from 0 to 21 inches. The clay content ranges from 0 to 5 percent.

3.1.2 Other Waters of the U.S.

This study also evaluated the presence of "waters of the United States" other than wetlands potentially subject to U.S. Army Corps of Engineers jurisdiction under Section 404 of the Clean Water Act (i.e., non-wetland waters). Other areas, besides wetlands, subject to Corps jurisdiction include lakes, rivers and streams (including intermittent streams) in addition to all areas below the high tide line (HTL) in areas subject to tidal influence. Table 4 below shows the elevations of the HTL and mean high water (MHW) based on National Oceanic and Atmospheric Administration tidal elevation data and highest predicted tide for the Santa Monica station. MHW tidal elevation value is used to determine the extent of Section 10 waters of the U.S., which are described in Section 3.2 below.

Jurisdiction in non-tidal areas extends to the ordinary high water mark (OHW) defined as:

> "*...that line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impresses on the bank, shelving, changes in the characteristics of the soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.*"
>
> Federal Register Vol. 51, No. 219,
> Part 328.3 (e). November 13, 1986

Identification of the ordinary high water mark followed the Corps Regulatory Guidance Letter No. 05-05, *Ordinary High Water Mark Identification* (Corps 2005).

Table 4. Tidal Elevations Relevant to Corps Jurisdiction at the Santa Monica Station, Santa Monica Bay, California (#9410840). Elevations are Relative to North American Vertical Datum (NADV) 88 Mean Lower Low Water (MLLW) Datum.

Tidal Benchmark	Elevation (MLLW datum)
HTL	7.0 feet
MHW	4.7 feet

3.1.3 Difficult Wetland Situations in the Arid West

The Arid West Supplement (Corps 2008a) includes procedures for identifying wetlands that may lack indicators due to natural processes (problem areas) or recent disturbances (atypical situations). "Problem area" wetlands are defined as naturally occurring wetland types that periodically lack indicators of hydrophytic vegetation, hydric soil, or wetland hydrology due to normal seasonal or annual variability. Some problem area wetlands may permanently lack certain indicators due to the nature of the soils or plant species on the site. "Atypical situations" are defined as wetlands in which vegetation, soil, or hydrology indicators are absent due to recent human activities or natural events.

The list of difficult wetland situations provided in the Arid West Supplement includes wetlands with problematic hydrophytic vegetation, problematic hydric soils, and wetlands that periodically lack indicators of wetland hydrology. In addition, the problem area and atypical situation sections of the Corps Manual (Environmental Laboratory 1987) were utilized to determine if any sample points taken within the Study Area met the criteria for a problem area or atypical situation. If any determination was based on less than three parameters, the rationale for the wetland determination was explained on the data sheets included in Appendix A. Although the Corps Manual (1987) and Arid West Supplement (2008a) were utilized in the wetland determination, they do not provide exhaustive lists of the difficult situations that can arise during delineations in the Arid West. As a result, WRA interpreted the gathered data using best professional judgment and our knowledge of the ecology of the wetlands in the region.

<u>Problematic Vegetation</u>

Given the Mediterranean climate of the region, precipitation levels often vary widely and can affect the structure and composition of plant communities. Due to the variability in climate in the arid west, wetlands may exhibit indicators of hydric soil and wetland hydrology but may lack hydrophytic vegetation, seasonally or year round. In addition, many wetlands in this region undergo season shifts in plant communities (Sanders 2000). Such areas require special procedures or additional analysis in identifying and delineating wetland boundaries.

A combination of field observations and review of scientific literature is recommended by the Corps in delineating wetlands with problematic vegetation. Such procedures and analysis should only be used when the area in question exhibits both hydric soils and wetland hydrology. The following procedure is taken from the Corps Regional Supplement for the Arid West (2008a):

> *(1) If possible, return to the site during the normal wet portion of the growing season and re-examine the site for indicators of hydrophytic vegetation.*

(2) Examine the site for identifiable plant remains, either alive or dead, or other evidence that the plant community that was present during the normal wet portion of the growing season was hydrophytic.

(3) Use off-site data sources to determine whether the plant community that is normally present during the wet portion of the growing season is hydrophytic. Approriate data sources include early growing season aerial photography, NWI maps, soil survey reports, remotely sensed data, public interviews, and previous reports about the site. If necessary, re-examine the site at a later date to verify the hydrophtyuic vegetation determination.

After monitoring the vegetation within the Ballona Wetlands for over 11 years, Sanders (2000) observed that the timing and amount of precipitation experienced during the months of October through May had substantial effects on herbaceous vegetation communities throughout the study area. Monitoring data showed that the majority of herbaceous plant communities outside the saltmarsh and ditches (areas with perennial hydrology) undergo extreme changes in species composition in years of substantially different rainfall. During dry years, areas that did not exhibit any indicators of hydric soils or wetland hydrology were typically vegetated by upland grasses such as ripgut brome (*Bromus diandrus*, UPL), foxtail brome (*Bromus madritensis*, UPL), and wild oats (*Avena fatua*, UPL). During wet years, however, these same areas were found to sometimes support hydrophytic species such as alkali weed (*Cressa truxillensis*, FACW), rabbits foot-grass (*Polypogon monspeliensis*, FACW), bristly ox tongue (*Picris echioides*, FAC), perennial ryegrass (*Lolium perenne*, FAC), and alkali mallow (*Malvella leprosa*, FAC) (Sanders 2000). Based on the vegetation and community shifts observed over the past 11 years, such factors were given careful consideration when delineating each wetland boundary.

Aggressive Invasive Plant Species

Native and non-native aggressive, invasive FACU or UPL plant species often become established in wetlands due to their aggressive growth habits and adaptability to a wide range of habitats. Invasive species often exclude other species by competing successfully for space, sunlight, or other resources. Examples of invasive species in the region include pampas grass (*Cortaderia selloana*, UPL) and sea fig (*Carpobrotus edulis*, UPL).

The Corps has recommended the following procedure when the site has indicators of hydric soil and wetland hydrology but the plant community is dominated by FACU or UPL aggressive, invasive plant species. To use this procedure, there must be evidence of the species' invasive nature, such as published literature or listing of the species on a state or local list of invasive plants (e.g., the USDA Plants database http://plants.usda.gov/index.html). This procedure is taken from the Corps Regional Supplement for the Western Mountains, Valleys, and Coast Region (2008b):

(1) Examine a nearby reference site having similar soils, topography, and hydrologic conditions, and a similar plant community without or with reduced presence of the invasive species. Assume that the same plant community would exist on the original site, if invasive species were not prevalent.

(2) If feasible, remove the invasive species and reevaluate the vegetation during the next growing season. Take into consideration that many invasive species are very difficult to

remove and will resprout or reemerge next season. However, even temporary removal of the invasive plant may release other species.

(3) If an appropriate reference site cannot be located and the invasive species cannot be removed and the site reevaluated next season, make the wetland determination based on indicators of hydric soil and wetland hydrology.

Areas within the Ballona Wetlands that were dominated by aggressive, invasive vegetation, but met hydric soil and wetland hydrology criteria, were generally delineated as Corps and CCC jurisdictional wetlands during the March, 2010 surveys (i.e., areas dominated by pampas grass [UPL] and sea fig [UPL]). Areas that were dominated by invasive plant species, but did not meet hydric soil or wetland hydrology criteria, including small patches of habitat dominated by tree tobacco (*Nicotiana glauca*; FAC), were delineated as upland habitat, regardless of their indicator status.

3.1.4 Areas Exempt from Section 404 Jurisdiction

Some areas that meet the technical criteria for wetlands or waters may not be jurisdictional under the Clean Water Act. Included in this category are some man-induced wetlands, which are areas that have developed at least some characteristics of naturally occurring wetlands due to either intentional or incidental human activities. Examples of man-induced wetlands may include, but are not limited to, irrigated wetlands, impoundments, or drainage ditches excavated in uplands, wetlands resulting from filling of formerly deep water habitats, dredged material disposal areas, and depressions within construction areas.

In addition, some isolated wetlands and waters may also be considered outside of Corps jurisdiction as a result of the Supreme Court's decision in *Solid Waste Agency of Northern Cook County (SWANCC) vs. United States Army Corps of Engineers* (531 U.S. 159 (2001)). Isolated wetlands and waters are those areas that do not have a surface or groundwater connection to, and are not adjacent to a navigable "waters of the U.S.", and do not otherwise exhibit an interstate commerce connection.

3.2 Section 10 Waters of the U.S.

Historic Section 10 Waters

Historic Section 10 waters occur behind levees, are currently not exposed to tidal or muted-tidal influence, and meet certain criteria. These criteria include: 1) the area is presently at or below MHW; 2) the area was historically at or below MHW in its "unobstructed, natural state", and; 3) there is no evidence that the area was ever above MHW (Calvin Fong Memo, Corps, 1983). Procedures for determining Historical Section 10 jurisdiction behind levees are as follows:

1. First, determine present MHW for the area in question.

    a. Use surveyed elevation data from the prospective applicant.

    b. If elevation data are not available, use the survey technique for determining MHW on the outboard side of the dike and project the MHW line back to the area in question.

    c. Those areas behind dikes that are presently above MHW are not subject to Section 10 permit requirements (provided they were above MHW prior to 28 January 1972 or

were filled to above MHW thereafter under Corps permit) because they are presently at or above MHW.

d. Those areas that are presently at or below MHW may be subject to Section 10 permit requirements. To determine whether these areas are subject to Section 10, two additional facts must be obtained (which are numbers 2 and 3 of the historical waters definition provided above).

2. The second step is to determine whether those areas presently at or below MHW were historically below MHW before the dikes were built.

a. If available, use elevation data that were surveyed just prior to or just after the dikes were built. More often then not, this information is not available but potential sources include city and county planning commissions, public works departments, Caltrans, SLC, etc.

b. If historic elevation data are not available, use the T-charts of 1850-90 to determine the location of the historic sloughs, if any, in those areas that are presently below MHW. The premise is that the historic sloughs were subject to the ebb and flow of the tides, and thus were below MHW.

c. Those areas presently below MHW and historically below MHW as determined by elevation data or T-charts would be considered at or below MHW historically.

d. Areas that were historically below MHW and filled above MHW (as shown by reliable data) but due to subsidence are now below MHW are not subject to Section 10 authority, but may be subject to Section 404 jurisdiction.

To accurately map Historic Section 10 waters, historic site topography is typically used in conjunction with tidal elevation data (Table 4). For the delineation presented here, Historic Section 10 waters were identified based on the Historical Conditions figure generated for the Ballona Wetlands Restoration Feasibility Report (PWA 2008). Data used to create this figure were derived from the U.S. Coast and Geodetic Survey Topographic Sheet of “West Beach to Vicinity of Santa Monica, 1876" (No. 1432b) (PWA 2008).

Current Section 10 Waters

Current Section 10 waters can occur in both tidal and fresh water systems. In tidal waters, Section 10 waters includes open water, mud flats, and adjacent special aquatic sites up to the limit of the mean high water mark (MHW) in areas currently exposed to fully tidal or muted-tidal action. In freshwater sites, Section 10 includes the lateral extent of the ordinary high water mark on opposing channel banks. Table 4 shows the elevations of the MHW based on National Oceanic and Atmospheric Administration tidal elevation data and highest predicted tide for the Santa Monica station. To accurately map Current Section 10 waters, site topography is typically used in conjunction with tidal elevation data (Table 4). For the delineation presented here, Current Section 10 waters were approximated by using areas that appeared to be below MHW based upon our understanding of tidal marsh topography and plant species salinity tolerances (i.e., open water or tidal waters). Current Section 10 waters are likely greater than this acreage on the site; additional Section 10 waters may be present in low elevation areas where levees restrict tidal waters. However, without detailed site topography, we can not accurately map Current Section 10 waters.

3.3 Coastal Zone Wetlands within CCC Jurisdiction

The CCC's regulations (California Code of Regulations Title 14 (14 CCR)) establish a "one parameter definition" that only requires evidence of a single parameter to establish wetland conditions and accepts wetland determinations based on the presence of one parameter-wetland vegetation, wetland soils, or, under certain conditions, wetland hydrology (using the Corps methods for each parameter). In contrast, the Corps generally uses a three parameter definition for delineating wetlands. Similar to the Corps, the CCC uses the following general decision rules for establishing the upland boundary of wetlands:

> *…the upland limit of a wetland shall be defined as:*
>
> > *a. the boundary between land with predominantly hydrophytic cover and land with predominantly mesophytic or xerophytic cover;*
> >
> > *b. the boundary between soil that is predominantly hydric and soil that is predominantly nonhydric; or*
> >
> > *c. in the case of wetlands without vegetation or soils, the boundary between land that is flooded or saturated at some time during years of normal precipitation, and land that is not.* (14 CCR Section 13577)

CCC wetland delineators commonly use the Corps Manual (1987) and the Arid West Supplement (2008) for guidance in defining each CCC wetland parameter (see Section 3.1). Therefore, wetlands which meet all three Corps criteria for wetlands (vegetation, soils, and hydrology) resulted in an overlap of CCC wetlands with Section 404 Corps wetlands; additionally, areas which only met one or two Corps criteria were considered to be CCC jurisdictional wetlands.

3.4 Streams, Lakes and Riparian Habitat within CDFG Jurisdiction

The CDFG has not published specific guidance for delineating jurisdictional features within tidally-influenced waters and habitats. The limits of CDFG jurisdiction within the Study Area were mapped to include open water and linear waters features, as well as the surrounding vegetation which “occurs in and/or adjacent to a stream and is dependent on, and occurs because of, the stream itself” (CDFG ESD 1994). Therefore, all channels, sloughs and open water were mapped as CDFG jurisdictional areas, as well as the vegetation communities surrounding these waters that were determined to occur in the Study Area due to the presence and proximity of the waters. Further guidance was provided by David Lawhead and Rick Mayfield of the CDFG during a site visit to the Study Area on October 26, 2010. During the site visit, the CDFG scientists idenitified areas under their jurisdiction based upon internal guidance at the CDFG. It was determined that all willow (*Salix* spp.) vegetation patches, slough channels, or areas with tidal flow and their “contributing watershed” area would be jurisdictional.

4.0 STUDY AREA DESCRIPTION

The Study Area contains approximately 605 acres of open space located in Los Angeles County, California (Figure 1). All lands within the Study Area are owned by the CDFG and the SLC. The SLC also owns the 24-acre freshwater marsh to the east of the Study Area. The freshwater marsh was created as part of a restoration effort between 2001 and 2003 and was not delineated for this report, which describes only those lands that are proposed for future restoration. Currently, the Ballona Wetlands are bounded on all sides by urban development; development activities within and adjacent to the wetland habitats have altered the natural topography, hydrology, vegetation communities, and soil composition within the Study Area.

4.1 Site History

Human Influence

The current structure of the Ballona Wetlands differs drastically from its original, historic state. Prior to the late 1890s, the Ballona Wetlands extent covered a total of 2,120 acres of wetlands, approximately 93 percent larger than what is present today. The extensive lagoons within the marsh provided ample space for duck hunting lodges and other resorts to provide hunting, sailing and rowing activities. Construction within the wetlands began in the 1880's with the construction of the Atcheson, Topeka, and Santa Fe Railways. Review of the 1896 U.S.G.S. Redondo quad map indicated that the Ballona Wetlands had since been reduced to 1,550 acres and about 34 percent was now comprised of a series of lagoons and interconnecting channels with some islands in the lagoons. The interconnecting lagoons connected to a 1.7 mile channel with the entire system emptying into the Pacific Ocean at Port Ballona. By this time, railways were fully assembled and a newly constructed roadway into Port Ballona was now present. During this period, hydrologic input to the Ballona marsh system was provided by three main sources; Ballona Creek, Centinela Creek, and artesian wells.

By 1924, the Ballona wetlands had been reduced to 1,150 acres as development adjacent to and within the marsh continued. An 18-mile speedway, currently known as Culver Boulevard, now extended through the marsh along with the Pacific Electric Railroad Line. By this time, the Ballona Creek had been partially channelized, though it still emptied into the northern wetlands. Most of the contributing hydrologic flow from Ballona Creek into the wetlands was cut off in 1938 when the Corps extended the creek channel to the ocean. Dredge materials from the construction of this creek extension were subsequently dumped into the adjacent marsh lands. Within two years, the entire natural inlet for the wetlands system was closed due to sedimentation.

Development and construction continued at a steady pace for the next three decades. Review of the 1950 Venice quad map indicated only approximately 550 acres of wetland habitat remained and this would further be reduced by discharge and dredge materials from the construction of Marina del Rey and its harbor (Henrickson 1991).

Specific human influences which have altered or degraded the Ballona Wetlands from their natural state within the last century include (from Sanders 2000):

> *a) One of the most influential human alterations of the Playa Vista area occurred when the Los Angeles River channel was diverted to Long Beach m the 1800s. This action significantly reduced the wetness of the floodplain, and enabled numerous other changes to be made;*
>
> *b) Ballona Channel with its concrete-bed banks was constructed through the floodplain,*

thereby channeling potential area runoff directly into Santa Monica Bay without allowing it to flow into and across the Playa Vista property;

c) Flap gates were constructed in the Ballona Channel levee at the western end of Area B that allows surface runoff to flow at low tide from the salt marsh into Ballona Channel. However, these flap gates have greatly reduced the movement of salt water into the marsh, which has resulted in significant degradation of the salt marsh;

d) Centinela Creek was channelized to prevent flows off the Westchester Bluffs and sheetflows from north of the creek from spreading across the floodplain, thereby enabling agricultural activities in portions of Playa Vista;

e) The storm drain along Jefferson Boulevard was constructed to outflow into the area immediately east of Gas Company Road, thereby reducing surface flows into the eastern portion of Area B, but increasing the wetness in western portions;

f) Numerous other smaller drainage ditches have been dug, especially associated with agricultural activities;

g) Large portions of Playa Vista have been filled. Area A now consists predominantly of filled material, having been filled in the late 1950's during construction of the Marina del Rey Small Craft Harbor;

h) Road construction has significantly altered flows. The landscape pattern produced by the interacting effects of Lincoln Boulevard, Jefferson Boulevard, Culver Boulevard, and Gas Company Road, as well as the old Red Line tram embankment, have produced several small drainage basins, some of which are totally isolated from other portions of Playa Vista;

i) Construction of oil/gas roads and well pads has further limited flows into or out of some areas; and

j) Farming activities have significantly affected the portion of Area B located east of Gas Company Road. Most of this portion of Area B was famed &om the 1930's until about 1985. During this time, the berm along the north side of Centinela Ditch was maintained, and only the most extreme storm events caused overtopping or breaching of the berm. Another major effect of the farming was to greatly reduce plant species diversity in the area. Farming activities consisted primarily of planting luna beans or barley.

Overall, human influences within and surrounding the Ballona Wetlands have resulted in much drier site conditions, deposition of non-native soils, and alteration of the vegetation community. Although portions of the property still support wetlands, many others do not.

Hydrologic Regimes

Historical factors influencing the present hydrology of Playa Vista as presented above have resulted in a great diversity of hydrologic regimes. The hydrologic regimes affecting wetland conditions within the study area have been described by Sanders (2000) and are presented in the following section:

In unfilled areas, hydrologic regimes are strongly influenced by water table levels and the presence/absence of ponding of water on the soil surface. In filled portions of the property (e.g., Area A), very few areas are subject to water table influences. The hydrology of filled portions of

these areas (as well as filled portions of Area B) is determined by the relative ability of a given area to pond water on the soil surface and hold the water in a ponded or saturated soil condition for long periods under conditions of normal rainfall.

Under normal environmental conditions and normal circumstances, the vast majority of Playa Vista has not been influenced by storm tides or overbank flooding of streams. There is limited tidal influence in the western portion of Area B due to partially malfunctioning flap gates along the Ballona Creek Flood Control Channel. In addition, there is tidal influence on the ditch that borders the north side of Area A, but this influence is limited to the channel only. After agricultural activities ceased in Area B, breaches developed in the Centinela Ditch berm and storm runoff now enters into the adjacent field, thereby creating wetter conditions in a portion of the field. The major source of hydrologic input at Playa Vista under conditions of normal rainfall is direct precipitation and its associated runoff. Although little ponding occurs on the property during years within the range of normal rainfall, excessive ponding may occur during years of greatest rainfall, such as in 1997-1998, when rainfall was greatest for any year of record at Los Angeles International Airport. Straw (1987) calculated the average annual rainfall for the area to be 12.64 inches. Although three of the six wettest years of record have occurred since the wetland delineation in 1987, average annual rainfall has increased by only 0.02 inch to 12.66 inches (Straw, 2000). Abundant evidence exists in many portions of Playa Vista that ponding occurred during the 1997- 1998 rainfall year, both in areas that qualified as wetlands and in those that qualified as non-wetlands in 1987.

Another major element of the hydrology of Playa Vista is the recurring periodic low-rainfall years. During 47 of the 79 years of record (59.5%), annual rainfall has been less than the average of 12.66 inches (Straw, 2000). Moreover, low-rainfall years appear to occur in-groups of two to five. Although three of the six wettest rainfall years in the record have occurred during the 11 years since the original delineation, seven of the 11 years have experienced below average rainfall, including the five-year period from 1986-87 to 1990-1 991 during which the average annual rainfall was only 7.01 inches (Straw, 1999). Such periods of below normal rainfall have a profound effect on the composition of plant communities and distribution of indicators of wetland hydrology.

Except for the tidally-influenced ditch on the north side of Area A, the only source of available water in Area A, as well as for portions of Area B, is direct rainfall and the resulting local runoff. In areas lacking tidal influence and/or overbank flooding due to large storm events, the water table does not rise near enough to the surface to produce saturated soils in a major portion of the root zone (Fruit Growers Laboratory, 1982). Only closed depressions of such areas may have wetland hydrology, which results from surface runoff. Other areas (e.g., the ditch on the northern side of Area A) have wetland hydrology due to tidal flows or hgh water table levels for much of the effective growing season, especially the lowest unfilled areas. High water tables occur in these areas, and water table levels do not appear to drop significantly lower during dry years, presumably due to the area receiving the greatest amount of runoff that does occur, and, in some cases, the presence of tidal flows.

Some of Area B is inundated by surface water only during extreme flooding events (Straw, 1987). These areas do not receive and hold sufficient runoff during years of average rainfall to result in soil saturation for the requisite period to produce wetland hydrologic conditions (Shapiro and Associates, 1980). Sanders (1987) found water table levels to be deeper than 20 inches below the surface in much of the agricultural field during the time one would expect the highest water table levels of the year. However, depressional areas typically had water table levels nearer to the soil surface than 12 inches.

The height of the capillary fringe above the water table and its potential influence on wetland delineations became an issue after the 1987 wetland delineation at Playa Vista. Capillary fringe, defined as a zone of saturated soil above the water table produced as a result of adhesive forces, holding the water in capillary pores against the forces of gravity, was considered by some to be sufficient to cause areas with low water table levels to meet the wetland hydrology criterion. Williams (1982) conducted a theoretical study and concluded that soils could be saturated as much as five feet above the water table due to capillary rise. Three factors precluding achievement of the theoretical potential for soil saturation due to capillary action include coarse soil textures, limited duration of continuous exposure of potential capillary strata to the water table, and lack of vertical and horizontal uniformity of the soil profile. The three aforementioned factors, discussed in the following subparagraphs, significantly limit the potential for substantial saturation due to capillary rise in the majority of the study area.

a)Coarse soil textures. The potential for capillary rise in sandy soils (including soil strata exceeding three inches in &chess) is negligible. Depending on the coarseness of the texture, the maximum rise ranges from about 0.1 inch to 1.6 inches. The major reason is that there are few, if any, capillary- sized pores in coarse textured soils. On the other hand, fine-textured clay has significant potential for facilitating capillary rise, since most, if not all, pores are capillary size.

b) Length of exposure of potential capillary strata to the water table. The duration of exposure to the water table of a stratum capable of facilitating capillary rise is critical in determining the potential for capillary rise. To achieve even a fraction of the potential rise due to capillary action, a fine-textured soil stratum must be exposed to the water table continuously for long periods, usually several months. Since the water table in large portions of Playa Vista occurs relatively near the surface for only a short period during the growing season before starting to decline (Fruit Growers Laboratory, 1982; Converse Consultants, 1982; McLaren Environmental Engineering, 1987), the theoretical potential for capillary rise cannot be achieved. Capillary tensions are broken as soon as a stratum begins to become dewatered, which occurs by April in most of the study area in years of normal rainfall. Saturation due to capillary rise is a significant consideration only in areas where the water table levels remains within 24 inches of the soil surface for most of the growing season. This limits the potential for capillary rise to be a factor in the delineation to only a few depressional areas.

c) Lack of vertical and horizontal uniformity of the soil profile. A soil profile that consists of alternating fine- and coarse-textured strata has little potential for capillary rise unless the water table rises into a fine-textured stratum that is continuous into the major portion of the root zone. Coarse- textured strata block the potential for capillary rise, even where the coarse stratum is overlain by a fine-textured stratum capable of facilitating capillary rise.

Considering the above factors and, in light of field observations at Playa Vista, Sanders (1987) concluded that capillary fringe could account for no more than 5 inches of soil saturation above the water table for portions of the property having clayey soils. For areas having sandy soils or significant sand lenses within the profile, the capillary fringe is less than 2.0 inches. The major factor limiting capillary fringe at Playa Vista appears to be the lack of a water table sufficiently near the surface long enough to provide time for significant rise by capillary action, except possibly in the western portion of Area B and in depressional areas elsewhere.

4.2 Current Conditions

Based on results from the present delineation, there are approximately 236.2 acres of Corps-jurisdictional (278.5 acres of CCC-jurisdictional) wetlands and non-wetland waters currently present within the Study Area. Roads and one large channel separate the Study Area into three distinct regions: Areas A, B, and C, which also coincide with previous study descriptions (Figure 1). Further descriptions of these individual areas are described below.

4.2.1 Area A

Area A encompasses approximately 150 acres and is bounded by Ballona Creek to the south, Lincoln Boulevard to the east, and Fiji Way to the north and west. Elevations in this area range from nine to 17 feet (based on the National Geodetic Vertical Datum [NGVD]). Dredged materials from the excavations of Ballona Creek and Marina Del Rey have been placed throughout Area A. Although largely undeveloped, this area contains a small parking area along the western boundary, a man-made drainage channel (Marina Ditch) along the northern boundary, and four monitoring wells installed by the Gas Company in the western portion of Area A. Historic tidal influence has been altered by the construction of a levee to contain Ballona Creek and by the deposition of dredged materials which have raised the elevations within Area A up to 17 feet (PWA 2006). The only tidally influenced hydrology within Area A occurs in the Marina Ditch; however, tidal influence does not reach beyond the channel. Other sources of hydrologic input include precipitation and stormwater runoff from adjacent lands.

Area A contains extensive amounts of dredge fill material, and native soils are not generally accessible using the soil sampling methods described in the Corps Manual (1987). Areas in which dredge materials were encountered during wetland delineations were considered “atypical situations”. In these areas, the rationale for the wetland determination was explained on the data sheets included in Appendix A.

4.2.2 Area B

The majority of Area B is composed of potentially jurisdictional wetlands characterized as emergent, estuarine marsh. Area B encompasses approximately 315 acres and is bounded by Ballona Creek to the north, Lincoln Boulevard to the east, urban development along Vista Del Mar to the west, and Cabora Drive to the south. Elevations in this area range from two to 50 feet NGVD. Area B contains the largest area of remnant unfilled wetlands, with abandoned agricultural lands to the southwest, and the freshwater marsh to the northeast. This area also contains several major roads with drainage culverts, as well as a Gas Company easement for oil wells, which includes one active oil well and supporting access roads. With the exceptions of areas surrounding the oil and gas platforms, the ground surface in Area B represents the original marsh surface (PWA 2006). Aggressive, invasive plants encountered in Area B include extensive patches of pampas grass (UPL) and sea fig (UPL). These species were observed within both upland and wetland habitats, and both are classified as highly invasive by the California Invasive Plant Council (Cal-IPC 2010). The western portion of this area is also tidally influenced; however, tidal influence has been limited by partially malfunctioning flap gates along the Ballona Creek Channel. Other sources of hydrologic input include precipitation and stormwater runoff from adjacent lands.

Area B contains limited amounts of dredge fill material, and native soils are not always accessible using the soil sampling methods described in the Corps Manual (1987). However, this area is the least disturbed of the three areas and currently contains the greatest extent of jurisdictional wetlands. Areas in which dredge materials were encountered during wetland

delineations were considered “atypical situations”. In these areas, the rationale for the wetland determination was explained on the data sheets included in Appendix A.

4.2.3 Area C

Dredged materials from the excavations of Ballona Creek and Marina Del Rey have been placed throughout Area C, particularly in the southern portion (PWA 2006). Area C occupies approximately 85 acres and is bounded by Lincoln Blvd to the west, the Marina Freeway to the northeast, and Ballona Creek to the south. Elevations in this area range from four to 25 feet NGVD. Area C is mostly undeveloped with the exception of the ball fields, minor structures, and Culver Boulevard, which runs through the middle of this area. Natural hydrological sources for Area C include precipitation, surface run-off from adjacent lands, and channelized tidal flow. Playa Vista is directly connected to Areas A and C through a culvert under Fiji Way that allows tidal flow to enter the Marina Ditch; however, tidal influence is limited to the Marina Ditch channel and does not extend into the Area C wetlands.

4.2.4 Ballona Creek

Ballona Creek occupies approximately 55 acres of the Study Area. It has been channelized and is currently an open, lined, trapezoidal creek from its mouth at Santa Monica Bay to the intersection of Venice Boulevard and Pickford Street, approximately nine miles upstream. The creek’s bottom widths vary from 80 to 200 feet and depths vary from 19 to 23 feet from the top of the levee. The side slopes are composed of concrete, paving stones and riprap, but the channel bottom is not armored. Ballona Creek is tidally influenced, and the CDFG owns the portion of creek that flows through the Study Area.

5.0 RESULTS

Vegetation, soils and hydrology data collected during delineation site visits are reported on standard Corps Arid West Region data forms in Appendix A. Features which met less than three parameters were carefully evaluated considering problematic vegetation, including the presence of aggressive, invasive plant species, to determine the presence or absence of wetlands. Potential Section 404, Section 10, CCC, and CDFG jurisdictional areas are described in the following sections and depicted in Appendices A, B and C. Photos of representative portions of the Study Area and sample points are shown in Appendix D. A list of plant species observed in the Study Area during March 2010 site visits is included in Appendix E. The Study Area currently supports approximately 278.5 acres of CCC jurisdictional wetlands (Appendix B), of which 236.2 acres are considered potential Corps jurisdictional wetlands and waters of the U.S. (Appendix A), and 150.03 acres are considered potential CDFG jurisdictional habitat (Appendix C).

Small, fragmented patches of hydrophytic vegetation (i.e., alkali heath, *Frankenia salina* [FACW] and alkali weed [*Cressa truxillensis* var. *vallicola*, FACW]) were present throughout the Study Area; however, they did not meet the minimum mapping unit requirements (minimum of 10 feet by 10 feet) and were not delineated during the site visit. As a result, these patches are included in areas mapped as upland habitat. Likewise, small areas dominated by upland habitat occur within areas mapped as wetland habitat–we believe that this minimum mapping unit was suitable for the Study Area and that these “inclusions” of upland or wetland habitat within areas mapped as the opposite jurisdiction type are balanced within the Study Area. Areas that

consisted of a mosaic of small patches of hydrophytes within upland habitat were generally mapped as upland habitat for the Corps and wetland habitat for the CCC. These areas were not mapped as wetlands for the Corps if three parameters indicative of wetland habitat were not present.

5.1 Potential Corps, CCC and CDFG Jurisdictional Wetlands and Waters

5.1.1 Wetlands

The Study Area contains approximately 153.2 acres of Corps jurisdictional wetlands, 278.5 acres of CCC jurisdictional wetlands, and 150.0 acres of CDFG jurisdictional habitat. Area B supports the majority of these wetland areas. Areas A and C support a mix of upland vegetation and scattered wetlands related to the heterogenous dredge fill material that makes up the soil substrate in these areas. Relative to the other two areas, Area B contains less dredge fill material and currently receives hydrological input from tidal waters. Acreages of wetlands and non-wetland waters (excluding Ballona Creek) within each area are summarized in the following sections.

All wetlands mapped and presented in Appendix A are likely to be considered jurisdictional by the Corps as they are directly connected to a navigable "waters of the U.S." (Ballona Creek and the Pacific Ocean) or are separated from these waters by man-made levees. Water can flow through the Study Area to Ballona Creek and ultimately into the Pacific Ocean.

Within the southwest portion of Area A and throughout Area C, large stands of mule fat (*Baccharis salicifolia*; FACW) meet the single parameter requirement to be considered potential CCC jurisdictional wetlands (i.e., meet the hydric vegetation indicator); however, these stands do not appear to be functioning as hydrophytic vegetation and do not demonstrate any indicators of hydric soils or wetland hydrology, are not riparian features, and do not meet three parameter wetlands so are not Corps jurisdictional wetlands. Mule fat stands are distributed over a variety of landforms (e.g., within earthen roads, on steep hillsides and berms, and within road embankments) which are unlikely to ever support wetland hydrology (see sample point 3u); roadside medians in the area are planted with mule fat (FACW), indicative of its weedy nature in the region. This species is used as an ornamental landscaping plant throughout the region, which may have resulted in the unusual distribution observed within the Study Area. Due to its unusual distribution, mule fat was considered to be an unreliable indicator or wetland vegetation in the Study Area. Therefore, mule fat stands were mapped within the Study Area, but are not considered to be Corps wetlands. In addition, isolated mulefat plants (i.e., not a contiguous stand of mulefat) are considered to be non-jurisdictional by the CCC (pers com. with Jonna Engel during the September 2010 site visit), while contiguous stands of mulefat are considered to be jurisdictional by the CCC. Mule fat stands are depicted in Appendix B and representative photographs are given in Appendix D.

<u>Area A</u>

The acreage of potential Section 404, CCC and CDFG jurisdictional areas, as well as potentially non-jurisdictional upland areas, in Area A is summarized in Table 5 below.

The portion of Area A mapped as CDFG jurisdictional habitat includes the Marina Ditch and the associated band of vegetation growing on its banks. No additional areas within Area A met the criteria for CDFG jurisdictional habitat, as confirmed by staff scientists (Rick Mayfield, pers.

comm. February 16, 2011).

Table 5. Summary of Potential Corps, CCC and CDFG Jurisdictional Areas within Area A

Jurisdictional Agency	Wetlands (acres)	Non-Wetland Waters (acres)	Potentially Non-Jurisdictional Uplands (acres)	**Total Potentially Jurisdictional Areas (acres)**
Corps	7.4	0.4	142.0	**7.8**
CCC	19.0		130.5	**19.0**
CDFG	3.8		145.7	**3.8**

In the central and northern portions of Area A, potential Corps/CCC wetlands are dominated by pickleweed species (*Salicornia virginica* and *S. subterminalis,* OBL), saltbush (*Atriplex lentiformis*, FAC), slenderleaf iceplant (*Mesembryanthemum nodiflorum*, FACU), annual bluegrass (*Poa annua*, FACW), and open mud flat areas. In the southwestern portion of Area A, there are concentrated patches of alkali heath (FACW), which also meet Corps wetland criteria. One large wetland occurs within the central portion of Area A and consists of intermixed mudflat and hydric vegetation, with no clear transition to pure upland habitat surrounding the wetland.

The topographic depression in the center of Area A was characterized along a four-point transect (sample points 10a through 10d) due to the complex, large transition zone surrounding the wetland. Sample points 10a and 10b met the criteria for soils, hydrology, and vegetation, and both sample points passed the FAC neutral test. Sample point 10c met criteria for hydric soils and hydrology only. Sample point 10d did not meet any of the wetland criteria and is considered to be an upland point. Therefore, the limits of Corps jurisdiction were delineated between sample points 10b and 10c, at which point hydric vegetation is no longer present, while the limits of CCC jurisdiction were delineated between sample points 10c and 10d, at which point there are wetland indicators of vegetation, soils, or hydrology (Appendix A). Corps/CCC wetlands on either bank of the Marina Ditch and outside the surrounding berms in Area A were dominated by mule fat (FACW), saltbush (FAC), pickleweed (OBL), and open mud flat.

Soils in Area A sporadically contained historic redoximorphic features from dredge spoils and are composed of fill material excavated to create Marina Del Rey. Soils were assumed to be hydric if evidence of ponding/saturation for long duration was present. Soils of heterogeneous dredge material with concentrated fine material were observed within wetlands.

Indicators of wetland hydrology included soil cracking, salt crust, and biotic crust (algal matting). Natural hydrological sources for Area A include precipitation, surface run-off, stormwater flow from adjacent development, and tidal flow. Tidal flow enters Marina Ditch through a culvert connecting it to Marina Del Rey at the northern boundary of Area A. Open water was observed flowing through the Marina Ditch during the site visit only near the culvert at Fiji Way. Small puddles were observed further up the Marina Ditch, with most of the area consisting of dry ground with no saturation within the top six inches of soil.

Some additional habitat surrounding the Corps/CCC wetlands meets the criteria for at least one wetland parameter and therefore is mapped as a CCC wetland, but not as a Corps wetland. In Area A, these CCC wetland areas are dominated by ripgut brome and soft chess (*Bromus hordeaceus*, FACU). In addition, three small wetland polygons mapped in the southwestern corner of Area A represent concentrated groups of alkali heath patches which meet both the Corps and CCC criteria for wetlands.

Area B

The acreage of potential Section 404, CCC and CDFG jurisdictional areas, as well as potentially non-jurisdictional upland areas, in Area B is summarized in Table 6 below.

Table 6. Summary of Potential Corps, CCC and CDFG Jurisdictional Areas within Area B

Jurisdictional Agency	Wetlands (acres)	Non-Wetland Waters (acres)	Potentially Non-Jurisdictional Uplands (acres)	**Total Potentially Jurisdictional Areas (acres)**
Corps	143.4	27.2	171.7	**170.7**
CCC	172.3		142.7	**172.3**
CDFG	87.3		227.7	**87.3**

The portion of Area B mapped as CDFG jurisdictional habitat includes the tidal channels and their associated vegetation, as well as observed willow (*Salix* spp.) patches. The jurisdictional area extends laterally out from the tidal channels a substantial distance in some areas, particularly in the southwest of Area B, where the vegetation and landform was considered part of the "contributing watershed". CDFG jurisdictional areas have been confirmed by staff scientists (Rick Mayfield, pers. comm. February 16, 2011).

Tidal channels provide hydrological input to a large portion of the wetlands in this area, and vegetation communities observed here were composed primarily of estuarine marsh species. Dominant vegetation in areas considered to be Corps/CCC jurisdictional wetlands includes bristly ox-tongue, alkali ryegrass (*Leymus triticoides*, FAC), annual bluegrass (FACW), brass buttons (*Cotula coronopifolia*, FACW), toad rush (*Juncus bufonius*, FACW), pickleweed species (*S. virginica, S. subterminalis, S. europaea,* OBL), saltgrass (*Distichlis spicata*, FACW), common cattail (*Typha latifolia*, OBL), narrowleaf willow (*Salix exigua*, OBL), arroyo willow (*Salix lasiolepis*, FACW), and Italian ryegrass (*Lolium multiflorum*, FAC).

Soils generally had high clay content, although several features along the southern and eastern boundaries were composed of sandy soils with limited pockets of fill material. Natural hydrological sources for Area B include precipitation, urban and stormwater run-off, tidal input from Ballona Creek, and potentially groundwater discharge adjacent to bluffs south of the Study Area. Tidal gates along Ballona Creek's southern levee allow muted tidal flow to enter the wetlands. Although several major roads dissect Area B, drainage features bypass these barriers through a series of culverts.

Potential CCC wetlands encompass Section 404 wetlands, as well as additional surrounding habitat which meet the criteria for at least one wetland parameter. These additional CCC wetland areas are scattered throughout Area B and typically meet criteria for wetland hydrology or soils but lack indicators of wetland vegetation. For example, sample point 7U was taken in a basin in which biotic crust, a primary indicator of hydrology, was observed. This point represents a feature that showed indicators of hydrology, but lacked wetland soils and vegetation; it was considered a CCC jurisdictional wetland only.

Aggressive, invasive plants such as pampas grass (UPL) and sea fig (UPL) were observed throughout Area B. Individual stands of pampas grass were found in the southwestern, southeastern, and central sections of this area. These areas consistently met both wetland soils and hydrology parameters. Due to its lack of wetland indicator status and its ability to aggressively colonize areas, pampas grass was considered to be problematic vegetation. Where it occurred with hydric soils and wetland hydrology, such as at sample points 15W and 16W, it was delineated as part of the wetland habitat.

The same mapping criteria and methodology were applied to sea fig (UPL), which is also considered problematic vegetation due to its highly invasive nature. Sea fig was found throughout Area B, with a large concentration of the species occurring in the central portion, east of Culver Boulevard near sample point 13W. Areas dominated by sea fig were observed to be located in topographically low areas with highly saturated soils. These saturated soils appear to be contributing to the degradation of the sea fig-dominated community in this area, and may result in the re-colonization of hydrophytic vegetation such as alkali heath (FACW).

Area C

The acreage of potential Section 404, CCC and CDFG jurisdictional areas, as well as potentially non-jurisdictional upland areas, in Area C is summarized in Table 7 below.

Table 7. Summary of Potential Corps, CCC and CDFG Jurisdictional Areas within Area C

Jurisdictional Agency	Wetlands (acres)	Non-Wetland Waters (acres)	Potentially Non-Jurisdictional Uplands (acres)	**Total Potentially Jurisdictional Areas (acres)**
Corps	2.3	0.1	82.7	**2.4**
CCC	4.1		80.9	**4.1**
CDFG	3.6		81.4	**3.6**

The portion of Area C mapped as CDFG jurisdictional habitat includes the Marina Ditch and the associated band of vegetation growing on its banks. No additional areas within Area C met the criteria for CDFG jurisdictional habitat, as confirmed by staff scientists (Rick Mayfield, pers. comm. February 16, 2011).

Dominant vegetation in areas considered to be Corps/CCC jurisdictional wetlands includes bristly ox-tongue (FAC), curly dock (*Rumex crispus*, FACW), Italian ryegrass (FAC), pickleweed (OBL), saltbush (FAC), slenderleaf iceplant (UPL), and alkali heath (FACW). In the northeastern corner, the wetland area contains patches of bare ground with soil cracking, as well as a dominance of hydrophytic vegetation. Potential CCC wetlands also occur within the Marina Ditch's eastern portion and the drainage ditch along the northeastern boundary of Area C. The Marina Ditch is dominated by saltbush (FAC), and the drainage ditch is dominated by bristly ox-tongue (FAC), curly dock (FACW), Italian ryegrass (FAC), and black mustard (*Brassica nigra*, UPL). Although dominated by hydrophytic vegetation, these areas did not display indicators of wetland hydrology or soils.

The topography and hydrology of Area C have been significantly altered, resulting in the limited distribution of wetland areas observed during the site visit. Remnant wetlands exist along historic channels, in man-made drainage ditches, and in one depressional landform in the northwestern corner of the area. Open water in the Marina Ditch tapers off to the east, transitioning to a vegetated channel, which appears to follow a historic stream bed. The vegetated channel is dominated by saltbush (FAC) with sparse patches of pickleweed (OBL) scattered along its western section. Its eastern extent does not show signs of wetland hydrology and is therefore likely considered to be a jurisdictional feature under the CCC, but not under the Corps. The drainage ditch along the northeastern boundary is likely both a Corps and CCC jurisdictional feature, as it is dominated by herbaceous hydrophytic vegetation and shows indicators of wetland hydrology, including standing water. This ditch was delineated as a wetland feature despite the disturbed soils found at sample point 1W. The soils contained substantial amounts of fill material, which may not have been present for enough time to develop identifiable redoximorphic features, or which may be too saline to develop redoximorphic features.

As described above, small, sparse patches of hydrophytic vegetation were present throughout Area C; however, these areas did not meet the minimum mapping unit requirements and were not mapped during the site visit. In addition, as discussed above, mule fat was not considered to be a reliable indicator of wetland vegetation as it occurred only within upland habitat and was never observed with indicators of active wetland hydrology or hydric soils.

Uplands

Vegetation within upland habitat consists primarily of upland grass and herbaceous species. Grassland habitat consists of ripgut brome (*Bromus diandrus*, UPL), foxtail brome (*Bromus madritensis*, UPL), soft chess (FACU), California brome (*Bromus carinatus*, UPL), and areas dominated by thick stands of mustard *(Brassica* sp. and *Hirschfeldia incana*, UPL) or Garland daisy (*Chrysanthemum coronarium*, UPL), thickets of coyote brush (*Baccharis pilularis*, UPL) or California sagebrush (*Artemisia californica*, UPL), or are dominated by stands of laurel sumac (*Malosma laurina*, UPL) or acacia (*Acacia* sp., UPL). In addition, some upland habitat is dominated by sea fig, pampas grass, or slender leaved iceplant (*Mesembryanthemum nodiflorum*, FACU). Mule fat (FACW) also occurs in scattered locations within upland habitat in areas without any indicators of wetland hydrology and without hydric soils.

The border between upland and Corps/CCC jurisdictional wetland communities was determined primarily by vegetation type: areas dominated by upland vegetation species were not mapped as potentially regulated Corps jurisdictional wetlands. However, some areas considered to be upland habitat based on Corps criteria *are* considered to be potentially jurisdictional wetland habitat based on CCC criteria. Areas that were mapped as upland habitat for both the Corps and the CCC did not exhibit signs of active wetland hydrology such as a biotic crust (B4),

saturation (A3), or soil cracking (B6). Areas that were mapped as upland habitat under the Corps, but as potential CCC wetlands were typically dominated by upland vegetation, but showed signs of wetland hydrology and/or hydric soils. In other areas, potential CCC wetlands supported sparse hydrophytic vegetation (i.e., alkali weed, FACW) within upland habitat and, in some areas, exhibited indicators of active wetland hydrology, but not hydric soils. Soils in the areas identified as upland habitat under both the CCC and the Corps criteria lacked hydric soil indicators.

The border between CDFG jurisdictional habitat and uplands was determined primarily using the topography surrounding linear channel features. Topography was used as an indicator of water flow, and areas determined to be outside the "contributing watershed" based on their topography were determined to be non-jurisdictional CDFG uplands.

5.1.2 Section 10 and Non-Wetland Section 404 Corps/CCC Waters

The Study Area contains "non-wetland waters" which are regularly inundated and which may be subject to tidal influence. All tidally influenced areas within the Study Area that occur below the HTL fall under Corps Section 404 jurisdiction; areas below MHW fall under Corps Current Section 10 jurisdiction; areas below the Top of Bank fall under CDFG jurisdiction. Ballona Creek, which covers approximately 55.3 acres, makes up the majority of tidal waters present in the Study Area. This feature is a channelized, historic creek that is directly connected to Santa Monica Bay and is tidally influenced throughout the Study Area. In addition, several tidal channels carry waters from Ballona Creek into Area B through culverts under the creek levee and under the major roads that bisect the Study Area. Tide gates at the culverts mute the tidal flow along the channels. Within the Study Area, Ballona Creek and its associated tidal channels were mapped as Current Section 10 tidal waters and CDFG jurisdictional habitat.

Open water in the Marina Ditch is also tidal. The ditch is a straight, unlined, trapezoidal, man-made channel which flows west from Area C, through a culvert under Lincoln Boulevard, and out to Marina Del Rey via a culvert under Fiji Way. It receives tidal influence from the Marina and appears to convey surface runoff and stormwater flow from adjacent lands. Open water was present throughout the portion of the Marina Ditch that runs through Area A and the western portion of Area C. Beyond its upstream boundary, the ditch continues as a vegetated wetland through Area C.

The Study Area contains additional "non-wetland waters", as defined by the Corps, which are irregularly inundated. The western portion of Area B contains large, unvegetated salt flats which are visible in aerial imagery. Tide gates connect the Area B tidal channels to Ballona Creek, and incoming tides bring water up the channels and over the flats, which become submerged daily (PWA 2006). This habitat lacks vegetation over more than 95 percent of its area; therefore, it does not meet the definition of a Corps jurisdictional wetland. It is an aquatic feature with direct connection to navigable, "waters of the U.S." and is under Corps jurisdiction as potential "non-wetland waters of the U.S." The elevation of this feature falls between MHW and HTL (PWA 2008); therefore, it is considered to be Section 404 waters, but not Current Section 10 waters.

Each of these features considered "non-wetland waters" under Corps jurisdiction also fall under CCC jurisdiction as potential wetlands. The features meet, at a minimum, the parameter for wetland hydrology; therefore, 83.0 acres of other waters was added to the 195.5 acres of vegetated CCC wetlands in calculating total wetland acreage under potential CCC jurisdiction (Table 2).

5.1.3 Historic Section 10 Waters of the U.S.

A depiction of historic conditions at the Ballona Wetlands Study Area was created for the Ballona Wetlands Feasibility Report (PWA 2008) based on topographical sheets (T-sheets) produced in the 1870s. The Historical Conditions figure of this report shows historic tidal sloughs in Areas A, B and C, and marsh/wetland habitat and sand islands scattered throughout the current Study Area. The historic tidal sloughs are assumed to have occurred below the MHW line and would therefore be considered potential Historic Section 10 waters. Current T-sheets for the Study Area are not available in digital format and therefore could not be used to confirm the current elevations of historic slough areas. Thus, areas which were mapped as tidal sloughs in the 1870s are assumed to be potential jurisdictional Historic Section 10 waters. Potential Historic Section 10 waters are depicted in Figure 2, which was adapted from the Historical Conditions figure discussed above.

5.2 Difficult Wetland Situations in the Arid West

The utilization of the site as a dredge material disposal area has resulted in the placement of fill throughout the Study Area, particularly in Areas A and C. The placement of fill may have accounted for the lack of hydric soil indicators observed at sample point 1W. Although this area did not meet the hydric soil indicators for problematic hydric soils, the hydric soil indicators may have not yet formed due to the placement of fill or manipulation of the soil in the past or due to the high salinity content of the soil. As a result, WRA classified soil samples composed mainly of fill material as problematic and looked for other wetland indicators in these areas. Areas that appeared to pond for long duration or showed other clear signs of wetland hydrology and vegetation were mapped as wetland habitat. In addition, soil samples which appeared to contain recent redoximorphic features such as oxidized rhizospheres within the fill material were also considered hydric. Based on this methodology, sample point 1W was determined to represent a wetland area potentially under Corps and CCC jurisdiction.

In addition to disturbed soils, the Study Area contains aggressive, invasive plant species that are considered problematic vegetation. Invasive species have been known to out-compete wetland-associated plant species, particularly in disturbed areas. Sea fig and pampas grass (UPL) were observed within the Study Area, and both are classified as highly invasive upland species (Cal-IPC 2010). These species appear to have invaded wetland habitats within the Study Area. Sample points 13W, 15W, and 16W were dominated by invasive upland species but displayed strong indicators of hydrology and hydric soils. In these areas, vegetation was not a useful indicator of wetland boundaries and was considered problematic. Areas within the Ballona Wetlands that were dominated by aggressive, invasive vegetation, but met hydric soil and wetland hydrology criteria, were delineated as Corps and CCC jurisdictional wetlands. Problematic vegetation was noted on data forms for sample points in which it occurred (Appendix A).

5.3 Areas Exempt from Section 404 Jurisdiction

Based upon our previous experience with the Corps and our understanding that wetland habitat separated from navigable waters by levees are regulated features, we believe that all of the features mapped without a delineated connection to a water or wetland feature (i.e., wetland features that appear to be “islands” within upland habitat) on the site have a nexus to a navigable water (sub-surface flow or Historic or Current Section 10) and are likely regulated under by the Corps (and the CCC); however, ultimate jurisdiction lies with the regulatory agency.

5.4 Comparison of Past and Present Delineation Results

As described above, several delineations of the study area have been conducted over the past three decades. The following discussion presents a comparison of the results of the Sanders 1987, Sanders 2000, and WRA 2010 delineations. The purpose of this comparison is to

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Figure 2.
Historic Habitat Features within the Project Area

Legend

- Project Area: (604.9 acres)
- Coastal Plain: (73.1 acres)
- Marsh: (372. 7 acres)
- Sand: (114.4 acres)
- Sand Hills: (24.8 acres)
- Potential Historic Section 10 Waters: (19.7 acres)

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Map Date: May 2010
Map By: Sundaran Gillespie
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demonstrate any physical or environmental changes that may have occurred between delineation visits. Also, it will provide an explanation for the differences in acreages of wetlands and waters presented in the results for each delineation report.

The study area boundaries differed in each study: in 1987, Areas A, B, C and D were delineated, and Areas A, B and C were delineated for the present delineation. Only Area A and a large portion of Area B (excluding the approximately 61-acre area north and east of the Jefferson/Culver intersection, referred to as Area B2 in Appendix A) were delineated in 2000; therefore, the study area from 2000 is the only area where all three delineations overlap and can be compared. Acreages have been adjusted from the 1987 and 2010 reports to exclude Area C and D, as well as the northeastern corner of Area B, from the Ballona Wetlands Study Area total, and the results are presented for comparison in Table 8.

The main differences in wetland acreages between the 1987 and 2000 delineations have been attributed to the blockage of Centinela Ditch in the southern portion of Area B (referred to as Area B3 in Appendix A). Over the 13-year period between delineations, the ditch was blocked

Table 8. Comparison of Corps-jurisdictional wetland and waters acreages reported in 1987, 2000, and 2010.

Area	Delineation Report	Corps-jurisdictional Wetlands (acres)	Corps-jurisdictional Non-Wetland Waters (acres)	Non-Jurisdictional Uplands (acres)	Total Study Area (acres)
Area A	Sanders 1987	9.83	0	129.17	139
	Sanders 2000	8.08	0	130.92	139
	WRA 2010	7.4	0.4	142.0	150
Area B*	Sanders 1987	130.58	21.5	98.72	250.8
	Sanders 2000	116.81	21.9	112.09	250.8
	WRA 2010	143.4	27.2	171.7	254
Area C	Sanders 1987	1.80	0	83.2	85
	Sanders 2000	-	-	-	-
	WRA 2010	2.3	0.1	82.7	85
Combined Ballona Wetlands Study Area**	Sanders 1987	140.81	21.5	227.49	389.8
	Sanders 2000	124.89	21.9	243.01	389.8
	WRA 2010	157.03	27.6	219.18	403.81

* Excluding the approximately 61-acre area north of Jefferson Boulevard and east of the Jefferson/Culver intersection (Area B2).
** The total overlapping study area includes Area A and the majority of Area B, excluding Area B2 (Appendix A). Area A and the western portion of Area B are the only areas which overlap completely and can be compared across all three delineation reports; Area C and the eastern portion of Area B were not delineated in the Sanders 2000 study.

by the expansion of the alluvial fan east of Gas Company Road and south of Jefferson Boulevard. By 2000, the ditch no longer conveyed water under Gas Company Road west to the southwestern portion of Area B, and more water pooled immediately east of the road than in 1987. This change in hydrology resulted in a loss of approximately 13.77 wetland acres in southern Area B and a shift in the wetland vegetation to a more "water-tolerant" community consisting of common cattail and bulrush (*Scirpus robustus*, OBL) east of Gas Company Road. The remaining differences in wetland and waters acreages between 1987 and 2000 can largely be attributed to seasonal vegetation community shifts, which are discussed in Section 3.1.3.

The majority of differences in wetland and waters acreages between 2000 and 2010 can accounted for by shifts in vegetation communities and changes in methods applied, rather than major changes in topography or other physical conditions. The most pronounced increase in wetlands delineated from 2000 to 2010 occurs in Area B, west of the Jefferson/Culver intersection and south of Culver Boulevard (Area B3 in Appendix A). This area supports vast populations of problematic hydrophytic species, namely sea fig, which was likely mapped as uplands in 2000 due to differences in survey methodology and/or changes in the invasive status of problematic plant species over the 10-year time lapse. In addition to the areas of problematic vegetation observed in 2010, there were large saltgrass-dominated areas where the saltgrass was growing over a layer of dead sea fig, which was presumably the dominant species here in recent history. As described in Section 3.1.3 above, vegetation community shifts are common in this type of habitat and may lead to differences in wetland delineation results over years or even between seasons within the same year.

6.0 POTENTIAL CORPS, CCC, AND CDFG JURISDICTION

The Ballona Wetlands Study Area has 153.2 acres of potential Corps wetlands and 83 acres of non-wetland waters that will potentially be considered jurisdictional under Section 404 of the Clean Water Act (the ultimate jurisdictional determination lies with the regulatory agency, in this case, the Corps). Tidal waters are also considered potentially jurisdictional Current Section 10 waters, and the majority of the site may be considered Historic Section 10 waters under Section 10 of the Rivers and Harbors Act. The wetland areas were typically either seasonal wetlands or emergent marsh dominated by hydrophytic vegetation with FAC, FACW and OBL classified plants. They also contained hydric soil and wetland hydrology indicators. In addition, these areas are tributary to a navigable “waters of the U.S.” and therefore meet the definition of jurisdictional wetlands and waters under Section 404 of the Clean Water Act.

The Study Area contains 278.5 acres that will potentially be considered CCC jurisdictional wetlands under the California Coastal Act and the Coastal Zone Management Act. These wetland areas met one to three of the wetland parameters defined by the Corps. They include open water, Corps jurisdictional wetlands (which met all three wetland parameters), and areas that showed signs of wetland hydrology and/or hydric soils but were dominated by upland vegetation.

The Study Area contains 150.03 acres that are potentially jurisdictional features under Sections 1600 - 1616 of the California Fish and Game Code. These features include all willow (*Salix* spp.) vegetation patches, slough channels, or areas with tidal flow and their “contributing watershed” observed within the Study Area.

This delineation is based on conditions observed at the time of the field surveys conducted in March and October 2010.

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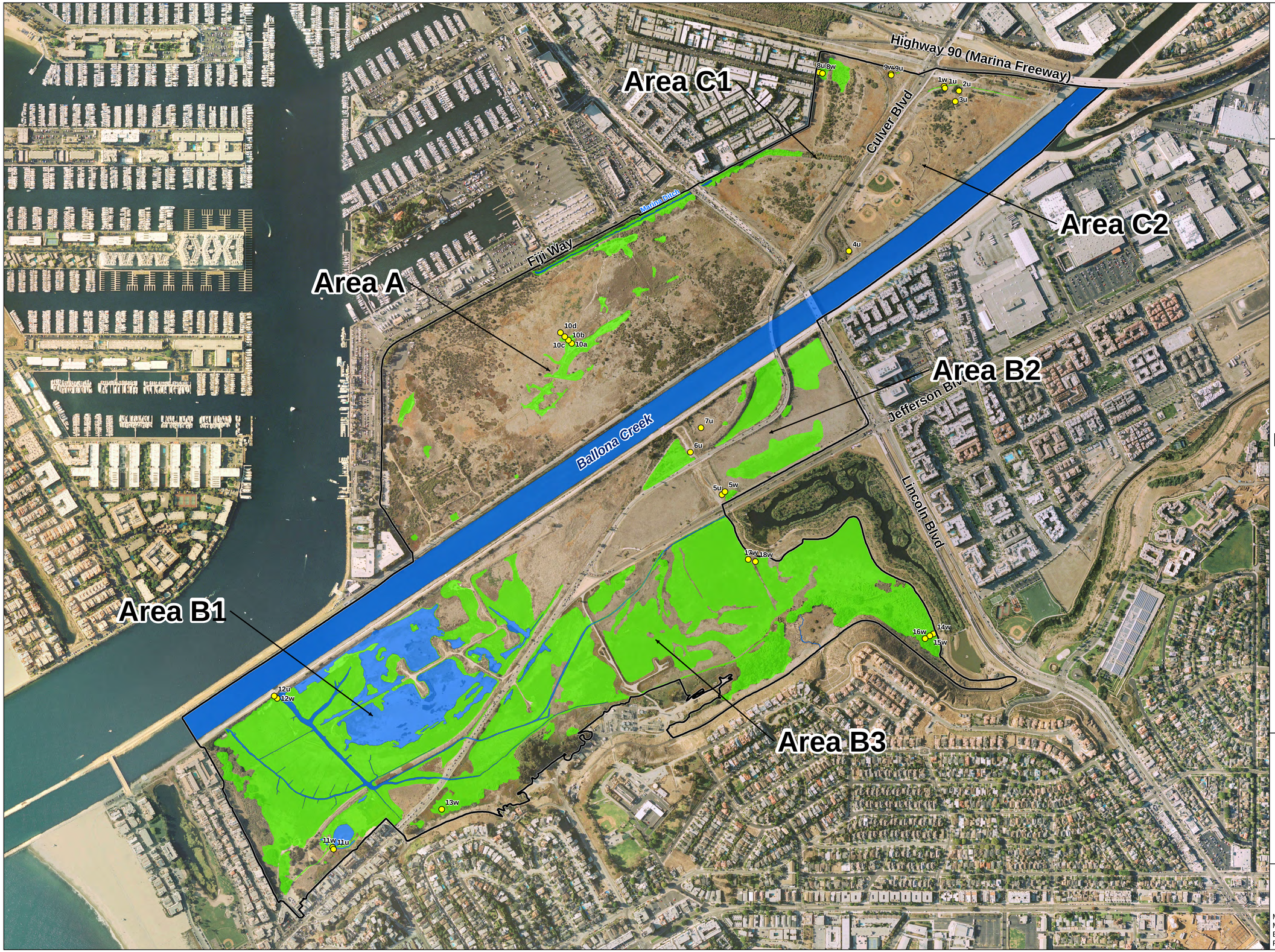
Appendix A - Preliminary Section 404 Jurisdictional Map and Data Sheets



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Appendix A. Preliminary Delineation of United States Army Corps of Engineers Jurisdictional Areas

Legend

- Project Area: (604.9 acres)
- Sample Point
- Potential Non-Wetland Waters: (83.0 acres)
- Potential Wetland: (153.2 acres)
- Upland Area: (368.7 acres)

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Feet
1 inch = 400 feet

Map Date: April 2010
Map By: Sundaran Gillespie
Base Source: source, date
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Appendix B - Preliminary California Coastal Act Jurisdictional Map



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Appendix B. Preliminary Delineation of California Coastal Commission Jurisdictional Areas

Legend

- Project Area: (604.9 acres)
- Sample Point
- Potential Non-Wetland Waters: (83.0 acres)
- Potential Wetland: (195.5 acres)
- Upland Area: (326.4 acres)

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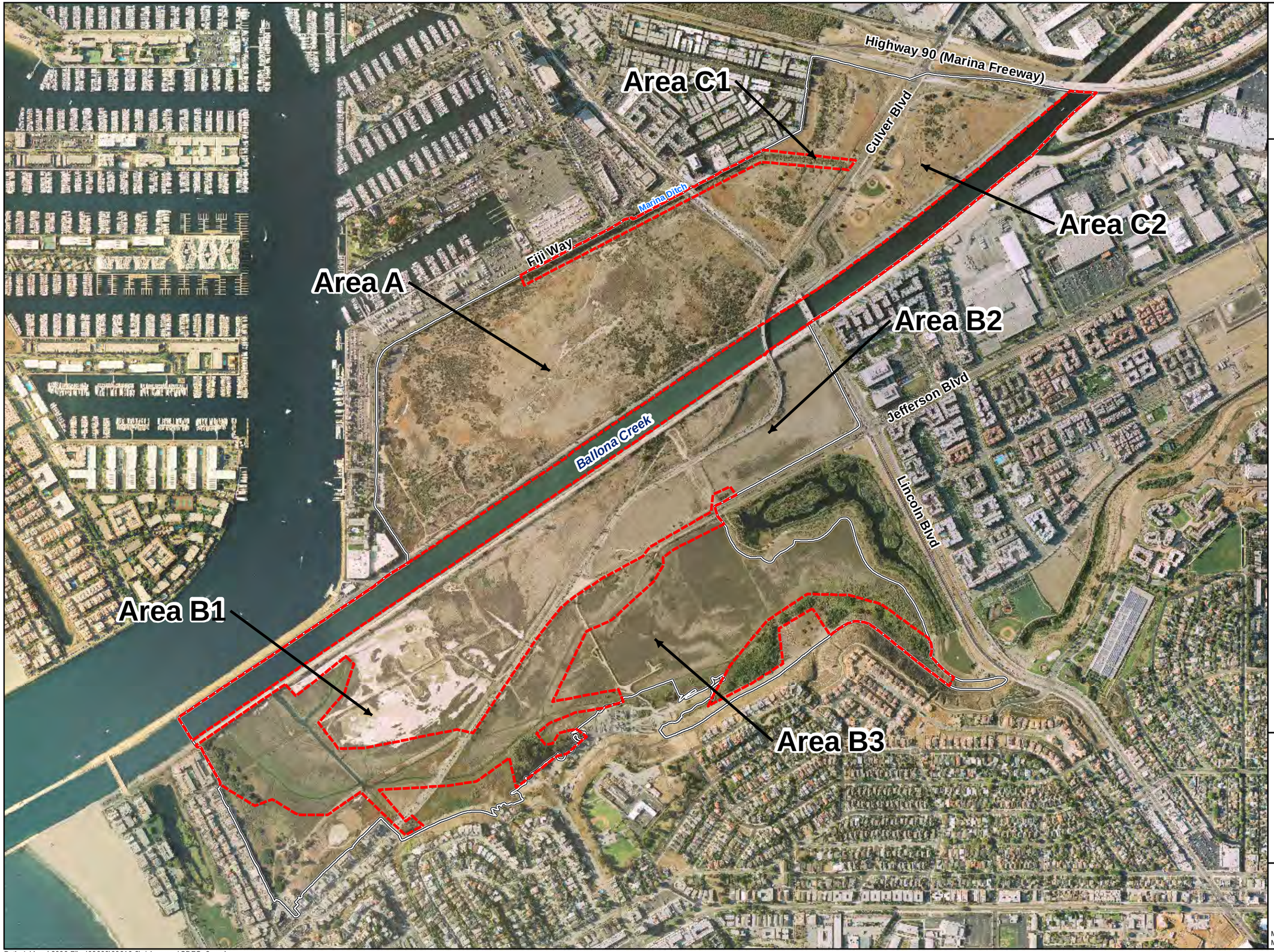
Feet
1 inch = 400 feet

Map Date: April 2010
Map By: Sundaran Gillespie
Base Source: County of LA
Filepath: I:\ACAD2000\00016-3\GIS\ArcMap\CCCDelin.mxd

Appendix C - Preliminary Section 1602 Jurisdictional Map



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Appendix C. California Department of Fish and Game Jurisdictional Areas

Legend

- Project Area: (604.9 acres)
- CDFG Jurisdiction: (150.03 acres)

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Map Date: January 2011
Map By: Sundaran Gillespie

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Appendix D - Representative Photographs of the Study Area





Top: Area A. Wetland sample point 10a was dominated by pickleweed, annual bluegrass, and mudflat.
Bottom: Area A. Upland sample point 10d was dominated by non-native upland grass species.

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Top: Area A. Garland daisy dominated the berm surrounding Marina Ditch (foreground); saltbush and mudflat dominate wetlands outside the berm in the northeast.
Bottom: Patches of alkali heath were found throughout Areas A, B, and C.

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Top: Area B. Wetland sample point 12w occurs in estuarine marsh dominated by pickleweed species.
Bottom: Area B. Tidal channels bring muted tidal flow from Ballona Creek to estuarine marsh habitat in Area B.

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Top: Area B. Sample points 17w and 18w represent the expansive central section of Area B, which is dominated by estuarine marsh.
Bottom: Area B. Soil pit from sample point 13w demonstrates wetland hydrology and is representative of pits throughout this Area.

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Top: Area B. Sample point 13w occurs in marsh habitat, bordered to the south by sand dunes. Between living plants, dead sea fig covered the ground.
Bottom: Area B. Near point 13w, saltgrass occurs with sea fig, which is considered problematic vegetation.

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Top: Area B. Sample point 11w represents a limited area adjacent to open water that was dominated by brass buttons and toad rush on sandy soils.
Bottom: Area B. Sample point 11u occurred on sand dunes which were dominated by non-native, invasive plant species.

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Top: Area B. Sample point 14w was dominated by cattail and surrounded to the north, west and south by pampas grass.
Bottom: Area B. Pampas grass, considered problematic vegetation, occurred with hydrophytic vegetation in wetland conditions throughout the Study Area.

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Top: Area B. Sample point 7u occurred in a basin surrounded by berms and fields of mustard. Observations of biotic crust potentially qualify this area to be a CCC jurisdictional wetland.
Bottom: Area B. Sample point 6u was taken on an upland berm with disturbed soils containing substantial amounts of dredge fill.

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Top: Area C. Sample point 1w represents the drainage channel along the northeastern boundary of Area C.
Bottom: Area C. Mule fat stands were observed in upland habitat throughout the Study Area and were mapped as potentially non-jurisdictional features.

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Top: Ballona Creek, a tidally influenced and channelized water feature, runs through the middle of the Study Area.
Bottom: Main tidal channel in Area B connects to Ballona Creek through culverts under the creek's levee.

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Appendix E - Plant Species Observed in the Study Area

Family	Scientific Name	Common Name	Wetland Indicator Status
Plant species documented from the Ballona Wetlands[1] Project Site. Species names given according to Hickman (1993) or Jepson Interchange (2010). Old names (Hickman 1993) are given in parentheses, as needed.			
DICOTS			
Aizoaceae	*Aptenia cordifolia*	Baby sun rose	UPL
Aizoaceae	*Carpobrotus chilense*	Sea-fig	UPL
Aizoaceae	*Carpobrotus edulis*	Sour-fig (Hottentot-fig)	UPL
Aizoaceae	*Delosperma litorale*	Seaside delosperma	UPL
Aizoaceae	*Malephora crocea*	Red-flowered iceplant	UPL
Aizoaceae	*Mesembryanthemum crystallinum*	Crystalline iceplant	UPL
Aizoaceae	*Mesembryanthemum nodiflorum*	Slender leaf iceplant	UPL
Aizoaceae	*Sesuvium verrucosum*	Western sea-purslane	FACW
Aizoaceae	*Tetragonia tetragonioides*	New Zealand spinach	UPL
Amaranthaceae	*Amaranthus albus*	White tumbleweed	FACU
Amaranthaceae	*Amaranthus californicus*	Amaranth/Ca. pigweed	FACW
Amaranthaceae	*Amaranthus deflexus*	Pigweed	UPL
Amaranthaceae	*Amaranthus tamariscanus*	Indehiscent pigweed	FACU
Amaryllidaceae	*Narcissus tazetta*	Paper white narcissus	UPL
Anacardiaceae	*Malosma laurina (Rhus laurina)*	Laurel sumac	UPL
Anacardiaceae	*Rhus integrifolia*	Lemonade berry	UPL
Anacardiaceae	*Schinus molle*	Peruvian pepper tree	UPL
Anacardiaceae	*Schinus terebinthifolius*	Brazilian pepper tree	UPL

[1] Species list adapted from 08/18/2006 Ballona Wetlands Floral Compendium

Family	Scientific Name	Common Name	Wetland Indicator Status
Apiaceae	*Apium graveolens*	Celery	FACW
Apiaceae	*Apium leptophyllum*	Marsh parsley	UPL
Apiaceae	*Conium maculatum*	Poison hemlock	FACW
Apiaceae	*Foeniculum vulgare*	Fennel	FACU
Apocynaceae	*Nerium oleander*	oleander	UPL
Araliaceae	*Hedera canariensis*	Algerian ivy	UPL
Asteraceae	*Ambrosia acanthicarpa*	Ragweed/Annual bursage	UPL
Asteraceae	*Ambrosia chamissonis*	Ragweed/Beach bur	UPL
Asteraceae	*Ambrosia psilostachya*	Western ragweed	FAC
Asteraceae	*Artemisia californica*	California sage brush	UPL
Asteraceae	*Artemisia douglasiana*	California/Douglas' mugwort	FACW
Asteraceae	*Artemisia dracunculus*	Dragon sagewort/Tarragon	UPL
Asteraceae	*Symphyotrichum subulatum* var. *ligulatum*	Marsh aster/Slender aster	UPL
Asteraceae	*Baccharis pilularis*	Coyote brush	UPL
Asteraceae	*Baccharis salicifolia*	Mule fat	FACW
Asteraceae	*Brickellia californica*	Brickellbush	FACU
Asteraceae	*Centaurea melitensis*	Tocalote	UPL
Asteraceae	*Centaurea repens*	Russian knapweed	UPL
Asteraceae	*Chaenactis glabriuscula*	Yellow chaenactis	UPL
Asteraceae	*Chamomilla suaveolens*	Pineapple weed	UPL
Asteraceae	*Chondrilla juncea*	Skelton weed	UPL

Family	Scientific Name	Common Name	Wetland Indicator Status
Asteraceae	*Chrysanthemum coronarium*	Garland daisy	UPL
Asteraceae	*Cichorium intybus*	Chicory	UPL
Asteraceae	*Cirsium vulgare*	Bull thistle	UPL
Asteraceae	*Conyza bonariensis*	Flax-leaved horseweed	UPL
Asteraceae	*Conyza canadensis*	Horseweed	FAC
Asteraceae	*Conyza coulteri*	Sticky conyza	FAC
Asteraceae	*Cotula australis*	Cotula	UPL
Asteraceae	*Cotula coronopifolia*	Brass buttons	FACW
Asteraceae	*Encelia californica*	California bush sunflower	UPL
Asteraceae	*Ericameria ericoides (Haplopappus e.)*	Goldenbush/Mock	UPL
Asteraceae	*Ericameria pinifolia (Haplopappus p.)*	Goldenbush	UPL
Asteraceae	*Euryops pectinatus*	Euryops daisy	UPL
Asteraceae	*Euthamia occidentalis (Solidago occidentalis)*	Western goldenrod	OBL
Asteraceae	*Filago sp.*	Filago	UPL
Asteraceae	*Gazania linearis (G. longiscapa)*	African daisy	UPL
Asteraceae	*Gazania scaposa*	African daisy	UPL
Asteraceae	*Gnaphalium bicolor*	Cudweed	UPL
Asteraceae	*Gnaphalium californicum*	California cudweed	UPL
Asteraceae	*Gnaphalium canescens* ssp. *beneolens*	Everlasting cudweed	UPL
Asteraceae	*Gnaphalium ramosissimum*	Pink cudweed	UPL
Asteraceae	*Gnaphalium stramineum (G. chilense)*	Chilean cudweed	FAC

Family	Scientific Name	Common Name	Wetland Indicator Status
Asteraceae	*Grindelia camporum (G. robusta)*	Gum plant	FACU
Asteraceae	*Hedypnois cretica*	Cretan weed	UPL
Asteraceae	*Helianthus annuus*	California sunflower	FAC
Asteraceae	*Deinandra fasciculata (Hemizonia f.)*	Common tarweed	UPL
Asteraceae	*Deinandra paniculata (Hemizonia p.)*	San Diego tarweed	FACU
Asteraceae	*Centromadia parryi australis (Hemizonia p.* ssp*. a.)*		FAC
Asteraceae	*Heterotheca grandiflora*	Telegraph weed	UPL
Asteraceae	*Heterotheca villosa (Chrysopis v.)*	Hairy goldenaster	UPL
Asteraceae	*Hypochaeris glabra*	Smooth cat's ear	UPL
Asteraceae	*Jaumea carnosa*	Fleshy juamea	OBL
Asteraceae	*Lactuca eucra*	-	-
Asteraceae	*Lactuca serriola*	Prickly lettuce	FAC
Asteraceae	*Lactuca virosa*	Wild lettuce	UPL
Asteraceae	*Lessingia filaginifolia (Corethrogyne filaginifolia)*		UPL
Asteraceae	*Malacothrix saxatilis*	Cliff aster	UPL
Asteraceae	*Osteospermum fruticosum (Dimorphotheca f.)*	African daisy	UPL
Asteraceae	*Picris echioides*	Bristly ox-tongue	FAC
Asteraceae	*Senecio vulgaris*	Common groundsel	UPL
Asteraceae	*Silybum marianum*	Milk thistle	UPL
Asteraceae	*Solidago californica*	California goldenrod	UPL

Family	Scientific Name	Common Name	Wetland Indicator Status
Asteraceae	*Euthamia occidentalis (Solidago o.)*	Western goldenrod	OBL
Asteraceae	*Sonchus asper* ssp. *asper*	Prickly sow thistle	FAC
Asteraceae	*Sonchus oleraceus*	Common sow thistle	NI
Asteraceae	*Stephanomeria exigua*	Small wire lettuce	UPL
Asteraceae	*Stephanomeria virgata*	Tall stephanomeria	UPL
Asteraceae	*Taraxacum officinale*	Dandelion	FACU
Asteraceae	*Xanthium spinosum*	Spiny cocklebur	FAC
Asteraceae	*Xanthium strumarium*	Rough cocklebur	FAC
Bataceae	*Batis maritima*	Salt wort	OBL
Boraginaceae	*Cryptantha intermedia*	White forget-me-not/popcorn flower	UPL
Boraginaceae	*Heliotropium curassavicum (H. ocellatum)*	Salt heliotrope	UPL
Brassicaceae	*Brassica nigra*	Black mustard	UPL
Brassicaceae	*Brassica rapa*	Field mustard	UPL
Brassicaceae	*Cakile maritima*	Sea-rocket	FACW
Brassicaceae	*Coronopus didymus*	Lesser swine cress	UPL
Brassicaceae	*Erysimum insulare* ssp. *suffrutescens*	Island wallflower	UPL
Brassicaceae	*Guillenia lasiophylla*	California mustard	UPL
Brassicaceae	*Hirschfeldia incana (Brassica geniculata)*	Field mustard	UPL
Brassicaceae	*Lepidium latifolium*	Broad-leaved peppergrass	FACW
Brassicaceae	*Lepidium virginicum* var. *pubescens (L. pubescens)*	Tall peppergrass	FACU

Family	Scientific Name	Common Name	Wetland Indicator Status
Brassicaceae	*Lobularia maritima*	Sweet alyssum	UPL
Brassicaceae	*Raphanus sativus*	Wild radish	UPL
Brassicaceae	*Sinapis alba (Brassica cf. hirta)*	White mustard	UPL
Brassicaceae	*Sisymbrium altissimum*	Tumble-mustard	UPL
Brassicaceae	*Sisymbrium irio*	London rocket	UPL
Cactaceae	*Opuntia ficus-indica*	Indian-fig	UPL
Cactaceae	*Opuntia littoralis*	Coastal prickly pear	UPL
Caprifoliaceae	*Sambucus mexicana*	elderberry	FAC
Caryophyllaceae	*Polycarpon tetraphyllum*	Four-leaved allseed	UPL
Caryophyllaceae	*Spergula arvensis*	Spurry starwort	UPL
Caryophyllaceae	*Silene gallica*	Common catchfly/ windmill pink	UPL
Caryophyllaceae	*Spergularia bocconei*	Boccone's sand-spurrey	UPL
Caryophyllaceae	*Spergularia macrotheca*	Salt marsh sand-spurrey	FAC
Caryophyllaceae	*Spergularia marina*	Hairy sand-spurrey	OBL
Caryophyllaceae	*Spergularia villosa*	Sand-spurrey	UPL
Chenopodiaceae	*Atriplex californica*	California saltbush	FAC
Chenopodiaceae	*Atriplex lentiformis*	Saltbush	FAC
Chenopodiaceae	*Atriplex patula*	Spear oracle	FACW
Chenopodiaceae	*Atriplex rosea*	Tumbling oracle	FACU
Chenopodiaceae	*Atriplex semibaccata*	Australian saltbush	FAC
Chenopodiaceae	*Atriplex triangularis*	Spearscale	FACW

Family	Scientific Name	Common Name	Wetland Indicator Status
Chenopodiaceae	*Bassia hyssopifolia*	Bassia	FAC
Chenopodiaceae	*Beta vulgaris*	Beet	FACU
Chenopodiaceae	*Chenopodium album*	White goosefoot/ Lambs-quarters	FAC
Chenopodiaceae	*Chenopodium ambrosioides*	Mexican tea	FAC
Chenopodiaceae	*Chenopodium berlandieri*	Pitseed goosefoot	UPL
Chenopodiaceae	*Chenopodium botrys*	Jerusalem oak	FACU
Chenopodiaceae	*Chenopodium murale*	Shiny-leaf goosefoot	UPL
Chenopodiaceae	*Chenopodium pumilio*	Glomerate goosefoot	UPL
Chenopodiaceae	*Salicornia bigelovii*	Annual pickleweed	OBL
Chenopodiaceae	*Arthrocnemum subterminale*	Parish's pickleweed	OBL
Chenopodiaceae	*Sarcocornia pacifica (Salicornia virginica)*	Common pickleweed	OBL
Chenopodiaceae	*Salsola tragus*	Russian thistle	FACU
Chenopodiaceae	*Suaeda calceoliformis (S. depressa* var. *erecta)*	Horned sea-blite	FACW
Chenopodiaceae	*Suaeda esteroa*	Sea-blite	UPL
Chenopodiaceae	*Suaeda taxifolia*	Woolly sea-blite	FACW
Convolvulaceae	*Calystegia macrostegia* var. *cyclostegia*	Coast morning glory	UPL
Convolvulaceae	*Convolvulus arvensis*	Bindweed	UPL
Convolvulaceae	*Cressa truxillensis* var. *vallicola*	Alkali weed	FACW
Convolvulaceae	*Dichondra occidentalis**	Western ponysfoot	UPL
Crassulaceae	*Crassula argentea*	Jade plant	UPL

Family	Scientific Name	Common Name	Wetland Indicator Status
Crassulaceae	*Crassula connata*	Pygmy weed	FAC
Cucurbitaceae	*Citrullus lanatus*	Watermelon	UPL
Cucurbitaceae	*Cucurbita foetidissima*	Calibazilla	UPL
Cupressaceae	*Cupressus arizonica* ssp. *arizonica*	cypress	UPL
Cuscutaceae	*Cuscuta californica*	California dodder	UPL
Cuscutaceae	*Cuscuta indecora*	Big-seed alfalfa dodder	UPL
Cuscutaceae	*Cuscuta pentagona (C. campestris)*	Five-angled dodder	UPL
Cuscutaceae	*Cuscuta salina*	Saltmarsh dodder	UPL
Euphorbiaceae	*Chamaesyce albomarginata*	Rattlesnake weed	FACU
Euphorbiaceae	*Chamaesyce maculata*	Spotted spurge	UPL
Euphorbiaceae	*Chamaesyce polycarpa*	Smallseeded sandmat	UPL
Euphorbiaceae	*Chamaesyce serpens*	Matted sandmat	UPL
Euphorbiaceae	*Croton californicus*	California Croton	UPL
Euphorbiaceae	*Euphorbia esula*	Leafy spurge	UPL
Euphorbiaceae	*Euphorbia peplus*	Petty spurge	UPL
Euphorbiaceae	*Ricinus communis*	Castor bean	FACU
Fabaceae	*Acacia longifolia*	Australian wattle	UPL
Fabaceae	*Acacia decurrens*	Green wattle	UPL
Fabaceae	*Acacia neriifolia*	Wattle	UPL
Fabaceae	*Albizia lophantha (A. distachya)*	Albizia	UPL
Fabaceae	*Astragalus trichopodus*	Ocean locoweed	UPL

Family	Scientific Name	Common Name	Wetland Indicator Status
Fabaceae	*Bauhinia variegata*	Orchid tree	UPL
Fabaceae	*Ceratonia siliqua*	Carob	UPL
Fabaceae	*Hoffmannseggia glauca*	Pig nut, Hog-potato	FACU
Fabaceae	*Lotus purshianus*	Spanish clover/Bird's foot trefoil	UPL
Fabaceae	*Lotus scoparius*	Deerweed	UPL
Fabaceae	*Lotus strigosus*	Strigose lotus	UPL
Fabaceae	*Lupinus bicolor*	Miniature lupine	UPL
Fabaceae	*Lupinus chamissonis*	Coastal bush lupine	UPL
Fabaceae	*Lupinus excubitus* ssp. *hallii*	Hall's lupine	UPL
Fabaceae	*Lupinus longifolius*	Longleaf bush lupine	UPL
Fabaceae	*Lupinus succulentus*	Arroyo lupine	UPL
Fabaceae	*Lupinus truncatus*	Lupine	UPL
Fabaceae	*Medicago polymorpha (M. hispida)*	California burclover	UPL
Fabaceae	*Melilotus albus*	White sweetclover	FACU
Fabaceae	*Melilotus indica*	Sourclover	FAC
Fabaceae	*Phaseolus limensis*	Large lima bean	UPL
Fabaceae	*Spartium junceum*	Spanish broom	UPL
Fagaceae	*Quercus agrifolia*	Coast live oak	UPL
Fagaceae	*Quercus x virginica*	Hybrid live oak	UPL
Frankeniaceae	*Frankenia salina*	Alkali heath	FACW
Geraniaceae	*Erodium botrys*	Storksbill/broad-lobed filaree	UPL

Family	Scientific Name	Common Name	Wetland Indicator Status
Geraniaceae	*Erodium cicutarium*	Storksbill	UPL
Geraniaceae	*Pelargonium zonale*	Garden Geranium	UPL
Grossulariaceae	*Ribes malvaceum*	Chaparral currant	UPL
Hamamelidaceae	*Liquidambar styraciflua*	liquidambar	UPL
Hydrophyllaceae	*Phacelia ramosissima* var. *austrolitoralis*	Branching phacelia	UPL
Juglandaceae	*Juglans regia*	English walnut	UPL
Lamiaceae	*Marrubium vulgare*	Horehound	FAC
Lythraceae	*Ammannia sp.*	Red stem	OBL
Lythraceae	*Lythrum hyssopifolium*	Hyssop loosestrife	FACW
Malvaceae	*Malacothamnus fasciculatus*	Bush mallow/Chaparral	UPL
Malvaceae	*Malva nicaeensis*	Bull mallow	UPL
Malvaceae	*Malva parviflora*	Cheeseweed mallow	UPL
Malvaceae	*Malvella leprosa*	Alkali mallow	FAC
Moraceae F	*Ficus carica*	Edible fig	UPL
Moraceae	*Morus alba*	White mulberry	NI
Myoporaceae	*Myoporum laetum*	Lollypop tree	UPL
Myrtaceae	*Eucalyptus camaldulensis*	Red gum	UPL
Myrtaceae	*Eucalyptus globulus*	Blue gum	UPL
Myrtaceae	*Eucalyptus tereticornis*	Forest red gum	UPL
Myrtaceae	*Eucalyptus viminalis*	Manna gum	UPL
Myrtaceae	*Luma apiculata (Eugenia sp.)*	temu	UPL

Family	Scientific Name	Common Name	Wetland Indicator Status
Nyctaginaceae	*Abronia umbellata*	Pink sand verbena	UPL
Oleaceae	*Fraxinus velutina*	Arizona/Velvet	FACW
Oleaceae	*Olea europaea*	Olive	UPL
Onagraceae	*Camissonia bistorta*	California sun cup	UPL
Onagraceae	*Camissonia cheiranthifolia* var. *suffruticosa*	Beach evening	UPL
Onagraceae	*Camissonia lewisii*	Lewis' evening primrose	UPL
Onagraceae	*Camissonia micrantha*	Miniture sun cup	UPL
Onagraceae	*Epilobium ciliatum*	Willow-herb	FACW
Onagraceae	*Oenothera elata* ssp*. hookeri*	Hooter's evening primrose	FACW
Onagraceae	*Oenothera elata* ssp. *hirsutissima*	Hairy evening primrose	FACW
Oxalidaceae	*Oxalis pes-caprae*	Bermuda buttercup	UPL
Papaveraceae	*Eschscholzia californica*	California poppy	UPL
Plantaginaceae	*Plantago lanceolata*	English plantain	FAC
Plantaginaceae	*Plantago major*	Common plantain	FACW
Plumbaginaceae	*Limonium californicum*	Sea lavender	OBL
Polygonaceae	*Eriogonum fasciculatum*	California buckwheat	UPL
Polygonaceae	*Eriogonum gracile*	Slender buckwheat	UPL
Polygonaceae	*Eriogonum parvifolium*	Dune buckwheat	UPL
Polygonaceae	*Polygonum arenastrum*	Common knotweed	FAC
Polygonaceae	*Polygonum lapathifolium*	Willow weed	OBL
Polygonaceae	*Rumex crispus*	Curly dock	FACW

Family	Scientific Name	Common Name	Wetland Indicator Status
Polygonaceae	*Rumex maritimus (Rumex fueginus)*	Golden dock	OBL
Polygonaceae	*Rumex salicifolius*	Willow dock	OBL
Primulaceae	*Anagallis arvensis*	Scarlet pimpernel	FAC
Ranunculaceae	*Clematis sp.*	clematis	UPL
Rosaceae	*Adenostoma fasciculatum*	Chamise	UPL
Rosaceae	*Heteromeles arbutifolia*	Toyon	UPL
Rosaceae	*Prunus persica*	Peach	UPL
Rosaceae	*Pyracantha sp.*	Firethorn	UPL
Rosaceae	*Rosa californica*	California rose	FAC
Rubiaceae	*Galium angustifolium*	Narrowleaf bedstraw	UPL
Salicaceae	*Populus fremontii*	Fremont cottonwood	FACW
Salicaceae	*Salix exigua (S. hindsiana)*	Narrow-leaved willow	OBL
Salicaceae	*Salix gooddingii*	Black willow	OBL
Salicaceae	*Salix laevigata*	Red willow	UPL
Salicaceae	*Salix lasiolepis*	Arroyo willow	FACW
Saururaceae	*Anemopsis californica*	Yerba mansa	OBL
Scrophulariaceae	*Verbascum virgatum*	Wand mullein	UPL
Scrophulariaceae	*Cordylanthus maritimus*	Bird's beak	OBL
Solanaceae	*Datura wrightii (D. meteloides)*	Jimsonweed	UPL
Solanaceae	*Lycium ferocissimum*	African boxthorn	UPL
Solanaceae	*Lycopersicon esculentum*	Tomato	UPL

Family	Scientific Name	Common Name	Wetland Indicator Status
Solanaceae	*Nicotiana glauca*	Tree tobacco	FAC
Solanaceae	*Petunia parviflora*	Wild Petunia	FACW
Solanaceae	*Solanum americanum (S. nodiflorum)*	Small-flowered nightshade	FAC
Solanaceae	*Solanum douglasii*	Douglas's Nightshade	FAC
Solanaceae	*Solanum nigrum*	Black nightshade	FACU
Solanaceae	*Solanum sarrachoides*	Hairy nightshade	UPL
Solanaceae	*Solanum xanti*	Chaparral nightshade	UPL
Tropaeolaceae	*Tropaeolum majus*	Garden nasturtium	UPL
Typhaceae	*Typha domingensis*	Southern Cattail	OBL
Typhaceae	*Typha latifolia*	Broad-leaved Cattail	OBL
Ulmaceae	*Ulmus parvifolia*	Chinese elm	UPL
Urticaceae	*Urtica dioica* ssp. *holosericea (U. holosericea)*	Hoary nettle	FACW
Urticaceae	*Urtica urens*	Dwarf nettle	UPL
Verbenaceae	*Verbena lasiostachys*	Common verbena	FAC
Verbenaceae	*Lantana camara*	Orange-flowered lantana	NI
Zygophyllaceae	*Tribulus terrestris*	Puncture vine	UPL
MONOCOTS			
Alismataceae	*Sagittaria montevidensis* ssp. *calycina*	Arrowhead	OBL
Arecaceae	*Phoenix canariensis*	Canary island date palm	UPL
Arecaceae	*Phoenix dactylifera*	Date palm	UPL
Arecaceae	*Washingtonia robusta*	Slender fan palm	UPL

Family	Scientific Name	Common Name	Wetland Indicator Status
Cyperaceae	*Carex praegracilis*	Clustered field sedge	FACW
Cyperaceae	*Cyperus eragrostis*	Galingale/Tall flat sedge	FACW
Cyperaceae	*Cyperus esculentus*	Yellow nutsedge	FACW
Cyperaceae	*Cyperus involucratus (C. alternifolius)*	Umbrella plant	OBL
Cyperaceae	*Eleocharis macrostachya*	Pale spike rush	OBL
Cyperaceae	*Eleocharis montevidensis*	Dombey's spike rush	FACW
Cyperaceae	*Schoenoplectus americanus (Scirpus a.)*	Olney bulrush	OBL
Cyperaceae	*Schoenoplectus californicus (Scirpus c.)*	California bulrush/Tule	OBL
Cyperaceae	*Bolboschoenus maritimus* ssp. *paludosus (Scirpus m.)*	Prairie burush	OBL
Cyperaceae	*Bolboschoenus robustus (Scirpus r.)*	Saltmarsh bulrush	OBL
Iridaceae	*Chasmanthe aethiopica*	Adams iris	UPL
Iridaceae	*Iris pseudacorus var. alba*	Horticultural iris	OBL
Juncaceae	*Juncus acutus* var. *leopoldii (J. a.* var. *sphaerocarpus)*	Spike-rush	FACW
Juncaceae	*Juncus balticus*	Wire rush	OBL
Juncaceae	*Juncus bufonius* var. *occidentalis (J. sphaerocarpus)*	rush	FACW
Juncaceae	*Juncus mexicanus*	Mexican rush	FACW
Juncaginaceae	*Triglochin maritima (*likely a misidentification of *T. concinnum)*	Arrow grass	OBL
Liliaceae	*Agave americana var. striata*	Giant agave	UPL
Liliaceae	*Agave attenuata*	Foxtail agave	UPL

Family	Scientific Name	Common Name	Wetland Indicator Status
Liliaceae	*Yucca gloriosa*	Spanish dagger	UPL
Liliaceae	*Aloe vera*	Medicinal aloe	UPL
Poaceae	*Agrostis viridis (A. semiverticillata)*	Bentgrass	OBL
Poaceae	*Agrostis stolonifera*	Redtop	FACW
Poaceae	*Arundo donax*	Giant reed grass	FACW
Poaceae	*Avena barbata*	Slender wild oat	UPL
Poaceae	*Avena fatua*	Wild oat	UPL
Poaceae	*Bromus catharticus (B. wildenovii)*	Rescue-grass	UPL
Poaceae	*Bromus diandrus*	Ripgut chess	UPL
Poaceae	*Bromus hordeaceus (B. mollis)*	Soft chess	FACU
Poaceae	*Bromus madritensis* ssp. *rubens*	Foxtail chess	UPL
Poaceae	*Bromus carinatus (B. marginatus)*	California brome	UPL
Poaceae	*Cortaderia selloana*	Pampas grass	UPL
Poaceae	*Cynodon dactylon*	Bermuda grass	FAC
Poaceae	*Digitaria sanguinalis*	Crabgrass	FACU
Poaceae	*Distichlis spicata*	Saltgrass	FACW
Poaceae	*Echinochloa crus-galli*	Barnyard grass	FACW
Poaceae	*Ehrharta erecta*	Upright veldt grass	UPL
Poaceae	*Festuca arundinacea*	Tall fescue	FAC
Poaceae	*Hordeum depressum*	Alkali barley	NI
Poaceae	*Hordeum murinum* ssp. *leporinum*	Wild barley	NI

Family	Scientific Name	Common Name	Wetland Indicator Status
Poaceae	*Hordeum vulgare*	Barley	UPL
Poaceae	*Lamarckia aurea*	Goldentop	UPL
Poaceae	*Leymus condensatus (Elymus c.)*	Giant ryegrass	FACU
Poaceae	*Leymus triticoides*	Alkali ryegrass	FAC
Poaceae	*Leptochloa uninervia*	Mexican sprangle top	FACW
Poaceae	*Lolium multiflorum*	Italian ryegrass	FAC
Poaceae	*Lolium perenne*	Perennial ryegrass	FAC
Poaceae	*Melica imperfecta*	Melic grass	UPL
Poaceae	*Monanthochloe littoralis*	Shoregrass	OBL
Poaceae	*Nassella cernua (Stipa cernua)*	Nodding Needlegrass	UPL
Poaceae	*Parapholis incurva*	Sickle grass	UPL
Poaceae	*Paspalum dilatatum*	Dallis grass	FAC
Poaceae	*Phalaris paradoxa*	Hood canary grass	UPL
Poaceae	*Piptatherum miliaceum (Oryzopsis miliacea)*	Smilo grass	UPL
Poaceae	*Poa annua*	Annual bluegrass	FACW
Poaceae	*Polypogon monspeliensis*	Rabbitsfoot grass	FACW
Poaceae	*Schismus barbatus*	Mediterranean grass	UPL
Poaceae	*Setaria gracilis (S. geniculata)*	Bristlegrass	FAC
Poaceae	*Sorghum halepense*	Johnsongrass	FACU
Poaceae	*Sorghum nutans*	Indian grass	UPL
Poaceae	*Stenotaphrum secundatum*	St. Augustine grass	FAC

Family	Scientific Name	Common Name	Wetland Indicator Status
Poaceae	*Vulpia myuros* var. *myuros (Festuca myuros)*	Fescue	UPL
Poaceae	*Vulpia myuros* var. *hirsuta (Festuca megalura)*	Foxtail fescue	UPL
Poaceae	*Spartina foliosa*	Cordgrass	OBL
Potamogetonaceae	*Ruppia maritima*	Ditch grass	OBL
Typhaceae	*Typha domingensis*	Southern Cattail	OBL
Typhaceae	*Typha latifolia*	Broad-leaved Cattail	OBL

APPENDIX D15
Jurisdictional Delineation Report, Potential Well Sites, Playa del Rey Storage Facility

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December 10, 2013

Anthony A. Klecha
Principal Environmental Scientist
Southern California Gas Company
P.O. Box 30777
Los Angeles, CA 90030

Subject: **Jurisdictional Delineation Report**
Potential Well Sites, Playa del Rey Storage Facility

Dear Mr. Klecha:

This letter report documents the findings of a routine jurisdictional delineation conducted by ICF International (ICF) for the Southern California Gas Company (SoCalGas) at the Potential Well Sites at the Playa del Rey Storage Facility (project). The purpose of the delineation is to assess the limits of potential features subject to the jurisdiction of the U.S. Army Corps of Engineers (USACE), Regional Water Quality Control Board (RWQCB), California Department of Fish and Wildlife (CDFW), and the California Coastal Commission (CCC) pursuant to Sections 404 and 401 of the Clean Water Act, Section 13260 of the Porter-Cologne Water Quality Control Act (California Water Code 13260[a]), Section 1602 of the California Fish and Game Code, and the California Coastal Act. Specifically, the delineation was conducted for the purpose of providing SoCalGas the location of potential jurisdictional resources within seven separate potential project footprints.

Project Location

The project site is located at an existing SoCalGas facility in Playa del Rey in Los Angeles County, California (Figure 1). The facility is found on the U.S. Geological Survey (USGS) 7.5-minute topographical map Venice quadrangle (dated 1964 and photorevised in 1981) within an un-sectioned portion of Township 2 South and Range 15 West (Figure 2). It is generally located northeast of the intersection of Falmouth Avenue and West 83rd Street (Figure 3).

Within the existing facility, the study area consists of seven separate potential project footprints. Sites 1 and 2 are located at the upper portion of the existing facility, located north of the intersection of Gulana Avenue and West 29th Street, and are approximately 150 feet above mean sea level (msl). Sites 3–7 are located at the lower portion of the existing facility, approximately 300 feet northwest of the upper facility, at the western terminus of Falmouth Street. These sites are located approximately 5 feet above msl. The coordinates for the approximate centerpoint for each of the seven potential sites are listed below (Table 1).

Table 1. Project Location on USGS 7.5 Minute Quadrangles

Site	Latitude	Longitude
1	33.962914°	-118.436739°
2	33.962875°	-118.437491°
3	33.963281°	-118.439935°
4	33.962849°	-118.440713°
5	33.964415°	-118.438851°
6	33.964864°	-118.436117°
7	33.965152°	-118.435449°

Methodology

The study area consisted of the seven separate potential project footprints, plus a 50-foot buffer around each footprint. However, where the potential project footprint or buffer extended into an area that had previously been subject to jurisdictional delineation by WRA Environmental Consultants (WRA), the study area for this delineation was reduced so that no overlap occurred. The findings for the previous delineation are documented in the Ballona Creek Wetlands Ecological Reserve Preliminary Delineation of Wetlands and Non-Wetland Waters, prepared by WRA and dated August 2011.

ICF senior biologist Paul Schwartz and senior regulatory specialist Megan Jameson conducted a routine jurisdictional delineation at the site on December 2, 2013, and Paul Schwartz conducted a follow-up visit on December 6, 2013. Prior to beginning the field delineation, a 200-scale color aerial photograph was analyzed to determine the locations of potential areas of USACE, RWQCB, CDFW and/or CCC jurisdiction. During the fieldwork, the study area was surveyed on foot. Jurisdictional limits were recorded onto a 200-scale color aerial photograph using visible landmarks and were mapped using a Trimble Yuma global positioning system (GPS) unit with a Trimble Pro XT receiver, which provided sub-meter accuracy. Common plant species observed were identified by visual characteristics and morphology in the field. Taxonomic nomenclature for plants follows *The Jepson Manual: Higher Plants of California*, 2nd edition (Baldwin et al. 2012).

Potentially jurisdictional features within the study area were evaluated for the presence of a definable channel and/or wetland vegetation, soils, and hydrology. The project area was analyzed for potential wetlands using the methodology set forth in the USACE 1987 Wetland Delineation Manual (Wetland Manual) (Environmental Laboratory 1987) and the 2008 Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region Version 2.0 (Arid West Supplement) (USACE 2008a). Lateral limits of non-wetland waters were identified using field indicators of an Ordinary High Water Mark (OHWM) (USACE 2008b). Wetland indicator status for plants was determined using the Arid West 2013 Regional Wetland Plant List (USACE 2013).

For features potentially subject to USACE and RWQCB jurisdiction, non-wetland waters were delineated based on the presence of OHWM indicators. At each evaluation area, three criteria were considered to determine whether the sample point was within a wetland. The three criteria that

must be fulfilled in order to classify an area as a jurisdictional USACE wetland (in normal conditions) are: (1) a predominance of hydrophytic vegetation, (2) the presence of hydric soils, and (3) the presence of wetland hydrology.

CDFW jurisdiction typically includes water features with a defined bed and bank and extent of associated riparian or wetland vegetation. Evaluation of potentially jurisdictional areas followed the guidance of relevant standard practices by CDFW personnel. Briefly, CDFW jurisdiction was delineated by measuring the outer width and length boundaries of potentially jurisdictional areas, consisting of the greater of either the top of bank measurement or the extent of associated riparian or wetland vegetation.

To identify CCC jurisdiction, the study areas were first evaluated for inclusion within the coastal zone. Sites 1 and 2 were not within the coastal zone; however, Sites 3–7 were within the coastal zone. Subsequently, CCC jurisdiction is identified using the same parameters listed above for USACE and RWQCB wetland determinations. However, while the USACE determines a feature to be a wetland only if it exhibits all three criteria (in normal conditions), the CCC determines a feature to be a wetland if it exhibits any of the three criteria. Therefore, any features within Sites 3–7 that exhibited any of the three USACE criteria listed above are considered a CCC wetland.

Environmental Setting

Sites 1 and 2 are located on top of the bluffs overlooking the Ballona Creek Wetland Ecological Reserve, approximately 150 feet above msl, and Sites 3–7 are located on the southern edge of the Ballona Reserve, approximately 5 feet above msl. Average annual rainfall for the study area (Santa Monica Pier, California) totals 12.62 inches per year (Western Regional Climate Center 2013).

The lower sites receive flows primarily through runoff from the adjacent bluffs and residential areas, both from rainfall and from nuisance flows such as irrigation. Furthermore, the lower sites are south of and adjacent to a low-lying, undeveloped area known as the Ballona Creek Wetlands, and north of the Ballona Creek Wetlands are the Ballona Channel and the Marina del Rey Marina. The upper facility is bounded on the north by a steep slope leading down to the lower facility and by residential properties to the south, east, and west. The lower facility is bounded by slopes along the southern side and the Ballona Creek Wetlands to the north, east, and west. The slope along the southern side of the lower facility supports the upper SoCalGas facility as well as residential properties at the east and west ends. The lower facility is adjacent to open areas mapped by the USFWS National Wetlands Inventory as Freshwater Emergent, Freshwater Forested/Shrub, and Estuarine and Marine, but the study areas specific to this delineation were not mapped as wetlands (USFWS 2013).

The SoCalGas facility has been in use since approximately the 1940s. Within the limits of the upper facility vegetation is limited to low-growing grasses such as Bermuda grass (*Cynodon dactylon;* FACU) and iceplant (*Carpobrotus edulis;* UPL) and intermittent trees such as eucalyptus (*Eucalyptus* sp.). Within the limits of the lower facility, vegetation is also limited to low growing grasses consisting chiefly of Bermuda grass, dallis grass (*Paspalum dilatatum;* FAC), and iceplant, with the exception of the southeast end of the facility. Within the southeast end of the lower facility, large stands of pampas grass (*Cortaderia selloana;* FACU) and arroyo willow (*Salix lasiolepis;* FACW) are

found, as well as leafy spurge (*Euphorbia esula;* UPL), western goldentop (*Euthamnia occidentalis;* FACW), fennel (*Foeniculum vulgare;* UPL), and iceplant. Additional detail on the vegetation species identified at each site is provided below.

Results

Within the study areas for Sites 1, 2, and 3, no potential jurisdictional features were noted. Within Sites 4, 5, 6, and 7, features subject only to the jurisdiction of the CCC were identified based on the presence of hydrology and/or vegetation indicators (Table 2). Within Sites 4 and 6, the identified CCC jurisdiction was located within the 50-foot buffer; within Sites 5 and 7, the identified CCC jurisdiction was located within the proposed project footprint (Table 3). The findings for the study area at each site are listed, described in greater detail below, and shown in photos (attached Figures 4a–d and photo log).

The information and results presented herein document the investigation, best professional judgment, and conclusions of ICF. It is correct and complete to the best of our knowledge. However, all jurisdictional determinations should be considered preliminary until reviewed and approved by the regulatory agencies. In addition, it should be noted that the CCC generally requires 100-foot buffers to protect wetlands from effects of disturbance and to provide necessary habitat for species associated with wetlands (CCC 1994).

Table 2. Potential Agency Jurisdiction Within Study Area

Study Area Site #	USACE/RWQCB	CDFW	CCC Wetland
1	None	None	N/A
2	None	None	N/A
3	None	None	None
4	None	None	0.049 acre
5	None	None	0.012 acre
6	None	None	0.003 acre
7	None	None	0.088 acre

Table 3. Potential CCC Jurisdiction Within Proposed Project Footprint and Buffer Area

Study Area Site #	Proposed Project Footprint	Buffer Area	Total
4	N/A	0.049 acre	0.049 acre
5	0.012 acre	N/A	0.012 acre
6	N/A	0.003 acre	0.003 acre
7	0.004 acre	0.084 acre	0.088 acre

Site 1

The study area for Site 1 consists of a large open storage area, existing paved road, and surrounding disturbed, vegetated area. In addition to the open area, two structures are located within the study area: a tank and a brick building. The site slopes gently from east to west. The open storage area is

covered with small rocks and is currently being used to store materials and equipment. Vegetation found in the study area consists of ruderal species such as iceplant, telegraph weed (*Heterotheca grandifolia;* UPL), rattlesnake weed (*Chamaesyce* sp.), acacia (*Acacia* sp.), castor bean (*Ricinus communis;* FACU), bermuda grass, fennel, and two eucalyptus trees.

No jurisdictional features were observed within the Site 1 study area (Figure 4a).

Site 2

The study area for Site 2 is located almost entirely within a developed portion of the existing gas facility that is already used for operations. The study area is mostly paved, except for small vegetated areas adjacent to roads and gates that support the same ruderal herbaceous species discussed above for Site 1.

No jurisdictional features were observed within the Site 2 study area (Figure 4a).

Site 3

The study area for Site 3 consists of an existing paved access road and two vegetated areas, one north and one south of the road. Each of the vegetated areas is occupied primarily by iceplant.

No jurisdictional features were observed within the Site 3 study area (Figure 4b; Wetland Data Form 3A).

Site 4

The study area for Site 4 consists of a paved, gravel and dirt access road and several adjacent vegetated open areas. The vegetated open areas within the fenced SoCalGas property consist primarily of ruderal species that include iceplant, pampas grass, bermuda grass, red-stemmed filaree (*Erodium cicutarium;* UPL), and telegraph weed. To the south of the SoCalGas property, within the study area, is an area with multiple slopes primarily covered in iceplant.

The east side of Site 4 is bound by a culvert and corrugated steel pipe that accepts flows from Falmouth Street and the adjacent residential neighborhood. The culvert is located between two headwalls, on a concrete pad, at the northern terminus of Falmouth Street, which is an asphalt road on a hill. The culvert opens into a large (18- to 24-inch) corrugated steel pipe that extends approximately 200 feet to the north, beyond the limits of the SoCalGas property. The corrugated steel pipe is located above the grade of the adjacent vegetated areas (between Sites 3 and 4) but is covered in vegetation and is not readily apparent without close examination.

At the time of the field visit, nuisance flows were running down Falmouth Street into the culvert and approximately 1–4 inches of sediment deposition was present, both at the initial debris blockers and at the entrance to the culvert. The deposited sediment was heavily vegetated with herbaceous species that can grow in one season. Species observed included dallis grass, umbrella sedge (*Cyperus esculentus;* FACW), leafy spurge, field mustard (*Hirschfeldia incana;* UPL), perennial ryegrass (*Festuca perenne;* UPL), wild radish (*Raphanus sativa;* UPL), horseweed (*Erigeron Canadensis;* FACU), and willow herb (*Epilobium ciliatum;* FACW). Although the vegetated areas met the hydrophytic vegetation requirements, the vegetation was growing atop of a few inches of sediment

that was completely underlined by concrete. This area is generally considered a previously impacted area and would be scalped during a storm event. In addition, the immature form of the vegetation indicated that this wetland has only been established for one growing season, as no older, mature vegetation was observed and as any sediment and vegetation are probably regularly displaced by heavy flows following storm events. As such, this area was not determined to be a CCC jurisdictional wetland (Figure 4b; Wetland Data Form 4A). However, as noted previously in this report, all jurisdictional determinations should be considered preliminary until reviewed and approved by the regulatory agencies.

Along the south side of the Site 4 study area, outside the fenced limits of SoCalGas property, a low point that supports a large arroyo willow was identified at the bottom of the converging slopes. This area was mapped as an area of potential CCC jurisdiction based on the presence of hydrophytic vegetation (Figure 4b; Wetland Data Forms 4A-D) and is located entirely within the buffer area.

Site 5

The study area for Site 5 consists of a paved area currently being used for material storage and a flat vegetated area. The vegetated area consists primarily of ruderal species such as Bermuda grass and dallis grass.

Within the Site 5 study area, a low wet spot was identified that exhibited indicators of hydrology. As no OHWM was evident in this site and this low spot did not exhibit all three wetland criteria, it was determined to be a wetland only subject to CCC jurisdiction, based on the presence of hydrology indicators and hydric soil indicators (Figure 4c; Wetland Data Forms 5A and 5B) and is located entirely within the proposed project footprint.

Site 6

The study area for Site 6 consists of an existing gravel and dirt road and adjacent vegetated areas. Vegetation within this area consists primarily of iceplant, western goldentop, acacia, eucalyptus, and fennel.

A small area of potential CCC jurisdiction was mapped along the northeast corner of the Site 6 study area based on the presence of hydrophytic vegetation (western goldentop) (Figure 4d) and is located entirely within the buffer area.

Site 7

The study area for Site 7 consists of an existing gravel and dirt road and adjacent vegetated areas. Vegetation within this study area consists primarily of western goldentop, leafy spurge, arroyo willow, pampas grass, horseweed, and fennel.

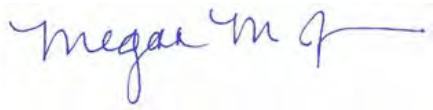
Within the Site 7 study area, three polygons of potential CCC jurisdiction were mapped based on the presence of hydrophytic vegetation and/or hydric soils (Figure 4d; Wetland Data Forms 7A-C). At this site the features subject to CCC jurisdiction were located both in the proposed project footprint and the buffer area.

Conclusion

Four of the seven study areas assessed during this jurisdictional delineation were found to support one or more features subject to the jurisdiction of the CCC. No potential features that exhibited any indicators of USACE/RWQCB and/or CDFW jurisdiction were identified. Of those four sites, two sites had features subject to CCC jurisdiction within the proposed project footprint and three sites had features subject to CCC jurisdiction within the buffer area. As noted above, the information and results presented herein document the investigation, best professional judgment, and conclusions of ICF and are correct and complete to the best of our knowledge. However, all jurisdictional determinations should be considered preliminary until reviewed and approved by the regulatory agencies.

If you have any questions about the information in this report, please contact me at (949) 333-6633 or megan.jameson@icfi.com.

Sincerely,



Megan Jameson
Senior Regulatory Specialist

Figures:

Figure 1: Regional Vicinity Map
Figure 2: USGS Map
Figure 3: Local Vicinity Map
Figure 4a: Sites 1 & 2 – Jurisdictional Delineation Results
Figure 4b: Sites 3 & 4 – Jurisdictional Delineation Results
Figure 4c: Site 5 – Jurisdictional Delineation Results
Figure 4d: Sites 6 & 7– Jurisdictional Delineation Results

Attachments:

Photo Log
Wetland Determination Data Forms

References

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Figures



Figure 1
Regional Vicinity Map
SoCal Gas Potential Well Sites, Playa del Rey

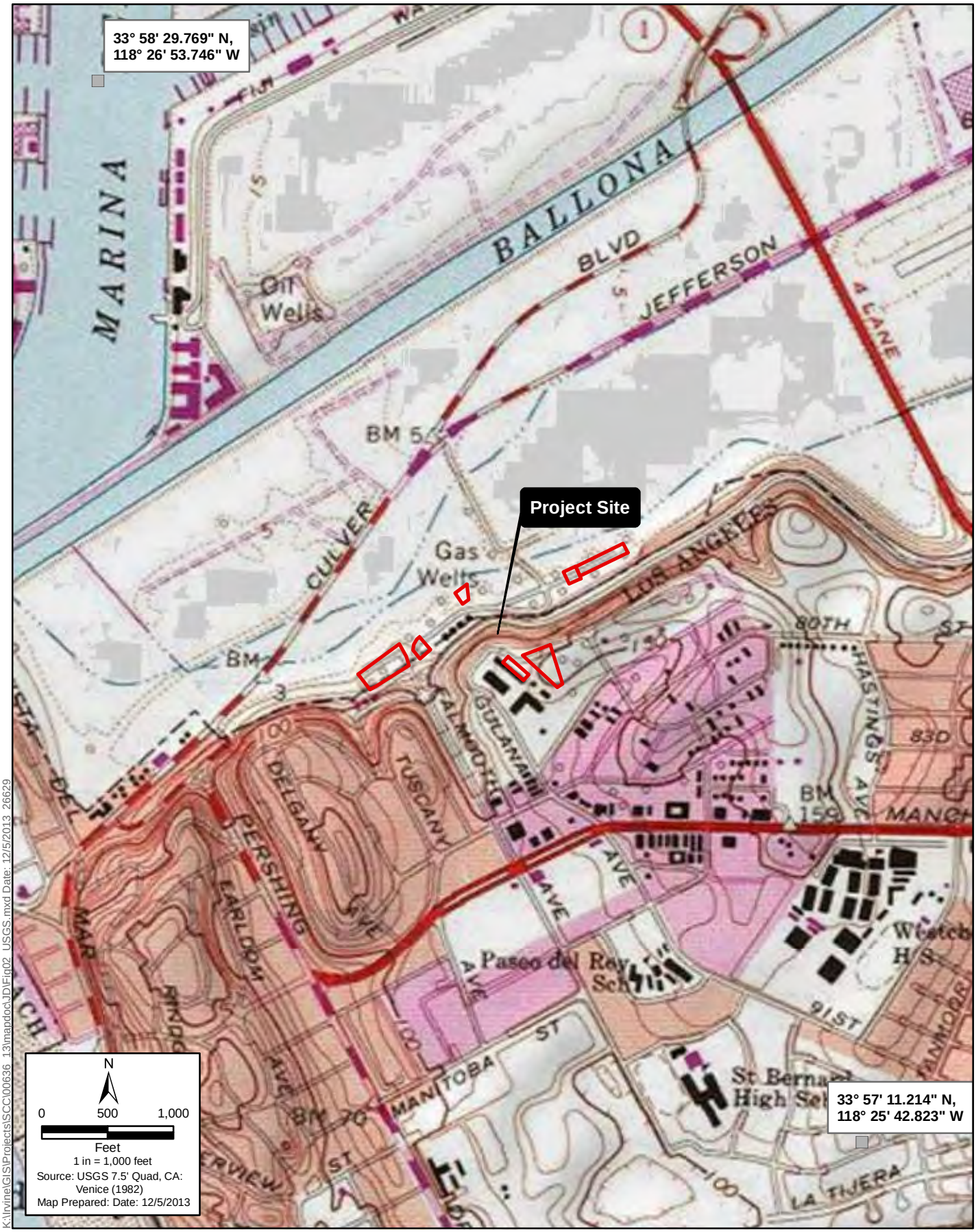

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Figure 2
USGS Map
SoCal Gas Potential Well Sites, Playa del Rey



Figure 3
Local Vicinity Map
SoCal Gas Potential Well Sites, Playa del Rey



Figure 4a: Sites 1 & 2
Jurisdictional Delineation Results
SoCal Gas Potential Well Sites, Playa del Rey



Figure 4b: Sites 3 & 4
Jurisdictional Delineation Results
SoCal Gas Potential Well Sites, Playa del Rey

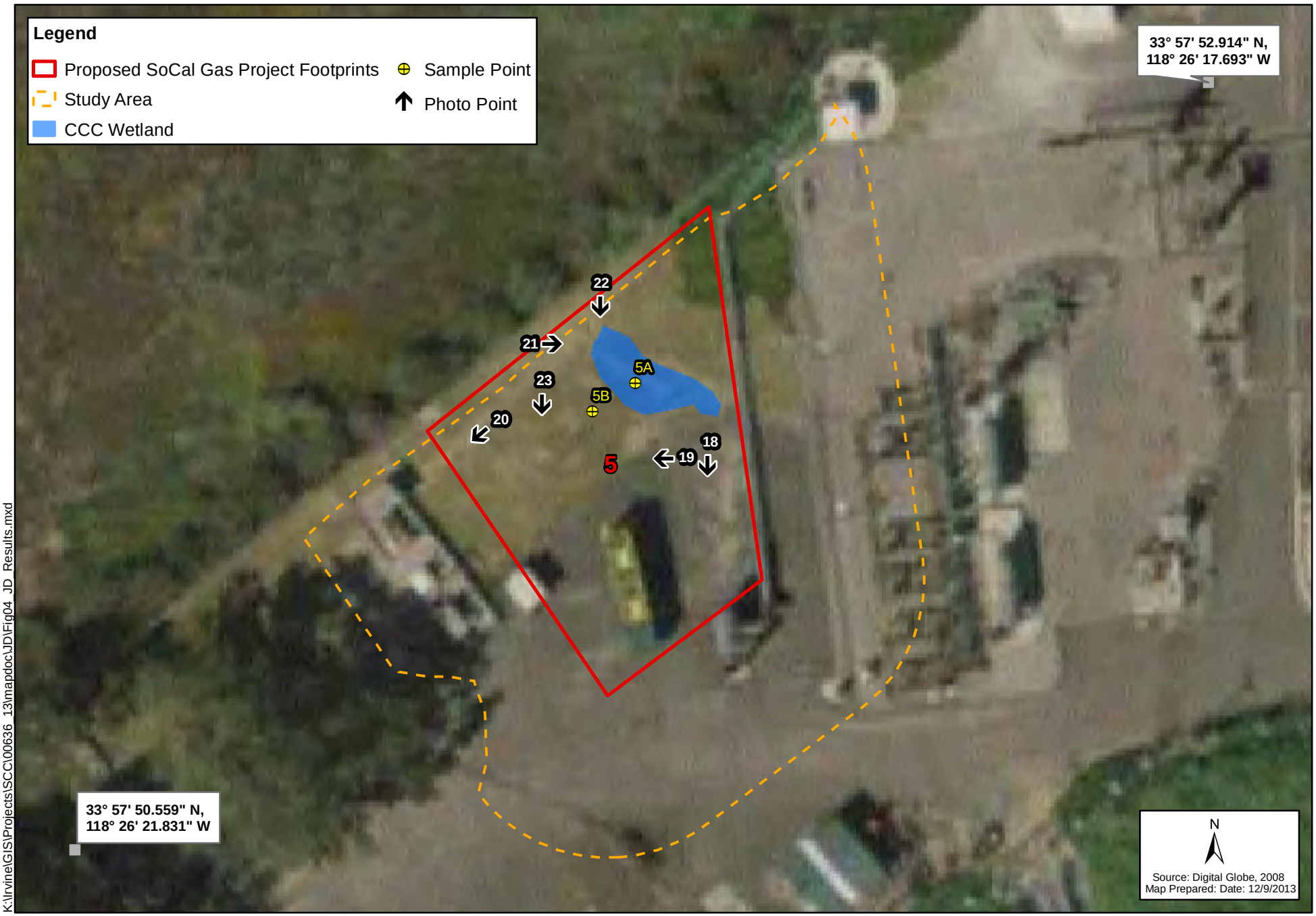


Figure 4c: Site 5
Jurisdictional Delineation Results
SoCal Gas Potential Well Sites, Playa del Rey



Figure 4d: Sites 6 & 7
Jurisdictional Delineation Results
SoCal Gas Potential Well Sites, Playa del Rey

Photo Log



Photograph # 1
Photo Date 12/2/13
Location Site 1
Direction East
Comment Gravel storage yard



Photograph # 2
Photo Date 12/2/13
Location Site 1
Direction West
Comment Gravel storage yard



Photograph # 3
Photo Date 12/2/13
Location Site 1
Direction Southwest
Comment Open area



Photograph #	4
Photo Date	12/2/13
Location	Site 2
Direction	Northwest
Comment	Paved, already-used part of the facility



Photograph #	5
Photo Date	12/2/13
Location	Site 2
Direction	West
Comment	Paved, already-used part of the facility



Photograph #	6
Photo Date	12/2/13
Location	Site 2
Direction	Southeast
Comment	Paved, already-used part of the facility



Photograph #	7
Photo Date	12/2/13
Location	Site 3
Direction	Northeast
Comment	Vegetated area south of access road, at toe of slopes



Photograph #	8
Photo Date	12/2/13
Location	Site 3
Direction	East
Comment	Vegetated area north of access road



Photograph #	9
Photo Date	12/6/13
Location	Site 3
Direction	Northwest
Comment	Wetland data point 3A (non-wetland); vegetated area south of access road, at toe of slope



Photograph #	10
Photo Date	12/2/13
Location	Site 4
Direction	North
Comment	Deposited sediment and associated vegetation on asphalt road at mouth of culvert



Photograph #	11
Photo Date	12/2/13
Location	Site 4
Direction	North
Comment	Deposited sediment and associated vegetation on asphalt road at base of hill, outside culvert



Photograph #	12
Photo Date	12/2/13
Location	Site 4
Direction	North
Comment	Deposited sediment and associated vegetation on asphalt road at base of hill, outside culvert; wetland data point 4A (non-wetland)



Photograph #	13
Photo Date	12/2/13
Location	Site 4
Direction	East
Comment	Gravel and dirt access road and open, vegetated area



Photograph #	14
Photo Date	12/2/13
Location	Site 4
Direction	South
Comment	Gravel and dirt access road and open, vegetated area



Photograph #	15
Photo Date	12/6/13
Location	Site 4
Direction	Southwest
Comment	Vegetated area adjacent to arroyo willow; wetland data point 4D (non-wetland)



Photograph #	16
Photo Date	12/6/13
Location	Site 4
Direction	Northeast
Comment	Vegetated area adjacent to arroyo willow; wetland data point 4C (non-wetland)



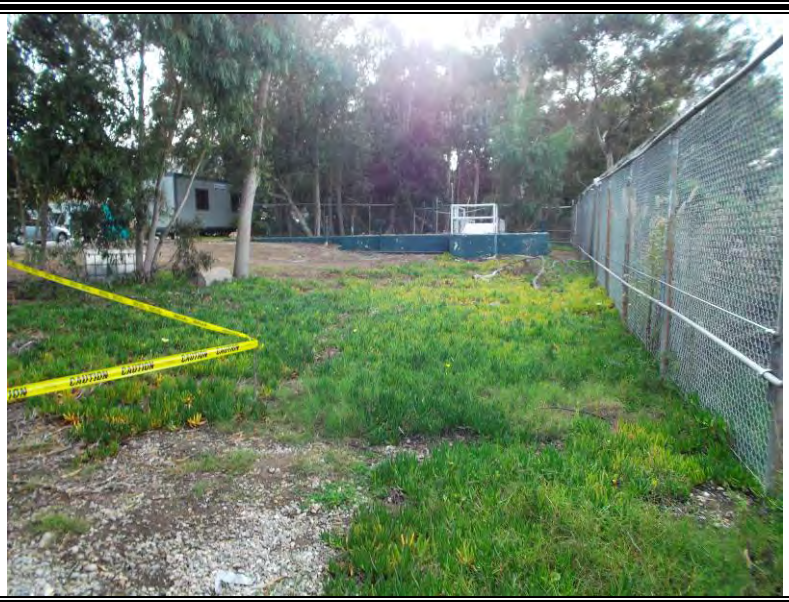
Photograph #	17
Photo Date	12/6/13
Location	Site 4
Direction	Northeast
Comment	CCC wetland located at toe of slope; arroyo willow; wetland data point 4B (CCC wetland)



Photograph #	18
Photo Date	12/2/13
Location	Site 5
Direction	South
Comment	Paved storage area



Photograph #	19
Photo Date	12/2/13
Location	Site 5
Direction	Northwest
Comment	Vegetated area adjacent to paved facility



Photograph #	20
Photo Date	12/2/13
Location	Site 5
Direction	Southwest
Comment	Vegetated area adjacent to paved facility



Photograph #	21
Photo Date	12/2/13
Location	Site 5
Direction	South
Comment	CCC wetland feature in vegetated area adjacent to paved facility



Photograph #	22
Photo Date	12/2/13
Location	Site 5
Direction	South
Comment	Wetland data point 5A (CCC wetland)



Photograph #	23
Photo Date	12/2/13
Location	Site 5
Direction	South
Comment	Wetland data point 5B (non-wetland point)



Photograph #	24
Photo Date	12/2/13
Location	Site 6
Direction	Southeast
Comment	Gravel and dirt access road and adjacent vegetated area



Photograph #	25
Photo Date	12/2/13
Location	Site 6
Direction	North
Comment	Gravel and dirt access road and adjacent vegetated area



Photograph #	26
Photo Date	12/2/13
Location	Site 6 (and Site 7 beyond)
Direction	Northeast
Comment	Gravel and dirt access road



Photograph #	27
Photo Date	12/2/13
Location	Site 6 (Feature 6-1)
Direction	North
Comment	CCC wetland feature adjacent to fence



Photograph #	28
Photo Date	12/2/13
Location	Site 7
Direction	Northwest
Comment	Asphalt access road and adjacent unvegetated , dirt open area



Photograph #	29
Photo Date	12/2/13
Location	Site 7
Direction	South
Comment	Vegetated area adjacent to unvegeted, dirt open area



Photograph #	30
Photo Date	12/2/13
Location	Site 7
Direction	Northeast
Comment	Vegetated area adjacent to existing access road and bare dirt area



Photograph #	31
Photo Date	12/2/13
Location	Site 7
Direction	Northeast
Comment	Wetland data point 7A (non-wetland)



Photograph #	32
Photo Date	12/2/13
Location	Site 7
Direction	South
Comment	Wetland data point 7B (CCC wetland)



Photograph #	33
Photo Date	12/2/13
Location	Site 7
Direction	North
Comment	Wetland data point 7C (non-wetland)

Wetland Determination Data Forms

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Potential Well Sites City/County: Playa Del Rey, Los Angeles Sampling Date: 12/6/13

Applicant/Owner: Southern California Gas Co. State: CA Sampling Point: 3A

Investigator(s): Paul Schwartz, Megan Jameson Section, Township, Range: Unsectioned, T2S, R15W

Landform (hillslope, terrace, etc.): toe of slope Local relief (concave, convex, none): none Slope (%): ~1%

Subregion (LRR): Mediterranean CA Lat: 33.963132 Long: -118.439735 Datum: NAD 83

Soil Map Unit Name: Not Available NWI classification: Not mapped as wetland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No ✓	**Is the Sampled Area within a Wetland?** Yes _____ No ✓
Hydric Soil Present?	Yes _____	No ✓	
Wetland Hydrology Present?	Yes _____	No ✓	

Remarks:

Looking to ID presence/absence of CCC wetland only. No evidence of OHWM. No CCC wetland present.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 5')			
1. Carpobrotus edulis	20	Yes	UPL
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	20 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	0 = Total Cover		

% Bare Ground in Herb Stratum 60 % Cover of Biotic Crust 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No ✓

Remarks:

20% litter in herb stratum

SOIL

Sampling Point: 3A

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-16"	10YR 5/4	100					Sand	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes ___ No ✓

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No ✓ Depth (inches): ___

Water Table Present? Yes ___ No ✓ Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No ✓ Depth (inches): ___

Wetland Hydrology Present? Yes ___ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Potential Well Sites City/County: Playa Del Rey, Los Angeles Sampling Date: 12/2/13

Applicant/Owner: Southern California Gas Co. State: CA Sampling Point: 4A

Investigator(s): Paul Schwartz, Megan Jameson Section, Township, Range: Unsectioned, T2S, R15W

Landform (hillslope, terrace, etc.): terrace of floodplain Local relief (concave, convex, none): None Slope (%): <1-2%

Subregion (LRR): Mediterranean CA Lat: 33.963993 Long: -118.440223 Datum: NAD 83

Soil Map Unit Name: Not Available NWI classification: Not mapped as wetland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes _____ No ✓

Are Vegetation ✓, Soil ✓, or Hydrology ✓ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓	No _____	**Is the Sampled Area within a Wetland?** Yes _____ No ✓
Hydric Soil Present?	Yes _____	No ✓	
Wetland Hydrology Present?	Yes ✓	No _____	

Remarks:

Looking to ID presence/absence of CCC wetland only. Site consists of sediment deposited on top of asphalt and concrete in front of culvert entrance that has accumulated from neighborhood nuisance flows. Deposited sediment is now vegetated. While CCC vegetation and hydrology are present, bc it overlays a concrete/asphalt area, considered already impacted and is also regularly displaced by flows following storm events.

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: limits of veg)			
1. Cyperus esculentis	25	Yes	FACW
2. Euphorbia esula	20	Yes	UPL
3. Festuca perenne	15	Yes	UPL
4. Paspalum dalatatum	15	Yes	FAC
5. Raphanus sativa	10	No	UPL
6. Erigeron canadensis	5	No	FACU
7. Hirshfeldia incana	5	No	UPL
8. Epilobium ciliatum	5	No	FACW
	100 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 0 % Cover of Biotic Crust 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:	
OBL species _____	x 1 = _____	
FACW species 30	x 2 = 60	
FAC species 15	x 3 = 45	
FACU species 5	x 4 = 20	
UPL species 50	x 5 = 250	
Column Totals: 100 (A)	375 (B)	

Prevalence Index = B/A = 3.75

Hydrophytic Vegetation Indicators:

✓ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No _____

Remarks:

Veg cover is limited to where sediment has been deposited. Veg cover estimate reflect polygon only. Remainder of area is asphalt or concrete. All vegetation is immature herbaceous, indicating the site is probably new and regularly is washed away.

SOIL

Sampling Point: 4A

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No _____

Remarks:

No soils taken. Only 1-4" sediment deposited on top of concrete and asphalt.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ✓ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ✓ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No _____ Depth (inches): _____

Water Table Present? Yes _____ No _____ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ✓ No _____ Depth (inches): _____

Wetland Hydrology Present? Yes ✓ No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

At time of survey, flowing water running running down the hill from the adjacent residential neighborhood into this point. Point occurs on asphalt and concrete at culvert entrance.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Potential Well Sites City/County: Playa Del Rey, Los Angeles Sampling Date: 12/6/13

Applicant/Owner: Southern California Gas Co. State: CA Sampling Point: 4B

Investigator(s): Paul Schwartz, Megan Jameson Section, Township, Range: Unsectioned, T2S, R15W

Landform (hillslope, terrace, etc.): toe of slope Local relief (concave, convex, none): concave Slope (%): <1%

Subregion (LRR): Mediterranean CA Lat: 33.962628 Long: -118.440552 Datum: NAD 83

Soil Map Unit Name: Not Available NWI classification: Not mapped as wetland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓ No _____	**Is the Sampled Area within a Wetland?** Yes ✓ No _____
Hydric Soil Present?	Yes _____ No ✓	
Wetland Hydrology Present?	Yes _____ No ✓	

Remarks:

Looking to ID presence/absence of CCC wetland only. No evidence of OHWM. CCC wetland present based on hydrophytic vegetation.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix lasiolepsis	65	Yes	FACW
2.			
3.			
4.			
	65 = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 5')			
1. Carpobrotus edulis	25	Yes	UPL
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	25 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	0 = Total Cover		

% Bare Ground in Herb Stratum 0 % Cover of Biotic Crust 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:	
OBL species _____	x 1 =	_____
FACW species 65	x 2 =	130
FAC species _____	x 3 =	_____
FACU species _____	x 4 =	_____
UPL species 25	x 5 =	125
Column Totals: 90 (A)		255 (B)

Prevalence Index = B/A = 2.8

Hydrophytic Vegetation Indicators:

✓ Dominance Test is >50%

✓ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No _____

Remarks:

Lots of leaf litter under willow.

SOIL

Sampling Point: 4B

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-16"	10YR 3/2	96	7YR 4/6	4	C	PL/M	SCL	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes ___ No ✓

Remarks:

Approximately 10" of leaf litter under willow.
SCL=Sandy Clay Loam
Almost meets F6.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No ✓ Depth (inches): ___

Water Table Present? Yes ___ No ✓ Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No ✓ Depth (inches): ___

Wetland Hydrology Present? Yes ___ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Potential Well Sites City/County: Playa Del Rey, Los Angeles Sampling Date: 12/6/13

Applicant/Owner: Southern California Gas Co. State: CA Sampling Point: 4C

Investigator(s): Paul Schwartz, Megan Jameson Section, Township, Range: Unsectioned, T2S, R15W

Landform (hillslope, terrace, etc.): toe of slope Local relief (concave, convex, none): concave Slope (%): <1%

Subregion (LRR): Mediterranean CA Lat: 33.962580 Long: -118.440634 Datum: NAD 83

Soil Map Unit Name: Not Available NWI classification: Not mapped as wetland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No ✓	**Is the Sampled Area within a Wetland?** Yes _____ No ✓
Hydric Soil Present?	Yes _____	No ✓	
Wetland Hydrology Present?	Yes _____	No ✓	

Remarks:

Looking to ID presence/absence of CCC wetland only. No evidence of OHWM. No CCC wetland present.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 5)			
1. Chrysanthemum coranatum	35	Yes	UPL
2. Carpobrotus edulis	25	Yes	UPL
3. Bromus diandrus	5	No	UPL
4.			
5.			
6.			
7.			
8.			
	65 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	0 = Total Cover		

% Bare Ground in Herb Stratum 35 % Cover of Biotic Crust 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No ✓

Remarks:

SOIL

Sampling Point: 4C

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-16"	10YR 3/2	100					SL	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes ___ No ✓

Remarks:

SL=Sandy Loam

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No ✓ Depth (inches): ___

Water Table Present? Yes ___ No ✓ Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No ✓ Depth (inches): ___

Wetland Hydrology Present? Yes ___ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Potential Well Sites City/County: Playa Del Rey, Los Angeles Sampling Date: 12/6/13

Applicant/Owner: Southern California Gas Co. State: CA Sampling Point: 4D

Investigator(s): Paul Schwartz, Megan Jameson Section, Township, Range: Unsectioned, T2S, R15W

Landform (hillslope, terrace, etc.): toe of slope Local relief (concave, convex, none): concave Slope (%): ~1%

Subregion (LRR): Mediterranean CA Lat: 33.962679 Long: -118.440394 Datum: NAD 83

Soil Map Unit Name: Not Available NWI classification: Not mapped as wetland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No ✓	**Is the Sampled Area within a Wetland?** Yes _____ No ✓
Hydric Soil Present?	Yes _____	No ✓	
Wetland Hydrology Present?	Yes _____	No ✓	

Remarks:

Looking to ID presence/absence of CCC wetland only. No evidence of OHWM. No CCC wetland present.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 5')			
1. Carpobrotus edulis	85	Yes	UPL
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	85 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	0 = Total Cover		

% Bare Ground in Herb Stratum 60 % Cover of Biotic Crust 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No ✓

Remarks:

15% litter in herb stratum

SOIL

Sampling Point: 4D

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-16"	10YR 3/2	100					SL	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes ___ No ✓

Remarks:

SL= Sandy Loam

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No ✓ Depth (inches): ___

Water Table Present? Yes ___ No ✓ Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No ✓ Depth (inches): ___

Wetland Hydrology Present? Yes ___ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Potential Well Sites City/County: Playa Del Rey, Los Angeles Sampling Date: 12/2/13

Applicant/Owner: Southern California Gas Co. State: CA Sampling Point: 5A

Investigator(s): Paul Schwartz, Megan Jameson Section, Township, Range: Unsectioned, T2S, R15W

Landform (hillslope, terrace, etc.): terrace of floodplain Local relief (concave, convex, none): None Slope (%): <1%

Subregion (LRR): Mediterranean CA Lat: 33.964444 Long: -118.438816 Datum: NAD 83

Soil Map Unit Name: Not Available NWI classification: Not mapped as wetland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes _____ No ✓

Are Vegetation ✓, Soil ✓, or Hydrology ✓ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No ✓	**Is the Sampled Area within a Wetland?** Yes ✓ No _____
Hydric Soil Present?	Yes _____	No ✓	
Wetland Hydrology Present?	Yes ✓	No _____	

Remarks:

CCC wetland only based on presence of wetland hydrology. No evidence of OHWM.

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 5')			
1. Cynodon dactylon	60	Yes	FACU
2. Paspalum dilatatum	5	No	FAC
3. Chamaesyce albomarginata	5	No	UPL
4. Medicago polymorpha	3	No	FACU
5. Euthamnia occidentalis	2	No	FACW
6. Erigeron canadensis	2	No	FACU
7.			
8.			
	77 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 23 % Cover of Biotic Crust 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 0 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	2	x 2 =	4
FAC species	5	x 3 =	15
FACU species	65	x 4 =	260
UPL species	5	x 5 =	25
Column Totals:	77 (A)		304 (B)

Prevalence Index = B/A = 3.94

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No ✓

Remarks:

SOIL

Sampling Point: 5A

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-6"	10YR 3/2	100						Sandy clay loam
6-14"	10YR 4/4	95	7.5YR 4/6	5				Sandy loam

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No ✓

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ✓ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No ✓ Depth (inches): _____

Water Table Present? Yes _____ No ✓ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No ✓ Depth (inches): _____

Wetland Hydrology Present? Yes ✓ No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Soil cracking in area slightly lower than surrounding vegetated area.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Potential Well Sites City/County: Playa Del Rey, Los Angeles Sampling Date: 12/2/13

Applicant/Owner: Southern California Gas Co. State: CA Sampling Point: 5B

Investigator(s): Paul Schwartz, Megan Jameson Section, Township, Range: Unsectioned, T2S, R15W

Landform (hillslope, terrace, etc.): terrace of floodplain Local relief (concave, convex, none): None Slope (%): <1%

Subregion (LRR): Mediterranean CA Lat: 33.964404 Long: -118.438908 Datum: NAD 83

Soil Map Unit Name: Not Available NWI classification: Not mapped as wetland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes _____ No ✓

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No ✓	**Is the Sampled Area within a Wetland?** Yes _____ No ✓
Hydric Soil Present?	Yes _____	No ✓	
Wetland Hydrology Present?	Yes _____	No ✓	

Remarks:

Looking to ID presence/absence of CCC wetland only. No evidence of OHWM. No CCC wetland present.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 5')			
1. Cynodon dactylon	60	Yes	FACU
2. Cortaderia selloana	5	No	FACU
3. Erigeron canadensis	3	No	FACU
4. Paspalum dilatatum	2	No	FAC
5.			
6.			
7.			
8.			
	70 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 30 % Cover of Biotic Crust 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 0 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species 2	x 3 = 6
FACU species 68	x 4 = 272
UPL species _____	x 5 = _____
Column Totals: 70 (A)	278 (B)

Prevalence Index = B/A = 3.97

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No ✓

Remarks:

SOIL

Sampling Point: 5B

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-3"	10YR 3/2	100						Sandy clay loam
3-12"	7.5YR 4/4	100						Sand

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No ✓

Remarks:

Very hard, compact soil but no concrete chunks or layers as in other areas.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No ✓ Depth (inches): _____

Water Table Present? Yes _____ No ✓ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No ✓ Depth (inches): _____

Wetland Hydrology Present? Yes _____ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No indicators noted.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Potential Well Sites City/County: Playa Del Rey, Los Angeles Sampling Date: 12/2/13

Applicant/Owner: Southern California Gas Co. State: CA Sampling Point: 7A

Investigator(s): Paul Schwartz, Megan Jameson Section, Township, Range: Unsectioned, T2S, R15W

Landform (hillslope, terrace, etc.): terrace of floodplain Local relief (concave, convex, none): None Slope (%): <1%

Subregion (LRR): Mediterranean CA Lat: 33.964939 Long: -118.435586 Datum: NAD 83

Soil Map Unit Name: Not Available NWI classification: Not mapped as wetland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes _____ No ✓

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No ✓	**Is the Sampled Area within a Wetland?** Yes _____ No ✓
Hydric Soil Present?	Yes _____	No ✓	
Wetland Hydrology Present?	Yes _____	No ✓	

Remarks:

Looking to ID presence/absence of CCC wetland only. No evidence of OHWM. No CCC wetland present.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 5')			
1. Euphorbia esula	65	Yes	UPL
2. Foeniculum vulgare	10	No	UPL
3. Chrysanthemum coronarium	9	No	UPL
4. Cortaderia selloana	5	No	FACU
5. Erigeron canadensis	1	No	FACU
6.			
7.			
8.			
	90 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 10 % Cover of Biotic Crust 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 0 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:	
OBL species	x 1 =	
FACW species	x 2 =	
FAC species	x 3 =	
FACU species 6	x 4 =	24
UPL species 84	x 5 =	420
Column Totals: 90 (A)		444 (B)

Prevalence Index = B/A = 4.93

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No ✓

Remarks:

SOIL

Sampling Point: 7A

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-12"	10YR 3/2	100						Sandy clay loam

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No ✓

Remarks:

At 12" hit impenetrable surface (concrete?).

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No ✓ Depth (inches): _____

Water Table Present? Yes _____ No ✓ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No ✓ Depth (inches): _____

Wetland Hydrology Present? Yes _____ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No indicators noted.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Potential Well Sites City/County: Playa Del Rey, Los Angeles Sampling Date: 12/2/13

Applicant/Owner: Southern California Gas Co. State: CA Sampling Point: 7B

Investigator(s): Paul Schwartz, Megan Jameson Section, Township, Range: Unsectioned, T2S, R15W

Landform (hillslope, terrace, etc.): terrace of floodplain Local relief (concave, convex, none): None Slope (%): <1%

Subregion (LRR): Mediterranean CA Lat: 33.964858 Long: -118.435903 Datum: NAD 83

Soil Map Unit Name: Not Available NWI classification: Not mapped as wetland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes _____ No ✓

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓	No _____	**Is the Sampled Area within a Wetland?** Yes ✓ No _____
Hydric Soil Present?	Yes _____	No ✓	
Wetland Hydrology Present?	Yes _____	No ✓	

Remarks:

Looking to ID presence/absence of CCC wetland only. No evidence of OHWM. CCC wetland only, based on presence of hydrophytic vegetation.

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 5')			
1. Euthamnia occidentalis	45	Yes	FACW
2. Euphorbia esula	40	Yes	UPL
3. Foeniculum vulgare	13	No	UPL
4. Helminotheca echioides	2	No	FACU
5.			
6.			
7.			
8.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 0 % Cover of Biotic Crust 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

✓ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No _____

Remarks:

SOIL

Sampling Point: 7B

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-10"	10YR 3/2	100						Sandy loam
10-12"	10YR 2/1	99	7.5YR 5/6	1				Sandy clay loam

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No ✓

Remarks:

At approximately 12" hit impenetrable chunks or surface (concrete?).

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No ✓ Depth (inches): _____

Water Table Present? Yes _____ No ✓ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No ✓ Depth (inches): _____

Wetland Hydrology Present? Yes _____ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No indicators noted.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Potential Well Sites City/County: Playa Del Rey, Los Angeles Sampling Date: 12/2/13

Applicant/Owner: Southern California Gas Co. State: CA Sampling Point: 7C

Investigator(s): Paul Schwartz, Megan Jameson Section, Township, Range: Unsectioned, T2S, R15W

Landform (hillslope, terrace, etc.): terrace of floodplain Local relief (concave, convex, none): None Slope (%): <1%

Subregion (LRR): Mediterranean CA Lat: 33.964882 Long: -118.435945 Datum: NAD 83

Soil Map Unit Name: Not Available NWI classification: Not mapped as wetland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes _____ No ✓

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No ✓	**Is the Sampled Area within a Wetland?** Yes _____ No ✓
Hydric Soil Present?	Yes _____	No ✓	
Wetland Hydrology Present?	Yes _____	No ✓	

Remarks:

Looking to ID presence/absence of CCC wetland only. No evidence of OHWM. No CCC wetland present.

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 5')			
1. Euphorbia esula	60	Yes	UPL
2. Helminotheca echioides	15	No	FACU
3. Cortaderia selloana	10	No	FACU
4. Euthamnia occidentalis	5	No	FACW
5. Foeniculum vulgare	5	No	UPL
6.			
7.			
8.			
	95 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 5 % Cover of Biotic Crust 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species 5	x 2 = 10
FAC species 25	x 3 = 75
FACU species _____	x 4 = _____
UPL species 65	x 5 = 325
Column Totals: 95 (A)	410 (B)

Prevalence Index = B/A = 4.32

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No ✓

Remarks:

SOIL

Sampling Point: 7C

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-10"	10YR 3/2	100						Sandy loam
10-12"	10YR 2/1	100						Sandy clay loam (alot of concret

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No ✓

Remarks:

At approximately 12" impenetrable. Alot of concrete chunks throughout.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No ✓ Depth (inches): _____

Water Table Present? Yes _____ No ✓ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No ✓ Depth (inches): _____

Wetland Hydrology Present? Yes _____ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No indicators noted.

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APPENDIX D16
Patterns of Vehicle-Based Vertebrate Mortality in the Ballona Wetlands Ecological Reserve, Los Angeles, CA

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THE BAY FOUNDATION

(888) 301-2527
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Technical Memorandum:

Patterns of Vehicle-Based Vertebrate Mortality in the Ballona Wetlands Ecological Reserve, Los Angeles, CA

Prepared by: Karina Johnston[1], Ivan Medel[1], Patrick Tyrrell[2], and Sean Anderson[3]

[1] The Bay Foundation

[2] Friends of Ballona Wetlands

[3] Environmental Science and Resource Management Program, California State University Channel Islands

Submitted to: California State Coastal Conservancy
California Department of Fish and Wildlife

Date: November 26, 2014

Introduction

Roads have become ubiquitous features on our landscapes, with approximately 20% of all land within the conterminous United States within 150 meters of a roadway (Riitters and Wickham 2003). Within these areas, the movement of cars at medium and high speeds may negatively affect wildlife populations and behavior through direct mortalities, habitat fragmentation, and behavior change (Forman and Alexander 1998, Coffin 2007, Charry and Jones 2009). Traffic volume, or the number of cars on a stretch of road during a given time period, and speed have been associated as key parameters influencing the quantity of direct wildlife mortalities along a given roadway (S. Anderson, *unpublished data,* 2011). Vertebrate mortality surveys of frequently-traveled roadways help identify wildlife movement patterns and the impacts of habitat fragmentation on a given area.

Over the past decade, concerned stakeholders anecdotally noticed a high frequency of animal kills along the major roadways adjacent to the Ballona Wetlands Ecological Reserve ("BWER" or "Reserve") (L. Fimiani, *personal communication,* 2011). This memorandum was developed to quantify the vertebrate mortality along Reserve-adjacent roadways. Additionally, it will provide information and data to the ongoing CEQA process regarding wildlife-vehicle collisions and subsequent direct vertebrate mortality through surveys conducted along roads bisecting the BWER from 2010-2013.

City of Los Angeles traffic-count data across a 24-hour interval during the week calculated that approximately 20,000-60,000 cars travel along roadways bisecting and adjacent to the Reserve, including Culver Boulevard, West Jefferson Boulevard, and Lincoln Boulevard (CoLA 2014). High traffic volumes combined with 45 mile per hour (mph) speed limits may pose significant risks to wildlife within the BWER. Analyzing these data may help evaluate opportunities to minimize or reduce harm and impacts to fauna, as well as reducing hazards to drivers.

Specific survey goals included:

1) Comparison of vertebrate mortality along three road transects bisecting the Reserve,
2) Identification of animal type most vulnerable to vehicle-based mortality, and
3) Identification of locations demonstrating higher frequency wildlife-vehicle collisions ("hotspots").

These data and research summaries are a product of California State Coastal Conservancy grant 11-086 and volunteer time donated by the Friends of Ballona Wetlands.

Methods

The survey area was evaluated using three transects, each approximately one mile in length. These transects delineate the primary roads bisecting the Reserve (Figure 1). The "Lincoln Transect" (Transect 1) extended along Lincoln Boulevard from Loyola Marymount University Drive to Fiji Way; the "Culver-East Transect" (Transect 2) extended along Culver Boulevard from its intersection with West Jefferson Boulevard to the 90 Freeway; the "Culver/Jefferson Transect" (Transect 3) began on Culver Boulevard in Playa del Rey and extended to the intersection of Culver and Jefferson Boulevards, and then on to Lincoln Boulevard (Figure 1). Surveys were conducted biweekly from October 2010 through September 2013. Friends of Ballona Wetlands staff and The Bay Foundation staff and interns conducted surveys based on protocols developed by Sean Anderson's PIRatE Laboratory at California State University Channel Islands.

Transects were surveyed by resetting a vehicle's odometer at the start of each transect and subsequently driving each transect with a passenger noting the type of carcass, the odometer reading, and the direction of travel on a datasheet. Both lane directions of each transect were surveyed (e.g. Transect 1 was surveyed driving both north and south). Data are reported in miles, or frequency of mortality per tenth of a mile, based on the accuracy of the odometer survey method.



Figure 1. Map of survey transects bisecting the Ballona Wetlands Ecological Reserve.

The survey datasheet included several animal categories for all potential vertebrates found in the BWER. When possible, kills were identified to species (e.g. California kingsnake), but when damage prevented detailed identification, broader categories were used based on gross animal size. Large animals were coyote or larger sized. Medium size animals were raccoon or cat sized. Small sized animals were rabbit or squirrel sized. When a deceased animal was observed, its location was recorded using mileage measured from the beginning of each transect to a tenth of a mile and based on odometer accuracy. Occasionally, kills were also recorded using a handheld GPS, if there were unusual circumstances such as multiple adjacent kills or rare species. Importantly, the survey efforts provide realistic estimates of the overall kill rate via assessing the survey effort (number of surveys) and not merely the location of particular kills.

Supplemental site-specific data was provided by motion cameras located in the Reserve ("Critter Cams"). Detailed methods and protocols are available in the Ballona Wetlands Baseline Reports (Johnston et. al 2011, 2012) or in the draft Standard Operating Protocol (SMBRF 2014).

Error Avoidance and Assumptions

While the survey methodology provides informative data on the frequency of vehicle-based vertebrate mortality along the BWER-adjacent roads, there is also the potential for error within the quantification techniques. Care was taken to reduce observer effect error through the consistent use of the same surveyors for as many surveys as possible. If the regular surveyors were not available, trained substitutes conducted the survey. The protocols and surveyors underwent quality control and observer bias checks once annually through a trial run-through of each transect with all observers. Additional quality control was performed on the entered data though a third-party reviewer.

Errors relating to double-counting, or identifying the same kill on repeat surveys for a falsely-inflated count, was reduced by conducting a pilot study during the first month of the program. Surveys were conducted weekly for one month. Carcass removal rates vary significantly depending upon location and species (S. Anderson, *unpublished data*). For this study, every two weeks was determined to be an appropriate length of time for the kills to either be removed by county services, desiccated to the point of non-visibility, or consumed by scavengers. Additionally, errors were further reduced through specific recordings of the location and type of kill to allow for identification of repetitive counts. If the same type of kill was seen in consecutive surveys in the same location, best professional judgment based on the level of desiccation was used to determine if the kill was a repeat sighting, or new since the previous survey.

Error may still be incurred in three ways: 1) natural or anthropogenic removal of carcasses between surveys, 2) washing away or removal from a storm event, or 3) undercounting based on visibility restrictions or the movement of the animal off of the roadway after being hit but before mortality occurred. All of these potential contributors of error would result in underestimations of vehicle-based vertebrate mortalities. Regardless of such error, the data provide a robust, and possibly conservative estimate of kill rates to initiate discussions of the ecological and socioeconomic impacts of roads on Reserve wildlife.

Analysis Methods

Basic summary statistics were calculated for the data including averages, standard error, frequency graphs, and one-way ANOVAs. Polygon length boundaries used for map figures and geospatial analyses were identified by GPS, where end points were tagged for every one-tenth mile increment according to the vehicle's odometer along each transect. Polygons within map figures are 55 m wide for ease of viewing and are not accurate representations of road edges.

Results

A high rate of mortality was documented with kills found regularly and frequently along all three transects. In three years of surveys, a total of 654 kills were recorded during 70 surveys of each of the three transects. During the first survey year, 231 kills were recorded; 208 in the second survey year; and 215 in the third survey year. A significantly higher number of kills were found on both the Culver-East and the Culver/Jefferson Transects than the Lincoln Transect (ANOVA, $F = 31.48$, $p < 0.001$; Table 1).

Table 1. Frequency of kills by transect and averaged over the total number of surveys (± SE). The kill rates can be inferred as either kill rates per day (liberal) or per week (conservative).

Transect	Total # of Kills / mile	# of Surveys	Average # per Survey	Standard Error
1: Lincoln	106	70	1.51	0.148
2: Culver-East	297	70	4.24	0.309
3: Culver/Jefferson	251	70	3.59	0.245

These results for the BWER transects are an order of magnitude, or in some cases two orders of magnitude, higher than regional survey kill rates (i.e. kills per mile; S. Anderson, *unpublished data,* 2011). The highest mortality throughout the evaluation period was desert cottontail rabbits (*Sylvilagus audubonii*) for a total of 192 kills or approximately 30% of the aggregate mortality (Figures 2 and 3). It is probable that a significant portion of the "unknown" and "small mammal" category (i.e. too damaged to definitively identify) were also cottontails. This would indicate that an estimate closer to 50-70% of the total kills were actually cottontails. Other vertebrates frequently sighted included squirrels (family Sciuridae) and the Virginia opossum (*Didelphis virginiana*). Larger mammals like raccoons (*Procyon lotor)* and coyotes (*Canis latrans)* were rarely seen; however, there were several anecdotal reports of coyote kills that were removed before the next scheduled survey took place. It is therefore possible that the larger fauna were underestimated. Occasionally, birds were also recorded. Figure 2 lists each species or animal group that was identified along the transects. Species with only one kill (or 0.2% of the aggregate mortality) included cat, coyote, California kingsnake, and rat. Common species were similar to those frequently identified on Critter Cam stations within the Reserve, especially for the smaller fauna and cottontail rabbits (Johnston et al. 2011, 2012).

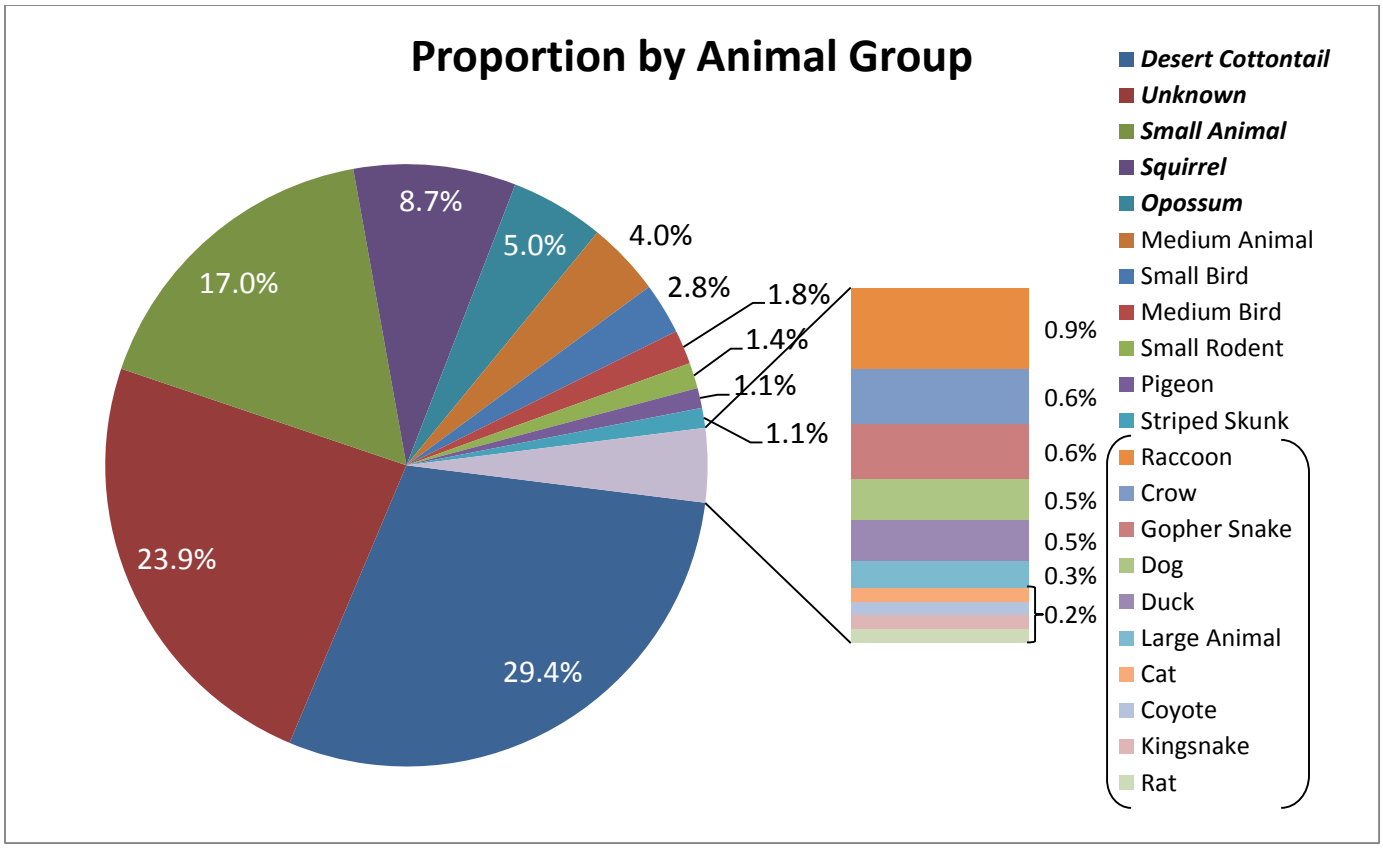

Figure 2. Proportion of animal mortality by group. Bold and italicized animal groups were the most common; animal groups in parenthesis each accounted for less than 1% of the total proportion.



Figure 3. Photographs of the most common vertebrate mortality species (desert cottontail rabbit) from Critter Cam stations within the Reserve.

When analyzed by month, the highest average mortality was seen during the warmer late spring and summer months from approximately May through June (Figure 4), consistent with broader regional patterns of kills (S. Anderson, *unpublished data,* 2014). The largest standard error was seen in January, due to one survey occurrence of a particularly high mortality count in 2010.

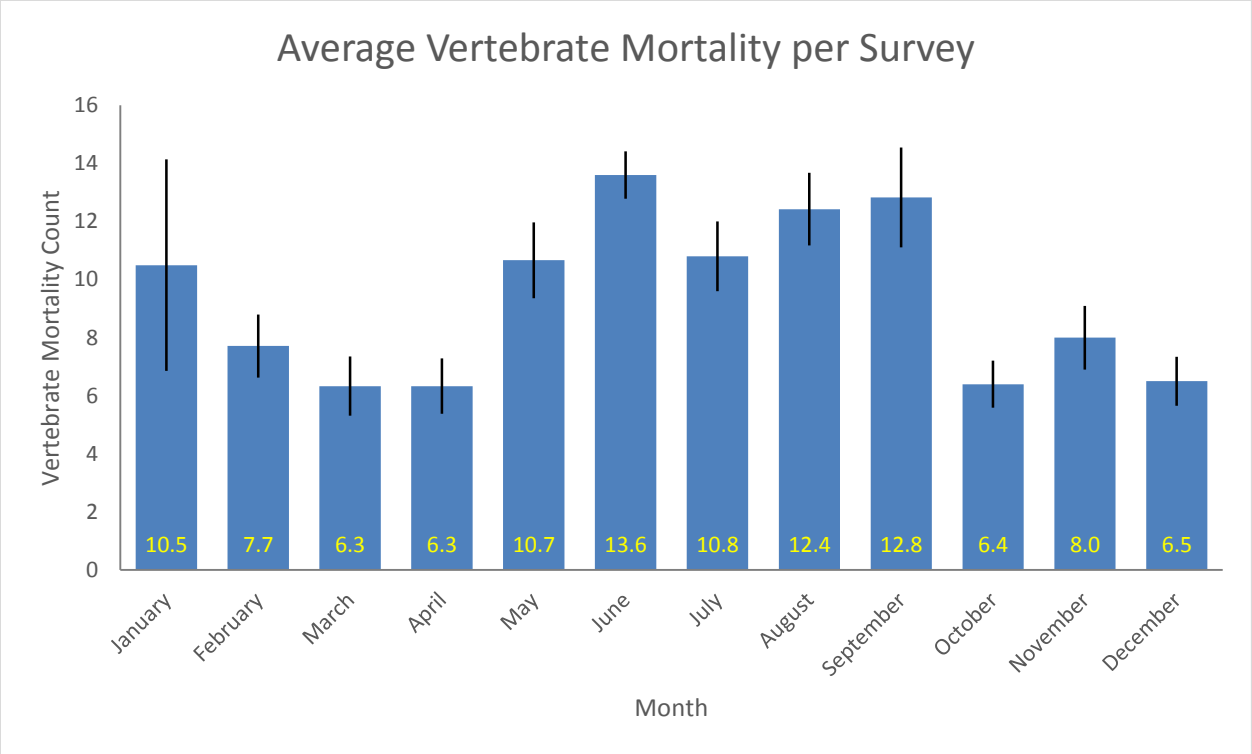

Figure 4. Vertebrate mortality counts averaged by total number of surveys for that month (± SE). Averages are analyzed using all three transects and all three years combined and are shown in yellow.

Figure 5 displays variable mortality rates (kills per tenth of a mile) based on transect, specific location, and side of the road. It also shows that the parallel sections of Culver and Jefferson along the perimeter of the "triangle" roughly in the center of the graph, are particularly hazardous to wildlife (Figure 5). This example location reinforces the trend that roads bisecting the Reserve with open space on both sides tend to display higher kill rates than Lincoln Boulevard, the third side of "triangle", which is bordered by urban development on one side.

Additionally, the bidirectional survey methodology allows us to independently assess the vulnerability of vertebrates along both directions of car travel within a given stretch of road. Animals using the road adjacent to the North Area C parcel (along eastern Culver Boulevard) seem to be more susceptible to traffic collisions than those along the opposite direction. A similar trend is noticeable for wildlife crossing eastern Culver Boulevard from the south-eastern corner of Area B towards the salt pan habitat (Figure 5). Reasons for the increased susceptibility along specific directional road segments such as visibility or barriers to Reserve access were not analyzed as part of this survey.

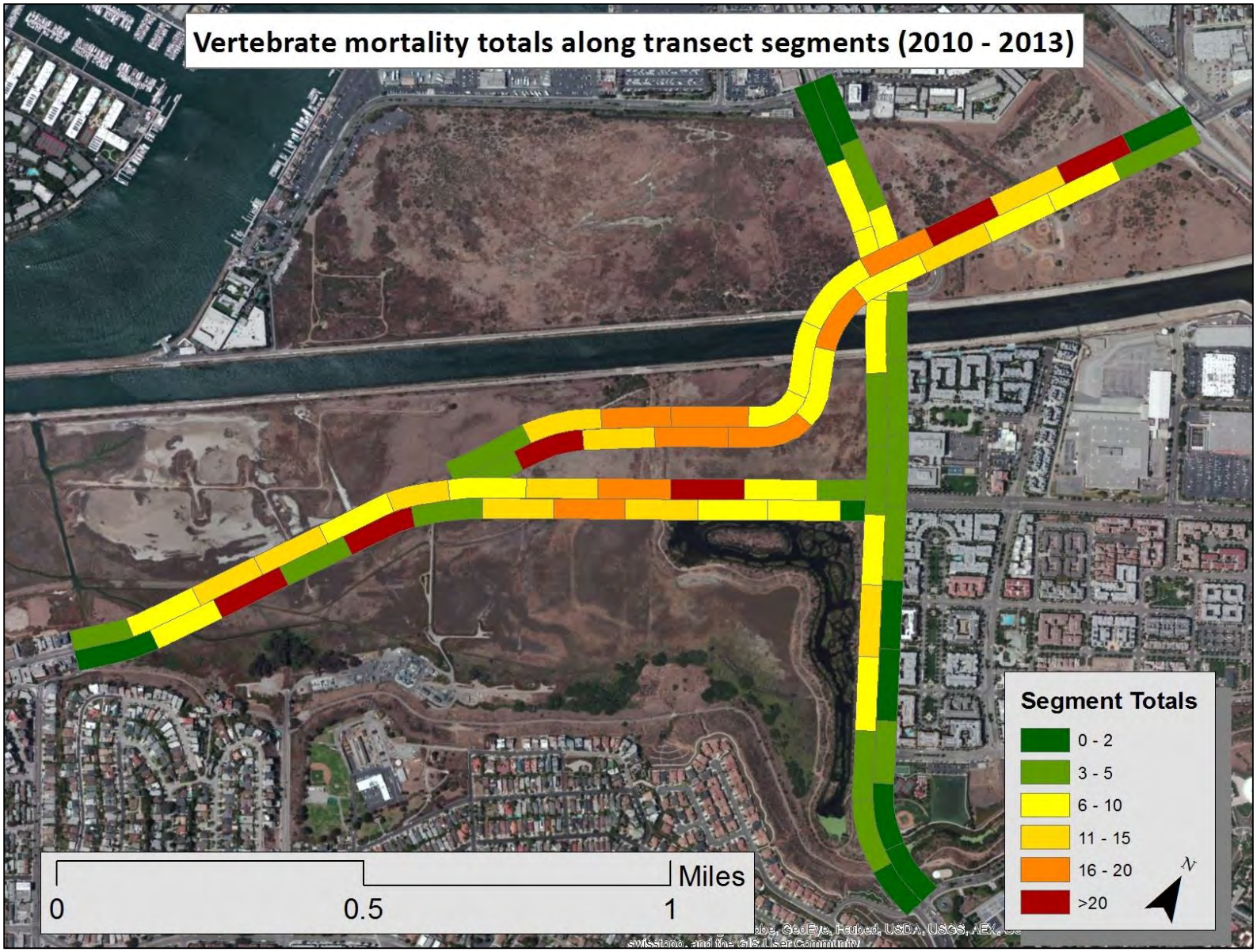

Figure 5. Map of total vertebrate mortality in 0.1-mile segments during the 2010-2013 surveys.

Conclusions

Roadways bisecting the BWER present a major obstacle to wildlife mobility, with specific segments of the roadways depicting higher kills rates than other segments. This survey, which identified roadway segments with higher kill rates and likely groups of impacted animals, could be used to inform future studies to identify or increase our understanding of the factors that differentiate the segments' kill rates. Examples of additional research and analysis could include an analysis of the data against high-resolution traffic patterns or wildlife cameras and an in-depth regional assessment for comparison. Additional data from municipalities tasked with roadkill removal would allow for an even higher degree of accuracy of the total mortality rates along the Reserve transects, especially for the larger fauna.

Additionally, underestimations of mortality may have occurred for some of the organism groups. Antworth el at. 2005 estimated that scavenging results in the removal of 60 – 97% of roadkill carcasses within the first 36 hours, with snakes exhibiting the highest disappearance rates. The results of this study may explain lower numbers of snakes identified on surveys, ultimately leading to an underestimation. The anthropogenic removal, particularly of larger wildlife species, also occurs through active collection by municipalities between surveys. While smaller carcasses (e.g. squirrels and rabbits) may go relatively unnoticed by passing motorists, the obstacle and dangers presented by carcasses of larger wildlife species (e.g. coyotes and dogs) is more noticeable and may prompt phone calls from drivers or immediate action by city workers. This process may help explain the lower relative frequency of observations of larger animals in the data.

The proximity of these major roadways to the Reserve, an undeveloped open space, increase the possibility of vehicle-related mortalities on wildlife and increase the potential costs and environmental effects associated with those incidences. The phenomenon of wildlife-vehicle collisions is not unique to the Reserve. In fact, wildlife vehicle collisions are an issue across the United States and even globally. Scientific literature exists on the topic and provides examples of potential measures for addressing it such as lowering speed limits and displaying cautionary signage. Measures such as those presented in the literature could be considered for the roadways within the Reserve.

Socioeconomic and Public Safety Concerns

In addition to the negative ecological effects, there are socioeconomic and public safety considerations associated with vertebrate mortality relating to collisions with wildlife and other vehicles. Nearly one quarter (26%) of Unites States drivers do not carry the necessary comprehensive insurance to cover vehicle damage as a result of collisions with larger wildlife species (IIS 2013). As a result, the socioeconomic ramifications associated with these situations results in these individuals incurring out-of-pocket expenses to repair wildlife-related vehicle damage.

A larger consideration involves drivers accidentally colliding with other motorists from last second evasive maneuvers to avoid wildlife collisions. Collisions between vehicles substantially increases the risk of bodily injury and vehicle damage when compared to collisions with wildlife (FWHA 2008, NHTSA 2014). In 2008, a study conducted by the U.S. Department of Transportation's Federal Highway

Administration estimated annual costs associated with wildlife-vehicles collisions to be $8,388,000,000 (FWHA 2008). Therefore, the interaction between vehicles and wildlife should be minimized where ever feasible and appropriate to reduce risks to both humans and wildlife.

Literature Cited

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APPENDIX D17
Biological Assessment

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BIOLOGICAL ASSESSMENT

FOR THE

BALLONA WETLANDS RESTORATION PROJECT

LOS ANGELES COUNTY, CALIFORNIA

July 11, 2017

1.0: INTRODUCTION

In accordance with 50 CFR § 402.14(c), this document provides the necessary information in support of the U.S. Army Corps of Engineers' (Corps) request to initiate informal consultation with the U.S. Fish and Wildlife Service (USFWS), and request their concurrence that the proposed project may affect, but is not likely to adversely affect, five federally listed species (El Segundo blue butterfly, California least tern, Coastal California gnatcatcher, Least Bell's vireo, and Light-footed Ridgway's rail) potentially found within the Project site.

1.1 SUMMARY OF PROPOSED ACTION

This Ballona Wetlands Restoration Project (Project) is a major Federal action for which discretionary permits would be required from the Corps for compliance with Section 404 of the Clean Water Act and Sections 10 and 14 of the Rivers and Harbors Act, among other authorities. Corps approval also would be required to modify the Operation, Maintenance, Repair, Replacement and Rehabilitation plan (OMRR&R, Los Angeles District, Corps of Engineers 1999) to reflect any approved changes to existing LACDA project infrastructure within the Project site. The proposed activities also would require discretionary approvals from state or local agencies for activities that could result in a significant impact on the physical environment. Therefore, environmental review of the Project is required under both NEPA and CEQA. The proposed activities are described in greater detail in the Executive Summary, as well as in Chapters 1 and 2, of the Ballona Wetlands Restoration Project (BWRP) Environmental Impact Statement/ Environmental Impact Report (EIS/EIR).

The Ballona Reserve has been subject to multiple jurisdictional delineations, most recently in August 2011 (Appendix D14 of BWRP EIS/EIR: WRA Delineation Report). A jurisdictional delineation also was conducted for the SoCalGas Property in 2013 (ICF 2013). A Preliminary Jurisdictional Determination was issued by the Corps for the Project site (Corps 2012). In the BWRP EIS/EIR, Table 3.4-5, Wetland and Nonwetland Potential Jurisdictional Resources, summarizes the potential aquatic features within the Project site under the jurisdiction of the Corps. Table 3.4-5 also summarizes the potential resources under the jurisdiction of the RWQCB and the California Coastal Commission (CCC).

After permits and funding are acquired and a contractor to implement the project is hired, restoration could commence immediately pending any biological constraints. Phase 1 is expected to be completed approximately 6.5 years later. Phase 2 would end approximately two years after completing Phase 1.

1.2 PURPOSE OF THE BIOLOGICAL ASSESSMENT

The purpose of this document is to provide the USFWS with the information required for the preparation of a biological opinion. This Biological Assessment describes the direct and indirect effects of the proposed project to the federally listed species discussed above, and their designated critical habitats, in accordance with Section 7 of the Endangered Species Act of 1973, as amended (ESA 16 U.S.C. 1531 *et seq.*). This document supports the Corps' request for the initiation of informal consultation with the USFWS for effects associated with the Project to those species listed above. The geographic scope of this assessment includes the BWRP site, as well as the LA-2 and LA-3 offshore disposal sites.

1.3 HISTORY OF CONSULTATION TO DATE

Although Section 7 consultation has not been initiated previously, representatives from the Corps and USFWS have met with the applicant, CDFW, periodically to discuss the proposed project. Furthermore, under NEPA, agencies other than the NEPA lead agency that have jurisdiction by law or special expertise with respect to the environmental effects anticipated from the Project may participate in the NEPA process as cooperating agencies (40 CFR §§1501.6, 1508.5). The United States Fish and Wildlife Service (USFWS) participated in the development of the Draft EIS/EIR for the Ballona Wetlands Restoration Project as a Cooperating Agency between January 5, 2015 and February 1, 2017 (USFWS 2017).

2.0: PROJECT DESCRIPTION

2.1 PROJECT LOCATION

The project site includes the Ballona Reserve and seven potential natural gas storage well relocation sites proposed within the SoCalGas Property located adjacent to the Ballona Reserve. The project site is located in southern California, south of Marina del Rey and east of Playa del Rey. It extends roughly from the Marina Freeway (State Route [SR] 90) to the east, the Westchester bluffs to the south, Playa del Rey to the west, and Fiji Way to the north. See Figure ES-1, Regional Location, in the BWRP EIS/EIR. CDFW manages and maintains primary ownership of the Ballona Reserve, with a smaller interest owned by the California State Lands Commission (CSLC). The Los Angeles County Department of Public Works-Flood Control District (LACFCD) owns and operates the Ballona Creek channel and levee system, which are features of the Federally-authorized Los Angeles County Drainage Area (LACDA) project.

2.2 ACTION AREA

Given waters of the U.S. occur throughout the site, and to account for potential noise effects, the entirety of the proposed project site, including upland areas, is included within the Action Area. In addition, to account for potential offshore disposal of dredged material, the offshore disposal sites LA-2 and LA-3 are also included within the Action Area.

2.3 PROJECT OVERVIEW

Seeking to restore wetland habitat and functions within the Ballona Reserve, CDFW is proposing a large-scale effort to restore, enhance, and establish native coastal wetland and upland habitats within the Ballona Reserve; these efforts would require incidental work on adjacent property. To implement the proposal, CDFW is working with the LACFCD to modify LACDA project features (e.g., the Ballona Creek channel and levee system) within the Ballona Reserve. The three main components of the Project are restoring wetlands and wetland functions within the Ballona Reserve, restoring and improving public access to the Ballona Reserve, and maintaining existing levels of flood risk management provided by the Ballona Creek channel and levee system. Aspects of the project that may affect federally-listed threatened or endangered species include extensive earth moving (grading) to attain elevations allowing for tidal influence, demolition of existing flood risk infrastructure (Ballona Creek channel levees), construction of new levees along the project perimeter, and also construction of attendant features such as a parking structure, new bridges (two), trails, and elevated pathways.

3.0: REGULATORY STATUS OF THE SPECIES

Discussions of the protection status, physical description, habitat association, behavior, geographic range, and other relevant information for the five species listed above can be found in Section 3.4. of the BWRP EIS/EIR (see Special-Status Biological Resources on pages 3.4-17 through 3.4-63).

4.0: ENVIRONMENTAL BASELINE

The historical wetlands ecosystem in the vicinity of the Ballona Reserve once spanned more than 2,100 acres and supported a great diversity of wetland types that stretched from Playa del Rey to Venice and inland to the Baldwin Hills (Dark et al. 2011; LACDPW 2013). By the mid-1900s, the Ballona wetlands was greatly reduced in extent and ecological function

through the loss of most of its tidal salt marsh and freshwater marsh (Cooper 2008). The USEPA has determined all wetland habitats within the Ballona Reserve are impaired (USEPA 2012). Furthermore, a portion of the Ballona Reserve has been identified as "among the most degraded wetlands in California" using standardized wetland condition protocols (Johnston et al. 2015a). Therefore, CDFW proposes a large-scale restoration of the Ballona Reserve that would entail restoring, enhancing, and establishing native coastal wetland and upland habitats within the Ballona Reserve. Long term effects following completion of restoration activities would be beneficial and result in measureable improvements in the functions and values of habitat resources compared to existing conditions. The environmental baseline (affected environment) is described in greater detail in Section 3.4.2 of the BWRP EIS/EIR (pages 3.4-1 through 63).

5.0: EFFECTS OF THE ACTION AND DETERMINATION OF EFFECTS

The direct and indirect effects of proposed project implementation are expected to be beneficial overall, given the purpose of the Project is ecological restoration. The direct and indirect effects of the Project are described in greater detail in Section 3.4.6 of the BWRP EIS/EIR (see pages 3.4-77 through 81, 144 and 178).

FESA Species Effect Determinations to Support Section 7 Consultation

Following completion of a biological assessment (Appendix D17), the Corps has made a determination implementation of Alternative 1 may affect, but is not likely to adversely affect, the following Federally-listed species: El Segundo blue butterfly, light-footed Ridgway's rail, coastal California gnatcatcher, California least tern, and least Bell's vireo. As such, Section 7 consultation with USFWS is required. In addition, the Corps has made a no effect determination regarding the following species: coastal dunes milk-vetch, salt marsh bird's beak, Ventura marsh milk-vetch, Pacific pocket mouse, steelhead, green sea turtle, blue whale, fin whale, humpback whale, sei whale, sperm whale, gray whale, Guadalupe fur seal, leatherback turtle, loggerhead turtle, olive ridley sea turtle, and the scalloped hammerhead shark. As such, Section 7 consultation is not required for these species. The basis for each no effect determination is provided below. Table 1 below (also appearing in the EIS/EIR as Table 3.4-8) summarizes the impact determinations for Federally-listed species that could occur within the Project area, and the location of the analysis within the EIS/EIR.

El Segundo blue butterfly: No direct impacts to suitable or occupied habitat for El Segundo blue butterflies would occur. There is a limited potential for butterfly collisions with

equipment during the flight season, and potential indirect impacts related to accumulation of fugitive dust, vibration, trail maintenance, and increased human activity. However, with implementation of Project Design Features and mitigation measures, Alternative 1 may affect, but is not likely to adversely affect El Segundo blue butterfly or its habitat.

Light-footed Ridgway's rail: This species has been observed foraging on the Project site, and has the potential to breed within the Project site. If site activities commence during the avian nesting season, the breeding success of light-footed Ridgway's rail could be impacted. Temporary disturbance of marsh habitat would occur during restoration activities. However, with implementation of Project Design Features and mitigation measures, Alternative 1 may affect, but is not likely to adversely affect light-footed Ridgway's rail or its habitat.

Coastal California gnatcatcher: This species is not expected to breed or forage on the Project site considering the habitat conditions onsite and the lack of recent observations of this species. However, since focused surveys for this species have not been conducted at the Ballona Reserve since 2011, although unlikely, potential impacts to nesting could occur if this species is confirmed present onsite. However, with implementation of Project Design Features and mitigation measures, Alternative 1 may affect, but is not likely to adversely affect coastal California gnatcatcher or its habitat.

TABLE 1: SPECIES EFFECT DETERMINATIONS TO SUPPORT SECTION 7 CONSULTATION – ALTERNATIVE 1

Species	Federal Listing Status	Location of Effects Analysis	Effect Determination
El Segundo blue butterfly	Endangered	1-BIO-1c	May Affect, Not Likely to Adversely Affect
California least tern	Endangered	1-BIO-1o	May Affect, Not Likely to Adversely Affect
Coastal California gnatcatcher	Threatened	1-BIO-1j	May Affect, Not Likely to Adversely Affect
Least Bell's vireo	Endangered	1-BIO-1k	May Affect, Not Likely to Adversely Affect
Light-footed Ridgway's rail	Endangered	1-BIO-1p	May Affect, Not Likely to Adversely Affect
Coastal dunes milk-vetch	Endangered	3.4.2.2 Environmental Setting, Special-Status Plant Species	No Effect
Salt marsh bird's-beak	Endangered	3.4.2.2 Environmental Setting, Special-Status Plant Species	No Effect

Species	Federal Listing Status	Location of Effects Analysis	Effect Determination
Ventura marsh milk-vetch	Endangered	3.4.2.2 Environmental Setting, Special-Status Plant Species	No Effect
Pacific pocket mouse	Endangered	3.4.2.2 Environmental Setting, Special-Status Mammals	No Effect
Steelhead	Endangered	3.4.2.2 Environmental Setting, Special-Status Fish	No Effect
Green sea turtle	Threatened	3.4.2.2 Environmental Setting, Special-Status Reptiles and Amphibians	No Effect
Blue whale	Endangered	3.4.6.1 Alternative 1: Full Tidal Restoration/Proposed Action, FESA Species Effect Determinations to Support Section 7 Consultation	No Effect
Fin whale	Endangered	3.4.6.1 Alternative 1: Full Tidal Restoration/Proposed Action, FESA Species Effect Determinations to Support Section 7 Consultation	No Effect
Humpback whale	Threatened	3.4.6.1 Alternative 1: Full Tidal Restoration/Proposed Action, FESA Species Effect Determinations to Support Section 7 Consultation	No Effect
Sei whale	Endangered	3.4.6.1 Alternative 1: Full Tidal Restoration/Proposed Action, FESA Species Effect Determinations to Support Section 7 Consultation	No Effect
Sperm whale	Endangered	3.4.6.1 Alternative 1: Full Tidal Restoration/Proposed Action, FESA Species Effect Determinations to Support Section 7 Consultation	No Effect
Gray whale, Western North Pacific DPS	Endangered	3.4.6.1 Alternative 1: Full Tidal Restoration/Proposed Action, FESA Species Effect Determinations to Support Section 7 Consultation	No Effect
Guadalupe fur seal	Threatened	3.4.6.1 Alternative 1: Full Tidal Restoration/Proposed Action, FESA Species Effect Determinations to Support Section 7 Consultation	No Effect

Species	Federal Listing Status	Location of Effects Analysis	Effect Determination
Leatherback turtle	Endangered	3.4.6.1 Alternative 1: Full Tidal Restoration/Proposed Action, FESA Species Effect Determinations to Support Section 7 Consultation	No Effect
Loggerhead turtle, North Pacific Ocean DPS	Endangered	3.4.6.1 Alternative 1: Full Tidal Restoration/Proposed Action, FESA Species Effect Determinations to Support Section 7 Consultation	No Effect
Olive ridley sea turtle	Threatened	3.4.6.1 Alternative 1: Full Tidal Restoration/Proposed Action, FESA Species Effect Determinations to Support Section 7 Consultation	No Effect
Scalloped hammerhead shark	Threatened	3.4.6.1 Alternative 1: Full Tidal Restoration/Proposed Action, FESA Species Effect Determinations to Support Section 7 Consultation	No Effect

California least tern: This species is not expected to breed or forage on the Project site considering the habitat conditions onsite and the lack of recent observations of this species. This species unsuccessfully attempted to breed in Area B in 2014, so potential impacts to nesting could occur if this species attempts to nest onsite again. However, with implementation of Project Design Features and mitigation measures, Alternative 1 may affect, but is not likely to adversely affect California least tern or its habitat.

Least Bell's vireo: This species is known to breed and forage in Southeast Area B. Potential impacts to nesting could occur if this species attempts to nest onsite again. However, with implementation of Project Design Features and mitigation measures, occupied habitat for this species would be avoided. Alternative 1 may affect, but is not likely to adversely affect least Bell's vireo or its habitat.

Coastal dunes milk-vetch, salt marsh bird's beak, and Ventura marsh milk-vetch: None of these plants were detected during floristic rare plant surveys last conducted at the Project site in April 2011. Coastal dunes milk-vetch and salt marsh bird's beak were last detected in the early 1900s and 1981, respectively, between 1 to 4 miles from the Ballona Reserve. The nearest and most recent documented occurrence of Ventura marsh milk-vetch was in 1951

within the historic Ballona wetlands (WRA 2011a). Therefore, Alternative 1 would have no effect on coastal dunes milk-vetch, salt marsh bird's beak or Ventura marsh milk-vetch.

Pacific pocket mouse: This species has not been observed on-site since 1938, despite surveys conducted in 1996, 2000, 2007, 2009, 2010, and 2011. Given the lack of any recent observations, Alternative 1 would not affect the Pacific pocket mouse.

Steelhead: Steelhead have only been observed once near the Project site; a 2008 sighting of two individuals upstream of the Project site. Furthermore, the existing Ballona Creek would provide only limited spawning habitat for this species. Therefore, given the lack of regular or recent observations, coupled with the limited ability of Ballona Creek to support steelhead reproduction, Alternative 1 would not affect steelhead.

Green sea turtle: This species has not been observed onsite. Given the lack of suitable habitat elements and in combination with Project Design Feature BIO-8: Biological Monitoring and Safety Zones to Protect Marine Mammals and Sea Turtles , Alternative 1 would not affect green sea turtles.

In addition, in consideration of the Project's potential inclusion of offshore disposal of dredged material, the Corps has made a determination that implementation of the Project would not affect the following Federally-listed species: blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), sei whale (*Balaenoptera borealis*), sperm whale (*Physeter macrocephalus*), gray whale [Western North Pacific distinct population segment (DPS) (*Eschrichtius robustus*)], Guadalupe fur seal (*Arctocephalus townsendi*), leatherback turtle (*Dermochelys coriacea*), loggerhead turtle [North Pacific Ocean DPS (*Caretta caretta*)], olive ridley sea turtle (*Lepidochelys olivacea*), green turtle (*Chelonia mydas*), scalloped hammerhead shark (*Sphyrna lewini*). These species are highly mobile and unlikely to be affected by slow-moving dredge material transport vessels as they haul material to the LA-2 offshore disposal site. In addition, in the original site designation for LA-2 and the accompanying EIS which was prepared by EPA and the Corps, Section 1.1.3 of the General Introduction Chapter 1 describes the proposed action: designation of the site for offshore disposal, including transport to and discharge of dredged material at the LA-2 site (see 1.1.3: dredging operations). Furthermore, the EIS includes correspondence from NMFS providing a list of species that may be affected by the proposed action (same species listed above), and a subsequent letter from NMFS concurring with a determination those species would not be adversely affected. Although the EIS was finalized in 1987, no operational changes in the transport and discharge of dredged material to/from/at LA-2 have been identified that would require re-initiation of Section 7 consultation for these species by the Corps. In addition, the USEPA prepared a final site

designation for LA-3 in July 2005 that included a re-evaluation of LA-2. The Final EIS also concluded no effect to listed species.

6.0: CUMULATIVE EFFECTS

Cumulative effects are effects resulting from future state or private actions, not involving federal actions, that are reasonably certain to occur in the Action Area of the federal action subject to consultation. Cumulative effects are described in Section 3.4.7 of the BWRP EIS/EIR (see pages 3.4-207 through 212).

7.0: MITIGATION MEASURE RECOMMENDATIONS

Proposed major mitigation measures to address potential impacts to federally-listed threatened or endangered species are listed below:

El Segundo blue butterfly: BIO-1b-ii (Biological Monitoring) and BIO-1b-iii (Noxious Weed Control Plan)(See BWRP EIS/EIR pages 3.4-88 through 89).

California least tern: Mitigation Measures BIO-1b-ii (Biological Monitoring) and BIO-1i-i (Nesting Bird and Raptor Avoidance)(See BWRP EIS/EIR pages 3.4-113 through 115).

Coastal California gnatcatcher: Mitigation Measure BIO-1j-i: Coastal California Gnatcatcher Avoidance (See BWRP EIS/EIR pages 3.4-102 through 104). To avoid indirect impacts of restoration on nesting coastal California gnatcatcher, work activities within 500 feet of coastal scrub vegetation shall be timed to avoid the season when nests may be active for this species (March 15 to June 30). If avoidance of work activities within this time period is not feasible, a focused survey for coastal California gnatcatchers shall be conducted in the season prior to initiation of work activities to determine their presence or absence within suitable habitat 500 feet of work limits. In accordance with the USFWS protocol for the coastal California gnatcatcher (USFWS 1997) focused surveys shall be conducted by a permitted biologist a minimum of: a) six (6) surveys at least on week apart between March 15-June 30; or b) nine (9) surveys conducted at least two weeks apart between July 1 to March 14. The results shall be submitted in a report to the Corps, USFWS, and CDFW. If occupied habitat and/or nesting individuals are determined to be present based on the focused survey, measures to avoid take of coastal California gnatcatchers and active nests,

such as the creation of suitably-sized no-work buffers, shall be implemented prior to restoration activities.

Prior to construction or post-restoration maintenance activities during the breeding season, a preconstruction clearance and nest survey shall be performed by a qualified biologist within 7 days prior to work activities to determine the location of nests within 500 feet of work areas. Measures such as erecting a temporary barrier with stacked hay bales shall be implemented to reduce the amount of work noise and motion in proximity to active nests. If a nest is detected, work shall halt within 500 feet of the nest, and the nest shall be monitored on a weekly basis by a qualified biologist familiar with coastal California gnatcatchers, until he/she determines the nest is no longer active or the young have fledged.

Least Bell's vireo: Mitigation Measures BIO-1b-ii (Biological Monitoring), BIO-1b-iii (Noxious Weed Control), and BIO-1k (Least Bell's Vireo Avoidance)(See BWRP EIS/EIR pages 3.4-104 through 107).

Mitigation Measure BIO-1k: Least Bell's Vireo Avoidance. To avoid direct impacts of restoration on occupied habitat or potentially suitable habitat for least Bell's vireos, all willow riparian habitat shall be avoided. All aspects of Project design such as the establishment of tidal channels, and any associated habitat disturbance including vegetation trimming or removal, shall avoid all willow habitat in Southeast Area B.

To avoid indirect impacts of restoration on nesting least Bell's vireos, work activities within 500 feet of riparian vegetation shall be timed to avoid the season when nests may be active for this species (March 15 to September 15). If avoidance of work activities within this time period is not feasible, a focused survey for least Bell's vireos shall be conducted in the season prior to initiation of work activities to determine their presence or absence within suitable habitat 500 feet of work limits. The focused survey shall consist of eight site visits conducted 10 days apart during the period of April 10 to July 31 in compliance with the USFWS protocol. The results shall be submitted in a report to the Corps, USFWS and CDFW. If occupied habitat and/or nesting individuals are determined to be present based on the focused survey, measures to avoid take of least Bell's vireos and active nests shall be implemented prior to restoration activities.

Prior to construction activities during the breeding season, a preconstruction clearance and nest survey shall be performed by a qualified biologist within 7 days prior to work activities to determine the location of nests within 500 feet of work areas. Measures such as erecting a temporary barrier with stacked hay bales shall be implemented to reduce the amount of

work noise and motion in proximity to active nests. If a nest is detected, work shall halt within 500 feet of the nest, and the nest shall be monitored on a weekly basis by a qualified biologist familiar with least Bell's vireos, until he/she determines the nest is no longer active or the young have fledged.

Post-restoration, willow habitat in Southeast Area B shall be monitored to ensure tidal habitats are not adversely affecting the survival or health of the willow thickets. The tidal range shall be managed to prevent salinity-related impacts to the willow thickets and ensure persistence of this habitat. Monitoring requirements and adaptive management actions for least Bell's vireos and occupied/suitable habitat for this species during restoration and post-restoration shall be identified in the Habitat Restoration and Monitoring Plan.

Light-footed Ridgway's rail: Mitigation Measures BIO-1b-ii (Biological Monitoring) and BIO-1i-i (Nesting Bird and Raptor Avoidance)(See BWRP EIS/EIR pages 3.4-115 through 117).

A complete list of proposed mitigation measures are described throughout Section 3.4.7 of the BWRP EIS/EIR.

8.0 PREPARERS AND REVIEWERS

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9.0 REFERENCES CITED

See Section 3.4.8 (page 3.4-213) of the BWRP EIS/EIR.

APPENDIX E
Geotechnical Investigation Report

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GEOTECHNICAL INVESTIGATION REPORT
BALLONA WETLANDS RESTORATION PROJECT
MARINA DEL REY AREA
LOS ANGELES COUNTY, CALIFORNIA

Prepared for:

Santa Monica Bay Restoration Commission
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GDC Project No. LA-962A
July 1, 2013

GROUP DELTA CONSULTANTS

Geotechnical Engineering
Geology
HydroGeology
Earthquake Engineering
Materials Testing & Inspection
Forensic Services

July 1, 2013 LA-962A

Santa Monica Bay Restoration Commission
1 LMU Drive, North Hall
Pereira Annex MS:8160
Los Angeles, California, 90045

Attention: Ms. Diana Hurlbert
Restoration Project Coordinator

Subject: Geotechnical Investigation Report
Ballona Wetlands Restoration Project
Marina Del Rey Area
Los Angeles County, California

Dear Ms. Diana Hurlbert:

Group Delta Consultants, Inc. is pleased to submit this Geotechnical Report for the Ballona Wetlands Restoration Project. This report summarizes the results of our geotechnical investigation, laboratory testing and engineering analyses for the project and provides geotechnical recommendations for the proposed earthwork and construction.

We appreciate the opportunity to provide geotechnical services for this significant project. If you have any questions pertaining to this report, or if we can be of further service, please do not hesitate to contact us.

Very truly yours,
Group Delta Consultants, Inc.

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GEOTECHNICAL INVESTIGATION REPORT
BALLONA WETLANDS RESTORATION PROJECT
MARINA DEL REY AREA
LOS ANGELES COUNTY, CALIFORNIA

EXECUTIVE SUMMARY

This report presents the results of our geotechnical investigation performed in support of the restoration of the Ballona Wetland under the conditions of a United States Army Corps of Engineers (USACE) 408 permit. The proposed restoration would restore estuarine wetland and upland habitats that are connected to a realigned Ballona Creek. The project area is shown in Figures 1 and 2 (Areas A, B and C).

The project site encompasses about 600 acres between Marina Del Rey to the north and Playa Del Rey to the south. Key elements of the restoration are described in the Preliminary Design Report (PDR; ESA PWA, 2013a) for the project, and include:

Ballona Creek Channel Restoration

- Removal of the existing north and south levees in four locations, and the realignment of the channel for the creation of a natural meandering channel. This requires backfilling a portion of the existing channel
- Armoring against current induced erosion at locations of potential high creek flow velocities.

Area A

- Mass excavation to reclaim wetlands lost when the area was hydraulically filled during the development of Marina Del Rey. The excavation will slope down to the south from Fiji Way at a gradient of about 10 horizontal to 1 vertical or flatter, to a maximum depth of about 20 to 25 feet in the area of the existing channel. The excavation will remove primarily hydraulic fill soils.
- Construction of flood protection levees along the west, north and east perimeter of Area A. The levees will generally extend about 5 to 10 feet above the existing grade.

Area B

- Construction of flood protection levees along the north side of Culver Boulevard and east of the dunes in West Area B. The levees will generally extend up to a maximum of about 15 feet above existing grade.
- Full restoration of wetlands between the new levees and the realigned Ballona Channel and managed restoration of the wetlands area located south of the new levees.

- The area between Culver and Jefferson Boulevards will be used as a balance site, where excess cut material will be placed and compacted, resulting in uplands habitat.

Area C

- North Area C, located north of Culver Boulevard, will also be used as a balance site where excess cut material will be placed and compacted with primarily uplands habitat created.
- South Area C will be graded with uplands and will be the site for the construction of a planned complimentary service facility to the Wetlands Restoration Project.

Other Elements

- Construction of a pedestrian/bicycle bridge spanning the Ballona Channel near the existing Culver Boulevard Bridge, and an at-grade bicycle path along the new levee in Area B.
- Construction of buried culverts in Area B, extending under Culver Boulevard.

Group Delta Consultants (GDC) conducted a geotechnical subsurface investigation for the project during September/October 2012. The investigation included a total of 25 rotary wash borings, 31 cone penetration tests (CPT), 8 hollow stem auger borings and 1 hand auger boring. In addition, 10 borings were performed for obtaining samples for chemical, environmental and erosion testing. Explorations were advanced to a maximum depth of 71.5 feet. Shear Wave Velocity measurements were performed in 7 of the CPTs. Four field permeability tests were performed to evaluate the permeability of the soils in the area where the Ballona Channel will be breached. The findings from the GDC investigation were supplemented by data from previous geotechnical and environmental investigations conducted within the project areas to characterize the soil properties (Law Crandall, 1988, 1991; Diaz Yourman & Associates, 2010; and Weston Solutions, 2009).

Based on our findings and analyses, it is our opinion that the project is feasible from a geotechnical standpoint and can be successfully accomplished as planned, following the recommendations addressed in this report. The major geotechnical factors affecting the project are briefly discussed below.

The stability analyses performed indicate that the new levees planned will be stable and meet or exceed the minimum factor of safety required under static, seismic and rapid drawdown conditions. Where a new levee ties into an existing levee, the existing levee will experience additional loading and settlement that can cause cracking of the existing levee. Therefore, it is recommended that mitigation measures, such as deep soil mixing, be performed at and adjacent to tie-in locations to improve the stability of the existing levees that will remain in Areas A and B. In

Area C, the restoration project will not alter or impose any new loads on the existing levees. It is recommended that any surcharge loads planned in Area C should be setback a minimum of 70 feet away from the top of the channel slope.

The soils that will be excavated in Area A were found to be loose/soft and have high moisture contents, generally ranging about 5% to 35% above the optimum. Therefore, the use of heavy scrapers and dozers is expected to be limited. The excavation must be carefully planned and conducted to avoid overstressing the soils and/or bogging down equipment. The need for excavators, support mats, moving haul roads, low ground pressure equipment and dredging should be considered in planning how to accomplish the excavation. The need to control the ground water should also be anticipated during excavation. Because of the high moisture content in the excavated soils, it will be necessary to dry the excavated soils prior to placement, which will require spreading and turning/disking.

The soils excavated from Area A will also undergo significant volume reduction when compacted for the levee construction. This loss of volume is estimated to range up to 20 to 30 percent. Additional soil "loss" will also occur as the soft soils below the new levees settle under the embankment load.

Prior to placement of compacted fill for the new levees, the subgrade soils along the levee alignments should be excavated and recompacted to a minimum depth 4 feet under the levee "core." The levee "core" is defined as the zone of the levee within 3 to 1 slopes extending down from the edges of the levee crest. Beyond the core, the removal should extend to a depth of 2 feet for a minimum equipment width, as shown in Appendix I (Plates I-2 through I-4). Outside the removal zones, vegetation should be stripped.

The actual limits for removals should be determined by the project geotechnical engineer during construction, based on the conditions exposed. Deeper removals under the levee core will be needed if unsuitable soils are present. In particular, deeper removals should be planned where the levee crosses the existing drainage channels in West Area B. Deeper excavation should also be planned to remove buried organics in the area of a celery dump known to have been present in northeast Area A. The location and limits of the celery dump will be determined during grading operations.

If permeable sand layers are exposed that could provide a path for seepage under the new levee core. It will be necessary to overexcavate and replace such layers to the limits determined by the project geotechnical engineer during grading. In particular, shallow sand layers may extend below the alignment of the levee planned in West Area B, because of the proximity of the natural dunes.

If wet and/or soft soils are exposed in the excavation made for removals, the excavation will need to be performed using an excavator or low ground pressure equipment. In addition, geogrid (Tensar BX 1200 or equivalent) may be needed to stabilize the exposed bottom and provide a firm working surface before the new fill can be placed.

In general, the hydraulic fill in Area A is a fine-grained silty to clayey loose/soft soil with a high moisture content, and the near surface native soils and fill in area B are moderately soft to soft with a high moisture content and a shallow ground water table. Temporary excavations should be planned at a maximum inclination of 1-1/2 (horizontal) to 1 (vertical).

The subgrade conditions along the new levees generally consist of moderately soft to soft fine-grained silts and clays that are weak and compressible. Therefore, the selection and operation of equipment and the placement of compacted fill for levees should be planned and controlled to avoid overstressing these soils. The fill should be advanced uniformly without creating unbalanced loads. The rate of fill placement should also be controlled to allow the soft soils to consolidate and gain strength. Increasing the height of the fill slowly, at about 5 feet per month, will also provide time for settlement to occur and mitigate the potential for differential settlement to create cracks in the embankment. Recommendations for monitoring the fill settlement are discussed in Section 15.8.

The new levee in West Area B will cross two existing drainage channels (Refer to Figure 4A). Both of these channels range from 5 to 8 feet in depth and are expected to contain soft sediment. The easternmost of these channels crosses perpendicular to the levee alignment. The westernmost channel extends under the length of the planned levee at the west end of Area B. It should be anticipated that there is the possibility that other old channels may also be present in the area, and may have been filled in. All soft and sandy material should be removed and replaced with compacted fill. The excavation for these removals will extend below ground water and, dewatering will be required to accomplish the removals and backfilling. Shoring or cofferdams are anticipated to be needed. The exposed bottom should be stabilized with geogrid before placing backfill.

The new levees will range from about 5 to 10 feet high in Area A to a maximum of 15 feet high in Area B. The levee fill will cause compression of the underlying native silts and clays and any remaining hydraulic fill, resulting in settlement on the order of 1 to 2 inches for every foot of fill placed. Therefore, the maximum settlement is expected to range from about 10 inches to on the order of 2.5 feet. It is anticipated that 90 percent of the consolidation settlement will essentially be complete within three to six months of fill placement. Settlement plates should be installed to monitor the rate of settlement to confirm when primary compression is complete, as

well as to control the rate of fill loading. Capping of the levee core should be planned as the last step of grading, after settlements are complete.

New culverts should not be installed until 90% of the primary consolidation is completed. Culvert locations could be surcharged in advance of placement of the levee embankment to avoid a delay in their installation. A temporary culvert pipe can be installed before placing the fill. Once the settlement is completed, the temporary pipe can be excavated, removed and the permanent culvert installed and backfilled.

The proposed pedestrian and bicycle bridge can be supported on piles installed into the dense sand and gravel bearing layer that underlies the site at a depth of about 50 to 60 feet.

1.0 INTRODUCTION

This report presents the results of our geotechnical investigation conducted in support for the restoration of the Ballona Wetland under the conditions of a United States Army Corps of Engineers (USACE) 408 permit. The proposed restoration would restore estuarine wetland and upland habitats that are connected to a realigned Ballona Creek.

The project site is shown on the Vicinity Map in Figure 1 and is comprised of approximately 600 acres, between Marina Del Rey (to the north) and Playa Del Rey (to the south), and from about 2,000 feet east of the Pacific Ocean to about 10,500 feet farther upstream along Ballona Creek. The project is divided into three primary Areas: Areas A, B and C. Area A is located north of Ballona Creek and west of Lincoln Boulevard. Area B is located south of Ballona Creek, and Area C is located north of Ballona Creek and east of Lincoln Boulevard.

The Ballona Wetlands Restoration Project (Project) involves the expansion and enhancement of wetlands adjacent to lower Ballona Creek, and associated site modifications necessary to avoid adverse effects to the surrounding property and interests. The Project includes removing the existing flood control levees, constructing new flood protection levees around the perimeter of Area A and along the north side of Culver Boulevard in Area B, upland of the restored wetlands; constructing a new creek meander channel; mass excavating of soil from Area A to remove previously placed dredged fill; full restoration of wetlands between the new levees and the realigned Ballona Channel; and placement of excess cut material as compacted fill in North Area C and in Area B between Culver and Jefferson Boulevards. The project also includes the construction of a pedestrian and bicycle bridge spanning Ballona Creek near the Culver Boulevard Bridge; an at-grade bicycle path along the new Area B levee; and, the construction of culverts to provide drainage of south Area B (ESA PWA, 2013a).

2.0 PURPOSES AND SCOPE OF WORK

The purposes of this investigation were to investigate the subsurface conditions within the project site by performing field explorations; characterize the soil conditions; identify the geotechnical factors impacting the project; geotechnical analyses to evaluate the feasibility of the project from a geotechnical standpoint, and development of recommendations for design and construction, including earthwork, construction of levees, the pedestrian bridge and culverts.

Our scope of work for the Project includes the following:

- Performing a site reconnaissance and developing a Geotechnical Work Plan for the planning and executing the field investigation, depicting the proposed

exploratory boring locations and access routes for review and approval by the appropriate agencies. The Geotechnical Work Plan was also used to obtain permits from the California Department of Fish and Wildlife, USACE and the California Coastal Commission.

- Review of available published geotechnical and geologic maps and reports pertaining to the project area, including previous geotechnical and environmental reports for the property.
- Conducting a field investigation including drilling 25 rotary wash borings, 8 hollow stem borings, and 31 Cone Penetrations tests (CPT), performing shear wave velocity measurements at seven locations using specially equipped CPTs, and conducting four field permeability tests. In addition, 10 borings were performed to obtain representative samples for chemical, biological and erosion testing, performed and analyzed by others.
- Performing geotechnical laboratory testing on selected representative samples to evaluate their physical properties and engineering characteristics. Collected samples for chemical testing, and sediment analysis were sent to outside laboratories for testing, as directed by the project environmental consultant.
- Performing engineering analyses of the field and laboratory data to develop geotechnical recommendations for the design and development of the wetland restoration project. This included performing stability analyses of the proposed levees under static, seismic and rapid drawdown conditions and development of recommendations concerning excavation; levee design and construction; stripping/clearing, excavation; dewatering; removals; placement of fill; anticipated settlements; foundation support of the pedestrian bridge and culverts and recommendations to address constructing options, phasing, monitoring and logistics.
- Attending and participating in project meetings, telephone calls, and reviews, as requested.
- Preparation of this Geotechnical Investigation Report.

3.0 HISTORICAL BACKGROUND

3.1 Historical Land Use

The following information was taken from a report by the U.S. Environmental Protection Agency (USEPA), titled "*Ballona Creek Wetlands, Total Maximum Loads for Sedimentation and Invasive Exotic Vegetation*" (USEPA, 2012). Table 1 summarizes some of the anthropogenic activities perform at Ballona Wetlands since the early 1900s until 1960s.

During the late 1800's the Ballona Wetlands were used by several hunting lodges and resorts for recreation. Rail lines were constructed through the marsh in the 1880's and roadways were built between 1900 and 1910. Oil and gas exploration and production began in the 1930's and in 1934 Ballona Creek was channelized to the ocean. The channelization of Ballona Creek (See aerial photos in Appendix C) caused flow to the wetlands and lagoons to be limited, and caused them to dry (USEPA, 2012).

Between the 1930's and 1950's, oil derricks were built throughout the wetland areas including the construction of dikes, which caused the wetlands to be drained or artificial ponds to develop. The Marina Del Rey development in the late 1950's removed a large portion of the remaining wetlands, when hydraulic fill was placed in Area A. As a result, the wetlands shrank to less than 200 acres, about 10 percent of the original area (USEPA, 2012).

The precise limits of Ballona Creek Wetlands are complex. Until about 2004, only the undeveloped Area B (south of Ballona Creek and north of Culver Boulevard) was identified as the Ballona Creek Wetlands. The construction of tide gates between the late 1990s to early 2000s restored some tidal flushing to the central portion of Area B. In 2001, the State of California retained Area C (north of Ballona Creek and east of Lincoln Boulevard) as part of a tax settlement. The Freshwater Marsh was completed in 2008 (south of Jefferson Boulevard and west of Lincoln Boulevard), where storm water runoff from the Playa Vista development and Jefferson Drain is discharged (USEPA, 2012).

Table 1: Anthropogenic Activities at Ballona Wetlands since the 1880's

Time period	Anthropogenic Activity	Impact
1880's to Early 1900s	Pacific Electric railroad tracks built on artificial fill earthen berms altered tidal flows in areas A, B and C	Sediment deposition; habitat alteration; reduced tidal flushing
1918	Lincoln and Jefferson Blvds. were constructed. Surface flows from eastern portions of wetlands were routed into culverts under Culver Blvd. in area B	Sediment movement; habitat alteration; reduced and/or restricted freshwater flows
1920s	Artificial fill was dumped in several places to construct oil and gas drilling platforms and protect them from extreme tides, and to build on artificial fill berms for access roads for the platforms; The Gas Company Rd. in Area B especially restricts flows from the east, and platforms and access roads in Area A created depressions where water continues to pond sporadically	Sediment deposition; habitat alteration; reduced tidal flushing and/or restricted freshwater flows
1930-1958	Farming of lima beans and barley in Areas B (east of The Gas Company Rd.) and C resulted in filling of many natural tidal channels	Sediment deposition and transport; habitat burial
1930s	Ballona Creek was straightened and channelized in concrete levees by the USACE; culverts with flap gates allowed drainage from Area B but prevented tidal inflows (except when gates malfunctioned)	Sediment deposition; habitat alteration; reduced and/or restricted freshwater flows and tidal flushing
1950s-60s	Centinela Ditch was excavated through Area B before 1950. The ditch directed freshwater flows from east of Lincoln Blvd. along the south border of the wetlands area. In 1962, Centinela Creek was fully channelized in concrete and diverted to Ballona Creek channel at Centinela Ave, at the then-eastward extent of the remaining wetlands.	Sediment deposition and removal; reduced and/or restricted freshwater flows
1960s	The southwest portion of the extant wetlands in 1960 was dredged to create Marina Del Rey marina. The dredged mud was deposited on what is now Area A, and raised the land surface 12 – 15 feet above previous mean sea level.	Sediment deposition; reduced tidal flushing

Excerpt from, *U. S. Environmental Protection Agency, 2012, Ballona Creek Wetlands, Total Maximum Loads for Sedimentation and Invasive Exotic Vegetation*

3.2 Historical Aerial Photos

Historical aerial photos from the UCLA Spence oblique aerial photo collection and other photos available on line at HistoricAerials.com (http://www.historicaerials.com) were reviewed to identify changes that occurred a within the project site from 1924 to 2005.

The Spence oblique aerial collection includes photographs taken from 1924 to 1938, which span the period before and after the construction of the Ballona Creek levees. Copies of some of these photographs are included in Appendix C. In the 1924 and 1928 photos, parcels to the east of the wetlands were being farmed. Ballona Creek had meandering channels throughout its central portion and Centinela Creek was flowing along the north edge of the El Segundo Sand Hills. At that time, water from both creeks was blocked by the coastal sand dunes and flowed to the north through the sand dune complex, then west to the coastal waters near the El Segundo Sand Hills.

The1933 Spence aerial photos show widespread farming parcels located through the Ballona Gap, with a moderate density of oil wells along the coast. Ballona Creek flowed west to the sand dune hills along the coast while the Centinela Creek flowed north along the toe area of the Westchester Cliffs to the west. In 1937, the photos show the Ballona Creek channel has concrete levee slopes east of Lincoln Boulevard with rip rap levees to the west. They show that when the channel was excavated, most of the excavated soils was placed on the north side and lesser amounts placed on the south side of the channel, as hydraulic fill for the levee. Construction of the levee system core was built up using the excavated soils. The 1938 photos indicate an increase of oil well density along the coast and inland to the east, with farm parcels increasing to the north.

The HistoricalAerials.com collection included aerial photos from the years 1952, 1972, 1980 and 2003 – 2005. The 1952 photo shows that the Marina Del Rey Harbor channel was not yet dredged and farm parcels were scattered within the Ballona Wetland area, and were more abundant to the north. The 1972 and 1980 photos show the Marina Del Rey Harbor channel as dredged with the dredged hydraulic fill placed across Area A and part of Area C. The old Howard Hughes Airport is visible east of Lincoln Boulevard and south of Jefferson Boulevard. The 1972 and 1980 photos show that to the north, the majority of the farming was gone and was replaced with residential and commercial buildings. By this time most of the farmland had been developed to the north. The 2003 – 2005 aerial photos show the airport as abandoned and the Playa Vista development under construction.

4.0 SITE DESCRIPTION

The Ballona Wetlands Restoration Project area consists of over 600 acres and is located in the northwest corner of the Los Angeles Basin, just south of Marina Del Rey. The project is divided into three primary Areas: Areas A, B and C, as shown in Figure 2. Area A is located north of Ballona Creek and west of Lincoln Boulevard. Area B is located south of Ballona Creek, and Area C is located north of Ballona Creek and east of Lincoln Boulevard. A brief description of each of the areas is provided in the USEPA (2012) report, as is summarized below.

4.1 Area A

Area A is approximately 139 acres in size and lies north of Ballona Creek, west of Lincoln Boulevard and south of Fiji Way (Figure 2). Elevations range between approximately 12 and 20 feet NAVD, with the higher ground located near Fiji Way. The original grade generally ranged from Elevation +2 to +10 feet NAVD. Fill was placed in Area A during the excavation of Ballona Creek in the early 1930's and in the 1960's when dredged soils from the development of Marina Del Rey were placed on the site. Area A is generally undeveloped, with the exception of a parking area along the western boundary and an unlined drainage channel located along Fiji Way located along the northern boundary in the eastern portion of the area (Fiji ditch). The Gas Company also currently maintains five monitoring well pad sites in the western end of this area (USEPA, 2012).

4.2 Area B

Area B is approximately 338 acres in size and lies south of Ballona Creek and west of Lincoln Boulevard. Area B extends south to Cabora Drive, a utility access road located near the base of the Playa Del Rey Bluffs (Figure 2). To the west, Area B extends into the natural sand dunes that border homes along Vista Del Mar. Elevations across Area B typically range between approximately +5 and +8 feet NAVD in the lower flat portions, and slopes up to about 50 feet NAVD below the Del Rey Bluffs, south of Culver Boulevard. Area B contains the largest area of remnant unfilled wetlands with abandoned agricultural lands to the southwest and the existing Freshwater Marsh to the northeast. The Gas Company has easements in Area B for 12 well sites (1 injection/withdrawal well and 11 monitoring wells) and a system of access roads (USEPA, 2012).

4.3 Area C

Area C is located north of Ballona Creek and east of Lincoln Boulevard (Figure 2). The Marina Freeway forms the northeastern border of Area C. The area is approximately 64 acres in size and is traversed in an east-west direction by Culver Boulevard. North Area C lies north of Culver and south Area C lies to the south. Area C contains fill from the construction of the Ballona Creek channel, and fill

generated from developments such as Marina Del Rey, the Pacific Electric Railroad, the raising of Culver Boulevard and the Marina Freeway. Elevations within Area C range from approximately +7 to +28 feet NAVD. Area C is mostly undeveloped with the exception of 4 baseball fields and supporting minor structures, located in the west portion of south Area C. The Gas Company has no facilities in Area C (USEPA, 2012).

5.0 DESCRIPTION OF PROJECT

The proposed restoration would restore estuarine wetland and upland habitats that are connected to a realigned Ballona Creek. The construction will be performed in phases.

1) Phase 1 involves excavation in Area A and construction of new levees around the enhanced wetland areas in Areas A and B.
2) Phase 2 involves excavation of a new meander channel for Ballona Creek; breaching and removing the existing Ballona Creek levees and filling in Ballona Creek between breach points; and, increasing muted tidal action in South Area B by constructing new culverts.
3) Phase 3 involves restoring tidal action to West Area B by lowering and breaching the intermediate Ballona Creek levee placed during phase1 in the eastern portion of West Area B.

Key Elements of the Restoration:

Key elements of the restoration project are described in the PDR (ESA PWA, 2013a), and include:

Ballona Creek Channel Restoration

- Removal of the existing levees downstream of the Culver Boulevard Bridge for a length of about 4,000 feet along the existing north levee and about 6,000 feet along the existing south levee, and the lowering and realignment of the channel for the creation of a natural meandering channel.

Area A

- Mass excavation to reclaim wetlands lost when the area was hydraulically filled during the development of Marian Del Rey. The excavation will slope down to the south from Fiji Way at a gradient of about 10 horizontal to 1 vertical to approximate elevation of 11 feet, and then at flatter gradients of about 100H:1V (horizontal to vertical) to a maximum depth of about 20 to 25 feet below the existing grade near the existing channel. The excavation will remove primarily hydraulic fill soils.

- Construction of flood protection levees along the west, north and east perimeter of Area A. The levees will generally extend about 5 to 10 feet above the existing grade in Area A.

Area B

- Construction of flood protection levees along the north side of Culver Boulevard in north and west Area B and east of the dunes in West Area B. The levees will generally extent up to a maximum of about 15 feet above existing grade.
- Full restoration of wetlands between the new levees and the realigned Ballona Channel and managed restoration of the wetlands area located south of the new levees.
- The area between Culver and Jefferson Boulevards will be used as a balance site, where excess cut material will be placed and compacted.

Area C

- North Area C, located north of Culver Boulevard, will also be used as a balance site where excess cut material will be placed and compacted.
- South Area C may be graded and developed by others as a complimentary service facility to the Wetlands Restoration Project.

Other Elements

- Construction of a pedestrian and bicycle bridge spanning the Ballona Channel near the Culver Boulevard Bridge, and an at-grade bicycle path along the new levee in Area B.
- Construction of buried culverts.

5.1 New Perimeter Levees

New engineered flood control levees will be built along the north, west and east perimeter of Area A and in Area B, north of Culver Boulevard and east of the dunes in West Area B. The proposed levees will be designed to meet or exceed the current flood control standards. The hydraulic analysis has been performed for hydraulic modeling for a number of flood events, including the project 100-year design flow, and future sea level rise (SLR), as included in the Preliminary Hydrology and Hydraulics Report of the project (ESA PWA, 2013b). The SLR is considered to be approximately 4.9 feet by 2100. The locations of the new levees are shown on Figure 4A.

At the preliminary design level, the perimeter levees have been designed with a constant levee crest of El. 20.5 feet NAVD. With this design elevation, the minimum freeboard considering SLR along the new levees will be about 4 feet (i.e. 3.81 feet). In general, all levees will include a compacted low permeability core with 3H:1V side

slopes. However, the actual levee slopes are significantly flatter with creek side slopes as flat as 10H:1V.

5.1.1 Area A Levee

The proposed levee is planned to follow the perimeter of Area A with a minimum of about 30 feet offset from Fiji Way and Lincoln Boulevard. and placed just south of Fiji Channel (Figure 4A). The proposed levee will be offset to maintain the existing parking lots along Fiji Way and to avoid existing natural gas monitoring well, Del Rey 17. The levee will tie into the existing Ballona Creek levee at Culver Boulevard, at the upstream limit of the marsh restoration area.

The levee incorporates an idealized 6H:1V protected side slope and a 10H:1V channel side slope from El. 20.5 feet at the crest down to El. 11.0 feet. This levee is generally located 800 to 1,200 feet from the realigned Ballona Creek Channel.

5.1.2 Culver Levee in Area B

The Culver levee in Area B includes three distinct design sections.

1) The first section includes a wide plateau at the upstream limit between Culver Boulevard and the old railroad alignment. This wide section is intended to vary the widening of the restored Ballona Creek floodplain to help even out the hydraulic drop of flood levels as flood flows enter the Wetland Restoration Project Site.
2) A narrow section (20 feet top width) along Culver Boulevard, extending to the intersection with Jefferson Boulevard.
3) A wide section (100 feet top width) along Culver Boulevard, from Jefferson Boulevard, to West Area B.

The culver levee sections are planned with a minimum 30 foot offset from Culver Boulevard, and will be built with 3H:1V protected outside side slopes, and 10H:1V interior slopes down to El. +6.5 feet NAVD, with a flatter transitional slope to the adjacent tidal marsh plain.

5.1.3 West Area B Levee

The proposed West Area B Levee (Figure 4A) will be located about 300 feet east of the toe of the natural dunes that border the west end of West Area B. The levee will have a top width of 20 feet, a 3H:1V slope toward the existing dunes to the west and a 10H:1V slope down to the existing managed marsh to the east.

5.1.4 Temporary Area B Levee

The project will be phased will full restoration of West Area B delayed for a number of years until the restoration in Area A and North Area B demonstrates success. During this interim period, a temporary levee will connect the Culver Levee to the existing Ballona Creek South Levee just north of the existing natural gas monitoring well cluster in West Area B. The location of this levee is shown in Figure 4A.The temporary levee will be constructed with 5H:1V side slopes on the channel side, and a 3H:1V slope on the protected side.

5.2 Excavation and Channel Realignment

The reintroduction and revival of critical wetland habitat, involves mass grading, soil excavation and hauling of previously placed dredged materials to lower the grades in Area A to create tidal wetlands, salt pans, transitional habitat, upland habitat and seasonal wetlands.

Realignment of Ballona Creek will entail construction of new meander channel segments and filling of the existing channel segment that will be abandoned. A fully-connected Ballona Creek channel and wetland system will be restored across the site, beginning west of the Culver Bridge and extending through the site to the southwest (downstream) project boundary. The channel banks would be graded to slopes of approximately 5H:1V.

5.3 Stockpiles in Area B and Area C

The intent of the project is to balance earthwork on site. Excess excavated soils will be placed as stockpile fill in portions of Areas B and North Area C. The fill mounds in East Area B will be located in the area south of Culver Boulevard and North of Jefferson Boulevard Fill mounds will be offset from the streets to avoid significant settlements in roadways or utility lines, and will be sloped at a gradient of 10H:1V. The height of the fill mounds will be depend on the amount of excess soils.

5.4 Hydraulic Structures (Culverts)

Two new water control structures will be installed in Area B at the locations shown on Plate I-1. Both culverts will extend under the new Culver Levee and under Culver Boulevard.

5.5 Public Access Plan

A public access plan is being developed to maintain existing uses and provide additional access opportunities. Anticipated elements include a pedestrian bridge west of the Culver Boulevard Bridge, and parking and access at the southwest corner of Area B, where existing parking and trails are heavily used.

It should be noted that the Annenberg Foundation currently has plans for development in portions of Area C. Additional public access to other areas within the Wetlands may be created as part of these planned developments.

6.0 SUMMARY OF PREVIOUS INVESTIGATIONS

Several geotechnical investigations have previously been performed at the Project Site by Law Crandall Inc., Diaz Yourman & Associates, and Weston Solutions (Law Crandall, 1988, 1991; Diaz Yourman & Associates, 2010; and Weston Solutions, 2009). The previous investigations by Law Crandall, Inc. and Diaz Yourman & Associates were performed primarily for geotechnical purposes. Law Crandall, Inc. performed preliminary geotechnical investigations in each of the Areas within the project (Areas A, B and C) and presented the results of investigations in separate reports. Diaz Yourman & Associates performed a preliminary geotechnical investigation for Areas B and C. The investigations by Weston Solutions, Inc. were performed primarily for the chemistry and environmental testing of the soils present.

Data from these previous investigations was reviewed and used to supplement the information developed during the current investigation. However, in general, the previous investigations were performed to primarily characterize the physical properties, and limited data is provided regarding the engineering properties of the soils encountered. A summary of each of the previous investigations is provided below. The locations of the field explorations performed during these previous investigations are shown in Figure 3. Boring logs and CPT interpretations of previous investigations are included in Appendix A2. Selected results of the previous laboratory testing are presented in Appendix B2

GDC also has long-term experience with similar soils present within the Playa Vista Development, located east of Lincoln Boulevard. The experience at the Playa Vista Development was used in characterizing the engineering properties of the soils at this site.

6.1 Area A

Law Crandall, Inc. - 1991 Area A –Playa Vista Marina

This report presents the results of a preliminary geotechnical investigation of Area A for a then-proposed Playa Vista Marina, which included excavation to about Elevation -15 feet. Law Crandall, Inc. had done an earlier study to determine the location of an existing natural gas storage reservoir and the effect of the reservoir on the marina construction. In this study they investigated the physical characteristics

of the soils to provide recommendations for perimeter wall lateral earth pressures, and foundation support.

The field investigation included 20 borings (14 Rotary Wash and 6 Bucket-type borings) and 5 cone penetration tests (CPT) that were performed in December 1988 and January 1989.

According to this report, fill soils were encountered to 9 to 17 feet below ground surface, and consisted primarily of silts, clays and silty sands. The majority of the fill was placed hydraulically during dredging of the Marina Del Rey Harbor although some dump fill was also apparent to be present. Beneath the fill, the site is underlain by Holocene Alluvium extending to an estimated depth of 100 feet below ground surface. The alluvial deposits are predominantly cohesive soils to depths of about 50 to 70 feet and are underlain by dense sand and gravel. The upper cohesive soils consist of soft to medium stiff silts and clays with some layers of loose to dense silty sand and sand and occasional minor layers of peat. The alluvial deposits are of estuarine origin and contain decomposing organic materials, which generate the organic odor (hydrogen sulfide). The dense sands and gravel deposits were encountered at depths between 48 and 67 feet. These coarser sediments were described by Poland (1959) as the "50-foot-Gravel" a ground water aquifer.

Early Pleistocene San Pedro Formation sediments underlie the Holocene deposits. The sediments consist primarily of sand with some gravel, with some interbeds of silt. This layer extends to a depth of about 200 feet below ground surface. Below the Pleistocene soils underlies 5,800 feet of Tertiary age sedimentary rocks, which rest on metamorphic basement rocks of the Mesozoic Catalina Schist.

Groundwater was encountered in the borings at depths about 7 to 15 feet below ground surface corresponding to elevations of about +0 to +10 NAVD. The site was identified as potentially liquefiable. Liquefaction settlements on the order of 1 to 4 inches were indicated to be anticipated in looser interbedded sandy layers.

According to the report some peat deposits were encountered, but the peat deposits were below the ground water level and thus not subject to oxidation and drying. Collapsible soils were not encountered.

Law Crandall, Inc. - 1991 Area A – Playa Vista Marina – Supplemental Report

This report provides supplementary information for the 1991 Marina Report. According to this report a review of Los Angeles County Waste Management records revealed the presence of a former dump site, known as the *Celery Dump*, in the northeast portion of Area A that could affect ground water quality. The celery dump was apparently operated between 1945 and 1953. Two borings were drilled to depths of 17 and 22 feet to collect ground water samples for laboratory analyses

and to explore for organic materials that might be present from the former celery dump. Two additional shallow borings were also drilled to further explore the organic materials. Ground water was encountered at a depth of 14 to 17 feet.

The results of the environmental testing showed higher lead concentrations that were deemed acceptable for disposing of the ground water into the ocean. According to the report settlement due to placement of the fill in the area was estimated to be about 2 inches per foot of fill placed.

Weston Solutions, 2009 – Area A – Preliminary Geotechnical Investigation and Beneficial Use Assessment – for Port of Los Angeles

A total of five alternatives were assessed for the Restoration Project in Area A. The objectives of this preliminary Area A study were to identify the geotechnical, chemical, and physical characteristics of the soil and existing dredged material, determine the potential used of the dredged material and assess the cost associated with excavation and transporting the material. Chemical and geotechnical testing were performed on the samples collected from 20 direct push borings drilled to a maximum depth of about 24 feet. The geotechnical testing on the samples was limited to physical properties of the soils.

6.2 Area B

Law Crandall, Inc. - 1991 Area B – Proposed Wetland Restoration and Development north of Jefferson Boulevard

The investigation for the Wetland Restoration Project included 32 initial borings including 7 borings in the existing levee, and 5 additional borings to study a proposed embankment near Culver Boulevard in January and February of 1991. Additionally 21 borings were drilled in December of 1986 and April of 1987. Monitoring wells were installed in 12 of the borings to measure the fluctuations in the ground water levels beneath the site. Most of the borings were drilled using 5-inch-diameter rotary wash drilling equipment to a depth of approximately 20 to 60 feet. Six (6) borings were performed using 8-inch-diameter hollow-stem auger equipment to a depth of approximately 30 feet. Additionally, six 8-inch-diameter hand auger borings were drilled to a depth of 5 to 9 feet below the existing grade.

The report identified the artificial fill at the roads as dark reddish-brown sand, silty sand, and sandy silt. According to this report the surface soils near the western boundary are composed of Holocene dune sands. The sand dunes were characterized as poorly cemented, highly susceptible to erosion and at least 30 feet deep.

According to this report settlement due to placement of the fill in the area was estimated to be about 1.5 inches per foot of fill placed. Liquefaction and seismic settlement were anticipated to be limited. The ground water level ranged from about 0.1 to 4.5 feet below the ground surface, corresponding to elevations of +4 to +7.5 feet NAVD.

6.3 Areas B and C

Diaz Yourman & Associates, 2010 Areas B & C – Proposed improvement and restoration of Ballona Creek wetlands

The purpose of this study was to provide subsurface sediment sampling and laboratory testing on the sediment samples to determine the physical and chemical characteristics of sediments located in Areas B & C. Field investigation was performed using hollow-stem auger drilling equipment in February of 2009 and included drilling 13 borings in Area B and 7 boings in Area C to depths ranging from 16 to 32 feet below the existing grade, as well as collecting grab samples at three locations in Area B. Samples were collected for chemistry testing down to elevation -5 feet MLLW and for geotechnical testing down to elevation -10 feet MLLW.

Ground water was encountered in the borings at depths ranging from 2 to 11 feet bgs corresponding to elevations +8 and 2 feet NAVD in Area B, and at depths ranging from 17 to 23 feet bgs corresponding to Elevation +6 and +2 feet NAVD in Area C.

6.4 Area C

Law Crandall, Inc. - 1988 Area C – Report of Contamination Assessment

A study was performed to determine if soil or ground water contamination is present on the subject property. Up to 15 feet of fill were identified in the borings. The "50-foot-Gravel" layer was identified to be present at a depth of 60 feet. This investigation included 16 borings and 5 monitoring wells. The findings of this investigation indicated that no significant soil or ground water contamination is present beneath the site.

Law Crandall, Inc. - 1991 Area C – Proposed Development in Area C

The site conditions were explored by drilling 5 borings to depths of 60 to 75 feet using 5-inch-diameter rotary wash drilling equipment. Fill soils from 4 to 15 feet were encountered in the borings. At depths of about 41 to 57 feet below the existing grade the dense sandy and gravelly layer "50-foot Gravel" was identified.

The report used information from an earlier contamination assessment study at the site, which included 16 borings and 5 monitoring wells. According to the report settlement due to placement of the fill in the area was estimated to be about 1 inch per foot of fill placed. Water was measured in the borings at depths of 12 to 22 feet below the existing grade, corresponding to elevations between +0 to +6 feet NAVD.

7.0 SUBSURFACE EXPLORATION BY GDC

GDC conducted a geotechnical subsurface investigation for the project site from September 11, 2012 to October 22, 2012. Prior to the subsurface investigation, a geotechnical investigation work plan (GDC, 2012) was prepared, which outlined and defined the procedures for obtaining the necessary access and work permits, developing access routes and a plan to avoid special status plants, minimize impact to natural habitat, and/or archaeological sites within the project area. This work plan also describes the drilling equipment, soil sampling (including geotechnical, chemistry, and agronomy sampling), post-investigation site cleanup, and the laboratory testing program (geotechnical, chemical, and agronomy). The geotechnical investigation work plan and procedures were followed prior to, during, and subsequent to the field exploration, to obtain necessary site information for the project while minimizing environmental impact to the project.

The investigation consisted of rotary-wash and hollow-stem auger soil borings, one hand auger boring, and cone penetration tests. Exploration locations were planned approximately every 700 feet along the length of the levees. Typically, two explorations were performed at the crest and the toe of the levee. The exploration locations are shown in Figure 3. Geotechnical drive samples and bulk samples of the encountered materials were obtained from the borings, and tested in the laboratory to evaluate the physical and engineering characteristics of the subsurface materials encountered. In addition to geotechnical sampling, samples for chemical testing, and sediment analysis, were also collected in 10 borings, as directed by the project environmental consultants. Boring logs and CPT interpretations are included in Appendix A1. Geotechnical laboratory test results are included in Appendix B1.

7.1 Soil Borings

Twenty five (25) rotary wash borings were advanced to a maximum depth of 71.5 feet in Areas A and B. The rotary wash borings were located along the proposed levees as well as along the existing Ballona Creek levees. Eight (8) hollow stem auger borings were drilled to a maximum depth of 31.5 feet in planned excavation areas within Area A, and surcharge areas within Areas B and C. One hand auger boring was drilled to a depth of 5 feet in West Area B, where access was limited, due the presence of protected habitat plant. All borings were drilled from approximate elevations ranging from +5 to +21.1 feet NAVD. Subsurface materials were visually

logged and classified by a GDC field engineer in accordance with the Unified Soil Classification System (USCS).

Drive samples and bulk samples of the encountered materials were obtained from the borings and recorded on the boring logs. Drive samples were obtained with a California Sampler lined with 1-inch high metal sample rings and a Standard Penetration Test (SPT) sampler. Standard penetration tests (SPT) were conducted in accordance with ASTM D 1586 and samples were collected. Six-inch-long Shelby tubes were also used for sampling relatively undisturbed soil samples in the rotary wash borings.

In addition, representative bulk samples were taken within the upper 5 feet, as well as at depths as deep as 20 feet for compaction testing, expansion potential and corrosion testing, as well as chemistry and agronomy testing.

The boring logs are presented in Appendix A1.

7.2 Cone Penetration Tests (CPT)

Thirty one (31) Cone Penetration Test (CPT) probes were conducted at the site on from September 13, 2012 to October 15, 2012. The CPTs were generally advanced to depths ranging from 48 to 71.5 feet below existing grade. The CPT soundings were performed in general accordance with ASTM D3441, using a truck-mounted electric piezocone penetrometer. The locations of the soundings are shown in Figure 3.

As the CPT probe was advanced, electronic instruments recorded a continuous profile of both the tip and frictional resistances, which were then analyzed using established correlations, to classify the soils and evaluate insitu properties, including density, strength and compressibility. Additional details concerning the field exploration program, including copies of all the boring and CPT logs, are included in Appendix A.

The CPT logs and interpretations are presented in Appendix A1.

7.3 Shear Wave Velocity Measurement using CPTs

Shear Wave Velocity measurements were performed in seven (7) of the CPTs (A-CPT001, A-CPT004, A-CPT022, B-CPT031, B-CPT041, B-CPT048, and C-CPT060) to a depth of 70 feet, using a Seismic CPT. For the test large amplitude shear waves were generated by striking a seismic beam at the ground surface, and recording shear waves at various depths using a seismometer in the cone penetrometer. The seismic CPT test is typically performed at 5-foot intervals. The results of the seismic shear wave velocity measurements are presented in Appendix A1.

The average shear wave velocity in the upper 30 meters (Vs30) was estimated to be 202 m/s (662 feet/s). The shear wave velocity is used in seismic hazard analyses for the project.

Shear Wave Velocity Profiles are included in Appendix D.

7.4 Field Permeability Testing

As part of our field exploration program, four field permeability tests were performed at depths of 5 and 10 feet, at two exploration locations (i.e., A-HSA064 and A-HSA066) near the existing north levee to evaluate the permeability of the near surface soils. The tests were performed by filling hollow stemmed borings with water and estimating permeability of near surface soils using the falling head method, by measuring the drop in water elevation in the hole, over time. The results of the field permeability testing are presented in Appendix E.

7.5 Laboratory Testing Program

The following geotechnical laboratory testing was performed to evaluate the physical properties and engineering characteristics of representative subsurface materials at the site. The tests include:

- Natural moisture content & dry unit weight
- Atterberg Limit Tests
- Percent passing No. 200 sieve
- Grain Size Distribution
- Consolidation
- Direct shear
- Lab Vane shear
- Pocket penetrometer
- Expansion index
- Compaction
- Corrosivity (pH, sulfate, chloride, electrical resistivity)

A detailed description of the GDC geotechnical laboratory testing program and test results are presented in Appendix B1.

8.0 GEOLOGY AND SOIL CONDITIONS

8.1 Regional Geology and Faulting

Regionally, the Ballona Wetlands are located near the western edge of the southwest block of the Los Angeles Basin, within the Peninsular Range Geomorphic Province. To the north, the Peninsular Range Geomorphic Province merges with the Santa Monica Mountains, which is within the Transverse Range Geomorphic Province of California.

The project site is located within the seismically active area of southern California, and has the potential to experience strong ground shaking from local and regional faults. Table 2 provides a summary of the active faults in the site area, which have the potential to general strong ground shaking, within 30 kilometers of the Project Site. A Fault Map showing the major faults in the vicinity of the site is included in Appendix D (Plate D-1).

The closest mapped fault near the site is the Charnock Fault, mapped as being present about 1 mile east of the site. The Charnock Fault has been speculated to be a ground water barrier, a fault or both (Poland, 1959; Geo-Consultants, Inc, 1999). Various investigators concluded that the Charnock Fault was a deep fault and did not break the Pleistocene "50"-foot gravel layer, giving evidence that it is not active. During one of the latest investigations by Davis and Namson Consulting Geologists (2000), and Thomas Wright (1991), using seismic reflection and oil well data, it was concluded that the Charnock Fault was not detected within the depth of the geophysical acquisition and oil well data. Namson and Davis (2000) further suggested that if the Charnock Fault exists below the extent of the seismic reflection acquisition, the fault would likely be 1 to 2 million years old. The mapped location of the Charnock fault is also included in Appendix D (Plate D-2).

Table 2: Major Faults in the Vicinity of the Site

Fault Name	Type of Faulting	Maximum Magnitude (Mw)	Distance from Site (km)	Slip Rate (mm/yr)
Newport-Inglewood	Strike Slip	7.5	7.3	1.0
Santa Monica	Strike Slip	7.3	7.8	2.6
Palos Verdes	Strike Slip	7.7	8.9	3.0
Malibu Coast	Strike Slip	6.7	10.2	0.3
Puente Hills	Thrust	7.0	11.7	0.7
Hollywood	Strike Slip	6.7	12.8	1.0
Elysian Park (Upper)	Reverse	6.7	20.4	1.3
Anacapa-Dume	Reverse	7.2	23.7	3.0
Raymond	Strike Slip	6.8	25.9	1.5
Verdugo	Reverse	6.9	28.0	0.5

Note: USGS Fault Database (2008)

8.2 Historical Earthquakes

Historically, several major earthquakes with a Magnitude of 5.9 to 6.7 have occurred not too far from the Project Site. A brief description of the most recent of these historical earthquakes follows.

8.2.1 Long Beach Earthquake of 1933

The 6.4 magnitude Long Beach earthquake took place on March 10, 1933, causing widespread damage to buildings throughout Southern California. The epicenter was offshore, southeast of Long Beach on the Newport-Inglewood Fault, and approximately 35 miles south east of the site. The estimated ground motion caused at the site was less than 0.1g.

Although only moderate in terms of magnitude, this earthquake caused serious damage to weak masonry structures on land fill from Los Angeles south to Laguna Beach. Property damage was estimated at $40 million, and 115 people were killed. The earthquake was felt almost everywhere in the 10 southern counties of California. Damage to school buildings, which were among the structures most commonly and severely damaged by this earthquake, led to the State Legislature passing the Field Act, which now regulates building-construction practices in California (earthquake.usgs.gov).

8.2.2 San Fernando Earthquake of 1971

The 6.6 magnitude San Fernando earthquake occurred on February 9, 1971, in a sparsely populated area of the San Gabriel Mountains, near the city of San Fernando. It lasted about 60 seconds, and, in that brief span of time, took 65 lives, injured more than 2,000, and caused property damage estimated at $505 million. The epicenter was located about 30 miles north of the site. The Modified Mercalli Intensity (MMI) felt at the site ranged from V to VI (i.e. Moderate to Strong), corresponding to PGA values in the range of 0.04g to 0.18g and Peak Ground Velocity (PGV) of about 3 to 16 cm/sec (www.cisn.org).

8.2.3 Whittier Narrows Earthquake of 1987

The 5.9 magnitude Whittier Narrows earthquake occurred in the southern San Gabriel Valley and surrounding communities of Southern California on October 1, 1987. The epicenter was in the town of Rosemead, about 22 miles east of the site. The earthquake was caused by slip on a blind throughst fault near the northern end of the Whittier Fault, which is part of the Elsinore Fault Zone, on a previously unknown fault structure. There was no surface rupture. The Modified Mercalli Intensity (MMI) felt at the site was V (i.e. Moderate) corresponding to PGA values in the range of 0.04g to 0.09g and Peak Ground Velocity (PGV) of about 3 to 8 cm/sec (www.cisn.org).

8.2.4 Northridge Earthquake of 1994

The Northridge Earthquake occurred on January 17, 1994 in Northridge, California, approximately 20 miles northeast of the site. It was a magnitude 6.7 earthquake and ended up being the most costly earthquake in United States history.

The shaking heavily damaged communities throughout the San Fernando Valley and Simi Valley, and within the surrounding mountains north and west of Los Angeles, causing 20 billion dollars of loss.

Sixty people were killed, more than 7,000 were injured, and more than 40,000 buildings suffered damaged. This earthquake was occurred about 18 miles north of the site. The Modified Mercalli Intensity (MMI) felt at the site ranged from VI to VII (i.e. Strong to Very Strong) corresponding to PGA values in the range of 0.20g to 0.30g and Peak Ground Velocity (PGV) of about 30 cm/sec (www.cisn.org; and earthquake.usgs.gov).

8.3 Local Geology

The Ballona Wetlands are located in the Ballona Gap, which is bounded by the El Segundo Sand Hills to the south and the Ocean Park Plain to the north. The Ballona Gap was formed by erosion, repeated sea level fluctuations, and river channel migration. During the Holocene period, the Los Angeles River channel flowed though the Ballona Gap, while today the Los Angeles River flows through the Dominguez Gap and the Ballona Creek flows though the Ballona Gap.

The geologic map of the site is included in Appendix C (Plate C-1). In the Ballona Creek region, marine and non-marine sediments are around 6,000 feet thick and unconformably overlay the crystalline basement rock of the Mesozoic aged Catalina Schist.

During recent historic times, fill has been placed over the natural deposits, locally. The upper 50 feet of sediments consists of Holocene aged fluvial silts, clay and sand deposits from the flooding of creeks and streams, tidal marshes and sand dunes and other windblown deposits that filled the Ballona Valley. These Holocene sediments overlay on top of the "50 foot" gravel in isolated areas and the San Pedro and Pico Formations. Below the San Pedro and Pico Formations, the lower Tertiary formations were found to be rich in petroleum.

8.3.1 Local Site Micro-Seismicity

From 1994 to 2012, 10 micro-earthquakes were recorded near the site area with magnitudes in the range of 2.3 M_L to 3.5 M_L (Local Magnitude) and with epicenters at a depth of 9 to 16 kilometers. These micro-events occurred within a 3-kilometer

radius from the approximate center point of the restoration area located at 33.974N and 118.438W. Table 3 summarizes the epicenter data for these 10 events (http://earthquake.usgs.gov/earthquakes/eqarchives/epic/). A map showing the location of the epicenters is included in Appendix D (Plate D-2).

Table 3: Mapped Epicenter for Recent Micro-Earthquakes within 3 km of Site

DATE_TIME	LAT	LON	DEP	MAG	MT	SC
2011-12-21 17:06:22.59	33.978	-118.413	11.2	2.4	ml	pde
2009-06-07 09:02:58.62	33.967	-118.428	16.2	2.3	ml	pde
2009-05-12 09:01:24.27	33.992	-118.456	10.0	2.5	ml	pde
2008-10-22 22:03:33.87	33.989	-118.431	11.8	2.5	ml	pde
2005-06-23 10:32:11.23	33.980	-118.423	15.7	2.8	ml	pde
2004-03-23 01:51:29.00	33.967	-118.430	9.9	2.8	ml	pde
2000-09-16 13:24:41.33	33.976	-118.424	12.2	3.3	ml	pde
1994-12-11 10:48:26.17	33.989	-118.435	14.1	3.5	ml	pde
1994-07-21 22:57:50.76	33.973	-118.439	12.0	2.8	ml	pde
1994-01-18 18:46:58.63	33.964	-118.434	15.8	3.1	ml	pde

Notes: 1) LAT = latitude; LON = Longitude; DEP = Depth; MAG = Magnitude; MT = Magnirude Type; SC = Source
2) ml = Richter Local Magnitude
3) pde = Preliminary Determination of Epicenters.

It should be noted that none of the reported micro-earthquakes are shallow (minimum depth is 9.9 km) and that the depth and magnitude estimates were generated using seismometers located at relatively large distances from the source. Thus the accuracy of this data, including their location, is approximate. In our opinion, this micro-seismicity does not reveal the presence of shallow (near surface) active faults in the subject area.

8.4 Surface Conditions

8.4.1 Area A

Surface conditions in Area A consist of a somewhat level brushy soil surface. The surface elevation typically ranges from about +12 feet to +20 feet NAVD. The brush found to be low to medium in height with isolated patches of exposed to thinly vegetated soil. Area A is currently fenced off and is undeveloped with the exception of a parking area along the western boundary and a drainage channel along the northern boundary. The existing Ballona Creek levees are located along the southern edge of Area A. An excavated, unlined drainage channel known as the "Fiji Ditch" runs parallel to Fiji Way along the northern boundary in the eastern portion of the area, and drains to the ocean through an existing culvert perpendicular to Fiji Way. The elevations within Fiji Ditch are as low as about El. +4 feet NAVD. In addition, the Gas Company operates five gas monitoring well sites in

the western end of the area. In general, the surface soils are dry and loose. Some areas have abundant rodent activity and are difficult to walk over.

8.4.2 Area B

Area B which lies south of Ballona Creek, is undeveloped, and contains the largest area of the existing wetlands with elevations at about +5 feet NAVD. Though some fill is present in this area, most of the fills are limited to Culver Boulevard and Jefferson Boulevard Roads. Area B is divided into four sections: north, south, west and east. The existing Ballona Creek levees are located along the northern edge of Area B (north and west). The Gas Company maintains a gas storage facility beneath the site in the oil field between north Area B and west Area B. South Area B is located south of Jefferson Blvd and East Area B is located south of Culvert Blvd. and west of Lincoln Blvd.

8.4.3 Area C

Area C is located north of Ballona Creek and east of Lincoln Boulevard. The Marina Freeway forms the northeastern border of Area C. The area is approximately 64 acres in size and is divided into a north and south portion by Culver Boulevard.

North Area C is undeveloped and contains low mounds, low to medium-high brush and isolated patches of exposed to thinly vegetated soil. The surface elevation typically ranges from about +14 feet to +17 feet NAVD. The Fiji Ditch runs southeast to northwest through the center of the site. In south Area C, the western portion contains baseball diamonds and associated minor structures, with some trees and grass. The eastern portion is undeveloped. The elevation is typically about +20 to +24 feet NAVD, There is a low area adjacent to the on/off ramps which has an elevation of +9 feet NAVD. The elevation of the levee along the channel ranges from about +19 feet to +22 feet NAVD.

8.5 Subsurface Conditions

Generalized subsurface profiles developed from the borings and CPTs performed in each area of the site are presented in Figures 5A, 5C, and 5D for Area A, Figures 5B and 5C for Area B and in Figures 5E and 5F for Area C. The soil conditions in each area are described below.

8.5.1 Area A

Surface elevations at exploration locations generally range approximately between +12 to +21 feet NAVD. Three distinct layers were identified in our exploration locations.

Plots of moisture content, dry density, and consistency of Area A soils from our investigation and previous investigations are shown in Appendix B3 and B4, respectively (Plates B3-1 through B3-4 and B4-1 through B4-4).

8.5.1.1 Layer No. 1: Artificial (Hydraulic) Fill

Artificial fill primarily from dredging of Marina Del Rey and Ballona Creek Channel cover the surface of Area A. The thickness of the Fill layer varies from 8 to 20 feet, with bottom of the layer at elevations ranging from El -3 feet NAVD near the channel to El +9 feet NAVD near Fiji Way.

The fill materials encountered in our explorations were consistent with the findings of previous investigation and are comprised predominantly of soft to medium stiff sandy silts and clays (ML, and CL), and loose to medium dense silty sands (SM). To a lesser extent, other soil types encountered in the borings include poorly graded sands and gravels (SP, GP) as well as small layers of elastic silts (MH).

Moisture contents in the fill soils ranges from 6 to 57 percent, and dry densities range from 64 to 117 pcf. Liquid Limit ranges from 28 to 69, and Plasticity Index ranges from 13 to 37.

8.5.1.2 Layer No. 2: Fine Grained Soils with Interbedded Sands Layers

Below the Fill layer, lies a predominantly fine grained layer with interbedded sand and silt layers. This layer is approximately 35 to 50 feet thick, and predominantly includes very soft to medium stiff clays and silts (CL, CH, ML, and MH), and loose to medium dense sands (SM, SC, and SP). Some denser/stiffer soils are also present within this layer, but individual layers are not found to be laterally continuous.

Moisture contents in this layer ranges from 15 to 91 percent, and dry densities range from 44 to 115pcf. Liquid Limit ranges from 29 to 92, and Plasticity Index ranges from 8 to 40. Undrained Shear Strengths in the layer generally varies in the range of 250 psf and 2,000 psf, with typical values between 500 and 1,500 psf. Plots of undrained shear strength results from laboratory vane shear within Area A soils are included on Plate B3-1.

8.5.1.3 Layer No. 3: Dense to Very Dense Sands and Gravels

Dense to very dense sands are present at depth of about 55 to 70 feet NAVD (El -32 to El -52) with SPT blow counts greater than 30 blows per foot. The CPT tip resistance is generally greater than 100tsf, which depicts that the materials are generally very dense.

8.5.2 Area B

Surface elevations at exploration locations in Area B generally range approximately between +5 to +8 feet NAVD, and as high as El +21 feet at existing levees and eastern portions of Culver Blvd. Three distinct layers were identified in our exploration locations.

Plots of moisture content, dry density and consistency of Area B soils from our investigation and previous investigations are shown in Appendix B3 and B4, respectively (Plates B3-15 through B3-18, and B4-7 through B4-10).

8.5.2.1 Layer No. 1: Artificial Fill

A Fill layer is also present in non-wetland areas within Area B. The thickness of the Fill layer varies from 0 to about 15 feet, with bottom of the layer at elevations ranging from El 0 to El +6 NAVD.

The Fill materials predominantly include loose to medium dense silty sands (SM) and soft to stiff sandy silts and clays (ML). Other soil types encountered in the borings include poorly graded silty sands and gravels (SP-SM, GP).

Moisture contents in the Fill soils ranges from 21 to 31 percent, and dry densities range from 76 to 94pcf. Materials in this layer were either non-plastic or had low plasticity.

8.5.2.2 Layer No. 2: InterbeddedFine Grained and Coarse Grained Soils

Below the Fill layer, lies interbedded fine grained and coarse grained soils. Immediately below the fill very soft to medium stiff fine grained soils are present to about El -5 to -10 feet NAVD. These soils predominately consist of fat clays (CH) with lesser amounts of elastic silts (MH), low to medium plasticity clays and silts (CL, ML). Interbedded loose to very dense sands and fine grained soils extend below El -10 feet to about El -45. The interbedded sand layers are generally thicker on the west side of the Area B, with a thickness of about 35 feet near the sand dunes. Moisture contents in this layer ranges from 14 to 81 percent, and dry densities range from 51 to 118pcf. Liquid Limit ranges from 27 to 84, and Plasticity Index ranges from 3 to 50. Undrained Shear Strengths in the layer generally varies in the range of 250 psf and 2,000 psf, with typical values between 300 and 1,500 psf. Plots of undrained shear strength results from laboratory vane shear within Area B soils are included on Plate B3-14.

8.5.2.3 Layer No. 3: Dense to Very Dense Sands

Dense to very dense sands are present at depth of about 60 to 70 feet NAVD (El -45 to El -58) with SPT blow counts generally greater than 40 blows per foot. The CPT

tip resistance is generally greater than 100 tsf, which depicts that the materials are generally very dense.

8.5.3 Area C

Surface elevations at exploration locations in Area C generally range approximately between +13 to +24 feet NAVD. Three distinct layers were identified in our exploration locations.

Plots of moisture content, dry density and consistency of Area B soils from our investigation and previous investigations are shown in Appendix B3 and B4, respectively (Plates B3-21 through B3-24, and B4-13 through B4-16).

8.5.3.1 Layer No. 1: Artificial Fill

Artificial Fill is present in the upper 8 to 15 feet of Area C. The thickness of the Fill layer varies from 8 to 15 feet, with bottom of the layer at elevations ranging from El +7 to El +15 NAVD.

The Fill materials are a mixture of fine grained and coarse grained soils, and predominantly include loose to medium dense silty sands (SM) and soft to stiff sandy silts and clays (ML, and CL). Other soil types encountered in the borings include poorly graded sands and clayey sand (SP, SC) as well as high plasticity silts and clays (MH, CH).

Moisture contents in the Fill soils ranges from 2 to 53 percent, and dry densities range from 69 to 119pcf. Liquid Limit ranges from 40 to 71, and Plasticity Index ranges from 13 to 36.

8.5.3.2 Layer No. 2: InterbeddedFine Grained and Coarse Grained Soils

Below the Fill layer, interbedded layers of fine grained and coarse grainedsoils are present. This layer is approximately 40 to 50 feet thick, and predominantly includes soft to stiff clays and silts (CL, CH, ML, and MH), and loose to dense sands (SM, SC, and SP).

Moisture contents in this layer ranges from 8 to 53 percent, and dry densities range from 68 to 134pcf. Liquid Limit ranges from 24 to 75, and Plasticity Index ranges from 12 to 47. Undrained Shear Strengths in the layer generally varies in the range of 500 psf and 2,500 psf.

8.5.3.3 Layer No. 3: Dense to Very Dense Sands

Dense to very dense sands are present at depth of about 50 to 60 feet (El -30 to El -33 NAVD). The CPT tip resistance is generally greater than 200 tsf, which depicts that the materials are generally very dense.

8.6 Generalized Subsurface Cross sections

Based on the subsurface explorations performed, generalized subsurface cross sections along the length of the new levees planned in Area A and Area B are shown on Figures 5A and 5B, and a generalized subsurface profile along the existing Ballona Creek levees is shown on Figure 5C. These profiles include borings and CPTs located within about 100 feet of the levee alignment.

A generalized subsurface cross section within the interior of Area A showing the soils that will be excavated is presented on Figure 5D. Two generalized subsurface profiles were developed for Area C. An East-West cross section in Area C south, as shown on Figure 5E, and a North-South cross section extending through both north and south Area C is shown on Figure 5F.

In addition, for the analysis of levee stability, generalized subsurface cross-sections, were developed at critical locations that were selected for analyses based on the subsurface and topographical conditions encountered. The locations of these critical sections are shown on Figure 4 (4A and 4B). The cross-sections are labeled A-A' through L-L' and are shown in Figure 6 (6A through 6L). These cross-sections were chosen conservatively at locations where either softer and/or thicker fine-grained soils were present or where the topography was steepest, for static analyses, and where the thickness of the liquefied soils was thickest, for seismic analyses. The cross-sections are discussed in greater detail in the Slope Stability Section of this report.

9.0 SEISMICITY

9.1 Seismic Hazard Analysis

A probabilistic seismic hazard analysis (PSHA) is the preferred approach for seismic evaluation of levees. The PSHA incorporates an earthquake's frequency of occurrence for different magnitude events occurring on various seismic sources, the uncertainty of an earthquake's location, and a ground motion prediction, including its uncertainty of occurrence. A ground motion return period for seismic evaluation was selected based on the levee's category and the agency that coordinates the evaluation policy, and is often about the same level as the flood return period.

For levees in urban areas, such as the levees in this project, the Department of Water Resource (DWR, 2012) requires a 200-year return period for seismic evaluations, which is consistent with the targeted 200-year flood protection level. A return period of 224 years, defined as having a 20% probability of exceedence in 50 years, was adopted for seismic evaluation of the levees for the Project.

A PSHA was performed using the 2008 Interactive Deaggregation Tool Developed by USGS (USGS, 2008), for a return period of 224 years, and using a $V_{s,30}$ of 202 m/s (based on our seismic CPT measurements which are presented in Appendix D (Plates D-14 through D-17). The 2008 Interactive Deaggregation Tool is available on the web, and utilizes the 2008 Next Generation Attenuation (NGA) ground motion prediction equations (GMPEs).

The acceleration response spectrum based on USGS Deaggregations (2008) and a return period of 224 years is presented in Table4. The Deaggregation Results are shown in Appendix D.

Table 4: Acceleration Response Spectrum

Period (Sec)	Sa (g)
0.0	0.32
0.1	0.53
0.2	0.69
0.3	0.71
0.5	0.63
1.0	0.43
2.0	0.23
3.0	0.15
4.0	0.11
5.0	0.08

9.2 Design Earthquake

The design earthquake was selected based on the deaggregation of the seismic hazards for a return period of 224 years, at peak ground acceleration (PGA). Therefore, the design earthquake for this project was selected as an earthquake with a PGA of 0.32g, with a Magnitude of 6.7 that occurs at a distance of 13 kilometers from the site.

9.3 Seismic Hazards

The site is not within the Alquist-Priolo Earthquake Fault Zone, or a Fault Rupture Study Area. The closest Alquist-Priolo Earthquake Fault Zone is associated with the Newport-Inglewood fault, and is located approximately 3.5 miles east of the site. Based on the available geologic data, active or potentially active faults with the potential for surface fault rupture are not known to be located directly beneath or projecting toward the site. Therefore, the potential for surface rupture due to fault plane displacement propagating to the surface at the site is considered remote.

All low-lying areas along California's coast are subject to potentially dangerous tsunamis. Tsunamis are long-period waves generated primarily from distant and local offshore earthquakes, landslides, or volcanic eruptions. The magnitude of the potential hazard is a function of the coastline configuration, sea floor topography, individual wave characteristics, and distance and direction from the source. Two tsunamis, due to the 1960 Chile Earthquake, caused damage in the Los Angeles and Long Beach Harbors. In 1960, waves up to 5 feet in height occurred in Cerritos Channel, and currents up to 12 knots were reported. A 5-foot run-up for a 100-year tsunami, and an 8-foot run-up for a 500-year tsunami are predicted near the Marina Del Rey area (Ziony, Editor, 1985). If a 100-year and 500-year tsunamis coincide with high tide, the maximum water elevation near the site may reach El. +11 and +14 feet NAVD, respectively. Although the damage potential from a tsunami is expected to be low, it cannot be ruled out.

The possibility of seiches (wave oscillations in a body of water due to earthquake shaking) within the Ballona Creek is considered remote.

The hills to the south of the site in Playa Del Rey are mapped in the City of Los Angeles Landslide Map, according to the website, NavigateLA.lacity.org. However, these hillsides are relatively far from any Project Improvements and there does not appear to pose a threat to project improvement.

Seismic slope stability is discussed under Slope Stability Analysis. Seismic Hazard Maps for the Project Site are also included in Appendix D (Plates D-18 through D-21).

10.0 GROUNDWATER CONDITIONS

10.1 Groundwater in Current and Previous Investigations

Groundwater was measured in GDC's investigation at some of the hollow stem boring locations in Area A, and Area C and in one hand auger boring in Area B. A summary of groundwater measurements in our investigation is shown in Table 5.

Depth to groundwater was also measured in selected borings in the previous geotechnical investigations, as shown in Table 5. The elevations were presented in mean sea level (MSL) datum. Since the datum adopted for the Project is the North American Vertical Datum (NAVD), we have converted the MSL elevations to NAVD datum. The highest measured groundwater elevation was 10 feet NAVD in Area A.

Table 5: Groundwater Measured in Current and Previous Investigations

Area	Report	Depths (feet)	Approximate Elevations (NAVD)
A	Current Investigation by GDC	7 to 17	-6 to 5
	Law Crandall, 1991	7 to 15	0 to 10
	Law Crandall, 1991 (Supplementary Report)	14 to 17	N/A
B	Current Investigation by GDC	2	3
	Law Crandall, 1991	0.1 to 4.5	4 to 7
	Diaz Yourman & Associates	2 to 11	2 to 8
C	Current Investigation by GDC	18	-2
	Law Crandall, 1991	12 to 22	0 to 6
	Diaz Yourman & Associates	17 to 23	2 to 6
Note: N/A = Not Available			

10.2 Historically Highest Groundwater

The CGS Open File Report 98-36 Venice Quadrangle (CGS, 1998) includes Historically Highest Groundwater Contours and Borehole Log Data Locations for the Venice Quadrangle, which includes the project site. Historical highest groundwater map is shown in Appendix D (Plate D-19). Historically highest groundwater is at a depth of less than 5 feet in Area B (El. +0 to +5 feet), and at depths of 5 to 10 feet in Areas A, and C, (corresponding to approximate elevations of about El. +5 to +15 feet NAVD).

10.3 Design Groundwater

According to the in-progress USACE Technical Letter, dated September 1, 2012 (USACE, 2012) titled, "Guidelines for Seismic Evaluation of Levees", a typical "coincident water level" should be considered for the liquefaction triggering analysis and seismic slope stability analysis for design of levees." According to this Technical Letter, the water level should be assumed to be the highest of the following three conditions:

1) Median Annual Water Level (in Ballona Creek or groundwater): This water level corresponds to mean sea level (MSL), which corresponds to Elevation +2.6 feet NAVD.

2) Typical Seasonal Water Level: This water level could be conservatively assumed to be the flood water level in the creek during a relatively typical water level fluctuation, e.g., during a typical winter rainstorm. For this condition we used a water level for a two-year flood conservatively assumed to be around +9 feet NAVD.

3) Mean High Tide Elevation (including Sea Level Rise): The Mean Higher High Water (MHHW) elevation corresponds to an elevation of+5.2 feet NAVD. Assuming a Sea Level Rise of 4.6 feet, by 2100, this water level can be estimated to be at about +9.8 feet NAVD.

Based on the above, a coincident water level of +10 feet NAVD was adopted for the liquefaction triggering and seismic slope stability analyses. It is noted that a design groundwater level of +10 feet is also consistent with measurements taken during previous and current geotechnical investigations, and with the historically highest groundwater level for the site area.

It should be noted that other groundwater levels are used for non-seismic load cases, depending on the loading conditions, as applicable.

11.0 LIQUEFACTION

Liquefaction involves the sudden loss in strength of a saturated, cohesionless soil (predominantly sand or non-plastic silt/clay) caused by the build-up of pore water pressure during cyclic loading, such as that produced by an earthquake. This increase in pore water pressure can temporarily transform the soil into a fluid mass, resulting in vertical settlement and can also cause lateral ground deformations. Typically, liquefaction occurs in areas where there are loose sands and the depth to groundwater is less than 50 feet from the surface. Seismic shaking can also cause soil compaction and ground settlement without liquefaction occurring, including settlement of dry sands above the water table.

The site is located within a State of California Liquefaction Hazard Zone mapped by California Geologic Survey (CGS reference), as indicated in Appendix D (Plate D-19).

The site is underlain by relatively young and loose/soft interbedded deposits of fine-grained silt/clay with relatively thin discontinuous layers of sandy or non-plastic silt. Based on our analyses localized liquefaction is predicted to occur in the sand and non-plastic silt lenses and layers during the design earthquake. The results of the

liquefaction analysis are presented in Appendix E. The post-liquefaction settlement was estimated at CPT locations using the NCEER Method (Youd et al., 2001) based on the design earthquake and the design groundwater for the project. Post-Liquefaction Settlement on the order of 0 to 3 inches is anticipated for the design earthquake.

The site is relatively flat, and the proposed levees are located approximately 300 to 1,200 feet away from the meandering channel. Therefore, it is anticipated that the layers in which liquefaction occurs are essentially laterally confined and that the main effect from liquefaction will be post-liquefaction settlement. This was partly confirmed by an estimation of free field lateral spreading was performed using the Youd et al. (2002) method (Plates E-30 and E-31). Free field lateral spreading displacement was estimated to be on the order of 3 to 6 inches at the location of the new levees, at a distance of about 300 to 1000 feet from the meander channel. The results of the analyses are also presented in Appendix E (Plates E-30 through E-32).

Liquefaction causes a temporary loss of strength during and immediately after an earthquake. The strength of soils that liquefy is typically very small and is typically known as the post-liquefaction undrained shear strength. To take into account the temporary loss of strength due to liquefaction we performed stability and deformation analyses using post-liquefaction undrained shear strength. These analyses are presented in the slope stability section provide estimates of lateral deformations of levees and embankments.

12.0 SEEPAGE ANALYSES

As discussed earlier, four field permeability tests were performed at depths of 5 and 10 feet, at two exploration locations (A-HSA064 and A-HSA066) near the existing north Ballona Creek levee, to evaluate the permeability of the soils near the base of the levee section. Based on the field tests, the average permeability of the soils was estimated to be in the range of 3.2×10^{-4} cm/s to 1.5×10^{-3} cm/s. The upper bound permeability value of 1.5×10^{-3} cm/s was used in numerical Finite Element seepage models using the RocScience computer program, Slide (version 5), for evaluation of the hydraulic gradients and discharge values expected along critical levee sections. The discharge values were also evaluated for the lower bound estimated permeability value, in order to obtain a rough range of the anticipated seepage discharge values expected through the levees. Figures depicting our seepage analyses are presented in Appendix F.

12.1 Factor of Safety Against Piping

12.1.1 Introduction

To evaluate the Factor of Safety (FOS) against piping during construction, the hydraulic gradient was estimated for the following conditions:

1) Existing north levee during excavation of Area A and the new channel
2) Existing south Area B levee at downstream end of the project

12.1.2 Existing Levees During Excavation of Area A

The hydraulic gradient was evaluated assuming a steady state seepage condition with channel water level of El +18 at the location of existing north levee, after completion of the excavation of the new north meander channel (under dry condition), and prior to the breach of the levee. This analysis assumes the unlikely condition of a having a long-term high water level of El +18 (i.e. steady state), while the excavations of the meander channel is being completed. It should be noted that El +18 assumed for this analyses is higher than the design flood elevation (El +17). The exit hydraulic gradient for this conservative and highly improbable scenario was estimated to be approximately 0.2 (Plate F-3). Thus, the FOS for piping was calculated to be at least FOS = 5.0 (FOS_{min} = 1.0). This implies that piping potential is remote for lower, for more likely high water conditions.

12.1.3 Existing Levees During 100 Year Flood in West Area B

Second, the hydraulic gradient was evaluated assuming a steady state seepage condition with channel water level of El +13 (i.e. corresponding to the high water elevation during a 100-year flood event, including bed aggradation and also sea level rise) at the downstream of West Area B, where the existing levees are expected to remain. The existing levee crest elevation at its lowest point in Area B (i.e. El. +14) was used in this analysis. The exit hydraulic gradient for this very conservative scenario (steady state) was estimated to be approximately 0.27 (Plate F-4). Therefore, the FOS for piping was calculated to be at least FOS = 3.7 (FOS_{min} = 1.0).

12.1.4 New Levees During 100 Year Floods

The above results indicate that an internal erosion failure is not likely to occur for the existing levees, which are very steep compared to the new levees. The flatness of the new levees implies a longer flow path and thus much lower hydraulic gradients. Therefore, our seepage analyses in Appendix F indicate that the likelihood of piping for the new levees is remote.

12.2 Seepage Discharge Values

12.2.1 General

The discharge flow that is anticipated to seep into the excavation in Area A was evaluated using the range of permeabilities obtained from our field permeability tests, at the location of existing north levee, after completion of the excavation of the

new north meander channel (under dry condition), and prior to the breach of the levee. The following two conditions were considered.

1) A typical transient condition of tidal changes over a period of a week.
2) After a storm event that would raise the water level in the channel to El +18 for a period of 10 days.

12.2.2 Discharge Due to Typical Tidal Changes

For this transient seepage analysis, it was first assumed that a steady state condition was reached with a water level at El +3 corresponding to an average tide level in the channel. Then, water levels corresponding to typical tidal changes at Santa Monica Bay over a period of one week were applied along the channel location as transient water levels. The discharge in the excavation zone was evaluated at different steps during the analysis. Very minor fluctuations of the discharge values were computed as a result of tidal fluctuations in the channel (Plates F-7 to F-16).

The typical discharge values due to tidal changes in the channel were estimated to be in the range of about 0.04 to 0.19 ft^3/hour/ft, or approximately 0.3 to 1.43 gallons/hour/ft. Assuming a total excavation length of 1,500 feet in Zone A, complete dewatering would require a pumping capacity in the range of 60 to 285 ft^3/hour (Plates F-7 to F-16). Our seepage analyses are presented in Appendix F.

12.2.3 Discharge Due to a Major Storm

The seepage discharge rates after a 10-day storm event were estimated using a transient seepage analysis. For this analysis, a steady state condition was reached with water level in the channel at El +3 corresponding to an average tide level. Subsequently the water level in the channel was raised to El +18 for a period of 10 days to simulate a 10-day storm. The water level was then lowered to El +3 after the 10-day period.

The discharge rates were calculated to be in the range 0.045 to 0.21ft^3/hour/ft, or approximately 0.33 to 1.57 gallons/hour/ft (Plates F-18 to F-29). The discharge values in the excavation zone showed an increase of approximately ten percent following the storm relative to the typical discharge rates. This implies that discharge from a major storm that lasts for a fairly long period of time is only marginally more that the discharge into the excavation during normal tidal fluctuations.

Our estimates do not include drainage run-off. Our seepage analyses are included in Appendix F.

12.3 Rapid Drawdown

Past performance of the existing levees along the Ballona Channel indicate that rapid drawdown is not an issue. This is likely due to the relatively low permeability and strength of the existing materials. Furthermore, as can be seen from the results

of seepage analyses, the tidal fluctuations affect only a small volume of soil, located near the surface of the levees. This is also evident from observing the results of the seepage analyses during and after a 10-day storm.

Rapid drawdown is a condition that can affect levees when the water in the channel drops quickly following a long period of high water. Under such conditions, the soils within the embankment are usually fully saturated during the high water period. Shortly after drawdown the stabilizing external water pressure on the slope is removed, while the internal pore pressures within the saturated soils have not dissipated. The levees at Ballona Creek are geographically not prone to long period high water in the channel, where a large volume of levee soils become saturated. Therefore, a steady state high water condition will likely not develop at Ballona Creek levees. As a result, the likelihood of deep-seated failure during rapid drawdown failure is remote.

While shallow saturation of surface soils is possible on the slopes, due to the flatness of the protected slope of the new levees, the possibility of a surficial rapid drawdown failure also appears to be very low due to the strength of the materials. For example, assuming rapid drawdown creating a 5-foot-thick zone of saturation on a 5H:1V slope, the normal stress and shear stress at the base of the zone of saturation are on the order of 600 and 120 psf, respectively. Therefore, in order for the infinite slope to be stable, the base of the saturated zone should have either minimum undrained shear strength, S_u = 120 psf. At a depth of 5-feet out investigation typically showed undrained shear strengths of 300 psf, or higher. Therefore, further rapid drawdown analyses were not considered necessary for the levees.

13.0 SLOPE STABILITY OF LEVEES

13.1 Introduction

The static and seismic slope stability of the new (proposed) levees and the portions of the existing levees that will remain were evaluated for a 100-year flood event, and an earthquake with a hazard return period of 224 years. It was also found that the results of the analyses are not sensitive to higher water elevations in the channel (i.e., a less frequent, higher return period, flood event.)

Additionally, static slope stability of the existing north levee was evaluated for the temporary condition which involves the construction of the new meander channels. It should be noted that the existing north levee will be breached after the Area A excavation and the construction of the meander channel; however the construction will likely take several years, and thus the levee static stability was considered for a long term and not a short term condition.

The cross sections used for the slope stability analyses are shown in Figures 6 (6A through 6L). Slope stability analyses were performed at 12 locations along the new and the existing levees in areas (Sections A-A' through L-L').

Cross sections were made at locations were the levee cross section changes, as well as in areas where there was a significant change in subsurface soil conditions. Six conservatively selected idealized soil profiles were used for stability analyses.

13.2 Soil Strength Parameters

Soil strength parameters were assigned to each layer using field and laboratory data from our investigations as well as selected information from previous investigations (Tables G-1 through G-12 in Appendix G). The basis for adopted static soil strength parameters follow.

- Undrained shear strength in fine-grained clayey and silty soils were primarily selected on the basis of the results of a Geonor H-60 laboratory vane shear testing of Shelby Tube samples collected, as well as using correlations of undrained shear strength with CPT tip resistance (Plates G-7 through G-9). A number of direct shear tests were also performed on the clayey/silty soils to select the drained strength parameters of the fine-grained soils for use in the steady state long-term analyses (B1-3h and B1-3q).

- Shear strength soils parameters for fill soils, were conservatively selected based on the results of a number of direct shear tests performed on fill soils (Plates G-10 and G-11). Existing levee materials were slightly stronger than the fill soils based on direct shear test results. Therefore, a slightly higher cohesion value was adopted for levee embankment soils. New levee material strengths were taken to be the same as those of existing levees. This is conservative as the new levees will be compacted to modern standards that yield higher strengths.

- Shear strength parameters in coarser-grained sandy soils were conservatively selected based on the results of the direct shear parameters.

Liquefaction analyses indicated there are layers and lenses that will likely liquefy during a major seismic event. Therefore, stability analyses using the residual (post-liquefaction) shear strength were performed for seismic stability analyses.

- For seismic analyses, post-liquefaction residual strength of the liquefied layers were estimated using Seed and Harder (1990) correlations with blow counts, using representative SPT blow counts, corrected for the effects of overburden, energy, and fines content of the liquefied materials.

Plates showing shear strength ranges and adopted values for fill soils and undrained shear strength of fine-grained soils are included in Appendix G (Plates G-7 through G-11). Plates showing the depths and residual strength parameters are the liquefied soils are also included in Appendix G (Plates G-12 through G-15).

13.3 Idealized Soil Profiles

Six conservative idealized soil profiles were adopted along the alignment of the new and the existing levees based on distinct variations in the subsurface profile. Each of the levee cross sections analyzed was assumed to be underlain by one of the following idealized soil profiles.

- East Area A Profile (Levee Sections A-A' and B-B' and Existing North Levee; Table G-1 and G-2)
- West Area A Profile (Levee Sections C-C' and D-D'; Table G-3 and G-4)
- Eastern Ballona Creek Profile (Levee Sections E-E' and F-F'; Table G-5 and G-6)
- East Area B Profile (Levee Section G-G'; Table G-7 and G-8)
- West Area B Profile (Levee Sections H-H', I-I', J-J' and K-K'; Table G-9 and G-10)
- Area C Profile (Levee Section L-L'; Table G-11 and G-12)

13.4 Levee Cross Section Locations

Selected levee cross sections used for slope stability analyses are briefly discussed below.

- Section A-A' and Section B-B' were included to evaluate the stability of the new Area A perimeter levees in eastern portion of Area A.

- Section C-C' was included to evaluate the stability of the new Area A perimeters levees in western portion of Area A.

- Section D-D' was included to evaluate the stability of the existing portion of the north levee located at the downstream end of the new Area A levees. This is the downstream location were the existing north levees will tie in to the new levees and will remain as part of the improvements of the project.

- Section E-E' was included to evaluate the stability of the existing south levees just downstream of Lincoln Boulevard after placement of the Area B fill mounds to the south between Culver Boulevard and Jefferson Boulevard These existing levees will remain as part of the improved project and will tie into the new Culver Boulevard Levees.

- Section F-F' was included to evaluate the stability of the upstream end of the Culver Boulevard Area B levees. This is the widest section of the Culver Blvd Area B levees, and includes the old railroad fill area.

- Section G-G' was included to evaluate the stability of the Culver Boulevard Area B levees in East Area B.

- Section H-H' was included to evaluate the stability of the wide portion of Area B levees and using a West Area B subsurface soil profile.

- Section I-I' was included to evaluate the stability of the West Area B levees. The section in this area is planned with a varying wet side slope of ranging from 5H:1V to 10H:1V. The section analyzed was conservatively selected to have a 5H:1V wet side slope.

- Section J-J' was included to evaluate the stability of the temporary levees that will be built as part of the interim project. These levees will likely remain for many years after the first phase of construction, and thus, are analyzed as permanent levees.

- Section K-K' was included to evaluate the stability of the existing levees that remain a part of the improvement project, and tie-in to the new West Area B levees at the downstream end of Area B. Please note that this portion of the existing levees may be raised for flood management.

- Section L-L' was included to evaluate the stability of the existing north Area C levees located upstream of Lincoln Blvd. along the south side of South Area C. These levees will remain as part of the project, but are not affected by the improvements in the project.

13.5 Levee Cross Section Locations

The following loading conditions were considered in our levee slope stability analyses:

i) End of construction condition: This loading condition assumes that grading is being performed during the dry season and that the channel water elevation is affected primarily by tides. For stability, the critical stage of this loading condition is when excavations have reached the lowest level and surcharges are the highest, i.e., at the end of construction.

ii) High water short term condition: This conservative loading condition assumes that a near full channel water elevation is present due to large rainstorms, As previously discussed the duration of such event is not long enough for steady

state conditions to develop and the corresponding soils to become fully saturated. Nevertheless, our analysis conservatively assumes the pore pressures of a fully developed steady state phreatic surface in coarse-grained materials, while undrained shear strength is used for fine-grained soils. This loading condition is more stringent than typically adopted conditions, and thus generally not considered by USACE for slope stability analysis of levees. This loading condition is most analogous to a long term steady state stability analysis in terms of water level, except for its conservatism in the strength assumptions. As can be seen in Table 6, the high water short term condition consistently yields lower FOS values, than the high water long term (steady state) stability condition.

iii) Long term steady state stability: This loading condition also assumes that a near full channel water elevation has been present for a long time due to large rainstorms. This loading condition is similar to the previous one, except that steady state pore pressures are assumed for all soils. Therefore, drained soil strength parameters are applicable for both the coarse-grained and fine-grained soils. This loading condition was analyzed for only a few levee cross sections, to verify that the Factor of Safety (FOS) values for this condition are higher than the high water short term condition. It should be noted that the minimum FOS slope stability requirement for the long-term steady state condition was conservatively adopted for both the short-term and long-term high water conditions.

iv) Seismic slope stability during the design earthquake: The site contains low density materials that are prone to liquefaction during a major earthquake. This seismic loading condition considers where appropriate post-earthquake strength parameters, to evaluate the potential of slide failures during the design earthquake (i.e., if FOS < 1.0).

v) Deformation analysis for seismic condition: To estimate permanent seismic displacements, a seismic slope stability is first performed to calculate the yield acceleration, i.e., the acceleration that results in FOS=1.0. Then displacements of the levee are estimated for the design event earthquake using simplified methods such as Bray and Rathje (1998) method. The performance of levees is considered acceptable, if the permanent seismic displacements are estimated to be below 6 inches (15 cm).

13.6 Factor of Safety Criteria and Design Considerations

i) Short-term condition: A minimum FOS> 1.3 is adopted for sudden and short term loading conditions, e.g., immediately after the end of construction of the new and remaining levees. Undrained soil strengths parameters are

used to evaluate the resisting forces. A water level at Elevation +5 feet NAVD was assumed in the channel.

ii) High water short-term and long-term conditions: A minimum FOS > 1.5 is adopted for both short term and long term steady state conditions with water level conservatively selected at El +17 feet NAVD in the channel for the new levees and the existing levees, with the exception of the existing levee downstream of Area B (Section K-K'), where the water level was selected to be at El +13 NAVD, corresponding to the estimated high water for the 100-year flood at this location. It should be noted that short-term stability is essentially not very sensitive to a change in the water level in the channel.

iii) FOS > 1.0 is required for post-liquefaction condition, using undrained strength parameters and post-liquefaction residual shear strength for liquefiable soils. The water level in the analyses was assumed to be at El +10 NAVD for levee sections in Areas A and C, and assuming a groundwater at existing ground surface (i.e. ground surface elevation outside of the levee embankment cross section) for Area B, since generally ground surface elevations are lower than El +10 NAVD.

iv) A FOS greater than 1.0 under the previous loading condition (iii) does not guarantee acceptable performance. Hence, a deformation analysis was performed to evaluate the seismic displacements under design earthquake conditions. Seismic displacements on the order of 15 cm are generally considered acceptable for levees. The yield acceleration used in the deformation analysis is the horizontal acceleration that produces a FOS equal to 1.0. The yield acceleration was calculated for each levee section using conventional slope stability methods and the Bray and Rathje (1998) method was used to estimate seismic displacements.

A summary of the analyses results is presented in Table 6. The results of the slope stability analyses are included in Appendix G.

Table 6: Summary of Slope Stability Analyses

Section Analyzed	Static Factor of Safety			Seismic Stability		
	End of Construction Short term Stability	High Water Short Term Stability	High Water Long Term Stability (Steady State)	Post-liquefaction (Seismic)	Yield Acceleration	Deformations (cm)
	$FOS_{min} > 1.3$	$FOS_{min} > 1.5$	$FOS_{min} > 1.5$	$FOS_{min} > 1.0$		
Section A-A'	3.39	3.35	5.21	2.38	0.09	4
Section B-B'	3.51	4.32	N/C	2.38	0.08	4
Section C-C'	3.45	5.28	N/C	2.42	0.10	4
Section D-D'	1.49 [1]	2.28	N/C	1.29	0.05	47
Section E-E'	1.57	2.07	N/C	1.33	0.08	40
Section F-F'	2.19	2.19	N/C	1.59	0.10	3
Section G-G'	2.55	2.73	3.42	1.79	0.05	9
Section H-H'	1.94	1.87	N/C	1.24	0.04	8
Section I-I'	1.68	1.61	2.29	1.17	0.04	11
Section J-J'	2.09	2.48	N/C	1.47	0.05	6
Section K-K'	1.58	2.13	N/C	1.26	0.04	15
Section L-L'	1.60	2.26	N/C	1.40	0.08	30

Note: N/C = not calculated

13.7 Discussion on the Slope Stability Results of New and Remaining Levees

The stability of the new and existing levees was analyzed at the end of construction, during high water (short term and long term), and seismic conditions. A discussion follows.

- **End of Construction Condition:** The FOS for the end of construction short-term condition with channel water levels at elevation +5 feet NAVD was found to be satisfactory for the new and existing levee sections that were analyzed ($FOS_{min} > 1.3$).

- **High Water Short Term Condition**: The FOS for the high water condition assuming short term loading is satisfactory for the new and existing levee sections that were analyzed ($FOS_{min} > 1.5$).

- **Post-liquefaction Condition:** During the design earthquake it is anticipated that some soil layers will liquefy, and thus lose significant resistance. The FOS calculated using post-liquefaction residual shear strength was found to be greater than 1.0 for a water level at El +10 NAVD, or at ground surface (for Area B). As a result the likelihood of a catastrophic flow slide failure is remote.

- **Yield Acceleration and Deformation Analysis:** A deformation analysis using the Bray and Rathje (1998) method calculated displacements on the order of 4 to 11 centimeters (approximately 1.5 to 4.5 inches) for the new levees, and displacements on the order of 15 to 47 centimeters (approximately 6 to 19 inches) for the existing levees under the design earthquake. Generally displacements less than 15 cm (about 6 inches) are considered acceptable for non-inhabited structures. Therefore, in our opinion, the calculated displacements for the new levees are deemed acceptable. However, the displacements in the existing levees are large, and do not meet current seismic criteria. Where the new levees will tie into an existing levee, excessive deformation and cracking of the existing levee is a concern not only during seismic conditions, but also due to the additional loading and settlement that will be caused by construction of the new levee. Therefore, mitigation measures are recommended for all the existing levees where new levees will tie-in.

13.8 Post Excavation Stability of the Existing North Levee in Area A

During the excavations within Area A and the new meander channel north of the existing levee, the Existing North Levee along the existing channel provides flood protection, and therefore should remain functional. Post Excavation stability of the existing north levee was evaluated assuming the excavation in Area A will take at least several months to be completed. Additionally it was assumed that the

excavation will be performed in dry condition using dewatering, because this is the critical assumption for slope stability. However, the excavation may also be performed in the wet.

For this condition, the water level in the existing Ballona Creek channel was assumed to be about El +7 NAVD corresponding to approximately a 2-year flood condition. The water level in the protected side of the levee was assumed to be 1 to 2 feet below the elevation of the invert, at about El -6. Since the loading would be sudden, undrained soil strength parameters were used. Because the excavations in Area A will likely take at least several months, a minimum FOS of 1.5 was adopted,

Pursuant to our discussions with the civil designer, we assumed that the excavation in the protected side of the existing north levee will be sloped at 2.5H:1V to the top of the meander channel (approximately El +5 NAVD), and the meander channel will be sloped at 5H:1V to an invert elevation of El -5 NAVD. The distance between the bottom of the excavation on the protected side of the levee and the top of the meander channel forms a "stability berm". The analysis was performed with varying distance from the toe of the excavation. The results of the analyses show that a minimum distance of 70 feet from the protected edge of crest is needed to satisfy a FOS of 1.5.

Thus, to maintain the existing levee functional, the excavation in Area A should be performed in two distinct stages:

- **First Stage:** If the excavation is performed under "dry" conditions (i.e., with dewatering), excavation of Area A, should be initially performed at least 70 feet away from the existing levee protected side edge of crest. This stage will result in the creation of a "stability berm". <u>If the excavation is not dewatered and the excavation is performed under wet conditions, a berm is not required for stability.</u>

- **Second Stage:** Local excavation of the "stability berm" and existing levee should be performed immediately prior to breaching of the levee. Please note that locally lowering the top of the levee, prior to breaching, in areas where the levee will be breached, will also temporarily increase the static FOS.

13.9 Effect of Water Level in the Channel on Seismic Stability

13.9.1 Introduction

As discussed in the slope stability section, post liquefaction seismic stability analyses and seismic deformations analyses were performed assuming a design groundwater at Elevation +10 feet NAVD for levee sections in Areas A and C. For Area B the groundwater was assumed to be at the existing ground surface outside of the levee embankment, since the ground surface elevations are generally lower than Elevation +10 feet NAVD.

In all areas, for the seismic analysis the assumed water level in the channel is lower than the water level that occurs during an extreme high flow condition. Due to the low probability of the design earthquake coinciding with the period of high water, it is common practice to perform seismic slope stability and deformation analyses using water levels that are usually present in the channel, instead of extreme event water levels.

However, an evaluation was also made of the effect of changes in water level in the channel on the predicted seismic displacements for new and existing levees that will remain. A discussion of the findings of this evaluation is provided below.

13.9.2 New Levees

Our analyses show that the new levees are stable under post liquefaction conditions, and the predicted seismic displacements are within the acceptable range, based on a design water level Elevation of +10 feet NAVD in Areas A and C, and assuming a water level at the ground surface in Area B.

The new levees will be constructed a minimum distance of about 400 feet from the meander channel. As a result, the seismic stability of new levees will generally not be impacted by water level fluctuations in the meander channel (either tidal or seasonal). At the locations of the new levees, the water level is generally equal to the groundwater level, which is affected primarily by precipitation. Therefore, the effect of the water level in the channel on seismic displacements is negligible, for the new levees.

13.9.3 Existing Levees

The effect of changes in water level in the channel on the seismic displacements predicted for the existing levees was investigated for the levee located immediately downstream of Lincoln Boulevard (Section E-E'). The following four water levels were considered:

Case 1 – The water in the channel and in the area outside the channel coincide with the ground surface elevation of +7 feet NAVD. This is the design groundwater condition adopted for the previously presented seismic stability analyses of existing levees.

Case 2 – The water in the channel and in the area outside the channel is at Elevation +3 feet NAVD. This condition approximately corresponds to the average tidal condition.

Case 3 – A water level in the channel at Elevation +0 feet NAVD (corresponding to low tide) and a groundwater level outside the channel at Elevation +7 feet NAVD.

Case 4 – A water level in the channel of +0 feet NAVD and a groundwater level outside the channel at Elevation +3 feet NAVD.

The results of the seismic deformation slope stability analyses are included in Appendix G (Plates G-69 and G-70, and G-148 through G-153). A summary of the cases analyzed, including the estimated yield acceleration (ky) and calculated seismic displacements is presented in Table 7.

Table 7: Effect of Water Level on Seismic Displacement of Existing Levees

Case	Water Conditions		Yield Acceleration (ky) in units of g	Seismic Displacement (cm)
	Groundwater Elevation (feet; NAVD)	Channel Water Elevation (feet; NAVD)		
1	7	7	0.08	40
2	3	3	0.08	40
3	7	0	0.06	64
4	3	0	0.07	50

As indicated in Table 7, the maximum predicted deformation occurs when the water level in the channel corresponds with the low tide. However, the estimated seismic displacement for all cases is at least 40 cm (16 inches), which is unacceptable. On this basis, the variation in the water level in the channel has no effect on the acceptability of the performance of the existing levees, which for each Case are deficient under seismic conditions.

13.10 Mitigation Measures for the Remaining Existing Levees

As noted earlier, the Ballona Creek channel and levees were constructed in the 1930s, at a time when there was little geotechnical field quality control (including compaction testing) and virtually no geotechnical earthquake engineering. Portions of the existing levees in Areas A and B will act as abutments to the new levees, and consequently, will receive significant loading. If unimproved, we anticipate that in these "abutment areas" the existing levees will experience significant static settlement, and additional lateral displacements under seismic conditions. As discussed above, our analyses indicate that the original levees do not meet current USACE seismic requirements, and calculated displacements under the design earthquake are excessive even without additional loading.

Where a new levee ties into an existing levee, the existing levee will experience additional load and settlement that can cause cracking of the existing levee. Therefore, it is recommended that mitigation measures, such as deep soil mixing, be performed at and adjacent to tie-in locations to improve the stability of the existing levees that will remain in Areas A and B.

Ground Improvement is recommended at all locations where the new levees tie-in to an existing levee. These locations are delineated in Figure 7 and include:

- The existing south levee along the Ballona Creek channel between Lincoln Blvd. and Culver Blvd. Ground improvement should extend from the tie-in location for a minimum length of 80 feet from the centerline of the new levee crest (Figure 7).

- the existing north levees located along the Ballona Creek channel downstream of the new Area A levees. Ground improvement should extend from the tie-in location of the new and the existing levees for a minimum length of 80 feet from the centerline of the new levee crest (Figure 7).

- The existing south levee located along the Ballona Creek channel downstream of the new West Area B levee. Ground Improvement should extend from the tie-in point to the downstream property line (Figure 7). We understand that the crest elevation along this existing levee may be raised for additional flood protection. If ground improvement recommendations are followed, the levee can be raised without negatively impacting the integrity of the existing levee. The ground improvement should be done along the crest of the levee, and completed before the final grade is raised.

The Deep Soil Mixing (DSM) ground improvement zone for existing levees is anticipated to be on the order of 20 feet wide. The ground improvement zone should have a minimum average strength of 1,500 psf. The columns should extend to El -13 feet along south Ballona Creek channel between Lincoln Blvd. and Culver Blvd. down to El -25 feet downstream of the new Area A levees, and down to El -35 downstream of the West Area B new levees.

Please note that the alternative of replacing the deficient portions of the existing levees with new levee with flatter slope is significantly more costly. Rebuilding portions of the existing levees properly would require excavating to El. 0 NAVD to remove potentially liquefiable soils. This means that excavations should be extended below tide level and below groundwater using cofferdams and dewatering. Furthermore, surcharging a portion of any levee will also apply lateral loads on piles of Lincoln Boulevard and Culver Boulevard Bridges.

In Area C, where the existing levee will also remain, the restoration project will not alter or impose new loads to the existing levees, since stockpile soils will be placed a minimum of about 400 feet away from the edge of the channel. It is recommended that any surcharge or structure proposed near the unimproved existing levees be setback a minimum of 70 feet away from the top of the channel slope.

Please note that grading and development is currently planned in Area C, but will be kept at a minimum distance of 70 feet away from the top of the channel slope.

14.0 SETTLEMENT ANALYSES

14.1 Anticipated Settlements and Time Rate

A total of 20 consolidation tests were performed on representative soil samples collected during our field investigation. Settlement of the proposed levee embankments and surcharge areas was estimated using the consolidation test data, which was supplemented using correlations with liquid limit, and moisture content. In addition, we supplemented our settlement analyses with the extensive experience gained from surcharging similar nearby soils over the past 10 years, as the geotechnical engineer for the Playa Vista development, located immediately east of Lincoln Boulevard.

The consolidation test results showed that the soils are essentially normally consolidated below a depth of about 10 to 20 feet and slightly to moderately over-consolidated at shallower depths. The interpretation plots of consolidation parameters are provided in Appendix H.

The settlements under and extending out from the toe of new levees and embankments were evaluated for different surcharge heights and geometries. The results are provided in Table H-1 included in Appendix H.

The results indicate the anticipated settlement under new fill load is estimated to range from about 1 to 2 inches for every foot of embankment fill placed (i.e., a 10-foot high levee or embankment is anticipated to settle between 10 and 20 inches). More specifically, we anticipate that in Area A and B, settlements per foot of fill surcharge are likely to be about 1.5 to 2 inches, whereas 1.0 to 1.5 inches are anticipated in Area C.

Our analyses show that surcharges will cause a settlement bowl that may extend on the order of 30 to 50+ feet beyond the toe of the embankments, depending on the height of embankment. A summary of the estimated settlements, anticipated under levees of various heights is included in Table 8 for eight selected embankment locations and embankment heights ranging from about 5 to 15 feet.

Group Delta has significant experience with monitoring settlements in similar compressible soils during the development of the Playa Vista Development, located immediately east of Lincoln Boulevard, north and south of Jefferson Boulevard. Over the past 10 years, data has been collected from surcharge monitoring programs on numerous building sites. Representative data from these programs are graphically summarized on Plate H-47 (Appendix H), indicates 90 percent of primary consolidation occurred within about 100 to 150 days, generally considered to fall in a range of 3 to 6 months.

Based on the laboratory data and the empirical data from Playa Vista, within the Ballona wetlands primary consolidation during placement of the levees is expected to be 90 percent complete within three to six months of application of the last load increment.

Therefore, capping of the levee core should be planned as the last step of grading at least three to six months after completion of the levees, to raise the crest grade to the desired design elevation for flood control, after at least 90 percent of the primary consolidation has completed. Capping of the slopes is not required beyond the levee core.

Due to the soft nature of the subgrade soils and the large anticipated settlements, construction techniques typically used in soft ground, e.g., swamps have been considered. We recommended constructing levees slowly and using thin lifts to reduce post-construction long-term differential settlements and reduce the potential transverse cracking. For this purpose, the rate of fill placement should proceed at about 5 feet of fill per month or slower. The rate of settlement of the fill will be monitored during construction, and should be used to control the actual rate of fill placement.

14.2 Recommended Setback of New Embankments

Because of the soft nature of the existing ground, a settlement "bowl" will develop beyond the toe of new levees and surcharge areas and the resulting differential settlement could impact existing utility lines, pavement and other nearby improvements. A profile showing the shape and magnitude of the settlement bowl is presented on Plate H-7 (Appendix H).

The risk of damaging structures and utilities is generally considered minimal when the slope of the differential settlement, Δ / L, (where Δ is the differential settlement over a distance L) is less than about 1/480 (i.e., 1-inch in 40-feet). Based on the height of the fill planned, analyses indicate this controlling differential settlement slope generally occurs at a distance on the order of 25 to 30 feet beyond the toe of the embankment, and roughly coincides with the location where the total settlement is about 1-inch. However, it should be noted that the settlement bowl shown on Plate H-7 occurs perpendicular to the toe of the fill, and the existing improvements are oriented parallel to the fill toe. Therefore, the differential settlement along the improvements will actually be much less.

Using the 1/480 criteria, the following minimum setbacks between the toe of embankments and streets or utility lines are recommended. However, other, more stringent, criteria could be necessary for specific utilities, and the final criteria should be reviewed with utility agency.

Area A

- The toe of the new perimeter Area A levees should be setback along Fiji Way and from the existing parking lot pavement according to the following:
    - If the height of the levee is greater than 4 feet, the minimum setback should be 30 feet.
    - For levees that are 4 feet or less in height, the minimum setback should be 20 feet.
- In Area A, where the new levee will be placed near the Fiji Ditch, the toe of the levee should be setback behind a 3 to 1 slope extending up from the bottom of the Fiji Ditch.
- In the future, widening of Lincoln Boulevard is planned. The new levee planned along the west side of Lincoln Boulevard should be setback behind a 3 to 1 slope extending up from the west edge of the planned widening.

Area B

- The toe of the Area B levee should be setback a minimum of 30 feet from Culver Boulevard.
- The toe of the fill mounds placed in Area B should be setback a minimum of 30 feet from Culver Boulevard., Jefferson Boulevard, and Lincoln Boulevard.

Area C

- The toe of the fill mounds planned in North Area C should be setback a minimum of 25 feet from Culver Boulevard.

14.3 Protecting Utilities from Settlements

Where new culverts will extend under new the Area B levees, it should be planned to pre-load the area to remove most of the settlement prior to constructing of the culverts. This is discussed further in Section 15.8. If there are any existing, active or abandoned gas lines or other utility buried along the planned alignment of a levee, provisions should be made to relocate or reinstall them in a shallow trench that extends over the embankment fill. This would also provide easy access for any future maintenance.

Table 8: Summary of Estimates of Settlement at Different Sections along the Embankments

Area	Section	Approximate Embankment Height (feet)	Max Settlement (inches)	Max Settlement per foot of Fill (inches)	Settlement at Dry Side Toe (inches)	Settlement 10 feet from Dry Side Toe (inches)	Settlement 30 feet from Dry Side Toe (inches)	Settlement 50 feet from Dry Side Toe (inches)
Area A	Section A-A'	10	15.3	1.5	3.1	1.8	0.7	0.3
	Section B-B'	10	17.1	1.7	3.2	1.9	0.8	0.3
	Section C-C'	5	7.9	1.6	2.4	1.4	0.5	0.2
Area B	Section F-F'	14	26.7	1.9	5.8	3.4	1.3	0.6
	Section H-H'	14	26.3	1.9	5.8	3.4	1.3	0.6
	Section I-I'	15	26.0	1.7	5.8	3.4	1.3	0.6
	Surcharge Area B	25	41.4	1.7	2.2	1.4	0.6	0.3
Area C	Surcharge Area C	30	25.3	0.9	1.5	0.9	0.4	0.2

15.0 GRADING

15.1 General

The primary areas of grading for the project include:

- Excavation of approximately 2 million cubic yards of soil from Area A, to reclaim wetlands lost when the area was hydraulically filled during the development of Marina Del Rey. The excavation will slope down to the south from Fiji Way at a gradient of about 10 horizontal to 1 vertical to approximate elevation of 11 feet, and at flatter gradients of about 100H:1V (horizontal to vertical) to a maximum depth of about 20 to 25 feet in the area of the existing channel. The excavation will remove primarily hydraulic fill soils.

- The soils excavated from Area A will be used to construct the new levees around the west, north and east perimeter of Area A, and in Area B north of Culver Boulevard and east of the dunes in West Area B. The levees will generally extend about 5 to 10 feet above the existing grade in Area A, and up to a maximum of 15 feet above existing grade in Area B.

- Excavation of the meander channel for Ballona Creek and the lowering and breaching of the existing levees, at four locations.

- Any excavated soil not needed for new levee construction will be placed as compacted fill in north Area C and in Area B, between Culver Boulevard and Jefferson Boulevard.

The soils that will be excavated in Area A were found to be loose/soft and have high moisture contents, i.e., approximately 5% to 35% above the optimum moisture content. The alignments for the levees are in areas where the foundation soils are moderately soft to soft, and the ground water table is high. Therefore, earthwork must be carefully planned and conducted to avoid disturbing the soils, and the need for low ground pressure equipment and excavators should be planned. The use of heavy scrapers and dozers to excavate the soils in Area A is expected to be limited, and is discussed in Section 15.5.

Because of the high moisture content in the soils that will be excavated in Area A, it will be necessary to dry the soils before they can be used as compacted fill. Spreading and turning/disking will be needed to dry the excavated soils. In addition the loose soils excavated from Area A will undergo a significant compression, i.e., volume loss, when compacted for the levee construction. Volume loss is discussed below, in Section 15.7.

15.2 Clearing and Stripping

Prior to the start of earthwork, the areas planned for grading should be cleared of any trees and brush and stripped of any vegetation. When removing trees and bushes, all roots larger than 1-inch in diameter should be removed. All stripped vegetation should be removed from the site.

15.3 Removals

Prior to placement of compacted fill for the new levees, the subgrade soils along the levee alignments should be excavated and recompacted. The minimum limits for the recompaction under levees are shown in Appendix I (Plates I-2 through I-4) and are described below.

- Under the "core" of the levee, the removal and recompaction should extend to a minimum depth of 4 feet below the existing grade. The core is defined as the area within 3 (horizontal) to 1 (vertical) slopes extending down from the edge of the levee crest.

- Beyond the core, the removal should extend to a minimum depth of at least 2 feet below the existing grade for a minimum equipment width (10+ feet). Beyond this equipment width (10+ feet), specific overexcavation is not required under the flat (10 to 1) slopes planned, but vegetation should be stripped before placing fill,

- The actual limits for removals should be determined by the project geotechnical engineer during construction, based on the local conditions exposed during excavation. Deeper removals will be needed where unsuitable soils are present. In particular, deeper removals should be planned where the levees cross the existing drainage channels in West Area B. Please note that old buried channels may be present that require similar treatment. Deeper excavation should also be planned to remove buried organics in the area of the celery dump known to have been present in east Area A.

- In addition, if highly permeable layers are exposed in the excavation for levees, these layers would provide a path for seepage to occur, it will be necessary to overexcavate and replace these permeable layers to the limits determined by the project geotechnical engineer in the field.

- When wet and/or soft soils are exposed in the excavation made for removals, the excavation will need to be carefully performed using an excavator or low ground pressure equipment to avoid disturbing the soils and prevent equipment from bogging down. In addition, geogrid (Tensar BX 1200 or equivalent) may be needed to stabilize the exposed bottom and provide a firm working surface before new compacted fill can be placed.

15.4 Earthwork

All grading should conform to the requirements of the 2010 California Building Code, and the general grading recommendations outlined below.

1. The grading contractor is responsible for notifying the project geotechnical engineer of a pre-grading meeting prior to the start of earthwork operations and anytime that the operations are resumed after an interruption.

2. Prior to the start of earthwork the project civil engineer should locate any existing utilities in the area. Existing utilities should be removed, relocated or protected, as appropriate.

3. As discussed in Section 15.3, the subgrade soils along the new levee alignments should be overexcavated and recompacted to a minimum depth of 4 feet under the levee core, and 2 feet of overexcavation for a minimum of an equipment width beyond the levee core (Refer to Appendix I). Deeper removals will be needed where unsuitable soils are present. All removals should be performed under the direction of the project geotechnical engineer.

4. Temporary excavations in the soft, loose and wet soils should be planned at a maximum inclination of 1-1/2 (horizontal) to 1 (vertical).

5. The bottoms of excavations should be checked and approved by the project geotechnical engineer before placing any fill. If the bottoms of excavations encounter soft or wet soils, a 1 to 2 foot layer of dry soil with low permeability may be required to be placed over Biaxial Geogrid (Tensar BX 1200, or equivalent) to provide a firm base to support construction equipment and compaction activities. All fill material used under new levees should have low permeability to avoid providing a path for seepage, and must be approved by the geotechnical engineer before being placed. Dewatering of the excavation should also be anticipated.

6. All fill placed should be compacted to at least 90 percent of the maximum dry density determined by the most current ASTM D 1557 standard.

7. The soils encountered in Area A that will be excavated generally consist of fine-grained silty and clayey soils. It is anticipated that most of these soils will be suitable for use in the construction of new levees. However, as discussed in Section 15.5.2, much of the soils that will be excavated are very wet and will require spreading/disking to dry them back before they can be compacted in fills. Sandy soils will not be allowed to be used for the "core" of

the levees (per "core" definition in section 15.3, above). All fill soils shall be approved by the project geotechnical engineer.

8. All import soils should be free of highly expansive clay, organics, debris, rocks greater than 3 inches in any dimension, and other deleterious material. Import soils should have a maximum of about 60 percent passing the number 200 sieve and should have an Expansion Index of less than 60. Import soils should be approved by the geotechnical engineer before being brought to the site.

9. All earthwork and grading should be performed under the observation of the project geotechnical engineer. Compaction testing of the fill soils shall be performed at the discretion of geotechnical engineer. A test should be performed for approximately every 500 cubic yards of fill placed. If specified compaction is not achieved, additional compactive effort, moisture conditioning of the fill soils, and/or removal and recompaction of the below-minimum-compaction soils will be required.

10. Asphalt concrete used for levee roads shall conform to the 2012 "Green Book" or the equivalent, and shall be compacted to at least 95 percent relative compaction.

11. If, in the opinion of the geotechnical engineer, contractor, or owner, an unsafe condition is created or encountered during grading, all work in the area shall be stopped until measures can be taken to mitigate the unsafe condition. An unsafe condition shall be considered any condition that creates a danger to workers, on-site structures, on-site construction, or any off-site properties or persons.

15.5 Excavation

15.5.1 Excavation Slopes

In general, the hydraulic fill in Area A is a fine-grained silty to clayey lose/soft soil with a high moisture content, and the near surface native soils and fill in area B are and moderately soft to soft with a high moisture content and a shallow ground water table. Temporary excavations should be planned at a maximum inclination of 1-1/2 (horizontal) to 1 (vertical).

Surcharge loads, such as vehicular traffic, heavy construction equipment, and stockpiled materials, should be kept away from the top of temporary excavations a horizontal distance at least equal to the depth of excavation. Surface drainage should be controlled and prevented from running down the slope face. Seeping of

water should not be allowed within the excavation. Construction equipment and foot traffic should be kept off excavation slopes to minimize sloughing.

All excavation slopes and shoring systems should meet the minimum requirements of the Occupational Safety and Health (OSHA) Standards. Maintaining safe and stable slopes on excavations is the responsibility of the contractor and will depend on the nature of the soils and groundwater conditions encountered and his method of excavation. Excavations during construction should be carried out in such a manner that failure or ground movement will not occur. The contractor should perform any additional studies deemed necessary to supplement the information contained in this report for the purpose of planning and executing his excavation plan.

15.5.2 Excavation Methods – Area A

The soils that will be excavated in Area A were found to be loose/soft and have a high moisture content, ranging approximately 5% to 35% above the optimum moisture content. Therefore, the use of heavy scrapers and dozers is expected to be limited. The excavation must be carefully planned and conducted to avoid overstressing the soils and/or bogging down equipment. The need for excavators, support mats, moving haul roads, low ground pressure equipment and dredging should be considered in planning how to accomplish the excavation. The need to control the ground water perched within the hydraulic fill should also be anticipated during excavation.

As noted previously, it will be necessary to dry the excavated soils back before they can be used in compacted fill. This will require having an area where the soils can be spread and turned and/or disked. In addition the loose soils excavated from Area A are expected to undergo a significant volume loss when compacted for the levee construction, which is discussed in Section 15.7.

15.6 Fill Placement

15.6.1 General

The subgrade conditions along the new levee alignments generally consist of moderately soft to soft, wet, fine-grained silt and clay soils. The excavated soils are also generally silty and clayey, and hence, can be used for construction of the embankments. In addition, these soils are compressible and will settle on the order of 1 to 2 inches for every foot of fill placed. Therefore, the placement of compacted fill for levees should be planned and controlled to avoid overstressing the soils. Based on experience with similar soft soils, the fill should be advanced uniformly along the entire length of each levee without creating unbalanced loads. Furthermore the rate of fill placement should be controlled to allow the soft soils to slowly consolidate and gain strength. Increasing the height of the fill slowly will also

provide time for settlement to occur and thus mitigate the potential for differential settlement to create cracks in the embankment. Recommendations for monitoring the fill settlement are discussed in Section 15.8.

Following removals and before placing fill, the bottoms of excavations should be checked and approved by the project geotechnical engineer. If the bottom is soft or wet, a 1 to 2 foot layer of dry soil with low permeability may be required to be placed over Biaxial Geogrid (Tensar BX 1200, or equivalent) to provide a firm base to support construction equipment and compaction activities. Dewatering of the excavation should also be anticipated. The soil used for the backfill should have a low permeability to avoid creating a seepage path under the levee. All fill must be approved by the geotechnical engineer before being placed.

15.6.2 Special Considerations

In West Area B the alignment of the new levee will cross two existing channels. These channels range from about 5 to 8 feet deep and are expected to contain soft sediment, and may also contain sands eroded from the dunes present in West Area B. The easternmost of these channels crosses perpendicular to the levee alignment, about 300 feet east of the west end of Area B. The westernmost channel crosses extends under the length of the planned levee at the west end of Area B (Refer to Figure 4A). In addition, it should be anticipated that there is the possibility that other old channels may also be present, and may have been filled in.

At channel crossings, all soft and sandy material should be removed and replaced with compacted fill. The excavation for this removal will extend below the ground water. Therefore, dewatering will be required to accomplish the removal and backfilling. The exposed bottom should be stabilized with geogrid and a 1 to 2 foot layer of dry soil with low permeability, to provide a firm base to support construction equipment and compaction activities.

During construction of levees, after removals and before placing any fill, the geotechnical engineer should check for the presence of any sand layers that may extend below the alignment of the levee. This could be a particular problem in West Area B, because of the proximity of the natural dunes, there is the potential for eroded sand layers to be present throughout this area. If found to be present, the sand layers should be overexcavated and replaced with low permeability fill soils, to protect against seepage. The presence of any sand layers should also be looked for in all areas where the new levees are constructed.

15.7 Volume Change

The soils excavated from Area A will undergo significant volume reduction as they are compacted for the new levees. Based on our field explorations and the results of lab testing of representative soils, including in-situ density tests, compaction tests

and consolidation tests, the gross estimated range of the anticipated volume change that will occur is summarized below.

However, these values are based on limited data for such a large site and should be considered as gross ball-park estimates for gross planning purposes only. The actual amount of volume change is difficult to predict and will depend on the materials in situ density, final in place compacted density achieved, amount of soil blending that occurs in the handling process, and other factors.

- Volume loss of excavated soils taken from Area A that then compacted to a minimum density of 90% modified proctor (average of 92%) is in the range of 15% to 25%.

- Volume loss due to stripping of vegetation, where present, is estimated to range from about 2 to 4 inches.

- Volume loss from compacting the existing subgrade soils along the alignment of new levees and/or in areas to receive excess fill, is estimated to range from 15 to 25% in Area A, and from 10 to 20% in Area B and Area C.

- The anticipated settlement in Areas A and B as a result of placement of fill is on the order of 1.5 to 2 inches per foot of fill placed.

- Settlement in Areas C as a result of placement of fill is on the order of 1.0 to 1.5 inches per foot of fill placed.

- Volume loss due to "spillage" during hauling, wind, etc. may be on the order of 1%.

Recommended Volume Change Monitoring Program

To develop a better estimate of the volume reduction that occurs during construction, it is recommended that a monitoring program be conducted to during the initial phases of the earthwork. This will require surveying to determine, the volume excavated in Area A and the volume of fill placed to create a new embankment with that volume of excavated soil. In addition, a settlement monitoring program should be established the actual amount of settlement that occurs during filling. The settlement monitoring program is discussed in Section 15.8.

15.8 Settlement Monitoring

To evaluate both the magnitude and the rate of actual settlements during construction, it is recommended that a settlement monitoring program be developed and maintained. A detail of a settlement plate is provided in Figure 8. In

general, settlement plates should be installed on about 400-to 500-foot spacing along the alignment for new levees. The plates should be installed after removal and recompaction of the subgrade, and before placing the embankment fill.

The settlement plates should be surveyed every week as the fill placement is being placed, bi-weekly for the first two months after completion of the fill placement, and monthly thereafter, until 90 percent of the primary consolidation is deemed complete. Each time the plate is read, the elevation of the top of the fill should also be recorded. Care should be taken not to damage the monuments during grading. If a monument is irreparably damaged or destroyed, a replacement monument should be immediately installed within 10 feet of the lost monument and a new survey baseline established for the new monument.

16.0 CULVERTS

16.1 General

Two new culvert structures will be constructed to connect south Area B to the restored wetlands. The locations of the culverts are shown in Figure I-1 in Appendix I. Each of the culverts will extend under Culver Boulevard and the new Area B (Culver) levee.

Settlement on the order of about 20 to 27 inches is expected to occur as a result of construction of the new Culver levee. To minimize the potential for settlement of the culvert after construction, two options are presented.

- Culverts can be constructed after 90% of the primary consolidation is completed, after placing the Culver levee. This will require excavation of the new levee, installation of the culverts and then replacement of the levee fill.

- As an alternative, the culvert areas can be pre-surcharged 3 to 4 feet higher than the design levee height at each location along the alignment of the culvert. After 90% of the primary consolidation is complete, the surcharge can be removed to install the culvert.

A temporary culvert pipe can be installed before placing the fill. Once the settlement is completed, the temporary pipe can be removed and the permanent culvert can be installed.

Generally, it is expected that 90% of the primary settlement will occur within about three to six months. Settlement monitoring should be performed at culvert locations to determine when primary consolidation is complete and installation of the culverts can begin.

16.2 Construction Considerations

Excavations and shoring for culverts should comply with current OSHA regulations, and observed by the designated competent person on site. Excavations for the culverts should be planned at a maximum inclination of 1-1/2 (horizontal) to 1 (vertical). However, since the culverts will be installed below groundwater level, water should be controlled by installing sheet piles and performing dewatering, in lieu of sloping. The shoring should be designed for a lateral soil pressure equal to an equivalent fluid pressure of 40 pcf, if unbraced, and if braced, for a uniform pressure (psf) of 30H, where H is the height of the excavation. Both pressures assume the excavation is dewatered, and there are no hydrostatic pressures on the sheet piles.

The civil engineer should identify the presence of existing utilites in the area. Provisions should be developed to protect existing utilities, by supporting the utilities to span between the sheet piles. Because of the high volume of daily traffic on culver Boulevard, a traffic plan and phasing schedule are need to maintain traffic flow during construction of the culverts.

Very soft or wet soils are anticipated at the base of the Culverts. The bottoms of the excavation should be checked and approved by the project geotechnical engineer. If the bottom is soft or wet, a 1 to 2 foot layer of soil with low permeability may be required to be placed over Biaxial Geogrid (Tensar BX 1200, or equivalent) to provide a firm base to support construction equipment and compaction activities. Dewatering of the excavation should also be anticipated, and compaction of all fill should be performed in the dry. The soil used for the backfill should have a low permeability to avoid creating a seepage path under the levee. All fill must be approved by the geotechnical engineer before being placed. To minimize the potential of seepage around the culvert, a properly designed concrete headwall should be used at the entry and exit points of the culvert.

The bedding zone is defined as area containing the material specified that is supporting, surrounding, and extending to 1 foot above the top of Culvert. The bedding shall satisfy the requirements of Standard Specifications for Public Works Construction (SSPWC) Section 306-1.2.1.

Backfill shall be considered as starting 1-foot above, and 1-foot to the sides the Culvert. On-site excavated materials can be used as backfill. However, wet soils will need to be dried back. Any material larger than 3 inches in any dimensions shall be removed before backfilling. All backfill shall be placed in lifts not exceeding six to eight inches in thickness and be compacted to at least 90 percent of relative compaction as determined by the ASTM D-1557.

16.3 Earth Pressures on Culverts

Culverts should be designed for vertical and horizontal earth pressures according to pressures shown on Figure 9. Due to presence of shallow ground water, horizontal earth pressures shown on Figure 9, include hydrostatic earth pressures in addition to at-rest earth pressures.

For portions of the culverts, passing below Culver Blvd., traffic loads can be modeled as 2 feet of soil surcharge or 240 psf vertical pressures. For rigid wall of the culverts, a uniform lateral pressure of 100 psf should be added to the horizontal pressures, as shown on Figure 9.

17.0 PEDESTRIAN BRIDGE

As part of the public access plan, a pedestrian bridge is planned to be constructed west of the Culver Boulevard Bridge. Due to anticipated large loads of the bridge, presence of moderately to highly compressible clays below the site, and variable potential for liquefaction settlements anticipated across the site, it is recommended to use deep foundations for support of the pedestrian bridge. Pile foundation recommendations are provided below. The bridge may also be designed to accommodate trucks hauling excavated soil from Area A to Area B.

17.1 Pile Foundations

Due to the presence of moderately to highly compressible clays below the site, and variable potential for liquefaction settlements anticipated across the site, it is recommended to use deep foundations for support of the pedestrian bridge. The piles should be installed to practical refusal, about 3 to 5 feet into the dense sands below about El. -45 feet. We estimate the final tip elevations for piles to be roughly El. -50 feet.

We recommend the proposed building be supported using one of the following pile installation systems:

14-inch square

- Driven piles (square pre-stressed concrete)

14-inch diameter

- Auger cast displacement piles (ACD)

Based on our previous experience at the nearby Playa Vista, these pile types and diameter sizes can be successfully constructed. If driven piles are used we recommend that a Pile Driving Analyzer (PDA) be used during driving.

17.2 Pile Axial Capacity

Based on the results of our analyses and our experience at Playa Vista, allowable pile loads of 220 kips for 14-inch square driven piles, and 200 kips for 14-inch diameter ACD piles are recommended. .

Downdrag loads must be considered from ground settlement due to the potential liquefaction during a major seismic event. The downdrag calculations indicate that downdrag loads ranging from about 81 to 102 kips could develop during design seismic events.

If the site grade is raised (e.g., for elevating the roadway), additional downdrag loads may be expected that depend on final elevations. We recommend that downdrag loads from consolidation settlement due to any new fill be evaluated.

It should be noted that the maximum downdrag loads are based on the assumption that no settlement of the pile occurs due to the application of the downdrag load. It is estimated that piles could settle about 0.25 inches as the downdrag load is applied. This settlement will significantly reduce the downdrag load. However, for conservatism, we assumed the full downdrag.

Table 9 summarizes the axial pile capacity for the considered pile types.

Table 9: Axial Pile Capacity

Type	Pile Diameter	Allowable Compression	Allowable Uplift
Driven	14-inch square	220 k	125 k
ACD	14-inch round	200 k	100 k

It is generally recommended that the piles be installed to at least 3 pile diameters of penetration or practical refusal into the dense sands. Therefore, the final tip elevations for most piles are expected to be about El. -50 feet.

We recommend that piles be installed with a minimum 3 diameters center-to-center spacing. For piles with a minimum 3 diameters center-to-center spacing and two to three pile groups, no reduction in axial capacity is required.

17.3 Pile Settlement

It is anticipated these piles would settle about 0.25 inch under the recommended allowable load. No significant differential settlement is expected under static loads.

The additional settlement as a result of the design seismic event is estimated to be 0.25 inches or less. Hence, the estimated settlement including the static loads as well as drag loads due to potential liquefaction is anticipated to be about 0.5-inch. Differential settlement of similarly loaded columns may be taken as 50% of the total settlement.

17.4 Pile Lateral Capacity

We evaluated the lateral capacity of the recommended piles using the computer program LPILE 6.0 (Ensoft, 2010). The lateral capacities at 0.25 inches, 0.5 inches and 1.0 inch of pile head deflection, for both fixed head and free head conditions, and for single piles, are provided in Table 10. To utilize a fixed head condition, the pile and pile cap connections must be able to translate laterally without rotation, and be designed for the fixed head moment.

Table 10: Lateral Pile Capacity

Condition	Pile Type	Pile Head Deflection (inch)	Max Shear (kips)	Max Moment (kip-ft)	Depth to Max. Moment (feet)
Fixed	14-inch (square)	0.25	17	76	0
		0.5	31	146	0
		1	52	267	0
	14-inch (round)	0.25	14	56	0
		0.5	25	105	0
		1	41	192	0
Free	14-inch (square)	0.25	6	25	6.5
		0.5	12	50	6.5
		1	19	92	7
	14-inch (round)	0.25	5	19	6
		0.5	9	37	6
		1	15	68	6.5

Deflection, shear and moment diagrams for the piles under lateral load are provided in Appendix J. We recommend the project structural engineer verify the maximum moment capacity of the pile.

17.5 Lateral Resistance

For lateral resistance of pile caps, we recommend an allowable passive fluid pressure of 300 pcf above the water table (El. +10 feet NAVD). Friction resistance should not be used for pile caps due to potential seismic settlement, which may cause a slight separation between the pile caps and the subgrade soils.

18.0 CONSTRUCTION OF THE MEANDER CHANNEL

To create the new meander channel for Ballona Creek will require lowering and breaching of the existing levees. The construction of the meander will require careful planning, phasing and coordination. In general, the existing levee is lowered as much as possible prior to final breaching, to minimize the risk of uncontrolled breaching. Just prior to the breaching, the new meander channel is excavated.

The contractor could also use strategically located sheet piles and/or coffer dams to safely control the breaching. The use of coffer dams will also provide protection, so that with dewatering, the abandoned levee channel can be backfilled in the dry. The contractor's plans for the breaching and backfilling of the abandoned channel should be submitted for review and approval, before proceeding. The contractor's method should provide for controlled breaching and for the abandoned channel to be backfilled in the dry. Armor rock riprap is needed at the ends of the meander channel fill to provide protection against erosion. Since the fill will be compacted and the ends will have riprap, the ends of the meander channel fill are not critical for slope stability.

If the backfill in the abandoned creek channel is not adequately compacted, it could liquefy during a strong earthquake and flow laterally into the new meander channel. Potentially liquefiable backfill would require soil improvement along the edges to prevent lateral spreading into the new meander channel. This would be undesirable and expensive.

19.0 VEGETATION PLANTING

Generally, trees and deep rooted vegetation are not recommended on levees, since they have long term detrimental effects by creating voids due to root growth and root decay, hence having a potentially negative impact on the integrity of the levee (piping risk). The potential negative impact of the vegetation planting beyond the levee core is considered remote, because the flatness of the levee slopes results in a especially wide core.

Hydroseeding a native mix of plants (preferable perennial shallow rooted) is recommended to protect the surface of the levees again erosion.

Beyond the "vegetation-free zone" of the flood protection levees, larger vegetation and plants may be permitted.

Specific guidelines for the types and locations of the vegetation allowed on the levees should be addressed by the USACE.

20.0 ENVIRONMENTAL ISSUES

Evaluation of environmental issues for this project and their impact on site development are outside our scope of work and are the responsibility of the project environmental consultant.

21.0 CONCLUDING REMARKS

This investigation was performed in accordance with generally accepted Geotechnical Engineering principles and practice. The professional engineering work and judgments presented in this report meet the standard of care of our profession at this time. No other warranty, expressed or implied, is made. This report has been prepared for the Santa Monica Bay Restoration Commission, and their design consultants. It may not contain sufficient information for other parties or other purposes, and should not be used for other projects or other purposes without review and approval by GDC.

The recommendations for this project, to a high degree, are dependent upon proper quality control of site grading, fill and backfill placement. The recommendations are made contingent on the opportunity for GDC to observe the earthwork operations. This firm should be notified of any pertinent changes in the project, or if conditions are encountered in the field, which differ from those described herein. If parties other than GDC are engaged to provide such services, they must be notified that they will be required to assume complete responsibility for the geotechnical phase of the project, and must either concur with the recommendations in this report or provide alternate recommendations.

22.0 STATEMENT OF RESPONSIBILITY

We have reviewed the reports referenced in Appendix A2. Except as presented in this report, we concur with their findings and accept responsibility for using their results. However, the recommendations contained in our report supersede the recommendations contained in the reports in Appendix A2.

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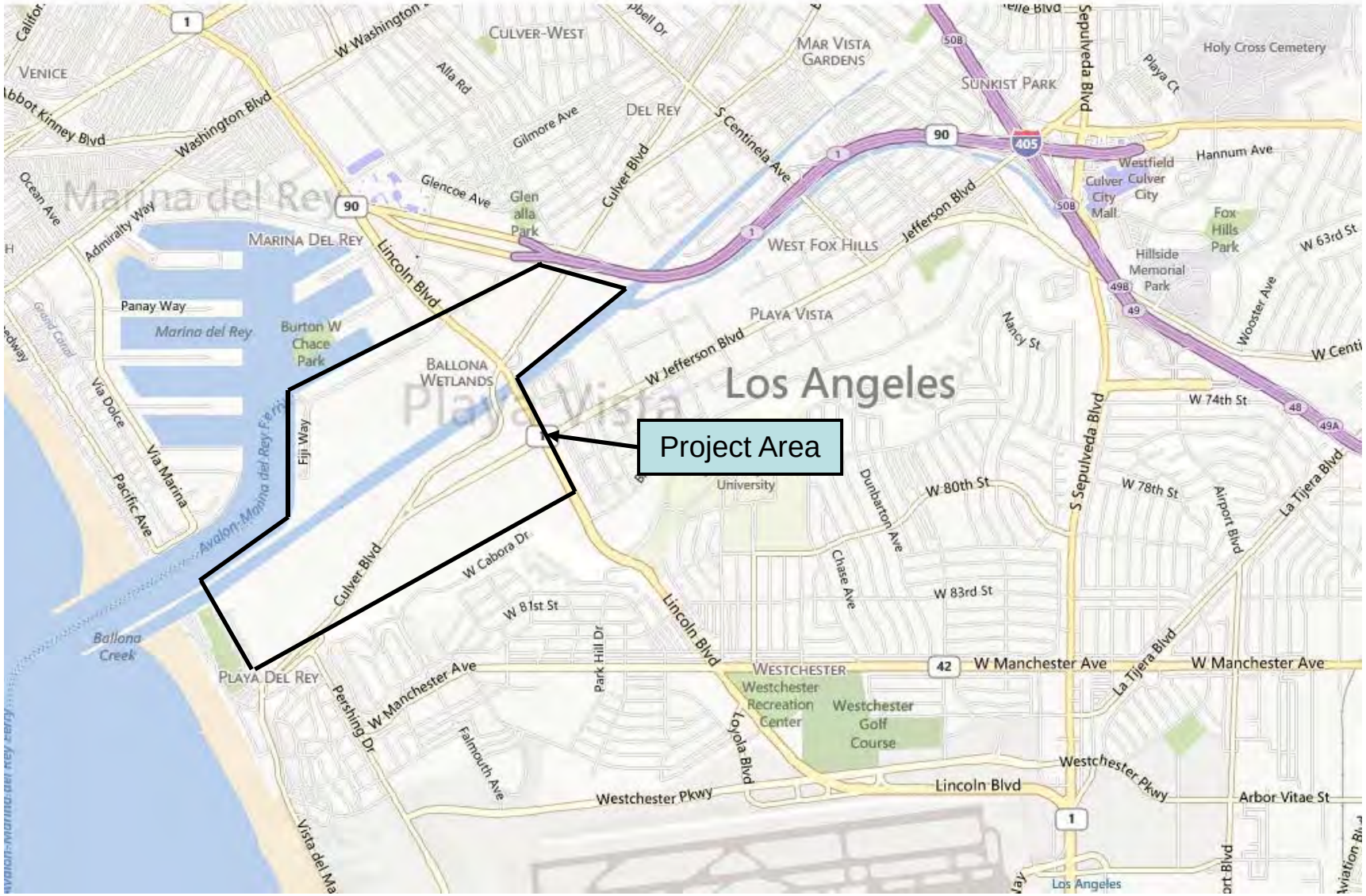
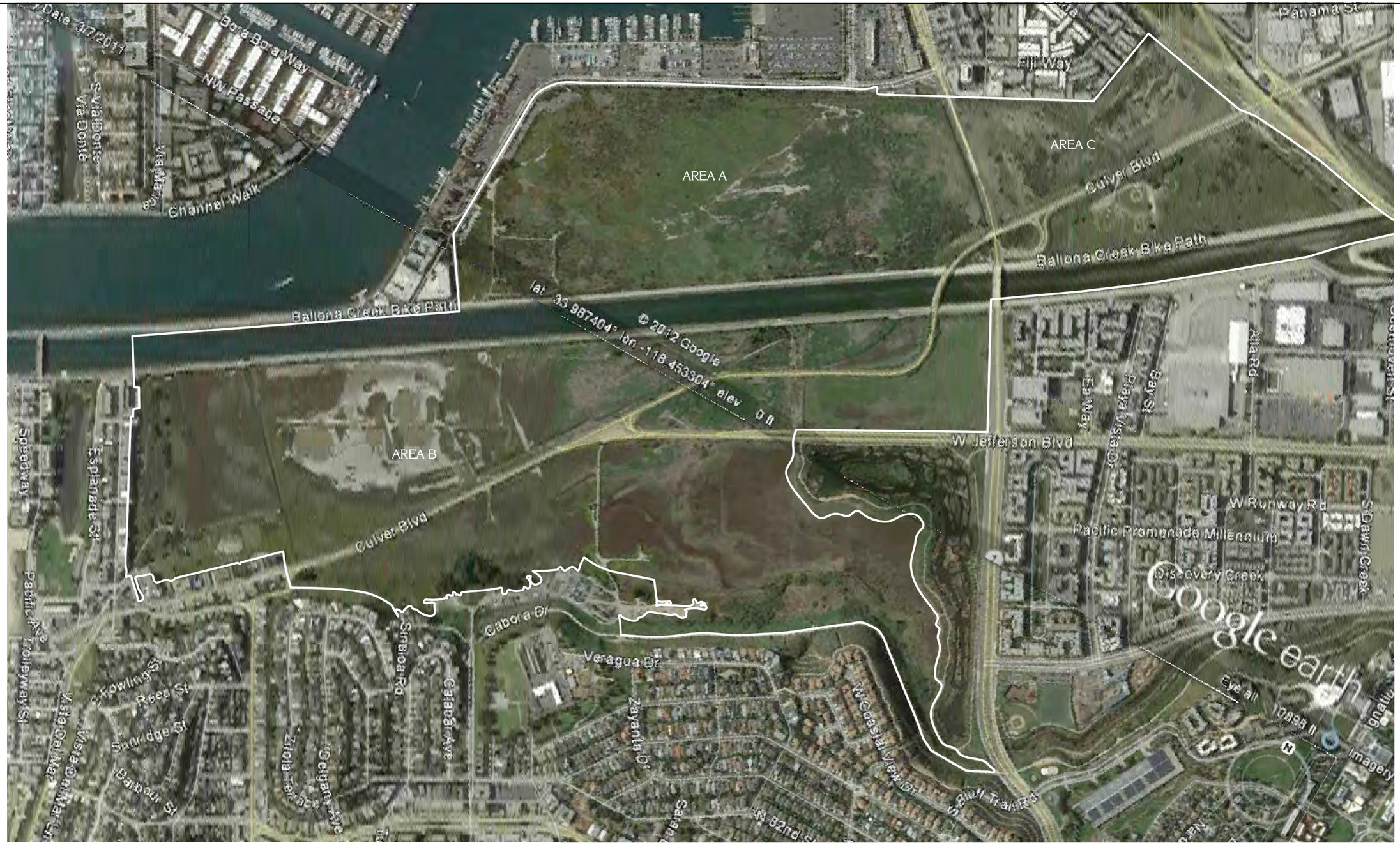
FIGURES

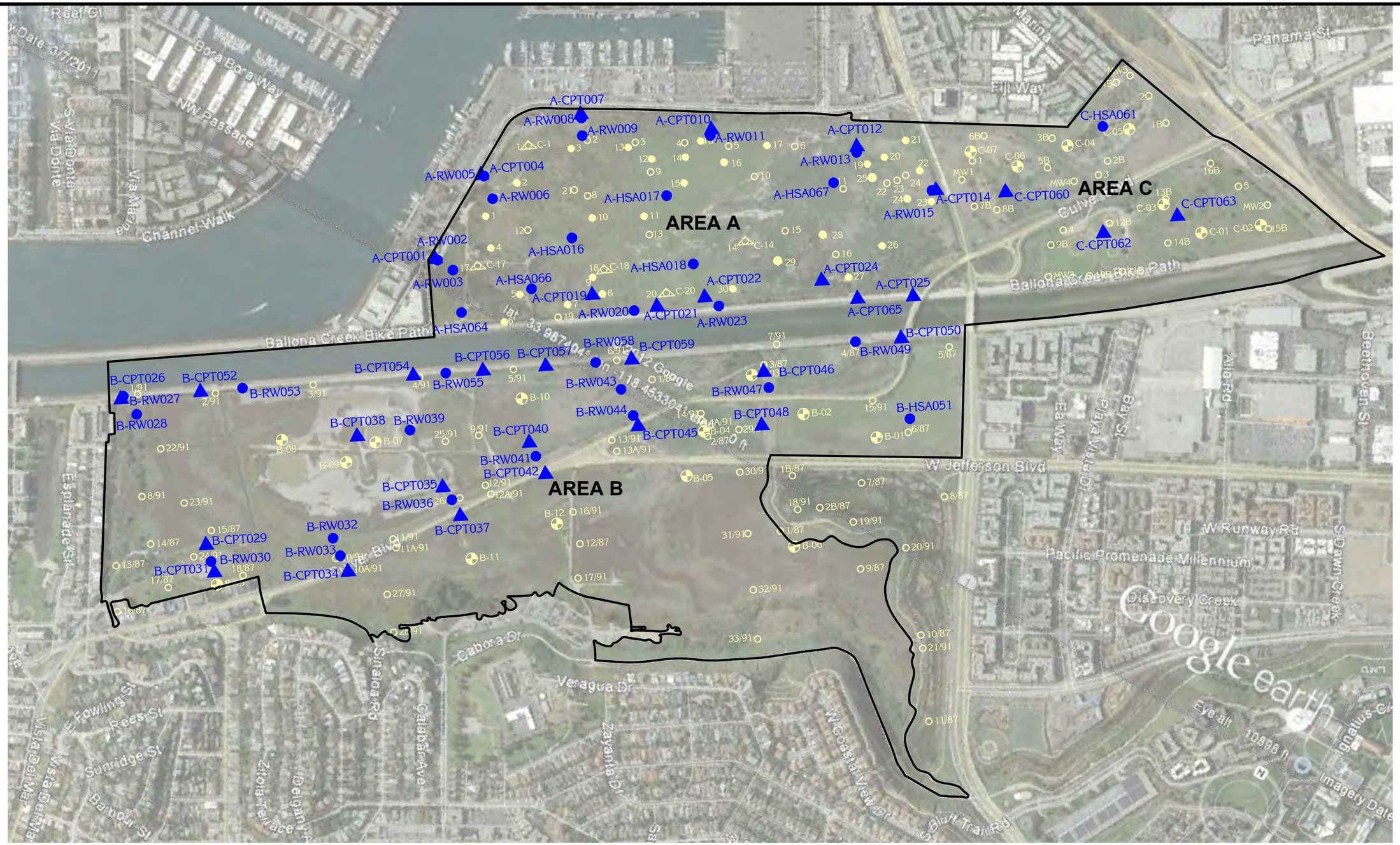


GROUP DELTA CONSULTANTS	**Vicinity Map**	Project Number: LA-962A Date: 5/28/2013
Group Delta Consultants. INC. 370 Amapola Ave. Torrance, Ca 90501	**Ballona Creek Wetlands Restoration**	Figure 1



DATE: 8/28/12	DRAWN BY: A. Helma	GROUP DELTA CONSULTANTS	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	SITE PLAN	PROJECT NUMBER: LA962A
REVISION:	APPROVED BY: P. Kashighandi			Ballona Wetlands Restoration Los Angeles, CA	SCALE: 1" = 750'
REVISION:					FIGURE NUMBER: 2

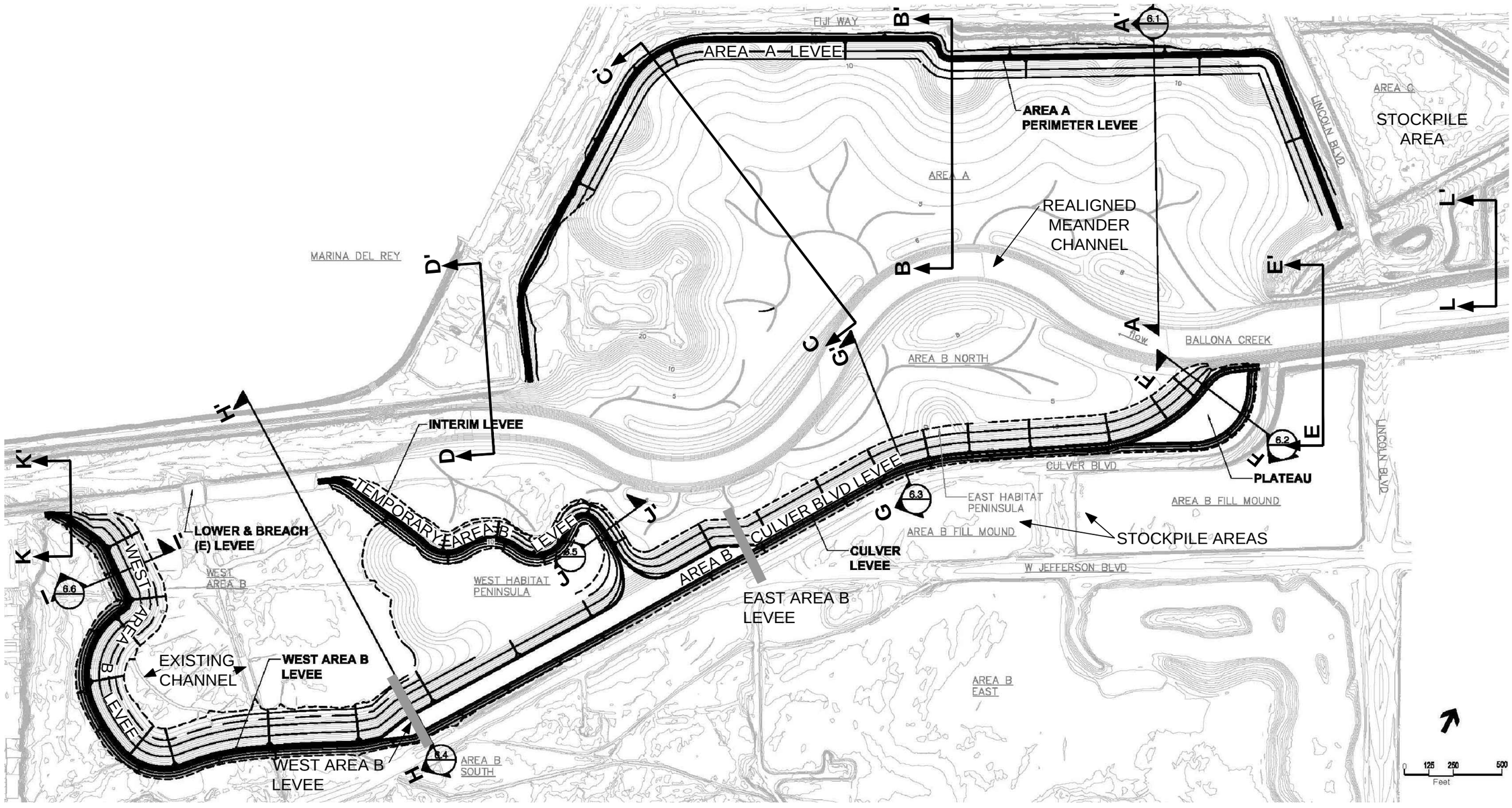
N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Drawings\L-962 Figures 1-3 - Site Plan.prev and prop borings.dwg



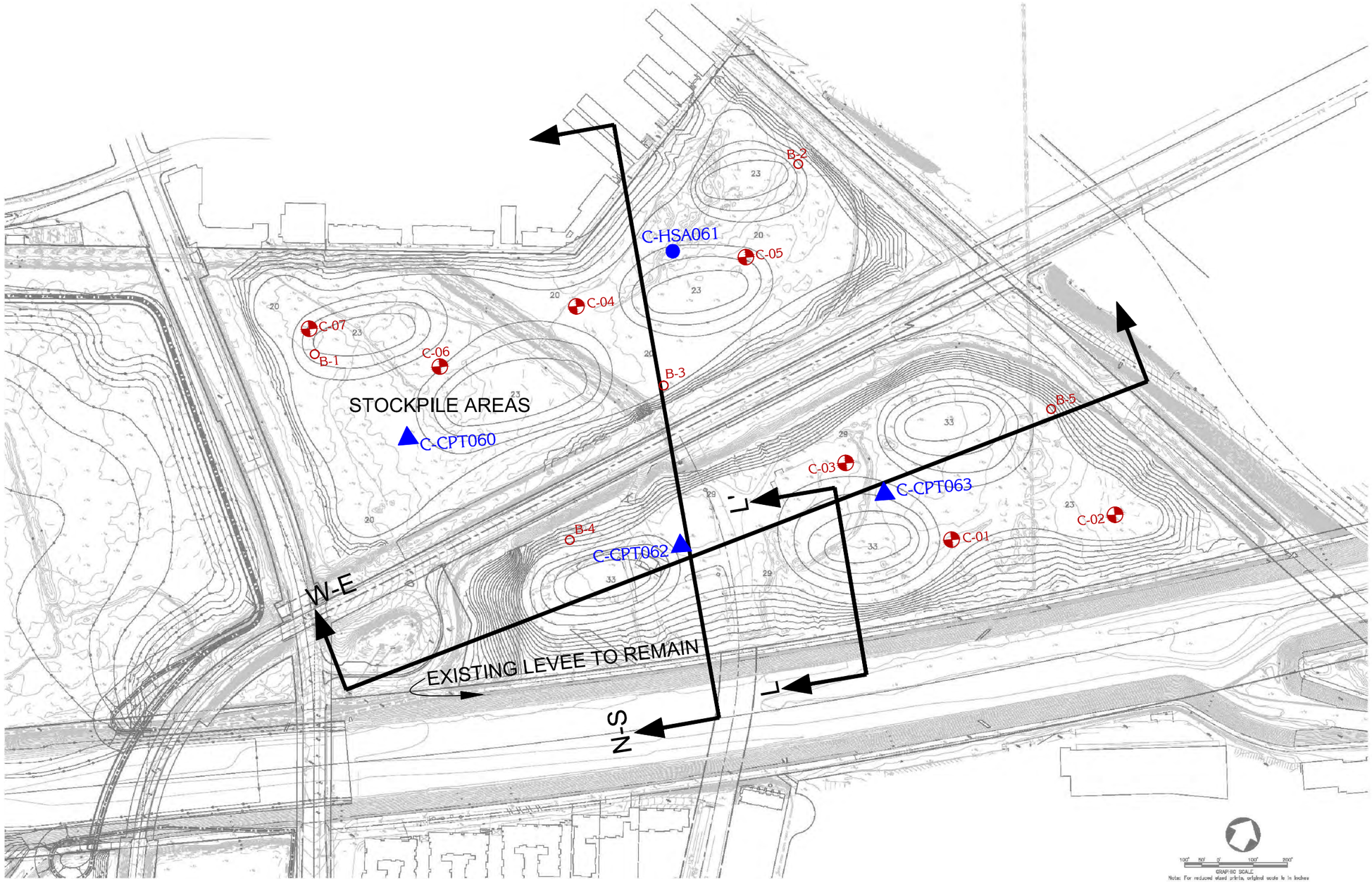
LEGEND

- A-RW002 GDC Boring (RW/HSA) Location
- A-CPT001 GDC CPT Location
- 33/91 Law Crandall Boring Locations (1991)
- 18/87 Law Crandall Boring Locations (1987)
- 24 Law Crandall Boring Locations in Area A (1991)
- B-13 Diaz Yourman Boring Locations in Area B (2010)
- C-07 Diaz Yourman Boring Locations in Area C (2010)
- 30 Weston Boring Locations (2009)

DATE: 1/22/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	PROJECT NUMBER: LA962A
REVISION:	APPROVED BY: P. Kashighandi	PREVIOUS AND CURRENT INVESTIGATION BORINGS Ballona Wetlands Restoration Los Angeles, CA	SCALE: 1" = 750'
REVISION:			FIGURE NUMBER: 3



DATE: 12/4/2012	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	PROPOSED GRADING PLAN AND CROSS SECTIONS	PROJECT NUMBER: L962A
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi			BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	SCALE: AS SHOWN
REVISION:					FIGURE NUMBER: 4A



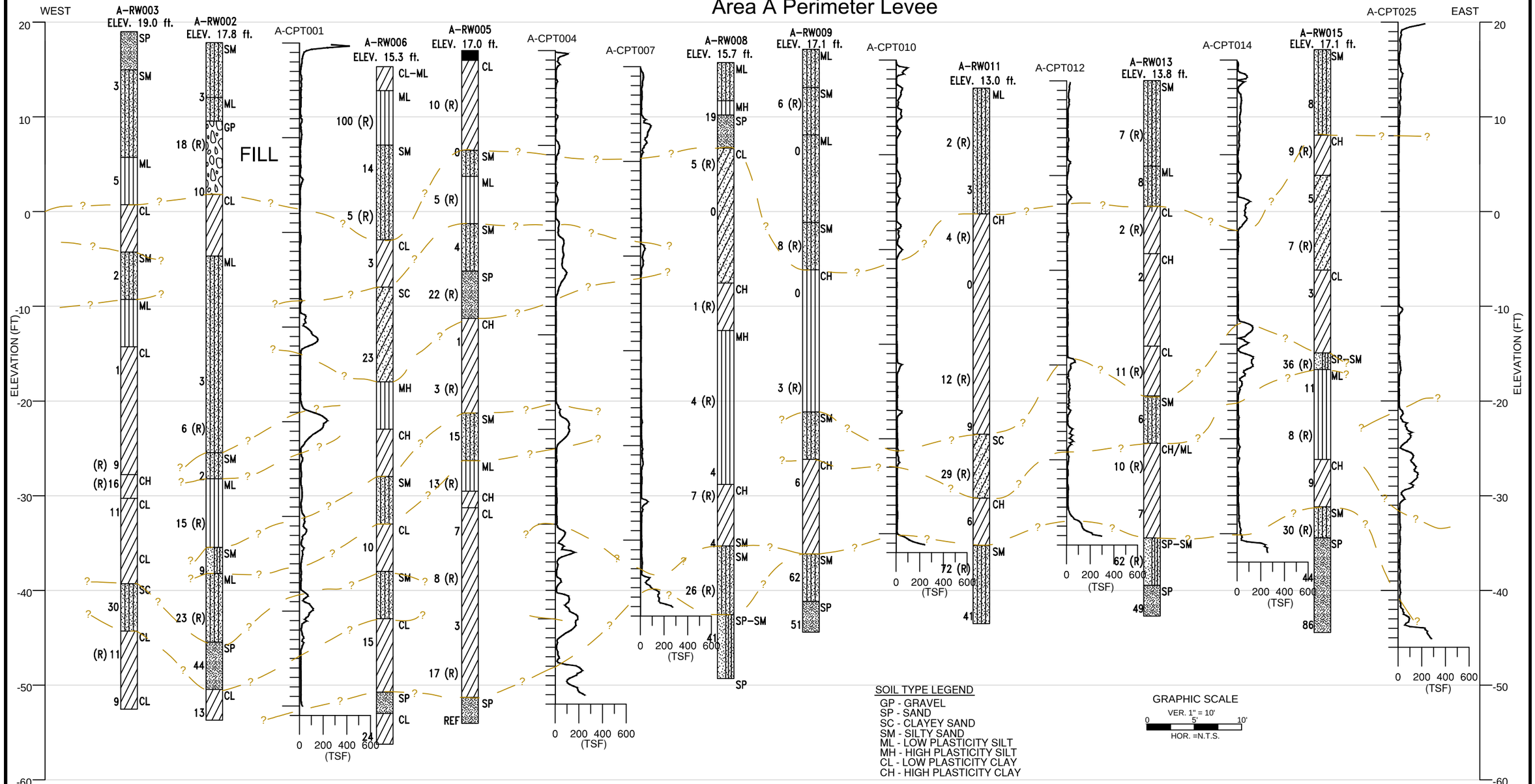
LEGEND

C-RW002	GDC Boring (RW/HSA) Location
C-CPT001	GDC CPT Location
B-5	Law Crandall Boring Locations in Area C (1991)
C-07	Diaz Yourman Boring Locations in Area C (2010)

DATE: 1/22/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	AREA C GRADING PLAN AND CROSS SECTIONS (LEVEE AND PERIMETER) BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi		
REVISION:			

PROJECT NUMBER: LA962A
SCALE: AS SHOWN
FIGURE NUMBER: 4B

Area A Perimeter Levee



SOIL TYPE LEGEND
GP - GRAVEL
SP - SAND
SC - CLAYEY SAND
SM - SILTY SAND
ML - LOW PLASTICITY SILT
MH - HIGH PLASTICITY SILT
CL - LOW PLASTICITY CLAY
CH - HIGH PLASTICITY CLAY

GRAPHIC SCALE
VER. 1" = 10'
0 5' 10'
HOR. =N.T.S.

LEGEND
9 SPT N-Value
20 (R) Blowcounts of Modified California Ring Sample
— ? — Interpreted Layer Boundry

NOTE
(1) PROFILE INCLUDES BORINGS WITHIN ABOUT 100 FEET OF THE PROPOSED AREA A PERIMETER LEVEES.
(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.
(3) BORINGS ARE SHOWN FROM WEST TO EAST. HORIZONTAL DISTANCES BETWEEN BORINGS ARE NOT TO SCALE.

DATE: 2/21/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	PROJECT NUMBER: L962A
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi	SUBSURFACE PROFILE ALONG AREA A PERIMETER LEVEE BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	SCALE: AS SHOWN
REVISION:			FIGURE NUMBER: 5A

Area B Perimeter Levee

WEST

EAST

ELEVATION (FT)

B-RW027 ELEV. 13.0 ft.
B-RW030 ELEV. 6.1 ft.
B-CPT031
B-RW032 ELEV. 8.2 ft.
B-RW033 ELEV. 6.3 ft.
B-CPT034
B-CPT035
B-RW036 ELEV. 9.1 ft.
B-CPT037
B-CPT040
B-RW041 ELEV. 6.8 ft.
B-RW043 ELEV. 8.8 ft.
B-RW044 ELEV. 9.2 ft.
B-CPT045
B-RW047 ELEV. 11.5 ft.
B-CPT050

FILL

0 200 400 600 (TSF)

LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

— ? — Interpreted Layer Boundry

NOTE

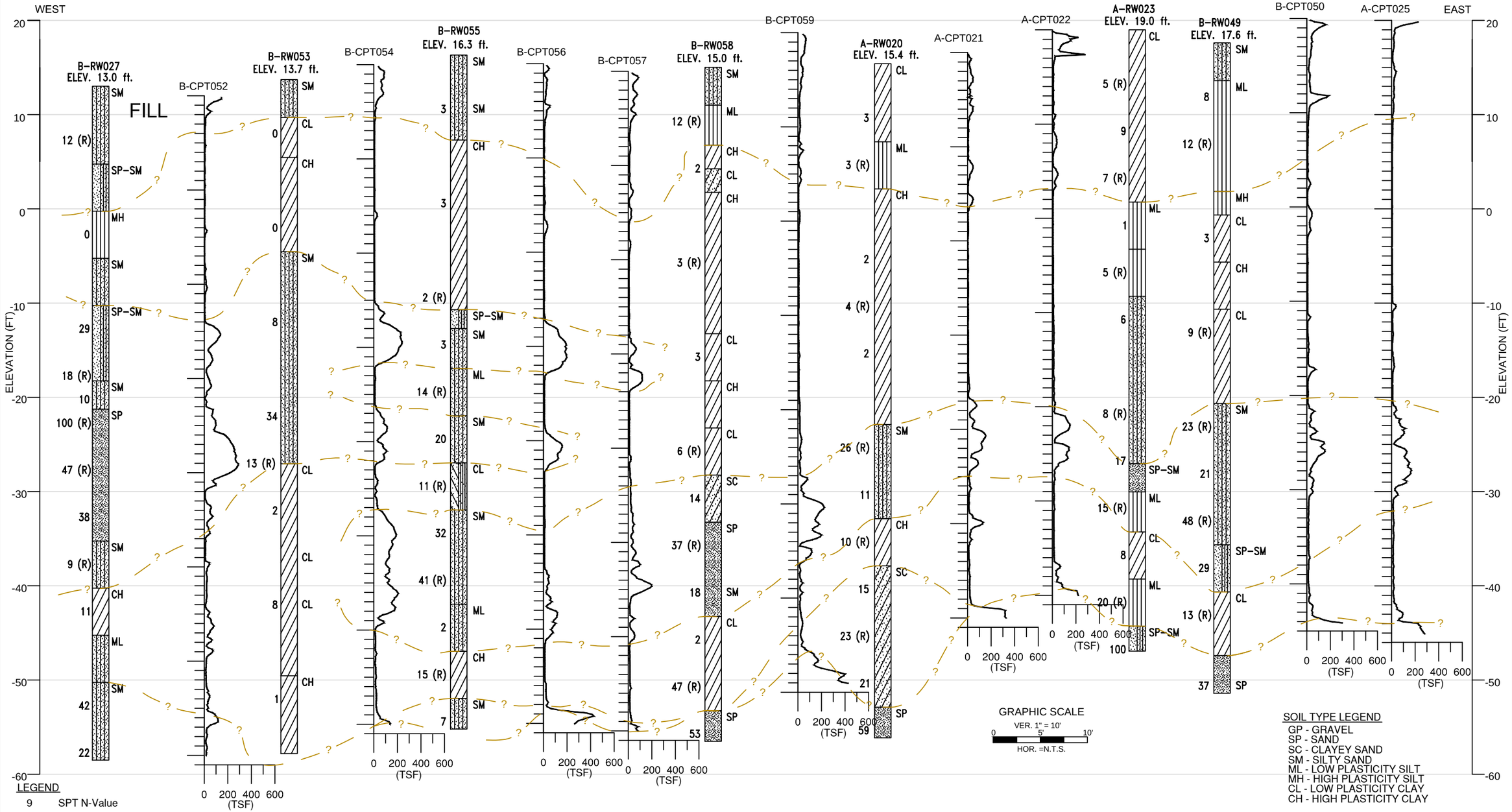
(1) PROFILE INCLUDES BORINGS WITHIN ABOUT 100 FEET OF THE PROPOSED AREA B LEVEES (WEST AREA B AND CULVER BLVD).
(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.
(3) BORINGS ARE SHOWN FROM WEST TO EAST. HORIZONTAL DISTANCES BETWEEN BORINGS ARE NOT TO SCALE.

GRAPHIC SCALE
VER. 1" = 10'
0 5' 10'
HOR. =N.T.S.

SOIL TYPE LEGEND
GP - GRAVEL
SP - SAND
SC - CLAYEY SAND
SM - SILTY SAND
ML - LOW PLASTICITY SILT
MH - HIGH PLASTICITY SILT
CL - LOW PLASTICITY CLAY
CH - HIGH PLASTICITY CLAY

DATE: 12/18/2012	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	SUBSURFACE PROFILE ALONG AREA B PERIMETER LEVEE BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi		PROJECT NUMBER: L962A SCALE: AS SHOWN FIGURE NUMBER: 5B
REVISION:			

Borings Along Ballona Creek Levee



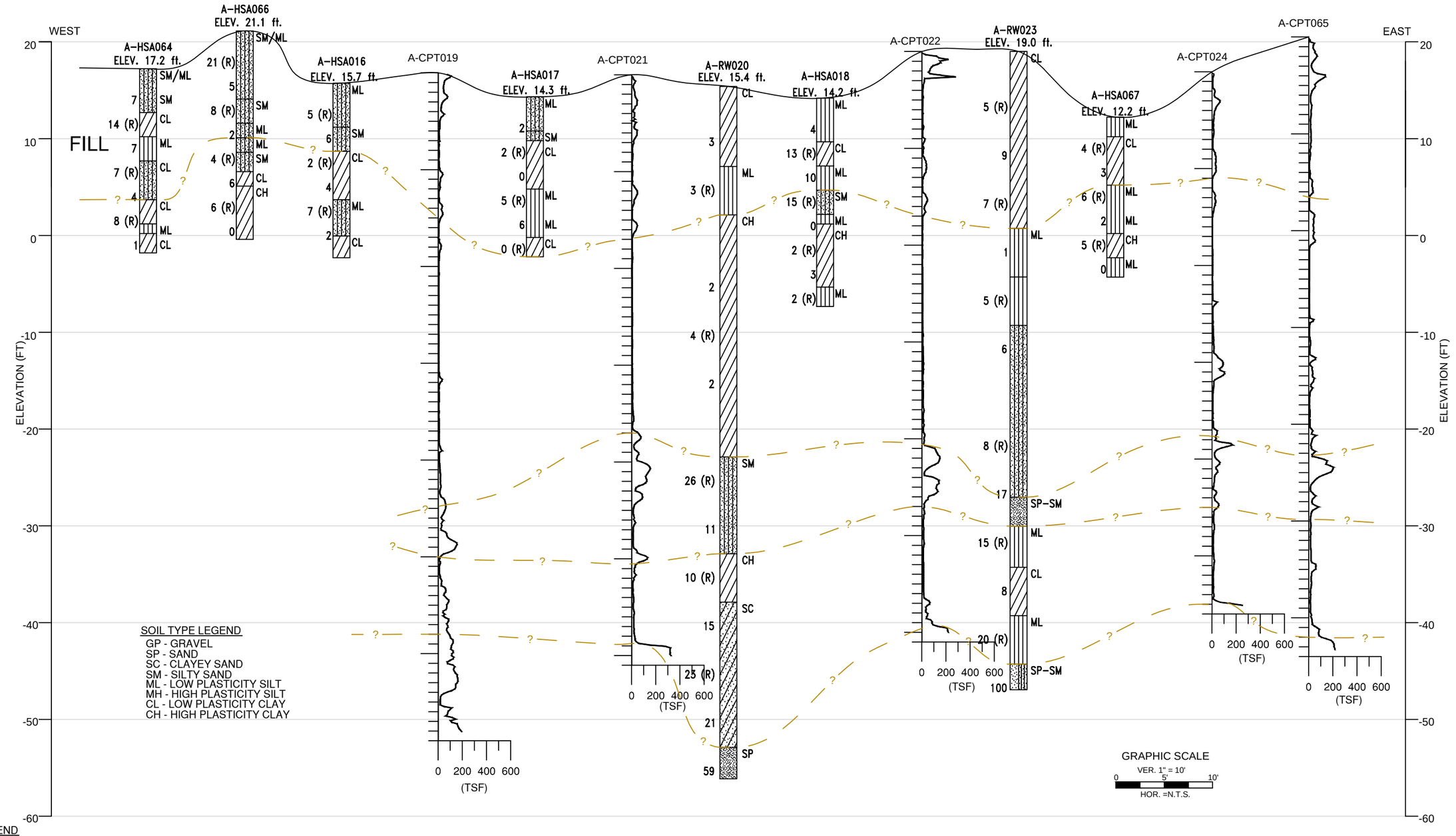
GRAPHIC SCALE
VER. 1" = 10'
0 5' 10'
HOR. =N.T.S.

SOIL TYPE LEGEND
GP - GRAVEL
SP - SAND
SC - CLAYEY SAND
SM - SILTY SAND
ML - LOW PLASTICITY SILT
MH - HIGH PLASTICITY SILT
CL - LOW PLASTICITY CLAY
CH - HIGH PLASTICITY CLAY

LEGEND
9 SPT N-Value
20 (R) Blowcounts of Modified California Ring Sample
— ? — Interpreted Layer Boundry

NOTE
(1) PROFILE INCLUDES BORINGS WITHIN ABOUT 100 FEET OF THE EXISTING BALLONA CREEK LEVEES.
(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.
(3) BORINGS ARE SHOWN FROM WEST TO EAST. HORIZONTAL DISTANCES BETWEEN BORINGS ARE NOT TO SCALE.

DATE: 12/18/2012	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	SUBSURFACE PROFILE ALONG BALLONA CREEK CHANNEL BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi		PROJECT NUMBER: L962A SCALE: AS SHOWN FIGURE NUMBER: 5C
REVISION:			



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

— ? — Interpreted Layer Boundry

NOTE

(1) PROFILE INCLUDES BORINGS WITHIN ABOUT 100 FEET WITHIN AREA A EXCAVATION ZONE.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

(3) BORINGS ARE SHOWN FROM WEST TO EAST. HORIZONTAL DISTANCES BETWEEN BORINGS ARE NOT TO SCALE.

DATE: 12/18/2012	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	SUBSURFACE PROFILE WITHIN AREA A EXCAVATION ZONE
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi		BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION:			PROJECT NUMBER: L962A SCALE: AS SHOWN FIGURE NUMBER: 5D

WEST

EAST

ELEVATION (FT)

30
20
10
0
-10
-20
-30
-40
-50

C-CPT062

C-CPT063

B-4

C-3

C-1

B-5

C-2

FILL

B-4: SM, ML, SM, ML, CL, SP, MH, ML, SP, ML, SP

C-3: CL, CH, CL, CH, SC, SP, SP-SC, CL, ML

C-1: SC, ML, CL, CH, CL, SC, SP-SC, CH

B-5: CL, ML, MH, CL, ML, CL, ML, SW, SP

C-2: SC, CH, SC, CL, SP-SC

0 200 400 600
(TSF)

0 200 400 600
(TSF)

SOIL TYPE LEGEND

GP - GRAVEL
SP - SAND
SC - CLAYEY SAND
SM - SILTY SAND
ML - LOW PLASTICITY SILT
MH - HIGH PLASTICITY SILT
CL - LOW PLASTICITY CLAY
CH - HIGH PLASTICITY CLAY

GRAPHIC SCALE
VER. 1" = 10'
0 5' 10'
HOR. =N.T.S.

LEGEND

C-CPT062 = GDC (2012)
C-HSA062 = GDC (2012)
B-4 = LAW CRANDALL (1991)
C-1 = DIAZ YOURMAN (2010)
— ? — Interpreted Layer Boundry

BORING LEGEND

9 SPT N-Value
20 (R) Blowcounts of Modified California Ring Sample

NOTE

(1) PROFILE INCLUDES GDC's BORINGS/CPT's AND SELECTED BORINGS FROM PREVIOUS INVESTIGATIONS WITHIN AREA C.
(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.
(3) BORINGS ARE SHOWN FROM WEST TO EAST. HORIZONTAL DISTANCES BETWEEN BORINGS ARE NOT TO SCALE.

DATE: 12/4/2012	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	SUBSURFACE PROFILE ALONG SOUTH AREA C (W-E) BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi		
REVISION:			

PROJECT NUMBER: L962A
SCALE: AS SHOWN
FIGURE NUMBER: 5E

SOUTH

NORTH

ELEVATION (FT)

30
20
10
0
-10
-20
-30
-40
-50

C-CPT062

C-CPT063

B-4

C-3

C-CPT060

B-3

C-4

C-5

C-HSA061
ELEV. 16.0 ft.

B-2

FILL

0 200 400 600
(TSF)

SOIL TYPE LEGEND

GP - GRAVEL
SP - SAND
SC - CLAYEY SAND
SM - SILTY SAND
ML - LOW PLASTICITY SILT
MH - HIGH PLASTICITY SILT
CL - LOW PLASTICITY CLAY
CH - HIGH PLASTICITY CLAY

GRAPHIC SCALE
VER. 1" = 10'
0 5' 10'
HOR. =N.T.S.

LEGEND

C-CPT062 = GDC (2012)
C-HSA061 = GDC (2012)
B-3 = LAW CRANDALL (1991)
C-3 = DIAZ YOURMAN (2010)
— ? — Interpreted Layer Boundry

BORING LEGEND

9 SPT N-Value
20 (R) Blowcounts of Modified California Ring Sample

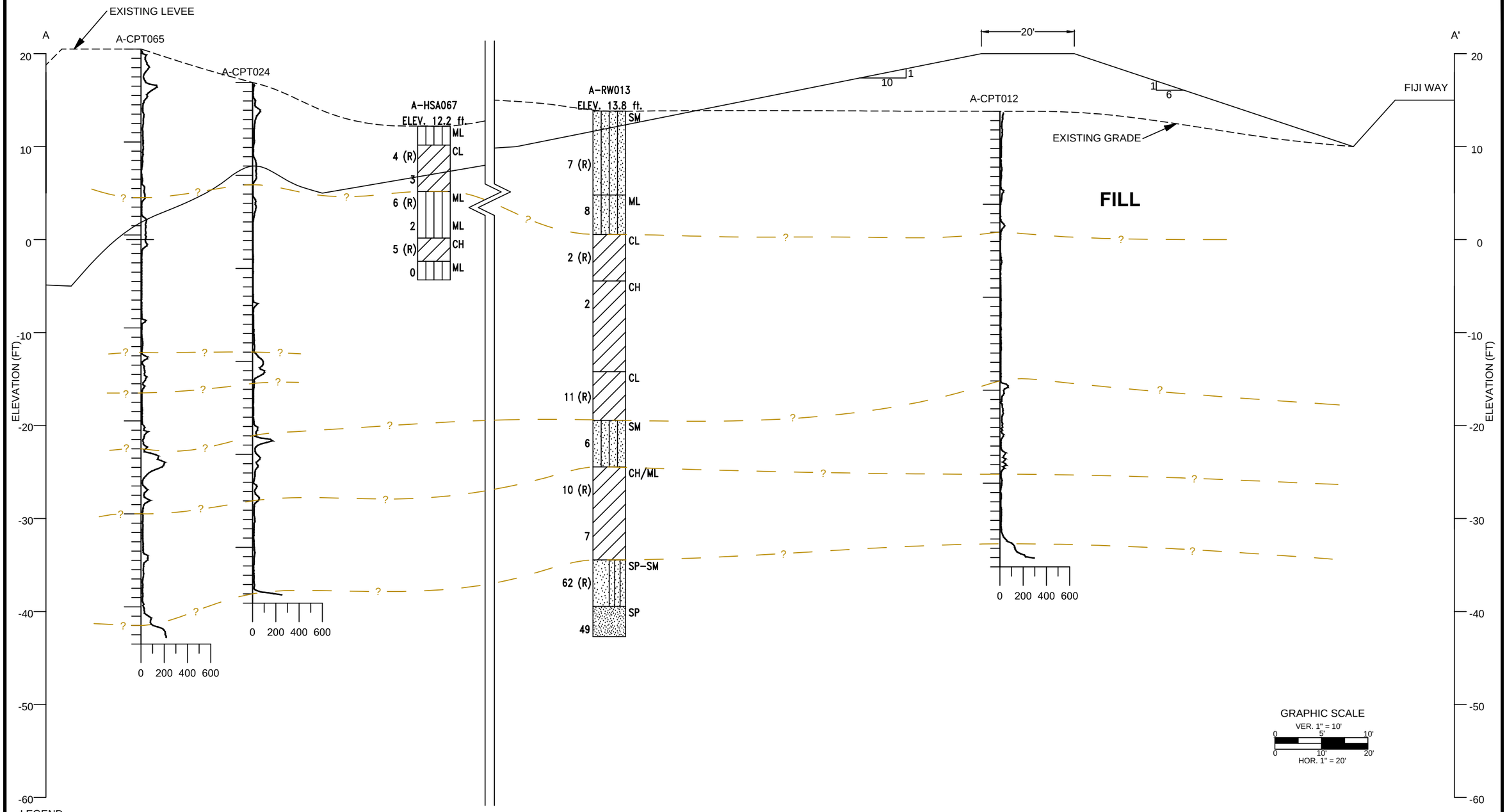
NOTE

(1) PROFILE INCLUDES GDC's BORINGS/CPT's AND SELECTED BORINGS FROM PREVIOUS INVESTIGATIONS WITHIN AREA C.
(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.
(3) BORINGS ARE SHOWN FROM SOUTH TO NORTH. HORIZONTAL DISTANCES BETWEEN BORINGS ARE NOT TO SCALE.

DATE: 12/4/2012	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	PROJECT NUMBER: L962A
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi		SCALE: AS SHOWN
REVISION:			FIGURE NUMBER: 5F

SUBSURFACE PROFILE WITHIN AREA C (N-S)

BALLONA WETLANDS RESTORATION PROJECT
LOS ANGELES, CA



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

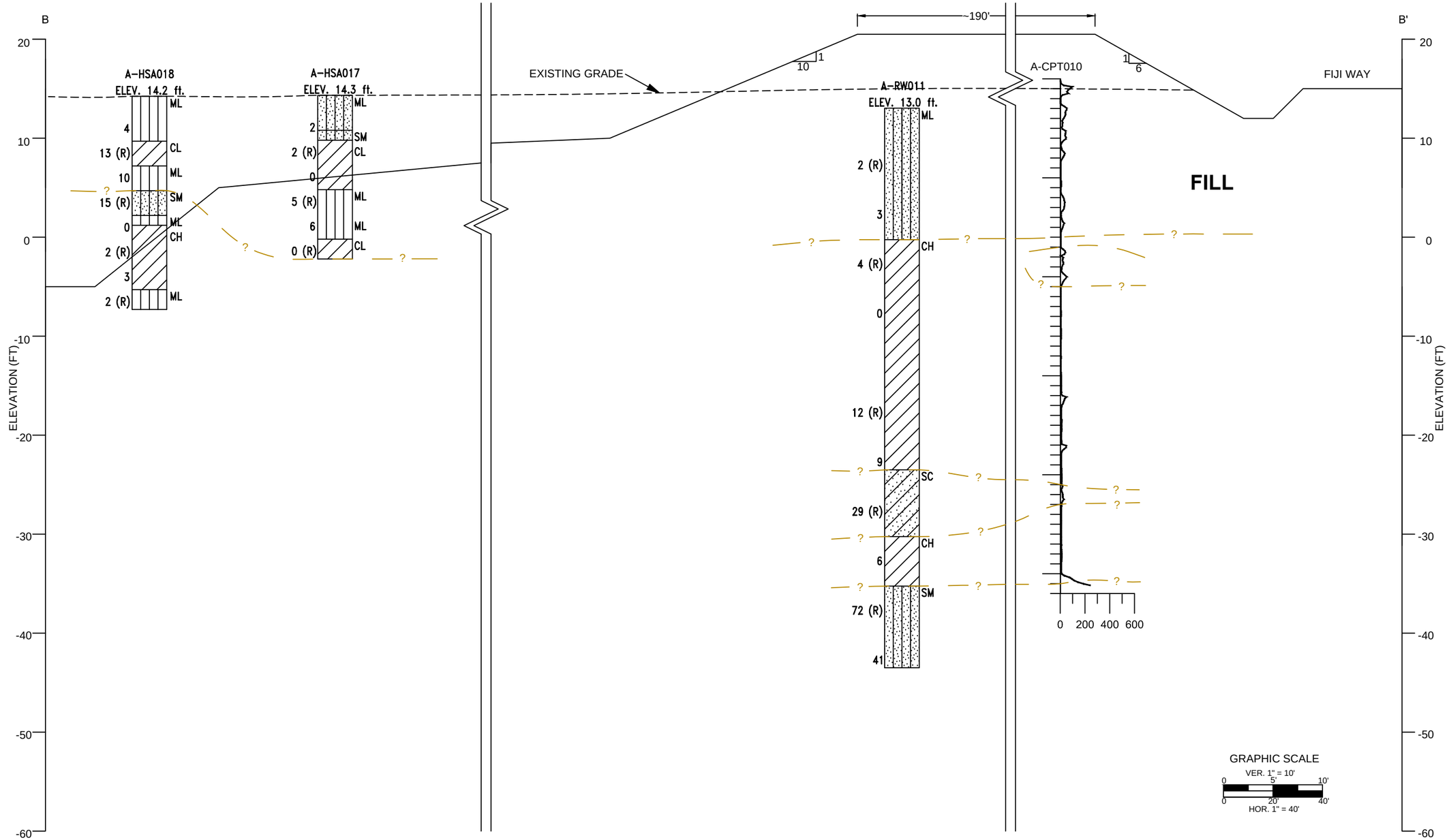
— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	PROJECT NUMBER: L962A
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi	CROSS SECTION A-A'	SCALE: AS SHOWN
REVISION:		BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	FIGURE NUMBER: 6A



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

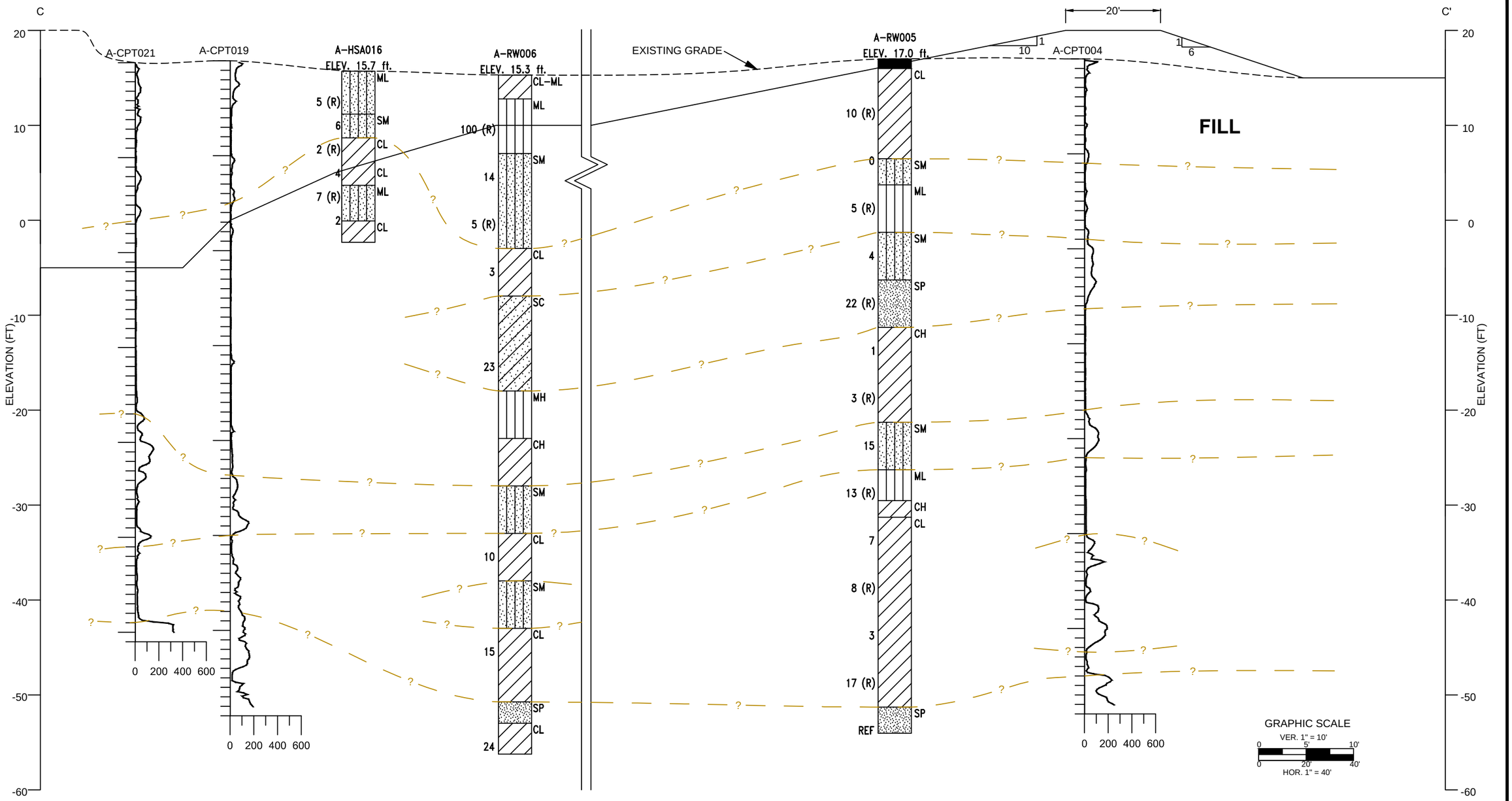
— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	CROSS SECTION B-B'
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi		BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION:			PROJECT NUMBER: L962A SCALE: AS SHOWN FIGURE NUMBER: 6B



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

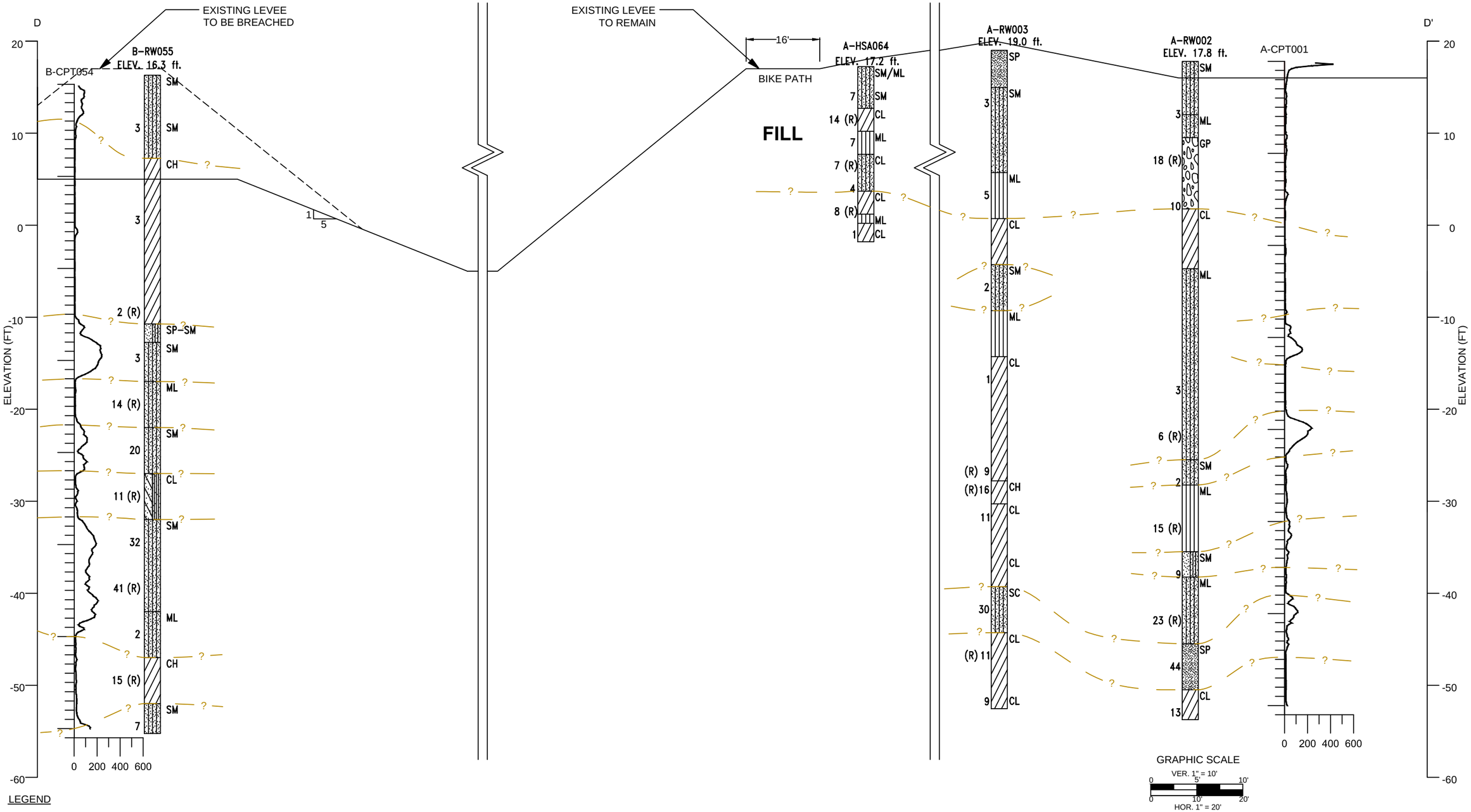
— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	CROSS SECTION C-C'
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi		BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION:			PROJECT NUMBER: L962A SCALE: AS SHOWN FIGURE NUMBER: 6C



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

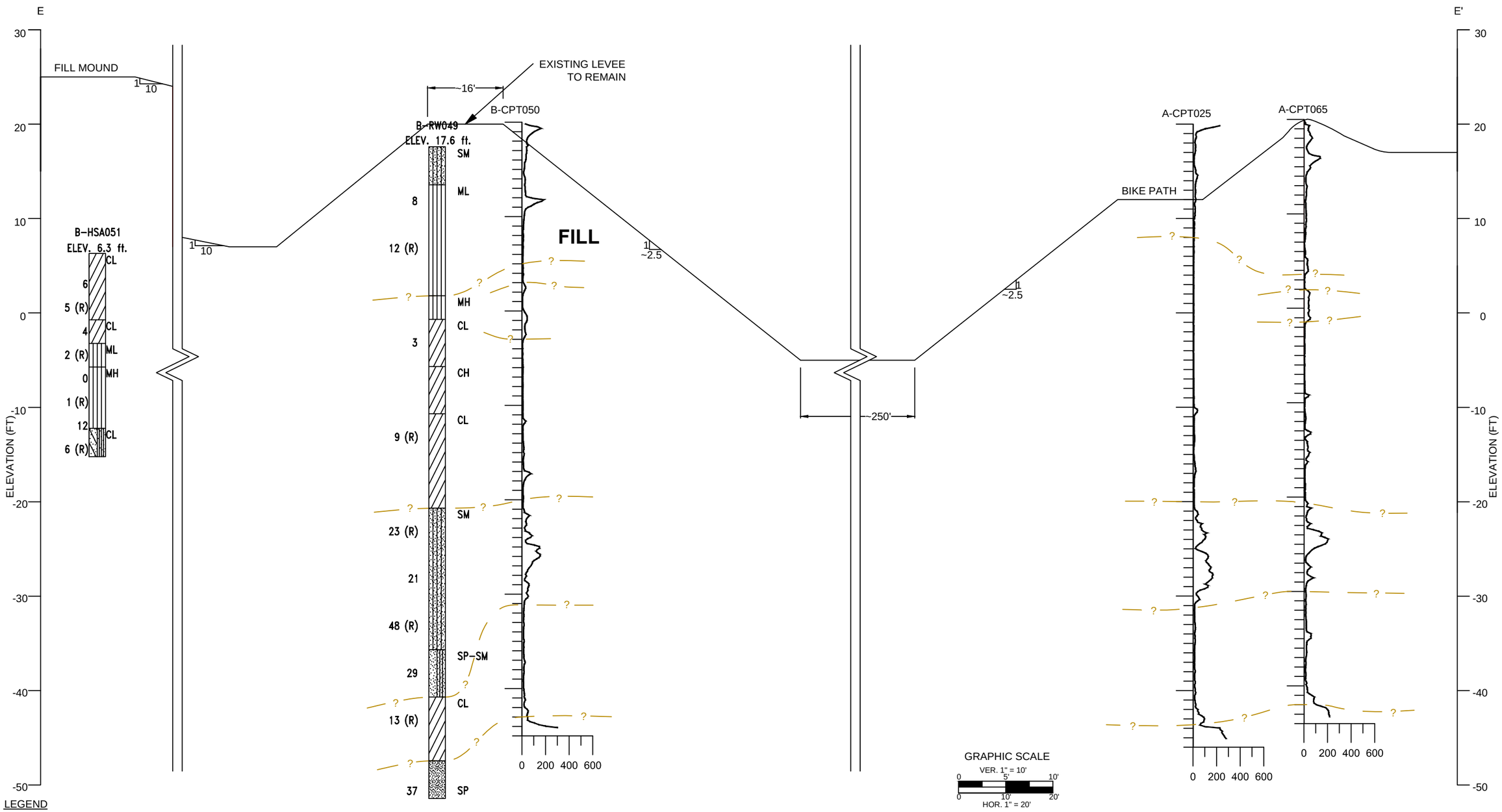
— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	CROSS SECTION D-D'
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi		BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION:			PROJECT NUMBER: L962A SCALE: AS SHOWN FIGURE NUMBER: 6D



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

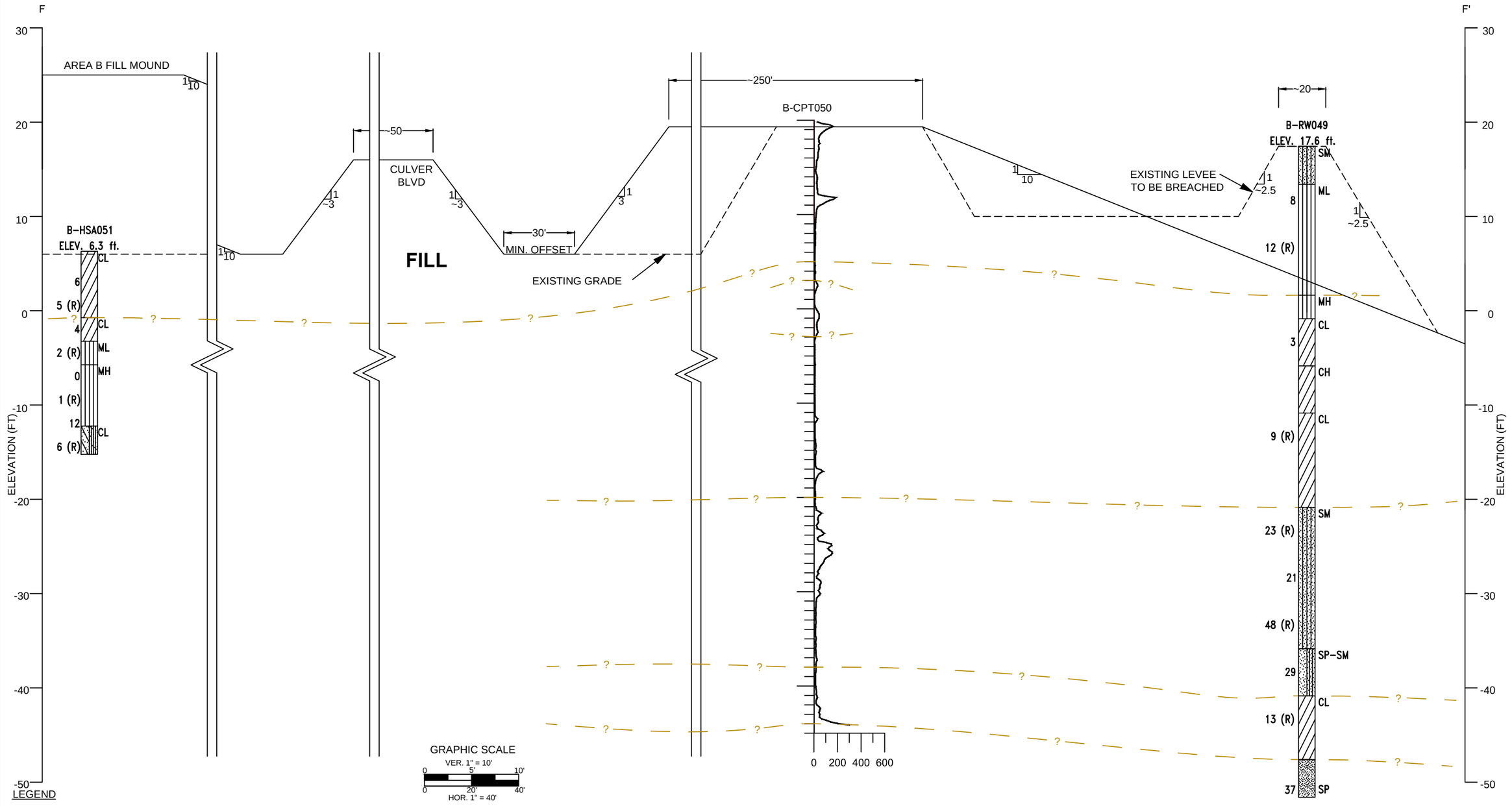
— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	PROJECT NUMBER: L962A
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi	CROSS SECTION E-E'	SCALE: AS SHOWN
REVISION:		BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	FIGURE NUMBER: 6E



GRAPHIC SCALE
VER. 1" = 10'
0 5' 10'
0 20' 40'
HOR. 1" = 40'

LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

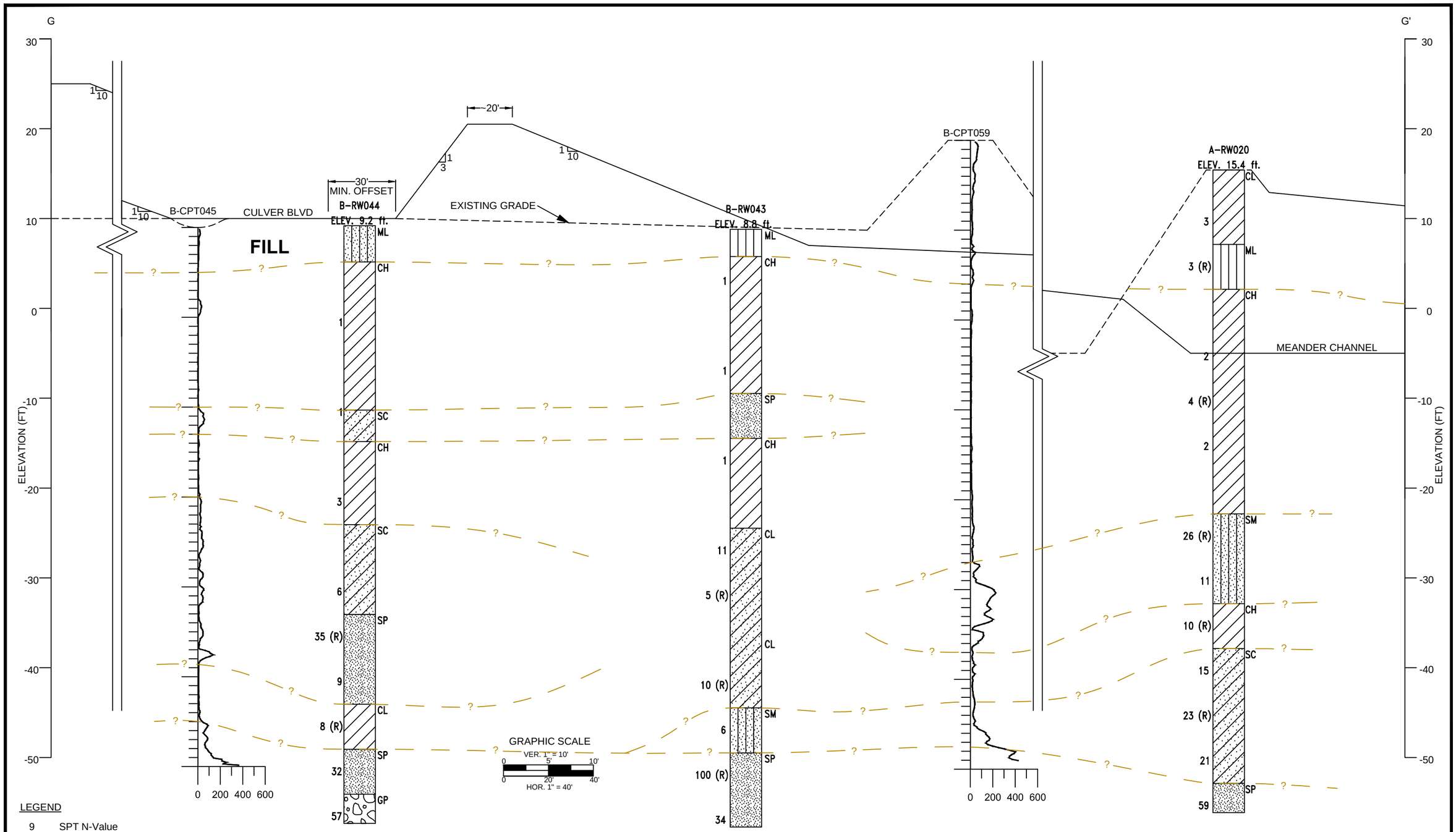
— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	PROJECT NUMBER: L962A
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi	CROSS SECTION F-F'	SCALE: AS SHOWN
REVISION:		BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	FIGURE NUMBER: 6F



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

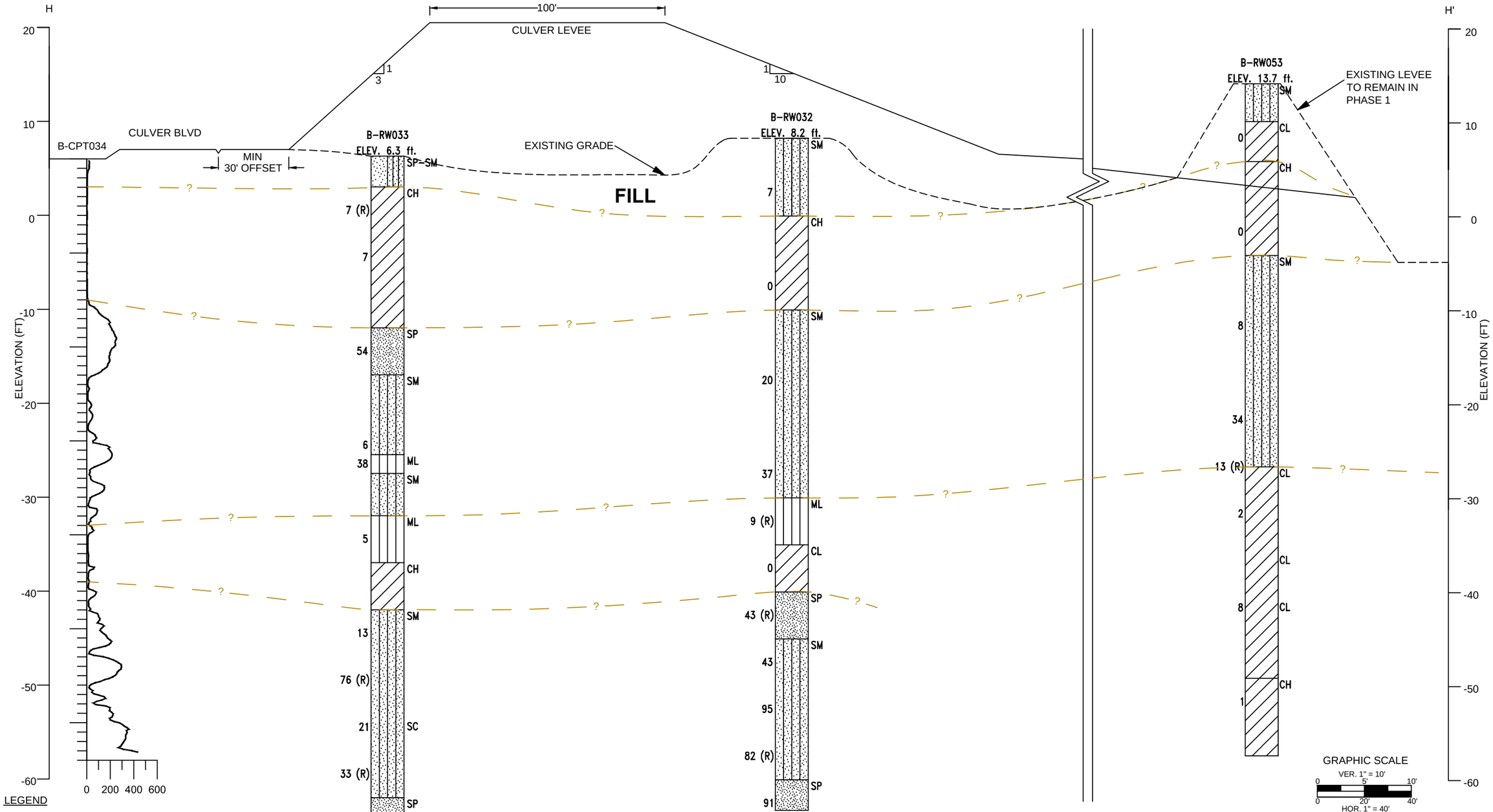
— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013	DRAWN BY: K. MADAMBA	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	PROJECT NUMBER: L962A
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi	CROSS SECTION G-G'	SCALE: AS SHOWN
REVISION:		BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	FIGURE NUMBER: 6G



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

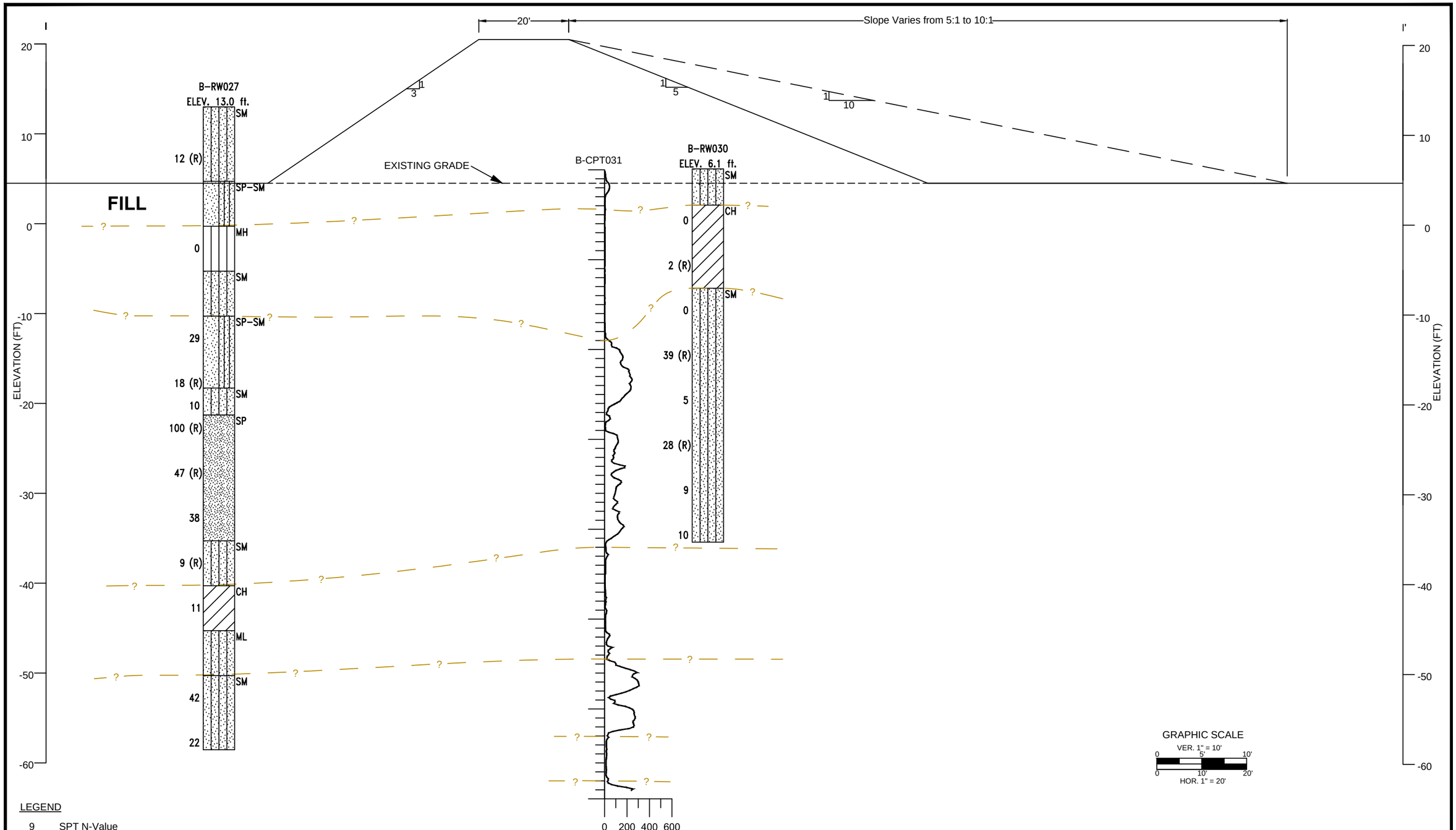
— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	PROJECT NUMBER: L962A
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi	CROSS SECTION H-H'	SCALE: AS SHOWN
REVISION:		BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	FIGURE NUMBER: 6H



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

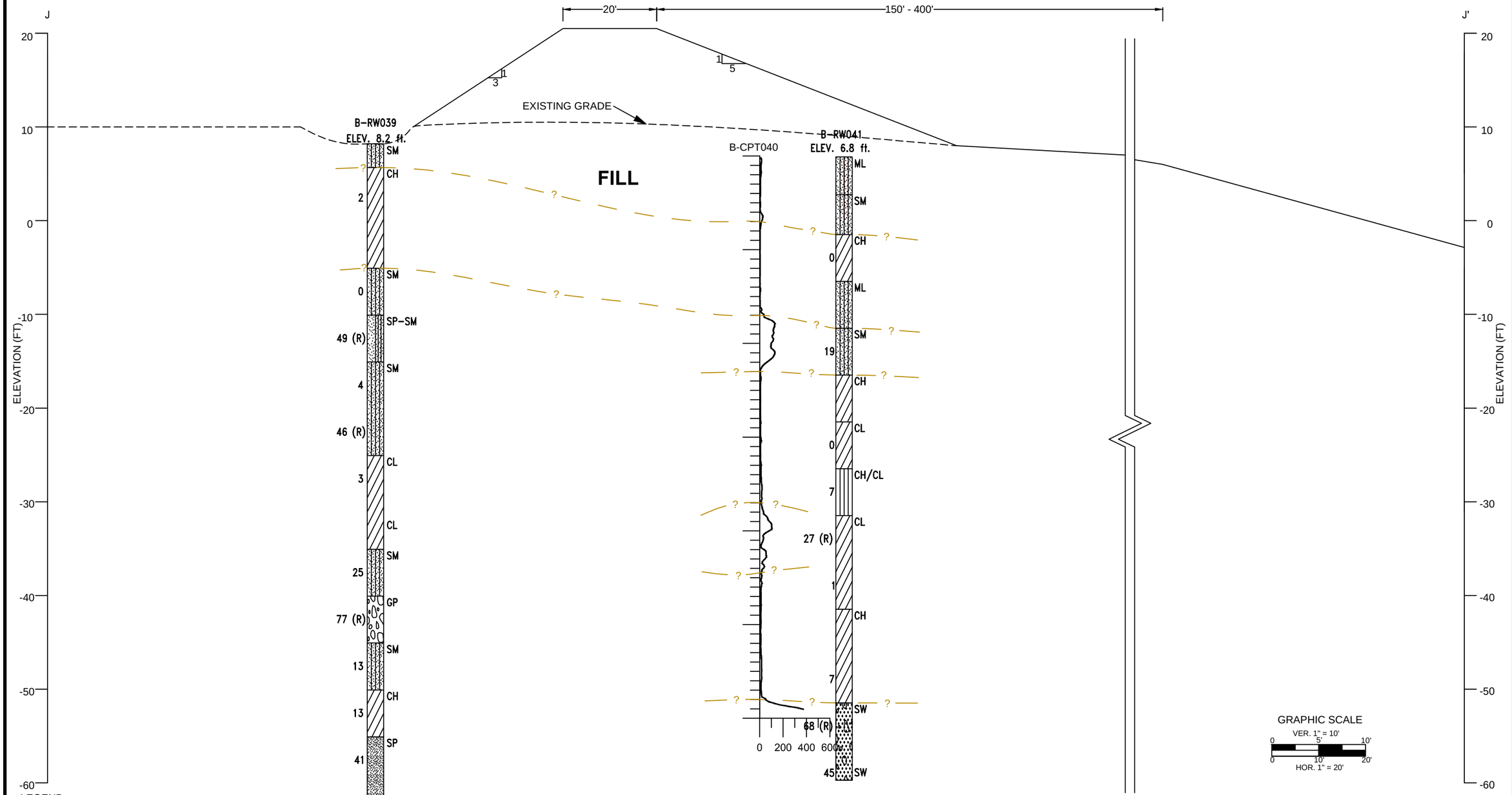
— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	CROSS SECTION I-I'
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi		BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION:			PROJECT NUMBER: L962A SCALE: AS SHOWN FIGURE NUMBER: 6I



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

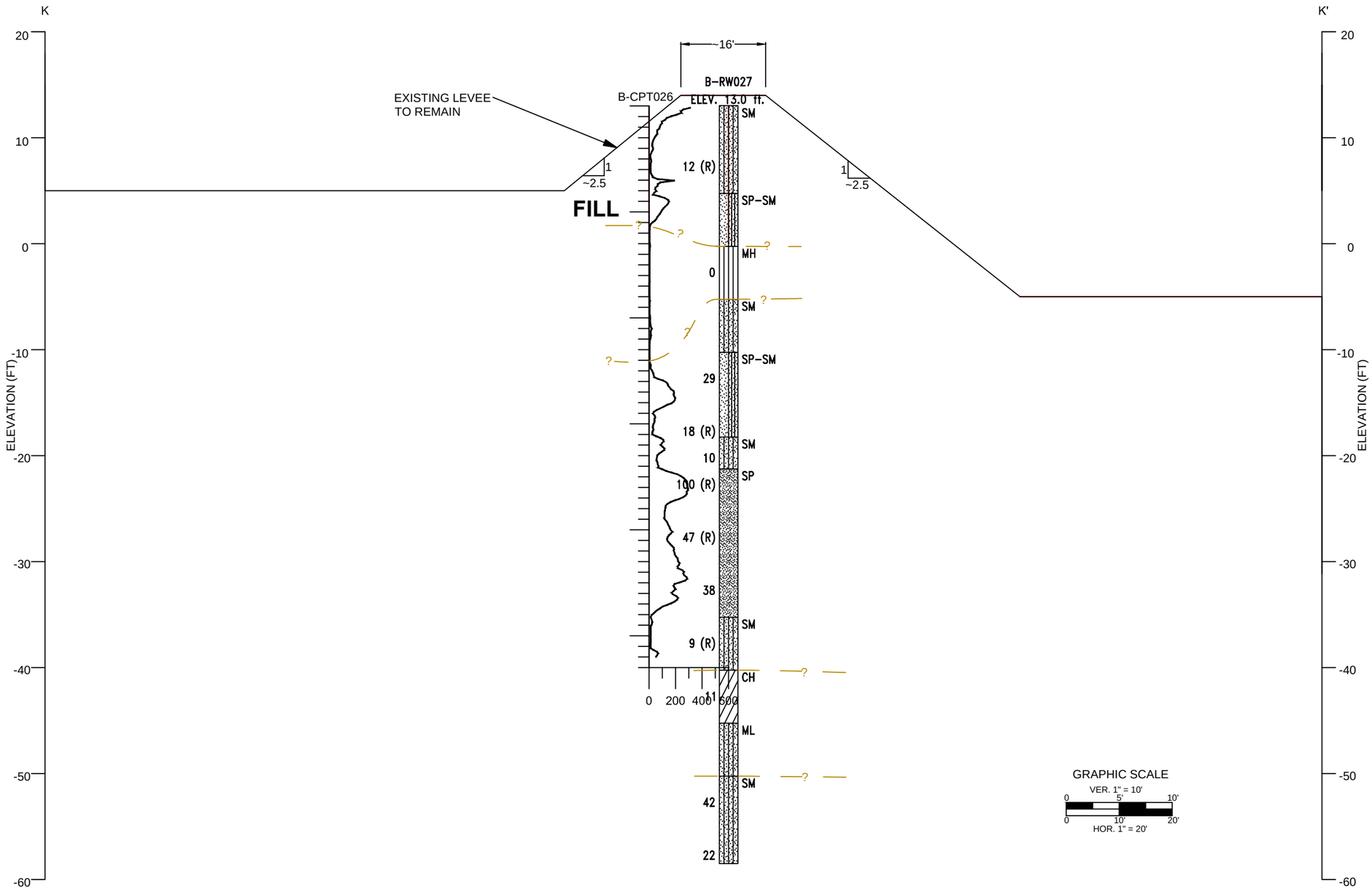
— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	PROJECT NUMBER: L962A
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi	CROSS SECTION J-J'	SCALE: AS SHOWN
REVISION:		BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	FIGURE NUMBER: 6J



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

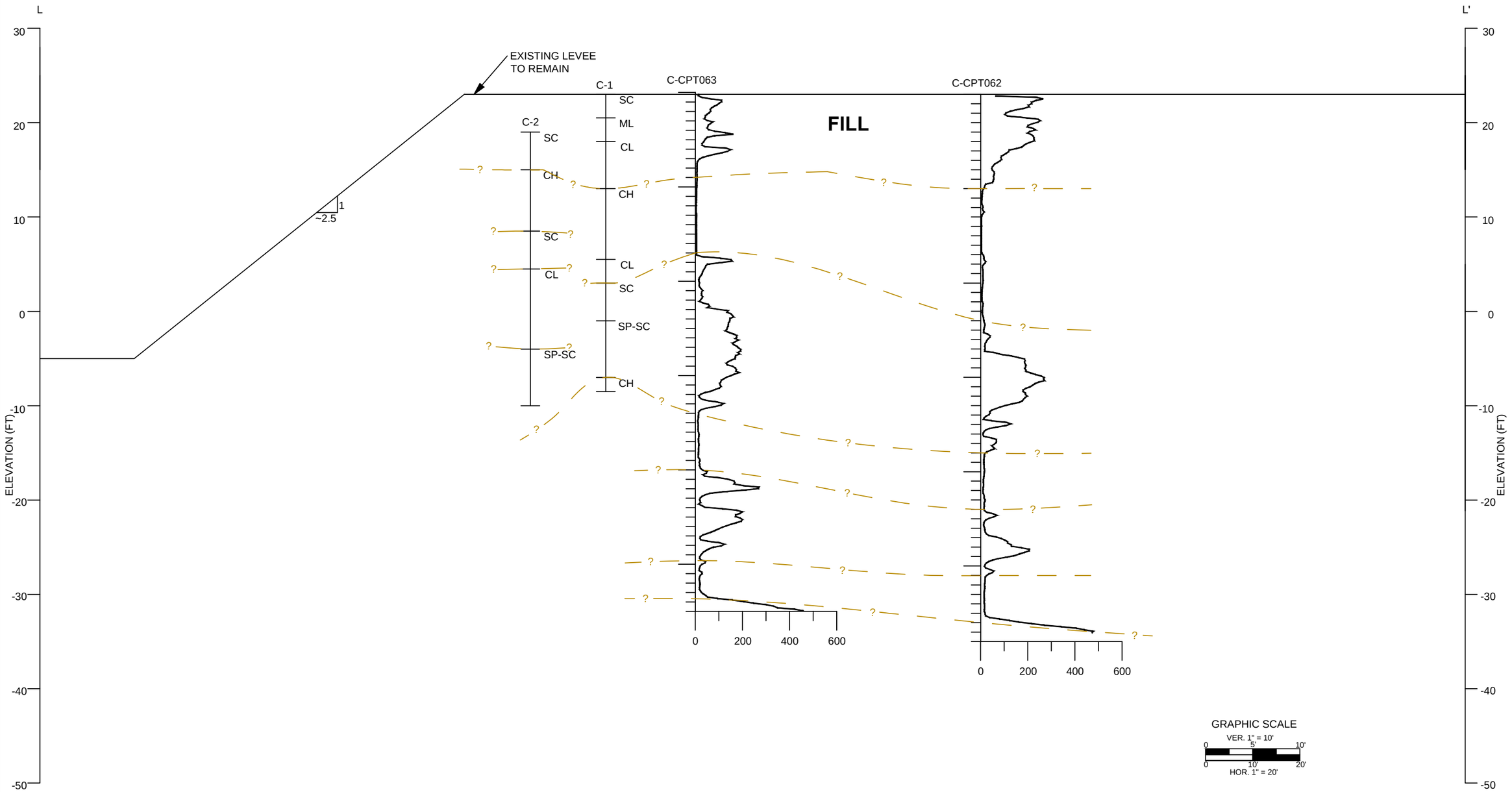
— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	PROJECT NUMBER: L962A
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi	CROSS SECTION K-K'	SCALE: AS SHOWN
REVISION:		BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	FIGURE NUMBER: 6K



GRAPHIC SCALE
VER. 1" = 10'
0 5' 10'
0 10' 20'
HOR. 1" = 20'

LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

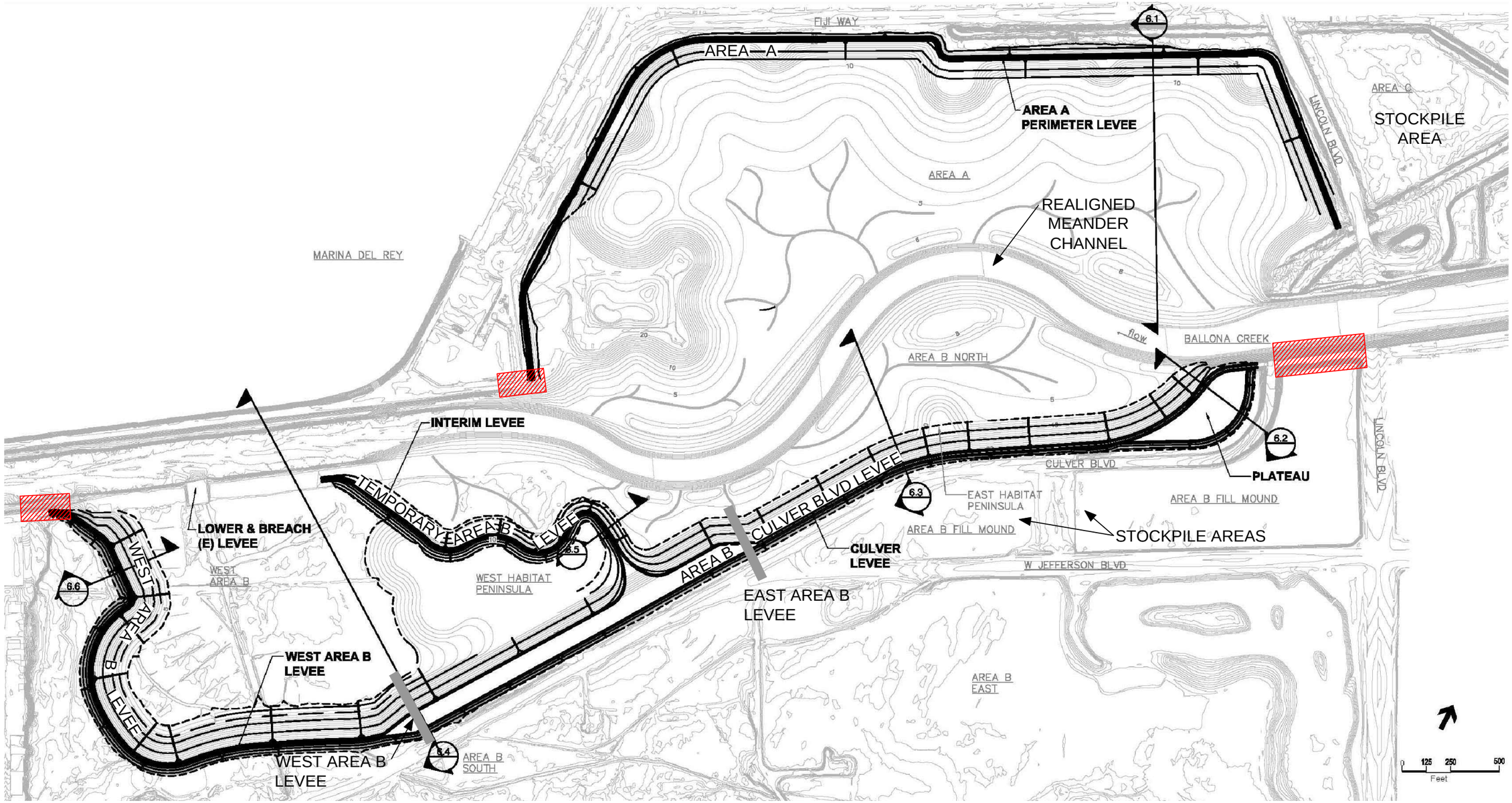
— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

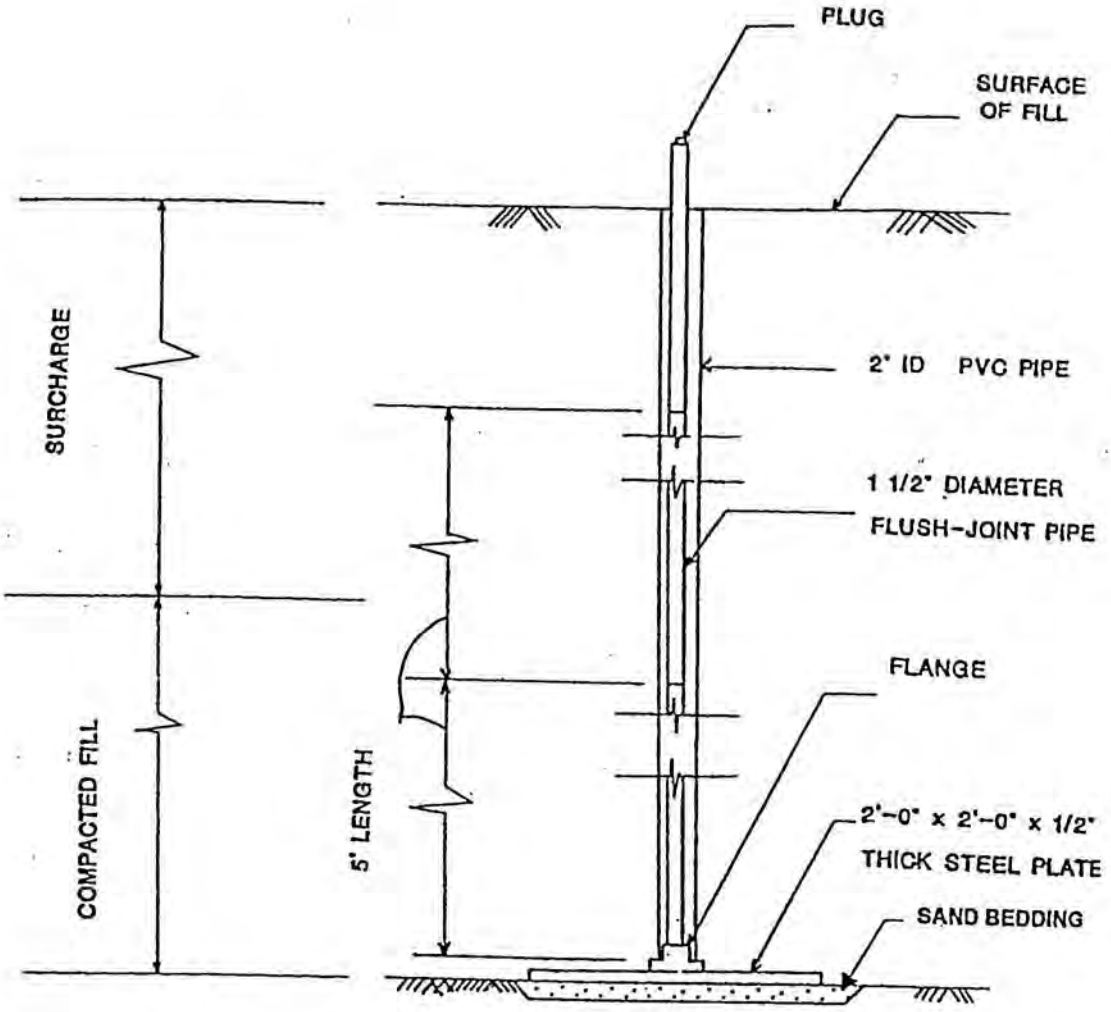
DATE: 12/4/2012	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	PROJECT NUMBER: L962A
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi	CROSS SECTION L-L'	SCALE: AS SHOWN
REVISION:		BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	FIGURE NUMBER: 6L



LEGEND

ZONES OF GROUND IMPROVEMENTS

DATE: 6/28/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	DELINEATED ZONES OF GROUND IMPROVEMENT BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	PROJECT NUMBER: L962A
REVISION:	APPROVED BY: P. Kashighandi				SCALE: AS SHOWN
REVISION:					FIGURE NUMBER: 7



Baldona Wetlands Restoration Project

Settlement Monitoring Plate Detail

PROJECT NUMBER: LA-962A8

DATE:

REVISED:

FIGURE:

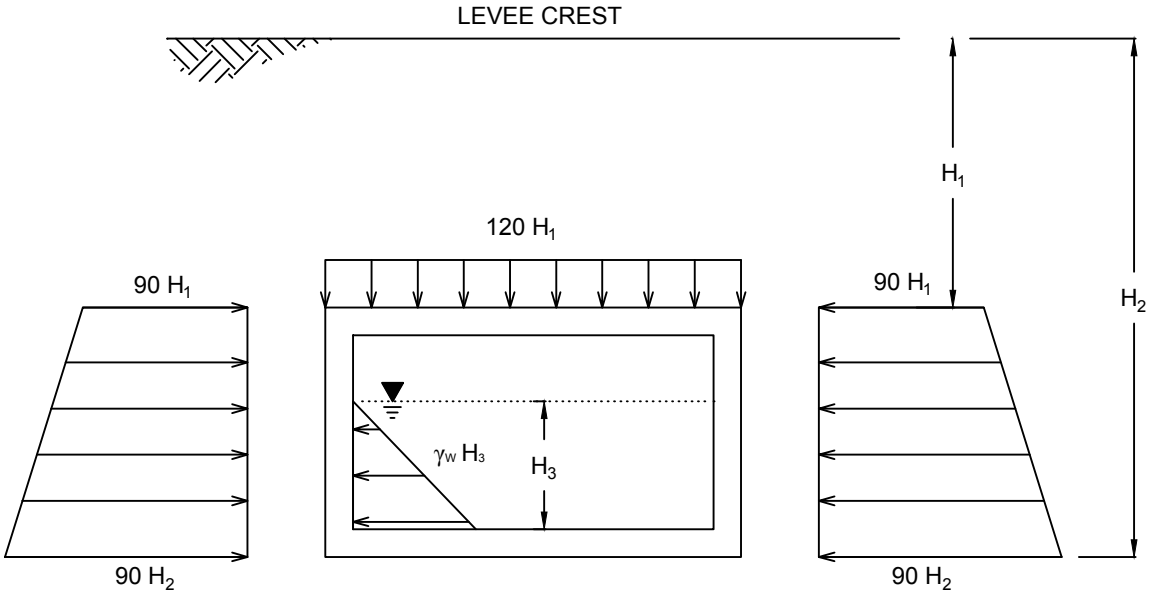
SCALE: NOT TO SCALE

DRAWN BY: T Ybarra

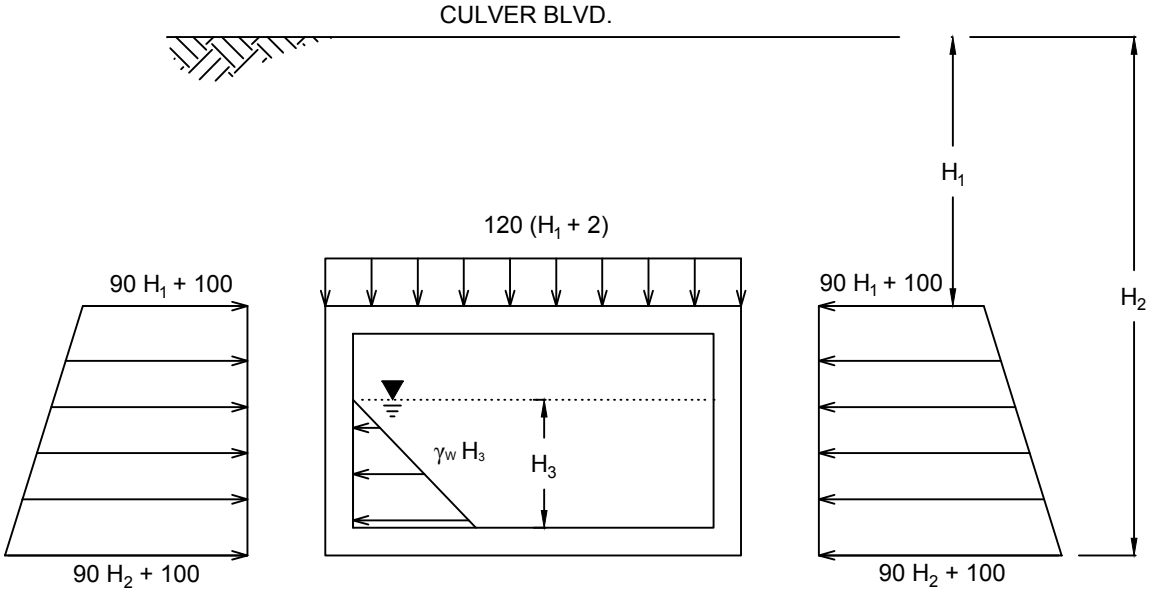
APPROVED BY: T Armstrong

GROUP DELTA CONSULTANTS, INC.

UNDER LEVEE



UNDER CULVER BLVD.



NOTE: ALL PRESSURES ARE IN UNITS OF POUNDS PER SQUARE FOOT (psf). ALL DEPTHS ARE IN UNITS OF FEET (ft).

GROUP DELTA CONSULTANTS, INC.
ENGINEERS AND GEOLOGISTS
370 Amapola Ave, Suite 212
Torrance, CA 90501 (310) 320-5100

PROJECT NUMBER: L962A

PROJECT NAME: BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CALIFORNIA

FIGURE NUMBER: 9

LATERAL EARTH PRESSURE FOR CULVERTS

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APPENDIX A1
GDC FIELD EXPLORATION

APPENDIX A1
GDC FIELD EXPLORATION

A1.1 INTRODUCTION

GDC conducted a geotechnical subsurface investigation for the project site from September 11, 2012 to October 22, 2012. Prior to the geotechnical subsurface investigation, a geotechnical investigation work plan (GDC, 2012) was prepared. The work plan outlined the procedures for obtaining site access and work permits; defined access routes to avoid special status plants as well as plans to minimize impact to natural habitats and/or archaeological sites within the project area. The work plan also describes the drilling equipment, soil sampling schedule (geotechnical, chemical, and agronomical sampling), post-investigation site cleanup, and laboratory testing program (geotechnical, chemical, and agronomical). The geotechnical investigation work plan was referenced throughout the project to obtain necessary site information while minimizing environmental impact to the project site.

The investigation consisted of rotary wash borings, hollow-stem auger borings, hand auger borings, and cone penetration tests. The exploration locations are shown in Figure 3 of the report. A summary of the field investigations is provided in Table A1-1.

A1.2 SOIL BORINGS

Twenty five (25) rotary wash borings were advanced to depths ranging from 56.5 to 71.5 feet in Areas A, B and C of the project site. The rotary wash borings were selected along the proposed levees as well as along the existing Ballona Creek levees. Eight (8) hollow stem auger borings were drilled to a depths ranging from 16 31.5 feet in areas planned for excavation in Area A, and surcharge areas within Areas B and C. In addtition, direct push exploration were also conducted to obtain environmental samples at the location of our hollow stem borings. Boring B-RW028 originally planned as a rotary wash boring in Area B, was drilled using hand auger equipment to a depth of 5 feet, due of proximity of special species plants. All borings were drilled at approximate elevations ranging from +5 to +21.1 feet NAVD. Subsurface materials were visually classified and recorded by a GDC field engineer in accordance with the Unified Soil Classification System (USCS).

Drive samples, bulk samples and push samples of the encountered materials were obtained from the borings and recorded on the boring logs. Drive samples were obtained with a California Sampler ring sampler and a Standard Penetration Test (SPT) sampler. The California Sampler, lined with 1-inch tall rings, has an outside diameter of 3-inches, and the inside diameter of 2.42-inches. The samples were retained in brass rings and placed in sealed plastic canisters to prevent moisture

loss. Standard penetration tests (SPT) were conducted using a standard 2-inch outside diameter, 1.375-inch inside diameter, split-spoon sampler in accordance with ASTM D 1586. SPT samples were placed in sealable plastic bags to prevent loss of moisture. The SPT and California samplers were driven into the soil at the using a 140-pound hammer free-falling 30 inches. The penetration resistance (or "blowcounts") were recorded in blows per six inches of driving. When soft fine grained soils were encountered, 6-inch-long Shelby tubes were used for sampling relatively undisturbed soil samples in the rotary wash borings.

Representative bulk samples were taken within the upper 5 feet, and selectively at depths as deep as 20 feet for compaction testing, expansion potential, corrosion testing, as well as chemical and agronomical testing. Bulk samples were placed into polyethylene bags. Additional chemistry testing samples were also obtained using direct push sampling equipment under the supervision of a project environmental engineer. Chemistry and agronomy samples were provided to the project environmental engineers for their use.

Additionally, four field permeability tests were performed at depths of 5 and 10 feet, at boring locations A-HSA064 and A-HSA066 near the existing north levee and existing gas injection wells to evaluate the permeability of the near surface soils. The tests were performed by filling the hollow stem auger borings with water and estimating permeability of near surface soils by measuring the drop in water elevation in the hole over time. The results of the field permeability testing are presented in Appendix F.

A key for soil classification and a legend for the logs of test borings are presented in Figures A1-1a and A1-1b. The boring logs are attached at the end of this Appendix.

A1.3 CONE PENETRATION TESTS (CPT)

Thirty one (31) cone penetration test (CPT) soundings were conducted at the site on from September 13, 2012 to October 15, 2012. The CPT soundings were generally advanced to depths ranging from 48 to 71.5 feet below existing grade. Two CPT locations in Area B (B-CPT029 and B-CPT042) encountered refusal at shallow depths, and had to be abandoned. In addition, B-CPT046 encountered shallow refusal at at a depth of 6 feet after making several attempts for advancement in adjacent locations. The CPT soundings were performed in general accordance with ASTM D3441, using a truck-mounted electric piezocone penetrometer. The locations of the soundings are shown in Figure 3 in the main body of the report.

CPTs are advanced from the ground surface with a truck-mounted hydraulic ram that pushes a steel rod with a conical tip and a cylindrical friction-sleeve into the ground. The conical tip has a 60-degree apex angle and a projected cross-sectional area of 1.55 square inches. The cylindrical friction sleeve has a surface area of 23.25 square inches. Both the tip and the sleeve have outside diameters of 1.4 inches.

As the rod is advanced, electronic instruments measure and record both the tip resistance and the frictional resistance on the sleeve. The tip and frictional resistance are then analyzed, using available correlations, to estimate soil classification, density, strength, and compressibility of the subsurface materials. Unlike soil borings, in which drive samples are typically taken at discrete intervals, the CPT provides a continuous record of soil properties with depth. Hence, the CPT can define the subsurface soil profile with much higher resolution than a soil boring, often detecting thin layers that are easily missed with conventional drilling and sampling.

Using a Seismic CPT test setup, Shear Wave Velocity measurements were performed in seven (7) of the CPTs to a maximum depth of 70 feet. The measurements were generally obtained in 5-foot intervals. The test involves generating large amplitude shear waves by striking a seismic beam at ground surface, and recording shear waves using a built-in seismometer in the cone penetrometer at various depths. The results of the seismic shear wave velocity measurements are presented in Appendix F.

The CPT logs and interpretations are presented at the end of this Appendix.

A1.4 LIST OF THE ATTACHED TABLE AND FIGURES

The following table and figures are attached and complete this appendix:

Table A1-1	Field Exploration Summary
Figure A1-1a	Key for Soil Classification
Figure A1-1b	Legend of CPT Interpretation Input
Figure A1-1c	Boring Log Legend
Figures A1-2 to A1-35	Boring Logs
Figures A1-36 to A1-66	CPT Logs

TABLE A1-1
FIELD EXPLORATION SUMMARY

Exploration No.	Date Performed	Ground Surface Elevation (feet, NAVD)	Total Depth (feet)	Exploration Type
A-CPT001	10/15/12	17.8	70	Cone Penetration Test
A-RW002	10/5/12	17.8	71.5	Rotary Wash Boring
A-RW003	9/21/12	19	71.5	Rotary Wash Boring
A-CPT004	10/15/12	17	68	Cone Penetration Test
A-RW005	10/9/12	17	71	Rotary Wash Boring
A-RW006	9/13/12	15.3	71.5	Rotary Wash Boring
A-CPT007	9/24/12	15.3	57	Cone Penetration Test
A-RW008	9/27/12	15.7	65	Rotary Wash Boring
A-RW009	9/27/12	17.1	61.5	Rotary Wash Boring
A-CPT010	9/24/12	16	51	Cone Penetration Test
A-RW011	9/28/12	13	56.5	Rotary Wash Boring
A-CPT012	9/24/12	13.8	48	Cone Penetration Test
A-RW013	9/26/12	13.8	56.5	Rotary Wash Boring
A-CPT014	9/24/12	16	51	Cone Penetration Test
A-RW015	10/2/12	17.1	61.5	Rotary Wash Boring
A-HSA016	10/10/12	15.7	18	Hollow Stem Auger Boring
A-HSA017	10/10/12	14.3	16.5	Hollow Stem Auger Boring
A-HSA018	10/10/12	14.2	21.5	Hollow Stem Auger Boring
A-CPT019	9/24/12	16.8	68	Cone Penetration Test
A-RW020	10/3/12	15.4	71.5	Rotary Wash Boring
A-CPT021	9/24/12	16.6	59	Cone Penetration Test
A-CPT022	9/26/12	19	59	Cone Penetration Test
A-RW023	10/3/12	19	65.9	Rotary Wash Boring
A-CPT024	9/24/12	16.9	55	Cone Penetration Test
A-CPT025	9/26/12	20	65	Cone Penetration Test
A-HSA064	10/15/12	17.2	19	Hollow Stem Auger Boring
A-CPT065	9/26/12	20.5	63	Cone Penetration Test
A-HSA066	10/15/12	21.1	21.5	Hollow Stem Auger Boring
A-HSA067	10/10/12	12.2	16.5	Hollow Stem Auger Boring
B-CPT026	9/14/12	13	52	Cone Penetration Test
B-RW027	9/24/12	13	71.5	Rotary Wash Boring
B-RW028	10/22/12	5	5	Hand Auger Boring
B-RW030	10/4/12	6.1	41.5	Rotary Wash Boring
B-CPT031	10/10/12	6	69	Cone Penetration Test
B-RW032	9/14/12	8.2	71.5	Rotary Wash Boring
B-RW033	9/12/12	6.3	71.5	Rotary Wash Boring
B-CPT034	9/13/12	6	63	Cone Penetration Test
B-CPT035	9/13/12	7.4	67	Cone Penetration Test
B-RW036	9/17/12	9.1	71.5	Rotary Wash Boring
B-CPT037	9/13/12	5	70	Cone Penetration Test
B-CPT038	9/13/12	8.4	68	Cone Penetration Test
B-CPT039	9/17/12	8.2	71	Cone Penetration Test
B-CPT040	10/15/12	6.9	59	Cone Penetration Test
Continued				

TABLE A1-1
FIELD EXPLORATION SUMMARY (CONTINUED)

Exploration No.	Date Performed	Ground Surface Elevation (feet, NAVD)	Total Depth (feet)	Exploration Type
B-RW041	9/20/12	6.8	66.5	Rotary Wash Boring
B-RW043	9/19/12	8.8	66.5	Rotary Wash Boring
B-RW044	9/19/12	9.2	66.5	Rotary Wash Boring
B-CPT045	9/13/12	9	60	Cone Penetration Test
B-CPT046	10/15/12	10.6	6	Cone Penetration Test
B-RW047	9/18/12	11.5	66.5	Rotary Wash Boring
B-CPT048	10/15/12	11	63	Cone Penetration Test
B-RW049	10/1/12	17.6	69	Rotary Wash Boring
B-CPT050	9/14/12	20.2	64	Cone Penetration Test
B-HSA051	10/16/12	6.3	21.5	Hollow Stem Auger Boring
B-CPT052	9/14/12	12	70	Cone Penetration Test
B-RW053	9/24/12	13.7	71.5	Rotary Wash Boring
B-CPT054	9/14/12	15.3	70	Cone Penetration Test
B-RW055	9/25/12	16.3	71.5	Rotary Wash Boring
B-CPT056	9/14/12	15.4	70	Cone Penetration Test
B-CPT057	9/14/12	14.6	70	Cone Penetration Test
B-RW058	9/25/12	15	71.5	Rotary Wash Boring
B-CPT059	9/14/12	18.7	70	Cone Penetration Test
C-CPT060	10/10/12	14.6	49	Cone Penetration Test
C-HSA061	10/16/12	16	31.5	Hollow Stem Auger Boring
C-CPT062	10/10/12	23	57	Cone Penetration Test
C-CPT063	10/10/12	23.2	55	Cone Penetration Test

KEY FOR SOIL CLASSIFICATION

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D-2487)				
PRIMARY DIVISIONS			***GROUP SYMBOL***	***SECONDARY DIVISIONS***
COARSE GRAINED SOILS (less than 50% fines passing the No. 200 Sieve)	GRAVEL (% GRAVEL > % SAND)	CLEAN GRAVEL (Less than 5% fines)	GW	Well-graded gravel, gravel with sand, little or no fines
			GP	Poorly-graded gravel, gravel with sand, little or no fines
		"DIRTY" GRAVEL (More than 12% fines)	GM	Silty gravel, silty gravel with sand, silty or non-plastic fines
			GC	Clayey gravel, clayey gravel with sand, clayey or plastic fines
	SAND (% SAND ≥ % GRAVEL)	CLEAN SAND (Less than 5% fines)	SW	Well-graded sand, sand with gravel, little or no fines
			SP	Poorly-graded sand, sand with gravel, little or no fines
		"DIRTY" SAND (More than 12% fines)	SM	Silty sand, silty sand with gravel, silty or non-plastic fines
			SC	Clayey sand, clayey sand with gravel, clayey or plastic fines
FINE GRAINED SOILS (50% or more fines passing the No. 200 Sieve)	SILTS AND CLAYS (Liquid Limit less than 50)		ML	Inorganic silt, sandy silt, gravelly silt, or clayey silt with low plasticity
			CL	Inorganic clay of low to medium plasticity, sandy clay, gravelly clay, silty clay, Lean Clay
			OL	Low to medium plasticity Silt or Clay with significant organic content (vegetative matter)
	SILTS AND CLAYS (Liquid Limit 50 or more)		MH	Inorganic elastic silt, sandy silt, gravelly silt, or clayey silt of medium to high plasticity
			CH	Inorganic clay of high plasticity, Fat Clay
			OH	Medium to high plasticity Silt or Clay with significant organic content (vegetative matter)
HIGHLY ORGANIC SOILS			PT	Peat or other highly organic soils

Note: Dual symbols are used for coarse grained soils with 5 to 12% fines (ex: SP-SM), and for soils with Atterberg Limits falling in the CL-ML band in the Plasticity Chart. Borderline classifications between groups may be indicated by two symbols separated by a slash (ex: CL/CH, SW/GW).

CONSISTENCY CLASSIFICATION				
COARSE GRAINED SOILS		***FINE GRAINED SOILS***		
Blowcount SPT[1] (CAL)[2]	Consistency	Blowcount[3] SPT[1] (CAL)[2]	Consistency	Undrained Shear Strenth[3], S_u (ksf)
0-4 (0-6)	Very Loose	<2 (<3)	Very Soft	< 0.25
		2-4 (3-6)	Soft	0.25 -0.50
5-10 (7-15)	Loose	5-8 (7-12)	Medium Stiff	0.50 - 1.0
11-30 (16-45)	Med. Dense	9-15 (13-22)	Stiff	1.0 - 2.0
31-50 (46-75)	Dense	16-30 (23-45)	Very Stiff	2.0 - 4.0
>50 (>75)	Very Dense	>31 (>45)	Hard	> 4.0

MOISTURE CLASSIFICATION
DRY - Absence of moisture, dusty, dry to the touch **MOIST-** Damp but no visible water **WET-** Visible free water, usually soil is below water table

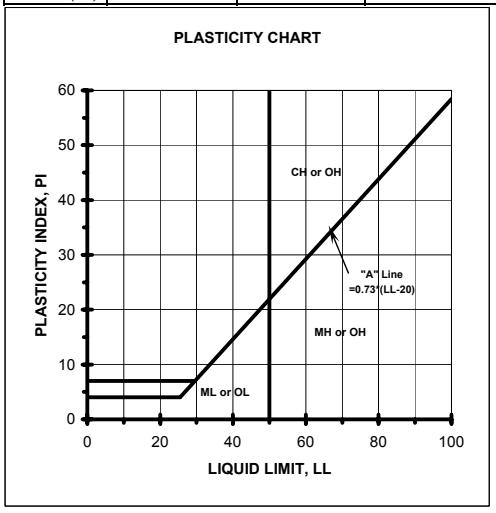
CONSISTENCY NOTES:

1. Number of blows of a 140-lb. hammer falling 30-inches to drive a 2-inch OD (1.375-inch ID) **SPT Sampler** [ASTM D-1585] the final 12-inches of driving
2. Number of blows of a 140-lb. hammer falling 30-inches to drive a 3-inch OD (2.42-inch ID) **California Ring Sampler** the final 12-inches of driving.
3. Undrained shear strength of cohesive soils predicted from field blowcounts is generally unreliable. Where possible, consistency should be based on S_u data from pocket penetrometer, torvane, or laboratory testing.

CLASSIFICATION CRITERIA BASED ON LABORATORY TESTS

Grain Size Classification

CLAY AND SILT	SAND			GRAVEL		COBBLES		BOULDERS	
	Fine	Medium	Coarse	Fine	Coarse				
US Std Sieve	**No. 200**	**No. 40**	**No. 10**	**No. 4**	**3/4"**	**3"**		**12"**		
Grain Size (mm)	0.075	0.425	2	4.75	19.1	76.2		304.8		



Classification of earth materials shown on the logs is based on field inspection and should not be construed to imply laboratory analysis unless so stated.

Granular Soil Gradation Parameters

Coefficient of Uniformity: $C_u = D_{60} / D_{10}$

Coefficient of Curvature: $C_C = (D_{30})^2 / (D_{10} \times D_{60})$

D_{10}= 10% of the soil is finer than this diameter

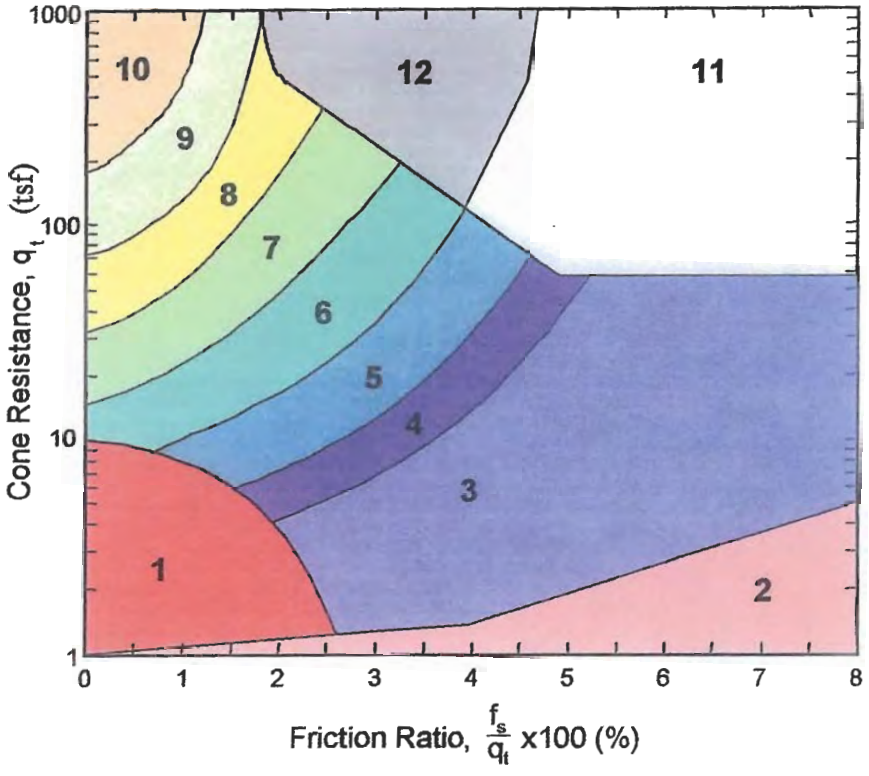
D_{30}= 30% of the soil is finer than this diameter

D_{30}= 60% of the soil is finer than this diameter

Group Symbol	Gradation or Plasticity Requirement
SW	C_u>6 and C_c between 1 and 3
GW	C_u>4 and C_c between 1 and 3
GP or SP	Clean gravel or sand not meeting requirement for GW or SW
GM or SM	Plots below "A" Line on Plasticity Chart or PI < 4
GC or SC	Plots above "A" Line on Plasticity Chart and PI > 7

FIGURE A1-1a

CPT Soil Behavior Type Legend (Robertson et al. 1986)



Zone	Soil Behavior Type
1	Sensitive, Fine Grained
2	Organic Material
3	Clay
4	Silty Clay to Clay
5	Clayey Silt to Silty Clay (Silt Mix)
6	Sandy Silt to Clayey Silt
7	Silty Sand to Sandy Silt (Sand Mix)
8	Sand to Silty Sand
9	Sand
10	Gravelly Sand to Sand
11	Very Stiff Fine Grained*
12	Sand to Clayey Sand*

*Overconsolidated or cemented

Figure A1-1b

LOG OF TEST BORING

PROJECT NAME Ballona Wetlands		**PROJECT NUMBER** LA-962A	**BORING** **LEGEND**
SITE LOCATION Marina Del Rey, CA	**START**	**FINISH**	**SHEET NO.** 1 of 1
DRILLING COMPANY Cascade	**DRILLING METHOD** Rotary Wash	**LOGGED BY** NB	**CHECKED BY** PK
DRILLING EQUIPMENT CME 85	**BORING DIA. (in)** 3.875"	**TOTAL DEPTH (ft)**	**GROUND ELEV (ft)**
SAMPLING METHOD SPT & Cal. Mod.	**NOTES**		**DEPTH/*ELEV.* GROUND WATER (ft)** ▼ / *na*

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	% PASSING #200	ATTERBERG LIMITS LL:PL:PI	POCKET PEN (tsf)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
5			B-1									
10			R-2									
15			S-3									
20												

BULK, CAL, SPT - Refers to the sampling method as described below

BULK - Refers to collecting sample by method of placing disturbed soil cuttings into a large plastic bag

CAL (CALIFORNIA MODIFIED) - A 3.0" o.d. split tube sampler lined with 2.42" i.d. metal sample rings generally driven into the soil by a 140 lbs. hammer free falling 30 inch

SPT (STANDARD PENETRATION TEST) - A 2.0" o.d. split spoon sampler with a 1.375" i.d. driven into the soil with a 140# hammer free falling a height of 30"

ABBREVIATIONS FOR OTHER TESTS:

AL = Atterberg Limits	GS = Grain Size Analyses
CN = Consolidation	PP = Pocket Pen
CO = Corrosivity	RV = R-Value
CP = Laboratory Compaction	WA = Wash on #200 Sieve
DS = Direct Shear	EI = Expansion Index
LL = Liquid Limit	TV = Torvane

GDC_LOG_BORING_1A_LA2 L-675 PRODUCT 425.GPJ GDCLOG.GDT 11/17/11

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Figure A1-1c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW002**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/5/2012	10/5/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	17.8	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
0	15													**Artificial Fill (af)**
														Silty Sand (SM), brown, dry to moist, fine to coarse grained sand, little oxidation, trace organics.
5			S-1	1 1 2	3									
	10													**Alluvium (Qa)**
														Sandy Silt (ML), gray, moist, soft, fine to medium grained sand, low plasticity.
10														**Sandy Gravel (GP)**, gray, moist to wet, medium dense, medium to coarse grained sand, fine to coarse gravel, trace shells.
			R-2	4 8 10	18	15								
	5													
15			S-3	2 5 5	10									-Loose, trace coarse gravel.
														Sandy/Gravely Clay (CL), gray, moist, coarse grained sand, trace fine to coarse gravel, low to medium plasticity.
	0													
20														
	-5													**Sandy Silt (ML)**, gray, fine grained sand, H2S odor.

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FIGURE
A1-2 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW002**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/5/2012	10/5/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	17.8	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			B-4					65			PA			Driller having problems keeping hole open due to caving from gravel material. Drilled to reach more clayey material to thicken mud.
	-10													
30														
	-15													
35			S-5	1 1 2	3			74			PA			**Sandy Silt (ML)**, gray, moist, soft, fine grained sand, low plasticity, trace shell fragments, trace organics, H2S odor.
	-20													
40			R-6	3 3 3	6	42	78			1.25	DS			**Clayey Silt (ML)**, gray, moist, soft, low to medium plasticity, trace oxidation.
	-25													**Silty Sand (SM)**, gray, moist, very loose, fine grained sand.
45			S-7	5 1 1	2			49			PA			**Clayey Silt (ML)**, gray, moist, low plasticity, trace shell fragments, trace oxidation.
	-30													

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FIGURE
A1-2 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW002**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/5/2012	10/5/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	17.8	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			R-8	5 7 8	15	22	106			1.0				-Loose, fine to medium grained sand, low plasticity, trace oxidation.
	-35													**Silty Sand (SM)**, gray, wet, loose, fine to medium coarse grained sand, trace fine gravel.
55			S-9	8 5 4	9					1.5				**Sandy Silt (ML)**, gray, moist, stiff, fine grained sand, low to medium plasticity.
	-40													
60			R-10	5 7 16	23	27	90			1.5				-Trace organics.
	-45													
65			S-11	27 22 22	44									**Sand (SP)**, gray, wet, dense, fine to coarse grained sand, trace fine gravel.
	-50													
70			S-12	3 6 7	13	34								**Lean Clay (CL)**, gray, moist, stiff, low to medium plasticity, trace organics. Note: Few fine grained sand in tip of sampler.
	-55													Boring terminated at 71.5 ft. Groundwater not measured. Hole backfilled with bentonite grout.

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FIGURE
A1-2 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW003**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/21/2012	9/21/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	19	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			B-1											**Artificial Fill (af)** **Sand (SP)**, brown, dry, loose, little roots, trace fine to coarse gravel. -Increase in density, no roots.
5	15		S-2	4 2 1	3			16			PA			**Silty Sand (SM)**, brown, wet, very loose, fine grained sand, trace medium grained sand, no plasticity.
10	10		SH-3			23	99				DS			-Gray, fine to medium grained sand, few shell fragments.
	5													**Sandy Silt (ML)**, gray, wet, medium stiff, fine grained sand, low plasticity, trace shell fragments.
15			S-4	1 3 2	5									
	0													**Alluvium (Qa)** **Silty Clay (CL)**, gray, moist, fine grained sand, trace oxidation. Vane Shear = 0.5 ksf
20			SH-5			54	71		40:21	0.35				
	-5													**Silty Sand (SM)**, gray, wet, very loose, fine grained sand, trace shell fragments, slight H2S odor.

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FIGURE
A1-3 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW003**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/21/2012	9/21/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	19	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-6	2 1 1	2									
	-10													**Sandy Silt (ML)**, gray, moist, soft, low to medium plasticity, little shell fragments.
30			SH-7			37	85			0.25	C DS			Vane Shear = 1.4 ksf
	-15													**Sandy Clay (CL)**, gray, moist, very soft, fine grained sand, medium plasticity, few organics, trace fine rootlets, trace shell fragments, H2S odor.
35			S-8	0 0 1	1				47:28					
	-20													
40			S-9							0.25				-No rootlets, no H2S odor.
	-25													
45			R-10	2 4 5	9									-No recovery, firm.
			R-11	5 7 9	16					0.75				**Fat Clay (CH)**, gray, moist, medium stiff, high plasticity, trace shell fragments.
	-30													**Clay with Sand (CL)**, gray, moist, stiff, fine grained sand,

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FIGURE
A1-3 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW003**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/21/2012	9/21/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	19	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-12	2 5 6	11					1.75				medium plasticity.
	-35													
55			SH-13			32	89		34:11	0.5				**Lean Clay (CL)**, gray, wet, medium stiff, few fine grained sand, medium plasticity. Vane shear = 0.9 ksf
	-40													**Clayey Sand (SC)**, gray, wet, medium dense, fine grained sand, trace medium grained sand, trace organics.
60			S-14	8 14 16	30									
	-45													**Sandy Clay (CL)**, gray, wet, medium stiff, fine grained sand, medium, some tree roots up to ~1/2" in diameter and over 2.5" long.
65			R-15	3 5 6	11	30	89		29:8					Vane shear = 0.37 ksf
	-50													
70			S-16	2 3 6	9	34				0.25				**Lean Clay (CL)**, gray, moist, stiff, medium plasticity, trace fine grained sand, trace roots, trace calcite.
	-55													Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

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FIGURE
A1-3 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW005**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/9/2012	10/9/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71	17	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														Asphalt
	15													**Artificial Fill (af)** **Lean Clay (CL)**, olive brown, moist, medium stiff, trace fine grained sand, medium plasticity, few sea shells.
5			R-1	3 5 5	10	30	89				C DS			
	10													
10			S-2	0 0 0	0									**Alluvium (Qa)** **Silty Sand (SM)**, gray, wet, very loose, fine grained sand, few shell fragments.
	5													**Silt (ML)**, gray, wet, soft, trace fine grained sand, none to low plasticity, trace sea shells, trace rootlets.
15			R-3	2 2 3	5	45	77				C			
	0													**Silty Sand (SM)**, mottled gray and orangish brown, wet, very loose, fine grained sand, none to low plasticity, some oxidation, trace sea shells.
20			S-4	2 1 3	4			28			PA			
	-5													**Sand (SP)**, gray, wet, medium dense, fine grained sand, trace fines.

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FIGURE

A1-4 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW005**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/9/2012	10/9/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71	17	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			R-5	12 14 8	22	28	94							
	-10													**Fat Clay (CH) or Organic Matter (OH)** gray, moist, very soft, high plasticity, laminations of fine shell fragments, H2S odor.
30			S-6	0 0 1	1	81			92:51	0.25				
	-15													
35			R-7	0 0 3	3	64	63				DS			-Soft, trace shell fragments. Vane shear = 0.32 ksf
	-20													**Silty Sand (SM)**, gray, wet, medium dense, fine grained sand.
40			S-8	4 5 10	15			41			PA			
	-25													**Clayey Silt (ML)**, gray, moist, medium stiff, few fine grained sand, low plasticity.
45			R-9	4 6 7	13	34	88			0.75				
	-30													**Fat Clay (CH)**, gray, moist, high plasticity.
														Silty Clay (CL), gray, moist, firm, few fine grained sand, medium plasticity.

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FIGURE
A1-4 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW005**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/9/2012	10/9/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71	17	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-10	1 3 4	7	28				0.75				
	-35													
55			R-11	2 3 5	8									-Little recovery with sand catcher.
	-40													
60			S-12	0 1 2	3	38				0.25				-Wet, soft, trace fine grained sand, trace wood fibers, trace fine rootlets.
	-45													
65			R-13	6 7 10	17									-Stiff.
	-50													
														Sand (SP), gray, wet, very dense, fine grained sand, trace fines, one gravel in tip of sampler.
70			S-14	40 50/5"	REF									
	-55													Boring terminated at 71 ft. Groundwater not measured. Boring backfilled with bentonite grout.

GDC_LOG_BORING_2011 L-962_PART 1.GPJ GDCLOG.GDT 1/24/13

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Torrance, CA 90501

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FIGURE

A1-4 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW006**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/13/2012	9/13/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	15.3	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	15		B-1											**Artificial Fill (af)** **Silty Clay w/ Sand (CL)**, brown, dry, fine grained sand, low plasticity, trace shell fragments, trace fine gravel.
5	10		R-2	14 50/3"	100	6	88	54			DS PA			**Sandy Silt (ML)**, brown, dry, hard, fine grained sand, with hard dark gray clay seams. trace of gravel and cobbles
10	5		S-3	4 7 7	14			30			PA			**Silty Sand with Clay (SM)**, brown, moist, medium dense, fine grained sand, trace roots.
15	0		R-4	1 2 3	5	16	106							-Wet, very loose.
20	-5		S-5	1 1 2	3				50:23					**Alluvium (Qa)** **Silty Clay (CL)**, gray, wet, soft, trace oxidation, micaceous.
														Clayey Sand (SC), gray, wet, loose, fine grained sand, few oxidation, trace shell fragments, low plasticity.

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FIGURE
A1-5 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW006**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/13/2012	9/13/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	15.3	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-10		SH-6			33	87	32			PA			-Shelby tube disturbed ~2" remain.
30	-15		S-7	11 15 8	23									-Medium dense, trace organics.
														Clayey Silt (MH) with laminations of light gray silt and light brown silt, gray, wet, trace fine grained sand, few shell fragments, strong H2S odor (~7ppm on gas meter), high plasticity.
35	-20		SH-8			68	65		64:31		C			Vane Shear = 0.65 ksf
														Silty Clay (CH), gray, wet, soft, little shell fragments and sea shells, strong H2S odor, micaceous, high plasticity.
40	-25		S-9			57			53:24					
														Silty Sand (SM), gray, wet, medium dense, fine grained sand, trace sea shells.
45	-30		SH-10			27	99							
														Silty Clay (CL), gray, moist, medium stiff, low to medium plasticity.

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FIGURE
A1-5 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW006**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/13/2012	9/13/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	15.3	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-35		S-11	0 5 5	10				44:21	0.5				
55	-40		SH-12			25	100							**Silty Sand (SM)**, gray, wet, fine grained sand.
60	-45		S-13	1 6 9	15				48:24	1.25				**Silty Clay (CL)**, gray, wet, stiff, low to medium plasticity, trace shell fragments, micaceous.
65	-50		SH-14											**Poorly Graded Sand (SP)**, gray, wet, fine to medium grained sand.
														Sandy Clay (CL), gray, moist, stiff, fine grained sand, medium plasticity, trace organics.
70	-55		S-15	6 7 17	24				32:13	1.25				Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

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FIGURE
A1-5 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW008**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/27/2012	9/28/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	65	15.7	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	15													**Artificial Fill (af)**
														Silt with Sand (ML), gray, dry, fine grained sand, no plasticity, trace organics.
5														**Elastic Silt (MH)**, gray, moist, trace fine grained sand, high plasticity.
	10		S-1	4 7 12	19			88			PA			**Sand (SP)**, brown, medium dense, fine grained sand, trace coarse grained sand, trace fine gravel.
10														**Alluvium (Qa)**
	5		R-2	2 3 2	5	32	83		48:25	1.25	DS			**Sandy Clay (CL)**, gray, wet, stiff, fine grained sand, medium plasticity, micaceous.
15														
	0		S-3	0 0 0	0					0.25				-Very soft, trace organics, slight H2S odor.
20														
	-5		SH-4											-No recovery.
														Fat Clay (CH), gray, wet, very soft, trace fine grained sand, high plasticity, shell fragments, H2S odor.

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FIGURE
A1-6 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW008**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/27/2012	9/28/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	65	15.7	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-10		R-5	0 0 1	1	63	64		50:23	0.25				**Elastic Silt (MH)**, gray, wet, high plasticity, trace shell fragments, H2S odor.
30	-15		SH-6			61	63		68:34	0.25	C			Vane Shear = 0.6 ksf
35	-20		R-7	1 1 3	4	50	71			0.25				-Soft.
40	-25		SH-8											-No recovery.
			S-9	2 2 2	4					0.25				-Moist, very soft.
45	-30		R-10	2 3 4	7	44	74		54:26	0.25				**Fat Clay (CH)**, gray, soft, wet, trace fine grained sand, high plasticity.

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FIGURE
A1-6 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW008**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/27/2012	9/28/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	65	15.7	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-35		S-11	3 2 2	4					0.25				-Moist, trace organics.
														Silty Sand (SM), gray, wet, very loose, fine to medium grained sand, trace organics.
55														
	-40		R-12	7 12 14	26	211	24							**Peat (PT)** , brown, moist.
														Sand with Silt (SP-SM), gray, wet, fine to medium grained sand, trace coarse grained sand, trace fine gravel, trace organics, trace seams of silt.
60														
	-45		S-13	13 19 22	41									
65														
	-50		S-14											**Sand with Gravels (SP)**, gray, wet, fine to coarse grained sand, fine to coarse gravel. NOTE: Hole kept collapsing, most of sample (S-14) was collapsed soil, blow counts not accurate. Boring terminated at 65 ft. Groundwater not measured. Boring backfilled with bentonite grout.
70														
	-55													

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FIGURE
A1-6 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW009**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/27/2012	9/27/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	61.5	17.1	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	15													**Artificial Fill (af)**
														Silt with Sand (ML), gray, dry, fine grained sand, no plasticity, few shell fragments, trace organics.
5			R-2	2 2 4	6	23	89	29			PA			**Silty Sand (SM)**, gray and olive brown, moist, very loose, fine grained sand, no plasticity, few oxidation, trace shell fragments, micaceous.
	10													
10			S-3	0 0 0	0			76			PA			**Alluvium (Qa)** **Sandy Silt (ML)**, gray, wet, very soft, fine grained sand, none to low plasticity.
	5													
15			SH-4			40	83							-Trace oxidation, highly micaceous.
	0													
														Silty Sand (SM), gray, wet, loose, fine grained sand, little oxidation.
20			R-5	4 4 4	8	35	79							
	-5													**Fat Clay (CH)**, gray, moist, very soft, high plasticity, H2S odor, trace organics.

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FIGURE
A1-7 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW009**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/27/2012	9/27/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	61.5	17.1	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-6	0 0 0	0				56:36					
	-10													
30			SH-7			48	73							-Soft, trace fine grained sand, no organics, trace shell fragments. Vane Shear = 0.6 ksf
	-15													
35			R-8	0 1 2	3	56	65			0.25				-Very soft, no fine grained sand.
	-20													
														Silty Sand (SM), gray, moist, fine grained sand, micaceous, few blebs of lightly cemented Sandy Silt.
40			SH-9			28	94	47			PA			
	-25													
														Fat Clay (CH), gray and dark grayish brown, moist, stiff, few fine grained sand, medium plasticity.
45			S-10	3 3 3	6					1.25				
	-30													

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FIGURE
A1-7 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW009**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/27/2012	9/27/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	61.5	17.1	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			SH-11			106	44		72:34	1.0				-Gray, wet, stiff, high plasticity, some organics.
	-35													
55			S-12	5 27 35	62									**Silty Sand (SM)**, gray, wet, very dense, fine grained sand, few organics. -Fine to coarse grained sand, fine to coarse gravel.
	-40													
60			S-13	23 27 24	51									**Sand (SP)**, gray, wet, very dense, fine to medium grained sand, trace fine to coarse gravel.
	-45													Boring terminated at 61.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
65														
	-50													
70														
	-55													

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FIGURE
A1-7 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW011**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/28/2012	9/28/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	56.5	13	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			B-1											**Artificial Fill (af)**
														Silt with Sand (ML), gray, dry, fine grained sand, no plasticity, trace organics.
	10													
5			R-2	1 1 1	2	29	88		28:1		C			**Sandy Silt (ML)**, gray, wet, very soft, fine grained sand, low to medium plasticity.
	5													
10			S-3	1 1 2	3									-Soft, trace fine grained sand, trace oxidation, trace roots, micaceous.
	0													
15			R-4	2 2 2	4	41	74		62:33					**Fat Clay (CH)**, gray, wet, soft, high plasticity, some oxidation, trace roots, micaceous. Vane Shear = 0.25 ksf
	-5													
20			S-5	0 0 0	0				66:36					-Trace fine grained sand, trace sea shells, trace organics, slight H2S odor.
	-10													

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FIGURE
A1-8 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW011**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/28/2012	9/28/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	56.5	13	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			SH-6						63:35					-Few fine grained sand.
	-15													
30			R-7	2 4 8	12	24	96			0.75				-Moist, medium stiff, trace fine grained sand.
	-20													
35			S-8	1 6 3	9					0.25				-Soft, trace blebs of lightly cemented soil.
	-25													**Clayey Sand (SC)** with Silt seams, gray, wet, medium dense, fine grained sand, trace medium to coarse grained sand.
40			R-9	9 12 17	29	23	102							
	-30													**Silty Clay (CH)**, gray, moist, medium stiff, trace fine grained sand, high plasticity, some organics.
45			S-10	0 2 4	6				58:30	0.5				
	-35													**Silty Sand (SM)**, gray, moist, dense, fine to coarse grained sand, few fine to coarse gravel, ~40% fines, little organics.

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FIGURE

A1-8 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW011**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/28/2012	9/28/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	56.5	13	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			R-11	3 12 50	72	18								
	-40													
55			S-12	17 22 29	41									-No organics, decrease in fines.
														Boring terminated at 56.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
	-45													
60														
	-50													
65														
	-55													
70														
	-60													

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FIGURE

A1-8 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW013**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/26/2012	9/26/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	56.5	13.8	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			B-1											**Artificial Fill (af)**
														Silty Sand (SM), brown, dry, fine to coarse grained sand, fine to coarse gravel, few organics, trace shell fragments, denser than other locations in Area A.
	10													
5			R-2	0 4 3	7	20	117							-Loose, no organics, few shell fragments.
	5													
10			S-3	3 4 4	8			84			PA			**Alluvium (Qa)** **Sandy Silt (ML)**, olive brown, wet, medium stiff, highly micaceous, some oxidation.
	0													**Lean Clay (CL)**, olive brown, wet, soft, medium plasticity, highly micaceous, some oxidation.
15			R-4	0 0 2	2	48	71	88	47:20		C PA			Vane Shear = 0.3 ksf
	-5													**Fat Clay (CH)**, gray, wet, soft, few fine grained sand, high plasticity, trace shell fragments, H2S odor.
20			S-5	0 1 1	2				56:28					
	-10													

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FIGURE

A1-9 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW013**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/26/2012	9/26/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	56.5	13.8	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			SH-6								C			-No recovery.
	-15													**Lean Clay (CL)**, gray, wet, medium stiff, trace coarse grained sand, medium plasticity. NOTE: Increase in stiffness at bottom.
30			R-7	5 5 6	11	15	115		34:16					Vane Shear = 1.2 ksf
	-20													**Silty Sand (SM)**, gray, wet, loose, fine grained sand, trace fine gravel.
35			S-8	3 3 3	6									
	-25													Interbedded layers of Fat Clay (CH) and Silt (ML): **Fat Clay (CH)**, gray, moist, stiff, medium to high plasticity, and; **Silt (ML)** , gray, wet, stiff, trace fine grained sand, medium plasticity.
40			R-9	4 4 6	10	57	69			1.25				
	-30													
45			S-10	3 3 4	7									**Peat (PT)** , brown, moist, firm, 4" layer of **Fat Clay (CH)**, tree stump or branch >3".
	-35													**Sand with Silt (SP-SM)**, gray, wet, dense, fine to medium grained sand, trace organics (wood fibers).

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FIGURE
A1-9 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW013**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/26/2012	9/26/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	56.5	13.8	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			R-11	22 27 35	62	21	104							
	-40													**Sand with Gravel (SP)**, gray, wet, dense, fine to medium grained sand, few coarse grained sand, fine to coarse gravel, trace clay.
55			S-12	15 24 25	49									
														Boring terminated at 56.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
	-45													
60														
	-50													
65														
	-55													
70														
	-60													

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FIGURE

A1-9 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW015**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/2/2012	10/2/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa/J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	61.5	17.1	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			B-1											**Artificial Fill (af)** **Silty Sand (SM)**, brown, dry, fine to coarse grained sand, few fine to coarse gravels, trace cobble, little sea shells, little rootlets/branches.
5	15		S-2	1 4 4	8									-Dark gray to brown, moist, loose, fine to medium grained sand, low to medium plasticity, trace shell fragments, little oxidation.
10	10		R-3	2 4 5	9	27			57:35	0.75				**Alluvium (Qa)** **Fat Clay (CH)**, dark gray to brown, moist, stiff, fine grained sand, high plasticity, little medium grained sand. Vane Shear = 1.1 ksf
15	5		S-4	1 2 3	5			43			PA			**Clayey Sand (SC)**, gray with mottled brown, moist, loose, fine grained sand, some oxidation, micaceous.
20	0		R-5	5 4 3	7	43	78				DS			-Wet, low plasticity, large shell fragments.
	-5													**Silty Clay (CL)**, gray, moist, medium stiff, trace fine grained sand, medium plasticity, H2S odor.

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FIGURE
A1-10 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW015**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/2/2012	10/2/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa/J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	61.5	17.1	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-6	0 1 2	3					0.75				
	-10													
30			SH-7											-Moist, fine to medium grained sand.
	-15													**Sand with Silt (SP-SM)**, gray, wet, medium dense, fine to coarse grained sand.
			R-8	13 18 18	36	25	107				DS			
														Silt (ML) , gray, wet, soft, trace fine grained sand, none to low plasticity, ~3" layer of **Sand with Silt (SM)**
35			S-9	4 5 6	11			63		0.25	PA			
	-20													
40			R-10	3 4 4	8	25								**Sandy Silt (ML)**, gray, wet, firm, fine grained sand, trace coarse grained sand, low plasticity.
	-25													
45														**Fat Clay (CH)**, gray, moist, medium stiff, high plasticity, some organics.
			S-11	1 4 5	9				57:29	0.5				
	-30													
														Silty Sand (SM), gray, moist to wet, medium dense, fine grained sand, trace organics.

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FIGURE
A1-10 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW015**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/2/2012	10/2/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa/J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	61.5	17.1	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			R-12	9 15 15	30	25	100	44		0.5	PA			
	-35													**Sand (SP)**, gray, wet, very dense, fine to coarse grained sand, few fine subangular gravel.
55			S-13	12 27 27	44									
	-40													
60			S-14	48 40 46	86									-Few fine to coarse gravel.
	-45													Boring terminated at 61.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
65														
	-50													
70														
	-55													

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FIGURE

A1-10 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-HSA016**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/10/2012	10/10/2012	1 of 1

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85 All Terrain	Hollow Stem Auger	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		8	18	15.7	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	15		B-1								CP			**Artificial Fill (af)** **Sandy Silt (ML)**, brown, dry, fine grained sand, little organics.
			R-2	1 2 3	5	25	81	65		2.5	PA			-Very stiff, moist, trace organics, trace oxidation, trace fine rootlets, trace clay seams, trace calcite or salt.
5	10		S-3	2 4 2	6									**Silty Sand (SM)**, light brown, dry, loose, fine grained sand.
			R-4 B-5	1 1 1	2	51	70							**Alluvium (Qa)** **Silty Clay (CL)**, gray, wet, very soft, few fine grained sand, medium plasticity.
10	5		S-6	0 1 3	4	41								**Clay (CL)**, gray, wet, soft, medium plasticity, laminations of silty sand, some organics (wood fibers and rootlets).
			R-7	1 3 4	7	36	85			0.25				**Sandy Silt (ML)**, gray, wet, soft, fine grained sand, no plasticity, few oxidation, trace organics, trace fine rootlets, micaceous.
15	0		S-8	0 0 2	2	41				0.25				-Light gray. **Clay (CL)**, light gray, moist, soft, medium plasticity.
			B-9						37:12					-Gray, wet. Boring terminated at 18 ft. Groundwater not encountered. Boring backfilled with tamped cuttings.
20	-5													

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FIGURE
A1-11

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-HSA017**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/10/2012	10/10/2012	1 of 1

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85 All Terrain	Hollow Stem Auger	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		8	16.5	14.3	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			B-1								CP			**Artificial Fill (af)**
			S-2	0 1 1	2			56			PA			**Sandy Silt (ML)**, light brown, dry, fine grained sand, no plasticity, little organics, trace snail shells. -Brown, moist, soft, low plasticity, little oxidation.
	10													**Silty Sand (SM)**, gray, moist, very loose, fine grained sand.
5			R-3	0 1 1	2	57	64							**Silty Clay (CL)**, gray, wet, soft, medium plasticity.
			B-4											
			S-5	0 0 0	0	49								-Very soft.
	5													
10			R-6	0 2 3	5	37	82	77		0.25	PA			**Silt (ML)**, gray, wet, soft, trace fine grained sand, low plasticity, trace wood fiber. -Soft, little oxidation.
			S-7	0 3 3	6	39								**Silt with Sand (ML)**, mottled gray and orangish brown, wet, medium stiff, some oxidation, trace organics, micaceous.
	0													
15			R-8 B-9	0 0 0	0	48	74			0.25				**Silty Clay (CL)**, mottled gray and orangish brown, wet, soft, some oxidation, trace organics, micaceous.
	-5													Boring terminated at 16.5 ft. Groundwater not encountered. Boring backfilled with tamped cuttings.
20														
	-10													

GDC_LOG_BORING_2011 L-962_PART 1.GPJ GDCLOG.GDT 1/24/13

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FIGURE
A1-12

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-HSA018**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/10/2012	10/10/2012	1 of 1

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85 All Terrain	Hollow Stem Auger	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		8	21.5	14.2	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			B-1								CP			**Artificial Fill (af)**
														Silt (ML), brown, dry, trace fine grained sand, low plasticity, little organics (dry brush).
			S-2	1 1 3	4	6								-Little recovery.
	10													
5			R-3	3 7 6	13	29	92			2.0				**Silty Clay (CL)**, brown, moist, very stiff, medium plasticity, trace shell fragments, trace calcite, micaceous.
			S-4	3 4 6	10	28				1.5				**Clayey Silt (ML)**, brown, moist, stiff, medium plasticity, trace shell fragments, trace calcite, few oxidation, micaceous.
	5													
10			R-5	4 7 8	15	23	95	38			PA			**Alluvium (Qa)** Interbedded layers of **Silty Sand (SM) and Silty Clay (CL)**, gray, moist, loose/stiff, fine grained sand, trace fine rootlets in SM, trace organics in CL.
			S-6	1 0 0	0	33			63:32					**Silt (ML)**, gray, wet, very soft, no plasticity, few oxidation, micaceous. **Fat Clay (CH)**, light gray, moist, very soft, high plasticity, trace sea shells.
	0													
15			R-7	1 0 2	2	48	75			0.25				**Fat Clay (CH)**, gray, wet, soft, few oxidation, trace organics.
			S-8	0 1 2	3	46								-Trace fine rootlets, micaceous.
			B-9											
	-5													
20			R-9	0 0 2	2	46	73							**Clayey Silt (ML)**, gray, wet, very soft, few fine grained sand, few shell fragments, H2S odor.
														Boring terminated at 21.5 ft. Groundwater not encountered. Boring backfilled with tampered cuttings.
	-10													

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FIGURE
A1-13

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW020**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/3/2012	10/3/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	15.4	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	15													**Artificial Fill (af)**
														Silty Clay (CL), brown, moist, oxidation, trace shells.
5														
	10		S-2	1 1 2	3	52				0.5				-Gray, moist, soft, low to medium plasticity.
														Silt (ML), gray, wet, very soft, fine to medium grained sand, none to low plasticity, trace shells.
10														
	5		R-3	1 2 1	3	53	71			0.15				
														Alluvium (Qa)
15														**Silty Clay (CH)**, gray, moist to wet, fine to medium grained sand, high plasticity, some oxidation, trace shell fragments.
	0		SH-4			83			63:35					
20														
	-5		S-5	0 1 1	2	46			50:24					-Soft, high plasticity, fine grained sand, trace organics.

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FIGURE
A1-14 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW020**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/3/2012	10/3/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	15.4	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-10		R-6	1 2 2	4	91	48		75:40	0.1				-Moist to wet, H2S odor.
30	-15		S-7	0 1 1	2	46								-Soft, few shell fragments, H2S odor, no organics.
35	-20		SH-8			50	70		73:40					-Moist, stiff, few oxidation. Vane shear = 0.75 ksf
														Silty Sand (SM), gray, moist, medium dense, fine to coarse grained sand.
40	-25		R-9	9 13 13	26	20	109	28			PA			
45	-30		S-10	5 5 6	11									-Fine to medium grained sand, few organics.
														Fat Clay (CH), gray, moist, medium stiff, fine grained sand, high plasticity.

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FIGURE
A1-14 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW020**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/3/2012	10/3/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	15.4	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-35		R-11	3 5 5	10	42	77		52:28	0.75				**Clayey Sand (SC)**, gray, wet, medium dense, fine grained sand, none to low plasticity, trace wood chunks.
55	-40		S-12	7 8 7	15									
60	-45		R-13	11 12 11	23	22	102							-Medium dense, no wood chunks, no plasticity.
65	-50		S-14	5 7 14	21									-Fine grained sand.
														Sand (SP), gray, wet, very dense, fine to coarse grained sand, few fine gravel.
70	-55		S-15	25 27 32	59									Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

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FIGURE
A1-14 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW023**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/3/2012	10/3/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	65.9	19	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			1											**Artificial Fill (af)** **Sandy Clay (CL)**, brown, dry, fine to medium grained sand, low plasticity, some roots/branches, few snail shells.
5	15		2	1 2 3	5	42	80	82			PA			-Gray, moist, soft, fine grained sand, trace roots, trace shell fragments.
10	10		3	2 4 5	9	37			38:13					-Stiff, trace roots.
15	5		4	1 2 5	7	48	72			0.25				-Medium stiff, low to medium plasticity.
20	0		5	0 0 1	1	48			46:16					**Alluvium (Qa)** **Silt (ML)**, gray, moist, very soft, fine grained sand, medium plasticity, oxidation.
	-5													**Clayey Silt (ML)**, gray, moist to wet, soft, medium plasticity, few shells, strong H2S odor.

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FIGURE
A1-15 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW023**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/3/2012	10/3/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	65.9	19	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			6	1 2 3	5	62	64			0.5				
	-10													**Sandy Silt (ML)**, gray, moist, stiff, low plasticity, trace shells.
30			7	1 2 4	6			70		1.25	PA			
	-15													
35			8			30	91			1.0				-Stiff, fine to medium grained sand, trace coarse grained sand, low to medium plasticity.
	-20													
40			9	2 4 4	8	48	71			0.1				-Medium stiff, trace roots.
	-25													
45			10	7 10 7	17									-Low plasticity, no roots.
														Silty Sand (SP-SM), gray, wet, fine to coarse grained sand.
	-30													**Clayey Silt (ML)**, gray, moist, stiff, low to medium plasticity, trace organics.

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FIGURE
A1-15 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-RW023**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/3/2012	10/3/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	65.9	19	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			11	6 7 8	15	32	90			1.5				
	-35													**Silty Lean Clay (CL)**, gray, moist, medium stiff, medium plasticity, trace organics.
55			12	3 4 4	8	35				0.75				
	-40													**Clayey Silt (ML)**, gray, moist, very stiff, low to medium plasticity, trace organics.
60			13	7 10 10	20	32	89			2.75				
	-45													**Silty Sand (SP-SM)**, gray, wet, very dense, fine to medium grained sand, coarse gravel.
65			14	60	100									
														Boring terminated at 65.9 ft. Groundwater not measured. Boring backfilled with bentonite grout.
	-50													
70														
	-55													

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FIGURE
A1-15 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-HSA064**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/15/2012	10/15/2012	1 of 1

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85 All Terrain	Hollow Stem Auger	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		8	19	17.2	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
0	15		S-1	1 4 3	7	9		45			PA			**Artificial Fill (af)** **Silty Sand (SM)**, light brown, dry, loose, fine grained sand, few fine roots, few shell fragments, trace dark brown clay seams.
5			R-2	6 6 8	14	24	95			>4.5				**Clay (CL)**, olive brown and gray, moist, hard, medium plasticity, some oxidation, few sea shells.
	10		S-3	3 4 3	7	27				2.5				**Clayey Silt (ML)**, olive brown and gray, moist, very stiff, low plasticity.
10			R-4	2 3 4	7	35	82							**Sandy Clay (CL)**, olive brown, wet, medium stiff, fine grained sand, few shell fragments, trace organics.
	5		S-5	0 0 4	4				42:20					**Alluvium (Qa)** **Silty Clay (CL)**, light gray and gray, moist, medium stiff, medium plasticity, trace shell fragments.
15			R-6	0 4 4	8	37	84							**Silt (ML)**, gray, moist, medium stiff, micaceous.
	0		S-7	0 0 1	1	42			43:20					**Silty Clay (CL)**, gray, wet, very soft, little shell fragments.
20														Boring terminated at 19 ft. Groundwater not measured. Boring backfilled with tamped cuttings.
	-5													

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FIGURE
A1-16

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-HSA066**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/15/2012	10/15/2012	1 of 1

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85 All Terrain	Hollow Stem Auger	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		8	21.5	21.1	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			B-1								CP			**Artificial Fill (af)**
	20													**Sandy Silt (ML)**, light brown, dry, fine grained sand, none to low plasticity, trace dead ice plant.
			R-2	9 11 10	21	10	90			>4.5				- Hard, increase in fine grained sand, no plasticity, no ice plant, trace fine roots.
5														
	15		S-3	1 2 3	5	10								-Medium stiff.
			R-4	2 3 5	8	33	83	48			PA			**Silty Sand (SM)**, grayish brown, wet, loose, fine grained sand, trace organics, trace shell fragments.
10														**Sandy Silt (ML)**, grayish brown, moist, soft, fine grained sand, little oxidation, micaceous.
	10		S-5	0 1 1	2	38								**Alluvium (Qa)** **Sandy Silt (ML)**, gray, moist, soft, fine grained sand, micaceous.
			R-6	0 0 4	4	42	75							**Silty Sand (SM)**, gray, moist, very loose, fine grained sand, micaceous.
15														**Silty Clay (CL)**, light gray, moist, medium stiff, medium plasticity.
	5		S-7	0 3 3	6	51								**Silty Fat Clay (CH)**, gray, moist, soft, high plasticity.
			R-8	1 3 3	6	46	73		71:39					-Brownish gray, medium plasticity, some oxidation, micaceous.
20														
	0		S-9	0 0 0	0	56			51:24					-Gray, very soft, trace shell fragments, H2S odor.
														Boring terminated at 21.5 ft. Groundwater not measured. Boring backfilled with tamped cuttings.

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FIGURE
A1-17

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**A-HSA067**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/10/2012	10/10/2012	1 of 1

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85 All Terrain	Hollow Stem Auger	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		8	16.5	12.2	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	10													**Artificial Fill (af)**
														Silt (ML), light brown, dry, low plasticity.
			R-1	1 2 2	4	36	74			0.25				**Silty Clay (CL)**, brown, moist, soft, low to medium plasticity, few oxidation, trace calcite, slightly micaceous.
5			S-2	0 1 2	3	46				0.5				
	5													**Alluvium (Qa)**
			R-3	1 3 3	6	36	78			0.75				**Silt (ML)**, olive brown, moist, medium stiff, trace fine grained sand, no plasticity, highly micaceous.
10			S-4	0 0 2	2	48								**Clayey Silt (ML)**, light brown, wet, soft, trace fine grained sand, low plasticity, few organics, trace sea shells.
	0													**Fat Clay (CH)**, olive brown, wet, medium stiff, trace fine grained sand, high plasticity, some oxidation, trace shell fragments, trace calcite or salt, micaceous.
			R-5	1 2 3	5	40	79		69:37					
15			S-6	0 0 0	0	45								**Silt (ML)**, mottled gray and orangish brown, wet, very soft, low plasticity, some to mostly oxidation, trace shell fragments, trace organics.
	-5													Boring terminated at 16.5 ft. Groundwater not measured. Boring backfilled with tampered cuttings.
20														
	-10													

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FIGURE
A1-18

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW027**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/24/2012	9/24/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	13	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	10													**Artificial Fill (af)**
														Silty Sand with Gravel (SM), light brown, dry, fine to coarse grained sand, fine to coarse gravel.
5			R-1	3 5 7	12	21	94				DS			**Silty Sand (SM)**, brown, moist, loose, fine grained sand, trace clay seams, trace rusted metal.
	5													**Sand with Silt (SP-SM)**, brown, wet, fine grained sand, trace wood ~2" long and ~1/2" wide.
10			SH-2			23	103							
	0													**Elastic Silt (MH)**, gray, wet, very soft, high plasticity.
15			S-3	0 0 0	0				71:33	0.25				- Brown, few shells, few rootlets, micaceous.
	-5													**Alluvium (Qa)**
20			SH-4			35	83				DS			**Silty Sand (SM)**, gray, wet, fine grained sand, few shell fragments, trace fine rootlets, micaceous.
	-10													**Sand with Silt (SP-SM)**, gray, wet, medium dense, fine grained sand, H2S odor.

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FIGURE
A1-19 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW027**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/24/2012	9/24/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	13	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-5	9 14 15	29									
	-15													
30			R-6	7 8 10	18									-No recovery.
														Silty Sand (SM), gray, wet, loose, fine grained sand, trace shell fragments.
	-20		S-7	4 4 6	10									
35			R-8	38 50/5"	100	24	100							**Sand (SP)**, gray, wet, very dense, fine grained sand, trace organics, trace fines.
	-25													
40			R-9	18 21 26	47	28								-Dense.
	-30													
45			S-10	14 18 20	38									
	-35													**Silty Sand (SM)**, gray, wet, firm, fine grained sand, low plasticity, trace shell fragments, micaceous.

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FIGURE
A1-19 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW027**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/24/2012	9/24/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	13	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			R-11	2 4 5	9	34	86	88			PA			
	-40													**Fat Clay(CH)**, dark brown, moist, stiff, fine grained sand, high plasticity.
55			S-12	4 5 6	11				58:31	1.5				
	-45													**Sandy Silt (ML)**, gray, wet, medium stiff, fine grained sand, low plasticity.
60			SH-13			21	107	50		0.75	PA			
	-50													**Silty Sand (SM)**, greenish gray, wet, dense, fine to coarse grained sand, trace fine gravel, multi colored sand and gravel.
65			S-14	11 22 20	42									
	-55													
70			S-15	5 8 14	22			29			PA			-Gray, medium dense, fine grained sand.
	-60													Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

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FIGURE
A1-19 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW028**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/22/2012	10/22/2012	1 of 1

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling		Hand Auger	N. Briffa/E. Ycoy	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
			5	5	▽ 4.0 / *1.0* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			B-1											**Artificial Fill (af)** **Sandy Silt (ML)**, brown, dry, fine grained sand, trace fine gravel. **Silt (ML)**, brown, moist, low plasticity, few shells. **Alluvium (Qa)** **Silt (ML)**, brown, moist, low plasticity, few shells, laminations of Silty Clay (CL) and Peat (Pt): **Silty Clay (CL)**, gray and brown, moist, medium plasticity, little oxidation. **Peat (Pt)**, dark brownish gray, moist. **Silty Sand (SM)**, gray, wet, fine grained sand. **Fat Clay (CH)**, gray, wet, medium to high plasticity. Boring terminated at 5 ft. Groundwater encountered at 4 ft. Boring backfilled with tamped cuttings.
5	0													
10	-5													
15	-10													
20	-15													

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FIGURE
A1-20

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW030**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/4/2012	10/4/2012	1 of 2

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	41.5	6.1	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	5		1											**Artificial Fill (af)** **Silty Sand (SM)**, brown, dry, fine to coarse grained sand, few roots/grass.
5	0		2	0 0 0	0	65			72:40					**Alluvium (Qa)** **Fat Clay (CH)**, light gray, moist, very soft, fine to coarse grained sand, high plasticity, trace shells.
10	-5		3	0 1 1	2	81	51		70:37	0.05				-Gray, trace organics, trace shell fragments, H2S odor.
15	-10		4	0 0 0	0			31			PA			**Silty Sand (SM)**, gray, wet, very loose, fine to medium grained sand, low plasticity, trace shell fragments.
20	-15		5	7 14 25	39	31	92							-Medium dense, none to low plasticity, slight H2S odor.

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FIGURE
A1-21 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW030**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/4/2012	10/4/2012	2 of 2

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	J. Wright	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	41.5	6.1	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-20		6	3 3 2	5									-Loose, fine to coarse grained sand, no plasticity, no H2S odor, little to some shells/shell fragments.
30	-25		7	8 12 16	28	25	99				DS			-Medium dense, fine to medium grained sand, none to low plasticity, trace shells.
35	-30		8	3 3 6	9									-Loose, fine grained sand.
40	-35		9	6 5 5	10									-Fine to medium grained sand, low plasticity, some shells.
														Boring terminated at 41.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
45	-40													

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FIGURE
A1-21 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW032**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/14/2012	9/14/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	8.2	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	5		B-1											**Artificial Fill (af)** **Silty Sand (SM)**, brown, dry, fine to coarse grained sand, few fine to coarse gravel, little organics.
5			S-2	15 6 1	7									-Loose, decrease in organics, no coarse gravel.
	0													**Alluvium (Qa)** **Fat Clay (CH)**, gray, wet, high plasticity, trace sea shells, slight H2S odor, micaceous.
10			SH-3			58	66		71:43		CS			Vane Shear = 0.42 ksf
	-5													
15			S-4	0 0 0	0	60								-No shells, no H2S.
	-10													**Silty Sand (SM)**, gray, wet, some shell fragments. No recovery in shelby tube.
20			SH-5			40	83	28			PA			
	-15													

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FIGURE
A1-22 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW032**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/14/2012	9/14/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	8.2	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-6	8 9 11	20									- gray, wet, medium dense, fine grained sand, micaceous.
	-20													
30			SH-7			34	89				DS			-Increase in silt, no recovery in shelby tube.
	-25													
35			S-8	11 17 20	37									-Dense, decrease in silt, ~15%.
	-30													**Sand Silt (ML)**, gray, wet, medium stiff, fine grained sand, micaceous.
40			R-9	3 4 5	9	35	85				DS			
	-35													**Sandy Silty Clay (CL)**, gray, wet, soft, fine grained sand, medium plasticity, micaceous, trace shell fragments.
45			S-10	0 0 0	0				36:13	0.5				
	-40													**Sand (SP)**, gray, wet, medium dense, fine to medium grained sand, few coarse grained sand, trace shell fragments.

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FIGURE
A1-22 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW032**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/14/2012	9/14/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	8.2	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			R-11	20 26 17	43	21	104							
	-45													**Silty Sand (SM)**, gray, wet, dense, fine grained sand, trace organics.
55			S-12	7 21 22	43			21			PA			
	-50													
60			S-13	17 45 50/4"	95			28			PA			-Very dense, micaceous, dark brown wood fibers in organics and silt.
	-55													
65			R-14	3 32 50/3"	82									No Recovery. Hole collapsed when inserting rod for next sample.
	-60													**Sand (SP)**, gray, wet, very dense, fine to medium grained sand, trace organics (wood fibers).
70			S-15	27 44 47	91									
	-65													Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

GDC_LOG_BORING_2011 L-962_PART 1.GPJ GDCLOG.GDT 1/24/13

GROUP DELTA CONSULTANTS, INC.
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Torrance, CA 90501

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FIGURE
A1-22 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW033**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/11/2012	9/12/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in. (Auto/Manual)		3.875	71.5	6.3	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	5													**Artificial Fill (af)** **Sand with Silt (SP-SM)**, yellowish brown, dry, fine grained sand. -Moist.
5	0		R-1	3 3 4	7	63	59							**Alluvium (Qa)** **Fat Clay (CH)**, gray, wet, medium stiff, high plasticity, trace organics, trace sea shells and shell fragments, slight H2S odor, trace burned wood or charcoal.
10	-5		S-2	2 3 4	7									
15	-10		SH-3			76			75:42					-Soft, no H2S odor, trace fine grained sand. Vane Shear = 0.25 ksf
20	-15		S-4	14 26 28	54									**Sand (SP)**, gray, wet, dense fine grained sand, trace shell fragments.
														Silty Sand (SM) with clay laminations, gray, wet, fine grained sand, few shell fragments, slight H2S odor, pocket of light brown fine grained sand.

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FIGURE
A1-23 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW033**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/11/2012	9/12/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in. (Auto/Manual)		3.875	71.5	6.3	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-20		SH-5			47	73	30			PA			-No recovery.
30				3										
	-25		S-6	4 2	6									
			S-7	8 18 20	38					1.25				**Sandy Silt (ML)**, gray, wet, stiff, fine grained sand, trace shell fragments.
35														**Silty Sand (SM)**, gray, wet, fine grained sand, trace shell fragments.
	-30		SH-8			30	91							
														Sandy Silt (ML), gray, wet, medium stiff, fine grained sand, low plasticity, trace shell fragments.
40				1										
	-35		S-9	2 3	5				28:3	0.75				
														Fat Clay (CH), gray, wet, medium stiff, high plasticity.
45														Vane Shear = 0.7 ksf
	-40		SH-10			42	82		53:31	0.5				
														Silty Sand (SM), gray, wet, medium dense, fine grained sand.

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FIGURE
A1-23 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW033**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/11/2012	9/12/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in. (Auto/Manual)		3.875	71.5	6.3	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-45		S-11	7 9 4	13									
55			R-12	18 34 42	76			27			PA			-Very dense, trace organics, micaceous.
	-50													
60			S-13	2 5 16	21									-Interbedded with layers of **Clayey Sand (SC)**, gray, wet, medium dense, fine to medium grained sand, trace organics in (SC).
	-55													
65			R-14	18 20 13	33									-Trace organics.
	-60													-Gravels (drill rig chatter)
														Poorly Graded Sand with Gravel (SP) gray, wet, dense, fine to coarse grained sand, fine to coarse gravel, drilling mud mixed in sample.
70			S-15	14 15 19	34									
	-65													Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

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FIGURE
A1-23 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW036**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/17/2012	9/17/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	9.1	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														Base (~18").
														Artificial Fill (af) Silty Sand (SM) , light brown, wet, very loose, fine grained sand, few gray clay seams.
5	5		S-1	3 1/12"	1									
10	0		SH-2			42	78		60:32		CS			**Alluvium (Qf)** **Fat Clay (CH)**, gray, wet, soft, micaceous, high plasticity in clay, trace oxidation. Vane Shear = 0.3 ksf
15	-5		S-3	0 0 1	1				69:38					-H2S odor.
20	-10		SH-4			26	97							**Silty Sand (SM)**, gray, wet, fine grained sand, micaceous, H2S odor, trace shell fragments.
	-15													**Sandy Silt (ML)**, gray, wet, soft, fine grained sand, micaceous, H2S odor, few shell fragments.

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FIGURE
A1-24 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW036**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/17/2012	9/17/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	9.1	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-5	6 1 1	2					0.25				
	-20													**Fat Clay (CH)**, gray, wet, medium stiff, micaceous, trace shell fragments, high plasticity.
30			SH-6			60	65	95	63:32	0.5	C DS PA			
	-25													**Silt with Sand (ML)**, gray, wet, very soft, fine grained sand, micaceous, trace shell fragments, low plasticity.
35			S-7	0 0 1	1					0.25				
	-30													**Silty Clay (CL)**, dark gray, moist, stiff, low to medium plasticity, few fine grained sand.
40			SH-8			22	106			1.75				
	-35													**Sandy Clay (CL)**, gray, wet, soft, fine grained sand, low to medium plasticity.
45			S-9	4 4 6	10			50		0.25	PA			
	-40													**Silty Sand (SM)**, gray, wet, fine grained sand, trace organics.

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FIGURE
A1-24 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW036**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/17/2012	9/17/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	9.1	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			SH-10			25	101							**Silt (ML)**, gray, wet, soft, low to medium plasticity, few fine grained sand.
	-45													
55			S-11	1 1 3	4					0.75				
	-50													**Silty Sand (SM)**, gray, wet, loose, fine grained sand, trace organics.
60			R-12	6 5 4	9									
	-55													**Silty Clay (CL)**, gray, wet, soft, medium plasticity, few organics (wood chunks ~1/8" in diameter).
65			S-13	8 8 9	17					0.25				
	-60													**Sand (SP)**, gray, wet, very dense, fine to medium grained sand, trace fines.
70			S-14	28 29 30	59									
	-65													Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

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FIGURE
A1-24 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW039**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/17/2012	9/17/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	8.2	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														Artifical Fill (af)
														Silty Sand with Gravel (SM), brown, dry, fine to coarse grained sand, fine gravel, few organics.
	5													**Alluvium (Qa)**
														Fat Clay (CH), olive brown, moist, soft, micaceous, high plasticity, few oxidation.
5		☒	S-1	1 1 1	2				65:37	0.5				
	0													
10		■	SH-2			57	69		68:37					-Gray, wet, trace shell fragments and sea shells, no oxidation, slight H2S odor. Vane shear = 0.4 ksf
	-5													**Silty Sand (SM)**, gray, wet, fine grained sand, some shell fragments, H2S odor, low plasticity, possible organic.
15		☒	S-3	0 0 0	0			33			PA			
	-10													**Sand with Silt (SP-SM)**, gray, wet, dense, fine grained sand, few shell fragments.
20		■	R-4	8 26 23	49	22	104							
	-15													**Silty Sand (SM)**, gray, wet, very loose, fine grained sand, some silt, micaceous.

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FIGURE
A1-25 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW039**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/17/2012	9/17/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	8.2	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-5	2 1 3	4									
	-20													
30			R-6	8 19 27	46	27	97							-Dense
	-25													**Silty Clay (CL)**, gray, wet, soft, trace fine grained sand, trace shell fragments, low to medium plasticity.
35			S-7	0 1 2	3				40:15	0.5				
	-30													
40			SH-8			20	108		30:14	1.75				**Sandy Clay (CL)**, gray, moist, stiff, some fine grained sand, medium plasticity, trace medium grained sand, trace organics. Vane shear = 1.9 ksf
	-35													**Silty Sand (SM)**, gray, wet, medium dense, fine to coarse grained sand.
45			S-9	8 12 13	25									
	-40													**Poorly Graded Gravel with Sand (GP)** greenish gray, wet, very dense, medium to coarse grained sand, fine to coarse subrounded gravel.

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FIGURE
A1-25 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW039**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/17/2012	9/17/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	8.2	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			R-10	8 30 47	77	14	118							
	-45													**Silty Sand (SM)**, gray, wet, medium dense, fine grained sand, some fines.
55			S-11	3 5 8	13									
	-50													**Silty Clay (CH)**, gray, moist, stiff, high plasiticity, trace rootlets ~1/16" in diameter.
60			S-12	3 5 8	13					1.75				
	-55													**Sand (SP)**, gray, wet, dense, fine to medium grained sand, trace fines.
65			S-13	12 19 22	41									
	-60													
70			S-14	13 19 33	52									- Light gray, wet, very dense, fine grained sand, trace medium grained sand, trace fines.
	-65													Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

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FIGURE
A1-25 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW041**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/20/2012	9/20/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	66.5	6.8	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	5		B-1											**Artificial Fill (af)** **Silt with Sand (ML)**, brown, dry, little organics, no plasticity.
5	0		SH-2			31	88	45			C DS PA			**Alluvium (Qa)** **Silty Sand (SM)**, gray, wet, fine grained sand, micaceous, few oxidation, trace fine rootlets.
10	-5		S-3	0 0 0	0									**Fat Clay (CH)**, gray, wet, very soft, high plasticity, trace organics, H2S odor.
15	-10		SH-4			33	81				DS			**Sandy Silt (ML)**, gray, wet, fine grained sand, low plasticity, little shell fragments, 1 sea shell ~1.5", H2S odor.
20	-15		S-5	8 9 10	19			17			PA			**Silty Sand (SM)**, medium dense, few shell fragments.
														Fat Clay (CH), gray, wet, medium stiff, high plasticity, trace shell fragments.

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FIGURE
A1-26 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW041**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/20/2012	9/20/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	66.5	6.8	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			SH-6			52	67		75:42		C			Vane shear = 0.5 ksf
	-20													**Lean Clay (CL)**, gray, wet, medium plasticity, trace shell fragments, 1 sea shell ~1.5".
30			S-7	0 0 0	0				40:20	0.5				
	-25													
35			S-8	1 2 5	7					2.0				Interbedded layers of Silty Clay (CH) and Sandy Clay (CL): -**Silty Clay (CH)**, gray, moist, medium stiff, medium plasticity. -**Sandy Clay (CL)**, gray, wet, medium stiff, fine grained sand, trace shell fragments, trace fine rootlets.
	-30													
40			R-9	8 11 16	27	21	103		33:13	1.25				**Lean Clay (CL)**, gray, moist, medium stiff, trace fine grained sand, medium plasticity. Vane shear = 0.8 ksf
	-35													
45			S-10	0 0 1	1					0.25				-Wet, very soft, trace organics.
	-40													**Fat Clay (CH)**, gray, wet, medium stiff, fine grained sand, high plasticity, micaceous.

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FIGURE
A1-26 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW041**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/20/2012	9/20/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	66.5	6.8	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			SH-11			28	94			0.75				Vane shear = 0.8 ksf
	-45													
55			S-12	1 3 4	7				59:34	1.25				-Moist, stiff, trace fine grained sand.
	-50													
60			R-13	32 31 37	68	9	131	6			PA			**Well Graded Sand with Gravel (SW)** gray, wet, dense, fine to coarse grained sand, fine to coarse gravel, trace fines, gravels up to 2".
	-55													
65			S-14	20 22 23	45									**Sand (SW)**, gray, wet, fine to coarse grained sand, few fine to coarse gravel, gravels up to ~1".
	-60													Boring terminated at 66.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
70														
	-65													

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FIGURE
A1-26 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW043**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/19/2012	9/19/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	66.5	8.8	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			B-1											**Artificial Fill (af)** **Sandy Silt (ML)**, brown, dry, none to low plasticity, fine grained sand, few roots.
	5													**Alluvium (Qa)**
5			S-2	0 0 1	1	49				0.5				**Fat Clay (CH)**, olive brown, moist, medium stiff, few oxidation streaks, trace fine grained sand, high plasticity, H2S odor.
	0													
10			SH-3			53	104		59:34	0.25				-Gray, wet, soft, few fine grained sand, micaceous, trace shell fragments, H2S odor. Vane shear = 0.5 ksf
	-5													
15			S-4	0 0 1	1	80								
	-10													**Sand (SP)**, gray, wet, fine grained sand, some shells above shelby tube, no fines.
20			SH-5			29								
	-15													**Fat Clay (CH)**, gray, wet, soft, trace fine grained sand, high plasticity, 1" layer with mostly shell fragments and wood chunk above (width of sampler)

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FIGURE
A1-27 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW043**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/19/2012	9/19/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	66.5	8.8	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-6	0 0 1	1	60			63:35					
	-20													
30			SH-7			33				1.25				-Stiff, dark gray, no shells, no wood, trace fine grained sand, no ring samples. Vane shear = 1.25 ksf
	-25													**Sandy Clay (CL)**, gray , wet, stiff, fine grained sand, medium plasticity, trace wood pieces.
35			S-8	5 5 6	11				47:27					
	-30													
40			R-9	5 3 2	5	32	89							-Soft, increase in fines, few wood fibers >1" long, trace black inclusions.
	-35													-Medium Stiff, fine to medium grained sand, trace wood fibers.
45			S-10							0.75				**Lean Clay (CL)**, gray, wet, medium stiff, medium plasticity, trace fine grained sand, trace wood fibers.
	-40													

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FIGURE
A1-27 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW043**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/19/2012	9/19/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	66.5	8.8	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			R-11	2 4 6	10	37	85		44:24	0.75				Vane shear = 0.65 ksf
	-45													**Silty Sand (SM)**, gray, wet, loose, fine grained sand, trace organics.
55			S-12	0 2 4	6									
	-50													**Sand with Gravel (SP)**, gray, wet, very dense, fine to medium grained sand, few coarse grained sand, few fine to coarse gravel, coarse gravel up to 2.5".
60			R-13	47 50 50/4"	100	16	112							
	-55													
65			S-14	16 17 17	34									
	-60													Boring terminated at 66.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
70														
	-65													

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FIGURE
A1-27 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW044**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/19/2012	9/19/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	66.5	9.2	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	5													**Artificial Fill (Qa)**
														Sandy Silt (ML), brown, dry, fine grained sand, none to low plasticity.
5			SH-1			58	63		84:52	0.39				**Alluvium (Qa)**
														Fat Clay (CH), olive brown, moist, medium stiff, trace fine grained sand, high plasticity, trace calcite, trace oxidation.
														Vane shear = 0.75 ksf
	0													
10			S-2	0 0 1	1	53								-Wet, very soft.
	-5													
15			SH-3			42	76		64:37	0.32				-Moist.
														Vane shear = 0.55 ksf
	-10													
20			S-4	0 0 1	1									-Gray, wet.
														Clayey Sand (SC), gray, wet, very loose, fine grained sand.
	-15													**Fat Clay (CH)**, gray, wet, medium stiff, fine grained sand, high plasticity, little shells in middle of sampler.

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FIGURE
A1-28 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW044**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/19/2012	9/19/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	66.5	9.2	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			SH-5			38	77		58:34	0.5				Vane shear = 0.55 ksf
	-20													
30			S-6	0 0 3	3									-Moist, few shell fragments.
	-25													**Clayey Sand (SC)**, gray, moist, fine grained sand, medium plasticity, trace organics, trace shell fragments.
35			SH-7			24	103				DS			
	-30													
40			S-8	5 4 2	6									-Wet, loose.
	-35													**Sand with Gravels (SP)**, gray, wet, medium dense, fine to medium grained sand, fine gravel.
45			R-9	16 17 18	35	21	109							
	-40													

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FIGURE
A1-28 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW044**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/19/2012	9/19/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	66.5	9.2	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-10	10 7 2	9									-Loose. Note: Most of sample fell out with sand catcher on.
	-45													**Lean Clay (CL)**, gray, moist, medium stiff, trace fine grained sand, medium plasticity.
55			R-11	3 3 5	8	33	89		39:21	0.75	C			
	-50													**Sand (SP)** , gray, wet, dense, fine to medium grained sand, trace coarse grained sand, piece of wood ~3/8" in diameter.
60			S-12	11 11 21	32									
	-55													**Poorly - Graded Gravel with Sand (GP)** gray, wet, very dense, medium to coarse grained sand, fine to coarse gravel.
65			S-13	17 22 35	57									
														Boring terminated at 66.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
70	-60													
	-65													

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FIGURE
A1-28 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW047**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/18/2012	9/18/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	66.5	11.5	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	10		B-1											**Artifical Fill (af)** **Silty Sand with Gravels (SM)**, light brown, dry, few organics.
5	5		S-2	2 2 2	4			60			PA			**Alluvium (Qa)** **Sandy Silt (ML)**, olive brown, moist, soft, fine grained sand, none to low elasticity.
10	0		SH-3			50	74		40:18	0.25				**Lean Clay (CL)**, olive brown, wet, medium stiff, medium plasticity, trace fine grained sand. Vane Shear = 0.6 ksf
15	-5		S-4	0 0 0	0					0.15				**Fat Clay (CH)**, gray, wet, very soft, high plasticity, micaceous.
20	-10		SH-5			65	59		82:50	0.75				-Medium stiff, not micaceous, laminations of light pinkish brown Clay with Sand, some sea shells in upper portion of sample, strong H2S odor. Vane shear = 0.9 ksf **Sandy Clay (CL)**, gray, wet, soft, fine grained sand, medium plasticity, few organics, trace shell fragments, micaceous.

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FIGURE
A1-29 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW047**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/18/2012	9/18/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	66.5	11.5	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-6	0 0 4	4			84	48:27		PA			
	-15													
30			SH-7			23	105			0-2.25				-Moist, very soft to very stiff, few fine grained sand, low to medium plasticity.
	-20													
														Silty Sand (SM), gray, moist, loose, fine grained sand, some fines, trace shell fragments.
35			S-8	2 3 5	8									
	-25													
														Sand (SP), gray, wet, medium grained sand, trace coarse grained sand, trace fine gravel.
40			SH-9											
	-30													
														Fat Clay (CH), gray, wet, stiff, high plasticity, micaceous.
45			S-10	3 5 6	11				57:36	1.5				
	-35													

GDC_LOG_BORING_2011 L-962_PART 1.GPJ GDCLOG.GDT 1/24/13

GROUP DELTA CONSULTANTS, INC.
370 Amaploa Ave., Suite 212
Torrance, CA 90501

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FIGURE
A1-29 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW047**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/18/2012	9/18/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	66.5	11.5	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-40		R-11	4 4 5	9	35	78		52:30	0.75				-Moist, soft. Vane shear = 0.4 ksf
55			S-12	11 12 10	22									**Silty Sand (SM)**, gray, wet, medium dense, fine grained sand, trace organics.
	-45													
60			R-13	26 50/4"	100	19	108							**Sand (SP)** , gray, wet, very dense, fine to medium grained sand, few coarse grained sand, few fg.
	-50													
65			S-14	17 18 17	35									**Poorly graded Gravel with Sand (GP)** gray, wet, dense, medium to coarse grained sand, fine to coarse gravel, subangular gravels.
	-55													Boring terminated at 66.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
70														
	-60													

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FIGURE
A1-29 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW049**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/1/2012	10/1/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	69	17.6	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			B-1											**Artificial Fill (af)** **Silty Sand with Gravel (SM)**, brown, dry, fine to coarse grained sand, fine to coarse gravel.
	15													
5			S-2	3 4 4	8									**Silt (ML)**, brown, moist, medium stiff, low plasticity, trace roots.
	10													
10			R-3	2 4 8	12	31	81			1.25				-Olive brown, low to medium plasticity, trace dark brown clay seams. Vane Shear = 0.7 ksf
	5													
15			SH-4			37	74	55	84:43	0.25	PA			-None to low plasticity, increase in roots, highly micaceous, no clay seams. Vane Shear = 0.5 ksf **Elastic Silt (MH)**, dark brown with orange spots of Silt, high plasticity, trace hair or fiber, trace shell fragments.
	0													**Alluvium (Qa)**
20			S-5	2 1 2	3				27:7					**Lean Clay (CL)**, gray, wet, soft, low to medium plasticity, some laminations and pinholes of oxidation, micaceous.
	-5													**Fat Clay (CH)**, gray, wet, medium stiff, trace fine grained sand, high plasticity, micaceous, H2S odor.

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FIGURE
A1-30 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW049**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/1/2012	10/1/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	69	17.6	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			SH-6			63	62		67:34	0.5				Vane Shear = 1.0 ksf
	-10													**Silty Clay (CL)**, gray, wet, medium stiff, few fine grained sand, low to medium plasticity, trace shell fragments, slight H2S odor.
30			R-7	3 4 5	9	32	89			1.0				
	-15													
35			SH-8			28	96		40:17	1.25				-Moist, stiff, trace fine grained sand, medium plasticity, trace rootlets. Vane Shear = 1.1 ksf
	-20													**Silty Sand (SM)**, gray, wet, medium dense, fine to coarse grained sand.
40			R-9	10 10 13	23	22	105				DS			
	-25													
45			S-10	9 9 12	21									-Fine grained sand, trace seams of Elastic Silt.
	-30													

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FIGURE
A1-30 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW049**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/1/2012	10/1/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	69	17.6	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			R-11	14 20 28	48	18	106							-Dense, fine to medium grained sand, trace fine gravel.
	-35													**Sand with Silt (SP-SM)**, gray, wet, medium dense, fine to medium grained sand, few coarse grained sand.
55			S-12	16 14 15	29									
	-40													**Silty Clay (CL)**, gray, moist, stiff, few fine grained sand, medium plasticity, trace organics.
60			R-13	4 5 8	13	31	85		39:16	1.0				Vane Shear = 1.0 ksf
	-45													
65			SH-14											No recovery.
	-50		S-15	3 14 23	37	21								**Sand (SP)** , gray, wet, dense, fine to medium grained sand, trace fines.
70														Boring terminated at 69 ft. Groundwater not measured. Boring backfilled with bentonite grout.
	-55													

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FIGURE
A1-30 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-HSA051**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/16/2012	10/16/2012	1 of 1

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85 All Terrain	Hollow Stem Auger	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		8	21.5	6.3	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			B-1											**Artificial Fill (af)**
	5													**Clay (CL)**, brown, dry, low to medium plasticity, trace organics, trace sea shells, few fine roots, trace white residue. -Moist
			S-2	0 2 4	6	17								-Firm, no snail shells.
5			R-3	1 2 3	5	42	76							-Soft, light brown and gray, moist, medium plasticity.
	0													**Alluvium (Qa)**
			S-4	1 2 2	4									Interbedded layers of **Silty Clay (CL) and Clayey Silt (ML)**, gray, wet, soft, fine grained sand, few oxidation, trace fine rootlets, micaceous.
10			R-5	0 0 2	2	49	68							**Clayey Silt (ML)**, gray, wet, very soft, low plasticity, trace oxidation, some small to large shell fragments, H2S odor.
	-5													
			S-6	0 0 0	0				87:44					**Elastic Silt (MH)**, gray, wet, very soft, few fine grained sand, medium plasticity, few shell fragments, few tan color blebs of organics or CH, strong H2S odor.
15			R-7	0 0 1	1	103	43							-Trace fine rootlets.
	-10													
			S-8	0 5 7	12									-Increase in shell fragments.
														Sandy Clay (CL), gray, wet, stiff, some fine grained sand, trace sea shells, H2S odor.
20			R-9	0 2 4	6	17	111							
	-15													Boring terminated at 21.5 ft. Groundwater not encountered. Boring backfilled with tamped cuttings. Strong H2S odor occurred at ~20'. H2S reading of >150 ppm.

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FIGURE
A1-31

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW053**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/24/2012	9/24/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	13.7	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														Artificial Fill (af)
														Silty Sand with Gravel (SM), brown, dry, fine to coarse sand, fine to coarse gravel.
	10													
5			S-1	0 0 0	0				48:27					**Alluvium (Qa)**
														Lean Clay (CL), olive brown, wet, very soft, trace fine grained sand, highly micaceous, interbedded layers of Fat Clay (CH).
	5													
10			SH-2			66	61		66:39		C			**Fat Clay (CH)**, dark brown and gray, moist, medium stiff, high plasticity.
														Vane Shear = 0.8 ksf
	0													
15			S-3	0 0 0	0									- Gray, wet, very soft, few sea shells.
	-5													**Silty Sand (SM)**, gray, wet, fine grained sand, low plasticity, little shells, H2S odor.
20			SH-4			34	87	35	28:4		PA			
	-10													

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FIGURE
A1-32 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW053**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/24/2012	9/24/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	13.7	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-5	4 4 4	8									- Loose, trace shell fragments.
	-15													
30			SH-6			29	92	30			DS PA			- No H2S odor.
	-20													
35			S-7	16 17 17	34			15			PA			- Dense
	-25													
40			R-8	12 7 6	13									-No recovery
	-30													**Lean Clay (CL)**, gray, moist, soft, medium plasticity, trace shell fragments.
45			S-9	1 1 1	2				47:27	0.5				
	-35													

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FIGURE
A1-32 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW053**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/24/2012	9/24/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	13.7	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			SH-10			20	108		32:17	2.0				**Silty Clay with Sand (CL)**, gray, moist, stiff, fine grained sand, medium plasticity, micaceous. Vane Shear = 1.5 ksf
	-40													
55			S-11	2 3 5	8			65		0.25	PA			**Sandy Clay (CL)**, gray, wet, soft, fine grained sand, medium plasticity, micaceous.
	-45													
60			SH-12			34	87		38:13	2.5				- Moist, very stiff. Vane Shear = 2.2 ksf
	-50													**Fat Clay (CH)**, gray, moist, stiff, high plasticity.
65			S-13	0 0 1	1					1.5				
	-55													
70			SH-14			39	81		81:53	2.0				- Very stiff, trace fine grained sand.
	-60													Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

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FIGURE
A1-32 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW055**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/25/2012	9/25/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	16.3	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	15													**Artificial Fill (af)**
														Silty Sand with Gravels (SM), brown, dry, fine to coarse grained sand, fine to coarse gravel.
5														
	10		S-1	1 2 1	3									**Silty Sand (SM)**, brown, moist, very loose, fine grained sand, trace coarse grained sand, trace oxidation, trace shell fragments.
10														**Alluvium (Qa)**
	5		SH-2			42	78		52:24					**Fat Clay (CH)**, olive brown, wet, medium stiff, high plasticity, few thin layers of oxidation (vertical), trace shell fragments, micaceous.
														Vane Shear = 0.7 ksf
15														
	0		S-3	0 0 3	3					0.75				-Light olive brown, moist, trace fine grained sand, micaceous.
20														
	-5		SH-4			65	60			0.5				-Gray, H2S odor, seams of light gray, dry, very stiff **Silt**.
														Vane Shear = 0.5 ksf

GDC_LOG_BORING_2011 L-962_PART 1.GPJ GDCLOG.GDT 1/24/13

GROUP DELTA CONSULTANTS, INC.
370 Amaploa Ave., Suite 212
Torrance, CA 90501

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE
A1-33 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW055**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/25/2012	9/25/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	16.3	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-10		R-5	1 1 1	2									-No recovery.
			SH-6			26	61							**Sand with Silt (SP-SM)**, gray, wet, fine grained sand.
30	-15		S-7	0 1 2	3									**Silty Sand (SM)**, gray, wet, very loose, fine grained sand, H2S odor.
35	-20		R-8	5 8 6	14	39	78	59		0.25	PA			**Sandy Silt (ML)**, gray, wet, soft, fine grained sand, none to low plasticity, micaceous.
40	-25		S-9	10 10 10	20									**Silty Sand (SM)**, gray, moist, medium dense, trace fine grained sand, micaceous.
45	-30		R-10	0 5 6	11	22	83		32:14	1.0				**Silty Clay with Sand (CL)**, gray, moist, stiff, fine grained sand, medium plasticity, trace shell fragments.
														Silty Sand (SM), gray, wet, dense, fine to coarse grained sand.

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FIGURE
A1-33 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW055**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/25/2012	9/25/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	16.3	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-11	10 16 16	32									
	-35													
55														
			R-12	20 19 22	41	14	115							-Medium dense, few fine gravel, decrease in fines.
	-40													
														Sandy Silt (ML), gray, wet, soft, fine grained sand, trace medium grained sand, low plasticity.
60														
			S-13	0 1 1	2					0.5				
	-45													
														Fat Clay (CH), gray, moist, stiff, high plasticity, micaceous, trace calcite.
65														
			R-14	4 8 7	15	38	85			1.0				
	-50													
														Silty Sand (SM), gray, wet, loose, fine to medium grained sand, few organics (roots).
70														
			S-15	1 3 4	7									
	-55													
														Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

GDC_LOG_BORING_2011 L-962_PART 1.GPJ GDCLOG.GDT 1/24/13

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FIGURE
A1-33 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW058**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/25/2012	9/25/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	15	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														Artificial Fill (af)
														Silty Sand with Gravels (SM), brown, dry, fine to coarse grained sand, fine to coarse gravel.
5	10		R-1	5 5 7	12	18	96	55			PA			**Silt (ML)**, olive brown, moist, medium stiff, laminations of oxidation, highly micaceous.
														Fat Clay (CH), gray, moist, soft, high plasticity.
10	5		S-2	1 1 1	2				58:30	2.25				**Alluvium (Qa)**
														Sandy Clay (CL), orangish brown, moist, soft, fine grained sand, medium plasticity, mostly oxidized.
														Fat Clay (CH), gray, moist, medium stiff, high plasticity, H2S odor, interbedded layers of peat and silt.
15	0		SH-3			74	58		75:42	1.5				Vane Shear = 0.65 ksf
20	-5		R-4	2 1 2	3	66	61							- Soft, few oxidation, micaceous, no H2S odor.

GDC_LOG_BORING_2011 L-962_PART 1.GPJ GDCLOG.GDT 1/31/13

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Torrance, CA 90501

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FIGURE
A1-34 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW058**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/25/2012	9/25/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	15	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			SH-5			85	51		71:38					- Trace shell fragments, micaceous, H2S odor.
														Lean Clay (CL), gray, wet, medium stiff, low to medium plasticity, trace shell fragments.
30	-15		S-6	1 1 2	3									Vane Shear = 0.85 ksf
														Fat Clay (CH), gray, wet, high plasticity, micaceous.
35	-20		SH-7			44	74							
														Lean Clay (CL), gray, wet, soft, few fine grained sand, medium plasticity, trace shell fragments.
40	-25		R-8	4 2 4	6	25	98							
														Clayey Sand (SC), gray, wet, medium dense, fine grained sand.
45	-30		S-9	2 6 8	14									**Silty Sand with Gravel (SP)**, gray, wet, medium dense, fine to coarse grained sand, fine to coarse gravel, angular gravels.

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FIGURE
A1-34 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW058**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/25/2012	9/25/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	15	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4"), SHELBY (3")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			R-10	32 28 9	37	13	123							
55	-40		S-11	8 8 10	18									**Silty Sand (SM)**, gray, wet, medium dense, fine grained sand, trace coarse grained sand, trace organics.
														Lean Clay (CL), gray, moist, soft, trace fine grained sand, medium plasticity.
60	-45		S-12	1 1 1	2				48:28	0.5				
65	-50		R-13	9 21 26	47	28	96			>4.5				-Hard, no fine grained sand, decrease in moisture.
														Sand (SP), gray, wet, very dense, fine grained sand, trace coarse grained sand, trace fine gravel, few organics (wood fibers).
70	-55		S-14	17 24 29	53									Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

GDC_LOG_BORING_2011 L-962_PART 1.GPJ GDCLOG.GDT 1/31/13

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FIGURE
A1-34 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	C-HSA061

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/16/2012	10/16/2012	1 of 2

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85 All Terrain	Hollow Stem Auger	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		8	31.5	16	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	15													**Artificial Fill (af)**
			R-1	4 4 4	8	5	90	11			PA			**Silty Sand (SM)**, light brown, dry, fine grained sand, few medium grained sand, trace dry brush. -Grayish brown, loose, few olive brown clay seams, no dry brush.
5														
	10		S-2	1 2 3	5									
			R-3	1 0 1	1	7	88							-Very loose, increase in fines.
10														**Alluvium (Qa)**
	5		S-4	2 5 3	8	18				2.25				**Clay (CL)**, mottled gray and light gray, moist, very stiff, few fine to medium grained sand, medium plasticity, few oxidation, trace organics, trace pieces of shale.
			R-5			19	111			1.0				**Clay with Sand (CL)**, gray, moist, stiff, fine to medium grained sand, medium plasticity, few oxidation, trace pieces of shale.
15														**Sandy Silt (ML)**, mottled brown and gray, moist, medium stiff, fine grained sand, low plasticity, trace fine rootlets.
	0		S-6	1 1 7	8			67		0.5	PA			Note: Auto hammer broke. Switched to down hole hammer.
			R-7	1 7 16	23	17	111		24:4					-Wet, very stiff, some fine grained sand, low plasticity, increase in sand at bottom.
20														
	-5		S-8	1 2 4	6									-Brown, fine to medium grained sand.
			R-9	4 8 17	25	23	102	52			PA			-Mottled brown and gray, very stiff, fine grained sand, low plasticity.

GDC_LOG_BORING_2011 L-962_PART 1.GPJ GDCLOG.GDT 1/24/13

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FIGURE
A1-35 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**C-HSA061**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/16/2012	10/16/2012	2 of 2

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85 All Terrain	Hollow Stem Auger	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		8	31.5	16	▽ / *na* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")		▼ / *na* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-10		S-10	4 4 2	6	36								**Silty Clay (CL)**, mottled gray and brown, wet, medium stiff, trace fine grained sand, low to medium plasticity.
30	-15		R-11	2 7 4	11	38	83		55:27	0.5				**Fat Clay (CH)**, mottled gray and brown, wet, medium stiff, trace fine grained sand, high plasticity.
														Boring terminated 31.5 ft. Groundwater not encountered. Boring backfilled with tamped cuttings.
35	-20													
40	-25													
45	-30													

GDC_LOG_BORING_2011 L-962_PART 1.GPJ GDCLOG.GDT 1/24/13

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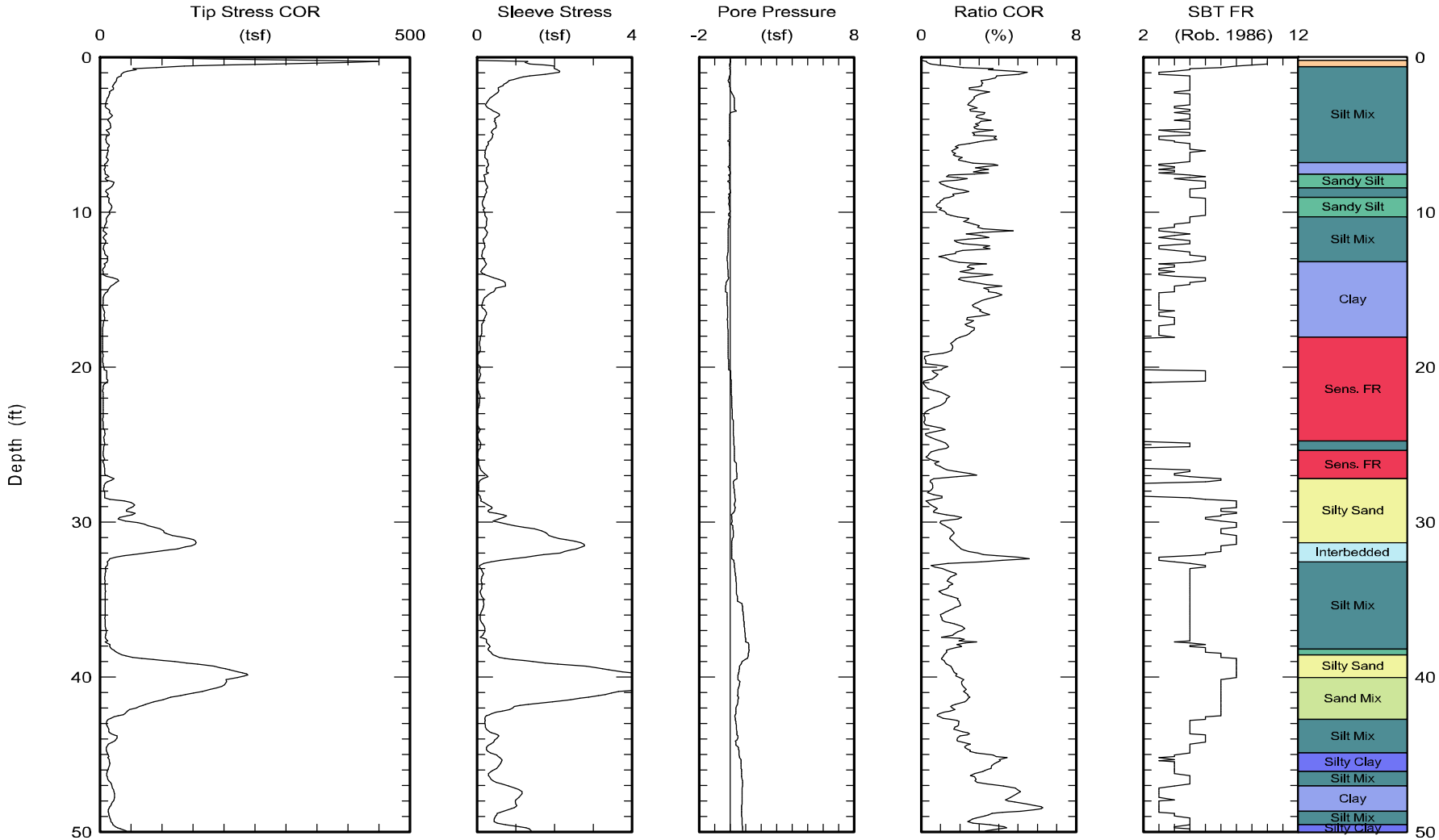
FIGURE
A1-35 b

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 15/Oct/2012 Test ID: CPT-001 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



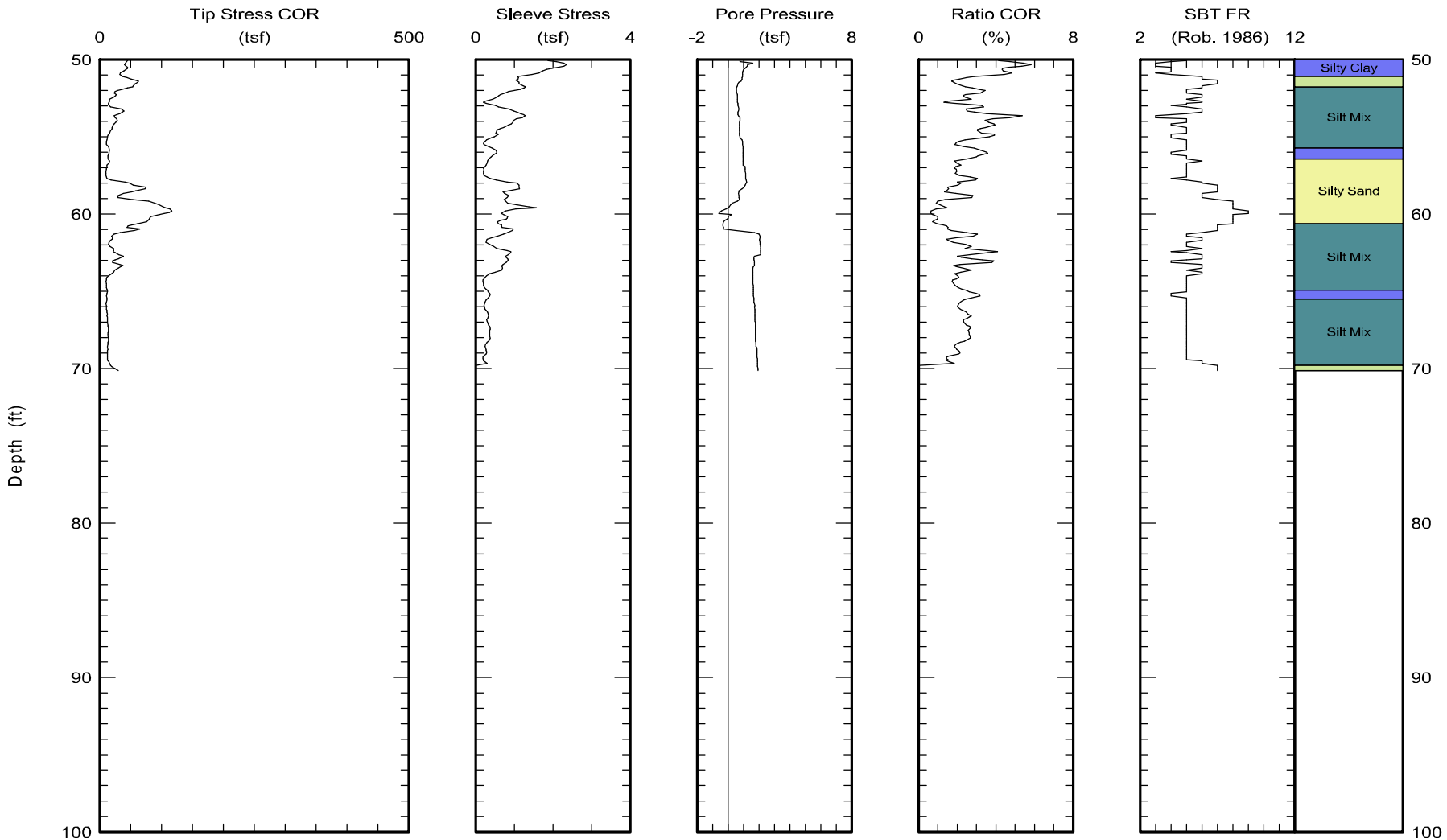
Maximum depth: 70.16 (ft)

FIGURE

A1-36 a

Test ID: CPT-001
File: Z15O1202C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 15/Oct/2012 Test ID: CPT-001 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



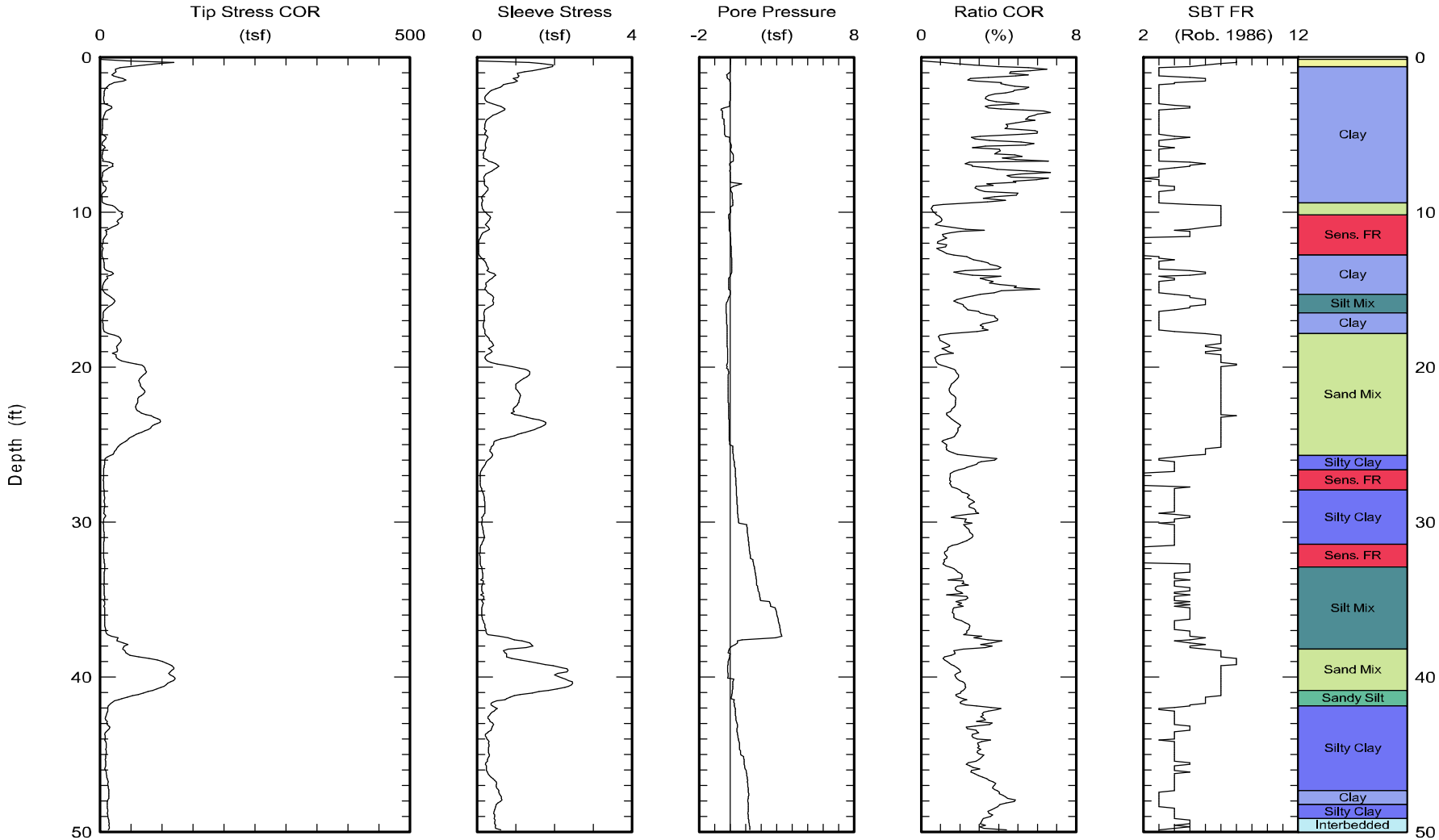
Maximum depth: 70.16 (ft)

FIGURE

A1-36 b

Test ID: CPT-001
File: Z15O1202C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 15/Oct/2012 Test ID: CPT-004 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



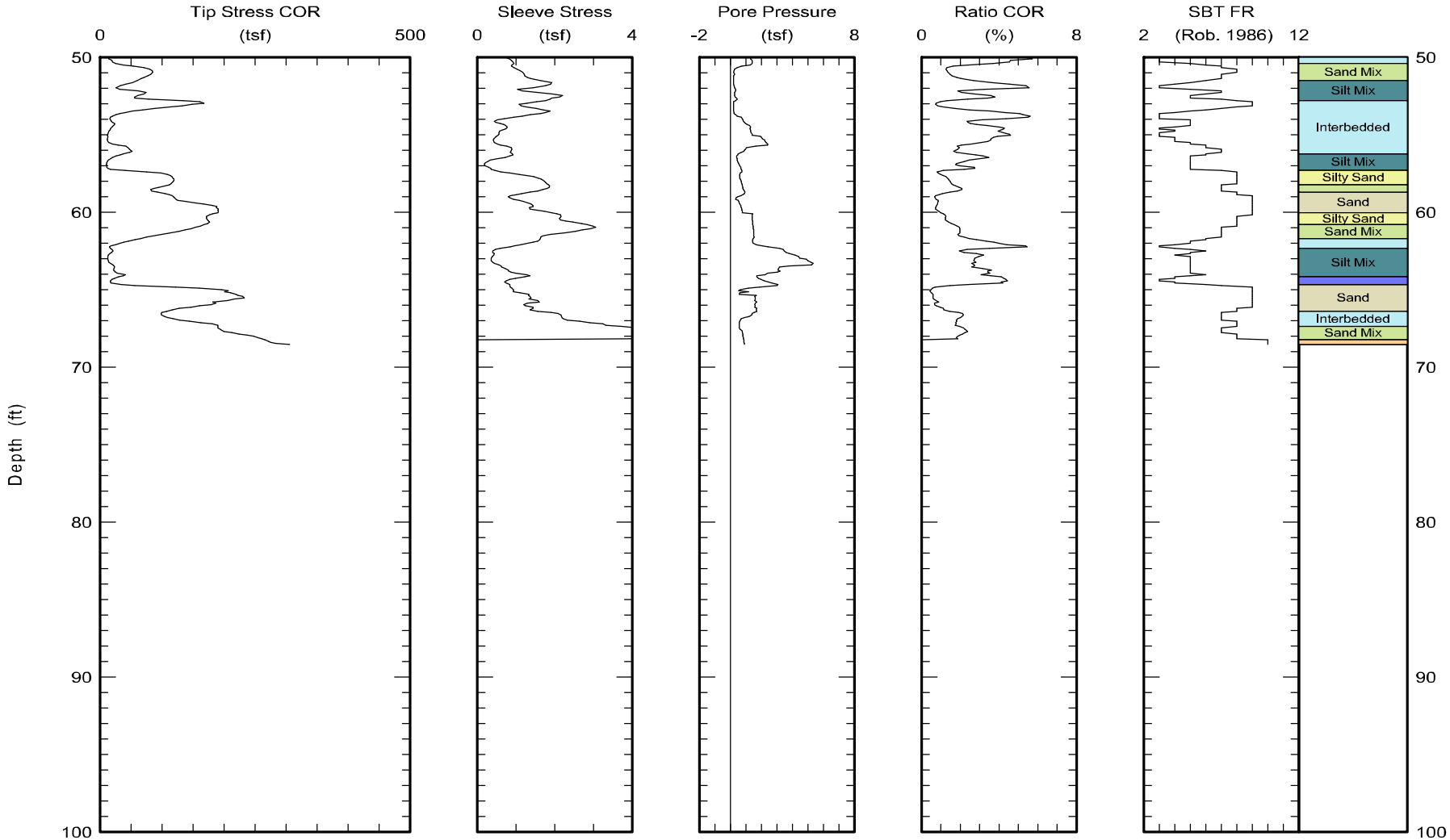
Maximum depth: 68.56 (ft)

FIGURE

A1-37 a

Test ID: CPT-004
File: Z15O1203C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 15/Oct/2012 Test ID: CPT-004 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



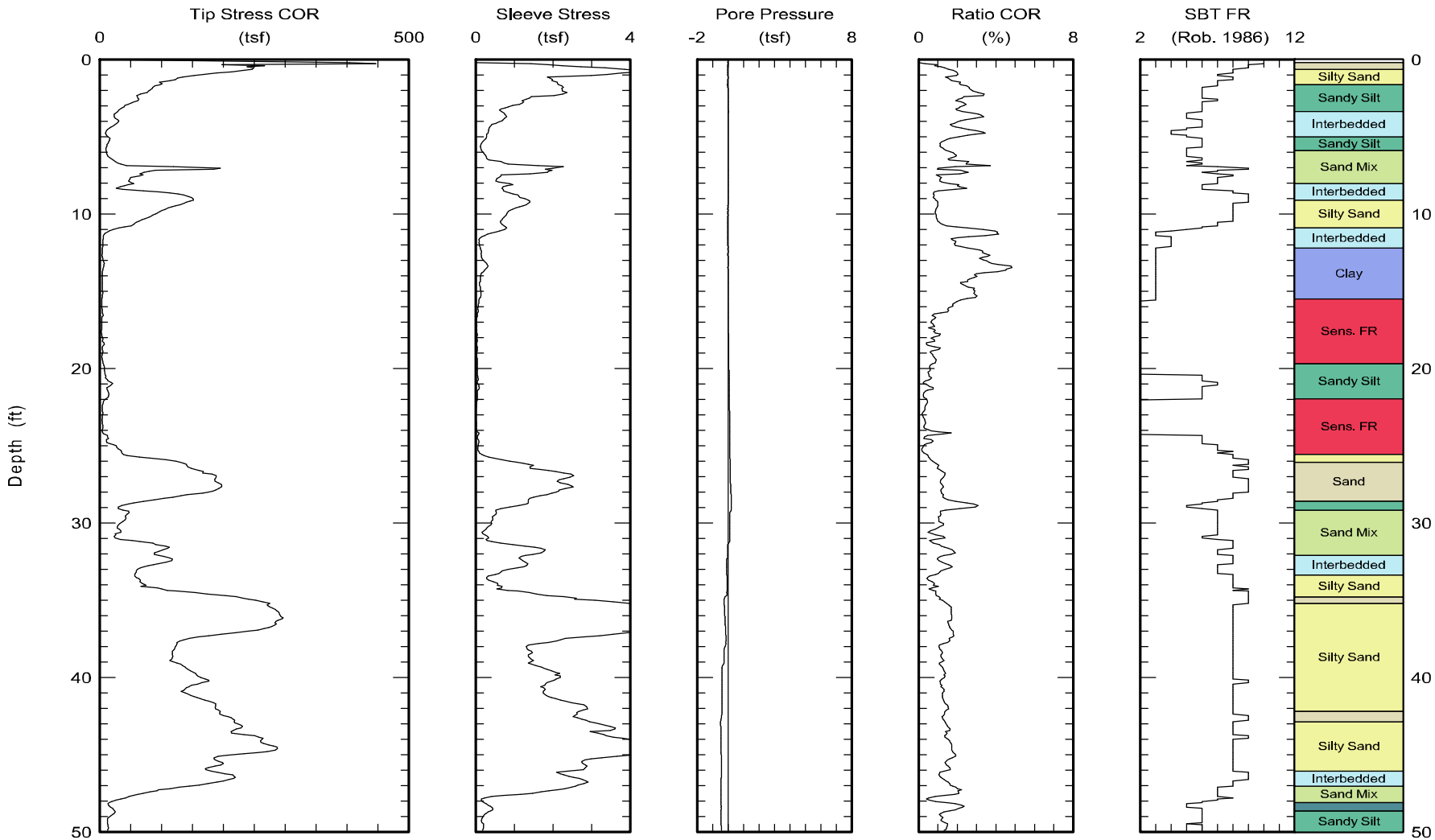
Maximum depth: 68.56 (ft)

FIGURE

A1-37 b

Test ID: CPT-004
File: Z15O1203C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 14/Sep/2012 Test ID: B-CPT-026B Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 52.39 (ft)

FIGURE

A1-38 a

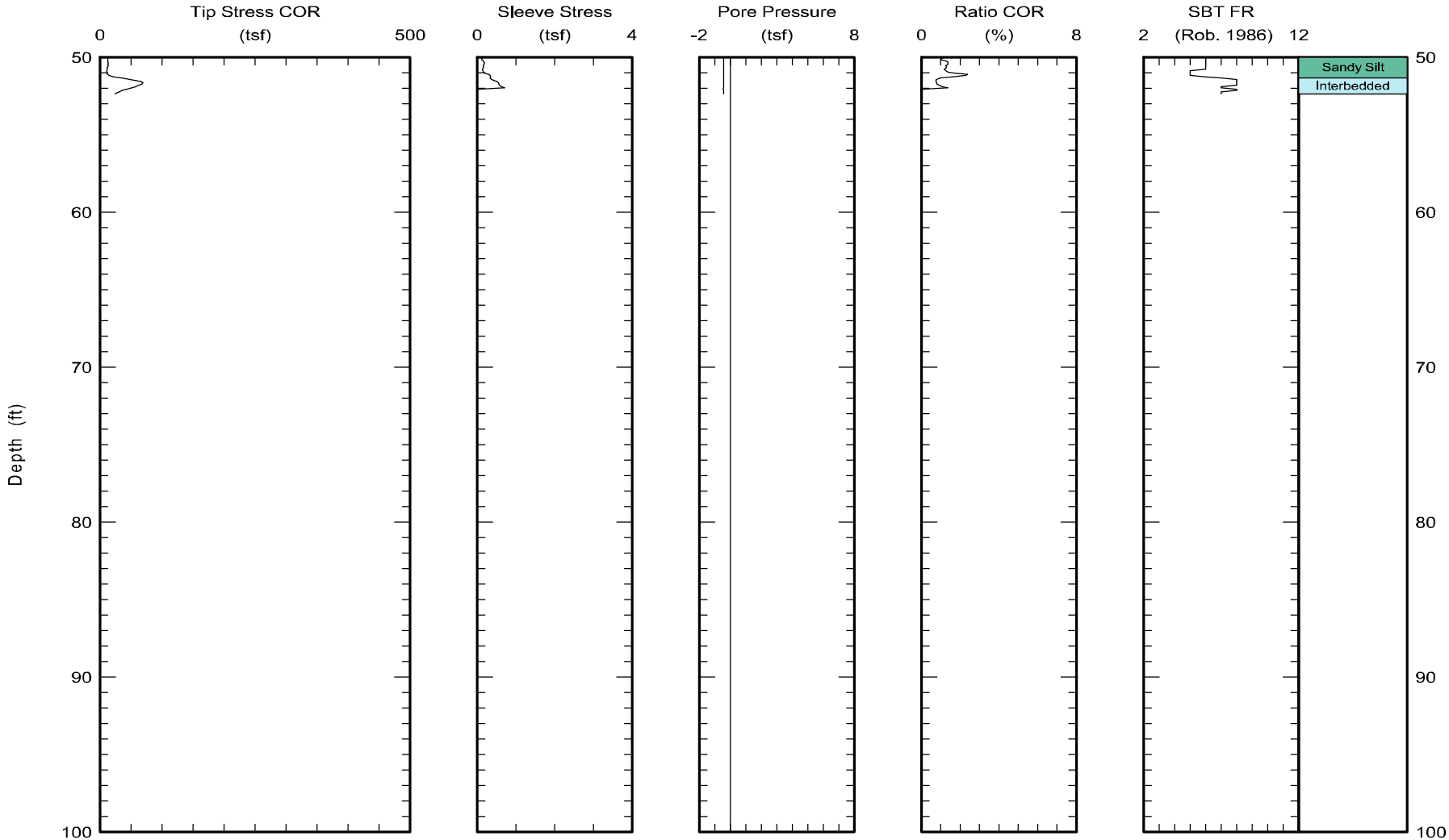
Test ID: B-CPT-026B
File: Z14S1212C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 14/Sep/2012
Test ID: B-CPT-026B
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 52.39 (ft)

FIGURE

A1-38 b

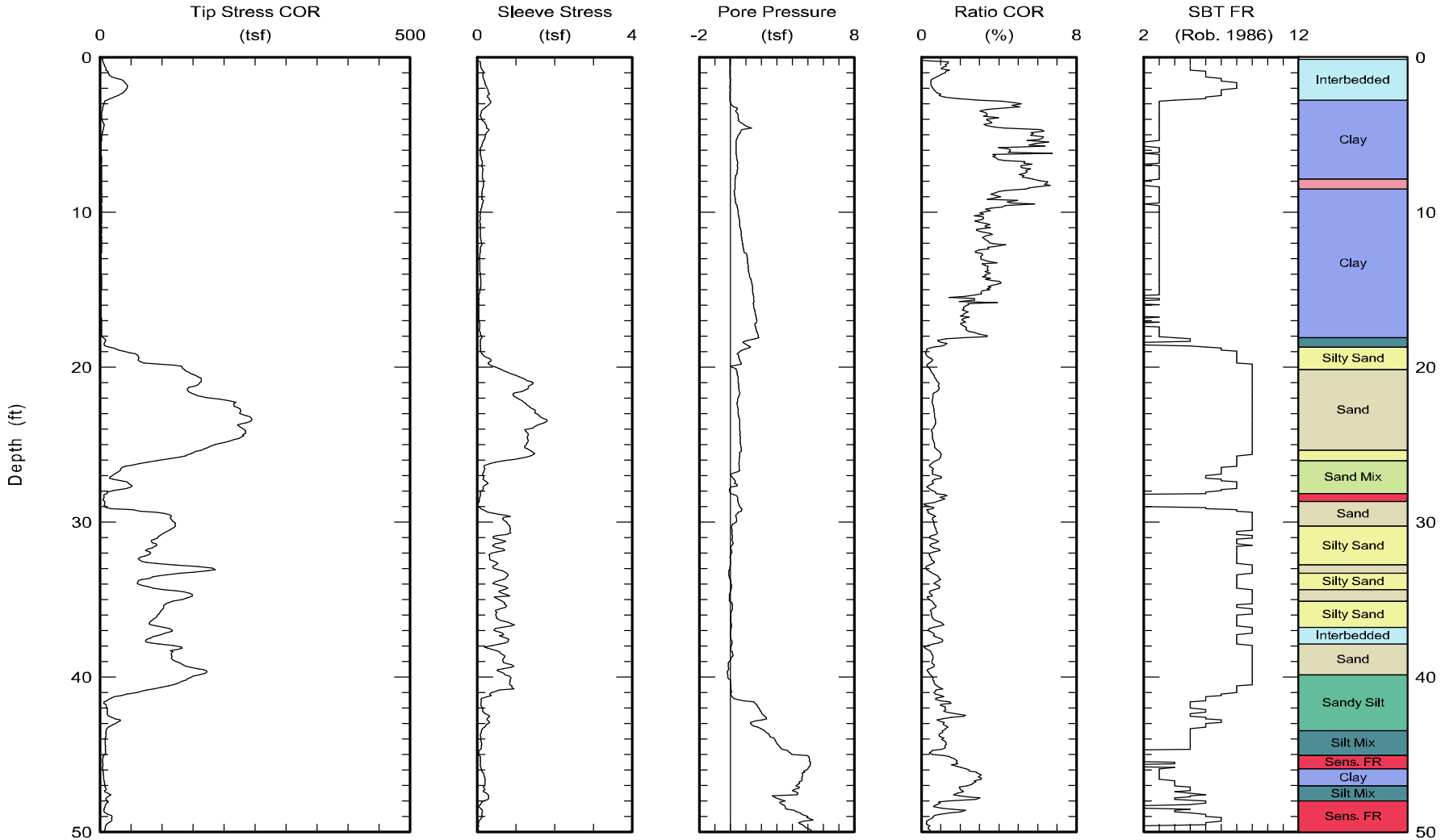
Test ID: B-CPT-026B
File: Z14S1212C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 10/Oct/2012
Test ID: CPT-031
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 69.62 (ft)

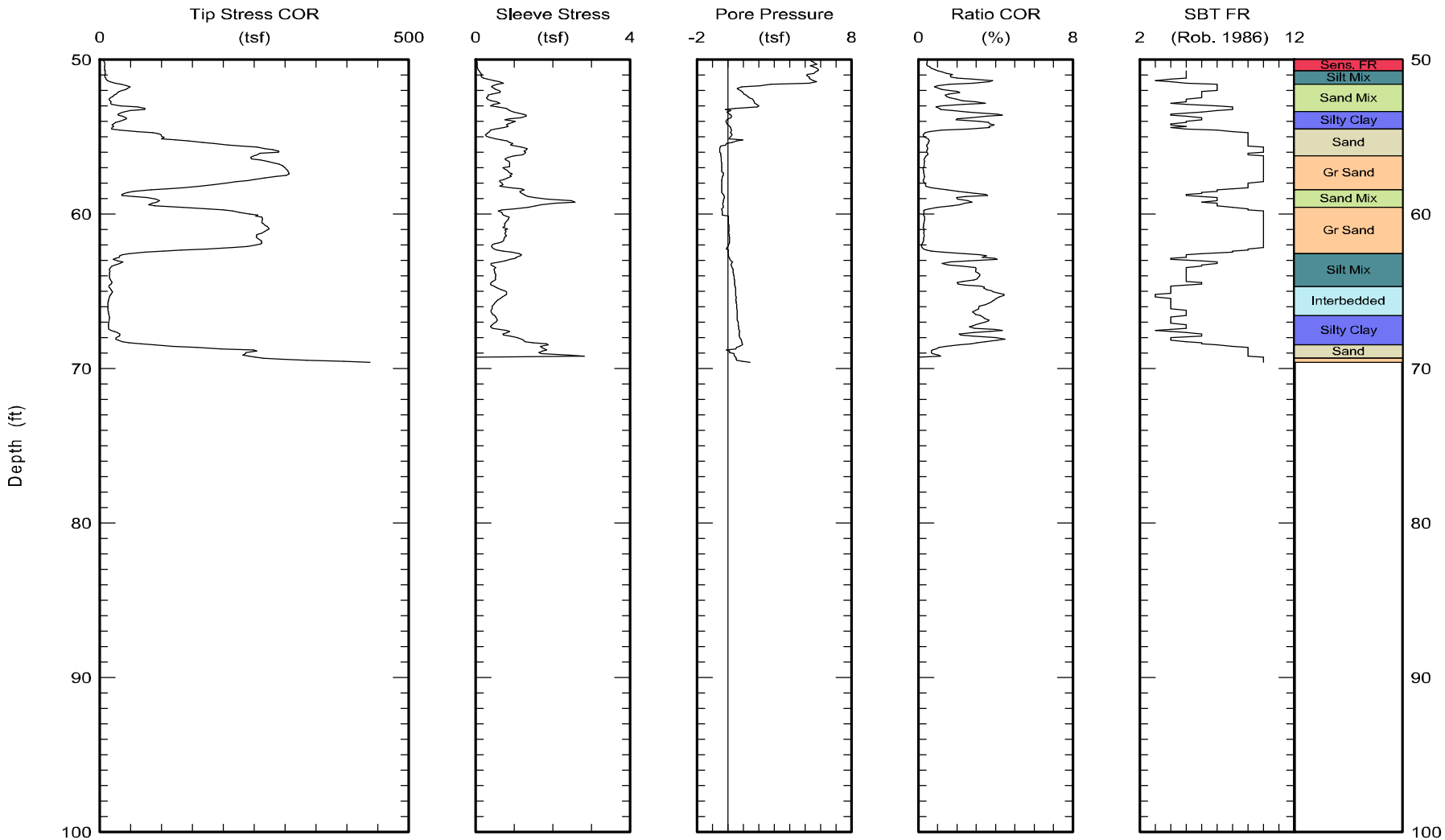
FIGURE

E-210

A1-39 a

Test ID: CPT-031
File: Z10O1201C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 10/Oct/2012 Test ID: CPT-031 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 69.62 (ft)

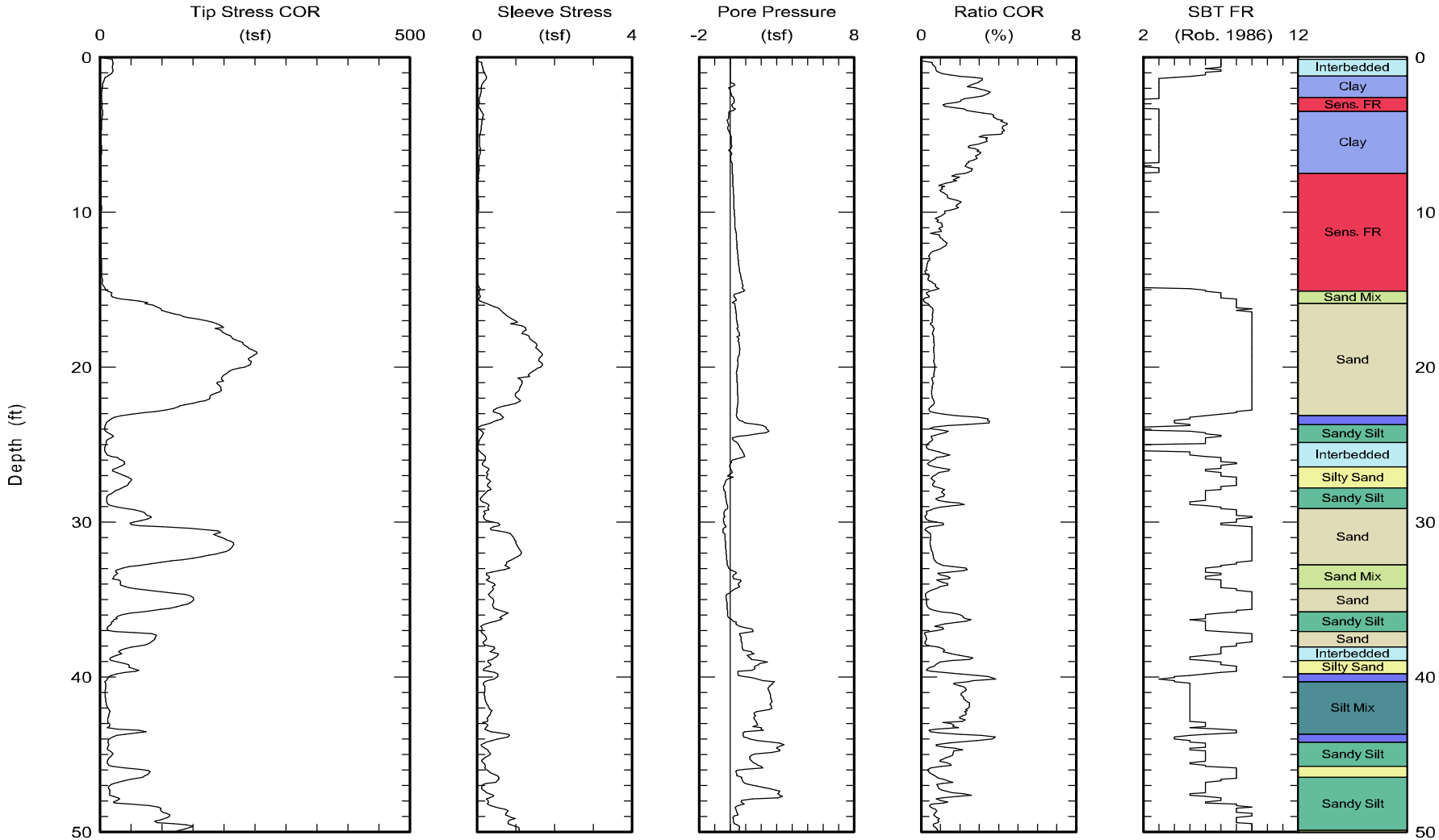
FIGURE

E-211

A1-39 b

Test ID: CPT-031
File: Z10O1201C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 13/Sep/2012 Test ID: B-CPT-034 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



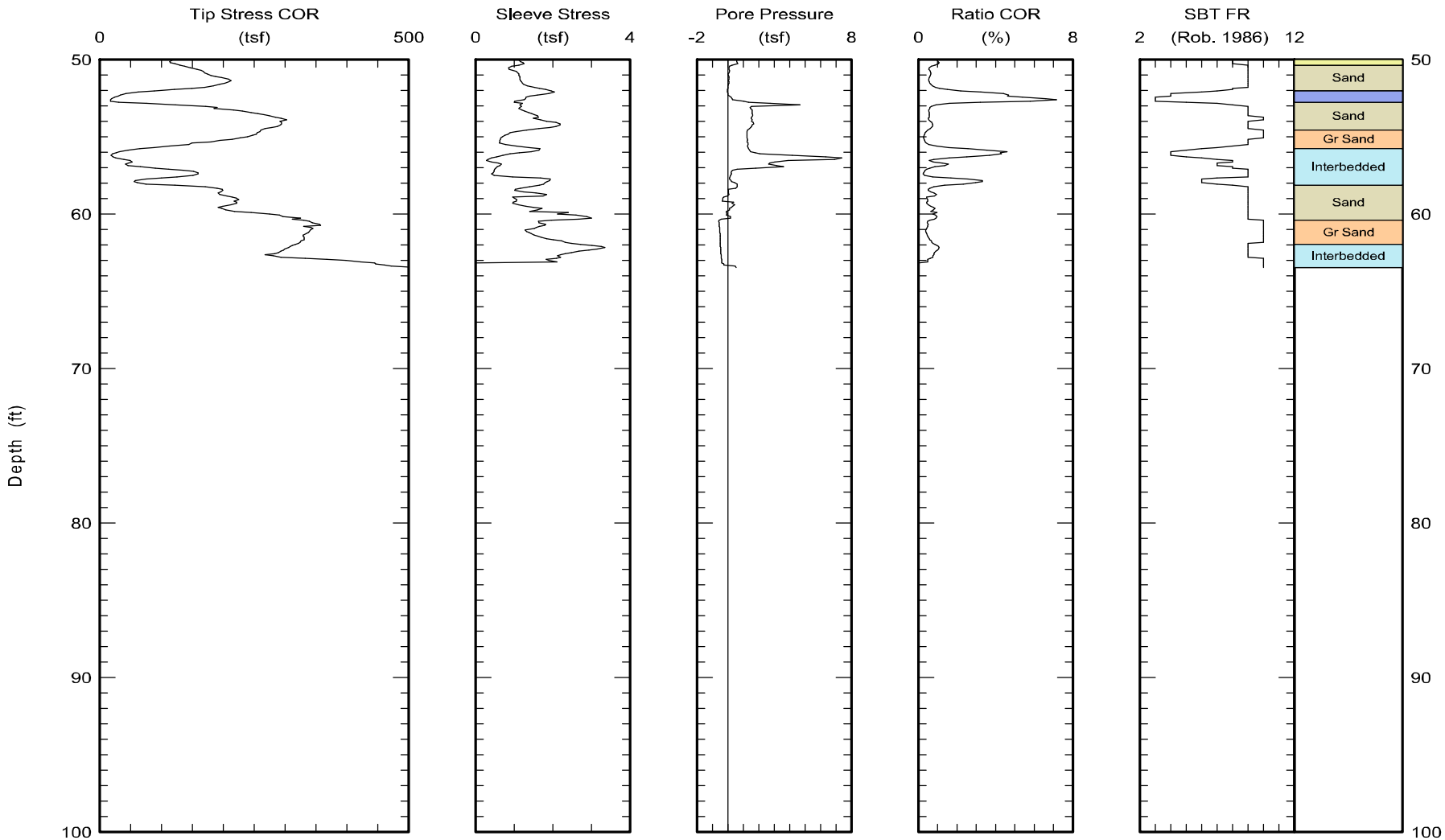
Maximum depth: 63.48 (ft)

FIGURE

A1-40 a

Test ID: B-CPT-034
File: Z13S1202C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 13/Sep/2012 Test ID: B-CPT-034 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



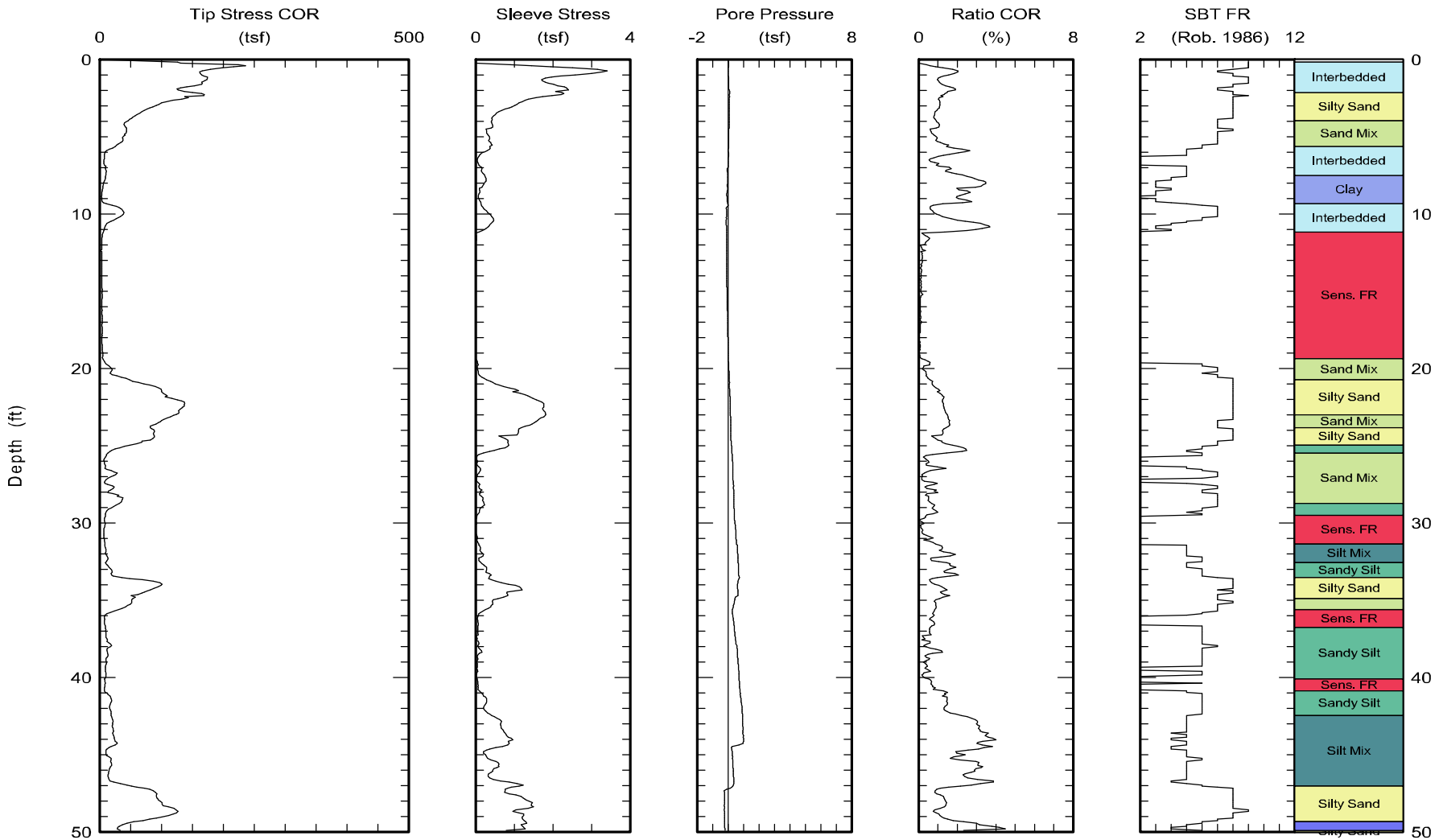
Maximum depth: 63.48 (ft)

FIGURE

A1-40 b

Test ID: B-CPT-034
File: Z13S1202C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 13/Sep/2012 Test ID: B-CPT-035 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



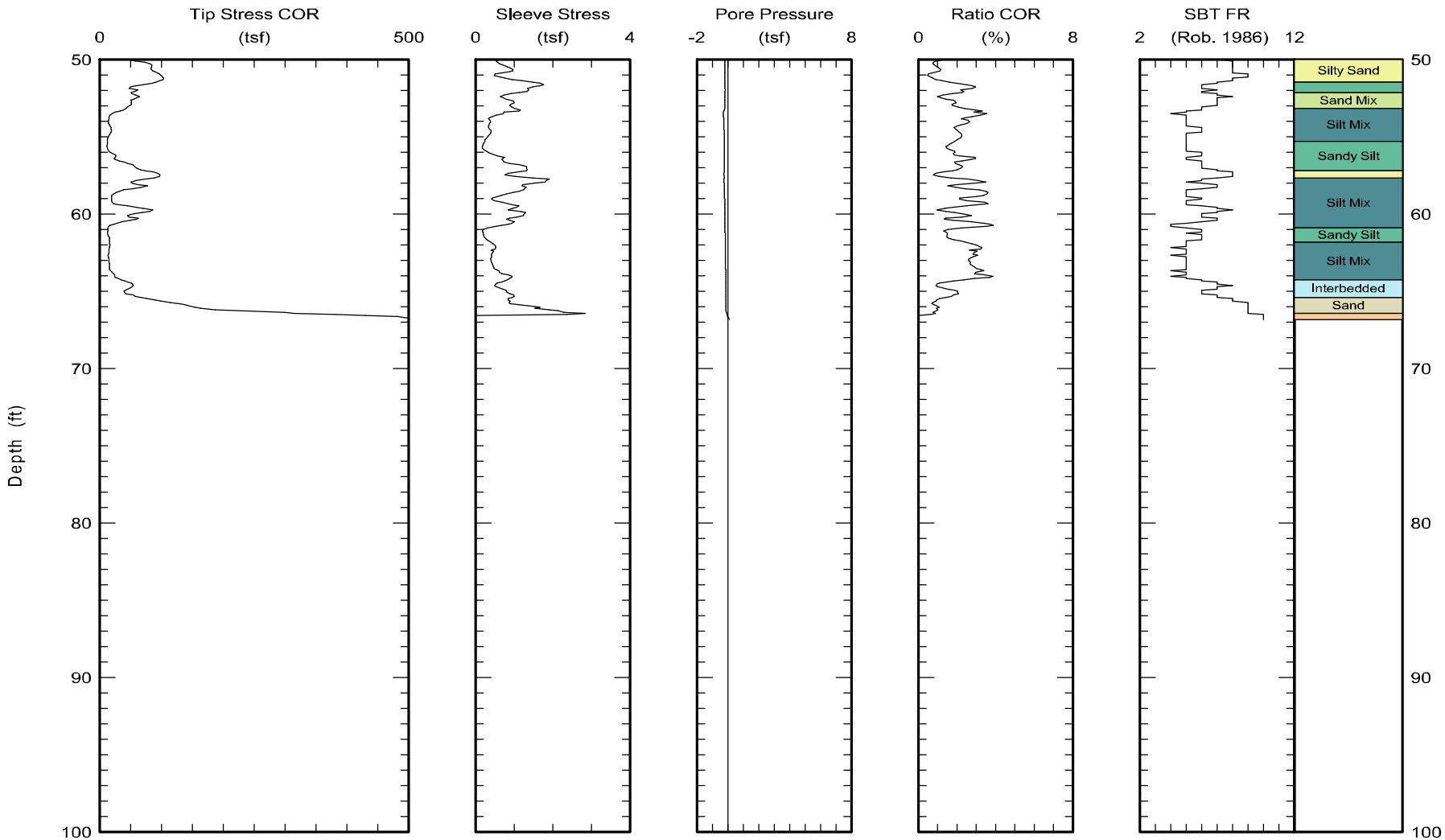
Maximum depth: 66.86 (ft)

FIGURE

A1-41 a

Test ID: B-CPT-035
File: Z13S1205C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 13/Sep/2012 Test ID: B-CPT-035 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



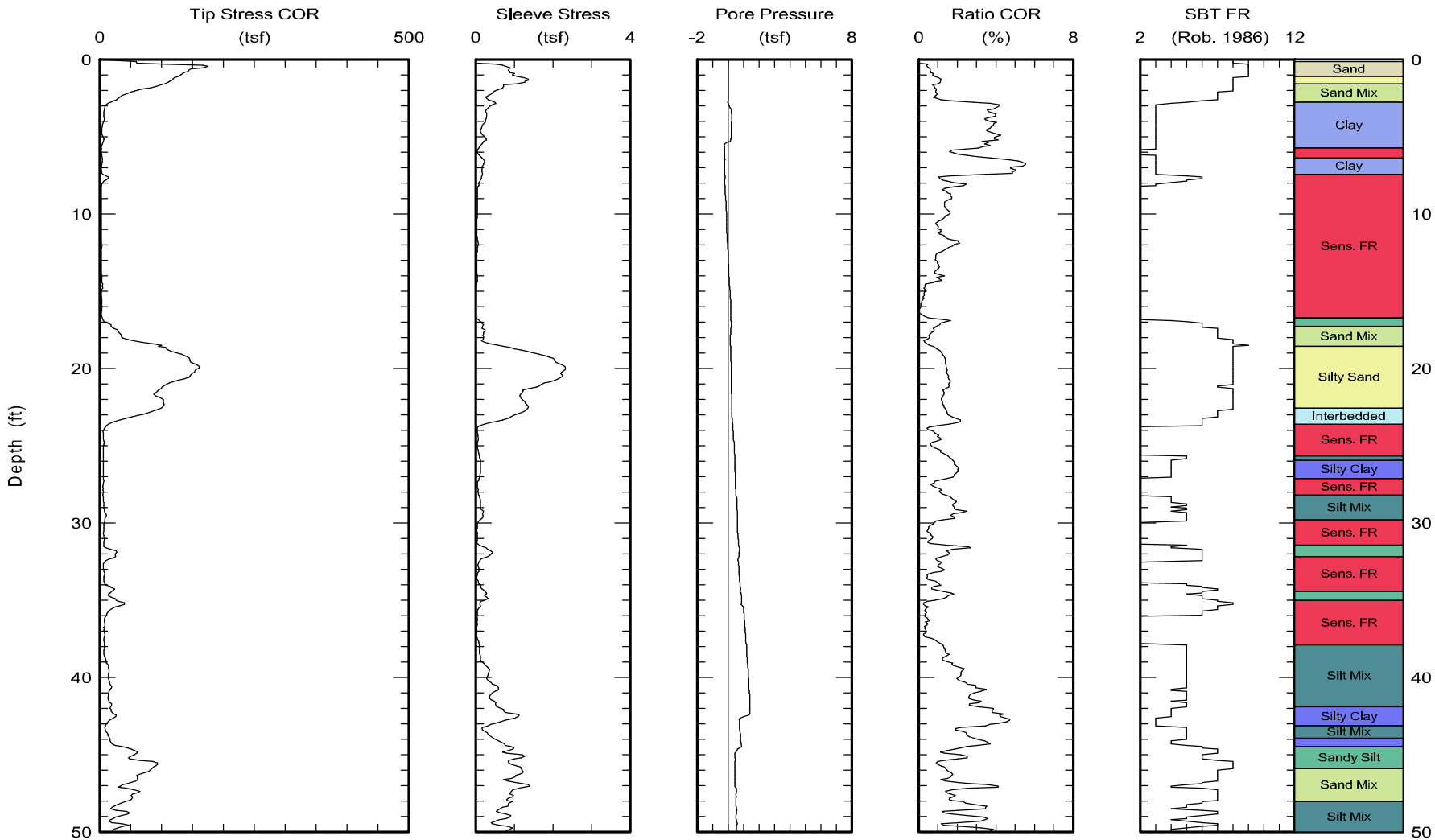
Maximum depth: 66.86 (ft)

FIGURE

A1-41 b

Test ID: B-CPT-035
File: Z13S1205C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 13/Sep/2012 Test ID: B-CPT-037 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



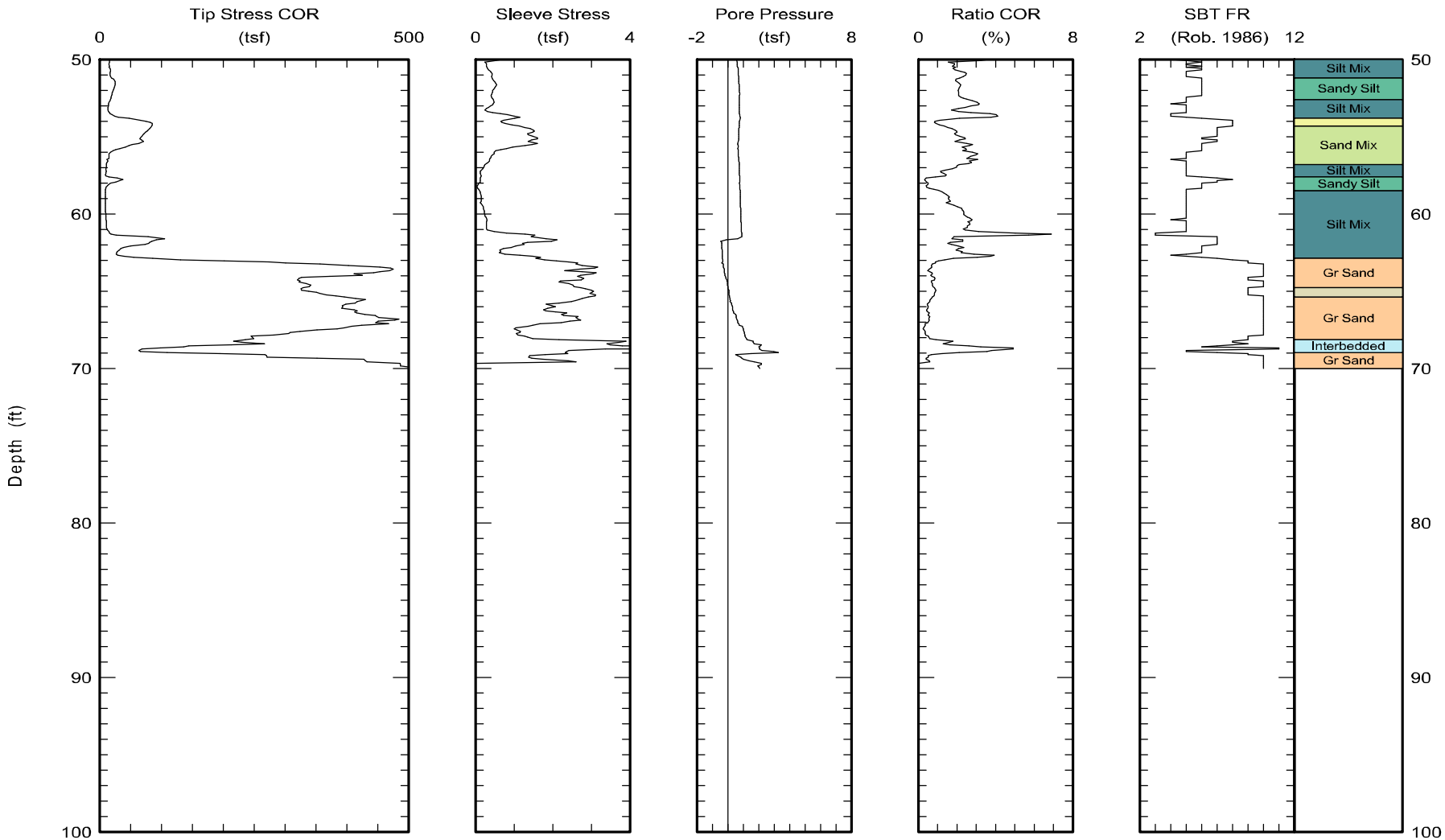
Maximum depth: 70.01 (ft)

FIGURE

A1-42 a

Test ID: B-CPT-037
File: Z13S1203C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 13/Sep/2012 Test ID: B-CPT-037 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



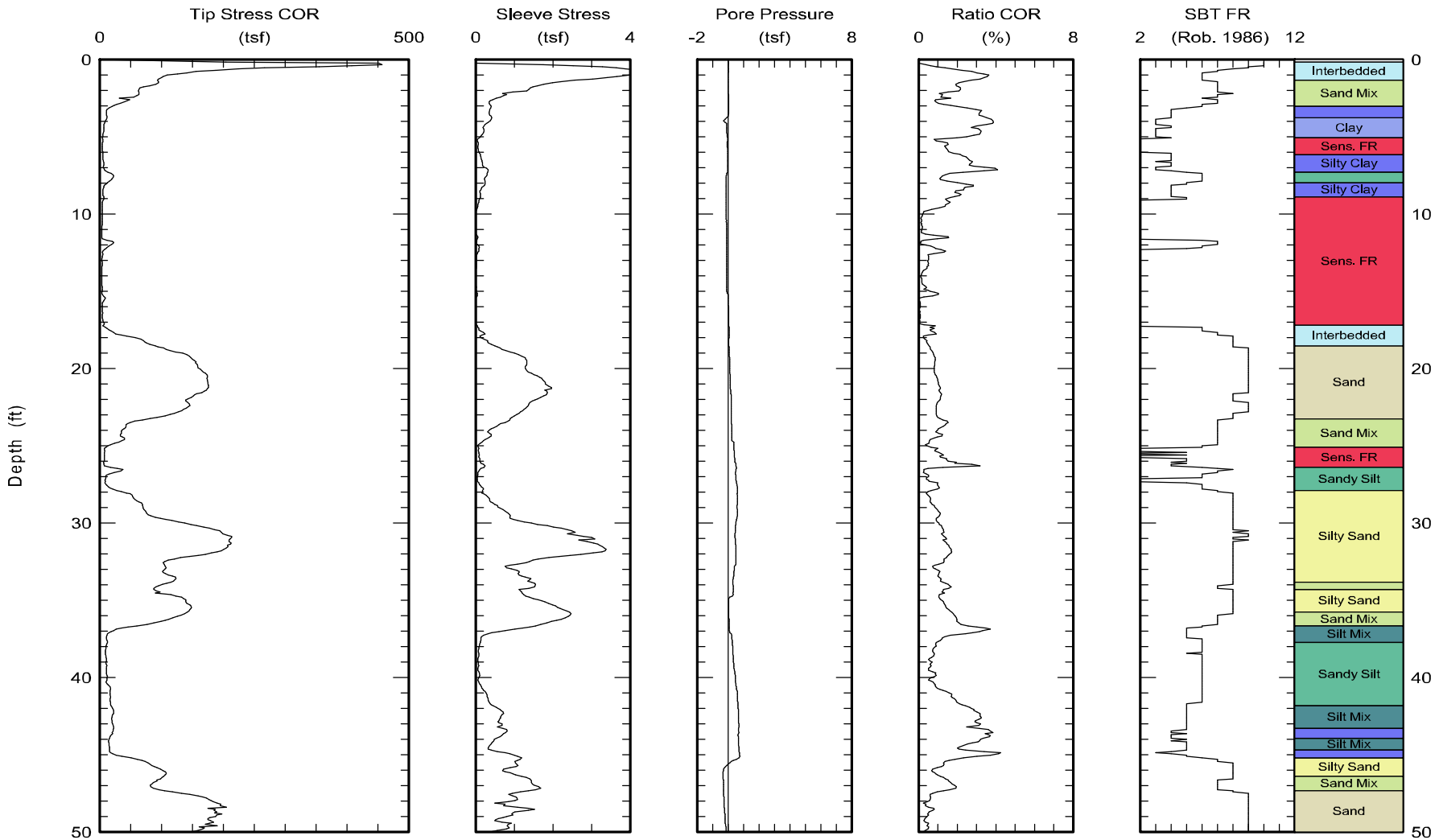
Maximum depth: 70.01 (ft)

FIGURE

A1-42 b

Test ID: B-CPT-037
File: Z13S1203C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 13/Sep/2012 Test ID: B-CPT-038 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



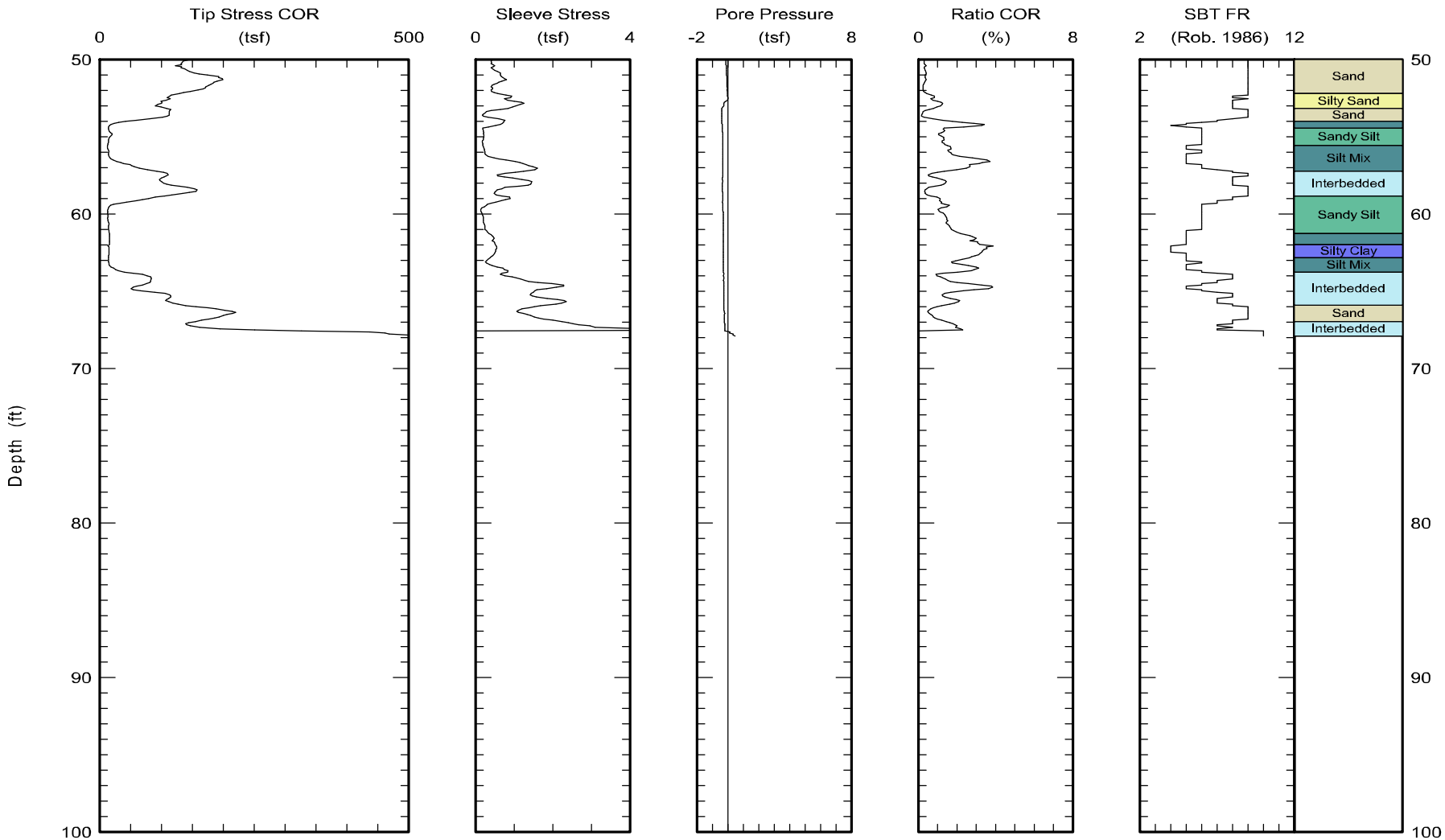
Maximum depth: 67.93 (ft)

FIGURE

A1-43 a

Test ID: B-CPT-038
File: Z13S1204C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 13/Sep/2012 Test ID: B-CPT-038 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



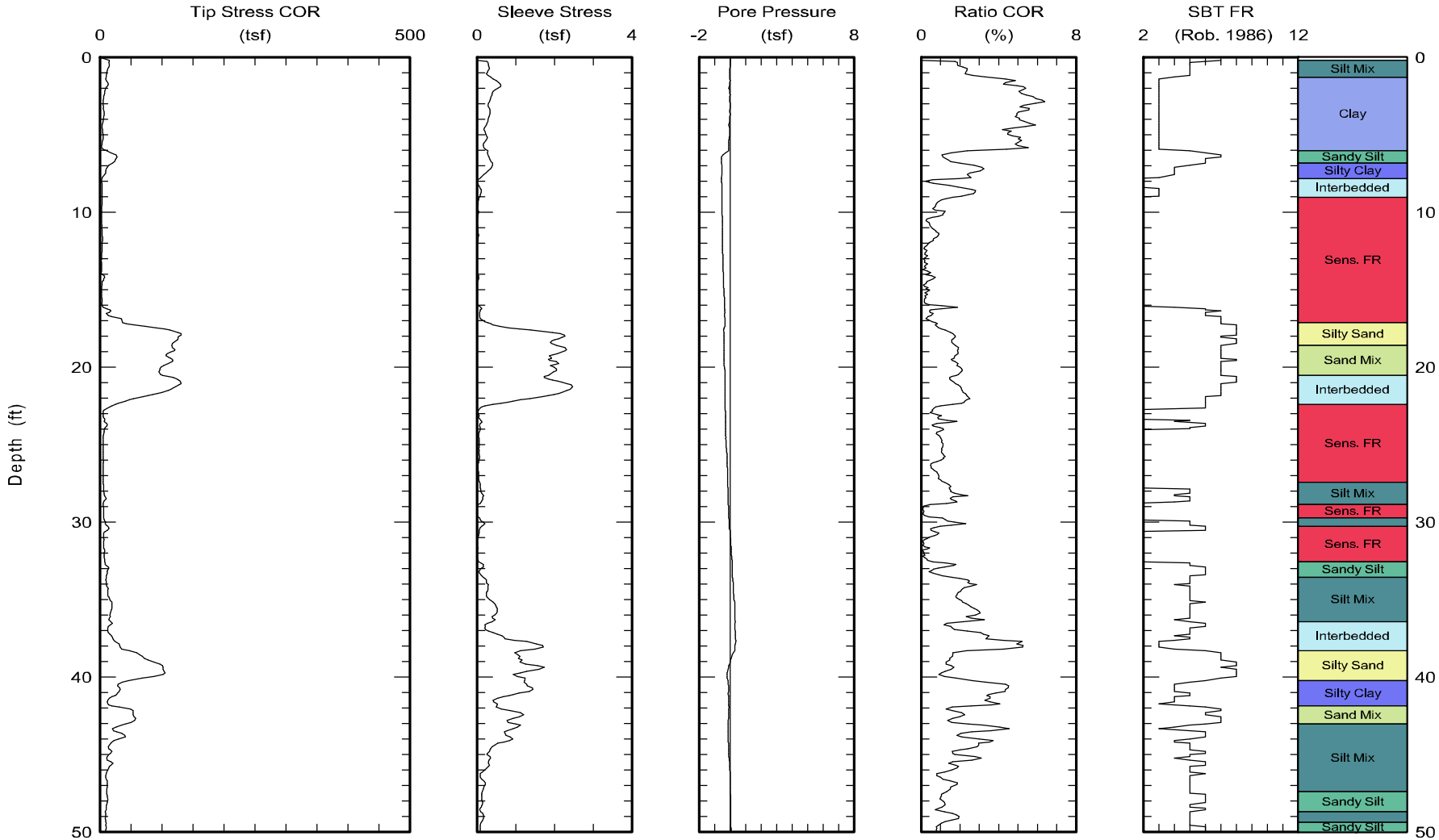
Maximum depth: 67.93 (ft)

FIGURE

A1-43 b

Test ID: B-CPT-038
File: Z13S1204C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 15/Oct/2012 Test ID: CPT-040 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 59.88 (ft)

FIGURE

A1-44 a

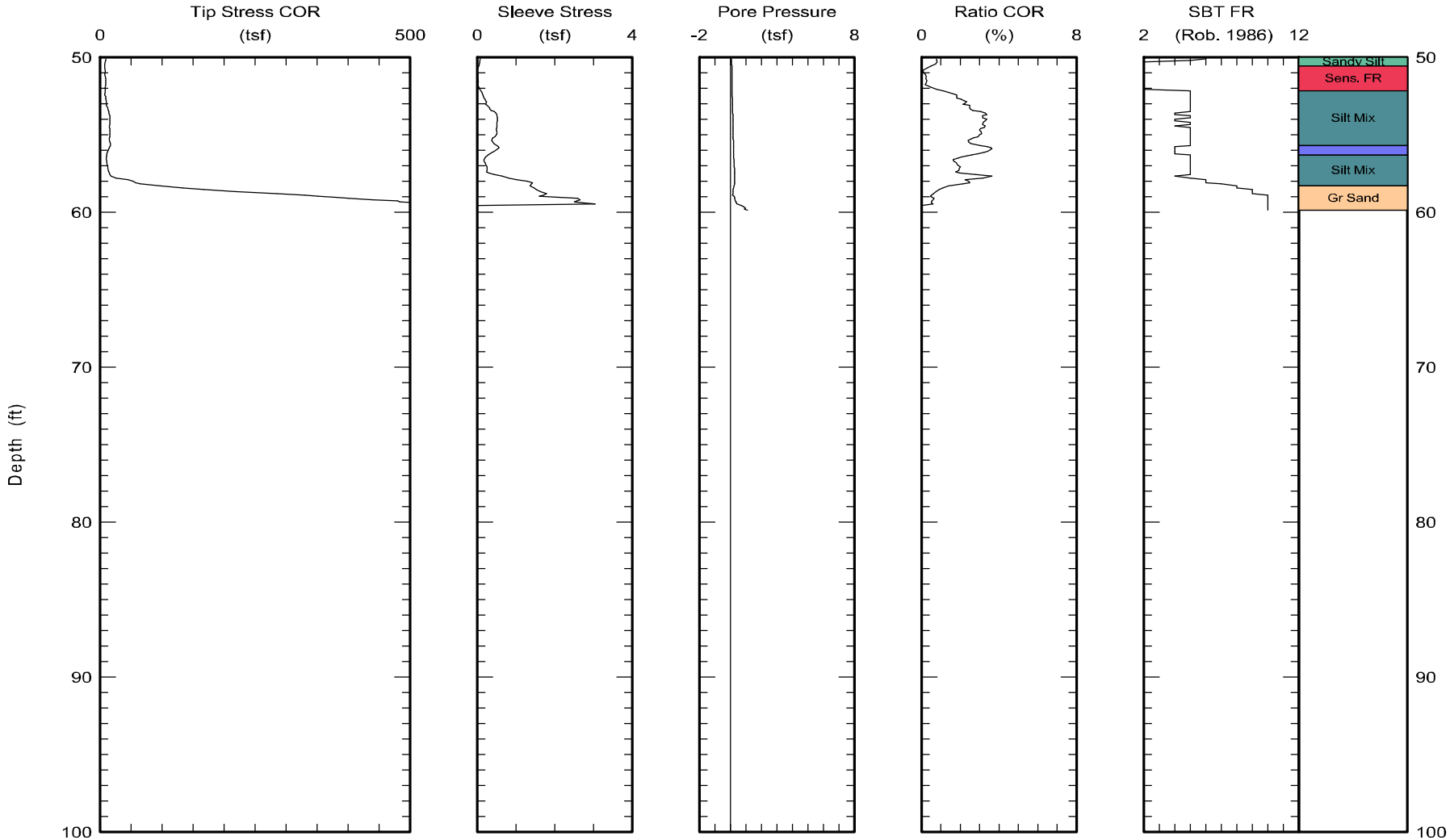
Test ID: CPT-041
File: Z15O1209C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 15/Oct/2012
Test ID: CPT-040
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



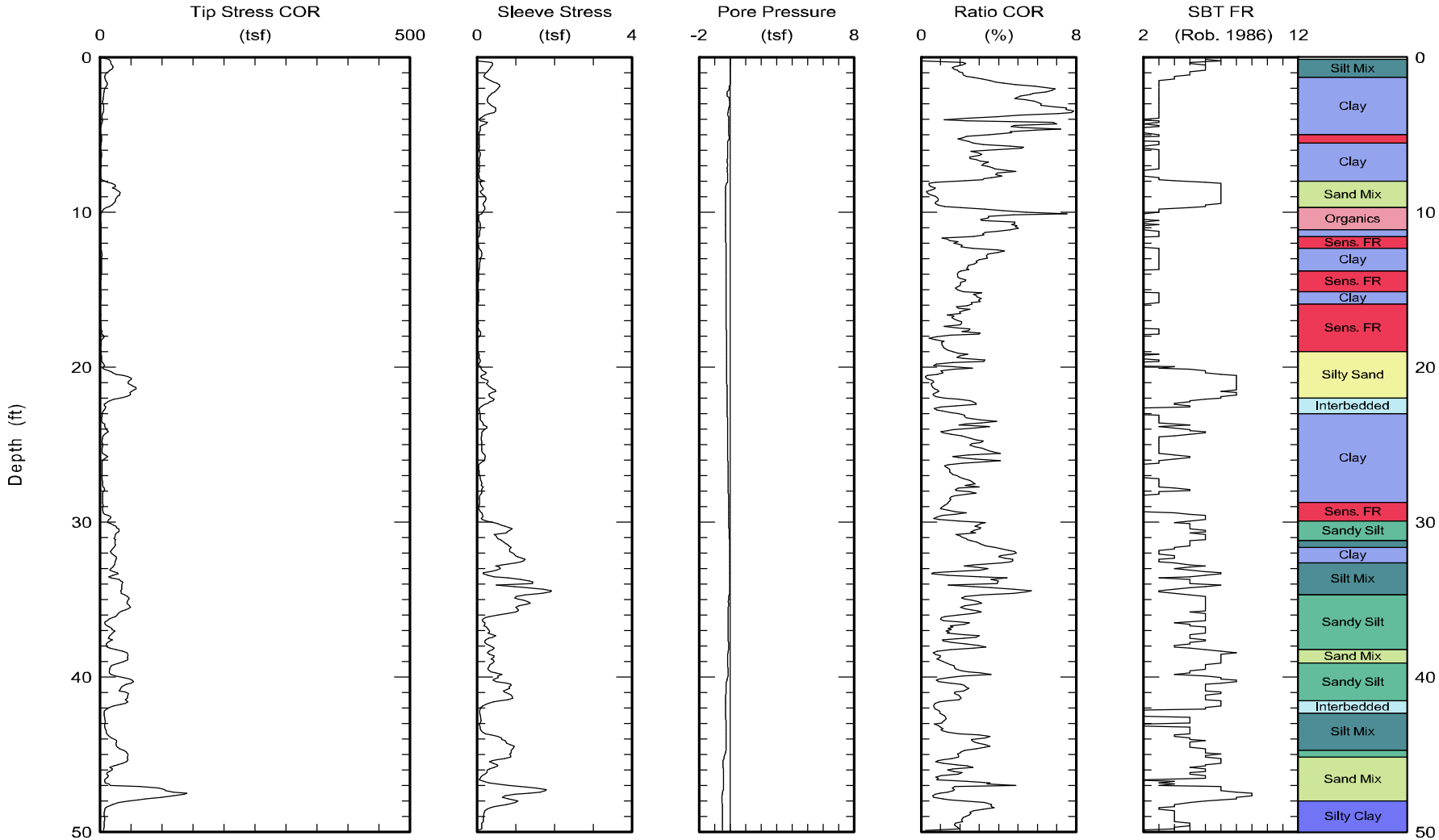
Maximum depth: 59.88 (ft)

FIGURE

A1-44 b

Test ID: CPT-041
File: Z15O1209C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 13/Sep/2012 Test ID: B-CPT-045 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



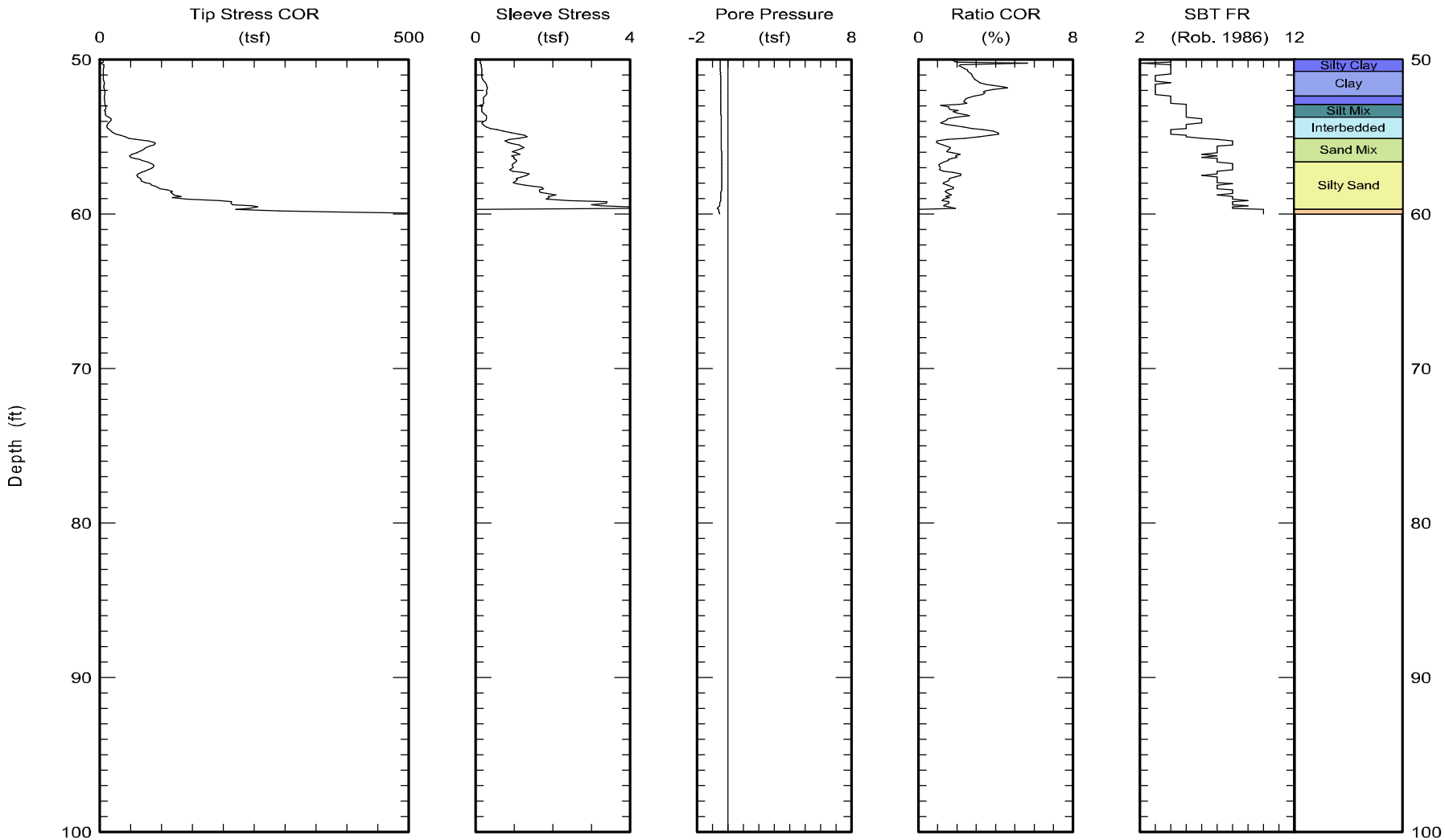
Maximum depth: 60.03 (ft)

FIGURE

A1-45 a

Test ID: B-CPT-045
File: Z13S1207C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 13/Sep/2012 Test ID: B-CPT-045 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



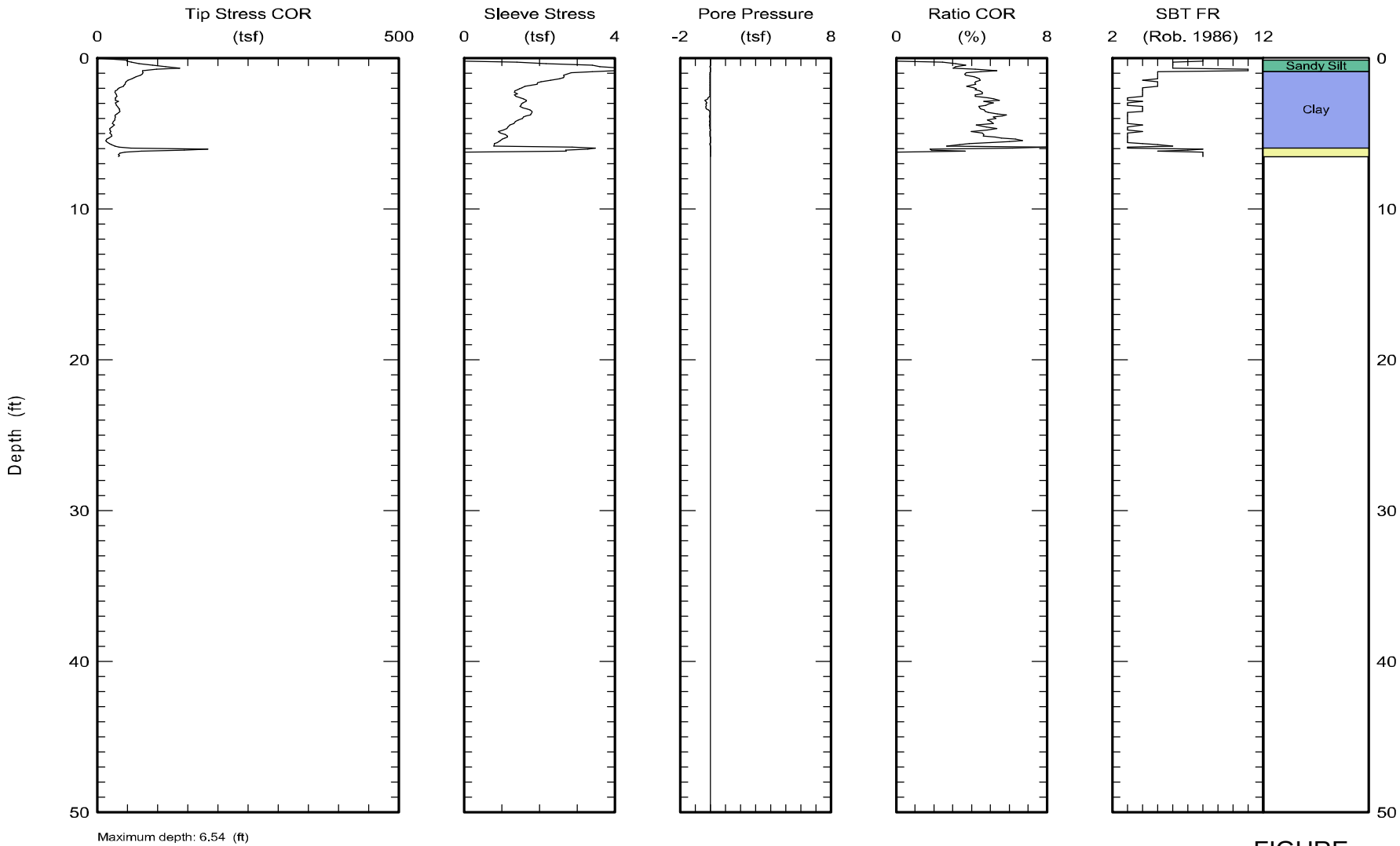
Maximum depth: 60.03 (ft)

FIGURE

A1-45 b

Test ID: B-CPT-045
File: Z13S1207C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 15/Oct/2012 Test ID: CPT-046C Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



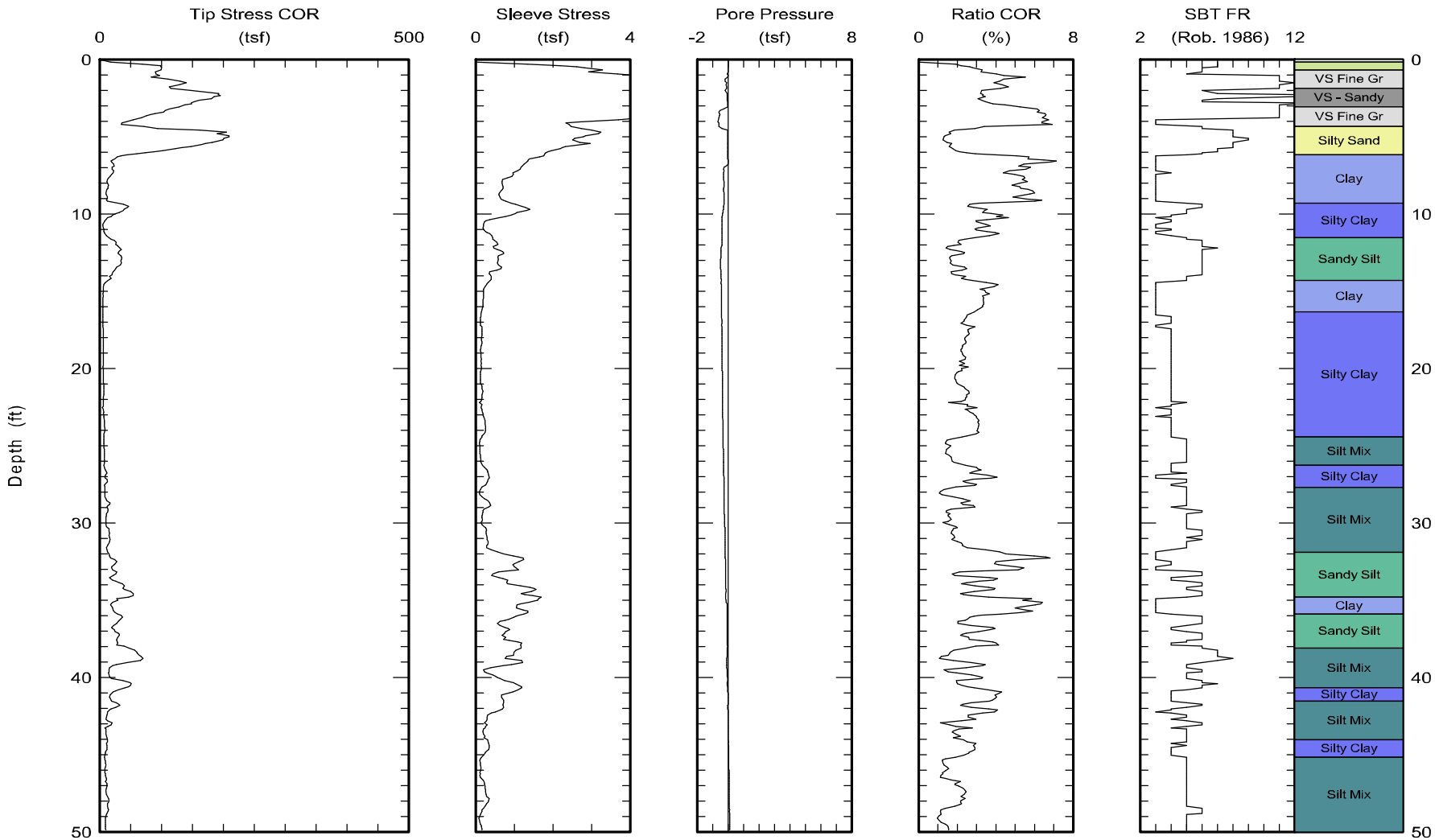
Maximum depth: 6.54 (ft)

FIGURE

A1-46

Test ID: CPT-046C
File: Z15O1208C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 15/Oct/2012 Test ID: CPT-048 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 62.85 (ft)

FIGURE

A1-47 a

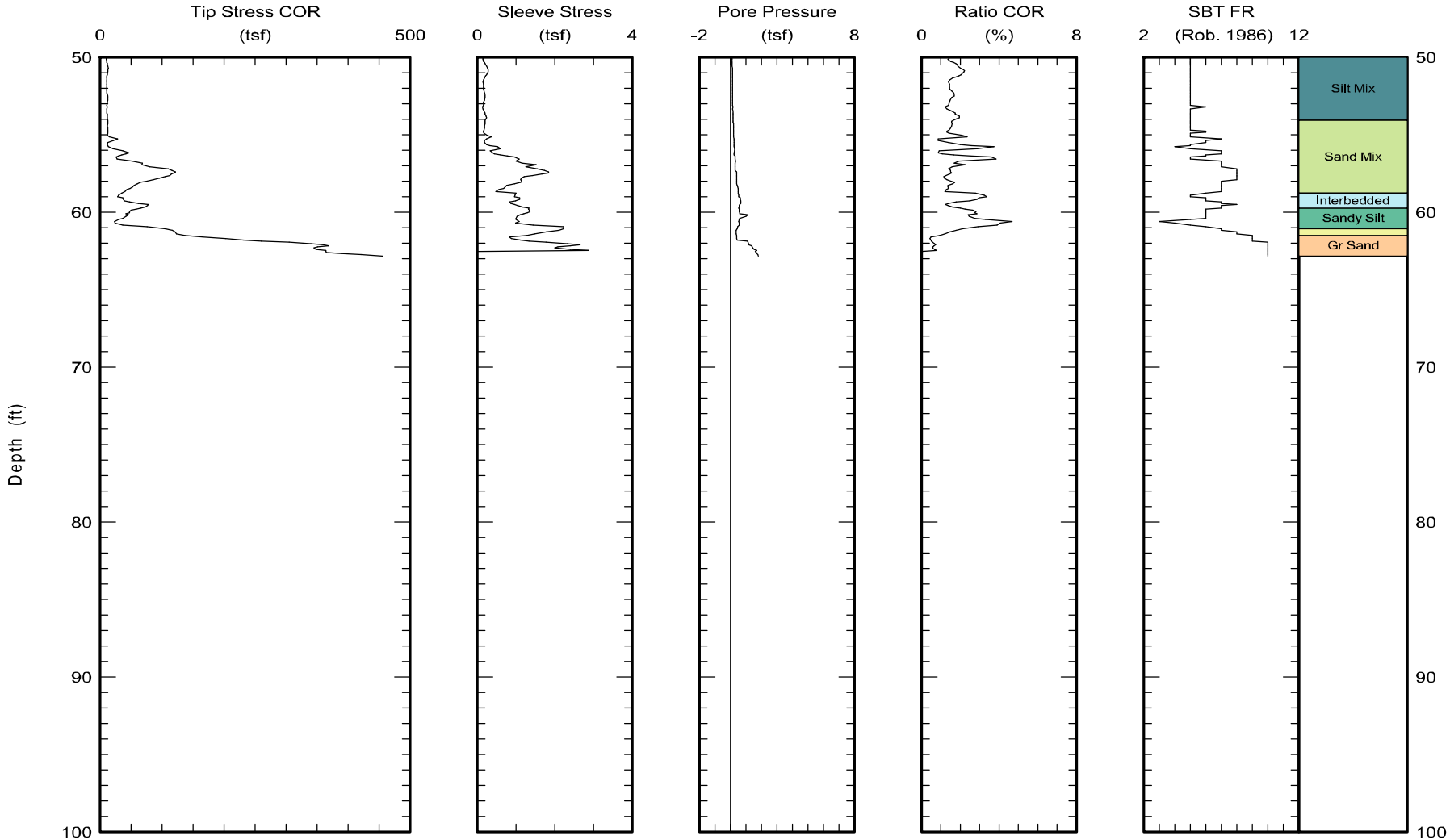
Test ID: CPT-048
File: Z15O1204C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 15/Oct/2012
Test ID: CPT-048
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



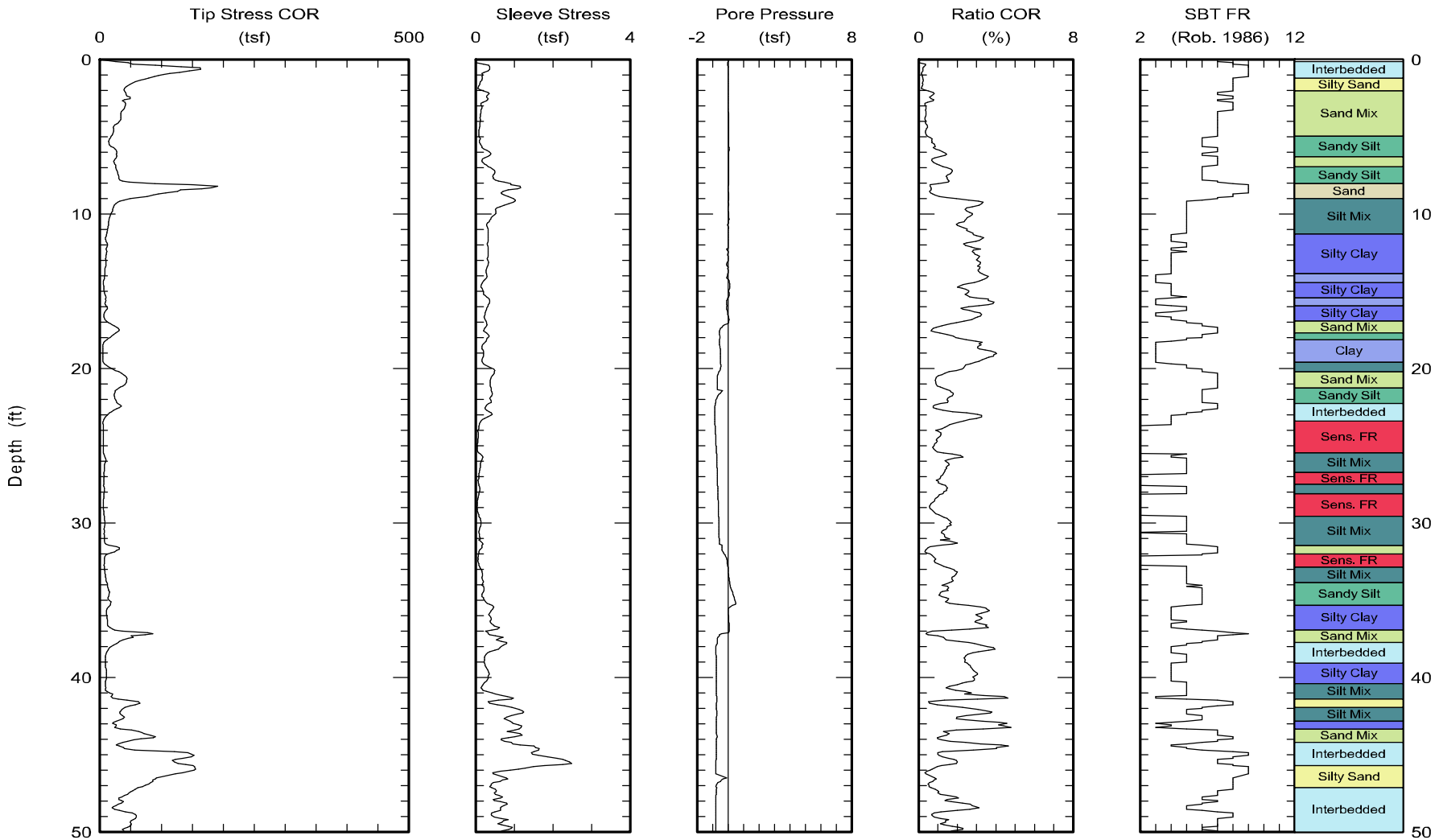
Maximum depth: 62.85 (ft)
Page 2 of 2

FIGURE

A1-47 b

Test ID: CPT-048
File: Z15O1204C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 14/Sep/2012 Test ID: B-CPT-050 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



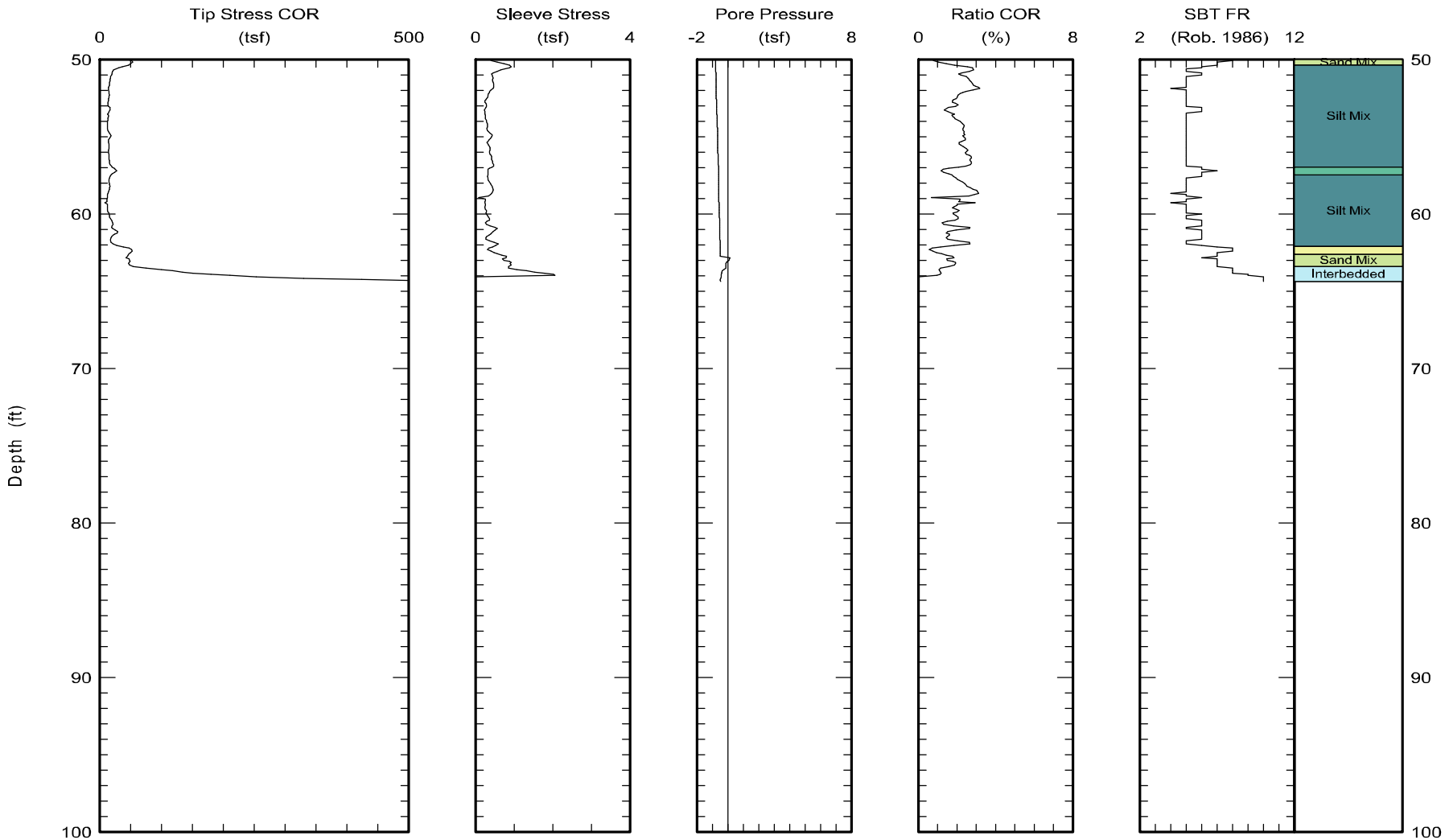
Maximum depth: 64.39 (ft)

FIGURE

A1-48 a

Test ID: B-CPT-050
File: Z14S1201C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 14/Sep/2012 Test ID: B-CPT-050 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



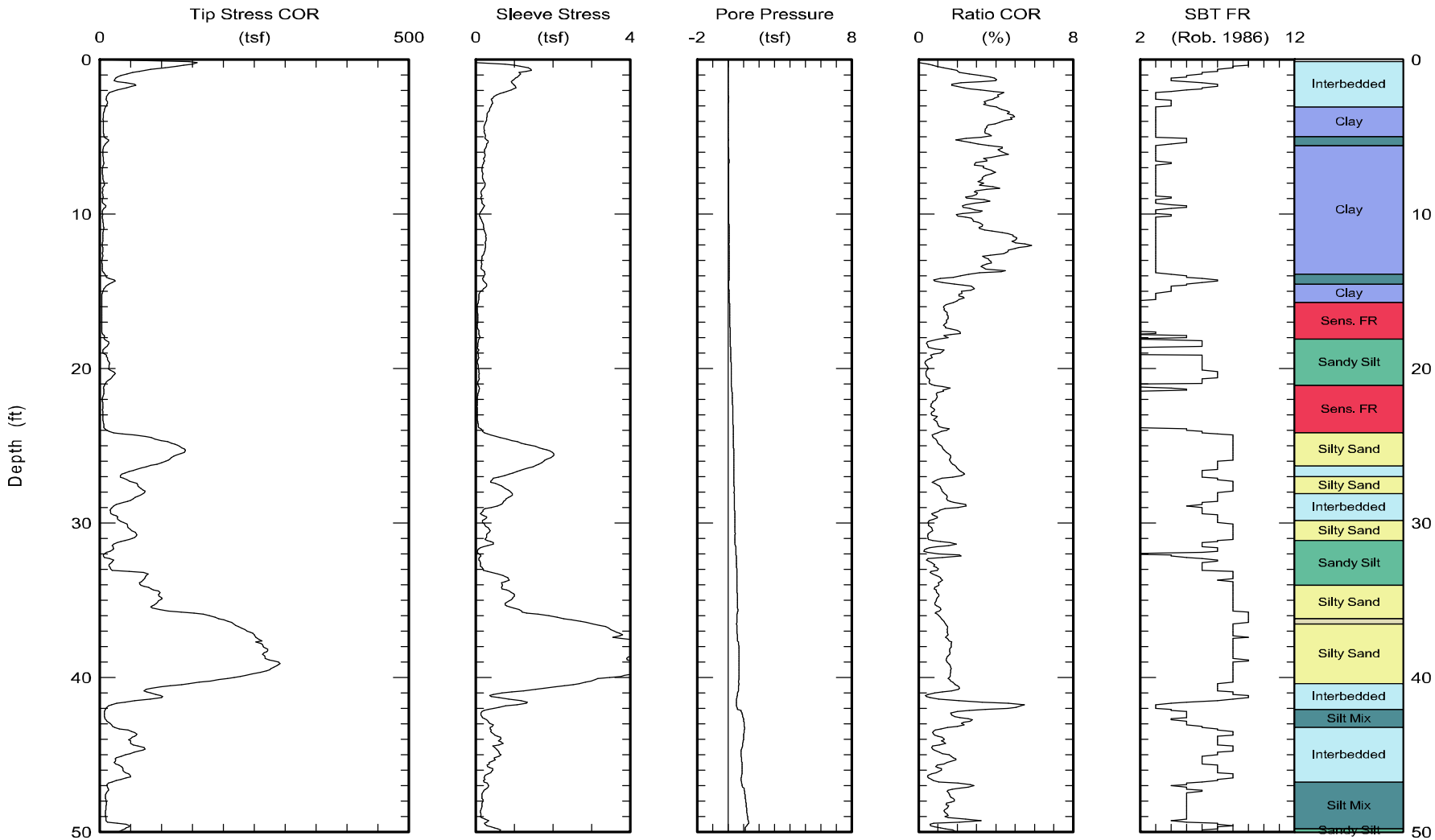
Maximum depth: 64.39 (ft)

FIGURE

A1-48 b

Test ID: B-CPT-050
File: Z14S1201C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 14/Sep/2012 Test ID: B-CPT-052 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



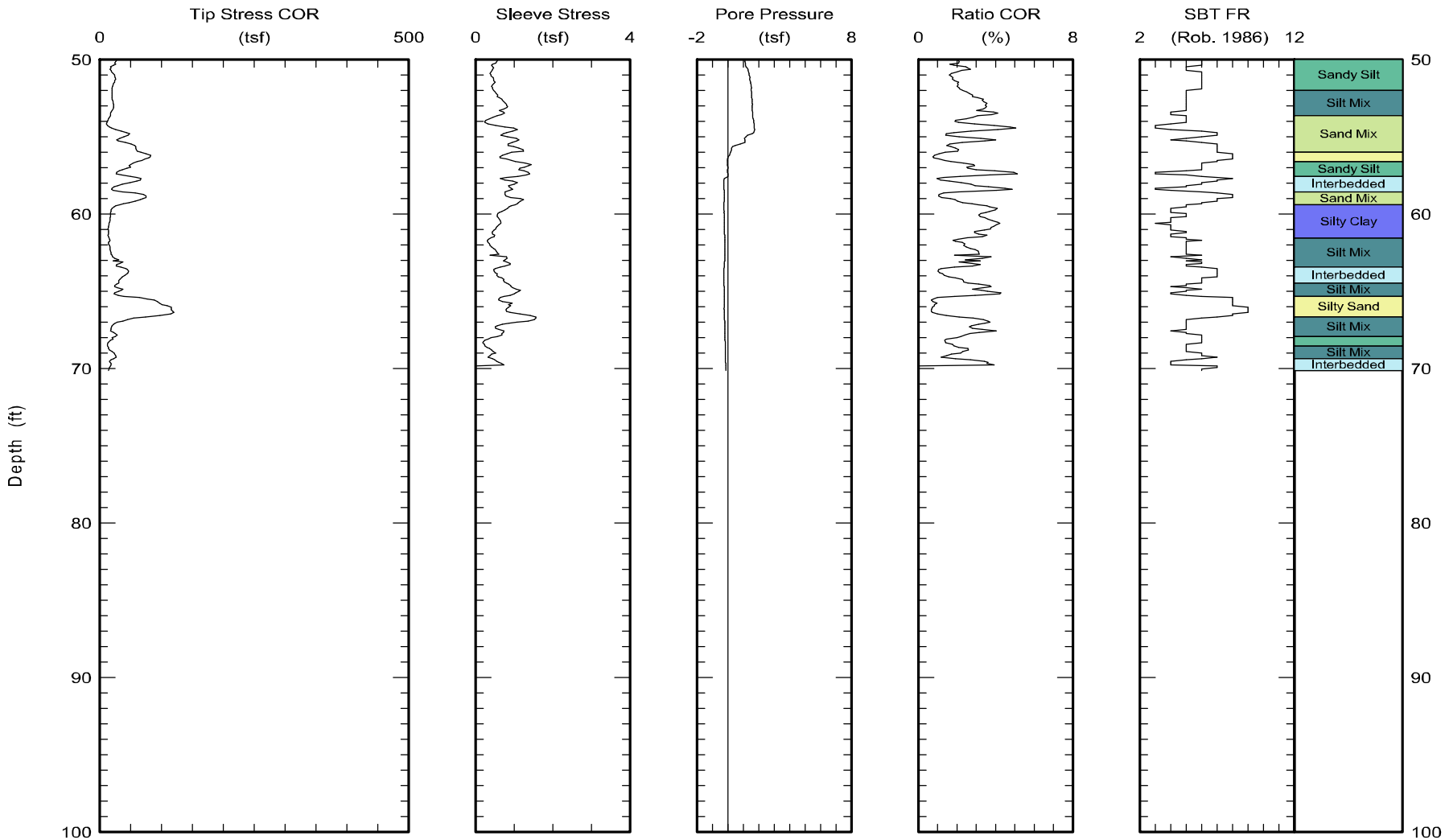
Maximum depth: 70.14 (ft)

FIGURE

A1-49 a

Test ID: B-CPT-052
File: Z14S1209C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 14/Sep/2012 Test ID: B-CPT-052 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 70.14 (ft)

FIGURE

A1-49 b

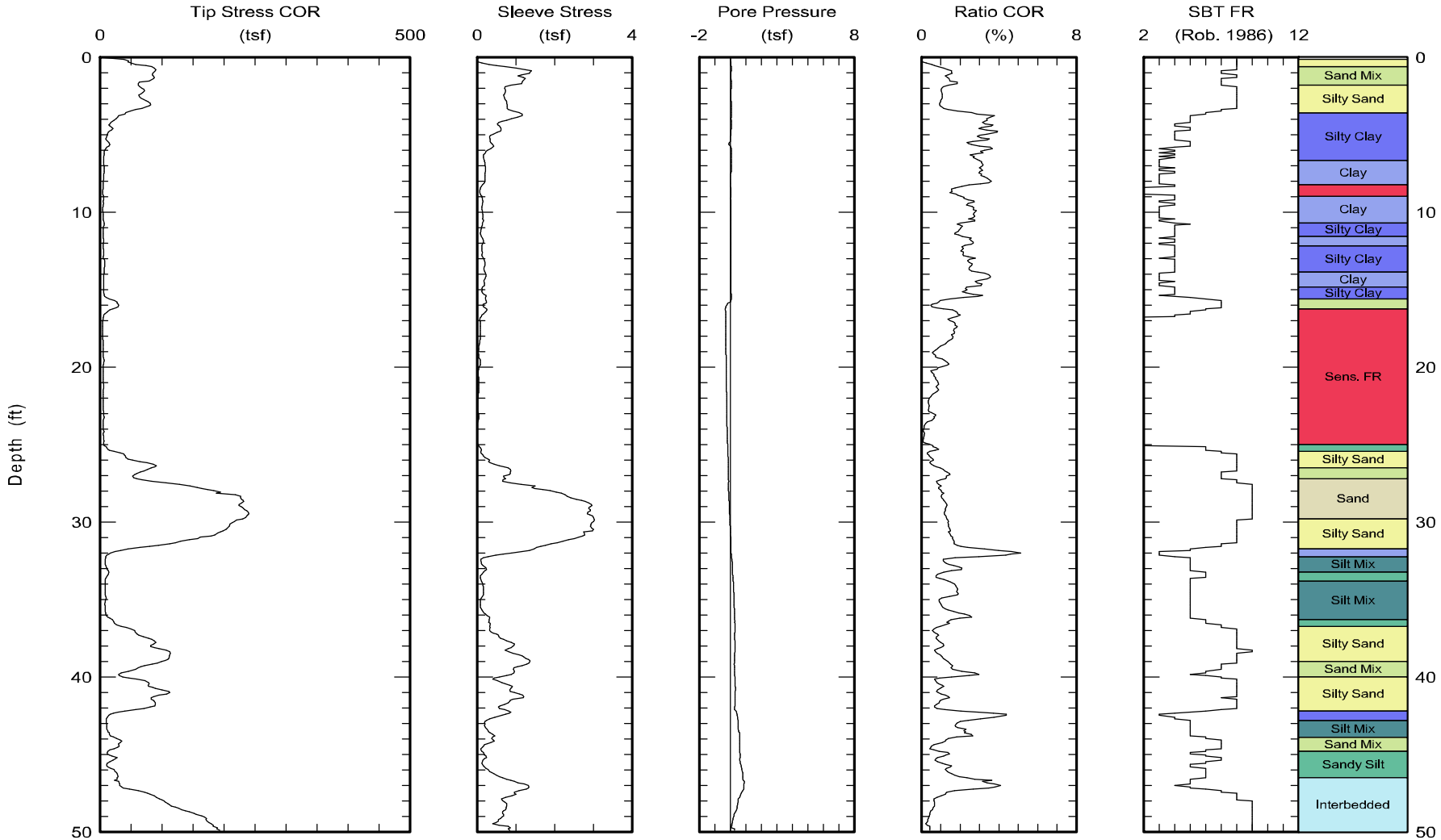
Test ID: B-CPT-052
File: Z14S1209C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 14/Sep/2012
Test ID: B-CPT-054
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 70.15 (ft)

FIGURE

A1-50 a

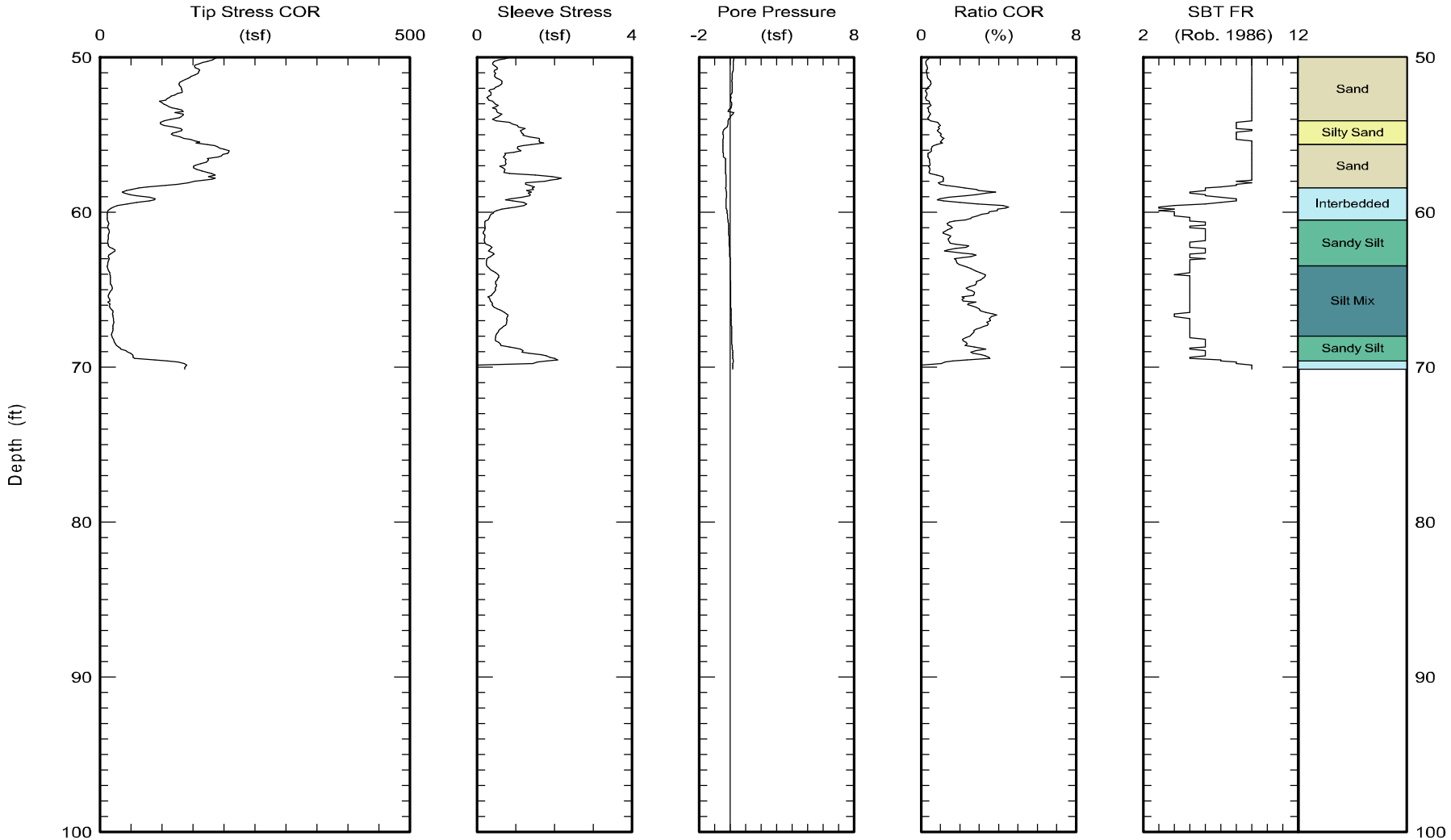
Test ID: B-CPT-054
File: Z14S1207C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 14/Sep/2012
Test ID: B-CPT-054
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 70.15 (ft)

FIGURE

A1-50 b

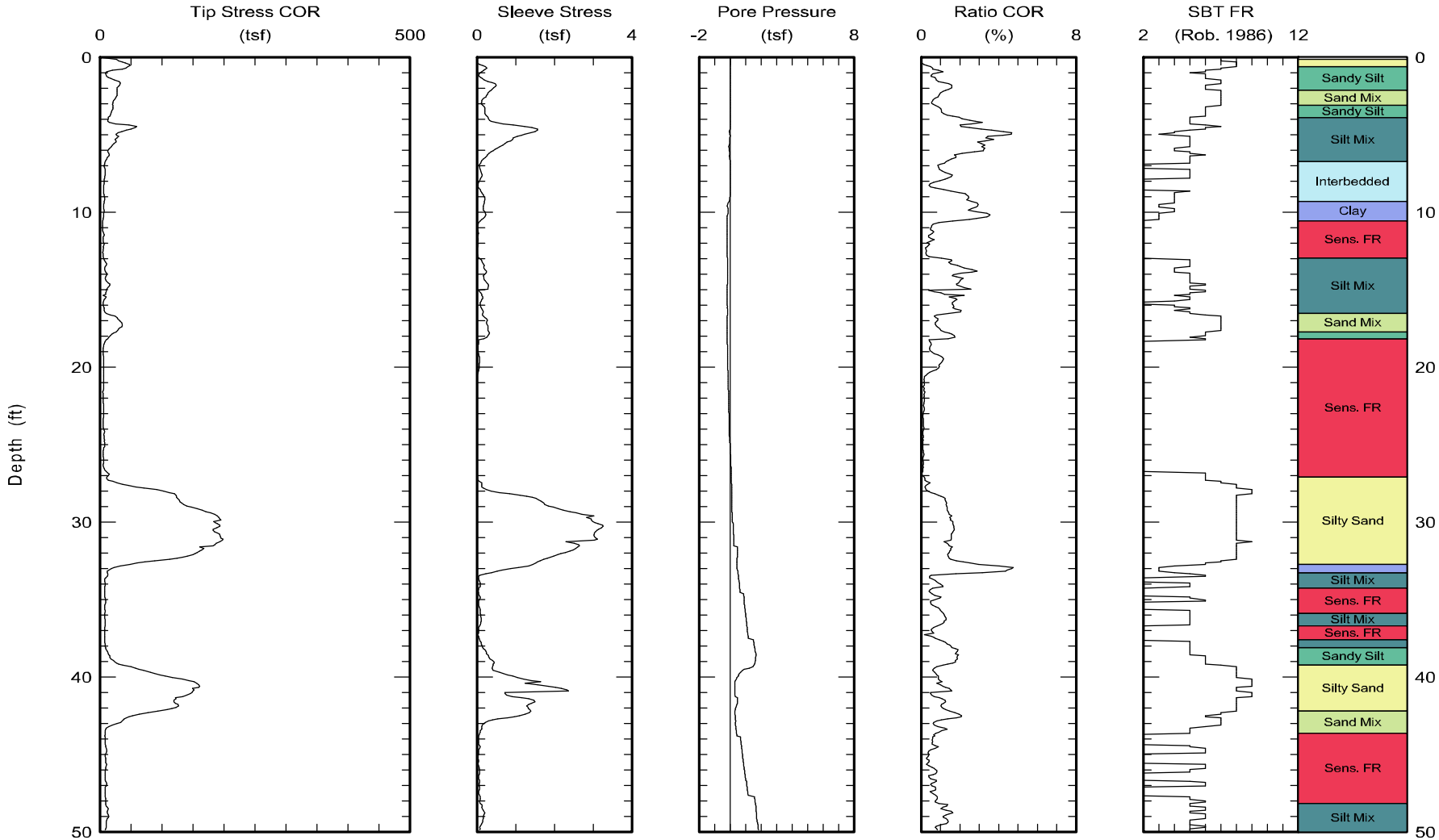
Test ID: B-CPT-054
File: Z14S1207C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 14/Sep/2012
Test ID: B-CPT-056
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 70.07 (ft)

FIGURE

A1-51 a

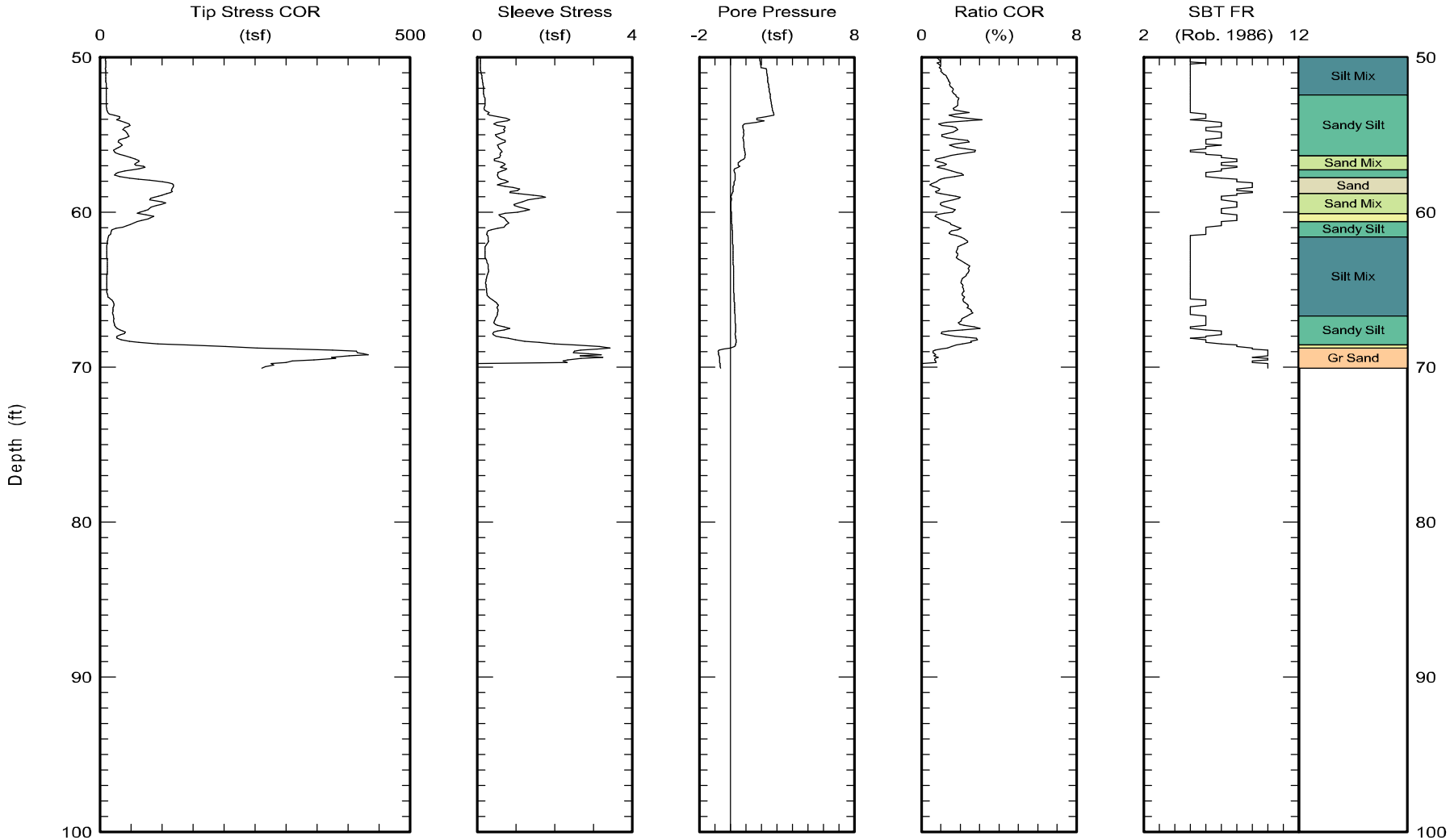
Test ID: B-CPT-056
File: Z14S1206C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 14/Sep/2012
Test ID: B-CPT-056
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



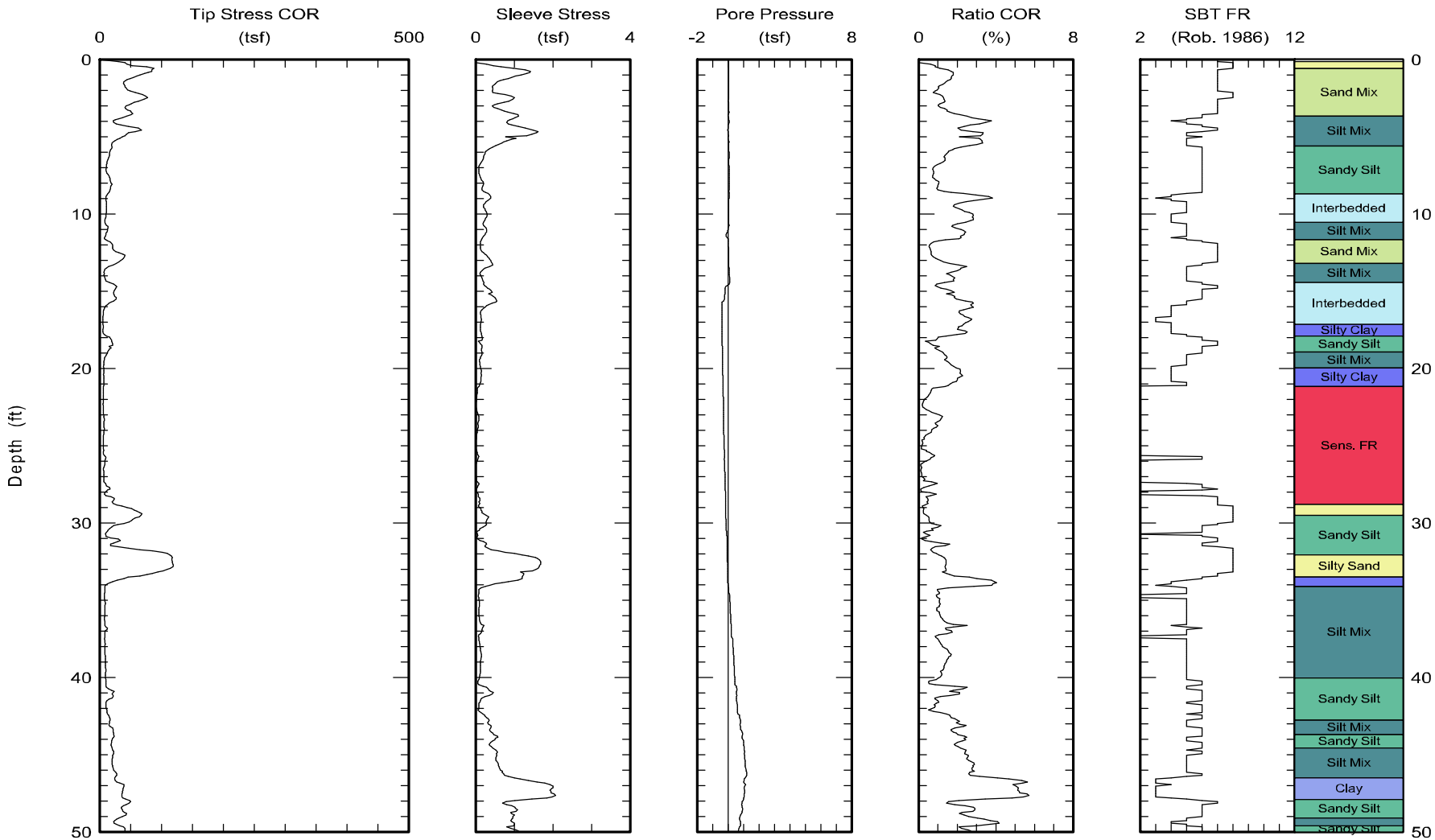
Maximum depth: 70.07 (ft)

FIGURE

A1-51 b

Test ID: B-CPT-056
File: Z14S1206C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 14/Sep/2012 Test ID: B-CPT-057 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



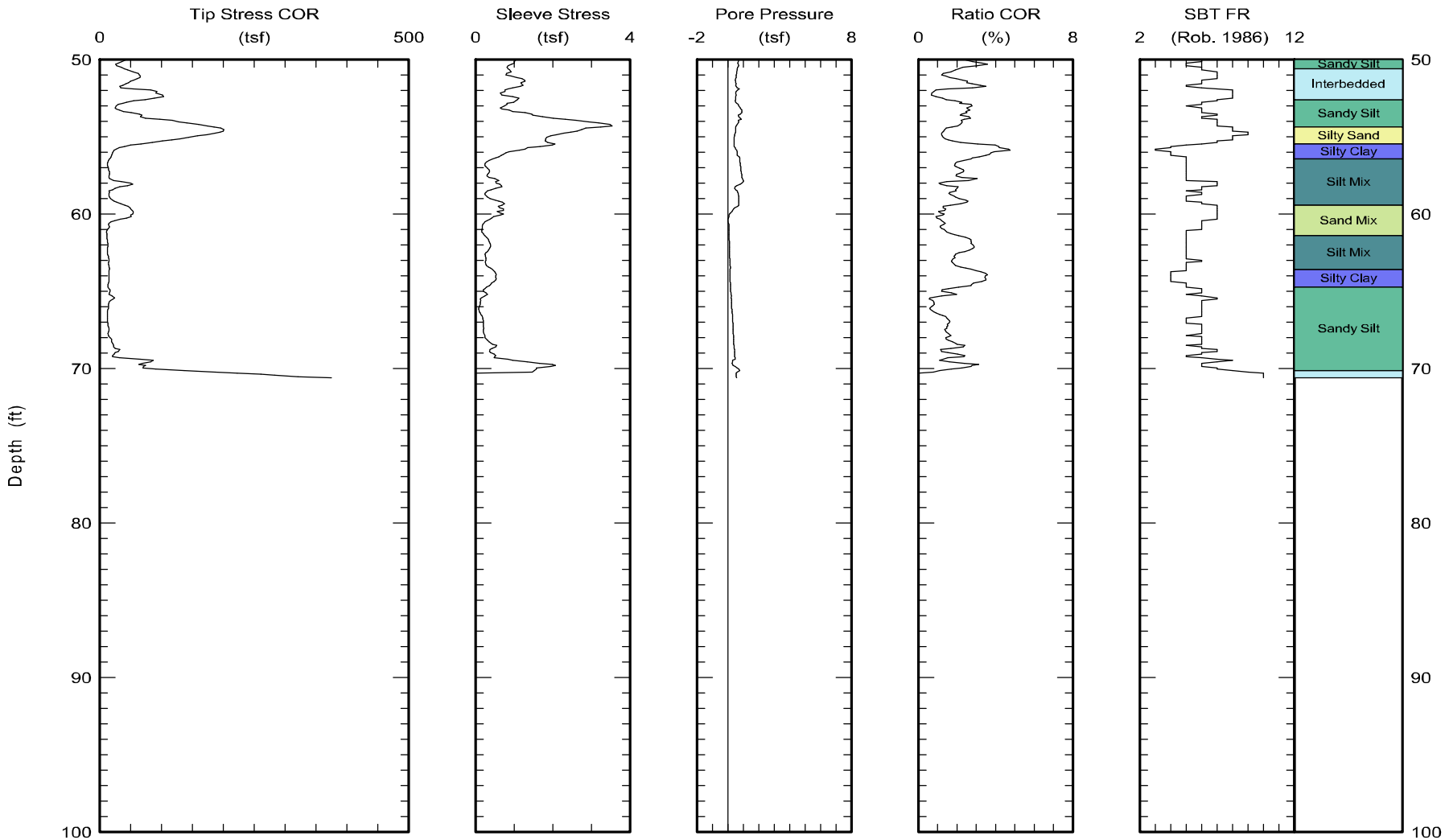
Maximum depth: 70.61 (ft)

FIGURE

A1-52 a

Test ID: B-CPT-057
File: Z14S1205C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 14/Sep/2012 Test ID: B-CPT-057 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



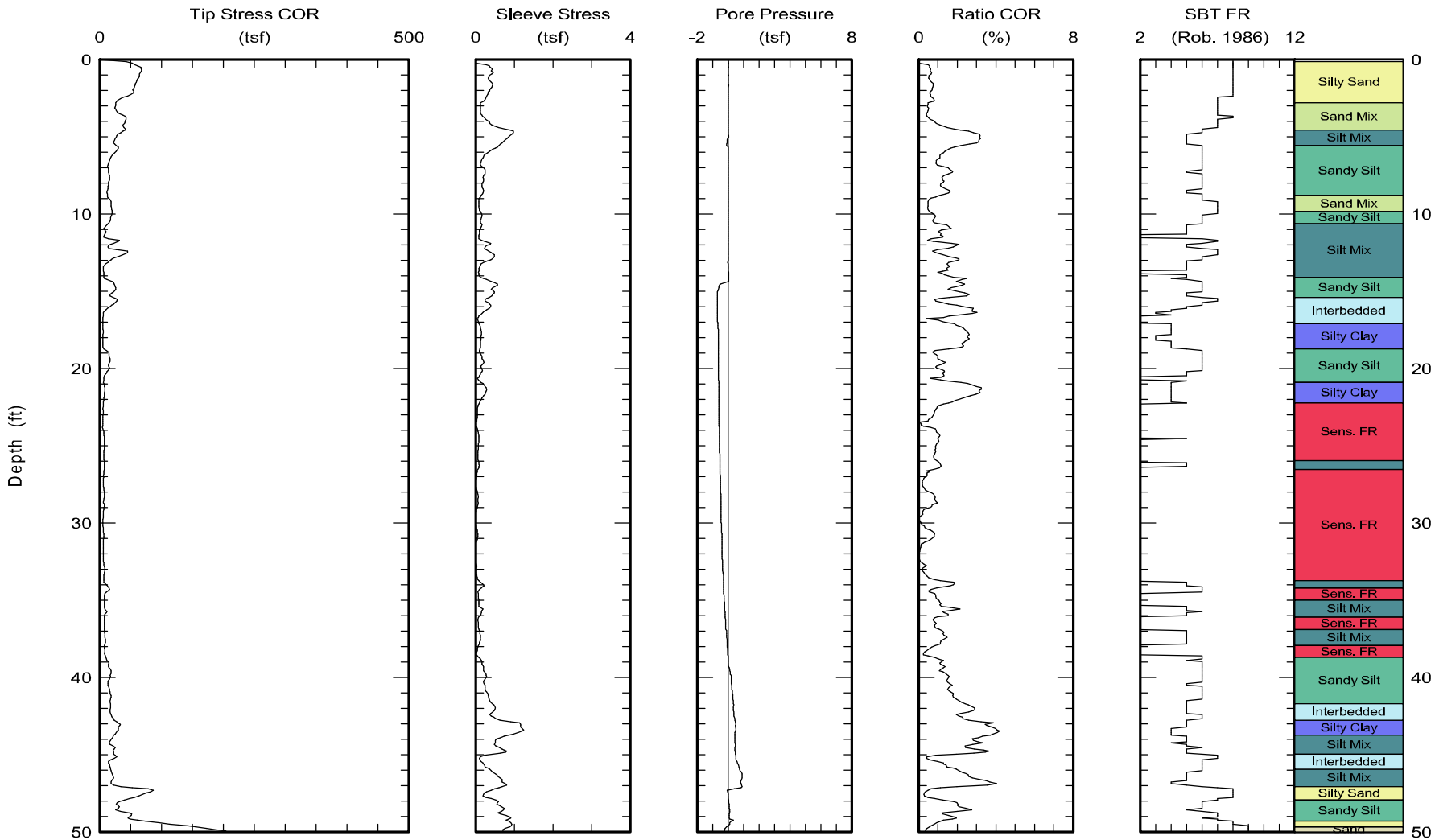
Maximum depth: 70.61 (ft)

FIGURE

A1-52 b

Test ID: B-CPT-057
File: Z14S1205C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 14/Sep/2012 Test ID: B-CPT-059 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 69.50 (ft)

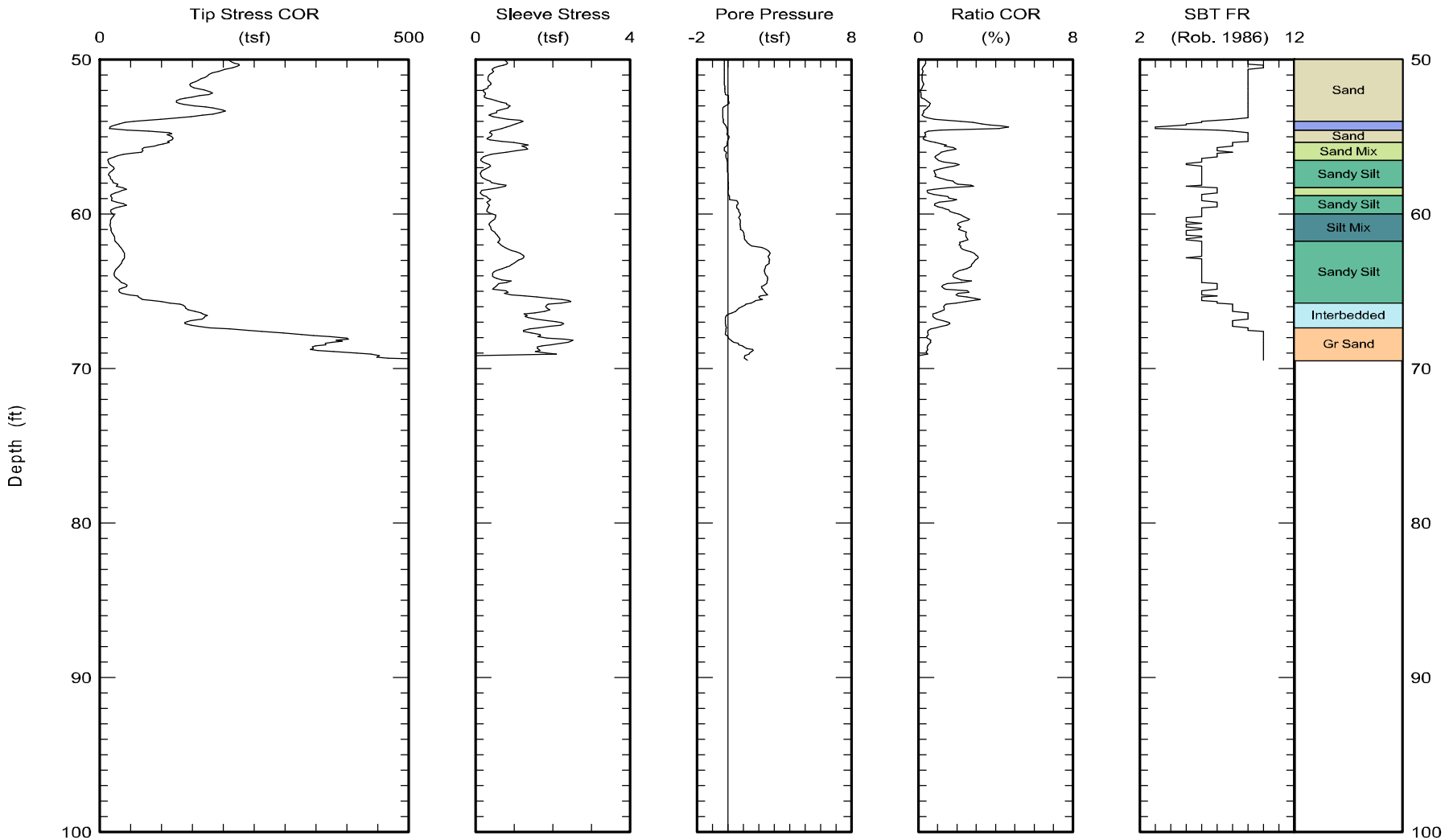
FIGURE

E-237

A1-53 a

Test ID: B-CPT-059
File: Z14S1204C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 14/Sep/2012 Test ID: B-CPT-059 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



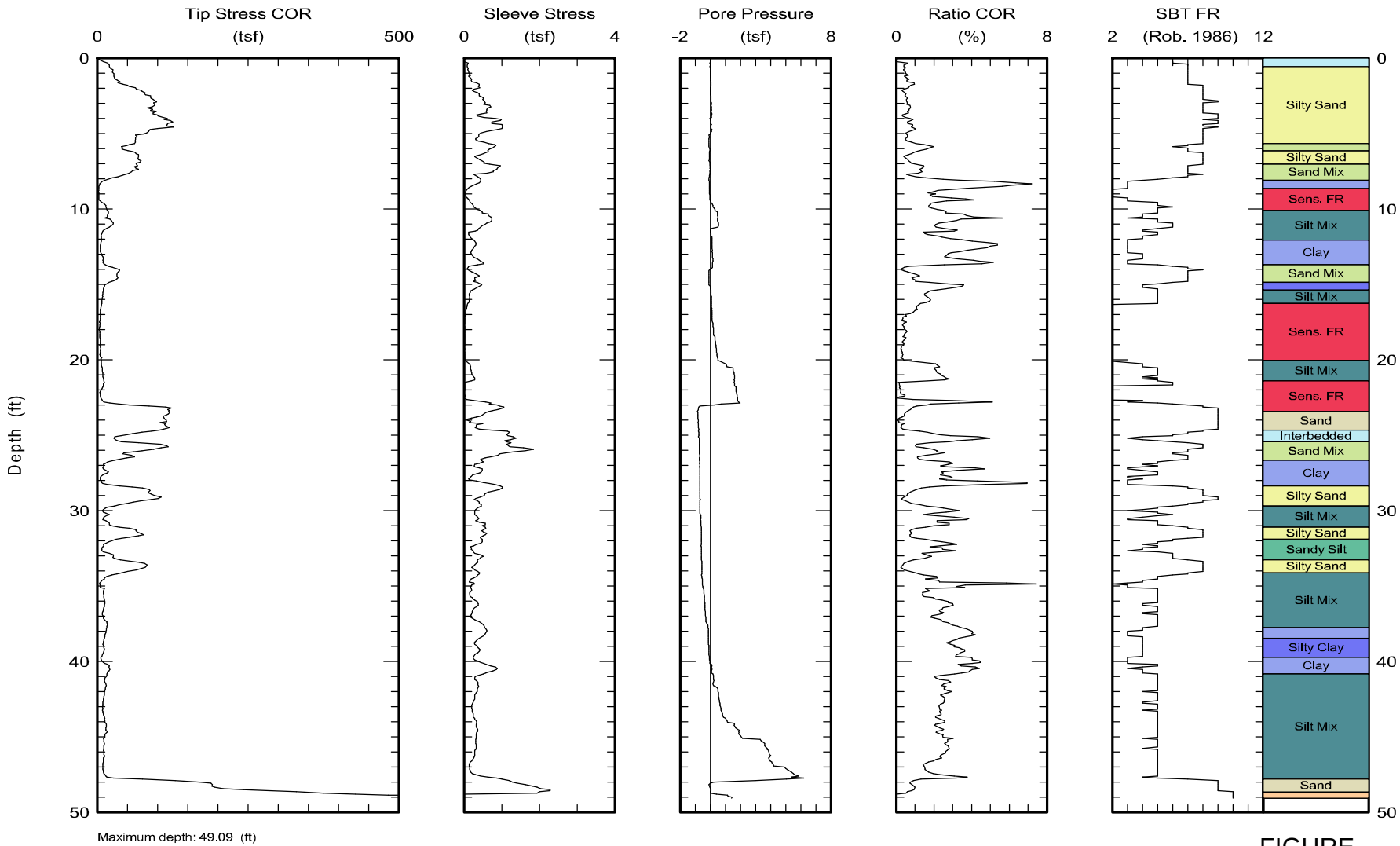
Maximum depth: 69.50 (ft)

FIGURE

A1-53 b

Test ID: B-CPT-059
File: Z14S1204C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 10/Oct/2012 Test ID: CPT-060 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	

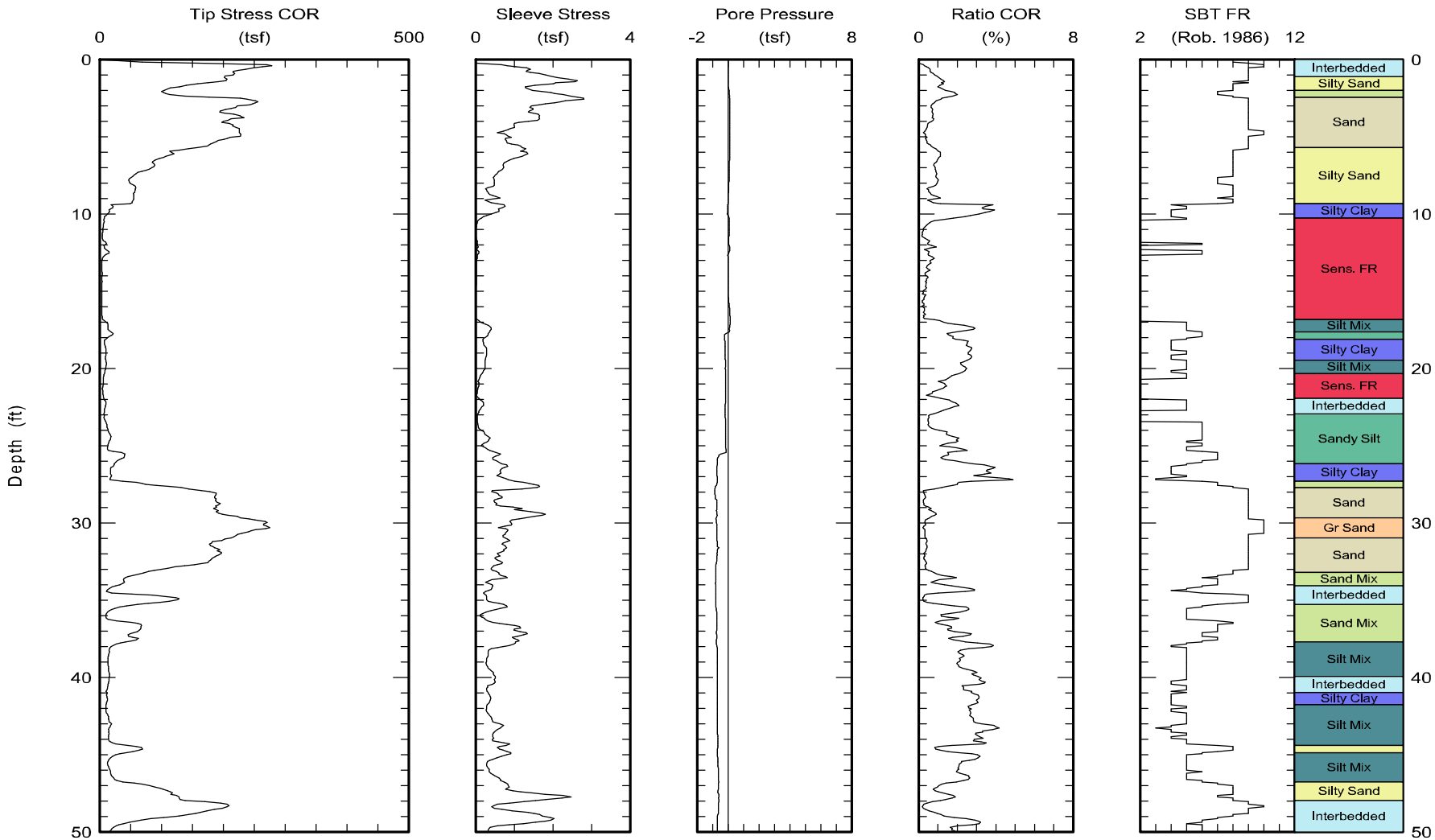


FIGURE

A1-54

Test ID: CPT-060
File: Z10O1207C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 10/Oct/2012 Test ID: CPT-062 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 57.62 (ft)

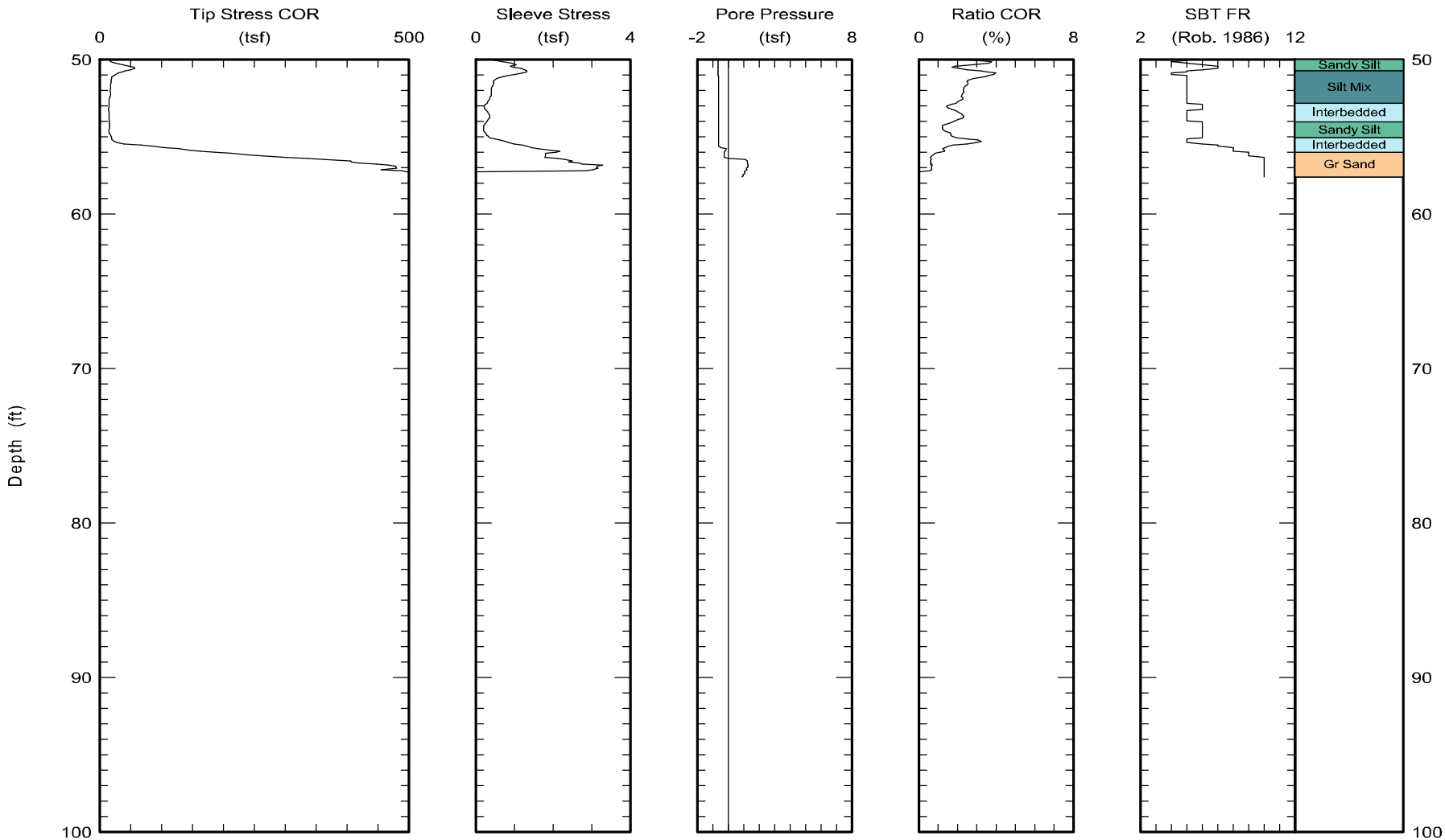
FIGURE

E-240

A1-55 a

Test ID: CPT-062
File: Z10O1203C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 10/Oct/2012 Test ID: CPT-062 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 57.62 (ft)

FIGURE

A1-55 b

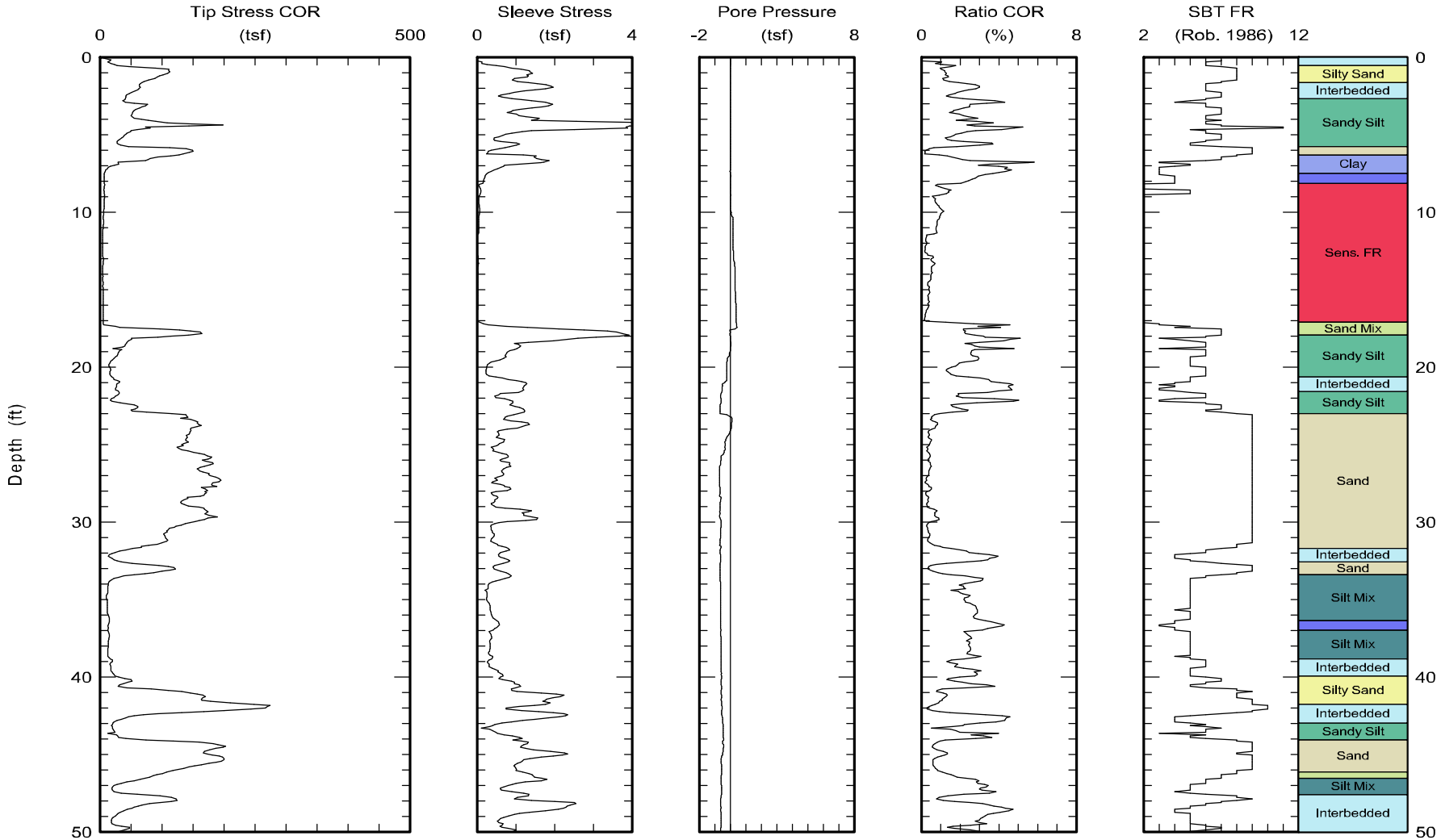
Test ID: CPT-062
File: Z10O1203C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 10/Oct/2012
Test ID: CPT-063
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



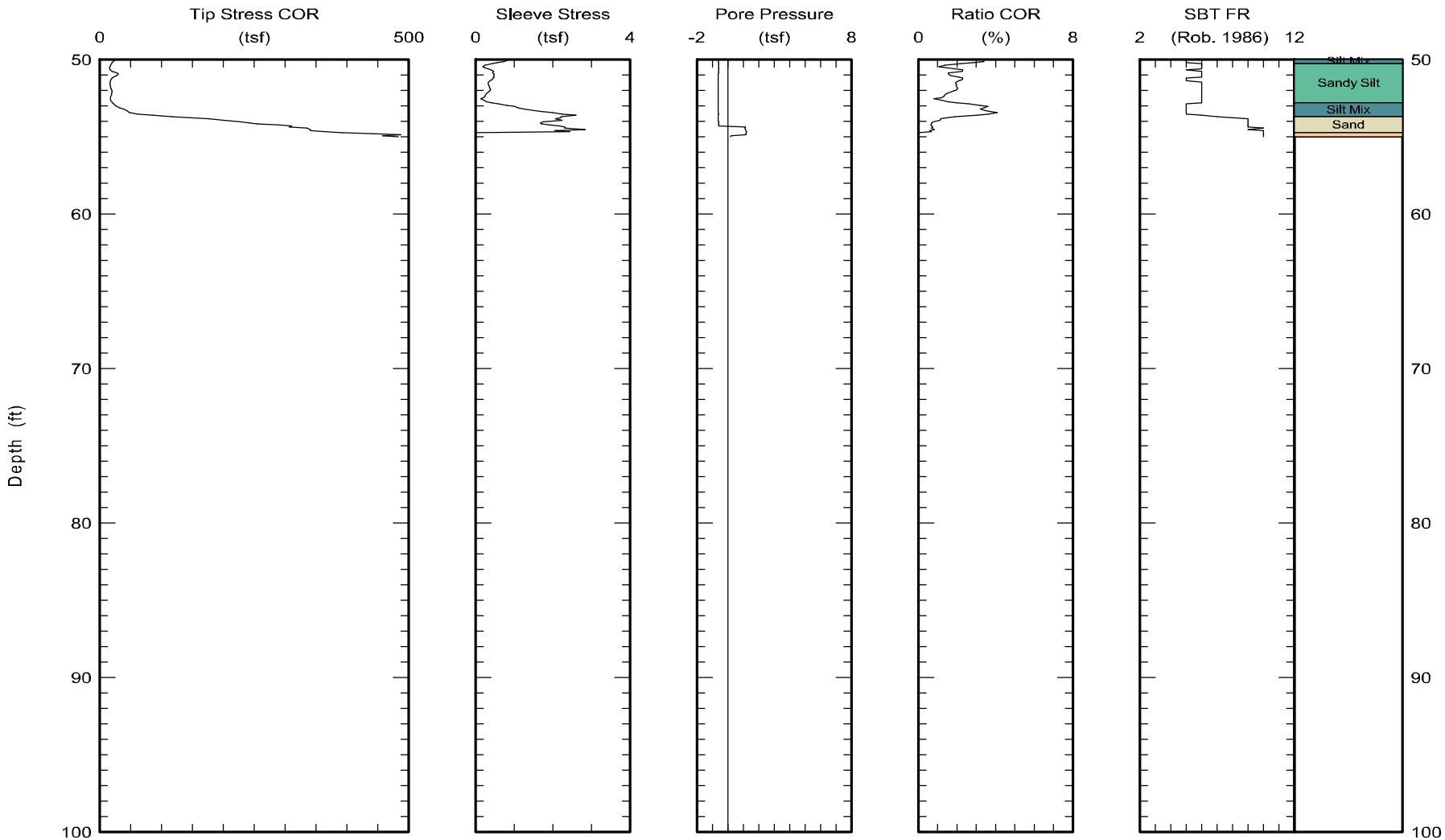
Maximum depth: 55.03 (ft)
Page 1 of 2

FIGURE

A1-56 a

Test ID: CPT-063
File: Z10O1205C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 10/Oct/2012 Test ID: CPT-063 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 55.03 (ft)

FIGURE

A1-56 b

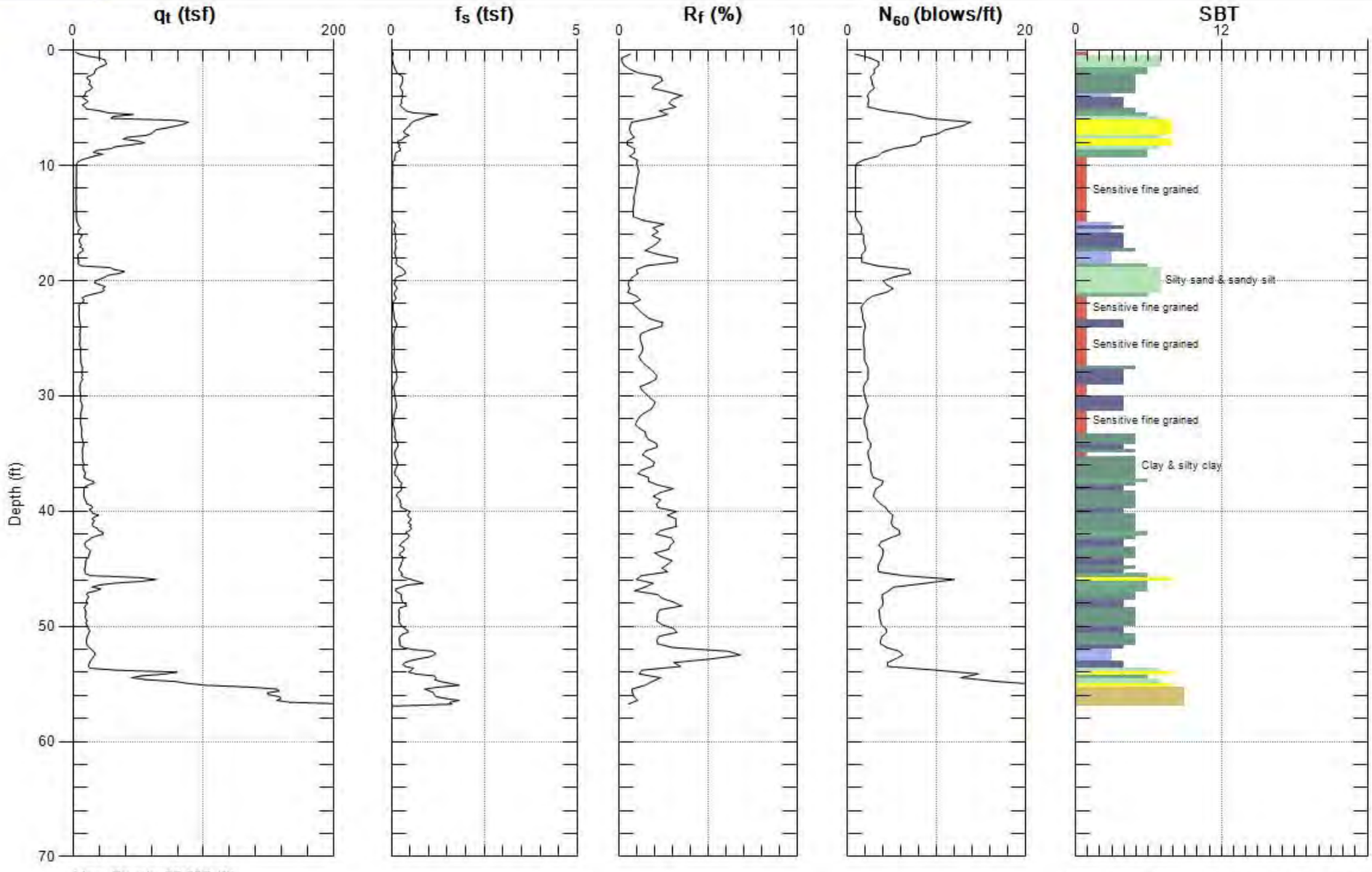
Test ID: CPT-063
File: Z10O1205C.ECP

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: ACPT-007

Engineer: E.HOLLIDAY
Date: 9/24/2012 08:23



Max. Depth: 57.087 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-57

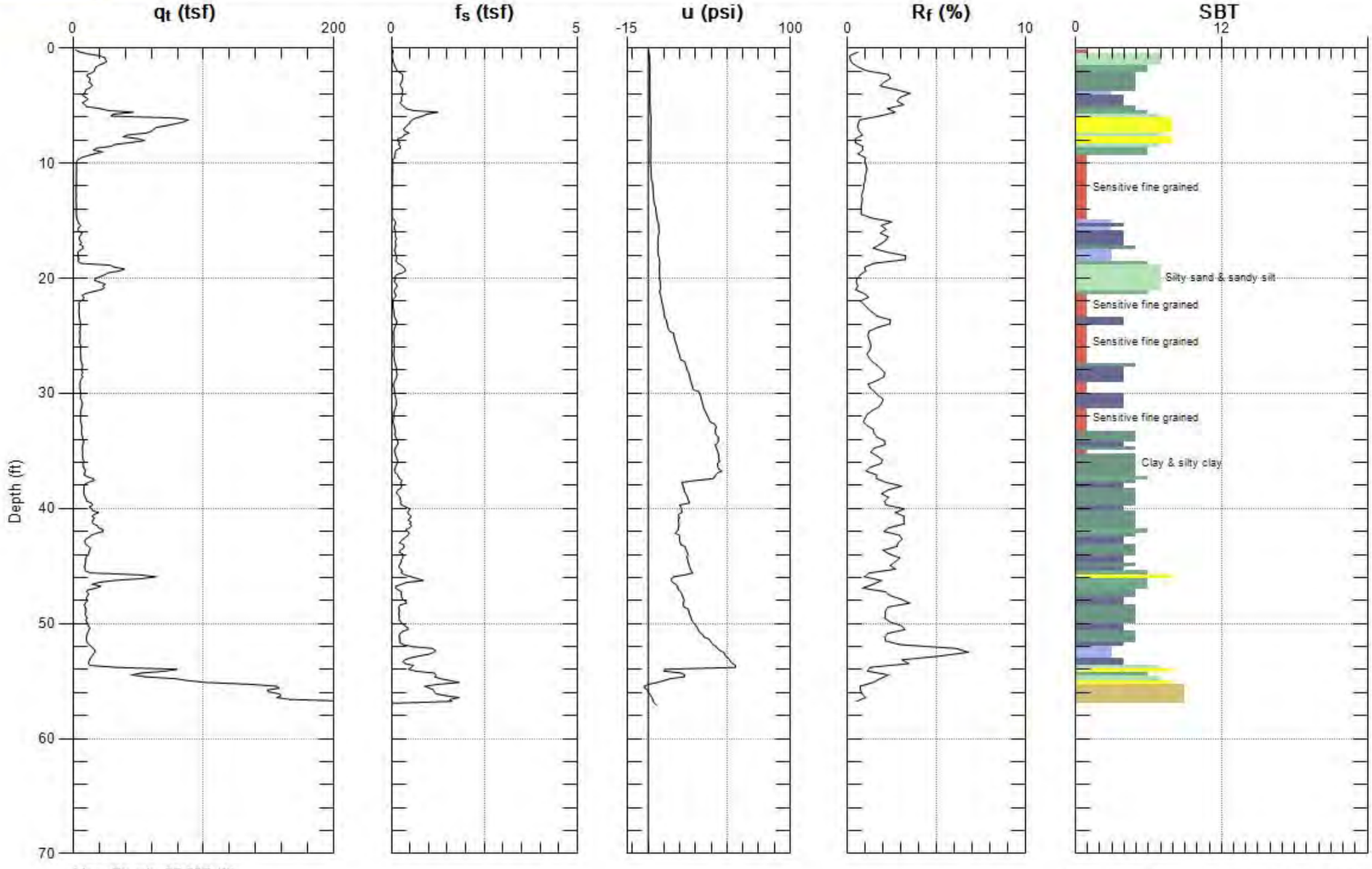
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: ACPT-007

Engineer: E.HOLLIDAY
Date: 9/24/2012 08:23



Max. Depth: 57.087 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-57

SBT: Soil Behavior Type (Robertson 1990)

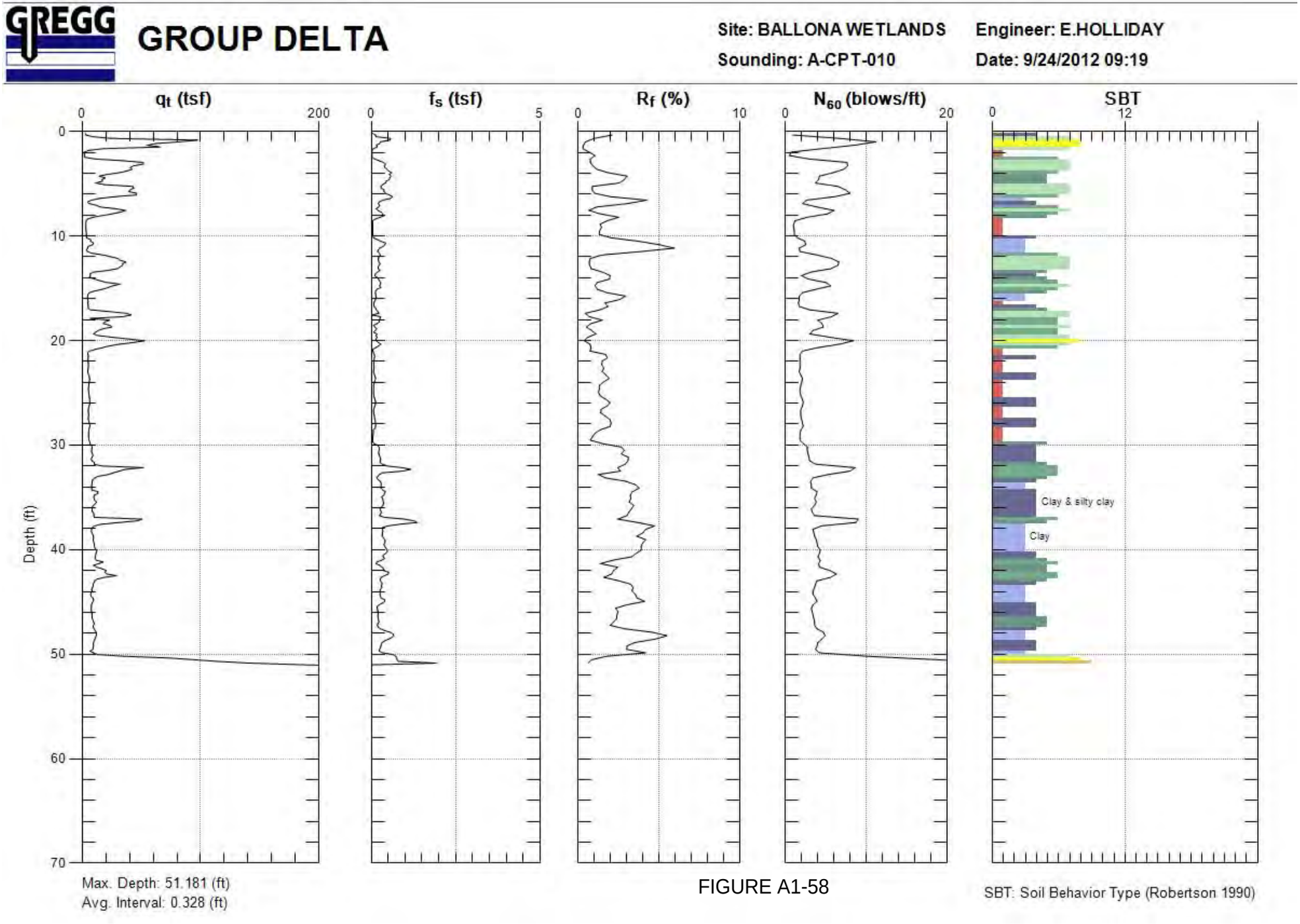

GREGG
GROUP DELTA
Site: BALLONA WETLANDS
Sounding: A-CPT-010
Engineer: E.HOLLIDAY
Date: 9/24/2012 09:19
q_t (tsf)
f_s (tsf)
R_f (%)
N_{60} (blows/ft)
SBT
Depth (ft)
Clay & silty clay
Clay
Max. Depth: 51.181 (ft)
Avg. Interval: 0.328 (ft)
SBT: Soil Behavior Type (Robertson 1990)

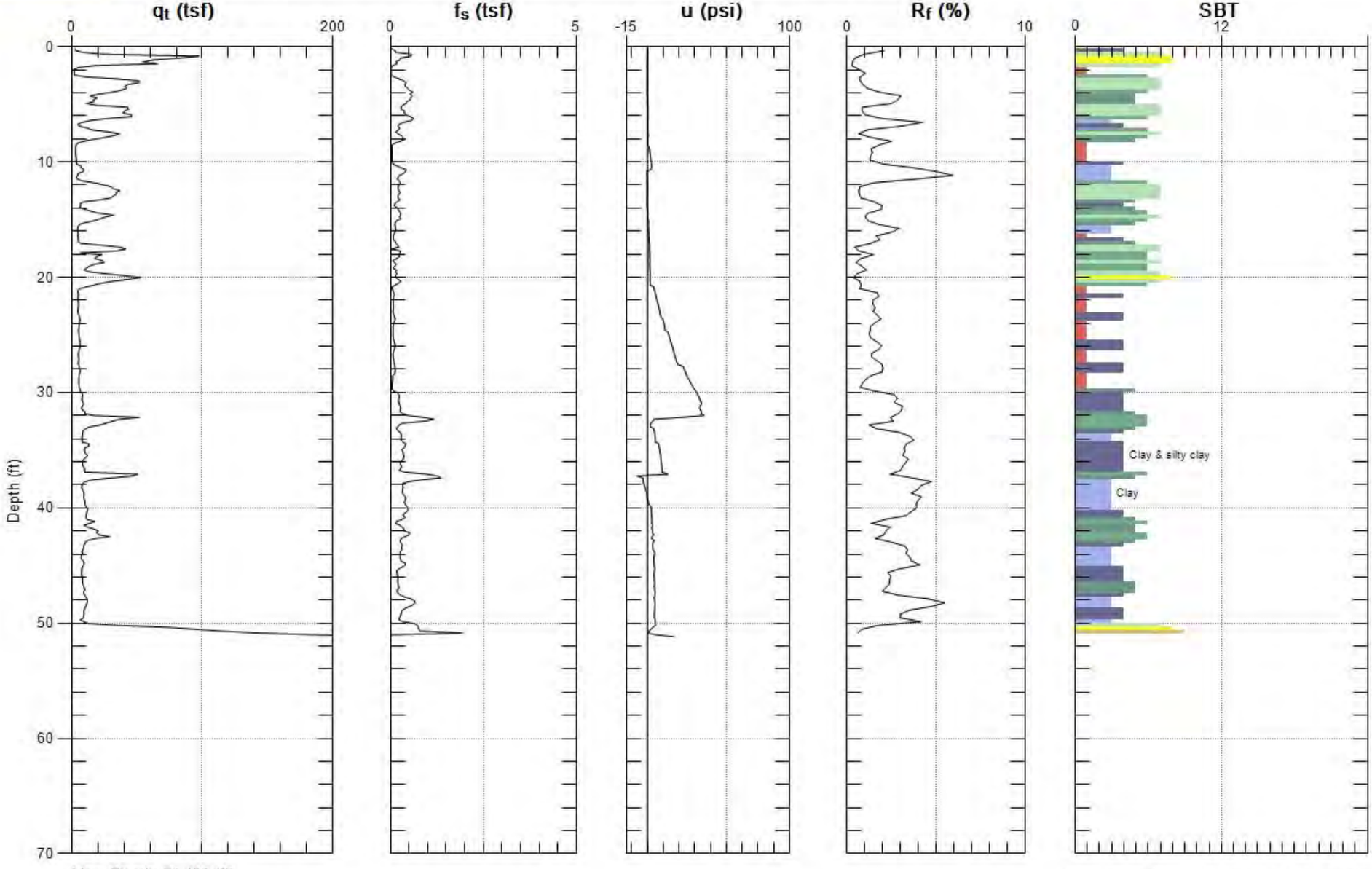
FIGURE A1-58

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-010

Engineer: E.HOLLIDAY
Date: 9/24/2012 09:19



Max. Depth: 51.181 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-58

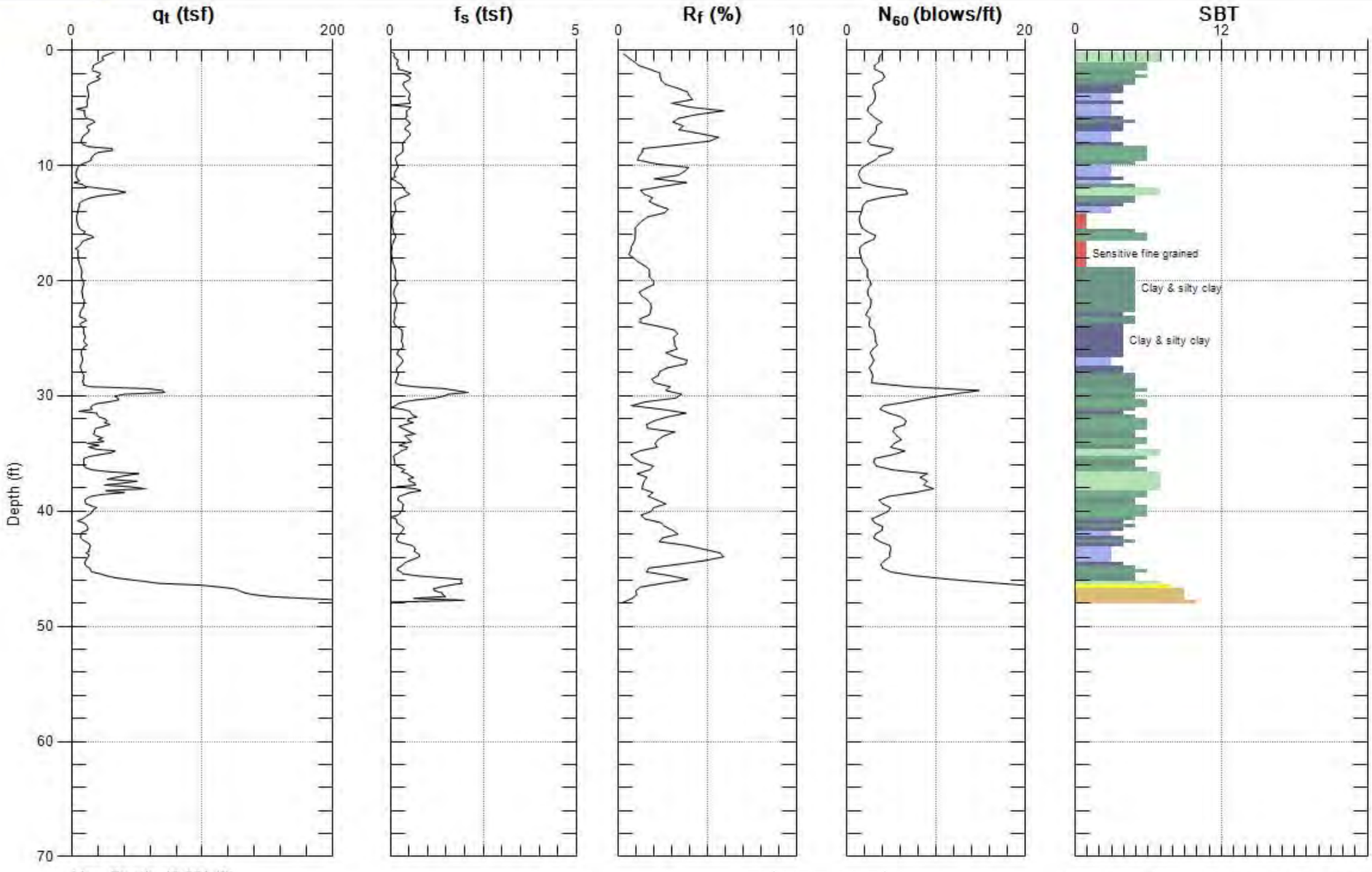
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-012

Engineer: E.HOLLIDAY
Date: 9/24/2012 09:59



Max. Depth: 48.064 (ft)
Avg. Interval: 0.328 (ft)

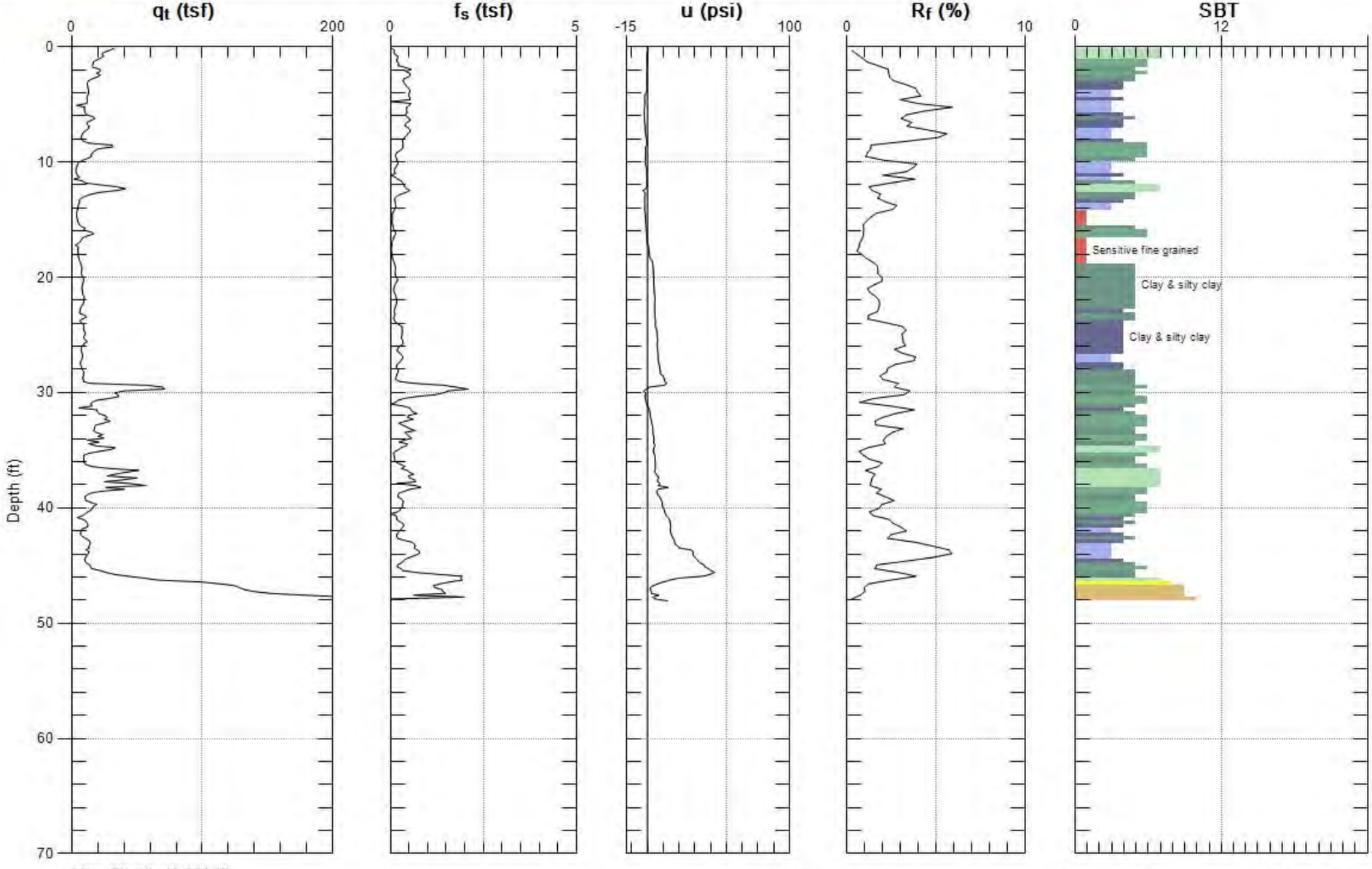
FIGURE A1-59

SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-012
Engineer: E.HOLLIDAY
Date: 9/24/2012 09:59



Max. Depth: 48.064 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-59

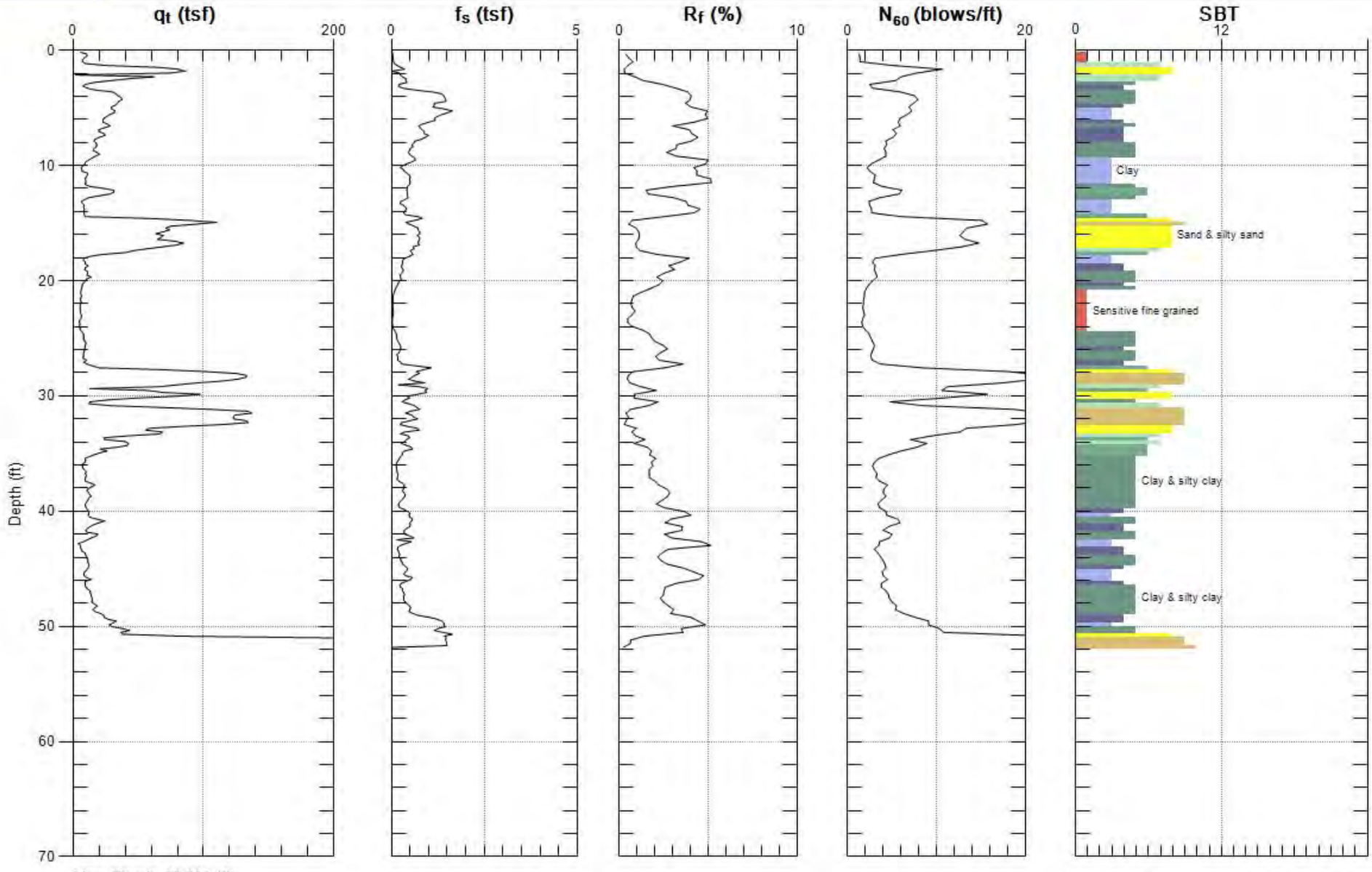
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-014

Engineer: E.HOLLIDAY
Date: 9/24/2012 10:28



Max. Depth: 52.001 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-60

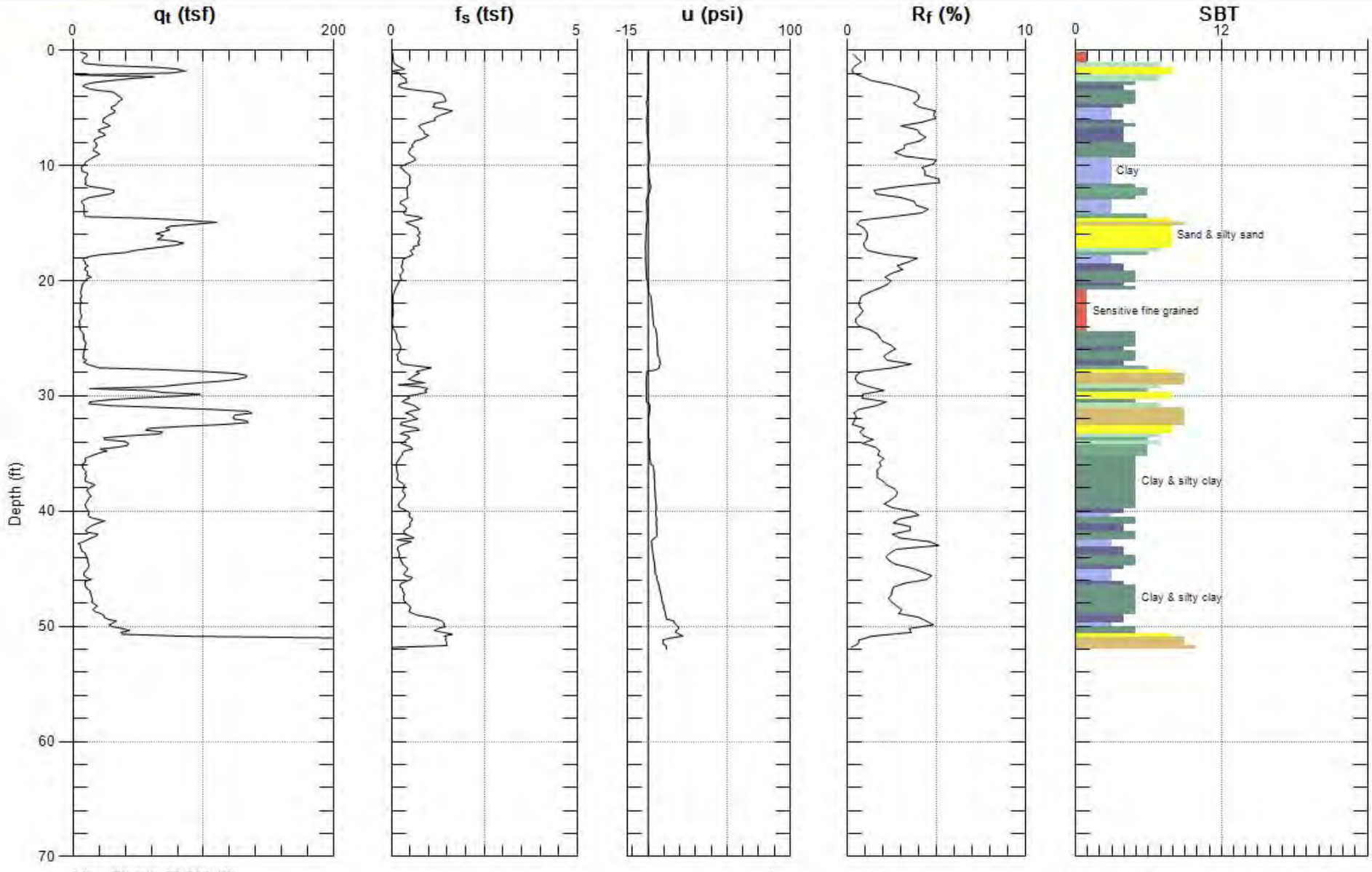
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-014

Engineer: E.HOLLIDAY
Date: 9/24/2012 10:28



Max. Depth: 52.001 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-60

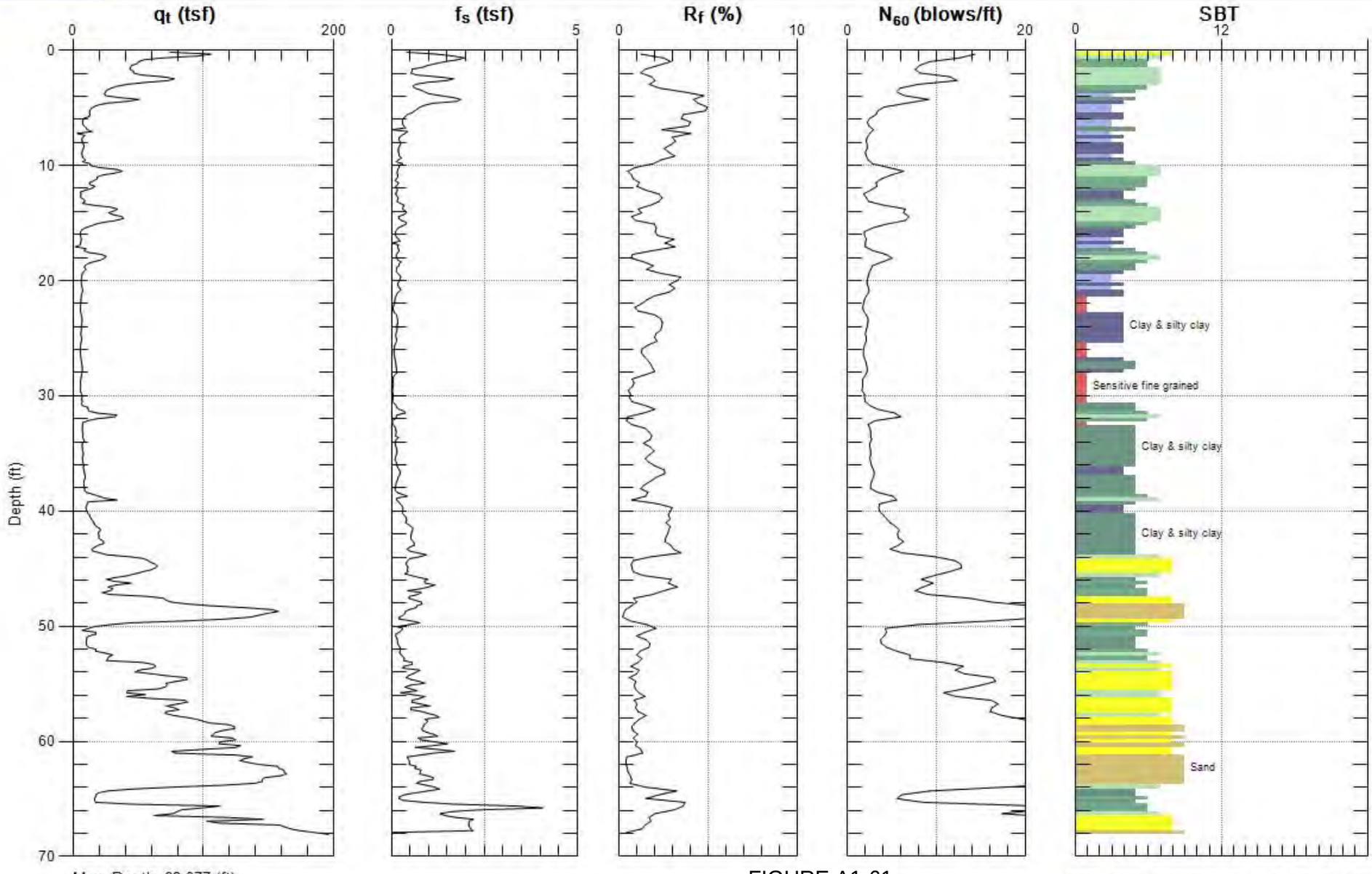
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-019

Engineer: E.HOLLIDAY
Date: 9/24/2012 12:47



Max. Depth: 68.077 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-61

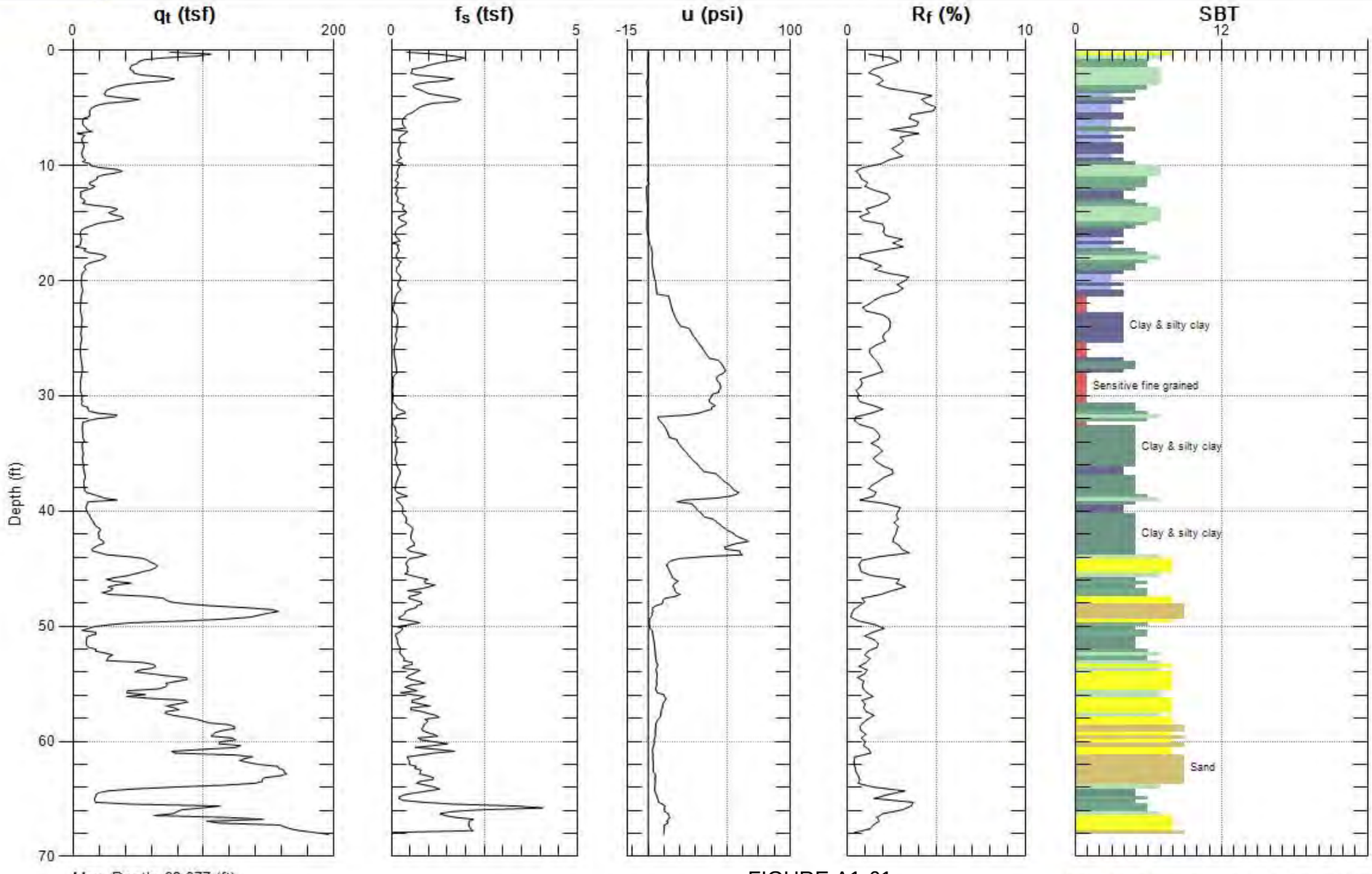
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-019

Engineer: E.HOLLIDAY
Date: 9/24/2012 12:47



Max. Depth: 68.077 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-61

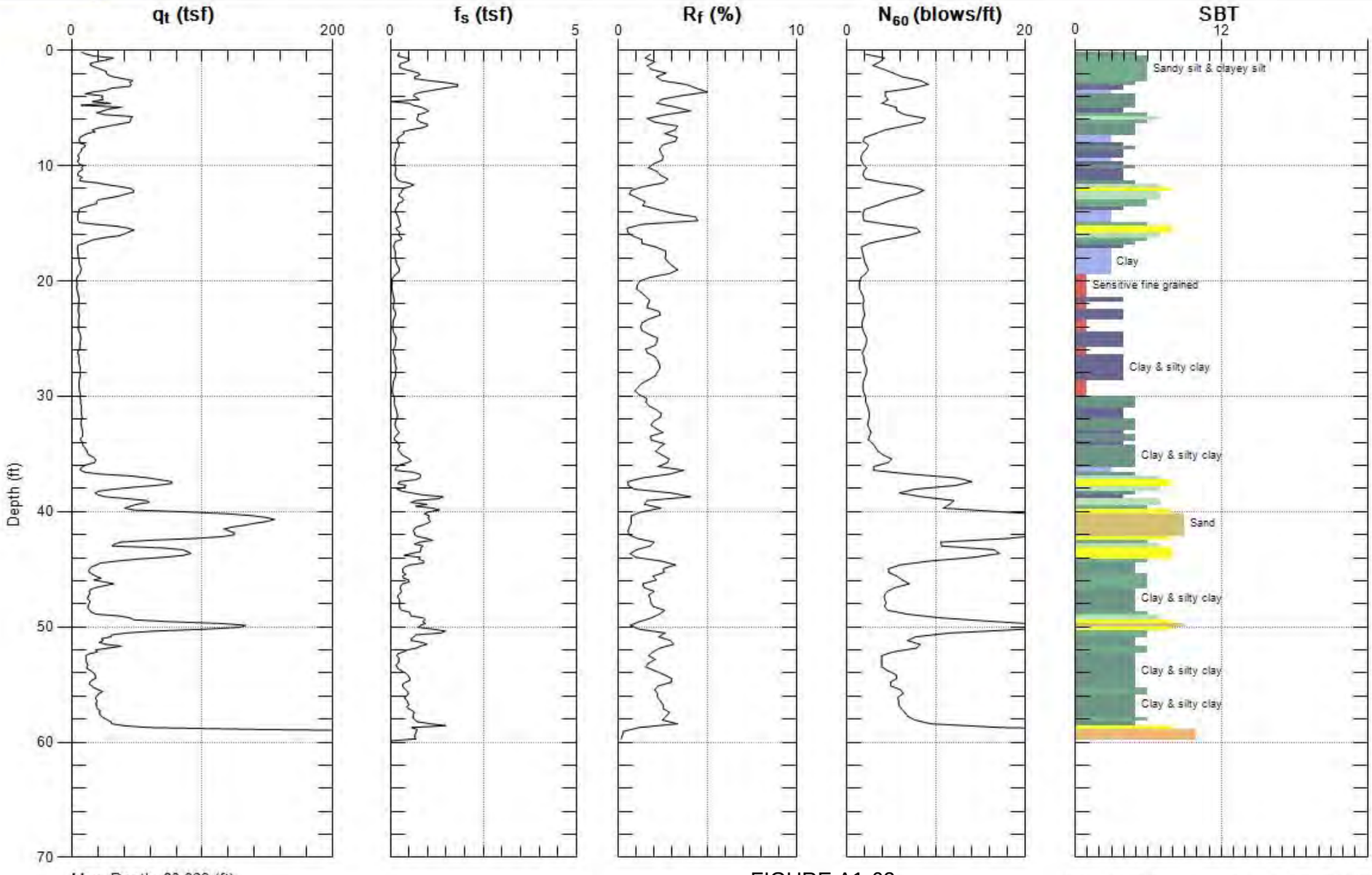
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-021

Engineer: E.HOLLIDAY
Date: 9/24/2012 01:28



Max. Depth: 60.039 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-62

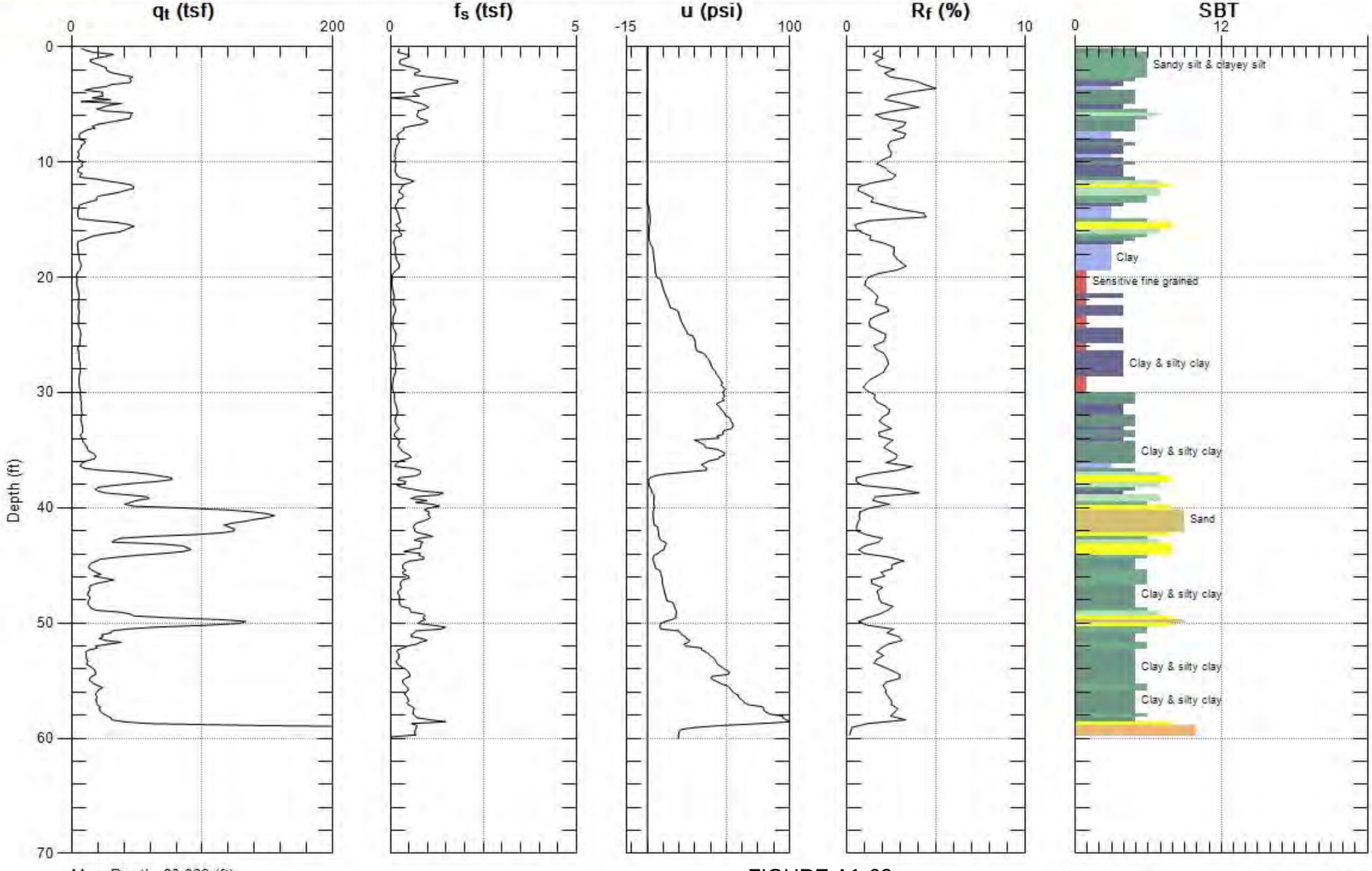
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-021

Engineer: E.HOLLIDAY
Date: 9/24/2012 01:28



Max. Depth: 60.039 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-62

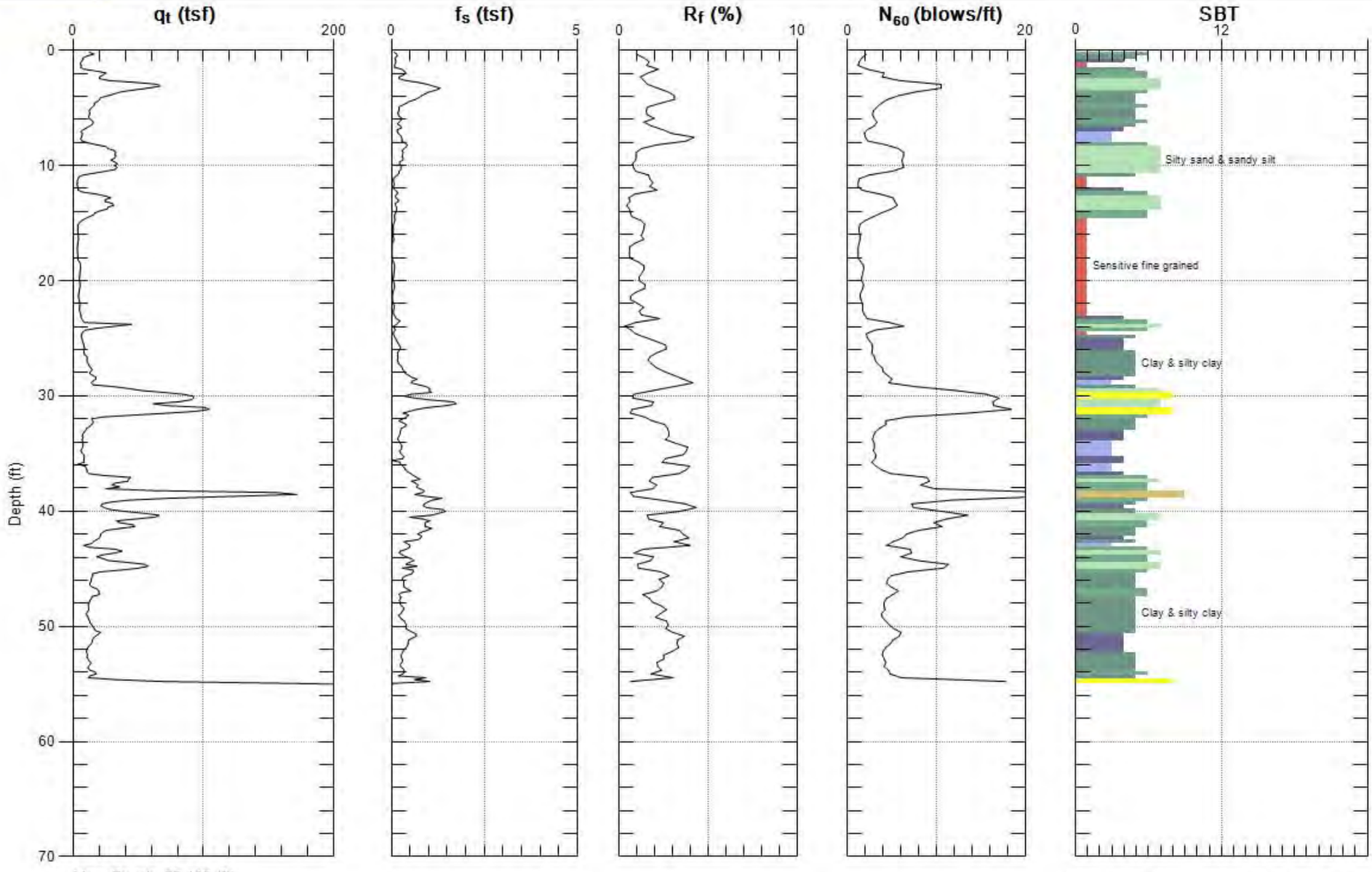
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-024

Engineer: E.HOLLIDAY
Date: 9/24/2012 11:40



Max. Depth: 55.118 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-63

SBT: Soil Behavior Type (Robertson 1990)

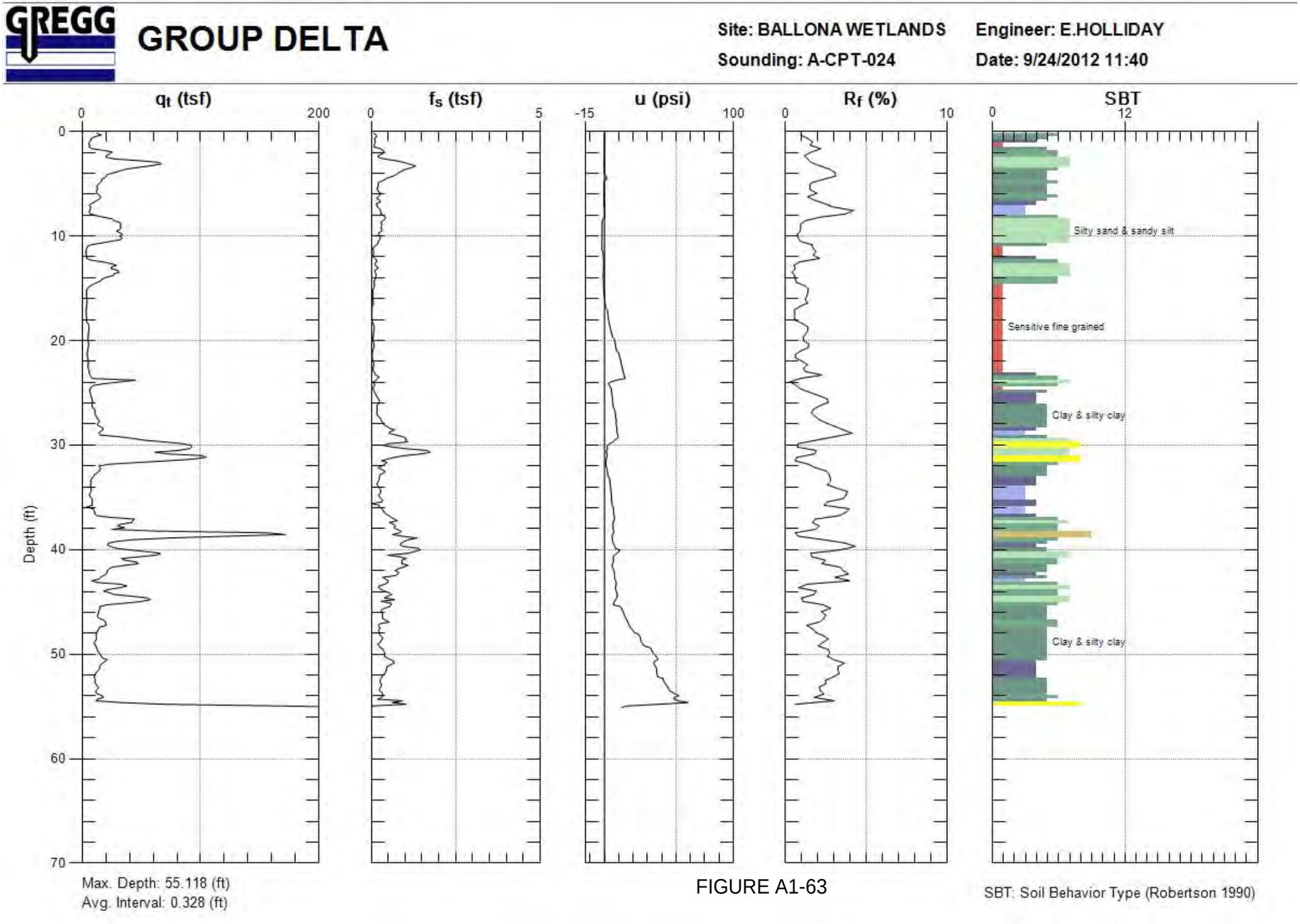

GREGG
GROUP DELTA
Site: BALLONA WETLANDS
Sounding: A-CPT-024
Engineer: E.HOLLIDAY
Date: 9/24/2012 11:40
q_t (tsf)
f_s (tsf)
u (psi)
R_f (%)
SBT
Depth (ft)
Silty sand & sandy silt
Sensitive fine grained
Clay & silty clay
Clay & silty clay
Max. Depth: 55.118 (ft)
Avg. Interval: 0.328 (ft)
SBT: Soil Behavior Type (Robertson 1990)

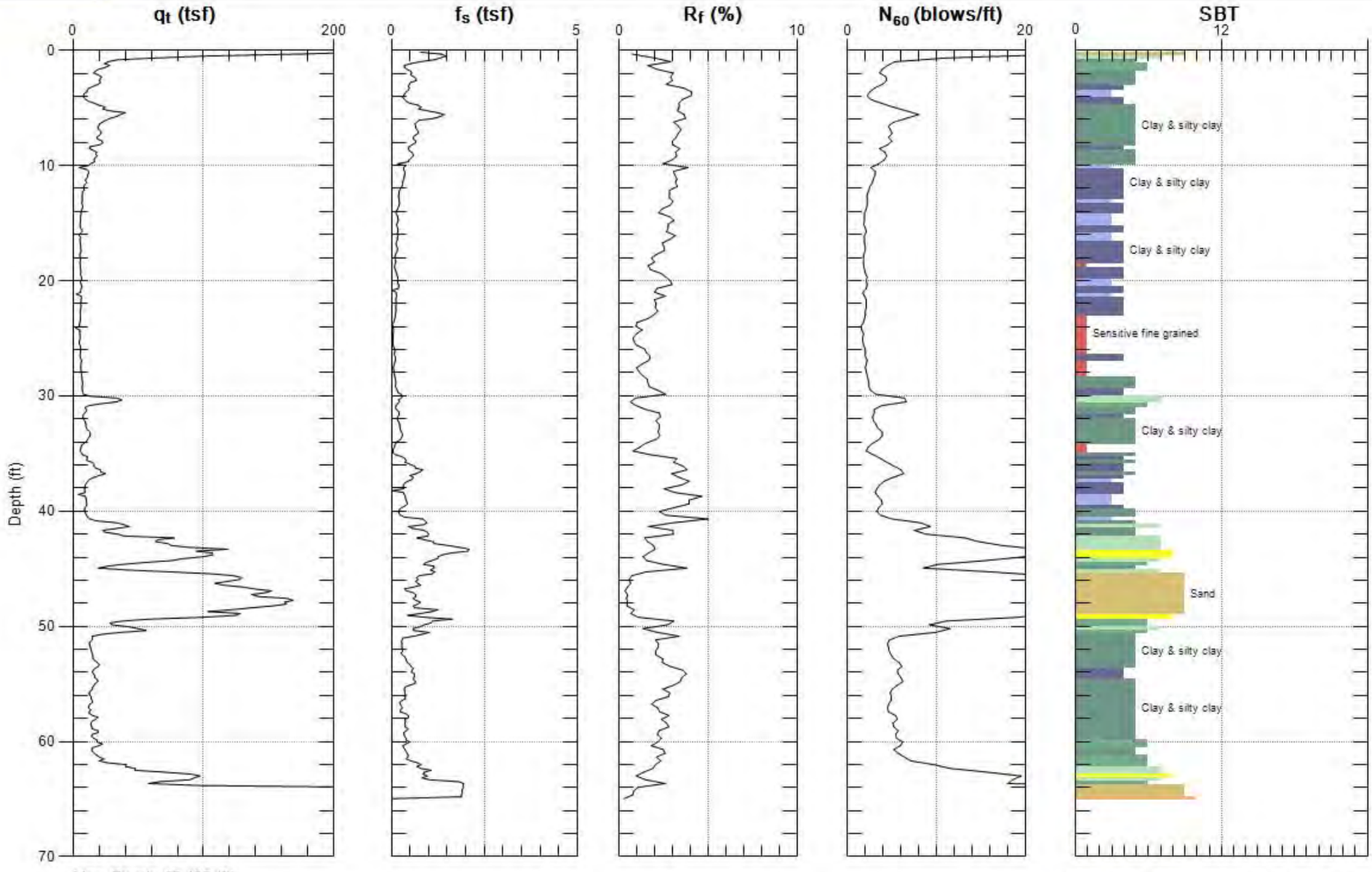
FIGURE A1-63

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-025

Engineer: E.HOLLIDAY
Date: 9/26/2012 10:30



Max. Depth: 65.125 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-64

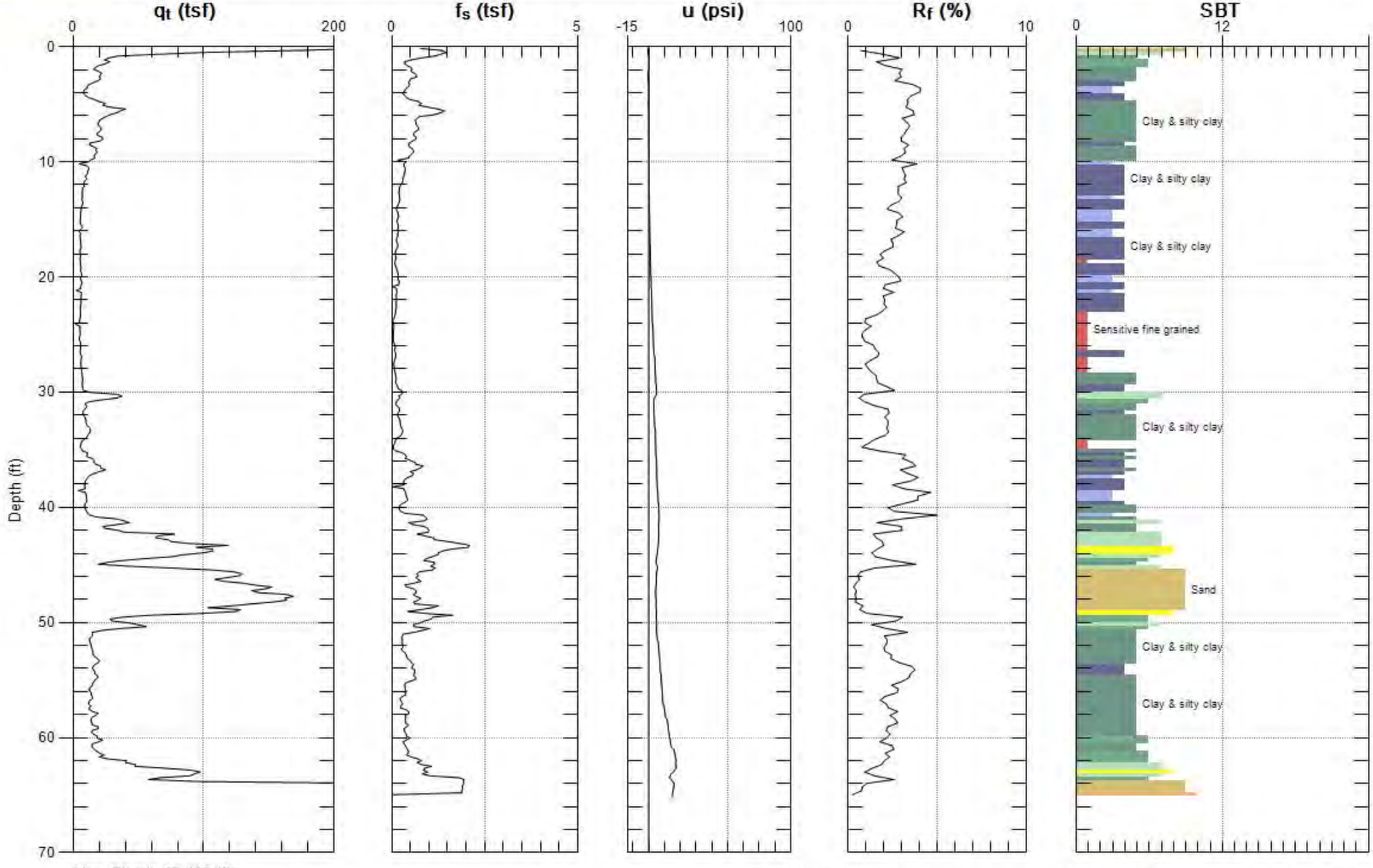
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-025

Engineer: E.HOLLIDAY
Date: 9/26/2012 10:30



Max. Depth: 65.125 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-64

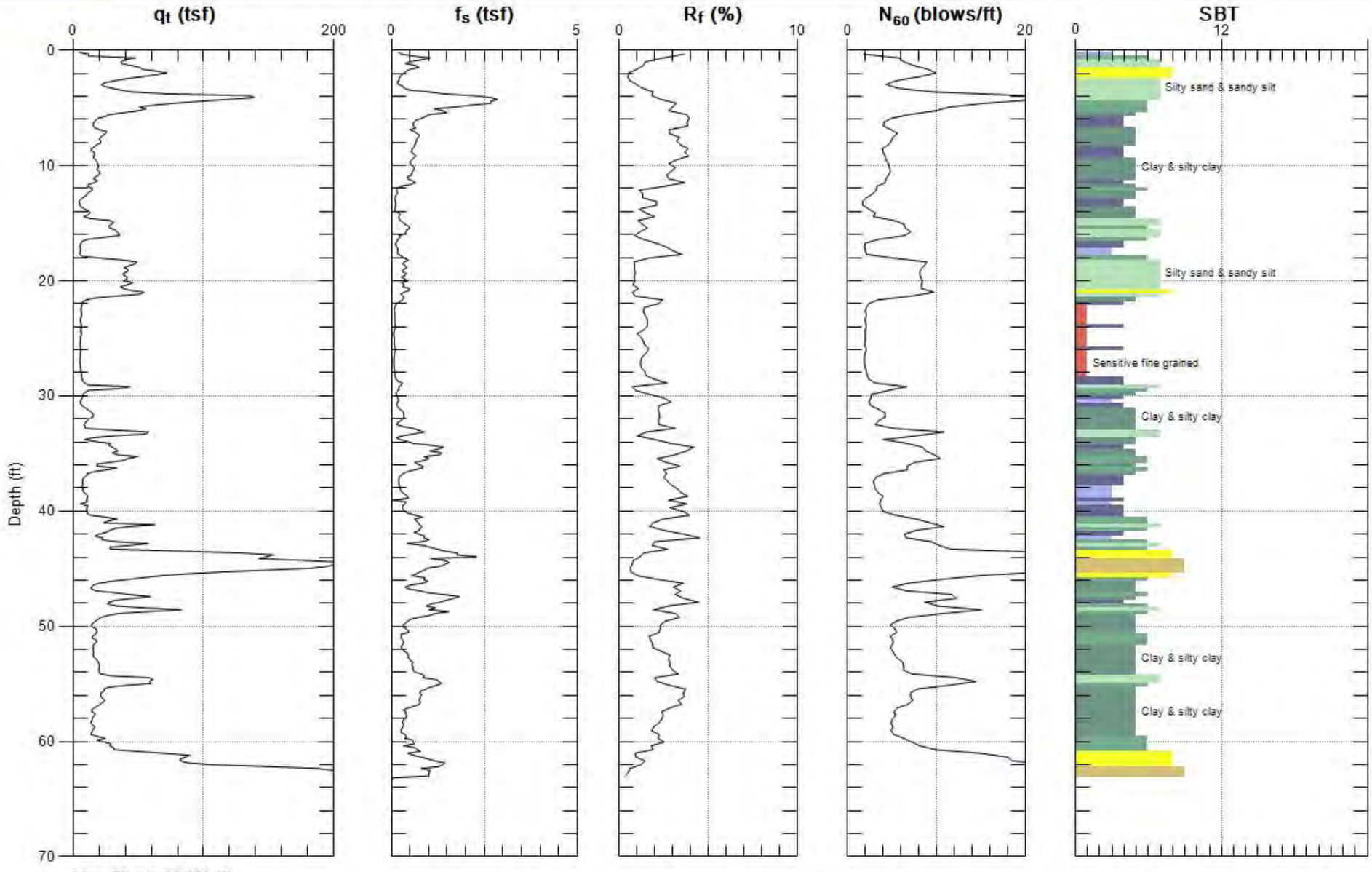
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-065

Engineer: E.HOLLIDAY
Date: 9/26/2012 09:52



Max. Depth: 63.320 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-65

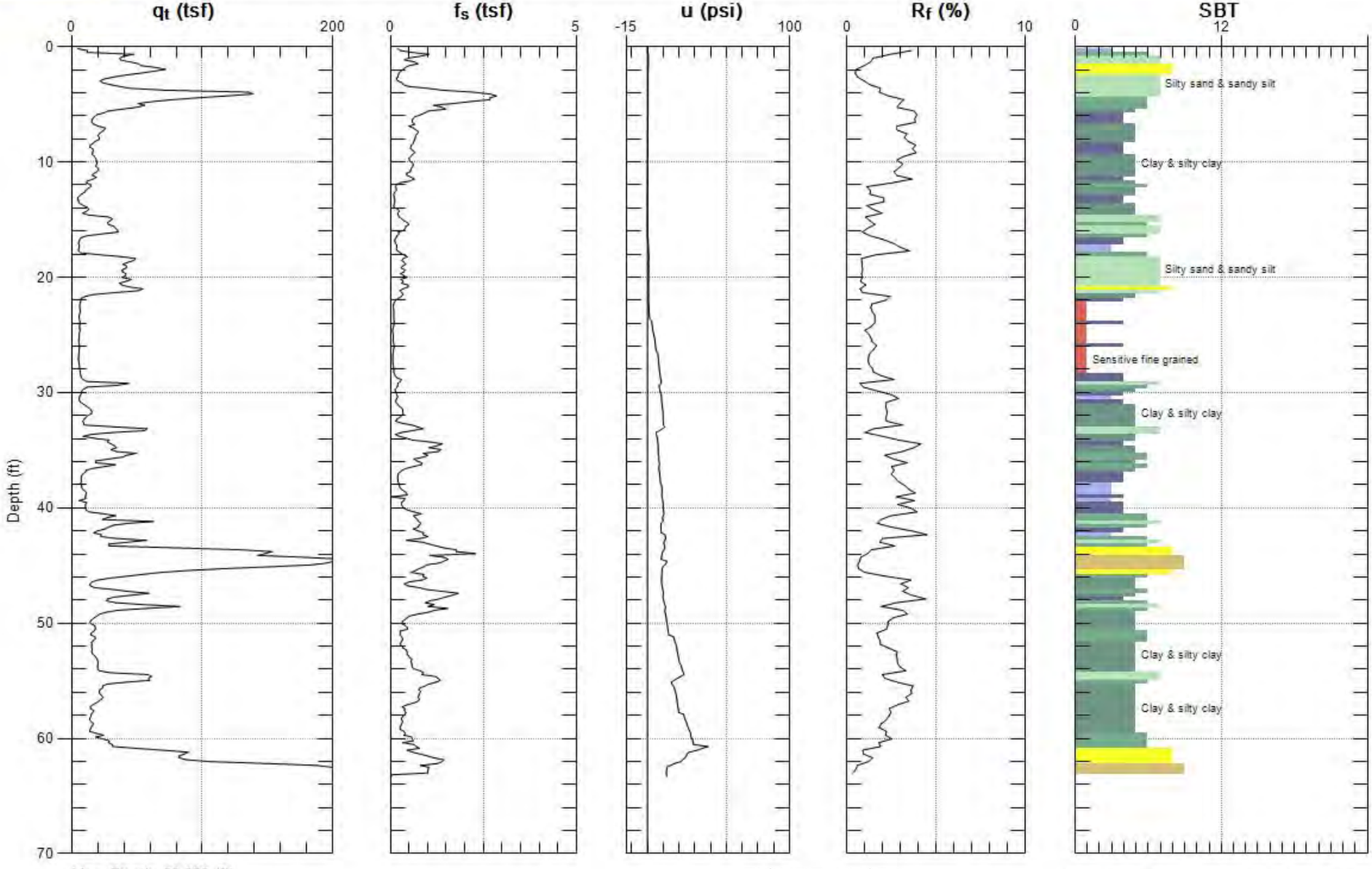
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-065

Engineer: E.HOLLIDAY
Date: 9/26/2012 09:52



Max. Depth: 63.320 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-65

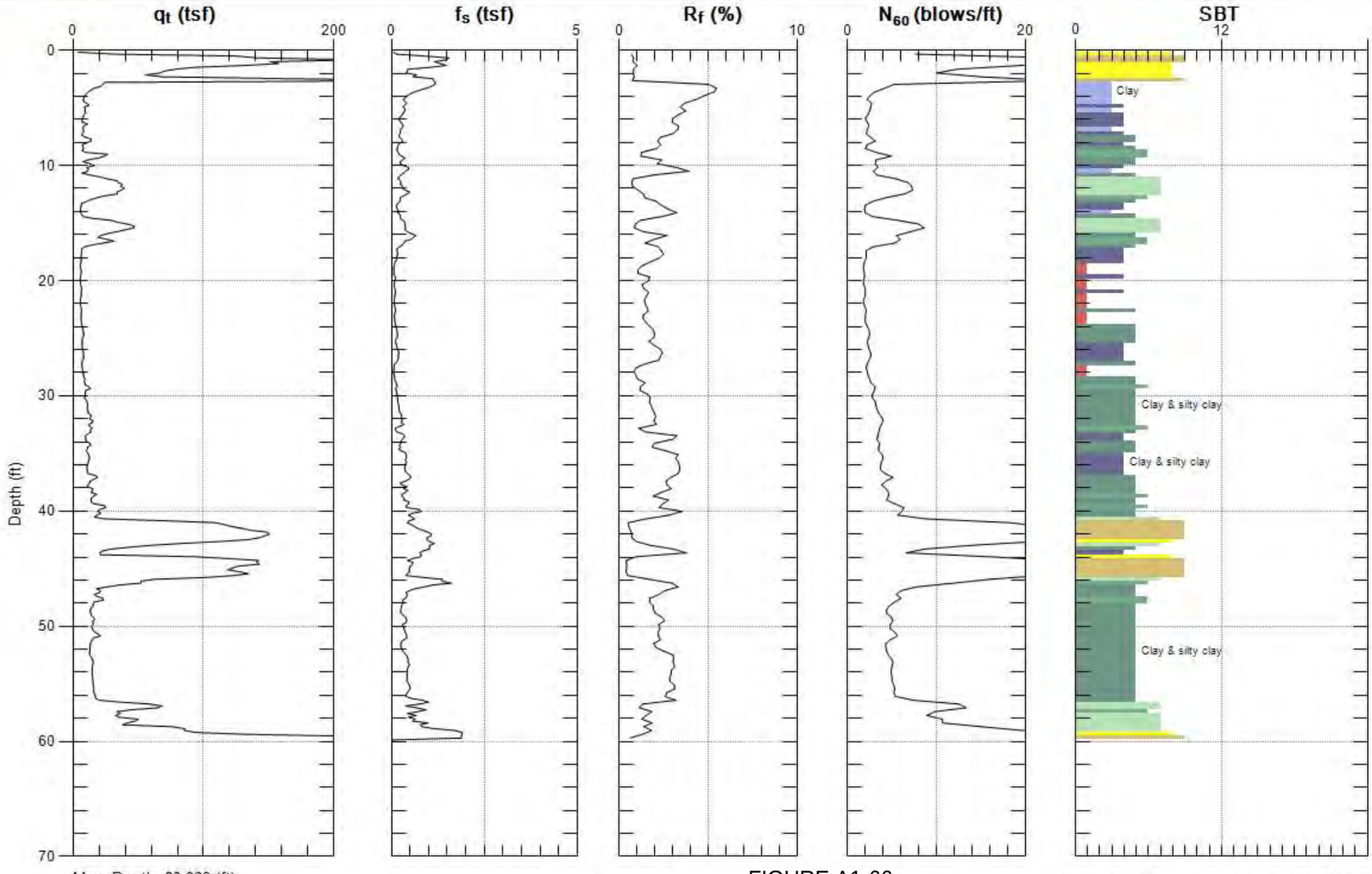
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-SCPT-022

Engineer: E.HOLLIDAY
Date: 9/26/2012 08:18



Max. Depth: 60.039 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-66

SBT: Soil Behavior Type (Robertson 1990)

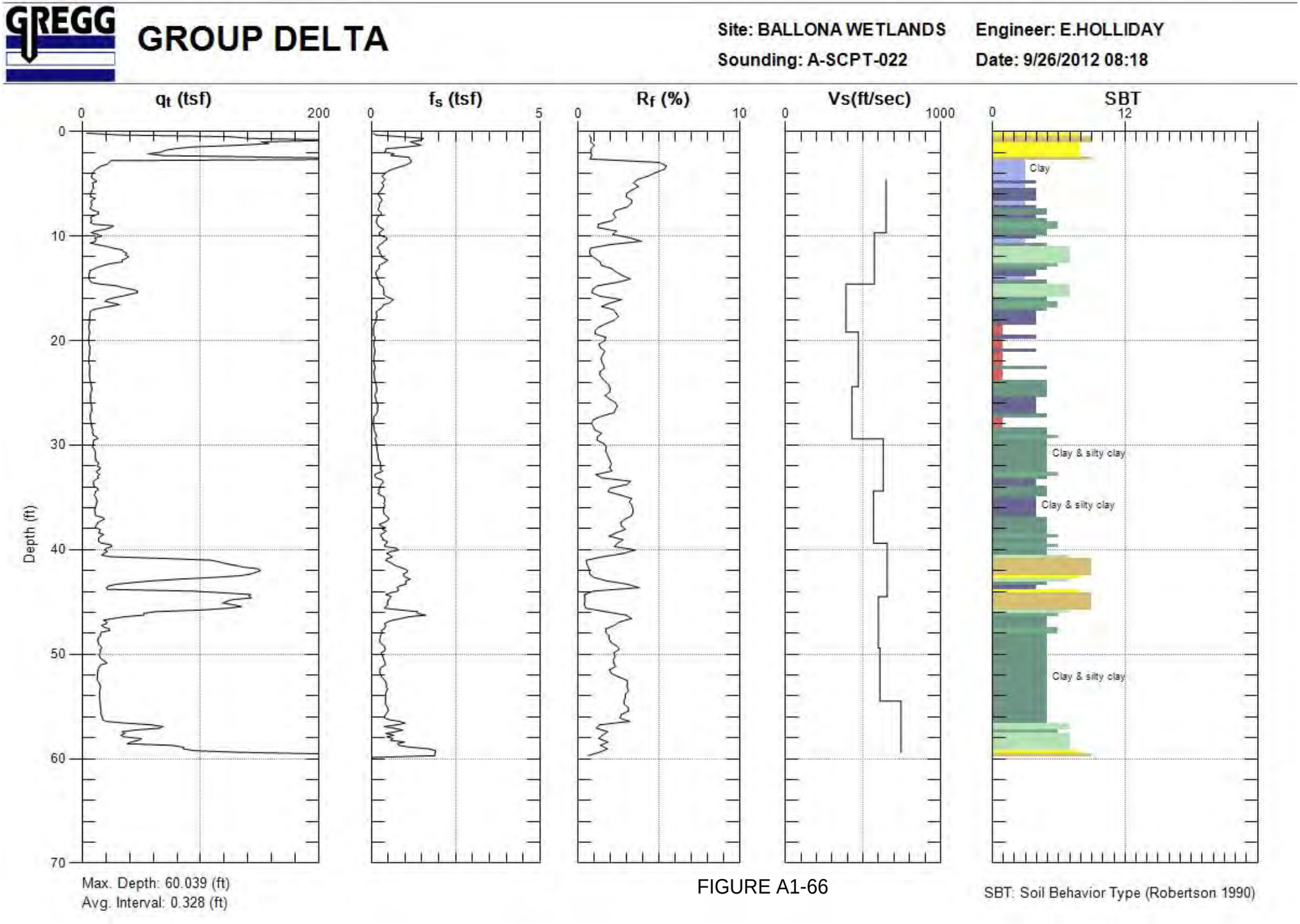

GREGG
GROUP DELTA
Site: BALLONA WETLANDS
Sounding: A-SCPT-022
Engineer: E.HOLLIDAY
Date: 9/26/2012 08:18
qt (tsf)
fs (tsf)
Rf (%)
Vs(ft/sec)
SBT
Depth (ft)
Clay
Clay & silty clay
Clay & silty clay
Clay & silty clay
Max. Depth: 60.039 (ft)
Avg. Interval: 0.328 (ft)
SBT: Soil Behavior Type (Robertson 1990)

FIGURE A1-66

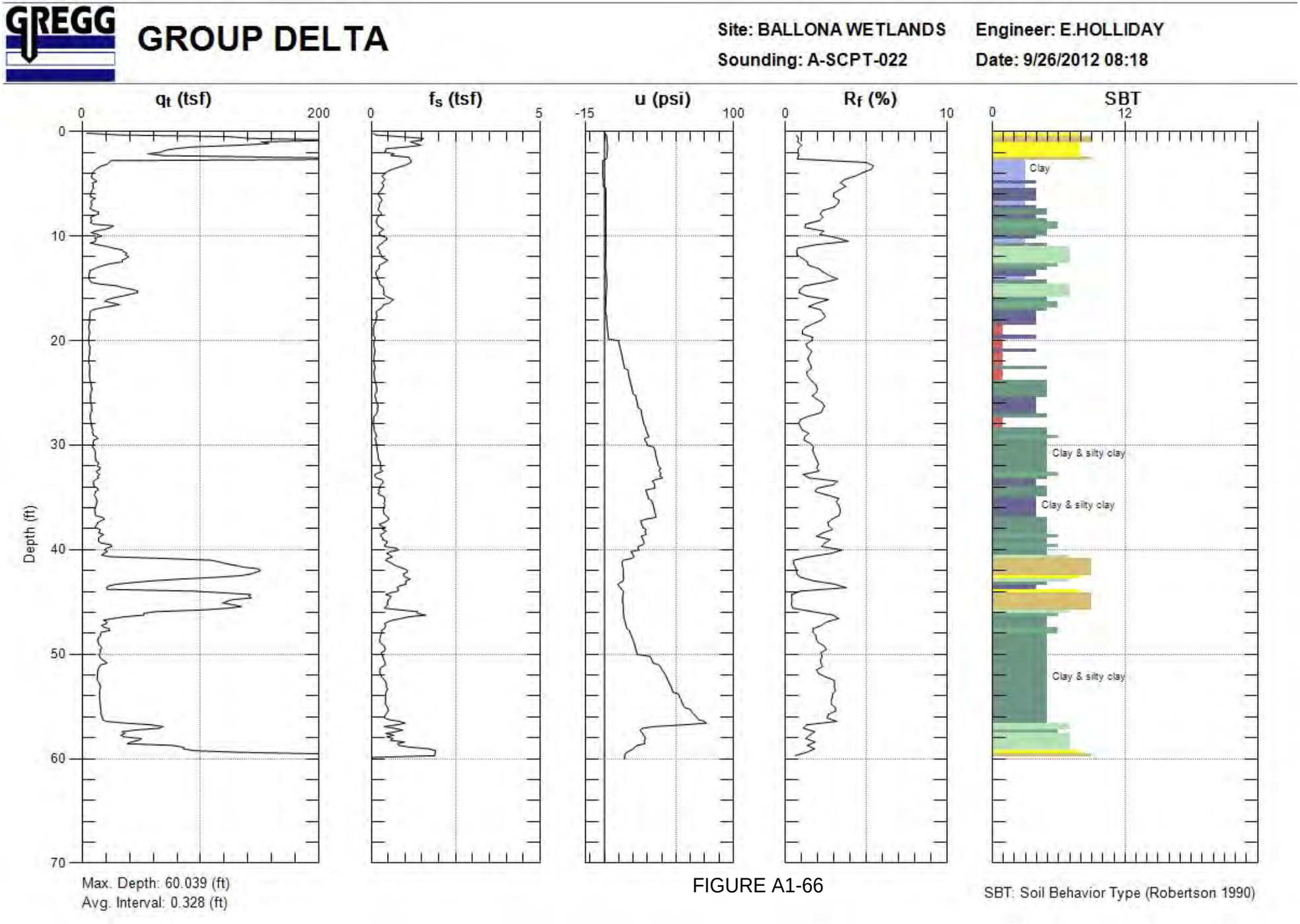

GREGG
GROUP DELTA
Site: BALLONA WETLANDS
Sounding: A-SCPT-022
Engineer: E.HOLLIDAY
Date: 9/26/2012 08:18
q_t (tsf)
f_s (tsf)
u (psi)
R_f (%)
SBT
Depth (ft)
Clay
Clay & silty clay
Clay & silty clay
Clay & silty clay
Max. Depth: 60.039 (ft)
Avg. Interval: 0.328 (ft)
SBT: Soil Behavior Type (Robertson 1990)

FIGURE A1-66

APPENDIX A2
FIELD EXPLORATIONS BY OTHERS

APPENDIX A2
PREVIOUS FIELD EXPLORATIONS

A2.1 INTRODUCTION

Several previous geotechnical and environmental investigations have been performed at the site location. Data from previous investigations by Law Crandall, Inc., Weston Solutions, Inc. and Diaz Yourman & Associates were used for preliminary analyses of this interim report. The exploration locations are shown in Figure 3 of the report.

Borings by Law Crandall, Inc. and Diaz Yourman & Associates were performed primarily for geotechnical purposes. Law Crandall, Inc. performed preliminary geotechnical investigations in each of the Areas within the project (Areas A, B and C) and presented the results of investigations within different areas in separate reports. Diaz Yourman & Associates performed a preliminary geotechnical investigation for Areas B and C. Borings by Weston Solutions, Inc. were performed primarily for the purpose of chemistry and environmental testing, and are not included in this Appendix. A summary of the geotechnical field investigations by Law Crandall, Inc. and Diaz Yourman & Associates, including previous geotechnical borings, is provided in this Appendix.

A2.2 LAW CRANDALL, INC. INVESTIGATIONS

In Area A, field investigation by Law Crandall, Inc. included 20 borings and 5 cone penetration tests (CPT). Drilling was performed in December 1988 and January 1989. Fourteen (14) of the borings were drilled using 5-inch-diameter rotary wash drilling equipment, while the other six (6) borings were performed using a bucket-type drilling equipement. Drilling mud was used for rotary wash borings to prevent caving. The rotary wash borings were drilled to a depth of approximately 60 feet. The bucket-type borings were drilled to a depth of approximately 16 to 20 feet below the existing grade using 16- and 18-inch bucket-type drilling equipment. Subsurface materials were visually classified and recorded by a field technician in accordance with the Unified Soil Classification System (USCS), and undisturbed and disturbed samples were collected for laboratory testing. Standard penetration tests (SPT) were performed in selected borings. CPTs were also advanced to a maximum depth of approximately 60 feet. The logs of borings and CPTs performed during this investigation are presented in this Appendix.

In Area B, field investigation by Law Crandall, Inc. included 32 borings in January and February 1991, and 21 borings at earlier investigation dates of December of 1986 and April of 1987. Most of the borings were drilled using 5-inch-diameter rotary wash drilling equipment to a depth of approximately 20 to 60 feet. Drilling mud was used for rotary wash borings to prevent caving. The drilling mud was removed following completion of the drilling to permit measurement of the

groundwater level. Six (6) borings were performed using 8-inch-diameter hollow stem auger equipment to a depth of approximately 30 feet. Additionally, six 8-inch-diameter hand auger borings were drilled to a depth of 5 to 9 feet below the existing grade. At twelve locations, the rotary wash borings were converted to groundwater monitoring wells to measure the fluctuations in the groundwater levels. Subsurface materials were visually classified and recorded by a field technician in accordance with the Unified Soil Classification System (USCS), and undisturbed and disturbed samples were collected for laboratory testing. Standard penetration tests (SPT) were performed in 21 of more recent borings as well as several of the earlier borings. The logs of borings performed during this investigation are presented in this Appendix.

In Area C, geotechnical field investigation by Law Crandall, Inc. included 5 borings. Drilling was performed in June 1991. The borings were drilled using 5-inch-diameter rotary wash drilling equipment. Drilling mud was used for rotary wash borings to prevent caving. The drilling mud was removed following completion of the drilling to permit measurement of the groundwater level. The rotary wash borings were drilled to a depth of approximately 60 to 75 feet. Subsurface materials were visually classified and recorded by a field technician in accordance with the Unified Soil Classification System (USCS), and undisturbed and bulk samples were collected for laboratory testing. Standard penetration tests (SPT) were performed in all borings in accordance with the ASTM Designation D1986-84 test procedure. Prior to the geotechnical field investigation Law Crandall, Inc. performed an investigation in 1988 for contamination assessment, which included drilling 17 8-inch hollow-stem auger borings. The logs of borings performed during both investigations are presented in this Appendix.

A2.3 DIAZ YOURMAN & ASSOCIATES INVESTIGATION

Field investigation by Diaz Yourman & Associates in Areas B and C included a total of 20 deep borings (13 borings in Area B and 7 borings in Area C), as well as three grab samples in Area B. The borings were drilled by Layne Christenson Company in February 2009, with a rubber tire-mounted CME-750 rig using hollow-stem auger drilling equipment to depths ranging from 16 to 32 feet below the existing grade. Subsurface samples were collected for both geotechnical and bulk chemistry testing. Grab samples for sediments were collected near the tidal gates of the Ballona Creek using a hand auger. Drive samples were collected with a 2.4-inch-inside-diameter (3.0-inch-outside diameter) modified California split-barrel sample lined with brass tubes and a standard split-spoon penetrometer with dimensions in accordance with ASTM 3550 and 1586, respectively. Both samplers were driven with a 140-pound hammer falling 30 inches. After samples were collected, boreholes were backfilled with soils cuttings and bentonite chips. The logs of borings performed during this investigation are presented in this Appendix.

A2.4 REFERENCES

Diaz Yourman & Associates, 2010, Geotechnical Investigation, Ballona wetlands, task Order No. 003, Contract No. W912PL-06-D-004, Los Angeles County, California, PN 2006, 023.05 for the USACE, 2010.

Law Crandall, 1988, "Report of Contamination Assessment, Playa Vista Project – Parcel C, Culvert Boulevard Between Lincoln Boulevard and Marina Freeway, Los Angeles, California", for Howard Hughes Properties, 1988.

Law Crandall, 1991, "Report of Preliminary Geotechnical Investigation, Proposed Marina, Playa Vista Project - Parcel A, Lincoln Boulevard and Ballona CreekLos Angeles County, California".

Law Crandall, 1991, "Supplementary Information, Proposed Marina, Playa Vista Project-Parcel A, Lincoln Boulevard and Ballona Creek, Los Angeles County, California".

Law Crandall, 1991, "Report of Geotechnical Investigation, Proposed Wetlands Restoration and Proposed Development, North of Jefferson Boulevard, Playa Vista Project – Parcel B, Los Angeles, California".

Law Crandall, 1991 "Report of Preliminary Geotechnical Investigation, Playa Vista Project – Parcel C, Culver and Lincoln Boulevards, Los Angeles, California," a report prepared for Maguire Thomas Partners, August 7, 1991.

JOB AE-88473 DATE 1/19/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

BORING 1

DATE DRILLED: January 5, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 14.9*

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							SM	FILL - SILTY SAND - fine, brown
							ML	FILL - CLAYEY SILT - dark grey
			17.8	91	9		SM	FILL - SILTY SAND - fine, lenses of Clayey Silt, brownish grey
10	5							
			22.2	101	17			Some seashells
							ML	FILL - SANDY SILT - lenses of Clayey Silt, some seashells, grey
5	10	6						
			41.2	77	1			SURFACE OF NATURAL SOIL
							ML	CLAYEY SILT - some seashells, grey
0	15							
		6						
			47.3	74	3			
-5	20						ML	SANDY SILT - grey
		11						
							MH	CLAYEY SILT - dark grey
-10	25		62.4	60	2			(LL = 68; PI = 21)
		2						
-15	30		79.9	53	2			Organic odor
		3						
-20	35		59.4	65	2			
							ML	CLAYEY SILT - brownish grey
-25	40	18						

* Elevations provided by Psomas & Associates.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.1a

Area A - Law Crandall Borings

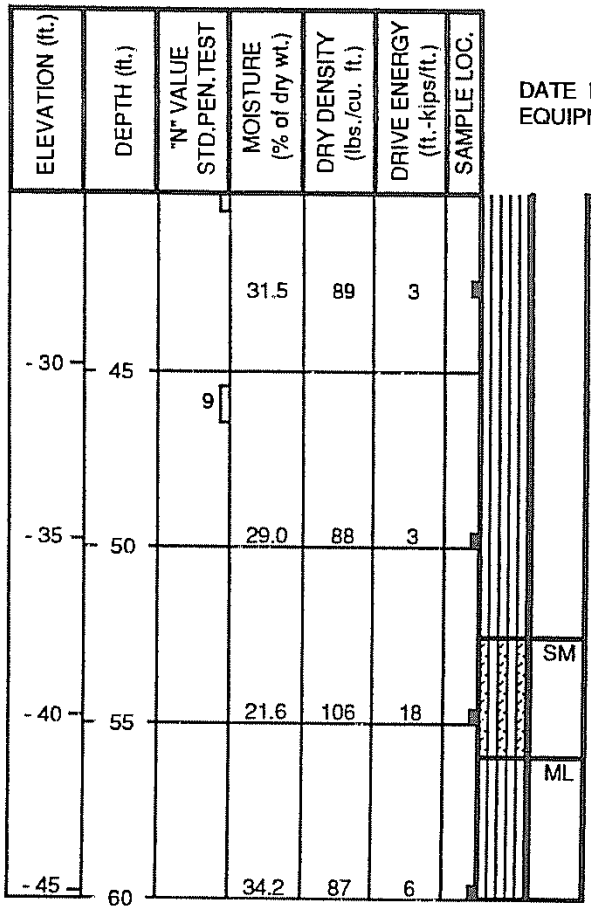
PLATE A2-1

B AE-88473 DATE 1/19/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 1 (Continued)

DATE DRILLED: January 5, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash



Bluish grey

SILTY SAND - fine, bluish grey

CLAYEY SILT - dark grey

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Drilled 18" - Diameter Bucket Boring 5' south of Rotary Wash Boring to a depth of 11-1/2' on 1/12/89 for water level determination. Water seepage encountered at a depth of 9-1/2'. Caving below 9-1/2' (to 2' in diameter).

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

Area A - Law Crandall Borings

PLATE A - 1.1b
PLATE A2-2

BORING 2

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 14.1

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
			37.8	80	2		ML	FILL - SANDY SILT - some seashells, brown
								Large amount of seashells, greyish brown
10			12.9	93	4		SM	FILL - SILTY SAND - fine, light brown
	5		59.3	66	1			Layers of Sandy Silt, some seashells, dark grey
			26.6	99	4			Grey
5	10		43.6	76	<1		ML	FILL - CLAYEY SILT - grey (LL = 43; PI = 10; oven dry LL = 39)
0								SURFACE OF NATURAL SOIL
	15		34.0	88	3		ML	SANDY SILT - slightly Clayey, brown and grey
								Some seashells
-5	20							Large amount of seashells
							MH	CLAYEY SILT - organic odor, grey
-10	25		77.9	55	1			
-15	30		48.4	71	2			Dark grey
-20	35		54.3	69	2			
-25	40		35.4	85	4		ML	CLAYEY SILT - dark grey (LL = 39; PI = 5)

(CONTINUED ON FOLLOWING PLATE)

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.2a

Area A - Law Crandall Borings

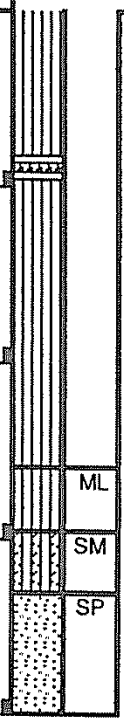
PLATE A2-3

JOB AE-88473 DATE 1/19/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD

BORING 2 (Continued)

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-30	45		33.8	86	4	
-35	50		52.3	65	3	
-40	55		19.1	111	18	
-45	60		19.5	104	54	



Layer of Peat

Traces of Peat

SANDY SILT - bluish grey

SILTY SAND - fine, some Gravel, traces of Peat, bluish grey

SAND - fine to medium, few Gravel and Cobbles, greyish brown

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 35' at completion of drilling. Water level measured at 7' after removal of mud. Boring grouted with cement-bentonite mixture.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

Area A - Law Crandall Borings

PLATE A - 1.2b
PLATE A2-4

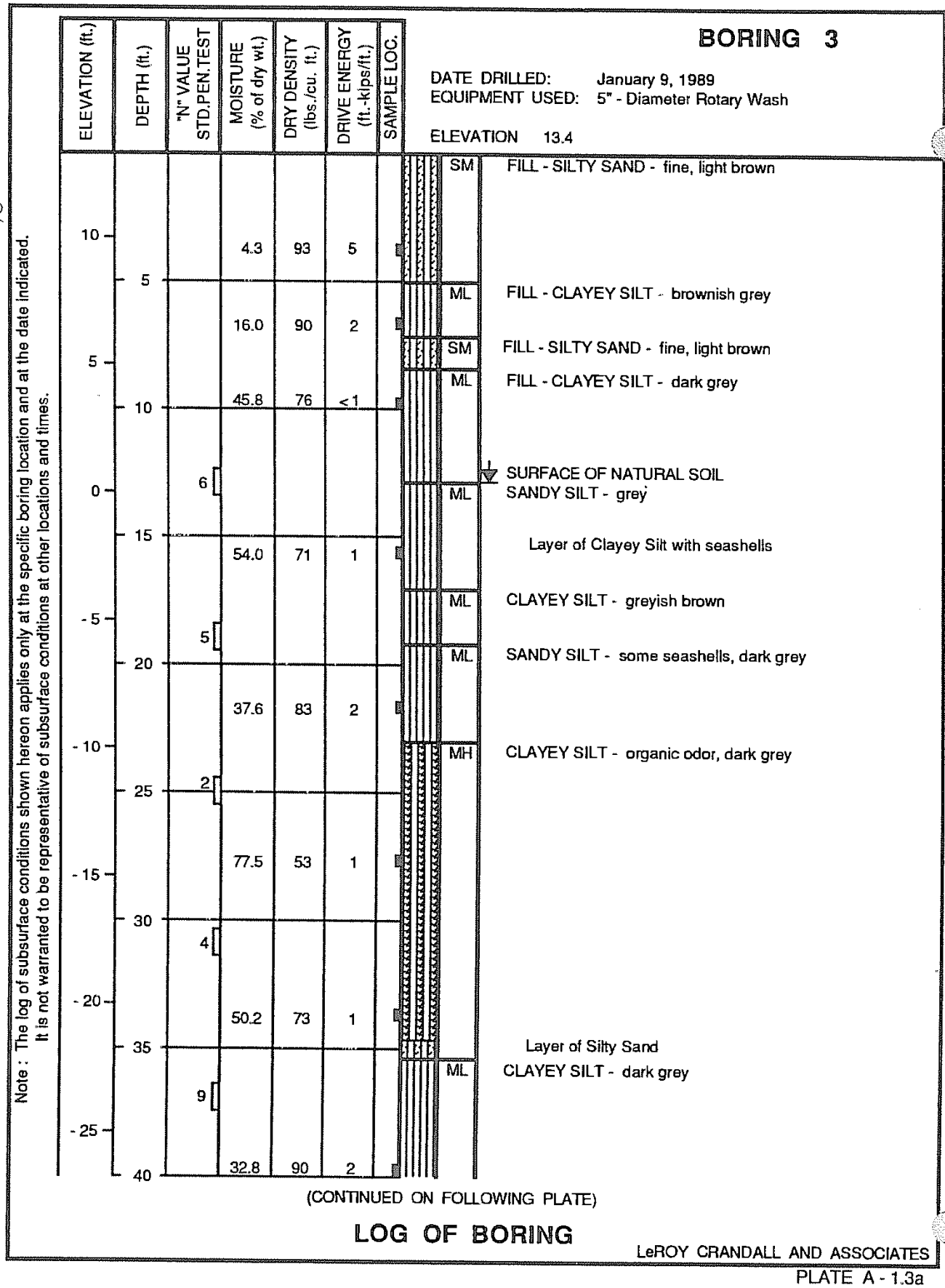


PLATE A - 1.3a

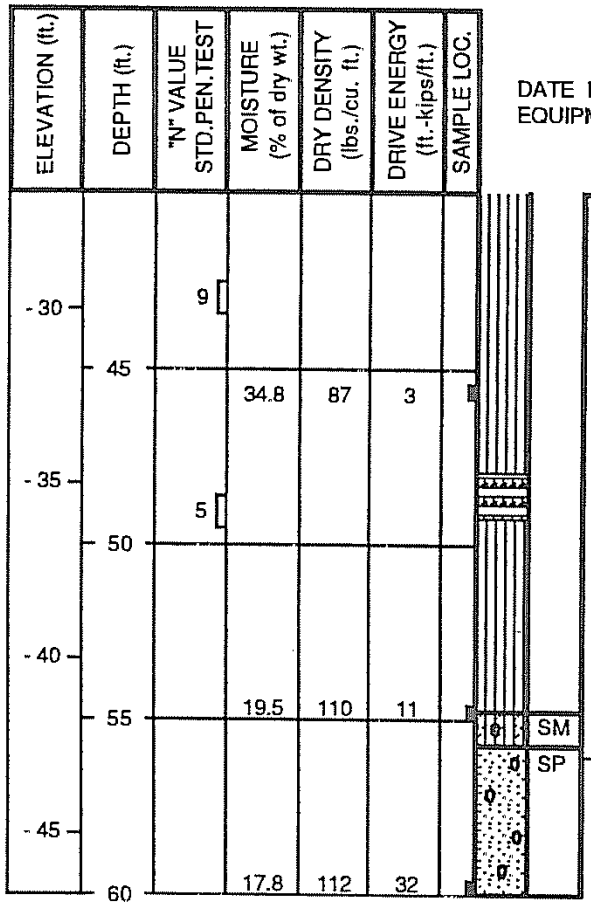
Area A - Law Crandall Borings

PLATE A2-5

AE-88473 DATE 1/19/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD BJL

BORING 3 (Continued)

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash



Layer of Peat

SILTY SAND - fine to medium, some Gravel, traces of Peat, grey

SAND - medium to coarse, about 15% Gravel, light grey

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

Area A - Law Crandall Borings

PLATE A - 1.3b
PLATE A2-6

JOB AE-88473 DATE 1/19/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 4

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 12.1

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10			14.4	91	3		SM	FILL - SILTY SAND - fine, lenses of Clayey Silt, brown and grey
	5		35.3	84	1		MH	FILL - CLAYEY SILT - dark grey
5			63.0	63	< 1			Some rootlets
	10		39.5	82	< 1		ML	FILL - CLAYEY SILT - brown
0								SURFACE OF NATURAL SOIL
			33.6	88	4		ML	CLAYEY SILT - lenses of Sandy Silt, light grey
	15		37.6	84	< 1		SM	SILTY SAND - fine, light brown
- 5								Grey
	20		37.9	84	1			
- 10							OH	CLAYEY SILT - some seashells, organic odor, dark grey
	25		85.8	49	1			(LL = 109; PI = 30; oven dry LL = 68)
- 15								
	30		46.5	71	1			About 20% seashells, brownish grey
- 20							ML	CLAYEY SILT - some seashells, bluish grey
	35		23.5	104	3			
- 25								
	40		35.5	88	3			Dark gray

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.4a

Area A - Law Crandall Borings

PLATE A2-7

BORING 4 (Continued)

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-30						
	45		81.3	49	3	
-35						
	50		22.7	104	5	
-40						
	55		12.5	129	40	
-45						
	60		8.2	137	50	

Traces of Peat

PT PEAT - brown

ML CLAYEY SILT - traces of Peat, dark grey

SP SAND - fine to coarse, about 30% Gravel and Cobbles, grey

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

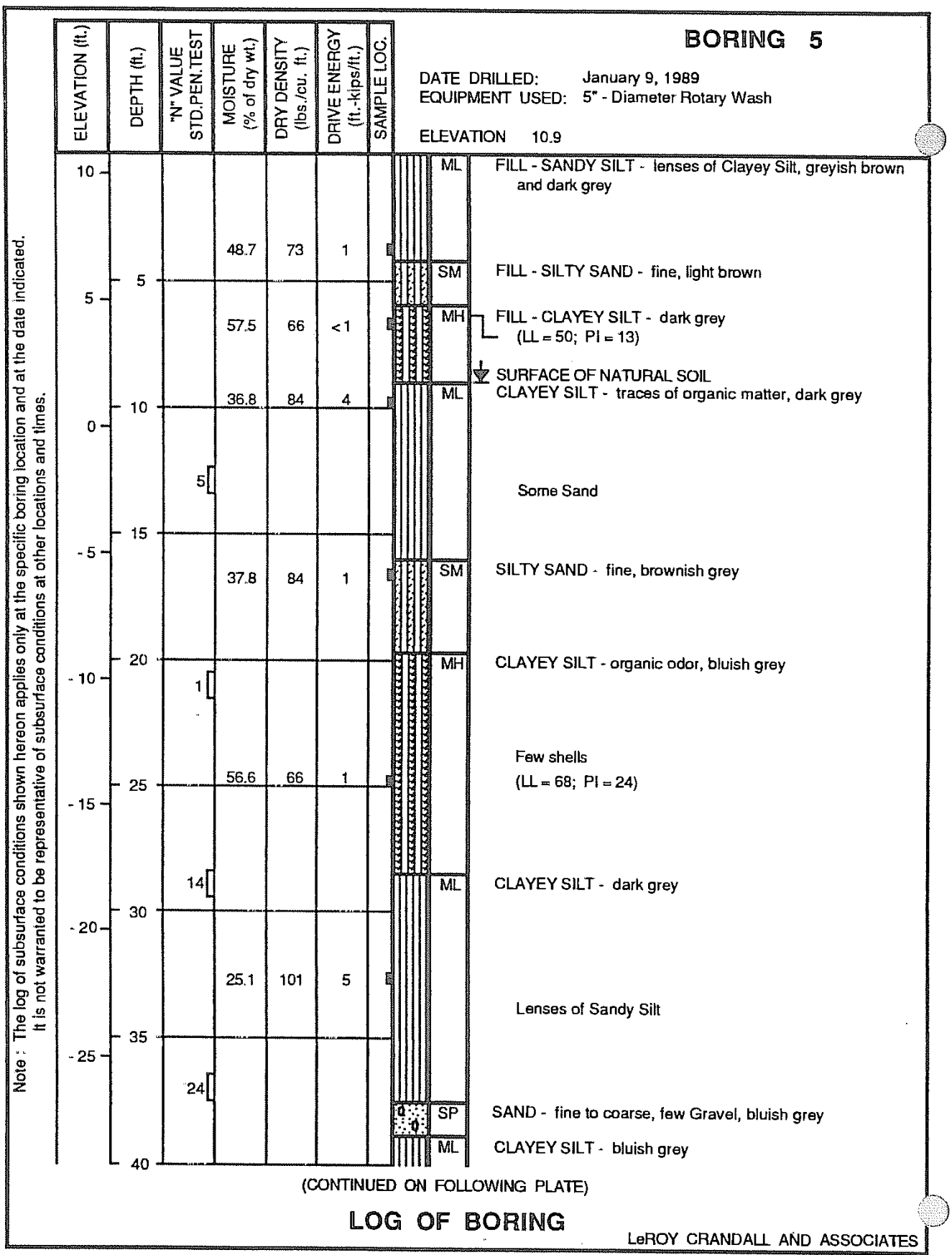
AE-88473 DATE 1/19/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD BJC

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

Area A - Law Crandall Borings

PLATE A - 1.4b
PLATE A2-8



JOB AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.5a

Area A - Law Crandall Borings

PLATE A2-9

BORING 5 (Continued)

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-30			29.2	89	6	
	45	8				
-35						
			17.7	114	54	
	50					
-40		53				
	55					
-45			9.4	128	39	
	60					
-50						
	65					

Traces of Peat

SP SAND - fine to coarse, some Silt, some Gravel and Cobbles, grey

Large amount of Gravel and Cobbles

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

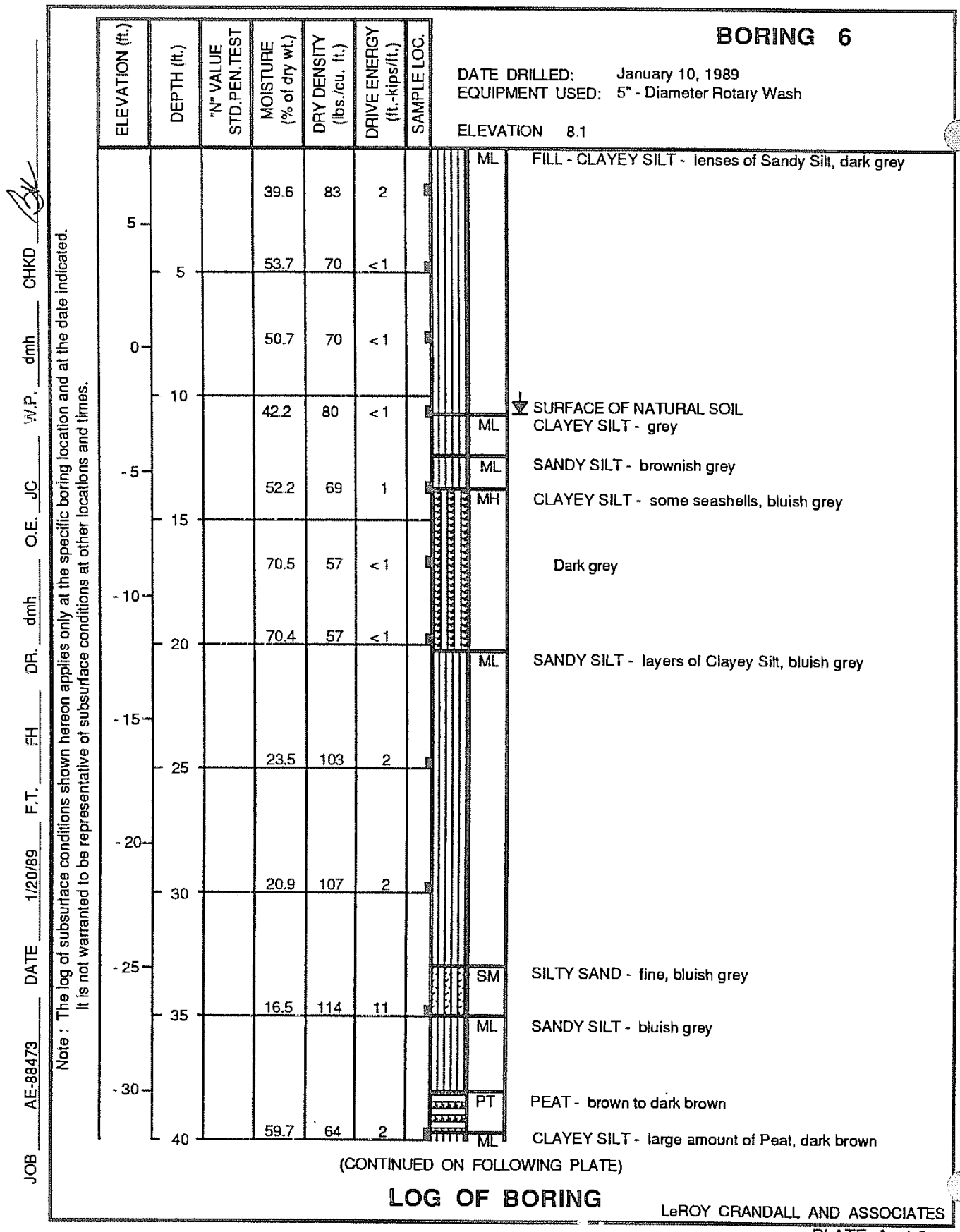
AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

Area A - Law Crandall Borings

PLATE A - 1.5b
PLATE A2-10



Area A - Law Crandall Borings

PLATE A2-11

AE-88473 DATE 1/20/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 6 (Continued)

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-35	45		20.2	108	14	
-40	50		11.3	126	32	
-45	55		10.0	130	36	
-50	60					

SM SILTY SAND - fine to medium, bluish grey

SP SAND - fine, grey

SW SAND - well graded, about 20% Gravel, grey

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Drilled 18" - Diameter Bucket Boring 5' south of Rotary Wash Boring to a depth of 12-1/2' on 1/12/89 for water level determination. Water seepage encountered at a depth of 11'. Hole squeezing in below 11'.

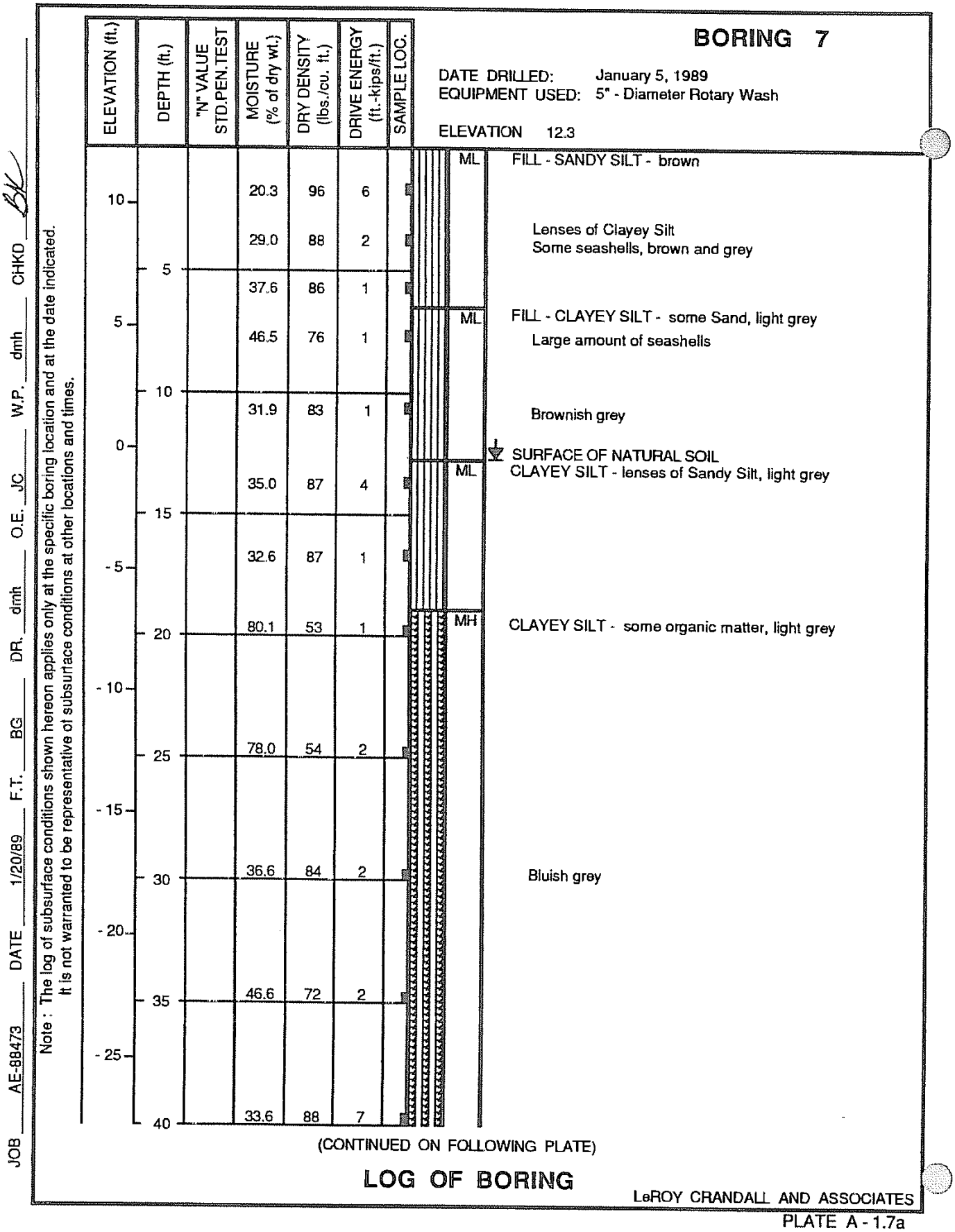
LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

Area A - Law Crandall Borings

PLATE A - 16b

PLATE A2-12



(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.7a

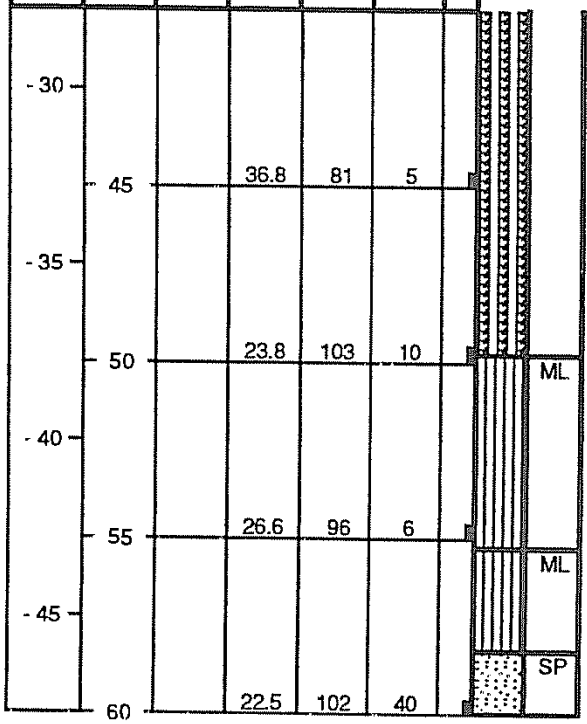
Area A - Law Crandall Borings

PLATE A2-13

JB AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD

BORING 7 (Continued)

DATE DRILLED: January 5, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash



(LL = 56; PI = 23)

SANDY SILT - few seashells, bluish grey

Black
CLAYEY SILT - grey

SAND - fine to medium, grey

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 60' at completion of drilling. Water level measured at 7' after removal of mud. Boring grouted with cement-bentonite mixture.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

Area A - Law Crandall Borings

PLATE A - 1.7b
PLATE A2-14

JOB AE-88473 DATE 1/20/89 F.T. TC DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 8

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 16" - Diameter Bucket

ELEVATION 12.9

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10	5		24.8	92	< 1		ML	FILL - SANDY SILT - brownish grey Some lumps of Clayey Silt
5	10		33.8	89	< 1		ML	FILL - CLAYEY SILT - grey (LL = 37; PI = 8)
			57.4	70	< 1		MH	FILL - CLAYEY SILT - bluish grey Brownish grey
0	15		48.1	73	< 1		ML	SURFACE OF NATURAL SOIL CLAYEY SILT - light brown
-5	20		35.8	86	< 1			

NOTE: Water seepage encountered at 13'. Water level measured at 15' at completion of drilling and at 13' 20 minutes later. Caving below 13'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.8

Area A - Law Crandall Borings

PLATE A2-15

BORING 9

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 16" - Diameter Bucket

ELEVATION 12.0

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10	0		19.2	96	< 1		SM	FILL - SILTY SAND - fine, light brown
							ML	FILL - SANDY SILT - greyish brown
			41.6	82	< 1		ML	FILL - CLAYEY SILT - dark grey
5	5		64.0	62	< 1		MH	FILL - CLAYEY SILT - dark grey
			47.9	72	< 1			
0	10		55.6	68	< 1			SURFACE OF NATURAL SOIL
							ML	CLAYEY SILT - some Sand, some cemented nodules, dark brown
-5	15							
	20							

NOTE: Water seepage encountered at 13-1/2'. Water level measured at 13' 20 minutes after completion of drilling. Caving below 12'. Hole squeezed in below 14' after drilling to 17'.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

B ___ AE-88473 ___ DATE ___ 1/20/89 ___ F.T. ___ TC ___ DR. ___ dmh ___ O.E. ___ JC ___ W.P. ___ dmh ___ CHKD ___

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

Area A - Law Crandall Borings

PLATE A - 1.9
PLATE A2-16

JOB AE-88473 DATE 1/20/89 F.T. TC DR. dmh O.E. JC W.P. dmh CHKD KBL

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 10

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 16" - Diameter Bucket

ELEVATION 10.6

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10			32.9	89	< 1		ML	FILL - SANDY SILT - brown
			62.5	61	< 1		MH	FILL - CLAYEY SILT - bluish grey and brown
	5							Some organic matter
5			83.5	53	< 1			Lenses of Sandy Silt
			32.7	86	< 1		ML	FILL - CLAYEY SILT - brownish grey
								SURFACE OF NATURAL SOIL
	10						ML	SANDY SILT - brownish grey
0			35.0	88	< 1			
			37.4	87	< 1			
	15						ML	CLAYEY SILT - bluish grey
-5								
	20							

NOTE: Water seepage encountered at a depth of 11'. Caving below 11'. Hole squeezed in below 12-1/2' after drilling to 16'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.10

Area A - Law Crandall Borings

PLATE A2-17

JOB AE-88473 DATE 1/20/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 11

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash
ELEVATION 10.3

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10							ML	FILL - CLAYEY SILT - greyish brown
			14.2	94	4			
5	5						SM	FILL - SILTY SAND - fine, greyish brown
			39.6	83	4		ML	FILL - CLAYEY SILT - some organic matter, brown
							ML	FILL - SANDY SILT - light grey
0	10		41.7	83	2			SURFACE OF NATURAL SOIL
		3					MH	CLAYEY SILT - traces of organic matter, light greyish brown
								Greyish brown
-5	15		48.1	74	<1			Some seashells, organic odor, grey
		0						Bluish grey
-10	20		77.6	52	<1			
		5						
-15	25		19.1	109	1			Some Sand, dark grey
-20	30						SP SM	SAND - fine to coarse, some Silt, about 10% Gravel, dark grey
		33						
			25.7	99	7		ML	SANDY SILT - bluish grey
-25	35							
		14					MH	CLAYEY SILT - bluish grey
	40		46.5	75	2			(LL = 67; PI = 32; oven dry LL = 62)

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

Area A - Law Crandall Borings

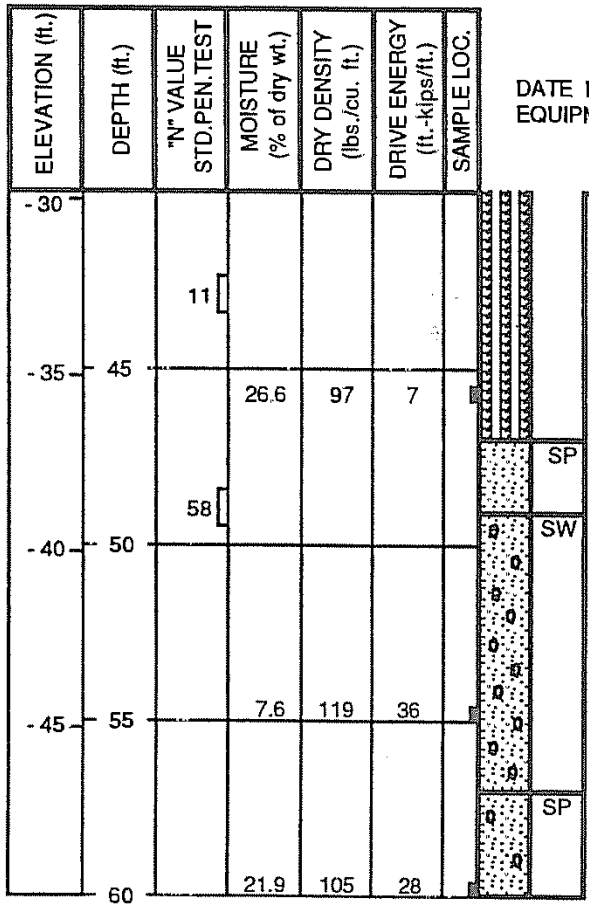
PLATE A - 1.11a
PLATE A2-18

JOB AE-88473 DATE 1/20/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 11 (Continued)

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash



Traces of Peat

Some Sand

SAND - fine to medium, grey

SAND - well graded, about 30% Gravel, grey

SAND - fine to medium, some Gravel, light grey

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.11b

Area A - Law Crandall Borings

PLATE A2-19

B ____ AE-88473 ____ DATE ____ 1/20/89 ____ F.T. ____ FH ____ DR. ____ dmh ____ O.E. ____ JC ____ W.P. ____ dmh ____ CHKD ____

BORING 12

DATE DRILLED: January 12, 1989
EQUIPMENT USED: 18" - Diameter Bucket

ELEVATION 13.2

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10			20.1	85	2		ML	FILL - CLAYEY SILT - layers of Sandy Silt, light brown and brown
			30.3	83	< 1			Some organic matter
	5						ML	FILL - SANDY SILT - layers of Clayey Silt, brown and dark grey
			22.7	91	< 1			
5			27.7	87	< 1			
	10						MH	FILL - CLAYEY SILT - dark grey
			45.6	75	< 1			
0							MH	SURFACE OF NATURAL SOIL CLAYEY SILT - some Sand, few seashells, brownish grey
	15		53.4	69	< 1			
- 5								
	20		40.2	81	< 1			Bluish grey

NOTE: Water seepage encountered at a depth of 13'. Water level measured at 16' 10 minutes after completion of drilling. Caving below 13' (to 2' in diameter).

Note ; The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

Area A - Law Crandall Borings

PLATE A - 1.12
PLATE A2-20

JOB AE-88473 DATE 1/20/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 13

DATE DRILLED: January 12, 1989
EQUIPMENT USED: 18" - Diameter Bucket

ELEVATION 11.6

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10			39.4	83	< 1		ML	FILL - SANDY SILT - light brown
							ML	FILL - CLAYEY SILT - bluish grey
			21.3	83	< 1		ML	FILL - SANDY SILT - light brown
	5						MH	FILL - CLAYEY SILT - bluish grey
5			62.5	65	< 1			Layers of Silty Sand and Sandy Silt, grey and dark grey
			35.8	87	< 1			
	10							
			34.0	87	< 1			SURFACE OF NATURAL SOIL
0							ML	CLAYEY SILT - some organic matter, bluish grey
	15		30.5	92	1			Brownish grey
-5							MH	CLAYEY SILT - bluish grey
	20							

NOTE: Water seepage encountered at a depth of 12'. Water level measured at 14-1/2' 10 minutes after completion of drilling. Caving below 12' (to 2' in diameter).

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.13

Area A - Law Crandall Borings

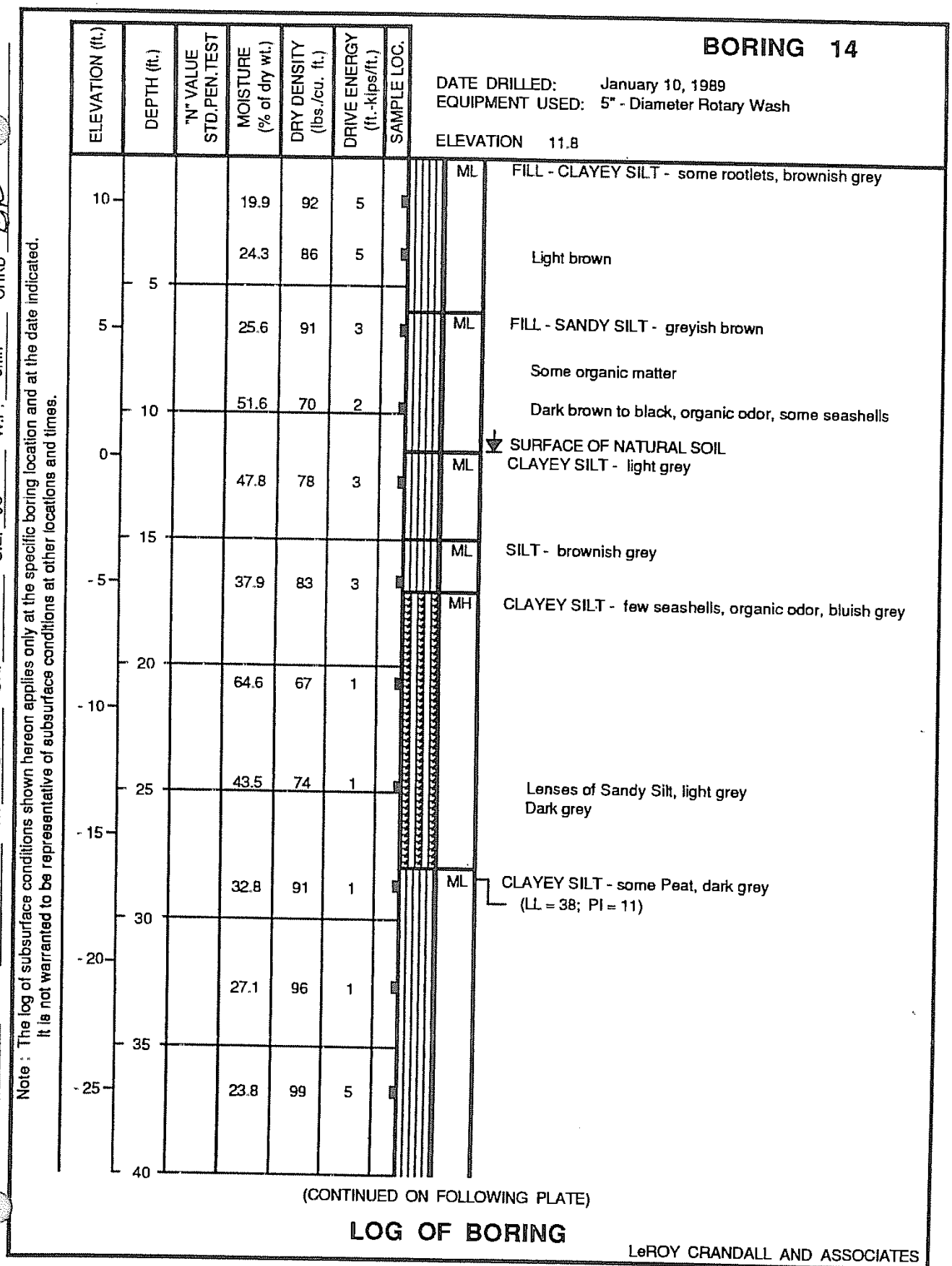
PLATE A2-21

BORING 14

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 11.8

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							ML	FILL - CLAYEY SILT - some rootlets, brownish grey
10			19.9	92	5			
			24.3	86	5			Light brown
	5							
5			25.6	91	3		ML	FILL - SANDY SILT - greyish brown
								Some organic matter
	10		51.6	70	2			Dark brown to black, organic odor, some seashells
								SURFACE OF NATURAL SOIL
0			47.8	78	3		ML	CLAYEY SILT - light grey
	15						ML	SILT - brownish grey
-5			37.9	83	3			
							MH	CLAYEY SILT - few seashells, organic odor, bluish grey
	20		64.6	67	1			
-10								
	25		43.5	74	1			Lenses of Sandy Silt, light grey Dark grey
-15								
			32.8	91	1		ML	CLAYEY SILT - some Peat, dark grey (LL = 38; PI = 11)
	30							
-20			27.1	96	1			
	35							
-25			23.8	99	5			
	40							



(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD BK

Area A - Law Crandall Borings

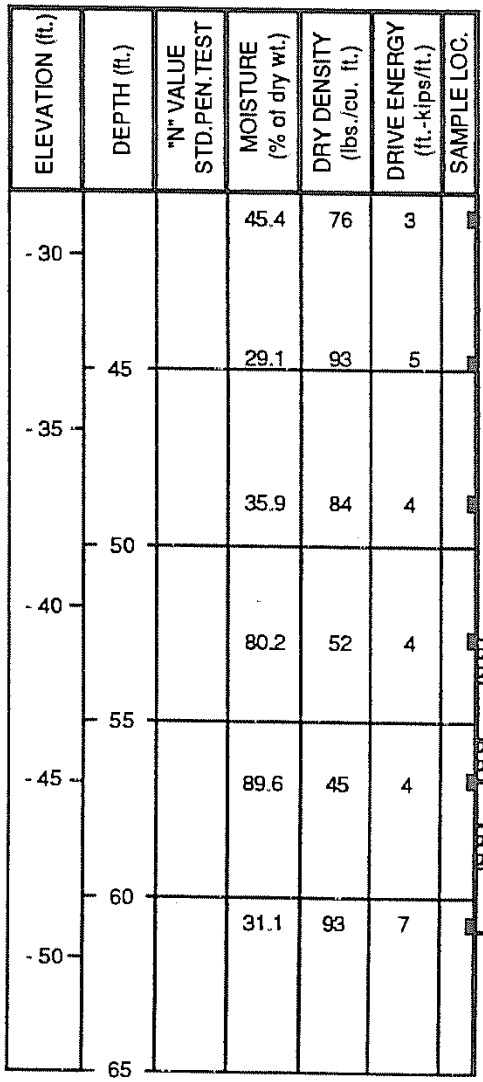
PLATE A - 1.14a

JOB AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 14 (Continued)

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash



Bluish grey

Dark grey

Layers of Peat, dark brownish grey and brown

Dark grey

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.14b

Area A - Law Crandall Borings

PLATE A2-23

JOB AE-88473 DATE 1/20/89 F.T. TC DR. dmh O.E. JC W.P. dmh CHKD

BORING 15

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 16" - Diameter Bucket

ELEVATION 10.7

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10							ML	FILL - SANDY SILT - greyish brown
			24.2	92	2			
								Lenses of Clayey Silt
	5		30.9	81	< 1			
5							ML	FILL - CLAYEY SILT - greyish brown
			40.0	80	< 1			Some organic matter
								Layer of Silty Sand
			44.2	79	< 1			SURFACE OF NATURAL SOIL
	10						ML	SANDY SILT - grey
0			51.9	69	< 1		MH	CLAYEY SILT - light grey
								(LL = 59; PI = 20)
	15							
-5			43.9	79	< 1			Brownish grey
	20							

NOTE: Water seepage encountered at a depth of 12'. Water level measured at 12-1/2' 10 minutes after completion of drilling. Caving below 12'. Hole squeezed in below 13-1/2' after drilling to 16'.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

Area A - Law Crandall Borings

PLATE A - 1.15
PLATE A2-24

JOB AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 16

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 11.3

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10			43.6	73	1		ML	FILL - CLAYEY SILT - brownish grey
			18.4	95	5		ML	FILL - SANDY SILT - light brown
5	5		21.4	84	1		ML	FILL - CLAYEY SILT - brown
	10		18.5	110	7		ML	FILL - SANDY SILT - few Gravel, brownish grey
0			48.5	71	2		MH	SURFACE OF NATURAL SOIL CLAYEY SILT - some Sand, traces of organic matter, dark grey
	15	3						Brownish grey
-5	20		71.7	56	2			Few seashells, organic odor, bluish grey
-10	25	4						Dark grey
-15			26.9	97	3			Layer of Sandy Silt, traces of Peat, dark greyish brown
	30	23						
-20	35		42.8	77	2			Traces of Peat
-25		15					ML	CLAYEY SILT - bluish grey
	40							

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.16a

BORING 16 (Continued)

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.	
-30	45	8	23.8	100	8		Some Sand
-35			37.3	85	8		Dark grey
-40	50	15					Traces of Peat
-45	55		32.5	86	6		
-50	60		10.5	129	72	SP	SAND - fine to coarse, some Gravel and Cobbles, light grey
	65						

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Drilled 18" - Diameter Bucket Boring 5' east of Rotary Wash Boring to a depth of 13' on 1/12/89 for water level determination. Water seepage encountered at a depth of 11-1/2'. No caving.

B AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

Area A - Law Crandall Borings

PLATE A - 1.16b
PLATE A2-26

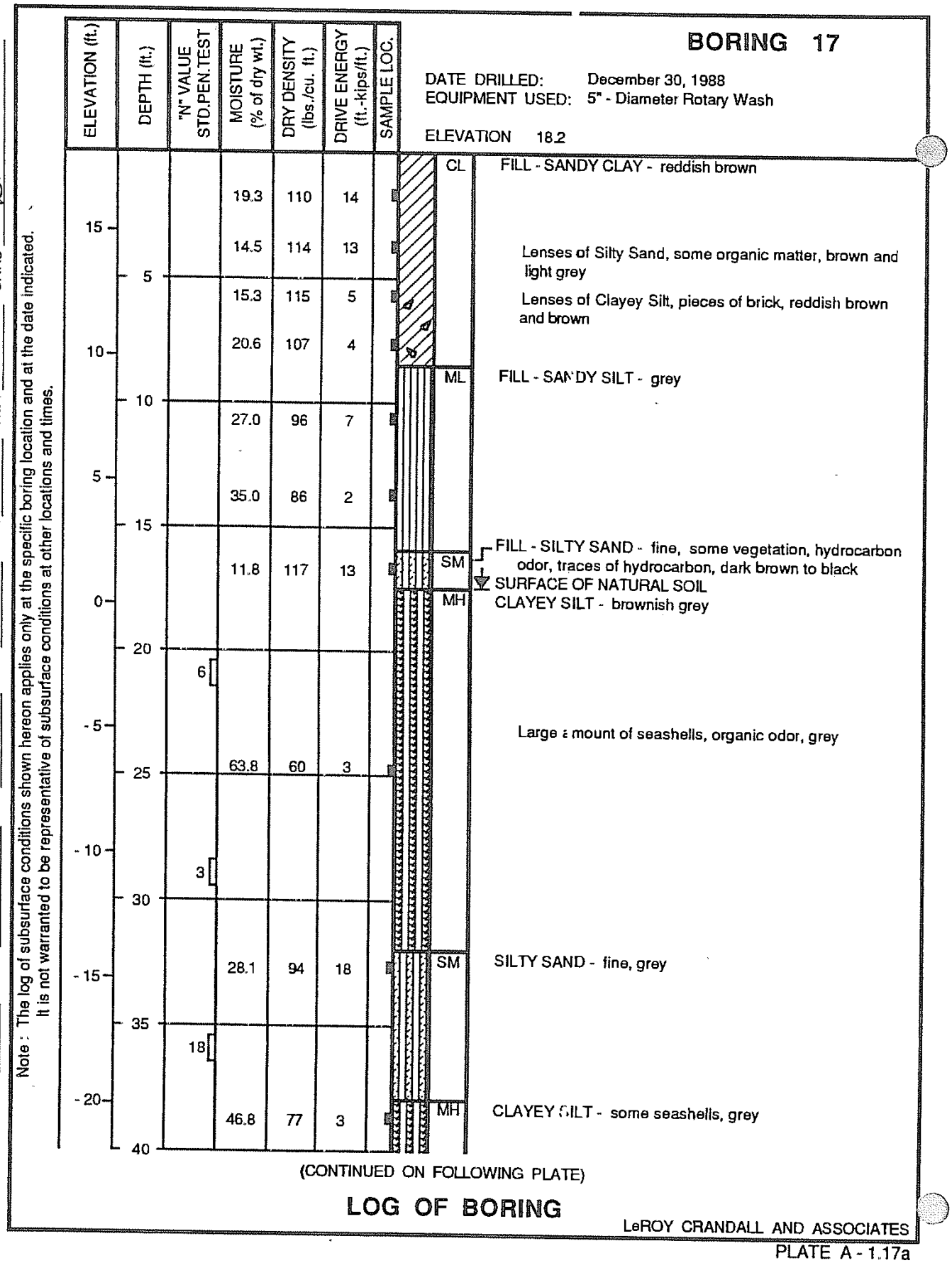


PLATE A - 1.17a

Area A - Law Crandall Borings

PLATE A2-27

BORING 17 (Continued)

DATE DRILLED: December 30, 1988
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
								Bluish grey
-25	45	8	23.7	94	45		SM	SILTY SAND - fine, grey
-30	50	10	19.9	109	16		ML	CLAYEY SILT - some seashells, bluish grey
								Some Sand
-35	55		20.6	109	5		ML	SANDY SILT - slightly Clayey, grey
-40			27.6	94	5		ML	CLAYEY SILT - some cemented lumps, bluish grey
	60		33.4	90	5			

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 40' at completion of drilling. Water level measured at 15-1/2' 4 days after removal of mud. Boring grouted with sand and cement slurry.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

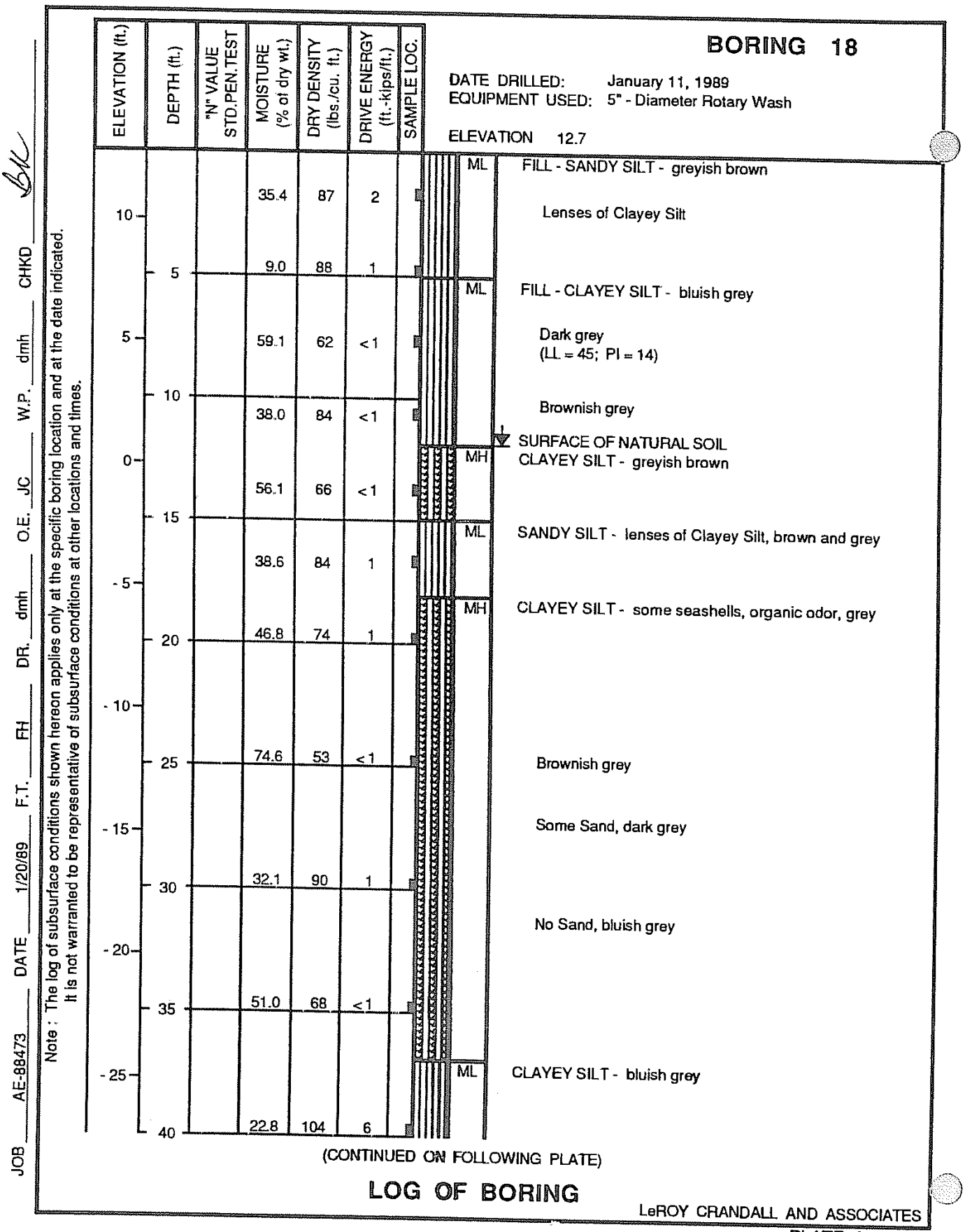
B AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

Area A - Law Crandall Borings

PLATE A - 1.17b
PLATE A2-28



(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.18a

Area A - Law Crandall Borings

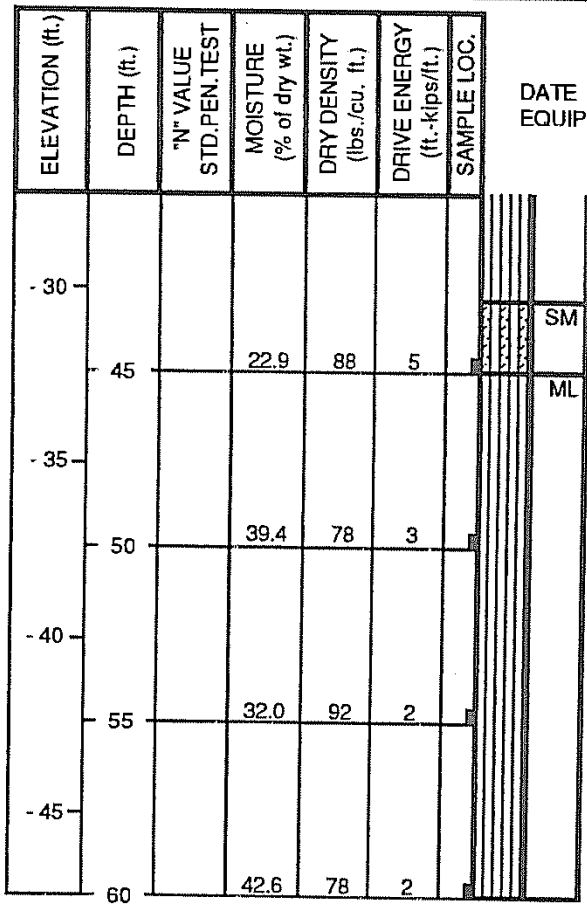
PLATE A2-29

JOB AE-88473 DATE 1/20/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 18 (Continued)

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash



SILTY SAND - fine, grey

CLAYEY SILT - dark grey

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Drilled 18" - Diameter Bucket Boring 5' east of Rotary Wash Boring to a depth of 16' on 1/12/89 for water level determination. Water seepage encountered at a depth of 11'. Caving below 11' (to 2' in diameter).

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.18b

Area A - Law Crandall Borings

PLATE A2-30

JOB AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 19

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 14.9

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
			22.1	92	6		SM	FILL - SILTY SAND - fine, lenses of Clayey Silt, brown and grey Large amount of seashells
			5.0	102	11			Light brown
10	5		29.5	92	8		ML	FILL - SANDY SILT - lenses of Clayey Silt, some seashells, grey and brown
5	10		43.4	81	2		ML	FILL - CLAYEY SILT - greyish brown
			43.4	76	1			Some Sand, some vegetation, grey and black
0	15		40.4	80	1			▽ SURFACE OF NATURAL SOIL
							MH	CLAYEY SILT - brownish grey
-5	20	3						
			42.1	77	1			Few seashells, organic odor, dark grey
-10	25							
		1						
-15	30						SM	SILTY SAND - fine, few seashells, organic odor, dark grey
			26.5	98	12		MH	CLAYEY SILT - brownish grey
-20	35	1						
			58.6	62	2			Few seashells
-25	40							

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.19a

Area A - Law Crandall Borings

PLATE A2-31

JB AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD

BORING 19 (Continued)

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
		4	46.6	73	2			Lenses of Silty Sand, traces of Peat, dark grey
-30	45	4	47.6	76	6		SP	GRAVELLY SAND - fine to coarse, about 40% Gravel and Cobbles, lenses of Sandy Silt, traces of Peat, black
-35	50	25						
-40	55		11.0	122	27		GW	GRAVEL - well graded, some Sand, few Cobbles, black
-45	60		9.0	120	24			
-50	65							

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.19b

Area A - Law Crandall Borings

PLATE A2-32

JOB AE-88473 DATE 1/20/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

BORING 20

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 12.3

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10			29.2	94	7		ML	FILL - SANDY SILT - light brown
	5						ML	FILL - CLAYEY SILT - brownish grey
5			24.0	96	3		ML	FILL - SANDY SILT - lenses of Clayey Silt, grey and brown
	10		41.1	80	1		ML	SURFACE OF NATURAL SOIL SANDY SILT - some organic matter, dark grey
0		5						
	15		32.8	90	4			Brownish grey
-5		0					MH	CLAYEY SILT - some seashells, organic odor, brown and dark grey
	20		48.7	72	<1			Dark grey
-10		0						
	25		57.4	64	<1			
-15								
	30	0						
-20			54.4	68	1			Grey
	35							
-25		8						
	40		20.7	109	8		SM	SILTY SAND - fine, dark grey

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations end times.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.20a

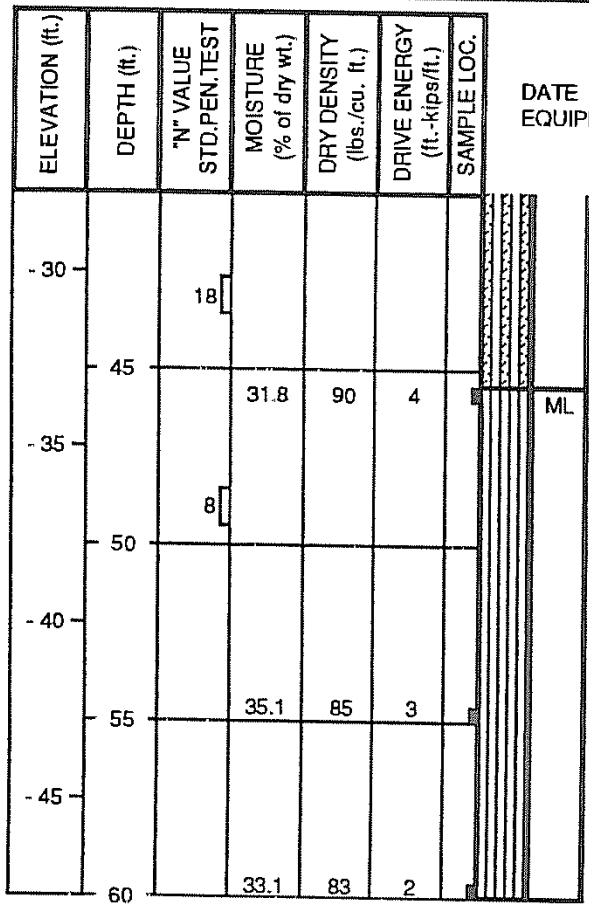
Area A - Law Crandall Borings

PLATE A2-33

JOB AE-88473 DATE 1/20/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

BORING 20 (Continued)

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash



Layers of Clayey Silt

CLAYEY SILT - lenses of Silty Sand, dark grey

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

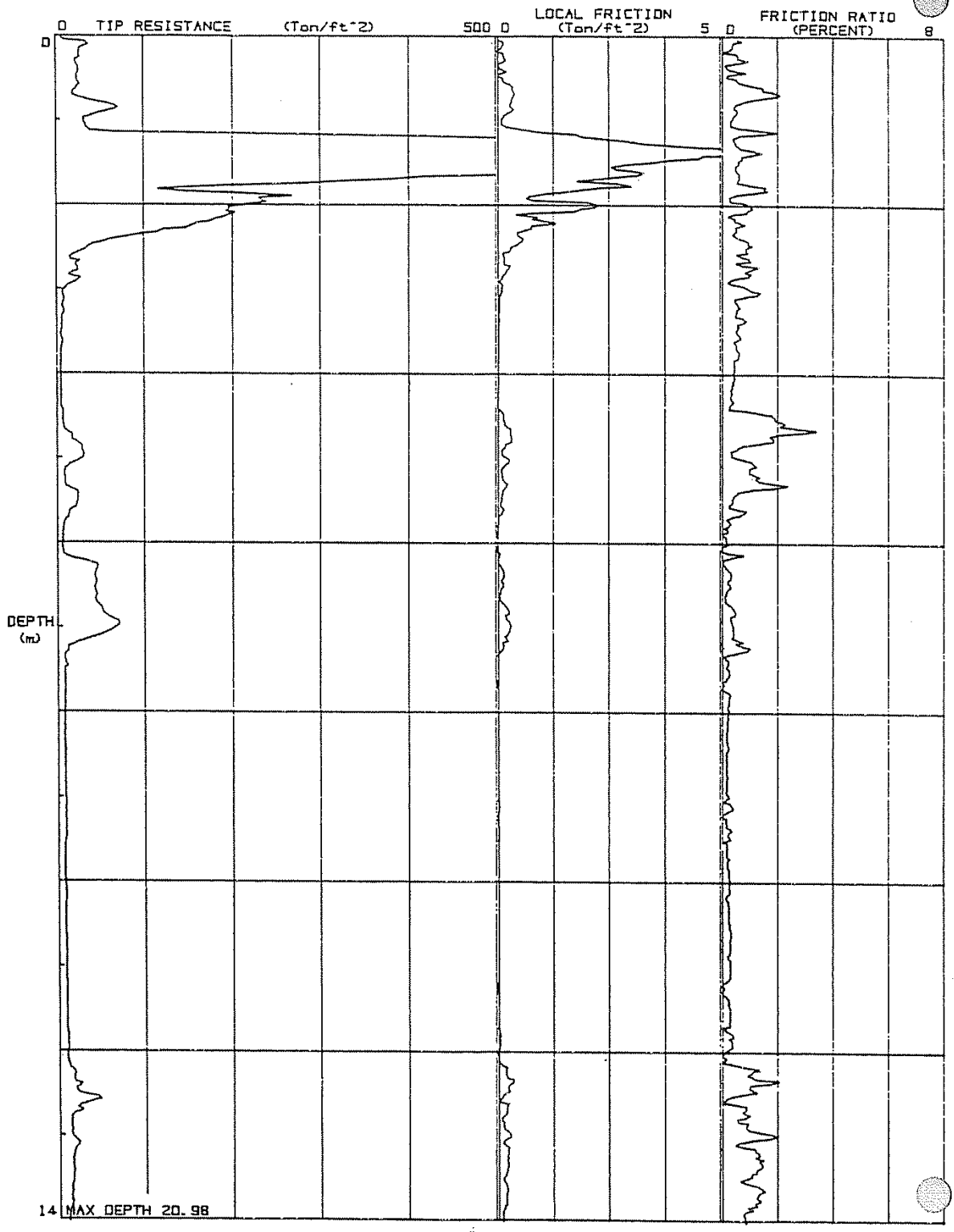
PLATE A - 1.20b

Area A - Law Crandall Borings

PLATE A2-34

C.P.T. - 1

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 14.9 FT *



* Elevations provided by Psomas and Associates

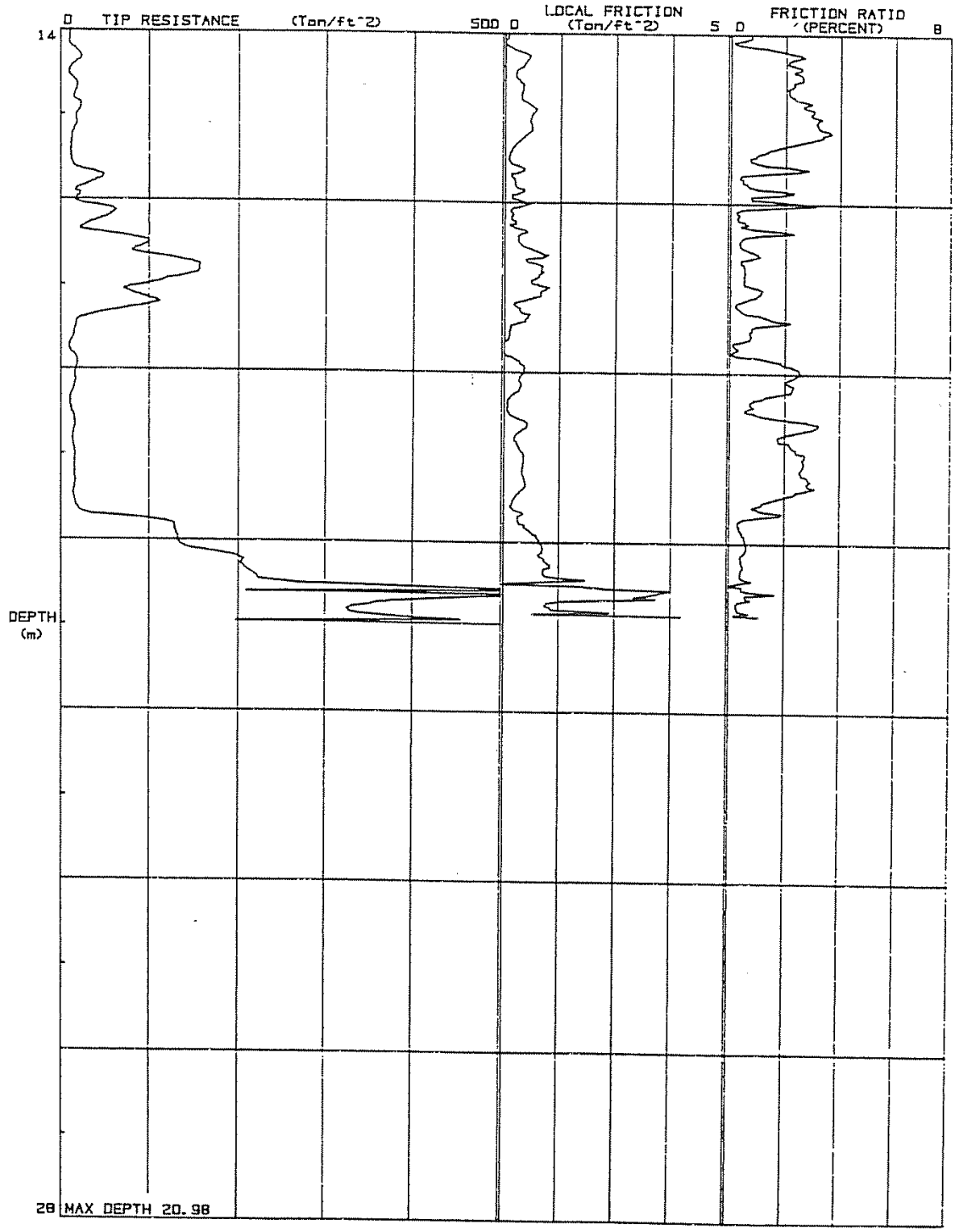
(CONTINUED)

Area A - Law Crandall CPTs

PLATE A2-35

C.P.T. - 1

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 14.9 FT



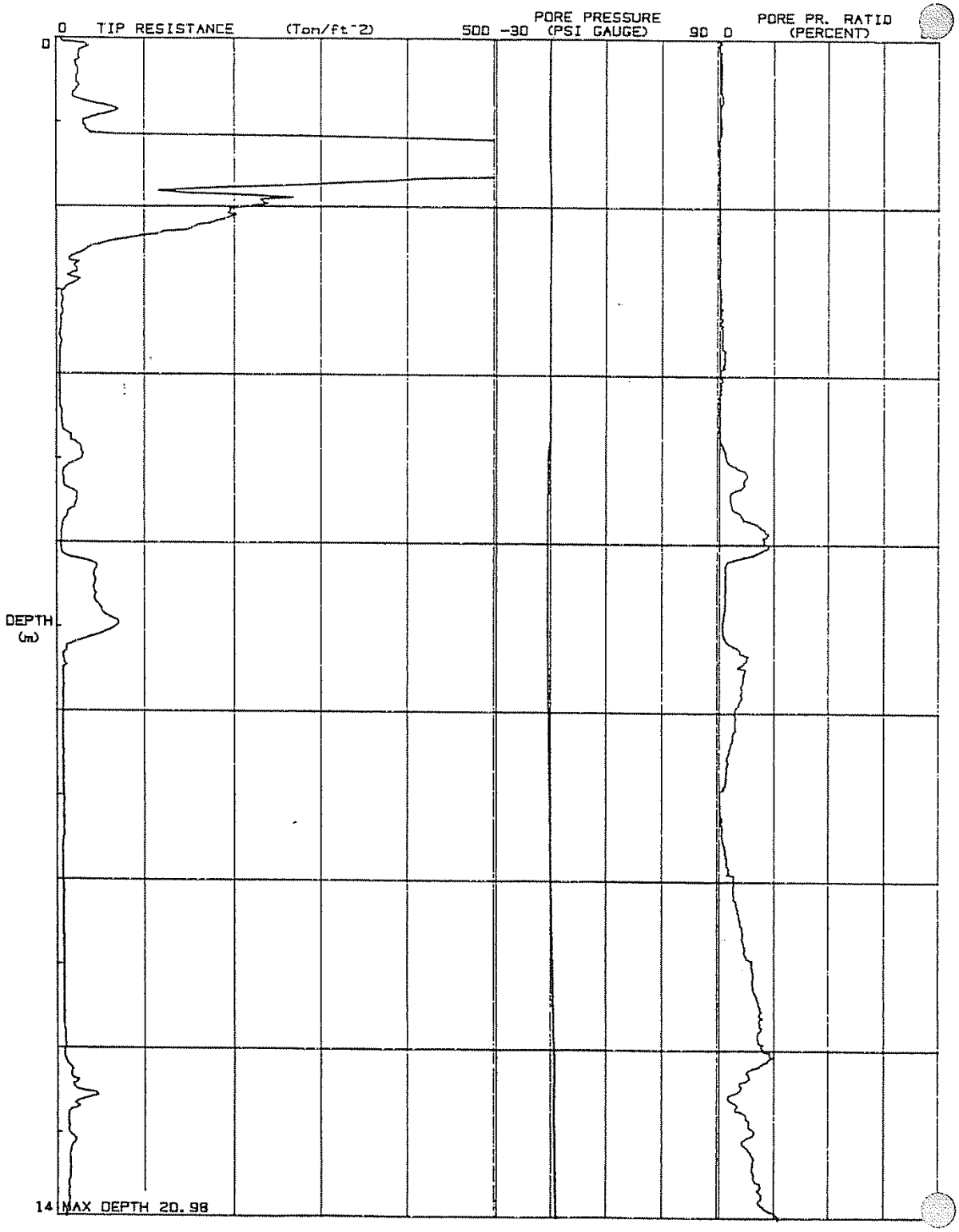
(CONTINUED)

Area A - Law Crandall CPTs

PLATE A2-36

C.P.T. - 1

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 14.9 FT



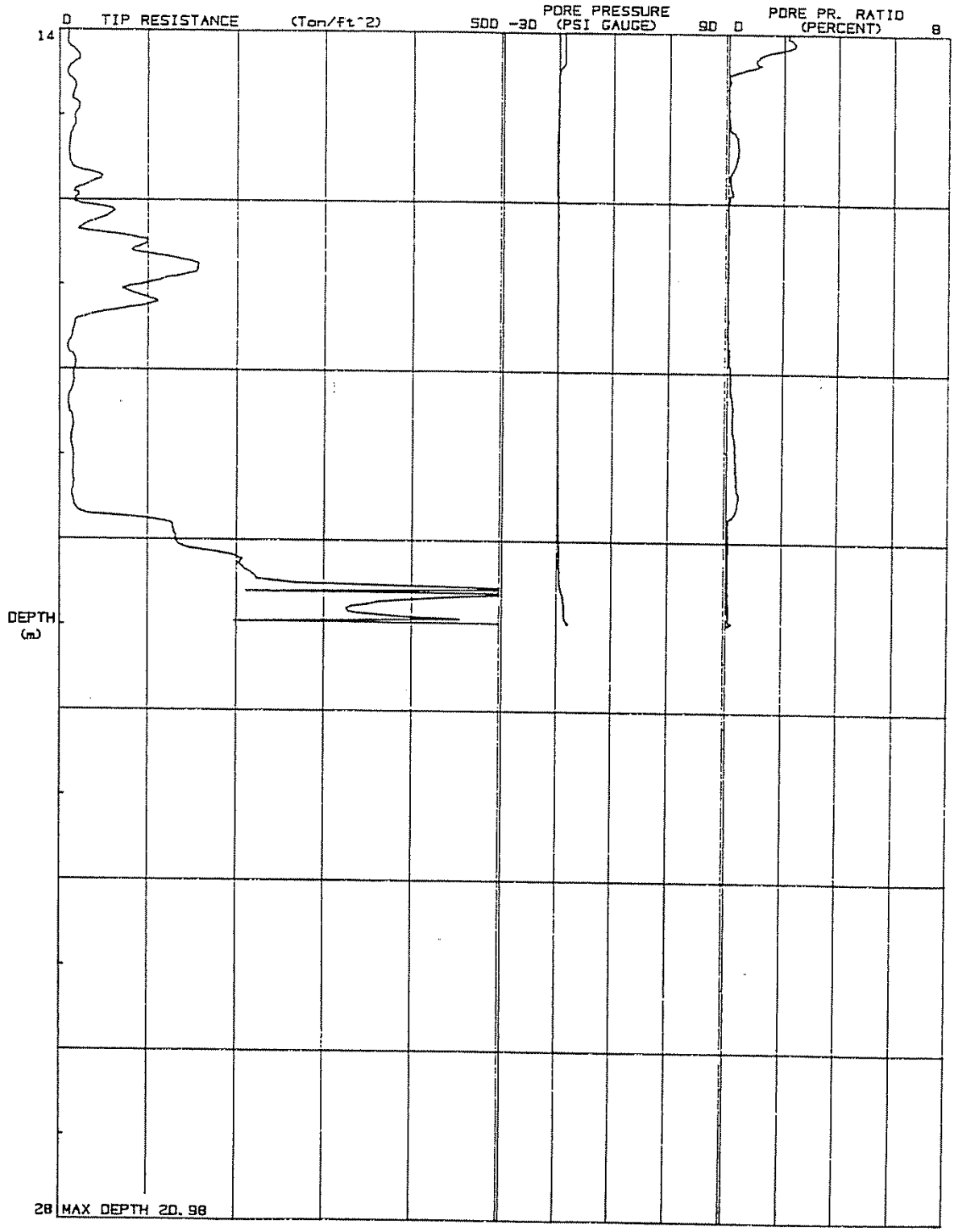
(CONTINUED)

Area A - Law Crandall CPTs

PLATE A2-37

C.P.T. - 1

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 14.9 FT

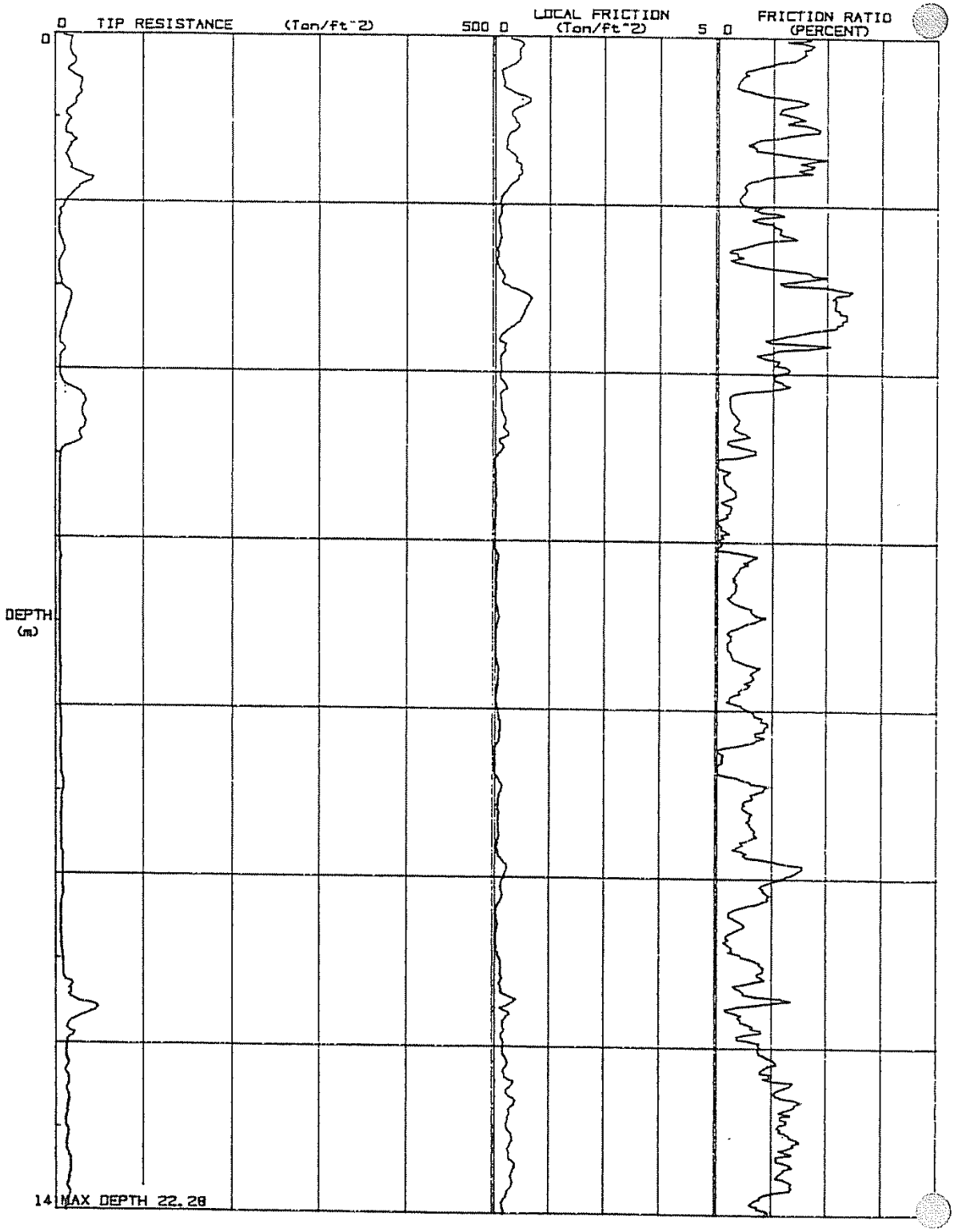


Area A - Law Crandall CPTs

PLATE A2-38

C.P.T. - 14

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 11.8 FT



(CONTINUED)

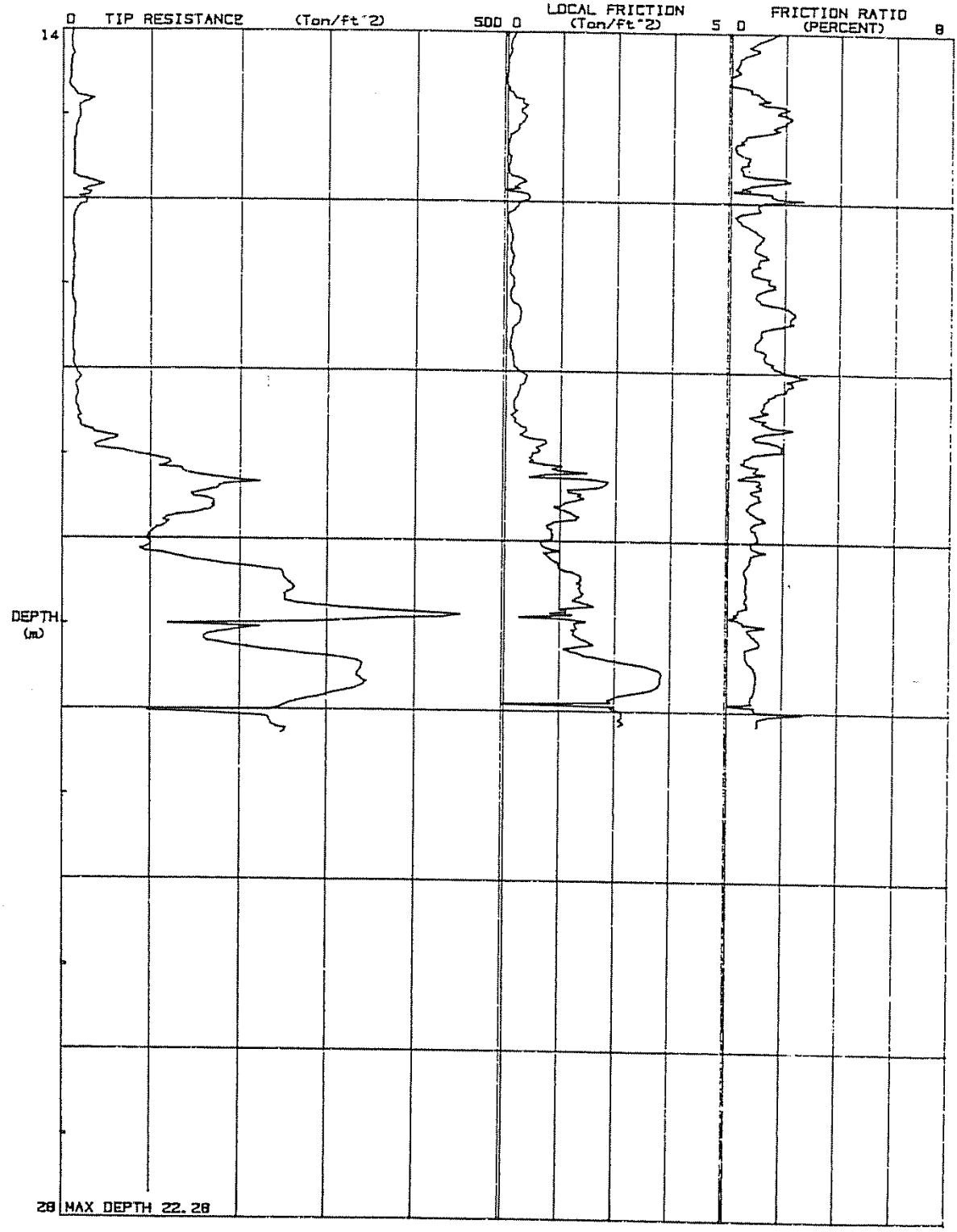
Area A - Law Crandall CPTs

PLATE A2-39

PLATE B-1.2

C.P.T. - 14

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 11.8 FT



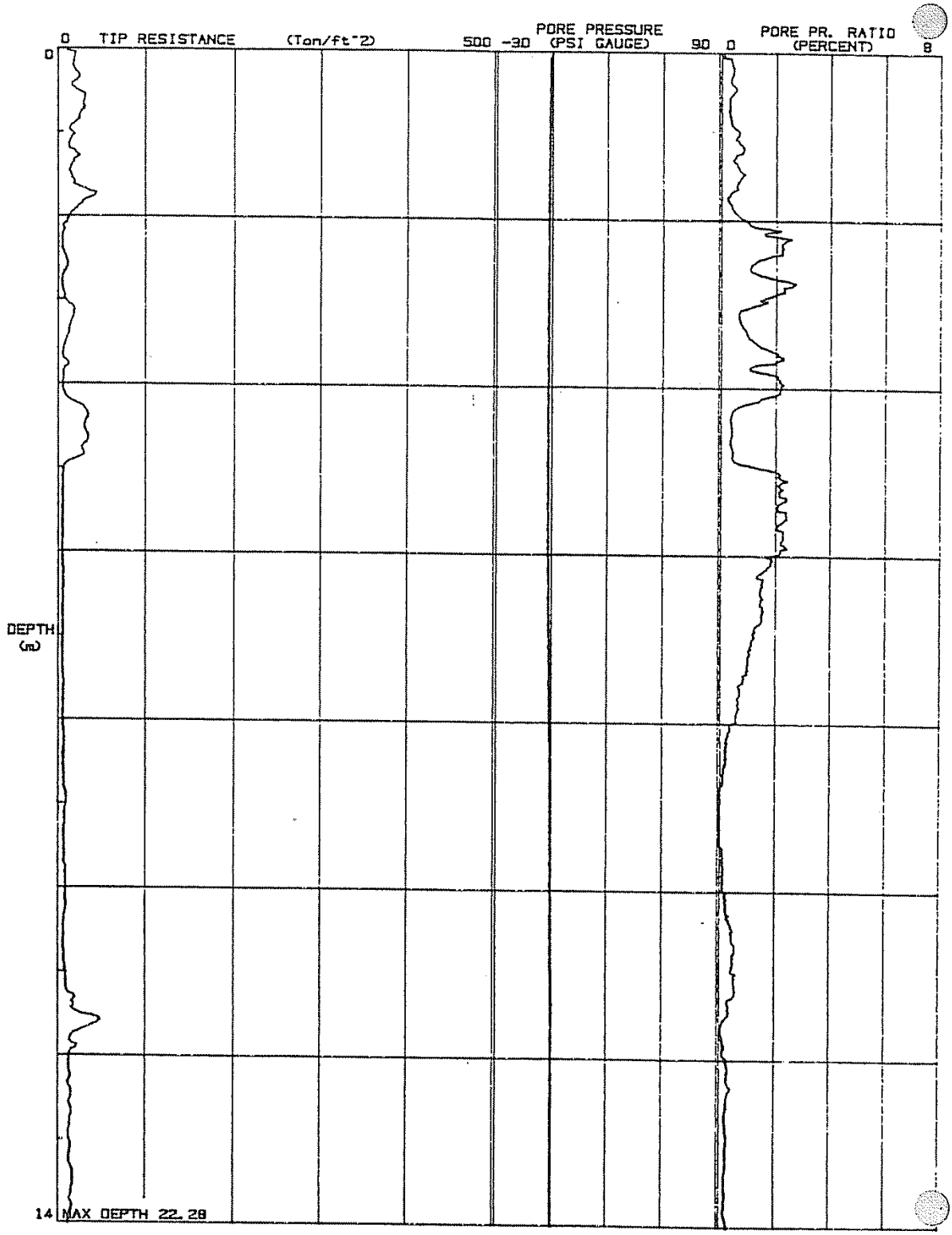
(CONTINUED)

Area A - Law Crandall CPTs

PLATE A2-40

C.P.T. - 14

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 11.8 FT



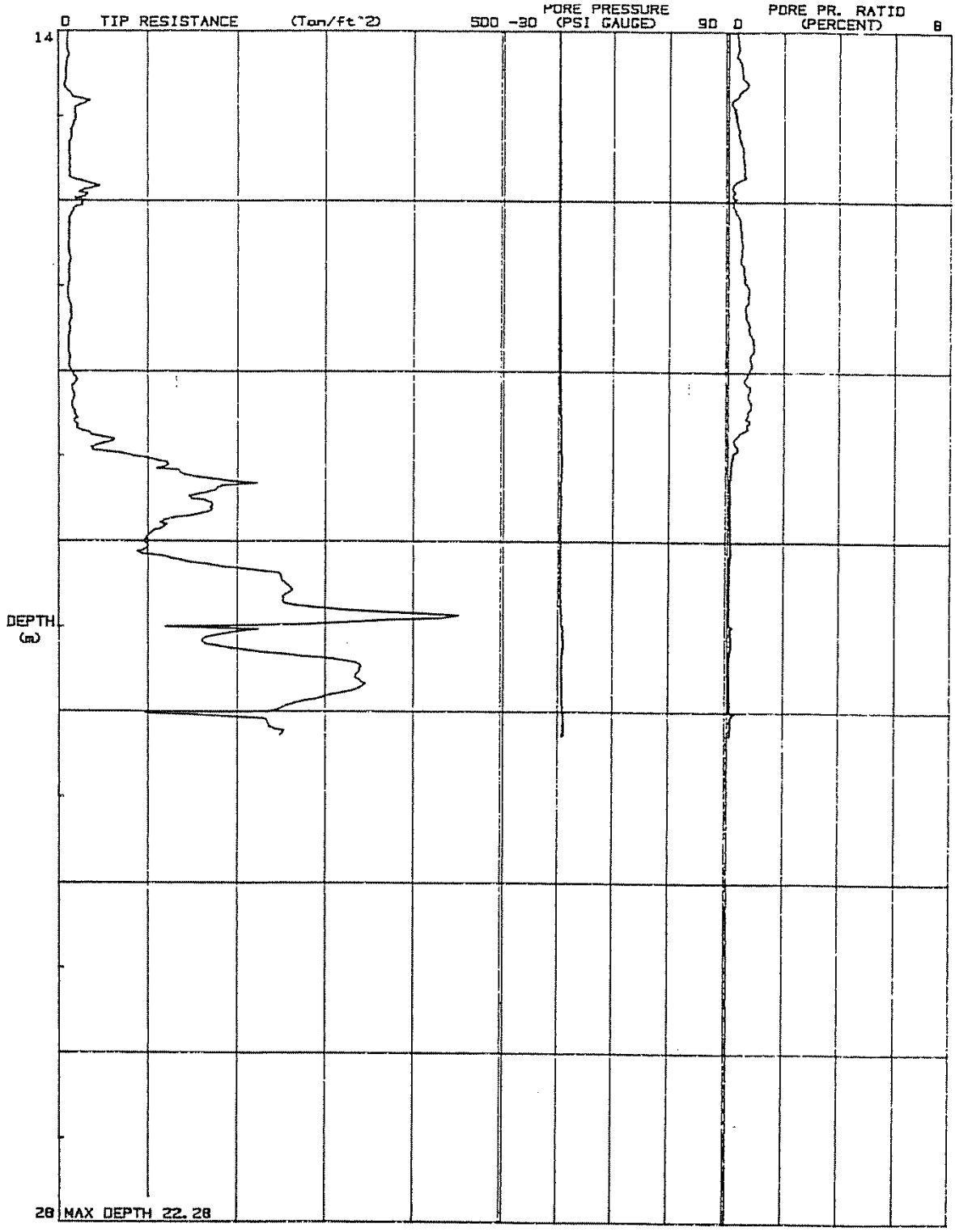
(CONTINUED)

Area A - Law Crandall CPTs

PLATE A2-41

C.P.T. - 14

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 11.8 FT

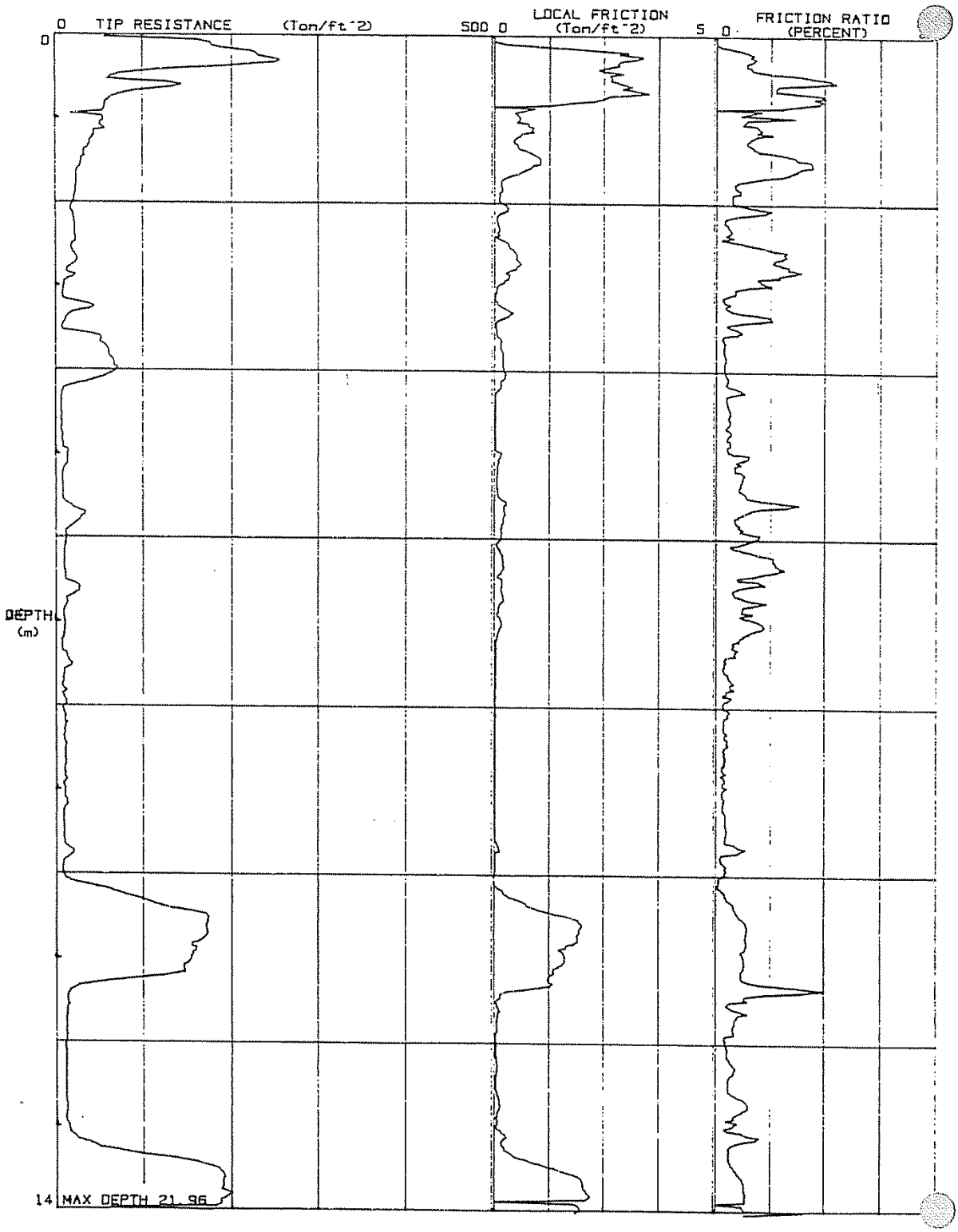


Area A - Law Crandall CPTs

PLATE A2-42

C.P.T. - 17

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 18.2 FT



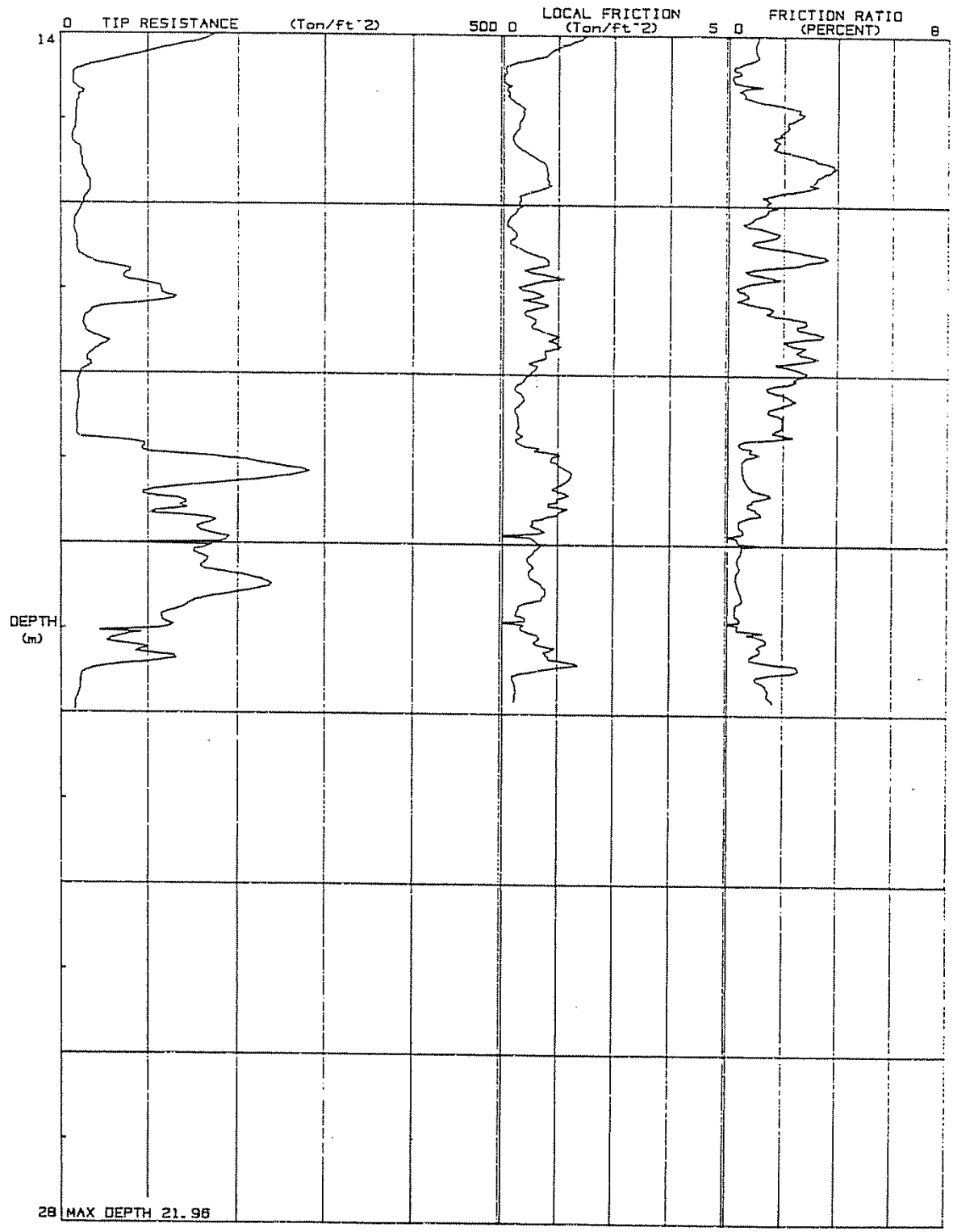
(CONTINUED)

Area A - Law Crandall CPTs

PLATE A2-43

C.P.T. - 17

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 18.2 FT



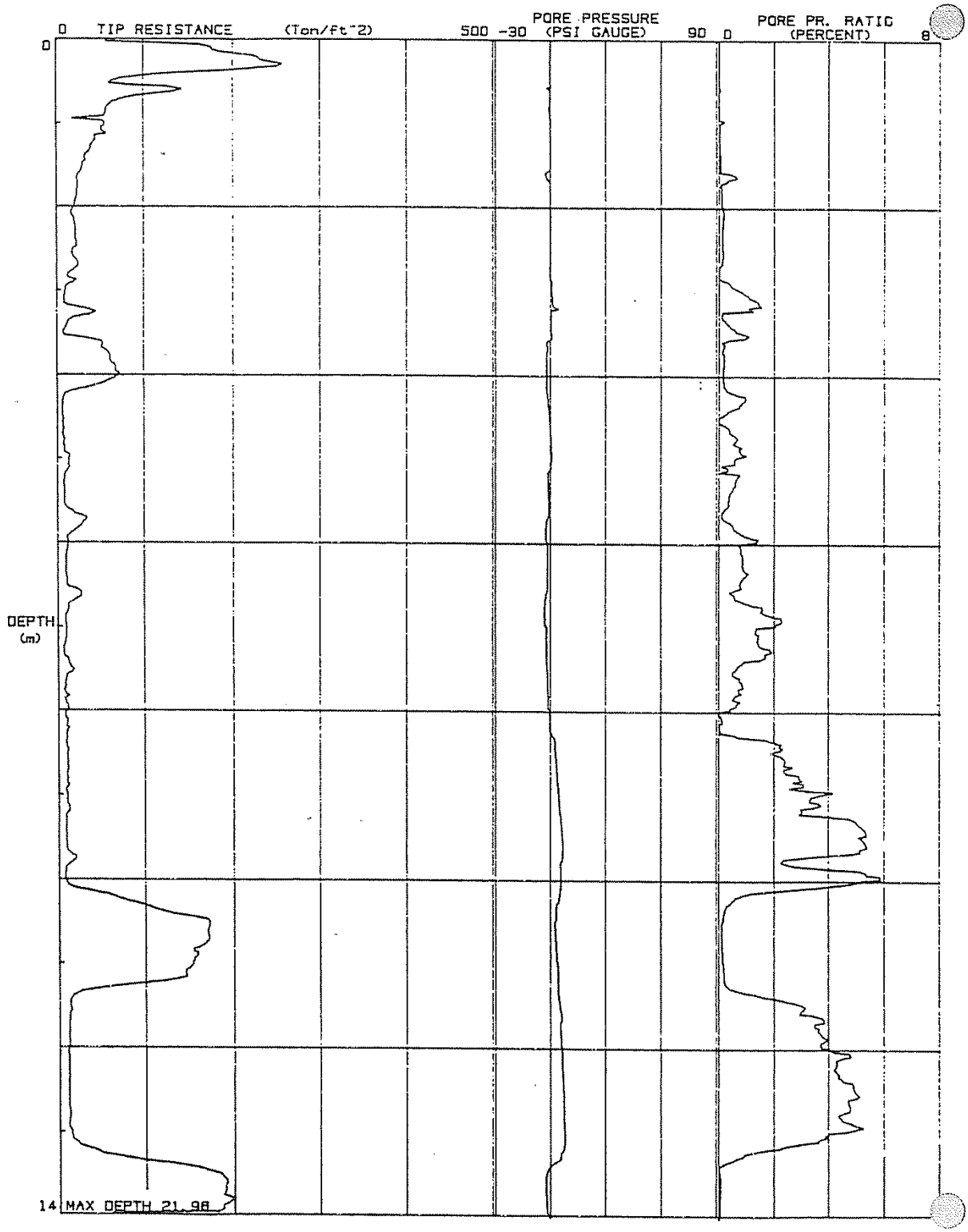
(CONTINUED)

Area A - Law Crandall CPTs

PLATE A2-44

C.P.T. - 17

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 18.2 FT



(CONTINUED)

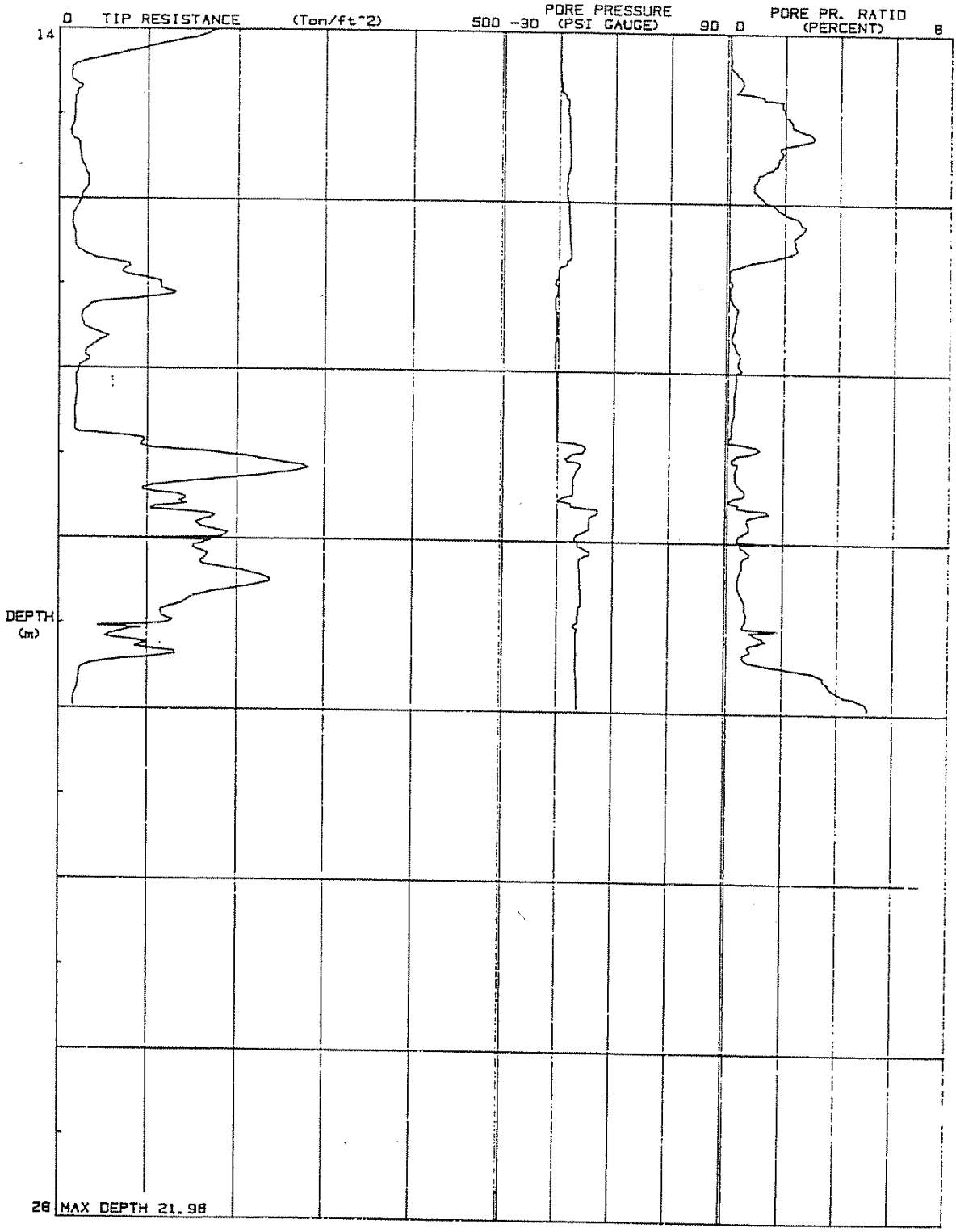
Area A - Law Crandall CPTs

PLATE A2-45

PLATE B-1.3c

C.P.T. - 17

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 18.2 FT

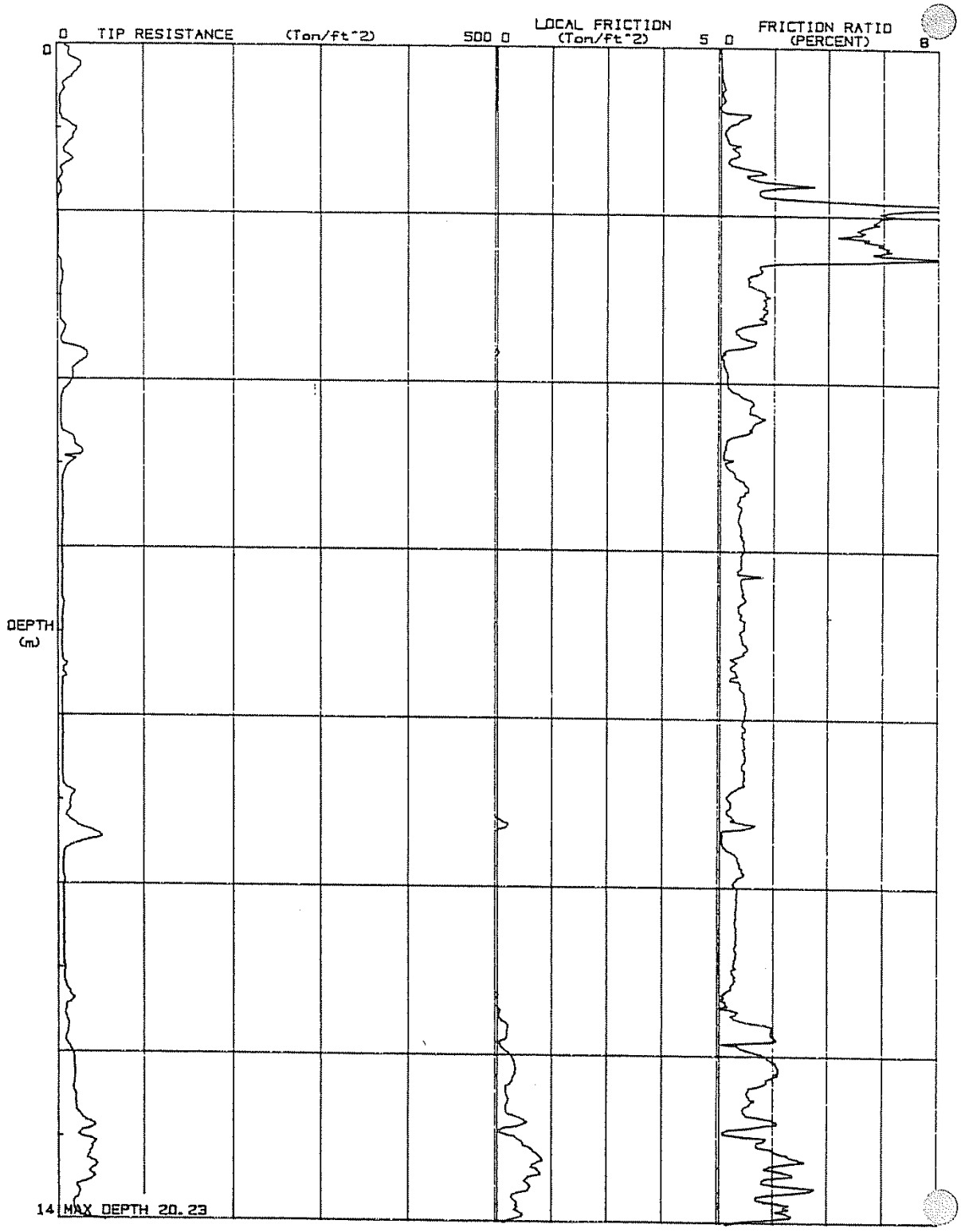


Area A - Law Crandall CPTs

PLATE A2-46

C.P.T. - 18

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 12.7 FT



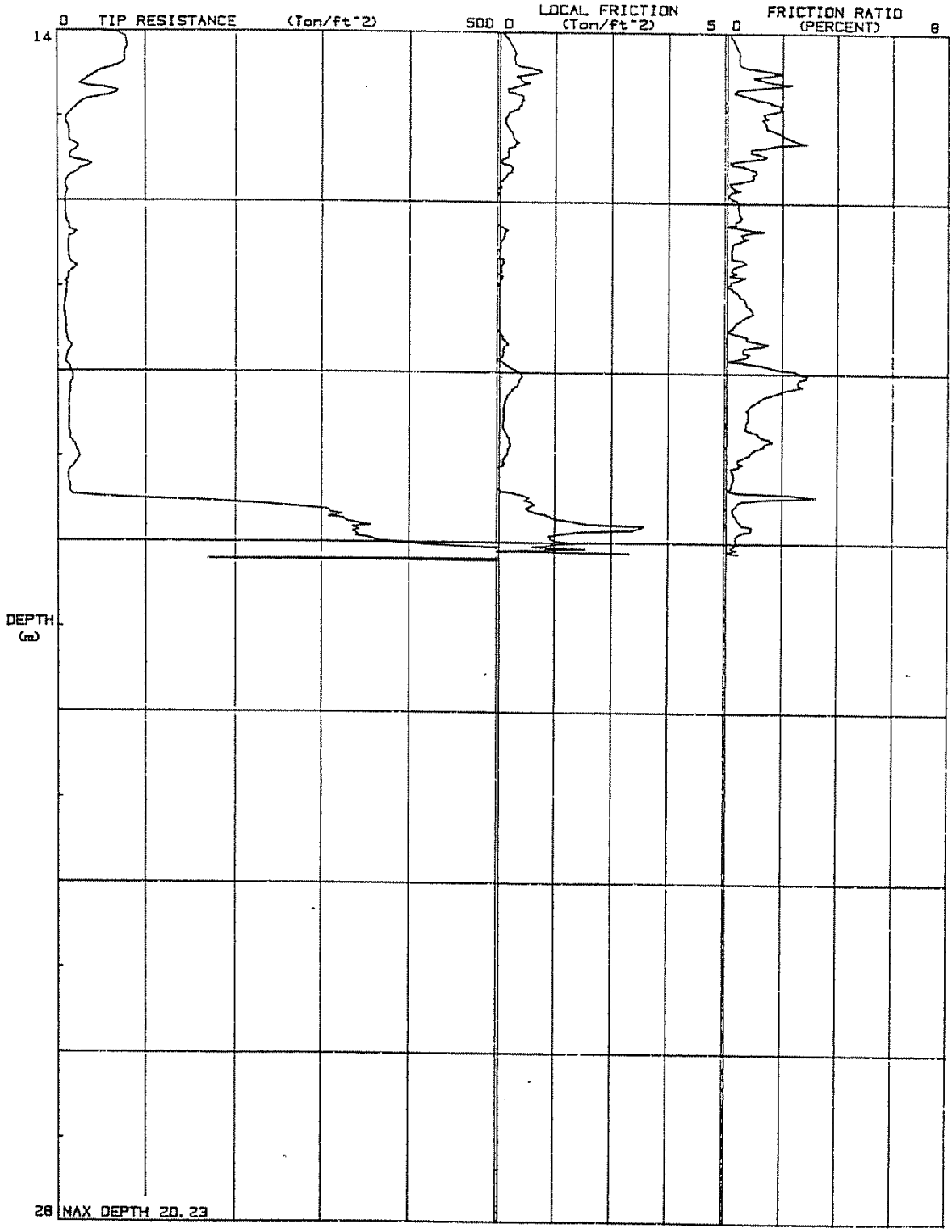
(CONTINUED)

Area A - Law Crandall CPTs

PLATE A2-47

C.P.T. - 18

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 12.7 FT



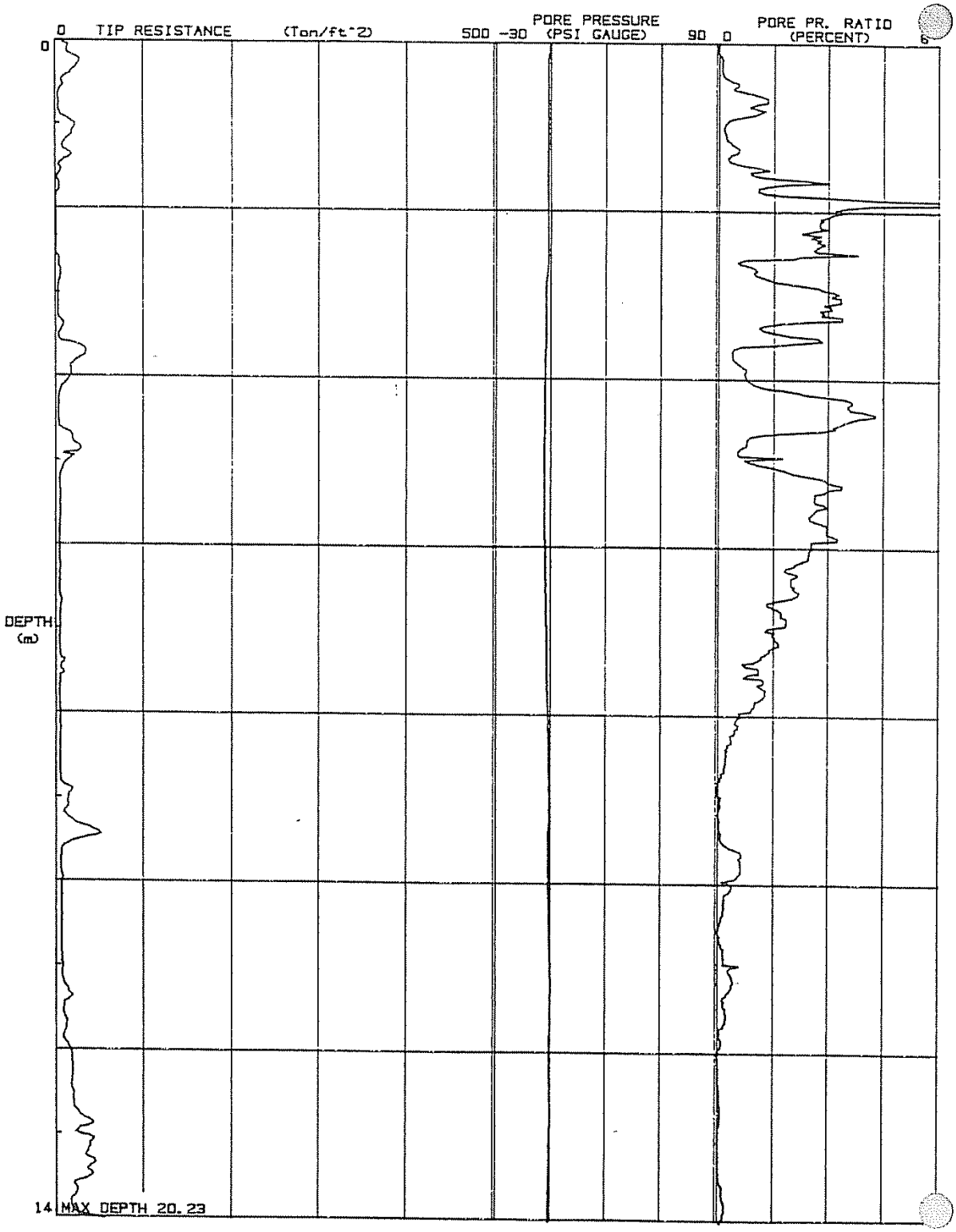
(CONTINUED)

Area A - Law Crandall CPTs

PLATE A2-48

C.P.T. - 18

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 12.7 FT



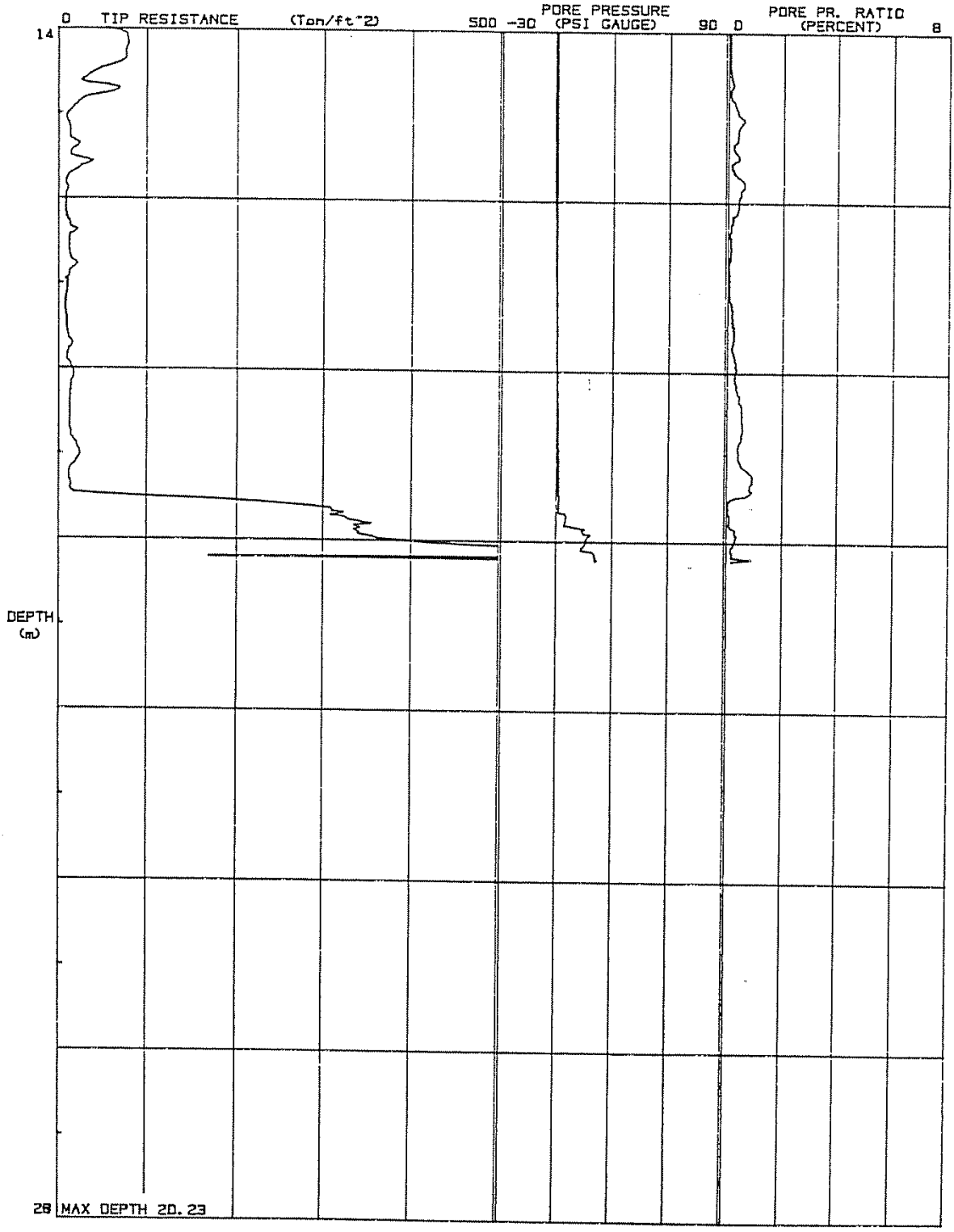
(CONTINUED)

Area A - Law Crandall CPTs

PLATE A2-49

C.P.T. - 18

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 12.7 FT

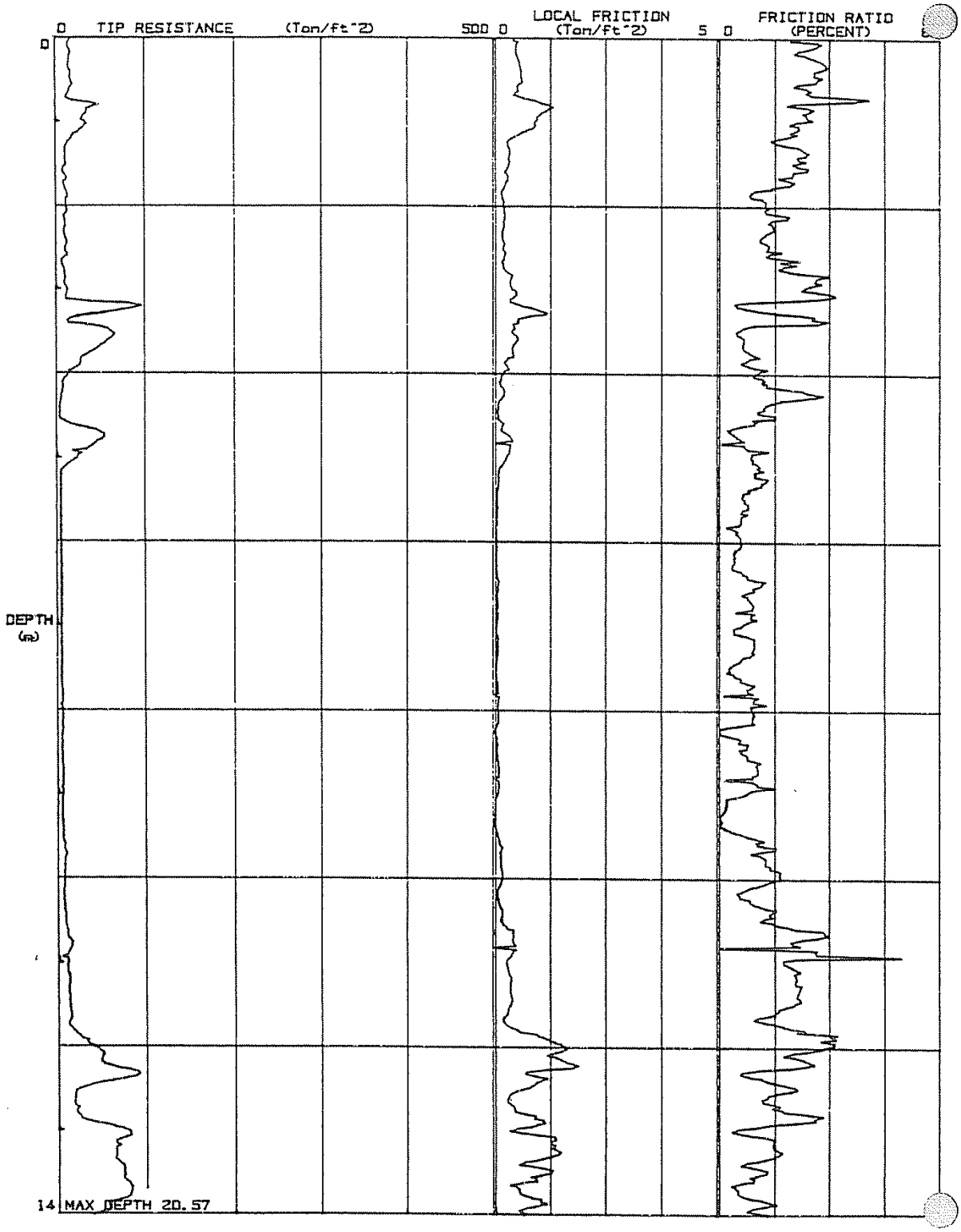


Area A - Law Crandall CPTs

PLATE A2-50

C.P.T. - 20

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 12.3 FT



(CONTINUED)

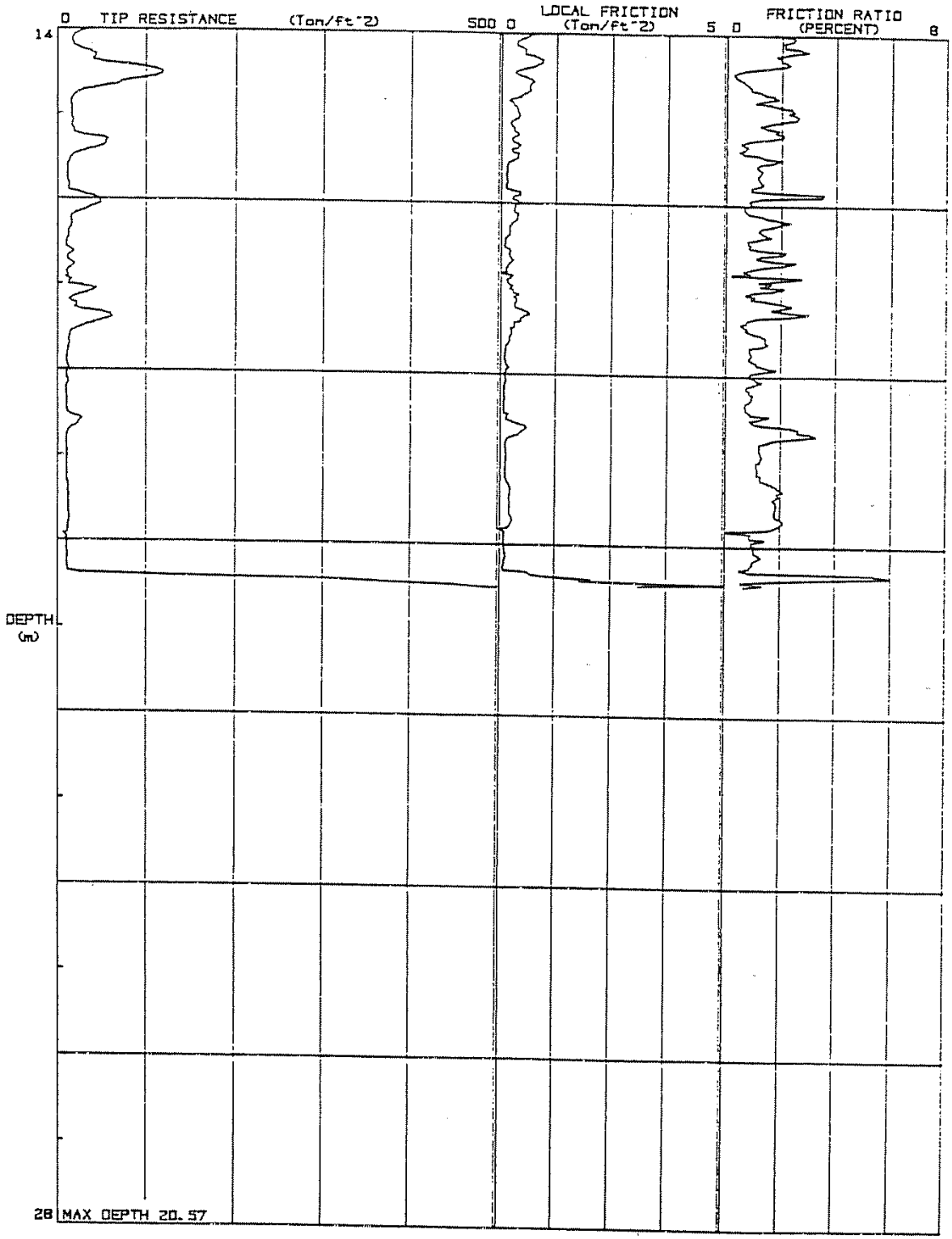
Area A - Law Crandall CPTs

PLATE A2-51

PLATE B-1 5a

C.P.T. - 20

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 12.3 FT



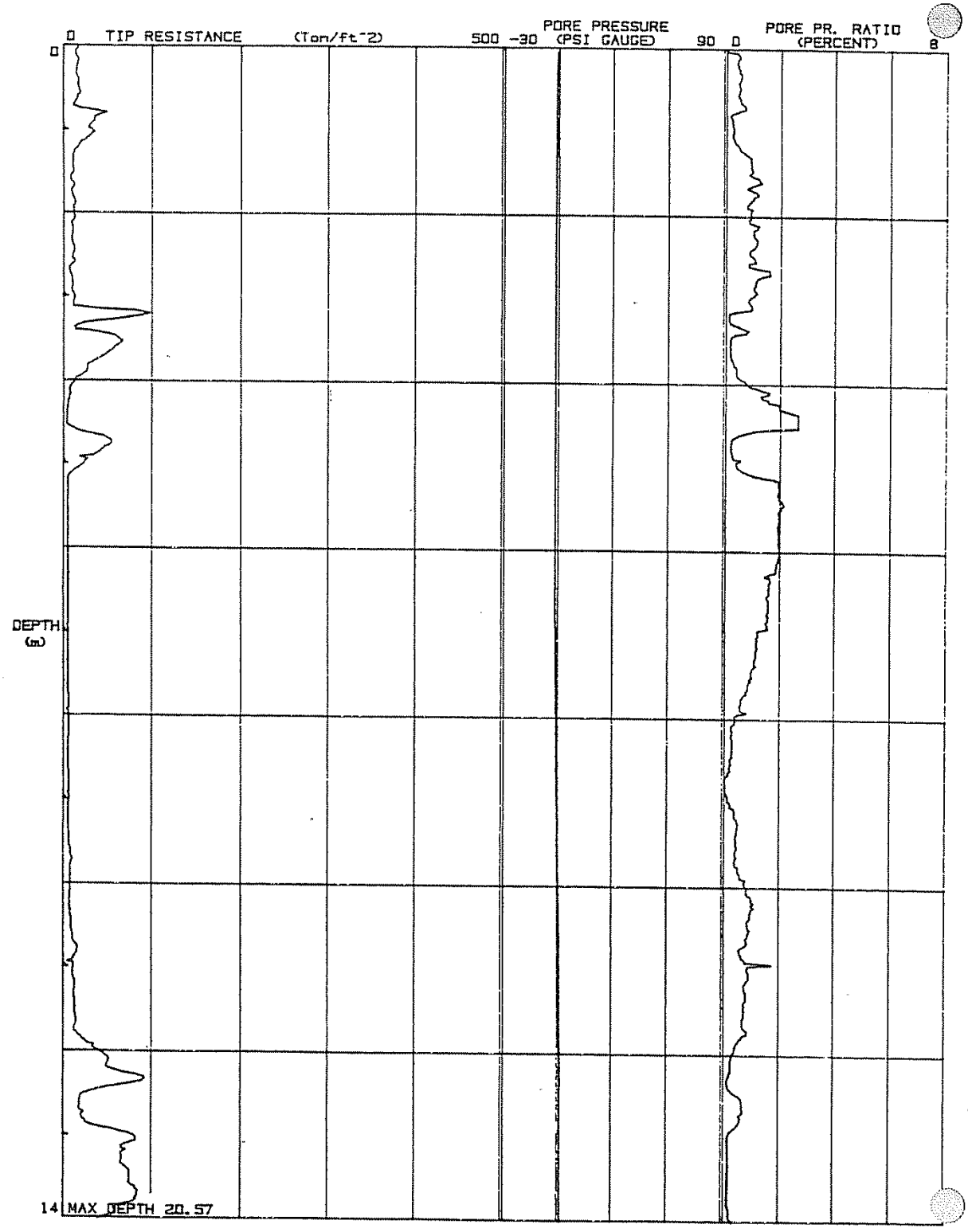
(CONTINUED)

Area A - Law Crandall CPTs

PLATE A2-52

C.P.T. - 20

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 12.3 FT



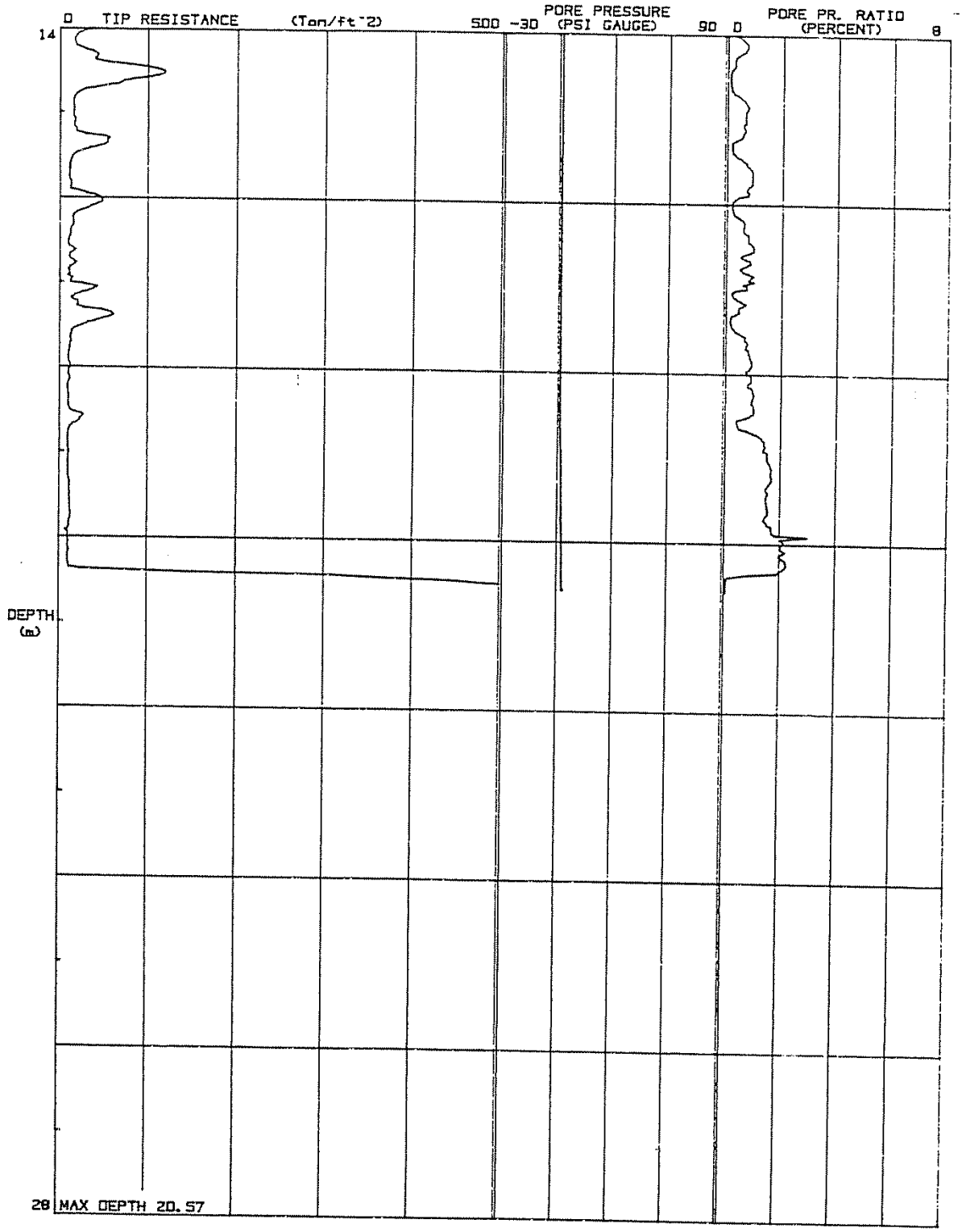
(CONTINUED)

Area A - Law Crandall CPTs

PLATE A2-53

C.P.T. - 20

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 12.3 FT



Area A - Law Crandall CPTs

PLATE A2-54

PLATE A2-54

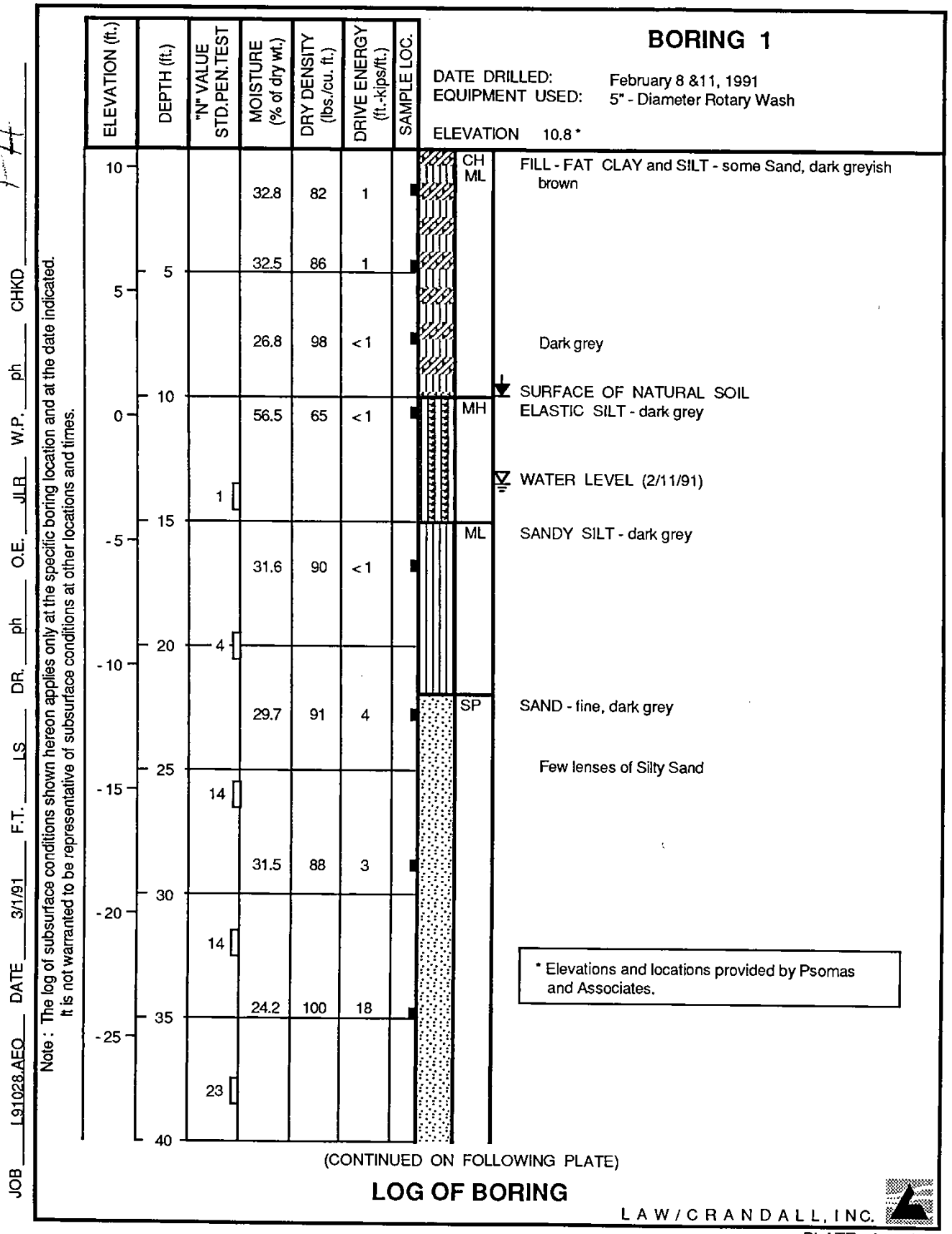


PLATE A - 1.1a

Area B - Law Crandall Borings

PLATE A2-55

JOB L91028.AEQ DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 1 (Continued)

DATE DRILLED: February 8 &11, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-30			28.5	96	8			
		37						
	45							
-35			32.7	89	10		ML	SANDY SILT - dark grey
	50	2						
-40							ML	CLAYEY SILT - dark grey
			19.9	109	5			
	55						SM	SILTY SAND - fine, dark grey
-45		15						
							SP	SAND - fine, grey
	60		16.7	111	6			

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Water level measured at 13-1/2' 15 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A-1.1b

Area B - Law Crandall Borings

PLATE A2-56

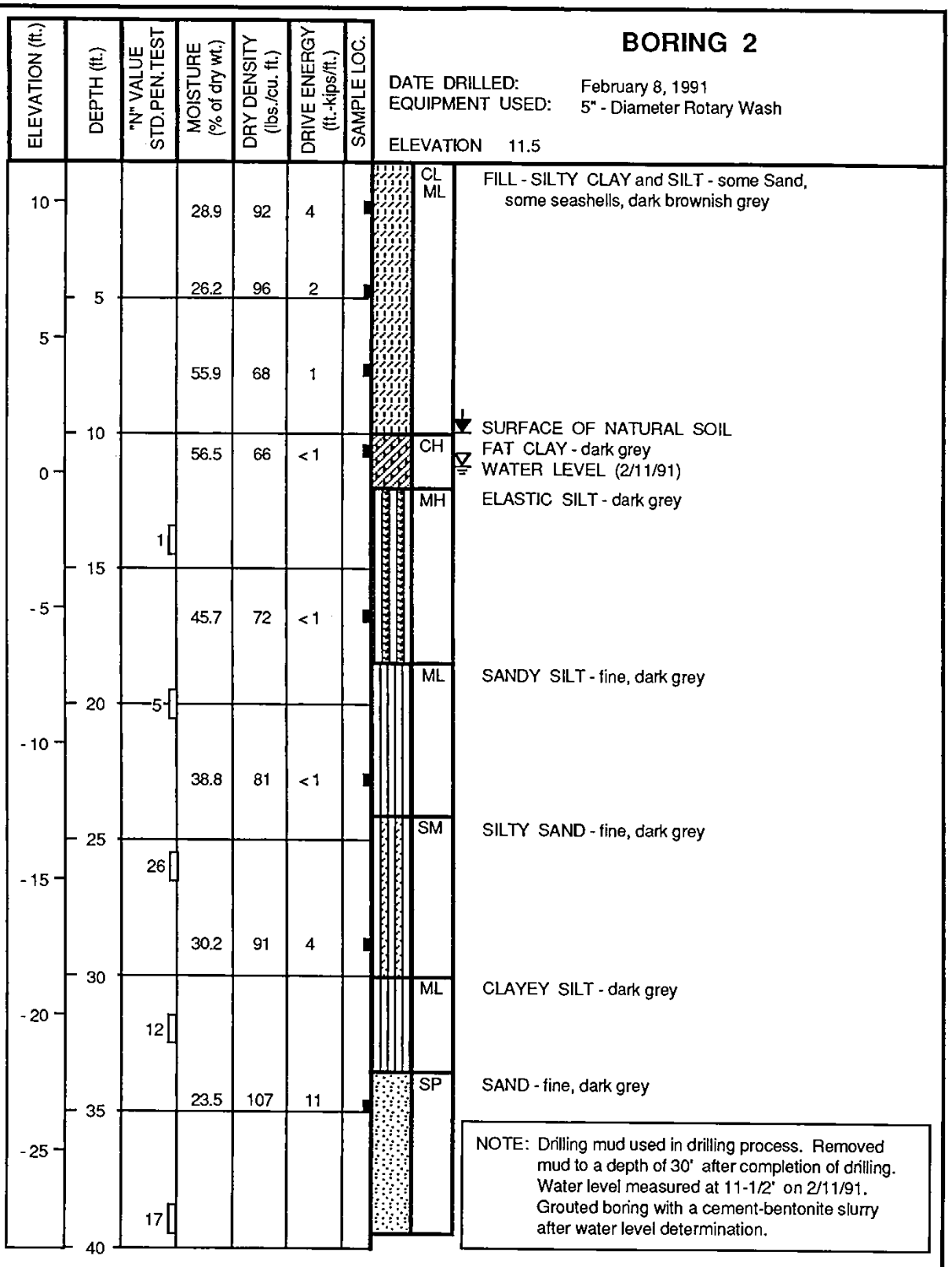
JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 2

DATE DRILLED: February 8, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 11.5



NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Water level measured at 11-1/2' on 2/11/91. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A-1.2

Area B - Law Crandall Borings

PLATE A2-57

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

BORING 3

DATE DRILLED: February 8, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 12.1

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10	0		10.0	105	6		SM	FILL - SILTY SAND - dark brown
			47.5	72	1		ML	FILL - CLAYEY SILT - dark greyish brown
5	5		48.6	73	< 1			SURFACE OF NATURAL SOIL
	10						ML	CLAYEY SILT - some lenses of Sand, dark grey
0			42.3	77	< 1			
	15	1						
-5			42.6	76	< 1			
	20	1						Some seashells
-10			37.1	85	< 1			
	25	27					SP	SAND - fine, dark grey
-15			24.2	100	22			
	30	12					ML	SANDY SILT - some seashells, dark grey
-20			36.0	85	< 1			
	35	26					SP	SAND - fine, dark grey
-25	40							

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.3a

Area B - Law Crandall Borings

PLATE A2-58

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 3 (Continued)

DATE DRILLED: February 8, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-30	45	2	26.4	97	7	ML
-35	50	10	45.5	78	1	
-40	55		27.5	96	3	
-45	60		31.6	92	1	
			27.3	95	3	

CLAYEY SILT - some fine Sand, dark grey

Layers of Sand

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Water level measured at 13' on 2/11/91. Grouted boring with cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.3b

Area B - Law Crandall Borings

PLATE A2-59

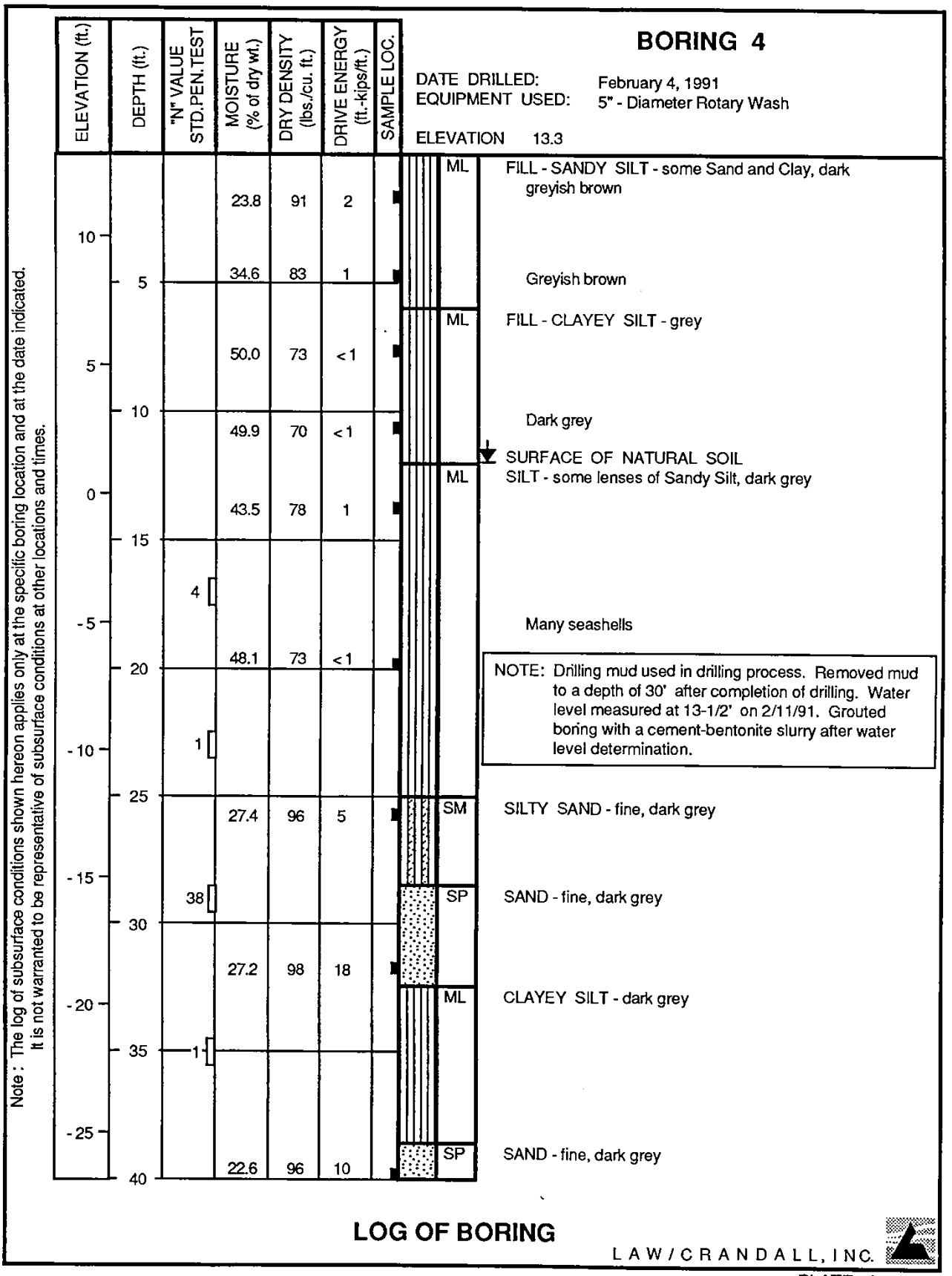


PLATE A - 1.4

Area B - Law Crandall Borings

PLATE A2-60

JOB 191028.AEQ DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 5

DATE DRILLED: February 4, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 14.4

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
			23.5	93	2		ML	FILL - SANDY SILT - dark greyish brown
10	5		32.4	91	4			Light brownish grey Some Clay
5	10		25.8	80	1			Dark brown
		2						SURFACE OF NATURAL SOIL
0	15		43.3	78	< 1		CL	SILTY CLAY - dark grey
		11					ML	CLAYEY SILT - grey
-5	20		55.2	69	< 1		MH	ELASTIC SILT - grey
		1						
-10	25		49.6	72	< 1			Dark grey
		15					SM	SILTY SAND - fine, some seashells, dark grey
-15	30		22.7	99	18		SP	SAND - fine, grey
-20	35	2					MH	ELASTIC SILT - some lenses of Sandy Silt, dark grey
			52.6	70	2			(LL = 52, PI = 18)
-25	40							

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.5a

Area B - Law Crandall Borings

PLATE A2-61

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

BORING 5 (Continued)

DATE DRILLED: February 4, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
		5	19.8	108	2		ML	SANDY SILT - dark grey
-30	45							
		10	23.9	97	5		ML	CLAYEY SILT - dark grey
-35	50							
		10					SM	SILTY SAND - fine, some seams of Sandy Silt, dark grey
-40	55		29.1	95	12		ML	CLAYEY SILT - some Sand, some seashells, dark grey
-45	60		28.8	94	3			

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 25' after completion of drilling. Water level measured at 14-1/2' on 2/5/91. Grouted boring with cement-bentonite slurry after water level determination.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.5b

Area B - Law Crandall Borings

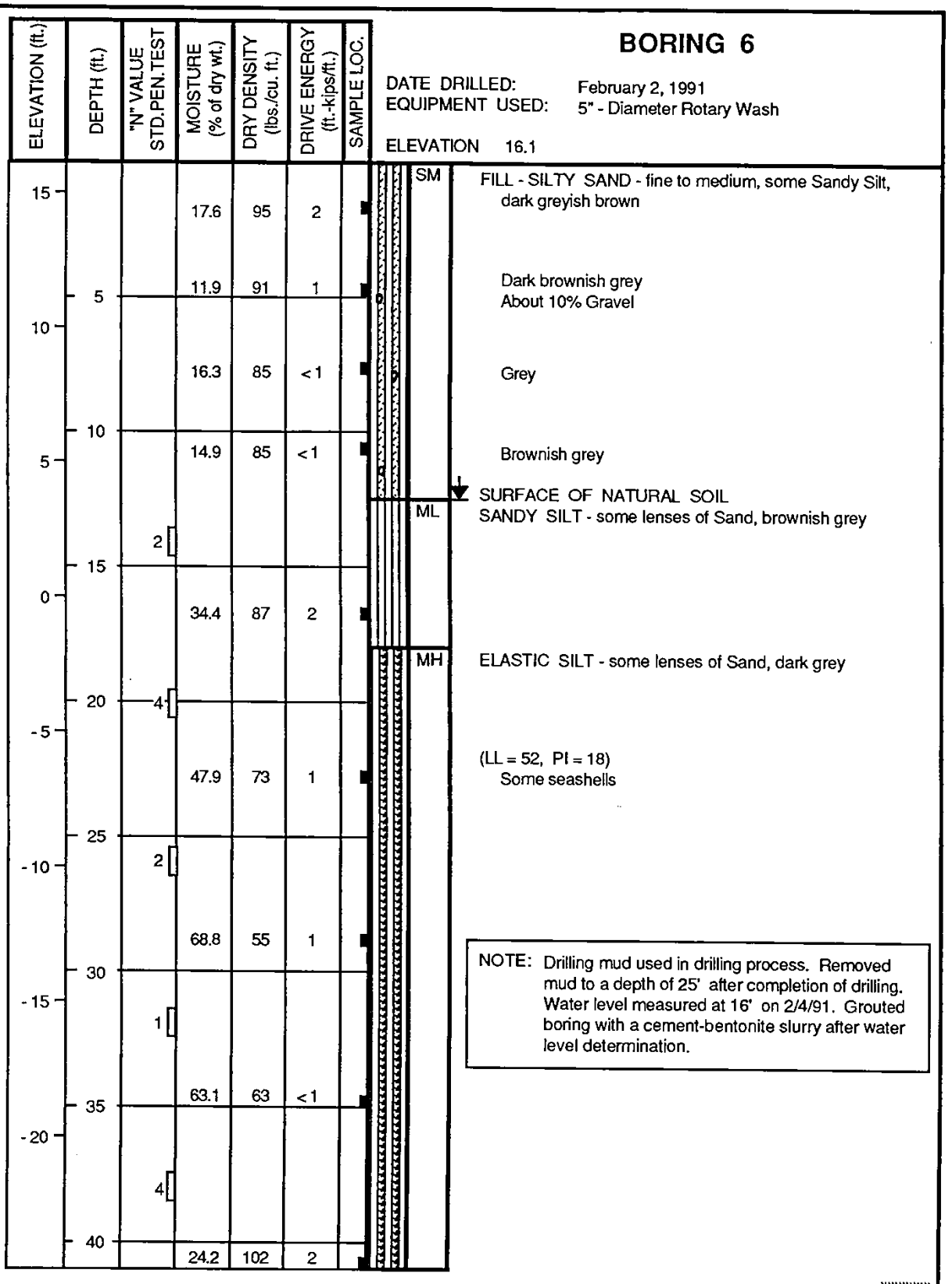
PLATE A2-62

JOB L91028.AEQ DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 6

DATE DRILLED: February 2, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash
ELEVATION 16.1



FILL - SILTY SAND - fine to medium, some Sandy Silt, dark greyish brown

Dark brownish grey
About 10% Gravel

Grey

Brownish grey

SURFACE OF NATURAL SOIL
SANDY SILT - some lenses of Sand, brownish grey

ELASTIC SILT - some lenses of Sand, dark grey

(LL = 52, PI = 18)
Some seashells

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 25' after completion of drilling. Water level measured at 16' on 2/4/91. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A-1.6

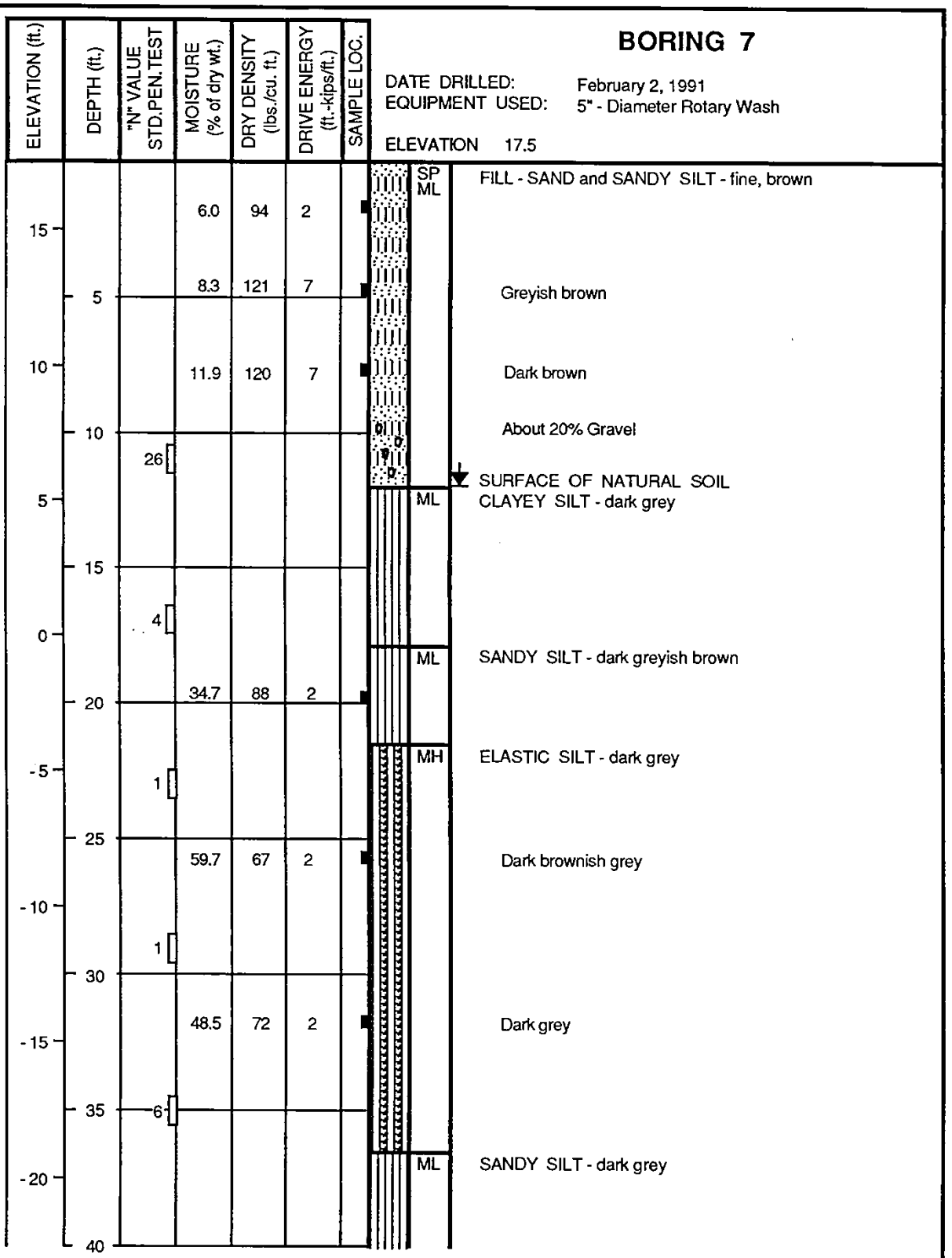
Area B - Law Crandall Borings

PLATE A2-63

JOB 91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

BORING 7

DATE DRILLED: February 2, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash
ELEVATION 17.5



Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A-1.7a

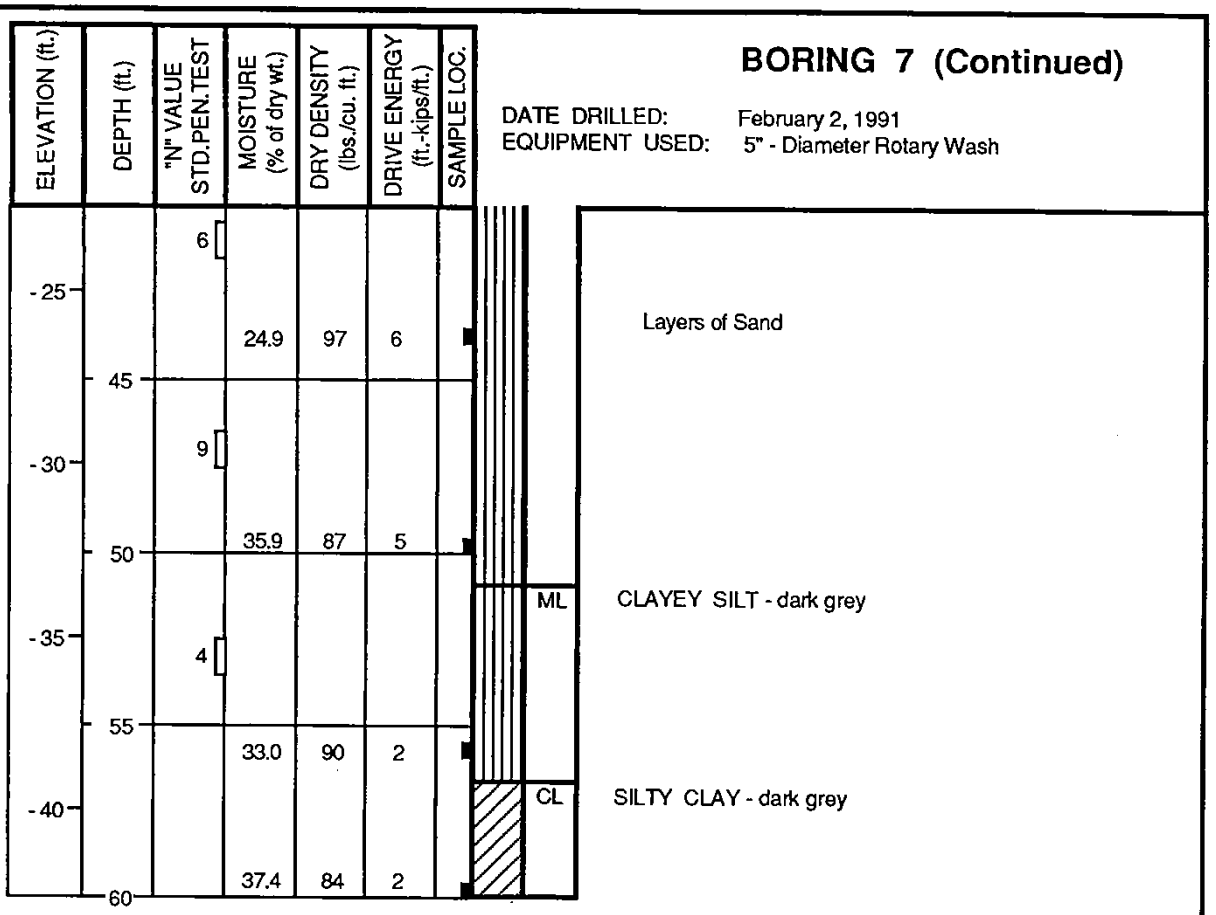
Area B - Law Crandall Borings

PLATE A2-64

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

BORING 7 (Continued)

DATE DRILLED: February 2, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash



NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Water level measured at 17' on 2/4/91. Grouted boring with a cement-bentonite slurry after water level determination.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.7b

Area B - Law Crandall Borings

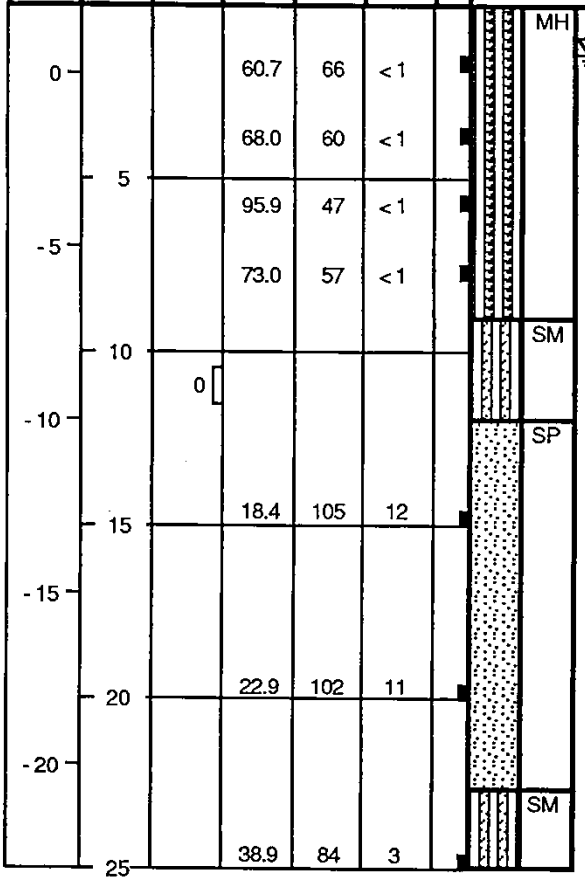
PLATE A2-65

JOB 91028.AEQ DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

BORING 8

DATE DRILLED: January 31, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 2.0



ELASTIC SILT - some lenses of fine Sand, mottled grey and dark grey

WATER LEVEL (1/31/91)

Light grey

Some seashells, dark grey

SILTY SAND - fine, dark grey

SAND - fine, grey

Dark grey

SILTY SAND - fine, layers of Sandy Silt, dark grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 15' after completion of drilling. Water level measured at 1-1/2' 15 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.8

Area B - Law Crandall Borings

PLATE A2-66

JOB 91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

BORING 9

DATE DRILLED: January 30, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 3.6

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		44.9	67	1		ML	FILL - CLAYEY SILT - some lenses of fine Sand, dark brownish grey
			31.5	92	1			SURFACE OF NATURAL SOIL
-5	5		42.0	81	1		ML	SANDY SILT - some seashells, dark brownish grey
			59.7	65	< 1			WATER LEVEL (1/31/91)
-10	10	1					MH	ELASTIC SILT - dark brownish grey
	15		28.8	92	< 1		SM	SILTY SAND - fine, dark grey
-15							SP	SAND - fine, grey
-20	20		25.3	98	11			
	25		52.3	72	1		MH	ELASTIC SILT - dark grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 15' after completion of drilling. Water level measured at 5-1/2' 15 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A-1.9

Area B - Law Crandall Borings

PLATE A2-67

JOB L91028.AEQ DATE 3/1/91 F.T. LS/AR DR. ph O.E. JLB W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 10-A

DATE DRILLED: February 12, 1991
EQUIPMENT USED: 8" - Diameter Hand Auger

ELEVATION 3.8

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		6.0	106			ML SP	FILL - SANDY SILT and SAND - brown
			50.6	71			CH	SURFACE OF NATURAL SOIL FAT CLAY - dark grey
-5	5		69.9	57			MH	ELASTIC SILT - grey
	10							

NOTE: Water level measured at 4-1/2' after completion of drilling. No caving.

BORING 10

DATE DRILLED: February 1, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 4.7

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		7.2	111	5		SM SP	FILL - SILTY SAND and SAND - fine, light brown
			66.1	62	< 1		MH	SURFACE OF NATURAL SOIL ELASTIC SILT - some layers of Sandy Silt, dark grey
	5		60.8	64	< 1			
-5			54.8	68	< 1			
	10	1						
-10	15		41.8	81	< 1			Some seashells
							SP	SAND - fine, grey
-15	20		24.2	100	12			

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 15' after completion of drilling. Water level measured at 6' 10 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A-1.10

Area B - Law Crandall Borings

PLATE A2-68

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 11-A

DATE DRILLED: February 12, 1991
EQUIPMENT USED: 8" - Diameter Hand Auger

ELEVATION 3.8

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		5.9	97			SM SP	FILL - SILTY SAND and SAND - fine to medium, mottled light brown and brown
			57.1	65			CH	SURFACE OF NATURAL SOIL FAT CLAY - dark grey
-5	5		56.5	67			MH	ELASTIC SILT - some seashells, grey
	10							

NOTE: Water level measured at 4' after completion of drilling. No caving.

BORING 11

DATE DRILLED: January 31, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 7.2

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
5			36.8	80	2		CL ML	FILL - SILTY CLAY and SILT - mottled grey and brown
	5		40.7	80	<1		MH	SURFACE OF NATURAL SOIL ELASTIC SILT - mottled light grey and grey
0		1						
	10		53.3	68	<1			Some seashells
-5		0						
	15							
-10			89.1	51	<1		ML	SANDY SILT - dark grey
	20	4						

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A-1.11a

Area B - Law Crandall Borings

PLATE A2-69

JOB 191028.AEQ DATE 3/15/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

BORING 11 (Continued)

DATE DRILLED: January 31, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-15			27.3	94	10		SP	SAND - fine, some seashells, grey
	25	10					MH	ELASTIC SILT - some Sand, grey
-20			49.8	72	1			
	30	4					ML	CLAYEY SILT - some layers of Sandy Silt, some seashells, dark grey
-25			30.7	90	2			
	35	2						
-30								
	40		21.1	106	2			
-35		0						
	45						ML	SANDY SILT - dark grey
-40			26.1	98	4			
	50		21.2	105	6		SM	SILTY SAND - fine, dark grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Water level measured at 6' 15 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

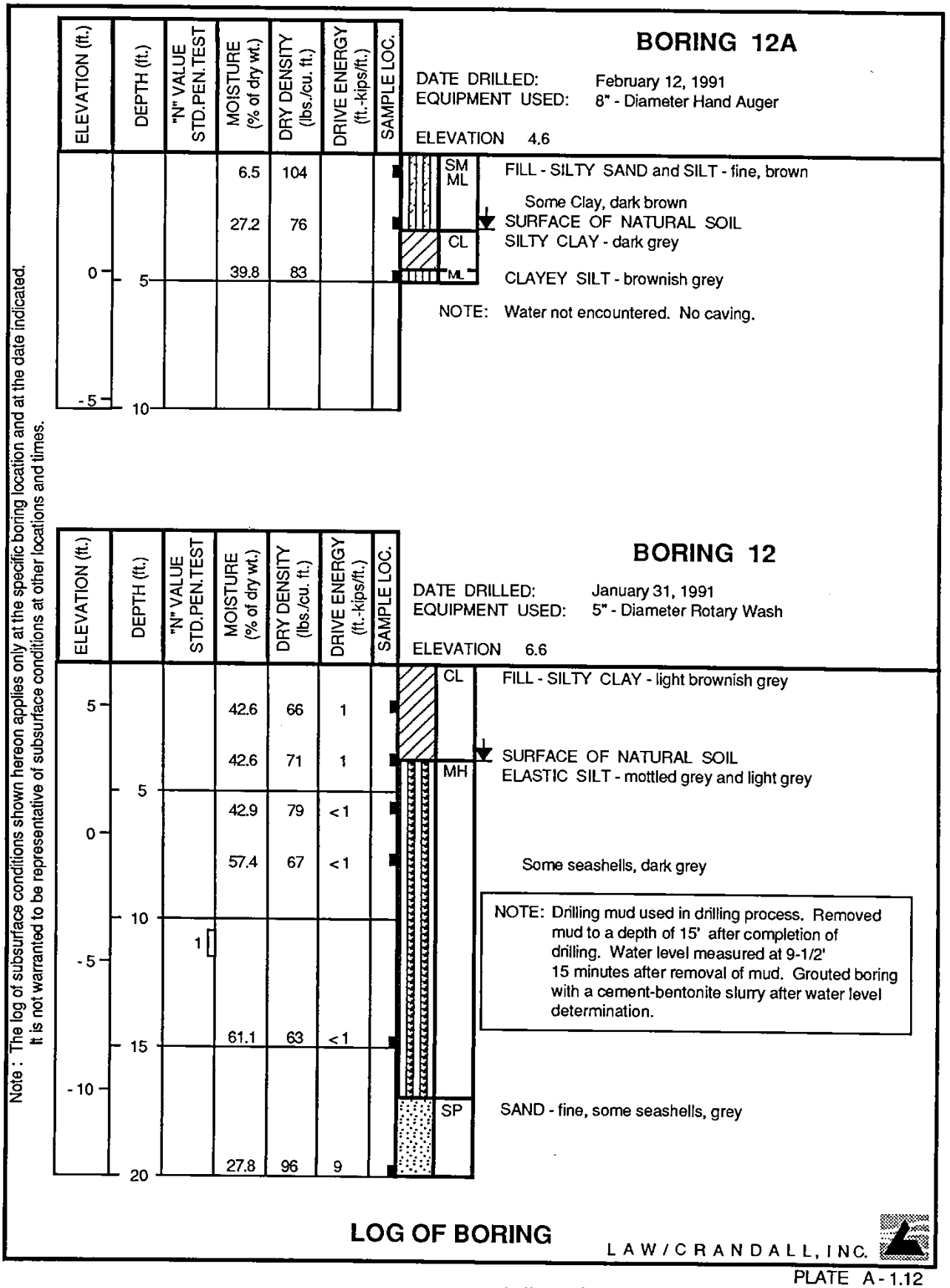
LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.11b

Area B - Law Crandall Borings

PLATE A2-70



Area B - Law Crandall Borings

PLATE A2-71

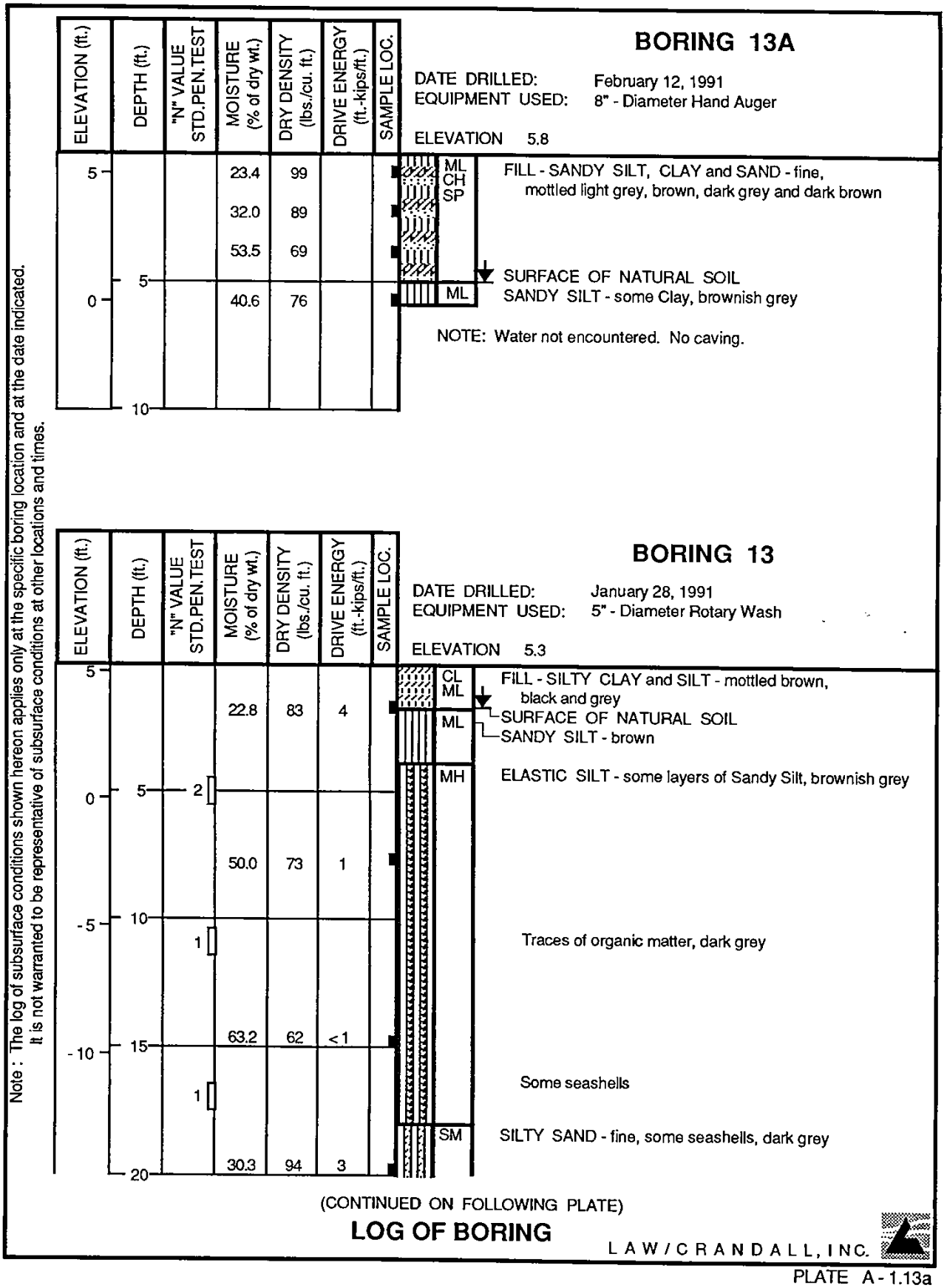


PLATE A - 1.13a

Area B - Law Crandall Borings

PLATE A2-72

JOB 91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 13 (Continued)

DATE DRILLED: January 28, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-15								
		2						
-20	25		69.6	59	<1		MH	ELASTIC SILT - some lenses of fine Sand, dark grey Some organic matter
		1						
-25	30		26.0	100	3		ML	SANDY SILT - some seashells, dark grey
-30	35	7	23.9	102	5		SM	SILTY SAND - fine, some layers of Sandy Silt, grey
-35	40	14	30.6	92	6		ML	SANDY SILT - some layers of Clayey Silt, dark grey
-40	45	8	31.9	91	6		ML	CLAYEY SILT - dark grey

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 30' after completion of drilling. Water level measured at 6' on 1/29/91. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.13b

Area B - Law Crandall Borings

PLATE A2-73

JOB 91028.AEO DATE 3/1/91 F.T. LS/AR DR. ph O.E. JLB W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 14A

DATE DRILLED: February 13, 1991
EQUIPMENT USED: 8" - Diameter Hand Auger

ELEVATION 6.3

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
5			14.4	108		
			23.3	93		
	5		49.4	69		
0			44.1	72		
	10					

ML — FILL - SANDY SILT - some Clay, mottled brown and grey

SURFACE OF NATURAL SOIL

ML — SANDY SILT - grey
Some Clay

NOTE: Water not encountered. No caving.

BORING 14

DATE DRILLED: February 1, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 7.1

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
5			19.0	82	4	
			49.4	68	1	
	5		42.4	77	<1	
0			53.4	68	<1	
	10		58.6	63	<1	
-5						
	15	2				
-10						
	20		60.9	65	<1	

ML SP — FILL - SANDY SILT and SAND - fine, some caliche, brown

SURFACE OF NATURAL SOIL

CH — FAT CLAY - mottled grey and light grey

MH — ELASTIC SILT - some lenses of Sand, brownish grey

(LL = 66, PI = 23)

Dark grey

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 15' after completion of drilling. Water level measured at 10' 15 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.14

Area B - Law Crandall Borings

PLATE A2-74

JOB L91028.AEQ DATE 3/1/91 F.T. LS/AR DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 15A

DATE DRILLED: February 13, 1991
EQUIPMENT USED: 8" - Diameter Hand Auger
ELEVATION 10.7

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
10			21.6	82		
			12.1	95		
	5		10.0	114		
5			3.5	101		
			36.2	80		
	10					

ML CL — FILL - SANDY SILT and CLAY - some Sand, mottled light grey, light brown and brown

Some layers of Sand

SURFACE OF NATURAL SOIL

CL — SILTY CLAY - dark grey

ML — SANDY SILT - grey

NOTE: Water not encountered. No caving.

BORING 15

DATE DRILLED: February 1, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash
ELEVATION 4.1

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			18.1	81	3	
			45.7	70	1	
0	5		34.4	88	2	
			48.2	74	< 1	
-5	10	1				
-10	15		90.8	48	< 1	
-15	20		12.1	125	5	

ML — FILL - SANDY SILT - grey

SURFACE OF NATURAL SOIL

MH — ELASTIC SILT - mottled light grey, grey and dark grey

Layer of Sandy Silt, grey

Dark grey

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 15' after completion of drilling. Water level measured at 13-1/2' 30 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

ML — SANDY SILT - about 10% Gravel, dark grey

LOG OF BORING

LAW / CRANDALL, INC.

PLATE A - 1.15

Area B - Law Crandall Borings

PLATE A2-75

JOB 91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

BORING 16

DATE DRILLED: January 30, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 7.6

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
5			7.7	119	7		SM ML	3" Asphaltic Paving FILL - SILTY SAND and SILT - fine, reddish brown
			9.2	115	2			SURFACE OF NATURAL SOIL
	5						CL	SILTY CLAY - some seashells, dark grey
			56.6	66	<1		MH	ELASTIC SILT - dark grey
0		2						
	10		58.1	61	<1			
-5								
	15	1						
-10							ML	SANDY SILT - some seashells, dark grey
	20		29.6	95	2			
-15							SP	SAND - fine, some seashells, grey
	25		28.3	95	9			

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 15' after completion of drilling. Water level measured at 10-1/2' 10 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.16

Area B - Law Crandall Borings

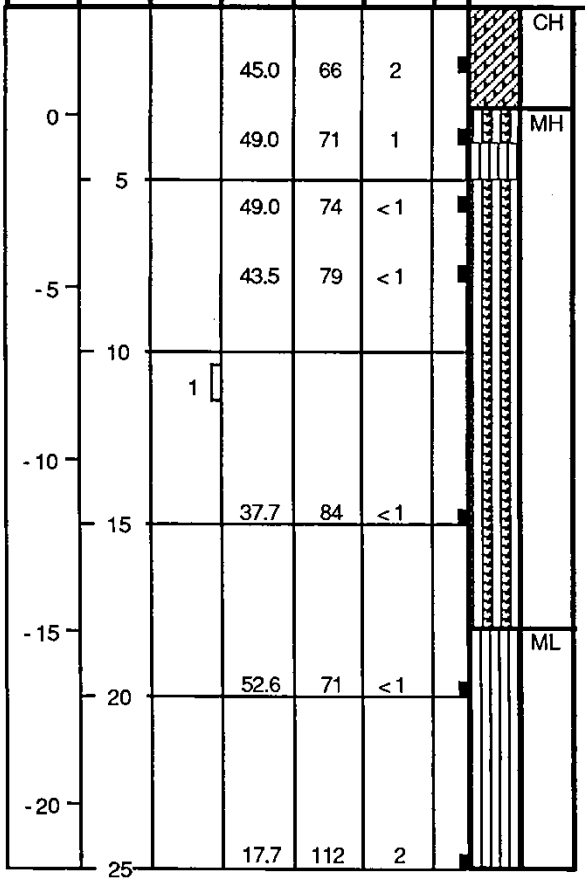
PLATE A2-76

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

BORING 18 *

DATE DRILLED: January 29, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 3.2



FAT CLAY - some caliche, mottled black and dark grey

ELASTIC SILT - some layers of Sand, dark grey

Layer of Sandy Silt

(LL = 48, PI = 12)

About 30% seashells

Few seashells

Sand seam

SANDY SILT - some layers of Elastic Silt, about 20% seashells, dark grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 15' after completion of drilling. Water level measured at 6-1/2' 15 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

* Boring 17 was deferred.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A-1.17

Area B - Law Crandall Borings

PLATE A2-77

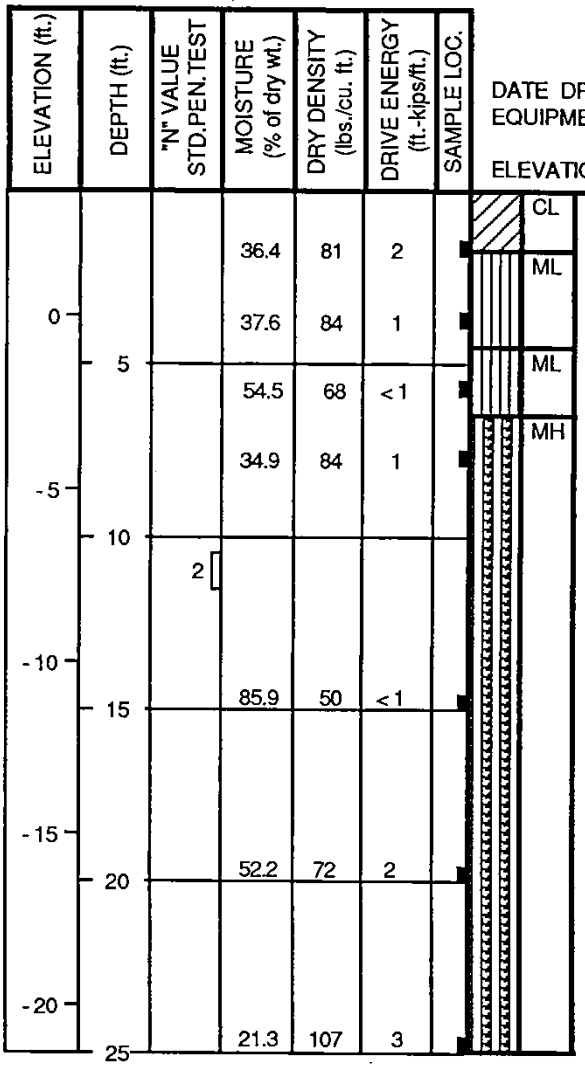
JOB 191028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 19

DATE DRILLED: January 29, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 3.6



SILTY CLAY - some caliche, mottled black, grey and dark grey

SANDY SILT - grey

CLAYEY SILT - dark grey

ELASTIC SILT - some layers of Sand, dark grey

About 50% seashells (from 10' to 12-1/2')

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 15' after completion of drilling. Water level measured at 6-1/2' 10 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.18

Area B - Law Crandall Borings

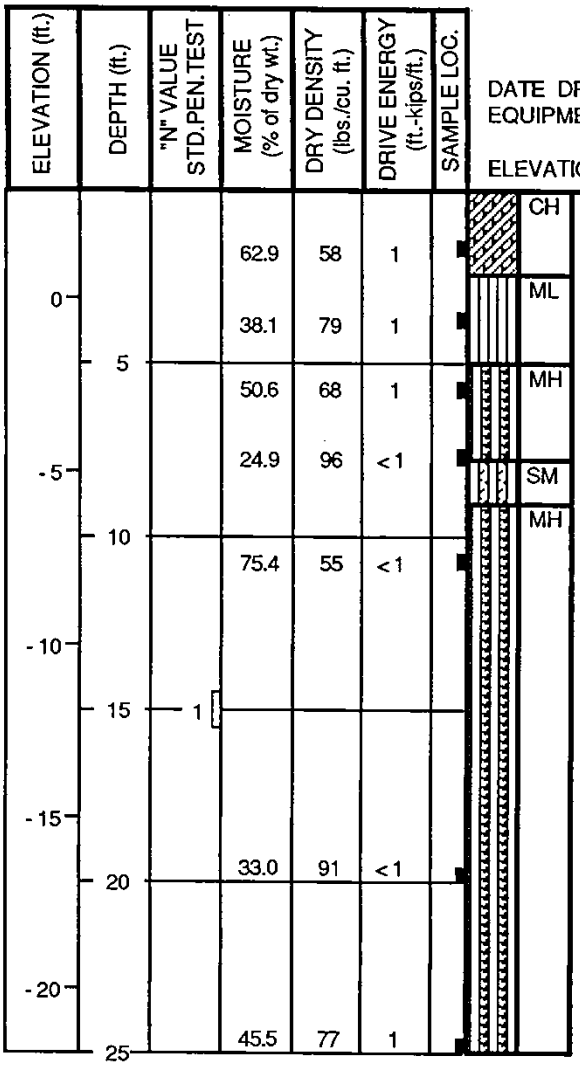
PLATE A2-78

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD F4

BORING 20

DATE DRILLED: January 29, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 3.1



FAT CLAY - some caliche, mottled grey and brown

Dark grey

SANDY SILT - brownish grey

Dark grey

ELASTIC SILT - dark grey

Layer of Sandy Silt

SILTY SAND - fine, grey

ELASTIC SILT - some layers of Sandy Silt, dark grey

Some seashells

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 20' after completion of drilling. Water level measured at 8' 10 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A-1.19

Area B - Law Crandall Borings

PLATE A2-79

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

BORING 21

DATE DRILLED: January 29, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 3.2

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		44.9	77	1		CL	SILTY CLAY - dark grey
			36.0	84	< 1		ML	SANDY SILT - dark grey
-5	5		49.2	69	< 1		MH	ELASTIC SILT - some seashells, grey and dark grey
			48.7	70	1			
-10	10	2						
	15		23.7	97	< 1		ML	SANDY SILT - dark grey
-15								
	20		24.3	99	2			
-20							MH	ELASTIC SILT - dark grey
	25		45.7	76	< 1			

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 15' after completion of drilling. Water level measured at 3-1/2' 10 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.20

Area B - Law Crandall Borings

PLATE A2-80

JOB L91028.AEO DATE 3/1/91 F.T. AR DR. ph O.E. JLR W.P. ph CHKD

BORING 22
(Monitoring Well MW-10)

DATE DRILLED: February 26, 1991
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

ELEVATION 3.4

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0						SP	FILL - SAND - fine to medium, grey
								SURFACE OF NATURAL SOIL
	5		55.3	67	<1		CH	FAT CLAY - grey
-5			69.1	58	<1		MH	ELASTIC SILT - some Sand, some seashells, dark grey
	10		44.7	77	<1		ML	SANDY SILT - dark grey
-10								
	15		36.0	86	<1			
-15							SP	SAND - fine to medium, grey
	20		26.3	97	8			
-20								Some layers of Silty Sand
	25		26.2	101	5			
-25								
	30		25.8	98	5			Some seashells

NOTE: Installed water level monitoring well; see Appendix C for well construction details.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.21

Area B - Law Crandall Borings

PLATE A2-81

JOB 191028.AEQ DATE 3/1/91 F.T. AR DR. ph O.E. JLR W.P. ph CHKD

BORING 23
(Monitoring Well MW-11)

DATE DRILLED: February 25, 1991
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

ELEVATION 1.8

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0						MH	ELASTIC SILT - some organic matter, mottled grey and brown
-5	5		55.6	66	< 1			
	10		73.9	56	< 1			
-10			76.9	54	< 1			Dark grey
-15	15		26.2	97	2		ML	SANDY SILT - dark grey Some seashells
-20	20		22.6	104	4		SM	SILTY SAND - fine, dark grey
-25	25		38.6	85	4			
	30		31.1	92	5			

NOTE: Installed water level monitoring well; see Appendix C for well construction details.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

PLATE A2-82

LOG OF BORING

LAW/CRANDALL, INC.

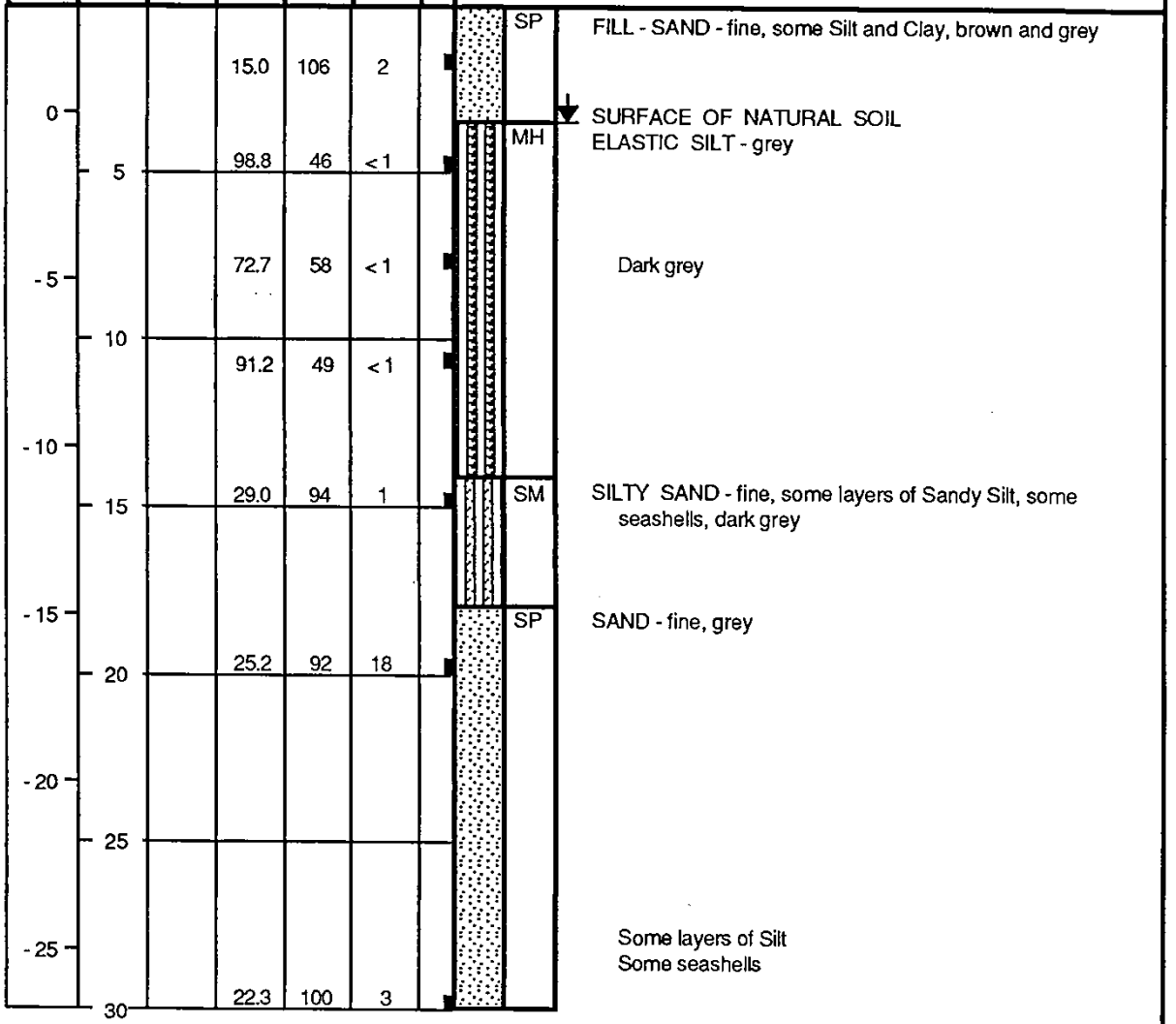
PLATE A - 1.22

JOB L91028.AEO DATE 3/22/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

BORING 24
(Monitoring Well MW-12)

DATE DRILLED: February 11, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 3.2



FILL - SAND - fine, some Silt and Clay, brown and grey

SURFACE OF NATURAL SOIL
ELASTIC SILT - grey

Dark grey

SILTY SAND - fine, some layers of Sandy Silt, some seashells, dark grey

SAND - fine, grey

Some layers of Silt
Some seashells

NOTE: Drilling mud used in drilling process. Flushed mud from boring using clear water after completion of drilling. Installed water level monitoring well; see Appendix C for well construction details.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.23

Area B - Law Crandall Borings

PLATE A2-83

JOB L91028.AEO DATE 3/22/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

BORING 25
(Monitoring Well MW-13)

DATE DRILLED: February 7, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 3.2

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		40.6	69	1		ML	SANDY SILT - brown
							CL	SILTY CLAY - mottled grey and dark grey
	5		37.1	86	1		ML	SANDY SILT - brownish grey
-5			70.8	59	< 1		MH	ELASTIC SILT - dark grey
	10		72.7	58	< 1			
-10								
	15		21.9	106	10		SP	SAND - fine, dark grey
-15								
	20		33.1	89	4			
-20							ML	SANDY SILT - dark grey
	25		42.1	78	< 1			
-25								
	30		29.1	92	9			

NOTE: Drilling mud used in drilling process. Flushed mud from boring using clear water after completion of drilling. Installed water level monitoring well; see Appendix C for well construction details.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.24

Area B - Law Crandall Borings

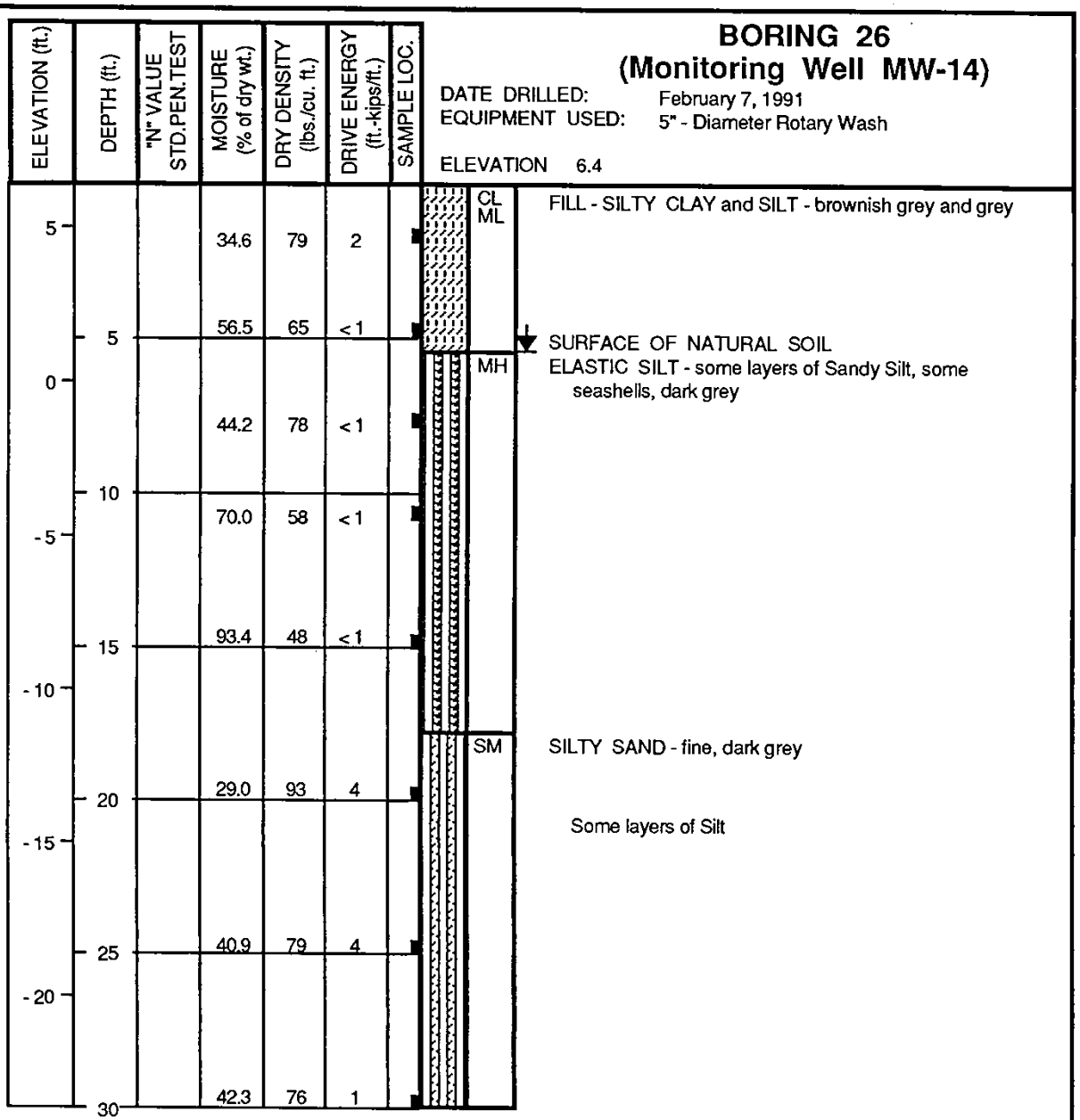
PLATE A2-84

JOB L91028.AEO DATE 3/22/91 F.T. LS DR. ph O.E. JLB W.P. ph CHKD

BORING 26
(Monitoring Well MW-14)

DATE DRILLED: February 7, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 6.4



NOTE: Drilling mud used in drilling process. Flushed mud from boring using clear water after completion of drilling. Installed water level monitoring well; see Appendix C for well construction details.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.25

Area B - Law Crandall Borings

PLATE A2-85

JOB L91028.AEO DATE 3/22/91 F.T. AR DR. ph O.E. JLR W.P. ph CHKD

BORING 27
(Monitoring Well MW-15)

DATE DRILLED: February 27, 1991
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

ELEVATION 2.2

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		47.9	67	2		CH	FAT CLAY - brownish grey
	5		43.7	77	1		MH	ELASTIC SILT - some seashells, grey
-5			75.7	55	< 1			Dark grey
	10		97.0	47	< 1			
-10								
	15		29.1	93	2		SM	SILTY SAND - fine, dark grey
-20								
	20		26.1	100	6		SP	SAND - fine, dark grey
-25								
	25		60.1	66	1		MH	ELASTIC SILT - dark grey
-30								
	30		51.1	69	1			

NOTE: Installed water level monitoring well; see Appendix C for well construction details.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.26

Area B - Law Crandall Borings

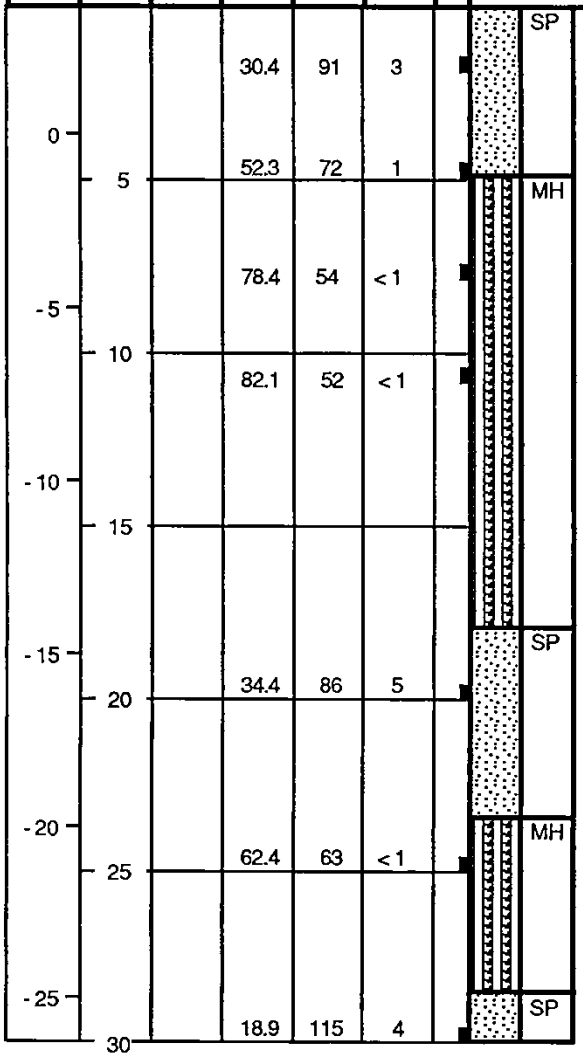
PLATE A2-86

JOB L91028.AEO DATE 3/22/91 F.T. AR DR. ph O.E. JLR W.P. ph CHKD

BORING 28
(Monitoring Well MW-16)

DATE DRILLED: March 5, 1991
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

ELEVATION 3.7



SAND - fine to medium, brown

ELASTIC SILT - grey

Dark grey

SAND - fine, dark grey

ELASTIC SILT - dark grey

SAND - fine to medium, dark grey

NOTE: Installed water level monitoring well; see Appendix C for well construction details.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.27

Area B - Law Crandall Borings

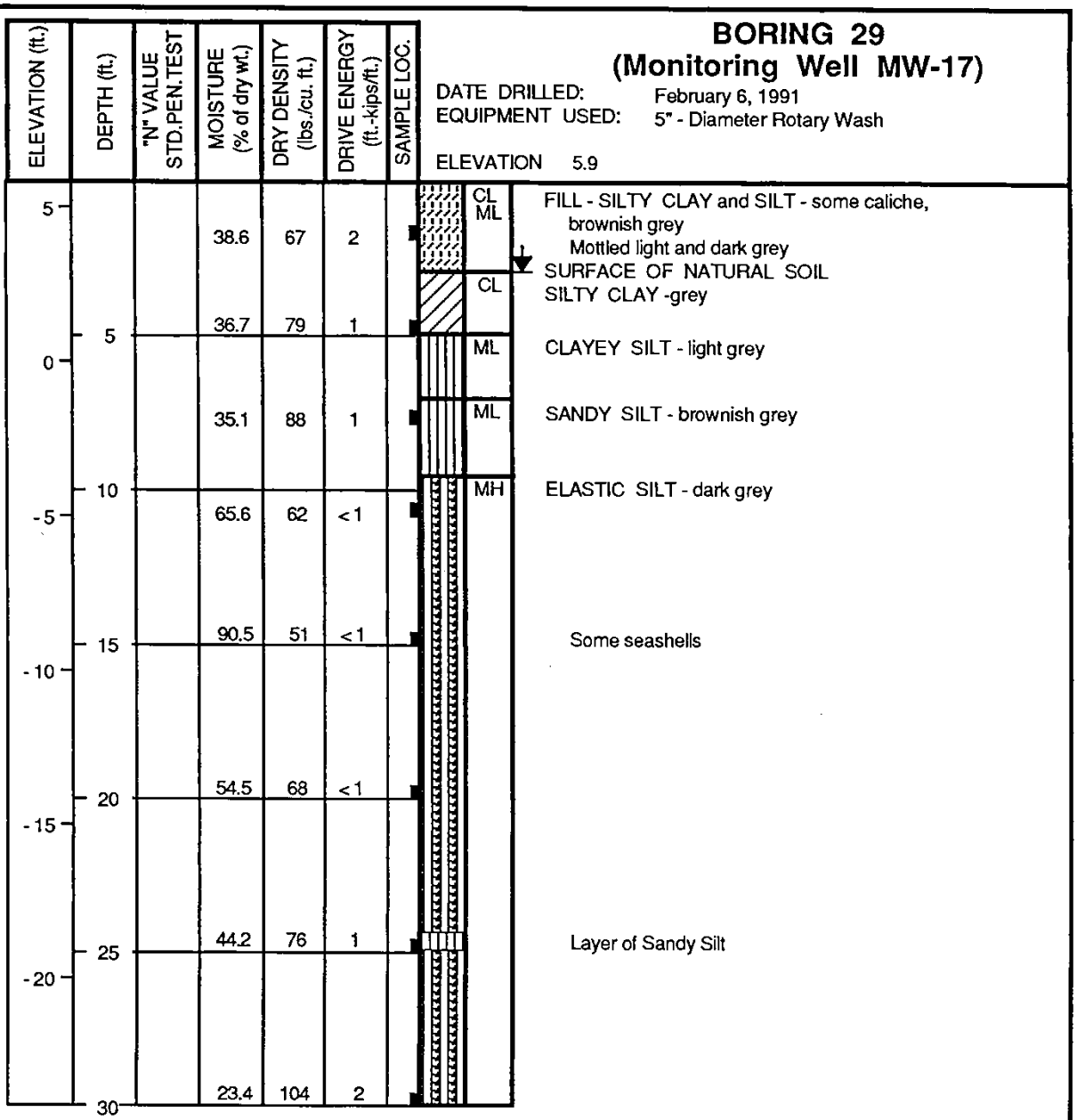
PLATE A2-87

JOB L91028.AEO DATE 3/22/91 F.T. LS DR. ph O.E. JLB W.P. ph CHKD

BORING 29
(Monitoring Well MW-17)

DATE DRILLED: February 6, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 5.9



NOTE: Drilling mud used in drilling process. Flushed mud from boring using clear water after completion of drilling. Installed water level monitoring well; see Appendix C for well construction details.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.28

Area B - Law Crandall Borings

PLATE A2-88

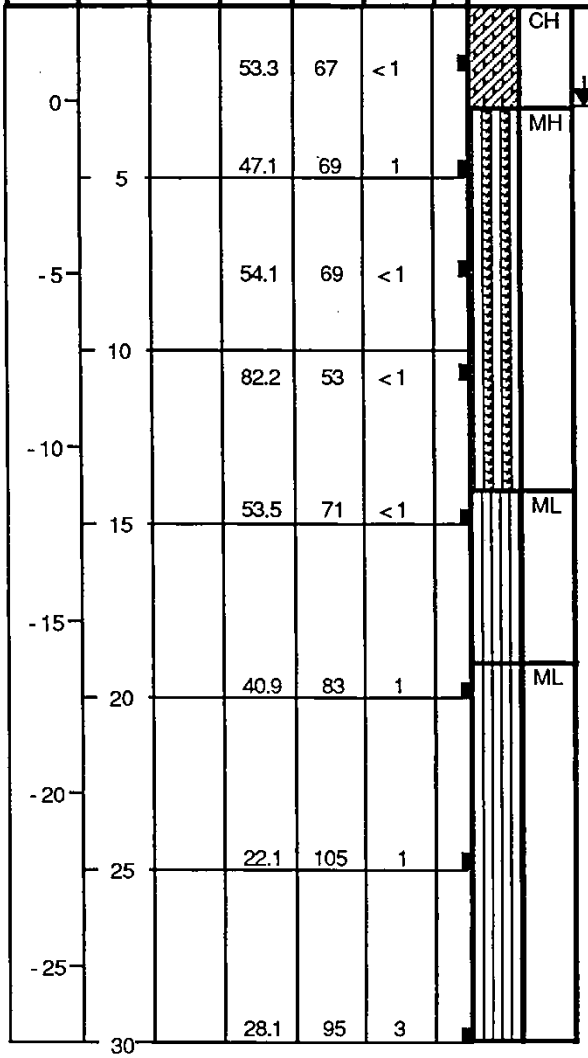
JOB L91028.AEQ DATE 3/22/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

BORING 30
(Monitoring Well MW-18)

DATE DRILLED: February 5, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 2.9

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.



CH FILL - FAT CLAY - some caliche, dark brownish grey

SURFACE OF NATURAL SOIL

MH ELASTIC SILT - some layers of Sandy Silt, brownish grey

Dark grey

Organic odor

ML CLAYEY SILT - dark grey

ML SANDY SILT - dark grey

NOTE: Drilling mud used in drilling process. Flushed mud from boring using clear water after completion of drilling. Installed water level monitoring well; see Appendix C for well construction details.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.29

Area B - Law Crandall Borings

PLATE A2-89

BORING 31
(Monitoring Well MW-19)

DATE DRILLED: February 5, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 2.5

JOB L91028.AEO DATE 3/22/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		40.6	77	1		CL	FILL - SILTY CLAY - some caliche, mottled brown, grey and dark grey
								SURFACE OF NATURAL SOIL
	5		36.7	86	< 1		ML	SANDY SILT - brownish grey
-5			59.1	66	< 1		MH	ELASTIC SILT - light grey
	10		98.9	45	< 1			Dark grey About 50% seashells (from 8' to 13')
-10								
	15		76.2	54	< 1			
-15								
	20		34.1	92	< 1		ML	SANDY SILT - dark grey
-20								
	25		24.4	100	< 1			
-25								
	30		38.2	83	1			Layer of Clayey Silt

NOTE: Drilling mud used in drilling process. Flushed mud from boring using clear water after completion of drilling. Installed water level monitoring well; see Appendix C for well construction details.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.30

Area B - Law Crandall Borings

PLATE A2-90

JOB L91028.AEQ DATE 3/22/91 F.T. LS DR. ph O.E. JLB W.P. ph CHKD

BORING 32
(Monitoring Well MW-20)

DATE DRILLED: February 6, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 2.7

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		43.5	74	1		CL	SILTY CLAY - dark brown
	5		59.8	64	< 1		MH	ELASTIC SILT - some layers of Clay, brownish grey
-5			51.8	71	< 1			Grey
	10		90.6	49	< 1			Dark grey
-10								
	15							
-15			39.3	82	< 1			
	20							
-20								
	25		70.1	58	< 1			
-25								
	30		73.5	55	< 1			

NOTE: Drilling mud used in drilling process. Flushed mud from boring using clear water after completion of drilling. Installed water level monitoring well; see Appendix C for well construction details.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.31

Area B - Law Crandall Borings

PLATE A2-91

JOB L91028.AEQ DATE 3/22/91 F.T. AR DR. ph O.E. BK W.P. ph CHKD

BORING 33
(Monitoring Well MW-21)

DATE DRILLED: March 6, 1991
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

ELEVATION 4.9

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
			11.3	82	4		SP	SAND - fine to medium, some rootlets, brown
0	5		54.7	68	3		CH	FAT CLAY - traces of organic matter, dark grey
			97.9	50	1		MH	ELASTIC SILT - some rootlets, dark grey
-5	10		23.2	105	4		SM	SILTY SAND - fine, dark grey
-10	15							
-15	20		21.0	107	4		SW	SAND - well graded, few Gravel, dark grey
-20	25		20.8	112	6		SP	SAND - fine, dark grey
-25	30		17.2	114	12			Light grey

NOTE: Drilling mud used in drilling process. Flushed mud from boring using clear water after completion of drilling. Installed water level monitoring well; see Appendix C for well construction details.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.32

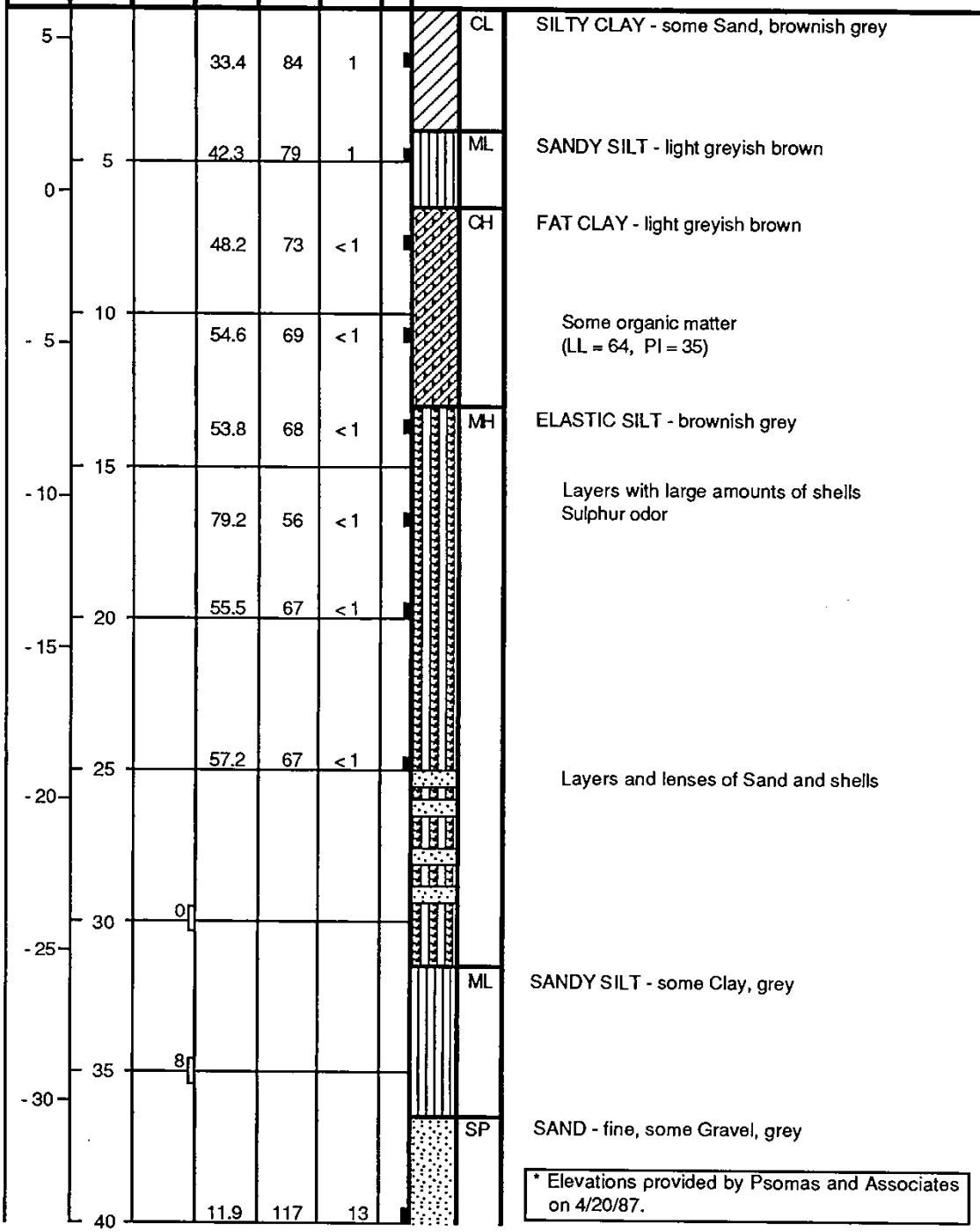
Area B - Law Crandall Borings

PLATE A2-92

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. lp CHKD

BORING 1
(LCA AE-87133)

DATE DRILLED: April 7, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash
ELEVATION 5.8*



* Elevations provided by Psomas and Associates on 4/20/87.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.33a

Area B - Law Crandall Borings

PLATE A2-93

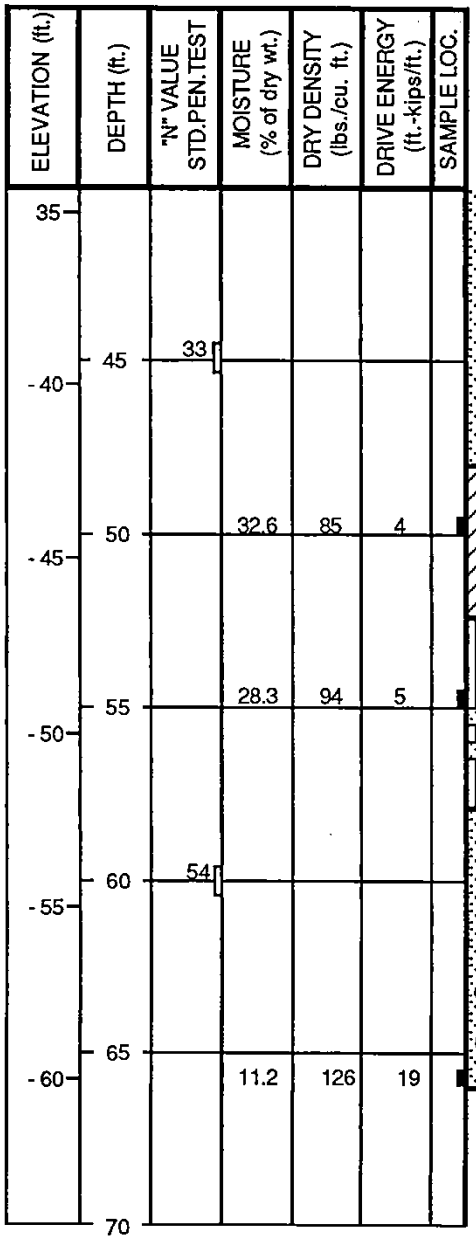
JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. dmh lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 1 (Continued)

(LCA AE-87133)

DATE DRILLED: April 7, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash



CL SILTY CLAY - dark grey

ML SANDY SILT - some Clay, dark grey

Layers of Sand

SW SAND - well graded, about 25% Gravel, some Cobbles, light grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 20'. Backfilled annular space with pea gravel. Water level measured at a depth of 5' on 5/4/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.33b

Area B - Law Crandall Borings

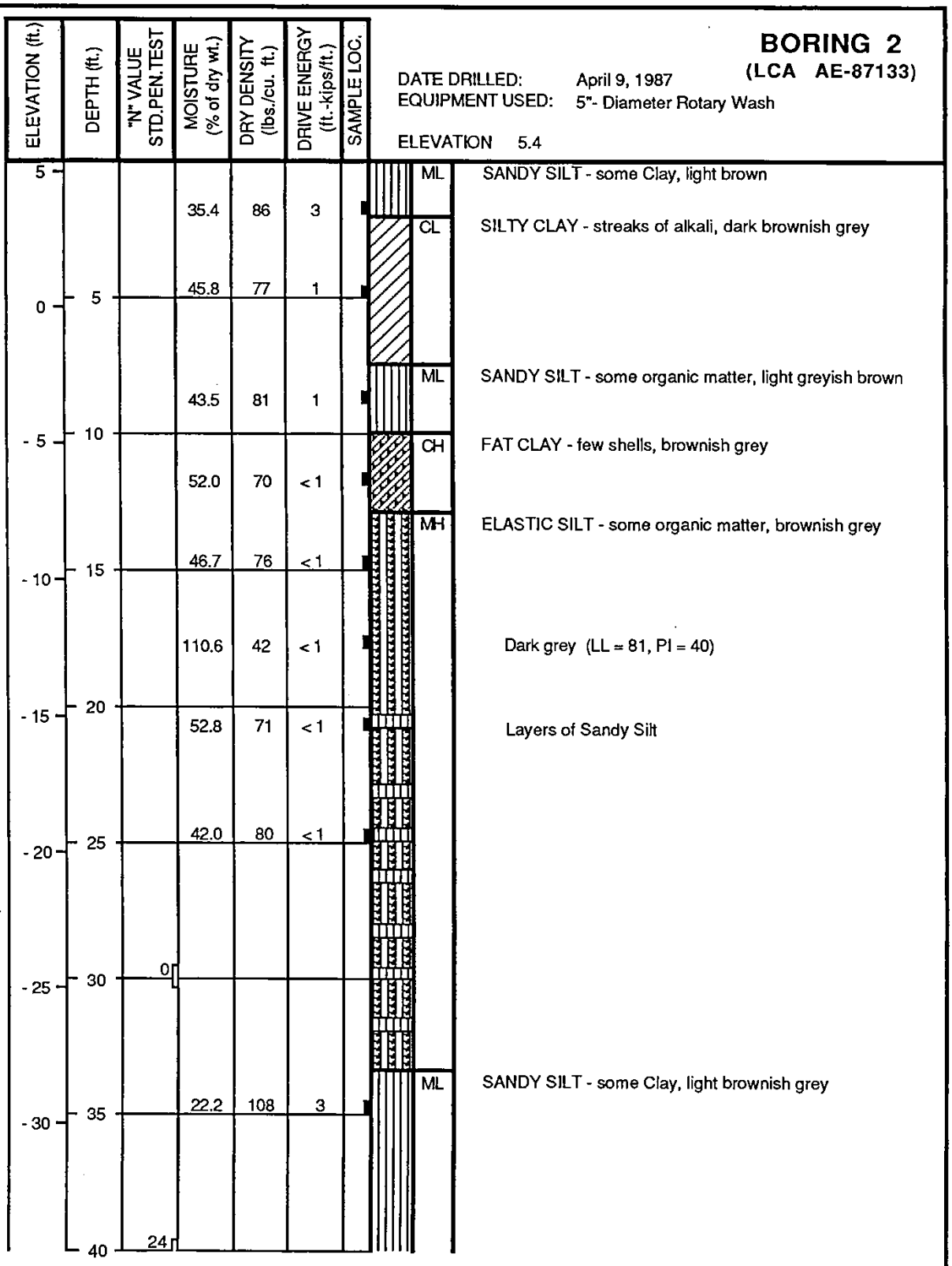
PLATE A2-94

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. dmh lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated.
It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 2
(LCA AE-87133)

DATE DRILLED: April 9, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash
ELEVATION 5.4



(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.34a

Area B - Law Crandall Borings

PLATE A2-95

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. lp. CHKD

BORING 2 (Continued)

(LCA AE-87133)

DATE DRILLED: April 9, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-40						
-45	45		24.9	104	2	
-50	50		35.9	87	1	
-55	55		31.6	92	2	
-60	60	60				
-65	65		13.2	123	28	
	70					

Layer of coarse Sand and Gravel

CL SILTY CLAY - brownish grey

Dark grey

ML SANDY SILT - dark grey

SW SAND - well graded, some Gravel, light grey

About 25% Gravel

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 20' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 20'. Backfilled annular space with pea gravel. Water level measured at a depth of 5-1/2' on 5/4/87.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.34b

Area B - Law Crandall Borings

PLATE A2-96

BORING 3
(LCA AE-87133)

DATE DRILLED: April 8, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash
ELEVATION 6.6

JOB L91028.AEQ DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
5			27.6	90	3		ML	FILL - SANDY SILT - some Clay, mottled brown and grey
							CL	SILTY CLAY - some organic matter, streaks of alkali, dark brownish grey
	5		42.0	78	1		ML	SANDY SILT - light brown
0							CH	FAT CLAY - some organic matter, light greyish brown
			55.8	69	< 1			
	10		35.2	86	1			Layers of Sandy Silt
- 5							MH	ELASTIC SILT - some shells and organic matter, brownish grey
		2						
	15							
-10			72.3	58	< 1			
	20		99.6	46	< 1			Light greyish brown Sulphur odor
-15								
	25		58.1	67	< 1			
- 20								
	30		21.9	108	1			Layers of Sandy Silt
- 25								
		27					SP	SAND - fine, some Silt, grey
	35							
- 30							SW	SAND - well graded, about 25% Gravel, grey
	40	56						

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.35a

Area B - Law Crandall Borings

PLATE A2-97

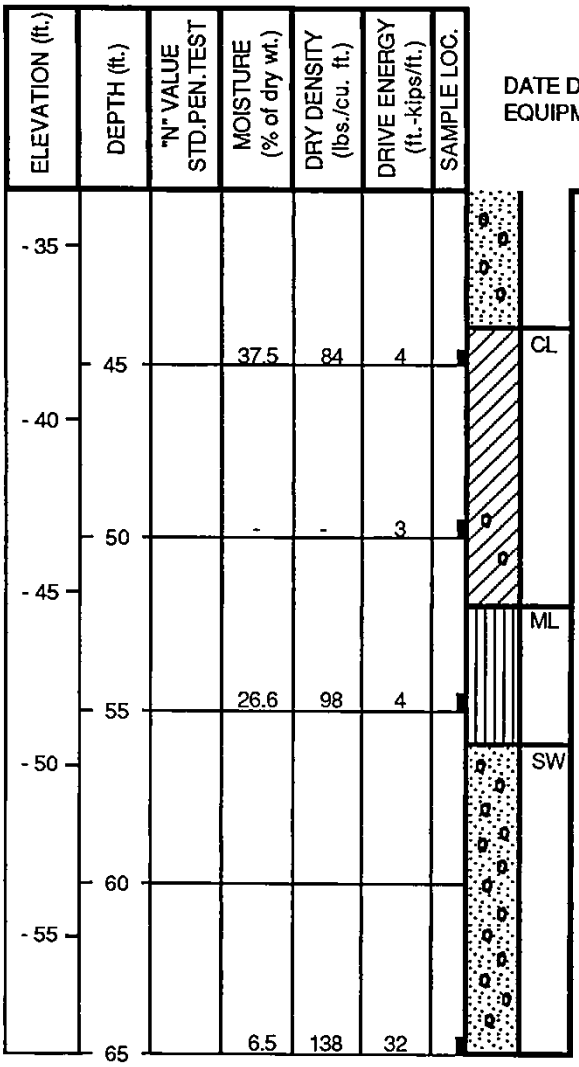
JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 3 (Continued)

(LCA AE-87133)

DATE DRILLED: April 9, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash



SILTY CLAY - dark grey

Some Gravel

SANDY SILT - dark grey

SAND - well graded, about 30% Gravel, light grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 20'. Backfilled annular space with pea gravel. Water level measured at a depth of 6' on 5/4/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.35b

Area B - Law Crandall Borings

PLATE A2-98

BORING 4

(LCA AE-87133)

DATE DRILLED: April 8, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash
ELEVATION 7.3

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
5			25.9	90	2		CL	FILL - SILTY CLAY - mottled brown
							ML	FILL - SANDY SILT - some Clay, mottled brown and grey
	5		39.7	80	1		CL	SILTY CLAY - streaks of alkali, dark greyish brown
0							CH	FAT CLAY - light greyish brown
			49.4	71	< 1			Lenses of Sandy Silt
	10		37.9	83	2		SM	SILTY SAND - fine, light grey
- 5							MH	ELASTIC SILT - some organic matter, few shells, light grey
	15		45.7	77	< 1			
- 10			74.1	57	< 1			(LL = 52, PI = 24)
	20		96.8	47	< 1			Light greyish brown Sulphur odor
- 15								
	25		29.1	94				Black
- 20								Layers of Sandy Silt
	30	2						
- 25								
	35		22.6	106			SP	SAND - fine, layers of Sandy Silt, light grey
- 35								
	40	9					SM	SILTY SAND - fine, layers of Sandy Silt, grey

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.36a

Area B - Law Crandall Borings

PLATE A2-99

BORING 4 (Continued)

(LCA AE-87133)

DATE DRILLED: April 8, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
- 40	45		40.0	82	2		CH	FAT CLAY - dark grey Black
- 45	50		38.8	83	2			Dark grey (LL = 56, PI = 28)
- 50							ML	SANDY SILT - some Clay, black
	55		14.8	120	16		SW	SAND - well graded, some Silt and Gravel, grey About 30% Gravel, some Cobbles
- 55	60		18.8	112	32			Layers of fine Sand
- 60	65		22.0	106	32		SP	SAND - fine, some Gravel, grey
- 65	70							

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 20'. Backfilled annular space with pea gravel. Water level measured at a depth of 7-1/2' on 5/4/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.36b

Area B - Law Crandall Borings

PLATE A2-100

BORING 5
(LCA AE-87133)

DATE DRILLED: April 10, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 4.2

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	5		35.0	87	1		ML	SANDY SILT - brownish grey
			57.0	70	<1		MH	ELASTIC SILT - light greyish brown
-5	10		-	-	1		ML	SANDY SILT - light greyish brown
			45.6	75	<1		MH	ELASTIC SILT - few shells, dark grey
-10	15		69.6	62	<1		CH	FAT CLAY - few shells, dark grey
			65.1	62	<1			
-15	20		20.1	111	1		CL ML	SILTY CLAY - lenses of shells, few Gravel, black (LL = 24, PI = 7)
-20	25		26.5	99	7		SM	SILTY SAND - fine, few shells, dark grey
-25	30	12					CL	SILTY CLAY - layers of Sandy Silt, dark grey
-30	35		32.0	91	3		ML	SANDY SILT - some Clay, dark grey
-35	40	6					MH	ELASTIC SILT - layers of Silty Sand, dark grey

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.37a

Area B - Law Crandall Borings

PLATE A2-101

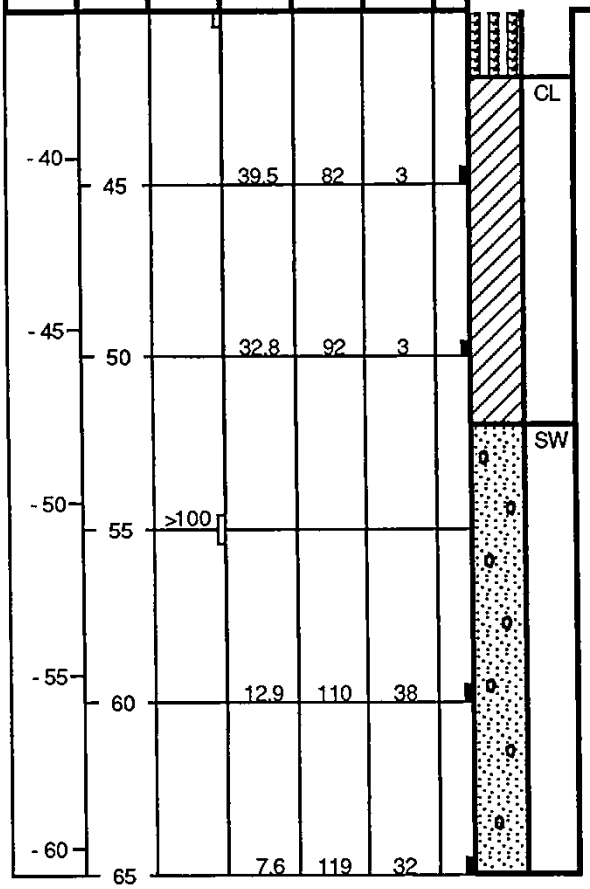
JOB L91028.AEO DATE 5/15/91 F.T. JD DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated.
It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 5 (Continued)

(LCA AE-87133)

DATE DRILLED: April 10, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash



SILTY CLAY - layers of Silty Sand, some organic matter, dark grey

SAND - well graded, some Gravel, grey

About 25% Gravel

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 15' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 19'. Backfilled annular space with pea gravel. Water level measured at a depth of 6' on 5/4/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.37b

Area B - Law Crandall Borings

PLATE A2-102

BORING 6
(LCA AE-87133)

DATE DRILLED: April 9, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 3.6

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		37.9	78	1		CL	SILTY CLAY - some organic matter, dark brownish grey
	5		66.9	57	< 1		CH	FAT CLAY - light greyish brown (LL= 84, PI = 51)
-5			40.6	81	1			Layers of Sandy Silt
	10		39.1	84	< 1			Large amount of shells, sulphur odor
-10			108.7	43	< 1		MH	ELASTIC SILT - light grey
	15		100.6	46	< 1			Some shells, sulphur odor
-15								Light brownish grey
	20		57.4	66	< 1			
-20								Layers of Sandy Silt
	25		19.2	113	1			
-25								
	30	18					SP	SAND - fine, grey
							SW	SAND - well graded, about 25% Gravel, grey
-30								
	35	44						
-35							CL	SILTY CLAY - dark grey
	40		34.9	89	3			

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.38a

Area B - Law Crandall Borings

PLATE A2-103

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. lp CHKD

BORING 6 (Continued)

(LCA AE-87133)

DATE DRILLED: April 9, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-40	45		37.8	83	1			(LL = 33, PI = 11)
-45	50		33.0	89	2		ML	SANDY SILT - dark grey
							SW	SAND - well graded, about 30% Gravel, some Cobbles, grey
-50	55							
-55	60		30.9	95	28		SM	SILTY SAND - fine, grey
-60	65							

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 25' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 17'. Backfilled annular space with pea gravel. Water level measured at a depth of 3' on 5/4/87.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.38b

Area B - Law Crandall Borings

PLATE A2-104

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. lp O.E. DW W.P. dmh lp CHKD

BORING 7
(LCA AE-87133)

DATE DRILLED: April 13, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 3.9

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	5		52.6	62	1	■	CH	FAT CLAY - brownish grey
			43.5	81	1	■	ML	SANDY SILT - light greyish brown
- 5	10		46.8	76	1	■	MH	ELASTIC SILT - some shells, greyish brown
			53.6	68	< 1	■		Large amount of shells Dark grey
-10	15		79.5	58	< 1	■		Light brownish grey
			55.7	68	< 1	■	CH	FAT CLAY - few shells, grey
-15	20		30.9	92	1	■	ML	SANDY SILT - few shells, dark grey
- 20	25		25.5	100	2	■	ML	CLAYEY SILT - layers of Silty Sand, dark grey
- 25	30	9						
- 30	35		26.3	100	4	■	ML	SANDY SILT - some Clay, dark grey
- 35	40						ML	CLAYEY SILT - some Sand, dark grey

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.39a

PLATE A2-105

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. lp O.E. DW W.P. lp CHKD

BORING 7 (Continued)

(LCA AE-87133)

DATE DRILLED: April 13, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			28.7	95	2	
-40	45		40.5	81	2	
-45	50		21.7	103	11	
-50	55		12.1	132	12	
-55	60		13.4	125	22	
-60	65					

CL SILTY CLAY - some organic matter, black

SP SAND - fine, few Gravel, grey

SW SAND - well graded, some Silt, about 15% Gravel, grey

About 25% Gravel

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 35' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 19'. Backfilled annular space with pea gravel. Water level measured at a depth of 4-1/2' on 5/4/87.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.39b

Area B - Law Crandall Borings

PLATE A2-106

JOB L91028.AEO DATE 5/15/91 F.T. BW DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 8
(LCA AE-87133)

DATE DRILLED: April 10, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash
ELEVATION 4.0

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		54.8	63	1	■	CH	FAT CLAY - some organic matter, brownish grey
	5		47.6	75	< 1	■		Light greyish brown (LL = 55, PI = 25)
- 5			42.8	80	< 1	■		
	10		46.7	76	< 1	■	MH	ELASTIC SILT - some Sand and organic matter, few shells, grey
-10			64.8	62	< 1	■		
	15		106.3	43	< 1	■		Light greyish brown
-15								
	20		57.6	66	< 1	■		Grey
- 20								
	25		45.0	77	< 1	■		Dark grey
- 25								
	30		58.5	63	< 1	■		
- 30							SM	SILTY SAND - fine, few shells, dark grey
	35		19.5	105	10	■		
- 35							SW	SAND - well graded, some Silt and Gravel, grey
	40							

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.40a

Area B - Law Crandall Borings

PLATE A2-107

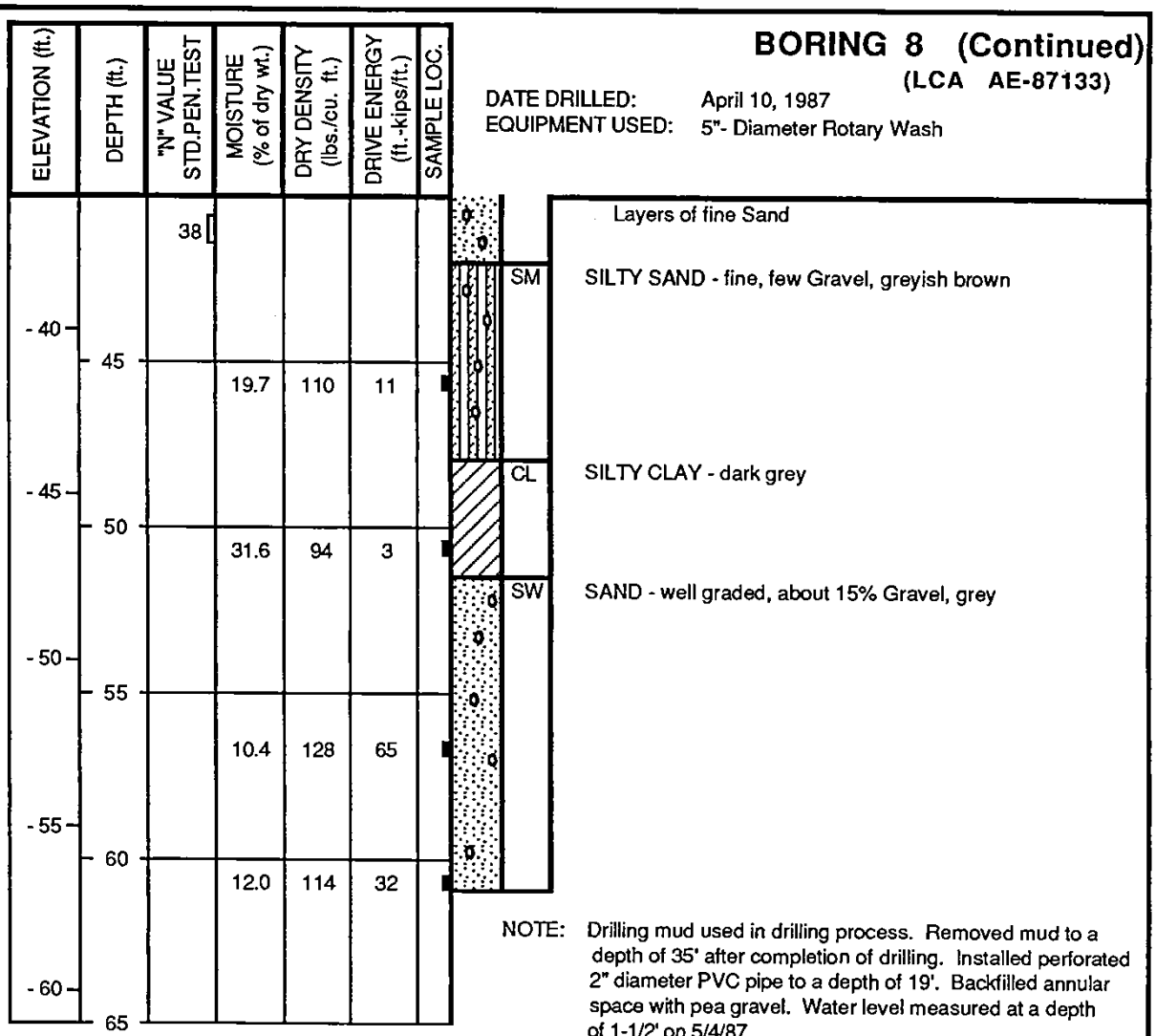
JOB L91028.AEO DATE 5/15/91 F.T. BW DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 8 (Continued)

(LCA AE-87133)

DATE DRILLED: April 10, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash



NOTE: Drilling mud used in drilling process. Removed mud to a depth of 35' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 19'. Backfilled annular space with pea gravel. Water level measured at a depth of 1-1/2' on 5/4/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

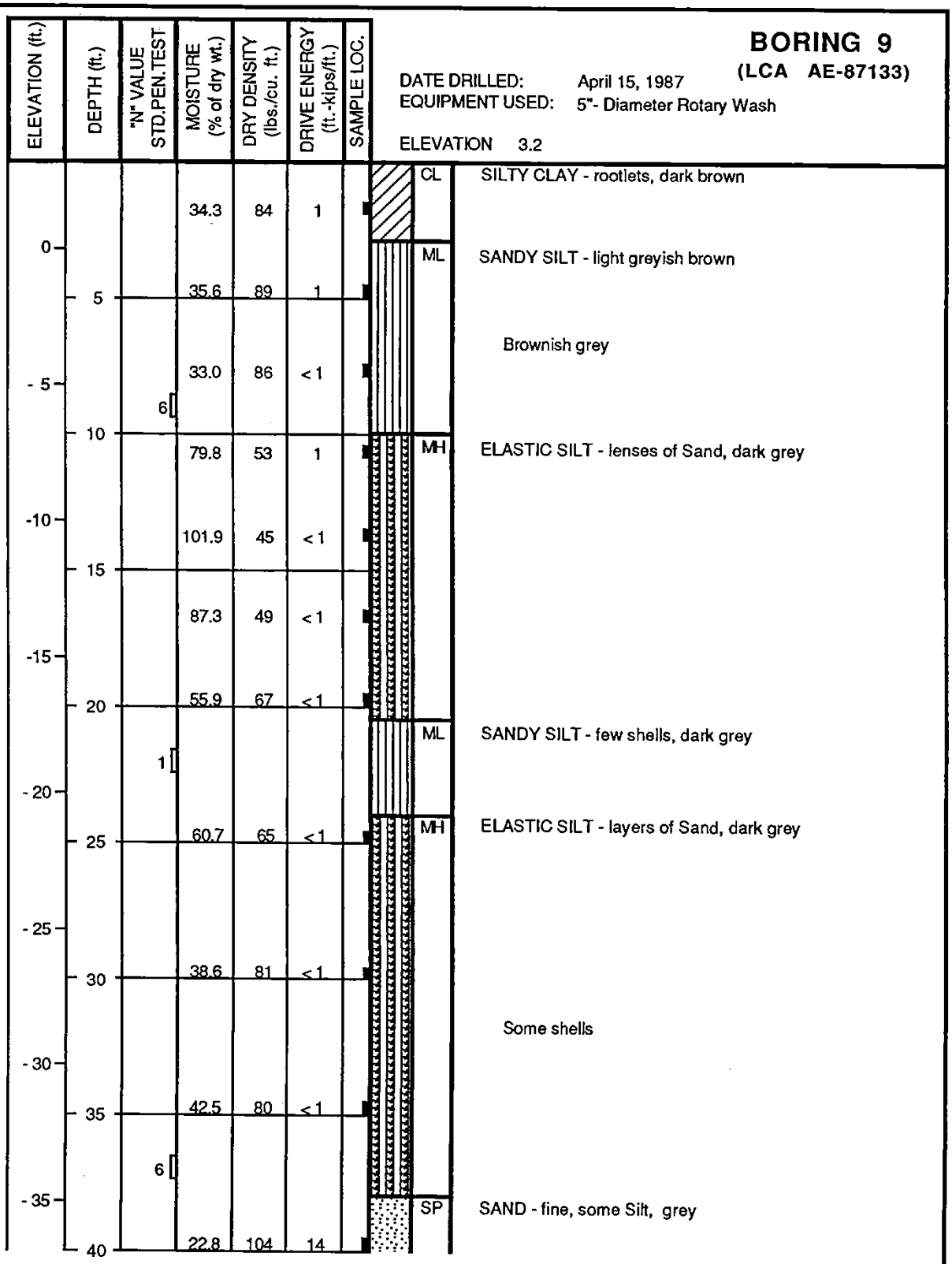
PLATE A - 1.40b

Area B - Law Crandall Borings

PLATE A2-108

BORING 9
(LCA AE-87133)

DATE DRILLED: April 15, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash
ELEVATION 3.2



Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L91028.AEQ DATE 5/15/91 F.T. JD DR. lp O.E. DW W.P. lp CHKD

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.41a

PLATE A2-109

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. lp O.E. DW W.P. lp CHKD

BORING 9 (Continued)

(LCA AE-87133)

DATE DRILLED: April 15, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-40	45	36	21.7	102	13	
-45	50	43	22.7	106	3	
-50	55		15.8	108	32	
-55	60		12.3	117	22	
-60	65					

Few Gravel

CL SILTY CLAY - some Sand filled cracks, dark grey and brown

SW SAND - well graded, some Silt, about 20% Gravel, grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 19'. Backfilled annular space with pea gravel. Water level measured at a depth of 4' on 5/4/87.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.41b

Area B - Law Crandall Borings

PLATE A2-110

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. lp O.E. DW W.P. lp CHKD

BORING 10
(LCA AE-87133)

DATE DRILLED: April 15, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 4.0

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	5		56.5	64	1		MH	ELASTIC SILT - light brownish grey
			41.7	80	1		ML	SANDY SILT - grey
- 5	10		38.9	85	1		MH	ELASTIC SILT - some organic matter, dark grey
			64.3	61	< 1			Lenses of Sand
-10	15		89.7	50	< 1			
			12.4	115	3		SP	SAND - fine, some Silt and Gravel, grey
-15	20	23						
			51.3	72	< 1		MH	ELASTIC SILT - some Sand filled cracks, dark grey
- 20	25							Medium to large amount of organic matter
			40.7	79	< 1			
- 25	30						SM	SILTY SAND - fine, grey
			17.9	108	2			
- 30	35	9						
			20.8	109	4		ML	SANDY SILT - some Clay, dark grey
- 35	40	22					SM	SILTY SAND - fine, some Gravel, grey

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.42a

Area B - Law Crandall Borings

PLATE A2-111

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 10 (Continued)

(LCA AE-87133)

DATE DRILLED: April 15, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
			16.7	115	6			
-40	45	10	62.4	59	-			Layer of Elastic Silt
			21.8	106	9			
-45	50	35	27.7	100	24		SP	SAND - fine, some Silt, grey
-50	55		13.8	126	34		SW	SAND - well graded, some Gravel, grey
-55	60		28.1	99	24		ML	SANDY SILT - grey
-60	65							

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 35' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 19'. Backfilled annular space with pea gravel. Water level measured at a depth of 2-1/2' on 5/4/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.42b

Area B - Law Crandall Borings

PLATE A2-112

BORING 11
(LCA AE-87133)

DATE DRILLED: April 7, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 5.8

JOB L91028.AEO DATE 5/15/91 F.T. DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
5			18.1	107	2		CL	FILL - SAND - fine, light brown SILTY CLAY - some Sand and organic matter, dark brown
	5		43.8	76	1			
0							CH	FAT CLAY - light brownish grey
			46.4	74	1			
	10		54.2	69	1		MH	ELASTIC SILT - lenses of Sand, grey
- 5			86.8	51	< 1			
	15							
-10			87.3	51	< 1			Sulpher odor
								Some organic matter, dark grey
	20		67.3	59	< 1			
-15			92.6	47	< 1			(LL = 60, PI = 24)
	25							
- 20			84.4	52	< 1			
	30							
- 25			42.5	81	< 1			
	35							
- 30			25.3	100	3		SM	SILTY SAND - fine, layers of Elastic Silt, dark grey
	40							

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.43a

PLATE A2-113

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 11 (Continued)

(LCA AE-87133)

DATE DRILLED: April 7, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-35	45	0					MH	ELASTIC SILT - layers of Silty Sand, dark grey
-40	50	24					SW	SAND - well graded, some Gravel, grey About 25% Gravel
-45	55		13.5	122	13			
-50	60	46					SP	SAND - fine, some Silt, grey
-55	65						SW	SAND - well graded, about 30% Gravel, grey
-60	70		30.4	92	19		ML	SANDY SILT - grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 25' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 19'. Backfilled annular space with pea gravel. Water level measured at a depth of 2' on 5/4/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.43b

Area B - Law Crandall Borings

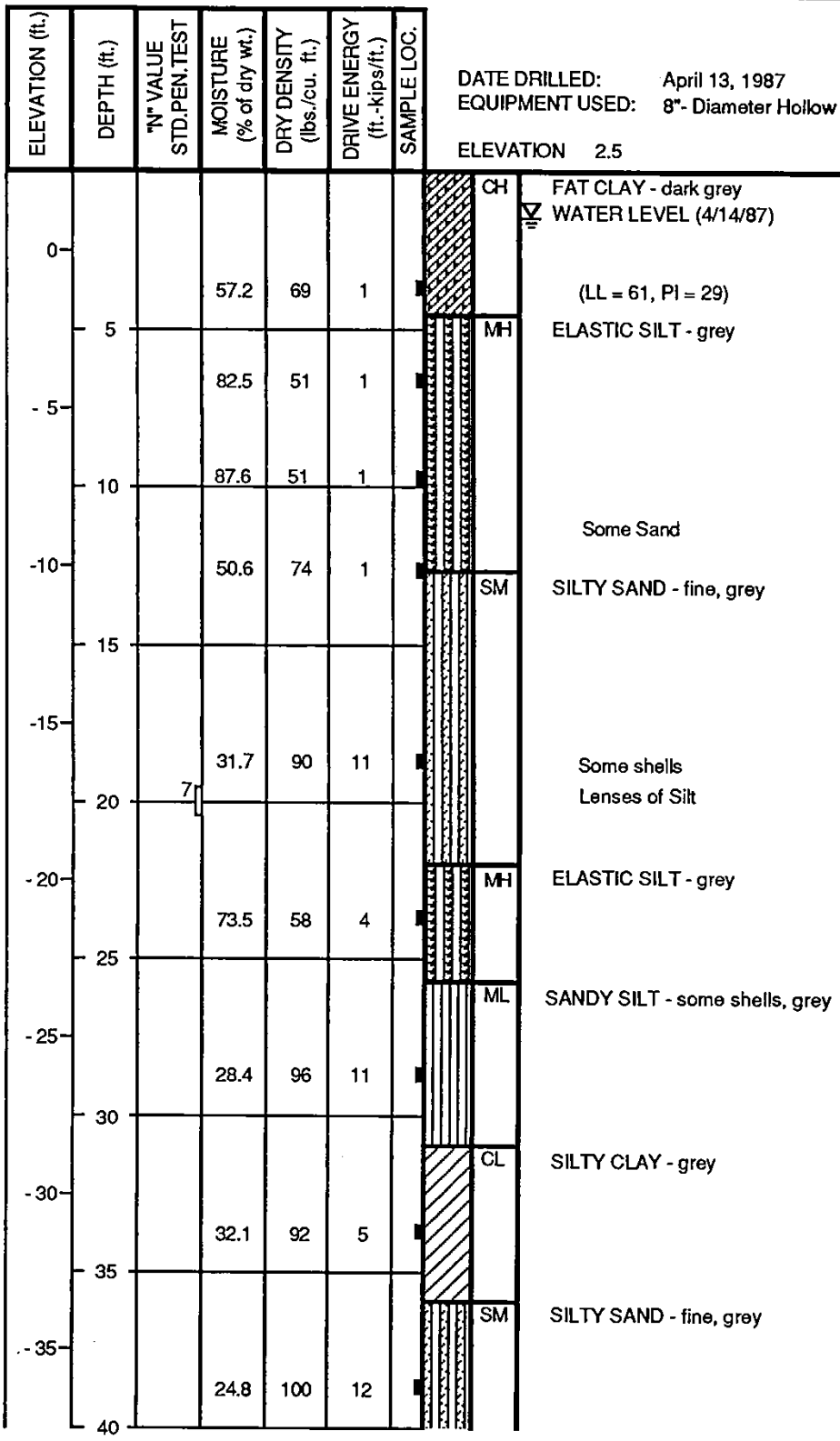
PLATE A2-114

JOB L91028.AEO DATE 5/15/91 F.T. TC DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 12
(LCA AE-87133)

DATE DRILLED: April 13, 1987
EQUIPMENT USED: 8"- Diameter Hollow Stem Auger
ELEVATION 2.5



(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.44a

PLATE A2-115

JOB 191028.AEQ DATE 5/15/91 F.T. TC DR. lp O.E. DW W.P. lp CHKD

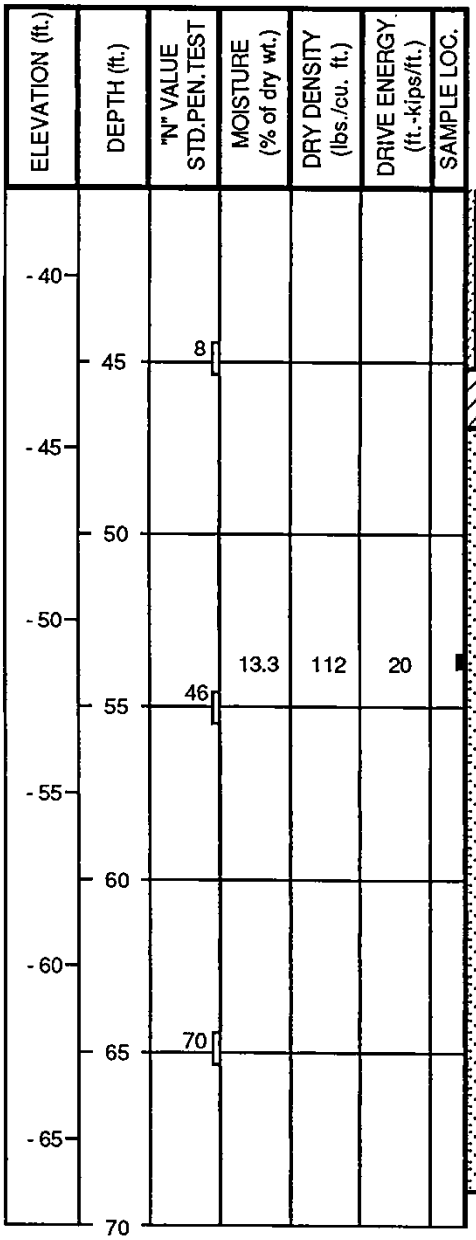
Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 12 (Continued)

(LCA AE-87133)

DATE DRILLED: April 13, 1987
EQUIPMENT USED: 8"- Diameter Hollow Stem Auger

PLATE A2-116



NOTE: Water level measured at a depth of 1-1/2' on 4/14/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.44b

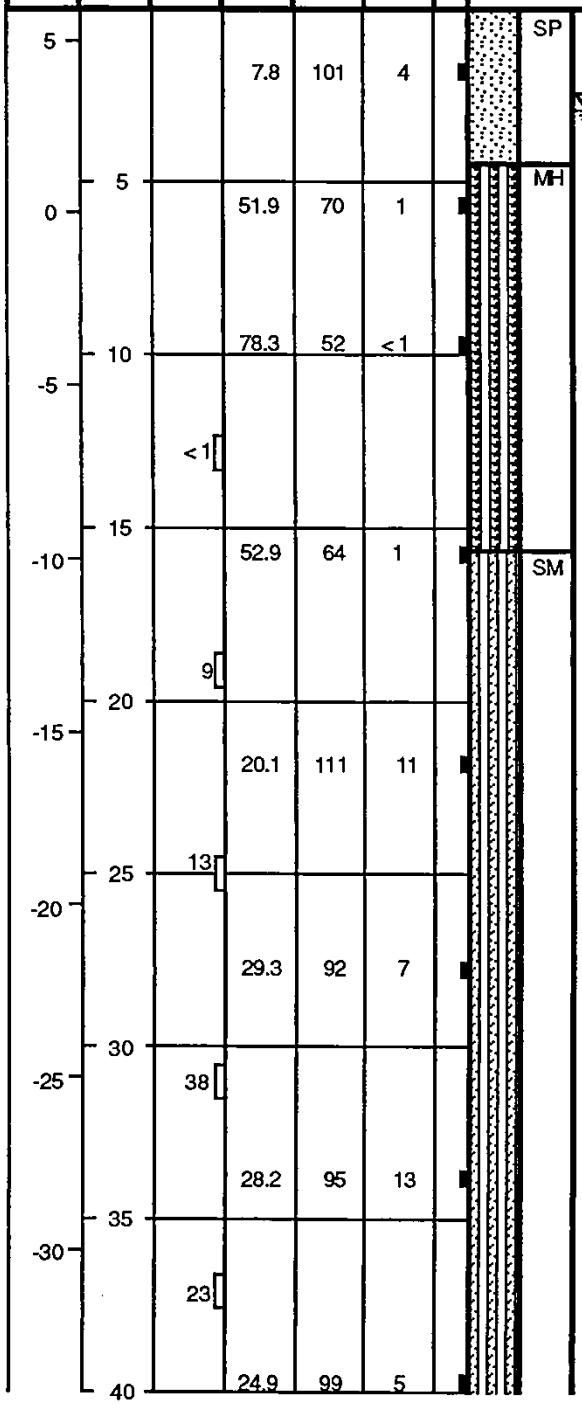
JOB L91028.AEO DATE 5/15/91 F.T. LS DR. dmh O.E. BK W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 13
(LCA AE-87133)

DATE DRILLED: December 29, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION +6



SAND - fine, light grey

WATER LEVEL (7/16/87)

ELASTIC SILT - some organic matter, grey

Dark grey

SILTY SAND - fine to medium, some layers of Sand, some organic matter, dark grey

Layers with large amount of shells

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.45a

PLATE A2-117

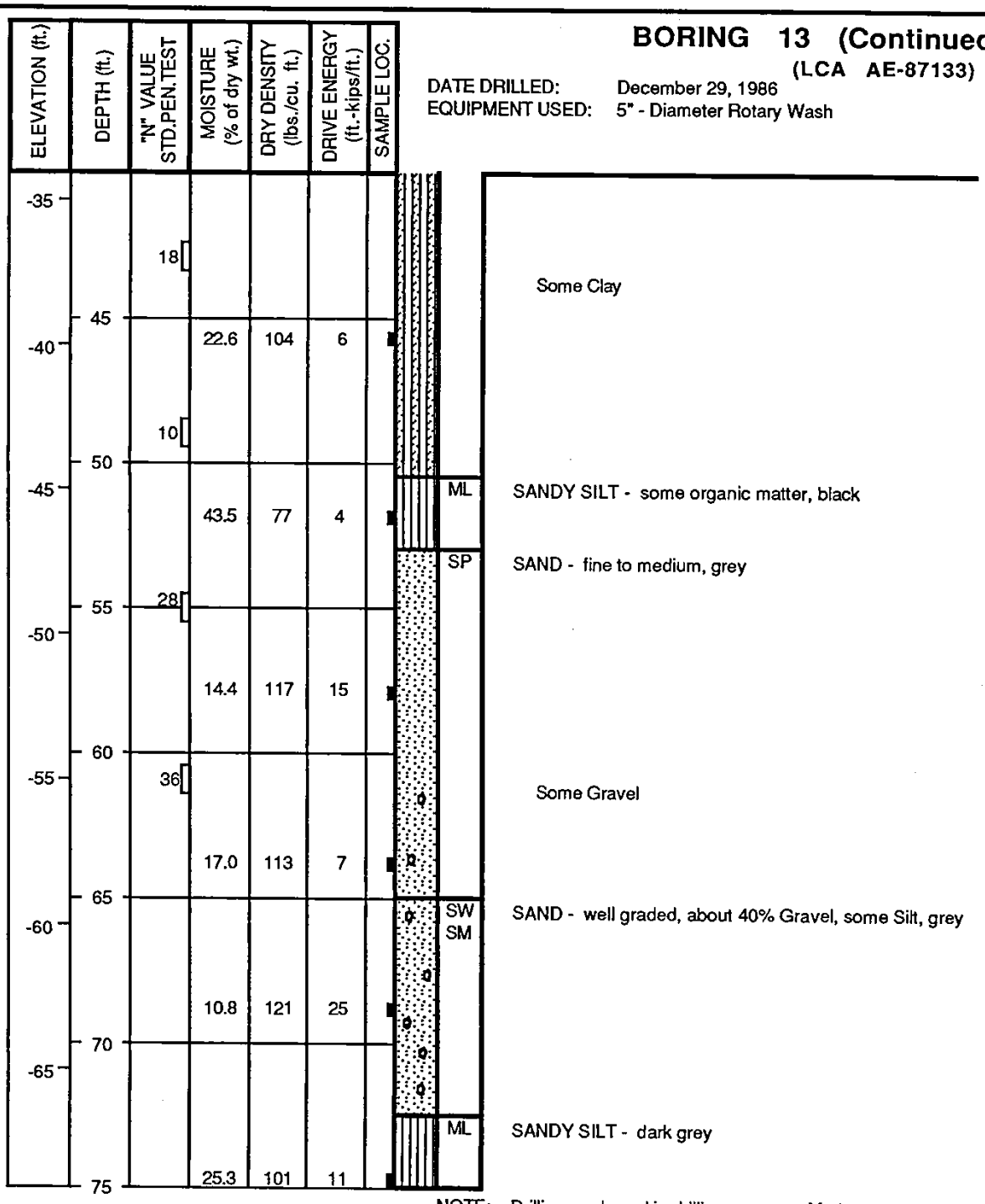
JOB L91028.AEO DATE 5/15/91 F.T. LS DR. dmh O.E. BK W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 13 (Continued)

(LCA AE-87133)

DATE DRILLED: December 29, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash



NOTE: Drilling mud used in drilling process. Mud removed to a depth of about 15'. Water level measured at 3' 15 minutes after removal of mud and at 3' on 12/31/86; bottom of boring at 3-1/2'. Set 5' of 2"-diameter perforated PVC pipe for water level determination (on 12/31/86). Backfilled annular space with pea gravel. Placed metal cover over pipe.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.45b

Area B - Law Crandall Borings

PLATE A2-118

JOB L91028.AEO DATE 5/15/91 F.T. LS DR. dmh O.E. BK W.P. dmh CHKD

BORING 14
(LCA AE-87133)

DATE DRILLED: December 30, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION +7

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
5			42.1	80	3		SP	FILL - SAND - fine, light brown
			56.6	65	2		CL	FILL - SILTY CLAY - lenses of fine Sand, mottled grey and dark grey
	5							▽ WATER LEVEL (7/15/87)
0			62.3	56	1		MH	ELASTIC SILT - some organic matter, dark grey
	10		49.4	73	<1			Hydrogen sulfide odor
-5								
	15		69.0	57	<1			
-10							SM	SILTY SAND - fine, dark grey
	20		61.0	64	2			Some Clay
-15								
	25		39.7	79	2			
-20							SP SM	SAND - fine, some Silt, dark grey
	30		24.1	100	25			
-25								
	35		26.3	97	18			
-30							SM	SILTY SAND - fine, dark grey
	40		30.1	91	8			

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.46a

Area B - Law Crandall Borings

PLATE A2-119

JOB L91028.AEO DATE 5/15/91 F.T. LS DR. dmh O.E. BK W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 14 (Continued)

(LCA AE-87133)

DATE DRILLED: December 30, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-35	45		28.6	95	10	
-40	50		33.0	89	3	
-45	55		24.9	101	13	
-50	60		94.9	55	7	
-55	65		35.0	91	7	
-60	70		22.7	106	32	
-65	75		14.3	115	36	

Some layers of Elastic Silt

Some organic matter

SP SM SAND - fine, some Silt, dark grey

Some Gravel

NOTE: Drilling mud used in drilling process. Mud removed to a depth of about 15'. Water level measured at 3' on 12/31/86; bottom of boring at 20'. Backfilled boring with pea gravel to a depth of 10'. Set 10' of 2"-diameter PVC pipe with lower 5' perforated for water level determination (on 12/31/86). Backfilled annular space with pea gravel. Placed metal cover over pipe. Water level measured at 4' on 1/13/87; bottom of boring at 8-1/2'.

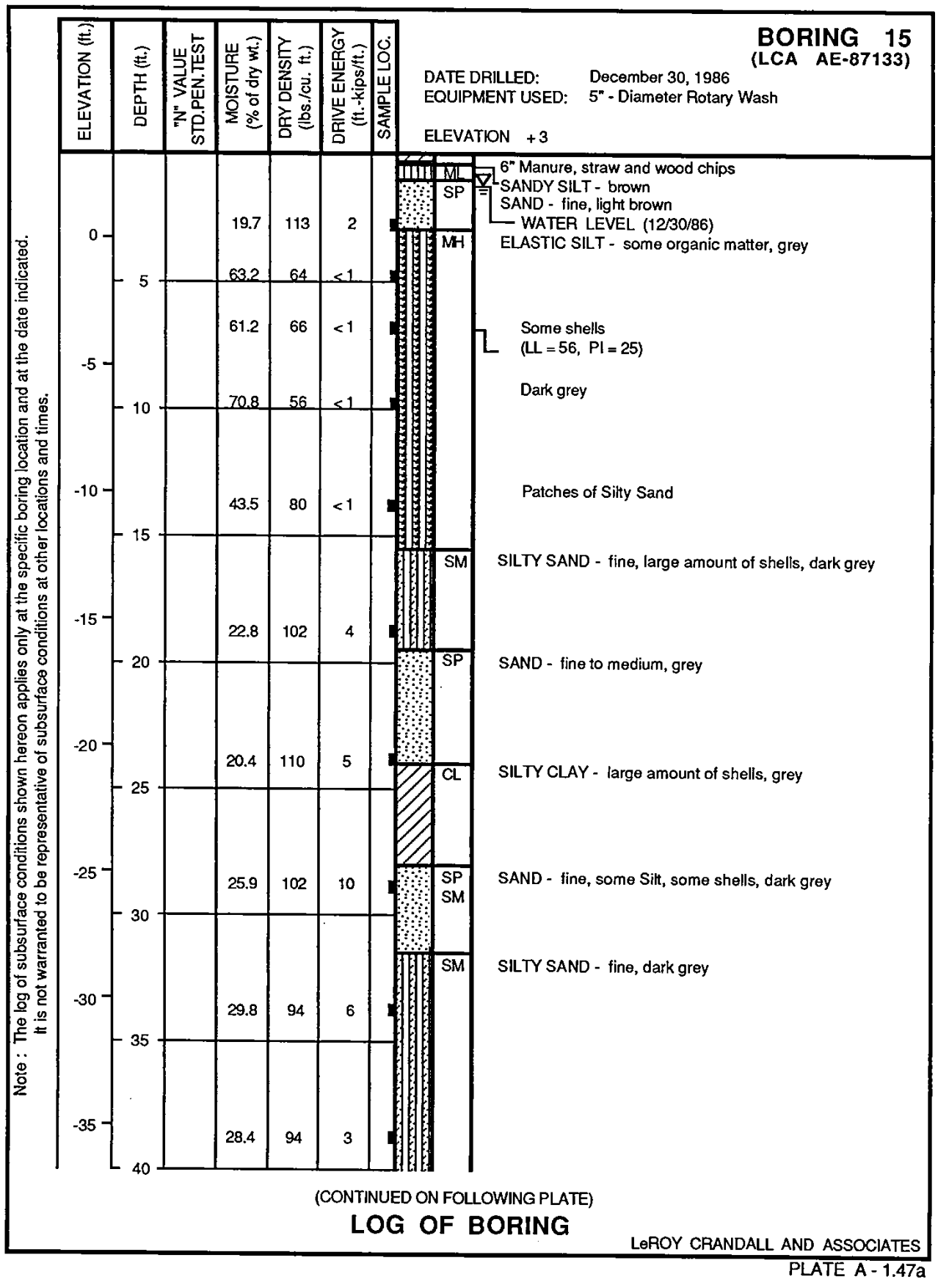
LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.46b

Area B - Law Crandall Borings

PLATE A2-120



BORING 15
(LCA AE-87133)

DATE DRILLED: December 30, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION +3

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							ML	6" Manure, straw and wood chips
							SP	SANDY SILT - brown
								SAND - fine, light brown
								WATER LEVEL (12/30/86)
0			19.7	113	2	■	MH	ELASTIC SILT - some organic matter, grey
	5		63.2	64	< 1	■		
			61.2	66	< 1	■		Some shells (LL = 56, PI = 25)
-5								
	10		70.8	56	< 1	■		Dark grey
-10			43.5	80	< 1	■		Patches of Silty Sand
	15						SM	SILTY SAND - fine, large amount of shells, dark grey
-15			22.8	102	4	■		
	20						SP	SAND - fine to medium, grey
-20			20.4	110	5	■	CL	SILTY CLAY - large amount of shells, grey
	25							
-25			25.9	102	10	■	SP SM	SAND - fine, some Silt, some shells, dark grey
	30							
							SM	SILTY SAND - fine, dark grey
-30			29.8	94	6	■		
	35							
-35			28.4	94	3	■		
	40							

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. dmh O.E. DW W.P. dmh CHKD

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.47a

PLATE A2-121

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. dmh O.E. DW W.P. dmh CHKD

BORING 15 (Continued)

(LCA AE-87133)

DATE DRILLED: December 30, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-40	45		46.2	80	2		ML	SANDY SILT - some Clay and shells, dark grey Some streaks of organic matter Patches of Sand
-45	50		27.5	96	4			Layers of Silty Sand
-50	55		26.0	98	18		SP	SAND - fine, grey
-55	60		15.6	115	16			Some Gravel
-60	65		17.0	115	30		SW SM	SAND - well graded, some Silt, about 20% Gravel, grey
-65	70		16.2	116	48			Large amount of Gravel, dark grey
-70	75		21.7	107	30			Few Gravel

NOTE: Drilling mud used in drilling process. Mud removed to a depth of about 10'. Water level measured at 1-1/2' 30 minutes after removal of mud; bottom of boring at 7'.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.47b

Area B - Law Crandall Borings

PLATE A2-122

BORING 16
(LCA AE-87133)

DATE DRILLED: December 30, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION +8

JOB L91028.AEO DATE 5/15/91 F.T. LS DR. dmh O.E. DW W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
			4.3	127	11		SP	FILL - SAND - fine, some Silt, light brown
5			19.1	98	6		SP	SAND - fine, light greyish brown WATER LEVEL (12/31/86)
	5		56.2	67	3		MH	ELASTIC SILT - grey
0								
	10		52.9	66	< 1			
-5								
	15		70.5	57	< 1			Some organic matter, dark grey (LL = 51, PI = 22)
-10								
	20		29.6	91	3		SM	SILTY SAND - fine, dark grey
-15								Large amount of shells
	25		26.1	102	7			
-20							SP SM	SAND - fine, some Silt, grey
	30		20.6	107	20			
-25								Dark grey
	35		24.9	98	13			
-30								Light grey
	40		20.8	106	27			

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.48a

Area B - Law Crandall Borings

PLATE A2-123

JOB L91028.AEO DATE 5/15/91 F.T. LS DR. dmh. O.E. DW W.P. dmh. CHKD

BORING 16 (Continued)

(LCA AE-87133)

DATE DRILLED: December 30, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-35	45		17.3	112	23			Large amount of shells, dark grey Layer of Silty Clay
-40	50		59.9	64	2		SM	SILTY SAND - fine, dark grey
							MH	ELASTIC SILT - dark grey
-45	55		28.9	93	6		SM	SILTY SAND - fine, few layers of Silty Clay, dark grey
-50	60		31.4	81	5			
-55	65		32.5	93	9			Some organic matter Some Gravel
-60	70		18.8	113	4			
-65	75		15.7	109	23		SP	SAND - fine to medium, about 20% Gravel, dark grey

NOTE: Drilling mud used in drilling process. Mud removed to a depth of about 15'. Water level measured at 4-1/2' 15 minutes after removal of mud and at 4' on 12/31/86; bottom of boring at 4-1/2'.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.48b

Area B - Law Crandall Borings

PLATE A2-124

BORING 17
(LCA AE-87133)

DATE DRILLED: December 30, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION +5

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
			10.0	125	7		SM	FILL - SILTY SAND fine, brown
							SP	SAND - fine, greyish brown WATER LEVEL (12/31/86)
							MH	ELASTIC SILT - some organic matter and shells, grey
0	5		59.4	65	< 1			
			75.0	55	< 1			(LL = 58, PI = 26)
-5	10	<1						Dark grey
			72.1	58	< 1			
-10	15	<1						
-15	20		24.7	101	2		SM	SILTY SAND - fine, dark grey
		36					SP	SAND - fine, grey
-20	25		22.7	103	16			Dark grey Some Silt
-25	30	14						
			21.4	104	8			Large amount of shells
-30	35	24						
-35	40		19.6	106	11			

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. dmh O.E. DW W.P. dmh CHKD

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.49a

PLATE A2-125

BORING 17 (Continued)

(LCA AE-87133)

DATE DRILLED: December 30, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. dmh O.E. DW W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
		12					SM	SILTY SAND - fine, dark grey Fine to medium
			16.4	113	10			
-40	45						ML	CLAYEY SILT - some Sand, dark grey
		10						
-45	50							Some organic matter
			29.8	93	3		CL	SILTY CLAY - dark grey (LL = 34, PI = 16)
-50	55							
			23.7	102	22		SM	SILTY SAND - fine, dark grey
-55	60						SP	SAND - fine, dark grey Some patches of Silt
			22.1	104	14			
-60	65							
			21.5	105	19			
-65	70							Some Gravel
-70	75		24.5	102	10			Some Silt, grey

NOTE: Drilling mud used in drilling process. Mud removed to a depth of about 15'. Water level measured at 2-1/2' 30 minutes after removal of mud and at 2' on 12/31/86; bottom of boring at 3'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.49b

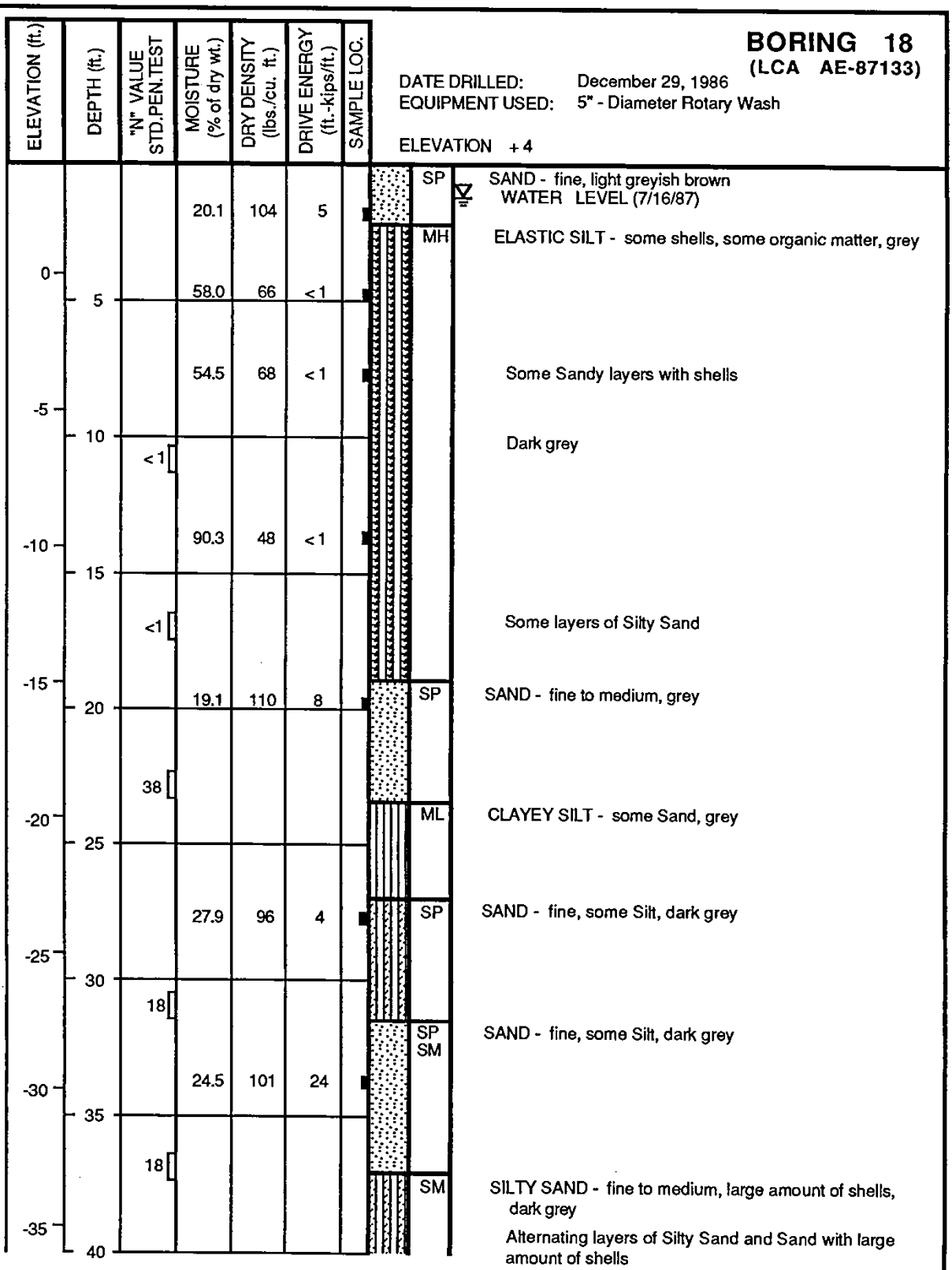
BORING 18
(LCA AE-87133)

DATE DRILLED: December 29, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION +4

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. dmh O.E. DW W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.



(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.50a

PLATE A2-127

BORING 18 (Continued)

(LCA AE-87133)

DATE DRILLED: December 29, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. dmh O.E. DW W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-40	45	13	20.9	110	7	
			50.4	73	2	
-45	50	41				
-50	55		26.2	95	5	
-55	60		22.5	105	4	
-60	65		23.6	101	17	
-65	70		15.3	117	19	
-70	75		21.4	104	39	

ML — CLAYEY SILT - some organic matter, dark grey

Lenses of Peat

ML — SANDY SILT - some organic matter, dark grey

Layers of Sand

SP — SAND - fine to medium, few Gravel and shells, grey

SW SM — SAND - well graded, some Silt, about 30% Gravel, dark grey

Layer of Clay

NOTE: Drilling mud used in drilling process. Mud removed to a depth of about 15'. Water level measured at 2-1/2' 30 minutes after removal of mud and at 1-1/2' on 12/31/86; bottom of boring at 17' and 8' respectively. Set 10' of 2"-diameter PVC pipe with lower 5' perforated for water level determination (on 12/31/86). Backfilled annular space with pea gravel. Placed metal cover over pipe. Water level measured at 1' on 1/13/87; bottom of boring at 10'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.50b

Area B - Law Crandall Borings

PLATE A2-128

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. dmh O.E. DW W.P. dmh CHKD

BORING 1
(LCA AE-86416)

DATE DRILLED: April 13, 1987
EQUIPMENT USED: 5" - Diameter Rotary Wash
ELEVATION +4.1 *

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
			45.7	73	1	■	CL	SILTY CLAY - black
0	5		64.8	60	< 1	■	MH	ELASTIC SILT - some Sand, few shells, brownish grey ▽ WATER LEVEL (6/22/87)
			40.8	82	1	■	ML	SANDY SILT - few shells, brownish grey (Non plastic)
-5	10		89.7	47	< 1	■	MH	ELASTIC SILT - large amount of shells, grey
-10	15		68.6	57	< 1	■		
			105.0	45	< 1	■	CH	FAT CLAY - organic odor, brownish grey
-15	20		48.9	75	< 1	■		
-20	25		32.2	91	< 1	■	ML	SANDY SILT - some Clay, few shells, grey (LL = 25, PI = 1)
-25	30		23.7	102	3	■	ML	CLAYEY SILT - some Sand, brownish grey
-30	35		31.5	90	3	■	CL	SILTY CLAY - lenses of Sandy Silt, grey (LL = 38, PI = 17)
-35	40		31.1	92	2	■		Dark grey

* Elevations provided by Psomas and Associates on 4/20/87.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.51a

Area B - Law Crandall Borings

PLATE A2-129

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. dmh O.E. DW W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 1 (Continued)

(LCA AE-86416)

DATE DRILLED: April 13, 1987
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-40	45		30.4	95	3			Lenses of Sand
-45	50		18.9	112	5		SM	SILTY SAND - fine, grey
							SW	SAND - well graded, about 15% Gravel, grey
-50	55		12.3	127	34			
-55	60		11.1	131	32			Layers of Silty Sand
-60	65		23.4	104	38			

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 35' after completion of drilling. Installed perforated 2"-diameter PVC pipe to a depth of 18-1/2'. Backfilled annular space with pea Gravel. Water level measured at a depth of 4-1/2' on 6/22/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.51b

Area B - Law Crandall Borings

PLATE A2-130

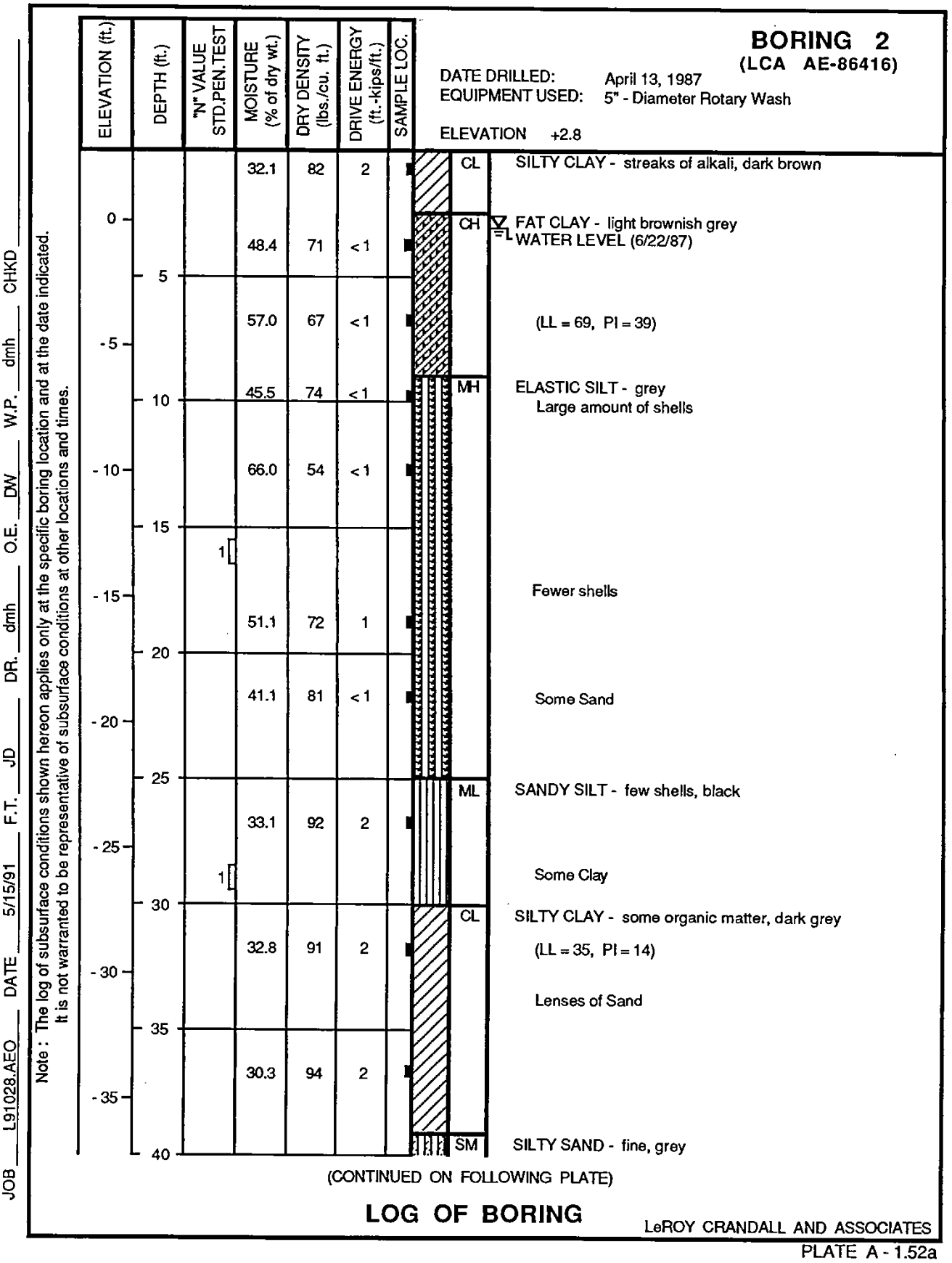


PLATE A - 1.52a

Area B - Law Crandall Borings

PLATE A2-131

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. dmh O.E. DW W.P. dmh CHKD

BORING 2 (Continued)

(LCA AE-86416)

DATE DRILLED: April 13, 1987
EQUIPMENT USED: 5" - Diameter Rotary Wash

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-40	45	30	19.8	102	6			
			23.6	102	6		CL	SILTY CLAY - some organic matter, dark grey
-45	50						ML	SANDY SILT - dark grey
			16.1	105	6		SW	SAND - well graded, about 10% Gravel, grey
-50	55	53						
			13.3	119	28			About 25% Gravel Layers of fine Sand
-55	60							
			28.4	96	22		ML	SANDY SILT - grey
-60	65							
			27.2	99	14			
-65	70						SM	SILTY SAND - fine, grey
			31.0	94	17			
-70	75							
			29.8	93	14			
-75	80							

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 25' after completion of drilling. Installed perforated 2"-diameter PVC pipe to a depth of 18-1/2'. Backfilled annular space with pea Gravel. Water level measured at a depth of 3' on 6/22/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.52b

Area B - Law Crandall Borings

PLATE A2-132

JOB 191028.AEO DATE 5/15/91 F.T. JD DR. dmh O.E. DW W.P. dmh CHKD

BORING 3
(LCA AE-86416)

DATE DRILLED: April 14, 1987
EQUIPMENT USED: 5" - Diameter Rotary Wash
ELEVATION +2.5

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
0	0		60.7	64	< 1		CH	FAT CLAY - greyish brown
								WATER LEVEL (6/22/87)
	5		64.9	62	< 1			Light greyish brown
-5			52.3	70	< 1		MH	ELASTIC SILT - some Sand, grey
	10		83.2	53	< 1			Layer of shells
-10								Some organic matter
	15		98.0	47	< 1			
-15			94.3	50	< 1			Brownish grey
	20		39.7	81	< 1			Grey
-20								
	25		35.1	87	1			
-25							ML	SANDY SILT - large amount of shells, dark grey
	30		35.2	80	1			
-30		0					MH	ELASTIC SILT - some Sand, grey
	35		25.1	97	< 1			
-35							CL	SILTY CLAY - some Sand and organic matter, dark grey
	40							

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.53a

Area B - Law Crandall Borings

PLATE A2-133

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. dmh O.E. DW W.P. dmh CHKD

BORING 3 (Continued)

(LCA AE-86416)

DATE DRILLED: April 14, 1987
EQUIPMENT USED: 5" - Diameter Rotary Wash

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-40	45		68.6	57	1	
-45	50		13.2	109	9	
-50	55		38.1	82	3	
-55	60					
-60	65		12.2	125	19	
-65	70		29.8	95	25	
-70	75		24.9	101	17	
-75	80		29.2	96	14	

Layers of well graded Sand
Few Gravel

SW — SAND - well graded, about 25% Gravel, grey

About 15% Gravel

Layers of Sandy Silt

ML — SANDY SILT - grey

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 25' after completion of drilling. Installed perforated 2"-diameter PVC pipe to a depth of 19'. Backfilled annular space with pea Gravel. Water level measured at a depth of 1-1/2' on 6/22/87.

LOG OF BORING

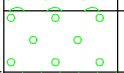
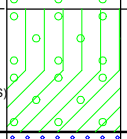
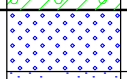
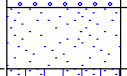
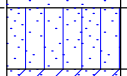
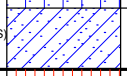
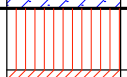
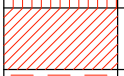
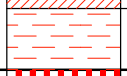
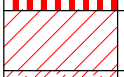
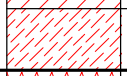
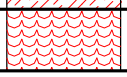
LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.53b

Area B - Law Crandall Borings

PLATE A2-134

SOIL CLASSIFICATION SYSTEM-ASTM D2487

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE-GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE-GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

 "Push" Sampler

 Split Barrel "Drive" Sampler With Liner

 Standard Penetration Test (SPT) Sampler

 Bag Sample

 Concrete/Rock Core

 Groundwater Surface

SPT "N" = 0.65 x modified California blows per foot

NP = Nonplastic
EI = Expansion Index Test
SG = Specific Gravity
SE = Sand Equivalent
UC = Unconfined Comp.
CD = Consol. Drained Triaxial.
CU = Consol. Undrained Triaxial.
UU = Undrained, Unconsol. Triaxial.
RV = R-Value
CA = Chemical Analysis
DS = Direct Shear
CN = Consolidation
CP = Collapse Potential
SA = Grain size; HD = Hydrometer
MD = Compaction Test
HC = Hydraulic Conductivity Test
[PID] Reading in ppm above background

USACE Ballona Creek Watershed
Project No. 2006-023.05

PLATE
B1

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	7 MLLW
LATITUDE:	33° 58' 17.6" N	**LONGITUDE:**	118° 26' 1.8" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	16.5
DATE STARTED:	2/24/09	**DATE COMPLETED:**	2/24/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
5				1 1 2	2		FAT CLAY (CH): very dark gray, moist, very soft, high plasticity, few roots						
							SILT (ML): olive brown, moist, soft, low plasticity, micaceous						
				1 2 2	3	0.25			39	41	7	98	
	5						SANDY SILT (ML): olive brown, wet, medium stiff, low plasticity, fine-grained sand						
0				2 4 7	7				32			52	
							ELASTIC SILT (MH): grayish brown, wet, soft, medium plasticity, veins of oxidation, micaceous						
				1 2 2	3	0.75			43	55	22	98	
	10						very dark gray, very soft, trace shell fragments, sulfur odor						
-5				1 1 2	2				60			93	
	15						gray						
				1 1 1	1	0.75			91			93	
-10							Bottom of boring at 16.5 feet. Groundwater encountered at 6 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
	20												
-15													
	25												
-20													

LOG OF BORING B-01

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USACE Ballona Creek Watershed
Project No. 2006-023.05

PLATE
B2

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	7 MLLW
LATITUDE:	33° 58' 16.1" N	**LONGITUDE:**	118° 26' 7.1" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	16.5
DATE STARTED:	2/24/09	**DATE COMPLETED:**	2/24/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				1 1 2	2		LEAN CLAY with SAND (CL): very dark brown, moist, very soft, medium plasticity, fine- to coarse-grained sand, little roots						
5				1 2 3	3		FAT CLAY (CH): gray, moist, soft, high plasticity, trace dark spots		39	50	32	97	
	5						SANDY SILT (ML): dark grayish brown, wet, medium stiff, low plasticity, fine-grained sand, micaceous		37			53	
0				3 5 4	6								
							LEAN CLAY (CL): olive brown, wet, very soft, medium plasticity, oxidation						
				1 1 2	2				40			98	
	10						SANDY LEAN CLAY (CL): olive brown, wet, very soft, medium plasticity, fine-grained sand, micaceous		38			51	
-5				1 1 2	2		FAT CLAY (CH): very dark gray, wet, very soft, high plasticity, sulfur odor		83			95	
	15						ELASTIC SILT (MH): gray, wet, very soft, medium plasticity, sulfur odor		107	64	17	96	
				1 1 2	2								
-10							Bottom of boring at 16.5 feet. Groundwater encountered at 6 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
	20												
-15													
	25												
-20													

LOG OF BORING B-02

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USACE Ballona Creek Watershed
Project No. 2006-023.05

PLATE
B3

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	10 MLLW
LATITUDE:	33° 58' 16.1" N	**LONGITUDE:**	118° 26' 12.6" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	19.5
DATE STARTED:	2/23/09	**DATE COMPLETED:**	2/23/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				2 4 8	8		SANDY SILT (ML): very dark grayish brown, moist, medium stiff, low plasticity, fine- to coarse-grained sand, trace fine to coarse gravel, little roots		19			66	
				50/6"	65		POORLY GRADED SAND with GRAVEL (SP): dark yellowish brown, moist, very dense, fine- to coarse-grained sand, fine to coarse gravel						
5	5			2 3 4	5		LEAN CLAY (CL): light brownish gray, moist, medium stiff, medium plasticity		45	46	21	99	
0	10			2 2 4	4		very dark grayish brown, soft, micaceous ▽		37			91	
				0 1 1	1	0.25	ELASTIC SILT (MH): dark gray, wet, very soft, medium plasticity, micaceous		42			98	
-5	15			1 2 2	3		FAT CLAY (CH): dark gray, wet, soft, high plasticity, trace shell fragments		62	73	46	90	
				1 1 2	2		gray, very soft, sulfur odor		87			96	
-10	20						Bottom of boring at 19.5 feet. Groundwater encountered at 11 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-15	25												
-20													

LOG OF BORING B-03

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USACE Ballona Creek Watershed

Project No. 2006-023.05

PLATE

B4

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	8 MLLW
LATITUDE:	33° 58' 11.2" N	**LONGITUDE:**	118° 26' 13.0" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	16.5
DATE STARTED:	2/24/09	**DATE COMPLETED:**	2/24/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				1 3 2	3		SILT with SAND (ML): brown, moist, soft, low plasticity, fine- to medium-grained sand, few roots		20			74	
5				4 6 8	9		LEAN CLAY (CL): very dark brown, moist, stiff, medium plasticity, trace roots, calcite stringer		34			91	
	5			4 4 6	6		SILT (ML): olive brown, wet, medium stiff, nonplastic, micaceous		34	NP	NP	98	
0				3 4 3	5		SANDY SILT (ML): olive brown, wet, medium stiff, low plasticity, fine-grained sand, micaceous		36			66	
	10			0 2 1	2		SILT (ML): very dark gray, wet, very soft, low plasticity, trace shell fragments, sulfur odor		42	40	7	99	
-5				1 1 1	1				100			93	
	15						Bottom of boring at 16.5 feet. Groundwater encountered at 6 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-10													
	20												
-15													
	25												
-20													

LOG OF BORING B-04

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USACE Ballona Creek Watershed
Project No. 2006-023.05

PLATE
B5

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	7 MLLW
LATITUDE:	33° 58' 7.9" N	**LONGITUDE:**	118° 26' 11.9" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	16.5
DATE STARTED:	2/25/09	**DATE COMPLETED:**	2/25/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
5				1 1 2	2		LEAN CLAY with SAND (CL): dark brown, moist, very soft, medium plasticity, fine-grained sand, trace roots		23			83	
	5			1 2 3	3		gray, soft						
0				2 6 4	6		olive gray, wet, medium stiff, micaceous		34			82	
	10			1 1 1	1		ELASTIC SILT (MH): olive gray, wet, very soft, medium plasticity, trace shell fragments		49	62	29	98	
-5				0 1 2	2		FAT CLAY (CH): dark gray, wet, very soft, high plasticity, sulfur odor		59			90	
	15			0 1 1	1		few shell fragments		95	67	38	95	
-10							Bottom of boring at 16.5 feet. Groundwater encountered at 6 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
	20												
-15													
	25												
-20													

LOG OF BORING B-05

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PLATE
B6

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	6 MLLW
LATITUDE:	33° 58' 6.8" N	**LONGITUDE:**	118° 26' 0.9" W
DRILLING EQUIPMENT:	Hand Auger	**DRILLING METHOD:**	Hand Auger
BORING DIAMETER (inches):	4	**BORING DEPTH (feet):**	8
DATE STARTED:	2/25/09	**DATE COMPLETED:**	2/25/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** inches	**WT:** lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
5							FAT CLAY (CH): dark olive brown, moist, high plasticity, little roots		54			98	
							ELASTIC SILT (MH): very dark brown, wet, medium plasticity		46	70	36	99	
0	5						FAT CLAY (CH): dark grayish brown, wet, soft, high plasticity		43			97	
-5	10						Bottom of boring at 8 feet. Groundwater encountered at 2 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-10	15												
-15	20												
-20	25												

LOG OF BORING B-06

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PLATE
B7

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	4 MLLW
LATITUDE:	33° 57' 56.6" N	**LONGITUDE:**	118° 26' 39.7" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	16.5
DATE STARTED:	2/19/09	**DATE COMPLETED:**	2/19/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				3 4 5	6		POORLY GRADED SAND with CLAY (SP-SC): brown, moist, loose, fine- to medium-grained sand, trace fine gravel, trace roots						
							▽ FAT CLAY (CH): dark gray, wet, soft, high plasticity						
0	5			1 2 3	3				58			98	
				2 2 3	3		SILT (ML): very dark gray, wet, soft, low plasticity, micaceous		26	33	6	95	
-5	10			1 1 2	2		ELASTIC SILT (MH): very dark gray, wet, very soft, medium plasticity, trace shell fragments		40	59	24	96	
				1 1 2	2		FAT CLAY (CH): very dark gray, wet, very soft, high plasticity, sulfur odor		60			92	
-10	15			2 3 5	5		CLAYEY SAND (SC): very dark gray, wet, loose, fine-grained sand, trace shell fragments, sulfur odor		34			39	
							Bottom of boring at 16.5 feet. Groundwater encountered at 2 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-15	20												
-20	25												
-25													

LOG OF BORING B-07

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USACE Ballona Creek Watershed

Project No. 2006-023.05

PLATE

B8

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	4 MLLW
LATITUDE:	33° 57' 52.7" N	**LONGITUDE:**	118° 26' 48.7" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	16.5
DATE STARTED:	2/18/09	**DATE COMPLETED:**	2/18/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				3 4 5	6		FAT CLAY (CH): olive brown, moist, medium stiff, high plasticity, micaceous		41	67	44	99	
				3 3 4	5		FAT CLAY with SAND (CH): grayish brown, moist, medium stiff, high plasticity, fine-grained sand, micaceous		36			80	
0	5			0 0 0	0		▽ FAT CLAY (CH): olive gray, wet, very soft, high plasticity, trace shell fragments		71			97	
-5	10			1 2 3	3		dark gray, soft, no shell fragments		58	53	24	98	
				0 0 5	3		CLAYEY SAND (SC): gray, wet, very loose, fine-grained sand, trace shell fragments		40			36	
-10	15			4 11 23	22		dark gray, medium dense		26			16	
							Bottom of boring at 16.5 feet. Groundwater encountered at 5 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-15	20												
-20	25												
-25													

LOG OF BORING B-08

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USACE Ballona Creek Watershed
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PLATE
B9

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION: See Figure 2	**ELEVATION AND DATUM (feet):** 4 MLLW
LATITUDE: 33° 57' 55.3" N	**LONGITUDE:** 118° 26' 42.1" W
DRILLING EQUIPMENT: CME 750	**DRILLING METHOD:** Hollow Stem Auger
BORING DIAMETER (inches): 8	**BORING DEPTH (feet):** 16.5
DATE STARTED: 2/19/09	**DATE COMPLETED:** 2/19/09
SPT HAMMER DROP: 30 inches **WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches **WT:** 140 lbs
LOGGED BY: JMS **CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)** **ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				3 3 4	5		CLAYEY SAND (SC): dark grayish brown, wet, loose, fine- to coarse-grained sand						
							FAT CLAY (CH): dark brown, wet, soft, high plasticity		43	64	37	99	
0				1 2 2	3		gray		52	58	29	99	
	5						ELASTIC SILT (MH): dark gray, wet, soft, medium plasticity, micaceous						
				1 2 2	3				58			97	
-5				1 1 1	1		very soft		81			97	
	10						CLAYEY SAND (SC): very dark gray, wet, loose, fine-grained sand, few shell fragments, sulfur odor						
				2 3 7	6				37			35	
-10													
	15			2 3 7	6				25			14	
							Bottom of boring at 16.5 feet. Groundwater encountered at 0 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-15													
	20												
-20													
	25												
-25													

LOG OF BORING B-09

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USACE Ballona Creek Watershed
Project No. 2006-023.05

PLATE
B10

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION: See Figure 2	**ELEVATION AND DATUM (feet):** 8 MLLW
LATITUDE: 33° 58' 6.1" N	**LONGITUDE:** 118° 26' 28.6" W
DRILLING EQUIPMENT: CME 750	**DRILLING METHOD:** Hollow Stem Auger
BORING DIAMETER (inches): 8	**BORING DEPTH (feet):** 16.5
DATE STARTED: 2/18/09	**DATE COMPLETED:** 2/18/09
SPT HAMMER DROP: 30 inches **WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches **WT:** 140 lbs
LOGGED BY: JMS **CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)** **ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				1 1 2	2		SILT with SAND (ML): brown, moist, very soft, low plasticity, fine- to medium-grained sand, micaceous, trace roots		29			76	
5				1 4 4	5		FAT CLAY (CH): dark brown, moist, medium stiff, high plasticity, color gradient, soft white deposites throughout		54			93	
	5			3 3 4	5		SILT (ML): olive brown, wet, medium stiff, nonplastic		31	NP	NP	94	
0				2 2 3	3		LEAN CLAY (CL): olive brown, wet, soft, medium plasticity		59			100	
	10			1 1 2	2		SILT (ML): gray, wet, very soft, low plasticity		48	46	15	100	
-5				1 2 1	2		SANDY LEAN CLAY (CL): gray, wet, very soft, medium plasticity, fine-grained sand, few shell fragments, sulfur odor		48			52	
	15			3 5 9	9		POORLY GRADED SAND with SILT (SP-SM): gray, wet, loose, fine-grained sand, few shell fragments, strong sulfur odor		29			12	
-10							Bottom of boring at 19.5 feet. Groundwater encountered at 6 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
	20												
-15													
	25												
-20													

LOG OF BORING B-10

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USACE Ballona Creek Watershed
Project No. 2006-023.05

PLATE
B11

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	6 MLLW
LATITUDE:	33° 57' 53.0" N	**LONGITUDE:**	118° 26' 26.3" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	16.5
DATE STARTED:	2/19/09	**DATE COMPLETED:**	2/19/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
5				1 2 2	3		LEAN CLAY (CL): brown, moist, soft, medium plasticity, some organics		37			90	
	5			2 2 2	3		ELASTIC SILT (MH): brownish gray, moist, soft, medium plasticity, trace shell fragments ▽ wet		72	80	40	96	
0				1 0 1	1		very soft, sulfur odor		58			91	
	10			0 1 1	1		dark gray		60	61	28	97	
-5									71			90	
	15			1 2 2	3		CLAYEY SAND (SC): very dark gray, wet, very loose, fine-grained sand, few shell fragments		54			45	
-10							Bottom of boring at 16.5 feet. Groundwater encountered at 5 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
	20												
-15													
	25												
-20													

LOG OF BORING B-11

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Project No. 2006-023.05

PLATE
B12

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	6 MLLW
LATITUDE:	33° 57' 58.3" N	**LONGITUDE:**	118° 26' 20.2" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	16.5
DATE STARTED:	2/20/09	**DATE COMPLETED:**	2/20/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
5				1 2 2	3		LEAN CLAY (CL): dark brown, moist, soft, medium plasticity, trace roots		49			98	
				3 3 4	5		ELASTIC SILT (MH): light gray, moist, medium stiff, medium plasticity, few shell fragments		45			97	
	5						▽ wet						
0				0 1 2	2		dark gray, very soft, trace shell fragments, sulfur odor		69			96	
	10			0 0 3	2		olive gray		84	52	13	95	
-5				1 1 1	1		dark gray		59			90	
	15			2 2 3	3		SANDY FAT CLAY (CH): gray, wet, soft, high plasticity, fine-grained sand, trace shell fragments, sulfur odor		56			56	
-10							Bottom of boring at 16.5 feet. Groundwater encountered at 5 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
	20												
-15													
	25												
-20													

LOG OF BORING B-12

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PLATE
B13

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	6 MLLW
LATITUDE:	33° 57' 42.6" N	**LONGITUDE:**	118° 26' 46.9" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	16.5
DATE STARTED:	2/19/09	**DATE COMPLETED:**	2/19/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
5				1 2 3	3		CLAYEY SAND (SC): brown, wet, very loose, fine- to medium-grained sand		17			21	
							FAT CLAY (CH): light gray, wet, soft, high plasticity						
				1 1 3	3				65			97	
	5												
0				0 0 1	1		very soft		56	60	29	96	
				1 0 1	1		trace shell fragments, sulfur odor		93			95	
	10												
-5				1 1 1	1		no shell fragments		65			99	
							CLAYEY SAND (SC): gray, wet, very loose, fine-grained sand						
	15			1 1 2	2				43			47	
-10							Bottom of boring at 16.5 feet. Groundwater encountered at 1 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
	20												
-15													
	25												
-20													

LOG OF BORING B-13

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PLATE
B14

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	23 MLLW
LATITUDE:	33° 58' 43.6" N	**LONGITUDE:**	118° 25' 40.4" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	31.5
DATE STARTED:	2/18/09	**DATE COMPLETED:**	2/18/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				2 3 5	5		CLAYEY SAND (SC): brown, moist, loose, fine- to medium-grained sand, trace roots		15			37	
20				7 6 7	8		SILT with SAND (ML): dark brown, moist, medium stiff, nonplastic, fine- to medium-grained sand						
	5			2 2 2	3		LEAN CLAY (CL): grayish brown, moist, soft, medium plasticity		34	40	20	96	
15									34			90	
	10			3 4 5	6		SANDY LEAN CLAY (CL): gray, moist, medium stiff, medium plasticity, fine-grained sand		22			59	
10				1 3 6	6		FAT CLAY (CH): gray, moist, medium stiff, high plasticity, sulfur odor, some white spots		46	75	47	92	
	15			4 6 9	10		FAT CLAY with SAND (CH): gray, moist, stiff, high plasticity, fine-grained sand		27			83	
5				1 3 5	5		LEAN CLAY (CL): gray, moist, medium stiff, medium plasticity, micaceous		33			95	
	20			3 9 19	18		CLAYEY SAND (SC): dark gray, moist, medium dense, fine- to medium-grained sand		13			28	
0							▽ wet						
	25			9 12 14	17		POORLY GRADED SAND with CLAY and GRAVEL (SP-SC): dark gray, wet, medium dense, fine- to coarse-grained sand, fine to coarse gravel		12			7	
-5				4 13 16	19								

LOG OF BORING C-01

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USACE Ballona Creek Watershed

Project No. 2006-023.05

PLATE

B15

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				2 2 5	5		FAT CLAY (CH): gray, wet, medium stiff, high plasticity		34			99	
-10	35						Bottom of boring at 31.5 feet. Groundwater encountered at 23 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-15	40												
-20	45												
-25	50												
-30	55												
-35	60												
-40	65												
-45													

LOG OF BORING C-01

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Project No. 2006-023.05

PLATE
B16

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	19 MLLW
LATITUDE:	33° 58' 48.7" N	**LONGITUDE:**	118° 25' 37.0" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	28.5
DATE STARTED:	2/17/09	**DATE COMPLETED:**	2/17/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				5 10 11	14		CLAYEY SAND (SC): dark brown, moist, medium dense, fine- to coarse-grained sand, trace fine gravel, trace roots		12			42	
				6 4 4	5		POORLY GRADED SAND with SILT (SP-SM): brown, moist, loose, fine- to medium-grained sand						
15	5						FAT CLAY (CH): olive brown, moist, medium stiff, high plasticity, trace roots						
				3 3 4	5		no roots, some oxidation		45	57	36	98	
10	10			3 4 4	5		gray		48			96	
				4 5 7	8		CLAYEY SAND (SC): very dark brown, moist, loose, fine-grained sand		18			23	
5	15			5 5 11	10		SANDY LEAN CLAY (CL): very dark gray, moist, stiff, medium plasticity, fine-grained sand, some oxidation		20			52	
				3 4 11	10		dark gray		19			52	
0	20						▽ wet						
				2 4 15	12		olive brown, fine- to medium-grained sand						
-5	25			5 6 17	15		POORLY GRADED SAND with CLAY (SP-SC): dark grayish brown, moist, medium dense, fine- to coarse-grained sand, trace fine gravel		19			7	
				8 9 14	15				14			7	
-10							Bottom of boring at 28.5 feet. Groundwater encountered at 20 ft below ground surface.						

LOG OF BORING C-02

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Project No. 2006-023.05

PLATE

B17

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
							Boring backfilled with bentonite chips then cuttings.						
-15	35												
-20	40												
-25	45												
-30	50												
-35	55												
-40	60												
-45	65												
-50													

LOG OF BORING C-02

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PLATE
B18

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	23 MLLW
LATITUDE:	33° 58' 45.3" N	**LONGITUDE:**	118° 25' 44.7" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	34.5
DATE STARTED:	2/17/09	**DATE COMPLETED:**	2/17/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				4 8 15	15		SANDY LEAN CLAY (CL): brown, moist, very stiff, medium plasticity, fine- to coarse-grained sand, trace concrete pieces - FILL		17			61	
20				8 22 50/5"	53		hard, trace organics		16			61	
	5			5 4 4	5		FAT CLAY (CH): olive brown, moist, medium stiff, high plasticity, some oxidation, micaceous		46			97	
15				2 3 5	5		SANDY LEAN CLAY (CL): olive brown, moist, medium stiff, medium plasticity, fine-grained sand		23			57	
	10			1 2 3	3		soft		23			52	
10				1 2 3	3		FAT CLAY (CH): gray, moist, soft, high plasticity		51	53	26	100	
	15			5 12 15	18		CLAYEY SAND (SC): reddish brown, moist, medium dense, fine- to medium-grained sand, trace fine gravel		14			46	
5							▽ wet						
	20			2 11 13	16		POORLY GRADED SAND with GRAVEL (SP): dark gray, wet, medium dense, fine- to coarse-grained sand, fine to coarse gravel		15			3	
0				5 8 13	14		POORLY GRADED SAND with CLAY and GRAVEL (SP-SC): dark gray, wet, medium dense, fine- to coarse-grained sand, fine to coarse gravel		13			9	
	25			2 2 4	4		LEAN CLAY with SAND (CL): olive brown, wet, soft, medium plasticity, fine-grained sand		27			71	
-5													

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Project No. 2006-023.05

PLATE

B19

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				3 4 3	5		SANDY LEAN CLAY (CL): olive brown, wet, medium stiff, medium plasticity, fine-grained sand		23			53	
-10				2 2 2	3		SILT (ML): olive brown, wet, soft, nonplastic		38	NP	NP	99	
	35						Bottom of boring at 34.5 feet. Groundwater encountered at 20 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-15													
	40												
-20													
	45												
-25													
	50												
-30													
	55												
-35													
	60												
-40													
	65												
-45													

LOG OF BORING C-03

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Project No. 2006-023.05

PLATE
B20

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	17 MLLW
LATITUDE:	33° 58' 45.8" N	**LONGITUDE:**	118° 25' 56.7" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	25.5
DATE STARTED:	2/23/09	**DATE COMPLETED:**	2/23/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
15				2 5 11	10		POORLY GRADED SAND with CLAY and GRAVEL (SP-SC): brown, moist, loose, fine- to coarse-grained sand, fine gravel		4			5	
				6 8 8	10				8			11	
	5						SANDY LEAN CLAY (CL): brown, moist, stiff, medium plasticity, fine-grained sand		18			60	
10				1 3 4	5		CLAYEY SAND (SC): gray, moist, loose, fine-grained sand		23			44	
	10			5 10 13	15		SANDY FAT CLAY (CH): dark gray, moist, very stiff, high plasticity, fine- to coarse-grained sand		20			57	
5				3 4 6	6		ELASTIC SILT (MH): light gray, moist, medium stiff, medium plasticity		38	54	23	95	
	15			3 6 7	8		SANDY FAT CLAY (CH): gray, moist, medium stiff, high plasticity, fine- to coarse-grained sand, trace fine gravel		23			60	
0				2 2 6	5		▽ wet, some oxidation		22			68	
	20			1 3 4	5		SANDY SILT (ML): olive brown, wet, medium stiff, low plasticity, fine-grained sand		23			61	
-5							SILT with SAND (ML): brownish gray, wet, medium stiff, nonplastic, fine-grained sand		24	NP	NP	79	
	25			1 3 5	5		Bottom of boring at 25.5 feet. Groundwater encountered at 18 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-10													

LOG OF BORING C-04

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Project No. 2006-023.05

PLATE
B21

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	17 MLLW
LATITUDE:	33° 58' 49.2" N	**LONGITUDE:**	118° 25' 49.1" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	25.5
DATE STARTED:	2/23/09	**DATE COMPLETED:**	2/23/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
15				3 10 13	15		SANDY LEAN CLAY (CL): dark brown, moist, very stiff, medium plasticity, fine- to coarse-grained sand, trace roots		21			65	
				4 5 6	7		POORLY GRADED SAND with SILT and GRAVEL (SP-SM): olive brown, moist, medium dense, fine- to coarse-grained sand, fine to coarse gravel		16			25	
	5						SILTY SAND (SM): dark gray, moist, loose, fine- to coarse-grained sand, trace fine to coarse gravel, trace shell fragments						
10				3 5 4	6		CLAYEY SAND (SC): very dark grayish brown, moist, loose, fine-grained sand, micaceous		25			38	
	10			3 6 10	10		FAT CLAY (CH): very dark gray, moist, stiff, high plasticity						
5				3 6 9	10		SANDY LEAN CLAY (CL): gray, moist, stiff, medium plasticity, fine-grained sand, some oxidation		19			57	
	15			4 5 13	12		SILTY SAND with GRAVEL (SM): olive brown, moist, medium dense, fine- to coarse-grained sand, fine to coarse gravel		15			21	
0				2 3 11	9		POORLY GRADED SAND (SP): dark grayish brown, wet, loose, fine- to coarse-grained sand						
	20			3 3 3	4		very loose						
-5				4 7 6	8		SILT (ML): brown, wet, medium stiff, low plasticity		43	47	19	99	
	25						Bottom of boring at 25.5 feet. Groundwater encountered at 17 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-10													

LOG OF BORING C-05

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PLATE
B22

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	17 MLLW
LATITUDE:	33° 58' 42.1" N	**LONGITUDE:**	118° 25' 58.5" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	28.5
DATE STARTED:	2/20/09	**DATE COMPLETED:**	2/20/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
15				1 3 4	5		POORLY GRADED SAND with GRAVEL (SP): brown, moist, loose, fine- to coarse-grained sand, fine to coarse gravel, trace shell fragments, trace roots		4			3	
				4 7 5	8		POORLY GRADED SAND with SILT and GRAVEL (SP-SM): dark gray, moist, loose, fine- to coarse-grained sand, fine to coarse gravel		4			5	
	5												
10				5 6 7	8		POORLY GRADED SAND with GRAVEL (SP): grayish brown, moist, loose, fine- to coarse-grained sand, fine gravel		2			2	
				3 3 4	5		LEAN CLAY (CL): olive brown, moist, medium stiff, medium plasticity		30			91	
	10												
5				2 2 4	4		FAT CLAY (CH): light gray, moist, soft, high plasticity, brown spots		43	57	35	98	
	15			2 3 5	5		medium stiff, oxidation spots, micaceous		39			100	
0							▽						
				1 2 3	3		SANDY LEAN CLAY (CL): dark gray, wet, soft, medium plasticity, fine- to medium-grained sand		29	42	23	70	
	20			2 4 6	6		medium stiff		22			62	
-5				3 5 7	8		SANDY FAT CLAY (CH): gray, wet, medium stiff, high plasticity, fine-grained sand		22			55	
	25												
-10				5 7 8	10		CLAYEY SAND (SC): gray, wet, loose, fine-grained sand, trace shell fragments, trace roots		23			21	
							Bottom of boring at 28.5 feet. Groundwater encountered at 17 ft below ground surface.						

LOG OF BORING C-06

Page 1 of 2

USACE Ballona Creek Watershed

Project No. 2006-023.05

PLATE

B23

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
-15	35						Boring backfilled with bentonite chips then cuttings.						
-20	40												
-25	45												
-30	50												
-35	55												
-40	60												
-45	65												
-50													

LOG OF BORING C-06

Page 2 of 2
USACE Ballona Creek Watershed
Project No. 2006-023.05

PLATE
B24

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	17 MLLW
LATITUDE:	33° 58' 41.4" N	**LONGITUDE:**	118° 26' 3.8" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	28.5
DATE STARTED:	2/20/09	**DATE COMPLETED:**	2/20/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
15				1 1 2	2		SILTY SAND (SM): brown, moist, very loose, fine- to medium-grained sand, trace fine gravel, trace roots		7			15	
				2 2 5	5		SILTY SAND with GRAVEL (SM): brown, moist, loose, fine- to coarse-grained sand, fine to coarse gravel		8			15	
10	5			3 5 6	7		FAT CLAY with SAND (CH): dark gray, moist, medium stiff, high plasticity, fine-grained sand, micaceous		30			75	
				3 5 7	8		SILT (ML): dark gray, moist, medium stiff, low plasticity		31	49	13	92	
5	10			2 2 3	3		FAT CLAY (CH): dark gray, moist, soft, high plasticity, some oxidation spots		42			88	
0	15			1 3 3	4		SILT with SAND (ML): light gray, moist, soft, low plasticity, fine-grained sand ▽ wet						
				0 0 1	1		very soft		51			71	
-5	20			1 4 5	6		FAT CLAY with SAND (CH): dark gray, wet, very soft, high plasticity, fine-grained sand medium stiff		27	51	33	74	
				2 4 3	5		SANDY FAT CLAY (CH): dark gray, wet, medium stiff, high plasticity, fine-grained sand		23			62	
-10	25			3 5 5	6		CLAYEY SAND (SC): gray, wet, loose, fine- to medium-grained sand		20			31	
							Bottom of boring at 28.5 feet. Groundwater encountered at 17 ft below ground surface.						

LOG OF BORING C-07

Page 1 of 2

USACE Ballona Creek Watershed

Project No. 2006-023.05

PLATE

B25

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
							Boring backfilled with bentonite chips then cuttings.						
-15													
	35												
-20													
	40												
-25													
	45												
-30													
	50												
-35													
	55												
-40													
	60												
-45													
	65												
-50													

LOG OF BORING C-07

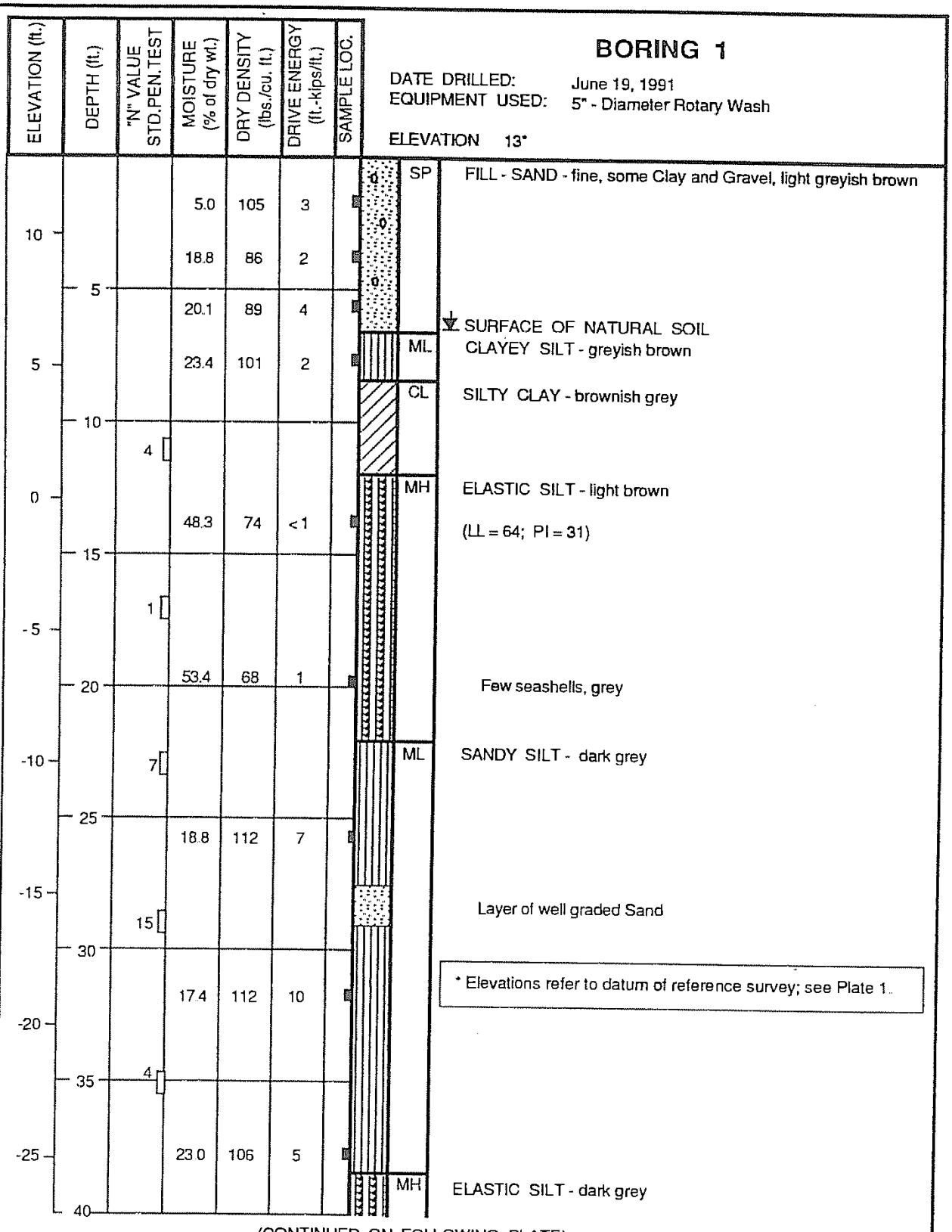
Page 2 of 2
USACE Ballona Creek Watershed
Project No. 2006-023.05

PLATE
B26

BORING 1

DATE DRILLED: June 19, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 13*



* Elevations refer to datum of reference survey; see Plate 1.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L91177.AEB DATE 8/24/91 F.T. LS DR. lk O.E. HRL CHKD

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LAW/CRANDALL, INC.

Area C - Law Crandall Borings

PLATE A-1.1a

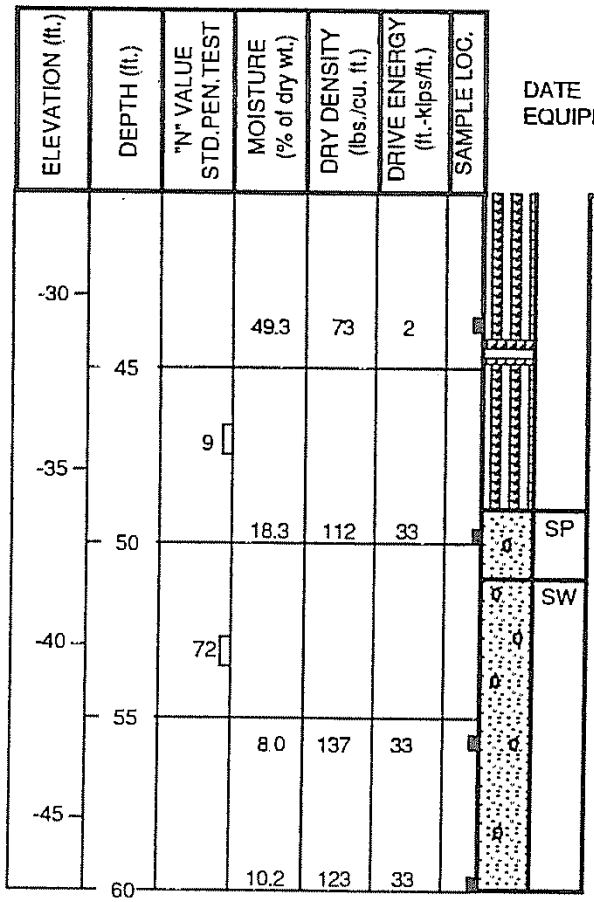
PLATE A2-161

JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD FH

Note: The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 1 (Continued)

DATE DRILLED: June 19, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash



Layer of Peat

SAND - fine, about 10% Gravel, dark grey

SAND - well graded, about 20% Gravel, grey

Some Clayey Silt

NOTE: Drilling mud used in drilling process. Mud removed to 30' at completion of drilling. Water level measured at 12-1/2' after removal of mud; bottom of boring at 21'. Boring grouted.

LOG OF BORING

LAW/CRANDALL, INC.

Area C - Law Crandall Borings

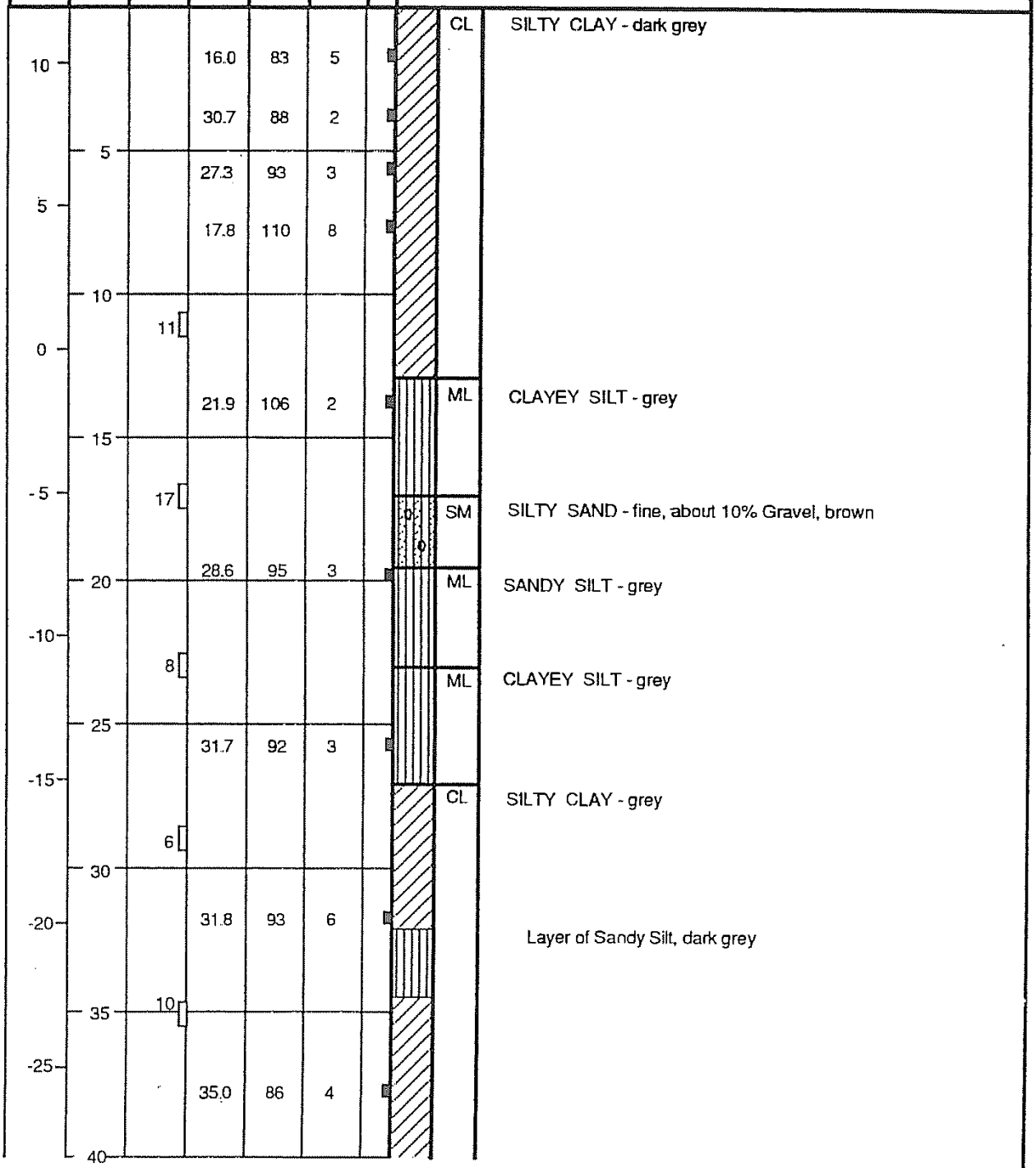
PLATE A2-16 2 1.1b

JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD EH

BORING 2

DATE DRILLED: June 20, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 12



Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated.
It is not warranted to be representative of subsurface conditions at other locations and times.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LAW / CRANDALL, INC.

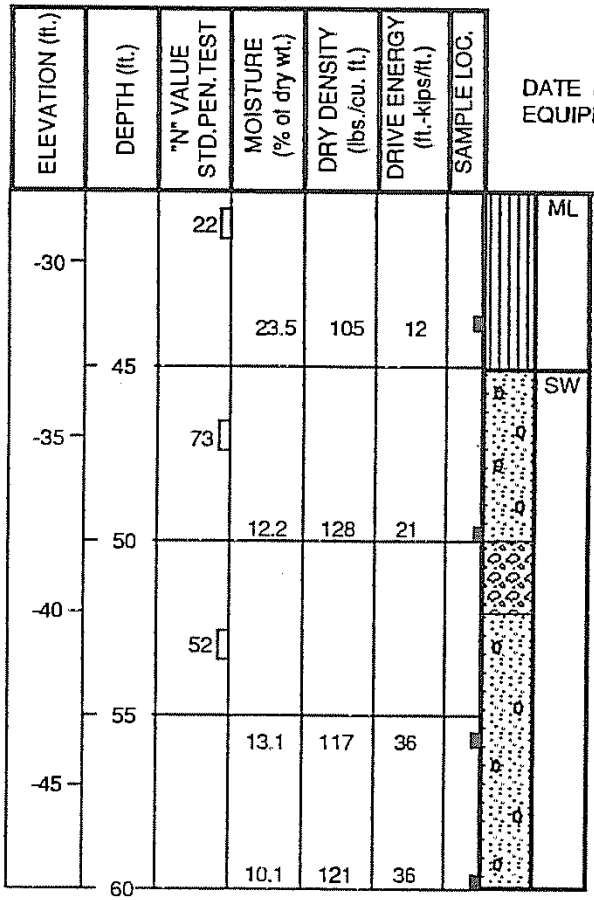
Area C - Law Crandall Borings

PLATE A2-1631.2a

JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD

BORING 2 (Continued)

DATE DRILLED: June 20, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash



SANDY SILT - brownish grey

SAND - well graded, about 20% Gravel, greyish brown

Layer of well graded Gravel

Yellowish brown

NOTE: Drilling mud used in drilling process. Mud removed to 30' at completion of drilling. Water level measured at 15' 15 minutes after removal of mud; bottom of boring at 21'. Boring grouted.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

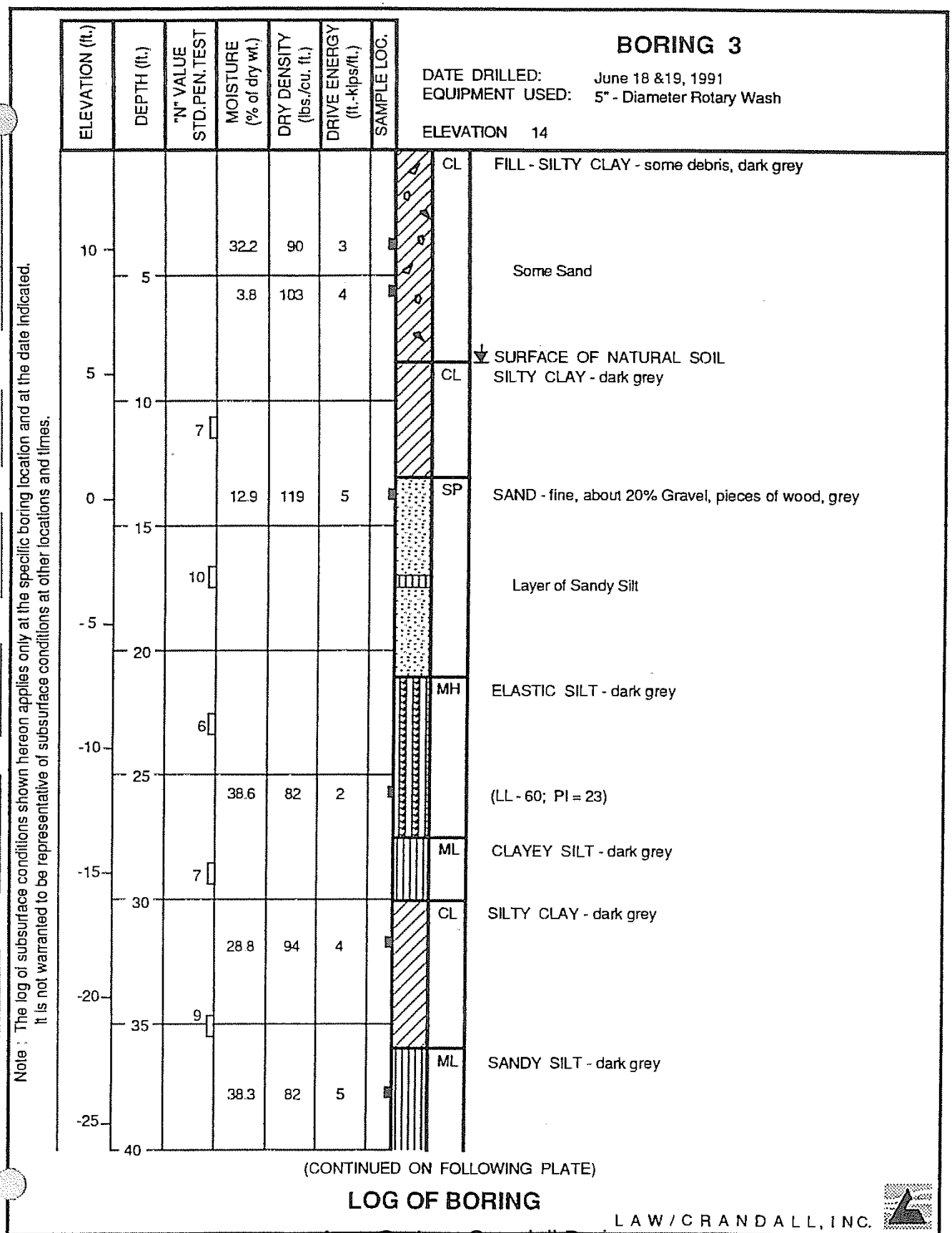
LOG OF BORING

LAW/CRANDALL, INC.

Area C - Law Crandall Borings

PLATE A-1.2b

PLATE A2-164



LOG OF BORING

LAW/CRANDALL, INC.

Area C - Law Crandall Borings

PLATE A2-A65.3a

JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD

BORING 3 (Continued)

DATE DRILLED: June 18 &19, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-30	45	27	14.6	121	23		SP	SAND - fine, grey
-35	50	65	13.0	125	36			Fine to coarse Sand, about 20% Gravel
-40	55	95 (10" pen)	6.4	118	33		SW	SAND - well graded, about 20% Gravel, grey
-45	60		8.9	126	30			

NOTE: Drilling mud used in drilling process. Mud removed to 30' at completion of drilling. Water level measured at 15-1/2' after removal of mud; bottom of boring at 26'. Boring grouted.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

Area C - Law Crandall Borings

PLATE A-1.3b

PLATE A2-166

JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 4

DATE DRILLED: June 17, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 20

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
			10.5	118	6		SP SM	FILL - SAND and SILTY SAND - fine, brown
			19.3	103	4		ML	FILL - CLAYEY SILT - greyish brown
15	5		24.3	98	2			
			15.8	103	2		SM	FILL - SILTY SAND - fine, greyish brown
								▽ SURFACE OF NATURAL SOIL
10	10	2					ML	CLAYEY SILT - dark grey
			34.9	86	2			
5	15							
		6						
0	20		36.3	84	2			
		1						
-5	25		23.2	104	2		CL	SILTY CLAY - some Sand, greyish brown (LL = 30; PI = 12)
		2						
-10	30						SP	SAND - fine, dark grey
			18.4	112	15			
-15	35	11						
							MH	ELASTIC SILT - grey
			33.9	89	8			
-20	40							

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LAW/CRANDALL, INC.

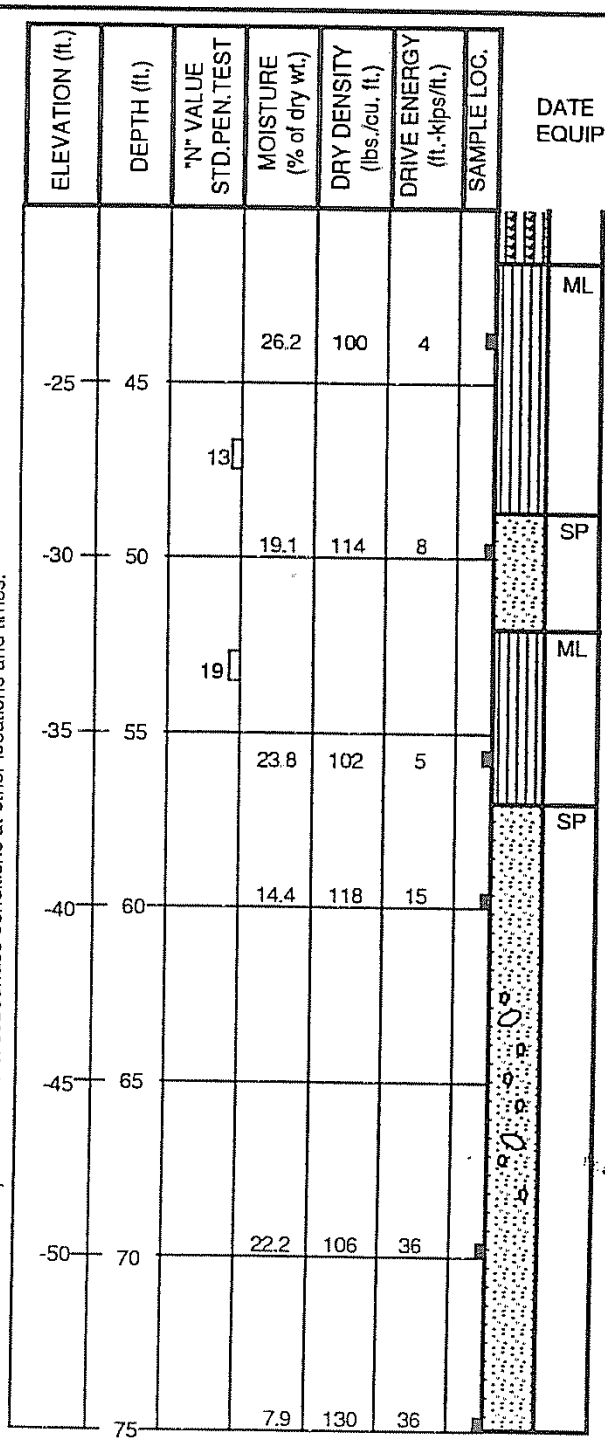
Area C - Law Crandall Borings

PLATE A2-1671.4a

JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD

BORING 4 (Continued)

DATE DRILLED: June 17, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash



ML	CLAYEY SILT - grey
SP	SAND - fine, dark grey
ML	SANDY SILT - dark grey
SP	SAND - fine, grey
	About 20% Gravel, few Cobbles (to 6" in size)
	No Gravel

NOTE: Drilling mud used in drilling process. Mud removed to 30' at completion of drilling. Water level measured at 22-1/2' 15 minutes after removal of mud; bottom of boring at 34'. Boring grouted.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW / CRANDALL, INC.

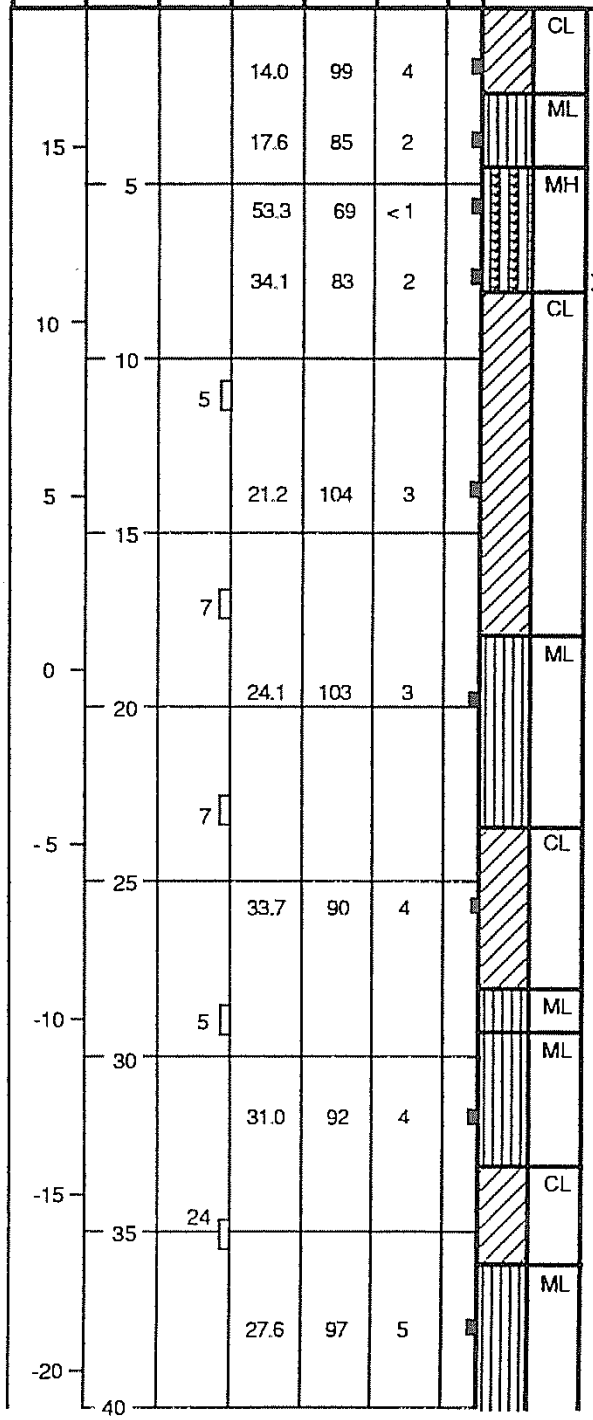
Area C - Law Crandall Borings

PLATE A-168 PLATE A-1.4b

BORING 5

DATE DRILLED: June 18, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 19



CL	FILL - SILTY CLAY - greyish brown
ML	FILL - CLAYEY SILT - greyish brown
MH	FILL - ELASTIC SILT - dark grey
	(LL = 71; PI = 36)
	▼ SURFACE OF NATURAL SOIL
CL	SILTY CLAY - dark grey
ML	SANDY SILT - dark grey
CL	SILTY CLAY - greyish brown
ML	CLAYEY SILT - greyish brown
ML	SANDY SILT - greyish brown
CL	SILTY CLAY - some Sand, greyish brown
ML	SANDY SILT - some Clayey layers, greyish brown

(CONTINUED ON FOLLOWING PLATE)

JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

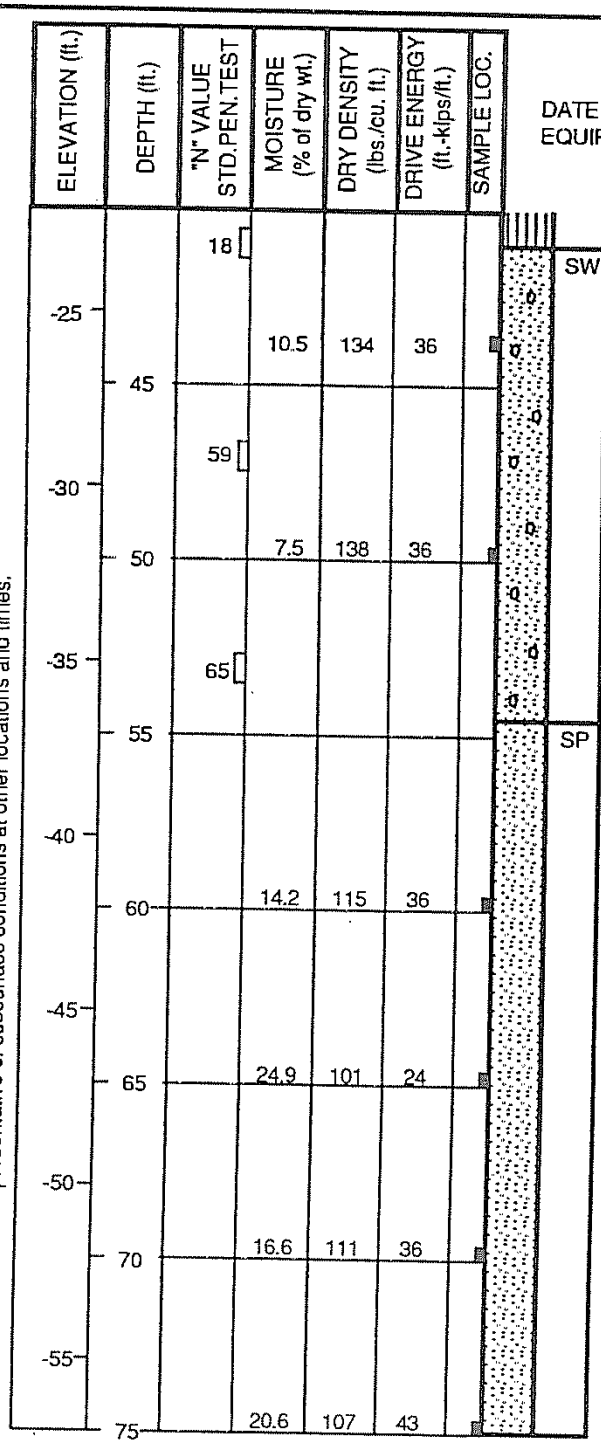
Area C - Law Crandall Borings

PLATE A2-169.1.5a

JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD

BORING 5 (Continued)

DATE DRILLED: June 18, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash



SW SAND - well graded, about 30% Gravel, brown

Dark grey

SP SAND - fine, grey

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

NOTE: Drilling mud used in drilling process. Mud removed to 40' at completion of drilling. Water level measured at 22-1/2' 15 minutes after removal of mud; bottom of boring at 44'. Boring grouted.

LOG OF BORING
Area C - Law Crandall Borings

LAW/CRANDALL, INC.

PLATE A2-170
PLATE A - 1.5b

JOB F-88218 DATE 7/6/88 F.T. DR. lp S.G. FB W.P. lp CHKD

Note ; The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING B - 1

DATE DRILLED: June 21, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						
10						
15						

SP	FILL - GRAVELLY SAND - moist, fine to coarse grained Sand, brown
CL	SILTY CLAY - very moist, blackish grey with lenses of brownish grey Clayey Silt
ML	CLAYEY SILT - very moist, multicolored grey and greyish brown
SM	SILTY SAND - very moist to wet, fine grained, reddish brown mottled with greenish grey

NOTE: Total depth 10'. Ground water level not encountered.

BORING B - 2

DATE DRILLED: June 21, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						
10						
15						

SM	FILL - SILTY SAND - moist, fine to coarse grained Sand, some blackish grey Silty Clay lumps
	Mostly fine to medium grained Sand
SP	POORLY GRADED SAND - wet, fine to coarse grained Sand, some blackish grey lumps No sample recovered, possibly sampling on top of Cobbles

NOTE: Total depth 10'. Ground water level not encountered.

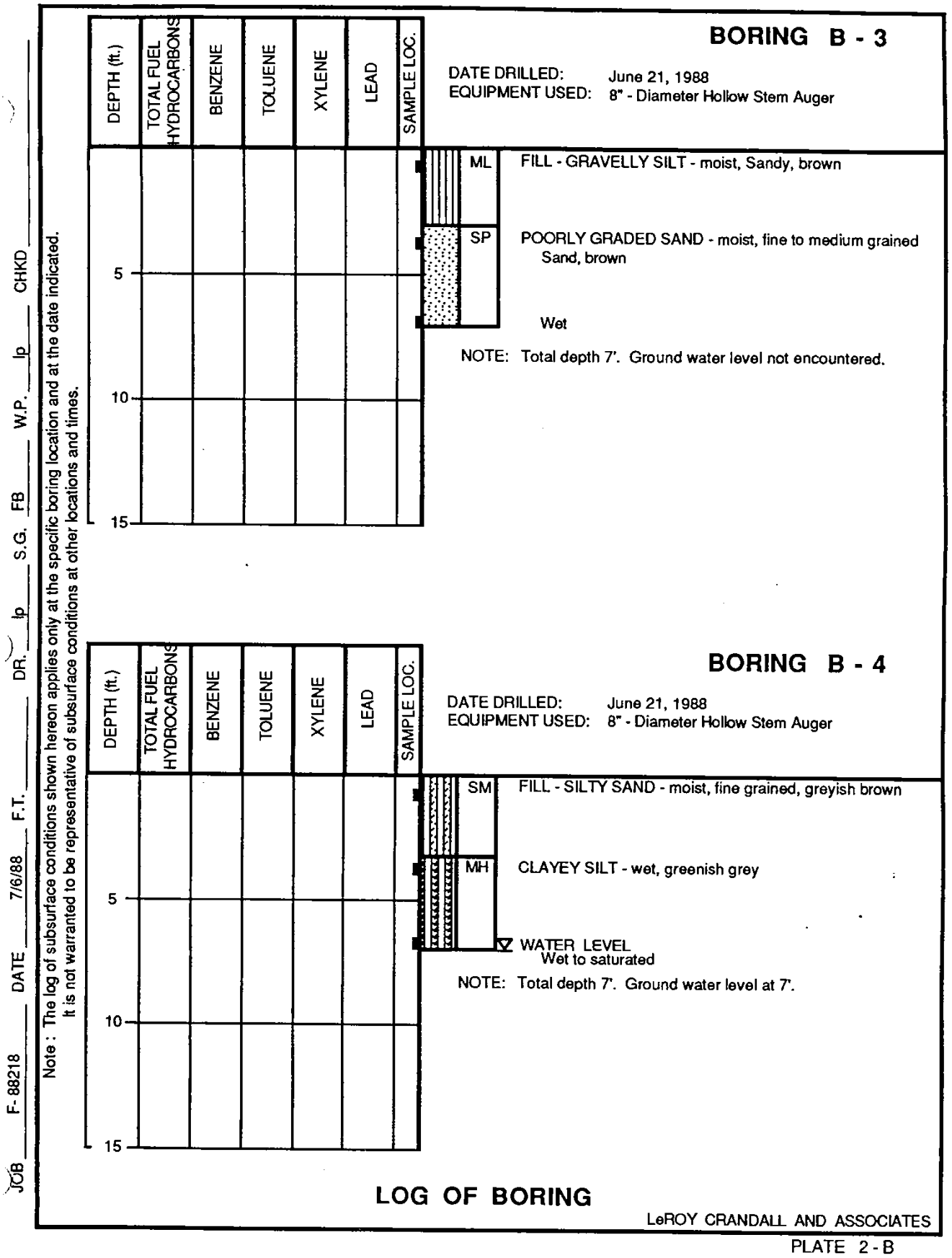
LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - A

Area C - Law Crandall Borings - 1988

PLATE A2-171



Area C - Law Crandall Borings - 1988

PLATE A2-172

JOB F-88218 DATE 7/6/88 F.T. DR. lp S.G. FB W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING B - 5

DATE DRILLED: June 22, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						
10						
15						

ML FILL - CLAYEY SILT - very moist, greyish brown

Very moist to wet

CL SILTY CLAY - wet with vertical 0.01' thick Silty fine Sand lense

Wet to saturated

NOTE: Total depth 10'. Ground water level not encountered.

BORING B - 6

DATE DRILLED: June 22, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						
10						
15						

SP FILL - SAND - very moist, gravelly, fine to coarse grained Sand, brown

Mostly fine to coarse grained Sand, wet

Saturated at 5.5'

NOTE: Total depth 6'. Saturated at 5.5'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - C

Area C - Law Crandall Borings - 1988

PLATE A2-173

JOB F- 88218 DATE 7/6/88 F.T. DR. lp S.G. FB W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING B - 7

DATE DRILLED: June 22, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						
10						
15						

- SM — FILL - SILTY SAND - moist, fine grained, some fine Gravel and Clay lumps
- MH — CLAYEY SILT - very moist to wet, some seashells
- SM — SILTY SAND - wet, fine grained, brownish grey
- ML — SANDY SILT - wet, fine grained, brownish grey

NOTE: Total depth 15'. Ground water level at 13'.

BORING B - 8

DATE DRILLED: June 22, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						
10						
15						

- SP — FILL - SAND - very moist, fine to coarse Sand with some Clay lumps, brown, locally with Gravel
- Very moist to wet
- ML — CLAYEY SILT - wet, dark greenish grey
- Wet to saturated

NOTE: Total depth 15'. Ground water not encountered. Sloughing from 13' to 15'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - D

Area C - Law Crandall Borings - 1988

PLATE A2-174

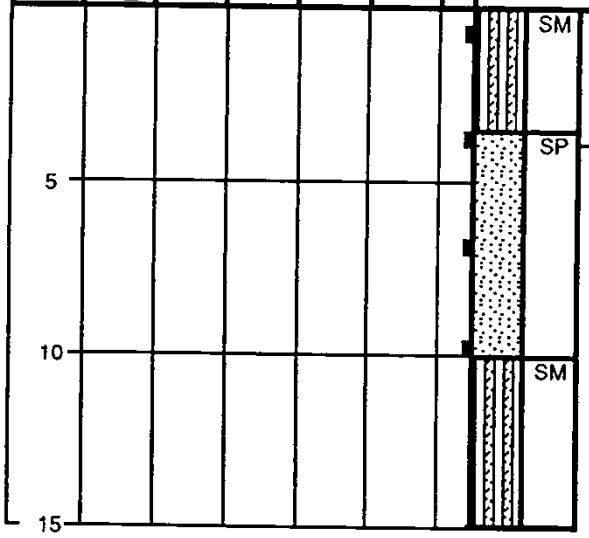
JOB F-88218 DATE 7/6/88 F.T. DR. lp S.G. FB W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING B - 9

DATE DRILLED: June 23, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.



SM FILL - SILTY SAND - dry to moist, fine to coarse Sand, brown to reddish brown

Very moist, fine to medium grained, thin lenses of blackish grey Silty Clay

SP SAND - wet, predominately fine grained Sand

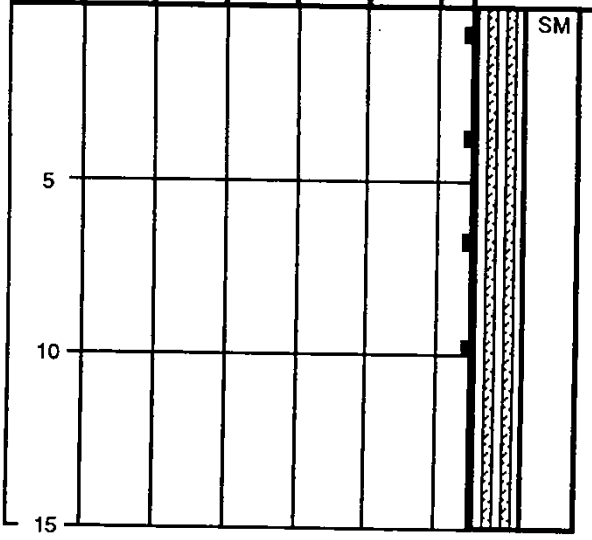
SM SILTY SAND - wet, fine grained Sand, dark greenish grey

NOTE: Total depth 15'. Ground water level not encountered.

BORING B - 10

DATE DRILLED: June 23, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.



SM FILL - SILTY SAND - moist, fine grained, some seashells

Abundant seashells, Clay lumps

Very moist to wet, brownish grey

Color change to dark greenish grey at 9.75'.

NOTE: Total depth 15'. Ground water level not encountered.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - E

Area C - Law Crandall Borings - 1988

PLATE A2-175

JOB F-88218 DATE 7/6/88 F.T. DR. lp S.G. FB W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING B - 11

DATE DRILLED: June 23, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						
10						
15						

SM — FILL - SILTY SAND - moist, fine grained, abundant seashells, brownish grey

Very moist, abundant seashells, some blackish grey Clay lumps, fine to coarse grained Sand

Very moist, fine grained Sand

Very moist to wet, dark greenish grey

NOTE: Total depth 15'. Ground water level not established.

BORING B - 12

DATE DRILLED: June 21, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						
10						
15						

SM — 3" Thick Asphaltic Paving
FILL - SILTY SAND - dry, fine grained, reddish brown

Very moist, fine to medium grained Sand

CL — SILTY CLAY - wet, grey mottled with dark greenish grey and greyish brown

Wet, grey mottled with greyish brown

NOTE: Total depth 15'. Ground water level not encountered.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - F

Area C - Law Crandall Borings - 1988

PLATE A2-176

JOB F-88218 DATE 7/6/88 F.T. DR. lp S.G. FB W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING B - 13

DATE DRILLED: June 23, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						
10						
15						

SP FILL - SILTY SAND - moist, Gravelly, fine to coarse grained Sand, reddish brown

SC CLAYEY SAND - very moist, fine to medium grained Sand, some Gravel, reddish brown

Very moist to wet, some dark greenish grey Clay lumps

ML CLAYEY SILT - wet, dark greenish grey

NOTE: Total depth 10'. Ground water level not encountered.

BORING B - 14

DATE DRILLED: June 23, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						
10						
15						

SM FILL - SILTY SAND - dry to moist, Clayey, brown

Very moist, fine to medium Sand, some seashells

NOTES: Total depth 15'. Ground water level not encountered.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - G

Area C - Law Crandall Borings - 1988

PLATE A2-177

JOB F-88218 DATE 7/6/88 F.T. DR. lp S.G. FB W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING B - 15

DATE DRILLED: June 27, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						
10						
15						

ML	FILL - CLAYEY SILT - moist, Gravelly, about 10% concrete fragments and glass, greyish brown
SM	FILL - SILTY SAND - moist, fine grained, about 5% concrete fragments, greyish brown
CL	SILTY CLAY - very moist, greenish grey
	Very moist, dark grey mottled with brownish grey

NOTE: Total depth 15'. Ground water level not encountered.

BORING B - 16

DATE DRILLED: June 27, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						
10						
15						

ML	FILL - SANDY SILT - moist, fine, reddish brown
	Moist to very moist, Gravelly, brown
	Very moist, brown grading to blackish and greenish grey
CL	SILTY CLAY - wet, dark greenish grey

NOTE: Total depth 15'. Wet below 10'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - H

Area C - Law Crandall Borings - 1988

PLATE A2-178

JOB F-88218 DATE 7/5/88 F.T. DR. lp S.G. FB W.P. lp CHKD

BORING MW - 1

DATE DRILLED: June 22, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						
10						
15						
20						
25						
30						
35						

SM FILL - SILTY SAND - moist to very moist, fine to medium grained, brown

Very moist

ML SANDY SILT - very moist to wet, fine grained, greyish brown

▽

CL SILTY CLAY - saturated, grey mottled with brown

Saturated, dark grey with abundant seashells

ML CLAYEY SILT - saturated, dark greenish grey

SM SILTY SAND - saturated, fine, slightly Clayey, dark greenish grey

NOTE: Total depth 32'. Ground water level at 12'. Converted into monitoring well.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2-1

Area C - Law Crandall Borings - 1988

PLATE A2-179

JOB F-88218 DATE 7/5/88 F.T. ____ DR. ____ lp ____ S.G. FB ____ W.P. ____ lp ____ CHKD ____

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING MW - 2

DATE DRILLED: June 27, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.		
0							SM	FILL - SILTY SAND - dry to moist, fine, brownish grey to greenish grey
5								Moist, greenish grey
10							CL	SILTY CLAY - very moist, dark grey
15							CL	SILTY CLAY - very moist, dark greenish grey mottled with reddish brown
20							SM	SILTY SAND - wet to saturated, fine to medium grained Sand, grey
25							SP	SAND - saturated, fine to coarse grained Sand, gravelly, dark grey
30								
35								
40								Clayey, grey

NOTE: Total depth 40.5'. Ground water level at 18.5'.

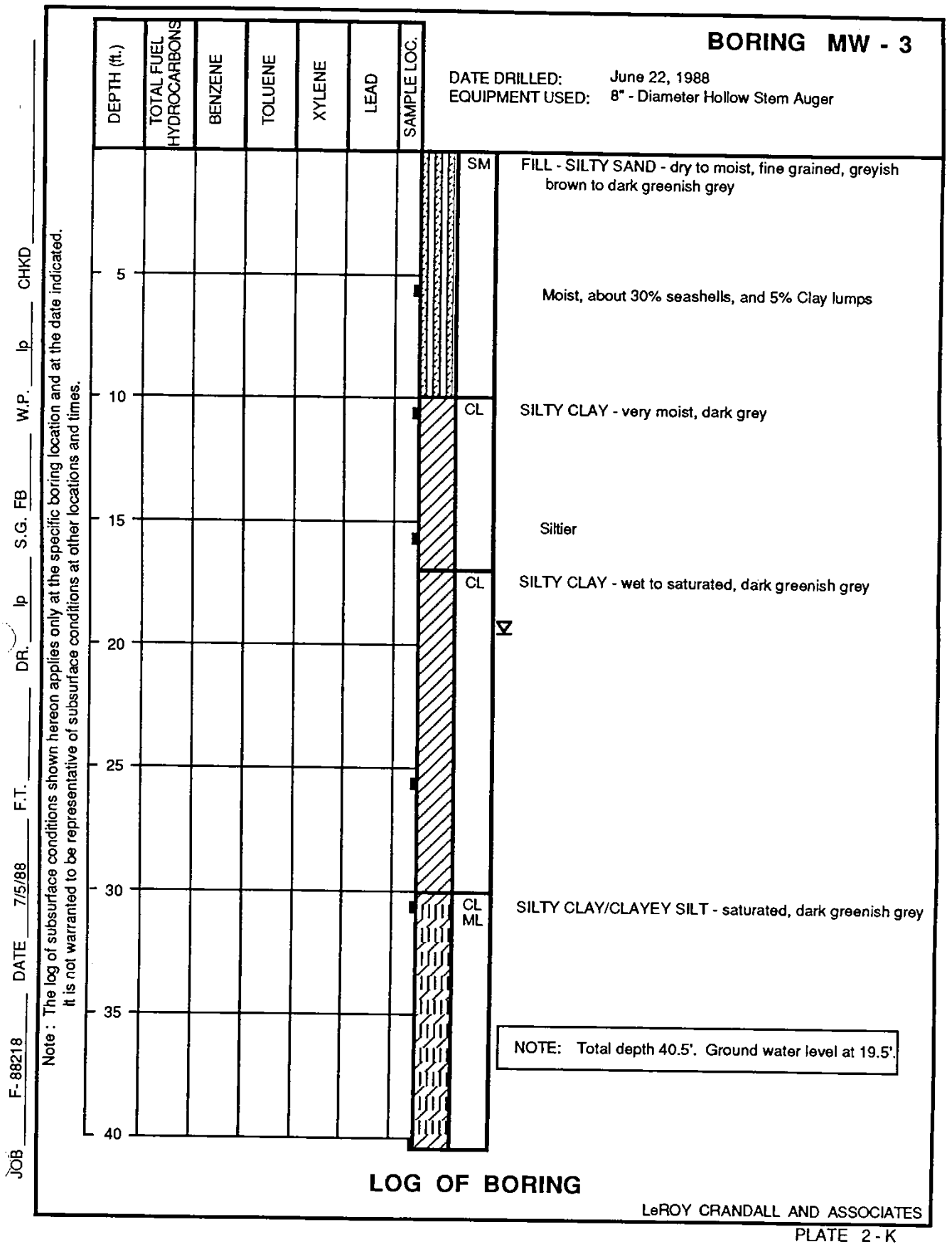
LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - J

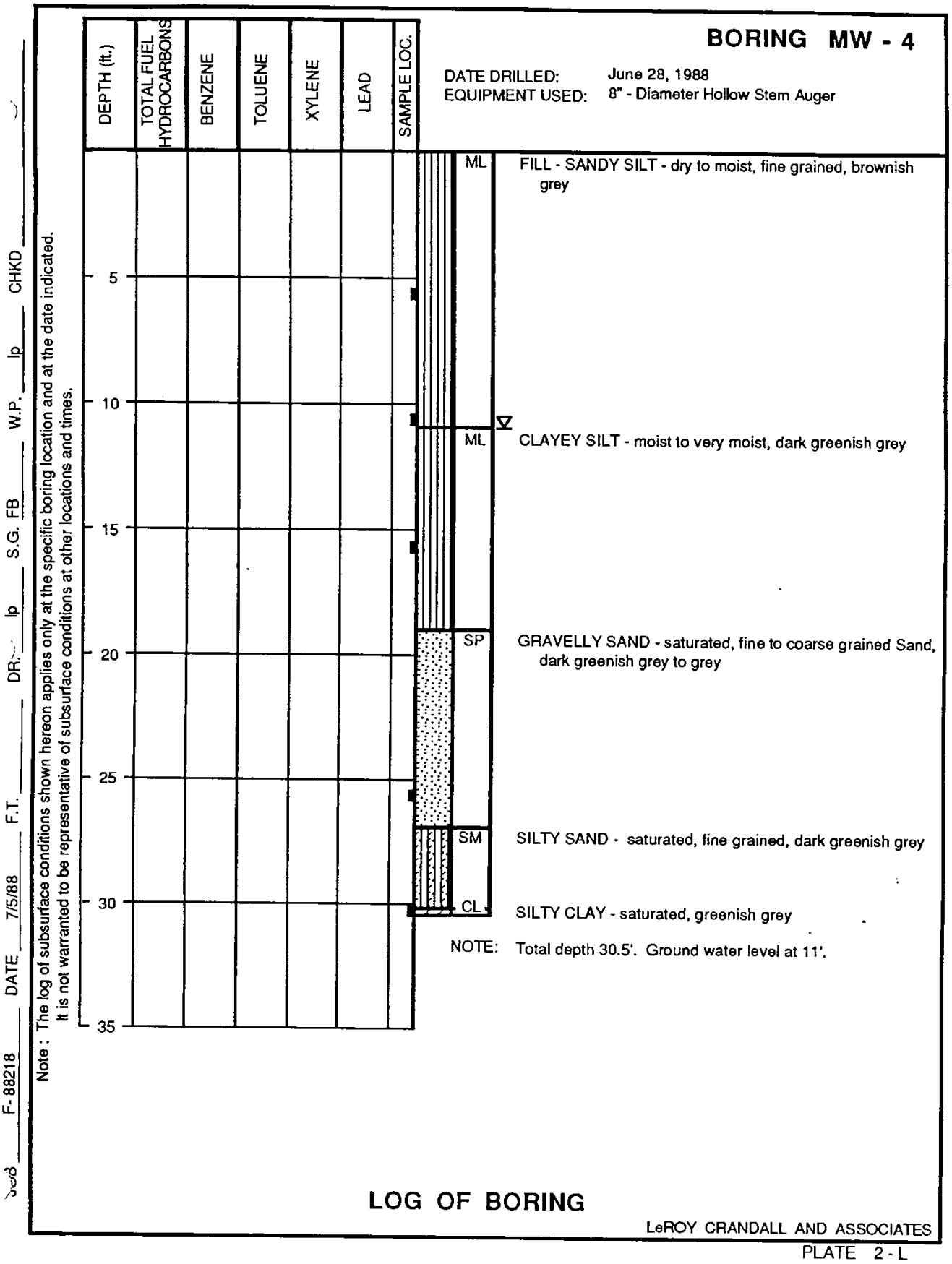
Area C - Law Crandall Borings - 1988

PLATE A2-180



Area C - Law Crandall Borings - 1988

PLATE A2-181



Area C - Law Crandall Borings - 1988

PLATE A2-182

JOB F-88218 DATE 7/5/88 F.T. DR. lp S.G. FB W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING MW - 5

DATE DRILLED: June 28, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						
10						
15						
20						
25						
30						

SM — FILL - SILTY SAND - moist to very moist, fine grained with some Gravel, greyish brown

Very moist to wet
CL — SILTY CLAY - wet, greyish brown

SM — SILTY SAND - saturated, fine grained, greyish brown, mottled with reddish brown

ML CL — CLAYEY SILT/SILTY CLAY - saturated, brownish grey mottled with reddish brown

SM — SILTY SAND - saturated, fine grained, greyish brown mottled with grey

NOTE: Total depth 27.5'. Ground water level at 8'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - M

Area C - Law Crandall Borings - 1988

PLATE A2-183

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APPENDIX B1
GDC LABORATORY TESTING

APPENDIX B1
LABORATORY TESTING

B1.1 General

The laboratory testing program performed for this investigation by GDC included determination of Moisture Content, Dry Unit Weight, Atterberg Limits, Consolidation, Pocket Penetrometer, Laboratory Vane Shear, Direct Shear, Expansion Index, Corrosivity, Compaction, and Grain Size/Percent Passing No. 200 Sieve. Descriptions of these tests are given below.

B1.2 Moisture Content and Dry Unit Weight

The natural moisture content and dry unit weight of California ring samples were determined in general accordance with ASTM D 2216 and ASTM D2937. Results of these tests are presented on the boring logs in Appendix A1.

B1.3 Atterberg Limits

Soil plasticity was evaluated by measuring the Atterberg limits. This test includes Liquid Limit (LL) and Plastic Limit (PL) tests to determine the Plasticity Index (PI) in accordance with ASTM D4318. Results of these tests are illustrated in the plasticity charts shown in Figures B1-1a to B1-1p and are presented on the boring logs in Appendix A1.

B1.4 Grain Size Distribution and Percent Passing No. 200 Sieve:

Representative samples were dried, weighed, soaked in water until individual soil particles were separated, and then washed on the No. 200 sieve. The percentage of fines (soil passing No. 200 sieve) was determined for selected samples in accordance with ASTM D 1140. For selected samples the washed fraction retained on the No. 200 sieve was then screened on a No. 4 sieve, and the fraction retained on No. 4 was weighed to determine the percentage of gravel. For selected samples, the washed material retained on No. 200 sieve was shaken through a standard stack of sieves in accordance with ASTM D 422 to determine the grain size distribution. The results of grain size distribution tests are plotted in Figures B1-4a through B1-4b of this appendix. The relative proportion (or percentage) by dry weight of fines (passing No. 200 sieve) are listed on the boring records in Appendix A1.

B1.5 Consolidation

The consolidation characteristics of the foundation soils were determined by performing one-dimensional consolidation in general accordance with ASTM D2435, using a floating ring consolidometer and dead weight system. Results of these tests are presented in Figures B1-2a to B1-2t.

B1.6 Direct Shear Test

To determine the shear strength parameters of the on-site soils, direct shear tests were performed on selected undisturbed drive samples in accordance with ASTM D 3080. After the initial weight and volume measurements were made, the sample was placed in a calibrated shear machine and a selected normal load was applied. The samples were submerged, allowed to consolidate, and then were sheared to failure. Shear stress and sample deformation were monitored throughout the test. The process was repeated under two additional normal loads. The test results are graphically presented in Figures B1-3a and B1-3t.

B1.7 Pocket Penetrometer

Undrained shear strengths (S_u) of cohesive samples were measured using a pocket penetrometer. The measured S_u values (in ksf) are presented in the boring logs of Appendix A1.

B.7 Miniature Vane Shear

Shear strength of selected cohesive samples was estimated in the laboratory in general accordance with ASTM D 4648 using a Geonor™ Inspection Vane Tester H-60 Miniature Vane Shear device with a 16 x 32 mm vane having an area ratio of 14%, respectively. The test consists of inserting the miniature shear vane into the soil sample, rotating the vane at a constant rate until the cylindrical surface surrounding the vane fails in shear, measuring the maximum torque exerted on the vane during testing, and calculating the unit shearing resistance on the cylindrical surface. Undrained shear strengths measured in the test are presented in the boring logs of Appendix A1.

B1.8 Soil Expansion Index

A silty sand sample of near surface soil in boring B-RW049 was collected from the site and tested to determine the expansion index. Testing was performed according to ASTM D4829. The results of these tests are presented in Table B1-1.

B1.9 Soil Corrosivity

Corrosivity testing included performing soil pH and resistivity (Caltrans Test Method 643), water-soluble chlorides (ASTM D512), and water soluble sulfates (ASTM D516). The test results are summarized in Table B1-2.

B1.10 Compaction

Compaction testing was performed on 10 representative bulk sample of the fill soils encountered in Area A. Testing was performed according to ASTM D1557-91. The results of the compaction test is summarized in Table B1-3.

B1.12 List Tables and Figures

The following table and figures are attached and complete this appendix:

Table B1-1	Soil Expansion
Table B1-2	Soil Corrosivity
Table B1-3	Compaction
Figures B1-1a to B1-1p	Atterberg Limits Plots
Figures B1-2a to B1-2t	Consolidation Plots
Figures B1-3a to B1-3t	Direct Shear Plots
Figures B1-4a to B1-4b	Sieve Analysis Plots

Table B1-1. Soil Expansion

Boring	Sample Depth, feet	Expansion Index
B-RW049	0 to 1	0 (very low)

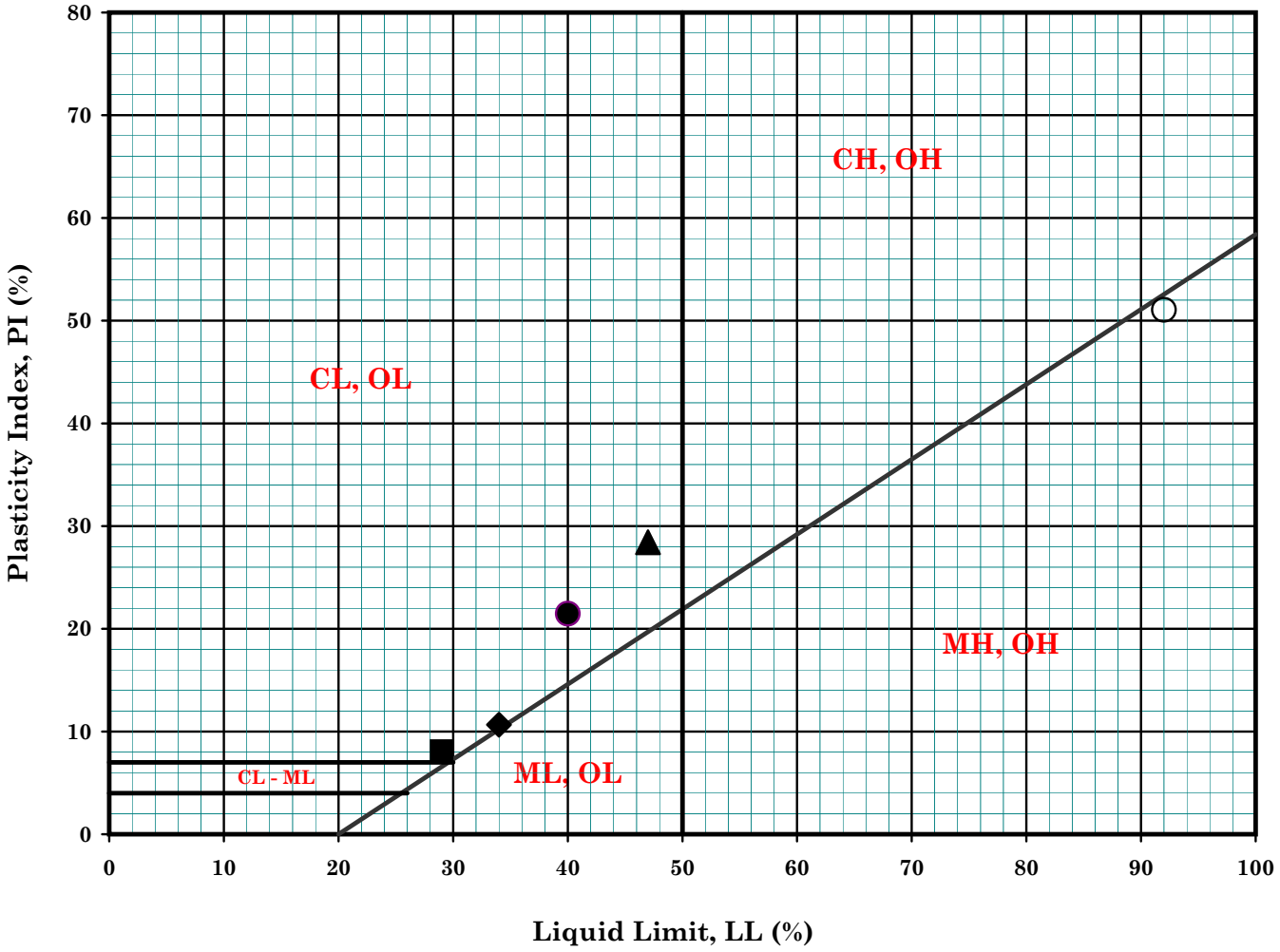
Table B1-2. Soil Corrosivity

Boring	Sample Depth, feet	pH	Chlorides ppm	Sulfates (% by weight)	Minimum Resistivity ohm-cm
B-RW049	0 to 1	7.61	55	0.04	1441

Table B1-3. Compaction

Boring	Sample Depth, feet	Maximum Dry Density, (pcf)	Optimum Moisture Content, (%)
A-HSA016	0-1	107.5	15
A-HSA016	8	121	12.5
A-HSA016	17	116	13
A-HSA017	0-1	105	15.5
A-HSA017	6.5	119.5	13
A-HSA017	15	119	13
A-HSA018	0-1	110	15
A-HSA018	18	116	15
A-HSA066	0-1	112.5	15
A-HSA067	0-1	109.5	16.5

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●	A-RW003	SH5B	20.0	21.5	6.1	6.6		40	19	21	Dark Greenish Gray Silty Clay (CL)
▲	A-RW003	S8	35.0	36.5	10.7	11.1		47	19	28	Very Dark Greenish Gray Silty Clay (CL)
◆	A-RW003	R13A	55.0	56.5	16.8	17.2		34	23	11	Very Dark Greenish Gray Silty Clay (CL)
■	A-RW003	R15	65.0	66.5	19.8	20.3		29	21	8	Very Dark Greenish Gray Silty Clay (CL)
○	A-RW005	S6	30.0	31.5	9.2	9.6		92	41	51	Dark Olive Brown Clay or Silt w/ Shells and Organic Matters (OH)
△											
◇											
□											

Remark :

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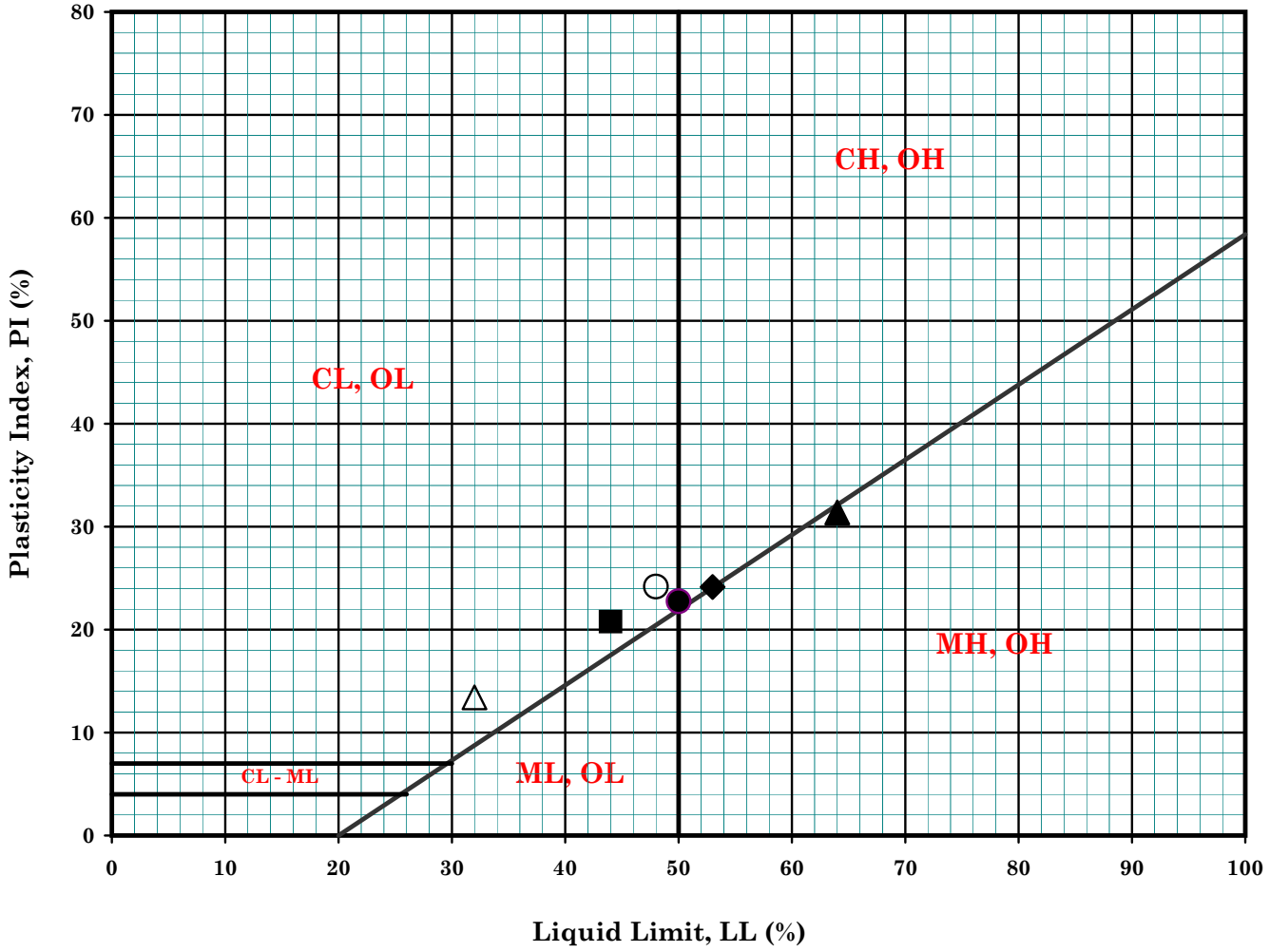
Ballona Creek Wetlands Restoration

Project No. : LA962A

Date : 01/28/13

ATTERBERG LIMITS
(ASTM D-4318-84)
Figure No. : B1-1a

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●	A-RW006	S5	20.0	21.5	6.1	6.6		50	27	23	Dark Grayish Brown Silty Clay (CL)
▲	A-RW006	SH8B	35.0	36.5	10.7	11.1		64	33	31	Dark Olive Gray Clayey Silt (MH)
◆	A-RW006	S9	40.0	41.5	12.2	12.7		53	29	24	Dark Olive Gray Clay / Silt with Shells (CH)
■	A-RW006	S11	50.0	51.5	15.3	15.7		44	23	21	Very Dark Greenish Gray Silty Clay (CL)
○	A-RW006	S13	60.0	61.5	18.3	18.8		48	24	24	Very Dark Greenish Gray Silty Clay (CL)
△	A-RW006	S15	70.0	71.5	21.4	21.8		32	19	13	Very Dark Greenish Gray Sandy Silty Clay (CL)
◇											
□											

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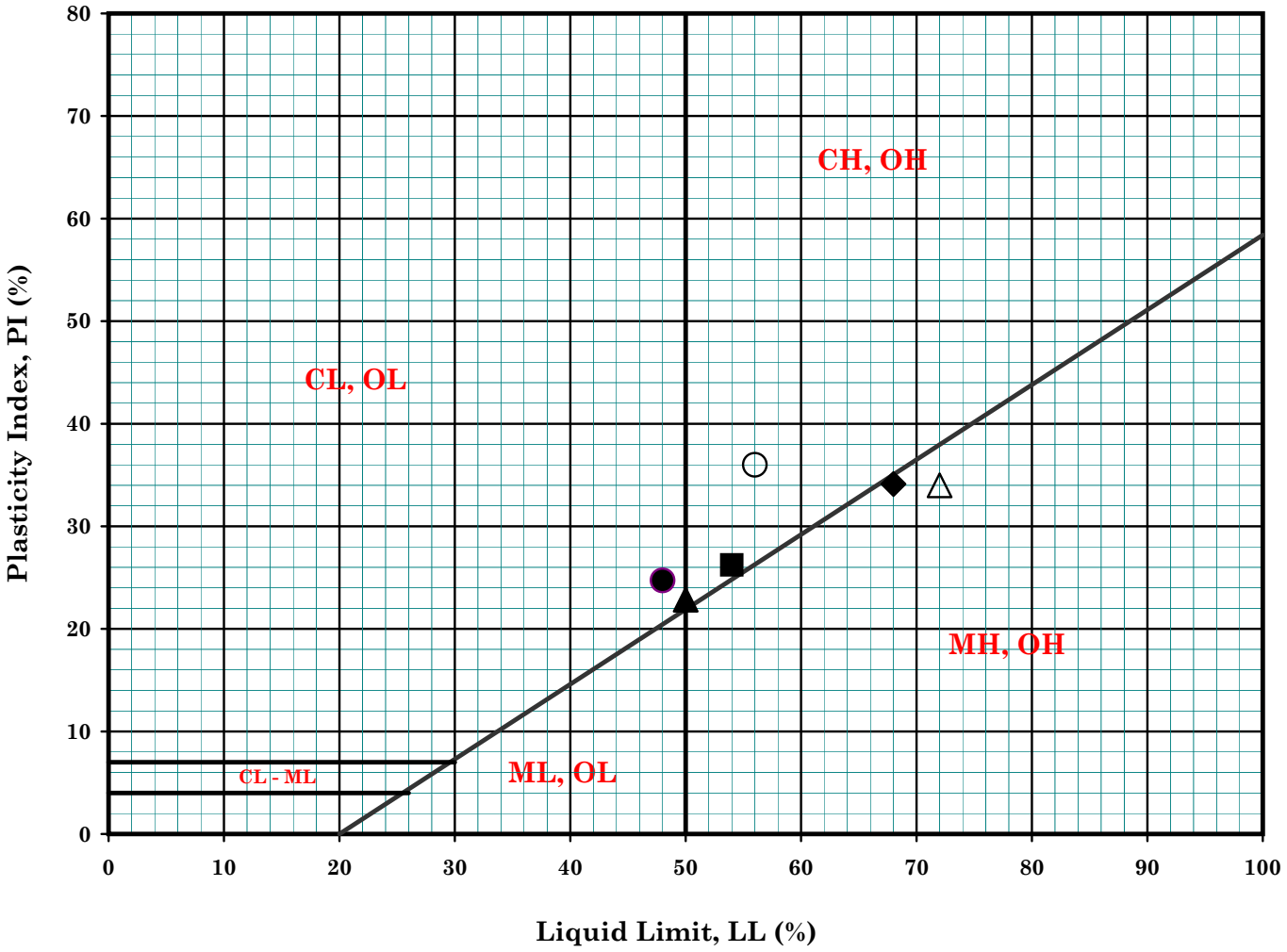
Project No. : LA962A

Date : 01/28/13

ATTERBERG LIMITS
(ASTM D-4318-84)
Figure No. : B1-1b

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●	A-RW008	R2	10.0	11.5	3.1	3.5		48	23	25	Dark Greenish Gray Silty Clay with Sand (CL)
▲	A-RW008	R5	25.0	26.5	7.6	8.1		50	27	23	Dark Greenish Gray Lean / Fat Clay with Traces of Shells (CL / CH)
◆	A-RW008	R6A	30.0	31.5	9.2	9.6		68	34	34	Dark Greenish Gray Clayey Silt with Traces of Shells (MH)
■	A-RW008	R10	45.0	46.5	13.7	14.2		54	28	26	Very Dark Greenish Gray Fat Clay (CH)
○	A-RW009	S6	25.0	26.5	7.6	8.1		56	20	36	Dark Greenish Gray Fat Clay (CH)
△	A-RW009	R11A	50.0	51.5	15.3	15.7		72	38	34	Very Dark Greenish Gray to Black Clay w/ Organic Matter (OH)
◇											
□											

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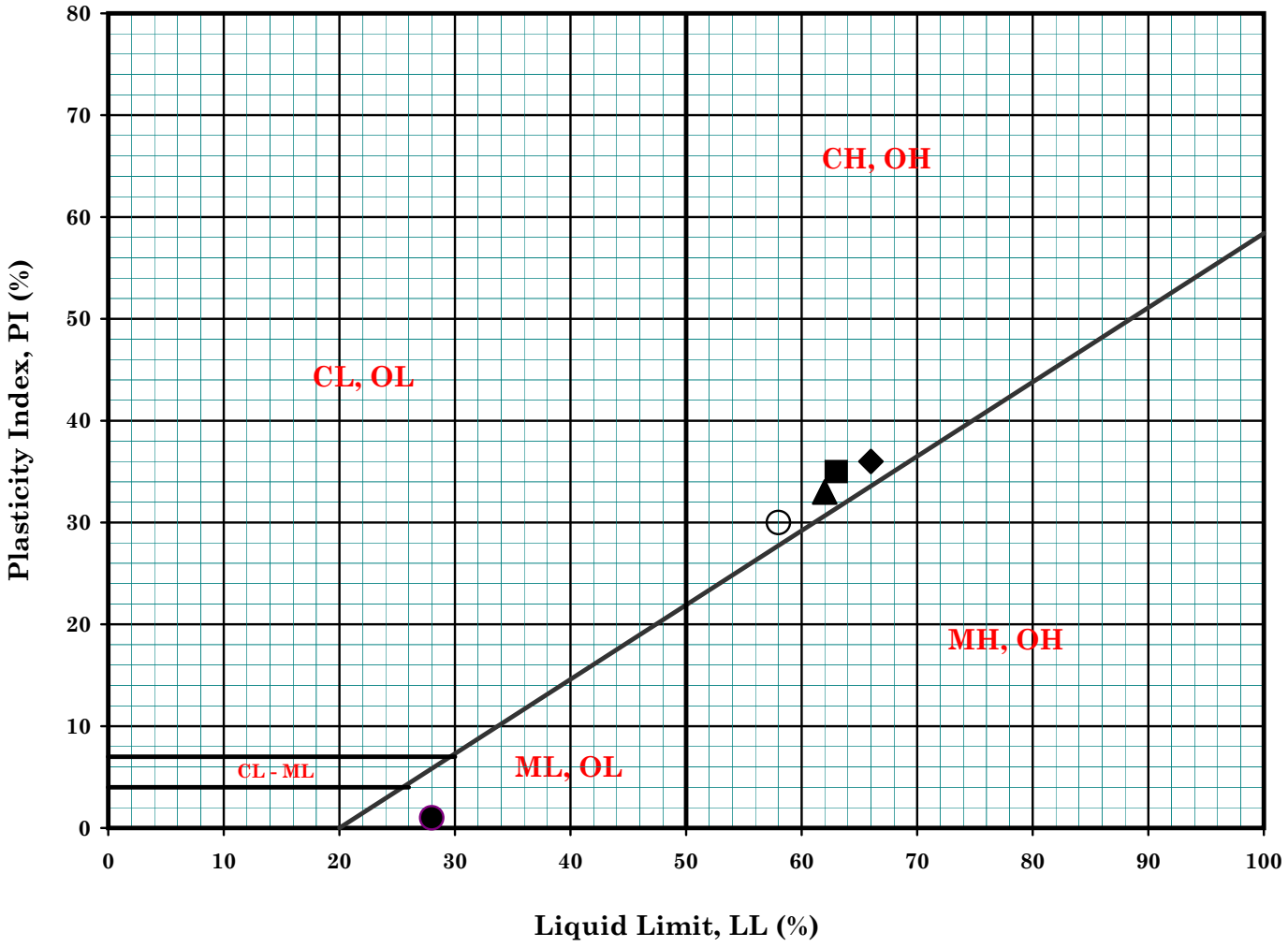
Project No. : LA962A

Date : 10/19/12

ATTERBERG LIMITS
(ASTM D-4318-84)
Figure No. : B1-1c

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●	A-RW011	R2	5.0	6.5	1.5	2.0		28	27	1	Dark Greenish Gray Sandy Silt (ML)
▲	A-RW011	R4	15.0	16.5	4.6	5.0		62	29	33	Light Olive Brown Fat Clay (CH)
◆	A-RW011	S5	20.0	21.5	6.1	6.6		66	30	36	Dark Greenish Gray Fat Clay (CH)
■	A-RW011	R6A	25.0	26.5	7.6	8.1		63	28	35	Dark Greenish Gray Fat Clay with Traces of Shells (CH)
○	A-RW011	S10	45.0	46.5	13.7	14.2		58	28	30	Very Dark Gray Fat Clay (CH)
△											
◇											
□											

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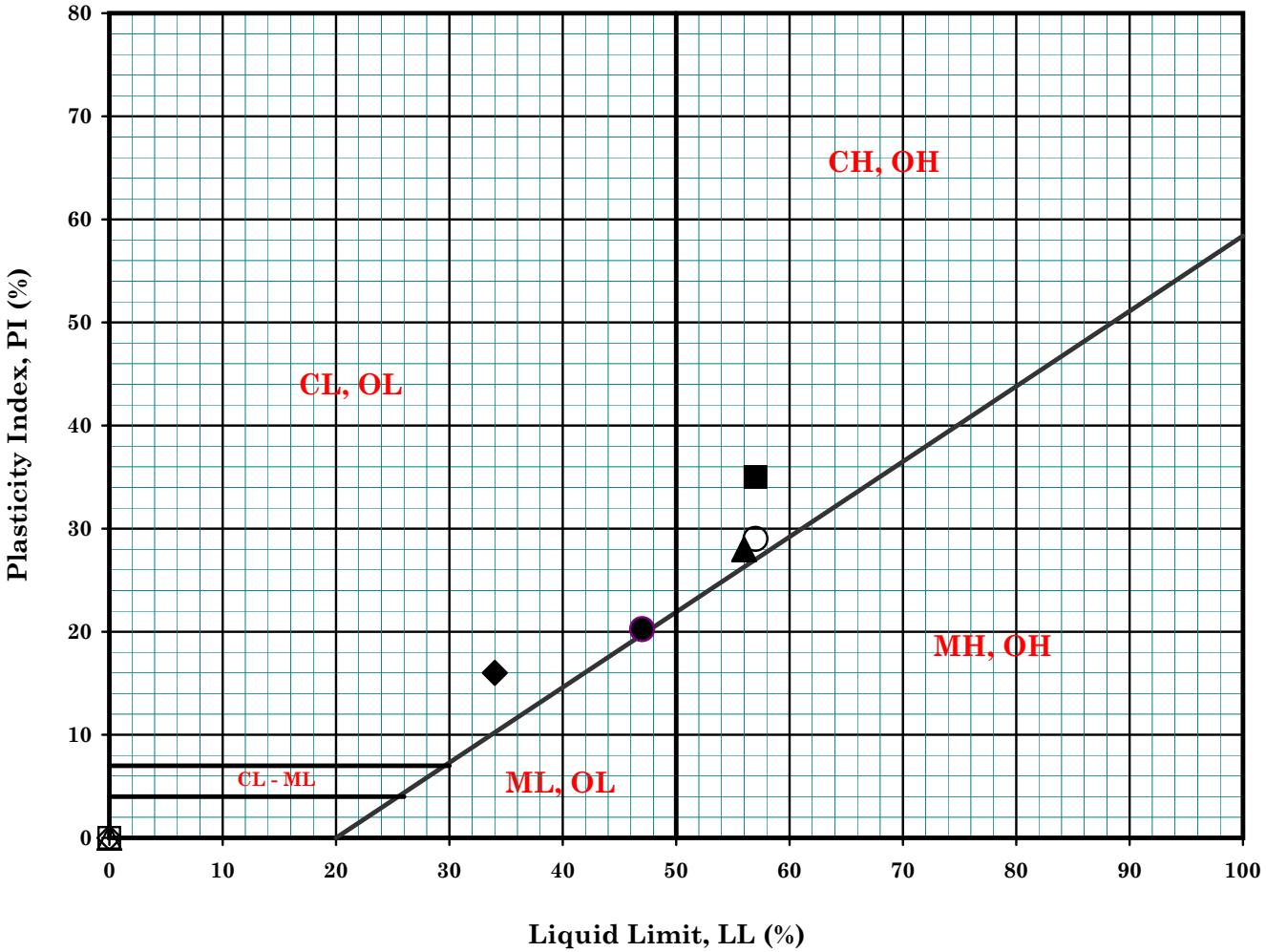
ATTERBERG LIMITS
(ASTM D-4318-84)
Figure No. : B1-1d

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●	A-RW013	R4	15.0	16.5	4.6	5.0		47	27	20	Olive Brown Silty Clay (CL)
▲	A-RW013	S5	20.0	21.5	6.1	6.6		56	28	28	Dark Greenish Gray Fat Clay (CH)
◆	A-RW013	R7	30.0	31.5	9.2	9.6		34	18	16	Very Dark Greenish Gray Sandy Clay w/ Traces of Gravel (CL)
■	A-RW015	R3	10.0	11.5	3.1	3.5		57	22	35	Very Dark Greenish Gray Fat Clay (CH)
○	A-RW015	S11	45.0	46.5	13.7	14.2		57	28	29	Dark Greenish Gray Fat Clay (CH)
△											
◇											
□											

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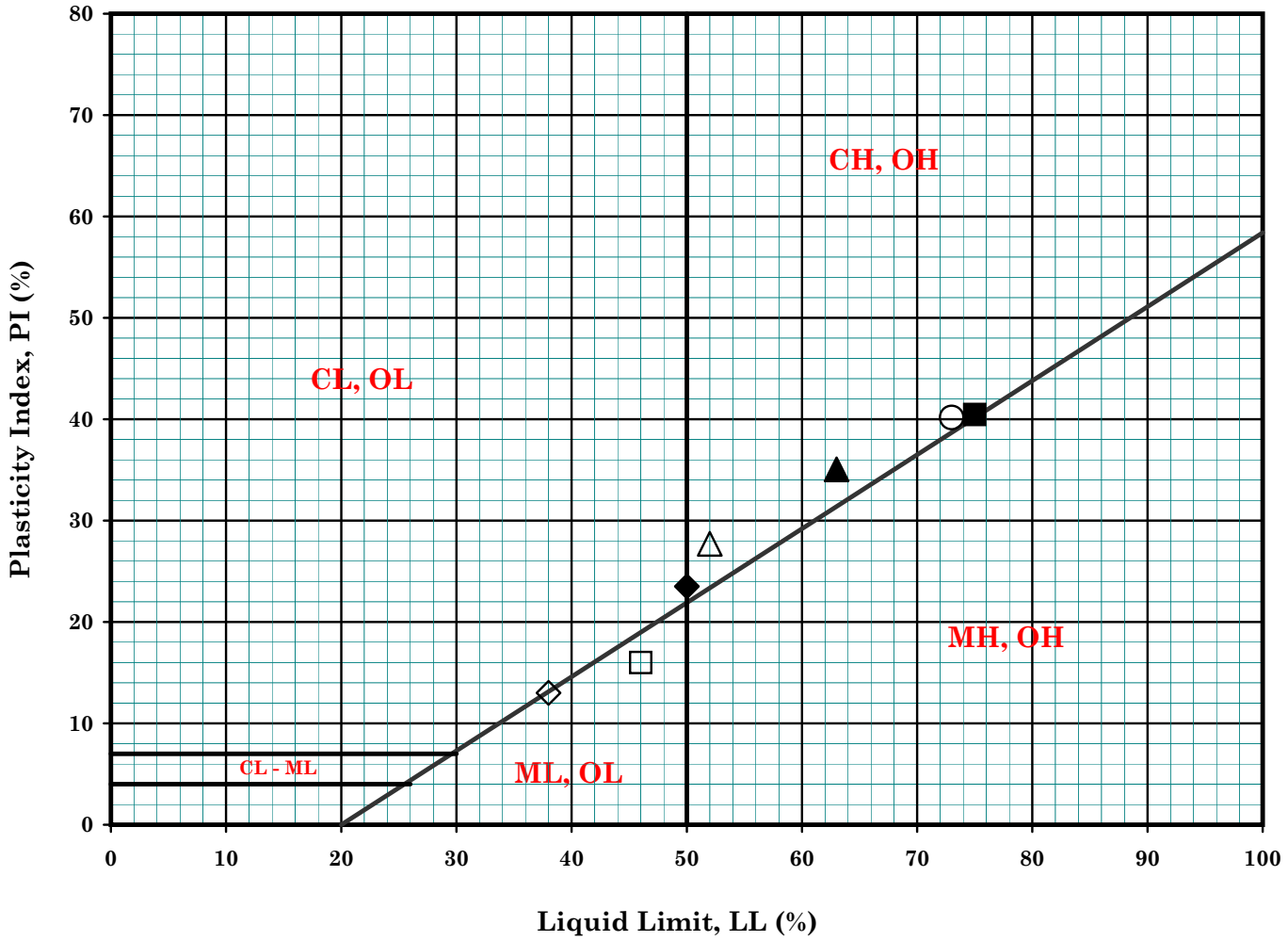
Project No. : LA962A

Date : 10/20/12

ATTERBERG LIMITS
(ASTM D-4318-84)
Figure No. : B1-1e

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●											
▲	A-RW020	R4A	15.0	16.5	4.6	5.0		63	28	35	Olive Brown Fat Clay (CH)
◆	A-RW020	S5	20.0	21.5	6.1	6.6		50	26	24	Dark Greenish Gray Silty Clay / Clayey Silt w/ Shells (CL/CH)
■	A-RW020	R6	25.0	26.5	7.6	8.1		75	35	40	Dark Greenish Gray Clay / Silt (CH / MH)
○	A-RW020	R8A	35.0	36.5	10.7	11.1		73	33	40	Dark Greenish Gray Silty Clay to Fat Clay (CH)
△	A-RW020	R11	50.0	51.5	15.3	15.7		52	24	28	Very Dark Greenish Gray Clay with Organic Matter (CH / OH)
◇	A-RW023	S3	10.0	11.5	3.1	3.5		38	25	13	Very Dark Greenish Gray Sandy Silty Clay/Sandy Clayey Silt (CL/ML)
□	A-RW023	S5	20.0	21.5	6.1	6.6		46	30	16	Dark Greenish Gray Sandy Clayey Silt (ML)

Remark :

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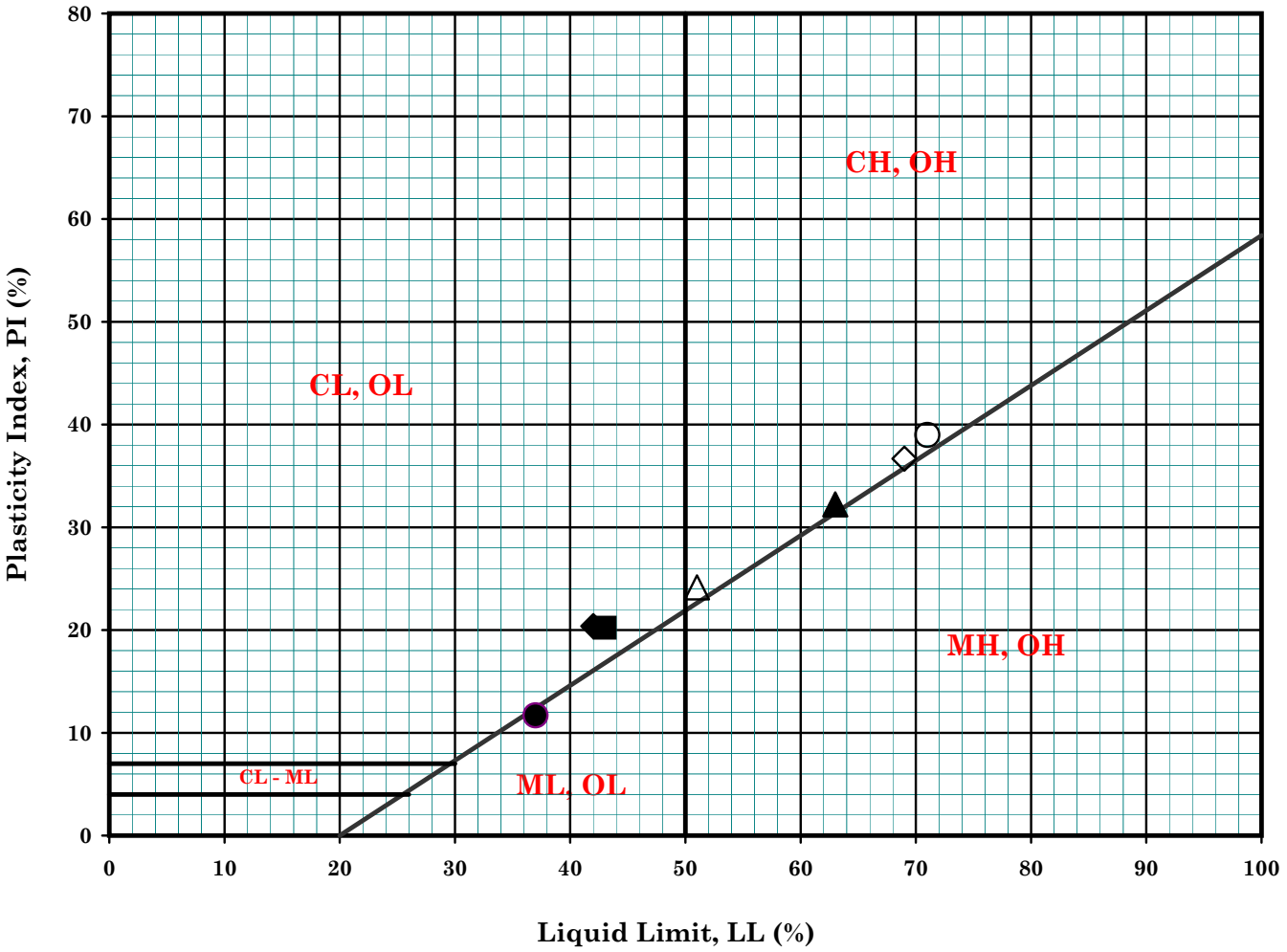
Ballona Creek Wetlands Restoration

Project No. : LA962A

Date : 11/9/12

ATTERBERG LIMITS
(ASTM D-4318-84)
Figure No. : B1-1f

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●	A-HSA016	B9	17.0	18.5	5.2	5.6		37	25	12	Dark Olive Gray Sandy Silt / Sandy Clay (CL-ML)
▲	A-HSA018	S6	12.5	14.0	3.8	4.3		63	31	32	Light Greenish Gray Clayey Silt / Clay (MH-CH)
◆	A-HSA064	S5	12.5	14.0	3.8	4.3		42	22	20	Olive Gray Sandy Clay with Shells (CL)
■	A-HSA064	S7	17.5	19.0	5.3	5.8		43	23	20	Dark Grayish Brown Silty Clay with Shells (CL)
○	A-HSA066	R8	17.5	19.0	5.3	5.8		71	32	39	Olive Brown Fat Clay (CH)
△	A-HSA066	S9	20.0	21.5	6.1	6.6		51	27	24	Dark Greenish Gray Fat Clay w/ Traces of Shells (CH)
◇	A-HSA067	R5	12.5	14.0	3.8	4.3		69	32	37	Olive Brown Fat Clay (CH)
□											

Remark :

GROUP DELTA CONSULTANTS

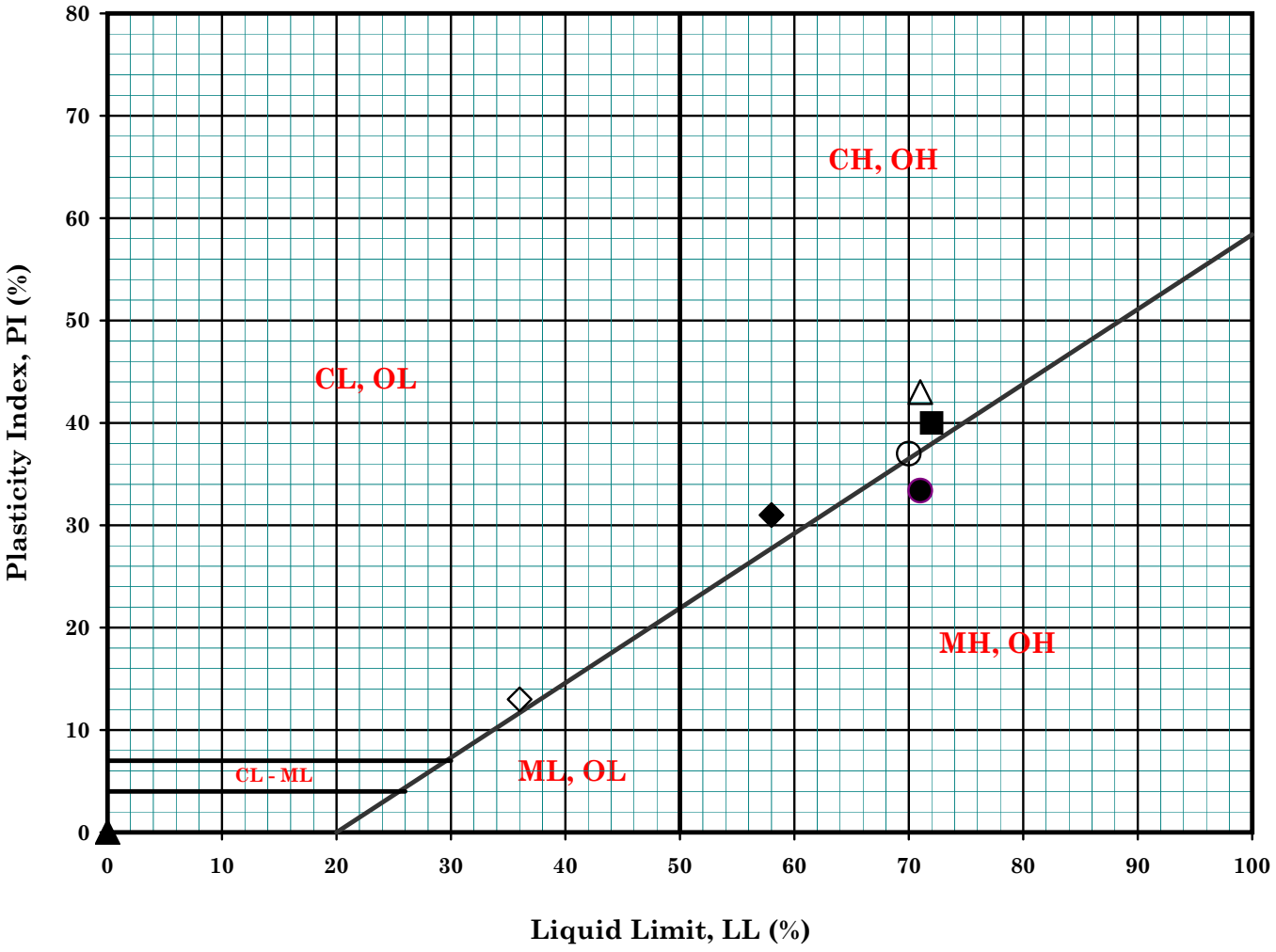
Ballona Creek Wetlands Restoration

Project No. : LA962A

Date : 11/19/12

ATTERBERG LIMITS
(ASTM D-4318-84)
Figure No. : B1-1g

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●	B-RW027	S3	15.0	16.5	4.6	5.0		71	38	33	Very Dark Greenish Gray Clayey Silt with Traces of Shells (MH)
▲	B-RW027	R4A	20.0	21.5	6.1	6.6		0	0	0	Dark Geenish Gray Silty Fine Sand with traces of Shells (NP)
◆	B-RW027	S6	25.0	26.5	7.6	8.1		58	27	31	Dark Greenish Gray Fat Clay (CH)
■	B-RW030	S2	5.0	6.5	1.5	2.0		72	32	40	Olive Brown Fat Clay (CH)
○	B-RW030	R3	10.0	11.5	3.1	3.5		70	33	37	Olive Brown Fat Clay with Shells (CH)
△	B-RW032	R3A	10.0	11.5	3.1	3.5		71	28	43	Light Olive Brown Fat Clay (CH)
◇	B-RW032	S10	45.0	46.5	13.7	14.2		36	23	13	Very Dark Greenish Gray Sandy Silty Clay (CL)
□											

Remark :

GROUP DELTA CONSULTANTS

Ballona Creek Wetlands Restoration

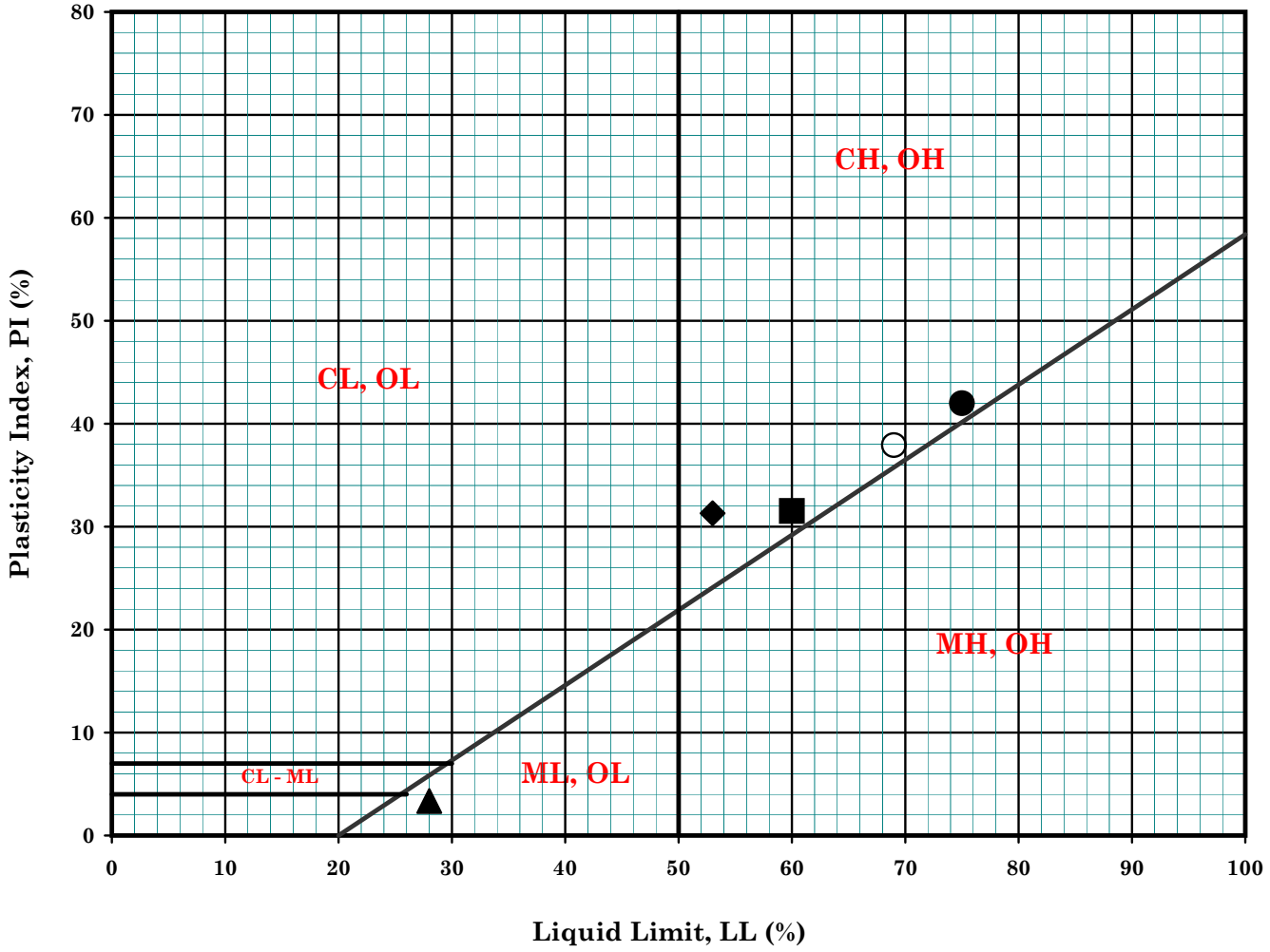
Project No. : LA962A

Date : 11/02/12

ATTERBERG LIMITS
(ASTM D-4318-84)

Figure No. : B1-1h

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●	B-RW033	R3A	15.0	16.5	4.6	5.0		75	33	42	Dark Greenish Gray Fat Clay (CH)
▲	B-RW033	S9	40.0	41.5	12.2	12.7		28	25	3	Very Dark Greenish Gray Sandy Silt with Shells (ML)
◆	B-RW033	R10A	45.0	46.5	13.7	14.2		53	22	31	Very Dark Greenish Gray Fat Clay (CH)
■	B-RW036	R2A	10.0	11.5	3.1	3.5		60	28	32	Dark Greenish Gray Fat Clay (CH)
○	B-RW036	S3	15.0	16.5	4.6	5.0		69	31	38	Dark Olive Gray Fat Clay (CH)
△											
◇											
□											

Remark :

GROUP DELTA CONSULTANTS

Ballona Creek Wetlands Restoration

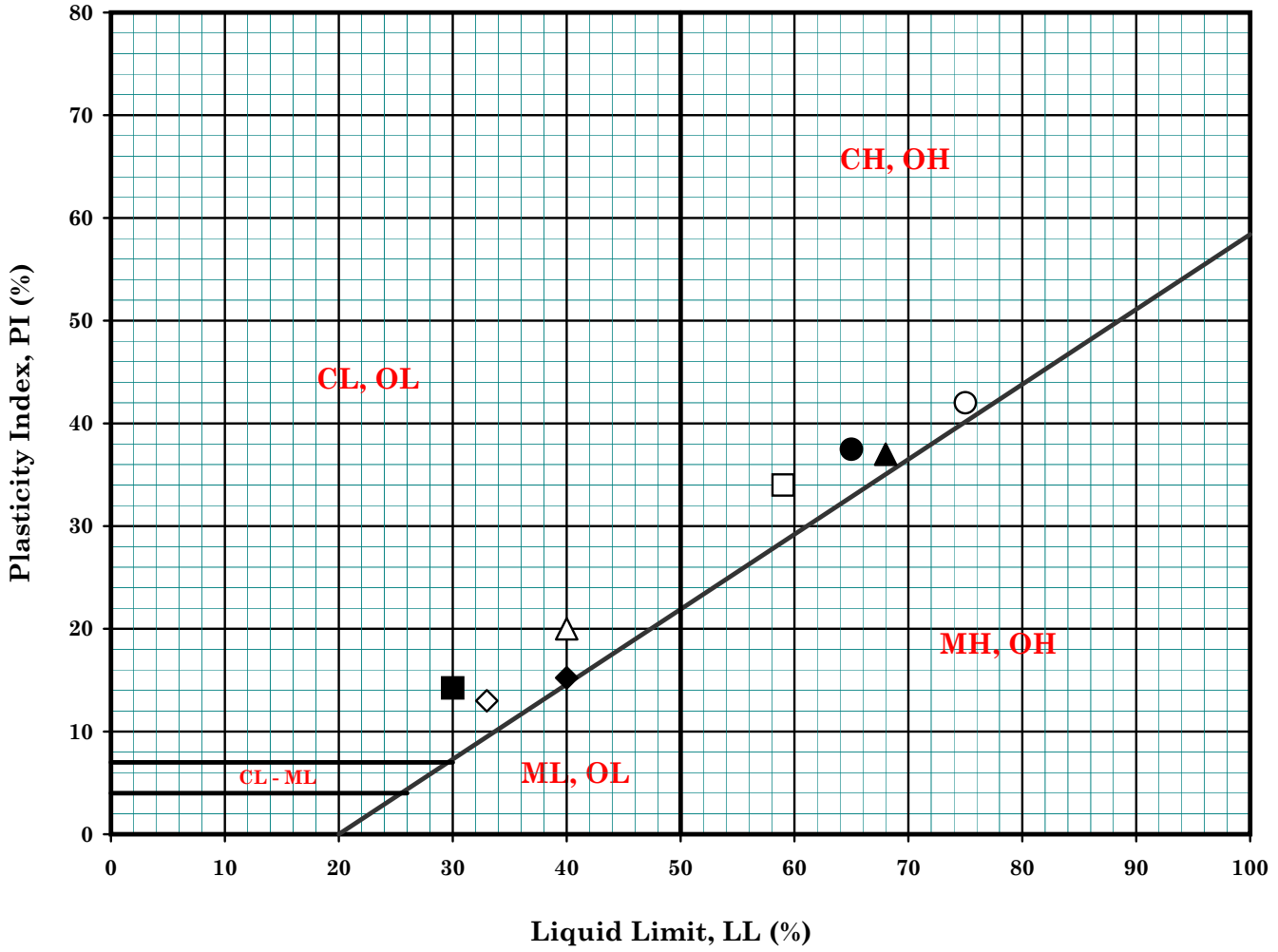
Project No. : LA962A

Date : 01/28/13

ATTERBERG LIMITS
(ASTM D-4318-84)

Figure No. : B1-1i

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●	B-RW039	S1	5.0	6.5	1.5	2.0		65	28	37	Dark Yellowish Brown Fat Clay
▲	B-RW039	SH2B	10.0	11.5	3.1	3.5		68	31	37	Olive Gray Fat Clay with Shells (CH)
◆	B-RW039	S7	35.0	36.5	10.7	11.1		40	25	15	Very Dark Greenish Gray Silty Clay / Clayey Silt with Shells
■	B-RW039	R8A	40.0	41.5	12.2	12.7		30	16	14	Very Dark Greenish Gray Sandy Clay
○	B-RW041	R6A	25.0	26.5	7.6	8.1		75	33	42	Dark Greenish Gray Fat Clay (CH)
△	B-RW041	S7	30.0	31.5	9.2	9.6		40	20	20	Very Dark Greenish Gray Silty Clay (CL)
◇	B-RW041	R9	40.0	41.5	12.2	12.7		33	20	13	Very Dark Greenish Gray Silty Clay (CL)
□	B-RW041	S12	55.0	56.5	16.8	17.2		59	25	34	Dark Gray Fat Clay (CH)

Remark :

GROUP DELTA CONSULTANTS

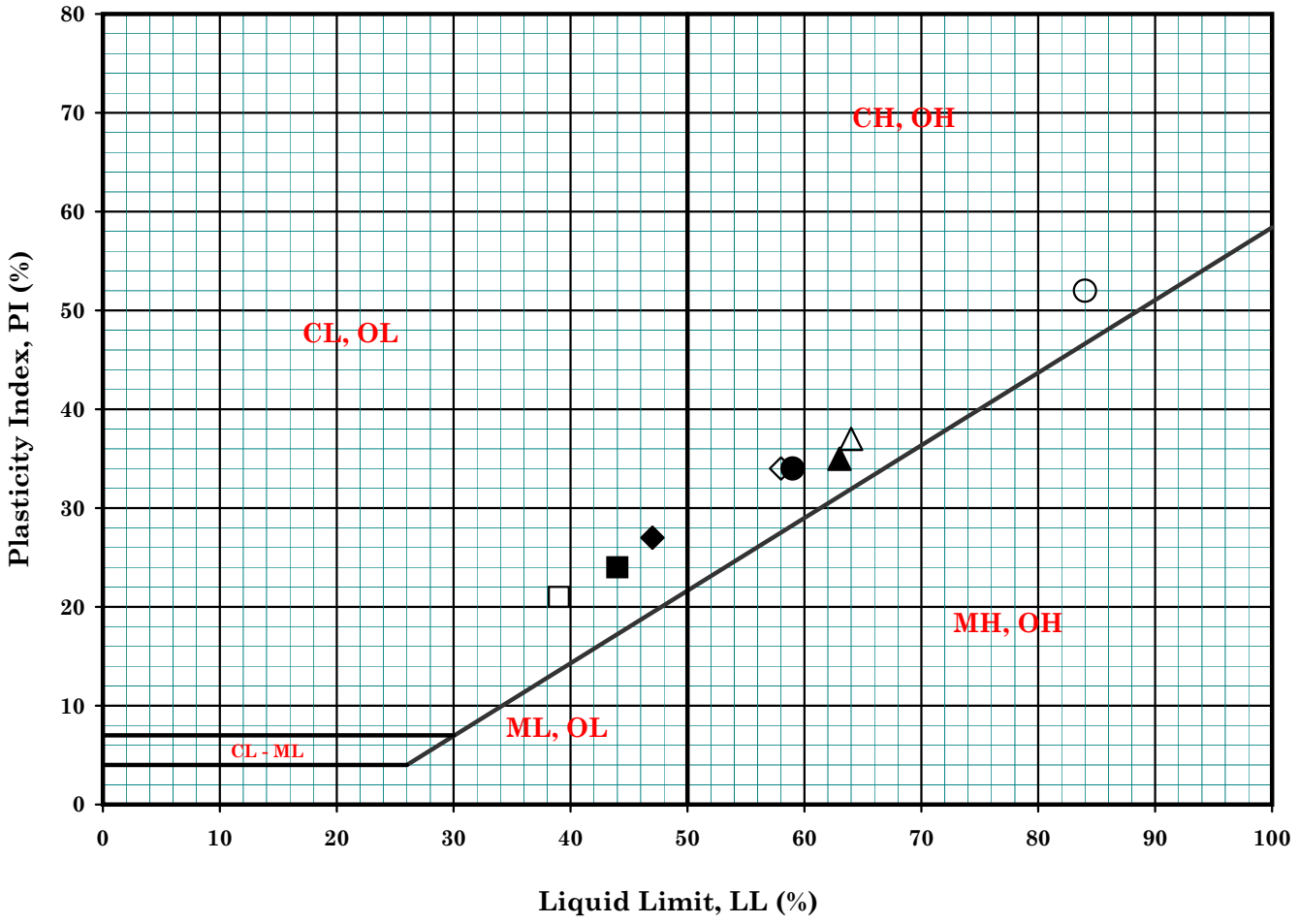
Ballona Creek Wetlands Restoration

Project No. : LA962A

Date : 01/28/13

ATTERBERG LIMITS
(ASTM D-4318-84)
Figure No. : B1-1j

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	LI	Description
●	B-RW043	R3A	10.0	11.5	3.1	3.5		59	25	34		Dark Greenish Gray Fat Clay (CH)
▲	B-RW043	S6	25.0	26.5	7.6	8.1		63	28	35		Very Dark Greenish Gray Fat Clay (CH)
◆	B-RW043	SH7B	30.0	31.5	9.2	9.6		47	20	27		Very Dark Greenish Gray Lean Clay (CL)
■	B-RW043	R11	50.0	51.5	15.3	15.7		44	20	24		Very Dark Greenish Gray Lean Clay (CL)
○	B-RW044	R1A	5.0	6.5	1.5	2.0		84	32	52		Dark Greenish Gray Fat Clay (CH)
△	B-RW044	SH3B	15.0	16.5	4.6	5.0		64	27	37		Dark Greenish Gray Fat Clay (CH)
◇	B-RW044	R5A	25.0	26.5	7.6	8.1		58	24	34		Very Dark Gray Fat Clay (CH)
□	B-RW044	R11	55.0	56.5	16.8	17.2		39	18	21		Dark Gray Silty Lean Clay (CL)

Remarks :

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Ballona Creek Wetlands Restoration

Project No. : LA962A

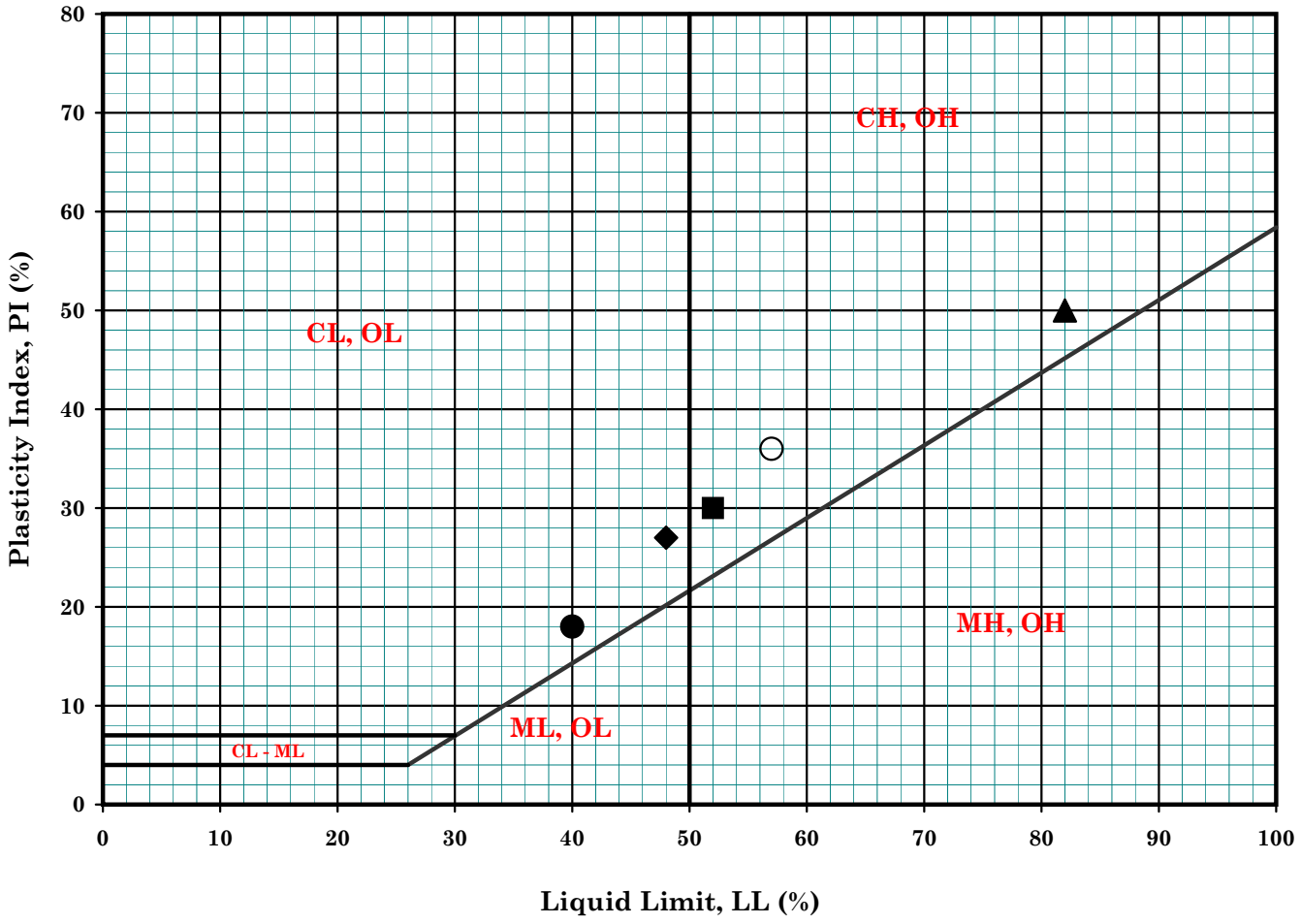
Date : 10/12/12

ATTERBERG LIMITS

(ASTM D-4318 / CT-204 / T-89)

Figure No. : B1-1k

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	LI	Description
●	B-RW047	SH3A	10.0	11.5	3.1	3.5		40	22	18		Light Gray Silty Lean Clay(CL)
▲	B-RW047	SH5A	20.0	16.5	6.1	5.0		82	32	50		Dark Greenish Gray Fat Clay (CH)
◆	B-RW047	S6	25.0	26.5	7.6	8.1		48	21	27		Dark Gray Silty Lean Clay (CL)
■	B-RW047	R11	50.0	51.5	15.3	15.7		52	22	30		Very Dark Gray Fat Clay (CH)
○	B-RW047	S10	45.0	46.5	13.7	14.2		57	21	36		Very Dark Gray Fat Clay (CH)
△												
◇												
□												

Remarks :

GROUP DELTA CONSULTANTS

Ballona Creek Wetlands Restoration

Project No. : LA962A

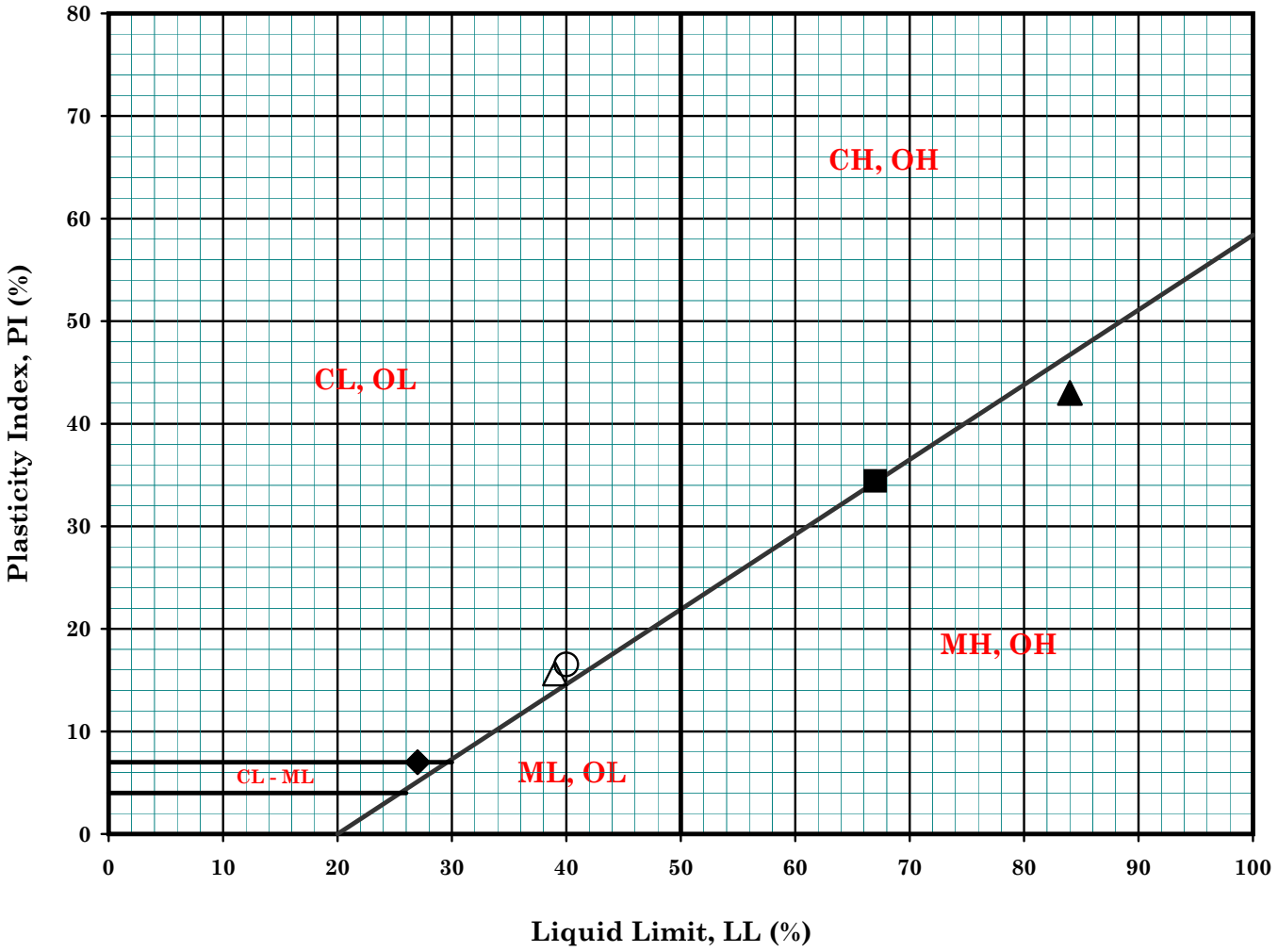
Date : 10/11/12

ATTERBERG LIMITS

(ASTM D-4318 / CT-204 / T-89)

Figure No. : B1-11

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●											
▲	B-RW049	R4A	15.0	16.5	4.6	5.0		84	41	43	Black to Light Olive Brown Silt or Clay with Organic Matter (OH)
◆	B-RW049	S5	20.0	21.5	6.1	6.6		27	20	7	Light Brown Clayey Silt (ML-CL)
■	B-RW049	R6A	25.0	26.5	7.6	8.1		67	33	34	Dark Geenish Gray Silt / Clay with Traces of Shells (CH/MH)
○	B-RW049	R8A	35.0	36.5	10.7	11.1		40	23	17	Very Dark Greenish Gray Silty Clay (CL)
△	B-RW049	R13	60.0	61.5	18.3	18.8		39	23	16	Very Dark Greenish Gray Sandy Silty Clay (CL)
◇											
□											

Remark :

GROUP DELTA CONSULTANTS

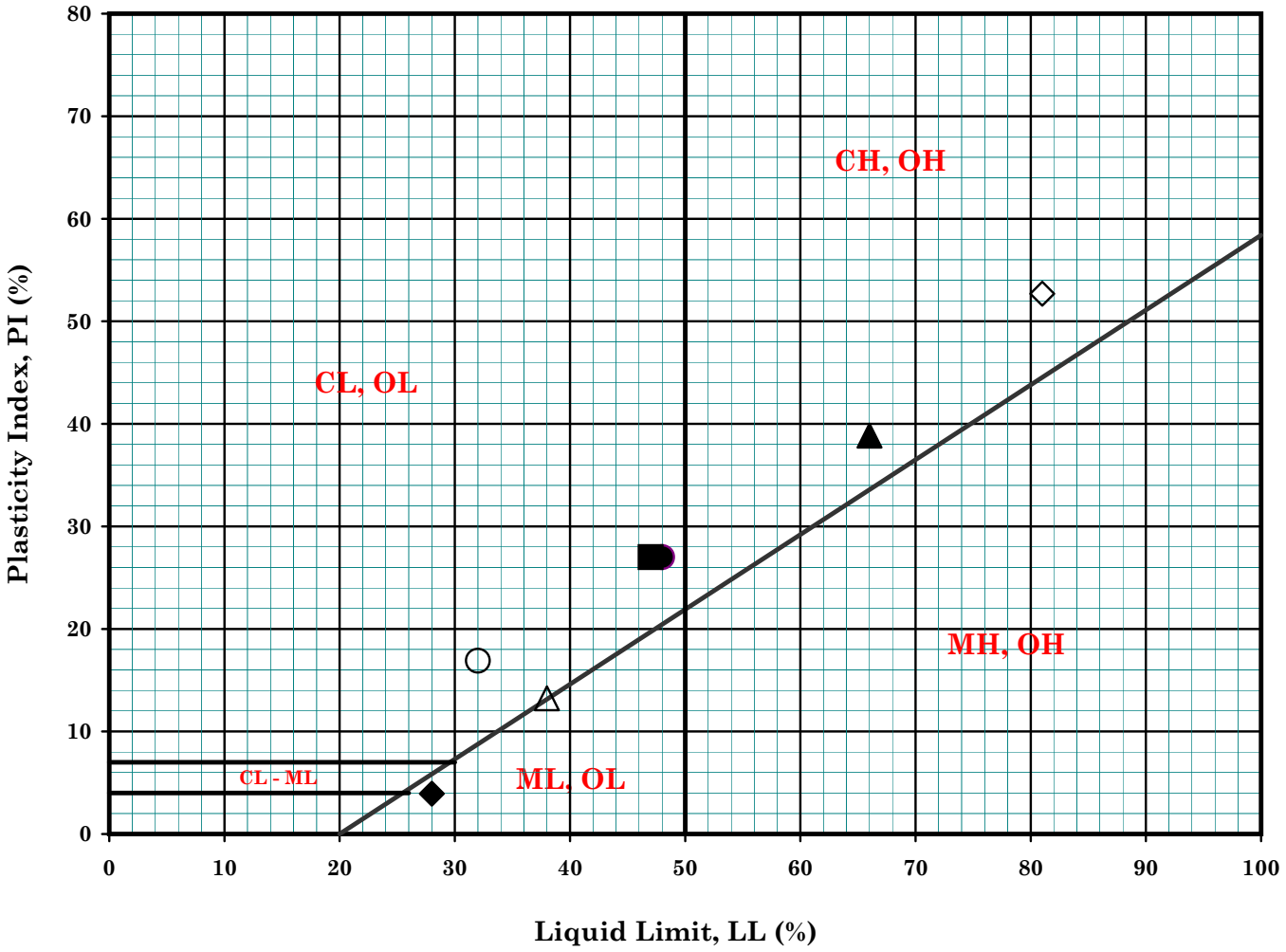
Ballona Creek Wetlands Restoration

Project No. : LA962A

Date : 11/02/12

ATTERBERG LIMITS
(ASTM D-4318-84)
Figure No. : B1-1m

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●	B-RW053	S1	5.0	6.5	1.5	2.0		48	21	27	Dark Gray Silty Lean Clay with Shells (CL)
▲	B-RW053	R2A	10.0	11.5	3.1	3.5		66	27	39	Dark to Light Olive Brown Clay with traces of Shells (CH)
◆	B-RW053	SH4B	20.0	21.5	6.1	6.6		28	24	4	Dark Greenish Gray Clayey Sandy Silt with Traces of Shells (ML)
■	B-RW053	S9	45.0	46.5	13.7	14.2		47	20	27	Dark Gray Silty Lean Clay with Shells (CL)
○	B-RW053	R10A	50.0	51.5	15.3	15.7		32	15	17	Dark Greenish Gray Sandy Clay (CL)
△	B-RW053	R12A	60.0	61.5	18.3	18.8		38	25	13	Very Dark Greenish Gray Silty Clay / Clayey Silt (CL/ML)
◇	B-RW053	R14A	70.0	71.5	21.4	21.8		81	28	53	Very Dark Greenish Gray Fat Clay (CH)
□											

Remark :

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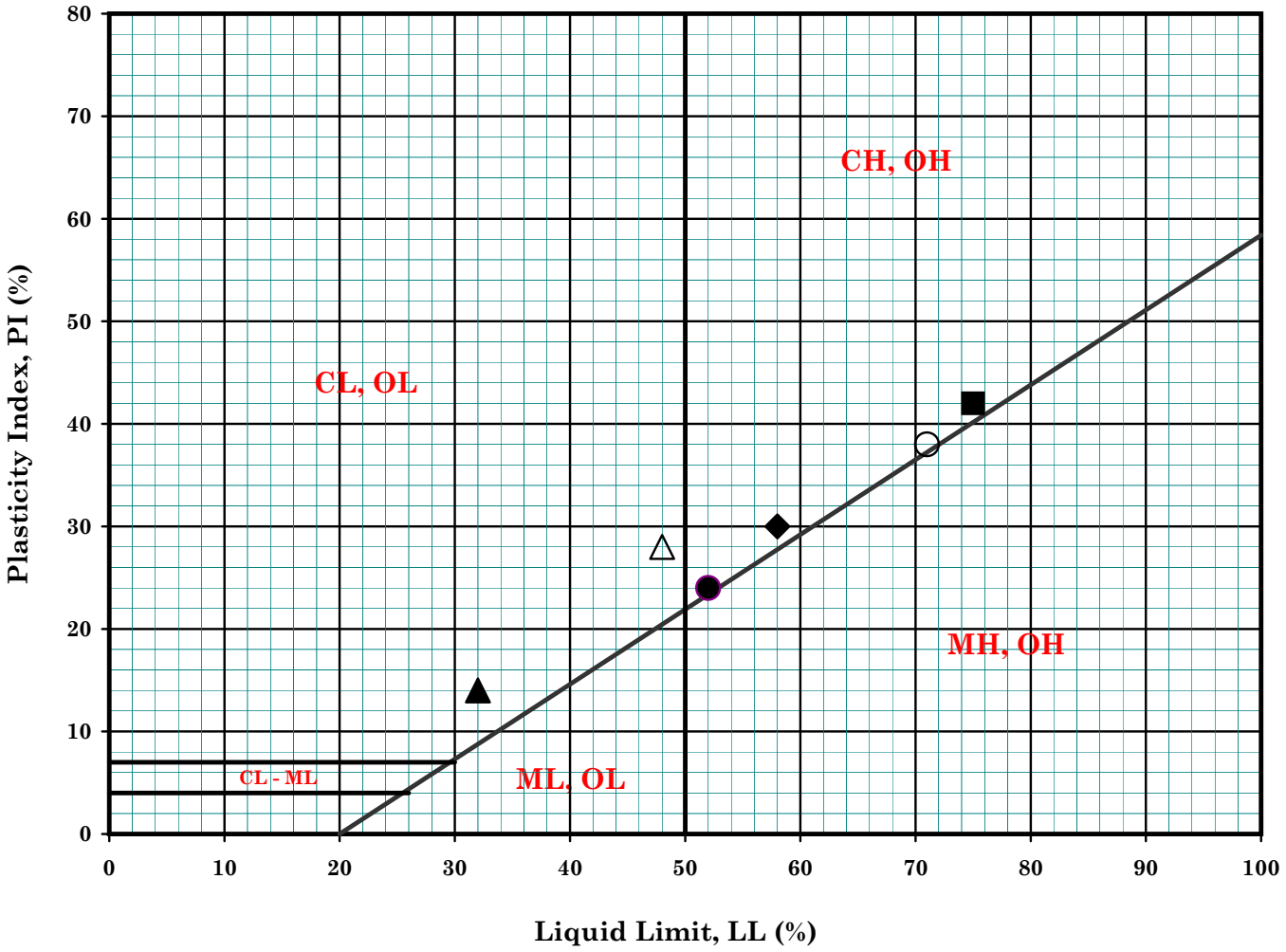
Ballona Creek Wetlands Restoration

Project No. : LA962A

Date : 11/02/12

ATTERBERG LIMITS
(ASTM D-4318-84)
Figure No. : B1-1n

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●	B-RW055	R2A	10.0	11.5	3.1	3.5		52	28	24	Yellowish Brown Clay with Shells (CH)
▲	B-RW055	R10	45.0	46.5	13.7	14.2		32	18	14	Very Dark Greenish Gray Sandy Clay with Traces of Gravel (CL)
◆	B-RW058	S2	10.0	11.5	3.1	3.5		58	28	30	Brown Fat Clay (CH)
■	B-RW058	R3A	15.0	16.5	4.6	5.0		75	33	42	Olive Clay with Organic Matter (CH or OH)
○	B-RW058	R5A	25.0	26.5	7.6	8.1		71	33	38	Dark Olive Brown Fat Clay with Traces of Shells (CH)
△	B-RW058	S12	60.0	61.5	18.3	18.8		48	20	28	Dark Gray Silty Lean Clay with Shells (CL)
◇											
□											

Remark :

GROUP DELTA CONSULTANTS

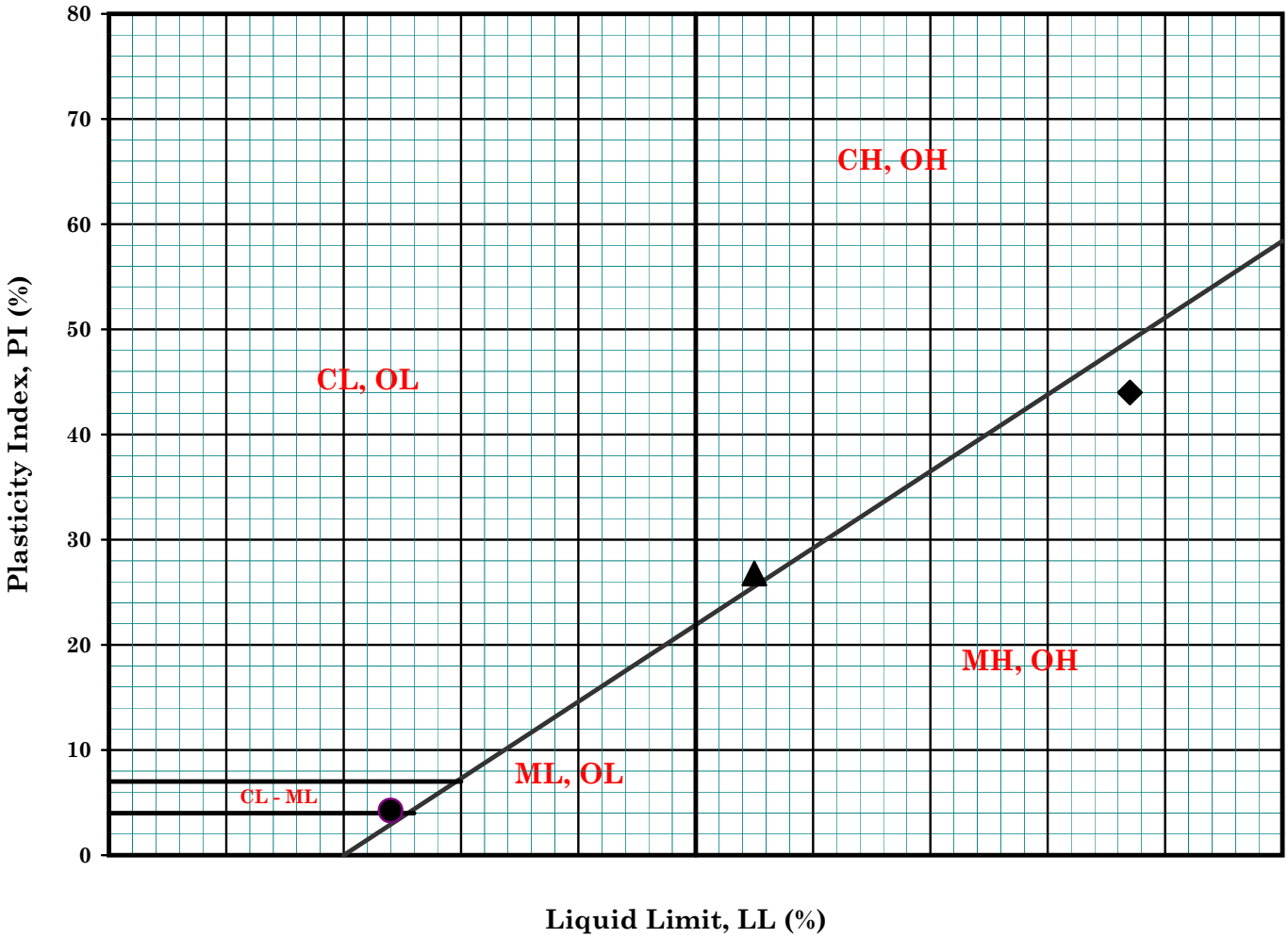
Ballona Creek Wetlands Restoration

Project No. : LA962A

Date : 11/02/12

ATTERBERG LIMITS
(ASTM D-4318-84)
Figure No. : B1-1o

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth (ft)		Depth (m)		MC (%)	LL (%)	PL (%)	PI (%)	Description
●	C-HSA061	R7	17.5	19.0	5.3	5.8		24	20	4	Dark Olive Brown Sandy Clay-Sandy Silt with Fine Gravel (CL-ML)
▲	C-HSA061	R11	30.0	31.5	9.2	9.6		55	28	27	Olive Brown Silty Clay to Fat Clay (CH)
◆	B-HSA051	S6	12.5	14.0	3.8	4.3		87	43	44	Dark Olive Gray Clayey Silt (MH)
■											
○											
△											
◇											
□											

Remark :

GROUP DELTA CONSULTANTS

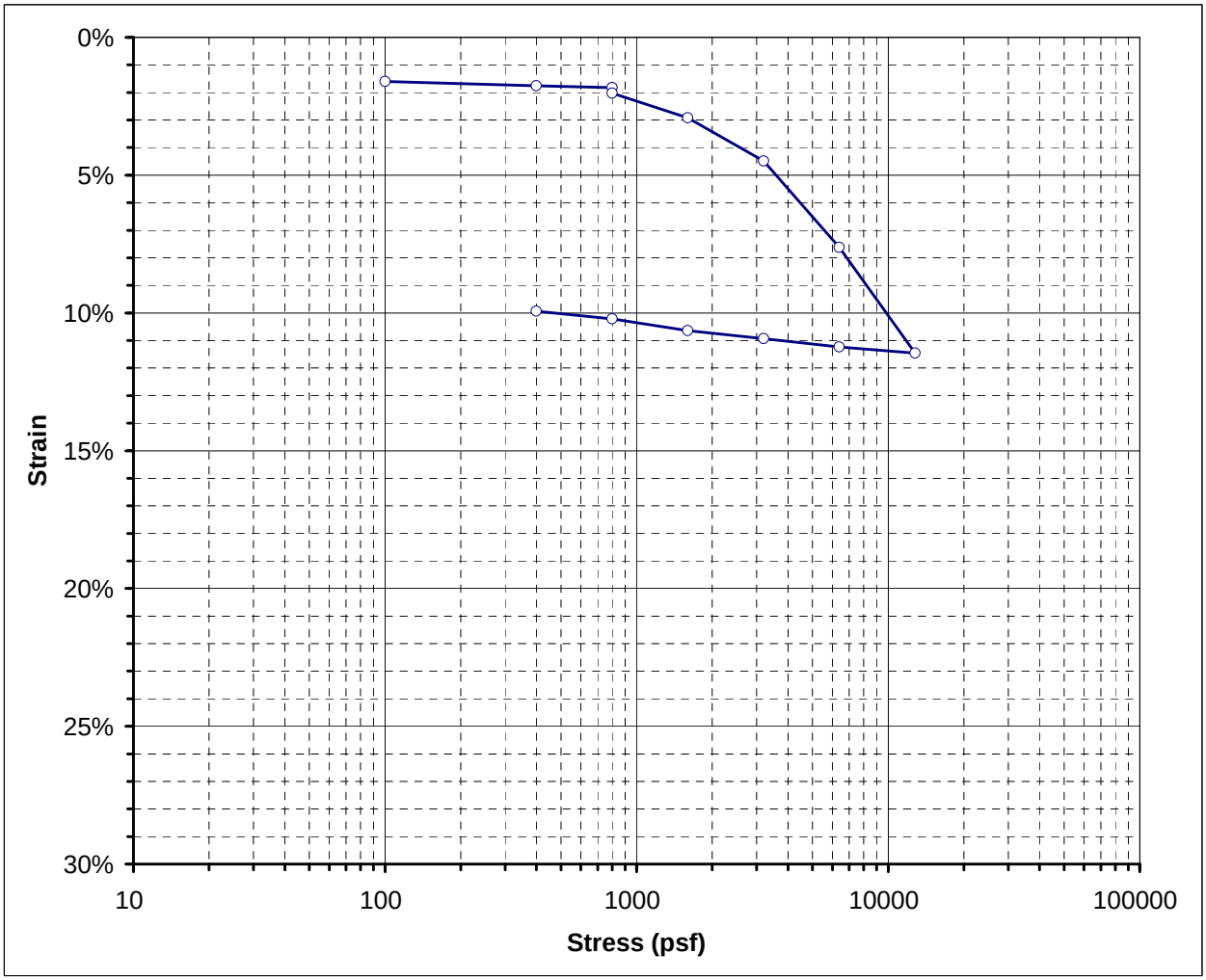
Ballona Creek Wetlands Restoration

Project No. : LA962A

Date : 11/19/12

ATTERBERG LIMITS
(ASTM D-4318-84)
Figure No. : B1-1p

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW003	**Sample Depth**	30 ft
Sample No.	R7A	**USCS**	0

BEFORE TEST

Initial Moisture Content:	35.6%	
Initial Dry Unit Wt:	85.8	pcf
Initial Total Unit Wt.:	116.3	pcf
Initial Void Ratio:	1.0301	
Initial Degree of Saturation:	96.3%	

AFTER TEST

Final Moisture Content:	30.2%	
Final Dry Unit Wt:	94.4	pcf
Final Total Unit Wt.:	112.8	pcf
Final Void Ratio:	0.8450	
Final Degree of Saturation:	99.6%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.60%	0.9976
400	1.75%	0.9945
800	1.82%	0.9931
800	2.02%	0.9890
1600	2.92%	0.9709
3200	4.49%	0.9390
6400	7.63%	0.8753
12800	11.45%	0.7976
6400	11.23%	0.8021
3200	10.93%	0.8082
1600	10.64%	0.8141
800	10.22%	0.8226
400	9.94%	0.8283

PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2a

GROUP DELTA CONSULTANTS

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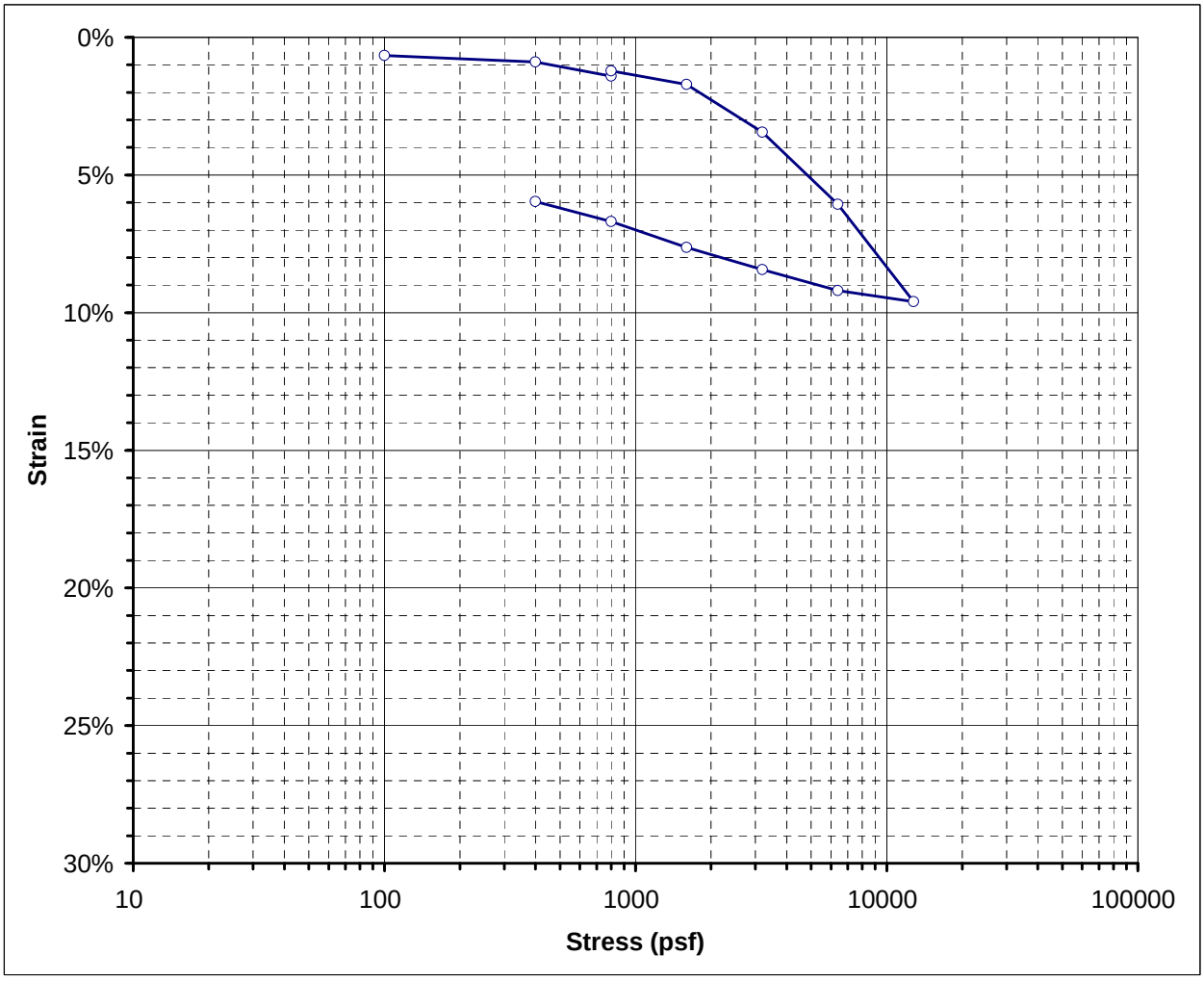
CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW005	**Sample Depth**	5 ft
Sample No.	R1	**USCS**	0

BEFORE TEST

Initial Moisture Content:	37.4%	
Initial Dry Unit Wt:	82.0	pcf
Initial Total Unit Wt.:	112.7	pcf
Initial Void Ratio:	1.1234	
Initial Degree of Saturation:	92.9%	

AFTER TEST

Final Moisture Content:	36.4%	
Final Dry Unit Wt:	86.5	pcf
Final Total Unit Wt.:	110.1	pcf
Final Void Ratio:	1.0129	
Final Degree of Saturation:	100.2%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	0.66%	1.1093
400	0.90%	1.1043
800	1.41%	1.0935
800	1.21%	1.0976
1600	1.71%	1.0870
3200	3.45%	1.0501
6400	6.06%	0.9947
12800	9.60%	0.9195
6400	9.19%	0.9281
3200	8.44%	0.9442
1600	7.63%	0.9613
800	6.69%	0.9812
400	5.96%	0.9968

PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2b

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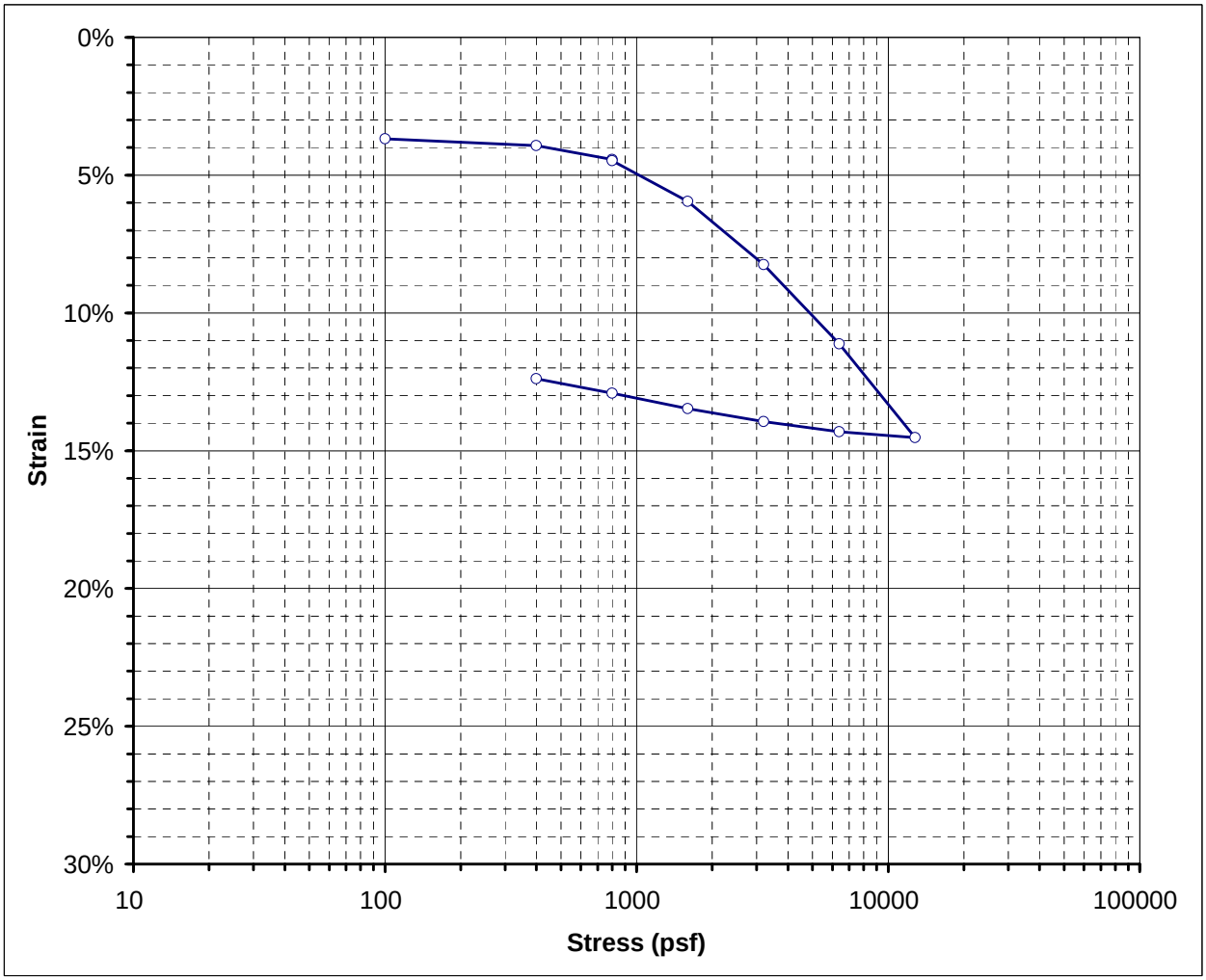
CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW005	**Sample Depth**	15 ft
Sample No.	R3	**USCS**	0

BEFORE TEST

Initial Moisture Content:	43.7%	
Initial Dry Unit Wt:	77.9	pcf
Initial Total Unit Wt.:	111.9	pcf
Initial Void Ratio:	1.2358	
Initial Degree of Saturation:	98.7%	

AFTER TEST

Final Moisture Content:	35.5%	
Final Dry Unit Wt:	87.5	pcf
Final Total Unit Wt.:	115.5	pcf
Final Void Ratio:	0.9895	
Final Degree of Saturation:	100.0%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	3.68%	1.1536
400	3.93%	1.1480
800	4.43%	1.1367
800	4.47%	1.1358
1600	5.95%	1.1028
3200	8.25%	1.0513
6400	11.13%	0.9871
12800	14.52%	0.9111
6400	14.31%	0.9158
3200	13.94%	0.9242
1600	13.48%	0.9345
800	12.91%	0.9471
400	12.39%	0.9588

PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2c

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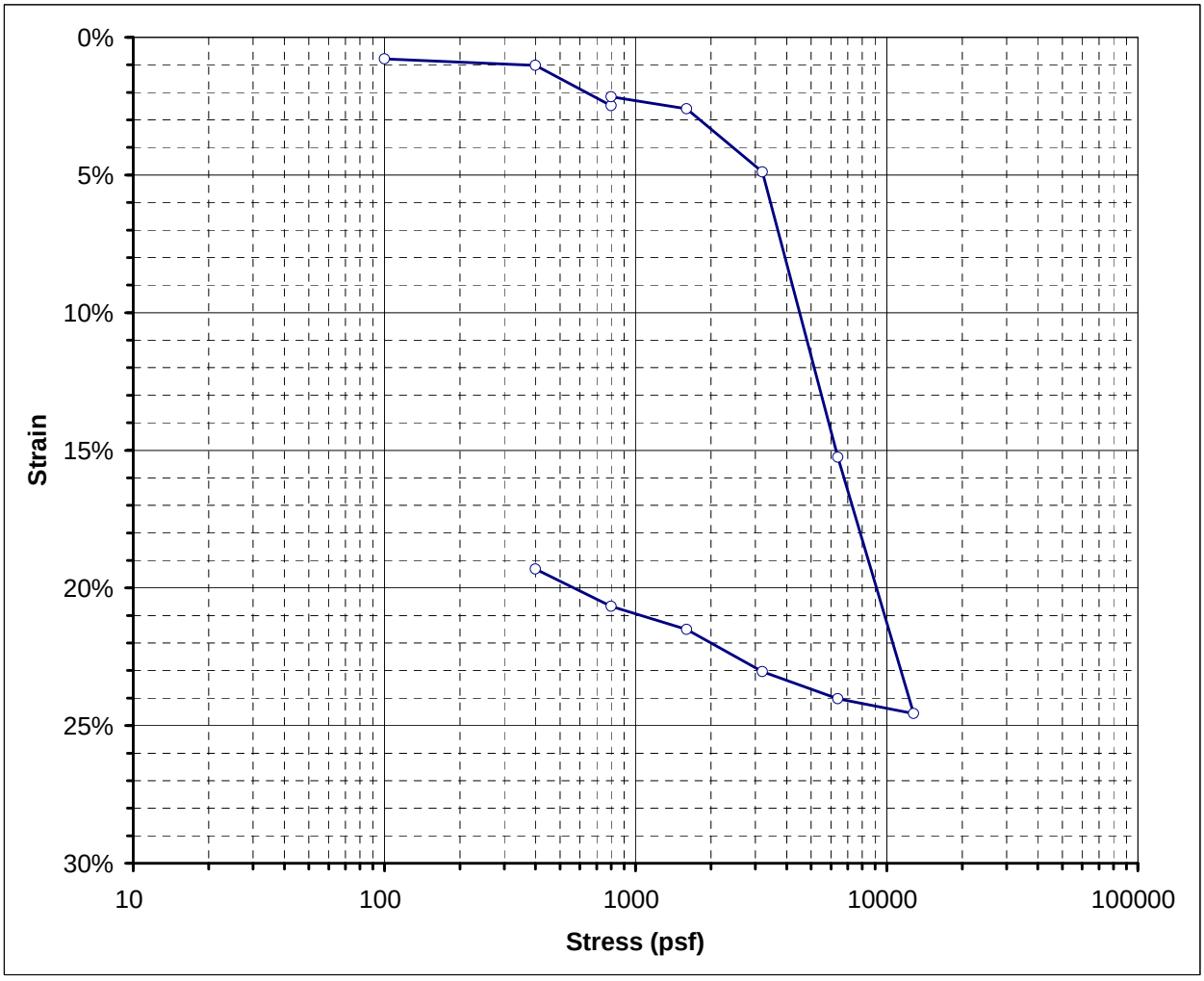
CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW006	**Sample Depth**	35 ft
Sample No.	R8A	**USCS**	MH

BEFORE TEST

Initial Moisture Content:	75.0%	
Initial Dry Unit Wt:	56.1	pcf
Initial Total Unit Wt.:	98.2	pcf
Initial Void Ratio:	2.1032	
Initial Degree of Saturation:	99.5%	

AFTER TEST

Final Moisture Content:	59.2%	
Final Dry Unit Wt:	68.1	pcf
Final Total Unit Wt.:	124.1	pcf
Final Void Ratio:	1.5571	
Final Degree of Saturation:	106.1%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=	64	**PL=**	33	**PI=**	31

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	0.78%	2.0790
400	1.02%	2.0716
800	2.48%	2.0263
800	2.16%	2.0362
1600	2.60%	2.0225
3200	4.89%	1.9515
6400	15.25%	1.6300
12800	24.56%	1.3411
6400	24.03%	1.3575
3200	23.04%	1.3882
1600	21.51%	1.4357
800	20.67%	1.4618
400	19.31%	1.5040

PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2d

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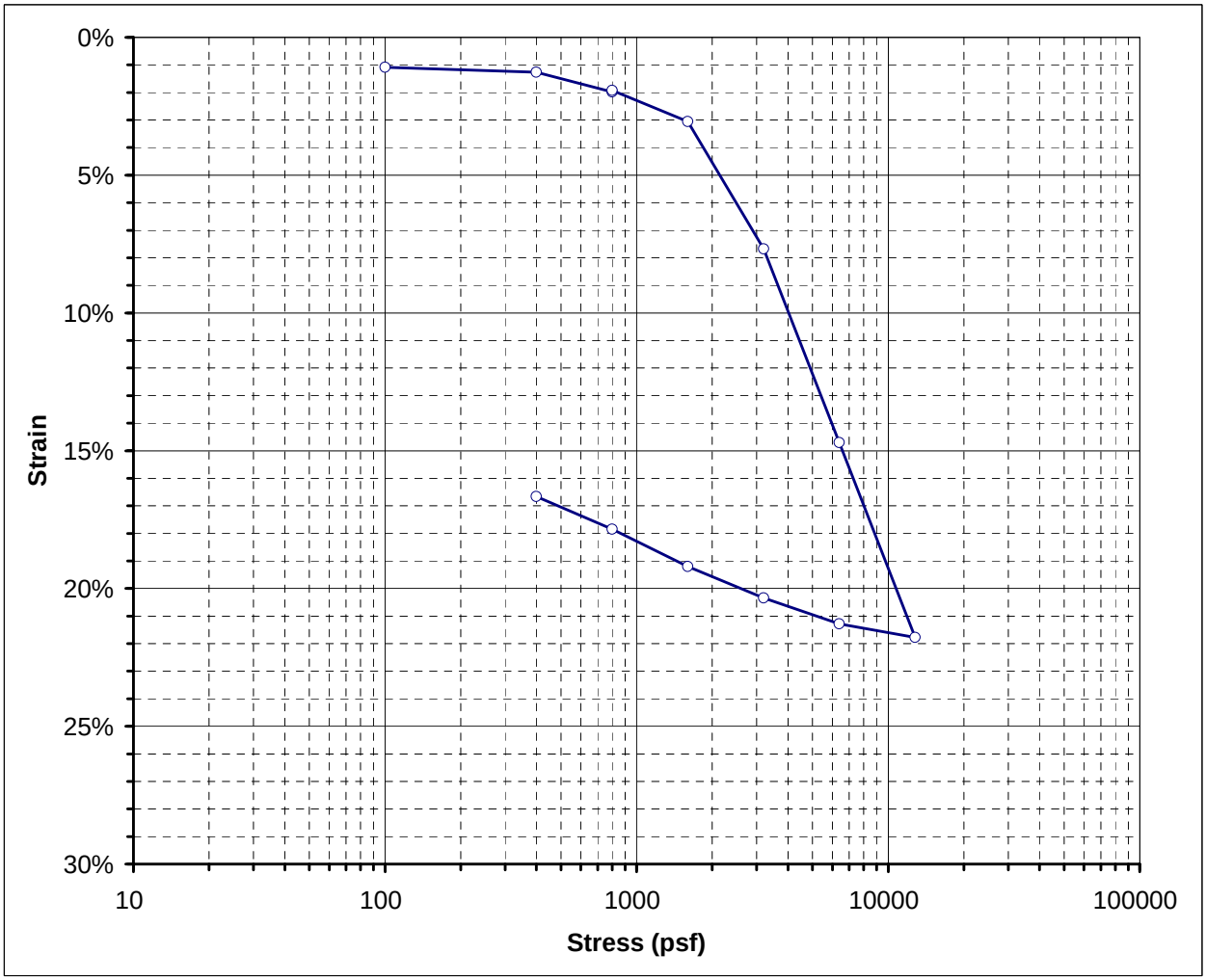
CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW008	**Sample Depth**	30 ft
Sample No.	R6A	**USCS**	0

BEFORE TEST

Initial Moisture Content:	62.1%	
Initial Dry Unit Wt:	63.1	pcf
Initial Total Unit Wt.:	102.2	pcf
Initial Void Ratio:	1.7601	
Initial Degree of Saturation:	98.4%	

AFTER TEST

Final Moisture Content:	49.2%	
Final Dry Unit Wt:	74.4	pcf
Final Total Unit Wt.:	120.7	pcf
Final Void Ratio:	1.3389	
Final Degree of Saturation:	102.5%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.09%	1.7301
400	1.26%	1.7254
800	1.98%	1.7055
800	1.92%	1.7071
1600	3.06%	1.6757
3200	7.68%	1.5482
6400	14.70%	1.3544
12800	21.78%	1.1590
6400	21.28%	1.1728
3200	20.34%	1.1987
1600	19.20%	1.2302
800	17.85%	1.2675
400	16.66%	1.3003

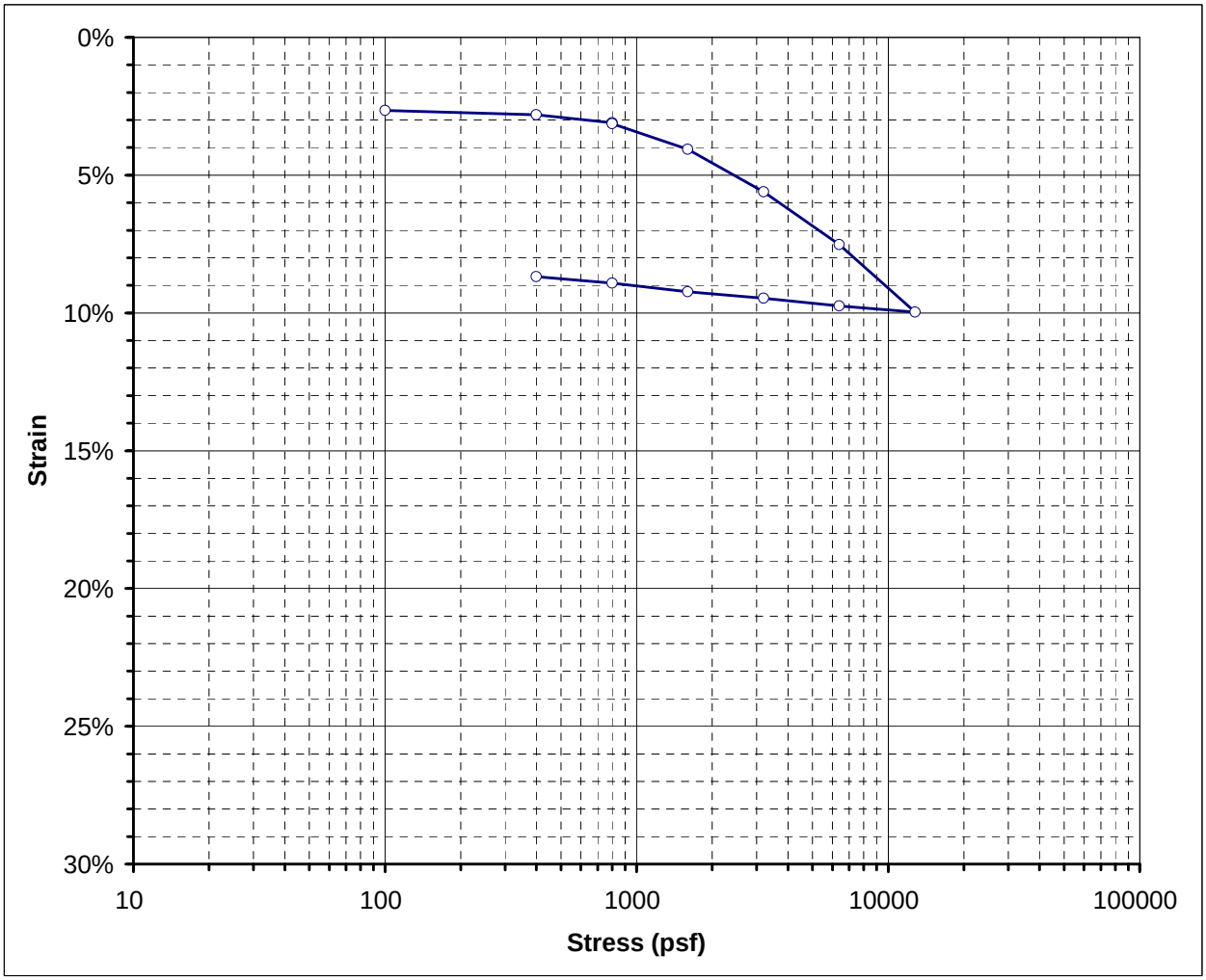
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2e

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-17-12\Consol A-RW008R6A@30'_1.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW011	**Sample Depth**	5
Sample No.	R2	**USCS**	0

BEFORE TEST

Initial Moisture Content:	35.2%	
Initial Dry Unit Wt:	86.8	pcf
Initial Total Unit Wt.:	117.3	pcf
Initial Void Ratio:	1.0058	
Initial Degree of Saturation:	97.6%	

AFTER TEST

Final Moisture Content:	29.0%	
Final Dry Unit Wt:	94.1	pcf
Final Total Unit Wt.:	114.3	pcf
Final Void Ratio:	0.8507	
Final Degree of Saturation:	95.0%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	2.65%	0.9526
400	2.80%	0.9495
800	3.10%	0.9435
800	3.13%	0.9429
1600	4.06%	0.9243
3200	5.61%	0.8933
6400	7.52%	0.8550
12800	9.97%	0.8058
6400	9.74%	0.8104
3200	9.46%	0.8159
1600	9.24%	0.8205
800	8.92%	0.8269
400	8.68%	0.8317

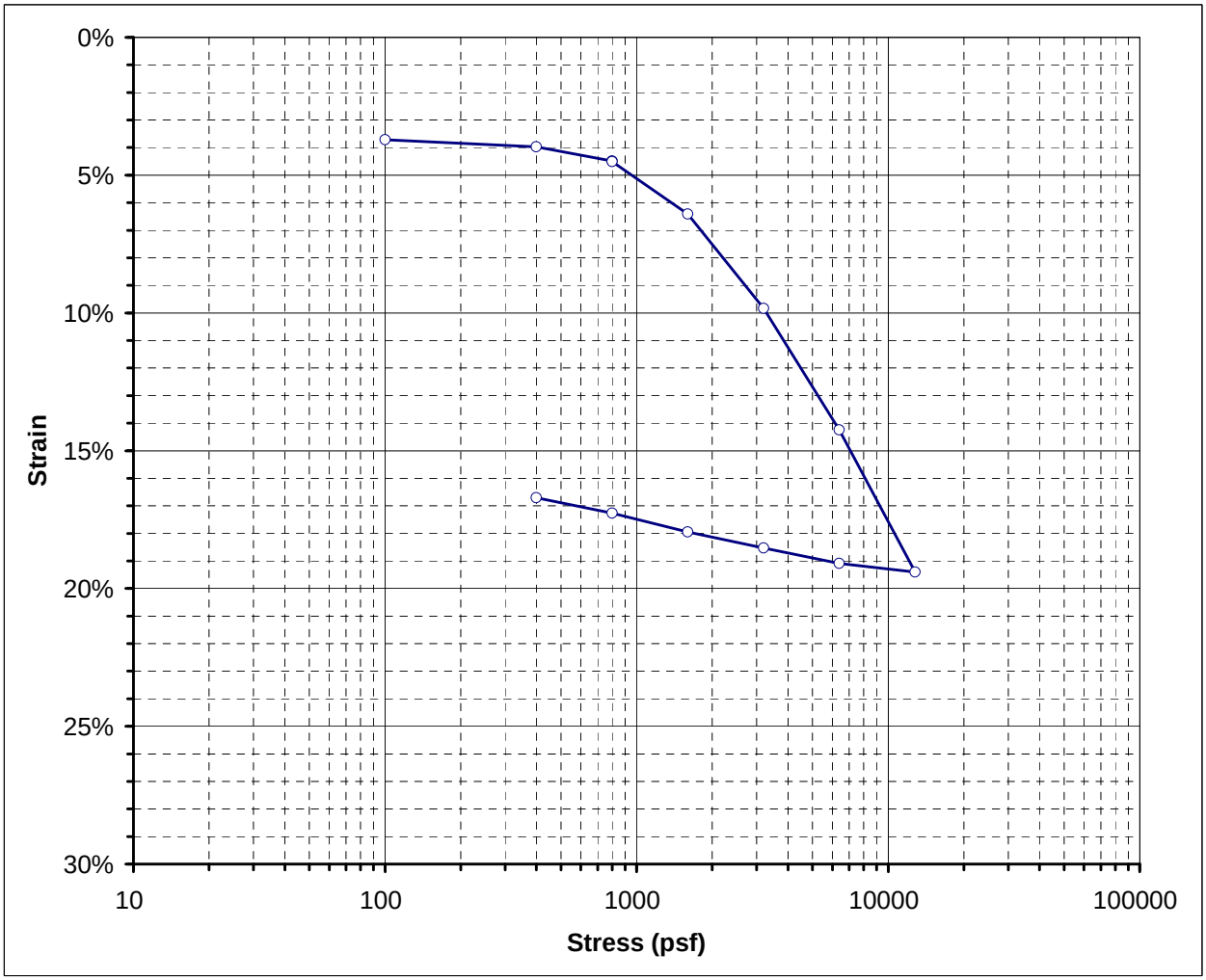
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO. B1-2f

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-17-12\Consol A-RW011R2@5'_2.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW013	**Sample Depth**	15
Sample No.	R4	**USCS**	0

BEFORE TEST

Initial Moisture Content:	50.9%	
Initial Dry Unit Wt:	73.3	pcf
Initial Total Unit Wt.:	110.6	pcf
Initial Void Ratio:	1.3750	
Initial Degree of Saturation:	103.3%	

AFTER TEST

Final Moisture Content:	38.6%	
Final Dry Unit Wt:	86.7	pcf
Final Total Unit Wt.:	123.5	pcf
Final Void Ratio:	1.0076	
Final Degree of Saturation:	106.9%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	3.71%	1.2868
400	3.97%	1.2807
800	4.49%	1.2684
800	4.51%	1.2679
1600	6.41%	1.2228
3200	9.84%	1.1414
6400	14.24%	1.0367
12800	19.41%	0.9141
6400	19.09%	0.9216
3200	18.53%	0.9349
1600	17.95%	0.9487
800	17.27%	0.9650
400	16.70%	0.9783

PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2g

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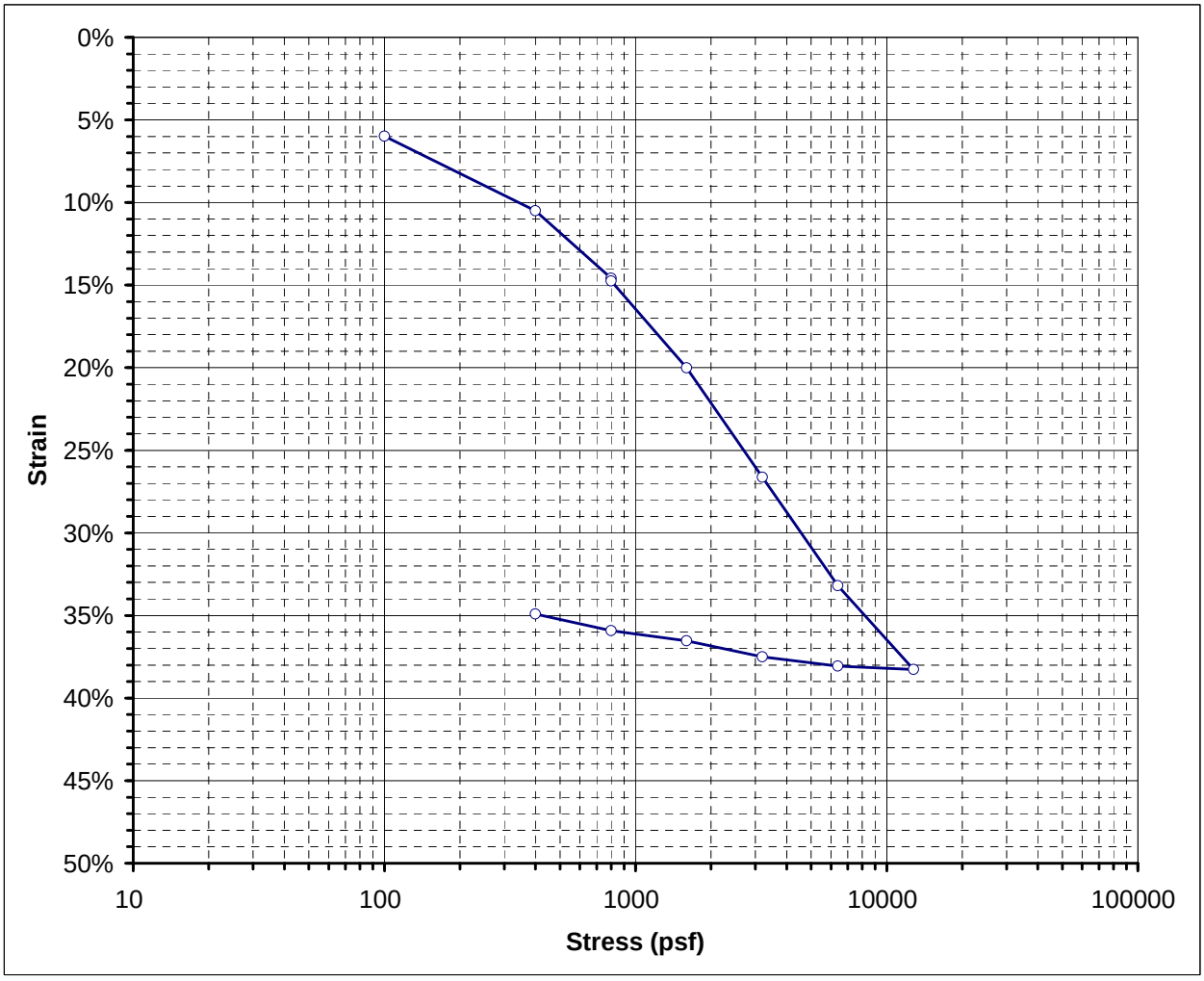
CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW030	**Sample Depth**	10
Sample No.	R3	**USCS**	0

BEFORE TEST

Initial Moisture Content:	107.6%	
Initial Dry Unit Wt:	43.5	pcf
Initial Total Unit Wt.:	90.3	pcf
Initial Void Ratio:	3.0033	
Initial Degree of Saturation:	100.0%	

AFTER TEST

Final Moisture Content:	61.0%	
Final Dry Unit Wt:	64.6	pcf
Final Total Unit Wt.:	152.6	pcf
Final Void Ratio:	1.6946	
Final Degree of Saturation:	100.5%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	5.99%	2.7633
400	10.49%	2.5833
800	14.58%	2.4197
800	14.75%	2.4128
1600	20.01%	2.2022
3200	26.63%	1.9373
6400	33.19%	1.6745
12800	38.26%	1.4715
6400	38.06%	1.4795
3200	37.51%	1.5016
1600	36.53%	1.5410
800	35.92%	1.5652
400	34.92%	1.6053

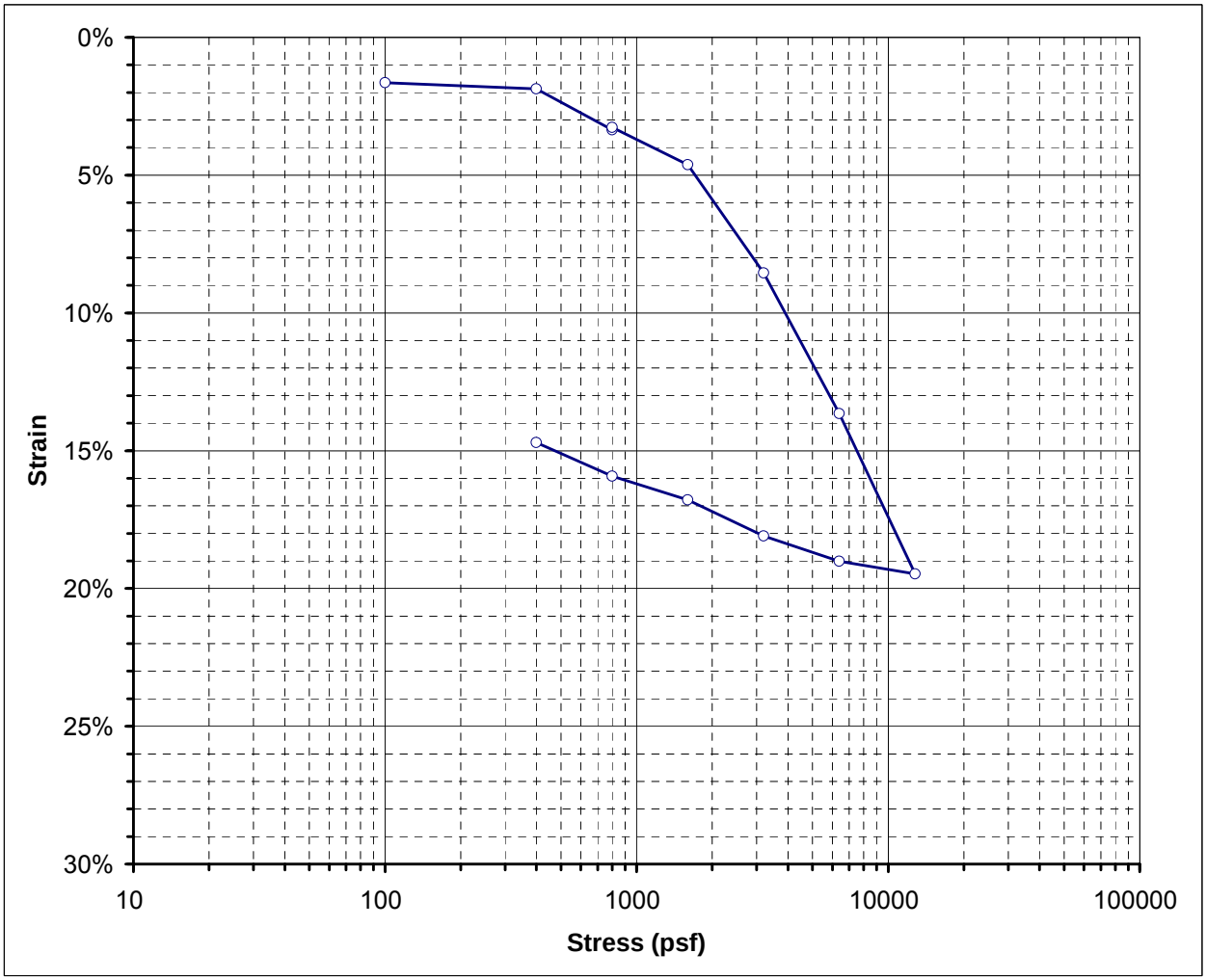
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2h

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 11-9-12\B-RW030 R3@10'_1.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW032	**Sample Depth**	10
Sample No.	R3A	**USCS**	CH

BEFORE TEST

Initial Moisture Content:	53.5%	
Initial Dry Unit Wt:	69.4	pcf
Initial Total Unit Wt.:	106.6	pcf
Initial Void Ratio:	1.5080	
Initial Degree of Saturation:	99.1%	

AFTER TEST

Final Moisture Content:	44.0%	
Final Dry Unit Wt:	79.8	pcf
Final Total Unit Wt.:	118.1	pcf
Final Void Ratio:	1.1817	
Final Degree of Saturation:	103.9%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=	71	**PL=**	28	**PI=**	43

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.65%	1.4667
400	1.87%	1.4612
800	3.35%	1.4239
800	3.26%	1.4262
1600	4.62%	1.3922
3200	8.55%	1.2935
6400	13.65%	1.1656
12800	19.47%	1.0198
6400	19.01%	1.0314
3200	18.09%	1.0543
1600	16.79%	1.0870
800	15.92%	1.1087
400	14.71%	1.1391

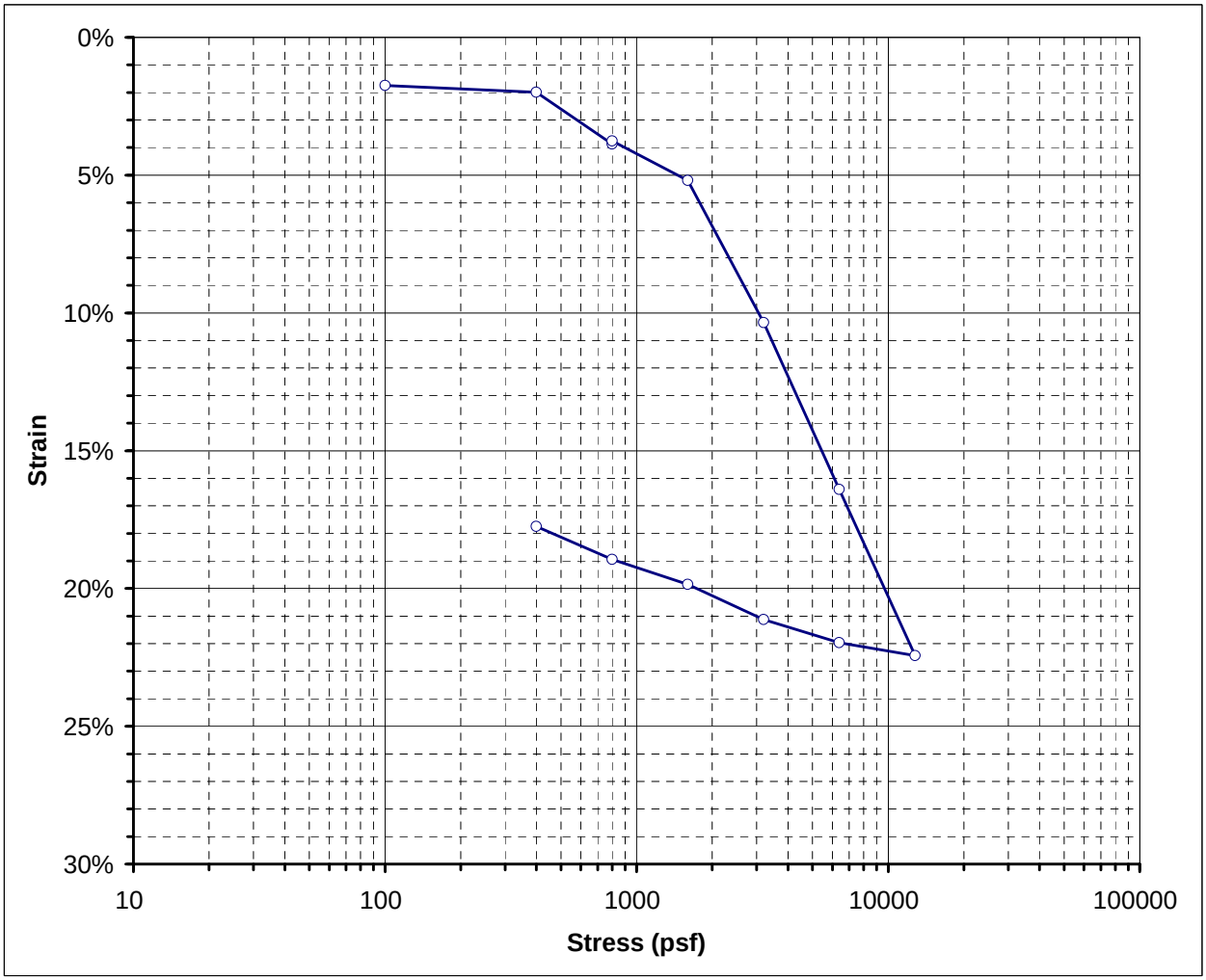
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2i

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 9-21-12\Consol B-RW032R3A@10'_2.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW036	**Sample Depth**	10
Sample No.	R2A	**USCS**	CH

BEFORE TEST

Initial Moisture Content:	51.2%	
Initial Dry Unit Wt:	71.3	pcf
Initial Total Unit Wt.:	107.7	pcf
Initial Void Ratio:	1.4431	
Initial Degree of Saturation:	98.9%	

AFTER TEST

Final Moisture Content:	39.0%	
Final Dry Unit Wt:	84.8	pcf
Final Total Unit Wt.:	122.3	pcf
Final Void Ratio:	1.0521	
Final Degree of Saturation:	103.3%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=	60	**PL=**	28	**PI=**	32

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.75%	1.4004
400	1.99%	1.3945
800	3.88%	1.3484
800	3.76%	1.3513
1600	5.19%	1.3163
3200	10.35%	1.1902
6400	16.41%	1.0423
12800	22.44%	0.8949
6400	21.97%	0.9064
3200	21.12%	0.9270
1600	19.85%	0.9581
800	18.95%	0.9802
400	17.75%	1.0094

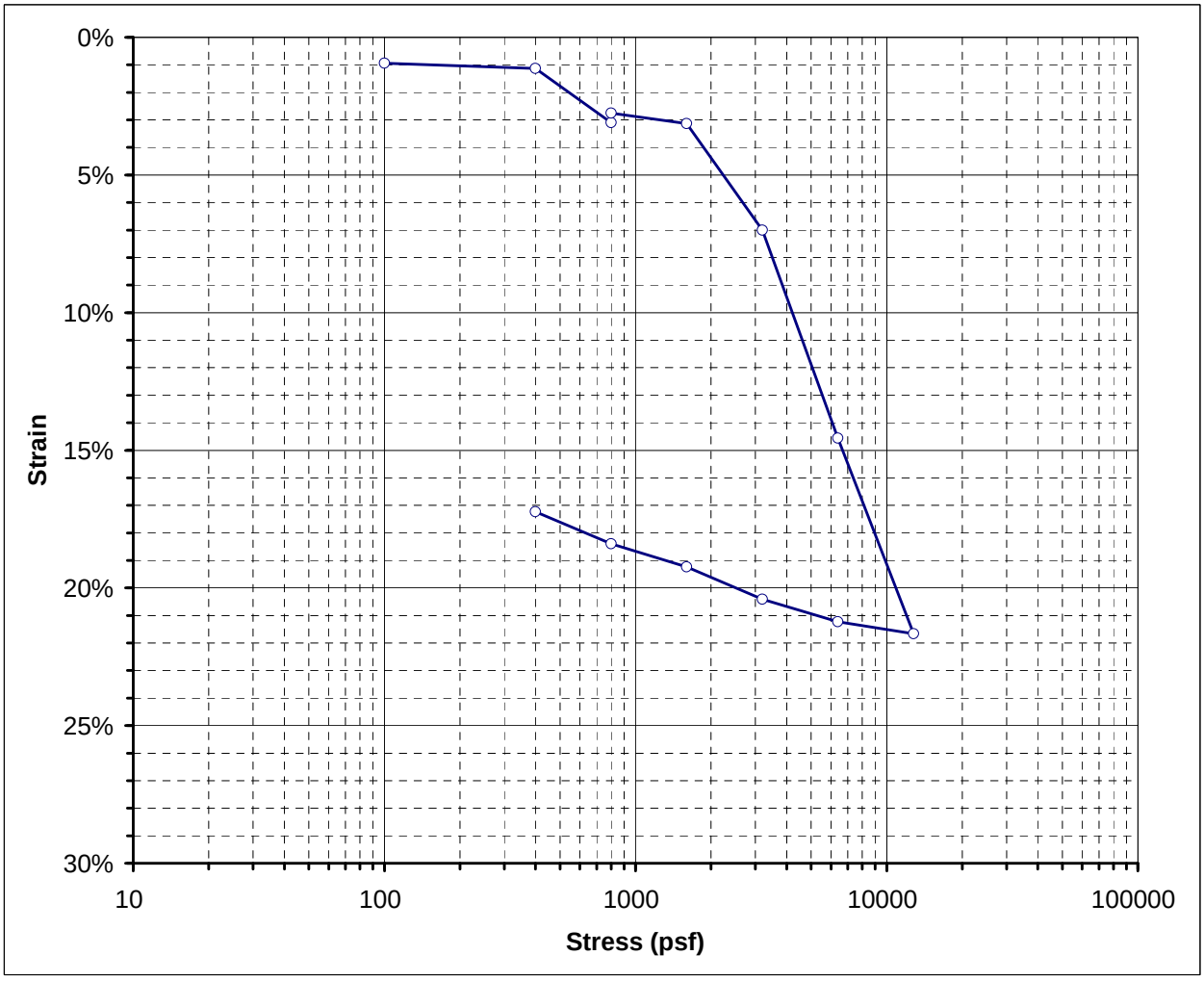
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO. B1-2j

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 9-21-12\Consol B-RW036R2A@10'_3.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW036	**Sample Depth**	30
Sample No.	R6A	**USCS**	MH

BEFORE TEST

Initial Moisture Content:	58.8%	
Initial Dry Unit Wt:	64.8	pcf
Initial Total Unit Wt.:	102.9	pcf
Initial Void Ratio:	1.6871	
Initial Degree of Saturation:	97.3%	

AFTER TEST

Final Moisture Content:	46.7%	
Final Dry Unit Wt:	76.3	pcf
Final Total Unit Wt.:	121.1	pcf
Final Void Ratio:	1.2809	
Final Degree of Saturation:	101.6%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

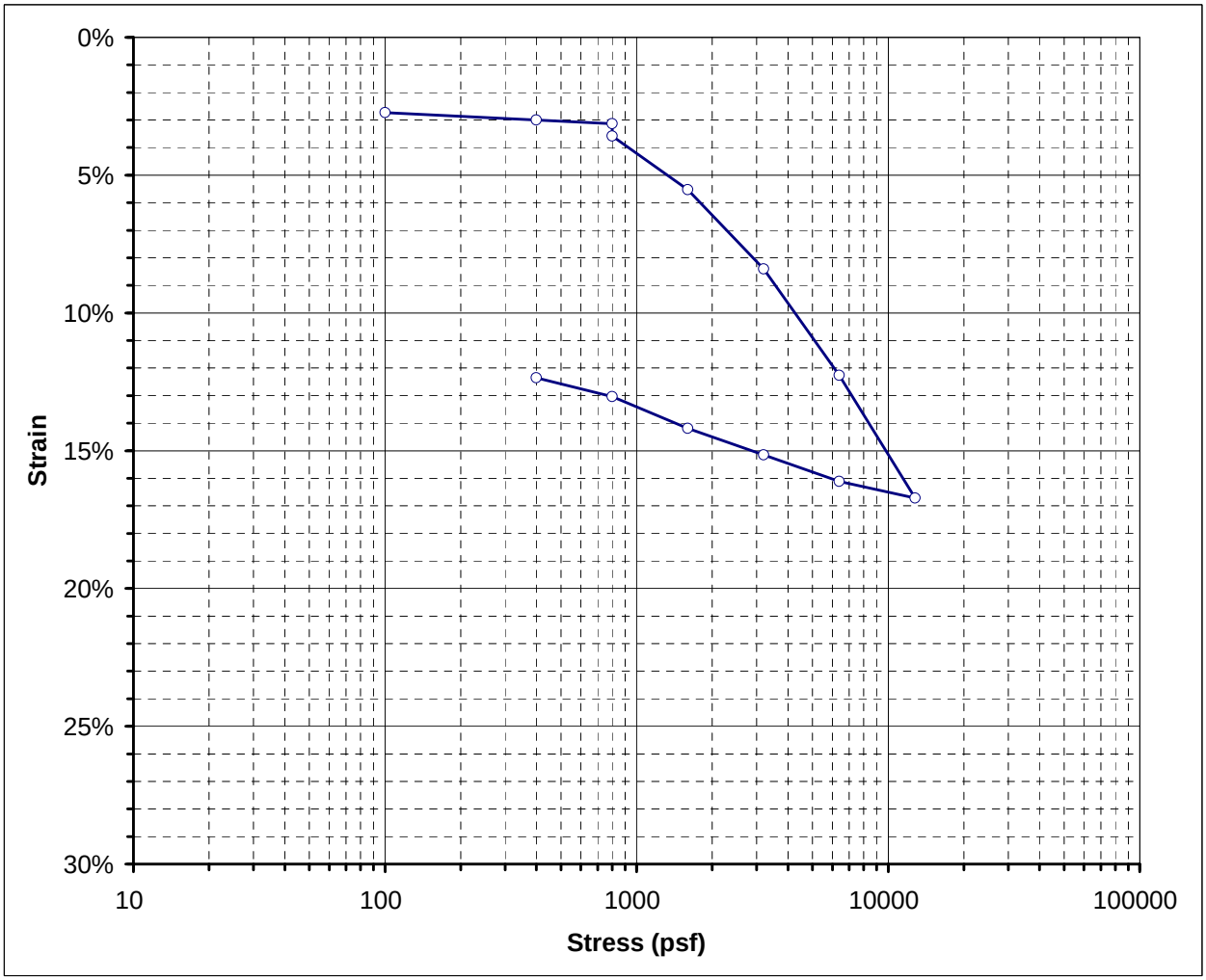
PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	0.93%	1.6619
400	1.13%	1.6568
800	3.10%	1.6039
800	2.75%	1.6131
1600	3.14%	1.6028
3200	7.01%	1.4988
6400	14.56%	1.2958
12800	21.67%	1.1048
6400	21.23%	1.1167
3200	20.41%	1.1386
1600	19.24%	1.1702
800	18.39%	1.1929
400	17.24%	1.2239

PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2k

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW041	**Sample Depth**	5 ft
Sample No.	R2A	**USCS**	0

BEFORE TEST

Initial Moisture Content:	47.4%	
Initial Dry Unit Wt:	75.0	pcf
Initial Total Unit Wt.:	110.6	pcf
Initial Void Ratio:	1.3207	
Initial Degree of Saturation:	100.2%	

AFTER TEST

Final Moisture Content:	39.5%	
Final Dry Unit Wt:	84.4	pcf
Final Total Unit Wt.:	115.2	pcf
Final Void Ratio:	1.0622	
Final Degree of Saturation:	103.7%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	2.73%	1.2573
400	3.00%	1.2510
800	3.13%	1.2480
800	3.58%	1.2376
1600	5.53%	1.1925
3200	8.41%	1.1256
6400	12.26%	1.0361
12800	16.72%	0.9328
6400	16.12%	0.9467
3200	15.16%	0.9690
1600	14.18%	0.9915
800	13.03%	1.0183
400	12.35%	1.0341

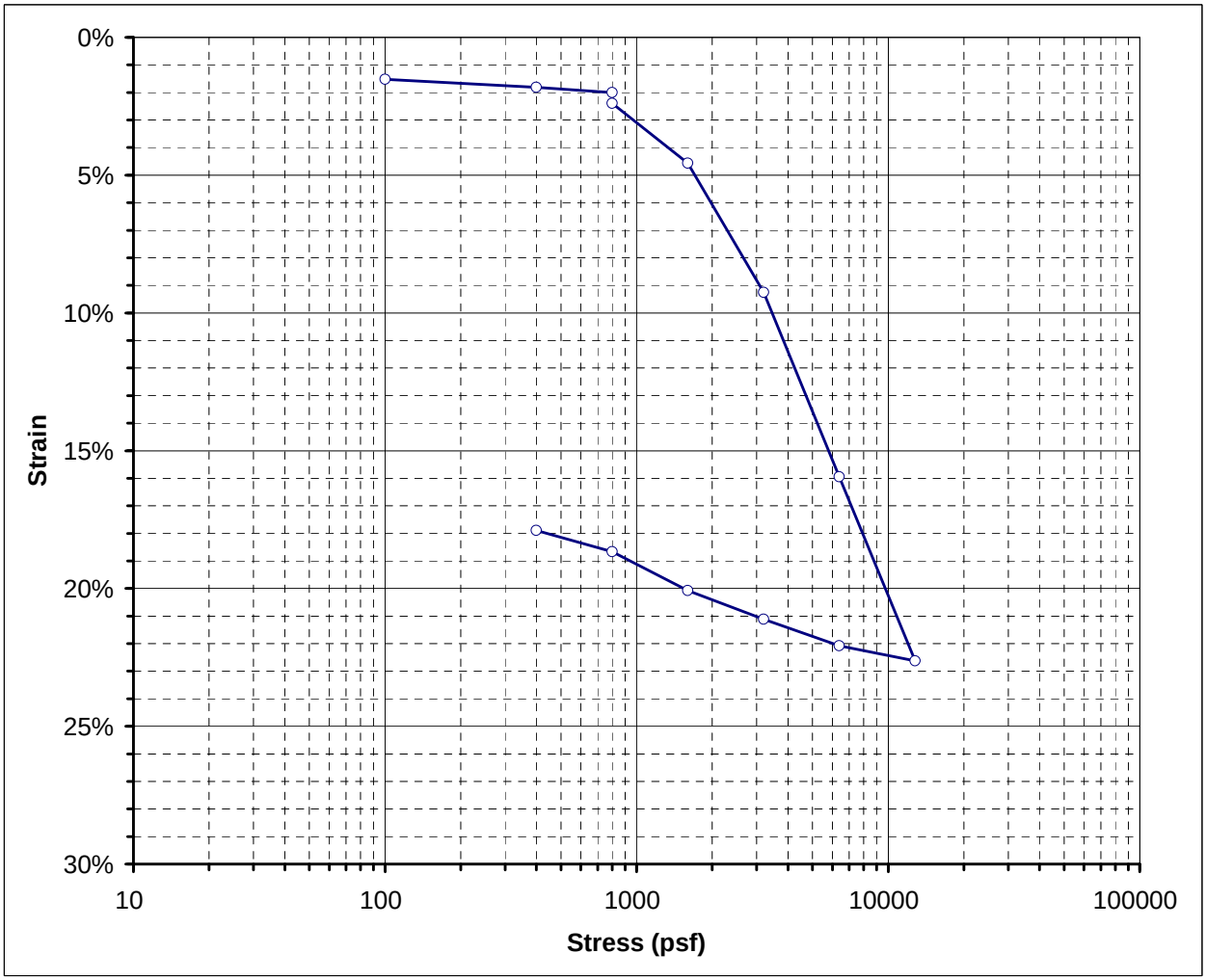
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2l

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-3-12\Consol B-RW041R2A@5'_2.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW041	**Sample Depth**	25 ft
Sample No.	R6A	**USCS**	0

BEFORE TEST

Initial Moisture Content:	58.0%	
Initial Dry Unit Wt:	65.2	pcf
Initial Total Unit Wt.:	103.0	pcf
Initial Void Ratio:	1.6717	
Initial Degree of Saturation:	96.8%	

AFTER TEST

Final Moisture Content:	45.4%	
Final Dry Unit Wt:	78.3	pcf
Final Total Unit Wt.:	122.9	pcf
Final Void Ratio:	1.2229	
Final Degree of Saturation:	103.5%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=	64	**PL=**	33	**PI=**	31

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.52%	1.6311
400	1.81%	1.6234
800	2.00%	1.6183
800	2.40%	1.6076
1600	4.57%	1.5496
3200	9.25%	1.4246
6400	15.94%	1.2459
12800	22.63%	1.0671
6400	22.08%	1.0818
3200	21.11%	1.1077
1600	20.08%	1.1353
800	18.67%	1.1729
400	17.89%	1.1938

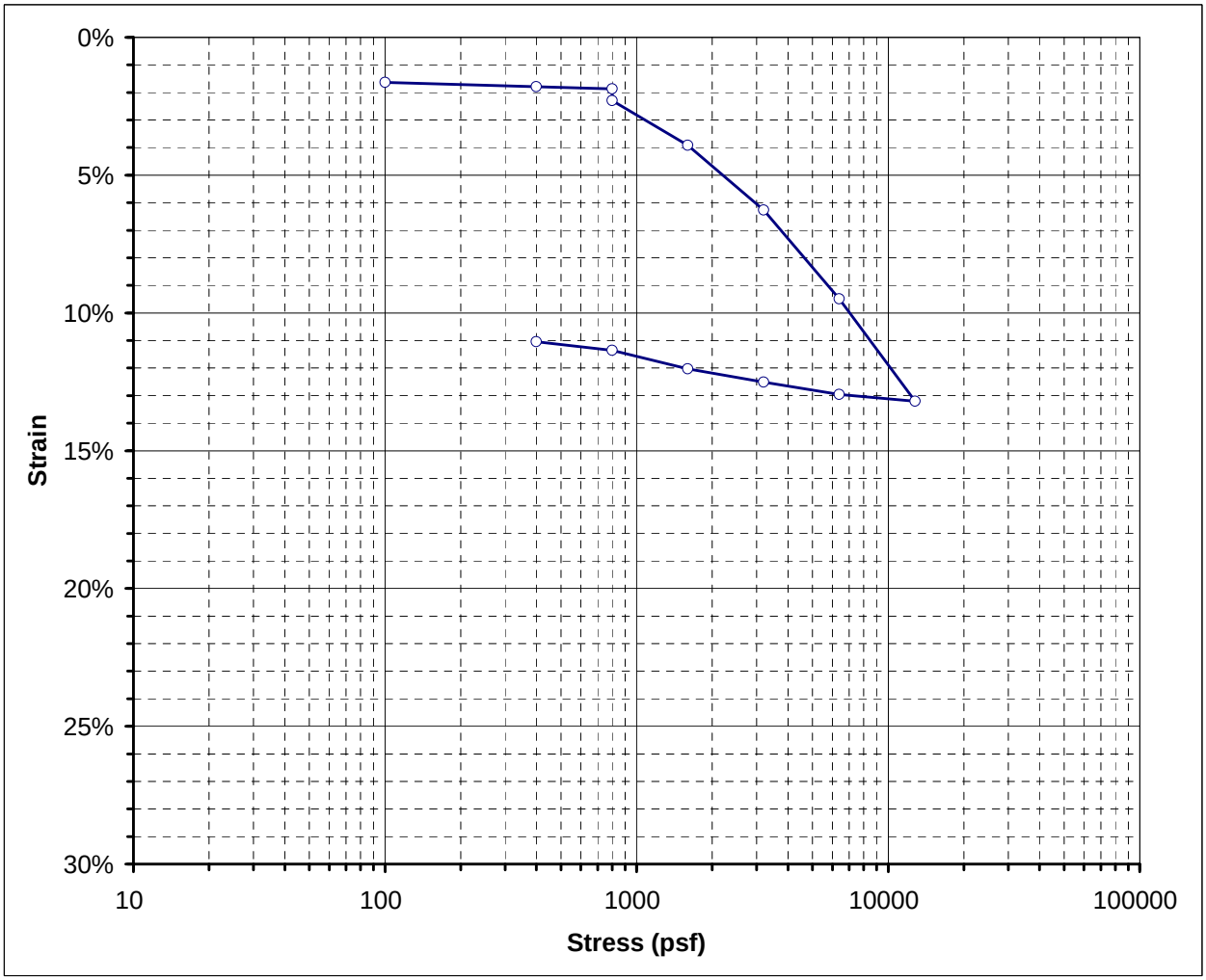
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2m

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-3-12\Consol B-RW041R6A@25'_3.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW044	**Sample Depth**	55 ft
Sample No.	R11	**USCS**	0

BEFORE TEST

Initial Moisture Content:	33.3%	
Initial Dry Unit Wt:	88.0	pcf
Initial Total Unit Wt.:	117.3	pcf
Initial Void Ratio:	0.9775	
Initial Degree of Saturation:	95.0%	

AFTER TEST

Final Moisture Content:	27.8%	
Final Dry Unit Wt:	98.4	pcf
Final Total Unit Wt.:	114.5	pcf
Final Void Ratio:	0.7692	
Final Degree of Saturation:	100.9%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.63%	0.9452
400	1.79%	0.9420
800	1.86%	0.9406
800	2.29%	0.9321
1600	3.92%	0.9000
3200	6.26%	0.8536
6400	9.49%	0.7898
12800	13.21%	0.7163
6400	12.96%	0.7213
3200	12.51%	0.7302
1600	12.02%	0.7397
800	11.36%	0.7528
400	11.04%	0.7591

PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2n

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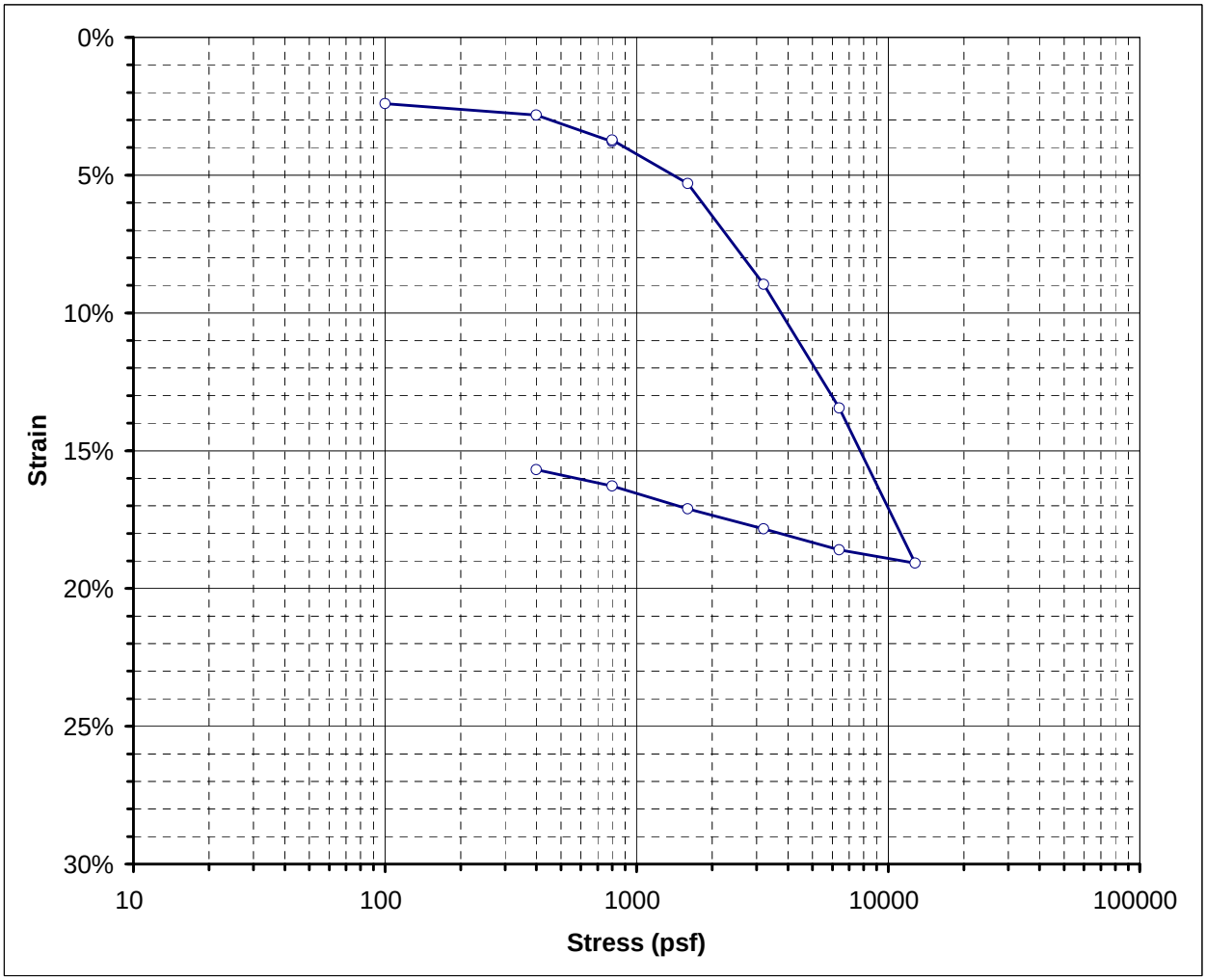
CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW049	**Sample Depth**	15
Sample No.	R4A	**USCS**	0

BEFORE TEST

Initial Moisture Content:	72.7%	
Initial Dry Unit Wt:	56.2	pcf
Initial Total Unit Wt.:	97.1	pcf
Initial Void Ratio:	2.0975	
Initial Degree of Saturation:	96.7%	

AFTER TEST

Final Moisture Content:	59.5%	
Final Dry Unit Wt:	65.9	pcf
Final Total Unit Wt.:	120.1	pcf
Final Void Ratio:	1.6422	
Final Degree of Saturation:	101.0%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	2.40%	2.0230
400	2.82%	2.0103
800	3.78%	1.9805
800	3.73%	1.9820
1600	5.30%	1.9333
3200	8.96%	1.8200
6400	13.45%	1.6810
12800	19.08%	1.5065
6400	18.60%	1.5214
3200	17.84%	1.5450
1600	17.10%	1.5677
800	16.28%	1.5931
400	15.69%	1.6114

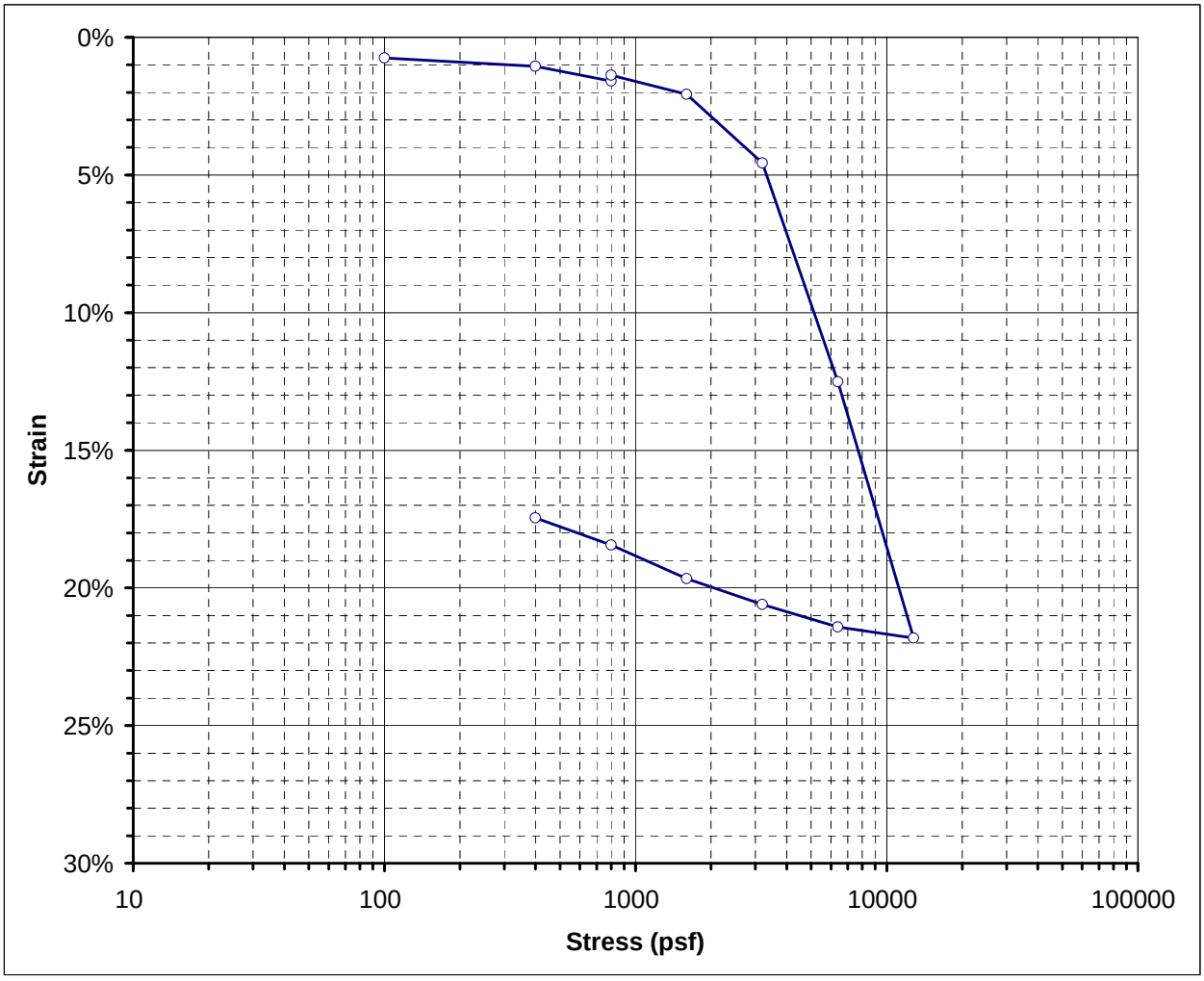
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2o

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-17-12\Consol A-RW049R4A@15'_4.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW049	**Sample Depth**	25 ft
Sample No.	R6A	**USCS**	0

BEFORE TEST

Initial Moisture Content:	64.3%	
Initial Dry Unit Wt:	60.4	pcf
Initial Total Unit Wt.:	99.2	pcf
Initial Void Ratio:	1.8822	
Initial Degree of Saturation:	95.2%	

AFTER TEST

Final Moisture Content:	50.8%	
Final Dry Unit Wt:	72.4	pcf
Final Total Unit Wt.:	122.8	pcf
Final Void Ratio:	1.4048	
Final Degree of Saturation:	100.8%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	0.75%	1.8605
400	1.05%	1.8518
800	1.59%	1.8362
800	1.37%	1.8426
1600	2.07%	1.8224
3200	4.57%	1.7505
6400	12.51%	1.5217
12800	21.82%	1.2532
6400	21.42%	1.2647
3200	20.60%	1.2884
1600	19.66%	1.3155
800	18.44%	1.3508
400	17.45%	1.3791

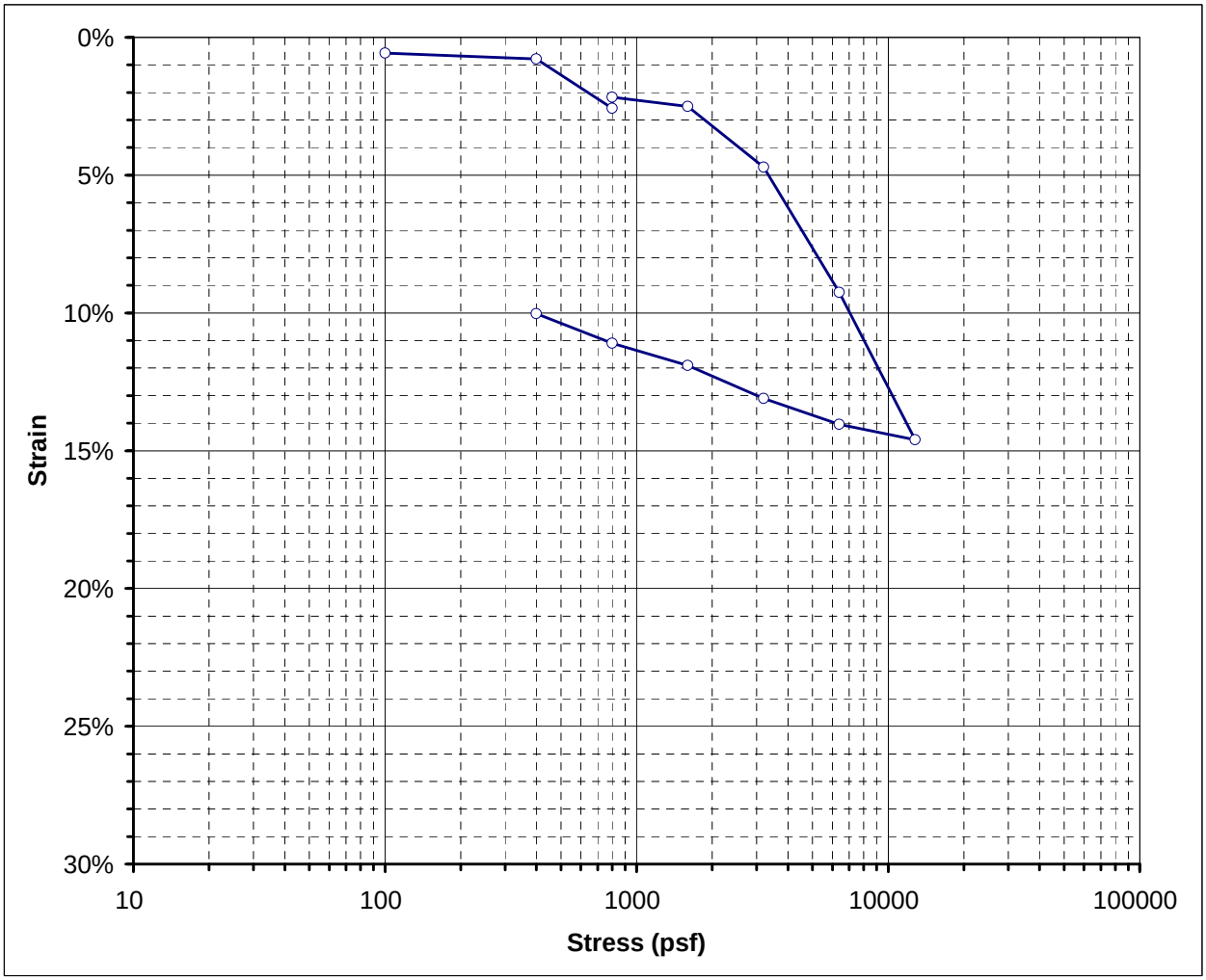
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2p

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-30-12\A-RW049 R6A@25'_1.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-HSA051	**Sample Depth**	5 ft
Sample No.	R3	**USCS**	0

BEFORE TEST

Initial Moisture Content:	45.1%	
Initial Dry Unit Wt:	75.7	pcf
Initial Total Unit Wt.:	109.9	pcf
Initial Void Ratio:	1.2998	
Initial Degree of Saturation:	96.9%	

AFTER TEST

Final Moisture Content:	40.9%	
Final Dry Unit Wt:	82.5	pcf
Final Total Unit Wt.:	111.6	pcf
Final Void Ratio:	1.1111	
Final Degree of Saturation:	102.6%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

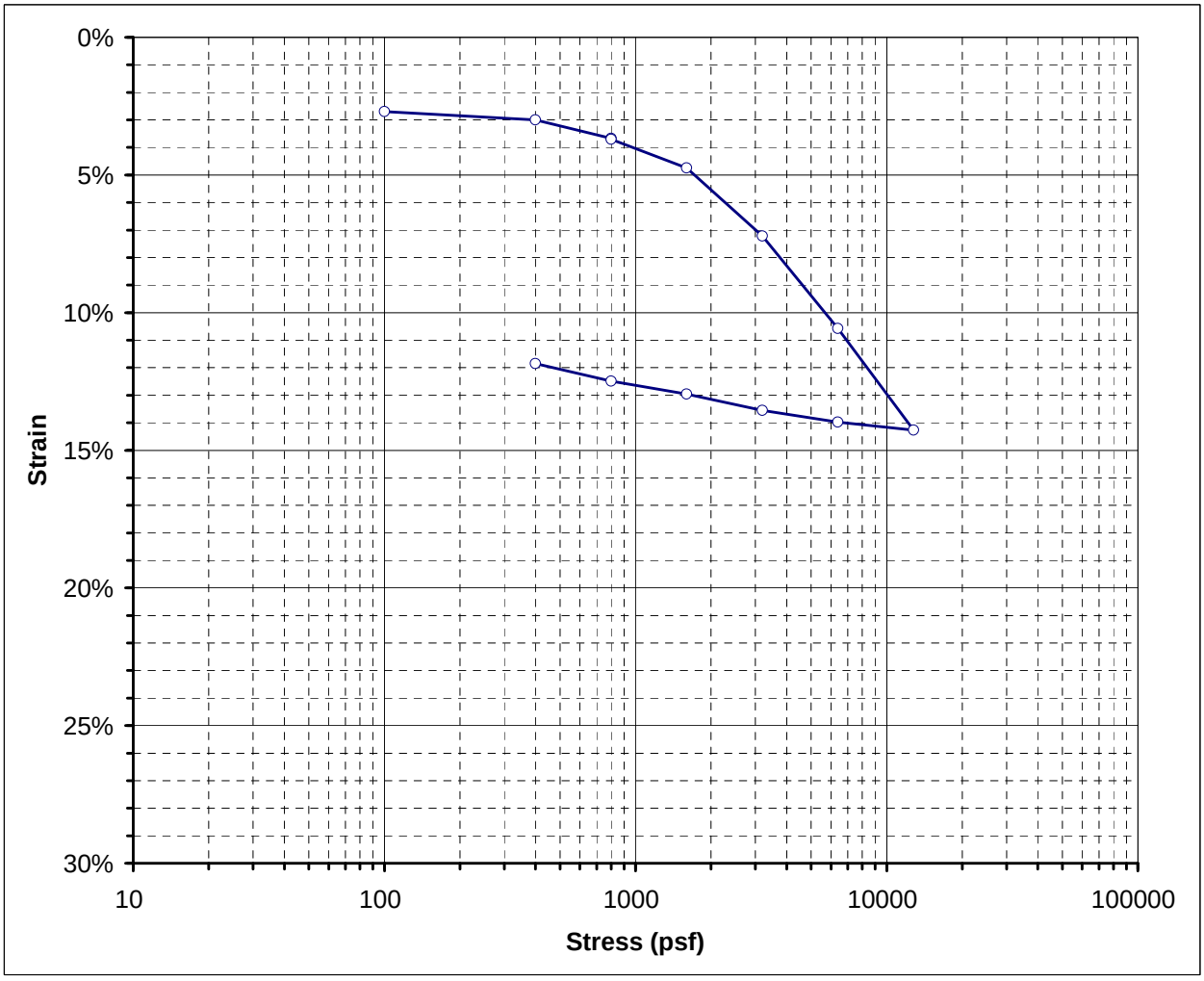
PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	0.57%	1.2867
400	0.78%	1.2819
800	2.58%	1.2406
800	2.17%	1.2498
1600	2.51%	1.2422
3200	4.71%	1.1915
6400	9.26%	1.0869
12800	14.60%	0.9641
6400	14.05%	0.9768
3200	13.11%	0.9984
1600	11.90%	1.0261
800	11.10%	1.0445
400	10.03%	1.0692

PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2q

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-HSA051	**Sample Depth**	10 ft
Sample No.	R5	**USCS**	0

BEFORE TEST

Initial Moisture Content:	43.6%	
Initial Dry Unit Wt:	77.5	pcf
Initial Total Unit Wt.:	111.3	pcf
Initial Void Ratio:	1.2466	
Initial Degree of Saturation:	97.5%	

AFTER TEST

Final Moisture Content:	36.8%	
Final Dry Unit Wt:	86.3	pcf
Final Total Unit Wt.:	114.5	pcf
Final Void Ratio:	1.0165	
Final Degree of Saturation:	100.9%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	2.69%	1.1861
400	2.99%	1.1793
800	3.67%	1.1642
800	3.70%	1.1635
1600	4.74%	1.1401
3200	7.22%	1.0845
6400	10.57%	1.0091
12800	14.27%	0.9260
6400	13.98%	0.9326
3200	13.55%	0.9423
1600	12.95%	0.9556
800	12.48%	0.9662
400	11.85%	0.9804

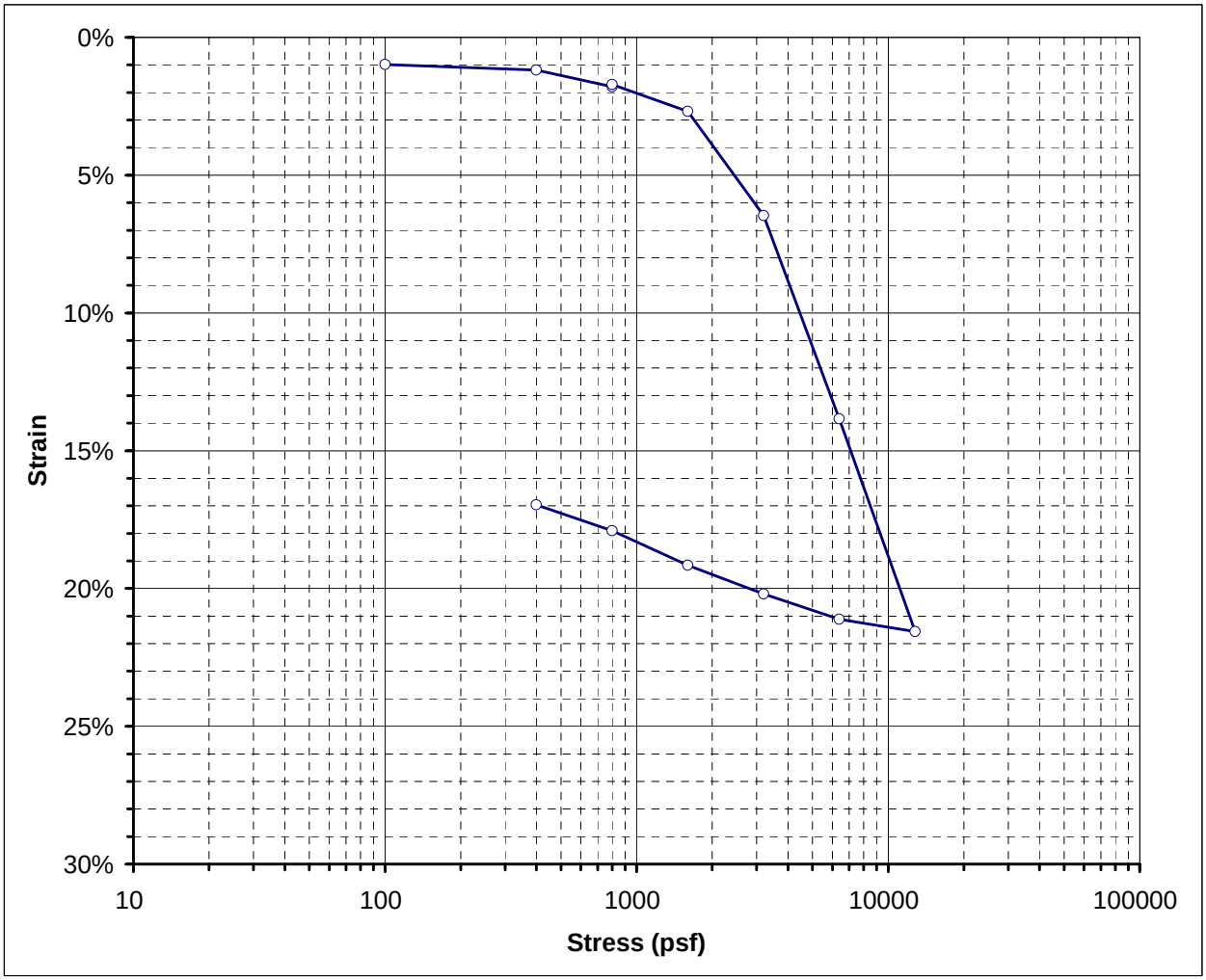
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2r

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 11-9-12\B-HSA051 R5@10'_3.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW053	**Sample Depth**	10 ft
Sample No.	R2A	**USCS**	0

BEFORE TEST

Initial Moisture Content:	59.5%	
Initial Dry Unit Wt:	63.9	pcf
Initial Total Unit Wt.:	101.8	pcf
Initial Void Ratio:	1.7261	
Initial Degree of Saturation:	96.1%	

AFTER TEST

Final Moisture Content:	47.6%	
Final Dry Unit Wt:	76.2	pcf
Final Total Unit Wt.:	122.1	pcf
Final Void Ratio:	1.2845	
Final Degree of Saturation:	103.4%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	0.98%	1.6993
400	1.19%	1.6937
800	1.79%	1.6773
800	1.71%	1.6795
1600	2.69%	1.6528
3200	6.47%	1.5498
6400	13.84%	1.3488
12800	21.56%	1.1384
6400	21.12%	1.1504
3200	20.20%	1.1755
1600	19.16%	1.2038
800	17.90%	1.2382
400	16.96%	1.2638

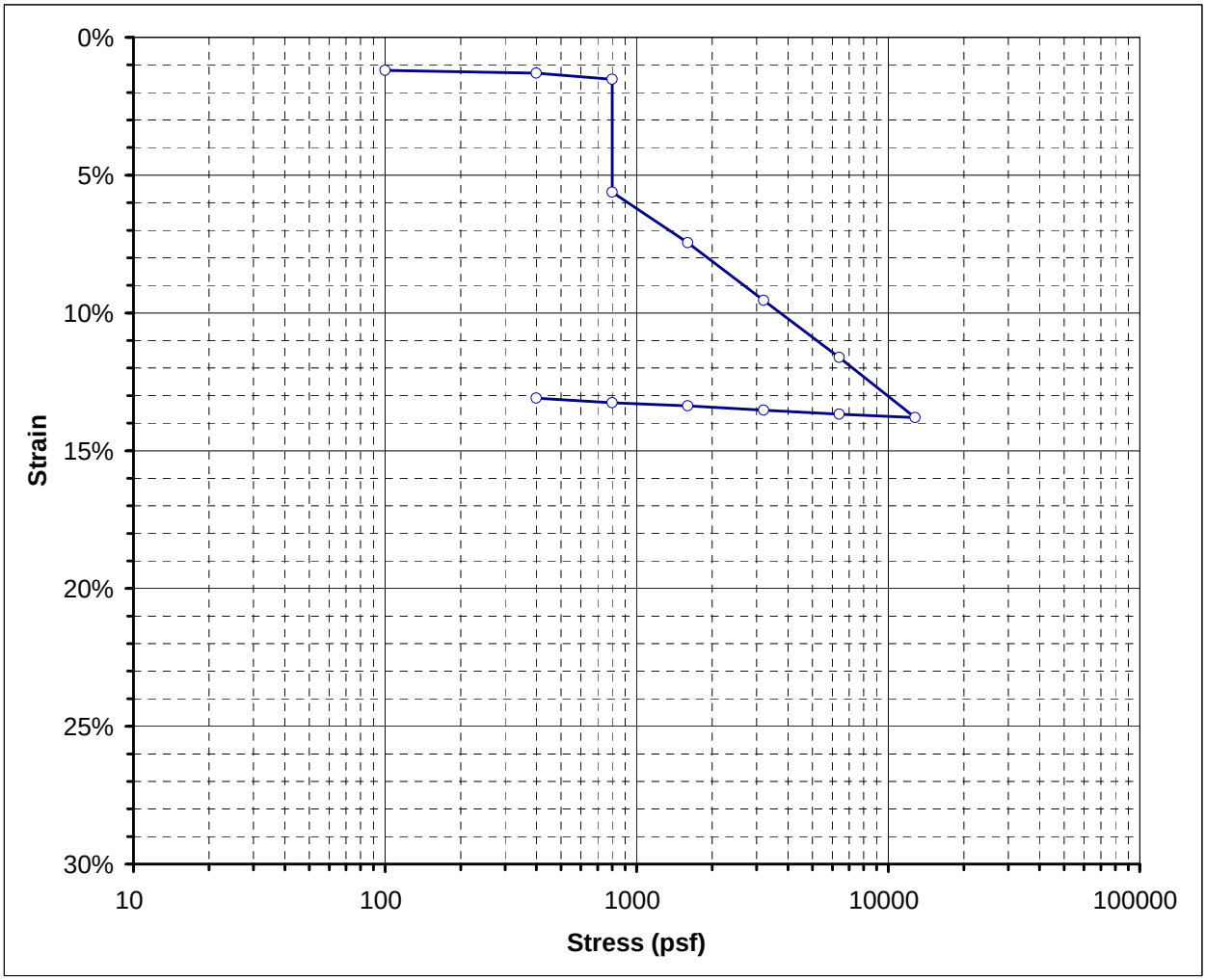
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2s

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-30-12\A-RW053 R2A@10'_2.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	C-HSA061	**Sample Depth**	7.5 ft
Sample No.	R3	**USCS**	0

BEFORE TEST

Initial Moisture Content:	7.2%	
Initial Dry Unit Wt:	88.6	pcf
Initial Total Unit Wt.:	94.9	pcf
Initial Void Ratio:	0.9655	
Initial Degree of Saturation:	20.8%	

AFTER TEST

Final Moisture Content:	20.7%	
Final Dry Unit Wt:	101.4	pcf
Final Total Unit Wt.:	117.1	pcf
Final Void Ratio:	0.7167	
Final Degree of Saturation:	80.7%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		**PL=**		**PI=**	

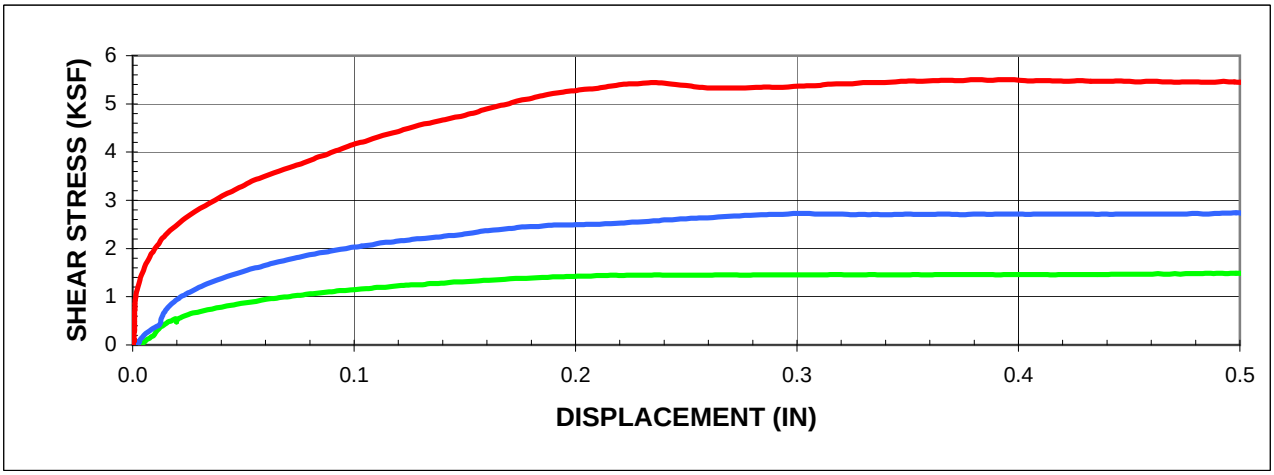
PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.20%	0.9419
400	1.30%	0.9400
800	1.52%	0.9356
800	5.62%	0.8551
1600	7.45%	0.8191
3200	9.55%	0.7778
6400	11.61%	0.7373
12800	13.80%	0.6943
6400	13.67%	0.6968
3200	13.53%	0.6996
1600	13.37%	0.7027
800	13.26%	0.7049
400	13.09%	0.7082

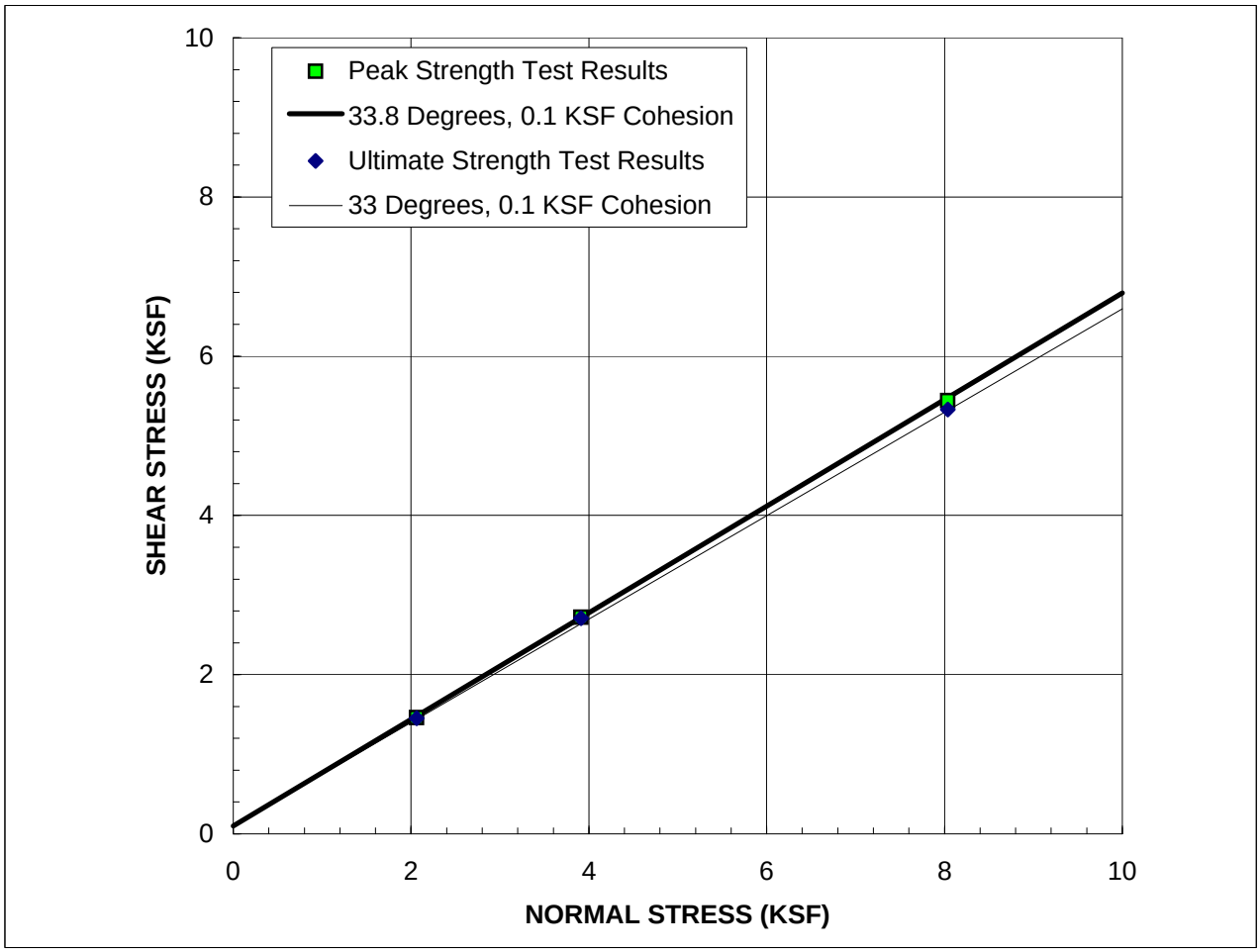
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO.
B1-2t

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 11-9-12\C-HSA061 R3@7.5'_4.xls





SAMPLE: A-RW002 R6@40'

Description:	Very Dark Greenish Gray Sandy Silty Clay with Traces of Shells

STRAIN RATE: 0.0025 IN/MIN

(Sample was consolidated and drained)

	PEAK	**ULTIMATE**
ϕ'	33.8 ^{o}	33.0 ^{o}
c'	0.10 KSF	0.10 KSF

	IN-SITU	**AS-TESTED**
γ_d	PCF	0.0 PCF
w_c	%	36.1 %

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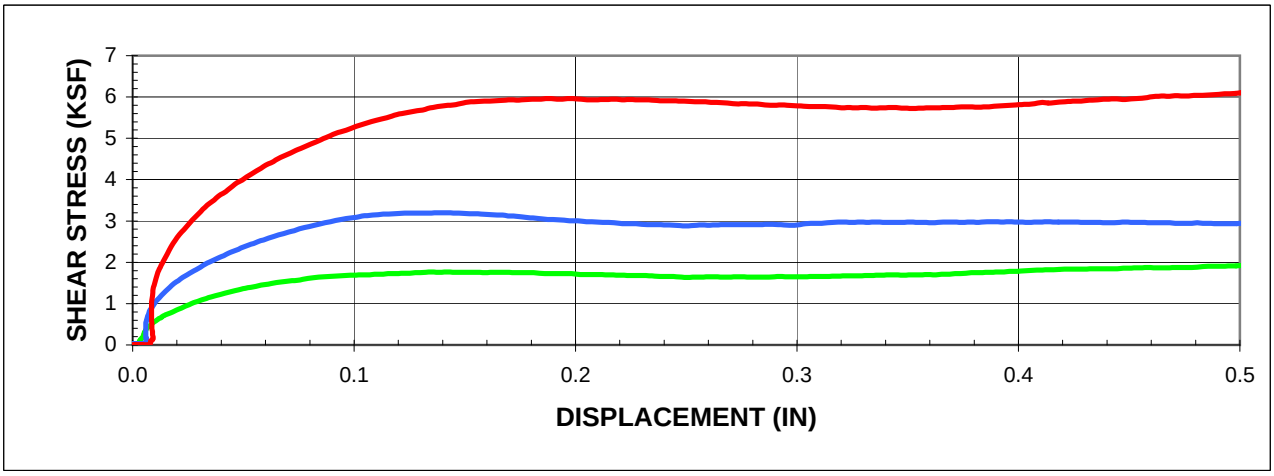
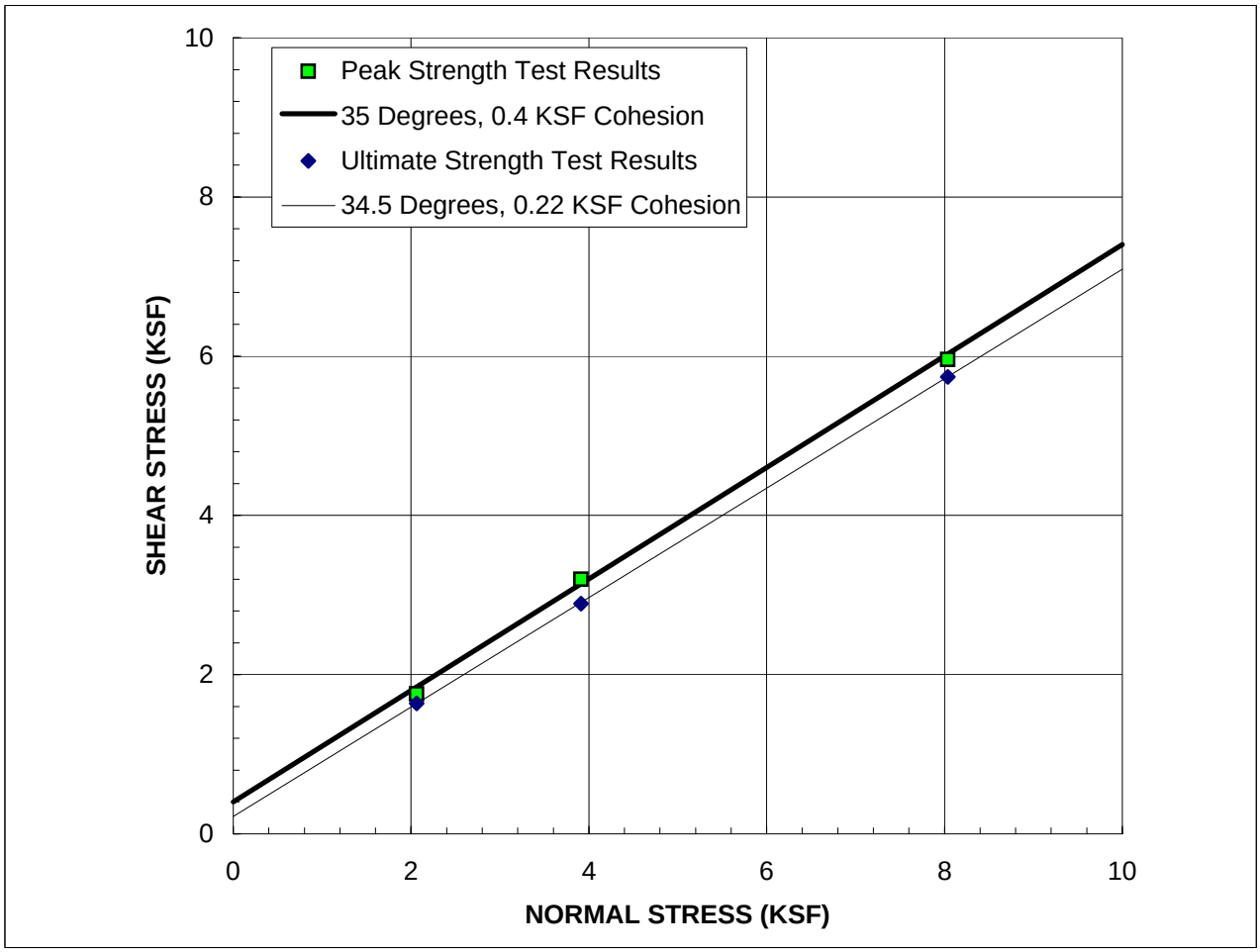
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3a





SAMPLE: A-RW003 R3A@10'

Description:	Very Dark Greenish Gray Clayey Sand with Traces of Shells

STRAIN RATE: 0.0050 IN/MIN

(Sample was consolidated and drained)

	PEAK	ULTIMATE
ϕ'	35 °	34.5 °
c'	0.40 KSF	0.22 KSF

	IN-SITU	AS-TESTED
γ_d	PCF	0.0 PCF
w_c	%	22.0 %

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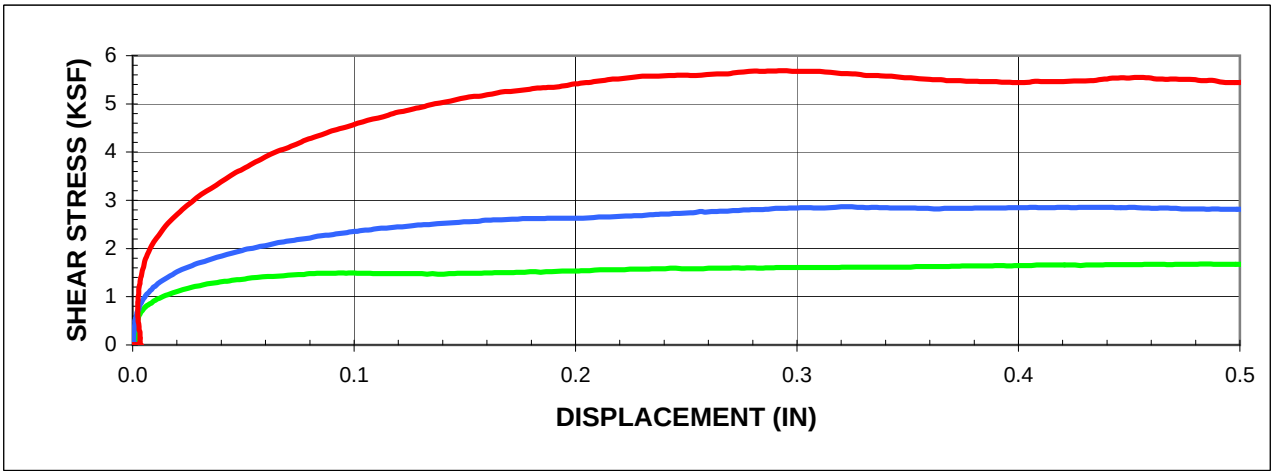
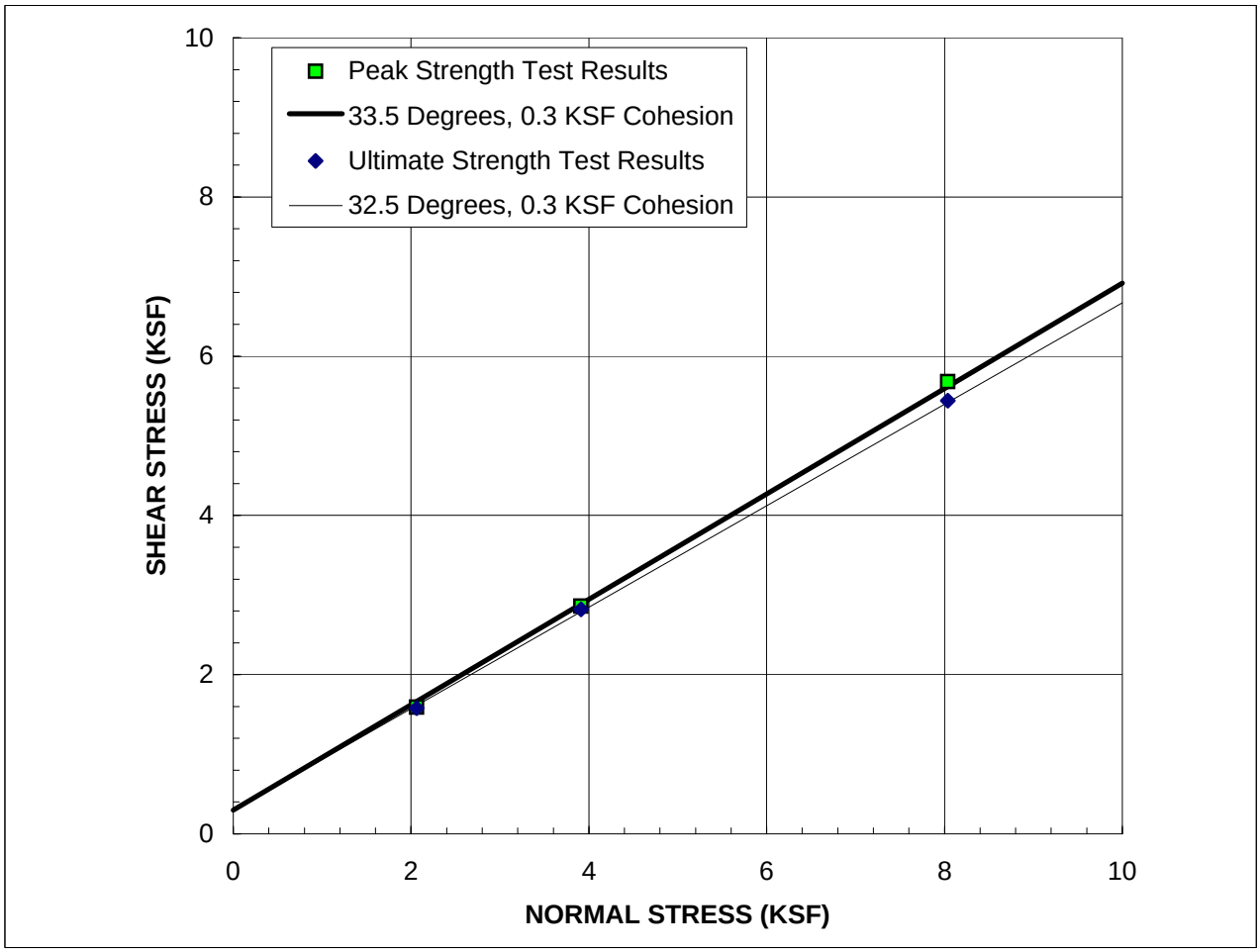
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3b





SAMPLE: A-RW003 R7A@30'

Description:	Very Dark Greenish Gray Sandy Clay with Shells

	PEAK	**ULTIMATE**
ϕ'	33.5 ^{o}	32.5 ^{o}
c'	0.30 KSF	0.30 KSF

STRAIN RATE: 0.0030 IN/MIN

(Sample was consolidated and drained)

	IN-SITU	**AS-TESTED**
γ_d	PCF	0.0 PCF
w_c	%	29.3 %

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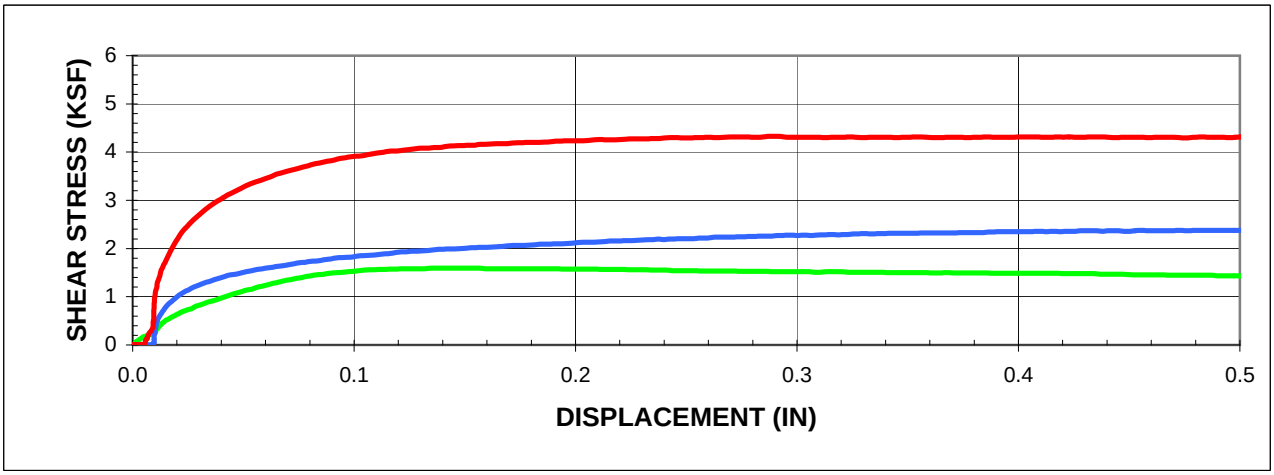
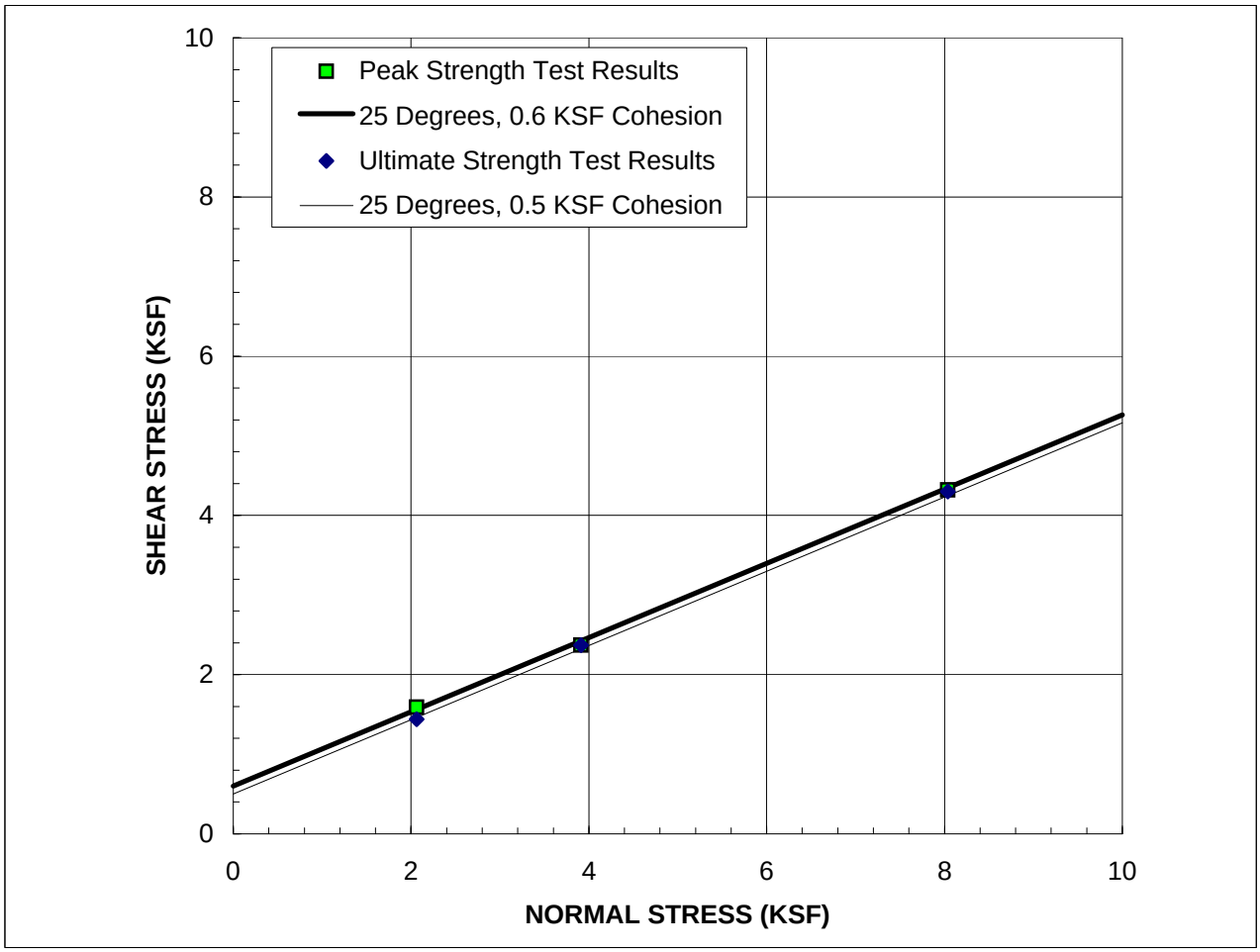
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3c





SAMPLE: A-RW005 R1@5'

Description: Olive Brown Clay with Shells

STRAIN RATE: 0.0025 IN/MIN

(Sample was consolidated and drained)

	PEAK	ULTIMATE
ϕ'	25.0 ^{o}	25.0 ^{o}
c'	0.60 KSF	0.50 KSF

	IN-SITU	AS-TESTED
γ_d	PCF	0.0 PCF
w_c	%	28.3 %

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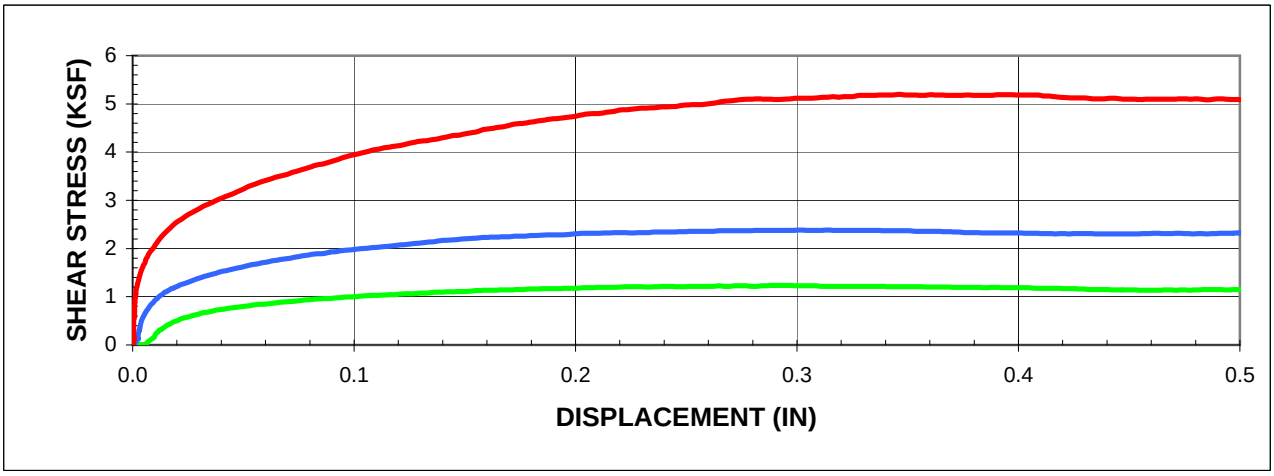
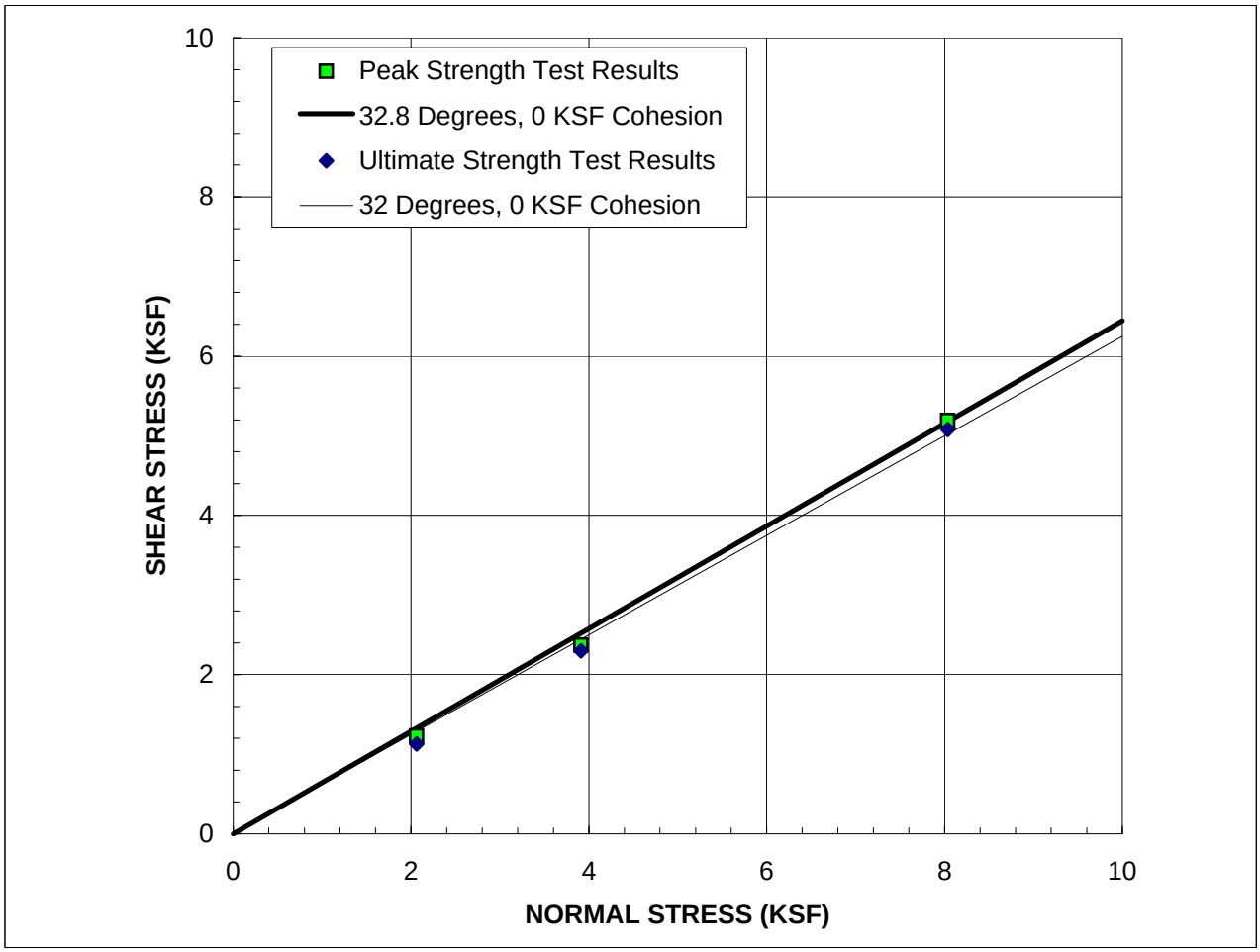
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3d





SAMPLE: A-RW005 R7@35'

Description:	Very Dark Greenish Gray Sandy Silty Clay with Traces of Shells

STRAIN RATE: 0.0025 IN/MIN

(Sample was consolidated and drained)

	PEAK	ULTIMATE
ϕ'	32.8 ^{o}	32 ^{o}
c'	0.00 KSF	0.00 KSF

	IN-SITU	AS-TESTED
γ_d	PCF	0.0 PCF
w_c	%	43.8 %

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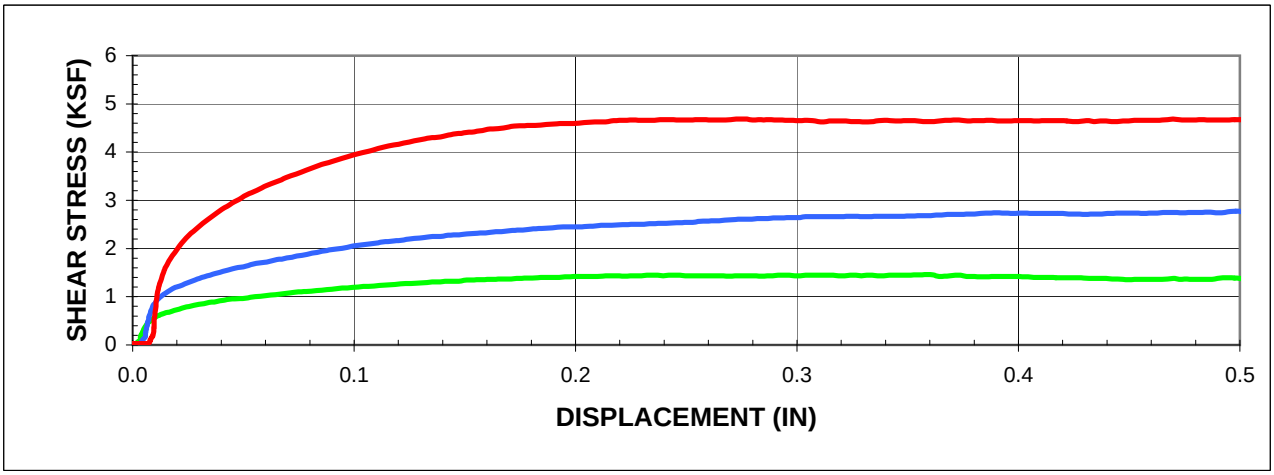
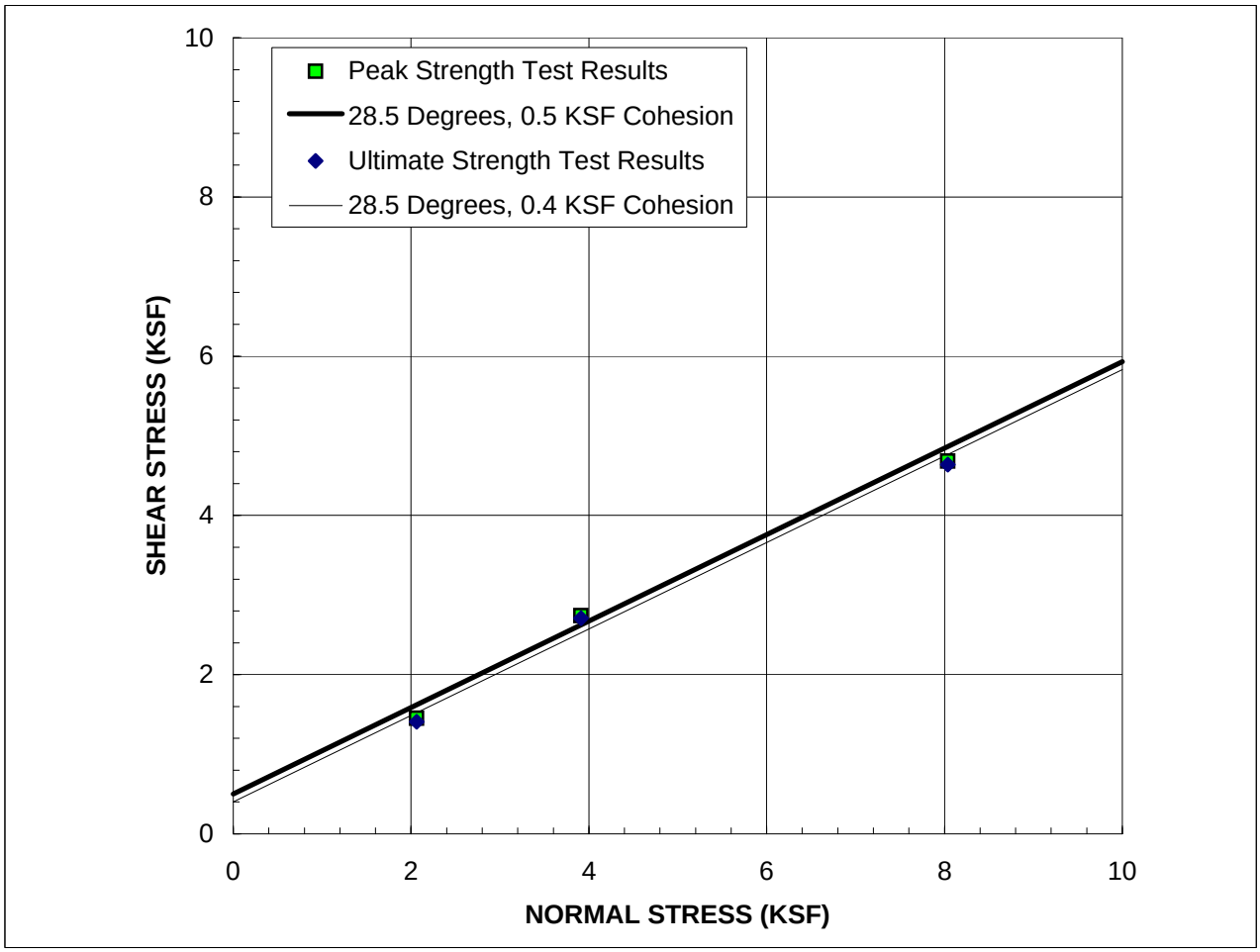
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3e





SAMPLE: A-RW006 R2@5'

Description:	Dark Brown Sandy Silt with Clay and Traces of Gravel with Asphalt

STRAIN RATE: 0.0030 IN/MIN

(Sample was consolidated and drained)

	PEAK	ULTIMATE
ϕ'	28.5 ^{o}	28.5 ^{o}
c'	0.50 KSF	0.40 KSF

	IN-SITU	AS-TESTED
γ_d	PCF	0.0 PCF
w_c	%	17.5 %

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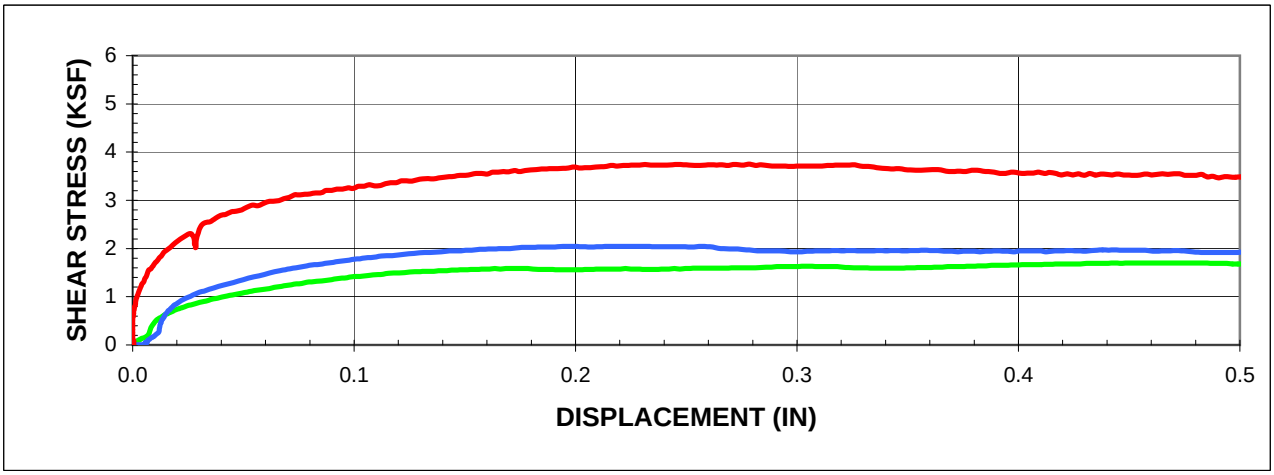
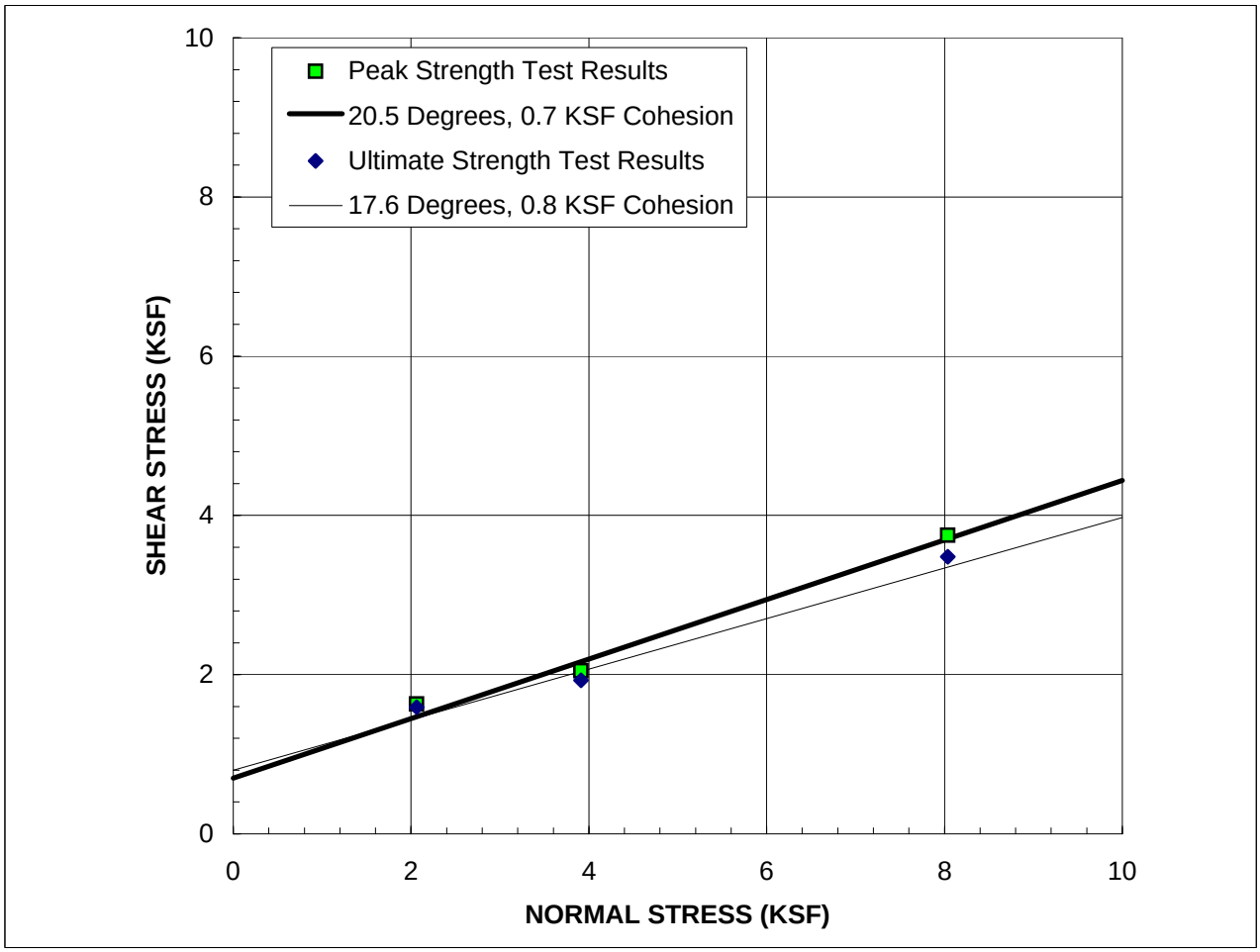
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3f





SAMPLE: A-RW008 R2@10'

Description: Olive Silty Clay with Sand

	PEAK	ULTIMATE
ϕ'	20.5 ^{o}	17.6 ^{o}
c'	0.70 KSF	0.80 KSF

STRAIN RATE: 0.0025 IN/MIN

(Sample was consolidated and drained)

	IN-SITU	AS-TESTED
γ_d	PCF	0.0 PCF
w_c	%	37.7 %

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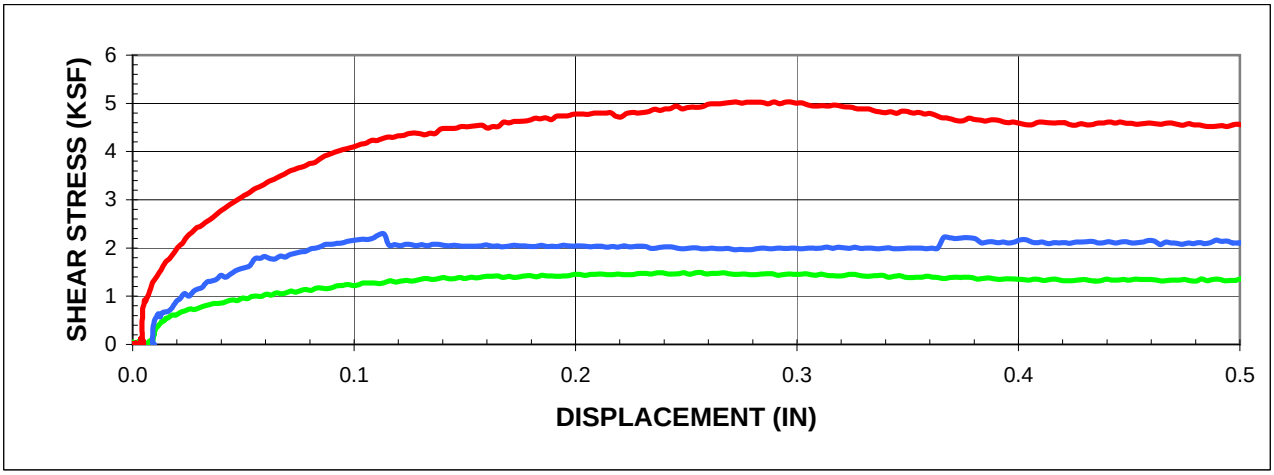
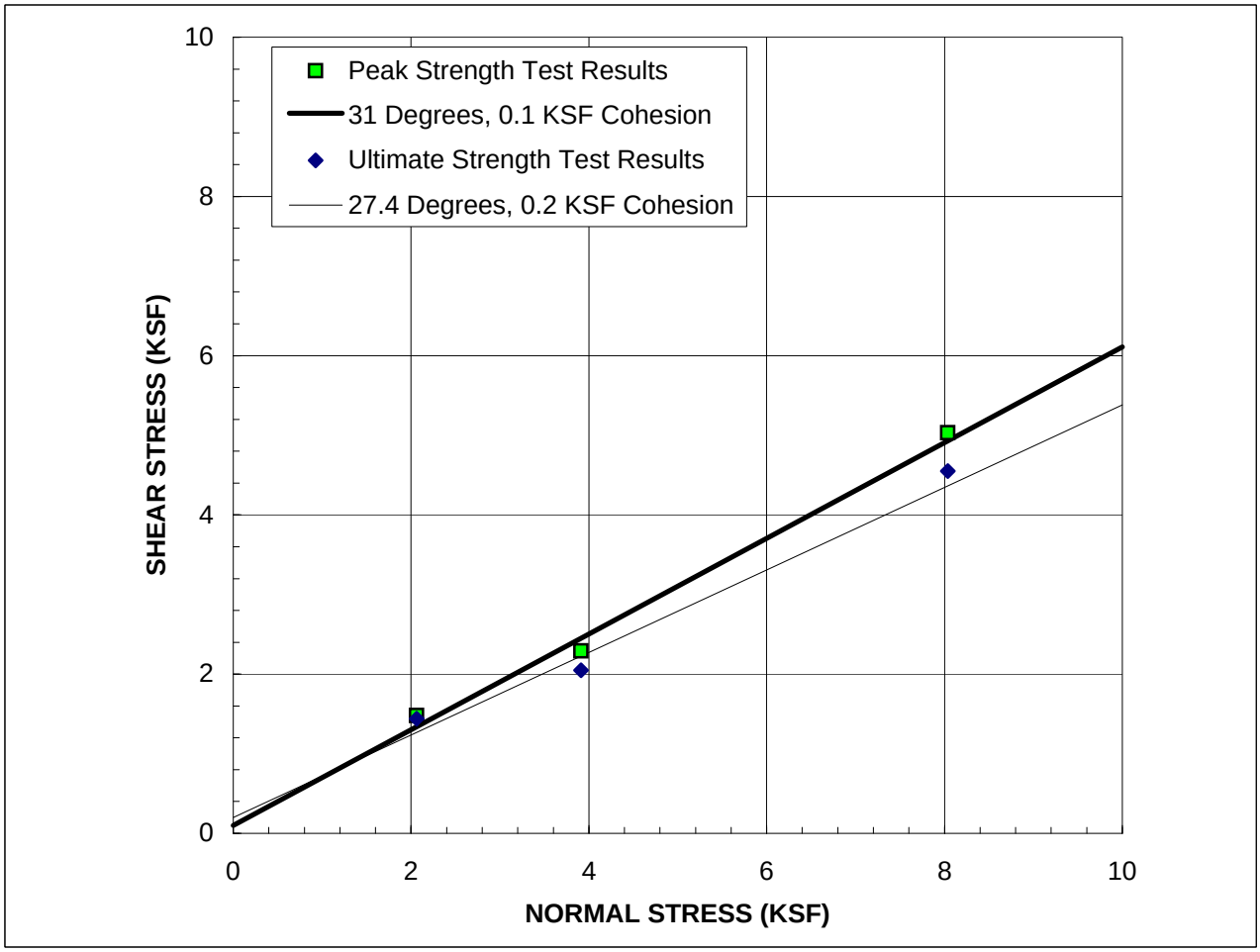
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3g





SAMPLE: A-RW015 R5@20'

Description:	Very Dark greenish Gray Silty Sand with Traces of Shells

STRAIN RATE: 0.0050 IN/MIN

(Sample was consolidated and drained)

	PEAK	**ULTIMATE**
ϕ'	31 ^{o}	27.4 ^{o}
c'	0.10 KSF	0.20 KSF

	IN-SITU	**AS-TESTED**
γ_d	PCF	0.0 PCF
w_c	%	34.8 %

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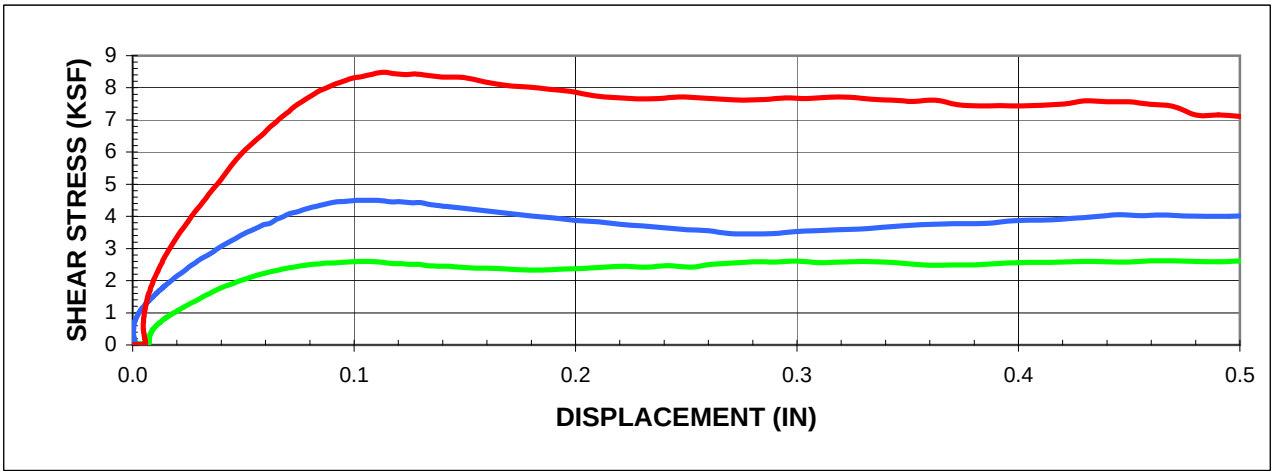
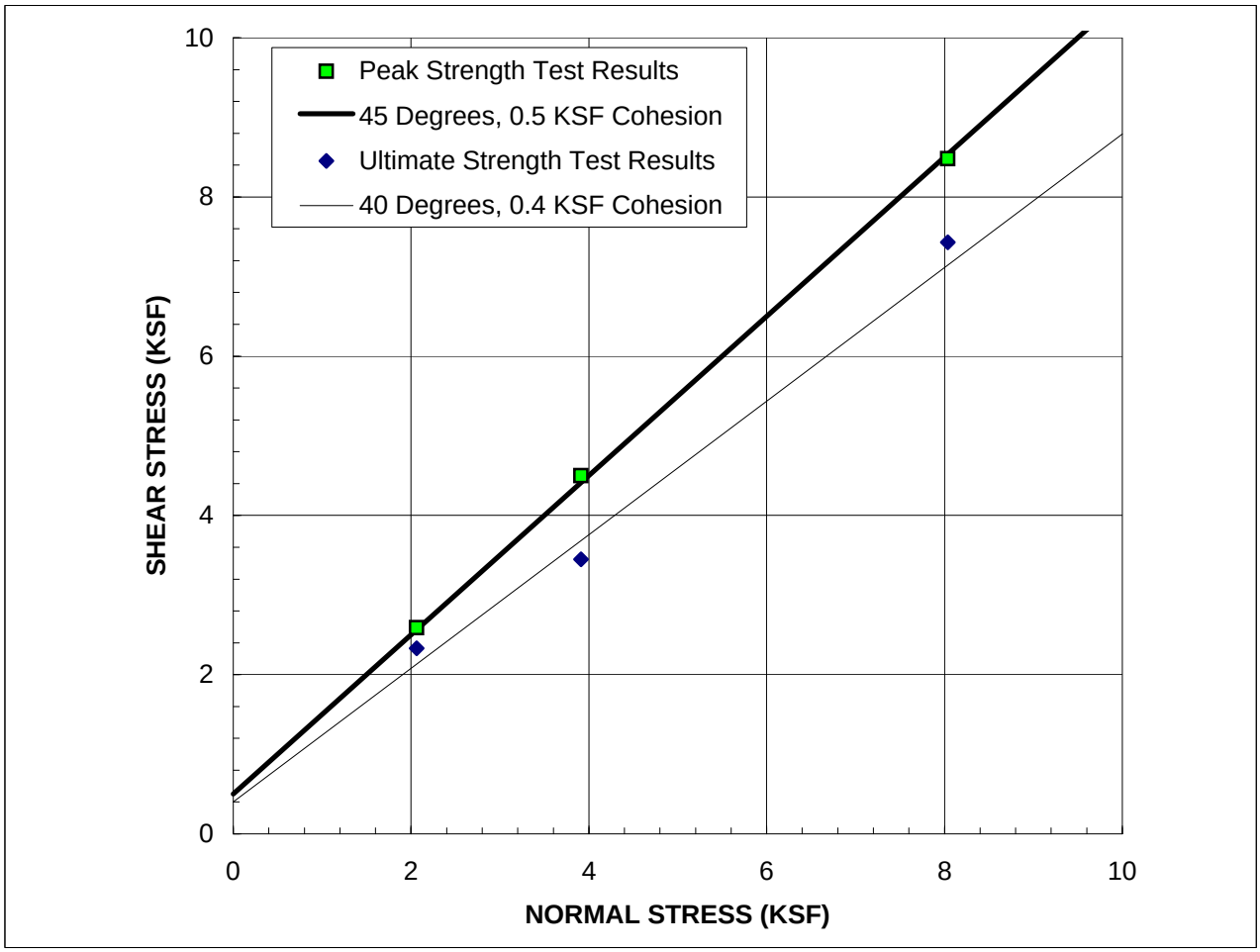
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3h





SAMPLE: A-RW015 R8@32.5

Description:	Very Dark Greenish Gray Coarse Sand

STRAIN RATE: 0.0250 IN/MIN

(Sample was consolidated and drained)

	PEAK	**ULTIMATE**
ϕ'	45 ^{o}	40 ^{o}
c'	0.50 KSF	0.40 KSF

	IN-SITU	**AS-TESTED**
γ_d	PCF	0.0 PCF
w_c	%	19.1 %

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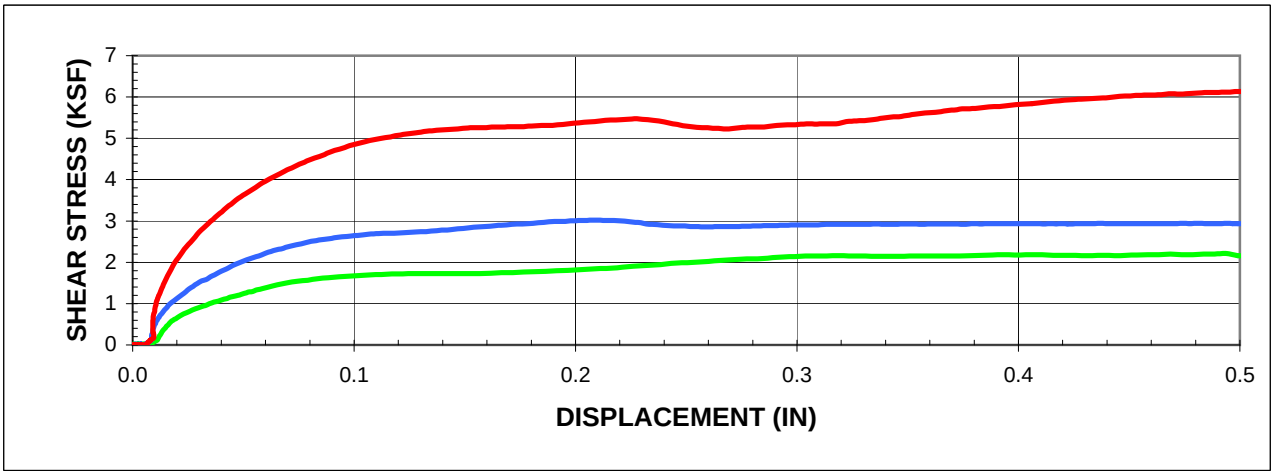
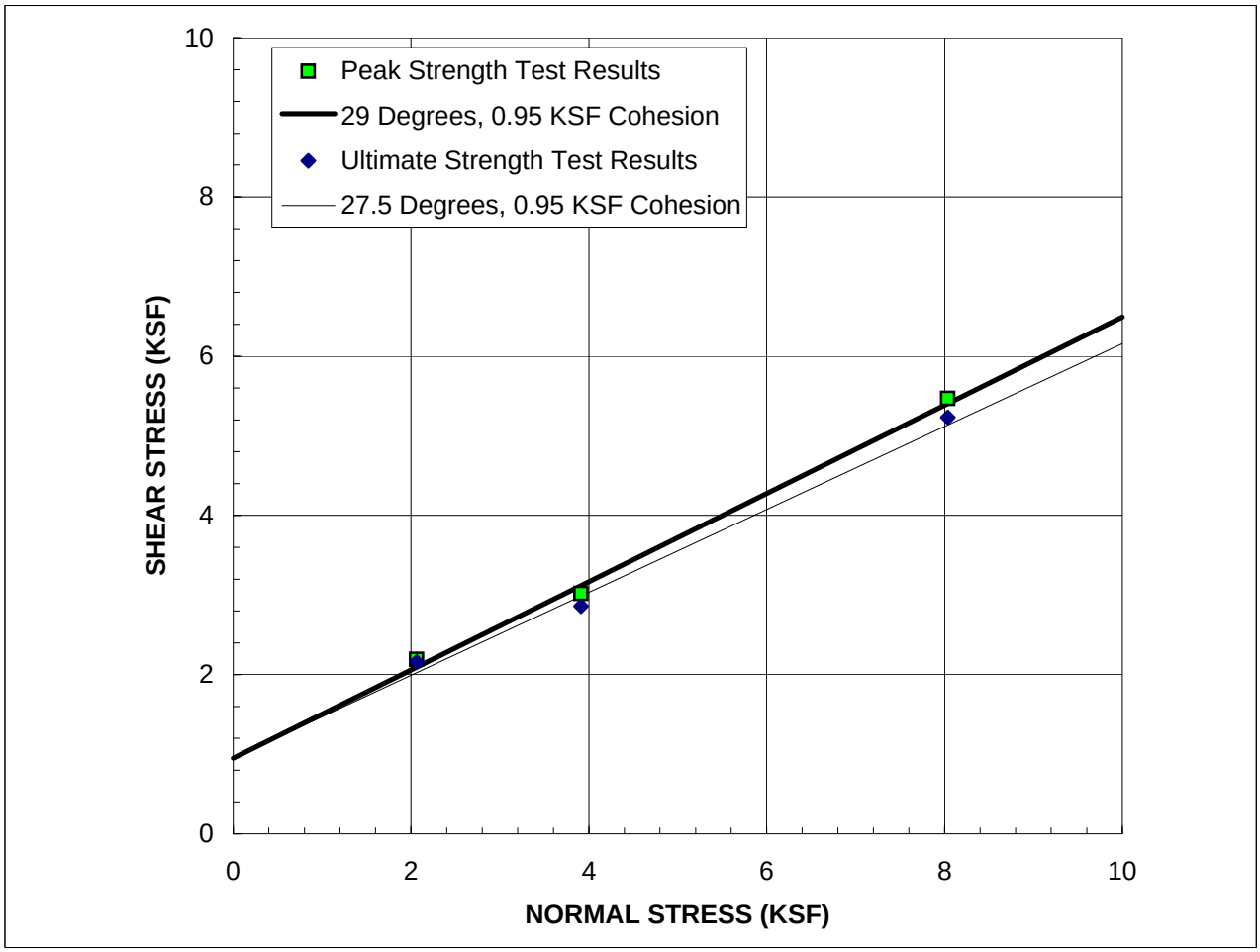
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3i





SAMPLE: B-RW027 R1@5'

Description:	Yellowish Brown Clayey Fine Sand

STRAIN RATE: 0.0050 IN/MIN

(Sample was consolidated and drained)

	PEAK	ULTIMATE
ϕ'	29.0 ^{o}	27.5 ^{o}
c'	0.95 KSF	0.95 KSF

	IN-SITU	AS-TESTED
γ_d	PCF	0.0 PCF
w_c	%	25.3 %

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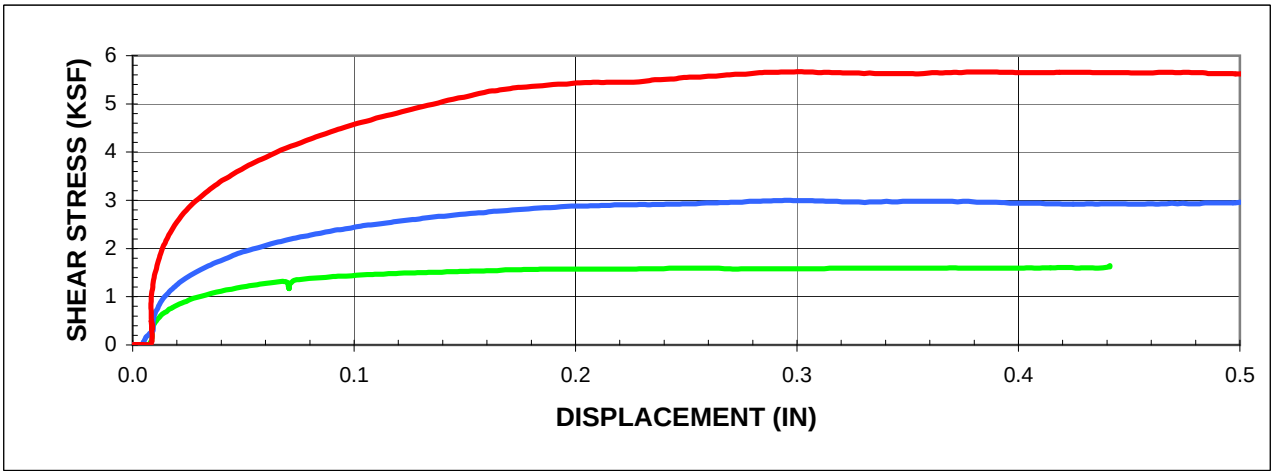
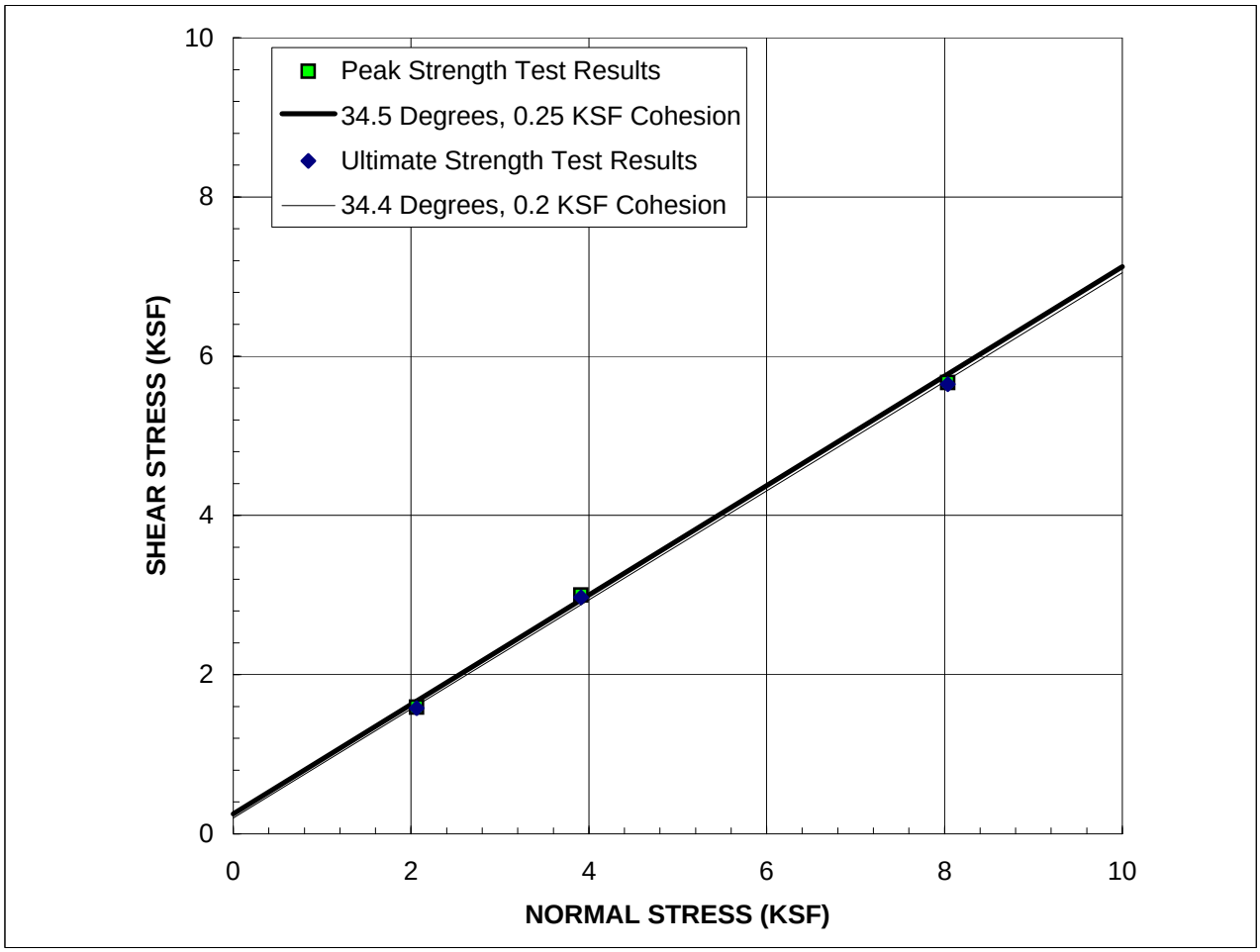
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3j





SAMPLE: B-RW027 R4A@20'

Description:	Dark Greenish Gray Silty Sand with Traces of Shells

STRAIN RATE: 0.0050 IN/MIN

(Sample was consolidated and drained)

	PEAK	ULTIMATE
ϕ'	34.5 ^{o}	34.4 ^{o}
c'	0.25 KSF	0.20 KSF

	IN-SITU	AS-TESTED
γ_d	PCF	0.0 PCF
w_c	%	33.3 %

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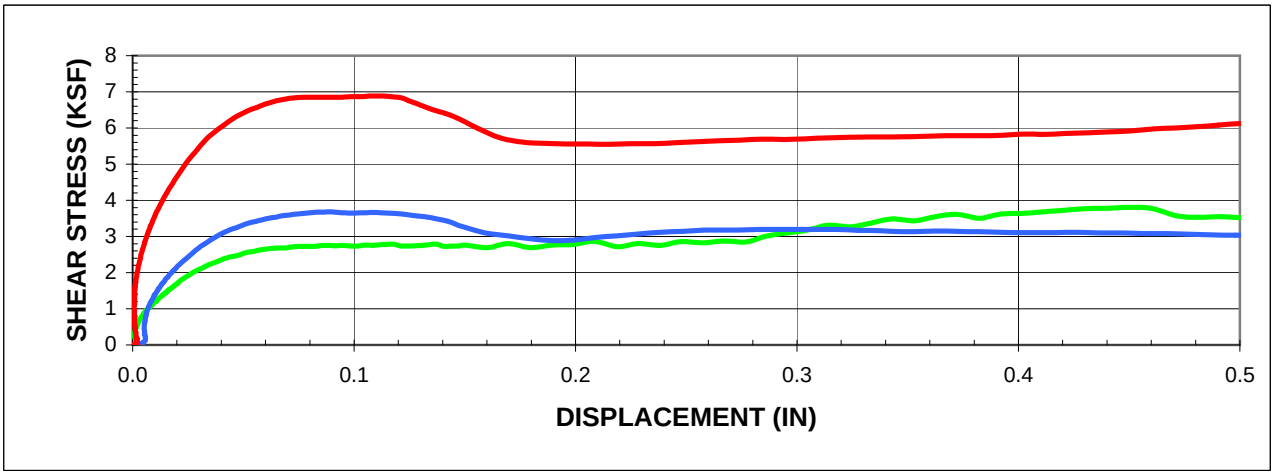
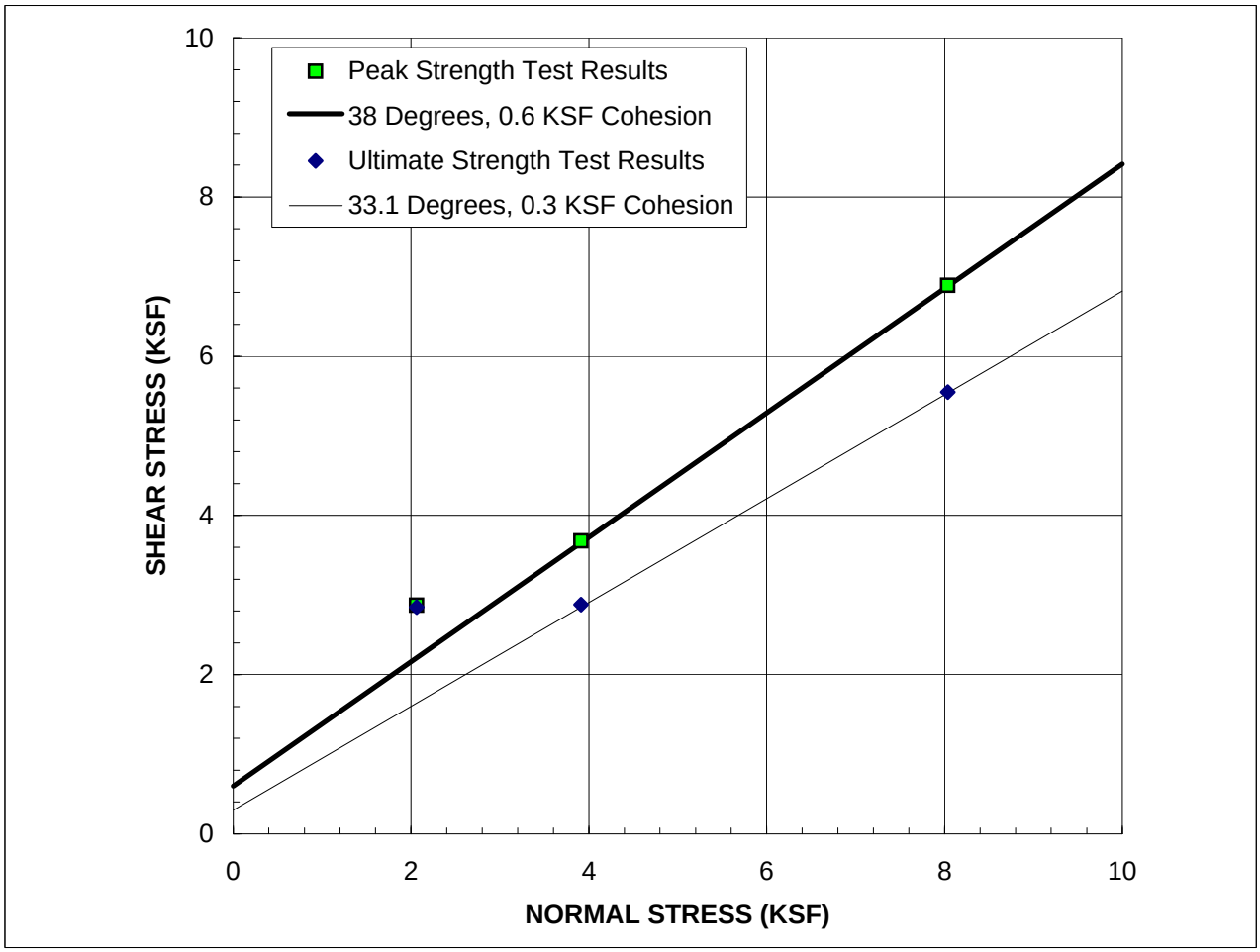
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3k





SAMPLE: B-RW030 R7@30'

Description:	Very Dark Greenish Gray Fine Sand with Silt and Traces of Shells

	PEAK	ULTIMATE
ϕ'	38.0 ^{o}	33.1 ^{o}
c'	0.60 KSF	0.30 KSF

STRAIN RATE: 0.0250 IN/MIN

(Sample was consolidated and drained)

	IN-SITU	AS-TESTED
γ_d	PCF	0.0 PCF
w_c	%	26.3 %

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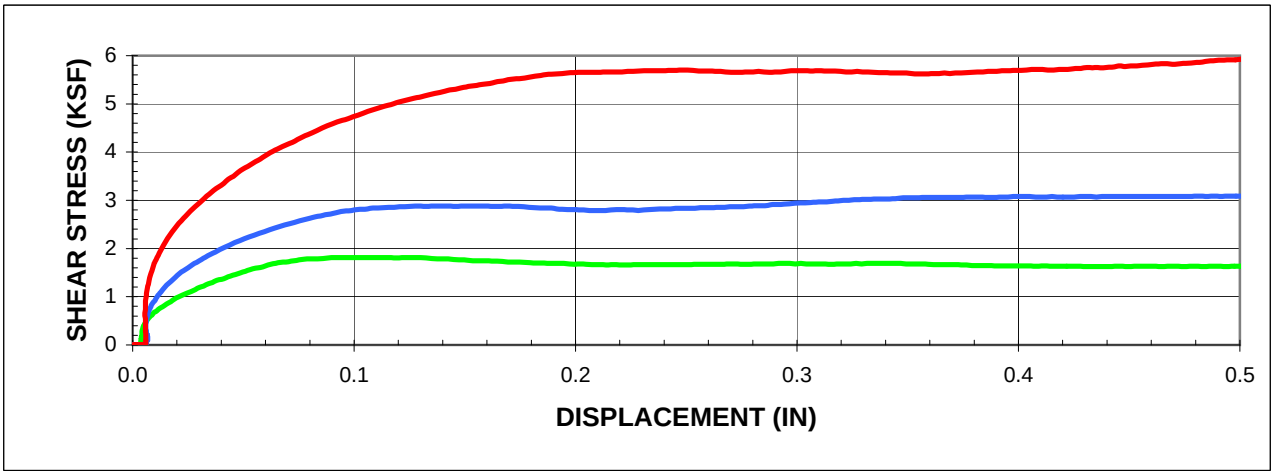
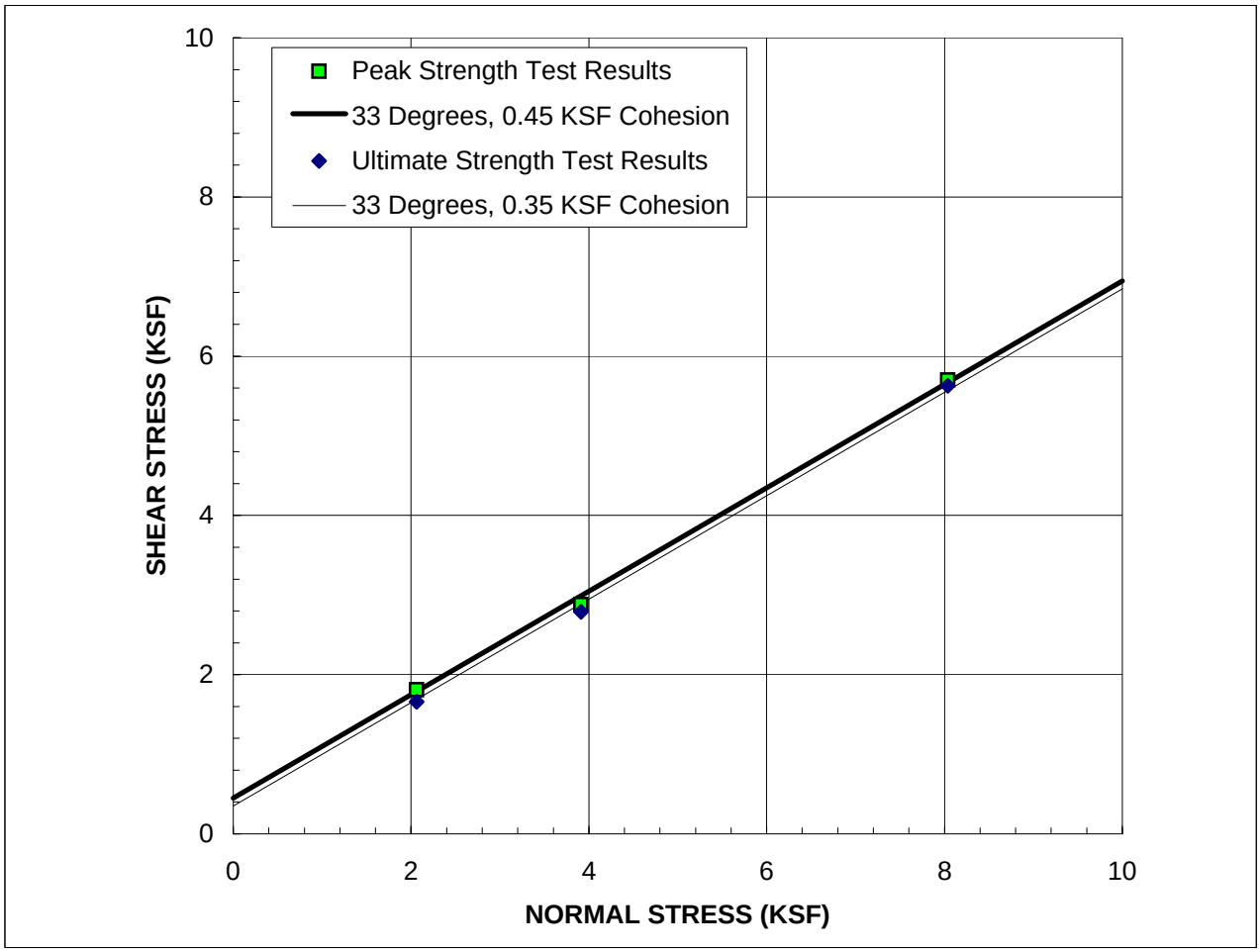
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3I





SAMPLE: B-RW032 R7A@30'

Description:	Very Dark Greenish Gray Silty Sand with Shells

STRAIN RATE: 0.0050 IN/MIN

(Sample was consolidated and drained)

	PEAK	**ULTIMATE**
ϕ'	33 ^{o}	33 ^{o}
c'	0.45 KSF	0.35 KSF

	IN-SITU	**AS-TESTED**
γ_d	PCF	0.0 PCF
w_c	%	30.0 %

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370 Amapola Ave., Suite 212, Torrance, CA 90501
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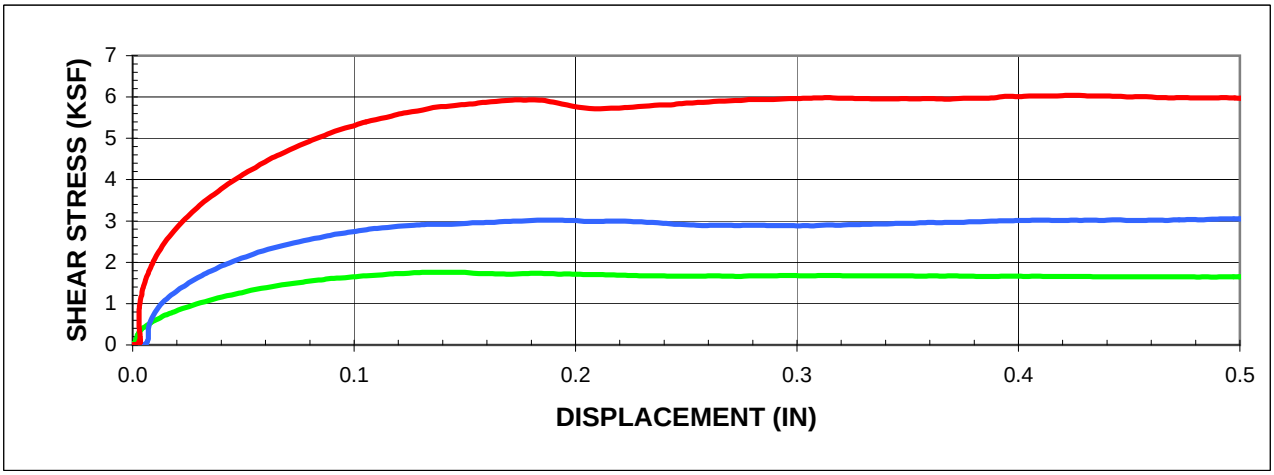
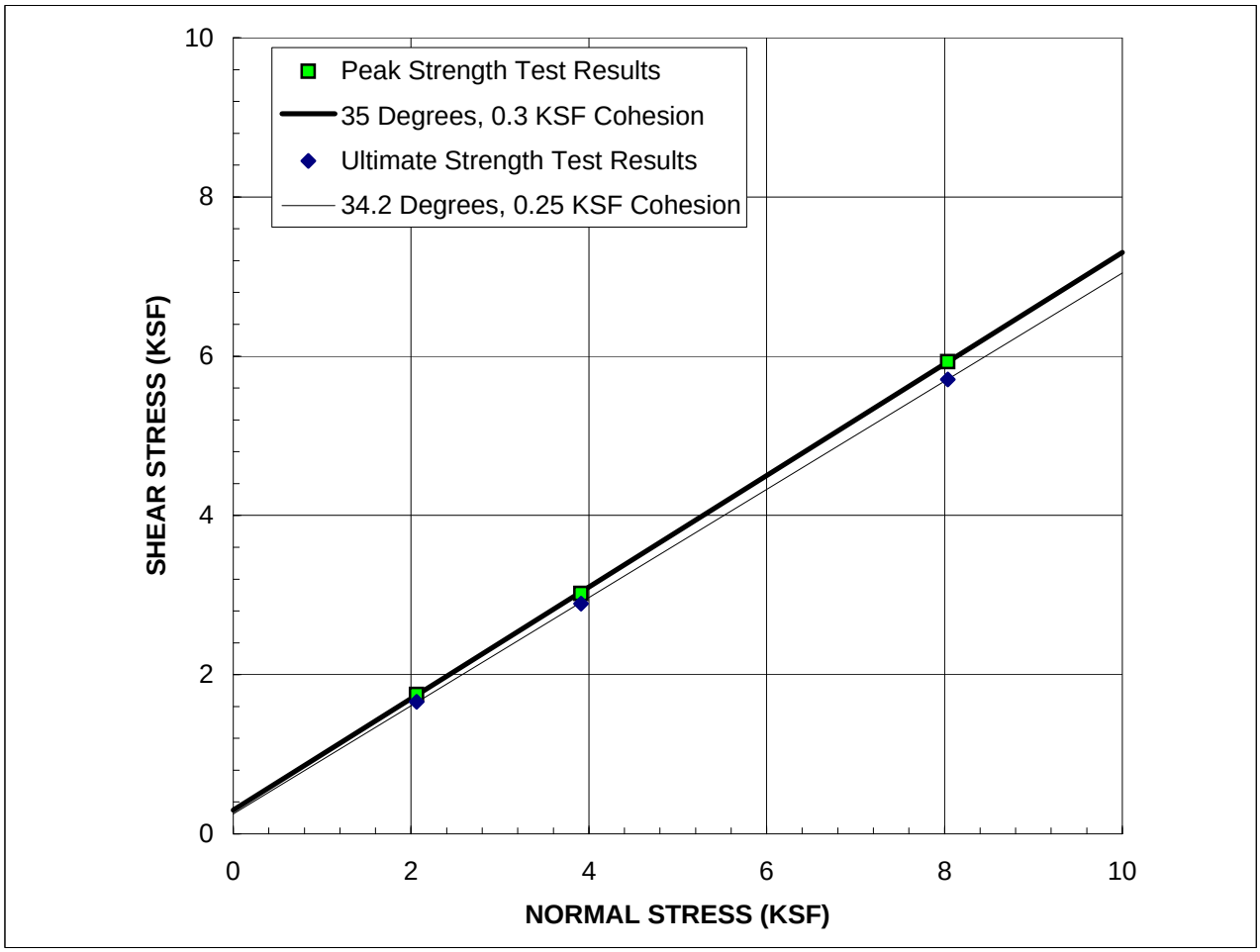
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3m





SAMPLE: B-RW032 R9@40'

Description:	Very Dark Greenish Gray Silty Sand

STRAIN RATE: 0.0050 IN/MIN

(Sample was consolidated and drained)

	PEAK	**ULTIMATE**
ϕ'	35 ^{o}	34.2 ^{o}
c'	0.30 KSF	0.25 KSF

	IN-SITU	**AS-TESTED**
γ_d	PCF	0.0 PCF
w_c	%	31.0 %

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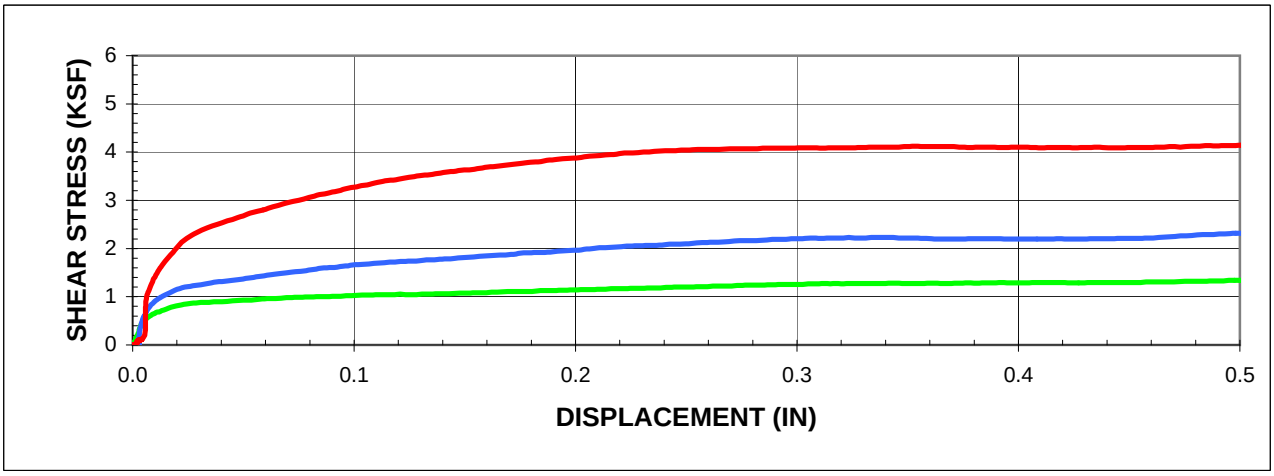
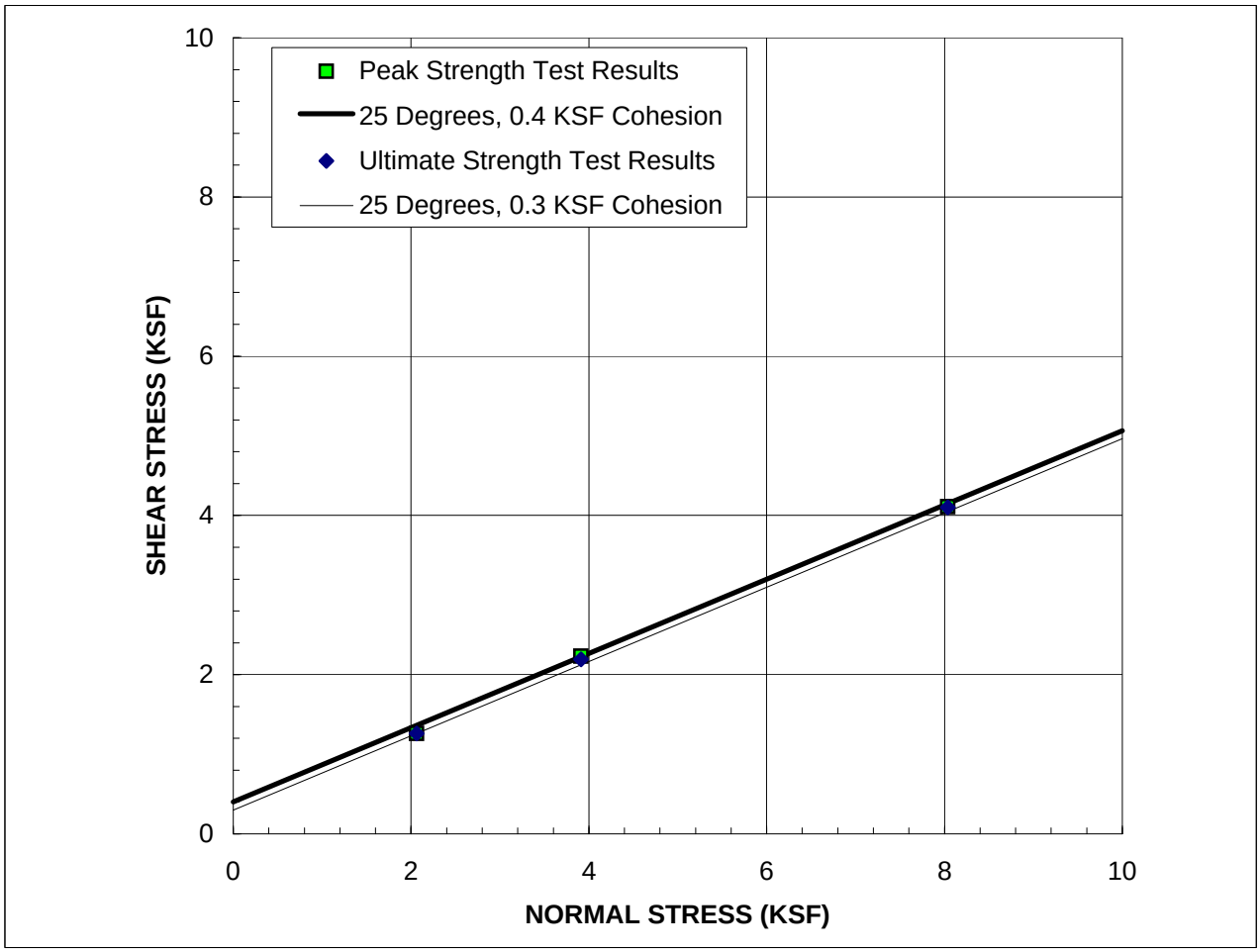
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3n





SAMPLE: B-RW036 R6A@30'

Description:	Very Dark Greenish Gray Sandy Silty Clay with Traces of Shells

STRAIN RATE: 0.0030 IN/MIN

(Sample was consolidated and drained)

	PEAK	ULTIMATE
ϕ'	25 ^{o}	25 ^{o}
c'	0.40 KSF	0.30 KSF

	IN-SITU	AS-TESTED
γ_d	PCF	0.0 PCF
w_c	%	48.1 %

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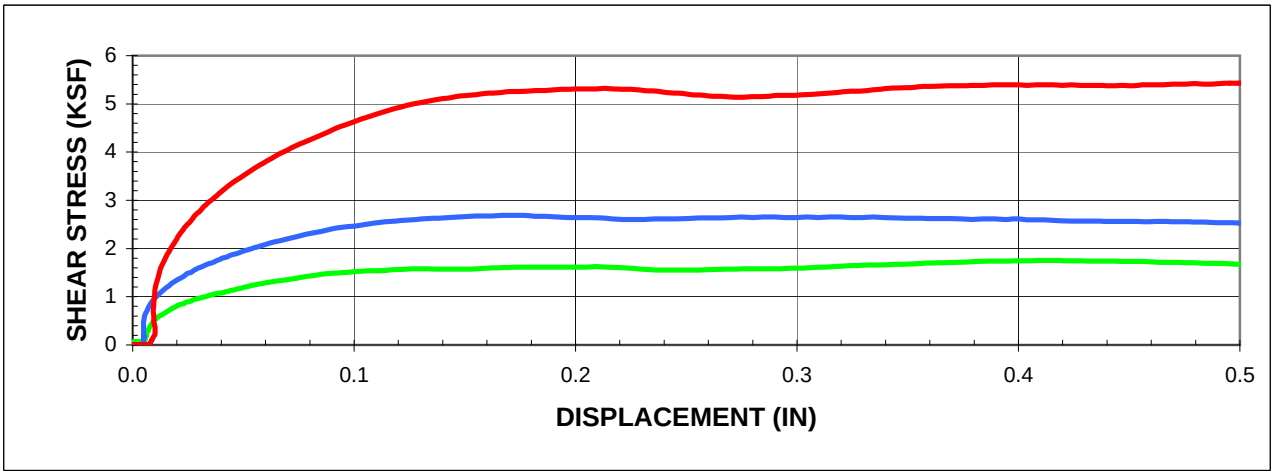
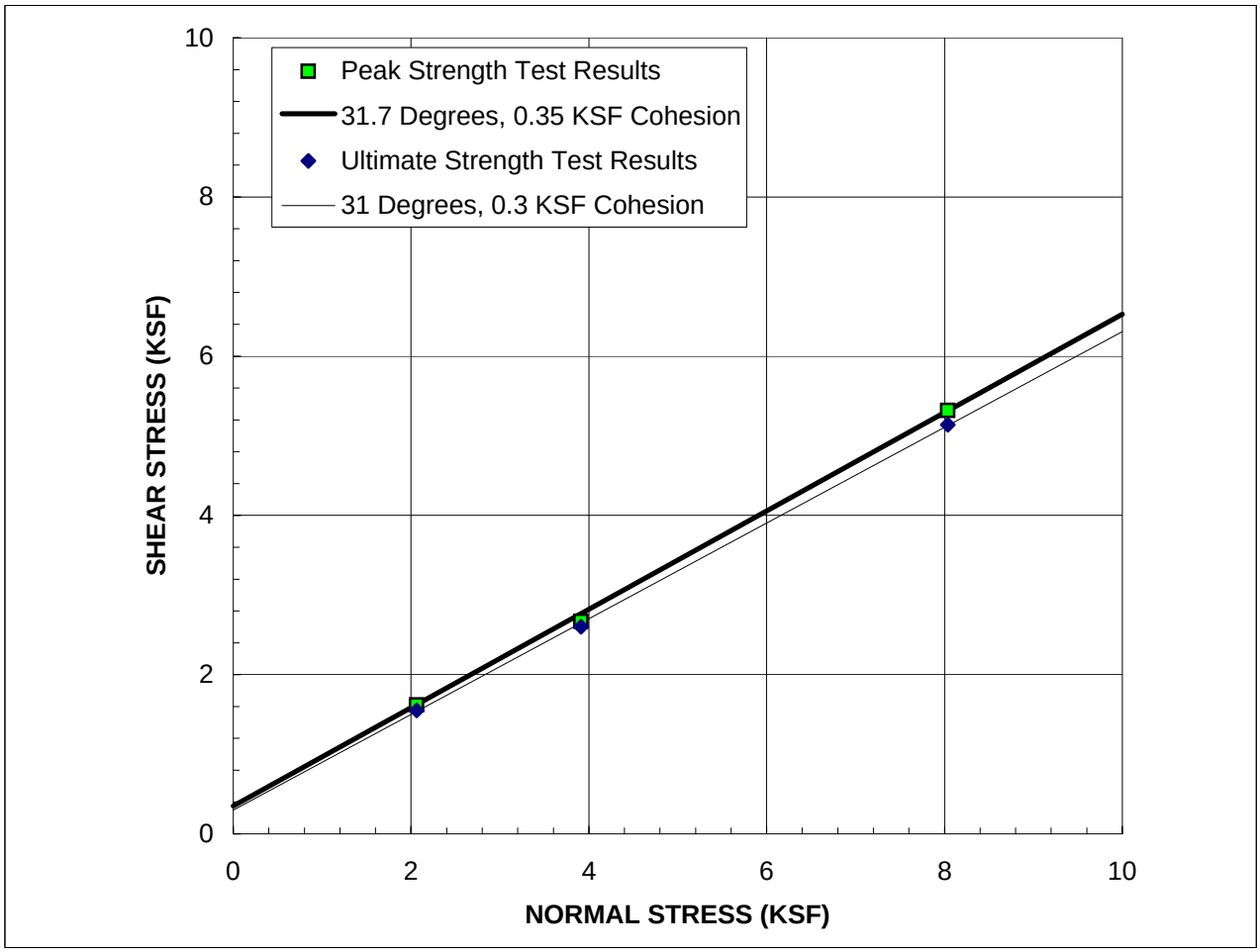
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3o





SAMPLE: B-RW041 R2A@5'

Description:	Yellowish Brown Clayey Silty Sand

STRAIN RATE: 0.0050 IN/MIN

(Sample was consolidated and drained)

	PEAK	**ULTIMATE**
ϕ'	31.7 ^{o}	31 ^{o}
c'	0.35 KSF	0.30 KSF

	IN-SITU	**AS-TESTED**
γ_d	PCF	0.0 PCF
w_c	%	36.1 %

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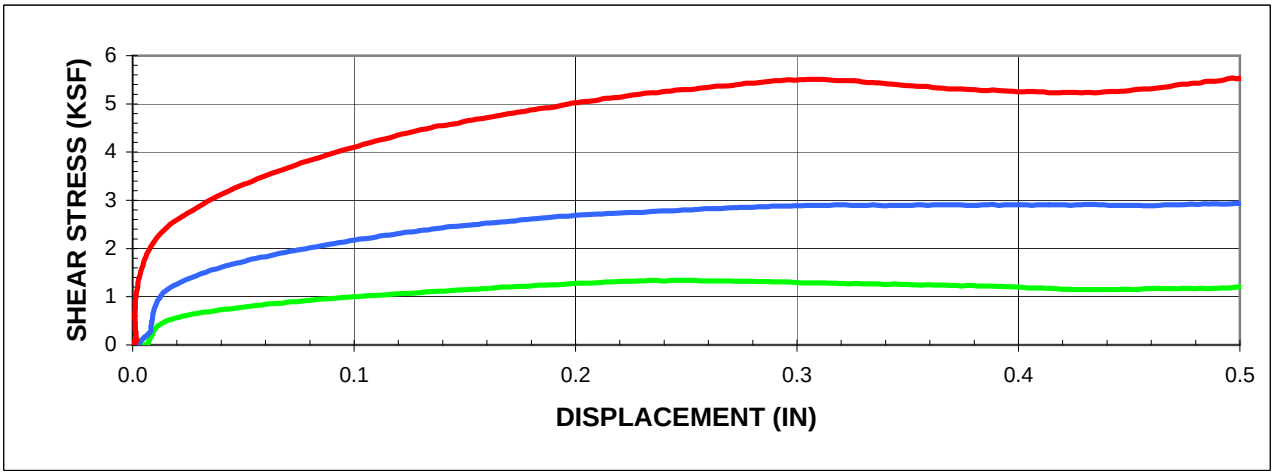
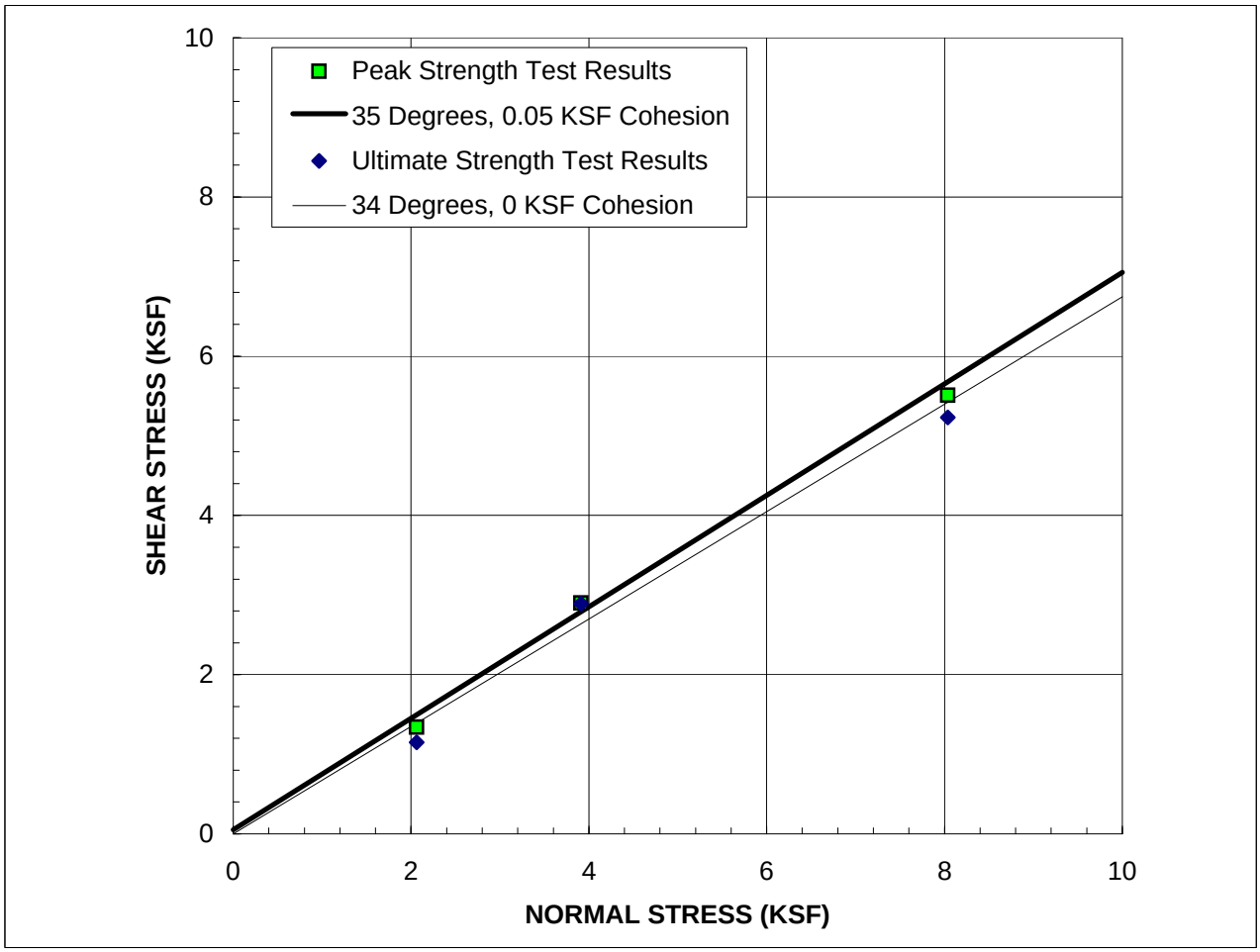
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3p





SAMPLE: B-RW041 R4A@15'

Description:	Dark Greenish Gray Clayey Silt / Silty Clay with Sand

	PEAK	**ULTIMATE**
ϕ'	35 ^{o}	34 ^{o}
c'	0.05 KSF	0.00 KSF

STRAIN RATE: 0.0025 IN/MIN

(Sample was consolidated and drained)

	IN-SITU	**AS-TESTED**
γ_d	PCF	0.0 PCF
w_c	%	43.8 %

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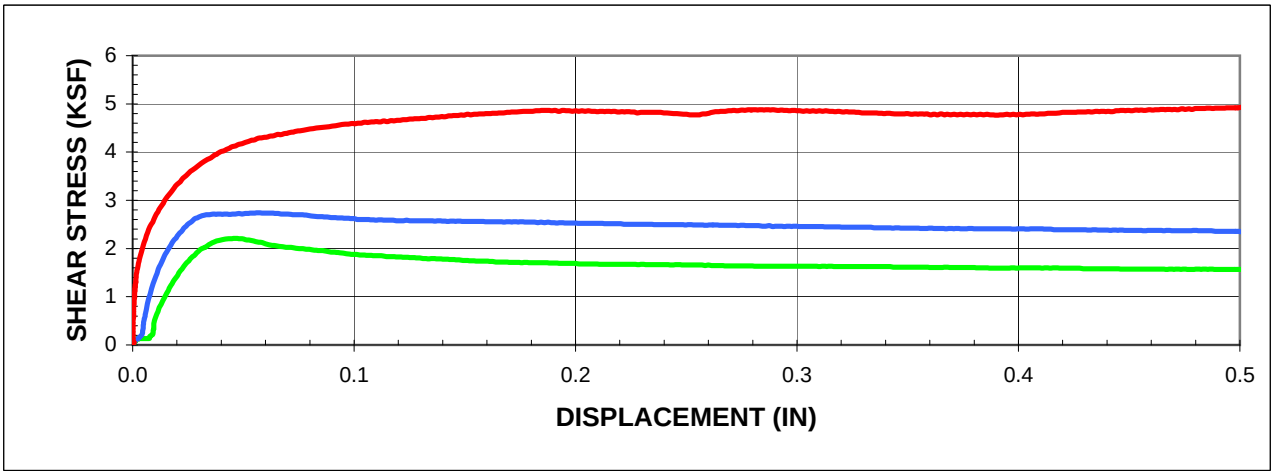
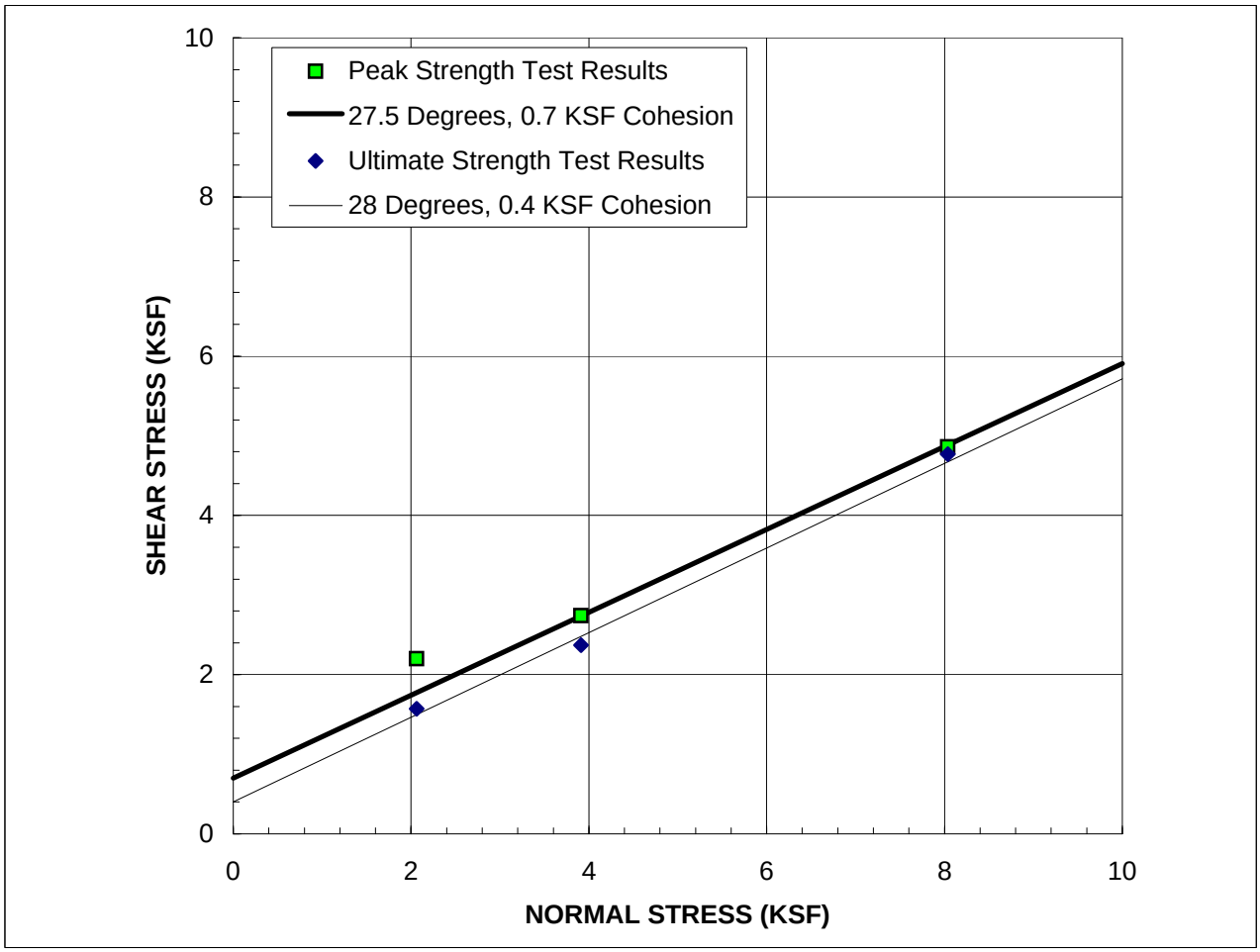
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3q





SAMPLE: B-RW044 R7A@35'

Description:	Very Dark Greenish Gray Clay

STRAIN RATE: 0.0025 IN/MIN

(Sample was consolidated and drained)

	PEAK	ULTIMATE
ϕ'	27.5 ^{o}	28.0 ^{o}
c'	0.70 KSF	0.40 KSF

	IN-SITU	AS-TESTED
γ_d	PCF	0.0 PCF
w_c	%	23.3 %

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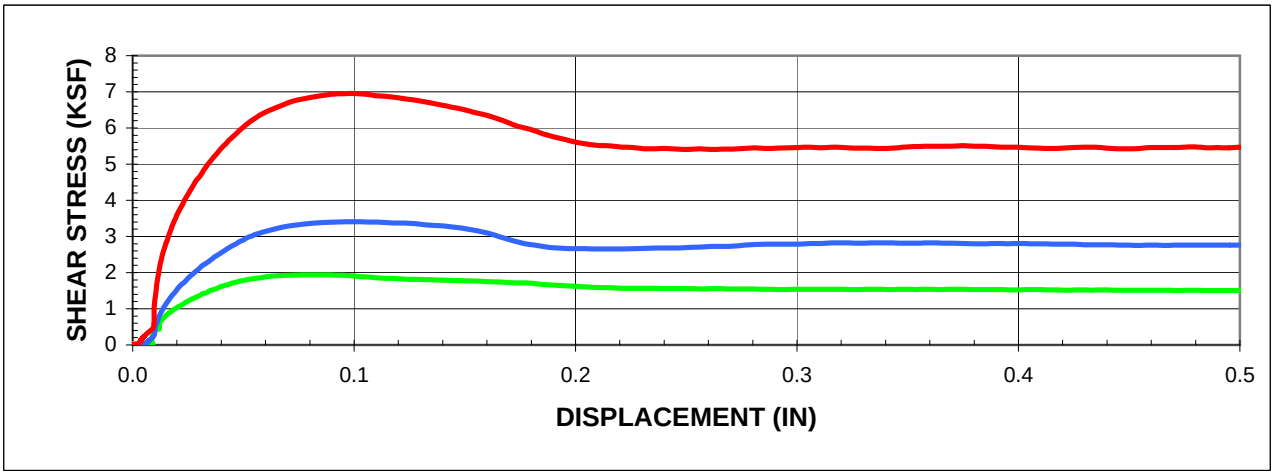
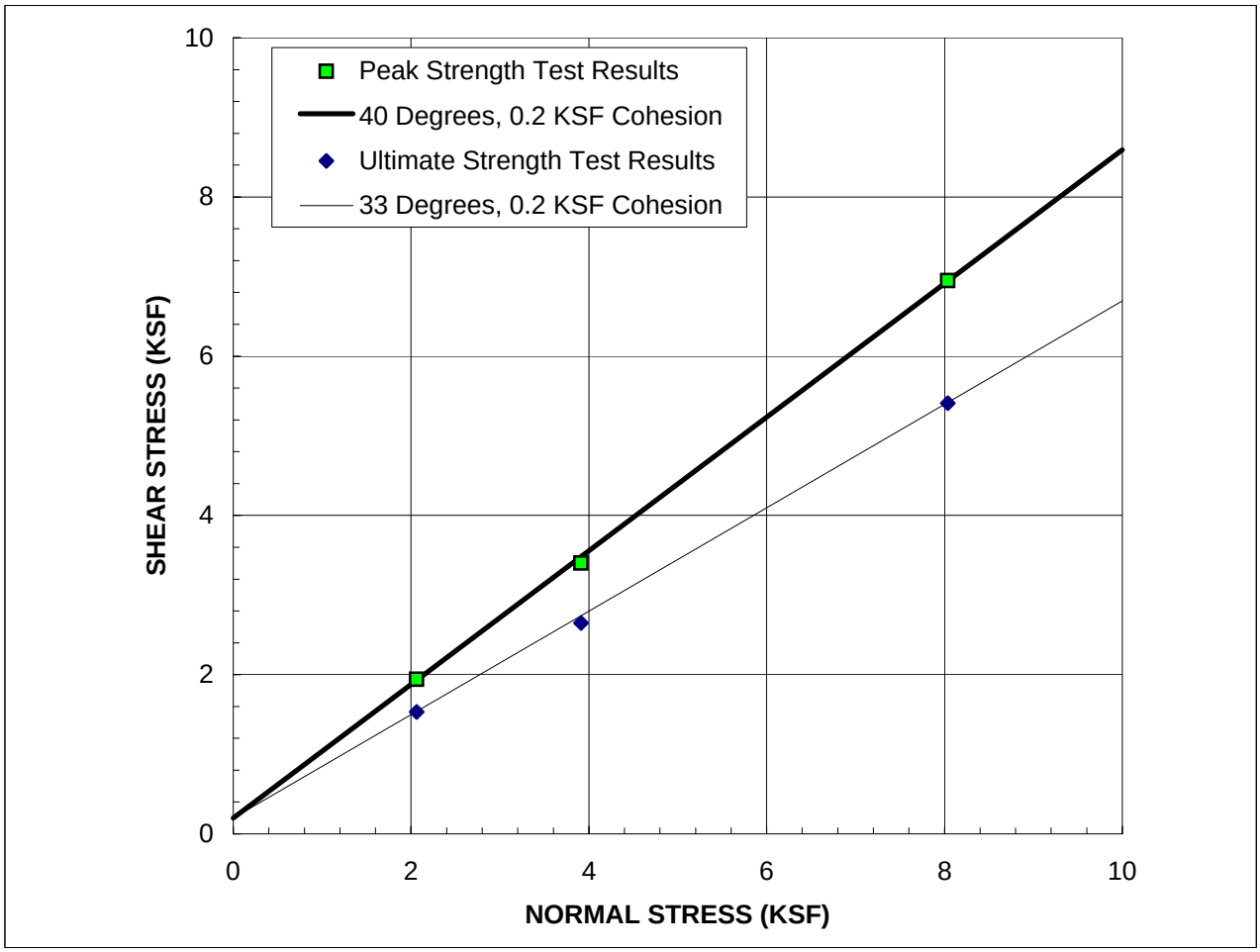
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3r





SAMPLE: B-RW049 R9@40'

Description: Dark Greenish Gray Sand

STRAIN RATE: 0.0250 IN/MIN

(Sample was consolidated and drained)

	PEAK	ULTIMATE
ϕ'	40 ^{o}	33 ^{o}
c'	0.20 KSF	0.20 KSF

	IN-SITU	AS-TESTED
γ_d	PCF	0.0 PCF
w_c	%	23.0 %

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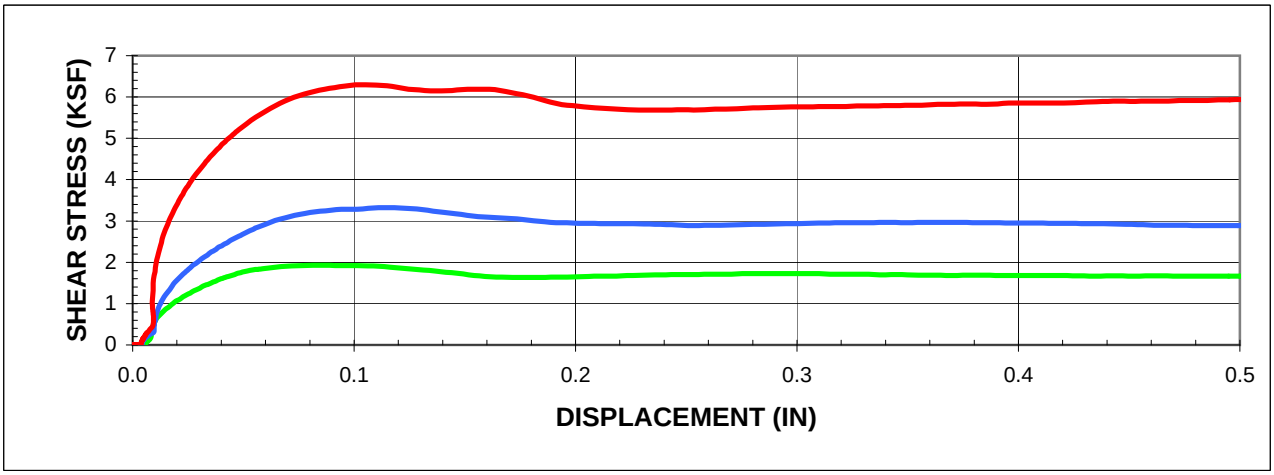
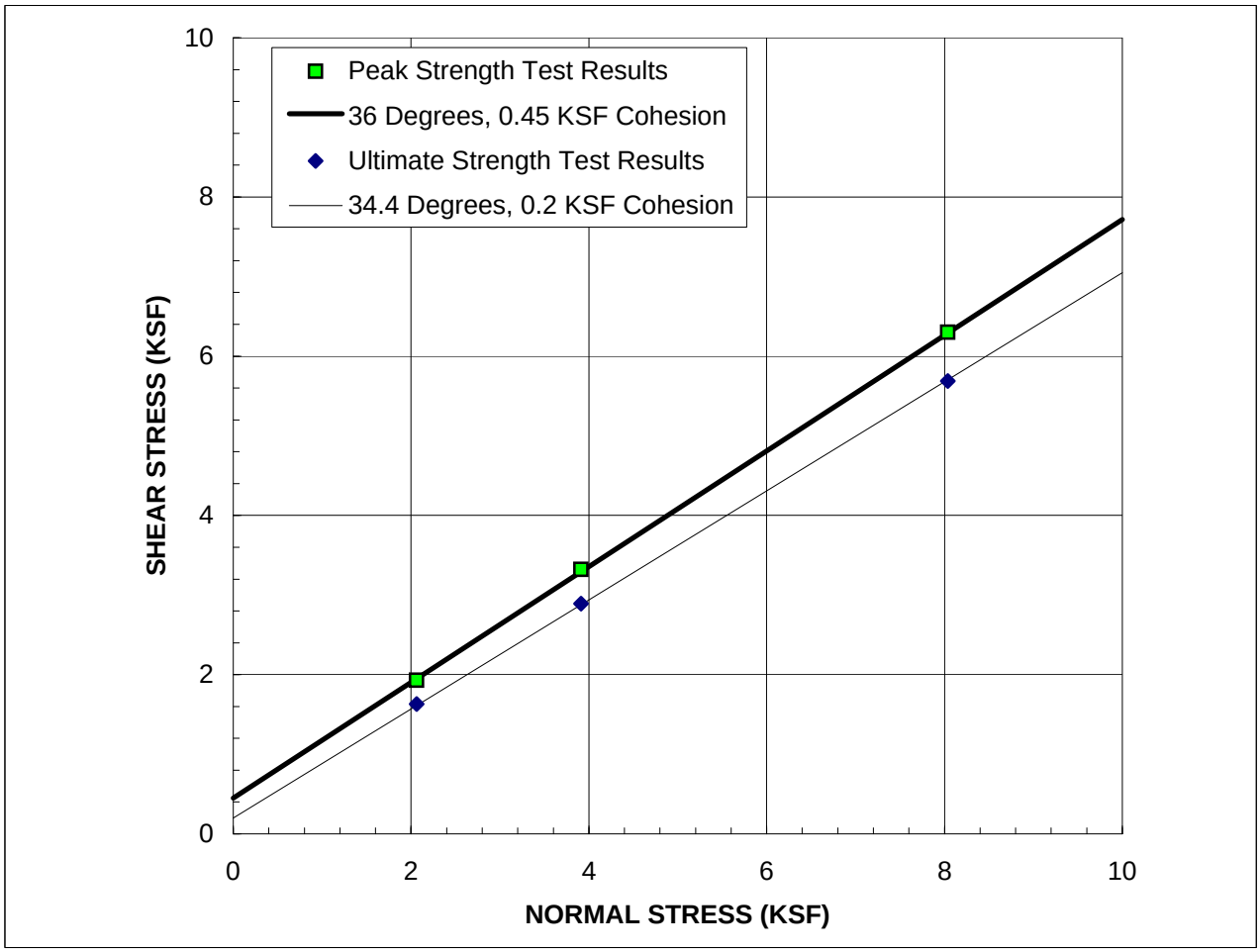
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3s





SAMPLE: B-RW053 R6A@30'

Description:	Very Dark Greenish Gray Silty Sand

STRAIN RATE: 0.0050 IN/MIN

(Sample was consolidated and drained)

	PEAK	ULTIMATE
ϕ'	36 ^{o}	34.4 ^{o}
c'	0.45 KSF	0.20 KSF

	IN-SITU	AS-TESTED
γ_d	PCF	0.0 PCF
w_c	%	29.4 %

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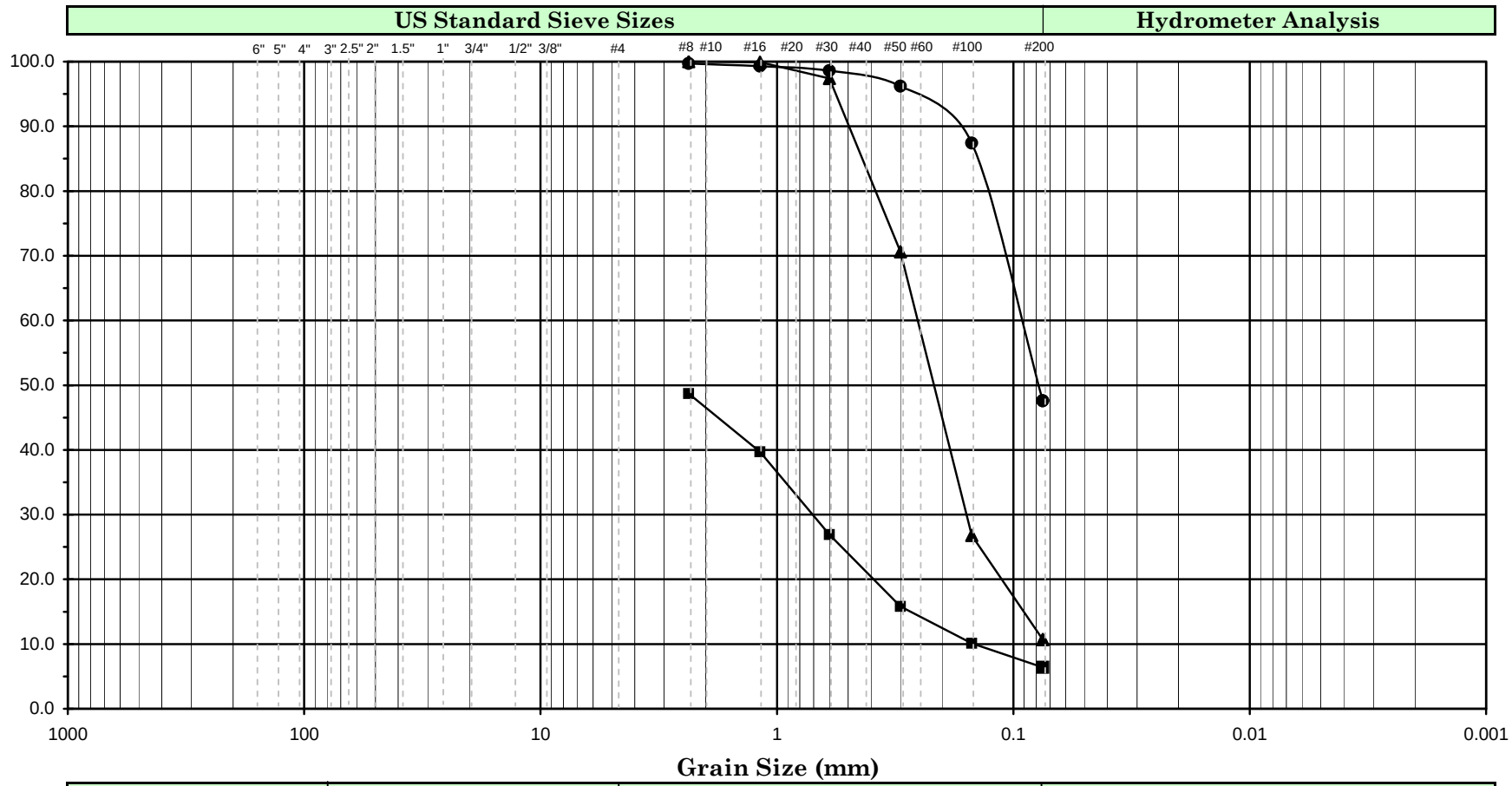
DIRECT SHEAR TEST RESULTS

Project No.: LA962A

FIGURE B1-3t



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

Symbol	Boring Number	Sample Number	Depth (ft)		Depth (m)		Soil Color	Soil Description	U.S.C.S.
●	A-HSA066	R4	7.5	9.0	2.3	2.7	Dark Grayish Brown	Clayey Sand with Shells	SC
▲	C-HSA061	R1	2.5	4.0	0.8	1.2	Yellowish Brown	Poorly graded Sand with Silt	SP-SM
■	B-RW041	R13	60.0	61.5	18.3	18.8	Dark Greenish Gray	Poorly graded Sand with Silt and Gravel	SP-SM
◆									
○									
△									
Remark									

GROUP DELTA CONSULTANTS

Ballona Creek Wetlands Restoration

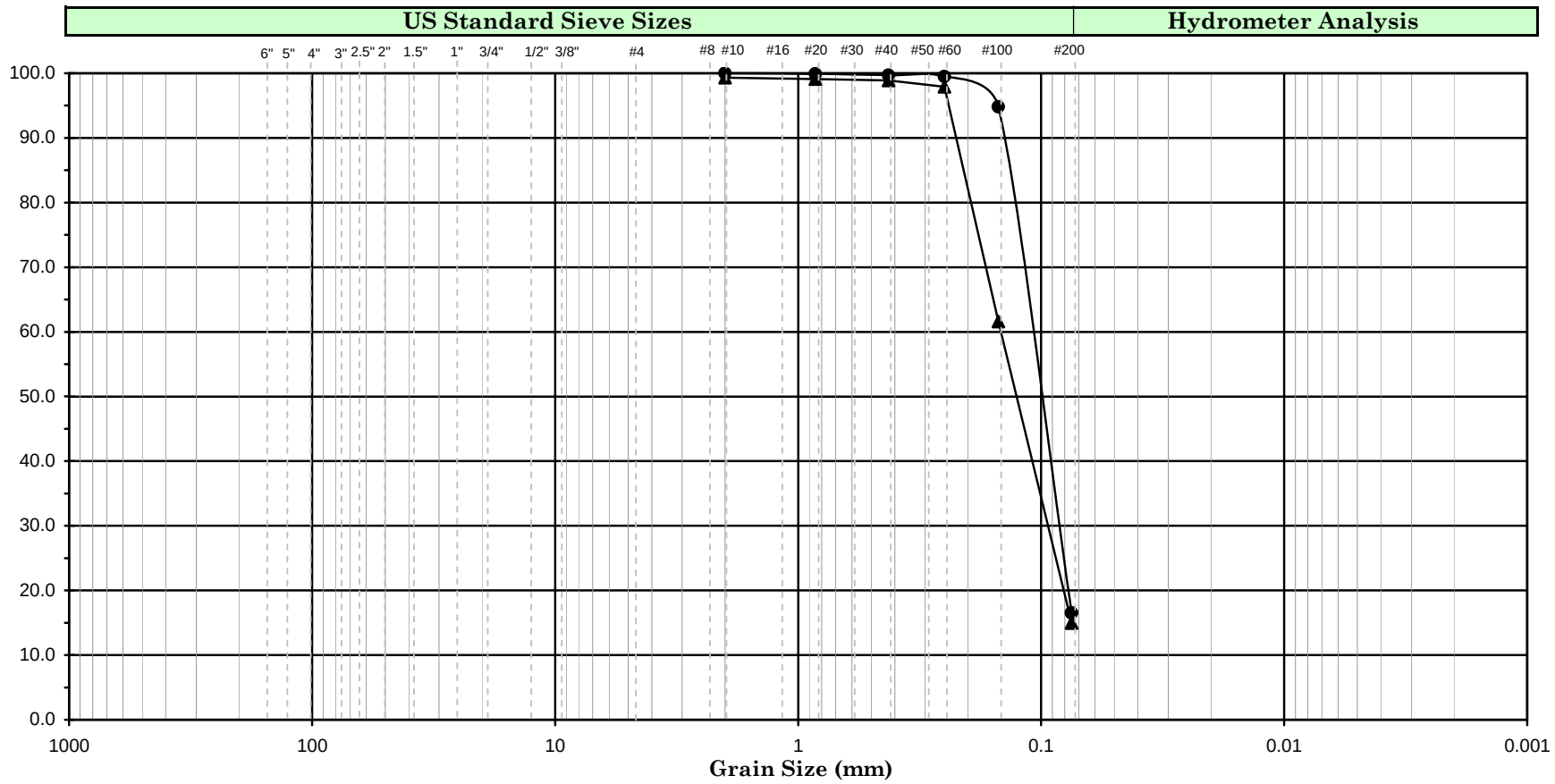
GRAIN SIZE ANALYSIS

(ASTM D-422-63)

Project No. : LA962A **Date : 01/28/13**

Figure No. : B1-4a

1



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

Symbol	Boring Number	Sample Number	Depth (ft)		Depth (m)		Soil Color	Soil Description	U.S.C.S.
●	B-RW041	S5	20.0	21.5	6.1	6.6	Very Dark Greenish Gray	Sand with Silt	SM
▲	B-RW053	S7	35.0	36.5	10.7	11.1	Dark Greenish Gray	Sand with Silt	SM
■									
◆									
○									
△									
Remark									

GROUP DELTA CONSULTANTS

Ballona Creek Wetlands Restoration

Project No. : LA962A

Date : 01/28/13

GRAIN SIZE ANALYSIS

(ASTM D-422-63)

Figure No. : B1-4b

2

APPENDIX B2
LABORATORY TESTING BY OTHERS

APPENDIX B
PREVIOUS LABORATORY TESTING

B2.1 General

Laboratory testing has been conducted as part of the previous geotechnical and environmental investigations at Ballona Creek Wetlands site. A short summary of the geotechnical laboratory testing programs adopted in previous investigations by Law Crandall, Inc. Diaz.Yourman & Associates and Weston Solutions, Inc. are presented below.

B2.2 Law Crandall, Inc. Laboratory Testing

Area A:

Field moisture content and dry density tests were performed on undisturbed samples. Atterberg limit tests were also performed on selected samples. Liquid limit tests were repeated on some oven-dried samples to assess the organic content. Direct shear tests were performed on selected undisturbed samples to determine the strength of the soils. The direct shear tests were performed at field and increased moisture content and at various different surcharge pressures on in-situ samples and some remolded samples. Confined consolidation tests were performed on 23 undisturbed samples to determine the compressibility of the soils. The samples were tested at field moisture content. Particle size analyses were performed using mechanical sieve analysis and hydrometer analysis testing methods on six samples. Compaction tests in accordance with the ASTM Designation D1557-70 were also performed on samples from two borings. Permeability tests were performed on ten undisturbed samples to determine the coefficient of permeability of the soils, under confining pressures of 200 and 1,000 psf. Soil corrosivity tests were also performed on eleven samples.

Area B

Field moisture content and dry density tests were performed on undisturbed samples. Atterberg limit tests were also performed on 4 samples. Direct shear tests were performed on selected undisturbed samples to determine the strength of the soils. The tests were performed at field and increased moisture content and at various different surcharge pressures. Tests were also performed on some remolded samples. Confined consolidation tests were performed on 10 undisturbed samples and 2 remolded samples to determine the compressibility of the soils. Most samples were tested at field moisture content, while three of the samples were tested at increased moisture content. Compaction tests in accordance with the ASTM Designation D1557-78 were performed on samples from two borings. Expansion Index tests were performed on two samples in accordance with Uniform Building Code No. 29-2 method. Permeability tests were performed on eight undisturbed samples to determine the coefficient of permeability of the soils, under

confining pressure of 200 psf. Particle size analyses were performed on representative samples to aid in classification of the soils.

Area C

Field moisture content and dry density tests were performed on undisturbed samples. Atterberg limit tests were also performed on three samples. Direct shear tests were performed on selected undisturbed samples to determine the strength of the soils. The tests were performed at field and near saturation moisture content, and at field overburden and increased surcharge pressures. Direct shear tests were also performed on some remolded samples. Confined consolidation tests were performed on 5 undisturbed samples to determine the compressibility of the soils. Four samples were tested at field moisture content, while one of the samples was tested at increased moisture content. Particle size analyses were performed using mechanical sieve analysis on two samples. Also, Expansion Index test was performed on one sample in accordance with Uniform Building Code No. 29-2 method.

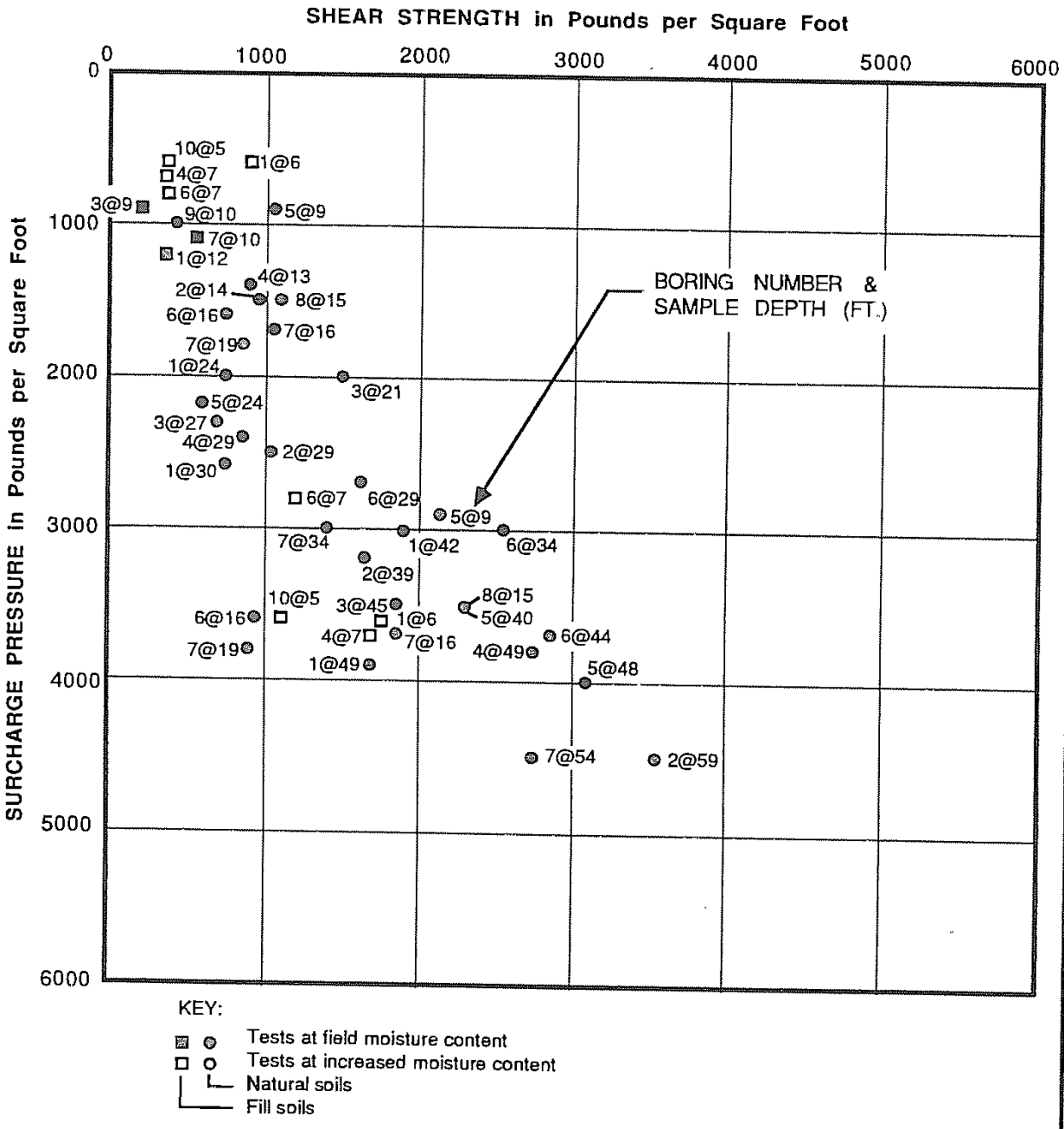
B2.3 Diaz.Yourman & Associates Laboratory Testing

Laboratory testing by Diaz.Yourman & Associates was limited to Areas B and C, and included field moisture content test and particle size analysis testing (including full sieve, percent passing #200 sieves, and hydrometer testing) on most samples, as well as Atterberg limits tests on selected samples. Furthermore, compaction tests were performed on three selected samples.

B2.4 Weston Solutions, Inc. Laboratory Testing

In addition to environmental testing, geotechnical sampling and testing was included as part of Weston's testing program in Area A. Geotechnical tests including in-situ moisture content, grain-size distribution tests (including mechanical sieve analyses and hydrometer testing), and Atterberg limits tests were performed on selected geotechnical samples.

JOB AE-88473 DATE 1/31/89 DR lp O.E. JC CHKD. BK



DIRECT SHEAR TEST DATA

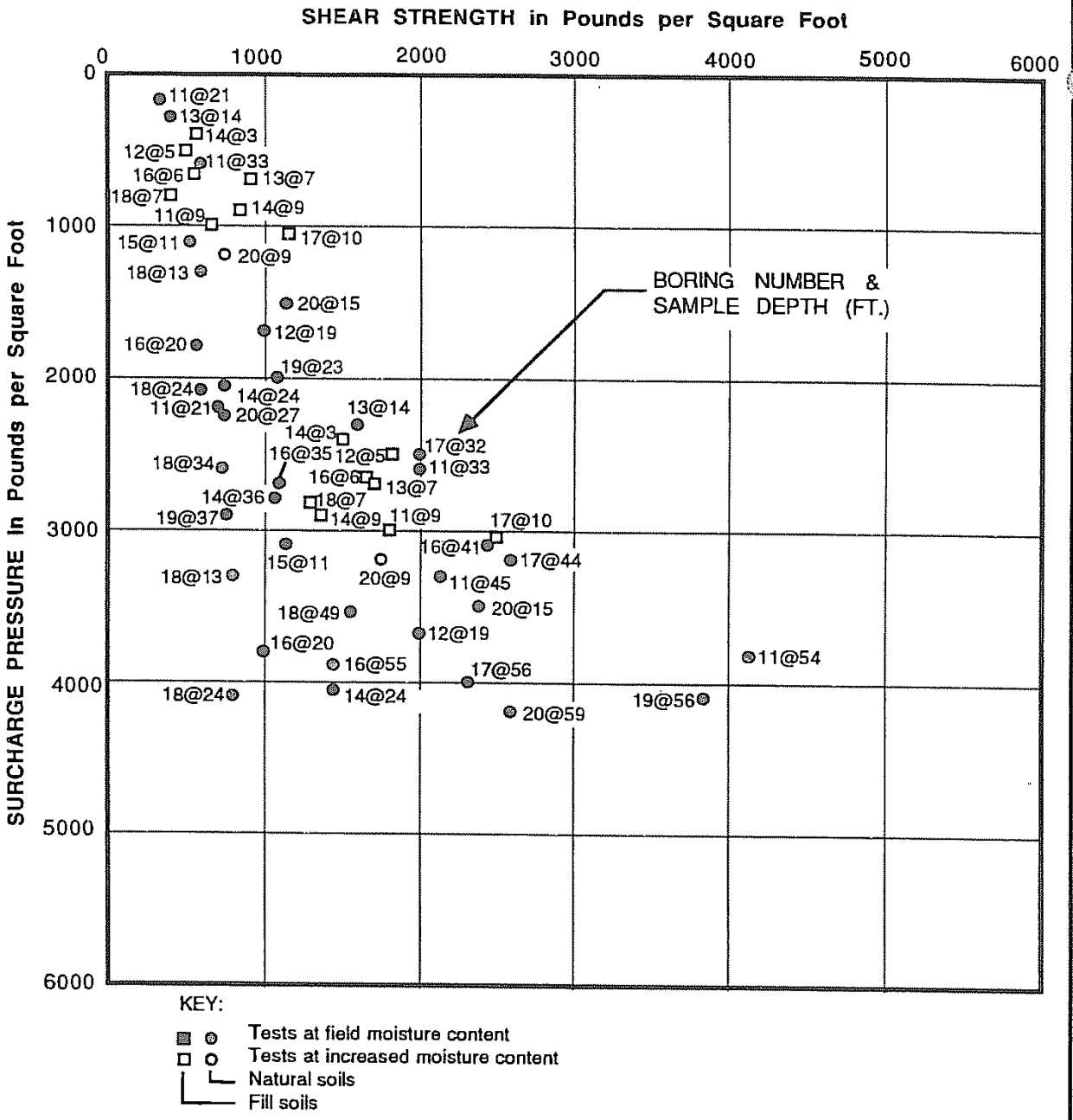
LeROY CRANDALL AND ASSOCIATES

Law Crandall Area A

PLATE A - 3.1

PLATE B2-1

JOB AE-88473 DATE 1/31/89 DR lp O.E. JC CHKD.



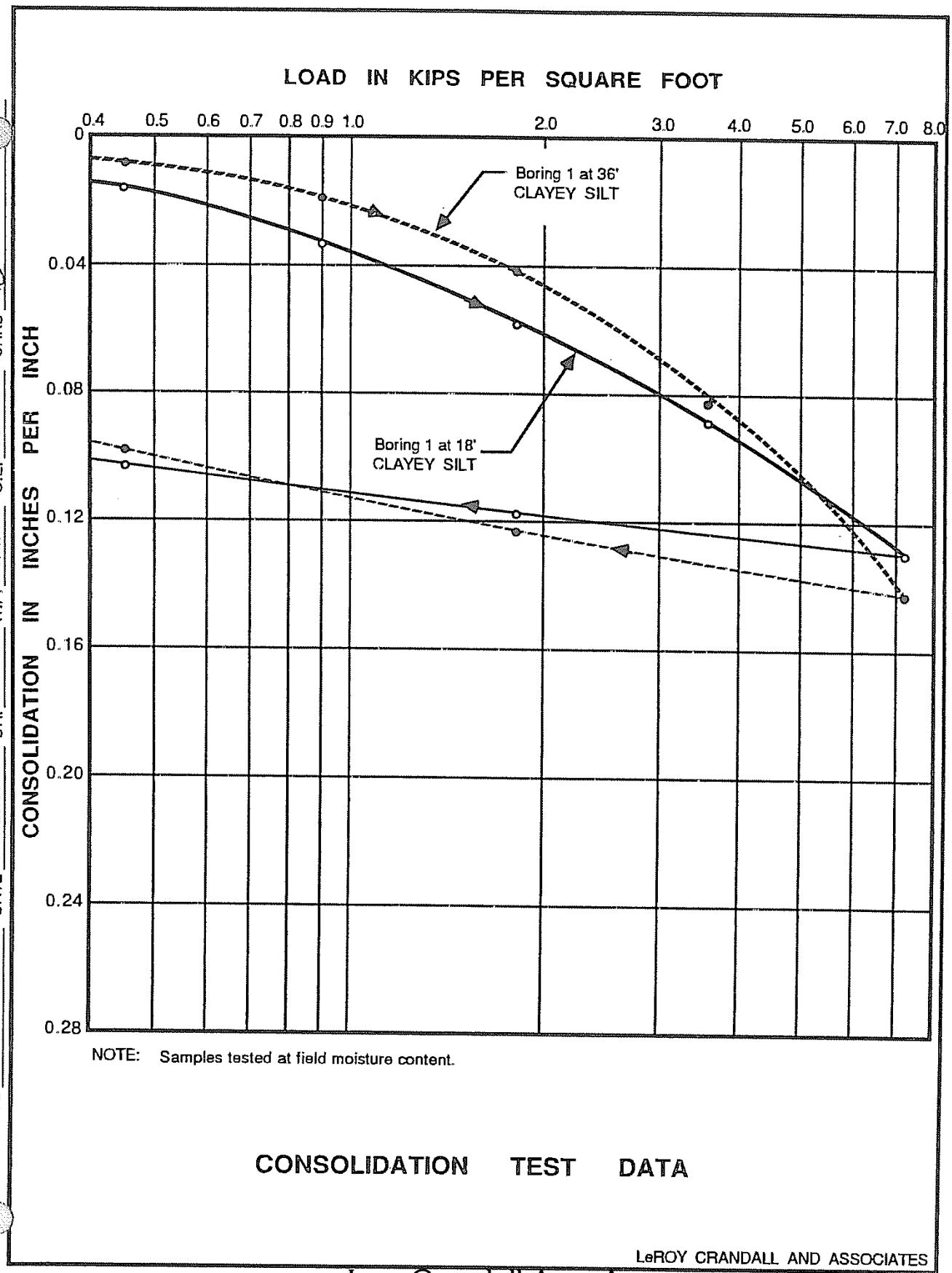
DIRECT SHEAR TEST DATA

LeROY CRANDALL AND ASSOCIATES

Law Crandall Area A

PLATE A - 3.2

PLATE B2-2



NOTE: Samples tested at field moisture content.

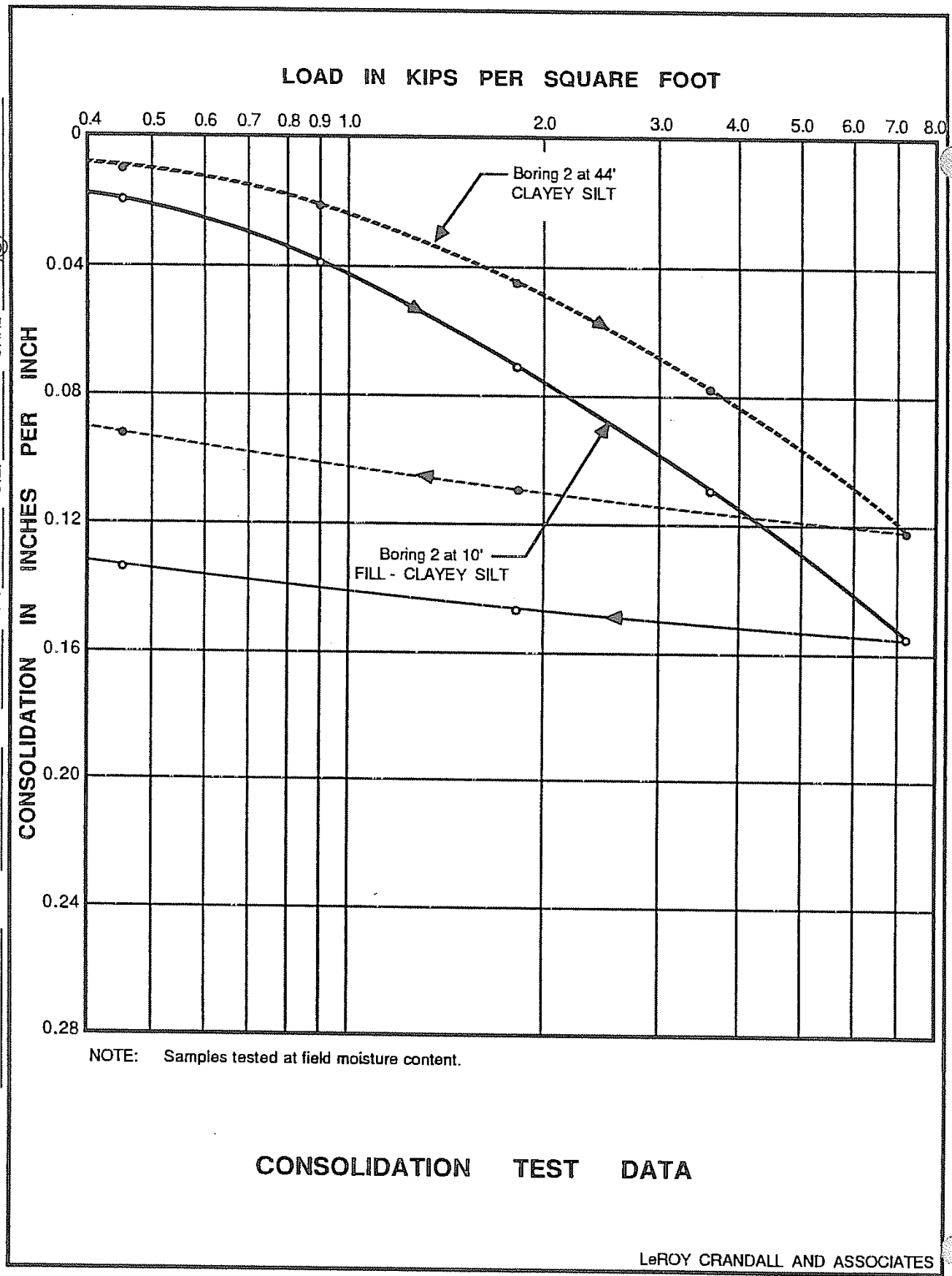
CONSOLIDATION TEST DATA

LeROY CRANDALL AND ASSOCIATES

Law Crandall Area A

PLATE A-4.1

PLATE B2-3



CONSOLIDATION TEST DATA

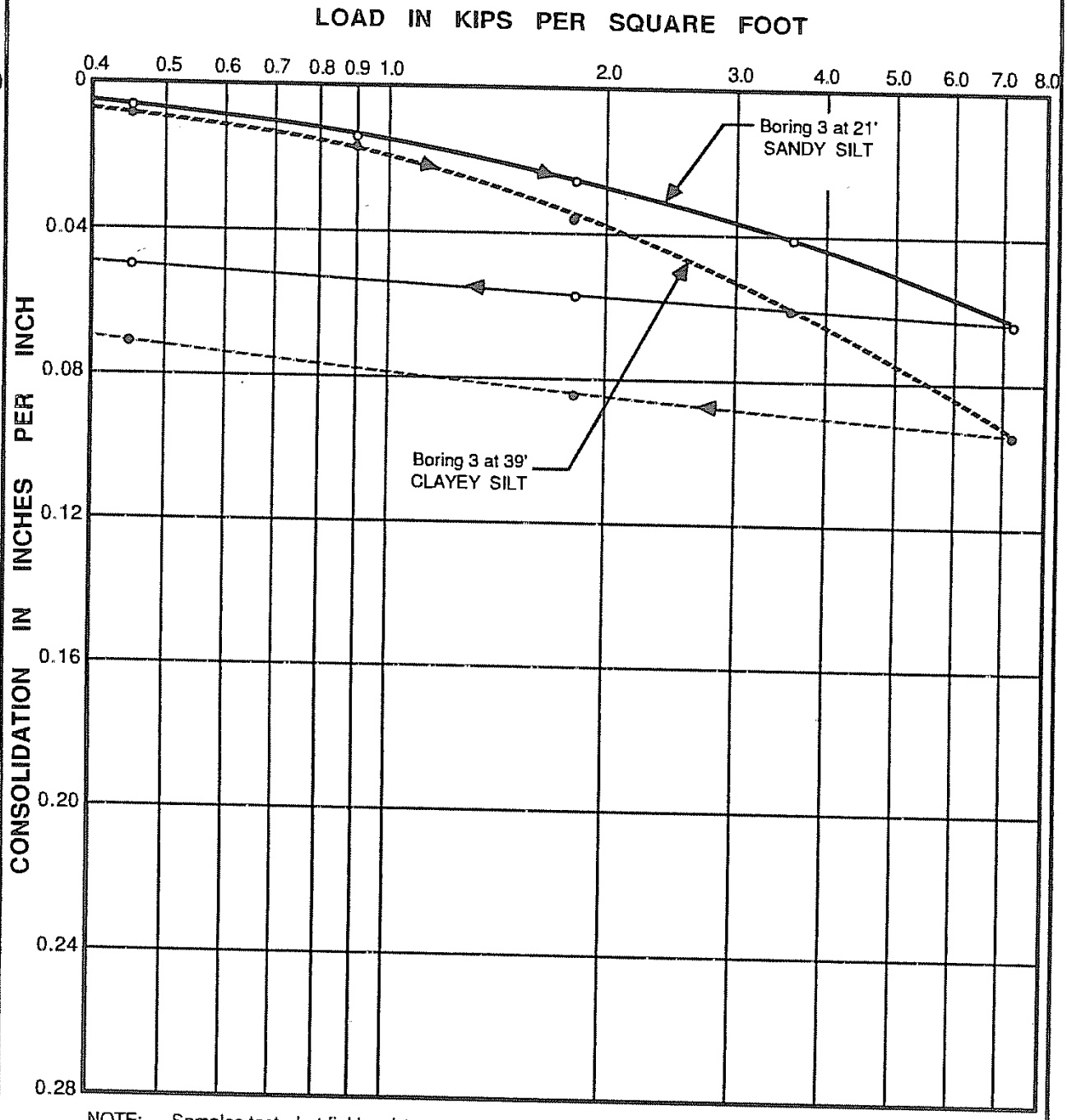
LeROY CRANDALL AND ASSOCIATES

PLATE A-4.2

Law Crandall Area A

PLATE B2-4

JOB AE-88473 DATE 1/25/89 DR. dmh W.P. dmh O.E. JC CHKD



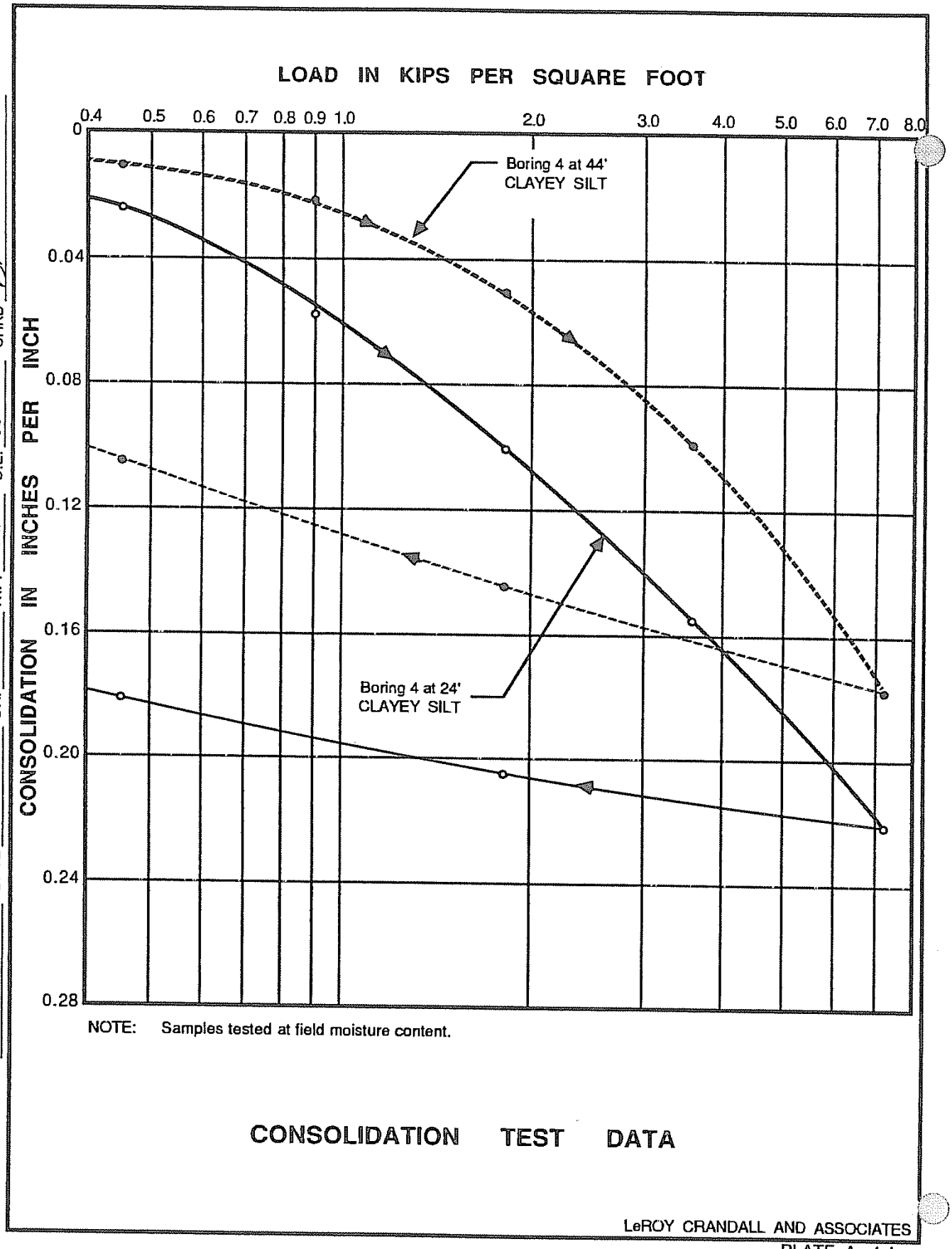
NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA

LeROY CRANDALL AND ASSOCIATES

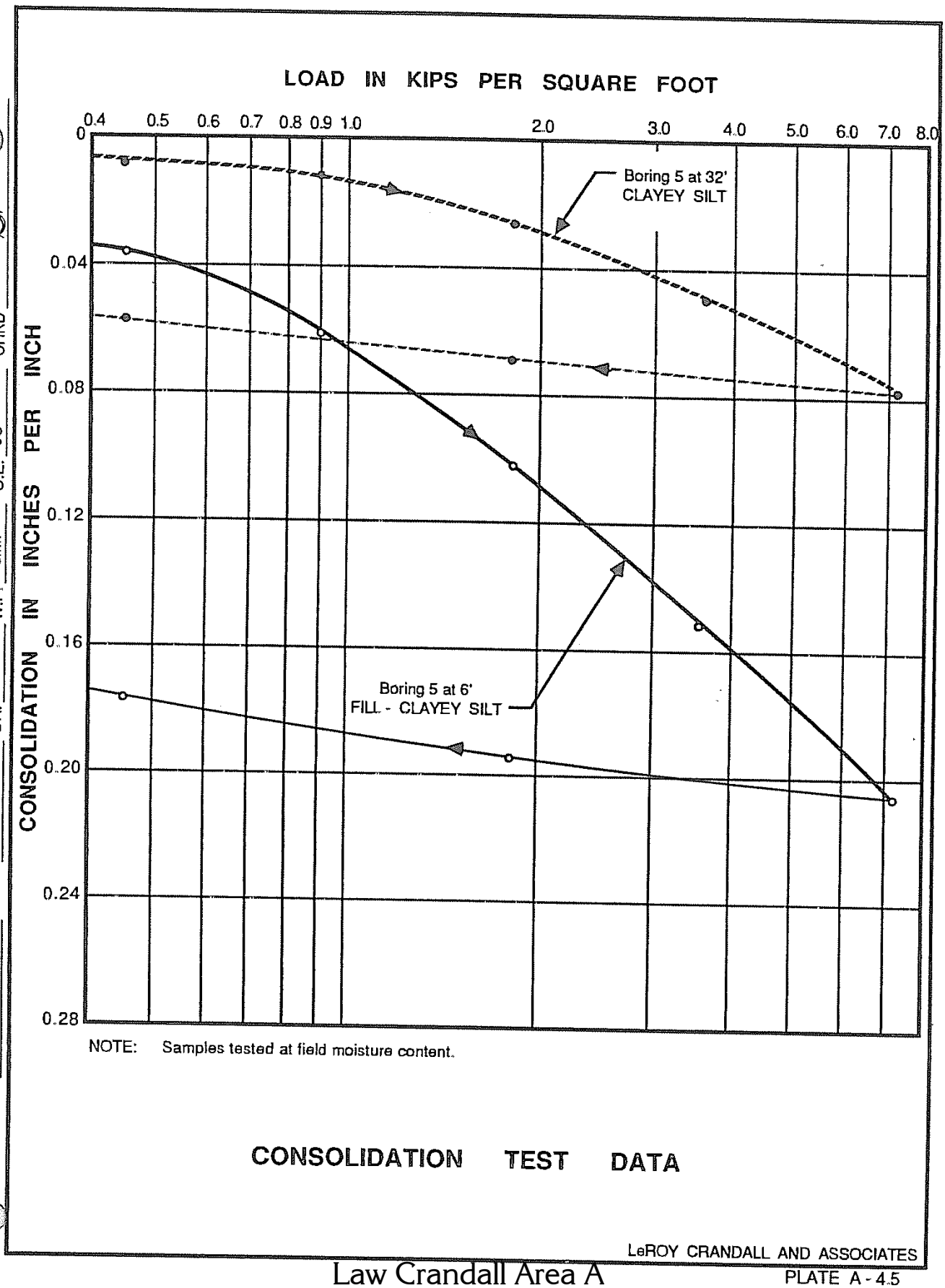
Law Crandall Area A

PLATE A - 4.3
PLATE B2-5



Law Crandall Area A

PLATE B2-6



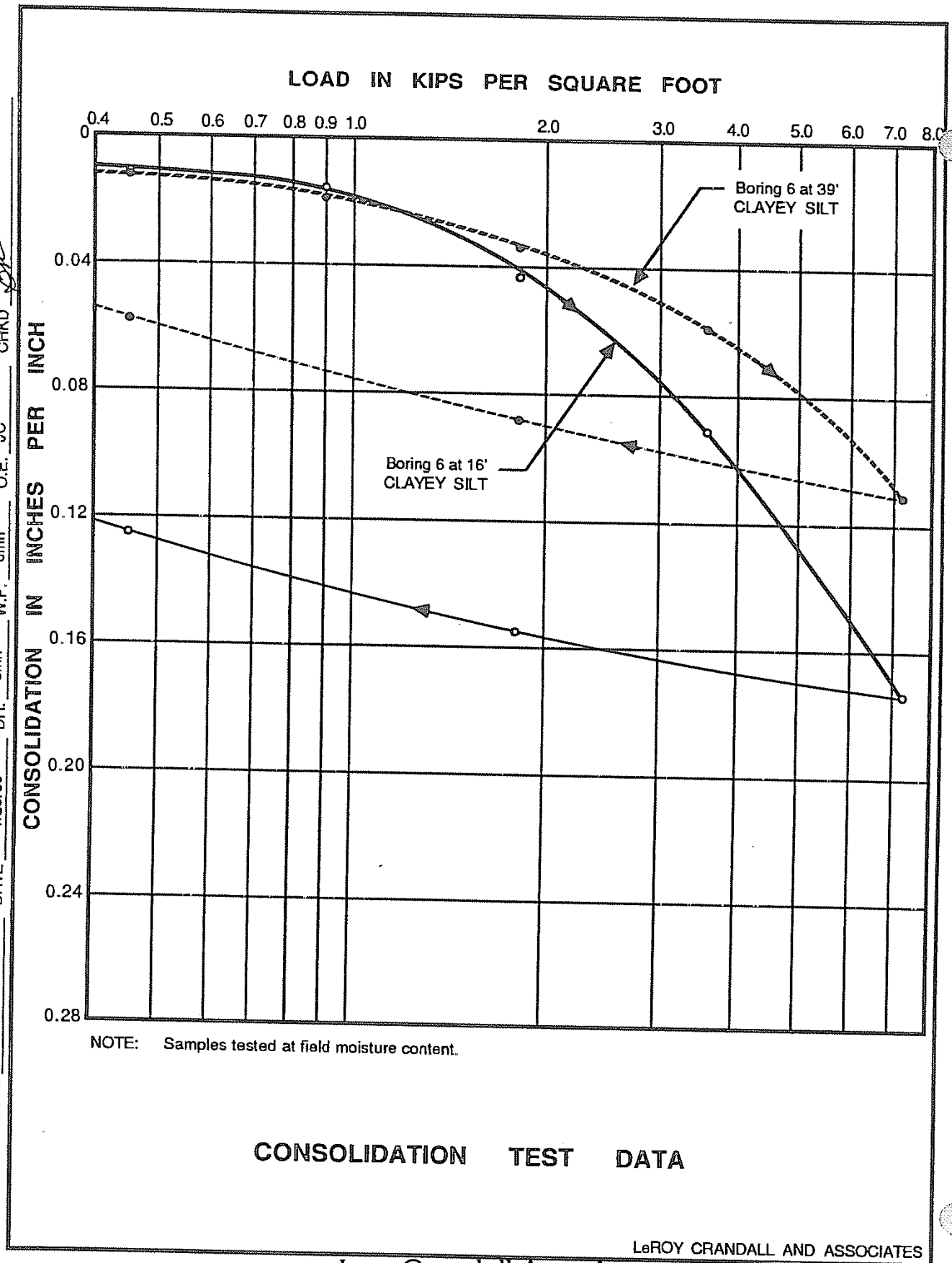
CONSOLIDATION TEST DATA

LeROY CRANDALL AND ASSOCIATES

Law Crandall Area A

PLATE A-4.5

PLATE B2-7



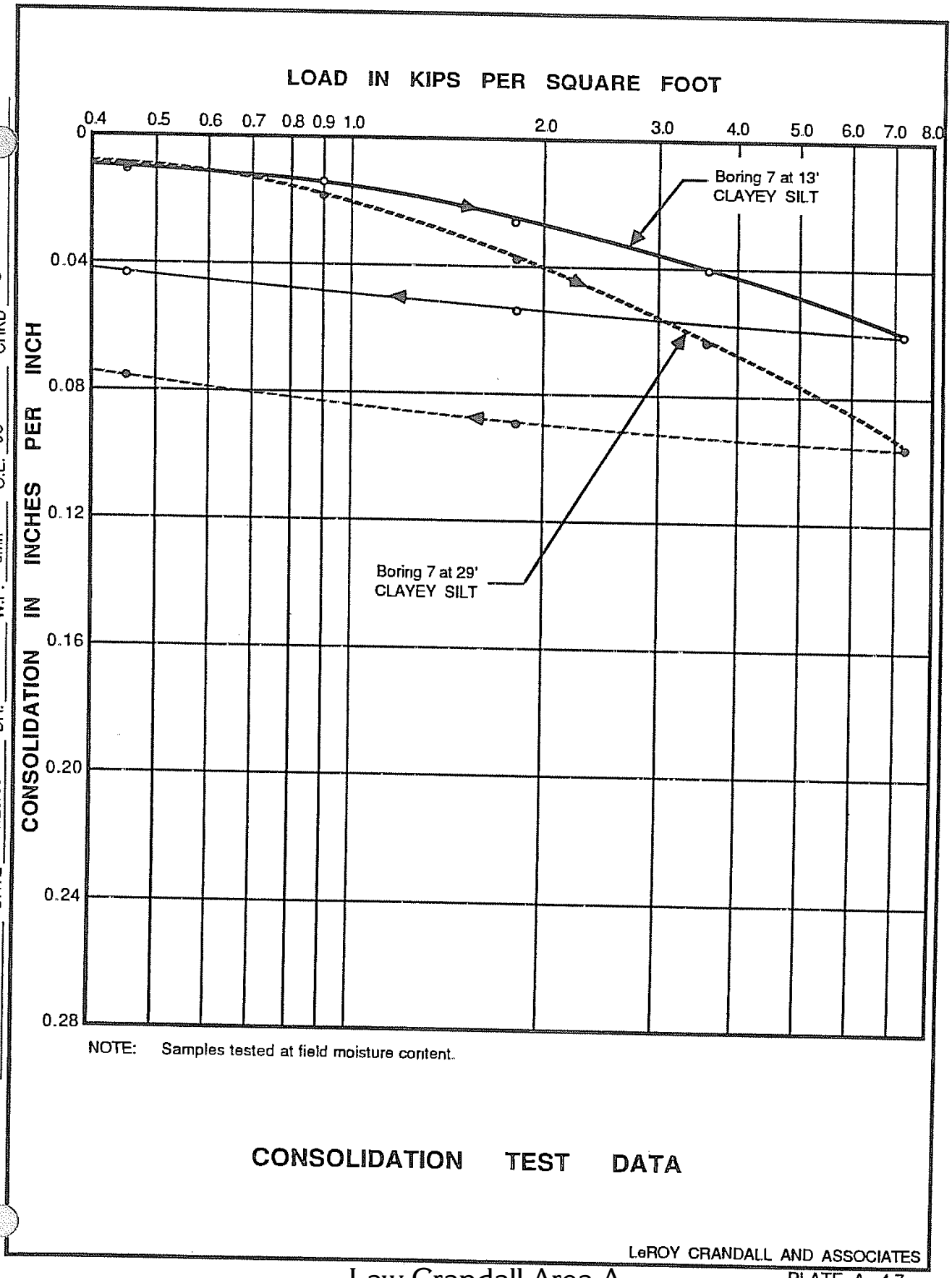
CONSOLIDATION TEST DATA

LeROY CRANDALL AND ASSOCIATES

Law Crandall Area A

PLATE A-4.6

PLATE B2-8



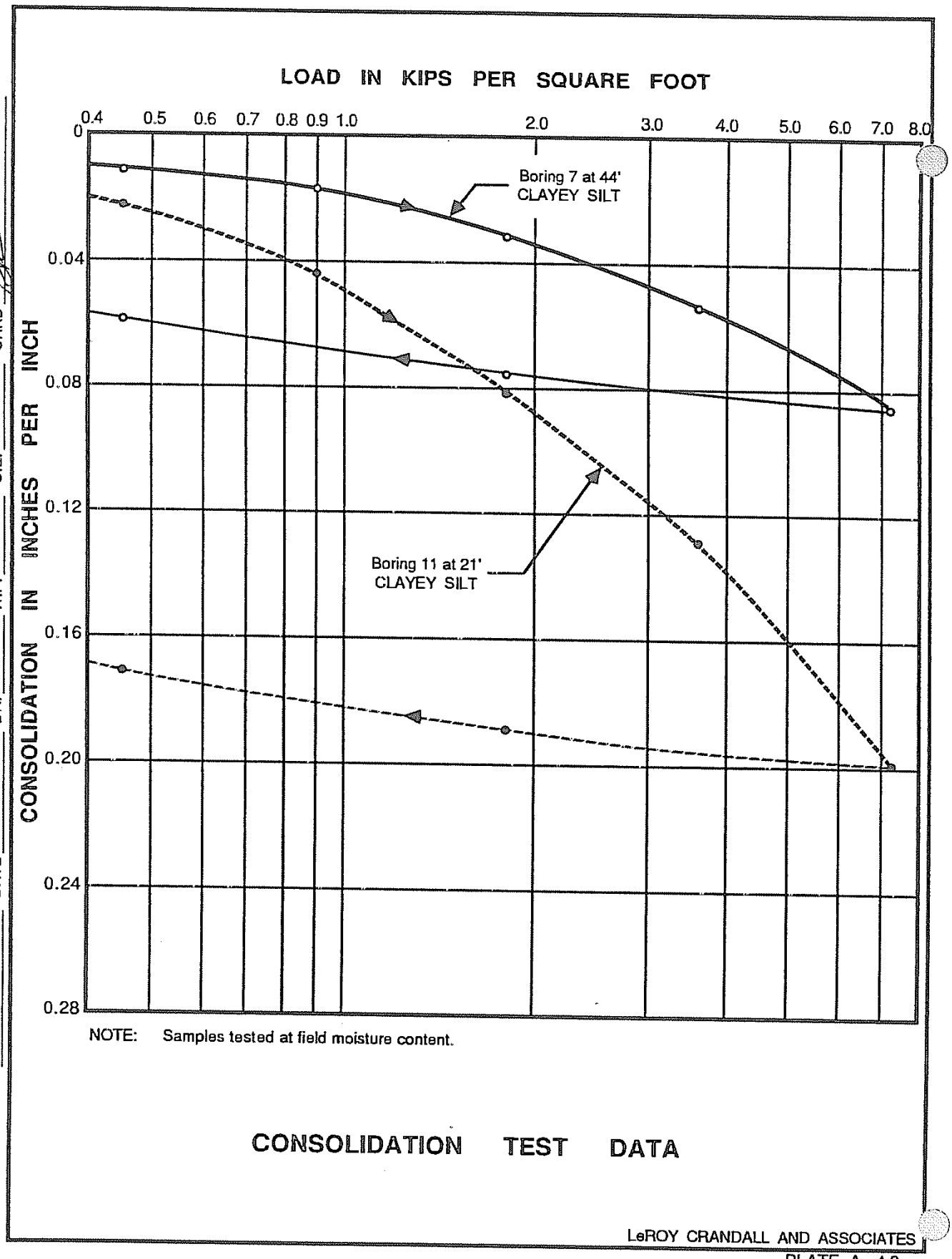
CONSOLIDATION TEST DATA

LeROY CRANDALL AND ASSOCIATES

Law Crandall Area A

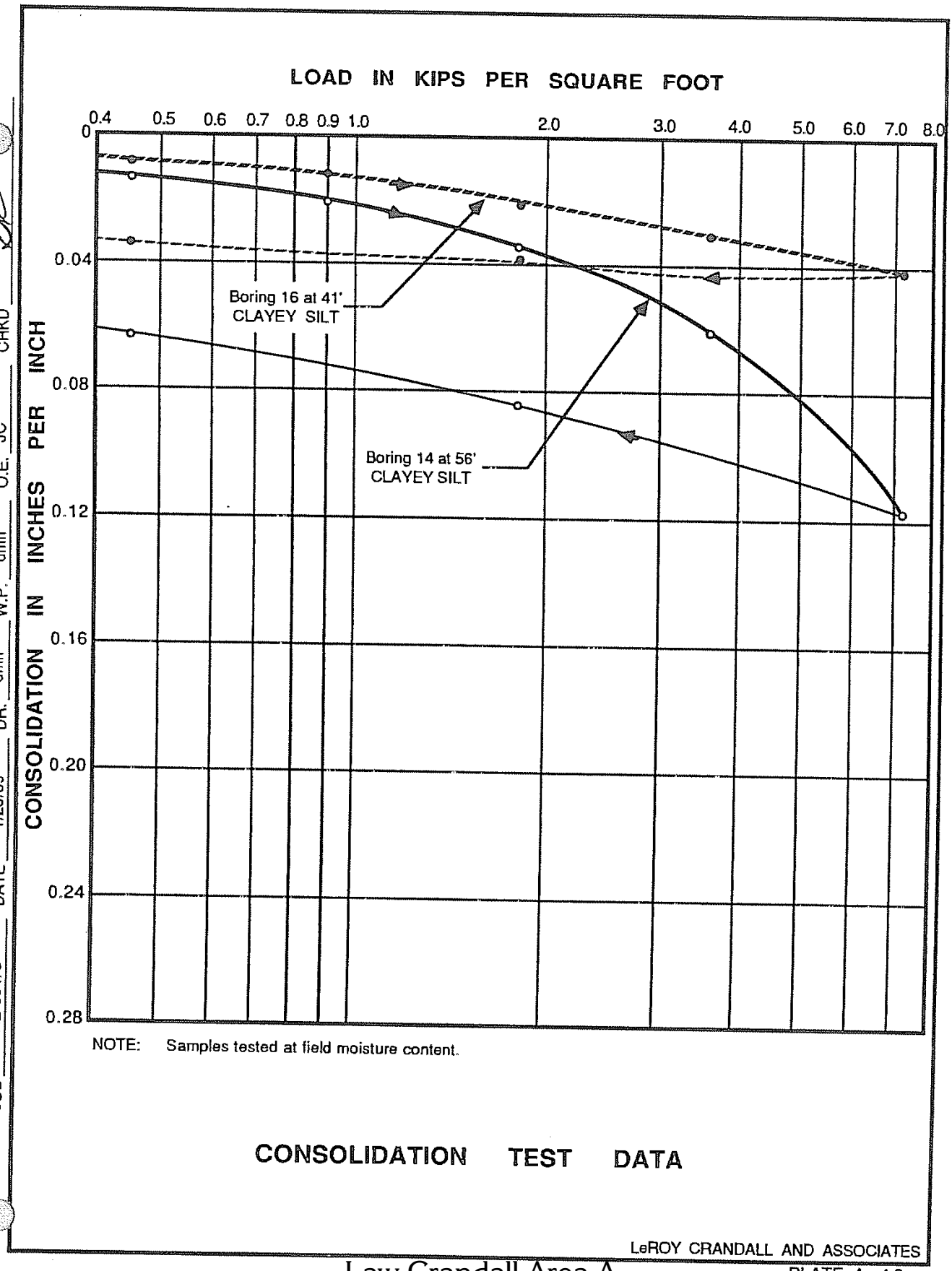
PLATE A-4.7

PLATE B2-9



Law Crandall Area A

PLATE B2-10



NOTE: Samples tested at field moisture content.

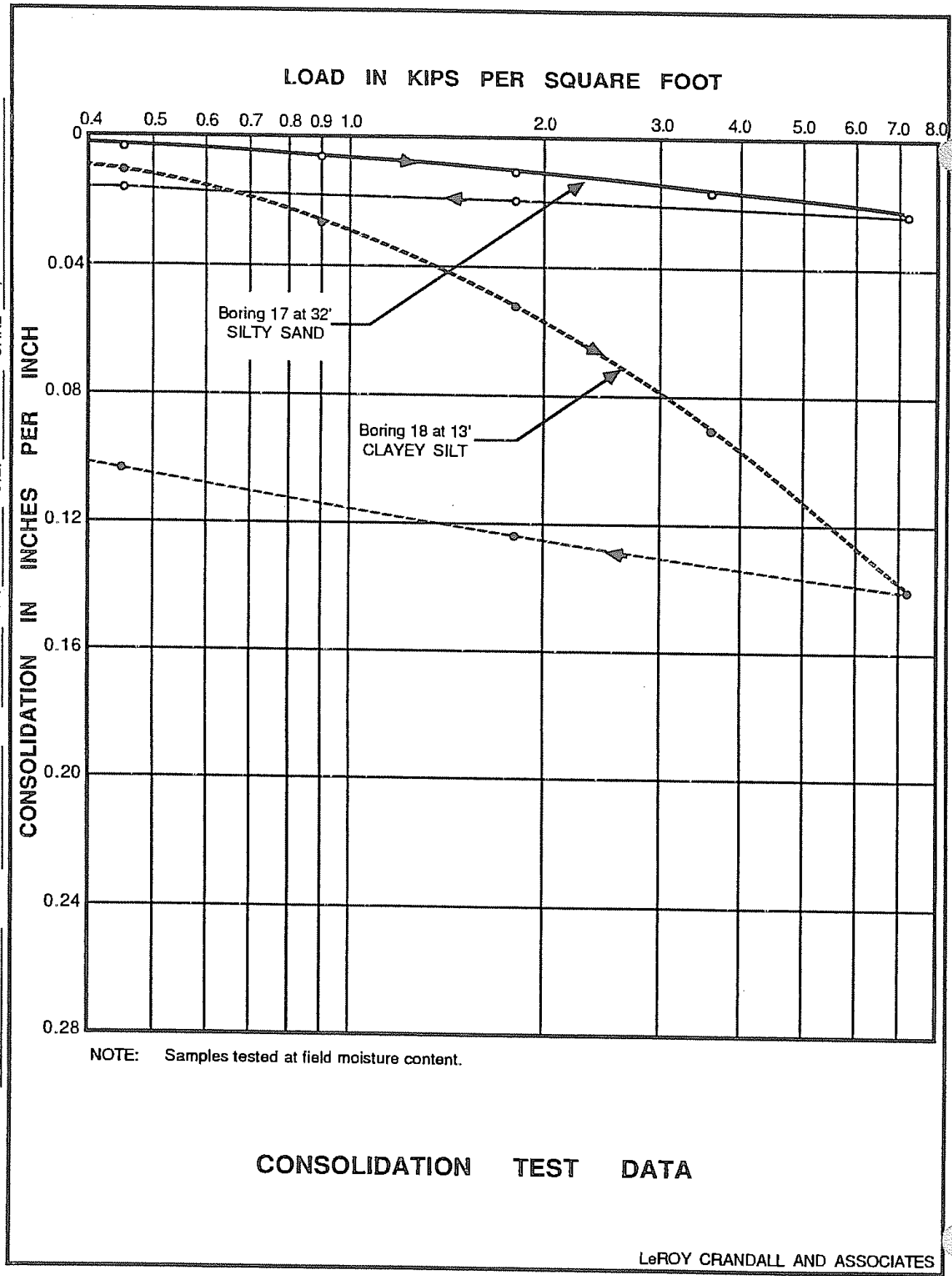
CONSOLIDATION TEST DATA

LeROY CRANDALL AND ASSOCIATES

Law Crandall Area A

PLATE A-4.9

PLATE B2-11



NOTE: Samples tested at field moisture content.

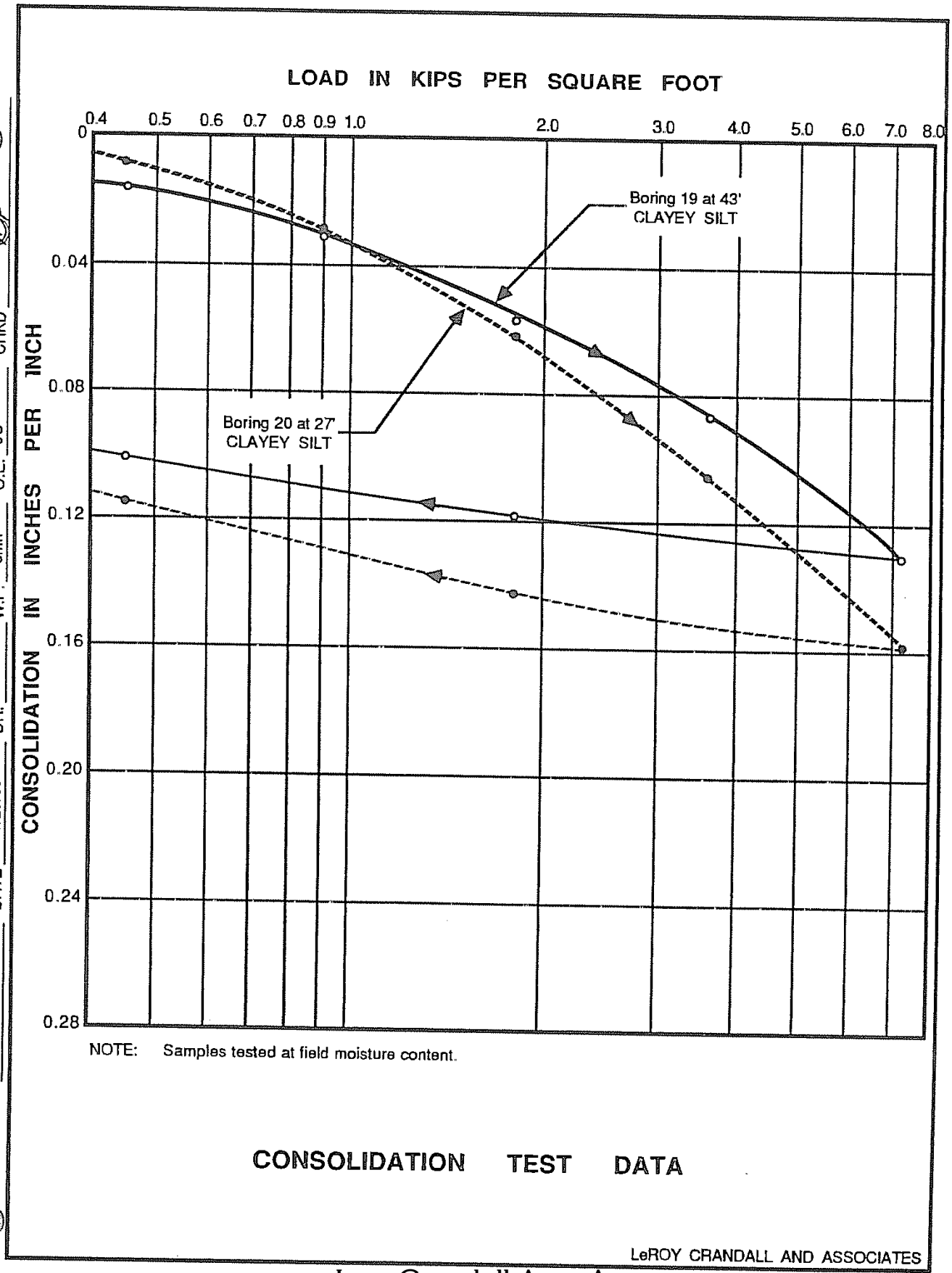
CONSOLIDATION TEST DATA

LeROY CRANDALL AND ASSOCIATES

PLATE A-4.10

Law Crandall Area A

PLATE B2-12



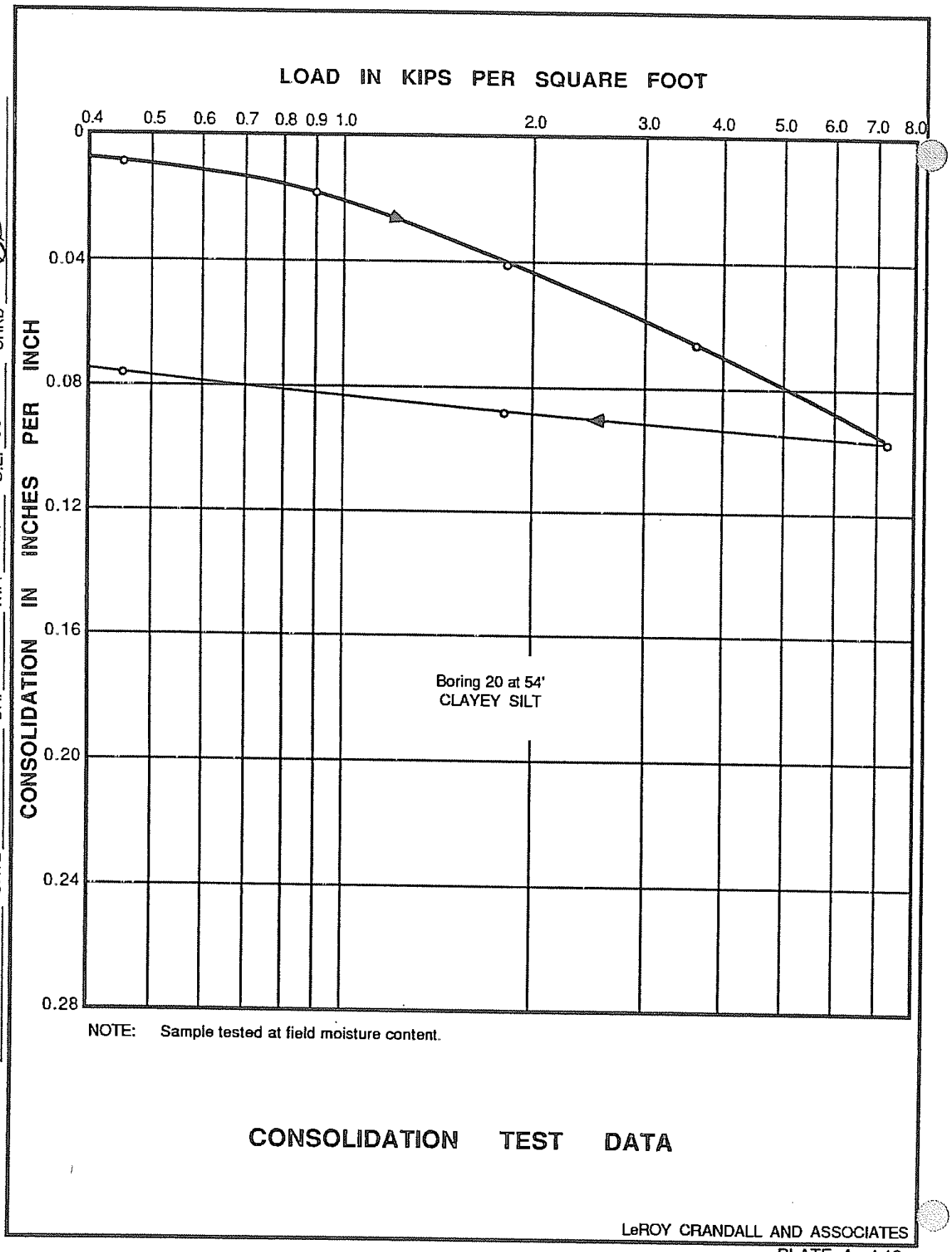
CONSOLIDATION TEST DATA

LeROY CRANDALL AND ASSOCIATES

PLATE A - 4. 11

Law Crandall Area A

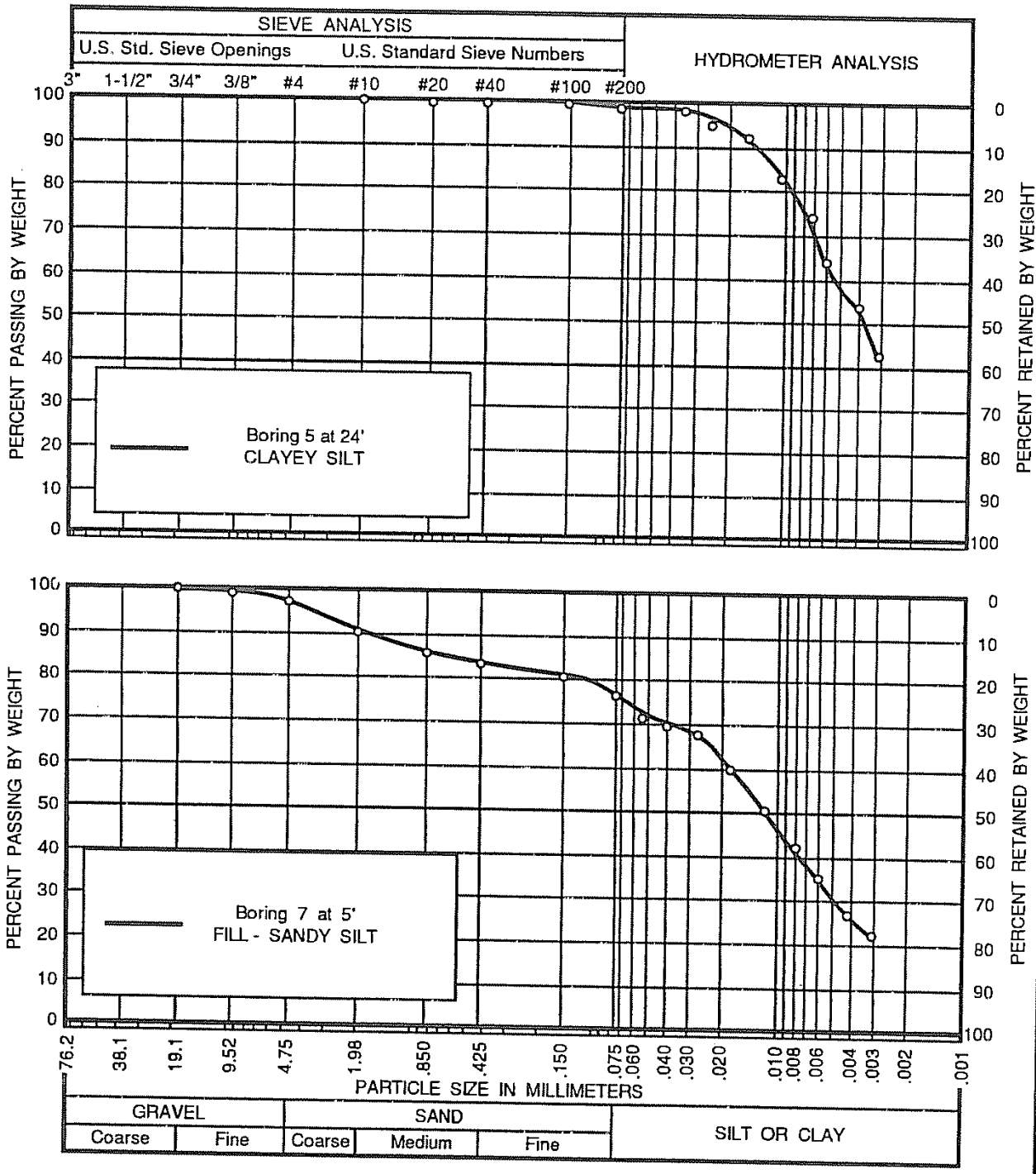
PLATE B2-13



Law Crandall Area A

PLATE B2-14

JOB AE-88473 DATE 3/23/89 BY dmh O.E. BK CHKD.



PARTICLE SIZE DISTRIBUTION

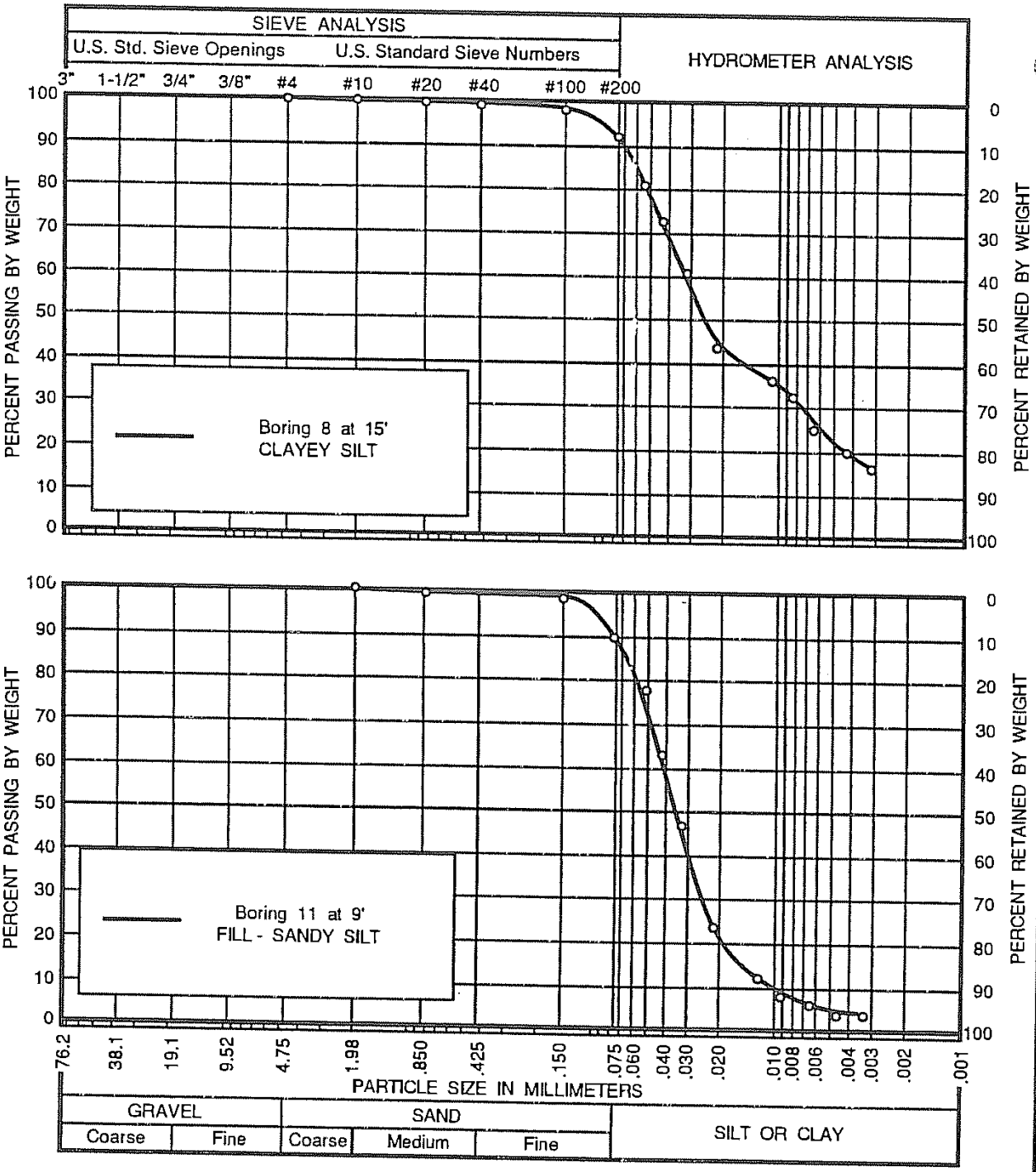
LeROY CRANDALL AND ASSOCIATES

Law Crandall Area A

PLATE A-5.1

PLATE B2-15

JOB AE-88473 DATE 3/23/89 BY dmh O.E. BK CHKD.



PARTICLE SIZE DISTRIBUTION

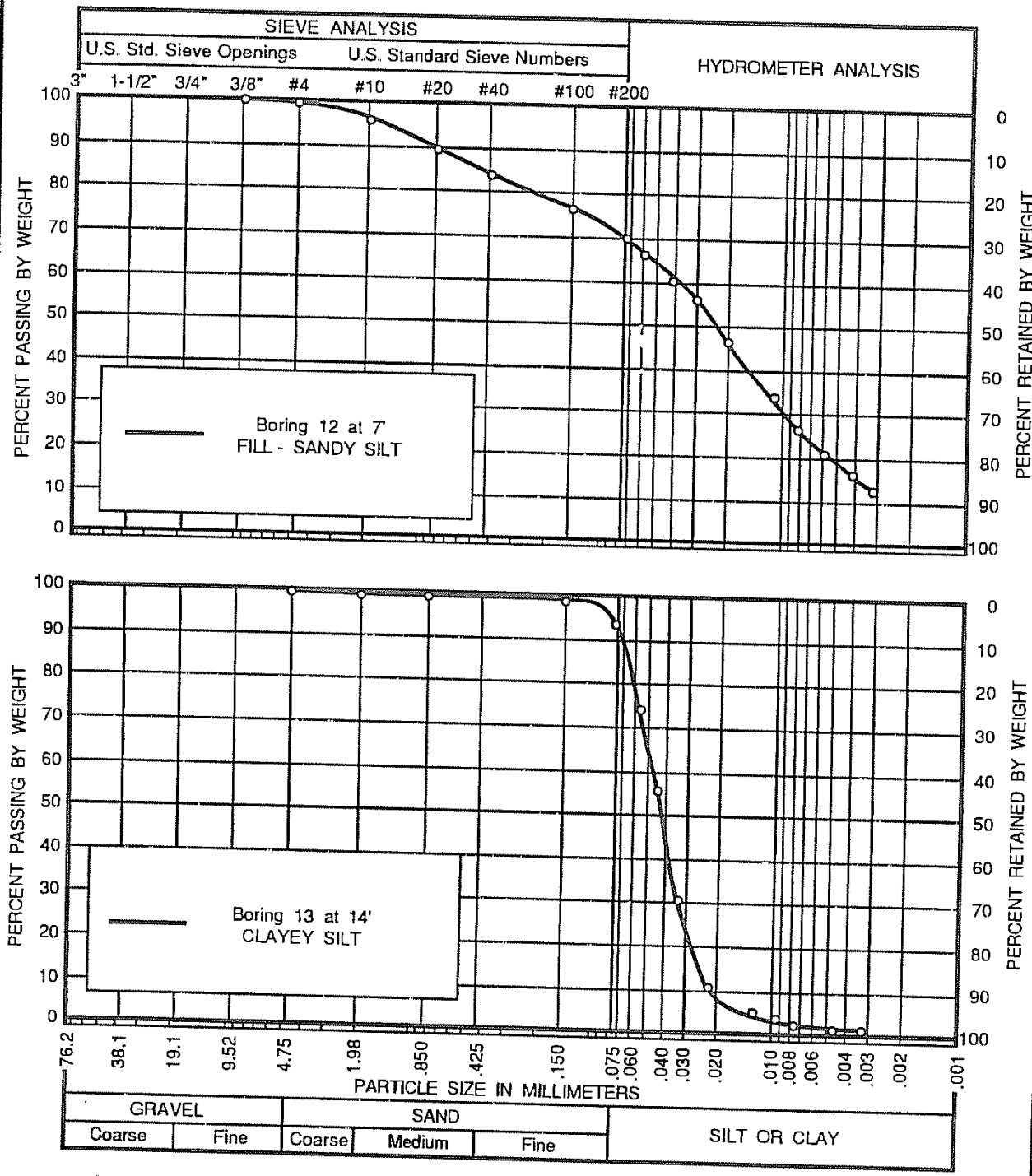
LeROY CRANDALL AND ASSOCIATES

PLATE A - 5.2

Law Crandall Area A

PLATE B2-16

JOB AE-88473 DATE 3/23/89 BY dmh O.E. BK CHKD



PARTICLE SIZE DISTRIBUTION

LeROY CRANDALL AND ASSOCIATES

Law Crandall Area A

PLATE A-5.3

PLATE B2-17

JOB AE-88473 DATE 1/26/89 W.P. dmh O.E. JC CHKD

BORING NUMBER AND SAMPLE DEPTH :	8 at 0' to 4'	9 at 4' to 8'
SOIL TYPE :	FILL - SANDY SILT	FILL - CLAYEY SILT
MAXIMUM DRY DENSITY : (lbs./cu. ft.)	116	110
OPTIMUM MOISTURE CONTENT : (% of dry wt.)	14	19

TEST METHOD : ASTM Designation D1557 - 70

COMPACTION TEST DATA

LeROY CRANDALL AND ASSOCIATES

PLATE A-6

Law Crandall Area A

PLATE B2-18

JOB AE-88473 DATE 1/26/89 W.P. dmh O.E. JC CHKD

BORING NUMBER AND SAMPLE DEPTH	SOIL TYPE	SURCHARGE PRESSURE (psf)	COEFFICIENT OF PERMEABILITY Ft./Yr.	Cm./Sec.
1 at 24'	CLAYEY SILT	900	0.1	1×10^{-7}
2 at 14'	SANDY SILT	200	11.1	1×10^{-5}
4 at 19'	SILTY SAND	500	3.6	3×10^{-6}
5 at 16'	SILTY SAND	400	1.9	2×10^{-6}
6 at 29'	SANDY SILT	1000	0.1	1×10^{-7}
11 at 33'	SANDY SILT	1000	7.5	7×10^{-6}
12 at 14'	CLAYEY SILT	200	0.1	1×10^{-7}
14 at 20'	CLAYEY SILT	600	0.1	1×10^{-7}
16 at 28'	SANDY SILT	1000	0.1	9×10^{-8}
19 at 23'	CLAYEY SILT	900	0.3	3×10^{-7}

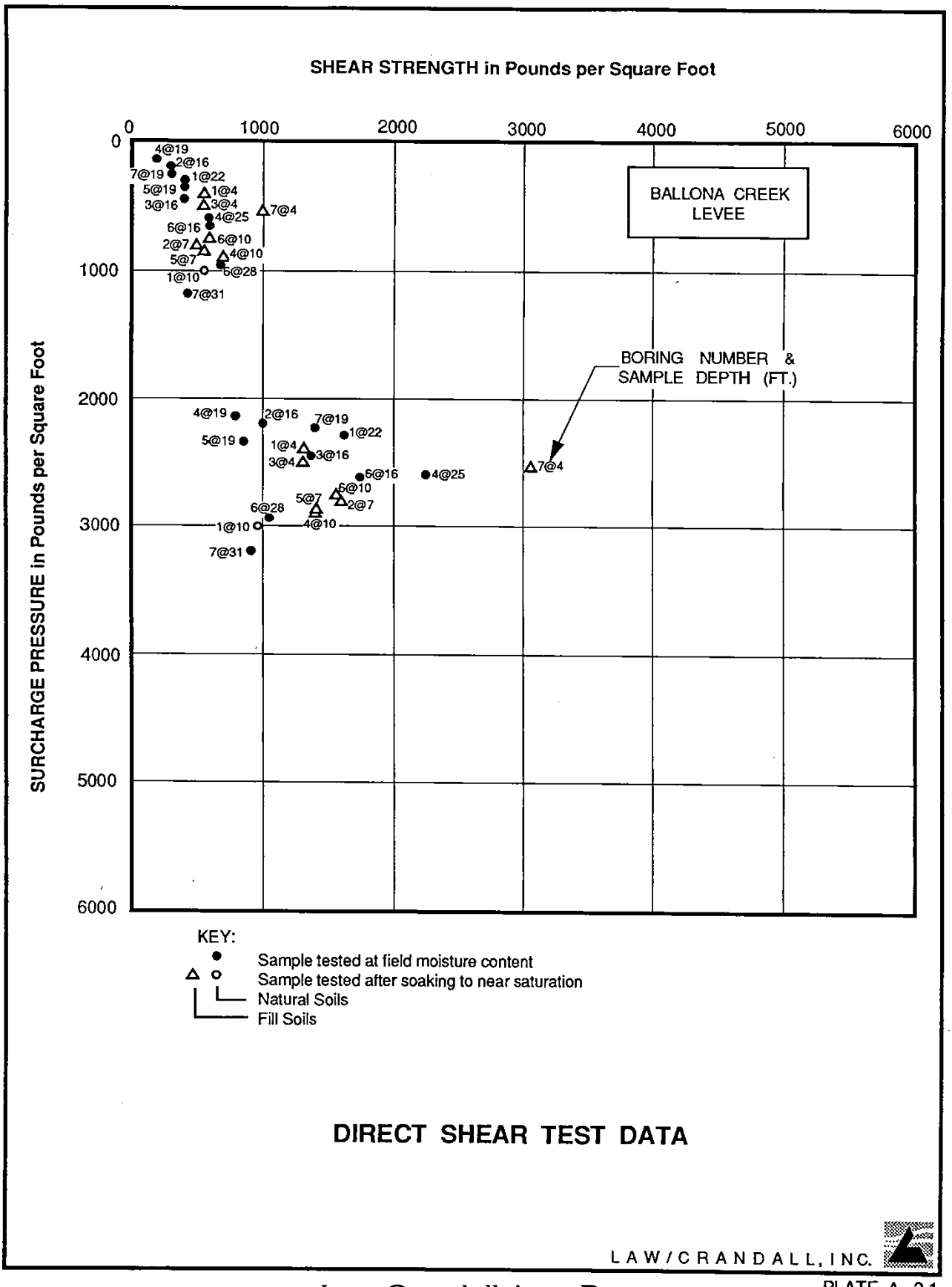
PERMEABILITY TEST DATA

LeROY CRANDALL AND ASSOCIATES

Law Crandall Area A

PLATE A-7

PLATE B2-19



DIRECT SHEAR TEST DATA

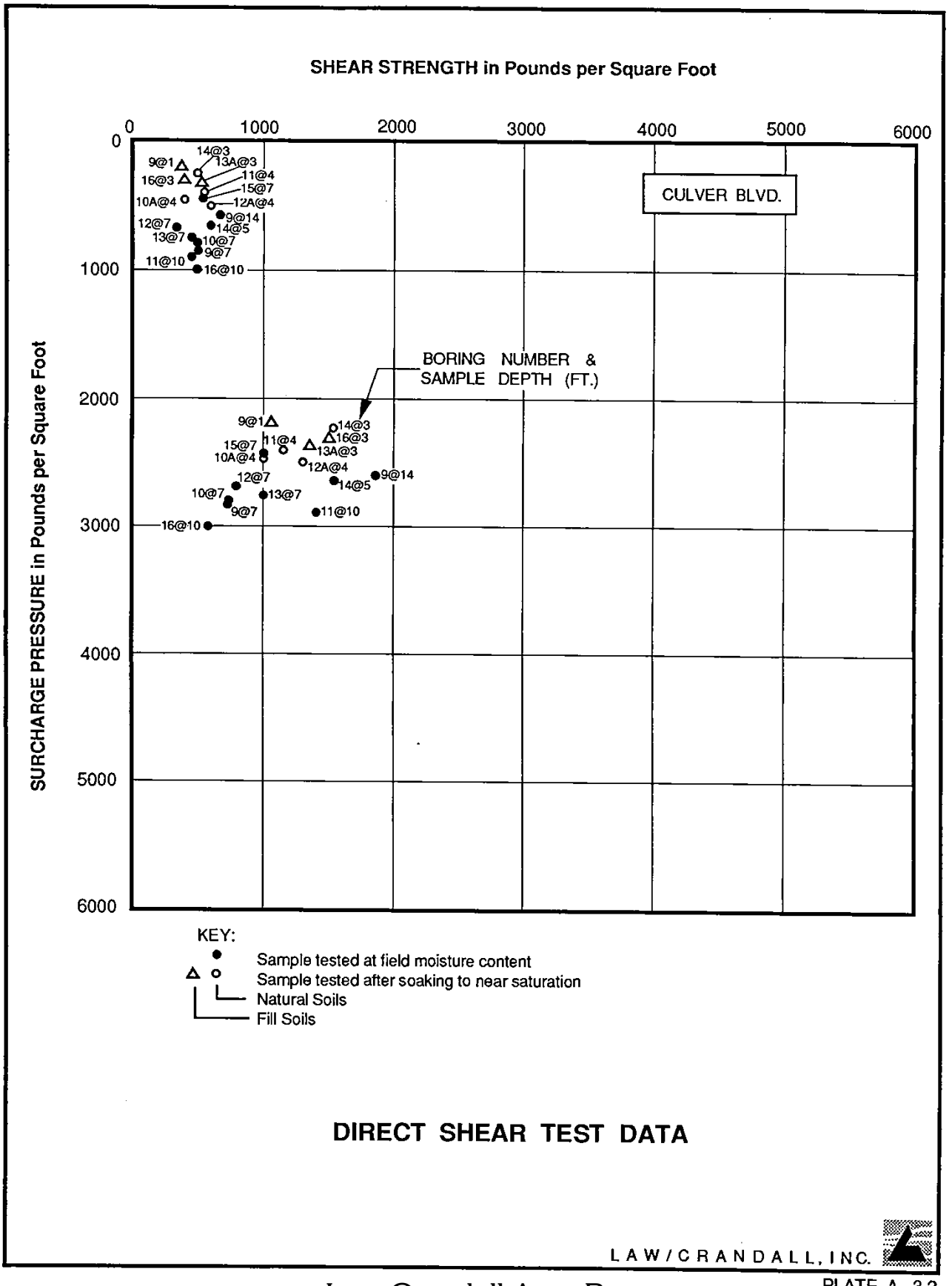
LAW/CRANDALL, INC.

PLATE A-3.1

Law Crandall Area B

PLATE B2-20

JOB L91028.AEO DATE 4/1/91 DR ph O.E. JLR CHKD.



DIRECT SHEAR TEST DATA

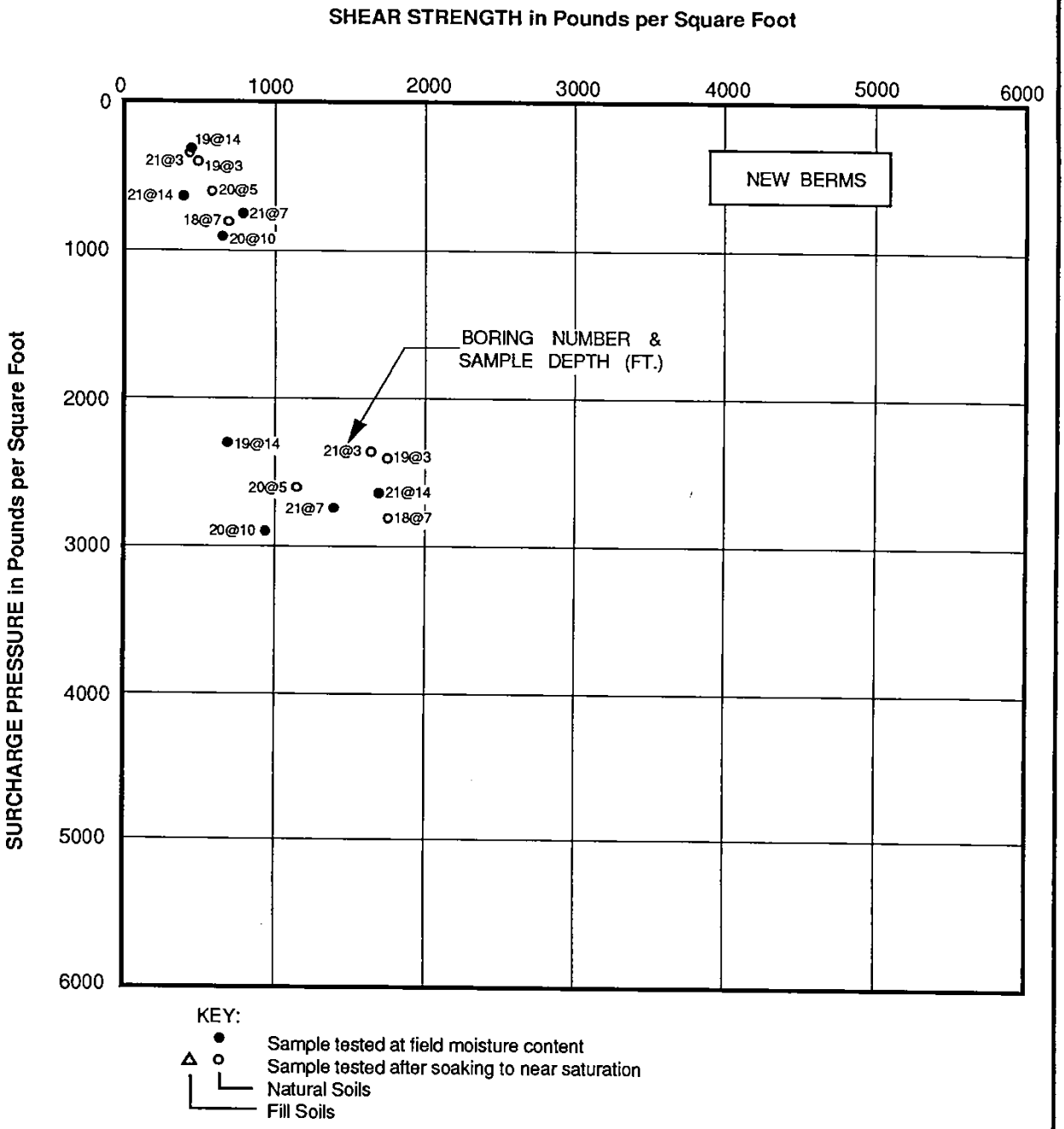
LAW/CRANDALL, INC.

PLATE A-3.2

Law Crandall Area B

PLATE B2-21

JOB L91028.AEO DATE 4/1/91 DR ph O.E. FH CHKD.



DIRECT SHEAR TEST DATA

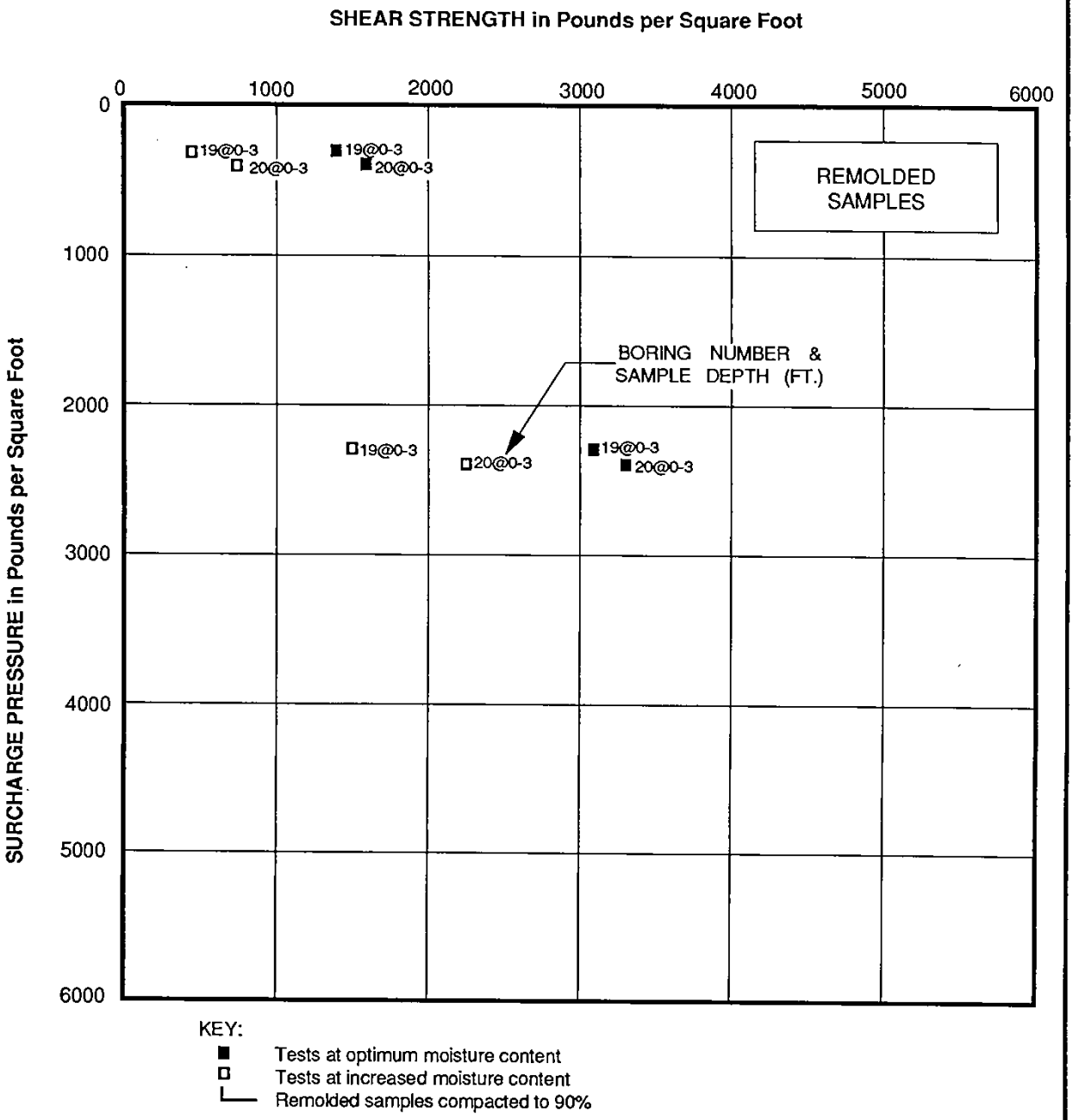
LAW/CRANDALL, INC.

PLATE A-3.3

Law Crandall Area B

PLATE B2-22

JOB 191028.AEO DATE 4/1/91 DR ph O.E. FH CHKD.



DIRECT SHEAR TEST DATA

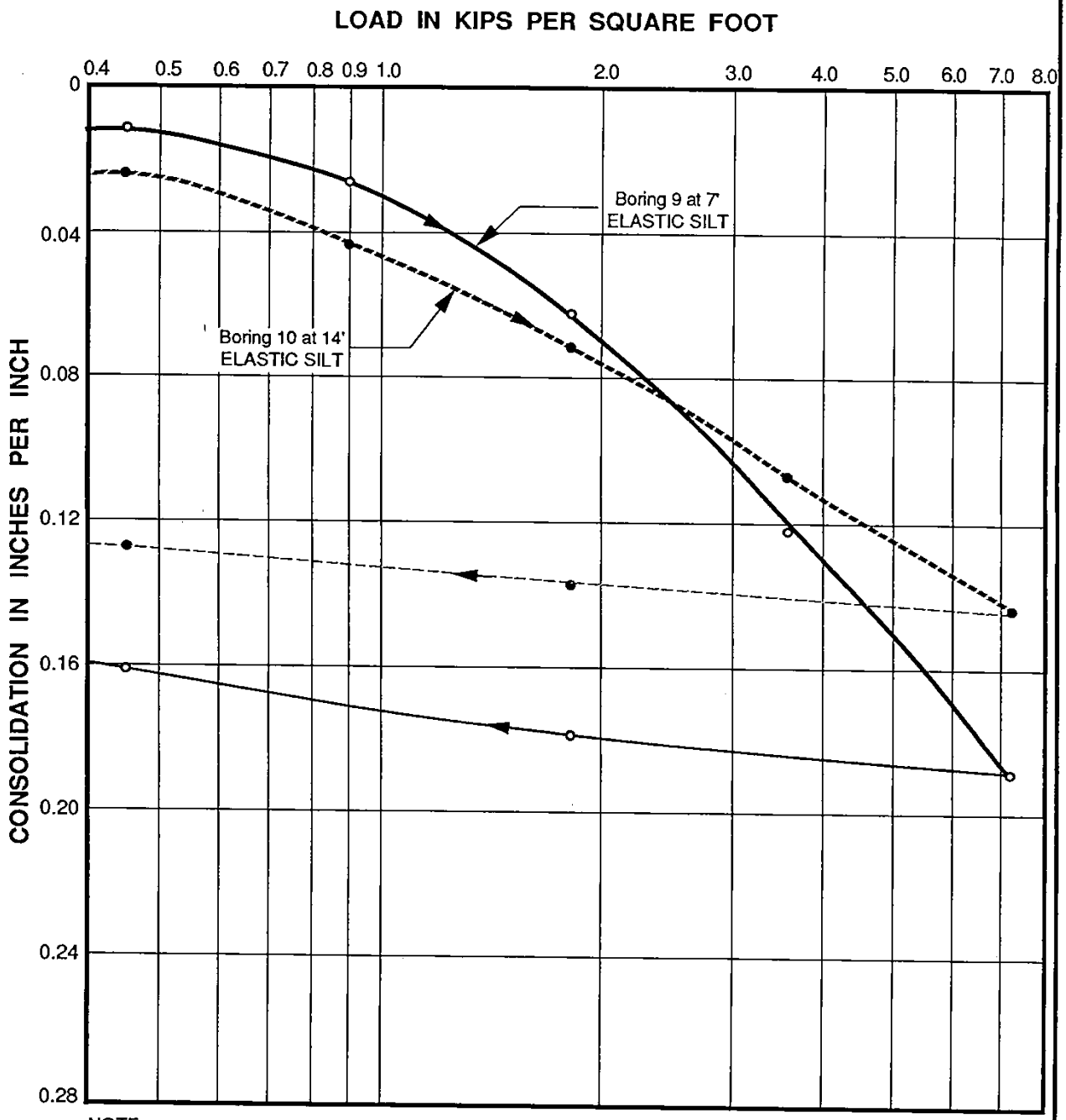
LAW/CRANDALL, INC.

PLATE A - 3.4

Law Crandall Area B

PLATE B2-23

JOB L91028.AEO DATE 3/29/91 DR. ph W.P. ph O.E. JLR/BK CHKD



NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA

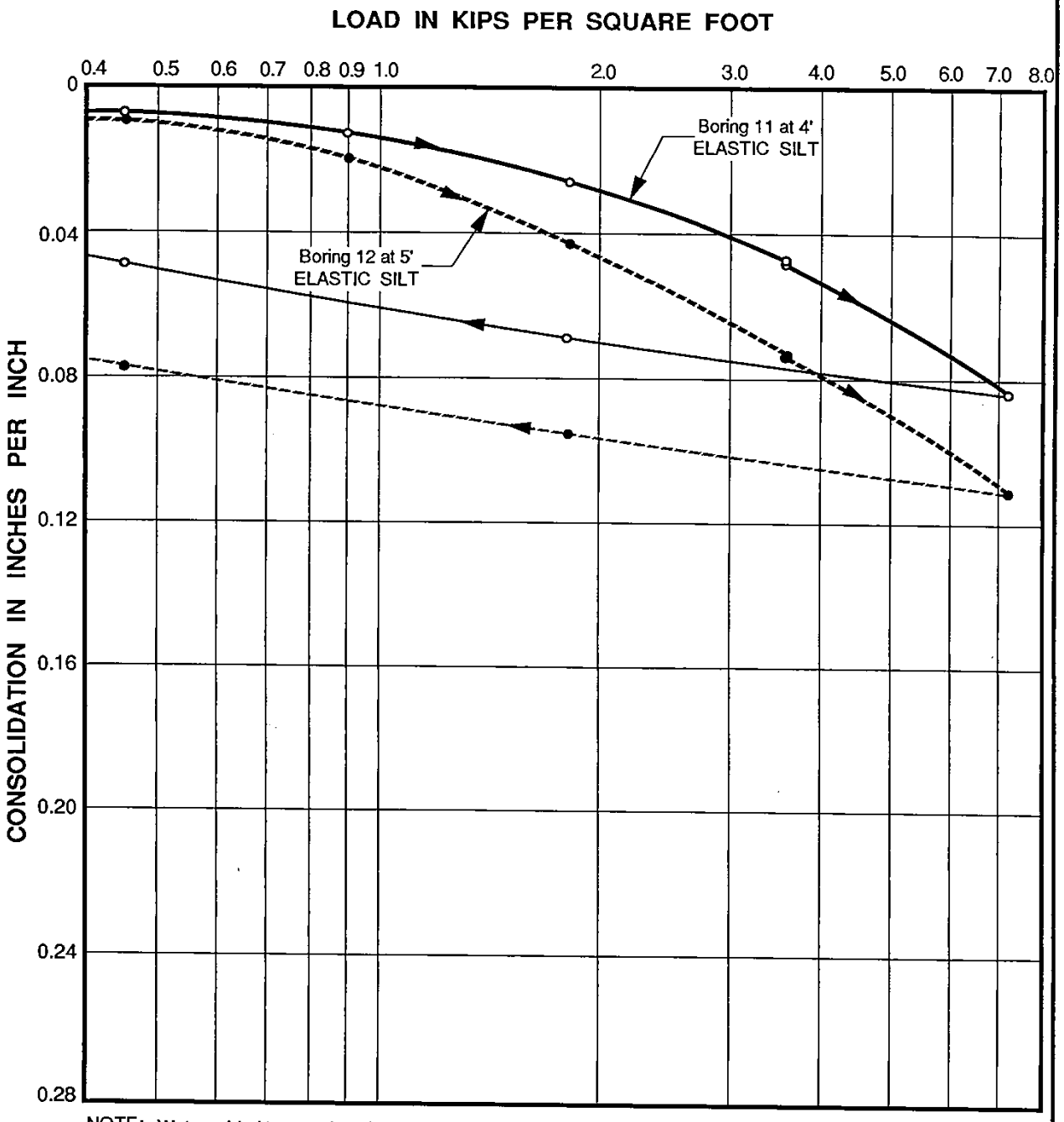
LAW/CRANDALL, INC.

PLATE A-4.1

Law Crandall Area B

PLATE B2-24

JOB 91028.AEO DATE 3/29/91 DR. ph W.P. ph O.E. JLR/BK CHKD



NOTE: Water added to samples after consolidation under a load of 3.6 kips per square foot.

CONSOLIDATION TEST DATA

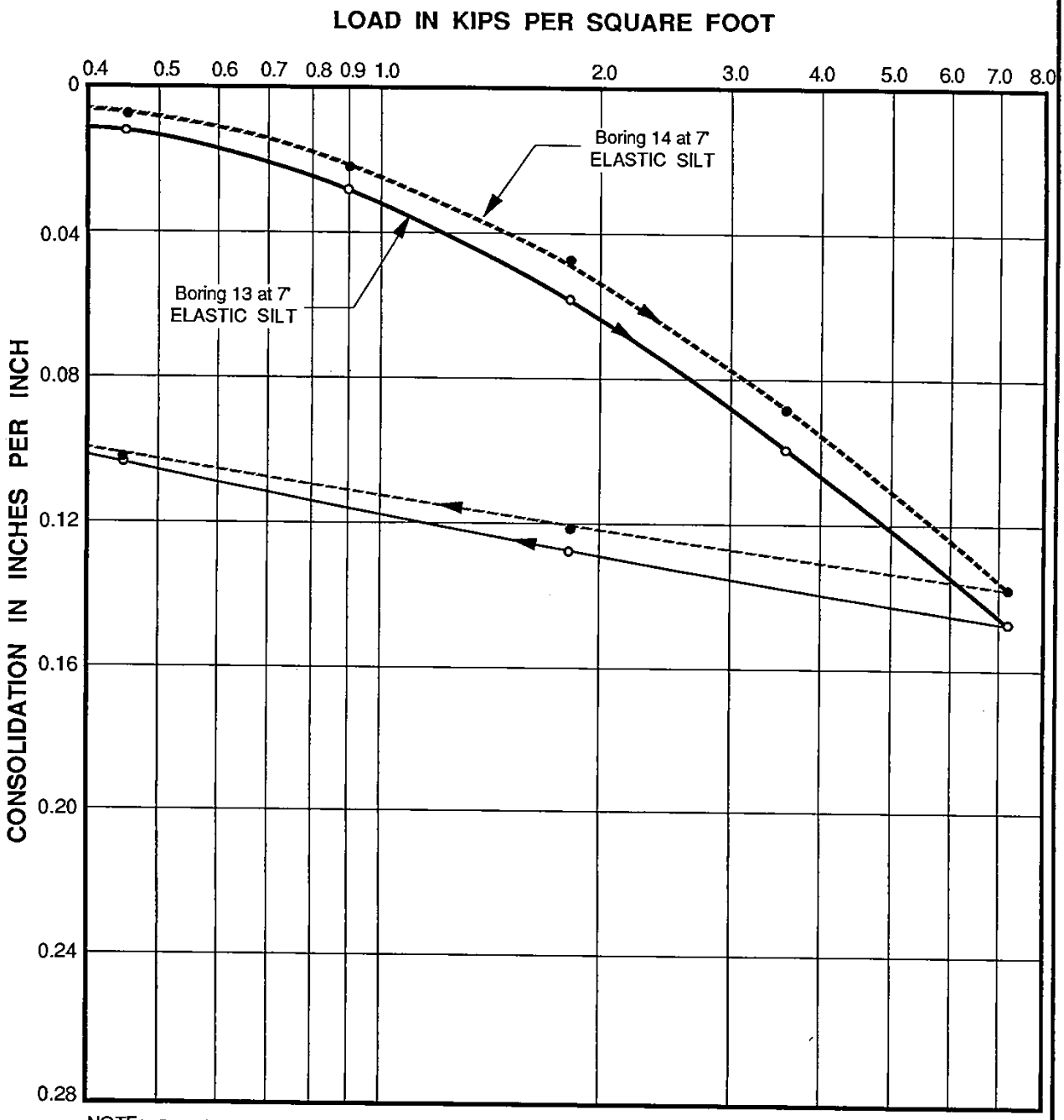
LAW/CRANDALL, INC.

PLATE A - 4.2

Law Crandall Area B

PLATE B2-25

JOB L91028.AEO DATE 3/29/91 DR. ph W.P. ph O.E. JLR/BK CHKD



NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA

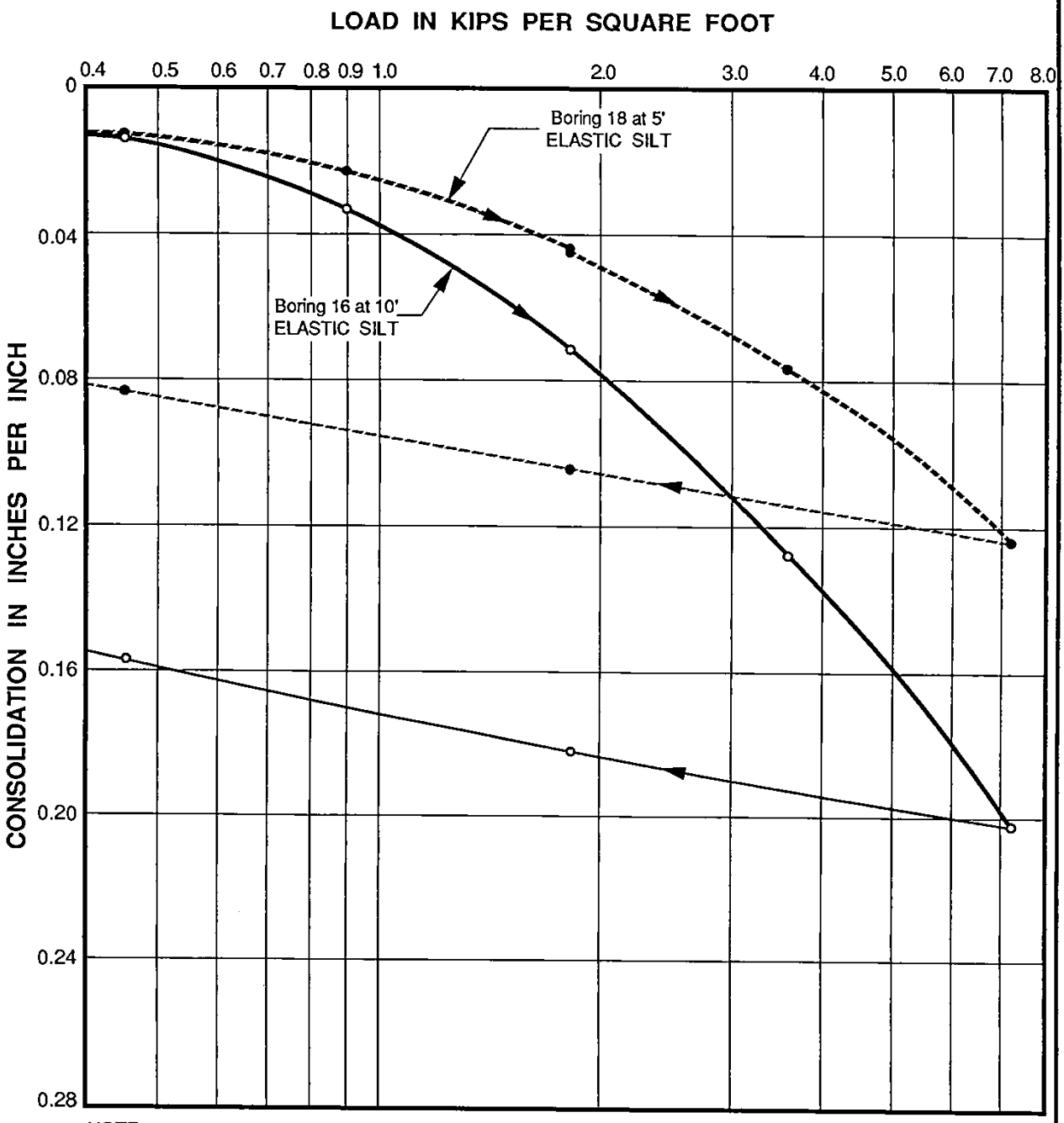
LAW/CRANDALL, INC.

PLATE A-4.3

Law Crandall Area B

PLATE B2-26

JOB L91028.AEO DATE 3/29/91 DR. ph W.P. ph O.E. JLR/BK CHKD



NOTE: Water added to sample from Boring 18 after consolidation under a load of 1.8 kips per square foot. The other sample tested at field moisture content.

CONSOLIDATION TEST DATA

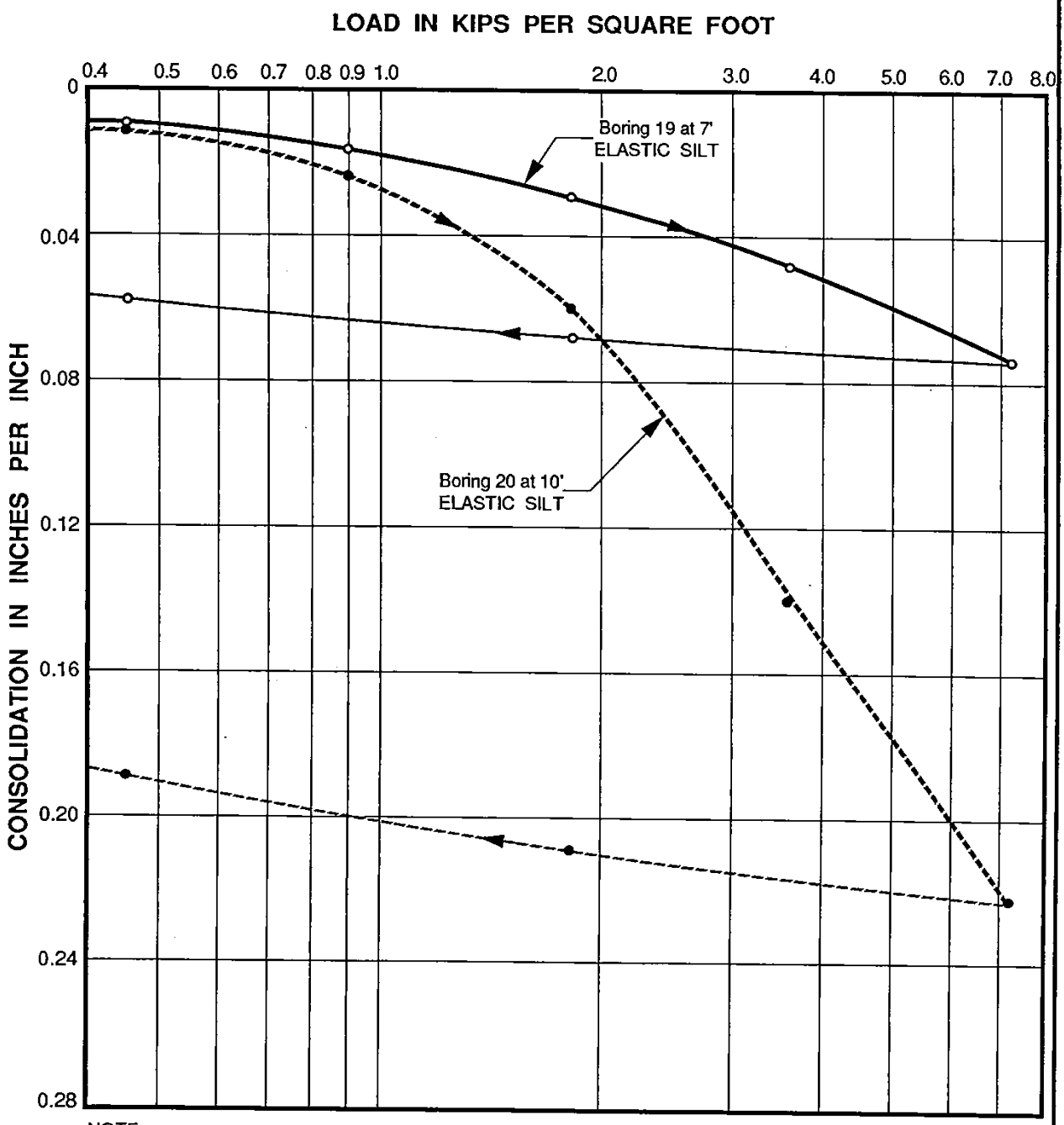
LAW/CRANDALL, INC.

Law Crandall Area B

PLATE A-4.4

PLATE B2-27

JOB L91028.AEQ DATE 3/29/91 DR. ph W.P. ph O.E. JLR/BK CHKD



NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA

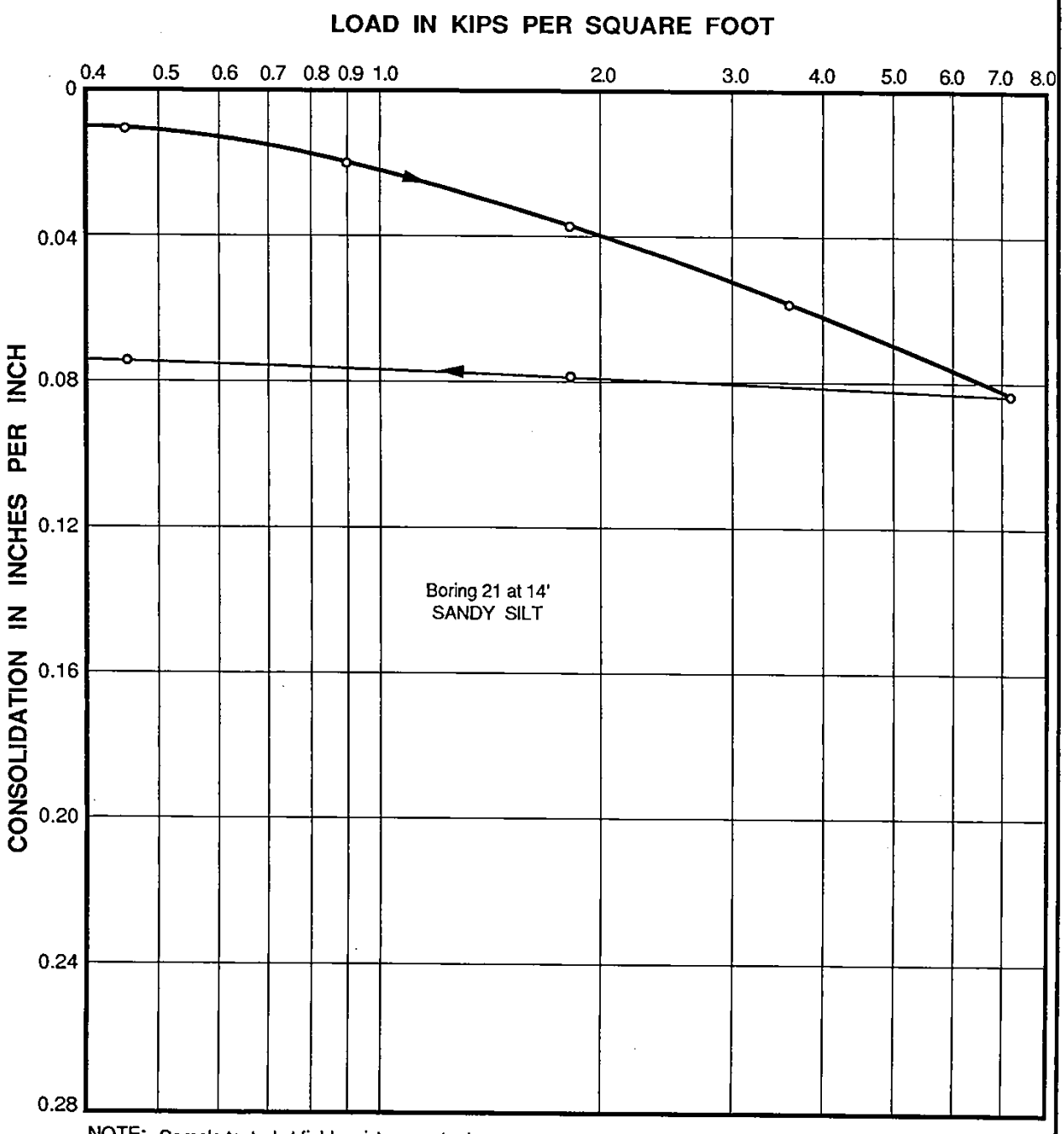
LAW/CRANDALL, INC.

PLATE A-4.5

Law Crandall Area B

PLATE B2-28

JOB L91028.AEO DATE 3/29/91 DR. ph W.P. ph O.E. JLR/BK CHKD



NOTE: Sample tested at field moisture content.

CONSOLIDATION TEST DATA

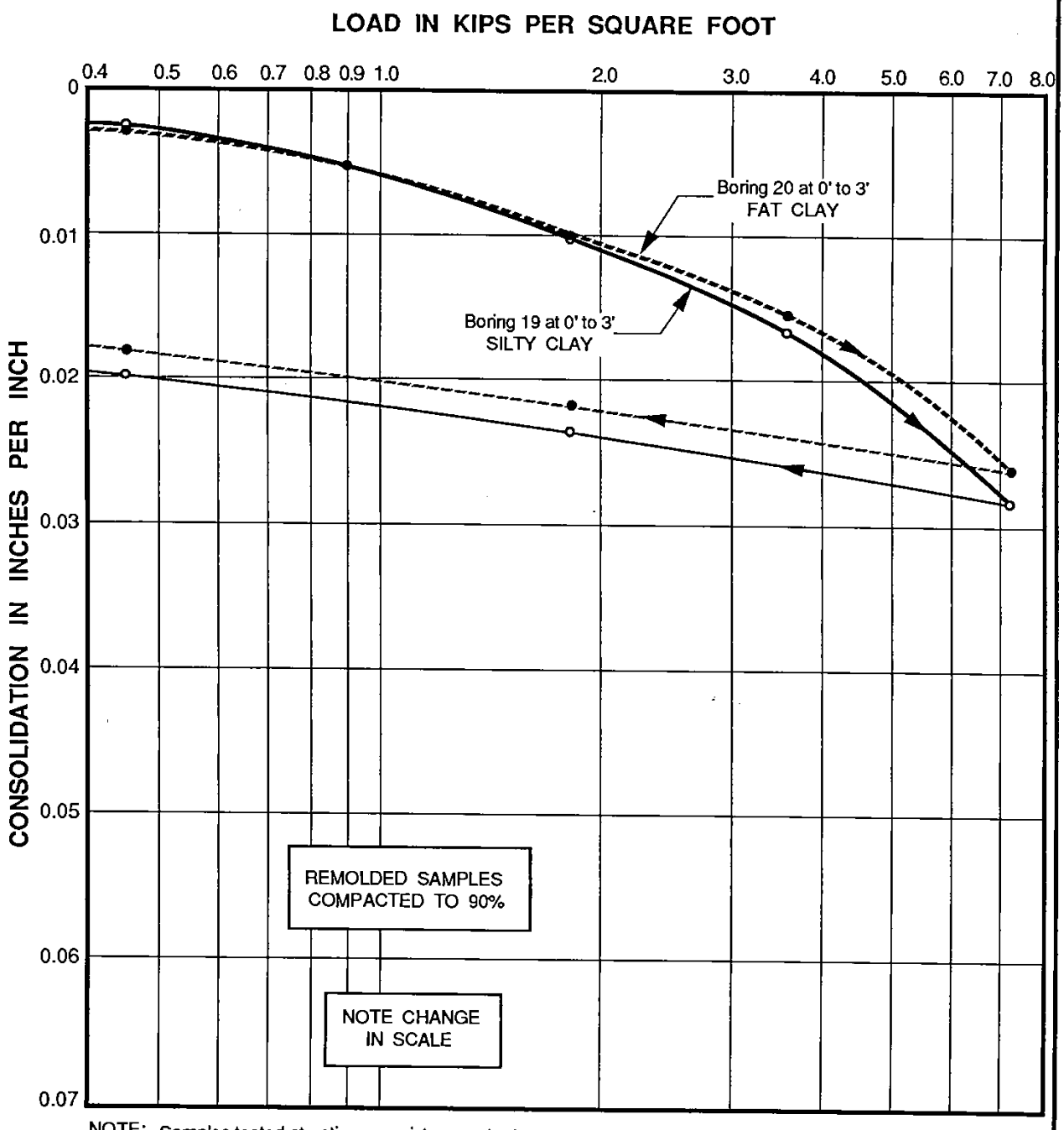
LAW/CRANDALL, INC.

Law Crandall Area B

PLATE A-4.6

PLATE B2-29

JOB L91028.AEQ DATE 3/29/91 DR. ph W.P. ph O.E. JLR/BK CHKD



NOTE: Samples tested at optimum moisture content.

CONSOLIDATION TEST DATA

LAW/CRANDALL, INC.

PLATE A-4.7

Law Crandall Area B

PLATE B2-30

JOB L91028.AEO DATE 4/1/91 W.P. ph O.E. FH CHKD

BORING NUMBER AND SAMPLE DEPTH :	19 at 0' to 3'	20 at 0' to 3'
SOIL TYPE :	SILTY CLAY	FAT CLAY
MAXIMUM DRY DENSITY : (lbs./cu. ft.)	114	109
OPTIMUM MOISTURE CONTENT : (% of dry)	14	18

TEST METHOD: ASTM Designation D1557 - 78

COMPACTION TEST DATA

LAW/CRANDALL, INC.

PLATE A-5

Law Crandall Area B

PLATE B2-31

JOB 191028.AEQ DATE 4/1/91 W.P. ph O.E. FH CHKD

BORING NUMBER AND SAMPLE DEPTH:	19 at 0' to 3'	20 at 0' to 3'
SOIL TYPE:	SILTY CLAY	FAT CLAY
CONFINING PRESSURE: (lbs./sq. ft.)	144	144
INITIAL MOISTURE CONTENT: (% of dry wt.)	13.0	13.0
FINAL MOISTURE CONTENT: (% of dry wt.)	33.8	38.1
DRY DENSITY: (lbs./cu. ft.)	98	99
EXPANSION INDEX:	87	155

TEST METHOD: Uniform Building Code Standard No. 29-2, Expansion Index Test

EXPANSION INDEX TEST DATA

LAW/CRANDALL, INC.

Law Crandall Area B

PLATE A-6

PLATE B2-32

JOB L91028.AEO DATE 4/1/91 W.P. ph O.E. JLR CHKD

BORING NUMBER AND SAMPLE DEPTH (ft.)	SOIL TYPE	COEFFICIENT OF PERMEABILITY (cm/sec)
9 at 7'	ELASTIC SILT	3.6×10^{-7}
10 at 5'	ELASTIC SILT	1.7×10^{-7}
11 at 10'	ELASTIC SILT	1.9×10^{-7}
12 at 5'	ELASTIC SILT	5.1×10^{-7}
16 at 10'	ELASTIC SILT	9.7×10^{-8}
18 at 7'	ELASTIC SILT	8.7×10^{-7}
20 at 10'	ELASTIC SILT	9.7×10^{-8}
24 at 14'	SILTY SAND	1.4×10^{-6}

PERMEABILITY TEST DATA

LAW/CRANDALL, INC.

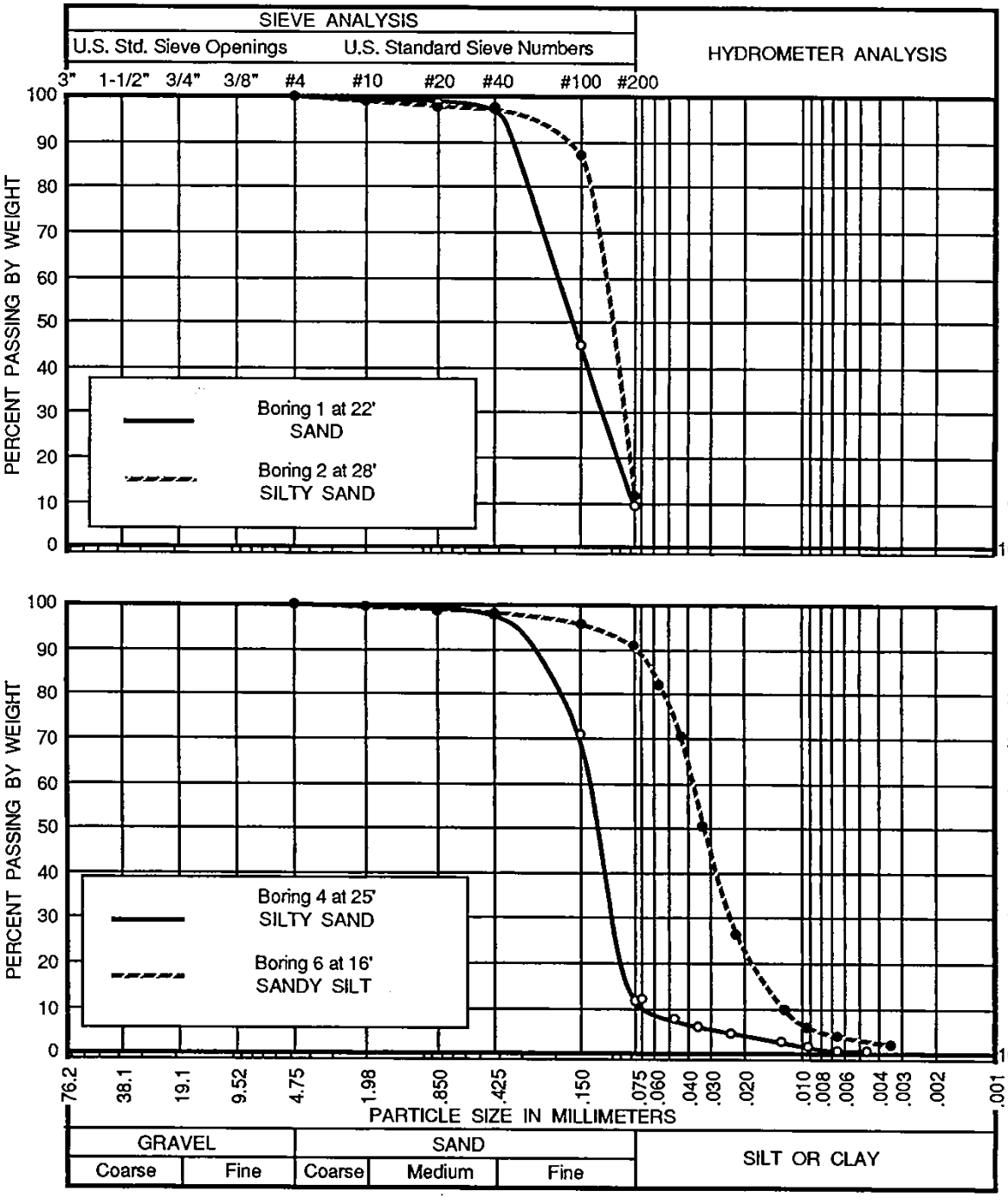
Law Crandall Area B

PLATE A-7

PLATE B2-33

PLATE B2-34

JOB L91028.AEQ DATE 4/1/91 DR ph O.E. FH CHKD.



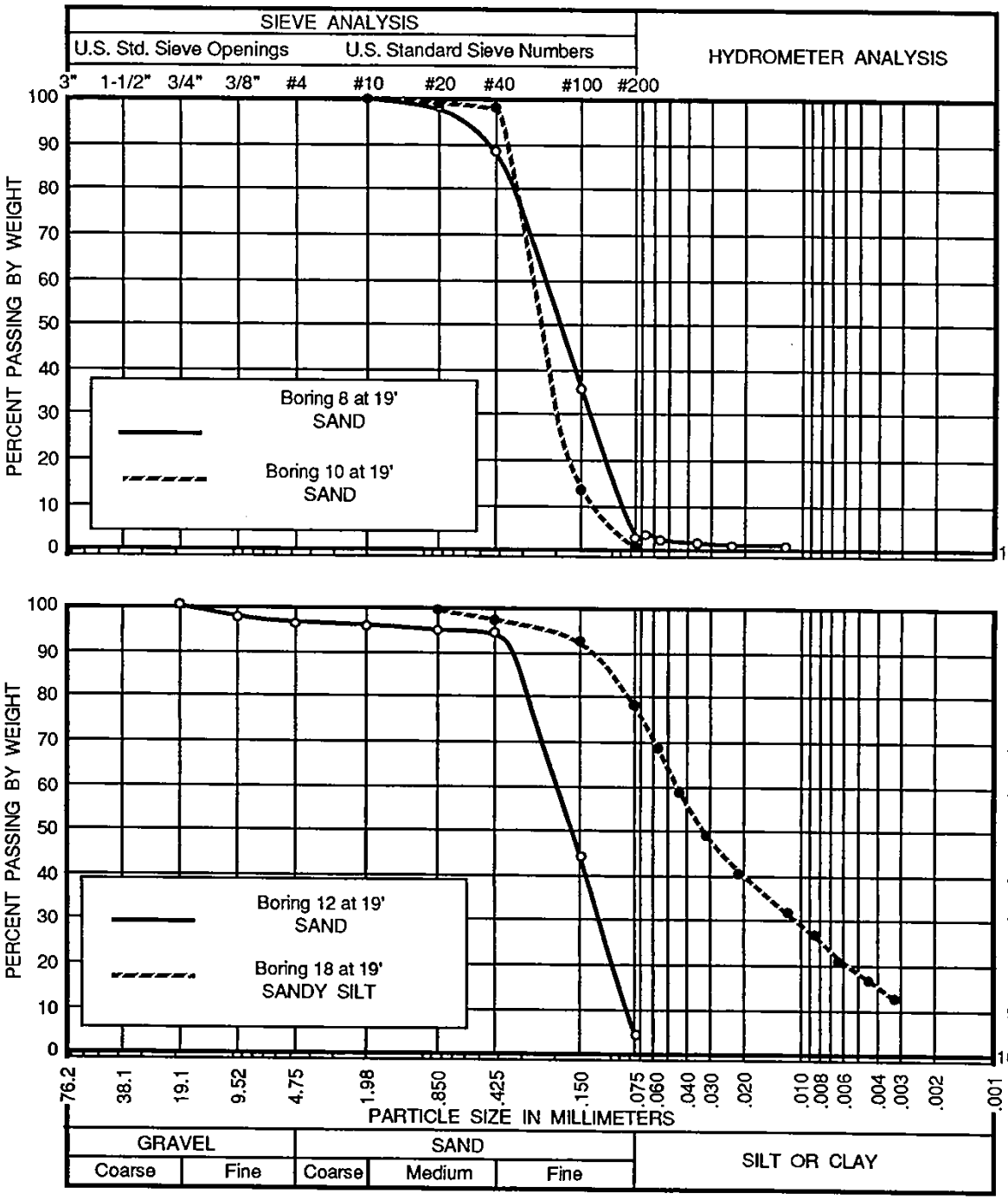
PARTICLE SIZE DISTRIBUTION

LAW/CRANDALL, INC.

PLATE A-8.1

Law/Crandall Area B

JOB L91028.AEQ DATE 4/1/91 DR ph O.E. BK CHKD.



PARTICLE SIZE DISTRIBUTION

LAW/CRANDALL, INC.

PLATE A-8.2

Law Crandall Area B

PLATE B2-35

Table C2 - GEOTECHNICAL LABORATORY TEST SUMMARY

BORING NUMBER	DEPTH (feet)	SOIL TYPE	INSITU MOISTURE CONTENT (percent)	PERCENTAGE PASSING SIEVE NO. 200	LIQUID LIMIT	PLASTICITY INDEX
B-1	3	ML	39	98	41	7
	6	ML	32	52	--	--
	9	MH	43	98	55	22
	12	MH	60	93	--	--
	15	MH	91	93	--	--
B-2	3	CH	39	97	50	31
	6	ML	37	53	--	--
	9	CL	40	98	--	--
	10	CL	38	51	--	--
	12	CH	83	95	--	--
	15	MH	107	96	64	17
B-3	0	ML	19	66	--	--
	6	CL	45	99	46	21
	9	CL	37	91	--	--
	12	MH	42	98	--	--
	15	CH	62	90	73	45
	18	CH	87	96	--	--
B-4	0	ML	20	94	--	--
	3	CL	34	91	--	--
	6	ML	34	98	NP	NP
	9	ML	36	66	--	--
	12	ML	42	99	40	2
	15	ML	100	93	--	--
B-5	0	CL	23	83	--	--
	6	CL	34	82	--	--
	9	MH	49	98	62	29
	12	CH	59	90	--	--
	15	CH	95	95	62	38
B-6	0	CH	54	98	--	--
	2.5	MH	46	99	70	35
	4.5	CH	43	92	--	--
B-7	3	CH	58	98	--	--
	6	ML	26	95	33	7
	9	MH	40	96	59	25
	12	CH	60	92	--	--
	15	SC	34	39	--	--
B-8	0	CH	41	99	67	45
	3	CH	36	80	--	--
	6	CH	71	97	--	--
	9	CH	58	98	53	24
	12	SC	40	36	--	--
	15	SC	26	16	--	--
B-9	1	CH	43	99	64	37
	3	CH	52	99	58	29
	6	MH	58	97	--	--
	9	MH	81	97	--	--
	12	SC	37	35	--	--
	15	SC	25	14	--	--
B-10	0	ML	29	76	--	--
	3	CH	54	93	--	--
	6	ML	31	94	NP	NP
	9	CL	59	100	--	--
	12	ML	48	100	46	15
	15	CL	48	52	--	--
	18	SM	29	12	--	--

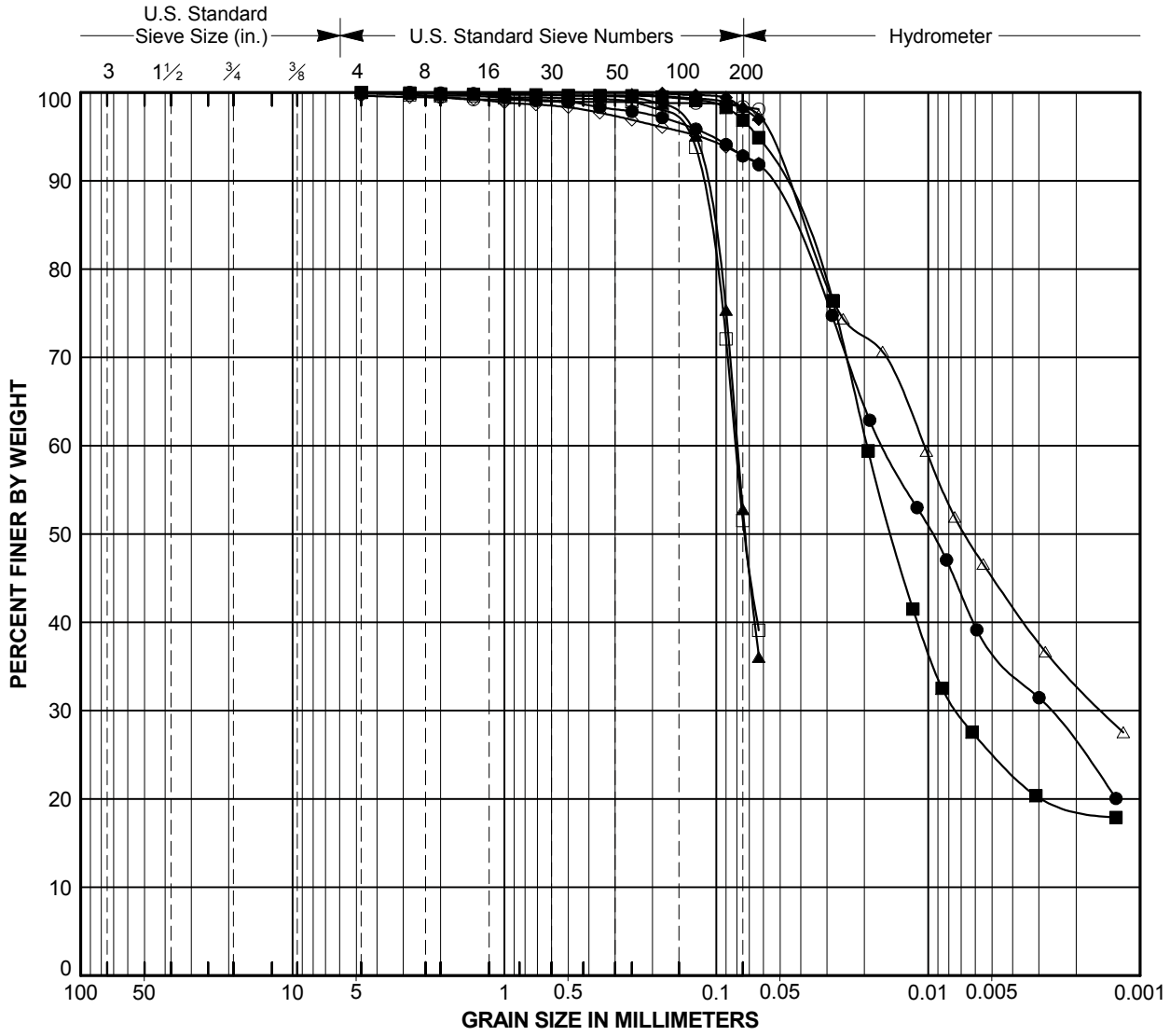
Table C2 - GEOTECHNICAL LABORATORY TEST SUMMARY

BORING NUMBER	DEPTH (feet)	SOIL TYPE	INSITU MOISTURE CONTENT (percent)	PERCENTAGE PASSING SIEVE NO. 200	LIQUID LIMIT	PLASTICITY INDEX
B-11	0	CL	37	90	--	--
	3	MH	72	96	80	40
	6	MH	58	91	--	--
	9	MH	60	97	61	28
	12	MH	71	90	--	--
	15	SC	54	45	--	--
B-12	0	CL	49	98	--	--
	3	MH	45	97	--	--
	6	MH	69	96	--	--
	9	MH	84	95	52	13
	12	MH	59	90	--	--
	15	CH	56	56	--	--
B-13	0	SC	17	21	--	--
	3	CH	65	97	--	--
	6	CH	56	96	60	29
	9	CH	93	95	--	--
	12	CH	65	99	--	--
	15	SC	43	47	--	--
C-1	0	SC	15	37	--	--
	6	CL	34	96	40	20
	7	CL	34	90	--	--
	9	CL	22	59	--	--
	12	CH	46	92	25	47
	15	CH	27	83	--	--
	18	CL	33	95	--	--
	21	SC	13	28	--	--
	24	SP-SC	12	7	--	--
	30	CH	34	99	--	--
C-2	0	SC	12	42	--	--
	6	CH	45	98	57	36
	9	CH	48	96	--	--
	12	SC	18	23	--	--
	15	CL	20	52	--	--
	18	CL	19	52	--	--
	24	SP-SC	19	7	--	--
	27	SP-SC	14	7	--	--
C-4	0	SP	4	5	--	--
	3	SP	8	11	--	--
	4	SP	18	60	--	--
	6	SC	23	44	--	--
	9	CH	20	57	--	--
	12	MH	38	95	54	23
	15	CH	23	60	--	--
	18	CH	22	68	--	--
	21	ML	23	61	--	--
	24	ML	24	79	NP	NP
C-5	0	CL	21	65	--	--
	3	SM	16	25	--	--
	6	SC	25	38	--	--
	12	CL	19	57	--	--
	15	SM	15	21	--	--
	24	ML	43	99	47	19

Table C2 - GEOTECHNICAL LABORATORY TEST SUMMARY

BORING NUMBER	DEPTH (feet)	SOIL TYPE	INSITU MOISTURE CONTENT (percent)	PERCENTAGE PASSING SIEVE NO. 200	LIQUID LIMIT	PLASTICITY INDEX
C-6	0	SP	4	3	--	--
	3	SP-SM	4	5	--	--
	6	SP	2	2	--	--
	9	CL	30	91	--	--
	12	CH	43	98	57	36
	15	CH	39	100	--	--
	18	CL	29	70	42	23
	21	CL	22	62	--	--
	24	CH	22	55	--	--
	27	SC	23	21	--	--
C-7	0	SM	7	15	--	--
	3	SM	8	15	--	--
	6	CH	30	75	--	--
	9	ML	31	92	49	12
	12	CH	42	88	--	--
	18	ML	51	71	--	--
	21	CH	27	74	51	33

Template: DY_SIEVE_WIN



COBBLES	Coarse	Fine	Coarse	Medium	Fine	SILT or CLAY
	GRAVEL		SAND			

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	B-01	3.0	SILT (ML)	39	41	7	98
□	B-01	6.0	SANDY SILT (ML)	32			52
△	B-01	9.0	ELASTIC SILT (MH)	43	55	22	98
◇	B-01	12.0	ELASTIC SILT (MH)	60			93
●	B-01	15.0	ELASTIC SILT (MH)	91			93
■	B-02	3.0	FAT CLAY (CH)	39	50	31	97
▲	B-02	6.0	SANDY SILT (ML)	37			53
◆	B-02	9.0	LEAN CLAY (CL)	40			98

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

Project No. 2006-023.05

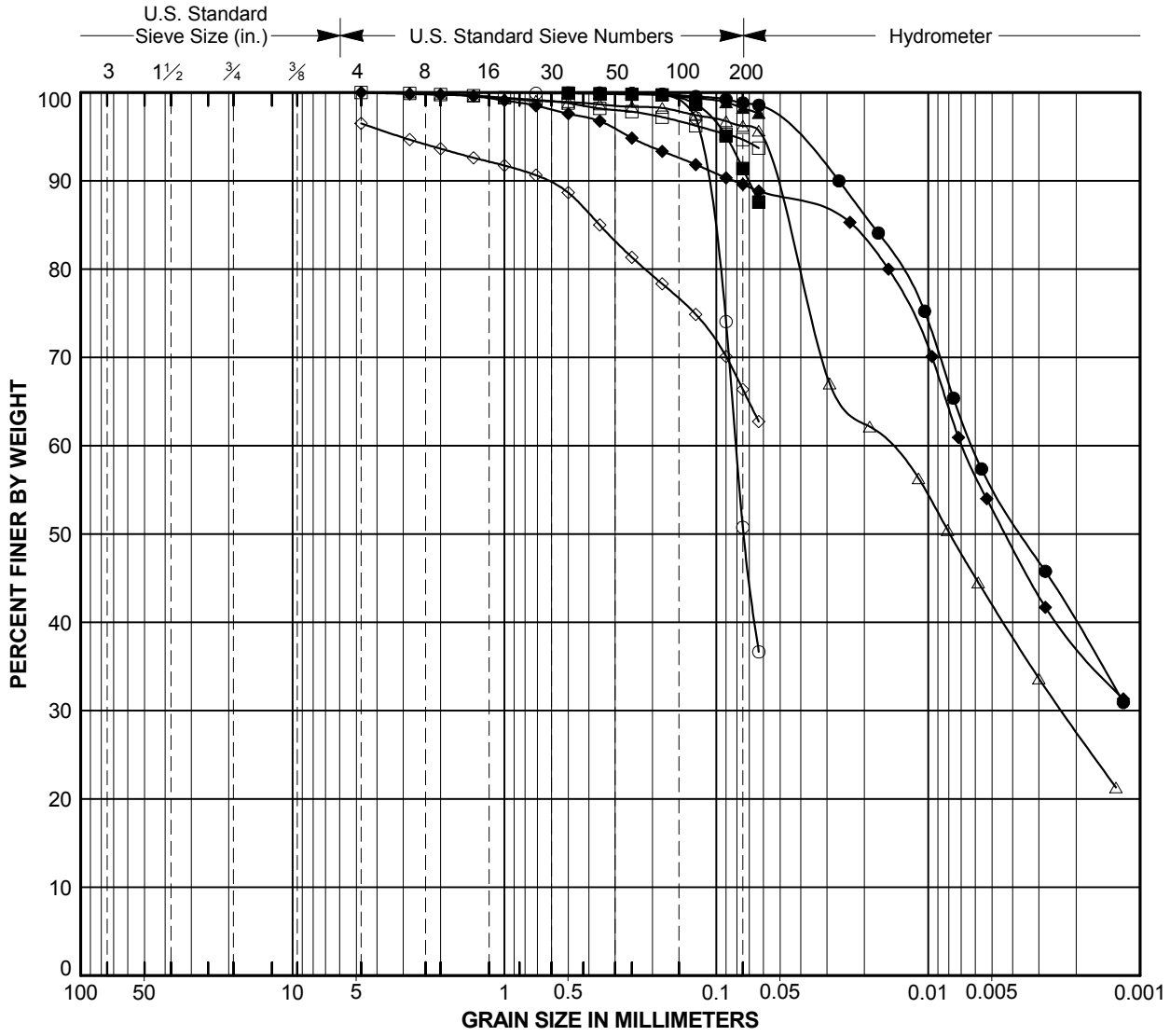
Diaz Yourman Areas B and C

PLATE

C1

PLATE B2-39

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	B-02	10.0	SANDY LEAN CLAY (CL)	38			51
□	B-02	12.0	FAT CLAY (CH)	83			95
△	B-02	15.0	ELASTIC SILT (MH)	107	64	17	96
◇	B-03	0.0	SANDY SILT (ML)	19			66
●	B-03	6.0	LEAN CLAY (CL)	45	46	21	99
■	B-03	9.0	LEAN CLAY (CL)	37			91
▲	B-03	12.0	ELASTIC SILT (MH)	42			98
◆	B-03	15.0	FAT CLAY (CH)	62	73	45	90

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

Project No. 2006-023.05

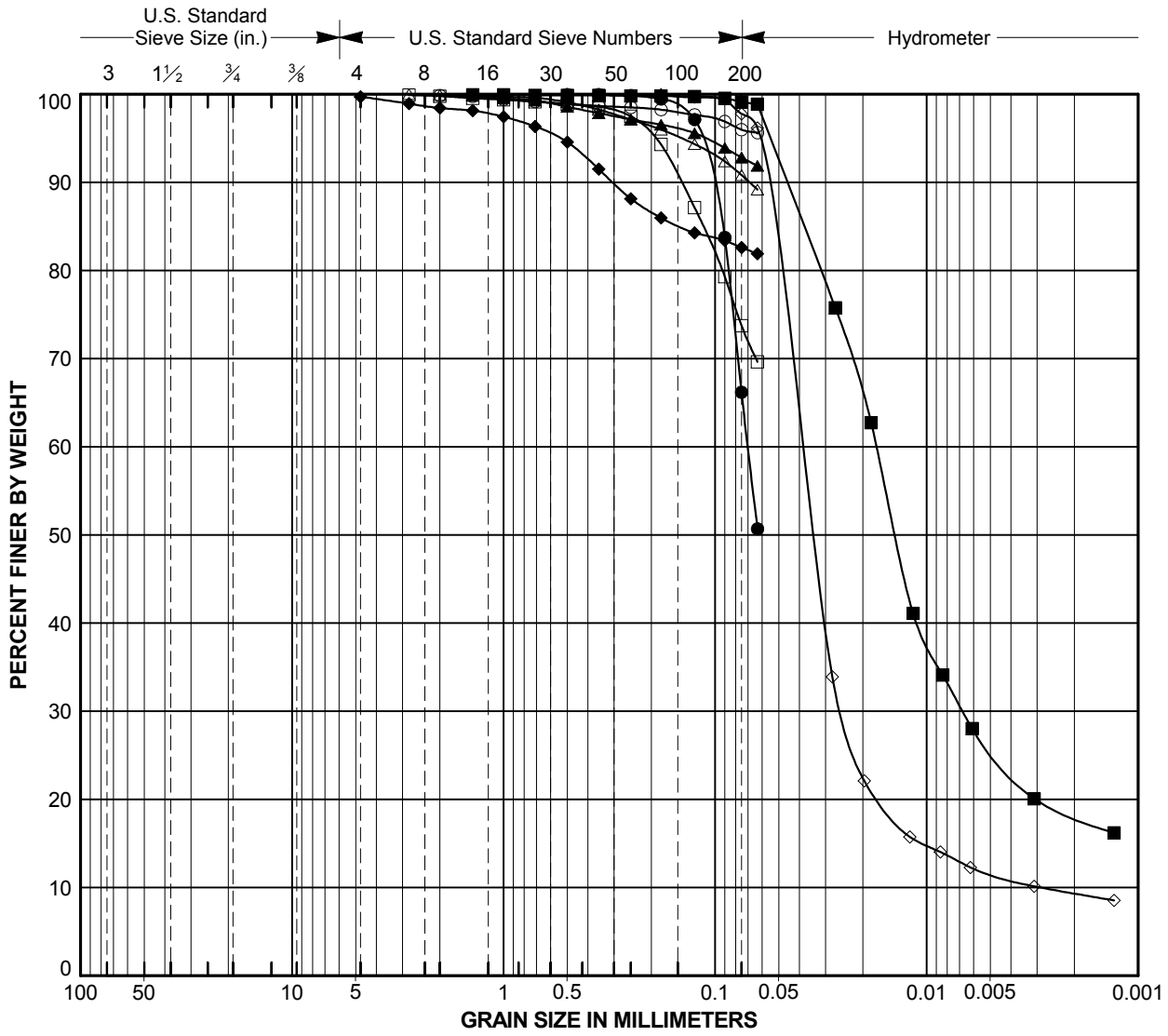
Diaz Yourman Areas B and C

PLATE

C2

PLATE B2-40

Template: DY_SIEVE_WIN



COBBLES	Coarse	Fine	Coarse	Medium	Fine	SILT or CLAY
	GRAVEL		SAND			

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	B-03	18.0	FAT CLAY (CH)	87			96
□	B-04	0.0	SILT WITH SAND (ML)	20			74
△	B-04	3.0	LEAN CLAY (CL)	34			91
◇	B-04	6.0	SILT (ML)	34	NP	NP	98
●	B-04	9.0	SANDY SILT (ML)	36			66
■	B-04	12.0	SILT (ML)	42	40	7	99
▲	B-04	15.0	SILT (ML)	100			93
◆	B-05	0.0	LEAN CLAY WITH SAND (CL)	23			83

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

Project No. 2006-023.05

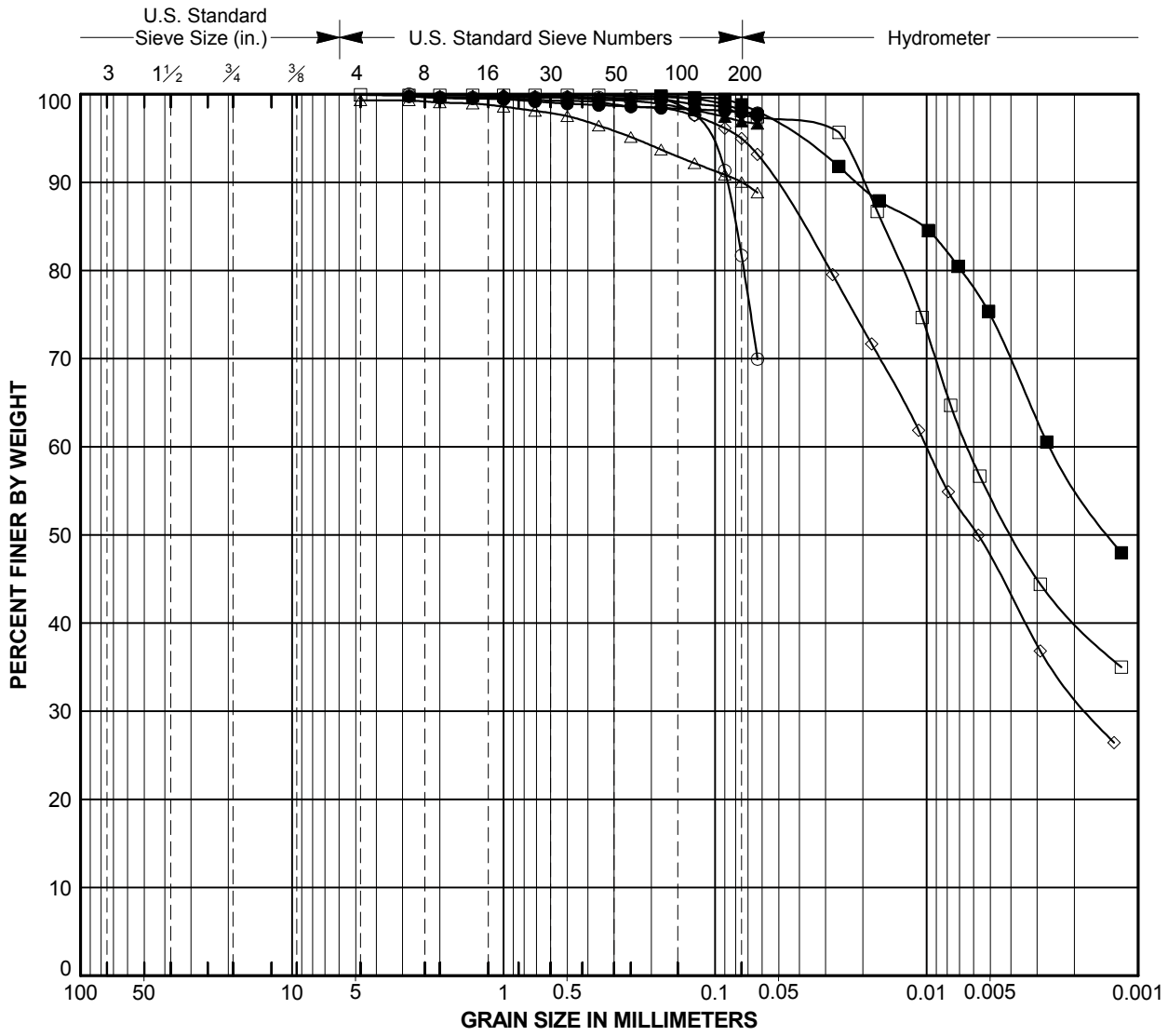
Diaz Yourman Areas B and C

PLATE

C3

PLATE B2-41

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	B-05	6.0	LEAN CLAY WITH SAND (CL)	34			82
□	B-05	9.0	ELASTIC SILT (MH)	49	62	29	98
△	B-05	12.0	FAT CLAY (CH)	59			90
◇	B-05	15.0	FAT CLAY (CH)	95	67	38	95
●	B-06	0.0	FAT CLAY (CH)	54			98
■	B-06	2.5	ELASTIC SILT (MH)	46	70	35	99
▲	B-06	4.5	FAT CLAY (CH)	43			97
◆	B-07	3.0	FAT CLAY (CH)	58			98

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

Project No. 2006-023.05

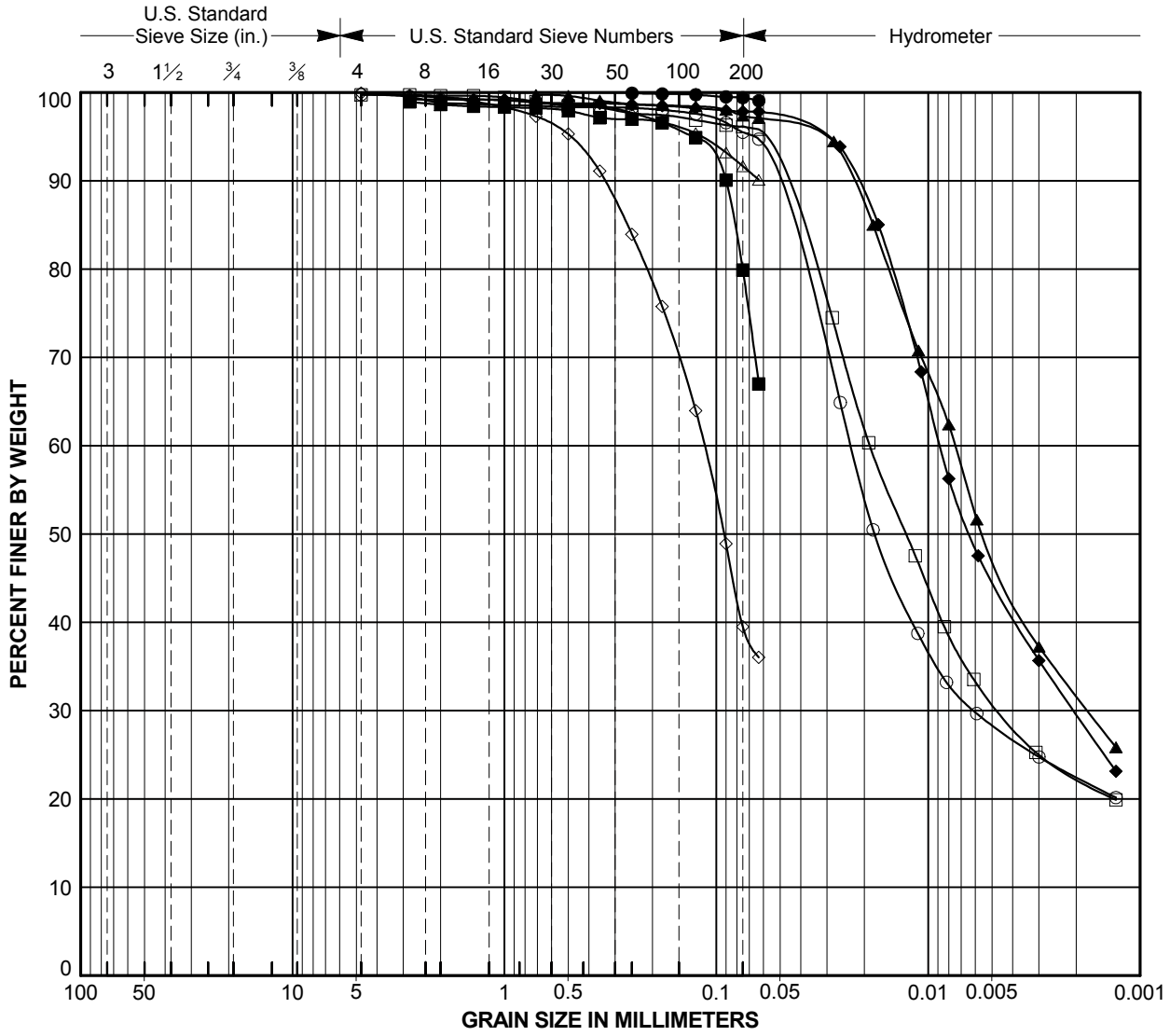
Diaz Yourman Areas B and C

PLATE

C4

PLATE B2-42

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	B-07	6.0	SILT (ML)	26	33	7	95
□	B-07	9.0	ELASTIC SILT (MH)	40	59	25	96
△	B-07	12.0	FAT CLAY (CH)	60			92
◇	B-07	15.0	CLAYEY SAND (SC)	34			39
●	B-08	0.0	FAT CLAY (CH)	41	67	45	99
■	B-08	3.0	FAT CLAY WITH SAND (CH)	36			80
▲	B-08	6.0	FAT CLAY (CH)	71			97
◆	B-08	9.0	FAT CLAY (CH)	58	53	24	98

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

Project No. 2006-023.05

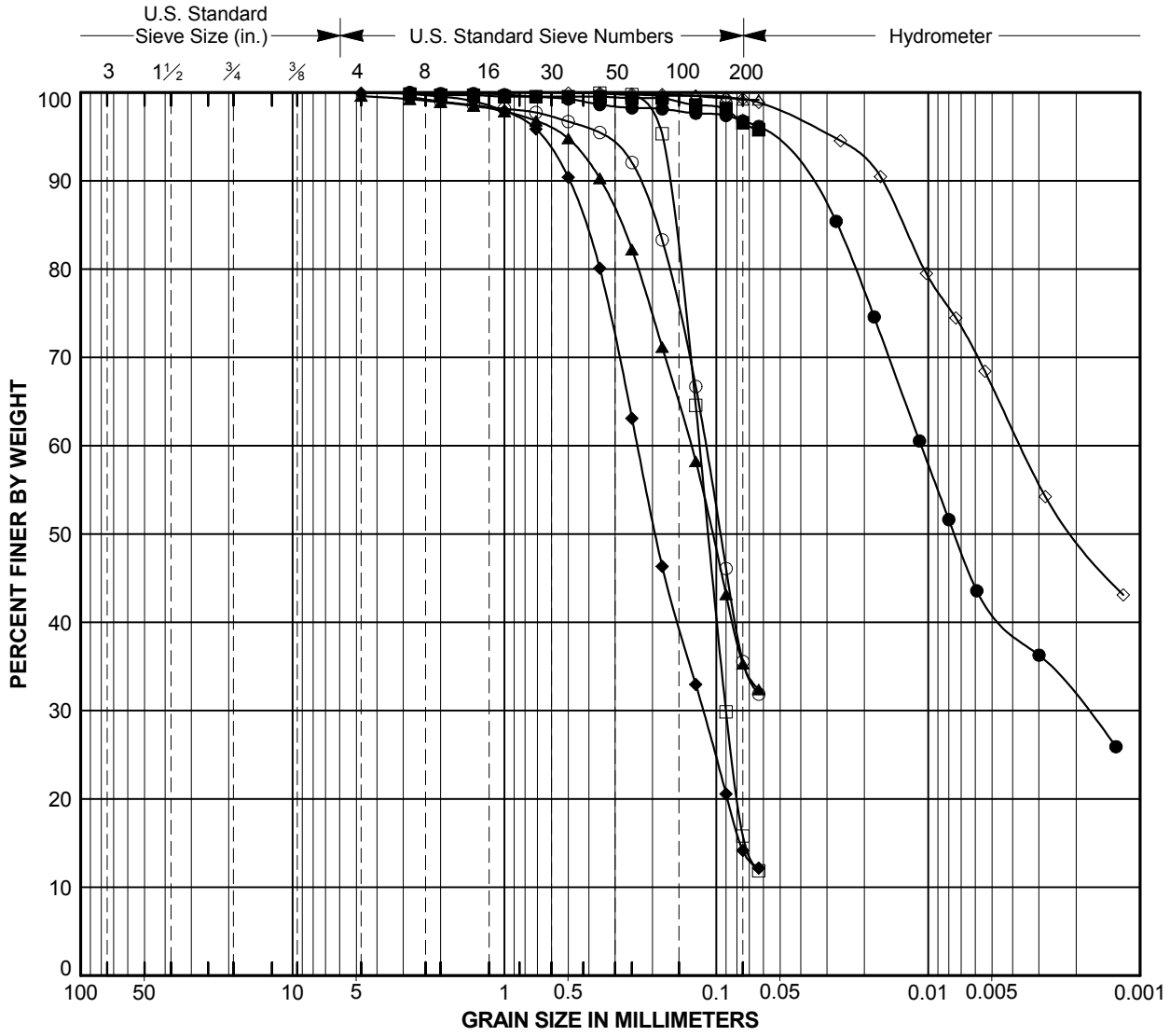
Diaz Yourman Areas B and C

PLATE

C5

PLATE B2-43

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	B-08	12.0	CLAYEY SAND (SC)	40			36
□	B-08	15.0	CLAYEY SAND (SC)	26			16
△	B-09	1.0	FAT CLAY (CH)	43	64	37	99
◇	B-09	3.0	FAT CLAY (CH)	52	58	29	99
●	B-09	6.0	ELASTIC SILT (MH)	58			97
■	B-09	9.0	ELASTIC SILT (MH)	81			97
▲	B-09	12.0	CLAYEY SAND (SC)	37			35
◆	B-09	15.0	CLAYEY SAND (SC)	25			14

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

Project No. 2006-023.05

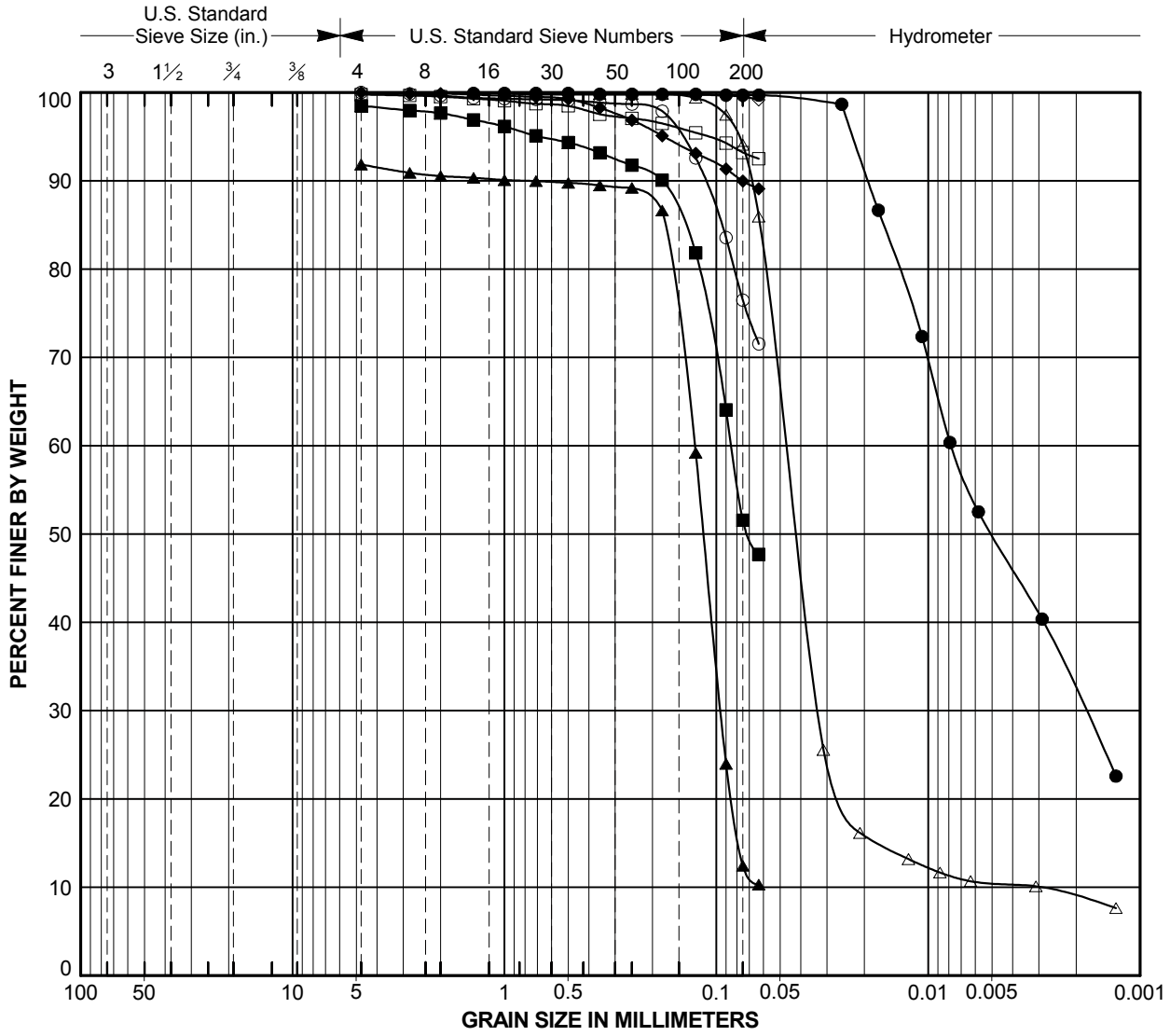
Diaz Yourman Areas B and C

PLATE

C6

PLATE B2-44

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	B-10	0.0	SILT WITH SAND (ML)	29			76
□	B-10	3.0	FAT CLAY (CH)	54			93
△	B-10	6.0	SILT (ML)	31	NP	NP	94
◇	B-10	9.0	LEAN CLAY (CL)	59			100
●	B-10	12.0	SILT (ML)	48	46	15	100
■	B-10	15.0	SANDY LEAN CLAY (CL)	48			52
▲	B-10	18.0	POORLY GRADED SAND WITH SILT (SP-SM)	29			12
◆	B-11	0.0	LEAN CLAY (CL)	37			90

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

Project No. 2006-023.05

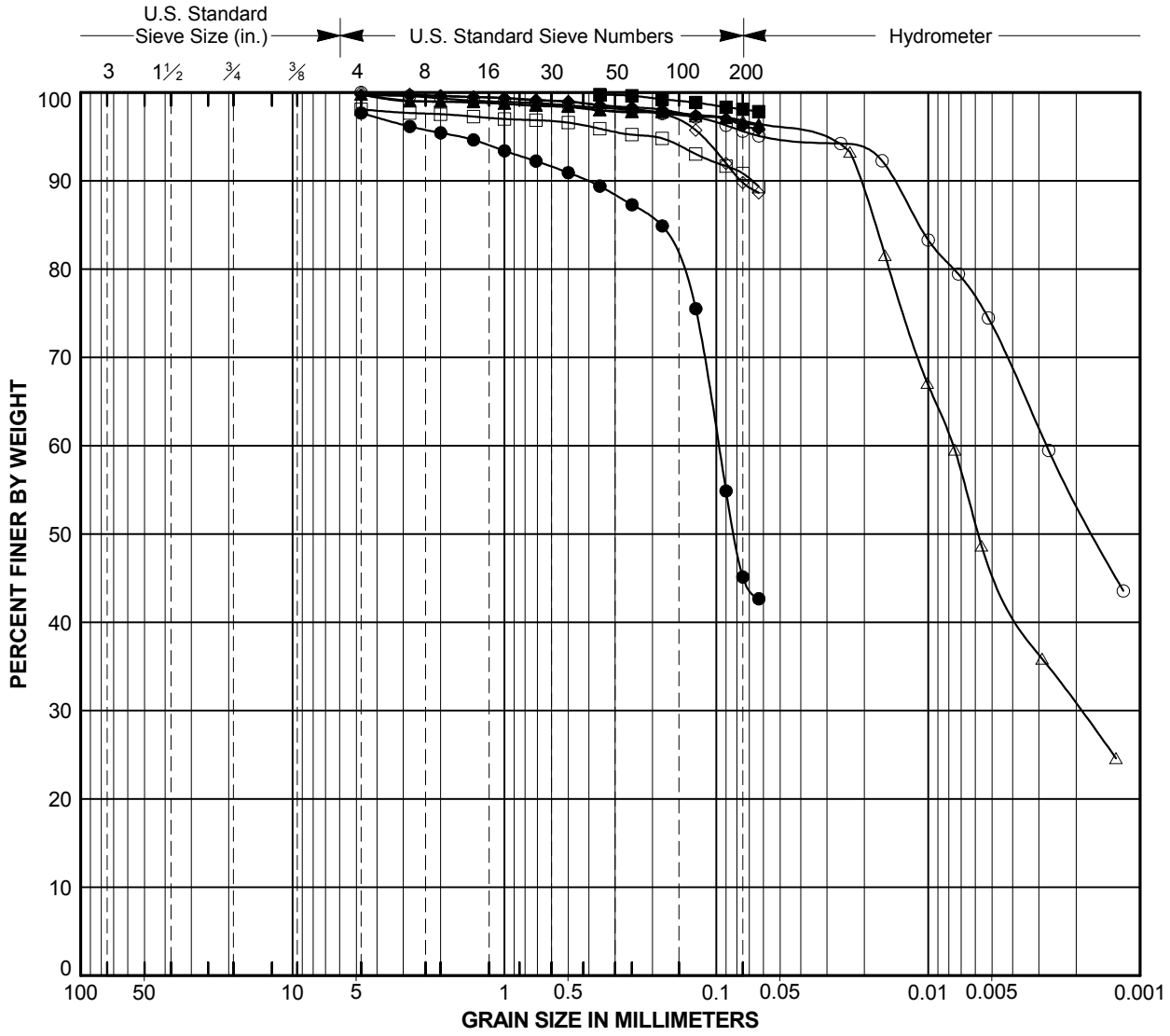
Diaz Yourman Areas B and C

PLATE

C7

PLATE B2-45

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	B-11	3.0	ELASTIC SILT (MH)	72	80	40	96
□	B-11	6.0	ELASTIC SILT (MH)	58			91
△	B-11	9.0	ELASTIC SILT (MH)	60	61	28	97
◇	B-11	12.0	ELASTIC SILT (MH)	71			90
●	B-11	15.0	CLAYEY SAND (SC)	54			45
■	B-12	0.0	LEAN CLAY (CL)	49			98
▲	B-12	3.0	ELASTIC SILT (MH)	45			97
◆	B-12	6.0	ELASTIC SILT (MH)	69			96

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

Project No. 2006-023.05

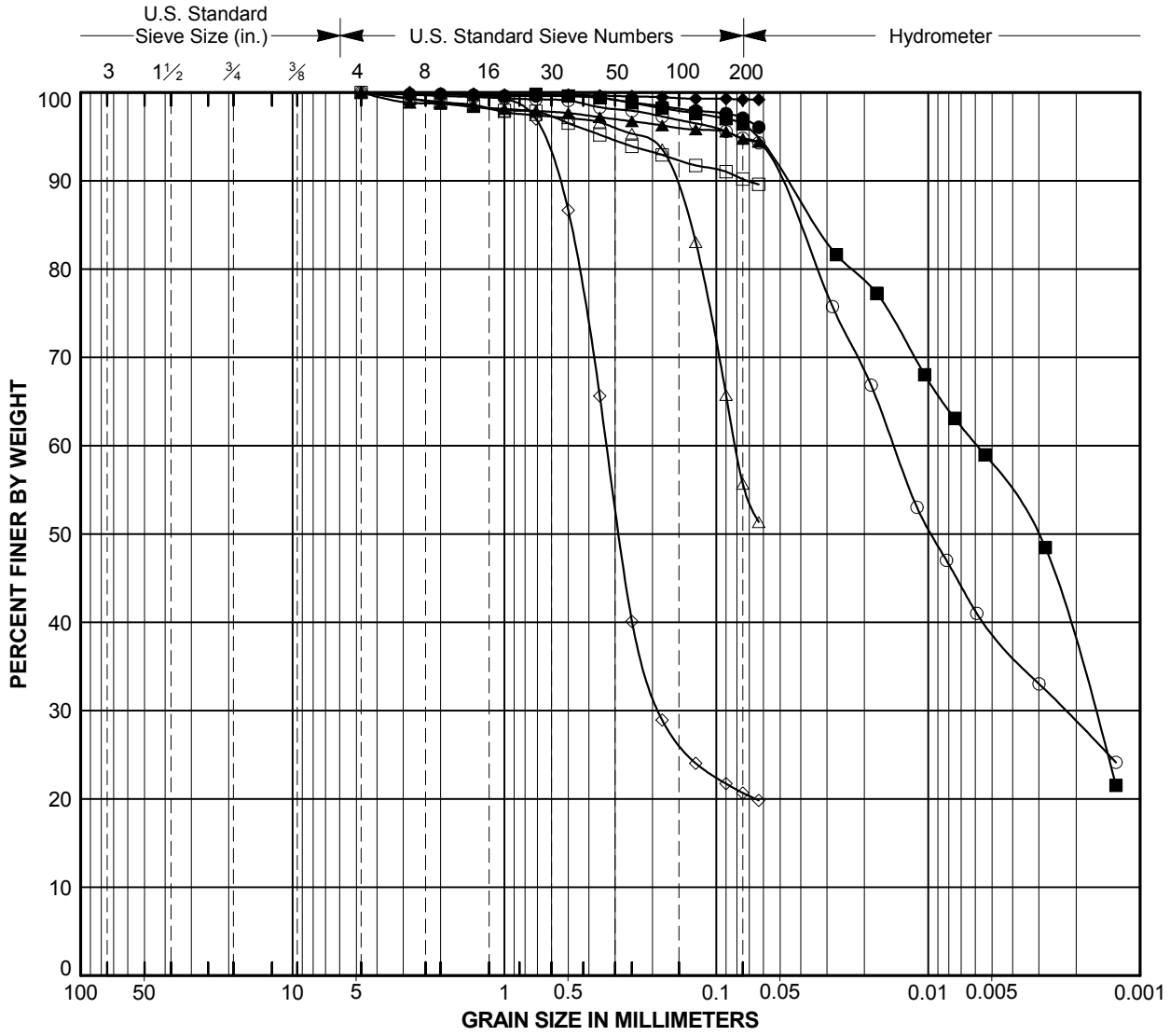
Diaz Yourman Areas B and C

PLATE

C8

PLATE B2-46

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	B-12	9.0	ELASTIC SILT (MH)	84	52	13	95
□	B-12	12.0	ELASTIC SILT (MH)	59			90
△	B-12	15.0	SANDY FAT CLAY (CH)	56			56
◇	B-13	0.0	CLAYEY SAND (SC)	17			21
●	B-13	3.0	FAT CLAY (CH)	65			97
■	B-13	6.0	FAT CLAY (CH)	56	60	29	96
▲	B-13	9.0	FAT CLAY (CH)	93			95
◆	B-13	12.0	FAT CLAY (CH)	65			99

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

Project No. 2006-023.05

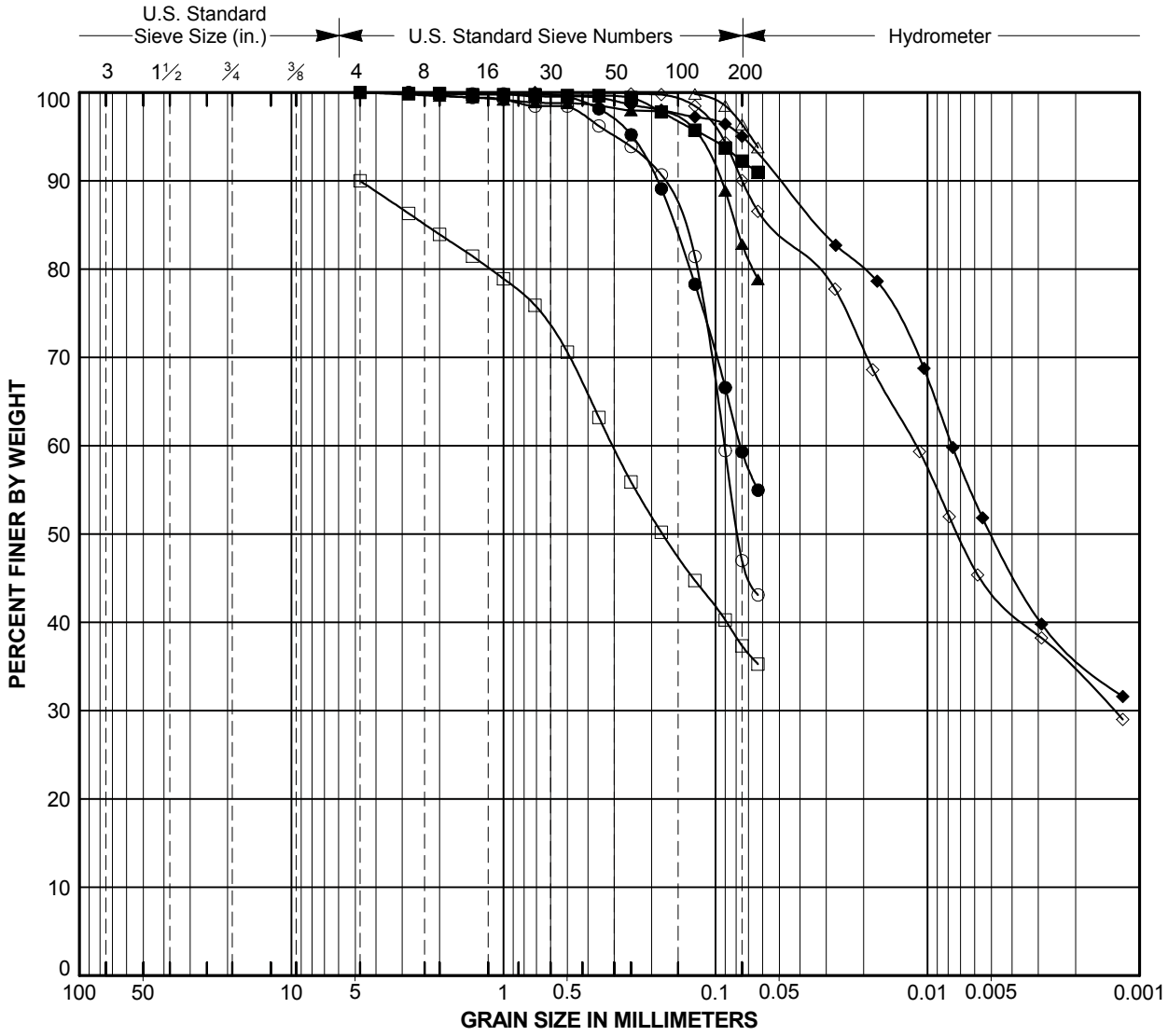
Diaz Yourman Areas B and C

PLATE

C9

PLATE B2-47

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	B-13	15.0	CLAYEY SAND (SC)	43			47
□	C-01	0.0	CLAYEY SAND (SC)	15			37
△	C-01	6.0	LEAN CLAY (CL)	34	40	20	96
◇	C-01	7.0	LEAN CLAY (CL)	34			90
●	C-01	9.0	SANDY LEAN CLAY (CL)	22			59
■	C-01	12.0	FAT CLAY (CH)	46	75	47	92
▲	C-01	15.0	FAT CLAY WITH SAND (CH)	27			83
◆	C-01	18.0	LEAN CLAY (CL)	33			95

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

Project No. 2006-023.05

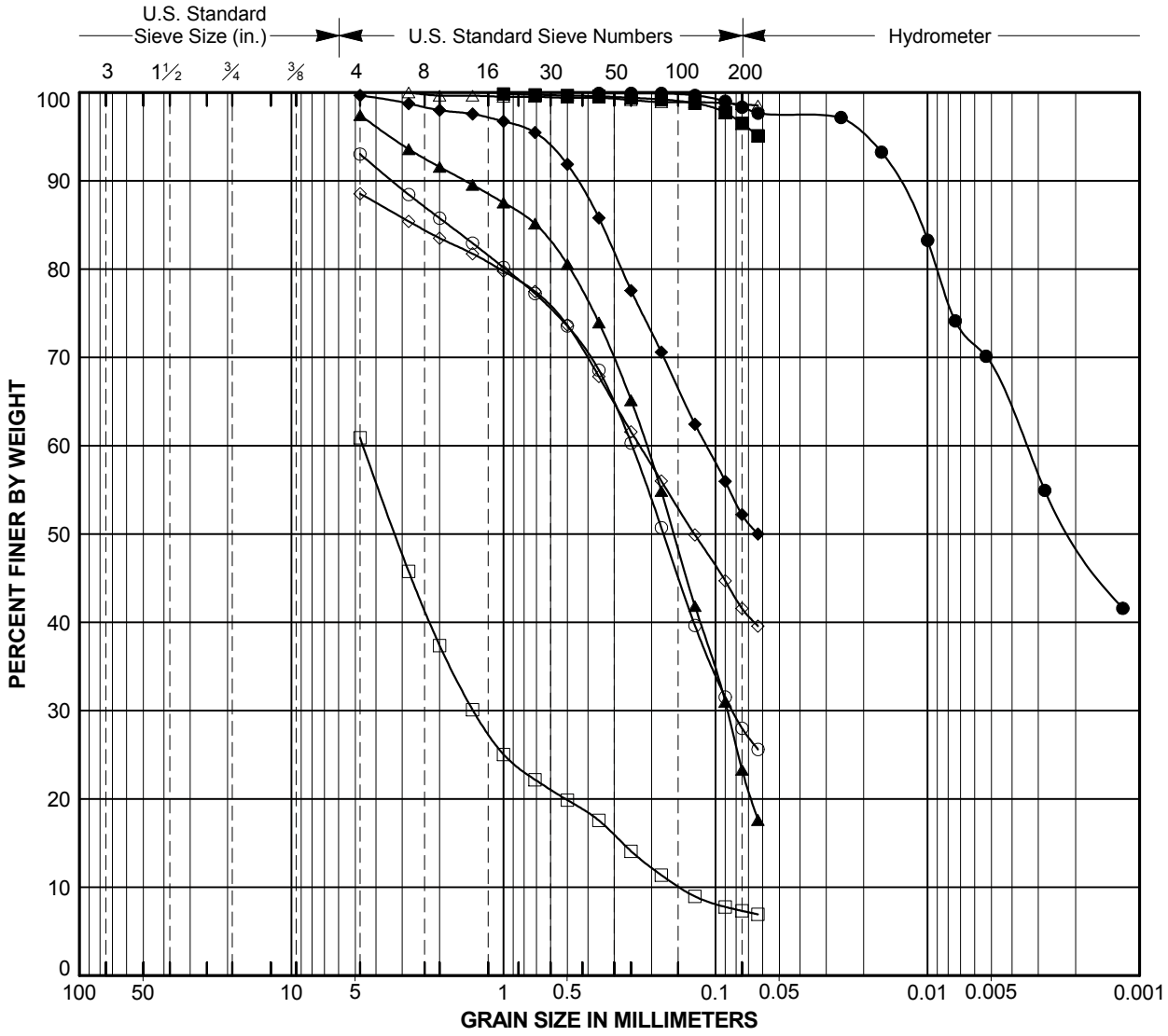
Diaz Yourman Areas B and C

PLATE

C10

PLATE B2-48

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	C-01	21.0	CLAYEY SAND (SC)	13			28
□	C-01	24.0	POORLY GRADED SAND WITH CLAY AND GRAVEL (SP-SC)	12			7
△	C-01	30.0	FAT CLAY (CH)	34			99
◇	C-02	0.0	CLAYEY SAND (SC)	12			42
●	C-02	6.0	FAT CLAY (CH)	45	57	36	98
■	C-02	9.0	FAT CLAY (CH)	48			96
▲	C-02	12.0	CLAYEY SAND (SC)	18			23
◆	C-02	15.0	SANDY LEAN CLAY (CL)	20			52

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

Project No. 2006-023.05

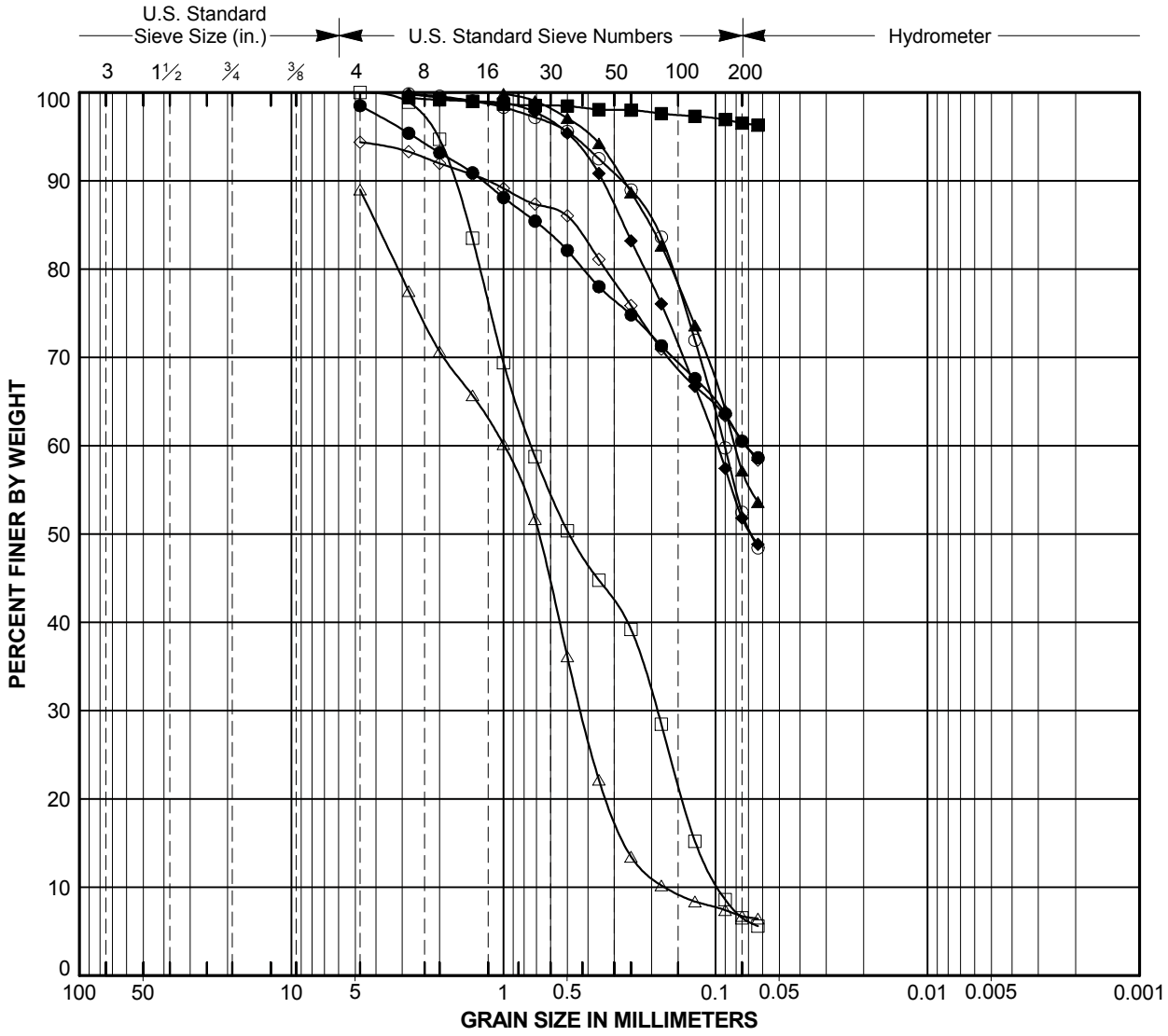
Diaz Yourman Areas B and C

PLATE

C11

PLATE B2-49

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	C-02	18.0	SANDY LEAN CLAY (CL)	19			52
□	C-02	24.0	POORLY GRADED SAND WITH CLAY (SP-SC)	19			7
△	C-02	27.0	POORLY GRADED SAND WITH CLAY (SP-SC)	14			7
◇	C-03	0.0	SANDY LEAN CLAY (CL)	17			61
●	C-03	3.0	SANDY LEAN CLAY (CL)	16			61
■	C-03	6.0	FAT CLAY (CH)	46			97
▲	C-03	9.0	SANDY LEAN CLAY (CL)	23			57
◆	C-03	12.0	SANDY LEAN CLAY (CL)	23			52

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

Project No. 2006-023.05

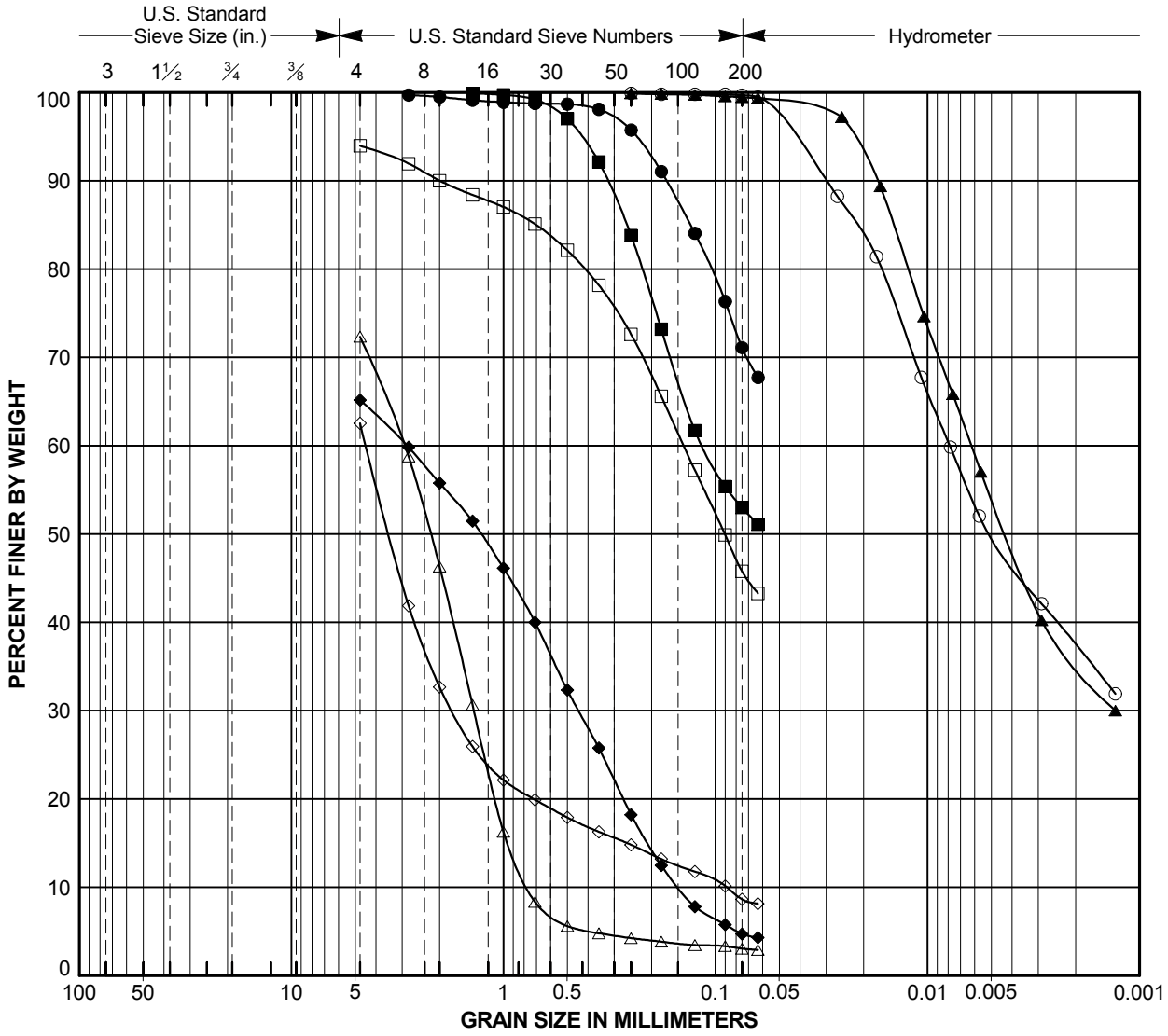
Diaz Yourman Areas B and C

PLATE

C12

PLATE B2-50

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	C-03	15.0	FAT CLAY (CH)	51	53	26	100
□	C-03	18.0	CLAYEY SAND (SC)	14			46
△	C-03	21.0	POORLY GRADED SAND WITH GRAVEL (SP)	15			3
◇	C-03	24.0	POORLY GRADED SAND WITH CLAY AND GRAVEL (SP-SC)	13			9
●	C-03	27.0	LEAN CLAY WITH SAND (CL)	27			71
■	C-03	30.0	SANDY LEAN CLAY (CL)	23			53
▲	C-03	33.0	SILT (ML)	38	NP	NP	99
◆	C-04	0.0	POORLY GRADED SAND WITH CLAY AND GRAVEL (SP-SC)	4			5

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

Project No. 2006-023.05

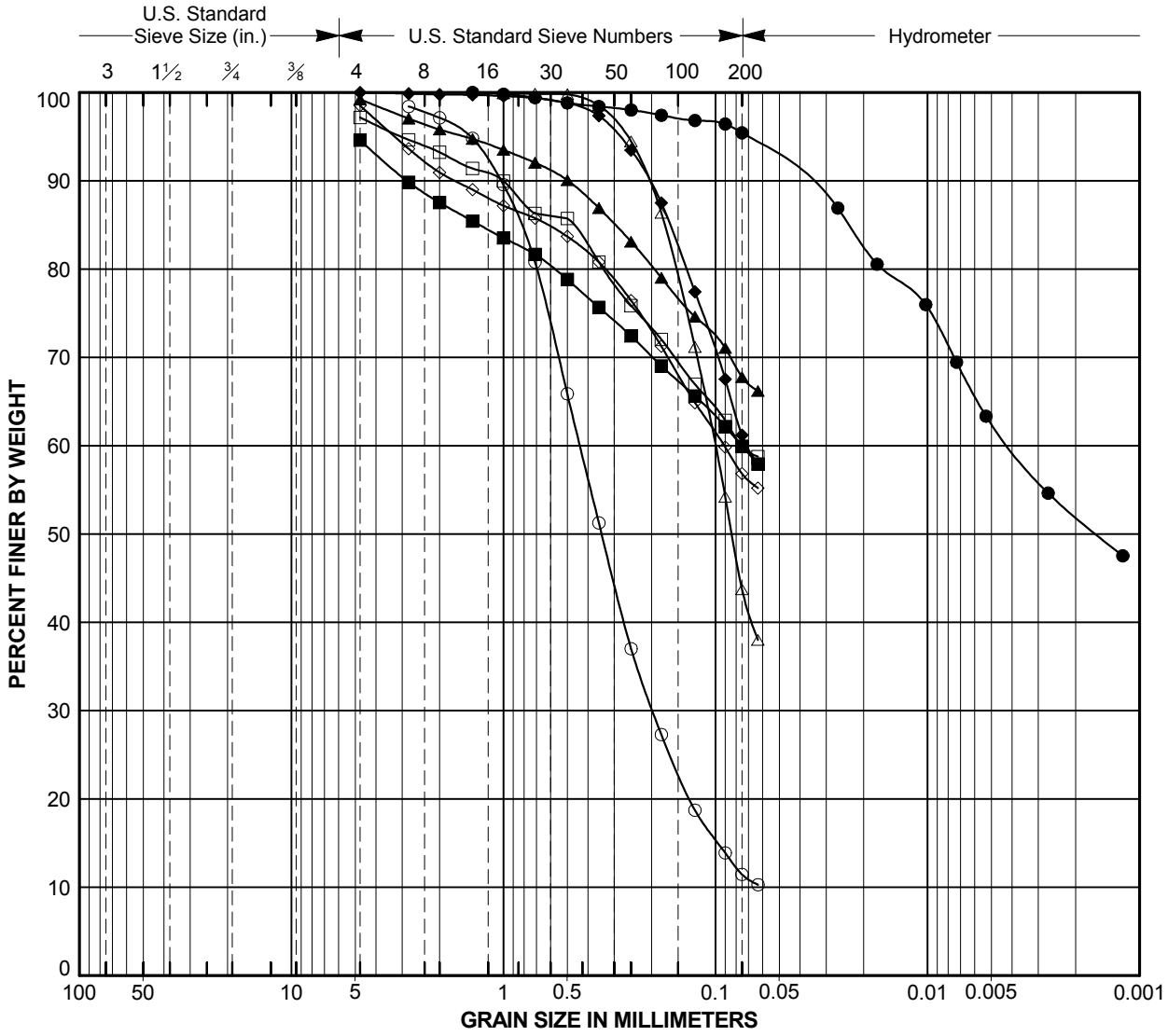
Diaz Yourman Areas B and C

PLATE

C13

PLATE B2-51

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	C-04	3.0	POORLY GRADED SAND WITH CLAY AND GRAVEL (SP-SC)	8			11
□	C-04	4.0	SANDY LEAN CLAY (CL)	18			60
△	C-04	6.0	CLAYEY SAND (SC)	23			44
◇	C-04	9.0	SANDY FAT CLAY (CH)	20			57
●	C-04	12.0	ELASTIC SILT (MH)	38	54	23	95
■	C-04	15.0	SANDY FAT CLAY (CH)	23			60
▲	C-04	18.0	SANDY FAT CLAY (CH)	22			68
◆	C-04	21.0	SANDY SILT (ML)	23			61

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

Project No. 2006-023.05

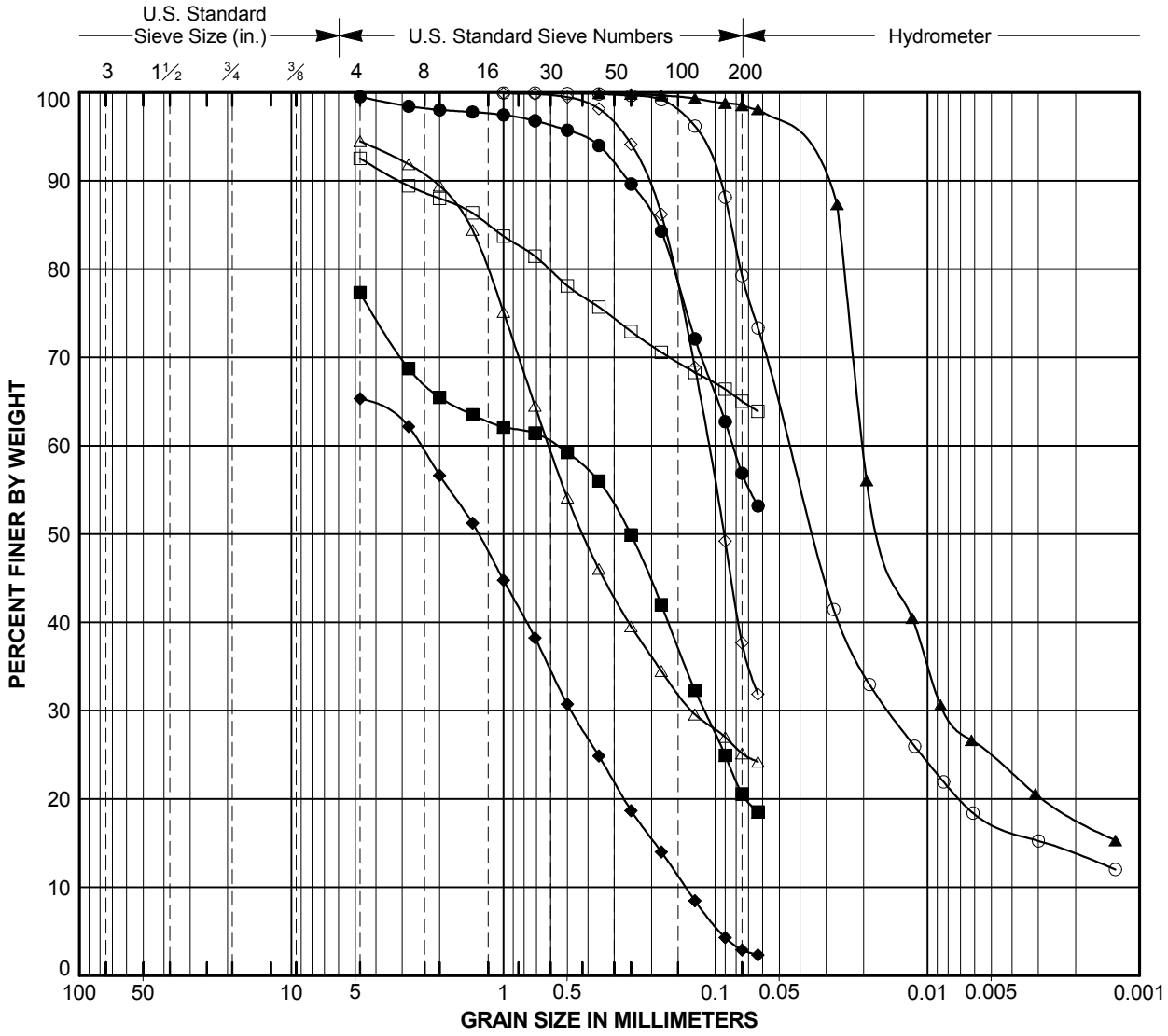
Diaz Yourman Areas B and C

PLATE

C14

PLATE B2-52

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	C-04	24.0	SILT WITH SAND (ML)	24	NP	NP	79
□	C-05	0.0	SANDY LEAN CLAY (CL)	21			65
△	C-05	3.0	SILTY SAND (SM)	16			25
◇	C-05	6.0	CLAYEY SAND (SC)	25			38
●	C-05	12.0	SANDY LEAN CLAY (CL)	19			57
■	C-05	15.0	SILTY SAND WITH GRAVEL (SM)	15			21
▲	C-05	24.0	SILT (ML)	43	47	19	99
◆	C-06	0.0	POORLY GRADED SAND WITH GRAVEL (SP)	4			3

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

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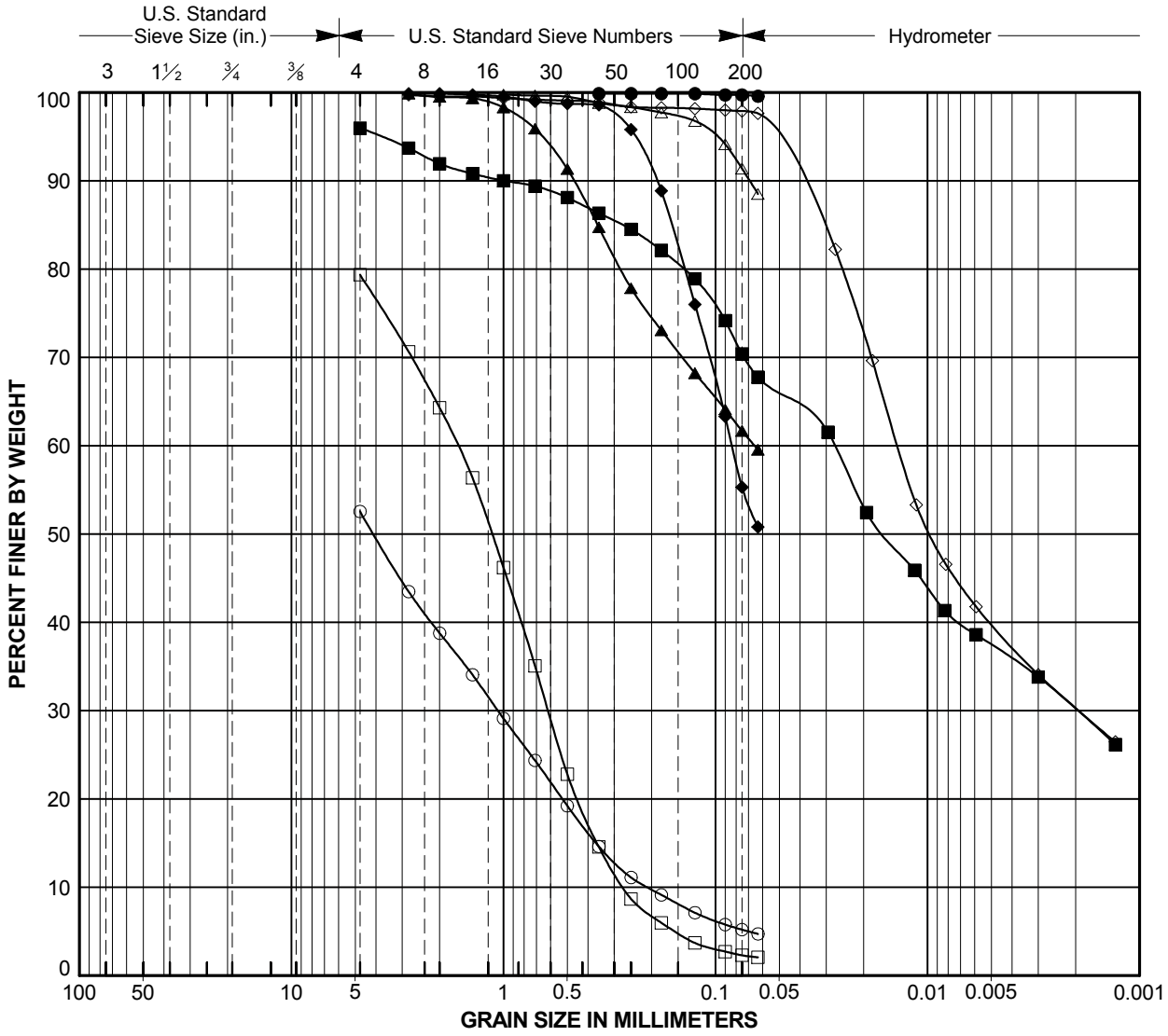
Diaz Yourman Areas B and C

PLATE

C15

PLATE B2-53

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	C-06	3.0	POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)	4			5
□	C-06	6.0	POORLY GRADED SAND WITH GRAVEL (SP)	2			2
△	C-06	9.0	LEAN CLAY (CL)	30			91
◇	C-06	12.0	FAT CLAY (CH)	43	57	36	98
●	C-06	15.0	FAT CLAY (CH)	39			100
■	C-06	18.0	SANDY LEAN CLAY (CL)	29	42	23	70
▲	C-06	21.0	SANDY LEAN CLAY (CL)	22			62
◆	C-06	24.0	SANDY FAT CLAY (CH)	22			55

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

Project No. 2006-023.05

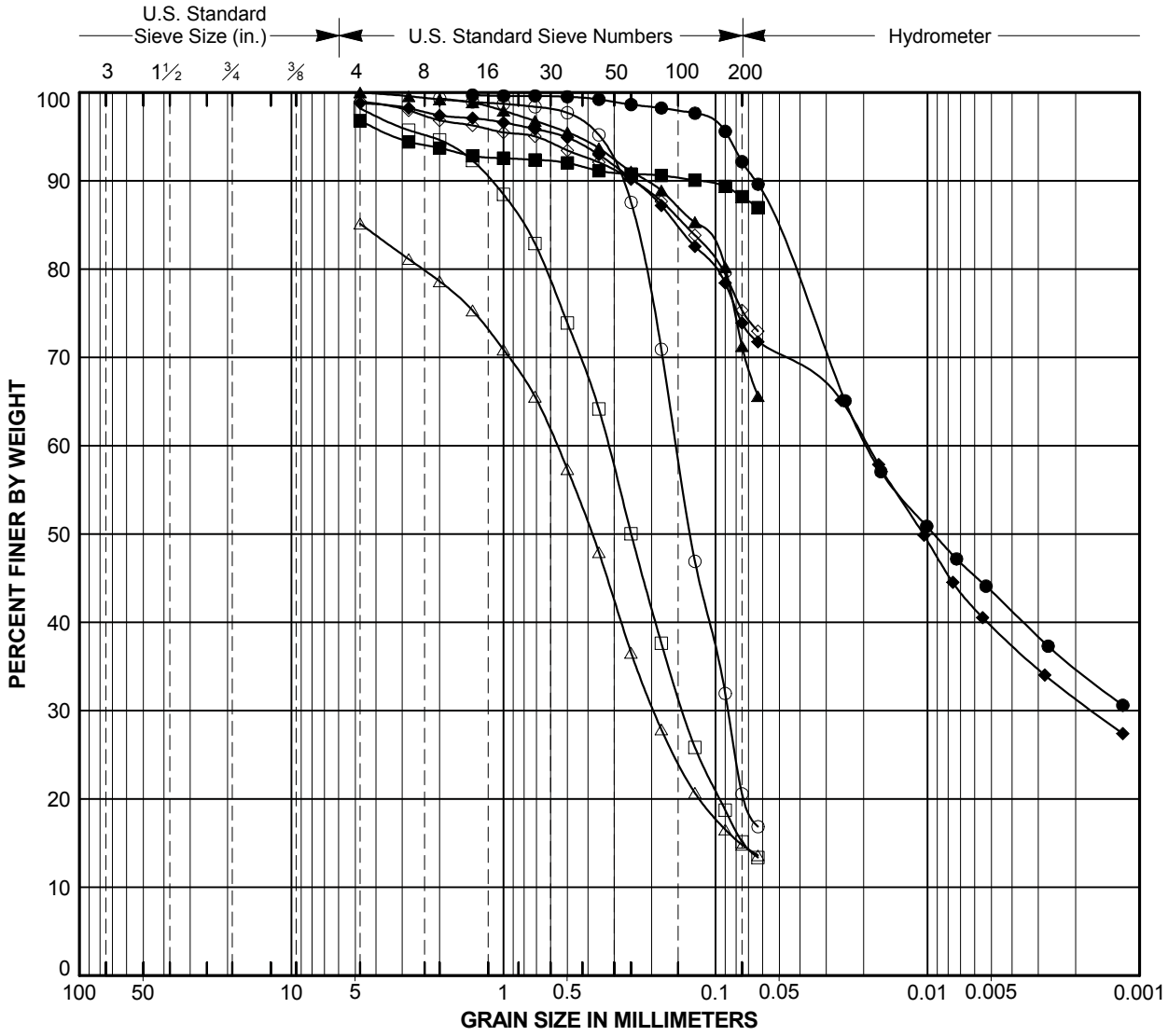
Diaz Yourman Areas B and C

PLATE

C16

PLATE B2-54

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	C-06	27.0	CLAYEY SAND (SC)	23			21
□	C-07	0.0	SILTY SAND (SM)	7			15
△	C-07	3.0	SILTY SAND WITH GRAVEL (SM)	8			15
◇	C-07	6.0	FAT CLAY WITH SAND (CH)	30			75
●	C-07	9.0	SILT (ML)	31	49	12	92
■	C-07	12.0	FAT CLAY (CH)	42			88
▲	C-07	18.0	SILT WITH SAND (ML)	51			71
◆	C-07	21.0	FAT CLAY WITH SAND (CH)	27	51	33	74

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

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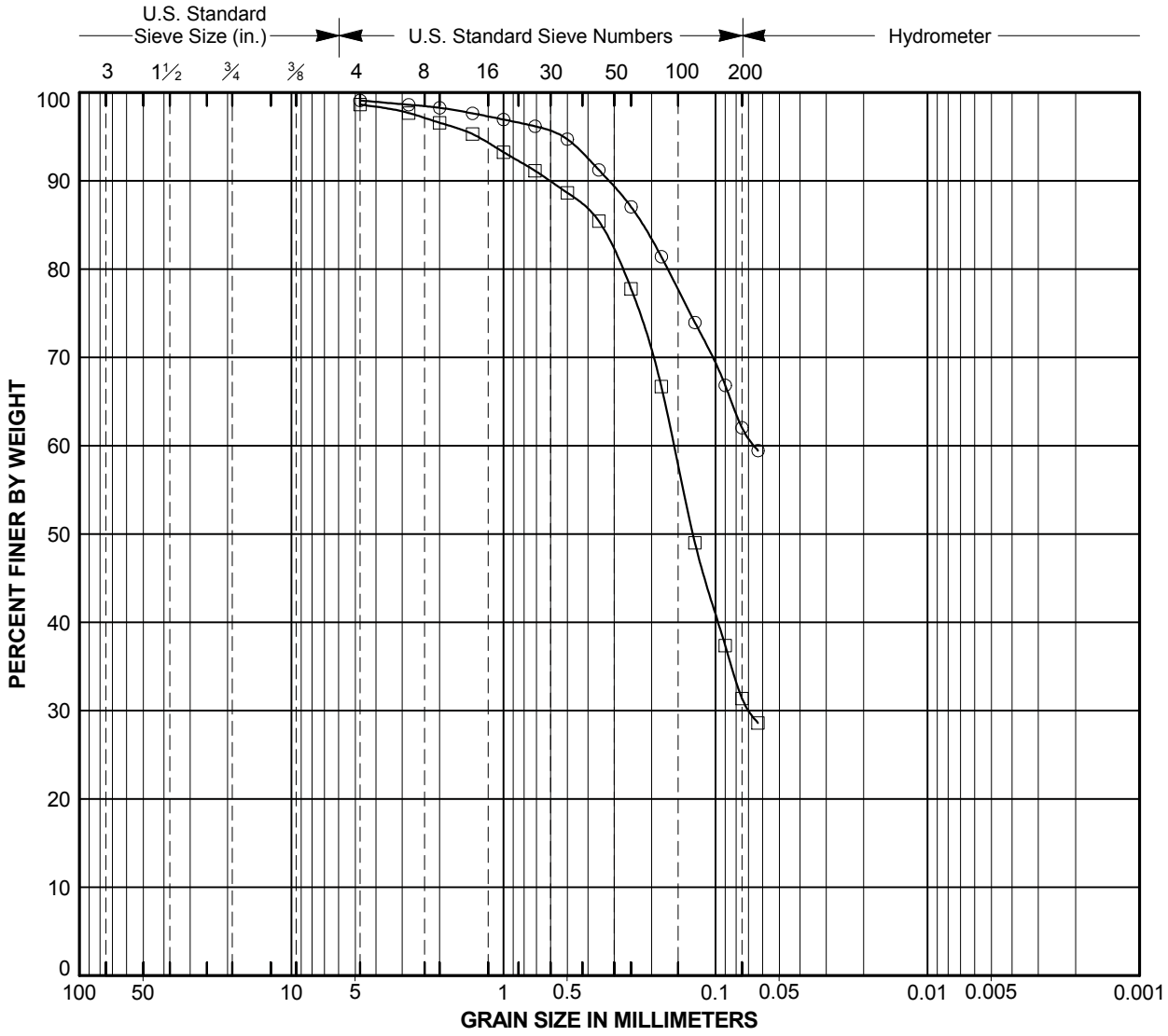
Diaz Yourman Areas B and C

PLATE

C17

PLATE B2-55

Template: DY_SIEVE_WIN



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
⊙	C-07	24.0	SANDY FAT CLAY (CH)	23			62
□	C-07	27.0	CLAYEY SAND (SC)	20			31

PARTICLE SIZE ANALYSIS

USACE Ballona Creek Watershed

Project No. 2006-023.05

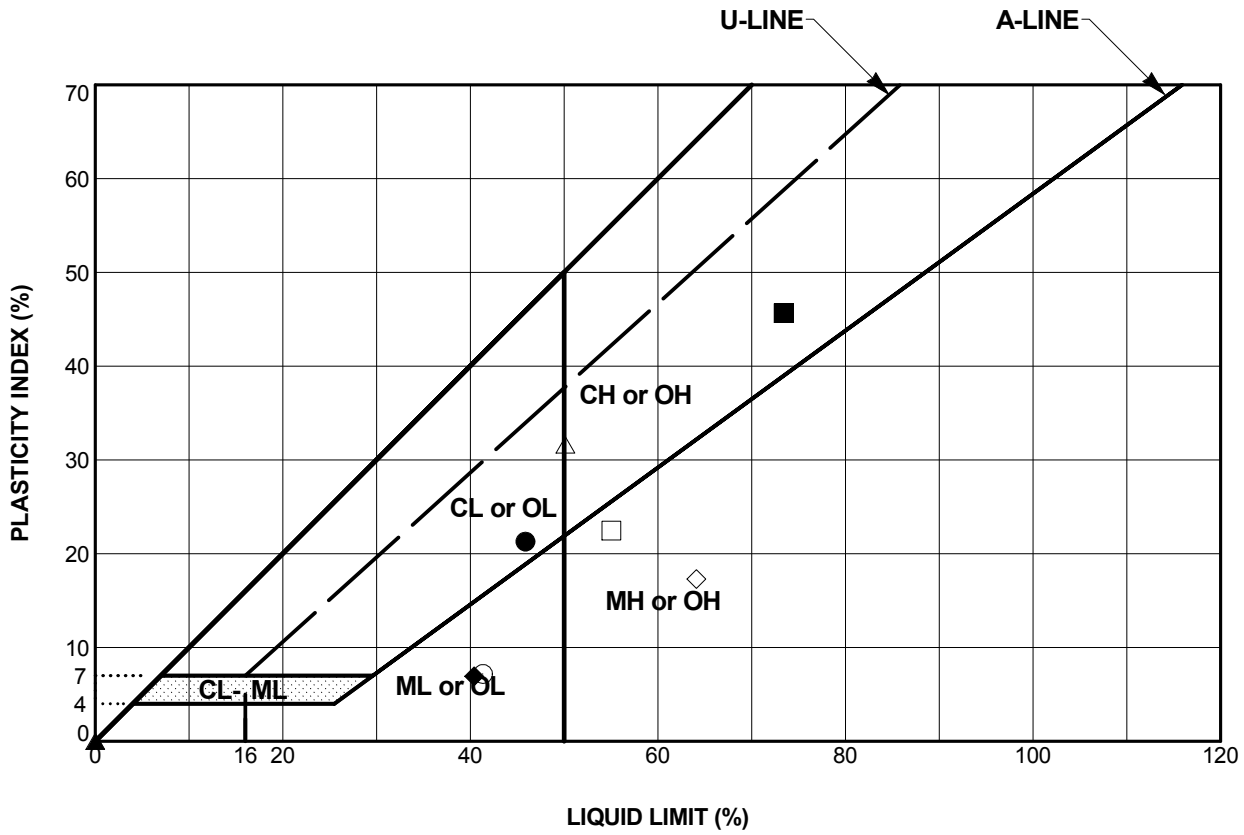
Diaz Yourman Areas B and C

PLATE

C18

PLATE B2-56

Template: DY_ATTERBERG_CHART_WIN



Laboratory Testing by: Diaz Yourman & Associates

Test Method: ASTM D4318-05

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	B-01	3.0	SILT (ML)	39	41	34	7	98
□	B-01	9.0	ELASTIC SILT (MH)	43	55	33	22	98
△	B-02	3.0	FAT CLAY (CH)	39	50	19	31	97
◇	B-02	15.0	ELASTIC SILT (MH)	107	64	47	17	96
●	B-03	6.0	LEAN CLAY (CL)	45	46	25	21	99
■	B-03	15.0	FAT CLAY (CH)	62	73	28	45	90
▲	B-04	6.0	SILT (ML)	34	NP	NP	NP	98
◆	B-04	12.0	SILT (ML)	42	40	33	7	99

PLASTICITY CHART

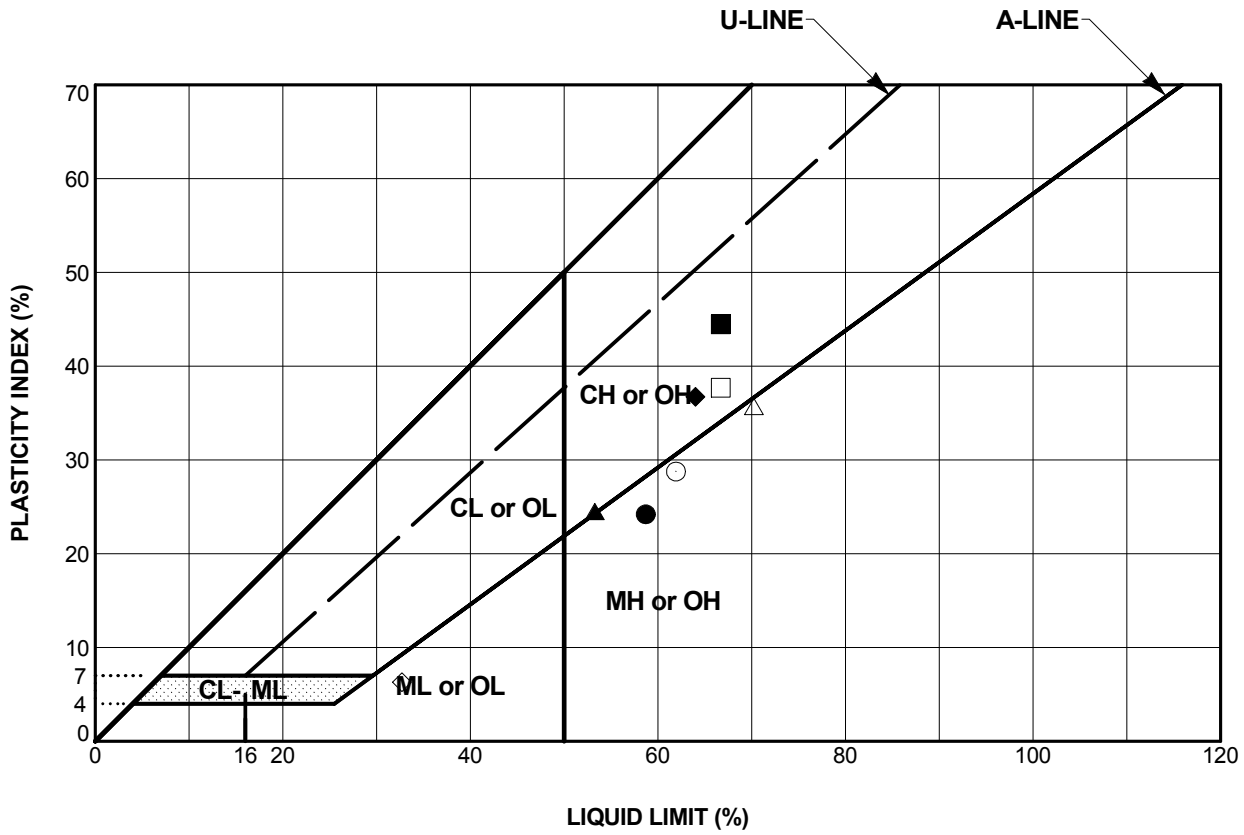
USACE Ballona Creek Watershed
Project No. 2006-023.05

Diaz Yourman Areas B and C

PLATE
C19

PLATE B2-57

Template: DY_ATTERBERG_CHART_WIN



Laboratory Testing by: Diaz Yourman & Associates

Test Method: ASTM D4318-05

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	B-05	9.0	ELASTIC SILT (MH)	49	62	33	29	98
□	B-05	15.0	FAT CLAY (CH)	95	67	29	38	95
△	B-06	2.5	ELASTIC SILT (MH)	46	70	35	35	99
◇	B-07	6.0	SILT (ML)	26	33	26	7	95
●	B-07	9.0	ELASTIC SILT (MH)	40	59	34	25	96
■	B-08	0.0	FAT CLAY (CH)	41	67	22	45	99
▲	B-08	9.0	FAT CLAY (CH)	58	53	29	24	98
◆	B-09	1.0	FAT CLAY (CH)	43	64	27	37	99

PLASTICITY CHART

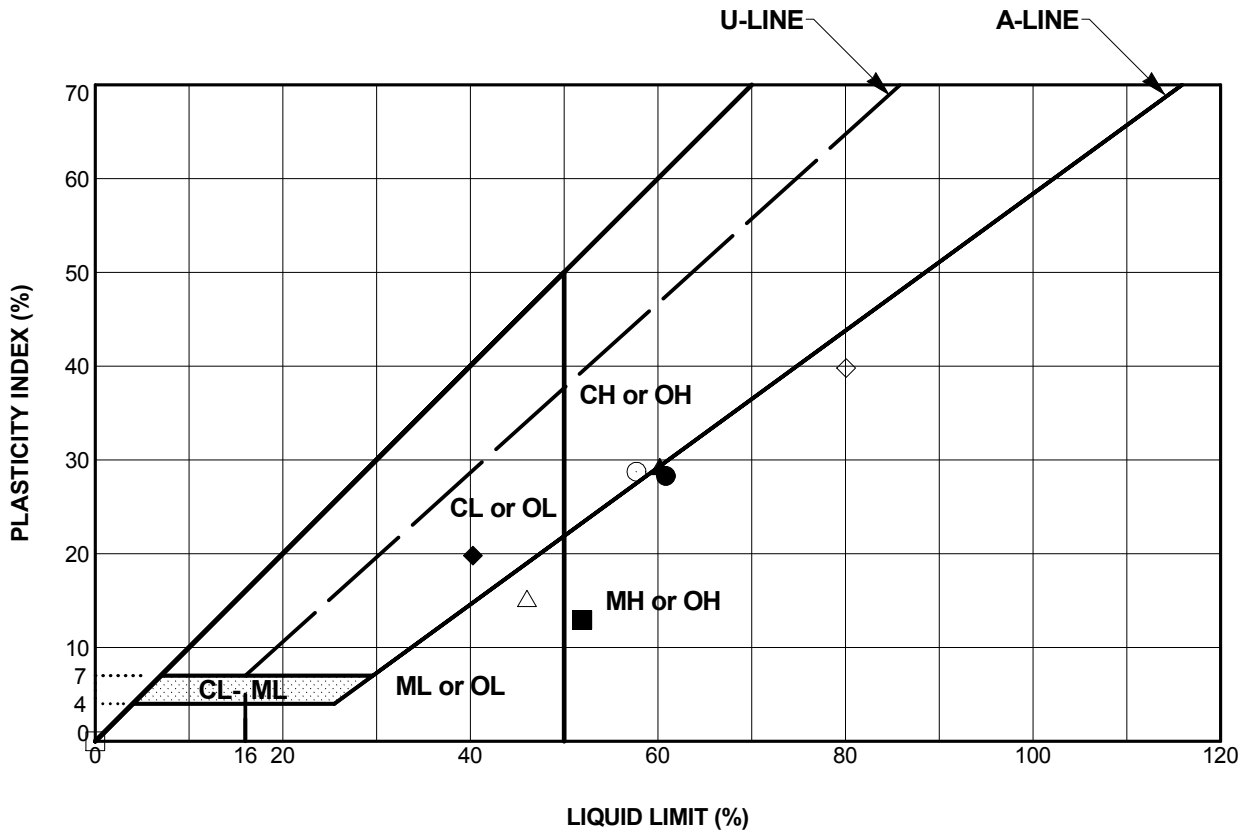
USACE Ballona Creek Watershed
Project No. 2006-023.05

Diaz Yourman Areas B and C

PLATE
C20

PLATE B2-58

Template: DY_ATTERBERG_CHART_WIN



Laboratory Testing by: Diaz Yourman & Associates

Test Method: ASTM D4318-05

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	B-09	3.0	FAT CLAY (CH)	52	58	29	29	99
□	B-10	6.0	SILT (ML)	31	NP	NP	NP	94
△	B-10	12.0	SILT (ML)	48	46	31	15	100
◇	B-11	3.0	ELASTIC SILT (MH)	72	80	40	40	96
●	B-11	9.0	ELASTIC SILT (MH)	60	61	33	28	97
■	B-12	9.0	ELASTIC SILT (MH)	84	52	39	13	95
▲	B-13	6.0	FAT CLAY (CH)	56	60	31	29	96
◆	C-01	6.0	LEAN CLAY (CL)	34	40	21	20	96

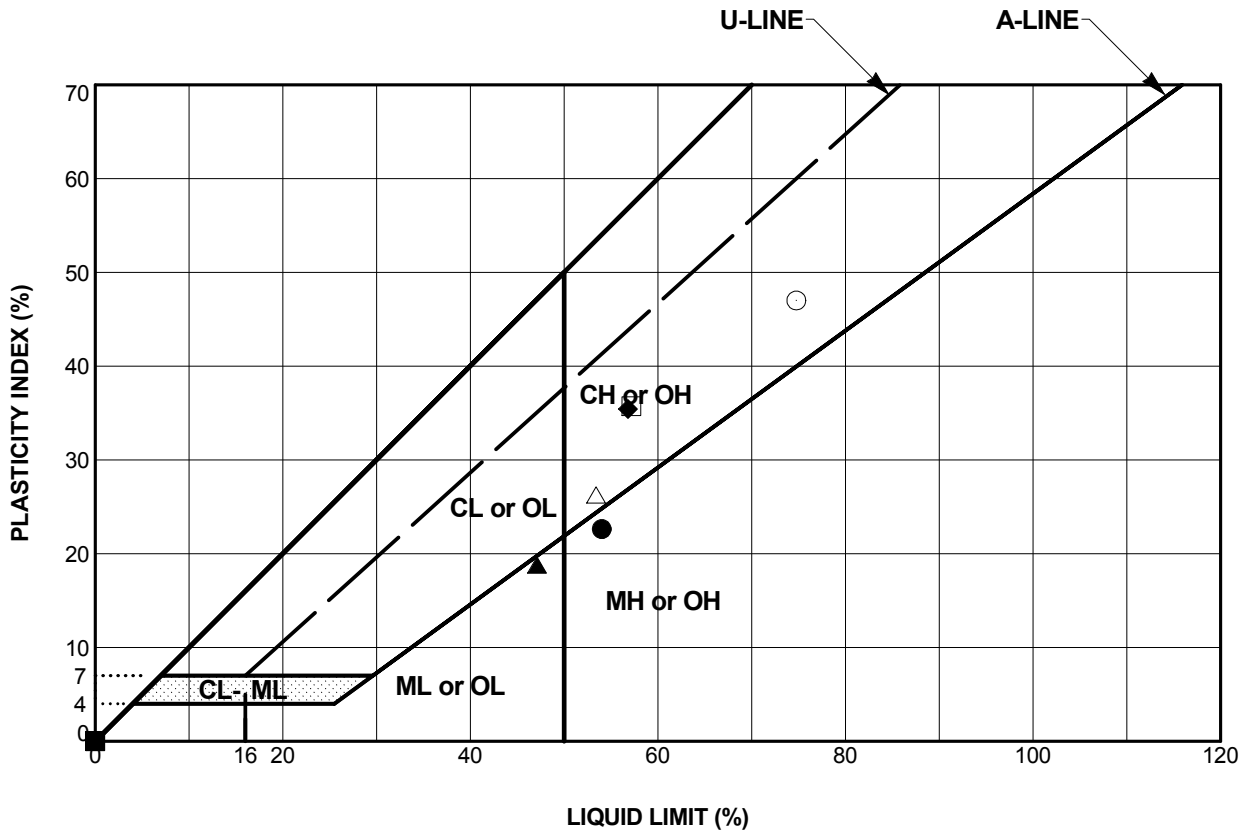
PLASTICITY CHART

USACE Ballona Creek Watershed
Project No. 2006-023.05
Diaz Yourman Areas B and C

PLATE
C21

PLATE B2-59

Template: DY_ATTERBERG_CHART_WIN



Laboratory Testing by: Diaz Yourman & Associates

Test Method: ASTM D4318-05

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	C-01	12.0	FAT CLAY (CH)	46	75	28	47	92
□	C-02	6.0	FAT CLAY (CH)	45	57	21	36	98
△	C-03	15.0	FAT CLAY (CH)	51	53	27	26	100
◇	C-03	33.0	SILT (ML)	38	NP	NP	NP	99
●	C-04	12.0	ELASTIC SILT (MH)	38	54	31	23	95
■	C-04	24.0	SILT WITH SAND (ML)	24	NP	NP	NP	79
▲	C-05	24.0	SILT (ML)	43	47	28	19	99
◆	C-06	12.0	FAT CLAY (CH)	43	57	21	36	98

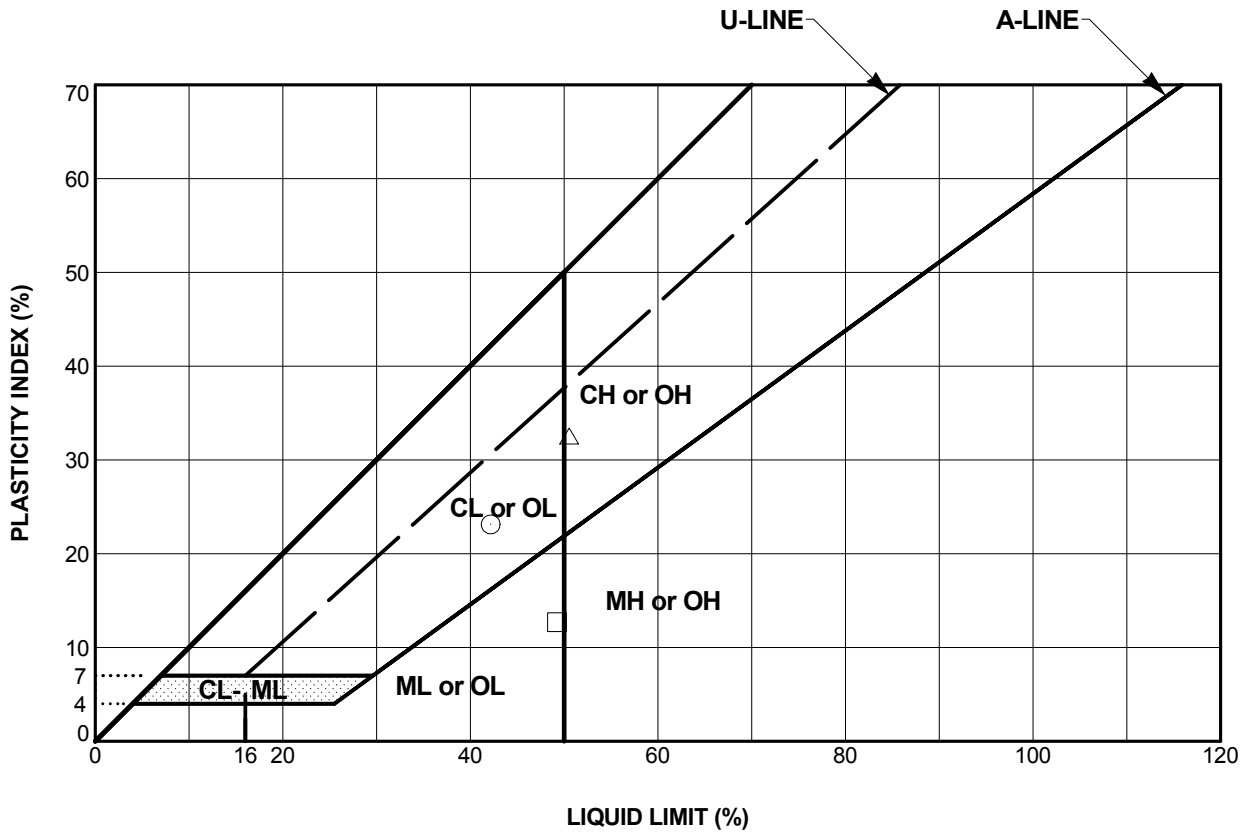
PLASTICITY CHART

USACE Ballona Creek Watershed
Project No. 2006-023.05
Diaz Yourman Areas B and C

PLATE
C22

PLATE B2-60

Template: DY_ATTERBERG_CHART_WIN



Laboratory Testing by: Diaz Yourman & Associates

Test Method: ASTM D4318-05

Symbol	Source	Depth (feet)	Classification	Natural M. C. (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
○	C-06	18.0	SANDY LEAN CLAY (CL)	29	42	19	23	70
□	C-07	9.0	SILT (ML)	31	49	37	12	92
△	C-07	21.0	FAT CLAY WITH SAND (CH)	27	51	18	33	74

PLASTICITY CHART

USACE Ballona Creek Watershed
Project No. 2006-023.05
Diaz Yourman Areas B and C

PLATE
C23

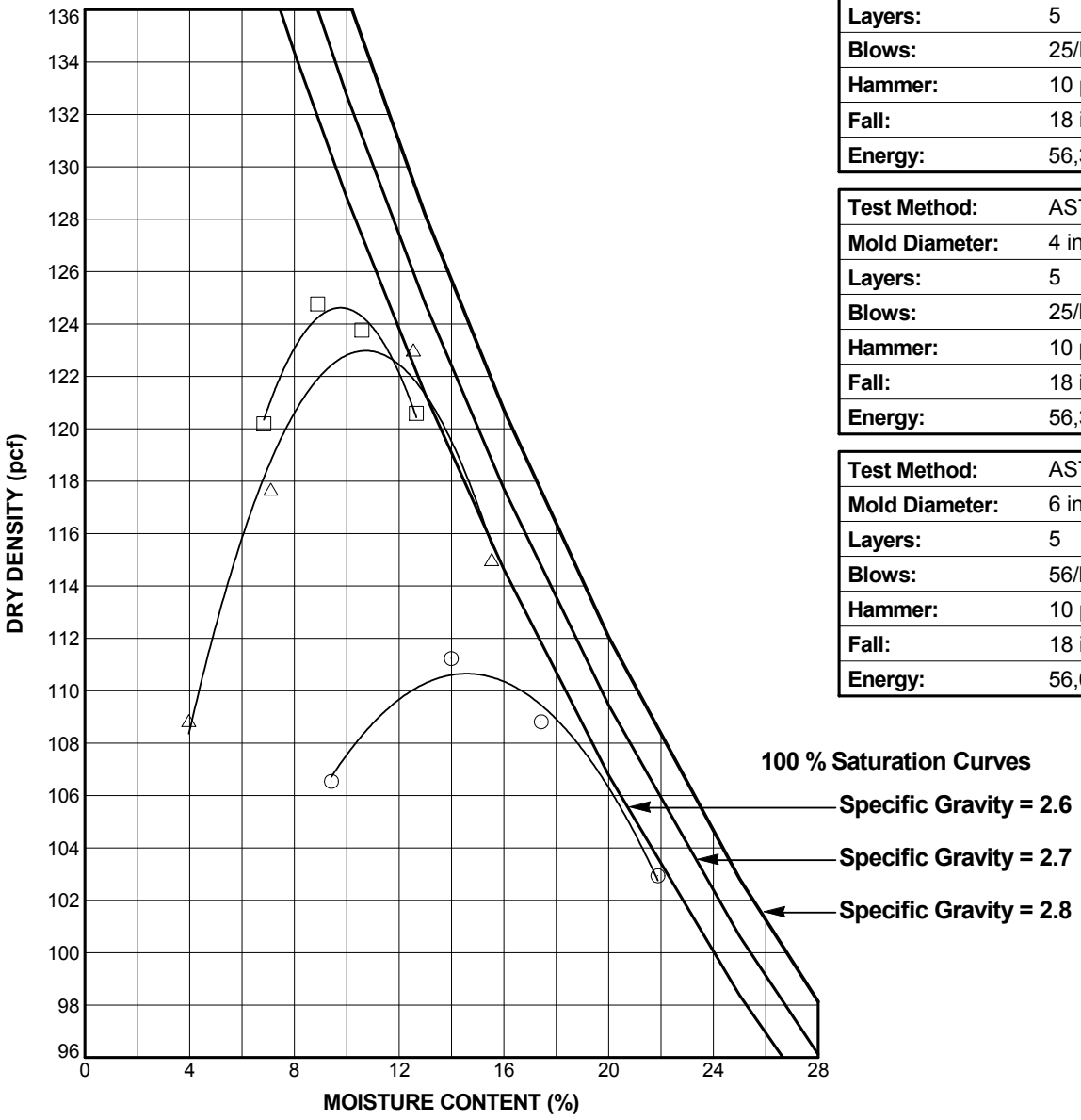
PLATE B2-61

Template: DY_COMPACT_4_PLOTS_WIN REV FEB07

Test Method:	ASTM D1557-91(A)
Mold Diameter:	4 inches
Layers:	5
Blows:	25/layer
Hammer:	10 pounds
Fall:	18 inches
Energy:	56,300 ft-lbs/cu ft

Test Method:	ASTM D1557-91(B)
Mold Diameter:	4 inches
Layers:	5
Blows:	25/layer
Hammer:	10 pounds
Fall:	18 inches
Energy:	56,300 ft-lbs/cu ft

Test Method:	ASTM D1557-91(C)
Mold Diameter:	6 inches
Layers:	5
Blows:	56/layer
Hammer:	10 pounds
Fall:	18 inches
Energy:	56,000 ft-lbs/cu ft



Laboratory Testing by: Diaz Yourman & Associates

Symbol	Source	Depth (feet)	Classification	Optimum Moisture Content (%)	Max. Dry Density (pcf)	Liquid Limit (%)	Plasticity Index (%)	%<#200 Sieve	ASTM Test Method
○	B-02	0.0	LEAN CLAY WITH SAND (CL)	16	112				1557A
□	B-13	0.0	CLAYEY SAND (SC)	10	126			21	1557A
△	C-01	0.0	CLAYEY SAND (SC)	10.5	124.5			37	1557A

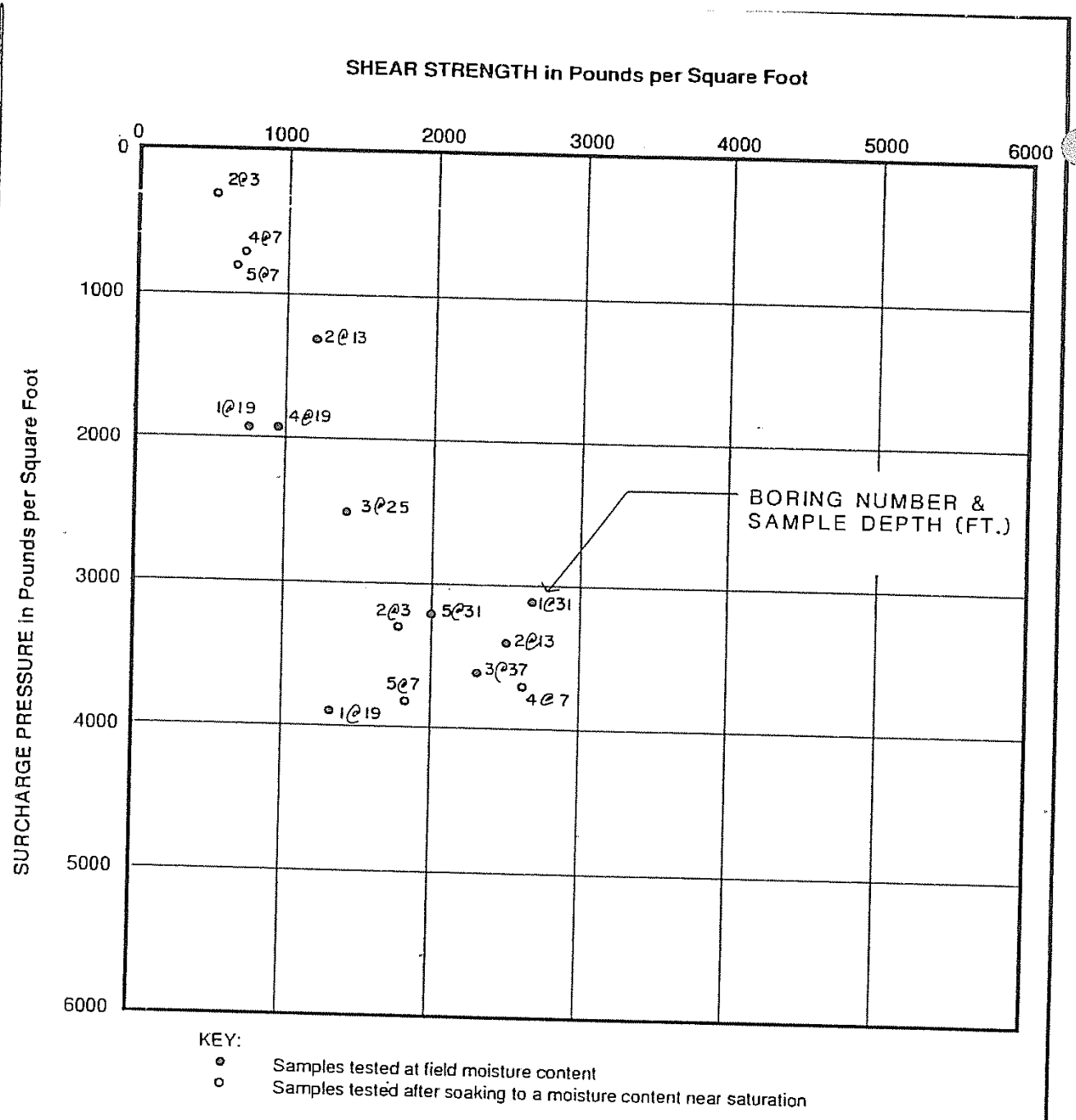
COMPACTION TEST DATA

USACE Ballona Creek Watershed
Project No. 2006-023.05

PLATE
C24

Diaz Yourman Areas B and C

PLATE B2-62

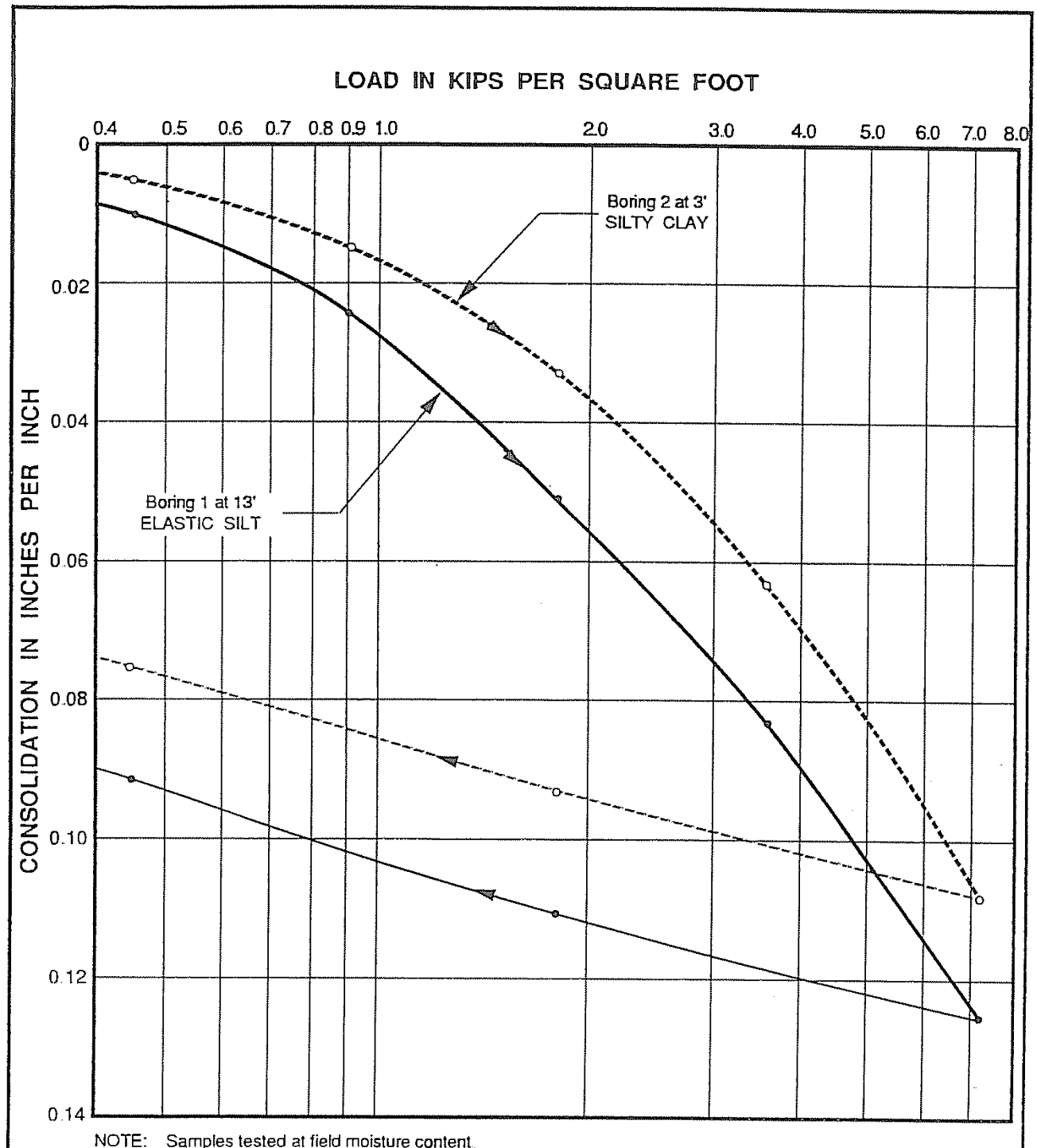


DIRECT SHEAR TEST DATA

Law Crandall Area C LAW/CRANDALL, INC.

PLATE B2-63
PLATE A-3

JOB L91177.AEB DATE 7/12/91 DR. lk O.E. HRL CHKD FH



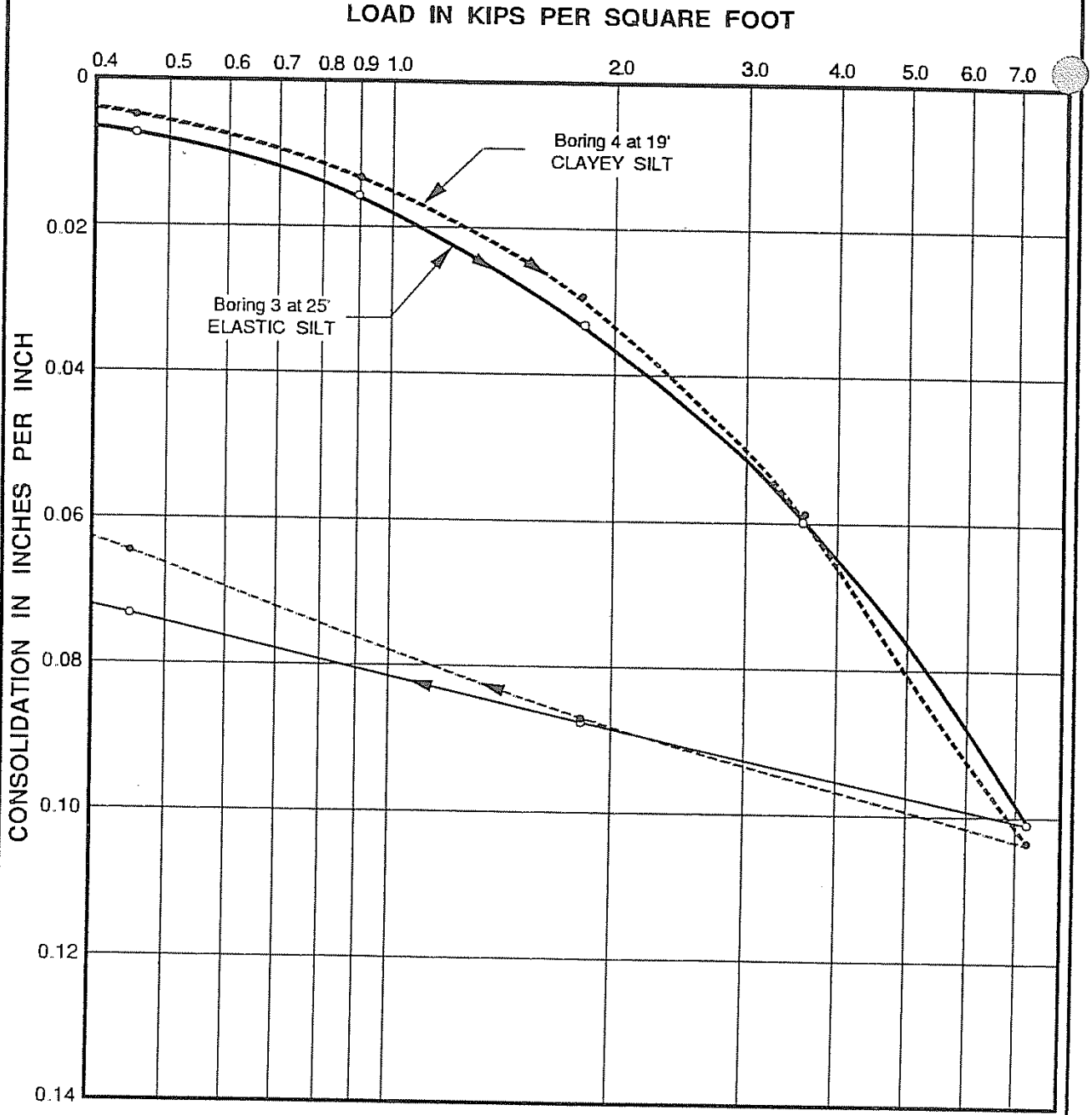
NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA

Law Crandall Area C LAW/CRANDALL, INC.

PLATE B2-64 4.1

JOB L91177.AEB DATE 7/12/91 DR. lk O.E. HRL CHKD FH



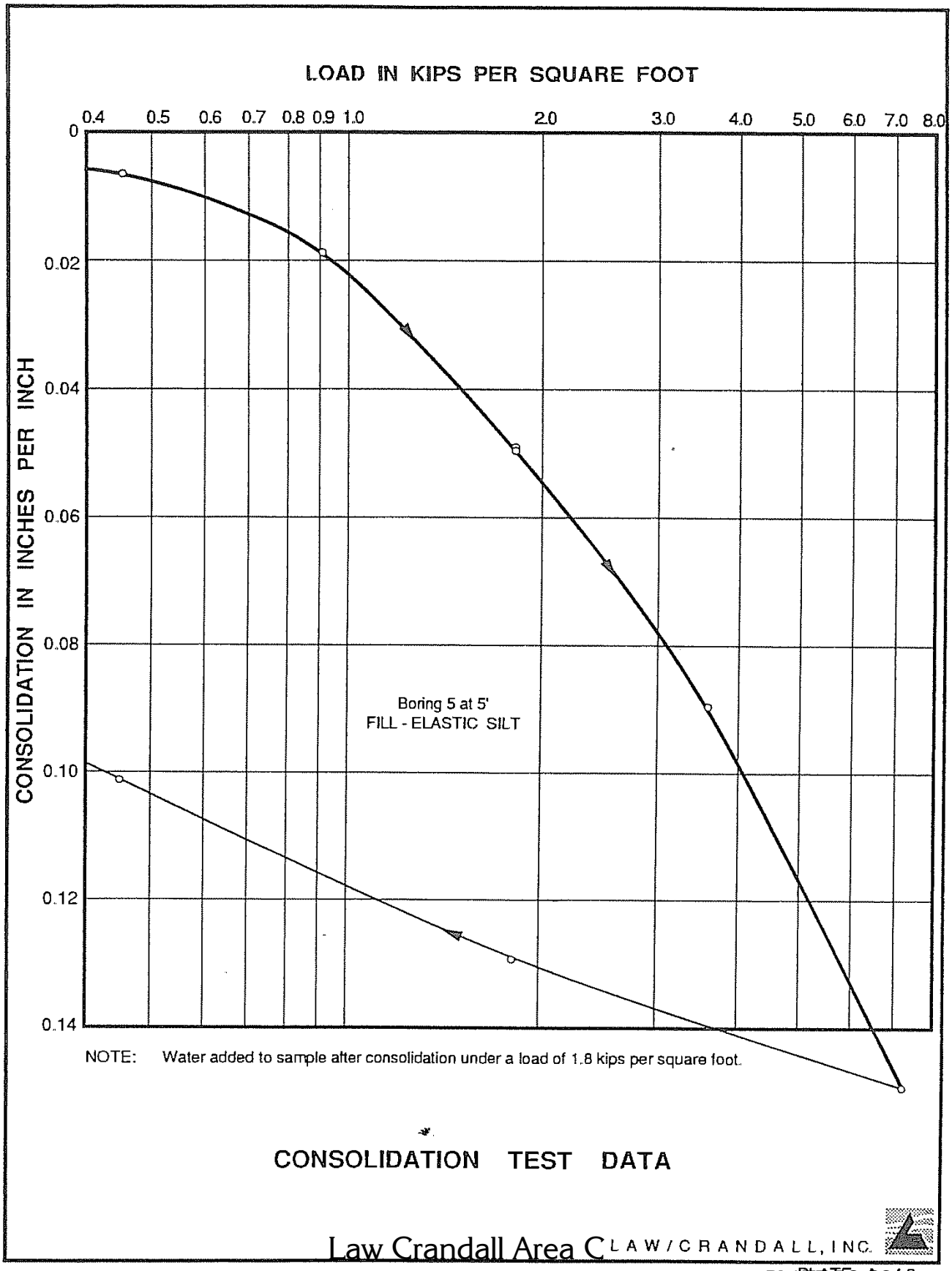
NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA

Law Crandall Area C LAW/CRANDALL, INC.

PLATE AB2-65-4.2

JOB L91177.AEB DATE 7/18/91 F.T. TC DR. lk O.E. HRL CHKD FH



NOTE: Water added to sample after consolidation under a load of 1.8 kips per square foot.

CONSOLIDATION TEST DATA

Law Crandall Area C LAW/CRANDALL, INC.

PLATE B2-664.3

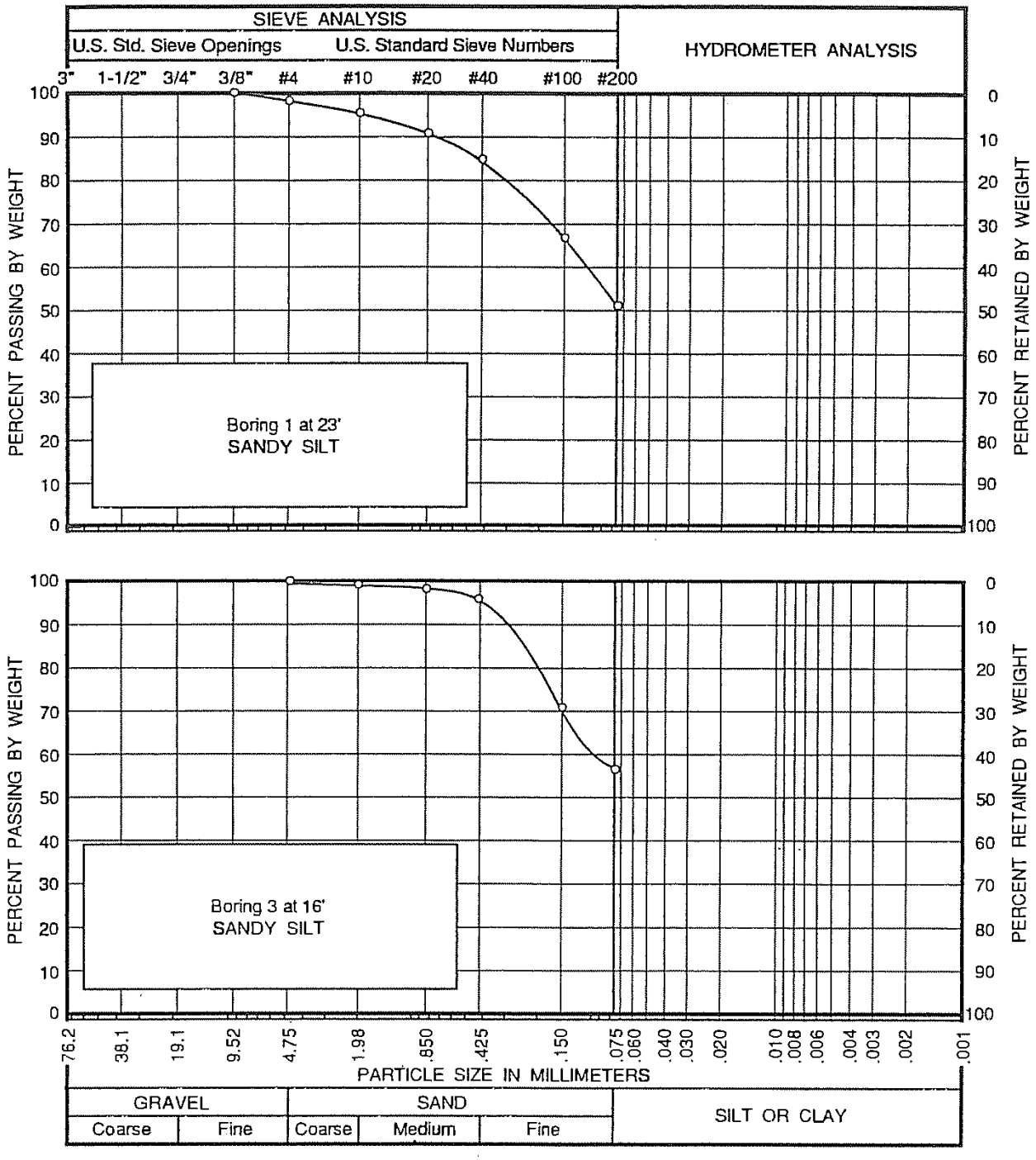
JOB L91177.AEB DATE 7/12/91 DR. lk O.E. HRL CHKD FH

BORING NUMBER AND SAMPLE DEPTH :	2 at 1' and 2 at 3' (Combined Sample)
SOIL TYPE :	SILTY CLAY
CONFINING PRESSURE : (lbs./sq. ft.)	144
INITIAL MOISTURE CONTENT : (% of dry wt.)	13.3
FINAL MOISTURE CONTENT : (% of dry wt.)	34.7
DRY DENSITY : (lbs./cu. ft.)	98
EXPANSION INDEX :	95

TEST METHOD : Uniform Building Code Standard No. 29-2, Expansion Index Test

EXPANSION INDEX TEST DATA

JOB L91177.AEB DATE 7/12/91 DR. lk O.E. HRL CHKD



PARTICLE SIZE DISTRIBUTION

Law Crandall Area C LAW/CRANDALL, INC.

PLATE B2-6A - 6

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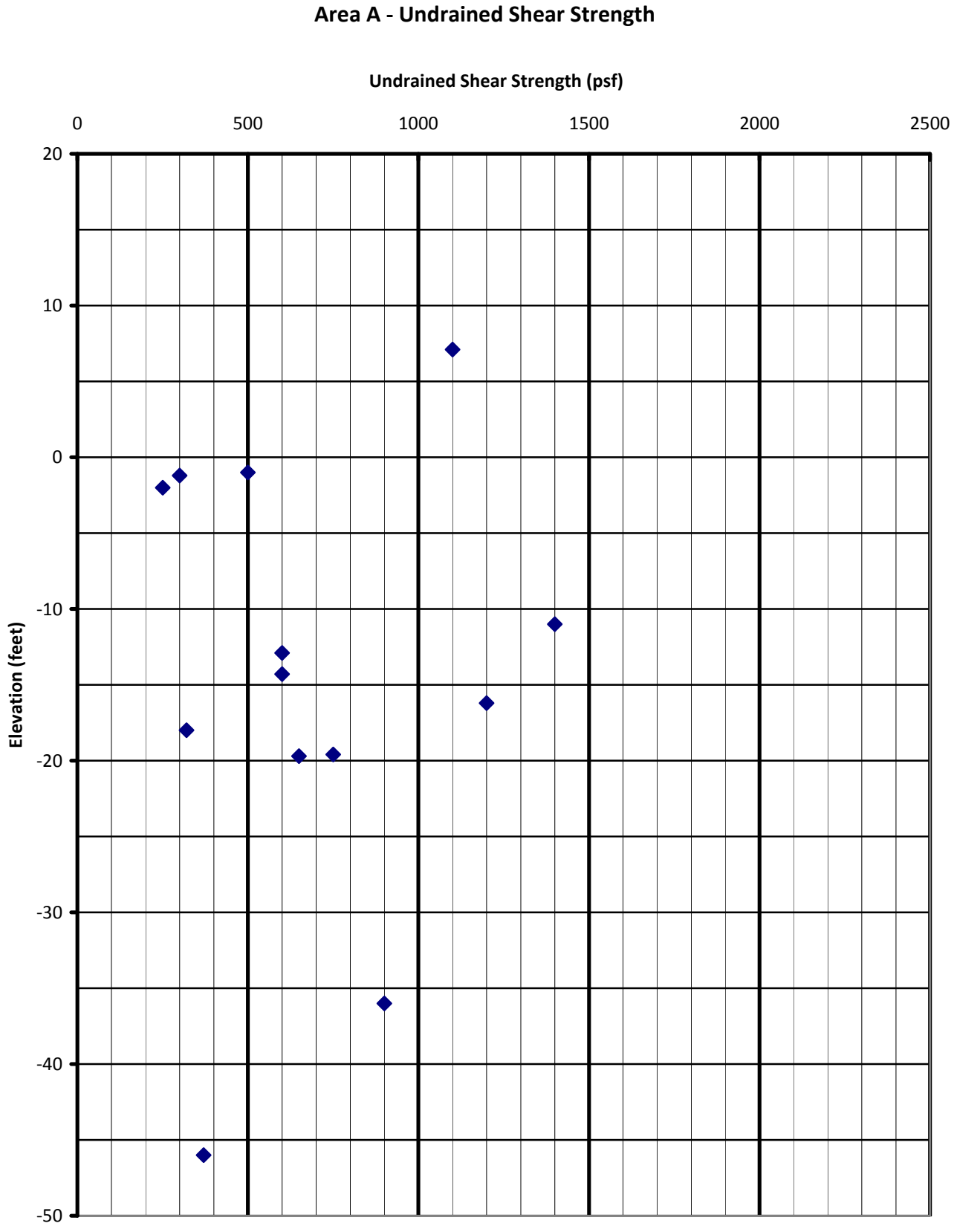
APPENDIX B3
LABORATORY TESTING INTERPRETATIONS OF GDC INVESTIGATION

APPENDIX B3
LABORATORY TESTING INTERPRETATIONS

B3.1 General

The following interpretation plots were generated based on the results of our laboratory data in Areas A, B, and C:

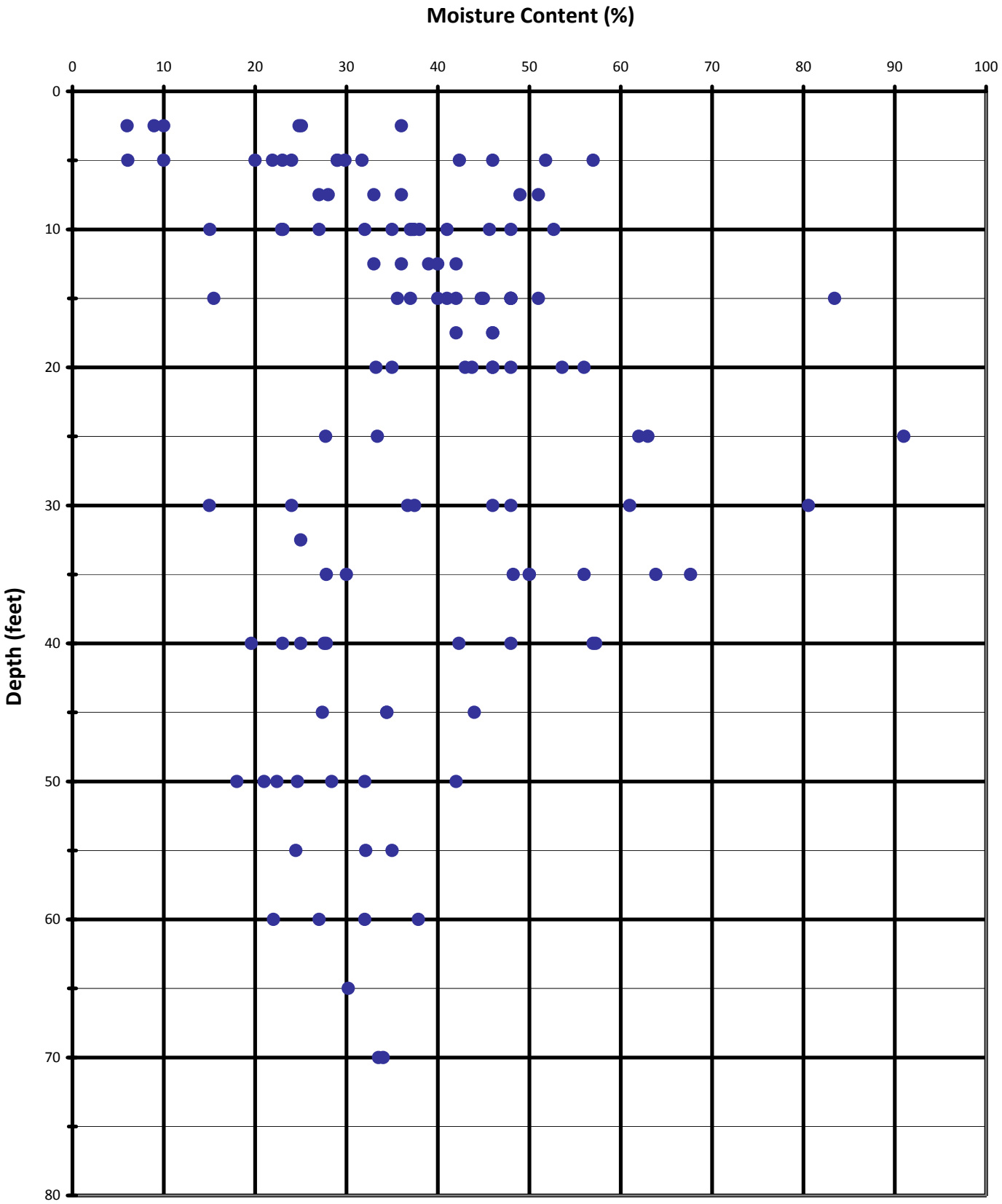
Plate B3-1	Area A – Undrained Shear Strength
Plate B3-2	Variation of Moisture Content with Depth – Area A
Plate B3-3	Variation of Dry Density with Depth – Area A
Plate B3-4	Variation of Liquid Limit with Depth – Area A
Plate B3-5	Variation of Plastic Limit with Depth – Area A
Plate B3-6	Variation of Fines Content with Depth – Area A
Plate B3-7	Plot of Moisture Content vs. Dry Density – Area A
Plate B3-8	Variation of Moisture Content with Elevation – Area A Fill Soils
Plate B3-9	Variation of Dry Density with Elevation – Area A Fill Soils
Plate B3-10	Variation of Liquid Limit with Elevation – Area A Fill Soils
Plate B3-11	Variation of Plastic Limit with Elevation – Area A Fill Soils
Plate B3-12	Variation of Fines Content with Elevation – Area A Fill Soils
Plate B3-13	Plot of Moisture Content vs. Dry Density – Area A Fill Soils
Plate B3-14	Area B – Undrained Shear Strength
Plate B3-15	Variation of Moisture Content with Depth – Area B
Plate B3-16	Variation of Dry Density with Depth – Area B
Plate B3-17	Variation of Liquid Limit with Depth – Area B
Plate B3-18	Variation of Plastic Limit with Depth – Area B
Plate B3-19	Variation of Fines Content with Depth – Area B
Plate B3-20	Plot of Moisture Content vs. Dry Density – Area B
Plate B3-21	Variation of Moisture Content with Depth – Area C
Plate B3-22	Variation of Dry Density with Depth – Area C
Plate B3-23	Variation of Liquid Limit with Depth – Area C
Plate B3-24	Variation of Plastic Limit with Depth – Area C
Plate B3-25	Variation of Fines Content with Depth – Area C
Plate B3-26	Plot of Moisture Content vs. Dry Density – Area C



Laboratory Vane Shear - Area A

PLATE B3-1

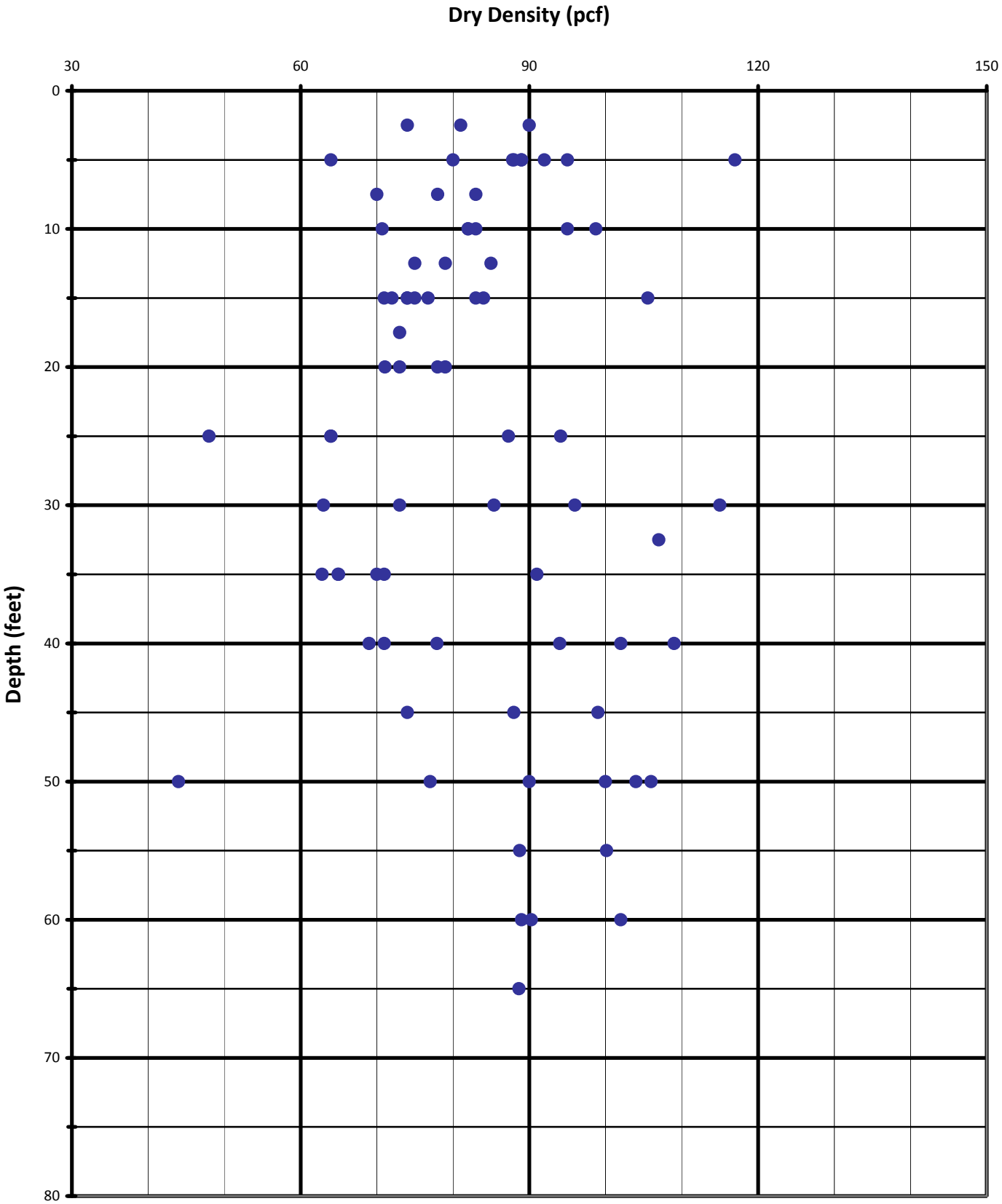
Variation of Moisture Content with Depth



Area A

PLATE B3-2

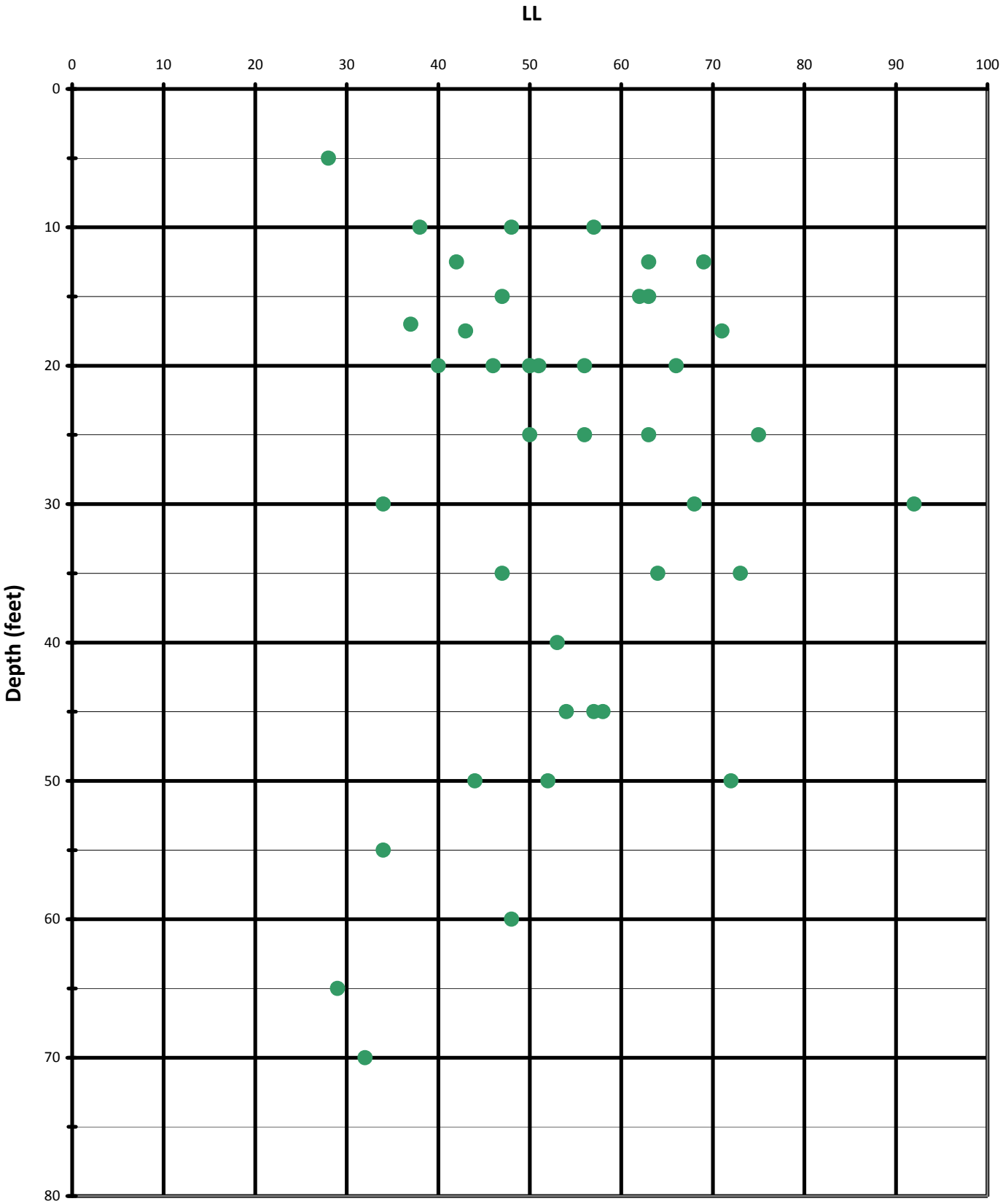
Variation of Dry Density with Depth



Area A

PLATE B3-3

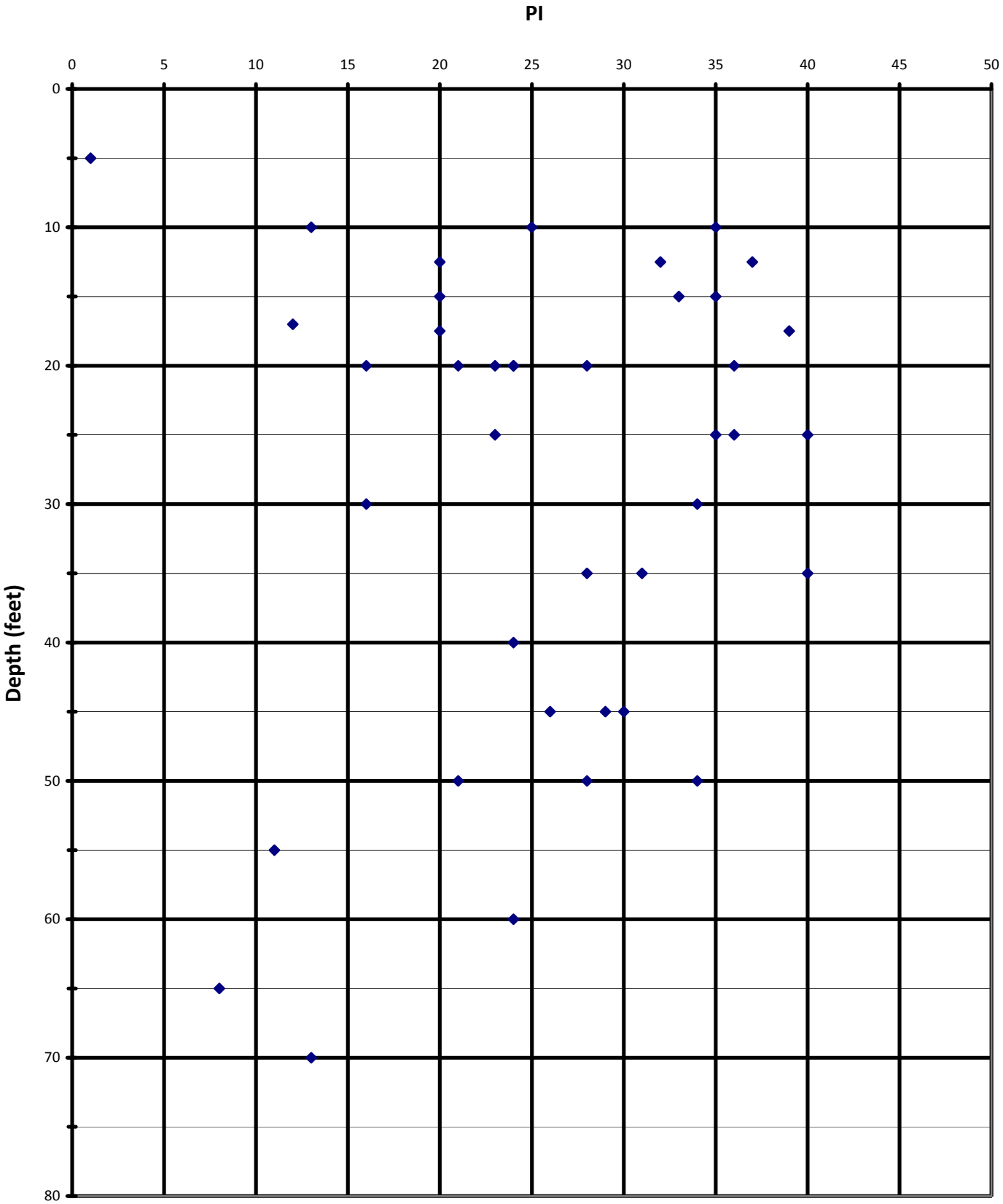
Variation of Liquid Limit with Depth



Area A

PLATE B3-4

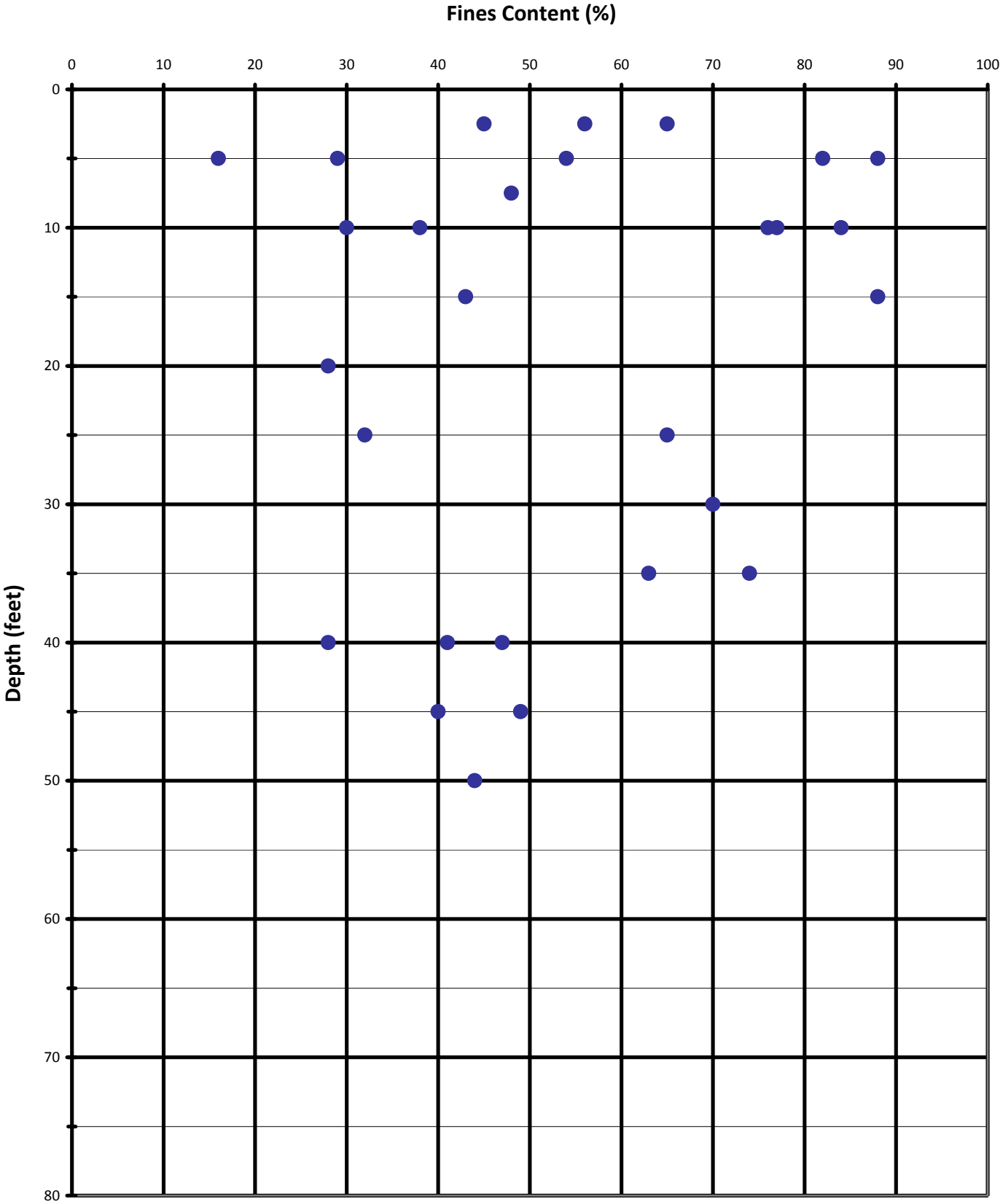
Variation of Plasticity Index with Depth



Area A

PLATE B3-5

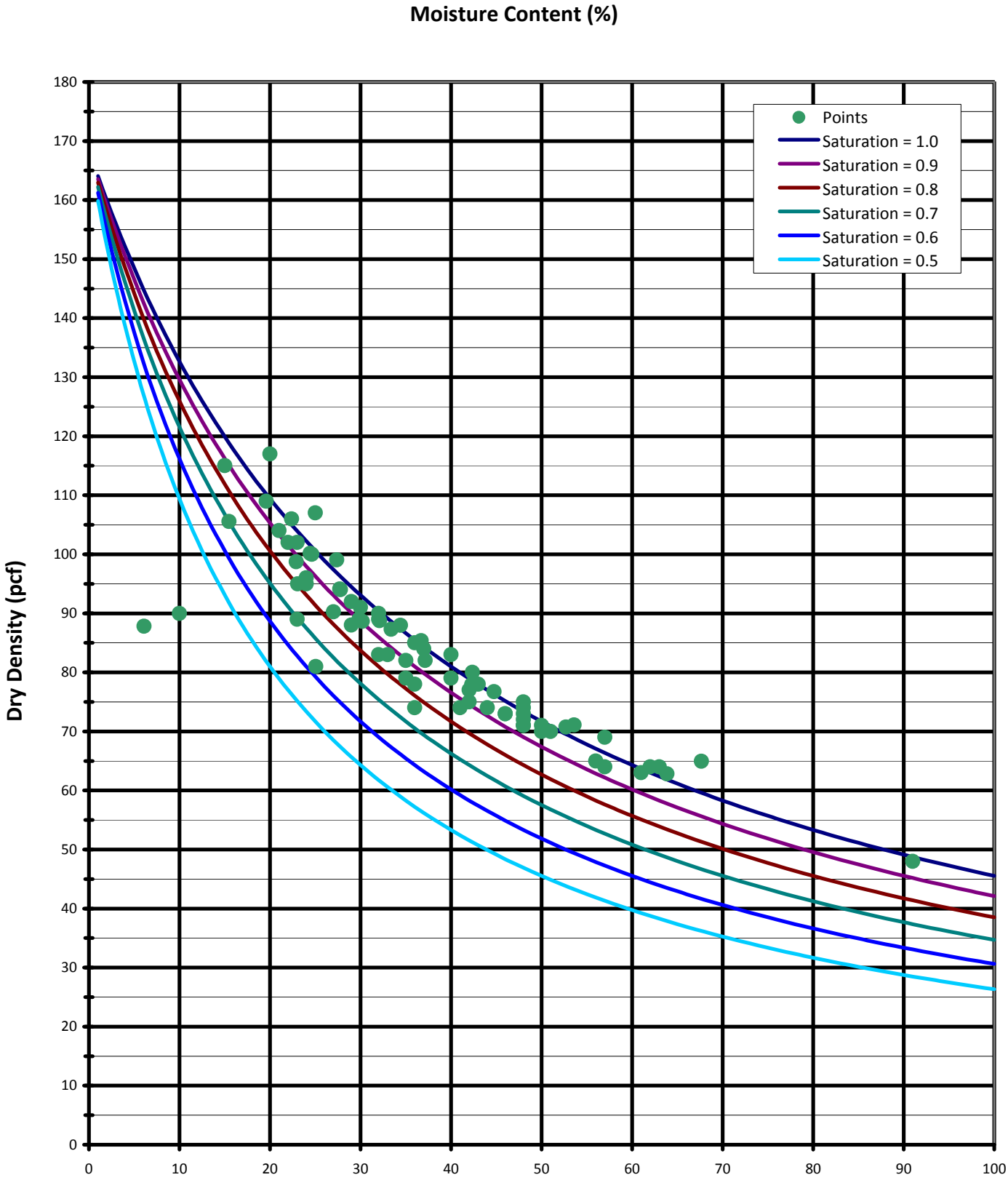
Variation of Fines Content with Depth



Area A

PLATE B3-6

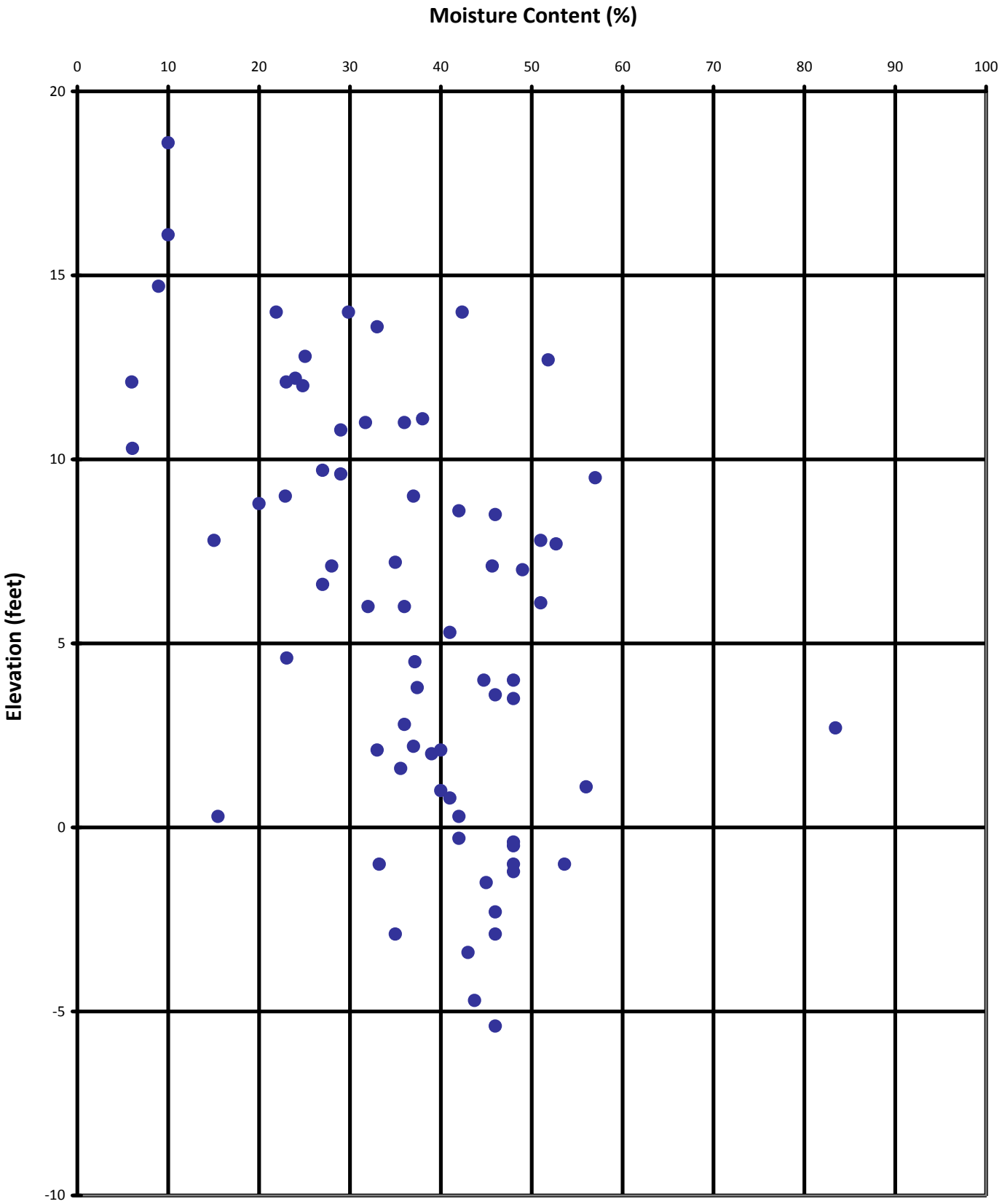
Moisture Content vs Dry Density



Area A

PLATE B3-7

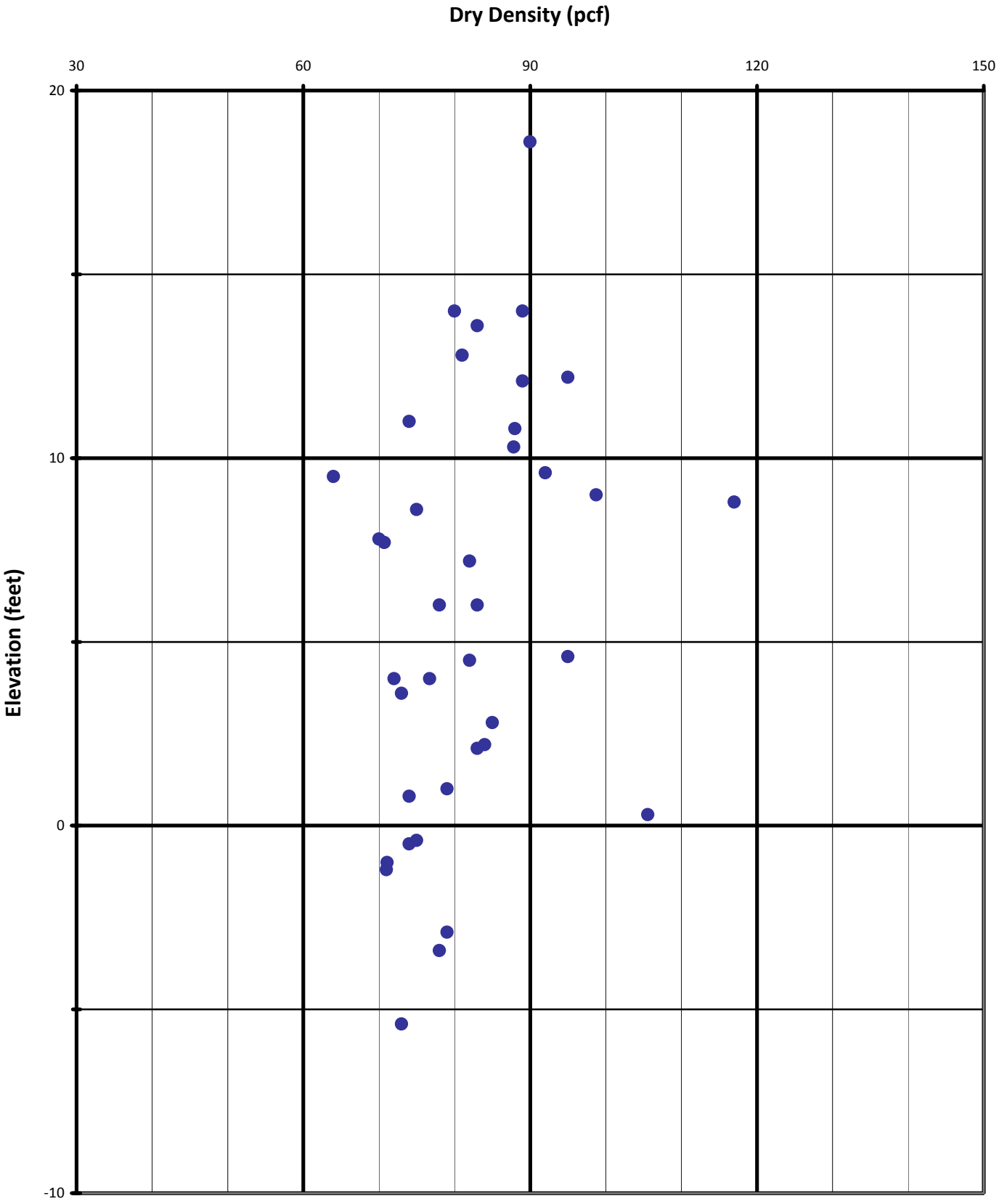
Variation of Moisture Content with Elevation



Fill Soils - Area A

PLATE B3-8

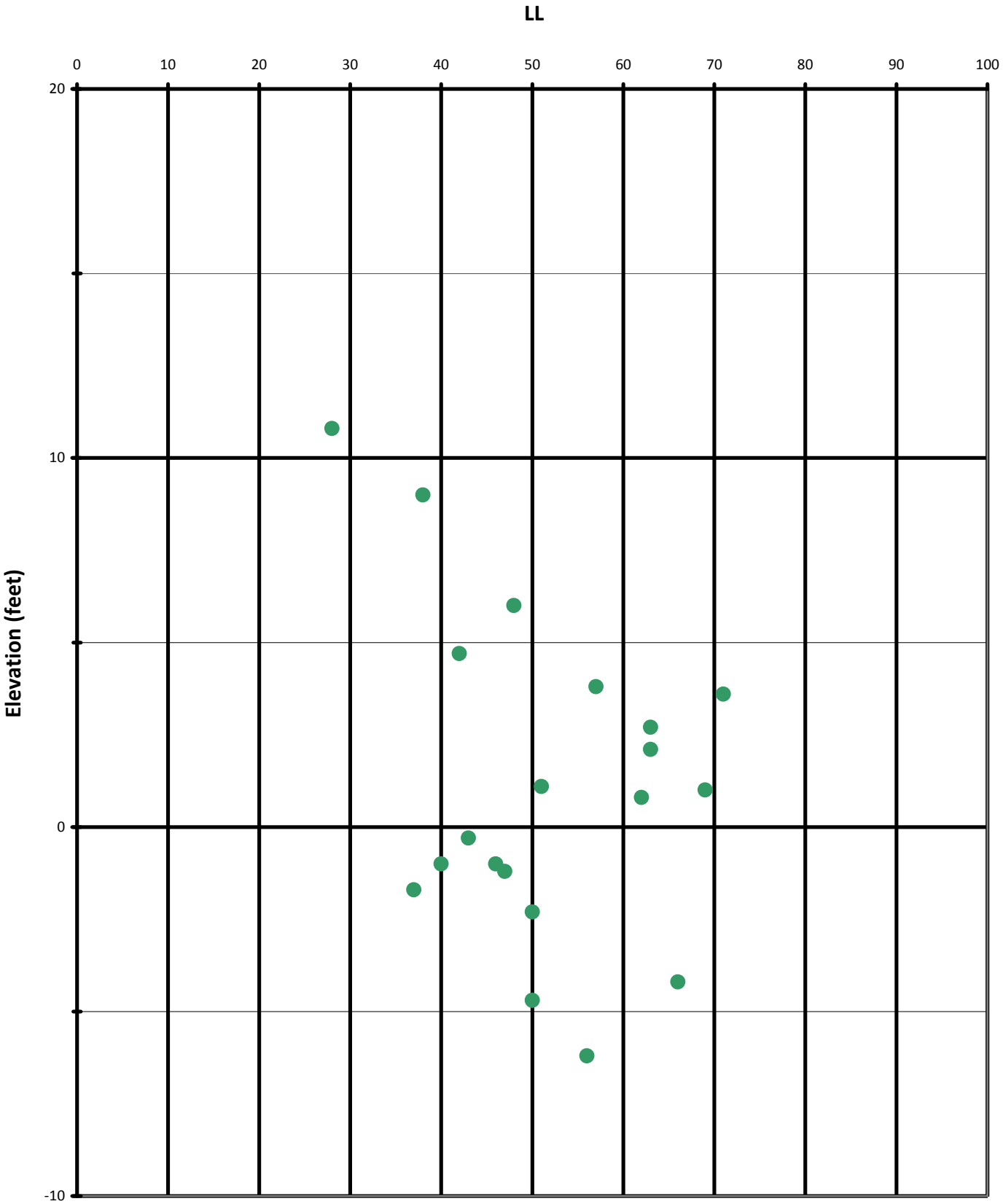
Variation of Dry Density with Elevation



Fill Soils - Area A

PLATE B3-9

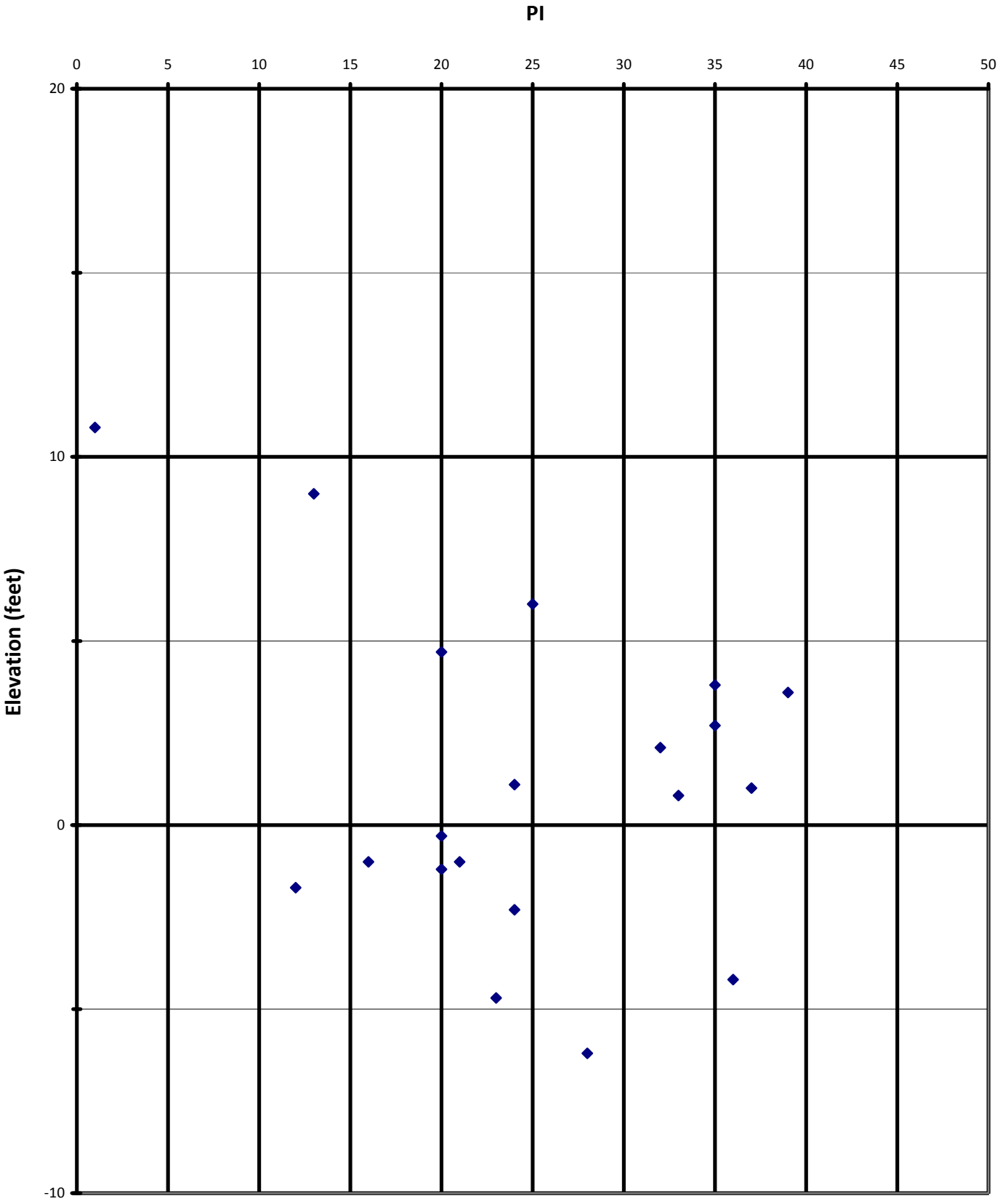
Variation of Liquid Limit with Elevation



Fill Soils - Area A

PLATE B3-10

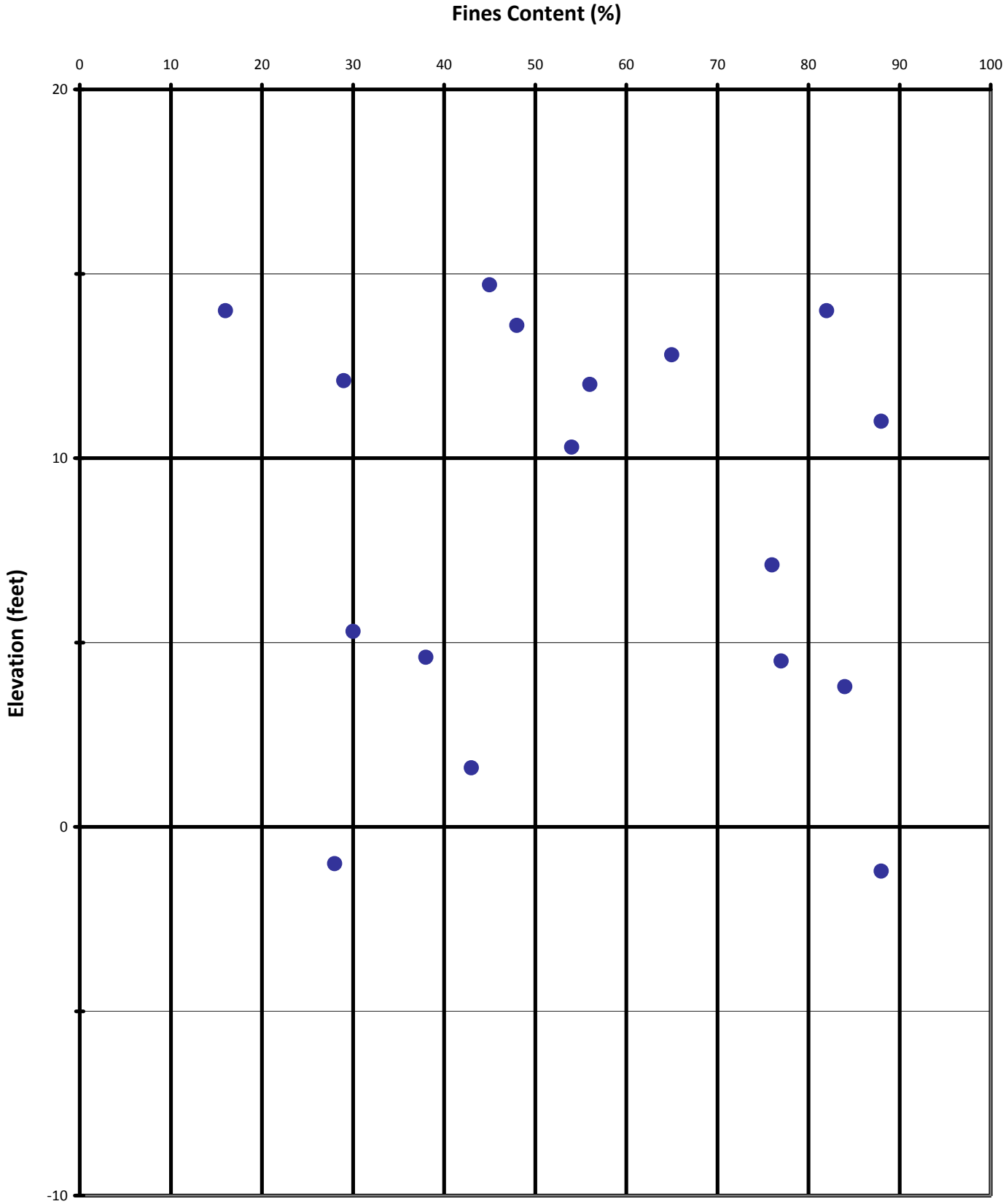
Variation of Plasticity Index with Elevation



Fill Soils - Area A

PLATE B3-11

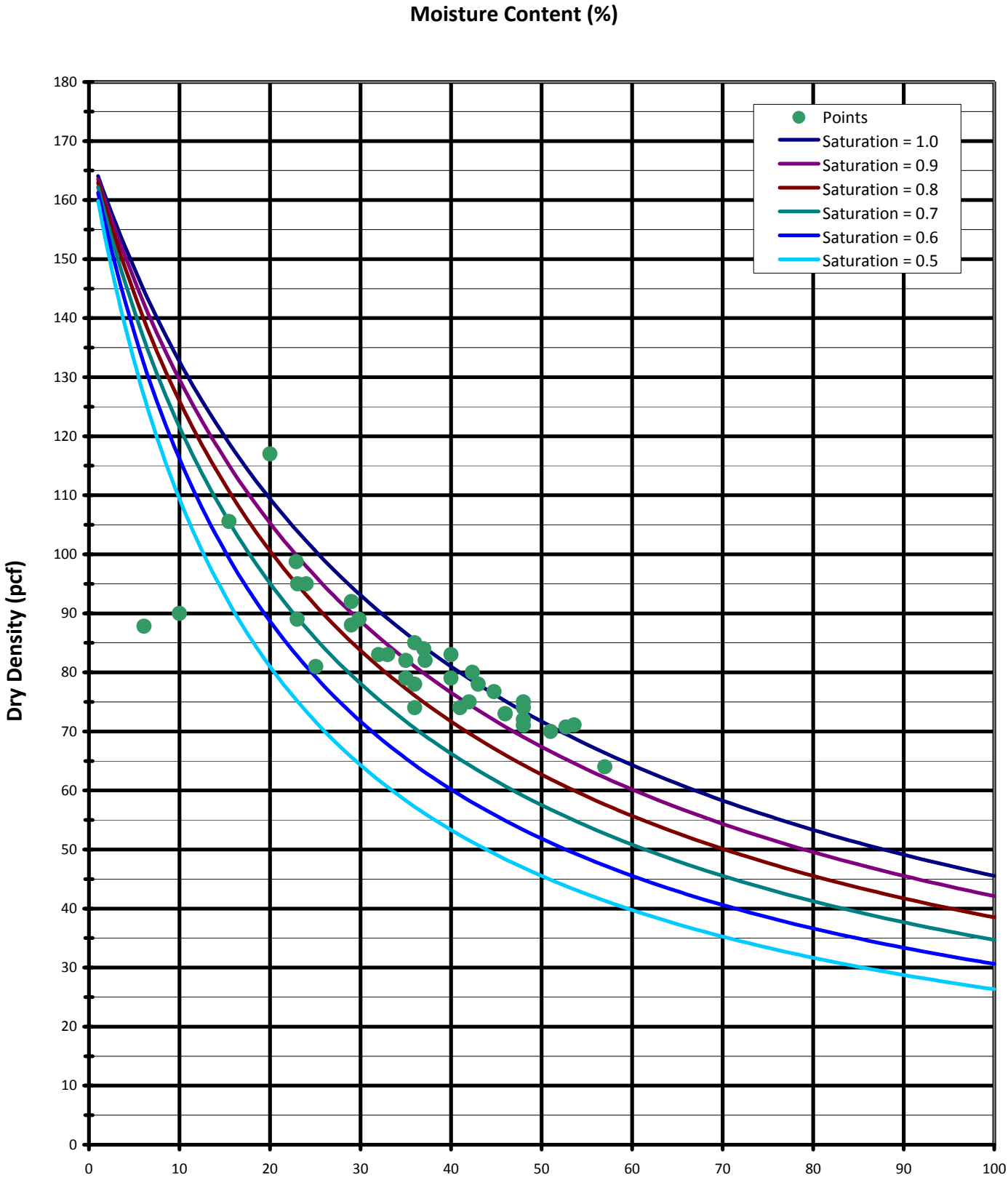
Variation of Fines Content with Elevation



Fill Soils - Area A

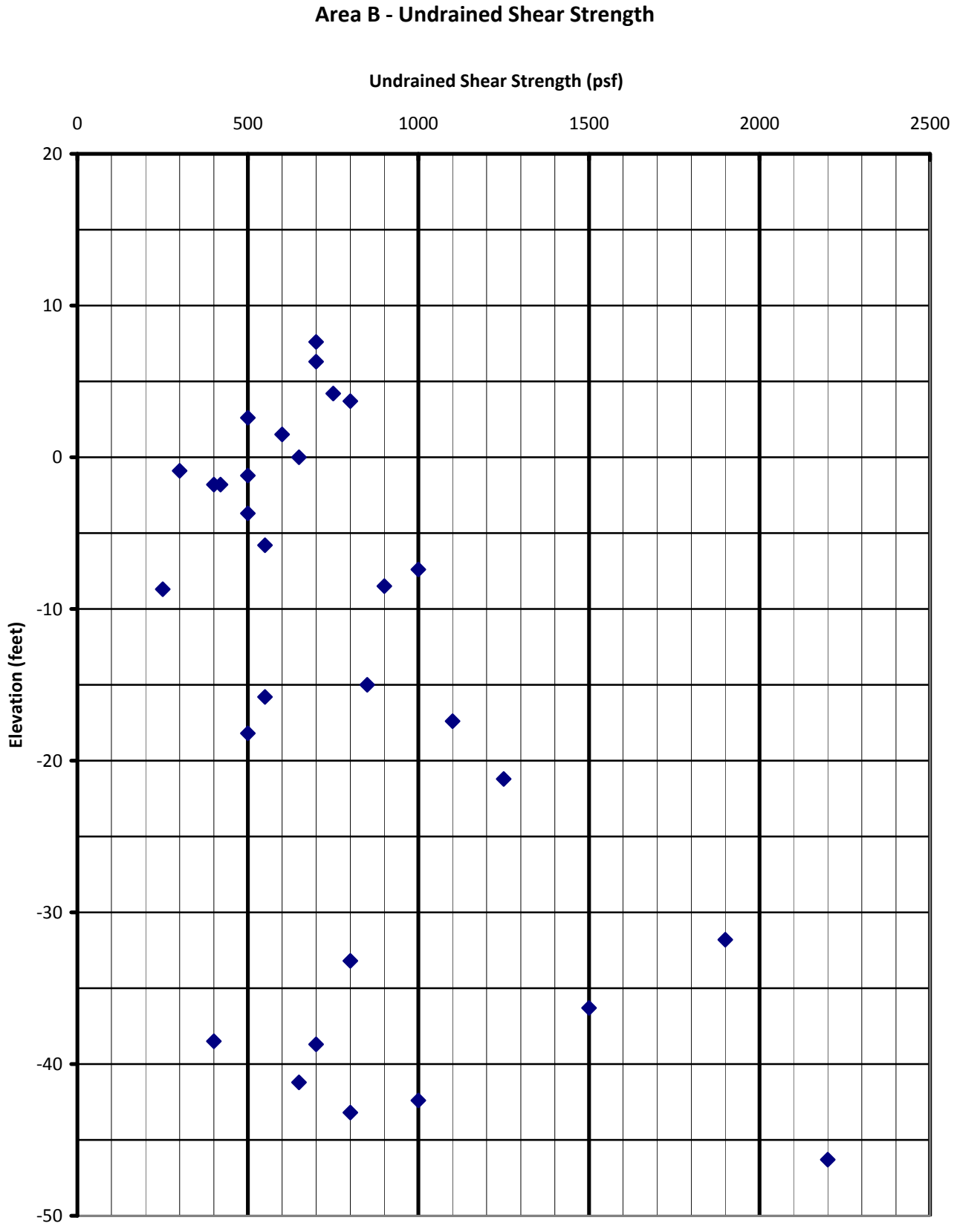
PLATE B3-12

Moisture Content vs Dry Density



Fill Soils - Area A

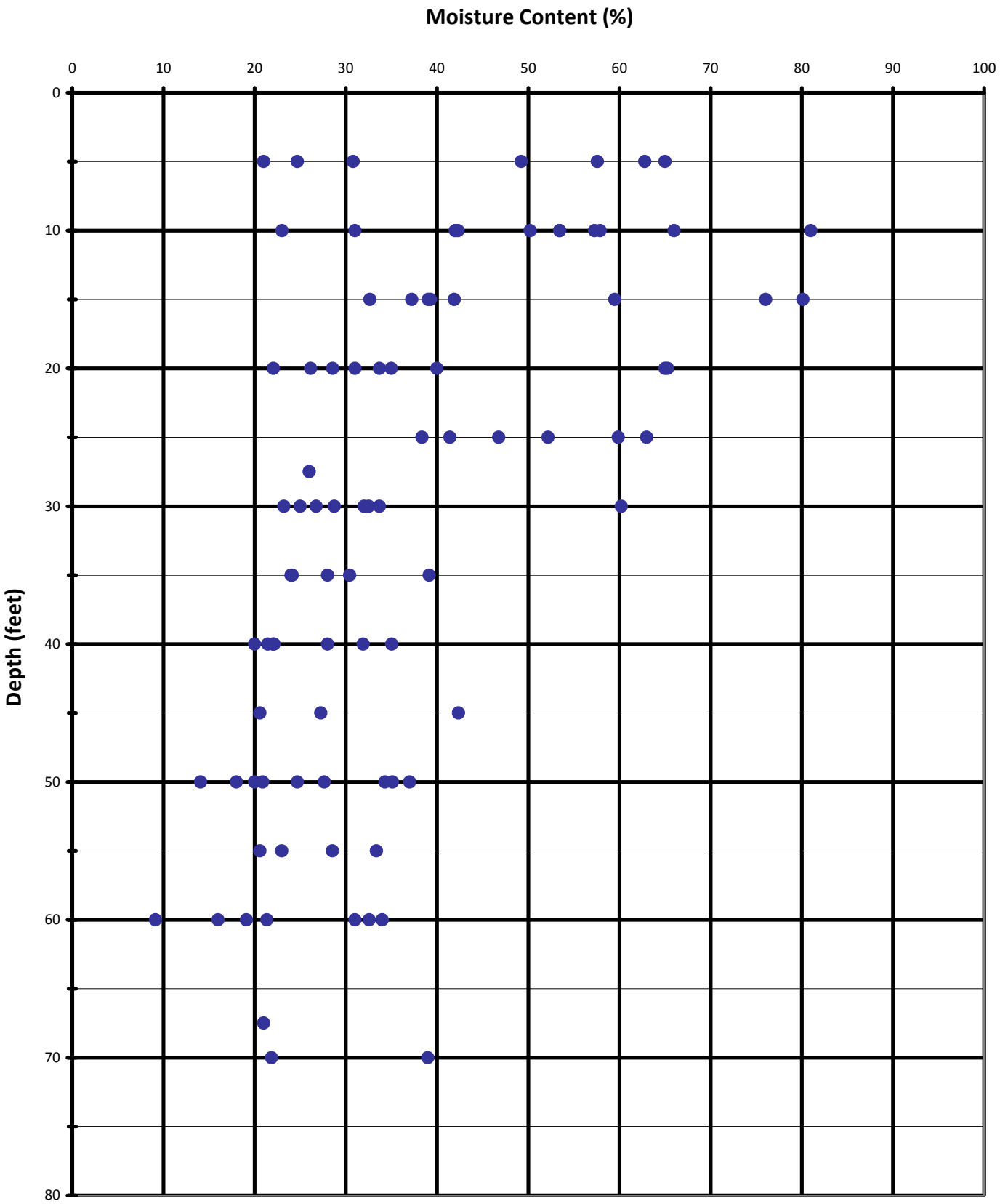
PLATE B3-13



Laboratory Vane Shear - Area B

PLATE B3-14

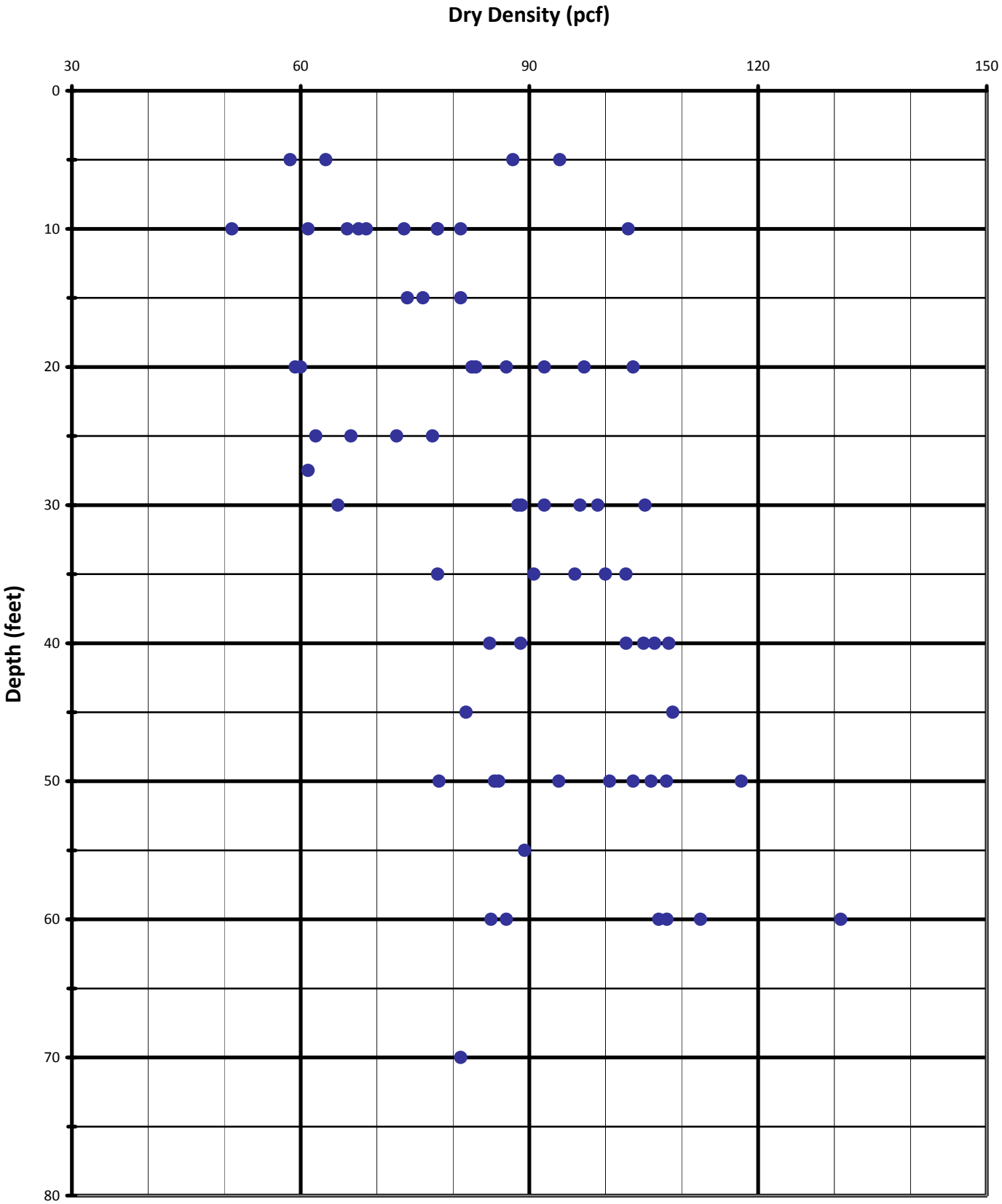
Variation of Moisture Content with Depth



Area B

PLATE B3-15

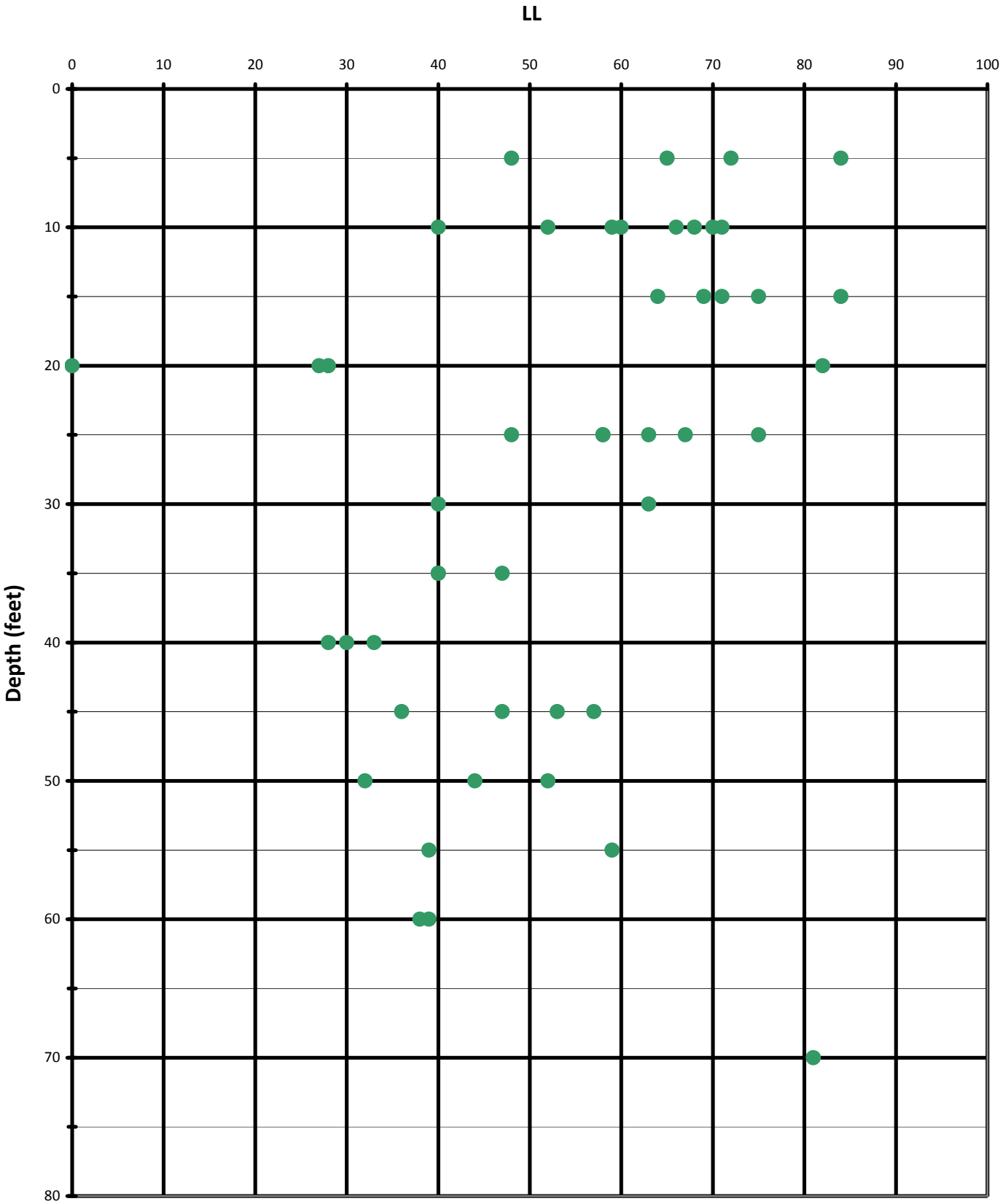
Variation of Dry Density with Depth



Area B

PLATE B3-16

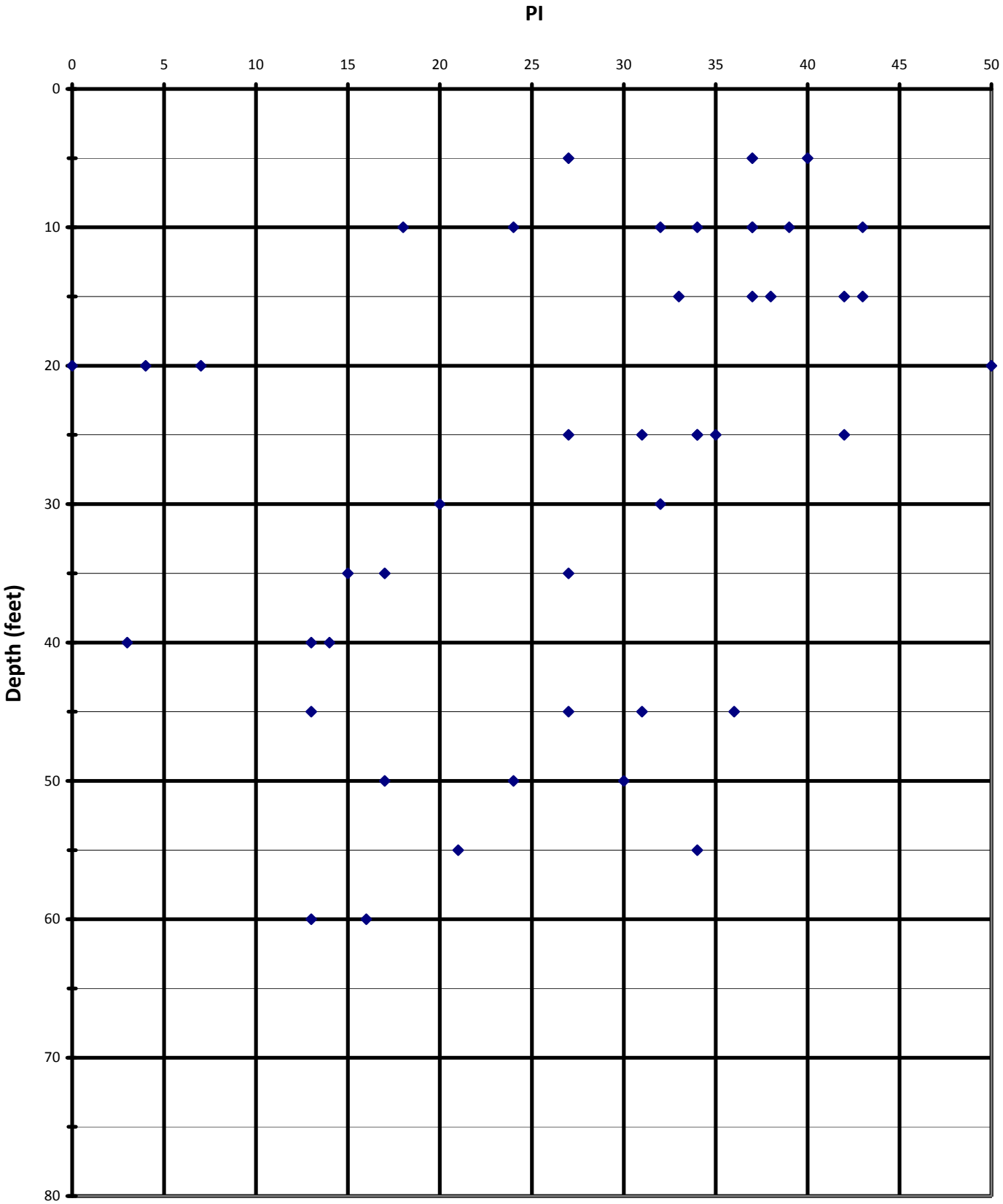
Variation of Liquid Limit with Depth



Area B

PLATE B3-17

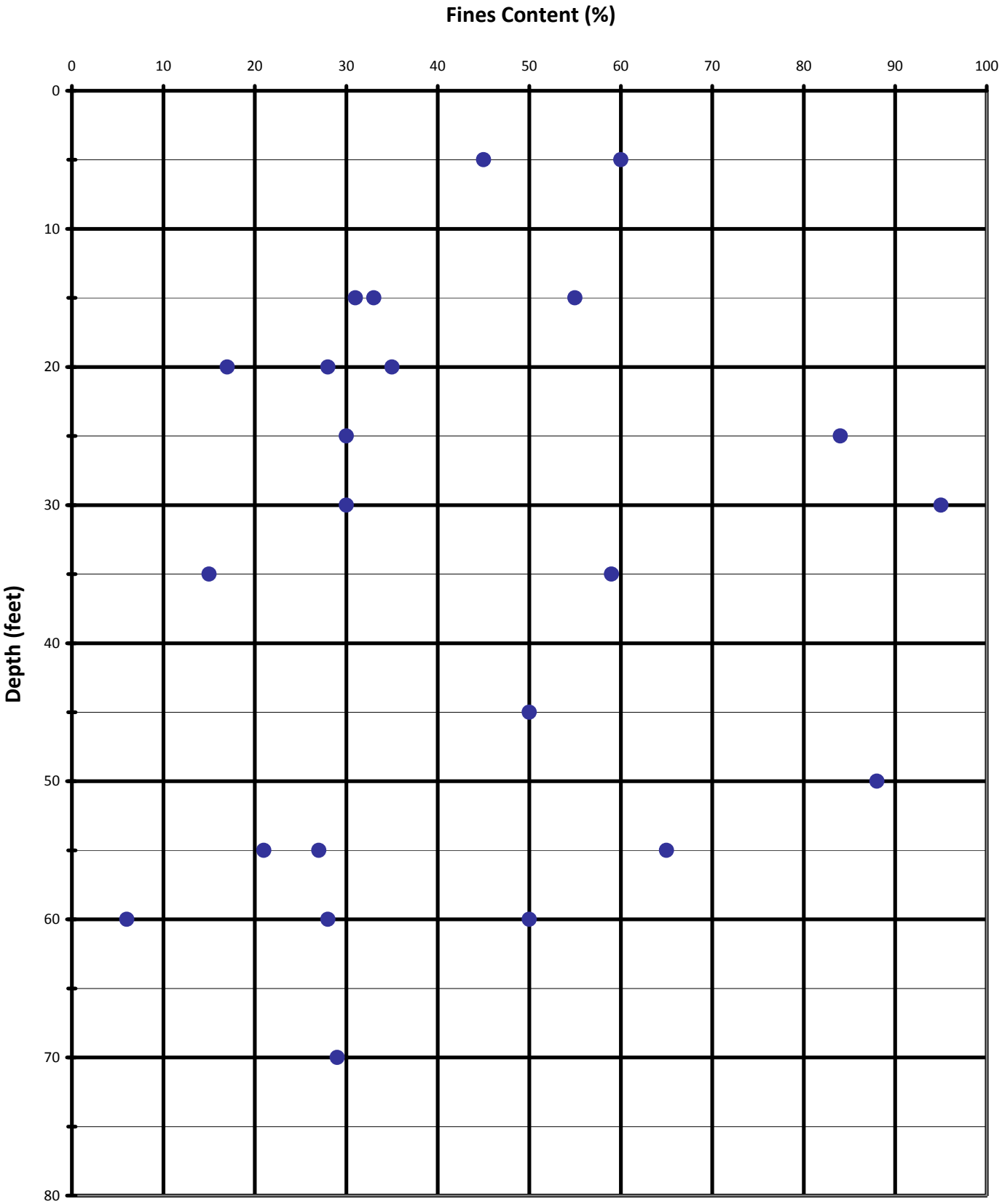
Variation of Plasticity Index with Depth



Area B

PLATE B3-18

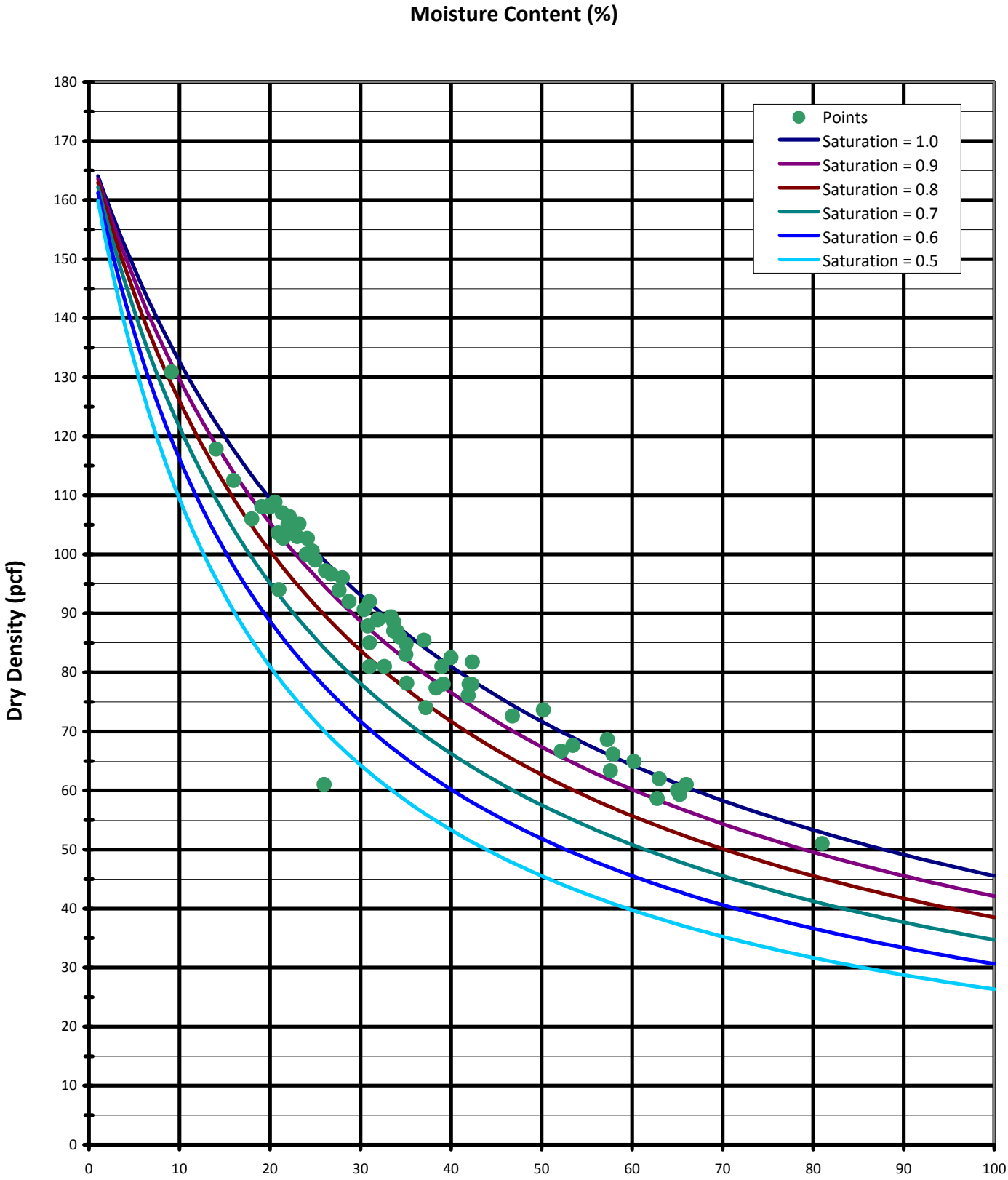
Variation of Fines Content with Depth



Area B

PLATE B3-19

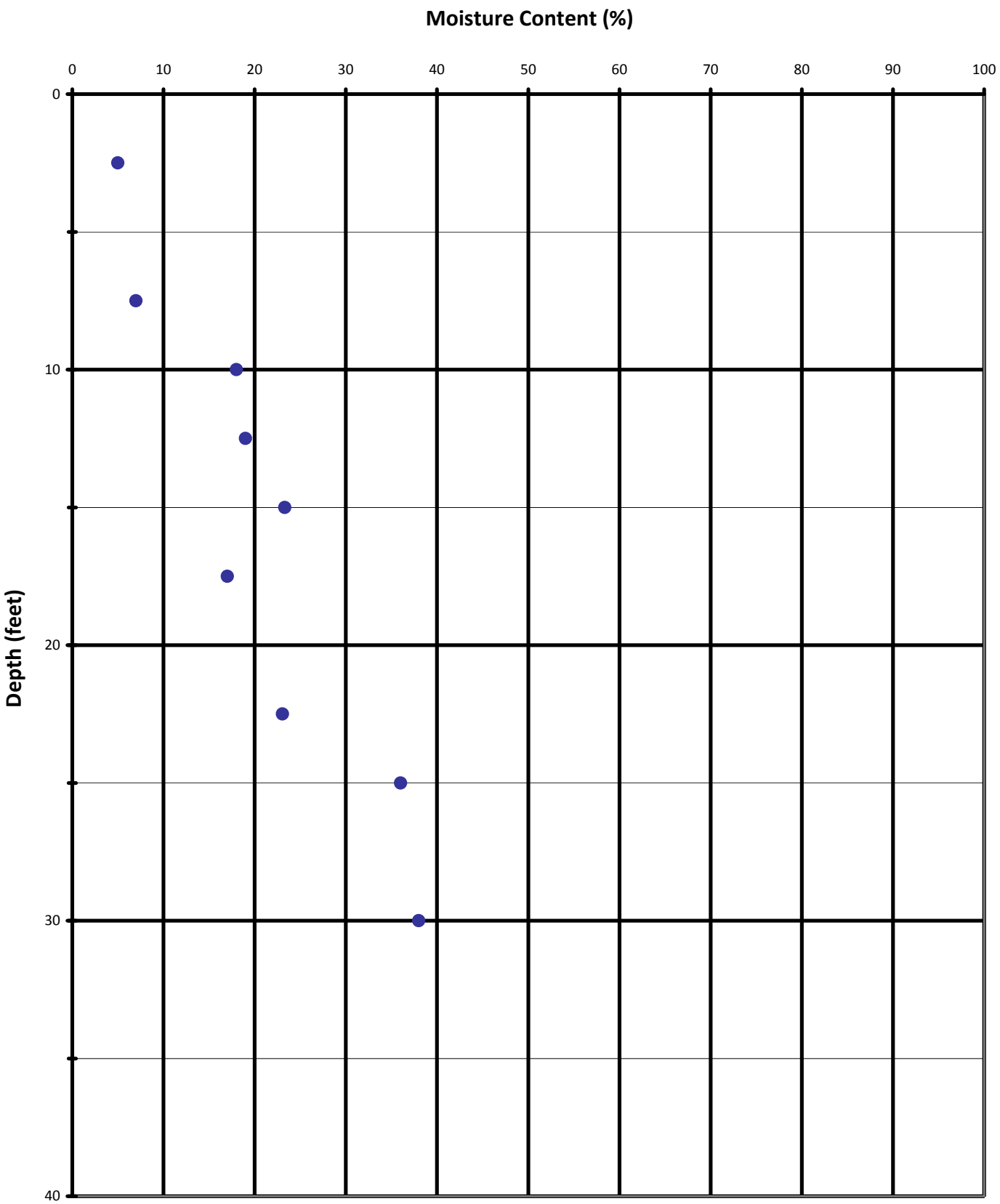
Moisture Content vs Dry Density



Area B

PLATE B3-20

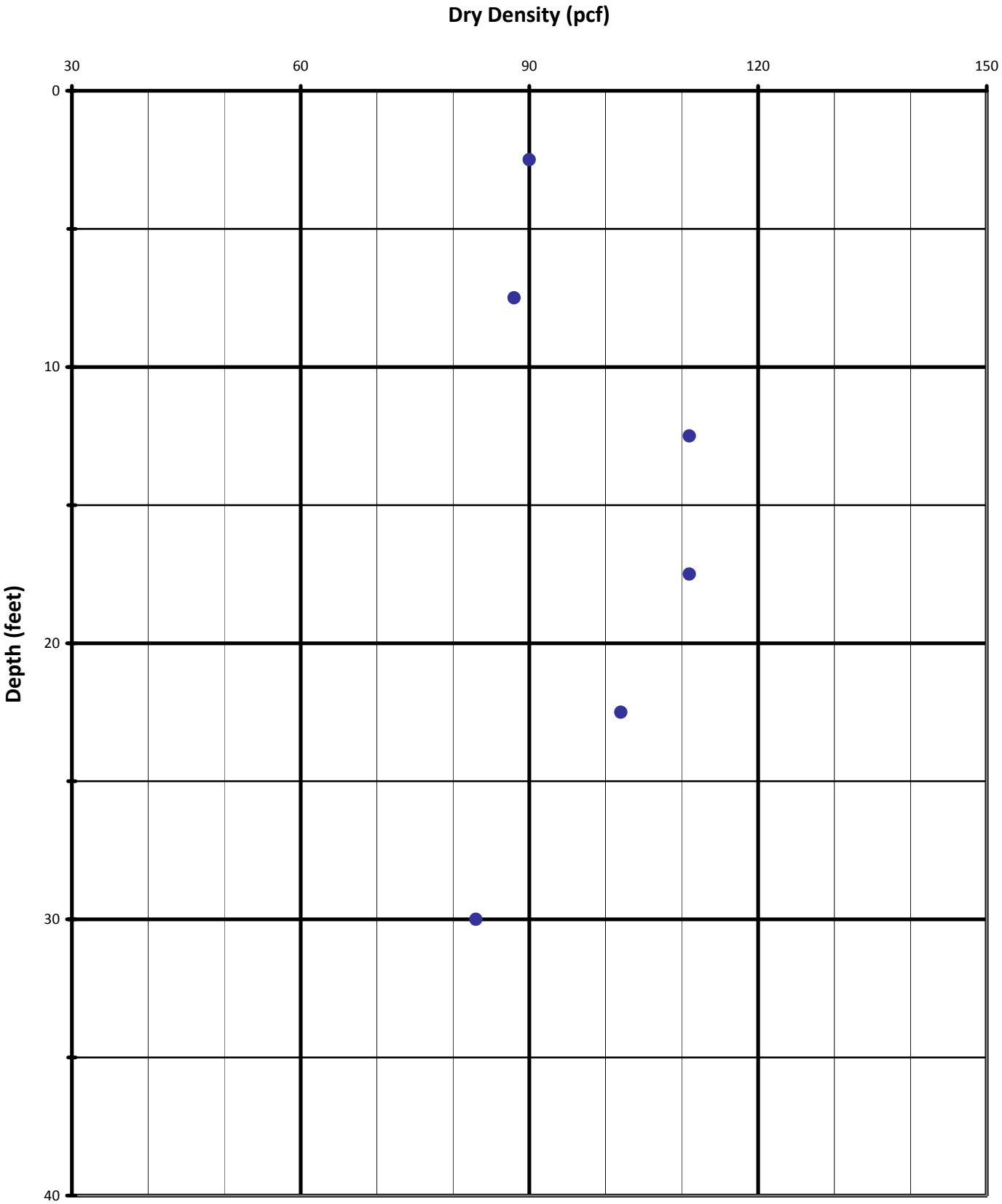
Variation of Moisture Content with Depth



Area C

PLATE B3-21

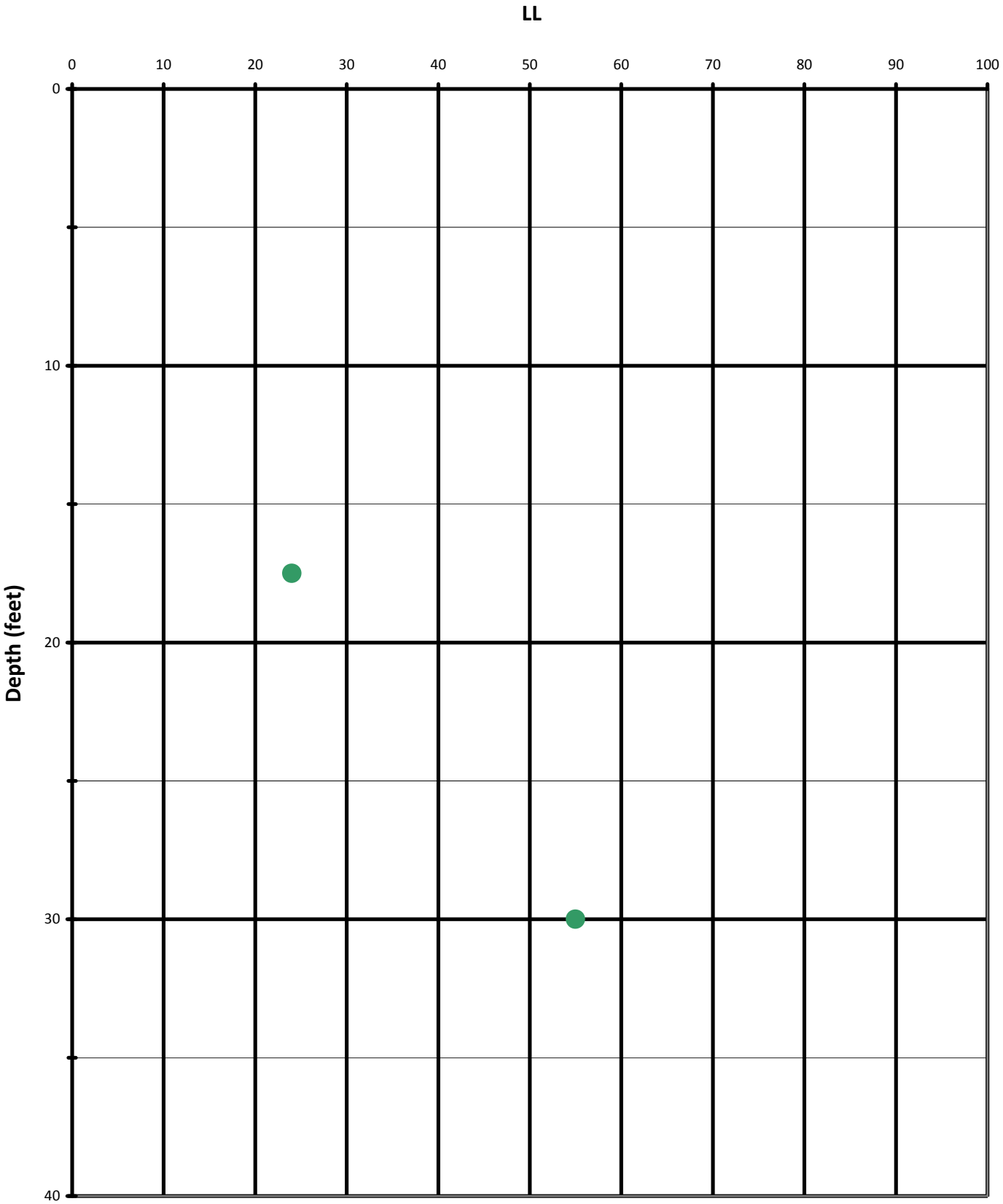
Variation of Dry Density with Depth



Area C

PLATE B3-22

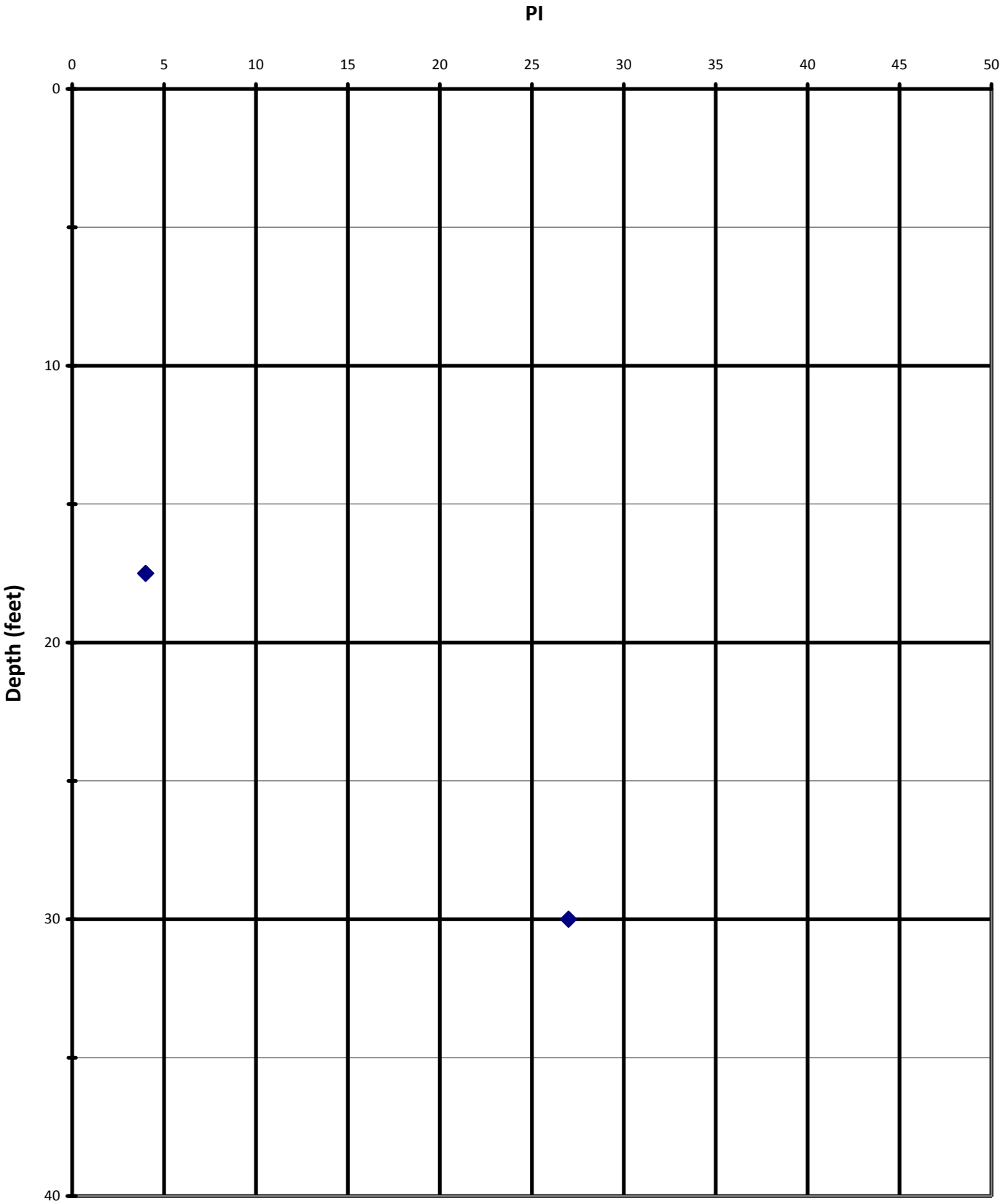
Variation of Liquid Limit with Depth



Area C

PLATE B3-23

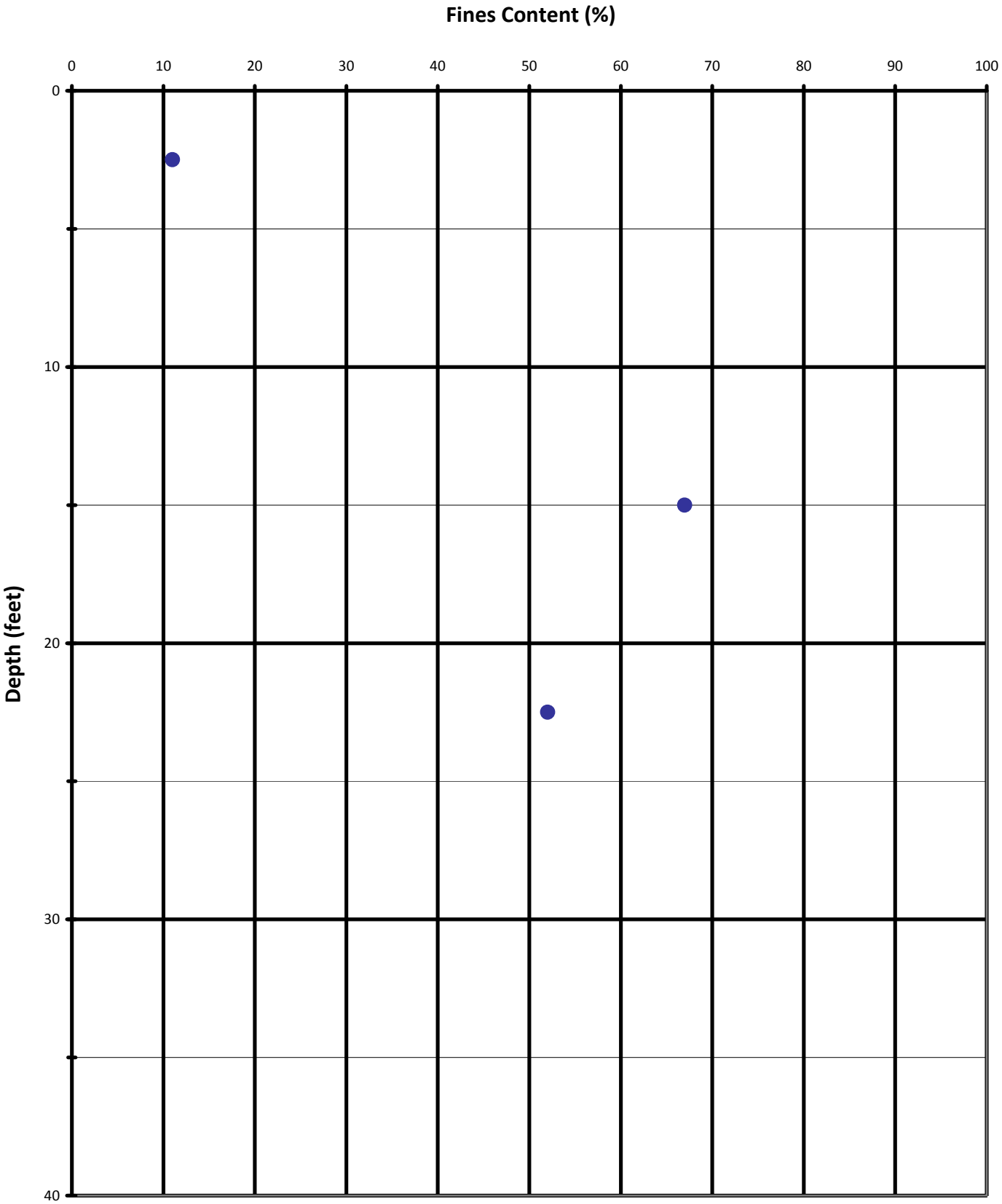
Variation of Plasticity Index with Depth



Area C

PLATE B3-24

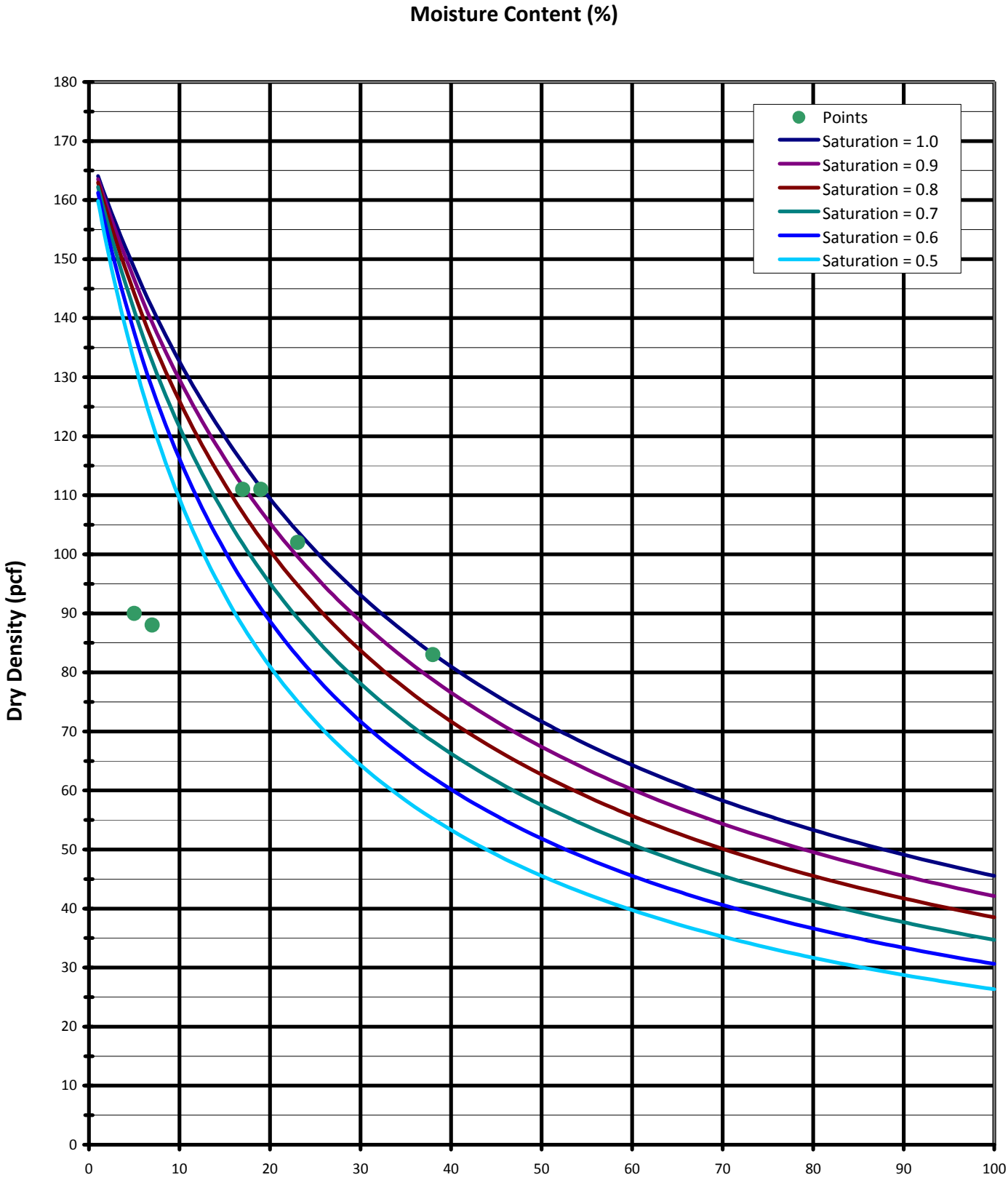
Variation of Fines Content with Depth



Area C

PLATE B3-25

Moisture Content vs Dry Density



Area C

PLATE B3-26

APPENDIX B4
LABORATORY TESTING INTERPRETATIONS OF INVESTIGATIONS BY OTHERS

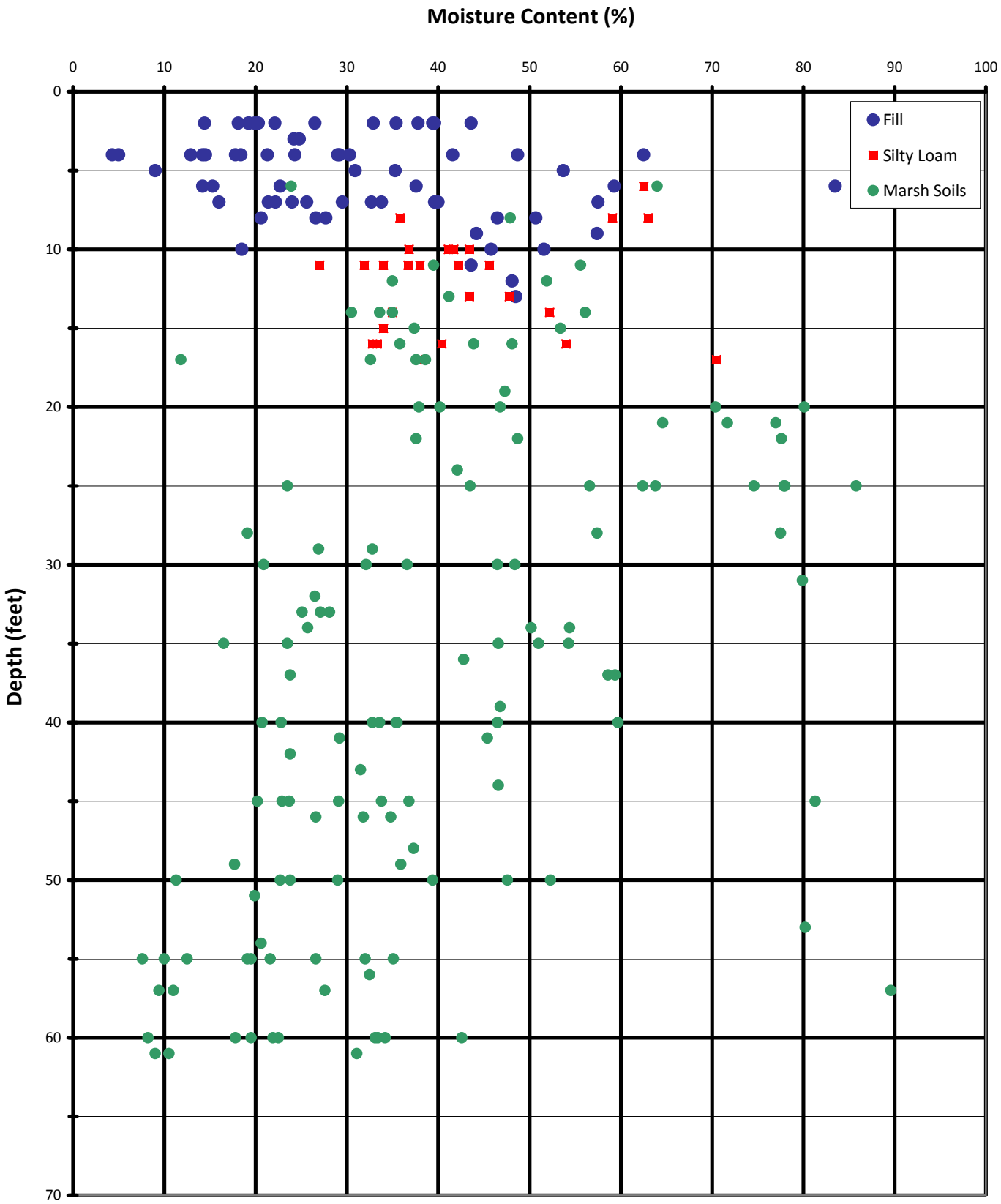
APPENDIX B4
LABORATORY TESTING INTERPRETATIONS

B4.1 General

The following interpretation plots were generated based on the results of laboratory testing data by other investigators, in Areas A, B, and C:

Plate B4-1	Variation of Moisture Content with Depth – Area A
Plate B4-2	Variation of Dry Density with Depth – Area A
Plate B4-3	Variation of Liquid Limit with Depth – Area A
Plate B4-4	Variation of Plastic Limit with Depth – Area A
Plate B4-5	Variation of Fines Content with Depth – Area A
Plate B4-6	Plot of Moisture Content vs. Dry Density – Area A
Plate B4-7	Variation of Moisture Content with Depth – Area B
Plate B4-8	Variation of Dry Density with Depth – Area B
Plate B4-9	Variation of Liquid Limit with Depth – Area B
Plate B4-10	Variation of Plastic Limit with Depth – Area B
Plate B4-11	Variation of Fines Content with Depth – Area B
Plate B4-12	Plot of Moisture Content vs. Dry Density – Area B
Plate B4-13	Variation of Moisture Content with Depth – Area C
Plate B4-14	Variation of Dry Density with Depth – Area C
Plate B4-15	Variation of Liquid Limit with Depth – Area C
Plate B4-16	Variation of Plastic Limit with Depth – Area C
Plate B4-17	Variation of Fines Content with Depth – Area C
Plate B4-18	Plot of Moisture Content vs. Dry Density – Area C

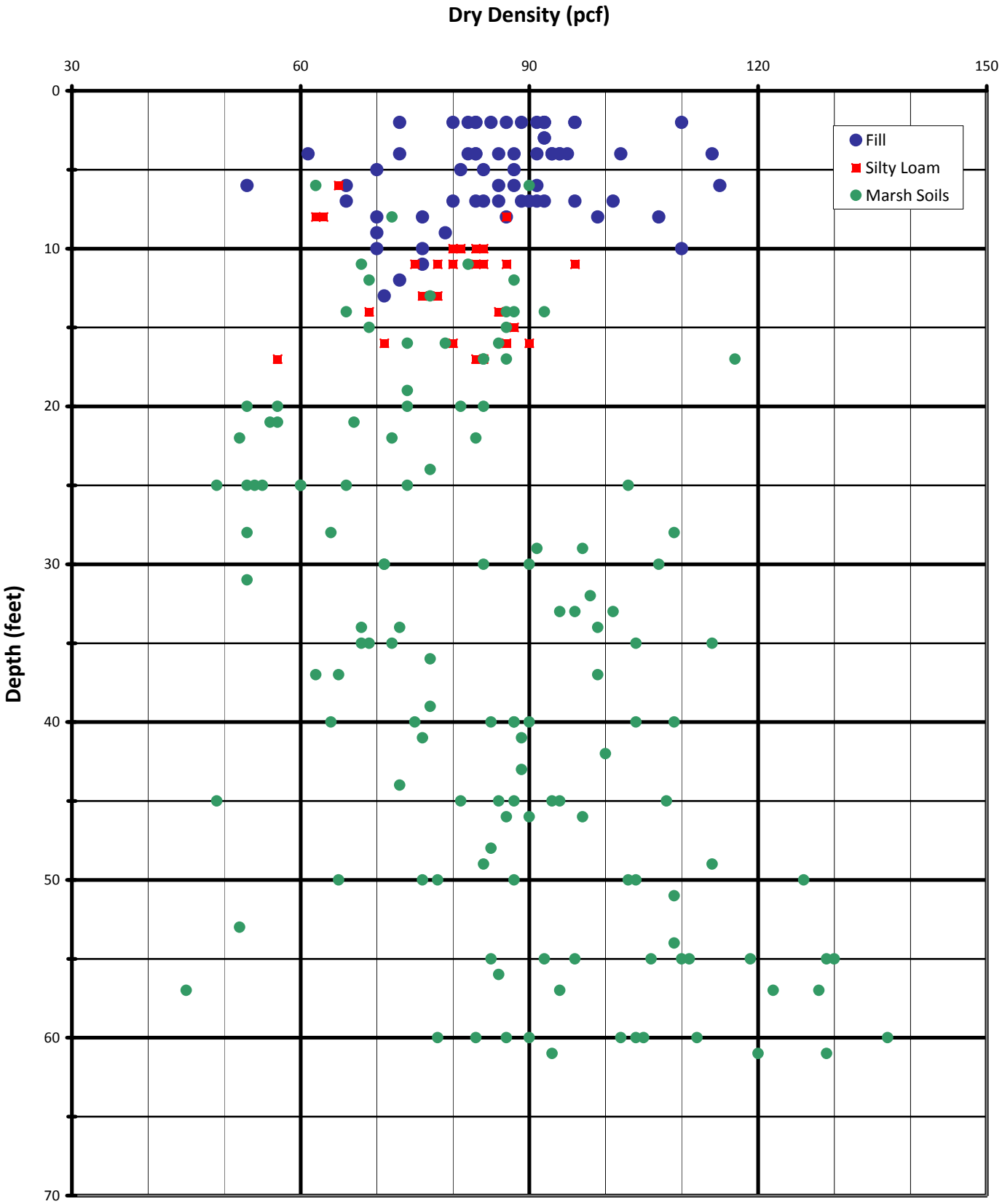
Variation of Moisture Content with Depth



Area A

PLATE B4-1

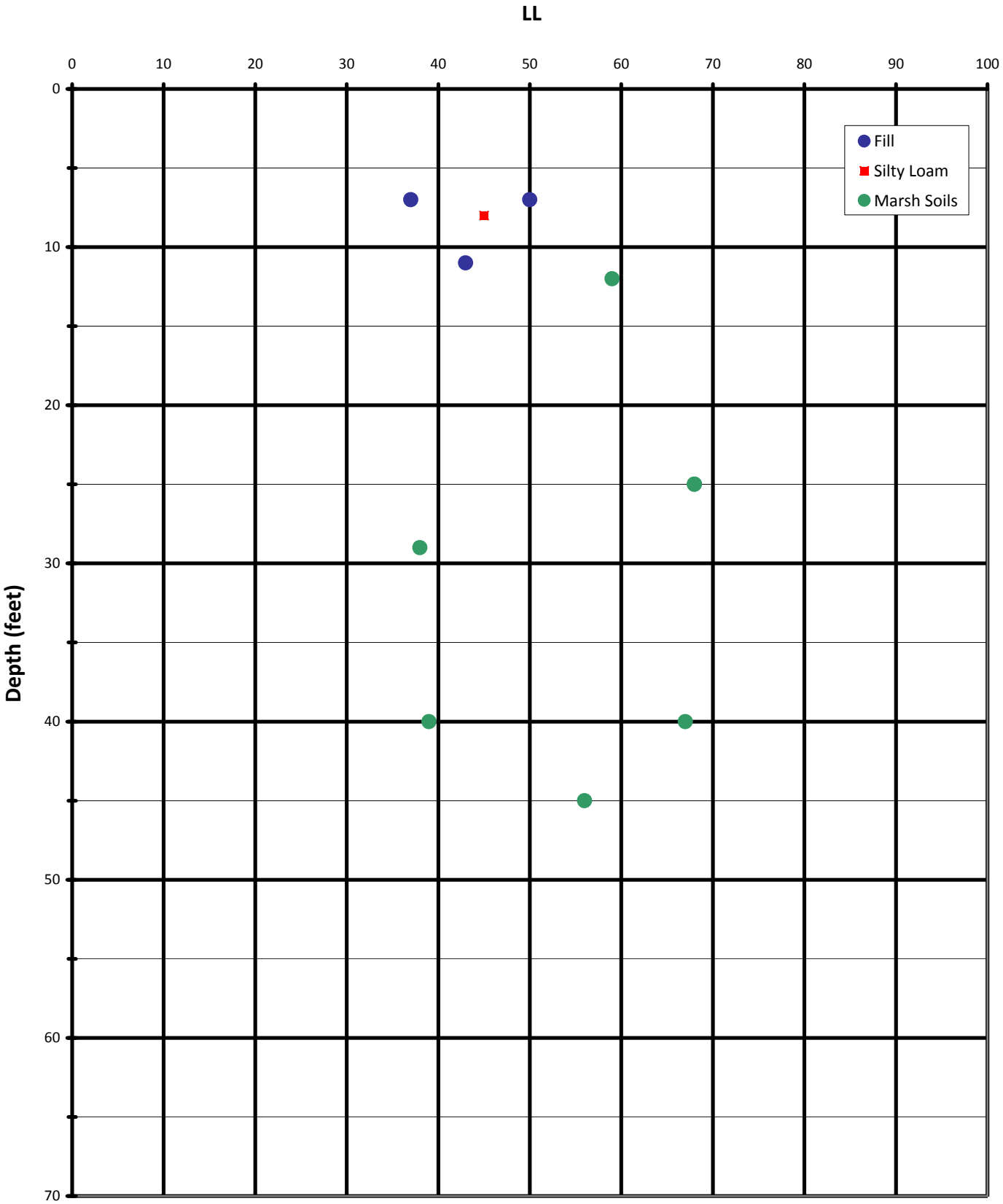
Variation of Dry Density with Depth



Area A

PLATE B4-2

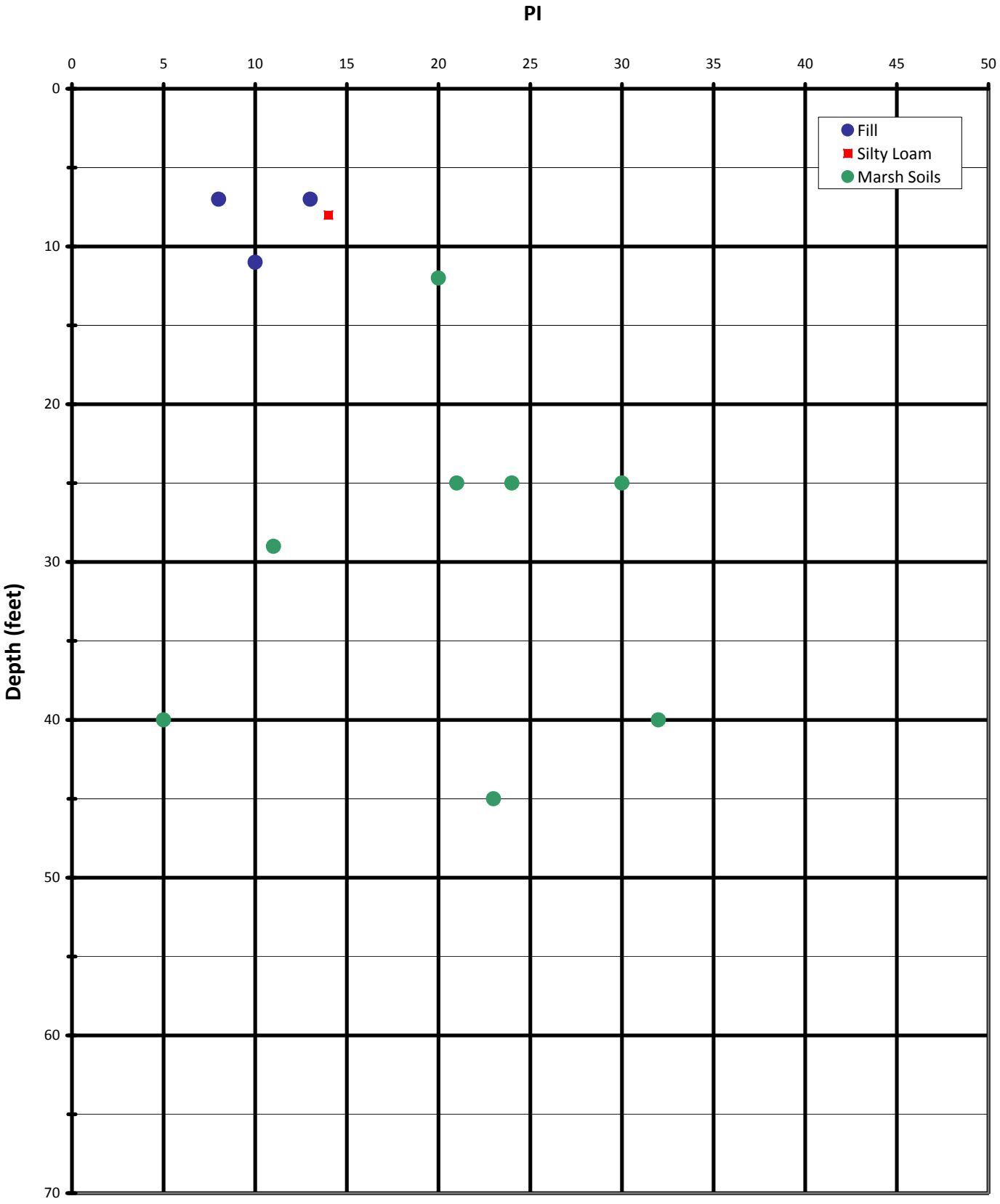
Variation of Liquid Limit with Depth



Area A

PLATE B4-3

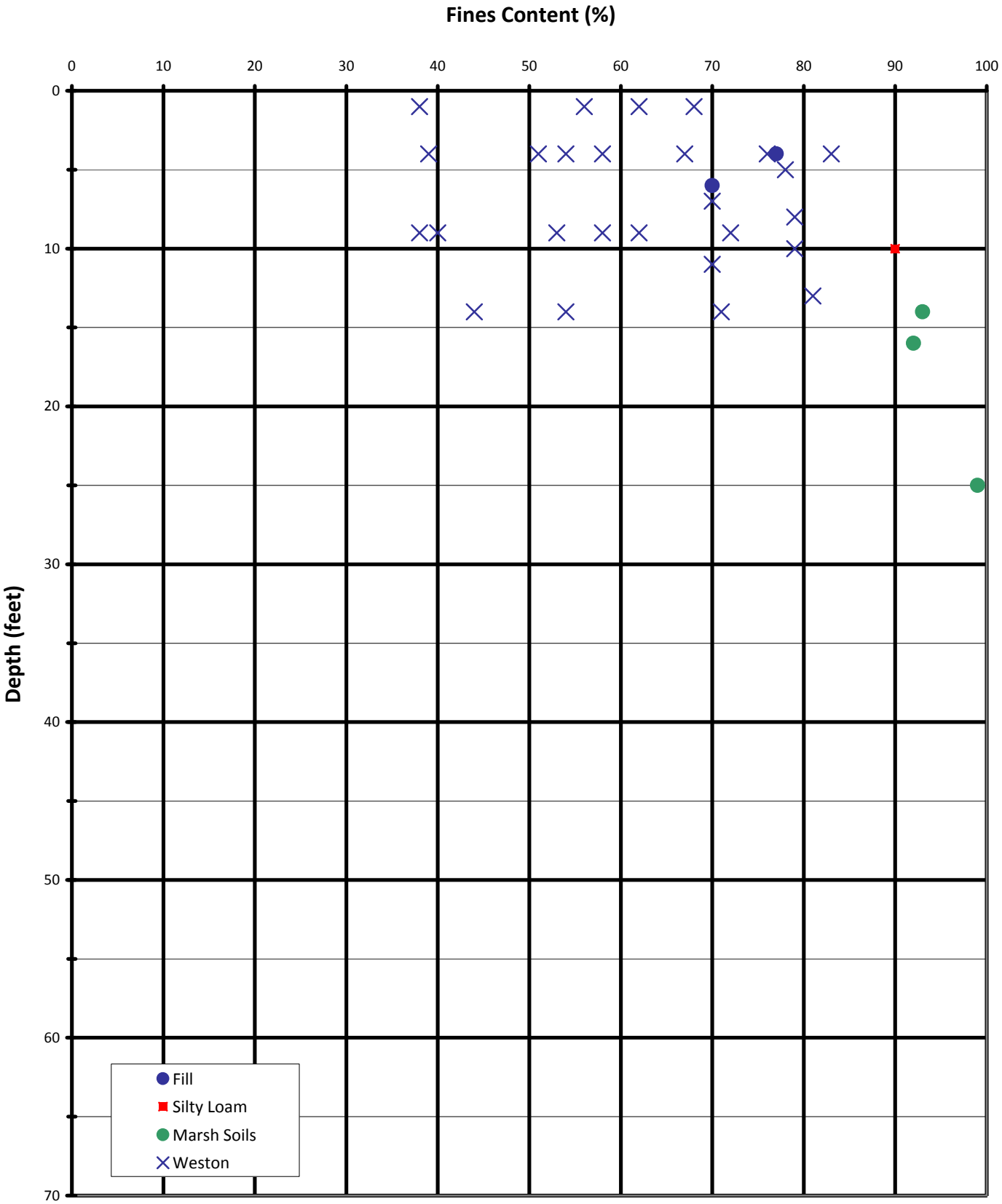
Variation of Plasticity Index with Depth



Area A

PLATE B4-4

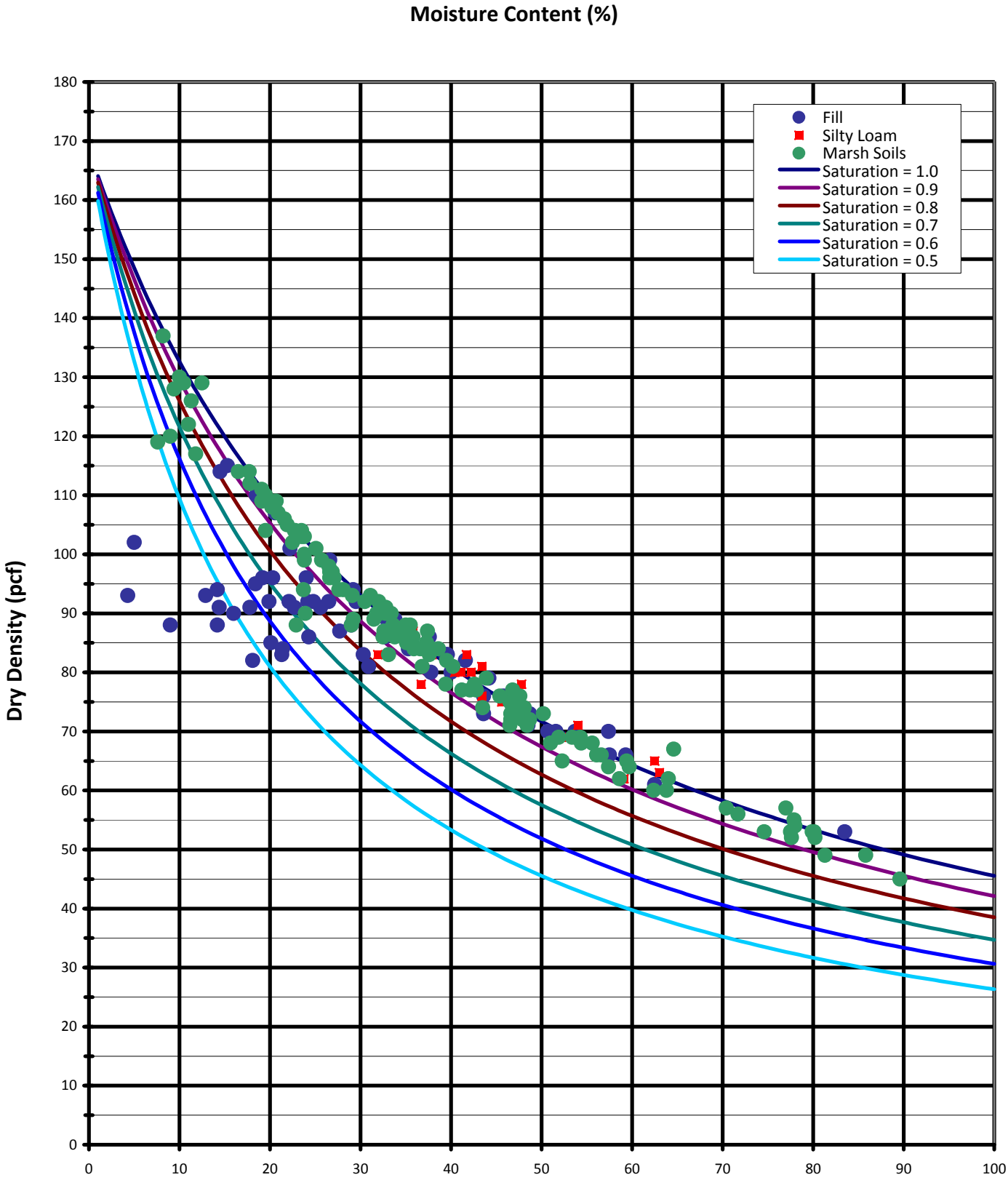
Variation of Fines Content with Depth



Area A

PLATE B4-5

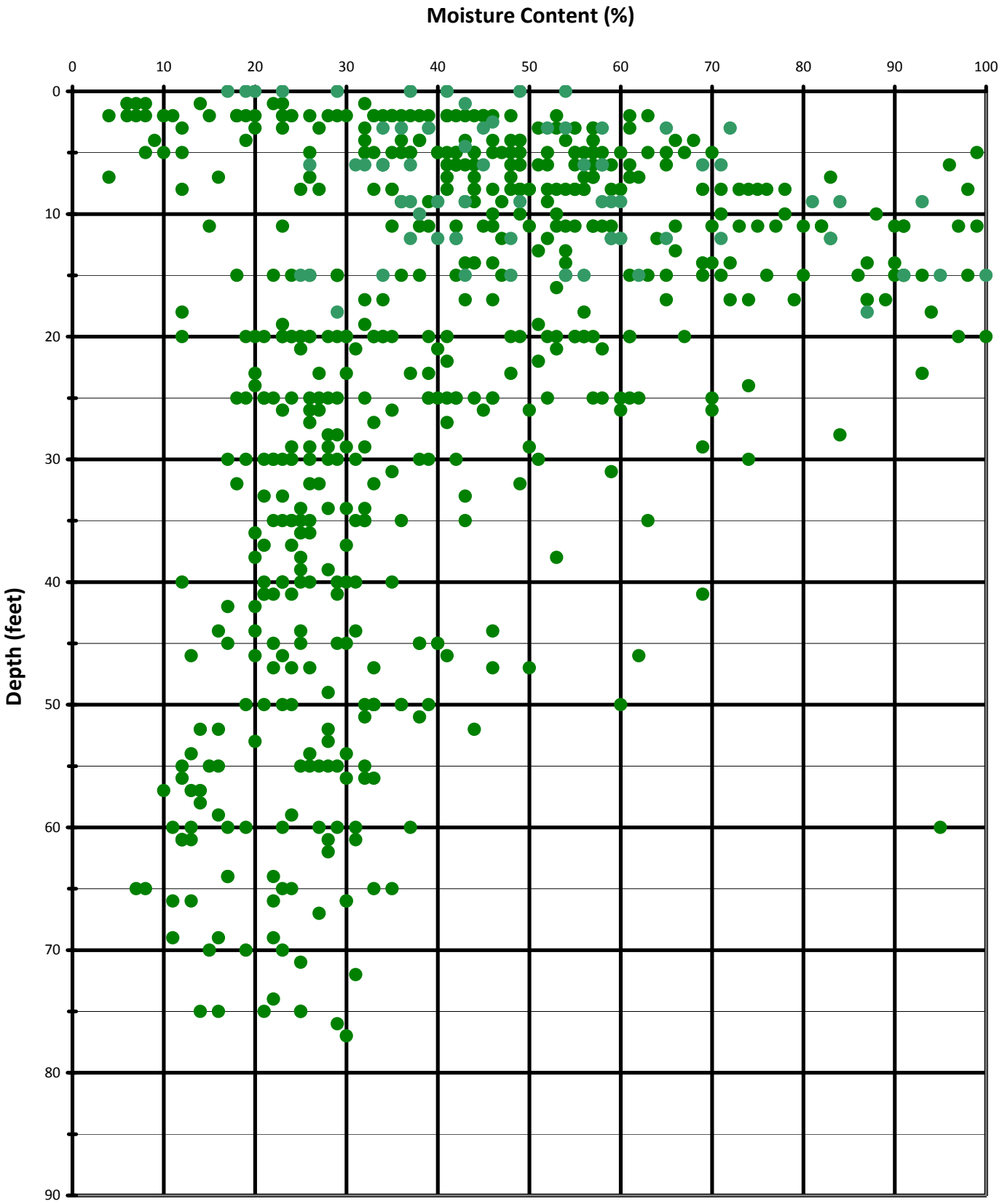
Moisture Content vs Dry Density



Area A

PLATE B4-6

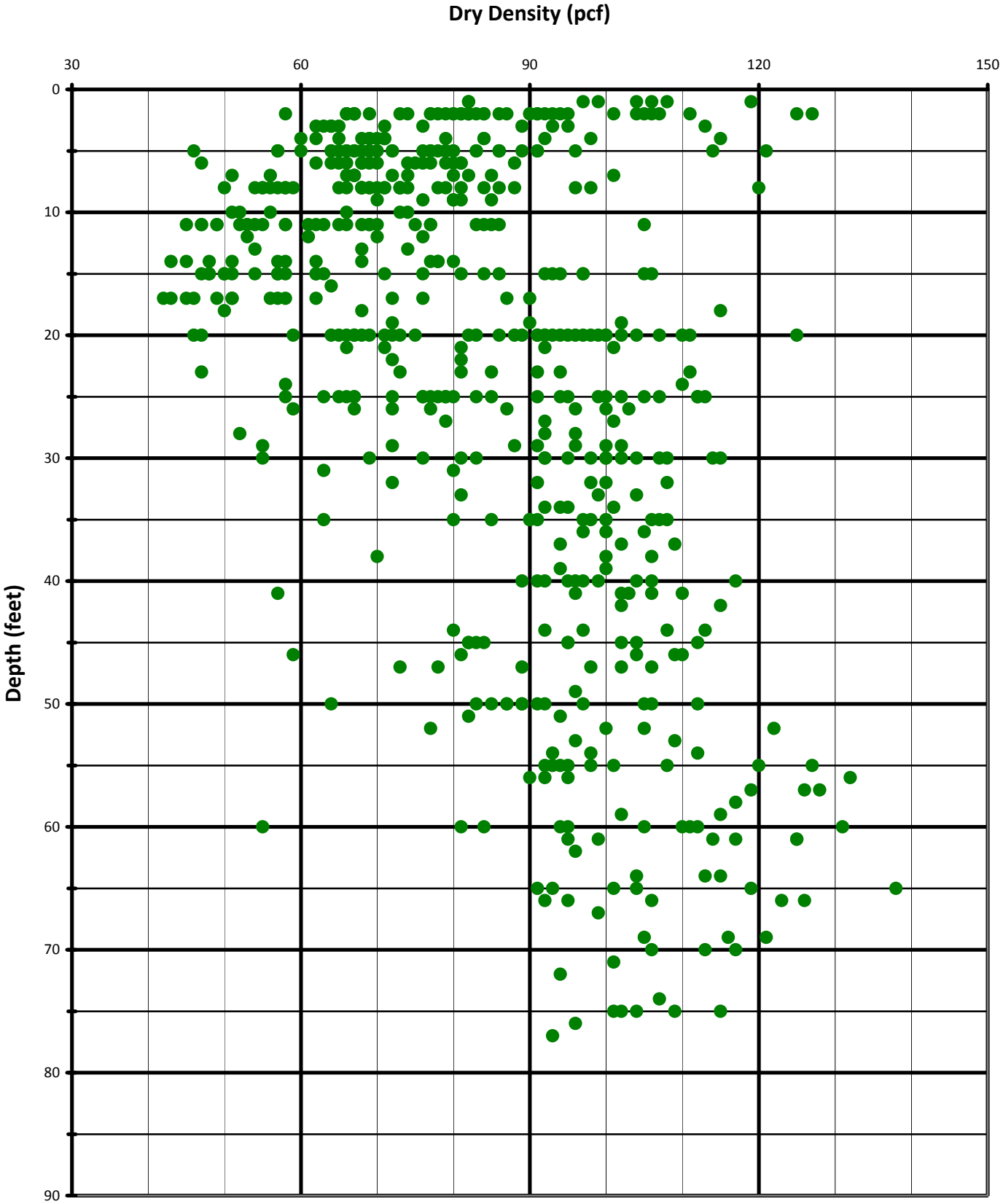
Variation of Moisture Content with Depth



Area B

PLATE B4-7

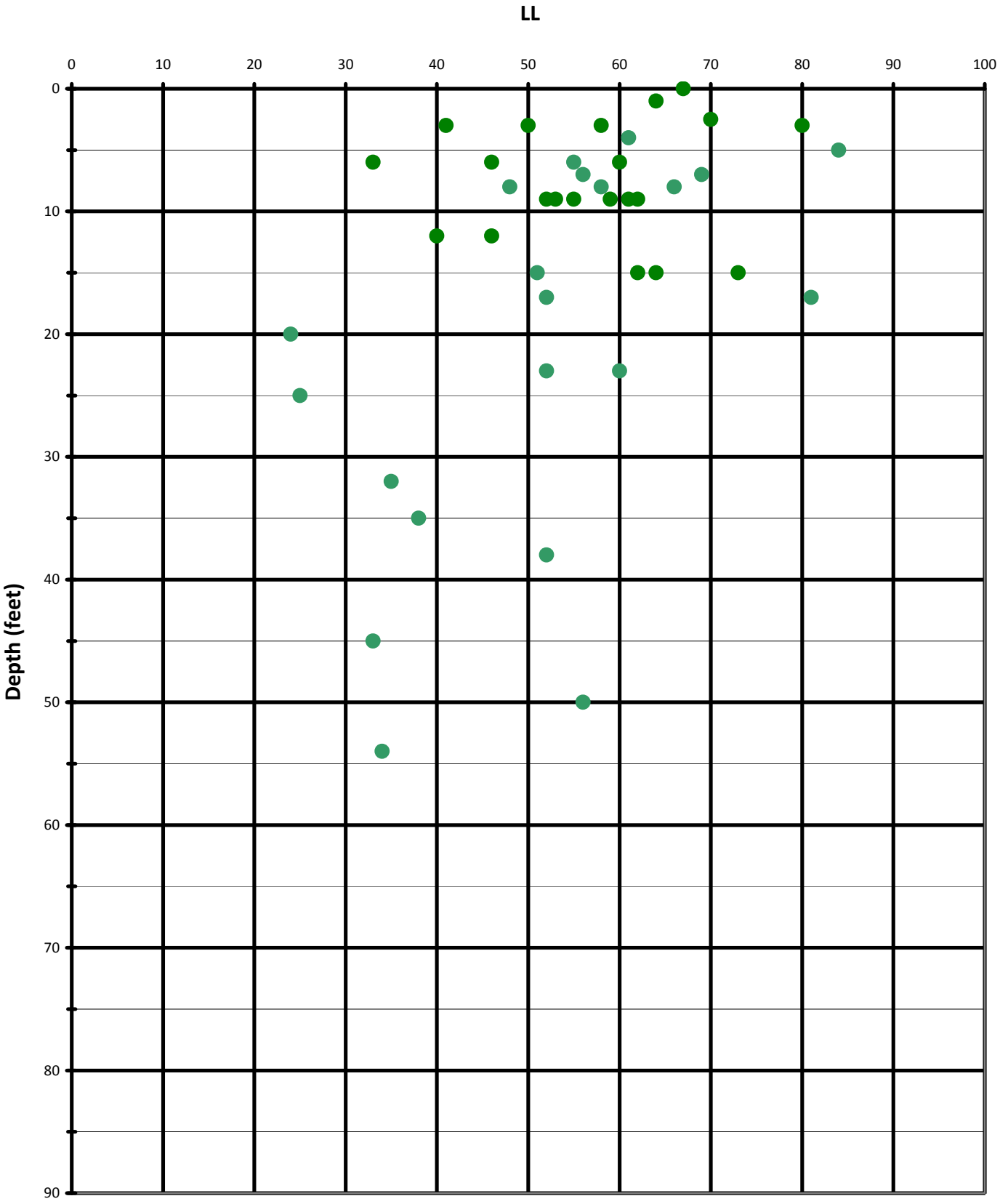
Variation of Dry Density with Depth



Area B

PLATE B4-8

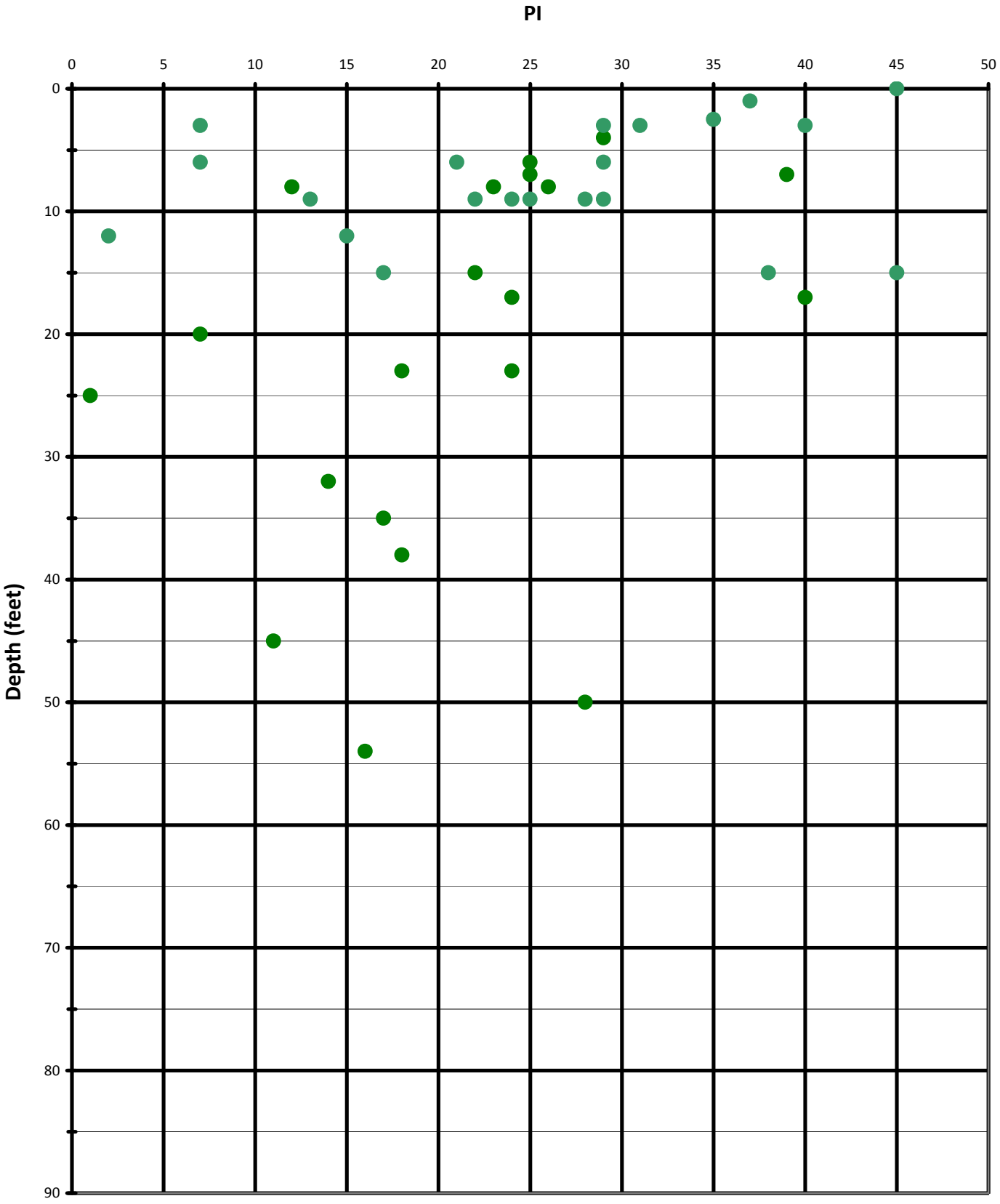
Variation of Liquid Limit with Depth



Area B

PLATE B4-9

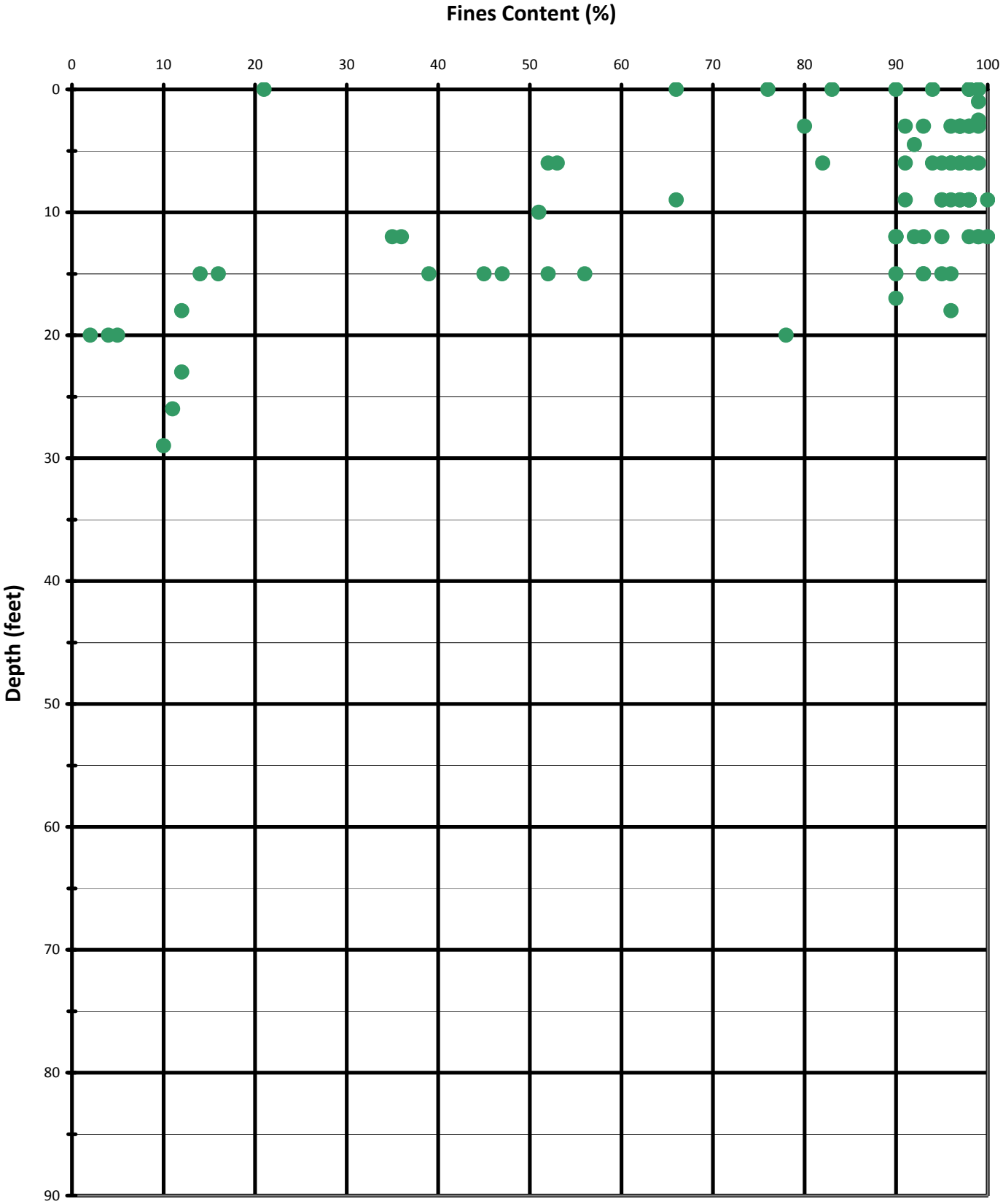
Variation of Plasticity Index with Depth



Area B

PLATE B4-10

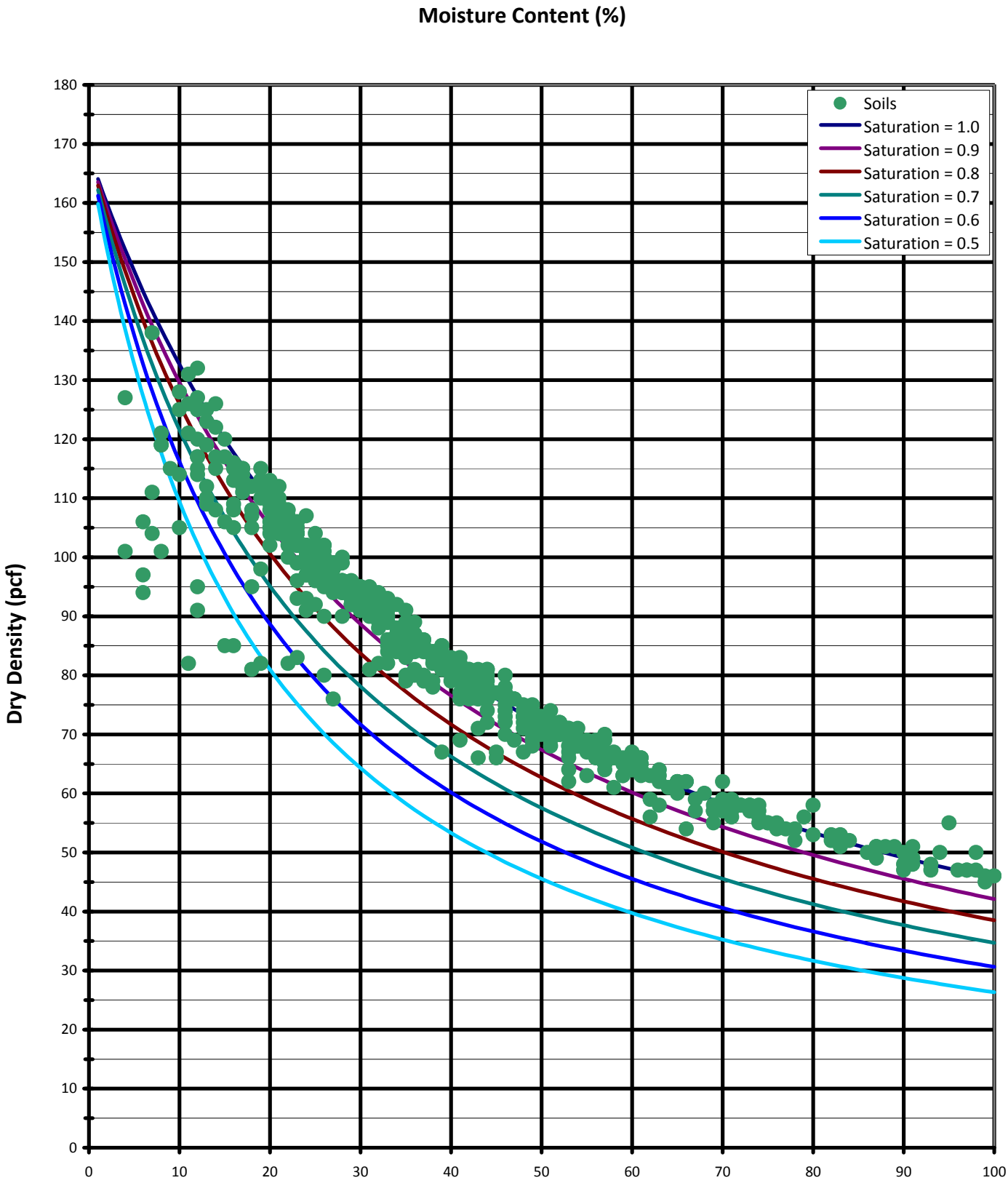
Variation of Fines Content with Depth



Area B

PLATE B4-11

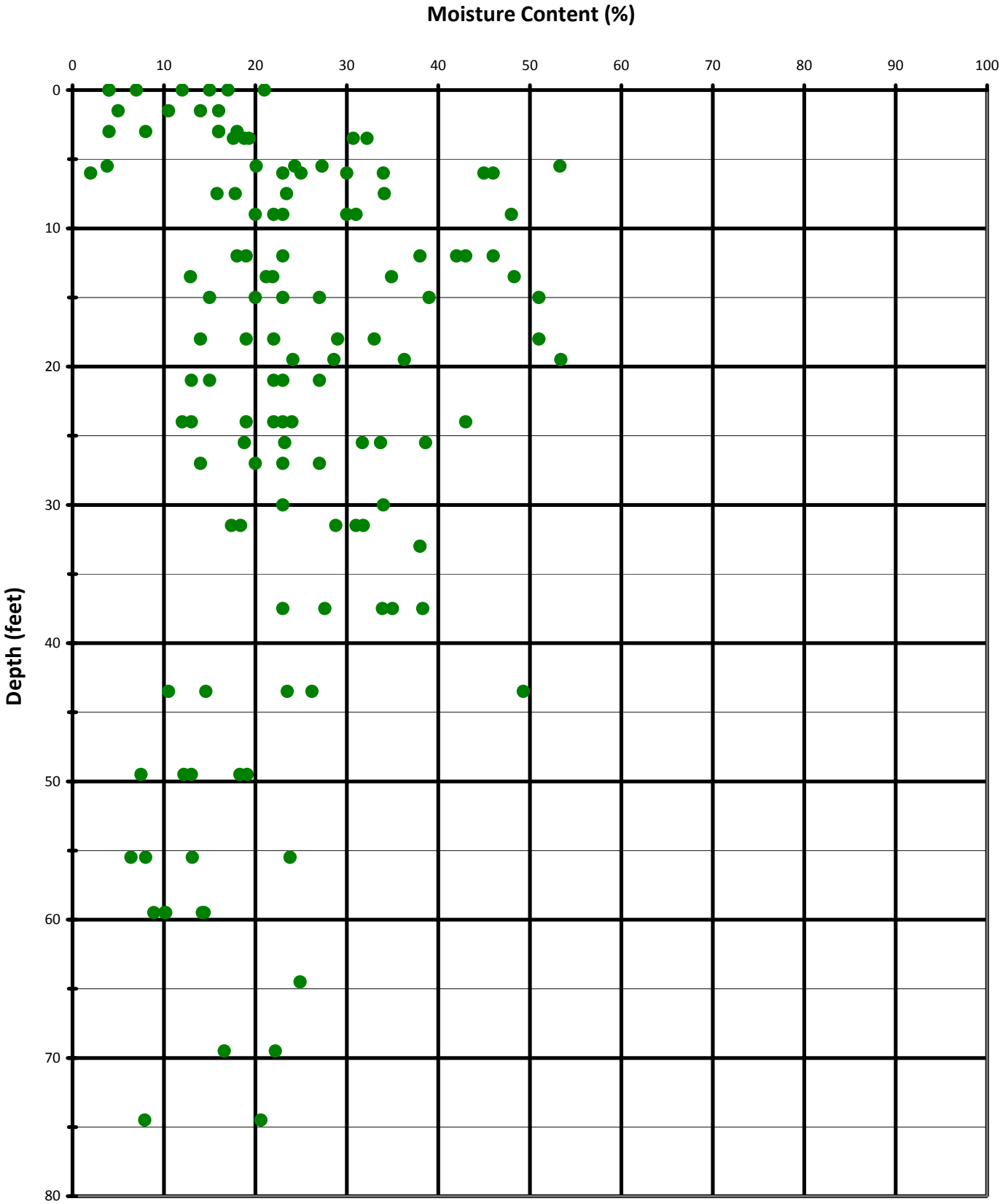
Moisture Content vs Dry Density



Area B

PLATE B4-12

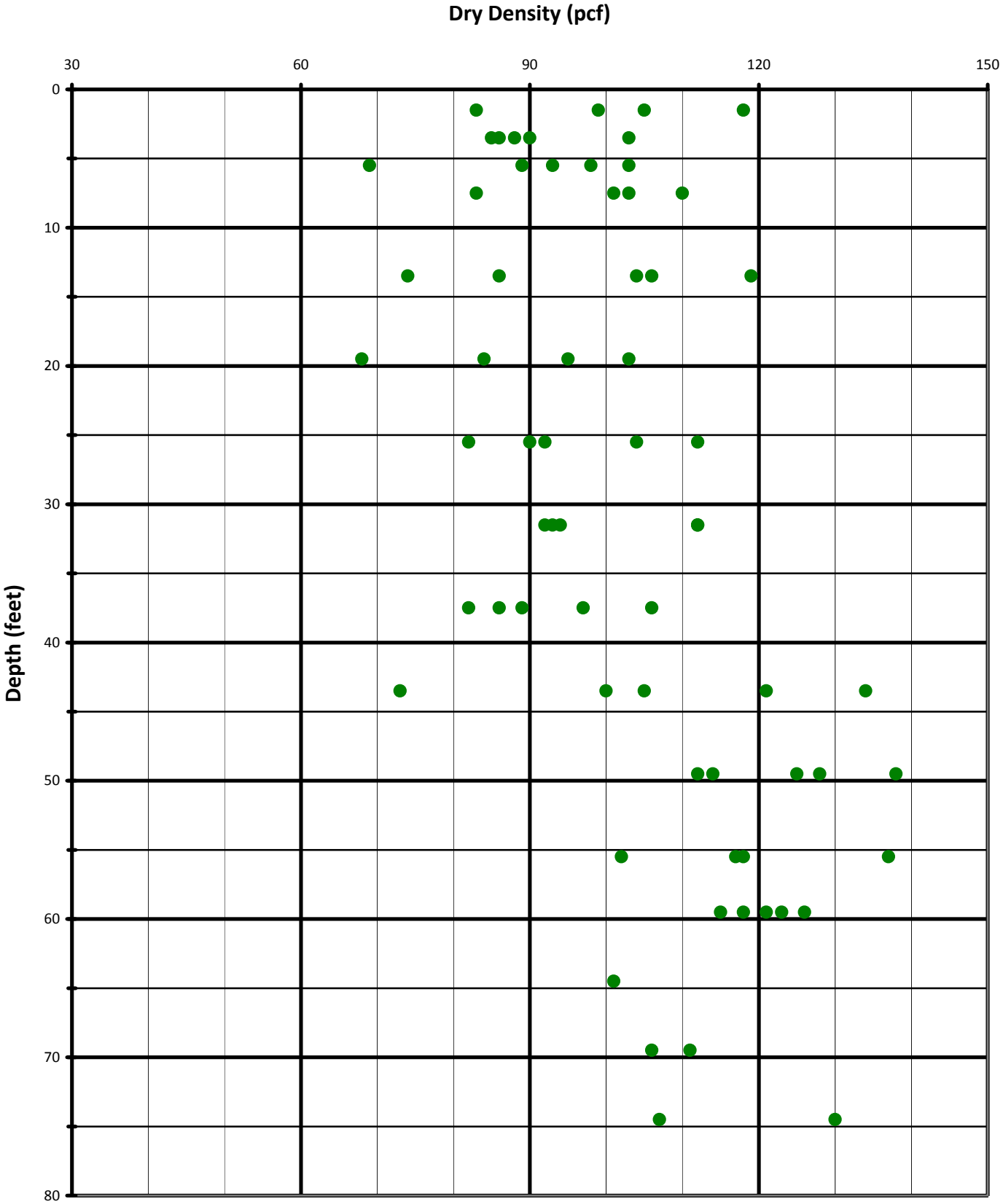
Variation of Moisture Content with Depth



AREA C

PLATE B4-13

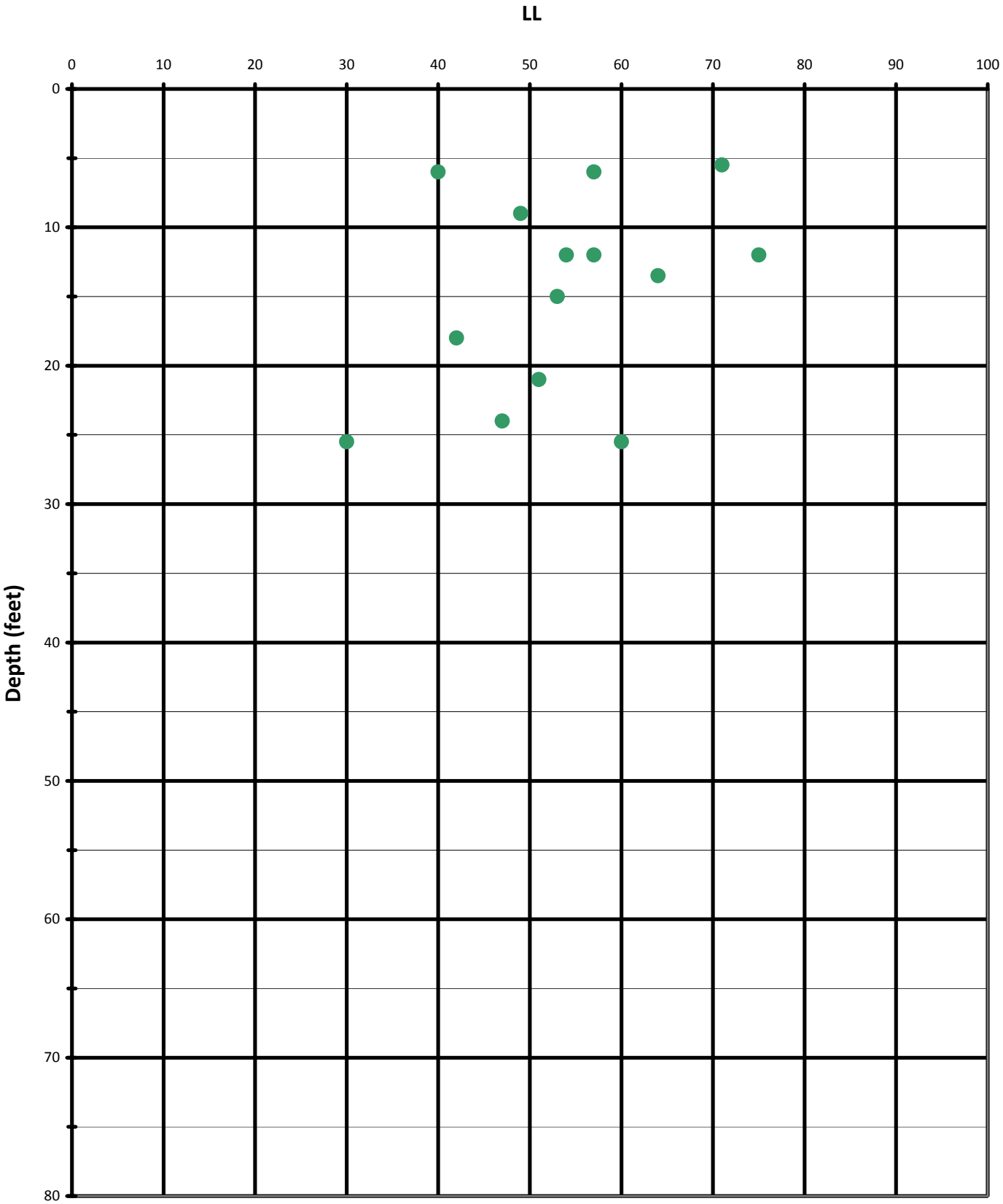
Variation of Dry Density with Depth



AREA C

PLATE B4-14

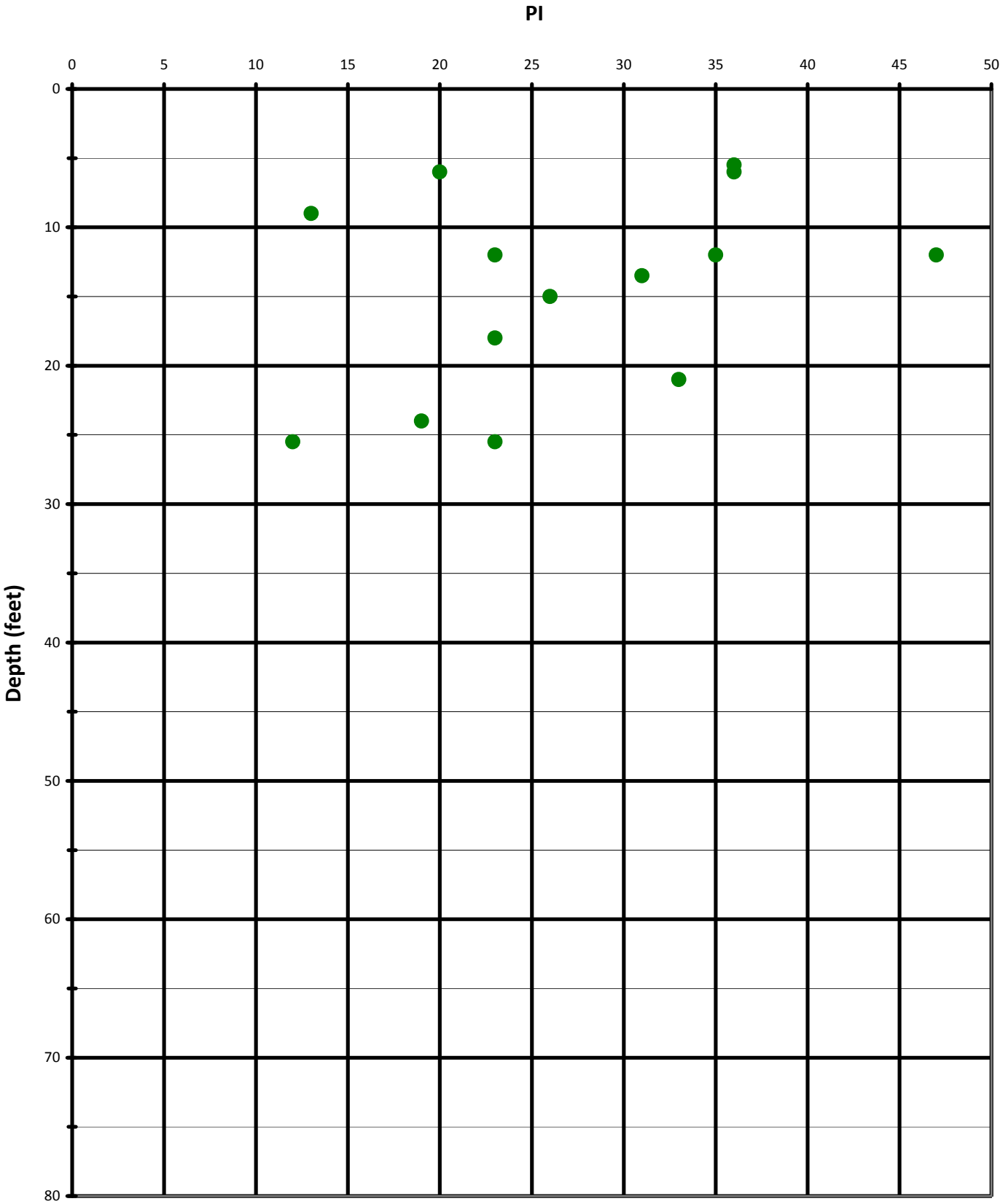
Variation of Liquid Limit with Depth



AREA C

PLATE B4-15

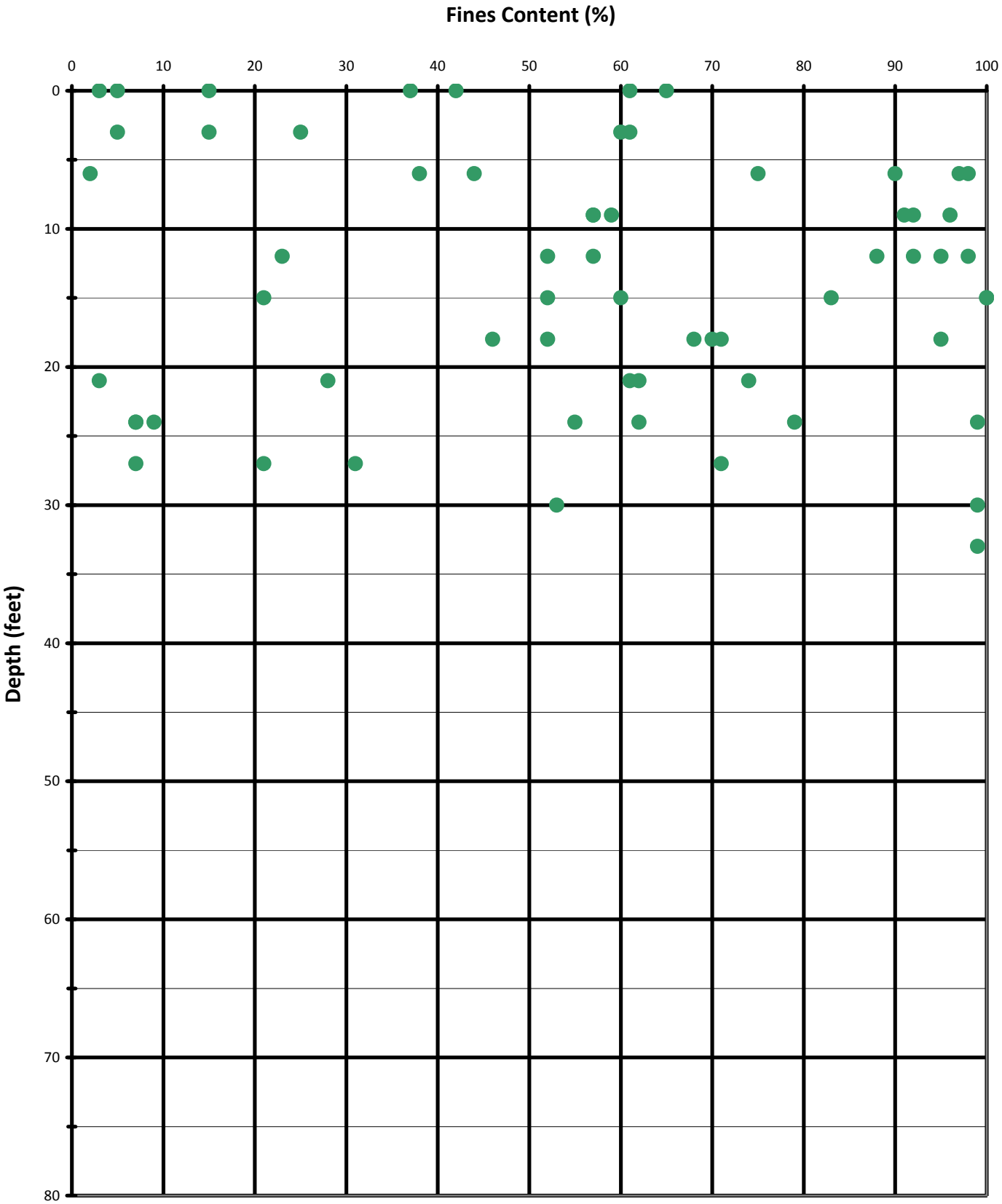
Variation of Plasticity Index with Depth



AREA C

PLATE B4-16

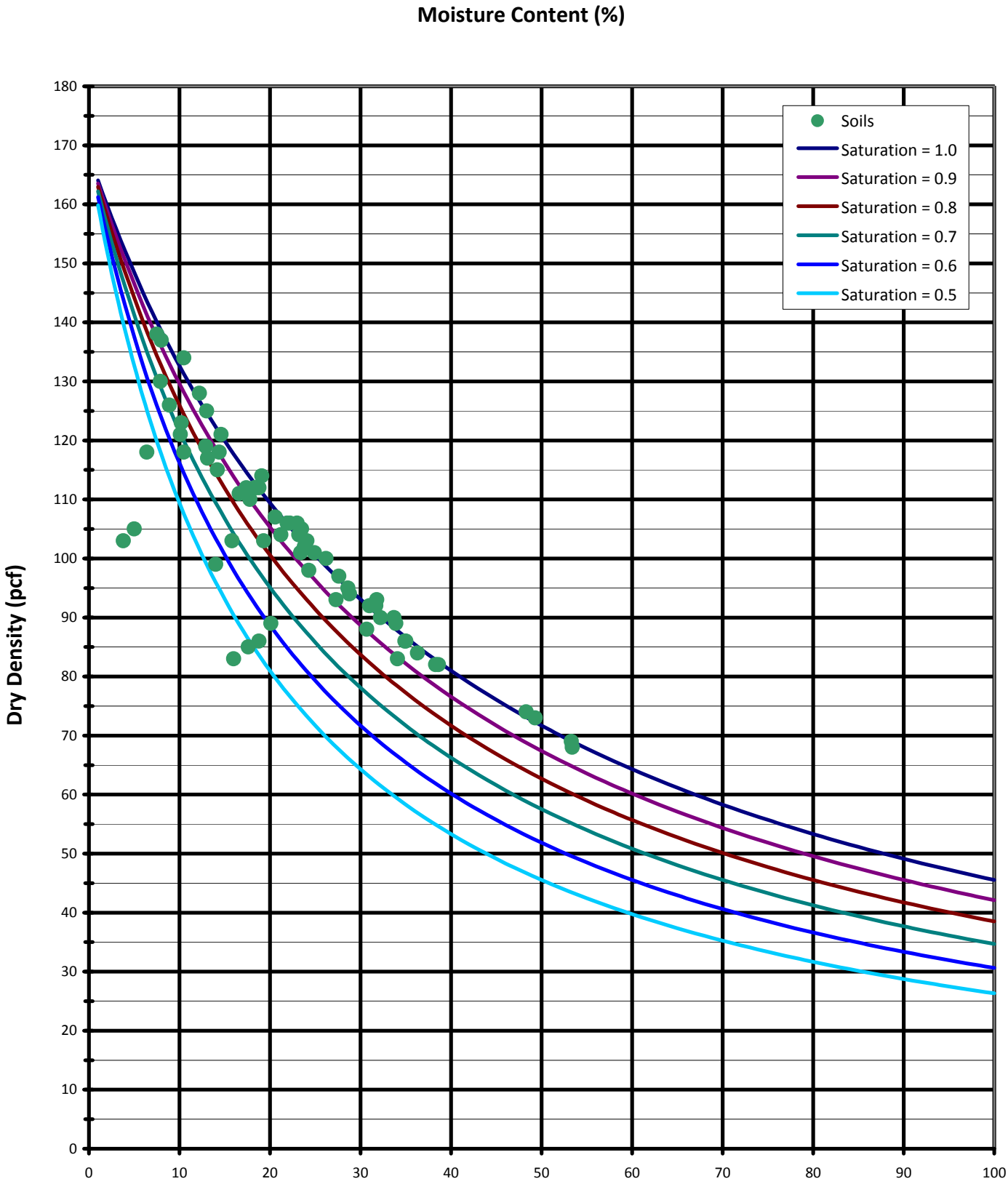
Variation of Fines Content with Depth



AREA C

PLATE B4-17

Moisture Content vs Dry Density



AREA C

PLATE B4-18

APPENDIX C
GEOLOGIC MAP / AERIAL PHOTOS

APPENDIX C
GEOLOGIC MAP/AERIAL PHOTOS

C.1 Contents

This appendix includes a geologic map, aerial photos of Ballona Wetlands selected from the UCLA Library Spence Collection of Aerial Photos (from years 1924 to 1938), and Topographic Maps from USGS prior and after the construction of the existing levees.

A list of the plates presented in this appendix follows:

Plate C-1	Geologic Map
Plate C-2 through C-9	UCLA Library Spence Aerial Photos (circa 1924-1938)
Plate C-10 and C-11	USGS Topographic Maps (1924 and 1942)



DATE: 6/28/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	GEOLOGIC MAP Ballona Wetlands Restoration Los Angeles, CA	PROJECT NUMBER: LA962A
REVISION:	APPROVED BY: P. Kashighandi				SCALE: 1" = 750'
REVISION:					PLATE NUMBER: C-1



Playa Del Rey - View of Bluffs to the South of Ballona Creek -

PLATE C-2

UCLA Library - Spence Photos - 1924



PLATE C-3

Marina Del Rey - Ballona Lagoons - Northward View -

UCLA Library - Spence Photos - 1928



PLATE C-4

Marina Del Rey - Westward View - Showing Oil Wells, Ballona Lagoon, Culver Boulevard, and Pacific Electric Railroad - 1933

UCLA Library - Spence Photos - 1933



PLATE C-5

Marina Del Rey- Eastward View - Showing Ballona Lagoon, Oil Wells, Culver Boulevard passing through in a southwestly

UCLA Library - Spence Photos - 1933



PLATE C-6

Ballona Creek Levees - 1937 - Eastward View

UCLA Library - Spence Photos - 1937



Ballona Creek Levees - 1937 - Eastward View

PLATE C-7

UCLA Library - Spence Photos - 1937



PLATE C-8

Marina Del Rey - Eastward view showing Pacific Electric Railroad, Lincoln Boulevard, Realignment of Culver Boulevard, and Ballona Creek

UCLA Library - Spence Photos - 1937



PLATE C-9

Marina Del Rey - Eastward view showing Completed Ballona Creek Levee

UCLA Library - Spence Photos - 1938

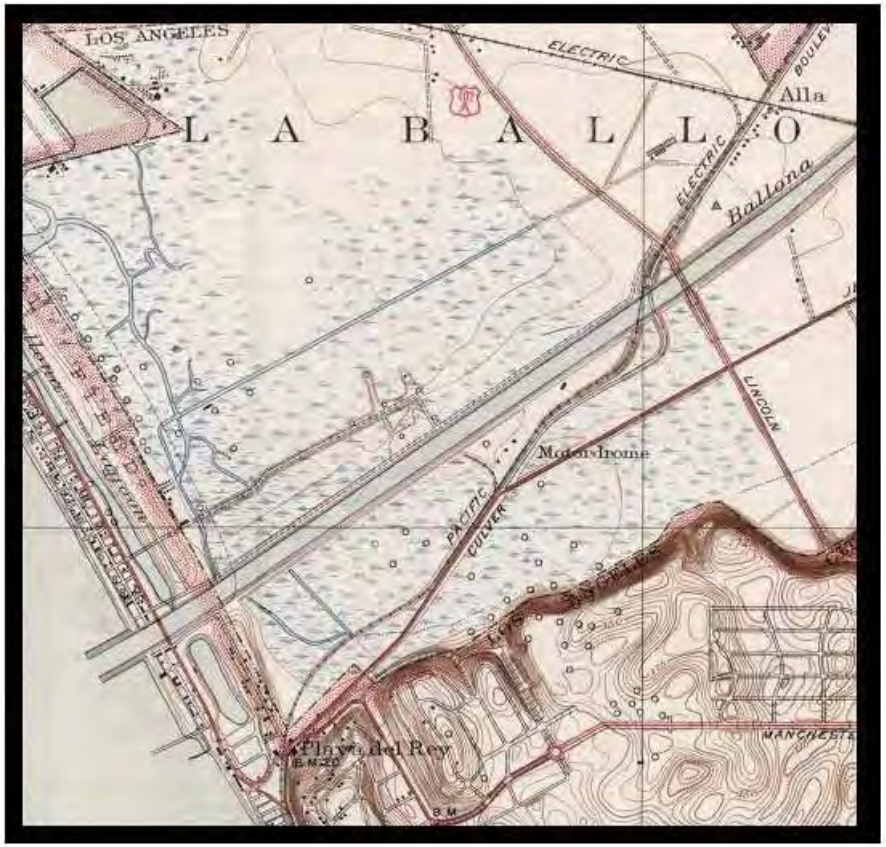
1924 USGS



Historic Topo:	**Venice**
Edition Date:	1924
Scale 1:	24000
County:	Los Angeles .
Longitude:	33°50', 33°55', 34°00'
Latitude:	118°20', 118°25', 118°30'
Township:	T2S SBM, T3S SBM.
Range:	R14W SBM, R15W SBM.
Bodies of Water:	Ballona Lagoon, Santa Monica Bay.
Place Names:	Alla, Culver Garden, Cypress Grove, Del Ray,
Schools:	Playa Del Rey School, Venice High School.
RR/Utilities:	Pacific Electric.
Roadways/Trails:	Coast Boulevard, Collingwood Street, El Segu
Land Grants:	La Ballona, Sausal Redondo.
File name:	HT_834.jpg

USGS TOPO MAPS - 1924

1942 USGS



Historic Topo:	**Venice**
Edition Date:	1934, 1942
Scale 1:	24000
County:	Los Angeles .
Longitude:	33°50', 33°55', 34°00'
Latitude:	118°20', 118°25', 118°30'
Township:	T2S SBM, T3S SBM.
Range:	R14W SBM, R15W SBM.
Bodies of Water:	Ballona Lagoon, Santa Monica Bay.
Place Names:	Alla, Culver City, Culver Garden, Cypress Grove, Del Ray,
Schools:	Playa Del Rey School, Venice High School.
RR/Utilities:	Pacific Electric.
Roadways/Trails:	Coast Boulevard, Collingwood Street, El Segundo Avenue, Boulevard.
Land Grants:	La Ballona, Sausal Redondo.
File name:	HT_835.jpg

USGS TOPO MAPS - 1942

PLATE C-11

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APPENDIX D
SEISMIC HAZARD MAPS AND SEISMIC DESIGN CRITERIA

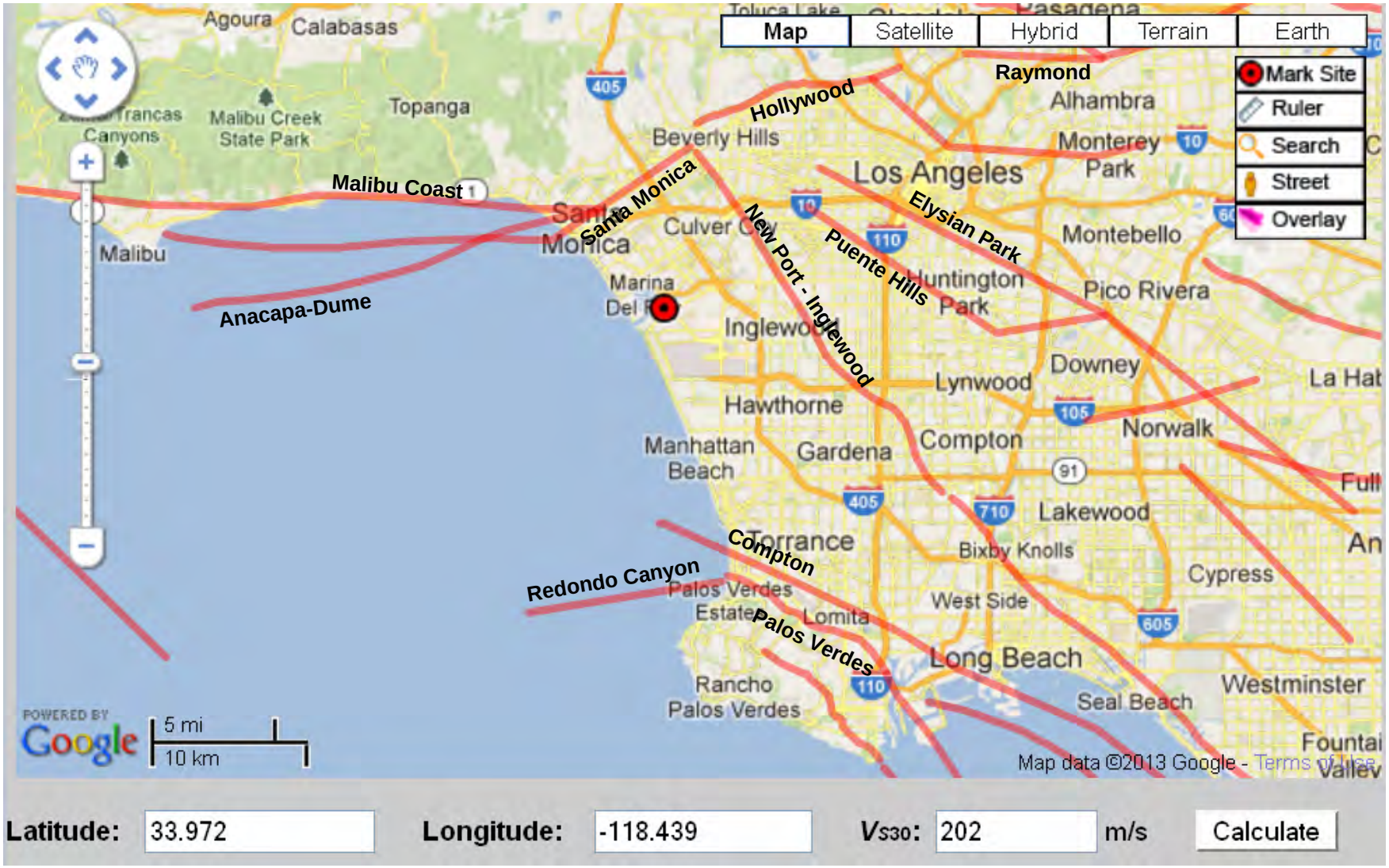
APPENDIX D
SEISMIC HAZARD MAPS / SEISMIC DESIGN CRITERIA

D.1 Contents

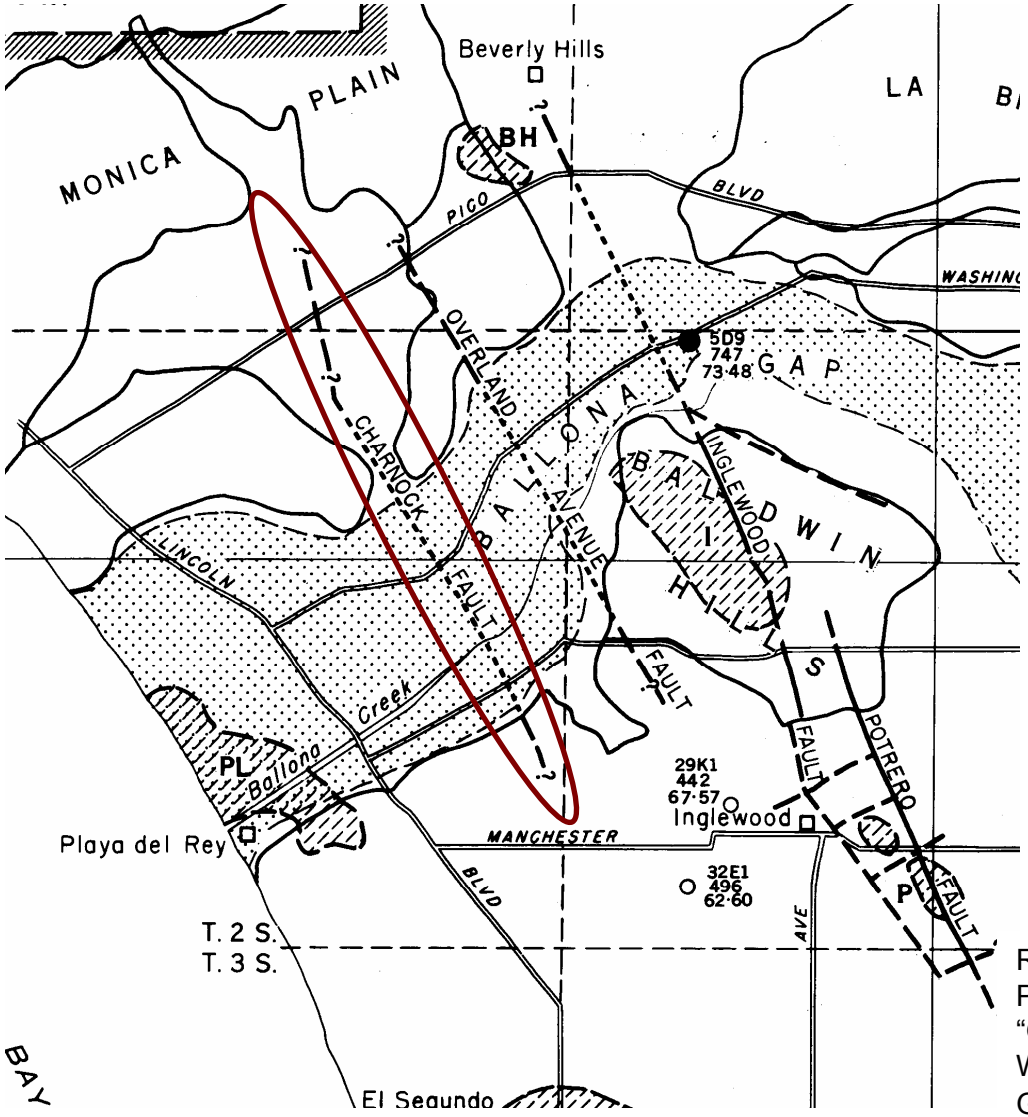
This appendix includes the seismic hazard maps and seismic design criteria adopted for the Ballona Wetlands Restoration Project.

A list of the plates presented in this appendix follows:

Plate D-1	CALTRANS Fault Map
Plate D-2	Mapped Location of Charnock Fault
Plate D-3	Estimation of Epicenter and Local Magnitude at or in the Vicinity of the Site (Past 10 years)
Plate D-4 through D-13	USGS Deaggregation Results at Ballona Wetlands for Return Period of 224 years (Vs = 202 m/s)
Plate D-14 through D-17	Shear Wave Velocity Profiles (Area A, B, West B, and C)
Plate D-18	CGS Historically Highest Ground Water Contour Map
Plate D-19	CGS Liquefaction Hazard Zone Map
Plate D-20	CGS Landslide Hazard Zone Map
Plate D-21	Navigate LA – Fault Rupture Study Zones and Landslide



GROUP DELTA CONSULTANTS	**Caltrans Fault Map**	Project Number LA-962A Date: 2/19/2013
Group Delta Consultants. INC. 370 Amapola Ave. Torrance, Ca 90501	Ballona Creek Wetlands Restoration Project Marina Del Rey, CA	PLATE D-1



EXPLANATION

Area underlain by Gaspur water-bearing zone or "50-foot gravel"

Fault, long dashes where approximately located, short dashes where concealed

Approximate location of ground-water barrier not related to known faults

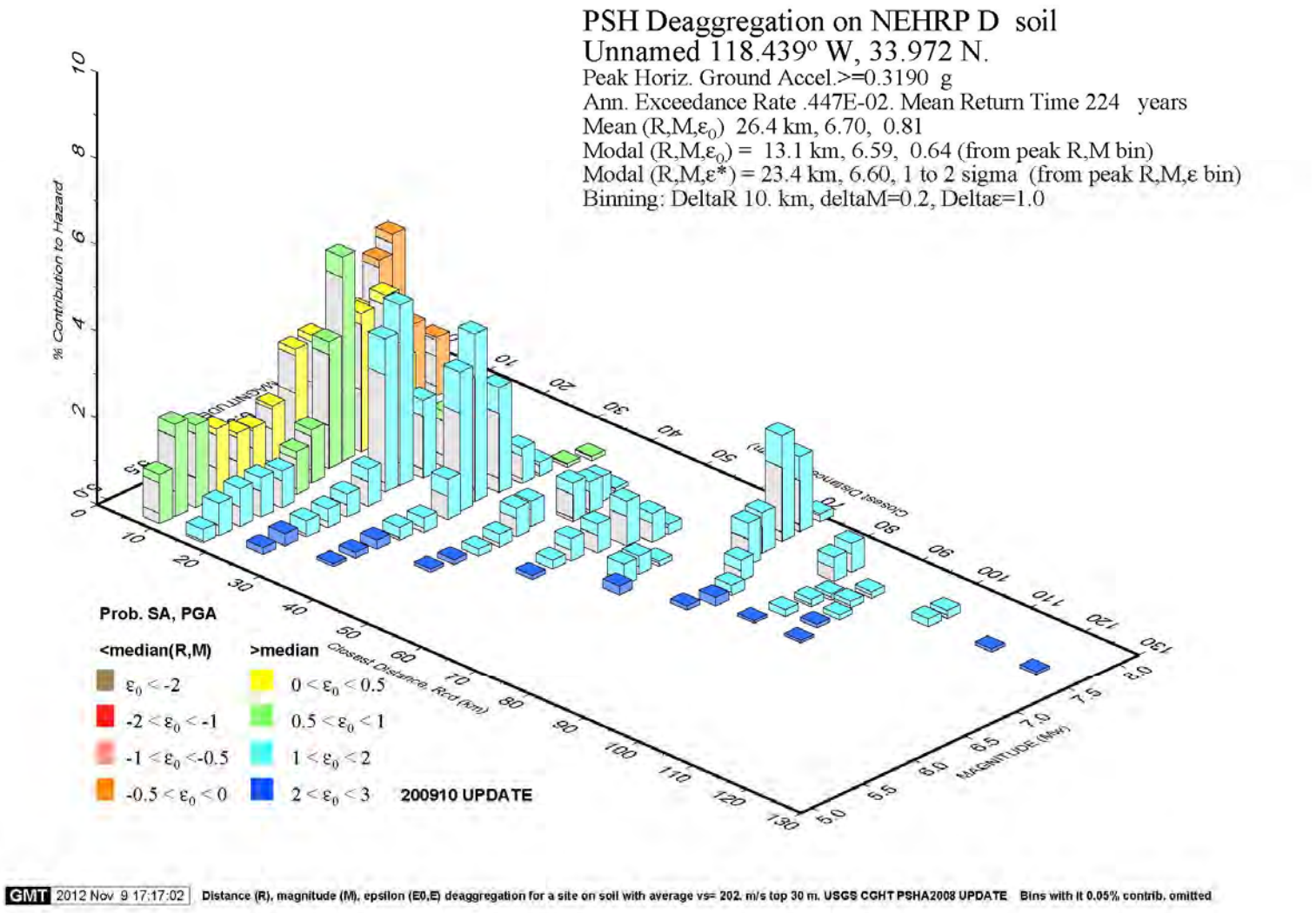
Reference:
Poland et al., 1959
"Geology, Hydrology, and Chemical Character of Ground Waters in the Torrance – Santa Monica Area, California Geologic Survey Water - Supply Paper 146"

GROUP DELTA CONSULTANTS	**Map showing Charnock Fault**	**Project Number LA-962A** **Date: 3/11//2013**
Group Delta Consultants. INC. 370 Amapola Ave. Torrance, Ca 90501	Ballona Creek Wetlands Restoration Project Marina Del Rey, CA	**PLATE D-2**



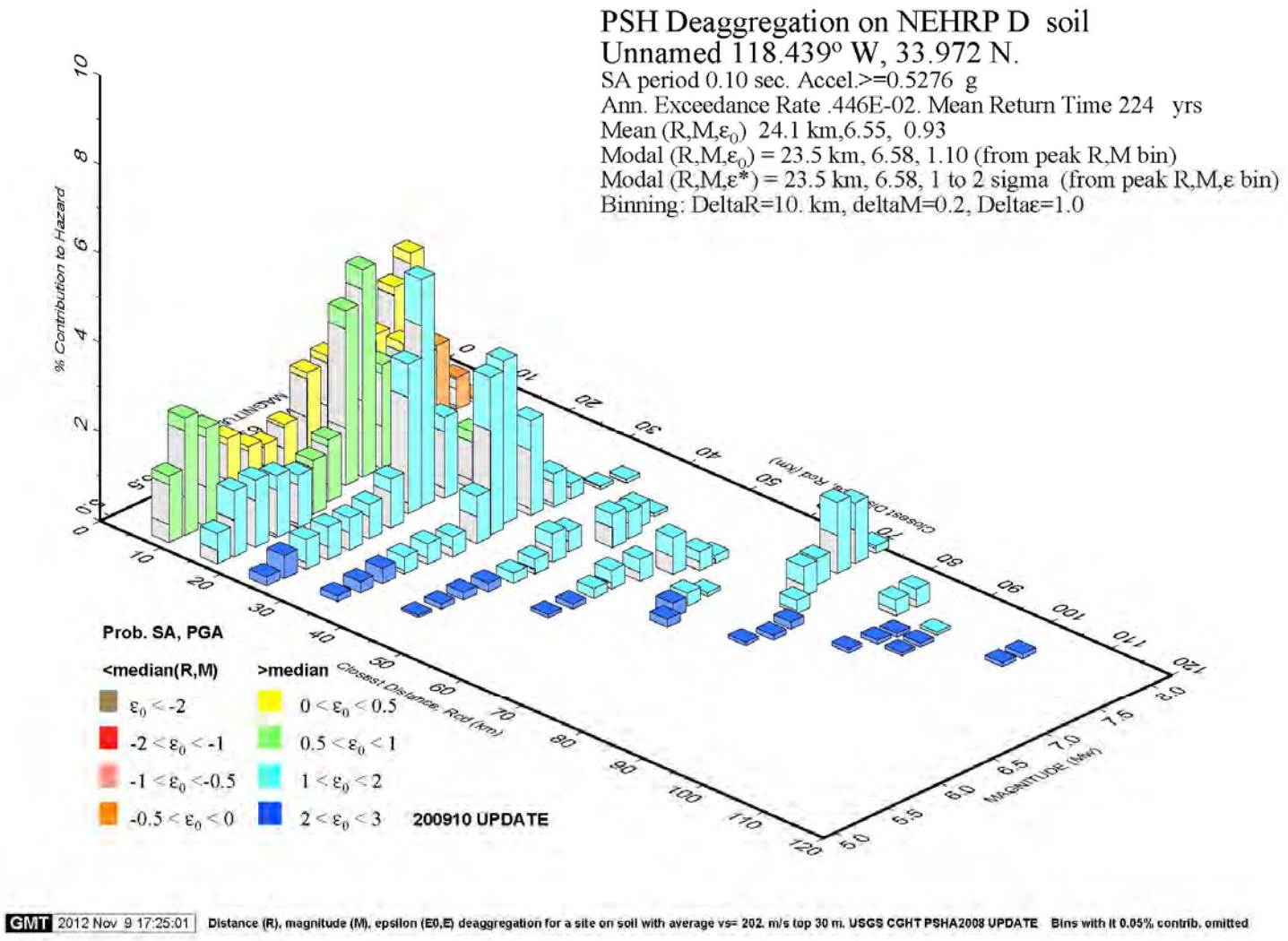
Estimation of Epicenter and Local Magnitude at or in the Vicinity of the Site (Past 10 years)

PLATE D-3



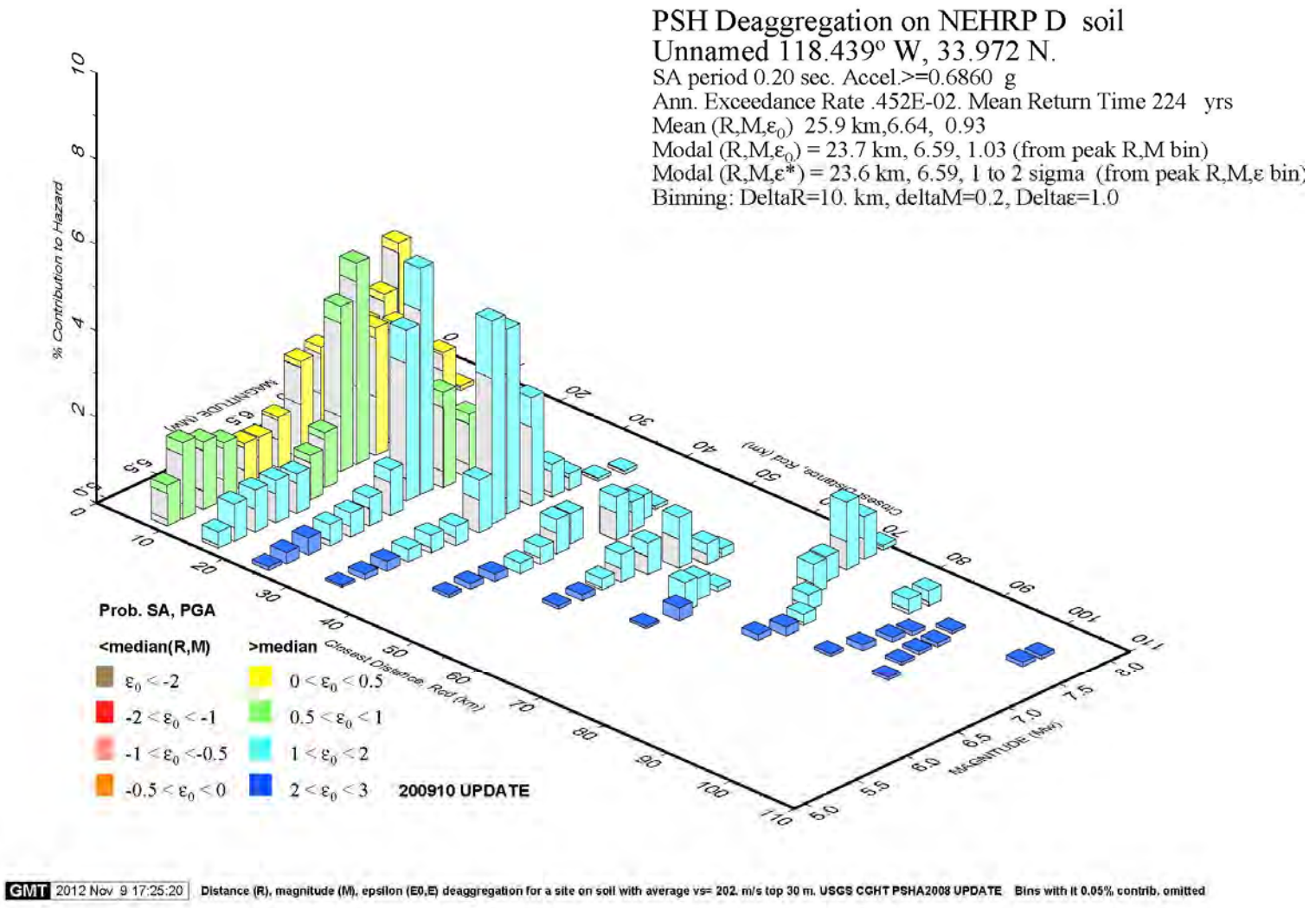
USGS Deaggregation at Ballona Wetlands for a Return Period of 224 years (Vs30 = 202 m/s)
At PGA

PLATE D-4



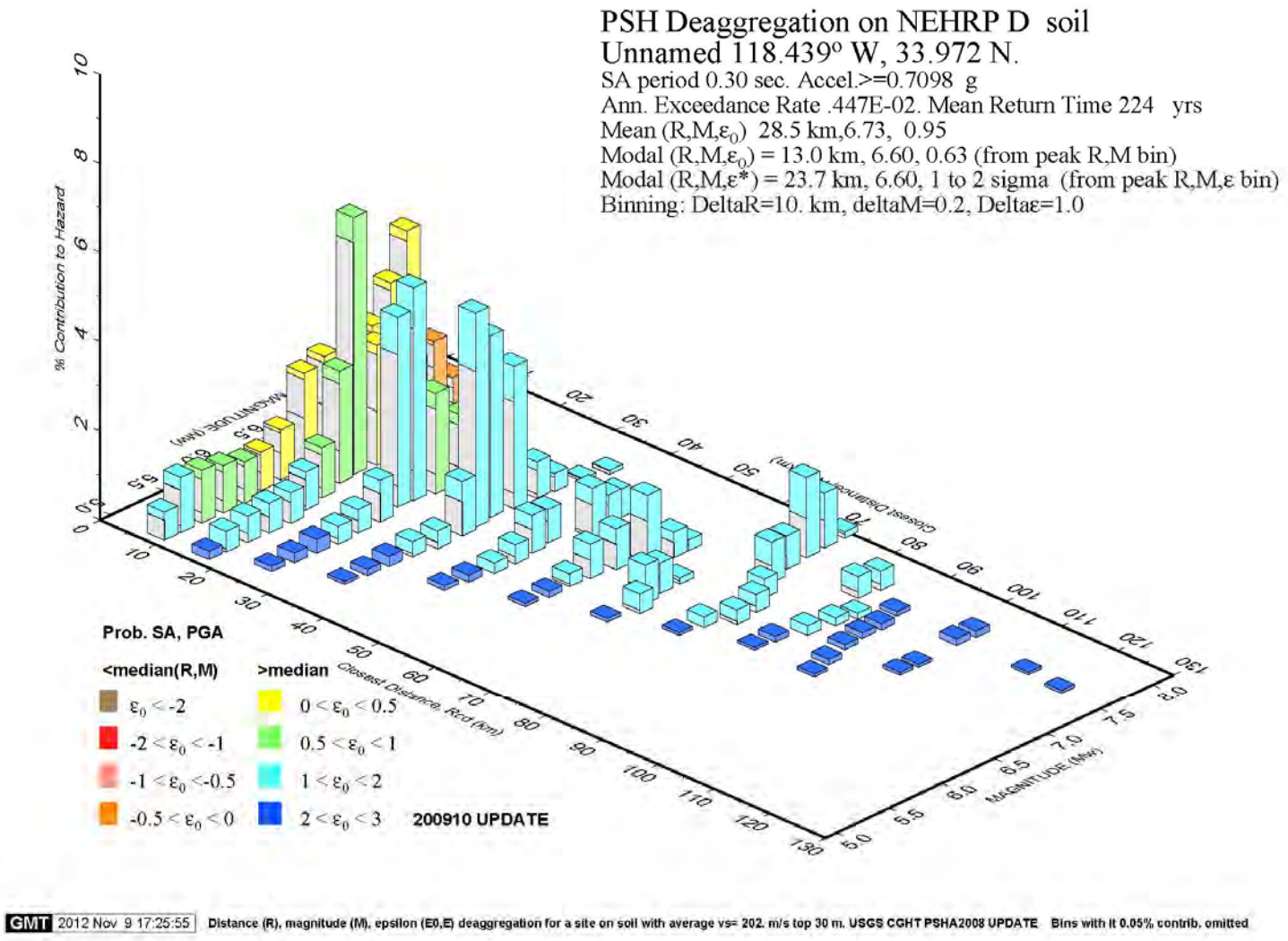
USGS Deaggregation at Ballona Wetlands for a Return Period of 224 years (Vs30 = 202 m/s)
At T=0.1 second

PLATE D-5



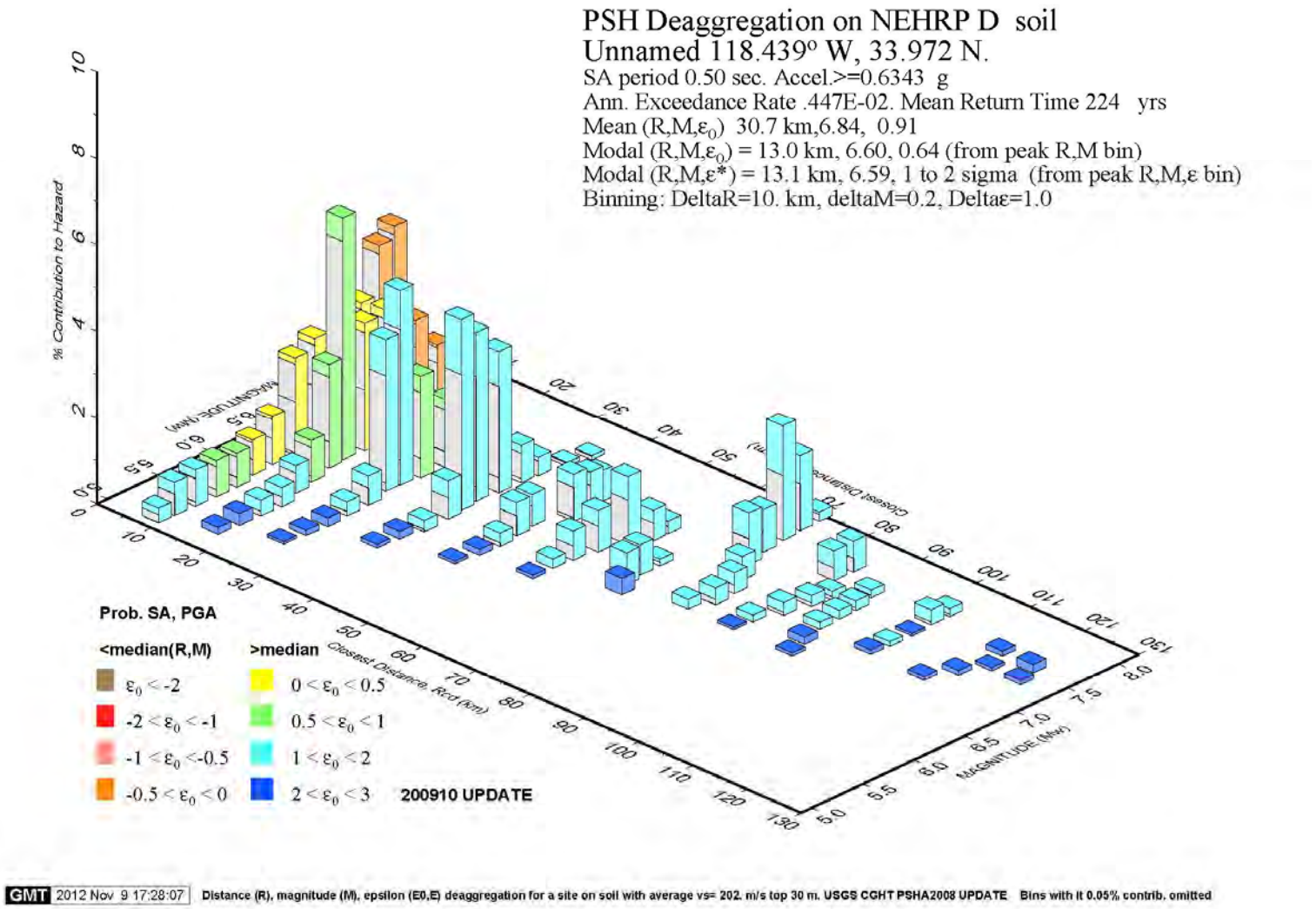
USGS Deaggregation at Ballona Wetlands for a Return Period of 224 years (Vs30 = 202 m/s)
At T=0.2 second

PLATE D-6



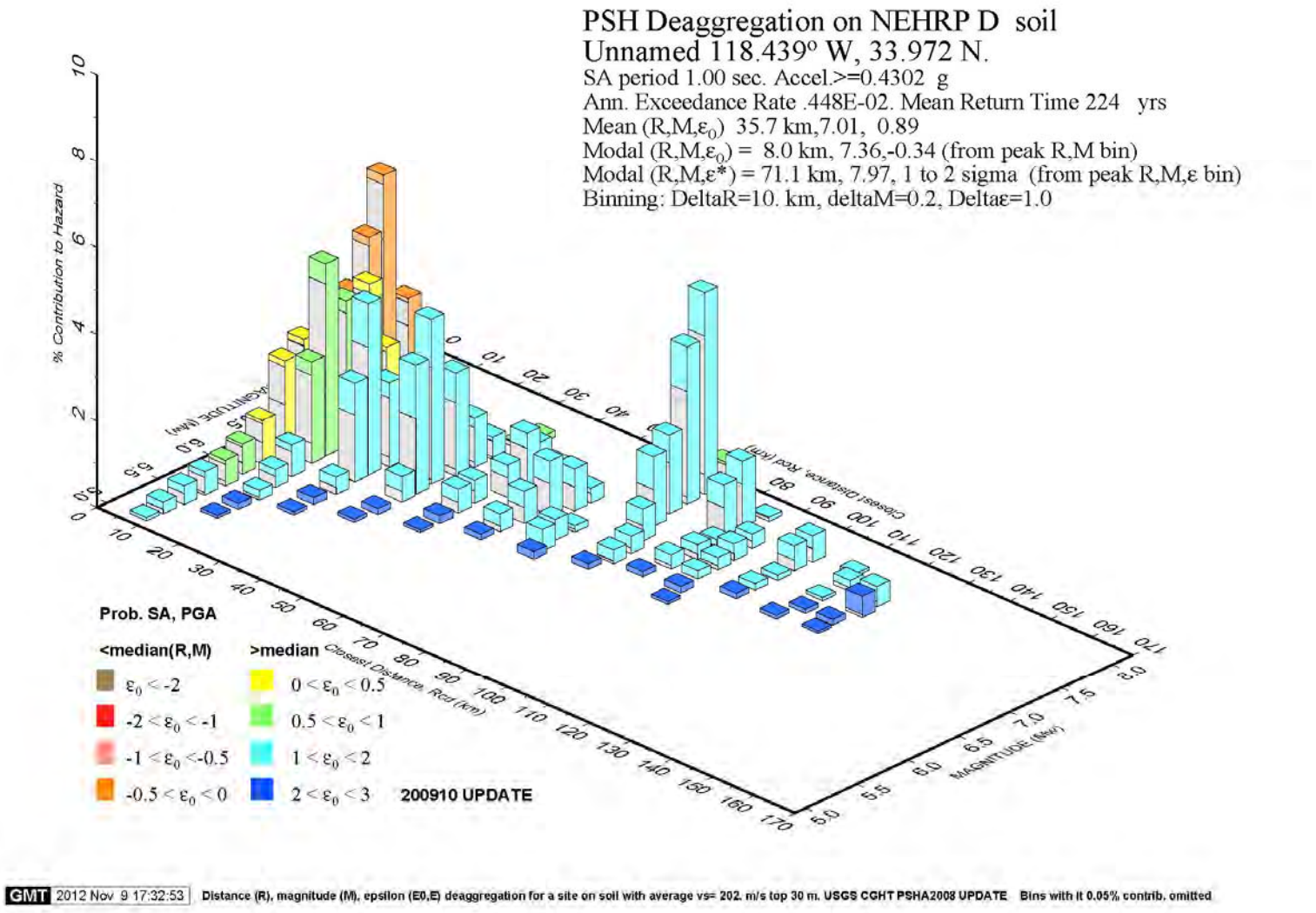
USGS Deaggregation at Ballona Wetlands for a Return Period of 224 years (Vs30 = 202 m/s)
At T=0.3 second

PLATE D-7



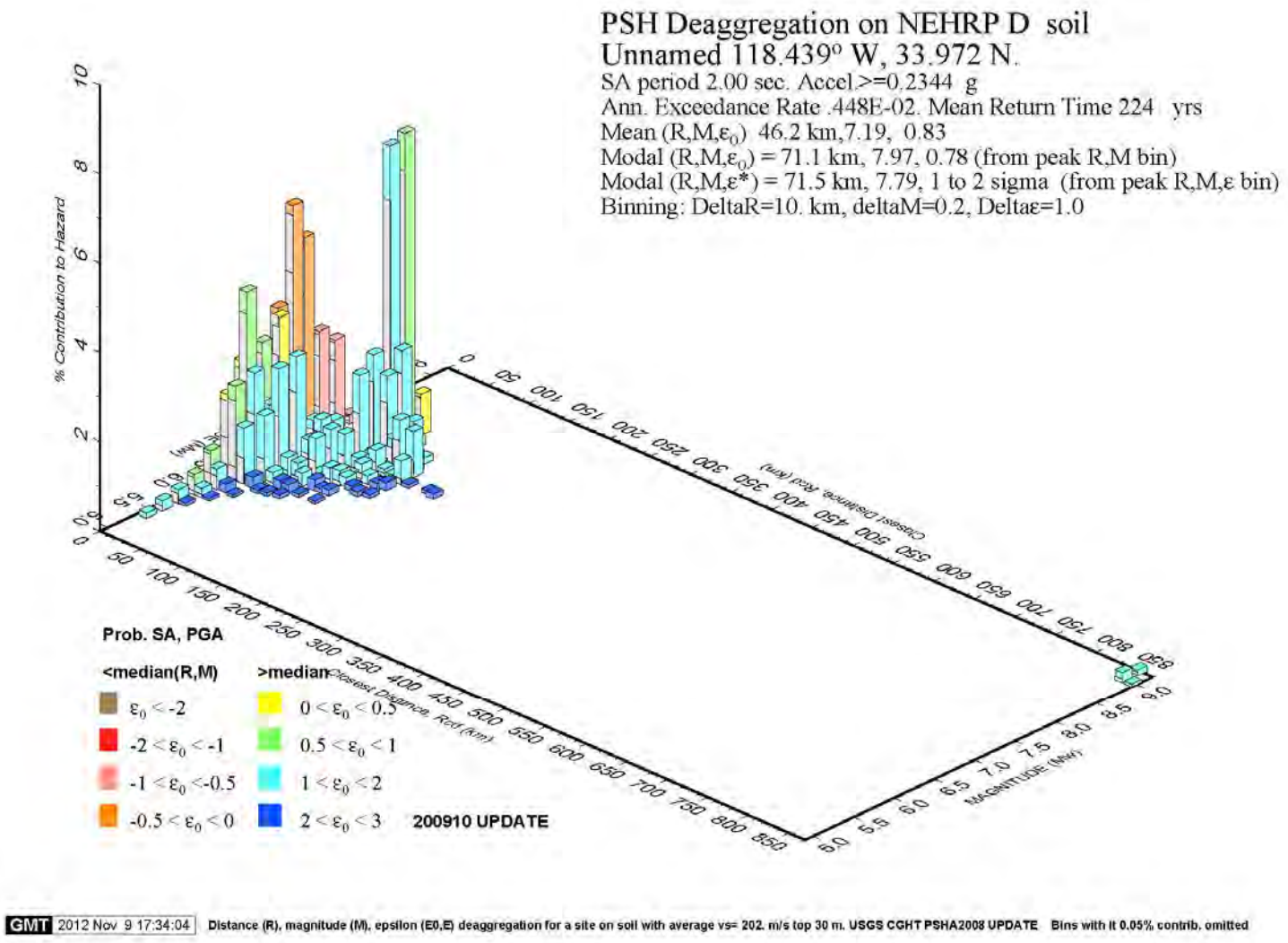
USGS Deaggregation at Ballona Wetlands for a Return Period of 224 years (Vs30 = 202 m/s)
At T=0.5 second

PLATE D-8



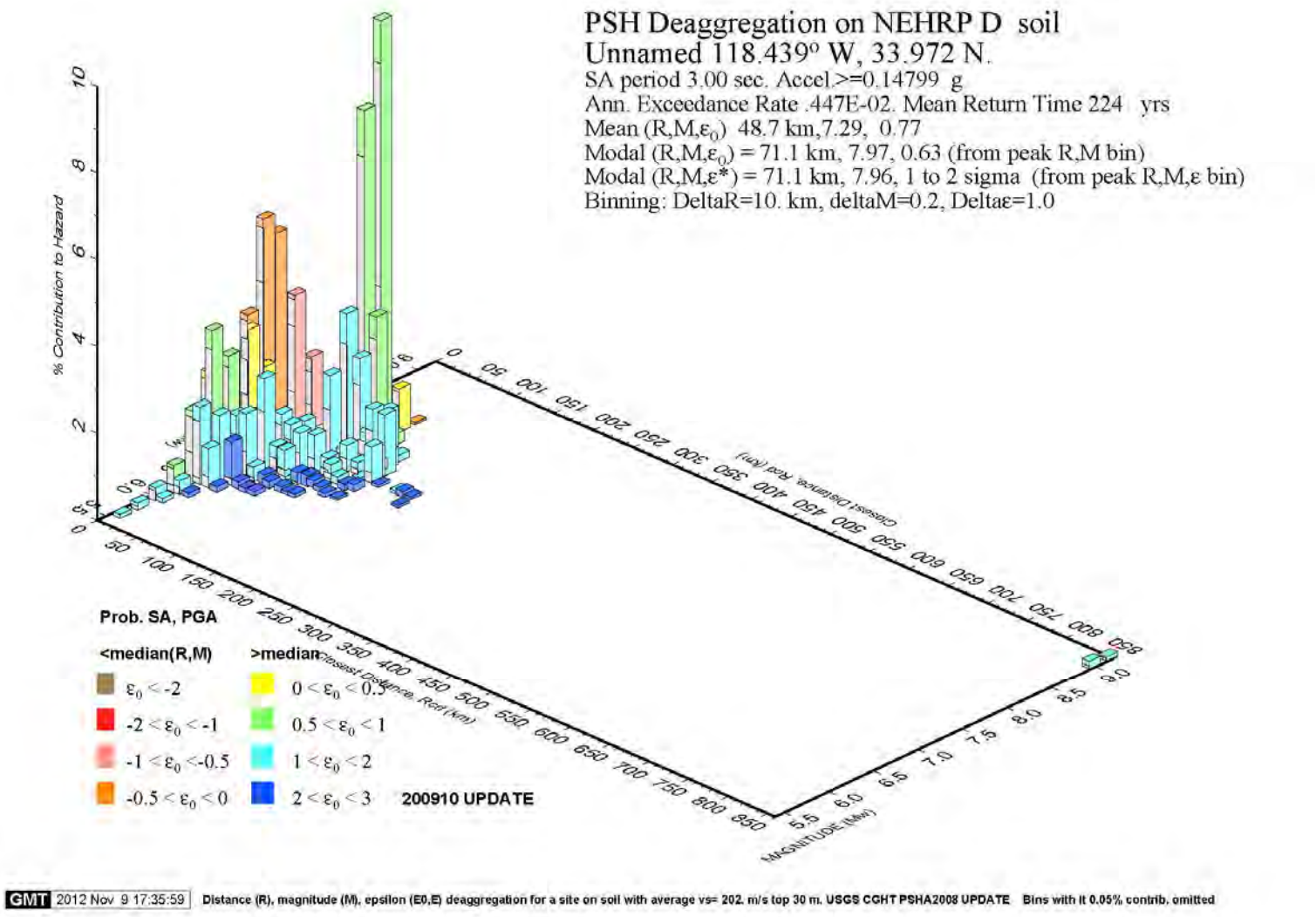
USGS Deaggregation at Ballona Wetlands for a Return Period of 224 years (Vs30 = 202 m/s)
At T=1.0 second

PLATE D-9



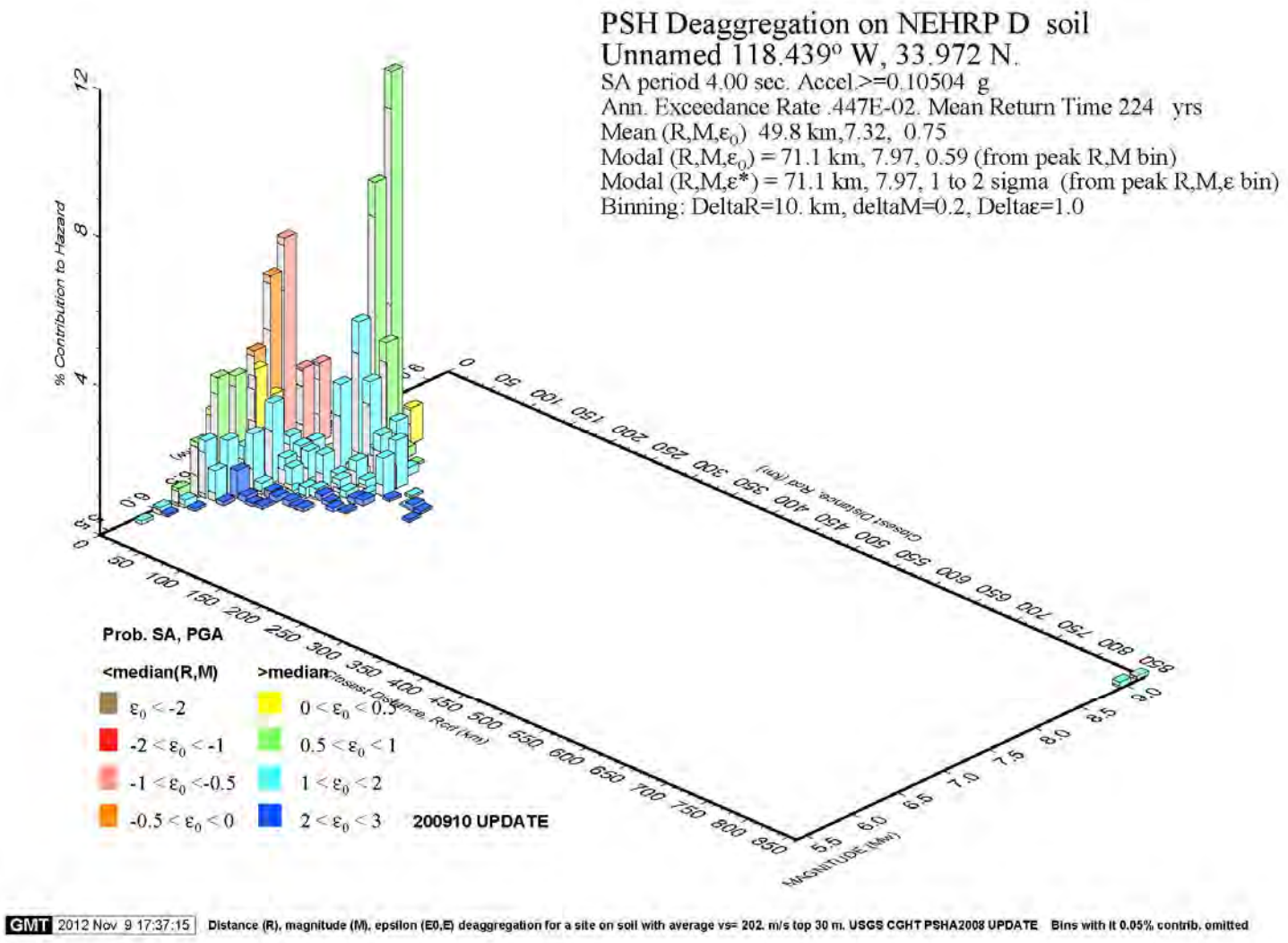
USGS Deaggregation at Ballona Wetlands for a Return Period of 224 years (Vs30 = 202 m/s)
At T=2.0 second

PLATE D-10



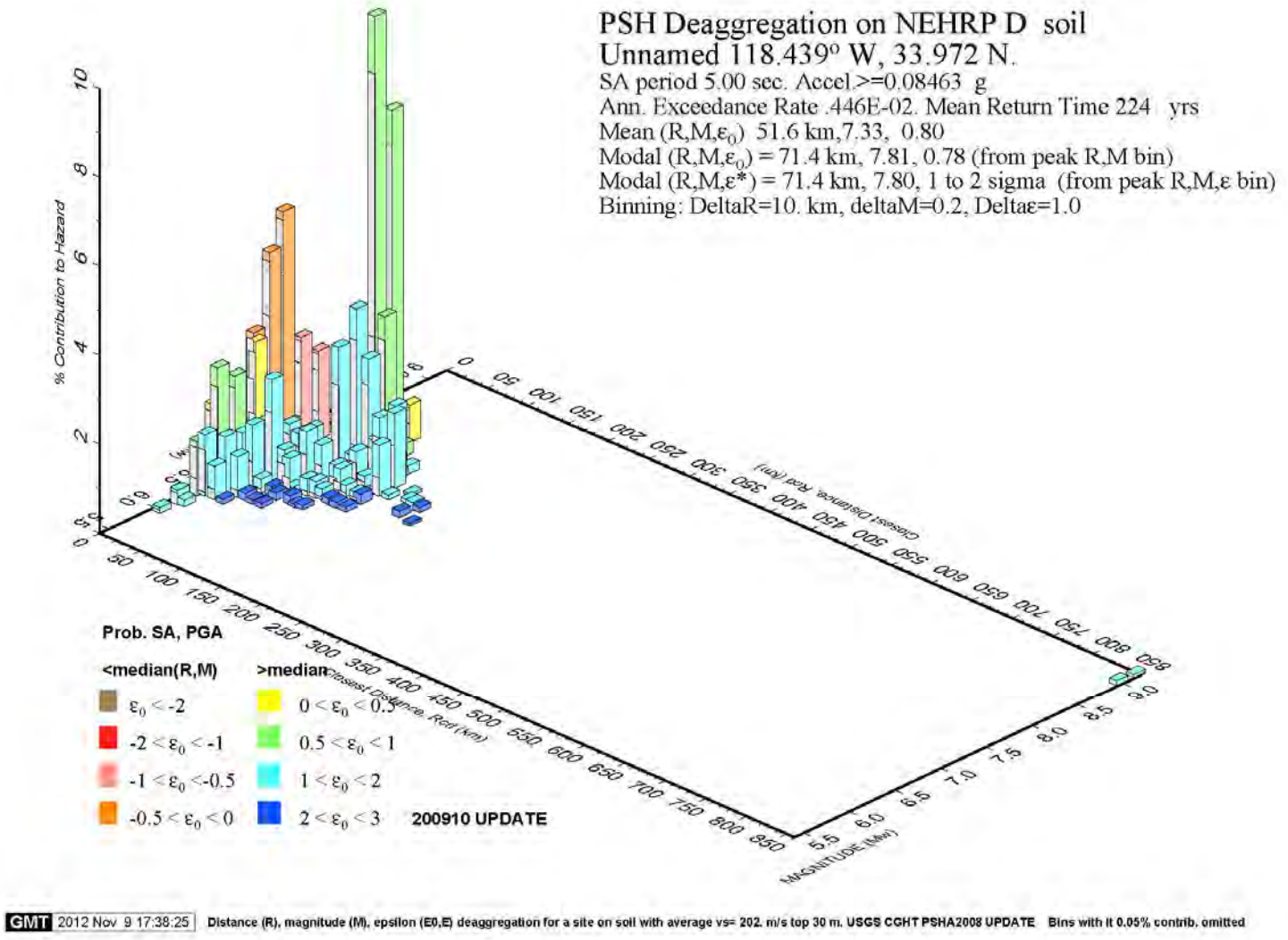
USGS Deaggregation at Ballona Wetlands for a Return Period of 224 years (Vs30 = 202 m/s)
At T=3.0 second

PLATE D-11



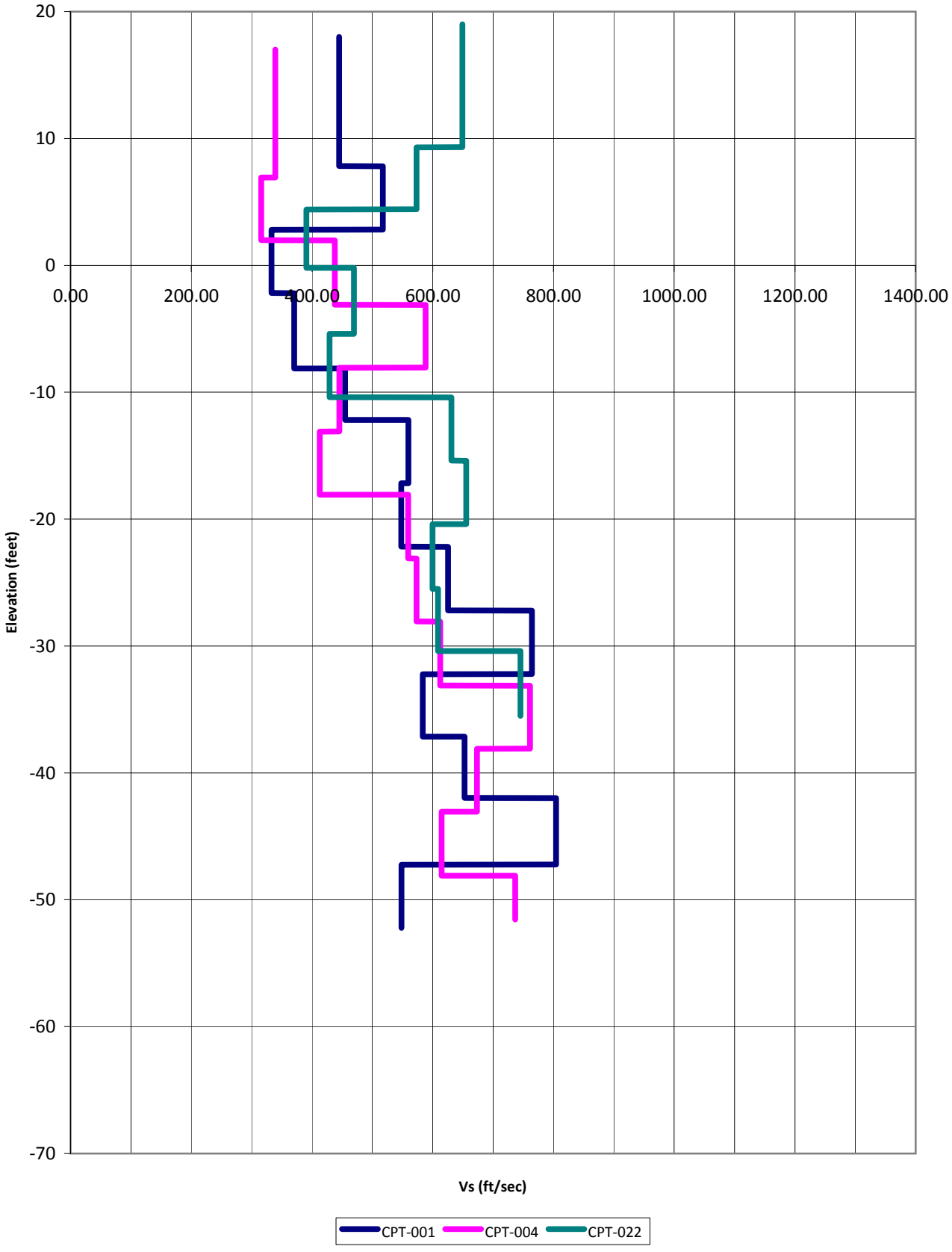
USGS Deaggregation at Ballona Wetlands for a Return Period of 224 years (Vs30 = 202 m/s)
At T=4.0 second

PLATE D-12



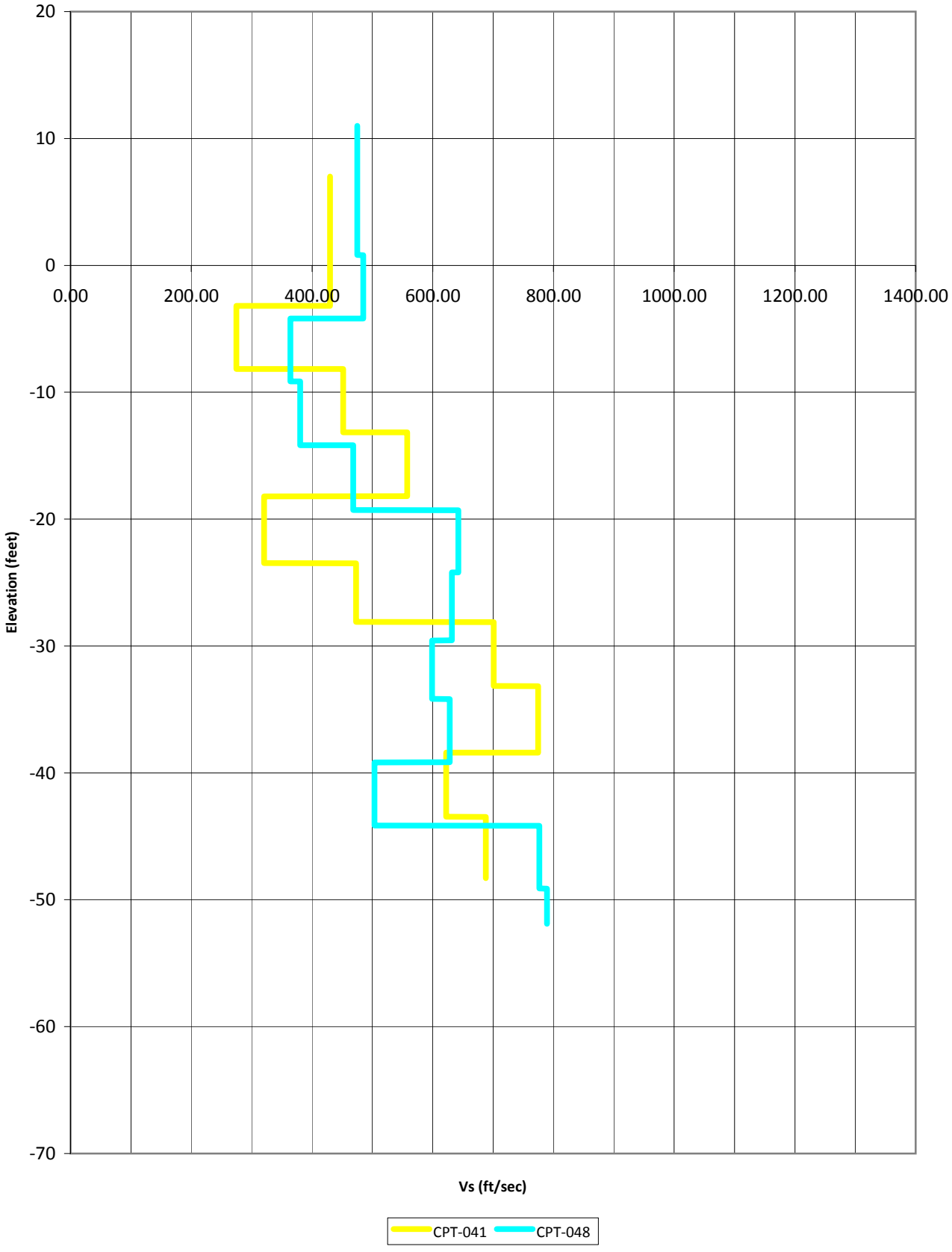
USGS Deaggregation at Ballona Wetlands for a Return Period of 224 years (Vs30 = 202 m/s)
At T=5.0 second

PLATE D-13



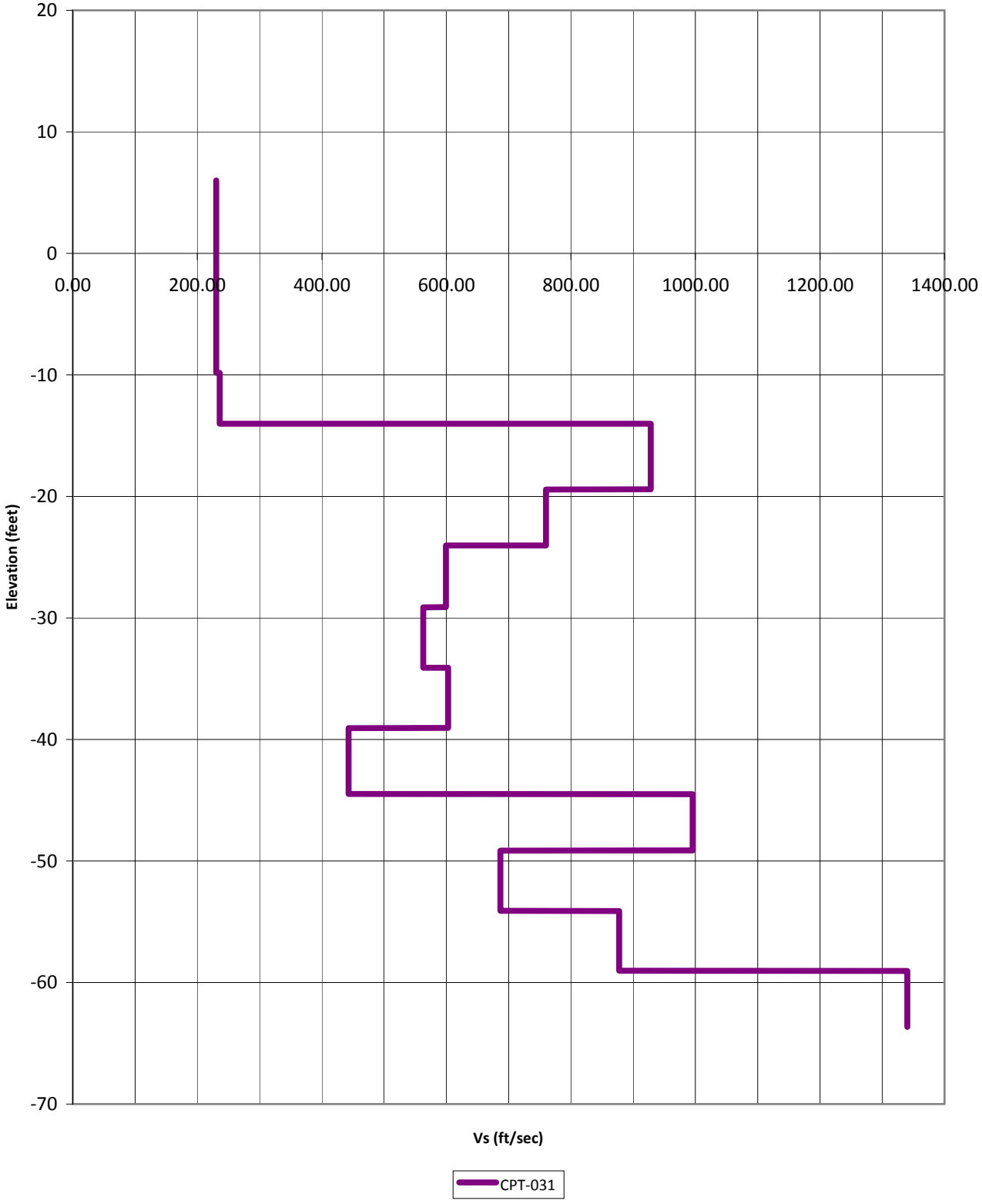
Shear Wave Velocity Profile
Area A

PLATE D-14



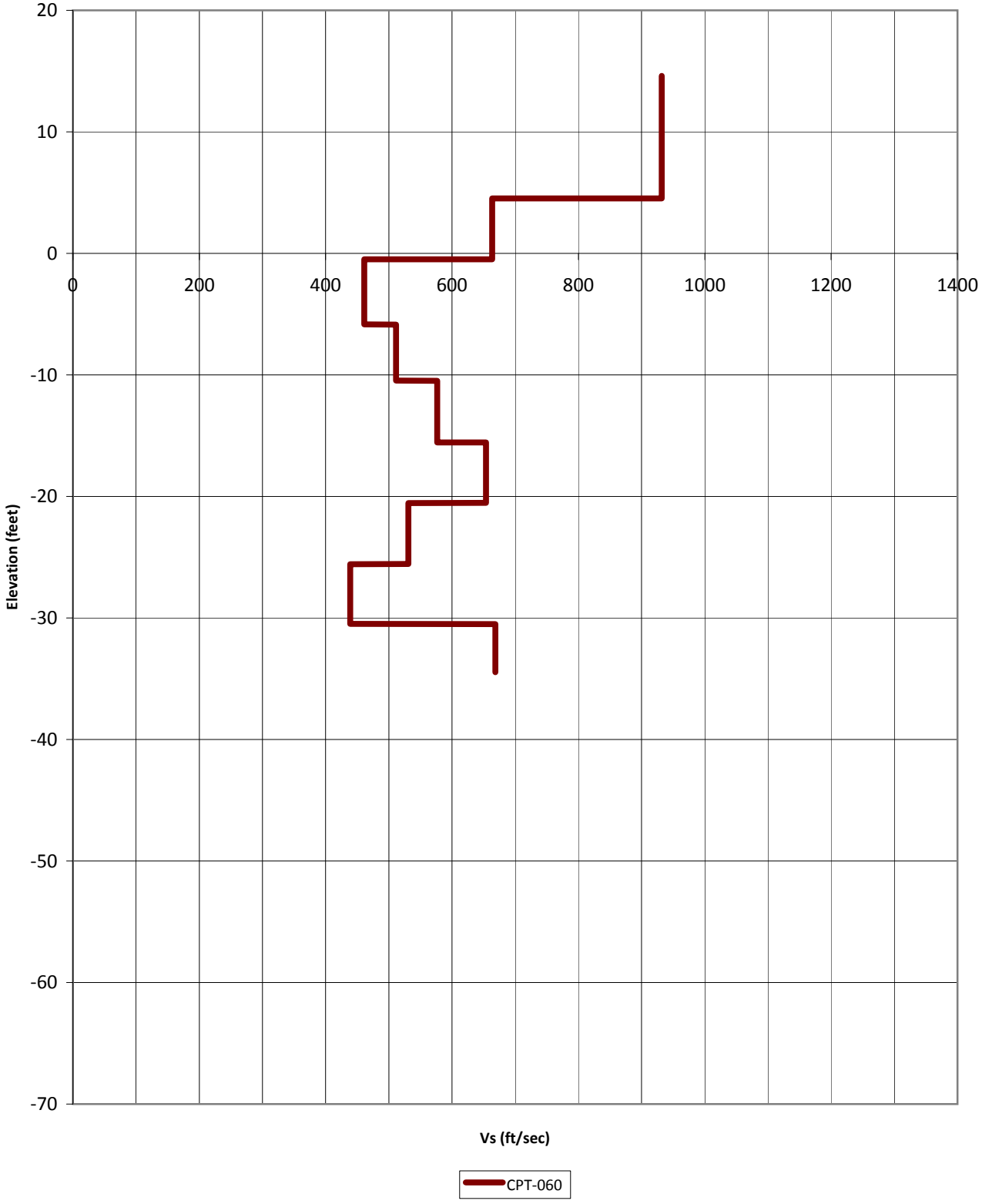
Shear Wave Velocity Profile
Area B

PLATE D-15



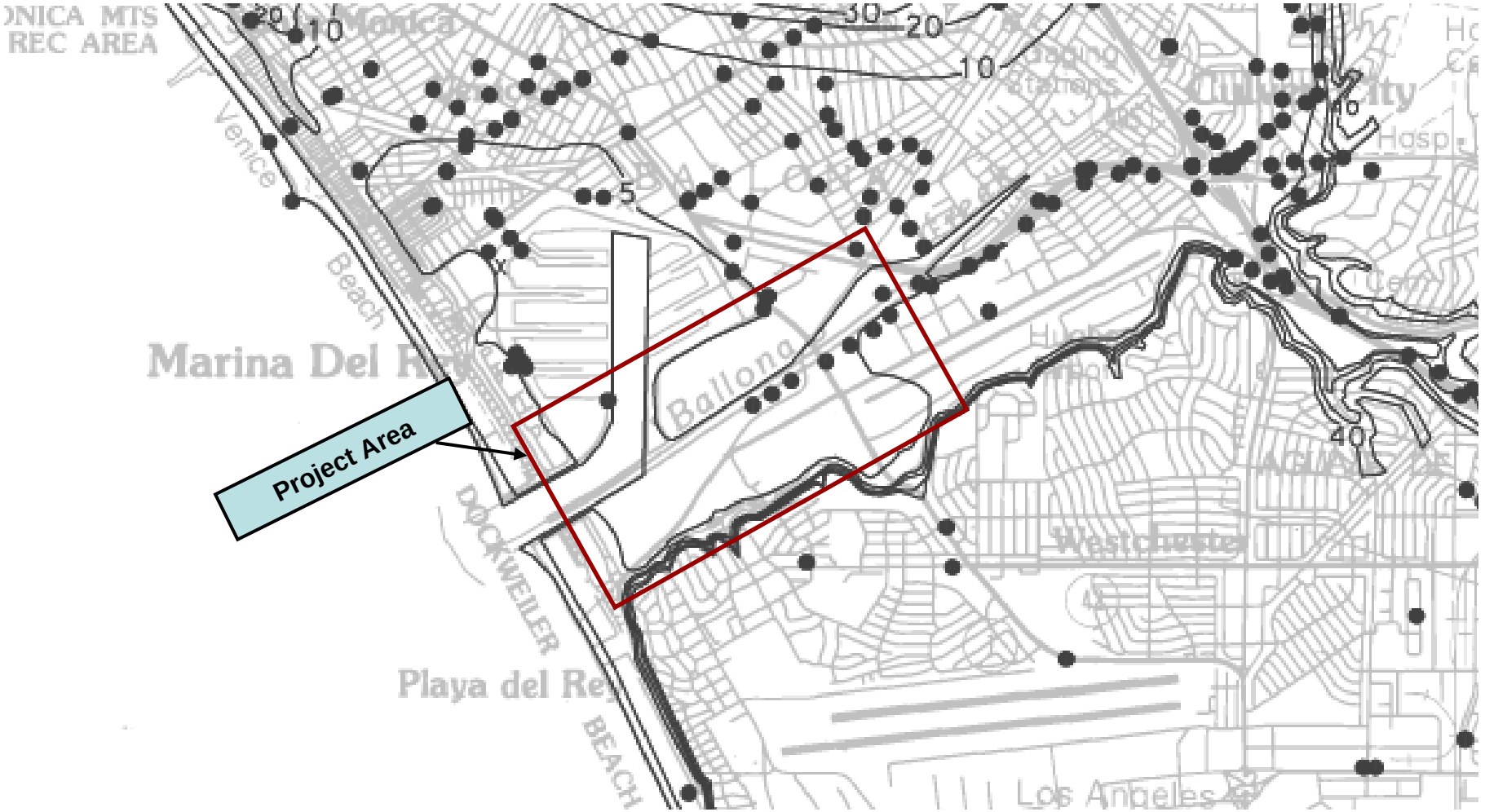
Shear Wave Velocity Profile
West Area B

PLATE D-16

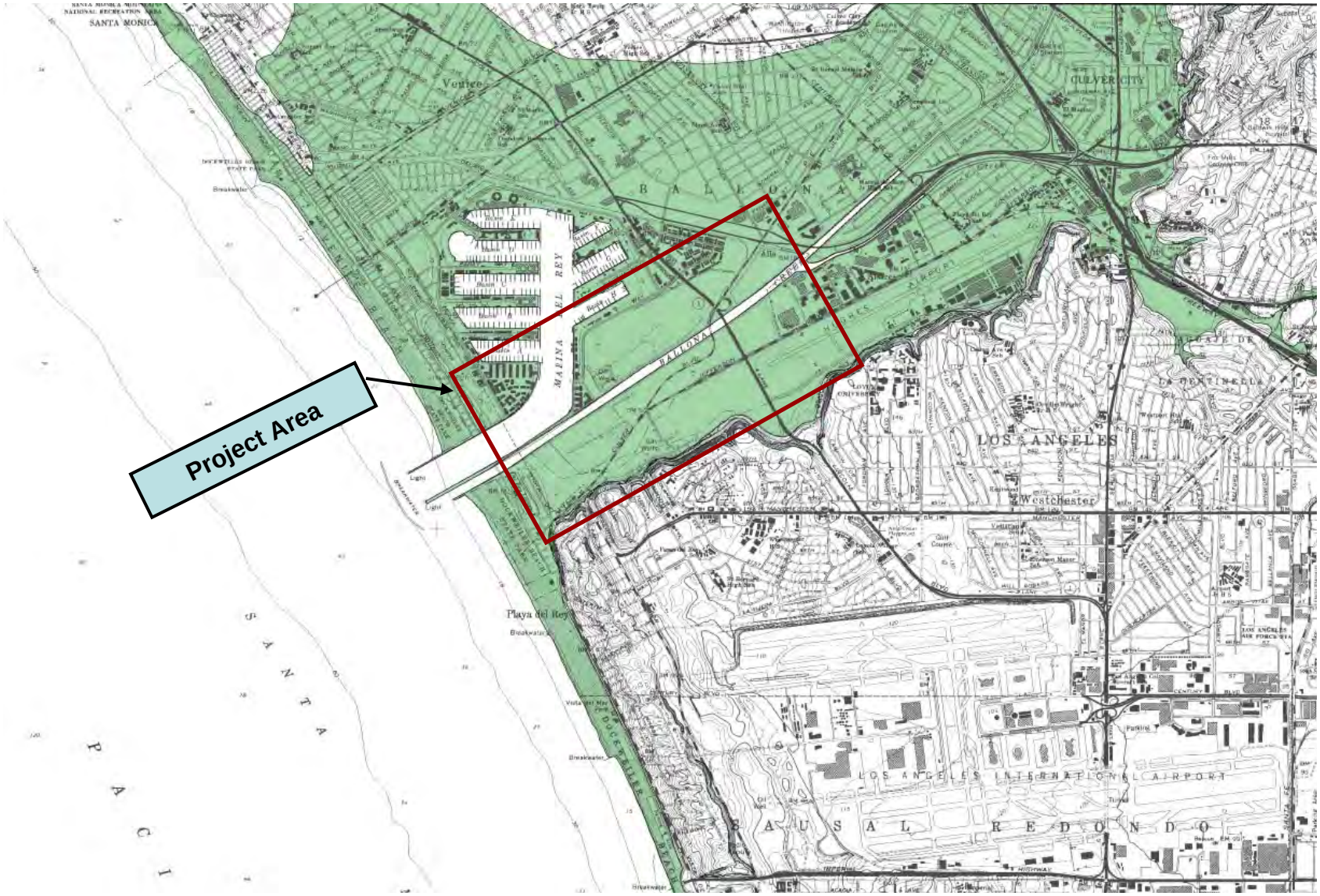


Shear Wave Velocity Profile
Area C

PLATE D-17



GROUP DELTA CONSULTANTS	**CGS Historically Highest Ground Water Contour Map**	Project Number LA-962A Date: 11/9/2012
Group Delta Consultants. INC. 370 Amapola Ave. Torrance, Ca 90501	Ballona Creek Wetlands Restoration Project Marina Del Rey, CA	PLATE D-18



GROUP DELTA CONSULTANTS

CGS Liquefaction Hazard Zone Map

Project Number LA-962A

Date: 11/9/2012

Group Delta Consultants. INC.
370 Amapola Ave.
Torrance, Ca 90501

Ballona Creek Wetlands Restoration Project
Marina Del Rey, CA

PLATE D-19



Plate 2.1 Landslide inventory, Shear Test Sample Locations, Venice Quadrangle.

shear test sample location landslide

GROUP DELTA CONSULTANTS

CGS Landslide Hazard Zone Map

Project Number LA-962A

Date: 11/9/2012

Group Delta Consultants. INC.
370 Amapola Ave.
Torrance, Ca 90501

Ballona Creek Wetlands Restoration Project
Marina Del Rey, CA

PLATE D-20

NavigateLA



GROUP DELTA CONSULTANTS	**Navigate LA – Faults Rupture Study Zones and Landslides**	Project Number LA-962A Date: 11/9/2012
Group Delta Consultants. INC. 370 Amapola Ave. Torrance, Ca 90501	Ballona Creek Wetlands Restoration Project Marina Del Rey, CA	PLATE D-21

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APPENDIX E
LIQUEFACTION SETTLMENT AND LATERAL SPREADING

APPENDIX E
LIQUEFACTION SETTLEMENT AND LATERAL SPREADING

E.1 Contents

This appendix includes the results estimates of post liquefaction settlements within the site and lateral spreading displacements of the new levees.

Post liquefaction settlements were performed using the Youd et al. (2001) method for estimation of post liquefaction settlements using the results of the CPTs within the area. The analyses assume design earthquake parameters for a 224 year return period, and a design groundwater at El. +10 feet NAVD.

Lateral spreading displacements were estimated using Youd et al. (2002) method based on distances of about 300 and 1000 feet from the meander channel, as would be applicable for the new levees.

A list of the plates presented in this appendix follows:

Plate E-1 through E-29 Post-liquefaction Settlements based on CPTs
Plate E-30 and E-32 Range of Lateral Spreading Displacements for New Levees

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT001

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	17.80 ft
GWT Elev. During Test	0.30 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$

+++ $FS = (CRR_{7.5}/CSR)\ MSF\ K_\sigma\ K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	17.50 ft below ground surface
GWT Depth For Design, Zwd =	7.80 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	13.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	1.15 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	1.15 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_l (in.)	Cumulative Settlement Profile (in.)
0.50	188.17	1.56	0.83	sand	16.8	1.66	62	60	60	60	0.95	1.00	1,798.77	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	105.9	0.007	0.000	0.00	1.15
1.50	26.63	0.92	3.47	clayey silt to silty clay	15.8	1.00	13	180	180	180	2.33	2.04	181.14	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.15
2.50	14.13	0.41	2.86	clayey silt to silty clay	14.8	1.00	7	300	300	300	2.54	3.00	109.37	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.15
3.50	14.38	0.42	2.90	clayey silt to silty clay	13.8	1.00	7	420	420	420	2.60	3.31	104.00	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.15
4.50	14.98	0.45	2.99	clayey silt to silty clay	12.8	1.00	7	540	540	540	2.53	2.91	116.59	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.15
5.50	12.13	0.32	2.64	clayey silt to silty clay	11.8	1.00	6	660	660	660	2.61	N/A	N/A	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.15
6.50	11.68	0.24	2.05	clayey silt to silty clay	10.8	1.00	6	780	780	780	2.61	N/A	N/A	0.985	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.15
7.50	9.53	0.24	2.49	silty clay to clay	9.8	1.00	6	900	900	900	2.77	N/A	N/A	0.983	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.15
8.50	16.22	0.24	1.45	sandy silt to clayey silt	8.8	1.00	6	1,020	976	1,020	2.52	2.90	67.23	0.980	1.000	0.213	0.108	0.678	YES	2.8	11.9	428	15.9	N/A	0.181	0.02	1.13
9.50	16.05	0.16	1.02	sandy silt to clayey silt	7.8	1.00	6	1,140	1,034	1,140	2.46	2.57	57.29	0.978	1.000	0.224	0.097	0.580	YES	2.8	11.3	389	15.2	N/A	0.457	0.05	1.07
10.50	11.43	0.23	2.03	clayey silt to silty clay	6.8	1.00	6	1,260	1,092	1,260	2.70	N/A	N/A	0.976	N/A	0.234	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
11.50	7.85	0.21	2.72	silty clay to clay	5.8	1.00	5	1,380	1,149	1,380	2.93	N/A	N/A	0.973	N/A	0.243	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
12.50	8.32	0.16	1.93	clayey silt to silty clay	4.8	1.00	4	1,500	1,207	1,500	2.84	N/A	N/A	0.971	N/A	0.251	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
13.50	8.00	0.18	2.22	silty clay to clay	3.8	1.00	5	1,620	1,264	1,620	2.91	N/A	N/A	0.969	N/A	0.258	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
14.50	20.03	0.56	2.79	clayey silt to silty clay	2.8	1.66	17	1,740	1,322	1,740	2.36	2.17	88.36	0.966	1.000	0.265	0.144	0.727	YES	2.8	20.6	1,200	N/A	N/A	0.000	0.00	1.07
15.50	7.27	0.25	3.49	clay	1.8	1.00	7	1,860	1,380	1,860	3.08	N/A	N/A	0.964	N/A	0.270	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
16.50	6.73	0.19	2.86	clay	0.8	1.00	7	1,980	1,437	1,980	3.08	N/A	N/A	0.962	N/A	0.276	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
17.50	5.28	0.13	2.54	clay	-0.2	1.00	5	2,100	1,495	2,100	3.16	N/A	N/A	0.959	N/A	0.280	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
18.50	4.67	0.08	1.75	sensitive fine grained	-1.2	1.00	2	2,220	1,552	2,158	3.14	N/A	N/A	0.957	N/A	0.285	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
19.50	5.08	0.03	0.50	sensitive fine grained	-2.2	1.00	3	2,340	1,610	2,215	2.88	5.52	33.03	0.955	N/A	0.289	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
20.50	10.00	0.07	0.66	sandy silt to clayey silt	-3.2	1.00	4	2,460	1,668	2,273	2.65	3.64	41.68	0.952	N/A	0.292	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
21.50	5.32	0.04	0.78	sensitive fine grained	-4.2	1.00	3	2,580	1,725	2,330	2.97	N/A	N/A	0.950	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
22.50	5.40	0.04	0.80	sensitive fine grained	-5.2	1.00	3	2,700	1,783	2,388	2.97	N/A	N/A	0.948	N/A	0.298	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
23.50	5.22	0.02	0.38	sensitive fine grained	-6.2	1.00	3	2,820	1,840	2,446	2.88	5.54	30.74	0.945	N/A	0.301	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
24.50	7.50	0.06	0.75	sensitive fine grained	-7.2	1.00	4	2,940	1,898	2,503	2.84	5.15	40.17	0.943	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
25.50	6.18	0.04	0.69	sensitive fine grained	-8.2	1.00	3	3,060	1,956	2,561	2.92	5.92	37.26	0.941	N/A	0.306	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
26.50	7.02	0.10	1.39	clayey silt to silty clay	-9.2	1.00	4	3,180	2,013	2,618	3.01	N/A	N/A	0.938	N/A	0.308	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
27.50	11.82	0.10	0.84	sandy silt to clayey silt	-10.2	1.00	5	3,300	2,071	2,676	2.70	3.97	45.75	0.936	N/A	0.310	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
28.50	23.13	0.11	0.47	silty sand to sandy silt	-11.2	1.00	8	3,420	2,128	2,734	2.31	2.00	44.77	0.934	0.988	0.312	0.087	0.369	YES	2.8	9.4	280	12.9	N/A	2.145	0.26	0.82
29.50	44.48	0.48	1.07	silty sand to sandy silt	-12.2	1.00	15	3,540	2,186	2,791	2.23	1.76	74.69	0.931	0.977	0.314	0.119	0.493	YES	2.8	15.4	712	20.1	N/A	1.114	0.13	0.68
30.50	89.57	1.30	1.45	silty sand to sandy silt	-13.2	1.00	30	3,660	2,244	2,849	2.08	1.41	119.58	0.926	0.958	0.314	0.239	0.972	YES	2.8	27.8	1,200	35.0	N/A	0.033	0.00	0.68
31.50	130.97	2.44	1.86	silty sand to sandy silt	-14.2	1.66	72	3,780	2,301	2,906	1.73	1.06	213.46	0.918	0.945	0.314	N/A	N/A	NO	N/A	N/A	N/A	77.0	N/A	0.000	0.00	0.68
32.50	19.67	0.63	3.21	clayey silt to silty clay	-15.2	1.66	16	3,900	2,359	2,964	2.53	2.93	84.19	0.909	0.956	0.313	0.135	0.552	YES	2.8	16.2	791	N/A	N/A	0.000	0.00	0.68
33.50	8.57	0.13	1.53	clayey silt to silty clay	-16.2	1.00	4	4,020	2,416	3,022	3.01	N/A	N/A	0.901	N/A	0.312	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
34.50	8.80	0.12	1.36	clayey silt to silty clay	-17.2	1.00	4	4,140	2,474	3,079	2.98	N/A	N/A	0.893	N/A	0.311	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
35.50	8.67	0.15	1.67	clayey silt to silty clay	-18.2	1.00	4	4,260	2,532	3,137	3.05	N/A	N/A	0.885	N/A	0.310	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
36.50	8.65	0.14	1.57	clayey silt to silty clay	-19.2	1.00	4	4,380	2,589	3,194	3.04	N/A	N/A	0.877	N/A	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
37.50	10.43	0.20	1.83	clayey silt to silty clay	-20.2	1.00	5	4,500	2,647	3,252	3.00	N/A	N/A	0.869	N/A	0.307	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
38.50	38.50	0.48	1.24	silty sand to sandy silt	-21.2	1.00	13	4,620	2,704	3,310	2.37	2.18	72.34	0.861	0.931	0.306	0.115	0.468	YES	2.8	12.8	493	17.0	N/A	1.529	0.18	0.49
39.50	191.38	3.04	1.59	sand to silty sand	-22.2	1.00	48	4,740	2,762	3,367	1.90	1.19	193.95	0.852	0.879	0.304	N/A	N/A	NO	N/A	N/A	N/A	41.1	N/A	0.000	0.00	0.49
40.50	199.73	4.30	2.15	silty sand to sandy silt	-23.2	1.00	67	4,860	2,820	3,425	1.99	1.29	217.34	0.844	0.872	0.303	N/A	N/A	NO	N/A	N/A	N/A	66.1	N/A	0.000	0.00	0.49
41.50	101.99	2.26	2.21	silty sand to sandy silt	-24.2	1.66	56	4,980	2,877	3,482	1.89	1.18	166.16	0.836	0.865	0.301	N/A	N/A	NO	N/A	N/A	N/A	56.2	N/A	0.000	0.00	0.49
42.50	27.32	0.36	1.33	sandy silt to clayey silt	-25.2	1.00	11	5,100	2,935	3,540	2.57	3.12	63.93	0.828	0.921	0.299	0.104	0.428	YES	2.8	11.0	371	14.9	N/A	1.840	0.22	0.27
43.50	18.42	0.37	1.98	sandy silt to clayey silt	-26.2	1.00	7	5,220	2,992	3,598	2.82	N/A	N/A	0.820	N/A	0.298	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
44.50	14.42	0.34	2.34	clayey silt to silty clay	-27.2	1.00	7	5,340	3,050	3,655	2.97	N/A	N/A	0.812	N/A	0.296	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
45.50	14.82	0.58	3.87	silty clay to clay	-28.2	1.00	10	5,460	3,107	3,713	3.09	N/A	N/A	0.804	N/A	0.294	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
46.50	13.62	0.41	2.96	clayey silt to silty clay	-29.2	1.00	7	5,580	3,165	3,770	3.07	N/A	N/A	0.795	N/A	0.292	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
47.50	22.00	1.06	4.77	clay	-30.2	1.00	22	5,700	3,223	3,828	3.01	N/A	N/A	0.787	N/A	0.290	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
48.50	16.22	0.84	5.11	clay	-31.2	1.00	16	5,820	3,280	3,886	3.15	N/A	N/A	0.779	N/A	0.288	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
49.50	22.52	0.76	3.35	clayey silt to silty clay	-32.2	1.00	11	5,940	3,338	3,943	2.91	N/A	N/A	0.771	N/A	0.285	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
50.50	41.47	1.96	4.69	silty clay to clay	-33.2	1.00	28	6,060	3,395	4,001	2.79	N/A	N/A	0.763	N/A	0.283	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
51.50	49.78	1.18	2.35	sandy silt to clayey silt	-34.2	1.66	33	6,180	3,453	4,058	2.18	1.61	100.86	0.755	0.821	0.281	0.175	0.684	YES	2.8	25.9	1,200	32.8	N/A	0.041	0.00	0.27
52.50	21.00	0.58	2.73	clayey silt to silty clay	-35.2	1.00	11	6,300	3,511	4,116	2.90	N/A	N/A	0.747	N/A	0.279	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
53.50	29.18	1.03	3.51	clayey silt to silty clay	-36.2	1.00	15	6,420	3,568	4,174	2.85	N/A	N/A	0.739	N/A	0.276	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
54.50	19.02	0.68	3.53	silty clay to clay	-37.2	1.00	13	6,540	3,626	4,231	3.02	N/A	N/A	0.730	N/A	0.274	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
55.50	13.17	0.35	2.65	clayey silt to silty clay	-38.2	1.00	7	6,660	3,683	4,289	3.11	N/A	N/A	0.722	N/A	0.272	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
56.50	14.05	0.36	2.52	clayey silt to silty clay	-39.2	1.00	7	6,780	3,741	4,346	3.07	N/A	N/A	0.714	N/A	0.269	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
57.50	15.17	0.34	2.20	clayey silt to silty clay	-40.2	1.00	8	6,900	3,799	4,404	3.01	N/A	N/A	0.706	N/A	0.267	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
58.50	52.13	0.95	1.82	silty sand to sandy silt	-41.2	1.00	17	7,020	3,856	4,462	2.48	2.67	85.15	0.698	0.845	0.264	0.137	0.587	YES	2.8	14.4	629	19.0	N/A	0.289	0.03	0.23
59.50	92.83	0.93	1.00	sand to silty sand	-42.2	1.00	23	7,140	3,914	4,519	2.06	1.39	92.21	0.690	0.820	0.262	0.153	0.640	YES	1.3	16.8	850	18.7	N/A	0.308	0.04	0.20
60.50	72.43	0.70	0.96	sand to silty sand	-43.2	1.00	18	7,260	3,971	4,577	2.14	1.54	79.08	0.682	0.837	0.259	0.126	0.543	YES	1.3	13.3	534	15.0	N/A	1.643	0.20	0.00

max=	1,200
min=	280
avg=	698

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT004

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	17.00 ft
GWT Elev. During Test	0.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$

+++ $FS = (CRR_{7.5}/CSR)\ MSF\ K_\sigma\ K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	17.00 ft below ground surface
GWT Depth For Design, Zwd =	7.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	21.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	1.14 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	1.14 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_l (in.)	Cumulative Settlement Profile (in.)
0.50	47.68	1.31	2.74	sandy silt to clayey silt	16.0	1.66	32	60	60	60	1.65	1.00	457.98	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	69.4	N/A	N/A	N/A	1.14
1.50	23.57	0.89	3.79	silty clay to clay	15.0	1.66	26	180	180	180	2.08	1.42	185.19	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.14
2.50	6.97	0.29	4.12	clay	14.0	1.00	7	300	300	300	2.73	N/A	N/A	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.14
3.50	11.33	0.53	4.72	clay	13.0	1.66	19	420	420	420	2.50	2.78	113.99	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.14
4.50	4.33	0.22	5.12	clay	12.0	1.00	4	540	540	540	3.10	N/A	N/A	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.14
5.50	6.90	0.24	3.46	clay	11.0	1.00	7	660	660	660	2.88	N/A	N/A	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.14
6.50	7.58	0.26	3.36	clay	10.0	1.00	8	780	780	780	2.89	N/A	N/A	0.985	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.14
7.50	8.62	0.34	3.88	clay	9.0	1.00	9	900	869	900	2.91	N/A	N/A	0.983	N/A	0.212	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.14
8.50	6.52	0.23	3.44	clay	8.0	1.00	7	1,020	926	1,020	3.00	N/A	N/A	0.980	N/A	0.224	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.14
9.50	12.68	0.14	1.07	sandy silt to clayey silt	7.0	1.00	5	1,140	984	1,140	2.55	3.05	55.17	0.978	1.000	0.236	0.096	0.541	YES	2.8	9.5	286	13.1	N/A	2.037	0.24	0.90
10.50	30.49	0.28	0.91	silty sand to sandy silt	6.0	1.66	17	1,260	1,042	1,260	1.89	1.18	82.51	0.976	1.000	0.245	0.132	0.719	YES	2.8	24.0	1,200	30.4	N/A	0.048	0.01	0.89
11.50	8.35	0.13	1.58	clayey silt to silty clay	5.0	1.66	7	1,380	1,099	1,380	2.52	2.85	53.17	0.973	1.000	0.254	0.094	0.493	YES	2.8	11.1	378	N/A	N/A	0.000	0.00	0.89
12.50	4.17	0.06	1.44	sensitive fine grained	4.0	1.00	2	1,500	1,157	1,500	3.05	N/A	N/A	0.971	N/A	0.262	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.89
13.50	9.82	0.27	2.73	silty clay to clay	3.0	1.00	7	1,620	1,214	1,620	2.87	N/A	N/A	0.969	N/A	0.269	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.89
14.50	8.78	0.31	3.53	clay	2.0	1.00	9	1,740	1,272	1,740	2.99	N/A	N/A	0.966	N/A	0.275	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.89
15.50	16.15	0.37	2.31	clayey silt to silty clay	1.0	1.66	13	1,860	1,330	1,860	2.39	2.28	74.81	0.964	1.000	0.280	0.119	0.566	YES	2.8	16.7	839	N/A	N/A	0.000	0.00	0.89
16.50	8.07	0.22	2.77	silty clay to clay	0.0	1.00	5	1,980	1,387	1,980	2.99	N/A	N/A	0.962	N/A	0.285	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.89
17.50	7.65	0.19	2.48	silty clay to clay	-1.0	1.00	5	2,100	1,445	2,069	2.99	N/A	N/A	0.959	N/A	0.290	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.89
18.50	30.60	0.35	1.15	silty sand to sandy silt	-2.0	1.00	10	2,220	1,502	2,126	2.32	2.01	70.98	0.957	1.000	0.294	0.113	0.514	YES	2.8	12.7	487	16.9	N/A	1.496	0.18	0.71
19.50	36.17	0.34	0.95	silty sand to sandy silt	-3.0	1.00	12	2,340	1,560	2,184	2.22	1.71	70.01	0.955	1.000	0.298	0.112	0.501	YES	2.8	14.3	621	18.8	N/A	1.198	0.14	0.57
20.50	69.24	1.21	1.75	silty sand to sandy silt	-4.0	1.00	23	2,460	1,618	2,242	2.16	1.58	121.38	0.952	1.000	0.301	0.246	1.091	YES	2.8	24.6	1,200	31.2	N/A	0.055	0.01	0.56
21.50	68.00	1.06	1.56	silty sand to sandy silt	-5.0	1.00	23	2,580	1,675	2,299	2.14	1.53	113.79	0.950	1.000	0.304	0.217	0.952	YES	2.8	23.9	1,200	30.4	N/A	0.061	0.01	0.56
22.50	60.93	1.00	1.64	silty sand to sandy silt	-6.0	1.00	20	2,700	1,733	2,357	2.20	1.66	108.51	0.948	1.000	0.307	0.199	0.864	YES	2.8	21.5	1,200	27.5	N/A	0.080	0.01	0.55
23.50	88.15	1.53	1.73	silty sand to sandy silt	-7.0	1.00	29	2,820	1,790	2,414	2.10	1.45	135.18	0.945	1.000	0.310	0.310	1.335	NO	N/A	N/A	N/A	37.1	N/A	0.019	0.00	0.54
24.50	52.98	0.85	1.61	silty sand to sandy silt	-8.0	1.66	29	2,940	1,848	2,472	1.94	1.23	111.97	0.943	1.000	0.312	0.211	0.900	YES	2.8	29.1	1,200	36.6	N/A	0.022	0.00	0.54
25.50	21.53	0.37	1.73	sandy silt to clayey silt	-9.0	1.66	14	3,060	1,906	2,530	2.29	1.90	69.48	0.941	1.000	0.314	0.111	0.472	YES	2.8	15.5	725	20.2	N/A	1.095	0.13	0.41
26.50	6.75	0.17	2.42	silty clay to clay	-10.0	1.00	5	3,180	1,963	2,587	3.15	N/A	N/A	0.938	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
27.50	6.00	0.10	1.59	sensitive fine grained	-11.0	1.00	3	3,300	2,021	2,645	3.12	N/A	N/A	0.936	N/A	0.318	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
28.50	7.28	0.18	2.44	silty clay to clay	-12.0	1.00	5	3,420	2,078	2,702	3.14	N/A	N/A	0.934	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
29.50	7.20	0.18	2.42	silty clay to clay	-13.0	1.00	5	3,540	2,136	2,760	3.15	N/A	N/A	0.931	N/A	0.321	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
30.50	6.15	0.15	2.42	silty clay to clay	-14.0	1.00	4	3,660	2,194	2,818	3.24	N/A	N/A	0.926	N/A	0.321	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
31.50	6.23	0.12	1.89	silty clay to clay	-15.0	1.00	4	3,780	2,251	2,875	3.18	N/A	N/A	0.918	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
32.50	6.70	0.09	1.29	sensitive fine grained	-16.0	1.00	3	3,900	2,309	2,933	3.08	N/A	N/A	0.909	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
33.50	6.95	0.15	2.05	silty clay to clay	-17.0	1.00	5	4,020	2,366	2,990	3.17	N/A	N/A	0.901	N/A	0.318	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
34.50	6.75	0.15	2.04	silty clay to clay	-18.0	1.00	5	4,140	2,424	3,048	3.20	N/A	N/A	0.893	N/A	0.317	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
35.50	6.78	0.13	1.83	silty clay to clay	-19.0	1.00	5	4,260	2,482	3,106	3.19	N/A	N/A	0.885	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
36.50	7.58	0.18	2.16	silty clay to clay	-20.0	1.00	5	4,380	2,539	3,163	3.18	N/A	N/A	0.877	N/A	0.315	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
37.50	23.82	0.77	3.19	clayey silt to silty clay	-21.0	1.00	12	4,500	2,597	3,221	2.81	N/A	N/A	0.869	N/A	0.313	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
38.50	52.55	0.94	1.78	silty sand to sandy silt	-22.0	1.00	18	4,620	2,654	3,278	2.34	2.10	95.85	0.861	0.924	0.312	0.162	0.641	YES	2.8	16.5	821	21.4	N/A	0.405	0.05	0.36
39.50	113.20	1.99	1.76	silty sand to sandy silt	-23.0	1.00	38	4,740	2,712	3,336	2.09	1.44	139.83	0.852	0.885	0.310	0.334	1.274	YES	2.8	32.0	1,200	40.1	N/A	0.000	0.00	0.36
40.50	107.65	2.25	2.09	silty sand to sandy silt	-24.0	1.66	59	4,860	2,770	3,394	1.85	1.15	173.58	0.844	0.878	0.308	N/A	N/A	NO	N/A	N/A	N/A	59.7	N/A	0.000	0.00	0.36
41.50	35.81	0.76	2.12	sandy silt to clayey silt	-25.0	1.66	24	4,980	2,827	3,451	2.23	1.73	86.33	0.836	0.896	0.306	0.140	0.545	YES	2.8	20.9	1,200	26.7	N/A	0.085	0.01	0.35
42.50	10.73	0.36	3.36	silty clay to clay	-26.0	1.00	7	5,100	2,885	3,509	3.17	N/A	N/A	0.828	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.35
43.50	11.28	0.31	2.74	silty clay to clay	-27.0	1.00	8	5,220	2,942	3,566	3.10	N/A	N/A	0.820	N/A	0.303	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.35
44.50	9.95	0.30	3.01	silty clay to clay	-28.0	1.00	7	5,340	3,000	3,624	3.19	N/A	N/A	0.812	N/A	0.301	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.35
45.50	9.13	0.26	2.81	silty clay to clay	-29.0	1.00	6	5,460	3,058	3,682	3.22	N/A	N/A	0.804	N/A	0.298	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.35
46.50	11.53	0.39	3.28	silty clay to clay	-30.0	1.00	8	5,580	3,115	3,739	3.16	N/A	N/A	0.795	N/A	0.296	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.35
47.50	13.92	0.58	4.11	clay	-31.0	1.00	14	5,700	3,173	3,797	3.15	N/A	N/A	0.787	N/A	0.294	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.35
48.50	12.18	0.49	3.93	clay	-32.0	1.00	12	5,820	3,230	3,854	3.20	N/A	N/A	0.779	N/A	0.292	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.35
49.50	14.30	0.49	3.36	silty clay to clay	-33.0	1.00	10	5,940	3,288	3,912	3.09	N/A	N/A	0.771	N/A	0.290	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.35
50.50	41.67	0.92	2.20	sandy silt to clayey silt	-34.0	1.00	17	6,060	3,346	3,970	2.57	3.17	89.70	0.763	0.876	0.287	0.147	0.598	YES	2.8	14.6	647	19.2	N/A	1.029	0.12	0.23
51.50	63.07	1.52	2.40	sandy silt to clayey silt	-35.0	1.00	25	6,180	3,403	4,027	2.41	2.36	114.32	0.755	0.845	0.285	0.219	0.866	YES	2.8	20.6	1,200	26.3	N/A	0.080	0.01	0.22
52.50	82.49	1.60	1.94	silty sand to sandy silt	-36.0	1.00	27	6,300	3,461	4,085	2.26	1.84	115.25	0.747	0.835	0.283	0.222	0.876	YES	2.8	22.0	1,200	28.1	N/A	0.069	0.01	0.21
53.50	57.45	1.35	2.34	sandy silt to clayey silt	-37.0	1.66	38	6,420	3,518	4,142	2.13	1.51	108.12	0.739	0.804	0.280	0.198	0.756	YES	2.8	29.2	1,200	36.7	N/A	0.019	0.00	0.21
54.50	17.78	0.62	3.43	silty clay to clay	-38.0	1.00	12	6,540	3,576	4,200	3.04	N/A	N/A	0.730	N/A	0.278	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
55.50	24.25	0.60	2.42	sandy silt to clayey silt	-39.0	1.00	10	6,660	3,634	4,258	2.83	N/A	N/A	0.722	N/A	0.275	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
56.50	24.97	0.58	2.30	sandy silt to clayey silt	-40.0	1.00	10	6,780	3,691	4,315	2.81	N/A	N/A	0.714	N/A	0.273	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
57.50	75.28	0.93	1.24	sand to silty sand	-41.0	1.00	19	6,900	3,749	4,373	2.18	1.63	89.52	0.706	0.845	0.270	0.147	0.612	YES	1.3	14.1	597	15.8	N/A	1.532	0.18	0.02
58.50	102.48	1.58	1.54	silty sand to sandy silt	-42.0	1.00	34	7,020	3,806	4,430	2.14	1.53	113.99	0.698	0.794	0.268	0.218	0.861	YES	2.8	25.8	1,200	32.5	N/A	0.041	0.00	0.02
59.50	157.78	1.25	0.79	sand	-43.0	1.00	32	7,140	3,864	4,488	1.81	1.11	126.41	0.690	0.797	0.265	0.268	1.075	YES	0.0	21.1	1,200	21.1	N/A	0.119	0.01	0.00
60.50	175.23	2.32	1.32	sand to silty sand	-44.0	1.00	44	7,260	3,922	4,546	1.93	1.21	151.90	0.682	0.764	0.262	0.406	1.577	NO	N/A	N/A	N/A	33.0	N/A	0.038	0.00	0.00
																						max= 1,200					
																						min= 286					
																						avg= 943					

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	A-CPT007

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	15.30 ft
GWT Elev. During Test	0.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	15.30 ft below ground surface
GWT Depth For Design, Zwd =	5.30 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	13.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	1.06 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	1.06 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance q_{t-avg} (tsf)	Average Sleeve Friction f_{s-avg} (tsf)	Average Friction Ratio R_{f-avg} (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_i (in.)	Cumulative Settlement Profile (in.)
0.50	16.44	0.03	0.19	silty sand to sandy silt	14.3	1.00	5	60	60	60	1.57	1.00	94.92	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	16.2	0.012	0.026	0.00	1.06
1.50	19.10	0.11	0.60	sandy silt to clayey silt	13.3	1.00	8	180	180	180	1.94	1.23	78.40	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	20.6	N/A	N/A	N/A	1.06
2.50	12.52	0.28	2.26	clayey silt to silty clay	12.3	1.00	6	300	300	300	2.52	2.85	92.24	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.06
3.50	11.08	0.28	2.55	clayey silt to silty clay	11.3	1.00	6	420	420	420	2.52	2.87	102.38	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.06
4.50	9.28	0.27	2.96	silty clay to clay	10.3	1.00	6	540	540	540	2.69	N/A	N/A	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.06
5.50	33.18	0.72	2.18	sandy silt to clayey silt	9.3	1.00	13	660	648	660	2.31	1.99	116.03	0.987	1.000	0.209	0.225	1.436	NO	N/A	N/A	N/A	32.1	N/A	0.034	0.00	1.06
6.50	76.04	0.47	0.62	sand to silty sand	8.3	1.00	19	780	705	780	1.70	1.04	132.89	0.985	1.000	0.227	0.298	1.756	NO	N/A	N/A	N/A	34.4	N/A	0.026	0.00	1.05
7.50	50.91	0.33	0.64	sand to silty sand	7.3	1.00	13	900	763	900	1.87	1.16	95.44	0.983	1.000	0.241	0.161	0.890	YES	1.3	20.3	1,200	22.4	N/A	0.086	0.01	1.04
8.50	29.77	0.19	0.64	silty sand to sandy silt	6.3	1.00	16	1,020	820	1,020	1.78	1.00	76.97	0.980	1.000	0.254	0.122	0.644	YES	2.8	25.8	1,200	32.6	N/A	0.038	0.00	1.04
9.50	9.00	0.07	0.74	clayey silt to silty clay	5.3	1.00	7	1,140	878	1,140	2.29	1.00	22.49	0.978	1.000	0.264	0.069	0.347	YES	2.8	12.7	485	N/A	N/A	0.000	0.00	1.04
10.50	2.65	0.03	1.06	sensitive fine grained	4.3	1.00	1	1,260	936	1,260	3.11	N/A	N/A	0.976	N/A	0.273	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.04
11.50	2.58	0.03	0.98	sensitive fine grained	3.3	1.00	1	1,380	993	1,380	3.13	N/A	N/A	0.973	N/A	0.281	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.04
12.50	2.45	0.02	0.86	sensitive fine grained	2.3	1.00	1	1,500	1,051	1,500	3.16	N/A	N/A	0.971	N/A	0.288	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.04
13.50	2.50	0.02	0.80	sensitive fine grained	1.3	1.00	1	1,620	1,108	1,620	3.16	N/A	N/A	0.969	N/A	0.294	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.04
14.50	2.73	0.03	0.98	sensitive fine grained	0.3	1.00	1	1,740	1,166	1,740	3.18	N/A	N/A	0.966	N/A	0.300	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.04
15.50	4.39	0.10	2.16	clay	-0.7	1.00	4	1,860	1,224	1,848	3.14	N/A	N/A	0.964	N/A	0.305	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.04
16.50	5.58	0.12	2.08	silty clay to clay	-1.7	1.00	4	1,980	1,281	1,905	3.05	N/A	N/A	0.962	N/A	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.04
17.50	6.02	0.11	1.77	silty clay to clay	-2.7	1.00	4	2,100	1,339	1,963	2.99	N/A	N/A	0.959	N/A	0.313	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.04
18.50	6.98	0.15	2.17	silty clay to clay	-3.7	1.00	5	2,220	1,396	2,020	2.99	N/A	N/A	0.957	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.04
19.50	30.45	0.28	0.93	silty sand to sandy silt	-4.7	1.00	10	2,340	1,454	2,078	2.26	1.84	65.63	0.955	1.000	0.320	0.106	0.444	YES	2.8	12.8	492	16.9	N/A	1.576	0.19	0.85
20.50	20.71	0.11	0.52	silty sand to sandy silt	-5.7	1.66	11	2,460	1,512	2,136	2.01	1.00	39.44	0.952	1.000	0.322	0.083	0.343	YES	2.8	13.9	580	18.3	N/A	1.406	0.17	0.68
21.50	8.18	0.08	0.96	clayey silt to silty clay	-6.7	1.00	4	2,580	1,569	2,193	2.79	N/A	N/A	0.950	N/A	0.325	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
22.50	4.65	0.05	1.17	sensitive fine grained	-7.7	1.00	2	2,700	1,627	2,251	3.09	N/A	N/A	0.948	N/A	0.327	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
23.50	5.25	0.11	2.18	silty clay to clay	-8.7	1.00	3	2,820	1,684	2,308	3.18	N/A	N/A	0.945	N/A	0.329	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
24.50	5.40	0.07	1.35	sensitive fine grained	-9.7	1.00	3	2,940	1,742	2,366	3.08	N/A	N/A	0.943	N/A	0.331	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
25.50	5.46	0.07	1.28	sensitive fine grained	-10.7	1.00	3	3,060	1,800	2,424	3.07	N/A	N/A	0.941	N/A	0.333	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
26.50	5.81	0.07	1.19	sensitive fine grained	-11.7	1.00	3	3,180	1,857	2,481	3.04	N/A	N/A	0.938	N/A	0.334	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
27.50	6.76	0.11	1.67	silty clay to clay	-12.7	1.00	5	3,300	1,915	2,539	3.06	N/A	N/A	0.936	N/A	0.335	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
28.50	6.52	0.13	1.97	silty clay to clay	-13.7	1.00	4	3,420	1,972	2,596	3.12	N/A	N/A	0.934	N/A	0.337	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
29.50	5.42	0.07	1.34	sensitive fine grained	-14.7	1.00	3	3,540	2,030	2,654	3.13	N/A	N/A	0.931	N/A	0.338	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
30.50	6.22	0.12	1.91	silty clay to clay	-15.7	1.00	4	3,660	2,088	2,712	3.16	N/A	N/A	0.926	N/A	0.338	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
31.50	6.14	0.09	1.45	sensitive fine grained	-16.7	1.00	3	3,780	2,145	2,769	3.11	N/A	N/A	0.918	N/A	0.336	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
32.50	6.06	0.06	1.02	sensitive fine grained	-17.7	1.00	3	3,900	2,203	2,827	3.06	N/A	N/A	0.909	N/A	0.335	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
33.50	6.77	0.11	1.55	clayey silt to silty clay	-18.7	1.00	3	4,020	2,260	2,884	3.10	N/A	N/A	0.901	N/A	0.333	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
34.50	7.52	0.15	1.93	silty clay to clay	-19.7	1.00	5	4,140	2,318	2,942	3.11	N/A	N/A	0.893	N/A	0.332	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
35.50	7.49	0.13	1.67	clayey silt to silty clay	-20.7	1.00	4	4,260	2,376	3,000	3.09	N/A	N/A	0.885	N/A	0.330	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
36.50	8.44	0.12	1.40	clayey silt to silty clay	-21.7	1.00	4	4,380	2,433	3,057	3.01	N/A	N/A	0.877	N/A	0.328	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
37.50	11.92	0.22	1.82	clayey silt to silty clay	-22.7	1.00	6	4,500	2,491	3,115	2.92	N/A	N/A	0.869	N/A	0.326	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
38.50	8.47	0.21	2.43	silty clay to clay	-23.7	1.00	6	4,620	2,548	3,172	3.15	N/A	N/A	0.861	N/A	0.325	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
39.50	11.67	0.26	2.18	clayey silt to silty clay	-24.7	1.00	6	4,740	2,606	3,230	2.99	N/A	N/A	0.852	N/A	0.323	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
40.50	15.56	0.47	3.01	clayey silt to silty clay	-25.7	1.00	8	4,860	2,664	3,288	2.96	N/A	N/A	0.844	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
41.50	18.32	0.48	2.62	clayey silt to silty clay	-26.7	1.00	9	4,980	2,721	3,345	2.87	N/A	N/A	0.836	N/A	0.318	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
42.50	11.54	0.34	2.96	silty clay to clay	-27.7	1.00	8	5,100	2,779	3,403	3.09	N/A	N/A	0.828	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
43.50	12.07	0.29	2.37	clayey silt to silty clay	-28.7	1.00	6	5,220	2,836	3,460	3.03	N/A	N/A	0.820	N/A	0.314	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
44.50	9.54	0.26	2.71	silty clay to clay	-29.7	1.00	6	5,340	2,894	3,518	3.17	N/A	N/A	0.812	N/A	0.312	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
45.50	29.99	0.36	1.21	silty sand to sandy silt	-30.7	1.00	10	5,460	2,951	3,575	2.51	2.82	63.10	0.804	0.923	0.309	0.103	0.412	YES	2.8	10.3	327	14.0	N/A	1.982	0.24	0.44
46.50	23.30	0.36	1.53	sandy silt to clayey silt	-31.7	1.66	15	5,580	3,009	3,633	2.32	2.01	63.22	0.795	0.902	0.307	0.103	0.406	YES	2.8	14.2	613	18.7	N/A	1.268	0.15	0.29
47.50	10.97	0.28	2.52	clayey silt to silty clay	-32.7	1.00	5	5,700	3,067	3,691	3.11	N/A	N/A	0.787	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
48.50	9.54	0.25	2.65	silty clay to clay	-33.7	1.00	6	5,820	3,124	3,748	3.19	N/A	N/A	0.779	N/A	0.302	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
49.50	10.15	0.23	2.22	clayey silt to silty clay	-34.7	1.00	5	5,940	3,182	3,806	3.13	N/A	N/A	0.771	N/A	0.299	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
50.50	11.77	0.34	2.88	silty clay to clay	-35.7	1.00	8	6,060	3,239	3,863	3.13	N/A	N/A	0.763	N/A	0.297	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
51.50	11.06	0.27	2.45	clayey silt to silty clay	-36.7	1.00	6	6,180	3,297	3,921	3.13	N/A	N/A	0.755	N/A	0.294	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
52.50	15.43	0.94	6.10	clay	-37.7	1.00	15	6,300	3,355	3,979	3.23	N/A	N/A	0.747	N/A	0.292	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
53.50	22.38	0.45	2.01	sandy silt to clayey silt	-38.7	1.00	9	6,420	3,412	4,036	2.79	N/A	N/A	0.739	N/A	0.289	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
54.50	64.20	1.09	1.71	silty sand to sandy silt	-39.7	1.00	21	6,540	3,470	4,094	2.31	1.99	97.02	0.730	0.852	0.286	0.165	0.655	YES	2.8	17.8	950	22.9	N/A	0.101	0.01	0.28
55.50	137.03	1.24	0.91	sand	-40.7	1.00	27	6,660	3,527	4,151	1.88	1.17	120.69	0.722	0.831	0.284	0.243	0.951	YES	0.0	19.0	1,083	19.0	N/A	1.011	0.12	0.16
56.50	176.53	1.32	0.75	sand	-41.7	1.66	58	6,780	3,585	4,209	1.43	1.00	218.31	0.714	0.792	0.281	N/A	N/A	NO	N/A	N/A	N/A	40.3	N/A	0.000	0.00	0.16
57.50	49.22	0.61	1.23	silty sand to sandy silt	-42.7	1.00	16	6,900	3,643	4,267	2.33	2.06	75.16	0.706	0.860	0.278	0.119	0.493	YES	2.8	14.0	595	18.5	N/A	1.041	0.12	0.03
58.50	112.23	0.91	0.81	sand to silty sand	-43.7	1.00	28	7,020	3,700	4,324	1.93	1.22	100.36	0.698	0.817	0.275	0.174	0.689	YES	1.3	20.4	1,200	22.5	N/A	0.098	0.01	0.02
59.50	87.65	1.27	1.45	silty sand to sandy silt	-44.7	1.00	29	7,140	3,758	4,382	2.17	1.60	102.62	0.690	0.810	0.273	0.180	0.716	YES	2.8	22.5	1,200	28.7	N/A	0.063	0.01	0.01
60.50	65.28	0.75	1.15	silty sand to sandy silt	-45.7	1.00	22	7,260	3,815	4,439	2.22	1.72	81.12	0.682	0.831	0.270	0.130	0.533	YES	2.8	17.4	914	22.5	N/A	0.096	0.01	0.00
																					max=	1,200					
																					min=	327					
																					avg=	834					

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	A-CPT010

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	16.00 ft
GWT Elev. During Test	0.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw = 16.00 ft below ground surface

GWT Depth For Design, Zwd = 6.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils = 13.00 feet

Earthquake-Induced Settlements:

- Liquefaction-Induced Settlement = 1.32 inches <--- Saturated Sands
- Seismic Compaction Settlement = 0.00 inches <--- Dry or Unsaturated Sands

Total: 1.32 inches

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +															RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_t (in.)	Cumulative Settlement Profile (in.)
0.50	42.96	0.29	0.68	silty sand to sandy silt	15.0	1.00	14	60	60	60	1.51	1.00	248.00	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	34.2	0.009	0.008	0.00	1.32
1.50	31.23	0.10	0.32	silty sand to sandy silt	14.0	1.00	10	180	180	180	1.62	1.00	104.11	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	26.2	0.018	0.022	0.00	1.32
2.50	21.15	0.16	0.75	sandy silt to clayey silt	13.0	1.00	8	300	300	300	2.05	1.37	75.04	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	22.3	N/A	N/A	N/A	1.32
3.50	38.51	0.47	1.23	silty sand to sandy silt	12.0	1.66	21	420	420	420	1.72	1.05	146.04	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	48.4	0.022	0.000	0.00	1.32
4.50	17.39	0.49	2.80	clayey silt to silty clay	11.0	1.00	9	540	540	540	2.57	3.13	104.68	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.32
5.50	39.93	0.37	0.92	silty sand to sandy silt	10.0	1.66	22	660	660	660	1.71	1.04	120.12	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	50.0	0.027	0.000	0.00	1.32
6.50	15.32	0.40	2.60	clayey silt to silty clay	9.0	1.00	8	780	749	780	2.56	3.11	99.47	0.985	1.000	0.213	0.172	1.073	YES	2.8	15.1	686	N/A	N/A	0.000	0.00	1.32
7.50	25.22	0.25	1.00	silty sand to sandy silt	8.0	1.66	14	900	806	900	1.93	1.22	80.40	0.983	1.000	0.228	0.128	0.751	YES	2.8	23.5	1,200	29.9	N/A	0.047	0.01	1.32
8.50	5.77	0.12	2.13	silty clay to clay	7.0	1.00	4	1,020	864	1,020	2.91	N/A	N/A	0.980	N/A	0.241	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.32
9.50	3.40	0.05	1.34	sensitive fine grained	6.0	1.00	2	1,140	922	1,140	3.04	N/A	N/A	0.978	N/A	0.252	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.32
10.50	6.97	0.27	3.81	clay	5.0	1.00	7	1,260	979	1,260	3.02	N/A	N/A	0.976	N/A	0.261	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.32
11.50	8.93	0.24	2.71	silty clay to clay	4.0	1.00	6	1,380	1,037	1,380	2.86	N/A	N/A	0.973	N/A	0.269	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.32
12.50	32.10	0.23	0.70	silty sand to sandy silt	3.0	1.66	18	1,500	1,094	1,500	1.83	1.00	71.85	0.971	1.000	0.277	0.114	0.552	YES	2.8	23.3	1,200	29.5	N/A	0.059	0.01	1.31
13.50	15.59	0.18	1.15	sandy silt to clayey silt	2.0	1.00	6	1,620	1,152	1,620	2.52	2.87	59.03	0.969	1.000	0.283	0.099	0.467	YES	2.8	9.7	297	13.3	N/A	2.083	0.25	1.06
14.50	19.87	0.25	1.24	sandy silt to clayey silt	1.0	1.66	13	1,740	1,210	1,740	2.15	1.55	65.57	0.966	1.000	0.289	0.106	0.490	YES	2.8	16.9	864	21.9	N/A	0.160	0.02	1.04
15.50	9.47	0.15	1.62	clayey silt to silty clay	0.0	1.00	5	1,860	1,267	1,860	2.77	N/A	N/A	0.964	N/A	0.294	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.04
16.50	4.99	0.10	2.00	silty clay to clay	-1.0	1.00	3	1,980	1,325	1,949	3.09	N/A	N/A	0.962	N/A	0.299	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.04
17.50	24.30	0.16	0.67	silty sand to sandy silt	-2.0	1.00	8	2,100	1,382	2,006	2.27	1.86	54.25	0.959	1.000	0.303	0.095	0.418	YES	2.8	10.9	363	14.7	N/A	1.869	0.22	0.82
18.50	19.55	0.17	0.87	sandy silt to clayey silt	-3.0	1.00	8	2,220	1,440	2,064	2.42	2.39	54.97	0.957	1.000	0.307	0.095	0.415	YES	2.8	10.5	340	14.2	N/A	1.942	0.23	0.58
19.50	17.39	0.13	0.76	sandy silt to clayey silt	-4.0	1.00	7	2,340	1,498	2,122	2.44	2.50	50.27	0.955	1.000	0.310	0.092	0.395	YES	2.8	9.6	288	13.1	N/A	2.115	0.25	0.33
20.50	25.65	0.15	0.57	silty sand to sandy silt	-5.0	1.66	14	2,460	1,555	2,179	1.95	1.00	48.15	0.952	1.000	0.313	0.090	0.384	YES	2.8	16.4	809	21.3	N/A	0.456	0.05	0.27
21.50	5.06	0.08	1.65	sensitive fine grained	-6.0	1.00	3	2,580	1,613	2,237	3.12	N/A	N/A	0.950	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
22.50	5.09	0.08	1.50	sensitive fine grained	-7.0	1.00	3	2,700	1,670	2,294	3.11	N/A	N/A	0.948	N/A	0.319	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
23.50	5.91	0.10	1.73	silty clay to clay	-8.0	1.00	4	2,820	1,728	2,352	3.08	N/A	N/A	0.945	N/A	0.321	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
24.50	5.47	0.07	1.29	sensitive fine grained	-9.0	1.00	3	2,940	1,786	2,410	3.07	N/A	N/A	0.943	N/A	0.323	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
25.50	6.18	0.10	1.67	silty clay to clay	-10.0	1.00	4	3,060	1,843	2,467	3.08	N/A	N/A	0.941	N/A	0.325	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
26.50	5.54	0.09	1.54	sensitive fine grained	-11.0	1.00	3	3,180	1,901	2,525	3.12	N/A	N/A	0.938	N/A	0.326	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
27.50	5.63	0.11	1.91	silty clay to clay	-12.0	1.00	4	3,300	1,958	2,582	3.17	N/A	N/A	0.936	N/A	0.328	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
28.50	5.80	0.09	1.48	sensitive fine grained	-13.0	1.00	3	3,420	2,016	2,640	3.12	N/A	N/A	0.934	N/A	0.329	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
29.50	6.12	0.07	1.08	sensitive fine grained	-14.0	1.00	3	3,540	2,074	2,698	3.04	N/A	N/A	0.931	N/A	0.331	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
30.50	8.23	0.23	2.74	silty clay to clay	-15.0	1.00	5	3,660	2,131	2,755	3.12	N/A	N/A	0.926	N/A	0.331	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
31.50	9.70	0.29	3.03	silty clay to clay	-16.0	1.00	6	3,780	2,189	2,813	3.09	N/A	N/A	0.918	N/A	0.330	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
32.50	29.05	0.64	2.21	sandy silt to clayey silt	-17.0	1.66	19	3,900	2,246	2,870	2.27	1.85	84.04	0.909	0.966	0.328	0.135	0.530	YES	2.8	18.9	1,066	24.3	N/A	0.159	0.02	0.26
33.50	9.35	0.24	2.61	silty clay to clay	-18.0	1.00	6	4,020	2,304	2,928	3.08	N/A	N/A	0.901	N/A	0.327	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.26
34.50	10.28	0.35	3.41	silty clay to clay	-19.0	1.00	7	4,140	2,362	2,986	3.12	N/A	N/A	0.893	N/A	0.326	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.26
35.50	10.39	0.34	3.27	silty clay to clay	-20.0	1.00	7	4,260	2,419	3,043	3.11	N/A	N/A	0.885	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.26
36.50	9.21	0.29	3.14	silty clay to clay	-21.0	1.00	6	4,380	2,477	3,101	3.16	N/A	N/A	0.877	N/A	0.323	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.26
37.50	26.36	0.86	3.27	clayey silt to silty clay	-22.0	1.66	22	4,500	2,534	3,158	2.43	2.44	94.59	0.869	0.929	0.321	0.159	0.613	YES	2.8	20.2	1,200	N/A	N/A	0.000	0.00	0.26
38.50	8.63	0.34	3.91	clay	-23.0	1.00	9	4,620	2,592	3,216	3.26	N/A	N/A	0.861	N/A	0.319	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.26
39.50	9.98	0.40	4.00	clay	-24.0	1.00	10	4,740	2,650	3,274	3.21	N/A	N/A	0.852	N/A	0.317	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.26
40.50	11.57	0.42	3.59	silty clay to clay	-25.0	1.00	8	4,860	2,707	3,331	3.13	N/A	N/A	0.844	N/A	0.315	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.26
41.50	14.74	0.30	2.03	clayey silt to silty clay	-26.0	1.00	7	4,980	2,765	3,389	2.89	N/A	N/A	0.836	N/A	0.313	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.26
42.50	18.09	0.36	1.97	sandy silt to clayey silt	-27.0	1.66	12	5,100	2,822	3,446	2.49	2.73	63.18	0.828	0.925	0.311	0.103	0.410	YES	2.8	11.9	431	16.0	N/A	1.695	0.20	0.05
43.50	8.72	0.29	3.31	clay	-28.0	1.00	9	5,220	2,880	3,504	3.26	N/A	N/A	0.820	N/A	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
44.50	8.45	0.32	3.77	clay	-29.0	1.00	8	5,340	2,938	3,562	3.31	N/A	N/A	0.812	N/A	0.307	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
45.50	7.98	0.21	2.59	silty clay to clay	-30.0	1.00	5	5,460	2,995	3,619	3.25	N/A	N/A	0.804	N/A	0.305	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
46.50	8.93	0.21	2.31	silty clay to clay	-31.0	1.00	6	5,580	3,053	3,677	3.18	N/A	N/A	0.795	N/A	0.302	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
47.50	10.48	0.34	3.23	silty clay to clay	-32.0	1.00	7	5,700	3,110	3,734	3.20	N/A	N/A	0.787	N/A	0.300	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
48.50	10.73	0.50	4.63	clay	-33.0	1.00	11	5,820	3,168	3,792	3.29	N/A	N/A	0.779	N/A	0.298	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
49.50	9.21	0.31	3.41	clay	-34.0	1.00	9	5,940	3,226	3,850	3.28	N/A	N/A	0.771	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
50.50	94.10	0.80	0.85	sand to silty sand	-35.0	1.00	24	6,060	3,283	3,907	1.98	1.28	93.81	0.763	0.859	0.293	0.157	0.613	YES	1.3	18.2	993	20.1	N/A	0.427	0.05	0.00

max= 1,200
min= 288
avg= 749

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	A-CPT012

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	13.80 ft
GWT Elev. During Test	0.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	13.80 ft below ground surface
GWT Depth For Design, Zwd =	3.80 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	11.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	1.47 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	1.47 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_l (in.)	Cumulative Settlement Profile (in.)
0.50	24.82	0.14	0.55	silty sand to sandy silt	12.8	1.00	8	60	60	60	1.63	1.00	143.28	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	21.9	0.011	0.016	0.00	1.47
1.50	17.96	0.31	1.75	sandy silt to clayey silt	11.8	1.00	7	180	180	180	2.24	1.77	105.76	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	19.7	N/A	N/A	N/A	1.47
2.50	17.84	0.43	2.43	clayey silt to silty clay	10.8	1.00	9	300	300	300	2.42	2.39	110.19	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
3.50	12.61	0.47	3.71	silty clay to clay	9.8	1.00	8	420	420	420	2.59	3.25	131.98	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
4.50	11.08	0.41	3.69	clay	8.8	1.00	11	540	496	540	2.67	N/A	N/A	0.990	N/A	0.224	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
5.50	10.27	0.44	4.33	clay	7.8	1.00	10	660	554	660	2.77	N/A	N/A	0.987	N/A	0.245	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
6.50	13.97	0.46	3.32	silty clay to clay	6.8	1.00	9	780	612	780	2.61	N/A	N/A	0.985	N/A	0.261	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
7.50	9.15	0.46	5.02	clay	5.8	1.00	9	900	669	900	2.90	N/A	N/A	0.983	N/A	0.275	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
8.50	19.39	0.33	1.69	sandy silt to clayey silt	4.8	1.00	8	1,020	727	1,020	2.45	2.51	80.63	0.980	1.000	0.286	0.129	0.600	YES	2.8	13.7	563	18.0	N/A	1.227	0.15	1.33
9.50	13.18	0.17	1.32	sandy silt to clayey silt	3.8	1.00	9	1,140	784	1,140	2.24	1.76	61.33	0.978	1.000	0.296	0.101	0.458	YES	2.8	14.4	623	18.9	N/A	1.177	0.14	1.19
10.50	4.06	0.15	3.68	clay	2.8	1.00	4	1,260	842	1,260	3.18	N/A	N/A	0.976	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.19
11.50	7.84	0.21	2.69	silty clay to clay	1.8	1.00	5	1,380	900	1,380	2.87	N/A	N/A	0.973	N/A	0.311	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.19
12.50	26.73	0.38	1.44	sandy silt to clayey silt	0.8	1.00	18	1,500	957	1,500	2.03	1.34	85.96	0.971	1.000	0.316	0.139	0.586	YES	2.8	23.2	1,200	29.5	N/A	0.069	0.01	1.18
13.50	6.36	0.14	2.14	silty clay to clay	-0.2	1.00	4	1,620	1,015	1,620	2.93	N/A	N/A	0.969	N/A	0.322	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.18
14.50	4.23	0.08	1.88	silty clay to clay	-1.2	1.00	3	1,740	1,072	1,696	3.08	N/A	N/A	0.966	N/A	0.326	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.18
15.50	6.58	0.06	0.97	sensitive fine grained	-2.2	1.00	3	1,860	1,130	1,754	2.78	N/A	N/A	0.964	N/A	0.330	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.18
16.50	11.25	0.10	0.90	sandy silt to clayey silt	-3.2	1.00	7	1,980	1,188	1,812	2.30	1.96	47.45	0.962	1.000	0.333	0.090	0.358	YES	2.8	10.6	347	14.4	N/A	1.931	0.23	0.95
17.50	4.83	0.03	0.65	sensitive fine grained	-4.2	1.00	2	2,100	1,245	1,869	2.87	5.37	37.00	0.959	N/A	0.336	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.95
18.50	5.79	0.07	1.16	sensitive fine grained	-5.2	1.00	3	2,220	1,303	1,927	2.91	N/A	N/A	0.957	N/A	0.339	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.95
19.50	7.67	0.13	1.73	clayey silt to silty clay	-6.2	1.00	4	2,340	1,360	1,984	2.90	N/A	N/A	0.955	N/A	0.342	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.95
20.50	8.52	0.14	1.66	clayey silt to silty clay	-7.2	1.00	4	2,460	1,418	2,042	2.86	N/A	N/A	0.952	N/A	0.344	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.95
21.50	9.05	0.14	1.57	clayey silt to silty clay	-8.2	1.00	5	2,580	1,476	2,100	2.83	N/A	N/A	0.950	N/A	0.345	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.95
22.50	7.40	0.13	1.79	silty clay to clay	-9.2	1.00	5	2,700	1,533	2,157	2.96	N/A	N/A	0.948	N/A	0.347	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.95
23.50	8.48	0.13	1.51	clayey silt to silty clay	-10.2	1.00	4	2,820	1,591	2,215	2.88	N/A	N/A	0.945	N/A	0.349	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.95
24.50	9.64	0.31	3.17	silty clay to clay	-11.2	1.00	6	2,940	1,648	2,272	3.01	N/A	N/A	0.943	N/A	0.350	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.95
25.50	9.70	0.31	3.18	silty clay to clay	-12.2	1.00	6	3,060	1,706	2,330	3.02	N/A	N/A	0.941	N/A	0.351	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.95
26.50	7.97	0.26	3.22	clay	-13.2	1.00	8	3,180	1,764	2,388	3.12	N/A	N/A	0.938	N/A	0.352	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.95
27.50	7.46	0.22	2.92	clay	-14.2	1.00	7	3,300	1,821	2,445	3.13	N/A	N/A	0.936	N/A	0.353	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.95
28.50	8.94	0.18	2.04	clayey silt to silty clay	-15.2	1.00	4	3,420	1,879	2,503	2.98	N/A	N/A	0.934	N/A	0.353	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.95
29.50	46.97	1.41	3.00	sandy silt to clayey silt	-16.2	1.00	19	3,540	1,936	2,560	2.48	2.66	127.14	0.931	1.000	0.354	0.271	1.022	YES	2.8	19.4	1,123	24.9	N/A	0.195	0.02	0.92
30.50	26.33	0.55	2.09	sandy silt to clayey silt	-17.2	1.00	11	3,660	1,994	2,618	2.58	3.22	84.89	0.926	1.000	0.353	0.137	0.517	YES	2.8	12.0	437	16.0	N/A	1.748	0.21	0.71
31.50	16.33	0.49	2.98	clayey silt to silty clay	-18.2	1.00	8	3,780	2,052	2,676	2.86	N/A	N/A	0.918	N/A	0.352	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.71
32.50	24.22	0.42	1.74	sandy silt to clayey silt	-19.2	1.00	10	3,900	2,109	2,733	2.58	3.21	74.80	0.909	0.989	0.350	0.119	0.448	YES	2.8	11.1	375	14.9	N/A	1.873	0.22	0.49
33.50	20.00	0.52	2.59	clayey silt to silty clay	-20.2	1.00	10	4,020	2,167	2,791	2.76	N/A	N/A	0.901	N/A	0.348	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.49
34.50	21.24	0.36	1.70	sandy silt to clayey silt	-21.2	1.00	8	4,140	2,224	2,848	2.64	N/A	N/A	0.893	N/A	0.346	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.49
35.50	13.79	0.12	0.87	sandy silt to clayey silt	-22.2	1.00	6	4,260	2,282	2,906	2.67	N/A	N/A	0.885	N/A	0.344	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.49
36.50	23.17	0.32	1.36	sandy silt to clayey silt	-23.2	1.00	9	4,380	2,340	2,964	2.57	3.14	64.71	0.877	0.968	0.341	0.105	0.398	YES	2.8	10.4	335	14.1	N/A	1.965	0.24	0.25
37.50	36.54	0.53	1.45	silty sand to sandy silt	-24.2	1.00	12	4,500	2,397	3,021	2.40	2.32	77.53	0.869	0.958	0.339	0.123	0.465	YES	2.8	12.7	488	16.9	N/A	1.629	0.20	0.06
38.50	29.82	0.47	1.58	sandy silt to clayey silt	-25.2	1.66	20	4,620	2,455	3,079	2.19	1.65	73.37	0.861	0.941	0.337	0.117	0.435	YES	2.8	18.7	1,051	24.1	N/A	0.189	0.02	0.03
39.50	13.32	0.30	2.23	clayey silt to silty clay	-26.2	1.00	7	4,740	2,512	3,136	2.93	N/A	N/A	0.852	N/A	0.335	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.03
40.50	12.01	0.19	1.56	clayey silt to silty clay	-27.2	1.00	6	4,860	2,570	3,194	2.90	N/A	N/A	0.844	N/A	0.332	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.03
41.50	9.60	0.27	2.82	silty clay to clay	-28.2	1.00	6	4,980	2,627	3,251	3.14	N/A	N/A	0.836	N/A	0.330	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.03
42.50	10.70	0.32	3.00	silty clay to clay	-29.2	1.00	7	5,100	2,685	3,309	3.12	N/A	N/A	0.828	N/A	0.327	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.03
43.50	12.89	0.70	5.46	clay	-30.2	1.00	13	5,220	2,743	3,367	3.21	N/A	N/A	0.820	N/A	0.325	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.03
44.50	11.44	0.37	3.20	silty clay to clay	-31.2	1.00	8	5,340	2,800	3,424	3.12	N/A	N/A	0.812	N/A	0.322	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.03
45.50	29.29	0.92	3.13	clayey silt to silty clay	-32.2	1.00	15	5,460	2,858	3,482	2.75	N/A	N/A	0.804	N/A	0.319	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.03
46.50	104.71	1.47	1.41	sand to silty sand	-33.2	1.00	26	5,580	2,915	3,539	2.06	1.39	120.53	0.795	0.882	0.317	0.243	0.903	YES	1.3	21.0	1,200	23.1	N/A	0.181	0.02	0.01
47.50	188.21	1.16	0.61	sand	-34.2	1.00	38	5,700	2,973	3,597	1.63	1.00	154.37	0.787	0.854	0.314	0.422	1.532	NO	N/A	N/A	N/A	28.1	N/A	0.078	0.01	0.00

max=	1,200
min=	335
avg=	704

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	A-CPT014

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	16.00 ft
GWT Elev. During Test	0.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw = 16.00 ft below ground surface

GWT Depth For Design, Zwd = 6.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils = 14.00 feet

Earthquake-Induced Settlements:

- Liquefaction-Induced Settlement = 0.83 inches <--- Saturated Sands
- Seismic Compaction Settlement = 0.00 inches <--- Dry or Unsaturated Sands

Total: 0.83 inches

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_t (in.)	Cumulative Settlement Profile (in.)
0.50	8.66	0.05	0.54	sensitive fine grained	15.0	1.00	4	60	60	60	2.01	1.31	65.54	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.83
1.50	54.88	0.17	0.32	sand to silty sand	14.0	1.66	23	180	180	180	1.11	1.00	302.88	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	43.0	0.015	0.000	0.00	0.83
2.50	25.56	0.33	1.27	sandy silt to clayey silt	13.0	1.00	10	300	300	300	2.12	1.49	98.29	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	25.9	N/A	N/A	N/A	N/A	0.83
3.50	24.49	0.93	3.81	silty clay to clay	12.0	1.00	16	420	420	420	2.51	2.81	150.22	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.83
4.50	33.69	1.31	3.90	clayey silt to silty clay	11.0	1.00	17	540	540	540	2.46	2.56	166.27	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.83
5.50	27.89	1.37	4.89	clay	10.0	1.00	28	660	660	660	2.54	2.96	189.59	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.83
6.50	23.82	0.87	3.67	silty clay to clay	9.0	1.00	16	780	749	780	2.60	3.31	128.68	0.985	1.000	0.213	0.278	1.739	NO	N/A	N/A	N/A	N/A	N/A	0.000	0.00	0.83
7.50	20.13	0.84	4.16	silty clay to clay	8.0	1.00	13	900	806	900	2.63	N/A	N/A	0.983	N/A	0.228	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.83
8.50	17.54	0.53	3.01	clayey silt to silty clay	7.0	1.00	9	1,020	864	1,020	2.60	3.31	108.80	0.980	1.000	0.241	0.200	1.107	YES	2.8	15.1	687	N/A	N/A	0.000	0.00	0.83
9.50	12.87	0.53	4.14	clay	6.0	1.00	13	1,140	922	1,140	2.81	N/A	N/A	0.978	N/A	0.252	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.83
10.50	8.69	0.37	4.30	clay	5.0	1.00	9	1,260	979	1,260	2.97	N/A	N/A	0.976	N/A	0.261	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.83
11.50	11.48	0.48	4.21	clay	4.0	1.00	11	1,380	1,037	1,380	2.89	N/A	N/A	0.973	N/A	0.269	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.83
12.50	22.82	0.42	1.85	sandy silt to clayey silt	3.0	1.66	15	1,500	1,094	1,500	2.18	1.61	82.20	0.971	1.000	0.277	0.132	0.635	YES	2.8	20.3	1,200	25.9	N/A	0.079	0.01	0.82
13.50	8.02	0.33	4.05	clay	2.0	1.00	8	1,620	1,152	1,620	3.03	N/A	N/A	0.969	N/A	0.283	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.82
14.50	40.27	0.54	1.34	silty sand to sandy silt	1.0	1.00	13	1,740	1,210	1,740	2.22	1.71	88.72	0.966	1.000	0.289	0.145	0.669	YES	2.8	17.2	893	22.3	N/A	0.143	0.02	0.80
15.50	78.51	0.64	0.81	sand to silty sand	0.0	1.00	20	1,860	1,267	1,860	1.86	1.16	113.95	0.964	1.000	0.294	0.218	0.987	YES	1.3	21.7	1,200	23.8	N/A	0.098	0.01	0.79
16.50	72.42	0.74	1.02	sand to silty sand	-1.0	1.00	18	1,980	1,325	1,949	1.96	1.25	111.32	0.962	1.000	0.299	0.208	0.930	YES	1.3	19.7	1,152	21.7	N/A	0.199	0.02	0.77
17.50	47.27	0.58	1.23	silty sand to sandy silt	-2.0	1.66	26	2,100	1,382	2,006	1.85	1.15	108.18	0.959	1.000	0.303	0.198	0.871	YES	2.8	28.8	1,200	36.3	N/A	0.024	0.00	0.76
18.50	9.68	0.33	3.36	clay	-3.0	1.00	10	2,220	1,440	2,064	2.98	N/A	N/A	0.957	N/A	0.307	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.76
19.50	10.83	0.27	2.52	silty clay to clay	-4.0	1.00	7	2,340	1,498	2,122	2.88	N/A	N/A	0.955	N/A	0.310	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.76
20.50	7.38	0.15	1.97	silty clay to clay	-5.0	1.00	5	2,460	1,555	2,179	2.98	N/A	N/A	0.952	N/A	0.313	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.76
21.50	6.06	0.04	0.71	sensitive fine grained	-6.0	1.00	3	2,580	1,613	2,237	2.87	5.40	38.47	0.950	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.76
22.50	5.75	0.04	0.75	sensitive fine grained	-7.0	1.00	3	2,700	1,670	2,294	2.92	5.85	38.46	0.948	N/A	0.319	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.76
23.50	5.36	0.03	0.54	sensitive fine grained	-8.0	1.00	3	2,820	1,728	2,352	2.90	5.74	34.31	0.945	N/A	0.321	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.76
24.50	7.27	0.12	1.62	clayey silt to silty clay	-9.0	1.00	4	2,940	1,786	2,410	2.99	N/A	N/A	0.943	N/A	0.323	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.76
25.50	9.19	0.22	2.38	silty clay to clay	-10.0	1.00	6	3,060	1,843	2,467	2.99	N/A	N/A	0.941	N/A	0.325	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.76
26.50	8.39	0.18	2.19	silty clay to clay	-11.0	1.00	6	3,180	1,901	2,525	3.02	N/A	N/A	0.938	N/A	0.326	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.76
27.50	48.12	0.68	1.42	silty sand to sandy silt	-12.0	1.00	16	3,300	1,958	2,582	2.26	1.82	88.61	0.936	1.000	0.328	0.145	0.589	YES	2.8	16.9	865	21.9	N/A	0.535	0.06	0.70
28.50	117.01	0.59	0.50	sand	-13.0	1.00	23	3,420	2,016	2,640	1.68	1.03	119.52	0.934	0.997	0.329	0.239	0.965	YES	0.0	20.4	1,200	20.4	N/A	1.164	0.14	0.56
29.50	60.52	0.76	1.26	silty sand to sandy silt	-14.0	1.00	20	3,540	2,074	2,698	2.16	1.57	93.15	0.931	0.989	0.331	0.155	0.619	YES	2.8	20.2	1,200	25.8	N/A	0.099	0.01	0.55
30.50	35.17	0.47	1.32	silty sand to sandy silt	-15.0	1.00	12	3,660	2,131	2,755	2.37	2.19	74.73	0.926	0.985	0.331	0.119	0.472	YES	2.8	12.8	494	17.0	N/A	1.601	0.19	0.36
31.50	119.31	0.58	0.49	sand	-16.0	1.00	24	3,780	2,189	2,813	1.68	1.00	114.05	0.918	0.970	0.330	0.218	0.856	YES	0.0	20.1	1,198	20.1	N/A	1.196	0.14	0.21
32.50	102.38	0.48	0.47	sand	-17.0	1.66	34	3,900	2,246	2,870	1.43	1.00	159.95	0.909	0.955	0.328	0.461	1.787	NO	N/A	N/A	N/A	28.3	N/A	0.081	0.01	0.20
33.50	45.71	0.42	0.92	silty sand to sandy silt	-18.0	1.00	15	4,020	2,304	2,928	2.20	1.67	70.92	0.901	0.963	0.327	0.113	0.445	YES	2.8	15.4	716	20.1	N/A	1.184	0.14	0.06
34.50	32.02	0.42	1.30	silty sand to sandy silt	-19.0	1.66	18	4,140	2,362	2,986	2.11	1.47	71.95	0.893	0.954	0.326	0.115	0.448	YES	2.8	17.3	900	22.4	N/A	0.386	0.05	0.01
35.50	11.89	0.22	1.81	clayey silt to silty clay	-20.0	1.00	6	4,260	2,419	3,043	2.91	N/A	N/A	0.885	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
36.50	8.71	0.15	1.73	clayey silt to silty clay	-21.0	1.00	4	4,380	2,477	3,101	3.04	N/A	N/A	0.877	N/A	0.323	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
37.50	11.78	0.24	1.99	clayey silt to silty clay	-22.0	1.00	6	4,500	2,534	3,158	2.95	N/A	N/A	0.869	N/A	0.321	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
38.50	12.34	0.34	2.72	clayey silt to silty clay	-23.0	1.00	6	4,620	2,592	3,216	3.02	N/A	N/A	0.861	N/A	0.319	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
39.50	10.46	0.24	2.34	clayey silt to silty clay	-24.0	1.00	5	4,740	2,650	3,274	3.06	N/A	N/A	0.852	N/A	0.317	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
40.50	14.14	0.49	3.43	silty clay to clay	-25.0	1.00	9	4,860	2,707	3,331	3.04	N/A	N/A	0.844	N/A	0.315	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
41.50	14.94	0.44	2.94	clayey silt to silty clay	-26.0	1.00	7	4,980	2,765	3,389	2.98	N/A	N/A	0.836	N/A	0.313	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
42.50	9.06	0.35	3.82	clay	-27.0	1.00	9	5,100	2,822	3,446	3.27	N/A	N/A	0.828	N/A	0.311	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
43.50	8.45	0.20	2.39	silty clay to clay	-28.0	1.00	6	5,220	2,880	3,504	3.19	N/A	N/A	0.820	N/A	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
44.50	11.55	0.33	2.88	silty clay to clay	-29.0	1.00	8	5,340	2,938	3,562	3.10	N/A	N/A	0.812	N/A	0.307	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
45.50	9.83	0.44	4.44	clay	-30.0	1.00	10	5,460	2,995	3,619	3.29	N/A	N/A	0.804	N/A	0.305	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
46.50	10.60	0.29	2.74	silty clay to clay	-31.0	1.00	7	5,580	3,053	3,677	3.14	N/A	N/A	0.795	N/A	0.302	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
47.50	14.48	0.35	2.42	clayey silt to silty clay	-32.0	1.00	7	5,700	3,110	3,734	2.98	N/A	N/A	0.787	N/A	0.300	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
48.50	18.05	0.52	2.89	clayey silt to silty clay	-33.0	1.00	9	5,820	3,168	3,792	2.95	N/A	N/A	0.779	N/A	0.298	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
49.50	28.10	1.25	4.44	silty clay to clay	-34.0	1.00	19	5,940	3,226	3,850	2.90	N/A	N/A	0.771	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
50.50	62.12	1.40	2.26	sandy silt to clayey silt	-35.0	1.00	25	6,060	3,283	3,907	2.39	2.29	110.80	0.763	0.855	0.293	0.206	0.804	YES	2.8	20.6	1,200	26.3	N/A	0.083	0.01	0.00
51.50	243.30	1.16	0.48	sand	-36.0	1.00	49	6,180	3,341	3,965	1.50	1.00	188.25	0.755	0.814	0.290	N/A	N/A	NO	N/A	N/A	N/A	34.6	N/A	0.033	0.00	0.00

max= 1,200
min= 494
avg= 1,007

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	A-CPT019

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	16.80 ft
GWT Elev. During Test	0.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	16.80 ft below ground surface
GWT Depth For Design, Zwd =	6.80 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	19.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	2.05 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	2.05 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{t1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_t (in.)	Cumulative Settlement Profile (in.)
0.50	72.08	1.46	2.02	silty sand to sandy silt	15.8	1.00	24	60	60	60	1.75	1.07	445.07	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	54.0	0.008	0.000	0.00	2.05
1.50	46.26	0.74	1.61	silty sand to sandy silt	14.8	1.00	15	180	180	180	1.92	1.21	186.06	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	36.5	0.016	0.013	0.00	2.05
2.50	59.46	1.10	1.84	silty sand to sandy silt	13.8	1.00	33	300	300	300	1.66	1.01	256.05	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	72.0	0.016	0.000	0.00	2.05
3.50	27.69	0.97	3.50	clayey silt to silty clay	12.8	1.00	14	420	420	420	2.44	2.50	151.34	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.05
4.50	29.09	1.28	4.38	silty clay to clay	11.8	1.00	32	540	540	540	2.23	1.74	161.20	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.05
5.50	11.79	0.47	4.01	clay	10.8	1.00	12	660	660	660	2.74	N/A	N/A	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.05
6.50	9.40	0.31	3.27	silty clay to clay	9.8	1.00	6	780	780	780	2.80	N/A	N/A	0.985	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.05
7.50	8.02	0.27	3.40	clay	8.8	1.00	8	900	856	900	2.90	N/A	N/A	0.983	N/A	0.215	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.05
8.50	7.67	0.21	2.72	silty clay to clay	7.8	1.00	5	1,020	914	1,020	2.87	N/A	N/A	0.980	N/A	0.228	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.05
9.50	9.02	0.21	2.36	silty clay to clay	6.8	1.00	6	1,140	972	1,140	2.80	N/A	N/A	0.978	N/A	0.239	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.05
10.50	27.06	0.18	0.65	silty sand to sandy silt	5.8	1.00	9	1,260	1,029	1,260	2.16	1.58	59.44	0.976	1.000	0.248	0.100	0.535	YES	2.8	14.2	606	18.6	N/A	0.185	0.02	2.03
11.50	15.45	0.15	0.94	sandy silt to clayey silt	4.8	1.66	10	1,380	1,087	1,380	2.17	1.59	55.14	0.973	1.000	0.257	0.096	0.496	YES	2.8	15.1	691	19.8	N/A	0.157	0.02	2.01
12.50	7.60	0.15	1.95	silty clay to clay	3.8	1.00	5	1,500	1,144	1,500	2.87	N/A	N/A	0.971	N/A	0.265	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.01
13.50	19.01	0.27	1.43	sandy silt to clayey silt	2.8	1.00	8	1,620	1,202	1,620	2.50	2.79	68.35	0.969	1.000	0.272	0.110	0.539	YES	2.8	11.2	386	15.1	N/A	1.703	0.20	1.81
14.50	32.47	0.30	0.92	silty sand to sandy silt	1.8	1.66	18	1,740	1,260	1,740	1.91	1.19	80.91	0.966	1.000	0.278	0.129	0.621	YES	2.8	22.0	1,200	28.1	N/A	0.068	0.01	1.80
15.50	11.42	0.23	2.00	clayey silt to silty clay	0.8	1.00	6	1,860	1,317	1,860	2.76	N/A	N/A	0.964	N/A	0.283	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.80
16.50	5.94	0.15	2.60	clay	-0.2	1.00	6	1,980	1,375	1,980	3.09	N/A	N/A	0.962	N/A	0.288	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.80
17.50	11.84	0.17	1.46	clayey silt to silty clay	-1.2	1.00	6	2,100	1,432	2,056	2.70	N/A	N/A	0.959	N/A	0.293	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.80
18.50	16.42	0.19	1.13	sandy silt to clayey silt	-2.2	1.66	11	2,220	1,490	2,114	2.24	1.78	56.09	0.957	1.000	0.297	0.096	0.434	YES	2.8	13.4	540	17.7	N/A	1.377	0.17	1.63
19.50	7.77	0.18	2.34	silty clay to clay	-3.2	1.00	5	2,340	1,548	2,172	3.00	N/A	N/A	0.955	N/A	0.300	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.63
20.50	6.77	0.20	2.98	clay	-4.2	1.00	7	2,460	1,605	2,229	3.12	N/A	N/A	0.952	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.63
21.50	6.12	0.10	1.61	sensitive fine grained	-5.2	1.00	3	2,580	1,663	2,287	3.04	N/A	N/A	0.950	N/A	0.307	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.63
22.50	5.93	0.08	1.33	sensitive fine grained	-6.2	1.00	3	2,700	1,720	2,344	3.02	N/A	N/A	0.948	N/A	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.63
23.50	6.73	0.16	2.39	silty clay to clay	-7.2	1.00	4	2,820	1,778	2,402	3.11	N/A	N/A	0.945	N/A	0.312	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.63
24.50	6.28	0.13	2.14	silty clay to clay	-8.2	1.00	4	2,940	1,836	2,460	3.12	N/A	N/A	0.943	N/A	0.314	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.63
25.50	5.93	0.10	1.70	silty clay to clay	-9.2	1.00	4	3,060	1,893	2,517	3.11	N/A	N/A	0.941	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.63
26.50	5.87	0.08	1.43	sensitive fine grained	-10.2	1.00	3	3,180	1,951	2,575	3.09	N/A	N/A	0.938	N/A	0.318	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.63
27.50	6.84	0.13	1.89	silty clay to clay	-11.2	1.00	5	3,300	2,008	2,632	3.09	N/A	N/A	0.936	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.63
28.50	5.98	0.06	0.99	sensitive fine grained	-12.2	1.00	3	3,420	2,066	2,690	3.03	N/A	N/A	0.934	N/A	0.321	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.63
29.50	5.92	0.04	0.63	sensitive fine grained	-13.2	1.00	3	3,540	2,124	2,748	2.96	6.29	35.62	0.931	N/A	0.323	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.63
30.50	7.24	0.07	0.96	sensitive fine grained	-14.2	1.00	4	3,660	2,181	2,805	2.95	N/A	N/A	0.926	N/A	0.323	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.63
31.50	20.33	0.22	1.07	sandy silt to clayey silt	-15.2	1.66	13	3,780	2,239	2,863	2.23	1.75	55.65	0.918	0.972	0.322	0.096	0.386	YES	2.8	14.1	597	18.5	N/A	1.374	0.16	1.47
32.50	9.03	0.07	0.75	clayey silt to silty clay	-16.2	1.00	5	3,900	2,296	2,920	2.83	5.00	40.71	0.909	N/A	0.321	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
33.50	7.75	0.14	1.74	clayey silt to silty clay	-17.2	1.00	4	4,020	2,354	2,978	3.08	N/A	N/A	0.901	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
34.50	7.44	0.13	1.69	clayey silt to silty clay	-18.2	1.00	4	4,140	2,412	3,036	3.10	N/A	N/A	0.893	N/A	0.319	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
35.50	7.56	0.12	1.62	clayey silt to silty clay	-19.2	1.00	4	4,260	2,469	3,093	3.09	N/A	N/A	0.885	N/A	0.318	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
36.50	8.33	0.20	2.38	silty clay to clay	-20.2	1.00	6	4,380	2,527	3,151	3.14	N/A	N/A	0.877	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
37.50	8.60	0.15	1.77	clayey silt to silty clay	-21.2	1.00	4	4,500	2,584	3,208	3.07	N/A	N/A	0.869	N/A	0.315	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
38.50	13.25	0.19	1.45	clayey silt to silty clay	-22.2	1.00	7	4,620	2,642	3,266	2.84	N/A	N/A	0.861	N/A	0.313	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
39.50	14.70	0.23	1.59	sandy silt to clayey silt	-23.2	1.00	6	4,740	2,700	3,324	2.83	N/A	N/A	0.852	N/A	0.311	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
40.50	12.33	0.35	2.82	silty clay to clay	-24.2	1.00	8	4,860	2,757	3,381	3.05	N/A	N/A	0.844	N/A	0.310	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
41.50	18.48	0.51	2.75	clayey silt to silty clay	-25.2	1.00	9	4,980	2,815	3,439	2.89	N/A	N/A	0.836	N/A	0.308	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
42.50	20.83	0.56	2.69	clayey silt to silty clay	-26.2	1.00	10	5,100	2,872	3,496	2.84	N/A	N/A	0.828	N/A	0.306	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
43.50	25.53	0.64	2.50	sandy silt to clayey silt	-27.2	1.00	10	5,220	2,930	3,554	2.75	N/A	N/A	0.820	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.47
44.50	60.51	0.43	0.71	sand to silty sand	-28.2	1.00	15	5,340	2,987	3,611	2.08	1.43	70.70	0.812	0.904	0.302	0.113	0.451	YES	1.3	12.6	479	14.3	N/A	1.931	0.23	1.24
45.50	41.48	0.61	1.47	silty sand to sandy silt	-29.2	1.00	14	5,460	3,045	3,669	2.41	2.34	78.51	0.804	0.904	0.300	0.125	0.503	YES	2.8	13.0	511	17.3	N/A	1.462	0.18	1.06
46.50	31.19	0.89	2.84	sandy silt to clayey silt	-30.2	1.00	12	5,580	3,103	3,727	2.73	N/A	N/A	0.795	N/A	0.298	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.06
47.50	59.82	0.65	1.09	silty sand to sandy silt	-31.2	1.00	20	5,700	3,160	3,784	2.20	1.67	79.44	0.787	0.878	0.295	0.127	0.502	YES	2.8	17.3	903	22.4	N/A	0.158	0.02	1.04
48.50	134.91	0.53	0.39	sand	-32.2	1.00	27	5,820	3,218	3,842	1.66	1.00	106.36	0.779	0.854	0.293	0.192	0.746	YES	0.0	19.5	1,130	19.5	N/A	1.052	0.13	0.92
49.50	81.41	0.40	0.50	sand to silty sand	-33.2	1.66	34	5,940	3,275	3,899	1.61	1.00	105.33	0.771	0.834	0.291	0.189	0.722	YES	1.3	25.5	1,200	27.8	N/A	0.073	0.01	0.91
50.50	13.11	0.19	1.46	clayey silt to silty clay	-34.2	1.00	7	6,060	3,333	3,957	2.93	N/A	N/A	0.763	N/A	0.289	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.91
51.50	11.33	0.19	1.63	clayey silt to silty clay	-35.2	1.00	6	6,180	3,391	4,015	3.03	N/A	N/A	0.755	N/A	0.286	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.91
52.50	24.60	0.28	1.12	sandy silt to clayey silt	-36.2	1.00	10	6,300	3,448	4,072	2.62	N/A	N/A	0.747	N/A	0.284	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.91
53.50	53.97	0.49	0.91	silty sand to sandy silt	-37.2	1.00	18	6,420	3,506	4,130	2.22	1.71	69.56	0.739	0.862	0.281	0.111	0.455	YES	2.8	15.3	709	20.0	N/A	0.302	0.04	0.87
54.50	73.59	0.59	0.80	sand to silty sand	-38.2	1.00	18	6,540	3,563	4,187	2.07	1.40	77.45	0.730	0.857	0.279	0.123	0.505	YES	1.3	14.0	596	15.8	N/A	1.595	0.19	0.68
55.50	58.87	0.54	0.92	sand to silty sand	-39.2	1.00	15	6,660	3,621	4,245	2.19	1.65	72.15	0.722	0.868	0.276	0.115	0.482	YES	1.3	11.4	398	13.1	N/A	2.118	0.25	0.43
56.50	69.53	0.72	1.04	sand to silty sand	-40.2	1.00	17	6,780	3,679	4,303	2.16	1.58	80.99	0.714	0.854	0.274	0.129	0.539	YES	1.3	13.2	525	14.9	N/A	1.763	0.21	0.21
57.50	76.31	0.88	1.15	sand to silty sand	-41.2	1.00	19	6,900	3,736	4,360	2.16	1.57	87.78	0.706	0.845	0.271	0.143	0.594	YES	1.3	14.3	614	16.0	N/A	1.493	0.18	0.04
58.50	107.92	0.94	0.87	sand to silty sand	-42.2	1.00	27	7,020	3,794	4,418	1.97	1.26	98.59	0.698	0.815	0.269	0.169	0.685	YES	1.3	19.5	1,132	21.5	N/A	0.108	0.01	0.02
59.50	113.67	0.97	0.85	sand to silty sand	-43.2	1.00	28	7,140	3,851	4,475	1.94	1.23	100.98	0.690	0.807	0.266	0.176	0.712	YES	1.3	20.3	1,200	22.4	N/A	0.095	0.01	0.01
60.50	112.56	1.15	1.02	sand to silty sand	-44.2	1.00	28	7,260	3,909	4,533	2.00	1.30	104.38	0.682	0.805	0.263	0.186	0.758	YES	1.3	20.0	1,188	22.1	N/A	0.096	0.01	0.00
																						max=	1,200				
																						min=	386				
																						avg=	769				

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	A-CPT021

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	16.60 ft
GWT Elev. During Test	0.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	16.60 ft below ground surface
GWT Depth For Design, Zwd =	6.60 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	13.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	0.77 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.01 inches	<--- Dry or Unsaturated Sands
Total:	0.78 inches	

INPUT SOIL PROFILE (CPT DATA)				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)
0.50	19.24	0.33	1.73	silty sand to sandy silt
1.50	21.70	0.46	2.12	silty sand to sandy silt
2.50	40.57	1.15	2.85	silty sand to sandy silt
3.50	23.66	1.01	4.27	clayey silt to silty clay
4.50	21.27	0.56	2.62	silty clay to clay
5.50	33.40	0.83	2.49	clay
6.50	29.44	0.79	2.67	silty clay to clay
7.50	8.68	0.25	2.92	clay
8.50	7.92	0.19	2.38	silty clay to clay
9.50	5.73	0.13	2.27	silty clay to clay
10.50	6.88	0.14	2.02	silty sand to sandy silt
11.50	20.27	0.38	1.87	sandy silt to clayey silt
12.50	38.98	0.29	0.75	silty clay to clay
13.50	13.47	0.21	1.55	sandy silt to clayey silt
14.50	5.08	0.20	3.87	silty sand to sandy silt
15.50	35.36	0.23	0.64	clayey silt to silty clay
16.50	20.67	0.21	1.00	clay
17.50	4.82	0.12	2.46	clayey silt to silty clay
18.50	5.94	0.17	2.83	sandy silt to clayey silt
19.50	5.76	0.16	2.77	silty clay to clay
20.50	4.24	0.05	1.14	clay
21.50	5.44	0.09	1.65	sensitive fine grained
22.50	5.38	0.11	2.08	sensitive fine grained
23.50	5.35	0.08	1.44	silty clay to clay
24.50	6.26	0.11	1.75	silty clay to clay
25.50	6.26	0.12	1.94	silty clay to clay
26.50	5.36	0.11	2.00	sensitive fine grained
27.50	6.30	0.14	2.29	silty clay to clay
28.50	5.95	0.10	1.74	sensitive fine grained
29.50	6.04	0.07	1.07	sensitive fine grained
30.50	6.88	0.11	1.64	sensitive fine grained
31.50	7.49	0.17	2.31	sandy silt to clayey silt
32.50	7.47	0.15	2.00	clayey silt to silty clay
33.50	7.85	0.16	2.07	clayey silt to silty clay
34.50	9.94	0.23	2.30	clayey silt to silty clay
35.50	15.70	0.42	2.70	clayey silt to silty clay
36.50	14.24	0.41	2.89	silty clay to clay
37.50	64.25	0.49	0.77	clayey silt to silty clay
38.50	27.60	0.69	2.51	clayey silt to silty clay
39.50	49.60	0.88	1.78	sandy silt to clayey silt
40.50	124.15	1.04	0.84	silty clay to clay
41.50	126.75	0.76	0.60	clayey silt to silty clay
42.50	59.31	0.87	1.46	clayey silt to silty clay
43.50	79.24	0.68	0.86	sandy silt to clayey silt
44.50	22.85	0.60	2.64	sand to silty sand
45.50	18.29	0.39	2.16	silty sand to sandy silt
46.50	20.29	0.31	1.53	sandy silt to clayey silt
47.50	13.24	0.23	1.76	silty sand to sandy silt
48.50	16.58	0.38	2.28	sand
49.50	82.23	0.84	1.03	sand to silty sand
50.50	56.96	0.98	1.71	clayey silt to silty clay
51.50	26.41	0.73	2.76	clayey silt to silty clay
52.50	13.33	0.25	1.90	sandy silt to clayey silt
53.50	12.72	0.23	1.78	silty sand to sandy silt
54.50	16.32	0.46	2.83	sand to silty sand
55.50	18.97	0.41	2.15	sand to silty sand
56.50	18.83	0.44	2.36	sand to silty sand
57.50	21.42	0.58	2.70	sand to silty sand
58.50	47.00	0.90	1.92	sand to silty sand
59.50	296.19	0.61	0.21	sand to silty sand

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +																RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r(psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_t (in.)	Cumulative Settlement Profile (in.)
15.6	1.00	6	60	60	60	2.04	1.35	150.44	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	18.1	0.012	0.022	0.00	0.78
14.6	1.00	7	180	180	180	2.23	1.75	126.76	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	19.8	0.020	0.033	0.00	0.78
13.6	1.00	14	300	300	300	2.22	1.71	178.74	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	32.6	0.021	0.020	0.00	0.78
12.6	1.00	12	420	420	420	2.55	3.06	157.86	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.78
11.6	1.00	14	540	540	540	2.48	2.67	109.49	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.78
10.6	1.00	33	660	660	660	2.35	2.13	123.90	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.78
9.6	1.66	32	780	780	780	2.13	1.51	118.04	0.985	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.78
8.6	1.00	9	900	844	900	2.82	N/A	N/A	0.983	N/A	0.218	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.78
7.6	1.00	5	1,020	901	1,020	2.83	N/A	N/A	0.980	N/A	0.231	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.78
6.6	1.00	4	1,140	959	1,140	2.96	N/A	N/A	0.978	N/A	0.242	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.78
5.6	1.00	2	1,260	1,017	1,260	2.88	N/A	N/A	0.976	N/A	0.251	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.78
4.6	1.00	8	1,380	1,074	1,380	2.53	2.91	80.40	0.973	1.000	0.260	0.128	0.659	YES	2.8	12.6	477	16.7	N/A	1.201	0.14	0.63
3.6	1.66	43	1,500	1,132	1,500	1.77	1.00	85.79	0.971	1.000	0.268	0.139	0.692	YES	5.0	54.7	1,200	N/A	N/A	0.000	0.00	0.63
2.6	1.66	9	1,620	1,189	1,620	2.34	2.10	60.67	0.969	1.000	0.274	0.101	0.490	YES	2.8	12.7	488	16.9	N/A	1.330	0.16	0.47
1.6	1.00	2	1,740	1,247	1,740	3.22	N/A	N/A	0.966	N/A	0.280	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
0.6	1.00	18	1,860	1,305	1,860	2.10	1.46	63.96	0.964	1.000	0.286	0.104	0.487	YES	2.8	21.1	1,200	N/A	N/A	0.000	0.00	0.47
-0.4	1.66	34	1,980	1,362	1,980	2.11	1.48	61.23	0.962	1.000	0.291	0.101	0.465	YES	5.0	39.4	1,200	N/A	N/A	0.000	0.00	0.47
-1.4	1.00	2	2,100	1,420	2,044	3.18	N/A	N/A	0.959	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-2.4	1.00	2	2,220	1,477	2,101	3.14	N/A	N/A	0.957	N/A	0.299	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-3.4	1.00	4	2,340	1,535	2,159	3.16	N/A	N/A	0.955	N/A	0.303	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-4.4	1.00	4	2,460	1,593	2,217	3.12	N/A	N/A	0.952	N/A	0.306	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-5.4	1.00	3	2,580	1,650	2,274	3.09	N/A	N/A	0.950	N/A	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-6.4	1.00	3	2,700	1,708	2,332	3.16	N/A	N/A	0.948	N/A	0.312	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-7.4	1.00	4	2,820	1,765	2,389	3.10	N/A	N/A	0.945	N/A	0.314	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-8.4	1.00	4	2,940	1,823	2,447	3.08	N/A	N/A	0.943	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-9.4	1.00	4	3,060	1,881	2,505	3.11	N/A	N/A	0.941	N/A	0.318	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-10.4	1.00	3	3,180	1,938	2,562	3.20	N/A	N/A	0.938	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-11.4	1.00	4	3,300	1,996	2,620	3.17	N/A	N/A	0.936	N/A	0.322	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-12.4	1.00	3	3,420	2,053	2,677	3.15	N/A	N/A	0.934	N/A	0.323	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-13.4	1.00	3	3,540	2,111	2,735	3.05	N/A	N/A	0.931	N/A	0.325	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-14.4	1.00	3	3,660	2,169	2,793	3.09	N/A	N/A	0.926	N/A	0.325	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-15.4	1.00	3	3,780	2,226	2,850	3.14	N/A	N/A	0.918	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-16.4	1.00	4	3,900	2,284	2,908	3.11	N/A	N/A	0.909	N/A	0.323	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-17.4	1.00	4	4,020	2,341	2,965	3.11	N/A	N/A	0.901	N/A	0.322	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-18.4	1.00	5	4,140	2,399	3,023	3.04	N/A	N/A	0.893	N/A	0.321	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-19.4	1.00	8	4,260	2,457	3,081	2.90	N/A	N/A	0.885	N/A	0.319	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-20.4	1.00	9	4,380	2,514	3,138	2.96	N/A	N/A	0.877	N/A	0.318	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-21.4	1.66	53	4,500	2,572	3,196	1.74	1.00	93.81	0.869	0.904	0.316	0.157	0.598	YES	2.8	44.9	1,200	N/A	N/A	0.000	0.00	0.47
-22.4	1.00	14	4,620	2,629	3,253	2.69	N/A	N/A	0.861	N/A	0.315	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-23.4	1.00	20	4,740	2,687	3,311	2.37	2.18	93.41	0.852	0.917	0.313	0.156	0.609	YES	2.8	18.2	999	23.5	N/A	0.153	0.02	0.45
-24.4	1.00	83	4,860	2,745	3,369	1.85	1.14	121.13	0.844	0.881	0.311	0.245	0.927	YES	5.0	68.8	1,200	N/A	N/A	0.000	0.00	0.45
-25.4	1.66	105	4,980	2,802	3,426	1.45	1.00	177.30	0.836	0.874	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	0.000	0.00	0.45
-26.4	1.00	30	5,100	2,860	3,484	2.26	1.83	90.91	0.828	0.881	0.307	0.150	0.573	YES	2.8	25.3	1,200	N/A	N/A	0.000	0.00	0.45
-27.4	1.66	52	5,220	2,917	3,541	1.72	1.05	113.95	0.820	0.860	0.305	0.218	0.818	YES	2.8	42.2	1,200	52.3	N/A	0.000	0.00	0.45
-28.4	1.00	6	5,340	2,975	3,599	2.81	N/A	N/A	0.812	N/A	0.303	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.45
-29.4	1.00	6	5,460	3,033	3,657	2.85	N/A	N/A	0.804	N/A	0.301	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.45
-30.4	1.00	8	5,580	3,090	3,714	2.73	N/A	N/A	0.795	N/A	0.299	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.45
-31.4	1.00	4	5,700	3,148	3,772	2.95	N/A	N/A	0.787	N/A	0.297	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.45
-32.4	1.00	3	5,820	3,205	3,829	2.92	N/A	N/A	0.779	N/A	0.294	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.45
-33.4	1.00	21	5,940	3,263	3,887	2.08	1.42	91.11	0.771	0.869	0.292	0.150	0.597	YES	1.3	16.1	782	18.0	N/A	1.297	0.16	0.30
-34.4	1.66	47	6,060	3,321	3,945	2.03	1.35	98.61	0.763	0.816	0.290	0.169	0.636	YES	2.8	36.4	1,200	N/A	N/A	0.000	0.00	0.30
-35.4	1.00	13	6,180	3,378	4,002	2.80	N/A	N/A	0.755	N/A	0.287	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
-36.4	1.00	5	6,300	3,436	4,060	3.00	N/A	N/A	0.747	N/A	0.285	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
-37.4	1.00	4	6,420	3,493	4,117	3.01	N/A	N/A	0.739	N/A	0.282	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
-38.4	1.00	4	6,540	3,551	4,175	3.02	N/A	N/A	0.730	N/A	0.280	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
-39.4	1.00	5	6,660	3,609	4,233	2.89	N/A	N/A	0.722	N/A	0.277	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
-40.4	1.00	5	6,780	3,666	4,290	2.92	N/A	N/A	0.714	N/A	0.275	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
-41.4	1.00	5	6,900	3,724	4,348	2.91	N/A	N/A	0.706	N/A	0.272	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
-42.4	1.00	12	7,020	3,781	4,405	2.53	2.90	84.67	0.698	0.874	0.269	0.136	0.591	YES	1.3	9.2	273	10.8	N/A	2.472	0.30	0.00
-43.4	1.00	74	7,140	3,839	4,463	1.26	1.00	213.78	0.690	0.770	0.267	N/A	N/A	NO	N/A	N/A	N/A	54.5	N/A	0.000	0.00	0.00
																max=	1,200					
																min=	273					
																avg=	971					

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	A-CPT022

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	19.00 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$

+++ $FS = (CRR_{7.5}/CSR)\ MSF\ K_\sigma\ K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	16.00 ft below ground surface
GWT Depth For Design, Zwd =	9.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	12.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	0.47 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	0.47 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r(psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_c (in.)	Cumulative Settlement Profile (in.)
0.50	130.52	0.99	0.76	sand	18.0	1.00	26	60	60	60	1.25	1.00	753.54	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	44.4	0.009	0.000	0.00	0.47
1.50	90.65	0.80	0.89	sand to silty sand	17.0	1.00	23	180	180	180	1.53	1.00	302.15	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	42.9	0.015	0.000	0.00	0.47
2.50	91.71	1.03	1.12	sand to silty sand	16.0	1.66	38	300	300	300	1.37	1.00	392.08	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	70.1	0.017	0.000	0.00	0.47
3.50	12.80	0.67	5.24	clay	15.0	1.00	13	420	420	420	2.69	N/A	N/A	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
4.50	9.58	0.36	3.75	clay	14.0	1.00	10	540	540	540	2.74	N/A	N/A	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
5.50	8.50	0.29	3.38	clay	13.0	1.00	8	660	660	660	2.81	N/A	N/A	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
6.50	8.45	0.27	3.19	clay	12.0	1.00	8	780	780	780	2.84	N/A	N/A	0.985	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
7.50	10.08	0.24	2.42	silty clay to clay	11.0	1.00	7	900	900	900	2.74	N/A	N/A	0.983	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
8.50	10.11	0.18	1.76	clayey silt to silty clay	10.0	1.00	5	1,020	1,020	1,020	2.69	N/A	N/A	0.980	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
9.50	16.23	0.28	1.75	sandy silt to clayey silt	9.0	1.00	6	1,140	1,109	1,140	2.59	3.29	71.74	0.978	1.000	0.209	0.114	0.730	YES	2.8	11.4	395	15.3	N/A	0.196	0.02	0.45
10.50	12.21	0.36	2.91	silty clay to clay	8.0	1.00	8	1,260	1,166	1,260	2.79	N/A	N/A	0.976	N/A	0.219	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.45
11.50	33.41	0.24	0.73	silty sand to sandy silt	7.0	1.00	11	1,380	1,224	1,380	2.14	1.53	65.30	0.973	1.000	0.228	0.106	0.619	YES	2.8	16.2	794	21.1	N/A	0.088	0.01	0.43
12.50	28.77	0.36	1.24	silty sand to sandy silt	6.0	1.66	16	1,500	1,282	1,500	2.02	1.33	79.07	0.971	1.000	0.236	0.126	0.711	YES	2.8	21.1	1,200	27.0	N/A	0.062	0.01	0.43
13.50	7.55	0.18	2.32	silty clay to clay	5.0	1.00	5	1,620	1,339	1,620	2.95	N/A	N/A	0.969	N/A	0.244	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
14.50	14.19	0.25	1.74	clayey silt to silty clay	4.0	1.00	7	1,740	1,397	1,740	2.66	N/A	N/A	0.966	N/A	0.250	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
15.50	39.50	0.39	1.00	silty sand to sandy silt	3.0	1.00	13	1,860	1,454	1,860	2.18	1.63	75.34	0.964	1.000	0.256	0.120	0.623	YES	2.8	16.5	818	21.4	N/A	0.097	0.01	0.42
16.50	23.64	0.48	2.01	sandy silt to clayey silt	2.0	1.66	16	1,980	1,512	1,949	2.24	1.78	80.11	0.962	1.000	0.262	0.128	0.651	YES	2.8	18.7	1,045	24.0	N/A	0.085	0.01	0.41
17.50	7.78	0.18	2.31	silty clay to clay	1.0	1.00	5	2,100	1,570	2,006	2.99	N/A	N/A	0.959	N/A	0.267	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
18.50	5.99	0.11	1.76	silty clay to clay	0.0	1.00	4	2,220	1,627	2,064	3.05	N/A	N/A	0.957	N/A	0.272	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
19.50	5.98	0.08	1.25	sensitive fine grained	-1.0	1.00	3	2,340	1,685	2,122	2.99	N/A	N/A	0.955	N/A	0.276	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
20.50	6.11	0.09	1.48	sensitive fine grained	-2.0	1.00	3	2,460	1,742	2,179	3.03	N/A	N/A	0.952	N/A	0.280	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
21.50	5.84	0.09	1.46	sensitive fine grained	-3.0	1.00	3	2,580	1,800	2,237	3.06	N/A	N/A	0.950	N/A	0.283	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
22.50	6.31	0.10	1.51	sensitive fine grained	-4.0	1.00	3	2,700	1,858	2,294	3.04	N/A	N/A	0.948	N/A	0.286	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
23.50	6.59	0.10	1.51	clayey silt to silty clay	-5.0	1.00	3	2,820	1,915	2,352	3.04	N/A	N/A	0.945	N/A	0.289	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
24.50	7.78	0.15	1.94	silty clay to clay	-6.0	1.00	5	2,940	1,973	2,410	3.03	N/A	N/A	0.943	N/A	0.292	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
25.50	7.10	0.14	1.97	silty clay to clay	-7.0	1.00	5	3,060	2,030	2,467	3.08	N/A	N/A	0.941	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
26.50	7.82	0.18	2.32	silty clay to clay	-8.0	1.00	5	3,180	2,088	2,525	3.09	N/A	N/A	0.938	N/A	0.297	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
27.50	7.17	0.08	1.06	sensitive fine grained	-9.0	1.00	4	3,300	2,146	2,582	2.97	N/A	N/A	0.936	N/A	0.299	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
28.50	8.54	0.10	1.16	clayey silt to silty clay	-10.0	1.00	4	3,420	2,203	2,640	2.92	N/A	N/A	0.934	N/A	0.301	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
29.50	10.54	0.14	1.29	clayey silt to silty clay	-11.0	1.00	5	3,540	2,261	2,698	2.86	N/A	N/A	0.931	N/A	0.303	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
30.50	10.28	0.18	1.74	clayey silt to silty clay	-12.0	1.00	5	3,660	2,318	2,755	2.94	N/A	N/A	0.926	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
31.50	12.20	0.24	1.97	clayey silt to silty clay	-13.0	1.00	6	3,780	2,376	2,813	2.91	N/A	N/A	0.918	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
32.50	13.60	0.23	1.71	clayey silt to silty clay	-14.0	1.00	7	3,900	2,434	2,870	2.84	N/A	N/A	0.909	N/A	0.303	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
33.50	10.92	0.27	2.48	clayey silt to silty clay	-15.0	1.00	5	4,020	2,491	2,928	3.03	N/A	N/A	0.901	N/A	0.303	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
34.50	11.62	0.25	2.12	clayey silt to silty clay	-16.0	1.00	6	4,140	2,549	2,986	2.97	N/A	N/A	0.893	N/A	0.302	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
35.50	11.93	0.39	3.27	silty clay to clay	-17.0	1.00	8	4,260	2,606	3,043	3.08	N/A	N/A	0.885	N/A	0.301	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
36.50	11.58	0.39	3.37	silty clay to clay	-18.0	1.00	8	4,380	2,664	3,101	3.10	N/A	N/A	0.877	N/A	0.300	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
37.50	14.23	0.39	2.75	clayey silt to silty clay	-19.0	1.00	7	4,500	2,722	3,158	2.98	N/A	N/A	0.869	N/A	0.299	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
38.50	15.05	0.36	2.37	clayey silt to silty clay	-20.0	1.00	8	4,620	2,779	3,216	2.92	N/A	N/A	0.861	N/A	0.298	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
39.50	18.38	0.45	2.44	clayey silt to silty clay	-21.0	1.00	9	4,740	2,837	3,274	2.86	N/A	N/A	0.852	N/A	0.296	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
40.50	25.33	0.60	2.35	sandy silt to clayey silt	-22.0	1.00	10	4,860	2,894	3,331	2.73	N/A	N/A	0.844	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
41.50	126.77	0.74	0.59	sand	-23.0	1.00	25	4,980	2,952	3,389	1.76	1.08	112.61	0.836	0.879	0.293	0.213	0.851	YES	0.0	19.5	1,131	19.5	N/A	1.053	0.13	0.28
42.50	104.24	1.04	1.00	sand to silty sand	-24.0	1.66	43	5,100	3,010	3,446	1.66	1.01	142.24	0.828	0.849	0.292	0.348	1.350	NO	N/A	N/A	N/A	36.9	N/A	0.018	0.00	0.28
43.50	43.49	0.83	1.90	sandy silt to clayey silt	-25.0	1.00	17	5,220	3,067	3,504	2.46	2.56	89.76	0.820	0.890	0.290	0.147	0.603	YES	2.8	15.9	769	20.8	N/A	0.273	0.03	0.24
44.50	130.99	0.52	0.40	sand	-26.0	1.00	26	5,340	3,125	3,562	1.67	1.00	104.80	0.812	0.862	0.289	0.187	0.746	YES	0.0	19.6	1,147	19.6	N/A	0.464	0.06	0.19
45.50	106.03	0.75	0.70	sand to silty sand	-27.0	1.66	44	5,460	3,182	3,619	1.58	1.00	139.18	0.804	0.830	0.287	0.331	1.278	YES	1.3	34.0	1,200	36.7	N/A	0.019	0.00	0.19
46.50	30.92	0.91	2.95	clayey silt to silty clay	-28.0	1.00	15	5,580	3,240	3,677	2.75	N/A	N/A	0.795	N/A	0.285	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
47.50	19.36	0.36	1.87	sandy silt to clayey silt	-29.0	1.00	8	5,700	3,298	3,734	2.82	N/A	N/A	0.787	N/A	0.283	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
48.50	14.03	0.27	1.95	clayey silt to silty clay	-30.0	1.00	7	5,820	3,355	3,792	2.97	N/A	N/A	0.779	N/A	0.281	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
49.50	15.34	0.37	2.38	clayey silt to silty clay	-31.0	1.00	8	5,940	3,413	3,850	2.98	N/A	N/A	0.771	N/A	0.279	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
50.50	16.81	0.37	2.22	clayey silt to silty clay	-32.0	1.00	8	6,060	3,470	3,907	2.93	N/A	N/A	0.763	N/A	0.277	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
51.50	13.66	0.29	2.11	clayey silt to silty clay	-33.0	1.00	7	6,180	3,528	3,965	3.01	N/A	N/A	0.755	N/A	0.275	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
52.50	13.41	0.38	2.87	clayey silt to silty clay	-34.0	1.00	7	6,300	3,586	4,022	3.10	N/A	N/A	0.747	N/A	0.273	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
53.50	14.86	0.45	3.03	clayey silt to silty clay	-35.0	1.00	7	6,420	3,643	4,080	3.08	N/A	N/A	0.739	N/A	0.271	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
54.50	14.85	0.43	2.88	clayey silt to silty clay	-36.0	1.00	7	6,540	3,701	4,138	3.07	N/A	N/A	0.730	N/A	0.268	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
55.50	15.76	0.47	2.97	clayey silt to silty clay	-37.0	1.00	8	6,660	3,758	4,195	3.06	N/A	N/A	0.722	N/A	0.266	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
56.50	32.02	0.65	2.02	sandy silt to clayey silt	-38.0	1.00	13	6,780	3,816	4,253	2.69	N/A	N/A	0.714	N/A	0.264	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
57.50	44.03	0.62	1.42	silty sand to sandy silt	-39.0	1.00	15	6,900	3,874	4,310	2.48	2.67	71.51	0.706	0.855	0.262	0.114	0.497	YES	2.8	12.8	495	17.0	N/A	1.145	0.14	0.05
58.50	50.96	0.75	1.47	silty sand to sandy silt	-40.0	1.00	17	7,020	3,931	4,368	2.38	2.23	80.95	0.698	0.842	0.259	0.129	0.561	YES	2.8	14.3	617	18.8	N/A	0.260	0.03	0.02
59.50	148.80	1.58	1.06	sand	-41.0	1.00	30	7,140	3,989	4,426	1.92	1.21	126.98	0.690	0.793	0.257	0.270	1.115	YES	0.0	20.0	1,186	20.0	N/A	0.144	0.02	0.00

max=	1,200
min=	395
avg=	900

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	A-CPT024

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	16.90 ft
GWT Elev. During Test	0.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$

+++ $FS = (CRR_{7.5}/CSR)\ MSF\ K_\sigma\ K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	16.90 ft below ground surface
GWT Depth For Design, Zwd =	6.90 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	19.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	1.31 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	1.31 inches	

INPUT SOIL PROFILE (CPT DATA)				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)
0.50	9.40	0.12	1.24	clayey silt to silty clay
1.50	13.07	0.23	1.75	clayey silt to silty clay
2.50	37.77	0.55	1.44	silty sand to sandy silt
3.50	40.61	1.03	2.53	sandy silt to clayey silt
4.50	17.49	0.42	2.39	clayey silt to silty clay
5.50	12.81	0.21	1.66	clayey silt to silty clay
6.50	11.99	0.21	1.76	clayey silt to silty clay
7.50	7.14	0.26	3.63	clay
8.50	26.29	0.35	1.33	sandy silt to clayey silt
9.50	31.94	0.28	0.86	silty sand to sandy silt
10.50	22.23	0.21	0.95	sandy silt to clayey silt
11.50	3.60	0.06	1.75	sensitive fine grained
12.50	15.83	0.13	0.82	sandy silt to clayey silt
13.50	26.87	0.14	0.51	silty sand to sandy silt
14.50	12.60	0.10	0.75	sandy silt to clayey silt
15.50	3.93	0.05	1.37	sensitive fine grained
16.50	4.02	0.05	1.15	sensitive fine grained
17.50	3.54	0.02	0.57	sensitive fine grained
18.50	4.81	0.05	1.08	sensitive fine grained
19.50	5.35	0.07	1.25	sensitive fine grained
20.50	5.06	0.06	1.25	sensitive fine grained
21.50	4.73	0.04	0.78	sensitive fine grained
22.50	5.42	0.07	1.24	sensitive fine grained
23.50	19.76	0.14	0.73	sandy silt to clayey silt
24.50	8.64	0.08	0.94	clayey silt to silty clay
25.50	8.14	0.20	2.45	silty clay to clay
26.50	9.84	0.18	1.80	clayey silt to silty clay
27.50	13.05	0.28	2.16	clayey silt to silty clay
28.50	15.61	0.56	3.60	silty clay to clay
29.50	55.69	0.87	1.56	silty sand to sandy silt
30.50	82.40	1.19	1.44	silty sand to sandy silt
31.50	66.36	0.51	0.77	sand to silty sand
32.50	13.41	0.31	2.32	clayey silt to silty clay
33.50	7.83	0.21	2.72	silty clay to clay
34.50	7.16	0.26	3.58	clay
35.50	7.81	0.22	2.87	silty clay to clay
36.50	11.21	0.40	3.60	clay
37.50	36.15	0.67	1.86	sandy silt to clayey silt
38.50	98.01	0.84	0.86	sand to silty sand
39.50	32.75	1.04	3.18	clayey silt to silty clay
40.50	50.06	1.04	2.07	sandy silt to clayey silt
41.50	32.86	0.91	2.77	sandy silt to clayey silt
42.50	15.83	0.58	3.64	silty clay to clay
43.50	26.61	0.34	1.29	sandy silt to clayey silt
44.50	43.53	0.53	1.21	silty sand to sandy silt
45.50	17.73	0.43	2.44	clayey silt to silty clay
46.50	15.94	0.37	2.31	clayey silt to silty clay
47.50	14.89	0.24	1.58	sandy silt to clayey silt
48.50	11.42	0.28	2.45	clayey silt to silty clay
49.50	12.76	0.32	2.51	clayey silt to silty clay
50.50	17.59	0.55	3.10	clayey silt to silty clay
51.50	13.42	0.44	3.30	silty clay to clay
52.50	10.88	0.29	2.66	silty clay to clay
53.50	12.96	0.29	2.23	clayey silt to silty clay
54.50	41.91	0.48	1.14	silty sand to sandy silt
55.50	15.76	0.47	2.97	clayey silt to silty clay
56.50	32.02	0.65	2.02	sandy silt to clayey silt
57.50	44.03	0.62	1.42	silty sand to sandy silt
58.50	50.96	0.75	1.47	silty sand to sandy silt
59.50	148.80	1.58	1.06	sand

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +																RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_t (in.)	Cumulative Settlement Profile (in.)
15.9	1.00	5	60	60	60	2.18	1.61	87.66	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.31
14.9	1.00	7	180	180	180	2.35	2.10	91.69	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.31
13.9	1.00	13	300	300	300	2.02	1.33	130.08	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	30.7	0.022	0.022	0.00	1.31
12.9	1.66	27	420	420	420	1.92	1.21	176.85	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	59.9	N/A	N/A	N/A	1.31
11.9	1.00	9	540	540	540	2.52	2.88	96.80	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.31
10.9	1.00	6	660	660	660	2.57	3.15	70.34	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.31
9.9	1.00	6	780	780	780	2.56	3.07	74.59	0.985	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.31
8.9	1.00	7	900	863	900	2.96	N/A	N/A	0.983	N/A	0.213	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.31
7.9	1.00	11	1,020	920	1,020	2.32	2.00	77.56	0.980	1.000	0.226	0.123	0.729	YES	2.8	17.5	927	22.7	N/A	0.080	0.01	1.30
6.9	1.00	11	1,140	978	1,140	2.15	1.56	71.08	0.978	1.000	0.237	0.113	0.638	YES	2.8	16.9	863	21.9	N/A	0.087	0.01	1.29
5.9	1.66	15	1,260	1,035	1,260	2.02	1.33	67.83	0.976	1.000	0.247	0.109	0.589	YES	2.8	21.3	1,200	27.3	N/A	0.064	0.01	1.28
4.9	1.00	2	1,380	1,093	1,380	3.13	N/A	N/A	0.973	N/A	0.256	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.28
3.9	1.00	6	1,500	1,151	1,500	2.44	2.48	51.79	0.971	1.000	0.263	0.093	0.471	YES	2.8	10.1	318	13.8	N/A	2.004	0.24	1.04
2.9	1.66	15	1,620	1,208	1,620	1.86	1.00	57.24	0.969	1.000	0.270	0.097	0.481	YES	2.8	19.3	1,110	24.8	N/A	0.084	0.01	1.03
1.9	1.66	8	1,740	1,266	1,740	2.24	1.00	26.21	0.966	1.000	0.276	0.072	0.347	YES	2.8	11.7	418	15.7	N/A	1.599	0.19	0.84
0.9	1.00	2	1,860	1,323	1,860	3.11	N/A	N/A	0.964	N/A	0.282	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
-0.1	1.00	2	1,980	1,381	1,980	3.08	N/A	N/A	0.962	N/A	0.287	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
-1.1	1.00	2	2,100	1,439	2,063	3.03	7.08	32.12	0.959	N/A	0.291	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
-2.1	1.00	2	2,220	1,496	2,120	3.02	N/A	N/A	0.957	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
-3.1	1.00	3	2,340	1,554	2,178	3.02	N/A	N/A	0.955	N/A	0.299	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
-4.1	1.00	3	2,460	1,611	2,235	3.05	N/A	N/A	0.952	N/A	0.302	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
-5.1	1.00	2	2,580	1,669	2,293	3.01	N/A	N/A	0.950	N/A	0.305	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
-6.1	1.00	3	2,700	1,727	2,351	3.05	N/A	N/A	0.948	N/A	0.308	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
-7.1	1.66	13	2,820	1,784	2,408	2.12	1.00	34.65	0.945	1.000	0.311	0.079	0.339	YES	2.8	14.7	655	19.3	N/A	1.205	0.14	0.69
-8.1	1.00	4	2,940	1,842	2,466	2.81	N/A	N/A	0.943	N/A	0.313	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.69
-9.1	1.00	5	3,060	1,899	2,523	3.06	N/A	N/A	0.941	N/A	0.315	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.69
-10.1	1.00	5	3,180	1,957	2,581	2.92	N/A	N/A	0.938	N/A	0.317	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.69
-11.1	1.00	7	3,300	2,015	2,639	2.86	N/A	N/A	0.936	N/A	0.319	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.69
-12.1	1.00	10	3,420	2,072	2,696	2.93	N/A	N/A	0.934	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.69
-13.1	1.00	19	3,540	2,130	2,754	2.25	1.79	96.87	0.931	0.981	0.322	0.165	0.669	YES	2.8	18.6	1,041	24.0	N/A	0.155	0.02	0.67
-14.1	1.00	27	3,660	2,187	2,811	2.10	1.45	114.36	0.926	0.968	0.322	0.219	0.878	YES	2.8	26.0	1,200	32.8	N/A	0.049	0.01	0.67
-15.1	1.66	27	3,780	2,245	2,869	1.71	1.00	103.70	0.918	0.959	0.321	0.184	0.732	YES	1.3	24.3	1,200	26.5	N/A	0.091	0.01	0.66
-16.1	1.00	7	3,900	2,303	2,927	2.90	N/A	N/A	0.909	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.66
-17.1	1.00	5	4,020	2,360	2,984	3.18	N/A	N/A	0.901	N/A	0.319	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.66
-18.1	1.00	7	4,140	2,418	3,042	3.29	N/A	N/A	0.893	N/A	0.318	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.66
-19.1	1.00	5	4,260	2,475	3,099	3.21	N/A	N/A	0.885	N/A	0.317	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.66
-20.1	1.00	11	4,380	2,533	3,157	3.12	N/A	N/A	0.877	N/A	0.315	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.66
-21.1	1.00	14	4,500	2,591	3,215	2.51	2.80	83.47	0.869	0.937	0.314	0.134	0.534	YES	2.8	14.2	609	18.7	N/A	1.311	0.16	0.50
-22.1	1.66	41	4,620	2,648	3,272	1.62	1.00	141.03	0.861	0.894	0.312	0.341	1.302	NO	N/A	N/A	N/A	35.7	N/A	0.028	0.00	0.50
-23.1	1.00	16	4,740	2,706	3,330	2.70	N/A	N/A	0.852	N/A	0.311	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.50
-24.1	1.00	20	4,860	2,763	3,387	2.41	2.36	100.41	0.844	0.909	0.309	0.174	0.684	YES	2.8	18.2	995	23.5	N/A	0.144	0.02	0.48
-25.1	1.66	22	4,980	2,821	3,445	2.33	2.04	93.43	0.836	0.900	0.307	0.156	0.610	YES	2.8	19.4	1,121	24.9	N/A	0.096	0.01	0.47
-26.1	1.00	11	5,100	2,879	3,503	3.03	N/A	N/A	0.828	N/A	0.305	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
-27.1	1.00	11	5,220	2,936	3,560	2.57	3.14	62.69	0.820	0.922	0.303	0.103	0.418	YES	2.8	10.8	356	14.6	N/A	1.889	0.23	0.24
-28.1	1.66	24	5,340	2,994	3,618	2.03	1.33	78.62	0.812	0.880	0.301	0.125	0.488	YES	2.8	20.7	1,200	26.4	N/A	0.085	0.01	0.23
-29.1	1.00	9	5,460	3,051	3,675	2.90	N/A	N/A	0.804	N/A	0.299	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
-30.1	1.00	8	5,580	3,109	3,733	2.93	N/A	N/A	0.795	N/A	0.297	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
-31.1	1.00	6	5,700	3,167	3,791	2.88	N/A	N/A	0.787	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
-32.1	1.00	6	5,820	3,224	3,848	3.10	N/A	N/A	0.779	N/A	0.293	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
-33.1	1.00	6	5,940	3,282	3,906	3.06	N/A	N/A	0.771	N/A	0.290	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
-34.1	1.00	9	6,060	3,339	3,963	2.99	N/A	N/A	0.763	N/A	0.288	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
-35.1	1.00	9	6,180	3,397	4,021	3.12	N/A	N/A	0.755	N/A	0.286	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
-36.1	1.00	7	6,300	3,455	4,079	3.17	N/A	N/A	0.747	N/A	0.283	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
-37.1	1.00	6	6,420	3,512	4,136	3.05	N/A	N/A	0.739	N/A	0.281	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
-38.1	1.66	23	6,540	3,570	4,194	2.06	1.38	71.93	0.730	0.841	0.278	0.115	0.462	YES	2.8	18.8	1,056	24.2	N/A	0.090	0.01	0.22
-39.1	1.00	8	6,660	3,627	4,251	3.05	N/A	N/A	0.722	N/A	0.276	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.22
-40.1	1.00	13	6,780	3,685	4,309	2.68	N/A	N/A	0.714	N/A	0.273	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.22
-41.1	1.00	15	6,900	3,743	4,367	2.47	2.62	72.16	0.706	0.862	0.271	0.115	0.489	YES	2.8	12.7	490	16.9	N/A	1.283	0.15	0.07
-42.1	1.00	17	7,020	3,800	4,424	2.37	2.20	81.49	0.698	0.850	0.268	0.130	0.551	YES	2.8	14.2	611	18.7	N/A	0.375	0.04	0.02
-43.1	1.00	30	7,140	3,858	4,482	1.91	1.20	128.54	0.690	0.803	0.265	0.278	1.120	YES	0.0	19.9	1,173	19.9	N/A	0.184	0.02	0.00

	max=	1,200
	min=	318
	avg=	871

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	A-CPT025

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	20.00 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$

+++ $FS = (CRR_{7.5}/CSR)\ MSF\ K_\sigma\ K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	17.00 ft below ground surface
GWT Depth For Design, Zwd =	10.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	8.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	0.29 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	0.29 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r(psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_l (in.)	Cumulative Settlement Profile (in.)
0.50	87.79	1.11	1.27	sand to silty sand	19.0	1.66	36	60	60	60	1.23	1.00	839.18	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	67.2	0.008	0.000	0.00	0.29
1.50	21.28	0.46	2.14	sandy silt to clayey silt	18.0	1.00	9	180	180	180	2.24	1.78	126.25	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	22.4	N/A	N/A	N/A	0.29
2.50	20.04	0.57	2.83	clayey silt to silty clay	17.0	1.00	10	300	300	300	2.43	2.43	125.49	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
3.50	10.43	0.40	3.86	clay	16.0	1.00	10	420	420	420	2.66	N/A	N/A	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
4.50	16.19	0.55	3.38	silty clay to clay	15.0	1.00	11	540	540	540	2.54	2.98	128.61	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
5.50	31.94	1.13	3.53	clayey silt to silty clay	14.0	1.00	16	660	660	660	2.47	2.64	146.69	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
6.50	20.76	0.67	3.25	clayey silt to silty clay	13.0	1.00	10	780	780	780	2.54	2.96	124.54	0.985	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
7.50	20.52	0.65	3.15	clayey silt to silty clay	12.0	1.00	10	900	900	900	2.57	3.12	116.69	0.983	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
8.50	16.60	0.52	3.15	clayey silt to silty clay	11.0	1.00	8	1,020	1,020	1,020	2.67	N/A	N/A	0.980	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
9.50	16.04	0.47	2.90	clayey silt to silty clay	10.0	1.00	8	1,140	1,140	1,140	2.69	N/A	N/A	0.978	N/A	0.203	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
10.50	10.63	0.35	3.29	silty clay to clay	9.0	1.00	7	1,260	1,229	1,260	2.89	N/A	N/A	0.976	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
11.50	9.58	0.31	3.20	silty clay to clay	8.0	1.00	6	1,380	1,286	1,380	2.93	N/A	N/A	0.973	N/A	0.217	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
12.50	7.46	0.21	2.80	silty clay to clay	7.0	1.00	5	1,500	1,344	1,500	3.00	N/A	N/A	0.971	N/A	0.225	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
13.50	7.07	0.19	2.74	silty clay to clay	6.0	1.00	5	1,620	1,402	1,620	3.03	N/A	N/A	0.969	N/A	0.233	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
14.50	5.95	0.16	2.68	clay	5.0	1.00	6	1,740	1,459	1,740	3.11	N/A	N/A	0.966	N/A	0.240	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
15.50	6.02	0.16	2.70	clay	4.0	1.00	6	1,860	1,517	1,860	3.12	N/A	N/A	0.964	N/A	0.246	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
16.50	5.53	0.15	2.78	clay	3.0	1.00	6	1,980	1,574	1,980	3.18	N/A	N/A	0.962	N/A	0.252	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
17.50	5.79	0.14	2.37	silty clay to clay	2.0	1.00	4	2,100	1,632	2,069	3.13	N/A	N/A	0.959	N/A	0.257	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
18.50	5.55	0.10	1.80	silty clay to clay	1.0	1.00	4	2,220	1,690	2,126	3.10	N/A	N/A	0.957	N/A	0.262	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
19.50	6.05	0.14	2.23	silty clay to clay	0.0	1.00	4	2,340	1,747	2,184	3.12	N/A	N/A	0.955	N/A	0.266	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
20.50	5.90	0.15	2.50	silty clay to clay	-1.0	1.00	4	2,460	1,805	2,242	3.17	N/A	N/A	0.952	N/A	0.270	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
21.50	5.84	0.13	2.18	silty clay to clay	-2.0	1.00	4	2,580	1,862	2,299	3.16	N/A	N/A	0.950	N/A	0.274	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
22.50	5.76	0.12	2.03	silty clay to clay	-3.0	1.00	4	2,700	1,920	2,357	3.16	N/A	N/A	0.948	N/A	0.277	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
23.50	4.99	0.06	1.20	sensitive fine grained	-4.0	1.00	2	2,820	1,978	2,414	3.12	N/A	N/A	0.945	N/A	0.280	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
24.50	4.95	0.05	0.98	sensitive fine grained	-5.0	1.00	2	2,940	2,035	2,472	3.10	N/A	N/A	0.943	N/A	0.283	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
25.50	5.38	0.06	1.07	sensitive fine grained	-6.0	1.00	3	3,060	2,093	2,530	3.09	N/A	N/A	0.941	N/A	0.286	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
26.50	5.81	0.10	1.64	sensitive fine grained	-7.0	1.00	3	3,180	2,150	2,587	3.15	N/A	N/A	0.938	N/A	0.289	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
27.50	6.16	0.07	1.11	sensitive fine grained	-8.0	1.00	3	3,300	2,208	2,645	3.05	N/A	N/A	0.936	N/A	0.291	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
28.50	6.97	0.10	1.49	clayey silt to silty clay	-9.0	1.00	3	3,420	2,266	2,702	3.07	N/A	N/A	0.934	N/A	0.293	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
29.50	7.95	0.18	2.20	silty clay to clay	-10.0	1.00	5	3,540	2,323	2,760	3.11	N/A	N/A	0.931	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
30.50	24.38	0.19	0.79	silty sand to sandy silt	-11.0	1.66	13	3,660	2,381	2,818	2.11	1.48	54.68	0.926	0.957	0.296	0.095	0.411	YES	2.8	14.1	603	18.6	N/A	1.225	0.15	0.14
31.50	8.82	0.17	1.97	clayey silt to silty clay	-12.0	1.00	4	3,780	2,438	2,875	3.05	N/A	N/A	0.918	N/A	0.296	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.14
32.50	9.69	0.21	2.18	clayey silt to silty clay	-13.0	1.00	5	3,900	2,496	2,933	3.05	N/A	N/A	0.909	N/A	0.296	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.14
33.50	12.14	0.26	2.16	clayey silt to silty clay	-14.0	1.00	6	4,020	2,554	2,990	2.96	N/A	N/A	0.901	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.14
34.50	6.88	0.08	1.16	sensitive fine grained	-15.0	1.00	3	4,140	2,611	3,048	3.08	N/A	N/A	0.893	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.14
35.50	10.95	0.30	2.78	silty clay to clay	-16.0	1.00	7	4,260	2,669	3,106	3.08	N/A	N/A	0.885	N/A	0.294	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.14
36.50	19.50	0.66	3.40	clayey silt to silty clay	-17.0	1.00	10	4,380	2,726	3,163	2.91	N/A	N/A	0.877	N/A	0.293	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.14
37.50	12.50	0.45	3.56	silty clay to clay	-18.0	1.00	8	4,500	2,784	3,221	3.10	N/A	N/A	0.869	N/A	0.292	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.14
38.50	8.11	0.27	3.38	clay	-19.0	1.00	8	4,620	2,842	3,278	3.28	N/A	N/A	0.861	N/A	0.291	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.14
39.50	9.98	0.36	3.65	clay	-20.0	1.00	10	4,740	2,899	3,336	3.21	N/A	N/A	0.852	N/A	0.290	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.14
40.50	11.22	0.39	3.50	silty clay to clay	-21.0	1.00	7	4,860	2,957	3,394	3.16	N/A	N/A	0.844	N/A	0.289	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.14
41.50	32.05	0.83	2.60	sandy silt to clayey silt	-22.0	1.00	13	4,980	3,014	3,451	2.68	N/A	N/A	0.836	N/A	0.287	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.14
42.50	68.66	1.14	1.66	silty sand to sandy silt	-23.0	1.00	23	5,100	3,072	3,509	2.26	1.82	100.91	0.828	0.875	0.286	0.176	0.717	YES	2.8	20.1	1,194	25.7	N/A	0.084	0.01	0.13
43.50	100.05	1.65	1.65	silty sand to sandy silt	-24.0	1.66	55	5,220	3,130	3,566	1.82	1.12	148.75	0.820	0.836	0.284	0.386	1.514	NO	N/A	N/A	N/A	54.6	N/A	0.000	0.00	0.13
44.50	46.94	1.06	2.25	sandy silt to clayey silt	-25.0	1.00	19	5,340	3,187	3,624	2.52	2.88	95.31	0.812	0.878	0.283	0.161	0.664	YES	2.8	16.7	848	21.7	N/A	0.148	0.02	0.11
45.50	106.30	0.88	0.82	sand to silty sand	-26.0	1.00	27	5,460	3,245	3,682	1.93	1.22	101.45	0.804	0.852	0.281	0.177	0.715	YES	1.3	20.9	1,200	23.0	N/A	0.098	0.01	0.10
46.50	129.32	0.58	0.45	sand	-27.0	1.00	26	5,580	3,302	3,739	1.71	1.00	100.64	0.795	0.849	0.280	0.175	0.708	YES	0.0	18.9	1,072	18.9	N/A	0.477	0.06	0.05
47.50	154.94	0.66	0.43	sand	-28.0	1.00	31	5,700	3,360	3,797	1.64	1.00	119.54	0.787	0.832	0.278	0.239	0.954	YES	0.0	22.5	1,200	22.5	N/A	0.099	0.01	0.03
48.50	130.19	0.80	0.62	sand	-29.0	1.66	43	5,820	3,418	3,854	1.48	1.00	164.91	0.779	0.807	0.276	N/A	N/A	NO	N/A	N/A	N/A	31.1	N/A	0.050	0.01	0.03
49.50	56.42	1.05	1.87	silty sand to sandy silt	-30.0	1.00	19	5,940	3,475	3,912	2.38	2.24	95.93	0.771	0.859	0.274	0.162	0.678	YES	2.8	16.2	798	21.1	N/A	0.149	0.02	0.01
50.50	35.13	0.69	1.95	sandy silt to clayey silt	-31.0	1.66	23	6,060	3,533	3,970	2.25	1.81	79.01	0.763	0.841	0.272	0.126	0.519	YES	2.8	19.3	1,114	24.8	N/A	0.084	0.01	0.00
51.50	13.43	0.29	2.13	clayey silt to silty clay	-32.0	1.00	7	6,180	3,590	4,027	3.03	N/A	N/A	0.755	N/A	0.270	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
52.50	15.00	0.33	2.18	clayey silt to silty clay	-33.0	1.00	7	6,300	3,648	4,085	2.99	N/A	N/A	0.747	N/A	0.268	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
53.50	17.74	0.51	2.90	clayey silt to silty clay	-34.0	1.00	9	6,420	3,706	4,142	3.00	N/A	N/A	0.739	N/A	0.266	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
54.50	17.17	0.61	3.55	silty clay to clay	-35.0	1.00	11	6,540	3,763	4,200	3.07	N/A	N/A	0.730	N/A	0.264	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
55.50	14.53	0.40	2.78	clayey silt to silty clay	-36.0	1.00	7	6,660	3,821	4,258	3.08	N/A	N/A	0.722	N/A	0.262	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
56.50	13.79	0.30	2.20	clayey silt to silty clay	-37.0	1.00	7	6,780	3,878	4,315	3.05	N/A	N/A	0.714	N/A	0.260	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
57.50	13.66	0.33	2.43	clayey silt to silty clay	-38.0	1.00	7	6,900	3,936	4,373	3.09	N/A	N/A	0.706	N/A	0.257	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
58.50	15.13	0.39	2.58	clayey silt to silty clay	-39.0	1.00	8	7,020	3,994	4,430	3.06	N/A	N/A	0.698	N/A	0.255	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
59.50	16.65	0.37	2.24	clayey silt to silty clay	-40.0	1.00	8	7,140	4,051	4,488	2.99	N/A	N/A	0.690	N/A	0.253	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
60.50	17.85	0.38	2.11	clayey silt to silty clay	-41.0	1.00	9	7,260	4,109	4,546	2.95	N/A	N/A	0.682	N/A	0.250	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
																						max=	1,200				
																						min=	603				
																						avg=	1,004				

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT026

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	13.00 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	10.00 ft below ground surface
GWT Depth For Design, Zwd =	3.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	16.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	2.31 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	2.31 inches	

INPUT SOIL PROFILE (CPT DATA)				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)
0.50	239.18	2.65	1.11	sand
1.50	103.30	2.11	2.04	silty sand to sandy silt
2.50	60.72	1.59	2.62	sandy silt to clayey silt
3.50	29.23	0.73	2.49	sandy silt to clayey silt
4.50	17.20	0.38	2.21	clayey silt to silty clay
5.50	13.28	0.18	1.37	sandy silt to clayey silt
6.50	25.92	0.67	2.57	sandy silt to clayey silt
7.50	84.57	1.25	1.48	silty sand to sandy silt
8.50	77.98	0.86	1.11	sand to silty sand
9.50	126.50	1.18	0.93	sand to silty sand
10.50	62.21	0.74	1.18	silty sand to sandy silt
11.50	7.37	0.23	3.05	clay
12.50	4.68	0.15	3.17	clay
13.50	5.90	0.24	4.01	clay
14.50	4.55	0.12	2.60	clay
15.50	4.33	0.11	2.46	clay
16.50	4.42	0.05	1.06	sensitive fine grained
17.50	3.35	0.03	0.84	sensitive fine grained
18.50	5.58	0.04	0.66	sensitive fine grained
19.50	5.27	0.04	0.76	sensitive fine grained
20.50	11.44	0.05	0.46	sandy silt to clayey silt
21.50	13.58	0.06	0.43	sandy silt to clayey silt
22.50	5.17	0.02	0.32	sensitive fine grained
23.50	4.68	0.02	0.35	sensitive fine grained
24.50	11.62	0.06	0.54	sandy silt to clayey silt
25.50	51.43	0.24	0.46	sand to silty sand
26.50	154.23	1.71	1.11	sand
27.50	191.15	2.32	1.21	sand
28.50	99.75	1.52	1.52	silty sand to sandy silt
29.50	40.55	0.53	1.31	silty sand to sandy silt
30.50	30.12	0.29	0.96	silty sand to sandy silt
31.50	81.61	1.09	1.34	sand to silty sand
32.50	94.55	1.20	1.27	sand to silty sand
33.50	62.58	0.48	0.77	sand to silty sand
34.50	155.35	1.46	0.94	sand
35.50	278.95	4.48	1.61	sand to silty sand
36.50	282.60	4.64	1.64	sand to silty sand
37.50	161.95	2.66	1.64	sand to silty sand
38.50	118.52	1.40	1.18	sand to silty sand
39.50	141.72	1.79	1.26	sand to silty sand
40.50	155.78	1.91	1.23	sand to silty sand
41.50	168.59	2.30	1.36	sand to silty sand
42.50	207.23	2.77	1.34	sand to silty sand
43.50	234.58	3.47	1.48	sand to silty sand
44.50	267.75	4.60	1.72	sand to silty sand
45.50	188.20	2.99	1.59	sand to silty sand
46.50	197.58	2.56	1.30	sand to silty sand
47.50	78.23	1.37	1.76	silty sand to sandy silt
48.50	19.92	0.32	1.61	sandy silt to clayey silt
49.50	13.70	0.18	1.35	sandy silt to clayey silt
50.50	12.85	0.16	1.27	sandy silt to clayey silt
51.50	41.63	0.41	0.97	silty sand to sandy silt
52.50	50.60	0.71	1.40	silty sand to sandy silt

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +																RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ_v' (psf)	Effective Vert. Stress (Test) σ_v' (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r(psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_t (in.)	Cumulative Settlement Profile (in.)
12.0	1.66	79	60	60	60	1.05	1.00	2,286.45	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	134.6	0.006	0.000	0.00	2.31
11.0	1.00	34	180	180	180	1.79	1.10	378.98	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	75.2	0.013	0.000	0.00	2.31
10.0	1.66	40	300	300	300	1.77	1.08	281.51	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	87.0	N/A	N/A	N/A	2.31
9.0	1.00	12	420	389	420	2.31	1.98	131.54	0.992	1.000	0.223	0.292	1.746	NO	N/A	N/A	N/A	28.9	N/A	0.051	0.01	2.31
8.0	1.00	9	540	446	540	2.47	2.63	95.82	0.990	1.000	0.249	0.162	0.867	YES	2.8	17.4	916	N/A	N/A	0.000	0.00	2.31
7.0	1.00	5	660	504	660	2.46	2.58	68.39	0.987	1.000	0.269	0.110	0.545	YES	2.8	11.8	425	15.8	N/A	1.521	0.18	2.12
6.0	1.00	10	780	562	780	2.42	2.39	116.75	0.985	1.000	0.285	0.228	1.069	YES	2.8	19.4	1,123	24.9	N/A	0.088	0.01	2.11
5.0	1.00	28	900	619	900	1.90	1.19	180.28	0.983	1.000	0.297	N/A	N/A	NO	N/A	N/A	N/A	55.4	N/A	0.000	0.00	2.11
4.0	1.00	19	1,020	677	1,020	1.85	1.14	153.07	0.980	1.000	0.307	0.414	1.796	NO	N/A	N/A	N/A	31.1	N/A	0.057	0.01	2.11
3.0	1.66	52	1,140	734	1,140	1.34	1.00	345.65	0.978	1.000	0.316	N/A	N/A	NO	N/A	N/A	N/A	75.2	N/A	0.000	0.00	2.11
2.0	1.66	34	1,260	792	1,229	1.65	1.01	164.74	0.976	1.000	0.323	N/A	N/A	NO	N/A	N/A	N/A	57.6	N/A	0.000	0.00	2.11
1.0	1.00	7	1,380	850	1,286	2.91	N/A	N/A	0.973	N/A	0.329	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.11
0.0	1.00	5	1,500	907	1,344	3.11	N/A	N/A	0.971	N/A	0.334	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.11
-1.0	1.00	6	1,620	965	1,402	3.10	N/A	N/A	0.969	N/A	0.338	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.11
-2.0	1.00	5	1,740	1,022	1,459	3.12	N/A	N/A	0.966	N/A	0.342	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.11
-3.0	1.00	4	1,860	1,080	1,517	3.14	N/A	N/A	0.964	N/A	0.345	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.11
-4.0	1.00	2	1,980	1,138	1,574	2.97	N/A	N/A	0.962	N/A	0.348	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.11
-5.0	1.00	2	2,100	1,195	1,632	3.07	N/A	N/A	0.959	N/A	0.351	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.11
-6.0	1.00	3	2,220	1,253	1,690	2.81	4.88	38.70	0.957	N/A	0.353	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.11
-7.0	1.00	3	2,340	1,310	1,747	2.88	5.48	39.63	0.955	N/A	0.355	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.11
-8.0	1.00	5	2,460	1,368	1,805	2.51	2.82	38.99	0.952	1.000	0.356	0.082	0.309	YES	2.8	7.6	204	10.8	N/A	2.474	0.30	1.81
-9.0	1.66	9	2,580	1,426	1,862	2.15	1.00	26.64	0.950	1.000	0.358	0.072	0.269	YES	2.8	12.1	445	16.2	N/A	1.737	0.21	1.60
-10.0	1.00	3	2,700	1,483	1,920	2.80	4.76	30.81	0.948	N/A	0.359	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.60
-11.0	1.00	2	2,820	1,541	1,978	2.87	5.42	30.88	0.945	N/A	0.360	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.60
-12.0	1.00	5	2,940	1,598	2,035	2.54	2.99	41.12	0.943	1.000	0.361	0.084	0.312	YES	2.8	7.4	196	10.5	N/A	2.513	0.30	1.30
-13.0	1.00	13	3,060	1,656	2,093	1.94	1.00	56.52	0.941	1.000	0.361	0.097	0.357	YES	1.3	13.9	584	15.7	N/A	1.798	0.22	1.08
-14.0	1.00	31	3,180	1,714	2,150	1.78	1.09	181.94	0.938	1.000	0.362	N/A	N/A	NO	N/A	N/A	N/A	29.7	N/A	0.080	0.01	1.07
-15.0	1.00	38	3,300	1,771	2,208	1.75	1.07	217.52	0.936	1.000	0.363	N/A	N/A	NO	N/A	N/A	N/A	36.4	N/A	0.028	0.00	1.07
-16.0	1.66	55	3,420	1,829	2,266	1.71	1.05	180.69	0.934	1.000	0.363	N/A	N/A	NO	N/A	N/A	N/A	67.1	N/A	0.000	0.00	1.07
-17.0	1.00	14	3,540	1,886	2,323	2.29	1.93	80.43	0.931	1.000	0.363	0.128	0.471	YES	2.8	15.3	712	20.0	N/A	1.319	0.16	0.91
-18.0	1.00	10	3,660	1,944	2,381	2.34	2.07	63.18	0.926	1.000	0.363	0.103	0.381	YES	2.8	12.0	436	16.0	N/A	1.758	0.21	0.70
-19.0	1.00	20	3,780	2,002	2,438	2.07	1.40	113.87	0.918	1.000	0.360	0.217	0.804	YES	1.3	19.8	1,166	21.9	N/A	1.108	0.13	0.57
-20.0	1.00	24	3,900	2,059	2,496	2.01	1.31	121.93	0.909	0.990	0.358	0.249	0.917	YES	1.3	22.5	1,200	24.7	N/A	0.277	0.03	0.53
-21.0	1.00	16	4,020	2,117	2,554	2.02	1.33	81.10	0.901	0.984	0.356	0.130	0.478	YES	1.3	15.2	697	17.0	N/A	1.642	0.20	0.34
-22.0	1.00	31	4,140	2,174	2,611	1.77	1.08	161.24	0.893	0.968	0.354	N/A	N/A	NO	N/A	N/A	N/A	27.2	N/A	0.097	0.01	0.33
-23.0	1.00	70	4,260	2,232	2,669	1.77	1.09	286.95	0.885	0.957	0.351	N/A	N/A	NO	N/A	N/A	N/A	65.8	N/A	0.000	0.00	0.33
-24.0	1.00	71	4,380	2,290	2,726	1.78	1.09	288.48	0.877	0.947	0.349	N/A	N/A	NO	N/A	N/A	N/A	65.9	N/A	0.000	0.00	0.33
-25.0	1.00	40	4,500	2,347	2,784	1.94	1.23	183.36	0.869	0.938	0.346	N/A	N/A	NO	N/A	N/A	N/A	38.5	N/A	0.011	0.00	0.32
-26.0	1.00	30	4,620	2,405	2,842	1.94	1.23	132.63	0.861	0.933	0.344	0.297	1.075	YES	1.3	26.2	1,200	28.6	N/A	0.084	0.01	0.31
-27.0	1.00	35	4,740	2,462	2,899	1.90	1.19	152.27	0.852	0.920	0.341	0.408	1.469	NO	N/A	N/A	N/A	33.3	N/A	0.048	0.01	0.31
-28.0	1.00	39	4,860	2,520	2,957	1.87	1.16	161.06	0.844	0.912	0.339	N/A	N/A	NO	N/A	N/A	N/A	36.1	N/A	0.028	0.00	0.31
-29.0	1.00	42	4,980	2,578	3,014	1.88	1.17	173.92	0.836	0.904	0.336	N/A	N/A	NO	N/A	N/A	N/A	38.5	N/A	0.011	0.00	0.30
-30.0	1.00	52	5,100	2,635	3,072	1.82	1.12	201.88	0.828	0.896	0.333	N/A	N/A	NO	N/A	N/A	N/A	46.3	N/A	0.000	0.00	0.30
-31.0	1.00	59	5,220	2,693	3,130	1.82	1.12	226.24	0.820	0.888	0.331	N/A	N/A	NO	N/A	N/A	N/A	51.6	N/A	0.000	0.00	0.30
-32.0	1.00	67	5,340	2,750	3,187	1.83	1.13	258.65	0.812	0.880	0.328	N/A	N/A	NO	N/A	N/A	N/A	58.1	N/A	0.000	0.00	0.30
-33.0	1.00	47	5,460	2,808	3,245	1.91	1.20	190.29	0.804	0.873	0.325	N/A	N/A	NO	N/A	N/A	N/A	41.2	N/A	0.000	0.00	0.30
-34.0	1.66	82	5,580	2,866	3,302	1.52	1.00	273.31	0.795	0.866	0.322	N/A	N/A	NO	N/A	N/A	N/A	69.2	N/A	0.000	0.00	0.30
-35.0	1.66	43	5,700	2,923	3,360	1.91	1.20	128.39	0.787	0.859	0.319	0.277	0.994	YES	2.8	36.1	1,200	45.0	N/A	0.000	0.00	0.30
-36.0	1.00	8	5,820	2,981	3,418	2.74	N/A	N/A	0.779	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
-37.0	1.00	5	5,940	3,038	3,475	2.86	N/A	N/A	0.771	N/A	0.314	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
-38.0	1.00	5	6,060	3,096	3,533	2.89	N/A	N/A	0.763	N/A	0.311	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
-39.0	1.00	14	6,180	3,154	3,590	2.31	1.99	65.82	0.755	0.896	0.308	0.107	0.414	YES	2.8	13.2	523	17.4	N/A	1.467	0.18	0.13
-40.0	1.00	17	6,300	3,211	3,648	2.33	2.06	82.08	0.747	0.882	0.305	0.131	0.508	YES	2.8	15.3	707	20.0	N/A	1.066	0.13	0.00

max=	1,200
min=	196
avg=	733

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT031

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	6.00 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	6.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	3.00 ft below ground surface
GWT Depth For Design, Zwd =	0.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	20.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	1.99 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	1.99 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +															RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ_v' (psf)	Effective Vert. Stress (Test) σ_v' (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_l (in.)	Cumulative Settlement Profile (in.)
0.50	8.10	0.09	1.15	clayey silt to silty clay	5.0	1.00	4	60	29	60	2.08	1.42	96.05	0.999	1.000	0.433	0.162	0.501	YES	2.8	9.7	295	N/A	N/A	0.000	0.00	1.99
1.50	33.45	0.19	0.58	silty sand to sandy silt	4.0	1.00	11	180	86	180	1.60	1.00	160.94	0.997	1.000	0.432	N/A	N/A	NO	N/A	N/A	N/A	27.7	N/A	0.383	0.05	1.94
2.50	24.75	0.31	1.25	sandy silt to clayey silt	3.0	1.66	16	300	144	300	1.69	1.03	157.55	0.994	1.000	0.431	0.444	1.374	NO	N/A	N/A	N/A	38.4	N/A	0.015	0.00	1.94
3.50	3.77	0.15	3.85	clay	2.0	1.00	4	420	202	389	2.83	N/A	N/A	0.992	N/A	0.430	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
4.50	5.05	0.23	4.33	clay	1.0	1.00	5	540	259	446	2.83	N/A	N/A	0.990	N/A	0.429	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
5.50	2.62	0.15	5.75	clay	0.0	1.00	3	660	317	504	3.19	N/A	N/A	0.987	N/A	0.428	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
6.50	2.27	0.11	4.58	clay	-1.0	1.00	2	780	374	562	3.24	N/A	N/A	0.985	N/A	0.427	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
7.50	2.55	0.14	5.35	clay	-2.0	1.00	3	900	432	619	3.28	N/A	N/A	0.983	N/A	0.426	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
8.50	2.82	0.15	5.09	clay	-3.0	1.00	3	1,020	490	677	3.27	N/A	N/A	0.980	N/A	0.425	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
9.50	2.97	0.13	4.18	clay	-4.0	1.00	3	1,140	547	734	3.23	N/A	N/A	0.978	N/A	0.424	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
10.50	2.40	0.08	3.20	clay	-5.0	1.00	2	1,260	605	792	3.29	N/A	N/A	0.976	N/A	0.423	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
11.50	2.68	0.09	3.24	clay	-6.0	1.00	3	1,380	662	850	3.28	N/A	N/A	0.973	N/A	0.422	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
12.50	2.35	0.08	3.20	clay	-7.0	1.00	2	1,500	720	907	3.37	N/A	N/A	0.971	N/A	0.421	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
13.50	1.83	0.07	3.53	clay	-8.0	1.00	2	1,620	778	965	3.56	N/A	N/A	0.969	N/A	0.420	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
14.50	2.37	0.10	3.67	clay	-9.0	1.00	2	1,740	835	1,022	3.47	N/A	N/A	0.966	N/A	0.419	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
15.50	1.80	0.06	2.70	clay	-10.0	1.00	2	1,860	893	1,080	3.59	N/A	N/A	0.964	N/A	0.418	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
16.50	1.85	0.05	2.23	sensitive fine grained	-11.0	1.00	1	1,980	950	1,138	3.55	N/A	N/A	0.962	N/A	0.417	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
17.50	2.60	0.07	2.39	clay	-12.0	1.00	3	2,100	1,008	1,195	3.40	N/A	N/A	0.959	N/A	0.416	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94
18.50	11.12	0.09	0.82	sandy silt to clayey silt	-13.0	1.00	4	2,220	1,066	1,253	2.58	3.19	48.61	0.957	1.000	0.415	0.090	0.291	YES	2.8	8.4	235	11.7	N/A	2.326	0.28	1.66
19.50	67.00	0.25	0.37	sand to silty sand	-14.0	1.00	17	2,340	1,123	1,310	1.72	1.00	89.40	0.955	1.000	0.414	0.146	0.472	YES	1.3	22.0	1,200	24.2	N/A	1.076	0.13	1.53
20.50	149.81	0.95	0.64	sand	-15.0	1.00	30	2,460	1,181	1,368	1.56	1.00	194.98	0.952	1.000	0.413	N/A	N/A	NO	N/A	N/A	N/A	36.2	N/A	0.035	0.00	1.53
21.50	152.55	1.15	0.75	sand	-16.0	1.00	31	2,580	1,238	1,426	1.61	1.00	193.86	0.950	1.000	0.412	N/A	N/A	NO	N/A	N/A	N/A	36.1	N/A	0.036	0.00	1.52
22.50	219.10	1.34	0.61	sand	-17.0	1.00	44	2,700	1,296	1,483	1.45	1.00	272.18	0.948	1.000	0.411	N/A	N/A	NO	N/A	N/A	N/A	50.9	N/A	0.000	0.00	1.52
23.50	234.98	1.63	0.69	sand	-18.0	1.00	47	2,820	1,354	1,541	1.47	1.00	285.63	0.945	1.000	0.410	N/A	N/A	NO	N/A	N/A	N/A	53.5	N/A	0.000	0.00	1.52
24.50	222.10	1.30	0.58	sand	-19.0	1.00	44	2,940	1,411	1,598	1.44	1.00	264.40	0.943	1.000	0.409	N/A	N/A	NO	N/A	N/A	N/A	49.7	N/A	0.000	0.00	1.52
25.50	150.53	1.30	0.86	sand	-20.0	1.66	50	3,060	1,469	1,656	1.38	1.00	290.84	0.941	1.000	0.408	N/A	N/A	NO	N/A	N/A	N/A	54.8	N/A	0.000	0.00	1.52
26.50	46.82	0.28	0.59	sand to silty sand	-21.0	1.00	12	3,180	1,526	1,714	2.01	1.31	70.35	0.938	1.000	0.407	0.112	0.369	YES	1.3	14.0	590	15.8	N/A	1.827	0.22	1.30
27.50	35.45	0.19	0.52	silty sand to sandy silt	-22.0	1.66	20	3,300	1,584	1,771	1.81	1.00	65.95	0.936	1.000	0.406	0.107	0.351	YES	2.8	23.6	1,200	29.9	N/A	0.092	0.01	1.29
28.50	8.43	0.07	0.80	clayey silt to silty clay	-23.0	1.00	4	3,420	1,642	1,829	2.77	N/A	N/A	0.934	N/A	0.405	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.29
29.50	78.17	0.41	0.53	sand to silty sand	-24.0	1.00	20	3,540	1,699	1,886	1.81	1.12	94.58	0.931	1.000	0.404	0.159	0.525	YES	1.3	21.5	1,200	23.6	N/A	1.104	0.13	1.16
30.50	113.10	0.81	0.71	sand to silty sand	-25.0	1.00	28	3,660	1,757	1,944	1.76	1.08	130.03	0.926	1.000	0.401	0.284	0.946	YES	1.3	30.0	1,200	32.6	N/A	0.067	0.01	1.15
31.50	85.01	0.54	0.64	sand to silty sand	-26.0	1.00	21	3,780	1,814	2,002	1.84	1.14	101.31	0.918	1.000	0.398	0.177	0.593	YES	1.3	22.6	1,200	24.8	N/A	0.870	0.10	1.05
32.50	99.32	0.40	0.40	sand	-27.0	1.00	20	3,900	1,872	2,059	1.68	1.00	102.66	0.909	1.000	0.394	0.181	0.611	YES	0.0	19.6	1,141	19.6	N/A	1.453	0.17	0.87
33.50	103.27	0.64	0.62	sand to silty sand	-28.0	1.00	26	4,020	1,930	2,117	1.77	1.09	114.33	0.901	1.000	0.391	0.219	0.748	YES	1.3	26.4	1,200	28.8	N/A	0.097	0.01	0.86
34.50	118.85	0.66	0.55	sand	-29.0	1.00	24	4,140	1,987	2,174	1.70	1.04	123.59	0.893	1.000	0.387	0.256	0.881	YES	0.0	22.8	1,200	22.8	N/A	1.119	0.13	0.73
35.50	104.30	0.62	0.59	sand to silty sand	-30.0	1.00	26	4,260	2,045	2,232	1.77	1.08	111.76	0.885	0.992	0.384	0.210	0.724	YES	1.3	26.0	1,200	28.4	N/A	0.098	0.01	0.72
36.50	91.42	0.65	0.71	sand to silty sand	-31.0	1.00	23	4,380	2,102	2,290	1.87	1.16	103.28	0.877	0.983	0.380	0.182	0.630	YES	1.3	22.7	1,200	24.9	N/A	0.433	0.05	0.66
37.50	92.20	0.67	0.73	sand to silty sand	-32.0	1.00	23	4,500	2,160	2,347	1.87	1.16	103.33	0.869	0.974	0.376	0.183	0.630	YES	1.3	22.6	1,200	24.8	N/A	0.417	0.05	0.61
38.50	120.58	0.52	0.43	sand	-33.0	1.00	24	4,620	2,218	2,405	1.66	1.00	114.51	0.861	0.964	0.373	0.220	0.758	YES	0.0	22.0	1,200	22.0	N/A	1.143	0.14	0.48
39.50	150.62	0.72	0.48	sand	-34.0	1.00	30	4,740	2,275	2,462	1.60	1.00	141.21	0.852	0.951	0.369	0.342	1.174	YES	0.0	27.1	1,200	27.1	N/A	0.118	0.01	0.46
40.50	118.30	0.82	0.70	sand	-35.0	1.66	39	4,860	2,333	2,520	1.48	1.00	181.40	0.844	0.940	0.366	N/A	N/A	NO	N/A	N/A	N/A	34.9	N/A	0.040	0.00	0.46
41.50	22.51	0.20	0.86	sandy silt to clayey silt	-36.0	1.00	9	4,980	2,390	2,578	2.47	2.64	54.27	0.836	0.963	0.362	0.095	0.336	YES	2.8	10.7	354	14.5	N/A	1.926	0.23	0.23
42.50	19.22	0.26	1.30	sandy silt to clayey silt	-37.0	1.00	8	5,100	2,448	2,635	2.65	N/A	N/A	0.828	N/A	0.359	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
43.50	11.22	0.13	1.14	clayey silt to silty clay	-38.0	1.00	6	5,220	2,506	2,693	2.86	N/A	N/A	0.820	N/A	0.355	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
44.50	8.38	0.09	0.96	clayey silt to silty clay	-39.0	1.66	7	5,340	2,563	2,750	2.65	3.66	42.17	0.812	N/A	0.352	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
45.50	3.83	0.09	1.77	sensitive fine grained	-40.0	1.00	2	5,460	2,621	2,808	3.65	N/A	N/A	0.804	N/A	0.348	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
46.50	5.60	0.19	2.85	clay	-41.0	1.00	6	5,580	2,678	2,866	3.48	N/A	N/A	0.795	N/A	0.345	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
47.50	10.32	0.24	2.14	clayey silt to silty clay	-42.0	1.00	5	5,700	2,736	2,923	3.08	N/A	N/A	0.787	N/A	0.341	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
48.50	9.12	0.10	1.05	clayey silt to silty clay	-43.0	1.00	5	5,820	2,794	2,981	2.99	N/A	N/A	0.779	N/A	0.338	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
49.50	12.77	0.05	0.39	sandy silt to clayey silt	-44.0	1.00	5	5,940	2,851	3,038	2.66	3.69	36.10	0.771	N/A	0.334	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
50.50	7.33	0.06	0.71	sensitive fine grained	-45.0	1.00	4	6,060	2,909	3,096	3.05	N/A	N/A	0.763	N/A	0.331	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
51.50	22.72	0.40	1.71	sandy silt to clayey silt	-46.0	1.00	9	6,180	2,966	3,154	2.72	N/A	N/A	0.755	N/A	0.327	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
52.50	24.56	0.44	1.79	sandy silt to clayey silt	-47.0	1.00	10	6,300	3,024	3,211	2.70	N/A	N/A	0.747	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
53.50	44.10	1.02	2.31	sandy silt to clayey silt	-48.0	1.00	18	6,420	3,082	3,269	2.55	3.01	96.02	0.739	0.887	0.320	0.162	0.600	YES	2.8	16.6	833	21.6	N/A	0.482	0.06	0.17
54.50	50.70	0.56	1.09	silty sand to sandy silt	-49.0	1.00	17	6,540	3,139	3,326	2.26	1.84	74.51	0.730	0.885	0.316	0.118	0.442	YES	2.8	15.9	765	20.7	N/A	1.039	0.12	0.04
55.50	201.12	0.98	0.49	sand	-50.0	1.00	40	6,660	3,197	3,384	1.56	1.00	159.08	0.722	0.829	0.313	0.454	1.606	NO	N/A	N/A	N/A	30.9	N/A	0.059	0.01	0.04
56.50	268.27	0.95	0.35	gravelly sand to sand	-51.0	1.00	45	6,780	3,254	3,442	1.38	1.00	210.31	0.714	0.823	0.309	N/A	N/A	NO	N/A	N/A	N/A	34.1	N/A	0.038	0.00	0.03
57.50	280.95	0.81	0.29	gravelly sand to sand	-52.0	1.66	78	6,900	3,312	3,499	1.02	1.00	361.49	0.706	0.817	0.306	N/A	N/A	NO	N/A	N/A	N/A	58.6	N/A	0.000	0.00	0.03
58.50	99.32	1.06	1.07	sand to silty sand	-53.0	1.00	25	7,020	3,370	3,557	2.03	1.34	102.37	0.698	0.845	0.302	0.180	0.670	YES	1.3	20.0	1,181	22.0	N/A	0.195	0.02	0.01
59.50	132.62	1.55	1.17	sand to silty sand	-54.0	1.00	33	7,140	3,427	3,614	1.96	1.25	126.44	0.690	0.818	0.299	0.268	0.979	YES	1.3	26.0	1,200	28.3	N/A	0.072	0.01	0.00

	max=	1,200
	min=	235
	avg=	1,000

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT035

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	7.40 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	7.40 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$

+++ $FS = (CRR_{7.5}/CSR)\ MSF\ K_\sigma\ K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	4.40 ft below ground surface
GWT Depth For Design, Zwd =	0.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	25.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	2.07 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	2.07 inches	

INPUT SOIL PROFILE (CPT DATA)				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)
0.50	175.98	2.02	1.15	sand
1.50	156.73	2.05	1.31	sand to silty sand
2.50	130.05	1.59	1.22	sand to silty sand
3.50	63.90	0.59	0.92	sand to silty sand
4.50	42.17	0.36	0.86	silty sand to sandy silt
5.50	27.98	0.37	1.31	sandy silt to clayey silt
6.50	7.87	0.09	1.10	clayey silt to silty clay
7.50	9.67	0.22	2.24	clayey silt to silty clay
8.50	4.75	0.13	2.70	clay
9.50	19.92	0.17	0.85	sandy silt to clayey silt
10.50	20.70	0.38	1.82	sandy silt to clayey silt
11.50	4.58	0.03	0.73	sensitive fine grained
12.50	3.82	0.01	0.22	sensitive fine grained
13.50	3.60	0.01	0.19	sensitive fine grained
14.50	3.73	0.01	0.13	sensitive fine grained
15.50	4.10	0.00	0.08	sensitive fine grained
16.50	4.27	0.00	0.04	sensitive fine grained
17.50	4.30	0.00	0.04	sensitive fine grained
18.50	4.18	0.00	0.04	sensitive fine grained
19.50	8.08	0.03	0.31	sensitive fine grained
20.50	36.33	0.20	0.55	silty sand to sandy silt
21.50	103.53	1.13	1.09	sand to silty sand
22.50	132.07	1.76	1.33	sand to silty sand
23.50	96.18	1.46	1.52	silty sand to sandy silt
24.50	78.52	0.90	1.14	sand to silty sand
25.50	17.18	0.30	1.76	sandy silt to clayey silt
26.50	14.98	0.08	0.51	sandy silt to clayey silt
27.50	15.32	0.08	0.49	sandy silt to clayey silt
28.50	29.73	0.18	0.59	silty sand to sandy silt
29.50	11.05	0.07	0.58	sandy silt to clayey silt
30.50	7.62	0.02	0.22	sensitive fine grained
31.50	8.81	0.10	1.07	clayey silt to silty clay
32.50	12.92	0.18	1.37	clayey silt to silty clay
33.50	50.90	0.45	0.87	silty sand to sandy silt
34.50	71.78	0.89	1.23	sand to silty sand
35.50	34.73	0.30	0.85	silty sand to sandy silt
36.50	8.75	0.06	0.68	clayey silt to silty clay
37.50	12.42	0.06	0.45	sandy silt to clayey silt
38.50	12.70	0.08	0.65	sandy silt to clayey silt
39.50	10.12	0.04	0.34	sandy silt to clayey silt
40.50	8.57	0.06	0.69	clayey silt to silty clay
41.50	16.27	0.23	1.42	sandy silt to clayey silt
42.50	19.60	0.48	2.41	clayey silt to silty clay
43.50	22.08	0.76	3.40	clayey silt to silty clay
44.50	17.78	0.55	3.06	clayey silt to silty clay
45.50	17.18	0.47	2.70	clayey silt to silty clay
46.50	19.00	0.57	2.98	clayey silt to silty clay
47.50	83.72	1.00	1.19	sand to silty sand
48.50	113.13	1.30	1.15	sand to silty sand
49.50	55.47	1.22	2.20	sandy silt to clayey silt
50.50	77.98	0.74	0.95	sand to silty sand
51.50	84.08	1.16	1.38	sand to silty sand
52.50	54.76	0.97	1.77	silty sand to sandy silt
53.50	24.82	0.69	2.77	clayey silt to silty clay
54.50	17.07	0.37	2.15	clayey silt to silty clay
55.50	13.13	0.23	1.77	clayey silt to silty clay
56.50	35.10	0.78	2.23	sandy silt to clayey silt
57.50	77.77	1.35	1.73	silty sand to sandy silt
58.50	42.52	1.05	2.48	sandy silt to clayey silt
59.50	46.10	0.86	1.87	silty sand to sandy silt
60.50	37.88	0.90	2.38	sandy silt to clayey silt

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +																RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ_v' (psf)	Effective Vert. Stress (Test) σ_v' (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_l (in.)	Cumulative Settlement Profile (in.)
6.4	1.00	35	60	29	60	1.31	1.00	1,466.53	0.999	1.000	0.433	N/A	N/A	NO	N/A	N/A	N/A	59.8	N/A	0.000	0.00	2.07
5.4	1.00	39	180	86	180	1.46	1.00	754.08	0.997	1.000	0.432	N/A	N/A	NO	N/A	N/A	N/A	72.3	N/A	0.000	0.00	2.07
4.4	1.00	54	300	144	300	1.23	1.00	802.48	0.994	1.000	0.431	N/A	N/A	NO	N/A	N/A	N/A	98.4	N/A	0.000	0.00	2.07
3.4	1.00	16	420	202	420	1.66	1.01	203.54	0.992	1.000	0.430	N/A	N/A	NO	N/A	N/A	N/A	31.0	N/A	0.089	0.01	2.06
2.4	1.00	14	540	259	534	1.82	1.12	131.09	0.990	1.000	0.429	0.290	0.901	YES	2.8	26.7	1,200	33.7	N/A	0.062	0.01	2.05
1.4	1.66	19	660	317	591	1.80	1.10	128.59	0.987	1.000	0.428	0.278	0.866	YES	2.8	34.3	1,200	42.8	N/A	0.000	0.00	2.05
0.4	1.66	4	780	374	649	2.56	3.07	55.90	0.985	1.000	0.427	0.096	0.301	YES	2.8	9.5	285	N/A	N/A	0.000	0.00	2.05
-0.6	1.66	8	900	432	707	2.37	2.18	75.05	0.983	1.000	0.426	0.119	0.374	YES	2.8	16.3	800	N/A	N/A	0.000	0.00	2.05
-1.6	1.00	5	1,020	490	764	2.89	N/A	N/A	0.980	N/A	0.425	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.05
-2.6	1.00	8	1,140	547	822	2.22	1.71	65.03	0.978	1.000	0.424	0.106	0.332	YES	2.8	15.2	701	19.9	N/A	1.473	0.18	1.87
-3.6	1.66	14	1,260	605	879	2.10	1.46	90.89	0.976	1.000	0.423	0.150	0.473	YES	2.8	23.5	1,200	29.8	N/A	0.098	0.01	1.86
-4.6	1.00	2	1,380	662	937	2.70	4.03	42.31	0.973	N/A	0.422	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.86
-5.6	1.00	2	1,500	720	995	2.63	3.54	29.06	0.971	N/A	0.421	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.86
-6.6	1.00	2	1,620	778	1,052	2.68	3.84	28.10	0.969	N/A	0.420	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.86
-7.6	1.00	2	1,740	835	1,110	2.65	3.67	26.40	0.966	N/A	0.419	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.86
-8.6	1.00	2	1,860	893	1,167	2.60	3.34	25.06	0.964	N/A	0.418	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.86
-9.6	1.00	2	1,980	950	1,225	2.60	3.31	24.69	0.962	1.000	0.417	0.071	0.226	YES	5.0	7.7	208	N/A	N/A	0.000	0.00	1.86
-10.6	1.00	2	2,100	1,008	1,283	2.61	3.41	24.51	0.959	N/A	0.416	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.86
-11.6	1.00	2	2,220	1,066	1,340	2.64	3.60	24.18	0.957	N/A	0.415	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.86
-12.6	1.00	4	2,340	1,123	1,398	2.56	3.08	33.24	0.955	1.000	0.414	0.078	0.251	YES	5.0	9.8	303	N/A	N/A	0.000	0.00	1.86
-13.6	1.00	12	2,460	1,181	1,455	2.04	1.36	64.42	0.952	1.000	0.413	0.105	0.339	YES	2.8	17.0	873	22.0	N/A	1.266	0.15	1.71
-14.6	1.00	26	2,580	1,238	1,513	1.85	1.14	150.62	0.950	1.000	0.412	0.398	1.289	YES	1.3	31.1	1,200	33.7	N/A	0.059	0.01	1.70
-15.6	1.00	33	2,700	1,296	1,571	1.84	1.14	186.82	0.948	1.000	0.411	N/A	N/A	NO	N/A	N/A	N/A	41.5	N/A	0.000	0.00	1.70
-16.6	1.00	32	2,820	1,354	1,628	1.99	1.28	150.11	0.945	1.000	0.410	0.395	1.285	YES	2.8	38.3	1,200	47.6	N/A	0.000	0.00	1.70
-17.6	1.66	33	2,940	1,411	1,686	1.66	1.01	156.81	0.943	1.000	0.409	0.439	1.432	NO	N/A	N/A	N/A	39.6	N/A	0.004	0.00	1.70
-18.6	1.00	7	3,060	1,469	1,743	2.61	N/A	N/A	0.941	N/A	0.408	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.70
-19.6	1.00	6	3,180	1,526	1,801	2.44	2.49	42.66	0.938	1.000	0.407	0.086	0.281	YES	2.8	9.1	267	12.6	N/A	2.196	0.26	1.44
-20.6	1.00	6	3,300	1,584	1,859	2.43	2.45	42.09	0.936	1.000	0.406	0.085	0.280	YES	2.8	9.2	268	12.6	N/A	2.189	0.26	1.17
-21.6	1.66	16	3,420	1,642	1,916	1.90	1.00	54.34	0.934	1.000	0.405	0.095	0.313	YES	2.8	19.6	1,140	25.1	N/A	0.837	0.10	1.07
-22.6	1.00	4	3,540	1,699	1,974	2.60	3.34	41.67	0.931	N/A	0.404	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
-23.6	1.00	4	3,660	1,757	2,031	2.64	3.56	29.91	0.926	N/A	0.401	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
-24.6	1.00	4	3,780	1,814	2,089	2.84	N/A	N/A	0.918	N/A	0.398	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
-25.6	1.00	6	3,900	1,872	2,147	2.74	N/A	N/A	0.909	N/A	0.394	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.07
-26.6	1.00	17	4,020	1,930	2,204	2.11	1.48	76.80	0.901	1.000	0.391	0.122	0.417	YES	2.8	19.0	1,076	24.4	N/A	0.889	0.11	0.97
-27.6	1.66	30	4,140	1,987	2,262	1.78	1.09	129.84	0.893	1.000	0.387	0.284	0.978	YES	1.3	29.3	1,200	31.8	N/A	0.070	0.01	0.96
-28.6	1.66	19	4,260	2,045	2,319	1.96	1.25	71.18	0.885	0.993	0.384	0.114	0.392	YES	2.8	20.6	1,200	26.4	N/A	0.173	0.02	0.94
-29.6	1.00	4	4,380	2,102	2,377	2.81	4.83	40.69	0.877	N/A	0.380	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.94
-30.6	1.00	5	4,500	2,160	2,435	2.59	3.26	38.22	0.869	0.985	0.376	0.082	0.286	YES	2.8	7.3	193	10.4	N/A	2.533	0.30	0.63
-31.6	1.00	5	4,620	2,218	2,492	2.65	3.64	42.81	0.861	N/A	0.373	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
-32.6	1.00	4	4,740	2,275	2,550	2.66	3.68	33.82	0.852	N/A	0.369	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
-33.6	1.00	4	4,860	2,333	2,607	2.86	5.28	40.33	0.844	N/A	0.366	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
-34.6	1.00	7	4,980	2,390	2,665	2.73	N/A	N/A	0.836	N/A	0.362	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
-35.6	1.00	10	5,100	2,448	2,723	2.79	N/A	N/A	0.828	N/A	0.359	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
-36.6	1.00	11	5,220	2,506	2,780	2.85	N/A	N/A	0.820	N/A	0.355	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
-37.6	1.00	9	5,340	2,563	2,838	2.91	N/A	N/A	0.812	N/A	0.352	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
-38.6	1.00	9	5,460	2,621	2,895	2.90	N/A	N/A	0.804	N/A	0.348	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
-39.6	1.00	10	5,580	2,678	2,953	2.89	N/A	N/A	0.795	N/A	0.345	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
-40.6	1.00	21	5,700	2,736	3,011	2.08	1.42	101.68	0.787	0.908	0.341	0.178	0.631	YES	1.3	18.4	1,017	20.4	N/A	1.212	0.15	0.49
-41.6	1.66	47	5,820	2,794	3,068	1.66	1.01	159.97	0.779	0.875	0.338	0.461	1.593	NO	N/A	N/A	N/A	42.1	N/A	0.000	0.00	0.49
-42.6	1.00	22	5,940	2,851	3,126	2.40	2.32	107.69	0.771	0.894	0.334	0.196	0.700	YES	2.8	20.5	1,200	26.3	N/A	0.097	0.01	0.48
-43.6	1.00	19	6,060	2,909	3,183	2.06	1.38	89.40	0.763	0.895	0.331	0.146	0.529	YES	1.3	16.8	852	18.7	N/A	1.383	0.17	0.31
-44.6	1.00	21	6,180	2,966	3,241	2.13	1.52	104.90	0.755	0.887	0.327	0.187	0.678	YES	1.3	17.8	960	19.8	N/A	1.224	0.15	0.16
-45.6	1.66	30	6,300	3,024	3,299	2.04	1.36	100.00	0.747	0.860	0.324	0.173	0.614	YES	2.8	26.3	1,200	33.2	N/A	0.046	0.01	0.16
-46.6	1.00	12	6,420	3,082	3,356	2.81	N/A	N/A	0.739	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.16
-47.6	1.00	9	6,540	3,139	3,414	2.90	N/A	N/A	0.730	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.16
-48.6	1.00	7	6,660	3,197	3,471	2.97	N/A	N/A	0.722	N/A	0.313	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.16
-49.6	1.00	14	6,780	3,254	3,529	2.63	N/A	N/A	0.714	N/A	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.16
-50.6	1.00	26	6,900	3,312	3,587	2.24	1.78	107.65	0.706	0.847	0.306	0.196	0.724	YES	2.8	22.2	1,200	28.2	N/A	0.075	0.01	0.15
-51.6	1.00	17	7,020	3,370	3,644	2.60	N/A	N/A	0.698	N/A	0.302	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.15
-52.6	1.00	15	7,140	3,427	3,702	2.50	2.77	85.38	0.690	0.873	0.299	0.138	0.537	YES	2.8	14.1	600	18.6	N/A	1.251	0.15	0.00
-53.6	1.00	15	7,260	3,485	3,759	2.64	N/A	N/A	0.682	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
																max=	1,200					
																min=	193					
																avg=	862					

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT037

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	5.00 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	5.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \to \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw = 2.00 ft below ground surface

GWT Depth For Design, Zwd = 0.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils = 14.00 feet

Earthquake-Induced Settlements:

- Liquefaction-Induced Settlement = 0.93 inches <--- Saturated Sands
- Seismic Compaction Settlement = 0.00 inches <--- Dry or Unsaturated Sands

Total: 0.93 inches

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +															RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_i (in.)	Cumulative Settlement Profile (in.)
0.50	127.88	0.67	0.52	sand	4.0	1.00	26	60	29	60	1.04	1.00	1,065.69	0.999	1.000	0.433	N/A	N/A	NO	N/A	N/A	N/A	43.5	N/A	0.000	0.00	0.93
1.50	101.18	0.97	0.96	sand to silty sand	3.0	1.66	42	180	86	180	1.13	1.00	806.04	0.997	1.000	0.432	N/A	N/A	NO	N/A	N/A	N/A	77.1	N/A	0.000	0.00	0.93
2.50	29.52	0.40	1.34	sandy silt to clayey silt	2.0	1.66	20	300	144	269	1.66	1.01	183.52	0.994	1.000	0.431	N/A	N/A	NO	N/A	N/A	N/A	44.9	N/A	0.000	0.00	0.93
3.50	7.55	0.29	3.78	clay	1.0	1.00	8	420	202	326	2.59	3.24	136.80	0.992	1.000	0.430	0.318	0.987	YES	5.0	17.8	959	N/A	N/A	0.000	0.00	0.93
4.50	4.42	0.17	3.84	clay	0.0	1.00	4	540	259	384	2.84	N/A	N/A	0.990	N/A	0.429	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
5.50	4.53	0.16	3.54	clay	-1.0	1.00	5	660	317	442	2.85	N/A	N/A	0.987	N/A	0.428	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
6.50	3.88	0.16	4.11	clay	-2.0	1.00	4	780	374	499	2.99	N/A	N/A	0.985	N/A	0.427	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
7.50	7.13	0.16	2.19	silty clay to clay	-3.0	1.66	8	900	432	557	2.47	2.62	66.59	0.983	1.000	0.426	0.107	0.337	YES	5.0	18.4	1,016	N/A	N/A	0.000	0.00	0.93
8.50	3.38	0.06	1.75	sensitive fine grained	-4.0	1.00	2	1,020	490	614	2.91	N/A	N/A	0.980	N/A	0.425	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
9.50	3.07	0.05	1.48	sensitive fine grained	-5.0	1.00	2	1,140	547	672	2.96	N/A	N/A	0.978	N/A	0.424	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
10.50	2.96	0.03	1.17	sensitive fine grained	-6.0	1.00	1	1,260	605	730	2.95	N/A	N/A	0.976	N/A	0.423	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
11.50	2.93	0.05	1.60	sensitive fine grained	-7.0	1.00	1	1,380	662	787	3.06	N/A	N/A	0.973	N/A	0.422	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
12.50	3.28	0.04	1.22	sensitive fine grained	-8.0	1.00	2	1,500	720	845	2.98	N/A	N/A	0.971	N/A	0.421	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
13.50	3.25	0.03	0.97	sensitive fine grained	-9.0	1.00	2	1,620	778	902	2.97	N/A	N/A	0.969	N/A	0.420	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
14.50	4.15	0.03	0.64	sensitive fine grained	-10.0	1.00	2	1,740	835	960	2.81	4.85	38.73	0.966	N/A	0.419	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
15.50	3.40	0.01	0.24	sensitive fine grained	-11.0	1.00	2	1,860	893	1,018	2.77	4.57	28.42	0.964	N/A	0.418	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
16.50	3.97	0.02	0.54	sensitive fine grained	-12.0	1.00	2	1,980	950	1,075	2.85	5.19	35.94	0.962	N/A	0.417	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
17.50	24.82	0.19	0.75	silty sand to sandy silt	-13.0	1.00	8	2,100	1,008	1,133	2.23	1.73	60.60	0.959	1.000	0.416	0.101	0.323	YES	2.8	13.8	574	18.2	N/A	1.614	0.19	0.74
18.50	81.40	0.58	0.71	sand to silty sand	-14.0	1.00	20	2,220	1,066	1,190	1.79	1.10	122.31	0.957	1.000	0.415	0.250	0.805	YES	1.3	27.7	1,200	30.1	N/A	0.093	0.01	0.72
19.50	144.83	1.97	1.36	sand to silty sand	-15.0	1.00	36	2,340	1,123	1,248	1.80	1.11	214.05	0.955	1.000	0.414	N/A	N/A	NO	N/A	N/A	N/A	50.5	N/A	0.000	0.00	0.72
20.50	140.19	2.14	1.52	sand to silty sand	-16.0	1.00	35	2,460	1,181	1,306	1.85	1.15	209.65	0.952	1.000	0.413	N/A	N/A	NO	N/A	N/A	N/A	48.0	N/A	0.000	0.00	0.72
21.50	96.40	1.29	1.33	sand to silty sand	-17.0	1.00	24	2,580	1,238	1,363	1.93	1.22	149.56	0.950	1.000	0.412	0.391	1.268	YES	1.3	30.5	1,200	33.1	N/A	0.064	0.01	0.72
22.50	93.60	1.27	1.35	sand to silty sand	-18.0	1.00	39	2,700	1,296	1,421	1.64	1.00	192.01	0.948	1.000	0.411	N/A	N/A	NO	N/A	N/A	N/A	50.7	N/A	0.000	0.00	0.72
23.50	24.65	0.42	1.71	sandy silt to clayey silt	-19.0	1.66	16	2,820	1,354	1,478	2.17	1.60	79.31	0.945	1.000	0.410	0.126	0.412	YES	2.8	21.8	1,200	27.8	N/A	0.157	0.02	0.70
24.50	6.30	0.06	0.90	sensitive fine grained	-20.0	1.00	3	2,940	1,411	1,536	2.86	N/A	N/A	0.943	N/A	0.409	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.70
25.50	6.15	0.08	1.34	sensitive fine grained	-21.0	1.00	3	3,060	1,469	1,594	2.97	N/A	N/A	0.941	N/A	0.408	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.70
26.50	6.15	0.12	1.93	silty clay to clay	-22.0	1.00	4	3,180	1,526	1,651	3.07	N/A	N/A	0.938	N/A	0.407	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.70
27.50	6.13	0.07	1.07	sensitive fine grained	-23.0	1.00	3	3,300	1,584	1,709	2.96	N/A	N/A	0.936	N/A	0.406	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.70
28.50	6.17	0.10	1.64	silty clay to clay	-24.0	1.00	4	3,420	1,642	1,766	3.06	N/A	N/A	0.934	N/A	0.405	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.70
29.50	8.80	0.16	1.74	clayey silt to silty clay	-25.0	1.00	4	3,540	1,699	1,824	2.93	N/A	N/A	0.931	N/A	0.404	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.70
30.50	7.00	0.04	0.61	sensitive fine grained	-26.0	1.00	4	3,660	1,757	1,882	2.82	4.98	38.45	0.926	N/A	0.401	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.70
31.50	13.54	0.20	1.45	sandy silt to clayey silt	-27.0	1.00	5	3,780	1,814	1,939	2.73	N/A	N/A	0.918	N/A	0.398	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.70
32.50	12.32	0.14	1.10	sandy silt to clayey silt	-28.0	1.00	5	3,900	1,872	1,997	2.71	N/A	N/A	0.909	N/A	0.394	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.70
33.50	7.60	0.06	0.78	sensitive fine grained	-29.0	1.00	4	4,020	1,930	2,054	2.86	N/A	N/A	0.901	N/A	0.391	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.70
34.50	19.80	0.24	1.18	sandy silt to clayey silt	-30.0	1.00	8	4,140	1,987	2,112	2.55	3.05	60.67	0.893	1.000	0.387	0.101	0.347	YES	2.8	10.5	340	14.2	N/A	1.961	0.24	0.46
35.50	23.72	0.09	0.37	silty sand to sandy silt	-31.0	1.66	13	4,260	2,045	2,170	1.97	1.00	38.84	0.885	0.994	0.384	0.082	0.285	YES	2.8	15.4	714	20.1	N/A	1.376	0.17	0.30
36.50	8.00	0.03	0.41	sensitive fine grained	-32.0	1.00	4	4,380	2,102	2,227	2.76	4.46	34.37	0.877	N/A	0.380	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
37.50	7.53	0.05	0.69	sensitive fine grained	-33.0	1.00	4	4,500	2,160	2,285	2.89	N/A	N/A	0.869	N/A	0.376	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
38.50	7.87	0.11	1.34	clayey silt to silty clay	-34.0	1.00	4	4,620	2,218	2,342	3.01	N/A	N/A	0.861	N/A	0.373	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
39.50	13.92	0.29	2.07	clayey silt to silty clay	-35.0	1.00	7	4,740	2,275	2,400	2.87	N/A	N/A	0.852	N/A	0.369	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
40.50	16.48	0.45	2.67	clayey silt to silty clay	-36.0	1.00	8	4,860	2,333	2,458	2.88	N/A	N/A	0.844	N/A	0.366	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
41.50	15.77	0.47	2.96	clayey silt to silty clay	-37.0	1.00	8	4,980	2,390	2,515	2.93	N/A	N/A	0.836	N/A	0.362	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
42.50	19.25	0.82	4.23	clay	-38.0	1.00	19	5,100	2,448	2,573	2.95	N/A	N/A	0.828	N/A	0.359	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
43.50	11.72	0.31	2.60	clayey silt to silty clay	-39.0	1.00	6	5,220	2,506	2,630	3.03	N/A	N/A	0.820	N/A	0.355	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.30
44.50	39.25	0.80	2.03	sandy silt to clayey silt	-40.0	1.00	16	5,340	2,563	2,688	2.48	2.68	92.81	0.812	0.934	0.352	0.154	0.547	YES	2.8	16.3	808	21.3	N/A	1.146	0.14	0.16
45.50	74.43	1.06	1.42	silty sand to sandy silt	-41.0	1.00	25	5,460	2,621	2,746	2.16	1.58	102.73	0.804	0.911	0.348	0.181	0.631	YES	2.8	24.0	1,200	30.4	N/A	0.071	0.01	0.15
46.50	60.63	1.06	1.75	silty sand to sandy silt	-42.0	1.00	20	5,580	2,678	2,803	2.30	1.93	101.31	0.795	0.913	0.345	0.177	0.625	YES	2.8	19.9	1,172	25.5	N/A	0.143	0.02	0.13
47.50	50.70	0.99	1.95	silty sand to sandy silt	-43.0	1.00	17	5,700	2,736	2,861	2.39	2.28	98.82	0.787	0.915	0.341	0.170	0.608	YES	2.8	16.9	866	22.0	N/A	1.021	0.12	0.01
48.50	33.65	0.76	2.25	sandy silt to clayey silt	-44.0	1.00	13	5,820	2,794	2,918	2.61	N/A	N/A	0.779	N/A	0.338	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
49.50	27.10	0.71	2.62	sandy silt to clayey silt	-45.0	1.00	11	5,940	2,851	2,976	2.74	N/A	N/A	0.771	N/A	0.334	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
50.50	16.50	0.38	2.27	clayey silt to silty clay	-46.0	1.00	8	6,060	2,909	3,034	2.90	N/A	N/A	0.763	N/A	0.331	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
51.50	22.13	0.48	2.15	sandy silt to clayey silt	-47.0	1.00	9	6,180	2,966	3,091	2.78	N/A	N/A	0.755	N/A	0.327	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
52.50	18.19	0.44	2.40	clayey silt to silty clay	-48.0	1.00	9	6,300	3,024	3,149	2.89	N/A	N/A	0.747	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
53.50	29.92	0.64	2.13	sandy silt to clayey silt	-49.0	1.00	12	6,420	3,082	3,206	2.67	N/A	N/A	0.739	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
54.50	78.33	1.26	1.60	silty sand to sandy silt	-50.0	1.00	26	6,540	3,139	3,264	2.21	1.69	105.91	0.730	0.858	0.316	0.190	0.689	YES	2.8	23.2	1,200	29.5	N/A	0.069	0.01	0.00
55.50	49.98	1.19	2.37	sandy silt to clayey silt	-51.0	1.66	33	6,660	3,197	3,322	2.16	1.58	103.47	0.722	0.837	0.313	0.183	0.653	YES	2.8	28.5	1,200	35.8	N/A	0.027	0.00	0.00
56.50	13.42	0.36	2.63	clayey silt to silty clay	-52.0	1.00	7	6,780	3,254	3,379	3.06	N/A	N/A	0.714	N/A	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
57.50	17.62	0.14	0.77	sandy silt to clayey silt	-53.0	1.00	7	6,900	3,312	3,437	2.68	3.82	46.10	0.706	N/A	0.306	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
58.50	10.80	0.10	0.91	sandy silt to clayey silt	-54.0	1.00	4	7,020	3,370	3,494	2.94	N/A	N/A	0.698	N/A	0.302	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
59.50	9.42	0.19	1.93	clayey silt to silty clay	-55.0	1.00	5	7,140	3,427	3,552	3.18	N/A	N/A	0.690	N/A	0.299	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
60.50	10.62	0.28	2.56	silty clay to clay	-56.0	1.00	7	7,260	3,485	3,610	3.19	N/A	N/A	0.682	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00

max= 1,200
min= 340
avg= 975

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT038

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	8.40 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	8.40 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	5.40 ft below ground surface
GWT Depth For Design, Zwd =	0.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	27.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	1.98 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	1.98 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ_v' (psf)	Effective Vert. Stress (Test) σ_v' (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_c (in.)	Cumulative Settlement Profile (in.)
0.50	243.24	2.91	1.19	sand	7.4	1.66	81	60	29	60	1.08	1.00	3,356.15	0.999	1.000	0.433	N/A	N/A	NO	N/A	N/A	N/A	136.9	N/A	0.000	0.00	1.98
1.50	85.37	2.17	2.54	sandy silt to clayey silt	6.4	1.00	34	180	86	180	1.84	1.13	466.18	0.997	1.000	0.432	N/A	N/A	NO	N/A	N/A	N/A	74.7	N/A	0.000	0.00	1.98
2.50	47.72	0.58	1.22	silty sand to sandy silt	5.4	1.66	26	300	144	300	1.48	1.00	294.48	0.994	1.000	0.431	N/A	N/A	NO	N/A	N/A	N/A	58.7	N/A	0.000	0.00	1.98
3.50	12.23	0.38	3.11	silty clay to clay	4.4	1.00	8	420	202	420	2.55	3.04	117.14	0.992	1.000	0.430	0.229	0.712	YES	5.0	18.9	1,066	N/A	N/A	0.000	0.00	1.98
4.50	6.79	0.22	3.24	clay	3.4	1.00	7	540	259	540	2.64	N/A	N/A	0.990	N/A	0.429	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.98
5.50	4.83	0.07	1.42	sensitive fine grained	2.4	1.00	2	660	317	654	2.60	3.30	63.46	0.987	1.000	0.428	0.104	0.324	YES	5.0	9.1	266	N/A	N/A	0.000	0.00	1.98
6.50	6.05	0.15	2.45	silty clay to clay	1.4	1.00	4	780	374	711	2.70	N/A	N/A	0.985	N/A	0.427	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.98
7.50	15.80	0.28	1.76	clayey silt to silty clay	0.4	1.66	13	900	432	769	2.13	1.51	84.90	0.983	1.000	0.426	0.137	0.429	YES	2.8	23.9	1,200	N/A	N/A	0.000	0.00	1.98
8.50	7.06	0.16	2.27	silty clay to clay	-0.6	1.00	5	1,020	490	827	2.69	N/A	N/A	0.980	N/A	0.425	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.98
9.50	5.06	0.06	1.19	sensitive fine grained	-1.6	1.00	3	1,140	547	884	2.70	N/A	N/A	0.978	N/A	0.424	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.98
10.50	4.40	0.01	0.23	sensitive fine grained	-2.6	1.00	2	1,260	605	942	2.52	2.88	31.02	0.976	1.000	0.423	0.076	0.239	YES	5.0	8.2	226	N/A	N/A	0.000	0.00	1.98
11.50	10.17	0.03	0.33	sandy silt to clayey silt	-3.6	1.00	4	1,380	662	999	2.35	1.00	17.66	0.973	1.000	0.422	0.065	0.205	YES	2.8	8.6	241	11.9	N/A	2.301	0.28	1.71
12.50	6.63	0.05	0.80	sensitive fine grained	-4.6	1.00	3	1,500	720	1,057	2.60	3.30	47.17	0.971	1.000	0.421	0.089	0.283	YES	5.0	9.6	288	N/A	N/A	0.000	0.00	1.71
13.50	3.99	0.02	0.38	sensitive fine grained	-5.6	1.00	2	1,620	778	1,115	2.71	4.10	33.14	0.969	N/A	0.420	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.71
14.50	3.94	0.01	0.30	sensitive fine grained	-6.6	1.00	2	1,740	835	1,172	2.71	4.10	31.11	0.966	N/A	0.419	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.71
15.50	5.82	0.02	0.26	sensitive fine grained	-7.6	1.00	3	1,860	893	1,230	2.54	2.99	31.90	0.964	1.000	0.418	0.077	0.245	YES	5.0	8.7	248	N/A	N/A	0.000	0.00	1.71
16.50	4.76	0.00	0.00	sensitive fine grained	-8.6	1.00	2	1,980	950	1,287	2.89	5.59	46.42	0.962	N/A	0.417	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.71
17.50	17.18	0.10	0.58	sandy silt to clayey silt	-9.6	1.00	7	2,100	1,008	1,345	2.32	2.01	48.66	0.959	1.000	0.416	0.091	0.291	YES	2.8	11.2	381	15.1	N/A	1.893	0.23	1.48
18.50	85.95	0.45	0.53	sand to silty sand	-10.6	1.00	21	2,220	1,066	1,403	1.69	1.03	121.34	0.957	1.000	0.415	0.246	0.792	YES	1.3	27.0	1,200	29.4	N/A	0.100	0.01	1.47
19.50	149.32	1.24	0.83	sand	-11.6	1.00	30	2,340	1,123	1,460	1.63	1.00	199.25	0.955	1.000	0.414	N/A	N/A	NO	N/A	N/A	N/A	35.0	N/A	0.047	0.01	1.46
20.50	171.04	1.57	0.92	sand	-12.6	1.00	34	2,460	1,181	1,518	1.63	1.00	222.60	0.952	1.000	0.413	N/A	N/A	NO	N/A	N/A	N/A	39.3	N/A	0.007	0.00	1.46
21.50	161.96	1.82	1.12	sand	-13.6	1.00	32	2,580	1,238	1,575	1.72	1.05	216.37	0.950	1.000	0.412	N/A	N/A	NO	N/A	N/A	N/A	36.5	N/A	0.033	0.00	1.46
22.50	135.51	1.28	0.95	sand	-14.6	1.66	45	2,700	1,296	1,633	1.42	1.00	278.72	0.948	1.000	0.411	N/A	N/A	NO	N/A	N/A	N/A	49.7	N/A	0.000	0.00	1.46
23.50	59.26	0.70	1.18	silty sand to sandy silt	-15.6	1.00	20	2,820	1,354	1,691	2.07	1.41	101.32	0.945	1.000	0.410	0.177	0.576	YES	2.8	24.3	1,200	30.8	N/A	0.085	0.01	1.45
24.50	32.63	0.26	0.81	silty sand to sandy silt	-16.6	1.66	18	2,940	1,411	1,748	1.90	1.19	76.41	0.943	1.000	0.409	0.121	0.397	YES	2.8	22.1	1,200	28.1	N/A	0.142	0.02	1.43
25.50	8.30	0.09	1.02	clayey silt to silty clay	-17.6	1.00	4	3,060	1,469	1,806	2.78	N/A	N/A	0.941	N/A	0.408	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.43
26.50	17.70	0.13	0.73	sandy silt to clayey silt	-18.6	1.00	7	3,180	1,526	1,863	2.44	2.48	50.24	0.938	1.000	0.407	0.092	0.301	YES	2.8	10.1	319	13.8	N/A	2.007	0.24	1.19
27.50	13.65	0.11	0.77	sandy silt to clayey silt	-19.6	1.00	5	3,300	1,584	1,921	2.54	2.98	48.46	0.936	1.000	0.406	0.090	0.297	YES	2.8	8.4	233	11.7	N/A	2.335	0.28	0.91
28.50	57.52	0.35	0.61	sand to silty sand	-20.6	1.00	14	3,420	1,642	1,979	1.95	1.24	78.85	0.934	1.000	0.405	0.126	0.414	YES	1.3	15.8	754	17.7	N/A	1.651	0.20	0.71
29.50	85.55	0.84	0.98	sand to silty sand	-21.6	1.00	21	3,540	1,699	2,036	1.94	1.22	113.61	0.931	1.000	0.404	0.216	0.716	YES	1.3	22.5	1,200	24.7	N/A	0.999	0.12	0.59
30.50	178.65	2.17	1.22	sand to silty sand	-22.6	1.00	45	3,660	1,757	2,094	1.77	1.08	206.80	0.926	1.000	0.401	N/A	N/A	NO	N/A	N/A	N/A	48.2	N/A	0.000	0.00	0.59
31.50	202.66	3.12	1.54	sand to silty sand	-23.6	1.00	51	3,780	1,814	2,151	1.82	1.12	237.91	0.918	1.000	0.398	N/A	N/A	NO	N/A	N/A	N/A	53.7	N/A	0.000	0.00	0.59
32.50	117.07	1.38	1.18	sand to silty sand	-24.6	1.00	29	3,900	1,872	2,209	1.90	1.19	143.96	0.909	1.000	0.394	0.357	1.210	YES	1.3	29.2	1,200	31.7	N/A	0.073	0.01	0.58
33.50	112.39	1.30	1.16	sand to silty sand	-25.6	1.00	28	4,020	1,930	2,267	1.91	1.20	137.50	0.901	1.000	0.391	0.322	1.099	YES	1.3	27.7	1,200	30.2	N/A	0.085	0.01	0.57
34.50	108.40	1.33	1.23	sand to silty sand	-26.6	1.00	27	4,140	1,987	2,324	1.95	1.24	134.51	0.893	1.000	0.387	0.306	1.056	YES	1.3	26.5	1,200	28.8	N/A	0.095	0.01	0.56
35.50	142.66	2.15	1.51	sand to silty sand	-27.6	1.00	36	4,260	2,045	2,382	1.93	1.22	171.56	0.885	0.991	0.384	N/A	N/A	NO	N/A	N/A	N/A	36.8	N/A	0.027	0.00	0.56
36.50	80.56	1.77	2.20	silty sand to sandy silt	-28.6	1.66	44	4,380	2,102	2,439	1.91	1.20	156.33	0.877	0.980	0.380	0.435	1.498	NO	N/A	N/A	N/A	53.3	N/A	0.000	0.00	0.56
37.50	13.04	0.22	1.69	clayey silt to silty clay	-29.6	1.00	7	4,500	2,160	2,497	2.83	N/A	N/A	0.869	N/A	0.376	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.56
38.50	10.27	0.07	0.71	sandy silt to clayey silt	-30.6	1.00	4	4,620	2,218	2,555	2.76	4.44	42.21	0.861	N/A	0.373	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.56
39.50	11.22	0.08	0.68	sandy silt to clayey silt	-31.6	1.00	4	4,740	2,275	2,612	2.72	4.15	42.32	0.852	N/A	0.369	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.56
40.50	14.00	0.12	0.87	sandy silt to clayey silt	-32.6	1.00	6	4,860	2,333	2,670	2.68	N/A	N/A	0.844	N/A	0.366	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.56
41.50	18.11	0.37	2.04	clayey silt to silty clay	-33.6	1.00	9	4,980	2,390	2,727	2.77	N/A	N/A	0.836	N/A	0.362	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.56
42.50	21.15	0.65	3.07	clayey silt to silty clay	-34.6	1.00	11	5,100	2,448	2,785	2.83	N/A	N/A	0.828	N/A	0.359	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.56
43.50	20.32	0.70	3.42	clayey silt to silty clay	-35.6	1.00	10	5,220	2,506	2,843	2.88	N/A	N/A	0.820	N/A	0.355	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.56
44.50	16.44	0.48	2.93	clayey silt to silty clay	-36.6	1.00	8	5,340	2,563	2,900	2.93	N/A	N/A	0.812	N/A	0.352	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.56
45.50	71.95	1.03	1.43	silty sand to sandy silt	-37.6	1.00	24	5,460	2,621	2,958	2.17	1.61	101.04	0.804	0.914	0.348	0.176	0.616	YES	2.8	22.5	1,200	28.7	N/A	0.084	0.01	0.55
46.50	98.17	1.21	1.23	sand to silty sand	-38.6	1.00	25	5,580	2,678	3,015	2.03	1.34	114.03	0.795	0.907	0.345	0.218	0.765	YES	1.3	21.3	1,200	23.4	N/A	0.380	0.05	0.50
47.50	129.55	1.24	0.96	sand to silty sand	-39.6	1.00	32	5,700	2,736	3,073	1.87	1.16	128.65	0.787	0.887	0.341	0.278	0.964	YES	1.3	27.5	1,200	29.9	N/A	0.073	0.01	0.49
48.50	191.91	1.00	0.52	sand	-40.6	1.00	38	5,820	2,794	3,131	1.57	1.00	162.38	0.779	0.875	0.338	N/A	N/A	NO	N/A	N/A	N/A	30.7	N/A	0.067	0.01	0.48
49.50	173.66	0.73	0.42	sand	-41.6	1.00	35	5,940	2,851	3,188	1.56	1.00	145.44	0.771	0.870	0.334	0.366	1.272	YES	0.0	27.5	1,200	27.5	N/A	0.088	0.01	0.47
50.50	139.30	0.47	0.34	sand	-42.6	1.00	28	6,060	2,909	3,246	1.60	1.00	115.51	0.763	0.877	0.331	0.223	0.790	YES	0.0	21.9	1,200	21.9	N/A	0.803	0.10	0.38
51.50	182.96	0.61	0.33	sand	-43.6	1.00	37	6,180	2,966	3,303	1.49	1.00	150.23	0.755	0.854	0.327	0.395	1.377	NO	N/A	N/A	N/A	28.5	N/A	0.079	0.01	0.37
52.50	116.86	0.85	0.72	sand	-44.6	1.00	23	6,300	3,024	3,361	1.85	1.14	108.73	0.747	0.877	0.324	0.200	0.721	YES	0.0	18.0	979	18.0	N/A	1.443	0.17	0.19
53.50	98.09	0.49	0.50	sand to silty sand	-45.6	1.66	41	6,420	3,082	3,419	1.53	1.00	130.84	0.739	0.841	0.320	0.288	1.011	YES	1.3	32.4	1,200	35.0	N/A	0.033	0.00	0.19
54.50	18.29	0.34	1.87	sandy silt to clayey silt	-46.6	1.00	7	6,540	3,139	3,476	2.83	N/A	N/A	0.730	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
55.50	14.23	0.21	1.45	sandy silt to clayey silt	-47.6	1.00	6	6,660	3,197	3,534	2.89	N/A	N/A	0.722	N/A	0.313	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
56.50	27.90	0.80	2.85	clayey silt to silty clay	-48.6	1.00	14	6,780	3,254	3,591	2.79	N/A	N/A	0.714	N/A	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.19
57.50	96.74	1.12	1.15	sand to silty sand	-49.6	1.00	24	6,900	3,312	3,649	2.06	1.38	103.74	0.706	0.852	0.306	0.184	0.683	YES	1.3	19.2	1,106	21.3	N/A	0.367	0.04	0.15
58.50	128.98	0.83	0.64	sand	-50.6	1.00	26	7,020	3,370	3,707	1.80	1.11	110.14	0.698	0.843	0.302	0.204	0.760	YES	0.0	18.9	1,075	18.9	N/A	1.210	0.15	0.00

max=	1,200
min=	226
avg=	888

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT040

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	6.90 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	6.90 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

\+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	3.90 ft below ground surface
GWT Depth For Design, Zwd =	0.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	9.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	0.47 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	0.47 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +															RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ_v' (psf)	Effective Vert. Stress (Test) σ_v' (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_c (in.)	Cumulative Settlement Profile (in.)
0.50	13.50	0.25	1.82	clayey silt to silty clay	5.9	1.00	7	60	29	60	2.05	1.37	154.26	0.999	1.000	0.433	0.421	1.299	YES	2.8	14.3	615	N/A	N/A	0.000	0.00	0.47
1.50	11.40	0.48	4.17	clay	4.9	1.00	11	180	86	180	2.53	2.92	159.98	0.997	1.000	0.432	0.461	1.424	NO	N/A	N/A	N/A	N/A	N/A	0.000	0.00	0.47
2.50	6.73	0.38	5.57	clay	3.9	1.00	7	300	144	300	2.66	N/A	N/A	0.994	N/A	0.431	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
3.50	6.17	0.32	5.19	clay	2.9	1.00	6	420	202	420	2.75	N/A	N/A	0.992	N/A	0.430	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
4.50	4.60	0.23	5.02	clay	1.9	1.00	5	540	259	503	2.89	N/A	N/A	0.990	N/A	0.429	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
5.50	4.37	0.22	4.92	clay	0.9	1.00	4	660	317	560	2.96	N/A	N/A	0.987	N/A	0.428	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.47
6.50	21.60	0.33	1.51	sandy silt to clayey silt	-0.1	1.66	14	780	374	618	1.95	1.24	102.68	0.985	1.000	0.427	0.181	0.565	YES	2.8	27.1	1,200	34.2	N/A	0.057	0.01	0.46
7.50	8.52	0.23	2.75	silty clay to clay	-1.1	1.66	9	900	432	675	2.46	2.58	78.22	0.983	1.000	0.426	0.125	0.390	YES	5.0	21.0	1,200	N/A	N/A	0.000	0.00	0.46
8.50	3.87	0.07	1.86	sensitive fine grained	-2.1	1.00	2	1,020	490	733	2.87	N/A	N/A	0.980	N/A	0.425	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.46
9.50	3.55	0.03	0.97	sensitive fine grained	-3.1	1.00	2	1,140	547	791	2.80	N/A	N/A	0.978	N/A	0.424	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.46
10.50	3.16	0.02	0.65	sensitive fine grained	-4.1	1.00	2	1,260	605	848	2.81	4.90	37.91	0.976	N/A	0.423	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.46
11.50	4.03	0.03	0.72	sensitive fine grained	-5.1	1.00	2	1,380	662	906	2.75	4.40	40.63	0.973	N/A	0.422	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.46
12.50	3.40	0.01	0.30	sensitive fine grained	-6.1	1.00	2	1,500	720	963	2.72	4.18	30.58	0.971	N/A	0.421	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.46
13.50	2.80	0.01	0.31	sensitive fine grained	-7.1	1.00	1	1,620	778	1,021	2.84	5.11	29.07	0.969	N/A	0.420	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.46
14.50	4.75	0.02	0.47	sensitive fine grained	-8.1	1.00	2	1,740	835	1,079	2.69	3.93	35.95	0.966	N/A	0.419	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.46
15.50	3.25	0.01	0.31	sensitive fine grained	-9.1	1.00	2	1,860	893	1,136	2.83	5.02	29.90	0.964	N/A	0.418	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.46
16.50	16.12	0.08	0.50	sandy silt to clayey silt	-10.1	1.00	6	1,980	950	1,194	2.30	1.96	45.80	0.962	1.000	0.417	0.088	0.282	YES	2.8	11.1	379	15.0	N/A	1.897	0.23	0.23
17.50	85.13	1.03	1.22	sand to silty sand	-11.1	1.00	21	2,100	1,008	1,251	1.91	1.20	143.76	0.959	1.000	0.416	0.356	1.144	YES	1.3	28.2	1,200	30.7	N/A	0.088	0.01	0.22
18.50	121.43	2.12	1.74	silty sand to sandy silt	-12.1	1.00	40	2,220	1,066	1,309	1.93	1.21	201.87	0.957	1.000	0.415	N/A	N/A	NO	N/A	N/A	N/A	65.0	N/A	0.000	0.00	0.22
19.50	112.13	1.99	1.77	silty sand to sandy silt	-13.1	1.00	37	2,340	1,123	1,367	1.96	1.25	187.37	0.955	1.000	0.414	N/A	N/A	NO	N/A	N/A	N/A	59.3	N/A	0.000	0.00	0.22
20.50	109.01	1.96	1.80	silty sand to sandy silt	-14.1	1.00	36	2,460	1,181	1,424	1.98	1.28	181.25	0.952	1.000	0.413	N/A	N/A	NO	N/A	N/A	N/A	56.7	N/A	0.000	0.00	0.22
21.50	100.82	2.15	2.14	silty sand to sandy silt	-15.1	1.66	56	2,580	1,238	1,482	1.76	1.08	228.30	0.950	1.000	0.412	N/A	N/A	NO	N/A	N/A	N/A	82.6	N/A	0.000	0.00	0.22
22.50	21.07	0.37	1.75	sandy silt to clayey silt	-16.1	1.66	14	2,700	1,296	1,539	2.22	1.73	74.86	0.948	1.000	0.411	0.119	0.387	YES	2.8	18.7	1,049	24.1	N/A	1.077	0.13	0.09
23.50	8.37	0.08	0.99	clayey silt to silty clay	-17.1	1.00	4	2,820	1,354	1,597	2.74	N/A	N/A	0.945	N/A	0.410	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
24.50	6.07	0.06	0.97	sensitive fine grained	-18.1	1.00	3	2,940	1,411	1,655	2.89	N/A	N/A	0.943	N/A	0.409	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
25.50	5.40	0.06	1.15	sensitive fine grained	-19.1	1.00	3	3,060	1,469	1,712	3.00	N/A	N/A	0.941	N/A	0.408	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
26.50	5.50	0.04	0.70	sensitive fine grained	-20.1	1.00	3	3,180	1,526	1,770	2.90	5.74	38.68	0.938	N/A	0.407	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
27.50	5.63	0.07	1.24	sensitive fine grained	-21.1	1.00	3	3,300	1,584	1,827	3.02	N/A	N/A	0.936	N/A	0.406	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
28.50	7.37	0.12	1.57	clayey silt to silty clay	-22.1	1.00	4	3,420	1,642	1,885	2.96	N/A	N/A	0.934	N/A	0.405	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
29.50	6.33	0.03	0.42	sensitive fine grained	-23.1	1.00	3	3,540	1,699	1,943	2.80	4.76	34.07	0.931	N/A	0.404	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
30.50	9.95	0.10	1.02	clayey silt to silty clay	-24.1	1.00	5	3,660	1,757	2,000	2.76	N/A	N/A	0.926	N/A	0.401	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
31.50	6.61	0.01	0.19	sensitive fine grained	-25.1	1.00	3	3,780	1,814	2,058	2.70	3.99	28.41	0.918	N/A	0.398	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
32.50	9.27	0.08	0.83	clayey silt to silty clay	-26.1	1.00	5	3,900	1,872	2,115	2.78	N/A	N/A	0.909	N/A	0.394	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
33.50	10.87	0.16	1.46	clayey silt to silty clay	-27.1	1.00	5	4,020	1,930	2,173	2.83	N/A	N/A	0.901	N/A	0.391	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
34.50	13.12	0.27	2.05	clayey silt to silty clay	-28.1	1.00	7	4,140	1,987	2,231	2.85	N/A	N/A	0.893	N/A	0.387	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
35.50	18.42	0.48	2.61	clayey silt to silty clay	-29.1	1.00	9	4,260	2,045	2,288	2.78	N/A	N/A	0.885	N/A	0.384	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
36.50	15.97	0.32	1.98	clayey silt to silty clay	-30.1	1.00	8	4,380	2,102	2,346	2.78	N/A	N/A	0.877	N/A	0.380	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
37.50	20.98	0.86	4.08	silty clay to clay	-31.1	1.00	14	4,500	2,160	2,403	2.87	N/A	N/A	0.869	N/A	0.376	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
38.50	55.10	1.24	2.25	sandy silt to clayey silt	-32.1	1.00	22	4,620	2,218	2,461	2.37	2.18	114.10	0.861	0.966	0.373	0.218	0.754	YES	2.8	22.7	1,200	28.8	N/A	0.090	0.01	0.08
39.50	99.28	1.30	1.31	sand to silty sand	-33.1	1.66	41	4,740	2,275	2,519	1.71	1.04	160.58	0.852	0.950	0.369	N/A	N/A	NO	N/A	N/A	N/A	40.9	N/A	0.000	0.00	0.08
40.50	43.88	1.30	2.96	sandy silt to clayey silt	-34.1	1.66	29	4,860	2,333	2,576	2.22	1.70	114.69	0.844	0.943	0.366	0.220	0.758	YES	2.8	28.4	1,200	35.7	N/A	0.034	0.00	0.08
41.50	21.27	0.66	3.08	clayey silt to silty clay	-35.1	1.00	11	4,980	2,390	2,634	2.82	N/A	N/A	0.836	N/A	0.362	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.08
42.50	53.62	0.96	1.79	silty sand to sandy silt	-36.1	1.00	18	5,100	2,448	2,691	2.33	2.04	98.97	0.828	0.942	0.359	0.170	0.596	YES	2.8	18.2	997	23.5	N/A	0.562	0.07	0.01
43.50	31.38	0.89	2.83	sandy silt to clayey silt	-37.1	1.00	13	5,220	2,506	2,749	2.67	N/A	N/A	0.820	N/A	0.355	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
44.50	17.47	0.46	2.63	clayey silt to silty clay	-38.1	1.00	9	5,340	2,563	2,807	2.87	N/A	N/A	0.812	N/A	0.352	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
45.50	15.10	0.30	2.01	clayey silt to silty clay	-39.1	1.00	8	5,460	2,621	2,864	2.87	N/A	N/A	0.804	N/A	0.348	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
46.50	11.02	0.15	1.32	clayey silt to silty clay	-40.1	1.00	6	5,580	2,678	2,922	2.92	N/A	N/A	0.795	N/A	0.345	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
47.50	11.67	0.15	1.25	clayey silt to silty clay	-41.1	1.00	6	5,700	2,736	2,979	2.89	N/A	N/A	0.787	N/A	0.341	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
48.50	10.27	0.13	1.22	clayey silt to silty clay	-42.1	1.00	5	5,820	2,794	3,037	2.95	N/A	N/A	0.779	N/A	0.338	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
49.50	9.60	0.12	1.21	clayey silt to silty clay	-43.1	1.00	5	5,940	2,851	3,095	2.99	N/A	N/A	0.771	N/A	0.334	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
50.50	8.55	0.05	0.60	sensitive fine grained	-44.1	1.00	4	6,060	2,909	3,152	2.92	5.85	37.79	0.763	N/A	0.331	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
51.50	9.15	0.02	0.22	sensitive fine grained	-45.1	1.00	5	6,180	2,966	3,210	2.74	4.28	29.17	0.755	N/A	0.327	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
52.50	9.14	0.15	1.67	clayey silt to silty clay	-46.1	1.00	5	6,300	3,024	3,267	3.10	N/A	N/A	0.747	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
53.50	14.10	0.42	2.98	clayey silt to silty clay	-47.1	1.00	7	6,420	3,082	3,325	3.05	N/A	N/A	0.739	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
54.50	16.10	0.51	3.16	clayey silt to silty clay	-48.1	1.00	8	6,540	3,139	3,383	3.02	N/A	N/A	0.730	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
55.50	15.82	0.46	2.93	clayey silt to silty clay	-49.1	1.00	8	6,660	3,197	3,440	3.01	N/A	N/A	0.722	N/A	0.313	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
56.50	11.37	0.26	2.28	clayey silt to silty clay	-50.1	1.00	6	6,780	3,254	3,498	3.10	N/A	N/A	0.714	N/A	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
57.50	20.52	0.49	2.38	clayey silt to silty clay	-51.1	1.00	10	6,900	3,312	3,555	2.87	N/A	N/A	0.706	N/A	0.306	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
58.50	164.50	1.53	0.93	sand	-52.1	1.00	33	7,020	3,370	3,613	1.82	1.12	141.96	0.698	0.824	0.302	0.346	1.258	YES	0.0	24.5	1,200	24.5	N/A	0.097	0.01	0.00
59.50	375.80	2.01	0.54	gravelly sand to sand	-53.1	1.00	63	7,140	3,427	3,671	1.39	1.00	287.08	0.690	0.806	0.299	N/A	N/A	NO	N/A	N/A	N/A	46.2	N/A	0.000	0.00	0.00

	max=	1,200
	min=	379
	avg=	1,024

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT045

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	9.00 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	9.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$

+++ $FS = (CRR_{7.5}/CSR)\ MSF\ K_\sigma\ K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	6.00 ft below ground surface
GWT Depth For Design, Zwd =	0.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	16.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	0.88 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	0.88 inches	

INPUT SOIL PROFILE (CPT DATA)				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)
0.50	17.12	0.29	1.68	sandy silt to clayey silt
1.50	9.62	0.39	4.06	clay
2.50	5.98	0.35	5.87	clay
3.50	5.32	0.35	6.51	clay
4.50	2.40	0.11	4.65	clay
5.50	2.15	0.06	2.87	clay
6.50	2.32	0.07	2.89	clay
7.50	1.72	0.07	3.86	clay
8.50	24.22	0.13	0.53	silty sand to sandy silt
9.50	19.60	0.20	1.01	sandy silt to clayey silt
10.50	1.71	0.08	4.70	organic material
11.50	1.92	0.05	2.54	clay
12.50	2.70	0.09	3.31	clay
13.50	2.67	0.07	2.45	clay
14.50	1.73	0.03	1.98	sensitive fine grained
15.50	1.62	0.04	2.80	clay
16.50	1.37	0.03	1.92	sensitive fine grained
17.50	2.33	0.05	2.25	sensitive fine grained
18.50	3.18	0.03	0.90	sensitive fine grained
19.50	3.48	0.06	1.74	sensitive fine grained
20.50	29.69	0.18	0.59	silty sand to sandy silt
21.50	49.63	0.36	0.73	silty sand to sandy silt
22.50	9.72	0.19	1.93	clayey silt to silty clay
23.50	5.53	0.14	2.58	clay
24.50	6.88	0.13	1.85	silty clay to clay
25.50	6.08	0.16	2.60	clay
26.50	3.87	0.08	1.98	clay
27.50	4.93	0.12	2.37	clay
28.50	4.60	0.08	1.83	silty clay to clay
29.50	9.32	0.11	1.15	clayey silt to silty clay
30.50	24.22	0.65	2.70	clayey silt to silty clay
31.50	22.70	0.75	3.33	clayey silt to silty clay
32.50	23.72	0.93	3.91	silty clay to clay
33.50	25.67	0.75	2.92	clayey silt to silty clay
34.50	38.37	1.30	3.38	clayey silt to silty clay
35.50	41.48	1.08	2.61	sandy silt to clayey silt
36.50	15.73	0.23	1.46	sandy silt to clayey silt
37.50	17.05	0.31	1.79	sandy silt to clayey silt
38.50	34.87	0.38	1.08	silty sand to sandy silt
39.50	21.35	0.41	1.90	sandy silt to clayey silt
40.50	41.35	0.68	1.64	silty sand to sandy silt
41.50	37.34	0.56	1.50	silty sand to sandy silt
42.50	8.05	0.09	1.08	clayey silt to silty clay
43.50	11.92	0.26	2.15	clayey silt to silty clay
44.50	32.78	0.85	2.58	sandy silt to clayey silt
45.50	35.50	0.55	1.54	silty sand to sandy silt
46.50	11.98	0.22	1.88	clayey silt to silty clay
47.50	99.50	1.20	1.21	sand to silty sand
48.50	16.35	0.49	2.99	clayey silt to silty clay
49.50	7.15	0.14	1.91	silty clay to clay
50.50	6.52	0.15	2.28	silty clay to clay
51.50	6.98	0.23	3.34	clay
52.50	8.57	0.22	2.64	silty clay to clay
53.50	12.23	0.22	1.81	clayey silt to silty clay
54.50	19.78	0.62	3.15	clayey silt to silty clay
55.50	73.55	1.03	1.40	silty sand to sandy silt
56.50	68.25	1.02	1.49	silty sand to sandy silt
57.50	69.22	1.10	1.59	silty sand to sandy silt
58.50	106.67	1.64	1.54	sand to silty sand
59.50	235.33	2.01	0.86	sand

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +																RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ_v' (psf)	Effective Vert. Stress (Test) σ_v' (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_l (in.)	Cumulative Settlement Profile (in.)
8.0	1.00	7	60	29	60	1.95	1.24	177.56	0.999	1.000	0.433	N/A	N/A	NO	N/A	N/A	N/A	19.0	N/A	1.565	0.19	0.88
7.0	1.00	10	180	86	180	2.57	3.16	146.11	0.997	1.000	0.432	0.370	1.144	YES	5.0	21.3	1,200	N/A	N/A	0.000	0.00	0.88
6.0	1.00	6	300	144	300	2.71	N/A	N/A	0.994	N/A	0.431	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.88
5.0	1.66	9	420	202	420	2.55	3.02	148.47	0.992	1.000	0.430	0.384	1.193	YES	5.0	20.0	1,182	N/A	N/A	0.000	0.00	0.88
4.0	1.00	2	540	259	540	3.10	N/A	N/A	0.990	N/A	0.429	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.88
3.0	1.00	2	660	317	660	3.08	N/A	N/A	0.987	N/A	0.428	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.88
2.0	1.00	2	780	374	749	3.10	N/A	N/A	0.985	N/A	0.427	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.88
1.0	1.00	2	900	432	806	3.35	N/A	N/A	0.983	N/A	0.426	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.88
0.0	1.00	8	1,020	490	864	2.02	1.33	64.88	0.980	1.000	0.425	0.105	0.331	YES	2.8	15.1	687	19.7	N/A	1.490	0.18	0.70
-1.0	1.66	13	1,140	547	922	1.96	1.25	77.59	0.978	1.000	0.424	0.123	0.389	YES	2.8	21.9	1,200	27.9	N/A	0.226	0.03	0.67
-2.0	1.00	2	1,260	605	979	3.53	N/A	N/A	0.976	N/A	0.423	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.67
-3.0	1.00	2	1,380	662	1,037	3.36	N/A	N/A	0.973	N/A	0.422	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.67
-4.0	1.00	3	1,500	720	1,094	3.29	N/A	N/A	0.971	N/A	0.421	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.67
-5.0	1.00	3	1,620	778	1,152	3.26	N/A	N/A	0.969	N/A	0.420	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.67
-6.0	1.00	1	1,740	835	1,210	3.45	N/A	N/A	0.966	N/A	0.419	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.67
-7.0	1.00	2	1,860	893	1,267	3.61	N/A	N/A	0.964	N/A	0.418	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.67
-8.0	1.00	1	1,980	950	1,325	3.71	N/A	N/A	0.962	N/A	0.417	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.67
-9.0	1.00	1	2,100	1,008	1,382	3.41	N/A	N/A	0.959	N/A	0.416	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.67
-10.0	1.00	2	2,220	1,066	1,440	3.07	N/A	N/A	0.957	N/A	0.415	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.67
-11.0	1.00	2	2,340	1,123	1,498	3.19	N/A	N/A	0.955	N/A	0.414	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.67
-12.0	1.00	10	2,460	1,181	1,555	2.14	1.53	58.98	0.952	1.000	0.413	0.099	0.320	YES	2.8	14.0	594	18.5	N/A	1.586	0.19	0.48
-13.0	1.66	27	2,580	1,238	1,613	1.69	1.00	104.44	0.950	1.000	0.412	0.186	0.603	YES	2.8	33.3	1,200	41.6	N/A	0.000	0.00	0.48
-14.0	1.00	5	2,700	1,296	1,670	2.82	N/A	N/A	0.948	N/A	0.411	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-15.0	1.00	6	2,820	1,354	1,728	3.14	N/A	N/A	0.945	N/A	0.410	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-16.0	1.00	5	2,940	1,411	1,786	2.98	N/A	N/A	0.943	N/A	0.409	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-17.0	1.00	6	3,060	1,469	1,843	3.13	N/A	N/A	0.941	N/A	0.408	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-18.0	1.00	4	3,180	1,526	1,901	3.30	N/A	N/A	0.938	N/A	0.407	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-19.0	1.00	5	3,300	1,584	1,958	3.23	N/A	N/A	0.936	N/A	0.406	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-20.0	1.00	3	3,420	1,642	2,016	3.22	N/A	N/A	0.934	N/A	0.405	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-21.0	1.00	5	3,540	1,699	2,074	2.81	N/A	N/A	0.931	N/A	0.404	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-22.0	1.00	12	3,660	1,757	2,131	2.65	N/A	N/A	0.926	N/A	0.401	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-23.0	1.00	11	3,780	1,814	2,189	2.74	N/A	N/A	0.918	N/A	0.398	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-24.0	1.00	16	3,900	1,872	2,246	2.78	N/A	N/A	0.909	N/A	0.394	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-25.0	1.00	13	4,020	1,930	2,304	2.68	N/A	N/A	0.901	N/A	0.391	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-26.0	1.00	19	4,140	1,987	2,362	2.59	3.25	125.24	0.893	1.000	0.387	0.263	0.906	YES	2.8	20.5	1,200	N/A	N/A	0.000	0.00	0.48
-27.0	1.66	27	4,260	2,045	2,419	2.18	1.61	109.25	0.885	0.992	0.384	0.201	0.694	YES	2.8	27.8	1,200	35.0	N/A	0.042	0.01	0.48
-28.0	1.00	6	4,380	2,102	2,477	2.71	N/A	N/A	0.877	N/A	0.380	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-29.0	1.00	7	4,500	2,160	2,534	2.73	N/A	N/A	0.869	N/A	0.376	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.48
-30.0	1.00	12	4,620	2,218	2,592	2.33	2.06	68.37	0.861	0.976	0.373	0.110	0.383	YES	2.8	13.0	511	17.3	N/A	1.642	0.20	0.28
-31.0	1.00	9	4,740	2,275	2,650	2.68	N/A	N/A	0.852	N/A	0.369	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.28
-32.0	1.00	14	4,860	2,333	2,707	2.39	2.26	86.39	0.844	0.961	0.366	0.140	0.491	YES	2.8	14.6	648	19.2	N/A	1.416	0.17	0.11
-33.0	1.66	21	4,980	2,390	2,765	2.09	1.44	81.36	0.836	0.946	0.362	0.130	0.453	YES	2.8	20.3	1,200	26.0	N/A	0.160	0.02	0.09
-34.0	1.00	4	5,100	2,448	2,822	2.99	N/A	N/A	0.828	N/A	0.359	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
-35.0	1.00	6	5,220	2,506	2,880	2.97	N/A	N/A	0.820	N/A	0.355	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
-36.0	1.00	13	5,340	2,563	2,938	2.63	N/A	N/A	0.812	N/A	0.352	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
-37.0	1.66	20	5,460	2,621	2,995	2.14	1.52	78.15	0.804	0.922	0.348	0.124	0.439	YES	2.8	18.8	1,061	24.2	N/A	0.260	0.03	0.06
-38.0	1.00	6	5,580	2,678	3,053	2.96	N/A	N/A	0.795	N/A	0.345	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.06
-39.0	1.66	41	5,700	2,736	3,110	1.71	1.05	147.47	0.787	0.882	0.341	0.378	1.305	NO	N/A	N/A	N/A	37.1	N/A	0.021	0.00	0.06
-40.0	1.66	14	5,820	2,794	3,168	2.63	N/A	N/A	0.779	N/A	0.338	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.06
-41.0	1.00	5	5,940	2,851	3,226	3.23	N/A	N/A	0.771	N/A	0.334	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.06
-42.0	1.00	4	6,060	2,909	3,283	3.33	N/A	N/A	0.763	N/A	0.331	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.06
-43.0	1.00	7	6,180	2,966	3,341	3.40	N/A	N/A	0.755	N/A	0.327	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.06
-44.0	1.00	6	6,300	3,024	3,398	3.24	N/A	N/A	0.747	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.06
-45.0	1.00	6	6,420	3,082	3,456	2.99	N/A	N/A	0.739	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.06
-46.0	1.00	10	6,540	3,139	3,514	2.93	N/A	N/A	0.730	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.06
-47.0	1.00	25	6,660	3,197	3,571	2.20	1.66	96.53	0.722	0.860	0.313	0.164	0.600	YES	2.8	21.1	1,200	27.0	N/A	0.085	0.01	0.05
-48.0	1.00	23	6,780	3,254	3,629	2.24	1.78	95.35	0.714	0.861	0.309	0.161	0.596	YES	2.8	19.7	1,153	25.3	N/A	0.095	0.01	0.03
-49.0	1.00	23	6,900	3,312	3,686	2.26	1.83	98.21	0.706	0.856	0.306	0.168	0.627	YES	2.8	19.8	1,164	25.4	N/A	0.093	0.01	0.02
-50.0	1.00	27	7,020	3,370	3,744	2.11	1.47	120.64	0.698	0.841	0.302	0.243	0.903	YES	1.3	20.8	1,200	22.9	N/A	0.152	0.02	0.00
-51.0	1.00	47	7,140	3,427	3,802	1.68	1.02	184.04	0.690	0.806	0.299	N/A	N/A	NO	N/A	N/A	N/A	34.1	N/A	0.036	0.00	0.00
																	max=	1,200				
																	min=	511				
																	avg=	1,038				

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT048

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	11.00 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$

+++ $FS = (CRR_{7.5}/CSR)\ MSF\ K_\sigma\ K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	8.00 ft below ground surface
GWT Depth For Design, Zwd =	1.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	11.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	0.45 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	0.45 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_l (in.)	Cumulative Settlement Profile (in.)
0.50	79.50	2.35	2.95	sandy silt to clayey silt	10.0	1.00	32	60	60	60	1.87	1.17	534.77	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	69.9	N/A	N/A	N/A	0.45
1.50	119.95	5.11	4.26	very stiff fine grained (*)	9.0	1.00	120	180	149	180	2.03	1.34	587.21	0.997	1.000	0.251	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	0.000	0.00	0.45
2.50	168.40	5.89	3.50	sandy silt to clayey silt	8.0	1.00	67	300	206	300	1.92	1.21	631.72	0.994	1.000	0.301	N/A	N/A	NO	N/A	N/A	N/A	142.4	N/A	0.000	0.00	0.45
3.50	89.02	5.53	6.22	very stiff fine grained (*)	7.0	1.00	89	420	264	420	2.29	1.90	466.44	0.992	1.000	0.328	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	0.000	0.00	0.45
4.50	122.97	2.78	2.26	silty sand to sandy silt	6.0	1.00	41	540	322	540	1.86	1.15	352.83	0.990	1.000	0.346	N/A	N/A	NO	N/A	N/A	N/A	88.6	N/A	0.000	0.00	0.45
5.50	161.12	2.46	1.53	sand to silty sand	5.0	1.66	67	660	379	660	1.37	1.00	612.65	0.987	1.000	0.357	N/A	N/A	NO	N/A	N/A	N/A	121.3	N/A	0.000	0.00	0.45
6.50	33.18	1.49	4.50	silty clay to clay	4.0	1.00	22	780	437	780	2.48	2.67	189.31	0.985	1.000	0.366	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	0.000	0.00	0.45
7.50	18.23	0.94	5.16	clay	3.0	1.00	18	900	494	900	2.62	N/A	N/A	0.983	N/A	0.372	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.45
8.50	12.40	0.66	5.38	clay	2.0	1.00	12	1,020	552	989	2.77	N/A	N/A	0.980	N/A	0.377	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.45
9.50	30.37	1.02	3.34	clayey silt to silty clay	1.0	1.66	25	1,140	610	1,046	2.15	1.55	141.44	0.978	1.000	0.380	0.343	1.204	YES	2.8	37.6	1,200	N/A	N/A	0.000	0.00	0.45
10.50	12.01	0.45	3.77	clay	0.0	1.00	12	1,260	667	1,104	2.73	N/A	N/A	0.976	N/A	0.383	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.45
11.50	17.03	0.44	2.61	clayey silt to silty clay	-1.0	1.00	9	1,380	725	1,162	2.52	2.89	105.48	0.973	1.000	0.385	0.189	0.655	YES	2.8	14.0	590	N/A	N/A	0.000	0.00	0.45
12.50	33.40	0.59	1.78	sandy silt to clayey silt	-2.0	1.00	13	1,500	782	1,219	2.29	1.90	101.65	0.971	1.000	0.387	0.178	0.612	YES	2.8	19.9	1,176	25.5	N/A	0.283	0.03	0.42
13.50	27.28	0.53	1.94	sandy silt to clayey silt	-3.0	1.66	18	1,620	840	1,277	2.08	1.42	98.85	0.969	1.000	0.389	0.170	0.583	YES	2.8	25.4	1,200	32.1	N/A	0.068	0.01	0.41
14.50	10.33	0.31	3.00	silty clay to clay	-4.0	1.00	7	1,740	898	1,334	2.80	N/A	N/A	0.966	N/A	0.390	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
15.50	5.85	0.20	3.41	clay	-5.0	1.00	6	1,860	955	1,392	3.06	N/A	N/A	0.964	N/A	0.390	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
16.50	5.52	0.15	2.74	clay	-6.0	1.00	6	1,980	1,013	1,450	3.05	N/A	N/A	0.962	N/A	0.391	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
17.50	6.00	0.15	2.56	clay	-7.0	1.00	6	2,100	1,070	1,507	3.02	N/A	N/A	0.959	N/A	0.391	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
18.50	6.38	0.15	2.35	silty clay to clay	-8.0	1.00	4	2,220	1,128	1,565	2.99	N/A	N/A	0.957	N/A	0.392	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
19.50	6.27	0.15	2.35	silty clay to clay	-9.0	1.00	4	2,340	1,186	1,622	3.01	N/A	N/A	0.955	N/A	0.392	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
20.50	6.51	0.13	2.04	silty clay to clay	-10.0	1.00	4	2,460	1,243	1,680	2.98	N/A	N/A	0.952	N/A	0.392	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
21.50	6.97	0.17	2.45	silty clay to clay	-11.0	1.00	5	2,580	1,301	1,738	3.01	N/A	N/A	0.950	N/A	0.392	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
22.50	6.40	0.16	2.56	silty clay to clay	-12.0	1.00	4	2,700	1,358	1,795	3.07	N/A	N/A	0.948	N/A	0.392	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
23.50	7.90	0.24	3.08	clay	-13.0	1.00	8	2,820	1,416	1,853	3.04	N/A	N/A	0.945	N/A	0.392	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
24.50	7.33	0.16	2.17	silty clay to clay	-14.0	1.00	5	2,940	1,474	1,910	3.00	N/A	N/A	0.943	N/A	0.391	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
25.50	7.77	0.12	1.55	clayey silt to silty clay	-15.0	1.00	4	3,060	1,531	1,968	2.91	N/A	N/A	0.941	N/A	0.391	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
26.50	8.82	0.25	2.80	silty clay to clay	-16.0	1.00	6	3,180	1,589	2,026	3.01	N/A	N/A	0.938	N/A	0.391	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
27.50	9.87	0.24	2.47	silty clay to clay	-17.0	1.00	7	3,300	1,646	2,083	2.94	N/A	N/A	0.936	N/A	0.390	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
28.50	11.75	0.24	2.06	clayey silt to silty clay	-18.0	1.00	6	3,420	1,704	2,141	2.84	N/A	N/A	0.934	N/A	0.390	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
29.50	11.68	0.20	1.70	clayey silt to silty clay	-19.0	1.00	6	3,540	1,762	2,198	2.81	N/A	N/A	0.931	N/A	0.389	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
30.50	13.83	0.24	1.73	clayey silt to silty clay	-20.0	1.00	7	3,660	1,819	2,256	2.75	N/A	N/A	0.926	N/A	0.387	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
31.50	14.24	0.38	2.71	clayey silt to silty clay	-21.0	1.00	7	3,780	1,877	2,314	2.86	N/A	N/A	0.918	N/A	0.384	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
32.50	21.87	1.08	4.96	clay	-22.0	1.00	22	3,900	1,934	2,371	2.88	N/A	N/A	0.909	N/A	0.381	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
33.50	25.48	0.69	2.72	clayey silt to silty clay	-23.0	1.00	13	4,020	1,992	2,429	2.67	N/A	N/A	0.901	N/A	0.378	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
34.50	43.57	1.48	3.39	clayey silt to silty clay	-24.0	1.00	22	4,140	2,050	2,486	2.55	3.05	130.56	0.893	0.992	0.375	0.287	1.012	YES	2.8	22.3	1,200	N/A	N/A	0.000	0.00	0.41
35.50	23.07	1.23	5.33	clay	-25.0	1.00	23	4,260	2,107	2,544	2.91	N/A	N/A	0.885	N/A	0.372	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
36.50	28.33	0.77	2.71	sandy silt to clayey silt	-26.0	1.00	11	4,380	2,165	2,602	2.65	N/A	N/A	0.877	N/A	0.369	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
37.50	28.93	0.87	3.01	clayey silt to silty clay	-27.0	1.00	14	4,500	2,222	2,659	2.68	N/A	N/A	0.869	N/A	0.366	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
38.50	59.73	0.99	1.65	silty sand to sandy silt	-28.0	1.66	33	4,620	2,280	2,717	1.94	1.23	114.03	0.861	0.949	0.363	0.218	0.761	YES	2.8	31.1	1,200	38.9	N/A	0.008	0.00	0.41
39.50	22.60	0.58	2.57	clayey silt to silty clay	-29.0	1.00	11	4,740	2,338	2,774	2.74	N/A	N/A	0.852	N/A	0.360	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.41
40.50	36.63	0.94	2.55	sandy silt to clayey silt	-30.0	1.00	15	4,860	2,395	2,832	2.57	3.15	100.75	0.844	0.954	0.356	0.175	0.625	YES	2.8	15.1	690	19.8	N/A	1.330	0.16	0.25
41.50	22.23	0.73	3.27	clayey silt to silty clay	-31.0	1.00	11	4,980	2,453	2,890	2.83	N/A	N/A	0.836	N/A	0.353	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
42.50	13.85	0.36	2.62	clayey silt to silty clay	-32.0	1.00	7	5,100	2,510	2,947	2.96	N/A	N/A	0.828	N/A	0.350	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
43.50	11.67	0.23	1.97	clayey silt to silty clay	-33.0	1.00	6	5,220	2,568	3,005	2.97	N/A	N/A	0.820	N/A	0.347	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
44.50	11.38	0.32	2.77	silty clay to clay	-34.0	1.00	8	5,340	2,626	3,062	3.07	N/A	N/A	0.812	N/A	0.343	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
45.50	9.10	0.14	1.54	clayey silt to silty clay	-35.0	1.00	5	5,460	2,683	3,120	3.04	N/A	N/A	0.804	N/A	0.340	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
46.50	10.28	0.16	1.51	clayey silt to silty clay	-36.0	1.00	5	5,580	2,741	3,178	2.99	N/A	N/A	0.795	N/A	0.337	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
47.50	12.00	0.28	2.33	clayey silt to silty clay	-37.0	1.00	6	5,700	2,798	3,235	3.03	N/A	N/A	0.787	N/A	0.334	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
48.50	13.30	0.21	1.60	clayey silt to silty clay	-38.0	1.00	7	5,820	2,856	3,293	2.90	N/A	N/A	0.779	N/A	0.330	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
49.50	9.65	0.13	1.30	clayey silt to silty clay	-39.0	1.00	5	5,940	2,914	3,350	3.00	N/A	N/A	0.771	N/A	0.327	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
50.50	11.77	0.21	1.79	clayey silt to silty clay	-40.0	1.00	6	6,060	2,971	3,408	2.99	N/A	N/A	0.763	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
51.50	11.45	0.20	1.70	clayey silt to silty clay	-41.0	1.00	6	6,180	3,029	3,466	3.00	N/A	N/A	0.755	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
52.50	12.07	0.19	1.53	clayey silt to silty clay	-42.0	1.00	6	6,300	3,086	3,523	2.96	N/A	N/A	0.747	N/A	0.317	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
53.50	11.70	0.19	1.63	clayey silt to silty clay	-43.0	1.00	6	6,420	3,144	3,581	3.00	N/A	N/A	0.739	N/A	0.314	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
54.50	12.58	0.19	1.51	clayey silt to silty clay	-44.0	1.00	6	6,540	3,202	3,638	2.95	N/A	N/A	0.730	N/A	0.310	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
55.50	18.40	0.33	1.81	sandy silt to clayey silt	-45.0	1.00	7	6,660	3,259	3,696	2.83	N/A	N/A	0.722	N/A	0.307	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25
56.50	44.15	0.87	1.97	sandy silt to clayey silt	-46.0	1.00	18	6,780	3,317	3,754	2.52	2.88	87.15	0.714	0.873	0.304	0.142	0.543	YES	2.8	15.7	744	20.5	N/A	0.498	0.06	0.19
57.50	103.22	1.44	1.39	sand to silty sand	-47.0	1.66	43	6,900	3,374	3,811	1.78	1.09	143.44	0.706	0.811	0.300	0.354	1.278	YES	1.3	32.3	1,200	34.9	N/A	0.031	0.00	0.19
58.50	48.20	0.85	1.75	silty sand to sandy silt	-48.0	1.00	16	7,020	3,432	3,869	2.42	2.41	88.57	0.698	0.871	0.297	0.145	0.566	YES	2.8	14.4	622	18.9	N/A	1.189	0.14	0.05
59.50	54.03	1.09	2.01	silty sand to sandy silt	-49.0	1.00	18	7,140	3,490	3,926	2.42	2.41	98.47	0.690	0.861	0.294	0.169	0.661	YES	2.8	15.7	741	20.4	N/A	0.381	0.05	0.00
60.50	37.43	1.17	3.11	clayey silt to silty clay	-50.0	1.00	19	7,260	3,547	3,984	2.73	N/A	N/A	0.682	N/A	0.290	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
																						max=	1,200				
																						min=	590				
																						avg=	960				

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT050

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	20.00 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$

+++ $FS = (CRR_{7.5}/CSR)\ MSF\ K_\sigma\ K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	17.00 ft below ground surface
GWT Depth For Design, Zwd =	10.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	14.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	0.84 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.02 inches	<--- Dry or Unsaturated Sands
Total:	0.86 inches	

INPUT SOIL PROFILE (CPT DATA)				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)
0.50	104.53	0.23	0.22	sand
1.50	57.47	0.13	0.22	sand to silty sand
2.50	42.85	0.26	0.61	silty sand to sandy silt
3.50	36.18	0.13	0.37	silty sand to sandy silt
4.50	23.82	0.10	0.41	silty sand to sandy silt
5.50	19.15	0.16	0.83	sandy silt to clayey silt
6.50	25.97	0.27	1.05	silty sand to sandy silt
7.50	30.67	0.48	1.58	sandy silt to clayey silt
8.50	124.85	0.89	0.72	sand
9.50	29.12	0.76	2.60	sandy silt to clayey silt
10.50	15.40	0.37	2.43	clayey silt to silty clay
11.50	11.35	0.32	2.82	silty clay to clay
12.50	10.83	0.32	2.97	silty clay to clay
13.50	9.40	0.30	3.19	silty clay to clay
14.50	7.12	0.20	2.82	silty clay to clay
15.50	9.43	0.30	3.15	silty clay to clay
16.50	9.40	0.26	2.74	silty clay to clay
17.50	24.28	0.28	1.14	sandy silt to clayey silt
18.50	8.22	0.22	2.73	silty clay to clay
19.50	6.90	0.21	3.06	clay
20.50	36.31	0.43	1.18	silty sand to sandy silt
21.50	27.67	0.40	1.46	sandy silt to clayey silt
22.50	25.75	0.34	1.32	sandy silt to clayey silt
23.50	6.98	0.15	2.23	silty clay to clay
24.50	6.27	0.06	1.01	sensitive fine grained
25.50	7.67	0.11	1.44	clayey silt to silty clay
26.50	8.15	0.11	1.42	clayey silt to silty clay
27.50	7.30	0.09	1.21	sensitive fine grained
28.50	6.95	0.07	0.95	sensitive fine grained
29.50	7.42	0.08	1.09	sensitive fine grained
30.50	7.92	0.11	1.43	clayey silt to silty clay
31.50	17.09	0.13	0.77	sandy silt to clayey silt
32.50	7.88	0.09	1.08	clayey silt to silty clay
33.50	10.13	0.18	1.78	clayey silt to silty clay
34.50	14.62	0.20	1.35	sandy silt to clayey silt
35.50	14.37	0.37	2.59	clayey silt to silty clay
36.50	14.97	0.46	3.09	clayey silt to silty clay
37.50	47.78	0.57	1.20	silty sand to sandy silt
38.50	12.20	0.37	3.08	silty clay to clay
39.50	10.58	0.29	2.78	silty clay to clay
40.50	10.32	0.23	2.24	clayey silt to silty clay
41.50	37.01	0.68	1.83	sandy silt to clayey silt
42.50	32.33	0.99	3.06	clayey silt to silty clay
43.50	57.98	1.02	1.77	silty sand to sandy silt
44.50	67.35	1.30	1.93	silty sand to sandy silt
45.50	140.32	1.92	1.37	sand to silty sand
46.50	104.55	0.60	0.57	sand
47.50	48.68	0.51	1.05	silty sand to sandy silt
48.50	36.22	0.61	1.70	sandy silt to clayey silt
49.50	49.93	0.75	1.50	silty sand to sandy silt
50.50	37.35	0.65	1.75	sandy silt to clayey silt
51.50	17.12	0.46	2.68	clayey silt to silty clay
52.50	14.99	0.31	2.11	clayey silt to silty clay
53.50	15.17	0.26	1.71	clayey silt to silty clay
54.50	14.72	0.34	2.34	clayey silt to silty clay
55.50	15.32	0.36	2.37	clayey silt to silty clay
56.50	16.47	0.43	2.61	clayey silt to silty clay
57.50	20.08	0.33	1.67	sandy silt to clayey silt
58.50	15.08	0.40	2.68	clayey silt to silty clay
59.50	13.00	0.26	2.02	clayey silt to silty clay
60.50	18.82	0.34	1.83	sandy silt to clayey silt

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +																RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ_v' (psf)	Effective Vert. Stress (Test) σ_v' (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_t (in.)	Cumulative Settlement Profile (in.)
19.0	1.00	21	60	60	60	0.89	1.00	603.52	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	35.5	0.009	0.008	0.00	0.86
18.0	1.00	14	180	180	180	1.31	1.00	191.56	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	28.1	0.017	0.019	0.00	0.86
17.0	1.00	14	300	300	300	1.75	1.07	118.28	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	34.1	0.021	0.018	0.00	0.86
16.0	1.00	12	420	420	420	1.76	1.00	78.96	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	29.6	0.026	0.027	0.00	0.85
15.0	1.00	8	540	540	540	1.99	1.00	45.84	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	21.2	0.033	0.051	0.01	0.85
14.0	1.00	8	660	660	660	2.26	1.82	60.74	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	20.6	N/A	N/A	N/A	0.85
13.0	1.00	9	780	780	780	2.23	1.75	72.79	0.985	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	21.6	0.039	0.059	0.01	0.84
12.0	1.00	12	900	900	900	2.30	1.96	89.50	0.983	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	26.9	N/A	N/A	N/A	0.84
11.0	1.66	41	1,020	1,020	1,020	1.32	1.00	289.46	0.980	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	57.9	0.032	0.000	0.00	0.84
10.0	1.00	12	1,140	1,140	1,140	2.50	2.77	106.76	0.978	N/A	0.203	N/A	N/A	NO	N/A	N/A	N/A	23.5	N/A	N/A	N/A	0.84
9.0	1.00	8	1,260	1,229	1,260	2.67	N/A	N/A	0.976	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
8.0	1.00	8	1,380	1,286	1,380	2.84	N/A	N/A	0.973	N/A	0.217	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
7.0	1.00	7	1,500	1,344	1,500	2.88	N/A	N/A	0.971	N/A	0.225	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
6.0	1.00	6	1,620	1,402	1,620	2.96	N/A	N/A	0.969	N/A	0.233	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
5.0	1.00	5	1,740	1,459	1,740	3.05	N/A	N/A	0.966	N/A	0.240	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
4.0	1.00	6	1,860	1,517	1,860	2.98	N/A	N/A	0.964	N/A	0.246	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
3.0	1.00	6	1,980	1,574	1,980	2.96	N/A	N/A	0.962	N/A	0.252	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.84
2.0	1.66	16	2,100	1,632	2,069	2.11	1.48	65.77	0.959	1.000	0.257	0.106	0.553	YES	2.8	18.6	1,040	24.0	N/A	0.084	0.01	0.83
1.0	1.00	5	2,220	1,690	2,126	3.03	N/A	N/A	0.957	N/A	0.262	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.83
0.0	1.00	7	2,340	1,747	2,184	3.14	N/A	N/A	0.955	N/A	0.266	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.83
-1.0	1.00	12	2,460	1,805	2,242	2.29	1.93	73.81	0.952	1.000	0.270	0.117	0.580	YES	2.8	14.2	612	18.7	N/A	0.393	0.05	0.78
-2.0	1.00	11	2,580	1,862	2,299	2.45	2.55	73.00	0.950	1.000	0.274	0.116	0.566	YES	2.8	13.1	520	17.4	N/A	1.214	0.15	0.64
-3.0	1.66	17	2,700	1,920	2,357	2.15	1.56	67.90	0.948	1.000	0.277	0.109	0.525	YES	2.8	18.5	1,029	23.9	N/A	0.091	0.01	0.63
-4.0	1.00	5	2,820	1,978	2,414	3.10	N/A	N/A	0.945	N/A	0.280	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
-5.0	1.00	3	2,940	2,035	2,472	2.99	N/A	N/A	0.943	N/A	0.283	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
-6.0	1.00	4	3,060	2,093	2,530	2.98	N/A	N/A	0.941	N/A	0.286	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
-7.0	1.00	4	3,180	2,150	2,587	2.96	N/A	N/A	0.938	N/A	0.289	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
-8.0	1.00	4	3,300	2,208	2,645	2.99	N/A	N/A	0.936	N/A	0.291	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
-9.0	1.00	3	3,420	2,266	2,702	2.97	N/A	N/A	0.934	N/A	0.293	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
-10.0	1.00	4	3,540	2,323	2,760	2.98	N/A	N/A	0.931	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
-11.0	1.00	4	3,660	2,381	2,818	3.02	N/A	N/A	0.926	N/A	0.296	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.63
-12.0	1.66	11	3,780	2,438	2,875	2.25	1.00	25.62	0.918	0.955	0.296	0.071	0.307	YES	2.8	12.2	453	16.3	N/A	1.596	0.19	0.44
-13.0	1.00	4	3,900	2,496	2,933	2.98	N/A	N/A	0.909	N/A	0.296	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.44
-14.0	1.00	5	4,020	2,554	2,990	2.99	N/A	N/A	0.901	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.44
-15.0	1.00	6	4,140	2,611	3,048	2.78	N/A	N/A	0.893	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.44
-16.0	1.00	7	4,260	2,669	3,106	2.95	N/A	N/A	0.885	N/A	0.294	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.44
-17.0	1.00	7	4,380	2,726	3,163	2.98	N/A	N/A	0.877	N/A	0.293	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.44
-18.0	1.66	26	4,500	2,784	3,221	1.97	1.27	84.92	0.869	0.893	0.292	0.137	0.559	YES	2.8	23.6	1,200	29.9	N/A	0.061	0.01	0.43
-19.0	1.00	8	4,620	2,842	3,278	3.08	N/A	N/A	0.861	N/A	0.291	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
-20.0	1.00	7	4,740	2,899	3,336	3.12	N/A	N/A	0.852	N/A	0.290	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
-21.0	1.00	5	4,860	2,957	3,394	3.08	N/A	N/A	0.844	N/A	0.289	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
-22.0	1.00	15	4,980	3,014	3,451	2.54	2.95	80.37	0.836	0.902	0.287	0.128	0.537	YES	2.8	14.1	598	18.5	N/A	1.150	0.14	0.29
-23.0	1.00	16	5,100	3,072	3,509	2.73	N/A	N/A	0.828	N/A	0.286	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
-24.0	1.00	19	5,220	3,130	3,566	2.34	2.08	96.18	0.820	0.880	0.284	0.163	0.672	YES	2.8	17.3	901	22.4	N/A	0.123	0.01	0.28
-25.0	1.00	22	5,340	3,187	3,624	2.31	1.99	106.33	0.812	0.867	0.283	0.192	0.784	YES	2.8	19.5	1,131	25.0	N/A	0.087	0.01	0.26
-26.0	1.00	35	5,460	3,245	3,682	1.97	1.27	139.73	0.804	0.831	0.281	0.334	1.316	NO	N/A	N/A	N/A	29.6	0.060	0.01	0.26
-27.0	1.66	35	5,580	3,302	3,739	1.54	1.00	134.72	0.795	0.828	0.280	0.307	1.214	YES	0.0	25.3	1,200	25.3	N/A	0.084	0.01	0.25
-28.0	1.00	16	5,700	3,360	3,797	2.28	1.88	70.67	0.787	0.875	0.278	0.113	0.474	YES	2.8	14.6	642	19.1	N/A	0.417	0.05	0.20
-29.0	1.00	14	5,820	3,418	3,854	2.56	3.09	74.92	0.779	0.878	0.276	0.119	0.506	YES	2.8	13.2	529	17.5	N/A	1.214	0.15	0.05
-30.0	1.00	17	5,940	3,475	3,912	2.37	2.18	82.47	0.771	0.867	0.274	0.132	0.558	YES	2.8	14.7	653	19.3	N/A	0.347	0.04	0.01
-31.0	1.66	25	6,060	3,533	3,970	2.20	1.67	77.76	0.763	0.836	0.272	0.124	0.507	YES	2.8	20.4	1,200	26.1	N/A	0.077	0.01	0.00
-32.0	1.00	9	6,180	3,590	4,027	2.98	N/A	N/A	0.755	N/A	0.270	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-33.0	1.00	7	6,300	3,648	4,085	2.98	N/A	N/A	0.747	N/A	0.268	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-34.0	1.00	8	6,420	3,706	4,142	2.93	N/A	N/A	0.739	N/A	0.266	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-35.0	1.00	7	6,540	3,763	4,200	3.03	N/A	N/A	0.730	N/A	0.264	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-36.0	1.00	8	6,660	3,821	4,258	3.02	N/A	N/A	0.722	N/A	0.262	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-37.0	1.00	8	6,780	3,878	4,315	3.02	N/A	N/A	0.714	N/A	0.260	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-38.0	1.00	8	6,900	3,936	4,373	2.83	N/A	N/A	0.706	N/A	0.257	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-39.0	1.00	8	7,020	3,994	4,430	3.07	N/A	N/A	0.698	N/A	0.255	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-40.0	1.00	7	7,140	4,051	4,488	3.07	N/A	N/A	0.690	N/A	0.253	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
-41.0	1.00	8	7,260	4,109	4,546	2.90	N/A	N/A	0.682	N/A	0.250	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
																max=	1,200					
																min=	453					
																avg=	836					

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT052

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	12.00 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	9.00 ft below ground surface
GWT Depth For Design, Zwd =	2.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	26.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	2.92 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	2.92 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ_v' (psf)	Effective Vert. Stress (Test) σ_v' (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_c (in.)	Cumulative Settlement Profile (in.)
0.50	99.30	0.99	0.99	sand to silty sand	11.0	1.66	41	60	60	60	1.11	1.00	949.25	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	75.7	0.007	0.000	0.00	2.92
1.50	37.35	0.99	2.66	sandy silt to clayey silt	10.0	1.66	25	180	180	180	1.84	1.13	233.71	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	55.5	N/A	N/A	N/A	2.92
2.50	13.08	0.50	3.85	clay	9.0	1.00	13	300	269	300	2.48	2.68	158.13	0.994	1.000	0.231	0.448	2.589	NO	N/A	N/A	N/A	N/A	N/A	0.000	0.00	2.92
3.50	7.10	0.32	4.49	clay	8.0	1.00	7	420	326	420	2.77	N/A	N/A	0.992	N/A	0.265	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
4.50	6.42	0.24	3.69	clay	7.0	1.00	6	540	384	540	2.79	N/A	N/A	0.990	N/A	0.289	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
5.50	9.08	0.28	3.02	silty clay to clay	6.0	1.00	6	660	442	660	2.65	N/A	N/A	0.987	N/A	0.307	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
6.50	6.02	0.22	3.60	clay	5.0	1.00	6	780	499	780	2.88	N/A	N/A	0.985	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
7.50	5.30	0.18	3.42	clay	4.0	1.00	5	900	557	900	2.94	N/A	N/A	0.983	N/A	0.330	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
8.50	5.78	0.19	3.26	clay	3.0	1.00	6	1,020	614	1,020	2.92	N/A	N/A	0.980	N/A	0.338	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
9.50	6.15	0.17	2.76	clay	2.0	1.00	6	1,140	672	1,109	2.88	N/A	N/A	0.978	N/A	0.345	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
10.50	5.63	0.16	2.91	clay	1.0	1.00	6	1,260	730	1,166	2.95	N/A	N/A	0.976	N/A	0.350	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
11.50	5.33	0.26	4.80	clay	0.0	1.00	5	1,380	787	1,224	3.13	N/A	N/A	0.973	N/A	0.355	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
12.50	4.80	0.21	4.39	clay	-1.0	1.00	5	1,500	845	1,282	3.17	N/A	N/A	0.971	N/A	0.359	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
13.50	5.38	0.18	3.30	clay	-2.0	1.00	5	1,620	902	1,339	3.07	N/A	N/A	0.969	N/A	0.362	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
14.50	13.98	0.23	1.61	clayey silt to silty clay	-3.0	1.66	12	1,740	960	1,397	2.30	1.95	65.02	0.966	1.000	0.364	0.106	0.387	YES	2.8	16.7	838	N/A	N/A	0.000	0.00	2.92
15.50	3.95	0.08	1.98	clay	-4.0	1.00	4	1,860	1,018	1,454	3.12	N/A	N/A	0.964	N/A	0.366	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
16.50	3.78	0.06	1.44	sensitive fine grained	-5.0	1.00	2	1,980	1,075	1,512	3.09	N/A	N/A	0.962	N/A	0.368	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
17.50	4.40	0.07	1.61	sensitive fine grained	-6.0	1.00	2	2,100	1,133	1,570	3.06	N/A	N/A	0.959	N/A	0.370	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.92
18.50	10.05	0.07	0.71	sandy silt to clayey silt	-7.0	1.00	4	2,220	1,190	1,627	2.56	3.09	45.82	0.957	1.000	0.371	0.088	0.317	YES	2.8	7.3	191	10.3	N/A	2.541	0.30	2.61
19.50	12.68	0.07	0.52	sandy silt to clayey silt	-8.0	1.00	5	2,340	1,248	1,685	2.47	2.62	42.03	0.955	1.000	0.372	0.085	0.305	YES	2.8	8.3	231	11.6	N/A	2.343	0.28	2.33
20.50	17.41	0.08	0.47	sandy silt to clayey silt	-9.0	1.66	12	2,460	1,306	1,742	2.04	1.00	35.69	0.952	1.000	0.373	0.080	0.285	YES	2.8	15.2	694	19.8	N/A	1.372	0.16	2.17
21.50	6.22	0.07	1.12	sensitive fine grained	-10.0	1.00	3	2,580	1,363	1,800	2.90	N/A	N/A	0.950	N/A	0.374	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.17
22.50	5.13	0.04	0.74	sensitive fine grained	-11.0	1.00	3	2,700	1,421	1,858	2.92	N/A	N/A	0.948	N/A	0.375	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.17
23.50	6.55	0.08	1.16	sensitive fine grained	-12.0	1.00	3	2,820	1,478	1,915	2.91	N/A	N/A	0.945	N/A	0.375	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.17
24.50	78.00	0.73	0.94	sand to silty sand	-13.0	1.00	20	2,940	1,536	1,973	1.94	1.23	109.15	0.943	1.000	0.375	0.201	0.714	YES	1.3	21.0	1,200	23.1	N/A	1.041	0.12	2.04
25.50	127.10	1.87	1.47	sand to silty sand	-14.0	1.00	32	3,060	1,594	2,030	1.92	1.20	171.45	0.941	1.000	0.376	N/A	N/A	NO	N/A	N/A	N/A	35.6	N/A	0.036	0.00	2.04
26.50	66.67	1.30	1.94	silty sand to sandy silt	-15.0	1.00	22	3,180	1,651	2,088	2.21	1.69	124.08	0.938	1.000	0.376	0.258	0.915	YES	2.8	24.5	1,200	31.1	N/A	0.073	0.01	2.03
27.50	55.60	0.60	1.08	silty sand to sandy silt	-16.0	1.00	19	3,300	1,709	2,146	2.11	1.48	88.87	0.936	1.000	0.376	0.145	0.516	YES	2.8	20.7	1,200	26.5	N/A	0.161	0.02	2.01
28.50	51.23	0.80	1.56	silty sand to sandy silt	-17.0	1.66	28	3,420	1,766	2,203	1.94	1.22	110.46	0.934	1.000	0.376	0.205	0.729	YES	2.8	29.7	1,200	37.3	N/A	0.022	0.00	2.01
29.50	23.58	0.22	0.94	sandy silt to clayey silt	-18.0	1.00	9	3,540	1,824	2,261	2.41	2.37	58.54	0.931	1.000	0.376	0.099	0.350	YES	2.8	11.7	414	15.6	N/A	1.814	0.22	1.79
30.50	50.57	0.30	0.58	sand to silty sand	-19.0	1.00	13	3,660	1,882	2,318	2.02	1.33	69.11	0.926	1.000	0.375	0.111	0.394	YES	1.3	13.1	516	14.8	N/A	1.900	0.23	1.56
31.50	26.97	0.22	0.82	silty sand to sandy silt	-20.0	1.00	9	3,780	1,939	2,376	2.34	2.09	57.33	0.918	1.000	0.372	0.098	0.350	YES	2.8	11.0	373	14.9	N/A	1.889	0.23	1.33
32.50	15.73	0.13	0.81	sandy silt to clayey silt	-21.0	1.00	6	3,900	1,997	2,434	2.56	3.12	49.08	0.909	1.000	0.369	0.091	0.328	YES	2.8	8.5	239	11.8	N/A	2.310	0.28	1.06
33.50	66.23	0.65	0.98	sand to silty sand	-22.0	1.00	17	4,020	2,054	2,491	2.06	1.38	90.39	0.901	0.992	0.367	0.149	0.537	YES	1.3	16.2	791	18.0	N/A	1.545	0.19	0.87
34.50	91.12	0.87	0.95	sand to silty sand	-23.0	1.00	23	4,140	2,112	2,549	1.94	1.23	109.25	0.893	0.982	0.364	0.201	0.724	YES	1.3	21.5	1,200	23.6	N/A	0.621	0.07	0.80
35.50	109.57	1.06	0.96	sand to silty sand	-24.0	1.00	27	4,260	2,170	2,606	1.89	1.18	123.98	0.885	0.971	0.361	0.257	0.922	YES	1.3	25.3	1,200	27.6	N/A	0.096	0.01	0.79
36.50	211.85	2.87	1.36	sand to silty sand	-25.0	1.00	53	4,380	2,227	2,664	1.79	1.10	220.68	0.877	0.958	0.359	N/A	N/A	NO	N/A	N/A	N/A	50.6	N/A	0.000	0.00	0.79
37.50	253.80	3.97	1.56	sand to silty sand	-26.0	1.00	63	4,500	2,285	2,722	1.79	1.10	261.27	0.869	0.948	0.356	N/A	N/A	NO	N/A	N/A	N/A	59.5	N/A	0.000	0.00	0.79
38.50	268.83	4.21	1.57	sand to silty sand	-27.0	1.00	67	4,620	2,342	2,779	1.78	1.09	271.31	0.861	0.939	0.353	N/A	N/A	NO	N/A	N/A	N/A	62.3	N/A	0.000	0.00	0.79
39.50	271.32	4.40	1.62	sand to silty sand	-28.0	1.00	68	4,740	2,400	2,837	1.79	1.10	272.83	0.852	0.930	0.350	N/A	N/A	NO	N/A	N/A	N/A	62.2	N/A	0.000	0.00	0.79
40.50	140.67	2.48	1.76	silty sand to sandy silt	-29.0	1.66	78	4,860	2,458	2,894	1.70	1.04	217.80	0.844	0.921	0.347	N/A	N/A	NO	N/A	N/A	N/A	82.5	N/A	0.000	0.00	0.79
41.50	56.64	0.79	1.40	silty sand to sandy silt	-30.0	1.66	31	4,980	2,515	2,952	1.93	1.22	102.23	0.836	0.917	0.344	0.179	0.637	YES	2.8	28.5	1,200	35.9	N/A	0.030	0.00	0.78
42.50	10.05	0.23	2.23	clayey silt to silty clay	-31.0	1.00	5	5,100	2,573	3,010	3.07	N/A	N/A	0.828	N/A	0.341	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.78
43.50	44.48	0.48	1.07	silty sand to sandy silt	-32.0	1.00	15	5,220	2,630	3,067	2.27	1.87	72.40	0.820	0.931	0.338	0.115	0.423	YES	2.8	14.8	659	19.4	N/A	1.325	0.16	0.62
44.50	57.98	0.58	1.00	silty sand to sandy silt	-33.0	1.00	19	5,340	2,688	3,125	2.16	1.58	78.89	0.812	0.917	0.335	0.126	0.458	YES	2.8	18.3	1,003	23.6	N/A	0.251	0.03	0.59
45.50	30.63	0.43	1.41	sandy silt to clayey silt	-34.0	1.00	12	5,460	2,746	3,182	2.52	2.87	69.25	0.804	0.929	0.332	0.111	0.413	YES	2.8	12.5	473	16.7	N/A	1.647	0.20	0.40
46.50	34.40	0.29	0.83	silty sand to sandy silt	-35.0	1.66	19	5,580	2,803	3,240	2.02	1.33	63.96	0.795	0.907	0.329	0.104	0.383	YES	2.8	17.7	946	22.9	N/A	0.318	0.04	0.36
47.50	11.43	0.22	1.85	clayey silt to silty clay	-36.0	1.00	6	5,700	2,861	3,298	3.00	N/A	N/A	0.787	N/A	0.326	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.36
48.50	10.08	0.15	1.48	clayey silt to silty clay	-37.0	1.00	5	5,820	2,918	3,355	3.02	N/A	N/A	0.779	N/A	0.323	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.36
49.50	26.98	0.33	1.23	sandy silt to clayey silt	-38.0	1.00	11	5,940	2,976	3,413	2.56	3.09	61.97	0.771	0.918	0.320	0.102	0.391	YES	2.8	11.1	374	14.9	N/A	1.855	0.22	0.13
50.50	22.52	0.48	2.11	sandy silt to clayey silt	-39.0	1.00	9	6,060	3,034	3,470	2.77	N/A	N/A	0.763	N/A	0.317	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.13
51.50	23.28	0.45	1.93	sandy silt to clayey silt	-40.0	1.00	9	6,180	3,091	3,528	2.74	N/A	N/A	0.755	N/A	0.314	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.13
52.50	20.74	0.64	3.02	clayey silt to silty clay	-41.0	1.00	10	6,300	3,149	3,586	2.91	N/A	N/A	0.747	N/A	0.311	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.13
53.50	17.70	0.57	3.16	clayey silt to silty clay	-42.0	1.00	9	6,420	3,206	3,643	2.99	N/A	N/A	0.739	N/A	0.308	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.13
54.50	27.90	0.71	2.52	sandy silt to clayey silt	-43.0	1.00	11	6,540	3,264	3,701	2.76	N/A	N/A	0.730	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.13
55.50	48.17	1.06	2.19	sandy silt to clayey silt	-44.0	1.00	19	6,660	3,322	3,758	2.52	2.87	94.47	0.722	0.867	0.301	0.158	0.608	YES	2.8	16.9	858	21.9	N/A	0.198	0.02	0.11
56.50	66.10	0.99	1.50	silty sand to sandy silt	-45.0	1.00	22	6,780	3,379	3,816	2.26	1.84	93.45	0.714	0.855	0.298	0.156	0.597	YES	2.8	18.8	1,054	24.1	N/A	0.098	0.01	0.10
57.50	46.38	1.09	2.34	sandy silt to clayey silt	-46.0	1.00	19	6,900	3,437	3,874	2.56	3.09	95.59	0.706	0.862	0.295	0.161	0.629	YES	2.8	16.1	787	21.0	N/A	0.287	0.03	0.06
58.50	43.50	0.87	2.00	sandy silt to clayey silt	-47.0	1.00	17	7,020	3,494	3,931	2.54	3.01	86.03	0.698	0.863	0.292	0.139	0.550	YES	2.8	15.2	699	19.9	N/A	0.456	0.05	0.01
59.50	36.70	0.96	2.61	sandy silt to clayey silt	-48.0	1.66	24	7,140	3,552	3,989	2.32	2.00	91.16	0.690	0.836	0.288	0.150	0.582	YES	2.8	20.0	1,187	25.7	N/A	0.085	0.01	0.00
60.50	16.43	0.60	3.67	silty clay to clay	-49.0	1.00	11	7,260	3,610	4,046	3.09	N/A	N/A	0.682	N/A	0.285	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
																				max=	1,200						
																				min=	191						
																				avg=	797						

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT054

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	15.30 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$

+++ $FS = (CRR_{7.5}/CSR)\ MSF\ K_\sigma\ K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	12.30 ft below ground surface
GWT Depth For Design, Zwd =	5.30 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	24.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	2.25 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	2.25 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r(psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_i (in.)	Cumulative Settlement Profile (in.)
0.50	68.05	0.64	0.95	sand to silty sand	14.3	1.00	17	60	60	60	1.48	1.00	392.89	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	32.8	0.010	0.009	0.00	2.25
1.50	74.52	1.04	1.40	silty sand to sandy silt	13.3	1.00	25	180	180	180	1.74	1.06	264.26	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	55.7	0.014	0.000	0.00	2.25
2.50	70.53	0.73	1.04	sand to silty sand	12.3	1.00	18	300	300	300	1.73	1.06	192.71	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	33.9	0.021	0.019	0.00	2.25
3.50	50.92	0.94	1.84	silty sand to sandy silt	11.3	1.66	28	420	420	420	1.75	1.07	196.89	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	62.3	0.020	0.000	0.00	2.25
4.50	17.27	0.59	3.40	silty clay to clay	10.3	1.00	12	540	540	540	2.52	2.88	132.69	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.25
5.50	12.13	0.36	2.97	silty clay to clay	9.3	1.00	8	660	648	660	2.64	N/A	N/A	0.987	N/A	0.209	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.25
6.50	6.58	0.20	2.96	clay	8.3	1.00	7	780	705	780	2.88	N/A	N/A	0.985	N/A	0.227	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.25
7.50	6.63	0.21	3.18	clay	7.3	1.00	7	900	763	900	2.92	N/A	N/A	0.983	N/A	0.241	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.25
8.50	5.25	0.12	2.32	silty clay to clay	6.3	1.00	4	1,020	820	1,020	2.95	N/A	N/A	0.980	N/A	0.254	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.25
9.50	5.53	0.14	2.50	clay	5.3	1.00	6	1,140	878	1,140	2.97	N/A	N/A	0.978	N/A	0.264	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.25
10.50	5.89	0.14	2.43	silty clay to clay	4.3	1.00	4	1,260	936	1,260	2.96	N/A	N/A	0.976	N/A	0.273	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.25
11.50	5.50	0.12	2.24	silty clay to clay	3.3	1.00	4	1,380	993	1,380	2.98	N/A	N/A	0.973	N/A	0.281	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.25
12.50	5.93	0.14	2.27	silty clay to clay	2.3	1.00	4	1,500	1,051	1,488	2.98	N/A	N/A	0.971	N/A	0.288	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.25
13.50	7.47	0.20	2.63	silty clay to clay	1.3	1.00	5	1,620	1,108	1,545	2.94	N/A	N/A	0.969	N/A	0.294	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.25
14.50	6.20	0.19	3.04	clay	0.3	1.00	6	1,740	1,166	1,603	3.06	N/A	N/A	0.966	N/A	0.300	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.25
15.50	14.57	0.20	1.34	sandy silt to clayey silt	-0.7	1.00	6	1,860	1,224	1,660	2.55	3.03	63.82	0.964	1.000	0.305	0.104	0.456	YES	2.8	9.2	270	12.7	N/A	2.182	0.26	1.99
16.50	14.28	0.16	1.13	sandy silt to clayey silt	-1.7	1.66	9	1,980	1,281	1,718	2.27	1.85	54.60	0.962	1.000	0.309	0.095	0.411	YES	2.8	13.0	511	17.2	N/A	1.499	0.18	1.81
17.50	4.67	0.08	1.73	sensitive fine grained	-2.7	1.00	2	2,100	1,339	1,776	3.09	N/A	N/A	0.959	N/A	0.313	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.81
18.50	5.12	0.06	1.24	sensitive fine grained	-3.7	1.00	3	2,220	1,396	1,833	3.00	N/A	N/A	0.957	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.81
19.50	6.02	0.06	0.98	sensitive fine grained	-4.7	1.00	3	2,340	1,454	1,891	2.89	N/A	N/A	0.955	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.81
20.50	5.41	0.04	0.75	sensitive fine grained	-5.7	1.00	3	2,460	1,512	1,948	2.90	5.75	38.38	0.952	N/A	0.322	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.81
21.50	5.78	0.04	0.70	sensitive fine grained	-6.7	1.00	3	2,580	1,569	2,006	2.88	5.48	38.01	0.950	N/A	0.325	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.81
22.50	5.82	0.02	0.38	sensitive fine grained	-7.7	1.00	3	2,700	1,627	2,064	2.79	4.71	32.00	0.948	N/A	0.327	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.81
23.50	5.98	0.03	0.42	sensitive fine grained	-8.7	1.00	3	2,820	1,684	2,121	2.81	4.83	32.89	0.945	N/A	0.329	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.81
24.50	6.35	0.01	0.16	sensitive fine grained	-9.7	1.00	3	2,940	1,742	2,179	2.68	3.82	26.92	0.943	N/A	0.331	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.81
25.50	27.37	0.13	0.48	silty sand to sandy silt	-10.7	1.00	9	3,060	1,800	2,236	2.21	1.70	49.09	0.941	1.000	0.333	0.091	0.365	YES	2.8	11.4	397	15.4	N/A	1.811	0.22	1.59
26.50	73.22	0.65	0.89	sand to silty sand	-11.7	1.00	18	3,180	1,857	2,294	1.98	1.27	96.76	0.938	1.000	0.334	0.164	0.656	YES	1.3	18.4	1,020	20.4	N/A	1.182	0.14	1.45
27.50	107.97	1.06	0.98	sand to silty sand	-12.7	1.00	27	3,300	1,915	2,352	1.88	1.17	128.90	0.936	1.000	0.335	0.279	1.110	YES	1.3	26.2	1,200	28.6	N/A	0.081	0.01	1.44
28.50	218.17	2.48	1.14	sand	-13.7	1.00	44	3,420	1,972	2,409	1.71	1.04	228.89	0.934	1.000	0.337	N/A	N/A	NO	N/A	N/A	N/A	39.8	N/A	0.002	0.00	1.44
29.50	233.58	2.94	1.26	sand	-14.7	1.00	47	3,540	2,030	2,467	1.72	1.05	244.26	0.931	0.994	0.338	N/A	N/A	NO	N/A	N/A	N/A	42.1	N/A	0.000	0.00	1.44
30.50	202.17	2.90	1.43	sand to silty sand	-15.7	1.66	84	3,660	2,088	2,524	1.50	1.00	327.64	0.926	0.983	0.338	N/A	N/A	NO	N/A	N/A	N/A	80.6	N/A	0.000	0.00	1.44
31.50	91.94	1.81	1.97	silty sand to sandy silt	-16.7	1.66	51	3,780	2,145	2,582	1.84	1.14	167.25	0.918	0.972	0.336	N/A	N/A	NO	N/A	N/A	N/A	58.6	N/A	0.000	0.00	1.44
32.50	9.68	0.21	2.13	clayey silt to silty clay	-17.7	1.00	5	3,900	2,203	2,640	3.01	N/A	N/A	0.909	N/A	0.335	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.44
33.50	10.93	0.14	1.25	clayey silt to silty clay	-18.7	1.00	5	4,020	2,260	2,697	2.84	N/A	N/A	0.901	N/A	0.333	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.44
34.50	9.03	0.15	1.64	clayey silt to silty clay	-19.7	1.00	5	4,140	2,318	2,755	2.99	N/A	N/A	0.893	N/A	0.332	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.44
35.50	8.82	0.12	1.34	clayey silt to silty clay	-20.7	1.00	4	4,260	2,376	2,812	2.97	N/A	N/A	0.885	N/A	0.330	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.44
36.50	26.65	0.32	1.20	sandy silt to clayey silt	-21.7	1.00	11	4,380	2,433	2,870	2.50	2.75	63.25	0.877	0.957	0.328	0.104	0.403	YES	2.8	11.7	415	15.7	N/A	1.764	0.21	1.23
37.50	73.80	0.64	0.87	sand to silty sand	-22.7	1.00	18	4,500	2,491	2,928	2.02	1.33	88.17	0.869	0.938	0.326	0.144	0.551	YES	1.3	16.6	831	18.5	N/A	1.394	0.17	1.06
38.50	104.85	1.00	0.96	sand to silty sand	-23.7	1.00	26	4,620	2,548	2,985	1.93	1.22	113.06	0.861	0.919	0.325	0.214	0.810	YES	1.3	22.8	1,200	25.0	N/A	0.116	0.01	1.05
39.50	61.57	1.06	1.72	silty sand to sandy silt	-24.7	1.00	21	4,740	2,606	3,043	2.28	1.88	101.37	0.852	0.922	0.323	0.177	0.675	YES	2.8	19.4	1,127	25.0	N/A	0.111	0.01	1.03
40.50	73.67	0.69	0.94	sand to silty sand	-25.7	1.00	18	4,860	2,664	3,100	2.06	1.38	88.22	0.844	0.921	0.320	0.144	0.551	YES	1.3	16.1	786	18.0	N/A	1.435	0.17	0.86
41.50	90.73	0.89	0.98	sand to silty sand	-26.7	1.66	38	4,980	2,721	3,158	1.69	1.03	132.53	0.836	0.884	0.318	0.296	1.099	YES	1.3	31.2	1,200	33.8	N/A	0.041	0.00	0.85
42.50	20.33	0.52	2.52	clayey silt to silty clay	-27.7	1.00	10	5,100	2,779	3,215	2.82	N/A	N/A	0.828	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.85
43.50	15.63	0.32	2.01	clayey silt to silty clay	-28.7	1.00	8	5,220	2,836	3,273	2.88	N/A	N/A	0.820	N/A	0.314	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.85
44.50	24.57	0.22	0.89	silty sand to sandy silt	-29.7	1.00	8	5,340	2,894	3,331	2.51	2.84	52.96	0.812	0.929	0.312	0.094	0.373	YES	2.8	9.1	268	12.6	N/A	2.191	0.26	0.59
45.50	17.48	0.19	1.06	sandy silt to clayey silt	-30.7	1.00	7	5,460	2,951	3,388	2.70	N/A	N/A	0.804	N/A	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.59
46.50	28.32	0.70	2.45	sandy silt to clayey silt	-31.7	1.00	11	5,580	3,009	3,446	2.72	N/A	N/A	0.795	N/A	0.307	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.59
47.50	69.18	1.01	1.45	silty sand to sandy silt	-32.7	1.00	23	5,700	3,067	3,503	2.22	1.72	96.05	0.787	0.875	0.304	0.162	0.623	YES	2.8	20.2	1,200	25.9	N/A	0.089	0.01	0.58
48.50	127.83	0.72	0.56	sand	-33.7	1.00	26	5,820	3,124	3,561	1.76	1.08	110.23	0.779	0.864	0.302	0.205	0.781	YES	0.0	19.2	1,097	19.2	N/A	1.174	0.14	0.44
49.50	178.62	0.64	0.36	sand	-34.7	1.00	36	5,940	3,182	3,619	1.53	1.00	141.61	0.771	0.836	0.299	0.344	1.282	YES	0.0	26.6	1,200	26.6	N/A	0.083	0.01	0.43
50.50	167.72	0.54	0.32	sand	-35.7	1.00	34	6,060	3,239	3,676	1.54	1.00	131.78	0.763	0.835	0.297	0.293	1.100	YES	0.0	24.7	1,200	24.7	N/A	0.094	0.01	0.42
51.50	140.88	0.55	0.39	sand	-36.7	1.00	28	6,180	3,297	3,734	1.65	1.00	109.73	0.755	0.843	0.294	0.203	0.776	YES	0.0	20.6	1,200	20.6	N/A	0.353	0.04	0.38
52.50	117.41	0.37	0.32	sand	-37.7	1.00	23	6,300	3,355	3,791	1.68	1.00	90.66	0.747	0.852	0.292	0.149	0.582	YES	0.0	17.1	879	17.1	N/A	1.449	0.17	0.20
53.50	124.77	0.52	0.41	sand	-38.7	1.00	25	6,420	3,412	3,849	1.71	1.00	95.52	0.739	0.844	0.289	0.161	0.627	YES	0.0	18.0	974	18.0	N/A	1.264	0.15	0.05
54.50	114.97	1.01	0.88	sand to silty sand	-39.7	1.00	29	6,540	3,470	3,907	1.93	1.22	106.23	0.730	0.829	0.286	0.191	0.740	YES	1.3	21.9	1,200	24.1	N/A	0.094	0.01	0.04
55.50	162.95	1.33	0.82	sand	-40.7	1.00	33	6,660	3,527	3,964	1.79	1.10	135.07	0.722	0.815	0.284	0.309	1.185	YES	0.0	23.1	1,200	23.1	N/A	0.098	0.01	0.03
56.50	184.97	0.80	0.43	sand	-41.7	1.00	37	6,780	3,585	4,022	1.59	1.00	138.15	0.714	0.800	0.281	0.325	1.235	YES	0.0	26.1	1,200	26.1	N/A	0.080	0.01	0.02
57.50	169.50	1.23	0.72	sand	-42.7	1.66	56	6,900	3,643	4,079	1.44	1.00	207.95	0.706	0.787	0.278	N/A	N/A	NO	N/A	N/A	N/A	39.3	N/A	0.004	0.00	0.02
58.50	79.53	1.41	1.77	silty sand to sandy silt	-43.7	1.00	27	7,020	3,700	4,137	2.26	1.83	106.93	0.698	0.820	0.275	0.194	0.770	YES	2.8	21.2	1,200	27.1	N/A	0.072	0.01	0.01
59.50	49.45	0.95	1.93	silty sand to sandy silt	-44.7	1.66	27	7,140	3,758	4,195	2.14	1.53	91.28	0.690	0.814	0.273	0.151	0.601	YES	2.8	21.6	1,200	27.6	N/A	0.069	0.01	0.00
60.50	12.78	0.29	2.29	clayey silt to silty clay	-45.7	1.00	6	7,260	3,815	4,252	3.10	N/A	N/A	0.682	N/A	0.270	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
																						max=	1,200				
																						min=	268				
																						avg=	957				

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT056

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	15.40 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw = 12.40 ft below ground surface

GWT Depth For Design, Zwd = 5.40 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils = 14.00 feet

Earthquake-Induced Settlements:

- Liquefaction-Induced Settlement = 1.20 inches <--- Saturated Sands
- Seismic Compaction Settlement = 0.01 inches <--- Dry or Unsaturated Sands

Total: 1.21 inches

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_i (in.)	Cumulative Settlement Profile (in.)
0.50	32.82	0.11	0.33	silty sand to sandy silt	14.4	1.00	11	60	60	60	1.40	1.00	189.47	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	27.3	0.010	0.012	0.00	1.21
1.50	23.25	0.27	1.15	sandy silt to clayey silt	13.4	1.00	9	180	180	180	2.04	1.35	104.63	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	24.0	N/A	N/A	N/A	1.21
2.50	25.53	0.23	0.89	silty sand to sandy silt	12.4	1.00	9	300	300	300	2.02	1.33	87.89	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	22.4	0.024	0.035	0.00	1.20
3.50	18.52	0.22	1.18	sandy silt to clayey silt	11.4	1.00	7	420	420	420	2.27	1.86	74.98	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	20.1	N/A	N/A	N/A	1.20
4.50	34.65	1.06	3.05	clayey silt to silty clay	10.4	1.00	17	540	540	540	2.37	2.20	146.78	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.20
5.50	23.42	0.79	3.37	clayey silt to silty clay	9.4	1.66	19	660	654	660	2.24	1.78	120.64	0.987	1.000	0.207	0.243	1.566	NO	N/A	N/A	N/A	N/A	N/A	0.000	0.00	1.20
6.50	11.70	0.22	1.91	clayey silt to silty clay	8.4	1.00	6	780	711	780	2.56	3.10	78.67	0.985	1.000	0.225	0.125	0.744	YES	2.8	12.2	448	N/A	N/A	0.000	0.00	1.20
7.50	8.12	0.10	1.23	clayey silt to silty clay	7.4	1.00	4	900	769	900	2.62	N/A	N/A	0.983	N/A	0.239	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.20
8.50	6.65	0.08	1.13	sensitive fine grained	6.4	1.00	3	1,020	827	1,020	2.70	N/A	N/A	0.980	N/A	0.252	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.20
9.50	7.02	0.18	2.61	silty clay to clay	5.4	1.00	5	1,140	884	1,140	2.89	N/A	N/A	0.978	N/A	0.262	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.20
10.50	5.40	0.12	2.26	silty clay to clay	4.4	1.00	4	1,260	942	1,260	2.97	N/A	N/A	0.976	N/A	0.271	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.20
11.50	5.78	0.03	0.49	sensitive fine grained	3.4	1.00	3	1,380	999	1,380	2.66	3.72	36.22	0.973	N/A	0.280	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.20
12.50	5.75	0.02	0.41	sensitive fine grained	2.4	1.00	3	1,500	1,057	1,494	2.65	3.67	34.06	0.971	N/A	0.287	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.20
13.50	9.27	0.19	2.03	clayey silt to silty clay	1.4	1.00	5	1,620	1,115	1,551	2.79	N/A	N/A	0.969	N/A	0.293	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.20
14.50	11.95	0.24	1.98	clayey silt to silty clay	0.4	1.00	6	1,740	1,172	1,609	2.71	N/A	N/A	0.966	N/A	0.298	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.20
15.50	7.88	0.11	1.34	clayey silt to silty clay	-0.6	1.00	4	1,860	1,230	1,667	2.79	N/A	N/A	0.964	N/A	0.303	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.20
16.50	14.50	0.16	1.09	sandy silt to clayey silt	-1.6	1.00	6	1,980	1,287	1,724	2.52	2.87	57.87	0.962	1.000	0.308	0.098	0.425	YES	2.8	9.0	263	12.5	N/A	2.209	0.27	0.94
17.50	30.38	0.29	0.95	silty sand to sandy silt	-2.6	1.66	17	2,100	1,345	1,782	1.95	1.24	76.08	0.959	1.000	0.312	0.121	0.518	YES	2.8	20.6	1,200	26.3	N/A	0.089	0.01	0.93
18.50	9.13	0.09	0.94	clayey silt to silty clay	-3.6	1.00	5	2,220	1,403	1,839	2.70	N/A	N/A	0.957	N/A	0.315	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
19.50	6.02	0.06	0.97	sensitive fine grained	-4.6	1.00	3	2,340	1,460	1,897	2.90	N/A	N/A	0.955	N/A	0.318	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
20.50	6.13	0.03	0.44	sensitive fine grained	-5.6	1.00	3	2,460	1,518	1,955	2.77	4.50	33.89	0.952	N/A	0.321	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
21.50	5.73	0.01	0.17	sensitive fine grained	-6.6	1.00	3	2,580	1,575	2,012	2.70	3.96	27.17	0.950	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
22.50	5.90	0.01	0.17	sensitive fine grained	-7.6	1.00	3	2,700	1,633	2,070	2.69	3.94	27.07	0.948	N/A	0.326	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
23.50	5.80	0.01	0.17	sensitive fine grained	-8.6	1.00	3	2,820	1,691	2,127	2.71	4.10	26.97	0.945	N/A	0.328	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
24.50	7.20	0.01	0.12	sensitive fine grained	-9.6	1.00	4	2,940	1,748	2,185	2.59	3.29	26.24	0.943	1.000	0.330	0.072	0.291	YES	5.0	8.4	236	N/A	N/A	0.000	0.00	0.93
25.50	6.22	0.01	0.16	sensitive fine grained	-10.6	1.00	3	3,060	1,806	2,243	2.70	3.99	26.80	0.941	N/A	0.332	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
26.50	8.27	0.01	0.10	sensitive fine grained	-11.6	1.00	4	3,180	1,863	2,300	2.55	3.02	26.31	0.938	1.000	0.333	0.072	0.288	YES	5.0	8.9	254	N/A	N/A	0.000	0.00	0.93
27.50	37.08	0.09	0.24	sand to silty sand	-12.6	1.00	9	3,300	1,921	2,358	1.99	1.00	37.84	0.936	1.000	0.334	0.082	0.325	YES	1.3	9.9	305	11.4	N/A	2.371	0.28	0.64
28.50	123.80	1.29	1.04	sand to silty sand	-13.6	1.00	31	3,420	1,979	2,415	1.85	1.15	142.99	0.934	1.000	0.336	0.352	1.399	NO	N/A	N/A	N/A	32.0	N/A	0.057	0.01	0.64
29.50	175.17	2.50	1.43	sand to silty sand	-14.6	1.00	44	3,540	2,036	2,473	1.85	1.14	198.55	0.931	0.993	0.337	N/A	N/A	NO	N/A	N/A	N/A	43.8	N/A	0.000	0.00	0.64
30.50	188.88	3.11	1.65	sand to silty sand	-15.6	1.00	47	3,660	2,094	2,531	1.88	1.17	215.68	0.926	0.982	0.337	N/A	N/A	NO	N/A	N/A	N/A	46.5	N/A	0.000	0.00	0.64
31.50	178.76	2.65	1.48	sand to silty sand	-16.6	1.66	74	3,780	2,151	2,588	1.55	1.00	285.37	0.918	0.971	0.335	N/A	N/A	NO	N/A	N/A	N/A	70.7	N/A	0.000	0.00	0.64
32.50	83.45	1.58	1.90	silty sand to sandy silt	-17.6	1.66	46	3,900	2,209	2,646	1.86	1.16	152.17	0.909	0.961	0.334	0.408	1.565	NO	N/A	N/A	N/A	53.1	N/A	0.000	0.00	0.64
33.50	10.73	0.20	1.82	clayey silt to silty clay	-18.6	1.00	5	4,020	2,267	2,703	2.94	N/A	N/A	0.901	N/A	0.333	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.64
34.50	8.05	0.06	0.73	sensitive fine grained	-19.6	1.00	4	4,140	2,324	2,761	2.88	N/A	N/A	0.893	N/A	0.331	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.64
35.50	8.37	0.07	0.76	clayey silt to silty clay	-20.6	1.00	4	4,260	2,382	2,819	2.88	N/A	N/A	0.885	N/A	0.329	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.64
36.50	8.18	0.09	1.03	clayey silt to silty clay	-21.6	1.00	4	4,380	2,439	2,876	2.96	N/A	N/A	0.877	N/A	0.327	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.64
37.50	7.80	0.06	0.79	sensitive fine grained	-22.6	1.00	4	4,500	2,497	2,934	2.94	N/A	N/A	0.869	N/A	0.326	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.64
38.50	13.40	0.25	1.83	clayey silt to silty clay	-23.6	1.00	7	4,620	2,555	2,991	2.89	N/A	N/A	0.861	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.64
39.50	58.43	0.50	0.86	sand to silty sand	-24.6	1.00	15	4,740	2,612	3,049	2.12	1.48	75.91	0.852	0.933	0.322	0.121	0.467	YES	1.3	13.2	523	14.9	N/A	1.859	0.22	0.41
40.50	145.95	1.63	1.11	sand to silty sand	-25.6	1.00	36	4,860	2,670	3,107	1.87	1.16	146.73	0.844	0.891	0.320	0.374	1.390	NO	N/A	N/A	N/A	33.2	N/A	0.046	0.01	0.41
41.50	128.70	1.17	0.91	sand to silty sand	-26.6	1.66	53	4,980	2,727	3,164	1.55	1.00	182.48	0.836	0.883	0.318	N/A	N/A	NO	N/A	N/A	N/A	46.9	N/A	0.000	0.00	0.41
42.50	57.77	0.86	1.49	silty sand to sandy silt	-27.6	1.66	32	5,100	2,785	3,222	1.96	1.25	101.44	0.828	0.883	0.315	0.177	0.661	YES	2.8	27.9	1,200	35.1	N/A	0.032	0.00	0.40
43.50	10.65	0.09	0.82	sandy silt to clayey silt	-28.6	1.00	4	5,220	2,843	3,279	2.85	N/A	N/A	0.820	N/A	0.313	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.40
44.50	9.50	0.06	0.59	sandy silt to clayey silt	-29.6	1.00	4	5,340	2,900	3,337	2.85	5.24	37.68	0.812	N/A	0.311	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.40
45.50	9.58	0.04	0.41	sandy silt to clayey silt	-30.6	1.00	4	5,460	2,958	3,395	2.80	4.75	33.93	0.804	N/A	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.40
46.50	9.27	0.06	0.62	sandy silt to clayey silt	-31.6	1.00	4	5,580	3,015	3,452	2.89	5.56	37.86	0.795	N/A	0.306	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.40
47.50	8.80	0.07	0.72	clayey silt to silty clay	-32.6	1.00	4	5,700	3,073	3,510	2.95	N/A	N/A	0.787	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.40
48.50	11.25	0.14	1.21	clayey silt to silty clay	-33.6	1.00	6	5,820	3,131	3,567	2.94	N/A	N/A	0.779	N/A	0.301	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.40
49.50	10.58	0.12	1.11	clayey silt to silty clay	-34.6	1.00	5	5,940	3,188	3,625	2.96	N/A	N/A	0.771	N/A	0.299	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.40
50.50	8.93	0.09	0.93	clayey silt to silty clay	-35.6	1.00	4	6,060	3,246	3,683	3.02	N/A	N/A	0.763	N/A	0.296	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.40
51.50	9.38	0.13	1.34	clayey silt to silty clay	-36.6	1.00	5	6,180	3,303	3,740	3.08	N/A	N/A	0.755	N/A	0.294	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.40
52.50	9.87	0.18	1.78	clayey silt to silty clay	-37.6	1.00	5	6,300	3,361	3,798	3.12	N/A	N/A	0.747	N/A	0.291	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.40
53.50	17.12	0.35	1.99	clayey silt to silty clay	-38.6	1.00	9	6,420	3,419	3,855	2.91	N/A	N/A	0.739	N/A	0.288	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.40
54.50	41.43	0.64	1.53	silty sand to sandy silt	-39.6	1.00	14	6,540	3,476	3,913	2.49	2.73	74.80	0.730	0.878	0.286	0.119	0.487	YES	2.8	12.7	485	16.8	N/A	1.443	0.17	0.23
55.50	34.18	0.59	1.72	sandy silt to clayey silt	-40.6	1.00	14	6,660	3,534	3,971	2.60	N/A	N/A	0.722	N/A	0.283	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
56.50	45.73	0.59	1.29	silty sand to sandy silt	-41.6	1.00	15	6,780	3,591	4,028	2.37	2.19	74.86	0.714	0.866	0.280	0.119	0.490	YES	2.8	13.5	554	17.9	N/A	1.191	0.14	0.09
57.50	49.22	0.61	1.23	silty sand to sandy silt	-42.6	1.00	16	6,900	3,649	4,086	2.33	2.06	75.14	0.706	0.858	0.278	0.119	0.493	YES	2.8	14.3	616	18.8	N/A	0.477	0.06	0.03
58.50	112.23	0.91	0.81	sand to silty sand	-43.6	1.00	28	7,020	3,707	4,143	1.93	1.22	100.30	0.698	0.815	0.275	0.174	0.688	YES	1.3	20.8	1,200	22.9	N/A	0.096	0.01	0.02
59.50	87.65	1.27	1.45	silty sand to sandy silt	-44.6	1.00	29	7,140	3,764	4,201	2.17	1.61	102.57	0.690	0.808	0.272	0.180	0.715	YES	2.8	23.0	1,200	29.2	N/A	0.060	0.01	0.01
60.50	65.28	0.75	1.15	silty sand to sandy silt	-45.6	1.00	22	7,260	3,822	4,259	2.22	1.72	81.09	0.682	0.829	0.269	0.130	0.532	YES	2.8	17.7	946	22.9	N/A	0.094	0.01	0.00

max= 1,200
min= 236
avg= 674

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT057

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	14.60 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	11.60 ft below ground surface
GWT Depth For Design, Zwd =	4.60 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	24.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	2.80 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	2.80 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ_v' (psf)	Effective Vert. Stress (Test) σ_v' (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_c (in.)	Cumulative Settlement Profile (in.)
0.50	64.60	0.82	1.26	silty sand to sandy silt	13.6	1.00	22	60	60	60	1.60	1.00	372.97	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	48.9	0.008	0.000	0.00	2.80
1.50	44.37	0.60	1.35	silty sand to sandy silt	12.6	1.00	15	180	180	180	1.87	1.17	172.41	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	35.2	0.016	0.014	0.00	2.80
2.50	62.97	0.73	1.16	silty sand to sandy silt	11.6	1.00	21	300	300	300	1.80	1.11	179.71	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	47.8	0.019	0.000	0.00	2.80
3.50	41.70	0.83	2.00	sandy silt to clayey silt	10.6	1.00	17	420	420	420	2.15	1.54	140.37	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	39.0	N/A	N/A	N/A	2.80
4.50	45.55	1.24	2.72	sandy silt to clayey silt	9.6	1.00	18	540	540	540	2.25	1.81	158.58	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	42.2	N/A	N/A	N/A	2.80
5.50	22.92	0.63	2.76	clayey silt to silty clay	8.6	1.00	11	660	604	660	2.49	2.72	113.47	0.987	1.000	0.224	0.216	1.283	YES	2.8	22.3	1,200	N/A	N/A	0.000	0.00	2.80
6.50	13.93	0.18	1.28	sandy silt to clayey silt	7.6	1.00	6	780	661	780	2.48	2.66	64.48	0.985	1.000	0.242	0.105	0.580	YES	2.8	11.7	417	15.7	N/A	1.209	0.15	2.65
7.50	13.87	0.11	0.79	sandy silt to clayey silt	6.6	1.00	6	900	719	900	2.39	2.28	52.70	0.983	1.000	0.256	0.094	0.488	YES	2.8	11.1	374	14.9	N/A	1.649	0.20	2.46
8.50	16.27	0.24	1.50	sandy silt to clayey silt	5.6	1.00	7	1,020	777	1,020	2.49	2.72	70.93	0.980	1.000	0.268	0.113	0.564	YES	2.8	11.9	430	15.9	N/A	1.488	0.18	2.28
9.50	11.02	0.27	2.41	clayey silt to silty clay	4.6	1.00	6	1,140	834	1,140	2.69	N/A	N/A	0.978	N/A	0.278	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.28
10.50	10.70	0.25	2.34	clayey silt to silty clay	3.6	1.00	5	1,260	892	1,260	2.71	N/A	N/A	0.976	N/A	0.287	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.28
11.50	12.87	0.19	1.47	clayey silt to silty clay	2.6	1.00	6	1,380	949	1,380	2.54	3.00	67.46	0.973	1.000	0.294	0.109	0.492	YES	2.8	10.5	342	N/A	N/A	0.000	0.00	2.28
12.50	31.27	0.23	0.75	silty sand to sandy silt	1.6	1.00	17	1,500	1,007	1,444	1.83	1.00	72.96	0.971	1.000	0.301	0.116	0.515	YES	2.8	23.1	1,200	29.4	N/A	0.066	0.01	2.27
13.50	15.30	0.27	1.76	clayey silt to silty clay	0.6	1.00	8	1,620	1,065	1,501	2.56	3.08	75.70	0.969	1.000	0.307	0.120	0.524	YES	2.8	11.6	411	N/A	N/A	0.000	0.00	2.27
14.50	18.33	0.24	1.31	sandy silt to clayey silt	-0.4	1.00	7	1,740	1,122	1,559	2.49	2.69	65.95	0.966	1.000	0.312	0.107	0.457	YES	2.8	11.1	377	15.0	N/A	1.838	0.22	2.05
15.50	21.15	0.44	2.10	sandy silt to clayey silt	-1.4	1.66	14	1,860	1,180	1,617	2.25	1.80	81.89	0.964	1.000	0.316	0.131	0.553	YES	2.8	18.4	1,015	23.7	N/A	0.153	0.02	2.03
16.50	6.48	0.16	2.46	silty clay to clay	-2.4	1.00	4	1,980	1,237	1,674	3.01	N/A	N/A	0.962	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.03
17.50	6.52	0.14	2.14	silty clay to clay	-3.4	1.00	4	2,100	1,295	1,732	2.99	N/A	N/A	0.959	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.03
18.50	18.17	0.14	0.79	sandy silt to clayey silt	-4.4	1.66	12	2,220	1,353	1,789	2.11	1.00	36.58	0.957	1.000	0.327	0.080	0.329	YES	2.8	15.5	728	20.3	N/A	1.162	0.14	1.89
19.50	8.62	0.13	1.48	clayey silt to silty clay	-5.4	1.00	4	2,340	1,410	1,847	2.82	N/A	N/A	0.955	N/A	0.329	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.89
20.50	6.94	0.14	2.06	silty clay to clay	-6.4	1.00	5	2,460	1,468	1,905	3.00	N/A	N/A	0.952	N/A	0.332	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.89
21.50	6.25	0.04	0.67	sensitive fine grained	-7.4	1.00	3	2,580	1,525	1,962	2.83	5.04	38.58	0.950	N/A	0.334	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.89
22.50	6.15	0.03	0.44	sensitive fine grained	-8.4	1.00	3	2,700	1,583	2,020	2.78	4.61	33.82	0.948	N/A	0.336	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.89
23.50	7.32	0.07	0.99	sensitive fine grained	-9.4	1.00	4	2,820	1,641	2,077	2.86	N/A	N/A	0.945	N/A	0.338	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.89
24.50	6.67	0.02	0.35	sensitive fine grained	-10.4	1.00	3	2,940	1,698	2,135	2.73	4.25	32.01	0.943	N/A	0.340	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.89
25.50	7.68	0.04	0.50	sensitive fine grained	-11.4	1.00	4	3,060	1,756	2,193	2.74	4.26	36.11	0.941	N/A	0.341	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.89
26.50	7.38	0.01	0.16	sensitive fine grained	-12.4	1.00	4	3,180	1,813	2,250	2.63	3.48	27.69	0.938	N/A	0.342	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.89
27.50	10.43	0.04	0.40	sandy silt to clayey silt	-13.4	1.00	4	3,300	1,871	2,308	2.59	3.27	35.89	0.936	1.000	0.343	0.080	0.311	YES	2.8	6.7	173	9.7	N/A	2.647	0.32	1.57
28.50	19.40	0.09	0.44	silty sand to sandy silt	-14.4	1.00	6	3,420	1,929	2,365	2.35	1.00	19.76	0.934	1.000	0.344	0.066	0.258	YES	2.8	8.7	249	12.1	N/A	2.265	0.27	1.30
29.50	58.08	0.22	0.38	sand to silty sand	-15.4	1.66	24	3,540	1,986	2,423	1.60	1.00	96.50	0.931	1.000	0.345	0.164	0.632	YES	1.3	23.2	1,200	25.4	N/A	0.148	0.02	1.28
30.50	19.48	0.14	0.72	sandy silt to clayey silt	-16.4	1.00	8	3,660	2,044	2,481	2.46	2.55	49.17	0.926	0.996	0.345	0.091	0.350	YES	2.8	9.8	301	13.4	N/A	2.070	0.25	1.03
31.50	48.89	0.38	0.77	silty sand to sandy silt	-17.4	1.00	16	3,780	2,101	2,538	2.12	1.48	70.72	0.918	0.986	0.343	0.113	0.433	YES	2.8	17.3	900	22.4	N/A	0.875	0.10	0.93
32.50	116.87	1.60	1.37	sand to silty sand	-18.4	1.66	48	3,900	2,159	2,596	1.66	1.01	187.65	0.909	0.970	0.342	N/A	N/A	NO	N/A	N/A	N/A	47.0	N/A	0.000	0.00	0.93
33.50	53.45	1.06	1.99	silty sand to sandy silt	-19.4	1.66	29	4,020	2,217	2,653	2.03	1.33	112.22	0.901	0.962	0.340	0.211	0.798	YES	2.8	28.4	1,200	35.7	N/A	0.031	0.00	0.93
34.50	8.52	0.11	1.33	clayey silt to silty clay	-20.4	1.00	4	4,140	2,274	2,711	2.97	N/A	N/A	0.893	N/A	0.338	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
35.50	8.92	0.10	1.06	clayey silt to silty clay	-21.4	1.00	4	4,260	2,332	2,769	2.91	N/A	N/A	0.885	N/A	0.336	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
36.50	9.33	0.14	1.49	clayey silt to silty clay	-22.4	1.00	5	4,380	2,389	2,826	2.97	N/A	N/A	0.877	N/A	0.334	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
37.50	8.55	0.10	1.18	clayey silt to silty clay	-23.4	1.00	4	4,500	2,447	2,884	2.97	N/A	N/A	0.869	N/A	0.332	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
38.50	8.90	0.14	1.52	clayey silt to silty clay	-24.4	1.00	4	4,620	2,505	2,941	3.02	N/A	N/A	0.861	N/A	0.330	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
39.50	9.65	0.13	1.29	clayey silt to silty clay	-25.4	1.00	5	4,740	2,562	2,999	2.95	N/A	N/A	0.852	N/A	0.328	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
40.50	12.03	0.17	1.37	clayey silt to silty clay	-26.4	1.00	6	4,860	2,620	3,057	2.88	N/A	N/A	0.844	N/A	0.326	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
41.50	15.33	0.20	1.28	sandy silt to clayey silt	-27.4	1.00	6	4,980	2,677	3,114	2.76	N/A	N/A	0.836	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
42.50	14.73	0.24	1.62	clayey silt to silty clay	-28.4	1.00	7	5,100	2,735	3,172	2.84	N/A	N/A	0.828	N/A	0.321	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
43.50	21.02	0.44	2.09	sandy silt to clayey silt	-29.4	1.00	8	5,220	2,793	3,229	2.77	N/A	N/A	0.820	N/A	0.319	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
44.50	20.45	0.46	2.21	sandy silt to clayey silt	-30.4	1.00	8	5,340	2,850	3,287	2.80	N/A	N/A	0.812	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
45.50	20.95	0.57	2.70	clayey silt to silty clay	-31.4	1.00	10	5,460	2,908	3,345	2.85	N/A	N/A	0.804	N/A	0.314	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
46.50	27.90	1.14	4.04	silty clay to clay	-32.4	1.00	19	5,580	2,965	3,402	2.86	N/A	N/A	0.795	N/A	0.311	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
47.50	38.10	1.90	4.95	clay	-33.4	1.00	38	5,700	3,023	3,460	2.81	N/A	N/A	0.787	N/A	0.309	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93
48.50	41.47	0.94	2.25	sandy silt to clayey silt	-34.4	1.00	17	5,820	3,081	3,517	2.56	3.08	92.48	0.779	0.892	0.306	0.154	0.597	YES	2.8	15.3	708	20.0	N/A	1.073	0.13	0.80
49.50	31.82	0.95	2.96	clayey silt to silty clay	-35.4	1.00	16	5,940	3,138	3,575	2.74	N/A	N/A	0.771	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.80
50.50	39.75	0.93	2.32	sandy silt to clayey silt	-36.4	1.00	16	6,060	3,196	3,633	2.59	3.28	91.81	0.763	0.886	0.301	0.152	0.597	YES	2.8	14.6	644	19.2	N/A	1.168	0.14	0.66
51.50	50.58	1.09	2.15	sandy silt to clayey silt	-37.4	1.00	20	6,180	3,253	3,690	2.45	2.53	100.34	0.755	0.869	0.298	0.174	0.676	YES	2.8	17.7	944	22.9	N/A	0.143	0.02	0.64
52.50	71.21	0.85	1.19	sand to silty sand	-38.4	1.00	18	6,300	3,311	3,748	2.17	1.60	88.54	0.747	0.873	0.295	0.145	0.570	YES	1.3	14.3	621	16.1	N/A	1.626	0.20	0.44
53.50	62.25	1.50	2.41	sandy silt to clayey silt	-39.4	1.00	25	6,420	3,369	3,805	2.42	2.38	114.28	0.739	0.847	0.293	0.219	0.845	YES	2.8	20.9	1,200	26.7	N/A	0.081	0.01	0.43
54.50	176.72	2.76	1.56	sand to silty sand	-40.4	1.66	73	6,540	3,426	3,863	1.64	1.00	222.94	0.730	0.806	0.290	N/A	N/A	NO	N/A	N/A	N/A	57.7	N/A	0.000	0.00	0.43
55.50	68.08	1.61	2.37	sandy silt to clayey silt	-41.4	1.66	45	6,660	3,484	3,921	2.07	1.41	120.18	0.722	0.801	0.287	0.241	0.898	YES	2.8	35.0	1,200	43.6	N/A	0.000	0.00	0.43
56.50	16.08	0.45	2.75	clayey silt to silty clay	-42.4	1.00	8	6,780	3,541	3,978	3.02	N/A	N/A	0.714	N/A	0.284	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
57.50	18.58	0.40	2.14	clayey silt to silty clay	-43.4	1.00	9	6,900	3,599	4,036	2.90	N/A	N/A	0.706	N/A	0.282	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
58.50	26.37	0.43	1.60	sandy silt to clayey silt	-44.4	1.00	11	7,020	3,657	4,093	2.69	N/A	N/A	0.698	N/A	0.279	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
59.50	39.08	0.63	1.60	silty sand to sandy silt	-45.4	1.00	13	7,140	3,714	4,151	2.55	3.01	73.91	0.690	0.870	0.276	0.118	0.495	YES	2.8	11.8	425	15.9	N/A	1.570	0.19	0.25
60.50	30.82	0.36	1.16	silty sand to sandy silt	-46.4	1.00	10	7,260	3,772	4,209	2.57	3.12	59.77	0.682	0.881	0.273	0.100	0.430	YES	2.8	9.9	305	13.5	N/A	2.054	0.25	0.00
																						max=	1,200				
																						min=	173				
																						avg=	690				

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT059

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	18.70 ft
GWT Elev. During Test	3.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$

+++ $FS = (CRR_{7.5}/CSR)\ MSF\ K_\sigma\ K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	15.70 ft below ground surface
GWT Depth For Design, Zwd =	8.70 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	14.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	1.53 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.01 inches	<--- Dry or Unsaturated Sands
Total:	1.54 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_t (in.)	Cumulative Settlement Profile (in.)
0.50	60.80	0.32	0.52	sand to silty sand	17.7	1.00	15	60	60	60	1.31	1.00	351.03	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	29.6	0.010	0.010	0.00	1.54
1.50	58.72	0.39	0.66	sand to silty sand	16.7	1.00	15	180	180	180	1.57	1.00	195.72	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	28.7	0.017	0.019	0.00	1.54
2.50	37.82	0.24	0.62	silty sand to sandy silt	15.7	1.00	13	300	300	300	1.79	1.10	107.70	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	30.7	0.022	0.022	0.00	1.54
3.50	33.95	0.18	0.52	silty sand to sandy silt	14.7	1.00	11	420	420	420	1.85	1.15	85.04	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	28.1	0.027	0.029	0.00	1.53
4.50	37.25	0.71	1.89	sandy silt to clayey silt	13.7	1.00	15	540	540	540	2.20	1.68	120.19	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	35.4	N/A	N/A	N/A	1.53
5.50	26.37	0.63	2.38	sandy silt to clayey silt	12.7	1.00	11	660	660	660	2.42	2.38	109.19	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	26.5	N/A	N/A	N/A	1.53
6.50	17.62	0.19	1.07	sandy silt to clayey silt	11.7	1.00	7	780	780	780	2.38	2.23	62.91	0.985	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	18.5	N/A	N/A	N/A	1.53
7.50	15.18	0.22	1.45	sandy silt to clayey silt	10.7	1.00	6	900	900	900	2.53	2.94	66.61	0.983	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	15.9	N/A	N/A	N/A	1.53
8.50	13.40	0.17	1.27	sandy silt to clayey silt	9.7	1.00	5	1,020	1,020	1,020	2.57	3.17	59.42	0.980	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	14.0	N/A	N/A	N/A	1.53
9.50	18.52	0.09	0.50	sandy silt to clayey silt	8.7	1.00	7	1,140	1,090	1,140	2.27	1.86	46.68	0.978	1.000	0.213	0.089	0.558	YES	2.8	12.6	481	16.8	N/A	0.126	0.02	1.52
10.50	14.87	0.14	0.95	sandy silt to clayey silt	7.7	1.00	6	1,260	1,148	1,260	2.49	2.74	53.70	0.976	1.000	0.223	0.094	0.565	YES	2.8	10.3	328	14.0	N/A	1.457	0.17	1.34
11.50	15.62	0.17	1.09	sandy silt to clayey silt	6.7	1.00	6	1,380	1,205	1,380	2.51	2.84	57.19	0.973	1.000	0.232	0.097	0.561	YES	2.8	10.3	329	14.0	N/A	1.646	0.20	1.15
12.50	28.37	0.37	1.31	sandy silt to clayey silt	5.7	1.00	19	1,500	1,263	1,500	2.04	1.35	79.93	0.971	1.000	0.240	0.127	0.709	YES	2.8	24.5	1,200	31.0	N/A	0.044	0.01	1.14
13.50	8.37	0.12	1.45	clayey silt to silty clay	4.7	1.00	4	1,620	1,320	1,620	2.80	N/A	N/A	0.969	N/A	0.247	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.14
14.50	19.70	0.39	2.00	sandy silt to clayey silt	3.7	1.00	8	1,740	1,378	1,740	2.57	3.13	81.46	0.966	1.000	0.254	0.130	0.685	YES	2.8	11.2	386	15.1	N/A	1.569	0.19	0.95
15.50	22.53	0.37	1.63	sandy silt to clayey silt	2.7	1.66	15	1,860	1,436	1,860	2.20	1.66	73.08	0.964	1.000	0.260	0.116	0.597	YES	2.8	18.3	1,004	23.6	N/A	0.087	0.01	0.94
16.50	8.07	0.18	2.29	silty clay to clay	1.7	1.00	5	1,980	1,493	1,930	2.96	N/A	N/A	0.962	N/A	0.265	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.94
17.50	5.80	0.13	2.22	silty clay to clay	0.7	1.00	4	2,100	1,551	1,988	3.10	N/A	N/A	0.959	N/A	0.270	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.94
18.50	6.63	0.12	1.89	silty clay to clay	-0.3	1.00	4	2,220	1,608	2,045	3.02	N/A	N/A	0.957	N/A	0.275	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.94
19.50	15.90	0.16	1.03	sandy silt to clayey silt	-1.3	1.00	6	2,340	1,666	2,103	2.55	3.01	54.84	0.955	1.000	0.279	0.095	0.456	YES	2.8	9.0	261	12.4	N/A	2.217	0.27	0.68
20.50	9.73	0.13	1.32	clayey silt to silty clay	-2.3	1.00	5	2,460	1,724	2,160	2.80	N/A	N/A	0.952	N/A	0.283	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
21.50	8.10	0.23	2.89	silty clay to clay	-3.3	1.00	5	2,580	1,781	2,218	3.07	N/A	N/A	0.950	N/A	0.286	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
22.50	6.15	0.07	1.13	sensitive fine grained	-4.3	1.00	3	2,700	1,839	2,276	2.99	N/A	N/A	0.948	N/A	0.289	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
23.50	5.75	0.03	0.48	sensitive fine grained	-5.3	1.00	3	2,820	1,896	2,333	2.88	5.48	32.80	0.945	N/A	0.292	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
24.50	7.72	0.08	1.01	sensitive fine grained	-6.3	1.00	4	2,940	1,954	2,391	2.89	N/A	N/A	0.943	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
25.50	7.48	0.07	0.88	sensitive fine grained	-7.3	1.00	4	3,060	2,012	2,448	2.89	N/A	N/A	0.941	N/A	0.298	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
26.50	7.57	0.06	0.80	sensitive fine grained	-8.3	1.00	4	3,180	2,069	2,506	2.87	N/A	N/A	0.938	N/A	0.300	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
27.50	6.80	0.02	0.27	sensitive fine grained	-9.3	1.00	3	3,300	2,127	2,564	2.77	4.49	29.19	0.936	N/A	0.302	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
28.50	7.47	0.06	0.81	sensitive fine grained	-10.3	1.00	4	3,420	2,184	2,621	2.90	N/A	N/A	0.934	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
29.50	6.42	0.01	0.21	sensitive fine grained	-11.3	1.00	3	3,540	2,242	2,679	2.78	4.63	27.24	0.931	N/A	0.306	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
30.50	6.30	0.03	0.51	sensitive fine grained	-12.3	1.00	3	3,660	2,300	2,736	2.92	5.91	33.52	0.926	N/A	0.306	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
31.50	6.13	0.02	0.26	sensitive fine grained	-13.3	1.00	3	3,780	2,357	2,794	2.85	5.22	28.30	0.918	N/A	0.306	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
32.50	7.08	0.01	0.17	sensitive fine grained	-14.3	1.00	4	3,900	2,415	2,852	2.75	4.34	26.66	0.909	N/A	0.305	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
33.50	7.90	0.07	0.87	sensitive fine grained	-15.3	1.00	4	4,020	2,472	2,909	2.94	N/A	N/A	0.901	N/A	0.305	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
34.50	11.10	0.10	0.92	sandy silt to clayey silt	-16.3	1.00	4	4,140	2,530	2,967	2.81	N/A	N/A	0.893	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
35.50	8.95	0.12	1.39	clayey silt to silty clay	-17.3	1.00	4	4,260	2,588	3,024	2.99	N/A	N/A	0.885	N/A	0.303	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
36.50	8.03	0.07	0.90	sensitive fine grained	-18.3	1.00	4	4,380	2,645	3,082	2.96	N/A	N/A	0.877	N/A	0.302	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
37.50	8.92	0.11	1.25	clayey silt to silty clay	-19.3	1.00	4	4,500	2,703	3,140	2.99	N/A	N/A	0.869	N/A	0.301	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
38.50	9.40	0.06	0.66	sandy silt to clayey silt	-20.3	1.00	4	4,620	2,760	3,197	2.85	5.22	38.53	0.861	N/A	0.300	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
39.50	16.47	0.21	1.26	sandy silt to clayey silt	-21.3	1.00	7	4,740	2,818	3,255	2.74	N/A	N/A	0.852	N/A	0.298	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
40.50	15.17	0.24	1.58	sandy silt to clayey silt	-22.3	1.00	6	4,860	2,876	3,312	2.83	N/A	N/A	0.844	N/A	0.297	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
41.50	17.71	0.39	2.19	clayey silt to silty clay	-23.3	1.00	9	4,980	2,933	3,370	2.86	N/A	N/A	0.836	N/A	0.295	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
42.50	21.82	0.61	2.76	clayey silt to silty clay	-24.3	1.00	11	5,100	2,991	3,428	2.84	N/A	N/A	0.828	N/A	0.294	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
43.50	26.73	1.00	3.71	clayey silt to silty clay	-25.3	1.00	13	5,220	3,048	3,485	2.85	N/A	N/A	0.820	N/A	0.292	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
44.50	20.58	0.59	2.86	clayey silt to silty clay	-26.3	1.00	10	5,340	3,106	3,543	2.88	N/A	N/A	0.812	N/A	0.290	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
45.50	18.78	0.20	1.03	sandy silt to clayey silt	-27.3	1.00	8	5,460	3,164	3,600	2.68	N/A	N/A	0.804	N/A	0.288	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
46.50	20.37	0.61	2.97	clayey silt to silty clay	-28.3	1.00	10	5,580	3,221	3,658	2.91	N/A	N/A	0.795	N/A	0.287	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.68
47.50	62.70	0.39	0.62	sand to silty sand	-29.3	1.00	16	5,700	3,279	3,716	2.06	1.38	67.67	0.787	0.882	0.285	0.109	0.450	YES	1.3	12.8	498	14.6	N/A	1.868	0.22	0.45
48.50	34.98	0.64	1.84	sandy silt to clayey silt	-30.3	1.00	14	5,820	3,336	3,773	2.59	3.25	77.52	0.779	0.885	0.283	0.123	0.515	YES	2.8	13.0	509	17.2	N/A	1.346	0.16	0.29
49.50	110.05	0.85	0.78	sand to silty sand	-31.3	1.00	28	5,940	3,394	3,831	1.91	1.20	101.04	0.771	0.838	0.281	0.176	0.701	YES	1.3	21.2	1,200	23.3	N/A	0.096	0.01	0.28
50.50	209.07	0.63	0.30	sand	-32.3	1.00	42	6,060	3,452	3,888	1.45	1.00	159.14	0.763	0.804	0.279	0.455	1.751	NO	N/A	N/A	N/A	30.0	N/A	0.057	0.01	0.27
51.50	159.57	0.35	0.22	sand	-33.3	1.00	32	6,180	3,509	3,946	1.50	1.00	120.46	0.755	0.818	0.276	0.243	0.957	YES	0.0	22.7	1,200	22.7	N/A	0.097	0.01	0.26
52.50	152.01	0.45	0.30	sand	-34.3	1.00	30	6,300	3,567	4,004	1.58	1.00	113.83	0.747	0.818	0.274	0.217	0.864	YES	0.0	21.5	1,200	21.5	N/A	0.131	0.02	0.25
53.50	155.73	0.68	0.44	sand	-35.3	1.66	52	6,420	3,624	4,061	1.35	1.00	191.54	0.739	0.788	0.272	N/A	N/A	NO	N/A	N/A	N/A	36.2	N/A	0.021	0.00	0.24
54.50	62.98	0.66	1.05	sand to silty sand	-36.3	1.00	16	6,540	3,682	4,119	2.20	1.67	77.71	0.730	0.859	0.270	0.124	0.525	YES	1.3	12.3	458	14.0	N/A	1.965	0.24	0.01
55.50	94.80	0.92	0.97	sand to silty sand	-37.3	1.66	39	6,660	3,740	4,176	1.73	1.06	121.23	0.722	0.783	0.268	0.246	0.960	YES	1.3	28.5	1,200	31.0	N/A	0.049	0.01	0.00
56.50	24.02	0.30	1.26	sandy silt to clayey silt	-38.3	1.00	10	6,780	3,797	4,234	2.68	N/A	N/A	0.714	N/A	0.265	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
57.50	19.02	0.22	1.16	sandy silt to clayey silt	-39.3	1.00	8	6,900	3,855	4,292	2.77	N/A	N/A	0.706	N/A	0.263	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
58.50	28.63	0.38	1.33	sandy silt to clayey silt	-40.3	1.00	11	7,020	3,912	4,349	2.63	N/A	N/A	0.698	N/A	0.260	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
59.50	26.22	0.33	1.27	sandy silt to clayey silt	-41.3	1.00	10	7,140	3,970	4,407	2.66	N/A	N/A	0.690	N/A	0.258	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
60.50	19.10	0.44	2.28	clayey silt to silty clay	-42.3	1.00	10	7,260	4,028	4,464	2.94	N/A	N/A	0.682	N/A	0.256	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00

max=	1,200
min=	261
avg=	732

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT060

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	14.60 ft
GWT Elev. During Test	-2.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d

+++ FS = ($CRR_{7.5}$/CSR) MSF K_σ $K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	16.60 ft below ground surface
GWT Depth For Design, Zwd =	4.60 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	12.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	0.52 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	0.52 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +															RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_t (in.)	Cumulative Settlement Profile (in.)
0.50	19.68	0.09	0.44	silty sand to sandy silt	13.6	1.00	7	60	60	60	1.66	1.00	113.64	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	18.4	0.012	0.022	0.00	0.52
1.50	39.48	0.28	0.70	silty sand to sandy silt	12.6	1.00	13	180	180	180	1.72	1.05	138.48	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	31.8	0.017	0.016	0.00	0.52
2.50	84.72	0.42	0.50	sand to silty sand	11.6	1.00	21	300	300	300	1.46	1.00	218.74	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	40.2	0.020	0.000	0.00	0.52
3.50	95.70	0.53	0.55	sand to silty sand	10.6	1.00	24	420	420	420	1.50	1.00	208.83	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	45.1	0.023	0.000	0.00	0.52
4.50	108.37	0.84	0.77	sand to silty sand	9.6	1.00	27	540	540	540	1.60	1.00	208.55	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	50.8	0.025	0.000	0.00	0.52
5.50	59.78	0.54	0.90	sand to silty sand	8.6	1.00	15	660	604	660	1.85	1.15	124.94	0.987	1.000	0.224	0.261	1.554	NO	N/A	N/A	N/A	29.1	N/A	0.050	0.01	0.51
6.50	63.75	0.50	0.78	sand to silty sand	7.6	1.00	16	780	661	780	1.81	1.11	123.43	0.985	1.000	0.242	0.255	1.408	NO	N/A	N/A	N/A	29.2	N/A	0.053	0.01	0.51
7.50	55.93	0.65	1.16	silty sand to sandy silt	6.6	1.66	31	900	719	900	1.67	1.02	156.81	0.983	1.000	0.256	0.439	2.288	NO	N/A	N/A	N/A	60.2	N/A	0.000	0.00	0.51
8.50	6.58	0.26	3.88	clay	5.6	1.00	7	1,020	777	1,020	2.98	N/A	N/A	0.980	N/A	0.268	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.51
9.50	6.73	0.14	2.03	silty clay to clay	4.6	1.00	4	1,140	834	1,140	2.83	N/A	N/A	0.978	N/A	0.278	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.51
10.50	19.70	0.59	2.99	clayey silt to silty clay	3.6	1.00	10	1,260	892	1,260	2.57	3.13	112.87	0.976	1.000	0.287	0.214	0.995	YES	2.8	15.2	699	N/A	N/A	0.000	0.00	0.51
11.50	11.53	0.27	2.34	clayey silt to silty clay	2.6	1.00	6	1,380	949	1,380	2.70	N/A	N/A	0.973	N/A	0.294	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.51
12.50	6.02	0.25	4.20	clay	1.6	1.00	6	1,500	1,007	1,500	3.11	N/A	N/A	0.971	N/A	0.301	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.51
13.50	14.68	0.28	1.93	clayey silt to silty clay	0.6	1.00	7	1,620	1,065	1,620	2.60	3.30	77.84	0.969	1.000	0.307	0.124	0.539	YES	2.8	11.0	367	N/A	N/A	0.000	0.00	0.51
14.50	30.67	0.30	0.96	silty sand to sandy silt	-0.4	1.66	17	1,740	1,122	1,740	1.92	1.20	81.60	0.966	1.000	0.312	0.131	0.559	YES	2.8	20.9	1,200	26.8	N/A	0.086	0.01	0.50
15.50	10.13	0.24	2.34	clayey silt to silty clay	-1.4	1.00	5	1,860	1,180	1,860	2.81	N/A	N/A	0.964	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.50
16.50	6.68	0.09	1.27	sensitive fine grained	-2.4	1.00	3	1,980	1,237	1,980	2.85	N/A	N/A	0.962	N/A	0.320	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.50
17.50	4.78	0.02	0.42	sensitive fine grained	-3.4	1.00	2	2,100	1,295	2,044	2.81	4.90	32.48	0.959	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.50
18.50	4.55	0.02	0.44	sensitive fine grained	-4.4	1.00	2	2,220	1,353	2,101	2.86	5.31	32.41	0.957	N/A	0.327	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.50
19.50	5.38	0.02	0.33	sensitive fine grained	-5.4	1.00	3	2,340	1,410	2,159	2.76	4.45	31.14	0.955	N/A	0.329	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.50
20.50	7.77	0.15	1.89	clayey silt to silty clay	-6.4	1.00	4	2,460	1,468	2,217	2.94	N/A	N/A	0.952	N/A	0.332	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.50
21.50	9.65	0.11	1.05	clayey silt to silty clay	-7.4	1.00	5	2,580	1,525	2,274	2.74	N/A	N/A	0.950	N/A	0.334	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.50
22.50	12.27	0.23	1.80	clayey silt to silty clay	-8.4	1.00	6	2,700	1,583	2,332	2.77	N/A	N/A	0.948	N/A	0.336	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.50
23.50	113.27	0.60	0.53	sand	-9.4	1.00	23	2,820	1,641	2,389	1.67	1.02	127.27	0.945	1.000	0.338	0.272	1.073	YES	0.0	20.7	1,200	20.7	N/A	1.157	0.14	0.36
24.50	99.23	0.63	0.64	sand to silty sand	-10.4	1.00	25	2,940	1,698	2,447	1.77	1.08	116.81	0.943	1.000	0.340	0.228	0.897	YES	1.3	23.8	1,200	26.0	N/A	0.106	0.01	0.34
25.50	68.52	1.31	1.92	silty sand to sandy silt	-11.4	1.00	23	3,060	1,756	2,505	2.21	1.68	122.83	0.941	1.000	0.341	0.252	0.988	YES	2.8	23.2	1,200	29.5	N/A	0.076	0.01	0.33
26.50	41.15	0.75	1.83	sandy silt to clayey silt	-12.4	1.66	27	3,180	1,813	2,562	2.06	1.38	98.86	0.938	1.000	0.342	0.170	0.662	YES	2.8	26.9	1,200	33.9	N/A	0.044	0.01	0.33
27.50	11.00	0.31	2.85	silty clay to clay	-13.4	1.00	7	3,300	1,871	2,620	2.97	N/A	N/A	0.936	N/A	0.343	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.33
28.50	51.33	0.72	1.40	silty sand to sandy silt	-14.4	1.00	17	3,420	1,929	2,677	2.23	1.74	91.02	0.934	1.000	0.344	0.150	0.582	YES	2.8	17.6	933	22.7	N/A	0.589	0.07	0.26
29.50	61.30	0.41	0.66	sand to silty sand	-15.4	1.66	25	3,540	1,986	2,735	1.68	1.00	101.85	0.931	1.000	0.345	0.178	0.689	YES	1.3	23.0	1,200	25.2	N/A	0.156	0.02	0.24
30.50	13.80	0.36	2.59	clayey silt to silty clay	-16.4	1.00	7	3,660	2,044	2,793	2.89	N/A	N/A	0.926	N/A	0.345	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.24
31.50	50.23	0.51	1.02	silty sand to sandy silt	-17.4	1.66	28	3,780	2,101	2,850	1.86	1.16	93.76	0.918	0.982	0.343	0.157	0.598	YES	2.8	26.0	1,200	32.9	N/A	0.052	0.01	0.23
32.50	14.47	0.32	2.20	clayey silt to silty clay	-18.4	1.00	7	3,900	2,159	2,908	2.84	N/A	N/A	0.909	N/A	0.342	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.23
33.50	61.22	0.32	0.52	sand to silty sand	-19.4	1.66	25	4,020	2,217	2,965	1.66	1.00	96.28	0.901	0.965	0.340	0.163	0.618	YES	1.3	22.1	1,200	24.3	N/A	0.187	0.02	0.21
34.50	16.90	0.27	1.61	sandy silt to clayey silt	-20.4	1.00	7	4,140	2,274	3,023	2.72	N/A	N/A	0.893	N/A	0.338	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
35.50	10.35	0.19	1.89	clayey silt to silty clay	-21.4	1.00	5	4,260	2,332	3,081	2.97	N/A	N/A	0.885	N/A	0.336	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
36.50	10.93	0.28	2.59	silty clay to clay	-22.4	1.00	7	4,380	2,389	3,138	3.03	N/A	N/A	0.877	N/A	0.334	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
37.50	14.53	0.42	2.88	clayey silt to silty clay	-23.4	1.00	7	4,500	2,447	3,196	2.95	N/A	N/A	0.869	N/A	0.332	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
38.50	11.98	0.42	3.54	silty clay to clay	-24.4	1.00	8	4,620	2,505	3,253	3.09	N/A	N/A	0.861	N/A	0.330	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
39.50	9.60	0.33	3.40	clay	-25.4	1.00	10	4,740	2,562	3,311	3.18	N/A	N/A	0.852	N/A	0.328	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
40.50	16.77	0.64	3.82	silty clay to clay	-26.4	1.00	11	4,860	2,620	3,369	2.99	N/A	N/A	0.844	N/A	0.326	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
41.50	13.70	0.35	2.53	clayey silt to silty clay	-27.4	1.00	7	4,980	2,677	3,426	2.97	N/A	N/A	0.836	N/A	0.324	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
42.50	10.45	0.26	2.46	clayey silt to silty clay	-28.4	1.00	5	5,100	2,735	3,484	3.09	N/A	N/A	0.828	N/A	0.321	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
43.50	10.80	0.26	2.36	clayey silt to silty clay	-29.4	1.00	5	5,220	2,793	3,541	3.07	N/A	N/A	0.820	N/A	0.319	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
44.50	14.23	0.34	2.30	clayey silt to silty clay	-30.4	1.00	7	5,340	2,850	3,599	2.96	N/A	N/A	0.812	N/A	0.316	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
45.50	10.73	0.31	2.73	silty clay to clay	-31.4	1.00	7	5,460	2,908	3,657	3.14	N/A	N/A	0.804	N/A	0.314	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
46.50	9.87	0.22	2.10	clayey silt to silty clay	-32.4	1.00	5	5,580	2,965	3,714	3.12	N/A	N/A	0.795	N/A	0.311	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.21
47.50	31.07	0.48	1.50	sandy silt to clayey silt	-33.4	1.00	12	5,700	3,023	3,772	2.56	3.11	70.89	0.787	0.911	0.309	0.113	0.445	YES	2.8	11.8	426	15.9	N/A	1.703	0.20	0.01
48.50	283.85	1.57	0.55	gravelly sand to sand	-34.4	1.00	47	5,820	3,081	3,829	1.47	1.00	228.71	0.779	0.841	0.306	N/A	N/A	NO	N/A	N/A	N/A	34.2	N/A	0.037	0.00	0.00
49.50	578.80	0.00	0.00	gravelly sand to sand	-35.4	1.00	96	5,940	3,138	3,887	2.68	3.85	1,590.87	0.771	N/A	0.304	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00

max=	1,200
min=	367
avg=	1,002

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT062

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	23.00 ft
GWT Elev. During Test	-2.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$

+++ $FS = (CRR_{7.5}/CSR)\ MSF\ K_\sigma\ K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	25.00 ft below ground surface
GWT Depth For Design, Zwd =	13.00 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	11.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	0.77 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.02 inches	<--- Dry or Unsaturated Sands
Total:	0.79 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +															RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r(psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_l (in.)	Cumulative Settlement Profile (in.)
0.50	205.77	1.04	0.51	sand	22.0	1.00	41	60	60	60	1.01	1.00	1,188.00	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	70.0	0.007	0.000	0.00	0.79
1.50	162.27	1.86	1.15	sand to silty sand	21.0	1.00	41	180	180	180	1.48	1.00	540.89	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	74.8	0.013	0.000	0.00	0.79
2.50	189.85	2.20	1.16	sand	20.0	1.00	38	300	300	300	1.50	1.00	490.19	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	64.5	0.017	0.000	0.00	0.79
3.50	213.83	1.53	0.72	sand	19.0	1.00	43	420	420	420	1.34	1.00	466.62	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	72.7	0.019	0.000	0.00	0.79
4.50	219.92	0.89	0.40	sand	18.0	1.00	44	540	540	540	1.18	1.00	423.23	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	74.8	0.022	0.000	0.00	0.79
5.50	172.27	1.00	0.58	sand	17.0	1.00	34	660	660	660	1.40	1.00	299.88	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	58.6	0.026	0.000	0.00	0.79
6.50	98.57	0.99	1.00	sand to silty sand	16.0	1.00	25	780	780	780	1.76	1.08	170.68	0.985	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	43.9	0.031	0.000	0.00	0.79
7.50	60.80	0.56	0.92	sand to silty sand	15.0	1.00	15	900	900	900	1.92	1.21	109.67	0.983	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	26.2	0.039	0.047	0.01	0.78
8.50	55.45	0.39	0.70	sand to silty sand	14.0	1.00	14	1,020	1,020	1,020	1.91	1.20	92.87	0.980	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	22.8	0.043	0.062	0.01	0.77
9.50	35.88	0.58	1.61	silty sand to sandy silt	13.0	1.66	20	1,140	1,140	1,140	1.99	1.28	100.93	0.978	N/A	0.203	N/A	N/A	NO	N/A	N/A	N/A	36.5	0.039	0.032	0.00	0.77
10.50	7.77	0.12	1.52	clayey silt to silty clay	12.0	1.00	4	1,260	1,260	1,260	2.82	N/A	N/A	0.976	N/A	0.203	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
11.50	6.40	0.03	0.39	sensitive fine grained	11.0	1.00	3	1,380	1,380	1,380	2.68	3.89	32.86	0.973	N/A	0.202	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
12.50	8.98	0.05	0.56	sandy silt to clayey silt	10.0	1.66	6	1,500	1,500	1,500	2.36	2.17	37.27	0.971	N/A	0.202	N/A	N/A	NO	N/A	N/A	N/A	13.2	N/A	N/A	N/A	0.77
13.50	3.95	0.02	0.51	sensitive fine grained	9.0	1.00	2	1,620	1,589	1,620	2.98	6.52	30.62	0.969	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
14.50	3.87	0.02	0.43	sensitive fine grained	8.0	1.00	2	1,740	1,646	1,740	2.98	6.55	29.32	0.966	N/A	0.212	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
15.50	3.65	0.01	0.27	sensitive fine grained	7.0	1.00	2	1,860	1,704	1,860	2.96	6.33	26.04	0.964	N/A	0.219	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
16.50	4.45	0.02	0.41	sensitive fine grained	6.0	1.00	2	1,980	1,762	1,980	2.93	6.04	29.54	0.962	N/A	0.225	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
17.50	15.98	0.32	2.03	clayey silt to silty clay	5.0	1.00	8	2,100	1,819	2,100	2.72	N/A	N/A	0.959	N/A	0.230	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
18.50	9.67	0.23	2.38	silty clay to clay	4.0	1.00	6	2,220	1,877	2,220	2.97	N/A	N/A	0.957	N/A	0.235	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
19.50	10.45	0.26	2.48	silty clay to clay	3.0	1.00	7	2,340	1,934	2,340	2.95	N/A	N/A	0.955	N/A	0.240	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
20.50	7.46	0.14	1.88	silty clay to clay	2.0	1.00	5	2,460	1,992	2,460	3.03	N/A	N/A	0.952	N/A	0.245	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
21.50	5.72	0.06	1.03	sensitive fine grained	1.0	1.00	3	2,580	2,050	2,580	3.03	N/A	N/A	0.950	N/A	0.249	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
22.50	8.90	0.14	1.54	clayey silt to silty clay	0.0	1.00	4	2,700	2,107	2,700	2.94	N/A	N/A	0.948	N/A	0.253	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
23.50	10.45	0.06	0.59	sandy silt to clayey silt	-1.0	1.00	4	2,820	2,165	2,820	2.69	3.94	38.82	0.945	N/A	0.256	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
24.50	16.15	0.27	1.68	sandy silt to clayey silt	-2.0	1.00	6	2,940	2,222	2,940	2.73	N/A	N/A	0.943	N/A	0.259	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.77
25.50	28.30	0.43	1.53	sandy silt to clayey silt	-3.0	1.00	11	3,060	2,280	3,029	2.51	2.81	72.03	0.941	0.971	0.263	0.115	0.566	YES	2.8	12.0	436	16.0	N/A	1.410	0.17	0.60
26.50	20.83	0.68	3.26	clayey silt to silty clay	-4.0	1.00	10	3,180	2,338	3,086	2.82	N/A	N/A	0.938	N/A	0.265	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.60
27.50	78.68	1.08	1.37	silty sand to sandy silt	-5.0	1.00	26	3,300	2,395	3,144	2.11	1.48	106.34	0.936	0.940	0.268	0.192	0.897	YES	2.8	23.7	1,200	30.1	N/A	0.054	0.01	0.60
28.50	188.78	0.56	0.29	sand	-6.0	1.00	38	3,420	2,453	3,202	1.42	1.00	170.47	0.934	0.922	0.271	N/A	N/A	NO	N/A	N/A	N/A	29.8	N/A	0.056	0.01	0.59
29.50	212.07	1.30	0.61	sand	-7.0	1.00	42	3,540	2,510	3,259	1.56	1.00	189.29	0.931	0.913	0.273	N/A	N/A	NO	N/A	N/A	N/A	33.2	N/A	0.038	0.00	0.58
30.50	250.87	0.79	0.32	gravelly sand to sand	-8.0	1.00	42	3,660	2,568	3,317	1.34	1.00	221.39	0.926	0.905	0.274	N/A	N/A	NO	N/A	N/A	N/A	32.5	N/A	0.042	0.01	0.58
31.50	191.36	0.75	0.39	sand	-9.0	1.00	38	3,780	2,626	3,374	1.49	1.00	167.01	0.918	0.897	0.275	N/A	N/A	NO	N/A	N/A	N/A	29.5	N/A	0.059	0.01	0.57
32.50	158.78	0.55	0.34	sand	-10.0	1.66	53	3,900	2,683	3,432	1.24	1.00	226.98	0.909	0.889	0.275	N/A	N/A	NO	N/A	N/A	N/A	40.1	N/A	0.000	0.00	0.57
33.50	52.02	0.53	1.02	silty sand to sandy silt	-11.0	1.00	17	4,020	2,741	3,490	2.21	1.68	74.74	0.901	0.918	0.275	0.119	0.529	YES	2.8	15.9	767	20.8	N/A	0.172	0.02	0.55
34.50	56.05	0.32	0.58	sand to silty sand	-12.0	1.00	14	4,140	2,798	3,547	2.05	1.38	65.17	0.893	0.922	0.275	0.106	0.473	YES	1.3	11.9	426	13.5	N/A	2.050	0.25	0.31
35.50	42.77	0.48	1.12	silty sand to sandy silt	-13.0	1.00	14	4,260	2,856	3,605	2.31	1.98	70.76	0.885	0.917	0.275	0.113	0.503	YES	2.8	13.4	544	17.7	N/A	1.148	0.14	0.17
36.50	45.28	0.62	1.37	silty sand to sandy silt	-14.0	1.00	15	4,380	2,914	3,662	2.34	2.10	78.67	0.877	0.910	0.274	0.125	0.555	YES	2.8	14.0	588	18.4	N/A	1.000	0.12	0.05
37.50	48.08	1.10	2.28	sandy silt to clayey silt	-15.0	1.66	32	4,500	2,971	3,720	2.15	1.55	101.29	0.869	0.866	0.274	0.177	0.746	YES	2.8	26.2	1,200	33.0	N/A	0.039	0.00	0.04
38.50	15.25	0.37	2.46	clayey silt to silty clay	-16.0	1.00	8	4,620	3,029	3,778	2.95	N/A	N/A	0.861	N/A	0.273	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.04
39.50	14.87	0.37	2.48	clayey silt to silty clay	-17.0	1.00	7	4,740	3,086	3,835	2.96	N/A	N/A	0.852	N/A	0.272	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.04
40.50	14.20	0.41	2.88	clayey silt to silty clay	-18.0	1.00	7	4,860	3,144	3,893	3.03	N/A	N/A	0.844	N/A	0.271	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.04
41.50	11.71	0.34	2.92	silty clay to clay	-19.0	1.00	8	4,980	3,202	3,950	3.12	N/A	N/A	0.836	N/A	0.271	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.04
42.50	14.27	0.40	2.82	clayey silt to silty clay	-20.0	1.00	7	5,100	3,259	4,008	3.03	N/A	N/A	0.828	N/A	0.270	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.04
43.50	15.57	0.54	3.51	silty clay to clay	-21.0	1.00	10	5,220	3,317	4,066	3.06	N/A	N/A	0.820	N/A	0.268	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.04
44.50	42.62	0.73	1.71	silty sand to sandy silt	-22.0	1.66	24	5,340	3,374	4,123	2.14	1.53	83.03	0.812	0.853	0.267	0.133	0.568	YES	2.8	19.2	1,100	24.7	N/A	0.083	0.01	0.03
45.50	15.93	0.40	2.52	clayey silt to silty clay	-23.0	1.00	8	5,460	3,432	4,181	2.98	N/A	N/A	0.804	N/A	0.266	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.03
46.50	30.27	0.58	1.93	sandy silt to clayey silt	-24.0	1.00	12	5,580	3,490	4,238	2.66	N/A	N/A	0.795	N/A	0.265	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.03
47.50	113.07	1.47	1.30	sand to silty sand	-25.0	1.00	28	5,700	3,547	4,296	2.05	1.36	115.87	0.787	0.828	0.263	0.225	0.943	YES	1.3	20.6	1,200	22.7	N/A	0.092	0.01	0.02
48.50	180.27	0.98	0.54	sand	-26.0	1.66	60	5,820	3,605	4,354	1.34	1.00	222.32	0.779	0.790	0.262	N/A	N/A	NO	N/A	N/A	N/A	40.5	N/A	0.000	0.00	0.02
49.50	51.97	1.20	2.31	sandy silt to clayey silt	-27.0	1.00	21	5,940	3,662	4,411	2.53	2.92	96.32	0.771	0.844	0.260	0.163	0.706	YES	2.8	16.8	853	21.8	N/A	0.096	0.01	0.01
50.50	36.23	0.96	2.66	sandy silt to clayey silt	-28.0	1.00	14	6,060	3,720	4,469	2.70	N/A	N/A	0.763	N/A	0.259	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
51.50	19.75	0.56	2.86	clayey silt to silty clay	-29.0	1.00	10	6,180	3,778	4,526	2.95	N/A	N/A	0.755	N/A	0.257	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
52.50	16.60	0.35	2.11	clayey silt to silty clay	-30.0	1.00	8	6,300	3,835	4,584	2.95	N/A	N/A	0.747	N/A	0.255	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
53.50	15.45	0.31	2.01	clayey silt to silty clay	-31.0	1.00	8	6,420	3,893	4,642	2.98	N/A	N/A	0.739	N/A	0.253	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
54.50	16.48	0.24	1.47	sandy silt to clayey silt	-32.0	1.00	7	6,540	3,950	4,699	2.88	N/A	N/A	0.730	N/A	0.252	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01
55.50	73.55	1.18	1.61	silty sand to sandy silt	-33.0	1.00	25	6,660	4,008	4,757	2.27	1.87	96.99	0.722	0.812	0.250	0.165	0.716	YES	2.8	18.7	1,049	24.1	N/A	0.081	0.01	0.00
56.50	359.00	2.36	0.66	gravelly sand to sand	-34.0	1.00	60	6,780	4,066	4,814	1.49	1.00	251.80	0.714	0.753	0.248	N/A	N/A	NO	N/A	N/A	N/A	38.6	N/A	0.007	0.00	0.00
57.50	471.80	3.13	0.66	gravelly sand to sand	-35.0	1.00	79	6,900	4,123	4,872	1.41	1.00	328.59	0.706	0.749	0.246	N/A	N/A	NO	N/A	N/A	N/A	50.4	N/A	0.000	0.00	0.00

	max=	1,200
	min=	426
	avg=	851

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	B-CPT063

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	23.20 ft
GWT Elev. During Test	-2.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$

+++ $FS = (CRR_{7.5}/CSR)\ MSF\ K_\sigma\ K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	25.20 ft below ground surface
GWT Depth For Design, Zwd =	13.20 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	12.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	0.37 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.00 inches	<--- Dry or Unsaturated Sands
Total:	0.37 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_i (in.)	Cumulative Settlement Profile (in.)
0.50	56.22	0.63	1.12	silty sand to sandy silt	22.2	1.00	19	60	60	60	1.59	1.00	324.57	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	43.2	0.009	0.000	0.00	0.37
1.50	78.40	1.41	1.80	silty sand to sandy silt	21.2	1.00	26	180	180	180	1.81	1.12	291.72	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	58.3	0.014	0.000	0.00	0.37
2.50	47.15	1.11	2.34	sandy silt to clayey silt	20.2	1.00	19	300	300	300	2.11	1.47	179.18	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	43.5	N/A	N/A	N/A	0.37
3.50	59.10	1.31	2.21	sandy silt to clayey silt	19.2	1.00	24	420	420	420	2.07	1.41	181.67	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	53.2	N/A	N/A	N/A	0.37
4.50	90.68	2.68	2.96	sandy silt to clayey silt	18.2	1.00	36	540	540	540	2.09	1.44	251.10	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	79.0	N/A	N/A	N/A	0.37
5.50	50.78	0.71	1.39	silty sand to sandy silt	17.2	1.00	17	660	660	660	2.05	1.37	120.74	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	39.5	0.029	0.022	0.00	0.37
6.50	94.05	1.15	1.22	sand to silty sand	16.2	1.00	39	780	780	780	1.53	1.00	249.36	0.985	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	67.8	0.027	0.000	0.00	0.37
7.50	9.90	0.37	3.72	clay	15.2	1.00	10	900	900	900	2.86	N/A	N/A	0.983	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
8.50	7.13	0.10	1.36	clayey silt to silty clay	14.2	1.00	4	1,020	1,020	1,020	2.77	N/A	N/A	0.980	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
9.50	6.95	0.06	0.82	sensitive fine grained	13.2	1.00	3	1,140	1,140	1,140	2.71	4.08	43.18	0.978	N/A	0.203	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
10.50	5.81	0.05	0.90	sensitive fine grained	12.2	1.00	3	1,260	1,260	1,260	2.84	N/A	N/A	0.976	N/A	0.203	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
11.50	4.42	0.02	0.44	sensitive fine grained	11.2	1.00	2	1,380	1,380	1,380	2.87	5.37	31.34	0.973	N/A	0.202	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
12.50	4.47	0.02	0.37	sensitive fine grained	10.2	1.00	2	1,500	1,500	1,500	2.86	5.36	29.72	0.971	N/A	0.202	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
13.50	4.90	0.03	0.54	sensitive fine grained	9.2	1.00	2	1,620	1,601	1,620	2.90	5.70	33.00	0.969	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
14.50	4.85	0.02	0.41	sensitive fine grained	8.2	1.00	2	1,740	1,659	1,740	2.87	5.46	30.45	0.966	N/A	0.211	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
15.50	4.98	0.02	0.39	sensitive fine grained	7.2	1.00	2	1,860	1,716	1,860	2.87	5.43	30.33	0.964	N/A	0.217	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
16.50	5.38	0.01	0.24	sensitive fine grained	6.2	1.00	3	1,980	1,774	1,980	2.79	4.67	27.53	0.962	N/A	0.223	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
17.50	75.22	1.76	2.34	sandy silt to clayey silt	5.2	1.00	30	2,100	1,832	2,100	2.24	1.78	139.55	0.959	1.000	0.229	0.333	1.941	NO	N/A	N/A	N/A	40.2	N/A	0.000	0.00	0.37
18.50	52.78	1.78	3.37	clayey silt to silty clay	4.2	1.00	44	2,220	1,889	2,220	2.16	1.57	140.90	0.957	1.000	0.234	0.340	1.941	NO	N/A	N/A	N/A	N/A	N/A	0.000	0.00	0.37
19.50	23.03	0.59	2.57	clayey silt to silty clay	3.2	1.00	12	2,340	1,947	2,340	2.67	N/A	N/A	0.955	N/A	0.239	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
20.50	20.53	0.51	2.50	clayey silt to silty clay	2.2	1.00	10	2,460	2,004	2,460	2.71	N/A	N/A	0.952	N/A	0.243	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
21.50	27.05	0.95	3.51	clayey silt to silty clay	1.2	1.00	14	2,580	2,062	2,580	2.72	N/A	N/A	0.950	N/A	0.247	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
22.50	51.63	1.02	1.98	silty sand to sandy silt	0.2	1.00	17	2,700	2,120	2,700	2.34	2.07	103.93	0.948	0.983	0.251	0.184	0.964	YES	2.8	17.6	936	22.8	N/A	0.088	0.01	0.36
23.50	149.02	0.98	0.66	sand	-0.8	1.00	30	2,820	2,177	2,820	1.68	1.02	146.17	0.945	0.969	0.255	0.370	1.880	NO	N/A	N/A	N/A	25.1	N/A	0.077	0.01	0.35
24.50	141.30	0.58	0.41	sand	-1.8	1.00	28	2,940	2,235	2,940	1.58	1.00	133.67	0.943	0.961	0.258	0.302	1.501	NO	N/A	N/A	N/A	23.3	N/A	0.087	0.01	0.34
25.50	152.65	0.57	0.38	sand	-2.8	1.00	31	3,060	2,292	3,041	1.54	1.00	142.58	0.941	0.950	0.261	0.350	1.697	NO	N/A	N/A	N/A	24.8	N/A	0.081	0.01	0.33
26.50	169.92	0.73	0.43	sand	-3.8	1.00	34	3,180	2,350	3,099	1.53	1.00	156.75	0.938	0.939	0.264	0.438	2.079	NO	N/A	N/A	N/A	27.3	N/A	0.068	0.01	0.32
27.50	184.73	0.63	0.34	sand	-4.8	1.00	37	3,300	2,408	3,156	1.45	1.00	168.37	0.936	0.928	0.267	N/A	N/A	NO	N/A	N/A	N/A	29.4	N/A	0.057	0.01	0.32
28.50	149.45	0.45	0.30	sand	-5.8	1.00	30	3,420	2,465	3,214	1.51	1.00	134.61	0.934	0.927	0.269	0.307	1.408	NO	N/A	N/A	N/A	23.6	N/A	0.090	0.01	0.31
29.50	171.27	1.18	0.69	sand	-6.8	1.00	34	3,540	2,523	3,272	1.67	1.02	155.02	0.931	0.914	0.272	0.426	1.913	NO	N/A	N/A	N/A	26.8	N/A	0.073	0.01	0.30
30.50	121.12	0.43	0.36	sand	-7.8	1.00	24	3,660	2,580	3,329	1.64	1.00	106.63	0.926	0.921	0.273	0.193	0.867	YES	0.0	18.8	1,057	18.8	N/A	0.421	0.05	0.25
31.50	75.84	0.56	0.73	sand to silty sand	-8.8	1.00	19	3,780	2,638	3,387	1.98	1.28	84.27	0.918	0.924	0.273	0.136	0.611	YES	1.3	15.9	765	17.8	N/A	1.126	0.14	0.11
32.50	52.93	0.61	1.15	silty sand to sandy silt	-9.8	1.00	18	3,900	2,696	3,444	2.23	1.74	79.17	0.909	0.921	0.274	0.126	0.567	YES	2.8	16.2	798	21.1	N/A	0.147	0.02	0.09
33.50	48.85	0.64	1.31	silty sand to sandy silt	-10.8	1.66	27	4,020	2,753	3,502	1.98	1.28	88.23	0.901	0.897	0.274	0.144	0.629	YES	2.8	23.2	1,200	29.4	N/A	0.059	0.01	0.09
34.50	12.33	0.26	2.12	clayey silt to silty clay	-11.8	1.00	6	4,140	2,811	3,560	2.97	N/A	N/A	0.893	N/A	0.274	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
35.50	12.28	0.33	2.70	clayey silt to silty clay	-12.8	1.00	6	4,260	2,868	3,617	3.04	N/A	N/A	0.885	N/A	0.273	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
36.50	14.52	0.49	3.38	silty clay to clay	-13.8	1.00	10	4,380	2,926	3,675	3.04	N/A	N/A	0.877	N/A	0.273	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
37.50	14.38	0.35	2.44	clayey silt to silty clay	-14.8	1.00	7	4,500	2,984	3,732	2.96	N/A	N/A	0.869	N/A	0.273	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
38.50	14.13	0.34	2.45	clayey silt to silty clay	-15.8	1.00	7	4,620	3,041	3,790	2.98	N/A	N/A	0.861	N/A	0.272	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
39.50	19.23	0.43	2.27	clayey silt to silty clay	-16.8	1.00	10	4,740	3,099	3,848	2.84	N/A	N/A	0.852	N/A	0.271	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
40.50	50.43	0.87	1.73	silty sand to sandy silt	-17.8	1.00	17	4,860	3,156	3,905	2.38	2.24	89.86	0.844	0.888	0.270	0.147	0.646	YES	2.8	14.8	665	19.4	N/A	0.279	0.03	0.05
41.50	196.71	1.68	0.85	sand	-18.8	1.66	65	4,980	3,214	3,963	1.41	1.00	256.93	0.836	0.827	0.269	N/A	N/A	NO	N/A	N/A	N/A	46.3	N/A	0.000	0.00	0.05
42.50	80.42	1.54	1.92	silty sand to sandy silt	-19.8	1.66	44	5,100	3,272	4,020	1.94	1.23	128.32	0.828	0.821	0.268	0.276	1.129	YES	2.8	34.1	1,200	42.6	N/A	0.000	0.00	0.05
43.50	23.93	0.58	2.43	sandy silt to clayey silt	-20.8	1.00	10	5,220	3,329	4,078	2.80	N/A	N/A	0.820	N/A	0.267	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
44.50	170.13	1.48	0.87	sand	-21.8	1.00	34	5,340	3,387	4,136	1.79	1.10	143.49	0.812	0.825	0.266	0.355	1.467	NO	N/A	N/A	N/A	23.7	N/A	0.088	0.01	0.04
45.50	174.05	1.26	0.73	sand	-22.8	1.66	58	5,460	3,444	4,193	1.42	1.00	219.60	0.804	0.805	0.265	N/A	N/A	NO	N/A	N/A	N/A	39.8	N/A	0.001	0.00	0.04
46.50	74.67	1.33	1.79	silty sand to sandy silt	-23.8	1.00	25	5,580	3,502	4,251	2.27	1.87	105.30	0.795	0.841	0.264	0.189	0.802	YES	2.8	19.9	1,172	25.5	N/A	0.078	0.01	0.03
47.50	57.80	0.95	1.64	silty sand to sandy silt	-24.8	1.00	19	5,700	3,560	4,308	2.34	2.09	90.53	0.787	0.855	0.262	0.149	0.648	YES	2.8	15.9	767	20.8	N/A	0.125	0.01	0.02
48.50	58.50	1.94	3.31	sandy silt to clayey silt	-25.8	1.66	39	5,820	3,617	4,366	2.23	1.73	124.71	0.779	0.796	0.261	0.260	1.061	YES	2.8	29.0	1,200	36.5	N/A	0.019	0.00	0.02
49.50	28.33	0.67	2.39	sandy silt to clayey silt	-26.8	1.00	11	5,940	3,675	4,424	2.76	N/A	N/A	0.771	N/A	0.259	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.02
50.50	21.35	0.49	2.30	sandy silt to clayey silt	-27.8	1.00	9	6,060	3,732	4,481	2.86	N/A	N/A	0.763	N/A	0.258	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.02
51.50	20.38	0.40	1.97	sandy silt to clayey silt	-28.8	1.00	8	6,180	3,790	4,539	2.85	N/A	N/A	0.755	N/A	0.256	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.02
52.50	20.34	0.38	1.89	sandy silt to clayey silt	-29.8	1.00	8	6,300	3,848	4,596	2.84	N/A	N/A	0.747	N/A	0.254	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.02
53.50	97.75	1.93	1.98	silty sand to sandy silt	-30.8	1.00	33	6,420	3,905	4,654	2.23	1.75	122.40	0.739	0.793	0.253	0.251	1.050	YES	2.8	24.2	1,200	30.6	N/A	0.048	0.01	0.01
54.50	352.53	1.37	0.39	gravelly sand to sand	-31.8	1.66	97	6,540	3,963	4,712	1.04	1.00	414.67	0.730	0.761	0.251	N/A	N/A	NO	N/A	N/A	N/A	63.4	N/A	0.000	0.00	0.01
55.50	73.55	1.18	1.61	silty sand to sandy silt	-32.8	1.00	25	6,660	4,020	4,769	2.27	1.87	96.92	0.722	0.812	0.249	0.165	0.717	YES	2.8	18.7	1,046	24.1	N/A	0.081	0.01	0.00
56.50	359.00	2.36	0.66	gravelly sand to sand	-33.8	1.00	60	6,780	4,078	4,827	1.49	1.00	251.41	0.714	0.752	0.247	N/A	N/A	NO	N/A	N/A	N/A	38.5	N/A	0.007	0.00	0.00
57.50	471.80	3.13	0.66	gravelly sand to sand	-34.8	1.00	79	6,900	4,136	4,884	1.41	1.00	328.10	0.706	0.748	0.245	N/A	N/A	NO	N/A	N/A	N/A	50.3	N/A	0.000	0.00	0.00

max=	1,200
min=	665
avg=	1,000

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING CPT DATA (METHOD 2)

(Engineer: Curt Scheyhing)

PROJECT INFORMATION	
Project Name	Ballona Wetlands Restoration
Project No.	LA-962A
Location	Los Angeles
Exploration No.	A-CPT065

GENERAL INPUT DATA	
Ground Surf. Elev. During Test	20.50 ft
GWT Elev. During Test	0.00 ft
GWT Elev. For Design	10.00 ft
Total Soil Unit Weight, γ_t	120.00 pcf
Earthquake Magnitude, M_{eq}	6.70
Peak Ground Acceleration, A_{max}	0.32 g
Required Factor of Safety	1.30

REFERENCES

+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)

++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$

+++ $FS = (CRR_{7.5}/CSR)\ MSF\ K_\sigma\ K_{\alpha \rightarrow \gg}$ where $CRR_{7.5}$ is evaluated from direct CPT data, K_α =1.0 and MSF = 1.33

* Residual strength values of liquefied soils are evaluated from converted SPT blow counts using the median curve by Seed & Harder (1990)

** Ground settlements are evaluated from converted SPT blow counts using the method developed by Tokimatsu and Seed (1987).

Note: This analysis asssumes level ground condition and depth of liquefiable soils does not change.

GWT Depth During Test, Zw =	20.50 ft below ground surface
GWT Depth For Design, Zwd =	10.50 ft below ground surface

***** SUMMARY OF RESULTS *****

Total Thickness of Liquefiable Soils =	14.00 feet	
Earthquake-Induced Settlements:		
- Liquefaction-Induced Settlement =	0.90 inches	<--- Saturated Sands
- Seismic Compaction Settlement =	0.01 inches	<--- Dry or Unsaturated Sands
Total:	0.91 inches	

INPUT SOIL PROFILE (CPT DATA)					SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +														RESIDUAL STRENGTH *			GROUND SETTLEMENT **				
Soil Depth During Test (ft)	Average Cone Tip Resistance $q_{t\text{-}avg}$ (tsf)	Average Sleeve Friction $f_{s\text{-}avg}$ (tsf)	Average Friction Ratio $R_{f\text{-}avg}$ (%)	Soil Behavior Type (Robertson et al., 1983)	Bottom of Layer Elevation (ft)	Thin Layer Correction Factor (Lunne, et al., 1997)	Equiv. SPT Blow Count N_{60}(blows/ft)	Total Vert. Stress σ_v (psf)	Effective Vert. Stress (Design) σ'_v (psf)	Effective Vert. Stress (Test) σ'_v (psf)	Soil Behavior Type Index I_c	Fines Correction Factor K_c	Corrected Tip Resistance q_{c1Ncs}	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio $CRR_{7.5}$	Factor of Safety Against Liqefaction +++ FS	Liquefy ?	SPT Blow Count Correction $N_{corr.}$	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength S_r (psf)	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Cyclic Shear Strain γ_c (%)	Vol. Strain ε_v (%)	Layer Settlement S_l (in.)	Cumulative Settlement Profile (in.)
0.50	26.90	0.57	2.12	sandy silt to clayey silt	19.5	1.00	11	60	60	60	2.01	1.31	203.42	0.999	N/A	0.208	N/A	N/A	NO	N/A	N/A	N/A	27.0	N/A	N/A	N/A	0.91
1.50	55.69	0.49	0.89	sand to silty sand	18.5	1.00	14	180	180	180	1.68	1.02	189.55	0.997	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	27.3	0.018	0.020	0.00	0.91
2.50	36.25	0.22	0.61	silty sand to sandy silt	17.5	1.00	12	300	300	300	1.80	1.11	103.89	0.994	N/A	0.207	N/A	N/A	NO	N/A	N/A	N/A	29.7	0.022	0.023	0.00	0.90
3.50	65.50	1.15	1.75	silty sand to sandy silt	16.5	1.00	22	420	420	420	1.97	1.26	180.16	0.992	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	49.5	0.022	0.000	0.00	0.90
4.50	84.23	2.30	2.73	sandy silt to clayey silt	15.5	1.00	56	540	540	540	1.78	1.09	292.39	0.990	N/A	0.206	N/A	N/A	NO	N/A	N/A	N/A	118.8	N/A	N/A	N/A	0.90
5.50	33.06	1.10	3.32	clayey silt to silty clay	14.5	1.00	17	660	660	660	2.44	2.50	143.77	0.987	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.90
6.50	17.83	0.61	3.41	silty clay to clay	13.5	1.00	12	780	780	780	2.60	N/A	N/A	0.985	N/A	0.205	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.90
7.50	22.29	0.69	3.11	clayey silt to silty clay	12.5	1.00	11	900	900	900	2.60	3.33	110.54	0.983	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.90
8.50	16.36	0.59	3.63	silty clay to clay	11.5	1.00	11	1,020	1,020	1,020	2.71	N/A	N/A	0.980	N/A	0.204	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.90
9.50	17.40	0.57	3.25	clayey silt to silty clay	10.5	1.00	9	1,140	1,140	1,140	2.69	N/A	N/A	0.978	N/A	0.203	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.90
10.50	19.30	0.56	2.90	clayey silt to silty clay	9.5	1.00	10	1,260	1,260	1,260	2.65	N/A	N/A	0.976	N/A	0.203	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.90
11.50	15.28	0.46	3.00	clayey silt to silty clay	8.5	1.00	8	1,380	1,318	1,380	2.75	N/A	N/A	0.973	N/A	0.212	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.90
12.50	10.95	0.13	1.22	clayey silt to silty clay	7.5	1.00	5	1,500	1,375	1,500	2.67	N/A	N/A	0.971	N/A	0.220	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.90
13.50	6.66	0.11	1.63	silty clay to clay	6.5	1.00	4	1,620	1,433	1,620	2.94	N/A	N/A	0.969	N/A	0.228	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.90
14.50	15.78	0.22	1.37	sandy silt to clayey silt	5.5	1.00	6	1,740	1,490	1,740	2.58	3.19	62.77	0.966	1.000	0.235	0.103	0.586	YES	2.8	9.6	289	13.1	N/A	2.023	0.24	0.66
15.50	30.86	0.41	1.33	silty sand to sandy silt	4.5	1.00	10	1,860	1,548	1,860	2.35	2.14	74.92	0.964	1.000	0.241	0.119	0.660	YES	2.8	13.5	548	17.8	N/A	0.200	0.02	0.64
16.50	17.25	0.20	1.13	sandy silt to clayey silt	3.5	1.00	11	1,980	1,606	1,980	2.24	1.77	56.31	0.962	1.000	0.247	0.097	0.523	YES	2.8	14.3	616	18.8	N/A	0.170	0.02	0.62
17.50	5.76	0.18	3.04	clay	2.5	1.00	6	2,100	1,663	2,100	3.20	N/A	N/A	0.959	N/A	0.252	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.62
18.50	36.88	0.37	0.99	silty sand to sandy silt	1.5	1.00	12	2,220	1,721	2,220	2.24	1.77	70.25	0.957	1.000	0.257	0.112	0.583	YES	2.8	14.5	632	19.0	N/A	0.198	0.02	0.59
19.50	40.47	0.34	0.85	silty sand to sandy silt	0.5	1.00	13	2,340	1,778	2,340	2.17	1.60	68.77	0.955	1.000	0.261	0.110	0.563	YES	2.8	15.3	705	20.0	N/A	0.163	0.02	0.57
20.50	43.19	0.36	0.84	silty sand to sandy silt	-0.5	1.00	24	2,460	1,836	2,460	1.85	1.14	85.45	0.952	1.000	0.265	0.138	0.694	YES	2.8	24.3	1,200	30.8	N/A	0.050	0.01	0.57
21.50	17.62	0.25	1.40	sandy silt to clayey silt	-1.5	1.00	12	2,580	1,894	2,518	2.31	1.98	59.38	0.950	1.000	0.269	0.099	0.493	YES	2.8	13.2	526	17.5	N/A	1.130	0.14	0.43
22.50	6.42	0.09	1.39	sensitive fine grained	-2.5	1.00	3	2,700	1,951	2,575	3.03	N/A	N/A	0.948	N/A	0.273	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
23.50	6.11	0.10	1.56	sensitive fine grained	-3.5	1.00	3	2,820	2,009	2,633	3.09	N/A	N/A	0.945	N/A	0.276	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
24.50	6.13	0.07	1.20	sensitive fine grained	-4.5	1.00	3	2,940	2,066	2,690	3.04	N/A	N/A	0.943	N/A	0.279	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
25.50	5.71	0.09	1.48	sensitive fine grained	-5.5	1.00	3	3,060	2,124	2,748	3.13	N/A	N/A	0.941	N/A	0.282	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
26.50	5.57	0.08	1.34	sensitive fine grained	-6.5	1.00	3	3,180	2,182	2,806	3.13	N/A	N/A	0.938	N/A	0.284	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
27.50	5.80	0.08	1.29	sensitive fine grained	-7.5	1.00	3	3,300	2,239	2,863	3.12	N/A	N/A	0.936	N/A	0.287	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
28.50	7.64	0.16	2.11	silty clay to clay	-8.5	1.00	5	3,420	2,297	2,921	3.11	N/A	N/A	0.934	N/A	0.289	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.43
29.50	19.05	0.18	0.93	sandy silt to clayey silt	-9.5	1.00	13	3,540	2,354	2,978	2.24	1.77	51.42	0.931	0.961	0.291	0.093	0.408	YES	2.8	13.1	521	17.4	N/A	1.385	0.17	0.27
30.50	6.72	0.17	2.52	silty clay to clay	-10.5	1.00	4	3,660	2,412	3,036	3.23	N/A	N/A	0.926	N/A	0.292	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
31.50	13.37	0.30	2.22	clayey silt to silty clay	-11.5	1.00	7	3,780	2,470	3,094	2.91	N/A	N/A	0.918	N/A	0.292	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
32.50	12.38	0.32	2.62	clayey silt to silty clay	-12.5	1.00	6	3,900	2,527	3,151	2.99	N/A	N/A	0.909	N/A	0.292	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27
33.50	32.07	0.45	1.40	silty sand to sandy silt	-13.5	1.00	11	4,020	2,585	3,209	2.48	2.65	70.18	0.901	0.946	0.292	0.112	0.485	YES	2.8	11.2	385	15.1	N/A	1.780	0.21	0.05
34.50	28.96	1.06	3.65	clayey silt to silty clay	-14.5	1.00	14	4,140	2,642	3,266	2.77	N/A	N/A	0.893	N/A	0.291	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
35.50	36.69	0.95	2.59	sandy silt to clayey silt	-15.5	1.00	15	4,260	2,700	3,324	2.60	N/A	N/A	0.885	N/A	0.290	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
36.50	20.27	0.58	2.87	clayey silt to silty clay	-16.5	1.00	17	4,380	2,758	3,382	2.53	2.94	77.48	0.877	0.917	0.290	0.123	0.521	YES	2.8	15.7	746	N/A	N/A	0.000	0.00	0.05
37.50	7.82	0.21	2.69	silty clay to clay	-17.5	1.00	5	4,500	2,815	3,439	3.23	N/A	N/A	0.869	N/A	0.289	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
38.50	9.09	0.32	3.56	clay	-18.5	1.00	9	4,620	2,873	3,497	3.24	N/A	N/A	0.861	N/A	0.288	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
39.50	10.33	0.32	3.10	silty clay to clay	-19.5	1.00	7	4,740	2,930	3,554	3.16	N/A	N/A	0.852	N/A	0.287	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
40.50	18.55	0.58	3.13	clayey silt to silty clay	-20.5	1.00	9	4,860	2,988	3,612	2.93	N/A	N/A	0.844	N/A	0.286	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
41.50	33.35	0.74	2.23	sandy silt to clayey silt	-21.5	1.00	13	4,980	3,046	3,670	2.63	N/A	N/A	0.836	N/A	0.284	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
42.50	33.73	0.82	2.43	sandy silt to clayey silt	-22.5	1.00	13	5,100	3,103	3,727	2.65	N/A	N/A	0.828	N/A	0.283	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05
43.50	105.27	1.54	1.46	sand to silty sand	-23.5	1.00	26	5,220	3,161	3,785	2.08	1.43	119.44	0.820	0.861	0.282	0.238	0.972	YES	1.3	20.5	1,200	22.5	N/A	0.104	0.01	0.04
44.50	184.64	1.29	0.70	sand	-24.5	1.66	61	5,340	3,218	3,842	1.38	1.00	240.99	0.812	0.827	0.280	N/A	N/A	NO	N/A	N/A	N/A	44.1	N/A	0.000	0.00	0.04
45.50	76.78	0.80	1.04	sand to silty sand	-25.5	1.66	32	5,460	3,276	3,900	1.80	1.10	109.68	0.804	0.838	0.279	0.203	0.814	YES	1.3	24.1	1,200	26.4	N/A	0.078	0.01	0.03
46.50	19.24	0.65	3.39	clayey silt to silty clay	-26.5	1.00	10	5,580	3,334	3,958	2.97	N/A	N/A	0.795	N/A	0.277	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.03
47.50	39.81	1.45	3.63	clayey silt to silty clay	-27.5	1.00	20	5,700	3,391	4,015	2.73	N/A	N/A	0.787	N/A	0.275	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.03
48.50	47.75	1.18	2.48	sandy silt to clayey silt	-28.5	1.66	32	5,820	3,449	4,073	2.20	1.67	100.66	0.779	0.825	0.274	0.175	0.704	YES	2.8	25.0	1,200	31.6	N/A	0.047	0.01	0.02
49.50	18.15	0.52	2.85	clayey silt to silty clay	-29.5	1.00	9	5,940	3,506	4,130	2.97	N/A	N/A	0.771	N/A	0.272	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.02
50.50	16.72	0.35	2.07	clayey silt to silty clay	-30.5	1.00	8	6,060	3,564	4,188	2.93	N/A	N/A	0.763	N/A	0.270	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.02
51.50	16.28	0.30	1.83	clayey silt to silty clay	-31.5	1.00	8	6,180	3,622	4,246	2.91	N/A	N/A	0.755	N/A	0.268	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.02
52.50	16.18	0.43	2.65	clayey silt to silty clay	-32.5	1.00	8	6,300	3,679	4,303	3.01	N/A	N/A	0.747	N/A	0.266	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.02
53.50	19.80	0.57	2.89	clayey silt to silty clay	-33.5	1.00	10	6,420	3,737	4,361	2.96	N/A	N/A	0.739	N/A	0.264	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.02
54.50	44.30	1.01	2.28	sandy silt to clayey silt	-34.5	1.00	18	6,540	3,794	4,418	2.59	3.29	90.11	0.730	0.847	0.262	0.148	0.639	YES	2.8	14.7	655	19.3	N/A	0.204	0.02	0.00
55.50	30.03	0.98	3.25	clayey silt to silty clay	-35.5	1.00	15	6,660	3,852	4,476	2.84	N/A	N/A	0.722	N/A	0.260	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
56.50	21.87	0.76	3.46	clayey silt to silty clay	-36.5	1.00	11	6,780	3,910	4,534	2.98	N/A	N/A	0.714	N/A	0.258	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
57.50	15.90	0.41	2.57	clayey silt to silty clay	-37.5	1.00	8	6,900	3,967	4,591	3.04	N/A	N/A	0.706	N/A	0.255	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
58.50	14.87	0.32	2.16	clayey silt to silty clay	-38.5	1.00	7	7,020	4,025	4,649	3.03	N/A	N/A	0.698	N/A	0.253	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
59.50	16.99	0.35	2.08	clayey silt to silty clay	-39.5	1.00	8	7,140	4,082	4,706	2.97	N/A	N/A	0.690	N/A	0.251	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
60.50	30.12	0.61	2.02	sandy silt to clayey silt	-40.5	1.00	12	7,260	4,140	4,764	2.73	N/A	N/A	0.682	N/A	0.249	N/A	N/A	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00

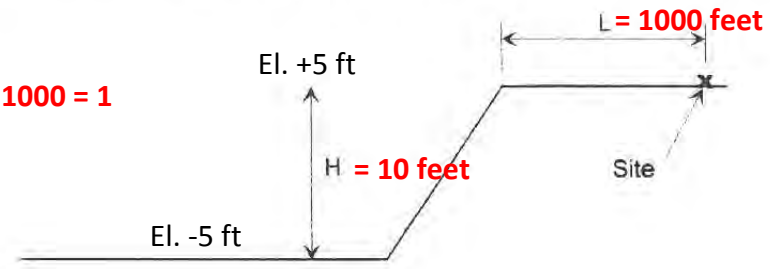
max=	1,200
min=	289
avg=	744

Youd et al. (2002) Procedure for Estimating Lateral Spread Displacements

Free-Face Conditions:

$$\log(D_H) = -16.713 + 1.532M - 1.406\log R^* - 0.012R + 0.592\log W + 0.540\log(T_{15}) + 3.413\log(100 - F_{15}) - 0.795\log(D50_{15} + 0.1mm)$$

D_H = lateral ground displacement, m
M = magnitude (generally M_w). Range is 6-8.
R^* = $Ro + r_{jb}$; $Ro = 10^{(0.89M - 5.64)}$
r_{jb} = closest horizontal distance to surface projection of seismic source (≥ 0.5 km)
W = $100 \cdot H/L$, see figure: Range is $W = 1$ to 20%



W = 100 x 10 / 1000 = 1

			Addition of Terms	
Input Parameters			-16.71	
Magnitude	M:	6.7	10.26	
Distance	R	13	-0.16	
$Ro = 10^{(0.89M - 5.64)}$	Ro:	2	0.00	
$R^* = R + R_o$	R*:	15	-1.66	
Freeface Ratio (%)	W:	1	0.00	
Cumulative Thickness (m)	T15:	6.1	0.42	
Average Fine Contents	F15:	35	6.19	
Mean Grain Size (mm)	D50:	0.1	0.56	
	log (DH):		-1.10	
	DH:		0.08	meter
			0.26	feet
			3	inches

PLATE E-30

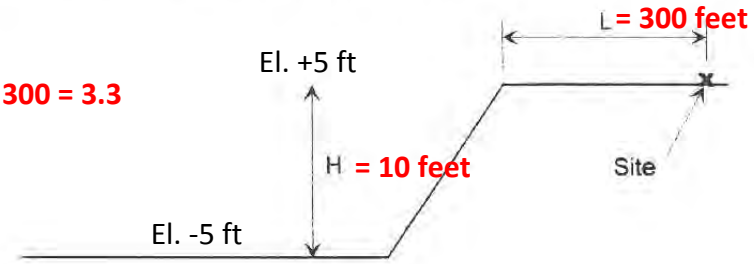
Youd et al. (2002) Procedure for Estimating Lateral Spread Displacements

Free-Face Conditions:

$$\log(D_H) = -16.713 + 1.532M - 1.406\log R^* - 0.012R + 0.592\log W + 0.540\log(T_{15}) + 3.413\log(100 - F_{15}) - 0.795\log(D50_{15} + 0.1mm)$$

D_H = lateral ground displacement, m
M = magnitude (generally M_w). Range is 6-8.
R^* = $Ro + r_{jb}$; $Ro = 10^{(0.89M - 5.64)}$
r_{jb} = closest horizontal distance to surface projection of seismic source (≥ 0.5 km)
W = $100 \cdot H/L$, see figure: Range is W = 1 to 20%

W = 100 x 10 / 300 = 3.3



			Addition of Terms	
Input Parameters			-16.71	
Magnitude	M:	6.7	10.26	
Distance	R	13	-0.16	
$Ro = 10^{(0.89M - 5.64)}$	Ro:	2	0.00	
$R^* = R + R_o$	R*:	15	-1.66	
Freeface Ratio (%)	W:	3.3	0.31	
Cumulative Thickness (m)	T15:	6.1	0.42	
Average Fine Contents	F15:	35	6.19	
Mean Grain Size (mm)	D50:	0.1	0.56	
	log (DH):		-0.79	
	DH:		0.16	meter
			0.53	feet
			6	inches

PLATE E-31

Freefield Lateral Spreading versus Distance from Channel

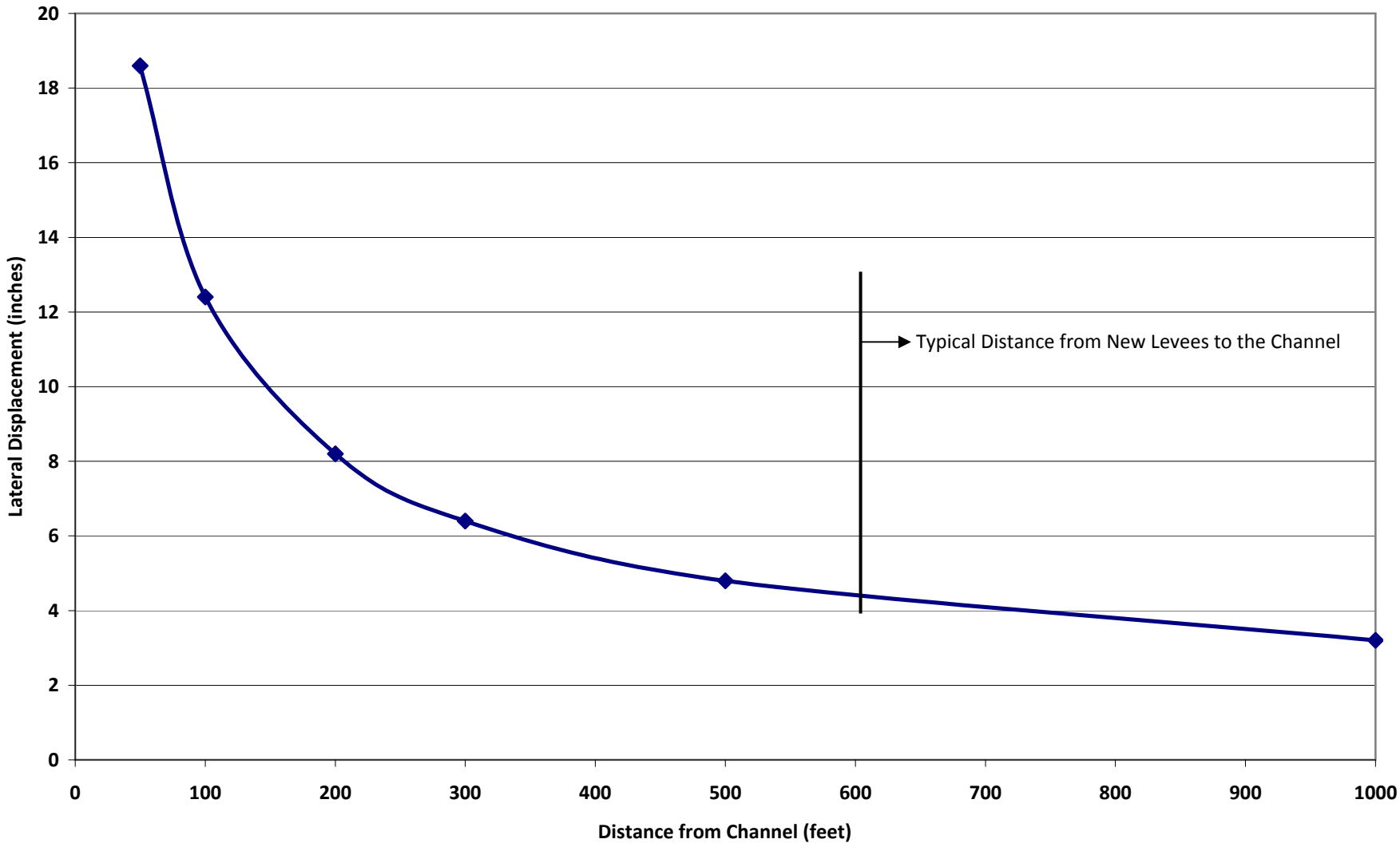


PLATE E-32

APPENDIX F
SEEPAGE

APPENDIX F
SEEPAGE

F.1 Contents

This appendix includes the results calculations of permeability using our field permeability data, as well as the results of the seepage analyses. using the RocScience Program, Slide v.5.

Seepage analyses included estimation of hydraulic gradients for two conservative conditions as follows:

- Steady State Condition at Existing North Area A Levee after Excavation of the New Meander Channel and Prior to Breach
- Steady State Condition at West Area B Existing Levee During a High Water Event

The seepage analyses also show the results of the transient seepage analysis during a week of typical tidal changes, as well as the transient seepage analysis following a 10-day high water flood condition.

A list of the plates presented in this appendix follows:

Plate F-1 and F-2	Permeability Calculations
Plate F-3	Hydraulic Gradient – Steady State Condition at Existing North Area A Levee after Excavation and Prior to Breach
Plate F-4	Hydraulic Gradient – Steady State Condition at West Area B Levee
Plate F-5	Transient Water Level for Tidal Changes over a period of a week
Plate F-6	Typical Tidal Changes in Water Level in Santa Monica Bay Over One Week – Used in Seepage Analyses
Plate F-7 thru F-16	Discharge Flow Analysis for Tidal Changes over a Week
Plate F-17	Transient Water Level for a 10-day Flood Condition
Plate F-17 thru F-29	Discharge Flow Analysis During and After a 10-day Flood

Field Permeability Test Data

Boring A-HSA066

5 foot deep hole
(8 inch diameter hole)

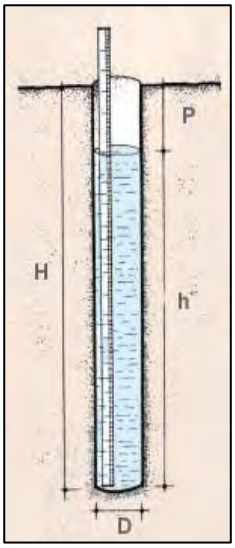
Average Permeability: **K ~= 1.5 x 10^-3 cm/s**

Time (min)	Reading (inches)	Drop in Water (inches)	Height of Water (inches)	Rate of Descent (in/min)	K (in/min)	K (cm/s)
0	0	-14				
0.5	14	0	46	0.00	0.00000	0.00000
1	14	0	46	1.00	0.04396	0.00186
2	15	1	45	1.00	0.04495	0.00190
3	16	2	44	0.00	0.00000	0.00000
4	16	2	44	1.00	0.04598	0.00195
5	17	3	43	0.80	0.03810	0.00161
7.5	19	5	41	1.20	0.06079	0.00257
10	22	8	38	0.60	0.03290	0.00139
15	25	11	35			

10 foot deep hole
(8 inch diameter hole)

Average Permeability: **K ~= 3.2 x 10^-4 cm/s**

Time (min)	Reading (inches)	Drop in Water (inches)	Height of Water (inches)	Rate of Descent (in/min)	K (in/min)	K (cm/s)
0	0	-7				
0.5	7	0	113	2.00	0.03556	0.00151
1	8	1	112	2.00	0.03604	0.00153
2	10	3	110	1.00	0.01826	0.00077
3	11	4	109	1.00	0.01843	0.00078
4	12	5	108	1.00	0.01860	0.00079
5	13	6	107	0.40	0.00751	0.00032
7.5	14	7	106	0.40	0.00758	0.00032
10	15	8	105	0.40	0.00769	0.00033
15	17	10	103			



$$K = (D \div 2) \times \ln (h_1 \div h_2) / 2 (t_2 - t_1)$$

Source: ftp://ftp.fao.org/fi/CDrom/FAO_Training/FAO_Training/General/x6706e/x6706e09.htm

Field Permeability Test Data

Boring A-HSA064

5 foot deep hole
(8 inch diameter hole)

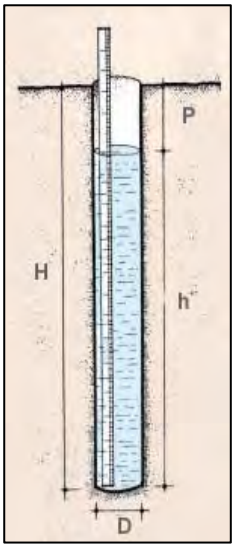
Average Permeability: **K ~= 7.5 x 10^-4 cm/s**

Time (min)	Reading (inches)	Drop in Water (inches)	Height of Water (inches)	Rate of Descent (in/min)	K (in/min)	K (cm/s)
0	0					
0.5	6	0	54	2.00	0.07477	0.00317
1	7	1	53	1.00	0.03810	0.00161
2	8	2	52	1.00	0.03884	0.00164
3	9	3	51	1.00	0.03961	0.00168
4	10	4	50	1.00	0.04041	0.00171
5	11	5	49	0.40	0.01650	0.00070
7.5	12	6	48	0.80	0.03405	0.00144
10	14	8	46	0.40	0.01778	0.00075
15	16	10	44			

10 foot deep hole
(8 inch diameter hole)

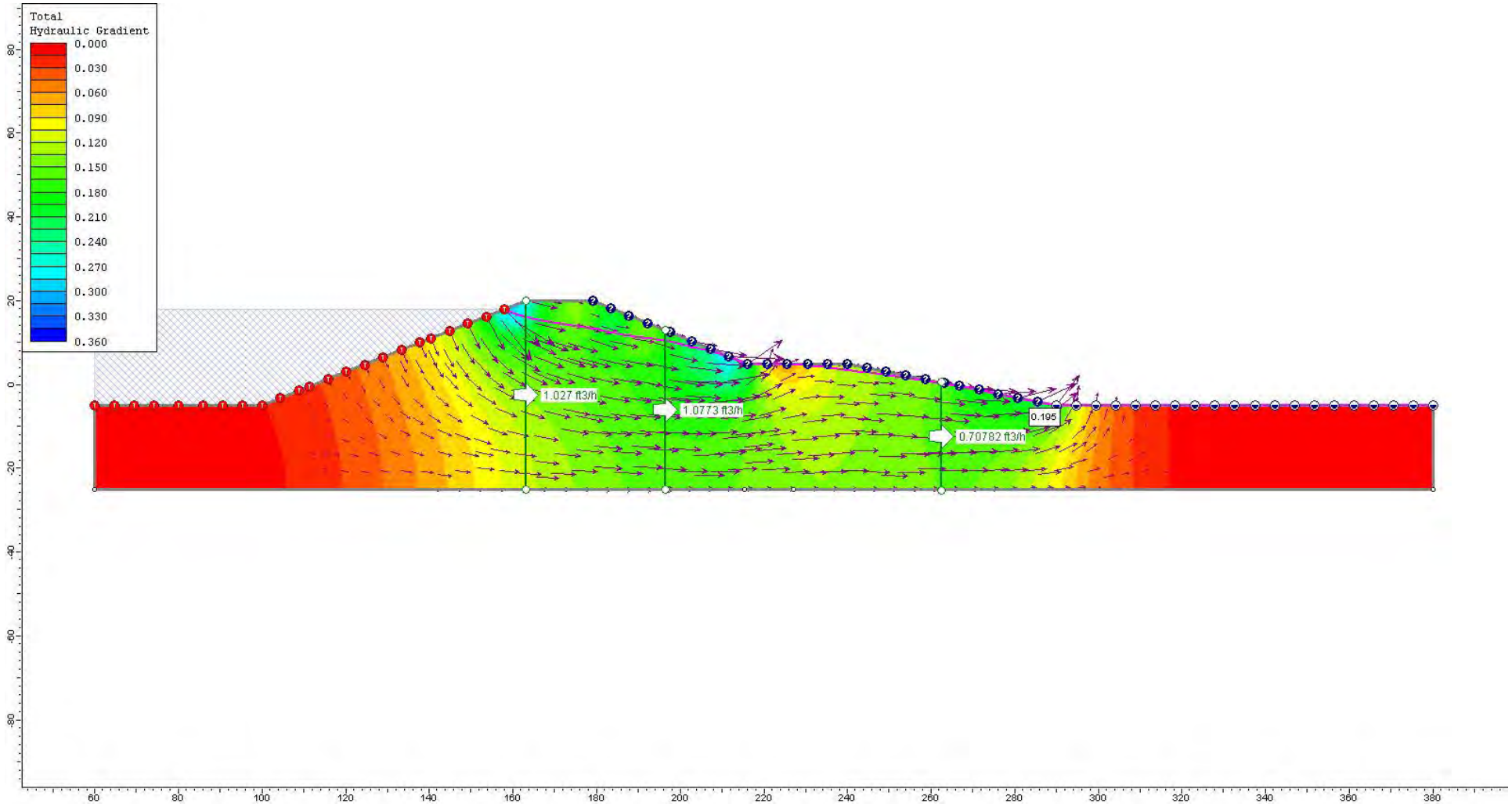
Average Permeability: **K ~= 7.5 x 10^-4 cm/s**

Time (min)	Reading (inches)	Drop in Water (inches)	Height of Water (inches)	Rate of Descent (in/min)	K (in/min)	K (cm/s)
0	0					
0.5	6	0	114	136.00	3.63023	0.15368
1	74	68	46	0.00	0.00000	0.00000
2	74	68	46	0.00	0.00000	0.00000
3	74	68	46	0.00	0.00000	0.00000
4	74	68	46	0.00	0.00000	0.00000
5	74	68	46	0.00	0.00000	0.00000
7.5	74	68	46	0.00	0.00000	0.00000
10	74	68	46	0.40	0.01778	0.00075
15	76	70	44			



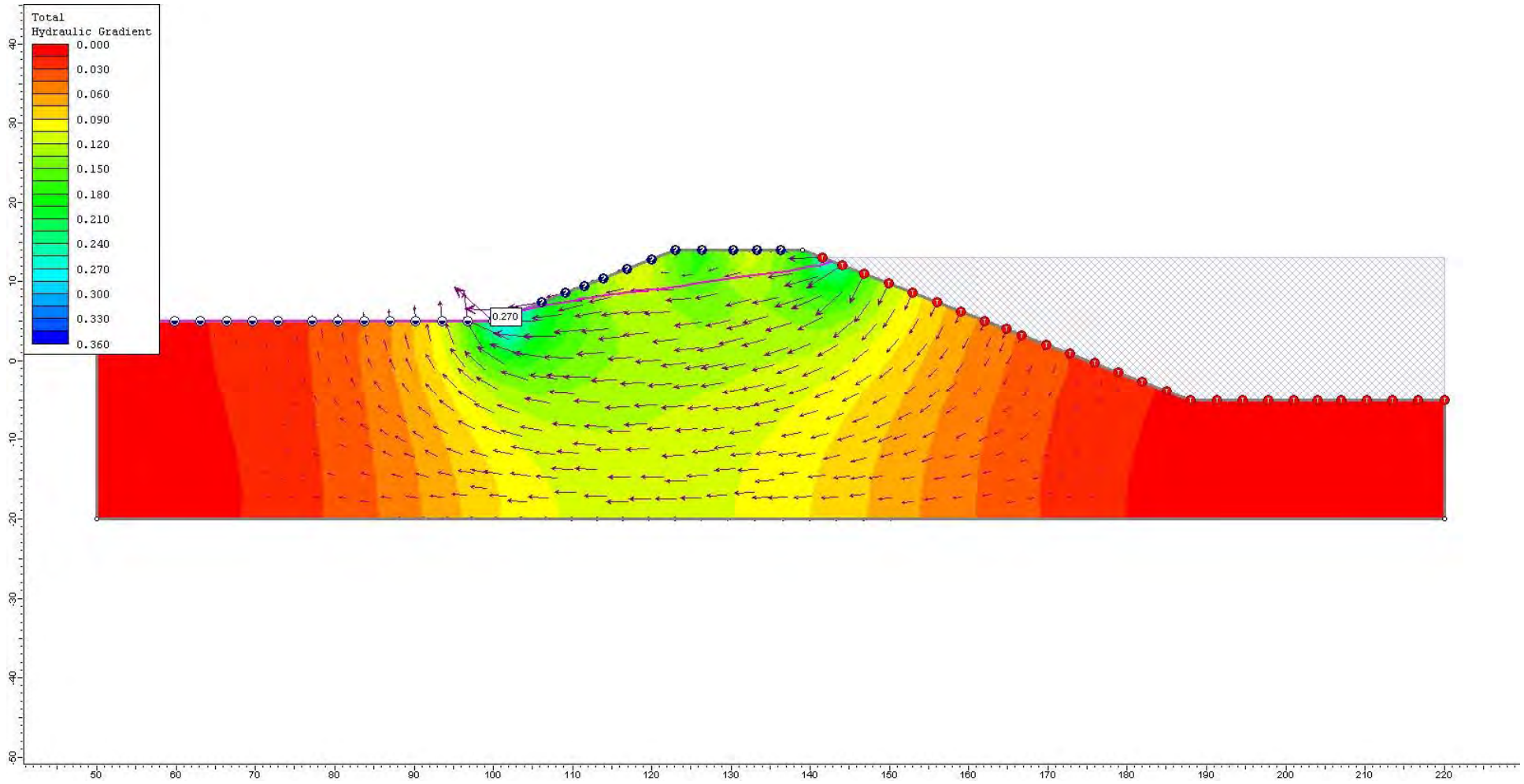
$$K = (D \div 2) \times \ln (h_1 \div h_2) / 2 (t_2 - t_1)$$

Source: ftp://ftp.fao.org/fi/CDrom/FAO_Training/FAO_Training/General/x6706e/x6706e09.htm



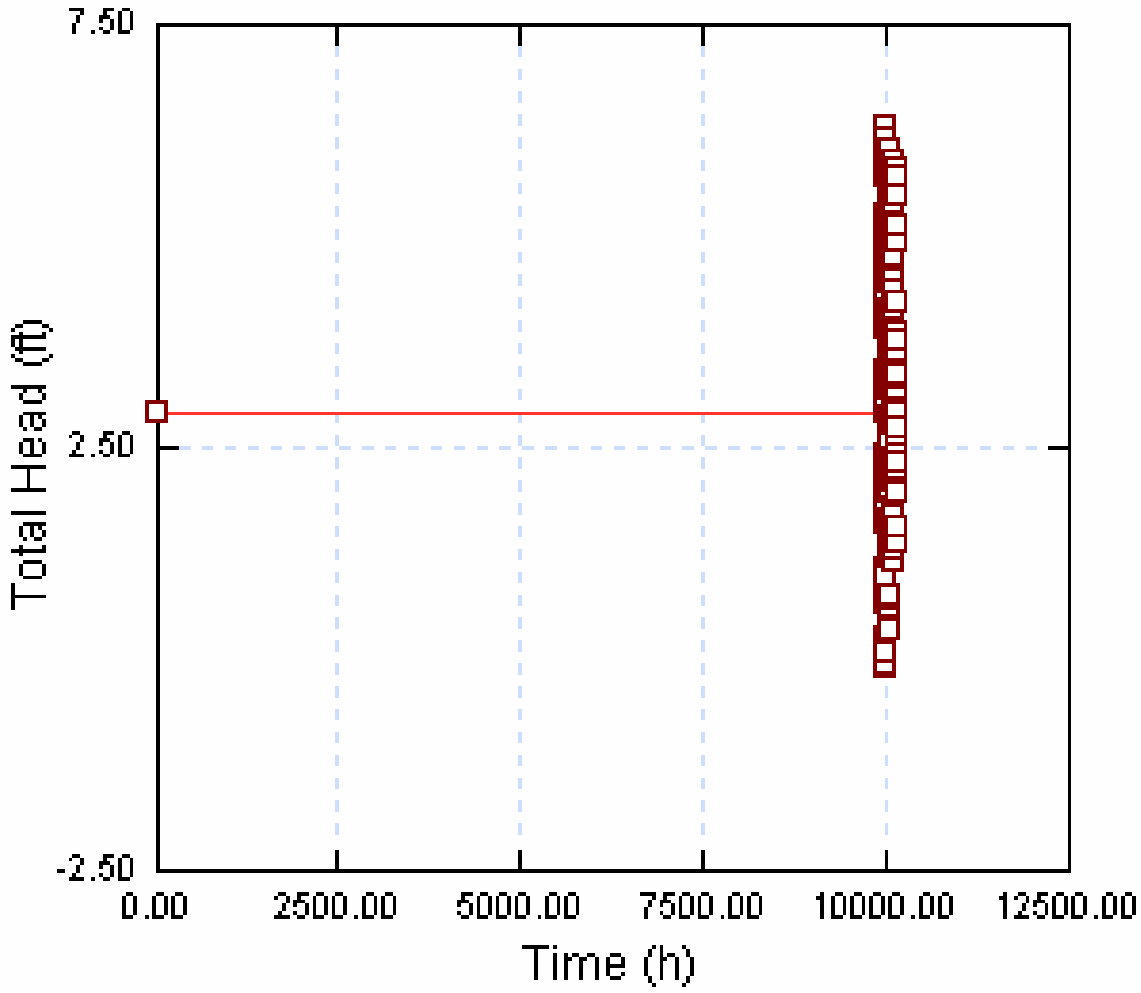
Hydraulic Gradient – Steady State Condition at Existing North Area A Levee after Excavation and Prior to Breach (i=0.195; FS > 5)

PLATE F-3



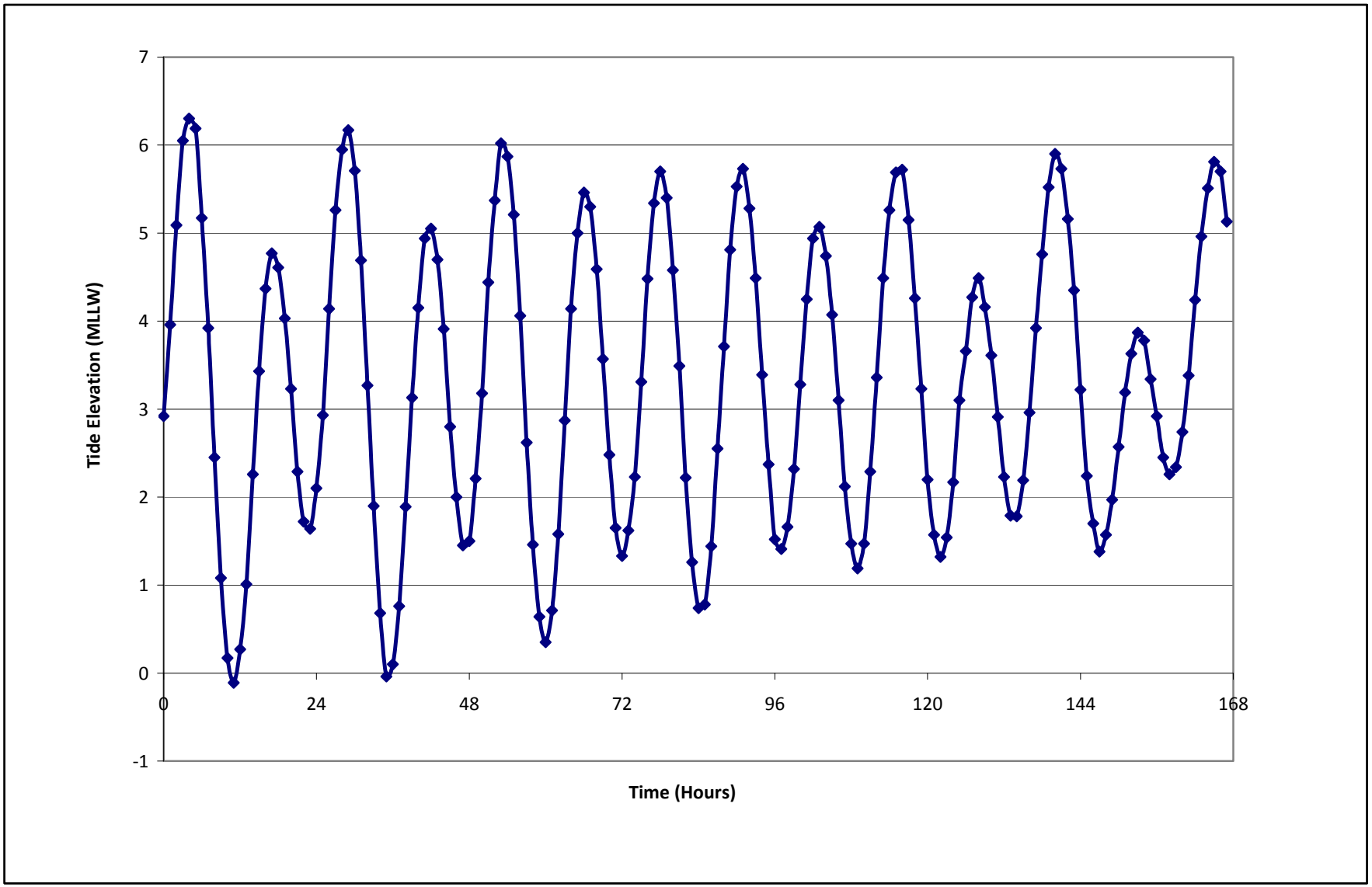
Hydraulic Gradient – Steady State Condition at West Area B Levee (i=0.27; FS > 3.7)

PLATE F-4



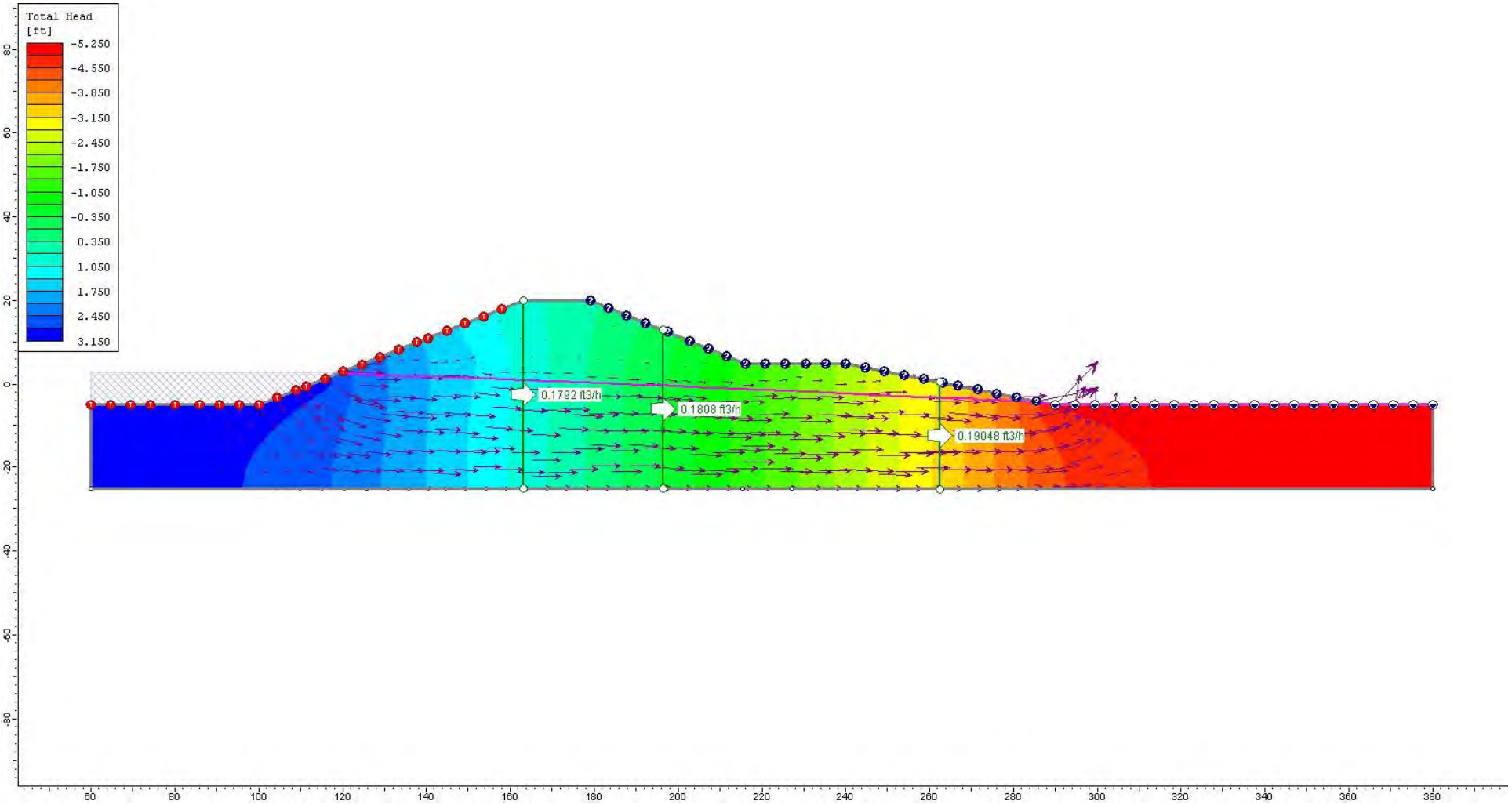
Transient Water Level for Tidal Changed over a Period of One Week

PLATE F-5



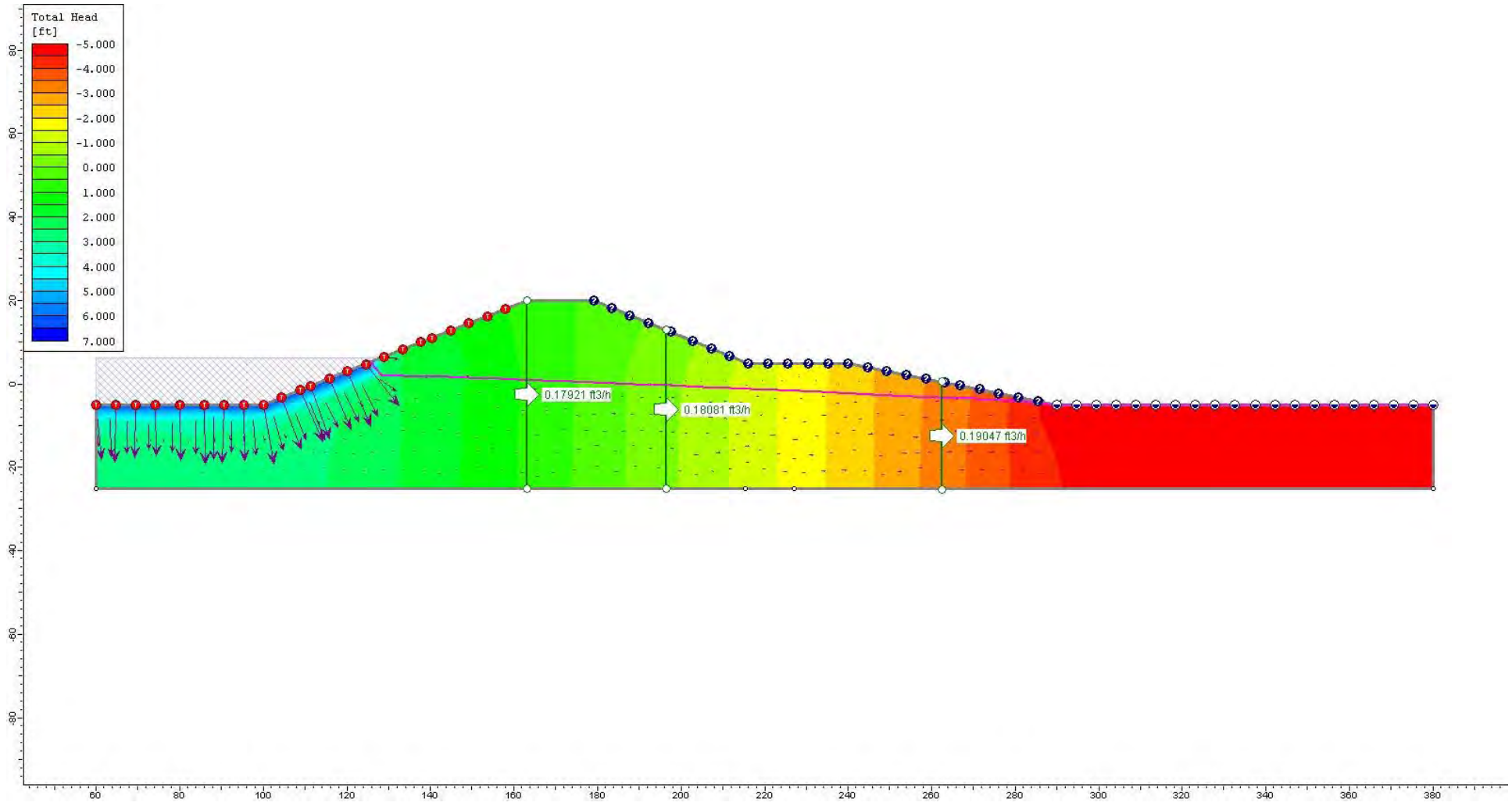
Typical Tidal Changes in Water Level in Santa Monica Bay Over One Week - Used in Seepage Analysis

PLATE F-6



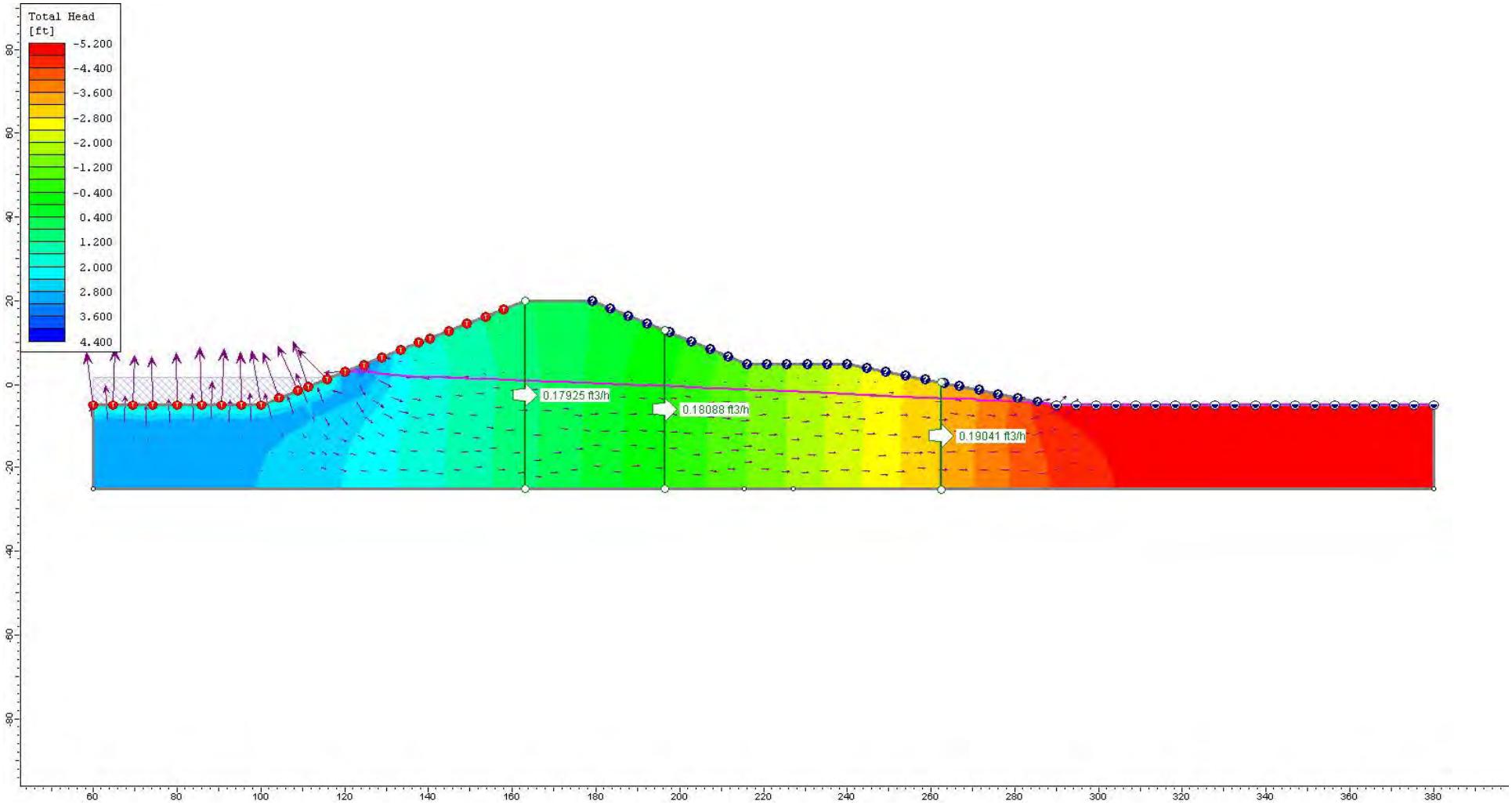
Stage 1 – Steady State at Average Tide Hide Prior to Tidal Fluctuations in the Analysis

PLATE F-7

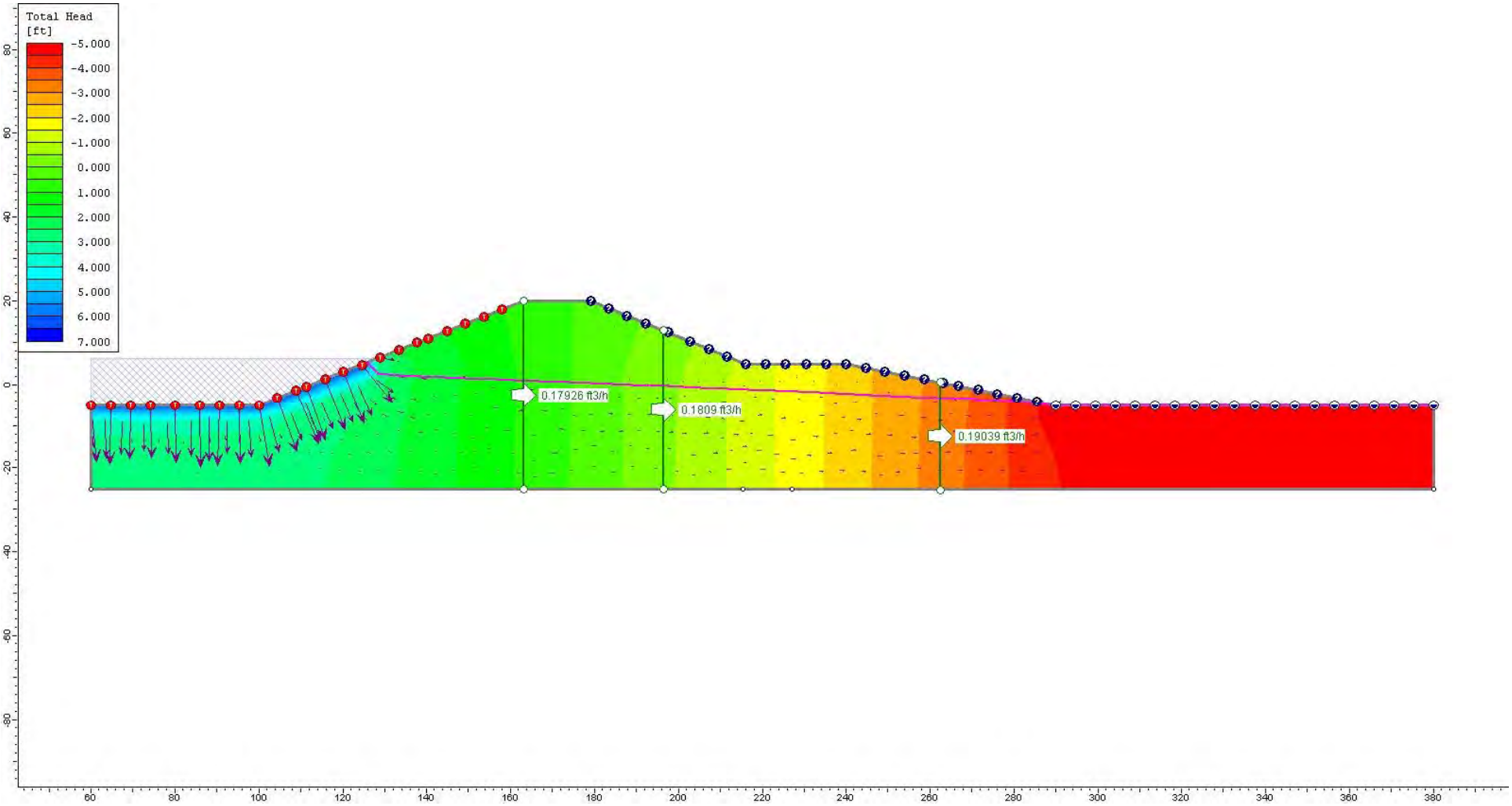


Stage 2 – First Peak – 4th Hour

PLATE F-8

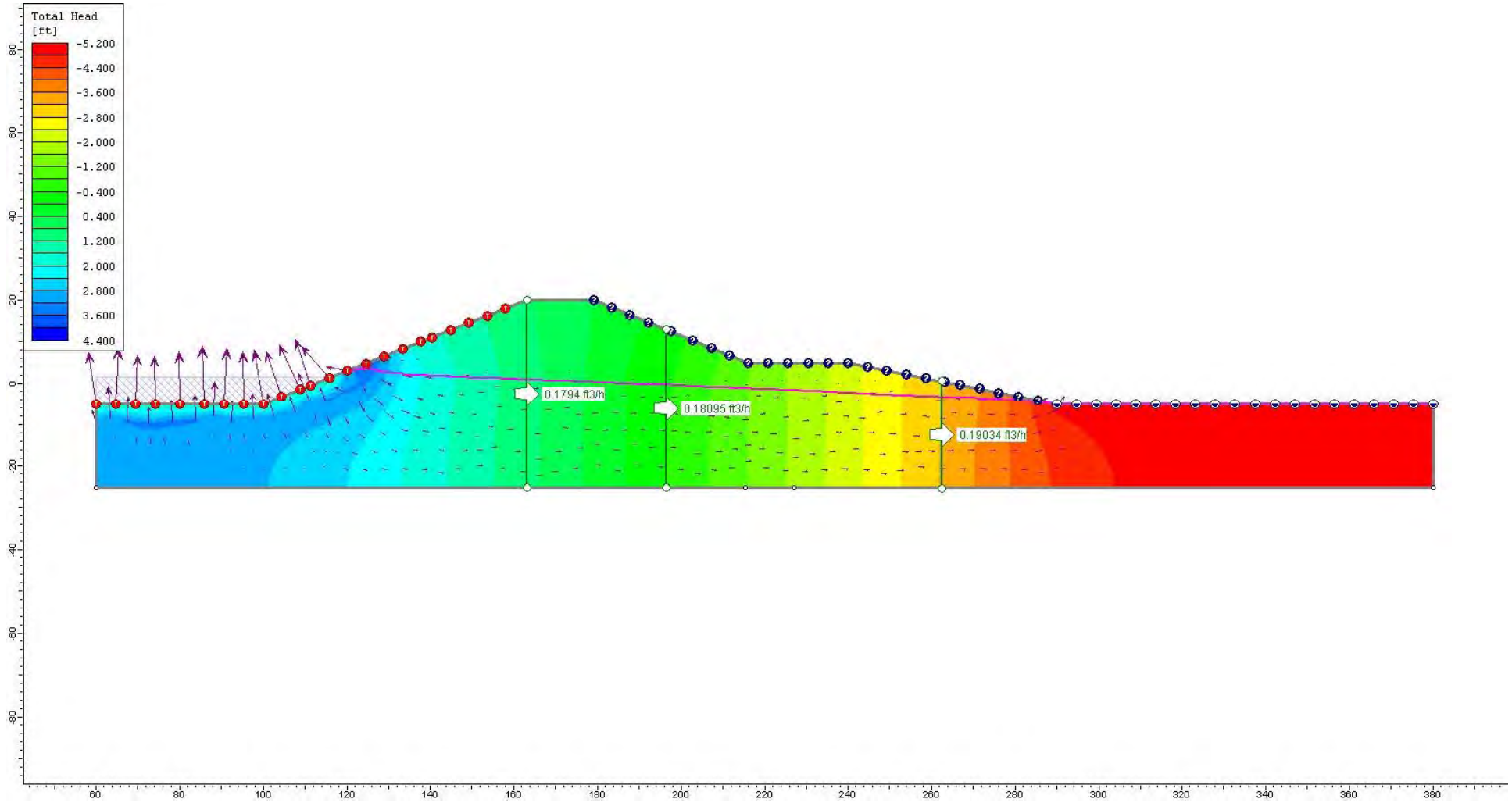


Stage 4 – Second Valley – 23th Hour



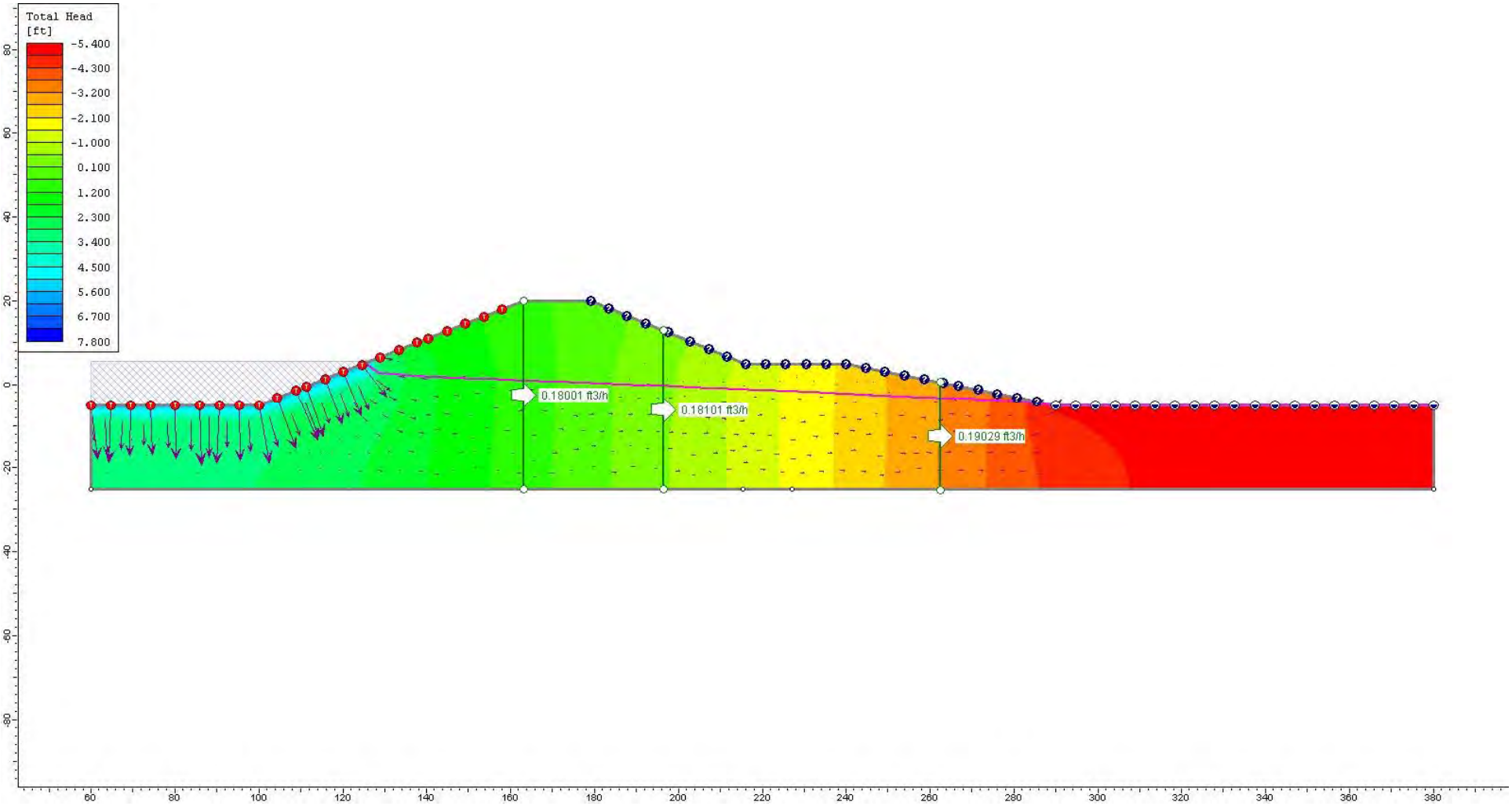
Stage 5 – Third Peak – 29th Hour

PLATE F-10



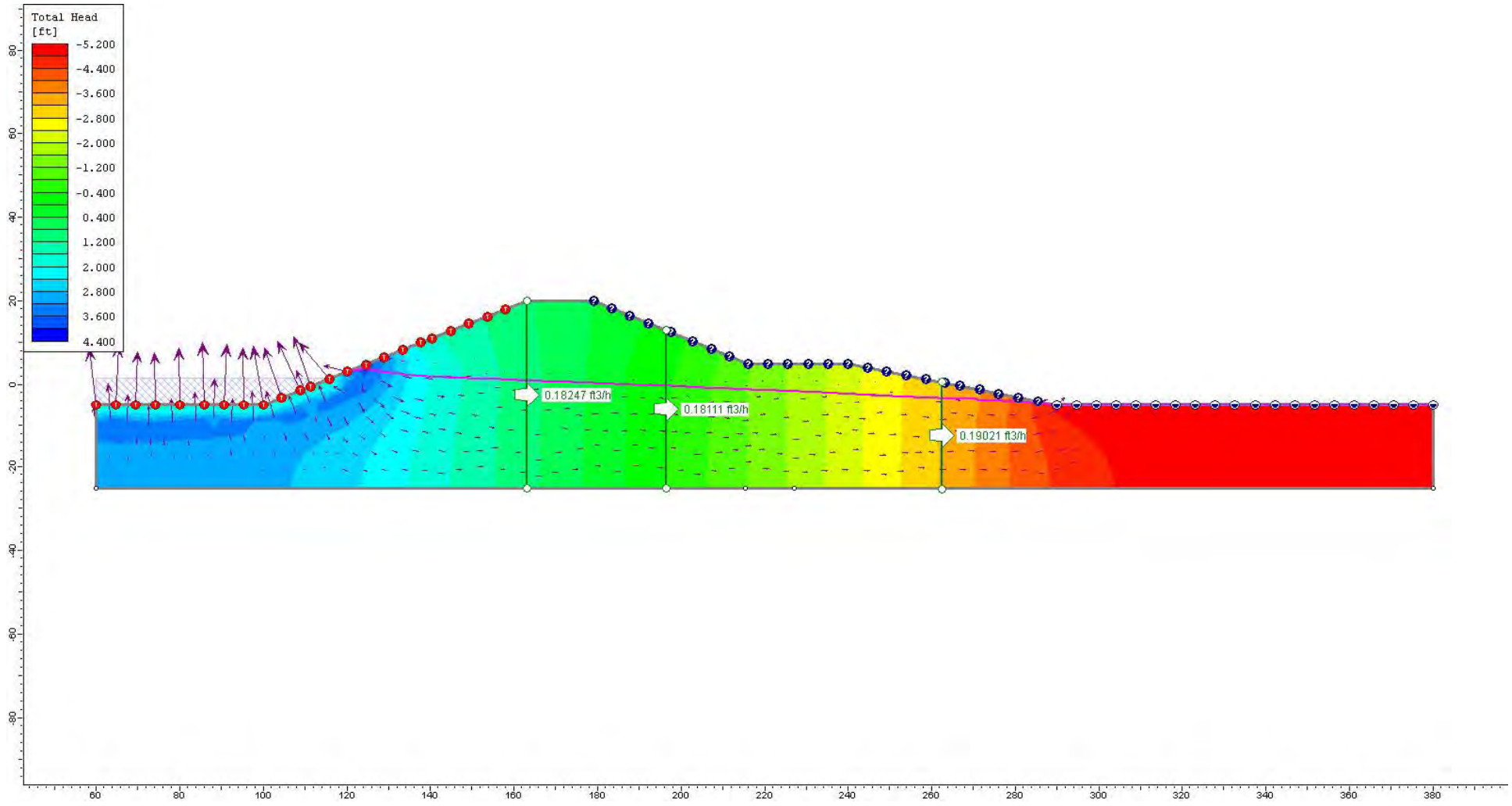
Stage 9 – Fourth Valley – 47th Hour

PLATE F-11



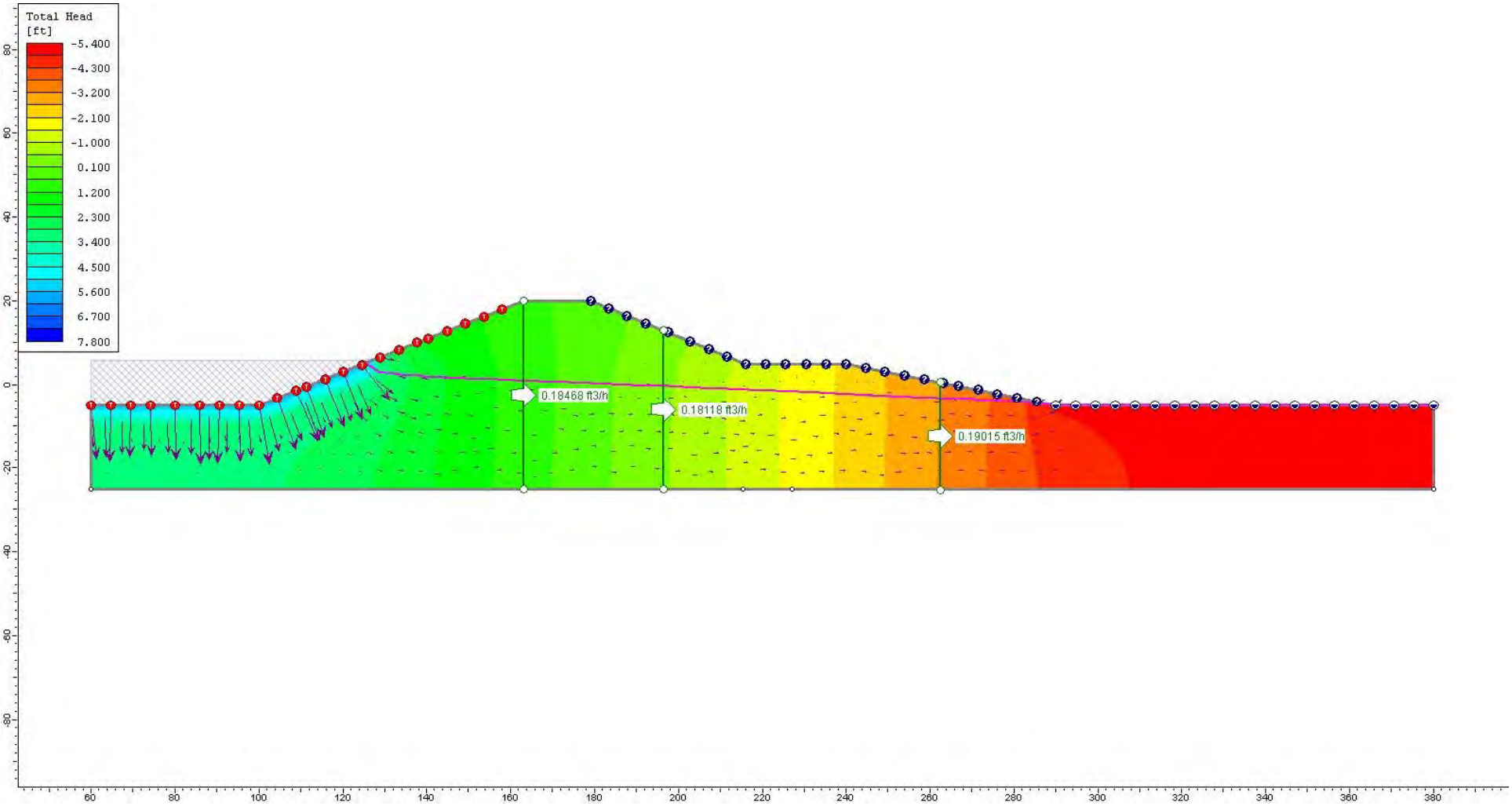
Stage 12 – Sixth Peak – 66th Hour

PLATE F-12



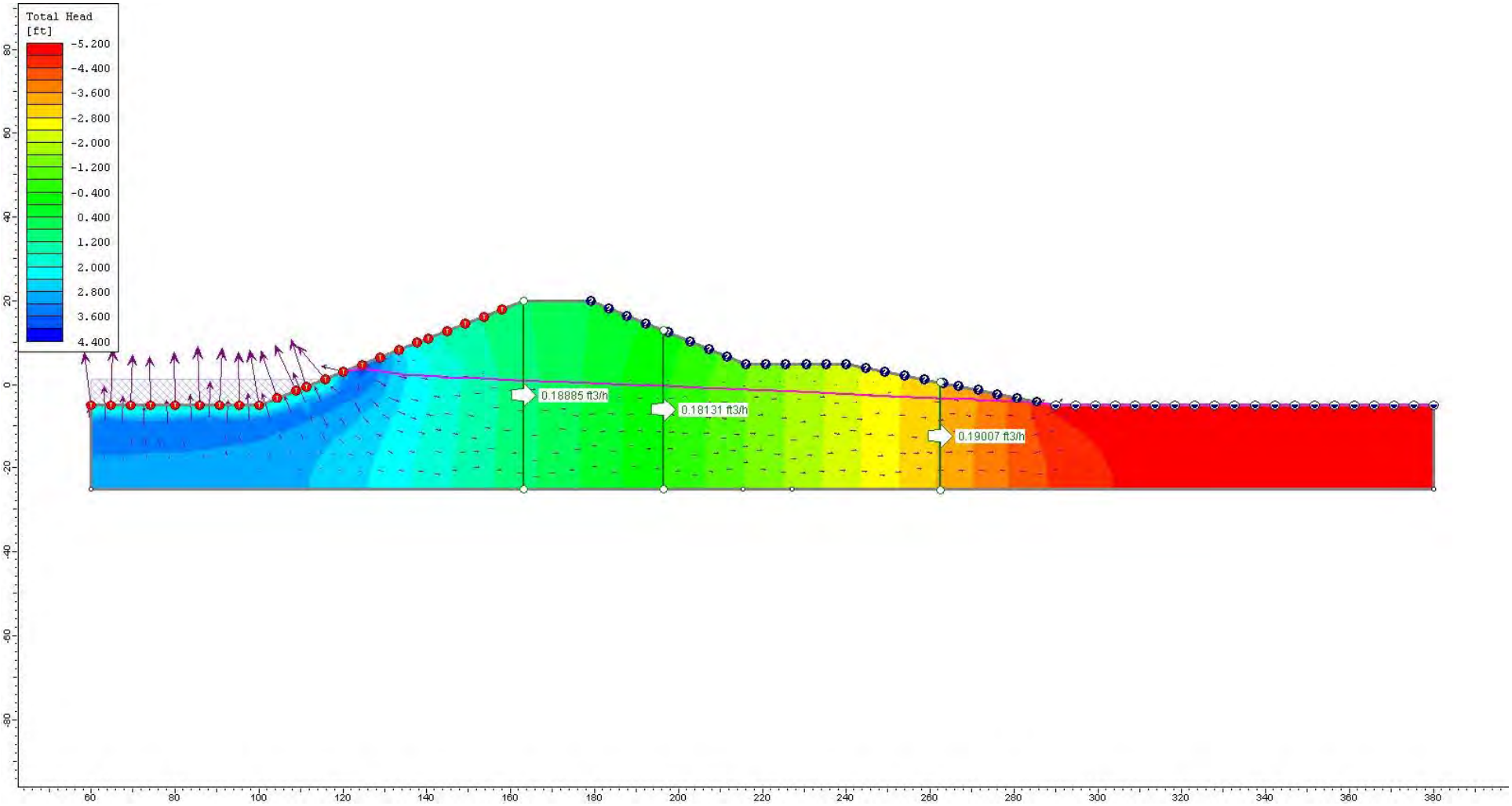
Stage 17 – Sixth Peak – 97th Hour

PLATE F-13



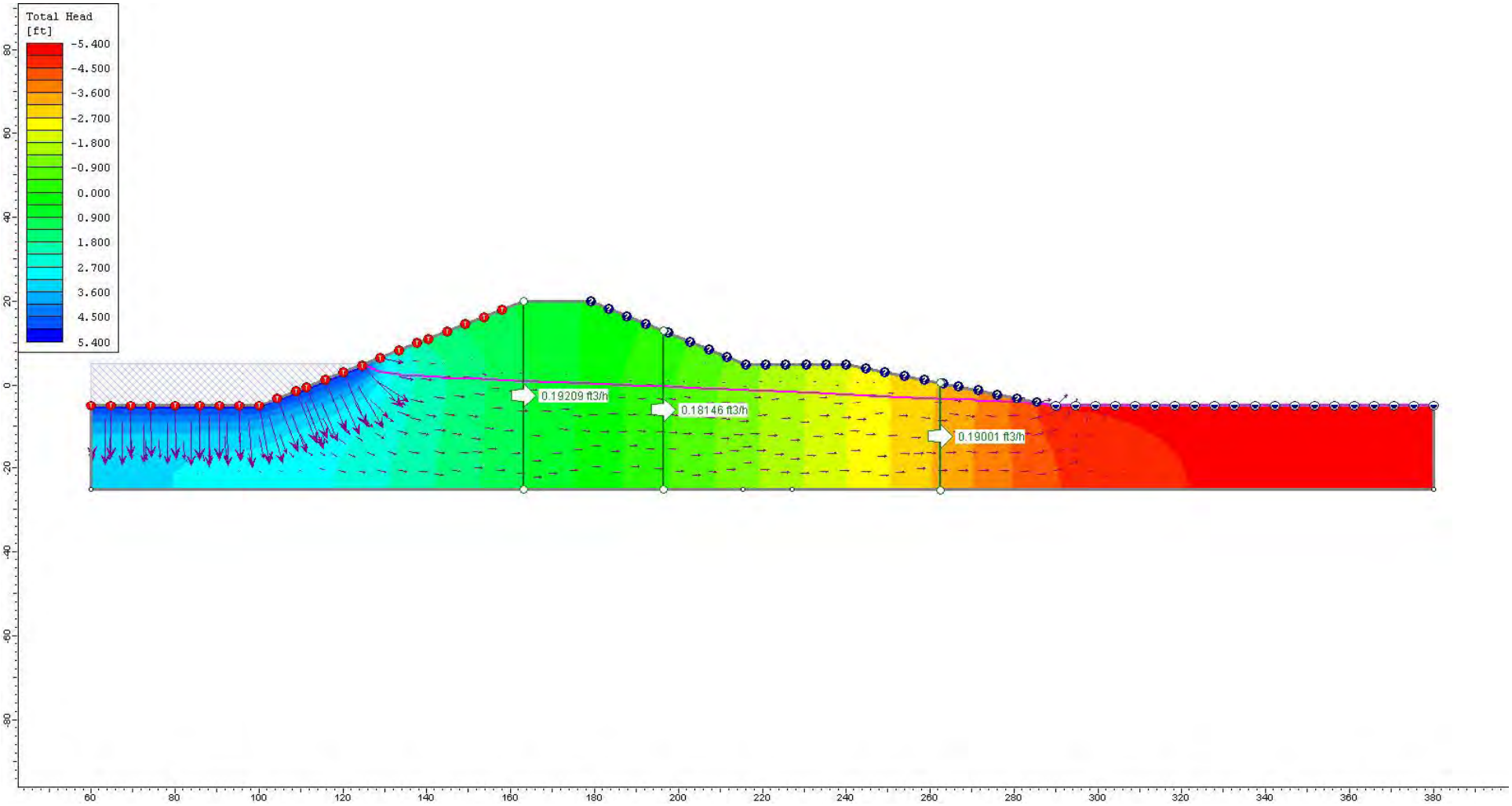
Stage 20 – Tenth Peak – 116th Hour

PLATE F-14



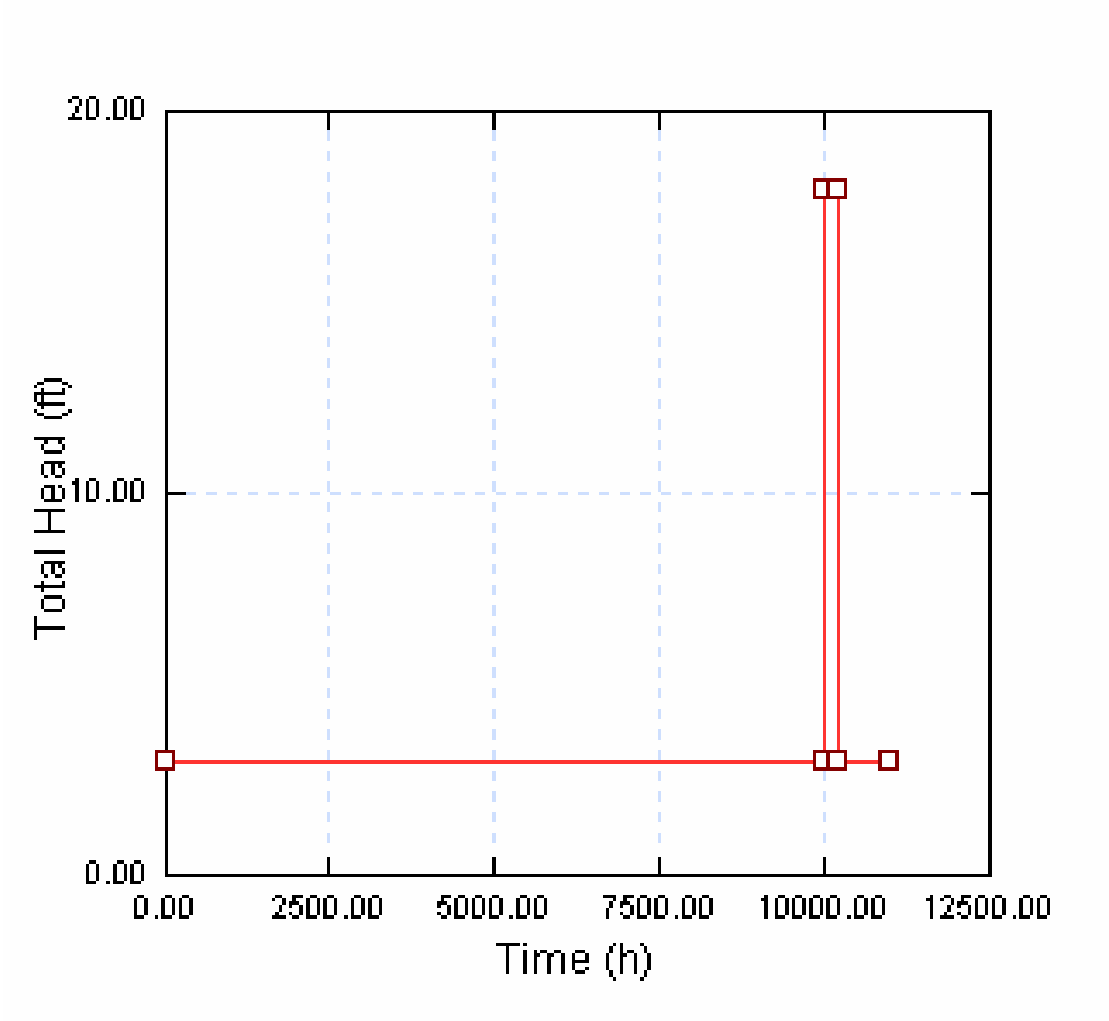
Stage 25 – Twelfth Valley – 147th Hour

PLATE F-15



Stage 29 – Fourtheenth Valley – 170th Hour

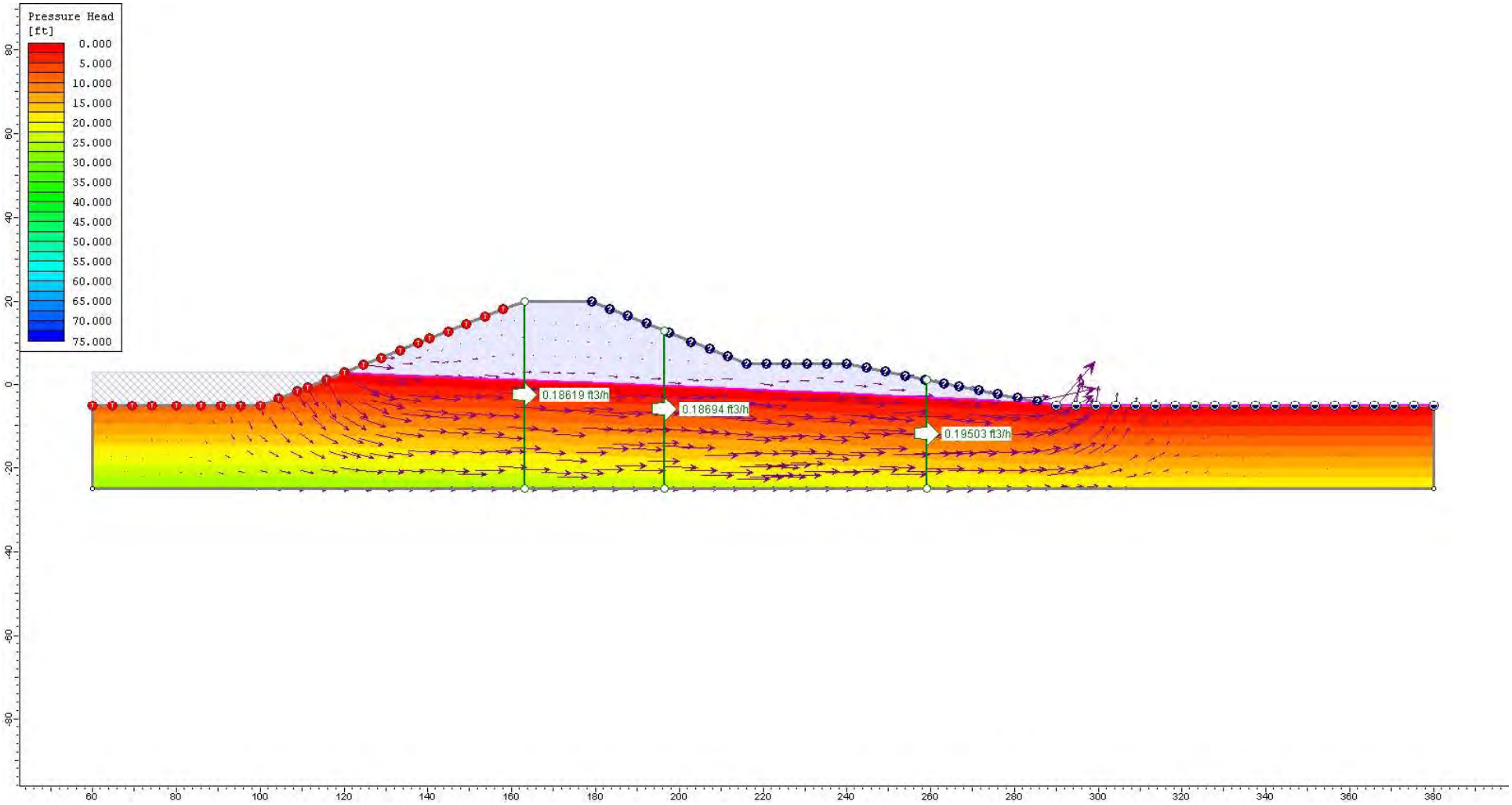
PLATE F-16



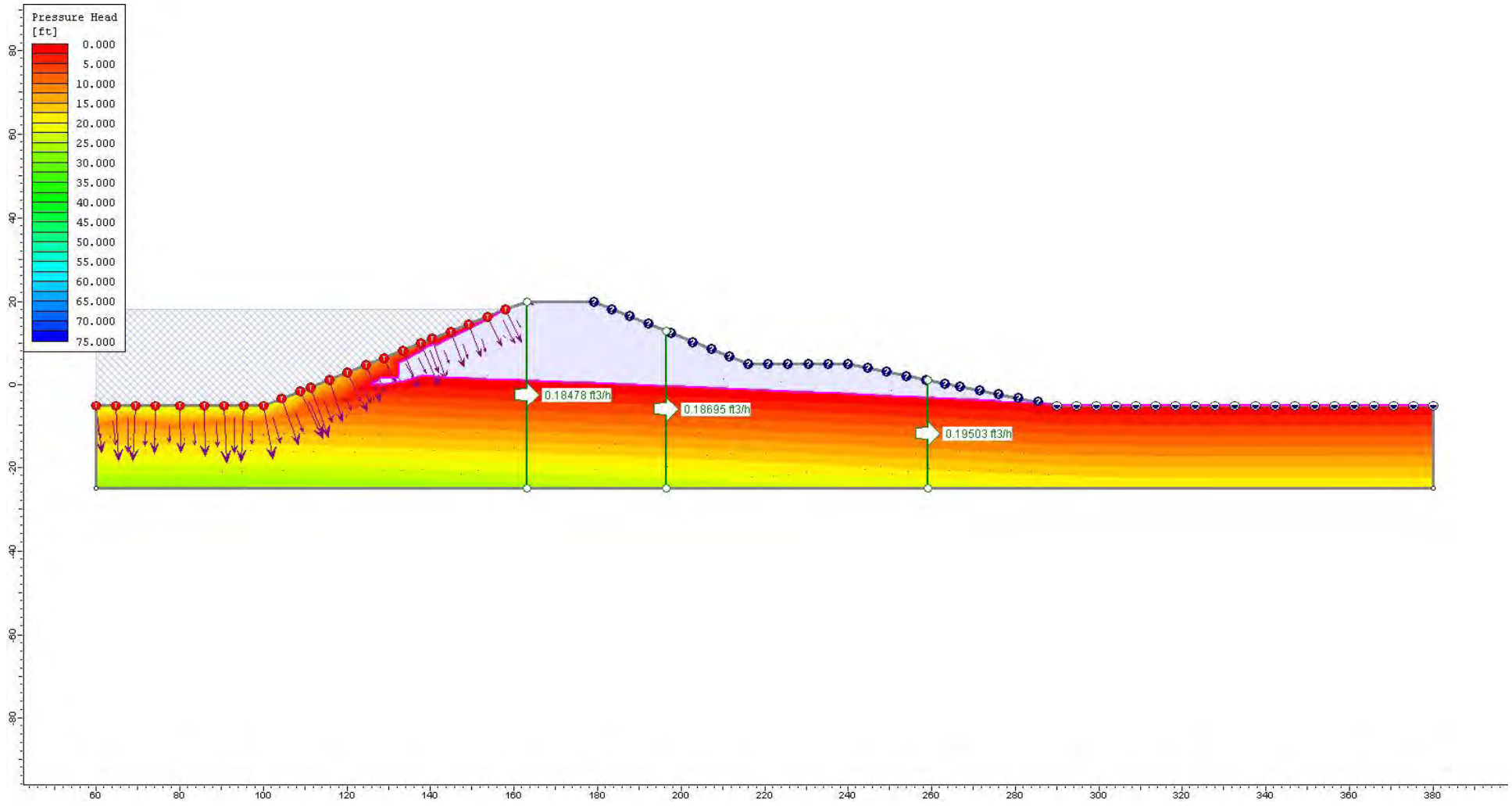
Transient Water Level for a 10 day Flood Condition:

1) Steady State is reached with Water Level at El. +3 feet
2) 10-Day Flood with Water Level at El. +18 feet
3) Water Level droped to El. +3 feet

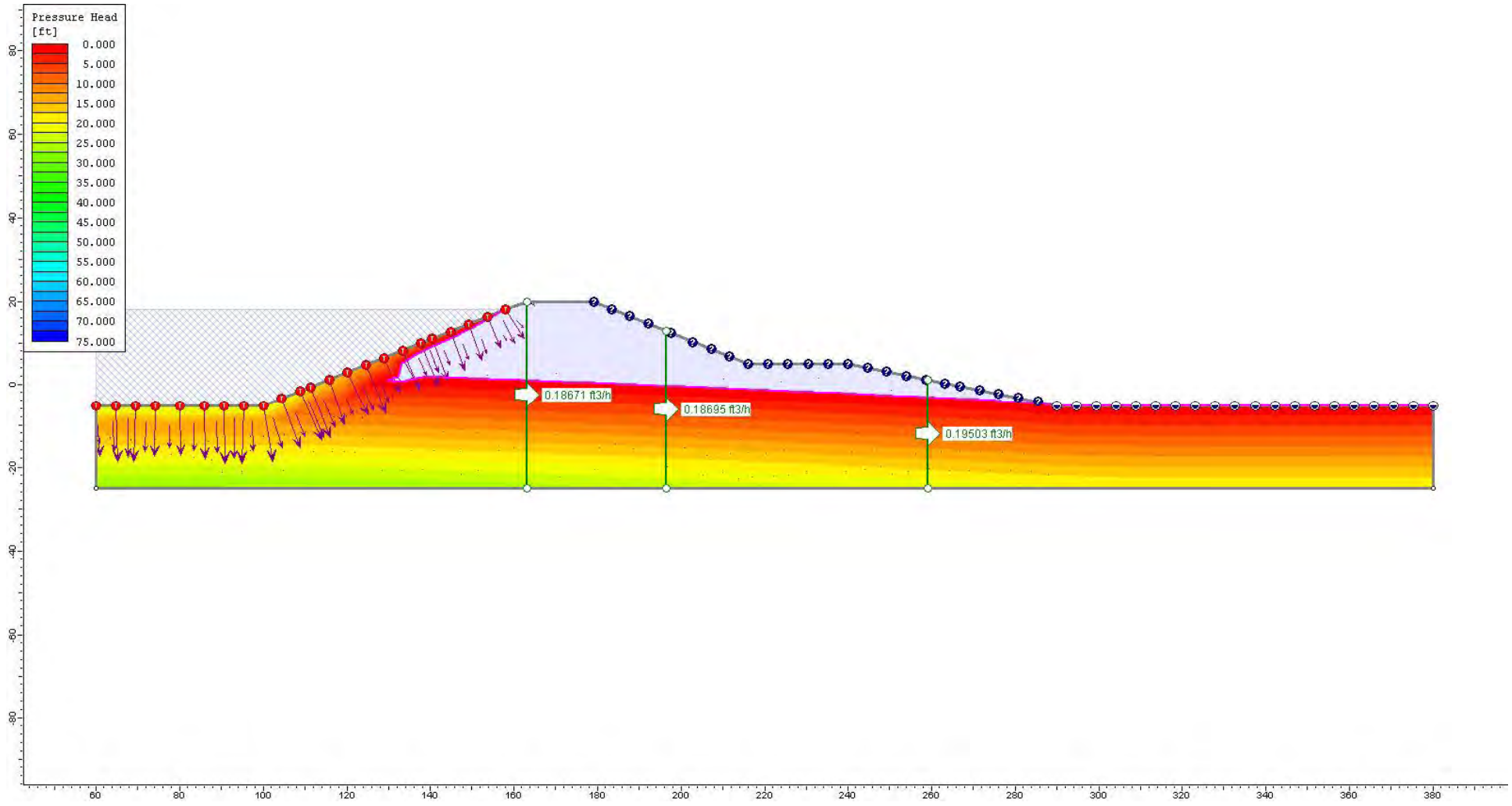
PLATE F-17



Stage 1 – Steady State Water Levels Prior to Flood

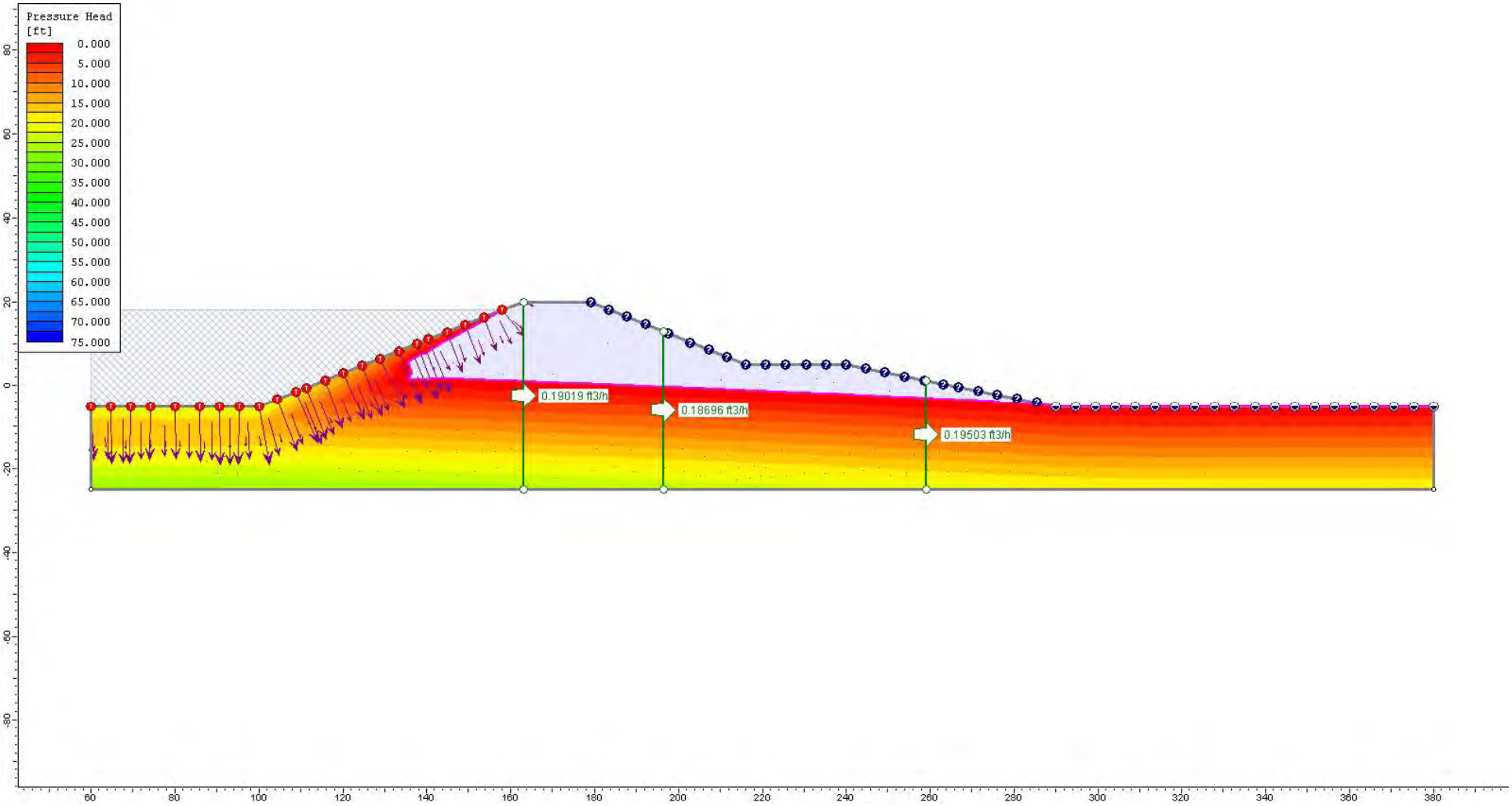


Stage 2 – One hour after the start of the Flood



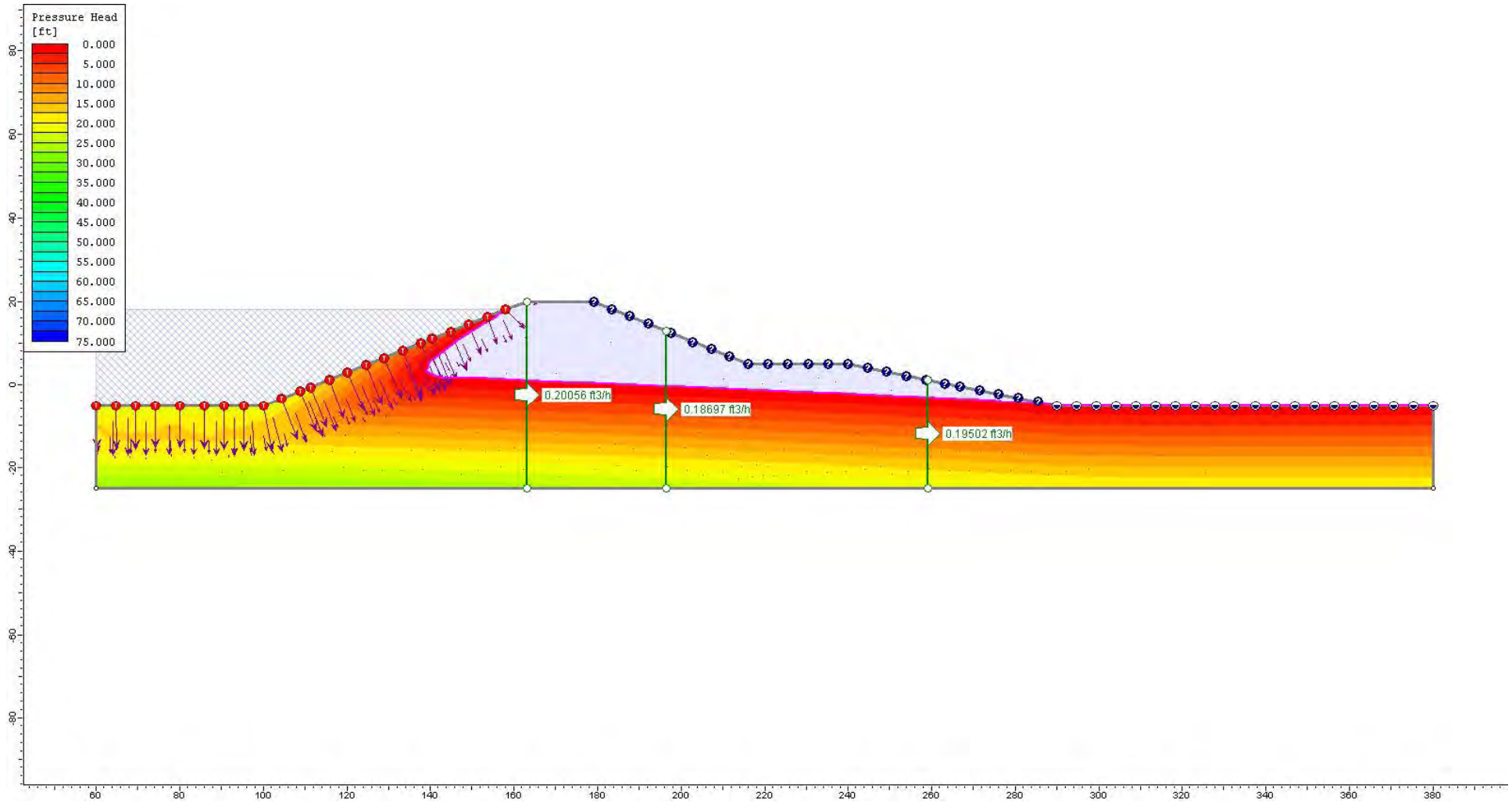
Stage 3 – Two hours after the start of the Flood

PLATE F-20



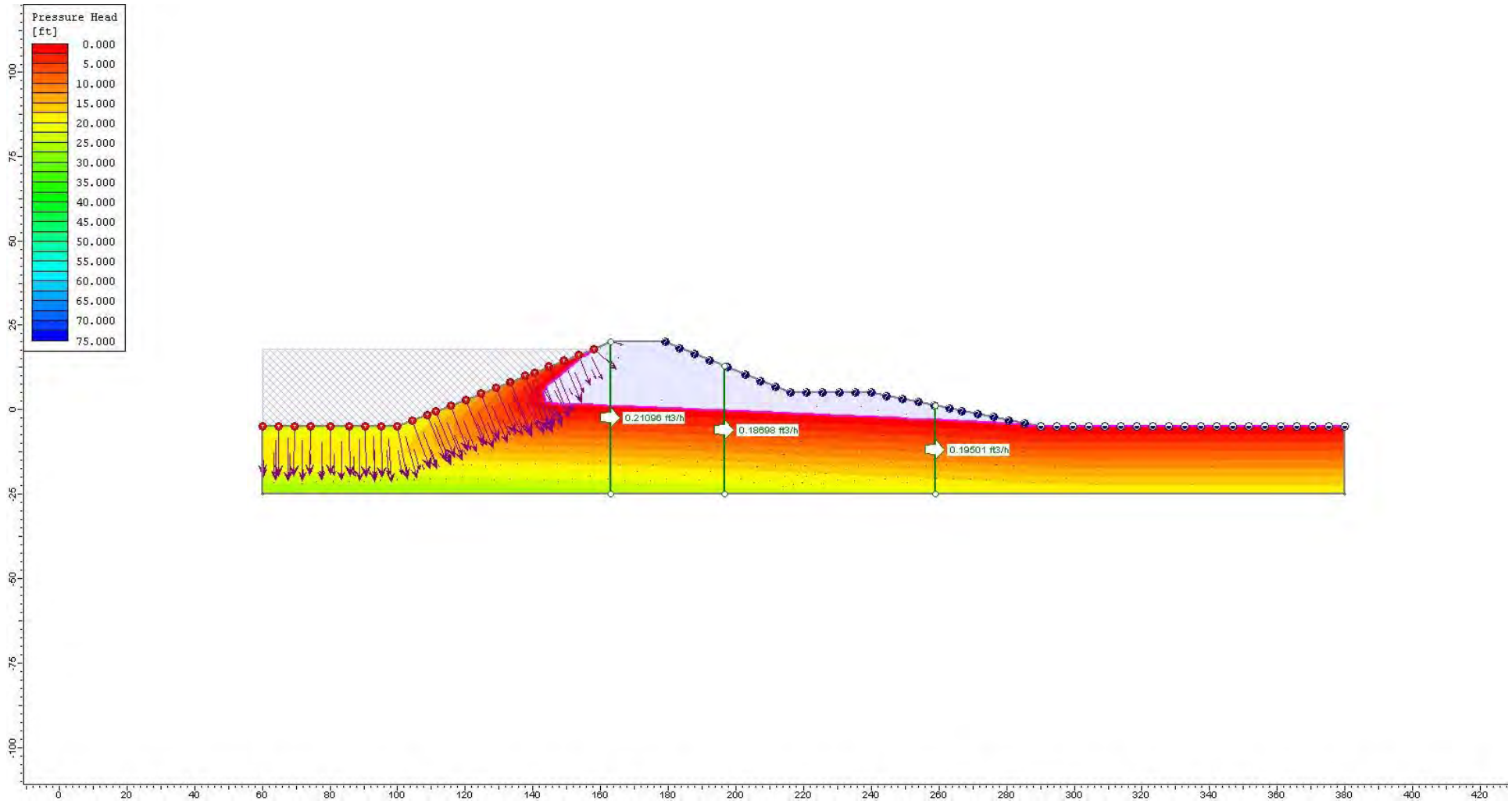
Stage 4 – Four hours after the start of the Flood

PLATE F-21



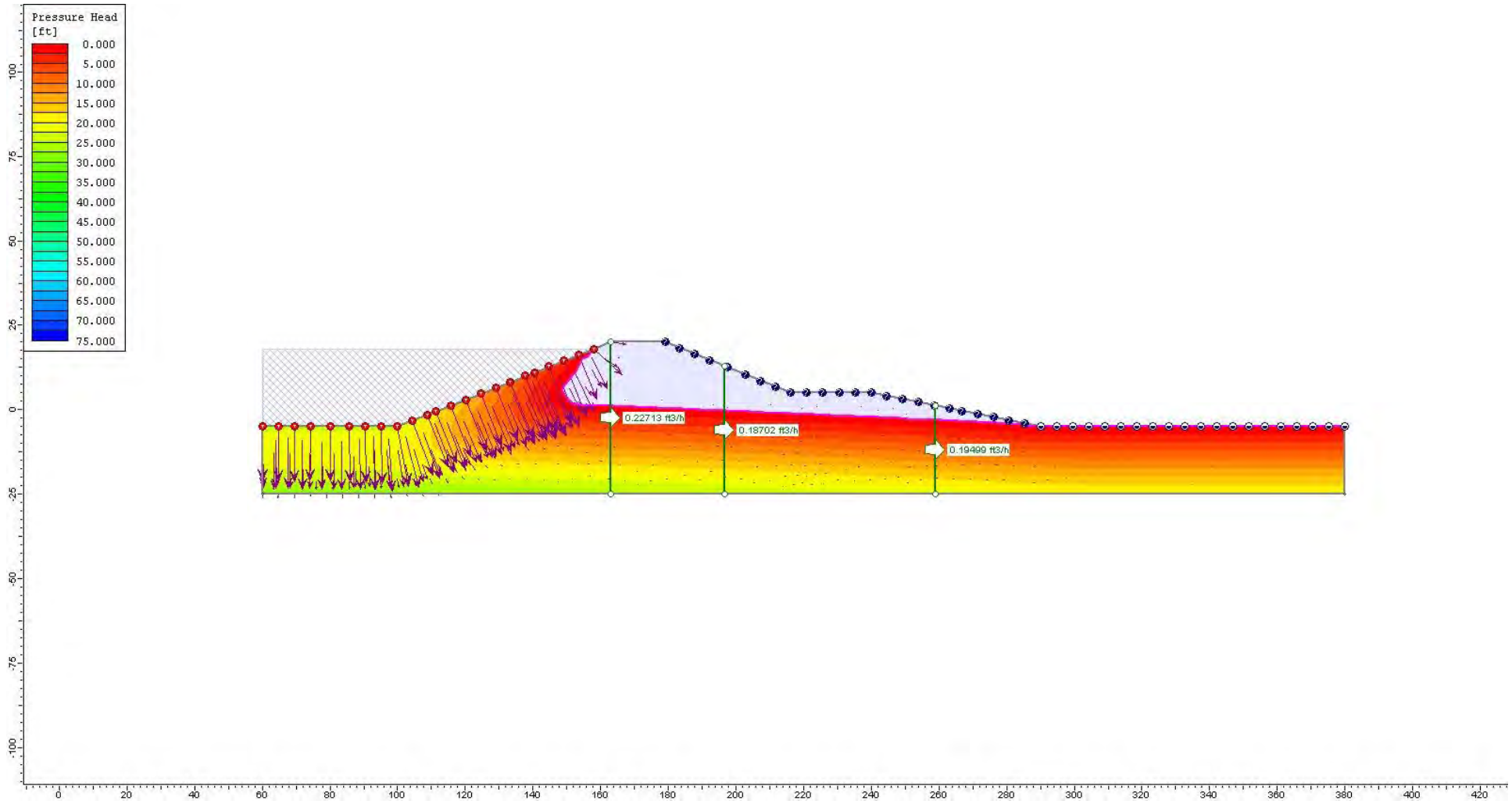
Stage 5 – Eight hours after the start of the Flood

PLATE F-22



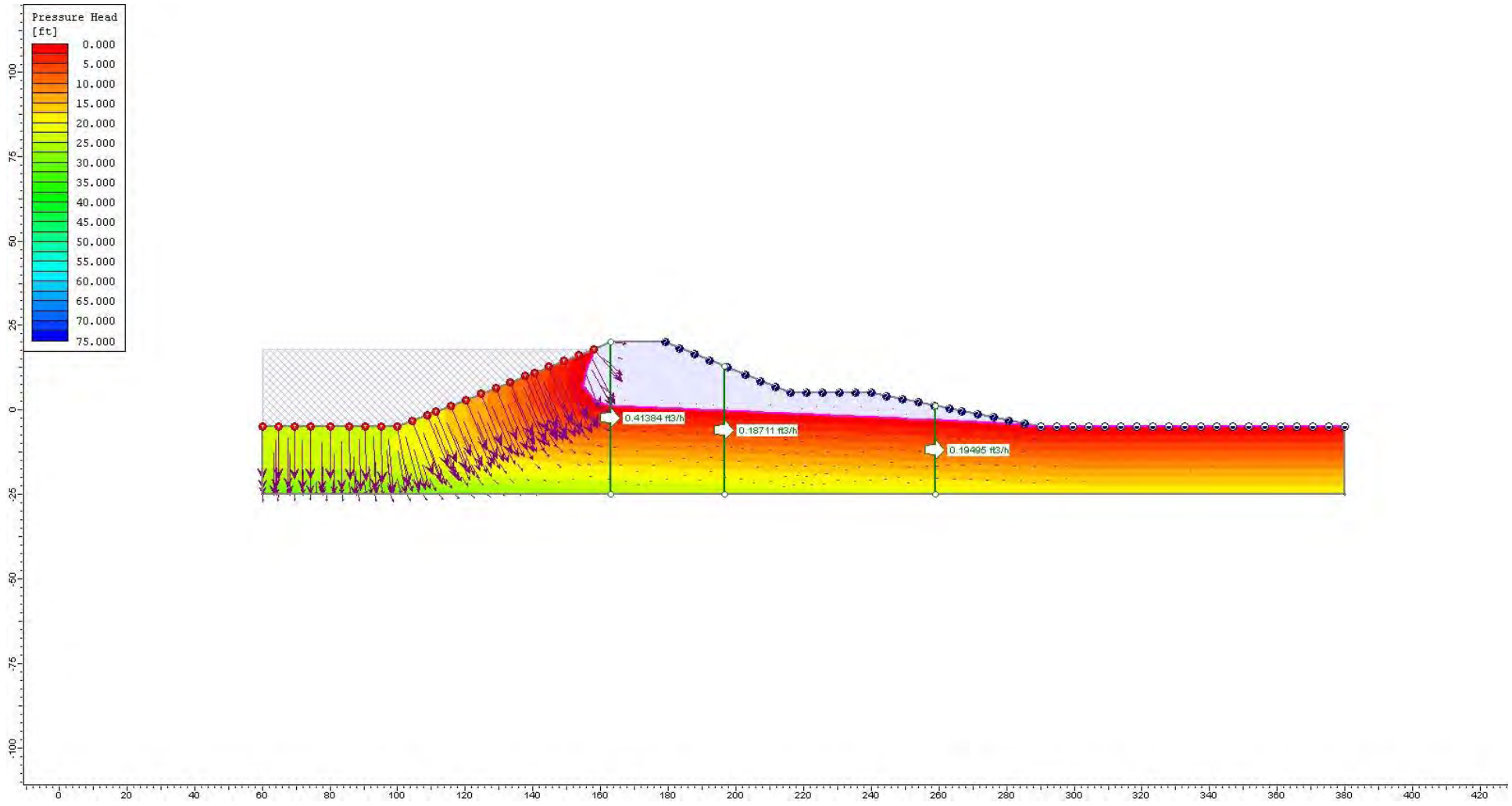
Stage 6 – 12 hours after the start of the Flood

PLATE F-23



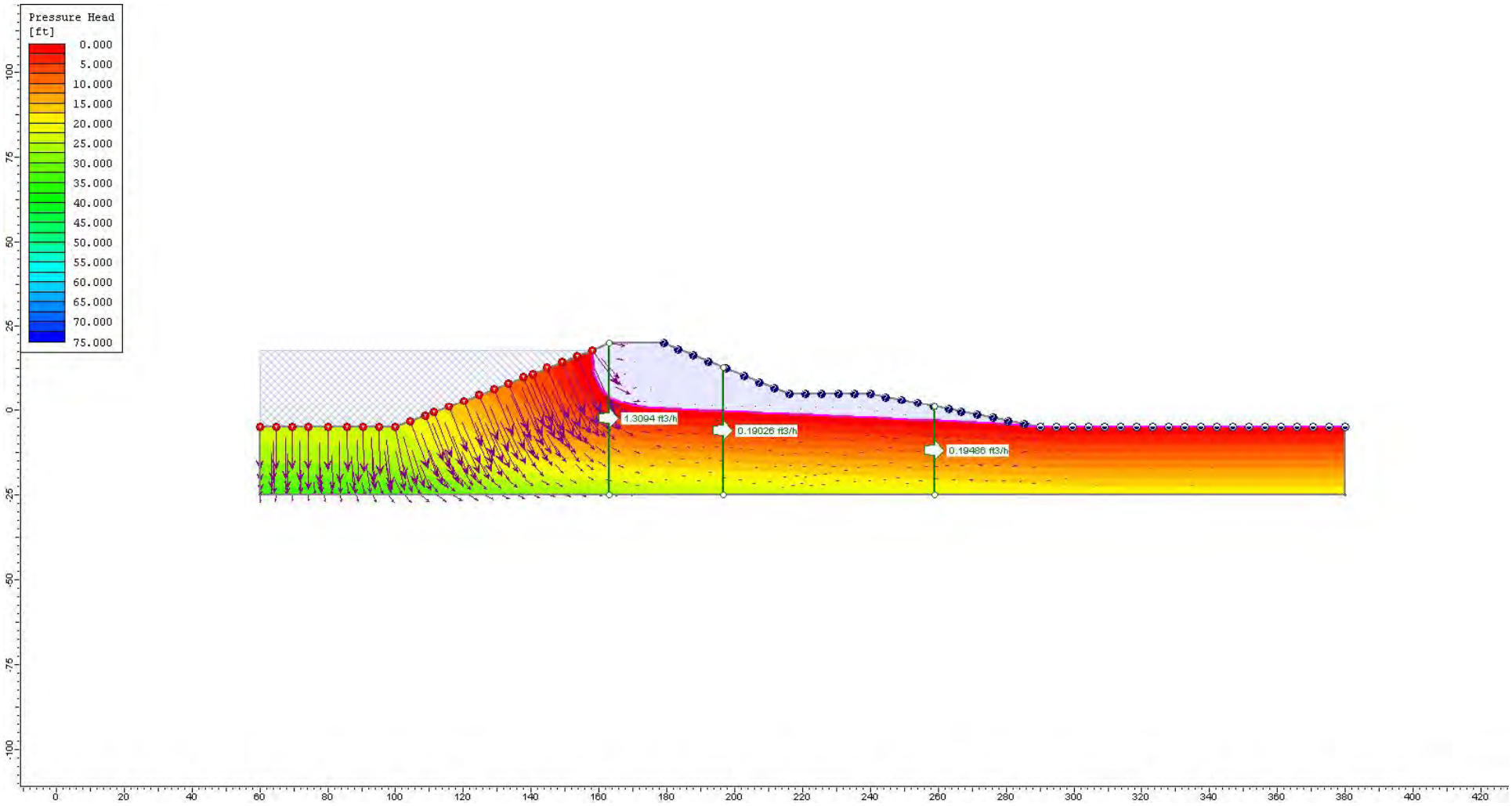
Stage 7 – 24 hours after the start of the Flood

PLATE F-24



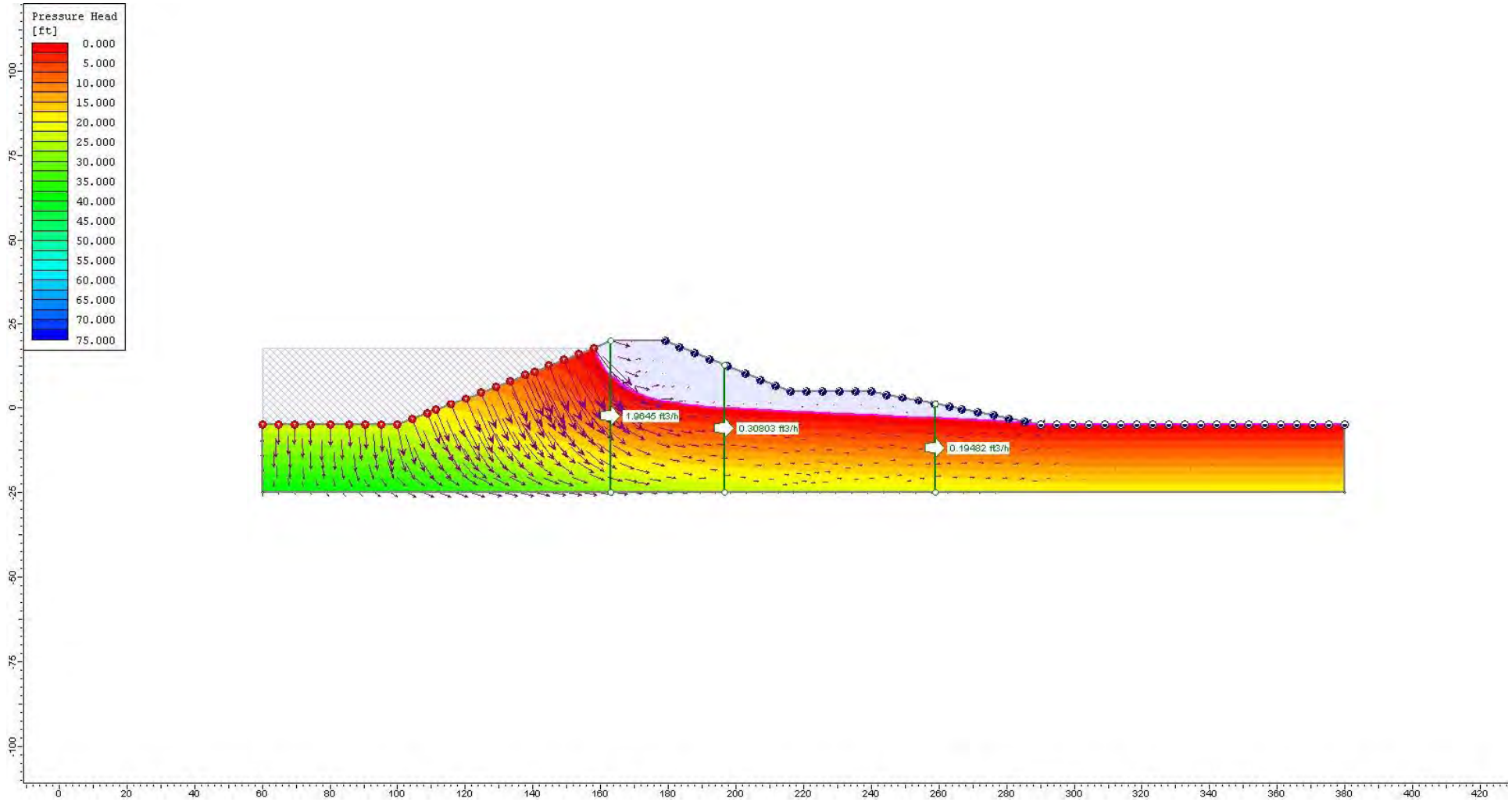
Stage 8 – 48 hours after the start of the Flood

PLATE F-25



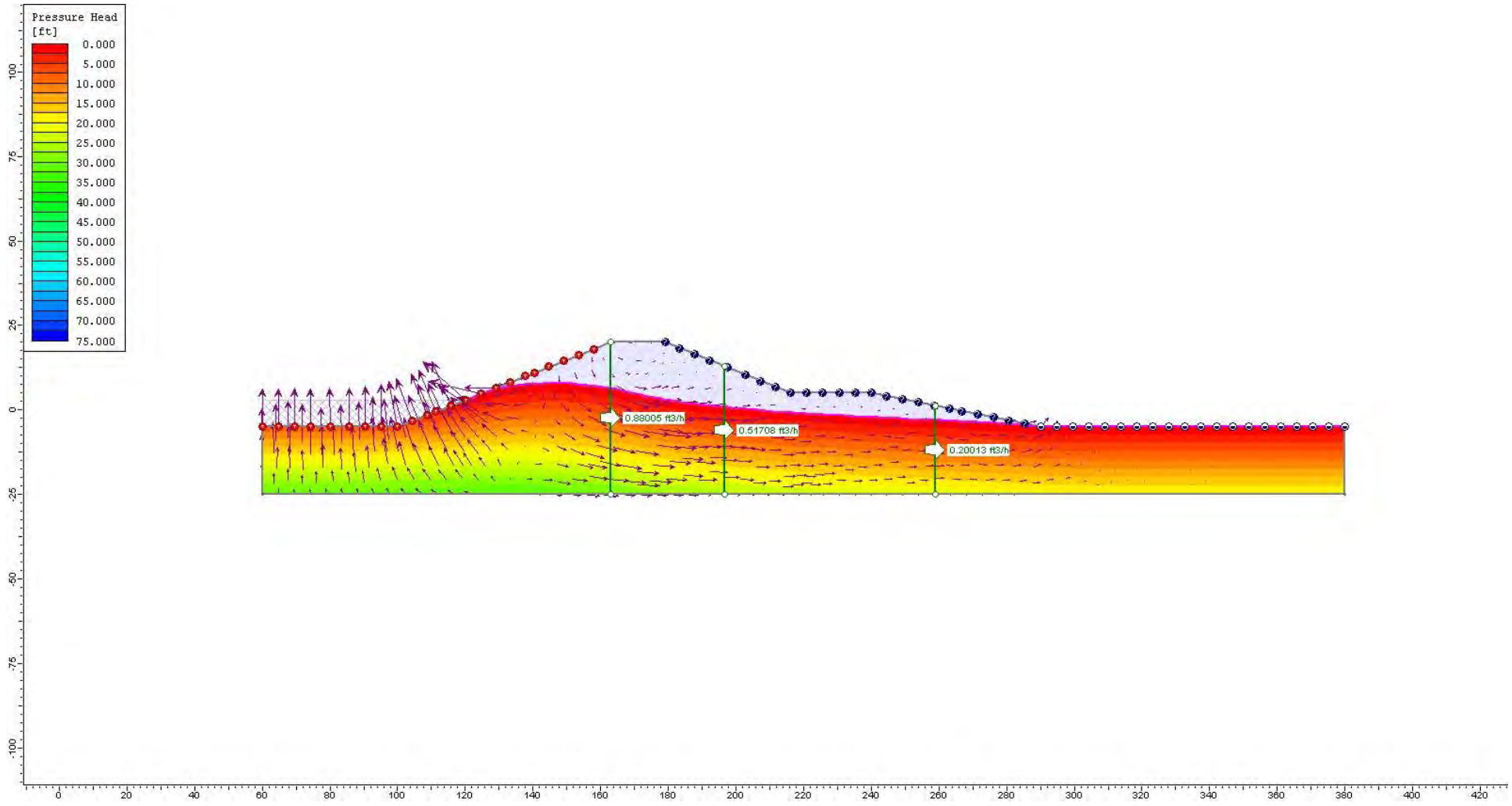
Stage 9 – 4 days after the start of the Flood

PLATE F-26



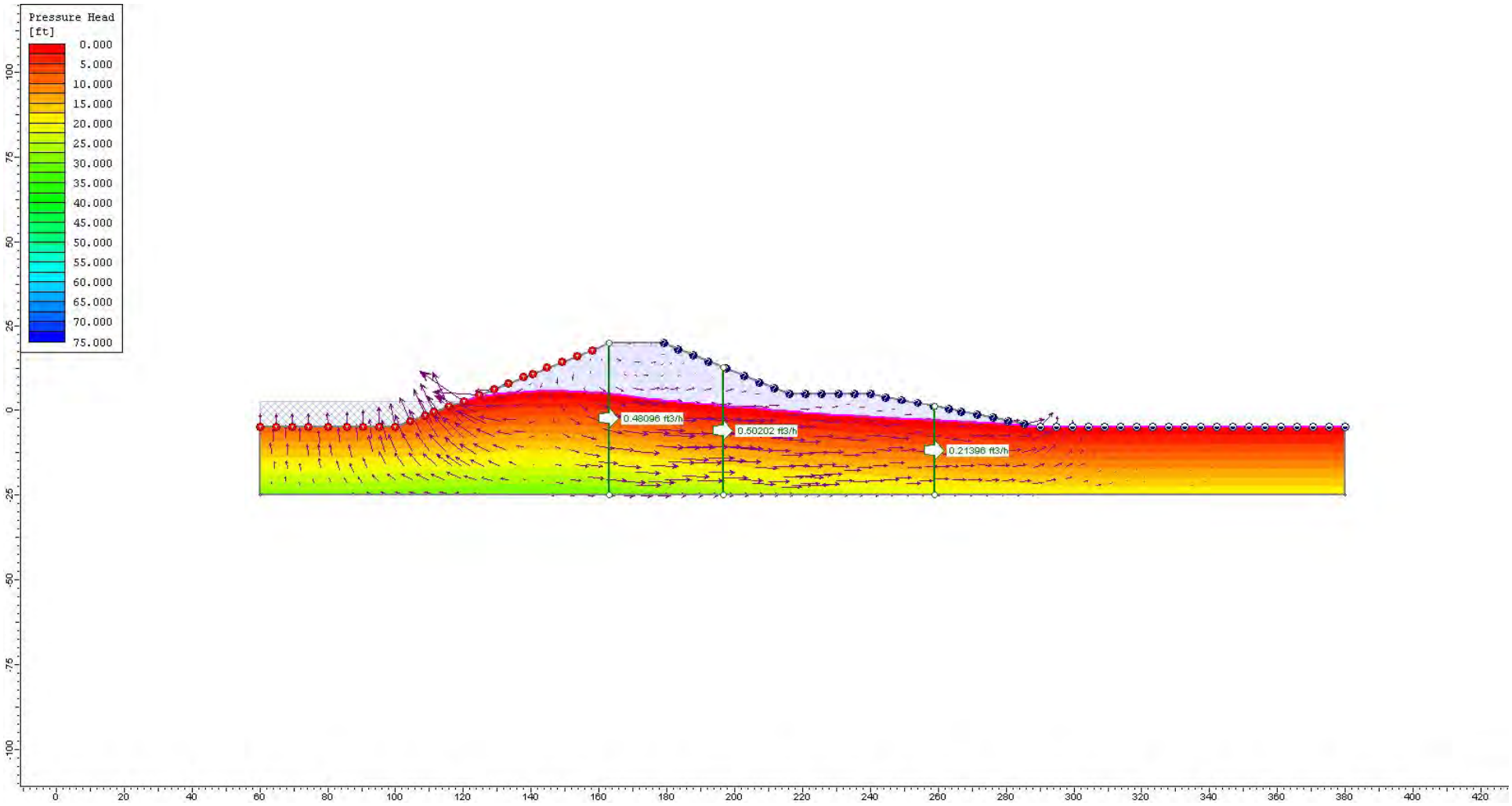
Stage 10 – 10 days after the start of the Flood (End of Flood)

PLATE F-27



Stage 11 – 10 days after the 10-day Flood

PLATE F-28



Stage 12 – 20 days after the 10-day Flood

PLATE F-29

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APPENDIX G
SLOPE STABILITY

APPENDIX G
SLOPE STABILITY

G.1 Summary of Contents

This appendix includes the following:

- Generalized soil profiles adopted for slope stability analyses of the levees.
- Soil strength parameters criteria, and adopted values for slope stability analyses.
- Strength gain calculations under the West Area B levees using SHANSEP method
- Summary of static analyses for end of construction (short term low water), short term high water, long term high water (steady state) for selected sections, seismic post liquefaction analysis, and analyses for determination of yield acceleration and seismic displacements using Bray and Rathje (1998) method, and potential mitigation measures for reducing seismic displacements for two sections of the existing levees.
- Comparison of FLAC SLOPE results with RocScience Slide v.5 Results
- Analysis results showing the effect of water level fluctuation of seismic deformations of existing levees

G.2 Generalized Soil Profile Tables

Generalized soils profiles shown in Tables G-1 thru G-12 were adopted based on the estimates of soil strength parameters using our boring and CPT and laboratory testing results for the conservative boring/CPT layering within each area.

G.3 Soil Strength Parameters

Soil strength parameter selection criteria are shown graphically in Plates G-7 through G-15. The undrained shear strengths within Areas A and B were selected based on vane shear test results corrected for plasticity index (using Bjerrum, 1972 chart), as well as CPT tip resistances in each area.

Plates G-10 and G-11 show the results of direct shear tests performed on Fill soils in Areas A and B, and also include the conservatively adopted shear strength parameters for Fills soils in all areas. The soil strength for the embankments (levees) was selected to have just slightly higher cohesion than the soil strength parameters for Fill soils, since the soils used for embankments will be primary comprised of Fill soils, but will be well compacted to 90% relative compaction; hence the higher cohesion.

Plates G-12 through G-15 show the profiles of CPTs within different areas, with potentially liquefiable layers/depths highlighted in green, on the CPTs. The adopted extents (depths) of potentially liquefiable layers are also shown within different areas. The post liquefaction residual shear strength values were determined based on

average $(N1)_{60cs}$ of representative liquefiable layers using Seed and Harder (1990) graph, as shown on the Plates.

G.4 Soil Strength Gain (SHANSEP)

The shallow clayey soils underlying portions of West Area B are naturally very soft with undrained shear strengths on the order of 300 psf, under current conditions. However, after placement of the fill these soils will consolidate and gain strength. The strength gain for clayey soils can be determined using the SHANSEP method, as presented in plates G-16 through G-22.

The SHANSEP strength gain analysis for these clayey soils assumed that the soils at a depth of 15 feet and beyond are normally consolidated, and the overconsolidation ratio (OCR) decreases linearly from 2 to 1 from a depth of 5 to 15 feet. The upper 5 feet of the profile were assumed to be Fill soils of different nature and strength parameters.

Assuming normally consolidated clayey soils with a strength of about 300 psf exist at a depth of 15 feet, the shear strength ratio, $(Su/\sigma v')_{NC}$ for normally consolidated was found to be 0.27. After calculating the increase in vertical effective stresses at different locations along the levee cross section as a result of construction of the levee, the final vertical effective stresses were calculated (Plate G-16). The increased shear strength for normally consolidated soils were then determined by multiplying the shear strength ratio, $(Su/\sigma v')_{NC}$ by the final vertical effective stresses, at each location along the levee section (Plate G-17).

A simplified strength layering was then used in levee slope stability analyses for West Area B levees, based on the results of the SHANSEP method.

G.5 Slope Stability Analyses

Static and seismic levee slope stability analyses were performed for different loading conditions at 12 distinct cross sections of both new and portions of the existing levees that remain as part of the project. Additionally, the static stability of portions of the existing north levee that will be breached after/during construction of the new meander channels was analyzed. The analyses were performed in FLAC/Slope V.7. The output plot and the input geometry and layering of each of the analyses are included in this appendix, as shown in Plates G-23 through G-144.

For the portions of the existing levees that will tie in to the new levees and remain as part of the project, the seismic displacements were found to be higher than generally acceptable. Analyses showing possible mitigation measures using ground improvement by Deep Soil Mixing (DSM) are also shown for two of the sections (Sections D-D' and E-E'). Rapid drawdown is not a likely condition, and a viable mode of failure for the Ballona Wetlands levees, and was not included in the levee stability analyses.

G.6 Examples of Comparison of FLAC SLOPE FOS with RocScience Slide

The FOS results from FLAC SLOPE were compared with the results of the RocScience Slide v.5 Slope Stability Program, for a number of Sections and Load Cases. As can be seen from the results shown on Plates G-145 thru G-147, the estimated FOS values from Slide v.5 are agreement with the estimated FOS values from FLAC Slope with variations on the order of 3%, or less. This validates the results of our slope stability analyses.

G.7 Analysis Results Showing the Effect of Water Level Fluctuation of Seismic Deformations of Existing Levees

The effect of changes in water level in the channel on the seismic displacements predicted for the existing levees was investigated for the existing levee located immediately downstream of Lincoln Boulevard (Section E-E') for the following four water levels:

- Case 1 – The water in the channel and in the area outside the channel coincide with the ground surface elevation of +7 feet. This is the design groundwater condition adopted for the previously presented seismic stability analyses of existing levees (Results presented in Plates G-69 and G-70).
- Case 2 – The water in the channel and in the area outside the channel is at Elevation +3 feet. This condition approximately corresponds to the average tidal condition (Plates G-148 and G-149).
- Case 3 – A water level in the channel at Elevation +0 feet (corresponding to low tide) and a groundwater level outside the channel at Elevation +7 feet (Plates G-150 and G-151).
- Case 4 – A water level in the channel of +0 feet and a groundwater level outside the channel at Elevation +3 feet (Plates G-152 and G-153).

The yield accelerations change slightly depending on the variation in water levels; however, estimated seismic displacement for each case is unacceptable. Therefore, mitigations are recommended as described in the text.

A list of the plates presented in this appendix follows:

Plate G-1 and G-6	Soil Profile Tables for Slope Stability
Plate G-7 and G-9	Undrained Shear Strength of Fine Grained Soils
Plate G-10 and G-11	Soil Strength Parameters for Fill Soils
Plate G-12 thru G-15	Liquefied Layers and Residual Strength Values for Difference Areas
Plate G-16 thru G-22	Strength Gain under West Area B Levees using SHANSEP Method
Plates G-23 thru G-33	Static and Seismic/Deformation Analyses – Section A-A'
Plates G-34 thru G-43	Static and Seismic/Deformation Analyses – Section B-B'
Plates G-44 thru G-51	Static and Seismic/Deformation Analyses – Section C-C'
Plates G-52 thru G-62	Static and Seismic/Deformation Analyses and Potential Mitigation Measures – Section D-D'
Plates G-63 thru G-73	Static and Seismic/Deformation Analyses and Potential Mitigation Measures – Section E-E'
Plates G-74 thru G-82	Static and Seismic/Deformation Analyses – Section F-F'
Plates G-83 thru G-93	Static and Seismic/Deformation Analyses - Section G-G'
Plates G-94 thru G-102	Static and Seismic/Deformation Analyses - Section H-H'
Plates G-103 thru G-113	Static and Seismic/Deformation Analyses – Section I-I'
Plates G-114 thru G-122	Static and Seismic/Deformation Analyses – Section J-J'
Plates G-123 thru G-131	Static and Seismic/Deformation Analyses – Section K-K'
Plates G-132 thru G-140	Static and Seismic/Deformation Analyses – Section L-L'
Plates G-141 thru G-144	Static Analyses of Existing North Levee during Meander Channel Excavation
Plates G-145 thru G-147	Comparison of FLAC Slope FOS values with RocScience Slide for a few sections and load cases
Plates G-148 thru G-153	Effect of Water Level Fluctuations on Seismic Deformation of Existing Levees (Section E-E')

Table G-1: East Area A Static Profile

Layer	Total Unit Weight (pcf)	Elevation (feet)		Friction Angle (Degrees)	Cohesion (psf)
		From	To		
Embankment	115	20	10	28	300
Fill	115	10	0	28	250
Soft Clay	115	0	-20	0	500 [1]
Stiff Clay	115	-20	-35	0	1200
Dense Sand	120	-35	-55	35	0

Notes: 1) For drained condition, $\phi = 27$, c = 200 psf

Table G-2: East Area A Seismic Profile

Layer	Total Unit Weight (pcf)	Elevation (feet)		Friction Angle (Degrees)	Cohesion (psf)	Post-Liquefaction Strength (psf)
		From	To			
Embankment	115	20	10	28	300	N/A
Liquefied Fill	115	10	0	N/A	N/A	300
Soft Clay	115	0	-15	0	500 [1]	N/A
Liq Sand	115	-15	-30	N/A	N/A	400
Stiff Clay	115	-30	-35	0	1200	N/A
Dense Sand	120	-35	-55	35	0	N/A

Notes: 1) For drained condition, $\phi = 27$, c = 200 psf

PLATE G-1

Table G-3: West Area A Static Profile

Layer	Total Unit Weight (pcf)	Elevation (feet)		Friction Angle (Degrees)	Cohesion (psf)
		From	To		
Embankment	115	20	10	28	300
Fill	115	10	0	28	250
Soft Clay	115	0	-25	0	500 [1]
Stiff Clay	115	-25	-52	0	1000
Dense Sand	120	-52	-55	35	0

Notes: 1) For drained condition, $\phi = 27$, c = 200 psf

Table G-4: West Area A Seismic Profile

Layer	Total Unit Weight (pcf)	Elevation (feet)		Friction Angle (Degrees)	Cohesion (psf)	Post-Liquefaction Strength (psf)
		From	To			
Embankment	115	20	10	28	300	N/A
Liquefied Fill	115	10	0	N/A	N/A	300
Soft Clay	115	0	-20	0	500 [1]	N/A
Liq Sand	115	-20	-25	N/A	N/A	400
Stiff Clay	115	-25	-33	0	1000	N/A
Liq Sand 2	115	-33	-45	N/A	N/A	500
Stiff Clay	115	-45	-52	0	1000	N/A
Dense Sand	120	-35	-55	35	0	N/A

Notes: 1) For drained condition, $\phi = 27$, c = 200 psf

Table G-5: East Ballona Creek Static Profile

Layer	Total Unit Weight (pcf)	Elevation (feet)		Friction Angle (Degrees)	Cohesion (psf)
		From	To		
Embankment	115	20	7	28	300
Soft Clay	115	7	-10	0	500 [1]
Stiff Clay	115	-10	-25	0	1000 [1]
Med. Sand	115	-25	-35	33	0
Stiff Clay	115	-35	-45	0	1000 [1]
Dense Sand	120	-45	-55	35	0

Notes: 1) For drained condition, $\phi = 34$, c = 0 psf

Table G-6: East Ballona Creek Seismic Profile

Layer	Total Unit Weight (pcf)	Elevation (feet)		Friction Angle (Degrees)	Cohesion (psf)	Post-Liquefaction Strength (psf)
		From	To			
Embankment	115	20	7	28	300	N/A
Liquefied Sand	115	7	-3	N/A	N/A	300
Soft Clay	115	-3	-10	0	500 [1]	N/A
Stiff Clay	115	-10	-20	0	1000 [1]	N/A
Liq Sand 2	115	-20	-35	N/A	N/A	550
Stiff Clay	115	-35	-45	0	1000 [1]	N/A
Dense Sand	120	-45	-55	35	0	N/A

Notes: 1) For drained condition, $\phi = 34$, c = 0 psf

Table G-7: East Area B Static Profile

Layer	Total Unit Weight (pcf)	Elevation (feet)		Friction Angle (Degrees)	Cohesion (psf)
		From	To		
Embankment	115	20	9	28	300
Fill	115	9	2	28	250
Soft Clay	115	2	-10	0	500 [1]
Med. Sand	115	-10	-15	33	0
Med. Stiff Clay	115	-15	-48	0	600 [1]
Dense Sand	120	-48	-55	35	0

Notes: 1) For drained condition, $\phi = 34$, c = 0 psf

Table G-8: East Area B Seismic Profile

Layer	Total Unit Weight (pcf)	Elevation (feet)		Friction Angle (Degrees)	Cohesion (psf)	Post-Liquefaction Strength (psf)
		From	To			
Embankment	115	20	9	28	300	N/A
Liquefied Fill	115	9	2	N/A	N/A	300
Soft Clay	115	2	-10	0	500 [1]	N/A
Liq Sand	115	-10	-13	N/A	N/A	300
Med Stiff Clay	115	-13	-20	0	600 [1]	N/A
Liq Sand	115	-20	-42	N/A	N/A	300
Med Stiff Clay	115	-42	-48	0	600 [1]	N/A
Dense Sand	120	-48	-55	35	0	N/A

Notes: 1) For drained condition, $\phi = 34$, c = 0 psf

Table G-9: West Area B Static Profile

Layer	Total Unit Weight (pcf)	Elevation (feet)		Friction Angle (Degrees)	Cohesion (psf)
		From	To		
Embankment	115	20	7	28	300
Fill	115	7	2	28	250
Soft Clay	115	2	-12	0	300 [1,2]
Med. Sand	115	-12	-34	33	0
Stiff Clay	115	-34	-43	0	1000 [1]
Med. Sand	115	-43	-48	33	0
Dense Sand	120	-48	-55	35	0

Notes: 1) For drained condition, $\phi = 34$, c = 0 psf

2) Undrained shear strength underneath the levee is higher due levee surcharge

Table G-10: West Area B Seismic Profile

Layer	Total Unit Weight (pcf)	Elevation (feet)		Friction Angle (Degrees)	Cohesion (psf)	Post-Liquefaction Strength (psf)
		From	To			
Embankment	115	20	7	28	300	N/A
Liquefied Fill	115	7	2	N/A	N/A	300
Soft Clay	115	2	-12	0	300 [1,2]	N/A
Liq Sand	115	-12	-34	N/A	N/A	300
Stiff Clay	115	-34	-43	0	1000 [1]	N/A
Liq Sand 2	115	-43	-48	N/A	N/A	500
Dense Sand	120	-48	-55	35	0	N/A

Notes: 1) For drained condition, $\phi = 34$, c = 0 psf

2) Undrained shear strength underneath the levee is higher due levee surcharge

Table G-11: Area C Static Profile

Layer	Total Unit Weight (pcf)	Elevation (feet)		Friction Angle (Degrees)	Cohesion (psf)
		From	To		
Fill	115	20	5	28	250
Soft Clay	115	5	-3	0	500 [1]
Med. Sand	115	-3	-13	33	0
Stiff Clay	115	-13	-33	0	1200
Dense Sand	120	-33	-55	35	0

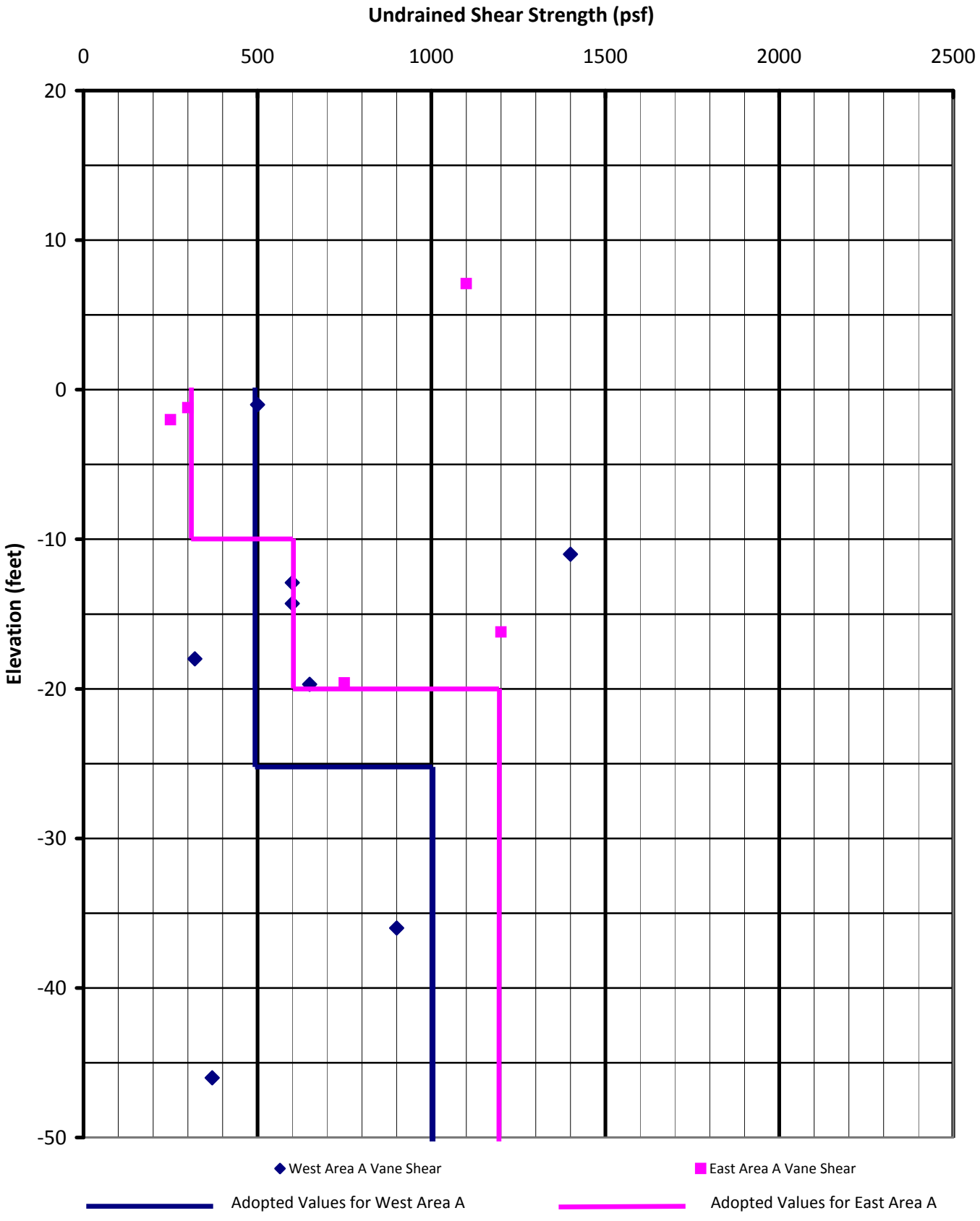
Notes: 1) For drained condition, $\phi = 27$, c = 200 psf

Table G-12: Area C Seismic Profile

Layer	Total Unit Weight (pcf)	Elevation (feet)		Friction Angle (Degrees)	Cohesion (psf)	Post-Liquefaction Strength (psf)
		From	To			
Fill	115	20	5	28	250	N/A
Soft Clay	115	5	-3	0	500 [1]	N/A
Med. Sand	115	-3	-8	33	0	N/A
Liq Sand	115	-8	-13	N/A	N/A	400
Stiff Clay	115	-13	-20	0	1200	N/A
Liq Sand 2	115	-20	-27	N/A	N/A	500
Stiff Clay	115	-27	-33	0	1200	N/A
Dense Sand	120	-33	-55	35	0	N/A

Notes: 1) For drained condition, $\phi = 27$, c = 200 psf

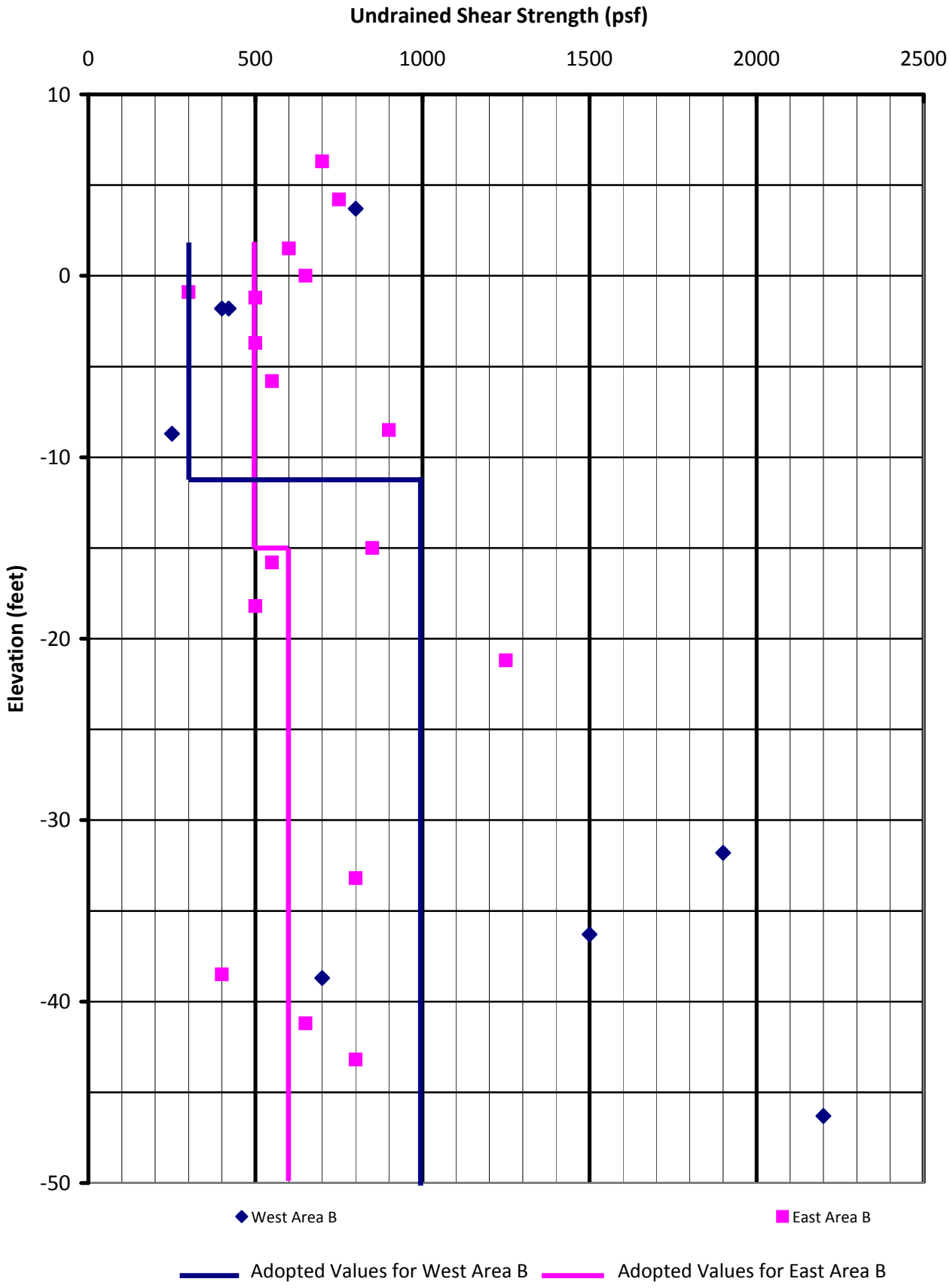
Area A - Undrained Shear Strength



Note: 1) The points shown on the graph are Vane Shear Strength Values adjusted based on Plasticity Index using Bjerrum (1972) Curve.
2) The adopted values consider the results of Lab Vane Shear, as well as estimates of undrained shear strength from CPT data.

PLATE G-7

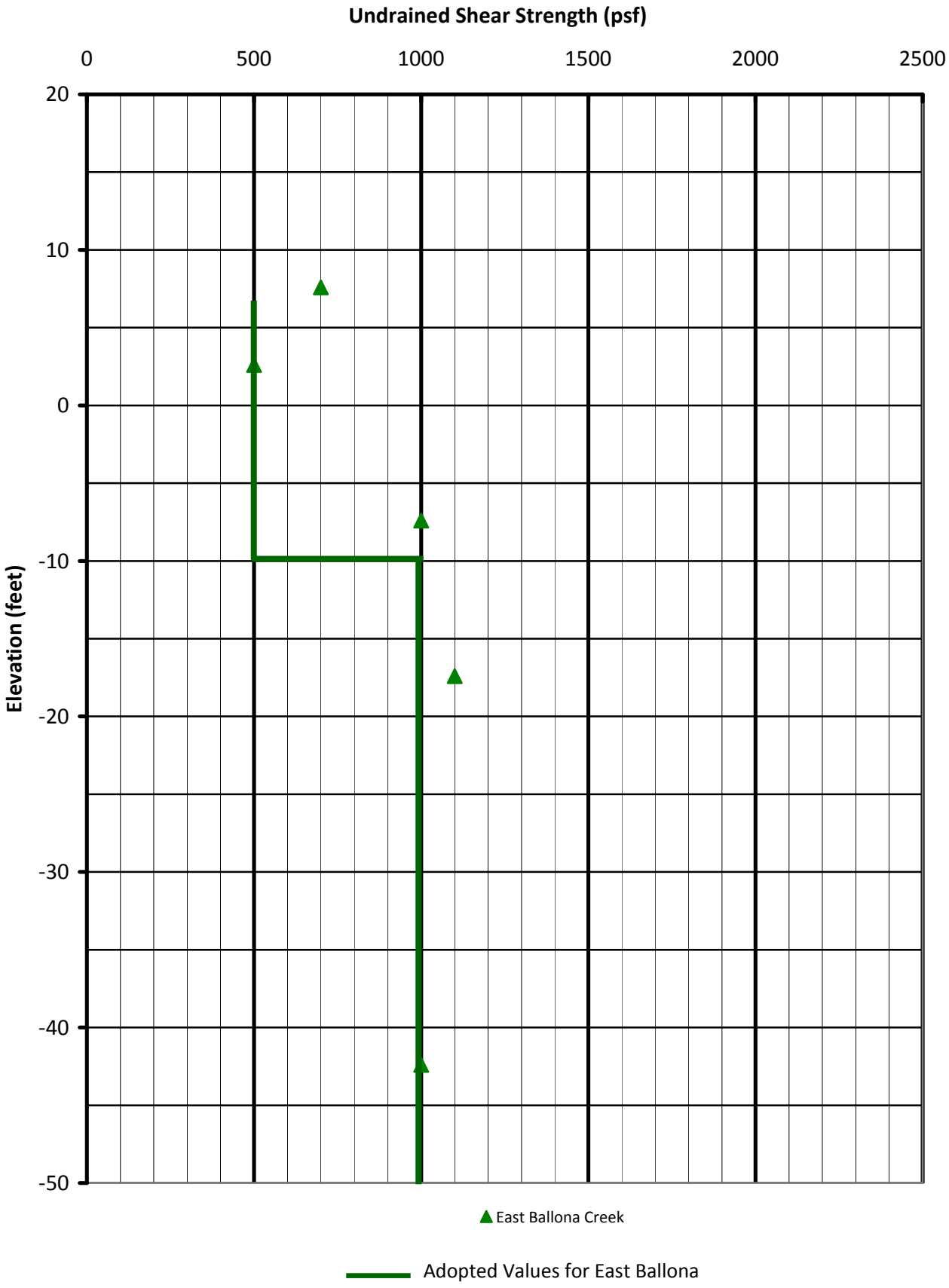
Area B - Undrained Shear Strength



Note: 1) The points shown on the graph are Vane Shear Strength Values adjusted based on Plasticity Index using Bjerrum (1972) Curve.
2) The adopted values consider the results of Lab Vane Shear, as well as estimates of undrained shear strength from CPT data.

PLATE G-8

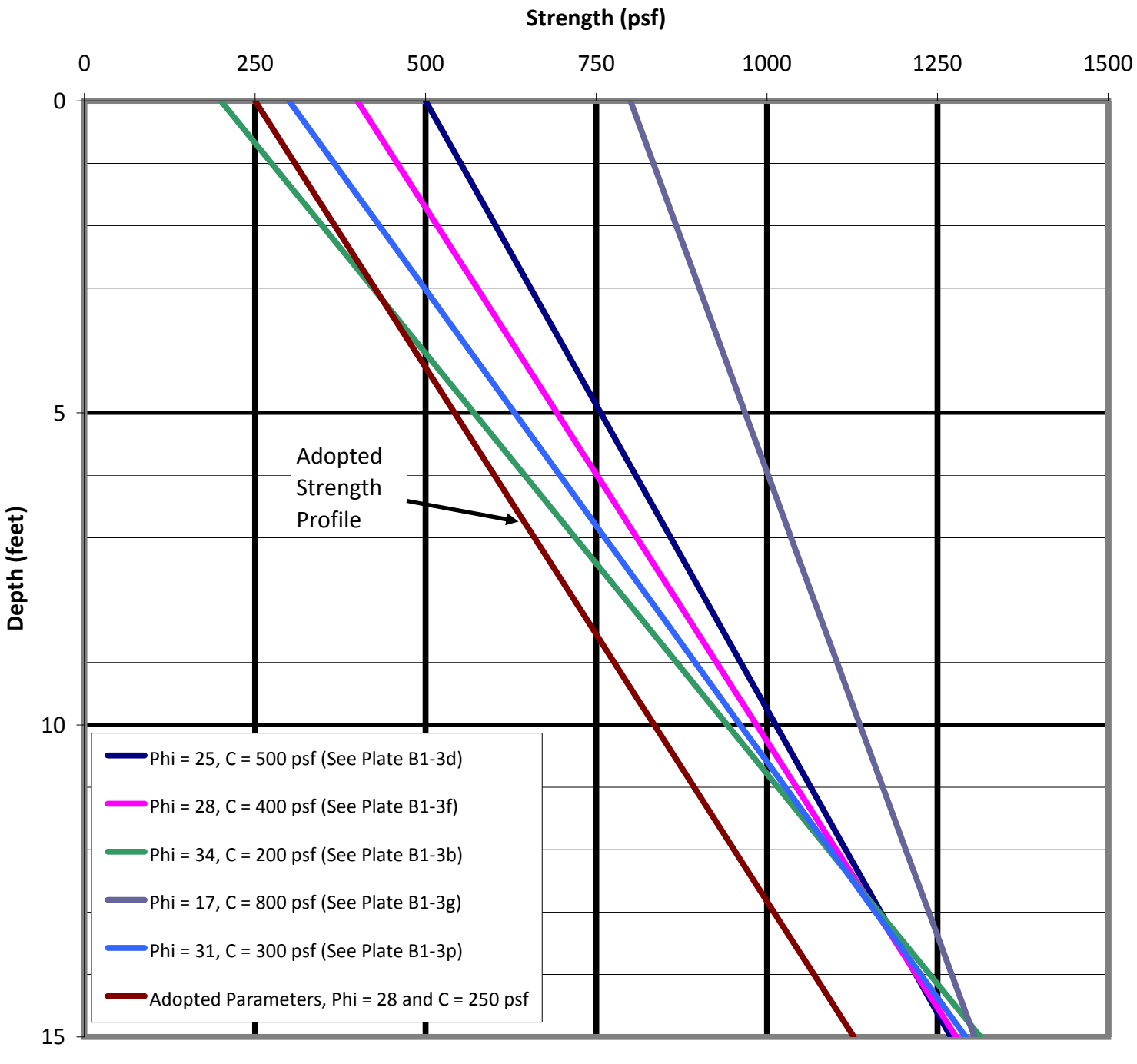
East Ballona Creek - Undrained Shear Strength



Note: 1) The points shown on the graph are Vane Shear Strength Values adjusted based on Plasticity Index using Bjerrum (1972) Curve.
2) The adopted values consider the results of Lab Vane Shear, as well as estimates of undrained shear strength from CPT data.

PLATE G-9

Soil Strength Parameters for Fill Soils (Unsaturated)



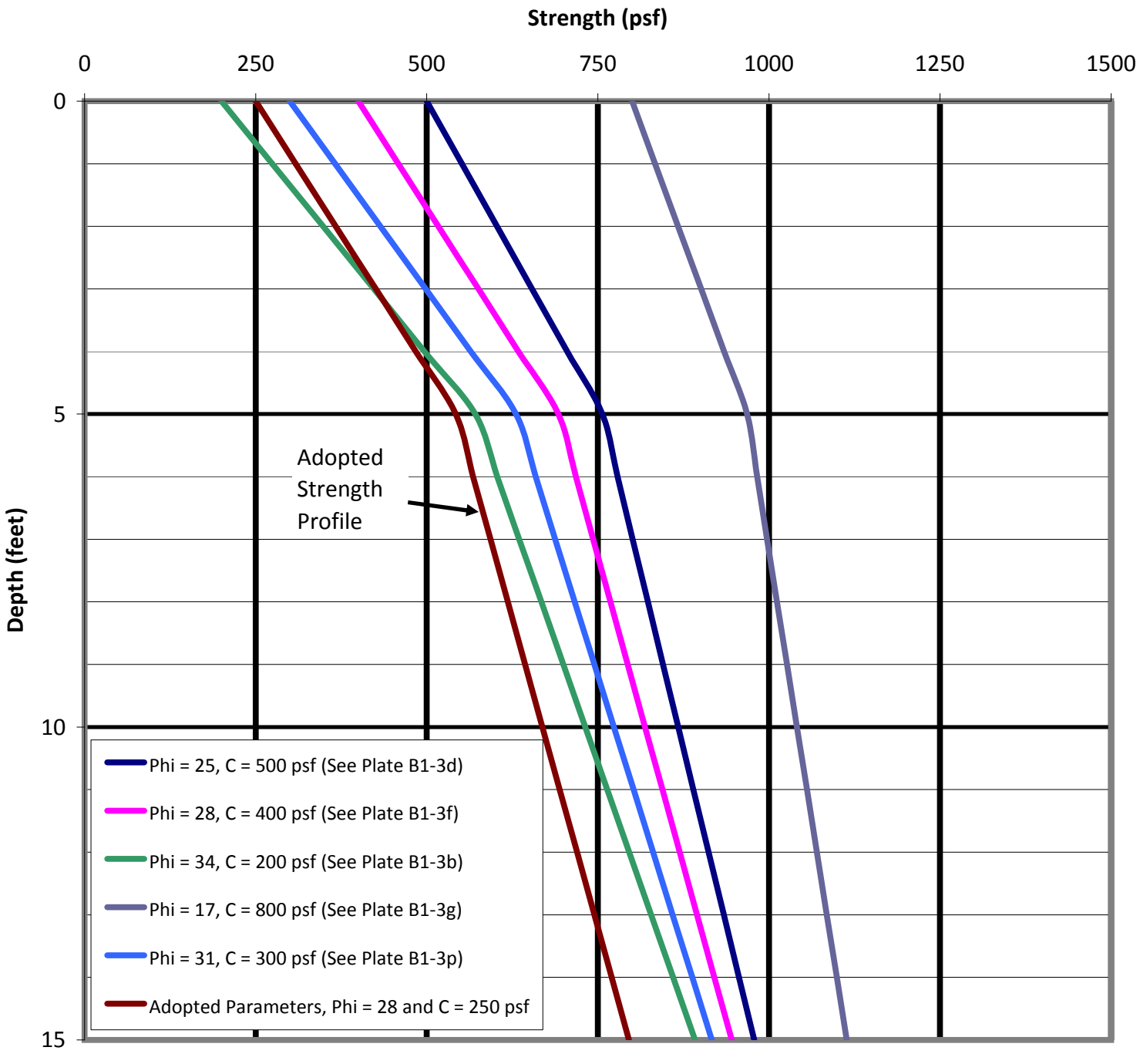
Note: 1) The lines shown are strength profiles versus depth using Parameters found from Direct Shear Tests on Near Surface Fill Soils.

2) The adopted profile is generally conservative, based on a Phi = 28 degrees, and C = 250 psf.

3) The adopted soil parameters for Embankment Soils are Phi = 28 degrees, and C = 300 psf, assuming proper compaction.

PLATE G-10

Soil Strength Parameters for Fill Soils (Saturated)



Note: 1) The lines shown are strength profiles versus depth using Parameters found from Direct Shear Tests on Near Surface Fill Soils, and assuming a groundwater depth of 5 feet.

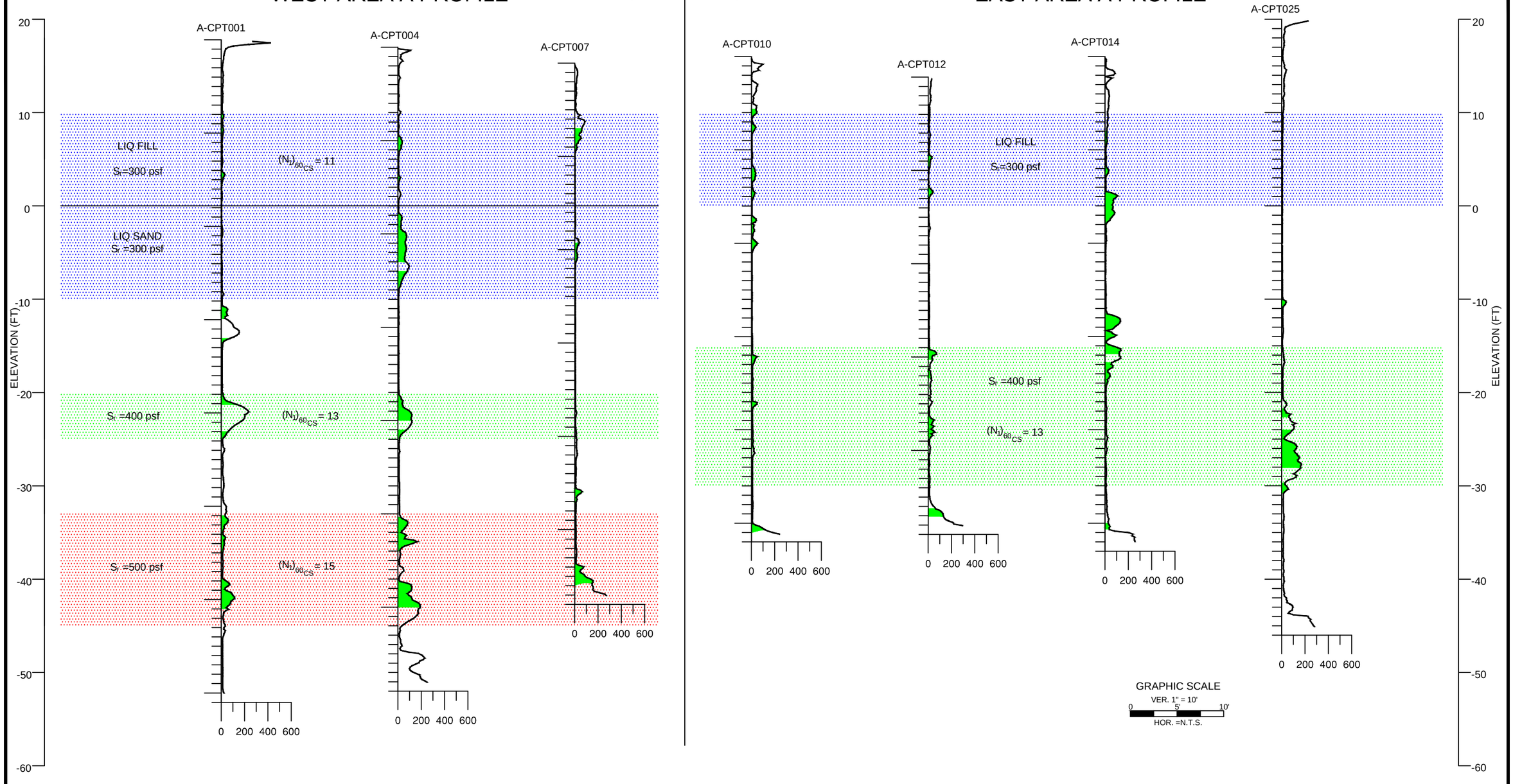
2) The adopted profile is generally conservative, based on a Phi = 28 degrees, and C = 250 psf.

3) The adopted soil parameters for Embankment Soils are Phi = 28 degrees, and C = 300 psf, assuming proper compaction.

PLATE G-11

WEST AREA A PROFILE

EAST AREA A PROFILE



GRAPHIC SCALE

VER. 1" = 10'

0 5' 10'

HOR. =N.T.S.

LEGEND

NOTE

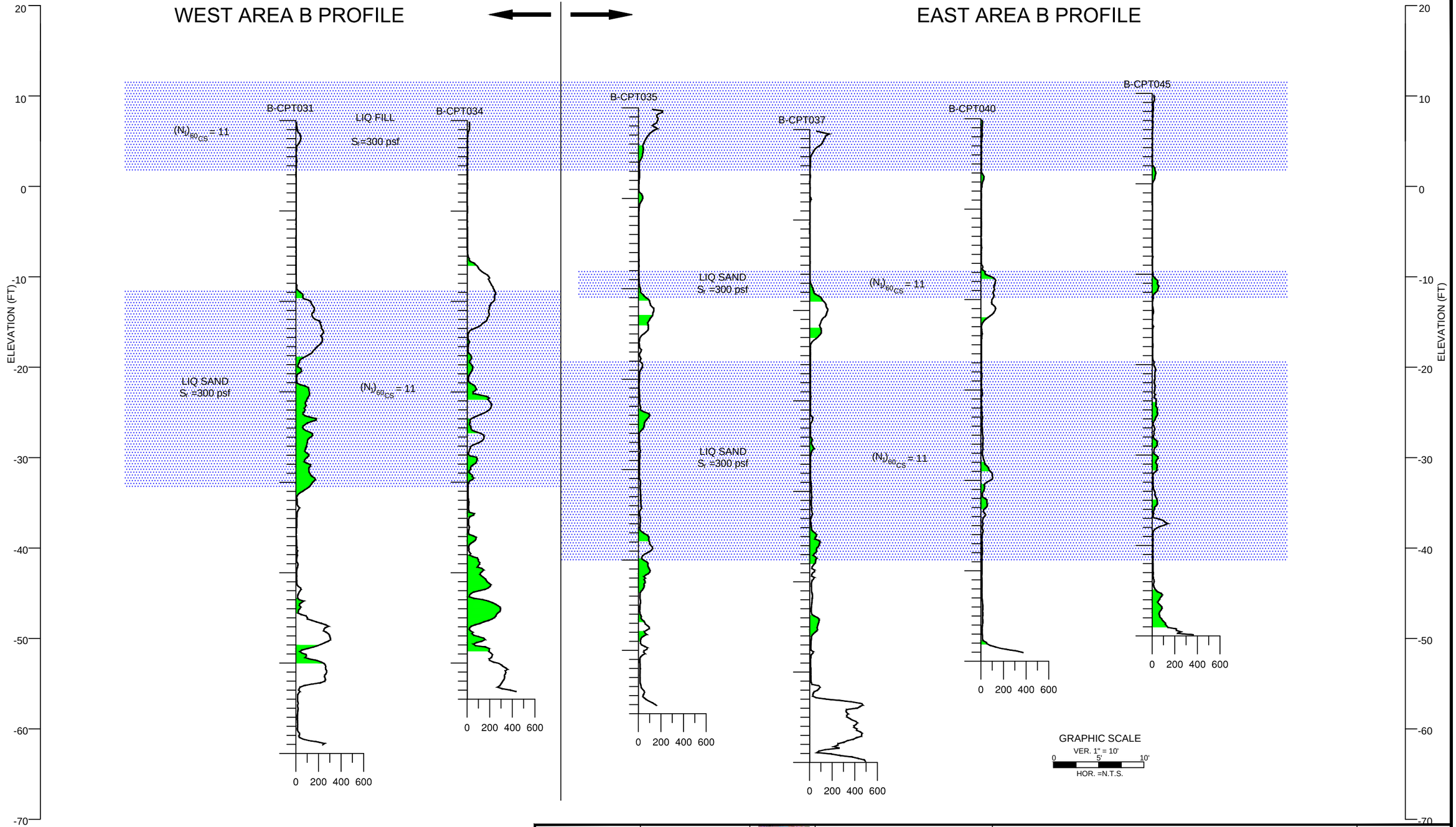
(1) SOME CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/28/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	PROJECT NUMBER: L962A
REVISION: 3/5/2013	APPROVED BY: P. Kashighandi	LIQUEFIED LAYERS ALONG AREA A PERIMETER LEVEE BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	SCALE: AS SHOWN
REVISION:			PLATE NUMBER: G-12

WEST AREA B PROFILE

EAST AREA B PROFILE



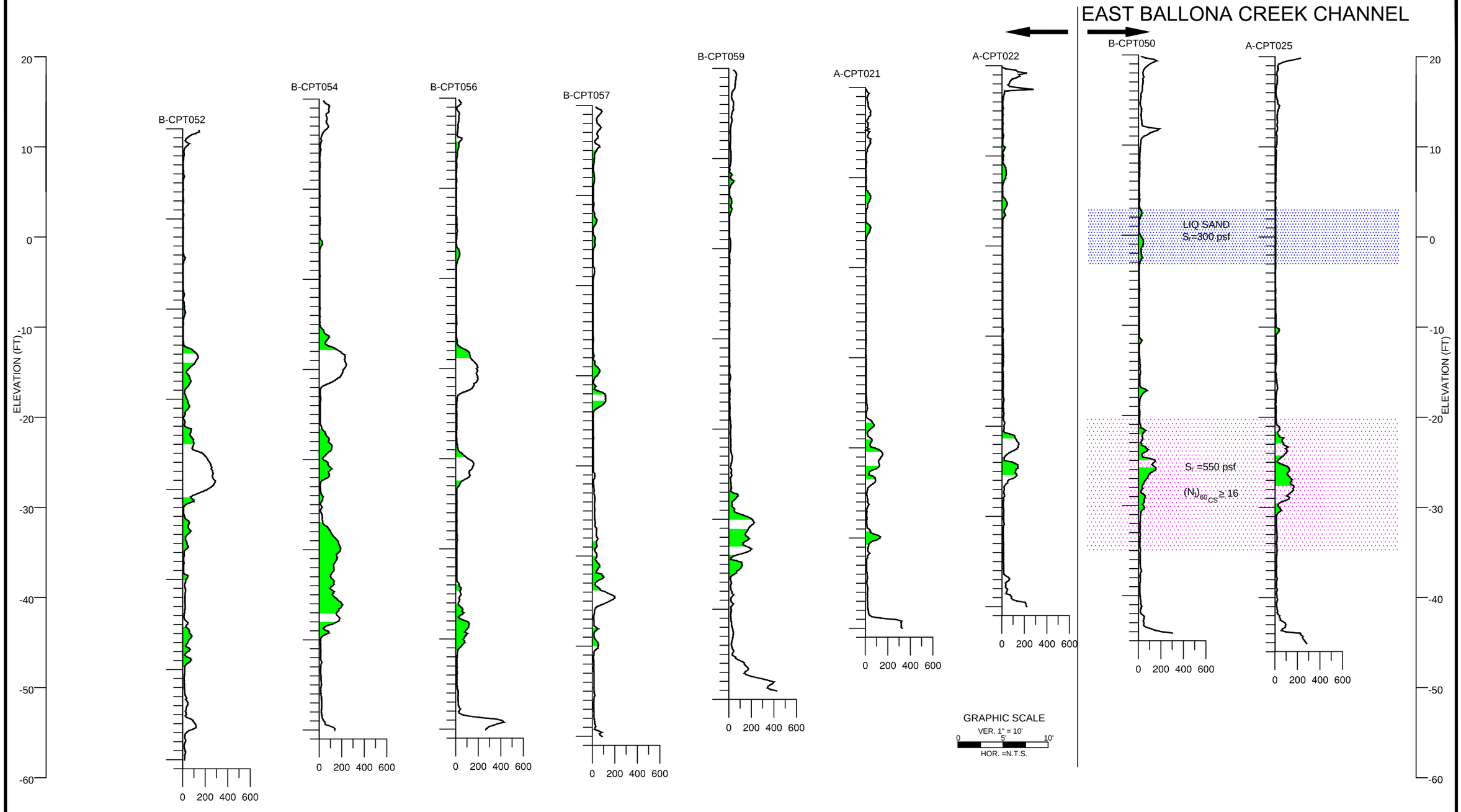
LEGEND

NOTE

(1) SOME CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/28/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	LIQUEFIED LAYERS ALONG AREA B PERIMETER LEVEE	PROJECT NUMBER: L962A
REVISION: 3/5/2013	APPROVED BY: P. Kashighandi		BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	SCALE: AS SHOWN
REVISION:				PLATE NUMBER: G-13



LEGEND

NOTE

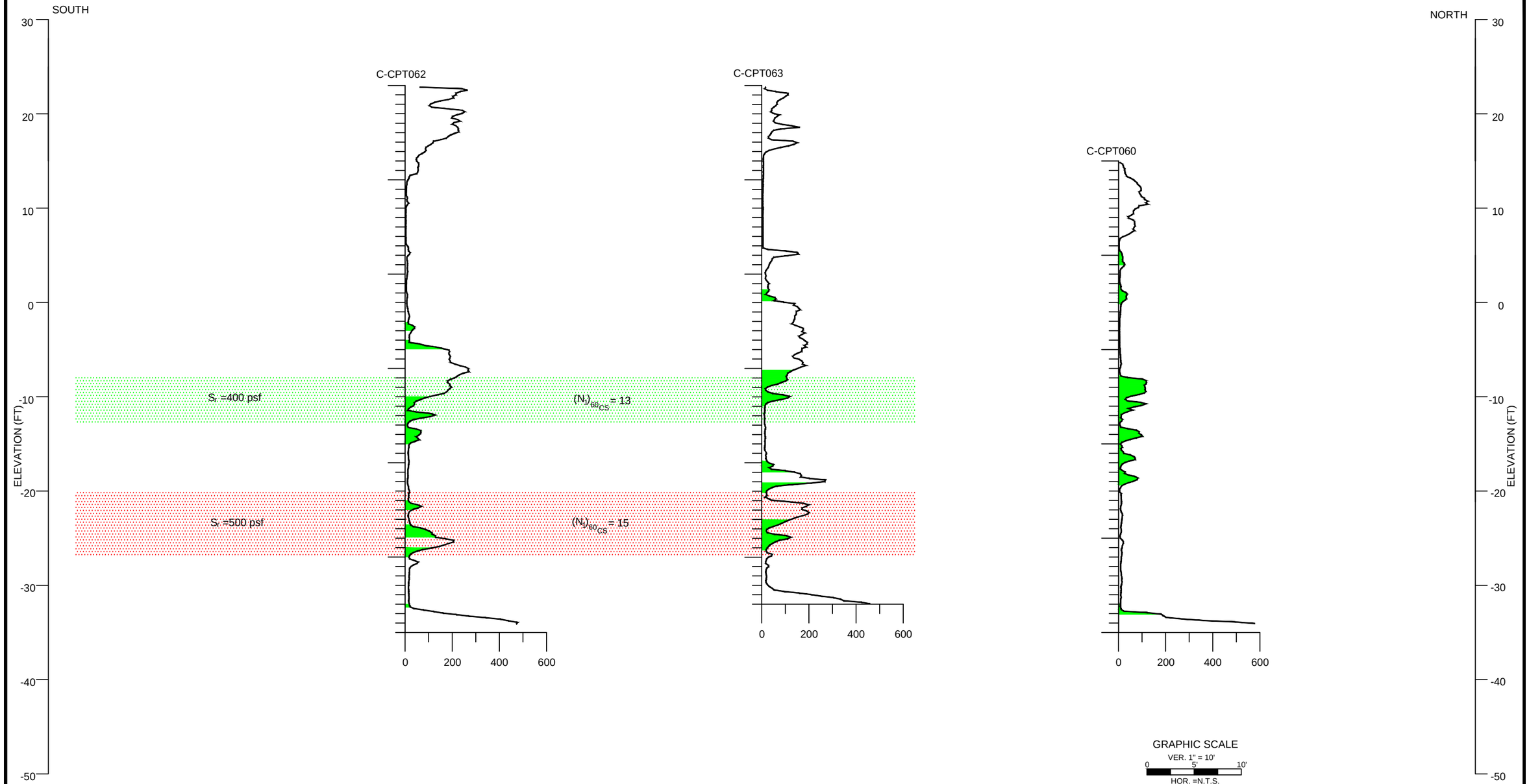
(1) SOME CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/28/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	PROJECT NUMBER: L962A
REVISION: 3/5/2013	APPROVED BY: P. Kashighandi		SCALE: AS SHOWN
REVISION:			PLATE NUMBER: G-14

LIQUEFIED LAYERS ALONG BALLONA CREEK LEVEE

BALLONA WETLANDS RESTORATION PROJECT
LOS ANGELES, CA



LEGEND

NOTE

(1) SOME CPT'S ARE SHOWN PROJECTED.

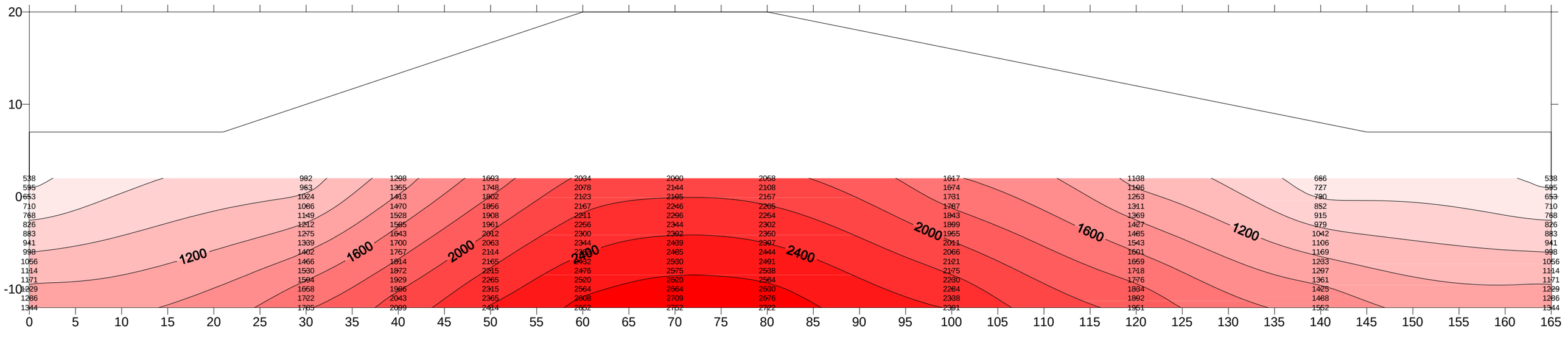
(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/28/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	LIQUEFIED LAYERS WITHIN AREA C BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION: 3/5/2013	APPROVED BY: P. Kashighandi		
REVISION:			

PROJECT NUMBER: L962A

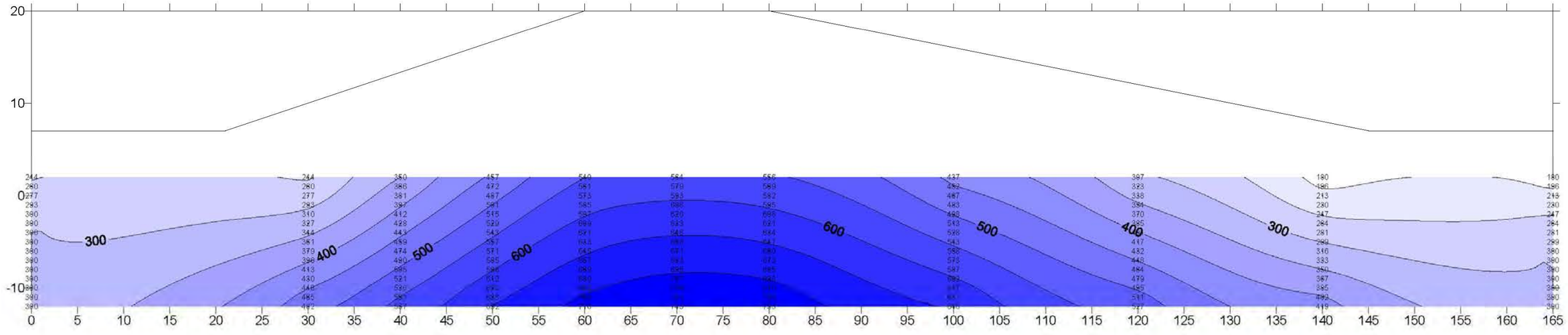
SCALE: AS SHOWN

FIGURE NUMBER: G-15



Stresses under West Area B Levees

PLATE G-16



SHANSEP assuming Normal Consolidation at 15', with $S_u = 300$ psf

$\sigma_v' = 4 \times 120 + 11 \times (120 - 62.4) = 1114$ psf

$\left(\frac{S_u}{\sigma_v'}\right)_{NC} = \left(\frac{300}{1114}\right) = \underline{0.27}$

Typical Range $\begin{cases} \left(\frac{S_u}{\sigma_v'}\right) \simeq 0.11 + 0.0037 \overset{40}{\uparrow}(PI) = 0.26 \\ \left(\frac{S_u}{\sigma_v'}\right) \simeq 0.45 \left(\frac{LL}{100}\right) = 0.45\ (0.7) = 0.32 \end{cases}$

Undrained Shear Strength Gain Due to Surcharging Under West Area B Levees using SHANSEP

PLATE G-17

Center of Embankment

Elev.	Depth	$\sigma v'_{init.}$	OCR	σ p	$\Delta\sigma$	$\sigma v'_{final}$	Su (psf)
7	0	0					Fil
6	1	120					Fil
5	2	240					Fil
4	3	360					Fil
3	4	480					Fil
2	5	538	2.0	1075	1,553	2,090	564
1	6	595	1.9	1131	1,548	2,144	579
0	7	653	1.8	1175	1,543	2,195	593
-1	8	710	1.7	1208	1,536	2,246	606
-2	9	768	1.6	1229	1,528	2,296	620
-3	10	826	1.5	1238	1,518	2,344	633
-4	11	883	1.4	1236	1,508	2,392	646
-5	12	941	1.3	1223	1,498	2,439	658
-6	13	998	1.2	1198	1,486	2,485	671
-7	14	1056	1.1	1162	1,474	2,530	683
-8	15	1114	1.0	1114	1,462	2,575	695
-9	16	1171	1.0	1171	1,449	2,620	707
-10	17	1229	1.0	1229	1,436	2,664	719
-11	18	1286	1.0	1286	1,422	2,709	731
-12	19	1344	1.0	1344	1,408	2,752	743

Dry Side Edge of Crest

Elev.	Depth	$\sigma v'_{init.}$	OCR	σ p	$\Delta\sigma$	$\sigma v'_{final}$	Su (psf)
7	0	0					Fil
6	1	120					Fil
5	2	240					Fil
4	3	360					Fil
3	4	480					Fil
2	5	538	2.0	1075	1,496	2,034	549
1	6	595	1.9	1131	1,483	2,078	561
0	7	653	1.8	1175	1,470	2,123	573
-1	8	710	1.7	1208	1,457	2,167	585
-2	9	768	1.6	1229	1,443	2,211	597
-3	10	826	1.5	1238	1,430	2,256	609
-4	11	883	1.4	1236	1,417	2,300	621
-5	12	941	1.3	1223	1,403	2,344	633
-6	13	998	1.2	1198	1,390	2,388	645
-7	14	1056	1.1	1162	1,376	2,432	657
-8	15	1114	1.0	1114	1,363	2,476	669
-9	16	1171	1.0	1171	1,349	2,520	680
-10	17	1229	1.0	1229	1,335	2,564	692
-11	18	1286	1.0	1286	1,322	2,608	704
-12	19	1344	1.0	1344	1,308	2,652	716

Undrained Shear Strength Gain Due to Surcharging Under West Area B Levees using SHANSEP

PLATE G-18

Water Side Edge of Crest

Elev.	Depth	$\sigma v'_{init.}$	OCR	σ p	$\Delta\sigma$	$\sigma v'_{final}$	Su (psf)
7	0	0					Fil
6	1	120					Fil
5	2	240					Fil
4	3	360					Fil
3	4	480					Fil
2	5	538	2.0	1075	1,521	2,058	556
1	6	595	1.9	1131	1,512	2,108	569
0	7	653	1.8	1175	1,504	2,157	582
-1	8	710	1.7	1208	1,495	2,205	595
-2	9	768	1.6	1229	1,486	2,254	608
-3	10	826	1.5	1238	1,476	2,302	621
-4	11	883	1.4	1236	1,466	2,350	634
-5	12	941	1.3	1223	1,456	2,397	647
-6	13	998	1.2	1198	1,446	2,444	660
-7	14	1056	1.1	1162	1,435	2,491	673
-8	15	1114	1.0	1114	1,424	2,538	685
-9	16	1171	1.0	1171	1,413	2,584	698
-10	17	1229	1.0	1229	1,402	2,630	710
-11	18	1286	1.0	1286	1,390	2,676	723
-12	19	1344	1.0	1344	1,378	2,722	735

10 foot Dry Side of Crest

Elev.	Depth	$\sigma v'_{init.}$	OCR	σ p	$\Delta\sigma$	$\sigma v'_{final}$	Su (psf)
7	0	0					Fil
6	1	120					Fil
5	2	240					Fil
4	3	360					Fil
3	4	480					Fil
2	5	538	2.0	1075	1,156	1,693	457
1	6	595	1.9	1131	1,153	1,748	472
0	7	653	1.8	1175	1,149	1,802	487
-1	8	710	1.7	1208	1,145	1,856	501
-2	9	768	1.6	1229	1,140	1,908	515
-3	10	826	1.5	1238	1,135	1,961	529
-4	11	883	1.4	1236	1,129	2,012	543
-5	12	941	1.3	1223	1,123	2,063	557
-6	13	998	1.2	1198	1,116	2,114	571
-7	14	1056	1.1	1162	1,109	2,165	585
-8	15	1114	1.0	1114	1,101	2,215	598
-9	16	1171	1.0	1171	1,094	2,265	612
-10	17	1229	1.0	1229	1,086	2,315	625
-11	18	1286	1.0	1286	1,078	2,365	638
-12	19	1344	1.0	1344	1,070	2,414	652

Undrained Shear Strength Gain Due to Surcharging Under West Area B Levees using SHANSEP

PLATE G-19

20 foot Dry Side of Crest

Elev.	Depth	σv' init.	OCR	σ p	Δσ	σv' final	Su (psf)
7	0	0					Fil
6	1	120					Fil
5	2	240					Fil
4	3	360					Fil
3	4	480					Fil
2	5	538	2.0	1075	760	1,298	350
1	6	595	1.9	1131	760	1,355	366
0	7	653	1.8	1175	760	1,413	381
-1	8	710	1.7	1208	760	1,470	397
-2	9	768	1.6	1229	760	1,528	412
-3	10	826	1.5	1238	760	1,585	428
-4	11	883	1.4	1236	759	1,643	443
-5	12	941	1.3	1223	759	1,700	459
-6	13	998	1.2	1198	759	1,757	474
-7	14	1056	1.1	1162	758	1,814	490
-8	15	1114	1.0	1114	758	1,872	505
-9	16	1171	1.0	1171	757	1,929	521
-10	17	1229	1.0	1229	757	1,986	536
-11	18	1286	1.0	1286	756	2,043	551
-12	19	1344	1.0	1344	755	2,099	567

30 foot Dry Side of Crest

Elev.	Depth	σv' init.	OCR	σ p	Δσ	σv' final	Su (psf)
7	0	0					Fil
6	1	120					Fil
5	2	240					Fil
4	3	360					Fil
3	4	480					Fil
2	5	538	2.0	1075	365	902	**244**
1	6	595	1.9	1131	368	963	**260**
0	7	653	1.8	1175	372	1,024	**277**
-1	8	710	1.7	1208	376	1,086	**293**
-2	9	768	1.6	1229	381	1,149	**310**
-3	10	826	1.5	1238	386	1,212	**327**
-4	11	883	1.4	1236	392	1,275	344
-5	12	941	1.3	1223	398	1,339	361
-6	13	998	1.2	1198	404	1,402	379
-7	14	1056	1.1	1162	410	1,466	396
-8	15	1114	1.0	1114	416	1,530	413
-9	16	1171	1.0	1171	423	1,594	430
-10	17	1229	1.0	1229	429	1,658	448
-11	18	1286	1.0	1286	435	1,722	465
-12	19	1344	1.0	1344	441	1,785	482

Note: Bold Su values imply that soils are still overconsolidated.
Strength gain is more than what's shown for overconsolidated depths

Undrained Shear Strength Gain Due to Surcharging Under West Area B Levees using SHANSEP

PLATE G-20

20 foot Water Side of Crest

Elev.	Depth	$\sigma v'_{init.}$	OCR	σ p	$\Delta\sigma$	$\sigma v'_{final}$	Su (psf)
7	0	0					Fil
6	1	120					Fil
5	2	240					Fil
4	3	360					Fil
3	4	480					Fil
2	5	538	2.0	1075	1,079	1,617	437
1	6	595	1.9	1131	1,079	1,674	452
0	7	653	1.8	1175	1,078	1,731	467
-1	8	710	1.7	1208	1,077	1,787	483
-2	9	768	1.6	1229	1,075	1,843	498
-3	10	826	1.5	1238	1,074	1,899	513
-4	11	883	1.4	1236	1,072	1,955	528
-5	12	941	1.3	1223	1,070	2,011	543
-6	13	998	1.2	1198	1,067	2,066	558
-7	14	1056	1.1	1162	1,065	2,121	573
-8	15	1114	1.0	1114	1,062	2,175	587
-9	16	1171	1.0	1171	1,058	2,230	602
-10	17	1229	1.0	1229	1,055	2,284	617
-11	18	1286	1.0	1286	1,051	2,338	631
-12	19	1344	1.0	1344	1,047	2,391	646

40 foot Water Side of Crest

Elev.	Depth	$\sigma v'_{init.}$	OCR	σ p	$\Delta\sigma$	$\sigma v'_{final}$	Su (psf)
7	0	0					Fil
6	1	120					Fil
5	2	240					Fil
4	3	360					Fil
3	4	480					Fil
2	5	538	2.0	1075	600	1,138	307
1	6	595	1.9	1131	600	1,196	323
0	7	653	1.8	1175	601	1,253	338
-1	8	710	1.7	1208	601	1,311	354
-2	9	768	1.6	1229	601	1,369	370
-3	10	826	1.5	1238	601	1,427	385
-4	11	883	1.4	1236	602	1,485	401
-5	12	941	1.3	1223	602	1,543	417
-6	13	998	1.2	1198	603	1,601	432
-7	14	1056	1.1	1162	603	1,659	448
-8	15	1114	1.0	1114	604	1,718	464
-9	16	1171	1.0	1171	605	1,776	479
-10	17	1229	1.0	1229	605	1,834	495
-11	18	1286	1.0	1286	606	1,892	511
-12	19	1344	1.0	1344	607	1,951	527

Undrained Shear Strength Gain Due to Surcharging Under West Area B Levees using SHANSEP

PLATE G-21

60 foot Water Side of Crest

Elev.	Depth	$\sigma v'_{init.}$	OCR	σ p	$\Delta\sigma$	$\sigma v'_{final}$	Su (psf)
7	0	0					Fil
6	1	120					Fil
5	2	240					Fil
4	3	360					Fil
3	4	480					Fil
2	5	538	2.0	1075	128	666	**180**
1	6	595	1.9	1131	132	727	**196**
0	7	653	1.8	1175	137	790	**213**
-1	8	710	1.7	1208	142	852	**230**
-2	9	768	1.6	1229	147	915	**247**
-3	10	826	1.5	1238	153	979	**264**
-4	11	883	1.4	1236	159	1,042	**281**
-5	12	941	1.3	1223	165	1,106	**299**
-6	13	998	1.2	1198	171	1,169	**316**
-7	14	1056	1.1	1162	177	1,233	333
-8	15	1114	1.0	1114	183	1,297	350
-9	16	1171	1.0	1171	190	1,361	367
-10	17	1229	1.0	1229	196	1,425	385
-11	18	1286	1.0	1286	202	1,488	402
-12	19	1344	1.0	1344	208	1,552	419

Note: Bold Su values imply that soils are still overconsolidated.
Strength gain is more than what's shown for overconsolidated depths

Undrained Shear Strength Gain Due to Surcharging Under West Area B Levees using SHANSEP

PLATE G-22

JOB TITLE : Section A-A' - End of Construction

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 11:07

Factor of Safety 3.39

Shear Strain Rate Contours

- 5.00E-08
- 1.00E-07
- 1.50E-07
- 2.00E-07
- 2.50E-07
- 3.00E-07
- 3.50E-07
- 4.00E-07
- 4.50E-07

Contour interval= 5.00E-08
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands

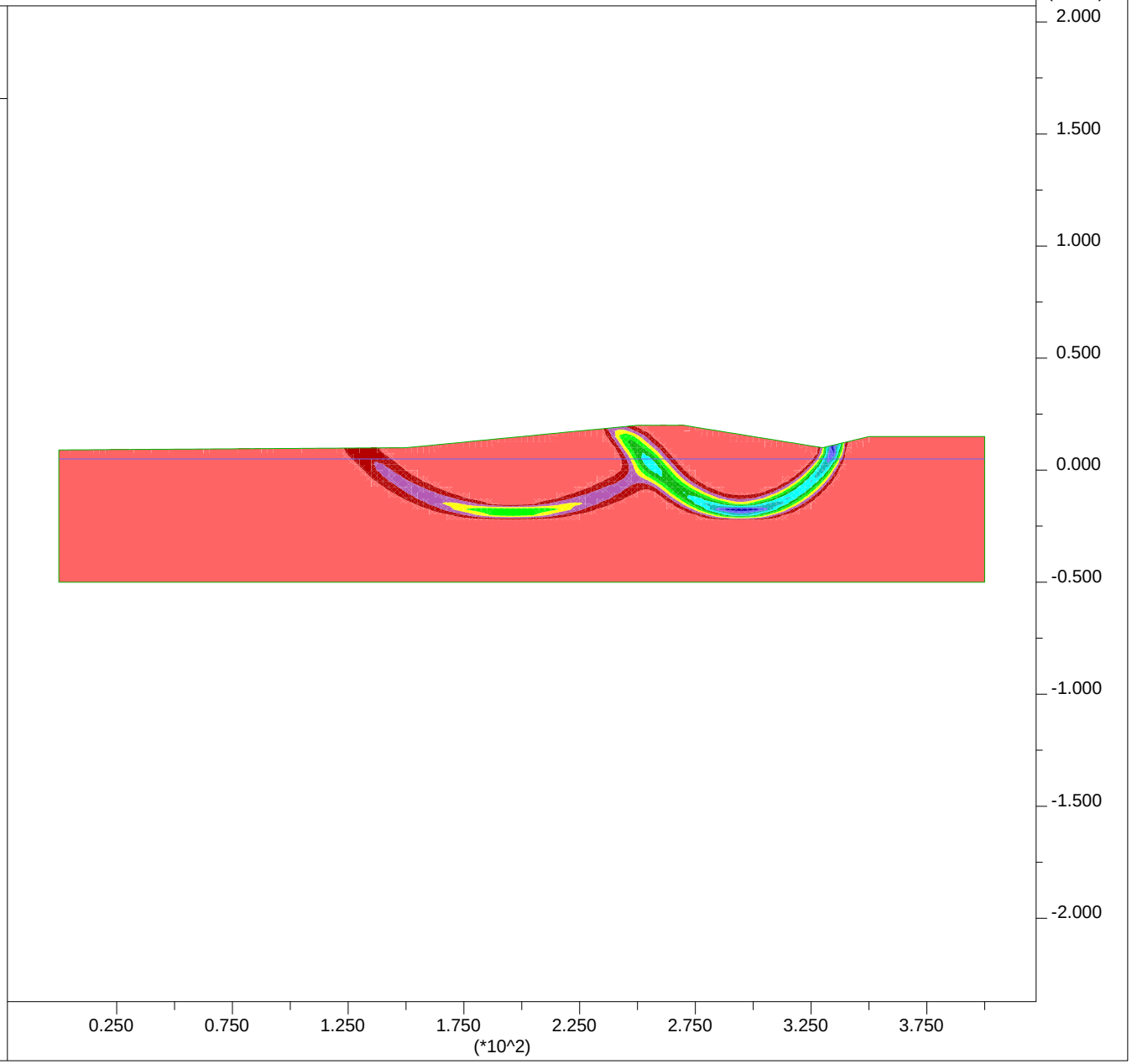


PLATE G-23

JOB TITLE : Section A-A' - End of Construction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 11:04

Factor of Safety 3.39

User-defined Groups
- User:Sand
- 'User:Stiff Clay'
- 'User:Soft Clay'
- User:Fill
- User:Embankment

Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands

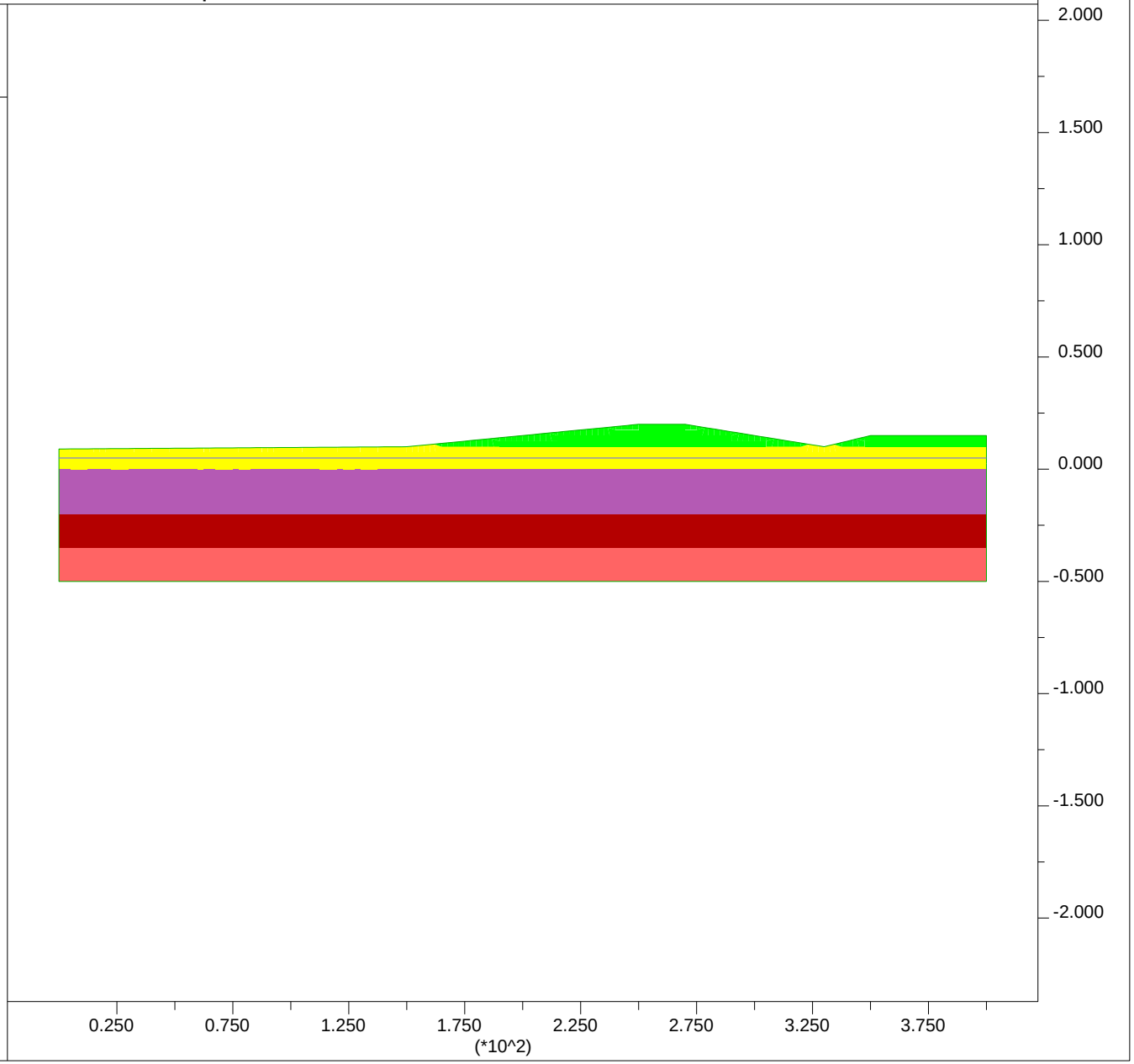


PLATE G-24

JOB TITLE : Section A-A' - High Water Short Term

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 11:09

Factor of Safety 3.35

Shear Strain Rate Contours

- 2.50E-07
- 5.00E-07
- 7.50E-07
- 1.00E-06
- 1.25E-06
- 1.50E-06
- 1.75E-06
- 2.00E-06
- 2.25E-06

Contour interval= 2.50E-07
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 1.247E+03

Group Delta Consultants
Ballona Wetlands

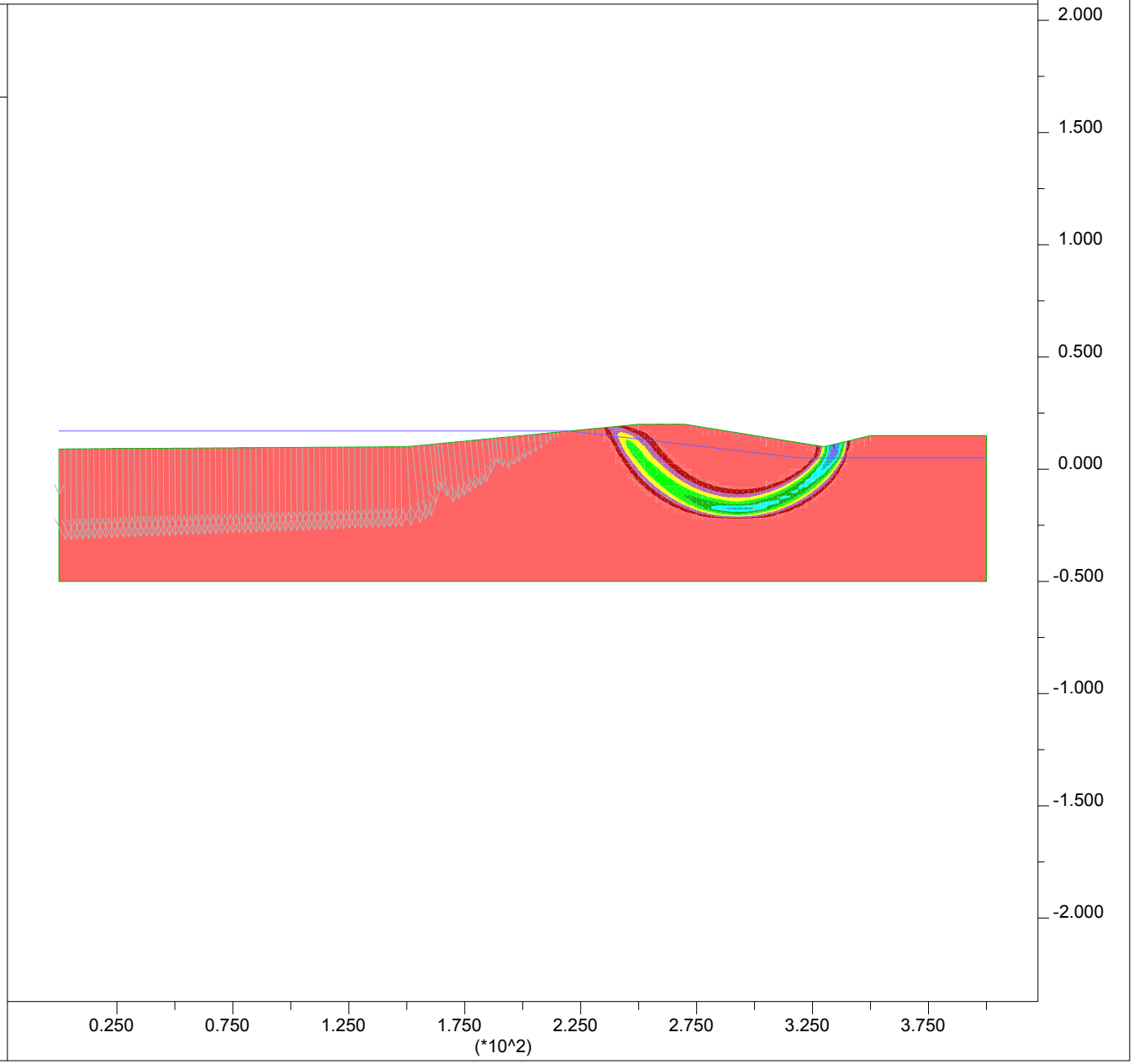


PLATE G-25

JOB TITLE : Section A-A' - High Water Short Term - Input

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 11:04

Factor of Safety 3.35

User-defined Groups
- User:Sand
- 'User:Stiff Clay'
- 'User:Soft Clay'
- User:Fill
- User:Embankment

Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 1.247E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands

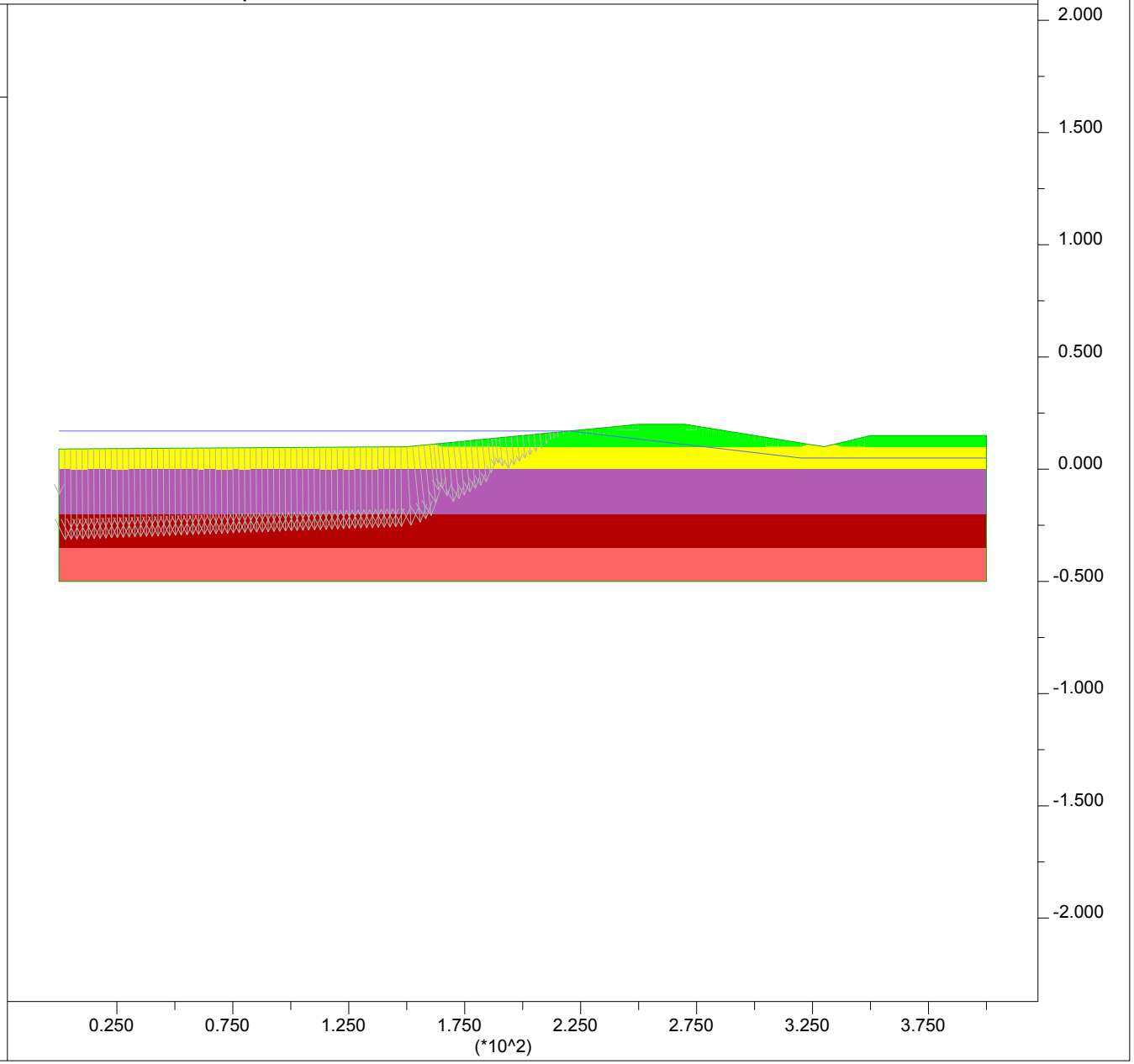


PLATE G-26

JOB TITLE : Section A-A' - High Water Long Term (Steady State)

FLAC/SLOPE (Version 7.00)

LEGEND

5-Mar-13 14:14

Factor of Safety 5.21

Shear Strain Rate Contours

- 2.50E-07
- 5.00E-07
- 7.50E-07
- 1.00E-06
- 1.25E-06
- 1.50E-06

Contour interval= 2.50E-07
(zero contour omitted)
Boundary plot

0 1E 2

Net Applied Forces

max vector = 9.947E+02

0 2E 3

Group Delta Consultants
Ballona Wetlands

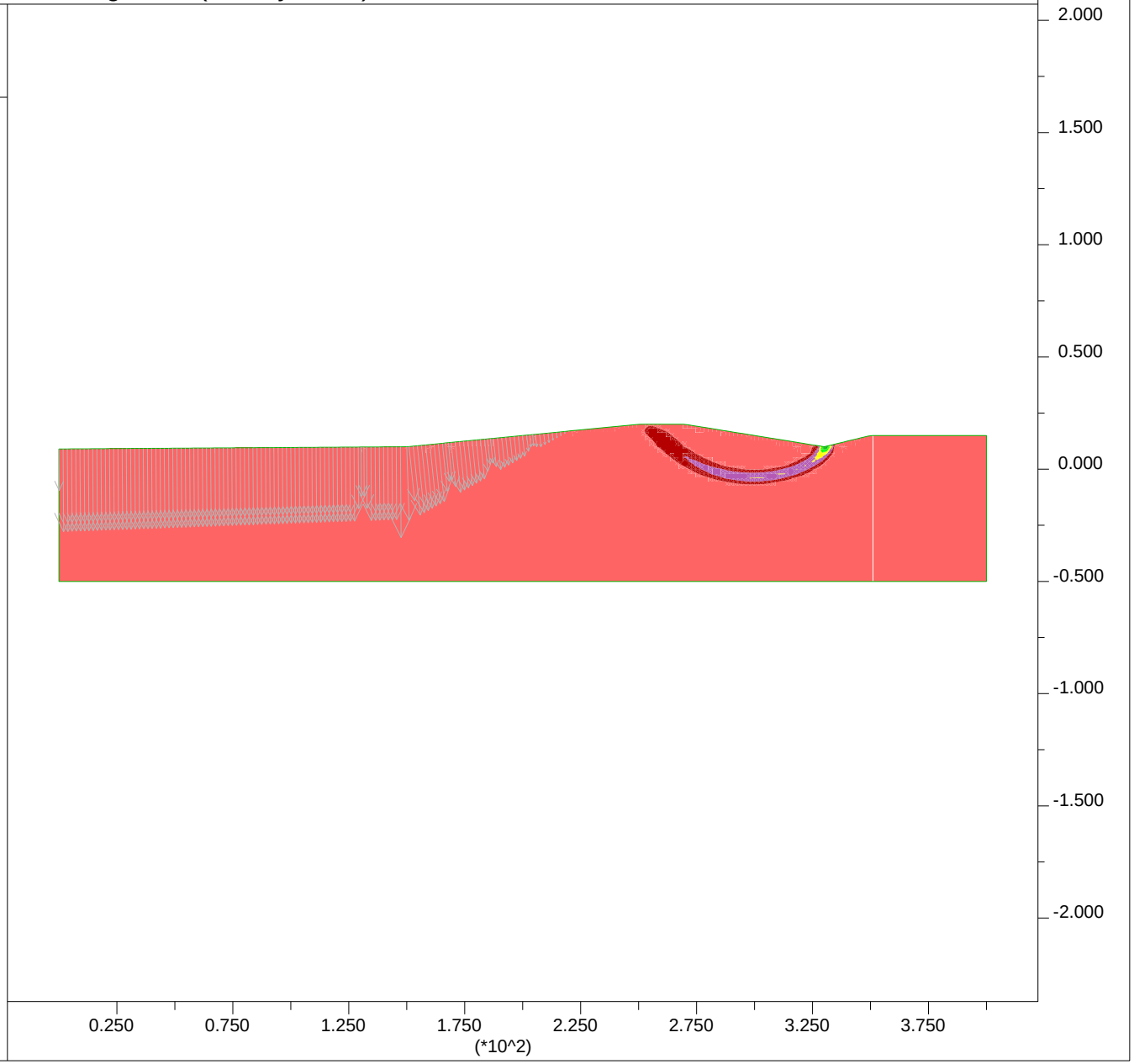


PLATE G-27

JOB TITLE : Section A-A' - High Water Long Term (Steady State) - Input

FLAC/SLOPE (Version 7.00)

LEGEND

5-Mar-13 14:22

Factor of Safety 5.21

User-defined Groups
- User:Sand
- 'User:Stiff Clay'
- 'User:Soft Clay'
- User:Fill
- User:Embankment

Boundary plot

0 1E 2

Net Applied Forces

max vector = 9.947E+02

0 2E 3

Group Delta Consultants
Ballona Wetlands

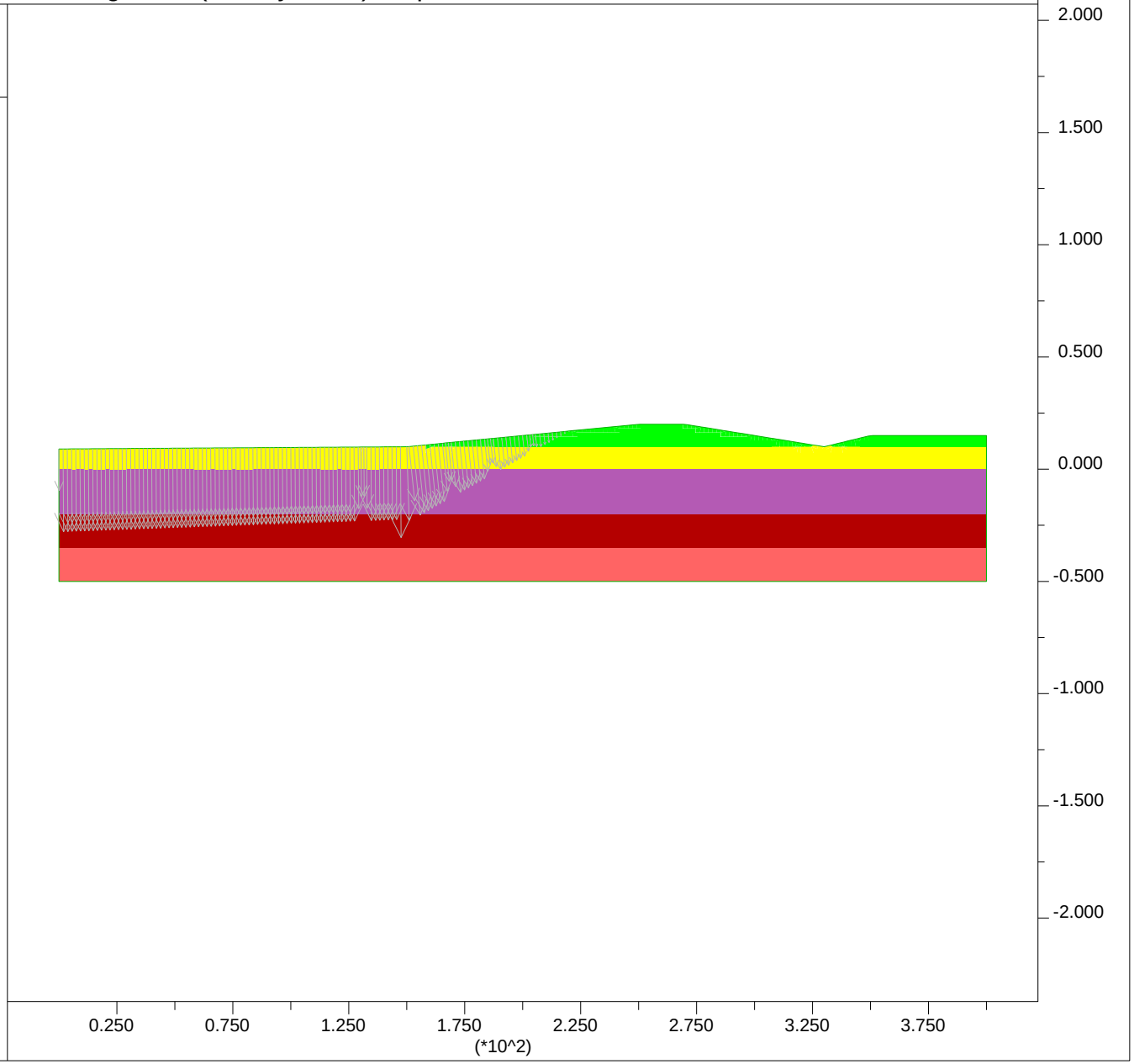


PLATE G-28

JOB TITLE : Section A-A' - Post Liquefaction

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 13:49

Factor of Safety 2.38

Shear Strain Rate Contours

- 2.00E-07
- 4.00E-07
- 6.00E-07
- 8.00E-07
- 1.00E-06
- 1.20E-06

Contour interval= 2.00E-07
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 1.536E+02

0 5E 2

Group Delta Consultants
Ballona Wetlands

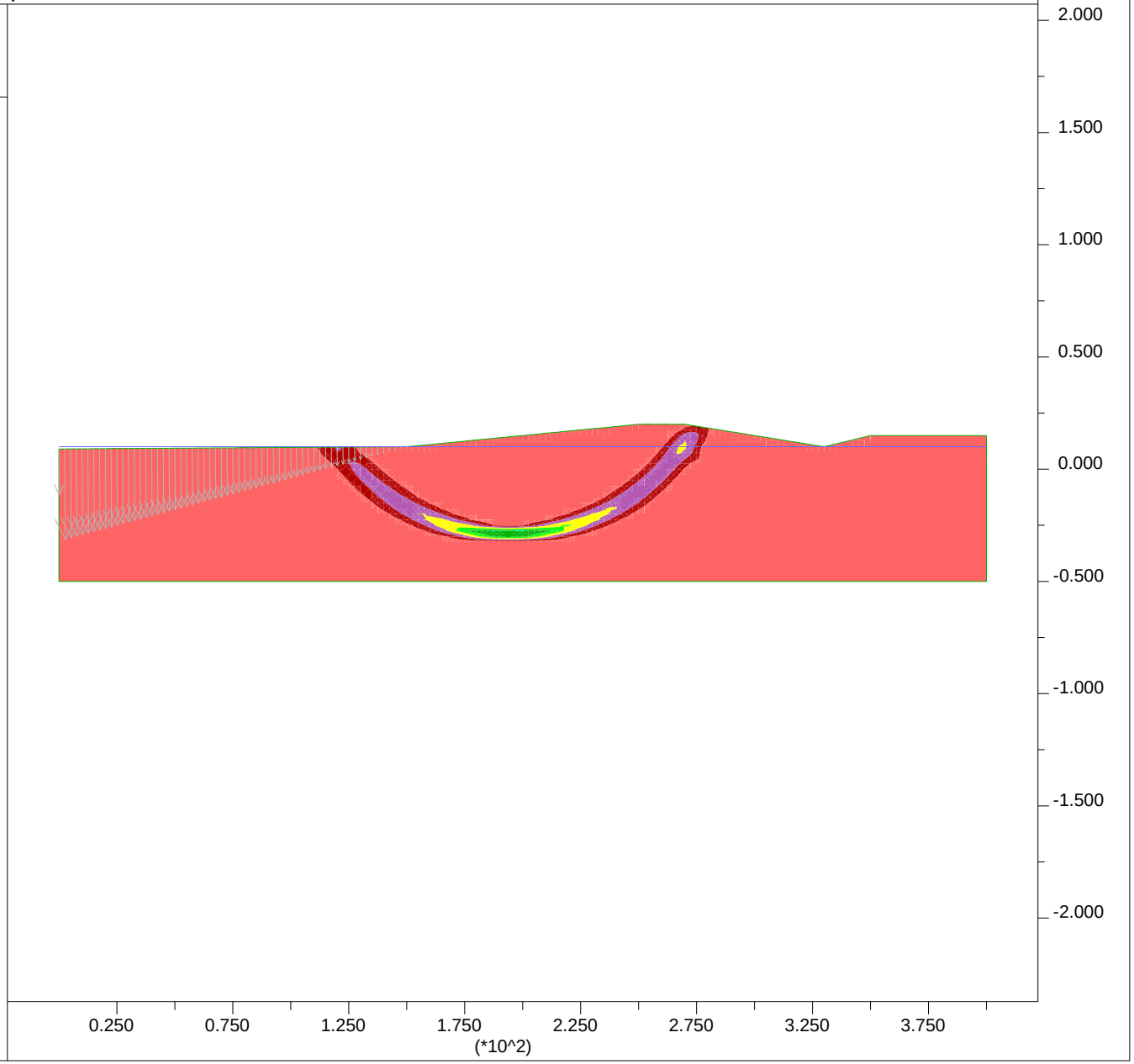


PLATE G-29

JOB TITLE : Section A-A' - Post Liquefaction Input

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 13:50

Factor of Safety 2.38

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Liq Sand'
- 'User:Soft Clay'
- 'User:Liq Fill'
- User:Embankment

Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 1.536E+02

0 5E 2

Group Delta Consultants
Ballona Wetlands

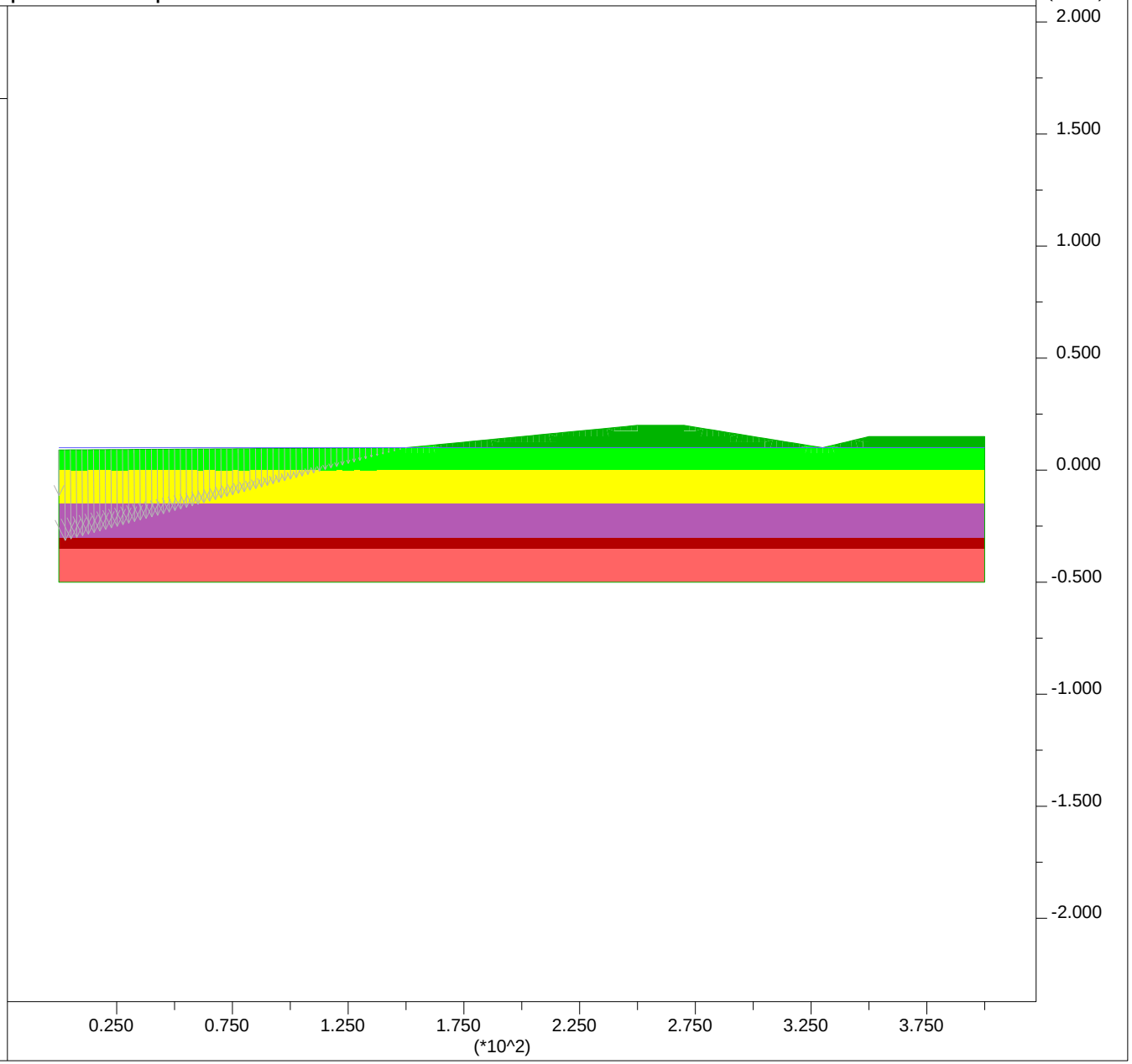


PLATE G-30

JOB TITLE : Section A-A' - Ky=0.09

FLAC/SLOPE (Version 7.00)

LEGEND

26-Mar-13 14:07

Factor of Safety 1.03

Shear Strain Rate Contours

1.00E-06
2.00E-06
3.00E-06
4.00E-06
5.00E-06

Contour interval= 1.00E-06
(zero contour omitted)
Boundary plot

0 2E 2

Water Table

Group Delta Consultants
Ballona Wetlands

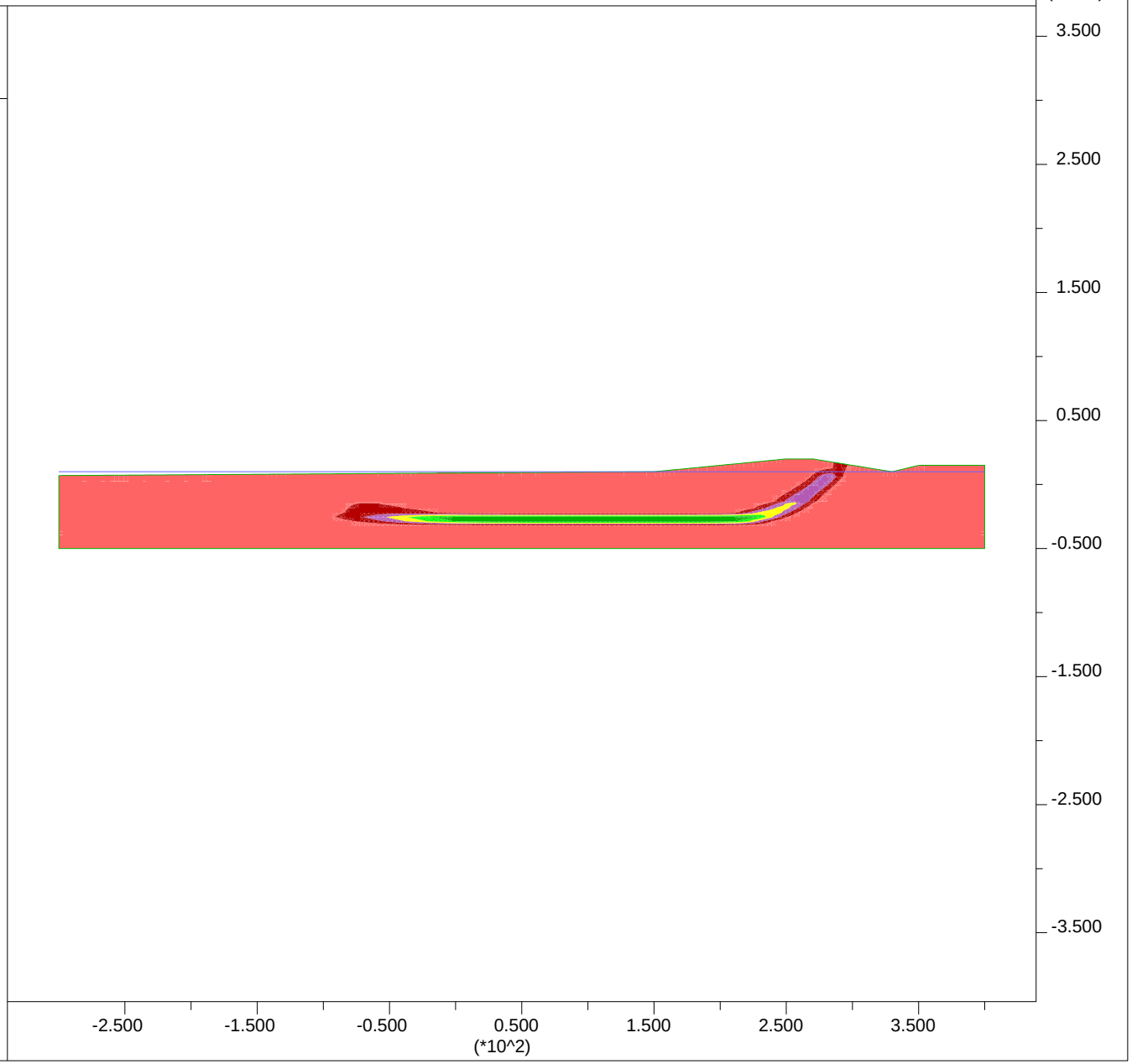


PLATE G-31

JOB TITLE : Section A-A' - Ky=0.09 Input

FLAC/SLOPE (Version 7.00)

LEGEND

26-Mar-13 14:07

Factor of Safety 1.03

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Liq Sand'
- 'User:Soft Clay'
- 'User:Liq Fill'
- User:Embankment

Boundary plot

0 2E 2

Water Table

Group Delta Consultants
Ballona Wetlands

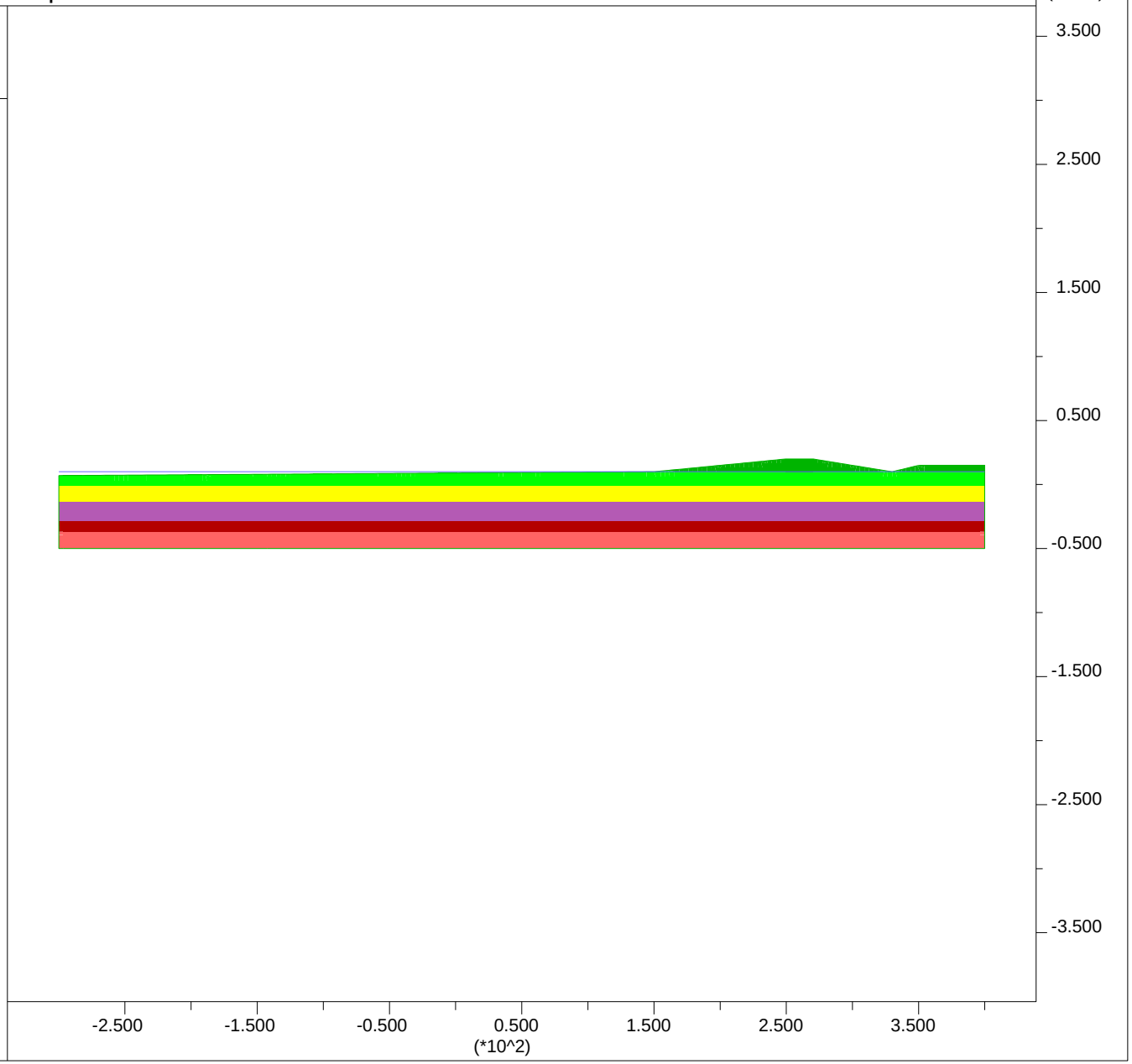


PLATE G-32

Newmark Displacements using Bray and Rathje (1998):

Section A-A'

Site Input				
PGA,rock =	0.25	g		
M =	6.6			
r =	13	km		
ky =	0.09		32.185	2.89665
Sliding Mass Input				
Vs =	150	m/s	assumed	
Thickness, H =	13.7	m		
	45	ft		
Output				
Tm =	0.49	sec		
D5-95 =	10.5	sec		
Ts =	0.37	sec		
NRF =	1.15			
Ts/Tm =	0.75			
kmax/(PGA,rock*NRF)	0.67			
kmax =	0.19			
ky / kmax =	0.47			
Displacement, u =	4	cm	0.1	feet
			1.4	inches

PLATE G-33

JOB TITLE : Section B-B' - End of Construction

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 14:08

Factor of Safety 3.51

Shear Strain Rate Contours

- 5.00E-07
- 1.00E-06
- 1.50E-06
- 2.00E-06
- 2.50E-06
- 3.00E-06
- 3.50E-06
- 4.00E-06

Contour interval= 5.00E-07
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands

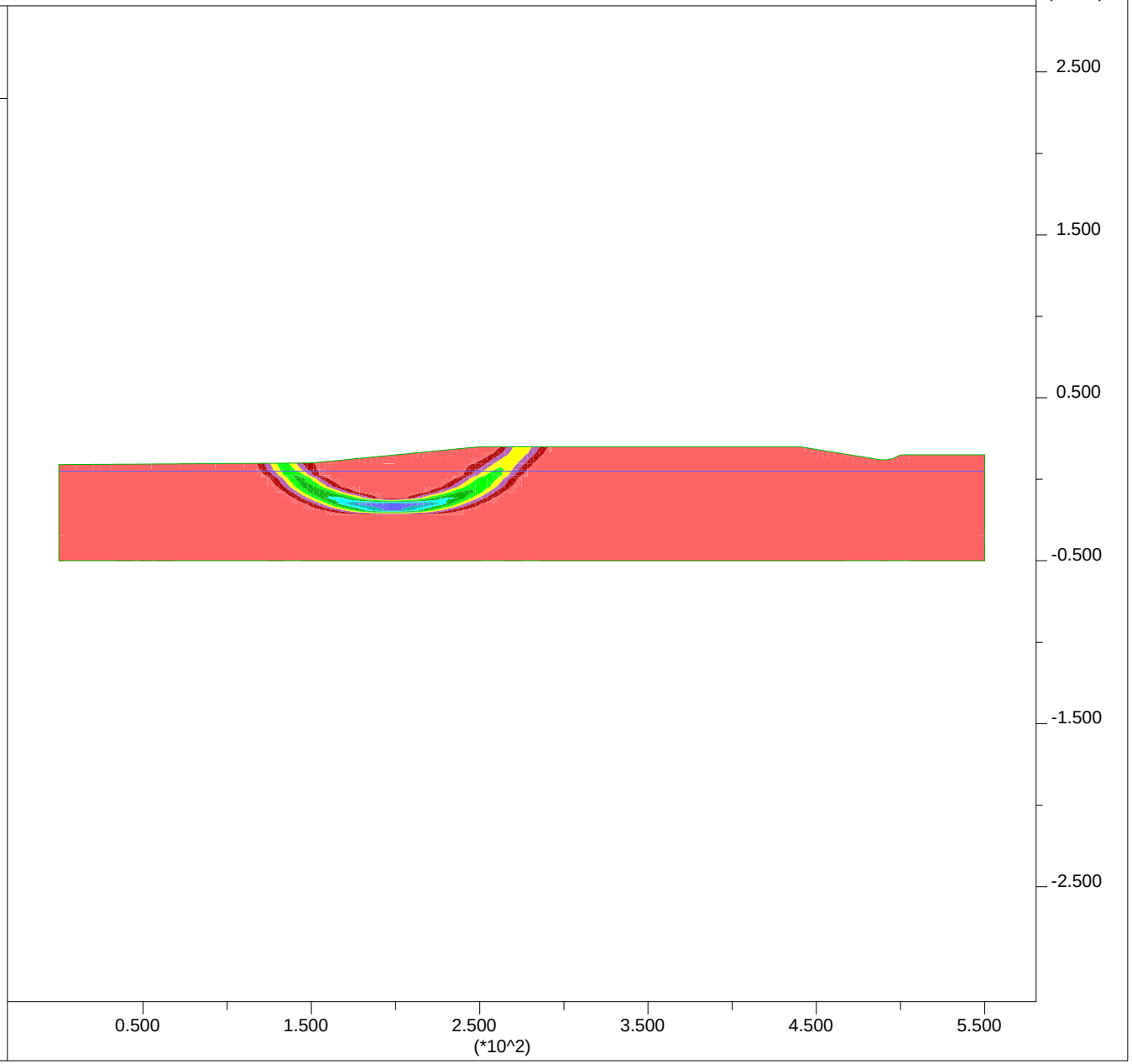


PLATE G-34

JOB TITLE : Section B-B' - End of Construction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 14:08

Factor of Safety 3.51

User-defined Groups
- User:Sand
- 'User:Stiff Clay'
- 'User:Soft Clay'
- User:Fill
- User:Embankment

Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands

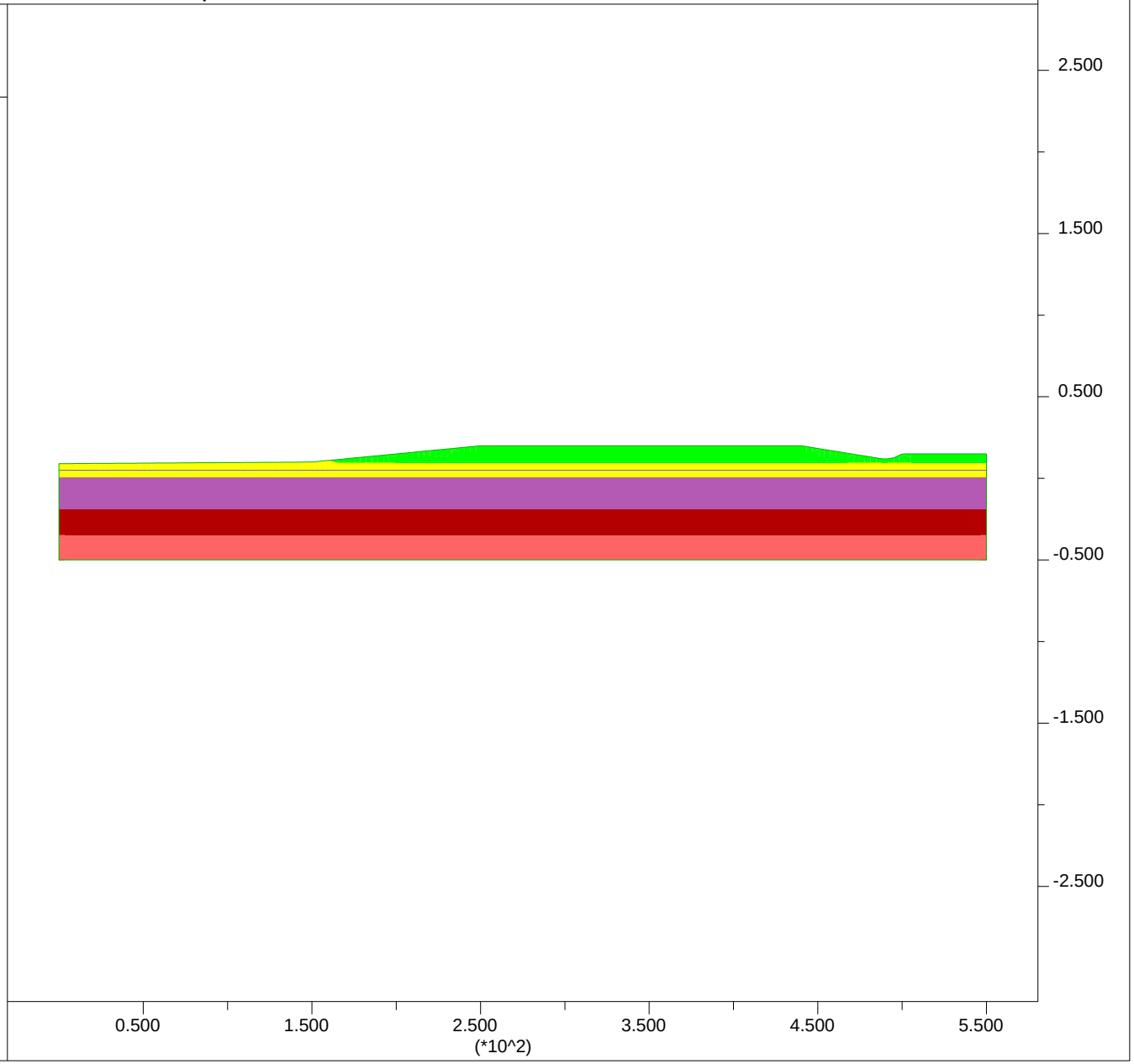


PLATE G-35

JOB TITLE : Section B-B' - High Water Short Term

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 14:24

Factor of Safety 4.32

Shear Strain Rate Contours

- 2.50E-06
- 5.00E-06
- 7.50E-06
- 1.00E-05
- 1.25E-05
- 1.50E-05
- 1.75E-05
- 2.00E-05
- 2.25E-05

Contour interval= 2.50E-06
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 1.713E+03

Group Delta Consultants
Ballona Wetlands

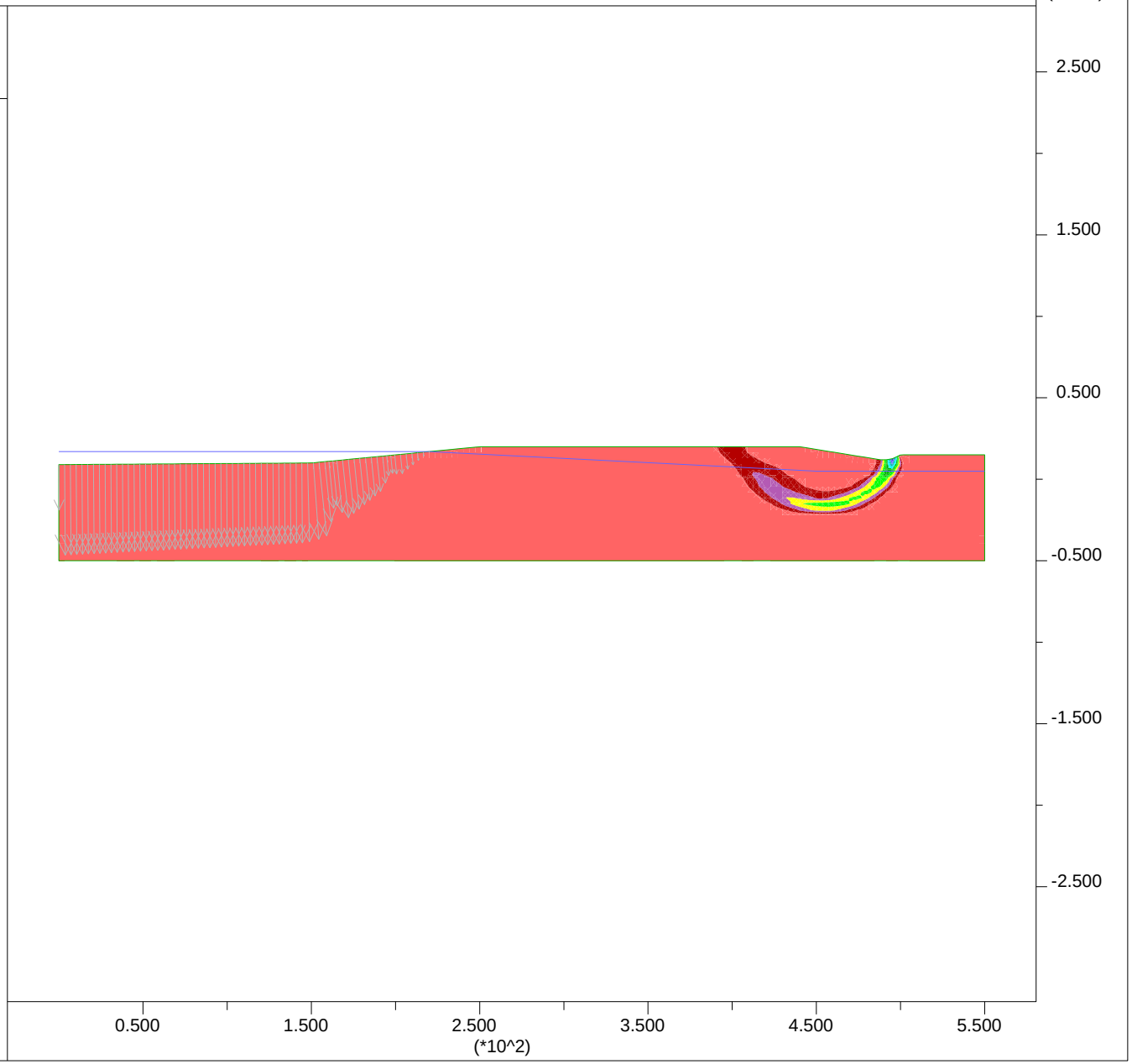


PLATE G-36

JOB TITLE : Section B-B' - High Water Short Term - Input

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 14:25

Factor of Safety 4.32

User-defined Groups
- User:Sand
- 'User:Stiff Clay'
- 'User:Soft Clay'
- User:Fill
- User:Embankment

Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 1.713E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands

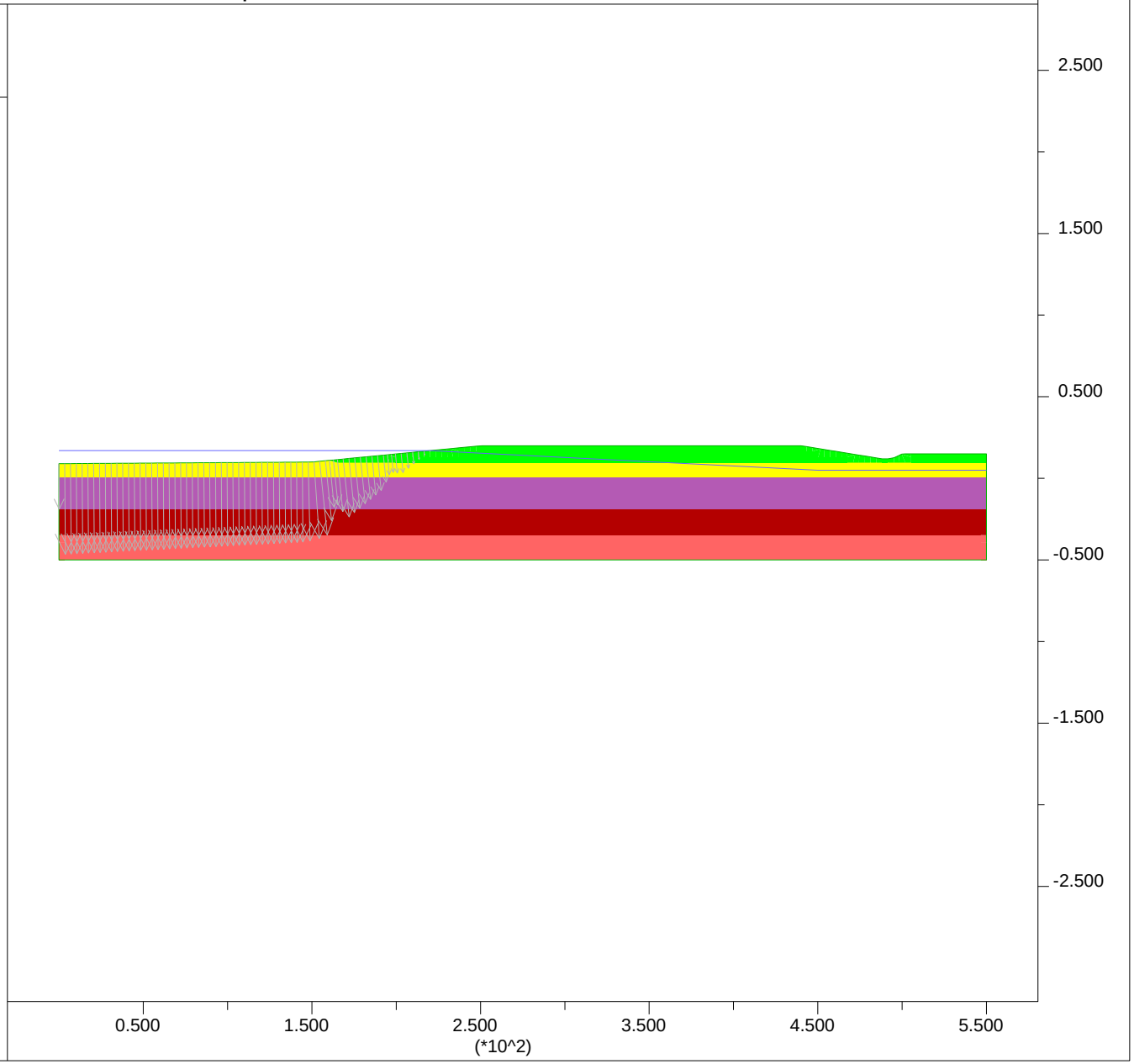


PLATE G-37

JOB TITLE : Section B-B' - Post Liquefaction

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 14:36

Factor of Safety 2.38

Shear Strain Rate Contours

1.00E-06
2.00E-06
3.00E-06
4.00E-06
5.00E-06

Contour interval= 1.00E-06
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 2.098E+02

0 5E 2

Group Delta Consultants
Ballona Wetlands

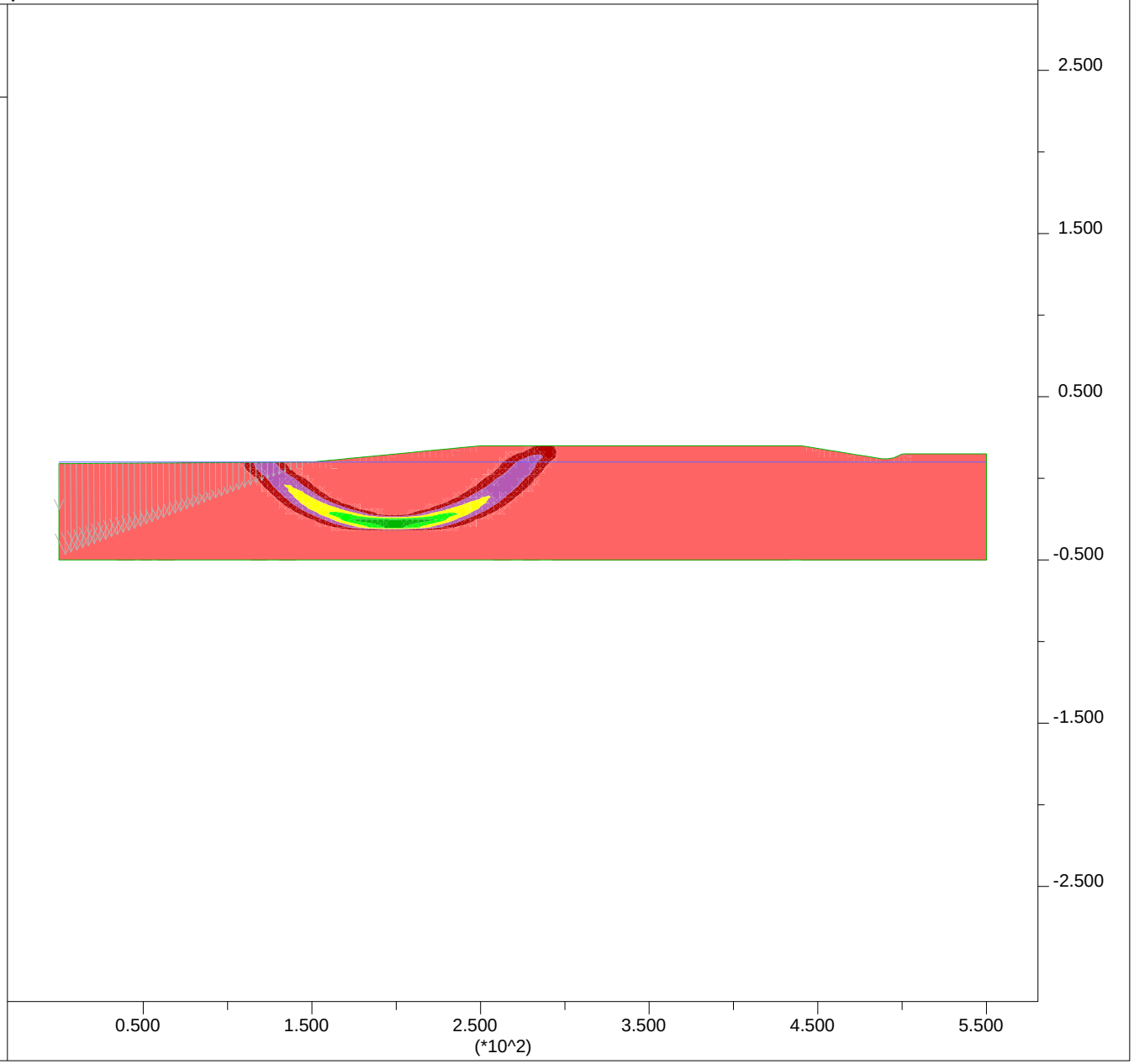


PLATE G-38

JOB TITLE : Section B-B' - Post Liquefaction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 14:37

Factor of Safety 2.38

User-defined Groups
- User:Sand
- 'User:Stiff Clay'
- 'User:Liq Sand'
- 'User:Soft Clay'
- 'User:Liq Fill'
- User:Embankment

Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 2.098E+02

0 5E 2

Group Delta Consultants
Ballona Wetlands

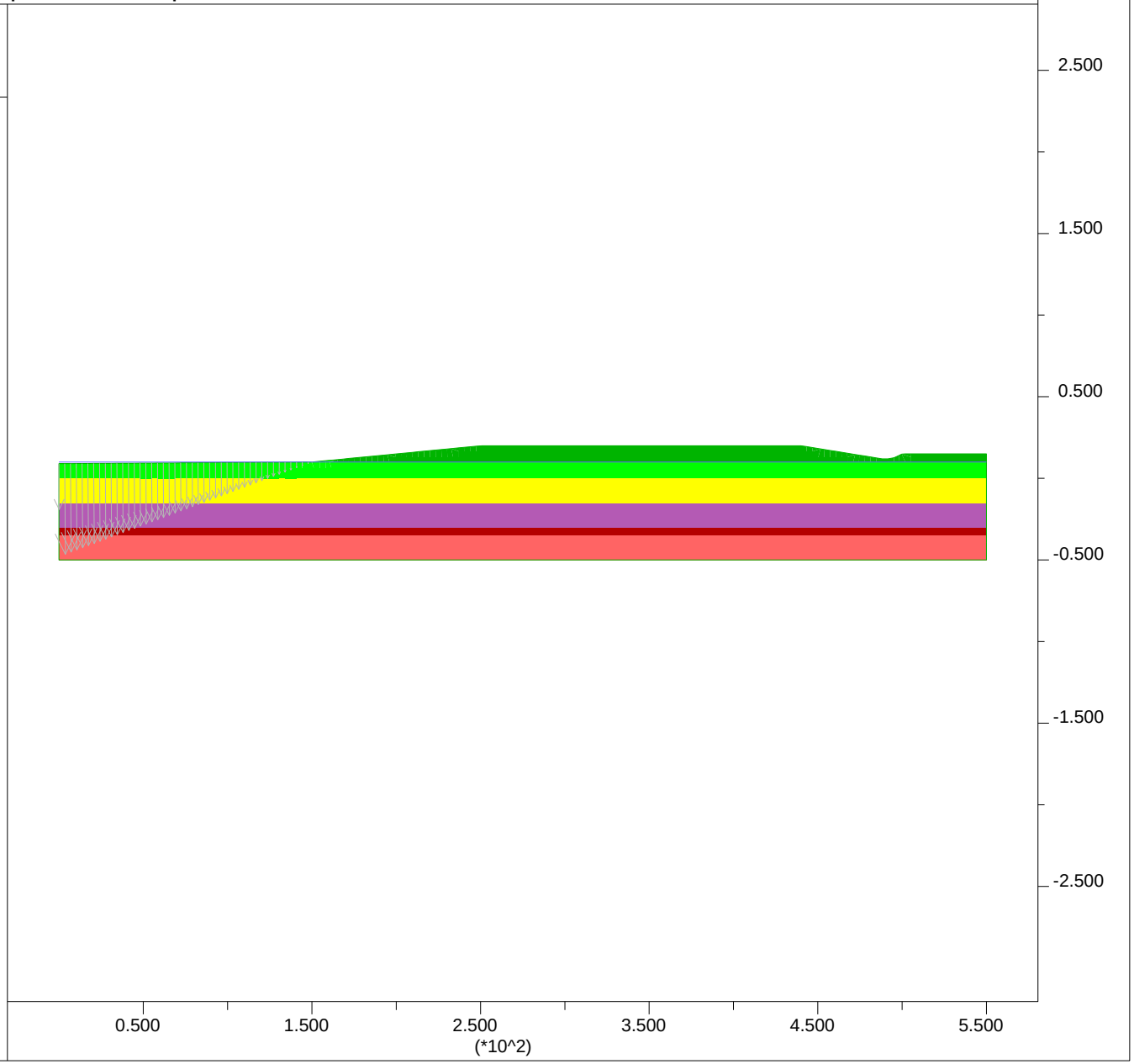


PLATE G-39

JOB TITLE : Section B-B' - Ky=0.08

FLAC/SLOPE (Version 7.00)

LEGEND

26-Mar-13 14:11

Factor of Safety 1.01

Shear Strain Rate Contours

- 2.50E-07
- 5.00E-07
- 7.50E-07
- 1.00E-06
- 1.25E-06
- 1.50E-06
- 1.75E-06
- 2.00E-06

Contour interval= 2.50E-07
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands

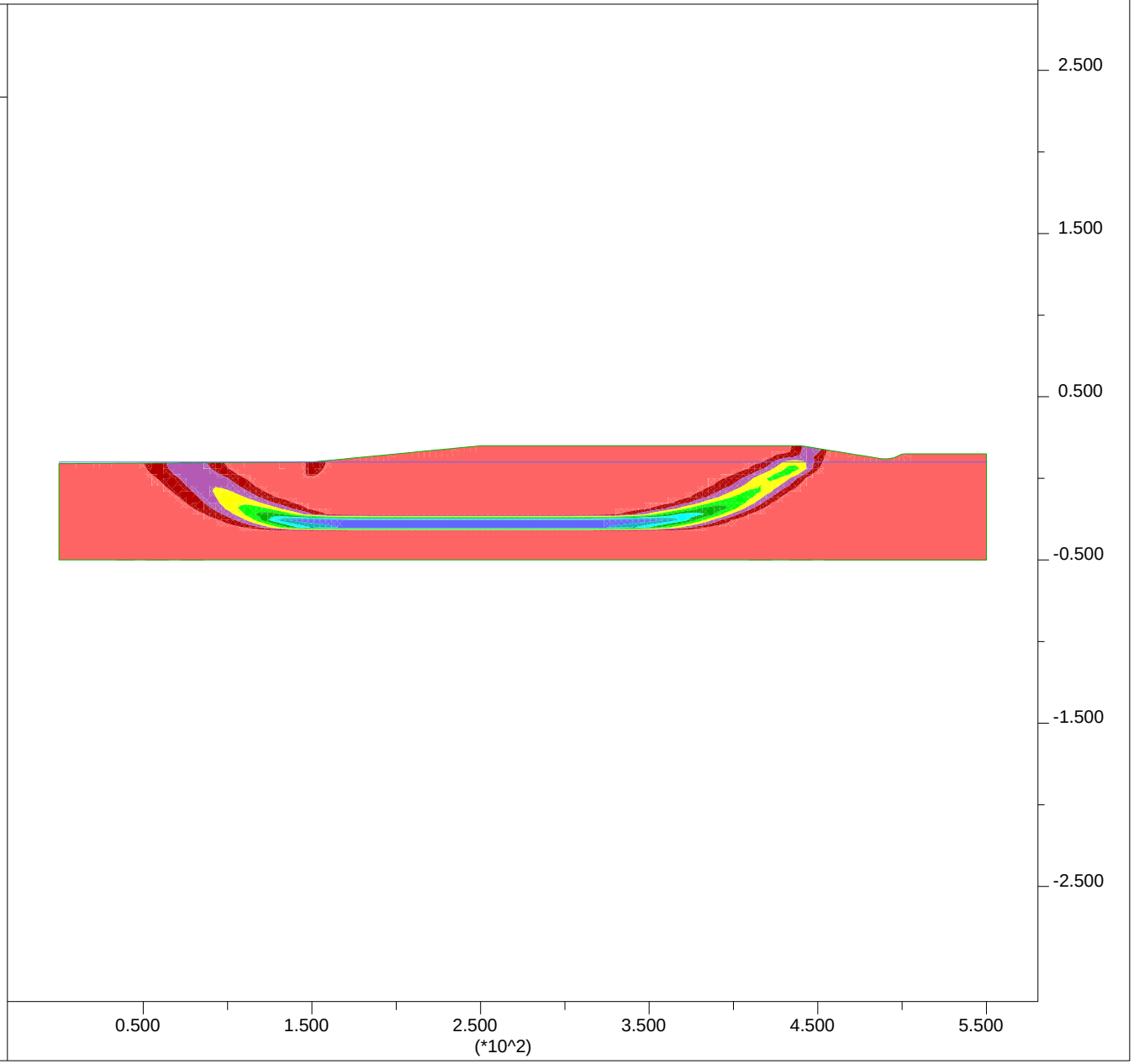


PLATE G-40

JOB TITLE : Section B-B' - Ky=0.08 Input

FLAC/SLOPE (Version 7.00)

LEGEND

26-Mar-13 14:12

Factor of Safety 1.01

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Liq Sand'
- 'User:Soft Clay'
- 'User:Liq Fill'
- User:Embankment

Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands

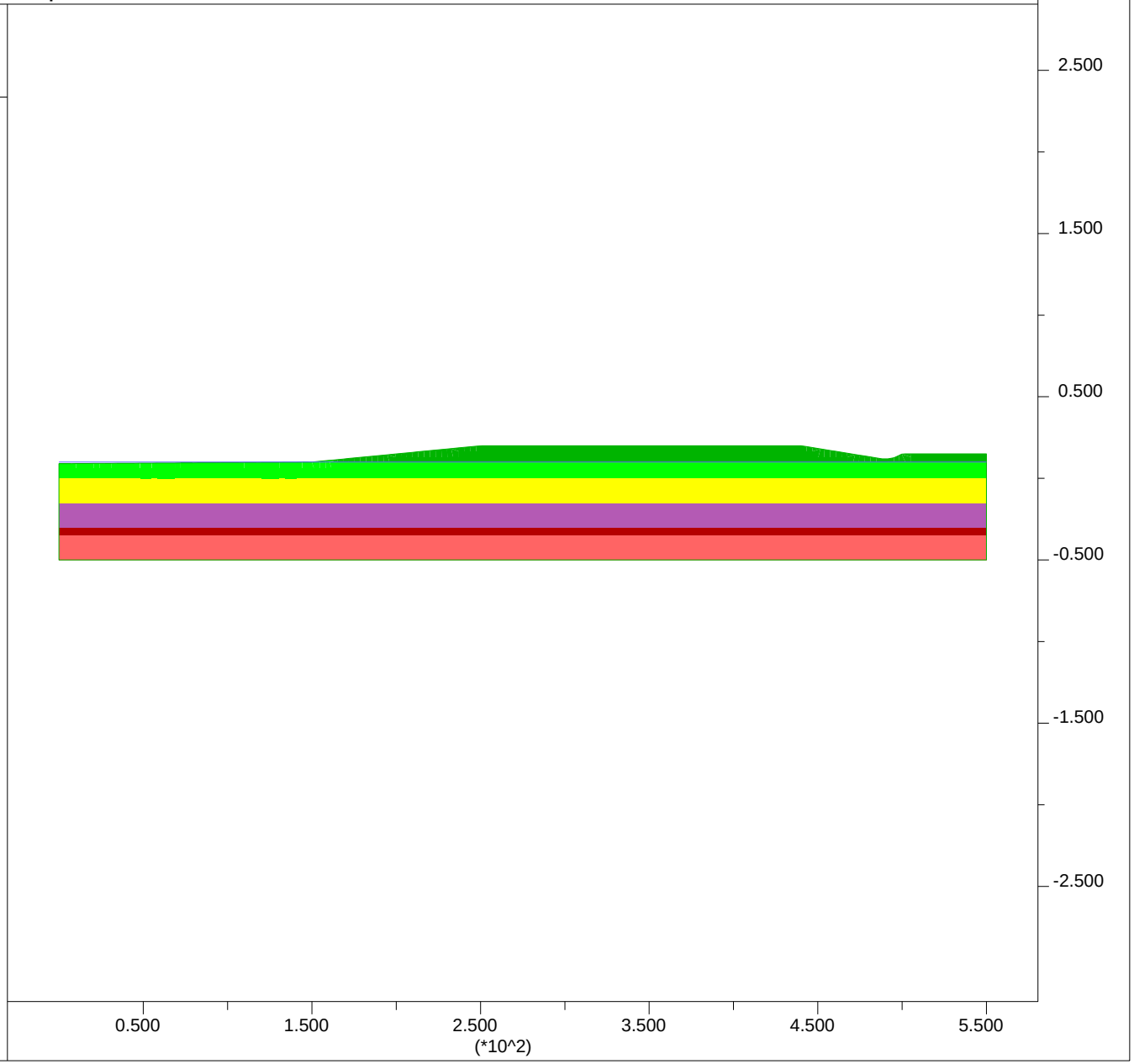


PLATE G-41

Newmark Displacements using Bray and Rathje (1998):

Section B-B'

Site Input				
PGA,rock =	0.25	g		
M =	6.6			
r =	13	km		
ky =	0.08		32.185	2.5748
Sliding Mass Input				
Vs =	150	m/s	assumed	
Thickness, H =	15.3	m		
	50	ft		
Output				
Tm =	0.49	sec		
D5-95 =	10.5	sec		
Ts =	0.41	sec		
NRF =	1.15			
Ts/Tm =	0.83			
kmax/(PGA,rock*NRF)	0.62			
kmax =	0.18			
ky / kmax =	0.45			
Displacement, u =	4	cm	0.1	feet
			1.5	inches

PLATE G-42

JOB TITLE : Section C-C' -End of Construction

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 16:16

Factor of Safety 3.45

Shear Strain Rate Contours

- 2.00E-07
- 4.00E-07
- 6.00E-07
- 8.00E-07
- 1.00E-06
- 1.20E-06

Contour interval= 2.00E-07
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands

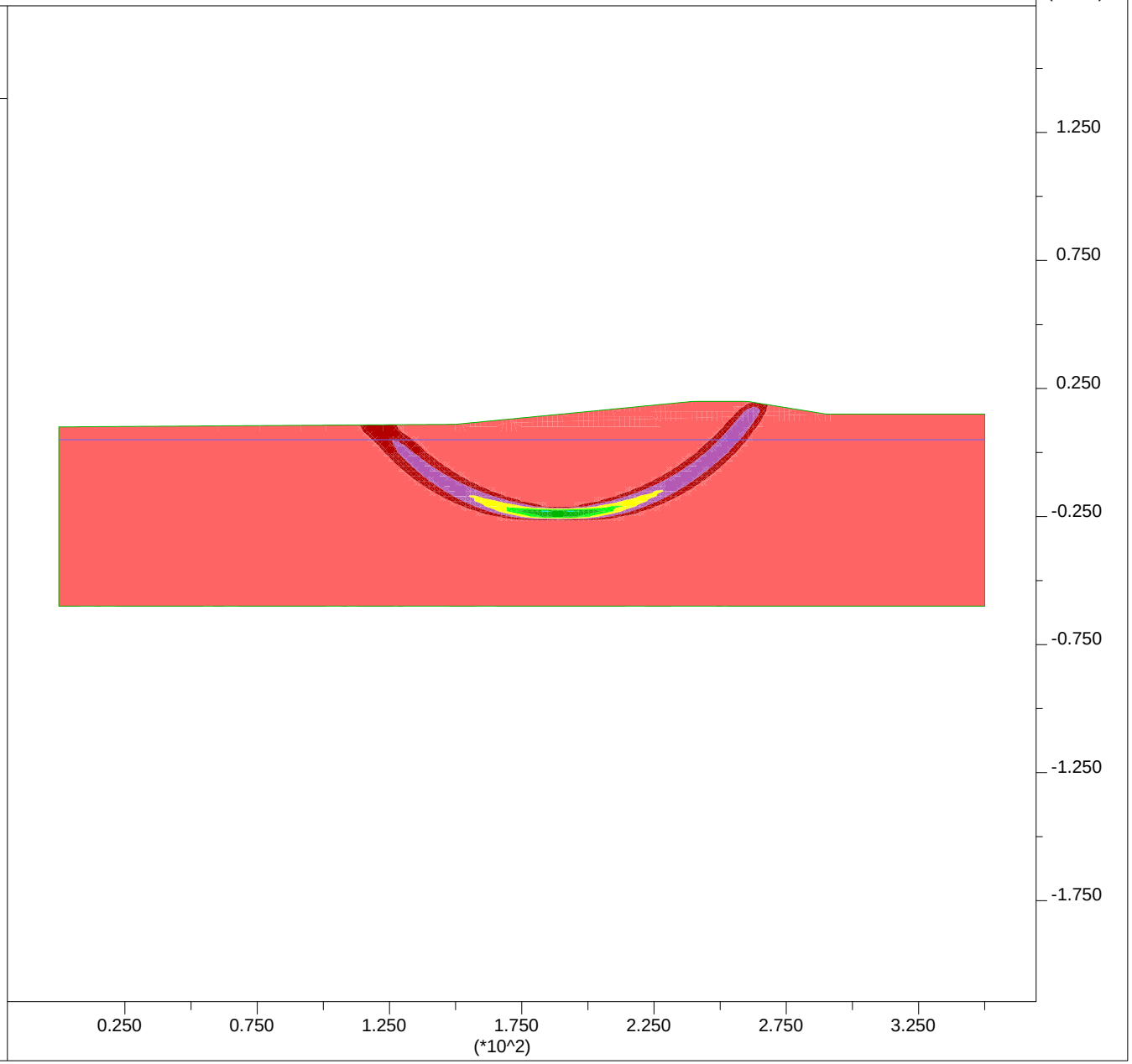


PLATE G-43

JOB TITLE : Section C-C' -End of Construction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 16:17

Factor of Safety 3.45

User-defined Groups
- User:Sand
- 'User:Stiff Clay'
- 'User:Soft Clay'
- User:Fill
- User:Embankment

Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands

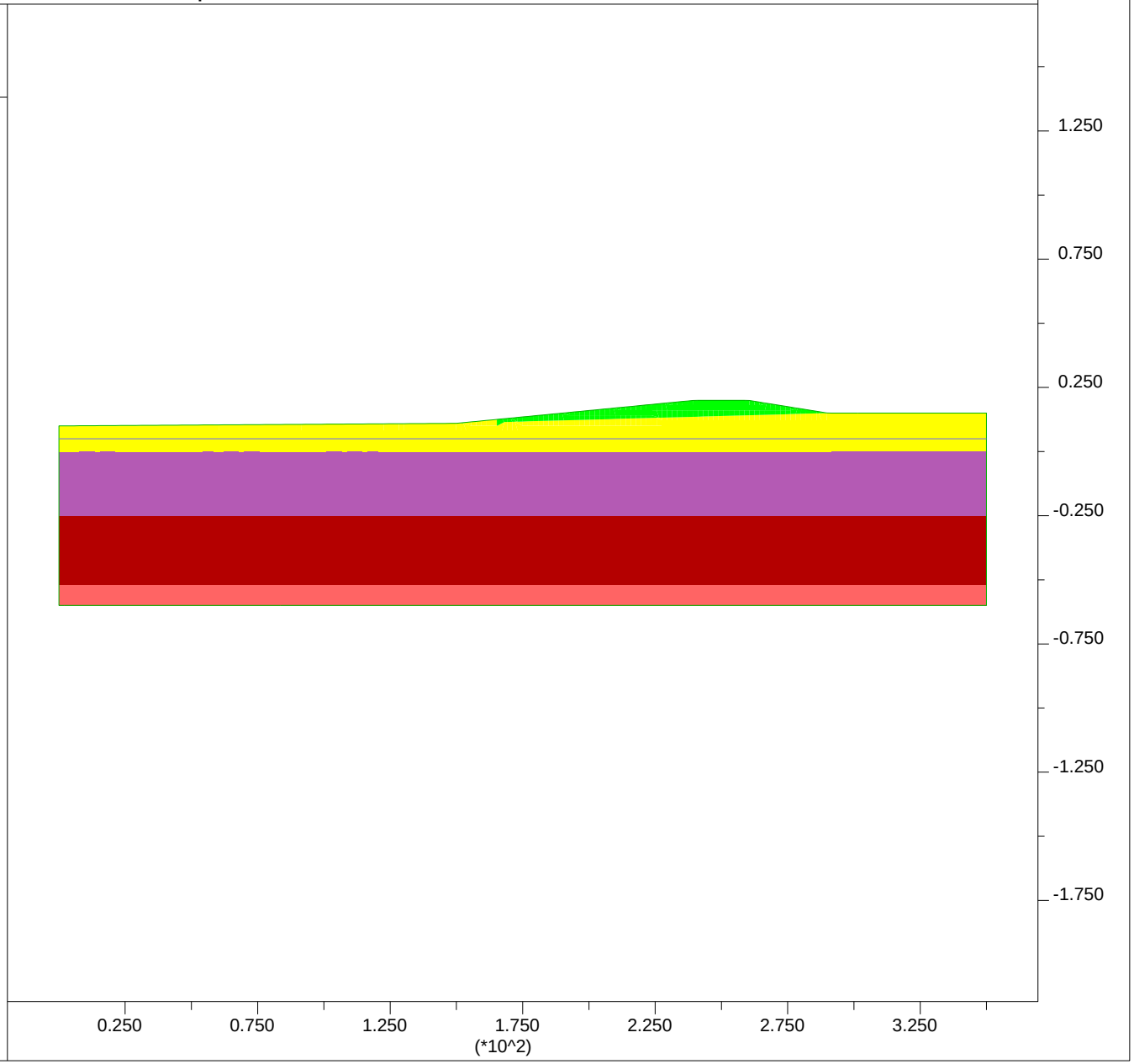


PLATE G-44

JOB TITLE : Section C-C' - High Water Short Term

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 17:38

Factor of Safety 5.28

Shear Strain Rate Contours

- 2.50E-08
- 5.00E-08
- 7.50E-08
- 1.00E-07
- 1.25E-07
- 1.50E-07
- 1.75E-07
- 2.00E-07

Contour interval= 2.50E-08
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 8.486E+02

0 2E 3

Group Delta Consultants
Ballona Wetlands

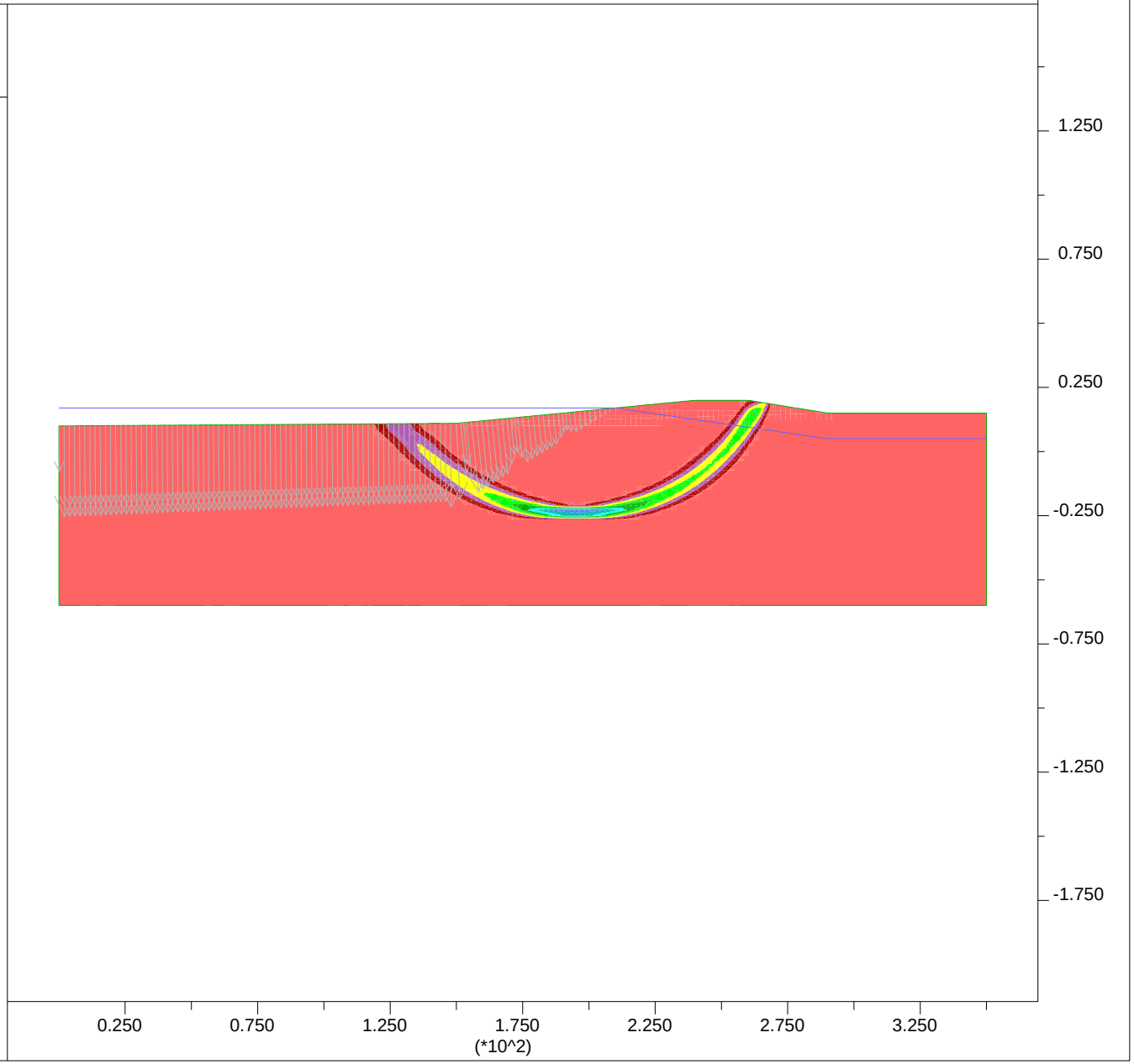


PLATE G-45

JOB TITLE : Section C-C' - High Water Short Term - Input

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 17:38

Factor of Safety 5.28

User-defined Groups
- User:Sand
- 'User:Stiff Clay'
- 'User:Soft Clay'
- User:Fill
- User:Embankment

Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 8.486E+02

0 2E 3

Group Delta Consultants
Ballona Wetlands

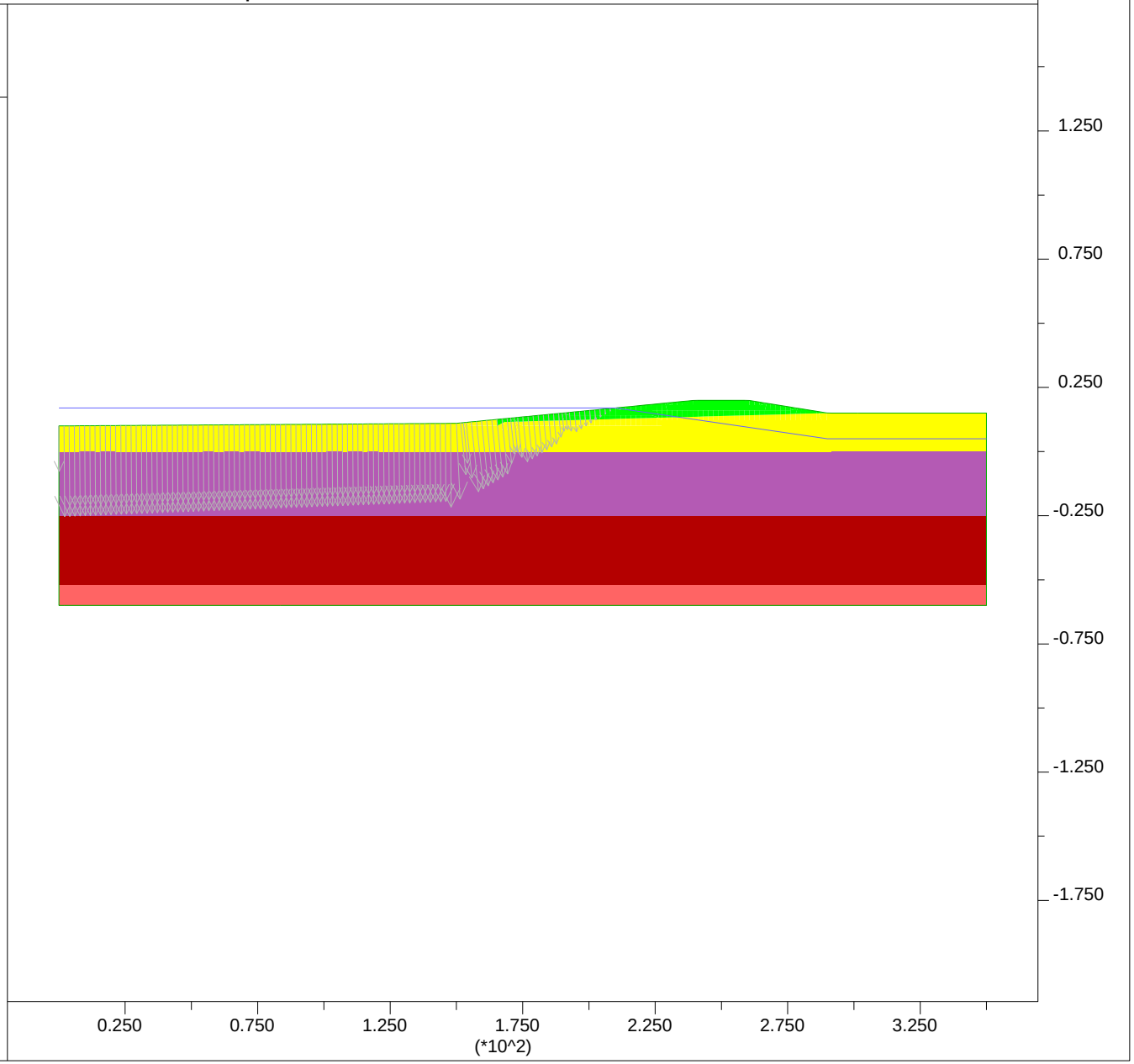


PLATE G-46

JOB TITLE : Section C-C' - Post Liquefaction

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 18:09

Factor of Safety 2.42

Shear Strain Rate Contours

- 2.50E-07
- 5.00E-07
- 7.50E-07
- 1.00E-06
- 1.25E-06
- 1.50E-06

Contour interval= 2.50E-07
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands

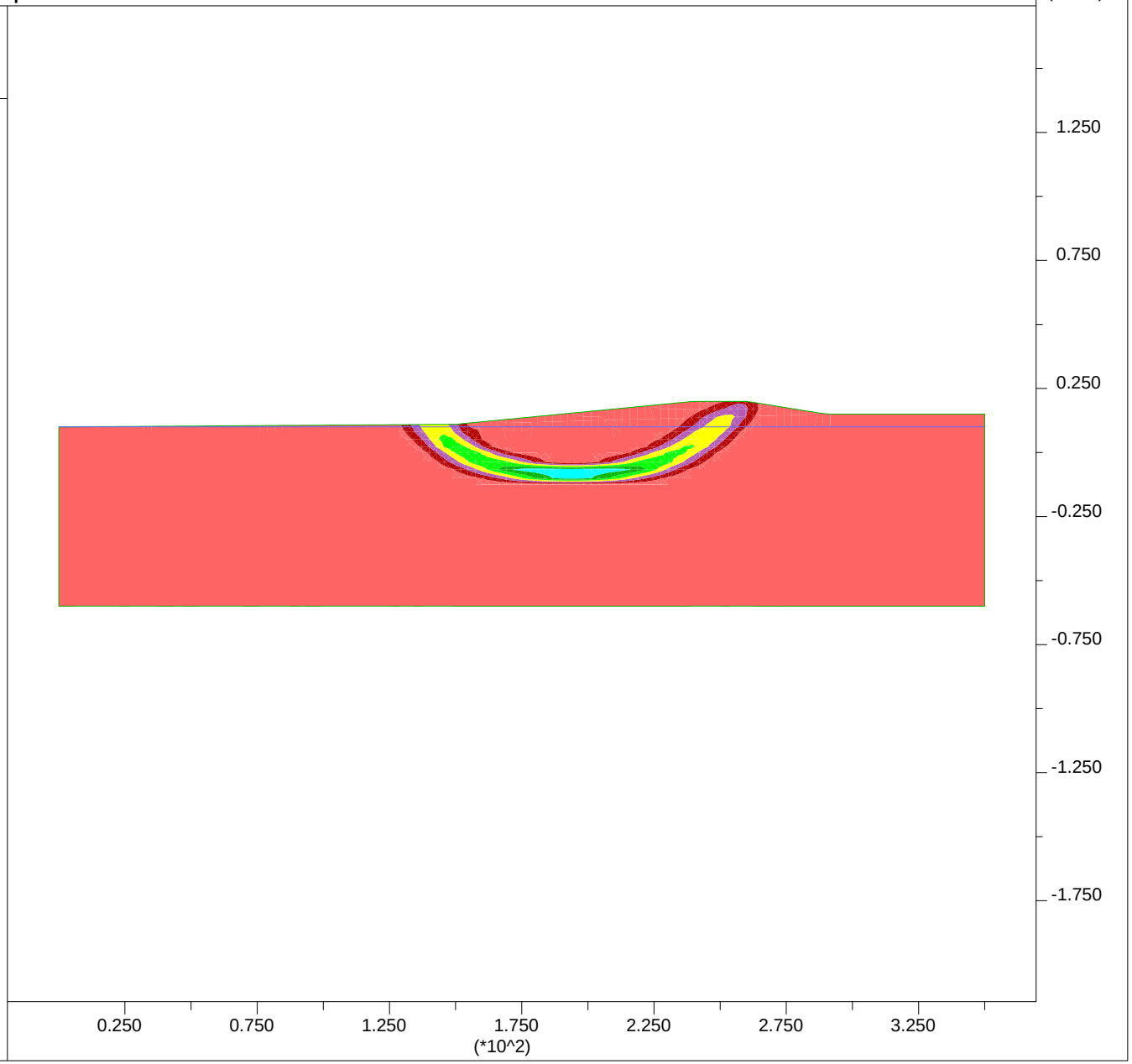


PLATE G-47

JOB TITLE : Section C-C' - Post Liquefaction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 18:09

Factor of Safety 2.42

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Liq Sand Deep'
- 'User:Liq Sand 2'
- 'User:Soft Clay'
- 'User:Liq Sand Shallow'
- 'User:Liq Fill'
- User:Fill
- User:Embankment

Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands

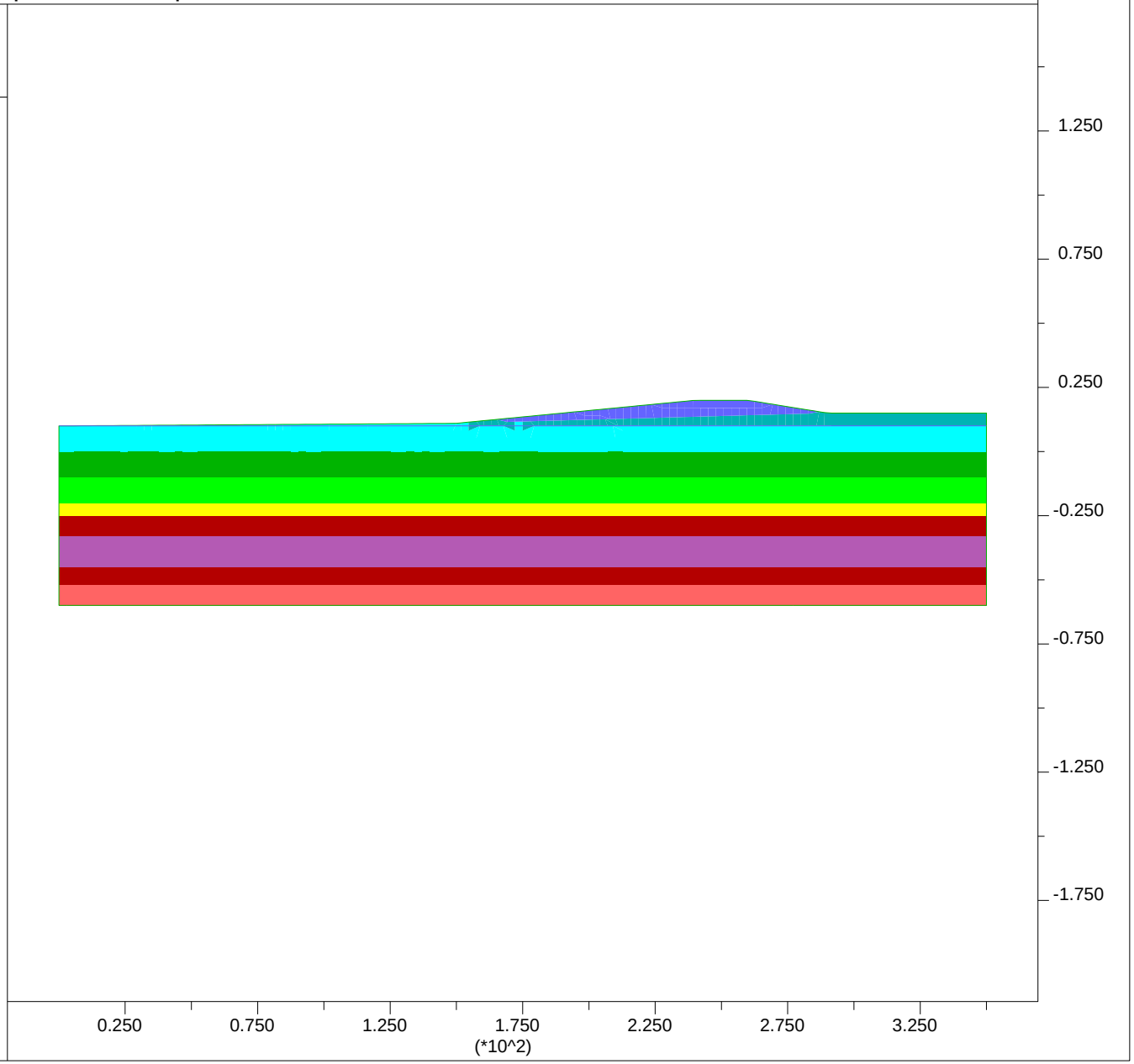


PLATE G-48

JOB TITLE : Section C-C' - Ky=0.1

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 19:11

Factor of Safety 0.99

Shear Strain Rate Contours

- 2.50E-07
- 5.00E-07
- 7.50E-07
- 1.00E-06
- 1.25E-06
- 1.50E-06
- 1.75E-06

Contour interval= 2.50E-07
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands

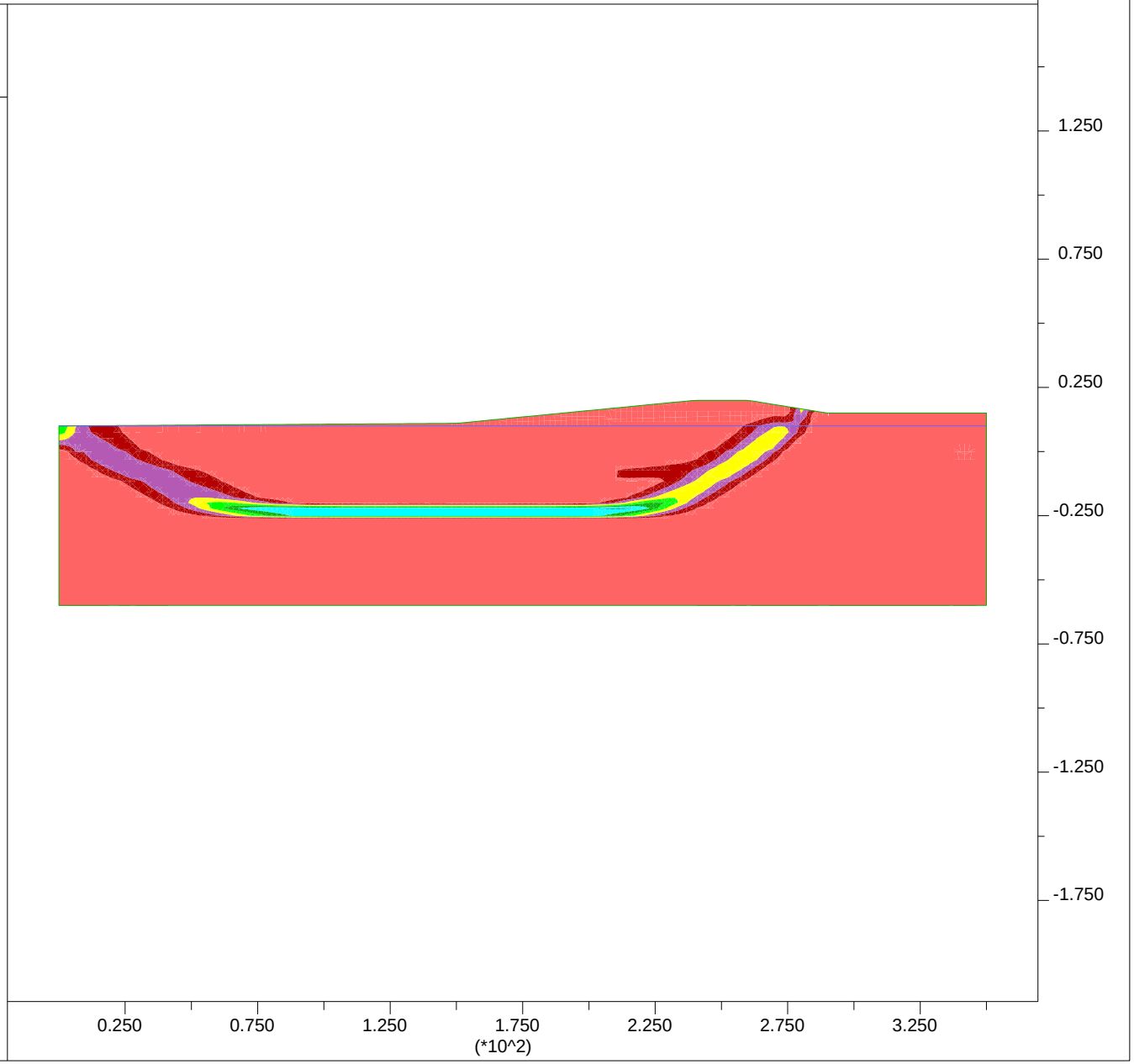


PLATE G-49

JOB TITLE : Section C-C' - Ky=0.1 nput

FLAC/SLOPE (Version 7.00)

LEGEND

26-Feb-13 19:14

Factor of Safety 0.99

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Liq Sand Deep'
- 'User:Liq Sand 2'
- 'User:Soft Clay'
- 'User:Liq Sand Shallow'
- 'User:Liq Fill'
- User:Fill
- User:Embankment

Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands

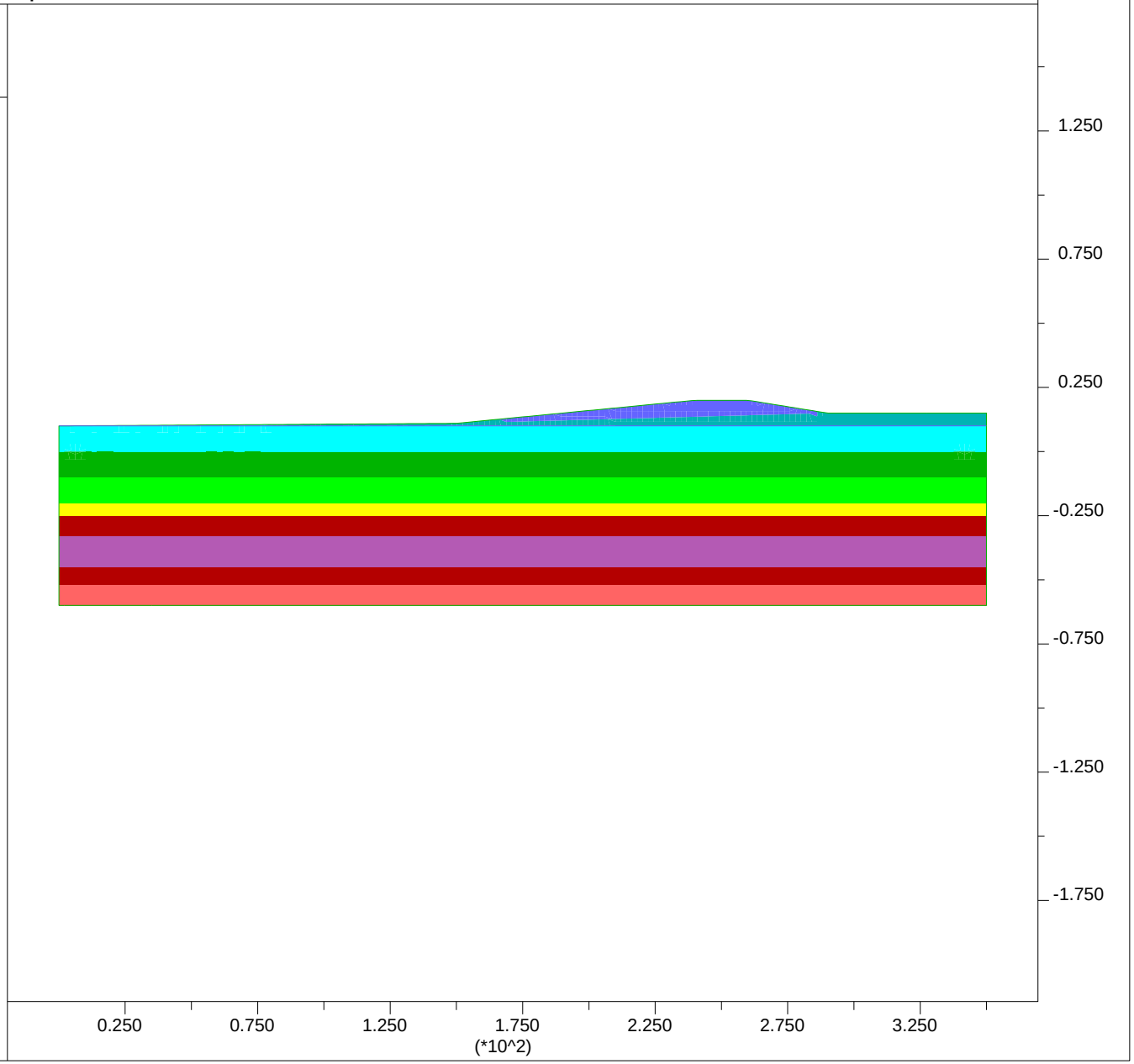


PLATE G-50

Newmark Displacements using Bray and Rathje (1998):

Section C-C'

Site Input

PGA,rock =	0.25	g	
M =	6.6		
r =	13	km	
ky =	0.1		
Sliding Mass Input			
Vs =	150	m/s	assumed
Thickness, H =	12.2	m	
	40	ft	

Output

Tm =	0.49	sec				
D5-95 =	10.5	sec				
Ts =	0.33	sec				
NRF =	1.15					
Ts/Tm =	0.67					
kmax/(PGA,rock*NRF)	0.74					
kmax =	0.21					
ky / kmax =	0.47					
Displacement, u =	4	cm	0.1	feet	1.5	inches

PLATE G-51

JOB TITLE : Section D-D' - End of Construction

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 9:18

Factor of Safety 1.49

Shear Strain Rate Contours

1.00E-06
2.00E-06
3.00E-06
4.00E-06
5.00E-06
6.00E-06
7.00E-06
8.00E-06

Contour interval= 1.00E-06
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 1.366E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands

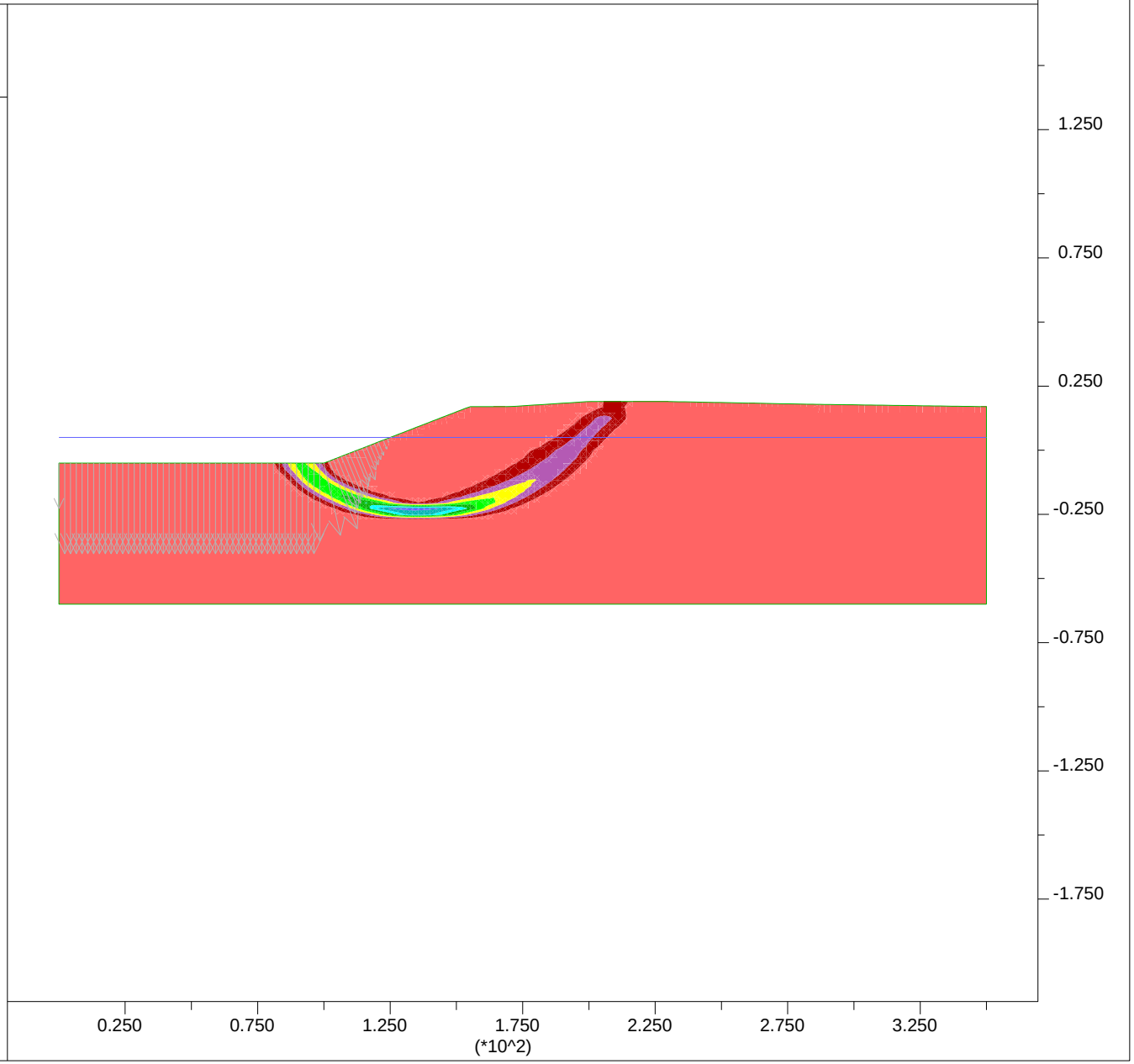


PLATE G-52

JOB TITLE : Section D-D' - End of Construction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 9:18

Factor of Safety 1.49

User-defined Groups
- User:Sand
- 'User:Stiff Clay'
- 'User:Soft Clay'
- User:Fill

Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 1.366E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands

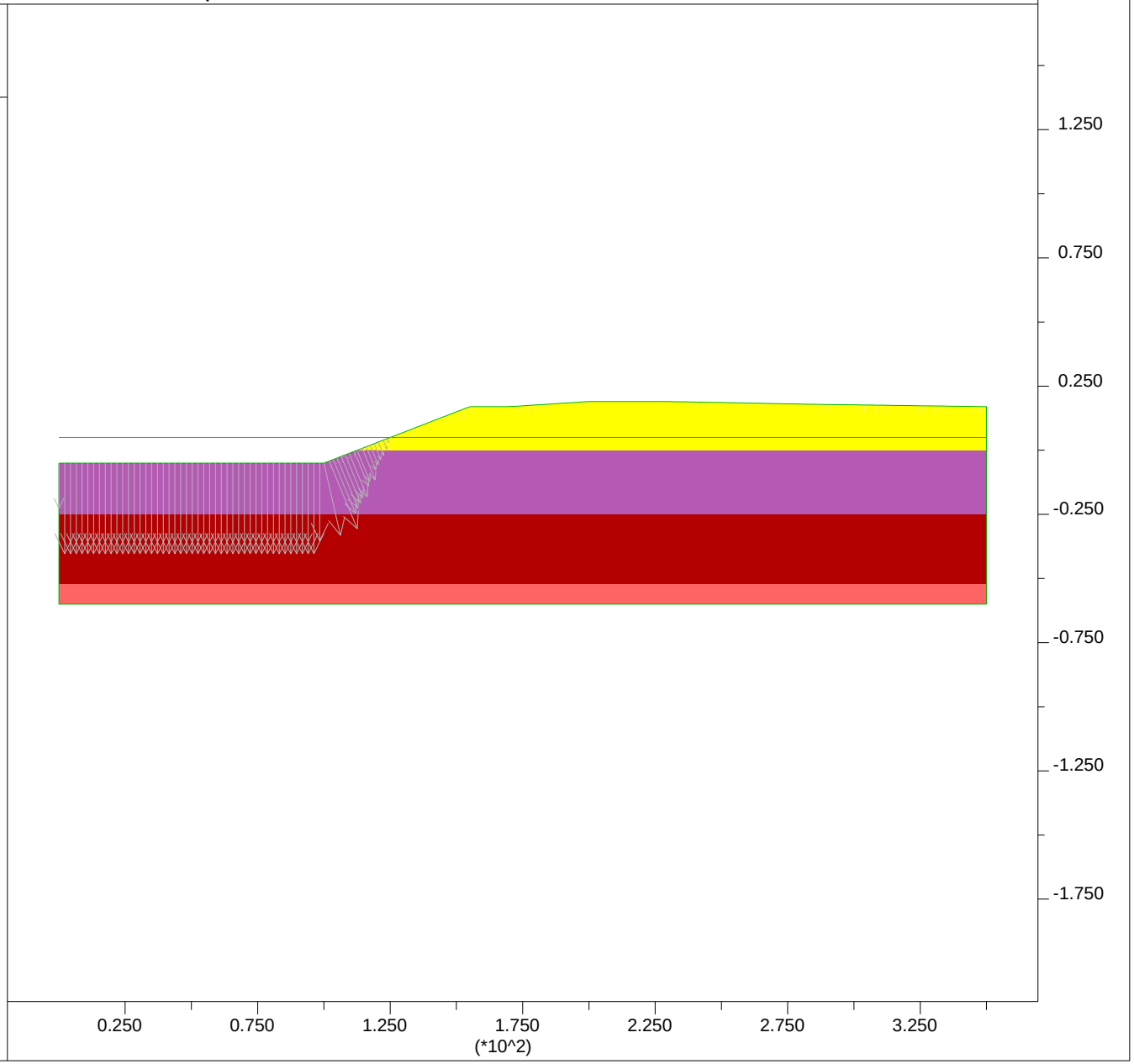


PLATE G-53

JOB TITLE : Section D-D' - High Water Short Term

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 9:19

Factor of Safety 2.28

Shear Strain Rate Contours

- 5.00E-07
- 1.00E-06
- 1.50E-06
- 2.00E-06
- 2.50E-06
- 3.00E-06
- 3.50E-06
- 4.00E-06

Contour interval= 5.00E-07
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 2.733E+03

0 3E 3

Group Delta Consultants
Ballona Wetlands

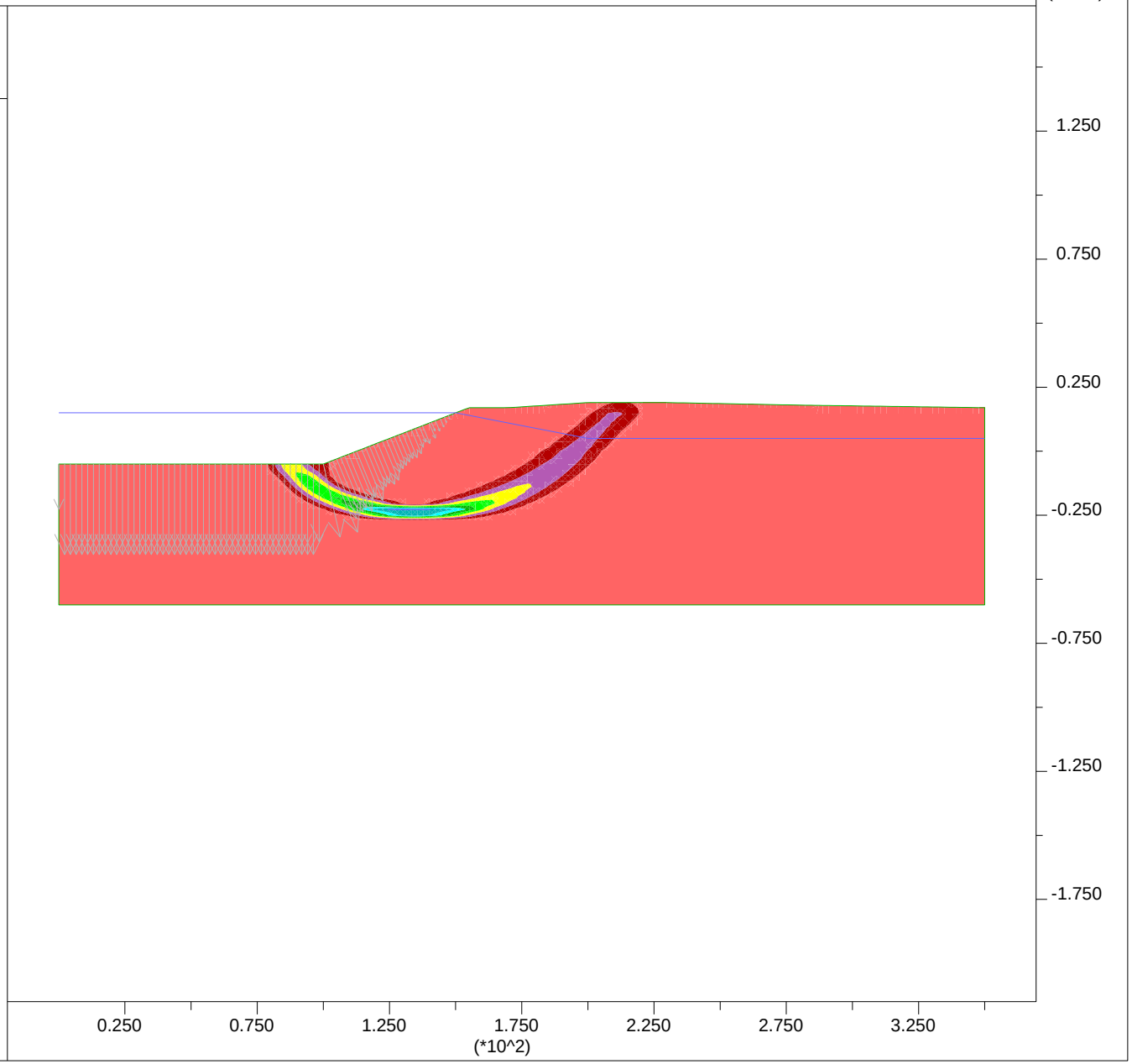


PLATE G-54

JOB TITLE : Section D-D' - High Water Short Term - Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 9:20

Factor of Safety 2.28

User-defined Groups
- User:Sand
- 'User:Stiff Clay'
- 'User:Soft Clay'
- User:Fill

Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 2.733E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands

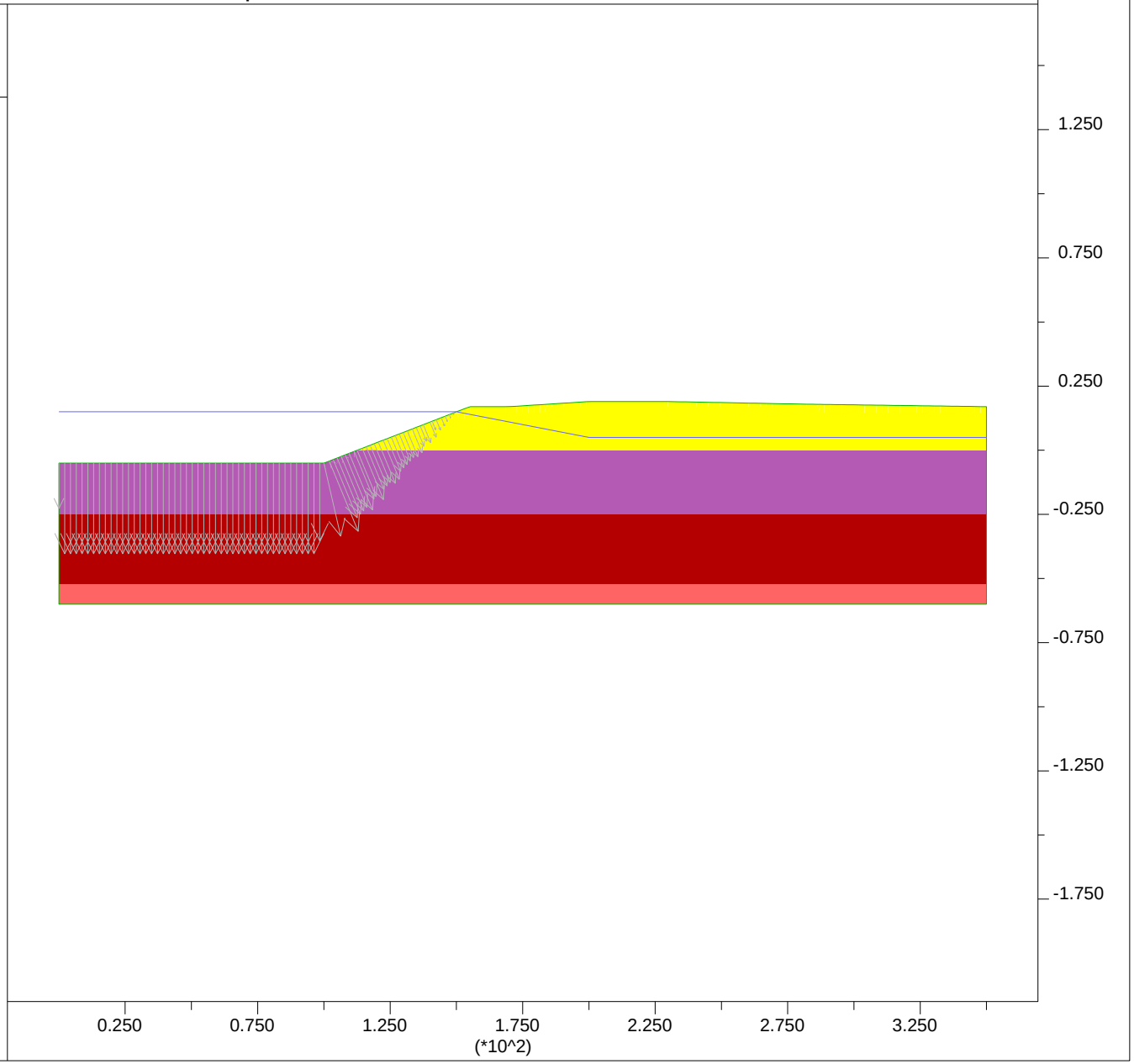


PLATE G-55

JOB TITLE : Section D-D' - Post Liquefaction

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 9:21

Factor of Safety 1.29

Shear Strain Rate Contours

- 2.50E-07
- 5.00E-07
- 7.50E-07
- 1.00E-06
- 1.25E-06
- 1.50E-06
- 1.75E-06
- 2.00E-06

Contour interval= 2.50E-07
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 2.050E+03

0 3E 3

Group Delta Consultants
Ballona Wetlands

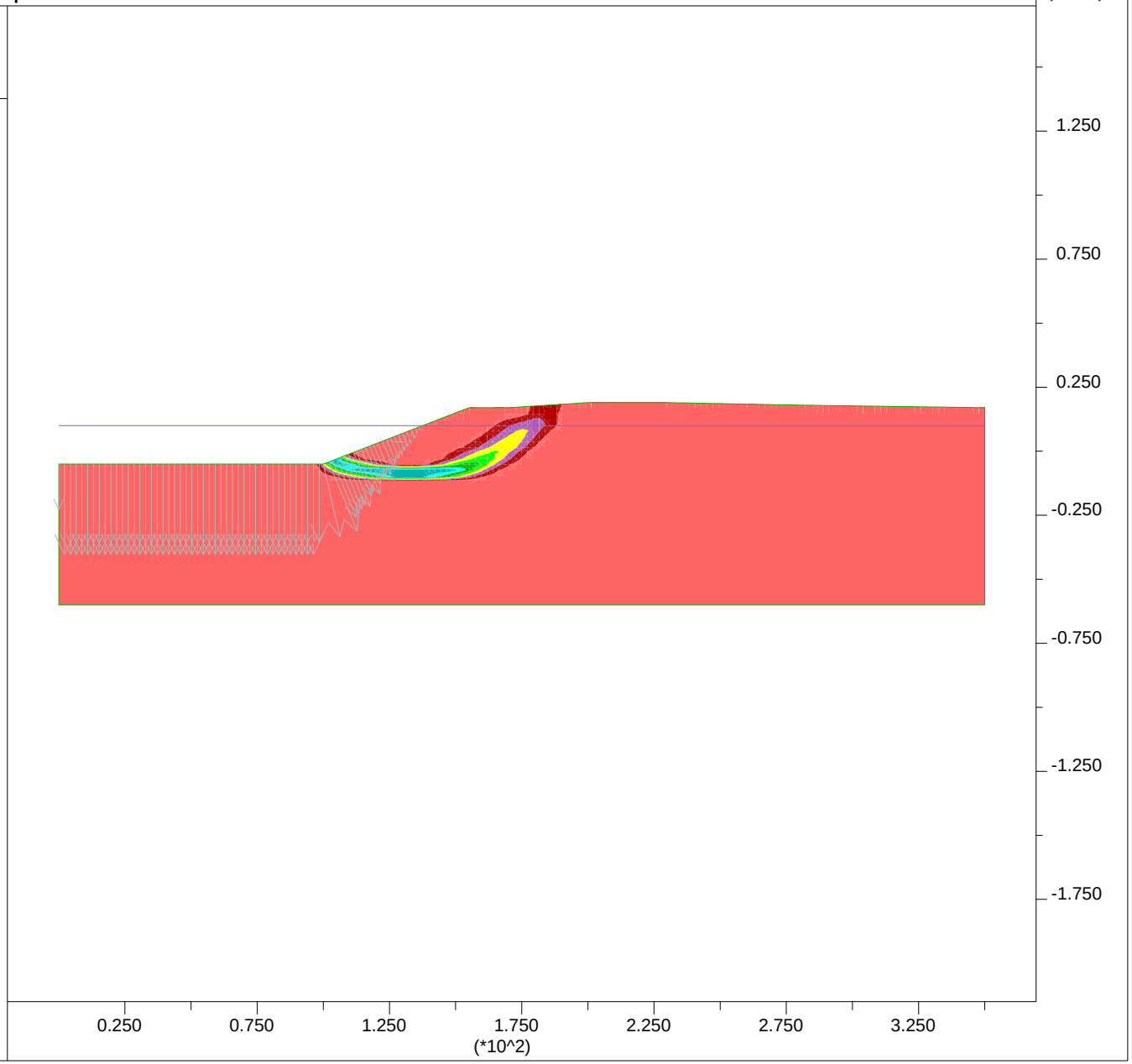


PLATE G-56

JOB TITLE : Section D-D' - Post Liquefaction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 9:22

Factor of Safety 1.29

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Liq Sand Deep'
- 'User:Liq Sand 2'
- 'User:Soft Clay'
- 'User:Liq Sand Shallow'
- User:LiqFill
- User:Fill

Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 2.050E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands

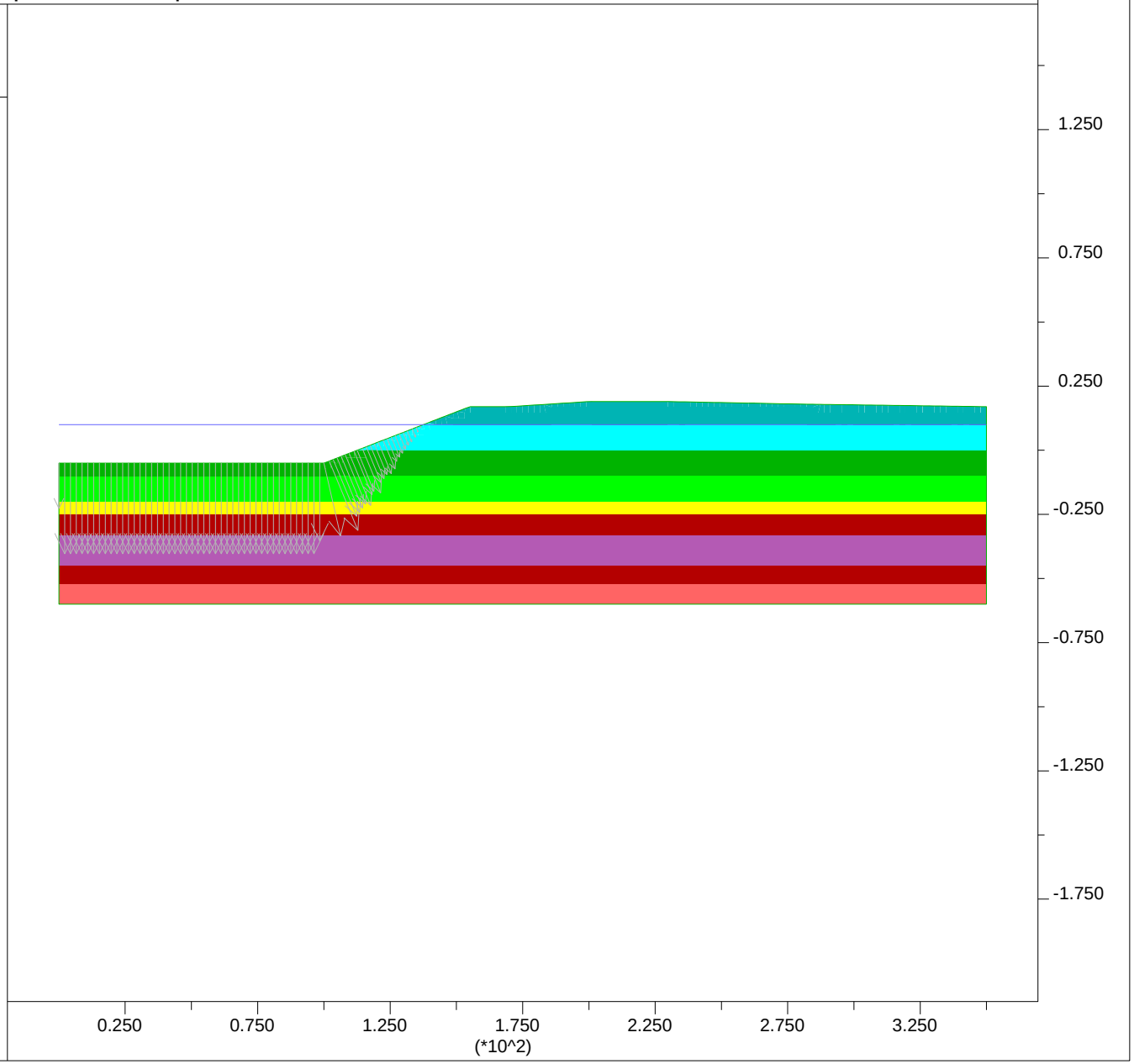


PLATE G-57

JOB TITLE : Section D-D' - Ky=0.05

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 9:25

Factor of Safety 1.00

Shear Strain Rate Contours

- 1.00E-07
- 2.00E-07
- 3.00E-07
- 4.00E-07
- 5.00E-07
- 6.00E-07
- 7.00E-07
- 8.00E-07

Contour interval= 1.00E-07
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 2.052E+03

0 3E 3

Group Delta Consultants
Ballona Wetlands

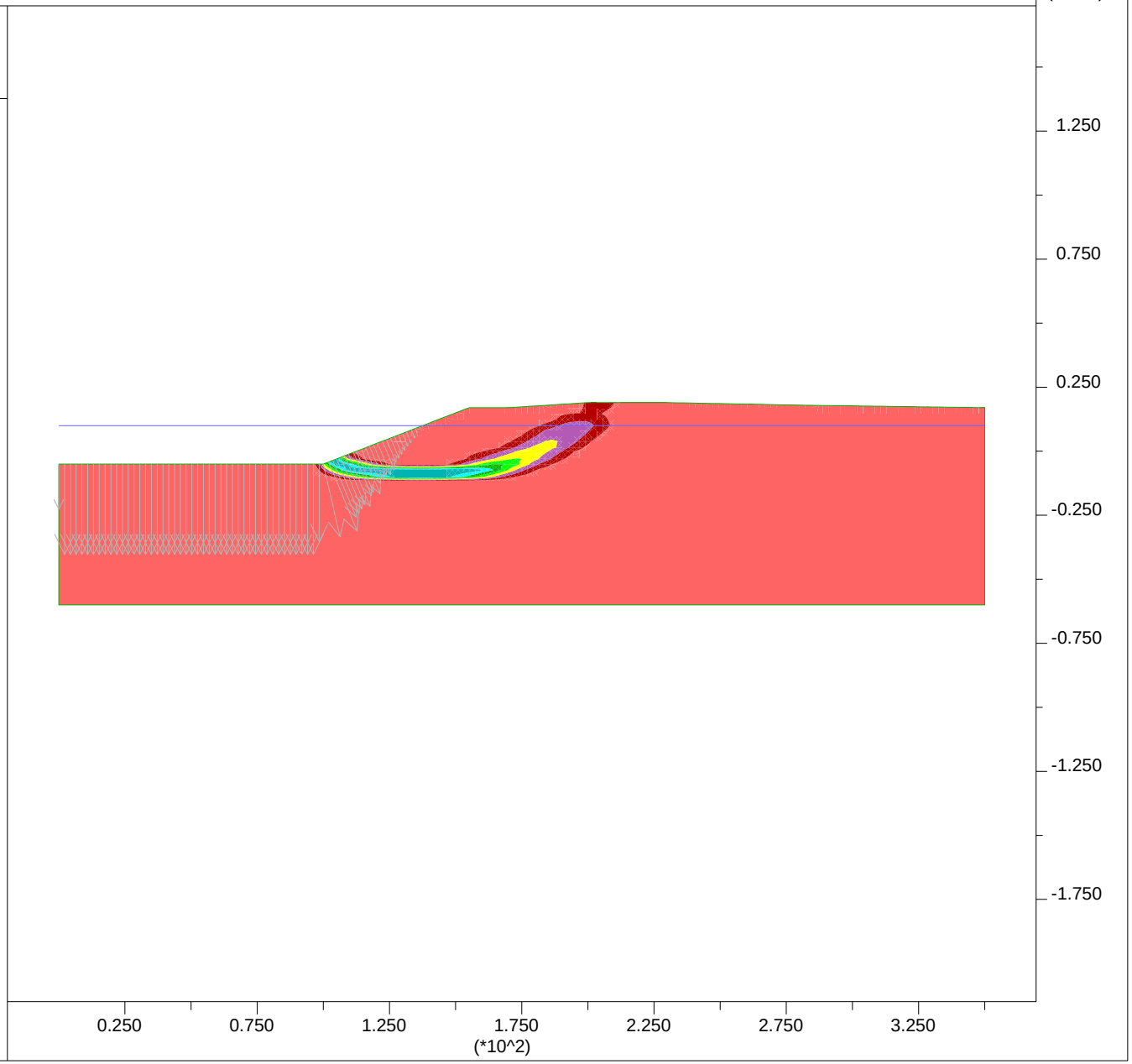


PLATE G-58

JOB TITLE : Section D-D' - Ky=0.05 - Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 9:24

Factor of Safety 1.00

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Liq Sand Deep'
- 'User:Liq Sand 2'
- 'User:Soft Clay'
- 'User:Liq Sand Shallow'
- User:LiqFill
- User:Fill

Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 2.052E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands

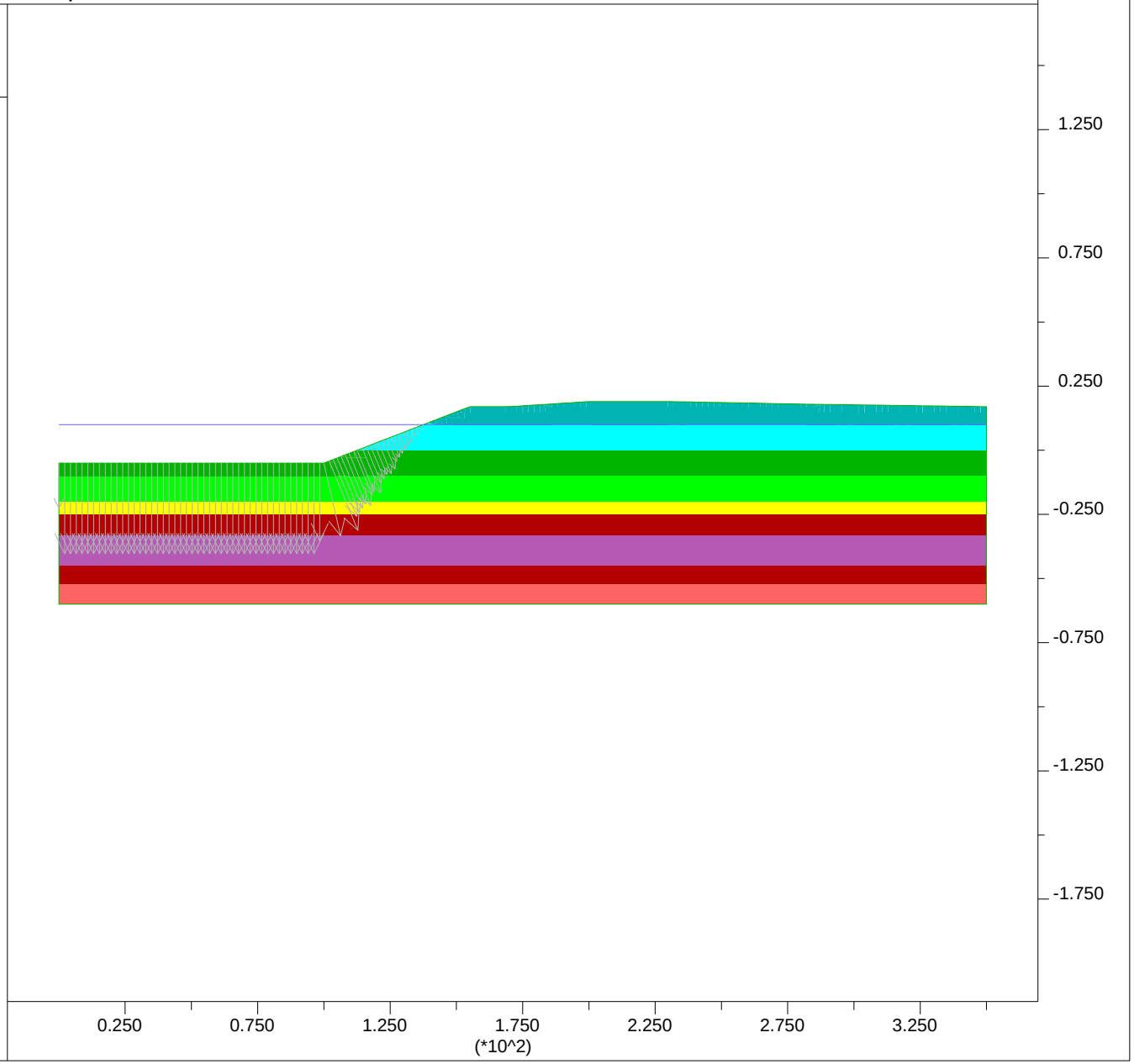


PLATE G-59

Newmark Displacements using Bray and Rathje (1998):

Section D-D'

Site Input				
PGA,rock =	0.25	g		
M =	6.6			
r =	13	km		
ky =	0.05		32.185	1.60925
Sliding Mass Input				
Vs =	137	m/s	assumed	
Thickness, H =	8.2	m		
	27	ft		
Output				
Tm =	0.49	sec		
D5-95 =	10.5	sec		
Ts =	0.24	sec		
NRF =	1.15			
Ts/Tm =	0.49			
kmax/(PGA,rock*NRF)	0.93			
kmax =	0.27			
ky / kmax =	0.19			
Displacement, u =	47	cm	1.5	feet
			18.4	inches

PLATE G-60

JOB TITLE : Section D-D' - Ground Improvement with DSM (ky=0.07)

FLAC (Version 7.00)

LEGEND

5-Mar-13 17:21
step 33918
-1.944E+01 <x< 3.694E+02
-2.149E+02 <y< 1.739E+02

Factor of Safety 0.98

Max. shear strain-rate
0.00E+00
5.00E-07
1.00E-06
1.50E-06
2.00E-06
2.50E-06
3.00E-06
3.50E-06
4.00E-06
4.50E-06

Contour interval= 5.00E-07
Extrap. by averaging
Boundary plot

0 1E 2

Group Delta Consultants
Ballona Wetlands

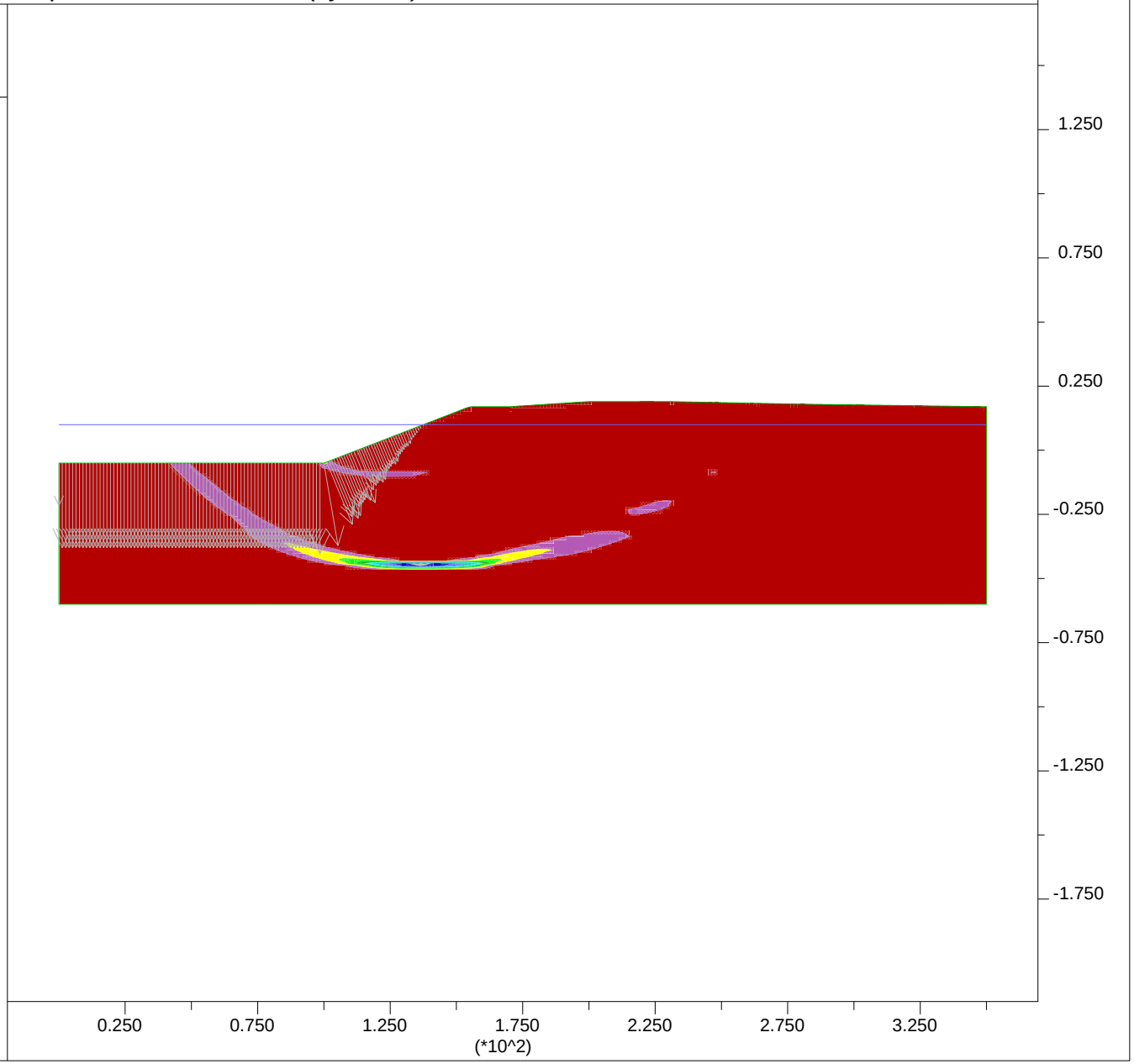


PLATE G-61

JOB TITLE : Section D-D' - Ground Improvement with DSM (ky=0.07) - Input

FLAC (Version 7.00)

LEGEND

5-Mar-13 17:20
step 0
-1.944E+01 <x< 3.694E+02
-2.149E+02 <y< 1.739E+02

User-defined Groups
- User:Sand
- 'User:Stiff Clay'
- 'User:Liq Sand Deep'
- 'User:Liq Sand 2'
- 'User:Soft Clay'
- 'User:Liq Sand Shallow'
- User:LiqFill
- User:Fill
- User:DSM

Net Applied Forces
max vector = 1.301E+03
0 2E 3

Group Delta Consultants
Ballona Wetlands

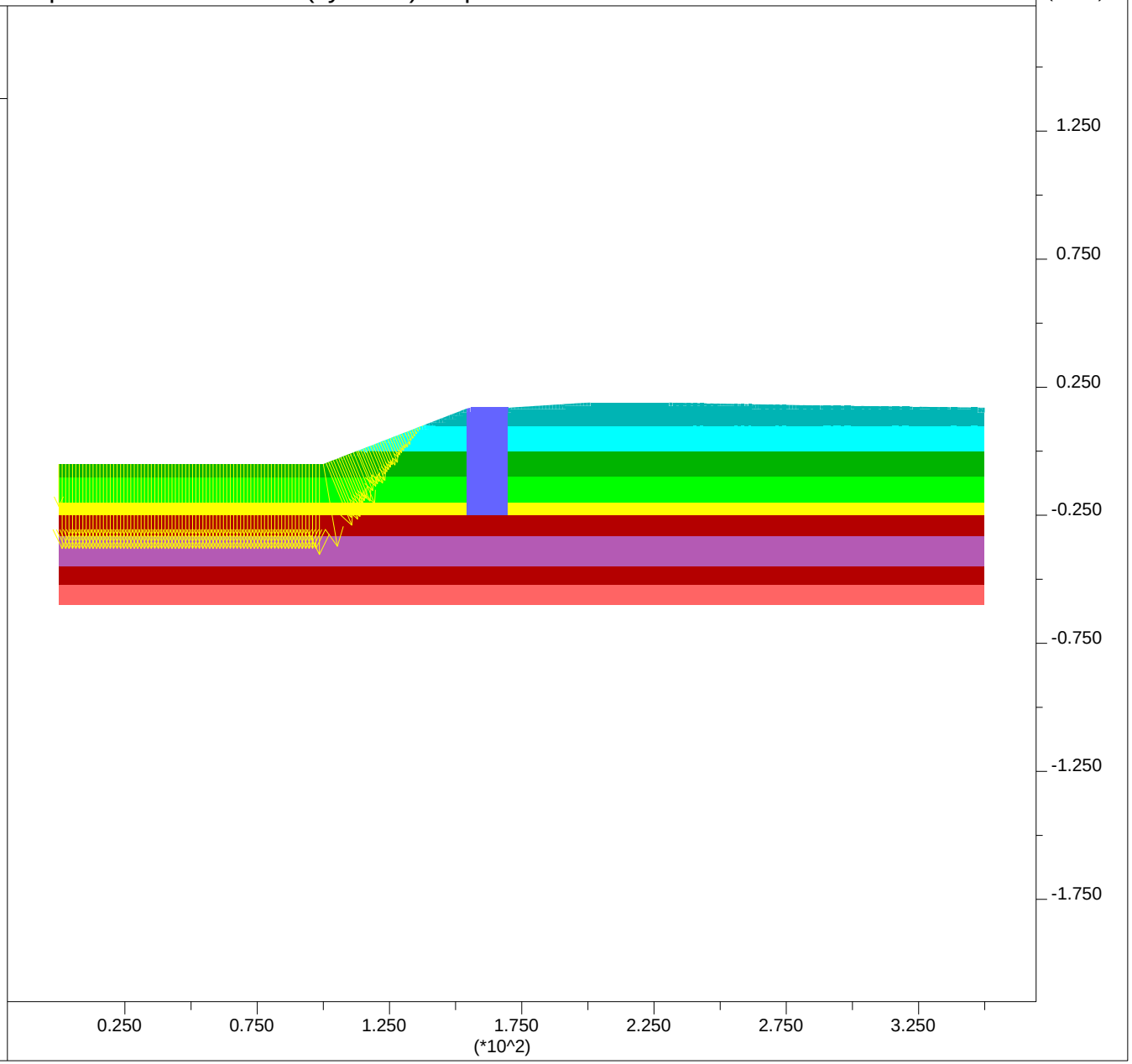


PLATE G-62

JOB TITLE : Section E-E' - End of Construction

FLAC/SLOPE (Version 7.00)

LEGEND

4-Mar-13 17:38

Factor of Safety 1.57

Shear Strain Rate Contours

- 5.00E-07
- 1.00E-06
- 1.50E-06
- 2.00E-06
- 2.50E-06
- 3.00E-06
- 3.50E-06

Contour interval= 5.00E-07
(zero contour omitted)
Boundary plot

0 2E 2

Water Table

Net Applied Forces

max vector = 1.718E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands

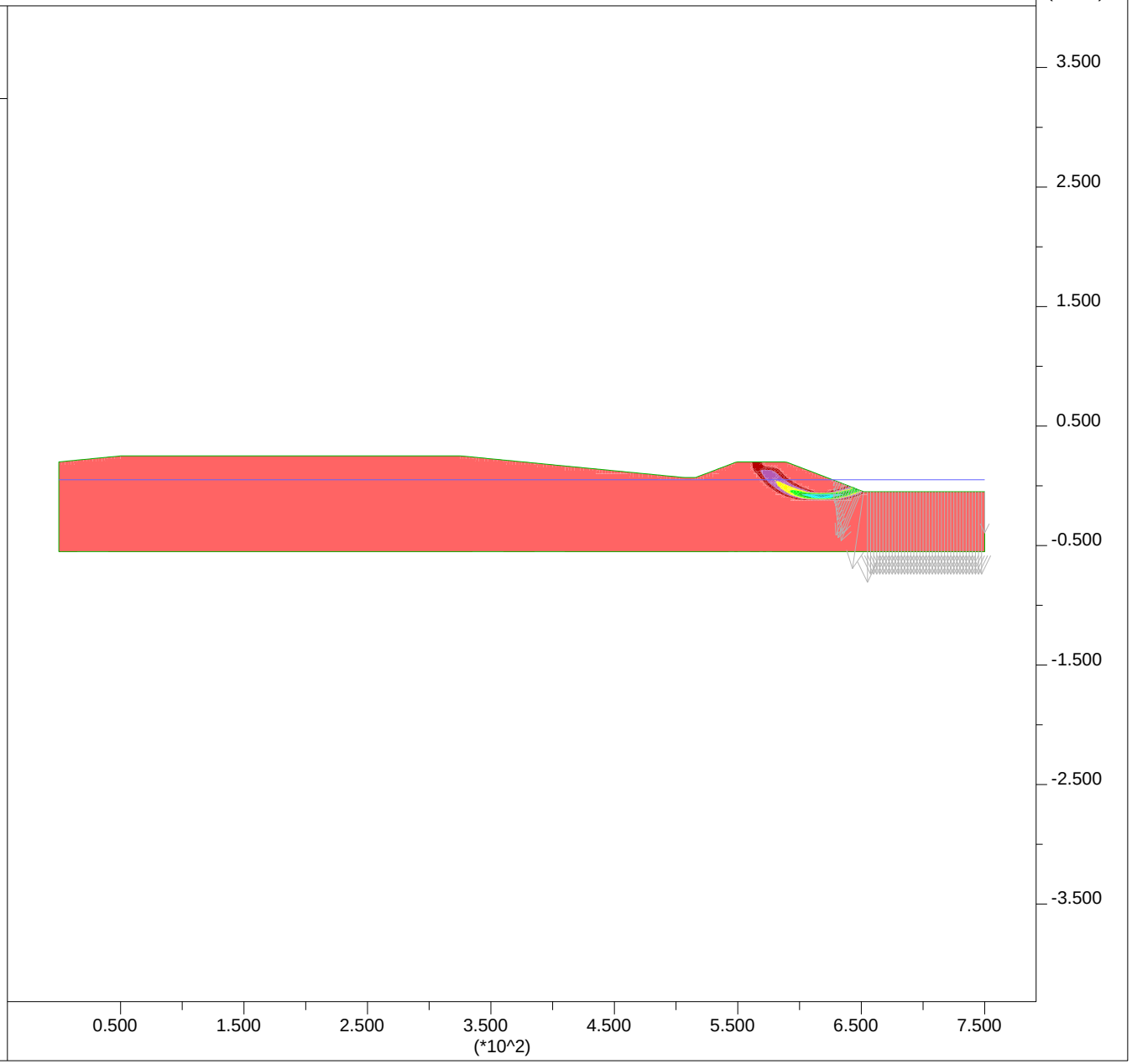


PLATE G-63

JOB TITLE : Section E-E' - End of Construction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

4-Mar-13 17:39

Factor of Safety 1.57

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Med Sand'
- 'User:Soft Clay'
- Fill:Fill
- User:Embankment

Boundary plot

0 2E 2

Water Table

Net Applied Forces

max vector = 1.718E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands

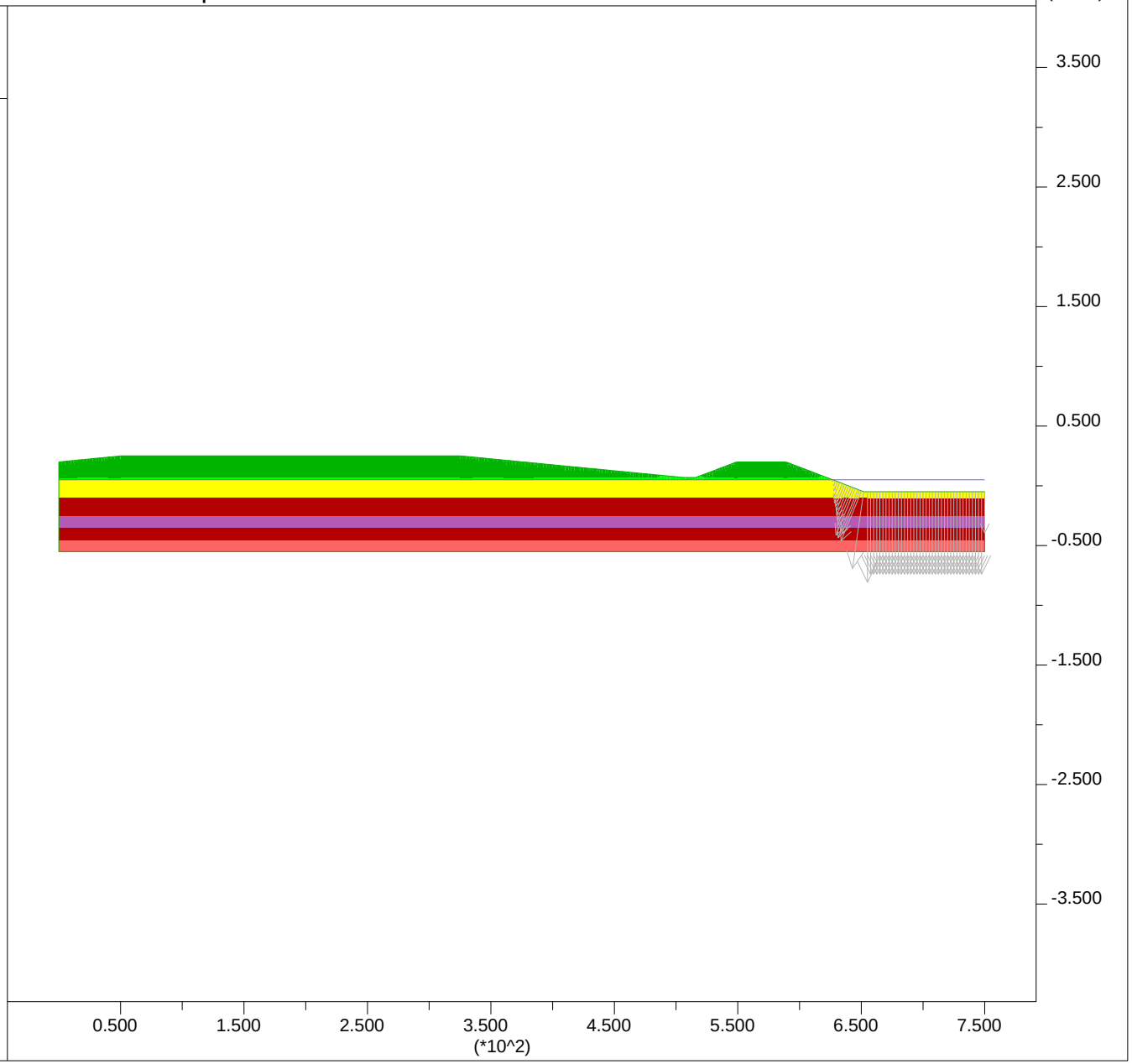


PLATE G-64

JOB TITLE : Section E-E' - High Water Short Term

FLAC/SLOPE (Version 7.00)

LEGEND

4-Mar-13 17:37

Factor of Safety 2.07

Shear Strain Rate Contours

- 1.00E-06
- 2.00E-06
- 3.00E-06
- 4.00E-06
- 5.00E-06
- 6.00E-06
- 7.00E-06

Contour interval= 1.00E-06
(zero contour omitted)
Boundary plot

0 2E 2

Water Table

Net Applied Forces

max vector = 3.779E+03

0 1E 4

Group Delta Consultants
Ballona Wetlands

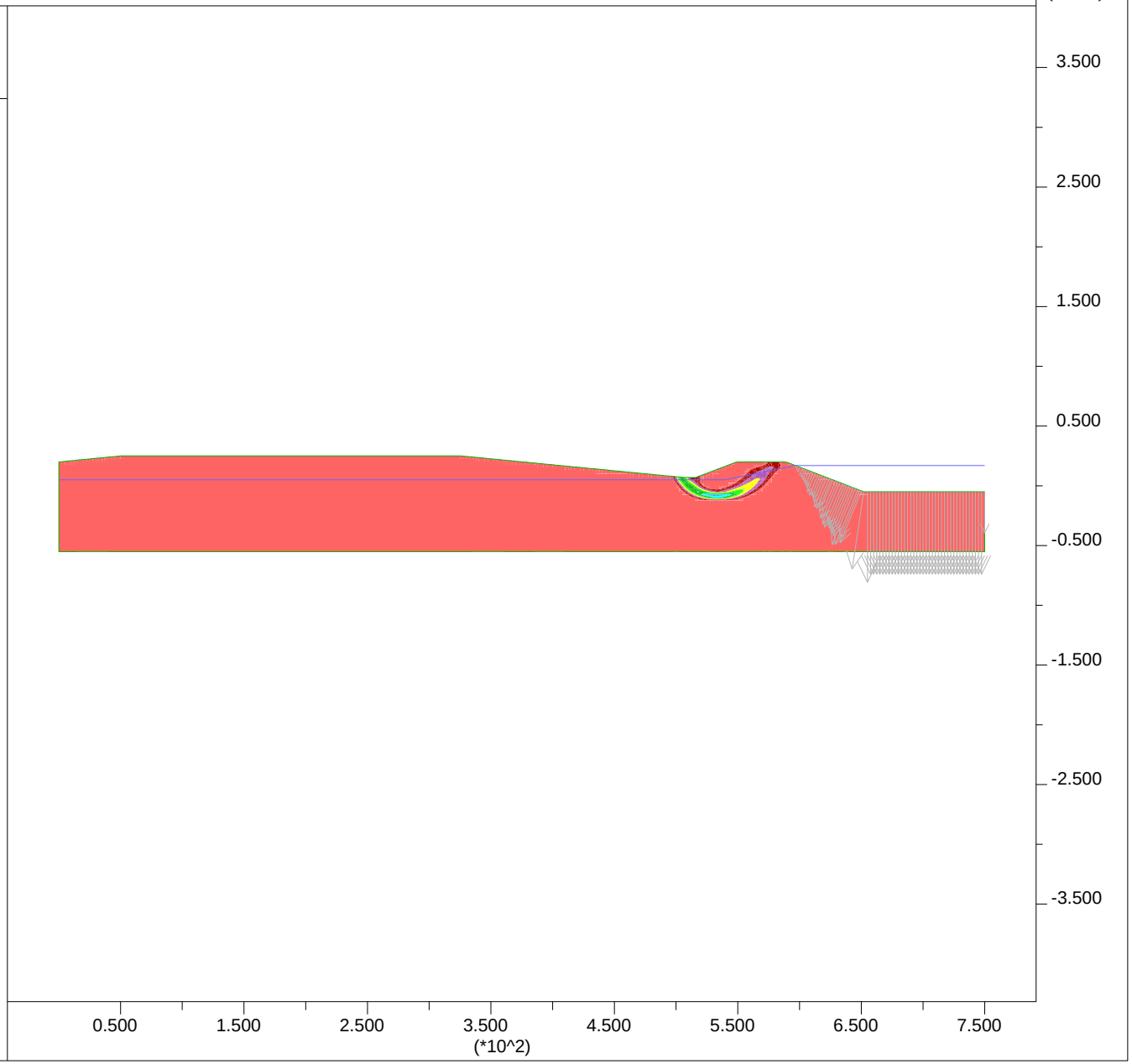


PLATE G-65

JOB TITLE : Section E-E' - High Water Short Term - Input

FLAC/SLOPE (Version 7.00)

LEGEND

4-Mar-13 17:37

Factor of Safety 2.07

User-defined Groups
- User:Sand
- 'User:Stiff Clay'
- 'User:Med Sand'
- 'User:Soft Clay'
- Fill:Fill
- User:Embankment

Boundary plot

0 2E 2

Water Table

Net Applied Forces

max vector = 3.779E+03

0 1E 4

Group Delta Consultants
Ballona Wetlands

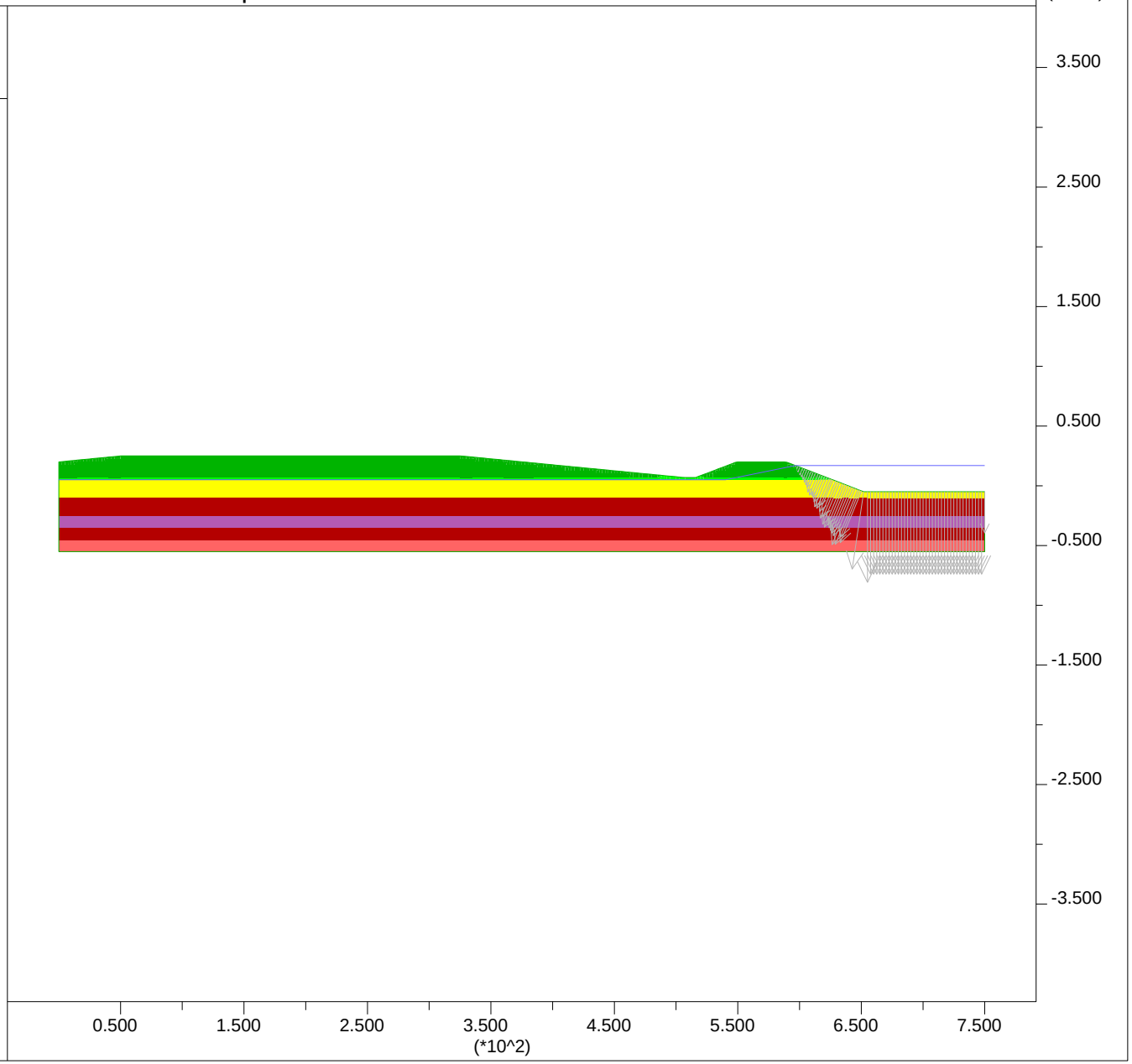


PLATE G-66

JOB TITLE : Section E-E' - Post Liquefaction

FLAC/SLOPE (Version 7.00)

LEGEND

4-Mar-13 17:40

Factor of Safety 1.33

Shear Strain Rate Contours

- 2.50E-07
- 5.00E-07
- 7.50E-07
- 1.00E-06
- 1.25E-06
- 1.50E-06
- 1.75E-06
- 2.00E-06

Contour interval= 2.50E-07
(zero contour omitted)
Boundary plot

0 2E 2

Water Table

Net Applied Forces

max vector = 2.061E+03

0 3E 3

Group Delta Consultants
Ballona Wetlands

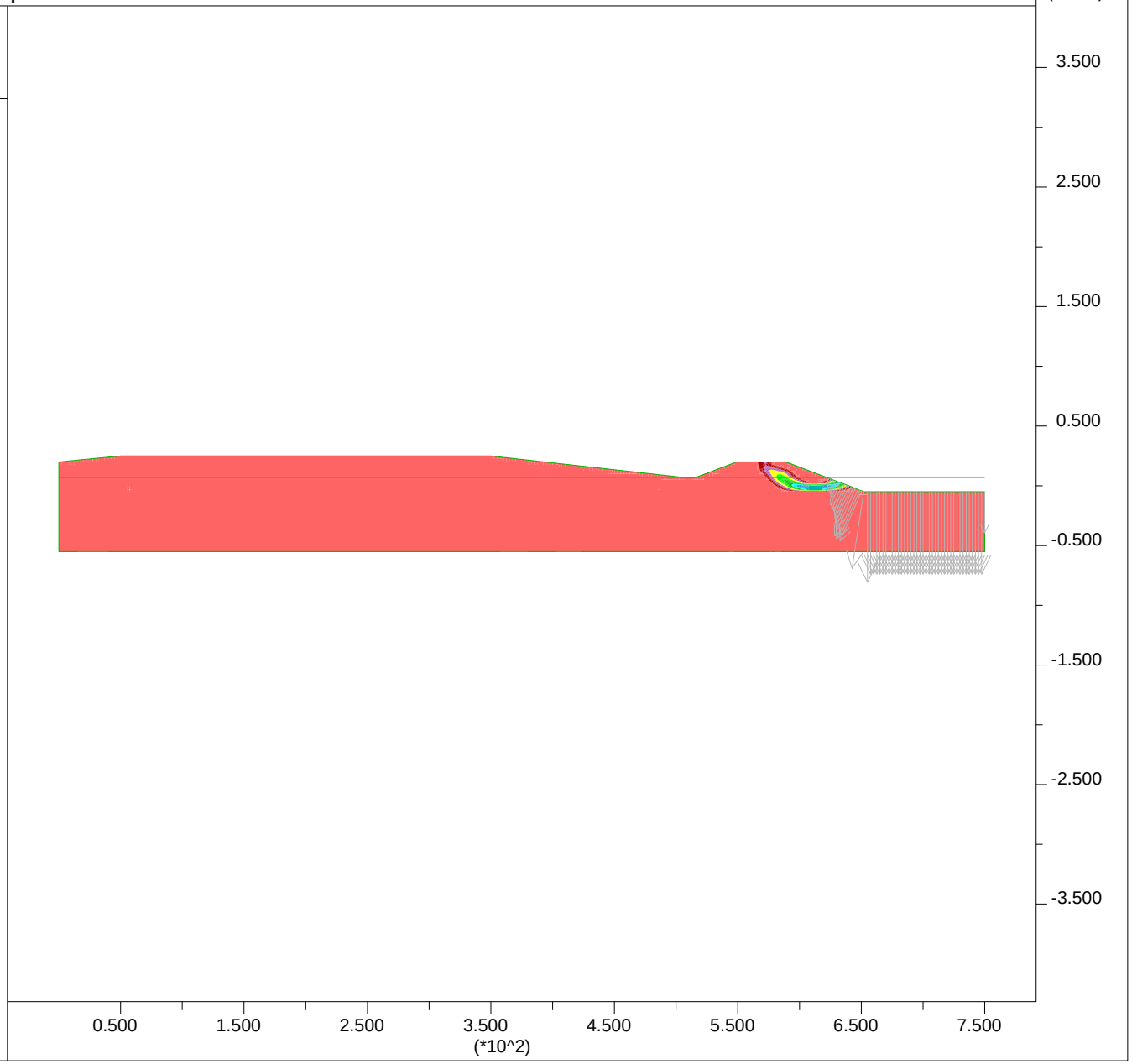


PLATE G-67

JOB TITLE : Section E-E' - Post Liquefaction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

4-Mar-13 17:40

Factor of Safety 1.33

User-defined Groups
- User:Sand
- 'User:Stiff Clay'
- 'Fill:Liq Sand 2'
- 'User:Soft Clay'
- 'Fill:Liq Fill'
- User:Embankment

Boundary plot

0 2E 2

Water Table

Net Applied Forces

max vector = 2.061E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands

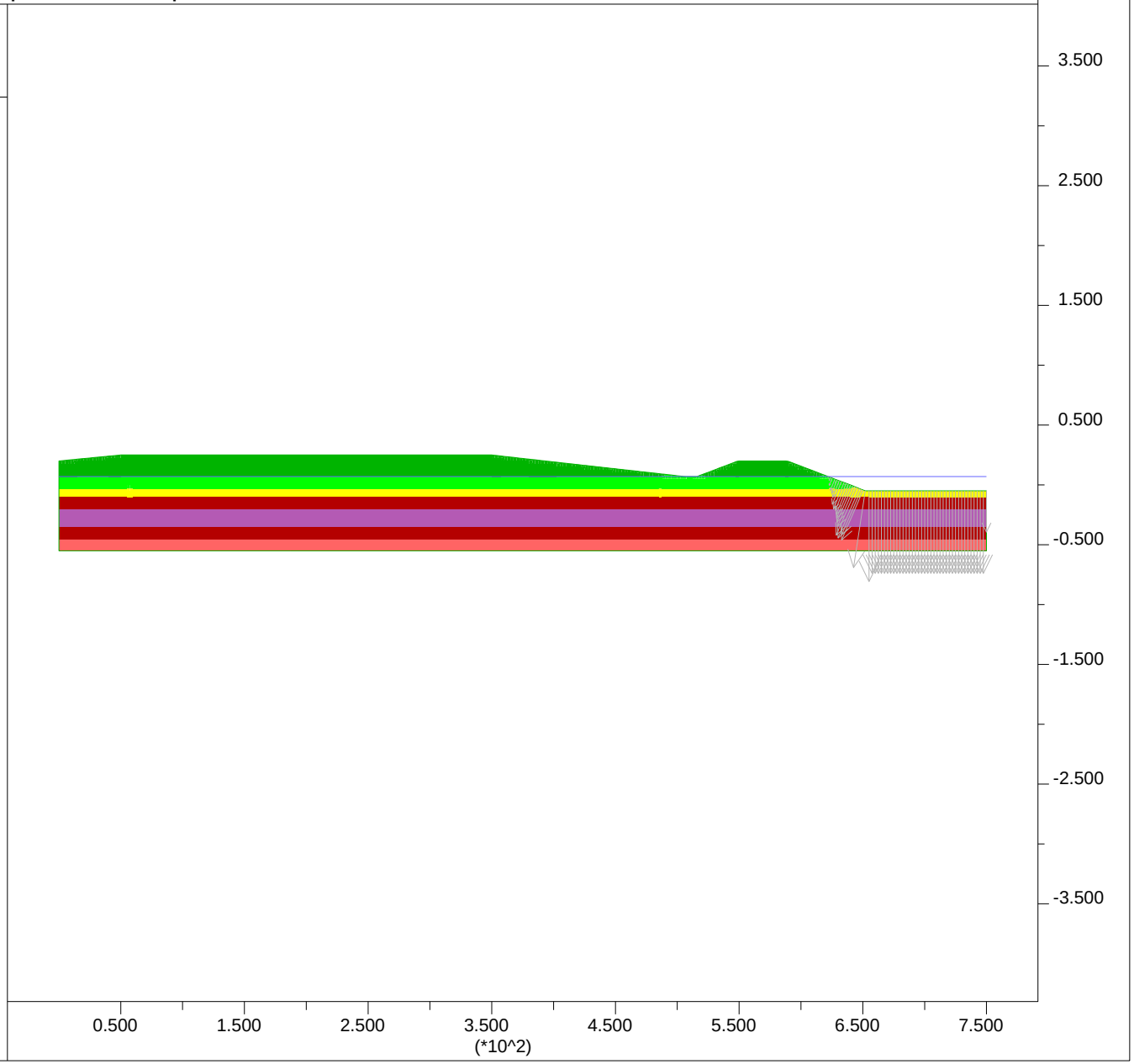


PLATE G-68

JOB TITLE : Section E-E' - Ky=0.08

FLAC/SLOPE (Version 7.00)

LEGEND

4-Mar-13 17:42

Factor of Safety 0.98

Shear Strain Rate Contours

- 5.00E-07
- 1.00E-06
- 1.50E-06
- 2.00E-06
- 2.50E-06
- 3.00E-06
- 3.50E-06
- 4.00E-06

Contour interval= 5.00E-07
(zero contour omitted)
Boundary plot

0 2E 2

Water Table

Net Applied Forces

max vector = 2.068E+03

0 3E 3

Group Delta Consultants
Ballona Wetlands

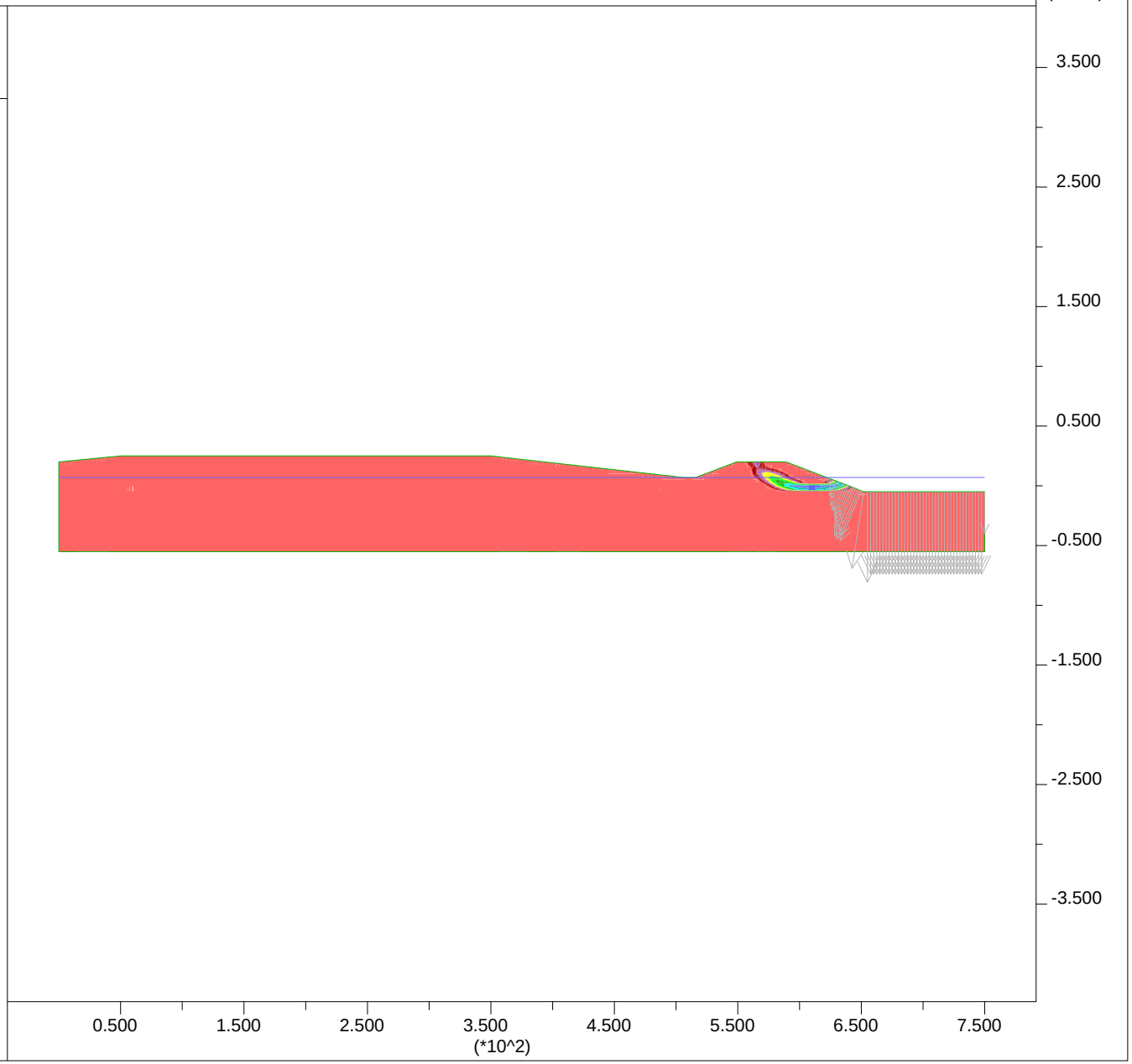


PLATE G-69

JOB TITLE : Section E-E' - Ky=0.08 - Input

FLAC/SLOPE (Version 7.00)

LEGEND

4-Mar-13 17:43

Factor of Safety 0.98

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'Fill:Liq Sand 2'
- 'User:Soft Clay'
- 'Fill:Liq Fill'
- User:Embankment

Boundary plot

0 2E 2

Water Table

Net Applied Forces

max vector = 2.068E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands

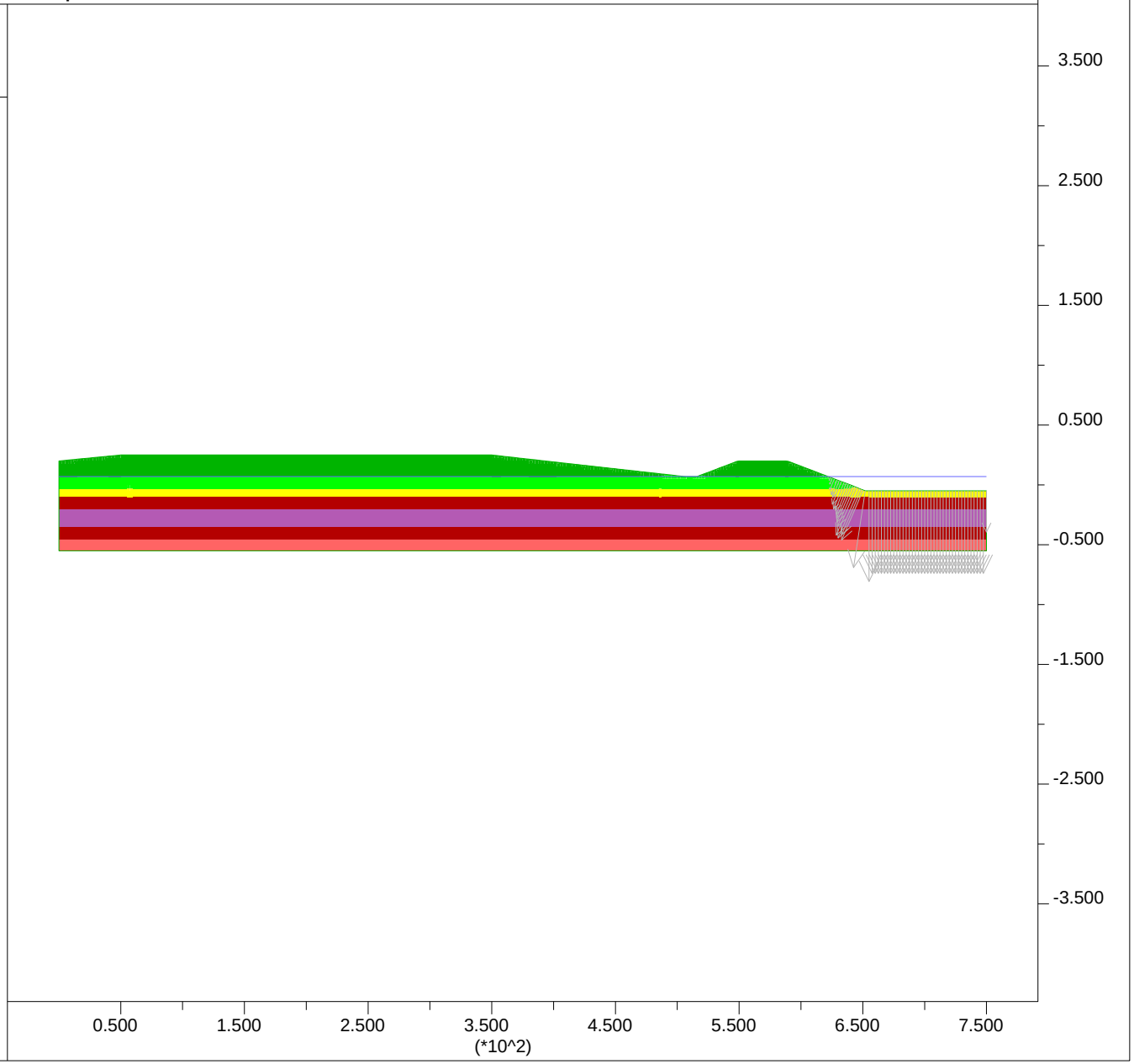


PLATE G-70

Newmark Displacements using Bray and Rathje (1998):

Section E-E'

Site Input				
PGA,rock =	0.25	g		
M =	6.6			
r =	13	km		
ky =	0.08		32.185	2.5748
Sliding Mass Input				
Vs =	137	m/s	assumed	
Thickness, H =	6.1	m		
	20	ft		
Output				
Tm =	0.49	sec		
D5-95 =	10.5	sec		
Ts =	0.18	sec		
NRF =	1.15			
Ts/Tm =	0.36			
kmax/(PGA,rock*NRF)	1.18			
kmax =	0.34			
ky / kmax =	0.24			
Displacement, u =	40	cm	1.3	feet
			15.6	inches

PLATE G-71

JOB TITLE : Section E-E' - Ground Improvement with DSM (ky=0.08)

FLAC (Version 7.00)

LEGEND

5-Mar-13 17:17
step 13290
-4.167E+01 <x< 7.917E+02
-4.317E+02 <y< 4.017E+02

Factor of Safety 1.00

Max. shear strain-rate
0.00E+00
5.00E-07
1.00E-06
1.50E-06
2.00E-06
2.50E-06

Contour interval= 5.00E-07
Extrap. by averaging
Boundary plot
0 2E 2

Water Table

Net Applied Forces

max vector = 2.061E+03
0 3E 3

Group Delta Consultants
Ballona Wetlands

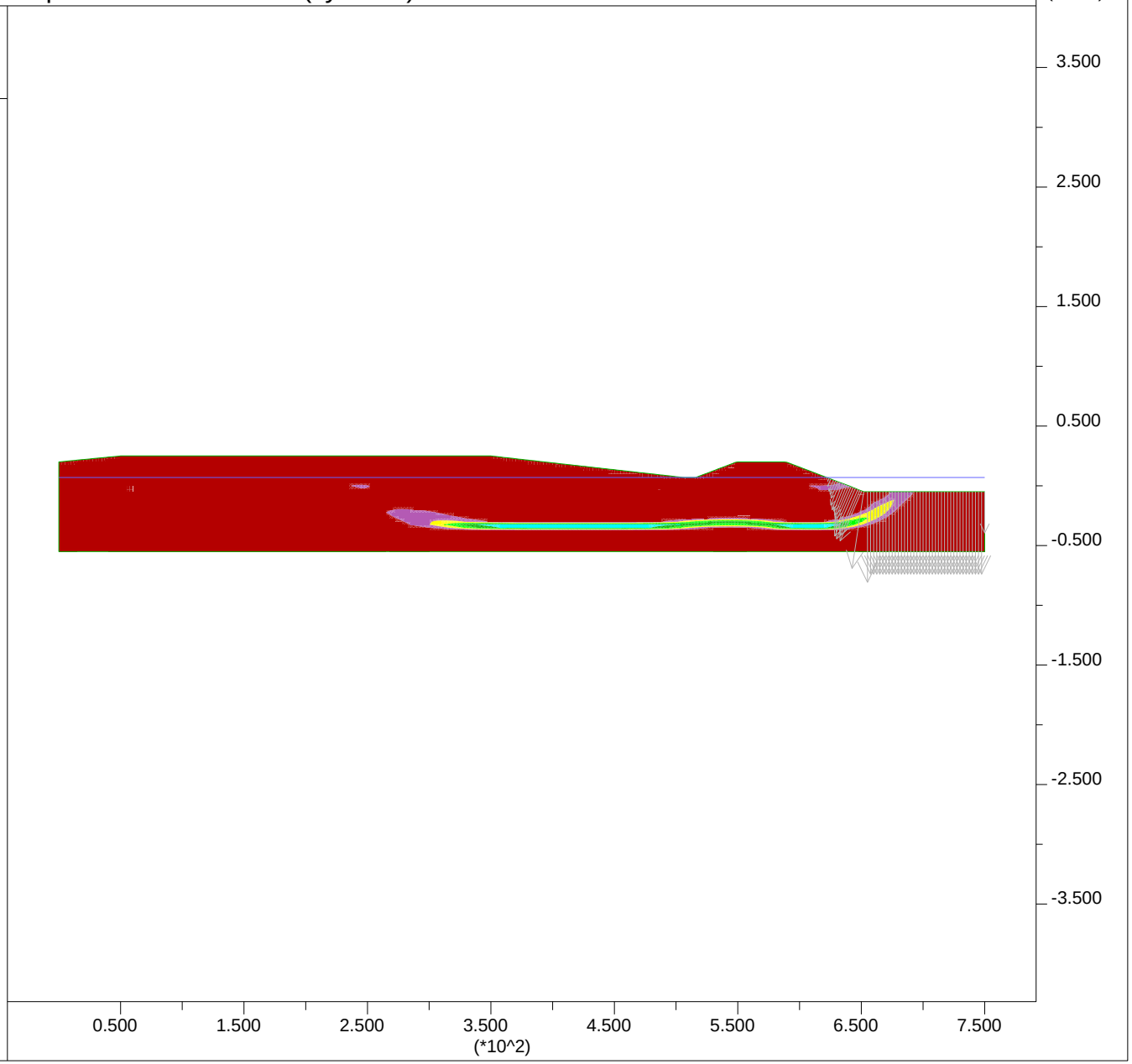


PLATE G-72

JOB TITLE : Section E-E' - Ground Improvement with DSM (ky=0.08) - Input

FLAC (Version 7.00)

LEGEND

5-Mar-13 17:16
step 13290
-4.167E+01 <x< 7.917E+02
-4.317E+02 <y< 4.017E+02

User-defined Groups
- User:Sand
- 'User:Stiff Clay'
- 'Fill:Liq Sand 2'
- 'User:Soft Clay'
- 'Fill:Liq Fill'
- User:Embankment
- User:DSM

Net Applied Forces
max vector = 2.061E+03
0 5E 3

Group Delta Consultants
Ballona Wetlands

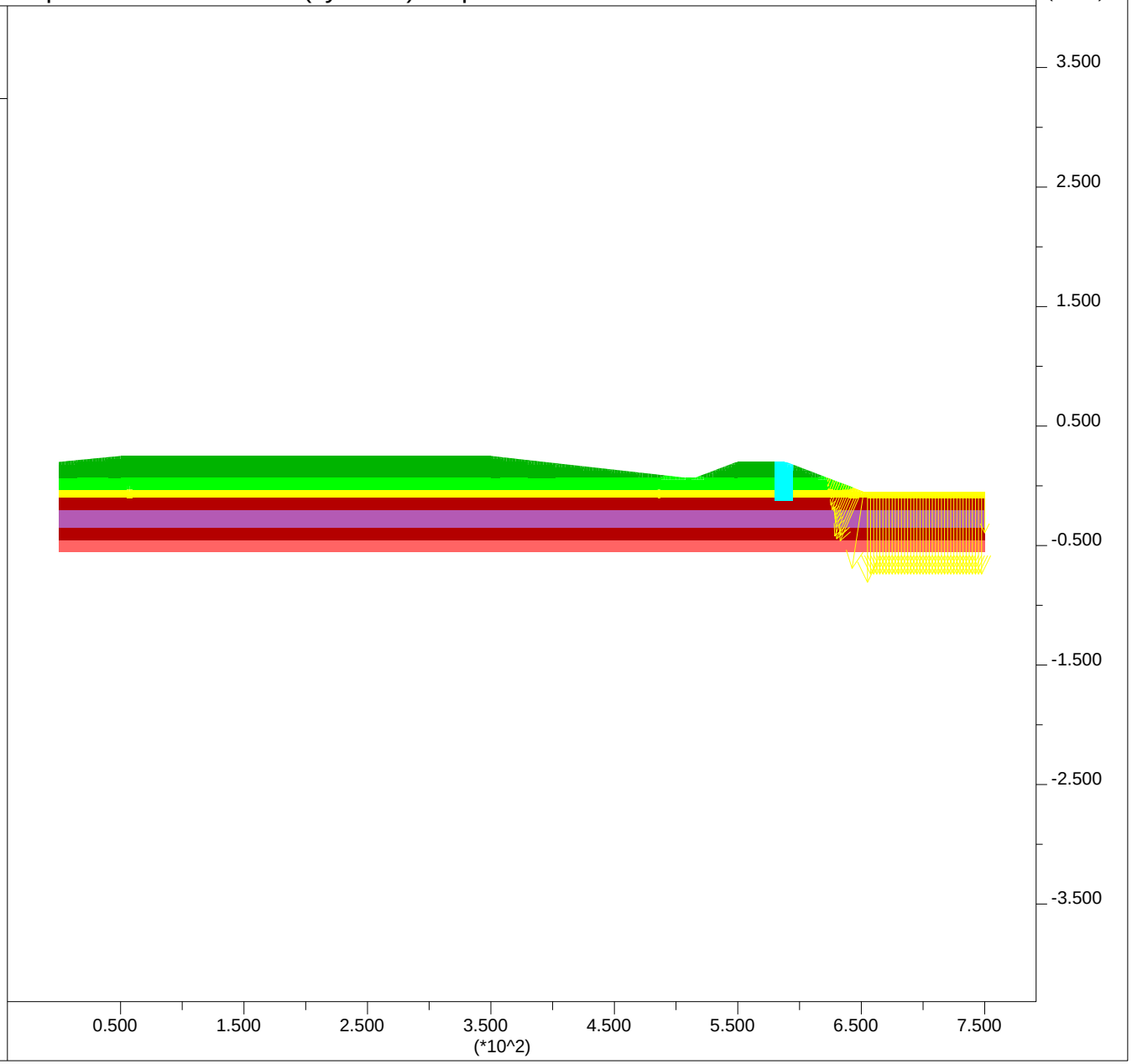


PLATE G-73

JOB TITLE : Section F-F' - End of Construction

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 20:06

Factor of Safety 2.19

Shear Strain Rate Contours

1.00E-06
2.00E-06
3.00E-06
4.00E-06
5.00E-06

Contour interval= 1.00E-06
(zero contour omitted)
Boundary plot

0 2E 2

Water Table

Net Applied Forces

max vector = 3.123E+03

0 1E 4

Group Delta Consultants
Torrance, CA

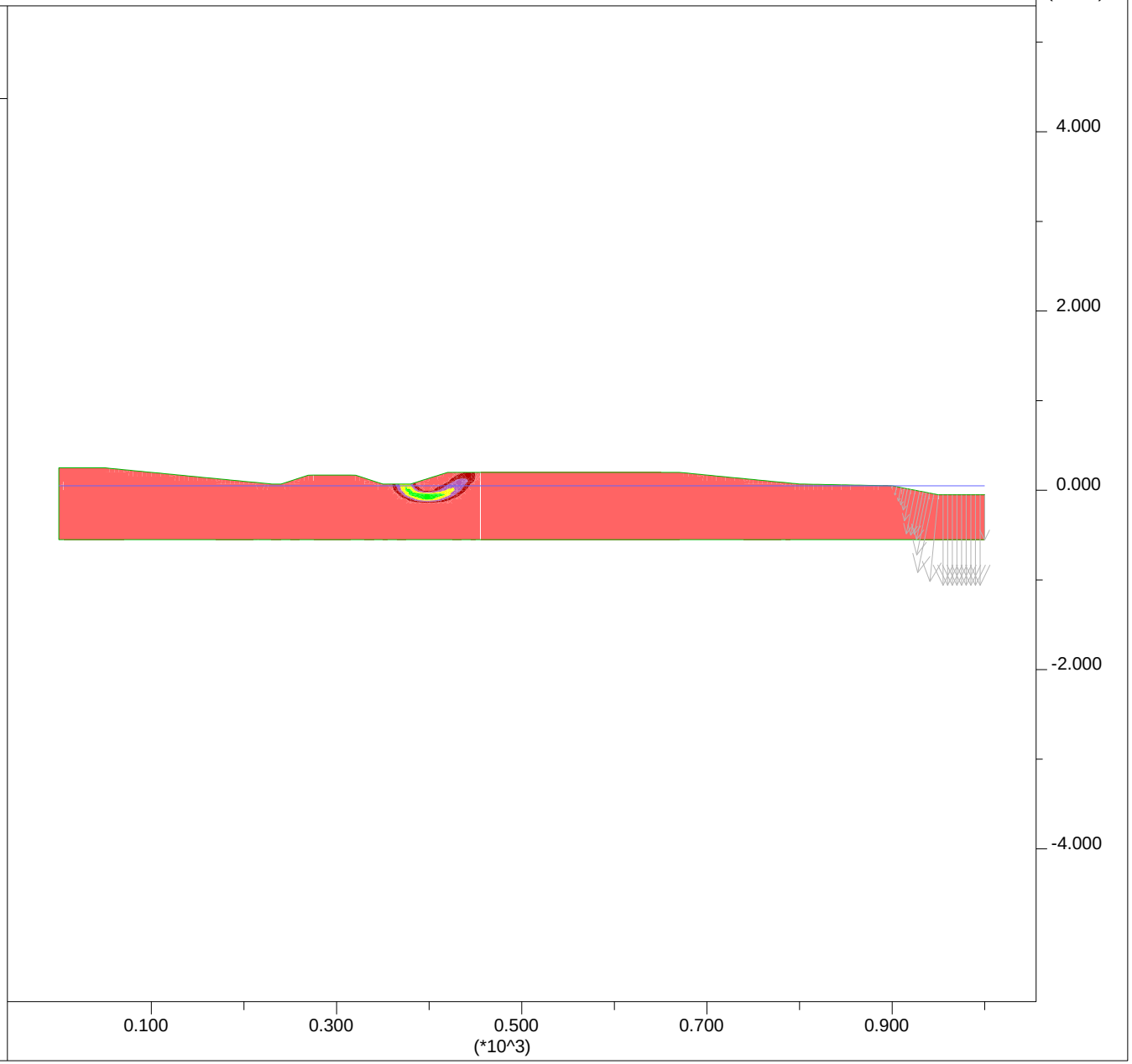


PLATE G-74

JOB TITLE : Section F-F' - End of Construction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 20:05

Factor of Safety 2.19

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Med Sand'
- 'User:Soft Clay'
- User:Embankment
- Fill:Fill

Boundary plot

0 2E 2

Water Table

Net Applied Forces

max vector = 3.123E+03

0 1E 4

Group Delta Consultants
Torrance, CA

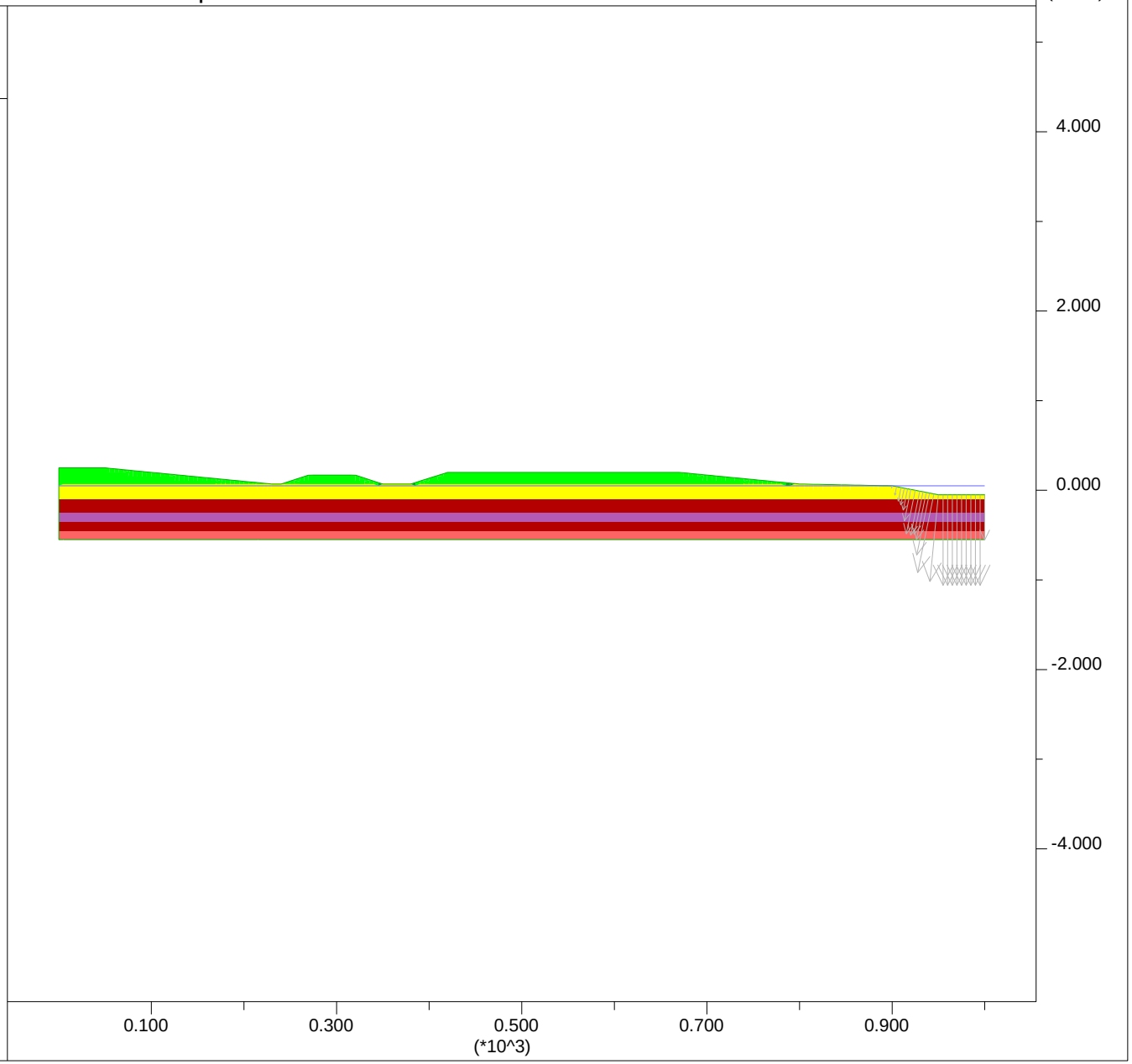


PLATE G-75

JOB TITLE : Section F-F' - High Water Short Term

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 19:52

Factor of Safety 2.19

Shear Strain Rate Contours

- 2.00E-06
- 4.00E-06
- 6.00E-06
- 8.00E-06
- 1.00E-05

Contour interval= 2.00E-06
(zero contour omitted)
Boundary plot

0 2E 2

Water Table

Net Applied Forces

max vector = 6.322E+03

0 2E 4

Group Delta Consultants
Torrance, CA

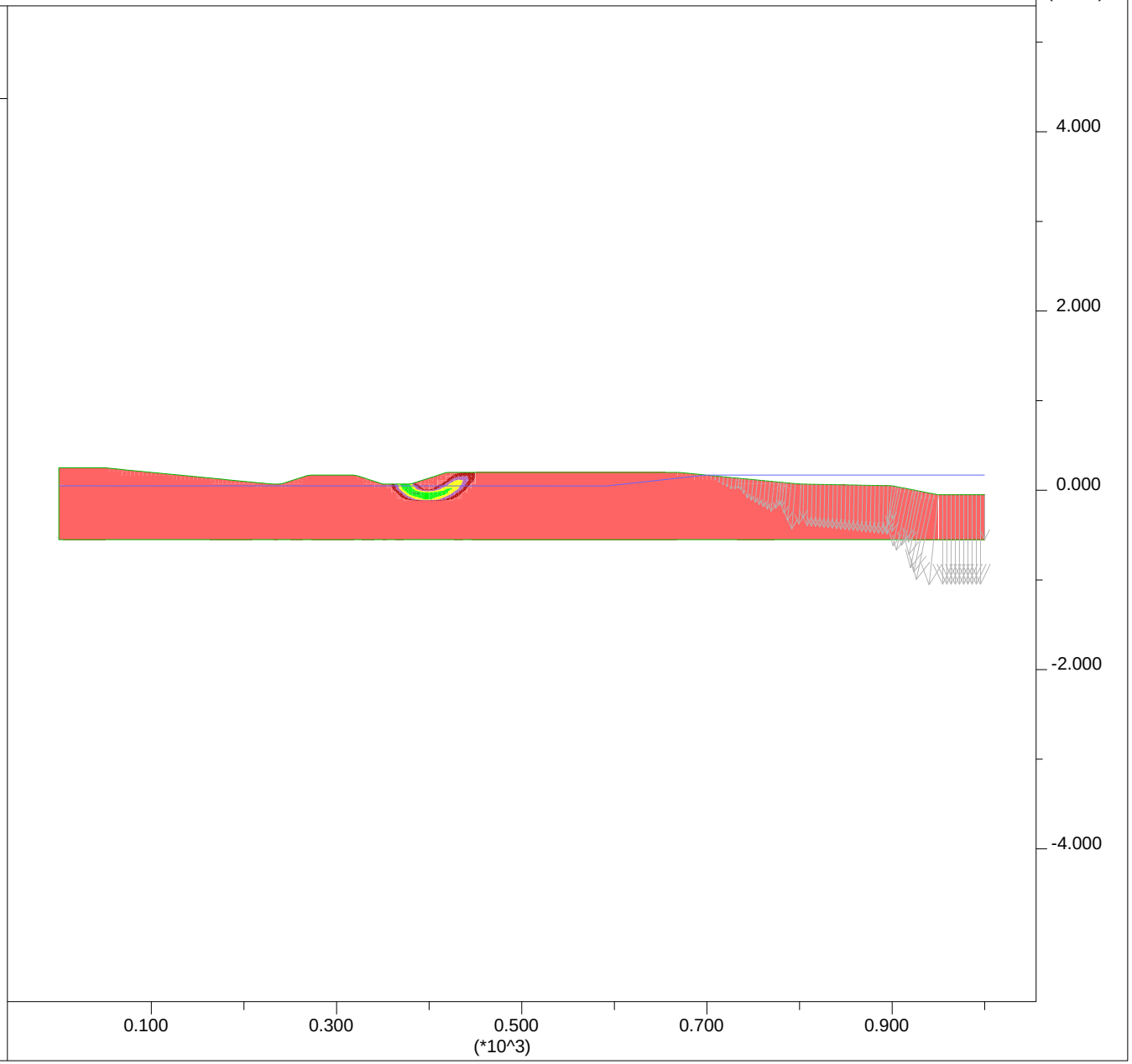


PLATE G-76

JOB TITLE : Section F-F' - High Water Short Term - Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 19:52

Factor of Safety 2.19

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Med Sand'
- 'User:Soft Clay'
- User:Embankment
- Fill:Fill

Boundary plot

0 2E 2

Water Table

Net Applied Forces

max vector = 6.322E+03

0 2E 4

Group Delta Consultants
Torrance, CA

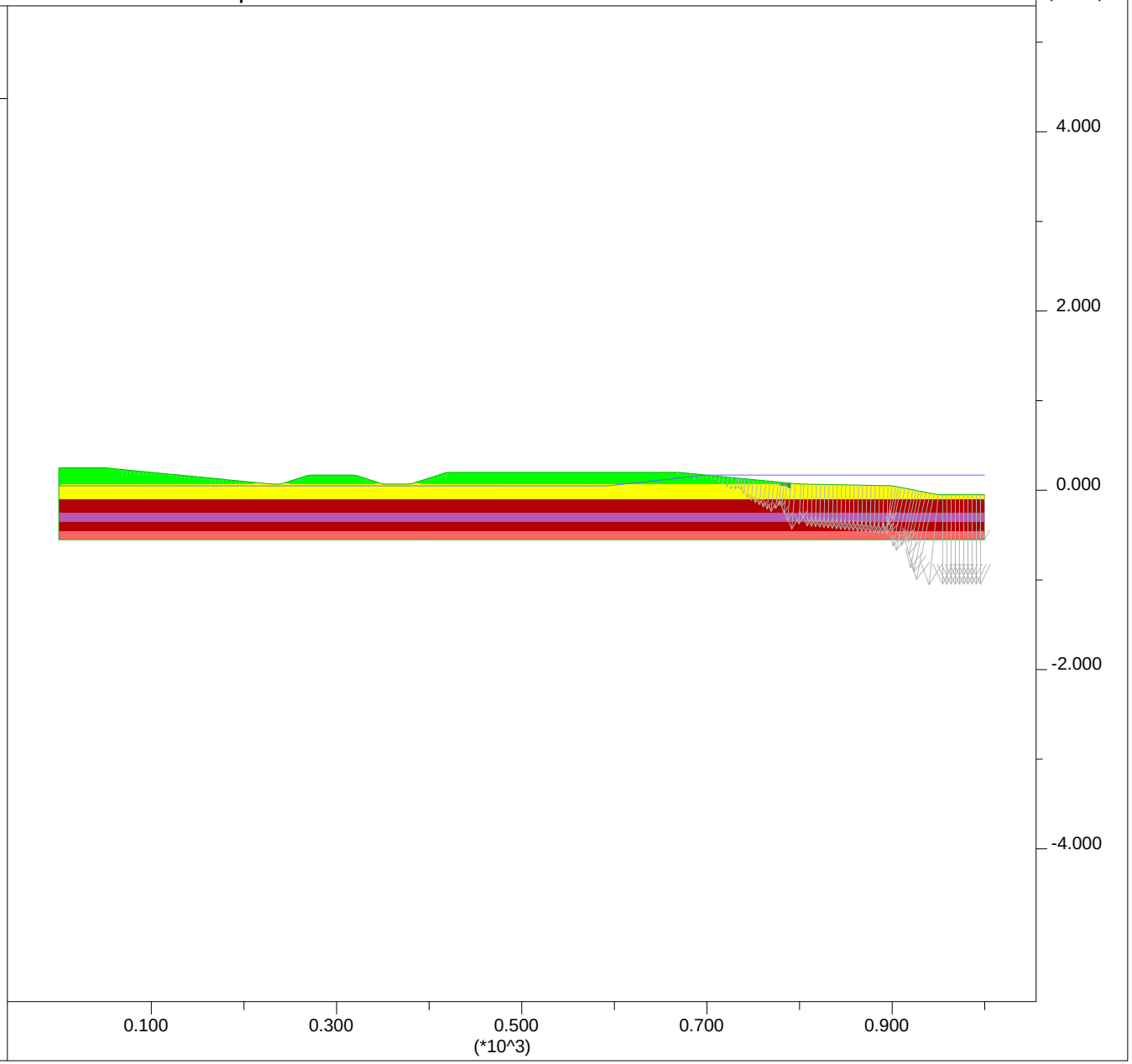


PLATE G-77

JOB TITLE : Section F-F' - Post Liquefaction

FLAC/SLOPE (Version 7.00)

LEGEND

4-Mar-13 17:45

Factor of Safety 1.59

Shear Strain Rate Contours

- 5.00E-07
- 1.00E-06
- 1.50E-06
- 2.00E-06
- 2.50E-06
- 3.00E-06
- 3.50E-06
- 4.00E-06
- 4.50E-06

Contour interval= 5.00E-07
(zero contour omitted)
Boundary plot

0 2E 2

Water Table

Net Applied Forces

max vector = 2.342E+03

Group Delta Consultants
Ballona Wetlands

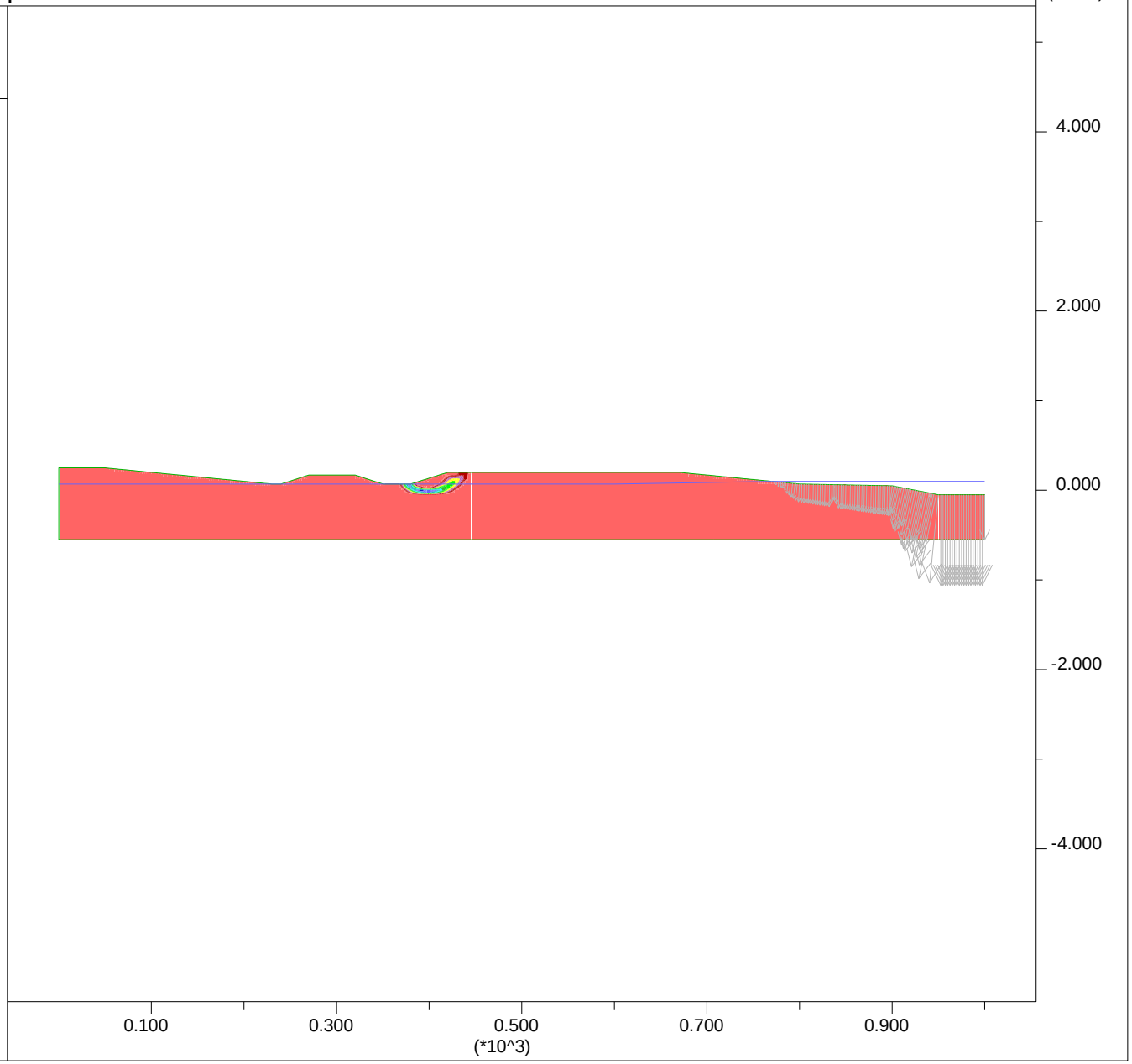


PLATE G-78

JOB TITLE : Section F-F' - Post Liquefaction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

4-Mar-13 17:46

Factor of Safety 1.59

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Liq Sand Deep'
- 'User:Soft Clay'
- 'User:Liq Sand'
- User:Embankment

Boundary plot

0 2E 2

Water Table

Net Applied Forces

max vector = 2.342E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands

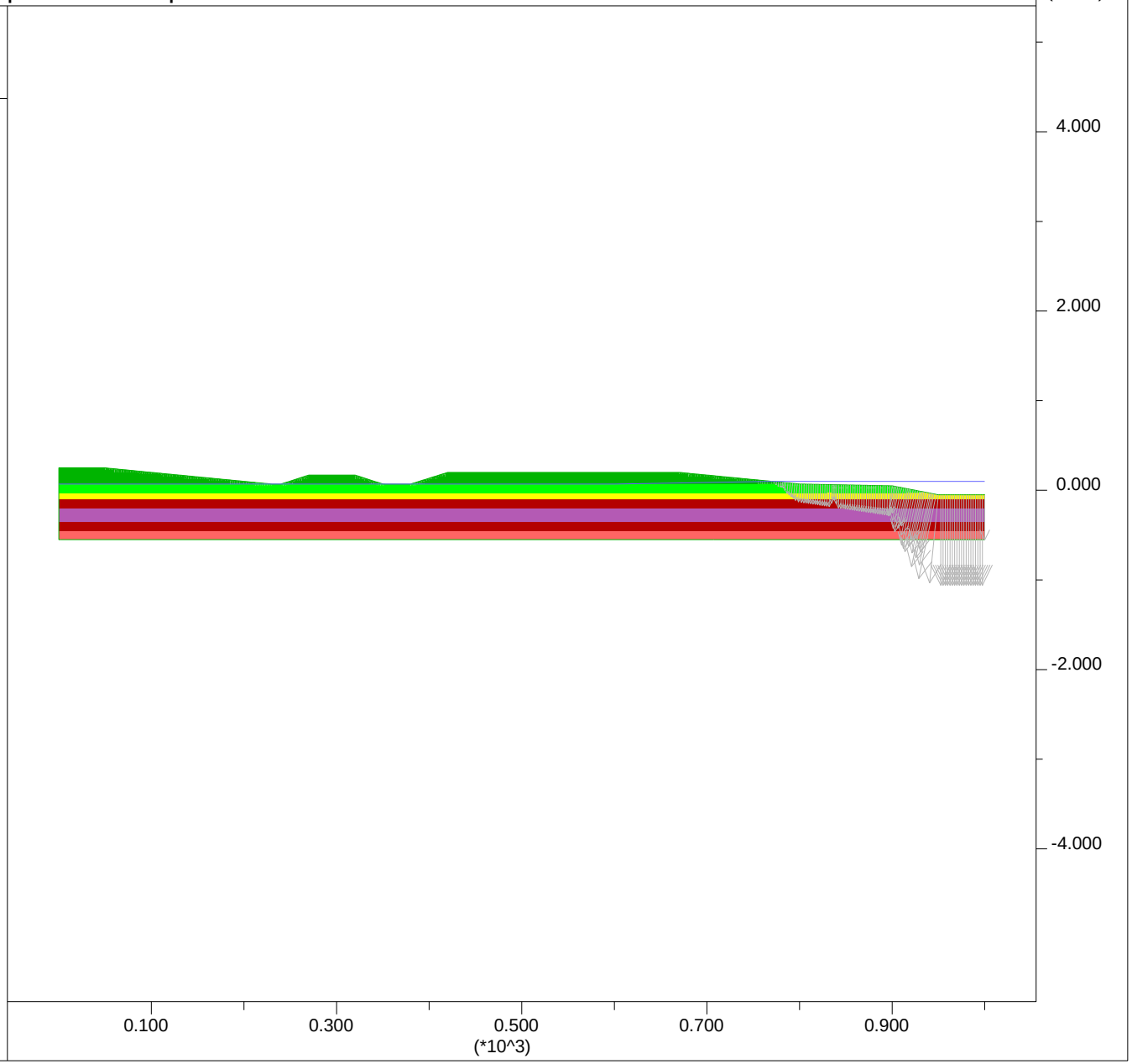


PLATE G-79

JOB TITLE : Section F-F' - Ky=0.10

FLAC/SLOPE (Version 7.00)

LEGEND

4-Mar-13 17:48

Factor of Safety 0.96

Shear Strain Rate Contours

1.00E-06
2.00E-06
3.00E-06
4.00E-06
5.00E-06
6.00E-06

Contour interval= 1.00E-06
(zero contour omitted)
Boundary plot

0 2E 2

Water Table

Net Applied Forces

max vector = 2.354E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands

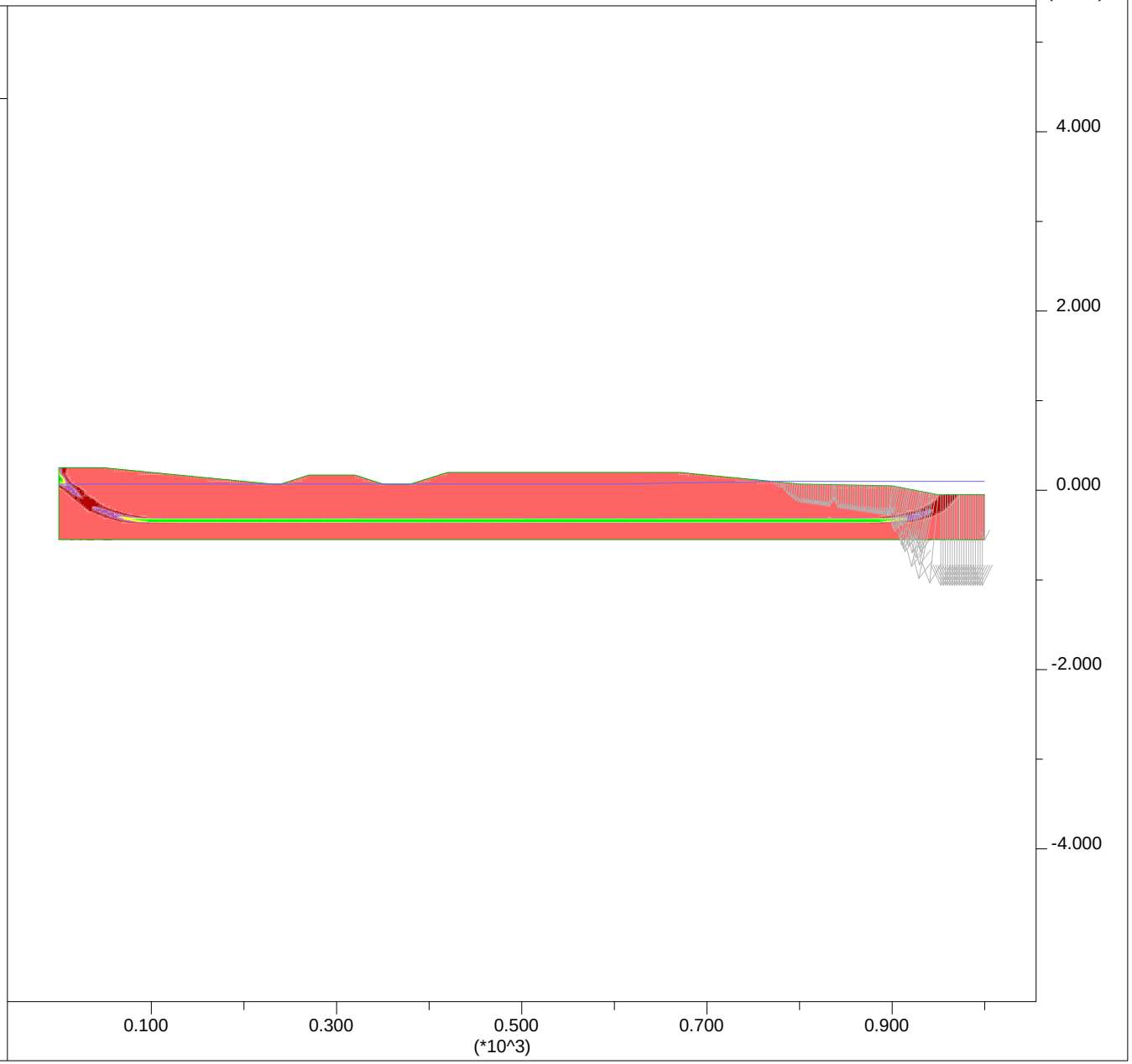


PLATE G-80

JOB TITLE : Section F-F' - Ky=0.10 - Input

FLAC/SLOPE (Version 7.00)

LEGEND

4-Mar-13 17:48

Factor of Safety 0.96

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Liq Sand Deep'
- 'User:Soft Clay'
- 'User:Liq Sand'
- User:Embankment

Boundary plot

0 2E 2

Water Table

Net Applied Forces

max vector = 2.354E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands

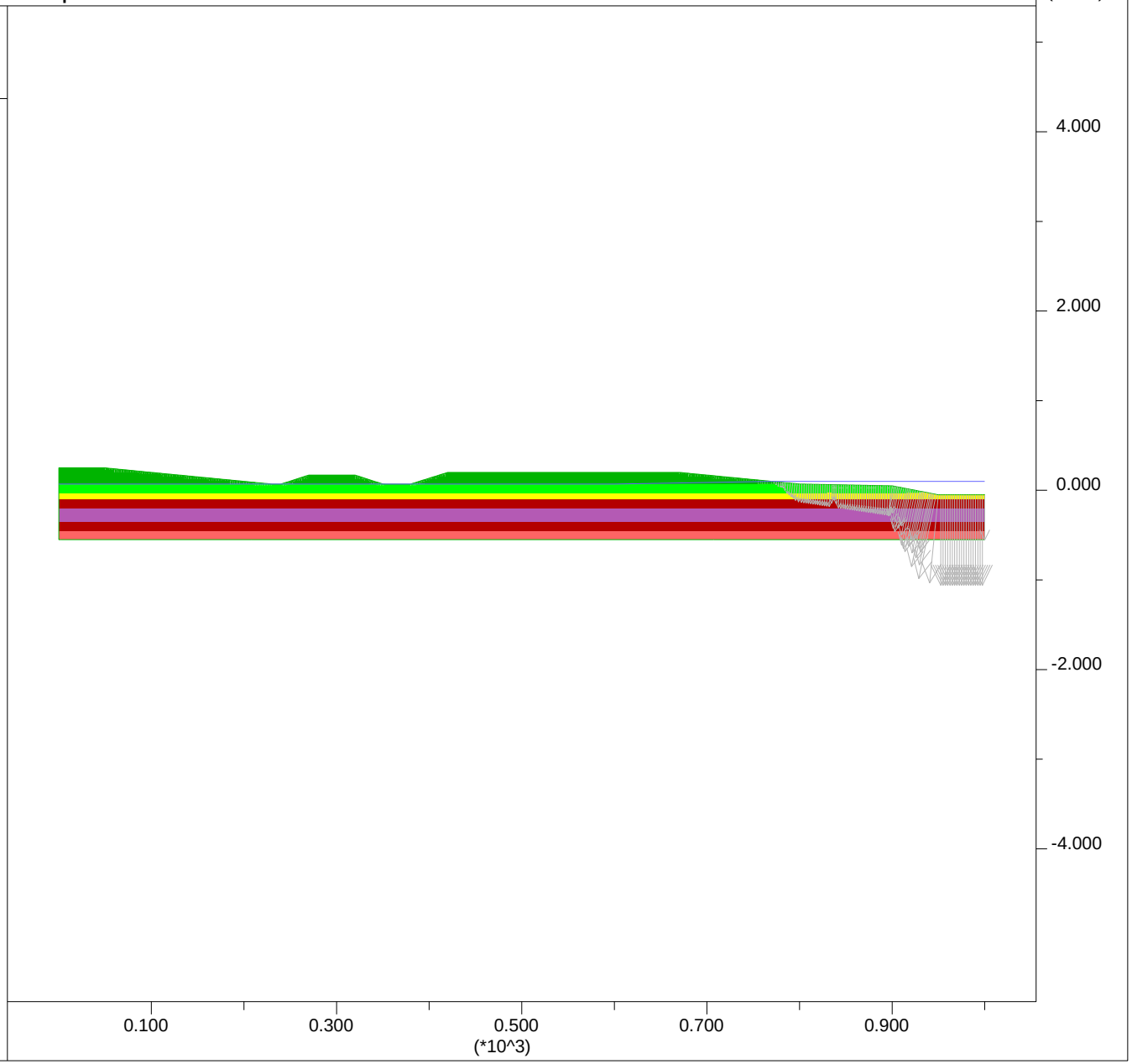


PLATE G-81

Newmark Displacements using Bray and Rathje (1998):

Section F-F'

Site Input				
PGA,rock =	0.25	g		
M =	6.6			
r =	13	km		
ky =	0.1		32.185	3.2185
Sliding Mass Input				
Vs =	200	m/s	assumed	
Thickness, H =	16.8	m		
	55	ft		
Output				
Tm =	0.49	sec		
D5-95 =	10.5	sec		
Ts =	0.34	sec		
NRF =	1.15			
Ts/Tm =	0.69			
kmax/(PGA,rock*NRF)	0.72			
kmax =	0.21			
ky / kmax =	0.49			
Displacement, u =	3	cm	0.1 feet	1.3 inches

PLATE G-82

JOB TITLE : Section G-G' - End of Construction

FLAC/SLOPE (Version 7.00)

LEGEND

21-Feb-13 14:43

Factor of Safety 2.55

Shear Strain Rate Contours

- 2.50E-07
- 5.00E-07
- 7.50E-07
- 1.00E-06
- 1.25E-06
- 1.50E-06
- 1.75E-06
- 2.00E-06

Contour interval= 2.50E-07
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands

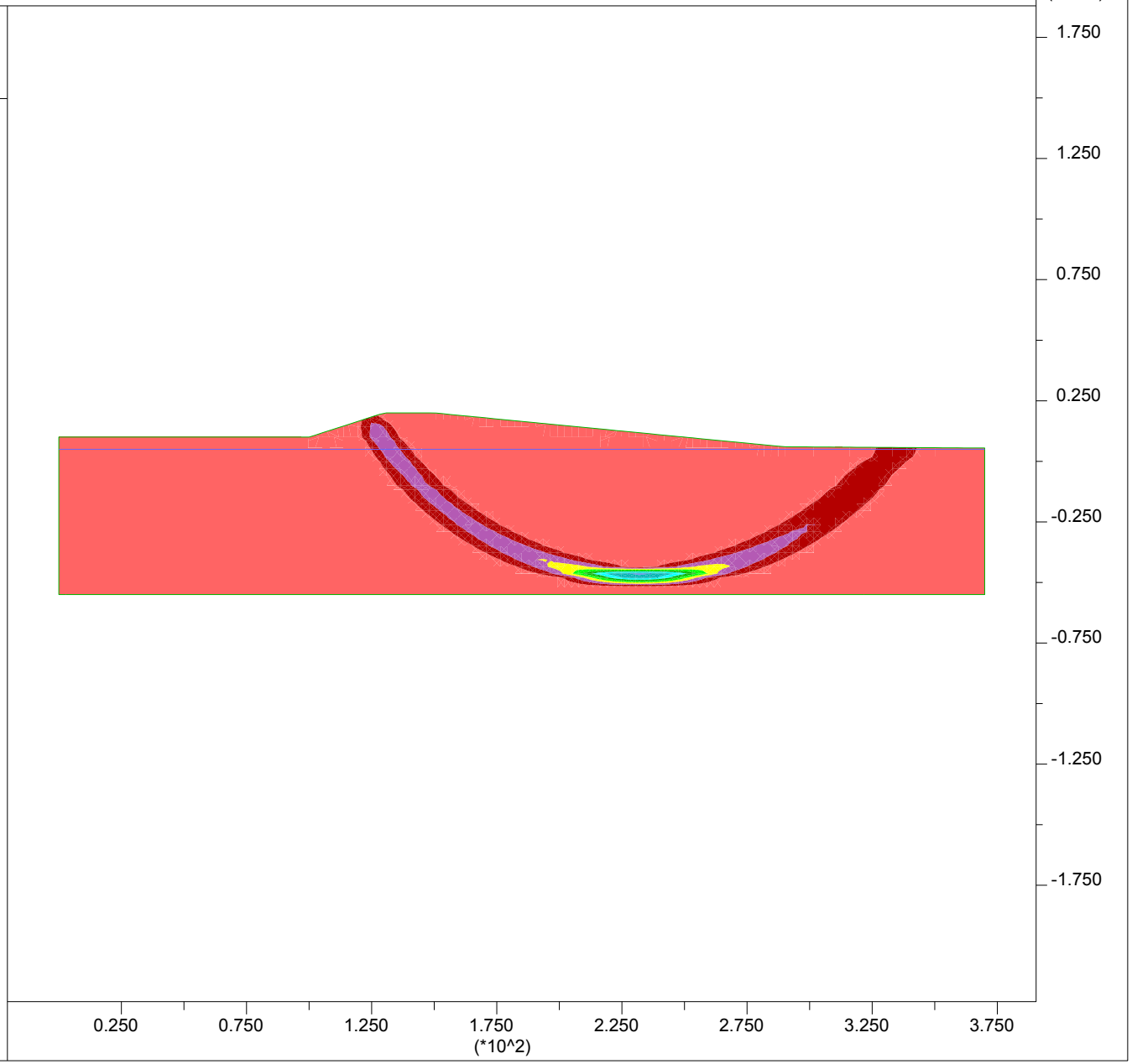


PLATE G-83

JOB TITLE : Section G-G' - End of Construction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

21-Feb-13 14:45

Factor of Safety 2.55

User-defined Groups

- User:Sand
- 'User:Med Clay'
- 'User:Med Sand'
- 'User:Soft Clay'
- Fill:Fill
- User:Embankment

Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands

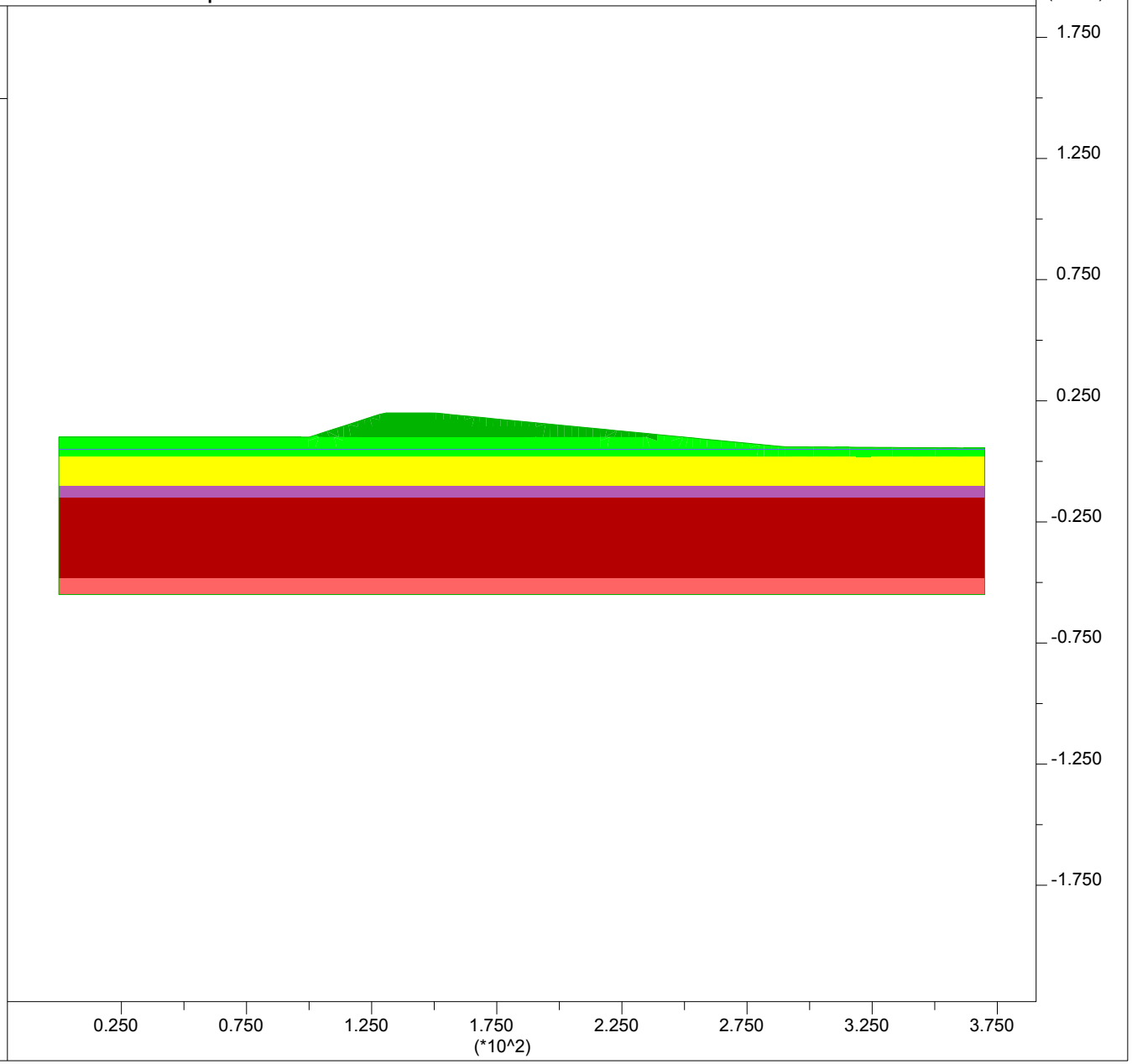


PLATE G-84

JOB TITLE : Section G-G' - High Water Short Term

FLAC/SLOPE (Version 7.00)

LEGEND

21-Feb-13 14:42

Factor of Safety 2.73

Shear Strain Rate Contours

- 2.00E-07
- 4.00E-07
- 6.00E-07
- 8.00E-07
- 1.00E-06
- 1.20E-06

Contour interval= 2.00E-07
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 2.041E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands

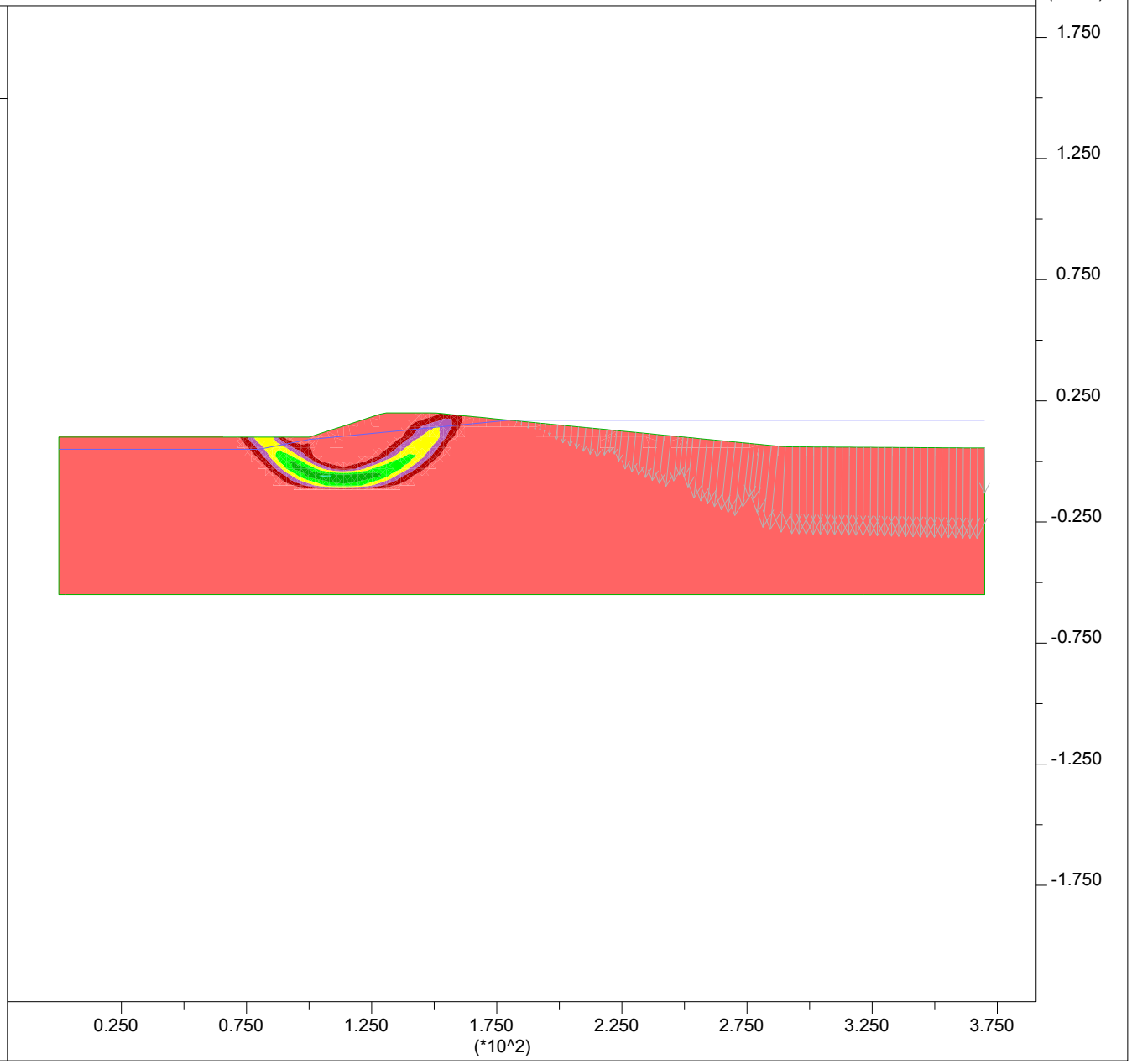


PLATE G-85

JOB TITLE : Section G-G' - High Water Short Term - Input

FLAC/SLOPE (Version 7.00)

LEGEND

21-Feb-13 14:40

Factor of Safety 2.73

User-defined Groups

- User:Sand
- 'User:Med Clay'
- 'User:Med Sand'
- 'User:Soft Clay'
- Fill:Fill
- User:Embankment

Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 2.041E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands

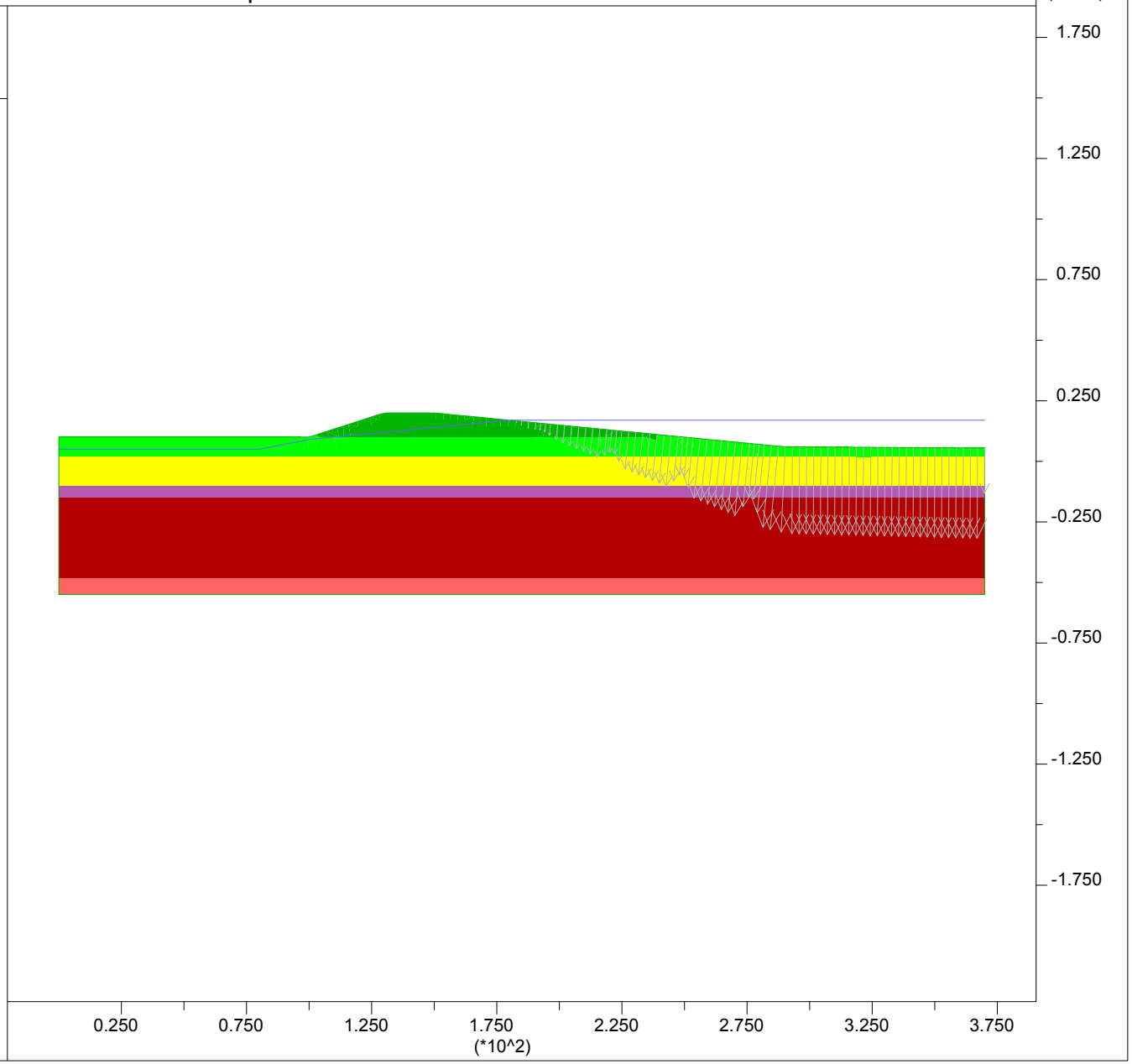


PLATE G-86

JOB TITLE : Section G-G' - High Water Long Term (Steady State)

FLAC/SLOPE (Version 7.00)

LEGEND

5-Mar-13 14:24

Factor of Safety 3.42

Shear Strain Rate Contours

- 2.50E-07
- 5.00E-07
- 7.50E-07
- 1.00E-06
- 1.25E-06
- 1.50E-06

Contour interval= 2.50E-07
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 1.326E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands

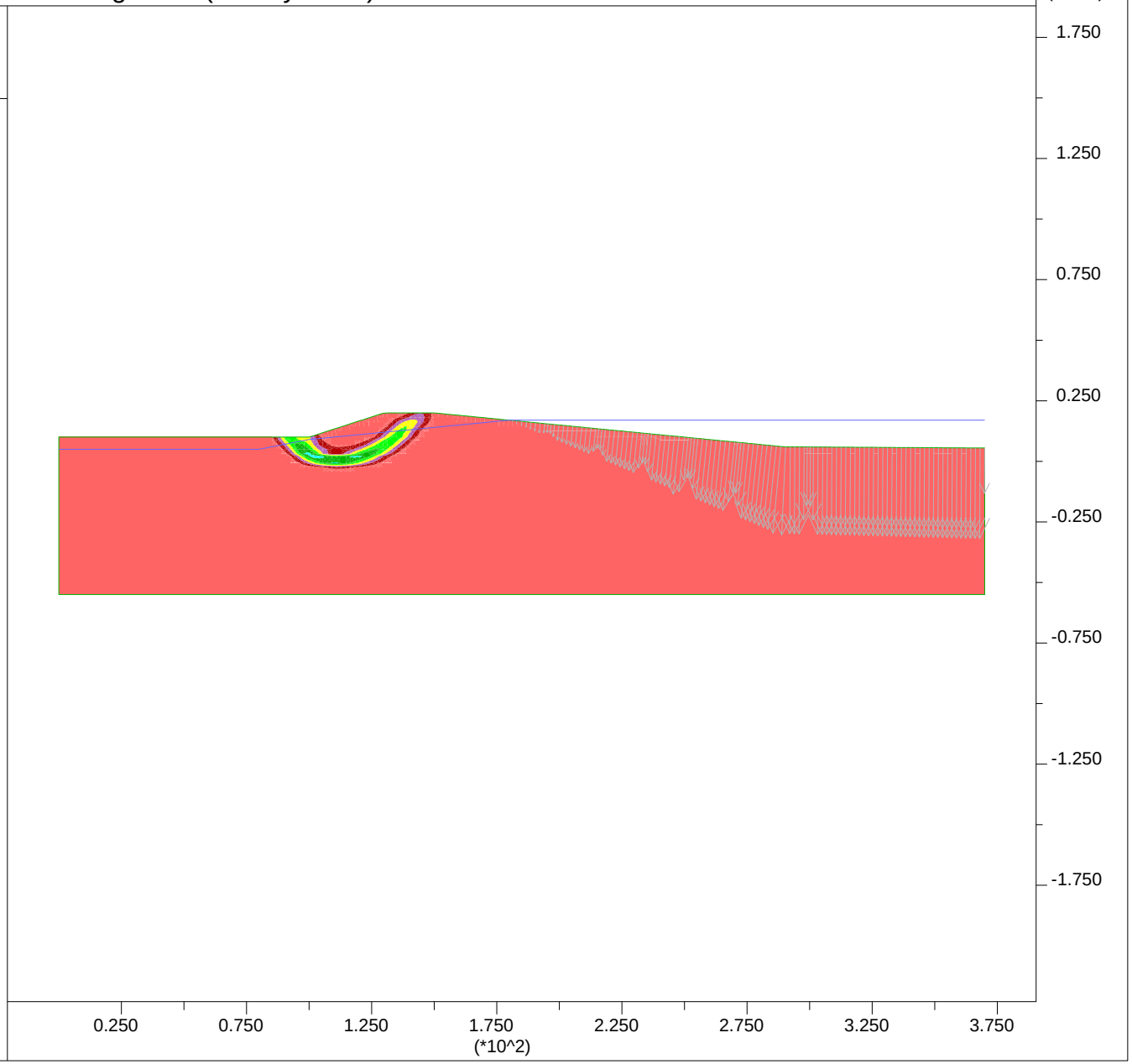


PLATE G-87

JOB TITLE : Section G-G' - High Water Long Term (Steady State) - Input

FLAC/SLOPE (Version 7.00)

LEGEND

5-Mar-13 14:24

Factor of Safety 3.42

User-defined Groups

- User:Sand
- 'User:Med Clay'
- 'User:Med Sand'
- 'User:Soft Clay'
- Fill:Fill
- User:Embankment

Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 1.326E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands

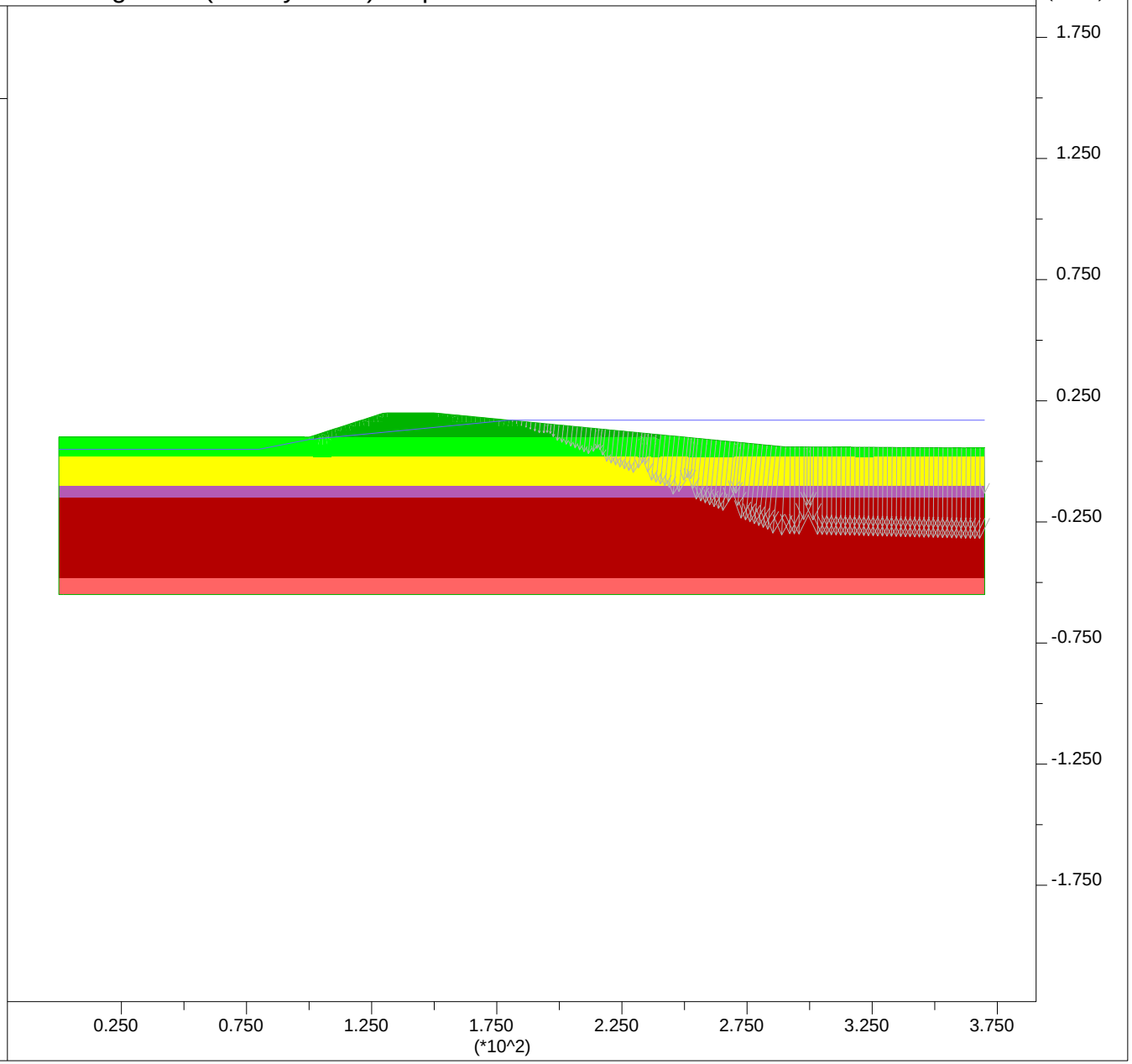


PLATE G-88

JOB TITLE : Section G-G' - Post Liquefaction

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 19:01

Factor of Safety 1.79

Shear Strain Rate Contours

- 5.00E-08
- 1.00E-07
- 1.50E-07
- 2.00E-07
- 2.50E-07
- 3.00E-07

Contour interval= 5.00E-08
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 6.479E+02

0 2E 3

Group Delta Consultants
Torrance, CA

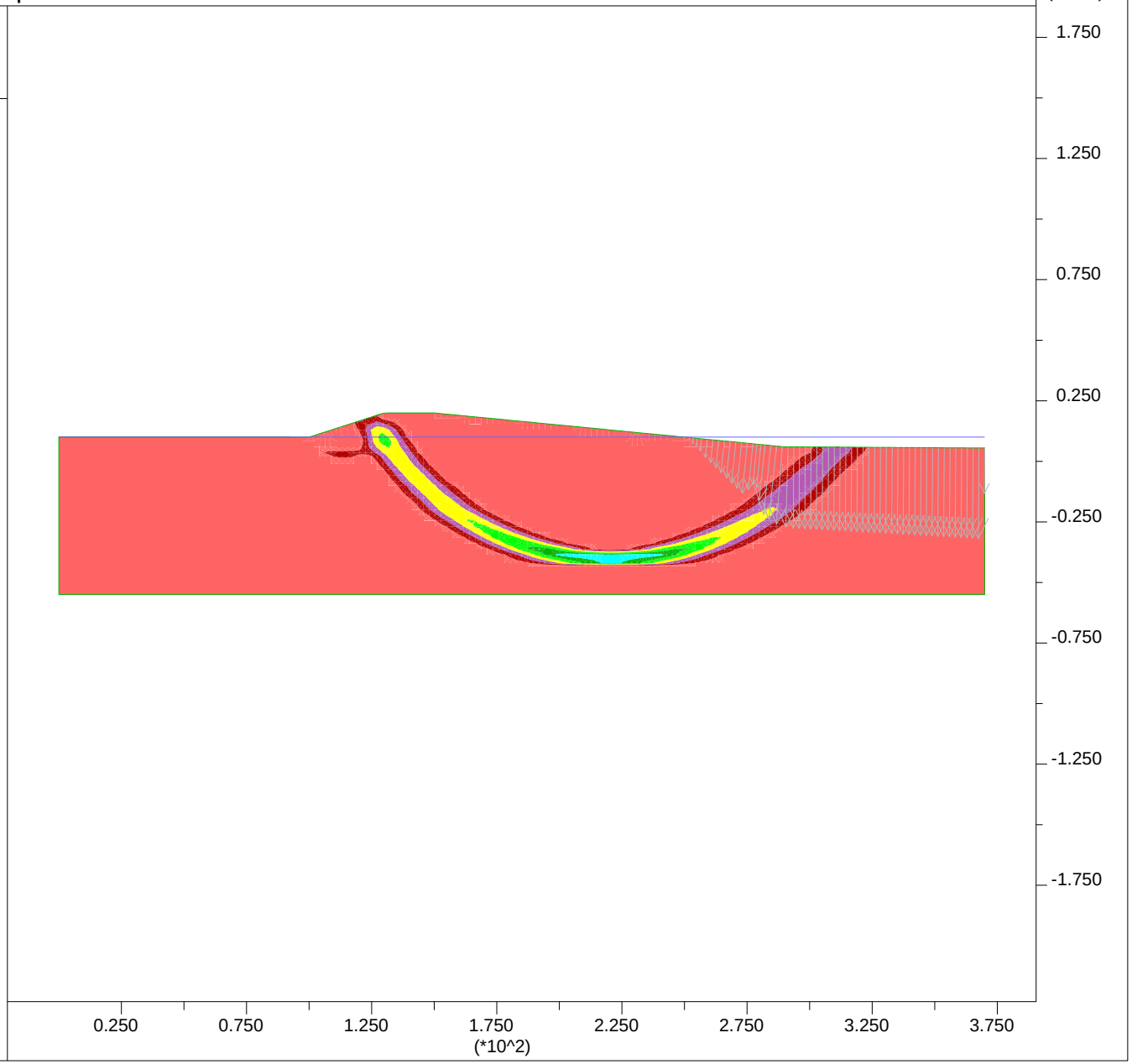


PLATE G-89

JOB TITLE : Section G-G' - Post Liquefaction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 19:01

Factor of Safety 1.79

User-defined Groups
- User:Sand
- 'User:Med Clay'
- 'User:Liq Sand'
- 'User:Soft Clay'
- 'Liq Fill:Liq Fill'
- User:Embankment

Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 6.479E+02

0 2E 3

Group Delta Consultants
Torrance, CA

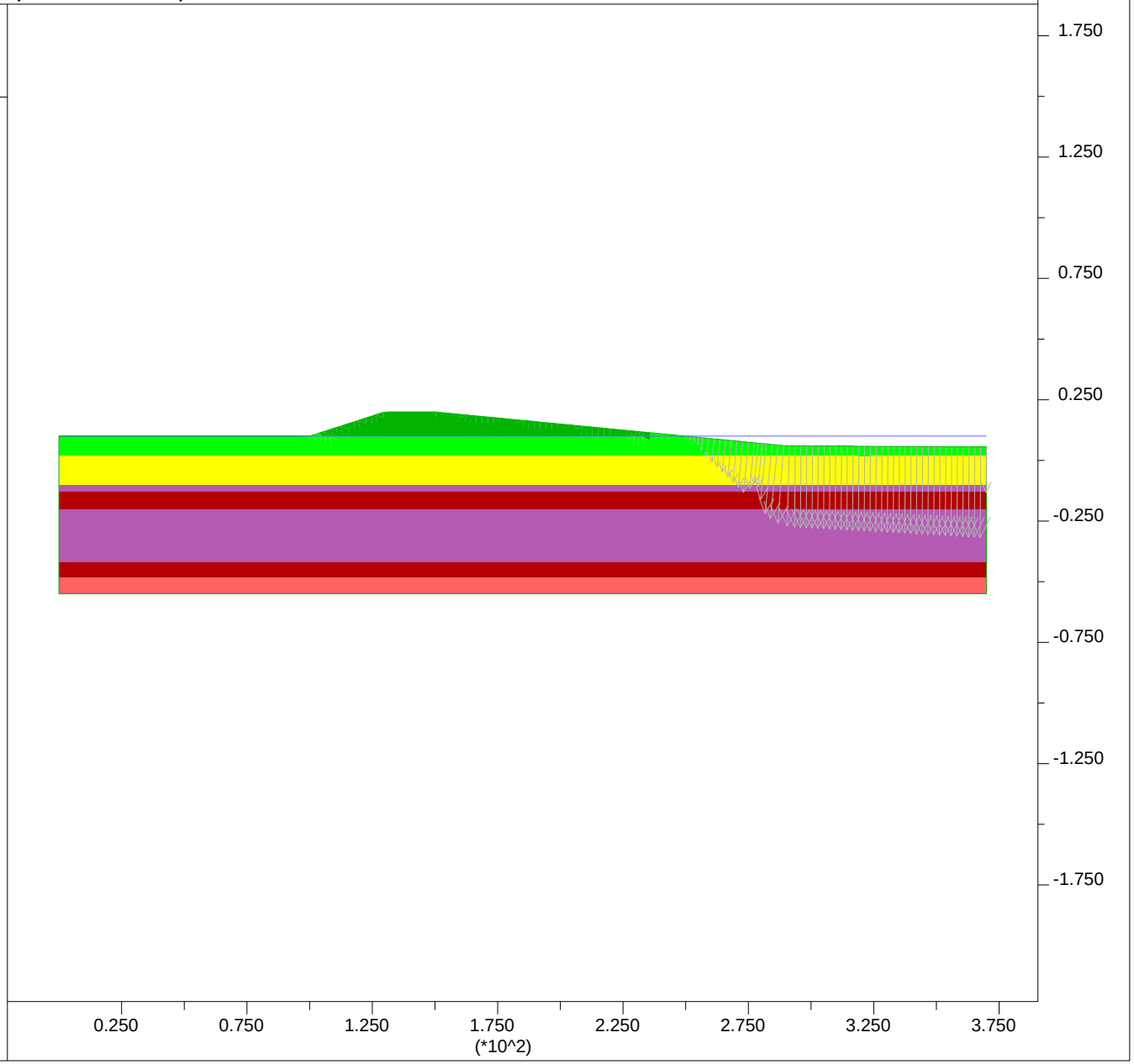


PLATE G-90

JOB TITLE : Section G-G' - Ky=0.05

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 19:26

Factor of Safety 0.98

Shear Strain Rate Contours

- 5.00E-07
- 1.00E-06
- 1.50E-06
- 2.00E-06
- 2.50E-06
- 3.00E-06

Contour interval= 5.00E-07
(zero contour omitted)
Boundary plot

0 2E 2

Water Table

Net Applied Forces

max vector = 3.377E+03

0 1E 4

Group Delta Consultants
Torrance, CA

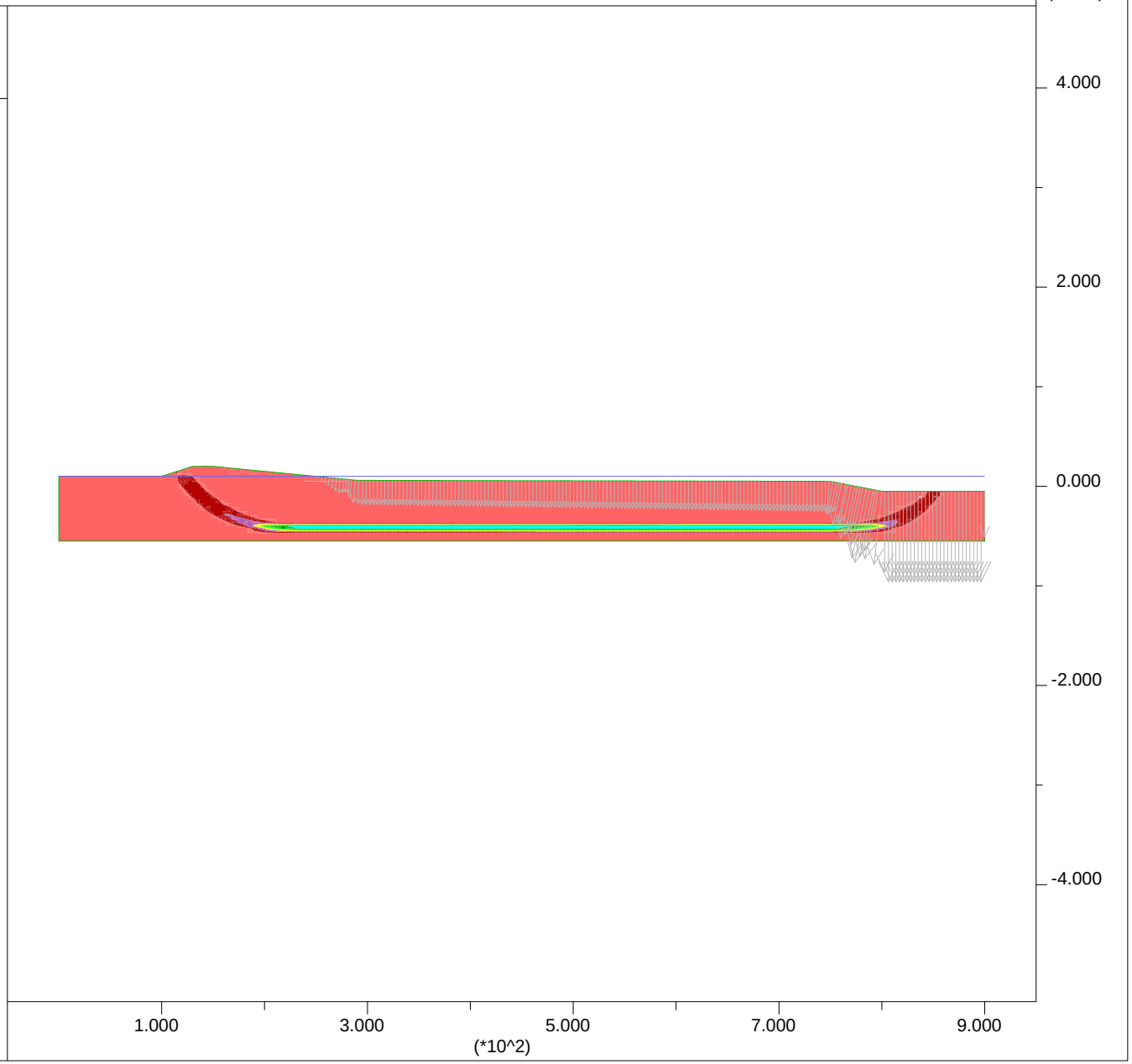


PLATE G-91

JOB TITLE : Section G-G' - Ky=0.05 - Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 19:25

Factor of Safety 0.98

User-defined Groups

- User:Sand
- 'User:Med Clay'
- 'User:Liq Sand'
- 'User:Soft Clay'
- 'Liq Fill:Liq Fill'
- User:Embankment

Boundary plot

0 2E 2

Water Table

Net Applied Forces

max vector = 3.377E+03

0 1E 4

Group Delta Consultants
Torrance, CA

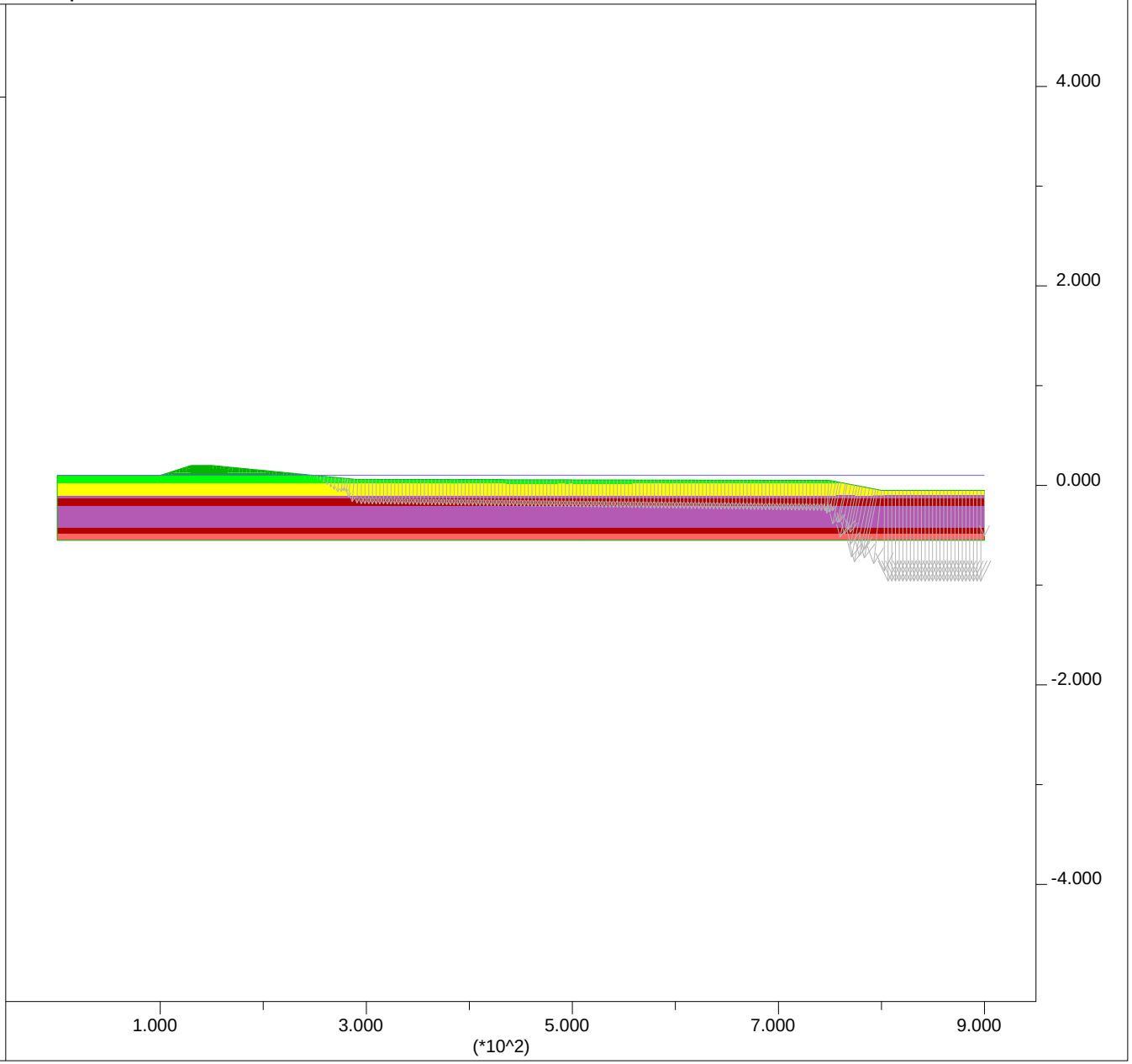


PLATE G-92

Newmark Displacements using Bray and Rathje (1998):

Section G-G'

Site Input				
PGA,rock =	0.25	g		
M =	6.6			
r =	13	km		
ky =	0.05		32.185	1.60925
Sliding Mass Input				
Vs =	150	m/s	assumed	
Thickness, H =	18.3	m		
	60	ft		
Output				
Tm =	0.49	sec		
D5-95 =	10.5	sec		
Ts =	0.49	sec		
NRF =	1.15			
Ts/Tm =	1.00			
kmax/(PGA,rock*NRF)	0.54			
kmax =	0.15			
ky / kmax =	0.33			
Displacement, u =	9	cm	0.3	feet
			3.5	inches

PLATE G-93

JOB TITLE : Section H-H' - End of Construction - Input

FLAC (Version 7.00)

LEGEND

27-Feb-13 13:52
step 18280
-2.778E+01 <x< 5.278E+02
-2.953E+02 <y< 2.603E+02

Factor of Safety 1.94

Max. shear strain-rate
- 0.00E+00
- 5.00E-07
- 1.00E-06
- 1.50E-06
- 2.00E-06
- 2.50E-06
- 3.00E-06
- 3.50E-06

Contour interval= 5.00E-07
Extrap. by averaging
Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands

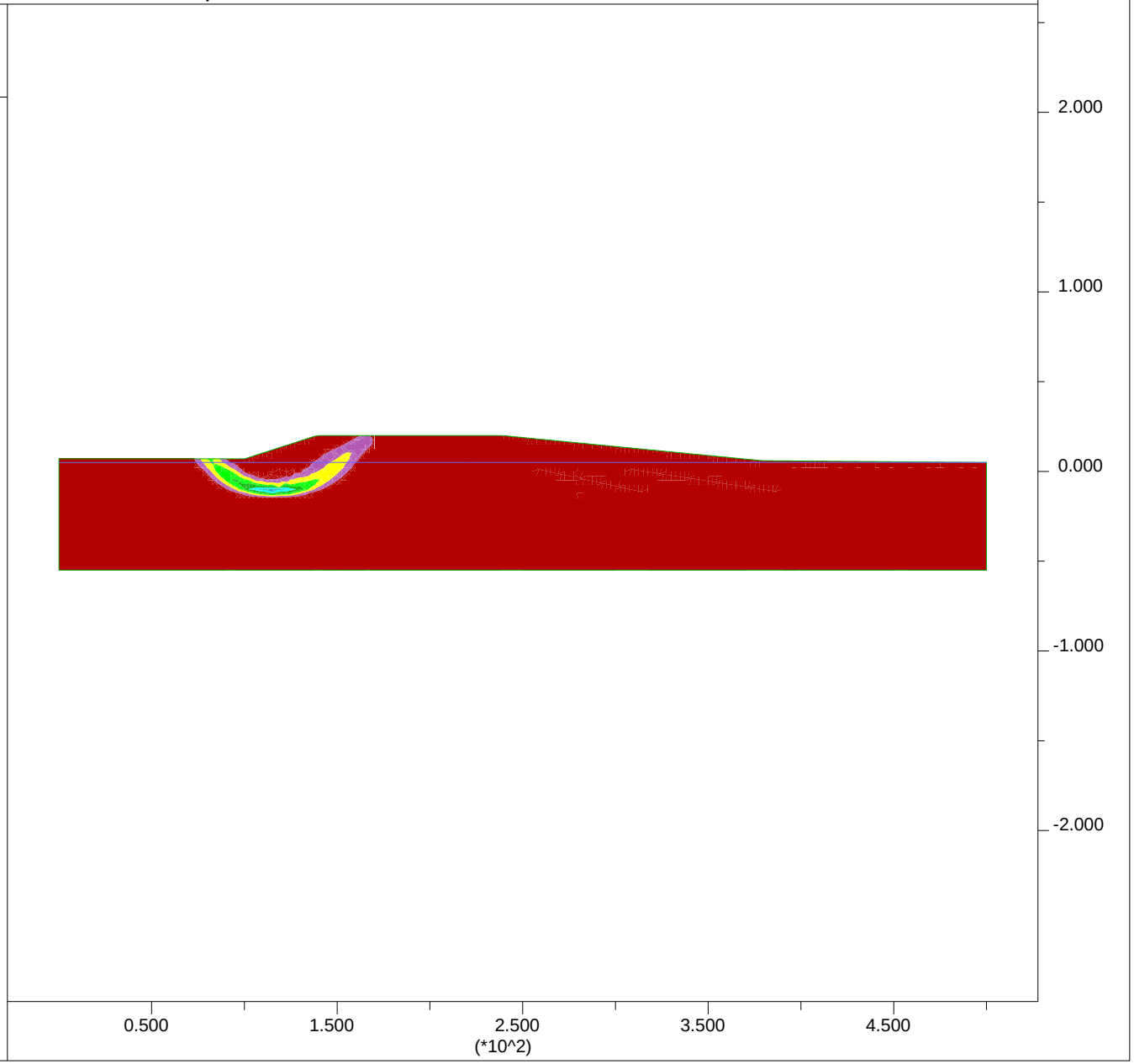


PLATE G-94

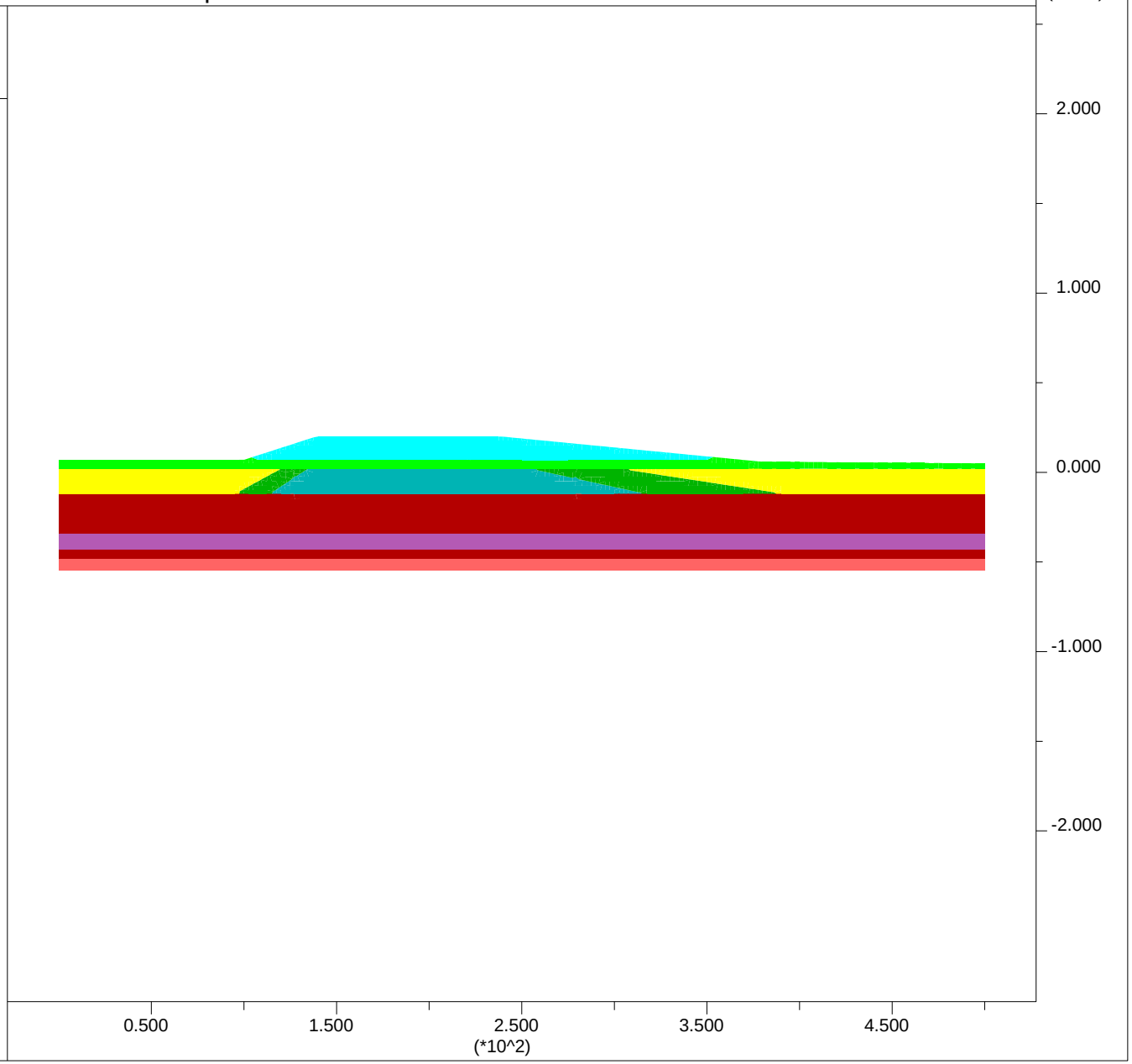
JOB TITLE : Section H-H' - End of Construction - Input

FLAC (Version 7.00)

LEGEND

27-Feb-13 13:49
step 0
-2.778E+01 <x< 5.278E+02
-2.953E+02 <y< 2.603E+02

User-defined Groups
- User:Sand
- 'User:Med Sand'
- 'S:Stiff Clay'
- 'User:V Soft Clay'
- Fill:Fill
- 'User:Clay 400'
- User:Embankment
- 'User:Soft Clay'



Group Delta Consultants
Ballona Wetlands

PLATE G-95

JOB TITLE : Section H-H' - High Water Short Term

FLAC (Version 7.00)

LEGEND

27-Feb-13 19:06
step 20150
-2.778E+01 <x< 5.278E+02
-2.953E+02 <y< 2.603E+02

Factor of Safety 1.87

Max. shear strain-rate
0.00E+00
2.50E-06
5.00E-06
7.50E-06
1.00E-05
1.25E-05

Contour interval= 2.50E-06
Extrap. by averaging
Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 1.892E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands

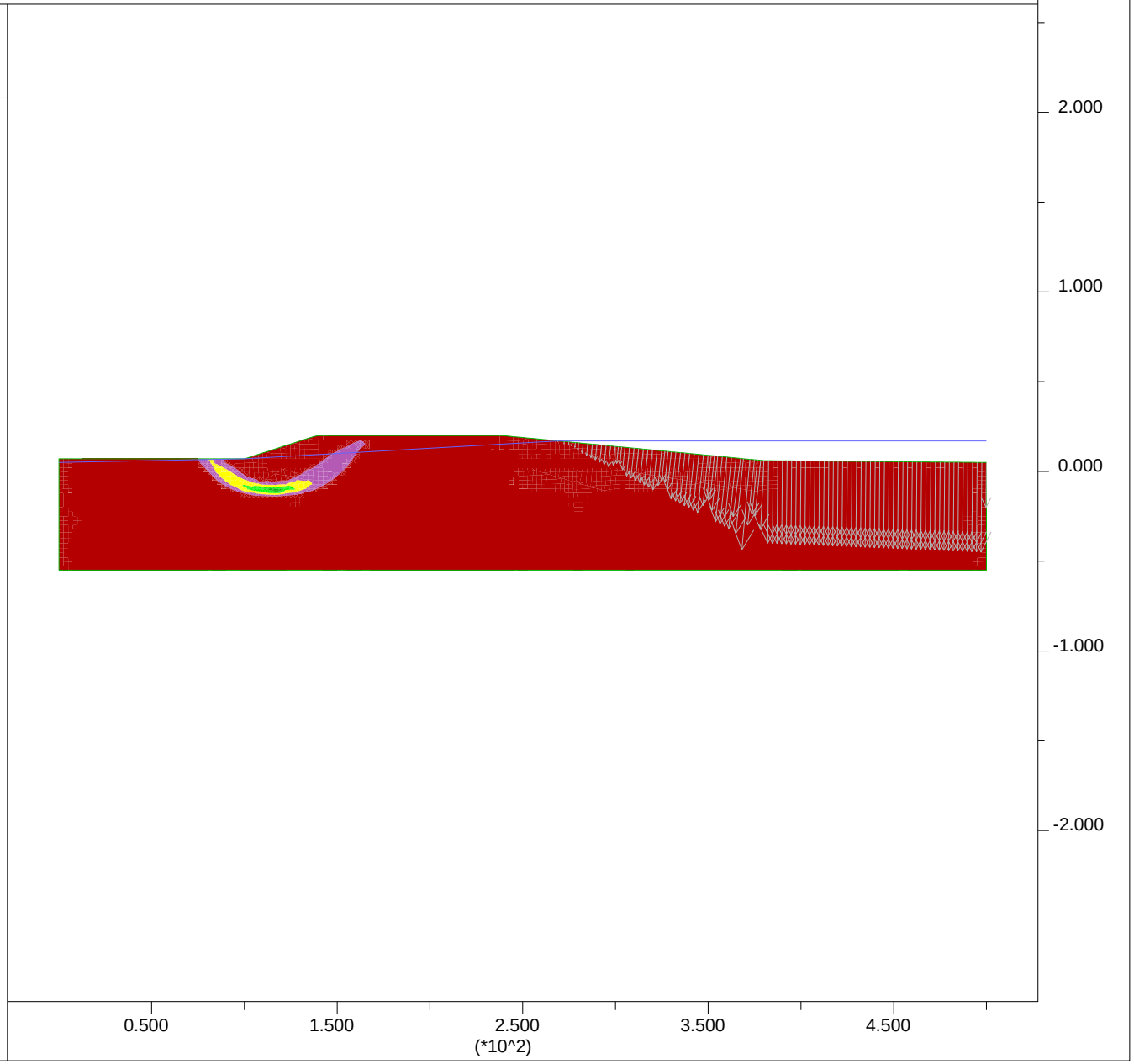


PLATE G-96

JOB TITLE : Section H-H' - High Water Short Term - Input

FLAC (Version 7.00)

LEGEND

27-Feb-13 19:09
step 20150
-2.778E+01 <x< 5.278E+02
-2.953E+02 <y< 2.603E+02

User-defined Groups
- User:Sand
- 'User:Med Sand'
- 'S:Stiff Clay'
- 'User:V Soft Clay'
- Fill:Fill
- 'User:Clay 400'
- User:Embankment
- 'User:Soft Clay'

Net Applied Forces
max vector = 1.892E+03
0 5E 3

Group Delta Consultants
Ballona Wetlands

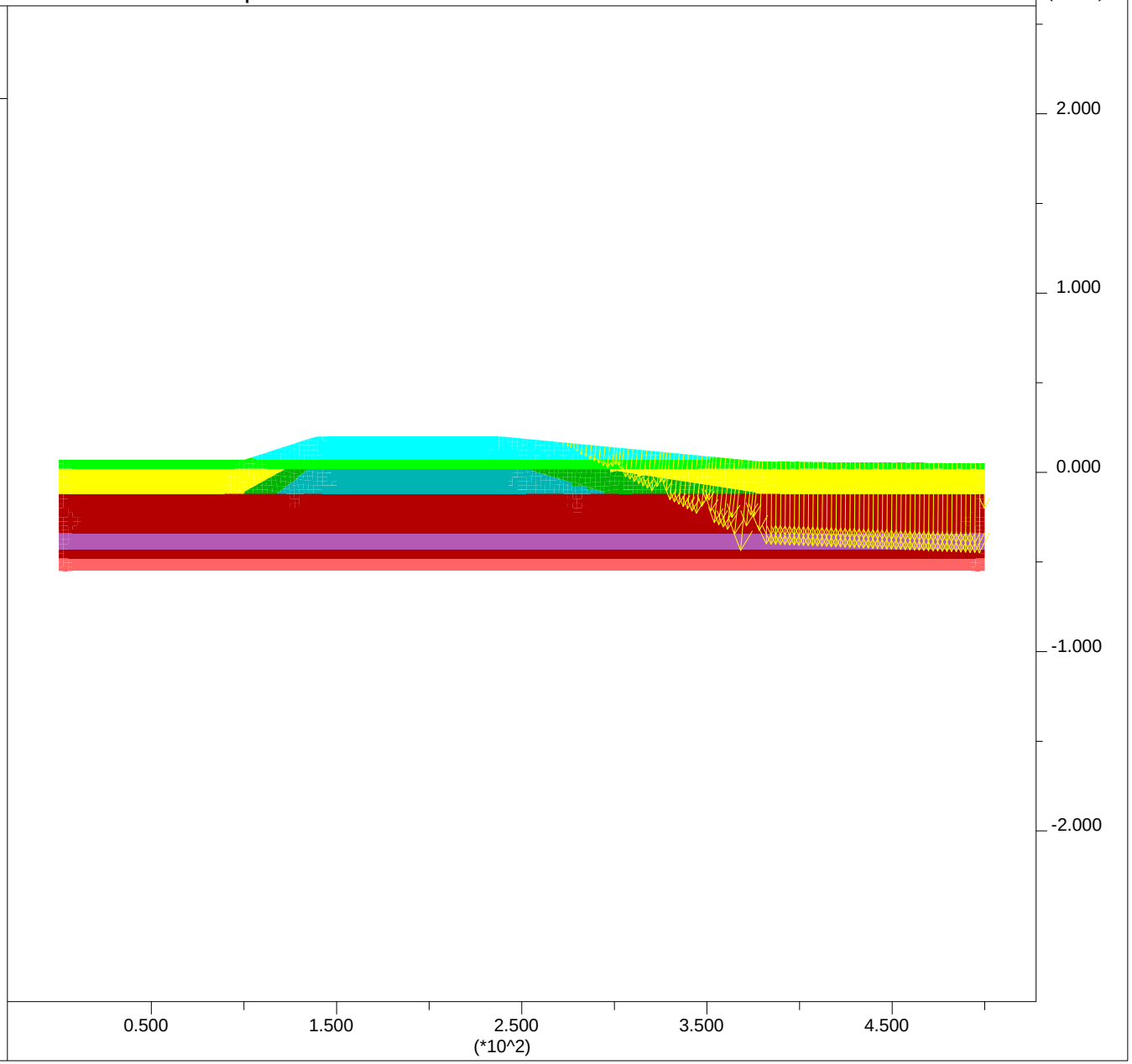


PLATE G-97

JOB TITLE : Section H-H' - Post Liquefaction

FLAC (Version 7.00)

LEGEND

26-Mar-13 14:19
step 28268
-2.778E+01 <x< 5.278E+02
-2.953E+02 <y< 2.603E+02

Factor of Safety 1.24

Max. shear strain-rate
0.00E+00
1.00E-06
2.00E-06
3.00E-06
4.00E-06
5.00E-06
6.00E-06
7.00E-06

Contour interval= 1.00E-06
Extrap. by averaging
Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands

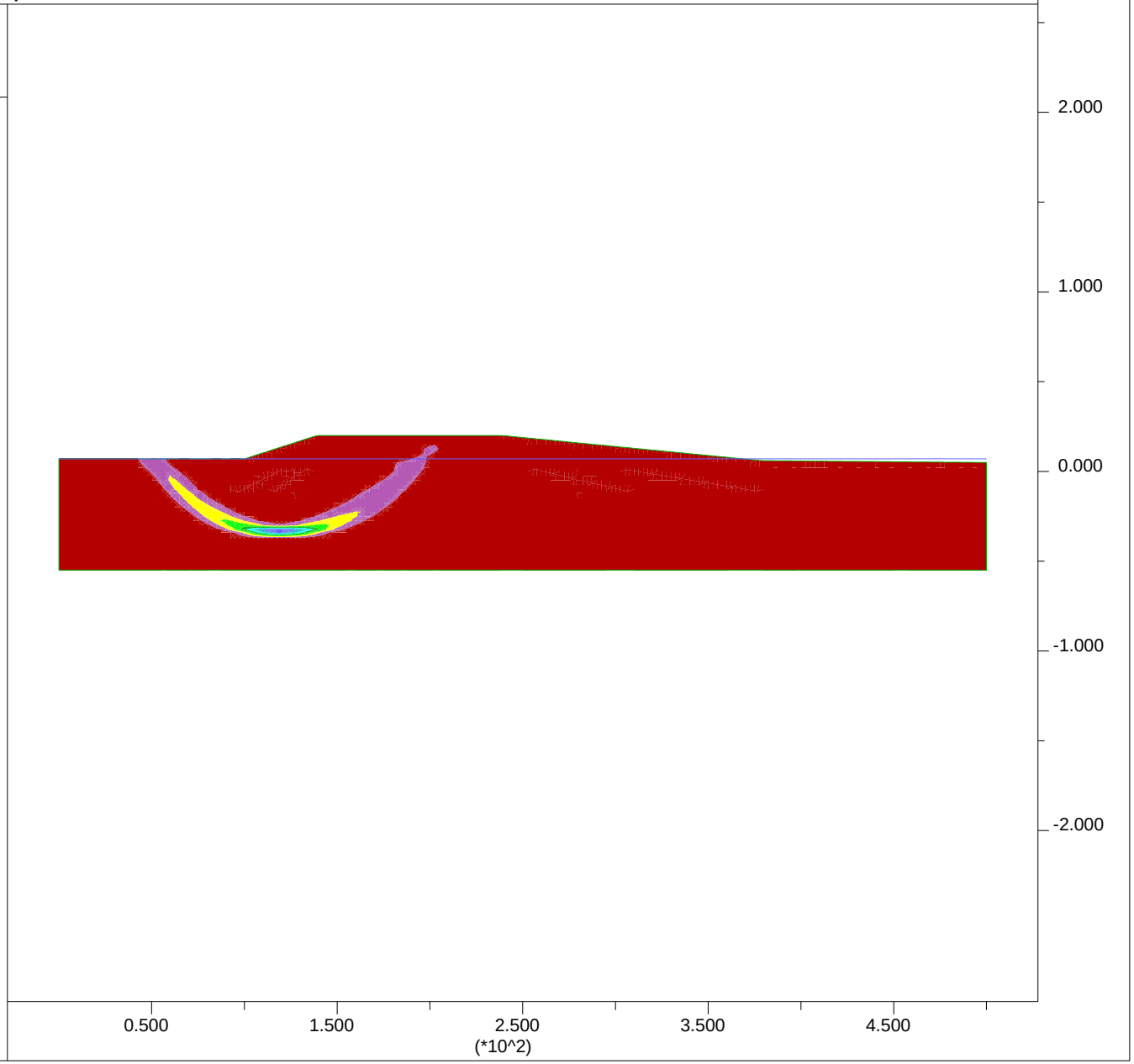


PLATE G-98

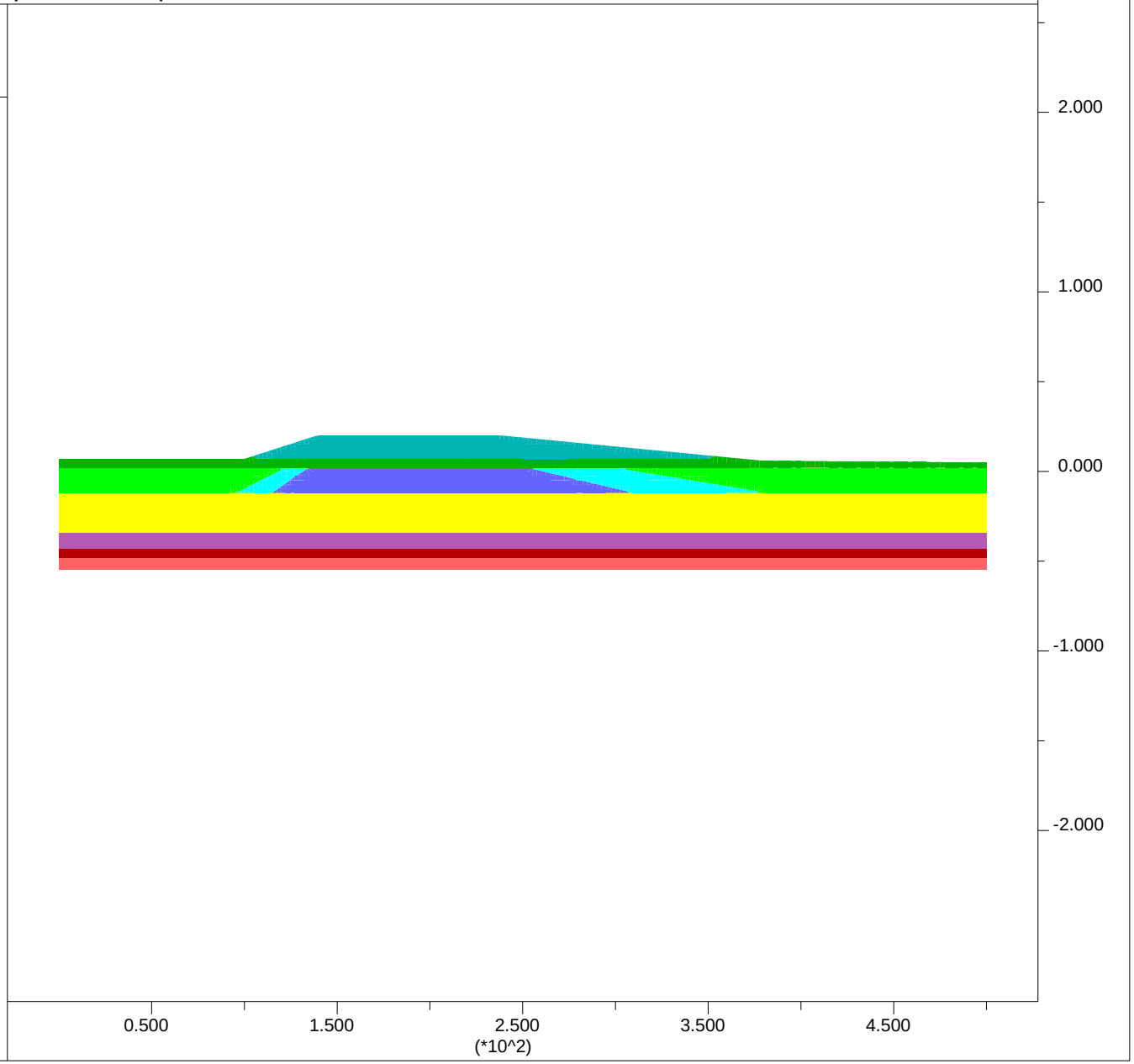
JOB TITLE : Section H-H' - Post Liquefaction Input

FLAC (Version 7.00)

LEGEND

26-Mar-13 14:21
step 28268
-2.778E+01 <x< 5.278E+02
-2.953E+02 <y< 2.603E+02

User-defined Groups
- User:Sand
- 'User:Liq Sand Deep'
- 'S:Stiff Clay'
- 'User:Liq Sand'
- 'User:V Soft Clay'
- 'User:Liq Fill'
- User:Clay400
- User:Embankment
- 'User:Soft Clay'



Group Delta Consultants
Ballona Wetlands

PLATE G-99

JOB TITLE : Section H-H' - Ky=0.04

FLAC (Version 7.00)

LEGEND

26-Mar-13 14:24
step 24768
-2.778E+01 <x< 5.278E+02
-2.953E+02 <y< 2.603E+02

Factor of Safety 0.99

Max. shear strain-rate
0.00E+00
2.50E-08
5.00E-08
7.50E-08
1.00E-07
1.25E-07
1.50E-07
1.75E-07
2.00E-07

Contour interval= 2.50E-08
Extrap. by averaging
Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands

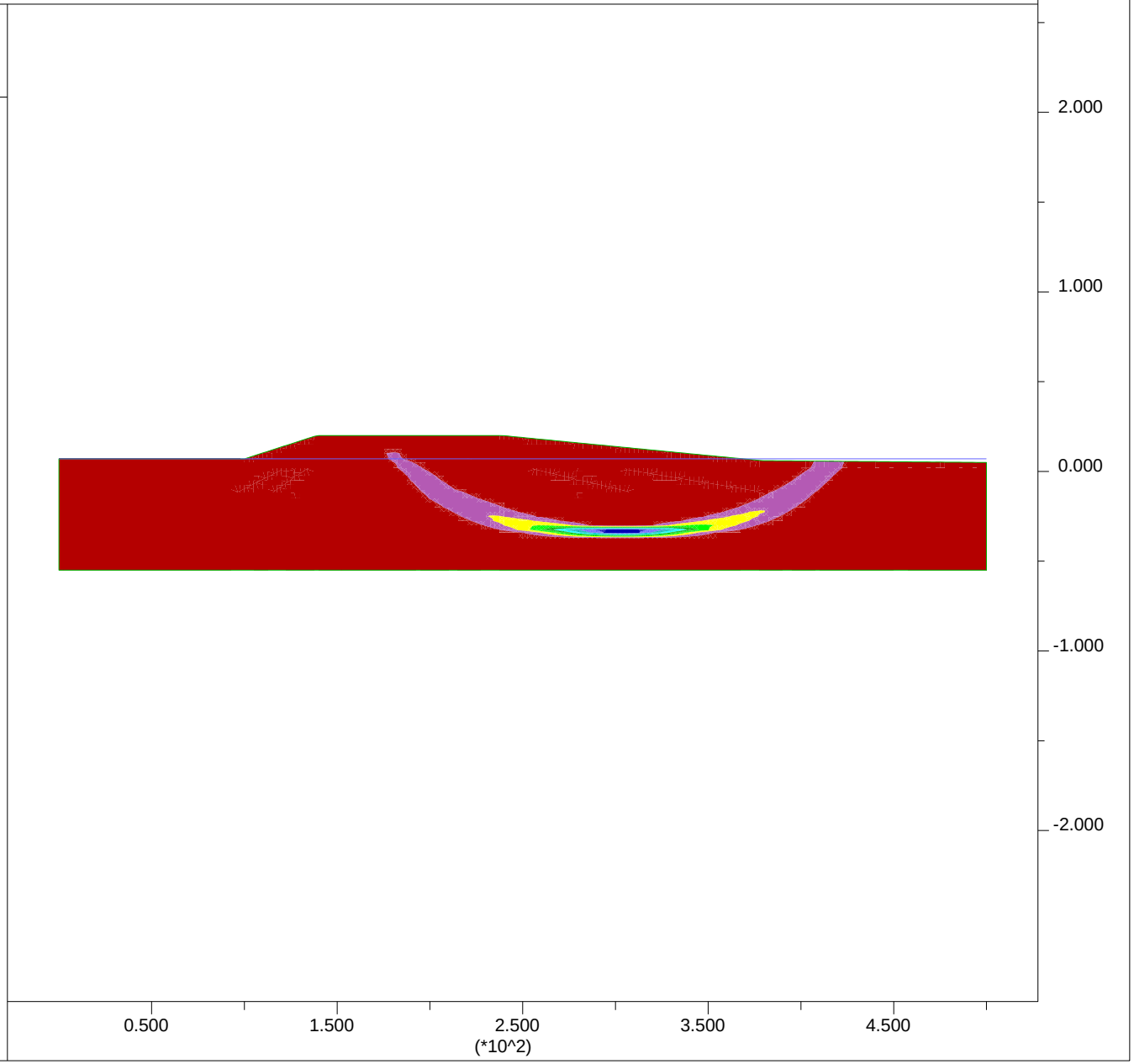


PLATE G-100

JOB TITLE : Section H-H' - Ky=0.04 - Input

FLAC (Version 7.00)

LEGEND

26-Mar-13 14:22
step 24768
-2.778E+01 <x< 5.278E+02
-2.953E+02 <y< 2.603E+02

User-defined Groups
- User:Sand
- 'User:Liq Sand Deep'
- 'S:Stiff Clay'
- 'User:Liq Sand'
- 'User:V Soft Clay'
- 'User:Liq Fill'
- User:Clay400
- User:Embankment
- 'User:Soft Clay'

Group Delta Consultants
Ballona Wetlands

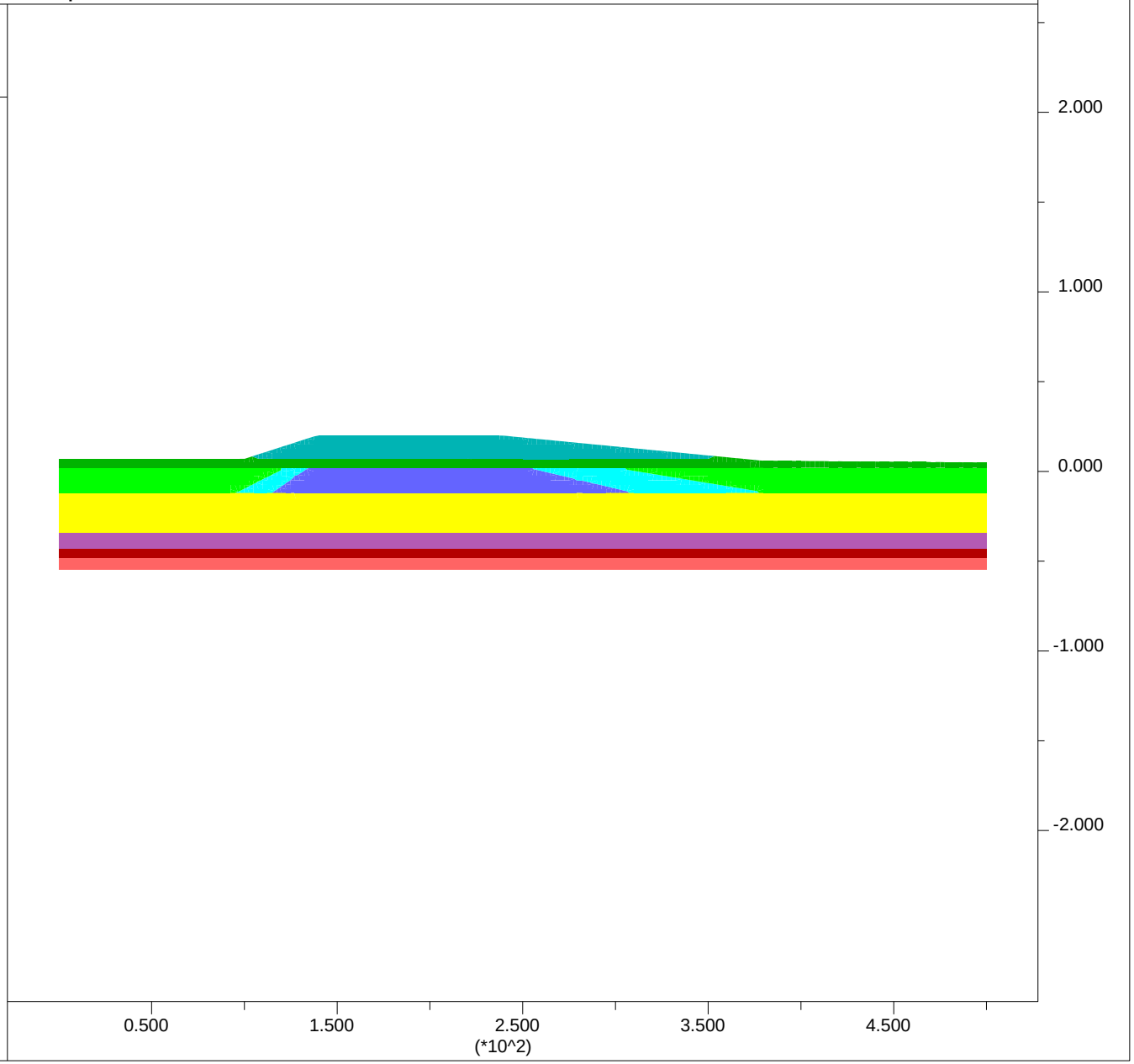


PLATE G-101

Newmark Displacements using Bray and Rathje (1998):

Section H-H'

Site Input				
PGA,rock =	0.25	g		
M =	6.6			
r =	13	km		
ky =	0.04		32.185	1.2874
Sliding Mass Input				
Vs =	110	m/s	assumed	
Thickness, H =	16.8	m		
	55	ft		

Output						
Tm =	0.49	sec				
D5-95 =	10.5	sec				
Ts =	0.61	sec				
NRF =	1.15					
Ts/Tm =	1.25					
kmax/(PGA,rock*NRF)	0.45					
kmax =	0.13					
ky / kmax =	0.31					
Displacement, u =	8	cm	0.3	feet	3.3	inches

PLATE G-102

JOB TITLE : Section I-I' - End of Construction

FLAC (Version 7.00)

LEGEND

27-Feb-13 14:56
step 10281
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

Factor of Safety 1.68

Max. shear strain-rate
0.00E+00
5.00E-07
1.00E-06
1.50E-06
2.00E-06
2.50E-06
3.00E-06
3.50E-06

Contour interval= 5.00E-07
Extrap. by averaging
Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands

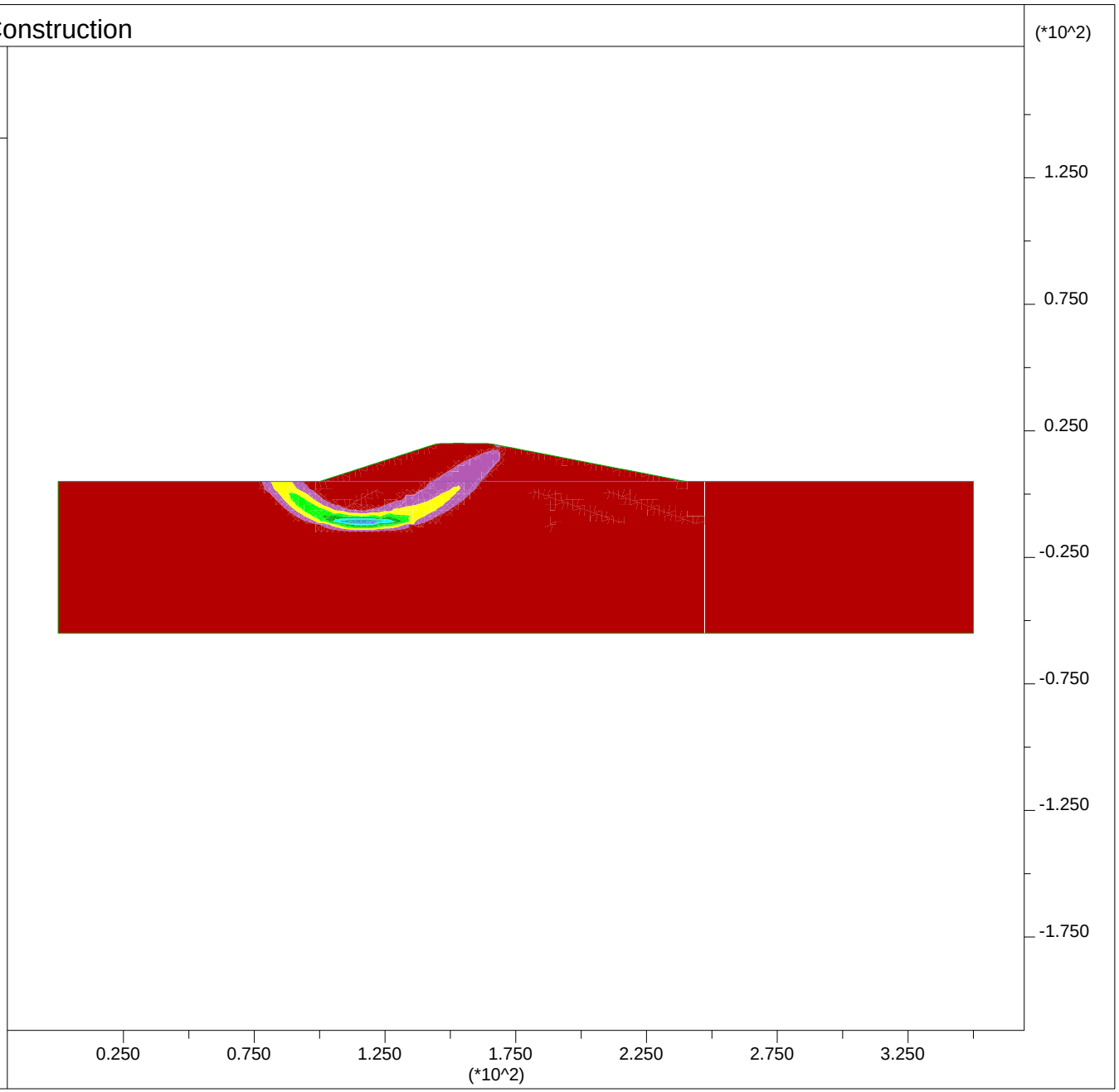


PLATE G-103

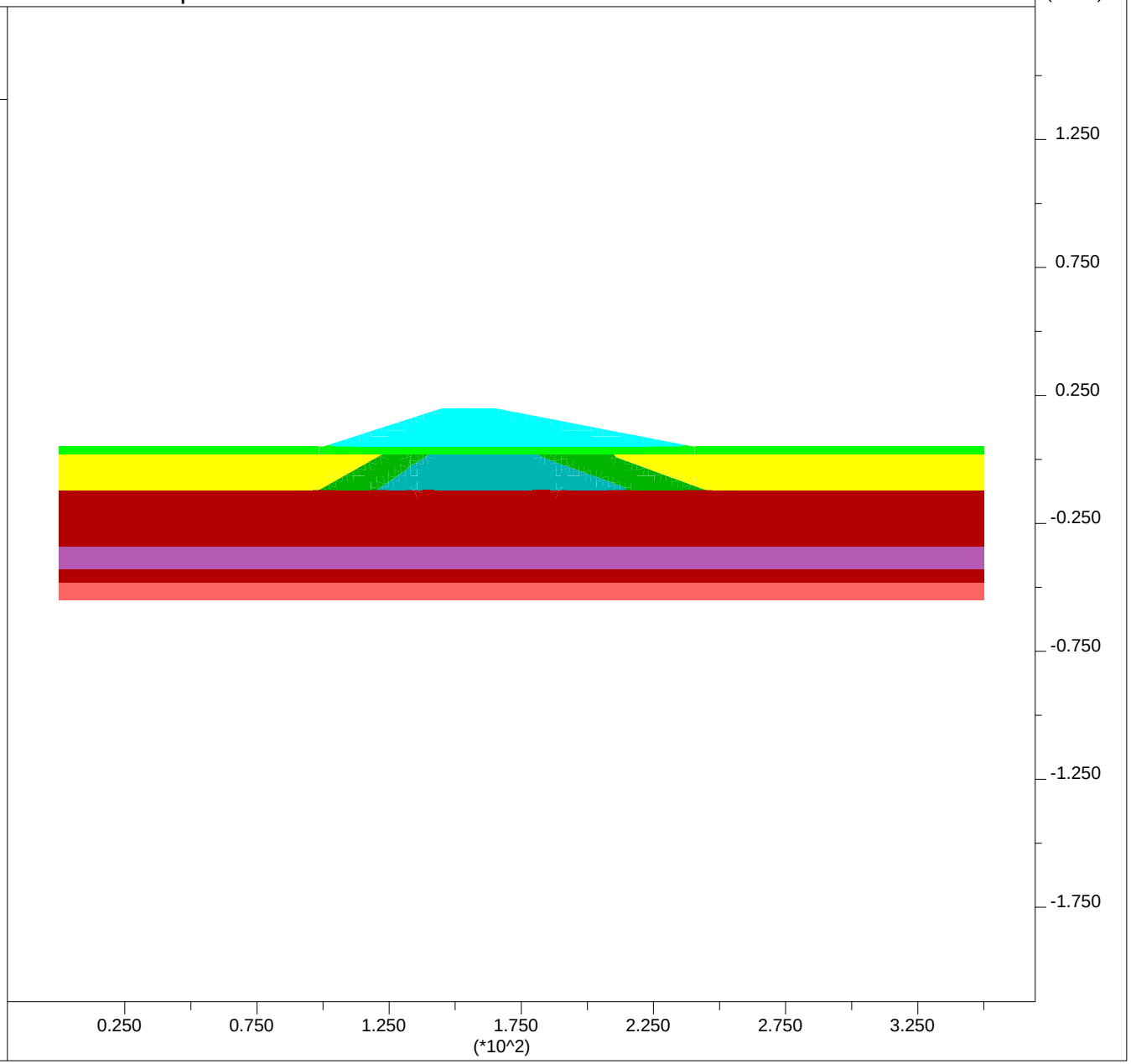
JOB TITLE : Section I-I' - End of Construction - Input

FLAC (Version 7.00)

LEGEND

27-Feb-13 14:57
step 10281
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

User-defined Groups
- User:Sand
- 'User:Med Sand'
- 'S:Stiff Clay'
- 'User:V Soft Clay'
- Fill:Fill
- User:Clay400
- User:Embankment
- 'User:Soft Clay'



Group Delta Consultants
Ballona Wetlands

PLATE G-104

JOB TITLE : Section I-I' - High Water Short Term

FLAC (Version 7.00)

LEGEND

27-Feb-13 14:37
step 21996
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

Factor of Safety 1.61

Max. shear strain-rate
0.00E+00
5.00E-07
1.00E-06
1.50E-06
2.00E-06
2.50E-06

Contour interval= 5.00E-07
Extrap. by averaging
Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 1.874E+03

0 3E 3

Group Delta Consultants
Ballona Wetlands

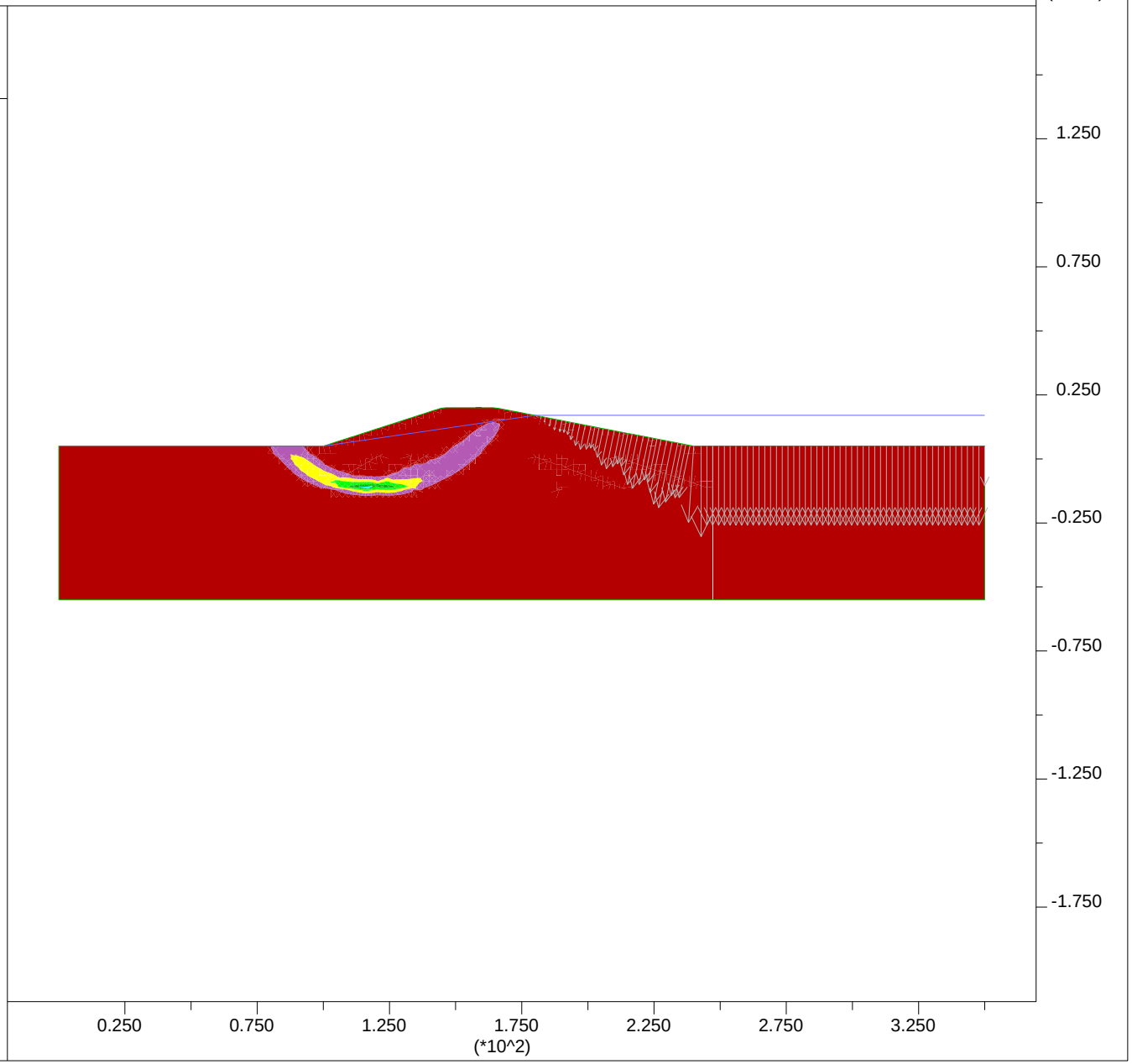


PLATE G-105

JOB TITLE : Section I-I' - High Water Short Term - Input

FLAC (Version 7.00)

LEGEND

27-Feb-13 14:38
step 21996
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

User-defined Groups
- User:Sand
- 'User:Med Sand'
- 'S:Stiff Clay'
- 'User:V Soft Clay'
- Fill:Fill
- User:Clay400
- User:Embankment
- 'User:Soft Clay'

Grid plot

0 1E 2

Net Applied Forces

max vector = 1.874E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands

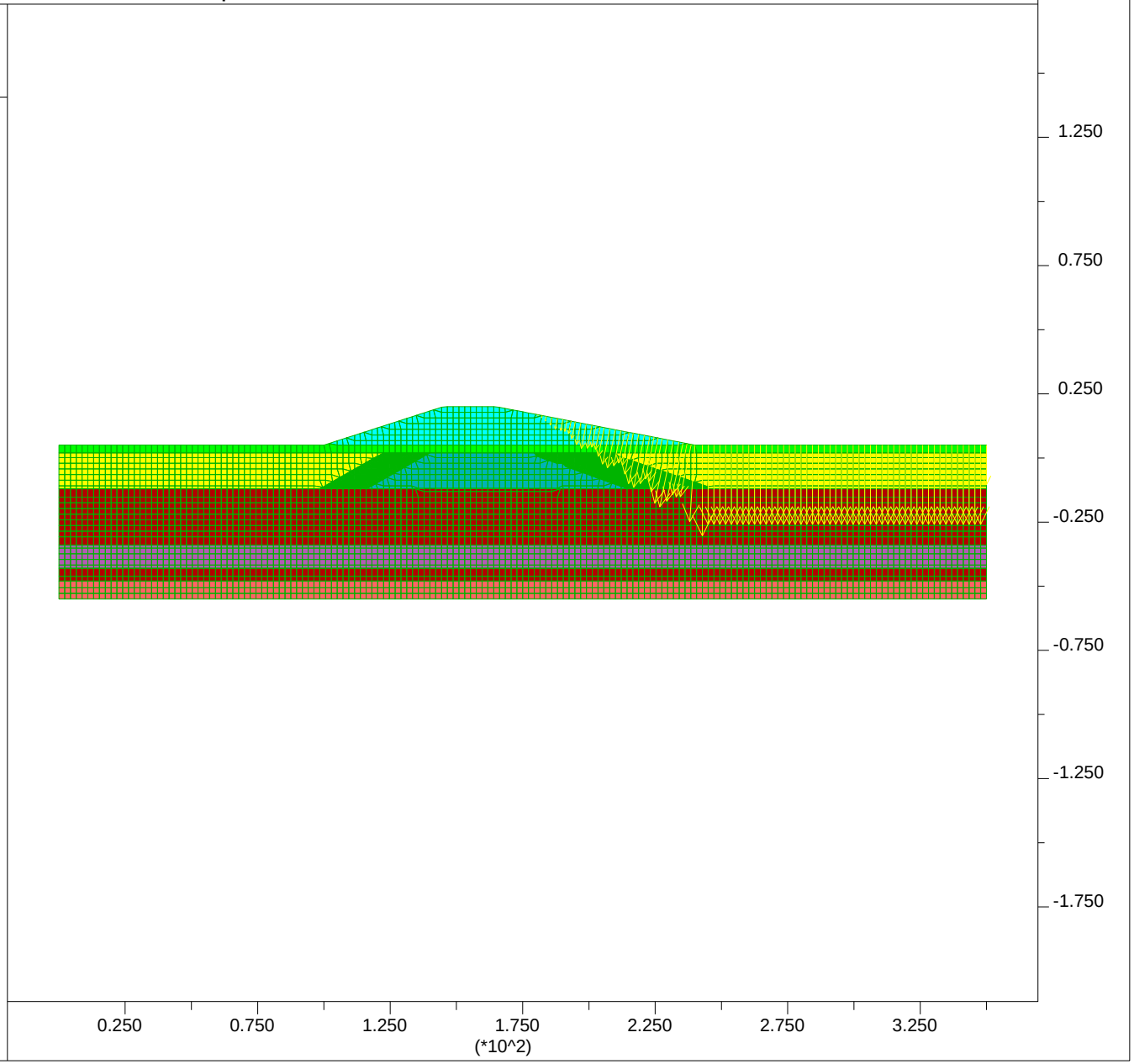


PLATE G-106

JOB TITLE : Section I-I' - High Water Long Term (Steady State)

FLAC/SLOPE (Version 7.00)

LEGEND

5-Mar-13 14:26

Factor of Safety 2.29

Shear Strain Rate Contours

- 2.50E-07
- 5.00E-07
- 7.50E-07
- 1.00E-06
- 1.25E-06
- 1.50E-06
- 1.75E-06
- 2.00E-06

Contour interval= 2.50E-07
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 1.327E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands

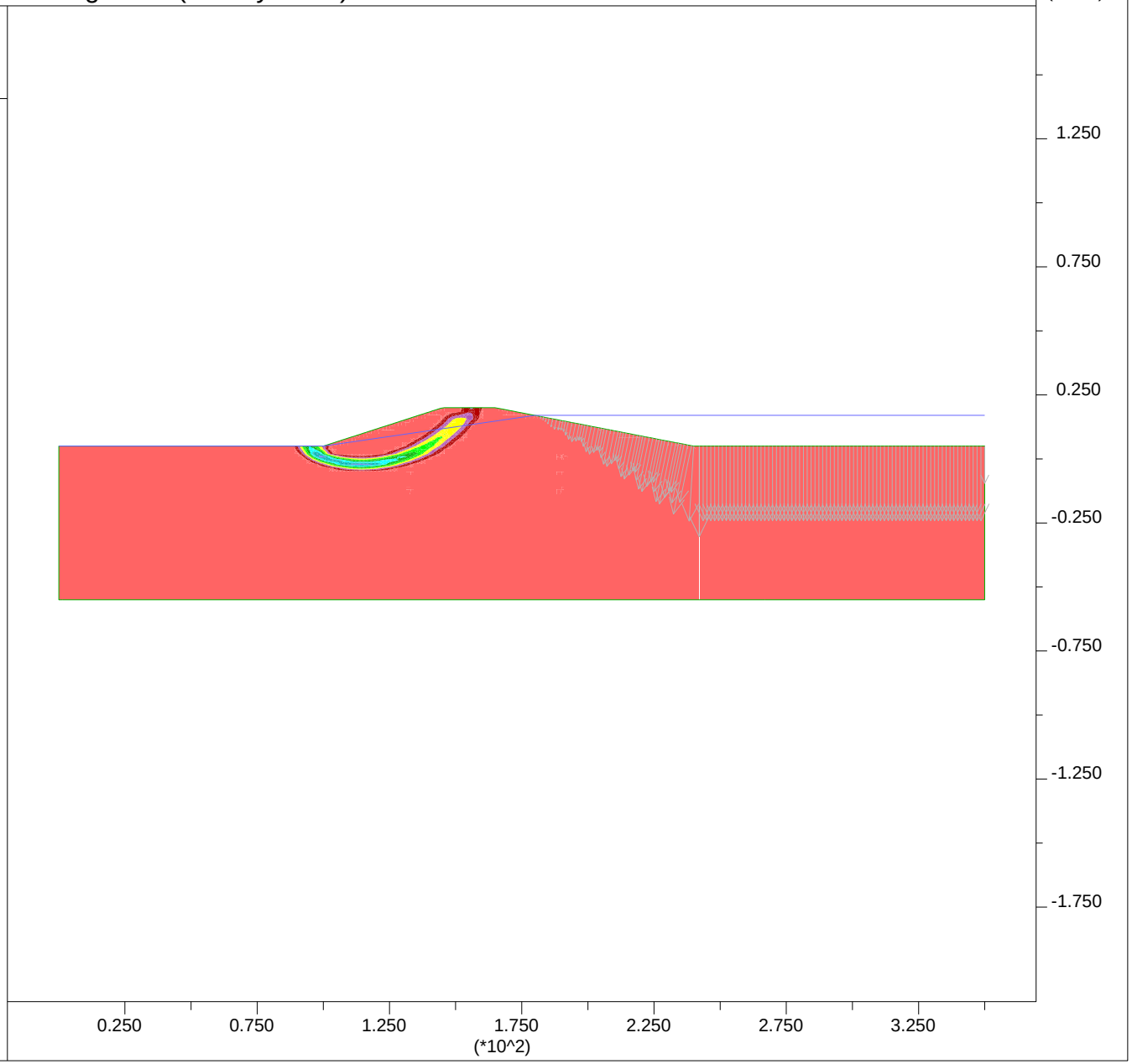


PLATE G-107

JOB TITLE : Section I-I' - High Water Long Term (Steady State) - Input

FLAC/SLOPE (Version 7.00)

LEGEND

5-Mar-13 14:27

Factor of Safety 2.29

User-defined Groups
- User:Sand
- 'User:Med Sand'
- 'S:Stiff Clay'
- 'User:Soft Clay'
- Fill:Fill
- User:Embankment

Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 1.327E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands

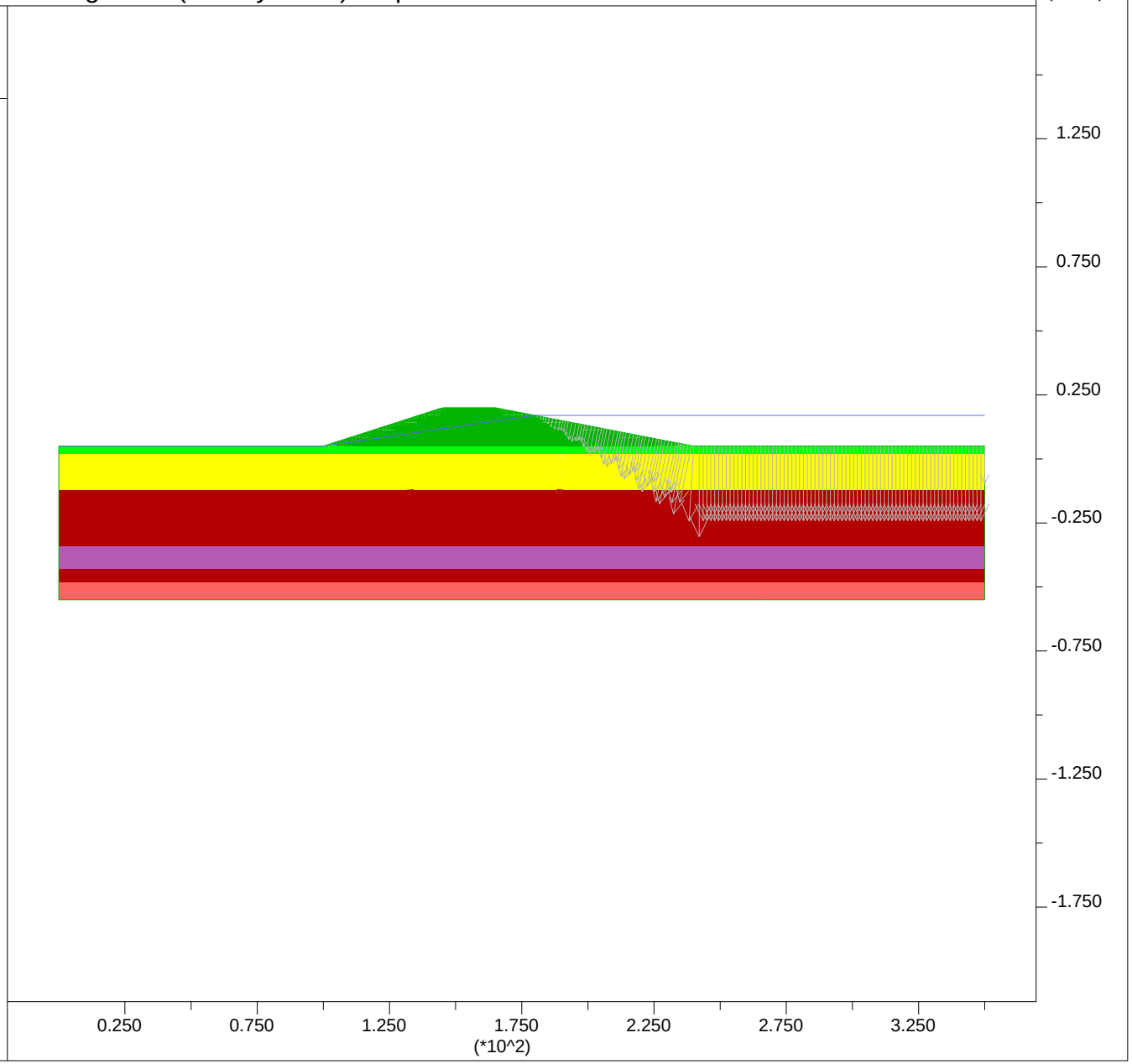


PLATE G-108

JOB TITLE : Section I-I' - Post Liquefaction

FLAC (Version 7.00)

LEGEND

27-Feb-13 15:15
step 9213
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

Factor of Safety 1.17

Max. shear strain-rate
0.00E+00
2.00E-07
4.00E-07
6.00E-07
8.00E-07
1.00E-06

Contour interval= 2.00E-07
Extrap. by averaging
Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands

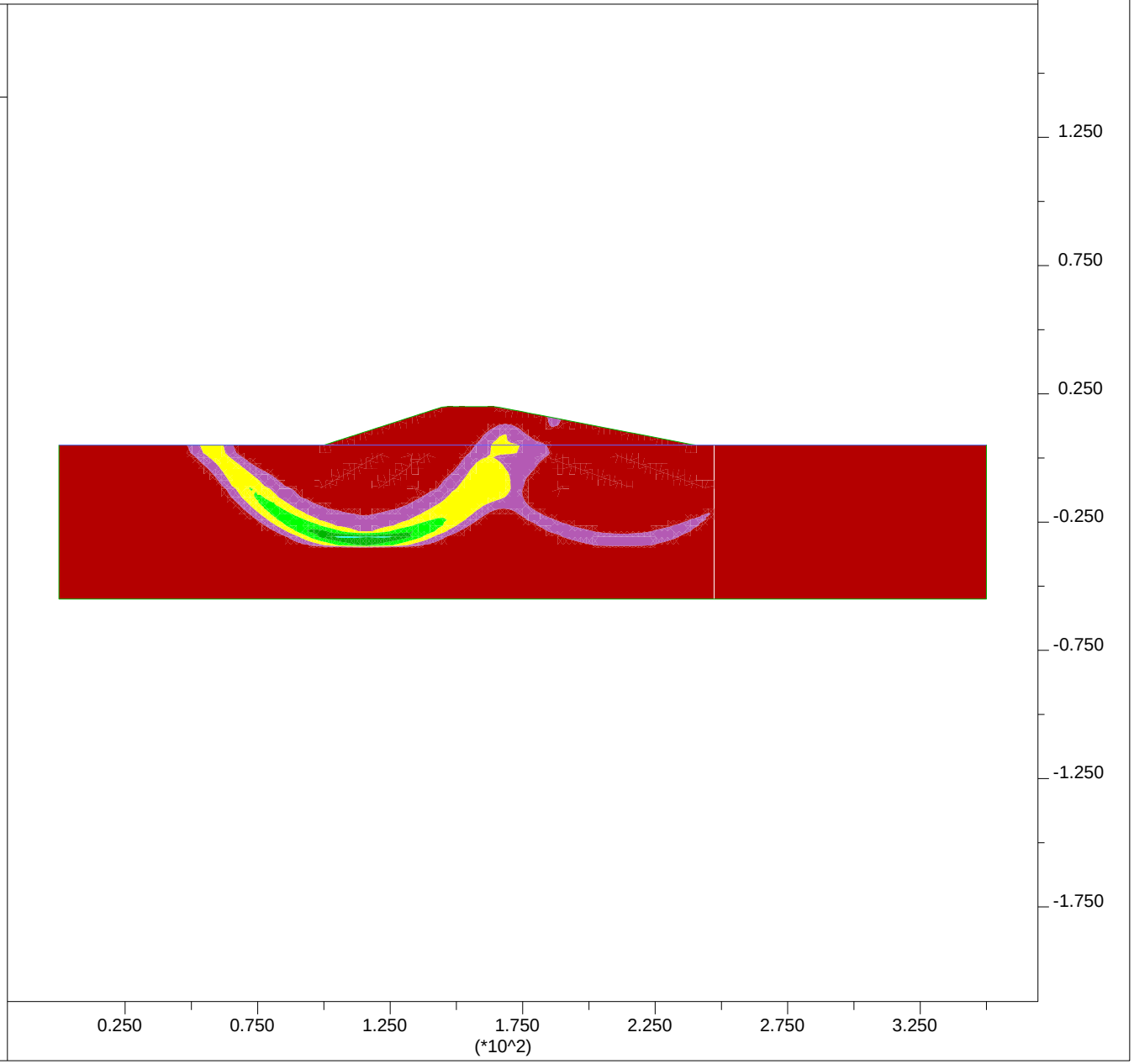


PLATE G-109

JOB TITLE : Section I-I' - Post Liquefaction - Input

FLAC (Version 7.00)

LEGEND

27-Feb-13 15:17
step 0
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

User-defined Groups
- User:Sand
- User:LiqSandDeep
- 'S:Stiff Clay'
- User:LiqSand
- 'User:V Soft Clay'
- Fill:LiqFill
- User:Clay400
- User:Embankment
- 'User:Soft Clay'

Group Delta Consultants
Ballona Wetlands

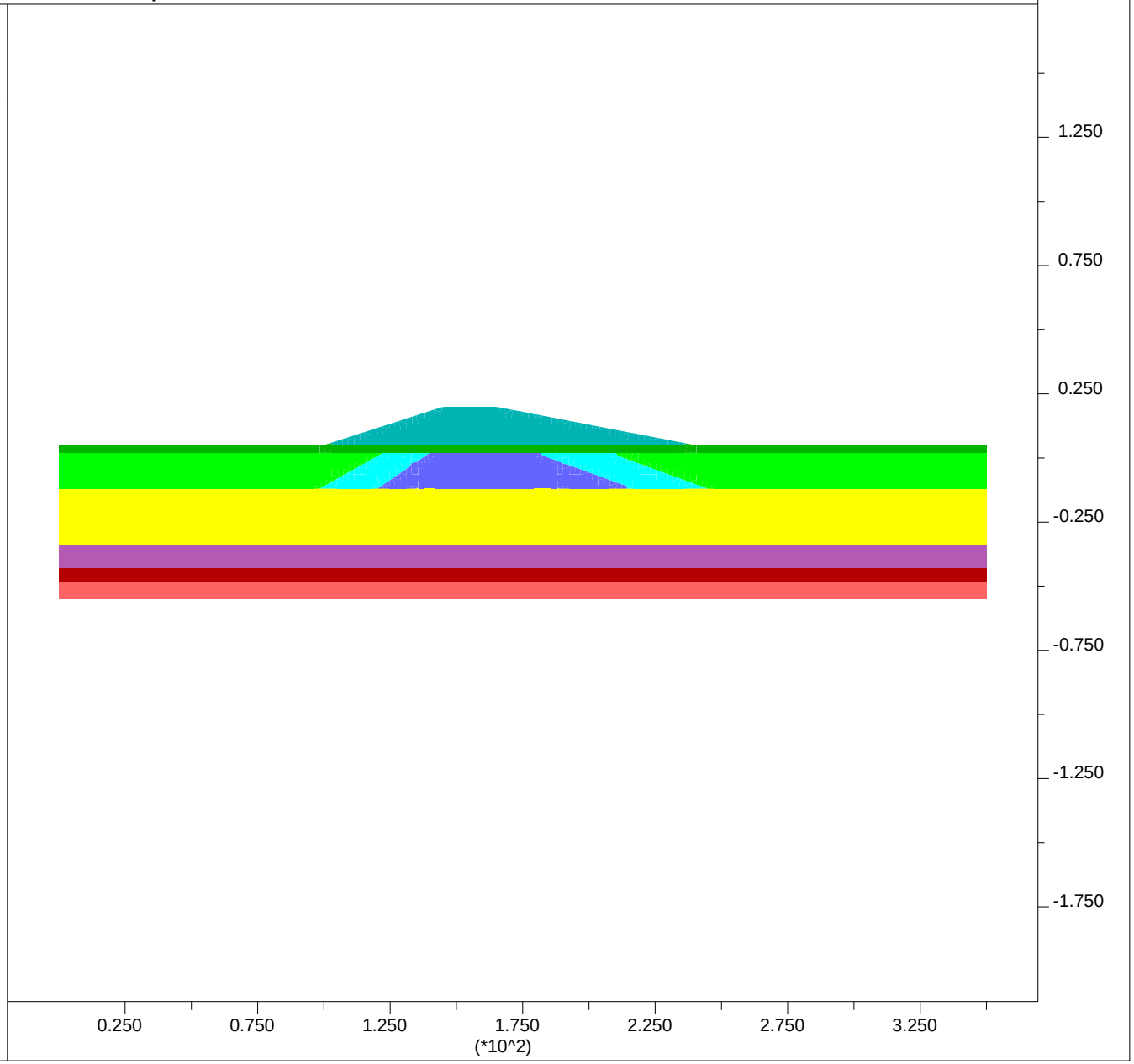


PLATE G-110

JOB TITLE : Section I-I' - Ky=0.04

FLAC (Version 7.00)

LEGEND

27-Feb-13 15:23
step 30986
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

Factor of Safety 1.00

Max. shear strain-rate
0.00E+00
1.00E-07
2.00E-07
3.00E-07
4.00E-07
5.00E-07
6.00E-07
7.00E-07
8.00E-07
9.00E-07

Contour interval= 1.00E-07
Extrap. by averaging
Boundary plot

0 1E 2

Group Delta Consultants
Ballona Wetlands

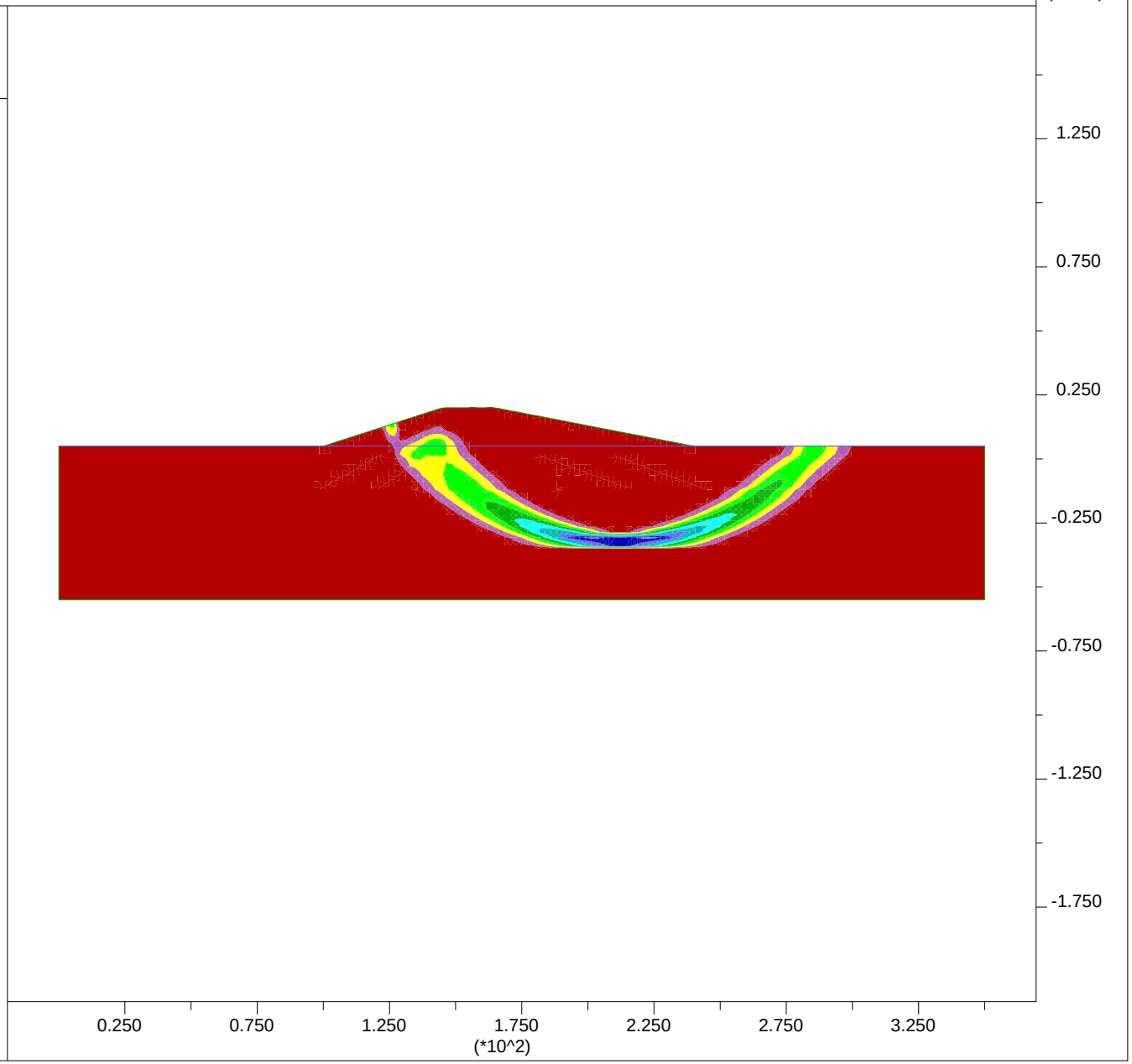


PLATE G-111

JOB TITLE : Section I-I' - Ky=0.04 - Input

FLAC (Version 7.00)

LEGEND

27-Feb-13 15:25
step 0
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

User-defined Groups
- User:Sand
- User:LiqSandDeep
- 'S:Stiff Clay'
- User:LiqSand
- 'User:V Soft Clay'
- Fill:LiqFill
- User:Clay400
- User:Embankment
- 'User:Soft Clay'

Group Delta Consultants
Ballona Wetlands

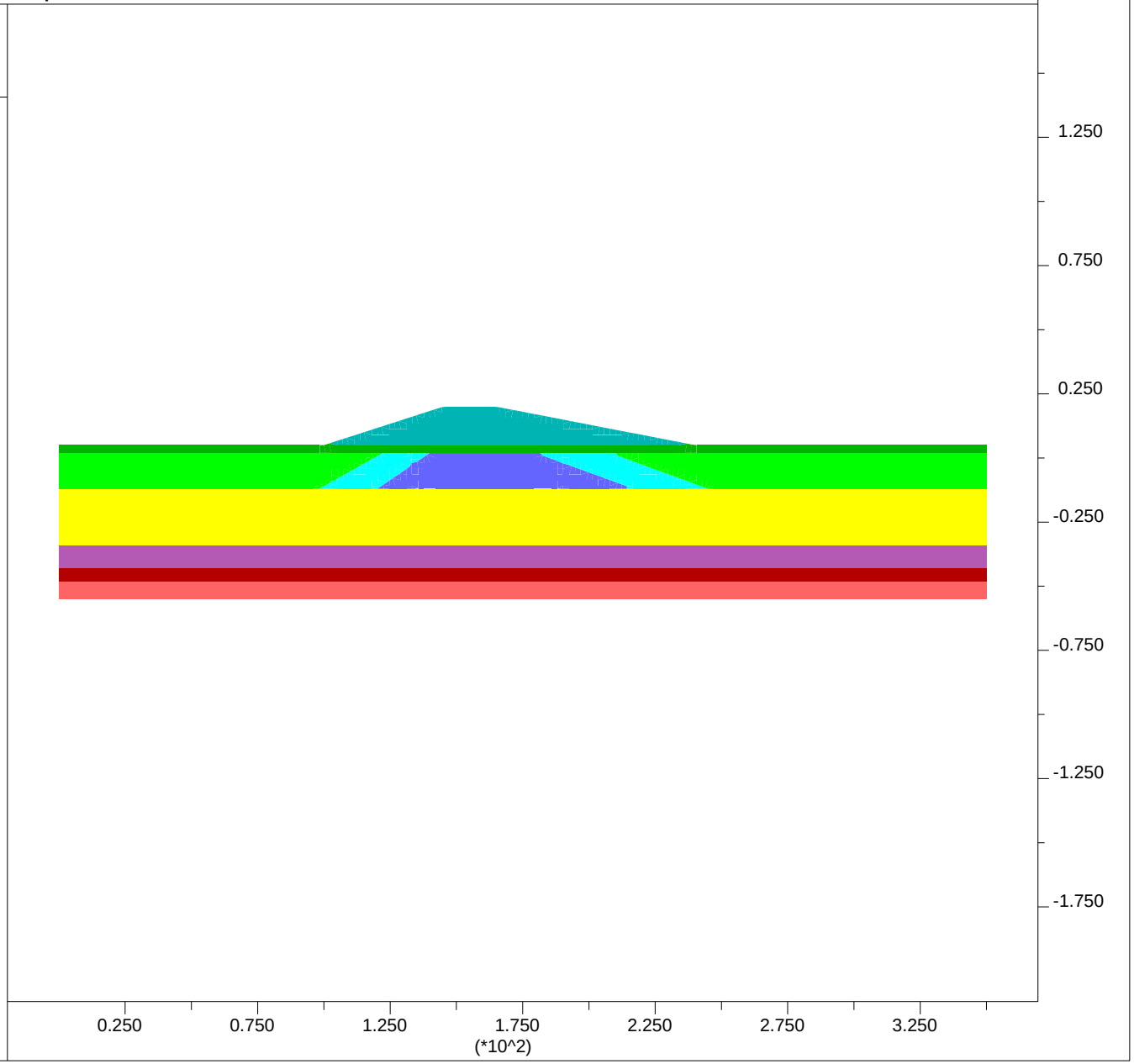


PLATE G-112

Newmark Displacements using Bray and Rathje (1998):

Section I-I'

Site Input				
PGA,rock =	0.25	g		
M =	6.6			
r =	13	km		
ky =	0.04			
Sliding Mass Input				
Vs =	110	m/s	assumed	
Thickness, H =	15.3	m		
	50	ft		
Output				
Tm =	0.49	sec		
D5-95 =	10.5	sec		
Ts =	0.55	sec		
NRF =	1.15			
Ts/Tm =	1.14			
kmax/(PGA,rock*NRF)	0.48			
kmax =	0.14			
ky / kmax =	0.29			
Displacement, u =	11	cm	0.4	feet	4.3	inches

PLATE G-113

JOB TITLE : Section J-J' - End of Construction

FLAC (Version 7.00)

LEGEND

27-Feb-13 15:27
step 16426
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

Factor of Safety 2.09

Max. shear strain-rate
0.00E+00
5.00E-07
1.00E-06
1.50E-06
2.00E-06
2.50E-06
3.00E-06
3.50E-06
4.00E-06

Contour interval= 5.00E-07
Extrap. by averaging
Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands

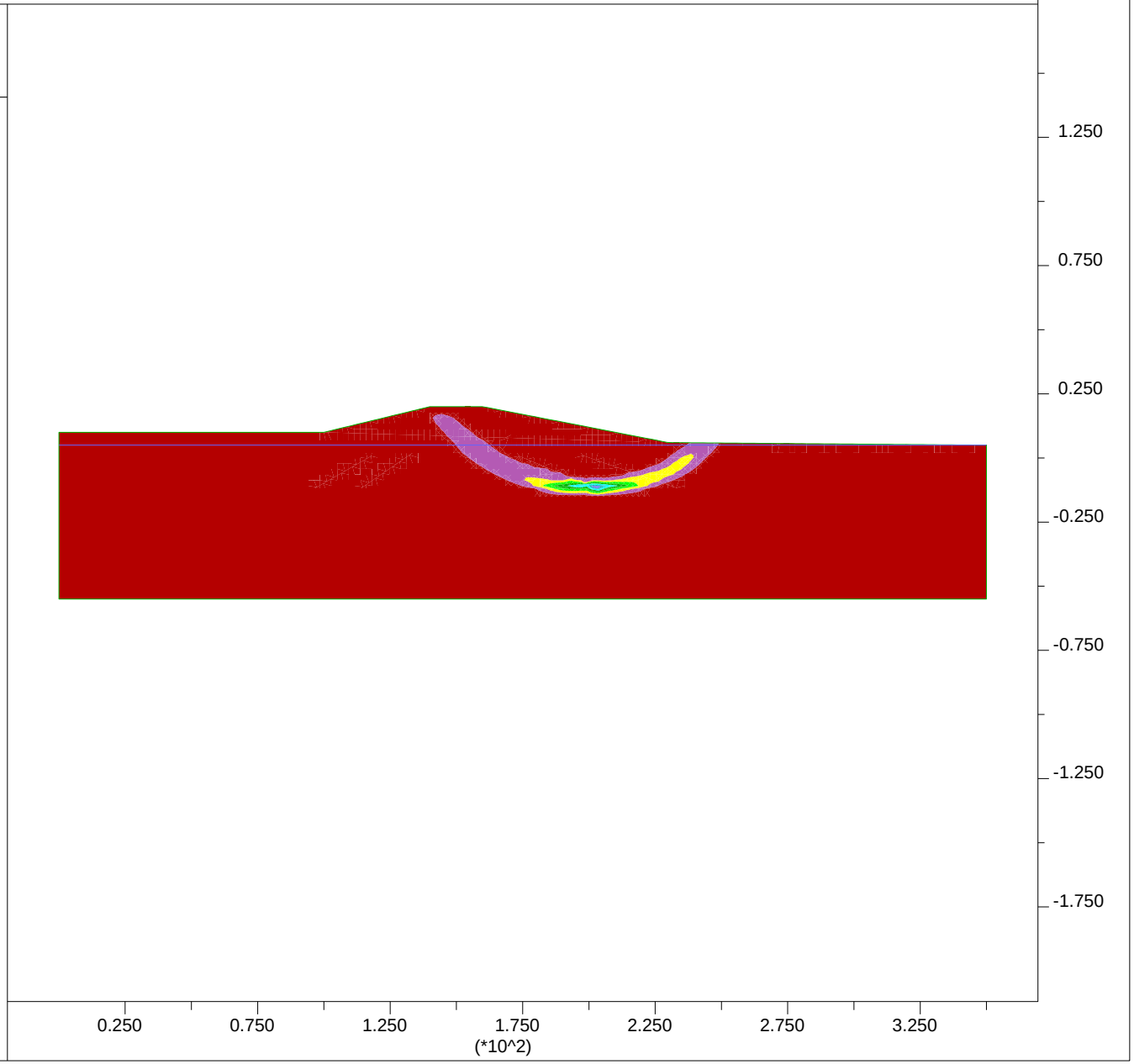


PLATE G-114

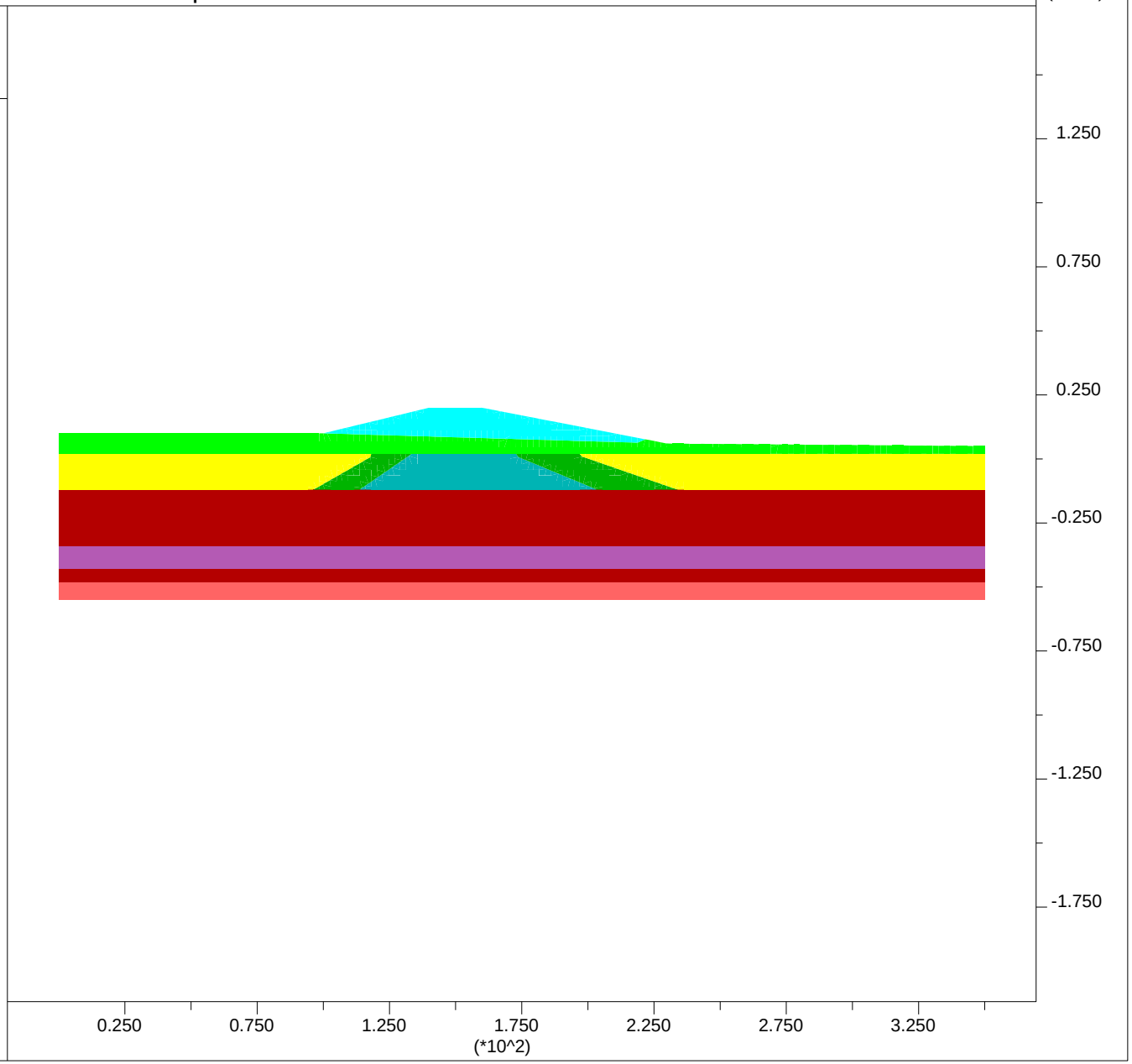
JOB TITLE : Section J-J' - End of Construction - Input

FLAC (Version 7.00)

LEGEND

27-Feb-13 15:30
step 0
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

User-defined Groups
- User:Sand
- 'User:Med Sand'
- 'S:Stiff Clay'
- 'User:V Soft Clay'
- Fill:Fill
- User:Clay400
- User:Embankment
- 'User:Soft Clay'



Group Delta Consultants
Ballona Wetlands

PLATE G-115

JOB TITLE : Section J-J' - High Water Short Term

FLAC (Version 7.00)

LEGEND

27-Feb-13 16:12
step 8130
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

Factor of Safety 2.48

Max. shear strain-rate
0.00E+00
5.00E-07
1.00E-06
1.50E-06
2.00E-06
2.50E-06

Contour interval= 5.00E-07
Extrap. by averaging
Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 1.636E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands

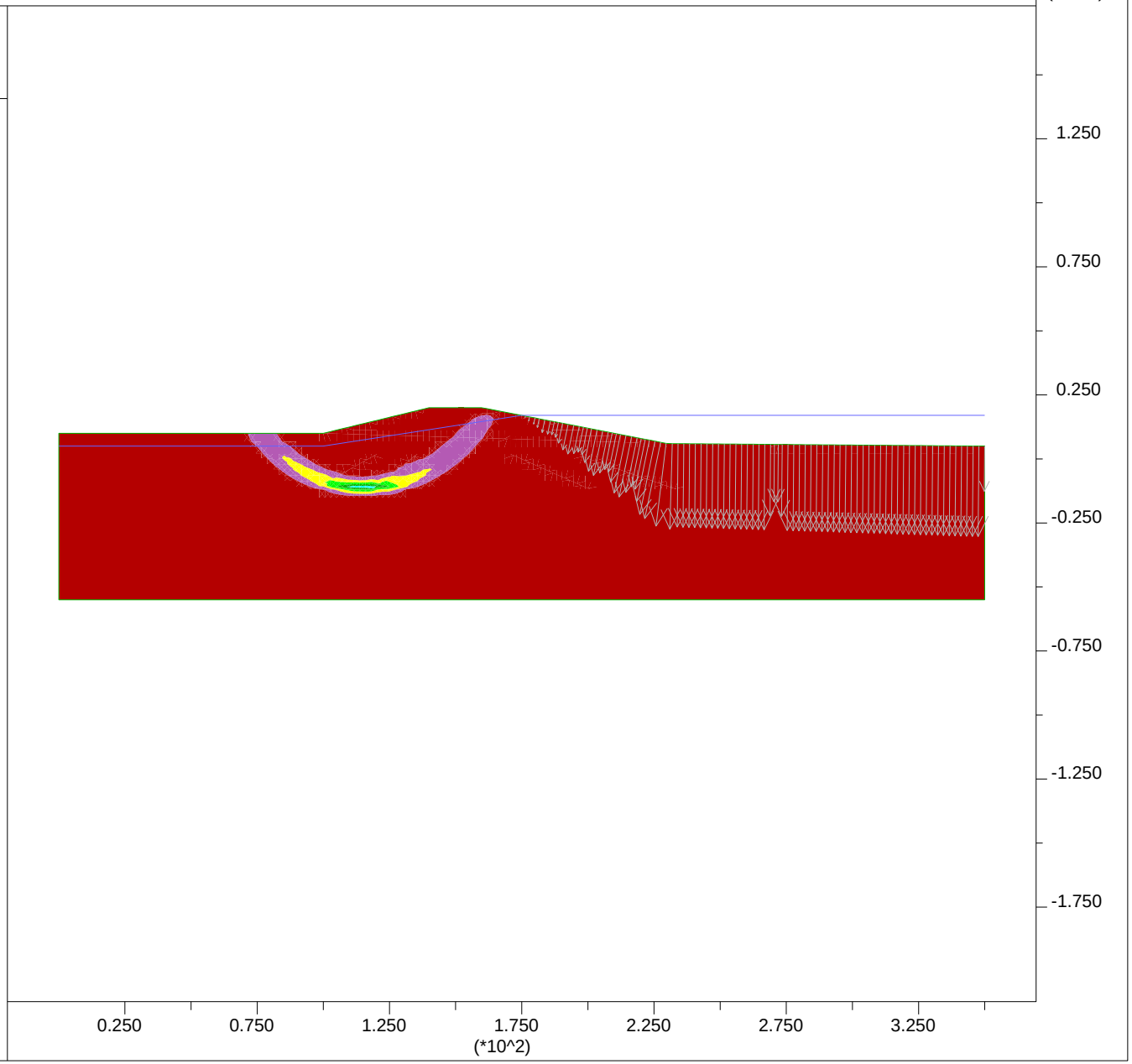


PLATE G-116

JOB TITLE : Section J-J' - High Water Short Term - Input

FLAC (Version 7.00)

LEGEND

27-Feb-13 15:37
step 1860
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

User-defined Groups
- User:Sand
- 'User:Med Sand'
- 'S:Stiff Clay'
- 'User:V Soft Clay'
- Fill:Fill
- User:Clay400
- User:Embankment
- 'User:Soft Clay'

Net Applied Forces
max vector = 1.636E+03
0 5E 3

Group Delta Consultants
Ballona Wetlands

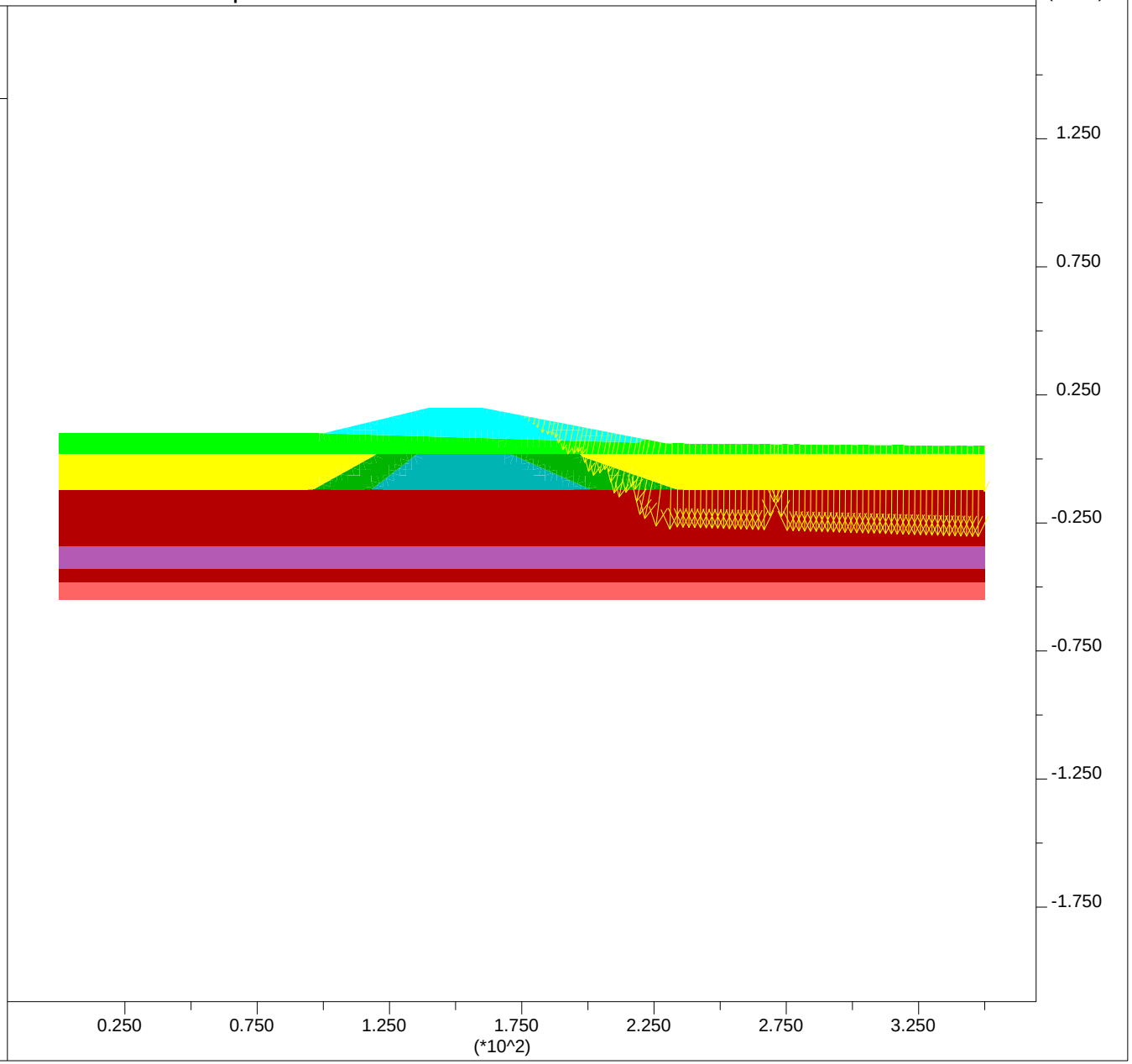


PLATE G-117

JOB TITLE : Section J-J' - Post Liquefaction

FLAC (Version 7.00)

LEGEND

27-Feb-13 15:33
step 19390
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

Factor of Safety 1.47

Max. shear strain-rate
0.00E+00
2.00E-07
4.00E-07
6.00E-07
8.00E-07
1.00E-06

Contour interval= 2.00E-07
Extrap. by averaging
Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 6.801E+02

0 2E 3

Group Delta Consultants
Ballona Wetlands

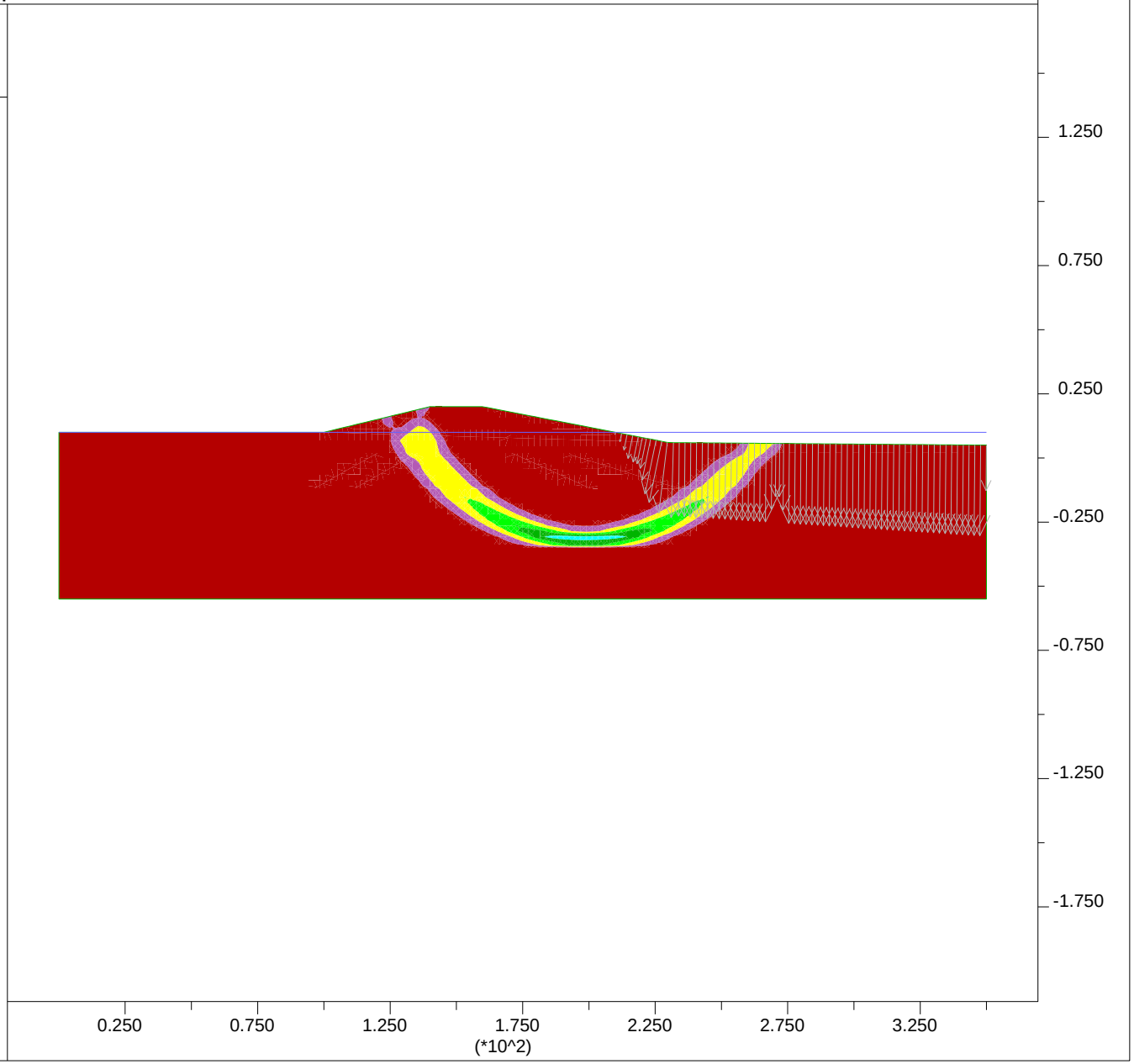


PLATE G-118

JOB TITLE : Section J-J' - Post Liquefaction - Input

FLAC (Version 7.00)

LEGEND

27-Feb-13 15:34
step 2710
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

User-defined Groups
- User:Sand
- User:LiqSandDeep
- 'S:Stiff Clay'
- User:LiqSand
- 'User:V Soft Clay'
- Fill:LiqFill
- User:Clay400
- User:Embankment
- 'User:Soft Clay'

Net Applied Forces
max vector = 6.801E+02
0 2E 3

Group Delta Consultants
Ballona Wetlands

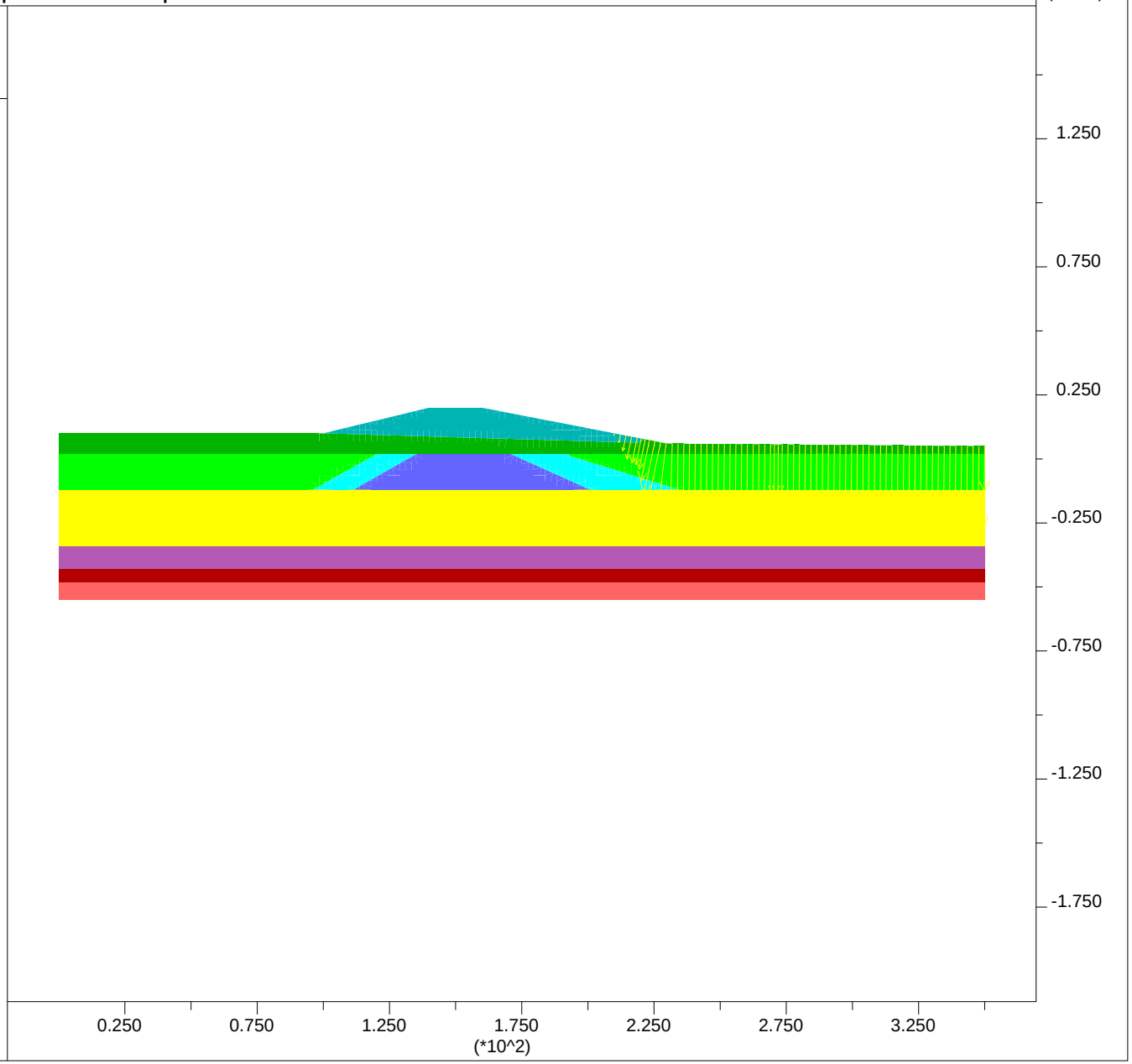


PLATE G-119

JOB TITLE : Section J-J' - Ky=0.05

FLAC (Version 7.00)

LEGEND

27-Feb-13 15:35
step 27420
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

Factor of Safety 1.01

Max. shear strain-rate
0.00E+00
1.00E-07
2.00E-07
3.00E-07
4.00E-07
5.00E-07
6.00E-07
7.00E-07
8.00E-07

Contour interval= 1.00E-07
Extrap. by averaging
Boundary plot

0 1E 2

Water Table

Group Delta Consultants
Ballona Wetlands

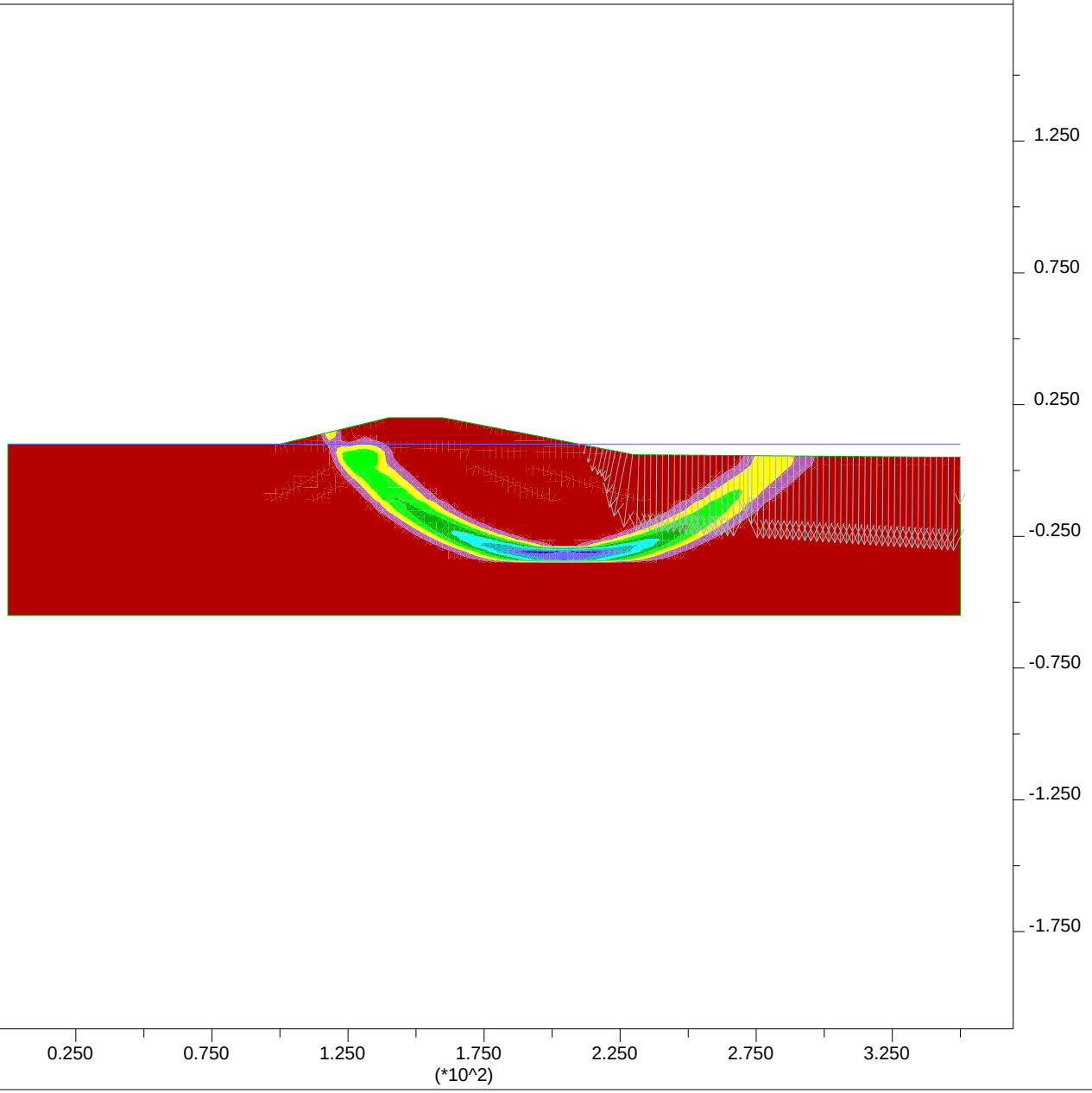


PLATE G-120

JOB TITLE : Section J-J' - Ky=0.05 - Input

FLAC (Version 7.00)

LEGEND

27-Feb-13 15:36
step 27420
-1.944E+01 <x< 3.694E+02
-2.119E+02 <y< 1.769E+02

User-defined Groups
- User:Sand
- User:LiqSandDeep
- 'S:Stiff Clay'
- User:LiqSand
- 'User:V Soft Clay'
- Fill:LiqFill
- User:Clay400
- User:Embankment
- 'User:Soft Clay'

Net Applied Forces

max vector = 6.801E+02

0 2E 3

Group Delta Consultants
Ballona Wetlands

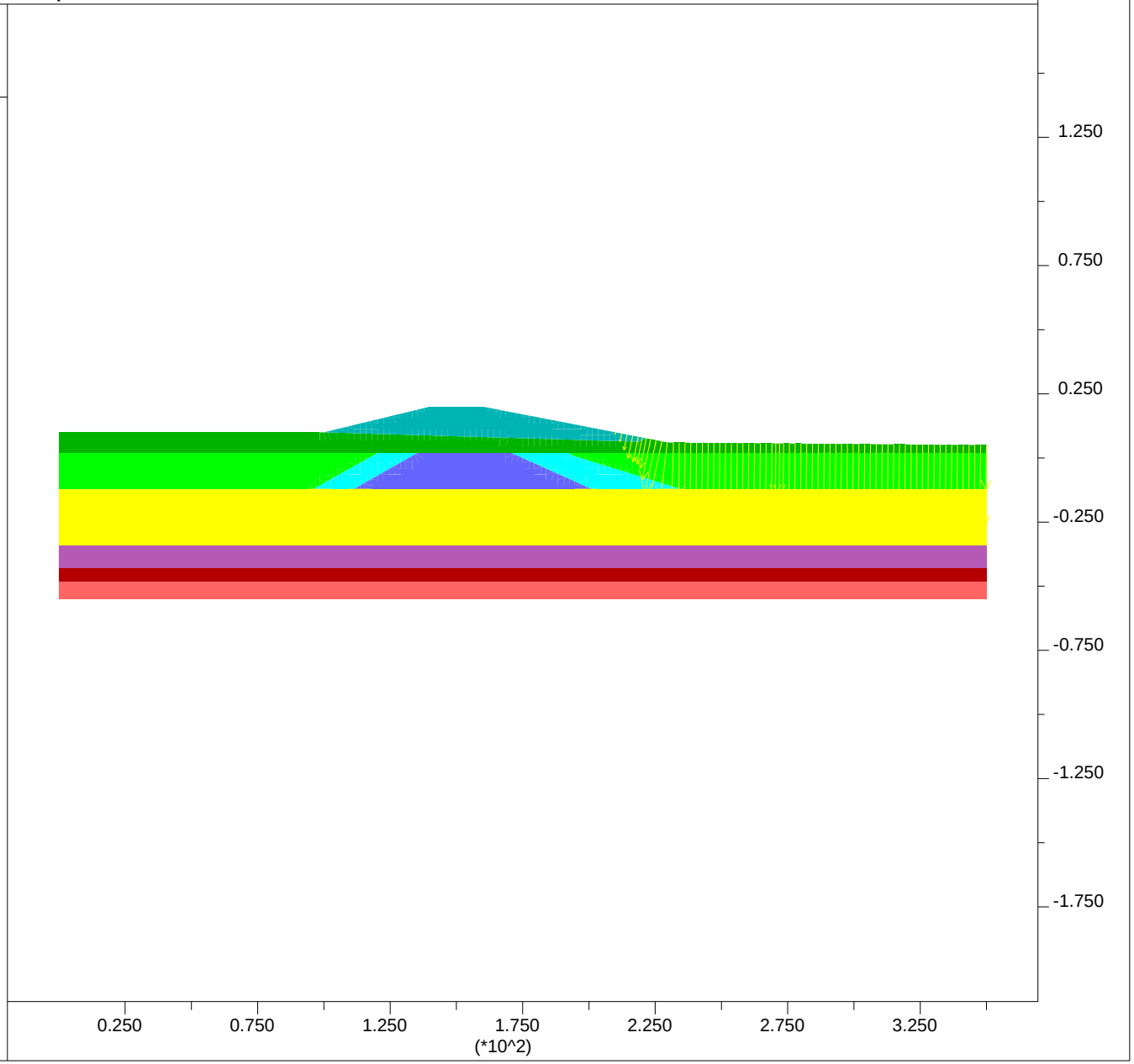


PLATE G-121

Newmark Displacements using Bray and Rathje (1998):

Section J-J'

Site Input				
PGA,rock =	0.25	g		
M =	6.6			
r =	13	km		
ky =	0.05			
Sliding Mass Input				
Vs =	110	m/s	assumed	
Thickness, H =	15.3	m		
	50	ft		
Output				
Tm =	0.49	sec		
D5-95 =	10.5	sec		
Ts =	0.55	sec		
NRF =	1.15			
Ts/Tm =	1.14			
kmax/(PGA,rock*NRF)	0.48			
kmax =	0.14			
ky / kmax =	0.36			
Displacement, u =	6	cm	0.2	feet
			2.4	inches

PLATE G-122

JOB TITLE : Section K-K' - End of Construction

FLAC (Version 7.00)

LEGEND

27-Feb-13 16:15
step 33610
-1.667E+01 <x< 3.167E+02
-1.872E+02 <y< 1.462E+02

Factor of Safety 1.58

Max. shear strain-rate
0.00E+00
2.00E-08
4.00E-08
6.00E-08
8.00E-08
1.00E-07

Contour interval= 2.00E-08
Extrap. by averaging
Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 1.327E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands

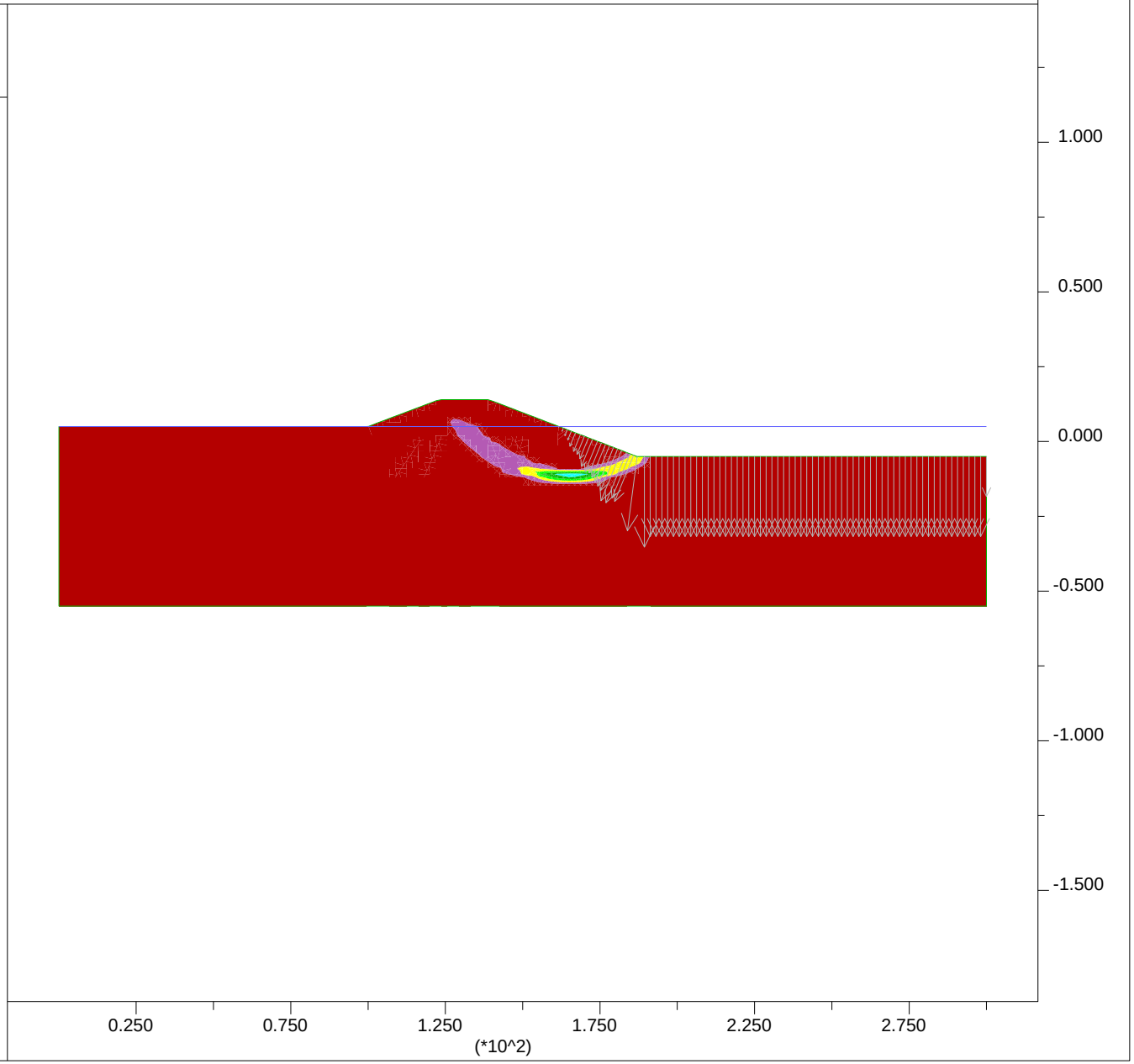


PLATE G-123

JOB TITLE : Section K-K' - End of Construction - Input

FLAC (Version 7.00)

LEGEND

27-Feb-13 16:17
step 670
-1.667E+01 <x< 3.167E+02
-1.872E+02 <y< 1.462E+02

User-defined Groups
- User:Sand
- 'User:Med Sand'
- 'S:Stiff Clay'
- 'User:V Soft Clay'
- Fill:Fill
- User:Embankment
- 'User:Clay 400'
- 'User:Soft Clay'

Net Applied Forces
max vector = 1.327E+03
0 2E 3

Group Delta Consultants
Ballona Wetlands

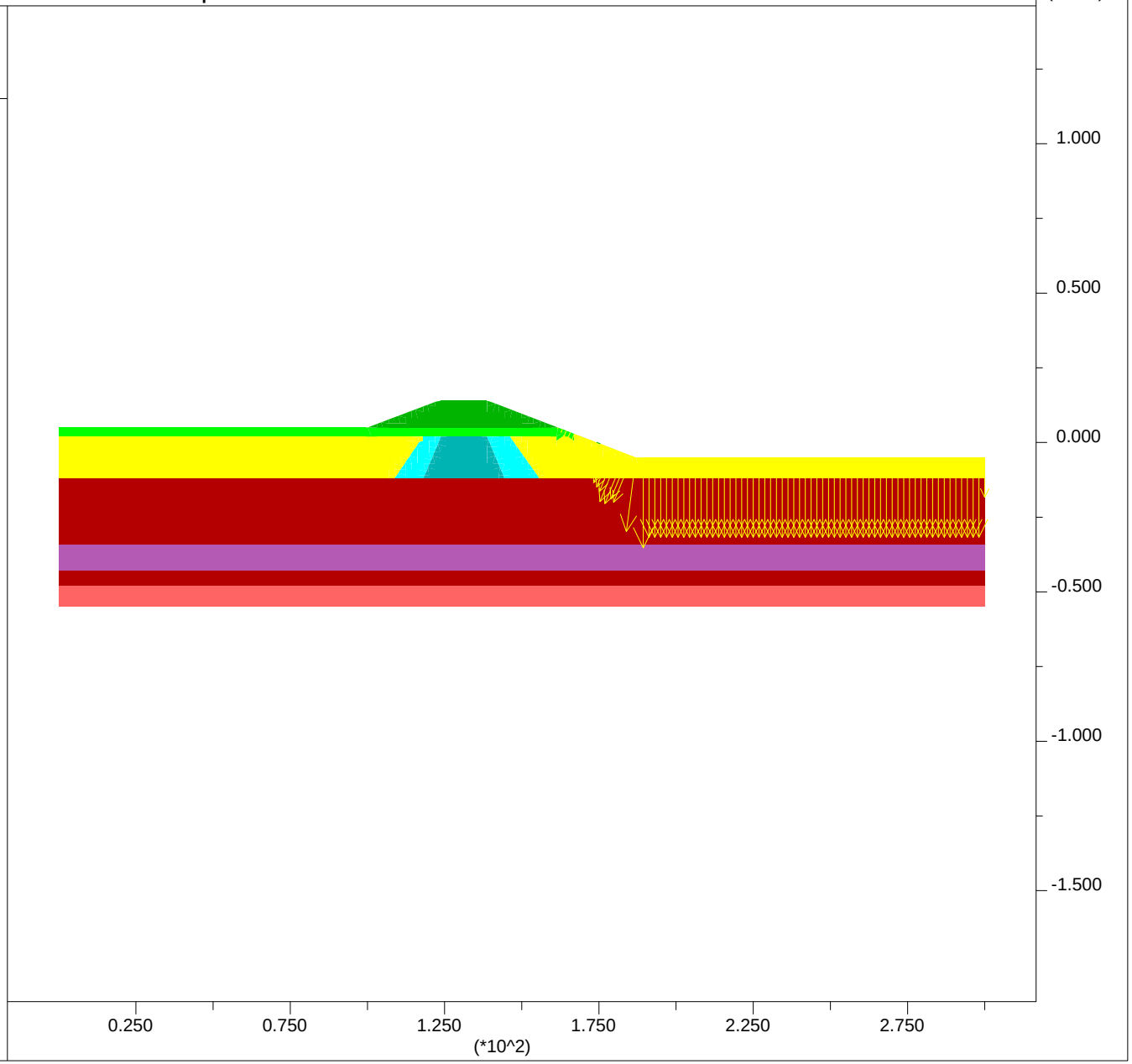


PLATE G-124

JOB TITLE : Section K-K' - High Water Short Term

FLAC (Version 7.00)

LEGEND

27-Feb-13 17:26
step 41778
-1.667E+01 <x< 3.167E+02
-1.872E+02 <y< 1.462E+02

Factor of Safety 2.13

Max. shear strain-rate
0.00E+00
1.00E-07
2.00E-07
3.00E-07
4.00E-07
5.00E-07
6.00E-07

Contour interval= 1.00E-07
Extrap. by averaging
Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 2.389E+03

Group Delta Consultants
Ballona Wetlands

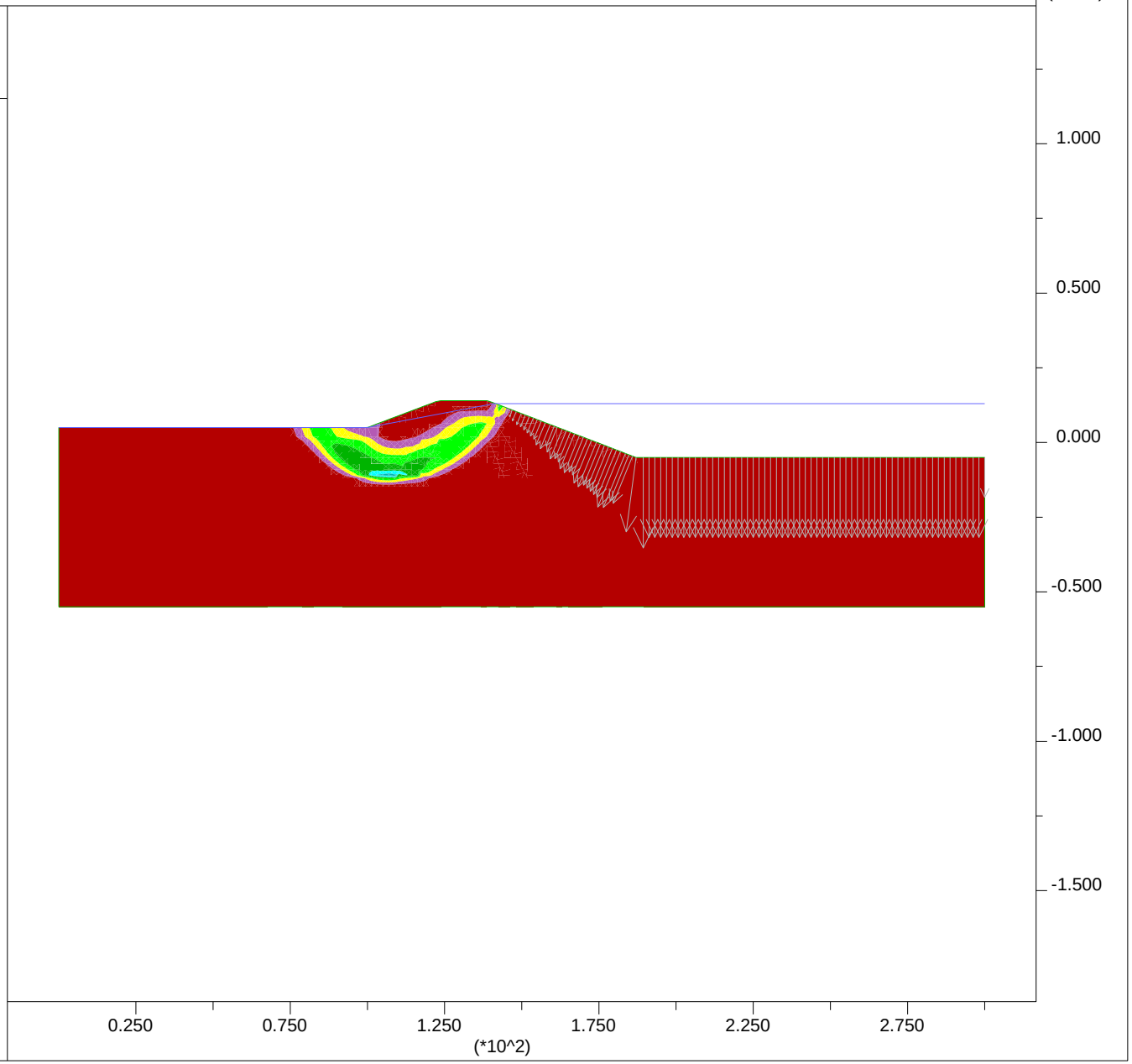


PLATE G-125

JOB TITLE : Section K-K' - High Water Short Term - Input

FLAC (Version 7.00)

LEGEND

27-Feb-13 16:24
step 0
-1.667E+01 <x< 3.167E+02
-1.872E+02 <y< 1.462E+02

User-defined Groups
- User:Sand
- 'User:Med Sand'
- 'S:Stiff Clay'
- 'User:V Soft Clay'
- Fill:Fill
- User:Embankment
- User:Clay400
- 'User:Soft Clay'

Net Applied Forces
max vector = 2.389E+03
0 5E 3

Group Delta Consultants
Ballona Wetlands

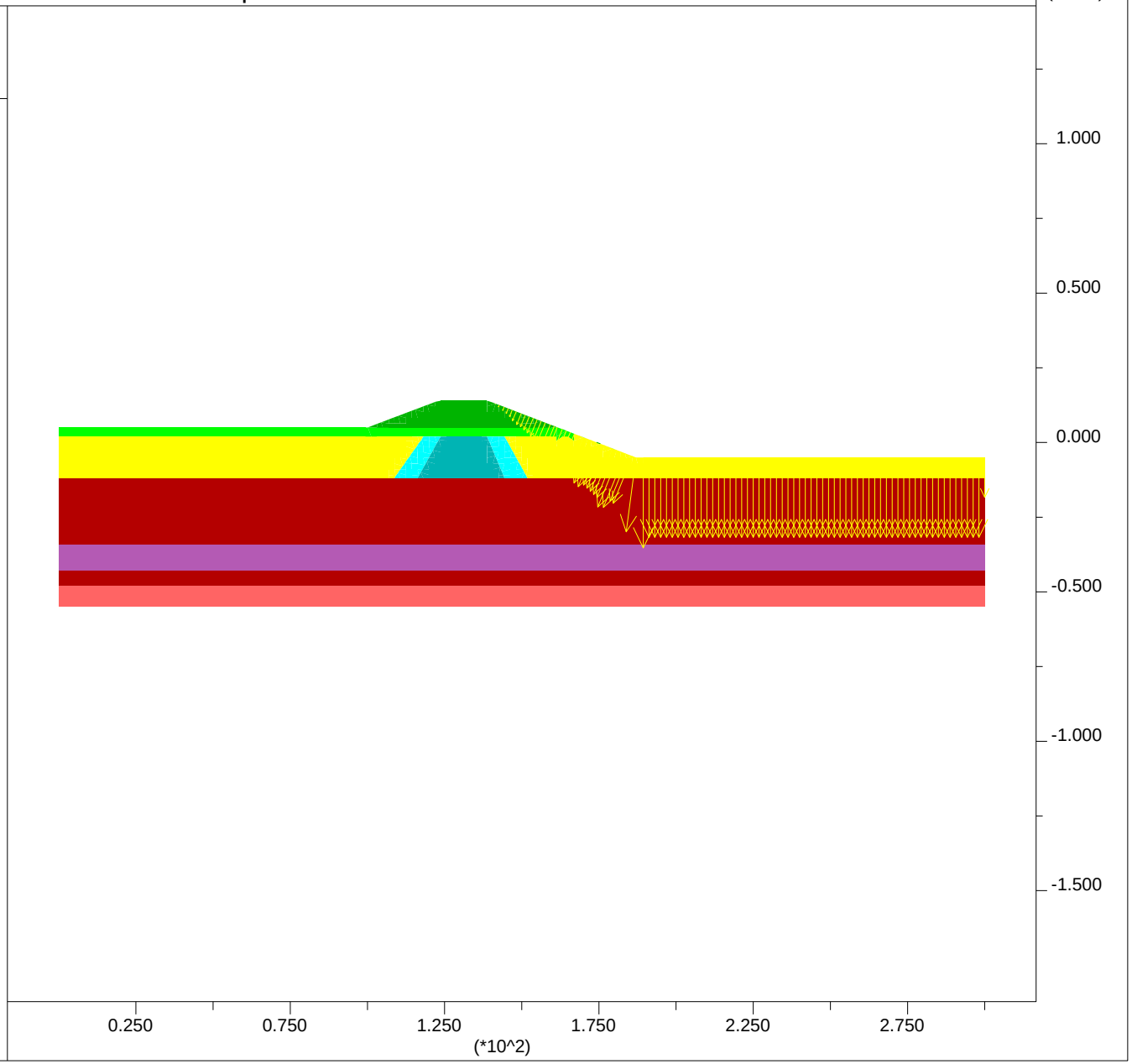


PLATE G-126

JOB TITLE : Section K-K' - Post Liquefaction

FLAC (Version 7.00)

LEGEND

27-Feb-13 16:18
step 24366
-1.667E+01 <x< 3.167E+02
-1.872E+02 <y< 1.462E+02

Factor of Safety 1.26

Max. shear strain-rate
0.00E+00
1.00E-07
2.00E-07
3.00E-07
4.00E-07
5.00E-07
6.00E-07

Contour interval= 1.00E-07
Extrap. by averaging
Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 1.327E+03

Group Delta Consultants
Ballona Wetlands

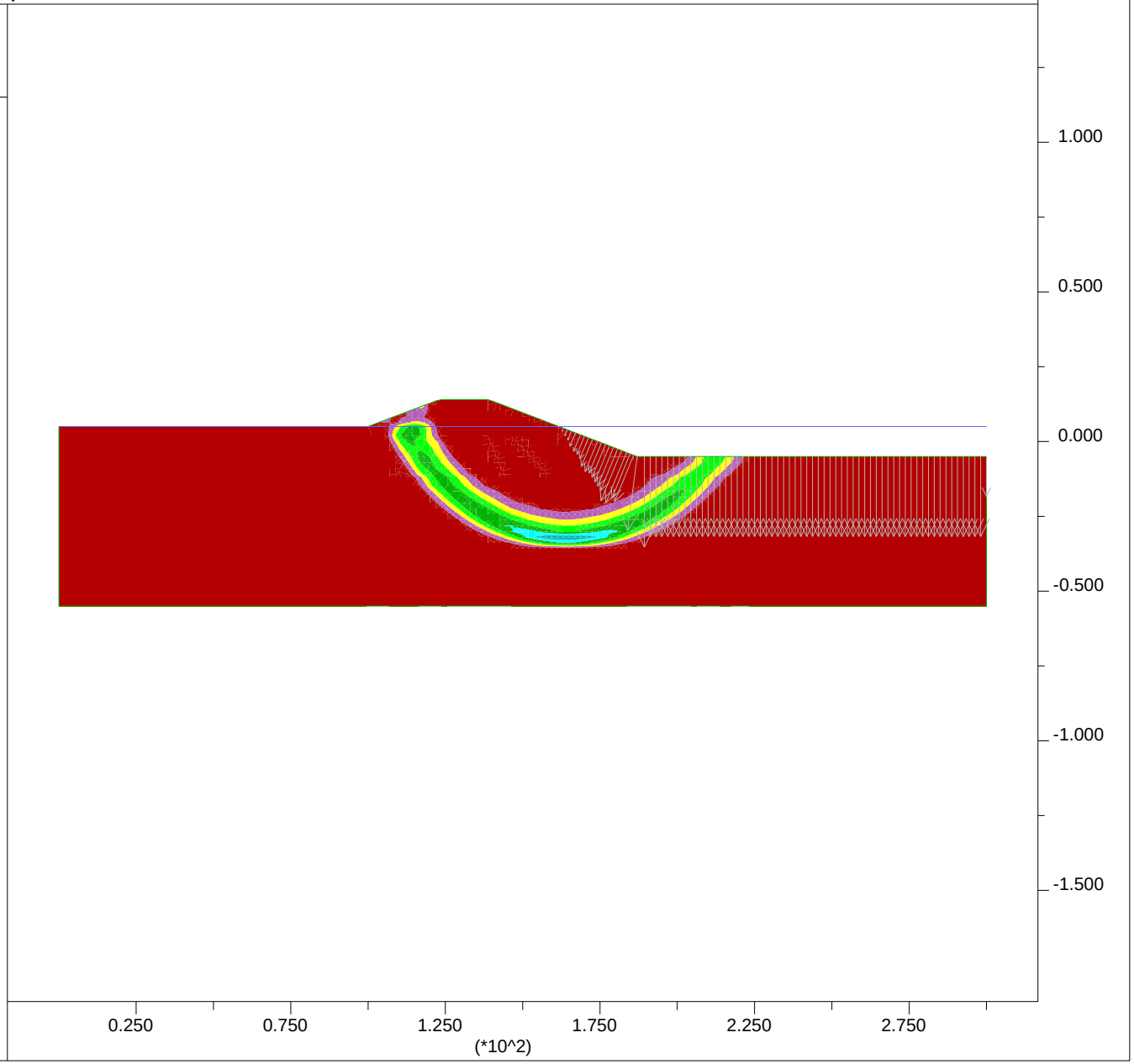


PLATE G-127

JOB TITLE : Section K-K' - Post Liquefaction - Input

FLAC (Version 7.00)

LEGEND

27-Feb-13 16:19
step 550
-1.667E+01 <x< 3.167E+02
-1.872E+02 <y< 1.462E+02

User-defined Groups
- User:Sand
- User:SandLiqDeep
- 'S:Stiff Clay'
- Fill:SandLiq
- 'User:V Soft Clay'
- Fill:FillLiq
- User:Embankment
- User:Clay400
- 'User:Soft Clay'

Net Applied Forces

max vector = 1.327E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands

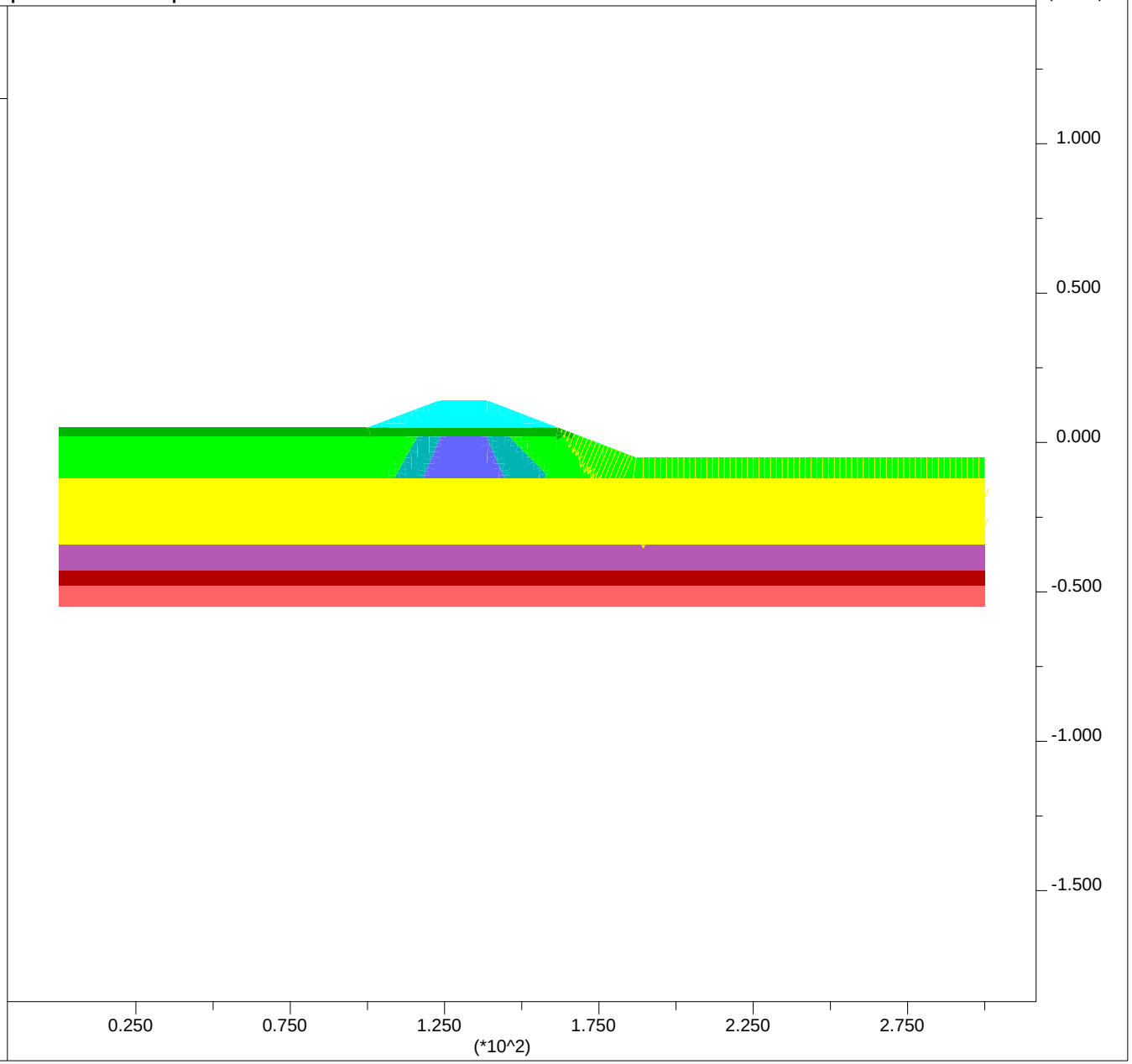


PLATE G-128

JOB TITLE : Section K-K' - Ky=0.04

FLAC (Version 7.00)

LEGEND

27-Feb-13 16:21
step 34246
-1.667E+01 <x< 3.167E+02
-1.872E+02 <y< 1.462E+02

Factor of Safety 1.01

Max. shear strain-rate
- 0.00E+00
- 5.00E-07
- 1.00E-06
- 1.50E-06
- 2.00E-06
- 2.50E-06

Contour interval= 5.00E-07
Extrap. by averaging
Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 1.327E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands

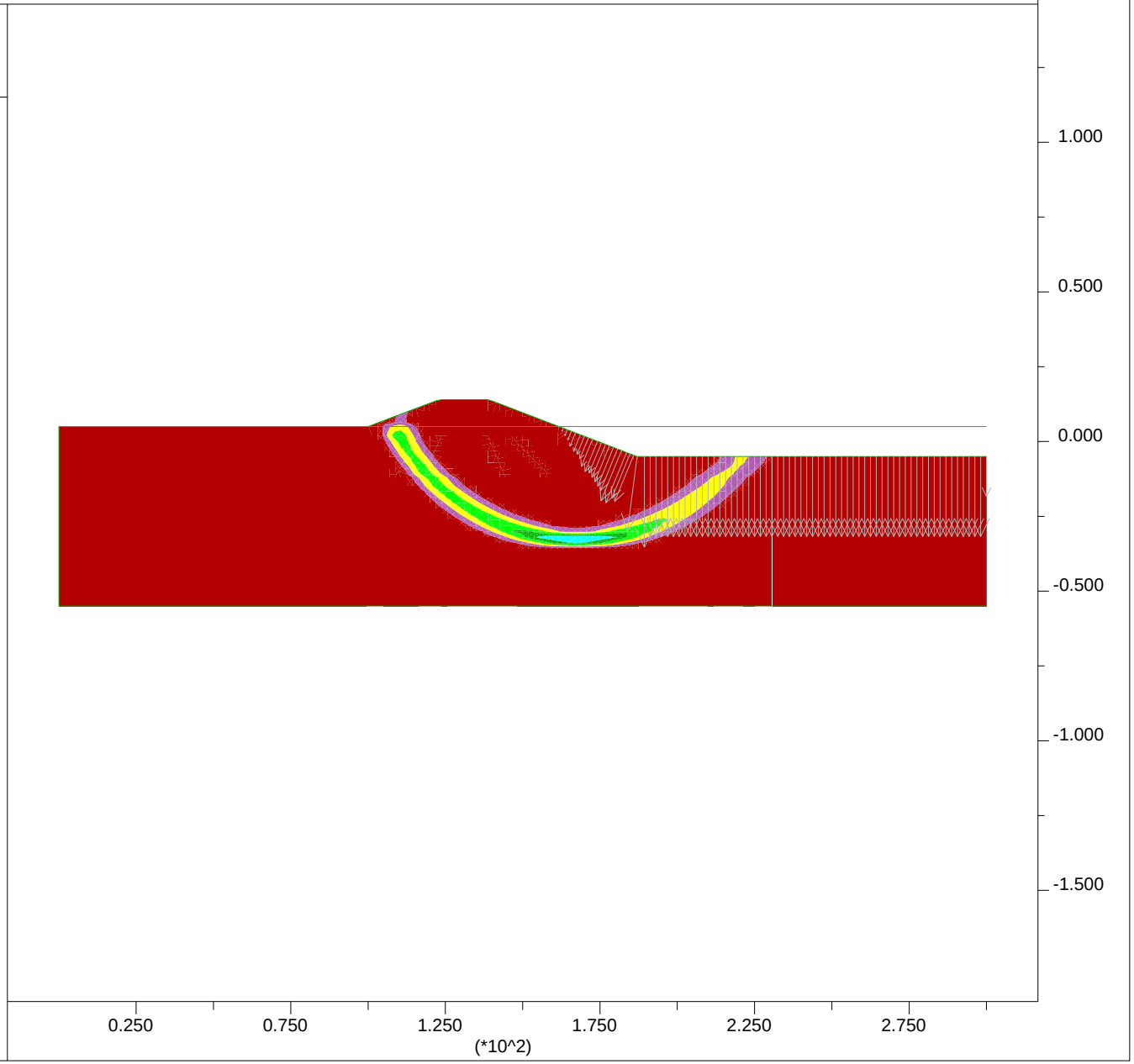


PLATE G-129

JOB TITLE : Section K-K' - Ky=0.04 - Input

FLAC (Version 7.00)

LEGEND

27-Feb-13 16:20
step 550
-1.667E+01 <x< 3.167E+02
-1.872E+02 <y< 1.462E+02

User-defined Groups
- User:Sand
- User:SandLiqDeep
- 'S:Stiff Clay'
- Fill:SandLiq
- 'User:V Soft Clay'
- Fill:FillLiq
- User:Embankment
- User:Clay400
- 'User:Soft Clay'

Net Applied Forces

max vector = 1.327E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands

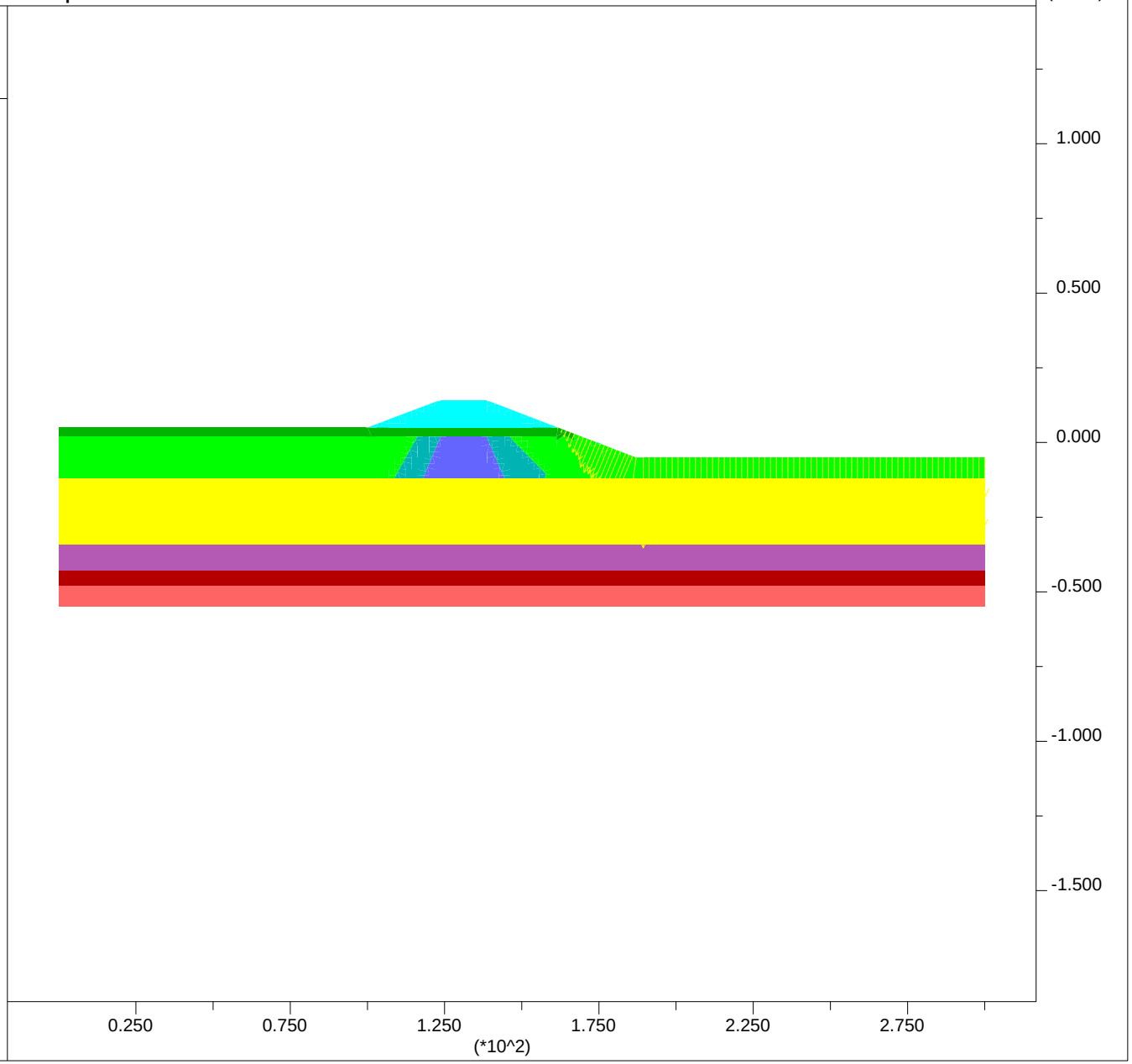


PLATE G-130

Newmark Displacements using Bray and Rathje (1998):

Section K-K'

Site Input				
PGA,rock =	0.25	g		
M =	6.6			
r =	13	km		
ky =	0.04		32.185	1.2874
Sliding Mass Input				
Vs =	100	m/s	assumed	
Thickness, H =	12.2	m		
	40	ft		
Output				
Tm =	0.49	sec		
D5-95 =	10.5	sec		
Ts =	0.49	sec		
NRF =	1.15			
Ts/Tm =	1.00			
kmax/(PGA,rock*NRF)	0.54			
kmax =	0.15			
ky / kmax =	0.26			
Displacement, u =	15	cm	0.5	feet	5.9	inches

PLATE G-131

JOB TITLE : Section L-L' - End of Construction

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 14:43

Factor of Safety 1.60

Shear Strain Rate Contours

5.00E-07
1.00E-06
1.50E-06
2.00E-06
2.50E-06

Contour interval= 5.00E-07
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 1.366E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands

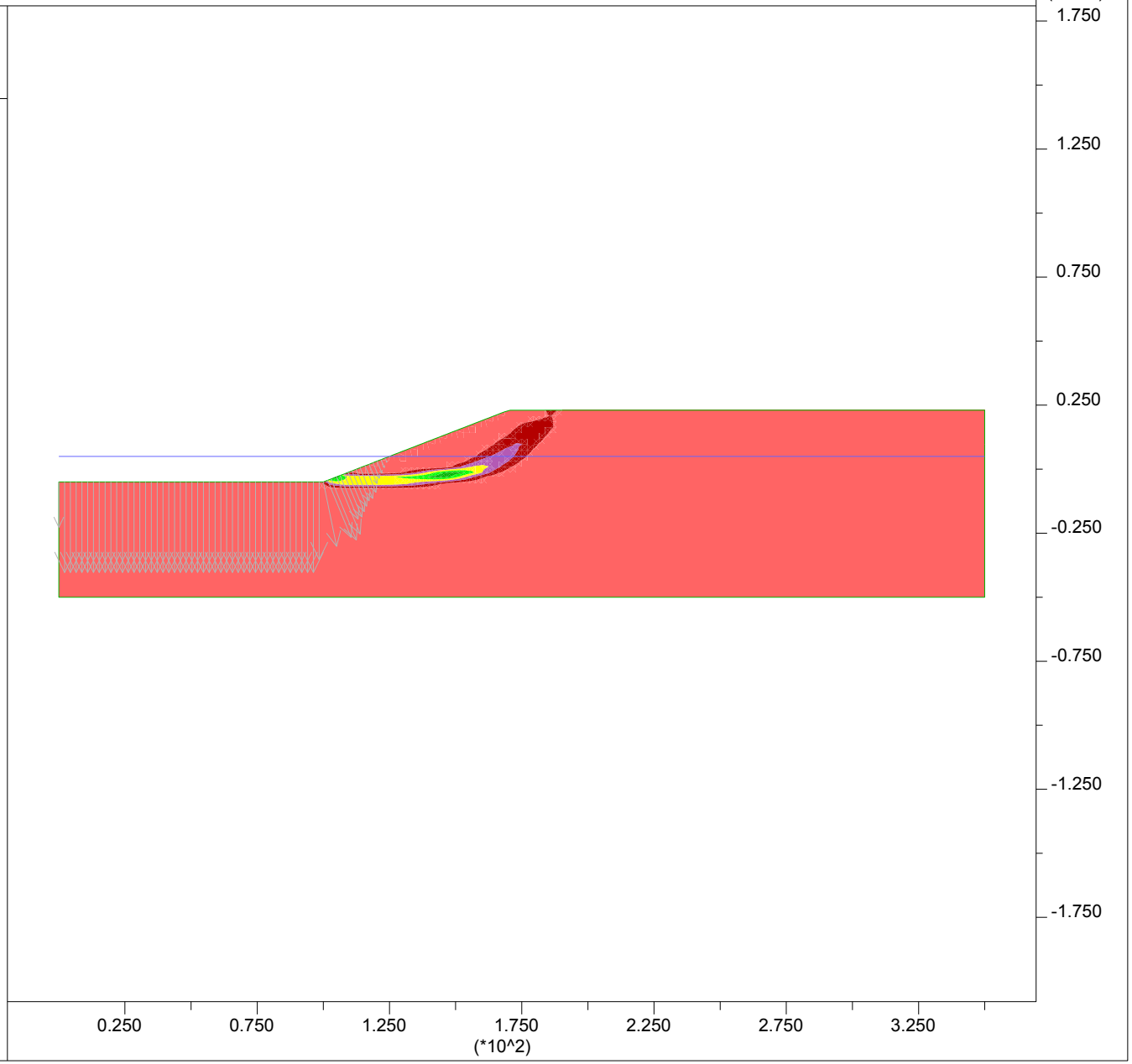


PLATE G-132

JOB TITLE : Section L-L' - End of Construction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 14:46

Factor of Safety 1.60

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Med Sand'
- 'User:Soft Clay'
- User:Fill

Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 1.366E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands

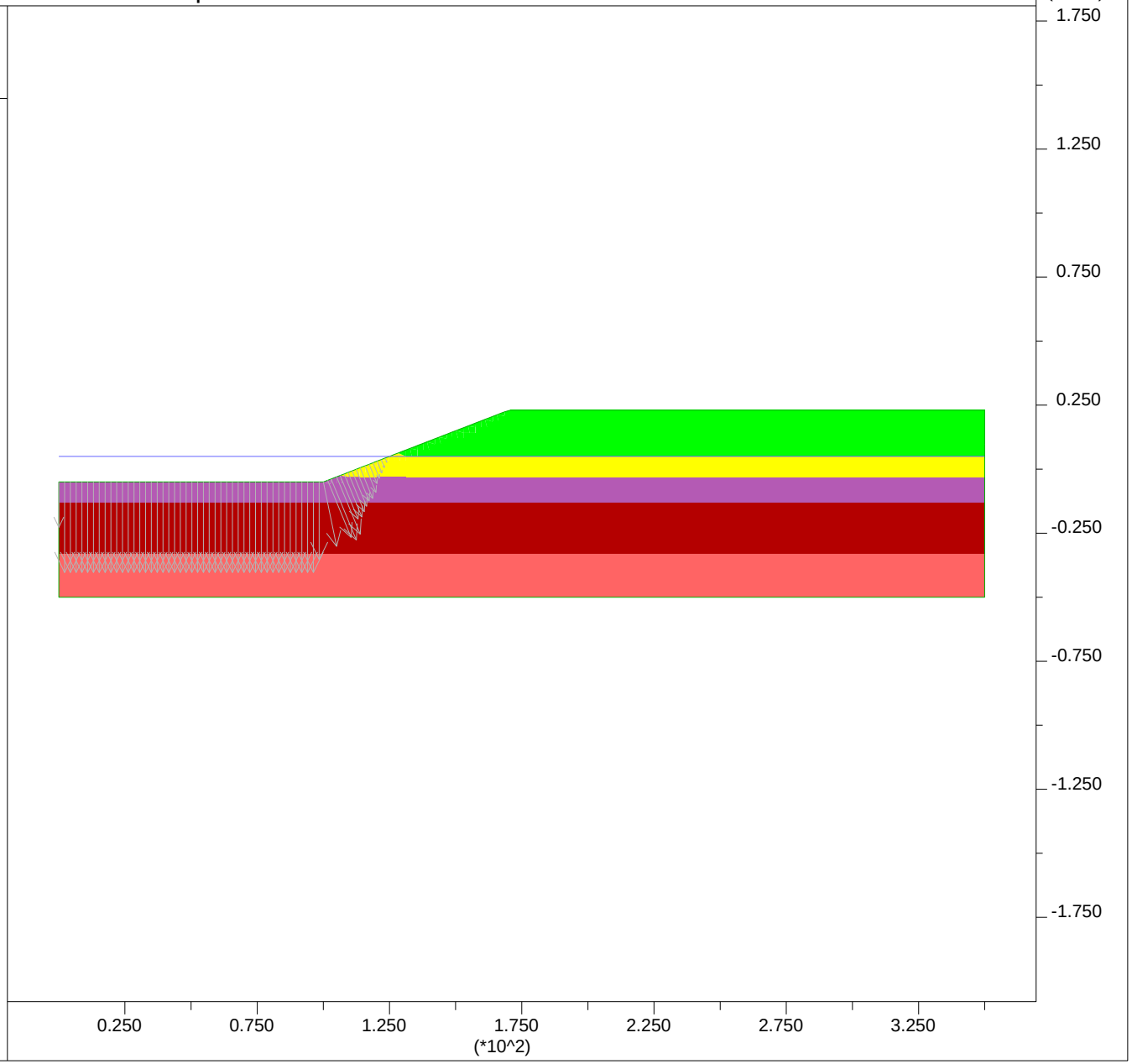


PLATE G-133

JOB TITLE : Section L-L' - High Water Short Term

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 14:49

Factor of Safety 2.26

Shear Strain Rate Contours

- 5.00E-07
- 1.00E-06
- 1.50E-06
- 2.00E-06
- 2.50E-06
- 3.00E-06
- 3.50E-06

Contour interval= 5.00E-07
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 3.006E+03

0 1E 4

Group Delta Consultants
Ballona Wetlands

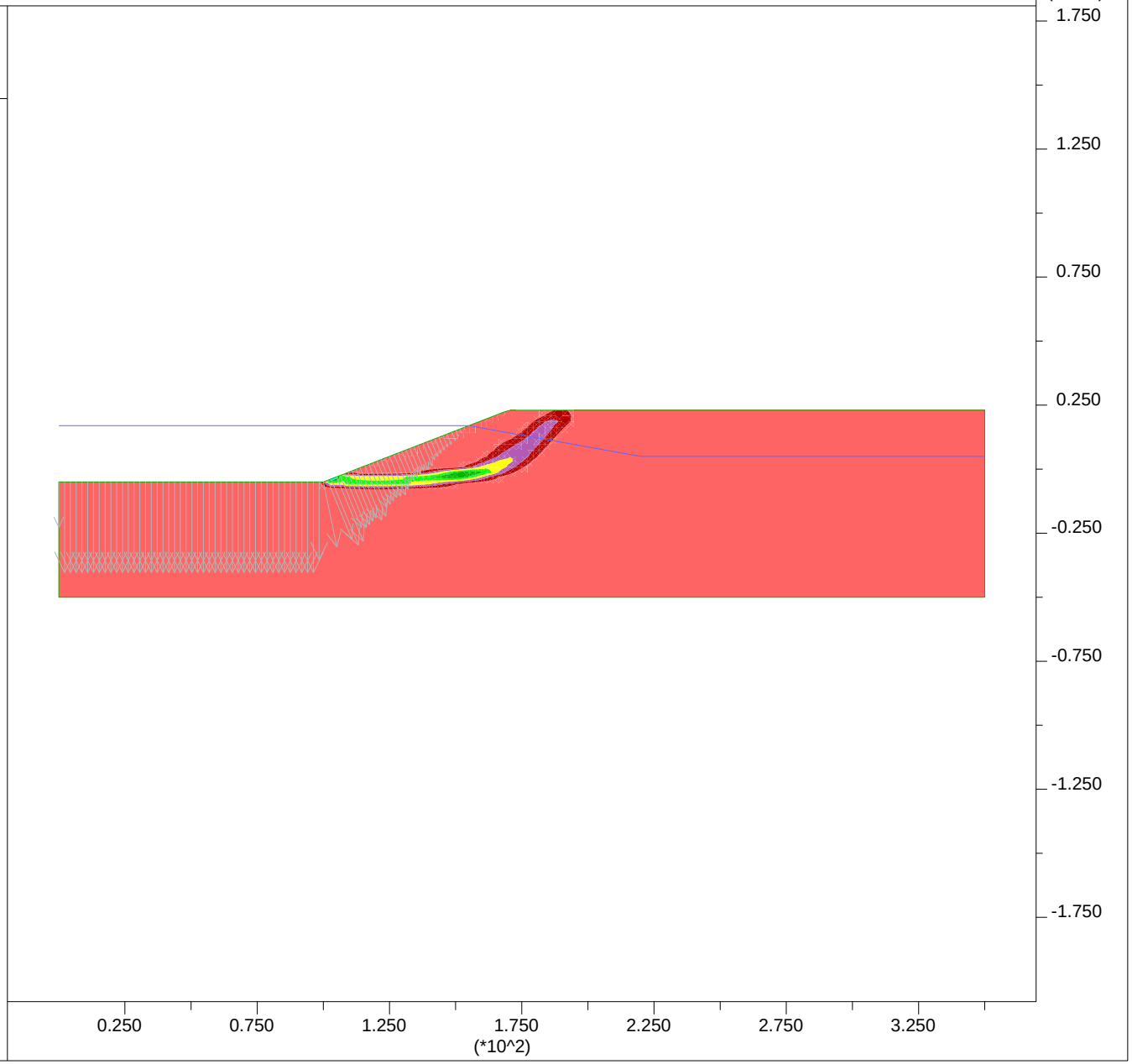


PLATE G-134

JOB TITLE : Section L-L' - High Water Short Term - Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 14:48

Factor of Safety 2.26

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Med Sand'
- 'User:Soft Clay'
- User:Fill

Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 3.006E+03

0 1E 4

Group Delta Consultants
Ballona Wetlands

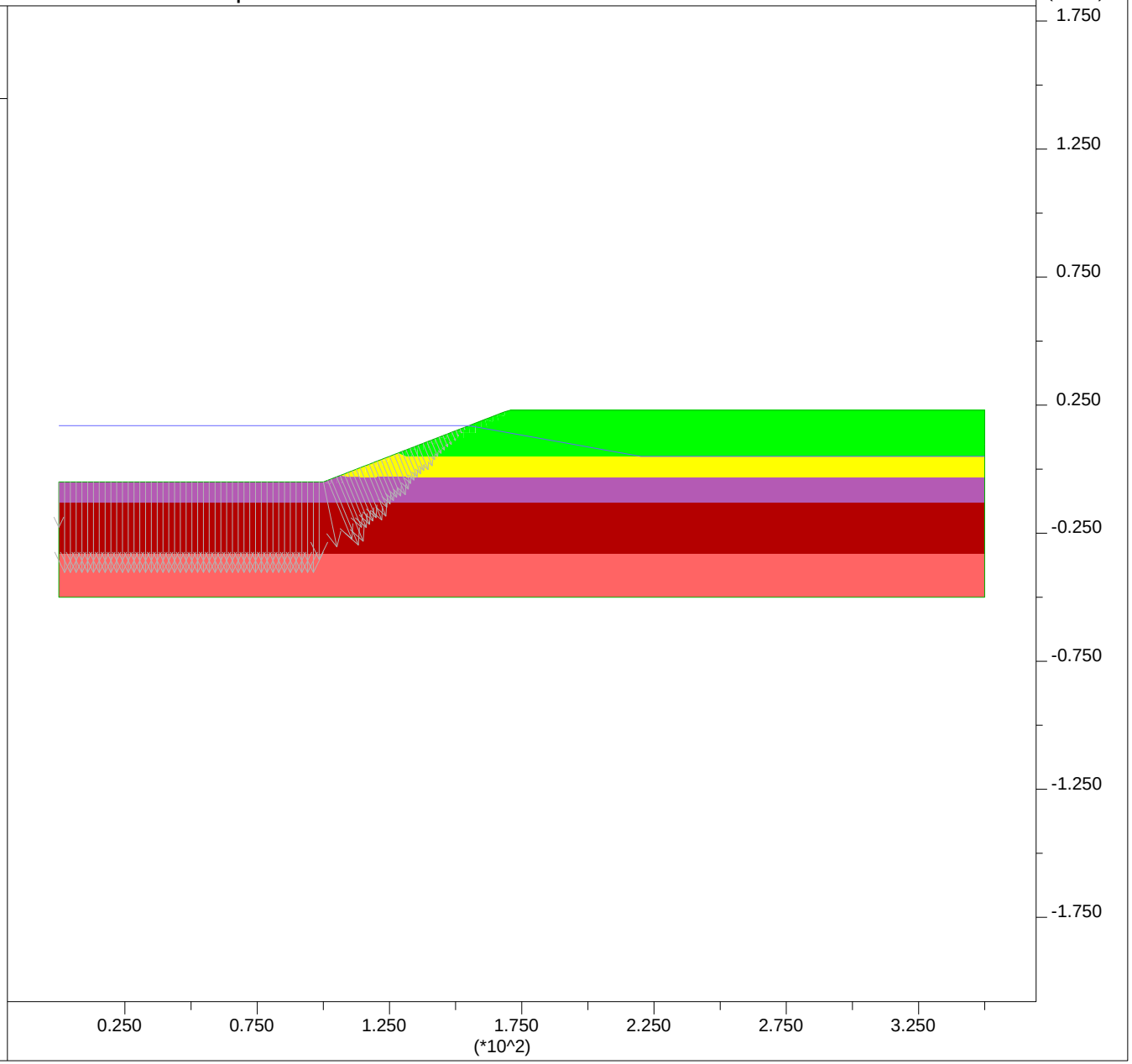


PLATE G-135

JOB TITLE : Section L-L' - Post Liquefaction

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 15:01

Factor of Safety 1.40

Shear Strain Rate Contours

- 5.00E-07
- 1.00E-06
- 1.50E-06
- 2.00E-06
- 2.50E-06
- 3.00E-06
- 3.50E-06

Contour interval= 5.00E-07
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 2.050E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands

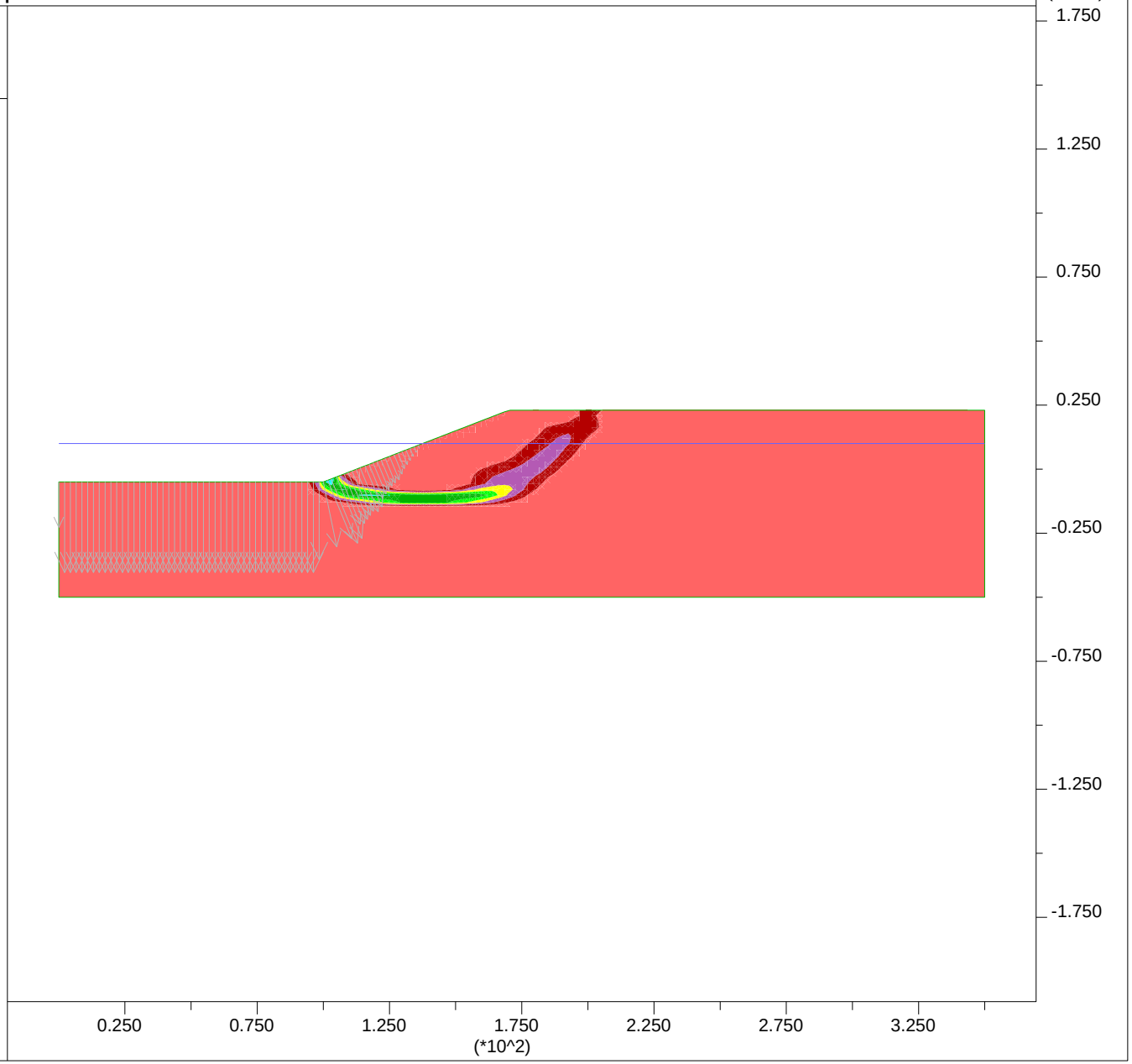


PLATE G-136

JOB TITLE : Section L-L' - Post Liquefaction - Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 15:03

Factor of Safety 1.40

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Liq Sand 2'
- 'User:Liq Sand'
- 'User:Med Sand'
- 'User:Soft Clay'
- User:Fill

Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 2.050E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands

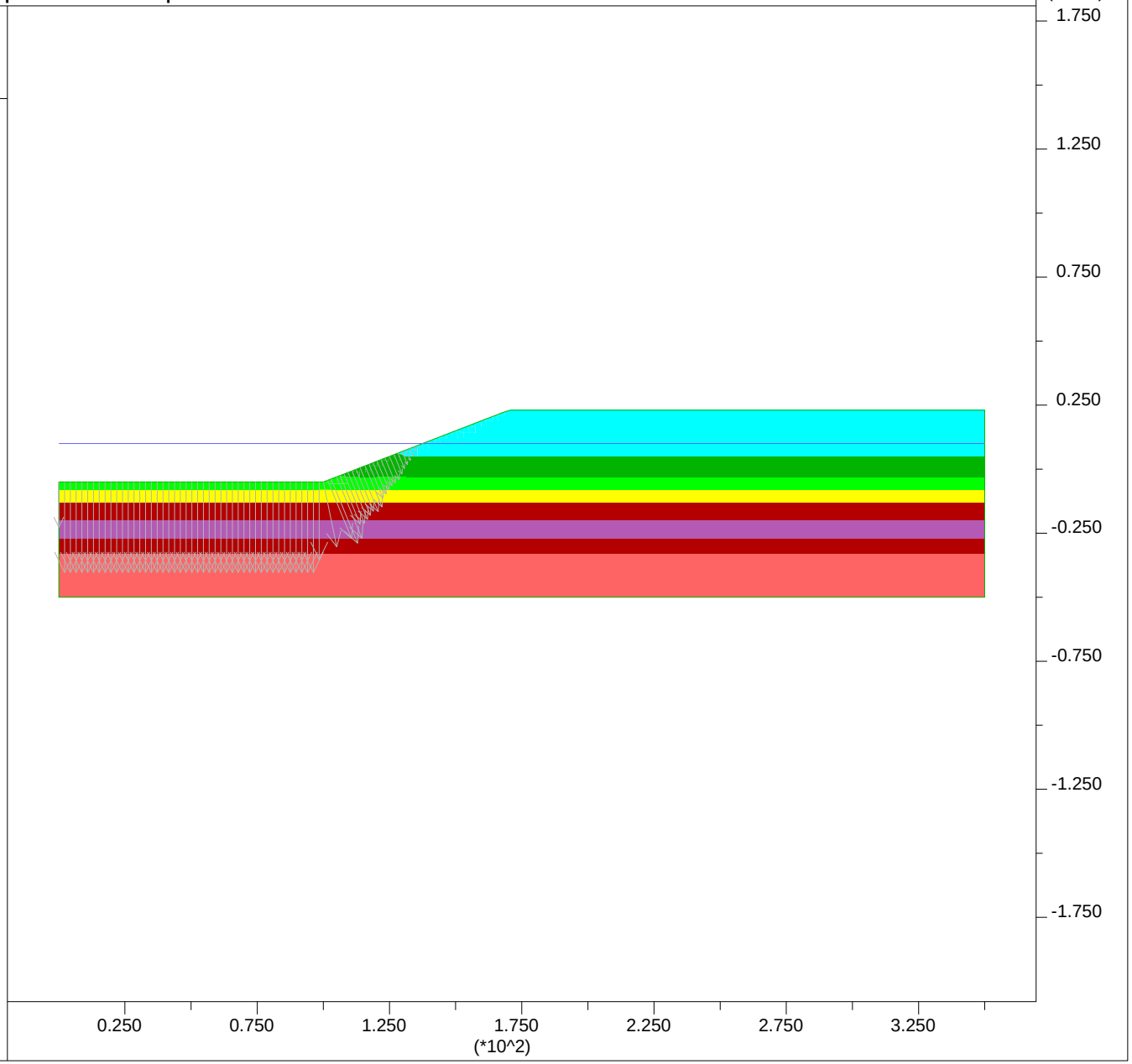


PLATE G-137

JOB TITLE : Section L-L' - Ky=0.08

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 14:53

Factor of Safety 0.99

Shear Strain Rate Contours

- 1.00E-07
- 2.00E-07
- 3.00E-07
- 4.00E-07
- 5.00E-07
- 6.00E-07
- 7.00E-07

Contour interval= 1.00E-07
(zero contour omitted)
Boundary plot

0 1E 2

Net Applied Forces

max vector = 2.056E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands

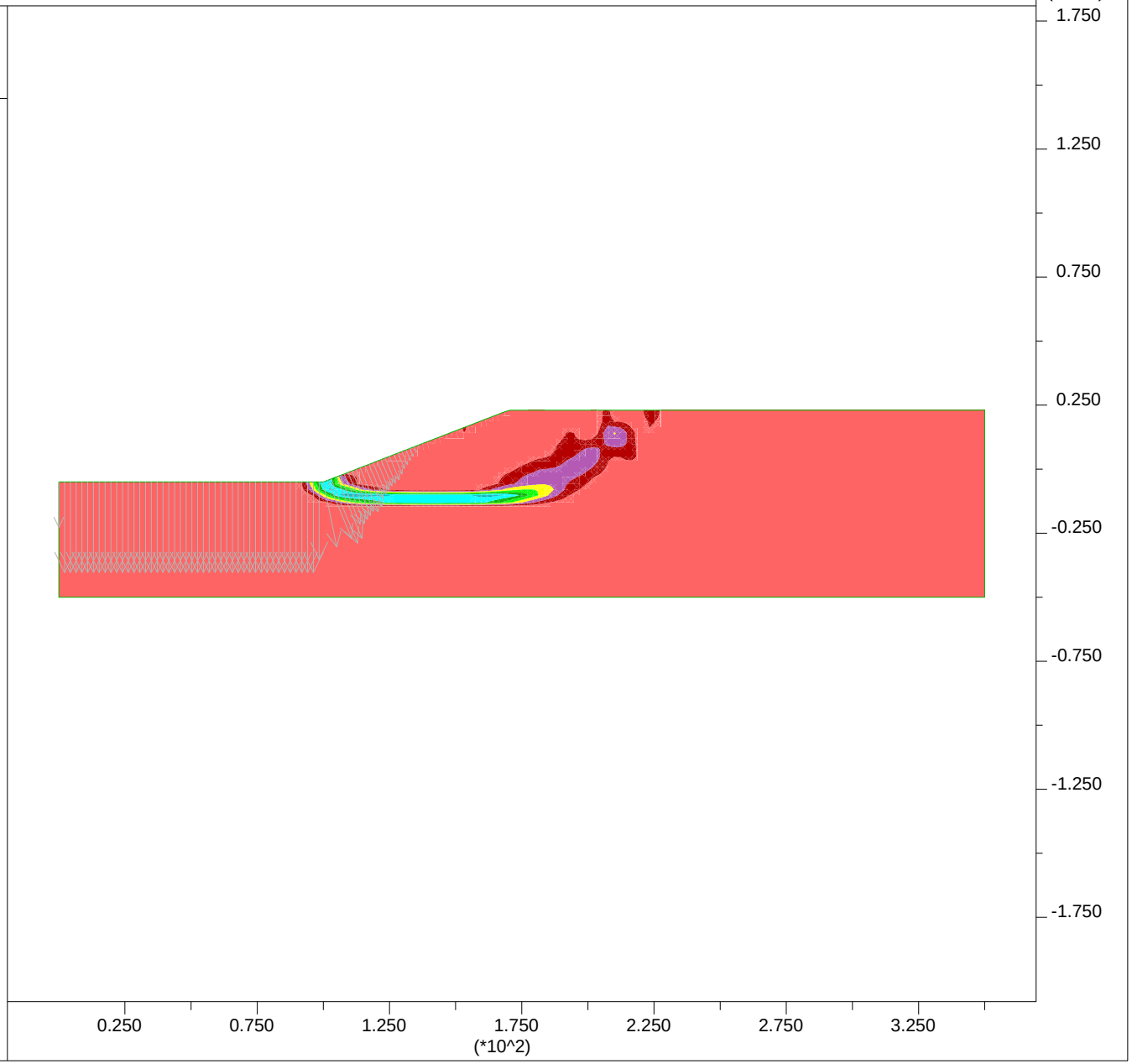


PLATE G-138

JOB TITLE : Section L-L' - Ky=0.08 - Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Feb-13 15:05

Factor of Safety 0.99

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Liq Sand 2'
- 'User:Liq Sand'
- 'User:Med Sand'
- 'User:Soft Clay'
- User:Fill

Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 2.056E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands

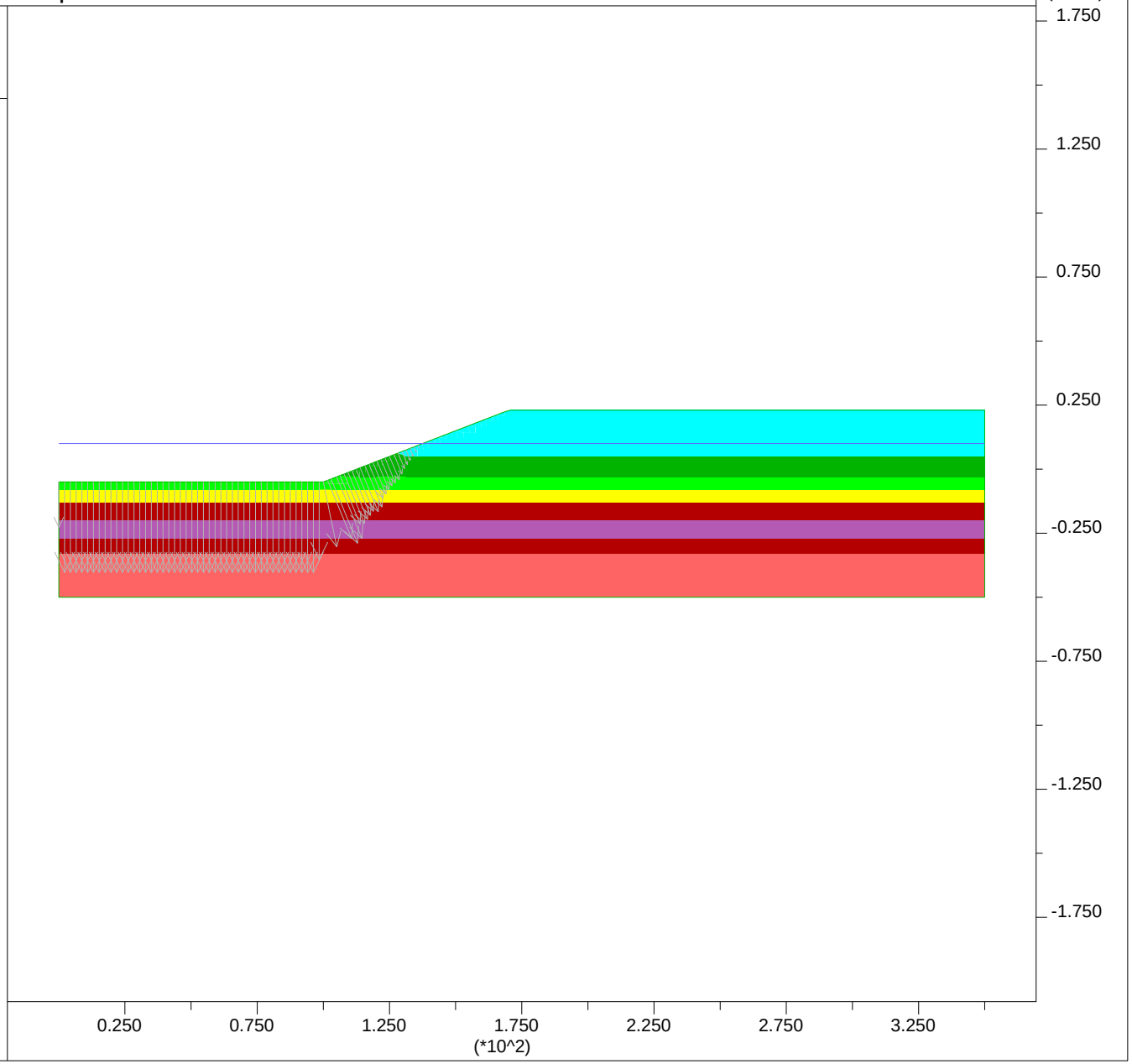


PLATE G-139

Newmark Displacements using Bray and Rathje (1998):

Section L-L'

Site Input				
PGA,rock =	0.25	g		
M =	6.6			
r =	13	km		
ky =	0.08			
Sliding Mass Input				
Vs =	200	m/s	assumed	
Thickness, H =	10.1	m		
	33	ft		
Output				
Tm =	0.49	sec		
D5-95 =	10.5	sec		
Ts =	0.20	sec		
NRF =	1.15			
Ts/Tm =	0.41			
kmax/(PGA,rock*NRF)	1.07			
kmax =	0.31			
ky / kmax =	0.26			
Displacement, u =	30	cm	1.0 feet	11.7 inches

PLATE G-140

JOB TITLE : Existing North Levee during Meander Channel Excavation - 60 foot berm

FLAC/SLOPE (Version 7.00)

LEGEND

5-Mar-13 14:09

Factor of Safety 1.46

Shear Strain Rate Contours

- 2.50E-07
- 5.00E-07
- 7.50E-07
- 1.00E-06
- 1.25E-06
- 1.50E-06
- 1.75E-06
- 2.00E-06

Contour interval= 2.50E-07
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 1.666E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands

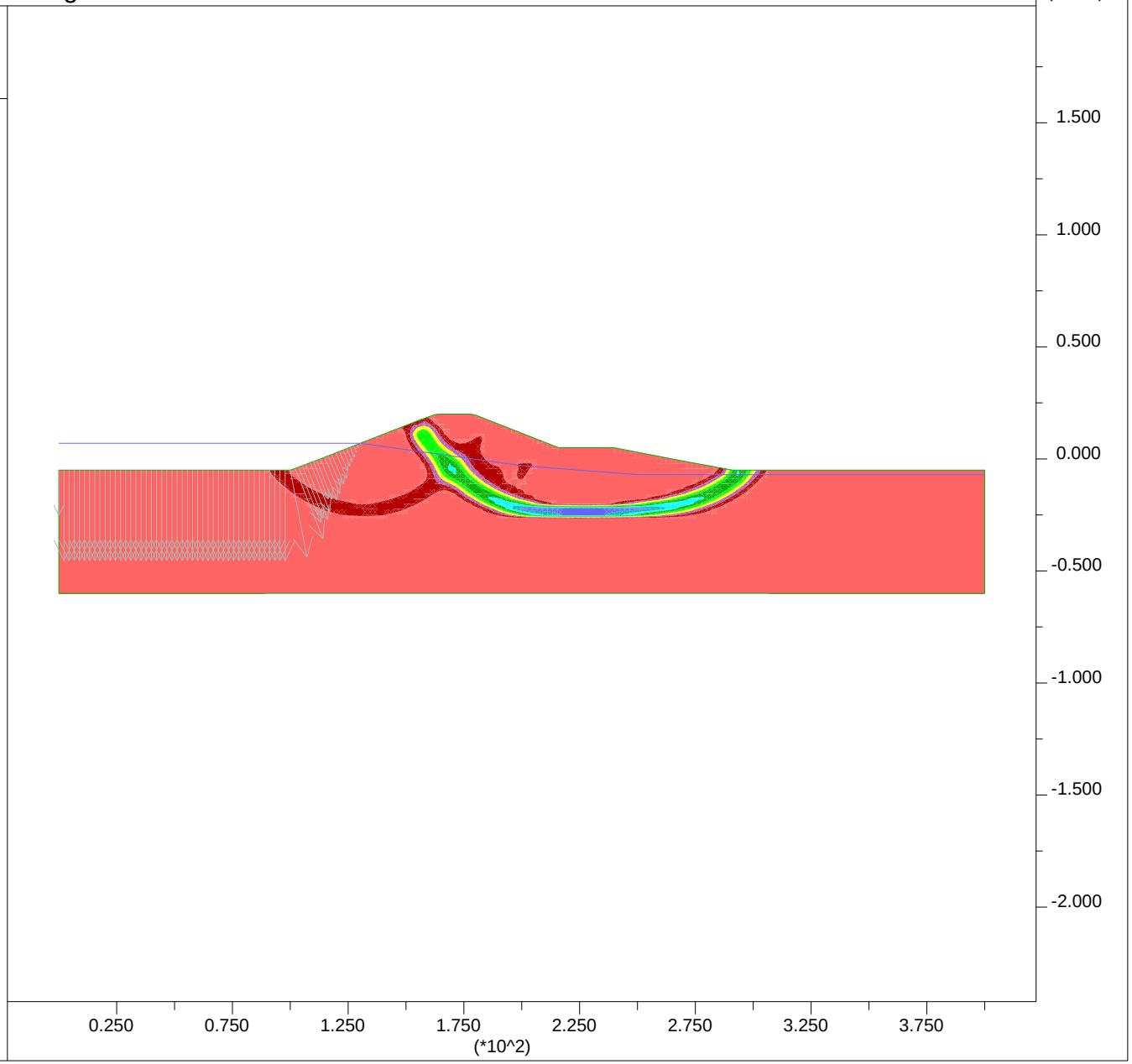


PLATE G-141

JOB TITLE : Existing North Levee during Meander Channel Excavation - 60 foot berm - Inp

FLAC/SLOPE (Version 7.00)

LEGEND

5-Mar-13 14:10

Factor of Safety 1.46

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'User:Soft Clay'
- Fill:Fill

Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 1.666E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands

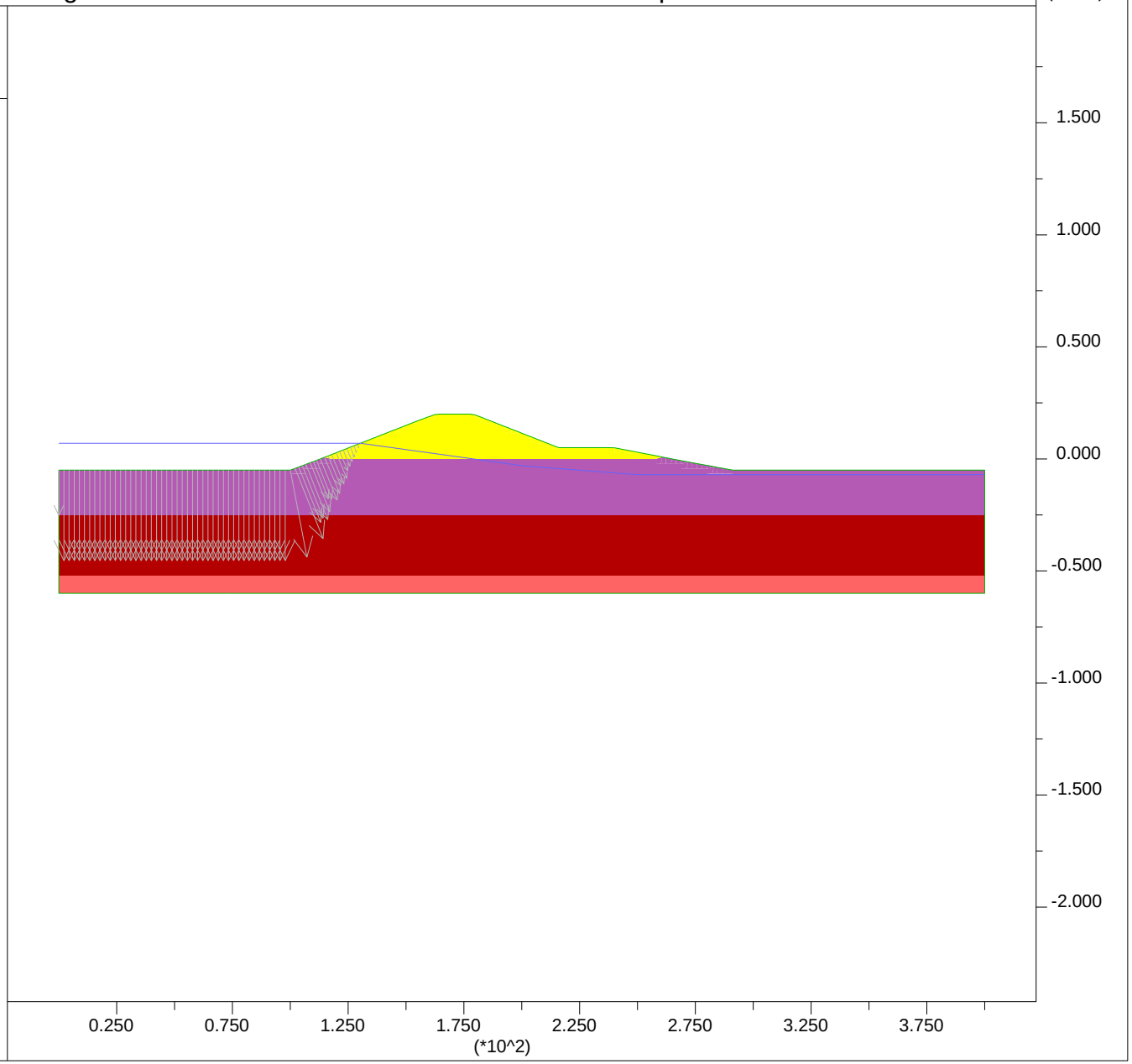


PLATE G-142

JOB TITLE : Existing North Levee during Meander Channel Excavation - 70 foot berm

FLAC/SLOPE (Version 7.00)

LEGEND

5-Mar-13 14:09

Factor of Safety 1.51

Shear Strain Rate Contours

- 5.00E-07
- 1.00E-06
- 1.50E-06
- 2.00E-06
- 2.50E-06

Contour interval= 5.00E-07
(zero contour omitted)
Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 1.874E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands

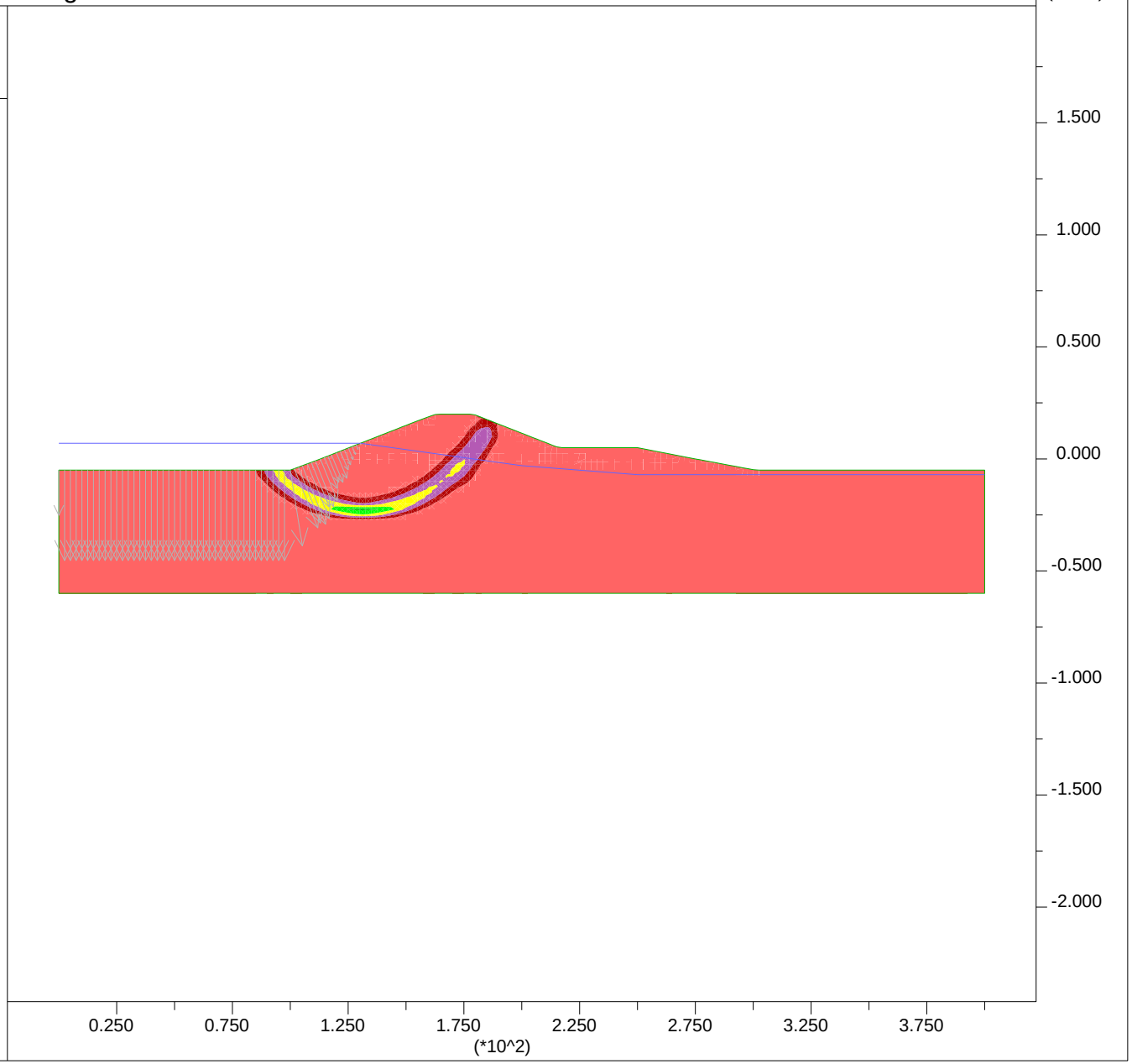


PLATE G-143

JOB TITLE : Existing North Levee during Meander Channel Excavation - 70 foot berm - Inp

FLAC/SLOPE (Version 7.00)

LEGEND

5-Mar-13 14:08

Factor of Safety 1.51

User-defined Groups
- User:Sand
- 'User:Stiff Clay'
- 'User:Soft Clay'
- Fill:Fill

Boundary plot

0 1E 2

Water Table

Net Applied Forces

max vector = 1.874E+03

0 5E 3

Group Delta Consultants
Ballona Wetlands

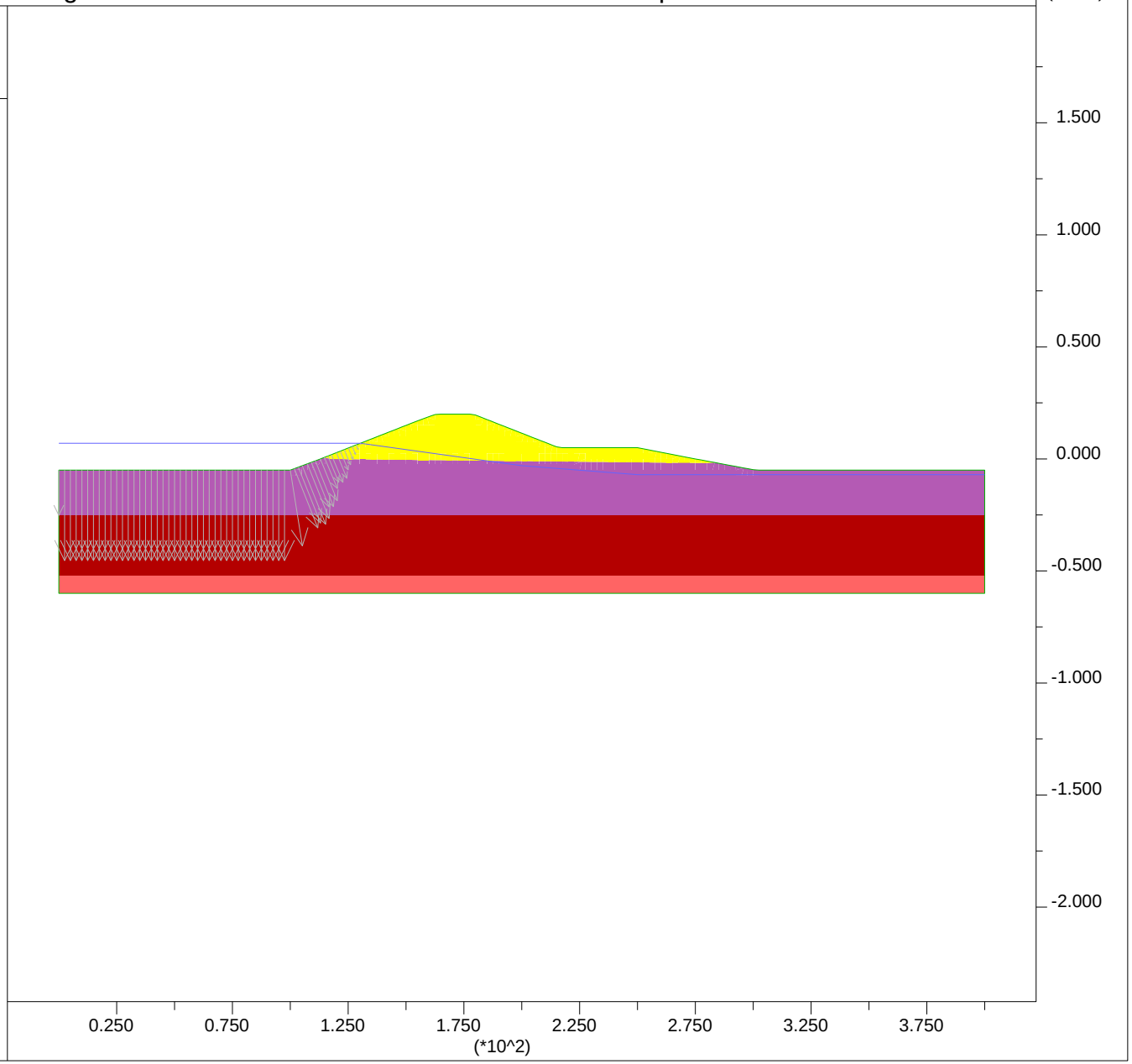
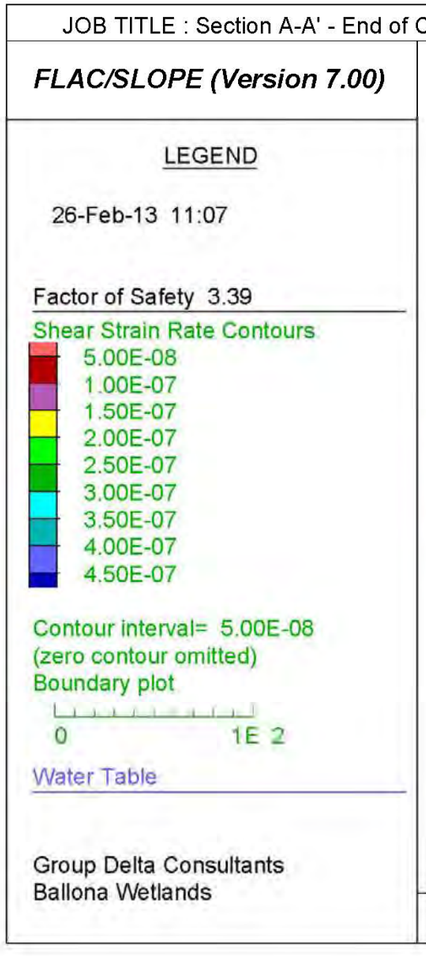
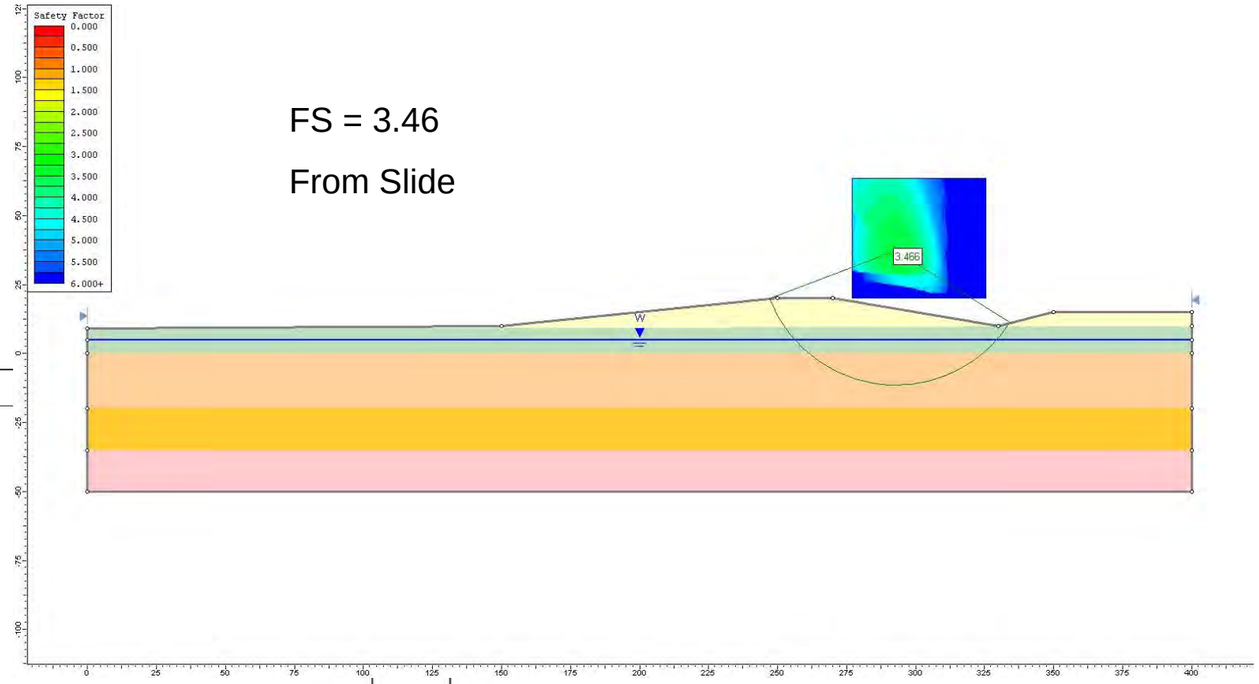


PLATE G-144

Section A-A’ – End of Construction

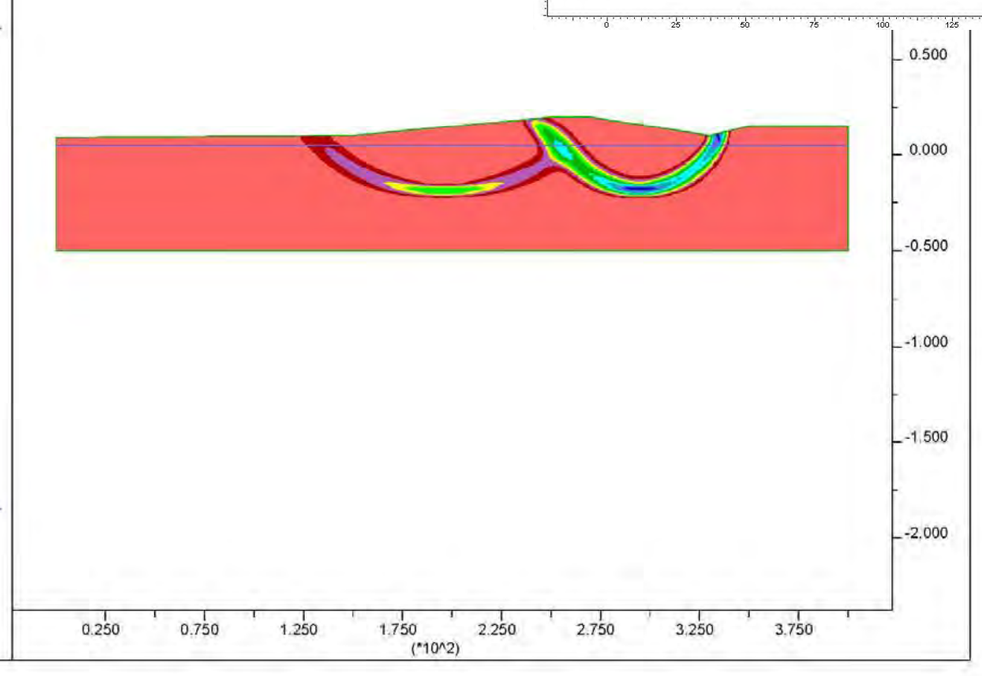


FS = 3.39
From FLAC SLOPE



FS = 3.46

From Slide

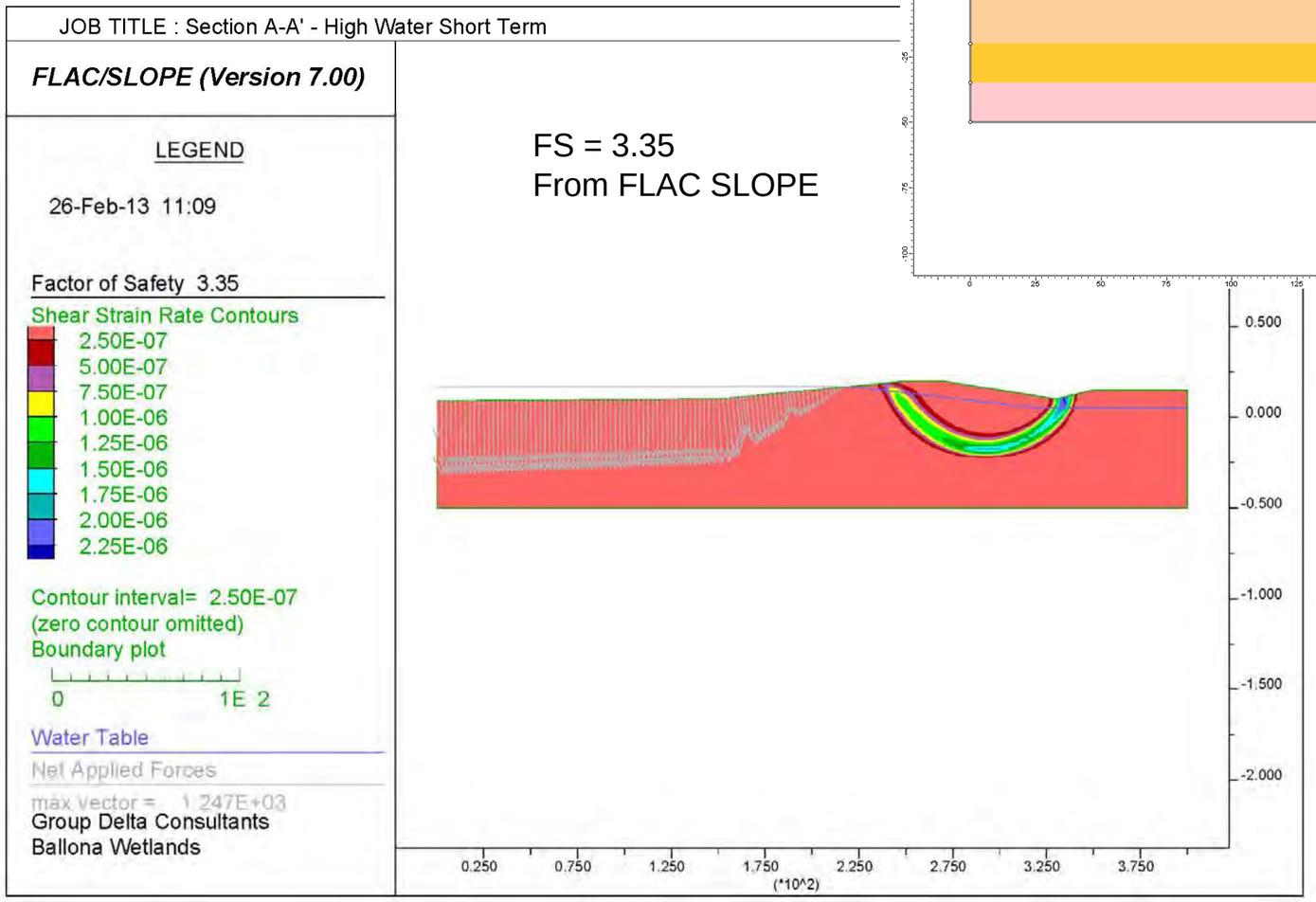


Percent Difference = 2.2%

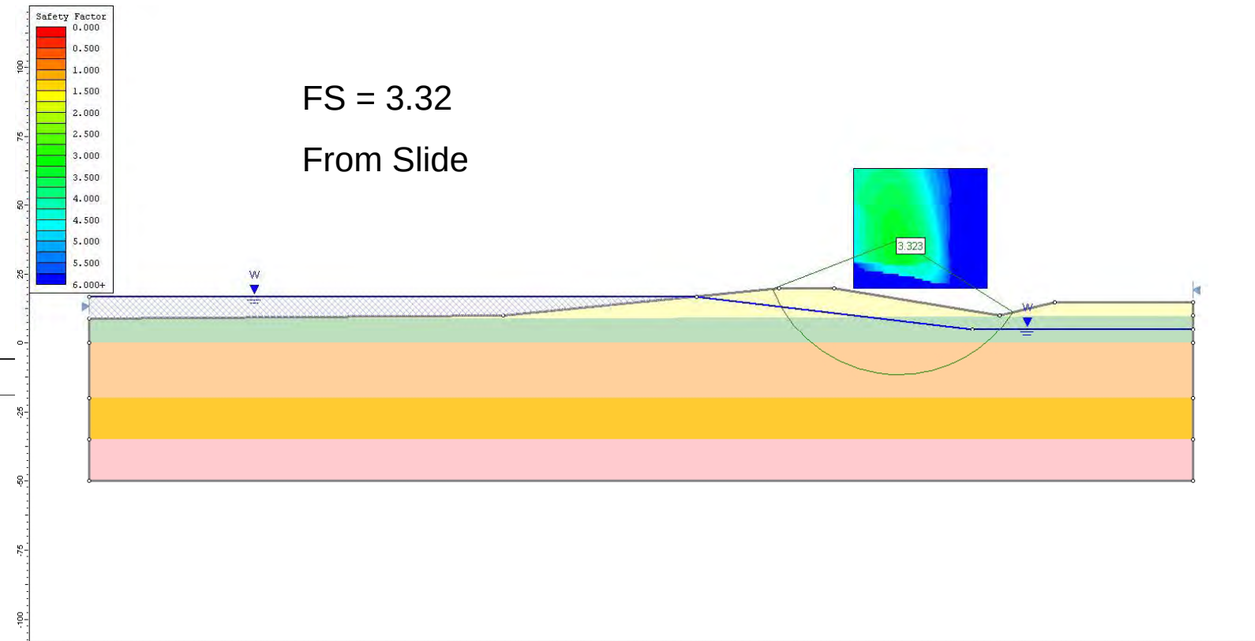
Comparison of FLAC SLOPE and RocScience Slide Results

PLATE G-145

Section A-A’ – High Water Short Term



FS = 3.35
From FLAC SLOPE



FS = 3.32

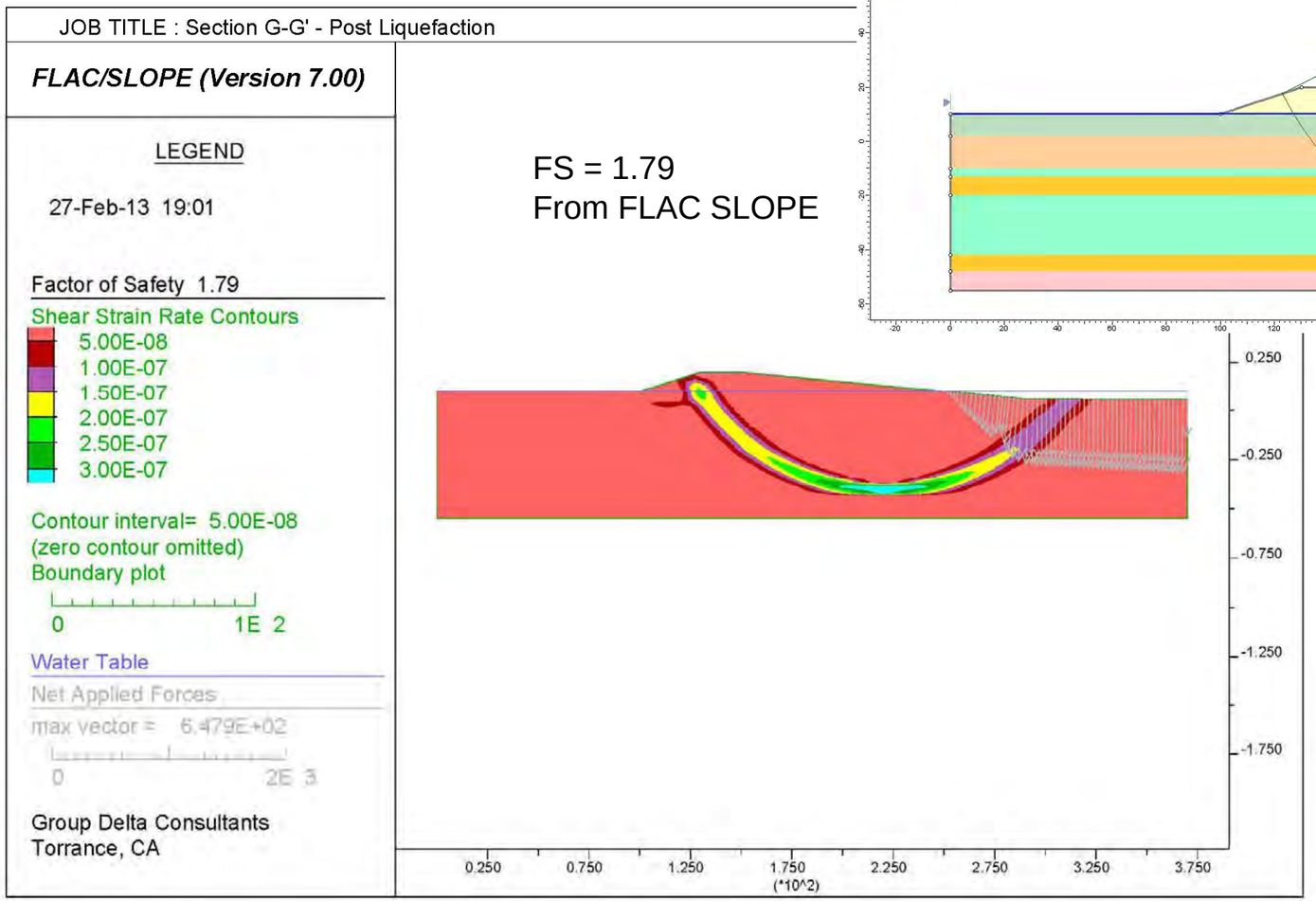
From Slide

Percent Difference = 0.9%

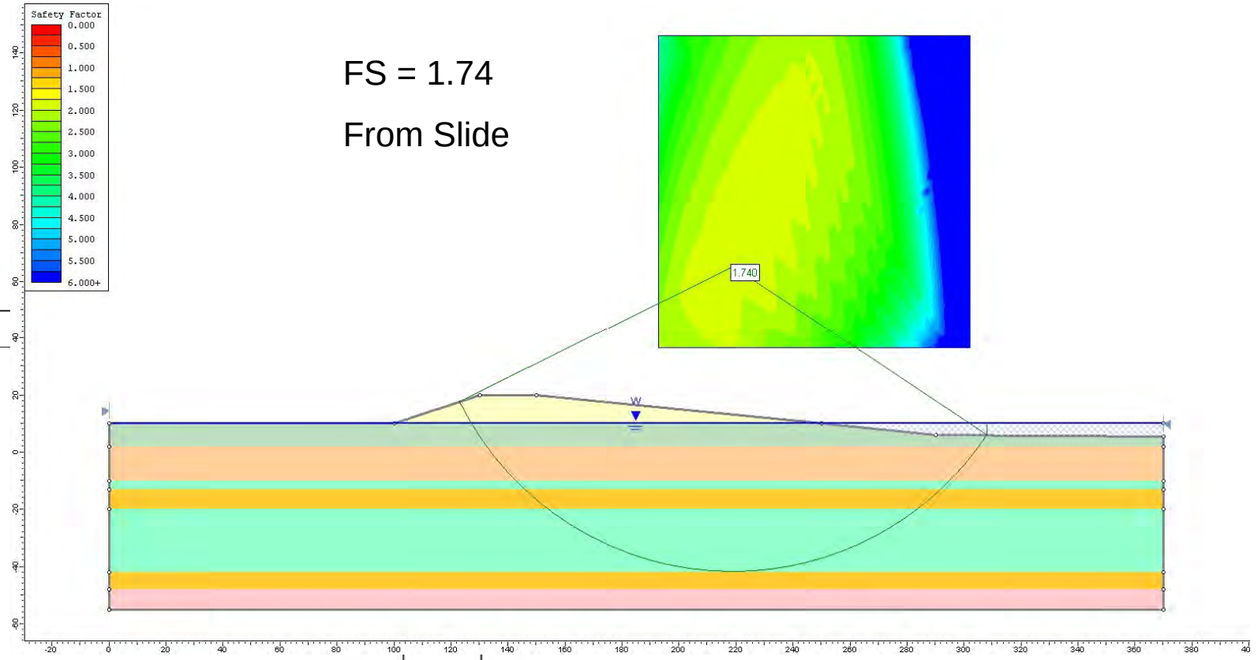
Comparison of FLAC SLOPE and RocScience Slide Results

PLATE G-146

Section G-G’ – Post Liquefaction



FS = 1.79
From FLAC SLOPE



FS = 1.74

From Slide

Percent Difference = 2.8%

Comparison of FLAC SLOPE and RocScience Slide Results

PLATE G-147

JOB TITLE : Section E ky =0.06 - Groundwater at El +7, Channel Water at Low Tide El. 0

FLAC/SLOPE (Version 7.00)

LEGEND

27-Mar-13 15:13

Factor of Safety 0.97

Shear Strain Rate Contours

- 5.00E-07
- 1.00E-06
- 1.50E-06
- 2.00E-06
- 2.50E-06
- 3.00E-06
- 3.50E-06
- 4.00E-06

Contour interval= 5.00E-07
(zero contour omitted)
Boundary plot

0 2E 2

Water Table

Net Applied Forces

max vector = 8.604E+02

0 2E 3

Group Delta Consultants
Ballona Wetlands

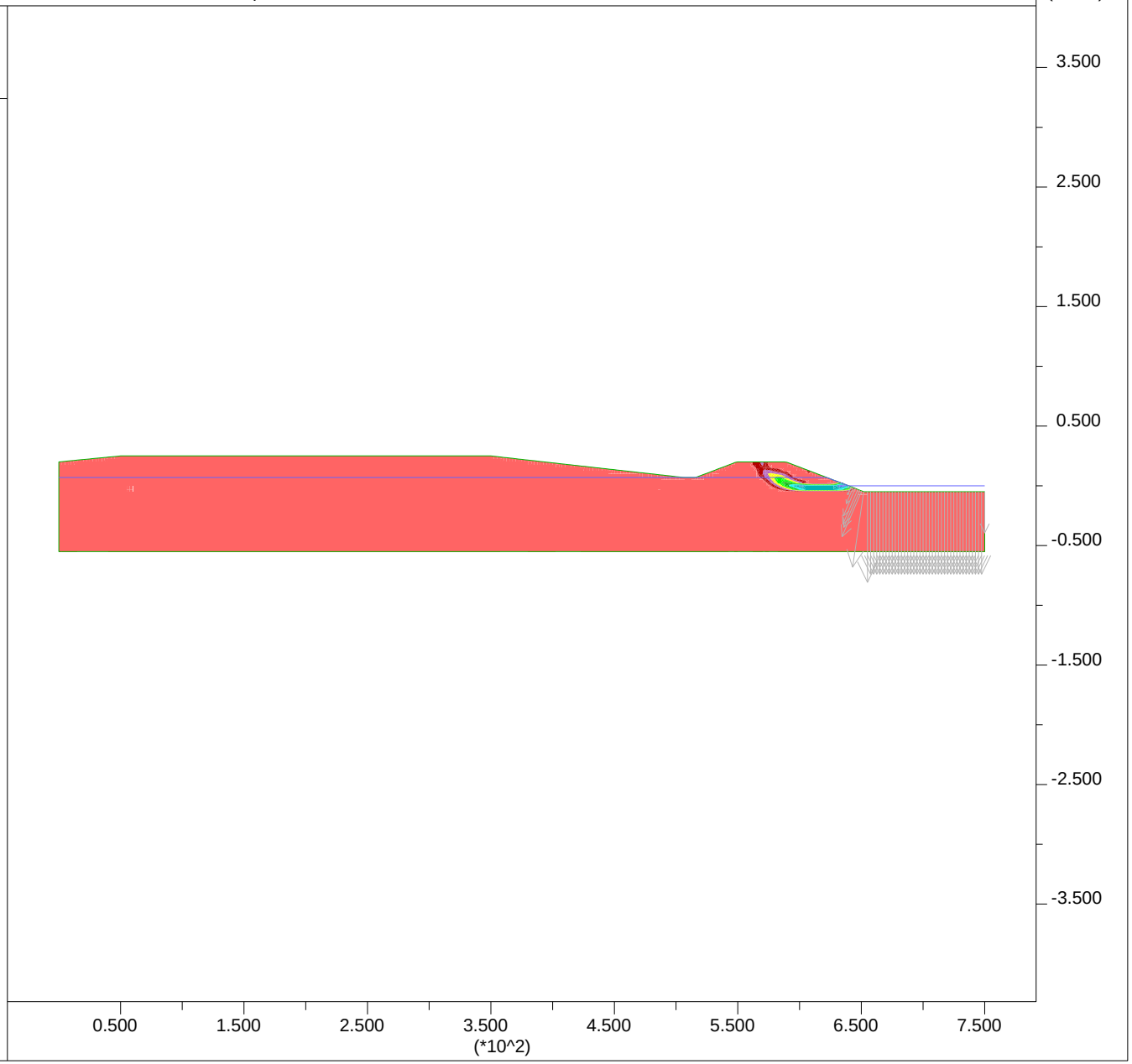


PLATE G-148

JOB TITLE : Section E ky =0.06 - GW at El +7, Channel Water at Low Tide El. 0 _ Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Mar-13 15:13

Factor of Safety 0.97

User-defined Groups
- User:Sand
- 'User:Stiff Clay'
- 'Fill:Liq Sand 2'
- 'User:Soft Clay'
- 'Fill:Liq Fill'
- User:Embankment

Boundary plot

0 2E 2

Water Table

Net Applied Forces

max vector = 8.604E+02

0 2E 3

Group Delta Consultants
Ballona Wetlands

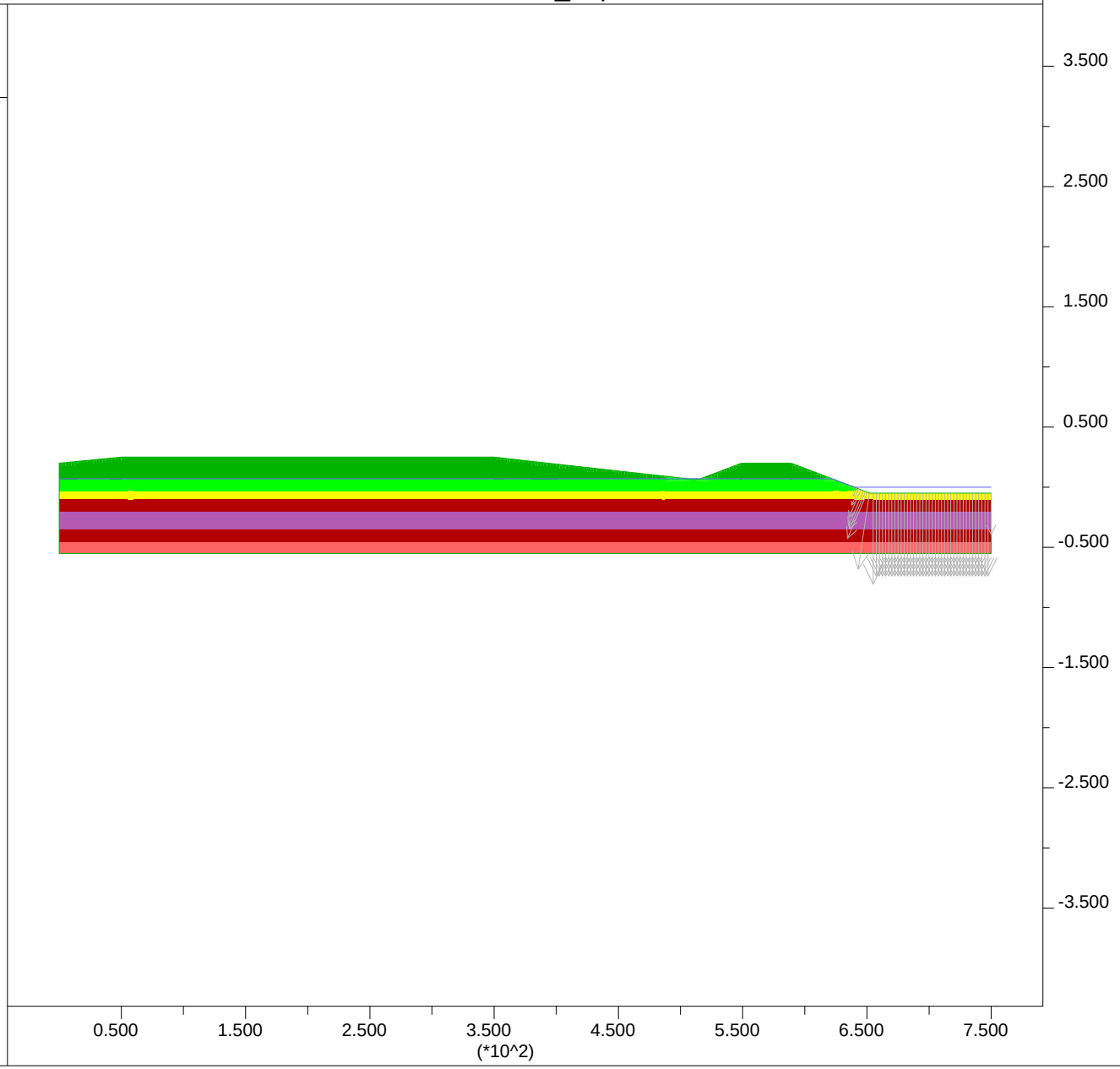


PLATE G-149

JOB TITLE : Section E ky =0.08 - Groundwater at El +3, Channel Water at Avg tide El +3

FLAC/SLOPE (Version 7.00)

LEGEND

27-Mar-13 15:19

Factor of Safety 0.99

Shear Strain Rate Contours

- 5.00E-07
- 1.00E-06
- 1.50E-06
- 2.00E-06
- 2.50E-06
- 3.00E-06
- 3.50E-06
- 4.00E-06

Contour interval= 5.00E-07
(zero contour omitted)
Boundary plot

0 2E 2

Water Table

Net Applied Forces

max vector = 1.379E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands

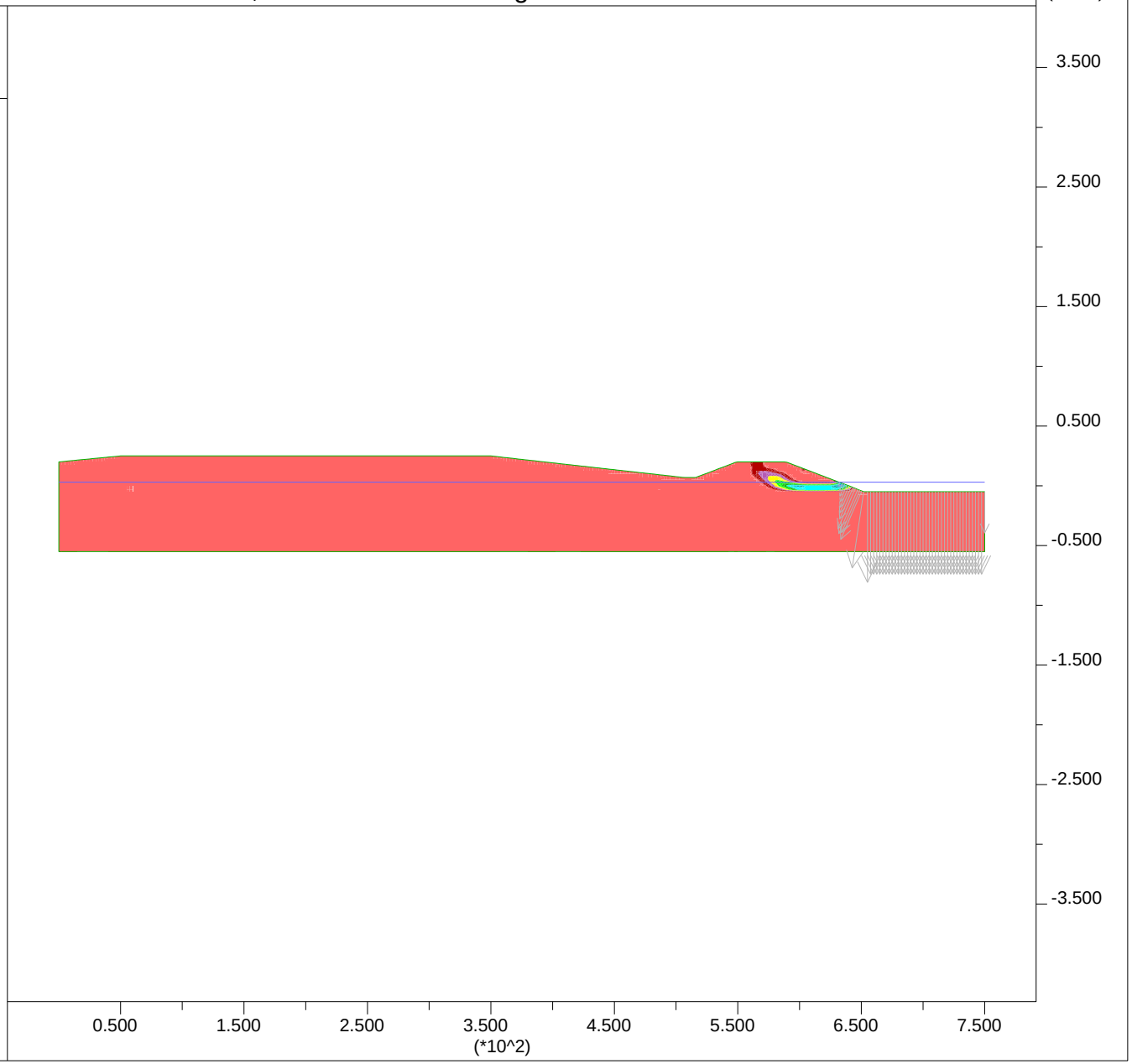


PLATE G-150

JOB TITLE : Section E ky =0.08 - GW at El +3, Channel Water at Avg tide El +3 _ Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Mar-13 15:17

Factor of Safety 0.99

User-defined Groups
- User:Sand
- 'User:Stiff Clay'
- 'Fill:Liq Sand 2'
- 'User:Soft Clay'
- 'Fill:Liq Fill'
- User:Embankment

Boundary plot

0 2E 2

Water Table

Net Applied Forces

max vector = 1.379E+03

0 2E 3

Group Delta Consultants
Ballona Wetlands

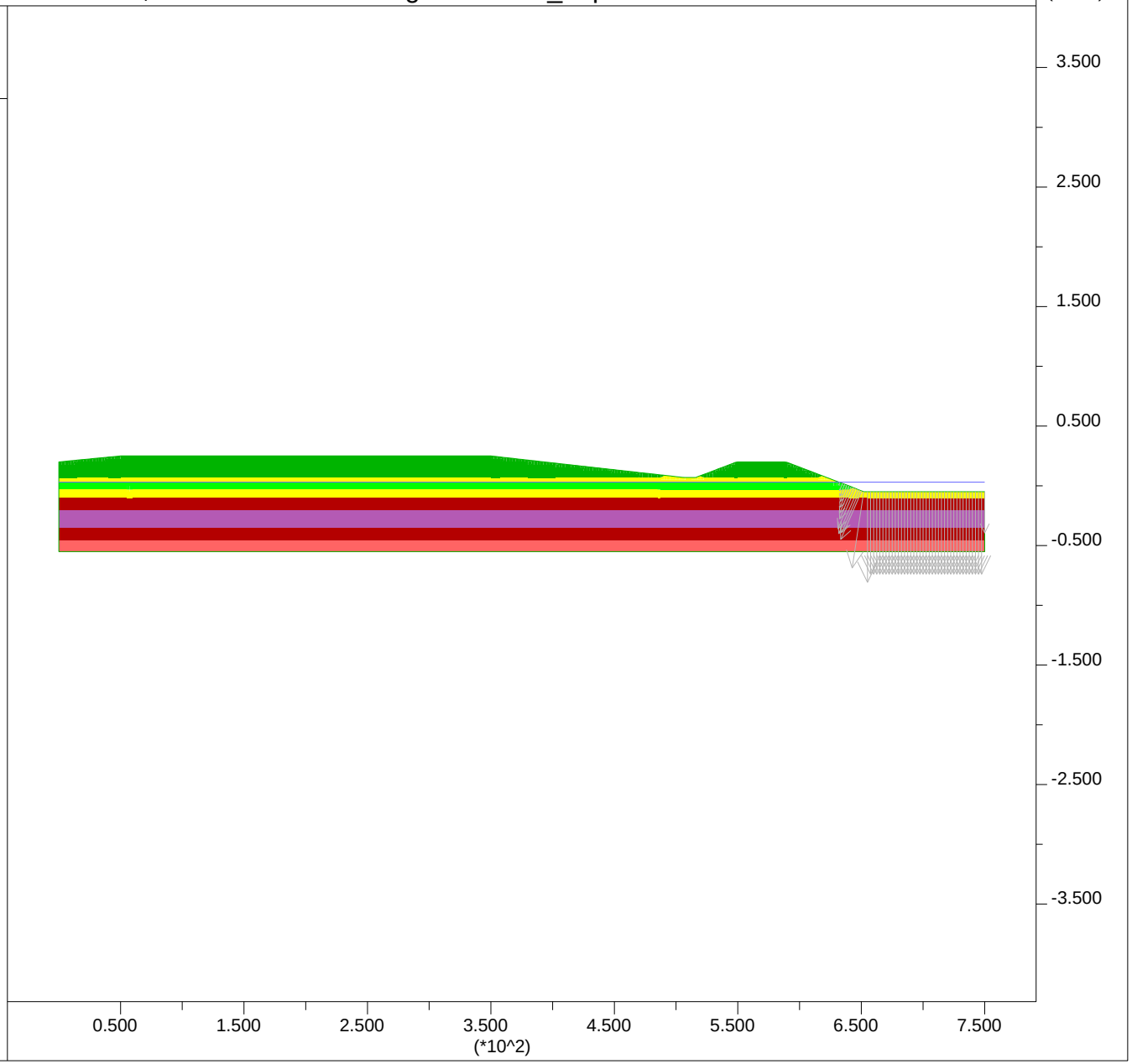


PLATE G-151

JOB TITLE : Section E ky =0.07 - Groundwater at El +3, Channel Water at Low Tide El. 0

FLAC/SLOPE (Version 7.00)

LEGEND

27-Mar-13 15:14

Factor of Safety 1.01

Shear Strain Rate Contours

- 2.50E-07
- 5.00E-07
- 7.50E-07
- 1.00E-06
- 1.25E-06

Contour interval= 2.50E-07
(zero contour omitted)
Boundary plot

0 2E 2

Water Table

Net Applied Forces

max vector = 8.610E+02

0 2E 3

Group Delta Consultants
Ballona Wetlands

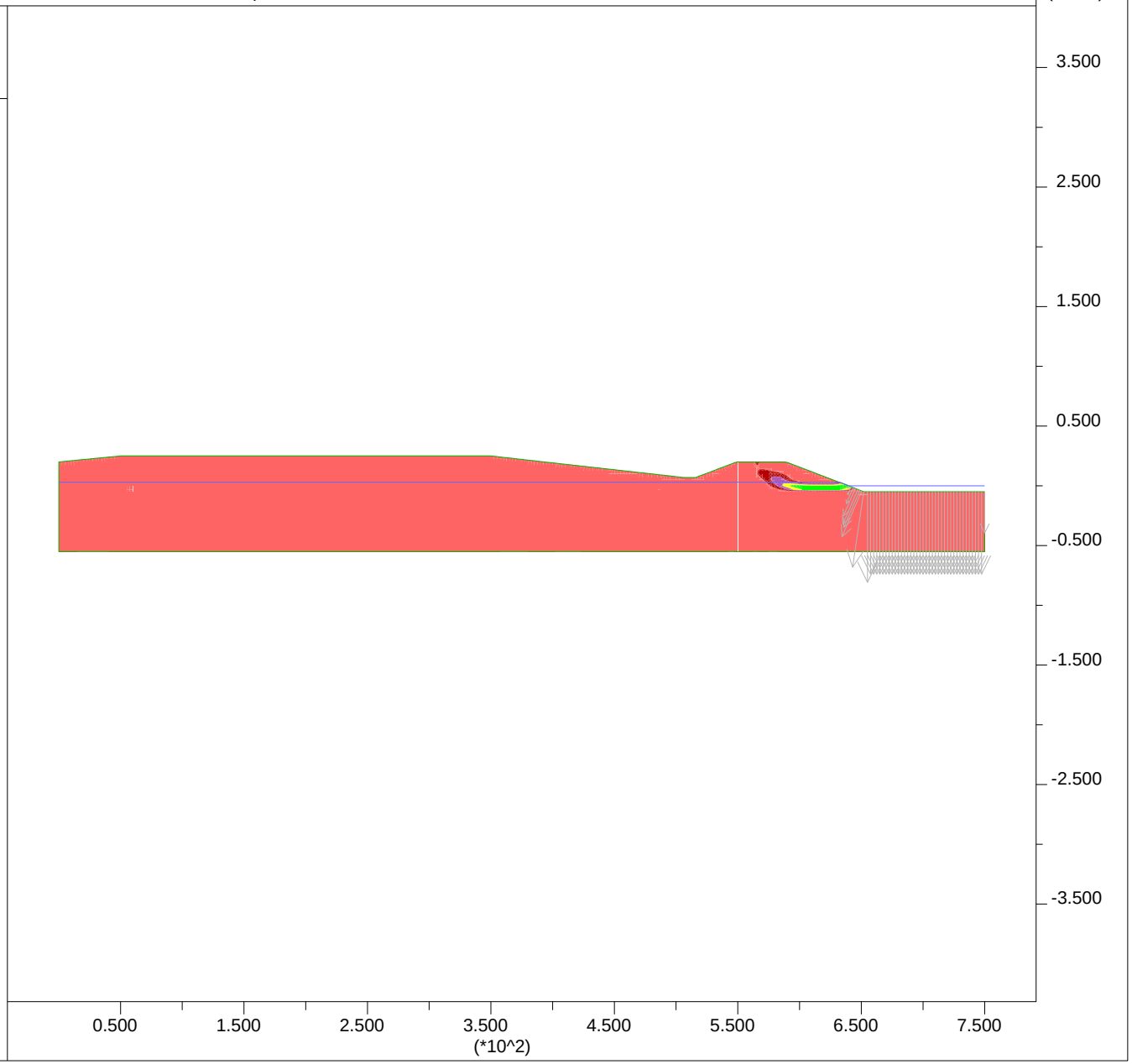


PLATE G-152

JOB TITLE : Section E ky =0.07 - GW at El +3, Channel Water at Low Tide El. 0 _ Input

FLAC/SLOPE (Version 7.00)

LEGEND

27-Mar-13 15:15

Factor of Safety 1.01

User-defined Groups

- User:Sand
- 'User:Stiff Clay'
- 'Fill:Liq Sand 2'
- 'User:Soft Clay'
- 'Fill:Liq Fill'
- User:Embankment

Boundary plot

0 2E 2

Water Table

Net Applied Forces

max vector = 8.610E+02

0 2E 3

Group Delta Consultants
Ballona Wetlands

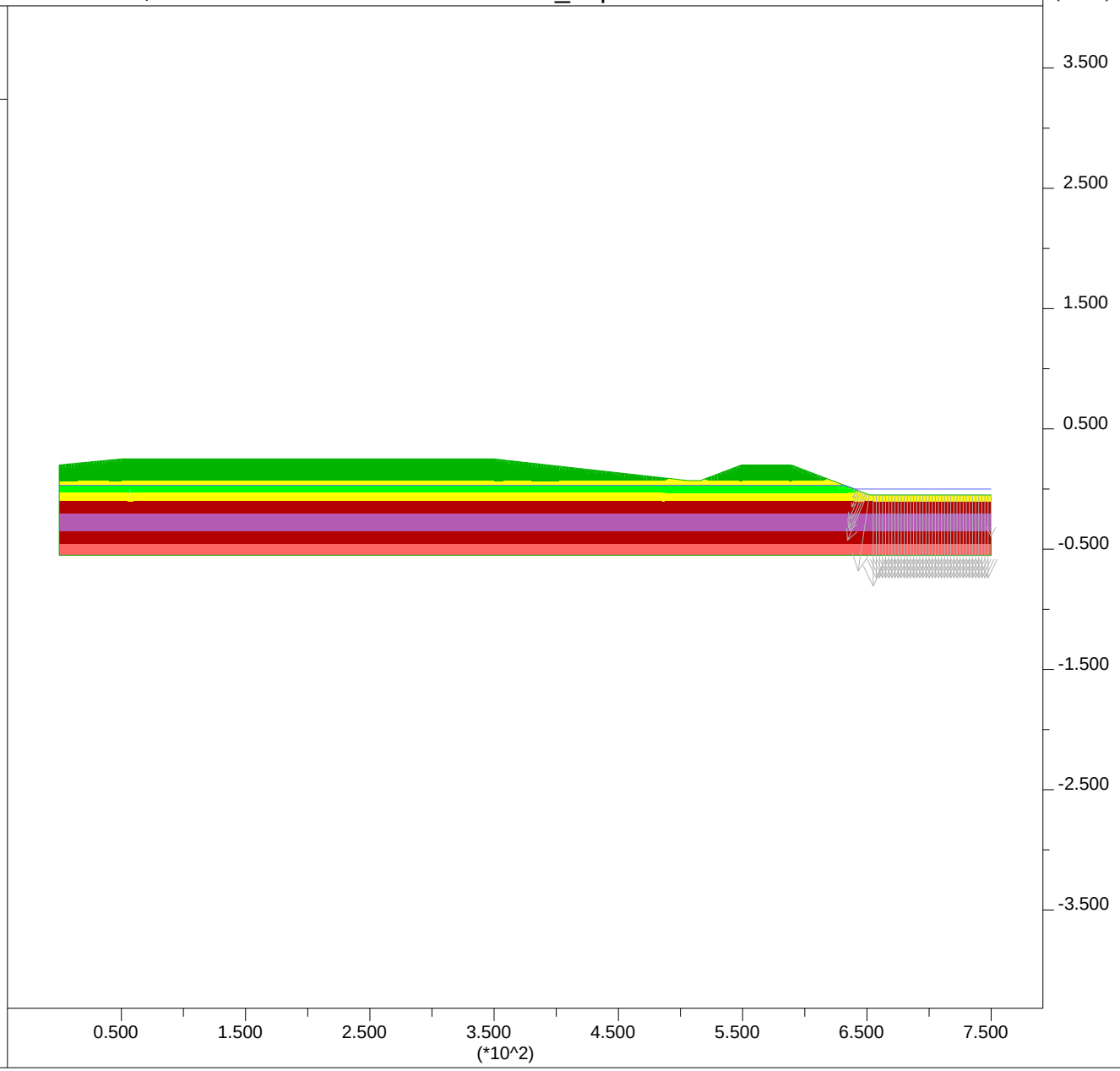


PLATE G-153

APPENDIX H
SETTLEMENT

APPENDIX H
SETTLEMENT

H.1 Summary of Contents

This appendix includes the following:

- Cc / $(1+e_o)$ data in Areas A, B, and C, and OCR data within Areas A and B
- Settlements at different locations along different sections of levees
- Settlement bowl beyond dry side toe of levees/embankments
- Examples showing stresses below different portions of levees
- Settlements along different locations below Section I-I' of West Area B levees
- Spreadsheets showing maximum settlement for different Sections of levees
- Consolidation Curves showing P_P and OCR Determination
- Examples of Settlement Monitoring Results at the Adjacent Playa Vista

H.2 Determination of Cc / $(1+e_o)$ and OCR for Settlement Analysis

Plots included in Plates H-1 to H-5 show the values determined from consolidation data for Cc / $(1+e_o)$ in Areas A, B, and C, and OCR in Areas A, and B plotted versus depth. Cc / $(1+e_o)$ is particularly important for settlement analyses at this site, since the clayey soils deeper than about 10 feet are essentially normally consolidated. For this reason, the Cc / $(1+e_o)$ values are companioned with values inferred from correlations with soil moisture content developed from our experience at Playa Vista, as well as a well-known correlation based on the Terzaghi and Peck (1967) relationship. Adopted values for Cc / $(1+e_o)$ and OCR at different depths are also shown for different areas. The adopted OCR values for Area A were also used for Area C. Consolidation test results showing P_P and OCR determination are included in Plates H-26 to H-45.

H.3 Settlements at Different Locations along Sections of Levee

Settlements were determined for different levees sections by estimating the increase in vertical stresses under the embankment at different locations along sections of the levee. Examples of calculation of stresses at different locations below the embankment are included in Plates H-8 and H-9. The stresses were then used to estimate settlement at different locations under the embankments. Estimated settlements at different locations under embankment for section I-I' are exemplified in Plates H-10 through H-18. Maximum estimated settlements are shown for the sections that were analyzed on H-19 through H-25. A summary of settlements at different locations along different sections of the levees that were analyzed is presented on Plate H-6.

H.4 Settlement away from Protected Side Toe of Levees or Embankments

To minimize the settlement impact to utility lines and adjacent structures, the levees/embankments should be offset a minimum distance from roads, utilities, and other essential facilities. Therefore, estimations of settlements were made for

different sections along the levees/embankments at distances of 0, 10, 30, and 50 feet away from the protected side toe, for the sections that were analyzed. The settlement bowl away from the protected side toe is presented graphically on Plate H-7. Impact of settlements to utilities perpendicular to the levee alignment are minimal where the slope of change in settlement over length becomes less than 1/480. This slope is also shown on Plate H-7.

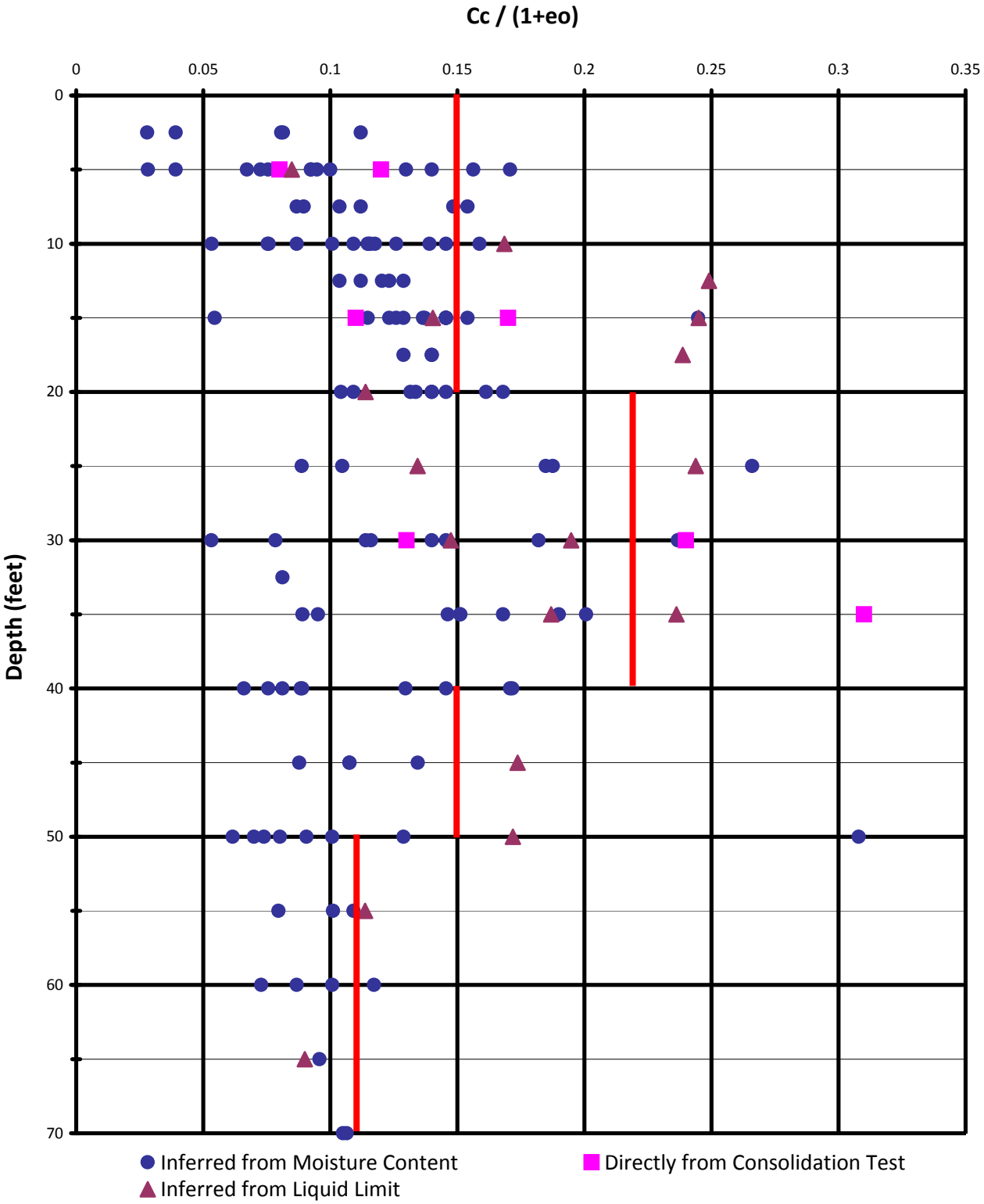
H.5 Rate of Settlement at the Adjacent Playa Vista Development

Examples of settlement monitoring results from our experience at the adjacent Playa Vista Development are included in this appendix. The normalized results (Plate H-47) suggest that 90% consolidation at Lots 1-6 of Area D2 within Playa Vista (located just south of Jefferson Blvd. and about 3,000 feet east of Lincoln Blvd.) occurred within about 100 to 150 days after placement of the full surcharge. Similar time rates of settlements are anticipated at the Ballona Wetlands Restoration Project.

A list of the plates presented in this appendix follows:

Plate H-1 and H-5	Cc / (1+e_o) and OCR Plots showing Consolidation Data, Correlations, and Adopted Values
Plate H-6	Settlements at Different Locations along Different Sections of Levees and Embankments
Plate H-7	Settlement away from Protected Side Toe of Levees or Embankments
Plate H-8 and H-9	Examples of Stresses under the Embankments
Plate H-10 thru H-18	Settlement Spreadsheet Showing Settlement along Different Locations along Section I-I'
Plates H-19 thru H-25	Maximum Levee/Embankment Settlements
Plates H-26 thru H-45	Consolidation Results showing P_p and OCR Estimations
Plates H-46 and H-47	Example of Settlement Monitoring Results at Playa Vista

Variation of Cc / (1+e_o) with Depth in Area A



Note: 1) Correlation based on Moisture Content is derived from experience at Playa Vista and Similar Soils:
Cc / (1+eo) = Mc x 0.0028 + 0.0112
2) Correlation based on Liquid Limit is based on Terzaghi and Peck (1967):
Cc / (1+eo) = 0.009 x (LL - 10) / (1+eo)

PLATE H-1

Variation of OCR with Depth in Area A

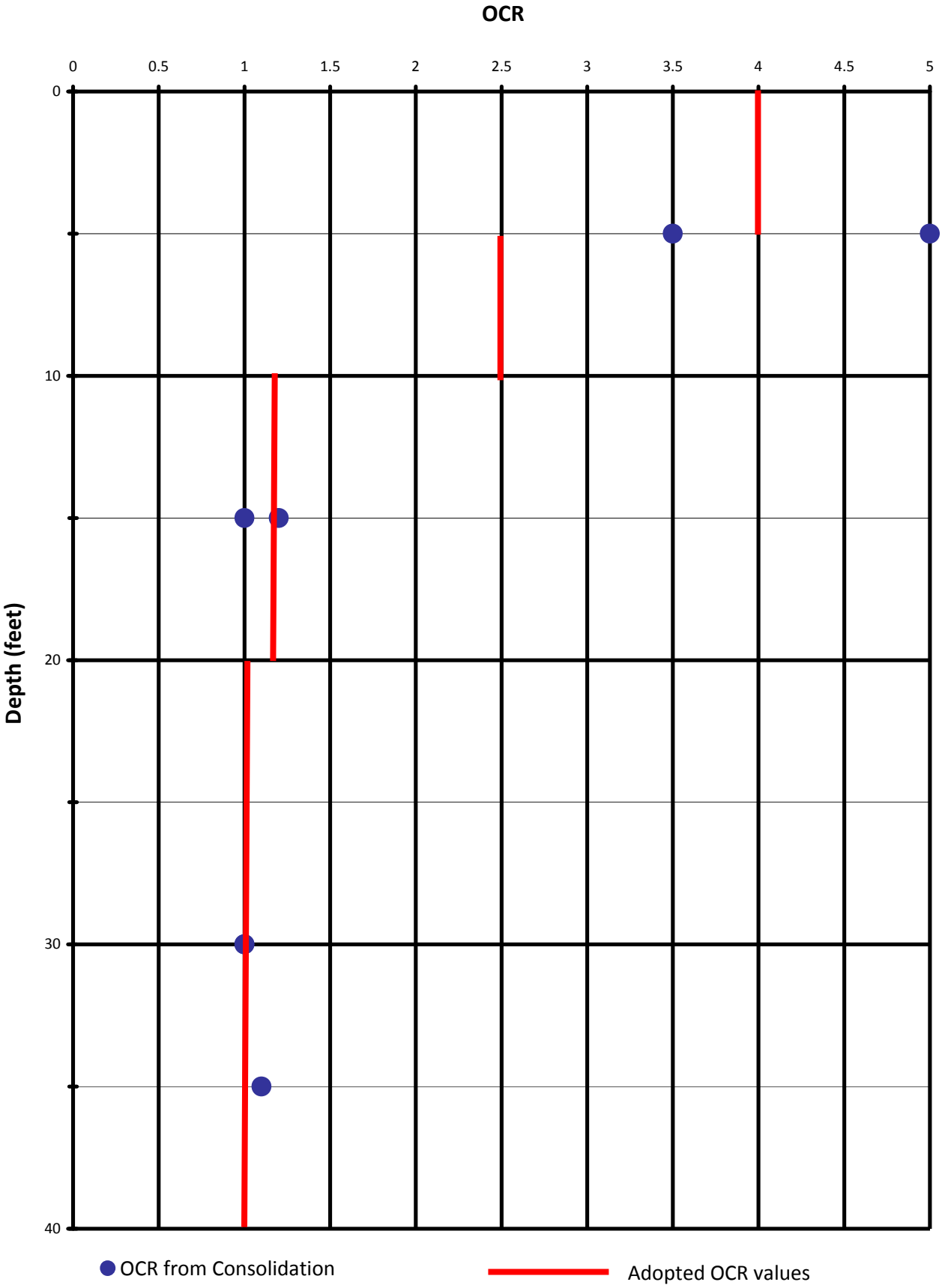
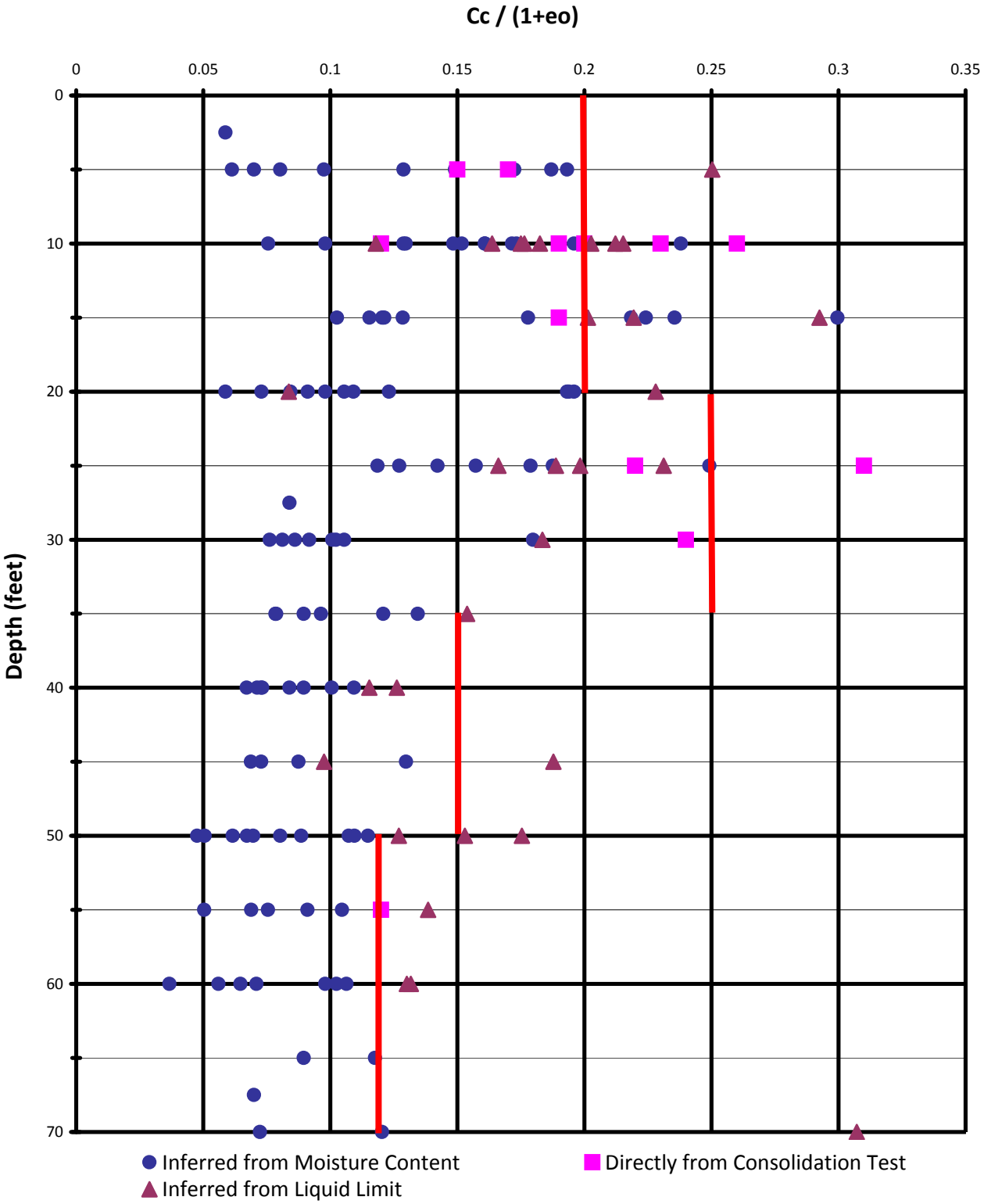


PLATE H-2

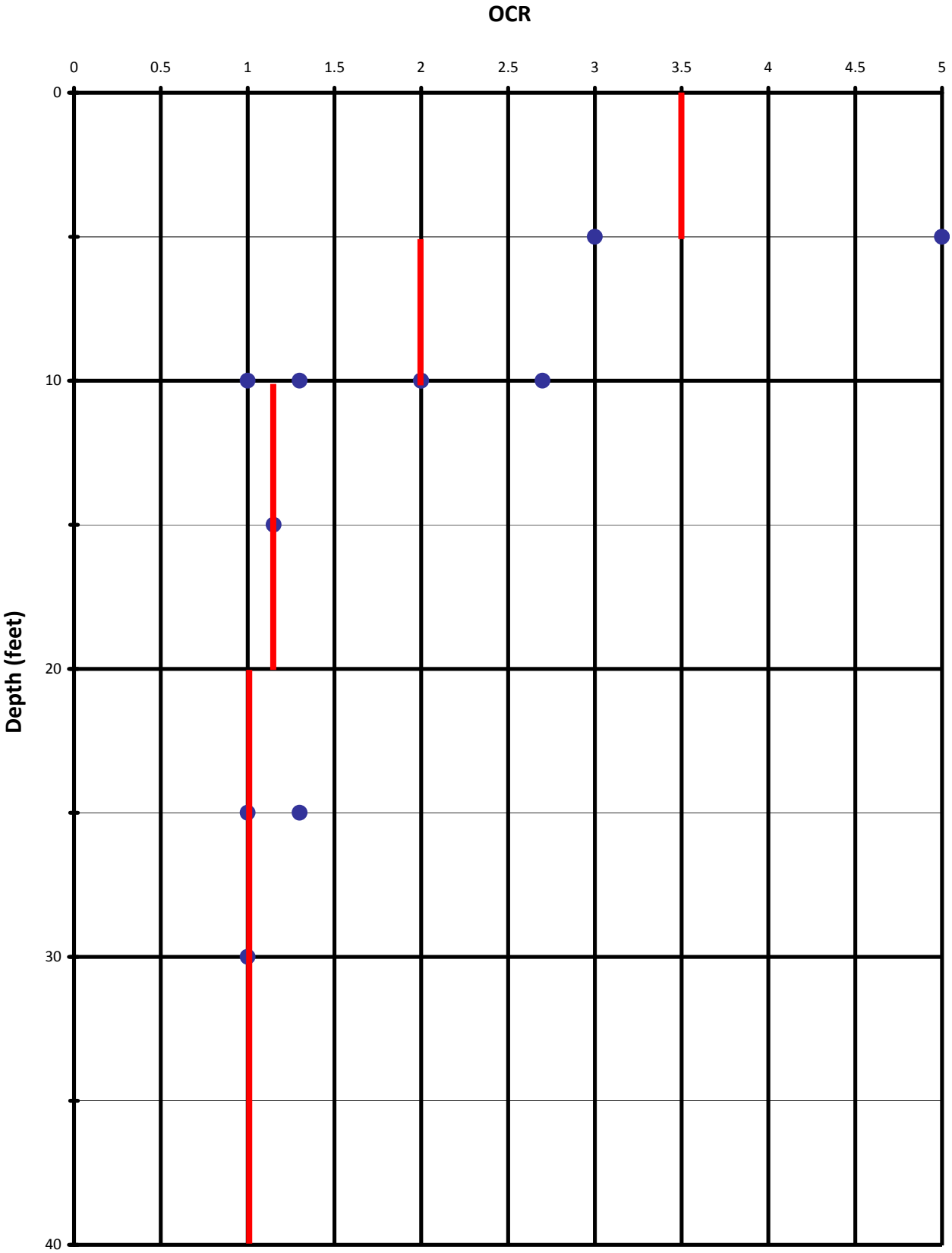
Variation of Cc / (1+e_o) with Depth in Area B



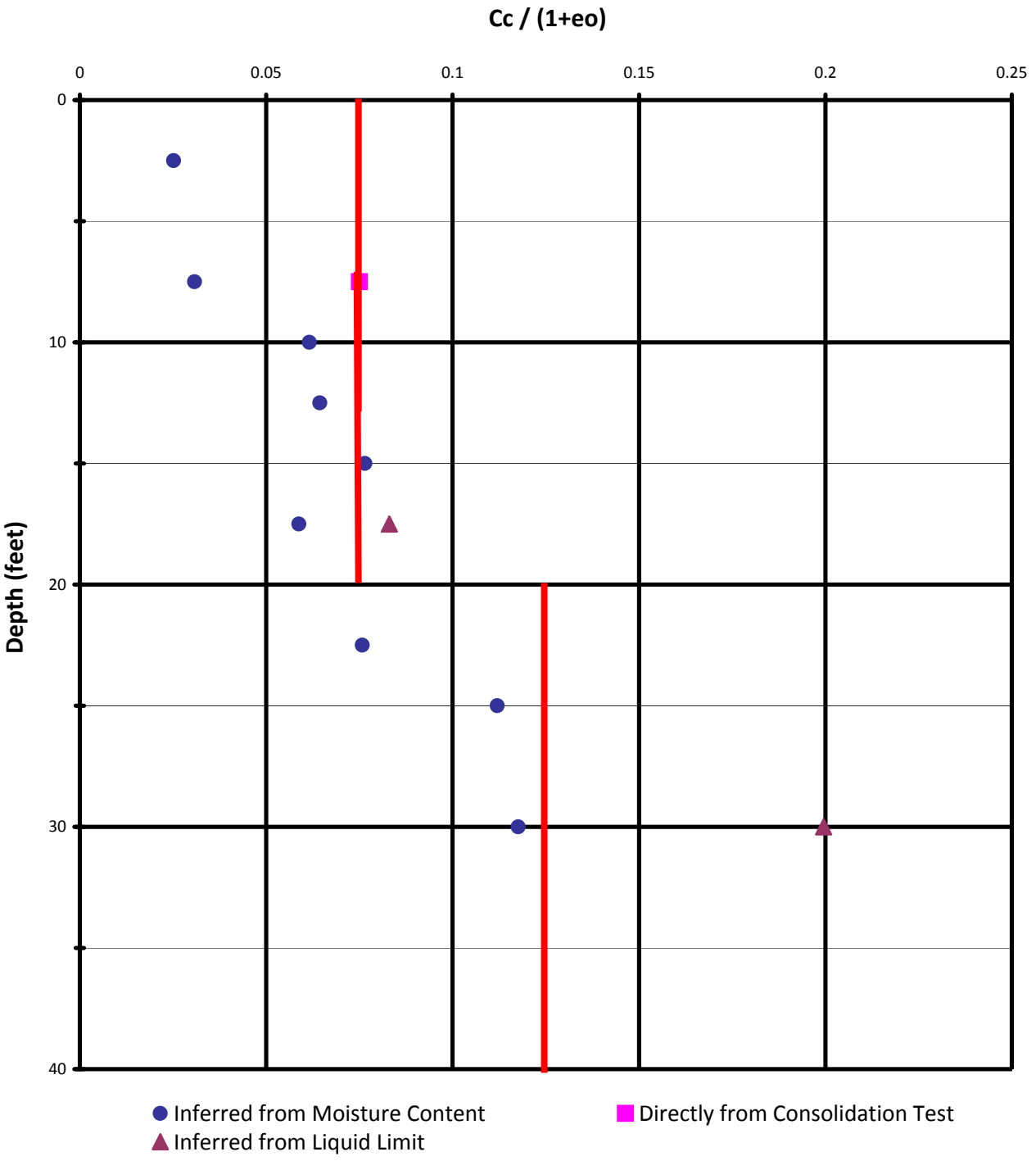
Note: 1) Correlation based on Moisture Content is derived from experience at Playa Vista and Similar Soils:
Cc / (1+eo) = Mc x 0.0028 + 0.0112
2) Correlation based on Liquid Limit is based on Terzaghi and Peck (1967):
Cc / (1+eo) = 0.009 x (LL - 10) / (1+eo)

PLATE H-3

Variation of OCR with Depth in Area B



Variation of Cc / (1+e_o) with Depth in Area C



Note: 1) Correlation based on Moisture Content is derived from experience at Playa Vista and Similar Soils:
Cc / (1+eo) = Mc x 0.0028 + 0.0112
2) Correlation based on Liquid Limit is based on Terzaghi and Peck (1967):
Cc / (1+eo) = 0.009 x (LL - 10) / (1+eo)

Area	Section	Approximate Embankment Height (feet)	Settlement (inches)									Max Settlement per foot of Fill (inches)
			Wet Side Toe	1/3 Height of Wet Side Slope	2/3 Height of Wet Side Slope	Wet Side Edge of Crest	Center	Dry Side Edge of Crest	2/3 Height of Dry Side Slope	1/3 Height of Dry Side Slope	Dry Side Toe	
Area A	Section A-A'	10	2.1	7.8	14.3	19	19.1	18.4	13.9	8.2	3.1	1.9
Area B	Section B-B'	10	2.1	7.9	14.6	19.9	21.4	19	14.2	8.3	3.2	2.1
	Section C-C'	5	1	4.2	7.5	9.9	9.9	9.5	7.4	4.6	2.4	2.0
	Section F-F'	14	2.2	11.7	23.1	32	33.4	29	22	13	5.8	2.4
	Section H-H'	14	2.2	11.7	23.1	31.9	32.9	28.9	22	13	5.8	2.4
	Section I-I'	15	2.1	12.3	24.5	32.5	32.1	30.4	23.3	13.6	5.8	2.2
	Surcharge Area B	25	2.2	20.9	38.5	50.7	51.8	50.7	38.5	20.9	2.2	2.1
Area C	Surcharge Area C	30	1.5	13.8	24	30.8	31.6	30.8	24	13.8	1.5	1.1

PLATE H-6

Settlement away from Protected Side Toe

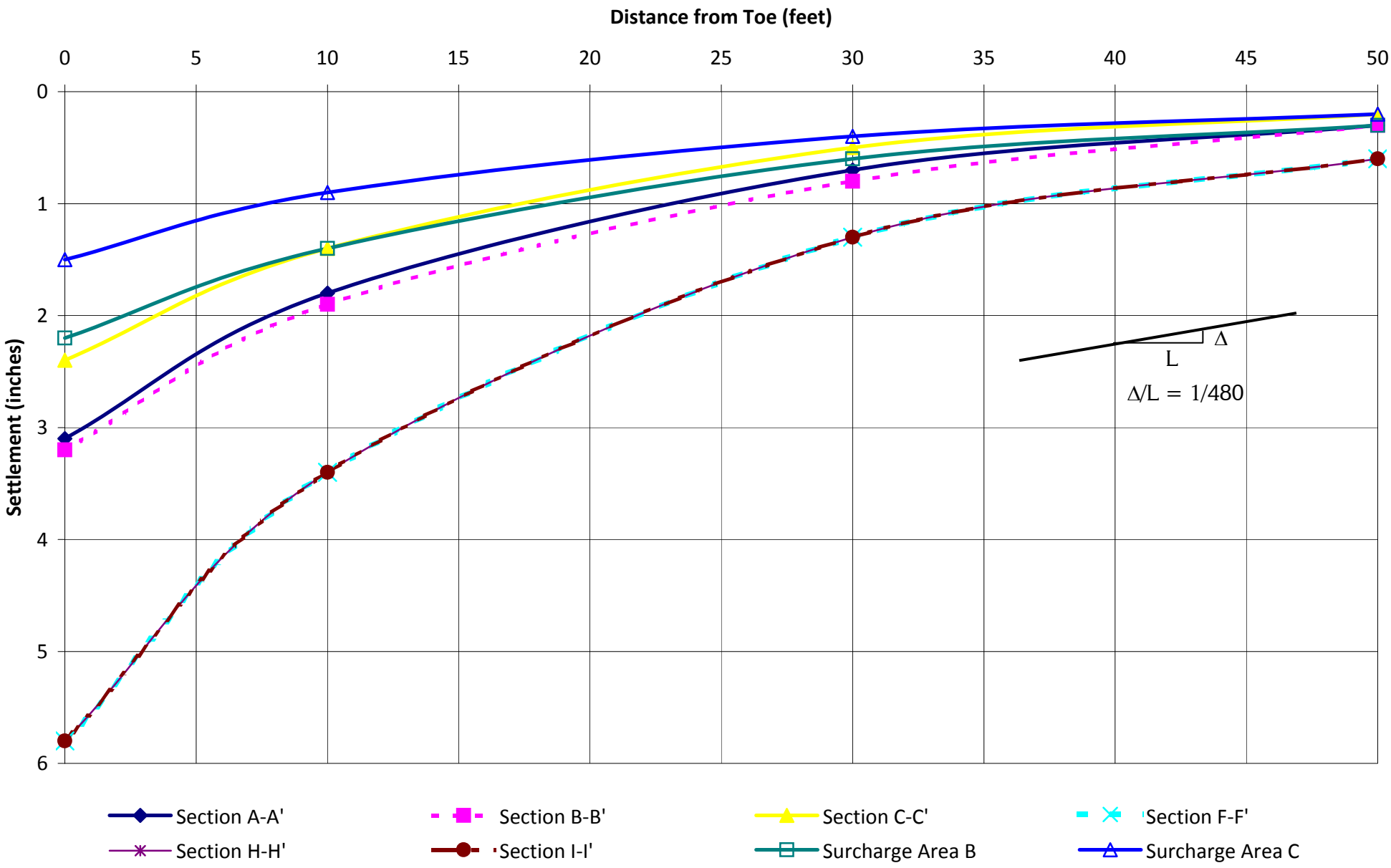


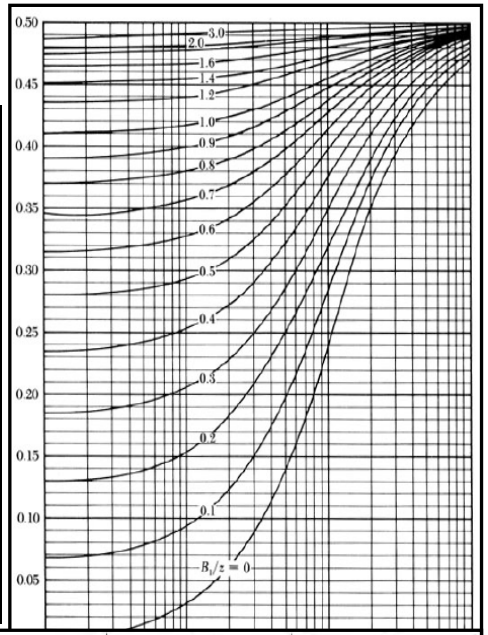
PLATE H-7

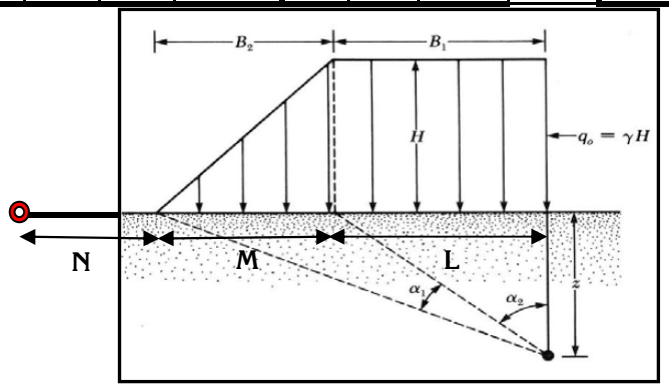
Osterberg, 1957 Chart Stresses Under An Embankemnt

Location: Center of Levee Section I-I'

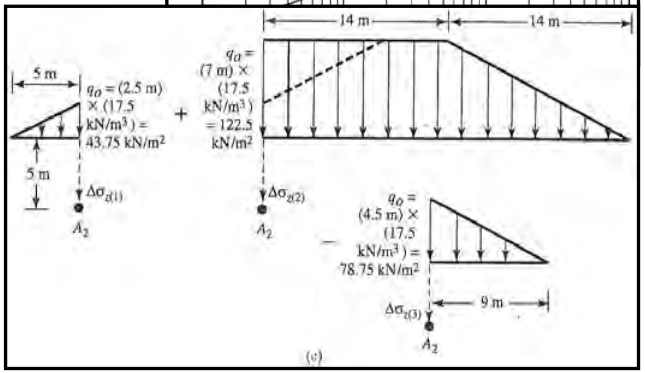
H:	**Surcharge Height:**	15	feet
q_o:	**Surcharge**	1,800	psf
L:	**Levee Crest Width:**	20	feet
M:	**Dry Side Slope HorizontalDist:**	45	feet
N:	**Distance to Levee Toe:**	NA	feet
O:	**Creek Side Horizontal Slope Dist:**	150	feet

LARGE TRAPEZOID				ADDITIVE TRAPEZOID				SUBTRACTIVE TRAPEZOID					
B1= 10 feet				B1= 10 feet				B1= 0 feet					
B2= 150 feet				B2= 45 feet				B2= 0 feet					
Z	α_2	α_1	σ	Z	α_2	α_1	σ	Z	α_2	α_1	σ	$\Delta\sigma$	% Surcharge
2.5	1.33	0.23	899.81	2.5	1.33	0.20	899	2.5	0.00	0.00	0	1799	99.94
7.5	0.93	0.60	895.95	7.5	0.93	0.51	887	7.5	0.00	0.00	0	1783	99.05
12.5	0.67	0.82	886.58	12.5	0.67	0.67	858	12.5	0.00	0.00	0	1744	96.90
17.5	0.52	0.94	873.59	17.5	0.52	0.74	818	17.5	0.00	0.00	0	1692	93.98
22.5	0.42	1.01	858.64	22.5	0.42	0.76	775	22.5	0.00	0.00	0	1633	90.75
27.5	0.35	1.05	842.65	27.5	0.35	0.76	731	27.5	0.00	0.00	0	1574	87.42
32.5	0.30	1.07	826.12	32.5	0.30	0.74	688	32.5	0.00	0.00	0	1514	84.13
37.5	0.26	1.08	809.35	37.5	0.26	0.71	648	37.5	0.00	0.00	0	1457	80.95
42.5	0.23	1.08	792.50	42.5	0.23	0.68	610	42.5	0.00	0.00	0	1402	77.91
47.5	0.21	1.07	775.70	47.5	0.21	0.65	575	47.5	0.00	0.00	0	1350	75.02
52.5	0.19	1.07	759.04	52.5	0.19	0.62	542	52.5	0.00	0.00	0	1301	72.30
57.5	0.17	1.05	742.57	57.5	0.17	0.59	513	57.5	0.00	0.00	0	1255	69.73
70	0.14	1.02	702.53	70	0.14	0.52	448	70	0.00	0.00	0	1151	63.93





Schematics from Das



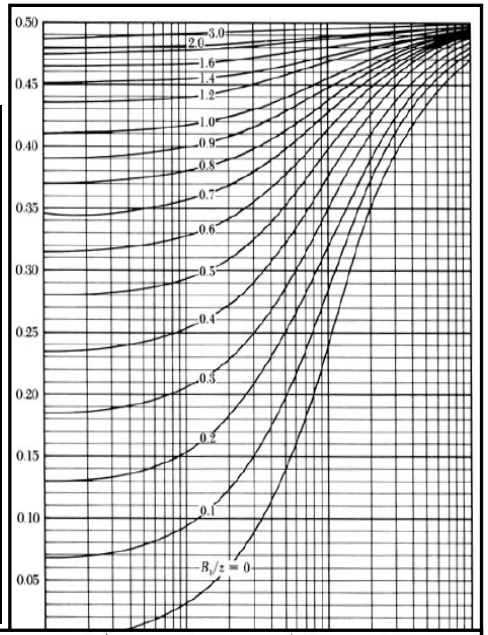
Osterberg, 1957 Chart Stresses Under An Embankemnt

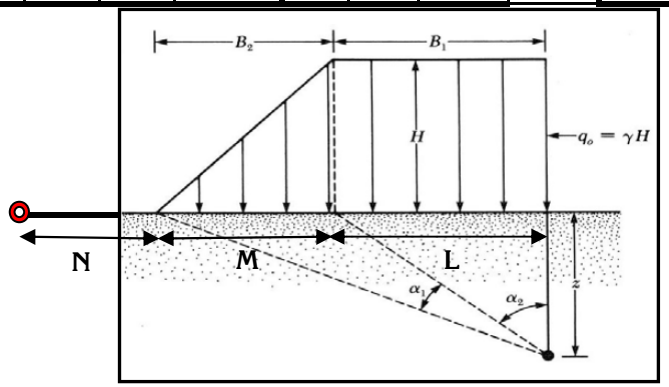
Location: 1/3 of Height - Dry Side Section I-I'

H:	**Surcharge Height:**	15	feet
q_o:	**Surcharge**	1,800	psf
L:	**Levee Crest Width:**	20	feet
M:	**Dry Side Slope HorizontalDist:**	45	feet
N:	**Distance to Levee Toe:**	NA	feet
O:	**Creek Side Horizontal Slope Dist:**	150	feet

LARGE TRAPEZOID				ADDITIVE TRAPEZOID				SUBTRACTIVE TRAPEZOID			
B1= 50 feet				B1= 0 feet				B1= 0 feet			
B2= 150 feet				B2= 15 feet				B2= 30 feet			
Z	α_2	α_1	σ	Z	α_2	α_1	σ	Z	α_2	α_1	σ
2.5	1.52	0.04	899.99	2.5	0.00	1.41	268	2.5	0.00	1.49	568
7.5	1.42	0.11	899.80	7.5	0.00	1.11	211	7.5	0.00	1.33	506
12.5	1.33	0.18	899.10	12.5	0.00	0.88	167	12.5	0.00	1.18	449
17.5	1.23	0.25	897.62	17.5	0.00	0.71	135	17.5	0.00	1.04	398
22.5	1.15	0.31	895.18	22.5	0.00	0.59	112	22.5	0.00	0.93	354
27.5	1.07	0.37	891.65	27.5	0.00	0.50	95	27.5	0.00	0.83	317
32.5	0.99	0.42	887.01	32.5	0.00	0.43	83	32.5	0.00	0.75	285
37.5	0.93	0.46	881.30	37.5	0.00	0.38	73	37.5	0.00	0.67	258
42.5	0.87	0.50	874.59	42.5	0.00	0.34	65	42.5	0.00	0.61	235
47.5	0.81	0.53	866.97	47.5	0.00	0.31	58	47.5	0.00	0.56	215
52.5	0.76	0.55	858.55	52.5	0.00	0.28	53	52.5	0.00	0.52	198
57.5	0.72	0.58	849.44	57.5	0.00	0.26	49	57.5	0.00	0.48	184
70	0.62	0.61	824.34	70	0.00	0.21	40	70	0.00	0.40	155

$\Delta\sigma$	% Surcharge
600	33.34
605	33.60
617	34.29
635	35.26
653	36.29
670	37.25
685	38.05
696	38.68
705	39.14
710	39.46
713	39.63
714	39.69
710	39.44





Schematics from Das

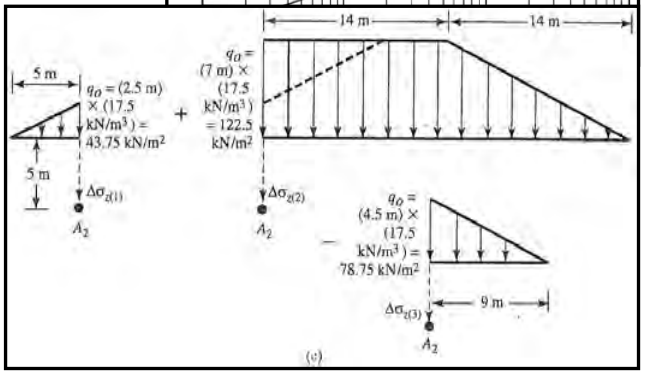


PLATE H-9

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: Wet Side Toe

Loaded	**Load, Q**	1,680	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **2.14** inches 0.15 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	**Depth (feet) top**	**bottom**	**center**	**Layer Height (feet)**	**γ (pcf)**	**σ'v (psf)**	**OCR**	**σ'p (psf)**	**Stress Distribution Δσ (psf)**	**Compress. Type E or C**	**E (ksf)**	**Cr 1+e0**	**Cc 1+e0**	**OCR Case**	**Strain ε (in/in)**	**Layer Settle (in)**	**Adjusted Layer Settle (in)**
Clay	0	5	2.5	5	120	300	3.5	1,050	10	C		0.025	0.2	1	0.000348	0.02	0.01
Clay	5	10	7.5	5	57.6	744	2	1,488	29	C		0.025	0.2	1	0.000411	0.02	0.02
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	48	C		0.025	0.2	1	0.000489	0.03	0.03
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	66	C		0.025	0.2	1	0.000532	0.03	0.03
Clay	20	25	22.5	5	57.6	1,608	1	1,608	85	C		0.025	0.25	3	0.005575	0.33	0.33
Clay	25	30	27.5	5	57.6	1,896	1	1,896	103	C		0.025	0.25	3	0.005732	0.34	0.34
Clay	30	35	32.5	5	57.6	2,184	1	2,184	120	C		0.025	0.25	3	0.005828	0.35	0.35
Clay	35	40	37.5	5	57.6	2,472	1	2,472	138	C		0.025	0.15	3	0.003529	0.21	0.21
Clay	40	45	42.5	5	57.6	2,760	1	2,760	154	C		0.025	0.15	3	0.003542	0.21	0.21
Clay	45	50	47.5	5	57.6	3,048	1	3,048	170	C		0.025	0.15	3	0.003541	0.21	0.21
Clay	50	55	52.5	5	57.6	3,336	1	3,336	186	C		0.025	0.12	3	0.002822	0.17	0.17
Clay	55	60	57.5	5	57.6	3,624	1	3,624	200	C		0.025	0.12	3	0.002804	0.17	0.17
Sand	60	80	70	20	57.6	4,344	1	4,344	234	E	1200	0.025	0.1	N/A	0.000195	0.05	0.05

TOTAL= **2.14** inches

PLATE H-10

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: 1/3 of Height - Wet Side - Slope I-I' of Area B

Loaded	**Load, Q**	1,800	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **12.26** inches 0.82 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	**Depth (feet) top**	**bottom**	**center**	**Layer Height (feet)**	**γ (pcf)**	**σ'v (psf)**	**OCR**	**σ'p (psf)**	**Stress Distribution Δσ (psf)**	**Compress. Type E or C**	**E (ksf)**	**Cr 1+e0**	**Cc 1+e0**	**OCR Case**	**Strain ε (in/in)**	**Layer Settle (in)**	**Adjusted Layer Settle (in)**
Clay	0	5	2.5	5	120	300	3.5	1,050	599	C		0.025	0.2	1	0.011915	0.71	0.50
Clay	5	10	7.5	5	57.6	744	2	1,488	597	C		0.025	0.2	1	0.006396	0.38	0.27
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	595	C		0.025	0.2	2	0.025711	1.54	1.54
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	595	C		0.025	0.2	2	0.018445	1.11	1.11
Clay	20	25	22.5	5	57.6	1,608	1	1,608	594	C		0.025	0.25	3	0.034155	2.05	2.05
Clay	25	30	27.5	5	57.6	1,896	1	1,896	595	C		0.025	0.25	3	0.029633	1.78	1.78
Clay	30	35	32.5	5	57.6	2,184	1	2,184	596	C		0.025	0.25	3	0.026202	1.57	1.57
Clay	35	40	37.5	5	57.6	2,472	1	2,472	598	C		0.025	0.15	3	0.014106	0.85	0.85
Clay	40	45	42.5	5	57.6	2,760	1	2,760	599	C		0.025	0.15	3	0.012803	0.77	0.77
Clay	45	50	47.5	5	57.6	3,048	1	3,048	601	C		0.025	0.15	3	0.011728	0.70	0.70
Clay	50	55	52.5	5	57.6	3,336	1	3,336	603	C		0.025	0.12	3	0.008658	0.52	0.52
Clay	55	60	57.5	5	57.6	3,624	1	3,624	604	C		0.025	0.12	3	0.008039	0.48	0.48
Sand	60	80	70	20	57.6	4,344	1	4,344	606	E	1200	0.025	0.1	N/A	0.000505	0.12	0.12

TOTAL= **12.26** inches

PLATE H-11

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: 2/3 of Height - Wet Side - Slope I-I' of Area B

Loaded	**Load, Q**	1,800	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **24.49** inches 1.63 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	Depth (feet) top	bottom	center	Layer Height (feet)	γ (pcf)	σ'_v (psf)	OCR	σ'_p (psf)	Stress Distribution Δσ (psf)	Compress. Type E or C	E (ksf)	Cr 1+e0	Cc 1+e0	OCR Case	Strain ε (in/in)	Layer Settle (in)	Adjusted Layer Settle (in)
Clay	0	5	2.5	5	120	300	3.5	1,050	1200	C		0.025	0.2	2	0.044581	2.67	1.87
Clay	5	10	7.5	5	57.6	744	2	1,488	1200	C		0.025	0.2	2	0.030727	1.84	1.29
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	1198	C		0.025	0.2	2	0.053078	3.18	3.18
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	1195	C		0.025	0.2	2	0.042148	2.53	2.53
Clay	20	25	22.5	5	57.6	1,608	1	1,608	1191	C		0.025	0.25	3	0.06016	3.61	3.61
Clay	25	30	27.5	5	57.6	1,896	1	1,896	1183	C		0.025	0.25	3	0.052659	3.16	3.16
Clay	30	35	32.5	5	57.6	2,184	1	2,184	1174	C		0.025	0.25	3	0.046713	2.80	2.80
Clay	35	40	37.5	5	57.6	2,472	1	2,472	1163	C		0.025	0.15	3	0.025112	1.51	1.51
Clay	40	45	42.5	5	57.6	2,760	1	2,760	1149	C		0.025	0.15	3	0.022674	1.36	1.36
Clay	45	50	47.5	5	57.6	3,048	1	3,048	1134	C		0.025	0.15	3	0.020598	1.24	1.24
Clay	50	55	52.5	5	57.6	3,336	1	3,336	1116	C		0.025	0.12	3	0.015045	0.90	0.90
Clay	55	60	57.5	5	57.6	3,624	1	3,624	1098	C		0.025	0.12	3	0.013792	0.83	0.83
Sand	60	80	70	20	57.6	4,344	1	4,344	1048	E	1200	0.025	0.1	N/A	0.000873	0.21	0.21

TOTAL= **24.49** inches

PLATE H-12

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: Wet Side Edge of Crest - Slope I-I' of Area B

Loaded	**Load, Q**	1,800	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **32.45** inches 2.16 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	Depth (feet) top	bottom	center	Layer Height (feet)	γ (pcf)	σ'_v (psf)	OCR	σ'_p (psf)	Stress Distribution Δσ (psf)	Compress. Type E or C	E (ksf)	Cr 1+e0	Cc 1+e0	OCR Case	Strain ε (in/in)	Layer Settle (in)	Adjusted Layer Settle (in)
Clay	0	5	2.5	5	120	300	3.5	1,050	1790	C		0.025	0.2	2	0.073396	4.40	3.08
Clay	5	10	7.5	5	57.6	744	2	1,488	1768	C		0.025	0.2	2	0.052995	3.18	2.23
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	1737	C		0.025	0.2	2	0.071882	4.31	4.31
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	1699	C		0.025	0.2	2	0.057996	3.48	3.48
Clay	20	25	22.5	5	57.6	1,608	1	1,608	1654	C		0.025	0.25	3	0.076794	4.61	4.61
Clay	25	30	27.5	5	57.6	1,896	1	1,896	1605	C		0.025	0.25	3	0.06658	3.99	3.99
Clay	30	35	32.5	5	57.6	2,184	1	2,184	1554	C		0.025	0.25	3	0.058333	3.50	3.50
Clay	35	40	37.5	5	57.6	2,472	1	2,472	1502	C		0.025	0.15	3	0.030923	1.86	1.86
Clay	40	45	42.5	5	57.6	2,760	1	2,760	1451	C		0.025	0.15	3	0.027514	1.65	1.65
Clay	45	50	47.5	5	57.6	3,048	1	3,048	1401	C		0.025	0.15	3	0.02463	1.48	1.48
Clay	50	55	52.5	5	57.6	3,336	1	3,336	1352	C		0.025	0.12	3	0.017733	1.06	1.06
Clay	55	60	57.5	5	57.6	3,624	1	3,624	1306	C		0.025	0.12	3	0.016035	0.96	0.96
Sand	60	80	70	20	57.6	4,344	1	4,344	1198	E	1200	0.025	0.1	N/A	0.000999	0.24	0.24

TOTAL= **32.45** inches

PLATE H-13

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: Center of Levee - Slope I-I' of Area B

Loaded	**Load, Q**	1,800	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **32.11** inches 2.14 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	**Depth (feet) top**	**bottom**	**center**	**Layer Height (feet)**	**γ (pcf)**	**σ'v (psf)**	**OCR**	**σ'p (psf)**	**Stress Distribution Δσ (psf)**	**Compress. Type E or C**	**E (ksf)**	**Cr 1+e0**	**Cc 1+e0**	**OCR Case**	**Strain ε (in/in)**	**Layer Settle (in)**	**Adjusted Layer Settle (in)**
Clay	0	5	2.5	5	120	300	3.5	1,050	1799	C		0.025	0.2	2	0.073763	4.43	3.10
Clay	5	10	7.5	5	57.6	744	2	1,488	1783	C		0.025	0.2	2	0.053522	3.21	2.25
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	1744	C		0.025	0.2	2	0.072095	4.33	4.33
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	1692	C		0.025	0.2	2	0.057792	3.47	3.47
Clay	20	25	22.5	5	57.6	1,608	1	1,608	1633	C		0.025	0.25	3	0.076113	4.57	4.57
Clay	25	30	27.5	5	57.6	1,896	1	1,896	1574	C		0.025	0.25	3	0.065608	3.94	3.94
Clay	30	35	32.5	5	57.6	2,184	1	2,184	1514	C		0.025	0.25	3	0.057189	3.43	3.43
Clay	35	40	37.5	5	57.6	2,472	1	2,472	1457	C		0.025	0.15	3	0.030186	1.81	1.81
Clay	40	45	42.5	5	57.6	2,760	1	2,760	1402	C		0.025	0.15	3	0.026764	1.61	1.61
Clay	45	50	47.5	5	57.6	3,048	1	3,048	1350	C		0.025	0.15	3	0.023892	1.43	1.43
Clay	50	55	52.5	5	57.6	3,336	1	3,336	1301	C		0.025	0.12	3	0.017165	1.03	1.03
Clay	55	60	57.5	5	57.6	3,624	1	3,624	1255	C		0.025	0.12	3	0.015498	0.93	0.93
Sand	60	80	70	20	57.6	4,344	1	4,344	1151	E	1200	0.025	0.1	N/A	0.000959	0.23	0.23

TOTAL= **32.11** inches

PLATE H-14

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: Dry Side Edge of Crest - Slope I-I' of Area B

Loaded	**Load, Q**	1,800	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **30.40** inches 2.03 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	Depth (feet) top	bottom	center	Layer Height (feet)	γ (pcf)	σ'_v (psf)	OCR	σ'_p (psf)	Stress Distribution Δσ (psf)	Compress. Type E or C	E (ksf)	Cr 1+e0	Cc 1+e0	OCR Case	Strain ε (in/in)	Layer Settle (in)	Adjusted Layer Settle (in)
Clay	0	5	2.5	5	120	300	3.5	1,050	1768	C		0.025	0.2	2	0.072471	4.35	3.04
Clay	5	10	7.5	5	57.6	744	2	1,488	1704	C		0.025	0.2	2	0.05077	3.05	2.13
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	1640	C		0.025	0.2	2	0.068766	4.13	4.13
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	1576	C		0.025	0.2	2	0.054381	3.26	3.26
Clay	20	25	22.5	5	57.6	1,608	1	1,608	1513	C		0.025	0.25	3	0.072015	4.32	4.32
Clay	25	30	27.5	5	57.6	1,896	1	1,896	1454	C		0.025	0.25	3	0.061786	3.71	3.71
Clay	30	35	32.5	5	57.6	2,184	1	2,184	1397	C		0.025	0.25	3	0.053682	3.22	3.22
Clay	35	40	37.5	5	57.6	2,472	1	2,472	1344	C		0.025	0.15	3	0.028276	1.70	1.70
Clay	40	45	42.5	5	57.6	2,760	1	2,760	1294	C		0.025	0.15	3	0.025041	1.50	1.50
Clay	45	50	47.5	5	57.6	3,048	1	3,048	1247	C		0.025	0.15	3	0.022344	1.34	1.34
Clay	50	55	52.5	5	57.6	3,336	1	3,336	1204	C		0.025	0.12	3	0.016056	0.96	0.96
Clay	55	60	57.5	5	57.6	3,624	1	3,624	1163	C		0.025	0.12	3	0.014506	0.87	0.87
Sand	60	80	70	20	57.6	4,344	1	4,344	1072	E	1200	0.025	0.1	N/A	0.000894	0.21	0.21

TOTAL= **30.40** inches

PLATE H-15

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: 2/3 of Height - Dry Side - Slope I-I' of Area B

Loaded	**Load, Q**	1,800	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **23.29** inches 1.55 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	**Depth (feet) top**	**bottom**	**center**	**Layer Height (feet)**	**γ (pcf)**	**σ'v (psf)**	**OCR**	**σ'p (psf)**	**Stress Distribution Δσ (psf)**	**Compress. Type E or C**	**E (ksf)**	**Cr 1+e0**	**Cc 1+e0**	**OCR Case**	**Strain ε (in/in)**	**Layer Settle (in)**	**Adjusted Layer Settle (in)**
Clay	0	5	2.5	5	120	300	3.5	1,050	1200	C		0.025	0.2	2	0.044569	2.67	1.87
Clay	5	10	7.5	5	57.6	744	2	1,488	1195	C		0.025	0.2	2	0.030501	1.83	1.28
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	1180	C		0.025	0.2	2	0.052367	3.14	3.14
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	1158	C		0.025	0.2	2	0.040859	2.45	2.45
Clay	20	25	22.5	5	57.6	1,608	1	1,608	1133	C		0.025	0.25	3	0.057896	3.47	3.47
Clay	25	30	27.5	5	57.6	1,896	1	1,896	1106	C		0.025	0.25	3	0.049892	2.99	2.99
Clay	30	35	32.5	5	57.6	2,184	1	2,184	1079	C		0.025	0.25	3	0.043601	2.62	2.62
Clay	35	40	37.5	5	57.6	2,472	1	2,472	1053	C		0.025	0.15	3	0.023123	1.39	1.39
Clay	40	45	42.5	5	57.6	2,760	1	2,760	1028	C		0.025	0.15	3	0.02063	1.24	1.24
Clay	45	50	47.5	5	57.6	3,048	1	3,048	1004	C		0.025	0.15	3	0.018552	1.11	1.11
Clay	50	55	52.5	5	57.6	3,336	1	3,336	981	C		0.025	0.12	3	0.013436	0.81	0.81
Clay	55	60	57.5	5	57.6	3,624	1	3,624	959	C		0.025	0.12	3	0.012234	0.73	0.73
Sand	60	80	70	20	57.6	4,344	1	4,344	907	E	1200	0.025	0.1	N/A	0.000756	0.18	0.18

TOTAL= **23.29** inches

PLATE H-16

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: 1/3 of Height - Dry Side - Slope I-I' of Area B

Loaded	**Load, Q**	1,800	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **13.56** inches 0.90 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	**Depth (feet) top**	**bottom**	**center**	**Layer Height (feet)**	**γ (pcf)**	**σ'v (psf)**	**OCR**	**σ'p (psf)**	**Stress Distribution Δσ (psf)**	**Compress. Type E or C**	**E (ksf)**	**Cr 1+e0**	**Cc 1+e0**	**OCR Case**	**Strain ε (in/in)**	**Layer Settle (in)**	**Adjusted Layer Settle (in)**
Clay	0	5	2.5	5	120	300	3.5	1,050	600	C		0.025	0.2	1	0.011931	0.72	0.50
Clay	5	10	7.5	5	57.6	744	2	1,488	605	C		0.025	0.2	1	0.00646	0.39	0.27
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	617	C		0.025	0.2	2	0.026863	1.61	1.61
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	635	C		0.025	0.2	2	0.020243	1.21	1.21
Clay	20	25	22.5	5	57.6	1,608	1	1,608	653	C		0.025	0.25	3	0.037017	2.22	2.22
Clay	25	30	27.5	5	57.6	1,896	1	1,896	670	C		0.025	0.25	3	0.032872	1.97	1.97
Clay	30	35	32.5	5	57.6	2,184	1	2,184	685	C		0.025	0.25	3	0.029615	1.78	1.78
Clay	35	40	37.5	5	57.6	2,472	1	2,472	696	C		0.025	0.15	3	0.016166	0.97	0.97
Clay	40	45	42.5	5	57.6	2,760	1	2,760	705	C		0.025	0.15	3	0.014812	0.89	0.89
Clay	45	50	47.5	5	57.6	3,048	1	3,048	710	C		0.025	0.15	3	0.013645	0.82	0.82
Clay	50	55	52.5	5	57.6	3,336	1	3,336	713	C		0.025	0.12	3	0.0101	0.61	0.61
Clay	55	60	57.5	5	57.6	3,624	1	3,624	714	C		0.025	0.12	3	0.009378	0.56	0.56
Sand	60	80	70	20	57.6	4,344	1	4,344	710	E	1200	0.025	0.1	N/A	0.000592	0.14	0.14

TOTAL= **13.56** inches

PLATE H-17

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: Dry Side Toe - Slope I-I' of Area B

Loaded	**Load, Q**	1,800	**psf**		(C)
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	(D)

TOTAL= **5.78** inches 0.39 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	**Depth (feet) top**	**bottom**	**center**	**Layer Height (feet)**	**γ (pcf)**	**σ'v (psf)**	**OCR**	**σ'p (psf)**	**Stress Distribution Δσ (psf)**	**Compress. Type E or C**	**E (ksf)**	**Cr 1+e0**	**Cc 1+e0**	**OCR Case**	**Strain ε (in/in)**	**Layer Settle (in)**	**Adjusted Layer Settle (in)**
Clay	0	5	2.5	5	120	300	3.5	1,050	32	C		0.025	0.2	1	0.001101	0.07	0.05
Clay	5	10	7.5	5	57.6	744	2	1,488	95	C		0.025	0.2	1	0.001299	0.08	0.05
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	155	C		0.025	0.2	1	0.001517	0.09	0.09
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	211	C		0.025	0.2	1	0.001611	0.10	0.10
Clay	20	25	22.5	5	57.6	1,608	1	1,608	263	C		0.025	0.25	3	0.016434	0.99	0.99
Clay	25	30	27.5	5	57.6	1,896	1	1,896	309	C		0.025	0.25	3	0.016403	0.98	0.98
Clay	30	35	32.5	5	57.6	2,184	1	2,184	350	C		0.025	0.25	3	0.016151	0.97	0.97
Clay	35	40	37.5	5	57.6	2,472	1	2,472	386	C		0.025	0.15	3	0.009456	0.57	0.57
Clay	40	45	42.5	5	57.6	2,760	1	2,760	417	C		0.025	0.15	3	0.009169	0.55	0.55
Clay	45	50	47.5	5	57.6	3,048	1	3,048	444	C		0.025	0.15	3	0.008852	0.53	0.53
Clay	50	55	52.5	5	57.6	3,336	1	3,336	466	C		0.025	0.12	3	0.006814	0.41	0.41
Clay	55	60	57.5	5	57.6	3,624	1	3,624	485	C		0.025	0.12	3	0.006543	0.39	0.39
Sand	60	80	70	20	57.6	4,344	1	4,344	518	E	1200	0.025	0.1	N/A	0.000432	0.10	0.10

TOTAL= **5.78** inches

PLATE H-18

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: Center of Levee - Slope A-A' of Area A

Loaded	**Load, Q**	1,200	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **19.12** inches 1.91 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	**Depth (feet) top**	**bottom**	**center**	**Layer Height (feet)**	**γ (pcf)**	**σ'v (psf)**	**OCR**	**σ'p (psf)**	**Stress Distribution Δσ (psf)**	**Compress. Type E or C**	**E (ksf)**	**Cr 1+e0**	**Cc 1+e0**	**OCR Case**	**Strain ε (in/in)**	**Layer Settle (in)**	**Adjusted Layer Settle (in)**
Clay	0	5	2.5	5	120	300	4	1,200	1199	C		0.025	0.15	2	0.029558	1.77	1.24
Clay	5	10	7.5	5	57.6	744	2.5	1,860	1189	C		0.025	0.15	2	0.012467	0.75	0.52
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	1165	C		0.025	0.15	2	0.039323	2.36	2.36
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	1132	C		0.025	0.15	2	0.030435	1.83	1.83
Clay	20	25	22.5	5	57.6	1,608	1	1,608	1094	C		0.025	0.22	3	0.049588	2.98	2.98
Clay	25	30	27.5	5	57.6	1,896	1	1,896	1055	C		0.025	0.22	3	0.042259	2.54	2.54
Clay	30	35	32.5	5	57.6	2,184	1	2,184	1015	C		0.025	0.22	3	0.036473	2.19	2.19
Clay	35	40	37.5	5	57.6	2,472	1	2,472	976	C		0.025	0.22	3	0.0318	1.91	1.91
Clay	40	45	42.5	5	57.6	2,760	1	2,760	938	C		0.025	0.15	3	0.019065	1.14	1.14
Clay	45	50	47.5	5	57.6	3,048	1	3,048	902	C		0.025	0.15	3	0.016886	1.01	1.01
Clay	50	55	52.5	5	57.6	3,336	1	3,336	867	C		0.025	0.11	3	0.011036	0.66	0.66
Clay	55	60	57.5	5	57.6	3,624	1	3,624	834	C		0.025	0.11	3	0.009891	0.59	0.59
sand	60	80	70	20	57.6	4,344	1	4,344	757	E	1200	0.025	0.11	N/A	0.000631	0.15	0.15
																TOTAL=	**19.12** inches

PLATE H-19

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: Center of Levee - Slope B-B' of Area A

Loaded	**Load, Q**	1,200	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **21.43** inches 2.14 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	**Depth (feet) top**	**bottom**	**center**	**Layer Height (feet)**	**γ (pcf)**	**σ'v (psf)**	**OCR**	**σ'p (psf)**	**Stress Distribution Δσ (psf)**	**Compress. Type E or C**	**E (ksf)**	**Cr 1+e0**	**Cc 1+e0**	**OCR Case**	**Strain ε (in/in)**	**Layer Settle (in)**	**Adjusted Layer Settle (in)**
Clay	0	5	2.5	5	120	300	4	1,200	1200	C		0.025	0.15	2	0.029571	1.77	1.24
Clay	5	10	7.5	5	57.6	744	2.5	1,860	1200	C		0.025	0.15	2	0.012818	0.77	0.54
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	1199	C		0.025	0.15	2	0.040338	2.42	2.42
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	1199	C		0.025	0.15	2	0.032191	1.93	1.93
Clay	20	25	22.5	5	57.6	1,608	1	1,608	1197	C		0.025	0.22	3	0.053168	3.19	3.19
Clay	25	30	27.5	5	57.6	1,896	1	1,896	1195	C		0.025	0.22	3	0.046697	2.80	2.80
Clay	30	35	32.5	5	57.6	2,184	1	2,184	1192	C		0.025	0.22	3	0.041612	2.50	2.50
Clay	35	40	37.5	5	57.6	2,472	1	2,472	1188	C		0.025	0.22	3	0.037496	2.25	2.25
Clay	40	45	42.5	5	57.6	2,760	1	2,760	1183	C		0.025	0.15	3	0.02324	1.39	1.39
Clay	45	50	47.5	5	57.6	3,048	1	3,048	1177	C		0.025	0.15	3	0.021275	1.28	1.28
Clay	50	55	52.5	5	57.6	3,336	1	3,336	1170	C		0.025	0.11	3	0.014366	0.86	0.86
Clay	55	60	57.5	5	57.6	3,624	1	3,624	1163	C		0.025	0.11	3	0.013292	0.80	0.80
Sand	60	80	70	20	57.6	4,344	1	4,344	1139	E	1200	0.025	0.11	N/A	0.000949	0.23	0.23

TOTAL= **21.43** inches

PLATE H-20

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: Center of Levee - Slope C-C' of Area A

Loaded	**Load, Q**	600	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **9.93** inches 1.99 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	**Depth (feet) top**	**bottom**	**center**	**Layer Height (feet)**	**γ (pcf)**	**σ'v (psf)**	**OCR**	**σ'p (psf)**	**Stress Distribution Δσ (psf)**	**Compress. Type E or C**	**E (ksf)**	**Cr 1+e0**	**Cc 1+e0**	**OCR Case**	**Strain ε (in/in)**	**Layer Settle (in)**	**Adjusted Layer Settle (in)**
Clay	0	5	2.5	5	120	300	4	1,200	600	C		0.025	0.15	1	0.011924	0.72	0.50
Clay	5	10	7.5	5	57.6	744	2.5	1,860	595	C		0.025	0.15	1	0.006377	0.38	0.27
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	582	C		0.025	0.15	2	0.019255	1.16	1.16
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	566	C		0.025	0.15	2	0.013341	0.80	0.80
Clay	20	25	22.5	5	57.6	1,608	1	1,608	547	C		0.025	0.22	3	0.027976	1.68	1.68
Clay	25	30	27.5	5	57.6	1,896	1	1,896	527	C		0.025	0.22	3	0.023447	1.41	1.41
Clay	30	35	32.5	5	57.6	2,184	1	2,184	508	C		0.025	0.22	3	0.019966	1.20	1.20
Clay	35	40	37.5	5	57.6	2,472	1	2,472	488	C		0.025	0.22	3	0.017217	1.03	1.03
Clay	40	45	42.5	5	57.6	2,760	1	2,760	469	C		0.025	0.15	3	0.010228	0.61	0.61
Clay	45	50	47.5	5	57.6	3,048	1	3,048	451	C		0.025	0.15	3	0.008988	0.54	0.54
Clay	50	55	52.5	5	57.6	3,336	1	3,336	433	C		0.025	0.11	3	0.005836	0.35	0.35
Clay	55	60	57.5	5	57.6	3,624	1	3,624	417	C		0.025	0.11	3	0.005201	0.31	0.31
Sand	60	80	70	20	57.6	4,344	1	4,344	379	E	1200	0.025	0.11	N/A	0.000316	0.08	0.08
																TOTAL=	**9.93** inches

PLATE H-21

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: Center of Levee - Slope F-F'

Loaded	**Load, Q**	1,680	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **33.44** inches 2.39 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	**Depth (feet) top**	**bottom**	**center**	**Layer Height (feet)**	**γ (pcf)**	**σ'v (psf)**	**OCR**	**σ'p (psf)**	**Stress Distribution Δσ (psf)**	**Compress. Type E or C**	**E (ksf)**	**Cr 1+e0**	**Cc 1+e0**	**OCR Case**	**Strain ε (in/in)**	**Layer Settle (in)**	**Adjusted Layer Settle (in)**
Clay	0	5	2.5	5	120	300	3.5	1,050	1679	C		0.025	0.2	2	0.068659	4.12	2.88
Clay	5	10	7.5	5	57.6	744	2	1,488	1680	C		0.025	0.2	2	0.049899	2.99	2.10
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	1679	C		0.025	0.2	2	0.070048	4.20	4.20
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	1679	C		0.025	0.2	2	0.057421	3.45	3.45
Clay	20	25	22.5	5	57.6	1,608	1	1,608	1678	C		0.025	0.25	3	0.077591	4.66	4.66
Clay	25	30	27.5	5	57.6	1,896	1	1,896	1676	C		0.025	0.25	3	0.068777	4.13	4.13
Clay	30	35	32.5	5	57.6	2,184	1	2,184	1674	C		0.025	0.25	3	0.061778	3.71	3.71
Clay	35	40	37.5	5	57.6	2,472	1	2,472	1671	C		0.025	0.15	3	0.03364	2.02	2.02
Clay	40	45	42.5	5	57.6	2,760	1	2,760	1667	C		0.025	0.15	3	0.030783	1.85	1.85
Clay	45	50	47.5	5	57.6	3,048	1	3,048	1663	C		0.025	0.15	3	0.028359	1.70	1.70
Clay	50	55	52.5	5	57.6	3,336	1	3,336	1657	C		0.025	0.12	3	0.021017	1.26	1.26
Clay	55	60	57.5	5	57.6	3,624	1	3,624	1651	C		0.025	0.12	3	0.01956	1.17	1.17
Sand	60	80	70	20	57.6	4,344	1	4,344	1631	E	1200	0.025	0.1	N/A	0.001359	0.33	0.33

TOTAL= **33.44** inches

PLATE H-22

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: Center of Levee - Slope H-H' of Area B

Loaded	**Load, Q**	1,680	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **32.91** inches 2.35 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	**Depth (feet) top**	**bottom**	**center**	**Layer Height (feet)**	**γ (pcf)**	**σ'v (psf)**	**OCR**	**σ'p (psf)**	**Stress Distribution Δσ (psf)**	**Compress. Type E or C**	**E (ksf)**	**Cr 1+e0**	**Cc 1+e0**	**OCR Case**	**Strain ε (in/in)**	**Layer Settle (in)**	**Adjusted Layer Settle (in)**
Clay	0	5	2.5	5	120	300	3.5	1,050	1680	C		0.025	0.2	2	0.068675	4.12	2.88
Clay	5	10	7.5	5	57.6	744	2	1,488	1679	C		0.025	0.2	2	0.049881	2.99	2.10
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	1677	C		0.025	0.2	2	0.069962	4.20	4.20
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	1672	C		0.025	0.2	2	0.057213	3.43	3.43
Clay	20	25	22.5	5	57.6	1,608	1	1,608	1663	C		0.025	0.25	3	0.077112	4.63	4.63
Clay	25	30	27.5	5	57.6	1,896	1	1,896	1652	C		0.025	0.25	3	0.068023	4.08	4.08
Clay	30	35	32.5	5	57.6	2,184	1	2,184	1636	C		0.025	0.25	3	0.06071	3.64	3.64
Clay	35	40	37.5	5	57.6	2,472	1	2,472	1618	C		0.025	0.15	3	0.032797	1.97	1.97
Clay	40	45	42.5	5	57.6	2,760	1	2,760	1596	C		0.025	0.15	3	0.029733	1.78	1.78
Clay	45	50	47.5	5	57.6	3,048	1	3,048	1573	C		0.025	0.15	3	0.027104	1.63	1.63
Clay	50	55	52.5	5	57.6	3,336	1	3,336	1547	C		0.025	0.12	3	0.019856	1.19	1.19
Clay	55	60	57.5	5	57.6	3,624	1	3,624	1520	C		0.025	0.12	3	0.018254	1.10	1.10
Sand	60	80	70	20	57.6	4,344	1	4,344	1449	E	1200	0.025	0.1	N/A	0.001207	0.29	0.29

TOTAL= **32.91** inches

PLATE H-23

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: Center of Surchage Area B

Loaded	**Load, Q**	3,000	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

TOTAL= **51.83** inches 2.07 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	Depth (feet) top	bottom	center	Layer Height (feet)	γ (pcf)	σ'_v (psf)	OCR	σ'_p (psf)	Stress Distribution Δσ (psf)	Compress. Type E or C	E (ksf)	Cr 1+e0	Cc 1+e0	OCR Case	Strain ε (in/in)	Layer Settle (in)	Adjusted Layer Settle (in)
Clay	0	5	2.5	5	120	300	3.5	1,050	2999	C		0.025	0.2	2	0.113051	6.78	4.75
Clay	5	10	7.5	5	57.6	744	2	1,488	3000	C		0.025	0.2	2	0.087667	5.26	3.68
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	3000	C		0.025	0.2	2	0.104505	6.27	6.27
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	2999	C		0.025	0.2	2	0.089113	5.35	5.35
Clay	20	25	22.5	5	57.6	1,608	1	1,608	2999	C		0.025	0.25	3	0.114279	6.86	6.86
Clay	25	30	27.5	5	57.6	1,896	1	1,896	2998	C		0.025	0.25	3	0.102956	6.18	6.18
Clay	30	35	32.5	5	57.6	2,184	1	2,184	2997	C		0.025	0.25	3	0.093784	5.63	5.63
Clay	35	40	37.5	5	57.6	2,472	1	2,472	2995	C		0.025	0.15	3	0.051706	3.10	3.10
Clay	40	45	42.5	5	57.6	2,760	1	2,760	2993	C		0.025	0.15	3	0.047846	2.87	2.87
Clay	45	50	47.5	5	57.6	3,048	1	3,048	2990	C		0.025	0.15	3	0.044534	2.67	2.67
Clay	50	55	52.5	5	57.6	3,336	1	3,336	2987	C		0.025	0.12	3	0.033323	2.00	2.00
Clay	55	60	57.5	5	57.6	3,624	1	3,624	2983	C		0.025	0.12	3	0.031299	1.88	1.88
Sand	60	80	70	20	57.6	4,344	1	4,344	2971	E	1200	0.025	0.1	N/A	0.002476	0.59	0.59

TOTAL= **51.83** inches

PLATE H-24

PROJECT NAME: Ballona Wetlands Restoration Project **PROJECT NUMBER:** LA-962A

PROBLEM DESCRIPTION: Center of Levee - Area C Surcharge

Loaded	**Load, Q**	3,600	**psf**		**(C)**
Area	**Depth, D**	0	**ft**	**must be at a layer boundary**	**(D)**

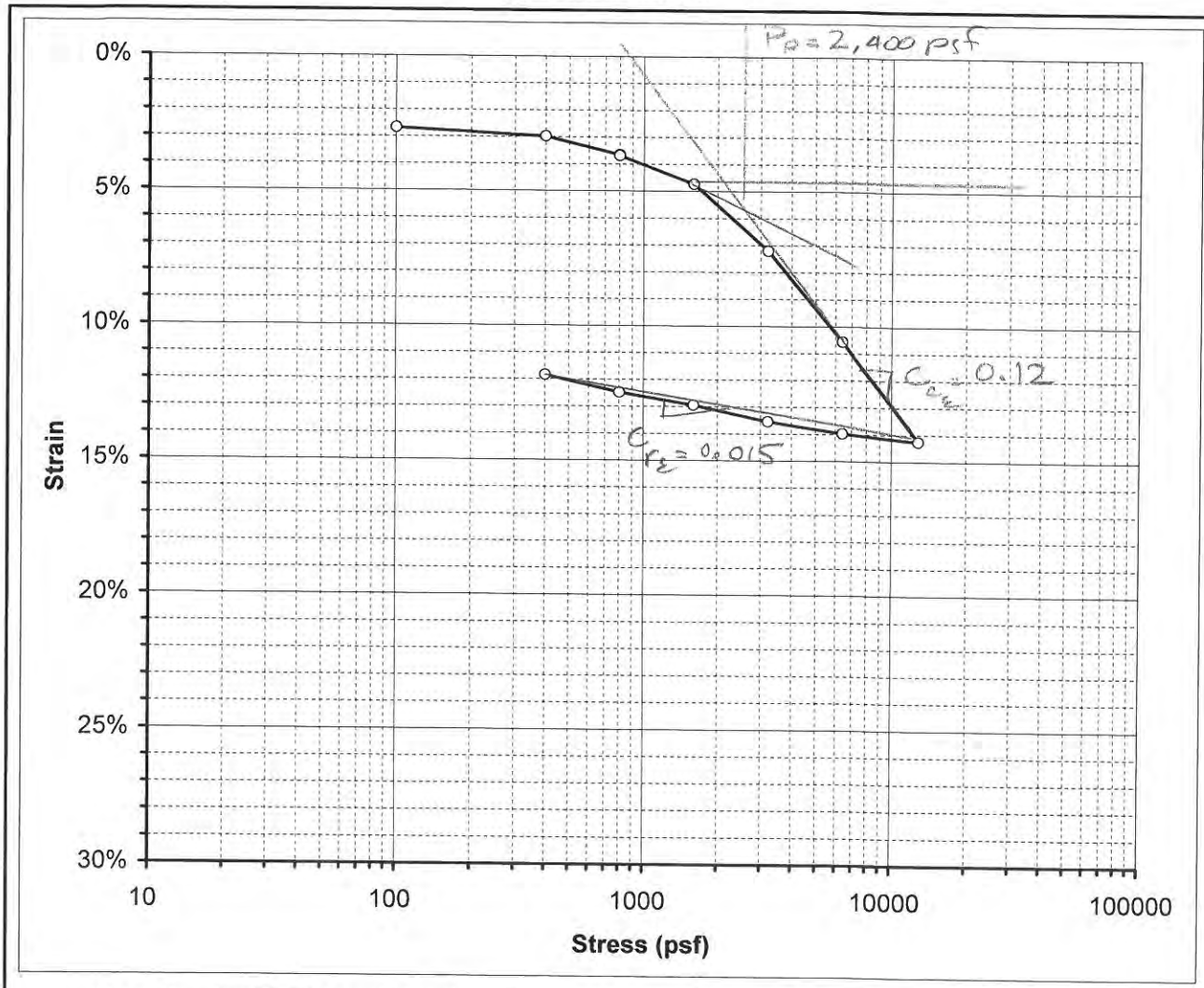
TOTAL= **31.63** inches 1.05 inch per foot

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Soil Layer	**Depth (feet) top**	**bottom**	**center**	**Layer Height (feet)**	**γ (pcf)**	**σ'v (psf)**	**OCR**	**σ'p (psf)**	**Stress Distribution Δσ (psf)**	**Compress. Type E or C**	**E (ksf)**	**Cr 1+e0**	**Cc 1+e0**	**OCR Case**	**Strain ε (in/in)**	**Layer Settle (in)**	**Adjusted Layer Settle (in)**
Clay	0	5	2.5	5	120	300	4	1,200	3599	C		0.025	0.075	2	0.053437	3.21	2.24
Clay	5	10	7.5	5	57.6	744	2.5	1,860	3600	C		0.025	0.075	2	0.037575	2.25	1.58
Clay	10	15	12.5	5	57.6	1,032	1.2	1,238	3600	C		0.025	0.075	2	0.044945	2.70	2.70
Clay	15	20	17.5	5	57.6	1,320	1.2	1,584	3599	C		0.025	0.075	2	0.03889	2.33	2.33
Clay	20	25	22.5	5	57.6	1,608	1	1,608	3599	C		0.025	0.125	3	0.063784	3.83	3.83
Clay	25	30	27.5	5	57.6	1,896	1	1,896	3598	C		0.025	0.125	3	0.057752	3.47	3.47
Clay	30	35	32.5	5	57.6	2,184	1	2,184	3596	C		0.025	0.125	3	0.052835	3.17	3.17
Clay	35	40	37.5	5	57.6	2,472	1	2,472	3594	C		0.025	0.125	3	0.048732	2.92	2.92
Clay	40	45	42.5	5	57.6	2,760	1	2,760	3591	C		0.025	0.11	3	0.039816	2.39	2.39
Clay	45	50	47.5	5	57.6	3,048	1	3,048	3588	C		0.025	0.11	3	0.03717	2.23	2.23
Clay	50	55	52.5	5	57.6	3,336	1	3,336	3584	C		0.025	0.11	3	0.034859	2.09	2.09
Clay	55	60	57.5	5	57.6	3,624	1	3,624	3580	C		0.025	0.11	3	0.032821	1.97	1.97
sand	60	80	70	20	57.6	4,344	1	4,344	3565	E	1200	0.025	0.11	N/A	0.002971	0.71	0.71

TOTAL= **31.63** inches

PLATE H-25

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-HSA051	Sample Depth	10 ft
Sample No.	R5	USCS	0

BEFORE TEST

Initial Moisture Content:	43.6%	
Initial Dry Unit Wt:	77.5	pcf
Initial Total Unit Wt.:	111.3	pcf
Initial Void Ratio:	1.2466	
Initial Degree of Saturation:	97.5%	

AFTER TEST

Final Moisture Content:	36.8%	
Final Dry Unit Wt:	86.3	pcf
Final Total Unit Wt.:	114.5	pcf
Final Void Ratio:	1.0165	
Final Degree of Saturation:	100.9%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	2.69%	1.1861
400	2.99%	1.1793
800	3.67%	1.1642
800	3.70%	1.1635
1600	4.74%	1.1401
3200	7.22%	1.0845
6400	10.57%	1.0091
12800	14.27%	0.9260
6400	13.98%	0.9326
3200	13.55%	0.9423
1600	12.95%	0.9556
800	12.48%	0.9662
400	11.85%	0.9804

$\sigma_v' = 5 \times 120 + 5 \times 57.6 = 888$

$OCR = \frac{2400}{888} = 2.7$

PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA CONSULTANTS

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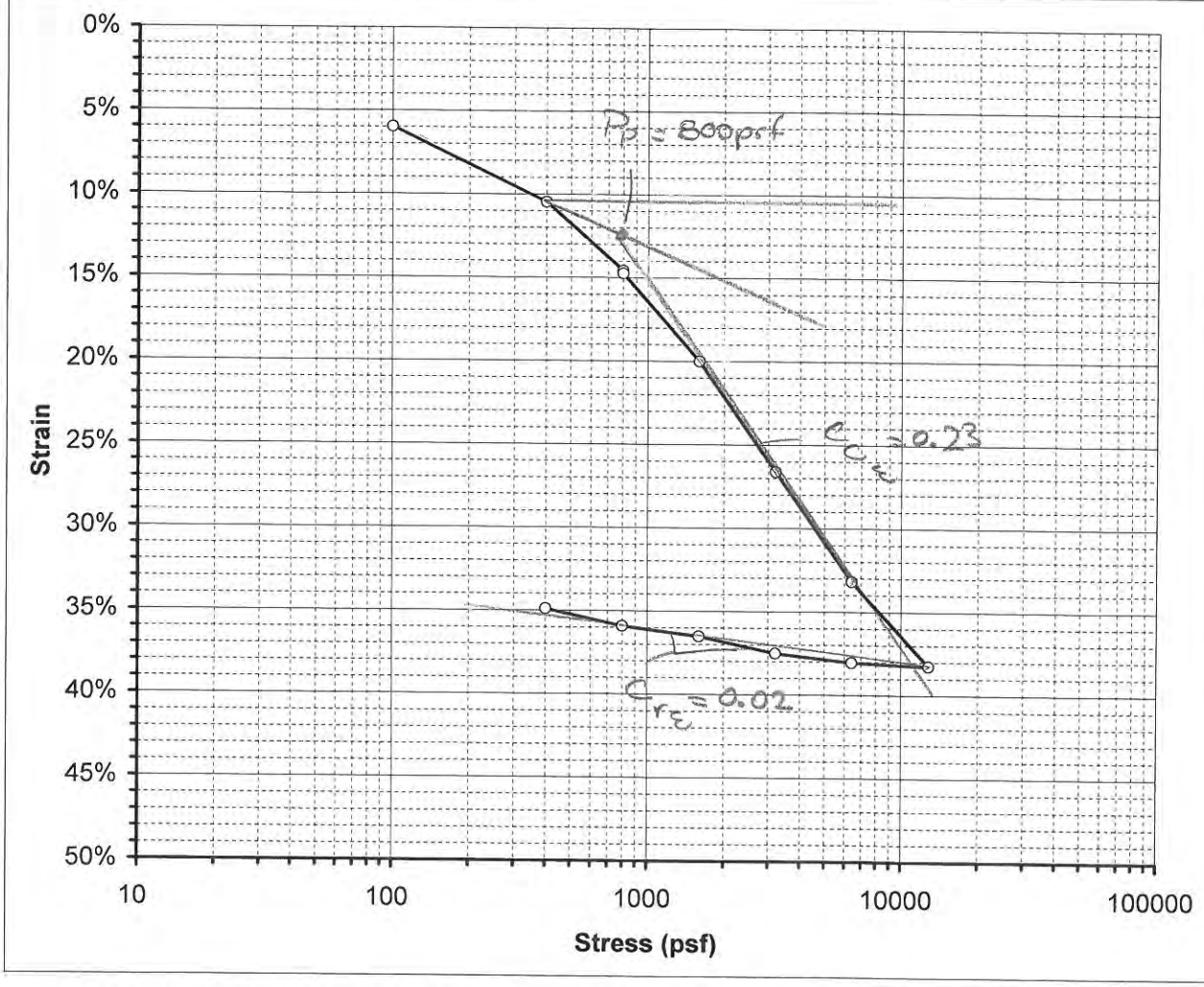
CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW030	Sample Depth	10
Sample No.	R3	USCS	0

BEFORE TEST

Initial Moisture Content:	107.6%	
Initial Dry Unit Wt:	43.5	pcf
Initial Total Unit Wt.:	90.3	pcf
Initial Void Ratio:	3.0033	
Initial Degree of Saturation:	100.0%	

AFTER TEST

Final Moisture Content:	61.0%	
Final Dry Unit Wt:	64.6	pcf
Final Total Unit Wt.:	152.6	pcf
Final Void Ratio:	1.6946	
Final Degree of Saturation:	100.5%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

$\sigma_v' = 5 \times 120 + 5 \times 57.6 = 888$ psf

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	5.99%	2.7633
400	10.49%	2.5833
800	14.58%	2.4197
800	14.75%	2.4128
1600	20.01%	2.2022
3200	26.63%	1.9373
6400	33.19%	1.6745
12800	38.26%	1.4715
6400	38.06%	1.4795
3200	37.51%	1.5016
1600	36.53%	1.5410
800	35.92%	1.5652
400	34.92%	1.6053

PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

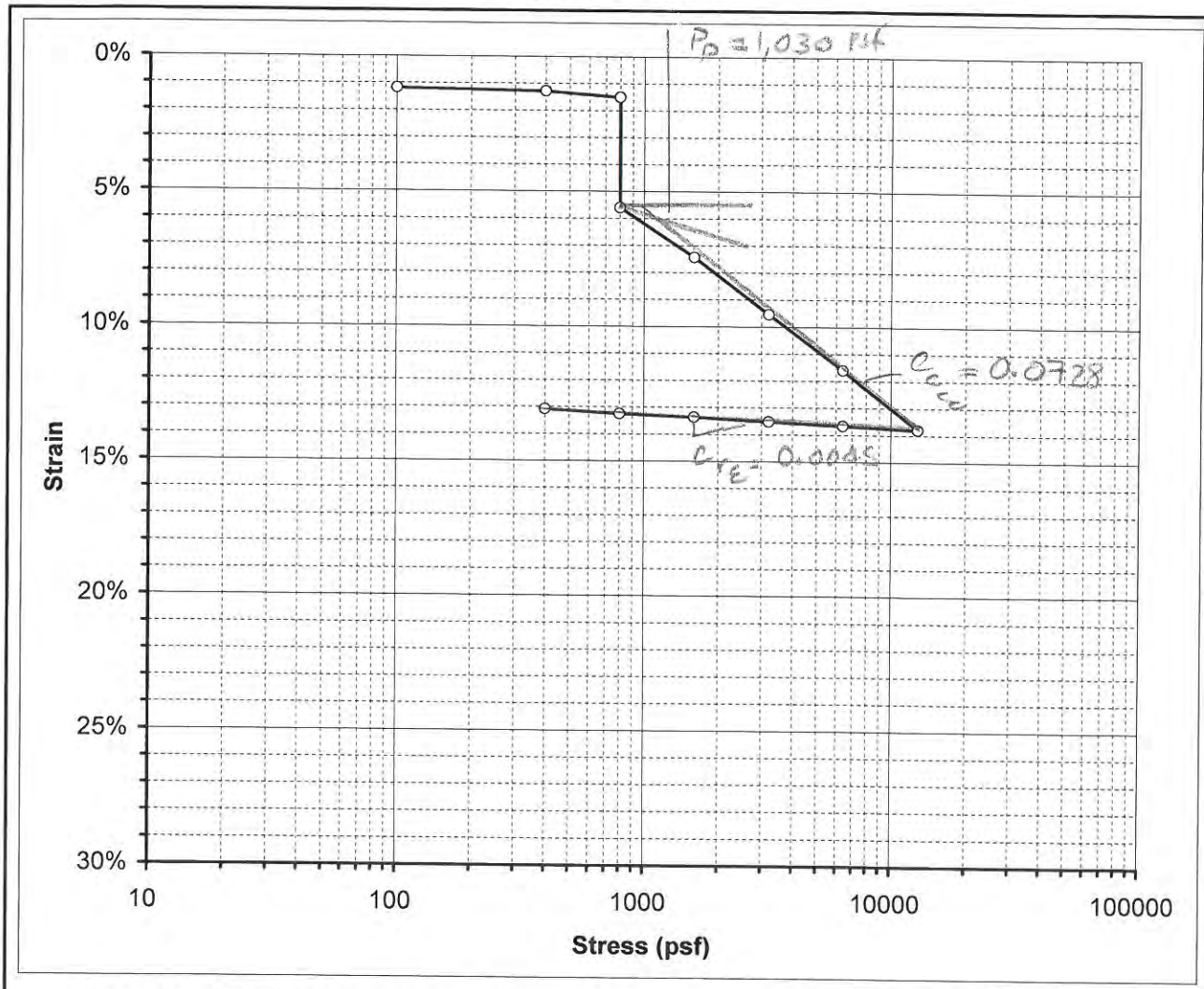
$OCR = \frac{800}{888} \sim 1.0$

FIGURE NO. B-3

GROUP DELTA CONSULTANTS

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 11-9-12\B-RW030 R3@10'_1.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	C-HSA061	Sample Depth	7.5 ft
Sample No.	R3	USCS	0

BEFORE TEST

Initial Moisture Content:	7.2%	
Initial Dry Unit Wt:	88.6	pcf
Initial Total Unit Wt.:	94.9	pcf
Initial Void Ratio:	0.9655	
Initial Degree of Saturation:	20.8%	

AFTER TEST

Final Moisture Content:	20.7%	
Final Dry Unit Wt:	101.4	pcf
Final Total Unit Wt.:	117.1	pcf
Final Void Ratio:	0.7167	
Final Degree of Saturation:	80.7%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.20%	0.9419
400	1.30%	0.9400
800	1.52%	0.9356
800	5.62%	0.8551
1600	7.45%	0.8191
3200	9.55%	0.7778
6400	11.61%	0.7373
12800	13.80%	0.6943
6400	13.67%	0.6968
3200	13.53%	0.6996
1600	13.37%	0.7027
800	13.26%	0.7049
400	13.09%	0.7082

$\sigma_v' = 120 \times 7.5 = 900$ psf OCR = $\frac{1,030}{900} = 1.15$

PROJECT NUMBER: LA-962A

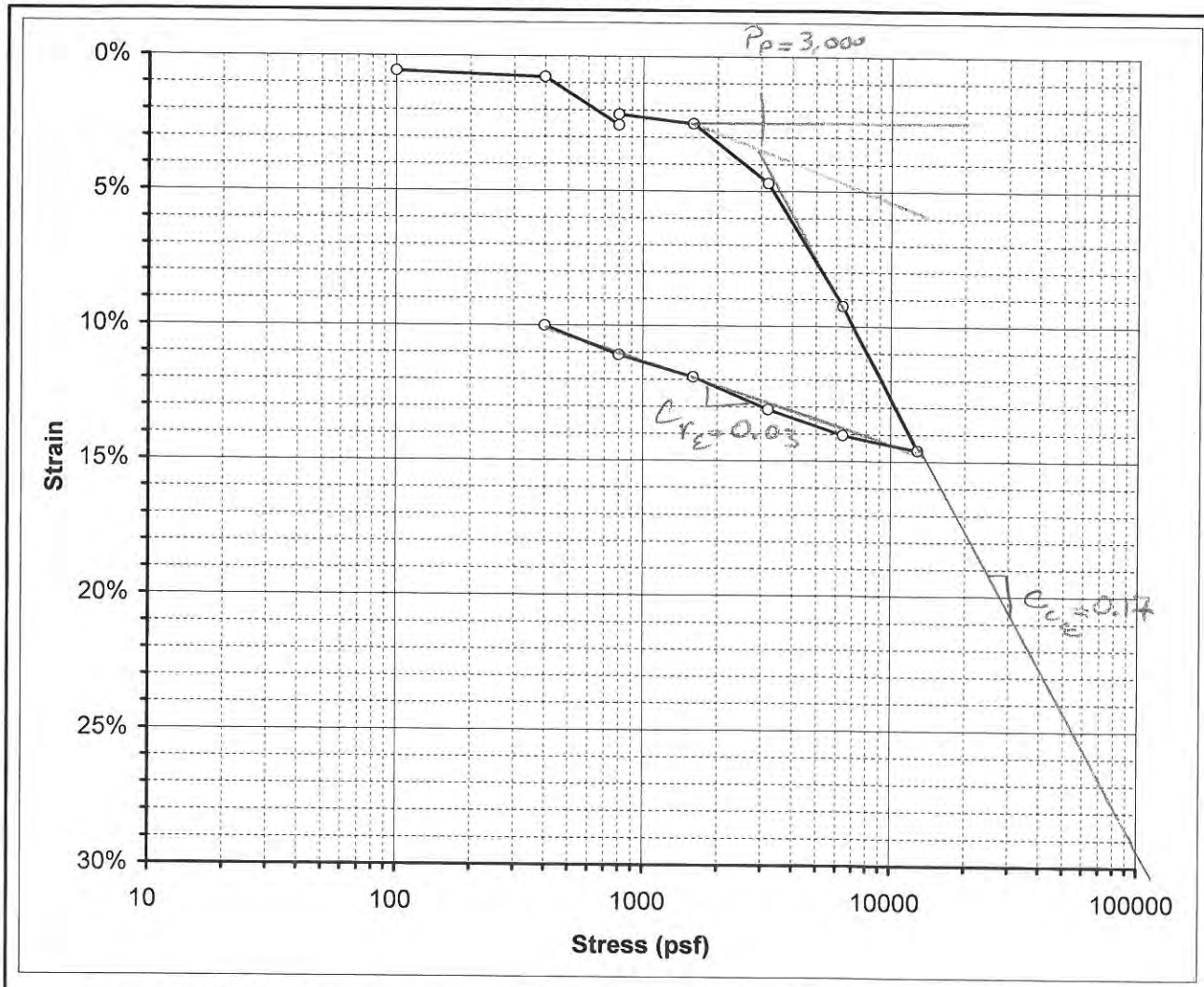
PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA CONSULTANTS

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 11-9-12\C-HSA061 R3@7.5'_4.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-HSA051	Sample Depth	5 ft
Sample No.	R3	USCS	0

BEFORE TEST

Initial Moisture Content:	45.1%	
Initial Dry Unit Wt:	75.7	pcf
Initial Total Unit Wt.:	109.9	pcf
Initial Void Ratio:	1.2998	
Initial Degree of Saturation:	96.9%	

AFTER TEST

Final Moisture Content:	40.9%	
Final Dry Unit Wt:	82.5	pcf
Final Total Unit Wt.:	111.6	pcf
Final Void Ratio:	1.1111	
Final Degree of Saturation:	102.6%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	0.57%	1.2867
400	0.78%	1.2819
800	2.58%	1.2406
800	2.17%	1.2498
1600	2.51%	1.2422
3200	4.71%	1.1915
6400	9.26%	1.0869
12800	14.60%	0.9641
6400	14.05%	0.9768
3200	13.11%	0.9984
1600	11.90%	1.0261
800	11.10%	1.0445
400	10.03%	1.0692

$\sigma_v' = 5 \times 120 = 600$ psf $OCR = \frac{3000}{600} \approx 5.0$

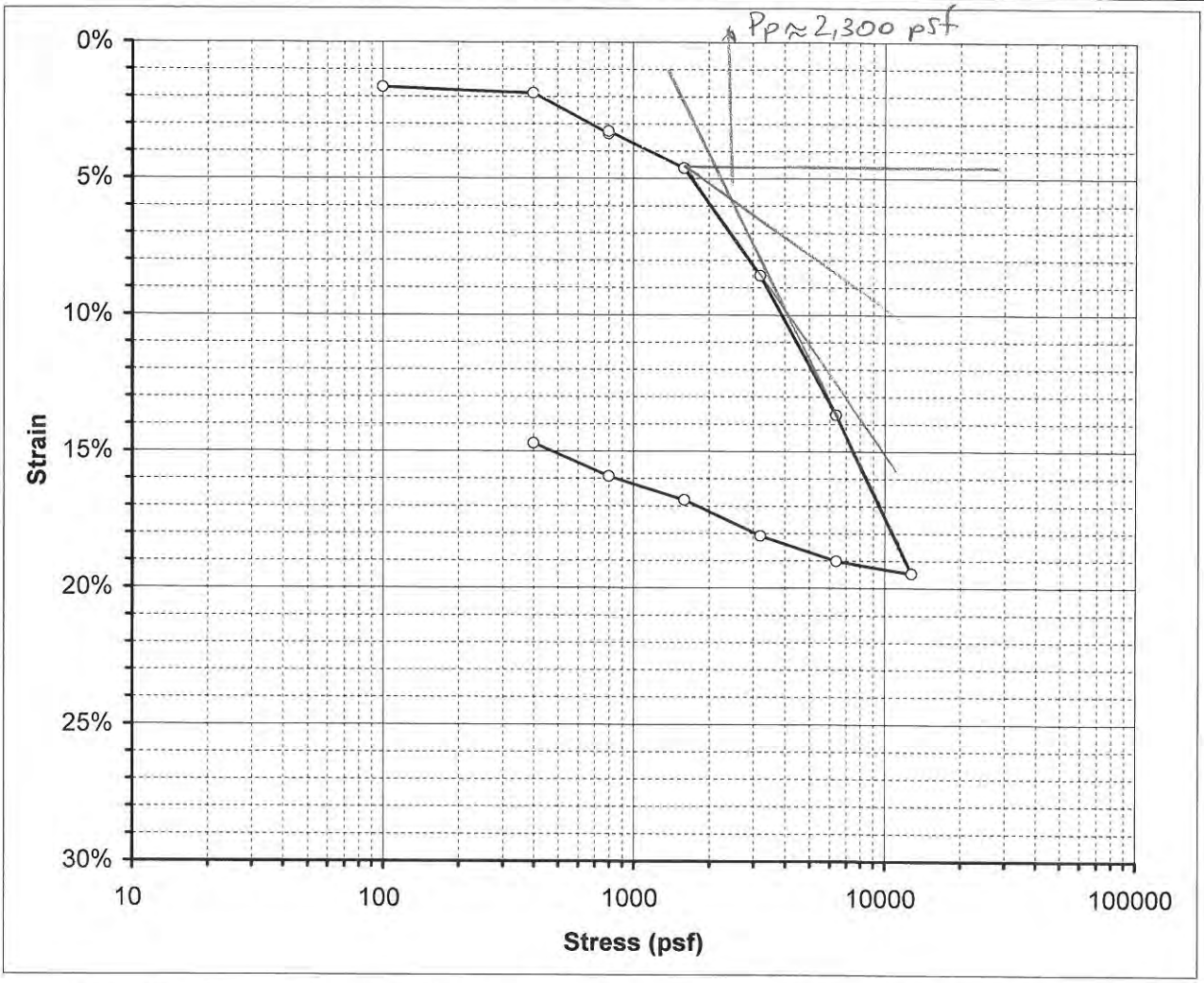
PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA CONSULTANTS

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW032	Sample Depth	10
Sample No.	R3A	USCS	CH

BEFORE TEST

Initial Moisture Content:	53.5%	
Initial Dry Unit Wt:	69.4	pcf
Initial Total Unit Wt.:	106.6	pcf
Initial Void Ratio:	1.5080	
Initial Degree of Saturation:	99.1%	

AFTER TEST

Final Moisture Content:	44.0%	
Final Dry Unit Wt:	79.8	pcf
Final Total Unit Wt.:	118.1	pcf
Final Void Ratio:	1.1817	
Final Degree of Saturation:	103.9%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=	71	PL=	28	PI=	43

$\sigma_v' \approx 1{,}200$ psf OCR ~ 2.0

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.65%	1.4667
400	1.87%	1.4612
800	3.35%	1.4239
800	3.26%	1.4262
1600	4.62%	1.3922
3200	8.55%	1.2935
6400	13.65%	1.1656
12800	19.47%	1.0198
6400	19.01%	1.0314
3200	18.09%	1.0543
1600	16.79%	1.0870
800	15.92%	1.1087
400	14.71%	1.1391

PROJECT NUMBER: LA-962A

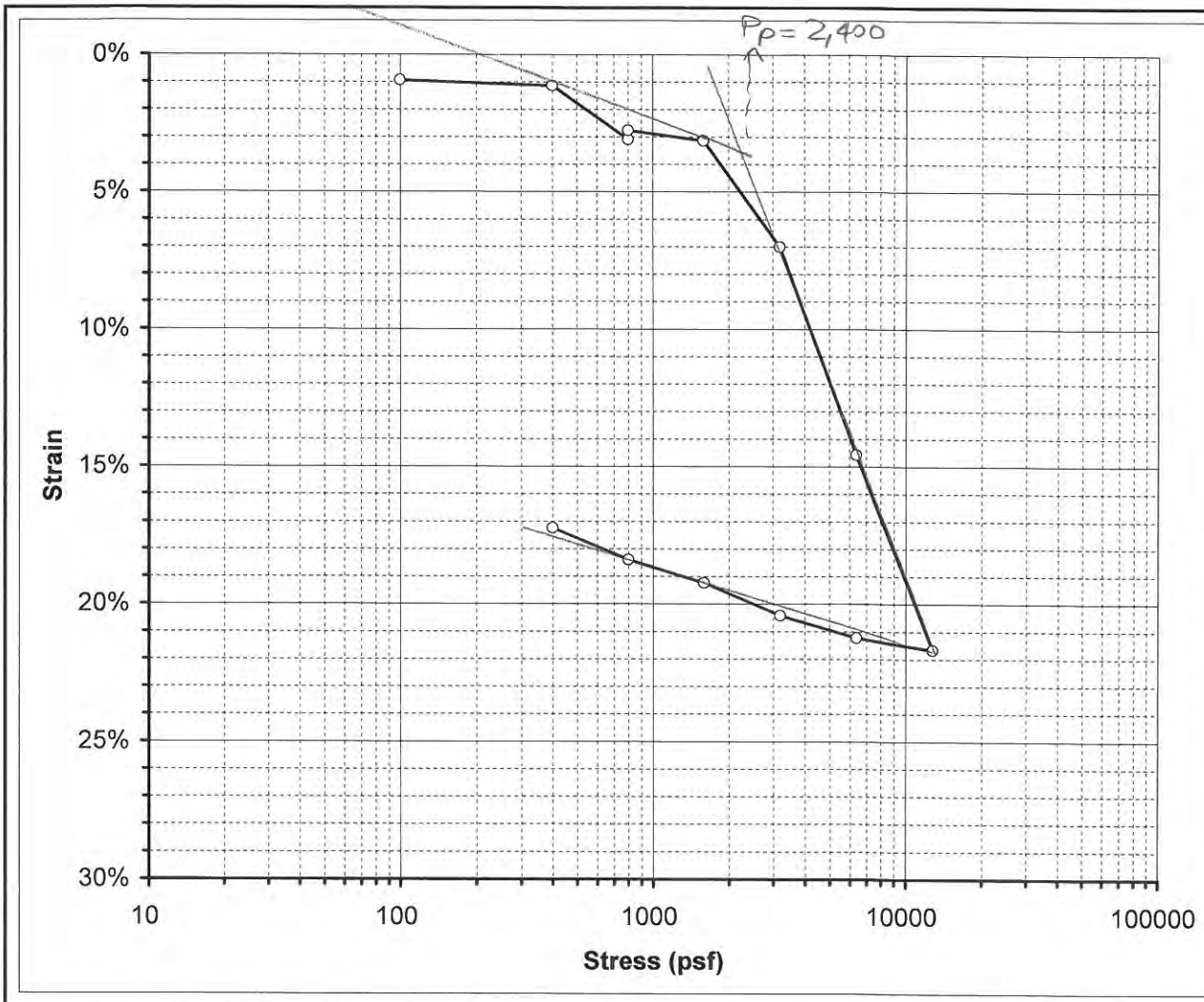
PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA CONSULTANTS

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 9-21-12\Consol B-RW032R3A@10'_2.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW036	Sample Depth	30
Sample No.	R6A	USCS	MH

BEFORE TEST

Initial Moisture Content:	58.8%	
Initial Dry Unit Wt:	64.8	pcf
Initial Total Unit Wt.:	102.9	pcf
Initial Void Ratio:	1.6871	
Initial Degree of Saturation:	97.3%	

AFTER TEST

Final Moisture Content:	46.7%	
Final Dry Unit Wt:	76.3	pcf
Final Total Unit Wt.:	121.1	pcf
Final Void Ratio:	1.2809	
Final Degree of Saturation:	101.6%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

$\sigma_v' \approx 2,400$ OCR ~ 1

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	0.93%	1.6619
400	1.13%	1.6568
800	3.10%	1.6039
800	2.75%	1.6131
1600	3.14%	1.6028
3200	7.01%	1.4988
6400	14.56%	1.2958
12800	21.67%	1.1048
6400	21.23%	1.1167
3200	20.41%	1.1386
1600	19.24%	1.1702
800	18.39%	1.1929
400	17.24%	1.2239

PROJECT NUMBER: LA-962A

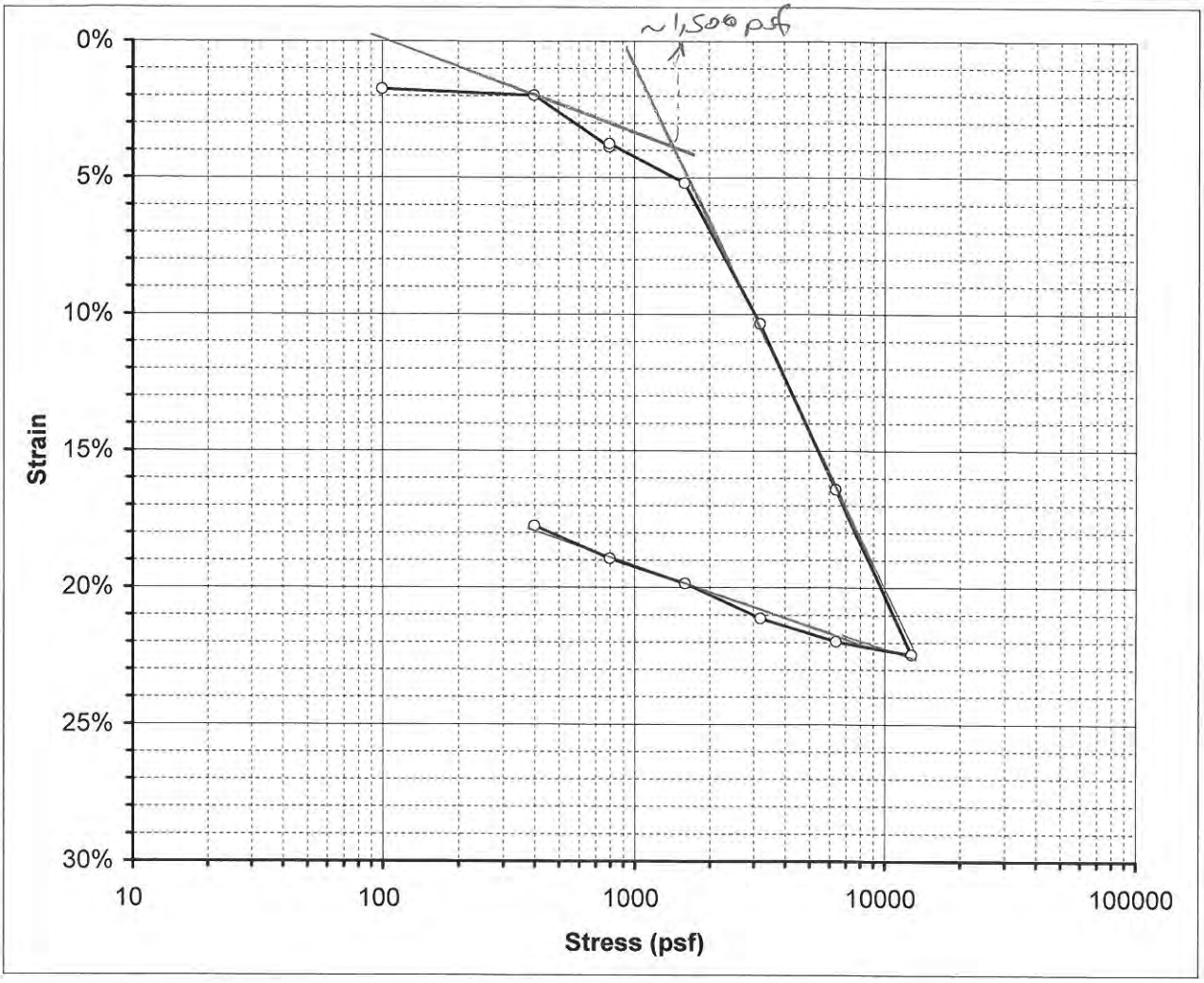
PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA CONSULTANTS

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 9-21-12\Consol B-RW036R6A@30'_4.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW036	Sample Depth	10
Sample No.	R2A	USCS	CH

BEFORE TEST

Initial Moisture Content:	51.2%	
Initial Dry Unit Wt:	71.3	pcf
Initial Total Unit Wt.:	107.7	pcf
Initial Void Ratio:	1.4431	
Initial Degree of Saturation:	98.9%	

AFTER TEST

Final Moisture Content:	39.0%	
Final Dry Unit Wt:	84.8	pcf
Final Total Unit Wt.:	122.3	pcf
Final Void Ratio:	1.0521	
Final Degree of Saturation:	103.3%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=	60	PL=	28	PI=	32

$\sigma_v' \approx 1150$ psf OCR ~ 1.3

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.75%	1.4004
400	1.99%	1.3945
800	3.88%	1.3484
800	3.76%	1.3513
1600	5.19%	1.3163
3200	10.35%	1.1902
6400	16.41%	1.0423
12800	22.44%	0.8949
6400	21.97%	0.9064
3200	21.12%	0.9270
1600	19.85%	0.9581
800	18.95%	0.9802
400	17.75%	1.0094

PROJECT NUMBER: LA-962A

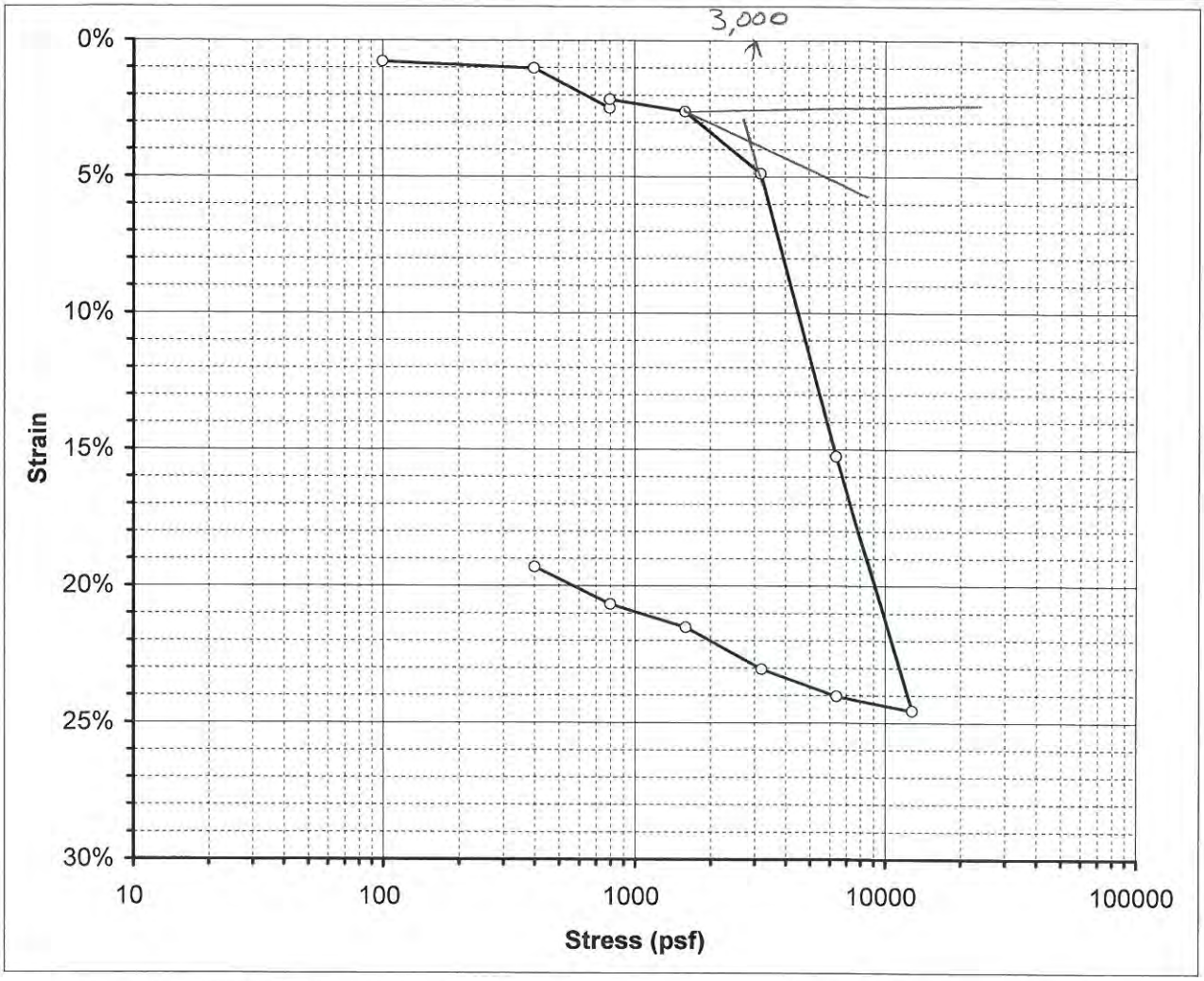
PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 9-21-12\Consol B-RW036R2A@10'_3.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW006	Sample Depth	35 ft
Sample No.	R8A	USCS	MH

BEFORE TEST

Initial Moisture Content:	75.0%	
Initial Dry Unit Wt:	56.1	pcf
Initial Total Unit Wt.:	98.2	pcf
Initial Void Ratio:	2.1032	
Initial Degree of Saturation:	99.5%	

AFTER TEST

Final Moisture Content:	59.2%	
Final Dry Unit Wt:	68.1	pcf
Final Total Unit Wt.:	124.1	pcf
Final Void Ratio:	1.5571	
Final Degree of Saturation:	106.1%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=	64	PL=	33	PI=	31

$\sigma_v' \approx 2650$ OCR ~ 1.1

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	0.78%	2.0790
400	1.02%	2.0716
800	2.48%	2.0263
800	2.16%	2.0362
1600	2.60%	2.0225
3200	4.89%	1.9515
6400	15.25%	1.6300
12800	24.56%	1.3411
6400	24.03%	1.3575
3200	23.04%	1.3882
1600	21.51%	1.4357
800	20.67%	1.4618
400	19.31%	1.5040

PROJECT NUMBER: LA-962A

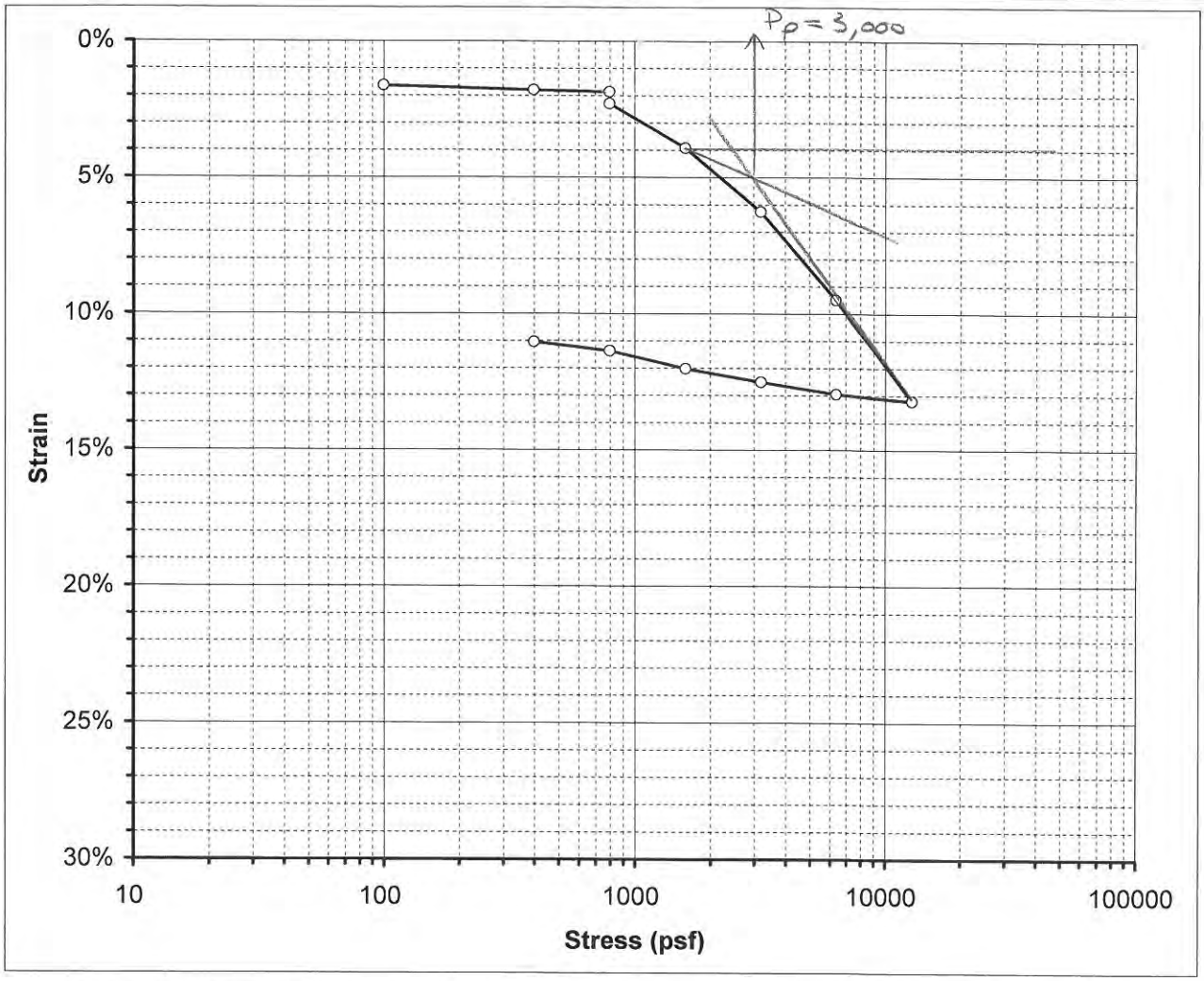
PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA CONSULTANTS

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 9-21-12\Consol A-RW006R8A@35'_1.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW044	Sample Depth	55 ft
Sample No.	R11	USCS	0

BEFORE TEST

Initial Moisture Content:	33.3%	
Initial Dry Unit Wt:	88.0	pcf
Initial Total Unit Wt.:	117.3	pcf
Initial Void Ratio:	0.9775	
Initial Degree of Saturation:	95.0%	

AFTER TEST

Final Moisture Content:	27.8%	
Final Dry Unit Wt:	98.4	pcf
Final Total Unit Wt.:	114.5	pcf
Final Void Ratio:	0.7692	
Final Degree of Saturation:	100.9%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

$\sigma_v' \approx 3,500$ psf OCR = 1

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.63%	0.9452
400	1.79%	0.9420
800	1.86%	0.9406
800	2.29%	0.9321
1600	3.92%	0.9000
3200	6.26%	0.8536
6400	9.49%	0.7898
12800	13.21%	0.7163
6400	12.96%	0.7213
3200	12.51%	0.7302
1600	12.02%	0.7397
800	11.36%	0.7528
400	11.04%	0.7591

PROJECT NUMBER: LA-962A

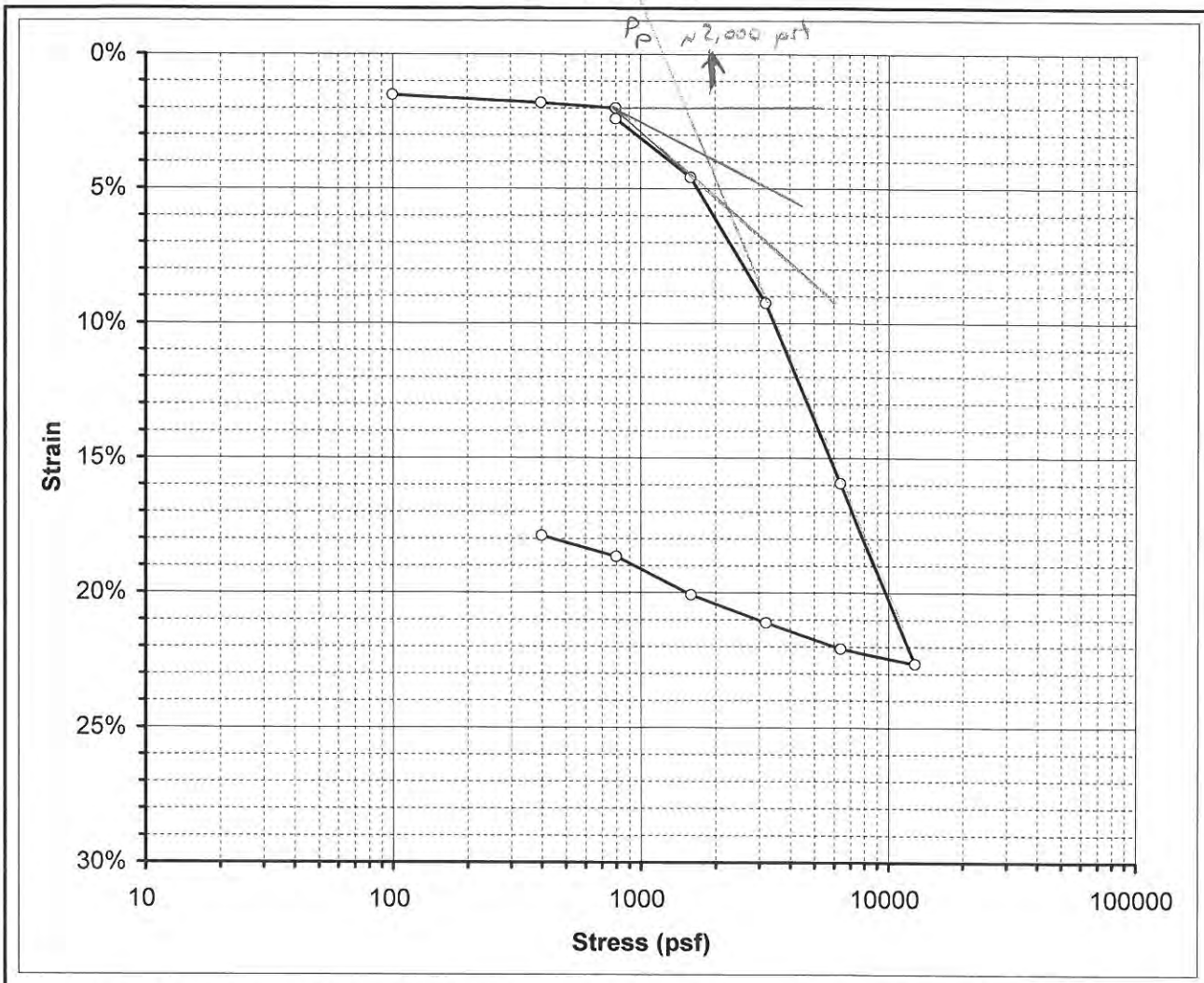
PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-3-12\Consol B-RW044R11@55'_4.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW041	Sample Depth	25 ft
Sample No.	R6A	USCS	0

BEFORE TEST	Initial Moisture Content:	58.0%	
	Initial Dry Unit Wt:	65.2	pcf
	Initial Total Unit Wt.:	103.0	pcf
	Initial Void Ratio:	1.6717	
	Initial Degree of Saturation:	96.8%	
AFTER TEST	Final Moisture Content:	45.4%	
	Final Dry Unit Wt:	78.3	pcf
	Final Total Unit Wt.:	122.9	pcf
	Final Void Ratio:	1.2229	
	Final Degree of Saturation:	103.5%	
	Water Added at:	800	psf

ATTERBERG LIMITS					
LL=	64	PL=	33	PI=	31

$\sigma_v' \approx 2{,}100$ psf OCR = 1

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.52%	1.6311
400	1.81%	1.6234
800	2.00%	1.6183
800	2.40%	1.6076
1600	4.57%	1.5496
3200	9.25%	1.4246
6400	15.94%	1.2459
12800	22.63%	1.0671
6400	22.08%	1.0818
3200	21.11%	1.1077
1600	20.08%	1.1353
800	18.67%	1.1729
400	17.89%	1.1938

PROJECT NUMBER: LA-962A

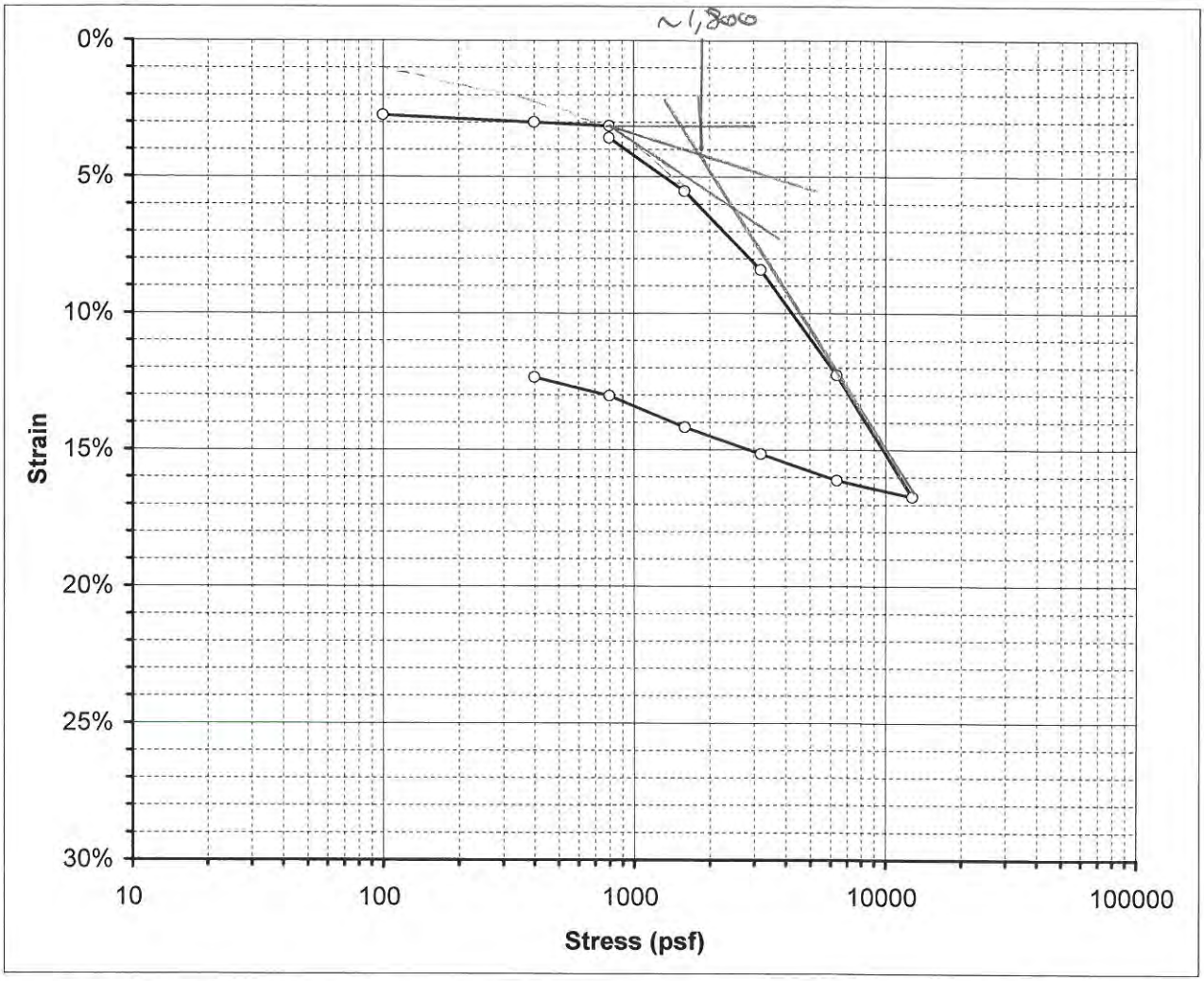
PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA CONSULTANTS

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-3-12\Consol B-RW041R6A@25'_3.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	B-RW041	Sample Depth	5 ft
Sample No.	R2A	USCS	0

BEFORE TEST

Initial Moisture Content:	47.4%	
Initial Dry Unit Wt:	75.0	pcf
Initial Total Unit Wt.:	110.6	pcf
Initial Void Ratio:	1.3207	
Initial Degree of Saturation:	100.2%	

AFTER TEST

Final Moisture Content:	39.5%	
Final Dry Unit Wt:	84.4	pcf
Final Total Unit Wt.:	115.2	pcf
Final Void Ratio:	1.0622	
Final Degree of Saturation:	103.7%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

$\sigma_v' \approx 600$ psf OCR ~ 3

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	2.73%	1.2573
400	3.00%	1.2510
800	3.13%	1.2480
800	3.58%	1.2376
1600	5.53%	1.1925
3200	8.41%	1.1256
6400	12.26%	1.0361
12800	16.72%	0.9328
6400	16.12%	0.9467
3200	15.16%	0.9690
1600	14.18%	0.9915
800	13.03%	1.0183
400	12.35%	1.0341

PROJECT NUMBER: LA-962A

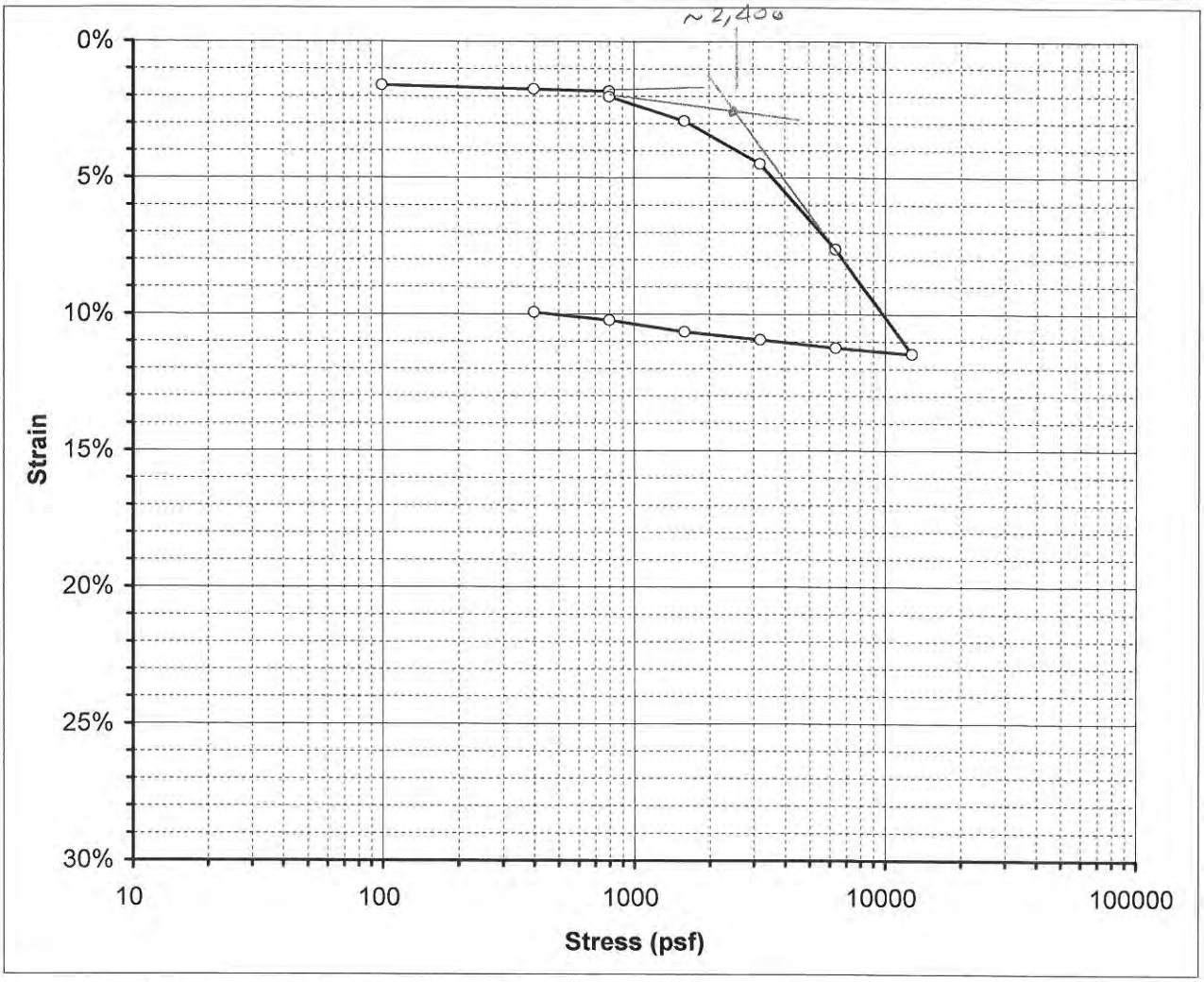
PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA CONSULTANTS

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-3-12\Consol B-RW041R2A@5'_2.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW003	Sample Depth	30 ft
Sample No.	R7A	USCS	0

BEFORE TEST

Initial Moisture Content:	35.6%	
Initial Dry Unit Wt:	85.8	pcf
Initial Total Unit Wt.:	116.3	pcf
Initial Void Ratio:	1.0301	
Initial Degree of Saturation:	96.3%	

AFTER TEST

Final Moisture Content:	30.2%	
Final Dry Unit Wt:	94.4	pcf
Final Total Unit Wt.:	112.8	pcf
Final Void Ratio:	0.8450	
Final Degree of Saturation:	99.6%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

$\sigma_v' \approx 2400$ OCR ~ 1

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.60%	0.9976
400	1.75%	0.9945
800	1.82%	0.9931
800	2.02%	0.9890
1600	2.92%	0.9709
3200	4.49%	0.9390
6400	7.63%	0.8753
12800	11.45%	0.7976
6400	11.23%	0.8021
3200	10.93%	0.8082
1600	10.64%	0.8141
800	10.22%	0.8226
400	9.94%	0.8283

PROJECT NUMBER: LA-962A

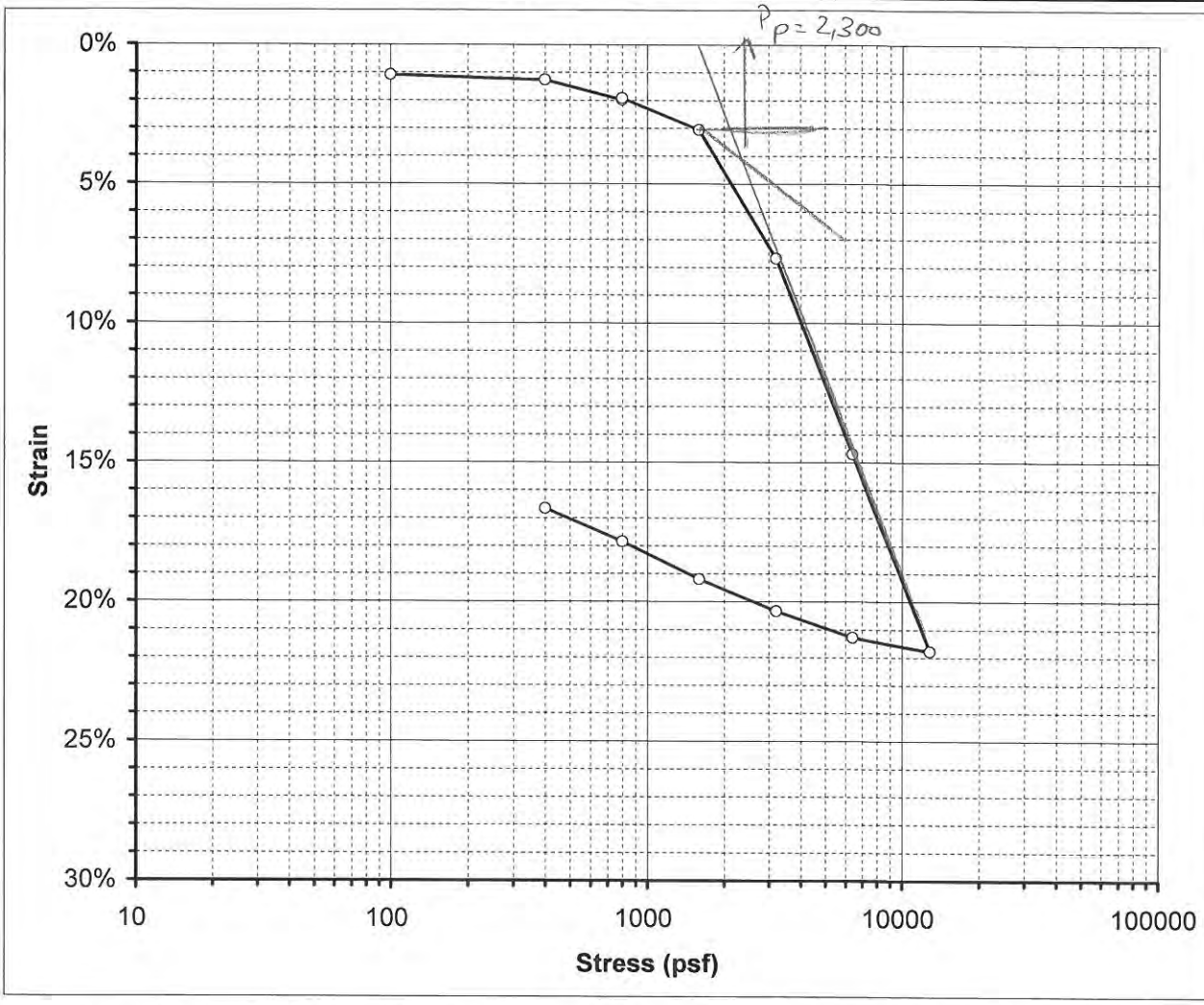
PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-3-12\Consol A-RW003R7A@30'_1.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW008	Sample Depth	30 ft
Sample No.	R6A	USCS	0

BEFORE TEST	Initial Moisture Content:	62.1%	
	Initial Dry Unit Wt:	63.1	pcf
	Initial Total Unit Wt.:	102.2	pcf
	Initial Void Ratio:	1.7601	
	Initial Degree of Saturation:	98.4%	
AFTER TEST	Final Moisture Content:	49.2%	
	Final Dry Unit Wt:	74.4	pcf
	Final Total Unit Wt.:	120.7	pcf
	Final Void Ratio:	1.3389	
	Final Degree of Saturation:	102.5%	
	Water Added at:	800	psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

$\sigma_v' \sim 2350$ psf OCR ~ 1.0

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	1.09%	1.7301
400	1.26%	1.7254
800	1.98%	1.7055
800	1.92%	1.7071
1600	3.06%	1.6757
3200	7.68%	1.5482
6400	14.70%	1.3544
12800	21.78%	1.1590
6400	21.28%	1.1728
3200	20.34%	1.1987
1600	19.20%	1.2302
800	17.85%	1.2675
400	16.66%	1.3003

PROJECT NUMBER: LA-962A

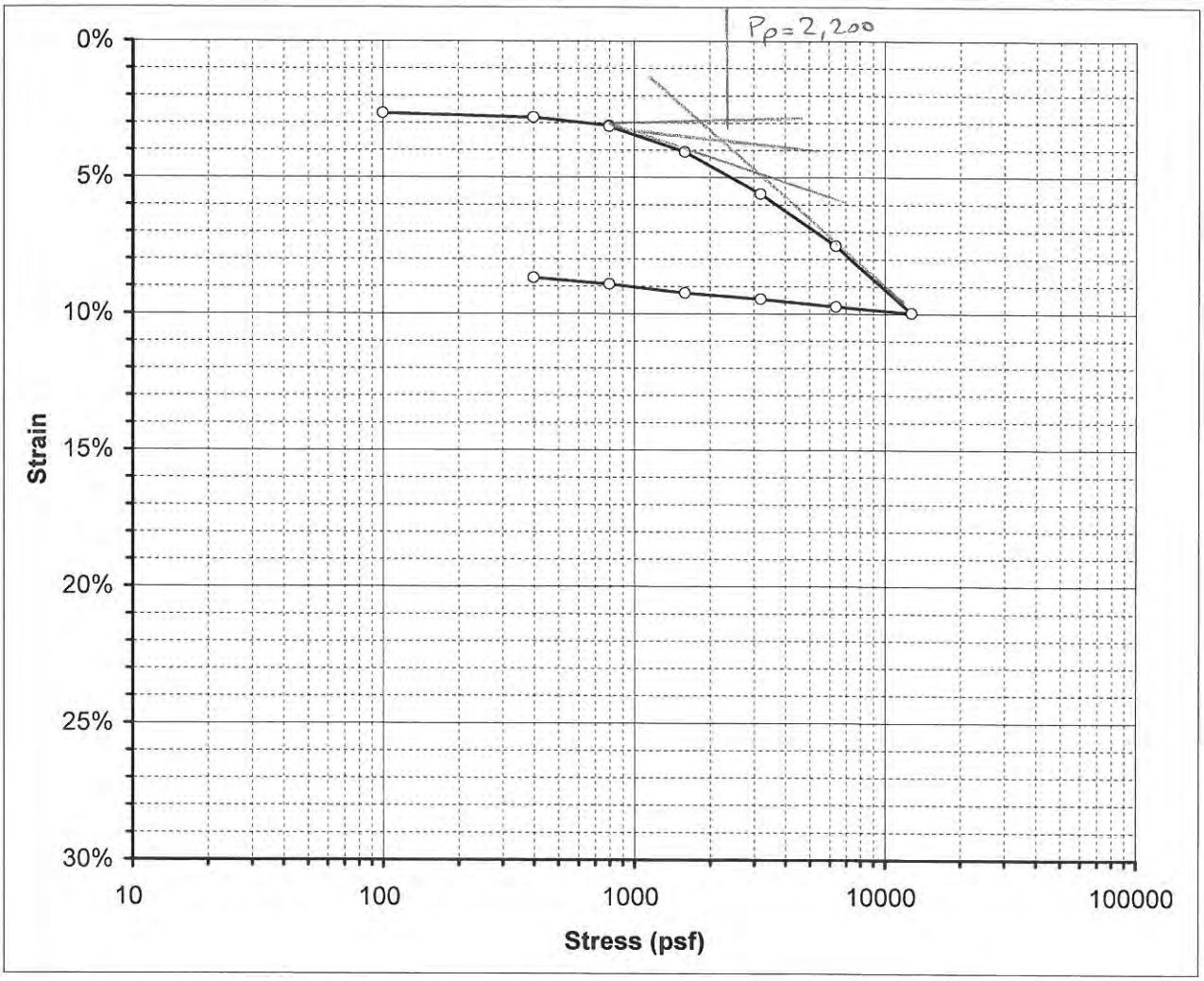
PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA CONSULTANTS

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-17-12\Consol A-RW008R6A@30'_1.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW011	Sample Depth	5
Sample No.	R2	USCS	0

BEFORE TEST

Initial Moisture Content:	35.2%	
Initial Dry Unit Wt:	86.8	pcf
Initial Total Unit Wt.:	117.3	pcf
Initial Void Ratio:	1.0058	
Initial Degree of Saturation:	97.6%	

AFTER TEST

Final Moisture Content:	29.0%	
Final Dry Unit Wt:	94.1	pcf
Final Total Unit Wt.:	114.3	pcf
Final Void Ratio:	0.8507	
Final Degree of Saturation:	95.0%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

$\sigma_v' \sim 600$ psf OCR ~ 3.5

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	2.65%	0.9526
400	2.80%	0.9495
800	3.10%	0.9435
800	3.13%	0.9429
1600	4.06%	0.9243
3200	5.61%	0.8933
6400	7.52%	0.8550
12800	9.97%	0.8058
6400	9.74%	0.8104
3200	9.46%	0.8159
1600	9.24%	0.8205
800	8.92%	0.8269
400	8.68%	0.8317

PROJECT NUMBER: LA-962A

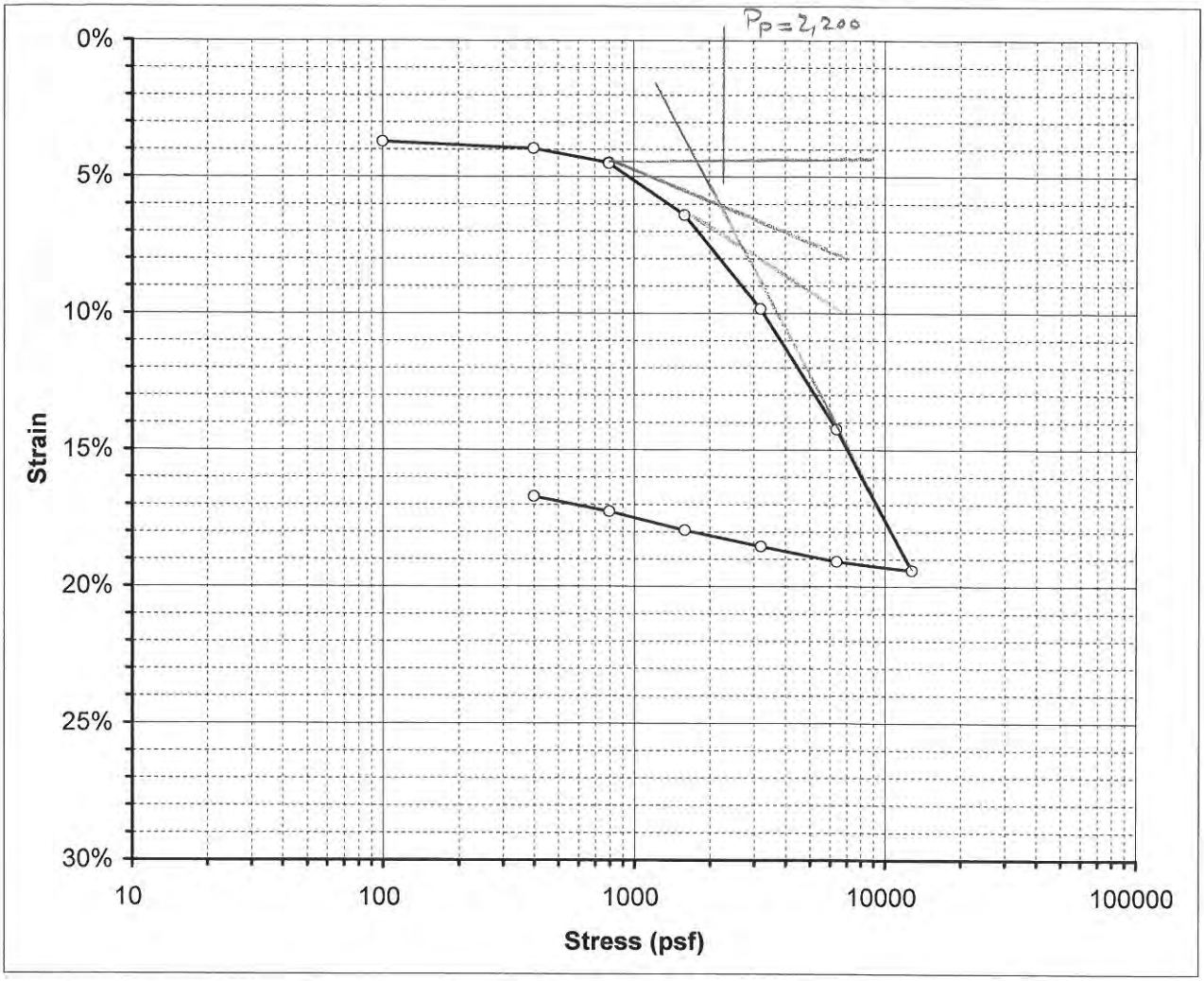
PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-17-12\Consol A-RW011R2@5'_2.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW013	Sample Depth	15
Sample No.	R4	USCS	0

BEFORE TEST

Initial Moisture Content:	50.9%	
Initial Dry Unit Wt:	73.3	pcf
Initial Total Unit Wt.:	110.6	pcf
Initial Void Ratio:	1.3750	
Initial Degree of Saturation:	103.3%	

AFTER TEST

Final Moisture Content:	38.6%	
Final Dry Unit Wt:	86.7	pcf
Final Total Unit Wt.:	123.5	pcf
Final Void Ratio:	1.0076	
Final Degree of Saturation:	106.9%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

$\sigma_v' \sim 1800$ psf OCR ~ 1.2

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	3.71%	1.2868
400	3.97%	1.2807
800	4.49%	1.2684
800	4.51%	1.2679
1600	6.41%	1.2228
3200	9.84%	1.1414
6400	14.24%	1.0367
12800	19.41%	0.9141
6400	19.09%	0.9216
3200	18.53%	0.9349
1600	17.95%	0.9487
800	17.27%	0.9650
400	16.70%	0.9783

PROJECT NUMBER: LA-962A

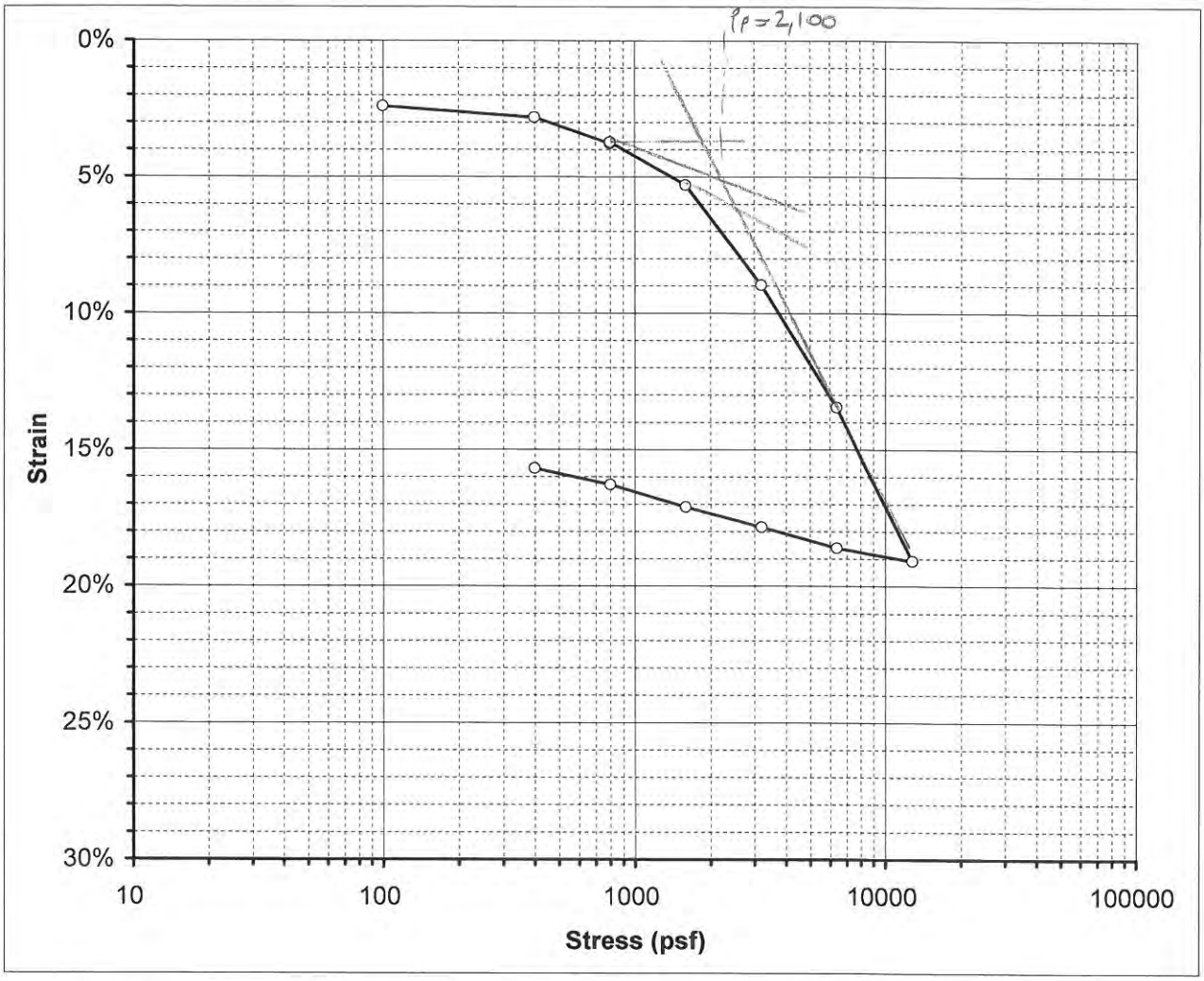
PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA CONSULTANTS

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-17-12\Consol A-RW013R4@15'_3.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW049	Sample Depth	15
Sample No.	R4A	USCS	0

BEFORE TEST

Initial Moisture Content:	72.7%	
Initial Dry Unit Wt:	56.2	pcf
Initial Total Unit Wt.:	97.1	pcf
Initial Void Ratio:	2.0975	
Initial Degree of Saturation:	96.7%	

AFTER TEST

Final Moisture Content:	59.5%	
Final Dry Unit Wt:	65.9	pcf
Final Total Unit Wt.:	120.1	pcf
Final Void Ratio:	1.6422	
Final Degree of Saturation:	101.0%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

$\sigma_v' = 1800$ psf OCR ~ 1.15

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	2.40%	2.0230
400	2.82%	2.0103
800	3.78%	1.9805
800	3.73%	1.9820
1600	5.30%	1.9333
3200	8.96%	1.8200
6400	13.45%	1.6810
12800	19.08%	1.5065
6400	18.60%	1.5214
3200	17.84%	1.5450
1600	17.10%	1.5677
800	16.28%	1.5931
400	15.69%	1.6114

PROJECT NUMBER: LA-962A

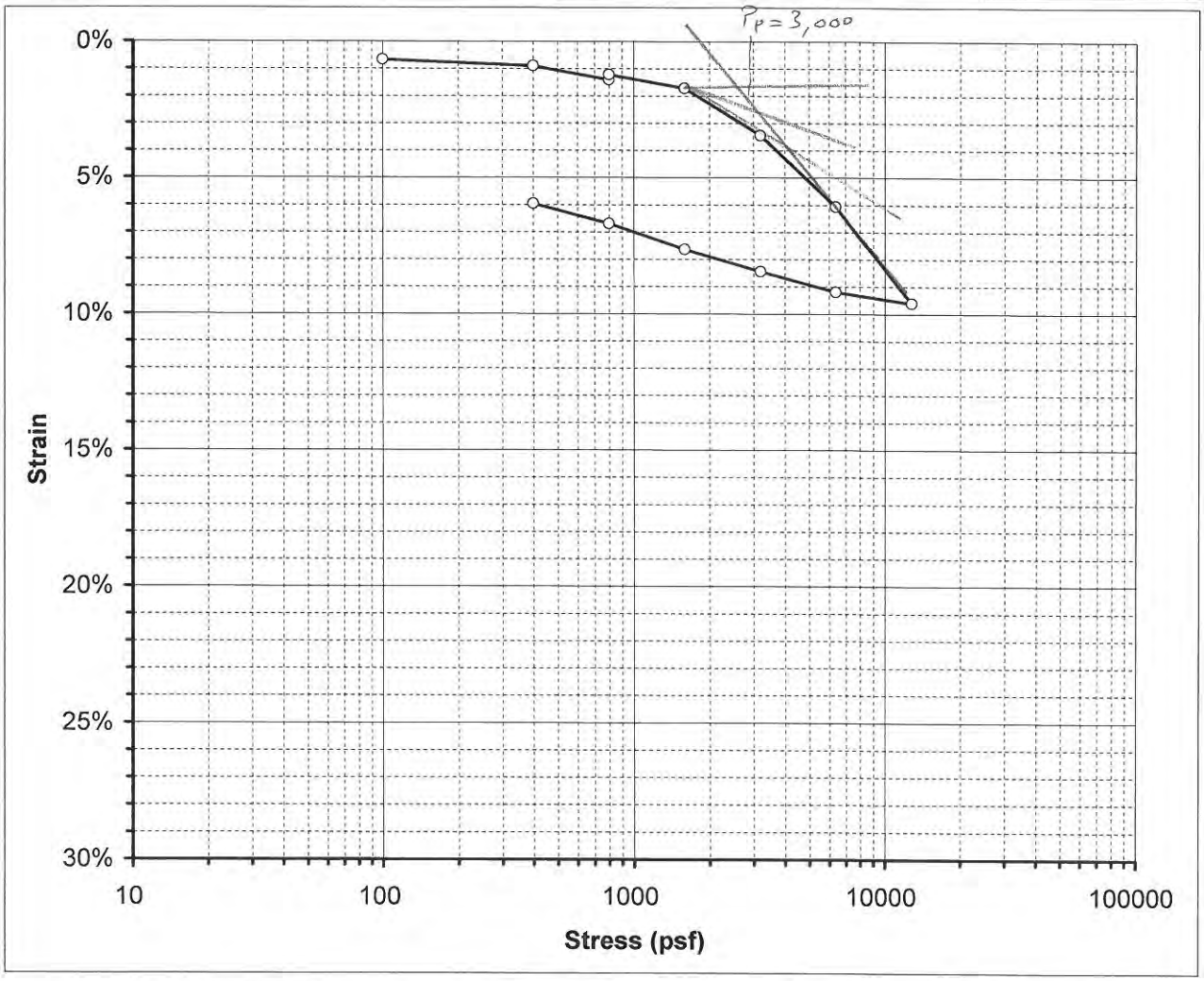
PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-17-12\Consol A-RW049R4A@15'_4.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW005	Sample Depth	5 ft
Sample No.	R1	USCS	0

BEFORE TEST	Initial Moisture Content:	37.4%	
	Initial Dry Unit Wt:	82.0	pcf
	Initial Total Unit Wt.:	112.7	pcf
	Initial Void Ratio:	1.1234	
	Initial Degree of Saturation:	92.9%	
AFTER TEST	Final Moisture Content:	36.4%	
	Final Dry Unit Wt:	86.5	pcf
	Final Total Unit Wt.:	110.1	pcf
	Final Void Ratio:	1.0129	
	Final Degree of Saturation:	100.2%	
	Water Added at:	800	psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	0.66%	1.1093
400	0.90%	1.1043
800	1.41%	1.0935
800	1.21%	1.0976
1600	1.71%	1.0870
3200	3.45%	1.0501
6400	6.06%	0.9947
12800	9.60%	0.9195
6400	9.19%	0.9281
3200	8.44%	0.9442
1600	7.63%	0.9613
800	6.69%	0.9812
400	5.96%	0.9968

$\sigma_v' \sim 600$ psf

OCR ~ 5.0

PROJECT NUMBER: LA-962A

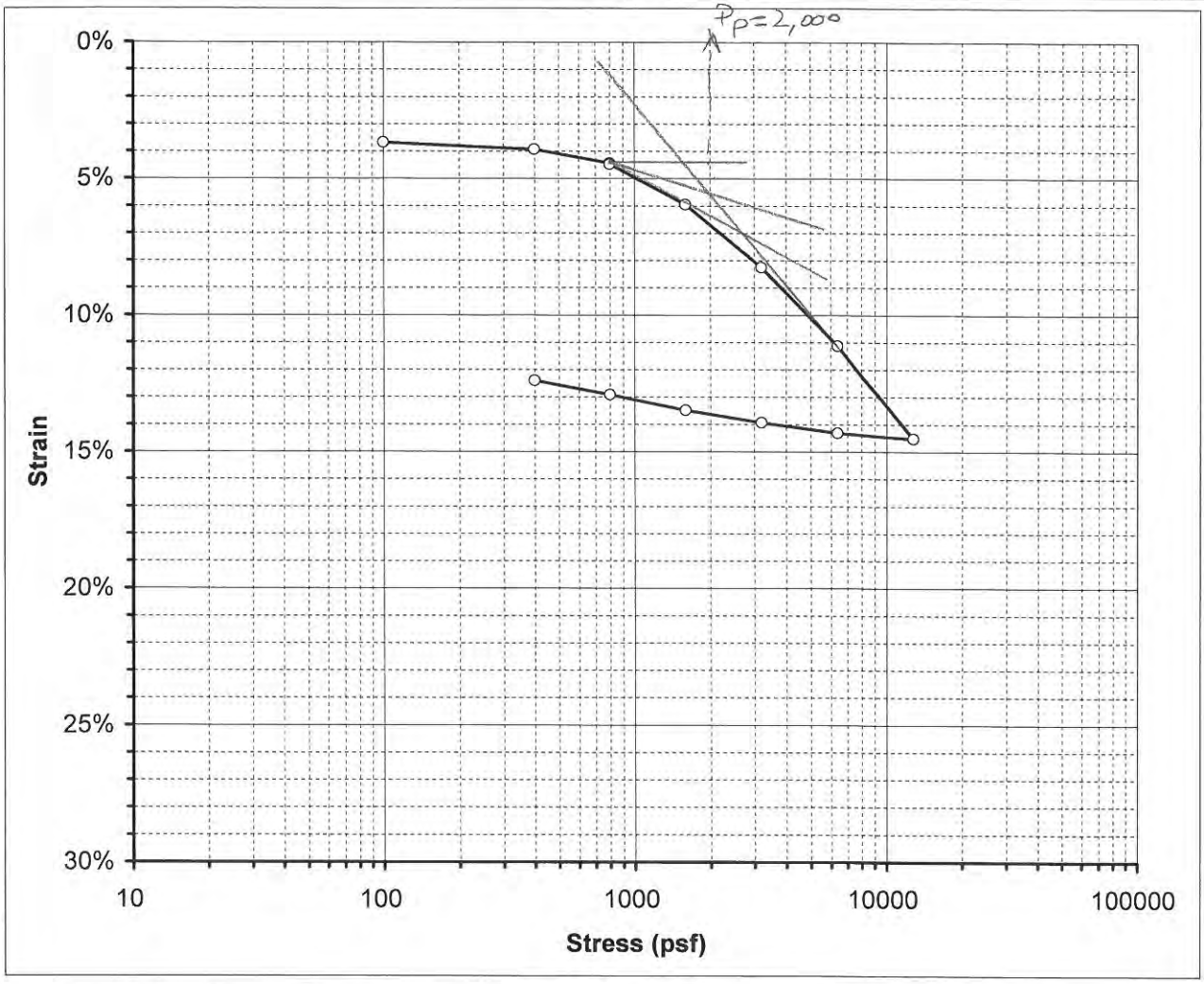
PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA CONSULTANTS

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-30-12\A-RW005 R1@5'_3.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW005	Sample Depth	15 ft
Sample No.	R3	USCS	0

BEFORE TEST	Initial Moisture Content:	43.7%	
	Initial Dry Unit Wt:	77.9	pcf
	Initial Total Unit Wt.:	111.9	pcf
	Initial Void Ratio:	1.2358	
	Initial Degree of Saturation:	98.7%	
AFTER TEST	Final Moisture Content:	35.5%	
	Final Dry Unit Wt:	87.5	pcf
	Final Total Unit Wt.:	115.5	pcf
	Final Void Ratio:	0.9895	
	Final Degree of Saturation:	100.0%	
	Water Added at:	800	psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

$\sigma_v' \approx 1,800$ OCR ~ 1.1

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	3.68%	1.1536
400	3.93%	1.1480
800	4.43%	1.1367
800	4.47%	1.1358
1600	5.95%	1.1028
3200	8.25%	1.0513
6400	11.13%	0.9871
12800	14.52%	0.9111
6400	14.31%	0.9158
3200	13.94%	0.9242
1600	13.48%	0.9345
800	12.91%	0.9471
400	12.39%	0.9588

PROJECT NUMBER: LA-962A

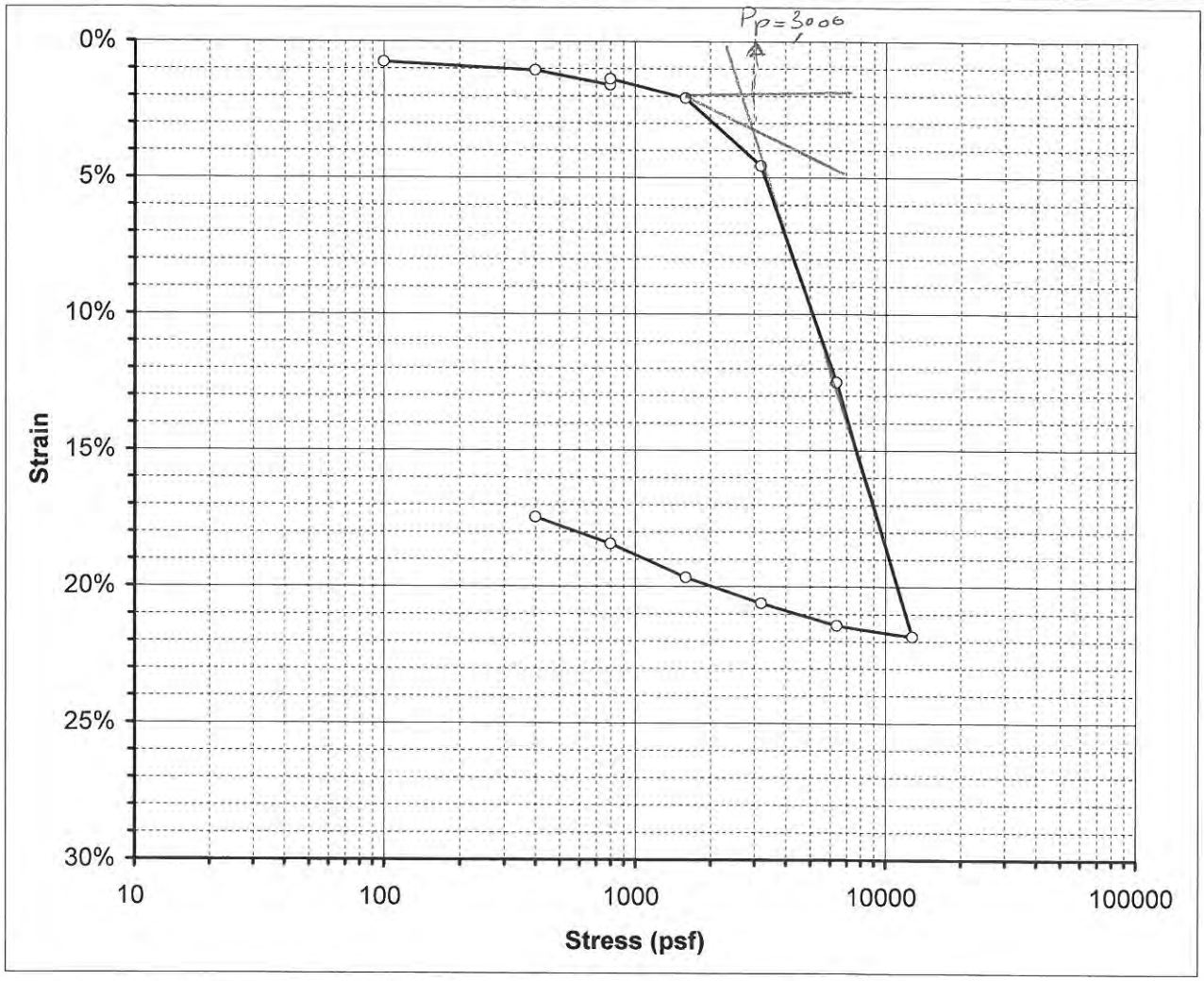
PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-30-12\A-RW005 R3@15'_4.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435



Boring No.	A-RW049	Sample Depth	25 ft
Sample No.	R6A	USCS	0

BEFORE TEST

Initial Moisture Content:	64.3%	
Initial Dry Unit Wt:	60.4	pcf
Initial Total Unit Wt.:	99.2	pcf
Initial Void Ratio:	1.8822	
Initial Degree of Saturation:	95.2%	

AFTER TEST

Final Moisture Content:	50.8%	
Final Dry Unit Wt:	72.4	pcf
Final Total Unit Wt.:	122.8	pcf
Final Void Ratio:	1.4048	
Final Degree of Saturation:	100.8%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

$\sigma_v' = 2{,}200$ psf OCR ~ 1.3

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	0.75%	1.8605
400	1.05%	1.8518
800	1.59%	1.8362
800	1.37%	1.8426
1600	2.07%	1.8224
3200	4.57%	1.7505
6400	12.51%	1.5217
12800	21.82%	1.2532
6400	21.42%	1.2647
3200	20.60%	1.2884
1600	19.66%	1.3155
800	18.44%	1.3508
400	17.45%	1.3791

PROJECT NUMBER: LA-962A

PROJECT NAME: Ballona Wetlands

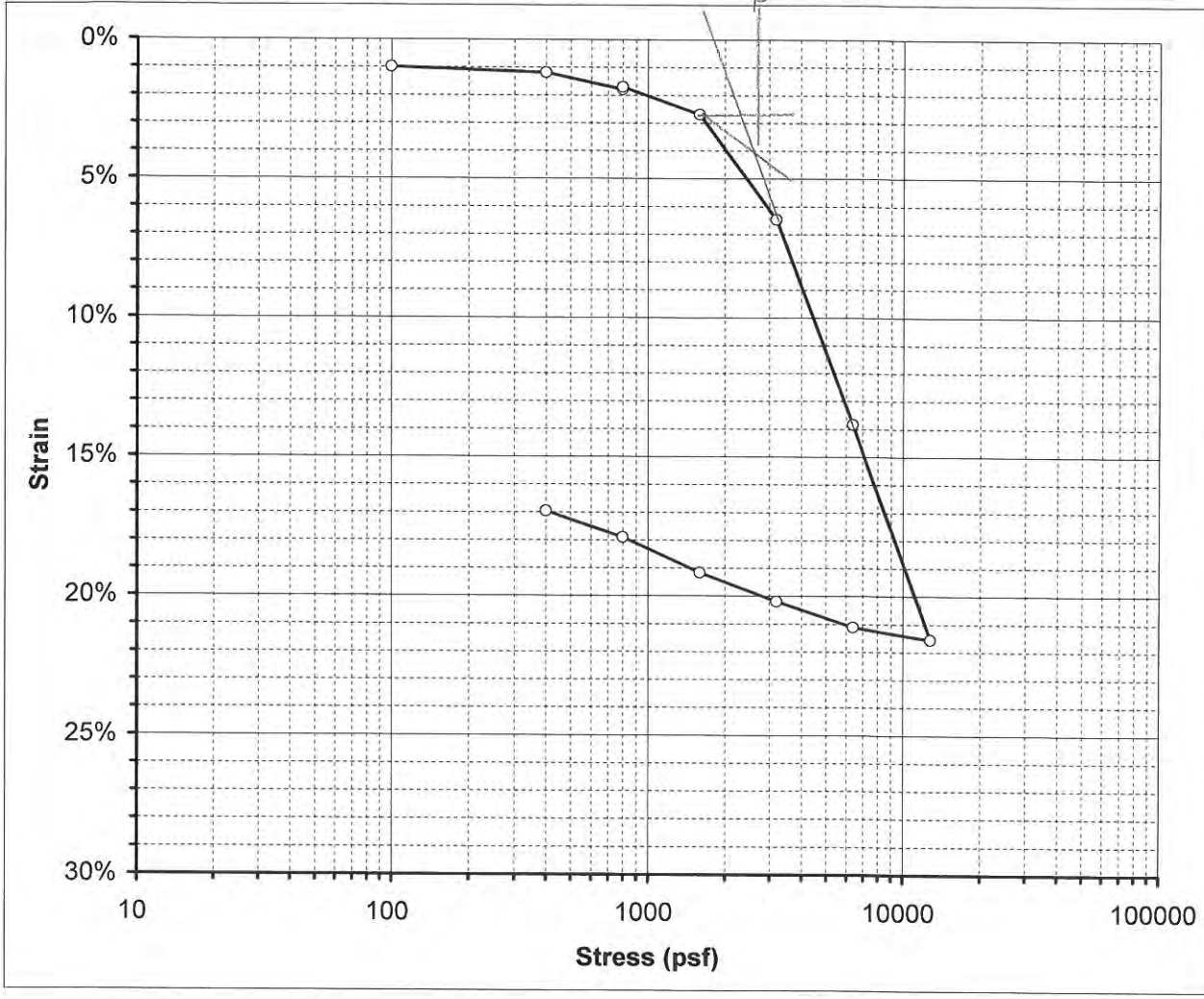
FIGURE NO. B-3

GROUP DELTA

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-30-12\A-RW049 R6A@25'_1.xls

CONSOLIDATION TEST RESULTS
ASTM D-2435

$P_c \approx 2,500$ psf



Boring No.	A-RW053	Sample Depth	10 ft
Sample No.	R2A	USCS	0

BEFORE TEST

Initial Moisture Content:	59.5%	
Initial Dry Unit Wt:	63.9	pcf
Initial Total Unit Wt.:	101.8	pcf
Initial Void Ratio:	1.7261	
Initial Degree of Saturation:	96.1%	

AFTER TEST

Final Moisture Content:	47.6%	
Final Dry Unit Wt:	76.2	pcf
Final Total Unit Wt.:	122.1	pcf
Final Void Ratio:	1.2845	
Final Degree of Saturation:	103.4%	

Water Added at: 800 psf

ATTERBERG LIMITS					
LL=		PL=		PI=	

$\sigma_v' \approx 1,200$ OCR ~ 2.0

PRESSURE (psf)	SAMPLE STRAIN	VOID RATIO
100	0.98%	1.6993
400	1.19%	1.6937
800	1.79%	1.6773
800	1.71%	1.6795
1600	2.69%	1.6528
3200	6.47%	1.5498
6400	13.84%	1.3488
12800	21.56%	1.1384
6400	21.12%	1.1504
3200	20.20%	1.1755
1600	19.16%	1.2038
800	17.90%	1.2382
400	16.96%	1.2638

PROJECT NUMBER: LA-962A

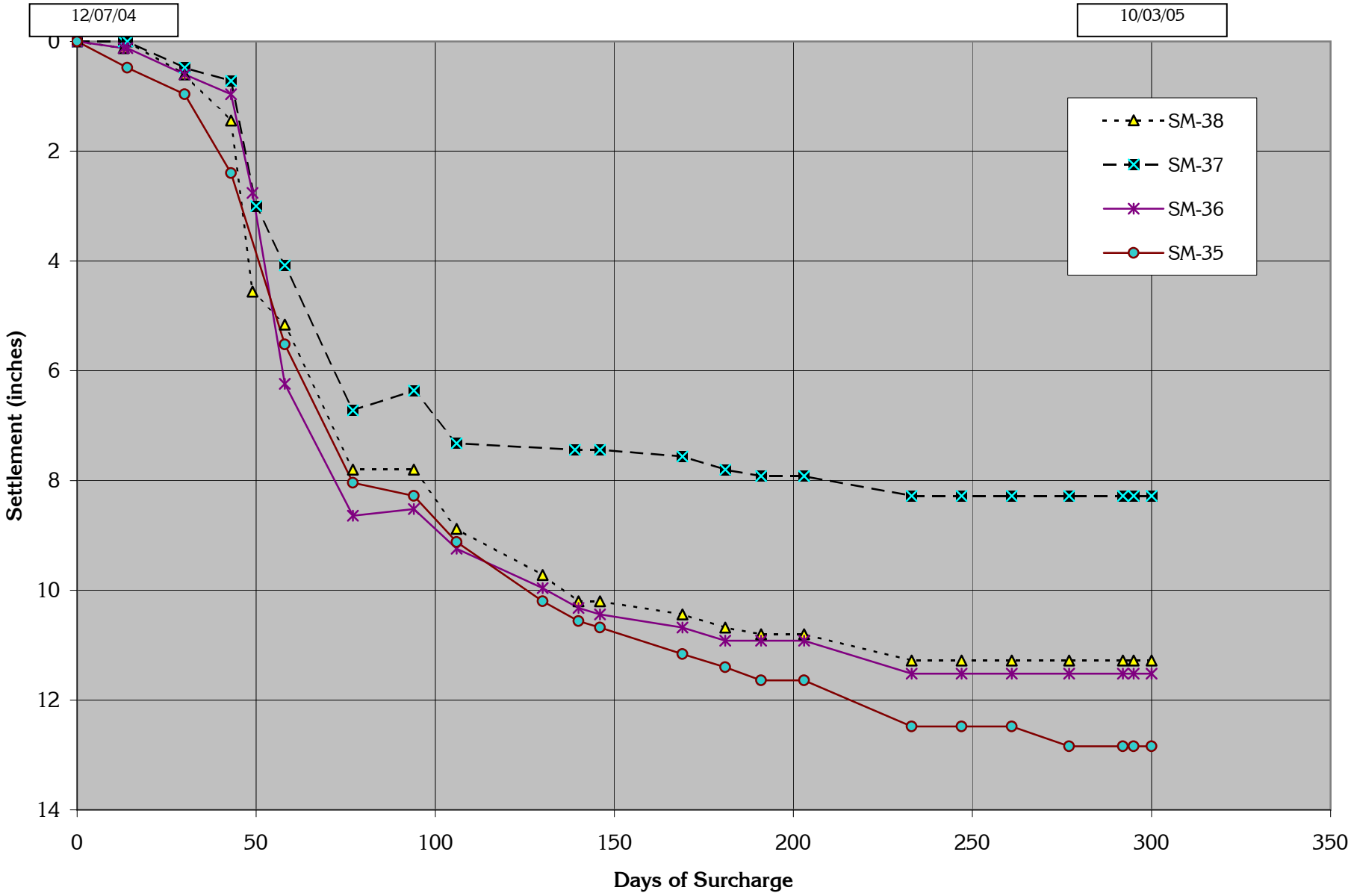
PROJECT NAME: Ballona Wetlands

FIGURE NO. B-3

GROUP DELTA CONSULTANTS

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Lab\Consol LA962A 10-30-12\A-RW053 R2A@10'_2.xls

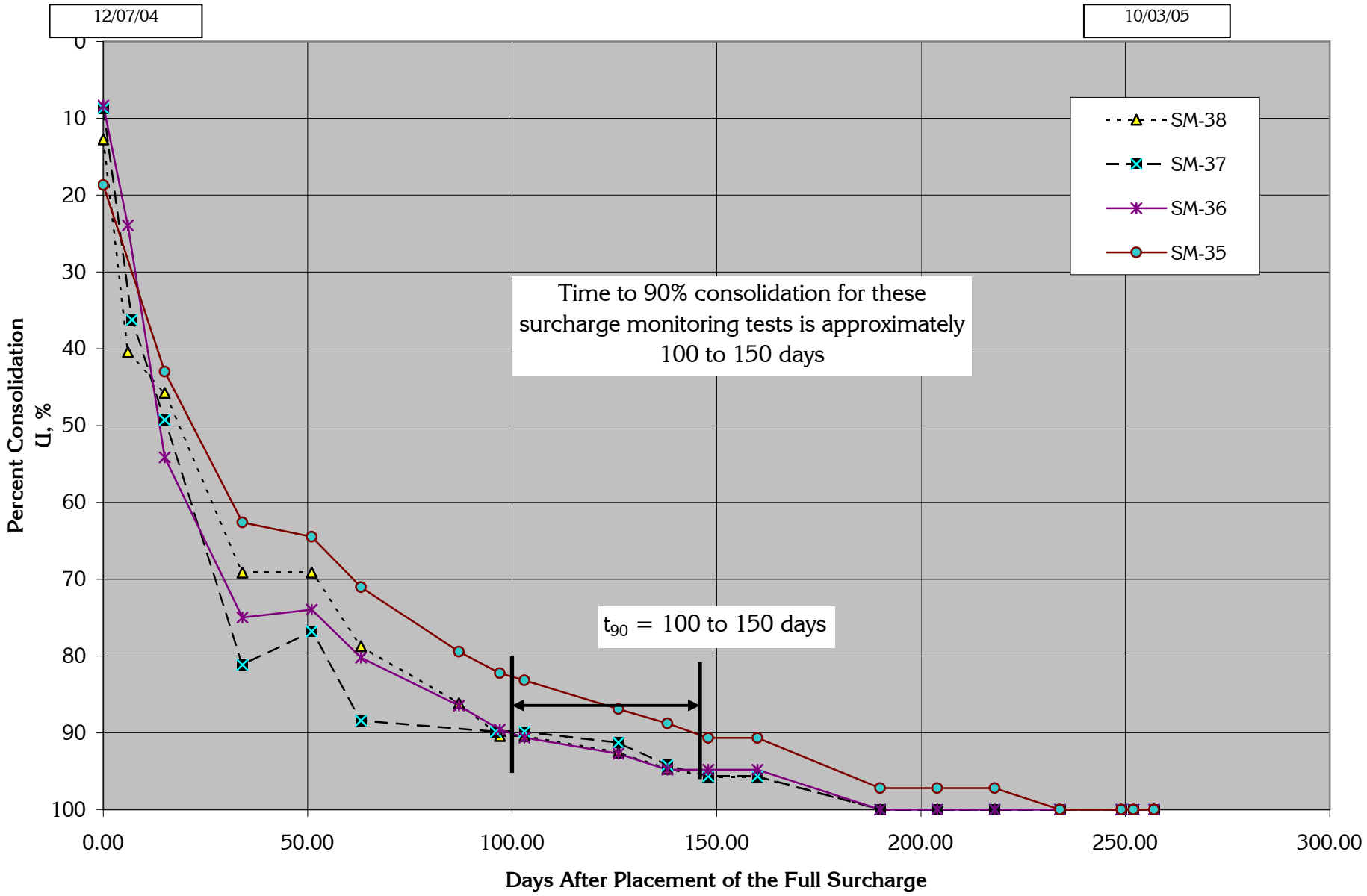
Playa Vista Area D2 Surcharge Settlement Lots 1-6



Group Delta Consultants, Inc.

PLATE H-46

Percent Consolidation vs Time



Group Delta Consultants, Inc.

PLATE H-47

APPENDIX I
EXTENTS OF REMOVAL AND RECOMPACTION UNDER LEVEES

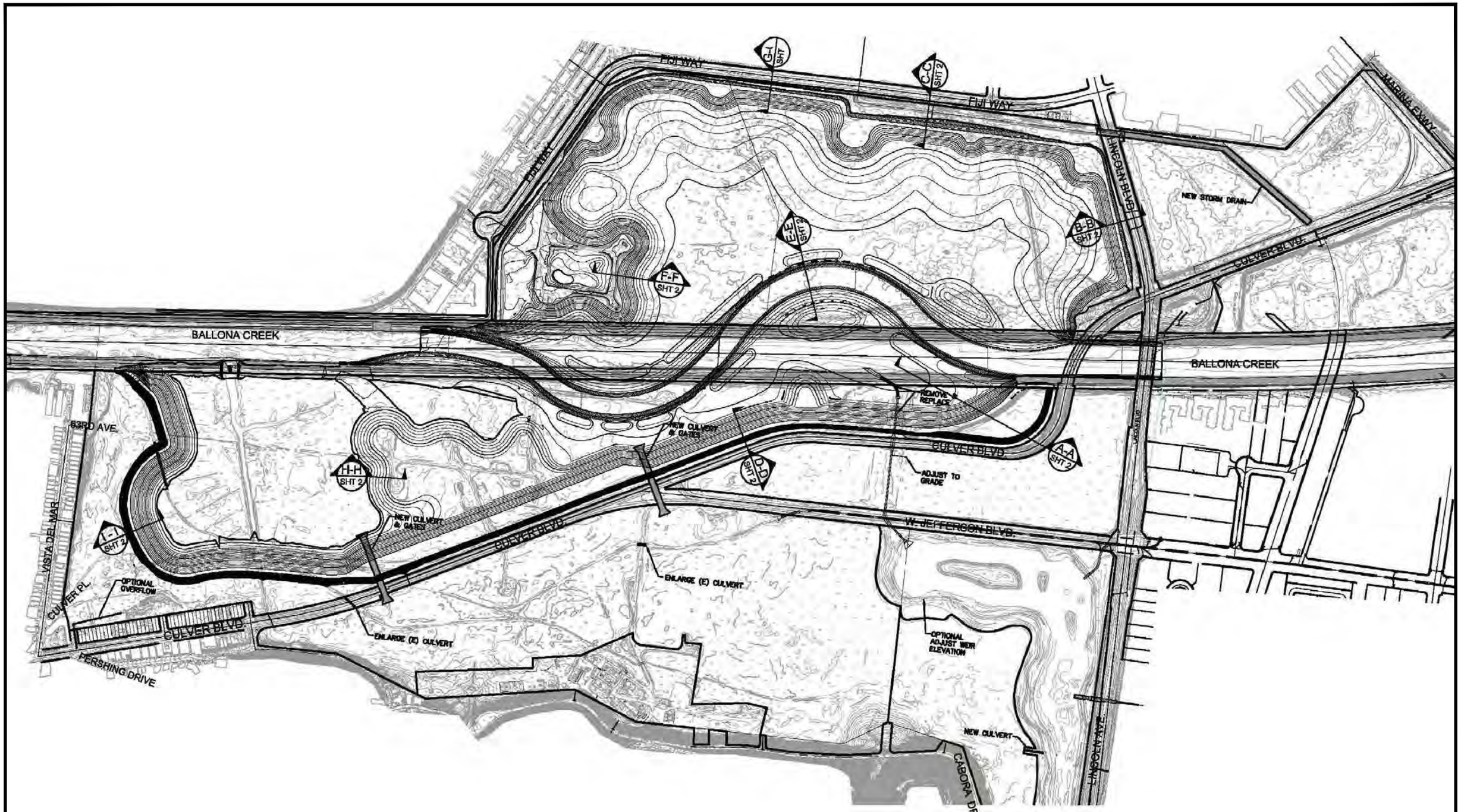
APPENDIX I
EXTENTS OF REMOVAL AND RECOMPACTION UNDER LEVEES

I.1 Contents

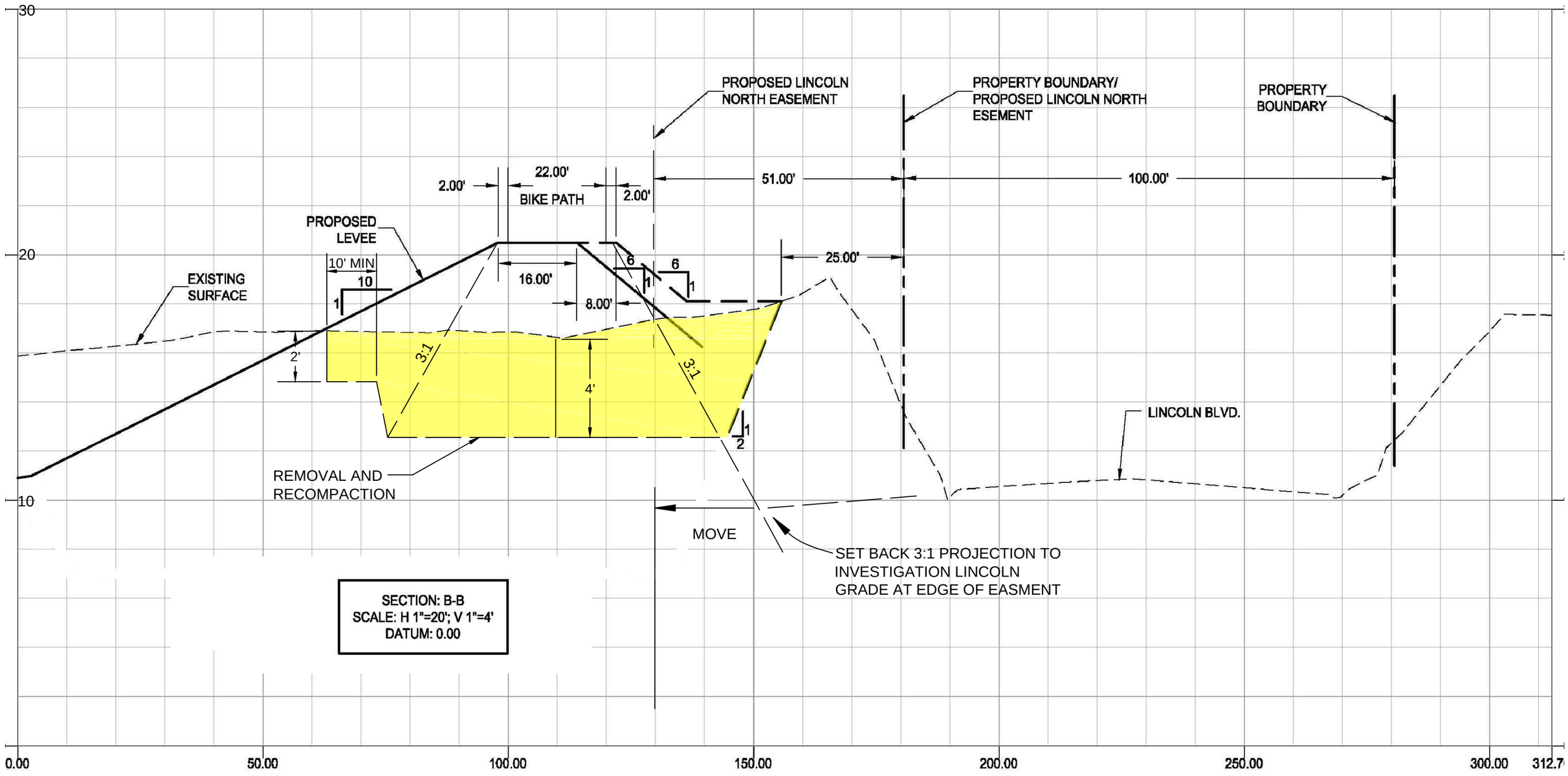
Prior to placement of compacted fill for the new levees, the subgrade soils along the levee alignments should be excavated and recompacted. Under the levee "core" the removals should extend to a minimum depth of 4 feet below the existing grade, while beyond the core, the removals should extend to a minimum depth of 1 feet. The actual limits for removals should be determined by the project geotechnical engineer during construction. The extents of removal and recompaction are shown graphically in this appendix for a number of cross sections.

A list of the plates presented in this appendix follows:

Plate I-1 Ballona Creek Levee Cross Sections Exhibit for Removals
Plate I-2 Extents of Removal and Recompaction (Section B-B)
Plate I-3 Extents of Removal and Recompaction (Sections C-C and D-D)
Plate I-4 Extents of Removal and Recompaction (Sections H-H, I-I and G-G)



DATE: 3/14/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	BALLONA CREEK LEVEE CROSS SECTIONS EXHIBIT FOR REMOVALS BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	PROJECT NUMBER: L962A
REVISION: --	APPROVED BY: P. Kashighandi				SCALE: NO SCALE
REVISION: --	E-949				PLATE NUMBER: I-1

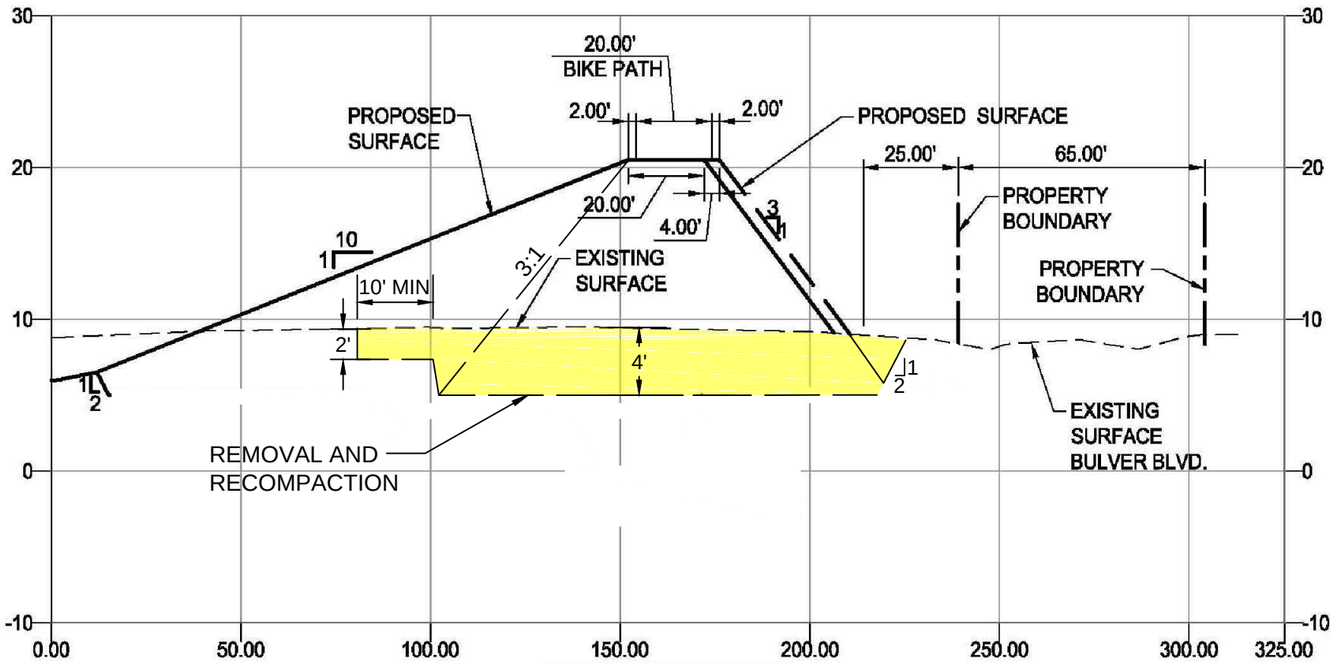


DATE: 6/28/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501
REVISION: --	APPROVED BY: P. Kashighandi		
REVISION: --	E-950		

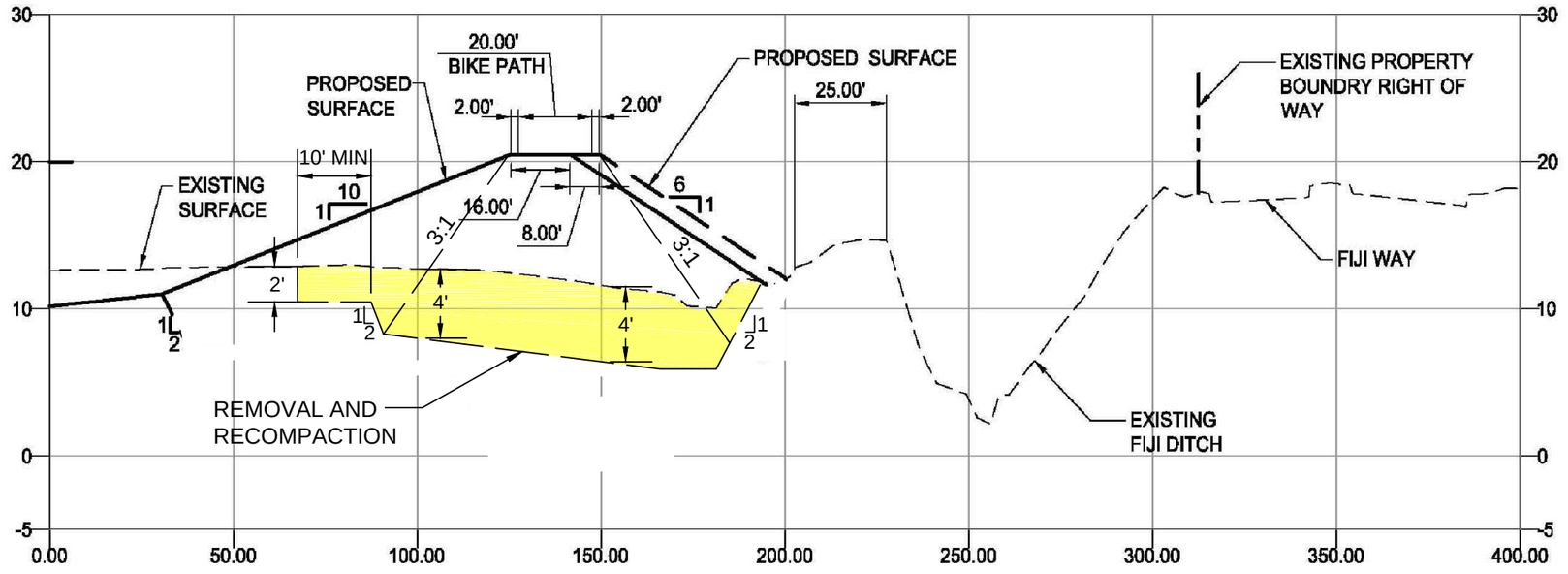
EXTENTS OF REMOVAL AND RECOMPACTION (SECTION B-B)

BALLONA WETLANDS RESTORATION PROJECT
LOS ANGELES, CA

PROJECT NUMBER:	L962A
SCALE:	NO SCALE
PLATE NUMBER:	I-2



SECTION D-D
SCALE: H 1"=40'; V 1"=10'



SECTION C-C
SCALE: H 1"=40'; V 1"=10'

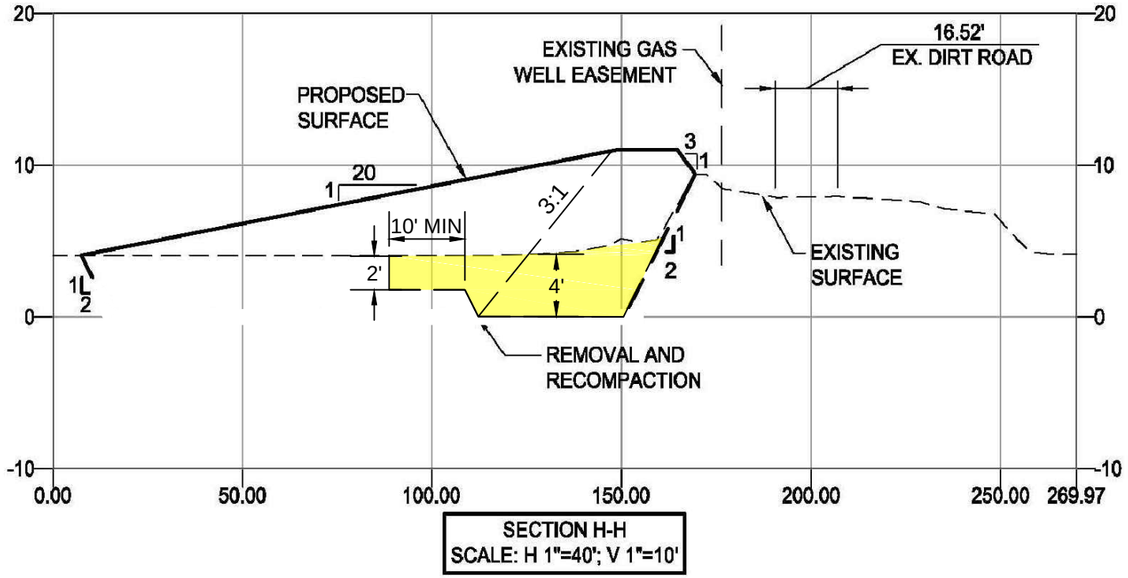
DATE: 6/28/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501
REVISION: --	APPROVED BY: P. Kashighandi		EXTENTS OF REMOVAL AND RECOMPACTION (SECTIONS C-C & D-D) BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA
REVISION: --	E-951		PROJECT NUMBER: L962A SCALE: NO SCALE PLATE NUMBER: I-3

WEST AREA B

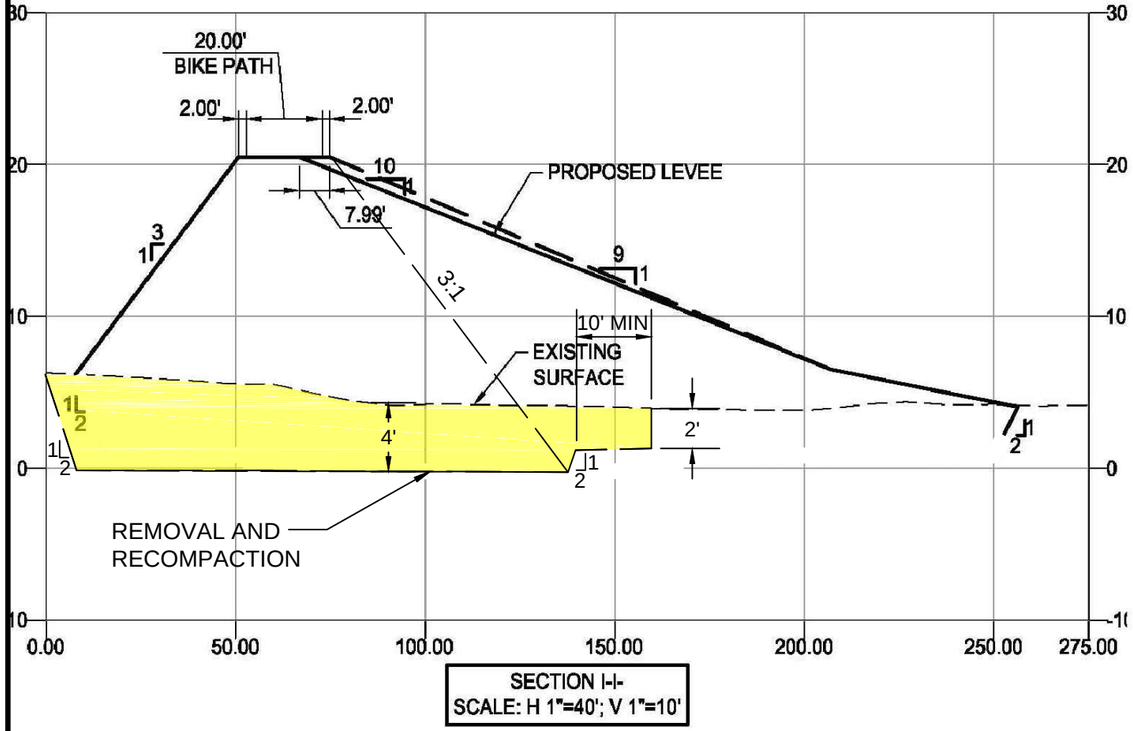
ANTICIPATE DEEPER REMOVALS:

- DE-MUCK AND REMOVE SAND IN CHANNELS AND BACKFILL.

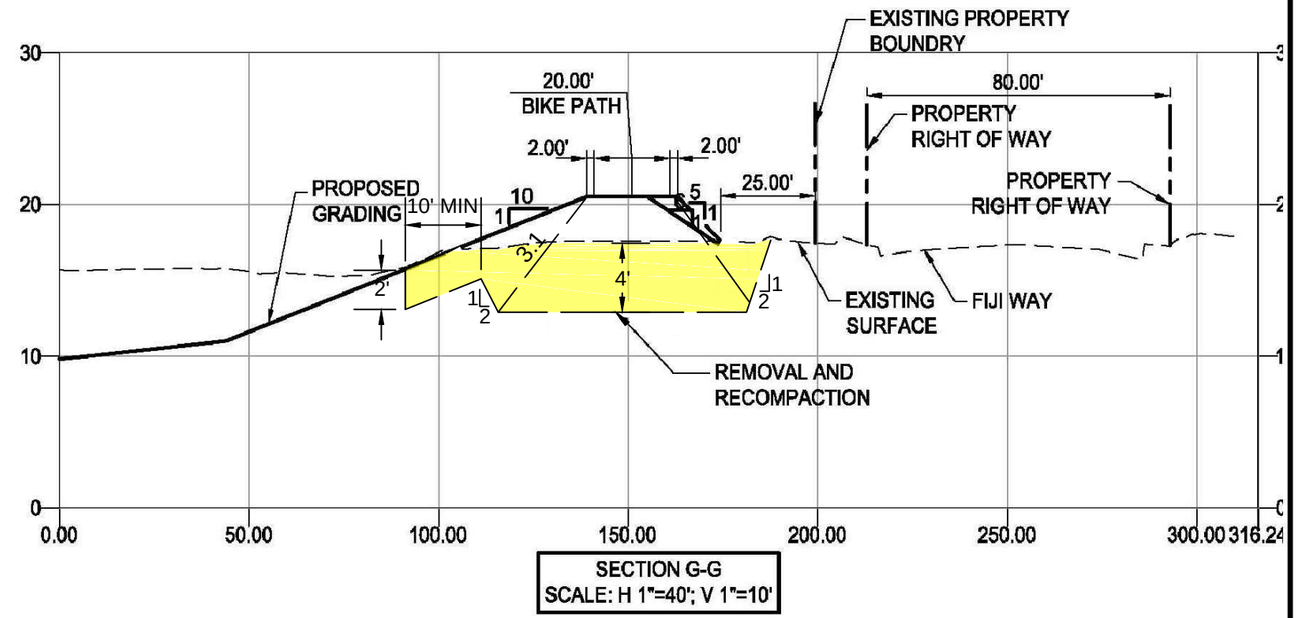
- ENSURE ELIMINATION OF ANY SAND LAGERS UNDER THE LEVEE TO PRTECT AGAINST SEEPAGE.



SECTION H-H
SCALE: H 1"=40'; V 1"=10'



SECTION I-I-
SCALE: H 1"=40'; V 1"=10'



SECTION G-G
SCALE: H 1"=40'; V 1"=10'

DATE: 6/27/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	EXTENTS OF REMOVAL AND RECOMPACTION (SECTIONS H-H, I-I, G-G)	PROJECT NUMBER: L962A
REVISION: --	APPROVED BY: P. Kashighandi			BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	SCALE: NO SCALE
REVISION: --	E-952				PLATE NUMBER: I-4

APPENDIX J
AXIAL AND LATERAL CAPACITY OF PILES FOR THE PEDESTRIAN BRIDGE

APPENDIX J
AXIAL AND LATERAL CAPACITY OF PILES FOR THE PEDESTRIAN BRIDGE

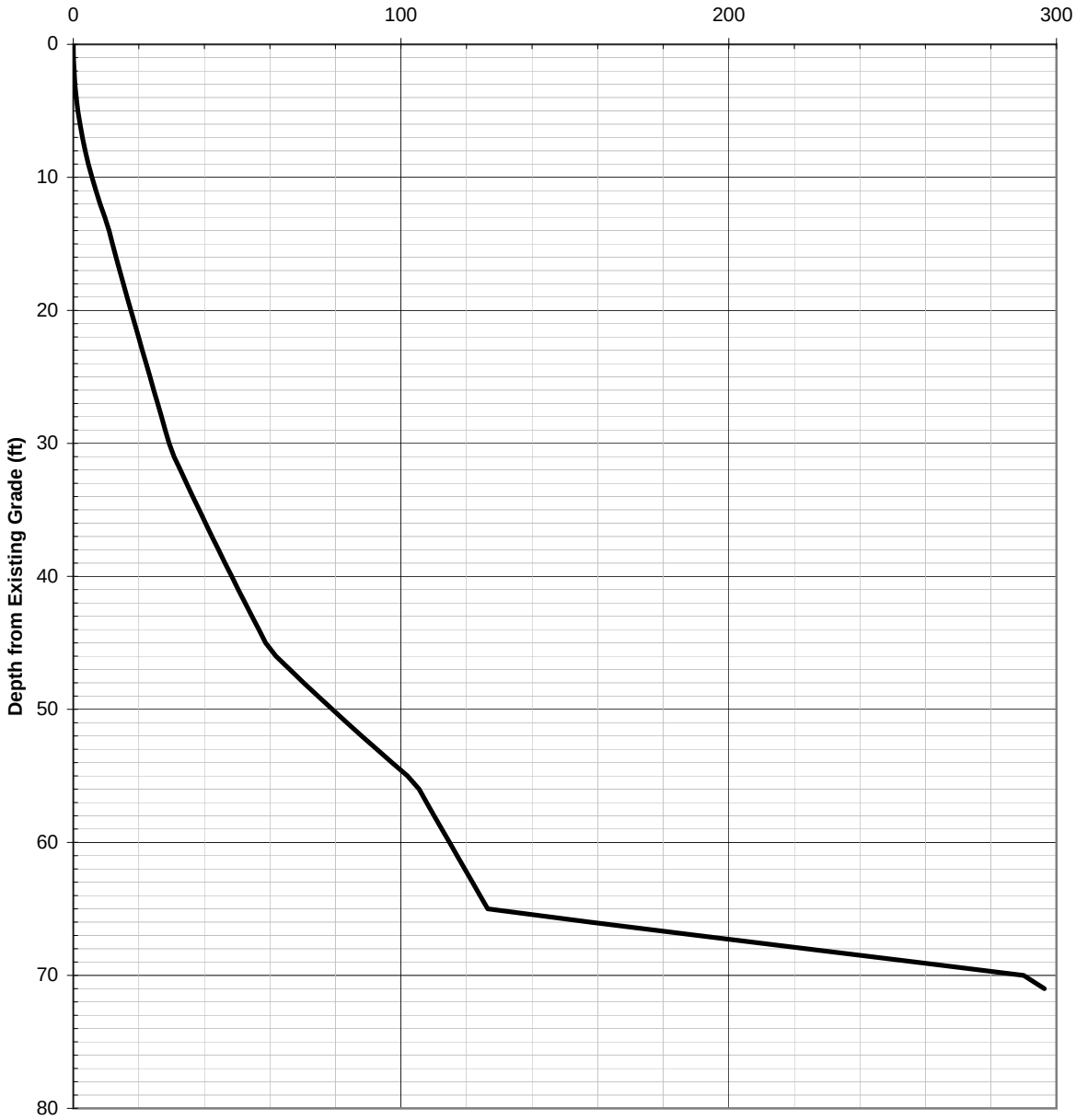
J.1 Contents

A pedestrian bridge is planned to be constructed to the west of the Culver Blvd. as part of the public access plan for the project. Due to large bridge loads, and presence of soft, and liquefiable soils, the bridge should be supported on piles. Pile axial capacity graphs are presented in this appendix for 14-inch square driven piles and 14-inch round Auger Cast Displacement (ACD) Piles. It should be noted that only recommended values presented in the body of the report should be used for the design of the pedestrian bridge. The axial capacity graphs included herein, are solely presented for reference.

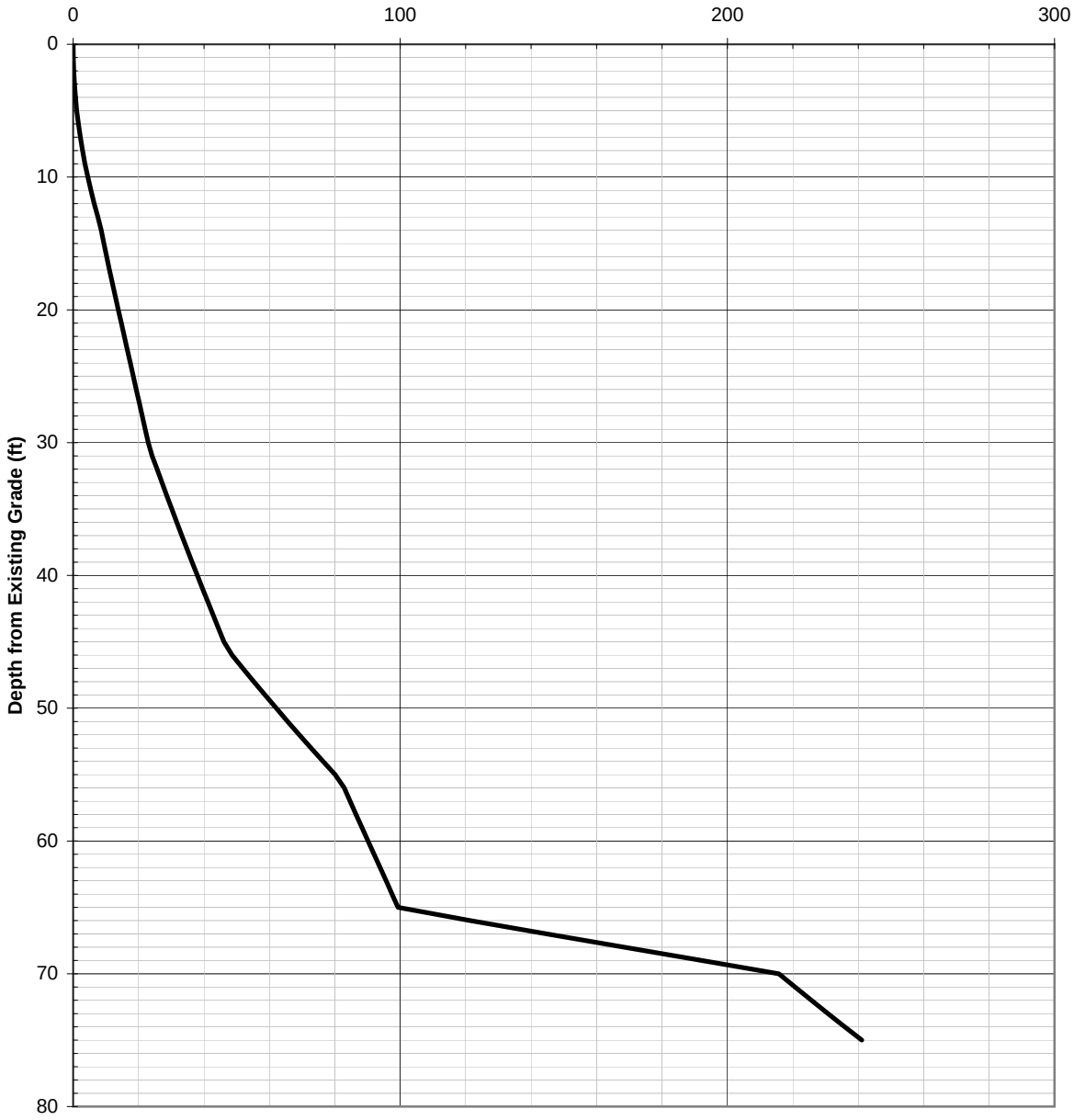
Graphs showing deflections, bending moments, and shear force for the piles under lateral loading are presented for driven and ACD piles for both fixed head and free head conditions.

A list of the plates presented in this appendix follows:

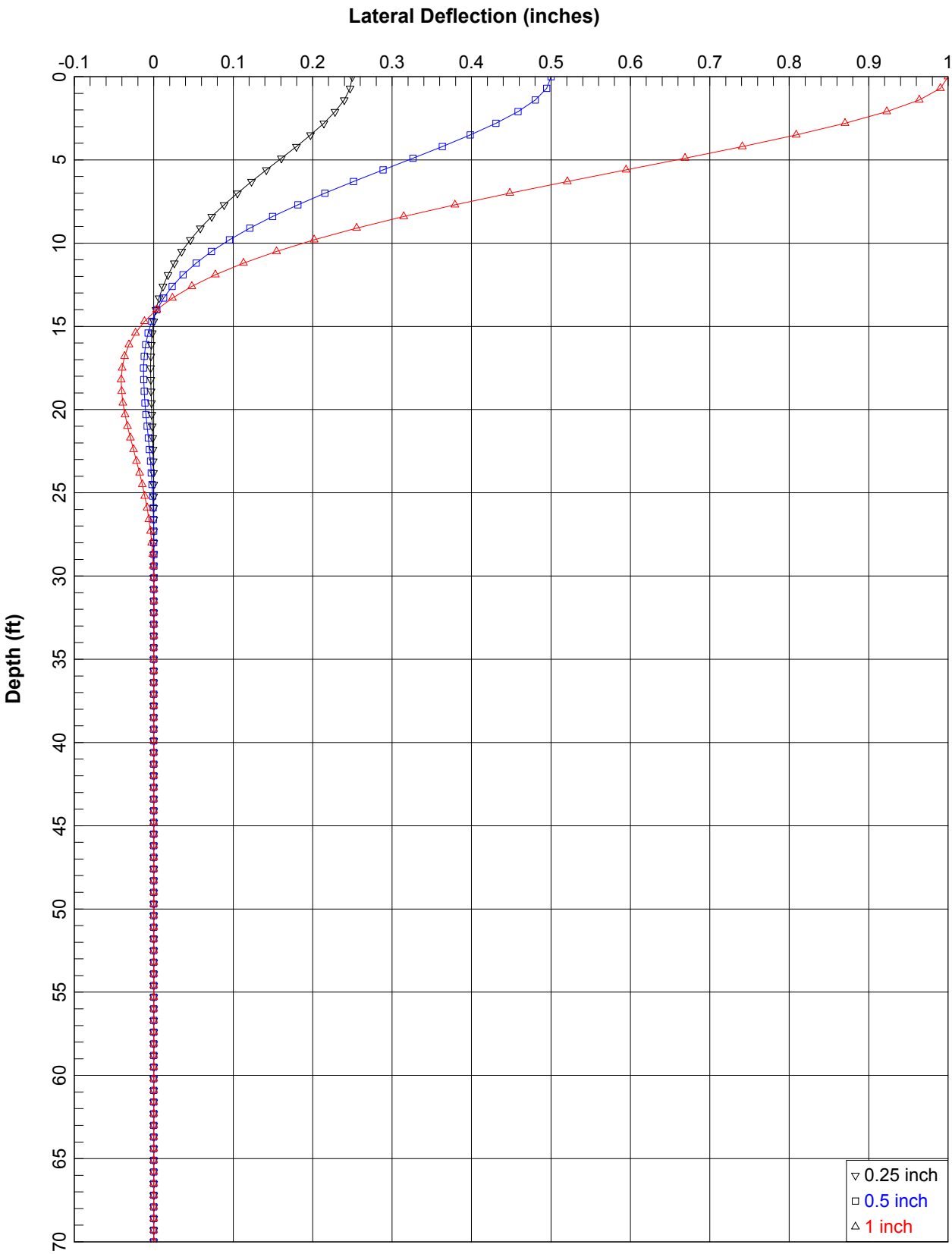
Plate J-1	Axial Capacity of 14-inch Square Driven Piles
Plate J-2	Axial Capacity of 14-inch Round ACD Piles
Plate J-3 thru J-5	Lateral Deflection/Bending Moment/Shear Force graphs for Driven Piles (Fixed Head)
Plate J-6 thru J-8	Lateral Deflection/Bending Moment/Shear Force graphs for ACD Piles (Free Head)
Plate J-9 thru J-11	Lateral Deflection/Bending Moment/Shear Force graphs for Driven Piles (Fixed Head)
Plate J-12 thru J-14	Lateral Deflection/Bending Moment/Shear Force graphs for ACD Piles (Free Head)



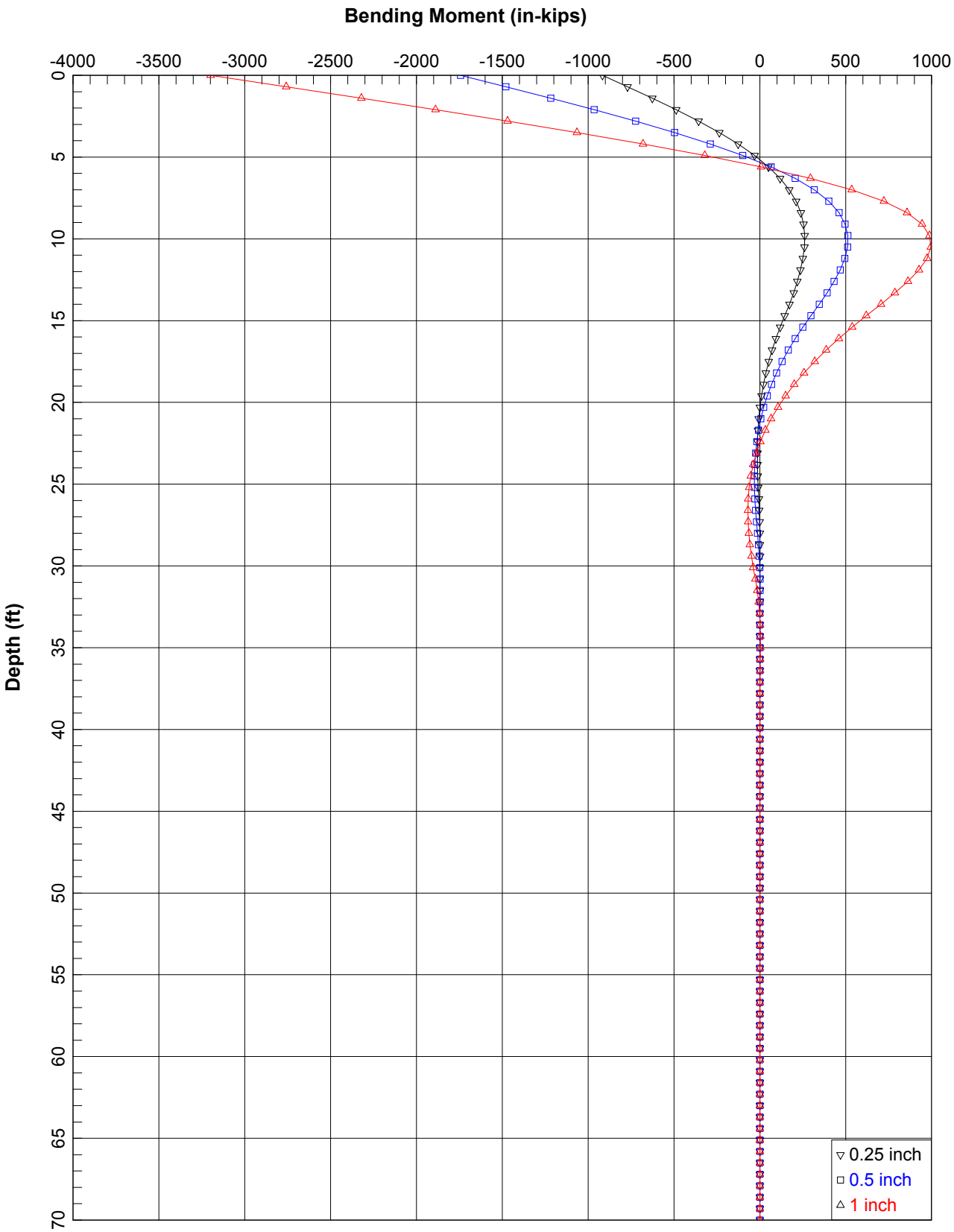
GROUP DELTA CONSULTANTS	Project	L962A - Ballona Creek Wetlands Restoration Project
	Pile Type	14-inch Square Driven Pile
	PLATE:	**J-1**



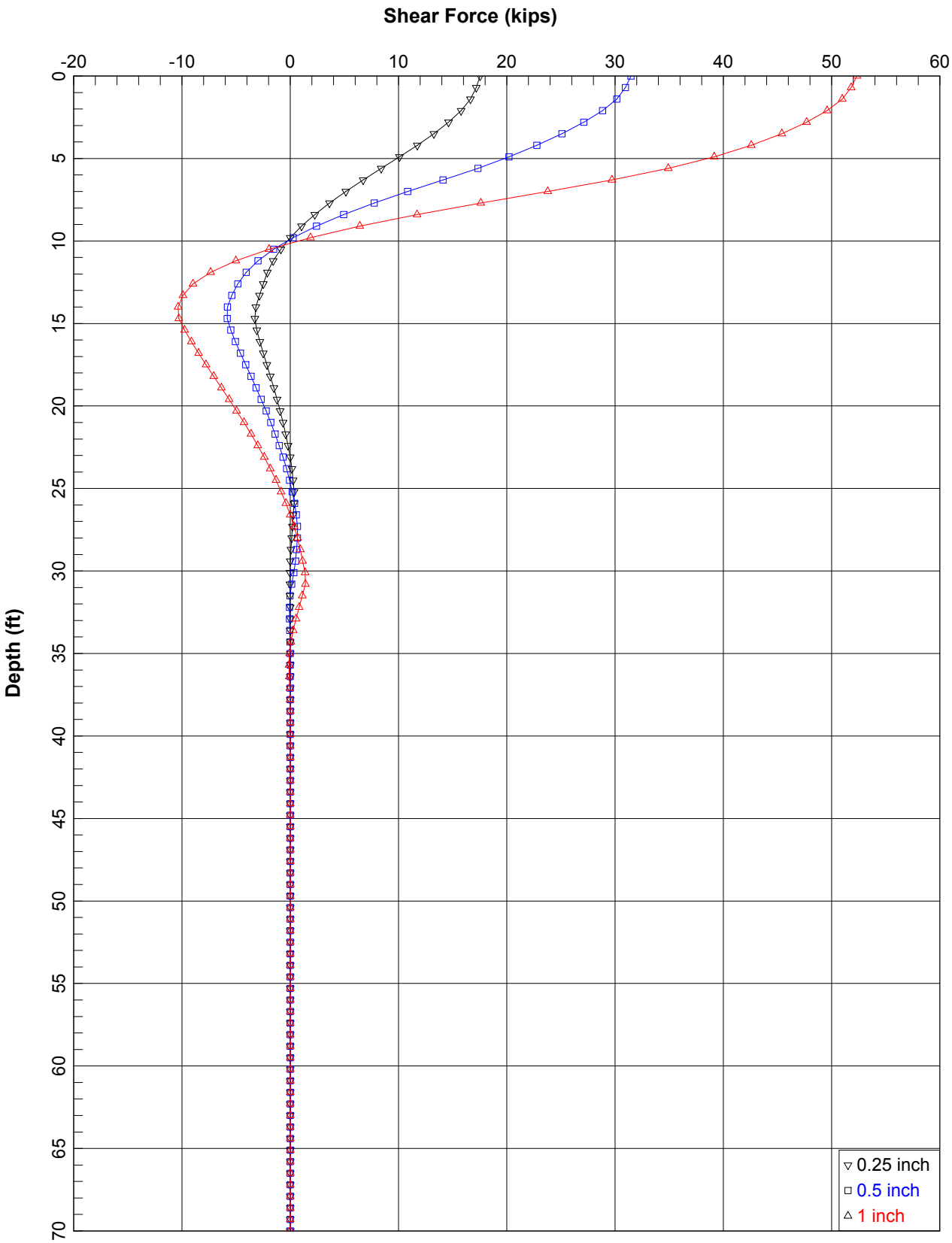
GROUP DELTA CONSULTANTS	Project	L962A - Ballona Creek Wetlands Restoration Project
	Pile Type	14-Diameter Auger Cast Displacement Piles
	PLATE:	**J-2**



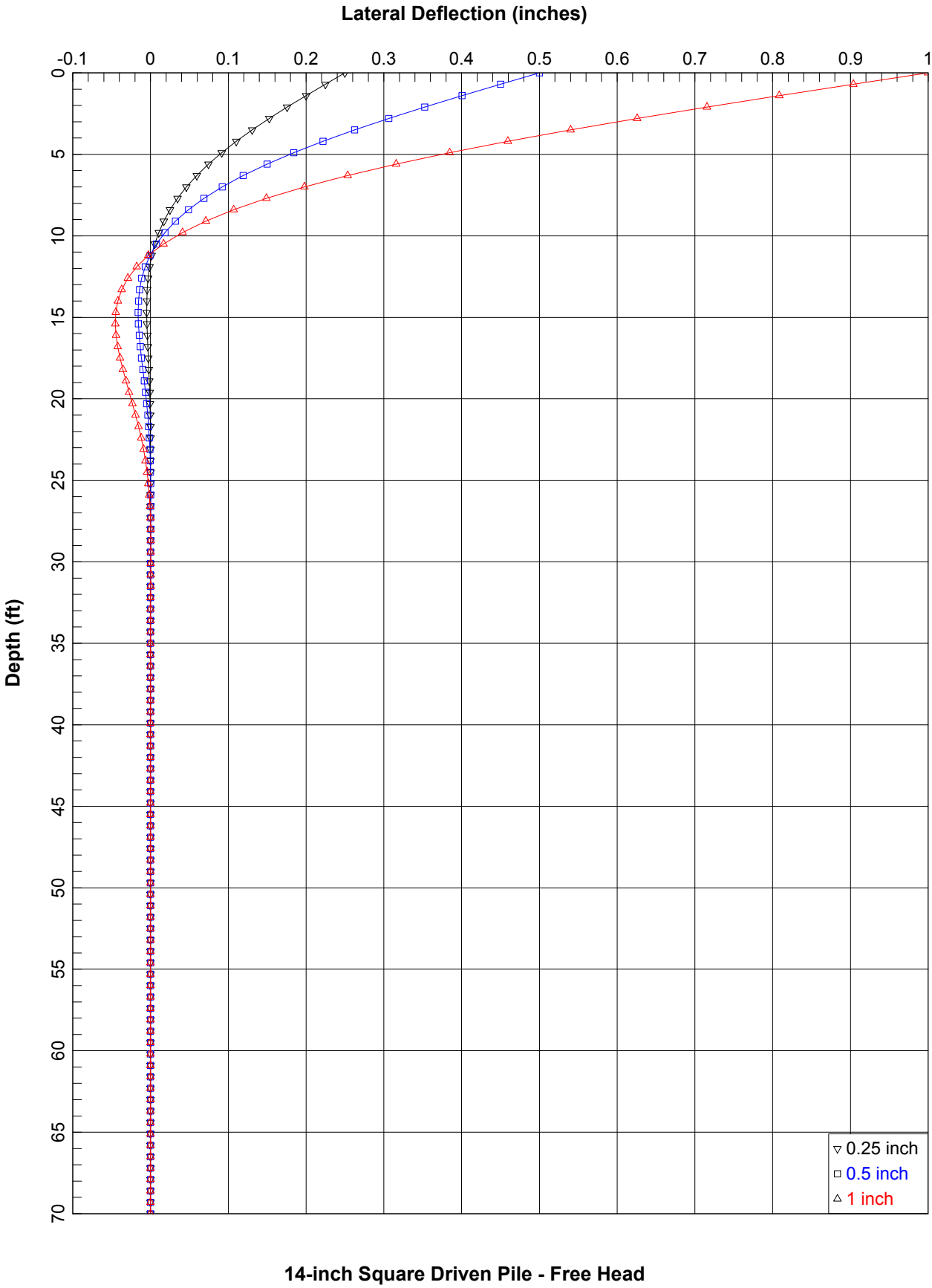
14-inch Square Driven Pile - Fixed Head



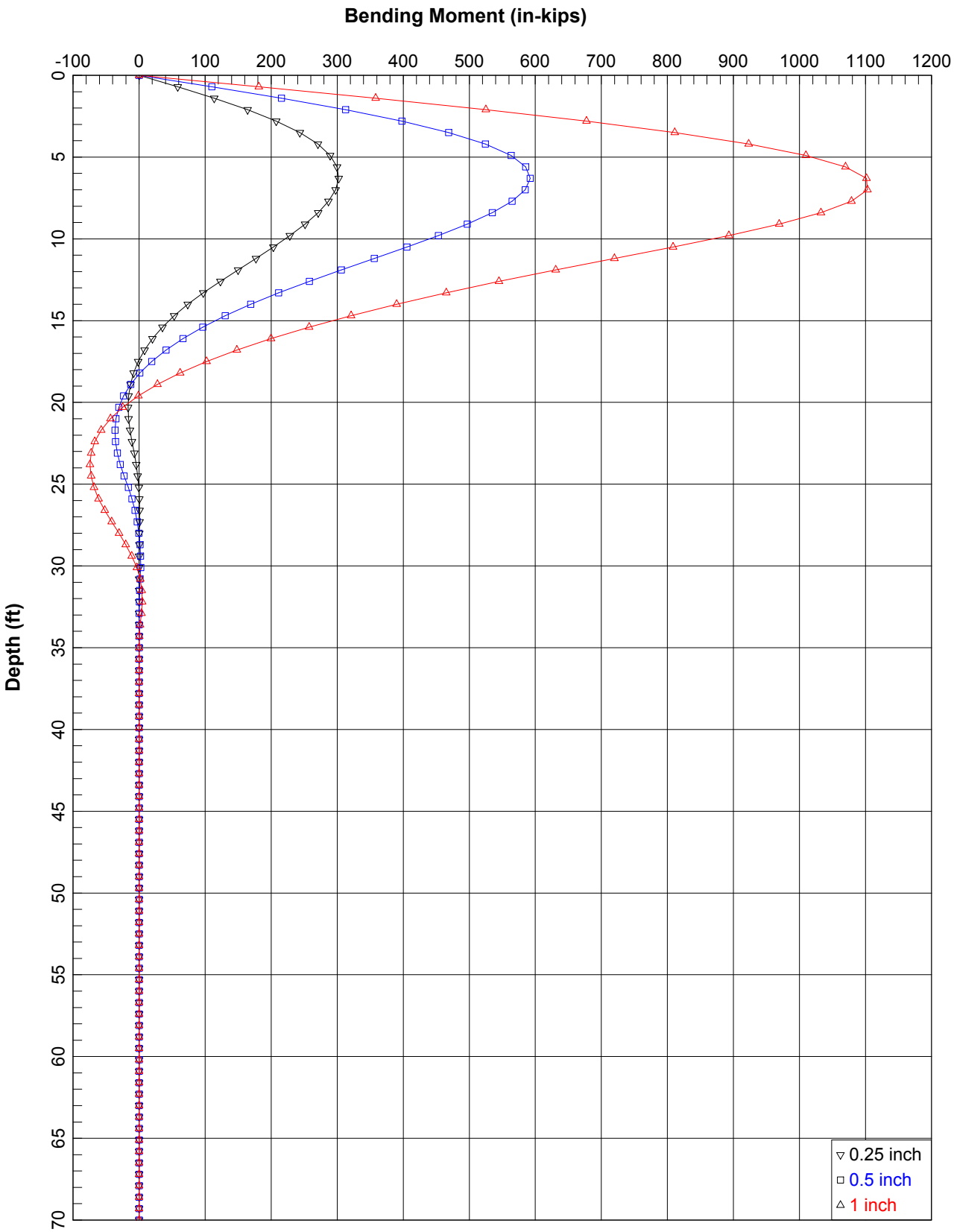
14-inch Square Driven Pile - Fixed Head



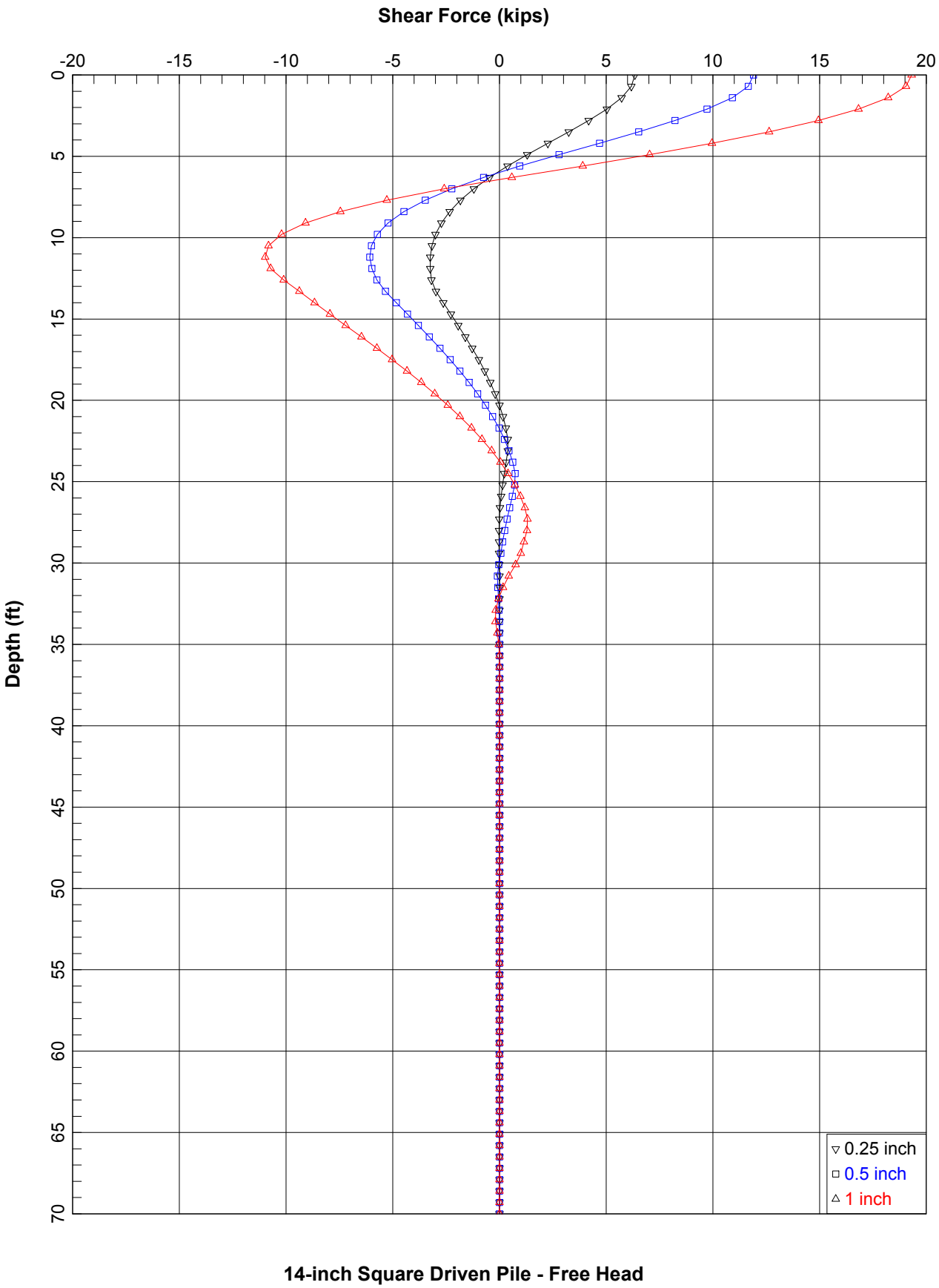
14-inch Square Driven Pile - Fixed Head



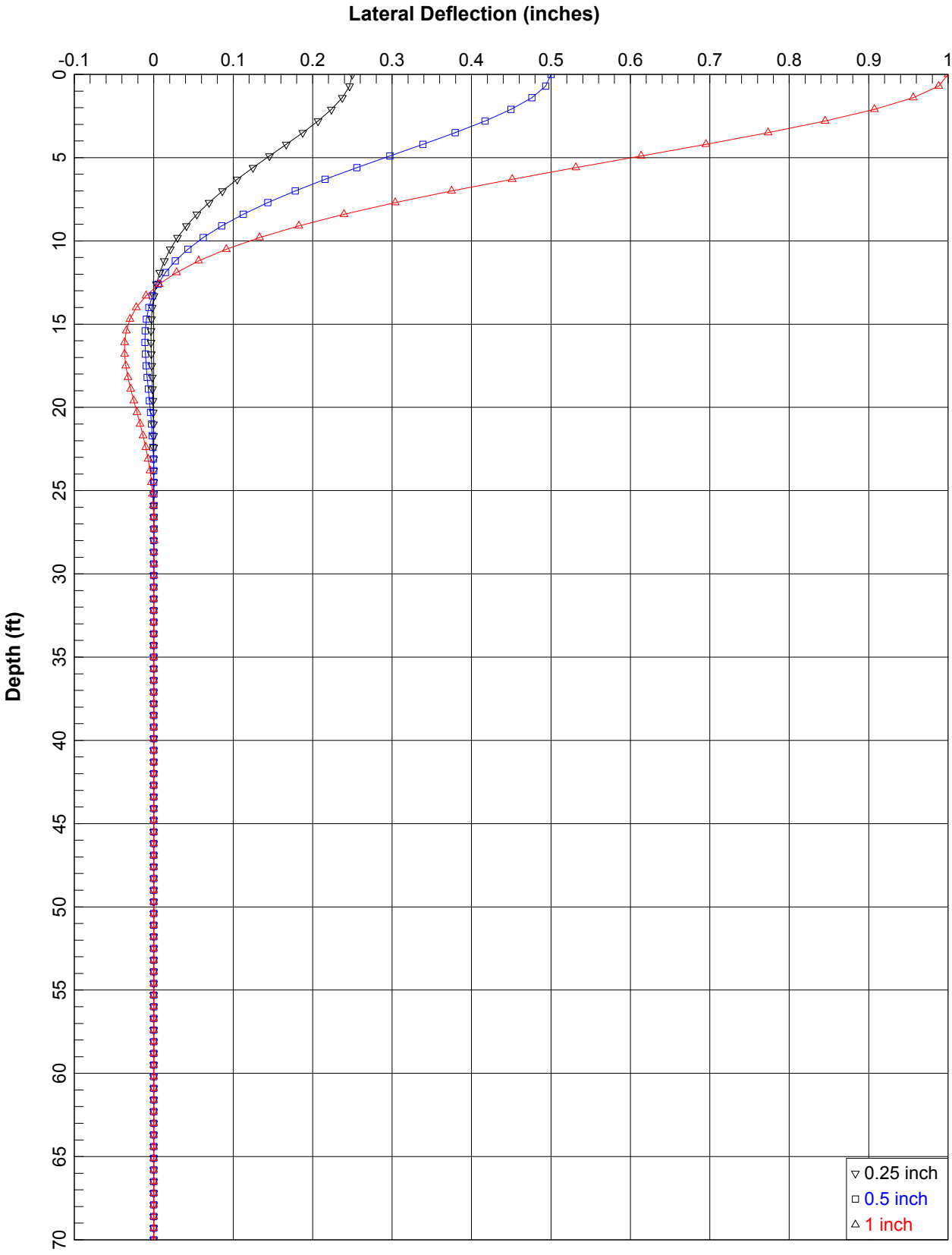
14-inch Square Driven Pile - Free Head



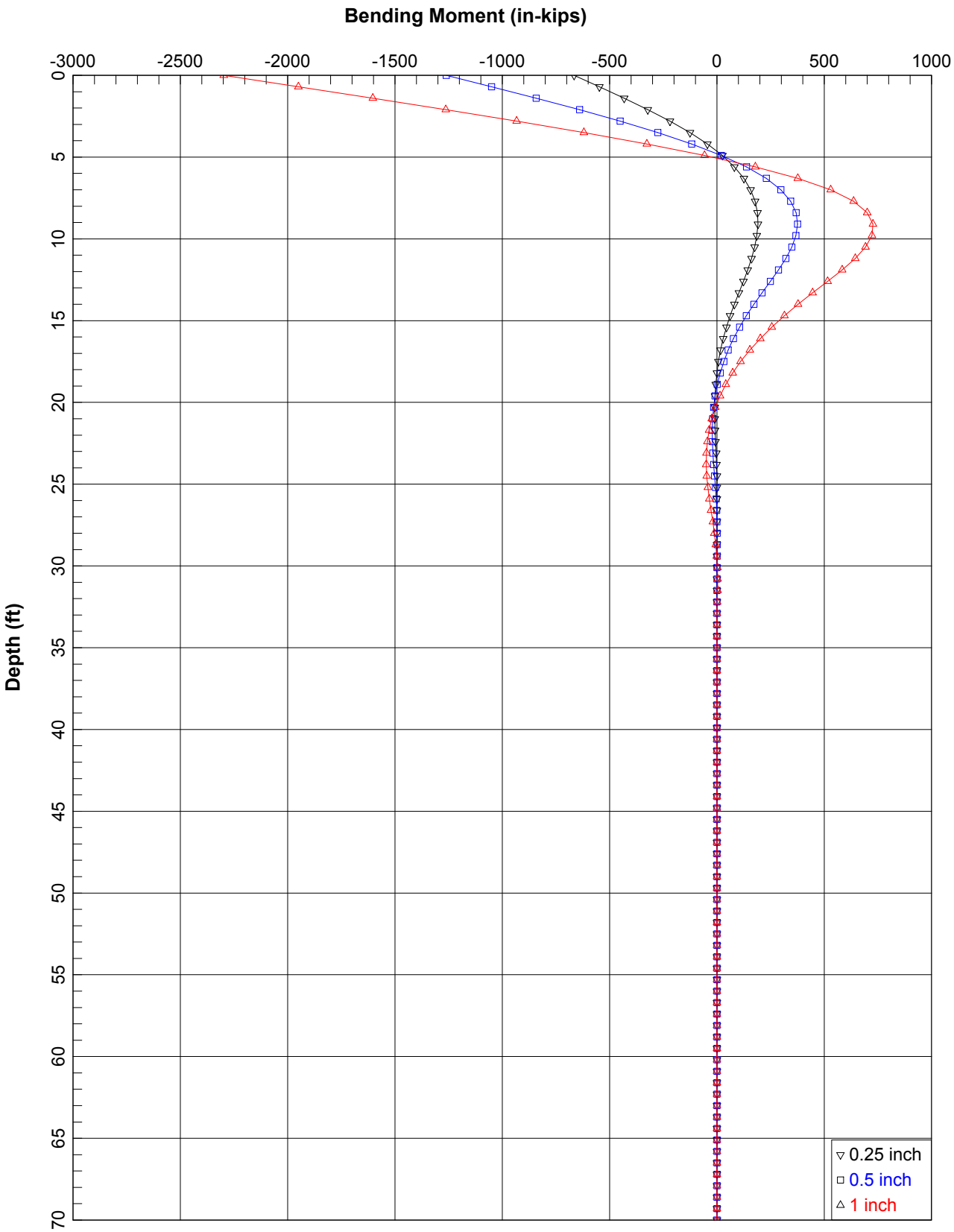
14-inch Square Driven Pile - Free Head



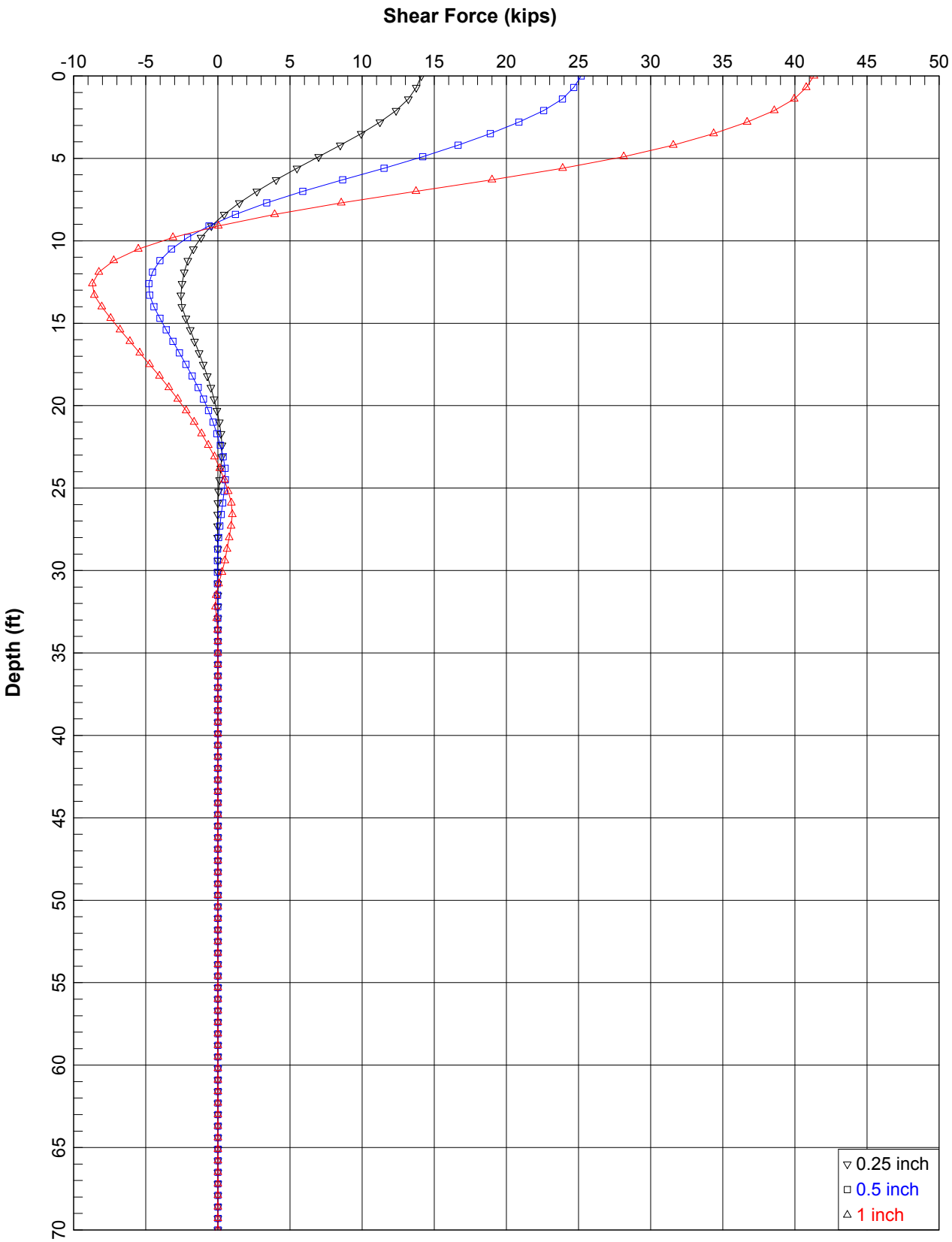
14-inch Square Driven Pile - Free Head



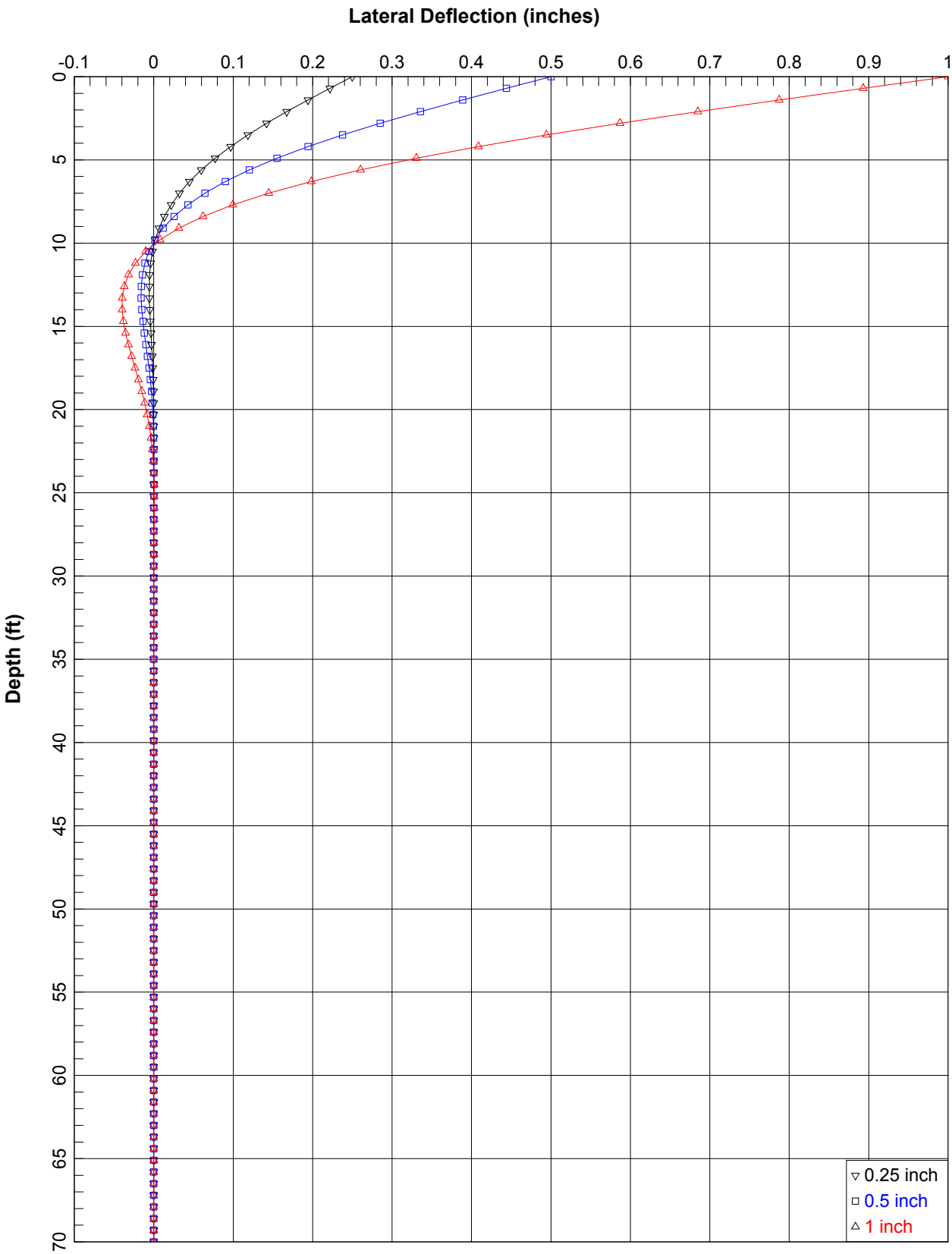
14-inch Round Auger Cast Pile - Fixed Head



14-inch Round Auger Cast Pile - Fixed Head



14-inch Round Auger Cast Pile - Fixed Head



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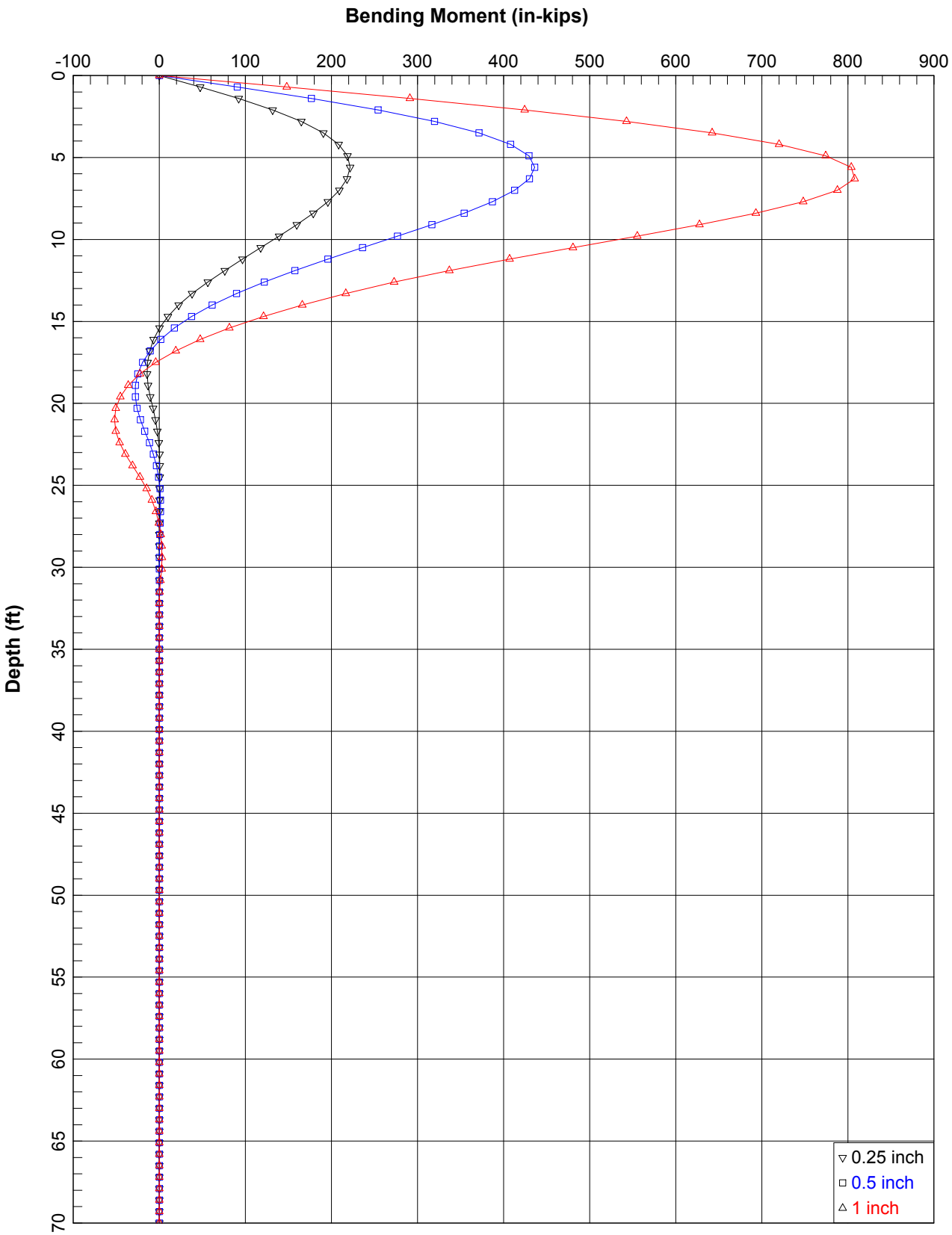
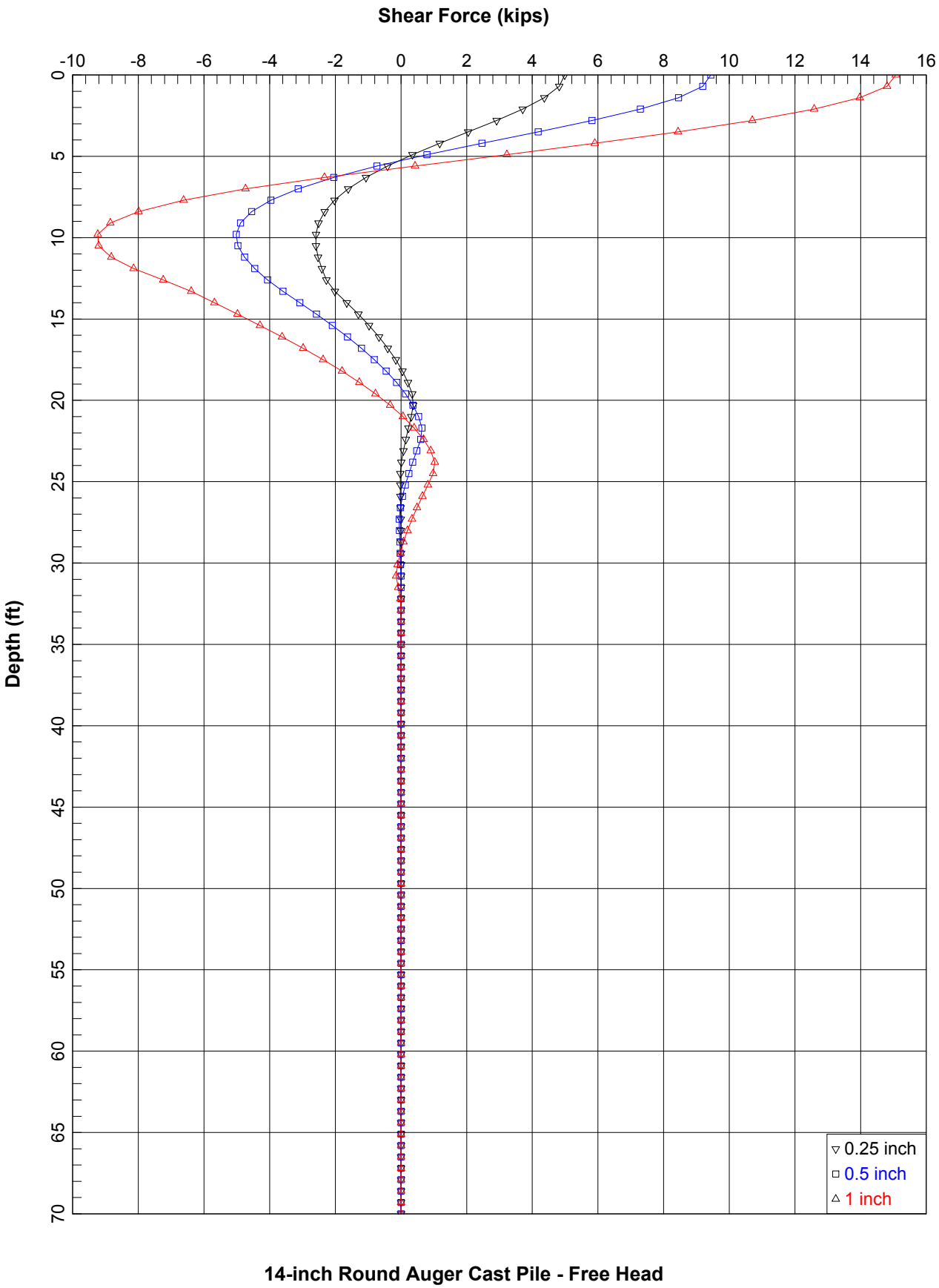


14-inch Round Auger Cast Pile - Free Head

PLATE J-13



14-inch Round Auger Cast Pile - Free Head

APPENDIX F
Hydrology and Water Quality

F1. Sediment Dynamics and Sediment Budget Analysis

F2. Summary of Results from Sediment Sampling and Analysis in Area B – Ballona Marsh, Draft Technical Memorandum

F3. Final Report – Ballona Wetland Preserve – Area A Preliminary Geotechnical Investigation and Beneficial Use Assessment

F4. Sediment Characteristics Sampling and Analysis Plan (SAP) for Ballona Wetlands

F5. Sediment Quality Investigation

F6. Water Quality Technical Report

F7. Hydraulics and Hydrology Report

F8. Hydraulic Modeling Addendum

F9. Draft Area B Managed Wetlands Preliminary Design

F10. Addendum 1. Sediment Transport Analysis

F11. Monitoring and Adaptive Management Plan

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APPENDIX F1
Sediment Dynamics and Sediment Budget Analysis

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memorandum

date May 15, 2015 – *updated 6/28/15*

to Mary Small, California State Coastal Conservancy

from Lindsey Sheehan, P.E., Nick Garrity, P.E., and Bob Battalio, P.E.

subject Ballona Creek and Wetlands Sediment Dynamics and Sediment Budget Analysis

This Sediment Dynamics and Sediment Budget Analysis assesses potential effects of the Ballona Wetlands Restoration Project on long-term deposition, erosion, and sediment transport patterns in the Ballona Creek channel, restored wetlands, Marina del Rey harbor entrance channel, and Santa Monica Bay for the purpose of assessing potential environmental impact for the Project EIR/S. The analysis builds on the results of other analyses in the separate Hydrology & Hydraulics Report (H&H Report; ESA 2013), Sediment Transport Analysis (ESA 2014), and Preliminary Design Report (ESA 2013 – update pending). Note that additional hydrologic analysis is anticipated to be performed for the U.S. Army Corps of Engineers Section 408 permit application (i.e., Section 408 Submittal B) and approval.

This analysis includes hydrodynamic modeling, geomorphic analyses, and estimates of potential changes in on-site and off-site erosion and deposition. The results of these analyses and the Sediment Transport Analysis sediment transport modeling results for a range of typical and extreme storm events are used to develop a sediment budget to estimate sediment deposition, erosion, and transport rates; equilibrium conditions; and the long-term potential effects over a series of years and storm events. The results of this analysis are also used to assess potential water and sediment quality effects in the Water Quality Technical Study.

The analyses assess both existing and proposed Project conditions to evaluate potential changes due to the Project. The Project conditions analysis focuses on the Proposed Action (Alternative 1) as the greatest change from existing conditions, and also discusses changes for Alternatives 2 and 3 based on the results for Alternative 1.

Section 1 presents the historic context of the existing system. Section 2 and 3 describe the hydrodynamic and sediment transport modeling and Section 3 presents geomorphic analyses for the fluvial, tidal, and coastal sediment transport processes. Section 4 compares Ballona to local reference sites and lastly, Section 5 summarizes the results and overall morphological development that is expected for the Ballona Wetlands Ecological Reserve under restored conditions.

1. HISTORIC PROCESSES

A brief discussion of the geomorphology of the historic Ballona Wetlands system is included for context. A more detailed assessment of the site evolution over geologic time is included in the Ballona Wetlands Existing Conditions Report (PWA and others 2006), the Ballona Wetlands Hydraulics and Hydrology Report (ESA PWA 2013a) and the Ballona Wetlands Historic Ecology Report (SCCWRP 2011). The Ballona Wetlands system has

developed over time due to geologic processes and human actions (see Attachment 1 for a detailed timeline from 1880 to 2012):

- Longshore sediment transport built a sand bar across the estuary as sea-level rise stabilized about 4000 years ago (4000 before present or BP).
- The Los Angeles River intermittently drained and delivered sediment to the Ballona estuary. There was frequent switching of its course between Long Beach and Ballona Creek. The sediment progressively filled in the estuary and formed wetlands (4000 – 200 BP).
- The Los Angeles River avulsed to its current location with its mouth at Long Beach (1825), where it was then channelized, which reduced storm flows and sediment delivery to Ballona (1884-1939). However, freshwater springs sustained much of the existing marsh (Dark et al 2011).
- The lagoon became constricted and seasonally closed due to longshore sediment transport, a smaller tidal prism (after establishment of the marshes), and the smaller storm flows (after the avulsion of the Los Angeles River). Attempts to create a harbor in the lagoon failed due to the large shoaling rates, which were greater than the available dredge capacity. Figure 1 shows the mouth of the lagoon located further south than the existing mouth.
- The Ballona Creek flood control channel and levees were constructed, disconnecting the remaining wetlands from tidal and fluvial inundation and sedimentation (completed in 1939). Shoaling occurred in the creek mouth before the jetties were constructed in 1938 (Figure 2 and Figure 3).
- The Marina del Rey breakwater and jetties were constructed (extending the Ballona Creek jetties), which reduced wave penetration and impacted the littoral sediment transport pathways (1959-1963)

The history of the Ballona Wetlands can be used to guide the design of the restoration; however, existing constraints must be considered as well. For example, although Ballona Creek was historically a seasonally closed lagoon system, the mouth of the Ballona Creek Flood Control Channel must be maintained open to protect the surrounding development from flooding.

2. HYDRODYNAMIC MODELING

ESA previously constructed an EFDC hydrodynamic model for the Ballona Wetlands to support the restoration planning process (PWA 2009, ESA PWA 2013a). The 2-D EFDC model was selected for application by the Project Management Team, Science Advisory Committee, the USACE, and ESA. The model was previously used in the Hydrology & Hydraulics Report to characterize the hydrodynamic response of various restoration alternatives, as well as to supplement 1-D hydraulic modeling analyses, the preliminary restoration design (ESA PWA 2013b), and to more closely examine some of the 2-D processes (plan-view, depth averaged), such as flow area, velocity, and bed shear stress (hydraulic) for Project Conditions. For model set up details, see the Hydraulics and Hydrology report (ESA PWA 2013a).

To further examine the 2-D processes effecting sediment transport, the model was run using the newest version of EFDC Explorer (version 7.1), which provides more model output and post-processing capabilities. The project conditions model was revised to use the project topography from the Preliminary Design Report (PDR; ESA PWA 2013b) and run for the 10- and 100-year storm events. Maps of hydraulic shear stress at the bed during the peak of the storm were exported to GIS for both runs (Figure 4) to use in the analysis of marshplain erosion (Section 4.1.4). Note that the high shear in the channel upstream of the site is due to a high point in the topography. During a major event, this will likely be flushed from the system.

3. SEDIMENT TRANSPORT MODELING

ESA conducted sediment transport modeling using HEC-RAS to look at sediment transport for the estimated effective discharge (Q_{eff}), 5-year discharge (Q5), 100-year discharge (Q100), and the channel design event (46,000 cubic feet per second (cfs) with a 7.63 ft NAVD tide boundary condition) to inform further design development (ESA PWA 2014). The following conclusions were drawn from the modeling:

- Sediment supply to the project site is low relative to the sediment transport capacity and the site can be characterized as generally sediment supply-limited. Sediment transport model results support this conclusion, with all sensitivity runs generally showing more potential for scour than for sediment deposition under existing conditions.
- Since the channel was constructed, the profile has been relatively stable, although some scour is observed immediately downstream of the end of the concrete channel lining.
- Baseline conditions model results over-predicted scour relative to the observed channel profile at the concrete to earthen channel bottom transition as well as in the vicinity of the existing bridges. This result suggests that either the grain size distribution of bed sediments is higher than what was sampled and modeled (Figure 5), or that other factors such as channel armoring and/or buried coarse sediments have historically mitigated scour potential during flood events.
- Project conditions model results show that at the channel bottom transition from concrete to earthen, the change in scour relative to existing conditions is within 0.1 ft for a 100-year event suggesting minimal changes between existing and project conditions.
- Project conditions model results demonstrate local increases in shear and erosion, caused by channel expansion and contraction at the upstream and downstream ends of the project reach.

4. SEDIMENT BUDGET AND GEOMORPHIC ANALYSES

ESA performed a geomorphic analysis to assess how the site will develop and evolve over time in response to the restoration and physical processes. Fluvial flood events, tidal action, and coastal sediment transport processes are examined below.

4.1 FLUVIAL FLOOD EVENTS

During a storm event, Ballona Creek conveys flood water and sediment from the watershed to Santa Monica Bay. The amount and size of the sediment, as well as historic scour and deposition analyses, can help determine where channel sediment is being transported, while hydraulic geometry relationships can provide estimates of channel equilibrium dimensions. These analyses are detailed below.

4.1.1 Ballona Creek Sediment Yield (Sediment Supply)

Sediment yield estimates for Ballona Creek vary widely in the literature (Table 1). The USACE (2003, 2009) presents values around 60,000 cy of sand per year, but it is unclear how these estimates were derived. Moffat & Nichol (1999) calculated a sediment yield value based off the Department of Water Resources 1969 report, which estimates the sand yield of Ballona Creek using a method that does not require sediment data and is based on discharge data from 1928-1950 only. Noble's 2013 Sediment Management Plan shows a sediment yield of

49,500 cy/yr, but details of the analysis are presented in the USACE's Coast of California Storm Waves and Tidal Study for Los Angeles Region, which is not yet available to the public.

TABLE 1
BALLONA CREEK SEDIMENT YIELD ESTIMATES

Source	Average Sediment Yield (cy/yr)	Method/Source	Note
ESA PWA	8,240	Based on channel surveys	Total load
ESA PWA	9,100	Based on suspended sediment rating curve derived from suspended sediment measurements collected by LACDPW (1999 - 2011) and SCCWRP (2001 - 2004) and USACE flood frequency analysis + 10% for bedload. Assumes a density of 1.15 ton/cy	Total load
Inmann & Jenkins, 1999	14,100	Based on suspended sediment rating curve of a similar watershed and gage data at USGS 11103500 (data from 1944-1995)	Total load
Leidersdorf, 1994	46,000	CA Dept of Naval and Ocean Development 1977 (update of 1969 report)	Fine sand
Noble, 2013	50,000	Analysis described in USACE's Coast of California Storm Waves and Tidal Study for Los Angeles Region, which is not yet available to the public	Fine grained sediment
M&N, 1999	46,000	Based off sand from SCCWRP, 1973, which was based off DWR, 1969	Sand
	5,000	Based off State of California, 1977	Silt
USACE, 2003	58,350	Method not documented; citation not included	unknown
USACE, 2009	60,000	Method not documented; citation not included	unknown

Inman and Jenkins (1999) estimated a sediment yield around 14,000 cy/yr using a sedimentation curve from a reference watershed and flow rates from Ballona Creek. In the Ballona Creek Hydraulics and Hydrology report (2013a), ESA calculated a sediment yield value of 8,530 cy/yr using a suspended sediment rating curve derived from suspended sediment measurements collected by LACDPW (1999 – 2011) and SCCWRP (2001 – 2004) and flow data from 1989 to 2009 and an estimate of bed (10% of suspended load). This assumed a density of 1.3 ton/cy.

ESA updated the sediment yield estimate for this analysis. Additional site data shows that the density is closer to 1.15 ton/cy at Ballona. Using the USACE flood frequency analysis (USACE 2010) combined with the rating curve, sediment transport for each storm was calculated and then weighted by the return frequency to find an average sediment yield that includes larger storms than in the 1989 to 2009 flow data used previously. Assuming an additional 10% of sediment is transported as bedload, this results in a sediment yield of 9,100 cy/yr.

ESA calculated a second value of 8,240 cy/yr of deposition in the Ballona Creek channel based on the difference between channel surveys from 1961 and 2012 (see Section 4.1.3). Since 1988, there have only been one Q5 event in 1998 and one Q10 storm event in 1994 in Ballona Creek. Hydraulic modeling shows that the channel bottom is relatively stable during storms of Q5 or smaller within the site (ESA PWA 2013), so since the Q10 storm in 1994, sediment has likely not been eroded out of the system. Assuming sediment from all storms since 1994 has accumulated in the channel, it can be estimated that Ballona Creek provided about 8,000 cy/yr between 1994 and 2012. Since some sediment leaves the system during storms, this is likely an underestimate.

Inman and Jenkins' and ESA's methods resulted in lower sediment yields than the other literature estimates, but use more recent, site-specific data. Since the ESA suspended sediment rating curve method uses the most recent data, a sediment yield of 9,100 cy/yr is used going forward in this memo.

The sediment transported via natural streams, creeks, and storm drains to the Santa Monica and Venice beaches is estimated to be 5,690 cy/yr (Moffatt and Nichol, 1999). Since the watershed surrounding Dockweiler beach has similar land uses, it is assumed that the same amount of sediment is transported to the littoral zone near Dockweiler beach as well.

The sediment yield from the Ballona Creek watershed is not expected to change under project conditions. In the future, climate change could increase storm frequency, which could increase sediment yield.

4.1.2 Sediment Size

As part of the Ballona Creek Sediment Control Management Plan (USACE 2003), the USACE collected a series of 20 sediment samples from Ballona Creek and its tributaries, and analyzed the samples for grain size distribution (GSD). A composite GSD for the creek was derived for sediment transport analyses and is shown in Figure 5. Sediments coming from Ballona Creek are 20% silt, 65% sand, and 15% gravel (USACE 2003).

Sampling data collected from 2007 – 2009 by SCCWRP, in 2011 and 2012 by the City of LA, and in 2012 by ESA show gravelly sediments upstream and sandy sediments with some silts downstream (Figure 5 and Figure 6). The proportion of sand in the samples increases going downstream, while the percentage of gravel decreases. Silt varies along the channel through time and may be dependent on storm and wave events.

Figure 7 shows the median diameter of sediment (D50) within the marina, based on sampling data from 2010-2012. The data show sediments in the north entrance tend to be sandier than those in the south entrance (more yellow, light orange in the north, indicating larger sediment sizes), as would be expected with net littoral transport to the south and the proximity of the entrance to the north beach (Kinnetic Laboratories 2010; AMEC 2012). However, silt is evenly spread through the mouth of the marina (equal reds, or smaller sediment sizes, throughout), and not just in front of Ballona Creek, as would be expected with a high sediment yield (Section 4.1.1).

Sand from the shoal in the mouth of the creek shows characteristics similar to the sand on the beach and the marina (Figure 5), suggesting that the shoal is formed from the tides and the occasional southern swells (Section 4.3.4). While fluvial events likely contribute sand of a size consistent with the shoal, the pattern of deposition in the channel indicates the primary drivers are waves and possibly flood tides (see Section 3.3). Note that when river flow rate is sufficient to transport sand all the way to the mouth, there is no physical reason for the sand to stop moving within the jettied creek channel under river flows only- the sand should deposit in a deltaic or splay pattern beyond the jetties. Hence, the contribution of sand-sized sediment by creek sediment yield is not really pertinent to shoal formation.

4.1.3 Fluvial Channel Scour and Deposition

The locations of fluvial scour and deposition in a channel are dependent on sediment yield or availability (Section 4.1.1), channel dimensions and materials, storm events, and tidal action (see Section 4.2). The effect of waves on channel morphology is considered negligble except at the mouth where the sand shoal exists (Section 4.3). This section examines historic data (Section 4.1.3.1), channel hydraulic geometry relationships (Section 4.1.3.2), and

sediment transport modeling (Section 4.1.3.3) to predict how Ballona Creek will change in response to storm events under project conditions.

4.1.3.1 *Historic Data*

Change in bathymetric surveys over time can help identify locations of scour and deposition. The Ballona Creek as-built survey from 1961 and the 2012 survey by PSOMAS (USACE 2003; ESA PWA 2013b) were compared to look at accretion within the channel. Figure 8 presents the five different historic sediment transport reaches:

- A slightly depositional reach exhibiting both erosion and deposition (Station 23070 to 16500)
- An erosional reach immediately downstream of the terminus of the concrete channel lining (Station 16500 to 14350), which includes a scour hole at the transition to the earthen channel bottom
- A depositional reach (Station 14350 to 7850)
- A slightly depositional reach exhibiting both erosion and deposition (Station 7850 to 2200)
- A depositional reach with channel shoal in the mouth of the creek (Station 2200 to 0)

The existing conditions sediment transport modeling in the H&H report (ESA PWA 2013a) shows similar patterns.

4.1.3.2 *Hydraulic Geometry Relationships for fluvial transport*

Another method used to predict channel geomorphology is to calculate the equilibrium channel dimensions using hydraulic geometry relationships. Empirical hydraulic geometry relationships between channel size (cross-section dimensions) and flows provide an estimate of the equilibrium channel dimensions that would form in sediment transport-limited conditions (i.e., with enough sediment in the system to deposit in the channel and reach equilibrium with tidal and fluvial flows).

Two methods were used to determine the predicted channel size under fluvial conditions: estimation of dominant discharge based on fluvial sediment transport analysis and the use of regional regressions to estimate bankfull channel width and depth for fluvial regimes. More details about this analysis can be found in Appendix 3 of the Ballona Wetlands Hydraulics and Hydrology Report (ESA PWA 2013a).

The set of fluvial-based methods produces a range of estimated channel cross sections from approximately 103 feet wide, based on dominant discharge, to 105 – 170 feet wide based on empirical regression equations. Channel depths range from 5-6 feet. The existing channel is much larger than these estimates (about 300 feet between levees and about 12.7 feet deep at high tide (MHHW)), and if there was more sediment in the system (under sediment transport-limited conditions), the channel would be expected to fill in to these dimensions.

TABLE 2
FLUVIAL ESTIMATES FOR CHANNEL DIMENSIONS

	Cross-sectional Area (ft^2)	Width (ft)	Bankfull Depth (ft)
Existing Conditions	4,500 – 5,000	350 - 400	10 - 15
Existing Conditions with “unlimited” sediment supply (i.e., sediment transport-limited conditions)	518	105 - 171	5.1- 6.4

Since fluvial flows are not expected to be altered by the project, these channel dimension estimates are the same for project conditions.

4.1.3.3 *Sediment Transport Modeling*

The sediment transport modeling (Section 3) was used to estimate how accretion and erosion in the channel might change under project conditions due to the widened channel cross sections across the marsh. Figure 9 presents the sediment transport reaches under project conditions:

- An erosive reach just upstream of the Culver and Lincoln bridges (Station 11600 – 10200). When flood waters enter the site just downstream of this reach, the water expands across the marsh and slows down. This causes water behind it to "pile-up" and cause erosion.
- A depositional reach downstream of the Culver and Lincoln bridges (Station 10200 – 7200). When the waters expand across the marsh, they slow and sediment can deposit.
- An erosive reach at the channel convergence caused by the levee peninsula in Area B and the south Marina del Rey levee at the downstream end of Area A (Station 7200 – 4900). As the water is forced back into the channel at this point, velocities increase and cause scour.
- A depositional reach in West Area B (Station 4900 – 3800). Waters expand into West Area B and slow, allowing sediment to drop out.
- An erosive reach at the channel convergence at the downstream end of the site (Station 3800 – 2250). The water is forced back into the channel again, causing velocities to increase and the channel to scour.

The erosion and deposition in these areas were quantified from the model and are included in the sediment budget in Section 6.1.

4.1.4 Fluvial Marshplain Scour and Deposition

Under existing conditions, the marshplain in Area B is protected from erosion due to fluvial events by the levee and self-regulating tide (SRT) gate. This is because the SRT gate does not allow high river flows to enter the Area B. Similarly, the SRT gate limits the amount of sediment that can enter the wetland system from the creek, so deposition is minimal. The following sections describe the scour and deposition analyses for project conditions.

4.1.4.1 *Scour*

On the marsh plain and along the channel banks, some erosion is expected during major storm events. The hydrodynamic modeling in Section 2 calculated where the highest areas of shear stress are expected to occur during the 100- and 10-year events (Figure 4). Ganthy (2011) and Simon and Hanson (2001) derived equations relating shear stress to erosion based on lab tests of field cores and in situ jet-testing measurements respectively. Ganthy proposes:

$$\boldsymbol{E = E_0\left(\frac{\tau_0}{\tau_{cr}} - 1\right)^{\alpha}}$$

where E is erosion in g/m^2-s, E_0 is erosion at the critical shear stress in g/m^2-s, τ_0 is shear stress in pascals (Pa), τ_{cr} is the critical shear stress in Pa, and α is an empirical constant. Simon and Hanson propose:

$$\boldsymbol{E = k_d(\tau_0 - \tau_{cr})}$$

where E is erosion in m/s, k_d is an erodibility coefficient in m^3/N-s, and τ_0 and τ_{cr} are in Pa. The erodibility coefficient can be calculated based on the critical shear stress as:

$$k_d = 0.2\tau_{cr}^{-0.5}$$

where k_d is in cm^3/N-s and τ_{cr} is in Pa.

Table 3 shows the critical shear stresses estimated for Ballona as well as values found in the literature. In 2012, Sea Engineering collected cores from North Area B and in the creek upstream of the Culver Blvd bridge to analyze in the lab (2013). Using the Sedflume analysis, varying flows were passed over the cores and erosion was measured. Additional samples taken throughout the site by Group Delta (2013) were analyzed for sediment characteristics in the lab, including bulk density and grain size distribution. Grabowski (2011) and Ahmad (2011) propose methods for using these characteristics to estimate the critical shear stress of the materials. Ganthy (2011) and Simon and Hanson (2001) offer estimates of critical shear stress for other sites, which provide a comparison to the Ballona estimates.

TABLE 3
CRITICAL SHEAR STRESS RANGES

Method	Critical Shear Stress (Pa)	Source	Note
Lab tests of field cores at Ballona	0.16 – 0.8	Sea Engineering (2013)	Critical shear stress increased with depth of core
Based on wet bulk density	0.51 – 0.8	Grabowski (2011)	Based on bulk density of samples from Ballona
Based on sand size and % mud	0.09 – 0.14	Ahmad (2011)	Based on sand size and % mud of samples from Ballona
Lab tests of field cores along French Atlantic coast	0.18 – 3.04	Ganthy (2011)	
In situ jet-testing in the Midwestern USA	0.38 – 400	Simon and Hanson (2001)	

Combining the equations above with the estimates of critical shear stress for Ballona provides a method to calculate erosion from the modeled shear stresses. Figure 10 presents the maximum erosion rates (Ganthy equation with a critical shear stress of 0.18 Pa- the lowest value applied by Ganthy) spatially at the peak of the 100- and 10-year storms. The high shear in the channel upstream of the site is due to a high point in the topography, which will likely be flushed from the system under a major storm event. Shear stress time series (Figure 11) were extracted to look at the total erosion over the course of the storms at the points marked in Figure 10. The Ganthy method was applied with the lower end critical shear stress to the point along the channel bank where modeled shear stress is highest to yield a conservatively high estimates of erosion assuming no vegetation on the marsh (Table 4). These conservatively high estimates show erosion of of 34 and 26 in over the duration of the 100- and 10-year storms, respectively.. The Simon and Hanson equation predicts up to 15 and 11 in of erosion during the 100- and 10-year storms respectively, so the Ganthy equation was chosen as the more conservative estimate.

During a 100-year event, erosion is expected, however, the erosion analysis shows that even under such extreme conditions and using conservatively high assumptions, the highest shear stresses are limited to areas along the channel banks and are estimated to cause less than 3 ft of erosion. Additionally, once vegetated, erosion on the marsh will be limited by vegetation, as the roots will help hold the sediment in place. Fischenich (2001) estimated the critical shear stress of short vegetation to be 40 Pa and tall vegetation to be 65 Pa. This would reduce the highest estimated amount of erosion on the marshplain to 26 and 19 in under the 100- and 10-year

storms respectively, assuming short vegetation (Table 4). Additionally, the project design includes armoring with three different levels of protection, and these estimates do not consider any armoring, which would decrease channel bank erosion.

TABLE 4
MAXIMUM EROSION USING GANTHY (2011)

	No vegetation		With Vegetation	
Location (Figure 9)	**10-year erosion (in)**	**100-year erosion (in)**	**10-year erosion (in)**	**100-year erosion (in)**
South bank at first channel meander (upstream expansion)	26	34	19	26
South bank at channel reconvergence	23	24	18	20
Marsh south of reconvergence	6	8	0	7

Notes: These rates use the Ganthy (2011) equation and a critical shear stress of 0.18 Pa for No Vegetation. With Vegetation, a critical shear stress of 0.8 Pa is used to represent vegetation until 40 Pa is reached and the vegetation is expected to erode away (Fischenich 2001). Then the critical shear stress drops to 0.18 Pa to represent unvegetated sediment.

The shear stress time series extracted from the points in Figure 10 were applied across the site to calculate the total erosion during the 10-year and 100-year events. The time series from the point at the channel reconvergence, which had the longest inundation duration of the three points, was applied to the entire low marsh, where flood waters would remain the longest (hatching in third panel of Figure 12 and Figure 13). The time series from the point on the south bank at the first channel meander was applied to the entire south bank at the meander (cross-hatch in third panel of Figure 12 and Figure 13). The shortest duration time series was from the point on the marsh south of the reconvergence and this time series was applied to the higher marsh elevations (outlined in black in the third panel of Figure 12 and Figure 13). The Ganthy equation was applied across the site using the these durations of erosion and the spatial grid of peak modeled shear stress and accounting for the effect of vegetation on reducing erosion (as described in Table 4 notes). The resulting erosion map (third panel) was used to analyze the habitats that would remain after a 100-yr and 10-year event (Figure 12 and Figure 13 respectively- second panel). During the 100-year event, erosion would lower parts of West Area B and along the channels in Area A and North Area B from mid marsh elevations to low marsh elevations and transition zone to high marsh elevations. During the 10-year event, erosion would result in similar changes between habitat types/elevations but to a lesser extent.

4.1.4.2 *Deposition*

In certain areas of the marsh where the velocities are slow, some deposition is expected during storm events. Most of the sediment that enters the wetland system will be brought in during storm events, and in areas experiencing velocities slower than the settling velocity of the sediment, the sediment is expected to drop out onto the marsh. Cahoon et al (1996) estimated that 0.64% of sediment yield was deposited on the marsh during storm events for creek mouth tidal wetlands. To roughly (and conservatively for erosion) approximate the amount of sediment being deposited at different locations at Ballona, the estimate of 0.64% was applied to the total sediment yield to estimate the volume of deposition. The total was then divided among the different slow-flowing marsh areas (Table 5). The areas in the marsh were roughly weighted based on the relative shear stresses during the 10-year storm event (Figure 4). For example, the high marsh at the upstream end of Area A experiences a slow moving eddy during large storms, which would result in more sediment dropping out than in areas where the flow moves faster, so 1/3 of the sediment in the system was attributed to this area. Similarly, in West Area B, shear

stresses are low, so 1/3 of the sediment was attributed to that area. The remaining 1/3 of the sediment was split between the downstream half of Area A and the part of West Area B along the channel, both of which experience slightly greater shear stresses (Figure 14). Because Ballona Creek is a sediment-limited system (Section 4.1.1), deposition is predicted to be minimal.

TABLE 5
MARSH DEPOSITION BY STORM EVENT

	Qeff-4650 cfs (cy)	Q2 (cy)	Q5 (cy)	Q10 (cy)	Q25 (cy)	Q50 (cy)	Q100 (cy)	Average Year (cy)
Total (based on 0.64% of sediment yield)	12	36	54	66	78	94	106	53
Area A, upstream high marsh (1/3 total)	4	12	18	22	26	31	35	18
Area A, downstream high marsh (1/6 total)	2	6	9	11	13	16	18	9
Area A, along channel	0	0	0	0	0	0	0	0
Area B, upstream along channel	0	0	0	0	0	0	0	0
Area B, downstream along channel (1/6 total)	2	6	9	11	13	16	18	9
Area B, west (1/3 total)	4	12	18	22	26	31	35	18

Note: Total marsh deposition based on Cahoon et al 1996.

4.2 TIDAL ACTION

Under exiting conditions, the tides at Ballona Creek contributed to sedimentation in the oversized creek. Under project conditions, tidal channels will be sized to accommodate the equilibrium tidal prism based on hydraulic geometry relationships, which will limit marshplain erosion.

4.2.1 Tidal Channel Scour and Deposition

Tidal channels deposit or scour in response to the size of the tidal prism that the channels convey. Tidal hydraulic geometry relationships provide an estimate of the equilibrium channel size (cross-section dimensions) in relationship to the tidal prism (the volume of water between MLLW and MHHW) or marsh area. These relationships were developed based on channels in historic marshes in San Francisco Bay, where sediments are cohesive, wave power is low, and fluvial inflow is minimal. At Ballona Creek, where sediments are sandier, the aspect ratio of width to depth is likely shallower and more braided than in more cohesive sediments.

Since Ballona Creek is oversized and has a low sediment supply, the tidal prism relationship was used to predict long term channel width, depth, and cross-sectional area (Table 6). Appendix 3 of the Ballona Wetlands Hydraulics and Hydrology Report (ESA PWA 2013a) contain further information on the tidal hydraulic geometry analysis.

The existing Ballona Creek flood control channel is oversized compared to predicted equilibrium dimensions. This suggests that the existing channel is depositional during normal tidal conditions and more frequent channel-forming storm flows, but that deposition is limited by sediment supply. Since the project will reconnect the channel to the marsh, the tidal prism will be increased from existing conditions and a slightly larger equilibrium channel would be expected. However, due to the low sediment supply, the channel is not expected to fill in to these dimensions; the values in Table 6 are estimates of the smallest size channel that would form if there were adequate sediment available.

TABLE 6
TIDAL ESTIMATES FOR CHANNEL DIMENSIONS

	Cross-sectional Area (ft^2 below MHHW)	Width (ft at MHHW)	Depth (ft below MHHW)
Existing Conditions	4,500 – 5,000	350 - 400	10 - 15
Existing Conditions (unlimited sediment supply)	600 – 1500	110 – 200	10 – 12.7
Project Conditions (unlimited sediment supply)	600 – 1700	110 – 220	10 – 13.2
Historic channel (T-sheet)		~180	
Fluvial estimate (unlimited sediment supply)	518	105 – 171	5.1- 6.4 (bankfull depth)

The tidal estimates for channel dimensions (Table 6) are much larger than the fluvial estimates (Table 2) and, within the site, the tides dominate sediment transport except for during storms of Q10 or above. Figure 16 shows the existing Ballona Creek channel cross-section compared to predicted tidal equilibrium dimensions for a natural unleveed creek channel, and the project design. Some scour may occur in the channel due to tidal conditions, however, since the equilibrium dimensions are based on cohesive sediments and Ballona has sandier sediments, the channel may stay shallower and wider, as designed. Since the channel is wider than the equilibrium dimensions, some deposition could occur in the channel, but the sediment supply is limited and storm events are expected to scour out the system periodically.

4.2.2 Tidal Marshplain Scour and Deposition

Under existing conditions, the SRT gate protects the marshes in Area B from any tidal scour by muting the tides, which limits tidal velocities. Similarly, the SRT gate limits how much sediment can enter the wetlands, so deposition is limited.

Undersizing channels can cause marshplain erosion, since tidal channels will scour to equilibrate with the tidal prism. However, when tidal channels are sized to convey the tidal prism of the marsh, as the restoration channels are (ESA PWA 2012a), the marshplain is not expected to erode under tidal conditions, once vegetated. Additionally, since little sediment is expected to come into the marsh on high tide, marshplain deposition is expected to be minimal.

Post-construction and before vegetation has established, some channel sloughing and sediment transport is expected. The design uses marshplain slope to guide the flow to the channel tributaries before discharging to the creek. This will focus shear stress in the channel rather than on the marshplain under tidal flows, however, some marshplain scour is expected until vegetation is established.

4.3 COASTAL SEDIMENT TRANSPORT

The coastal processes near Ballona Creek transport sediment mostly downcoast, where much of it deposits in the northern entrance to Marina del Rey (Figure 17). The marina breakwater creates a wave shadow that encourages deposition, which, without the jetties and with enough sediment, could form a tombolo, where a sand spit grows out to reach the wavebreak. However, regular dredging keeps the entrance open for boat access. Although the wave power is lowered by the breakwater, a wave-built shoal has formed in the mouth of Ballona Creek. The project is not expected to impact the coastal processes.

4.3.1 Longshore Transport, Surrounding Beaches

The historic longshore transport in Santa Monica Bay has been disrupted by the construction of a series of coastal structures in the recent past. In the vicinity of Marina del Rey, the alignment of the coastline and the associated prevailing waves create a predominant net sediment transport to the southeast (downcoast; Figure 18). This is reversed when southern swells approach the coastline during the summer, and occasionally under other conditions. The construction of the Marina del Rey jetties and breakwater created a littoral barrier that limits sediment transport. The sediment that accumulates in the marina entrance has been dredged and bypassed to Dockweiler Beach and, less frequently, backpassed to Venice Beach, in order to prevent the surrounding beaches from eroding (see Section 4.3.3). The construction of the King Harbor jetties downcoast of Dockweiler Beach in 1958 helped keep the majority of sediment in the system by preventing losses down into the Redondo Submarine Canyon. Leidersdorf (1994) found that coastal structures combined with sand placement (aka "beach nourishment") in the central and southern parts of Santa Monica Bay have created compartmentalized, wide, stable beaches.

4.3.2 Shore Planform

Like the longshore transport, the shore planform is influenced by the coastal structures in the bay, as well as by human intervention like sand placement. Beach nourishment began in 1938, and the beaches have widened by about 600 ft since then. Figure 19 and Figure 20 show shore lines collected by the County of Los Angeles Beaches and Harbors (Leidersdorf 1994) and the USGS (2006) respectively, and illustrate the beach width change over time. As mentioned in Section 4.3.1, beach nourishment and coastal structures have created compartmentalized beaches that are wider than historic conditions and relatively stable.

Within these compartmentalized beaches, breakwaters influence the shore planform without physically blocking longshore sediment transport like jetties. Breakwaters create wave shadows that slow transport and allow sediment to deposit behind them. The Venice breakwater, which is less than 2 miles upcoast of Marina del Rey, has produced a tombolo behind it from the sand that has deposited in the wave shadow. Due to the proximity of the Marina del Rey and Venice breakwaters and the nearly identical shoreline orientation, it can be assumed that the wave conditions are similar at both sites and the Venice breakwater can be used as a reference for the processes at work at Marina del Rey harbor.

The 600 ft-long Venice breakwater was built in 1905, and after the first large sand placements in the 1930s, supported a salient, which later developed into a tombolo. The average width of the tombolo based on aerial photographs spanning 1994-2012 is 238 ± 101 ft. Using the methods of Ming and Chiew (2000), which relates the length of the breakwater and the distance to shore with the area of sand deposition, about 126,000 ft^2 of sand was calculated to be behind the Venice breakwater. This relationship combined with geometric similarity predicts that a hypothetical tombolo at Marina del Rey (without the jetties) would be 1,040 ft wide and cover 2.02 million ft^2 (Figure 21). Assuming a depth of 20 ft (the federally designated dredge depth), the tombolo could contain 1.5 million cy of sediment.

When the same calculation is performed with the jetties in place (assuming that velocities between the jetties would lessen the amount of sand depositing in that area), the amount of sediment is reduced to approximately 460,000 cy. This result is the same order of magnitude as the dredging records of 1969 (390,000 cy; see Section 4.3.3). Because the breakwater provides wave protection, the area behind it (the entrance to the marina and creek) naturally tends to accumulate sand that is transported along shore by waves.

This analysis confirms that dredging is required to maintain the channels between the jetties. Without dredging, wave driven transport would likely close off the mouth of Ballona creek, resulting in a perched drainage outlet that would allow only limited tidal exchange, primarily only after the mouth scoured, during high fluvial flows (Behrens et al, manuscript).

4.3.3 Dredging History

A history of dredge events for Marina del Rey from 1969-2009 is provided in Table 7. Dredging is conducted as-needed to keep the entrances of the marina open for traffic. Surveys are conducted to evaluate conditions in the harbor before dredging (pre-dredge), after dredging (post-dredge), and in between dredging events (conditions). These surveys can be used to examine the shoaling rates in the marina entrance and creek mouth. Figure 22 shows these surveys from 2000 to 2012, and illustrates the salient or tombolo that might form without regular dredging (the red, higher elevations at the mouth; Section 4.3.2).

TABLE 7
DREDGE EVENTS AT MARINA DEL REY

Date[1]	Location	Material	Method	Destination	Quantity (cy)	Source[2]
1969	Ballona Creek mouth		Hydraulic dredge	Dockweiler Beach	389,800	3,4
1973	South side of north jetty		Hydraulic dredge	Venice Beach	16,100	3,4
1981	Entrance channel; Ballona creek mouth		Hydraulic dredge	Dockweiler Beach	217,400	3
1987	Jetty tips; Ballona Creek mouth		Hydraulic dredge	Dockweiler Beach	35,300	3
1992	Ballona Creek mouth	Chemically challenged	Dragging	in situ	21,500	2
1994	Entrance channel	Chemically challenged	Clamshell	Port of LA shallow water habitat	55,000	2,4
1996	Entrance channel	Beach quality	Hydraulic dredge	Dockweiler Beach	238,000	2
1998	Entrance channel	Chemically challenged	Clamshell	LA-2 Disposal Site	52,000	3
		Beach quality	Clamshell	Dockweiler State Beach	73,800	3
1999	Entrance channel	Chemically challenged	Clamshell	Port of Long Beach	390,000	4**
		Beach quality	Clamshell	Redondo Beach	282,000	4**
2007	North entrance	Beach quality	Clamshell	Dockweiler Beach	327,000	4
2009		Beach quality	Hydraulic dredge	Dockweiler Beach	4,700	4
2012		Chemically challenged	Clamshell	Port of Long Beach	471,000	
		Beach quality	Clamshell	Dockweiler Beach Redondo Beach	150,000 157,000	5

1. Indicates year project was started
2. Quantities from Source 2 are pay volumes; quantities from source 3 and 4 are unspecified, although volumes agree (with rounding) for 1969-1998

** There is a large discrepancy between source 2, 3 and 4. Source 4 was the middle value and the most recent report, so those values are included.

SOURCES:
1. USACE 2003, Draft EIR/EIS for the Ballona Creek Sediment Control Management Plan,
2. USACE 2003, Marina Del Rey and Ballona Creek Feasibility Study, Ballona Creek Sediment Control Management Plan, Dredging Analysis Appendix
3. USACE 2004, LA Regional Dredged Material Management Plan Feasibility Study, Baseline Conditions (F3) Report Technical Appendix
4. Kinnetic Laboratories, Inc, Halcrow Inc, 2011. Marina Del Rey Maintenance Dredging Project Follow-Up Sediment Tier II and III Investigation, Final Report
5. USACE 2014, DRAFT Maintenance Dredge History

In 2003, Moffat and Nichol (M&N) and USACE calculated shoaling rates at the marina using dredge maps spanning 1991 to 2001, using two different methods. In the first method, they calculated the sediment difference

between the last and first map, added in the dredge quantities, then divided by the total years, and found a rate of 93,670 cy/yr. The second method subtracted each subsequent map, added in the dredge quantities, divided by the years between each survey, and then averaged all of the rates. The second method resulted in a rate of 142,640 cy/yr. M&N also looked at four different areas within marina entrance. Figure 23 presents the accretion rates for these four areas using the dredge surveys from 2000 to 2012. The much higher accretion rate in Area H confirms that the longshore transport is largely downcoast from north to south, transporting the largest quantities of sand into the northern entrance of the marina (Section 4.3.1).

4.3.4 Shoal Formation

Tidal and wave processes largely drive the morphology of a tidal creek mouth. Walton and Adams (1976) examined the relationship of the tidal prism and inlet size to estimate the size of ebb shoals for different wave climates:

$$V = aP^b$$

where V is volume of the ebb shoals, P is the tidal prism, and a and b are correlation coefficients decided by the wave climate. Estimates of the size of potential shoals for the existing Ballona Creek system are 3,300-4,300 cy.

Additionally, work by Battalio and others (2006) on inlet closures expanded on the idea that the inlet morphology (cross-section area and thalweg elevation among other factors) will determine the location of sediment deposition in the inlet mouth. Since the Ballona Creek mouth is oversized (see Section 4.2.1), it is likely that sediment will deposit if transported into the mouth from the adjacent shore. Based on Battalio and others (2006), the size of the inlet relative to the volume of water (and sediment) exchange suggests that shoals inside the channel are to be expected. Aerials from 1937 and 1938 show shoaling in the channel entrance before the channel jetties were finished (Figure 2 and Figure 3) and surveys from 2006 and 2012 (Figure 15) confirm the presence of a shoal under existing conditions. However, the pattern and location of the shoal imply that waves may have more of an effect than tidal currents. Indeed, hydrodynamic modeling indicates the flood tide currents are less than 1 ft/sec most of the time and hence the flood tide may not be the dominate driver of this sand shoal at the entrance to Ballona Creek. Moreover, if the sand transport was driven by flood tides, the shoal should prograde up the channel: there is no evidence that the shoal is building upstream at a rate associated with daily flood tides, and hence it is more likely that the shoal is wave driven and limited in proportion to wave dissipation up-channel.

The sediment size of the shoal matches that of the beach (Section 4.1.2), indicating that the shoal is formed by coastal processes. The pattern of deposition in the present, as well as historic photos (e.g. the 1937 photo, Figure 2) indicate a coastal source with deposition near the end of the jetties.

Under project conditions, the restoration plan will increase tidal prism of the site by reconnecting Ballona Creek to the wetlands, and could potentially increase sediment transport into the channel from the ocean. However, the project will only increase the potential tidal prism by 60 ac-ft or 15%. Initial modeling shows that this increase in tidal prism does not significantly change tidal velocities in the mouth of the creek (H&H report). Under normal tidal conditions, velocities at the mouth changed from 0.76 ft/s under existing conditions to 0.96 ft/s under project conditions. Assuming a 15% increase in tidal prism translates to a 15% increase in the flood shoal volume, the shoal height could increase by 1.1 ft to a depth of -3.4 ft NAVD. However, flood shoal growth is primarily lateral under tidal action, with growth into the basin dominating, rather than accretion. Additionaly, low tidal currents in the creek are too low to move much sand (less than 3 ft/s), and hence it is unlikely that the tidal flows drive the shoal morphology.

4.4 SEDIMENT BUDGET

This section combines the analyses from the previous sections to build a sediment budget for the Ballona Creek system. As discussed above, the fluvial, tidal, and coastal processes determine how sediment is transported in and around the Creek and harbor entrance channels. Sections 4.1.1 and 4.1.2 discuss the sediment yield and size from Ballona Creek watershed, while Sections 4.1.3 through 4.2.2 examine where the sediment ends up in the channel and the marsh. Section 4.3.1 discusses littoral sediment transport in Santa Monica Bay, while Sections 4.3.2 through 4.3.4 examine how the sand builds the beaches and shoals and is dredged from the marina. These processes can be combined to build a sediment budget to quantitatively analyze the system around Marina del Rey, including Santa Monica, Venice, and Dockweiler Beaches.

Table 8 provides a sediment transport timeline. In 1934, the Santa Monica Breakwater was constructed and a tombolo formed, which limited the sand transport downshore to Venice and Dockweiler Beaches. However, large sand placements from the Hyperion facility more than replaced the sand lost in the tombolo. Shoreline profiles in 1935 and 1946 (Figure 19) show that the beaches grew 75 ft, adding approximately 916,600 cy of sand to the system. Large placements of sand continued through the early 1960s, building the beaches out 500 ft from the 1935 shoreline. With the deterioration of the Santa Monica breakwater in the 1960s, which allowed sand to move downshore to Venice Beach, and the construction of the King Harbor jetties downshore of Dockweiler Beach, which kept sand from being lost to the Redondo Submarine Canyon, the beaches have stabilized (Section 4.3.1).

In 1999, Moffat & Nichol constructed a sediment budget for the USACE to help evaluate shoaling in the mouth of Marina del Rey. However, more recent data and analyses show that some of their assumptions should be revised. For example, Moffat & Nichol assumed that no sediment is transported from Dockweiler Beach into Ballona Creek and the southern habor entrance and that no sediment is transported through the marina. However, as described in Sections 4.1.2 and 4.3.4, the shoal in the mouth of Ballona Creek shows sand characteristics that are similar to the sand on the beach, which is likely transported during southern swell events.

Table 9 presents a new sediment budget using the analyses presented in the previous sections of this memo. The budget is organized by storm return and tidal conditions, based on the data available from the sediment yield curve (Section 4.1.1) and the sediment transport modeling (Section 4.1.3.3). The different reaches of the channel are based on the reaches reported in the Sediment Transport Analysis (Appendix F10 of the EIR/S). Erosion and deposition in the channel were calculated from the sediment transport model for the Qeff, Q5, and Q100, and interpolated for the remaining storm returns. Sediment export from the system was then calculated by adding the eroded volume to the watershed input and subtracting any deposited material.

TABLE 8
SEDIMENT TRANSPORT TIMELINE NEAR MARINA DEL REY (CY)

	Santa Monica and Venice Beach			Marina del Rey			Dockweiler Beach				Notes and Sources
Year	In (From North)	Change	Out (To South)	In (From North)	Out of System (Removed)	Out (To South)	In (From North)	Change	Out (To South)	Rate Out (To South) CY/Yr	
1935-1946	2,581,106	208,922					2,644,774	458,300			Transport from the north (M&N 1999) and shoreline change (Leidersdorf 1994)
	62,590						62,590				Stream and Storm Drain yield (M&N 1999)
	210,000						1,800,000				Beach Fill (1938-1939, 1945) (Leidersdorf 1994)
							78,430				From Ballona Creek, rating curve minus channel deposition
Total 1935-1946	2,853,696	208,922	2,644,774				4,585,794	458,300	4,127,494	375,200	
1947-1953	1,642,522	4,540,078					11,042,274	3,055,600			Transport from the north (M&N 1999) and shoreline change (Leidersdorf 1994)
	39,830						39,830				Stream and Storm Drain yield (M&N 1999)
	13,900,000						240,000				Beach Fill (1946-48, 1951) (Leidersdorf 1994)
							49,910				From Ballona Creek, rating curve minus channel deposition
Total 1947-1953	15,582,352	4,540,078	11,042,274				11,372,014	3,055,600	8,316,414	1,188,100	
1954-1974	4,927,566	1,527,800		4,315,356			4,021,387	-458,300			Transport from the north (M&N 1999) and shoreline change (Leidersdorf 1994, USGS 2006)
	119,490						119,490				Stream and Storm Drain yield (M&N 1999)
	796,100						12,889,800				Beach Fill (1956, 1957-1958, 1960-1962, 1963, 1969, 1973) (Leidersdorf 1994, Kinnetic 2011)
				155,631							From Ballona Creek, rating curve minus channel deposition
					43,700						Shoal in Ballona Creek (assuming 100% from littoral transport)
					405,900						Dredging (1969, 1973) (Leidersdorf 1994, Kinnetic 2011)
Total 1954-1974	5,843,156	1,527,800	4,315,356	4,470,987	449,600	4,021,387	17,030,677	-458,300	17,488,977	832,800	
1975-1990	3,754,336	-672,300		4,517,676			4,371,387	213,900			Transport from the north (M&N 1999) and shoreline change (Leidersdorf 1994, USGS 2006)
	91,040						91,040				Stream and Storm Drain yield (M&N 1999)
							407,700				Beach Fill (1981, 1987, 1988) (Leidersdorf 1994, Kinnetic 2011)
				106,411							From Ballona Creek, data minus channel deposition
					252,700						Dredging (1981, 1987) (Leidersdorf 1994, Kinnetic 2011)
Total 1975-1990	3,845,376	-672,300	4,517,676	4,624,087	252,700	4,371,387	4,870,127	213,900	4,656,227	291,000	
1991-1998	1,877,168	0		1,922,688			1,565,878	0			Transport from the north (M&N 1999) and shoreline change (Leidersdorf 1994, USGS 2006)
	45,520						45,520				Stream and Storm Drain yield (M&N 1999)
							311,800				Beach Fill (1996, 1998) (Leidersdorf 1994, Kinnetic 2011)
				61,990							From Ballona Creek, data minus channel deposition
					418,800						Dredging (1994, 1996, 1998) (Leidersdorf 1994, Kinnetic 2011)
Total 1991-1998	1,922,688	0	1,922,688	1,984,678	418,800	1,565,878	1,923,198	0	1,923,198	240,400	
1999-2012	3,285,044	0		3,364,704			2,474,220	0			Transport from the north (M&N 1999) and shoreline change (assumed 0)
	79,660						79,660				Stream and Storm Drain yield (M&N 1999)
							481,700				Beach Fill (2007, 2009,2012) (Leidersdorf 1994, Kinnetic 2011, USACE 2013)
				113,216							From Ballona Creek, data minus channel deposition
					1,781,700						Dredging (1999, 2007, 2009, 2012) (Leidersdorf 1994, Kinnetic 2011, USACE 2013)
Total 1999-2012	3,364,704	0	3,364,704	3,477,920	1,781,700	1,696,220	2,257,580	0	2,257,580	161,300	

TABLE 9
SEDIMENT BUDGET NEAR MARINA DEL REY FOR EXISTING CONDITIONS (CY)

Area	Tidal	Qeff (4,650 cfs bankful discharge)	Q2 (15,700 cfs @ Sepulveda)	Q5 (22,690 cfs @ Sepulveda)	Q10 (27,130 cfs @ Sepulveda)	Q25 (31,160 cfs @ Sepulveda)	Q50 (36,740 cfs @ Sepulveda)	Q100 (40,960 cfs @ Sepulveda)	Average Year	Average Year (based on 1959-2012) for comparison	Notes
Watershed input	0	2,020	6,120	9,230	11,310	13,390	16,090	18,280	9,100	9100	From sed yield curve x 10% for bedload (assumes storms are 1 day)
Littoral transport from southern swell	820								820	820	Difference between 2012 -1959 divided by the years
Channel bed											
Upstream of I-90 erosive reach	0	370	-998	-5,100	-5,358	-6,132	-7,421	-10,000	-2,180	80	From sed transport modeling
On-Site/Upstream erosive reach	0	720	-560	-4,400	-4,353	-4,211	-3,974	-3,500	-1,160	-50	
Downstream aggradation reach	0	220	2,440	9,100	8,889	8,258	7,205	5,100	4,670	1,610	
Channel mouth	820	0	525	2,100	2,058	1,932	1,721	1,300	1,010	1150	
Area B Managed Wetlands	0	0	0	0	0	0	0	0	0	0	Assume negligble
Export	0	710	4,713	7,530	10,074	13,543	18,559	25,380	6,750	7130	
Exported From Ballona Creek	0	710	4,713	7,530	10,074	13,543	18,559	25,380	6,750	7130	
Deposited in MdR from Ballona Creek	0	569	3,686	5,783	7,656	8,166	9,576	8,172	4,930	5560	Trapping efficiency based on EFDC modeled velocities in marina and F4 Sed Control Management Plan (USACE 2003)

5. REFERENCE SITES

Coastal wetland habitats in southern California exhibit a broad range of morphologies, as well as degrees to which physical and ecological conditions and processes have been impacted by human activities (Grossinger et al. 2011). The morphology of a given coastal wetland is largely governed by the interactions between antecedent geology, fluvial processes (e.g. watershed size and characteristics, storm hydrology, and sediment transport), and coastal processes (e.g. tides, wave/swell exposure, littoral sediment transport, and dune movement), as well as vegetation communities that can have feedback effects on physical processes. The study of reference systems with similar physical and ecological conditions to those proposed for the Ballona restoration provides insight into how future Ballona habitats are anticipated to persist in the near-term. This section describes conditions at the Seal Beach Wetlands, just south of the Los Angeles County border in Orange County, and the San Elijo Lagoon wetlands, in northern San Diego County.

5.1 SEAL BEACH WETLANDS

The Seal Beach wetlands are located within Seal Beach National Wildlife Refuge, entirely within the boundaries of the Naval Weapons Station Seal Beach (Figure 24). Prior to western settlement, the Seal Beach wetlands were part of an extensive backbarrier wetland system of over 2,000 ac that included large areas of tidal salt marsh as well as freshwater marsh further inland. Mapping of the area from 1873 indicates a subtidal inlet (Grossinger et al. 2011), which when coupled with the significant size of the system, implies that the tidal prism was large enough to maintain an open inlet under most conditions. The open nature of the inlet stands in contrast to many other coastal wetland systems in southern California (including Ballona) which had seasonally closed inlets prior to western settlement (ibid). The wetlands have a watershed of approximately 38,000 acres (USFWS and US Navy 1990), compared to 57,000 acres at Ballona, and receive limited inflows from the Bolsa Chica and Wintersburg flood control channels as well as local runoff (Table 10; CDFG and USFWS 1976).

The development of the Naval Weapons Station and Huntington Harbor have significantly altered the local landscape, resulting in the loss of half of the system's wetlands as well as permanently anchoring an open inlet through the construction and armoring of Anaheim Bay (Figure 25). In addition, watershed urbanization and the construction of hydrologic impediments such as roads have altered circulation at the site; portions of the wetlands that were once fully tidal now have a muted tidal regime (USFWS 2013). Additionally, the channelization of the Santa Ana River redirects freshwater flow and sediment away from the marsh. Nonetheless, a comparison of existing habitats to historic habitats indicates that the planform of the remaining Seal Beach tidal salt marshes has remained remarkably consistent since the late 1800s.

Erosion has occurred in the constructed tidal channels, in areas where the marsh tidal prism is larger than the channel can convey. Some of these channels have reached equilibrium and erosion has diminished (USFWS 2011). At Ballona, the tidal channels have been sized to correspond to equilibrium conditions to avoid erosion (Section 4.2.1). At Seal Beach, additional erosion has occurred in Forrestal Pond, where the deeper water and longer fetch length has allowed waves to erode the northeast corner. At Ballona, the fetch within the site is not large, so erosion due to wind waves in not expected. Under sea-level rise conditions, this fetch may increase and cause erosion.

Due to the loss of fluvial sediment input, the periodic dredging of Anaheim Bay to remove sand deposited by littoral (longshore) transport, and the periodic dredging of Sunset/Huntington Harbor to remove sediment from the Bolsa Chica Channel, there has been a net loss of sediment from the wetland in the last 100 years (USFWS 2011).

Ballona Creek, although sediment poor, is still expected to contribute some sediment to the marsh (Section 4.1.4.2).

5.2 SAN ELIJO LAGOON

The coastal wetlands of San Elijo Lagoon are located within the San Elijo Lagoon Ecological Reserve, a regional park comprised of lands owned by San Diego County, the state of California, and the San Elijo Lagoon Conservancy (Figure 26). The reserve is 915 acres in size; approximately 600 of these acres are wetlands that include tidal salt marsh, brackish and freshwater wetlands, mudflats, and shallow open water habitats (Laton et al. 2002). The full extent of historic tidal habitats is not clear, as the earliest mapping in 1888 occurred after railroad development and diking activities throughout the basin (Grossinger et al. 2011). The lagoon shares a similar morphology with other lagoons within the Oceanside littoral cell, including Buena Vista, Agua Hedionda, and Batiquitos Lagoons to the north; its historic habitats likely were similar to these systems as well as the San Dieguito and Los Penasquitos lagoons to the south (ibid). The primary freshwater inflow to the lagoon is Escondido Creek, which has a watershed of approximately 54,000 ac (SELC 2013).

Like the Ballona and Seal Beach wetlands, the wetlands of San Elijo Lagoon have been significantly altered by human activity, including watershed urbanization, diking and draining of wetlands, road/berm construction across the lagoon, and the anchoring of the tidal inlet at the lagoon's northern end (Figure 27, Grossinger et al. 2011). As a result of this urbanization, increased sedimentation within the wetland basin has reduced the tidal prism relative to historic conditions (Laton et al. 2002), necessitating the annual dredging of the inlet to maintain open tidal conditions (SELC 2013). Proposed enhancement activities within the lagoon are largely aimed at decreasing sedimentation and increasing tidal exchange throughout the lagoon's wetlands and subtidal habitats. Despite the extensive alterations to the system, tidal wetlands in the lagoon have continued to persist, and in some locations have expanded due to sedimentation. The highly sinuous planform of the wetlands' main tidal channel has remained relatively unchanged, though this may primarily be due to the anchoring of the inlet location as evidence indicates the inlet was formerly farther south (Laton et al. 2002). Since Ballona Creek also has an anchored inlet, this may indicate that channel migration at Ballona will be minimal.

TABLE 10
REFERENCE SITE CHARACTERISTICS

Site	Watershed Area (acres)	100-Yr Streamflow (cfs)	Sediment Supply (cy/yr)	Inlet Condition	Depositional or Erosional?
Ballona Wetlands	57,328	44,270	9,380	Open Dredged	Expected to be stable
Seal Beach Wetlands	38,000[1]	Negligible input[2]	Negligible input[2]	Open Dredged	Erosional- due to tidal currents in undersized channels, wind waves over areas of long fetch, and negligible sediment input.[2]
San Elijo Lagoon wetlands	54,112[3]	22,255[4]	21,700 – 26,100[4]	Open Dredged	Depositional- due to urbanization: increased freshwater flows and sediment transport[4]

1. USFWS and US Navy 1990
2. USFWS 2011
3. Moffatt & Nichol 2012
3. Laton et al 2002

6. ASSESSMENT AND RESULTS

The coastal sediment transport around Ballona Creek and Marina del Rey is a complex system. Historically, seasonal wave action closed off the creek to the tides (Section 1). With the construction of the jetties and the concrete channel, sand continued to deposite in the mouth and impeded tidal connection. However, the offshore breakwater has reduced the wave-driven transport potential and maintenance dredging has prevented accumulation to the point of a beach building across the mouth, and the creek remains open year round. The construction of the breakwater would typically encourage sand to deposit in the marina and creek mouth and form a tombolo (Section 4.3.2): While regular dredging keeps the entrances open (Section 4.3.3), the dredging does not prevent or remove all wave-driven transport and a shoal exsists in the creel channel. Normal tidal action in the mouth of the creek may contribute to sand transport into and deposition in the creek, but wave transport is likely the main process. Additionally, sand moves south into the northern entrance of the marina, except during southern swell events when sand likely moves north into the southern marina entrance and the mouth of Ballona Creek (Section 4.3.1). Furthermore, large storm events bring both coarser and finer sediments down the creek to deposit in the mouth or marina entrance adding to the deposition in that area (Section 4.1). Figure 28 illustrates these processes. Note that Figure 28 differs from Figure 8 because Figure 8 shows the net change between 1961 and 2012, while Figure 28 shows the average change per year.

6.1 FUTURE SEDIMENT BUDGET

The analyses discussed in Section 4 were used to develop a future sediment budget for project conditions, presented in Table 11. The budget is organized by storm return and tidal conditions, based on the data available from the sediment yield curve (Section 4.1.1) and the sediment transport modeling (Section 4.1.3.3). Erosion and deposition in the channel were calculated from the sediment transport model for the Qeff, Q5, and Q100, and interpolated for the remaining return-period storm events. Marsh erosion was calculated from the hydrodynamic model for the Q10 and Q100, and interpolated or extrapolated for the remaining storm returns. Erosion volumes were developed by multiplying erosion depth by area (see Section 4.1.4.1). Marsh erosion and deposition (as described in Section 4.1.4.2) were then combined. Sediment export from the system was then calculated by adding the eroded volume to the watershed input and subtracting any deposited material.

Trapping efficiencies for each storm event were calculated for the marina mouth based on modeled velocities from EFDC (Section 2) and the USACE F4 Sediment Control Management Plan (2003). This was used to estimate how much of the exported sediment in Ballona Creek may end up in the mouth of Marina del Rey.

The sediment budget, shown in Figure 29, shows an increase in export from the Ballona Creek system, and an increase in the amount of sediment deposited in the marina mouth. For events below the Q10, this translates to roughly a 40% increase in the volume deposited in the marina, but only 8% of what is dredged annually. The larger events produce more sediment, but would occur less frequently.

TABLE 11
FUTURE SEDIMENT BUDGET (CY)

Area	Tidal	Qeff (4650 cfs bankful discharge)	Q2 (15,700 cfs @ Sepulveda)	Q5 (22,690 cfs @ Sepulveda)	Q10 (27,130 cfs @ Sepulveda)	Q25 (31,160 cfs @ Sepulveda)	Q50 (36,740 cfs @ Sepulveda)	Q100 (40,960 cfs @ Sepulveda)	Average Year	Notes/Tools
Watershed input	0	2,020	6,120	9,230	11,310	13,390	16,090	18,280	9,100	From sed yield curve x 10% for bedload (assumes storms are 1 day)
Littoral transport from southern swell	943								943	Tidal prism increases 15% from existing conditions, so assumed 15% increase in shoal volume.
Channel bed										
Upstream of I-90 erosive reach	0	730	-603	-4,600	-4,900	-5,800	-7,300	-10,300	-1,463	From sed transport modeling
Stable reach in historically aggradational reach	0	70	0	-100	-100	-100	-100	-100	30	
Aggradational reach upstream of site	0	120	400	1,400	1,400	1,400	1,400	1,300	840	
Erosive reach upstream of Culver and Lincoln	0	10	-1,100	-4,300	-4,400	-4,800	-5,500	-6,900	-2,210	
Depositional reach downstream of Culver and Lincoln	0	60	1,700	6,600	7,000	8,200	10,200	14,300	3,610	
Erosive reach at convergence at D/S end of Area A	0	10	-600	-2,500	-2,600	-2,900	-3,300	-4,200	-1,270	
Depositional reach at U/S end of West Area B	0	0	800	3,200	3,300	3,400	3,700	4,200	1,620	
Erosive reach at convergence at D/S end of West Area B	0	0	-100	-500	-800	-1,800	-3,500	-6,900	-440	
Channel mouth shoal/tombolo	943	0	300	1,200	1,100	800	300	-800	1473	
Area A wetlands										Marsh deposition minus erosion (Section 4.1.4)
Upstream	0	12	36	54	-63	-337	-538	-742	0	
Downstream	0	4	12	18	-3511	-4284	-4868	-5452	-660	
Along channel	0	2	6	9	-17973	-18721	-19286	-19851	-3,120	
Area B wetlands										
Upstream	0	0	0	0	-13003	-14134	-14989	-15844	-2,320	
Convergence	0	0	0	0	-15111	-18245	-20615	-22986	-2,880	
West	0	2	6	9	11	-140	-252	-366	-10	
Area B managed wetlands	0	0	0	0	0	0	0	0	0	Assume no erosion or deposition
Export	0	1,000	5,264	8,741	60,959	70,851	80,739	92,920	16,850	
Exported From Ballona Creek	0	1,000	5,264	8,741	60,959	70,851	80,739	92,920	16,850	
Deposited in MdR from Ballona Creek	0	802	4,116	6,713	46,329	42,723	41,661	29,920	11,680	Trapping efficiency based on EFDC modeled velocities in marina and F4 Sediment Control Management Plan (USACE 2003). Difference = 760 – 1,080 cy
Exported From Ballona Creek Under Existing Conditions		710	4,713	7,530	10,074	13,543	18,559	25,380	6,750	
Difference from Project Conditions		290	551	1,211	50,885	57,308	62,180	67,540	10,623	
Deposited in MdR Under Existing Conditions		569	3,686	5,783	7,656	8,166	9,576	8,172	4,930	
Difference from Project Conditions		233	431	930	38,673	34,557	32,085	21,748	6,750	

6.2 CONCLUSIONS

The analyses assess both existing and proposed Project conditions to evaluate potential changes due to the Project. Under existing conditions, storm events in the existing Ballona Creek channel transports approximately 9,100 cubic yards (CY) of sediment per year on average[1] from the Ballona Creek watershed. The reach of Ballona Creek downstream of the Marina Freeway and within the Ballona Wetlands Ecological Reserve is depositional, with approximately 1,900 CY of sediment deposition per year on average, representing about 20% of the watershed sediment load. A total of approximately 100,000 CY of sediment has deposited in this reach of the channel since it was constructed in 1961.

Under existing conditions, sediment is expected to continue to deposit in the channel until the channel cross-section is reduced to the point that deposition reaches an equilibrium with tidal and fluvial scouring (i.e., equilibrium channel dimensions) or until channel maintenance is performed to remove deposited sediment.

The Project conditions analysis focuses on the Proposed Action (Alternative 1) as the greatest change from existing conditions, and also discusses changes for Alternatives 2 and 3 based on the results for Alternative 1. In Alternative 1, the proposed restoration project would create a new realigned Ballona Creek channel downstream of Lincoln Boulevard through Area A and North Area B, remove the existing levees along Area A and Area B (to be replaced by new setback perimeter levees), and restore a natural marsh habitat channel bank and expanded marsh wetland floodplain. The channel banks and bed would only be armored in locations where higher rates of channel scour are expected.

During storm events under Project conditions, a pattern of channel deposition and erosion is expected to occur as the storm flows expand into the restored wetlands and contract into the existing channel downstream. The wetlands along the channel would experience erosion due to out-of-bank storm flows over the wetland floodplain; however, channel bank armoring would reduce erosion along the channel banks that would experience the highest erosive stress. The backwater wetland area in the northeast portion of Area A would experience some minor deposition, while other wetland areas farther from the channel may experience erosion during larger storm events. The following discussion further describes these on-site erosion and deposition patterns over a range of storm events, resulting changes in off-site erosion and deposition, and recommended measures to offset potential negative effects of the project.

6.2.1 On-site Erosion and Deposition

6.2.1.1 *Ballona Creek channel.*

Comparison of sediment transport model results for existing and Project conditions for typical storm events (< 5-yr event) show a slight decrease in channel deposition under Project conditions and a small potential increase in erosion at the Lincoln and Culver Blvd. bridges, with a potential for net erosion of up to about 300 CY/yr for the effective discharge (Q_{eff}); however, the magnitude of these changes is small and the proposed armored sill at the bridges is expected to offset the increase in erosion at the bridges. The slight decrease in deposition anticipated in

[1] Sediment erosion and deposition in the Ballona Creek channel and Ballona Wetlands Ecological Reserve (BWER) occur in response to Ballona Creek storm events (fluvial processes), as well as coastal and tidal processes; however, fluvial processes dominate sediment dynamics within the system. Fluvial processes are driven by rainfall-runoff storm events, which vary in intensity from typical seasonal events to infrequently-occurring extreme events. Infrequent extreme events have the potential to cause greater erosion and deposition; however, more frequently occurring events can have a greater cumulative effect on sediment dynamics over time. The analysis results include rates of erosion, deposition, and sediment transport for a range of storm events (i.e., 10-year and 100-year creek discharge events and the effective discharge, which is the flow rate at which the channel is full of water (bankfull)), as well as average annual rates. These average annual rates are weighted-averages that account for the chance of occurrence of extreme events and represent an annual average that could be expected over a series of years.

the channel during typical storm events is not expected to have a considerable effect on the restored channel, which is expected to be stable in response to typical storm events.

During the 5-year storm event, the Project would increase the gross amount of erosion and deposition within the restored channel compared to existing conditions (with a 25% increase in erosion from 9,500 CY under existing conditions to 12,000 CY under Project conditions and a 10% increase in deposition from 11,000 CY to 12,000 CY). The net change is expected to be a decrease in net channel deposition (70% decrease from 1,700 CY under existing conditions to 500 CY under Project conditions). Therefore, the sediment transport model results for the 5-year storm event show that the proposed channel would respond and adjust through erosion and deposition and would change from net depositional under existing conditions to slightly depositional under Project conditions.

During the 100-year storm event, the sediment transport results show that the existing channel is net erosional. Under Project conditions, results show that the proposed channel would experience a large increase in both erosion and deposition compared to existing conditions, increasing net channel erosion (from 7,000 CY net erosion under existing conditions to between 9,000 and 20,000 CY depending on whether sediment deposition is assumed to be confined to the channel or across the wetland floodplain in the model). As discussed above, the proposed armored sill at the bridges is expected to reduce the increase in erosion.

Overall, the restored channel is expected to be stable to slightly depositional in response to typical storm conditions, which is similar to the existing channel. During large infrequent storm events (5-year storm event and greater, or 20% or less annual chance of occurrence), the channel would experience erosion and deposition, with an increase in net erosion and sediment export from the channel compared to existing conditions. Infrequent erosion and deposition within the channel is expected to be compatible with the habitat and flood management objectives. The new proposed levees would be setback from the channel and the channel bank and levees would be armored in key locations to protect the levees from erosion (see PDR). Channel maintenance is not expected to be necessary for Alternative 1 because channel deposition due to storm events would not be large enough to increase flood levels.

Deposition is not expected beyond the predicted equilibrium channel dimensions because tidal and more frequent storm flows occurring between larger infrequent storms would maintain the equilibrium dimensions. The Project reach including the Area A meander up to the Culver Blvd bridge is expected to have the highest rate of deposition (approximately 3,600 CY/yr on average). This reach could aggrade until it reaches equilibrium channel dimensions over about 50 years, at which point tidal channel scour due to daily tidal flows would likely maintain equilibrium dimensions between depositional storm events and further net aggradation over time would not be expected. The depositional reaches downstream of Area A and at the mouth of Ballona Creek could also aggrade to equilibrium tidal channel dimensions over a longer period of time. Further analysis would be necessary to determine if deposition is actually expected to reach equilibrium tidal channel dimensions because storm events could possibly scour deposited material from the channel before it reaches the equilibrium tidal channel dimensions. These analyses could include performing sediment transport modeling for scenarios with the equilibrium tidal channel dimensions in depostional reaches to assess whether the deposition in these reaches would erode in response to frequent storm events.

The Preliminary Hydrology and Hydraulics Report Addendum (Appendix F8 to the EIR/S) modeled flood levels with the equilibrium tidal channel dimensions throughout the entire Ballona Creek channel as a conservatively high channel deposition scenario. The results for Atlernative 1 show that positive levee freeboard above the design flood event is maintained in this scenario. As deposition is not expected to reach or exceed the equilibrium

tidal channel dimensions and the modeling indicates that the channel would convey the design flood with these dimensions, channel maintenance to remove deposition is not expected to be required. The Preliminary Hydrology and Hydraulics Report Addendum model results show that in Phase 1 of Alternative 1 and Alternative 2, where the existing West Area B levee would remain at its existing elevation, flood levels would overtop the West Area B levee with the equilibrium tidal channel dimensions throughout the entire channel. Modeling of lower amounts of deposition (2 ft and 4 ft of deposition in the bottom of the channel) indicates that the channel would convey the design flood with up to 4 ft of deposition in the channel. Further analysis would be performed in subsequent steps of the project, including the USACE Section 408 approval, to assess the potential need for channel maintenance in Alternative 1, Phase 1 and Alternative 2. These analyses could include modeling the equilibrium tidal geometry in only reaches that are expected to be depositional and evaluating erosion of deposited material during more frequent storm events.

6.2.1.2 *Restored wetlands*

This analysis shows that some wetland deposition would occur during more frequent storm events; however, based on conservatively high estimates of potential wetland erosion, a relatively large amount of sediment could be eroded from restored wetlands along the channel during more extreme storm events (with a range from 50,000 CY of sediment erosion from wetlands during the 10-year storm to 70,000 CY of erosion during the 100-year event). During a 10-year event, results show that some wetland vegetation could scour away, with 4 to 12 inches of sediment erosion over a portion of the restored wetlands in Area A and 0 to 4 inches of erosion over a portion of the west Area B wetlands. Erosion of vegetated wetland area would result in a temporary loss of vegetated wetland; however, the estimated pattern of erosion would maintain the wetland surface at an elevation at which the wetland vegetation could re-establish and recover following the storm erosion event. During a 100-year event, results show 0 to 12 inches of erosion for a portion of Area A wetlands and 0 to 8 inches of erosion in West Area B. This pattern of erosion could lower mid marsh areas to elevations where low marsh would re-establish following the event, causing a conversion from mid marsh to low marsh habitat. The potential for mid to low marsh conversion due to erosion is relatively small in Area A. In West Area B, the results show the potential to convert some of the mid marsh to low marsh habitat because the West Area B mid marsh is only about 6 inches above the low marsh elevation range. Note that sea-level rise is also expected to convert West Area B from mid marsh to low marsh by about 2030 (based on a high-range sea-level rise projection) and it is therefore likely that the loss of mid marsh habitat could occur due to sea-level rise before a 100-year (1% annual chance of occurrence) event occurs. In summary, these conservatively high erosion results indicate that erosion and temporary loss of wetland may occur in response to large infrequent storm events, but that wetland vegetation could recover following the storm event. Conservatively high estimates of erosion are used to provide an upper end of the potential wetland erosion. Further refinement of the analysis would likely show less erosion due to better spatial representation of shear stress and consideration of a mid-range estimate of the critical shear stress for erosion, a range of erosion equations, and deposition of eroded material within the wetlands during the erosion event. Additionally, the project design includes armoring with three different levels of protection, and these estimates do not consider any armoring, which would decrease channel bank erosion. Furthermore, the degree of erosion estimated for Project during extreme events has not been observed or documented at other similar California river estuaries, such as San Elijo Lagoon. This degree of erosion is therefore not likely to occur, but provides an upper end estimate for the purpose of evaluating and planning for potential environmental effects.

Note that immediately after restoration, before vegetation has fully established, the potential for erosion is greater and pre-establishment of vegetation prior to breaching the levees is therefore recommended.

6.2.2 Off-site Erosion and Deposition

6.2.2.1 *Ballona Creek channel upstream of Lincoln Boulevard bridge*

Results from the Sediment Transport Analysis show that upstream of BWER and the Marina Freeway, no noteworthy changes in erosion and deposition are expected due to the Project. The modeled increase in erosion at the Lincoln and Culver Blvd. bridges would be offset by the proposed armored sill across the channel under the bridges.

6.2.2.2 *Ballona Creek channel mouth*

Large amounts of shoaling farther upstream of the mouth of the channel and within BWER due to coastal and tidal sediment transport is not expected. Mutliple lines of evidence indicate that the shoal at the mouth of Ballona Creek is controlled largely by waves with some fluvial and tidal influence. Grain size analysis showed that the sands within the shoal are similar in size and distribution to the sands on Dockweiler beach to the south. Longshore transport to the north likely moves these sediments into the mouth of the creek from the beach. Hydrodynamic modeling confirmed that tidal velocities were well below the 3 ft/s required to effectively move sand. Additionally, the shoal has not prograded up the channel as would be expected with a tidal shoal, and instead appears to be limited by the extent of the propagation of waves up the channel. While some deposition in the mouth of the creek is expected during fluvial storm event, materials also drop out upstream or continues out into the bay; the shoal feature is not likely built by fluvial processes.

The project will increase the tidal prism of the site by approximately 15%, which will increase tidal velocities which could increase the shoal size. However, under project conditions, tidal velocities are still below 3 ft/s, so sand movement due to the tides will be limited. Because the shoal is likely wave-built, rather than tidally-built, the project will not cause an increase in the size of the shoal.

6.2.2.3 *Marina del Rey harbor entrance channel*

Under existing conditions, approximately 7,000 CY/yr of sediment is exported from the mouth of Ballona Creek, of which about 70% or 5,000 CY/yr is estimated to deposit in the Marina del Rey harbor entrance channel. Coastal or littoral sand transport along the coast deposits about 48,000 CY/yr of sand in the entrance channel. Sediment deposited in the entrance channel (total volume of about 55,000 CY/yr from littoral transport and Ballona Creek) is dredged from the entrance channel. Since 1999, the following major dredge events have occurred:

- 1999: 670,000 CY dredged
- 2007: 330,000 CY dredged (8 years after 1999)
- 2012: 780,000 CY dredged (5 years after 2007)

For Project conditions, conservatively high estimates of potential erosion from the restored channel bed and wetlands show an increase in the amount of sediment exported from Ballona Creek and a corresponding increase in Ballona Creek deposition in the harbor entrance channel, particularly due to wetland erosion during extreme storm events (10-year event or 10% annual chance of occurrence and greater). The increase in export and deposition for more frequent events is expected to be low relative to littoral sand transport, deposition, and dredging in the entrance channel (range of 200 to 900 CY increase in deposition from the 1-year to 5-year event compared to average dredging of 55,000 CY/yr or 300,000 to 800,000 CY every 5 to 8 years). More extreme storm events have the potential to increase dredging amounts by about 20% (10-year to 100-year events deposit an additional 20,000 to 40,000 CY of sediment in the entrance channel compared to dredging of 300,000 to 800,000 CY every 5 to 8 years). Accounting for the chance of occurrence of extreme events, the annualized

average rate of entrance channel deposition has the potential to increase from 5,000 CY/yr under existing conditions to 12,000 CY/yr under Project conditions, which represents a 7,000 CY/yr or 12% increase in the annualized average dredging of 55,000 CY/yr. The results of this analysis therefore show the potential to increase the amount of dredging by about 12%, with corresponding increases in dredge event frequency, volumes, and costs. Note that as discussed in Section 6.2.1.2, the estimate of wetland erosion and resulting deposition in the entrance channel are conservatily high and not likely to occur, but provide high estimates for the purpose of evaluating and planning for potential environmental effects.

An erosion monitoring and adaptive management plan is recommended in which weltand erosion inspections and surveys are performed to assess whether erosion occurs. If erosion is observed, the Project could coordinate with LA County and the USACE to evaluate whether surveys of the Marina Del Rey entrance channel show a corresponding increase in sediment deposition in the entranct channel. Placing suitable-quality dredged material from the Marina del Rey entrance channel in the BWER restored wetlands could be considered as one adaptive management measure to offset the potential for extreme storm events to increase deposition in the entrance channel. Material dredged from the entrance channel could be barged up the Ballona Creek channel and sprayed onto the restored wetlands. Spray-dredging is a common practice in other parts of the U.S. and a similar spray-dredging pilot project is being planned for the Anaheim Bay entrance channel and Seal Beach National Wildlife Refuge by the U.S. Army Corps of Engineers and U.S. Fish and Wildlife Service. This type of dredge material placement in the wetlands would also help to offset wetland erosion during extreme events (discussed above) by effectively returning the eroded sediment that is deposited in the entrance channel back to the wetlands.

6.2.2.4 *Santa Monica Bay and beaches*

The potential increase in sediment export from Ballona Creek to Santa Monica Bay and deposition of fine-grained sediment at Dockweiler Beach and Venice Beach during typical storm events is expected to be low; however, as discussed above, conservatively high estimates of potential wetland erosion in response to larger infrequent storm events show an increase in the amount of sediment exported from Ballona Creek to Santa Monica Bay. During a 10-year event, results show 2,500 CY of sediment would be exported to the Bay under existing conditions and that the amount of exported sediment could increase to 14,500 CY under Project conditions. During a 100-year event, results show an increase from 17,000 CY to 63,000 CY. These events have a low probability of occurring in a given year (1% to 10% annual chance of occurrence). Increased deposition of fine-grained sediment on the adjacent beaches is expected following these infrequent storm events; however, the effects on the beach would be temporary because the fine sediment would be washed out by subsequent wave action. These conditions are expected to be similar to many other California river estuaries because the sediment export to the coast by rivers is a naturally occurring geologic process. At the Tijuana River Estuary, placement of fine-grained dredged material from the estuary on the beach has been tested and monitored and the results indicate that the effects are temporary. In summary, increased sediment export from Ballona Creek and deposition on the adjacent beaches is likely to occur infrequently and only temporarily, similar to conditions that occur at other California river estuaries.

6.2.3 Discussion of alternatives

6.2.3.1 *Alternative 2*

In Alternative 2, the existing levee along West Area B would remain and the West Area B wetlands would not experience erosion. The effects of Alternative 2 on on-site and off-site erosion and deposition would be similar to Alternative 1, but the changes would be less in magnitude.

Ballona Creek channel. Ballona Creek channel deposition and erosion would be similar to Alternative 1 in the realigned reach in Area A and North Area B. As in Alternative 1, changes in channel deposition and erosion are not expected to negatively affect flood performance or require channel maintenance.

Restored wetlands. Erosion and deposition patterns in the Area A and North Area B wetlands would be similar to Alternative 1, with the potential for large infrequent storm events to scour away vegetation and cause sediment erosion and temporary loss of vegetated wetland habitat until vegetation re-establishes. ***As in Alternative 1, pre-establishment of vegetation prior to breaching the levees is therefore recommended in the restored wetlands in Area A and North Area B to reduce the potential for erosion immediately after restoration in Alternative 2.***

In Alternative 2, wetland erosion would not occur in West Area B; however, loss of vegetated wetland habitat would occur over time because rising sea-levels would convert the managed tidal wetlands to a non-tidal pond.

Ballona Creek channel upstream of Lincoln Boulevard bridge. As in Alternative 1, no significant changes in erosion and deposition are expected upstream of BWER and the Marina Freeway due to the Alternative 2. Also as in Alternative 1, the potential increase in erosion at the Lincoln and Culver Blvd. bridges would be offset by the proposed armored sill across the channel under the bridges.

Ballona Creek channel mouth. As in Alternative 1, any change in shoaling at the channel mouth is not expected to be notable and shoaling farther upstream of the mouth of the channel and within BWER due to coastal and tidal sediment transport is not expected.

Marina del Rey harbor entrance channel. As in Alternative 1, Alternative 2 could potentially result in increased deposition and dredging in the harbor entrance channel; however, in Alternative 2, sediment would not be eroded from West Area B during extreme storm events. The potential increase in dredging in Alternative 2 would therefore be less than Alternative 1, with perhaps a 5-10% increase in dredging in Alternative 2. ***As in Alternative 1, consideration of placing suitable-quality dredged material from the Marina del Rey entrance channel in the BWER restored wetlands is recommended to offset the potential for extreme storm events to increase deposition in the entrance channel in Alternative 2.***

Santa Monica Bay and beaches. As in Alternative 1, increased sediment export from Ballona Creek and deposition on the adjacent beaches is likely to occur infrequently and only temporarily in Alternative 2, similar to conditions that occur at other California river estuaries. The potential increase in Alternative 2 could be about half of the increase in Alternative 1 because wetlands erosion would not occur in west Area B in Alternative 2.

6.2.3.2 *Alternative 3*

In Alternative 3, the existing levees and channel would remain and restored wetlands in Area A would be connected to Ballona Creek by open culverts through the existing levee. During large storm events, creek discharge would flow into the restored wetlands, but flow in the channel would otherwise be unaffected. Alternative 3 is therefore not expected to change existing patterns of erosion and deposition in any notable manner. Note that updated hydraulic modeling in progress for Alternative 3 will be used to confirm and support this conclusion.

Figures

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Figure 3. Ballona Creek, 1938 and 2012
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Figure 29. Sediment Budget Under Project Conditions (Average Year)

Attachments

Attachment 1. Timeline for Ballona Creek and Marina del Rey



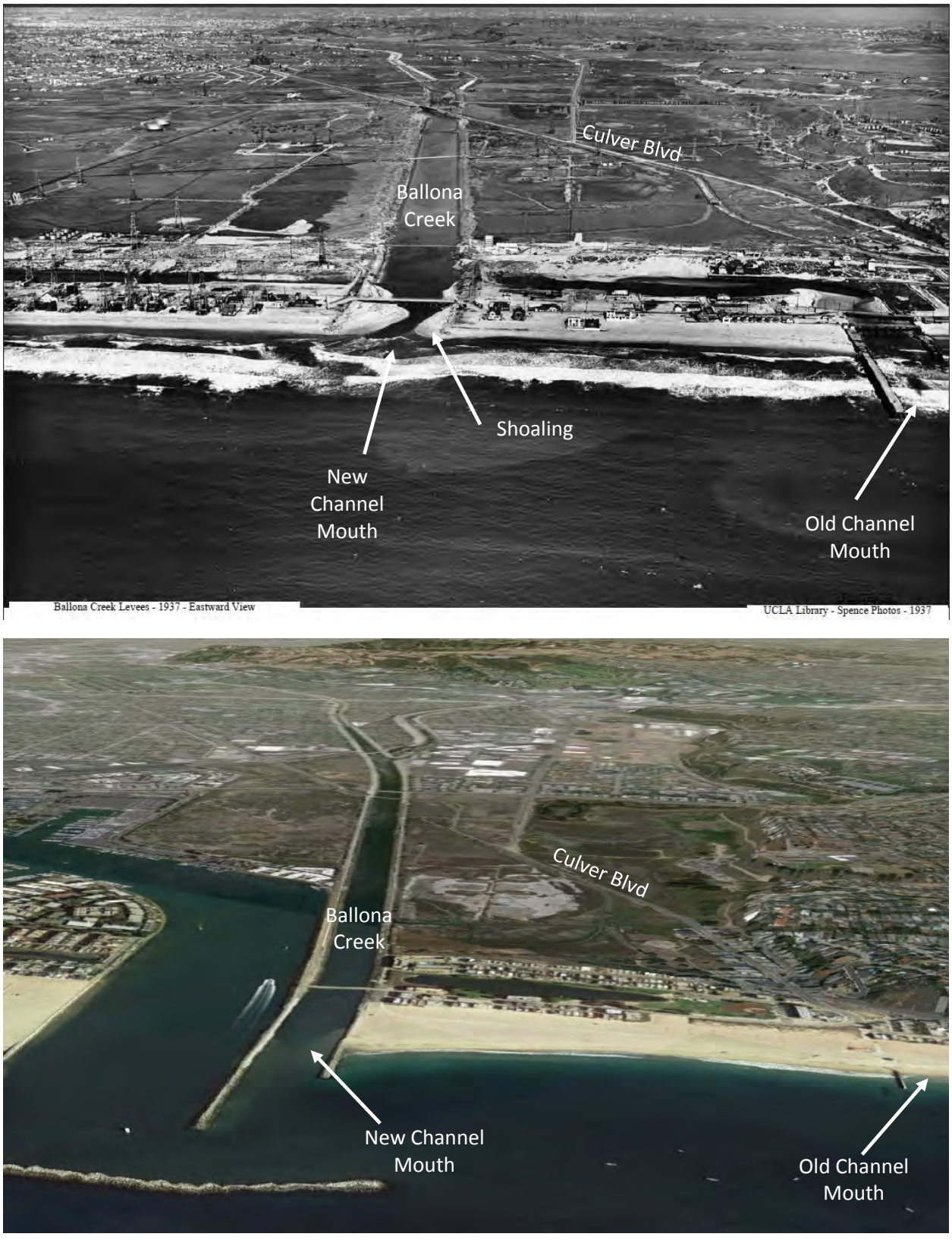


Ballona Wetlands . D120367

SOURCE: UCLA Library, Spence Photos; Google Earth

Figure 1
Ballona, 1933 and 2012

ESA PWA



SOURCE: UCLA Library, Spence Photos; Google Earth

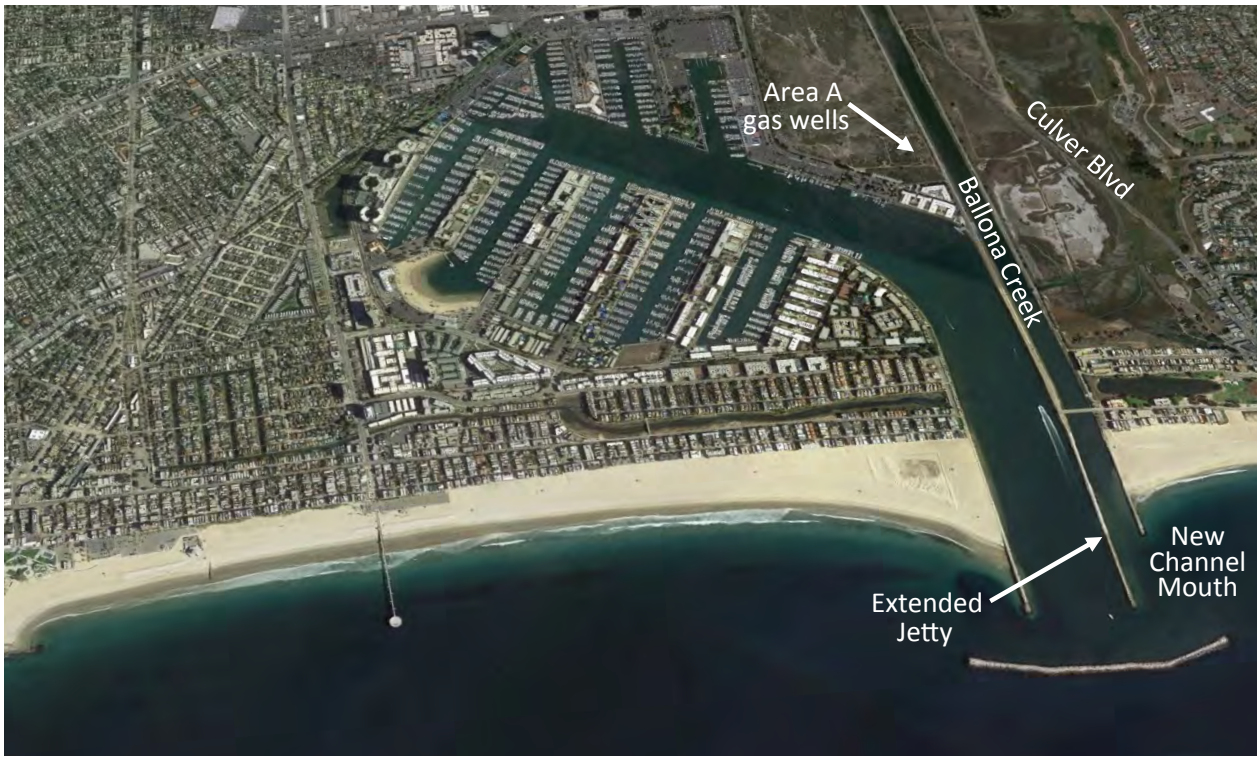
Ballona Wetlands . D120367

Figure 2

Ballona, 1937 and 2012

ESA PWA



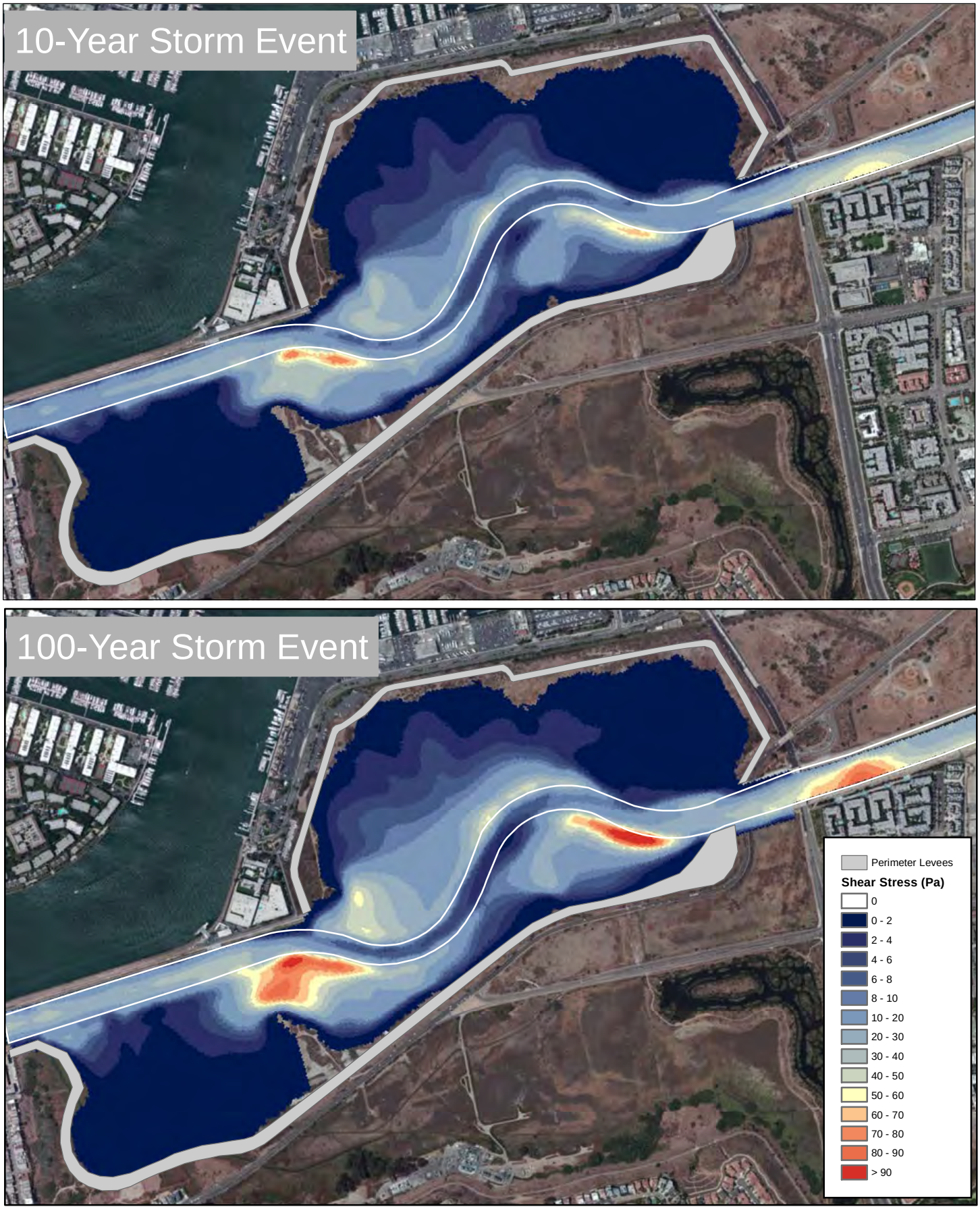


Ballona Wetlands . D120367

SOURCE: UCLA Library, Spence Photos; Google Earth

Figure 3
Ballona, 1938 and 2012

ESA PWA

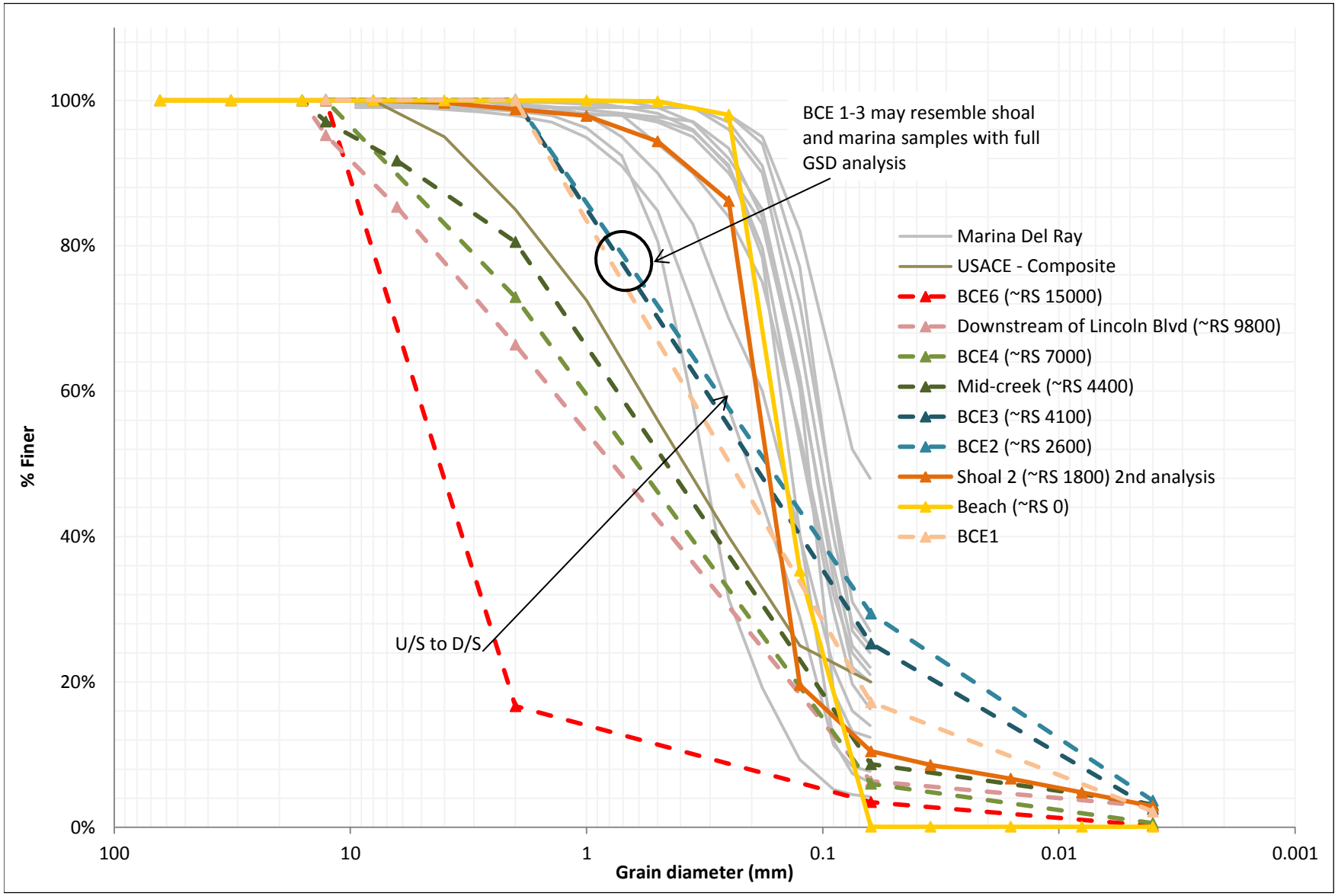


G:\1793_Ballona\Modeling\EFDC\ShearMap.mxd

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Ballona Wetlands. D120367

Figure 4
Modeled Shear Stress



SOURCE: USACE 2003; Wallace Labs 2013; SCCWRP 2010.
NOTES: Solid lines indicate complete grain size analysis, while dotted lines indicate only clay/silt/sand/gravel categorization.

Ballona Creek Wetlands . D120367

Figure 5

Ballona Creek Grain Size Distribution Curves

Sandy with Silt and Occasionally Gravel

Highly Variable

Gravelly with Sand/Silt

October 2007

June 2008

August 2009

2010

November 2011

December 2011

August 2012

October 2012

0 950 1,900 Feet

S:\GIS\1793_Ballona\Sediment_Transport\SedimentSize\SedSize_pie.mxd

Sediments

Clay

Silt (Silt and Clay in Marina)

Sand

Gravel

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community, Channel data from 2007-2009 from SCCWRP (2010), Marina data from 2010 from Kinnetic Laboratories (2010), channel data from 2011 and 2012 from City of LA (2012, 2013) at the same SCCWRP stations, Marina data from 2012 from AMEC (2012), ESA PWA survey (2012); Data from the marina is averaged by entrance over a season.

Ballona Wetlands. D120367

Figure 6

Sediment Transport Data

ESA PWA



J:\1793_Ballona\Sediment_Transport\SedimentSize\SedSize.mxd

Source: Kinnetic Laboratories (2010), AMEC (2012), ESA PWA survey (2012) Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

Ballona Wetlands. D120367

Figure 7

Sediment Size Map

ESA PWA



J:\1793_Ballona\Accretion.mxd

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community; USACE (2003), PSOMAS (2012)
Notes: Figure shows net change from 1961 to 2012.

ESA PWA

Ballona Wetlands. D120367

Figure 8
Ballona Creek Accretion between 1961 and 2012

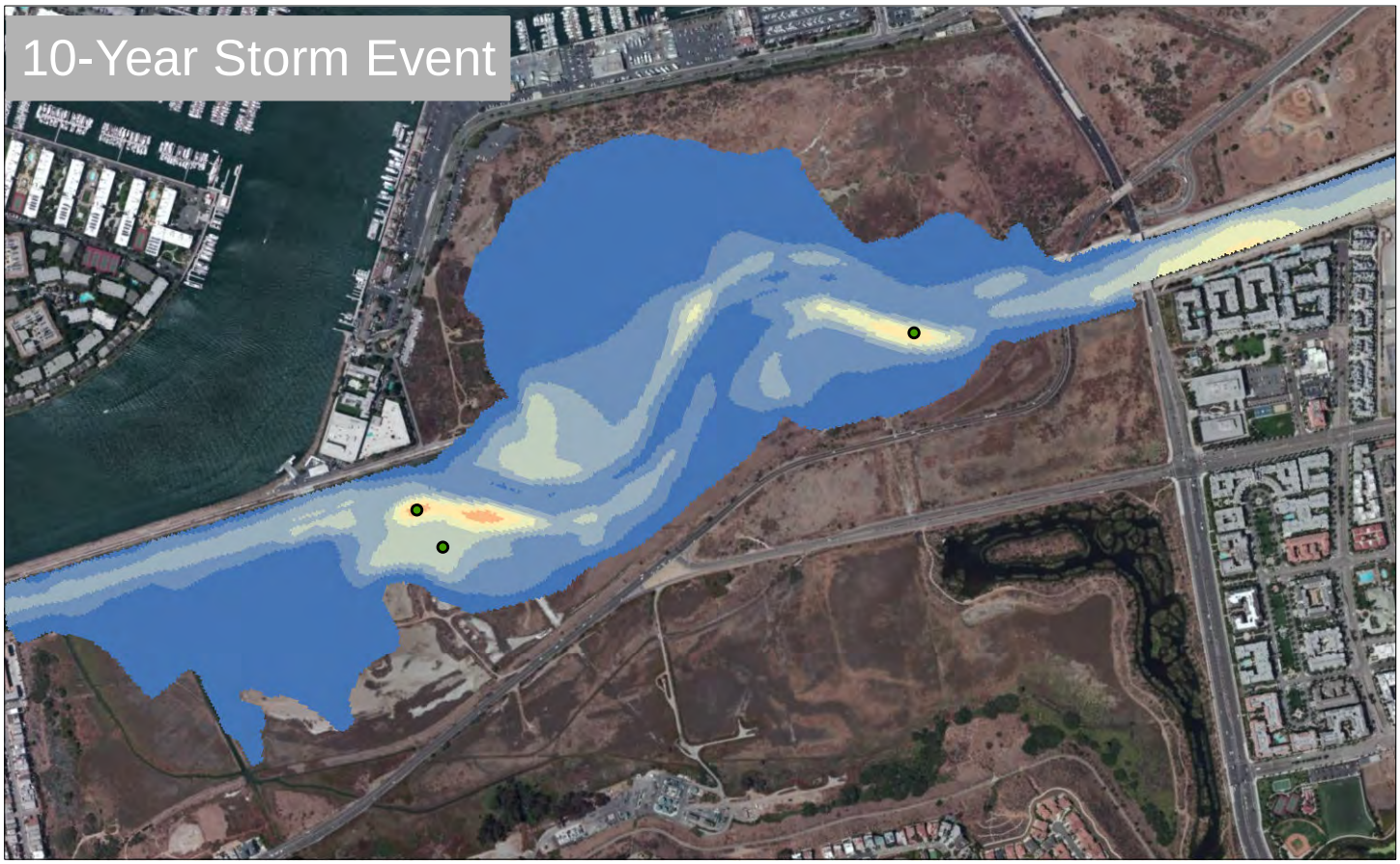


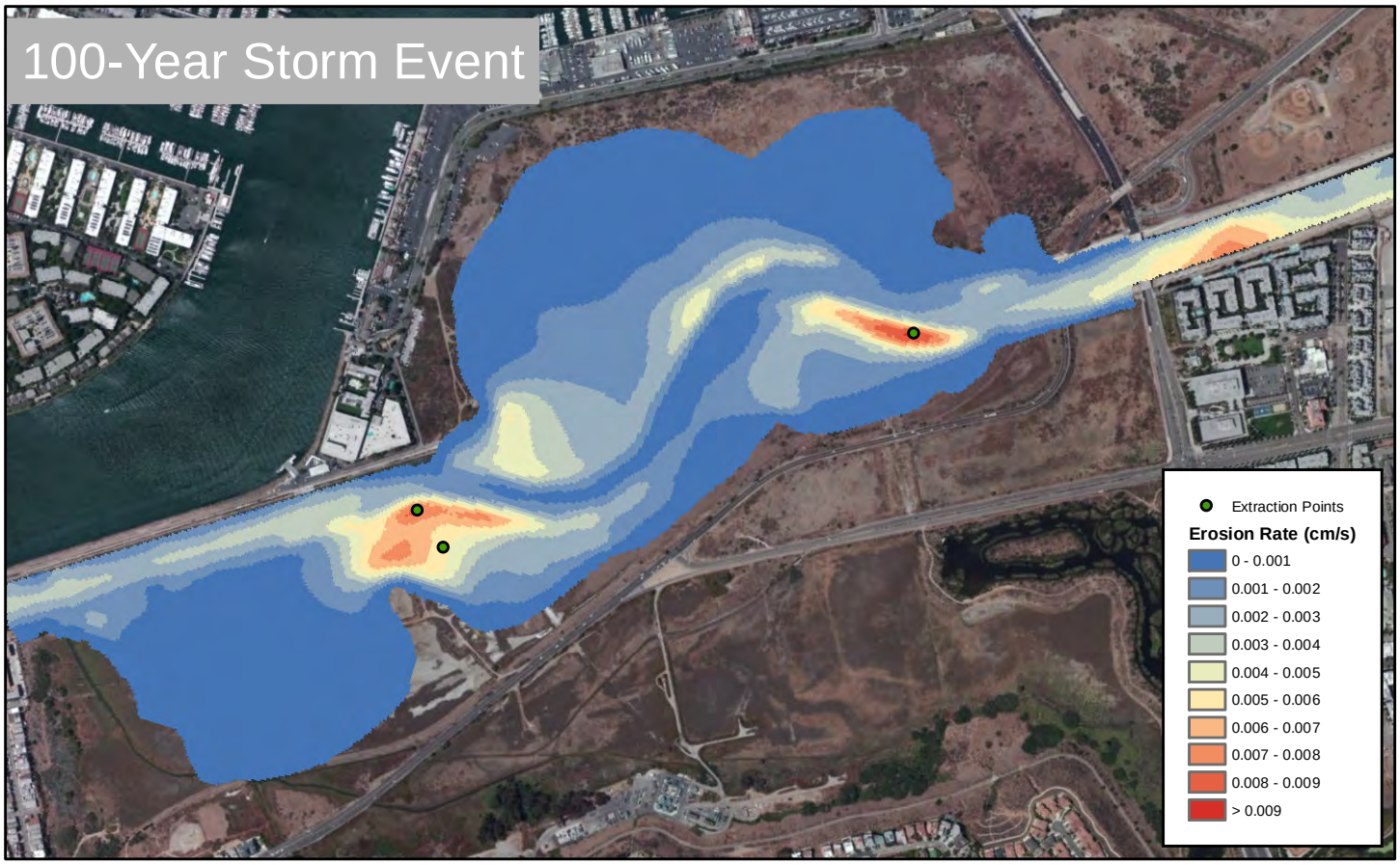
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community; USACE (2003), PSOMAS (2012)
Notes: Figure shows net change from 1961 to 2012.

Ballona Wetlands. D120367

Figure 9
Projected Accretion and Erosion during Q100 Storm

ESA PWA





G:\1793_Ballona\Modeling\EFDC\Max_ErosionMap.mxd

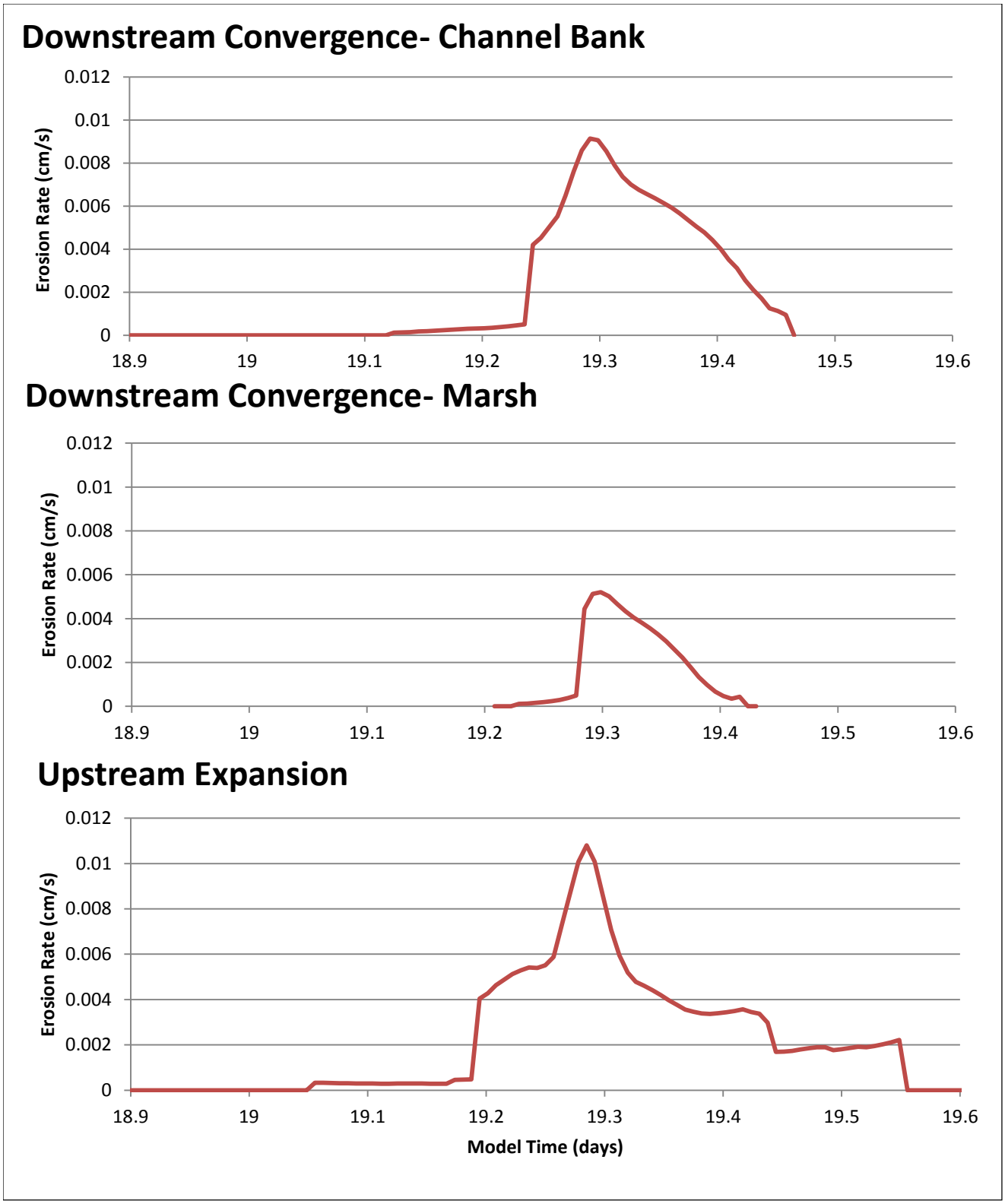
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

Ballona Wetlands. D120367

Figure 10

Maximum Erosion

ESA PWA

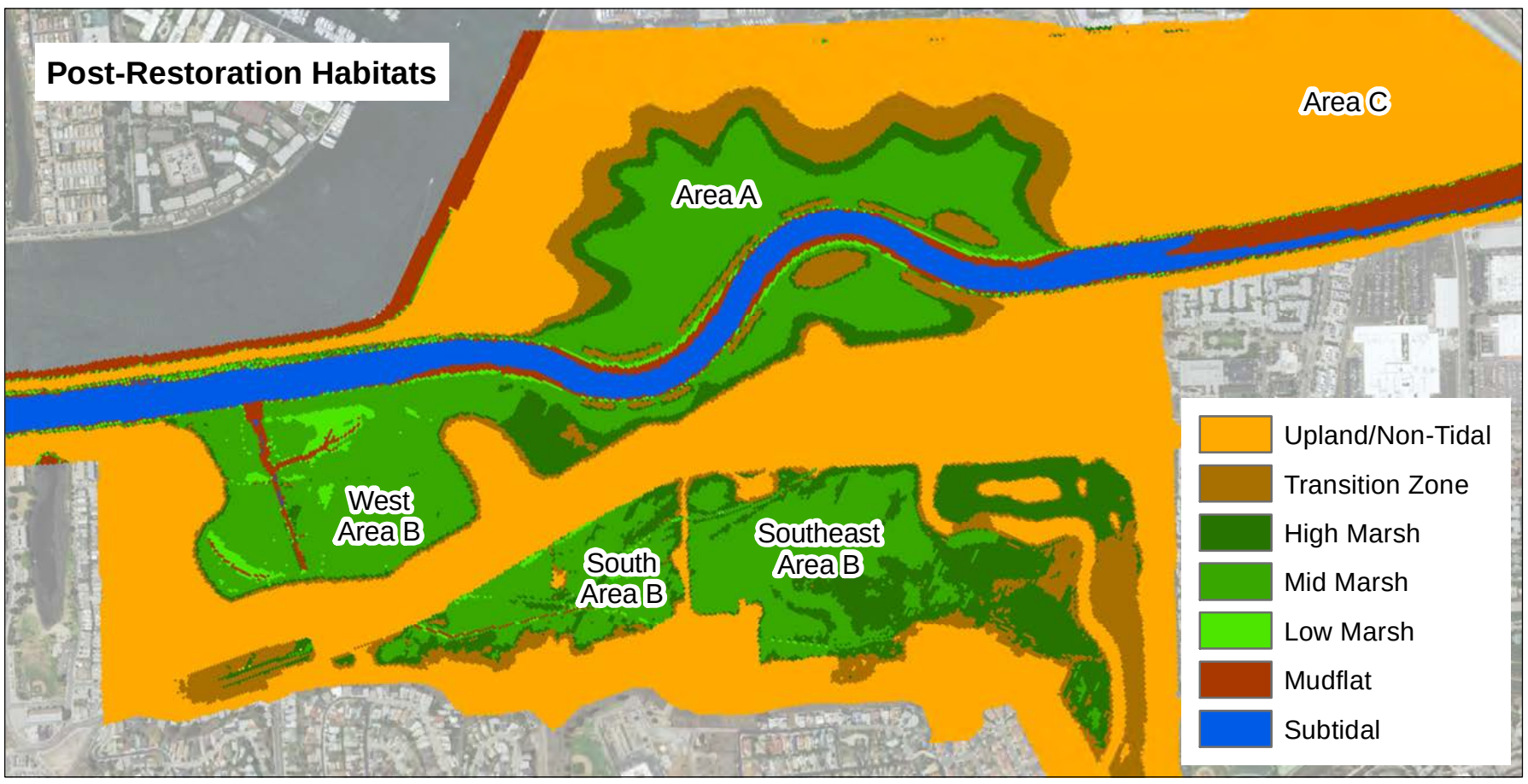


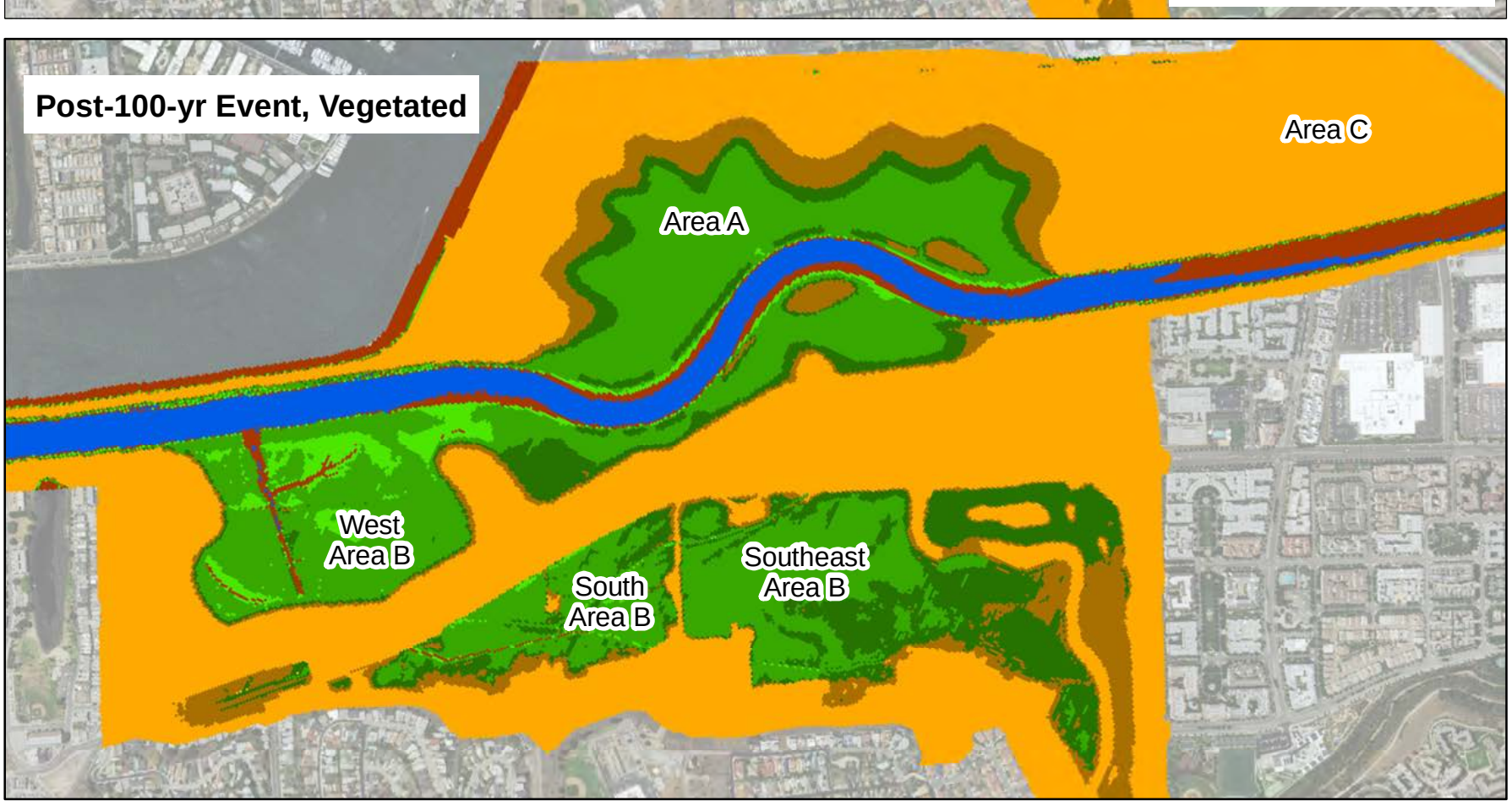
Notes: Rates are based on Ganthy (2011) equation with a critical shear stress of 0.18 Pa.

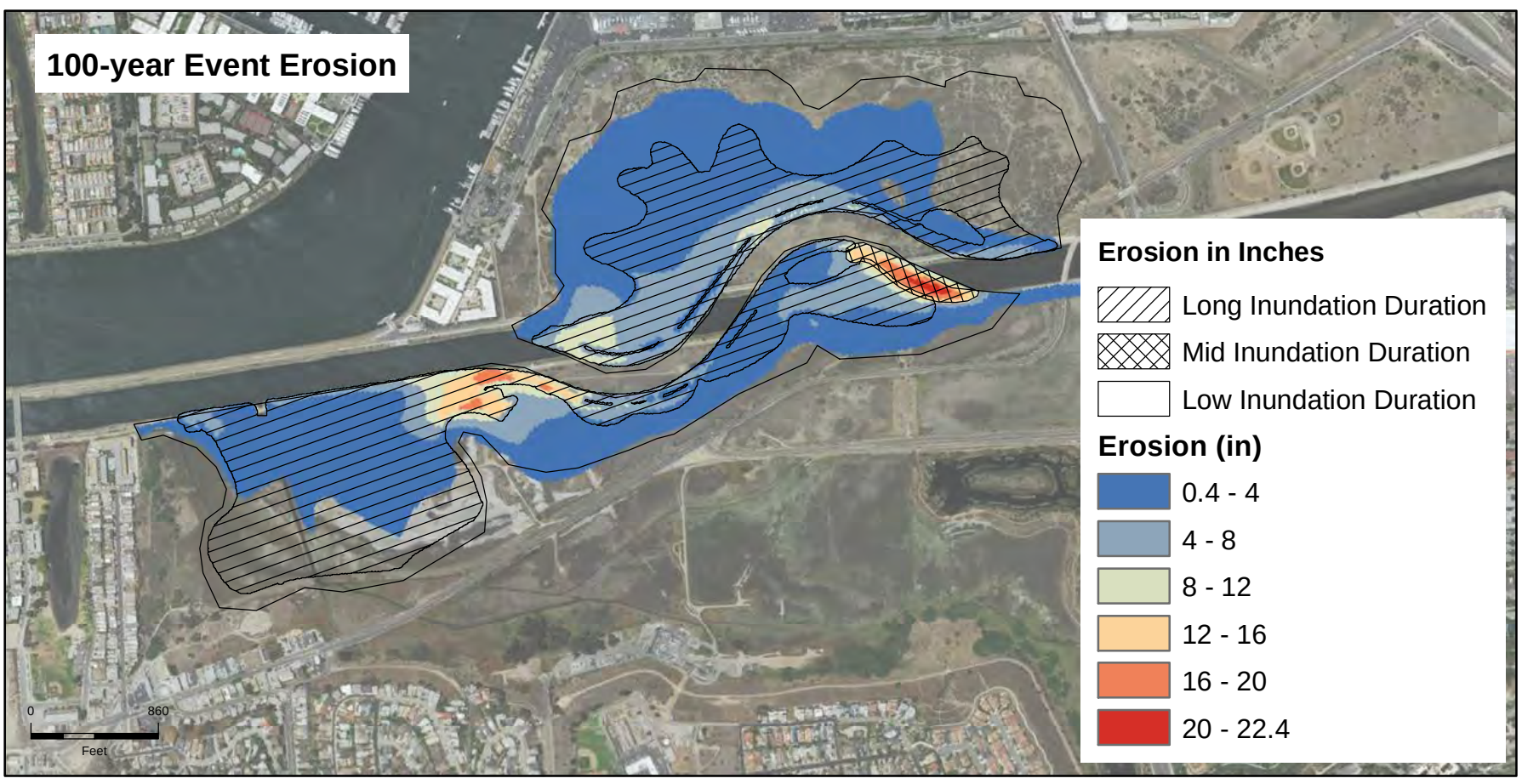
Ballona Creek Wetlands . D120367

Figure 11

Q100 Erosion Time Series





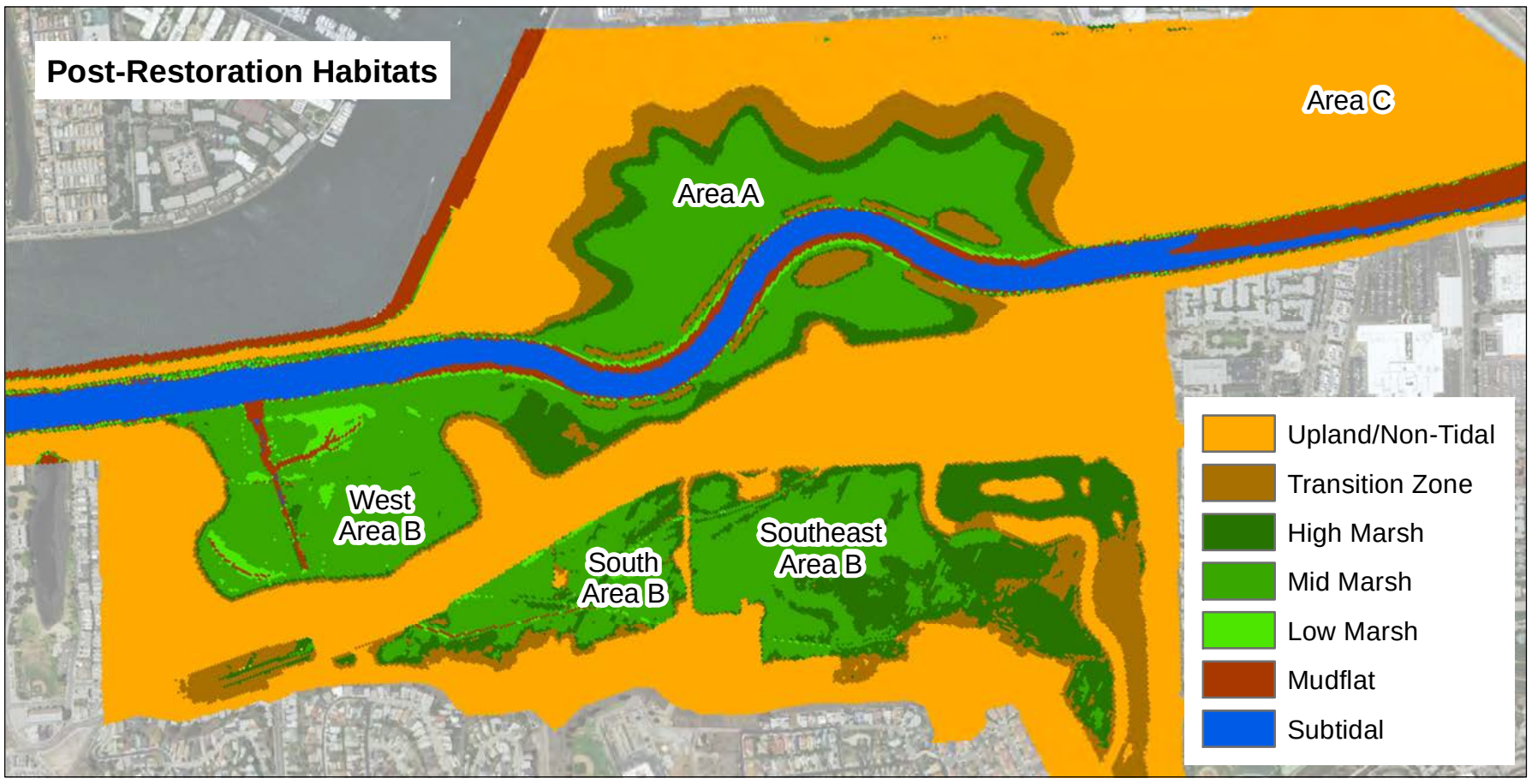


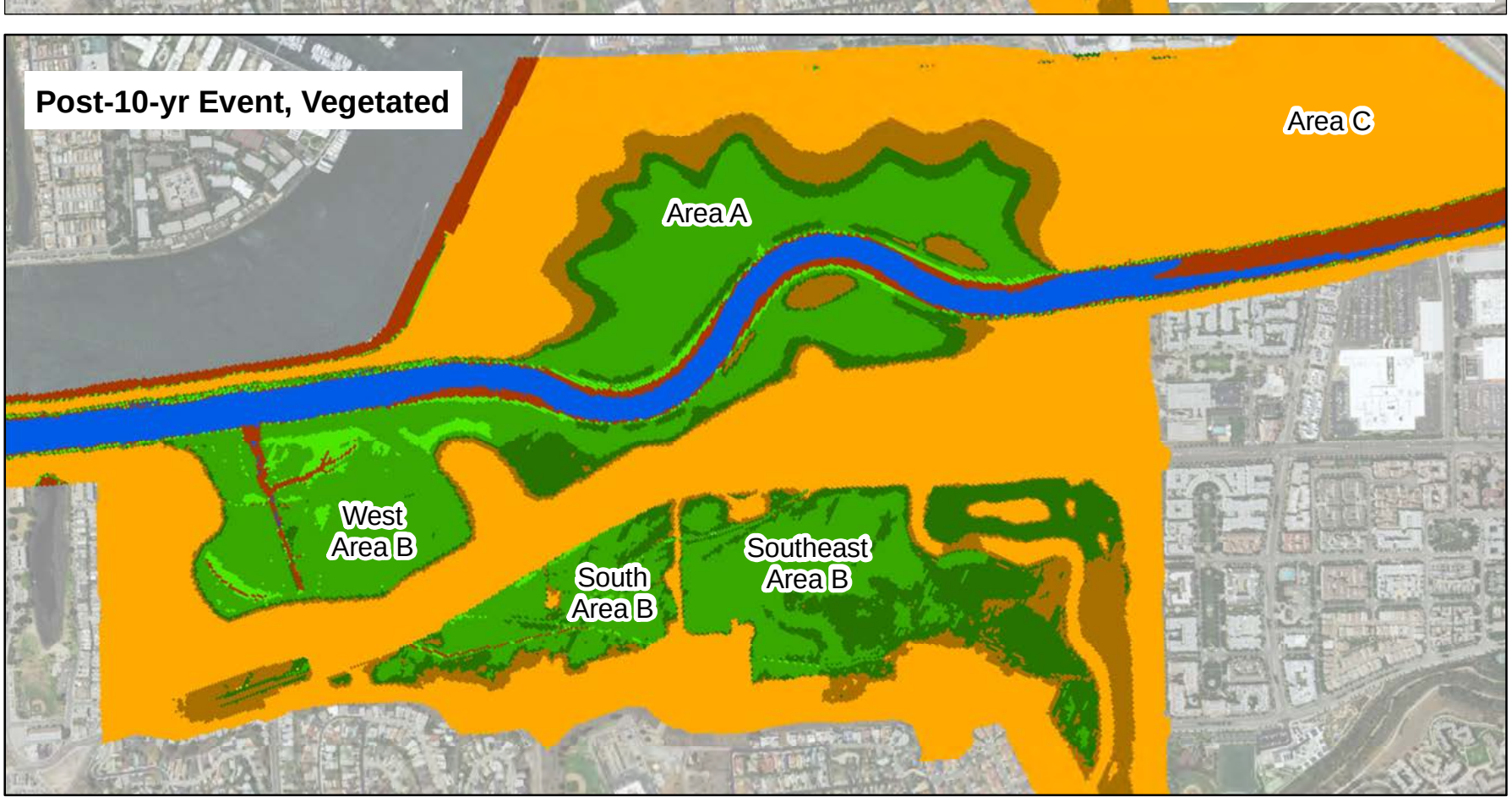
NOTES: Vegetation included. Armoring not included.

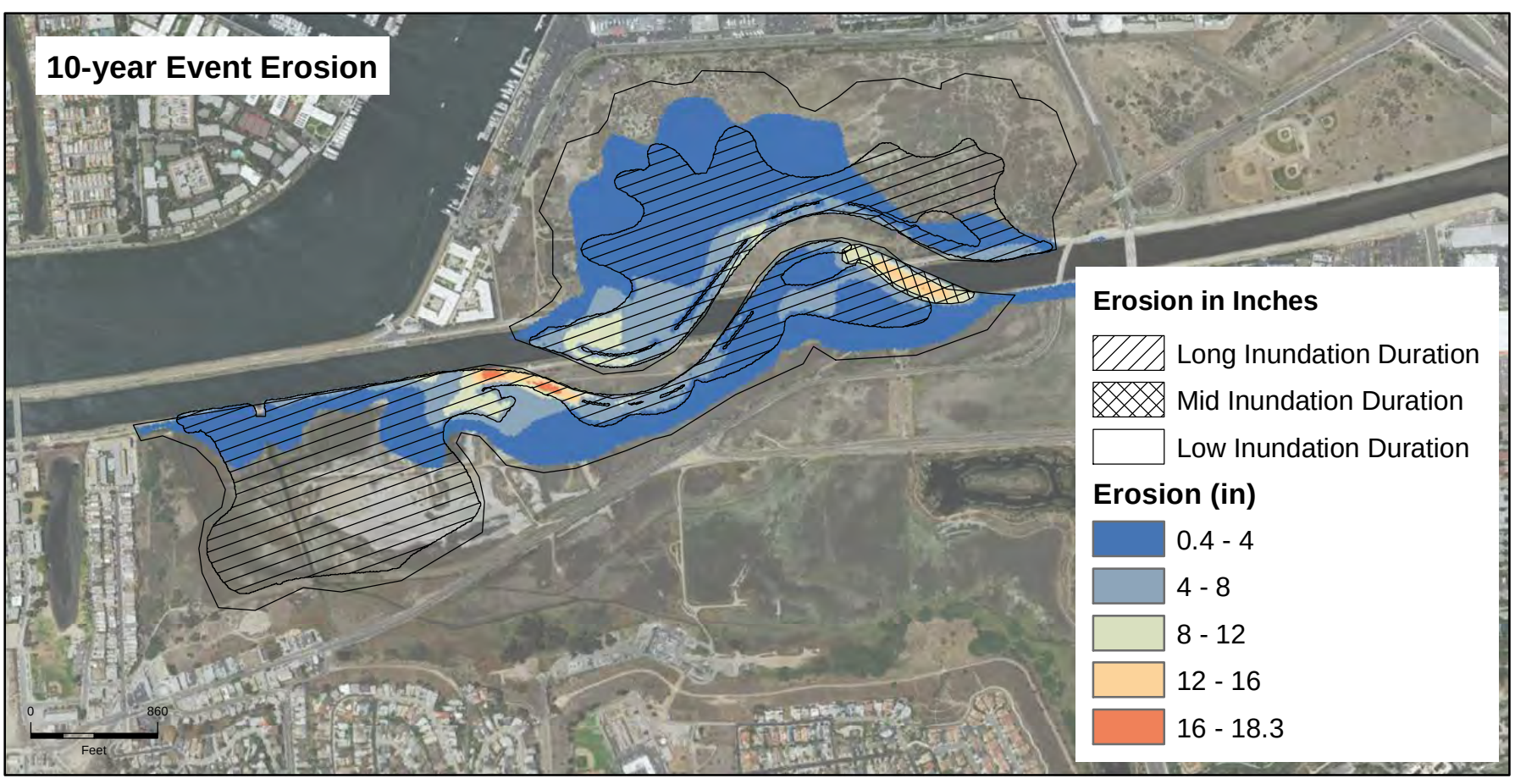
Ballona Wetlands. D120367

Figure 12

Q100 Erosion Map





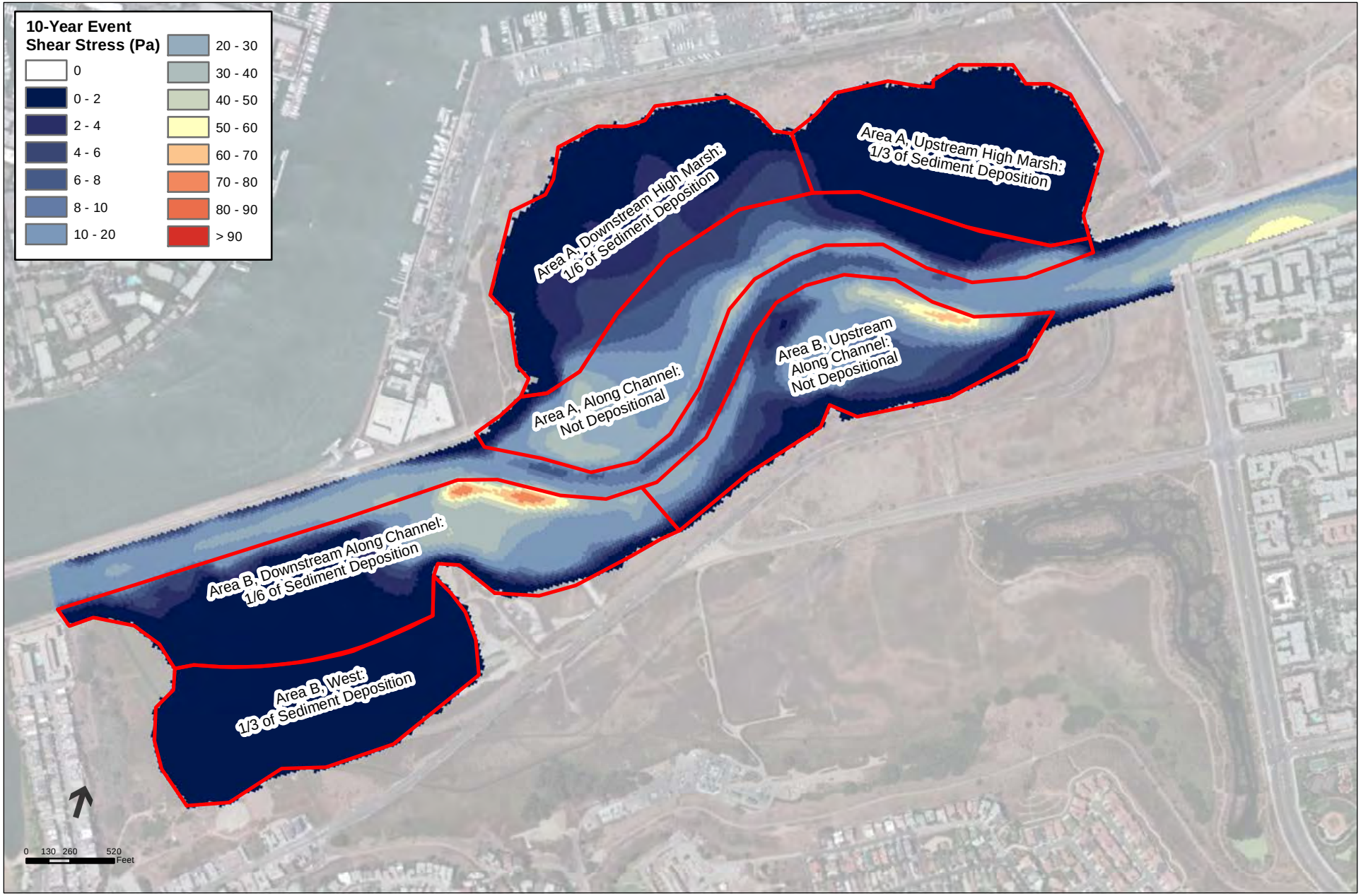


NOTES: Vegetation included. Armoring not included.

Ballona Wetlands. D120367

Figure 13

Q10 Erosion Map



G:\1793_Ballona\Modeling\EFDC\DepositionMap.mxd

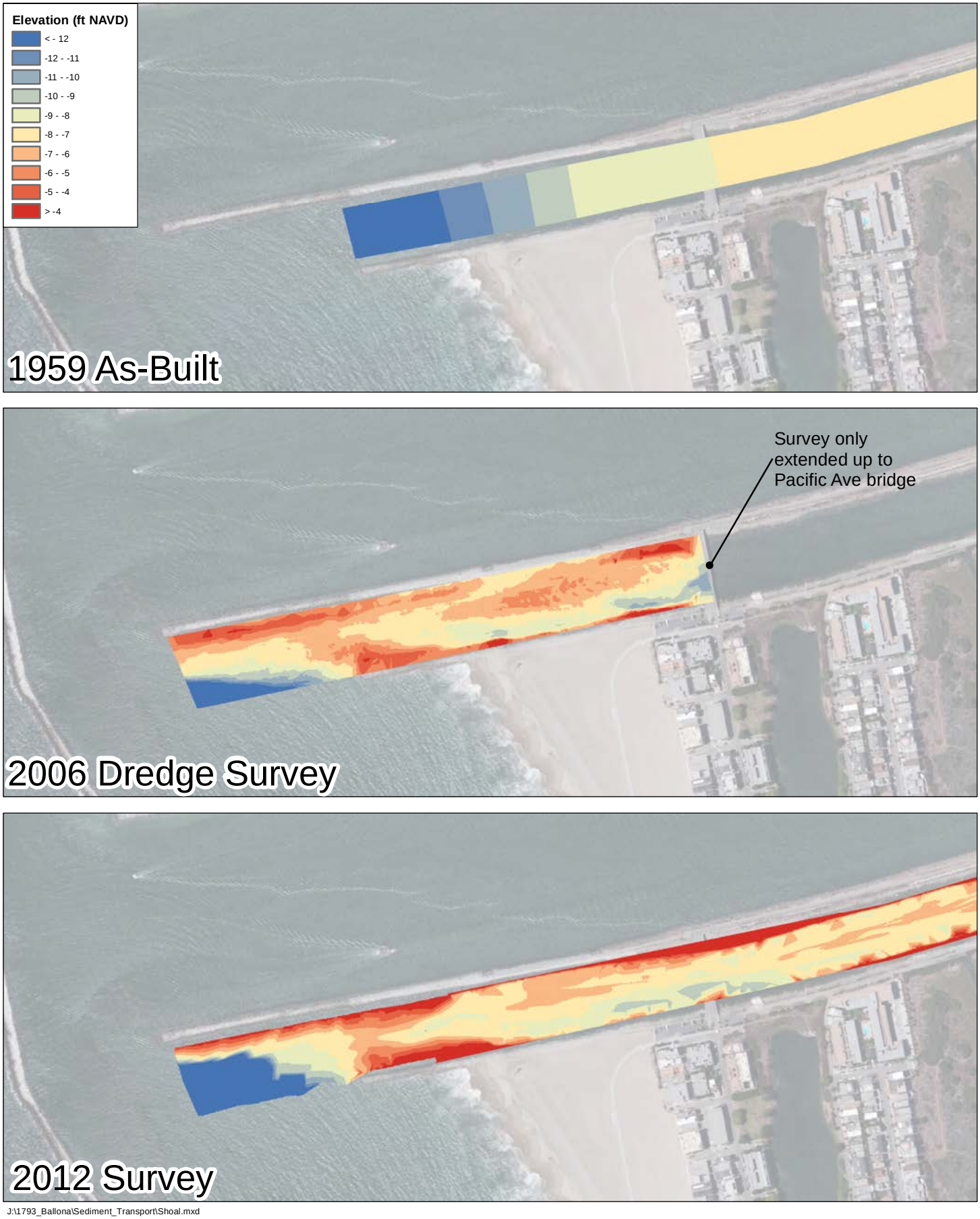
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community The shear stress is from the 10-year storm event.

Ballona Wetlands. D120367

Figure 14

Marsh Deposition Locations

ESA PWA

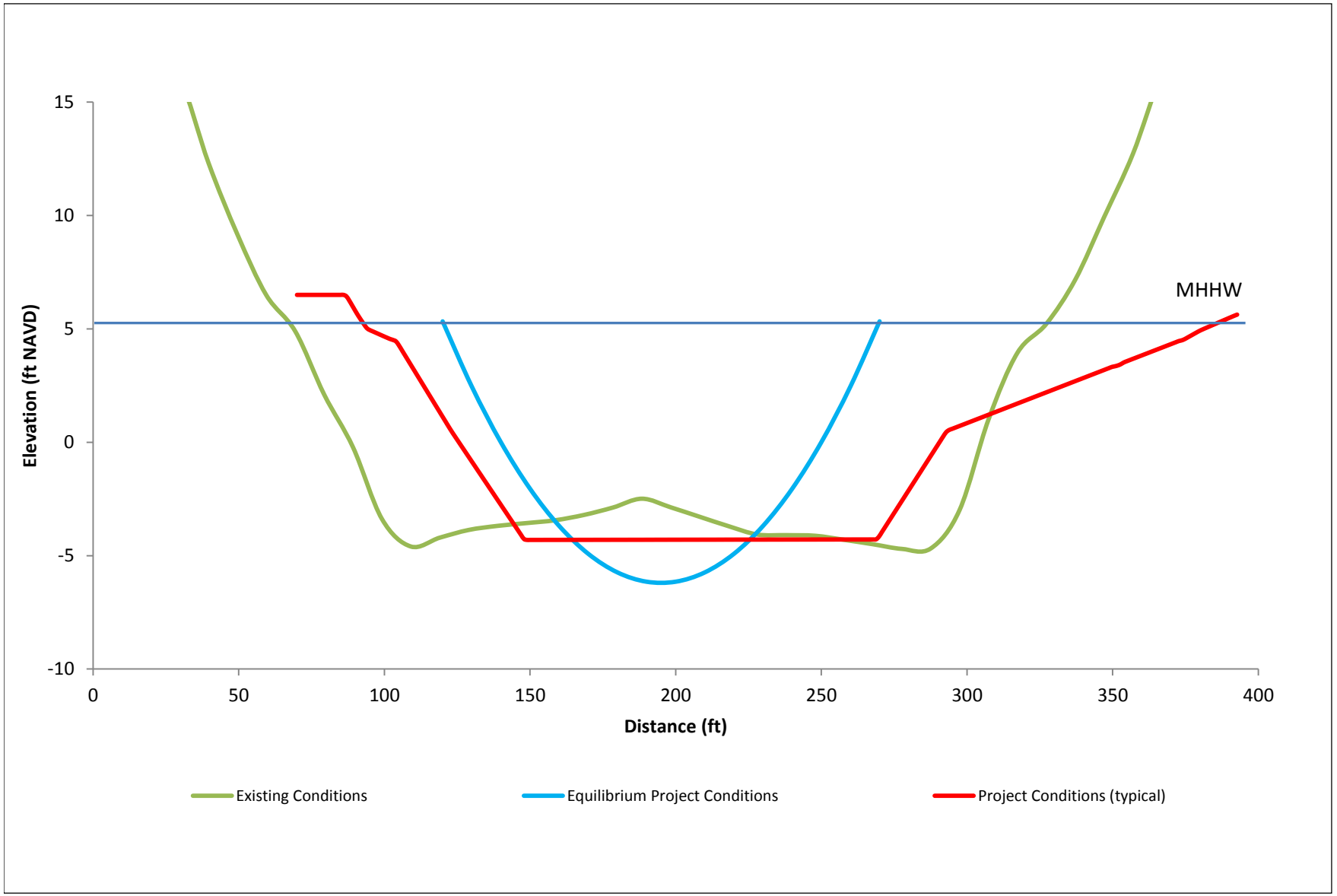


J:\1793_Ballona\Sediment_Transport\Shoal.mxd

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
USACE (2003), USACE (2006), PSOMAS (2012)

Ballona Wetlands. D120367

Figure 15
Ballona Creek Shoal

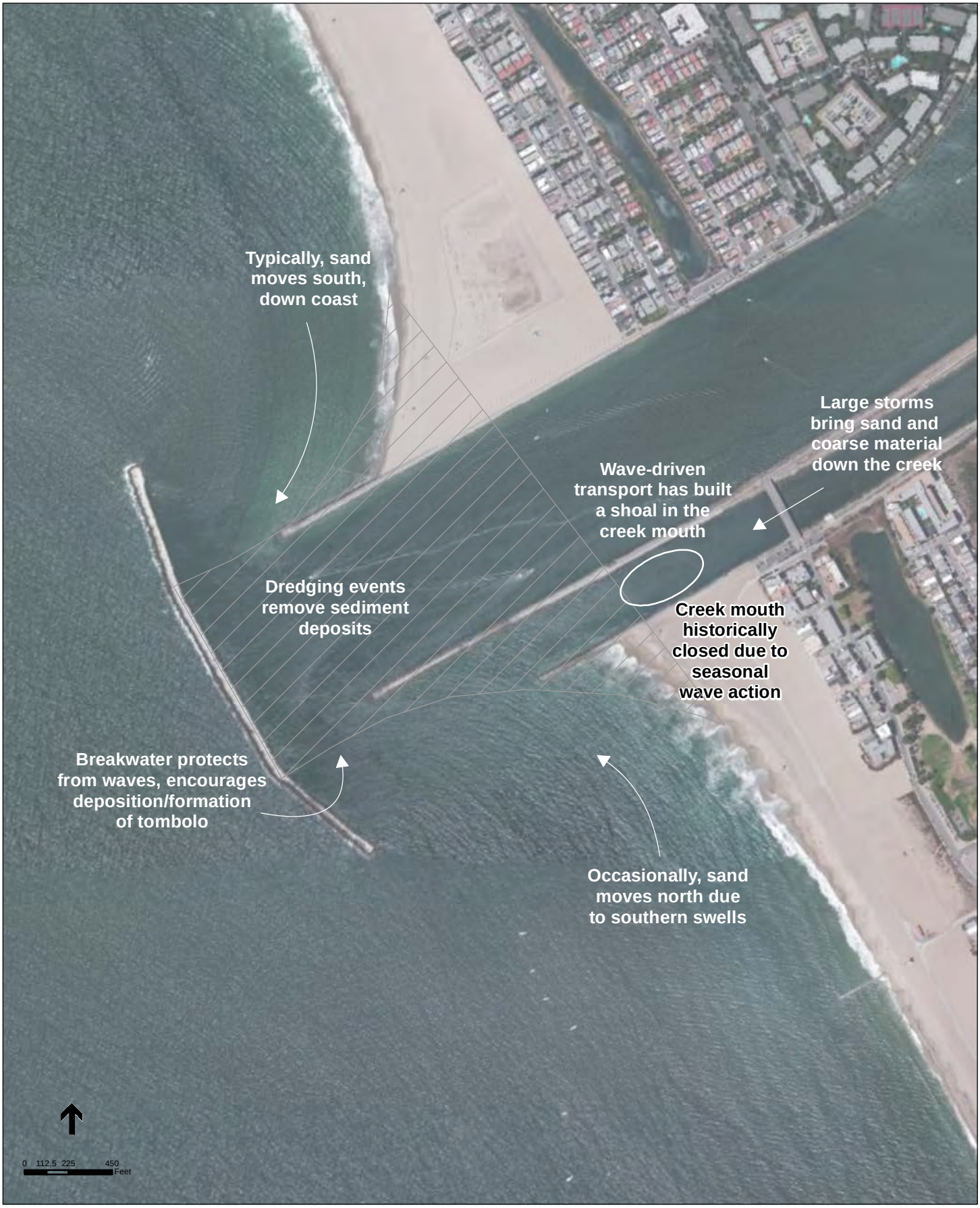


SOURCE: ESA PWA (2012)

Ballona Wetlands. D120367

Figure 16

Ballona Creek Channel Cross Section
Mid-Meander



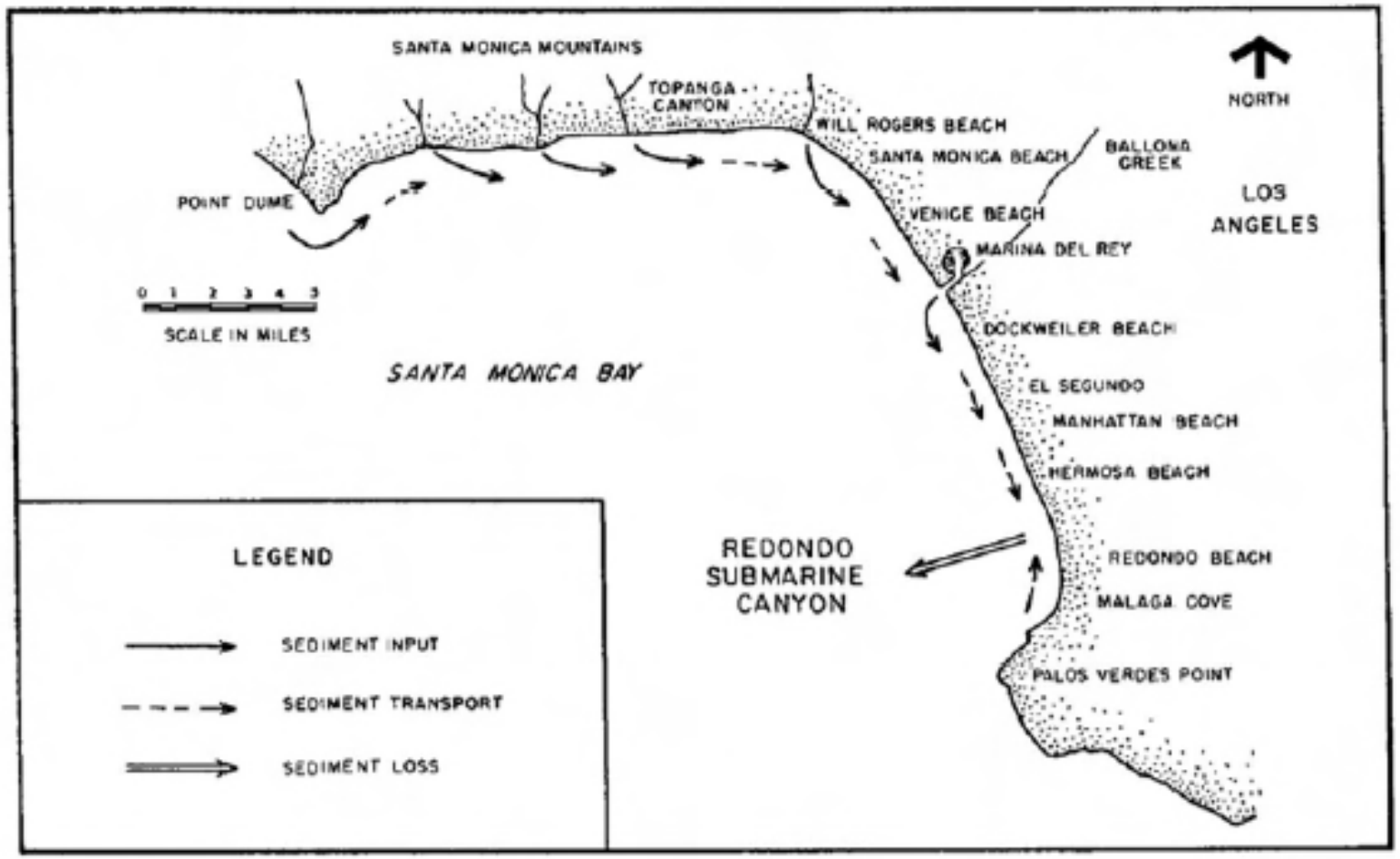
J:\1793_Ballona\CoastalProcesses.mxd

Source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP,

ESA PWA

Ballona Wetlands. D120367

Figure 17
Coastal Processes
Near Ballona Creek



SOURCE: Figure 2, Leidersdorf, Hollar, and Woodell (1994).

Ballona Wetlands . D120367

Figure 18

Santa Monica Littoral Cell

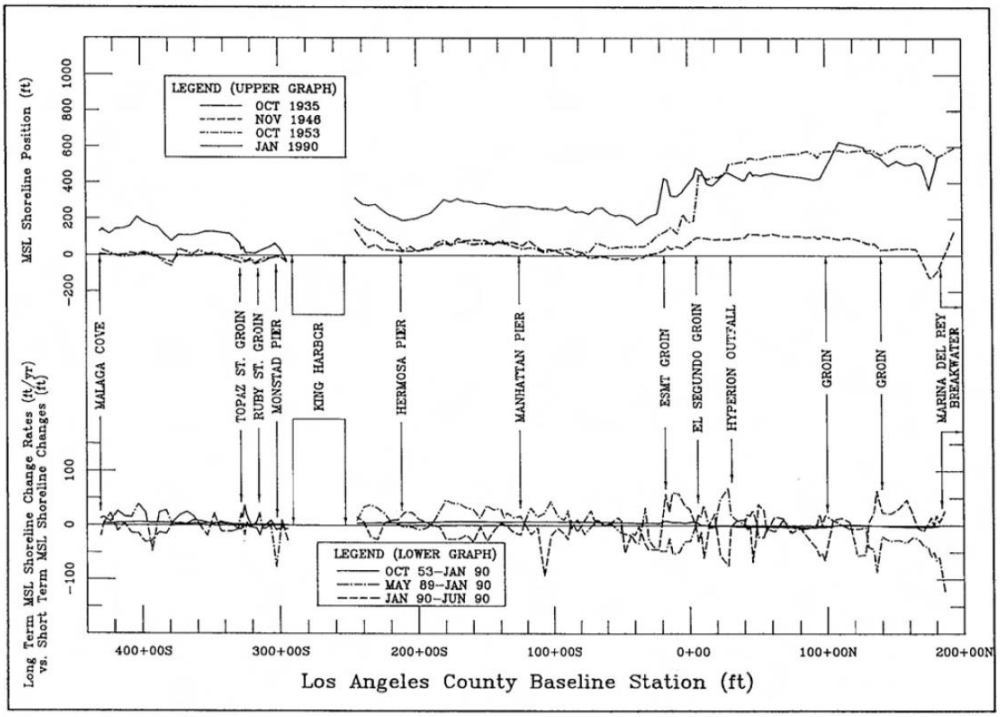


Figure 3a. MSL Shoreline Positions Relative to 1935, and Long Term MSL Shoreline Change Rates vs. Short Term MSL Shoreline Changes, between Malaga Cove and Dockweiler Beach.

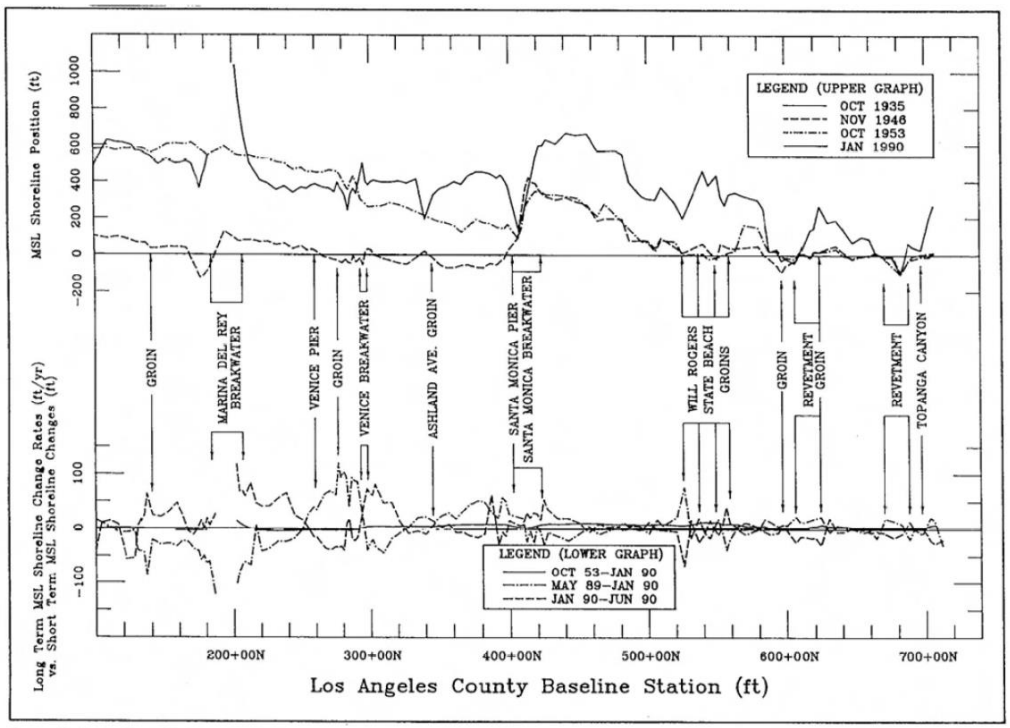
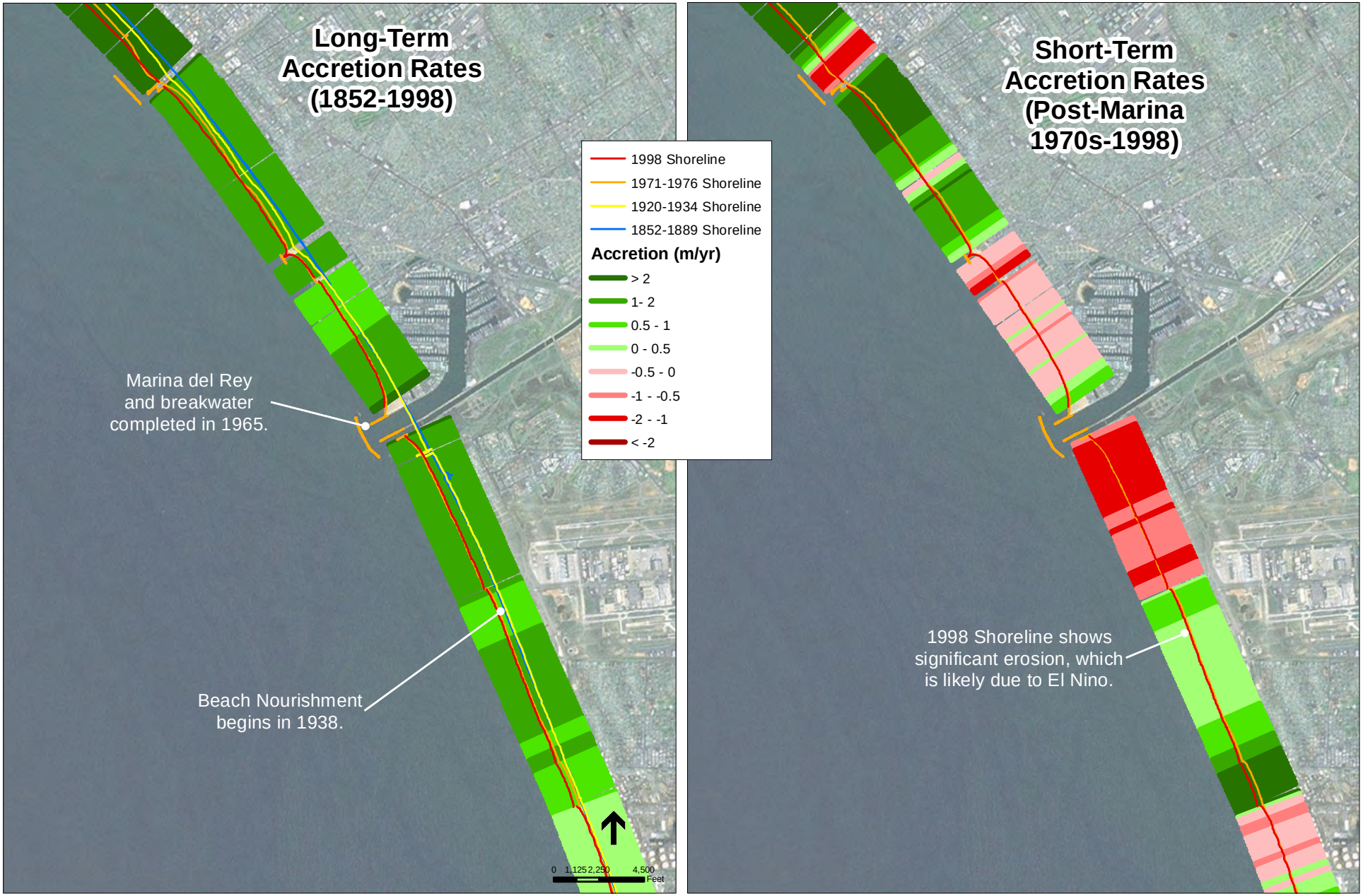


Figure 3b. MSL Shoreline Positions Relative to 1935, and Long Term MSL Shoreline Change Rates vs. Short Term MSL Shoreline Changes, between Dockweiler Beach and Topanga Canyon.

SOURCE: Reproduced from Figure 3, Leidersdorf 1994.

Figure 19
Shoreline Change Profiles
(Leidersdorf 1994)



J:\1793_Ballona\Coastal_ShorelineChanges.mxd

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community
Shoreline data from USGS 2006

ESA PWA

Ballona Wetlands. D120367

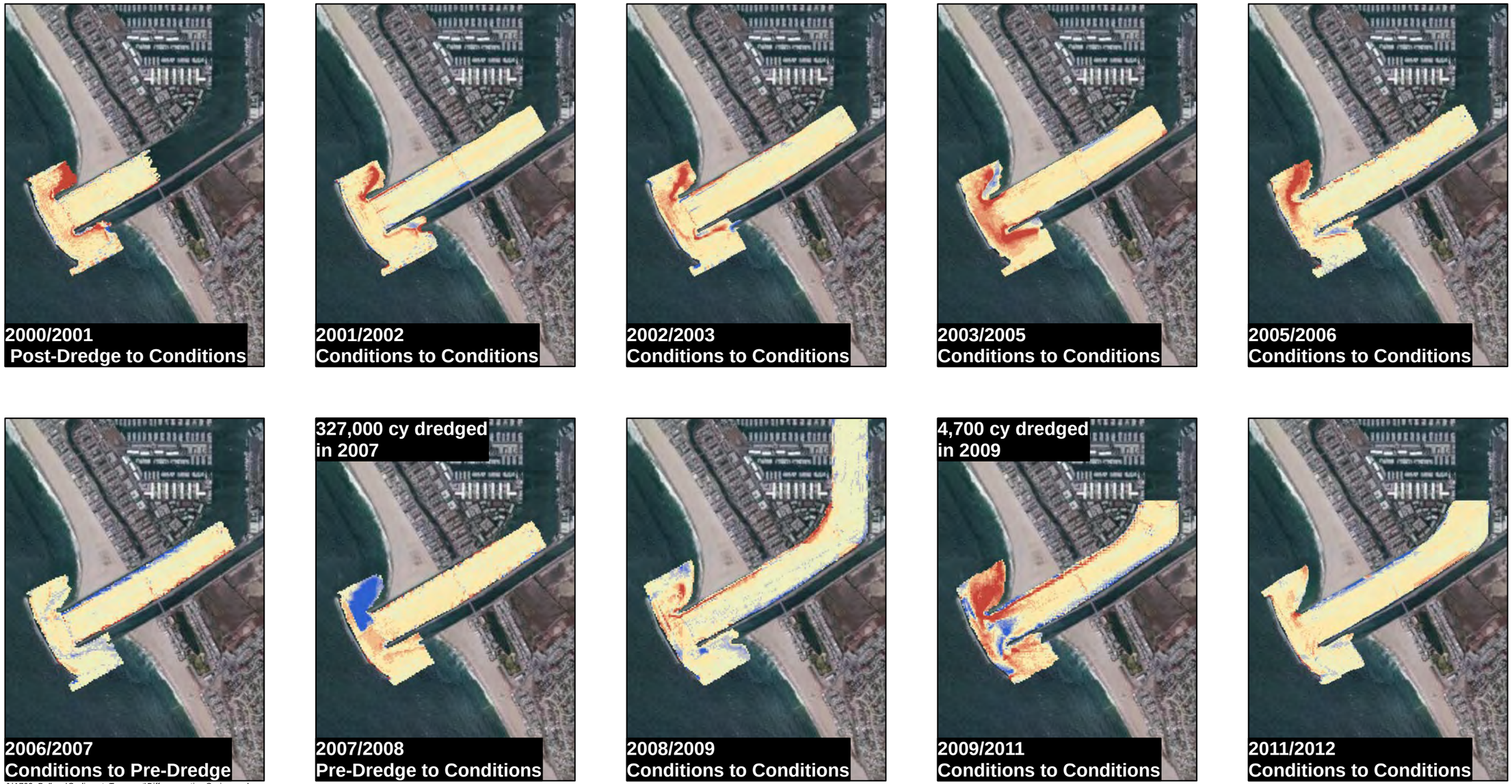
Figure 20

Coastal Shoreline Change Rates



J:\1793_Ballona\Accretion.mxd

Figure 21
Breakwaters and tombolos



Ballona Wetlands. D120367

Figure 22

Marina del Rey

Bathymetric Difference Maps



J:\1793_Ballona\Sediment_Transport\Areas_A_B_G_H_rates.mxd

Source: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

Ballona Wetlands. D120367

Figure 23

Marina del Rey Accretion Rates

ESA PWA



Seal Beach location_2014-0411ct.mxd

Service Layer Credits: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Ballona Wetlands. D120367

Figure 24

Seal Beach Wetlands Location

ESA PWA



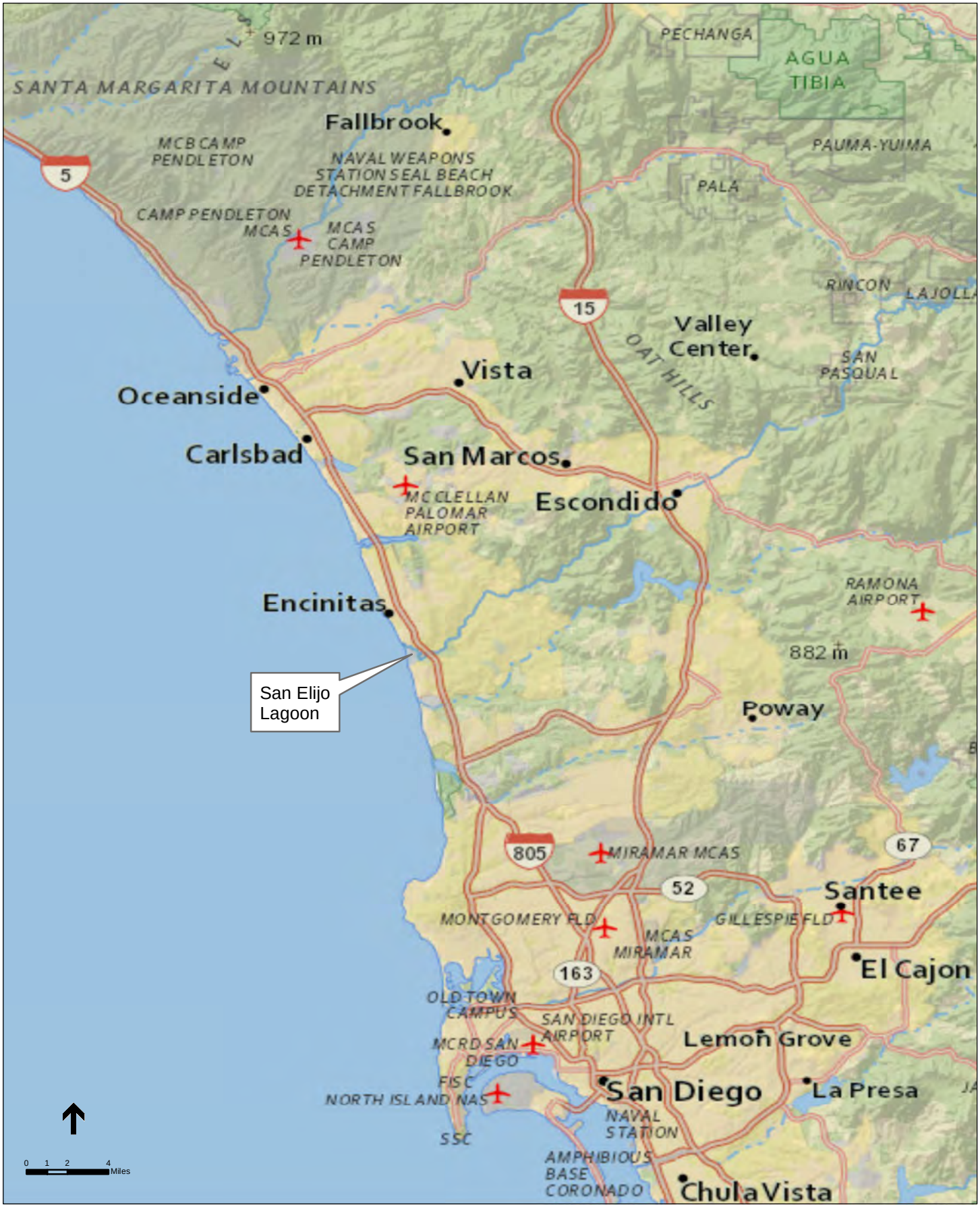
Seal Beach historic habitats_2014-0410ct.mxd

SOURCE: USDA 2012 (LA County air photo), USDA 2009 (Orange County air photo), SFEI 2011 (historic habitats)

Ballona Wetlands. D120367

Figure 25

Historic and Existing Habitats - Seal Beach Wetlands



San Elijo location_2014-0411ct.mxd

Service Layer Credits: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Ballona Wetlands. D120367

Figure 26

San Elijo Lagoon Location

ESA PWA



San Elijo historic habitats_2014-0410ct.mxd

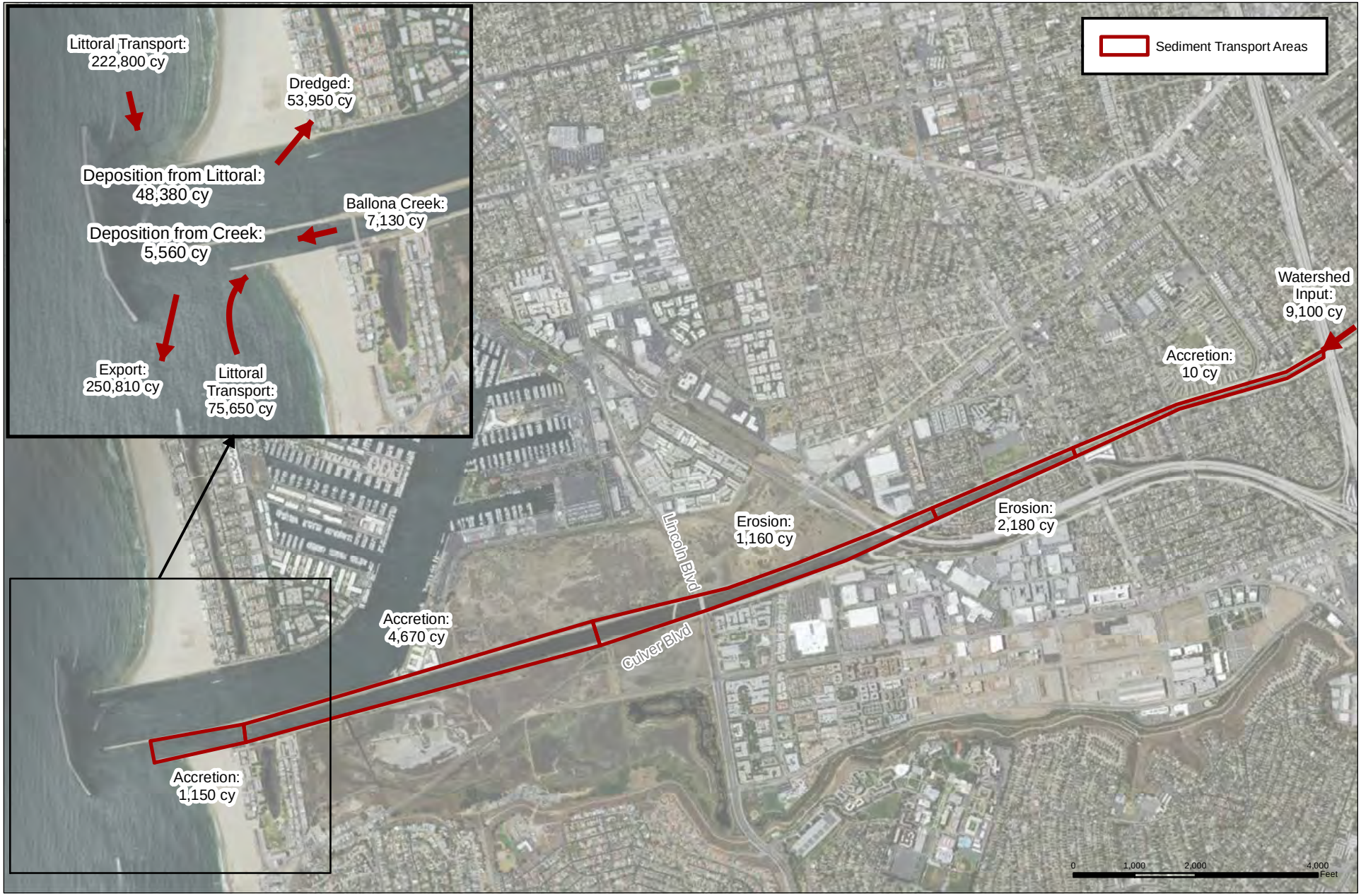
SOURCE: USDA 2010 (San Diego County air photo), SFEI 2011 (historic habitats)

Ballona Wetlands. D120367

Figure 27

Historic and Existing Habitats - San Elijo Lagoon

ESA PWA



G:\1793_Ballona\Sediment_Transport\BudgetBoxes_EC.mxd

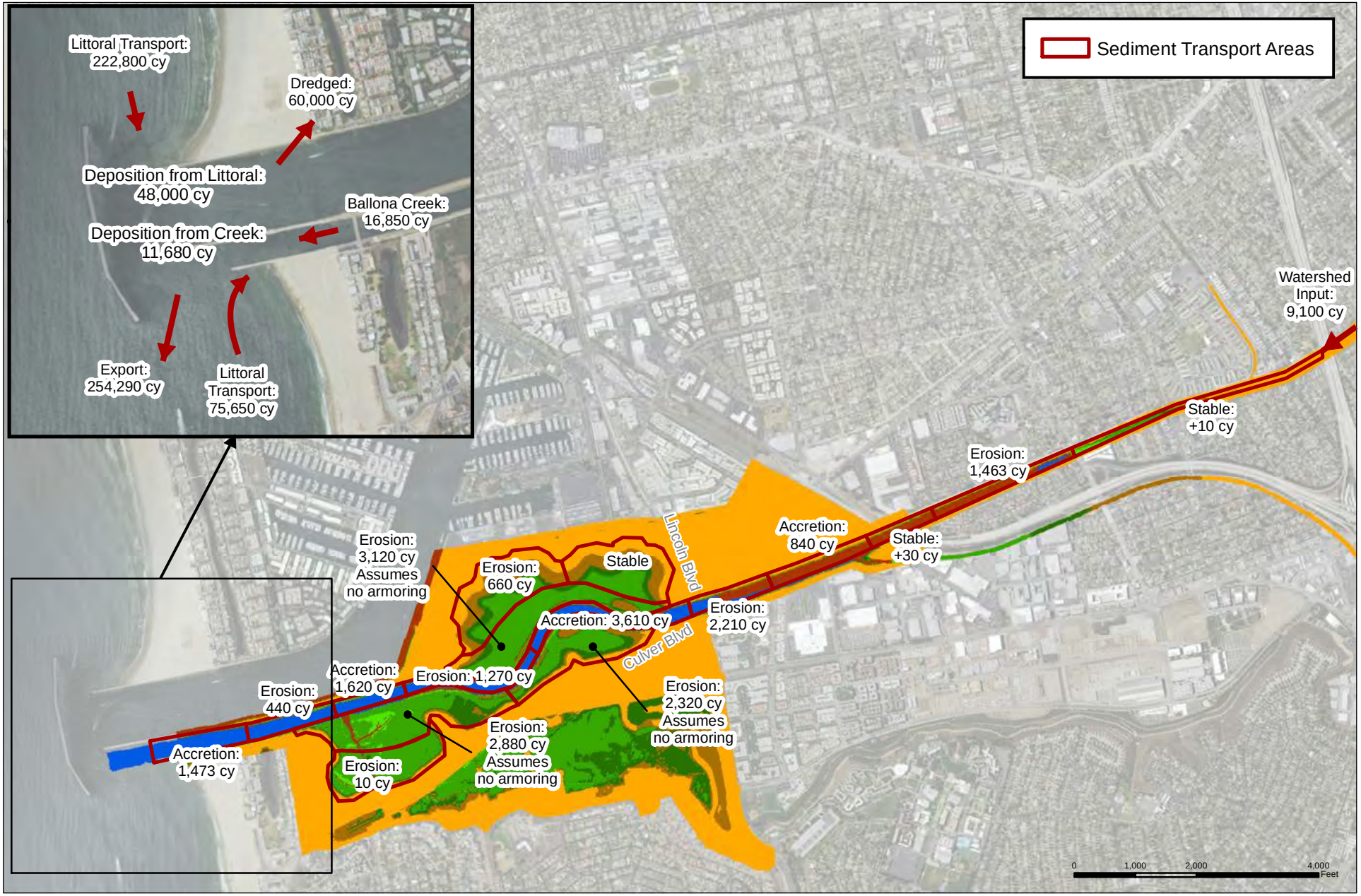
SOURCE: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

ESA PWA

Ballona Wetlands. D120367

Figure 28

Sediment Budget Under Existing Conditions (Average Year)



G:\1793_Ballona\Sediment_Transport\BudgetBoxes_EC.mxd

SOURCE: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

ESA PWA

Ballona Wetlands. D120367

Figure 29

Sediment Budget Under Project Conditions (Average Year)

ATTACHMENT
TIMELINE FOR BALLONA CREEK AND MARINA DEL REY AREAS

Green- In Wetlands/Upstream
Orange- Coastal Structures
Blue- Storm Events
Purple-Dredging/Beach Nourishment
Yellow-Coastal Processes

Year	Item	Reference
1880 (earliest)	Rail lines constructed in wetlands	EPA, 2012
1887	Timber jetties built at Ballona Creek	Leidersdorf, 1994
1900 (earliest)	Roadways constructed in wetlands	EPA, 2012
1904/1905	Venice Pier & Breakwater (breakwater remains)	Shaw, 1980, Tekmarine, 1985, and Leidersdorf, 1994
1905	Major coastal storm	Leidersdorf, 1994
1909	Old Ballona Creek Jetties (no longer exist)	Shaw, 1980 and Tekmarine, 1985
1909	Santa Monica Municipal Pier	Shaw, 1980, Tekmarine, 1985, and Leidersdorf, 1994
1912	Santa Monica Newcombe Pier	Leidersdorf, 1994
1915	Major coastal storm	Leidersdorf, 1994
1916	Flooding	Leidersdorf, 1994
1916-1930	Horseshoe Pier (Redondo Beach)	Leidersdorf, 1994
1923	Standard Oil Pier (El Segundo)	Leidersdorf, 1994
1923-1958	33 groins (Topanga Beach)	Leidersdorf, 1994
1926	Major coastal storm	Leidersdorf, 1994
1926-1937	Monstad Pier (Redondo Beach)	Leidersdorf, 1994
1928 (earliest)	20 groins Sunset Blvd to Santa Monica Pier (4 remain)	Shaw, 1980 and Tekmarine, 1985
1928	Open pile pier (Hermonsa Beach)	Leidersdorf, 1994
1929	Open pile pier (Manhattan Beach)	Leidersdorf, 1994
1930	Oil and gas exploration and production begins in wetlands	EPA, 2012
1931	Major coastal storm	Leidersdorf, 1994
1934	Santa Monica Breakwater	Shaw, 1980, Tekmarine, 1985, and Leidersdorf, 1994
1934	Rubble groin at Venice Beach	Leidersdorf, 1994
Pre-1935	Ocean Park Pier (no longer exists)	Shaw, 1980 and Tekmarine, 1985
1935	Ballona Creek flood control channels begin	SCCWRP, 2011
1937 – 1988	21 bridge crossings constructed over creek throughout watershed	National Bridge Inventory, 2012
1938	Severe flooding	Leidersdorf, 1994
1938 (earliest)	3 groins Santa Monica Pier to Venice Breakwater (2 groins remain)	Shaw, 1980 and Tekmarine, 1985
1938	1,800,000 cy fill from Hyperion facility to Dockweiler Beach	Leidersdorf, 1994
1938	Timber groin (El Segundo)	Leidersdorf, 1994
1938	Ballona Creek jetties	Leidersdorf, 1994
1939	Ballona Creek flood control channels completed	USACE, 1995
1939	Redondo Beach Breakwater	Shaw, 1980 and Tekmarine, 1985
1939	Tropical wave storm	Leidersdorf, 1994
1939	60,000 cy bypass from Santa Monica Breakwater to Santa Monica Beach	Leidersdorf, 1994
1939	North breakwater (King Harbor)	Leidersdorf, 1994
1941	Coastal storm	Leidersdorf, 1994
1945	150,000 cy from Hyperion to Venice Beach	Leidersdorf, 1994

Pre-1946 (earliest)	4-8 groins Ballona Creek to Redondo Beach (4 remain	Shaw, 1980 and Tekmarine, 1985
1946	South Jetty, Marina del Rey, Ballona Creek jetties extended	Shaw, 1980, Tekmarine, 1985, and Leidersdorf, 1994
1946-1948	13,900,000 cy fill from Hyperion to Venice and Dockweiler Beaches	Leidersdorf, 1994
1946-1948	Tombolo formed at Venice Beach after Hyperion fill	Leidersdorf, 1994
Post-1946	Venice Beach groin	Shaw, 1980 and Tekmarine, 1985
1947	3 groins built on Redondo Beach	Leidersdorf, 1994
1947	100,000 cy fill from onshore to Redondo Beach	Leidersdorf, 1994
1948	Groin at El Segundo	Leidersdorf, 1994
1949-1950	960,000 cy bypass from Santa Monica Breakwater	Leidersdorf, 1994
1950-1960	Sawtelle-Westwood system channels completed	USACE, 1995
1951	Two groins at Dockweiler Beach	Leidersdorf, 1994
1951	240,000 cy from Scattergood power plant to Dockweiler Beach	Noble, 2012
1952-1953	Coastal storm	Leidersdorf, 1994
1956	2,400,000 cy from Scattergood power plant to Dockweiler Beach	Leidersdorf, 1994
1957	Marina del Rey construction begins	LA County Department of Beaches and Harbors
1957-1958	780,000 cy bypass from Santa Monica Breakwater	Leidersdorf, 1994
1957-1958	Strong El Nino Winter	Leidersdorf, 1994
1958-1960	North breakwater extended (King Harbor)	Leidersdorf, 1994
1958-1964	South breakwater (King Harbor)	Leidersdorf, 1994
1959	Middle (extended) and North Jetties, Marina del Rey	USACE, 1995 and Leidersdorf, 1994
1960-1962	3,200,000 cy fill from Marina del Rey to Dockweiler	Leidersdorf, 1994
1962	Centinela Creek channel completed	USACE, 1995
1963	6,900,000 cy fill from Marina del Rey to Dockweiler	Leidersdorf, 1994
1963	Marina del Rey breakwater begins	Leidersdorf, 1994
1964	Benedict Canyon system channels completed	USACE, 1995
1965	Offshore breakwater, Marina del Rey completed; marina opened	USACE, 1995 and Leidersdorf, 1994
1968-1969	1,400,000 cy from offshore to Redondo Beach	Leidersdorf, 1994
1969	Flooding	Leidersdorf, 1994
1969	Dredging of Ballona Creek mouth	USACE, 2004
1969	389,000 cy bypass from Marina del Rey	Leidersdorf, 1994
1972-1973	Severe El Nino winter	Leidersdorf, 1994
1973	Dredging of Marina del Rey entrance	USACE, 2004
1973	17,000 cy backpass from Marina del Rey to Venice Beach	Leidersdorf, 1994
1975	10,000 cy bypass from Marina del Rey to Dockweiler Beach	Leidersdorf, 1994
1979-1980	Major coastal storm	Leidersdorf, 1994
1981	Dredging of Marina del Rey entrance and Ballona Creek mouth	USACE, 2004
1981	217,000 cy bypass from Marina del Rey to Dockweiler Beach	Leidersdorf, 1994
1982-1983	Severe El Nino winter, major coastal storms	Leidersdorf, 1994
1983-1984	Groin at El Segundo	Leidersdorf, 1994
1984	Groin at El Segundo	Leidersdorf, 1994
1984	620,000 cy from offshore to El Segundao	Leidersdorf, 1994
1987	Dredging of Marina del Rey entrance and Ballona Creek mouth	USACE, 2004

1987	35,000 bypass from Marina del Rey to Dockweiler Beach	Leidersdorf, 1994
1988	Coastal storm	Leidersdorf, 1994
1988	155,000 cy from Hyperion to Dockweiler	Leidersdorf, 1994
1988-1989	945,000 cy from Hyperion to El Segundo	Leidersdorf, 1994
1992	Dredging of Marina del Rey entrance	USACE, 2003
1994	Dredging of Marina del Rey entrance	USACE, 2003
1996	Dredging of Marina del Rey entrance	USACE, 2003
1996	240,000 cy from Marina del Rey to Dockweiler Beach	Kinnetic Laboratories, 2011
1998	Dredging of Marina del Rey entrance	USACE, 2004
1998	74,000 cy from Marina del Rey to Dockweiler Beach	Kinnetic Laboratories, 2011
1999	Dredging of Marina del Rey entrance	Kinnetic Laboratories, 2011
1999	282,000 cy from Marina del Rey to Redondo Beach	Kinnetic Laboratories, 2011
2004	State Coastal Conservancy funds Ballona Wetlands Restoration Project	State Coastal Conservancy
2007	Dredging of Marina del Rey entrance	Kinnetic Laboratories, 2011
2007	327,000 cy from Marina del Rey to Dockweiler Beach	Kinnetic Laboratories, 2011
2009	Dredging of Marina del Rey entrance	Kinnetic Laboratories, 2011
2009	4,700 cy from Marina del Rey to Dockweiler Breach	Kinnetic Laboratories, 2011
2012	Dredging of Marina del Rey entrance	Kinnetic Laboratories, 2011

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APPENDIX F2
Summary of Results from Sediment Sampling and Analysis in Area B – Ballona Marsh, Draft Technical Memorandum

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TECHNICAL MEMORANDUM – DRAFT

Date: July 22, 2006

To: Jeremy Lowe, PWA

From: David Pohl, PhD., P.E.
Cathy Hartman

Subject: Summary of Results from Sediment Sampling and Analysis in Area B – Ballona Marsh

Purpose of Sediment Investigation

The Draft Ballona Wetland Existing and Historical Conditions Report presented a summary of the available water and sediment quality data for the Project Area and also identified several data needs/gaps in Section 5. One of the unknown factors in the assessment was the sediment quality in the existing tidal marsh within Area B (Ballona Marsh). Although sediment quality results were available from the Ballona Creek estuary, a direct correlation to the current sediment characteristics in Area B could not made due to the significant difference in long-term loading history of these sediments. The sediments in the tidal marsh have experienced muted tidal flows and subsequent reduced constituent loadings while sediments in the Ballona Creek estuary have been subject to the full storm flows and constituent loadings from the entire Ballona Creek watershed. Sediment quality data from Area B is needed to characterize the current baseline condition and evaluate the long-term quality of sediments in the restoration areas and potential impacts to the wetland species.

Sample Location and Study Methods

Eight stations located within Area B were sampled by the City of Los Angeles Department of Sanitation for sediment quality on May 5, 2006 (Figure 1).

Sediments from Area B were analyzed for metals, PAHs, pesticides, PCBs, grain size, and toxicity. Most of the stations (BWS-3, 4, 5, 9, and 10) are within Area B's east channel between Ballona Creek and Culver Blvd. The east channel is connected to Ballona Creek by self-regulating tide gates which allow for muted tidal flow. One station, BWS-1, is located within the west channel, which is connected to Ballona Creek by a 36' pipe with a flap gate on the creek side which prevents tidal flows in while allowing drainage to occur. BWS-8 is located on the southeastern side of Culver Blvd., where it may be influenced by freshwater seeps. BWS-11 is located on the northwestern side of Culver Blvd. where it is likely influenced by storm water and urban runoff.



Figure 1. Sediment Quality Sampling Stations within Area B.

Currently, there are no universally accepted criteria for assessing contaminated sediments. However, the Effect Range Low (ERL) and Effect Range Median (ERM) values originally developed by Long and Morgan (1990) and subsequently revised and expanded upon by Long and MacDonald (1992) and Long et al. (1995) can be used to evaluate the potential for sediment to cause adverse biological effects (Table 1). These parameters were developed from a large data set where results of both sediment toxicity bioassays (e.g., amphipod tests) and chemical analyses were available for individual samples. The guidelines were intended to provide informal (non-regulatory) effects-based benchmarks of sediment chemistry data (Long et al. 1998). Two effects categories have been identified:

ERL – Effects Range Low: concentrations below which adverse biological effects are *rarely* observed and therefore provides a conservative benchmark; and

ERM – Effects Range Medium: concentrations above which adverse biological effects are more frequently, though not always observed.

Sediment chemistry data from samples collected in Area B were compared to the ERM and the more conservative ERL. In addition, for each sediment sample, ERM values were used to calculate a mean ERM quotient (ERM-Q). The concentration of constituents tested was divided by its ERM to produce a quotient, or proportion of the ERM equivalent to the magnitude by which the ERM value is exceeded or not exceeded. The mean ERM-Q for each sample was then calculated by summing the ERM-Qs for selected constituents, and then dividing by the total number of ERM-Qs assessed. ERM-Qs were not calculated for constituents below the detection limit and thus were not used in the generation of the mean ERM-Q. The mean ERM-Q thus

represents an assessment for each sample of the cumulative sediment chemistry relative to the threshold values. In this way, the cumulative risks of effect to the benthic community can provide a mechanism to compare channels within the existing marsh to the creek. This method has been used and evaluated by several researchers (Hyland et al. 1999, Carr et al. 1996, Chapman 1996, and Long et al. 1995) throughout the country.

The aggregate approach using an ERM-Q is a more reliable predictor of potential toxicity but should not be used to infer causality of specific contaminants. ERL and ERM values were originally derived to be broadly applicable and they cannot account for site-specific features that may affect their applicability on a more local or regional level. Local differences in geomorphology can result in chemicals being more or less available and therefore more or less toxic than an ERL or ERM value might indicate. Additionally, some regions of the country are naturally enriched in certain metals and local organisms have become adapted.

Table 1. Sediment Effects Guideline Values.

Parameter	Effects Range-Low (ERL)	Effects Range-Median (ERM)
Metals (mg/Kg)		
Antimony	2.0	2.5
Arsenic	8.2	70
Cadmium	1.2	9.6
Chromium	81	370
Copper	34	270
Lead	46.7	218
Nickel	20.9	51.6
Zinc	150	410
Organics (µg/Kg)		
Acenaphthene	16	500
Acenaphthylene	44	640
Anthracene	85.3	1,100
Fluorene	19	540
Naphthalene	160	2,100
Phenanthrene	240	1,500
Low-molecular weight PAH	552	3,160
Benz(a)anthracene	261	1,600
Benzo(a)pyrene	430	1,600
Chrysene	384	2,800
Dibenzo(a,h)anthracene	63.4	260
Fluoranthene	600	5,100
Pyrene	665	2,600
High molecular weight PAH	1,700	9,600
Total PAH	4,022	44,792
Total PCBs	22.7	180

Source: Long et al. 1995
ERL = Concentration at lower tenth percentile at which adverse biological effects were observed or predicted.
ERM = Concentration at which adverse biological effects were observed or predicted in 50% of test organisms.
mg/Kg = milligrams per kilogram.
µg /Kg = micrograms per kilogram.

Summary of Analytical Results

Sediments from Ballona Marsh were analyzed for four groups of constituents: metals, PAHs, pesticides, and PCBs. The key question of this sampling effort was whether known impacted waters from Ballona Creek have also impaired the sediments in the tidal channels within Area B. Concentrations of chemical constituents were expected to be greater in the Ballona Creek estuary sediments compared to Area B, due to greater overall loading from the Ballona Creek watershed. Flow into the existing tidal marsh of Area B has been restricted by tidal gates, and is from the creek estuary where mixing of the fresh water creek flows with the salt water of Santa Monica Bay occurs. However, wetlands are known to act as a sink for lower mobility constituents such as heavy metals and semi-volatile compounds that include PAHs. Additional questions that were to be investigated were whether there was evidence of impacts from historical uses of portions of Area B for agricultural purposes (bean cultivation) and from urban runoff. Area B is subject to urban runoff flows from adjacent residential communities and transportation corridors (Culver Blvd.). Table 2 presents the results of the chemical analysis and toxicity testing.

Metals

The concentrations of metals detected in the sediments samples exceeded the ERM at two of the eleven stations. The concentrations of copper, lead and zinc in the sediment at Station BWS-11 located adjacent to Culver Boulevard were above the ERM indicating potential impact to the sediments. These three metals are typically found in urban runoff and are generally associated with automobile tires, brake pads and emissions. Although these metals are also found at concentrations above the water quality objectives in Ballona Creek, the location of this sample adjacent to Culver Boulevard suggests a direct impact from runoff from the roadway and from direct aerial deposition.

Table 2. Analytical Results for Ballona Marsh Sediments

Parameter	Units	MDL	ERL*	ERM*	BWS-1	BWS-3	BWS-4	BWS-5	BWS-8	BWS-9	BWS-10	BWS-11
Toxicity												
Mean *Eohaustorius estuarius* survival (relative to control)	%				94.79	98.96	91.67	**64.58**	96.88	**34.38**	**60.42**	**9.38**
Sediment Size and TOC												
Gravel	%				0	0	0	0	0	0	0	0
Sand	%				51.2	70.2	79.7	22.8	47.4	37	30.5	47.4
Silt	%				41.8	24	16.6	51.5	46.6	51.5	57.9	45.1
Clay	%				7.11	5.98	3.73	25.8	6	11.5	11.6	7.47
Median size	microns				66	250	360	13	56	40	28	56
Mean size	microns				110	470	470	5.9	140	60	55	55
Total Organic Carbon	%	0.001			0.919	0.777	0.372	0.597	1.15	1.04	0.41	4.64
Metals												
Arsenic	mg/kg	0.22	8.2	70	6.13	3.7	4.26	**12.4**	**10.3**	**8.45**	5.56	**14.6**
Cadmium	mg/kg	0.02	1.2	9.6	**2.39**	**2.12**	**1.83**	**4.5**	**4.66**	**3.67**	**3.32**	**6.16**
Chromium	mg/kg	0.1	81	370	29.2	21.9	18	70.2	52.1	35.4	33.4	64.3
Copper	mg/kg	0.18	34	270	**35.3**	30.6	17	**60.8**	**82.9**	**48.8**	**39.3**	**440**
Lead	mg/kg	0.15	46.7	218	46.6	26.9	20.8	**103**	**92.5**	**62.6**	24	**248**
Mercury	mg/kg	4E-04	0.15	0.71	0.122	0.065	0.041	**0.229**	**0.272**	0.143	0.0976	**0.29**
Nickel	mg/kg	0.2	20.9	51.6	16	13.4	9.2	**30.7**	**27.9**	20.5	**21.7**	**38.5**
Silver	mg/kg	0.02	1	3.7	**1**	0.43	0.27	**3.77**	**1.54**	**1.85**	0.43	0.46
Zinc	mg/kg	0.21	150	410	**155**	109	54.9	**190**	**330**	**192**	124	**1770**
Selenium	mg/kg	0.35			0.48	0.56	0.55	<0.35	1.61	<0.35	0.42	0.55

Parameter	Units	MDL	ERL*	ERM*	BWS-1	BWS-3	BWS-4	BWS-5	BWS-8	BWS-9	BWS-10	BWS-11
PAHs												
Total detectable PAHs	mg/kg		4.022	44.79	0	0	0	0	0	0	0	1.5
Pesticides & PCBs												
Total detectable DDT	ug/kg		1.58	46.1	**3.6**	**17.1**	0	1.2	**7.3**	**5.6**	1	**9.6**
Total detectable chlordane	ug/kg		0.5	6	**4.5**	**51.4**	0	**1.2**	**2.4**	**2.7**	**1.2**	**6.7**
OP Pesticides												
Azinphosmethyl (Guthion)	ug/kg	13.8			<13.8	<13.8	<13.8	<13.8	<13.8	<13.8	<13.8	<13.8
Bolstar	ug/kg	1.5			<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Chlorpyrifos (Dursban)	ug/kg	1.6			<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6
Coumaphos	ug/kg	13.5			<13.5	<13.5	<13.5	<13.5	<13.5	<13.5	<13.5	<13.5
Def	ug/kg	3.5			<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5
Demeton (Total)	ug/kg	2.5			<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
Diazinon	ug/kg	2			<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Dichlorvos	ug/kg	3.3			<3.3	<3.3	<3.3	<3.3	<3.3	<3.3	<3.3	<3.3
Dimethoate	ug/kg	4.91			<4.91	<4.91	<4.91	<4.91	<4.91	<4.91	<4.91	<4.91
Disulfoton	ug/kg	1.8			<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
EPN	ug/kg	1.8			<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
Ethion	ug/kg	1.8			<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
Ethoprop	ug/kg	1.4			<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4
Fensulfothion	ug/kg	18.7			<18.7	<18.7	<18.7	<18.7	<18.7	<18.7	<18.7	<18.7
Fenthion	ug/kg	2.7			<2.7	<2.7	<2.7	<2.7	<2.7	<2.7	<2.7	<2.7
Malathion	ug/kg	0.6			<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
Merphos	ug/kg	4.5			<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5
Mevinphos	ug/kg	5.2			<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2
Naled	ug/kg	17			<17	<17	<17	<17	<17	<17	<17	<17
Parathion, ethyl	ug/kg	2.75			<2.75	<2.75	<2.75	<2.75	<2.75	<2.75	<2.75	<2.75
Parathion, methyl	ug/kg	3.4			<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4
Phorate	ug/kg	1.8			<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
Prowl (Pendimethalin)	ug/kg	1.8			<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	300
Ronnel	ug/kg	1.4			<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4
Stirophos	ug/kg	6.2			<6.2	<6.2	<6.2	<6.2	<6.2	<6.2	<6.2	<6.2
Sulfotep	ug/kg	1.14			<1.14	<1.14	<1.14	<1.14	<1.14	<1.14	<1.14	<1.14
Tokuthion	ug/kg	1.8			<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
Trichloronate	ug/kg	1.3			<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3
Trifluralin	ug/kg	4.4			<4.4	<4.4	<4.4	<4.4	<4.4	<4.4	<4.4	<4.4
Pyrethroids												
Bifenthrin	ug/kg				ND	ND	ND	ND	ND	ND	ND	34J
Cyfluthrin	ug/kg				ND	ND	ND	ND	ND	ND	ND	ND
Cypermethrin	ug/kg				ND	ND	ND	ND	ND	ND	ND	ND
Esfenvalerate/Fenvalerate	ug/kg				ND	ND	ND	ND	ND	ND	ND	ND
Lambda cyhalothrin	ug/kg				ND	ND	ND	ND	ND	ND	ND	ND
Permethrin	ug/kg				ND	ND	ND	ND	ND	ND	ND	ND
PCBs												
Total detectable PCBs	ug/kg		22.7	180	16	**25**	0	0	0	**36**	0	**24**
Mean ERM quotient					0.22	0.80	0.07	0.32	0.32	0.26	0.15	0.84

MDL = Method Detection Limit is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero, as defined in 40 CFR Part 136 Appendix B.

* Effects Range-Low and Effects Range-Median (Long et al. 1995)

Toxicity results in **bold** = moderately toxic (per Bight criteria)

Toxicity results in **bold** = highly toxic (per Bight criteria)

Chemistry results in **bold** = exceeds ERL

Chemistry results in **bold** = exceeds ERM

J - Estimated value

The other sediment sample that was observed to exceed the ERM was at BWS-5 for silver. The more conservative ERL benchmark was exceeded at numerous locations as shown on Table 2. The greatest number of exceedances is observed at Stations BWS-5, -8, -9 and -11. A summary of the results are presented below.

- *Arsenic* concentrations were above the more conservative ERL benchmark of 8.2 mg/kg at four stations; BWS-5, BWS-8, BWS-9, and BWS-11. Values ranged from 8.45 to 14.6 mg/kg at BWS-11. However, none approached the 70 mg/kg ERM.

- *Cadmium* concentrations were above the more conservative ERL of 1.2 mg/kg at all stations sampled. Values ranged from 1.83 mg/kg at BWS-4 to 6.16 mg/kg at BWS-11. However, none exceeded the ERM value of 9.6 mg/kg.

- *Copper* concentrations were above the ERL benchmark of 34 mg/kg at six out of eight stations. The concentrations at these stations ranged from just above the ERL at BWS-1 to 83 mg/kg at BWS-8. The concentrations were above the ERM of 270 mg/kg at BWS-11 with a detected value of 440 mg/kg.

- *Lead* concentrations were above the more conservative ERL of 46.7 mg/kg at four stations that included BWS-5, -8, -9 and -11. However, there the ERM of 218 mg/kg was exceeded at only at BWS-11 (248 mg/kg).

- *Mercury* concentrations were above the ERL of 0.15 mg/kg at three stations but had no exceedances of the ERM of 0.71 mg/kg. Exceedances at stations BWS-5, -8, and -11 ranged from 0.229 to 0.29 mg/kg.

- *Nickel* concentrations were above the more conservative ERL of 20.9 mg/kg at four stations. Exceedances at stations BWS-5, -8, -10, and -11 ranged from a low of 21.7 mg/kg at BWS-10 to a high of 38.5 mg/kg at BWS-11. The 20.5 mg/kg detected at BWS-9 fell just below the ERL. Nickel was not detected at any stations at levels above the ERM.

- *Silver* was detected at levels above the more conservative ERL of 1 mg/kg at four stations, including one exceedance of the ERM of 3.7 mg/kg. Stations BWS-1, -8, and -9 were each detected at concentrations between 1 and 1.85 mg/kg. The single exceedance of the ERM was at BWS-5, at which a concentration of 3.77 mg/kg was detected.

- *Zinc* exceeded the ERL of 155 mg/kg at five stations, including one exceedance of the ERM of 410 mg/kg. Samples collected from stations BWS-1, -5, -8, and -9 were each found to have concentrations between 155 mg/kg at BWS-1 and 330 mg/kg at BWS-8. The single exceedance of the ERM was at BWS-11, where a concentration of 1,770 mg/kg was detected.

PAHs
Total detectable PAHs were only detected at BWS-11 with a value of 1.5 mg/kg, below the ERL of 4.02 mg/kg. The results indicate no impact to the sediments of Area B from PAHs.

Pesticides
The concentration of organochlorine pesticides (OP pesticides) in the sediment samples in Area B exceeded the ERM at two (BWS-3 and -11) of the eleven locations for total detectable chlordane. Station BWS-3 is located adjacent to the tide gate in the main channel. Due to the location of this sample, the results indicate a potential impact from waters of Ballona Creek on the sediment near the tide gates with regard to chlordane. There were no other exceedances of the ERM in the main channel, and the concentrations of chlordane deceased in the main channel with greater distance from the tidal gate. The exceedances at BWS-11 of the ERM may be the result of impact from urban runoff at this location adjacent to Culvert Blvd. There were no other detections of pesticides above the ERM.

Other organochlorine pesticides detected, for which there are no current ERL/ERM guidelines, include nonachlors, enfosulfans, and oxychlordane. Cis-nonachlor was detected at station BWS-3, at a concentration of 5.4 µg/kg and at BWS-11 at a concentration of 2.9 µg/kg. Trans-nonachlor was detected at six of the eight stations at values ranging from a low of 0.4 µg/kg at BWS-5 to a high of 16.6 µg/kg at BWS-3. No nonachlors were detected at BWS-4 or BWS-8. Endosulfan I was detected at BWS-1 at a concentration of 0.6 µg/kg. Oxychlordane was detected at BWS-11 at a concentration of 1.3 µg/kg. OP pesticides and pyrethroids were also detected at BWS-11.

Total detectable DDT exceeded the ERL at five stations, BWS-1, -3, -8, -9, and -11, with values ranging from 3.6 µg/kg at BWS-1 to 17.1 µg/kg at BWS-3. Total detectable DDT was below the ERL value at BWS-5 and BWS-10 and was not detected at BWS-4. No levels were detected above the ERM of 46.1 µg/kg.

Total detectable chlordane exceeded the ERL of 0.5 µg/kg at seven out of eight sampled stations and the ERM of 6 µg/kg at two stations. No chlordanes were detected at BWS-4. The ERM was exceeded at BWS-3 and BWS-11, with respective values of 51.4 µg/kg and 6.7 µg/kg.

Dieldrin was detected in three of the eight stations sampled. Values above the ERL of 0.02 µg/kg ranged from 1 µg/kg at BWS-9 to 1.3 µg/kg at BWS-1 to 2.4 µg/kg at BWS-3. The remaining five stations were non-detect, however, the method detection limit for this constituent was 0.8 µg/kg, a higher value then the ERL. These five stations may in fact have exceeded the ERL if they were between 0.02 and 0.8 µg/kg. No samples exceeded the ERM of 8 µg/kg.

One OP pesticide and one pyrethroid were detected at levels above their method detection limits at BWS-11. Prowl (pendimethalin) was detected at concentrations of 300 µg/kg and bifenthrin at an estimated value of 34 µg/kg. These analytes are emerging contaminants of concern and do not have established ERLs or ERMs. Pendimethalin is an OP pesticide known as Prowl that is used as an herbicide and is considered of low acute toxicity (http://www.epa.gov/epaoswer/hazwaste/minimize/factshts/pendmeth.pdf). Bifenthrin is a pyrethroid insecticide and miticide classified as "Restricted Use" due to toxicity to fish and aquatic organisms; its use is prohibited in areas where it may result in exposure of endangered species (http://www.fs.fed.us/foresthealth/pesticide/bifenthr.html). That these two pesticides

were found only at BWS-11, where the primary influence is stormwater runoff and urban flows, may indicate that those flows are a transport mechanism. These constituents were not analyzed in sediments collected from the Ballona Creek estuary in 2003.

PCBs

There were no detections of PCBs in the sediment samples above the ERM. Total detectable PCBs exceeded the ERL of 22.7 µg/kg at three stations, BWS-3, BWS-9, and BWS-11. The exceedances ranged from 24 and 25 µg/kg at BWS-11 and BWS-3 to 36 µg/kg at BWS-9.

ERM –Q Results

ERM-Q values were above the threshold of 0.10 at seven of the eight stations monitored in Area B. Only BWS-4 had a mean ERM-Q value below 0.10, with a value of 0.07. The highest ERM-Q was calculated for the sediment samples from BWS-3 and BWS-11. As discussed above, the ERM-Q represents an assessment of the cumulative sediment chemistry relative to the threshold values. The high ERM-Q for BWS-3 is driven by the higher chlordane concentration. This sample is located the closest to the tide gates to Ballona Creek and therefore indicates a potential impact from tidal flows into the main channel from the creek. The ERM-Q for sample BWS-11 is driven by both metals and pesticide concentrations. BWS-11 is located adjacent to Culver Blvd and appears to be impacted by urban runoff. ERM-Q values for the samples between BWS-11 and BWS-3 along the main channel decease with distance from the tide gates (0.26, 0.15 and 0.07) indicating decreasing impact from Ballona Creek, and localized impact from urban runoff.

Summary of Acute Testing Results

The mean percent survival of the test organism, *E. estuarius,* exposed to Ballona Marsh sediments ranged from 9 to 99%. Percent survival was the lowest at stations BWS-9 and BWS-11, with values of 34% and 9%, respectively. Station BWS-9 is the second sampling location from the tide gates to Ballona Creek. The concentrations of metals, pesticides and PCBs in BWS-9 were not significantly greater than the other samples located in the main channel, and the ERM-Q of this sample was 0.26, compare to the ERM-Q of 0.80 at BWS-3 located closest to the tide gate. These results for BWS-9 suggest a possible constituent or physical condition that is resulting in toxic response as opposed to from the concentration of the constituents analyzed for this program. Further testing may be needed to determine the cause of the toxicity response.

The toxic response observed for BWS-11 corresponds to detected higher concentrations of metals and several pesticides in this sample. The toxicity results also correspond to the ERM-Q value for this sample, which is the highest of the eleven samples. The results for BWS-11, which is located in a tributary channel adjacent to Culver Blvd., indicate a potential impact from urban runoff that is resulting in toxic response to aquatic organisms.

The mean percent survival of *E. estuarius* at BWS-5 and BWS-10 were 65% and 61%, suggesting that the sediments in these areas were moderately toxic to the test organisms. The remaining stations had a mean percent survival range between 92 and 99%, which suggests that the sediments in this area did not demonstrate an acute toxic response.

Summary of Geotechnical Testing Results

Sand, silt, and clay were the dominant sediment constituents at the stations monitored in the Ballona Marsh. Sand dominated the sediment composition at five stations, BWS-1, -3, -4, -8, and -11, followed by silt. Silt was the dominant constituent at BWS-5, followed by clay, and at BWS-9 and -10, followed by sand. Median grain size ranged from 13 to 360 microns. TOC content ranged from 0.37 to 4.64%. Station BWS-4 had the largest median grain size and the lowest TOC content.

Conclusions

The key question of this sampling effort was:

Have known impacted waters from Ballona Creek also impaired the sediments in the tidal channels within Area B?

Concentrations of chemical constituents were expected to be greater in the Ballona Creek estuary sediments compared to Area B, due to greater overall loading from the Ballona Creek watershed. The results of this sediment sampling and testing program in Area B indicate that the sediment close to the tide gate is potentially impacted by pesticides, specifically chlordane and DDT from Ballona Creek. Concentrations of chlordane and DDT decrease in concentration with distance from the tide gates. The impact from Ballona Creek on the sediments in Area B with regard to metals is not conclusive, and the results indicate other sources of metals. The physical characteristics of the sediment also influence the concentration of metals detected. Sediment with higher fraction of clay (BWS-5) exhibit will exhibit a greater adsorption capacity for metals.

Additional questions that were to be investigated were whether there was evidence of impacts from historical uses of portions of Area B for agricultural purposes (bean cultivation) and from urban runoff. Area B is subject to urban runoff flows from adjacent residential communities and transportation corridors (Culver Blvd.). The following results of this investigation indicated a strong connection to exceedances of sediment guidelines and toxicity response to potential impacts from urban runoff:

- The concentrations of copper, lead and zinc in the sediment at Station BWS-11 located adjacent to Culver Boulevard were above the ERM indicating potential impact to the sediments. These three metals are typically found in urban runoff and are generally associated with automobile tires, brake pads and emissions. Although these metals are also found at concentrations above the water quality objectives in Ballona Creek, the location of this sample adjacent to Culver Boulevard suggests a direct impact from runoff from the roadway and from direct aerial deposition.

- The concentration of organochlorine pesticides (OP pesticides) in the sediment samples in Area B exceeded the ERM at two (BWS-3 and -11). The exceedances at BWS-11 of the ERM may be the result of impact from urban runoff at this location adjacent to Culvert Blvd.

These conclusions are further supported from the calculated ERM-Q. The highest ERM-Q was calculated for the sediment samples from BWS-3 and BWS-11. The ERM-Q represents an assessment of the cumulative sediment chemistry relative to the threshold values. The high ERM-Q for BWS-3 is driven by the higher chlordane concentration. This sample is located the closest to the tide gates to Ballona Creek and therefore indicates a potential impact from tidal flows into the main channel from the creek. The ERM-Q for sample BWS-11 is driven by both metals and pesticide concentrations. BWS-11 is located adjacent to Culver Blvd and appears to be impacted by urban runoff. ERM-Q values for the samples between BWS-11 and BWS-3 along the main channel decease with distance from the tide gates (0.26, 0.15 and 0.07) indicating decreasing impact from Ballona Creek, and localized impact from urban runoff.

The results of the toxicity testing indicate the percent survival was the lowest at stations BWS-9 and BWS-11, with values of 34% and 9%, respectively. Station BWS-9 is the second sampling location from the tide gates to Ballona Creek. The concentrations of metals, pesticides and PCBs in BWS-9 were not significantly greater than the other samples located in the main channel, and the ERM-Q of this sample was 0.26, compare to the ERM-Q of 0.80 at BWS-3 located closest to the tide gate. These results for BWS-9 suggest a possible synergistic effect of the constituents that were detected (many above the ERL as discussed below), or from another possible constituent or physical condition that was not tested or specifically identified as part of this project. Further testing may be needed to determine the cause of the toxicity response.

The toxic response observed for BWS-11 corresponds to detected higher concentrations of metals and several pesticides in this sample. The toxicity results also correspond to the ERM-Q value for this sample, which is the highest of the eleven samples. The results for BWS-11, which is located in a tributary channel adjacent to Culver Blvd., indicate a potential impact from urban runoff that is resulting in toxic response to aquatic organisms.

Comparisons to the more conservative ERL guidelines indicated the greatest number of exceedances observed at Stations BWS-5, -8, -9 and -11. The higher number of exceedances at BWS-11 corresponds to the highest ERM-Q and toxicity response of the sediment samples. As stated above, these results indicated potential impact from urban runoff as this sample is located adjacent to Culver Blvd and is subject to runoff from this roadway. The higher number of exceedances of the conservative ERL at the other locations may be a function of higher clay fraction in the case of BWS-5, and urban runoff/fresh water input at BWS-8. The higher number of exceedances observed at BWS-9, located in the main channel further inland from BWS-3 and the tide gates to the Creek may be due to possible impacts from Ballona Creek. However, a defined concentration gradient for metals is not evident. Furthermore, although a toxic response was observed for the BWS-9 sample, a defined correlations to the constituent concentrations detected is not well evident when compared to the concentrations of these constituents in samples that did not show a toxic response. Further investigation of these results is recommended.

The existing marsh is also not open to full tidal flow, but muted flow controlled by the tide gates. Sediment quality data collected from the Ballona Creek estuary during the 2003 Bight program also shows metals exceedances of copper, lead, and zinc. Higher concentrations than the Ballona Creek sediment samples are observed in sample BWS-11 as presented in Table 3. This samples is likely impacted by urban runoff from Culver Blvd. Higher concentrations were also observed

in samples BWS-3, -5, -8 and -9. Cadmium exceeded the ERL at each station sampled within Area B, but did not exceed criteria within Ballona Creek sediments sampled during the 2003 Bight program. It was reported to have exceeded the ERL in Ballona Creek sediments in the draft Total Maximum Daily Load report for Toxic Pollutants in Ballona Creek Estuary (CRWQCB & US EPA, Region IX, 2005). Cadmium has not been found to exceed water quality criteria within Ballona Creek.

Table 3. Range of Values for Constituents Found to Exceed within Ballona Marsh and Ballona Creek Estuary Sediments

	Ballona Marsh		Ballona Creek
	Range	Max	Estuary Range
Metals (mg/kg)			
Arsenic	3.7 – 14.6	BWS-11	2.37 – 4.01
Cadmium	1.83 – 6.16	BWS-11	0.13 – 0.96
Chromium	18 – 70.2	BWS-5	10.6 – 21.9
Copper	17 – 440	BWS-11	10.6 – 36.4
Lead	20.8 – 248	BWS-11	12.7 – 111
Mercury	0.041 – 0.29	BWS-11	0.03 – 0.11
Nickel	9.2 – 38.5	BWS-11	7.6 – 13.3
Selenium	<0.35 – 1.61	BWS-8	NA
Silver	0.27 – 3.77	BWS-5	0.36 – 0.87
Zinc	54.9 – 1770	BWS-11	73.5 – 202
PAHs (mg/kg)			
Total detectable PAHs	0 – 1.5	BWS-11	0.069 – 1.93
Pesticides and PCBs (ug/kg)			
Total detectable DDT	0 – 17.1	BWS-3	0 – 17.3
Total detectable chlordane	0 – 51.4	BWS-3	0 – 21.6
Prowl (Pendimethalin)	<1.8 – 300	BWS-11	NA
Bifenthrin	ND – 34J	BWS-11	NA
Total detectable PCBs	0 – 36	BWS-9	0 – 8

This comparison to the Ballona Creek sediments indicates the following:

- Most of the exceedances of the sediment guidelines within Area B were found in tributaries of the main channel both near the tidal inflow from the creek and at locations that are subject to urban runoff and fresh water flows from groundwater seeps.

- Area B may be acting as a sink for these metals that migrate to Area B in suspended sediment from Ballona Creek. Concentrations are in some locations greater in Area B possibly due to the control of tidal flows that limits the level of circulation and flushing that is observed in the Ballona Creek estuary, even through the creek estuary is subject to greater constituent loading.

- Urban Runoff and aerial deposition from Culvert Blvd. is impacting the sediments in the existing channels adjacent to the primary transportation corridor for Playa del Rey. As presented in Table 3, the majority of the highest concentrations of metals were detected in the sediment at BSW-11 located adjacent to Culver Blvd.

- Urban Runoff from adjacent communities and from portions of Area B that have been filled and subject to agricultural and oil/gas extraction may be contributing to metals concentrations in the channel sediments subject to these flows.

- It appears that metals from Ballona Creek could be accumulating in marsh sediments due to lack of tidal flushing, or there may be a source of metals other than Ballona Creek, such as urban runoff and stormwater flows from Culver Blvd. For constituents such as copper and zinc, where the highest values found in the marsh exceed those found in the creek by up to 10 times, a secondary source seems likely.

Steps Forward

Based on the results and conclusion of this sediment investigation of Area B, the following steps forward are recommended:

1. The benthic data that has been collected by the City of Los Angeles Department of Sanitation should be obtained and compared to the analytical and toxicity testing results from this study in order to determine if there is a correlation between higher constituent concentrations and/or toxicity response to the health of the benthic community. These data provide an additional set of results that will allow for further conclusions on the potential impact of sediments on the restored habitat. Evidence of benthic community impact will confirm results showing exceedances of sediment guidelines and/or toxic responses. These data may also indicate that there is little impact to the benthic community and therefore the chemistry and toxicity data do not provide the full picture with regard to the bioavailability of the constituents detected.

2. Results from Bight03 for other coastal wetlands should be compared to the results from this study to determine the level of impact compared to other wetlands in the region.

3. In order to better assess the potential impact of constituents detected in sediments and on the marsh habitat, tissue sampling and analysis of target species is recommended. Tissue sampling and analysis will provide data on the bioavailability and bioaccumulation of the constituents in the environment. Although several constituents were detected above the sediment guidelines, the actual impact to the species in the marsh needs to be assessed.

4. The alternative development for Area B should consider the evidence of impact from urban runoff and evaluate options to divert and treat these flows prior to their discharge into Area B.

5. Further evaluation of the future contribution/loads of legacy pesticides (chlordane and DDT) in the Ballona Creek estuary and potentially into Area B under muted tidal and full tidal flows should be performed to determine potential long-term impacts to the restored tidal wetlands.

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APPENDIX F3
Final Report – Ballona Wetland Preserve – Area A Preliminary Geotechnical Investigation and Beneficial Use Assessment

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Ballona Wetland Preserve - Area A
Preliminary Geotechnical Investigation
And Beneficial Use Assessment

Final Report

Prepared For:

Port of Los Angeles
Environmental Division
425 South Palos Verdes Street
San Pedro, CA 90731



April 2009



Ballona Wetland Preserve - Area A
Preliminary Geotechnical Investigation
and
Beneficial Use Assessment

Final Report

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April 2009

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1.0 INTRODUCTION

1.1 Site Background

The Ballona wetland Preserve Area A is a 139 acre portion of the Ballona Wetlands Ecological Reserve, an area currently under evaluation for restoration as part of the Ballona Wetlands Restoration Project (Restoration Project). The Restoration Project is led by the California Coastal Conservancy (CCC) and the current owner, California Department of Fish and Game (CDFG). A feasibility analysis of several restoration alternatives is currently underway. These alternatives include a range of options from enhancement of existing upland habitats to restoration of full tidal flow and establishment of a diverse community of sub-tidal, tidal, and upland habitats. The Port of Los Angeles (POLA) is currently evaluating the potential of Area A as a possible wetland mitigation site, pending the analysis of the full tidal alternative costs and potential credits.

Historical uses of Area A have changed the topography from a tidal wetland to disturbed upland habitat. The construction of railroads in the 1900s placed fill in the southeast corner to elevate the tracks above tidal elevation. Parts of Area A were also filled in the 1920s when gas and oil production began in the area. Platforms to protect the oil and gas facilities from high tides were constructed and connected by a series of access roads, which were also elevated on fill. Area A was altered during the channelization of Ballona Creek in the 1930s and during the excavation of Marina del Rey Harbor in the 1960s when the site received a large volume of dredge material. Appendix A provides historical photographs of the study area showing these changes.

The site is currently fenced off and undeveloped except for a paved parking area along the western boundary. Figure 1-1 presents a current aerial view of Area A. Fiji Ditch, a tidal channel connected to Basin H of Marina del Rey Harbor, starts in the middle of the northern edge of the site and runs east and west. A great blue heron rookery exists on the western edge of the site. Sempra Utilities monitoring wells are located just south of the rookery. Unauthorized use of the site is extensive. Construction of earthen jumps for off-road vehicle use has created many shallow depressions throughout the area, which compacts soil and collects water. It was estimated that 200–300 individuals were encamped within Area A in May 2006.



Figure 1-1. Ballona Wetland Preserve – Area A Location Map

In order to evaluate the potential of Area A as a possible wetland mitigation site, several alternatives were being assessed by CDFG and CCC. The United States Fish and Wildlife Service (USFWS) introduced Alternative 4, which was determined by POLA to provide the best opportunity for mitigation credits and a high-end estimate of mitigation costs.

A total of five distinct alternatives were being assessed for the Restoration Project. Each of the five alternatives were developed based on original conceptual designs that considered tidal sources, water quality, and developing sustainable habitats with sufficient transition zones to accommodate soil settlement and sea level rise. It was determined during this process that the open water channels needed to be located on one side of the site in order to establish sufficient transitional zones on the opposite side due to the 20–30 foot elevation differences from the open water to the upland areas. Each of these alternatives includes two inlets in order to provide sufficient tidal flow and circulation within the restored tidal marsh. The conceptual location of the inlet from the main channel of Marina del Rey can be relocated based on the proposed development in this area. Influent water from the main channel is preferred to the back basins and from Ballona Creek due to the water quality issues associated with these water sources.

Figure 1-2 presents Alternative 4, which is being evaluated as part of the Restoration Project. A corresponding cross section describing the depth of excavation and habitat elevation grade is provided on Figure 1-3. In order to begin evaluating the feasibility of using Area A as wetland mitigation site, POLA has contracted Weston Solutions, Inc. (WESTON) to conduct a Preliminary Geotechnical Investigation and Beneficial Use Assessment (Preliminary Area A Study) of the existing dredged material in Area A.

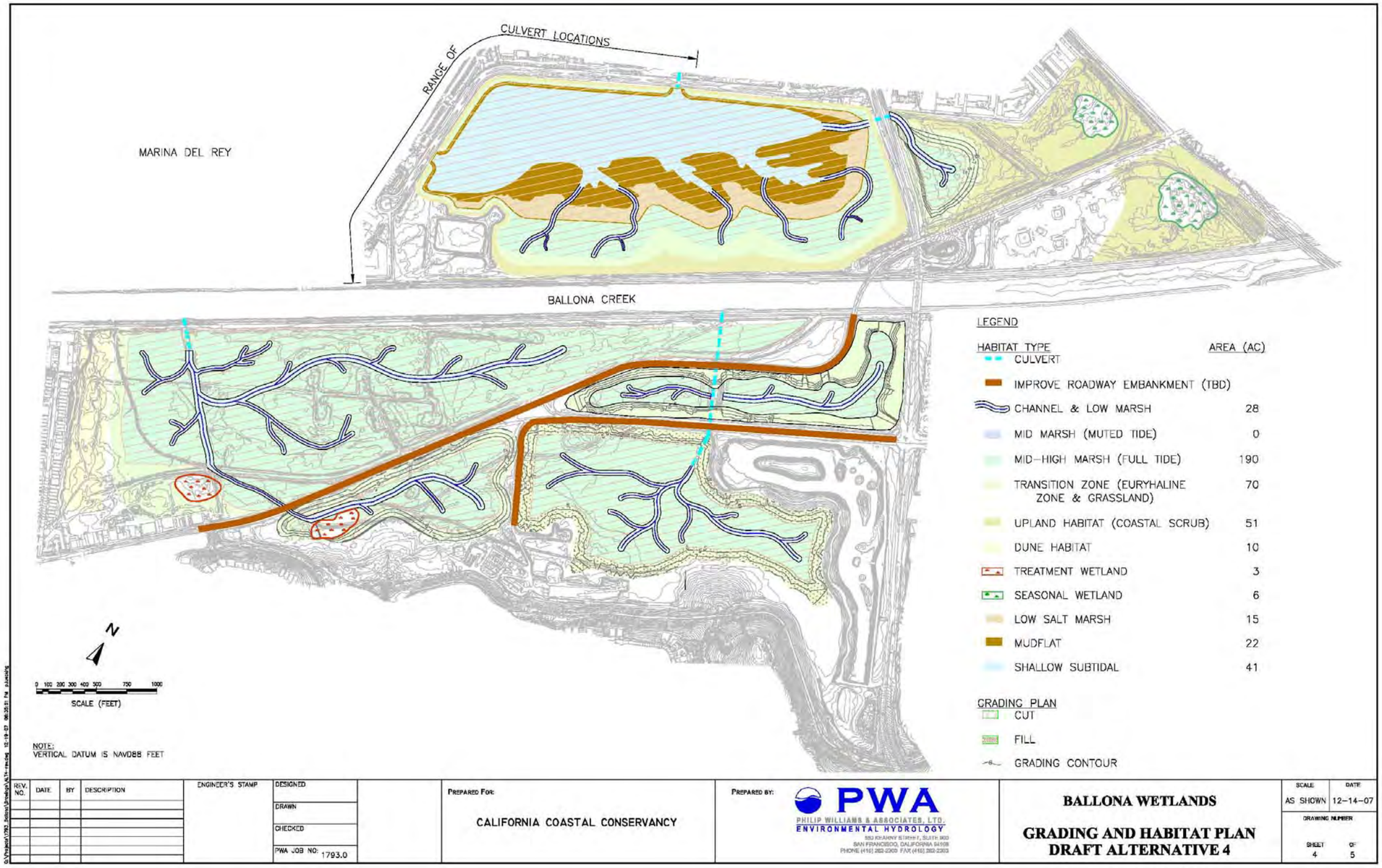

Figure 1-2. Ballona Wetland Restoration Project - Alternative 4

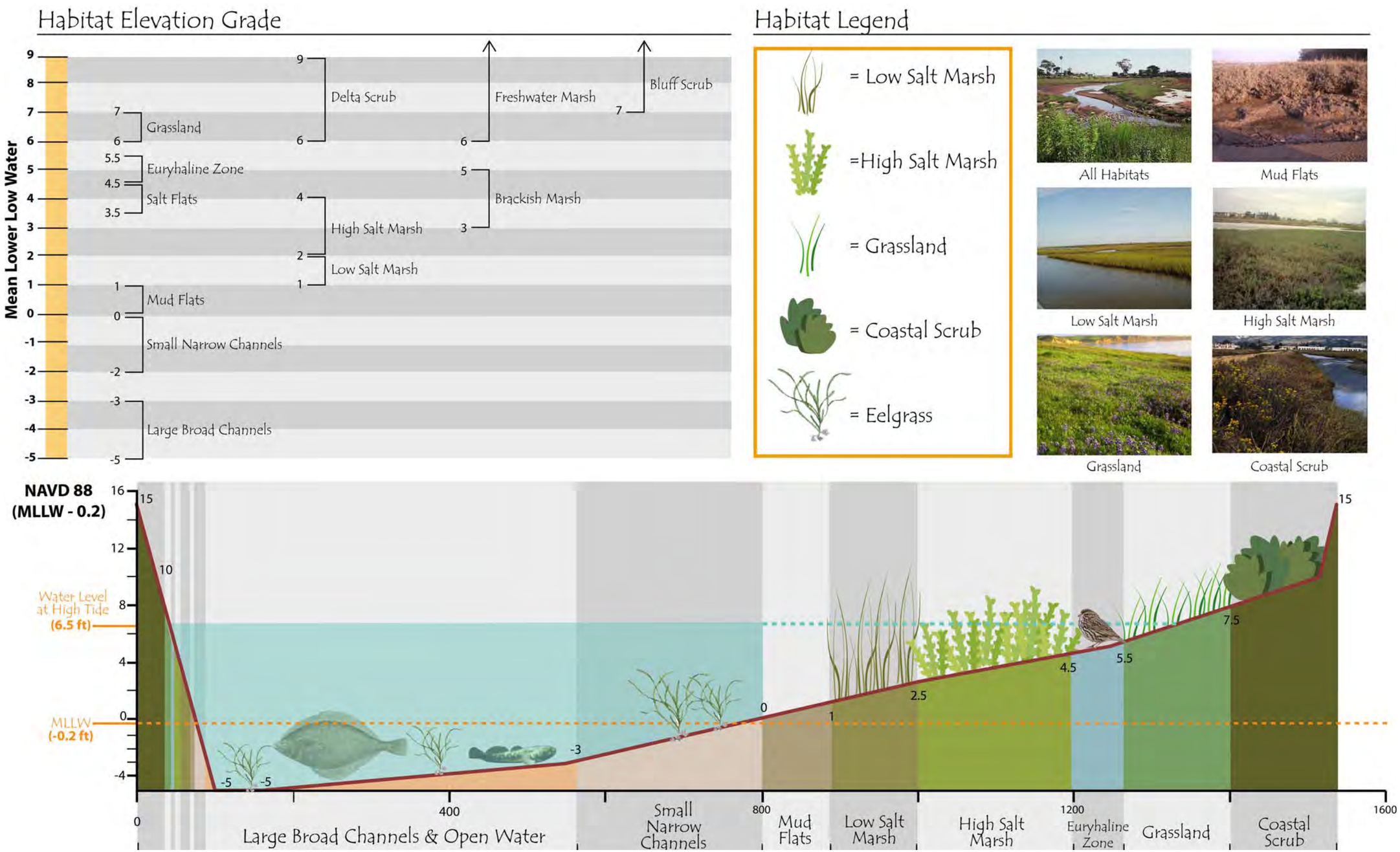

Figure 1-3. Cross Section of the Potential Tidal Restoration – Alternative 4

1.2 Scope of Work

The objectives of the Preliminary Area A Study were to identify the geotechnical, chemical, and physical characteristics of the soil and existing dredged material, determine the potential uses of the dredged material, and assess the cost associated with excavating and transporting the material. This screening level assessment will be used to guide a future, regulatory-compliant beneficial use assessment or dredge material evaluation for ocean disposal. The goal of this project was to answer the following study questions and provide recommendations to POLA.

Questions:

1. What are the chemical characteristics of the soil in Area A that are important to determine the required handling and use of the dredged material if removed to establish tidal flow?
2. Does the dredge material contain constituents of concern (COCs) at concentrations which require special handling or disposal due to historical gas extraction, or does it contain constituents, such as legacy pesticides, that may have existed in the dredged material prior to placement in Area A?
3. Will leachate from the dredge material contain COCs?
4. Are there chemical constituents in the soil that will remain a potential long-term risk to the ecosystem of the restored wetland?
5. What are the potential beneficial use and disposal options of the dredged material?
6. What are the geotechnical characteristics of the dredge material, including grain size distribution, that are key in determining potential beneficial uses of excavated material and the use of the dredge material for restoration?
7. Can the excavated dredge material be used for upland habitat in Area A?
8. What is the variability of grain size across Area A, with depth across the site, which may require segregation of materials for specific uses?
9. What is the volume of dredge material on site, and what level of assessment is necessary to attain regulatory compliance for beneficial uses?

Due to the unknown characteristics of the existing materials, a phased approach was recommended to address the questions listed above. This Preliminary Area A Study represents an initial assessment of the existing dredged material with regard to handling, placement, and potential beneficial uses. The Preliminary Area A Study consisted of three phases as presented on Figure 1-4.

- **Phase I** - included the analysis of existing geotechnical and groundwater data, review of historical and current topographical maps, completion of a field reconnaissance to identify possible sample location logistical and access issues, and preparation of a Study Work Plan. The Preliminary Area A Study Work Plan was prepared prior to permitting and field activities in order to identify the sampling locations and methods for the field and laboratory activities. The draft Study Work Plan was submitted to POLA for review. Comments from POLA were incorporated, and a draft final Study Work Plan was prepared and sent to CCC and CDFG for comment. Comments from these agencies were then incorporated, and the Final Study Work Plan was completed and submitted to POLA on December 12, 2007. Phase I also included completion of

required access permit documents and access requests to the site for the geotechnical borings. WESTON worked with CDFG in the location of boreholes and drill rig access routes to avoid sensitive vegetation/habitat. Permits for site access were granted on October 26, 2007 (Appendix B).

- **Phase II**: included completion of the geotechnical borings and soil sampling within Area A in accordance with the approved Study Work Plan. Field activities began on February 5, 2008 and were completed on February 8, 2008. Phase II also included the site selection, drilling, soil sampling, and laboratory analysis of the soil samples for geotechnical and chemical characterization.

- **Phase III:** included quality assurance/quality control (QA/QC) of the laboratory data, compilation of the geotechnical and chemical results, assessment of the results, and preparation of this report. The report describes the field and laboratory activities performed, results of the sample testing, and findings from these results. Results from this investigation were used to address the study questions developed in the scope of work.

First, this report provides a summary of the methods used for the field and laboratory program (Section 2). Section 3 provides the data interpretation and analysis of the findings with regard to the key project questions. Section 4 presents the updated cost estimate for the proposed Alternative 4 based on the findings of the Preliminary Area A Study. Finally, recommendations for the future regulatory-compliant assessment of the beneficial uses are included in Section 5.

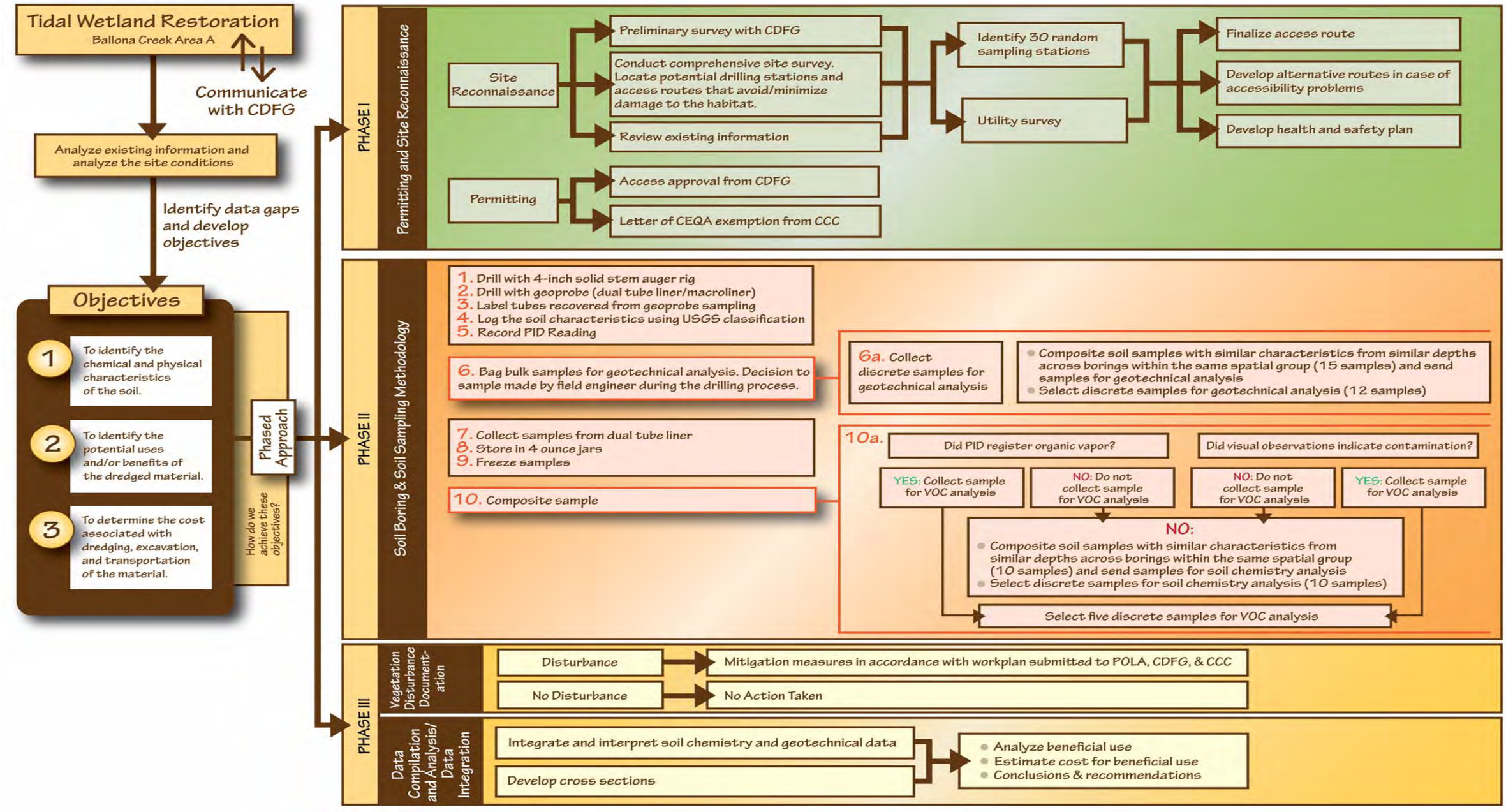

Figure 1-4. Schematic Representation of the Strategic Approach to Conduct Preliminary Geotechnical Investigation

2.0 MATERIALS & METHODS

This section describes the field sampling and laboratory methods and procedure used to complete the Preliminary Area A Study. Sampling and laboratory analysis was conducted in accordance with the approved Study Work Plan (WESTON, 2007). This section summarizes the process for the selection of representative sampling locations, acquisition of access and drilling permits, and completion of the sampling and laboratory programs for the Preliminary Area A Study.

2.1 Sampling Locations

In accordance with the approved Study Work Plan (WESTON, 2007), a total of twenty soil borings were proposed for the Preliminary Area A study. The following process for site selection was completed to ensure equal sample distribution across the study site, accessibility for the drill rig, and minimization of damage to sensitive species.

Step 1 - A random draw of 30 sample locations within the study site was done using Geographic Information Systems (GIS).
Step 2 –The Area A site map was divided into three equal segments. These three segments were then subdivided by transecting the subareas into three groups. It was intended to have two to three sample locations within each group in order to provide quality spatial representation of the sampling locations.
Step 3 - Field reconnaissance was conducted in coordination with POLA, CDFG, and CCC to identify the final 30 locations.
Step 4 – Twenty final sample locations were decided on the day of drilling, incorporating the constraints of drill rig accessibility and habitat considerations.

Table 2-1 includes the final location selections, grouped into segments and groups. Figure 2-1 depicts the initial and final sample locations, overlaid with the section lines and transects.

Table 2-1. Randomized Sampling Locations, Groups, and Segments

Segment	Groups	Stations
Segment 1	Group 1	5 ,6, 7,8,9
	Group 2	4, 10
	Group 3	1, 2, 3
Segment 2	Group 4	12, 13, 14,16, 17, 18
	Group 5	11, 15, 28
	Group 6	27, 29, 30
Segment 3	Group 7	19, 20, 21, 25
	Group 8	22, 23, 24, 26

WESTON staff worked in close coordination with POLA, CDFG, and the CCC to ensure the sampling activities were conducted in a manner that was sensitive to the ecological reserve. Necessary steps were taken to avoid any disturbance to the existing vegetation. Further

discussion of the vegetation mapping and modification of the sample site locations and access route is presented below.

WESTON met with representatives of CCC and CDFG to review the selected sample locations and likely access routes to these sampling sites. In addition, the local utilities were contacted to verify that no underground utilities were located near selected boring locations. WESTON met with representatives of Sempra Utilities, which has an operating natural gas well on the southwest corner of the site as well as gasoline product monitoring wells at multiple locations. These wells were verified, marked, and mapped using Global Positioning System (GPS) coordinates. These wells were avoided during soil sampling activities. Figure 2-1 presents the selected 30 potential soil boring locations in green and indicates the final 20 soil boring locations in red. Station 26 was the only location that was relocated eastward to avoid any potential impact from a known abandoned gas line. Relocation of this station did not result in change of spatial distribution of the sampling locations. During the field work, some of the sites were moved marginally to accommodate accessibility issues.



Figure 2-1. Potential and Selected Sampling Locations

2.2 Vegetation Survey and Habitat Protection during Sampling

In accordance with the conditions of CDFG permits (Appendix B) to access the site and conduct the proposed sampling, vegetation surveys were conducted in Area A before and after soil sampling occurred. The survey revealed that the altered elevation contours from the deposition of dredge material developed a variety of plant community types. For the purposes of this report, Area A is broken into six major communities: limited salt pan/mudflats, pickleweed salt marsh, transitional zone with largely exotic species, riparian scrub, *Baccharis* scrub, and coastal scrub (Appendix C). Groupings of plants or individual plants of concern were flagged, and a designated WESTON field biologist was on site during all sampling operations.

Prior to sampling activities, the sampling locations were identified, and routes to and from these sample sites were plotted. Routes were designed to maximize usage of existing access points and pathways and minimize impairment to native habitat. Routes were chosen such that they traversed the exotic transitional zone where iceplant, crown daisy, mustard, and exotic grasses were the dominant species. Potential sample collection sites, which could not be accessed without substantial native plant disturbance, were eliminated and alternative sites were chosen. Stations 15 and 24 were relocated approximately 30 feet from the original location to avoid disturbance of habitat. Relocation of these stations did not result in change of spatial distribution of the sampling locations. Patches of pickleweed, salt marsh, salt pan/mudflats, and coastal scrub along the routes were avoided to the greatest extent possible. The drill rig and the tending Bobcat were instructed to follow one another in a single path to minimize sensitive habitat impacts. Drill equipment operators were made familiar with plant species of concern, and the vehicles were escorted along a pre-scouted route to the station locations by a WESTON field biologist to ensure minimal habitat impact. The proposed access routes and final access routes are as shown on Figure 2-2 and Figure 2-3. The access routes were fairly similar to the proposed routes with only minor changes due to the sensitive habitat and the accessibility constraints of the rig.

Due to limited access at one location, the drill rig and Bobcat had to cross a designated saltpan area. The route selected to access Station 25 and Station 17 was, however, a historic utility dirt road that contained little vegetation due to the highly compacted soils from past and current use.

After sampling activities were completed, the WESTON field team walked the final access route used by equipment. Special attention was given to the salt flat areas. Areas impacted by equipment mobilization were raked and regraded. WESTON revisited the sampling locations and the access route on March 5, 2008, to confirm no sensitive habitat was adversely impacted.



Figure 2-2. Proposed Access Route

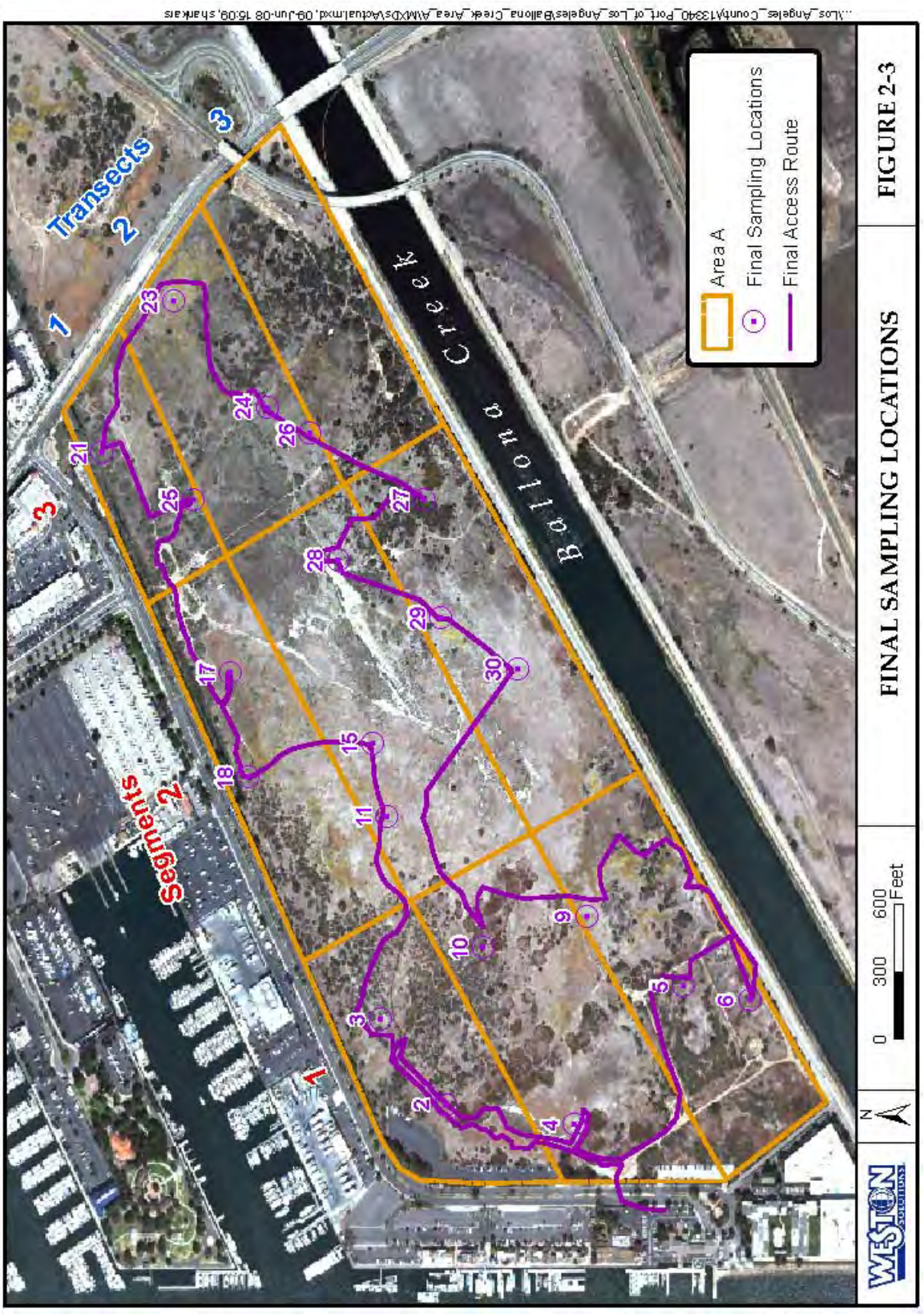

Figure 2-3. Final Access Route

2.3 Access and Permits

WESTON conducted field reconnaissance in accordance with the requirements of the access and sampling permit from CDFG. On October 26, 2007, WESTON obtained an access permit from CDFG to enter Area A in order to survey the site and propose access routes for the selected random sampling points (Appendix B). Field reconnaissance was conducted in the presence of a WESTON field biologist. Existing site conditions and flora was documented. Special vegetation avoidance measures were utilized while identifying the proposed route. Existing access points and pathways were utilized for travel within Area A to the maximum extent possible. Each of the randomized soil sampling locations were located using a portable GPS unit and marked with a painted stake.

After completing the field reconnaissance, WESTON obtained an access permit (dated 12/11/2007) from CDFG to conduct geotechnical and soil sampling in Area A (Appendix B). This permit required sampling to be restricted to the designated areas sample sites using the proposed access points/routes. WESTON also obtained a letter of California Environmental Quality Act (CEQA) exemption (dated 01/14/2008) from the CCC. This letter is included in Appendix B.

2.4 Sampling Methodology

2.4.1 Sample Collection

Soil borings were completed at each of the 20 sampling stations using an ATV-mounted direct push rig and a 4-inch diameter solid stem auger drill rig. This drilling technique was selected because of its smaller footprint and lighter weight which, therefore, minimized the potential impact to sensitive ecosystems present in Area A. Due to the potential presence of natural gas in this area, non-sparking tools were used. WESTON sub-contracted RSI Drilling to complete the soil borings in accordance with the approved Study.

The soil sampling approach for the Preliminary Area A Study is presented on Figure 2-4. The direct push coring technique (DPT) was used in collection of both discrete and composite soil chemistry samples. Discrete chemistry core samples are samples taken from a discrete boring depth interval from a single borehole. Composite chemistry core samples were taken from similar boring depths or similar soil types from different borings. The cores samples were combined and then homogenized into one sample. Soil chemistry core samples were collected by driving a dual-lined, 4-foot long, 1.5-inch diameter DPT soil core into the subsurface using hydraulic pressure. Upon retrieval of the 4 foot long core, visual observations were made by a field engineer. These observations led to the selection of discrete and composite soil samples for chemical analysis. These soil cores were also used to visually define any changes in soil texture, moisture, or evidence of contamination. Soil descriptions noted by the engineer are presented in the field boring logs provided in Appendix D. Drilling equipment was thoroughly decontaminated between each borehole to avoid cross-contamination.

Soil core samples were scanned with a Photo Ionization Detector (PID) to detect the presence of organic vapors potentially from volatile organic compounds (VOC). Soil samples were also visually inspected for evidence of contamination, such as soil staining or sheen on the pore fluid of the soil sample. Five discrete samples identified as potentially impacted based on the PID reading and/or visual evidence were sent to the CRG Marine Laboratories (CRG) for VOC analysis.

Samples for geotechnical analysis (grain size distribution, liquid and plastic limits, and hydrometer analysis) were collected using a 4-inch diameter solid stem auger rig. The solid stem auger was advanced at 5 foot intervals. The solid stem auger technique was used to collect bulk soil grab samples for geotechnical analysis because these analyses required greater sample volume. Both discrete and composite were collected from borehole cuttings for geotechnical analysis in accordance with the approved sampling strategy as outlined on Figure 2-4. Composite bulk geotechnical soil samples were taken from similar stratigraphic layers at different boring depths within a single boring. Composite samples were also taken from soil cuttings of similar soil type from 2-3 borings within the same sub area. The sampling depth interval from which the soil samples were collected was determined based on the measurement of the length of auger that had been advanced into the boring location.

The depth of the borings depended on the distance from the ground surface to native materials (i.e., marsh mat) and the depth of excavation expected during restoration. Auger samples were

collected to average depths of 12–13 feet below grade surface (bgs) where groundwater was typically encountered. DPT core samples were collected to the depth of approximately 24 feet bgs. Table 2-2 lists the boring locations, GPS coordinates, surface elevations, final boring depth, and depth to water (dtw). Table 2-3 shows the sample number for each discrete soil chemistry sample and the bore depth at which the sample was collected.

Table 2-2. Surface Elevations and Final Boring Depths

Boring Location	Latitude	Longitude	Drilling			Surface Elevation (ft)	Final Boring Depth		Depth to Ground-water (ft)
			Date	Start Time	End Time		Direct Push Technology (Dual Core Liner) (ft)	Solid Stem Auger Rig (Bulk Samples) (ft)	
Station 2	33.9734	-118.44451	2/5/2008	15:50	16:10	30	24	10	10
Station 3	33.97418694	-118.443475	2/8/2008	16:05	16:45	30	24	8	8
Station 4	33.97184333	-118.4447522	2/5/2008	13:30	13:55	30	24	16	16
Station 5	33.97051444	-118.4430675	2/6/2008	9:45	10:10	30	24	13	13
Station 6	33.96970806	-118.4432386	2/6/2008	7:45	8:10	20	24	13	13
Station 9	33.97168611	-118.4422205	2/6/2008	11:20	12:15	30	24	8	8
Station 10	33.97272	-118.46211	2/6/2008	13:40	14:10	30	24	5	5
Station 11	33.97410972	-118.4410092	2/7/2008	8:10	8:55	30	24	9	9
Station 15	33.97427444	-118.4401275	2/8/2008	15:05	15:35	30	24	4	4
Station 17	33.97600417	-118.4392794	2/8/2008	13:05	13:40	30	24	4.5	4.5
Station 18	33.97579	-118.4405436	2/8/2008	13:55	14:50	30	24	14	14
Station 21	33.97755694	-118.4365917	2/8/2008	9:50	10:50	30	24	18	18
Station 23	33.976865	-118.4345305	2/8/2008	8:35	9:30	30	24	12	12
Station 24	33.97556	-118.43605	2/8/2008	7:20	8:20	20	24	7	7
Station 25	33.97502917	-118.4378281	2/8/2008	11:15	12:50	20	24	6	6
Station 26	33.97504	-118.43637	2/7/2008	15:15	16:05	30	24	10	10
Station 27	33.97364	-118.63718	2/7/2008	14:05	15:05	30	24	12	12
Station 28	33.97469778	-118.4379058	2/7/2008	11:30	12:20	20	24	9	9
Station 29	33.97345389	-118.4386047	2/7/2008	10:30	11:15	30	24	9.5	9.5
Station 30	33.97252472	-118.4392269	2/7/2008	9:30	10:20	20	24	12	12

2.4.2 Sample Processing and Storage

The process for selecting soil samples for geotechnical and chemical analysis is outlined on Figure 2-4. Soil core and cuttings was bagged, labeled, and placed on ice. Once all drilling activities were complete, discrete samples (from a defined depth interval and single boring) were selected from the soil core and cuttings for geotechnical analysis in accordance with the selection process presented on Figure 2-4. Twelve discrete samples—samples from one soil horizon—were taken for geotechnical analysis, and 10 discrete samples were taken for chemical analysis. CRG was tasked to composite core samples from different soil horizons within one borehole or from across similar soil horizons from different boreholes. A total of 10 composite samples were analyzed for soil chemistry parameters. The various soil chemistry parameters that were analyzed have been tabulated in the following subsection. Table 2-3 shows boring locations and the corresponding depths at which the samples were collected for chemical analysis. Table 2-4 shows the individual samples used to create composite samples for chemical analysis. A total of 14 composite samples were combined from soil cuttings for geotechnical analysis. Table 2-5 shows boring locations and corresponding depths at which the samples were collected for geotechnical analysis. Table 2-5 also shows individual samples that were used to create 14 composite samples for geotechnical analysis.

Chain-of-custody procedures were followed in accordance with the approved Study Work Plan. Documentation of sample collection, transport, and list of analytes were recorded in the chain-of-custody. The chain-of-custodies are attached in Appendix E.

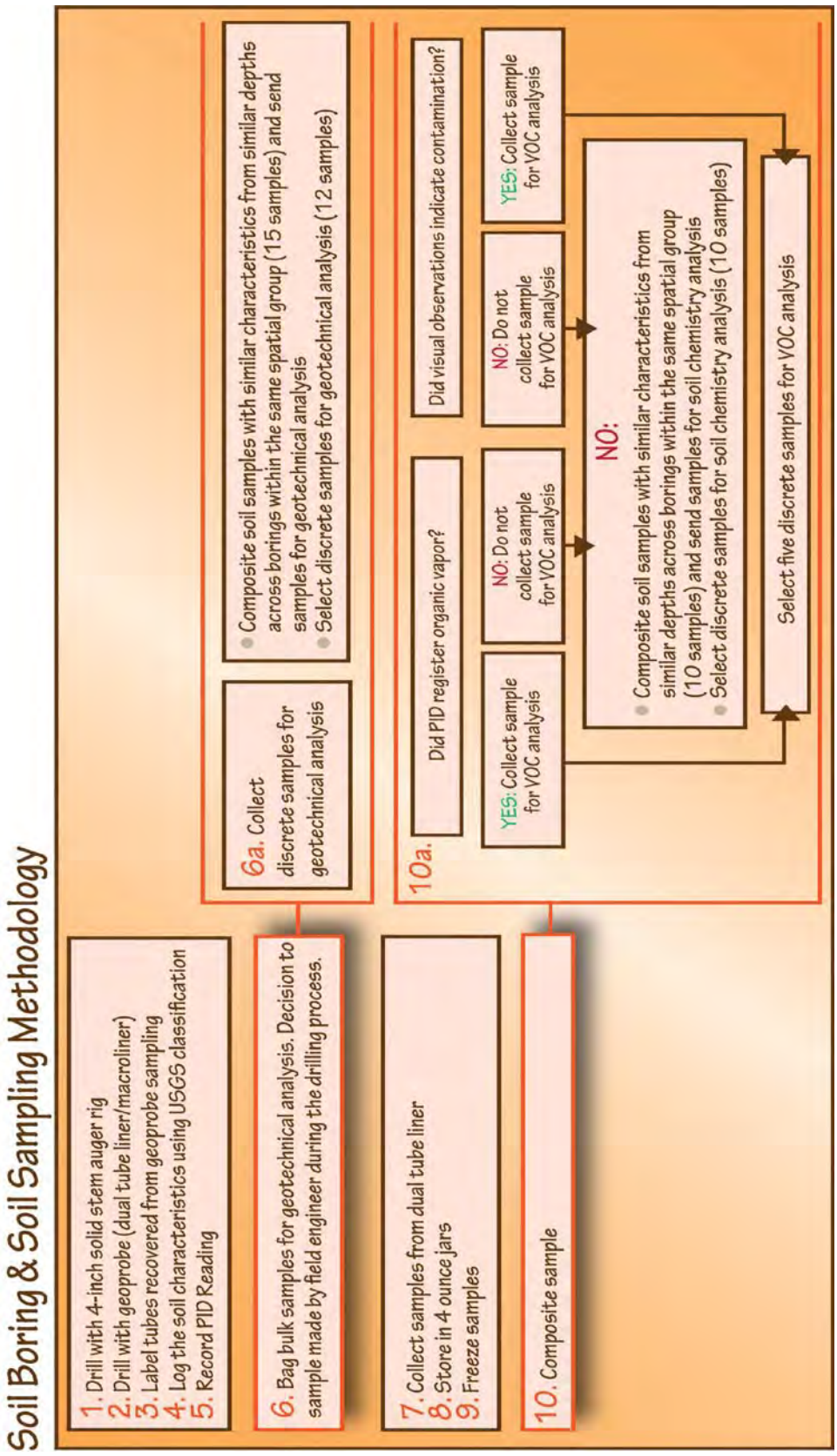

Figure 2-4. Soil Boring and Sampling Strategy

Table 2-3. Sample ID and Sampling Location Depth for Chemistry Analysis

Samples for Soil Chemistry Analysis	Station ID	Sample Depth (ft)
Discrete Samples		
S5-060208-15-16	Station 5	15-16
S9-060208-3-4	Station 9	3-4
S10-060208-6-7	Station 10	6-7
S18-060208-7-8	Station 18	7-8
S17-080208-10-11	Station 17	10-11
S15-080208-15-16	Station 15	15-16
S11-070208-14-15	Station 11	14-15
S29-070208-6-7	Station 29	6-7
S23-080208-12-13	Station 23	12-13
S21-080208-6-7	Station 21	6-7
Discrete Samples for VOC Analysis		
S18-080208-11-12	Station 18	11-12
S15-080208-11-12	Station 15	11-12
S23-080208-15-16	Station 23	15-16
S23-080208-12-13	Station 23	12-13
S21-080208-11-12	Station 21	11-12
Composite* Samples		
S5-S6-15-16	*	*
S5-S6-S9-3-4	*	*
S4-S10-5-7	*	*
S3-11-12-15-16	*	*
S17-S18-10-12	*	*
S15-S28-15-16	*	*
S11-S15-14-20	*	*
S27-S29-S30-6-8	*	*
S23-S24-S26-21-24	*	*
S21-S25-6-8	*	*

*see the Table 2-4 for component of composite samples

Table 2-4. Soil Compositing Information for Chemistry Analysis

Composite Sample ID	Discrete Samples*	Station Id	Sample Depth (ft)
S5-S6-15-16	S5-060208-15-16	Station 5	15-16
	S6-060208-15-16	Station 6	15-16
S5-S6-S9-3-4	S5-060208-3-4	Station 5	3-4
	S6-060208-3-4	Station 6	3-4
	S9-060208-3-4	Station 9	3-4
S4-S10-5-7	S4-050208-5-6	Station 4	5-6
	S10-060208-6-7	Station 10	6-7
S3-11-12-15-16	S3-080208-11-12	Station 3	11-12
	S3-080208-15-16	Station 3	15-16
S17-S18-10-12	S17-080208-10-11	Station 17	10-11
	S18-080208-11-12	Station 18	11-12
S15-S28-15-16	S15-080208-15-16	Station 15	15-16
	S28-070208-15-16	Station 28	15-16
S11-S15-14-20	S15-080208-17-18	Station 15	17-18
	S11-070208-14-15	Station 11	14-15
S27-S29-S30-6-8	S27-070208-7-8	Station 27	7-8
	S29-070208-6-7	Station 29	6-7
	S30-070208-7-8	Station 30	7-8
S23-S24-S26-21-24	S23-080208-23-24	Station 23	23-24
	S24-080208-21-22	Station 24	21-22
	S26-070208-22-23	Station 26	22-23
S21-S25-6-8	S21-080208-6-7	Station 21	6-7
	S25-080208-7-8	Station 25	7-8

* Samples were composited using equal amounts of the discrete samples.

Table 2-5. Sample ID and Sampling Location Depth for Geotechnical analysis

Samples for Soil Chemistry Analysis	Sample ID	Station ID	Sample Depth (ft)
Composite Samples			
G1-0-2	S6-060208-0-2	Station 6	0-2
	S5-060208-0-2	Station 5	0-2
	S9-060208-0-2	Station 9	0-2
G1-3-5	S5-060208-3-5	Station 5	3-5
	S9-060208-3-5	Station 9	3-5
	S6-060208-3-5	Station 6	3-5
G1-10-13	S6-060208-10-13	Station 6	10-13
	S5-060208-10-13	Station 5	10-13
G2-3-5	S4-050208-3-5	Station 4	3-5
	S10-060208-3-5	Station 10	3-5
G3-3-5	S2-080208-3-5	Station 2	3-5
	S3-080208-3-5	Station 3	3-5
G4-3-5	S18-050208-3-5	Station 18	3-5
	S17-080208-3-5	Station 17	3-5
G5-6-9	S11-070208-6-8	Station 11	6-8
	S28-070208-7-9	Station 28	7-9
G6-7-10	S29-070208-7-9	Station 29	7-9
	S27-070208-8-10	Station 27	8-10
	S30-070208-10-11	Station 30	10-11
G7-3-5	S21-080208-3-5	Station 21	3-5
	S25-080208-3-5	Station 25	3-5
G8-3-5	S26-070208-3-5	Station 26	3-5
	S23-080208-3-5	Station 23	3-5
	S24-080208-3-5	Station 24	3-5
G8-7-10	S26-070208-7-9	Station 26	7-9
	S23-080208-8-10	Station 23	8-10
	S24-080208-8-10	Station 24	8-10

Table 2-5. Sample ID and Sampling Location Depth for Geotechnical analysis

Samples for Soil Chemistry Analysis	Sample ID	Station ID	Sample Depth (ft)
Seg1-0-2	S2-050208-0-2	Station 2	0-2
	S3-080208-0-2	Station 3	0-2
	S10-060208-0-2	Station 10	0-2
Seg2-0-2	S15-080208-0-2	Station 15	0-2
	S28-070208-0-2	Station 28	0-2
	S18-080208-0-2	Station 18	0-2
	S11-070208-0-2	Station 11	0-2
	S29-070208-0-2	Station 29	0-2
	S30-070208-0-2	Station 30	0-2
	S17-080208-0-2	Station 17	0-2
	S27-070208-0-2	Station 27	0-2
Seg3-0-2	S21-080208-0-2	Station 21	0-2
	S25-080208-0-2	Station 25	0-2
	S23-080208-0-2	Station 23	0-2
	S24-080208-0-2	Station 24	0-2
Discrete Samples			
S6-060208-8-10		Station 6	8-10
S2-050208-8-10		Station 2	8-10
S21-080208-13-15		Station 21	13-15
S21-080208-8-10		Station 21	8-10
S18-080208-8-10		Station 18	8-10
S2-050108-13-15		Station 2	13-15
S25-080208-5-6		Station 25	5-6
S18-080208-12-14		Station 18	12-14
S30-070208-3-5		Station 30	3-5
S5-060208-8-10		Station 5	8-10
S4-050208-13-15		Station 4	13-15
S4-050208-8-10		Station 4	8-10

2.4.3 Geotechnical and Chemical Analysis

WESTON subcontracted the chemical analysis of the selected samples to CRG. G Force Companies (G Force) was sub-contracted for the geotechnical analysis of the selected soil samples. Geotechnical and geochemical analysis was conducted on 20 discrete and composited soil samples. Geotechnical analysis used American Society for Testing and Materials (ASTM) methods for grain size, liquid and plastic limits, and moisture content. Chemical analysis included general chemistry, metals, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), pesticides, semi-volatile organic carbons (s-VOCs) and VOCs. These analyses were performed using the appropriate United States Environmental Protection Agency (USEPA) methods. Table 2-6 shows the chemical analyses for each discrete and composite soil samples. Table 2-7 shows the samples and corresponding analysis for the geotechnical parameters.

Table 2-6. List of Analytes and Samples analyzed for Soil Chemistry

Samples for Soil Chemistry Analysis	Station ID	Depth (ft)	Trace Metals	Trace Mercury	Organotins	Polynuclear Aromatic Hydrocarbons	Phthalates	Acid Extractable Compounds	Organochlorine Pesticides & PCBs	Toxicity Characteristic Leachate Procedure (TCLP)	Dissolved sulfides	Percent solids	pH	Salinity	TOC	Total Sulfides	TPH diesel	TPH gas	Volatile Organic Compounds inc. Acrolein & Acrylonitrile	Ammonia in Sediment Determination	TRPH in Sediment Determination
Method			USEPA 6020(m)	USEPA 245.7(m)	Krone et. Al., 1989	USEPA 8270C(m)	USEPA 8270C(m)	USEPA 8270C(m)	USEPA 8270C(m)		Plumb, 1981/TERL	USEPA 160.3	SM 4500 H+	SM 2510 B	USEPA 9060 A	Plumb, 1981/TERL	USEPA 8015m	USEPA 8015m	USEPA 8260B	USEPA 8270C(m)	USEPA 1664
Discrete Samples																					
S5-060208-15-16	Station 5	15-16	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
S9-060208-3-4	Station 9	3-4	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
S10-060208-6-7	Station 10	6-7	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
S18-060208-7-8	Station 18	7-8	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
S17-080208-10-11	Station 17	10-11	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
S15-080208-15-16	Station 15	15-16	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
S11-070208-14-15	Station 11	14-15	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
S29-070208-6-7	Station 29	6-7	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
S23-080208-12-13	Station 23	12-13	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
S21-080208-6-7	Station 21	6-7	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
Discrete Samples for VOC analysis																					
S18-080208-11-12	Station 18	11-12																	Yes		
S15-080208-11-12	Station 15	11-12																	Yes		
S23-080208-15-16	Station 23	15-16																	Yes		
S23-080208-12-13	Station 23	12-13																	Yes		
S21-080208-11-12	Station 21	11-12																	Yes		
Composite Samples																					
S5-S6-15-16	*	*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
S5-S6-S9-3-4	*	*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
S4-S10-5-7	*	*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
S3-11-12-15-16	*	*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
S17-S18-10-12	*	*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
S15-S28-15-16	*	*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
S11-S15-14-20	*	*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
S27-S29-S30-6-8	*	*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
S23-S24-S26-21-24	*	*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
S21-S25-6-8	*	*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes

Table 2-7. List of Samples and Geotechnical Analysis

Samples for Soil Chemistry Analysis	Sample ID	Station ID	Depth (ft)	Grain Size Analysis with Hydrometer (ASTM D-422-63)	Atterberg Limits (ASTM D-4318)	Moisture Content (ASTM D-2216)
Composite Samples						
G1-0-2	S6-060208-0-2	Station 6	0-2	Yes		
	S5-060208-0-2	Station 5	0-2			
	S9-060208-0-2	Station 9	0-2			
G1-3-5	S5-060208-3-5	Station 5	3-5	Yes	Yes	
	S9-060208-3-5	Station 9	3-5			
	S6-060208-3-5	Station 6	3-5			
G1-10-13	S6-060208-10-13	Station 6	10-13	Yes	Yes	
	S5-060208-10-13	Station 5	10-13			
G2-3-5	S4-050208-3-5	Station 4	3-5	Yes	Yes	
	S10-060208-3-5	Station 10	3-5			
G3-3-5	S2-080208-3-5	Station 2	3-5	Yes	Yes	
	S3-080208-3-5	Station 3	3-5			
G4-3-5	S18-050208-3-5	Station 18	3-5	Yes	Yes	
	S17-080208-3-5	Station 17	3-5			
G5-6-9	S11-070208-6-8	Station 11	6-8	Yes	Yes	
	S28-070208-7-9	Station 28	7-9			
G6-7-10	S29-070208-7-9	Station 29	7-9	Yes	Yes	
	S27-070208-8-10	Station 27	8-10			
	S30-070208-10-11	Station 30	10-11			
G7-3-5	S21-080208-3-5	Station 21	3-5	Yes		
	S25-080208-3-5	Station 25	3-5			
G8-3-5	S26-070208-3-5	Station 26	3-5	Yes		
	S23-080208-3-5	Station 23	3-5			
	S24-080208-3-5	Station 24	3-5			
G8-7-10	S26-070208-7-9	Station 26	7-9	Yes	Yes	
	S23-080208-8-10	Station 23	8-10			
	S24-080208-8-10	Station 24	8-10			
Seg1-0-2	S2-050208-0-2	Station 2	0-2	Yes		
	S3-080208-0-2	Station 3	0-2			
	S10-060208-0-2	Station 10	0-2			
Seg2-0-2	S15-080208-0-2	Station 15	0-2	YES		
	S28-070208-0-2	Station 28	0-2			
	S18-080208-0-2	Station 18	0-2			
	S11-070208-0-2	Station 11	0-2			
	S29-070208-0-2	Station 29	0-2			

Table 2-7. List of Samples and Geotechnical Analysis

Samples for Soil Chemistry Analysis	Sample ID	Station ID	Depth (ft)	Grain Size Analysis with Hydrometer (ASTM D-422-63)	Atterberg Limits (ASTM D-4318)	Moisture Content (ASTM D-2216)
	S30-070208-0-2	Station 30	0-2	Yes		
	S17-080208-0-2	Station 17	0-2			
	S27-070208-0-2	Station 27	0-2			
Seg3-0-2	S21-080208-0-2	Station 21	0-2	Yes		
	S25-080208-0-2	Station 25	0-2			
	S23-080208-0-2	Station 23	0-2			
	S24-080208-0-2	Station 24	0-2			
Discrete Samples						
S6-060208-8-10	S6-060208-8-10	Station 6	8-10	Yes	Yes	Yes
S2-050208-8-10	S2-050208-8-10	Station 2	8-10	Yes	Yes	Yes
S21-080208-13-15	S21-080208-13-15	Station 21	13-15	Yes	Yes	Yes
S21-080208-8-10	S21-080208-8-10	Station 21	8-10	Yes	Yes	Yes
S18-080208-8-10	S18-080208-8-10	Station 18	8-10	Yes	Yes	Yes
S2-050108-13-15	S2-050108-13-15	Station 2	13-15	Yes	Yes	Yes
S25-080208-5-6	S25-080208-5-6	Station 25	5-6	Yes	Yes	Yes
S18-080208-12-14	S18-080208-12-14	Station 18	12-14	Yes	Yes	Yes
S30-070208-3-5	S30-070208-3-5	Station 30	3-5	Yes	Yes	Yes
S5-060208-8-10	S5-060208-8-10	Station 5	8-10	Yes	Yes	Yes
S4-050208-13-15	S4-050208-13-15	Station 4	13-15	Yes	Yes	Yes
S4-050208-8-10	S4-050208-8-10	Station 4	8-10	Yes	Yes	Yes

3.0 RESULTS AND FINDINGS

3.1 Geotechnical Results

Appendix D provides the soil boring logs for the 20 borings completed for the Preliminary Area A Study. The boring logs were developed from the field boring logs and the results of the geotechnical analysis of selected soil samples. The boring logs indicate that, in general, the dredged materials at the site do not greatly vary with depths or site location. The dredged materials are predominantly low plasticity clays, silty clays, and clayey silts. The exception is a gradual transition to soils with greater gravel and cobble content on the north eastern portion of the site adjacent to Lincoln Boulevard.

The results of the geotechnical analysis are provided in Appendix F and a summary of the geotechnical results is presented in Table 3-1. The results for the composite samples are shown for the depth interval from which the soil samples were taken. For example, composite sample G5-6-9 was composed of Station 11 discrete sample S11-070208-6-8 and Station 28 discrete sample S28-070208-7-9. The results of the geotechnical analysis for the individual Station 11 and Station 28 samples were then used to characterize the composite sample G5-6-9.

The results of the geotechnical analysis confirm the field observations which indicated the dredged materials within Area A do not vary greatly in grain size and soil classification. In fact, all the composite and discrete samples collected and analyzed for geotechnical properties were classified as low plasticity clays, silty clays, sandy clays or clayey silts (CL) per the Unified Soil Classification System (USCS). The only exception was the soil at Station 25 at a depth of 5-6 feet bgs. At this location, the soil is classified as high plasticity clay (CH). Historically, Area A was formed by filling the area with the dredge material that was excavated from Marina del Rey Harbor and Ballona Creek in the 1960s. These clayey soils are generally poor draining soils as evident by the seasonal ponding of precipitation during high rainfall years and the formation of salt pans and salt-marsh adapted vegetation on low lying areas of Area A. Due to the high clay content, these soils are generally not well suited for structural fill materials, but may be used for grading fill as part of the Restoration Project or other landscaped areas that are not subject to structural loading. Further discussion of potential beneficial uses of the dredged material is presented in Section 4. Beneficial uses will also depend on the chemical constituents present in the soil.

Table 3-1. Summary of Geotechnical Results by Depth and Sampling Locations

Depth	Station ID	Sample ID	Classification by Particle Size	Percent Retained															Atterberg Description	Atterberg Limits			USCS Classification
				Gravel								Sand						Clay/Silt					
				3"	2"	1.5"	1"	0.75"	0.5"	3/8"	Total Gravel #4	#10	#20	#40	#60	#100	Total Sand #200	Total Silt + Clay <#200		Liquid Limit	Plastic Limit	Plasticity	
0-2	Station 6	G1-0-2	Sandy Clay	0	0	0	0	0	0	0	1	3	5	7	9	14	32	68					
0-2	Station 5	G1-0-2	Sandy Clay	0	0	0	0	0	0	0	1	3	5	7	9	14	32	68					
0-2	Station 9	G1-0-2	Sandy Clay	0	0	0	0	0	0	0	1	3	5	7	9	14	32	68					
0-2	Station 2	Seg1-0-2	Clayey Sand	0	0	0	0	1	1	3	6	12	16	21	26	36	62	38					
0-2	Station 3	Seg1-0-2	Clayey Sand	0	0	0	0	1	1	3	6	12	16	21	26	36	62	38					
0-2	Station 10	Seg1-0-2	Clayey Sand	0	0	0	0	1	1	3	6	12	16	21	26	36	62	38					
0-2	Station 15	Seg2-0-2	Sandy Clay	0	0	0	0	0	0	1	3	8	12	17	21	28	44	56					
0-2	Station 28	Seg2-0-2	Sandy Clay	0	0	0	0	0	0	1	3	8	12	17	21	28	44	56					
0-2	Station 18	Seg2-0-2	Sandy Clay	0	0	0	0	0	0	1	3	8	12	17	21	28	44	56					
0-2	Station 11	Seg2-0-2	Sandy Clay	0	0	0	0	0	0	1	3	8	12	17	21	28	44	56					
0-2	Station 29	Seg2-0-2	Sandy Clay	0	0	0	0	0	0	1	3	8	12	17	21	28	44	56					
0-2	Station 30	Seg2-0-2	Sandy Clay	0	0	0	0	0	0	1	3	8	12	17	21	28	44	56					
0-2	Station 17	Seg2-0-2	Sandy Clay	0	0	0	0	0	0	1	3	8	12	17	21	28	44	56					
0-2	Station 27	Seg2-0-2	Sandy Clay	0	0	0	0	0	0	1	3	8	12	17	21	28	44	56					
0-2	Station 21	Seg3-0-2	Sandy Clay	0	0	0	0	0	0	0	0	1	3	6	9	18	38	62					
0-2	Station 25	Seg3-0-2	Sandy Clay	0	0	0	0	0	0	0	0	1	3	6	9	18	38	62					
0-2	Station 23	Seg3-0-2	Sandy Clay	0	0	0	0	0	0	0	0	1	3	6	9	18	38	62					
0-2	Station 24	Seg3-0-2	Sandy Clay	0	0	0	0	0	0	0	0	1	3	6	9	18	38	62					
3-5	Station 4	G2-3-5	Sandy Clay	0	0	0	0	0	0	0	0	0	1	2	4	13	49	51	Lean Clay	29	21	8	CL
3-5	Station 10	G2-3-5	Sandy Clay	0	0	0	0	0	0	0	0	0	1	2	4	13	49	51	Lean Clay	29	21	8	CL
3-5	Station 5	G1-3-5	Clayey Sand	0	0	0	0	0	1	3	10	14	18	22	27	35	61	39					
3-5	Station 9	G1-3-5	Clayey Sand	0	0	0	0	0	1	3	10	14	18	22	27	35	61	39					
3-5	Station 6	G1-3-5	Clayey Sand	0	0	0	0	0	1	3	10	14	18	22	27	35	61	39					
3-5	Station 2	G3-3-5	Sandy Clay	0	0	0	0	0	0	1	2	5	7	10	14	24	46	54	Lean Clay	38	18	20	CL
3-5	Station 3	G3-3-5	Sandy Clay	0	0	0	0	0	0	1	2	5	7	10	14	24	46	54	Lean Clay	38	18	20	CL
3-5	Station 18	G4-3-5	Sandy Clay	0	0	0	0	0	0	1	2	7	11	14	17	21	33	67	Lean Clay	38	20	18	CL
3-5	Station 17	G4-3-5	Sandy Clay	0	0	0	0	0	0	1	2	7	11	14	17	21	33	67	Lean Clay	38	20	18	CL
3-5	Station 21	G7-3-5	Sandy Clay	0	0	0	0	0	0	0	0	0	2	5	8	18	42	58					
3-5	Station 25	G7-3-5	Sandy Clay	0	0	0	0	0	0	0	0	0	2	5	8	18	42	58					
3-5	Station 26	G8-3-5	Sandy Clay	0	0	0	0	0	0	0	0	0	1	2	4	10	24	76	Lean Clay	45	17	28	CL
3-5	Station 23	G8-3-5	Sandy Clay	0	0	0	0	0	0	0	0	0	1	2	4	10	24	76	Lean Clay	45	17	28	CL
3-5	Station 24	G8-3-5	Sandy Clay	0	0	0	0	0	0	0	0	0	1	2	4	10	24	76	Lean Clay	45	17	28	CL
3-5	Station 30	S30-070208-3-5	Sandy Clay	0	0	0	0	0	0	0	0	0	1	2	4	8	17	83	Lean Clay	48	20	28	CL
5-6	Station 25	S25-080208-5-6	Sandy Clay	0	0	0	0	0	0	0	0	0	0	1	2	8	22	78	Fat Clay	51	18	33	CH
6-8	Station 11	G5-6-9	Sandy Clay	0	0	0	0	0	0	0	0	0	1	1	2	10	30	70	Lean Clay	38	17	21	CL
7-9	Station 28	G5-6-9	Sandy Clay	0	0	0	0	0	0	0	0	0	1	1	2	10	30	70	Lean Clay	38	17	21	CL
7-9	Station 29	G6-7-10	Sandy Clay	0	0	0	0	0	0	0	0	0	1	3	7	12	21	79	Lean Clay	40	19	21	CL

Table 3-1. Summary of Geotechnical Results by Depth and Sampling Locations

Depth	Station ID	Sample ID	Classification by Particle Size	Percent Retained														Atterberg Description	Atterberg Limits			USCS Classification
				Gravel								Sand						Clay/Silt				
				3"	2"	1.5"	1"	0.75"	0.5"	3/8"	Total Gravel #4	#10	#20	#40	#60	#100	Total Sand #200	Total Silt + Clay <#200		Liquid Limit	Plastic Limit	Plasticity	
7-9	Station 26	G8-7-10	Sandy Clay	0	0	0	0	0	0	0	0	0	1	2	4	9	21	79	Lean Clay	44	17	27	CL
8-10	Station 27	G6-7-10	Sandy Clay	0	0	0	0	0	0	0	0	0	1	3	7	12	21	79	Lean Clay	40	19	21	CL
8-10	Station 23	G8-7-10	Sandy Clay	0	0	0	0	0	0	0	0	0	1	2	4	9	21	79	Lean Clay	44	17	27	CL
8-10	Station 24	G8-7-10	Sandy Clay	0	0	0	0	0	0	0	0	0	1	2	4	9	21	79	Lean Clay	44	17	27	CL
8-10	Station 6	S6-060208-8-10	Sandy Clay	0	0	0	0	0	0	0	0	2	4	8	16	25	42	58	Lean Clay	37	16	21	CL
8-10	Station 2	S2-050208-8-10	Clayey Sand	0	0	0	0	0	0	1	3	7	13	23	33	44	60	40	Lean Clay	30	15	15	CL
8-10	Station 21	S21-080208-8-10	Sandy Clay	0	0	0	0	0	0	0	0	1	4	11	15	20	28	72	Lean Clay	46	18	28	CL
8-10	Station 18	S18-080208-8-10	Sandy Clay	0	0	0	0	0	0	1	5	10	16	22	27	32	38	62	Lean Clay	35	17	18	CL
8-10	Station 5	S5-060208-8-10	Clayey Sand	0	0	0	0	1	4	7	14	24	29	38	48	52	62	38	Lean Clay	35	16	19	CL
8-10	Station 4	S4-050208-8-10	Sandy Clay	0	0	0	0	0	0	0	1	3	6	9	13	20	47	53	Lean Clay	31	18	13	CL
10-11	Station 30	G6-7-10	Sandy Clay	0	0	0	0	0	0	0	0	0	1	3	7	12	21	79	Lean Clay	40	19	21	CL
10-13	Station 6	G1-10-13	Sandy Clay	0	0	0	0	0	0	0	1	2	4	6	10	15	30	70	Lean Clay	42	20	22	CL
10-13	Station 5	G1-10-13	Sandy Clay	0	0	0	0	0	0	0	1	2	4	6	10	15	30	70	Lean Clay	42	20	22	CL
12-14	Station 18	S18-080208-12-14	Sandy Clay	0	0	0	0	0	0	0	0	2	6	9	12	14	19	81	Lean Clay	43	19	24	CL
13-15	Station 21	S21-080208-13-15	Sandy Clay	0	0	0	0	0	0	0	0	1	3	8	14	21	29	71	Lean Clay	42	16	26	CL
13-15	Station 2	S2-050108-13-15	Clayey Sand	0	0	0	0	1	2	3	4	10	17	25	34	43	56	44	Lean Clay	33	16	17	CL
13-15	Station 4	S4-050208-13-15	Sandy Clay	0	0	0	0	0	0	0	1	2	5	12	22	28	46	54	Lean Clay	30	15	15	CL

USCS Definition:
CL- Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
CH- Inorganic clays of high plasticity, organic silts

3.2 Chemistry Results

3.2.1 Comparison to Relevant Criteria

Analytical results were compared to relevant soil screening levels, sediment quality guidelines, and hazardous waste criteria to determine suitability of material for specific beneficial uses or placement options. Relevant numeric standards for comparisons include:

- Hazardous Waste Criteria
  - Total Threshold Limit Concentration (TTLC) and Soluble Threshold Limit Concentration (STLC): TTLC and STLC are used to determine the hazardous waste characterization under California State regulations as outlined in Title 22 of the California Code of Regulations (CCR).Concentrations of contaminants in project soil were compared to TTLC and 10 times the STLC. If concentrations exceed 10 times the STLC, a Waste Extraction Test (WET) must be performed to estimate the contaminant leachate. If concentrations of contaminants in soil exceed the TTLC or leachate from the WET exceed the STLC, the material is classified as hazardous waste. If a waste is determined to be a hazardous waste, specific regulations and statutes regarding the management, storage, transportation and disposal must be met.
  - Toxicity Characteristic Leaching Procedure (TCLP): TCLP is the characterization for hazardous waste based on Federal guidelines. TCLP analysis was performed to provide an estimate of the soil contaminant leachate and to determine if this material is classified as hazardous waste or if it is considered suitable for upland placement. Analytes leaching from the soil were compared to USEPA Title 40 Code of Federal Regulations (CFR) Part 261 values (USEPA, 2006).

- Human Health Screening Levels
  - California Human Health Screening Levels (CHHSLs): Concentrations of 54 hazardous chemicals in soil that the California Environmental Protection Agency (Cal/EPA) considers to be below thresholds of concern for risks to human health based on ingestion, inhalation, and dermal absorption. The CHHSLs were developed by the Office of Environmental Health Hazard Assessment (OEHHA) on behalf of Cal/EPA, and are contained in their report entitled "Human-Exposure-Based Screening Numbers are Developed to Aid Estimation of Cleanup Costs for Contaminated Soil". Any exceedances of the CHHSLs do not indicate that the levels are of concern, but suggest that further evaluation of potential human health concerns may be considered. Residential CHHSLs are recommended for use by the California Department of Toxic Substances Control (DTSC) for human health screening evaluation described in the Preliminary Endangerment Assessment (PEA) Guidance Manual.
  - Preliminary Remediation Goals (PRGs): For contaminants that CHHSLs are not developed, the PRGs are used. The PRGs were developed by USEPA Region IX as a risk-based screening tool for evaluating and cleaning up contaminated sites. The Region IX PRGs were developed prior to the CHHSLs and are similar or slightly less stringent. The values are calculated from current human health toxicity values with standard exposure factors to estimate contaminant concentrations in environmental

media (soil, air, and water) that are considered by the Agency to be health protective of human exposures (including sensitive groups), over a lifetime. As with CHHSLs, exceedances do not indicate that the levels present are a human health concern, however, more evaluation may be required.

- Ecologically Relevant Screening Criteria
  - Interim Sediment Screening Criteria and Testing Requirements for Wetland Creation and Upland Beneficial Reuse. These sediment screening criteria and testing requirements are for the beneficial reuse of dredged material such as wetlands creation and upland disposal. The criteria were developed by the California Regional Water Quality Control Board.
  - Effects Range-Low (ER-L) and Effects Range-Median (ER-M) Values: Effect range values are used in dredged material evaluations for ocean disposal. These values were developed by Long et al. (1995), and are helpful in assessing the potential significance of elevated sediment-associated COCs, in conjunction with biological analyses. Briefly, these values were developed from a large data set where results of both benthic organism effects (e.g., toxicity tests, benthic community effects) and chemical analysis were available for individual samples. To derive these guidelines, the chemical values for paired data demonstrating benthic impairment were sorted in according to ascending chemical concentration. The ER-L was then calculated as the lower tenth percentile of the observed effects concentrations and the ER-M as the 50th percentile of the observed effects concentrations. While these values are useful for identifying elevated sediment-associated contaminants, they should not be used to infer causality because of the inherent variability and uncertainty of the approach. For dredged material evaluations, the ER-L and ER-M sediment quality values are used in conjunction with bioassay testing and are included for comparative purposes only. For certain pesticide compounds (i.e., chlordane and dieldrin) the ER-L and ER-M levels are so low as to make it largely impractical to detect them in typical harbor sediments using routine analytical procedures. Accordingly, having non-detect results that were greater than the ER-L, ER-M, or method detection limits (MDLs) would not require re-analysis.

A summary of the measured chemical constituents and comparison to the most appropriate soil screening levels, sediment quality guidelines, and hazardous waste criteria are provided in the appendices. The complete chemical analysis results from CRG of the selected soil samples are provided in Appendix G1 - G5. A summary of elevated contaminants above soil screening criteria and sediment quality guidelines are discussed below and presented in Table 3-2 and Table 3-3, respectively.

3.2.1.1 Comparison to Hazardous Waste Criteria

No chemicals were detected at concentrations greater than the TTLC or at concentrations greater than 10 times the STLC value (Appendix G1). Results of TCLP analyses indicated no analytes above the toxicity characteristic standards USEPA 40 CFR Part 261 values (USEPA, 2006) (Appendix G2). Therefore, the material is not classified as a hazardous waste and is suitable for upland placement options.

3.2.1.2 Comparison to Human Health Criteria

The analyzed organic chemicals of concern were PAHs, PCBs and organochlorine pesticides. With the exception of one soil sample, none of the Area A samples contained concentrations of PAHs, PCBs, or pesticides above the CHHSLs and PRGs soil criteria (Appendix G3). The concentration of benzo [a] pyrene at Station 27 was 39.7 µg/kg dry weight and this exceeded the human health screening level (set at 38 µg/kg dry weight) for potential use at residential land use.

While most of the chemical screening values for are below levels of concern for human health, arsenic and iron have ambient concentrations greater than residential CHHSLs and PRGs (Appendix G3). These exceedances suggest the material could be an issue if the sediments are used where humans will have continual contact (e.g. residential property or recreational property). The concentrations of arsenic and iron found are consistent with natural concentrations in marine sediments. A summary of soil samples that exceeded soil criteria is shown in Table 3-2.

During the boring and sampling operations, PID readings were taken to identify potential "hot" zones which might contain elevated VOC concentrations. Soil samples from five stations showed elevated PID readings in the field and were subsequently selected for s-VOC and VOC analysis. The results of the laboratory analysis showed that none of the five samples exceeded CHHSLs or PRGs criteria for residential and commercial land use. Appendix G3 shows the results of all the s-VOC and VOC analysis from the discrete and composite station samples.

Due to the historic and current presence of gasoline production and transportation at Area A, the 20 soil stations were analyzed for total petroleum hydrocarbons (TPHg and TPHd) and benzene, ethylbenzene, toluene, and xylenes (BETX). None of the soil samples had concentrations of TPHg, TPHd or BETX above the CHHSLs and PRGs (Appendix G3). However, during drilling operations at Station 25 and 26, the field engineer noted evidence of soil staining throughout the soil core. These two stations are closest to the abandoned gasoline transportation line that runs north-to-south through Area A. Additional soil sampling may be necessary prior to any large-scale excavation of site.

3.2.1.3 Comparison to Ecologic Criteria

The results of the chemical analysis were also compared to soil clean-up standards which may be applied to the Area A soils since the dredged material has been dewatered. In addition, the soil below the water table may be considered sediment and may be subject to proposed sediment quality criteria if used for the Restoration Project. The Interim Sediment Screening Criteria and Testing Requirements for Wetland Creation and Upland Beneficial Reuse, as established by the California Regional Water Quality Control Board, were used to determine if the Area A soil was suitable for wetland application (Appendix G4). The results of chemical analysis showed that all the analyzed chemical constituents were below the Interim Sediment Screening Criteria.

Concentrations of metals were also compared to ER-L and ER-M values (Appendix G5). Several metals slightly exceeded the corresponding ER-L values, including arsenic, cadmium, copper, lead, mercury, nickel, and silver (Table 3-3). No metals exceeded the corresponding ER-M values, indicating relatively low concentrations.

Concentrations of organics were also compared to ER-L and ER-M values (Appendix G5). The only organic to exceed the corresponding ER-L value was 4,4'-DDE in the composite sample from Stations 21 and 25 (Table 3-3). No organics exceeded the corresponding ER-M values, indicating relatively low concentrations.

CRG was not able to extract enough pore water from the soil samples for salinity and conductivity analysis. However, two soil samples were analyzed for salinity at the WESTON laboratory by using a refractometer. The dissolved salts were extracted from the soil samples by adding small quantities of deionized (DI) water and agitating the soil samples. The results indicate that the salt concentration of the soil is greater that 5 ppt. The soil at Area A is from marine sources such as Marina del Rey Harbor and Ballona creek. Currently there is existence of pickle weed which grows in soils with high salt content. Hence, it is inferred that the soil has a high salt content relative to that from a freshwater source. In addition, the soil pH indicates that it is basic in nature across Area A.

Table 3-2. Summary of Soil Samples with Analytes that Exceed California Human Health Screening Levels or Preliminary Remediation Goals

Group	Analyte	Units	RL	Residential Land Use		Commercial/Industrial Land Use Only		S10-060208-6-7	S11-070208-14-15	S11-S15-S28-14-20	S15-080208-15-16	S15-S28-15-16	S17-080208-10-11	S17-S18-10-12	S18-080208-7-8	S21-080208-6-7	S21-S25-6-8
				CHHSLs	PRG	CHHSLs	PRG	Discrete	Discrete	Composite	Discrete	Composite	Discrete	Composite	Discrete	Discrete	Composite
Metals	Arsenic (As)	µg/dry g	0.05	0.07	0.39	0.24	1.60	5.129	4.086	4.557	12.61	7.145	3.59	3.816	3.561	9.254	9.218
	Iron (Fe)	µg/dry g	5		23000		100000	15890	37840	41390	38250	32840	28970	37170	37940	30390	32920
PAHs	Benzo[a]pyrene	ng/dry g	5	38	15	130	210	<5	<5	<5	<5	<5	<5	<5	<5	7.3	6.8

Group	Analyte	Units	RL	Residential Land Use		Commercial/Industrial Land Use Only		S23-080208-12-13	S23-S24-S26-21-24	S27-S29-S30-6-8	S29-070208-6-7	S3-11-12-15-16	S4-S10-5-7	S5-060208-15-16	S5-S6-15-16	S5-S6-S9-3-4	S9-060208-3-4
				CHHSLs	PRG	CHHSLs	PRG	Discrete	Composite	Composite	Discrete	Composite	Composite	Discrete	Composite	Composite	Discrete
Metals	Arsenic (As)	µg/dry g	0.05	0.07	0.39	0.24	1.60	13.73	4.814	8.977	3.848	7.636	4.666	7.393	3.038	5.73	5.802
	Iron (Fe)	µg/dry g	5		23000		100000	27480	36000	31170	26180	34330	18770	35380	26340	20140	14270
PAHs	Benzo[a]pyrene	ng/dry g	5	38	15	130	210	3.4 J	<5	39.7	<5	6.1	<5	<5	<5	<5	<5

Notes:
J – Below the Reporting Limit (RL) but above the Method Detection Limit (MDL)
Yellow - Concentration exceeds respective soil screening criteria.

Table 3-3. Summary of Soil Samples with Analytes that Exceed Effects Range-Low or Effects Range-Median Values

Group	Analyte	Units	RL	Disposal Option Sediment Screening Criteria		S10-060208-6-7	S11-070208-14-15	S11-S15-S28-14-20	S15-080208-15-16	S15-S28-15-16	S17-080208-10-11	S17-S18-10-12	S18-080208-7-8	S21-080208-6-7	S21-S25-6-8
				ER-L	ER-M	Discrete	Discrete	Composite	Discrete	Composite	Discrete	Composite	Discrete	Discrete	Composite
Metals	Arsenic (As)	µg/dry g	0.05	8.2	70	5.129	4.086	4.557	12.61	7.145	3.59	3.816	3.561	9.254	9.218
	Cadmium (Cd)	µg/dry g	0.05	1.2	9.6	0.262	0.201	1.243	0.836	0.684	0.089	0.595	0.307	0.614	0.57
	Copper (Cu)	µg/dry g	0.05	34	270	11.15	33.62	22.17	39.25	28.84	18.03	28.89	28.99	31.63	35.6
	Lead (Pb)	µg/dry g	0.05	46.7	218	4.742	7.802	4.583	7.924	6.104	3.783	5.758	6.194	24.94	50.72
	Mercury (Hg)	µg/dry g	0.02	0.15	0.71	0.043	0.053	0.055	0.068	0.052	0.041	0.049	0.06	0.303	0.215
	Nickel (Ni)	µg/dry g	0.05	20.9	51.6	14.69	27.15	21.2	25.37	21.42	17.05	24.09	23.61	22.55	23.94
	Silver (Ag)	µg/dry g	0.05	1	3.7	0.04 J	0.035 J	0.072	0.038 J	0.113	0.042 J	0.173	0.052	1.079	1.027
Pesticides	4,4'-DDE	ng/dry g	5	2.2	27	<5	<5	<5	<5	<5	<5	<5	<5	<5	11.6

Group	Analyte	Units	RL	Disposal Option Sediment Screening Criteria		S23-080208-12-13	S23-S24-S26-21-24	S27-S29-S30-6-8	S29-070208-6-7	S3-11-12-15-16	S4-S10-5-7	S5-060208-15-16	S5-S6-15-16	S5-S6-S9-3-4	S9-060208-3-4
				ER-L	ER-M	Discrete	Composite	Composite	Discrete	Composite	Composite	Discrete	Composite	Composite	Discrete
Metals	Arsenic (As)	µg/dry g	0.05	8.2	70	13.73	4.814	8.977	3.848	7.636	4.666	7.393	3.038	5.73	5.802
	Cadmium (Cd)	µg/dry g	0.05	1.2	9.6	0.67	0.482	0.63	0.257	0.499	0.199	0.175	0.147	0.255	0.208
	Copper (Cu)	µg/dry g	0.05	34	270	25.64	30.61	37.79	20.12	28.08	14.52	27.21	21.25	12.81	9.257
	Lead (Pb)	µg/dry g	0.05	46.7	218	5.361	7.187	31.96	8.573	19.58	4.625	4.742	3.514	6.364	3.383
	Mercury (Hg)	µg/dry g	0.02	0.15	0.71	0.028	0.083	0.189	0.077	0.089	0.065	0.067	0.058	0.046	0.053
	Nickel (Ni)	µg/dry g	0.05	20.9	51.6	26.33	25.27	25.6	19.71	26.05	15.74	20.98	16.44	15.2	13.25
	Silver (Ag)	µg/dry g	0.05	1	3.7	0.105	0.221	0.224	0.129	0.174	0.096	<0.05	0.258	0.138	0.04 J
Pesticides	4,4'-DDE	ng/dry g	5	2.2	27	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5

Notes:
J – Below the Reporting Limit (RL) but above the Method Detection Limit (MDL)
Yellow - Concentration exceeds respective sediment screening criteria.

3.3 Soil Cross Sections

Soil cross sections were developed from boring logs (Appendix D) and geotechnical laboratory results. Figure 3-1 shows the location of the cross sections in the study site. Figure 3-2 shows the cross section A-A' and Figure 3-3 shows the cross section B-B'. For the purpose of development of cross sections, it was assumed that the area is topographically flat in elevation. The cross sections indicate that soil within the site could be characterized as having limited stratification and is spatially similar in nature. The cross sections show that the water table is tidally influenced. The water table indicated is representative of the water table at the specific time the water table was recorded or the sampling was conducted (Refer to Appendix D for borelogs and sampling times)

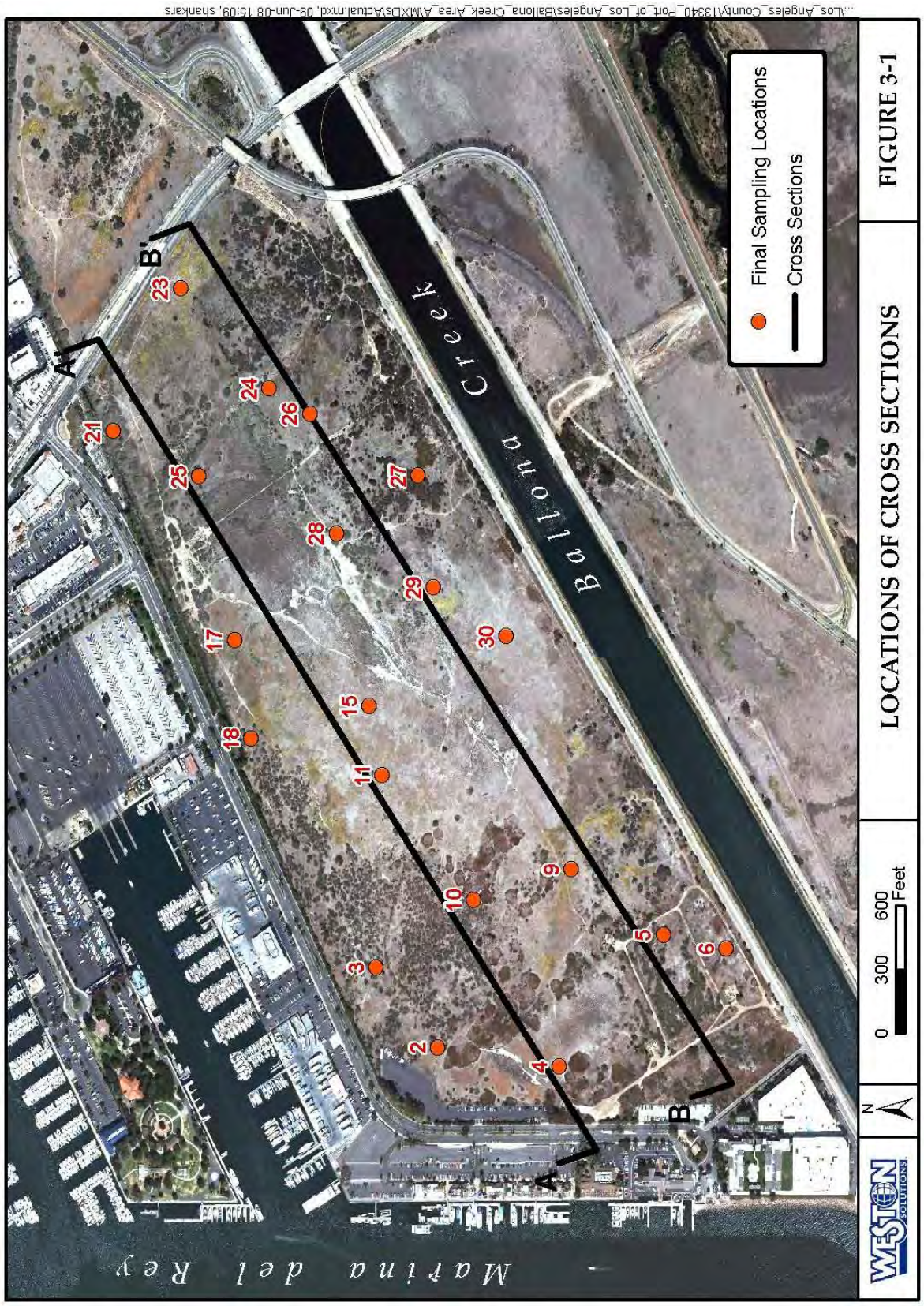

Figure 3-1. Location of Cross Sections

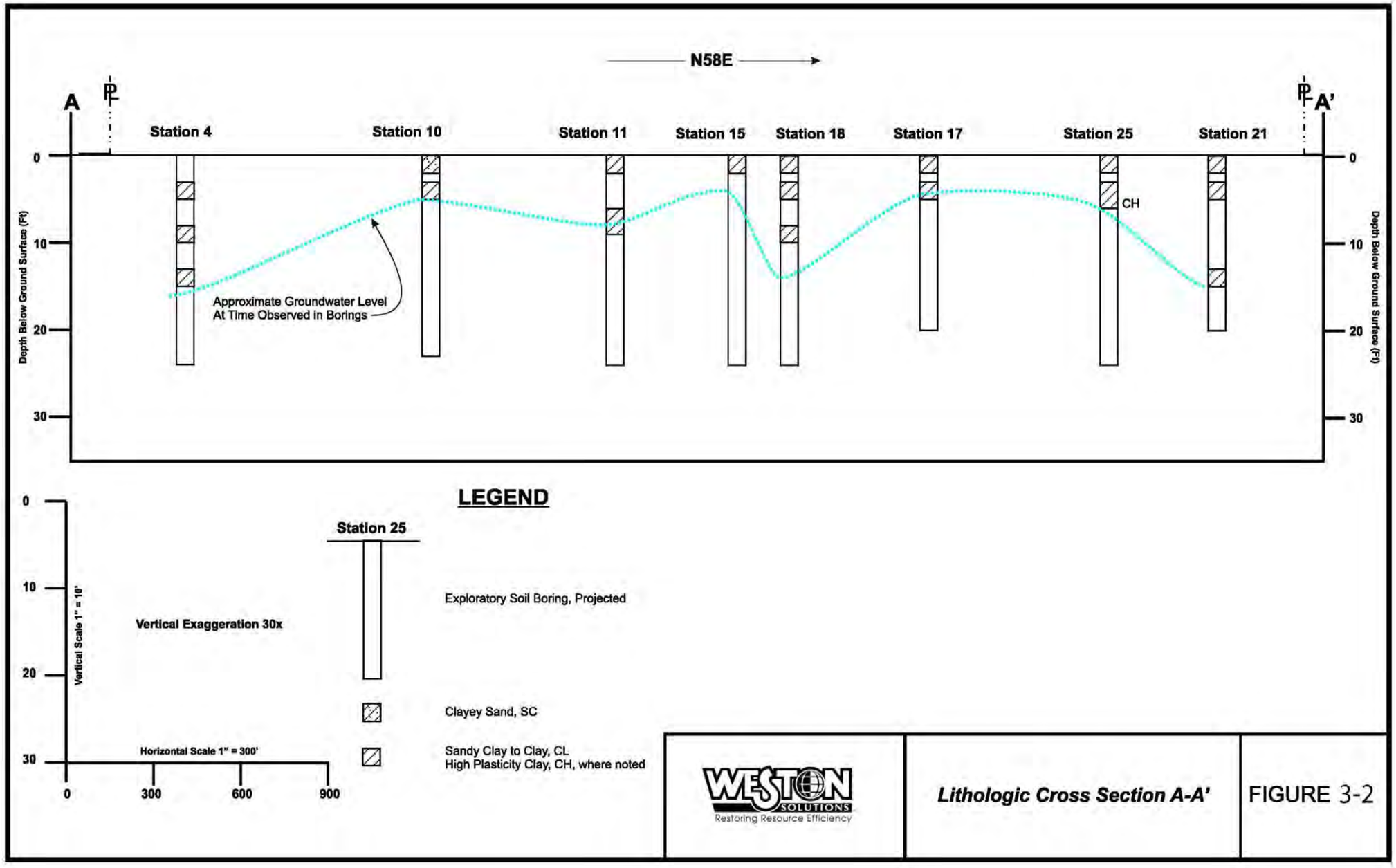

Figure 3-2. Cross Section A-A'

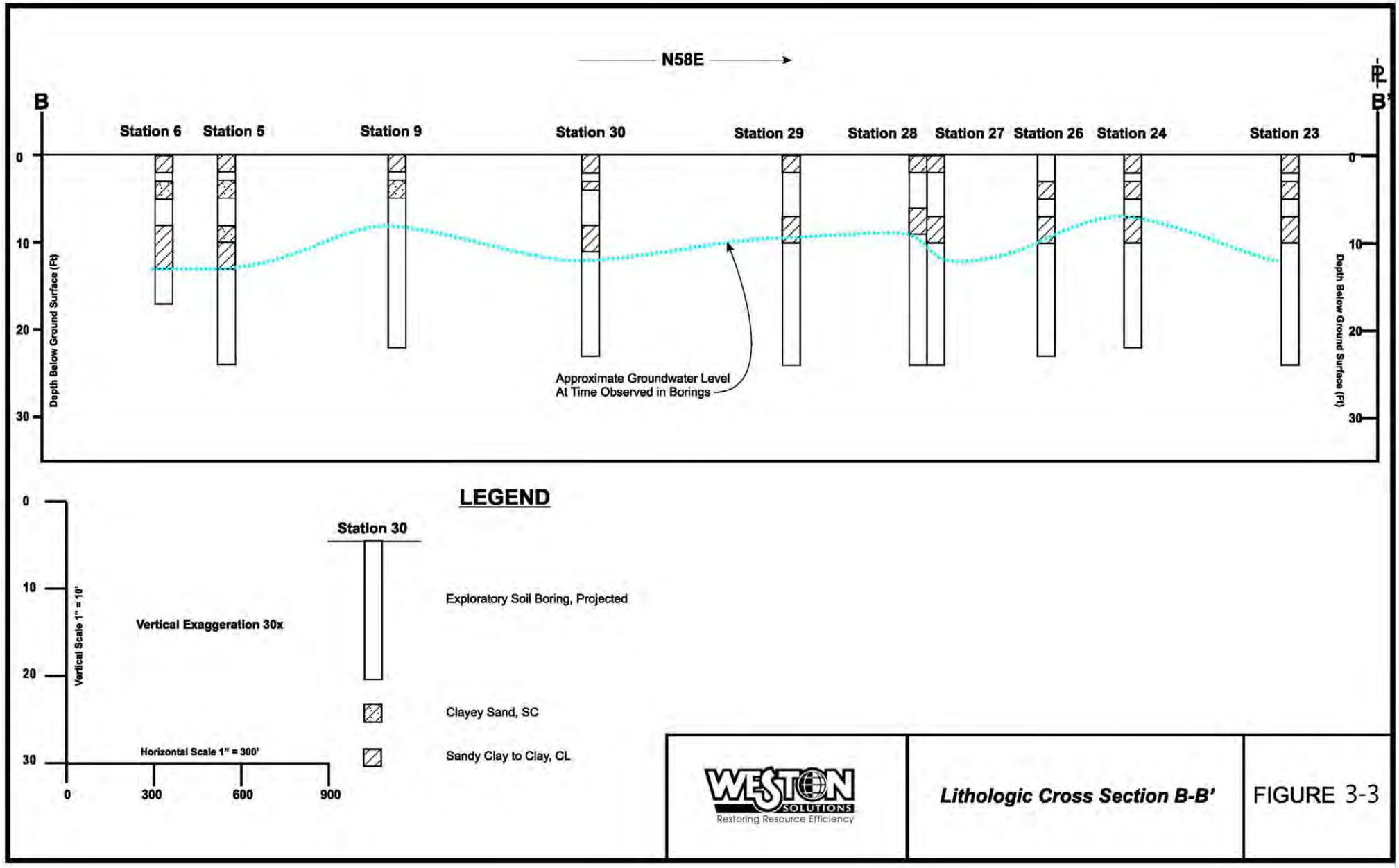

Figure 3-3. Cross Section B-B'

4.0 DISPOSAL OPTIONS

There are a number of environmental, economic and aesthetic beneficial uses for the soil at Area A. Five relevant general categories include: habitat restoration/enhancement, landscaping, beach nourishment, landfill development, and construction activities (i.e., road works/fill). The general criteria used to determine the feasibility of these beneficial uses is summarized in Table 4-1. The primary focus of this section was on potential beneficial uses; however, open water ocean disposal is also presented.

4.1 Habitat Restoration/Enhancement

Dredged material may be used beneficially as substrate for the restoration and enhancement of various wildlife habitats. Habitat restoration is defined as the return of a habitat to a close approximation of its condition prior to disturbance and habitat enhancement is the modification of specific structural features to increase one or more functions based on management objectives (USEPA, 2005). There are four general habitats suitable for the beneficial use of dredged material: wetland, upland, aquatic, and island habitats. The contamination levels compared to the California Regional Water Quality sediment screening criteria and the geotechnical characteristics of the material found in Area A would probably best be utilized for beneficial uses related to habitat development. The most cost effective solution would be to apply as much of the dewatered sediment onsite. The marine dredged material is completely dewatered; therefore, recommendations for material are most likely suitable for wetland and upland placement in coastal zones to support salt tolerant species. However, the saturated zones may be used for upland placement. These saturated soils may also be compared against the sediment criteria developed wetland restoration for San Francisco Bay region by the State of California.

The process steps for wetland restoration or upland habitat creation utilizing dewatered dredged material are as follows:

- Study and design (reconnaissance, feasibility study, design, permitting, easements);
- Perform tiered biological/chemical investigations regarding the effects of the material on plants and animals;
- Excavation of dewatered material from a confined disposal facility (CDF);
- Load, transport, and offload material from truck;
- Natural revegetation of the site or management of site to attract desired wildlife communities;
- Placement of temporary or permanent containment (plants or protective structure);
- Development of success criteria; and
- Ongoing monitoring.

Table 4-1. General Beneficial Use Evaluation Criteria

Beneficial Use	Type of Use	Soil Evaluation Criteria (USCS classification)	pH	Organics	Other Criteria	Area A Soil	Is this a potential Beneficial Use option ?	Comments
Habitat Restoration/ Enhancement	Upland	Upland: plant preferences	6-7.5	> 1.5%	Few pollutants; Salts < 500 ppm	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays and Fat clay (CL/CH) Very small pockets of Clayey sand Liquid limit ranges from 20 to 48 Plastic limit ranges from 15 to 20 Plasticity index ranges from 13 to 33 Low permeability. Low concentrations of pollutants (meets soil quality criteria in accordance with California code of regulations) Soil is non hazardous pH ranges from 8.5 to 9.5 Low to medium organic content	Yes	Salts may prevent beneficial use in the sediments below 5.5 mean lower low water (MLLW), where salt water intrusion may be occurring.
	Wetlands	Wetlands: fine grained; Upland: plant preferences	6-7.5	> 1.5%	Few pollutants; Salts < 500 ppm		Yes	Salts may prevent beneficial use in the sediments below 5.5 MLLW, where salt water intrusion may be occurring.
Landscape/ Vegetative Cover		sandy loam; silt loam	6-7.5	> 1.5%	Few pollutants, Low fines; Salts < 500 ppm; Possible to combine sands with loams (LL<50)		No	High salt content for typical landscape
Beach Nourishment		sands (typed to beach)	-	-	Little/No pollutants (compare against background levels)		No	Grain size: Area A sediments are too fine
Solid Waste Management: Landfill	Cap	CL, CH	-	Medium/ Low	Low permeability		Yes	
	Cover	sandy clay, clayey sand (ideal: 5-10% sand, 5% fines)	-	Medium/ Low	Few pollutants; Low permeability		Yes	
	Liner/Barrier	CL, CH	-	Medium/ Low	Few pollutants; Low permeability		Yes	
	Base	gravels (G-)	-	Low	PI < 1 (where PI=LL-PL)		Yes	
Solid Waste Management: Confined Aquatic Disposal Cap	Cap	CL, CH	-	Medium/ Low	Low permeability		Yes	
Construction Activities	Road fill subbase	gravels (G-)	-	Low	PI < 1 (where PI=LL-PL); if CL or CH, treat with lime/install enhancement fabric		No	Roadwork and other construction applications would likely require the excavated material to be gravels or coarse grained sand with low organic concentrations (to reduce swelling). As such, it is unlikely that the Area A material could be utilized in this manner.
	Road fill subgrade	-	-	-	PI < 12 (where PI=LL-PL)		No	
	General - Fill		-	Low	Little/No Pollutants		Yes	
	Pier A west - Backfill		6-9	Low	Little/No Pollutants Low to medium plasticity Salts < 500 ppm; Possible to combine sands with loams		Yes	

PI = Plasticity Index No
LL = Liquid Limit
PL = Plastic Limit

4.1.1 Wetland Habitat Restoration/Enhancement

Dredged material may be beneficially used to restore or enhance wetland habitats. A wetland habitat is a low-lying area characterized by vegetation that is subject to periodic inundations. Wetland restoration may be used to enhance or reclaim wetlands that have been lost to open water as the result of erosion, subsidence, sea-level rise, and other factors. Wetland enhancement entails the manipulation of the physical, chemical, or biological characteristics of a wetland site, often by modifying the site elevation or hydrology in order to improve a specific function, such as water quality or wildlife habitat. These improvements may provide protected areas free from human, feral, or non-indigenous species impacts, and enhance colonization by desirable organisms including threatened and endangered species. In addition, wetlands provide natural protection from coastal erosion, flooding and storm surge.

Wetland restoration and enhancement is a viable beneficial use option for consolidated clay and silt/soft clay as surface material, with the possibility for using coarser or contaminated sediment as foundational material. Restoration and enhancement is accomplished by either applying thin layers of dredged material to bring a degraded wetland up to an intertidal elevation, or by creating erosion barriers using dewatered dredge material to allow the natural revegetation of a degraded or impacted wetland. Restoration/enhancement of existing wetlands is generally more successful than the creation of a new wetland where none previously existed.

Advantages of wetland restoration and enhancement include:

- High public appeal;
- Enhancement of desirable biological communities, including threatened or endangered species;
- Barrier creation for protection from coastal erosion and storm-related flooding;
- Sequestration of certain contaminants in less bioavailable forms or locations; and
- Typically a lower-cost beneficial use option especially if proximate to dredging location.

Area A contains clayey soils and material is suitable as surface material. The soil chemistry was compared to CHHSLs and PRGs to assess the risk to human health and it was found that the soil is free of chemicals of concern except for increased concentrations for arsenic, iron and benzo[a]pyrene (at one station). The soil chemistry at Area A was also compared to the Interim Sediment Screening Criteria and Testing Requirements for Wetland Creation sediment screening criteria. The data showed that the concentrations of chemical constituents are lower than the prescribed standards and the soil at Area A is probably suitable for wetland habitat restoration/enhancement.

4.1.2 Upland Habitat Creation

An upland habitat is one in which the vegetation is not normally subjected to inundations. Upland habitats provide refuge for a broad category of terrestrial communities and range from bare ground to mature forest. Dredged material may be used to create upland habitat either through relocation of dewatered material to the proposed upland site. Upland habitat creation is a viable beneficial use option for virtually all sediments: rock, gravel and sand, consolidated clay, silt/soft clay, and sediment mixtures. Soil amendments, such as lime and organic matter,

may be required to provide a suitable medium for the growth of upland plant species. The relatively high salt concentrations may only allow for salt tolerant upland species (halophytes, e.g., mulefat, saltgrass, statice, sea-blite)

Advantages of upland habitat creation include:

- High public appeal;
- Minimal site management;
- Creation of desirable biological communities; and
- Typically a lower-cost beneficial use option especially if proximate to dredging location

Area A contains predominantly clayey soils. The soil chemistry at Area A was compared to the Interim Sediment Screening Criteria and Testing Requirements for Wetland Creation sediment screening criteria and it was found that the concentration of chemical constituents are lower than the prescribed standards and the soil at Area A is probably suitable for upland habitat creation. The saturated sediments from this region are also potentially viable for upland placement for habitat creation. The saturated sediment may be considered for placement in the upland region within the tidal restoration work at Area A.

4.2 Landscape/Vegetative Cover for Parks

Landscaping refers to the beneficial application of soil for landscaping, agriculture, residential and commercial horticulture, sod farming, and even livestock pastures. Depending on the contaminant levels of the excavated material, it could be applied directly or mixed with rich soils to create an amended mixture. The salt content in Area A limits the suitability of the sediments for typical landscaping.

4.3 Beach Nourishment

Beach nourishment refers to the strategic placement of large quantities of beach quality sand on an existing beach to provide a source of nourishment for littoral movement or restoration of a recreational beach. Generally, beach nourishment projects are carried out along a beach where a moderate and persistent erosion trend exists. Sediment with physical characteristics similar to the native beach material used is used. Material at Area A is predominantly fine-grained; therefore, it is not suitable for beach nourishment on adjacent beaches.

4.4 Solid Waste Management: Landfill Cover and Capping

Solid waste in sanitary landfills is covered everyday with a minimum quantity of site soil to prevent infiltration, control vectors, improve aesthetics, and prevent fires. Liners and barriers are used to prevent the lateral and vertical migration of pollutants. Once landfills reach capacity, a relatively impermeable cap in needed to close the system. Caps are usually covered with sandy and vegetated layers and include vents/drains to allow gases to dissipate into the atmosphere (United States Army Corps of Engineers [USACE], 1987; Great Lakes Commission, 2004).

Dewatered dredged material may be used beneficially at landfills as daily or final cover and as capping material for abandoned contaminated industrial sites known as "brownfields." Solid waste landfills require a minimum of 6 inches cover daily to prevent unsightly appearance, pest control, odor control, and to prevent surface water infiltration. In addition, the closure of a landfill or brownfield requires a cap of clean material to isolate the solid waste from the surrounding environment. Landfill cover is a viable beneficial use for consolidated clay and silt/clay. Final cover and capping is applicable for virtually all sediment types, although amendments to the material may be required to achieve the required physical properties for the intended end use.

The process steps for landside solid waste management utilizing dewatered dredged material are as follows:

- Study and Design (Reconnaissance, Feasibility Study, Design, Permitting);
- Excavation of dewatered material from CDF;
- Load, transport and offload material from trucks and stockpile at construction site;
- Blend dredged material with amendments in pug mill (due to the unconsolidated nature of the material);
- Place and spread material with bulldozers; and
- Monitoring.

A confined aquatic disposal (CAD) facility is a location where dredged material is disposed at the bottom of a body of water, usually within a depression constructed specifically for the disposal, or within a depression created during sand mining. Often, material placed in a CAD has elevated contaminants or physical characteristics that are not suitable for standard ocean disposal. Material contained in a CAD is confined to the designated area to prevent lateral or vertical movement. If material is elevated in contaminants, a clean layer of suitable clean sediment is required to minimize exposure to marine organisms.

The process steps for utilizing dewatered dredged material for cover at a CAD facility are as follows:

- Study and design (reconnaissance, feasibility study, design, permitting, easements);
- Perform tiered biological/chemical investigations regarding the effects of the material on plants and animals;
- Excavation of dewatered material from CDF;
- Load and transport by truck to barge loading site, then offload;
- Placement of cap; and
- Operation, maintenance, and monitoring of cap.

Advantages of using dewatered dredged material as daily of final landfill cover or for capping include:

- Accommodates relatively large quantities of dredged material compared to other beneficial uses;
- Dredged material typically possesses important cover material characteristics such as workability, moderate cohesion, and low permeability;
- Dredged material provides a cover that retards the infiltration of water and the diffusion of air to the waste, thus reducing infiltration of leachate into surface water and groundwater;

- Provides foundation for post-closure redevelopment such as parks, golf courses, parking lots, or light industrial use; and
- Material originated from the marine environment, therefore it is consistent with physical properties that are advantageous to placement back into the marine environment

Disadvantages of using dredged material as landfill cover include:

- Lack of availability of appropriate sites within reasonable distance of source

Area A contains fine grained clayey soils. The soil chemistry was compared to CHHSLs and PRGs to assess the risk to human health and it was found that the soil quality is acceptable for use as a landfill cover. The soil chemistry at Area A was also compared to the Interim Sediment Screening Criteria and Testing Requirements for Wetland Creation sediment screening criteria and it was found that the concentrations of chemicals of concern are lower than the prescribed standards. Thus, the soil at Area A is suitable for landfill cover and confined aquatic disposal. However, once the specific facility is identified, the soil quality needs to comply with the soil screening criteria set forth for the specific landfill/CAD.

4.5 Construction Activities: Roads and Fill

The use of dewatered dredged material as construction fill for roads, construction projects, dikes, levees or CDF expansion is a practical beneficial use. The use of dewatered dredged material for material transfer is a viable beneficial use for sands/gravel, consolidated clay, and silt/clay, although fine-grained dredged material may require amendment to provide the physical properties required for light load engineering uses. Road work includes the beneficial use of material for fill layers (base or subbase) for roads, foundations or small structures and grading. The beneficial application of soil for road construction in California is regulated by Caltrans while its application for other constructions is regulated by the California Building Code and local building regulations. The material must have a strong bearing strength and therefore, must consist of gravel with few organics or fines (Caltrans 2006; Port of Long Beach, 2000).

Material may be amended by the addition of crushed glass, lime, cement, and fly ash. The type, combination, and amount of amendment material depends on the moisture content, the amount of fines (clays and silts), and organic content of the dredged material. Greater amounts of amendments are typically required if the dredged material has a high clay and/or organic content. The amount and type of amendment will also be dictated by the required physical properties of the finished product. Such amendments can also be used to stabilize contaminants, making this a potential use for contaminated dredged material. Proven methods have been developed for land improvement by filling the site with sand or fine sediments, such as consolidated clay and silt/clay.

Advantages of utilizing dewatered dredged material for the beneficial use of material transfer for fill include the following:

- Provides a recycled material source to replace standard construction fill materials beneficial from both a cost and resource management perspective;
- Some large public projects require large quantities of fill material and could accommodate large quantities of dredged material;

- Use in CDF expansion creates additional capacity for future maintenance dredging needs;
- Favorable to the public and local officials due to economic benefits to the public and commercial communities that industrial development in port areas can create; and
- Use of dewatered dredge material from a nearby storage facility can offset the increased transportation costs associated with hauling material from a conventional source.

The disadvantages of utilizing dewatered dredged material for the beneficial use of material transfer for fill include the following:

- Availability of this beneficial use option depends upon need and timing of development projects with dredged material;
- Bearing capacity of unamended dredged material will not meet requirements of the proposed development and amendment of dredged material adds to project costs; and
- Rehandling and movement of dredged material over long distances could make use of dredged material impractical for some projects.

Area A has inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays and fat clay with very small pockets of clayey sand. The soil is characterized by low permeability. The soil chemistry was compared to CHHSLs and PRGs to assess the risk to human health and it was found that the soil quality is acceptable for use at both residential land uses and industrial/commercial land uses. The material at Area A is suitable for construction activities. Determination of final acceptance for a construction project will depend on the specific criteria for the specific construction activity.

4.6 Open Water Disposal

Open water disposal refers to the discharge of dredged material in oceans, rivers, lakes, or estuaries by means of a pipeline or release from a hopper dredge or barge. For the purpose of this project, dredged material would be discharged from a barge into the ocean at the USEPA designated LA-3 Ocean Disposal Site. This site is located approximately 31 nautical miles from the project site. Prior to disposal, dredged material from Area A must be evaluated for suitability in accordance with *Evaluation of Dredged Material Proposed for Ocean Disposal* (USEPA/USACE, 1991). This evaluation includes solid phase (SP), suspended particulate phase (SPP), and bioaccumulation potential (BP) tests. SP tests are performed to estimate the potential impact on of dredged material on benthic organisms that attempt to re-colonize the area. SPP tests are performed to estimate the potential impact of dredged material on organisms that live in the water column. BP tests are performed to estimate the potential uptake of dredged material contaminants by organisms.

Open-water placement must comply with applicable state and federal regulations. Such regulations include, but are not limited to the Marine Protection, Research, and Sanctuaries Act (MPRSA); Clean Water Act (CWA), Section 404 (in-harbor placement) and the National Environmental Policy Act (NEPA). In all instances, applicable state and federal regulations must be followed and appropriate permits must be obtained.

Advantages of ocean disposal include the following:

- Accommodates large quantities of dredged material compared to beneficial uses;

- More economical than most beneficial uses;
- Logistically easier than most beneficial uses.

Ocean disposal is more economical than most beneficial uses due to rehandling costs. Rehandling is the process of loading, transporting, and offloading dredged material. Rehandling is often the most important factor in determining the economic feasibility of a dredging project since costs increase with the number of times dredged material is re-handled. For disposal at the LA-3 Ocean Disposal Site, dredged material would be transported by barge. For beneficial use alternatives, material would be transported by truck. Truck haul begins to lose economic efficiency as the transport distance and/or dredged material volume increases.

Based on this screening level assessment, concentrations of contaminants in Area A are relatively low (< ER-M values), indicating the dredged material is potentially suitable for ocean disposal pending a full dredged material evaluation.

4.7 Cost Estimation

The cost estimate for beneficial use of excavated material was developed based on the tidal restoration Alternative 4, proposed by USFWS, that was included in alternatives being analyzed by CDFG and CCC. The purpose of this alternative was to establish tidal and sub-tidal habitat consistent with the tidal habitat that existed in this area before it was filled with dredge material from Marina del Rey Harbor and Ballona Creek. Alternative 4, which is currently under consideration, is shown in Figure 1-2. This concept design was used to estimate the excavation volume which in turn was used to estimate screening level costs. The calculation excavation volume for Alternative 4 is 2,379,000 cubic yards. Figure 1-3 shows the expected cross section after the proposed wetland restoration is completed.

The estimated costs to beneficially use excavated material as landfill cover and/or capping material at a brownfield are provided in Appendix H. The total cost including permitting, design, site preparation and development, excavation, transport, and placement is approximately $59 per cubic yard. This cost estimate is a screening level estimate only and assumes 6% to 8 % escalation of costs per year. If the dredged/excavated material is used for landfill, it is assumed to be transported and used as daily cover for sites within 125 mile radius of the Ballona wetlands.

5.0 CONCLUSIONS

The Ballona Wetlands Area A was a former wetland that was used in the early to mid 1900s as a depository for dredge material removed during construction activities in the Marina del Ray Harbor and Ballona Creek. Approximately 4.5 million cubic yards (mcy) of dredge material was placed on the wetlands and the material is now being considered for removal in support of wetland restoration activities. Before the dredge material can be transported for potential beneficial use or ocean disposal, a geotechnical and chemical study was needed to identify any special handling or disposal restrictions that may be required. The Ballona Wetlands Area A preliminary geotechnical investigation and beneficial use/ocean disposal analyses was performed to characterized the dredge material in terms of general USCS classification, chemical constituents, potential health and environment hazards associated with the dredge material, and potential beneficial uses or disposal options for the material after excavation from the former wetlands.

The geotechnical characteristics of the dredge material that are key to determining potential beneficial uses of the excavated soil and the use of the soil for restoration are 1) grain size distribution, 2) plastic limit, 3) liquid limit and 4) moisture content. The lithology of Area A is similar across the site and is classified as mixtures of clay. According to USCS classification, the soil is classified as inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays and lean clays. The northwest portion of the study site close to Lincoln Boulevard has cobbles and coarse gravel in the top few feet of soil. This subarea might need segregation and separate stockpiling during excavation since its beneficial use is different from the rest of the site.

Soil samples from 20 site locations were analyzed for a suite of organic constituents and metals to determine the potential human health risks associated with exposure to excavated dredge material. In addition, a leaching study was performed to determine potential environmental exposure to toxic metals. The key metrics for screening the Area A soils for beneficial use or ocean disposal was the ability to demonstrate that the soils did not contain chemicals of concern at concentrations exceeding TTCL, STLC, CHHSL, PRGs, Interim Sediment Screening Criteria, and ER-L and ER-M values. The leaching study performed on the soil samples successfully demonstrated that the soil was non hazardous and does not pose an environmental risk due to toxic levels of leachable metals. In addition the soil is suitable for a variety of beneficial uses due to concentrations of PAHs, PCBs, pesticide, s-VOCs, or VOCs that are below the regulated human exposure limits or interim sediment quality criteria. Several soil samples did exceed PRGs (residential use) for arsenic and lead and one sample exceeded the PRG (residential use) for benzo (a) pyrene. Soil samples that contained exceedances in arsenic were found in the eastern third of the site and in the general location where field engineers had noted discoloration and streaking of the soil during core sampling. This area is also the location of an abandoned underground fuel transportation line. Several metals and one organic exceeded the corresponding ER-L values; however, no analytes exceeded the corresponding ER-M values. This indicates relatively low concentrations of contaminants. The dredged material may potentially be suitable for ocean disposal pending a full dredged material evaluation.

The preliminary beneficial use analysis identified the following potential options:

a. Habitat Restoration/ Enhancement

b. Landscape/ Vegetative Cover
c. Beach Nourishment
d. Solid Waste Management: Landfill
e. Solid Waste Management: Confined Aquatic Disposal Cap
f. Construction Activities

The geotechnical characterization of the Area A soil showed that it is a mixture of fine-grained materials. Because the soil is predominately low plasticity clays, silty clays, sandy clays or clayey silts (CL), the dredged material is most suitable for landfill activities and habitat restoration activities. Soil amendments, such as lime and organic matter, may be required to provide a suitable medium for the growth of upland plant species. The salinity of the soil may only allow for salt tolerant upland species (halophytes such as mulefat, saltgrass, statice and sea-blite). In addition, the soil could be used for general fill if the top 3 or 4 feet of fill material consisted of soil with a higher organic content.

The volume of excavated material that would be generated under the Alternative 4 Restoration Project is estimated to be approximately 2.5 to 3 million cubic yards. The estimation is based on the concept design introduced by USFWS that is being evaluated by CDFG and CCC. A summary of the approximate volume potentially suitable for each beneficial use and placement alternative is presented in Table 5-1.

Table 5-1. Summary of Beneficial Use and Disposal Options and Approximate Volume Potentially Suitable for Each Alternative

Beneficial Use or Disposal Option	Type of Use	Approximate Volume Suitable	Comments
Habitat Restoration/ Enhancement	Upland	800,000 cy plus, dependent on salt content and end use.	Salts may prevent beneficial use in the sediments below 5.5 MLLW, where salt water intrusion may be occurring.
	Wetlands	800,000 cy plus, dependent on salt content and end use.	Salts may prevent beneficial use in the sediments below 5.5 MLLW, where salt water intrusion may be occurring.
Solid Waste Management: Landfill	Cap	2.4 mcy	
	Cover	2.4 mcy	
	Liner/Barrier	2.4 mcy	
	Base	2.4 mcy	
Solid Waste Management: Confined Aquatic Disposal Cap	Cap	2.4 mcy	Dependent on compatibility of material with area surrounding the Confined Aquatic Disposal facility.
Construction Activities	General - Fill	2.4 mcy	
	Pier A west - Backfill	2.4 mcy	
Ocean Disposal	N/A	1.5 mcy	Pending a full dredged material evaluation.

Although the preliminary chemical assessment demonstrated that the majority of the Area A soil is within regulatory limits for use as landfill material and restoration activities, the screening criteria cannot be applied without consideration of site specific factors. This is a screening level assessment and more analysis would be required before a disposal option is selected and/or implemented.

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APPENDIX F4
Sediment Characteristics Sampling and Analysis Plan (SAP) for Ballona Wetlands

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SEDIMENT CHARACTERISTICS SAMPLING AND ANALYSIS PLAN – BALLONA WETLAND

Final

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September 2012

Sediment Characteristics Sampling and Analysis Plan – Ballona Wetland

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1.0 INTRODUCTION

Weston Solutions, Inc. (Weston) under contract with ESA-PWA has prepared this work plan for sample collection and analysis to characterize soils and sediments within Areas A, B and C for beneficial use within the proposed Ballona Wetland Restoration Project, located in Los Angeles, California.

1.1 Purpose

The purpose of this work plan is to outline the sampling and analytical methods and procedures to characterize the chemical nature of the sediments within Areas A, B and C in order to determine their suitability for use as upland and/or wetland material within the Ballona Wetland Restoration Project. This Work Plan for chemical characterization of sediments is to be coordinated with the geotechnical investigation planned as part of the current design efforts. Samples for chemical and bioassay analysis as defined in this Work Plan will be collected during the geotechnical investigation completed by Group Delta Consultants, Inc. (GDC). Weston has coordinated through ESA-PWA with GDC on the development of this Work Plan to provide a cost effective approach to characterize the sediments for re-use on-site. This Work Plan also provides the proposed screening tools and guidelines that will be used to assess the on-site sediments for use in the Ballona Wetland Restoration Project.

1.2 Site Description

Areas A, B, and C are 139, 398, and 66 acres, respectively, portions of the Ballona Wetlands Ecological Reserve, an area currently proposed for restoration as part of the Ballona Wetlands Restoration Project (Restoration Project). The Restoration Project is led by the California Coastal Conservancy (CCC) and the current owner, California Department of Fish and Game (CDFG).

Area A is bound by Marina del Rey channel on the west, Ballona Creek on the south, Fiji Way to the north and Lincoln Boulevard to the east. Area A was altered during the channelization of Ballona Creek in the 1930s and during the excavation of Marina del Rey Harbor in the 1960s, when the site received a large volume of dredge material. Approximately 15 to 25 feet of dredged and fill material has been placed on Area A during the excavation of Ballona Creek and Marina del Rey.



Above: View of Area A from Marina Ditch culvert facing south. Black mustard, the yellow flowering plant predominant in this photo, is a non-native invasive species.

The site is currently fenced off and undeveloped except for a paved parking area along the western boundary. See Figure 1-1 for a current aerial view of Areas A, B and C.

Fiji Ditch, a tidal channel connected to Basin H of Marina del Rey Harbor, starts in the middle of the northern edge of the site and runs east and west.

Area C is bound on the north by residential area, on the south by Ballona Creek, and lies west of Highway 90 and east of Lincoln Boulevard. Culver Boulevard currently transects the site. One of the largest changes to the area came in the early 1960's with the excavation of Marina Del Rey and the disposal of dredge fill from that project on the remaining wetlands north of Ballona Creek. The land surface was raised 12 to 15 ft above MSL, raising the land surface above tidal inundation and burying the existing marsh surface and drainage channels. (Draft Ballona Wetland Existing Conditions Report 2nd Revision, version 4, Philip Williams and Associates, March 2006).



Above: Looking northwest across Area C from Culver Boulevard

Area B covers an area of 398 acres, bound on the north by the Ballona Creek Channel, on the south by the Del Rey Bluffs, and lies west of Lincoln Boulevard and Playa del Rey. Site elevations range between approximately 2 and 5 ft in the lower flat portions, and up to 50 ft MSL below Del Rey Bluff. It is surrounded by residential development on the east, west, and southern sides, and Ballona Creek on the north. Area A is directly north of Area B on the other side of Ballona Creek. Culver Boulevard dissects the site in a southwest to northeast manner. West Jefferson Boulevard also runs in this manner in the eastern portion of the site, merging with Culver Boulevard approximately mid way through the site.



Above: Looking south over a tidal channel in Area B



Figure 1-1. Aerial Photograph of Areas A, B and C

1.3 Project Description

The Ballona Wetlands restoration includes the reintroduction and revival of critical wetland habitat, including target animal and plant species, and the creation of a natural open space for the public benefit. The restoration plan will include the following (shown in Figure 1-2):

Ballona Creek Channel Restoration

- Removal (breaches) of the existing north and south levees in 4 locations, and the lowering and realignment of the channel for the creation of a natural meandering channel.

Area A

- Mass grading, soil excavation and removal, and hauling of previously placed dredged materials.
- Construction of flood protection levees along the north perimeter of the site using the excavated soils.
- Maintain Fiji Channel in current configuration

Area B

- Construction of flood protection levees along the north side of Culver Boulevard, and the west portion of the area
- Realignment of Ballona Creek by excavating of existing levee and lowering of existing higher elevation areas to between elevation 4.0 ft. and 6.0 ft. NAVD.
- Restoration of wetlands between the new levees and the realigned Ballona Channel, and managed restoration of the wetlands area located south of the new levees (construction of buried culverts).
- Fill placement in a stockpile area bordered by Culver Boulevard, Jefferson Boulevard, and Lincoln Boulevard.

Area C

- Fill placement in stockpile areas in locations on the north and south sides of Culver Boulevard.

Other Areas

- Construction of a pedestrian and bicycle bridge spanning the Ballona Creek Channel near Culver Boulevard, and an at-grade bicycle roadway along the new levee in Area B.

The implementation of the restoration plan will require a technical analysis and review, and approval by the U.S. Army Corps of Engineers (USACE) along with a Section 408 permit.

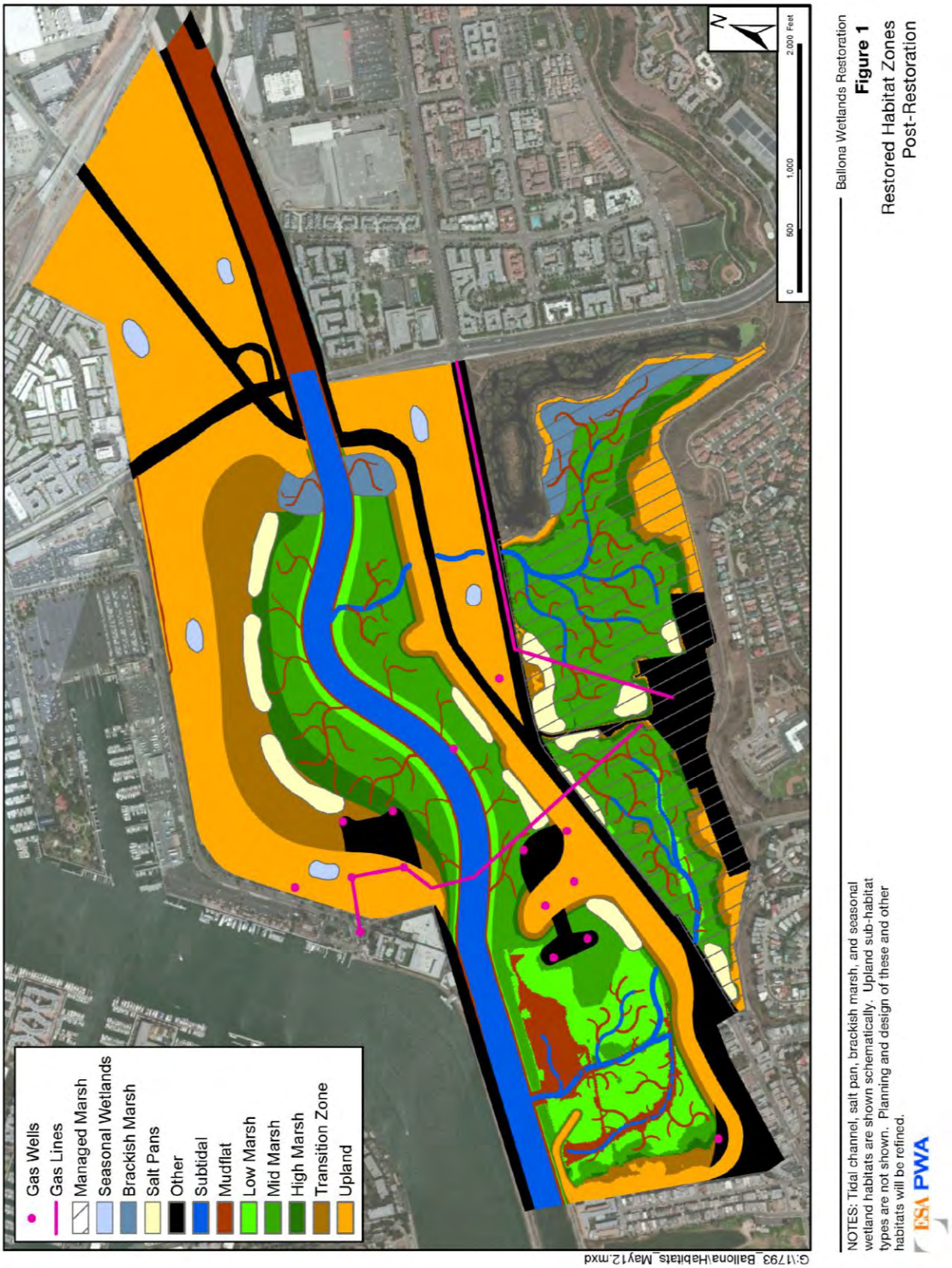

Figure 1-2. Ballona Wetland Restoration Plan

1.4 Results of Previous Geotechnical Investigation in Area A

A preliminary geotechnical investigation was completed by Weston under contract from the Port of Los Angeles in 2008. The primary objective of the Preliminary Study was to provide geotechnical and chemical data to characterize approximately 4.5 million cubic yards (cy) of dredge material which has been placed on Area A over the years and which is being considered for removal in support of the Restoration Project. This study was used to determine potential beneficial uses of the dredge material; to identify any special handling or disposal restrictions that may be required, based on sediment and leachate chemistry; and to guide any further assessment deemed necessary. This program included the collection of sediment samples from direct push cores for chemical and geotechnical analysis. The location of the completed borings for the Preliminary Study is shown on Figure 1-3. The complete results are presented in the Final Report – Ballona Wetland Preserve – Area A Preliminary Geotechnical Investigation and Beneficial Use Assessment (Weston, 2009).

This screening level assessment was used to guide a future, regulatory-compliant beneficial use assessment or dredge material evaluation for on-site beneficial use, off-site use and potential ocean disposal that would be needed for various restoration alternatives that were being evaluated at that time. The following subsections first present the screening criteria that were used to access the results of the Preliminary Investigation, and secondly, a summary of the results of chemical testing compared to these criteria. The results of the Preliminary Investigation were used to scope the sediment characterization sampling and analysis program presented in this Work Plan.

1.4.1 Relevant Screening Criteria for Area A Sediments

Analytical results will be compared to relevant soil screening levels, sediment quality guidelines, and hazardous waste criteria to determine suitability of material for specific beneficial uses or placement options. Relevant numeric standards for comparisons include:

- **Hazardous Waste Criteria**
  - **Total Threshold Limit Concentration (TTLC) and Soluble Threshold Limit Concentration (STLC)**: TTLC and STLC are used to determine the hazardous waste characterization under California State regulations as outlined in Title 22 of the California Code of Regulations (CCR).Concentrations of contaminants in project soil were compared to TTLC and 10 times the STLC. If concentrations exceed 10 times the STLC, a Waste Extraction Test (WET) must be performed to estimate the contaminant leachate. If concentrations of contaminants in soil exceed the TTLC or leachate from the WET exceed the STLC, the material is classified as hazardous waste. If a waste is determined to be a hazardous waste, specific regulations and statutes regarding the management, storage, transportation and disposal must be met.
  - **Toxicity Characteristic Leaching Procedure (TCLP):** TCLP is the characterization for hazardous waste based on Federal guidelines. TCLP analysis was performed to provide an estimate of the soil contaminant leachate and to determine if this material is classified as hazardous waste or if it is considered suitable for upland placement. Analytes leaching from the soil were compared to USEPA Title 40 Code of Federal Regulations (CFR) Part 261 values (USEPA, 2006).

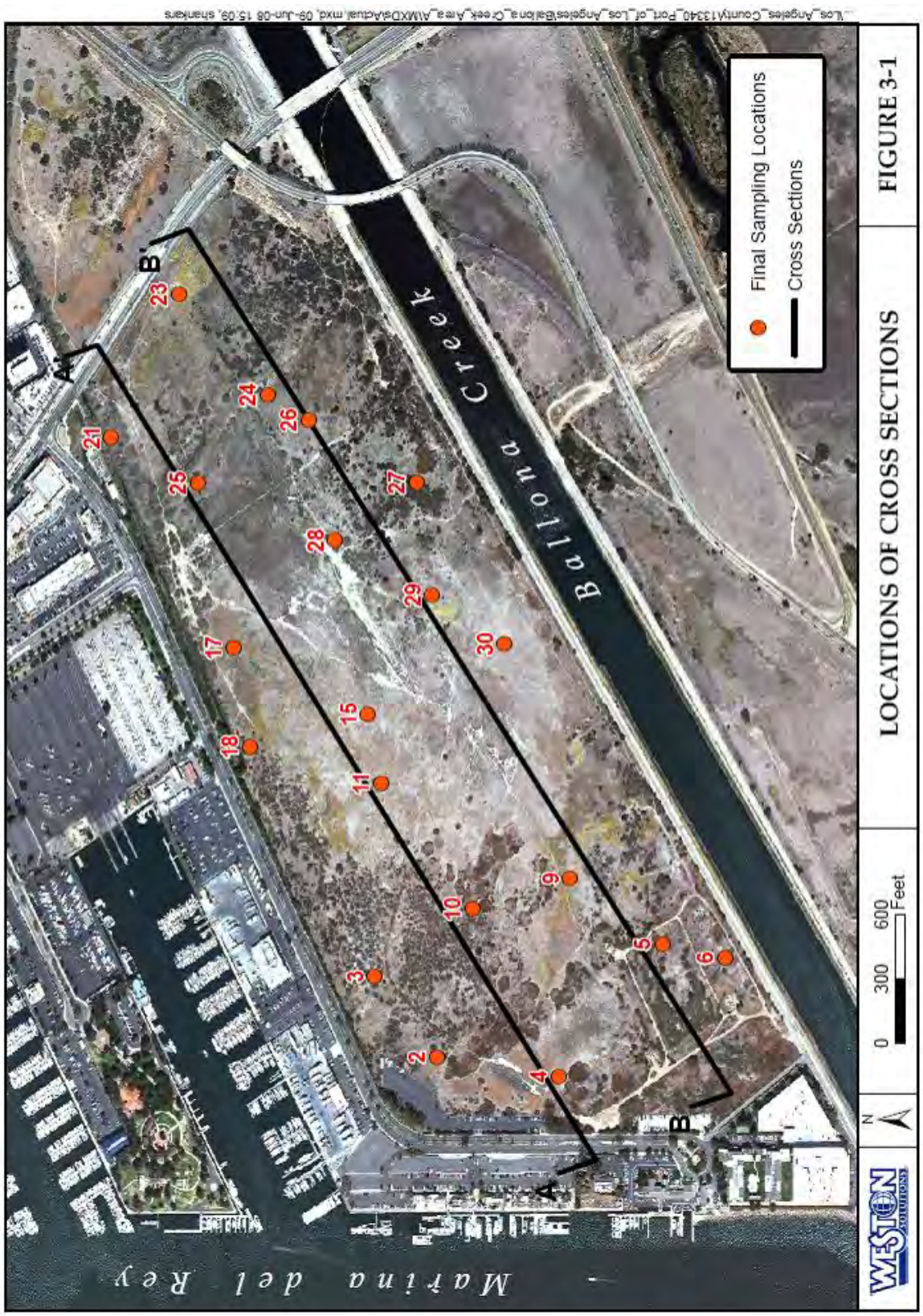

Figure 1-3. Preliminary Geotechnical Investigation Boring Location Plan

- **Human Health Screening Levels**
  - **California Human Health Screening Levels (CHHSLs)**: Concentrations of 54 hazardous chemicals in soil that the California Environmental Protection Agency (Cal/EPA) considers to be below thresholds of concern for risks to human health based on ingestion, inhalation, and dermal absorption. The CHHSLs were developed by the Office of Environmental Health Hazard Assessment (OEHHA) on behalf of Cal/EPA, and are contained in their report entitled "Human-Exposure-Based Screening Numbers are Developed to Aid Estimation of Cleanup Costs for Contaminated Soil". Any exceedances of the CHHSLs do not indicate that the levels are of concern, but suggest that further evaluation of potential human health concerns may be considered. Residential CHHSLs are recommended for use by the California Department of Toxic Substances Control (DTSC) for human health screening evaluation described in the Preliminary Endangerment Assessment (PEA) Guidance Manual.
  - **Preliminary Remediation Goals (PRGs)**: For contaminants that CHHSLs are not developed, the PRGs are used. The PRGs were developed by USEPA Region IX as a risk-based screening tool for evaluating and cleaning up contaminated sites. The Region IX PRGs were developed prior to the CHHSLs and are similar or slightly less stringent. The values are calculated from current human health toxicity values with standard exposure factors to estimate contaminant concentrations in environmental media (soil, air, and water) that are considered by the Agency to be health protective of human exposures (including sensitive groups), over a lifetime. As with CHHSLs, exceedances do not indicate that the levels present are a human health concern, however, more evaluation may be required.

- **Ecologically Relevant Screening Criteria**
  - **Interim Sediment Screening Criteria and Testing Requirements for Wetland Creation and Upland Beneficial Reuse**. These sediment screening criteria and testing requirements are for the beneficial reuse of dredged material such as wetlands creation and upland disposal. The criteria were developed by the California Regional Water Quality Control Board. (This sediment screening criteria and testing requirements are for the beneficial reuse of dredged material such as wetlands creation and upland disposal. The report document was created by the California Regional Water Quality Control Board for the San Francisco Bay Region.) The criterion for wetland surface material is based on ambient values within San Francisco Bay and therefore may not be applicable for Ballona Wetland. Other criterion that may be used includes Effects Range-Low value as discussed in the following bullet and ambient concentration in Area B. Ambient values are used because attaining lower values may not be possible if constituent inputs to existing wetlands continue after restoration. Sediment ambient values are available for Area B for comparison.
  - **Effects Range-Low (ER-L) and Effects Range-Median (ER-M) Values**: Effect range values are used in dredged material evaluations for ocean disposal. These values were developed by Long et al. (1995), and are helpful in assessing the potential significance of elevated sediment-associated COCs, in conjunction with biological analyses. Briefly, these values were developed from a large data set where results of both benthic organism effects (e.g., toxicity tests, benthic community

effects) and chemical analysis were available for individual samples. To derive these guidelines, the chemical values for paired data demonstrating benthic impairment were sorted in according to ascending chemical concentration. The ER-L was then calculated as the lower tenth percentile of the observed effects concentrations and the ER-M as the 50th percentile of the observed effects concentrations. While these values are useful for identifying elevated sediment-associated contaminants, they should not be used to infer causality because of the inherent variability and uncertainty of the approach. For dredged material evaluations, the ER-L and ER-M sediment quality values are used in conjunction with bioassay testing and are included for comparative purposes only. For certain pesticide compounds (i.e., chlordane and dieldrin) the ER-L and ER-M levels are so low as to make it largely impractical to detect them in typical harbor sediments using routine analytical procedures. Accordingly, having non-detect results that were greater than the ER-L, ER-M, or method detection limits (MDLs) would not require re-analysis. The use of ER-L and ER-M for use as screening criteria for sediments in Area A is appropriate when used as a tiered approach that includes using bioassay results to determine actual toxic effects to the benthic community.

- **Sediment Quality Objectives (SQOs)** - California's SQOs are described in the *Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality* (SWRCB and CA EPA, 2009). The goals of the SQOs are to determine whether pollutants in sediments are present in quantities that are toxic to benthic organisms and/or will bioaccumulate in marine organisms to levels that may be harmful to humans. The SQOs are based on a multiple lines of evidence (MLOE) approach in which sediment toxicity, sediment chemistry, and benthic community condition are the lines of evidence (LOE). The MLOE approach evaluates the severity of biological effects and the potential for chemically mediated effects to provide a final station level assessment. The use of SQOs require that the site be fully submerged under tidal conditions and assumes establishment of a benthic community. These conditions will not exist until after the restoration in Area A, therefore the use of the SQOs is not applicable. The SQOs ratings cannot be applied without the use of benthic data, and therefore are not applicable at this time to assess Area A sediments. However, in the absence of clearly defined criteria for evaluating use of sediment in Area A for wetland surface material, chemical and bioassay methods and screening used for SQOs may be used for planning purposes and establishing baseline data as part of multiple screening criteria.

1.4.2 Summary of Results from Previous Investigation of Area A Sediment Using Relevant Screening Criteria

A summary of the measured chemical constituents and comparison to the most appropriate soil screening levels, sediment quality guidelines, and hazardous waste criteria was conducted on samples collected from the Preliminary Geotechnical Investigation and Beneficial Use Assessment of Area A (Weston, 2009). A summary of constituents above soil screening criteria and sediment quality guidelines are discussed below and presented in Table 1-1 and Table 1-2, respectively.

Comparison to Hazardous Waste Criteria

No chemicals were detected at concentrations greater than the TTLC or at concentrations greater than 10 times the STLC value. Results of TCLP analyses indicated no analytes above the toxicity characteristic standards USEPA 40 CFR Part 261 values (USEPA, 2006). Therefore, the material is not classified as a hazardous waste and is suitable for upland placement options.

Comparison to Human Health Criteria

The analyzed organic chemicals of concern were PAHs, PCBs and organochlorine pesticides. With the exception of one soil sample, none of the Area A samples contained concentrations of PAHs, PCBs, or pesticides above the CHHSLs and PRGs soil criteria. The concentration of benzo [a] pyrene at Station 27 was 39.7 µg/kg dry weight and this exceeded the human health screening level (set at 38 µg/kg dry weight) for potential residential land use.

While most of the chemical screening values are below levels of concern for human health, arsenic and iron were measured at ambient concentrations greater than residential CHHSLs and PRGs. The concentrations of arsenic and iron found are consistent with natural concentrations in marine sediments. A summary of soil samples that exceeded soil criteria is shown in Table 1-1.

During the boring and sampling operations, PID readings were taken to identify potential "hot" zones which might contain elevated VOC concentrations. Soil samples from five stations showed elevated PID readings in the field and were subsequently selected for s-VOC and VOC analysis. The results of the laboratory analysis showed that none of the five samples exceeded CHHSLs or PRGs criteria for residential and commercial land use.

Due to the historic and current presence of gasoline production and transportation at Area A, the 20 soil stations were analyzed for total petroleum hydrocarbons (TPHg and TPHd) and benzene, ethylbenzene, toluene, and xylenes (BETX). None of the soil samples had concentrations of TPHg, TPHd or BETX above the CHHSLs and PRGs. However, during drilling operations at Station 25 and 26, the field engineer noted evidence of soil staining throughout the soil core. These two stations are closest to the compressed natural gas line that runs north-to-south through Area A.

Comparison to Ecologic Criteria

The results of the chemical analysis were also compared to soil clean-up standards which may be applied to the Area A soils since the dredged material has been dewatered. In addition, the soil below the water table may be considered sediment and may be subject to proposed sediment quality criteria if used for the Restoration Project. The Interim Sediment Screening Criteria and Testing Requirements for Wetland Creation and Upland Beneficial Reuse, as established by the California Regional Water Quality Control Board for San Francisco Bay use ambient values to assess suitability for surface wetland materials, and ER-M values for wetland foundation material (material is covered and not exposed). Comparisons to the ambient criteria were not performed as these values apply to San Francisco Bay.

Concentrations of metals were compared to ER-L and ER-M values. Several metals slightly exceeded the corresponding ER-L values, including arsenic, cadmium, copper, lead, mercury, nickel, and silver (Table 1-2). No metals exceeded the corresponding ER-M values, indicating relatively low concentrations.

Concentrations of organics were also compared to ER-L and ER-M values. The only organic to exceed the corresponding ER-L value was 4,4'-DDE in the composite sample from Stations 21 and 25 (Table 1-2). No organics exceeded the corresponding ER-M values, indicating relatively low concentrations.

Table 1-1. Summary of Soil Samples with Analytes that Exceed California Human Health Screening Levels or Preliminary Remediation Goals

Group	Analyte	Units	RL	Residential Land Use		Commercial/Industrial Land Use Only		S10-060208-6-7	S11-070208-14-15	S11-S15-S28-14-20	S15-080208-15-16	S15-S28-15-16	S17-080208-10-11	S17-S18-10-12	S18-080208-7-8	S21-080208-6-7	S21-S25-6-8
				CHHSLs	PRG	CHHSLs	PRG	Discrete	Discrete	Composite	Discrete	Composite	Discrete	Composite	Discrete	Discrete	Composite
Metals	Arsenic (As)	µg/dry g	0.05	0.07	0.39	0.24	1.60	5.129	4.086	4.557	12.61	7.145	3.59	3.816	3.561	9.254	9.218
	Iron (Fe)	µg/dry g	5		23000		100000	15890	37840	41390	38250	32840	28970	37170	37940	30390	32920
PAHs	Benzo[a]pyrene	ng/dry g	5	38	15	130	210	<5	<5	<5	<5	<5	<5	<5	<5	7.3	6.8

Group	Analyte	Units	RL	Residential Land Use		Commercial/Industrial Land Use Only		S23-080208-12-13	S23-S24-S26-21-24	S27-S29-S30-6-8	S29-070208-6-7	S3-11-12-15-16	S4-S10-5-7	S5-060208-15-16	S5-S6-15-16	S5-S6-S9-3-4	S9-060208-3-4
				CHHSLs	PRG	CHHSLs	PRG	Discrete	Composite	Composite	Discrete	Composite	Composite	Discrete	Composite	Composite	Discrete
Metals	Arsenic (As)	µg/dry g	0.05	0.07	0.39	0.24	1.60	13.73	4.814	8.977	3.848	7.636	4.666	7.393	3.038	5.73	5.802
	Iron (Fe)	µg/dry g	5		23000		100000	27480	36000	31170	26180	34330	18770	35380	26340	20140	14270
PAHs	Benzo[a]pyrene	ng/dry g	5	38	15	130	210	3.4 J	<5	39.7	<5	6.1	<5	<5	<5	<5	<5

Notes:

J – Below the Reporting Limit (RL) but above the Method Detection Limit (MDL)

Yellow - Concentration exceeds respective soil screening criteria.

Table 1-2. Summary of Soil Samples with Analytes that Exceed Effects Range-Low or Effects Range-Median Values

Group	Analyte	Units	RL	Disposal Option Sediment Screening Criteria		S10-060208-6-7	S11-070208-14-15	S11-S15-S28-14-20	S15-080208-15-16	S15-S28-15-16	S17-080208-10-11	S17-S18-10-12	S18-080208-7-8	S21-080208-6-7	S21-S25-6-8
				ER-L	ER-M	Discrete	Discrete	Composite	Discrete	Composite	Discrete	Composite	Discrete	Discrete	Composite
Metals	Arsenic (As)	µg/dry g	0.05	8.2	70	5.129	4.086	4.557	12.61	7.145	3.59	3.816	3.561	9.254	9.218
	Cadmium (Cd)	µg/dry g	0.05	1.2	9.6	0.262	0.201	1.243	0.836	0.684	0.089	0.595	0.307	0.614	0.57
	Copper (Cu)	µg/dry g	0.05	34	270	11.15	33.62	22.17	39.25	28.84	18.03	28.89	28.99	31.63	35.6
	Lead (Pb)	µg/dry g	0.05	46.7	218	4.742	7.802	4.583	7.924	6.104	3.783	5.758	6.194	24.94	50.72
	Mercury (Hg)	µg/dry g	0.02	0.15	0.71	0.043	0.053	0.055	0.068	0.052	0.041	0.049	0.06	0.303	0.215
	Nickel (Ni)	µg/dry g	0.05	20.9	51.6	14.69	27.15	21.2	25.37	21.42	17.05	24.09	23.61	22.55	23.94
	Silver (Ag)	µg/dry g	0.05	1	3.7	0.04 J	0.035 J	0.072	0.038 J	0.113	0.042 J	0.173	0.052	1.079	1.027
Pesticides	4,4'-DDE	ng/dry g	5	2.2	27	<5	<5	<5	<5	<5	<5	<5	<5	<5	11.6

Group	Analyte	Units	RL	Disposal Option Sediment Screening Criteria		S23-080208-12-13	S23-S24-S26-21-24	S27-S29-S30-6-8	S29-070208-6-7	S3-11-12-15-16	S4-S10-5-7	S5-060208-15-16	S5-S6-15-16	S5-S6-S9-3-4	S9-060208-3-4
				ER-L	ER-M	Discrete	Composite	Composite	Discrete	Composite	Composite	Discrete	Composite	Composite	Discrete
Metals	Arsenic (As)	µg/dry g	0.05	8.2	70	13.73	4.814	8.977	3.848	7.636	4.666	7.393	3.038	5.73	5.802
	Cadmium (Cd)	µg/dry g	0.05	1.2	9.6	0.67	0.482	0.63	0.257	0.499	0.199	0.175	0.147	0.255	0.208
	Copper (Cu)	µg/dry g	0.05	34	270	25.64	30.61	37.79	20.12	28.08	14.52	27.21	21.25	12.81	9.257
	Lead (Pb)	µg/dry g	0.05	46.7	218	5.361	7.187	31.96	8.573	19.58	4.625	4.742	3.514	6.364	3.383
	Mercury (Hg)	µg/dry g	0.02	0.15	0.71	0.028	0.083	0.189	0.077	0.089	0.065	0.067	0.058	0.046	0.053
	Nickel (Ni)	µg/dry g	0.05	20.9	51.6	26.33	25.27	25.6	19.71	26.05	15.74	20.98	16.44	15.2	13.25
	Silver (Ag)	µg/dry g	0.05	1	3.7	0.105	0.221	0.224	0.129	0.174	0.096	<0.05	0.258	0.138	0.04 J
Pesticides	4,4'-DDE	ng/dry g	5	2.2	27	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5

Notes:
J – Below the Reporting Limit (RL) but above the Method Detection Limit (MDL)
Yellow - Concentration exceeds respective sediment screening criteria.

2.0 SCOPE OF WORK

This Work Plan presents the proposed Sediment Characteristic Sampling and Analysis program for Areas A, B and C in order to determine the suitability of existing sediment/soils within these areas for use as upland and/or wetland material within the Ballona Wetland Restoration Project. Because Area C will not be excavated and will receive greater than three feet of fill material, no sampling and analysis of existing soils are planned in Area C under this Work Plan. Proposed sampling and analysis for sediment characterization are therefore focused on Areas A and B where excavation of existing materials is anticipated. The scope of work includes the chemical characterization and toxicity analysis of sediment samples that will be collected for the geotechnical investigation planned as part of the current design efforts. Samples for chemical and bioassay analysis as defined in this Work Plan will be collected during the geotechnical investigation completed by Group Delta Consultants, Inc. (GDC). This Work Plan also provides the proposed screening tools and guidelines that will be used to assess the on-site sediments for use in the Ballona Wetland Restoration Project. The Scope of Work includes preparation of a summary report of the chemical and bioassay analysis, and the assessment of the results using the proposed screening tools and guidelines outlines in this Work Plan.

2.1 Sample Collection

Samples for chemical characterization and bioassay will be collected from selected geotechnical borings. Figure 2-1 presents the proposed geotechnical boring locations that are planned for the Geotechnical Investigation. The drilling methods and procedures for the Geotechnical Investigation are defined in the Work Plan for Geotechnical Investigation Ballona Wetland Restoration (Group Delta, 2012). Based on these proposed drilling methods, sediment samples will be collected from either spilt spoon samplers advanced ahead of hollow stem or rotary wash drilling methods. Sediment samples for chemical and bioassay analysis shall include both discrete and composite samples. Discrete samples shall be collected using split spoon or direct push sampling methods. The spilt spoon sampler shall collect sediment cores of five foot lengths in advance of the hollow stem and rotary wash techniques to minimize sample disturbance and avoid potential down-hole contamination from materials above the spilt spoon samples. Where additional sample volume is needed for bioassay testing, samples may be collected over a 10 foot interval or two five foot cores. Split spoon sampler shall be decontaminated in accordance with the protocols outlined in this Work Plan to avoid cross contamination of samples.

Direct push core sampling techniques are also proposed adjacent to the proposed boring locations to collect sediment samples for chemical and bioassay analysis. This option has been provided to potentially address both the need to thoroughly decontaminate the split spoons and augers and the sample volume requirements for chemical and bioassay sampling. In addition, the cone penetrometer (CPT) technique that will be used at several geotechnical boreholes does not have the ability to collect physical samples. Direct push technology (DPT) refers to tools used to perform subsurface investigations by pushing hollow steel rods into the ground. This method provides a low impact drilling technique should adjacent borings be needed. The direct push boreholes are significantly smaller and the rigs can be mounted on vehicles such as ATVs which are small and highly maneuverable.

Due to the potential presence of natural gas in this area, non-sparking tools will be used.

The driller will perform a thorough decontamination between each borehole to avoid cross-contamination. Decontamination procedures are outlined in this section.

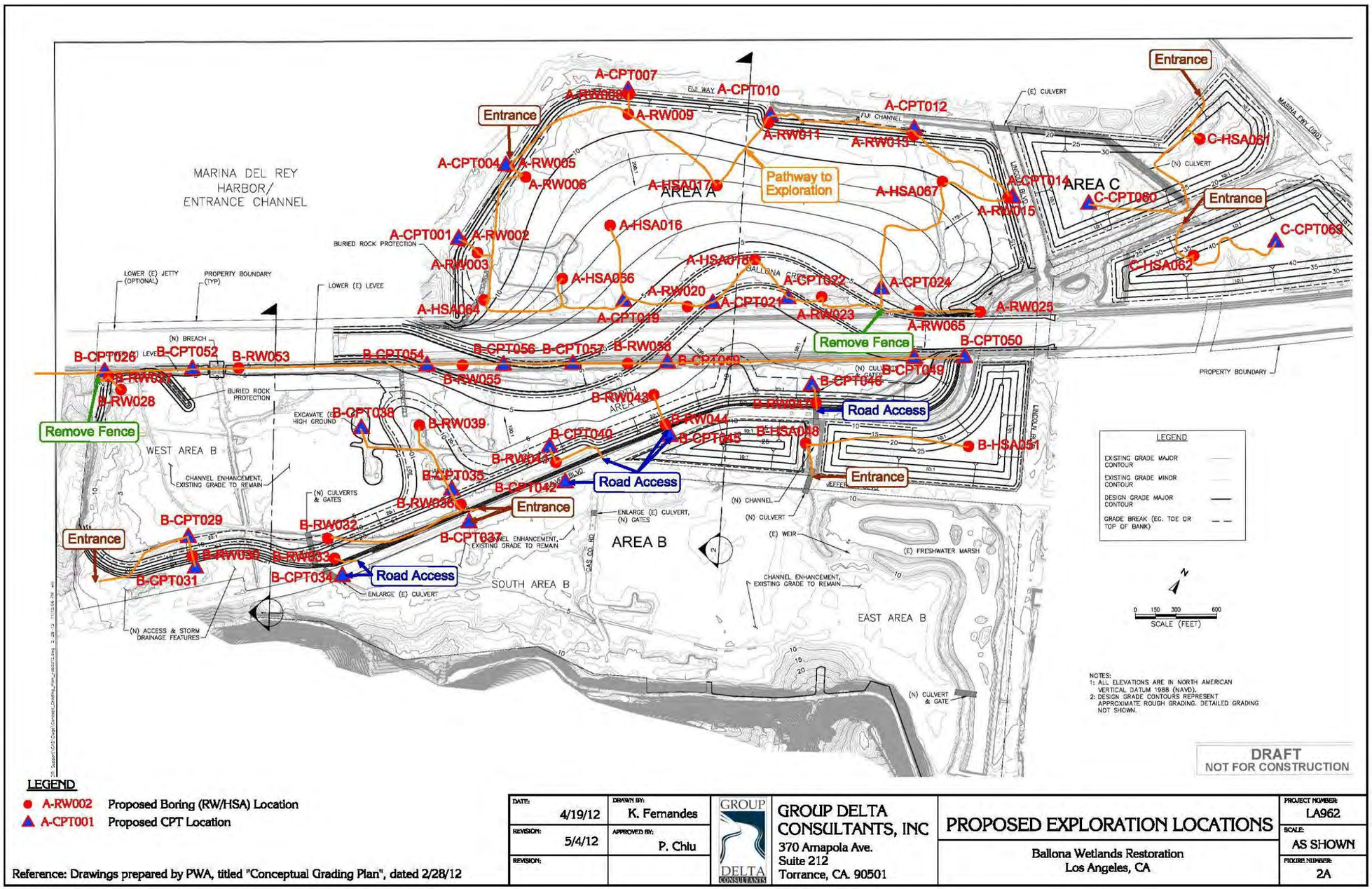

Figure 2-1. Proposed Geotechnical Investigation Boring Location Plan (Group Delta)

Based on these proposed drilling methods, sediment samples will be collected from selected Geotechnical Investigation borehole sites using either split spoon or DPT cores. Sediment samples for chemical and bioassay analysis shall include both discrete and composite samples. Discrete samples shall be collected from specific depths and material types. Composite samples shall be collected from multiple core samples within an interval of material.

Discrete Samples

Discrete samples are samples collected from one soil horizon and a specific elevation, and help to ensure accurate representation of the sediment by depth, soil type, and spatially. Discrete samples will be collected at proposed depths of excavation that will be exposed for restoration, and need to be assessed for suitability as tidal wetland or transition zone habitat. Multiple discrete samples may be needed at these proposed elevations should different materials be encountered. Discrete samples shall be collected from split spoon or DTP cores at the elevations and interval specified. Sufficient sample volume shall be collected to complete the chemical and bioassay testing specific in this Work Plan. For discrete sampling that requires sufficient volume for both chemical and bioassay testing to determine the suitability for wetland surface materials, samples may be collected from two consecutive five foot cores that equally straddle the proposed final elevation of the Restoration Project. If a different stratum is encountered within this 10 foot interval, such as the original marsh materials, separate chemical samples shall be collected from the different stratum, and similar materials above the different stratum shall be used for the bioassay and chemical samples for wetland surface suitability testing.

Composite Sampling

Composite samples are samples collected from different soil horizons within one borehole. Composites can be an efficient way to categorize larger volumes of sediment with a smaller number of samples. A qualified geologist or geotechnical engineer will base the selection of composite samples on the bore logs to ensure representative samples. Composite samples will be collected from spilt spoon or DTP cores over a 10-foot interval or greater. Composite samples will be mixed in the field. Each section to be composited will be homogenized in a stainless steel bowl with stainless steel utensils. Disposable mixing bowls and utensils may also be used, but shall be disposed of after use at each borehole location. The final composite will use a consistent sample volume from each section to be combined to ensure a representative sample. Separate composite samples will be taken from intervals above and below the water table in selected boreholes to characterize these materials suitability for use as upland materials.

Sediment samples shall be collected in accordance with the following four types of boreholes sites to address specific sediment characterization questions:

1. Area A and B Boreholes that are located in or near the proposed new Ballona Creek Channel alignment.
2. Area A and B Boreholes located within proposed Marsh Habitat and Transition Zone Habitat.
3. Area A Boreholes located in proposed Upland Areas.
4. Area A and B Boreholes near and within the Existing Gas Wells and subject to regrading.

Each of these sets of proposed boreholes and sediment samples address specific sampling objectives and therefore will have specific sampling requirements. These objectives consist of determining the suitability of existing materials for use in restored tidal wetland or upland habitat soils, and if contamination exists that require special material handling. The overall approach to the Sediment Characterization Program and chemical and bioassay analysis of selected sediment samples is presented in Table 2-1. Appendix A provides the coordinates for each of the proposed boring locations and the existing and proposed final grades at these sample locations. The depth of proposed sampling will be based on the sampling approach presented in Table 2-1 and the existing and proposed grades provided in Appendix A.

Table 2-1. Sediment Characterization Program – Chemical and Bioassay Analysis of Selected Sediment Samples

Borehole Sites	Sample ID	Sampling Objective	Sample Selection Process	Sample Type	Sampling Method	Estimated Depth	Chemical Analysis	Bioassay Analysis	Sample Volume Needed
1. Area A and B Boreholes in/near Proposed Channel **A-RW020** **A-HSA018** **B-RW055**	A-RW020-D-1 A-HSA018-D-1 B-RW055-D-1	Wetland Surface Suitability	Proposed Channel Elev.	Discrete	Split Spoon or Direct Push Core	Depth of Proposed Channel – Sample Interval 5 ft.	General Chemistry, Organics, Inorganics (See Table 2-3)	Acute, 2 Species Amphipod and Polychaete after sample acclimation	2 – 16 oz. sample jars (total 32 oz.) and 10 Liter Sample in Sediment Bag
	A-RW020-D-2 A-HSA018-D-2 B-RW055-D-2	Wetland Surface Suitability	Change in Material +/-5 ft. within Prop. Channel Elev. (e.g. old marsh mat'l) – if no change –collect 2.5 to 10 ft. below Channel Elev.	Discrete	Split Spoon or Direct Push Core	Within 10 foot interval of Proposed Channel Depth	General Chemistry, Organics, Inorganics (See Table 2-3)	No bioassay	2 – 16 oz. sample jars (total 32 oz.)
	A-RW020-C-3 A-HSA018-C-3 B-RW055-C-3	Use of Material for Upland Placement	Material above the water table – 10 ft interval of similar sediment	Composite	Split Spoon or Direct Push Core	Composite from two consecutive 5 ft. cores	General Chemistry, Organics, Inorganics (See Table 2-3)	No bioassay	2 – 16 oz. sample jars (total 32 oz.)
2.Area A and B Boreholes – Located in Proposed Marsh Habitat & Transition Zone **A-HSA016** **B-RW043**	A-HSA016-D-1 B-RW043-D-1	Wetland Surface Suitability	Proposed Wetland Restoration Elev.	Discrete	Split Spoon or Direct Push Core	Depth of Proposed Excavation – Sample Interval 5 ft.	General Chemistry, Organics, Inorganics (See Table 2-3)	Acute, 2 Species Amphipod and Polychaete after sample acclimation	2 – 16 oz. sample jars (total 32 oz.) and 10 Liter Sample in Sediment Bag
	A-HSA016-C-2 B-RW043-C-2	Use of Material for Upland Placement	Material above the water table – 10 ft interval of similar sediment	Composite	Split Spoon or Direct Push Core	Composite from two consecutive 5 ft. cores	General Chemistry, Organics, Inorganics (See Table 2-3)	No bioassay planned	2 – 16 oz. sample jars (total 32 oz.)
	A-HSA016-C-3 B-RW043-C-3	Use of Material for On-site Grading – Upland or Wetland	Material below the water table – 10 ft interval of similar sediment	Composite	Split Spoon or Direct Push Core	Composite from two consecutive 5 ft. cores	General Chemistry, Organics, Inorganics (See Table 2-3)	No bioassay planned	2 – 16 oz. sample jars (total 32 oz.)
3.Areas A Boreholes – Located in Upland Areas **A-HSA067**	A-HSA067-C-1	Use of Material for Upland Placement	Material above the water table – 10 ft interval to straddle proposed excavation depth	Composite	Split Spoon or Direct Push Core	Composite from two consecutive 5 ft. cores	General Chemistry, Organics, Inorganics (See Table 2-3)	No bioassay planned	2 – 16 oz. sample jars (total 32 oz.)/sample site
	A-HSA067-C-2	Use of Material for On-site Grading – Upland	Material below the water table – 10 ft interval of similar sediment	Composite	Split Spoon or Direct Push Core	Composite from two consecutive 5 ft. cores	General Chemistry, Organics, Inorganics (Table2-3)	No bioassay planned	2 – 16 oz. sample jars (total 32 oz.)/sample site
4.Area A and B Boreholes near Existing Gas Wells **A-HSA066 (DR 13)** **Del Rey 16 (Area A)** **B-HSA064 (DR 12)**	A-HSA066-S-1 DR-16-S-1 B-HSA064-S-1 Additional samples TBD based on site head space screening for VOCs and evidence of surface soil staining/stressed vegetation	Determine within area to be regraded if contains impacted surface soils from Gas Wells	Areas subject to regrading within gas well area and evidence of surface soil staining. No sampling planned at existing gas wells that are to be extended and filled over, unless site screening using head space analysis for VOC or evidence of surface soil staining is observed that indicate potential contamination	Discrete Surface Sample	Dedicated scoops or shovel	0 to 1 ft.	TRPH, TPH, PAHs (See Table 2-3)	No bioassay planned	1 – 16 oz. sample jar/sample site

A total of approximately 17 sediment samples and approximately 3 surface soil samples will be collected and analyzed at the borehole locations listed in Table 2-1. Table 2-1 outlines for each of the four site types, the corresponding Geotechnical Investigation boreholes, sampling objective, sample type, sampling methods, estimated depth and proposed laboratory analyses. Samples include both discrete and composite samples. Sample identification have also been assigned using the proposed Geotechnical Investigation designation and sample type (D for discrete and C for composite).

Sediment samples collected at or next to borehole locations that are in or adjacent to the proposed Ballona Creek channel realignment in Areas A and B (A-RW020, A-HSA018, and B-RW055) will include discrete samples at the proposed elevation of the new channel bottom and at designated intervals above and below the channel elevation. If different materials that include the original marsh materials are encountered within these intervals, discrete samples shall be collected of the marsh material and the fill material above. If no change in materials is observed within 5 feet of the proposed channel elevation, then a discrete sample shall be taken within 2.5 ft. and 10 ft. below the channel elevation. Because the proposed channel elevation is close to the original tidal marsh elevation, these discrete materials are anticipated to be encountered within this interval.

Because the sediments within five feet of the proposed channel elevation will establish the new tidal wetland materials, both chemical and bioassay testing is proposed. In order to obtain sufficient material volume for both chemical and bioassay testing, samples may be collected over a 10 foot interval of similar materials within five feet above and below the proposed channel elevation.

Composite samples shall be collected within 10 foot intervals or greater of materials above the water table at these borehole locations to assess the suitability of these materials for use in upland habitat. These soils will be removed for restoration and relocated to Areas C and B for uplands. Samples shall be collected for chemical analysis.

Sediment samples within boreholes in Areas A and B located within proposed marsh habitat and transitional zone habitat (A-HSA016 and B-RW043) will include both discrete and composite sampling similar to the approach for the channel boreholes. Discrete samples shall be collected within the 10 foot interval that straddles/intersects the proposed exaction elevation (five feet above and below the final elevation) of the restore wetlands. In order to assess the suitability of these materials for wetland habitat, both chemical and bioassay analysis is proposed. Composite samples shall be collected within 10 foot intervals or greater of materials above and below the water table at these borehole locations to assess the suitability of these materials for use in upland habitat. These soils will be removed for restoration and relocated to Areas C and B for uplands. Samples shall be collected for chemical analysis.

The third type of sample is located in proposed upland habitat areas within Area A (A-HSA067). Composite samples shall be collected within a 10 foot interval or greater of materials above the proposed depth of excavation and above the water table at this borehole location to assess the suitability of these materials for use in upland habitat.

Finally, the fourth type of samples includes surface soil samples collected near existing gas wells in Areas A and B where excavation and regrading is anticipated. Surface soil samples (0-1ft.) shall be collected using dedicated scoops/shovels near the existing gas wells and within areas that are proposed for regrading (A-HSA066-Del Rey 13, A-HSA064-Del Rey 12 and Del Rey 16). No sampling is planned at existing gas wells that are to be extended and filled over, unless there is evidence of contamination (surface staining, stressed vegetation, head space analysis using a photoionization detector (PID)) based on site screening. These surface soil samples will be analyzed for a select list of constituents including TRPH, TPH and PAHs as presented in Table 2-3.

Sample laboratory analyses required are described in this section.

2.2 Core Sample Description and Screening

Each five foot core will be logged and described by a qualified geologist or geotechnical engineer prior to sample collection for chemical and bioassay testing. For DPT borings, each core will be extracted using an acetate layer. Upon extraction, the acetate core will be labeled to indicate orientation to surface and split open for sampling. Upon opening, the core will immediately be scanned with an organic vapor monitor (OVM) or PID to assess if organic compounds are present and visually observed for evidence of contamination such as soil staining, impacted vegetation, or sheen. Based on the results of the organic vapor screening for the Preliminary Geotechnical Investigation, presence of volatile organic compounds is not anticipated, and therefore no VOC analysis is planned. Semi-volatile organic compounds may be present and will be screened for using head space analysis. This procedure will be conducted on cores where visual evidence of contamination is observed. Head space analysis shall also be conducted in samples collected near the gas wells. Head space analysis is conducted by collecting a soil sample and placing it into a sealed plastic bag. The sample is set in the sun or a warm place to promote volatilization of constituents in the sample for approximately 5-10 minutes. The PID is then used to insert the probe into a small opening in the sealed bag to measure any organic vapors. Observed measurements shall be recorded.

Sample processing will continue with geotechnical classification and additional sampling from the cores.

Geotechnical Description
Each 5′ core will be examined by a qualified geologist or geotechnical engineer and photographed. The geotechnical description of each core will include the texture, odor, color, length, approximate grain size distribution, plasticity characteristics of the fine-grained fraction, Unified Soils Classification System (USCS) designation, and any evident stratification of the sediment.

Geotechnical Samples
Geotechnical analysis will be performed on both discrete and composite samples. The analysis of sampled for geotechnical testing shall be coordinated with the proposed sampling for the Geotechnical Investigation to avoid duplication. If geotechnical analysis is already planned for the interval and location of the chemical analysis, then no additional geotechnical analysis is required. No geotechnical analysis is required for the nine shallow samples within the existing

gas well areas within Area A and B. Geotechnical analysis shall include grain size, liquid and plastic limits, and moisture content by the methods described in Table 2-2. The final sample total will be based on coordination with the Geotechnical Investigation.

Table 2-2. Geotechnical Analysis

Parameter	Method
Grain Size Distribution	ASTM D-422
Hydrometer Analysis	ASTM D-422-63
Liquid and Plastic Limits	ASTM D-4318
Moisture Content	ASTM D-2216

2.3 Decontamination Procedures

Split spoon sampler: Split spoon samplers used to collect sediment/soil samples for chemical and bioassay testing shall be decontaminated after all samples have been containerized and before using the sampler again by first scrubbing the samplers with a brush and an industrial detergent (Alconox) and potable water followed by a double rinse (2 separate buckets) of potable water. The driller shall containerize the decontamination fluids for characterization and disposal under an approved industrial discharge permit to the sanitary sewer or other approved treatment/disposal facility.

Hollow Stem Augers: Hollow stem augers shall be decontaminated between boreholes to avoid cross contamination. Auger flights shall be steam cleaned and fluid collected and containerized for containerization and proper disposal under an approved permit. Drillers shall provide the equipment to conduct the decontamination and collection of rinse waters. The drillers shall provide for the testing of the containerized fluids and proper off-site disposal. Driller may also bring sufficient augers to the site to cover expected drilling for that day and perform decontamination at their off-site facility that has been permitted to contain and disposed of these fluids through an industrial discharge permit.

Direct Push Sampling: Acetate liners shall be used within the hollow drive core for sediment/soil sampling. Acetate liners are to be disposed after use and therefore do not require decontamination. The drive core shall be decontaminated between boreholes to avoid cross contamination. Drive cores shall be shall be decontaminated by first scrubbing the core with a brush and an industrial detergent (Alconox) and potable water followed by a double rinse in buckets of potable water. The driller shall containerize the decontamination fluids for characterization and disposal under an approved discharge permit to the sanitary sewer or other approved treatment/disposal facility.

2.4 Selection, Preparation and Shipment of Samples for Chemical Analysis and Bioassay Testing

Sampling Procedures, Processing, and Storage
Once the five foot cores from each borehole are logged and screened, each core will be either sampled for discrete or composite samples as outlined in Table 2-1. Sample containers shall be

properly labeled with project name, date, station identification, sampling time, segment depth, and orientation to the surface; placed on ice; and shielded from light. Sediment samples for chemical and agronomy analysis shall be placed in two 16 oz. glass containers (total 32 oz.) provided by the laboratory and sealed with a Teflon-lined lid. Sediment samples for bioassay analysis shall consist of 10 liter plastic sampling bags that will be provided by the laboratory. Bioassay samples shall be stored at $\leq 4^{o}C$ until test initiation. All samples will be handled appropriately as detailed in Table 2-3 and labeled with project name, date, station identification, sampling time, segment depth, and orientation to the surface.

Table 2-3. Sample Preservation and Holding Times

Parameter	Sample Container	Preservation	Holding Time
Geotechnical			
Grain size distribution	Ziploc™ bag	Not applicable	Not applicable
Hydrometer analysis	Ziploc™ bag	Not applicable	Not applicable
Liquid and plastic limits	Ziploc™ bag	Not applicable	Not applicable
Moisture content	Ziploc™ bag	Store Cool at <4°C	Not applicable
General Chemistry and Agronomy			
Total solids	Glass jar w/ Teflon-lined lid*	Store Cool at <4°C	
Salinity	Glass jar w/ Teflon-lined lid*	Store Cool at <4°C	
pH	Glass jar w/ Teflon-lined lid*	Store Cool at <4°C	
TOC	Glass jar w/ Teflon-lined lid*	Store Cool at <4°C	28 Days
Total ammonia	Glass jar w/ Teflon-lined lid*	Store Cool at <4°C	28 Days
Total sulfides	Glass jar w/ Teflon-lined lid*	Store Cool at <4°C	7 Days
Soluble sulfides	Glass jar w/ Teflon-lined lid*	Store Cool at <4°C	
Agronomy Analysis			
Sodium and the five soluble and exchangeable major nutrients, , boron, USDA texture, organic matter content, and micronutrients, and the neutralization/ acid generation potential (N/AGP)	Glass jar w/ Teflon-lined lid*	Store Cool at <4°C	
Organics			
TRPH	Glass jar w/ Teflon-lined lid*	Store Cool at <4°C	14 Days
TPH (as diesel or gasoline)	Glass jar w/ Teflon-lined lid*	Store Cool at <4°C	14 Days
Organotins	Glass jar w/ Teflon-lined lid*	Store Cool at <4°C	6 Months
Pesticides (DDT, DDE & Chlordane) & PCBs (Aroclors)	Glass jar w/ Teflon-lined lid*	Store Cool at <4°C	40 Days
PAHs, Phenols, & Phthalates	Glass jar w/ Teflon-lined lid*	Store Cool at <4°C	40 Days
PAHs, Phenols, & Phthalates (individually)	Glass jar w/ Teflon-lined lid*	Store Cool at <4°C	40 Days
Inorganics			
Metals (As, Cd, Cu, Cr, Pb, Hg, Ni, Ag, Se, Zn) plus Boron	Glass jar w/ Teflon-lined lid*	Store Cool at <4°C	6 Months
Bioassay			
Acute – 2 species	Sediment Bag (20 liters)	Store Cool at <4°C	14 days (recommended; must not exceed 6 weeks)

*Combine General Chemistry and Inorganics into one 16 oz. container and then fill a second 16 oz. container for the Organic analysis.

2.5 Analytical Methods and Requirements

Chemistry Samples

General chemistry, organic and metals analysis will be performed on both discrete and composite samples. Up to 17 discrete and composited samples will be collected and analyzed for the chemical analyses listed in Table 2-4. The three surface samples collected near the existing gas wells will be analyzed for organic compounds as listed in Table 2-4. It is anticipated that 8 discrete, 9 composite and three surface samples will be sent for chemical analysis.

Table 2-4. General Chemistry, Organic and Inorganic Analyses

Parameter	Method	MDL	# of samples
General Chemistry			
Total solids	EPA 160.3	0.1	17
TOC	EPA 9060	0.01	17
Total Ammonia	EPA 350.2M	0.01 mg/dry kg	17
Total Sulfides	EPA 376.2M	0.05 mg/dry kg	17
Soluble Sulfides	EPA 376.2M	0.002mg/dry kg	17
Salinity			17
pH			17
Organics			
TRPH	EPA 418.1	0.01 mg/dry kg	20
TPH (as diesel, gasoline, or motor oil)	EPA 8015M	0.25 mg/dry kg	20
Pesticides (DDT, DDE. Chlordane) & PCBs (Aroclors)	EPA 8081A/8082	1-10 µg/dry kg	17
Organotins	Krone et al., 1989	1-10 µg/dry kg	17
PAHs, Phenols, & Phthalates	EPA 8270C	1-100 µg/dry kg	20
Inorganics			
Metals (As,Cd,Cu,Cr,Pb,Hg,Ni,Ag,Se,Zn)	EPA 6020/7471A	0.005-0.025 µg/dry kg	17

Bioassay Samples

Bioassay analysis shall be performed by an accredited laboratory that has conducted sediment toxicity testing for marine species. Samples shall be tested for acute toxicity using two marine species, an amphipod (*Eohaustorius estuarius*) and a polychaete (*Neanthes arenaceodentata*). It is estimated that a total of five bioassay tests will be conducted on the discrete samples collected from the Type 1 and 2 boreholes located in the proposed realigned channel or marsh/transitional habitat areas.

Because these sediments have been buried and under low oxygen environments and ammonia spikes are possible, sample acclimation with sea water will be required. Sample preparation and analysis shall be in accordance with EPA methods as defined in the Inland Testing Manual (ITM; USEPA and USACE, 1998). In order to acclimate the test sediments, samples shall be placed into test chambers and filled with raw (unfiltered, untreated) sea water. The overlying water will be gently aerated and replenished twice daily for a period of approximately one week depending on ammonia concentrations, which will be monitored throughout the acclimation. Bioassay tests will be initiated once ammonia concentrations are reduced to levels appropriate for each test specification.

Test conditions for the *E. estuarius* and *N. arenaceodentata* bioassays are summarized in Table 2-5.

Table 2-5. Test Conditions for Solid Phase Bioassay Tests

Test Conditions: 10 day Solid Phase Tests		
Sediment Sample Information	**Test Species**	
	E. estuarius	***N. arenaceodentata***
Holding Time Requirements	14 days, maximum 6 weeks	
Test Sample storage conditions	4°C, dark, minimal head space	
Control Sediment Source	From organism suppliers	
Supplier	Northwestern Aquatic Sciences, Newport, OR	Aquatic Toxicology Support, Bremerton, WA
Age/Size class	Mature, 3 – 5 mm	2-3 weeks post-emergence
Test Procedures	ITM (USEPA & USACE 1998); USEPA 1994; ASTM E1367-03 (2010)	
Test type/duration	Acute SP / 10 days	
Control water	Natural seawater, 3 µm filtered	
Test temperature	15 ± 2°C	20 ± 1°C
Test Salinity	20 ± 2 ppt	28 ± 2 ppt
Test dissolved oxygen	≥ 60% saturation	≥ 65% saturation
Test pH	Monitor for pH drift	
Test interstitial total ammonia	< 60 mg/L	No recommended concentration; bring ammonia down to laboratory historical threshold.
Test interstitial un-ionized ammonia	< 0.8 mg/L	
Test photoperiod	Constant light	12 hours light:12 hours dark
Illuminance	500-1000 lux	
Test chamber	1 L glass test chamber	
Replicates/treatment	5	
Organisms/replicate	20	10
Exposure volume	2 cm sediment; 800 mL water	
Feeding	None.	
Water renewal	None.	
Test Acceptability Criteria	Control survival ≥ 90%	

Agronomy Testing

The Chemical Characterization of sediment sampling also includes the assessment of sediment for suitability to establish vegetation for the proposed wetland and upland habitats. This assessment will require analysis of selected samples for agronomy testing. For the agronomy soil sampling, sediment from within Area A that will be used for upland materials and wetland surface will be analyzed for agronomy constituents. Because materials from within the levees will likely be used to construct the new levees and not uplands, no agronomy analysis is planned for samples collected within the levees. Therefore samples for agronomy analysis shall be collected from A-HSA016, A-HAS-018 and B-RW043. At these locations, the composite samples from above or below the water table and of discrete samples of the original marsh materials shall be collected and analyzed for agronomy analysis. In addition, the sample that is collected below the design depth shall also be analyzed for agronomy constituents. Agronomy

testing will include: pH, salinity, sodium and the five soluble and exchangeable major nutrients, sulfate, boron, USDA texture, organic matter content, and micronutrients. In addition, samples will be analyzed for neutralization/ acid generation potential (N/AGP). The N/AGP test measures the theoretical potential of the sediment to generate and neutralize that acid so that leaching conditions can be ruled out. The N/AGP test also determines if a buffered WET analysis is necessary, which uses buffered acidic extraction to determine the leachable fraction of metals from soil and sediment. Samples for agronomy testing shall be transported to the designated laboratory conducting these analyses.

Documentation and Chain-of-Custody

Chain-of-custody (COC) procedures will be initiated during sample collection. A COC record will be provided with each sample or sample group. Each person who had custody of the samples will sign the form and ensure that the samples will not be left unattended unless properly secured. Completed COC forms will be placed in a plastic envelope inside the ice chest containing the listed samples. The COC form will be signed by the person transferring custody of the samples. The condition of the samples will be recorded by the receiver. COC records will be included in the final analytical report prepared by the laboratory, and will be considered an integral part of that report. Samples will be considered to be in custody if they are (1) in the custodian's possession or view, or (2) retained in a secured place (under lock) with restricted access. The principal documents used to identify samples and to document possession will be COC records and field logbooks. COC procedures will be used for all samples throughout the collection, transport, and analytical process and for all data and data documentation, whether in hard copy or electronic format.

2.6 Report Preparation and Beneficial Use Assessment

The remaining effort will entail preparation of a draft report that will compile all collected data, present an analysis of these data, provide a preliminary evaluation of potential beneficial use alternatives and potential handling and disposal restrictions, and provide recommendations for further, regulatory-compliant assessment. The draft findings will be presented for comments prior to preparation of the final report. Chemistry and geotechnical data from the sediment sampling results will be compiled and analyzed. The draft report will present an analysis of these data, provide an evaluation of potential beneficial use alternatives and potential handling and placement restrictions, and provide recommendations for further study. The evaluation of beneficial use alternatives will include feasibility, material suitability, compliance with relevant environmental regulations, and economic feasibility. It is anticipated that any further study to be recommended would be to a regulatory compliance level for beneficial use as wetland material if constituent concentration and bioassay results do not meet the screening levels discussed in this section.

The screening tool that is proposed for evaluation of the sediment sampling results is presented in Figure 2-2. The screening tool was developed using the current guidance for use of sediments in wetland restoration prepared by the Regional Water Quality Control Board for restoration within the San Francisco Bay and other ecological and human health screening criteria that were mentioned in the introduction. Because the San Francisco Bay guidance is location specific as it uses local ambient concentrations for screening, a conservative screening tool that is applicable

to Ballona Wetland is proposed. This screening tool uses the ER-L criteria to compare with constitute concentrations along with the results of the bioassay to determine suitability for use as wetland materials. Comparisons to ambient conditions are also made, but not used directly in determining suitability. This is because the existing sediment quality in the Ballona Estuary is impacted from urban runoff from the Ballona Creek Watershed. A total maximum daily load (TMDL) has been established for multiple constituents and impairments including toxics for the Ballona Creek. It is the goal of these TMDLs to reduce the constituent loading from Ballona Creek in the next 10-20 years and reduce the potential impact to restored areas within the estuary including the proposed Restoration Project.

Suitability of materials for use as surface wetland material will also be based on the detection of bioaccumulative constituents that include mercury and persistent organic pollutants such as PCBs, DDT, and chlordane. The proposed screening tool includes bioaccumulative effects as part of the assessment of the sediments and provides options for beneficial use depending on the chemical results and decision regarding using the sediments as surface wetland materials or as sub-surface materials that would be overlain by at least three feet of suitable surface materials. Bioaccumulation bioassays are not planned for this phase of the work and not included as part of this Work Plan. Bioaccumulation testing would be conducted based on the results of the chemical and bioassay testing presented this Work Plan, and by the Design and Management Team for the Restoration Project based on the cost benefit of conducting these tests and the greater flexibility in the use of on-site materials.

The sediment chemistry and bioassay sampling and analysis proposed as part of the Geotechnical Investigation will also provide baseline condition data in which future assessment data can be compared. The adopted Sediment Quality Objectives cannot be applied unless the sediment is under full tidal conditions and the benthic community has been established in restored areas. The chemistry and bioassay results can be used to compare with future assessment sampling and analysis using the SQO methods when the benthic community is established in the marsh habitats. Key to these future assessments will be the potential impact from Ballona Creek on the restored estuary wetlands.

The screening tool as shown on Figure 2-2 also provides for assessment of existing materials for use as upland material using ER-M criteria compared to constituent concentrations. Human health criteria are also used to assess potential risk along with data on background concentrations.

The draft findings report will include maps that include data and observations. These maps will be used to present information and facilitate a discussion. The draft final will then be reviewed and comments incorporated for final review before the document is finalized.

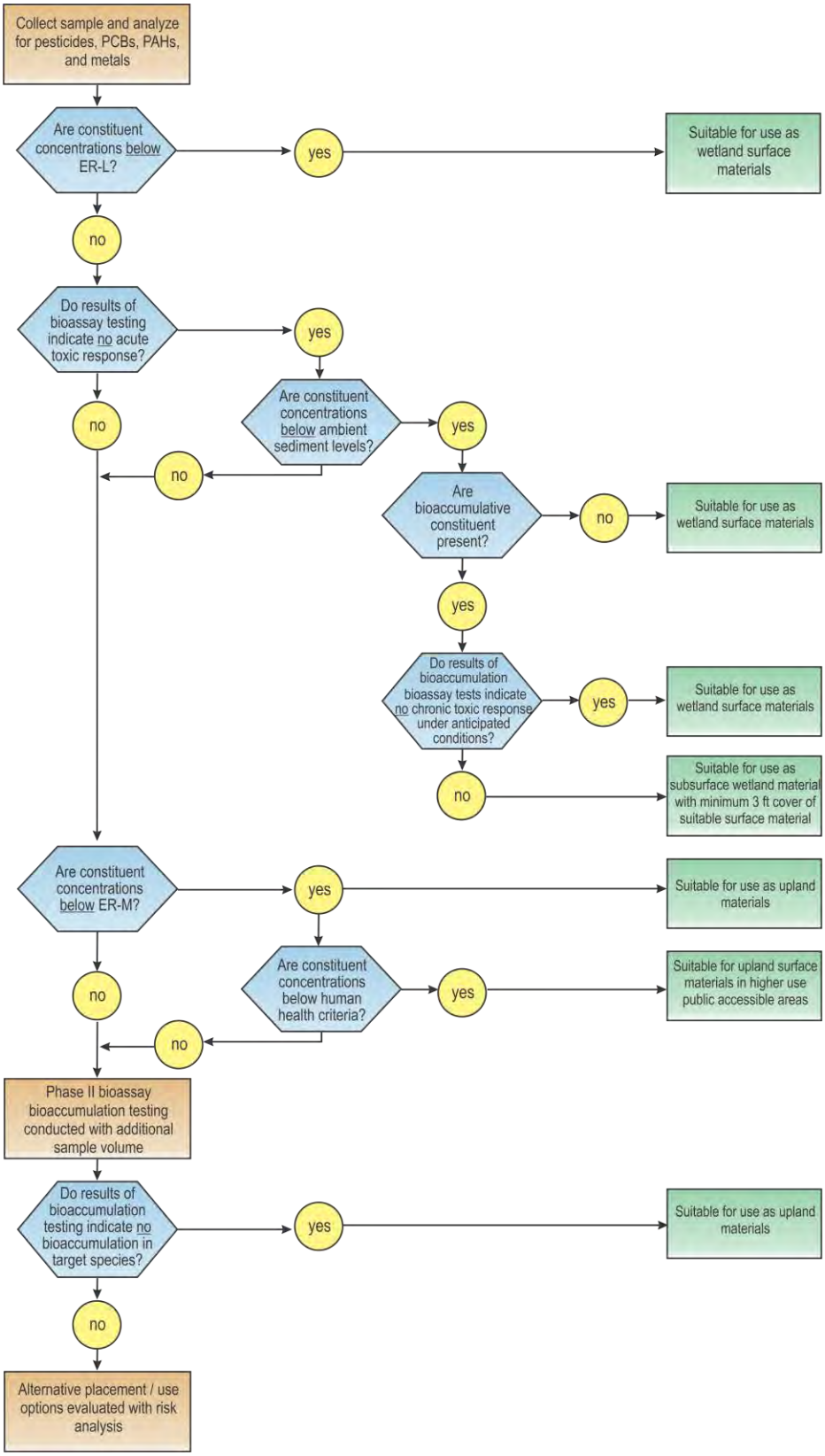

Figure 2-2. Sediment Beneficial Use Screening Tool

APPENDIX A

Geotechnical Borings Coordinates and Existing and Proposed Grading Depths

Boring	Type	Lat	Long	EG	FG	Area B West Levee				Environmental Sample
				ft NAVD	ft NAVD	Alt A-1	Alt A-2	Alt B	Alt C	
a-cpt012*	CPT	33.9769	-118.437	13.8	13.6					
a-cpt019	CPT	33.9709	-118.4412	16.8	5.3					
a-cpt021	CPT	33.9719	-118.4394	16.6	0.8					
a-cpt022	CPT	33.9728	-118.4379	20.1	4.6					
a-cpt024	CPT	33.9742	-118.4359	16.9	6.4					
a-rw009	RW	33.9741	-118.4436	16.7	10.7					
a-hsa016	HSA	33.972	-118.4425	15.3	7.4					See SAP Table, 2. Area A and B Boreholes - Located in Proposed Marsh Habitat & Transition Zone
a-hsa017	HSA	33.9739	-118.4408	14.5	7.8					
a-hsa018	HSA	33.9731	-118.4391	14.6	-4.0					See SAP Table, 1. Area A and B Boreholes in/near Proposed Channel
a-hsa064	HSA	33.9694	-118.4441	17.3	10.5					
a-hsa066	HSA	33.9702	-118.442507	21.1	TBD					See SAP Table, 4. Area A and B Boreholes near Existing Gas Wells (surface sample)
a-hsa067	HSA	33.9761	-118.4369	13.5	9.6					See SAP Table, 3. Area A Boreholes - Located in Upland Areas
a-rw002	RW	33.9701	-118.4453	17.8	20.5					
a-rw006	RW	33.9719	-118.4448	15.3	10.8					
a-rw008	RW	33.9744	-118.4439	16.0	20.6					
a-rw011	RW	33.9755	-118.4406	15.8	20.6					
a-rw013	RW	33.9769	-118.437	13.8	13.6					
a-rw015	RW	33.9769	-118.4348	16.6	20.6					
a-rw020	RW	33.9715	-118.4399	17.7	-4.4					See SAP Table, 1. Area A and B Boreholes in/near Proposed Channel
a-rw023	RW	33.9727	-118.4377	21.2	4.8					
a-rw065	RW	33.974	-118.4351	20.5	5.4					

APPENDIX A
Geotechnical Borings Coordinates and Existing and Proposed Grading Depths

Boring	Type	Lat	Long	EG	FG	Area B West Levee				Environmental Sample
				ft NAVD	ft NAVD	Alt A-1	Alt A-2	Alt B	Alt C	
b-cpt029*	CPT	33.9621	-118.4466	5.0	-	9.9	9.9	9.9	9.7	
b-cpt035*	CPT	33.9658	-118.4422	7.4	-	13.1	13.0	13.0	13.0	
b-cpt038	CPT	33.9658	-118.4447	8.4	11					
b-cpt040	CPT	33.9676	-118.4408	6.9	12.2					
b-cpt046	CPT	33.9716	-118.4363	10.6	6.3					
b-cpt049	CPT	33.9732	-118.4346	17.6	12					
b-cpt050	CPT	33.9737	-118.4335	20.2	20.5					
b-cpt052	CPT	33.965	-118.4491	6.9	5					
b-cpt054	CPT	33.9676	-118.4444	15.3	-3.6					
b-cpt056	CPT	33.9685	-118.4428	15.4	-4.5					
b-cpt057	CPT	33.9693	-118.4414	14.6	-4.0					
b-cpt059	CPT	33.9703	-118.4395	18.7	5.1					
b-hsa028*	HSA	33.9638	-118.4503	4.5	-	8.4	-	-	-	
b-hsa051*	HSA	33.9723	-118.4323	6.3	25					
b-rw030	RW	33.9619	-118.4464	6.6	-	19.4	19.4	19.4	19.2	
b-rw032	RW	33.9636	-118.4441	7.5	-	7.4	7.4	6.7	7.8	
b-rw033	RW	33.9633	-118.4437	6.5	-	18.3	18.3	18.3	20.3	
b-rw036	RW	33.9656	-118.4418	8.7	-	20.6	20.6	20.6	20.6	
b-rw039	RW	33.9663	-118.4436	8.2	11					
b-rw041	RW	33.9674	-118.4405	7.3	20.5					
b-rw043	RW	33.9694	-118.4394	8.8	6					See SAP Table, 2. Area A and B Boreholes - Located in Proposed Marsh Habitat & Transition Zone
b-rw044	RW	33.9693	-118.4387	9.2	20.5					
b-rw047	RW	33.9713	-118.436	11.7	20.2					
b-rw053	RW	33.9655	-118.4482	8.5	5					

APPENDIX A
Geotechnical Borings Coordinates and Existing and Proposed Grading Depths

Boring	Type	Lat	Long	EG	FG	Area B West Levee				Environmental Sample
				ft NAVD	ft NAVD	Alt A-1	Alt A-2	Alt B	Alt C	
b-rw055	RW	33.968	-118.4436	16.9	-5.6					See SAP Table, 1. Area A and B Boreholes in/near Proposed Channel
b-rw058	RW	33.9699	-118.4403	17.8	-4.8					
c-cpt060	CPT	33.9779	-118.4333	14.6	30					
c-cpt062	CPT	33.9779	-118.4303	23.0	40					
c-hsa061	HSA	33.9801	-118.4314	16.0	30					
c-hsa063	HSA	33.9791	-118.4288	23.2	40					
b-hsa064	DPT?									See SAP Table, 4. Area A and B Boreholes near Existing Gas Wells (surface sample)
Del Rey 16 (abandoned well in Area A)										See SAP Table, 4. Area A and B Boreholes near Existing Gas Wells (surface sample)

Prepared by ESA PWA, 9/12/12 draft

EG = Existing grade

FG = Proposed finished grade/design grade

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APPENDIX F5
Sediment Quality Investigation

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BALLONA WETLANDS RESTORATION PROJECT

Sediment Quality Investigation

Prepared for
California State Coastal Conservancy

May 2015

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BALLONA WETLANDS RESTORATION PROJECT

Sediment Quality Investigation

Prepared for
California State Coastal Conservancy

May 2015

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CHAPTER 1
Purpose of the Investigation

The purpose of the sediment characterization program is to assess the sediments within Areas A and B for beneficial use within the proposed Ballona Wetland Restoration Project, located in Los Angeles, California. More specifically, the purpose of the sediment sampling and analytical program was to determine their suitability for use as upland and/or wetland material within the Ballona Wetland Restoration Project. This memo also identifies next steps, including additional investigations to confirm suitability for possible in-ocean placement of excess excavated material. Design specifications for sediment management will be developed during subsequent phases of the design based on the Project EIR/S and regulatory requirements.

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CHAPTER 2
Scope of the Sediment Investigation

The field program for the sediment characterization was conducted from September 24 to 25, 2012 in accordance with the Sampling and Analysis Plan (SAP) (Weston 2012). A summary of the scope of the field and laboratory program is presented in Table 1. Sediment sample selection and boring profile descriptions were led by Weston under contract with ESA, and in coordination with Group Delta Consultants, Inc. (GDC). GDC lead the geotechnical investigation and contracted the driller and analytical laboratory for the sediment characterization program. GDC also provided a geologist to support Weston in the logging of the boreholes. Weston selected the samples for analysis and provided GDC with the prepared samples and chain of custodies for delivery to the analytical laboratory. American Environmental Testing Laboratory in Burbank, CA analyzed the selected sediment samples for the analyses listed in Table 2.

A total of seven direct push borings were completed using the depth and sampling criteria outlined in the SAP (Weston, 2012). The locations of the borings are presented in Figure 1, overlain onto the proposed restoration plan showing the new habitat types. Modifications to the SAP to respond to field conditions and observations are highlighted in the table and summarized as followed:

- **Relocation of Boring on Existing Levee** – Boring A-RW-020 and B-RW-055 were relocated down off the levee and approximately 350 feet from the toe of slope, due the presence of large rip rap. The relocation of these boring was noted in the field and the revised locations were surveyed. The depth of the samples specified in the Work Plan was modified to accommodate for the new existing ground elevation and the anticipated depth of excavation.
- **Modification of Samples Selected for Analysis** – As noted in Table 1, several samples were added for analysis at several boring locations where potential petroleum hydrocarbon contamination was observed and where readings above background were noted from the head space analysis of samples for volatile organic compound (VOC) vapors. Samples were collected where the sediment was observed to have been impacted, and above and below, in order to define the potential extent of contamination. In addition, several designated samples were not analyzed based on field observation that included no evidence of impacted soils near and adjacent to the gas wells.

Samples were transported to the analytical laboratory for chemical testing, and to Nautilus for bio-assay testing. PSOMAS surveyed the locations and ground elevations of the borings. Analytical, bioassay, and survey data have been provided and are summarized in this Technical Report.

TABLE 1
SEDIMENT CHARACTERIZATION PROGRAM – CHEMICAL AND BIOASSAY ANALYSIS OF SELECTED SEDIMENT SAMPLES

Borehole Sites	Sampling Objective	Sample Selection Process	Chemical Analysis	Bioassay Analysis	Samples Collected – ID and Depth
1. Area A and B Boreholes in/near Proposed Channel – A-RW020 – A-HSA018 – B-RW055	Wetland Surface/Foundation Suitability	Proposed Channel Elev.	General Chemistry, Organics, Inorganics (See Table 2)	Acute, 2 Species of Amphipods and 1 species of Polychaete after sample acclimation	Chemistry: A-RW-020-D1 (20'-28'); B-RW-055-D1 (10'-14'), A-HSA-018-D2 (16'-19'), A-HSA- (20'-24') Bioassay: A-RW-020-D1 (20'-28') composited with A-HSA-018-D1 (20'-28'); B-RW-055-D1 (10'-16') composited with B-RW-043- D3 (6.5'-10')
	Wetland Surface Suitability	Change in Material +/-5 ft. within Prop. Channel Elev. (e.g. old marsh mat'l) – if no change – collect 2.5 to 10 ft. below Channel Elev.	(See Table 2)	No bioassay	No change was observed below marsh material. Chemistry and bioassay performed on material located close to the proposed final grades. Samples listed above.
	Use for Upland Placement/ Wetland Grading	Material above the water table – 10 ft interval of similar sediment	(See Table 2)	No bioassay	A-RW-020-C3 (4'-9'), A-RW-020-D3 (12'-16') A-HSA-018-C3 (4'-8'),A-HAS-018-D3 (10'-12') B-RW-055-C1 (0'-3.5'); B-RW-055-C2 (4'-8')
	Use for On-site Grading/ Wetland Surface	Material below the water table – 10 ft interval of similar sediment	(See Table12)	No bioassay	A-RW-020-D2 (16'-19') A-HSA-018-D2 (16'-19')
2. Area A and B Boreholes – Located in Proposed Marsh Habitat & Transition Zone – A-HSA016 – B-RW043	Wetland Surface Suitability	Proposed Wetland Restoration Elev.	(See Table 2)	Acute, 3 Species	Chemistry: A-HSA-016-D1 (10.5'-12'); A-HAS-016-D2 (14'-16'); B-RW-043-D1 (3'-6'); B-RW-043-D2 (6'-6.5'); B-RW-043- D3 (8'-10'); B-RW-043- D5 (10'-16') Bioassay : A-HSA-016- (8'-12'); B-RW-043- D3 (6.5'-10') composited with B-RW-055-D1 (10'-16')
	Use for Upland Placement/wetland Grading	Material above the water table – 10 ft interval of similar sediment	(See Table 2)	No bioassay	A-HSA-016-C1 (0'-6')
	Use for On-site Grading – Wetland Surface	Material below the water table – 10 ft interval of similar sediment	(See Table 2)	No bioassay	A-HSA-016-C2 (6'-10.5') B-RW-043-C1 (0'-3')
3. Areas A Boreholes – Located in Upland Areas – A-HSA067	Use of Material for Upland Placement/Site Grading	Material above the water table – 10 ft interval to straddle proposed excavation depth	(See Table 2)	No bioassay	A-HAS-067-C1 (0'-6')

TABLE 2
LIST OF ANALYTES AND SAMPLES ANALYZED FOR SOIL CHEMISTRY

Samples for Soil Chemistry Analysis	Depth (ft)	Trace Metals	Trace Mercury	Organotins	Polynuclear Aromatic Hydrocarbons	Phthalates	Acid Extractable Compounds	Organochlorine Pesticides & PCBs	Percent solids	pH	Salinity	TOC	Total Sulfides	Dissolved sulfides	TPH diesel	TPH gas	Ammonia as N in Sediment Determination	TRPH in Sediment Determination
In/near proposed channel																		
A-RW-020-D1 (20' –28')	20-28	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
A-RW-020-D2 (16' –19')	16-19	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
A-RW-020-D3 (12'-16')	12-16	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
A-RW-020-C3 (4'-9')	4-9	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
A-HSA018-D2 (16' –19')	16-19	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
A-HSA018-D3 (10' –12')	10-12	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
A-HSA018-D1 (20'-24')	20-24	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
A-HSA018-C3 (4'-8')	4-8	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
B-RW-055-C1 (0' –3.5')	0-3.5	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
B-RW-055-C2 (4' –8')	4-8	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
B-RW-055-D1 (10' –14')	10-14	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
In proposed marsh/trans.																		
A-HSA-016-D1 (10.5'–12')	10.5–12	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
A-HSA-016-D2 (14'–16')	14-16	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
A-HSA-016-C2 (6' -10.5')	6-10.5	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
A-HSA-016-C1 (0' –6')	0-6	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
B-RW-043-C1 (0' –3')	0-3	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
B-RW-043-D1 (3' –6')	3-6	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
B-RW-043-D2 (6' –6.5')	6-6.5	NA	NA	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
B-RW-043-D3 (8'-10')	8-10	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
B-RW-043-D5 (10'-16')	10-16	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Upland																		
A-HSA-067-C1 (0' -6')	0-6	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

NA – not analyzed for these constituents

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J:\1793_Ballona\Fieldwork\SoilSampleLocations.mxd

SOURCE: Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

Ballona Wetlands. D120367

Figure 1

Soil Sample Locations

ESA PWA

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CHAPTER 3
Summary of Results

The results are presented here in four parts. The first part provides a summary of the previous results from the geotechnical investigation of Area A conducted by Weston in 2008 for the Port of Los Angeles. The second part presents the subsurface conditions observed with regard to the type of soils, evidence of impacted sediment, and evidence of original marsh soils. In the third section, the results of the chemical and bioassay testing are summarized. Finally, historic results are presented in the last section.

3.1 Results of 2008 Geotechnical Investigation in Area A

A preliminary geotechnical investigation was completed by Weston under contract with the Port of Los Angeles in 2008. The primary objective of the Preliminary Study was to provide geotechnical and chemical data to characterize approximately 4.5 million cubic yards (cy) of dredge material that has been placed on Area A and which is being considered for removal in support of the Restoration Project. This study was used to determine potential beneficial uses of the dredge material, to identify any special handling or disposal restrictions that may be required based on sediment and leachate chemistry, and to guide any further assessment deemed necessary. The results of the Preliminary Investigation were used to scope the 2012 sediment characterization SAP.

This program included the collection of sediment samples from direct push cores for chemical and geotechnical analysis. The locations of the completed borings are shown in Figure 2 and a summary of constituents above soil screening criteria and sediment quality guidelines are discussed below and presented in Table 3 and Table 4, respectively. The screening criteria that were used to assess the results are summarized in Appendix A. The complete results can be found in the Area A Preliminary Geotechnical Investigation and Beneficial Use Assessment (Weston, 2009).

3.1.1 Comparison to Hazardous Waste Criteria

No chemicals were detected at concentrations greater than the TTLC or greater than 10 times the STLC value. Results of TCLP analyses indicated no analytes above the toxicity characteristic standards USEPA 40 CFR Part 261 values (USEPA, 2006). Therefore, the material was not classified as a hazardous waste and is suitable for upland placement options.

Figure 2. Preliminary Geotechnical Investigation Boring Locations



TABLE 3
SUMMARY OF 2008 SAMPLE RESULTS IN COMPARISON TO HUMAN HEALTH CRITERIA

				Residential Land Use[1]		Commercial/Industrial Land Use Only[1]		S10-060208-6-7	S11-070208-14-15	S11-S15-S28-14-20	S15-080208-15-16	S15-S28-15-16	S17-080208-10-11	S17-S18-10-12	S18-080208-7-8	S21-080208-6-7	S21-S25-6-8
Group	**Analyte**	**Units**	**RL**	**CHHSLs**	**PRG**	**CHHSLs**	**PRG**	**Discrete**	**Discrete**	**Composite**	**Discrete**	**Composite**	**Discrete**	**Composite**	**Discrete**	**Discrete**	**Composite**
Metals	Arsenic (As)	µg/dry g	0.05	0.07	0.39	0.24	1.60	5.129	4.086	4.557	12.61	7.145	3.59	3.816	3.561	9.254	9.218
	Iron (Fe)	µg/dry g	5		23000		100,000	15890	37840	41390	38250	32840	28970	37170	37940	30390	32920
PAHs	Benzo[a]pyrene	ng/dry g	5	38	15	130	210	<5	<5	<5	<5	<5	<5	<5	<5	7.3	6.8

				Residential Land Use[1]		Commercial/Industrial Land Use Only[1]		S23-080208-12-13	S23-S24-S26-21-24	S27-S29-S30-6-8	S29-070208-6-7	S3-11-12-15-16	S4-S10-5-7	S5-060208-15-16	S5-S6-15-16	S5-S6-S9-3-4	S9-060208-3-4
Group	**Analyte**	**Units**	**RL**	**CHHSLs**	**PRG**	**CHHSLs**	**PRG**	**Discrete**	**Composite**	**Composite**	**Discrete**	**Composite**	**Composite**	**Discrete**	**Composite**	**Composite**	**Discrete**
Metals	Arsenic (As)	µg/dry g	0.05	0.07	0.39	0.24	1.60	13.73	4.814	8.977	3.848	7.636	4.666	7.393	3.038	5.73	5.802
	Iron (Fe)	µg/dry g	5		23000		100000	27480	36000	31170	26180	34330	18770	35380	26340	20140	14270
PAHs	Benzo[a]pyrene	ng/dry g	5	38	15	130	210	3.4 J	<5	39.7	<5	6.1	<5	<5	<5	<5	<5

Notes:

J – Below the Reporting Limit (RL) but above the Method Detection Limit (MDL)

Yellow - Concentration exceeds respective soil screening criteria.

[1] California Human Health Screening Levels (CHHSLs) and Preliminary Remediation Goal (PRGs) – see Appendix A for more detailed discussion of these criteria.

TABLE 4
SUMMARY OF 2008 SAMPLE RESULTS IN COMPARISON TO ECOLOGICAL CRITERIA

Group	Analyte	Units	RL	Dredged Material Placement Screening Criteria[1] ER-L	ER-M	S10-060208-6-7 Discrete	S11-070208-14-15 Discrete	S11-S15-S28-14-20 Composite	S15-080208-15-16 Discrete	S15-S28-15-16 Composite	S17-080208-10-11 Discrete	S17-S18-10-12 Composite	S18-080208-7-8 Discrete	S21-080208-6-7 Discrete	S21-S25-6-8 Composite
Metals	Arsenic (As)	µg/dry g	0.05	8.2	70	5.129	4.086	4.557	12.61	7.145	3.59	3.816	3.561	9.254	9.218
	Cadmium (Cd)	µg/dry g	0.05	1.2	9.6	0.262	0.201	1.243	0.836	0.684	0.089	0.595	0.307	0.614	0.57
	Copper (Cu)	µg/dry g	0.05	34	270	11.15	33.62	22.17	39.25	28.84	18.03	28.89	28.99	31.63	35.6
	Lead (Pb)	µg/dry g	0.05	46.7	218	4.742	7.802	4.583	7.924	6.104	3.783	5.758	6.194	24.94	50.72
	Mercury (Hg)	µg/dry g	0.02	0.15	0.71	0.043	0.053	0.055	0.068	0.052	0.041	0.049	0.06	0.303	0.215
	Nickel (Ni)	µg/dry g	0.05	20.9	51.6	14.69	27.15	21.2	25.37	21.42	17.05	24.09	23.61	22.55	23.94
	Silver (Ag)	µg/dry g	0.05	1	3.7	0.04 J	0.035 J	0.072	0.038 J	0.113	0.042 J	0.173	0.052	1.079	1.027
Pesticides	4,4'-DDE	ng/dry g	5	2.2	27	<5	<5	<5	<5	<5	<5	<5	<5	<5	11.6

Group	Analyte	Units	RL	Dredged Material Placcement Screening Criteria[1] ER-L	ER-M	S23-080208-12-13 Discrete	S23-S24-S26-21-24 Composite	S27-S29-S30-6-8 Composite	S29-070208-6-7 Discrete	S3-11-12-15-16 Composite	S4-S10-5-7 Composite	S5-060208-15-16 Discrete	S5-S6-15-16 Composite	S5-S6-S9-3-4 Composite	S9-060208-3-4 Discrete
Metals	Arsenic (As)	µg/dry g	0.05	8.2	70	13.73	4.814	8.977	3.848	7.636	4.666	7.393	3.038	5.73	5.802
	Cadmium (Cd)	µg/dry g	0.05	1.2	9.6	0.67	0.482	0.63	0.257	0.499	0.199	0.175	0.147	0.255	0.208
	Copper (Cu)	µg/dry g	0.05	34	270	25.64	30.61	37.79	20.12	28.08	14.52	27.21	21.25	12.81	9.257
	Lead (Pb)	µg/dry g	0.05	46.7	218	5.361	7.187	31.96	8.573	19.58	4.625	4.742	3.514	6.364	3.383
	Mercury (Hg)	µg/dry g	0.02	0.15	0.71	0.028	0.083	0.189	0.077	0.089	0.065	0.067	0.058	0.046	0.053
	Nickel (Ni)	µg/dry g	0.05	20.9	51.6	26.33	25.27	25.6	19.71	26.05	15.74	20.98	16.44	15.2	13.25
	Silver (Ag)	µg/dry g	0.05	1	3.7	0.105	0.221	0.224	0.129	0.174	0.096	<0.05	0.258	0.138	0.04 J
Pesticides	4,4'-DDE	ng/dry g	5	2.2	27	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5

Notes:
J – Below the Reporting Limit (RL) but above the Method Detection Limit (MDL)

Yellow - Concentration exceeds respective sediment screening criteria.

1 [1] Effects Range-Low (E-RL) and Effects Range Medium (E-RM) are used in dredged material evaluation for Ocean Disposal in combination with the results of bioassay testing and bioaccumulation testing. (Long et al. , 1995). See Appendix A for more detailed discussion of screening criteria

3.1.2 Comparison to Human Health Criteria

The analyzed organic chemicals of concern were PAHs, PCBs, and organochlorine pesticides. With the exception of one soil sample, none of the Area A samples contained concentrations of PAHs, PCBs, or pesticides above the CHHSLs and PRGs soil criteria. The concentration of benzo [a] pyrene at Station 27 was 39.7 µg/kg dry weight, which exceeded the human health screening level (set at 38 µg/kg dry weight) for potential residential land use.

While most of the chemical screening values are below levels of concern for human health, arsenic and iron were measured at ambient concentrations greater than residential CHHSLs and PRGs. The concentrations of arsenic and iron are consistent with natural concentrations in marine sediments. A summary of soil samples that exceeded soil criteria is shown in Table 3.

During the boring and sampling operations, PID readings were taken to identify potential "hot" zones which might contain elevated VOC concentrations. Soil samples from five stations showed elevated PID readings in the field and were subsequently selected for s-VOC and VOC analysis. The results of the laboratory analysis showed that none of the five samples exceeded CHHSLs or PRGs criteria for residential and commercial land use.

Due to the historic and current presence of gasoline production and transportation in Area A, the 20 soil stations were analyzed for total petroleum hydrocarbons (TPHg and TPHd) and benzene, ethylbenzene, toluene, and xylenes (BETX). None of the soil samples had concentrations of TPHg, TPHd or BETX above the Residential Soil Screening Criteria for Groundwater Protection as defined by the California Regional Water Quality Control Board, San Francisco Bay Region. However, during drilling operations at Station 25 and 26, the field engineer noted evidence of soil staining throughout the soil core. These two stations are closest to the compressed natural gas line that runs north-to-south through Area A.

3.1.3 Comparison to Ecological Criteria

Long et al. (1995) developed criteria to evaluate dredged material for ocean disposal, including the Effects Range- Low (ER-L) and Effects Range-Median (ER-M) values (Appendix A). The criteria are helpful in assessing the potential biological impact of elevated constituents of concern.

Concentrations of metals in the sediment samples were compared to ER-L and ER-M values. Several metals slightly exceeded the corresponding ER-L values, including arsenic, cadmium, copper, lead, mercury, nickel, and silver (Table 4). No metals exceeded the corresponding ER-M values, indicating relatively low concentrations.

3.2 Results of 2012 Subsurface Conditions In Areas A and B

Figure 1 presented the boring locations and the profile transects. The borehole profiles for the proposed channel alignment, Area A, and Area B are presented on Figure 3- Figure 5, respectively. The boring profiles include the observed geotechnical observations, field observations and screening, and the results of the comparison of the constituent concentrations to

relevant and applicable criteria/guidelines. The following summary highlights the observed sediment characteristics and the field observations compared to the analytical results:

, respectively. The boring profiles include the observed geotechnical observations, field observations and screening, and the results of the comparison of the constituent concentrations to relevant and applicable criteria/guidelines. The following summary highlights the observed sediment characteristics and the field observations compared to the analytical results:

3.2.1 Area A Proposed Channel Location

Two borings (A-RW020 and A-HSA018) were completed within the proposed channel in Area A (Figure 3). Both of these borings were advanced to below the proposed elevation of the channel into original marsh materials for a total depth of 28 feet below ground surface (bgs). The sediment at these locations is predominantly silty and sandy with low plasticity clays that transition to a high plasticity clay at approximately 14 ft bgs. Above this depth is a lens of more sandy wet clay from 10-14 ft bgs. At approximately 10-14 ft bgs a petroleum odor and dark staining was observed. This potentially impacted sediment is likely limited to an approximately 2-4 foot layer between 10-14 ft bgs. Discrete samples were taken from this layer at 12 to 14 ft bgs in A-RW020 and 10-12 ft in A-HSA018, where the greater petroleum order and staining was observed. Samples were collected for analysis above and below this potentially impacted layer to define the extent of the layer. Head space analysis of samples placed in plastic sealed bags indicated the potentially impacted layers appear to be limited to the sandy clay layer between 10-14 ft bgs. The results of the chemical analysis of these samples indicate TPH was detected at the highest concentrations in A-HSA-018-D3 (10'-12'), and also detected above this sample at lower concentrations in A-HSA-018-D3 (4'-8'). TPH was also detected in A-RW-020-D2 (12'-16'), but not in samples above and below this interval. However, the concentrations of TPH were all below the residential soil screening levels for shallow and deep soils. PAHs, which may include breakdown products of petroleum hydrocarbons, were not detected above the biological or human health criteria in these samples. This layer is above the final excavation depth of the proposed channel that is estimated at 22 ft and 18.5 ft bgs for boring locations A-RW020 and A-HSA018, respectively. The original marsh materials were encountered at approximately 19-20 ft bgs in both borings. Sediment for bioassay testing to assess the suitability of existing materials for wetland surface were collected from depths of 20-28 ft bgs in each boring.

3.2.2 Area A Transition Zone

Two direct push borings (A-HSA016 and A-HSA067) were completed in Area A within transitional habitat zones requiring less excavation (Figure 4). Anticipated excavation depths range from approximately 4 ft bgs at A-HSA067 to 8 ft bgs at A-HSA016. The sediment profile in both of these borings is characterized by sandy silt in the upper 6 ft, transitioning into a more silty clay. The depth of the boring at A-HSA067 was 8 ft bgs or 4 ft below the anticipated excavation depth. A composite sample of the materials from the surface to 6 ft bgs was collected. The results of the analysis indicated total DDT exceeded the most stringent ER-L value, but not the wetland surface criteria developed by the SFRWQCB. A-HSA016 was advanced to 16 ft bgs or 8 ft below anticipated final grades. At 10.5 ft bgs a petroleum odor and staining was observed.

Head space analysis of the sediment from 6-8 ft bgs and from 10.5 to 12 ft bgs, which was placed in a sealed plastic bag, was 0.4 and 0.6 units. The petroleum odor and staining appeared to be limited to 10.5 to 12 ft bgs. The results of the analytical analysis of these samples detected TPH as Heavy Hydrocarbons in the sample from 10.5 ft to 12 ft, but not in samples above and below this depth indicating the impact is limited to this depth. Additionally, the concentrations of TPH were all below the residential soil screening levels for shallow and deep soils. PAHs, which may include breakdown products of petroleum hydrocarbons, were not detected above the biological or human health criteria in these samples.

3.2.3 Area B Channel and Wetland

Two borings were completed in Area B to assess the existing material for use as wetland surface material and beneficial use of excavated materials. B-RW043 was completed in the proposed wetland area with an anticipated excavation depth of 3 ft (Figure 5). B-RW055 was completed in the proposed channel with an anticipated excavation depth of 22.5 ft (Figure 3). B-RW055 was moved off the existing levee due to the potential of encountering boulders and re-located at the toe of the levee. The original marsh materials were encountered in both borings at approximately 10-12 ft bgs. The materials above the original marsh sediments were observed to range from more sandy silts at the surface to silty clays of low and high plasticity. In both borings, a petroleum odor and staining was observed at approximately 6 to 6.5 ft bgs in B-RW043 and less evidently between 4-8 ft bgs in B-RW055. The results of the sample analysis indicated TPH was detected from 0 to 3.5 ft bgs in B-RW055 and B-RW043, but not in the samples below. The concentrations of TPH were, however, all below the residential soil screening levels for shallow and deep soils. PAHs, which may include breakdown products of petroleum hydrocarbons, were not detected above the biological or human health criteria in these samples. Samples for bioassay were collected from the original marsh materials below the potential impacted sediments at depth of 6.5 to 10 ft bgs in B-RW043 and from 10-16 ft bgs in B-RW055. The depth of the samples collected for bioassay were below the anticipated final grade at B-RW043, because of the field observations of potentially impacted sediment, and the potential for over-excavation to the original marsh materials.

3.3 Results of 2012 Sediment Characterization Investigation in Areas A and B

3.3.1 Results of Sediment Characterization Compared to Human Health Criteria/Guidelines

The results of the analytical analysis, compared to relevant California Human Health Screening criteria, are presented in Table 5. Arsenic concentrations are above these criteria in all of the 21 samples that were collected and analyzed. These are similar findings to those in the Area A Geotechnical Investigation conducted in 2008 (Weston, 2009). As reported in the 2008 study, these concentrations are characteristic of marine sediment.

Table 6 presents the results of the TPH analysis and comparison to the Residential Soil Screening Criteria for Groundwater Protection. Although there were multiple detections of TPH as diesel, TPH as Heavy Hydrocarbons, and Total Recoverable Petroleum Hydrocarbons, none of the concentrations were above the residential criteria. Residual concentrations of petroleum products were anticipated in soils within Areas A and B based on the historical uses of the property which was used for oil and gas extraction. Gas production wells remain active on the site. The soils in the areas around the existing gas wells were inspected and only minor surface staining was observed and did not extend below the surface of the soil (area less than one foot squared and only in 3-4 places). Shallow 10 foot boreholes were advanced around the existing well heads, but due to the lack of evidence of sediment impacts, no sampling was collected for analysis.

3.3.2 Results of Sediment Characterization Compared to Ecological Criteria/Guidelines

The summary of results of the Sediment Investigation compared to the ecological criteria is presented in Table 7.

In addition to the ER-L and ER-M criteria, discussed in Section 3.1.3, another measure of potential ecological impacts is the Beneficial Reuse criteria for wetland restoration, developed by the San Francisco Regional Water Quality Control Board (2000) and refined for use outside of San Francisco Bay by Germano & Associates (2004). The Beneficial Reuse criteria have different values for material that will be used as wetland surface (more conservative) and wetland foundation material (less conservative). Appendix A provides more detailed discussion of these screening criteria. The analytical results are compared to the Beneficial Reuse guidelines and historical average concentrations in sediment in the Area B marsh.

Additionally, the TMDL set goals for the estuary that apply to sediments within the tidal zone of Ballona Creek, which would likely apply to the reconfigured channel and tidal wetlands. These goals corresponded to the conservative ER-L values, but were revised based on results of the sediment characterization study conducted as part of the TMDL Reconsideration. The study indicated that the ER-L sediment quality guideline values used as target concentrations for the chemicals listed in the TMDL were inaccurate and highly conservative. The ER-Ls for some metals were below background concentrations typical of estuarine environments. For the organic compounds, ER-Ls were several orders of magnitude below toxicity thresholds for benthic organisms (SCCWRP, 2010). Therefore use of these guidelines for sediment screening purposes may not be applicable for the Ballona Estuary. In the 2013 TMDL Reconsideration, goals for the organic compounds were updated based on recent data in Table 7 includes the updated TMDL goals.

TABLE 5
SUMMARY OF SOIL SAMPLES WITH ANALYTES THAT EXCEED CALIFORNIA HUMAN HEALTH SCREENING LEVELS OR PRELIMINARY REMEDIATION GOALS

Error! Reference source not found.**A: In/near Proposed Channel**

Group	Analyte	Units	PQL	Residential Land Use[1] CHHSLs	Residential Land Use[1] PRG	Commercial/Industrial Land Use Only[1] CHHSLs	Commercial/Industrial Land Use Only[1] PRG	A-RW-020-D1 (20' –28')	A-RW-020-D2 (16' –19')	A-RW-020-D3 (12'-16')	A-RW-020-C3 (4'-9')	A-HSA018-D2 (16' –19')	A-HSA018-D3 (10' –12')	A-HSA018-D1 (20'-24')	A-HSA018-C3 (4'-8')	B-RW-055-C1 (0' –3.5')	B-RW-055-C2 (4' –8')	B-RW-055-D1 (10' –14')
Metals	Arsenic (As)	µg/dry g	0.120	0.07	0.39	0.24	1.60	2.32	1.79	0.953	2.60	0.953	16.6	1.71	5.30	1.88	2.80	1.78

Error! Reference source not found.**B: In Proposed Marsh and Transition Zone**

Group	Analyte	Units	PQL	Residential Land Use[1] CHHSLs	Residential Land Use[1] PRG	Commercial/Industrial Land Use Only[1] CHHSLs	Commercial/Industrial Land Use Only[1] PRG	A-HSA-016-D1 (10.5'–12')	A-HSA-016-D2 (14'–16')	A-HSA-016-C2 (6' -10.5')	A-HSA-016-C1 (0' –6')	B-RW-043-C1 (0' –3')	B-RW-043-D1 (3' –6')	B-RW-043-D3 (8'-10')	B-RW-043-D5 (10'-16')
Metals	Arsenic (As)	µg/dry g	0.120	0.07	0.39	0.24	1.60	2.67	1.77	2.57	2.01	1.91	0.895	1.20	2.01

Error! Reference source not found.**C: Upland**

Group	Analyte	Units	PQL	Residential Land Use[1] CHHSLs	Residential Land Use[1] PRG	Commercial/Industrial Land Use Only[1] CHHSLs	Commercial/Industrial Land Use Only[1] PRG	A-HSA-067-C1 (0' -6')
Metals	Arsenic (As)	µg/dry g	0.120	0.07	0.39	0.24	1.60	2.93

Notes:
J – Below the Reporting Limit (RL) but above the Method Detection Limit (MDL)
Yellow - Concentration exceeds respective soil screening criteria.
1 California Human Health Screening Levels (CHHSLs) and Preliminary Remediation Goal (PRGs) – see Appendix A for more detailed discussion of these criteria

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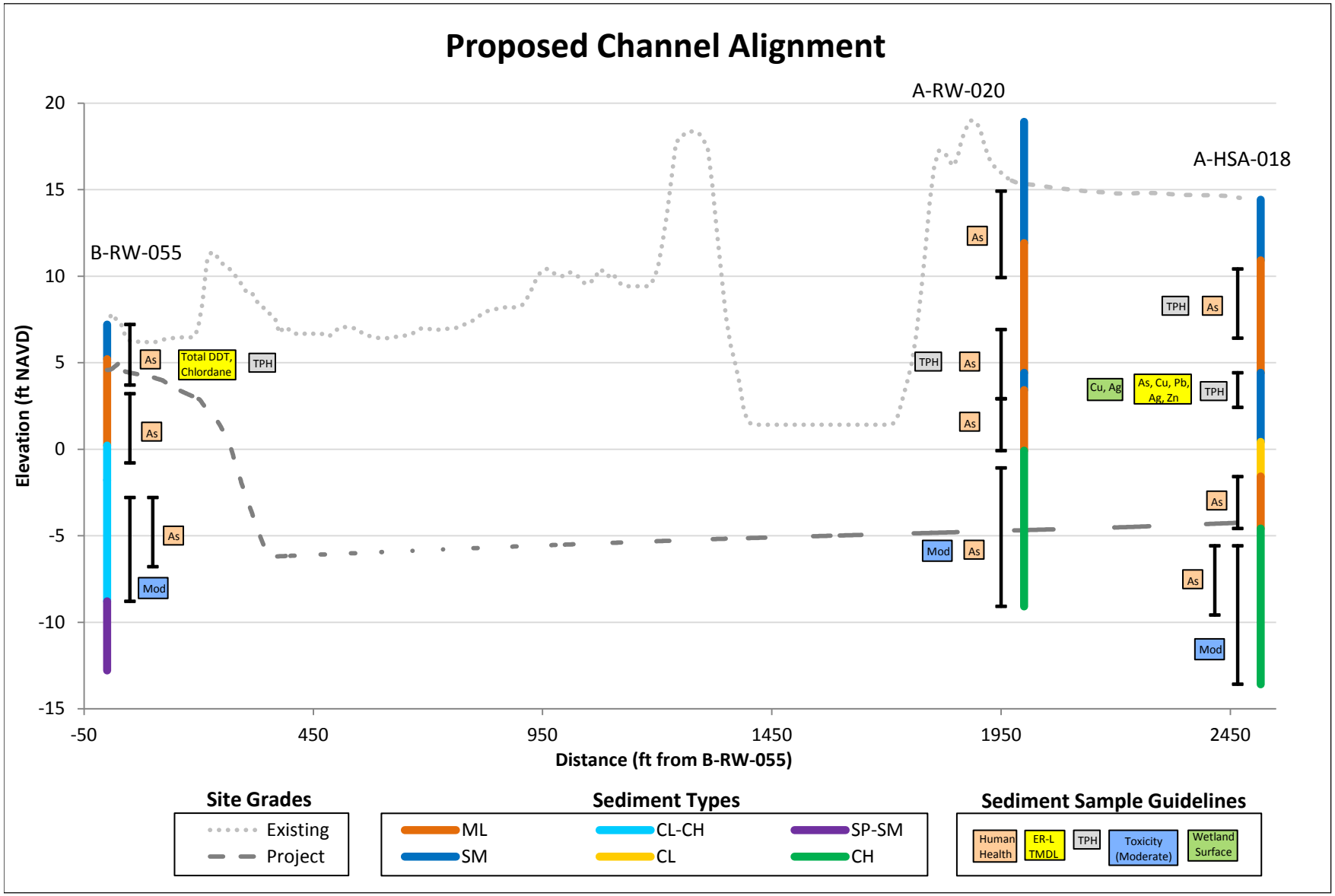
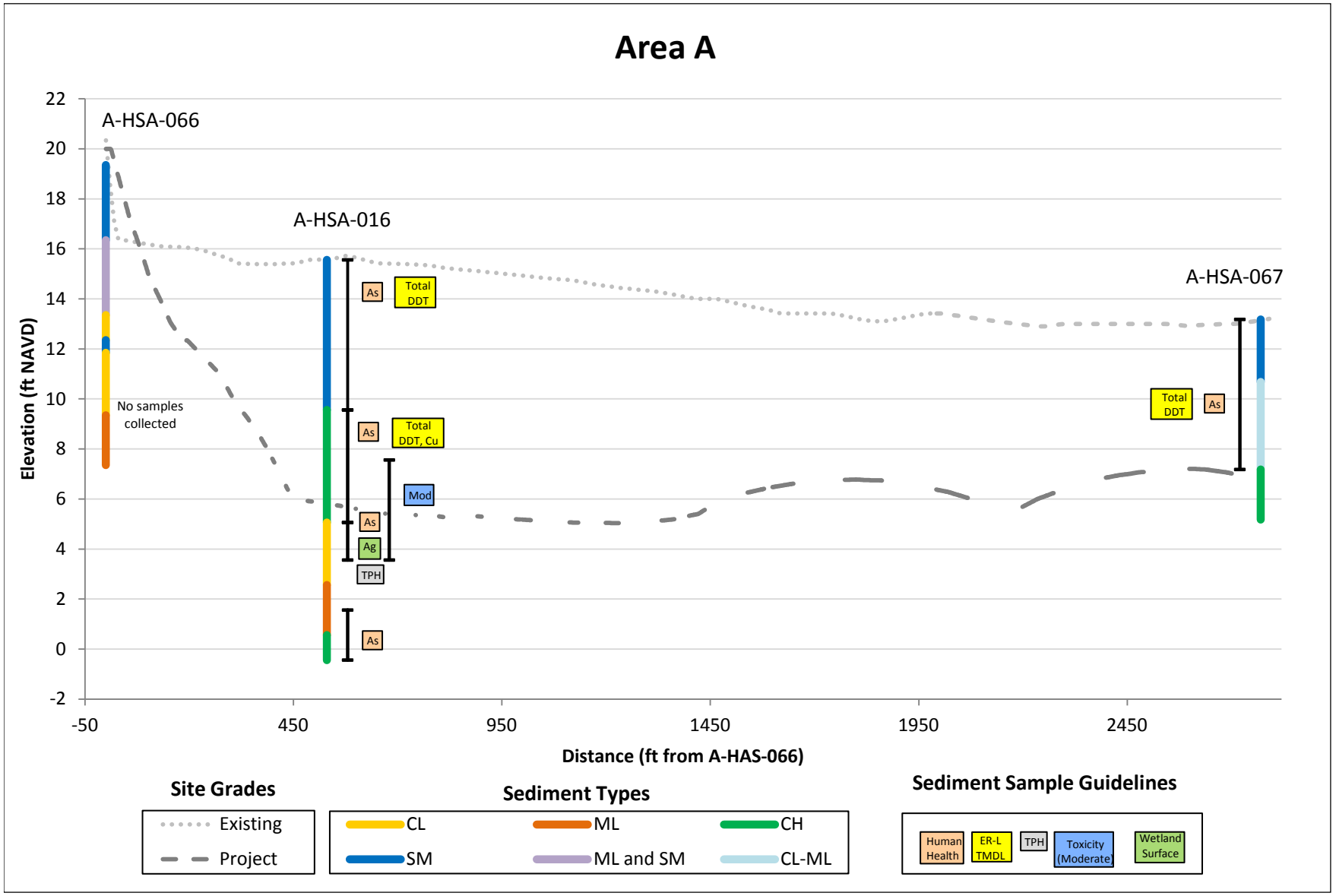


Ballona Wetlands. D120367

Figure 3

Boring Profiles for Transect
Along Proposed Channel Alignment



Ballona Wetlands. D120367

Figure 4

Boring Profiles for Transect in Area A

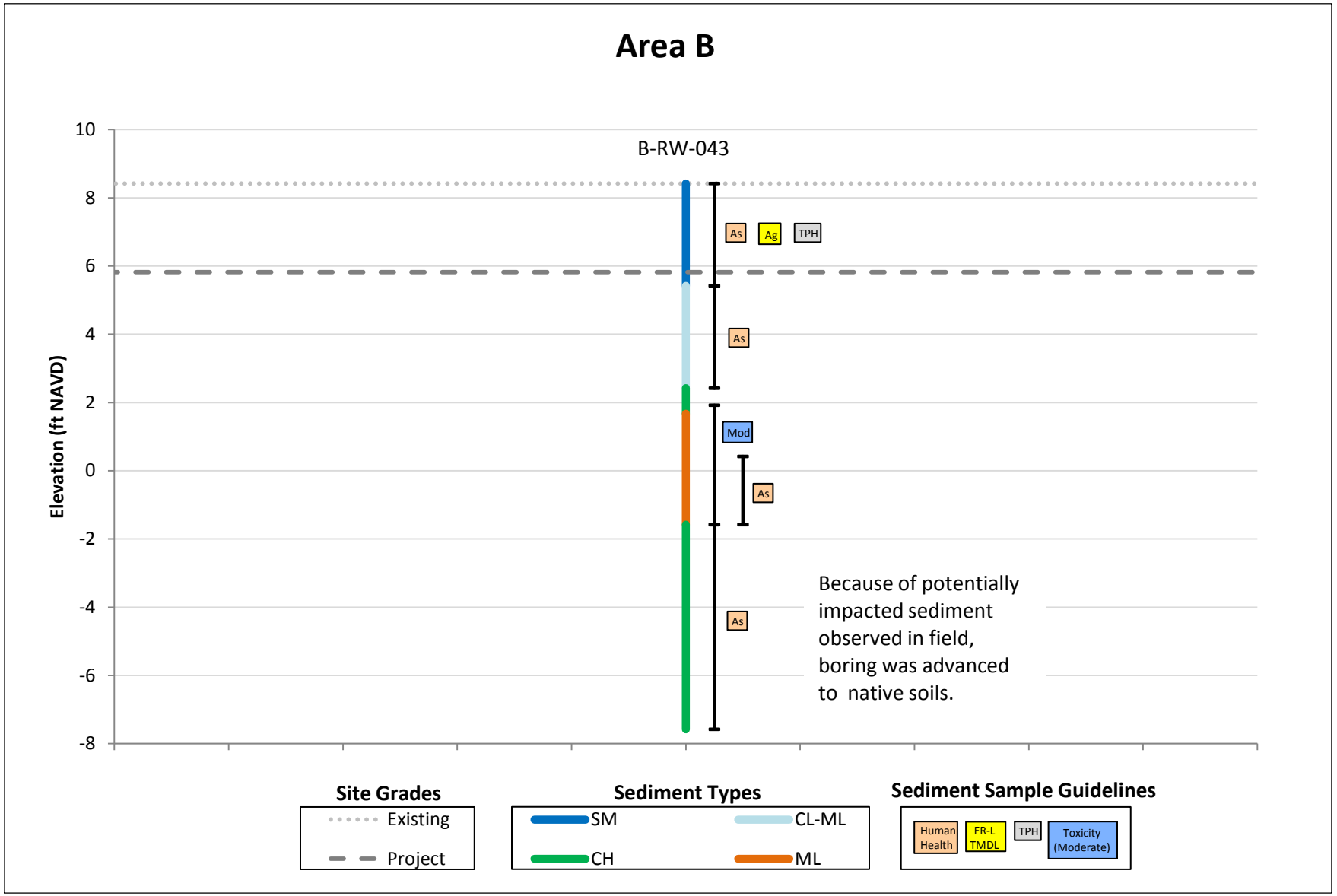


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Figure 5

Boring Profile for Area B

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TABLE 6
SUMMARY OF TPH AND TRPH RESULTS IN SOIL SAMPLES

Table 6A: In/near Proposed Channel

Analyte	Units	PQL	Soil Screening Criteria – Residential (Shallow Soils <3m)**	Soil Screening Criteria – Residential (Deep Soils >3m)**	A-RW-020-D1 (20' –28')	A-RW-020-D2 (16' –19')	A-RW-020-D3 (12'-16')	A-RW-020-C3 (4'-9')	A-HSA018-D2 (16' –19')	A-HSA018-D3 (10' –12')	A-HSA018-D1 (20'-24')	A-HSA018-C3 (4'-8')	B-RW-055-C1 (0' –3.5')	B-RW-055-C2 (4' –8')	B-RW-055-D1 (10' –14')
TPH as Gasoline and Light Hydrocarbons	µg/dry g	1.000	83	83	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
TPH as Diesel	µg/dry g	5.0	83	83	<0.10	<0.10	12.9	<0.10	<0.10	11.1	<0.10	<0.10	<0.10	<0.10	<0.10
TPH as Heavy Hydrocarbons	µg/dry g	5.0	370	5000	<0.10	<0.10	72.8	<0.10	<0.10	149	<0.10	5.26	<0.10	<0.10	<0.10
Total Recoverable Petroleum Hydrocarbons	µg/dry g	5.0			<1.0	<1.0	<1.0	<1.0	<1.0	35.0	<1.0	<1.0	315	<1.0	<1.0

Table 6B: In Proposed Marsh and Transition Zone

Analyte	Units	PQL	Soil Screening Criteria – Residential (Shallow Soils <3m)	Soil Screening Criteria – Residential (Deep Soils >3m)	A-HSA-016-D1 (10.5'–12')	A-HSA-016-D2 (14'–16')	A-HSA-016-C2 (6' -10.5')	A-HSA-016-C1 (0' –6')	B-RW-043-C1 (0' –3')	B-RW-043-D1 (3' –6')	B-RW-043-D2 (6' –6.5')	B-RW-043-D3 (8'-10')	B-RW-043-D5 (10'-16')
TPH as Gasoline and Light Hydrocarbons	µg/dry g	1.000	83	83	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
TPH as Diesel	µg/dry g	5.0	83	83	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
TPH as Heavy Hydrocarbons	µg/dry g	5.0	370	5000	13.0	<0.10	<0.10	<0.10	43.5	<0.10	<0.10	<0.10	<0.10
Total Recoverable Petroleum Hydrocarbons	µg/dry g	5.0			<1.0	<1.0	<1.0	<1.0	130	<1.0	<1.0	<1.0	<1.0

Table 6C: Upland

Analyte	Units	PQL	Soil Screening Criteria – Residential (Shallow Soils <3m)	Soil Screening Criteria – Residential (Deep Soils >3m)	A-HSA-067-C1 (0' -6')
TPH as Gasoline and Light Hydrocarbons	µg/dry g	1.000	83	83	<0.10
TPH as Diesel	µg/dry g	5.0	83	83	<0.10
TPH as Heavy Hydrocarbons	µg/dry g	0.10	370	5000	<0.10
Total Recoverable Petroleum Hydrocarbons	µg/dry g	5.0			<1.0

Notes: ** SFRWCQB, 2007.

J – Below the Reporting Limit (RL) but above the Method Detection Limit (MDL)

Blue - Detections of Constituents Listed.

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The results of the 2012 Sediment Characterization Investigation in Areas A and B are also presented based on the three types of final use/habitat types which were defined in the SAP and which formed the basis for the scope and focus of the investigation. The results are presented for samples collected:

1. in or near the proposed re-aligned channel – Table 7A;
2. in the proposed marsh or transition zones – Table 7B; and,
3. from proposed upland habitat areas –Table 7C.

Material Used for Wetland Surface in Proposed Realigned Channel

The results of the analytical analysis of samples taken at the proposed depth of the re-aligned channel indicate concentration of metals, pesticides, PAHs and PCB are all below the most stringent guidelines including the ER-L values (Young et. al., 1995) and the Beneficial Reuse wetland surface criteria (Germano & Associates, 2004). The concentrations are all well below the historical ranges and averages reported for the existing Area B tidal marsh channel sediments. Historical data on sediment characteristics in the existing Ballona Creek Estuary are discussed in Section 3.5.

A bioassay study was conducted on the samples collected within the anticipated depth of the new marsh surface. Results indicated low to moderate toxicity for one of the marine arthropods, *Eohaustorius estuarius*. These samples contained low concentrations of contaminants and a high percentage of fine sediments, leading to speculation that the toxicity was related to sediment grain size characteristics that were outside of the tolerance range of the toxicity test species (Kendall, 1999 and SCCWRP, Bight'08 Toxicology Lab. Manual). As an additional study to further evaluate the cause of the toxicity result, a toxicity identification evaluation (TIE) study was conducted by the Southern California Coastal Water Research Project (SCCWRP) in 2014 (Greenstein and Bay 2014; included as Appendix C). This TIE study concluded that multiple lines of evidence indicated that nonchemical factors, possibly related to sediment texture, were the most likely cause of toxicity for the sediment (Greenstein and Bay 2014). The result suggests that toxicity was impacted by some physical characteristic, such as clay content. The implication is that the physical sediment properties (e.g., texture, clay content) are not suitable for supporting the marine arthropod, *Eohaustorius estuaries* because this species is adapted to inhabiting environments with sandier sediment. Therefore, the bioassay and TIE results indicate that the fine-grained sediment at Ballona is not likely to support *Eohaustorius estuaries* and that the low concentrations of chemical contaminants are not likely to impact benthic communities.

Material Used for Wetland Surfaces in Areas A and B

The results of the analytical analysis of samples taken at approximately the proposed depth of the new marsh surface indicate the concentration of copper and total DDT are above the ER-L guidelines and similar TMDL goals, but below the Beneficial Reuse wetland surface criteria. Silver concentrations are above the wetland surface guidelines in two samples that could be used for this purpose. The silver and total PCB concentration are within the range of concentration detected in sediment within existing Area B marsh channel sediments, but above the average

concentrations in several samples. The copper concentration that is above the ER-L in sample A-HAS-016-C2 (6'-10.5'), is below the average concentration in the existing Area B marsh. The bioassay results on the samples collected within the anticipated depth of the new marsh surface indicated low to moderate toxicity for one of the marine arthropods, *Eohaustorius estuaries*. As discussed above, the TIE study concluded this is most likely due to sediment texture and not chemical contamination (Greenstein and Bay 2014; Appendix C).

Material Used for Potential On-site Wetland Grading and/or Upland

The results of the analytical analysis of samples taken within the depths that will be excavated and used for either wetland grading or predominantly upland placement, indicate the concentration of silver and total DDT are above the most stringent ER-L guidelines and similar TMDL goals in two of nine and three of nine samples, respectively. These concentrations were below the criteria for wetland surface criteria (Germano & Associates, 2004) with the exception of silver in A-HSA018-D3 (10'-12'). At this borehole location, copper concentrations were also higher than the wetland surface criteria. The silver and total PCB concentration are within the range of concentration detected in sediment within existing Area B marsh channel sediments, but above the average concentrations in two and one of the nine samples, respectively. Arsenic was above the average of Area B marsh sediments in A-HSA018-D3 (10'-12'). This borehole location had the highest and greatest number of constituents above the ER-L values and the only two constituents in all 21 total samples collected in Area A and B that were above the Beneficial Reuse wetland surface criteria. No bioassay testing was performed on this material.

Material Used for Wetland Foundation

The concentrations of constituents in the samples collected from depths that are anticipated to be below the proposed marsh surfaces and serve as wetland foundation material are all below the ER-L values with the exception of silver concentrations in one of eight samples (A-HAS-016-D1 -10.5'-12'). The concentrations for these materials are not above the guidelines for Beneficial Reuse wetland foundation material. The bioassay results on the samples collected within the anticipated depth of wetland foundation material indicated low to moderate toxicity for one of the marine arthropods, *Eohaustorius estuaries*. As discussed above, the TIE study concluded this is most likely due to sediment texture and not chemical contamination (Greenstein and Bay 2014; Appendix C).

Material Used for Potential Off-site Discharge in Marine Waters

The scope of this sediment investigation did not include sediment sampling and analyses for comparison to criteria for off-site discharge in marine waters (e.g., offshore disposal at the LA-2 disposal site). The proposed project includes potential off-site ocean disposal or open water placement (e.g., off-site shallow water habitat creation or either confined aquatic disposal (CAD) or CAD cover). Any material to be used for off-site ocean or open water placement will be tested and assessed in accordance with applicable EPA and USACE guidance as discussed in Section 4.

3.4 Ballona Creek Estuary Sediment Characteristics-Historical Results

Based on the current restoration plan for Ballona Wetlands, areas of the existing Ballona Creek will be filled and covered, while other parts of the channel will remain intact. Therefore, portions of the current sediment within the Ballona Creek Estuary will continue to serve as estuarine habitat. Investigation of the characteristics of these sediments and their suitability for use as wetland surface materials were not part of the field and laboratory sediment characterization

TABLE 7
SUMMARY OF SEDIMENT SAMPLES RESULTS AND COMPARISON TO BENEFICIAL USE GUIDELINES AND AREA B MARSH SEDIMENT QUALITY

Table 7A: Samples in/near Proposed Channel

Group	Analyte	Units	PQL	Dredged Material Screening Criteria[1] ER-L	ER-M	Wetland Benefial Use Guidelines[2] Wetland Surface	Wetland Foundation	Range of Concen. Ballona Area B[3]	Average Concen. Area B[4]	Ballona Estuary TMDL Goals (ER-L)[5]	A-RW-020-C3 (4'-9')	A-RW-020-D3 (12'-16')	A-RW-020-D2 (16' –19')	A-RW-020-D1 (20'-28')	A-HSA018-C3 (4'-8')	A-HSA018-D3 (10' –12')	A-HSA018-D2 (16' –19')	A-HSA018-D1 (20'-24')	B-RW-055-C1 (0' –3.5')	B-RW-055-C2 (4' –8')	B-RW-055-D1 (10' – 14')
Metals	Arsenic (As)	µg/dry g	0.120	8.2	70	40	40	3.7-14.6	8.43		2.60	0.953	1.79	2.32	5.30	**16.6**	0.953	1.71	1.88	2.80	1.78
	Cadmium (Cd)	µg/dry g		1.2	9.6	0.250	0.620	0.49-6.16	2.44	1.2	**0.639**	**0.927**	0.0623	**0.329**	**0.369**	**0.963**	0.101	**0.309**	**0.381**	0.161	**0.46**
	Chromium (Cr)	µg/dry g		81	370	119	320	18-97.2	55.34		16.8	17.3	16.4	18.2	17.2	20.6	20.7	16.2	15.3	15.2	14.1
	Copper (Cu)	µg/dry g	0.030	34	270	50	150	17-440	77.71	34	28.5	14.9	21.9	19.4	26.5	**53.7**	19.5	27.4	22.9	19.3	25.2
	Lead (Pb)	µg/dry g	0.010	46.7	218	200	200	20.8-265	88.16	46.7	7.00	4.74	2.42	4.23	7.64	**58.7**	5.20	6.10	11.2	5.03	6.21
	Mercury (hg)	µg/dry g		0.15	0.71	1.18	1.18	.041-.272	0.16		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Nickel (Ni)	µg/dry g		20.9	51.6	230	230	9.2-39.29	24.78		15.6	15.8	13.1	15.2	15.8	17.8	13.8	13.5	13.9	13.7	18.0
	Silver (Ag)	µg/dry g	0.020	1	3.7	0.28	2.00	0.05-3.77	1.15	1.0	**0.794**	0.164	0.0159 (J)	0.0545	0.110	**1.44**	0.0296	0.0748	**0.285**	0.083	0.0349
	Zinc (Zn)	µg/dry g	0.160	150	410	1200	1200	54.9-1770	285.54	150	67.9	46.0	56.0	41.5	60.8	**187**	60.9	52.2	59.9	45.4	53.3
Pesti-cides & PCBs	Total DDT	ng/dry g	2.0	1.58	46.1	250	250	0-17.1	4.41	1.9*	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**4.27**	<1.0	<1.0
	Total Chlordane	ng/dry g	2.0	0.5	6	69.2	69.2	0-51.4	6.03	1.3*	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**2.42**	<1.0	<1.0
	Total PCB	ng/dry g	2.0	22.7	180	600	600	0-36	10.8	3.2*	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.85 (J)	<1.0	<1.0
	Total PAHs	µg/dry g		4.022	44.79	6.3		0-3.25	0.434	4.022	<0.010	0.1159	<0.010	0.0134	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Bioassay	*Eohaustorius estuaries – 10 day survival*	%						98.6-9.38	79					79				79			69
Potential Beneficial Use (Wetland Surface (WS), Wetland Foundation (WF), Wetland Grading, Upland (WG/UP))											WG/UP	WG/UP	WG/WS	WS	WG/UP	WG/UP	WS	WS/WF	UP/WG	UP/WG	WS/WF

Table 7B: Samples in Proposed Marsh and Transition Zone

Group	Analyte	Units	PQL	Disposal Option Sediment Screening Criteria[1] ER-L	ER-M	Bay Area Recommended Guidelines[2] Wetland Surface	Wetland Foundation	Range of Concen. Ballona Area B[3]	Average Concen. Area B[4]	Ballona Estuary TMDL Goals (ER-L)[5]	A-HSA-016-C1 (0' –6')	A-HSA-016-C2 (6' - 10.5')	A-HSA-016-D1 (10.5'– 12')	A-HSA-016-D2 (14'– 16')	B-RW-043-C1 (0' –3')	B-RW-043-D1 (3' –6')	B-RW-043-D2 (6' –6.5')	B-RW-043-D3 (8'-10')	B-RW-043-D5 (10'-16')
Metals	Arsenic (As)	µg/dry g	0.120	8.2	70	40	40	3.7-14.6	8.43		2.01	2.57	2.67	1.77	1.91	0.895	N/A	1.2	2.01
	Cadmium (Cd)	µg/dry g		1.2	9.6	0.250	0.620	0.49-6.16	2.44	1.2	0.177	**0.537**	**0.779**	0.244	**0.460**	**0.441**	N/A	0.0713	**0.506**
	Chromium (Cr)	µg/dry g		81	370	119	320	18-97.2	55.34		9.75	23.0	19.8	14.1	11.9	13.6	N/A	11.3	15.1
	Copper (Cu)	µg/dry g	0.030	34	270	50	150	17-440	77.71	34	7.3	**35.6**	28.7	24.0	22.6	19.1	N/A	13.5	22.4
	Lead (Pb)	µg/dry g	0.010	46.7	218	200	200	20.8-265	88.16	46.7	2.26	6.84	24.2	4.69	42.6	9.11	N/A	2.52	5.29
	Mercury (hg)	µg/dry g		0.15	0.71	1.18	1.18	.041-.272	0.16		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	N/A	<0.1	<0.1
	Nickel (Ni)	µg/dry g		20.9	51.6	230	230	9.2-39.29	24.78		9.3	19.9	17.2	13.6	9.72	14.8	N/A	9.9	15.0
	Silver (Ag)	µg/dry g	0.020	1	3.7	0.28	2.00	0.05-3.77	1.15	1.0	0.039	0.114	**1.53**	.0174J	**1.25**	0.110	N/A	0.0583	0.103
	Zinc (Zn)	µg/dry g	0.160	150	410	1200	1200	54.9-1770	285.54	150	20.1	55.8	86.1	55.7	1.25	45.9	N/A	45.4	43.9
Pesti-cides & PCBs	Total DDT	ng/dry g	2.0	1.58	46.1	250	250	0-17.1	4.41	1.9*	**3.12**	**18.62**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Total Chlordane	ng/dry g	2.0	0.5	6	69.2	69.2	0-51.4	6.03	1.3*	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Total PCB	ng/dry g	50	22.7	180	600	600	0-36	10.8	3.2*	<25	<25	<25	<25	<25	<25	<25	<25	<25
	Total PAHs	µg/dry g		4.022	44.79	6.3		0-3.25	0.434	4.022	<0.010	<0.010	<0.010	<0.010	0.20	<0.010	<0.010	<0.010	<0.010
Bioassay	*Eohaustorius estuaries – 10 day survival*	%						98.6-9.38	79			86	86					69	
Potential Beneficial Use (Wetland Surface (WS), Wetland Foundation (WF), Wetland Grading, Upland (WG/UP))											WG/UP	WS/WG	WS/WF	WF	WS/WG	WS/WF	WF	WF	WF

Table 7C: Samples from Proposed Upland

Group	Analyte	Units	PQL	Dredged Material Screening Criteria[1] ER-L	ER-M	Wetland Beneficial Use Guidelines[2] Wetland Surface	Wetland Foundation	Range of Concen. Ballona Area B[3]	Average Concen. Area B[4]	Ballona Estuary TMDL Goals (ER-L)[5]	A-HSA-067-C1 (0'–6')
Metals	Arsenic (As)	µg/dry g	0.120	8.2	70	40	40	3.7-14.6	8.43		2.93
	Cadmium (Cd)	µg/dry g		1.2	9.6	0.250	0.620	0.49-6.16	2.44	1.2	**0.374**
	Chromium (Cr)	µg/dry g		81	370	119	320	18-97.2	55.34		21.2
	Copper (Cu)	µg/dry g	0.030	34	270	50	150	17-440	77.71	34	25.7
	Lead (Pb)	µg/dry g	0.010	46.7	218	200	200	20.8-265	88.16	46.7	7.74
	Mercury (hg)	µg/dry g		0.15	0.71	1.18	1.18	.041-.272	0.16		
	Nickel (Ni)	µg/dry g		20.9	51.6	230	230	9.2-39.29	24.78		19.1
	Silver (Ag)	µg/dry g	0.020	1	3.7	0.28	2.00	0.05-3.77	1.15	1.0	0.106
	Zinc (Zn)	µg/dry g	0.160	150	410	1200	1200	54.9-1770	285.54	150	53
Pesti-cides & PCBs	Total DDT	ng/dry g	2.0	1.58	46.1	250	250	0-17.1	4.41	1.58	**31.04**
	Total Chlordane	ng/dry g	2.0	0.5	6	69.2	69.2	0-51.4	6.03	0.5	<0.1
	Total PCB	ng/dry g	50	22.7	180	600	600	0-36	10.8	22.7	<25
	Total PAHs	µg/dry g		4.022	44.79	6.3		0-3.25	0.434	4.022	<0.010
Potential Beneficial Use (Wetland Surface (WS), Wetland Foundation (WF), Wetland Grading, Upland (WG/UP))[6]											WG/UP

Notes:

J – Below the Reporting Limit (RL) but above the Method Detection Limit (MDL)
Yellow - Concentration exceeds the ER-L and/or the TMDL Goals
Green - Concentration exceeds wetland beneficial use guidelines (see footnote 2) for wetland surface criteria
Blue - Concentration exceeds wetland beneficial use guidelines (see footnote 2) for wetland surface and foundation criteria
* Updated with TMDL Reconsideration

Footnotes:

[1] Effects Range-Low (E-RL) and Effects Range Medium (E-RM) are used in dredged material evaluation for Ocean Disposal in combination with the results of bioassay testing and bioaccumulation testing.

[2] Sediment Reuse Criteria for Wetland Restoration – Criteria for assessing sediment for wetland surface and foundation beneficial uses were first developed by the San Francisco Regional Water Quality Control Board (SFCRWQCB, 2000). The guidelines presented are based on revised guidelines based on a Floating Percentile Method for predicting acute amphipod toxicity (Germano & Associates, 2004), and can therefore be applied to application outside of the Bay area. However, these criteria need to be used in combination with site-specific background data (see range and average concentrations for Area B in Table) and bioassay testing results on site sediments.

[3] The range of sediment concentration is based on the results presented in Table 2 in Appendix B from sediment sampling and analysis in Area B for the Ballona Wetlands Ecological Reserve Baseline Assessment Program (Santa Monica Bay Restoration Commission, 2011 and Weston, 2006).

[4] The average concentration is based on historical sediment concentrations for Area B as presented in Table2 in AppendixB.

[5] These are concentration based waste load allocations from the Ballona Estuary Toxics TMDL and based on the E-RL. This TMDL is being re-evaluated. See Appendix A for more discussion of sediment screening criteria. Based on toxicity testing, these guidelines were found to be inaccurate and highly conservative (SCCWRP, 2000).

[6] Potential beneficial use based on elevation of the material from proposed final grades. Wetland surface material is within ±5 ft of proposed final grades. Material above this may be used for wetland grading or upland material. Material 3-5 ft below the proposed final grade is wetland foundation material (WF). If sample is between these depths, dual designated use is shown.

studies conducted as part of the Restoration Design. However, historical data was reviewed to assess suitability and potential sediment quality issues for materials within the Ballona Creek Estuary, which are within the Proposed Project limits. Previous studies, which include chemistry and toxicity testing of sediment within the Ballona Creek Estuary as part of the Bight '03 program, reported that sediments within Ballona Creek Estuary are contaminated and toxic to marine life (LARWQCB &USEPA Region 9, 2005). This prevalence of toxicity led to an Environmental Protection Agency 303(d) listing and the subsequent development of a total maximum daily load (TMDL) for multiple trace organics, metals, and sediment toxicity (LARWQCB &USEPA Region 9, 2005).

In support of the TMDL, a three-year study was conducted to determine the current extent of chemical contamination within the estuary and to identify the likely causes of toxicity. Advanced chemical analysis and toxicity identification evaluation (TIE) methods were used in this study. The results indicated that chemical contamination and toxicity were widespread in the estuary (SCCWRP, 2010). Concentrations of TMDL listed compounds, including DDT, DDE, and chlordane, often exceeded target levels. However, the results of toxicity testing indicated that the concentration of these constituents were 10 to 10000 times below toxicity thresholds either developed in this study or reported in other studies. Sediment concentrations of PAHs and PCBs were also below levels likely to cause direct sediment toxicity. Metals concentrations in field sampled sediment porewater were below California water quality standards for the protection of aquatic life (SCCWRP, 2010).

TIE analyses of whole sediments and porewater found that pyrethroid pesticides were likely the primary source of toxicity within the estuary. Comparison of these pesticides' toxicity thresholds to chemical analysis results confirmed that sufficient pyrethroids were present in the estuary sediments to cause toxicity. Another currently used pesticide, fipronil, was detected in estuary sediments and may also be of concern (SCCWRP, 2010). The issue of synthetic pyrethroids impacts on the sediment in the Ballona Estuary that will remain exposed per the Proposed Project needs to be addressed. Design measures to address this issue may include removal of the sediments to a depth that does not contain concentrations that are toxic and preserves the designated beneficial uses.

Guidelines for sediment quality for the Ballona Estuary are presented in the Toxics Pollutants TMDL developed by the Los Angeles Regional Water Quality Control Board (LARWQCB, 2005). These guidelines are based on the Effects Range-Low (E-RL) criteria. The results of the sediment characterization study as part of the TMDL Reconsideration, indicated the E-RL sediment quality guideline values used as target concentrations for the chemicals listed in the TMDL were found to be inaccurate and highly conservative. The ER-Ls for some metals were below background concentrations typical of estuarine environments. For the organic compounds, ER-Ls were several orders of magnitude below toxicity thresholds for benthic organisms (SCCWRP, 2010). Therefore use of these guidelines for sediment screening purposes may not be applicable for the Ballona Estuary. In the 2013 TMDL Reconsideration, goals for the organic compounds were updated based on recent data. Table 7 includes the updated TMDL goals.

CHAPTER 4
Ocean Disposal Requirements

On-site sediment that is not used for on-site beneficial use as wetland surface, wetland foundation or upland placement may be designated for alternative placement depending on final cut and fill balance quantities. The suitability of on-site excavated sediment for placement at a designated ocean dredged material disposal site such as LA-2 offshore of San Pedro, would require a Tier III evaluation in accordance with Evaluation of Dredged material Proposed for Discharge in Waters of the U.S. – Testing Manual (ITM; USEPA/USACE 1998, Section 6.7) and Evaluation of Dredged Material Proposed for Ocean Disposal – Testing Manual (OTM; USEPA/USACE 1991) guidelines. Sampling and testing requirements under these protocols include:

- **Sampling Frequency** - The general rule is a minimum of two composite samples will be used for the first 100,000 cubic yards (CY) and one composite sample will be used per subsequent 100,000 CY. However, additional composites or analyses of individual cores may be required if contaminant hot spots are identified.
- **Geotechnical Testing** - Physical analysis should include grain size, specific gravity, and total solids. Atterberg limits are also recommended to estimate strength and settlement characteristics of the sediment.
- **Chemical Testing** - Chemical analysis of bulk sediment should include general chemistry (i.e., ammonia, total sulfides, and total organic carbon [TOC]), trace metals, chlorinated pesticides, PCB Congeners, PAHs, other semivolatile organic compounds (i.e., phenols and phthalates), and organotins.

Similar to the assessment of the suitability of the project's excavated sediment for use as on-site wetland surface and foundation materials, the chemical analyses results may be compared to ER-L and ER-M values. The values are helpful in assessing the potential significance of elevated sediment-associated contaminants of concern, in conjunction with biological analysis. While these screening level values are useful for identifying elevated sediment-associated contaminants, they should not be used to infer causality because of the inherent variability and uncertainty of the approach. As presented previously, the results of chemical analyses of on-site sediment samples indicated concentrations of lead, copper, zinc, silver, and total DDT above the ER-L in several samples. Concentrations were not above the ER-Ms.

The additional biological testing that is required under the ocean disposal guidance includes:

- **Solid Phase Toxicity Testing** - Two solid phase (SP) 10-day acute tests performed on whole sediment are conducted to estimate potential adverse effects of ocean disposed dredged material on benthic organisms. One SP test may be conducted using an amphipod

species. The species should be selected based on grain size tolerance (i.e., *Eohaustorius estuarius* prefer primarily coarse-grained sediment while *Ampelisca abdita* prefer fine-grained sediment) to reduce confounding effects unrelated to contaminants. The polychaete *Neanthes arenaceodentata* may be used.

- **Suspended particulate phase (SPP) Toxicity Testing** – Three suspended particulate phase (SPP) tests are required. SPP tests are conducted to estimate the potential adverse effects of ocean disposed dredged material on organisms that live in the water column. These tests are performed on sediment elutriates, prepared at a ratio of one part sediment and four parts site water in accordance with ITM (USEPA/USACE 1998) and OTM (USEPA/USACE 1991) guidelines. SPP tests may be performed using the mysid shrimp *Americamysis bahia* (formerly *Mysidopsis bahia*), the fish *Menidia beryllina*, and the larvae of a bivalve. The bivalve species may include *Mytilus galloprovincialis*; however, if gravid mussels are not available, an alternate species should be selected in consultation with USEPA and USACE. Both the mysid shrimp and fish SPP tests are 96-hour acute tests, while the *M. galloprovincialis* SPP test is a 48-hour chronic test that measures both survival and development.

- **Bioaccumulation Potential Testing**—The Bioaccumulation Potential (BP) testing consists of a 28-day test performed on whole sediment. The purpose of the BP tests is to estimate the potential of benthic organisms to bioaccumulate contaminants of concern from ocean disposed dredged material. BP tests may be conducted using the bivalve *Macoma nasuta* and the polychaete *Nereis virens*; however, *Nephthys caecoides* may be used as an alternative polychaete species. At test termination, bioaccumulation tissue samples should be submitted for chemical analysis. The tissue analyte list should focus on those chemicals present at levels of concern in sediment (i.e., greater than ER-M values) and based on approval by the Contaminated Sediment Task Force prior to analysis of tissue samples.

The biological testing that has been performed to date on the on-site sediment for assessing suitability for on-site beneficial use has included solid phase toxicity testing. As discussed previously, the result of this toxicity testing indicated a significant difference from the control for one of the three species tested. The differences from the control sample were observed for the *Eohaustorius estuaries,* which is likely the result of the fine-grained nature of the sediment samples as discussed.

Based on the available results, the placement of on-site excavated sediments (not used for on-site wetland restoration and upland habitat) at a designated ocean disposal or open water placement site remains a potential option, if needed. However, the determination of suitability will require further biological testing in accordance with ITM (USEPA/USACE 1998) and OTM (USEPA/USACE 1991) guidelines as outlined above. The additional testing will include running the solid phase toxicity testing using a fine-grained control, and SSP and BP testing as discussed above.

For SPP testing, results are compared to the control. If a median lethal concentration (LC50) or median effective concentration (EC50) can be calculated, a dilution water model should be used to perform a comparison with water quality standards. A short-term fate (STFATE) mixing zone model should be used to determine if LPC requirements will be met; water column concentrations

must not exceed 1 percent of the LC50 or EC50 outside the mixing zone 4 hours after dredged material disposal.

For BP testing, tissue concentrations are compared with applicable U.S. Food and Drug Administration (FDA) action levels, and tissue concentrations of organisms exposed to reference sediment. If tissue concentrations of organisms exposed to test sediment are statistically elevated compared to the organisms exposed to reference sediment, results should be assessed based on the criteria specified in the OTM (USEPA/USACE 1991; e.g., toxicological importance of contaminants, magnitude of exceedance, and propensity to biomagnify).

The biological testing for the evaluation of suitability for on-site beneficial use and ocean disposal was performed using a phased approach to avoid the need for unnecessary testing. Additional testing will be performed as needed in accordance with applicable requirements.

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CHAPTER 5
Conclusions and Recommendations

Based on the sediment characterization results to date for Areas A and B, the following key conclusions and recommendation are presented:

Wetland Surface Materials

The results of the sediment characterization indicate that constituent concentrations in the sediments that are located at depths that are anticipated to serve as wetland surface material are below the Beneficial Reuse guidelines (SFBRWQCB, 2000 and Germano & Associates, 2004) with the exception of silver in two out of the nine samples tested. The concentrations of silver in these two samples are above both the ER-L (and therefore, TMDL) and Beneficial Reuse values. As discussed in Section 3.4, the results of the sediment characterization study conducted as part of the TMDL Reconsideration indicated the ER-L sediment quality guideline values used as target concentrations for the chemicals listed in the TMDL were inaccurate and highly conservative. Therefore use of these guidelines for sediment screening purposes may not be applicable for the Ballona Estuary. Additional investigation may be warranted to demonstrate that these concentrations are within the range of marine sediments, do not demonstrate toxic levels, and fall within the range of the concentrations measured in historical monitoring of the existing Area B tidal marsh.

Per the screening methodology presented in the SAP and shown on Figure 6, samples that have concentrations above the Beneficial Reuse guidelines for wetland surfaces underwent bioassay testing. The results of the bioassay tests on these samples indicate moderate to low toxicity for one of the three species tested. An additional TIE study concluded that multiple lines of evidence indicated that nonchemical factors, possibly related to sediment texture, were the most likely cause of toxicity for the sediment (Greenstein and Bay 2014; Appendix C). As discussed, the toxicity response in this arthropod species is likely due to fine-grained sediments despite the absences of chemical stressors (Kendall, 1999 and SCCWRP, Bight'08 Toxicology Lab Manual, Greenstein and Bay 2014). The results to date indicate that the materials that are anticipated for use as wetland surface and foundation materials are suitable.

Material Used for Wetland Grading and Upland Placement

The results of the sediment characterization indicate that constituent concentrations in the sediments that are located above the proposed restoration elevation that would be used for either wetland final grading or upland placement are below the Beneficial Reuse guidelines for wetland surface (SFBRWQCB, 2000 and Germano & Associates, 2004) with the exception of silver and copper in one sample (A-HAS-018-D3 -10'-12') out of the eight samples tested. The

concentrations of silver and copper in this one sample are above both the ER-L (and therefore TMDL) and Beneficial Reuse values. Concentrations of arsenic, lead, and zinc are also above the ER-Ls in this sample. Total DDT concentrations in three of the eight samples are above the ER-L values. Additional investigation may be warranted to demonstrate that these concentrations are within the range of marine sediments.

Per the screening methodology presented in the SAP and shown on Figure 6, samples that have concentrations above the wetland surface guidelines underwent bioassay testing. The results of the bioassay tests on these samples indicate moderate to low toxicity for one of the three species tested. As discussed, the toxicity response observed is likely due to the fine-grained nature of the sediments. The results indicated no concentrations above the wetland foundation guidelines. Testing of consolidated materials during the restoration phase should be considered prior to placement on-site to verify these results. Material used for wetland grading should undergo testing at a higher frequency compared to soils that will be used for upland placement.

Wetland Foundation Materials

The results of the sediment characterization indicate that sediments that will be used below the wetland surface are below the Beneficial Use guidelines for wetland foundation (SFBRWQCB, 2000 and Germano & Associates, 2004). One of the eight samples collected and analyzed contains silver concentrations above the ER-L value.

Ocean Disposal

Based on the available results, the possible placement of on-site excavated sediments (not used for on-site wetland restoration and upland habitat) at a designated ocean disposal or open water placement site remains a potential alternative if needed. However, the determination of suitability will require further biological testing in accordance with ITM (USEPA/USACE 1998) and OTM (USEPA/USACE 1991) guidelines as outlined in Section 4 above. The additional testing will include running the solid phase toxicity testing using a fine-grained control, and suspended solid phase toxicity and bioaccumulation potential testing.

TABLE 8
SUMMARY OF BIOASSAY RESULTS

Bioassay	Species	Endpoint	Laboratory Control	Thresholds for Toxicity Categories (Bight'08)	A-HSA-016 (8'-12')	B-RW-043- (6.5'-10') B-RW-055- (10'-16') Composite	A-HSA-018-D1(20'-28') A-HAS-020-D1(20'-28') Composite
10-day Solid Phase Test	*Ampelisca abdita* Marine amphipod	Mean Survival (%)	95.0		94.0	82.0	91.0
10-day Solid Phase Test	*Neanthes arenaceodentata* Marine polychacte	Mean Survival (%)	100		100	96.0	92.0
10-day Solid Phase Test	*Eohaustorius estuaries* Marine amphipod	Mean Survival (%)	96.0	90-100 –Nontoxic 82-89 – Low Toxicity 59-81 – Moderate Toxicity <59 High Toxicity	86.0	69.0	79.0
Grain Size Characteristics*					CL Low Plasticity Clay, Silty Clay	CH High Plasticity Clay, Silty Clay	CH High Plasticity Clay, Silty Clay

Notes: * SCCWRP, 2011 Annual Report, Greenstein, D. & Steven Bay

Yellow - Significant difference between Laboratory Control and test.

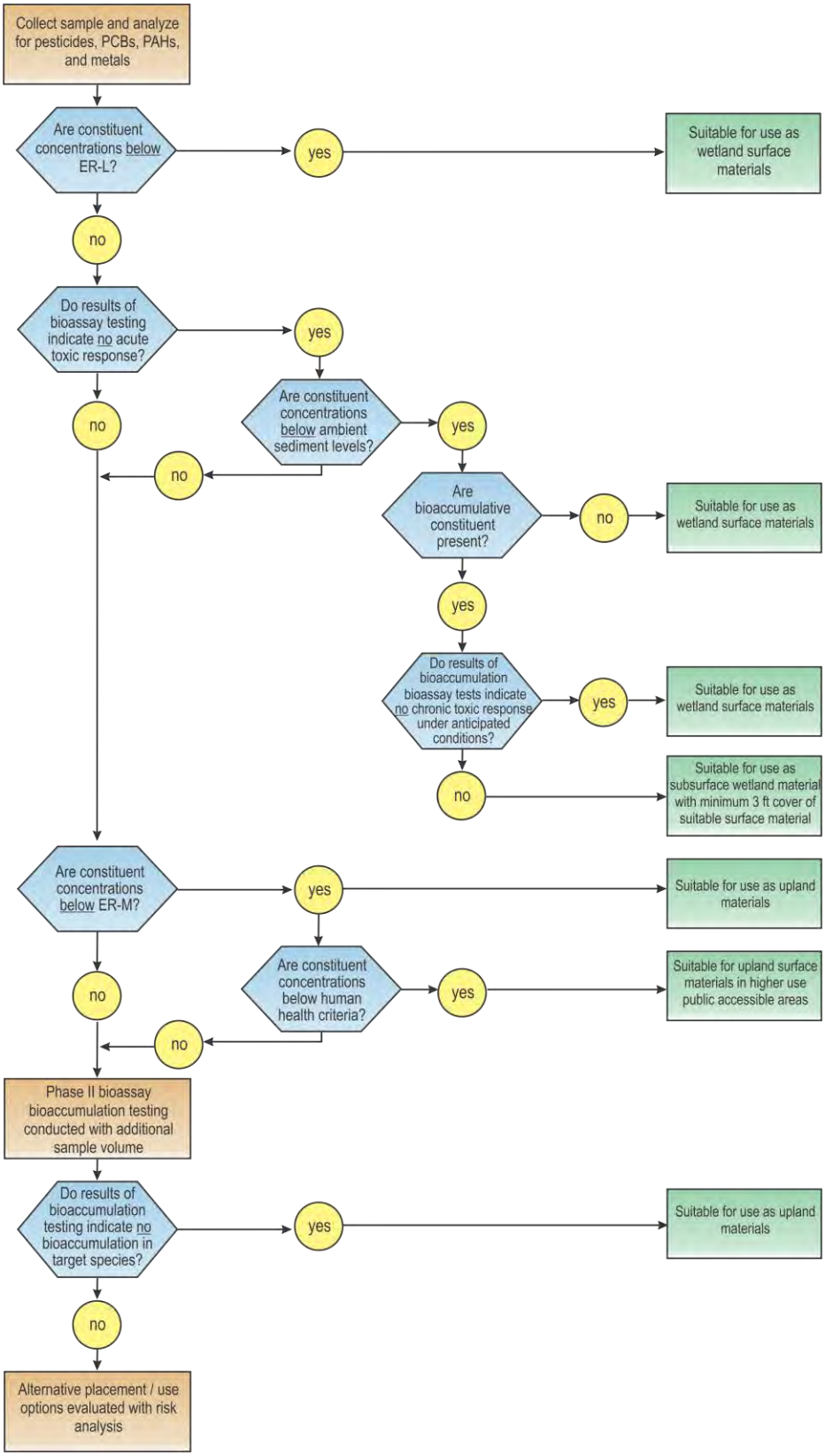

Figure 6. Sediment Beneficial Use Screening Tool

CHAPTER 6
Steps forward

Based on the conclusions and recommendations presented for this sediment characterization study, the following Steps Forward are presented to inform the Environmental Impact Report for the Proposed Ballona Restoration Project:

1. **Suitability of Upland Material** – Materials that are planned for use as upland material shall not possess constituent concentrations above the ER-M. These materials shall also be below the Soil Screening Criteria for shallow and deep soils, where applicable, depending on the depth of the final placement (SFRWCQB, 2007). Materials that are to be used as surface upland materials (top six inches) shall meet the applicable California Human Health Screening Levels (CHHSLs) and Preliminary Remediation Goal (PRGs), or demonstrate that the constituent concentrations are within the typical range of marine sediments and do not exhibit a potential human health risk. For the sediments sampled to date, the only constituent that is above these criteria is arsenic.

   If these materials are not able to be shown suitable for use as surface materials for upland areas based on the CHHSLs, then they shall be covered with a minimum one foot clean layer of soil that shall meet all the above criteria listed for suitability as surface upland materials for both ecological and human health criteria. The top foot of material shall also meet the agronomical requirements for establishing the designated upland habitat. Material below the one foot of clean cover shall still meet the PRGs and Soil Screening Criteria (SFRWCQB, 2007).

2. **Suitability for Potential Marine Discharge** – Any materials that are planned for off-site ocean disposal or open water placement shall be further tested and assessed in accordance with ITM (USEPA/USACE 1998) and OTM (USEPA/USACE 1991) guidelines. The testing results to date do not preclude this alternative, but require further biological testing to meet the applicable guidelines. This additional testing will include running the solid phase toxicity testing using a fine-grained control, and suspended solid phase toxicity and bioaccumulation potential testing. If the material is determined to be suitable for this placement alternative, specific permitting for ocean disposal or open-water placement will be required for the designated site.

3. **Sampling and Analysis Plan** – The methods and frequency for testing excavated sediment for use as the various proposed beneficial uses will be defined in coordination with the permitting agencies in a Sampling and Analysis Plan for any additional sampling performed during the restoration design and/or implementation.

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CHAPTER 7
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APPENDIX A.
Relevant Screening Criteria for Area A Sediments

Analytical results will be compared to relevant soil screening levels, sediment quality guidelines, and hazardous waste criteria to determine suitability of material for specific beneficial uses or placement options. Relevant numeric standards for comparisons include:

- **Ecologically Relevant Screening Criteria**
    - **Effects Range-Low (ER-L) and Effects Range-Median (ER-M) Values**: Effect range values are used in dredged material evaluations for ocean disposal. These values were developed by Long et al. (1995), and are helpful in assessing the potential significance of elevated sediment-associated COCs, in conjunction with biological analyses. Briefly, these values were developed from a large data set where results of both benthic organism effects (e.g., toxicity tests, benthic community effects) and chemical analysis were available for individual samples. To derive these guidelines, the chemical values for paired data demonstrating benthic impairment were sorted in according to ascending chemical concentration. The ER-L was then calculated as the lower tenth percentile of the observed effects concentrations and the ER-M as the 50th percentile of the observed effects concentrations. While these values are useful for identifying elevated sediment-associated contaminants, they should not be used to infer causality because of the inherent variability and uncertainty of the approach. For dredged material evaluations, the ER-L and ER-M sediment quality values are used in conjunction with bioassay testing and are included for comparative purposes only. For certain pesticide compounds (i.e., chlordane and dieldrin) the ER-L and ER-M levels are so low as to make it largely impractical to detect them in typical harbor sediments using routine analytical procedures. Accordingly, having non-detect results that were greater than the ER-L, ER-M, or method detection limits (MDLs) would not require re-analysis. The use of ER-L and ER-M for use as screening criteria for sediments in Area A is appropriate when used as a tiered approach that includes using bioassay results to determine actual toxic effects to the benthic community.
    - **Sediment Reuse Criteria for Wetland Restoration** - These criteria were first developed by the San Francisco Regional Water Quality Control Board (SFBRWQCB) and presented in the Draft Staff Report entitled, *Beneficial Reuse of Dredged Materials: Sediment Screening and Testing Guidelines* dated May 2000. The document was prepared to assist in planning beneficial reuse projects in the Bay Area by establishing general screening guidelines and general sediment testing requirements. The guidelines include specific criteria for reuse of sediments in wetland and upland beneficial uses. The guidelines for the wetland foundation use are based on the Effects-Range Medium (ER-M) concentrations (Long et. al.,

1995). Ambient concentrations in the San Francisco Bay were used to develop the guidelines for re-use of sediments for wetland surface. These guidelines are to be used in combination with bioassay testing to determine suitability of the materials for use in wetland restoration projects (SFBRWQCB, 2000).

Additional ambient sediment chemical and toxicity testing were performed following the Draft Staff Report in 2000. A statistical analysis was performed on the historical and more recent analytical data to develop a statically derived set of recommended sediment chemistry screening guidelines for beneficial reuse. The results of this analysis and recommended guidelines were presented in *An Evaluation of Existing Sediment Screening Guidelines for Wetland Creation/Beneficial Reuse of Dredged Material in the San Francisco Bay Area along with a Proposed Approach for Alternative Guideline Development* (Germano & Associates, 2004) that was funded by the California State Coastal Conservancy. The recommended guidelines presented in the 2004 report are based on the Floating Percentile Method for predicting acute amphipod toxicity. These guidelines presented in the 2004 Germano & Associates report, therefore can be applied to sites outside of the Bay area as they are based on toxicity testing results rather than ambient concentrations in San Francisco Bay. These guidelines are presented in the results summary tables to compare with constituent concentrations in sediment from Area A to assess the suitability of these materials for wetland surface and foundation beneficial uses.

- **Ballona Estuary Total Maximum Daily Loads (TMDL) Guidelines** - These guidelines for the Ballona Estuary are presented in the Toxics Pollutants TMDL developed by the Los Angeles Regional Water Quality Control Board (LARWQCB, 2005). As part of the TMDL Reconsideration, a study on the toxicity of the sediments in the Ballona Creek Estuary was performed by the Southern California Coastal Water Research Project (SCCWRP) and documented in the report on Toxicity Identification Evaluation (TIE) of Sediment in Ballona Creek Estuary (SCCWRP, 2010).

  The TIE testing was performed to determine the cause of the toxicity response in sediments and to compare the TMDL guidelines to actual ambient concentrations in the wetland. The TIE analyses of whole sediments and pore water found that pyrethroid pesticides were the likely primary source of toxicity within the estuary. Comparison of these pesticides' toxicity thresholds to chemical analysis results confirmed that sufficient pyrethroids were present in the estuary sediments to cause toxicity. Concentrations of TMDL listed compounds often exceeded target levels, but there was a poor correlation between these concentrations and toxicity. The Effects Range Low (ER-L) sediment quality guideline values used as target concentrations for the chemicals listed in the TMDL were found to be inaccurate and highly conservative. The ER-Ls for some metals were below background concentrations typical of estuarine environments. For the organic compounds, ER-Ls were several orders of magnitude below toxicity thresholds for benthic organisms. Based on these results, it can be anticipated that the current Toxics TMDL will be revised to reflect that the primary constituents of concern in the estuary are synthetic pyrethroid pesticides, and that the TMDL goals will be modified for the metals and organic compounds currently listed. The use of the TMDL goals based on the ER-L for screening purposes may not be applicable

based on these reported results. The TMDL goals are presented with in the summary results tables for sediment chemistry for information purposes.

- **Bight '08 Toxicity Criteria -** The level of toxicity associated with each sediment sample that underwent toxicity testing was calculated using thresholds established for the SQO program (Bay *et al*. 2009) and presented in the Bight '08 Sediment Toxicity Report (SCCWRP, 2008). The thresholds are specific to each of the toxicity test methods as shown on Table A-1 taken from the Bight '08 Sediment Toxicity Report. Using the thresholds, each sample was classified as Nontoxic, Low Toxicity, Moderate Toxicity, or High Toxicity. Each of these toxicity categories reflects both severity of toxicity and the confidence that the effects are real.

  - **Nontoxic**: Response is not substantially different from that expected in sediments that are uncontaminated and have optimum characteristics for the test species (e.g., control sediments).
  - **Low Toxicity**: A response that is of relatively low magnitude; the response may not be greater than test variability.
  - **Moderate Toxicity**: High confidence that a statistically significant toxic effect is present.
  - **High Toxicity**: High confidence that a toxic effect is present and the magnitude of response includes the strongest effects observed for the test.

TABLE-A-1
THRESHOLDS FOR CALCULATING TOXICITY CATEGORIES.

Test Species/Endpoint	Nontoxic (Percent)	Low Toxicity (Percent of Control)	Moderate Toxicity (Percent of Control)	High Toxicity (Percent of Control)
Eohaustorius estuaries Survival	90 to 100	82 to 89[a]	59 to 81[b]	< 59
Mytilus galloprovincialis Normal	80 to 100	77 to 79[a]	42 to 76[b]	< 42

a If the response is not significantly different from the negative control, then the category becomes Nontoxic.
b If the response is not significantly different from the negative control, then the category becomes Low toxicity.

- **Sediment Quality Objectives (SQOs) -** California's SQOs are described in the *Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality* (SWRCB and CA EPA, 2009). The goals of the SQOs are to determine whether pollutants in sediments are present in quantities that are toxic to benthic organisms and/or will bioaccumulate in marine organisms to levels that may be harmful to humans. The SQOs are based on a multiple lines of evidence (MLOE) approach in which sediment toxicity, sediment chemistry, and benthic community condition are the lines of evidence (LOE). The MLOE approach evaluates the severity of biological effects and the potential for chemically mediated effects to provide a final station level assessment. The use of SQOs require that the site be fully submerged under tidal conditions and assumes establishment of a benthic community. These conditions will not exist until after the restoration in Area A, therefore the use of the SQOs is not applicable. The SQOs ratings cannot be applied without the use of benthic data, and therefore are not applicable at this time

to assess Area A sediments. However, in the absence of clearly defined criteria for evaluating use of sediment in Area A for wetland surface material, chemical and bioassay methods and screening used for SQOs may be used for planning purposes and establishing baseline data as part of multiple screening criteria.

- **Human Health Screening Levels**
  - **California Human Health Screening Levels (CHHSLs)**: Concentrations of 54 hazardous chemicals in soil that the California Environmental Protection Agency (Cal/EPA) considers to be below thresholds of concern for risks to human health based on ingestion, inhalation, and dermal absorption. The CHHSLs were developed by the Office of Environmental Health Hazard Assessment (OEHHA) on behalf of Cal/EPA, and are contained in their report entitled "Human-Exposure-Based Screening Numbers are Developed to Aid Estimation of Cleanup Costs for Contaminated Soil". Any exceedances of the CHHSLs do not indicate that the levels are of concern, but suggest that further evaluation of potential human health concerns may be considered. Residential CHHSLs are recommended for use by the California Department of Toxic Substances Control (DTSC) for human health screening evaluation described in the Preliminary Endangerment Assessment (PEA) Guidance Manual.
  - **Preliminary Remediation Goals (PRGs)**: For contaminants that CHHSLs are not developed, the PRGs are used. The PRGs were developed by USEPA Region IX as a risk-based screening tool for evaluating and cleaning up contaminated sites. The Region IX PRGs were developed prior to the CHHSLs and are similar or slightly less stringent. The values are calculated from current human health toxicity values with standard exposure factors to estimate contaminant concentrations in environmental media (soil, air, and water) that are considered by the Agency to be health protective of human exposures (including sensitive groups), over a lifetime. As with CHHSLs, exceedances do not indicate that the levels present are a human health concern, however, more evaluation may be required.
  - **Soil Screening levels (ESLs):** These screening levels for soils and groundwater were developed by the California Regional Water Quality Control Board, San Francisco Bay Region and are presented in the Interim Final Report, "Screening Criteria for Environmental Concerns at Sites with Contaminated Soil and Groundwater (SFBRWQCB, 2007 – revised May 2008). These screening criteria include ELSs for shallow soils (</- 3m below ground surface (BGS)) and deep soils (>3m BGS), and are further distinguished between sites that are underlain with groundwater that is currently or is a potential drinking water sources and those that are not. These ELSs include criteria for metals, organic compound and petroleum hydrocarbon compounds and constituents. These ESLs are used to screen the sediment samples that contained total petroleum hydrocarbon compounds and constituents.
- **Hazardous Waste Criteria**
  - **Total Threshold Limit Concentration (TTLC) and Soluble Threshold Limit Concentration (STLC)**: TTLC and STLC are used to determine the hazardous waste characterization under California State regulations as outlined in Title 22 of the California Code of Regulations (CCR).Concentrations of contaminants in project soil were compared to TTLC and 10 times the STLC. If concentrations

exceed 10 times the STLC, a Waste Extraction Test (WET) must be performed to estimate the contaminant leachate. If concentrations of contaminants in soil exceed the TTLC or leachate from the WET exceed the STLC, the material is classified as hazardous waste. If a waste is determined to be a hazardous waste, specific regulations and statutes regarding the management, storage, transportation and disposal must be met.

- **Toxicity Characteristic Leaching Procedure (TCLP):** TCLP is the characterization for hazardous waste based on Federal guidelines. TCLP analysis was performed to provide an estimate of the soil contaminant leachate and to determine if this material is classified as hazardous waste or if it is considered suitable for upland placement. Analytes leaching from the soil were compared to USEPA Title 40 Code of Federal Regulations (CFR) Part 261 values (USEPA, 2006).

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APPENDIX B
Additional Result Tables

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TABLE 1
SUMMARY OF GENERAL CHEMISTRY RESULTS IN SOIL SAMPLES

TABLE 1A: IN/NEAR PROPOSED CHANNEL

Analyte	Units	PQL	A-RW-020-D1 (20' –28')	A-RW-020-D2 (16' –19')	A-RW-020-D3 (12'-16')	A-RW-020-C3 (4'-9')	A-HSA018-D2 (16' –19')	A-HSA018-D3 (10' –12')	A-HSA018-D1 (20'-24')	A-HSA018-C3 (4'-8')	B-RW-055-C1 (0' –3.5')	B-RW-055-C2 (4' –8')	B-RW-055-D1 (10' –14')
Salinity	salinity unit	1.0	10.9	8.41	3.63	4.58	4.68	5.30	7.35	4.78	4.66	3.91	5.17
Total Solids	%	1.0	67.5	74.2	70.5	69.1	71.2	70.1	57.0	78.8	83.0	50.9	65.1
pH	pH unit	1.00	7.86	8.01	8.08	7.48	7.97	7.82	7.86	7.80	8.03	8.01	8.05
Ammonia as Nitrogen	µg/dry g	1.00 - 10	35.8	11.0	27.4	31.4	15.3	58.6	35.0	20.1	17.9	8.82	40.0
Total Organic Carbon	µg/dry g	500	8,800	2,700	14,000	9,900	2,300	6,500	28,000	6,600	12,000	1,800	8,600
Sulfides, Acid-Soluble and Acid-Insoluble	µg/dry g	0.50 - 5	5.38	3.92	9.26	5.18	1.10	136	8.22	2.78	3.58	<0.50	14.5
Dissolved Sulfides, Acid-Soluble and Acid-Insoluble	µg/dry g	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50

TABLE 1B: IN PROPOSED MARSH AND TRANSITION ZONE

Analyte	Units	PQL	A-HSA-016-D1 (10.5'–12')	A-HSA-016-D2 (14'–16')	A-HSA-016-C2 (6' -10.5')	A-HSA-016-C1 (0' –6')	B-RW-043-C1 (0' –3')	B-RW-043-D1 (3' –6')	B-RW-043-D2 (6' –6.5')	B-RW-043-D3 (8'-10')	B-RW-043-D5 (10'-16')
Salinity	salinity unit	1.0	6.10	6.71	6.18	2.03	ND	4.71	5.44	5.92	8.57
Total Solids	%	1.0	71.2	72.8	63.1	83.0	81.4	69.8	67.9	75.0	62.8
pH	pH unit	1.00	8.11	7.88	8.07	7.94	8.39	7.93	8.02	7.96	7.84
Ammonia as Nitrogen	µg/dry g	1.00 - 10	53.6	21.8	40.8	10.8	31.8	41.9	54.2	6.96	47.7
Total Organic Carbon	µg/dry g	500	9,200	6,400	10,000	3,600	5,000	14,000	12,000	1,400	12,000
Sulfides, Acid-Soluble and Acid-Insoluble	µg/dry g	0.5 – 5.0	34.4	3.30	13.9	4.88	1.42	5.54	1.46	3.02	4.76
Dissolved Sulfides, Acid-Soluble and Acid-Insoluble	µg/dry g	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50

TABLE 1C: UPLAND

Analyte	Units	PQL	A-HSA-067-C1 (0' -6')
Salinity	salinity unit	1.0	8.79
Total Solids	%	1.00	70.2
pH	pH unit	1.00	7.45
Ammonia as Nitrogen	µg/dry g	1.00	19.9
Total Organic Carbon	µg/dry g	500	8,200
Sulfides, Acid-Soluble and Acid-Insoluble	µg/dry g	0.50	9.02
Dissolved Sulfides, Acid-Soluble and Acid-Insoluble	µg/dry g	0.50	<0.50

TABLE 2
ANALYTICAL RESULTS FOR BALLONA MARSH SEDIMENTS

Parameter	Units	MDL	ERL[1]	ERM[1]	WSC[2]	BWS-1[3]	BWS-3[3]	BWS-4[3]	BWS-5[3]	BWS-8[3]	BWS-9[3]	BWS-10[3]	BWS-11[3]		BW1[4]	BW4[4]	BW5[4]	BW6[4]	BW7[4]	BW8[4]	BW9[4]	BW1[5]	BW4[5]	BW5[5]	BW6[5]	BW7[5]	BW8[5]	Range[6]	Ave.[7]
Toxicity																													
Mean *Eohaustorius estuarius* survival (relative to control)	%					94.79	98.96	91.67	**64.58**	96.88	**34.38**	**60.42**	**9.38**		96.0	87.0	95.0	88.0	94.0	92.0	82.0							98.6-**9.38**	**79**
Sediment Size and TOC																													
Gravel	%					0	0	0	0	0	0	0	0																
Sand	%					51.2	70.2	79.7	22.8	47.4	37	30.5	47.4		48.1	45.6	12.8	24.9	8.4	63.6	20.7								
Silt	%					41.8	24	16.6	51.5	46.6	51.5	57.9	45.1		40.1	44	56.8	50.4	58.2	22.9	49.2								
Clay	%					7.11	5.98	3.73	25.8	6	11.5	11.6	7.47		11.4	10.4	30.4	24.7	32.4	12.3	29.7								
Median size	microns					66	250	360	13	56	40	28	56																
Mean size	microns					110	470	470	5.9	140	60	55	55																
Total Organic Carbon	%	0.001				0.919	0.777	0.372	0.597	1.15	1.04	0.41	4.64																
Metals																													
Arsenic	mg/kg	0.22	8.2	70	40	6.13	3.7	4.26	**12.4**	**10.3**	**8.45**	5.56	**14.6**		4.6	5.67	**10.84**	**10.55**	**12.25**	5.3	**11.78**	0.05	0.31	0.48	0.5	1.18	0.87	3.7-12.25	**8.43**
Cadmium	mg/kg	0.02	1.2	9.6	0.250	**2.39**	**2.12**	**1.83**	**4.5**	**4.66**	**3.67**	**3.32**	**6.16**		0.49	0.74	**1.66**	0.84	**1.27**	1.2	**1.82**	0.02	0.06	0.12	0.05	0.14	0.1	0.49-**6.16**	**2.44**
Chromium	mg/kg	0.1	81	370	119	29.2	21.9	18	70.2	52.1	35.4	33.4	64.3		38.9	60.7	**89.54**	**82.67**	**97.2**	40.15	**96.45**	0	0	0	0.03	0	0.13	18-**97.2**	55.34
Copper	mg/kg	0.18	34	270	50	**35.3**	30.6	17	**60.8**	**82.9**	**48.8**	**39.3**	**440**		**60**	**50.4**	**76.8**	**50.83**	**84.05**	28.7	**60.12**	0.13	0.04	0.11	0.86	0.13	1.21	17-**440**	**77.71**
Lead	mg/kg	0.15	46.7	218	200	46.6	26.9	20.8	**103**	**92.5**	**62.6**	24	**248**		23.1	**59.6**	**105.4**	**65.57**	**104.9**	**74.05**	**265.4**	2.93	12.53	16.3	16.46	4.03	56.47	20.8-**265.5**	**88.16**
Mercury	mg/kg	4E-04	0.15	0.71	1.18	0.122	0.065	0.041	**0.229**	**0.272**	0.143	0.0976	**0.29**		0.07	0.14	**0.2**	0.13	**0.21**	0.14	**0.19**	0	0	0	0	0	0	0.041-**.272**	**0.16**
Nickel	mg/kg	0.2	20.9	51.6	230	16	13.4	9.2	**30.7**	**27.9**	20.5	**21.7**	**38.5**		17.1	**25.9**	**37.44**	**29.11**	**39.29**	13.1	**31.93**	0.47	0.49	0.85	0.21	0.83	0.89	9.2-**39.29**	**24.78**
Silver	mg/kg	0.02	1	3.7	0.280	**1**	0.43	0.27	**3.77**	**1.54**	**1.85**	0.43	0.46		<0.05	0.61	**2.25**	0.5	**2**	0.63	**1.5**	0	0	0	0	0	0	0.05-**3.77**	**1.15**
Zinc	mg/kg	0.21	150	410	1200	**155**	109	54.9	**190**	**330**	**192**	124	**1770**		130.1	**176**	**238.2**	**172.5**	**304.9**	129.7	**206.8**	2.24	1.99	2.21	2.68	0.78	11.74	54.9-**1770**	**285.54**
Selenium	mg/kg	0.35				0.48	0.56	0.55	<0.35	1.61	<0.35	0.42	0.55		0.36	0.63	3.22	2.15	2.27	1.79	0.78							0.35-3.22	1.02
PAHs																													
Total detectable PAHs	mg/kg		4.022	44.79	6.3	0	0	0	0	0	0	0	1.5		.0308	0.333	0.225	3.25	0.215	0.679	0.281							0-3.25	0.434
Pesticides																													
Total detectable DDT	ug/kg		1.58	46.1	250	**3.6**	**17.1**	0	1.2	**7.3**	**5.6**	1	**9.6**		1.5	**3.1**	1.4	**2.7**	**3.3**	**4.2**	**4.6**							0-**17.1**	**4.41**
Total detectable chlordane	ug/kg		0.5	6	69.2	**4.5**	**51.4**	0	**1.2**	**2.4**	**2.7**	**1.2**	**6.7**		<1	**1.5**	**1.2**	<1	**1.1**	**5.9**	**9.7**							0-**51.4**	**6.03**
Pyrethroids																													
Bifenthrin	ug/kg					ND	ND	ND	ND	ND	ND	ND	34J																
PCBs																													
Total detectable PCBs	ug/kg		22.7	180	600	16	**25**	0	0	0	**36**	0	**24**		<1	4.4	11.8	<1	<1	17.2	**24.4**							0-36	10.8
Mean ERM quotient						0.22	0.80	0.07	0.32	0.32	0.26	0.15	0.84																

MDL = Method Detection Limit is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero, as defined in 40 CFR Part 136 Appendix B.
Toxicity results in bold = moderately toxic (per Bight criteria)*
Toxicity results in bold = highly toxic (per Bight criteria)*
Chemistry results in bold = exceeds ERL*
Chemistry results in bold = exceeds ERM*
J - Estimated value

FOOTNOTES:
[1] Effects Range-Low (E-RL) and Effects Range Medium (E-RM)(Long et al. , 1995)*
[2] WSC – Wetland Surface Criteria based on the Sediment Reuse Criteria for Wetland Restoration first developed by the San Francisco Regional Water Quality Control Board (SFBRWQCB)*
[3] Pohl, D. & Hartman, C., Weston Solutions, Inc., July 18, 2006. "Summary of Results from Sediment Sampling in Area B – Ballona Marsh." (Technical Memo to PWA)
[4] The Ballona Wetlands Ecological Reserve Baseline Assessment Program 2010-2011 Final Report, Santa Monica Bay Restoration Commission, June 2012 – Year 2 (2011) data.
[5] The Ballona Wetlands Ecological Reserve Baseline Assessment Program 2010-2011 Final Report, Santa Monica Bay Restoration Commission, June 2012 – Year 1 (2010) data. These results were not used for determining the average and range because the laboratory reports were not presented in the report in order to verify quality control/quality assurance data. These results were also not consistent with the two other sets for data presented in this table for which laboratory reports were available.
[6] Range of results is based on the data presented in the Weston memo dated 2006 and the 2011 data presented in the Santa Monica Bay Restoration Commission Report dated June 2012.
[7] Average of results is based on the data presented in the Weston memo dated 2006 and the 2011 data presented in the Santa Monica Bay Restoration Commission Report dated June 2012.

*See Appendix A for more detailed discussion of screening criteria

APPENDIX C
Toxicity Evaluation of Ballona Wetlands Sediment Cores

Note: As discussed in Section 3.3.2, the following toxicity identification evaluation (TIE) study was conducted by the Southern California Coastal Water Research Project (SCCWRP) in 2014 (Greenstein and Bay). This TIE study concluded that multiple lines of evidence indicated that nonchemical factors, possibly related to sediment texture, were the most likely cause of toxicity for the sediment. The result suggests that toxicity was impacted by some physical characteristic, such as clay content. The implication is that the physical sediment properties (e.g., texture, clay content) are not suitable for supporting the marine arthropod, *Eohaustorius estuaries* because this species is adapted to inhabiting environments with sandier sediment. Therefore, the bioassay and TIE results indicate that the fine-grained sediment at Ballona is not likely to support *Eohaustorius estuaries* and that the low concentrations of chemical contaminants are not likely to impact benthic communities. Results to date indicate that the materials that are anticipated for use as wetland surface and foundation materials are suitable.

Toxicity Evaluation of Ballona Wetlands Sediment Cores

November 7, 2014
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Southern California Coastal Water Research Project

Introduction

As part of an investigation into the feasibility of restoration of the Ballona Wetlands, subsurface sediment core samples were tested for toxicity to the amphipod *Eohaustorius estuarius* in 2012 (ESA PWA 2013). These core samples were taken at a depth approximate to the projected estuary surface following restoration. These tests indicated low levels of toxicity in a few samples, but the cause of the toxicity could not be determined. These samples contained low concentrations of contaminants and a high percentage of fine sediments, leading to speculation that the toxicity was related to sediment grain size characteristics that were outside of the tolerance range of the toxicity test species.

The goal of the current study was to determine the cause of the sediment toxicity detected in the previous study. Five core locations from the 2012 study were resampled and tested to verify the presence of toxicity. If toxicity was observed, then a sediment toxicity identification evaluation (TIE) would be conducted on one core sample in an effort to identify the cause of the toxicity. The TIE study plan included novel techniques to investigate whether sediment grain size was indeed a causative factor.

Methods

Subsurface sediment samples were collected on December 19 and 20, 2013 by push core using a hollow stem auger rig (Group Delta, Torrance, CA). Samples were taken from three sites in Area A and two sites in Area B (Figure 1). Sediment was collected at depths similar to those taken in 2012 and represented the location of the original grade of the wetland before the addition of fill material. Location and depth records for each sample are shown in Table 1. Multiple cores from each location were composited to provide sufficient sample for testing. Subsamples were stored in precleaned plastic or glass jars for analysis of toxicity/TIEs, contaminants, or grain size characteristics.

The sediment samples were manipulated to make them amenable for toxicity testing. The samples had a very low water content causing them to be difficult to homogenize. A small volume of sea water (20 psu) was slowly mixed into the samples to make them pliable. The volume of water added to the sample from each station was recorded.

The samples were tested for toxicity using the amphipod *Eohaustorius estuarius* and standard USEPA methods (1994) on January 10, 2014. Briefly, 150 ml of homogenized sediment was

added to each 1 L glass canning jar, and 800 ml of 20 psu sea water added above the sediment. For each of the five replicate jars, 20 amphipods were added at the start of the test. A sample of fine sandy sediment from amphipod supply site in Oregon was also included in the test as a control. The exposure was conducted at 15°C, under constant light and with gentle aeration. The only departure from standard methods was that the sediment was added to the jars four days prior to the addition of the animals and 50% of the overlying water was changed daily. This change was made because of the unusual nature of the sediments, having come from a buried, terrestrial source, rather than a marine surface sediment normally tested with this organism. The additional time gave the sediments a chance to better equilibrate with the overlying marine water. At the end of the 10 day exposure period the sediment was passed through a 0.5 mm mesh sieve and the surviving amphipods were enumerated.

The TIE experiment was initiated on February 21, 2014, and was conducted on a single sample that was selected based on the results of the initial screening test. The treatments included in the TIE are listed in Table 2. Treatments 1-9 comprise a typical basic TIE analysis for the purposes of characterizing the principal chemical toxicant type present (USEPA 2007). Each of the typical treatments included a corresponding blank treatment in which the TIE manipulation was carried out on control sediment to verify that the treatment itself was not toxic. Numerous additional treatments were included in this experiment to help determine whether toxicity was related to nonchemical factors, especially sediment texture (i.e., particle grain size and stickiness). These additional treatments consisted primarily of adding clean sediment containing various grain size characteristics, ranging from fine sand (control) to a sediment formulated to approximate the grain size distribution of the test sample (texture reference), to the test sample. The purpose of these additional treatments was to separate out the influence of contaminant dilution and grain size variations on sample toxicity. For all additions of clay, a 1:1 by dry weight mixture of two forms of Bentonite (IBEX200, a calcium ion dominated form and HPM20 a sodium ion dominated form, both from Aardvark Clay and Supplies, Santa Ana, CA) were used. The clays were hydrated with deionized water to form a paste before being mixed with the sediment.

Pore water extracted from the test sediment sample was also tested for toxicity. This test eliminated the physical influence of sediment particles on the test organism. Pore water was extracted from the sediment by centrifugation at 3000 x g for 30 minutes. After centrifugation, 10 ml of the pore water was pipetted into each of five 22 ml glass shell vials. Five *E. estuarius* were added to each vial. The animals were exposed to the pore water for 10 days at 15°C, in darkness and without aeration. At the end of the exposure the number of surviving amphipods was enumerated.

Chemical analysis of sediment from TIE test sample was conducted by Physis (Anaheim, CA). Chlorinated pesticides, PCBs, PAHs were measured using EPA Method 8270D, which includes final analysis by Gas Chromatograph with a Mass Spectrometer (GCMS). Trace metals were analyzed by EPA Method 6020 which includes final analysis by Inductively Coupled Plasma – Mass Spectrometry (ICPMS). Total organic carbon and total nitrogen were analyzed by EPA Method 9060.

Physical characteristics of the test sample and selected TIE treatments were also measured. Sediment particle size was measured using EPA Method 2560D on a laser diffraction particle size analyzer. Atterburg limits to measure sediment plasticity were analyzed by Group Delta (Torrance, CA) using ASTM D-4318.

Results

Results of the initial screening of the five stations indicated that all were toxic to varying degrees (Table 3). The survival ranged from 68 to 22% which represented a higher level of toxicity than was observed in 2012 (86 to 69% survival). Stations B-RW-043 and B-RW-055 exhibited the highest toxicity, with 22% survival in each. It was noted during termination of this test that there was a varying degree of difficulty getting the sediments to pass through a 0.5 mm sieve and that the difficulty seemed to match toxicity; the more difficult the screening, the greater the toxicity. This observation indicated that sediment texture might be playing a role in the observed toxicity.

Based on results of the initial testing, sample B-RW-055 (BW55) was selected for the TIE. Results of the TIE experiment are summarized in Table 4. The control was nontoxic (indicating that the test organisms were of good quality) and the BW55 test sample was still highly toxic, with 15% survival (Table 4). Each treatment is referenced by number to Table 2. Generally, the results for each specific treatment (except for blanks) are compared to that for BW55 (treatment 3) for interpretation. Results of the TIE indicated that none of the TIE treatments specific for chemicals (#4, 6, 8) affected toxicity; this indicates that organic chemicals, metals and ammonia are unlikely to be the cause of toxicity. The addition of fine sand to BW55 did reduce toxicity (#10, 11), while addition of a similar amount of a high silt/clay sediment similar to BW55 in grain size characteristics (#15, 16) did not reduce toxicity; these results are evidence sediment texture is a likely cause of BW55 toxicity.

Pore water from BW55 was tested as an additional line of evidence. No significant toxicity was detected in amphipods exposed to BW55 pore water (Table 5). Contact with dissolved chemicals in the pore water is considered to be a primary route of exposure of sediment-dwelling organisms to sediment contamination. Exposing the animals to the pore water alone removes any effects of sediment particle size that may be contributing to effects in the whole sediment test. Since the pore water was nontoxic, a conclusion that physical characteristics not related to chemical contaminants are the likely cause of the whole sediment toxicity is further supported.

The concentrations for all measured chemical analytes in BW55 were quite low (Tables 6-9). The only chlorinated hydrocarbon that was detectable was p,p'-DDT (Table 6). Only two PCB congeners were detected, the concentrations of both being between the method detection limit and the reporting limit (Table 7). Most PAHs were not detected and those that were had concentrations below 10 µg/kg (Table 8). None of the trace metals usually associated with toxicity were present at concentrations considered to be elevated (Table 9).

The chemical constituents were present at concentrations associated with a low probability of toxicity. All concentrations, except for p,p'-DDT, were below the Effects Range-Low (Long et al. 1995) guidelines, representing a low probability of toxicity to amphipods (Tables 6-9). The concentration of p,p'-DDT in this sample is similar to background levels in unimpacted sediments throughout the region, and is also more than 100 times less than the concentration found to cause toxicity to the toxicity test species used in this study (Greenstein et al. 2014). Evaluation of the chemistry data using methods specified in California Sediment Quality Objectives (SQO) guidance results in a classification category for BW55 of Low Exposure for sediment contaminants. The SQO exposure classification includes four categories: Minimal, Low, Moderate, and High. This classification is based on two sediment quality guidelines, the

Chemical Score Index (CSI) and California Logistic Regression Model (CALRM). The individual CSI and CALRM exposure categories were Moderate and Minimal, respectively.

Measurements of the physical properties of samples, representing a range of toxicity, were conducted. The results indicated the percentage of sediment fines (combination of silt and clay) was greater than 80% for both A-HAS-016 and B-RW-055 (Table 10). Each of these samples had a clay content of about 25% which is considerably higher than what is usually encountered in the marine environment in southern California. The Dana Pt. Reference is a typical example of fine grained marine sediments with fines around 75%, but less than 10% being clay. The total organic carbon content of the wetland core samples was in the range typically observed in the marine environment. The plasticity limits indicated the Ballona samples were in the medium plasticity range (PI 15-30).

The grain size analysis of the dilutions of BW55 with control sediment (treatments #11 and 12) did not yield as high a percentage of sand as was expected based on mass balance calculations (Table 10). This is apparently due to a previously undetected analytical issue related to the combination of very fine clay particles and the fine sand in the mixtures. The analysis method has a bias against the fine sand which is normally sieved out from coarse grained samples and analyzed separately from the silts and clays. Treatment number #12 was reanalyzed with a different sieving method and the percentage of sand was much closer to the expected value. There was not sufficient material available for treatment #11 for reanalysis.

Summary and Conclusions

Multiple lines of evidence with the capability to distinguish between chemical and nonchemical causes of toxicity were evaluated in this TIE. Comparison of these lines of evidence supports a conclusion that nonchemical factors possibly related to sediment texture were the most likely cause of toxicity for sediment from station B-RW-055 (Table 11). Three independent lines of evidence indicate that chemical factors were not a cause of toxicity. First, the three treatments that removed common types of contaminants (# 4, 6, and 8) had no effect on toxicity. Second, dilution of BW55 sediment with different types of reference or control sediments had variable effects on toxicity (e.g., #10, 12, and 15). This result suggests that toxicity was impacted by some physical characteristic, such as clay content, that varied among the treatments. Had the toxicity been related to chemical contamination in BW55, a consistent reduction in toxicity would have been observed in each sample having the same degree of dilution by reference or control sediment. The third line of evidence, lack of pore water toxicity, is also consistent with a nonchemical cause.

Measures of the physical properties of the wetland sediment samples were consistent with observations made during the toxicity test that the sediment was sticky and difficult for the test organisms to burrow through. The BW55 sediment had moderate plasticity and high clay content relative to the Dana Pt. Reference sediment. Unexpected values were obtained from the physical analysis of the texture reference TIE treatment (#13). Both the clay content and plasticity index of this sample were similar to that of treatment 2, although it was expected that these parameters would be higher than treatment 2 and similar to BW55. This may have been

due to a disconnect between the samples analyzed for the TIE and those analyzed for physical parameters There was not a sufficient amount of this sample to both conduct the TIE and measure particle size and Atterburg limits. A second batch of this mixture was created at a later date for the physical property analyses and may not have been representative of what was used in the TIE.

Direct evidence that sediment characteristics associated with clay content may be a cause of toxicity to *E. estuarius* is provided by the results for TIE treatment 13 (texture reference). This sample was composed of nontoxic natural fine-grained sediment from southern California (74% fines) that had been amended with natural clay to produce the same nominal percentage of clay as BW55. This amended sample was highly toxic, while a blank sample consisting of a similar amount of clay added to sand was nontoxic (# 14). Evidence for a sediment texture-related cause of toxicity is further supported by the results for treatments 10 and 11, where a reduction in percentage of clay in BW55 due to the addition of sandy sediment reduced the toxicity of the sample.

The magnitude of effect and specific aspects of sediment texture affecting *E. estuarius* survival is poorly understood. Previous studies by other researchers (unpublished) have reported either no effect or a much lower level of toxicity associated with additions of similar amounts of clay as used in this study. However, these other studies used different types of clay, did not conduct a detailed analysis of sediment physical characteristics, and may have used different methods to prepare the treatments. Additional research is needed to determine which specific characteristics of Ballona Wetlands sediment are responsible for the sediment toxicity measured in recent investigations, but the TIE and chemical analyses conducted in this study indicate that chemical contamination is not responsible. The more likely explanation is that the physical properties of the sediment in the core samples were not compatible with this particular toxicity test species, whose typical habitat is sandy estuarine sediment. Since this amphipod is not indigenous to the Ballona Creek Estuary and is not a species of special status, this incompatibility should not be a cause for concern.

Table 1. Location and depth of core samples taken from the Ballona Wetlands for toxicity testing.

Station	Latitude	Longitude	Depth (Feet below ground surface)
A-HSA-016	33.9720	-118.4425	8-12
A-HSA-018	33.9731	-118.4391	20-28
A-RW-020	33.9715	-118.4398	20-28
B-RW-043	33.9696	-118.4394	6.5-10
B-RW-055	33.9680	-118.4437	10-16

Figure 1. Map of coring stations within the Ballona Estuary.



Table 2. Sediment toxicity identification evaluation (TIE) treatments used on the Ballona Creek Wetland core sample.

#	Treatment or Sample	Description	Purpose	Interpretation
1	Control	Sandy sediment from amphipod collection site	Verification that the test animals are in good health	Mean survival of the amphipods must be greater than 90% for test to be valid. Results for other samples and blanks are compared to this control.
2	Fine sediment control	Silty sediment from a reference location off of Dana Pt.	Verification that finer grained sediments are not causing toxicity	High amphipod survival indicates minimal effect of fine sediments typical of southern California. Results for some treatments are compared to this treatment.
3	B-RW-055 Baseline	Unmodified test sample	Verification that test sample is still toxic following storage	Survival less than 70% of control indicates that sample is highly toxic and a TIE is feasible.
4	Coconut charcoal	Amendment of test sample with coconut charcoal at 15% (w/w)	Reduces bioavailable concentration of organic contaminants	Decrease in toxicity indicates nonpolar organic compounds as likely cause of toxicity.
5	Coconut charcoal blank	Amendment of control sediment with coconut charcoal at 15% (w/w)	QA sample to test for treatment artifacts	Survival similar to the control indicates the charcoal is not toxic.
6	Cation exchange resin	Amendment of test sample with cation exchange resin at 20% (w/w)	Reduces bioavailable concentration of cationic metals (e.g. copper, cadmium, zinc)	Decrease in toxicity indicates cationic metals as likely cause of toxicity.
7	Cation exchange resin blank	Amendment of control sediment with cation exchange resin at 20% (w/w)	QA sample to test for treatment artifacts	Survival similar to the control indicates the resin is not toxic.
8	Zeolite	Amendment of test sample with zeolite at 20% (w/w)	Reduces bioavailable concentration of ammonia	Decrease in toxicity indicates ammonia as likely cause of toxicity.
9	Zeolite blank	Amendment of control sediment with zeolite at 20% (w/w)	QA sample to test for treatment artifacts	Survival similar to the control indicates the zeolite is not toxic.
10	Dilution with control sediment - 20%	Amendment of test sample with control sediment at 20% (w/w)	Test for physical dilution effect of TIE amendments on sample toxicity. Likely to increase grain size characteristics of sample.	Decrease in toxicity similar to that obtained with chemical-specific treatments (charcoal, resin, and zeolite) indicates that those treatments were likely effective due to nonspecific dilution effects rather than binding of toxic substances. Difference in toxicity relative to other dilution treatments indicates sediment texture as a likely cause.

Table 2. Continued.

#	Treatment or Sample	Description	Purpose	Interpretation
11	Dilution with control sediment – 40%	Amendment of test sample with control sediment at 40% (w/w)	Test for effects of physical dilution and sediment texture change on test sample toxicity.	A reduction in toxicity would indicate toxicity caused by either contaminants in the sample or by sediment texture. A difference in toxicity relative to equivalent dilution by the texture reference indicates sediment texture as a likely cause.
12	Dilution with fine sediment control – 20%	Amendment of test sample with fine sediment control at 20% (w/w)	Test for physical dilution effect of TIE amendments on sample toxicity without substantially changing sediment texture.	Decrease in toxicity similar to that obtained with chemical-specific treatments indicates that those treatments were likely effective due to nonspecific dilution effects rather than binding of toxic substances. Difference in toxicity relative to other dilution treatments indicates sediment texture as a likely cause.
13	Texture reference	Mixture of Dana Pt. sediment and bentonite clay to match silt and clay content Ballona test sample.	Simulate sediment texture characteristics of test sample without presence of chemical toxicity	Increase in toxicity relative to control or fine sediment control indicates sediment texture as a likely cause of toxicity.
14	Texture reference blank – 20%	Amendment of control sediment with the texture reference at 20% (w/w)	QA sample to test for treatment artifacts	Survival similar to control indicates lack of chemical toxicity in treatment.
15	Dilution with texture reference – 20%	Amendment of test sample with texture reference sediment at 20% (w/w)	Test for physical dilution effect of TIE amendments on sample toxicity without changing sediment texture.	Decrease in toxicity similar to that obtained with chemical-specific treatments indicates that those treatments were likely effective due to nonspecific dilution effects rather than binding of toxic substances. Difference in toxicity relative to other dilution treatments indicates sediment texture as a likely cause.
16	Dilution with texture reference – 40%	Amendment of test sample with texture reference at 40% (w/w)	Test for effect of physical dilution without texture change on test sample toxicity	A reduction in toxicity indicates toxicity caused by contaminants. A difference in toxicity relative to equivalent dilution using the control sediment indicates texture as a likely cause.

Table 3. Sediment toxicity results for initial screening of core samples.

Sample	Mean Survival	Standard Deviation	Number of Replicates
Control Sediment	99	2.2	5
B-RW-043	22	8.4	5
B-RW-055	22	13.5	5
A-HAS-016	68	15.2	5
A-HAS-018	51	5.5	5
A-RW-020	28	9.7	5

Table 4. Toxicity results summary for toxicity identification evaluation treatments.

#	Treatment or Sample	Mean Survival (%)	Standard Deviation	Number of Replicates
1	Control Sediment	100	0.0	5
2	Fine Sediment Control	92.5	9.6	4
3	B-RW-055 Baseline	15	12.9	4
4	B-RW-055 Coconut Carbon	17.5	5.0	4
5	Coconut Carbon Blank	62.5	9.6	4
6	B-RW-055 Cation Exchange	12.5	12.6	4
7	Cation Exchange Blank	100	0.0	4
8	B-RW-055 Zeolite	12.5	12.6	4
9	Zeolite Blank	100	0.0	4
10	B-RW-055 Dil. Control 20%	35	5.8	4
11	B-RW-055 Dilution Control 40%	52.5	17.1	4
12	B-RW-055 Dil. Fine Sed. Control	15	5.8	4
13	Texture Reference	45	20.8	4
14	Texture Reference Blank	95	5.8	4
15	B-RW-055 Dil. Texture Reference 20%	27.5	5.0	4
16	B-RW-055 Dil. Texture Reference 40%	17.5	17.1	4

Table 5. Toxicity results summary for pore water.

#	Treatment or Sample	Mean Survival (%)	Standard Deviation	Number of Replicates
17	Control water	96	8.9	5
18	B-RW-055 pore water	88	17.9	5

Table 6. Chlorinated pesticide concentrations in sediment from station B-RW-055.

Analyte	Concentration (µg/kg dry wt)	Method Detection Limit	Reporting Limit	Effects Range Low Threshold
2,4'-DDD	ND	1	5	NA
2,4'-DDE	ND	1	5	NA
2,4'-DDT	ND	1	5	NA
4,4'-DDD	ND	1	5	NA
4,4'-DDE	ND	1	5	NA
4,4'-DDT	2.4	1	5	2.2
Aldrin	ND	1	5	NA
BHC-alpha	ND	1	5	NA
BHC-beta	ND	1	5	NA
BHC-delta	ND	1	5	NA
BHC-gamma	ND	1	5	NA
Chlordane-alpha	ND	1	5	NA
Chlordane-gamma	ND	1	5	NA
cis-Nonachlor	ND	1	5	NA
Dieldrin	ND	1	5	NA
Endosulfan sulfate	ND	1	5	NA
Endosulfan-I	ND	1	5	NA
Endosulfan-II	ND	1	5	NA
Endrin	ND	1	5	NA
Endrin aldehyde	ND	1	5	NA
Endrin ketone	ND	1	5	NA
Heptachlor	ND	1	5	NA
Heptachlor epoxide	ND	1	5	NA
Hexachlorobenzene	ND	1	5	NA
Methoxychlor	ND	1	5	NA
Mirex	ND	1	5	NA
Oxychlordane	ND	1	5	NA
Perthane	ND	5	10	NA
trans-Nonachlor	ND	1	5	NA

ND= Not detected
NA= Not available

Table 7. Polychlorinated biphenyl (PCB) congener concentrations in sediment from station B-RW-055.

Analyte	Concentration (µg/kg dry wt)	Method Detection Limit	Reporting Limit	Effects Range Low Threshold
PCB003	ND	1	5	NA
PCB008	ND	1	5	NA
PCB018	ND	1	5	NA
PCB028	ND	1	5	NA
PCB031	ND	1	5	NA
PCB033	ND	1	5	NA
PCB037	ND	1	5	NA
PCB044	ND	1	5	NA
PCB049	ND	1	5	NA
PCB052	ND	1	5	NA
PCB056(060)	ND	1	5	NA
PCB066	ND	1	5	NA
PCB070	ND	1	5	NA
PCB074	ND	1	5	NA
PCB077	ND	1	5	NA
PCB081	ND	1	5	NA
PCB087	ND	1	5	NA
PCB095	ND	1	5	NA
PCB097	ND	1	5	NA
PCB099	ND	1	5	NA
PCB101	ND	1	5	NA
PCB105	ND	1	5	NA
PCB110	ND	1	5	NA
PCB114	ND	1	5	NA
PCB118	ND	1	5	NA
PCB119	ND	1	5	NA
PCB123	ND	1	5	NA
PCB126	ND	1	5	NA
PCB128	ND	1	5	NA
PCB138	2	1	5	NA
PCB141	ND	1	5	NA
PCB149	ND	1	5	NA
PCB151	ND	1	5	NA
PCB153	1.5	1	5	NA
PCB156	ND	1	5	NA
PCB157	ND	1	5	NA
PCB158	ND	1	5	NA
PCB167	ND	1	5	NA
PCB168+132	ND	1	5	NA
PCB169	ND	1	5	NA

Table 7. Continued.

Analyte	Concentration (µg/kg dry wt)	Method Detection Limit	Reporting Limit	Effects Range Low Threshold
PCB170	ND	1	5	NA
PCB174	ND	1	5	NA
PCB177	ND	1	5	NA
PCB180	ND	1	5	NA
PCB183	ND	1	5	NA
PCB187	ND	1	5	NA
PCB189	ND	1	5	NA
PCB194	ND	1	5	NA
PCB195	ND	1	5	NA
PCB199(200)	ND	1	5	NA
PCB201	ND	1	5	NA
PCB206	ND	1	5	NA
PCB209	ND	1	5	NA
Total PCBs	3.5	1	5	22.7

ND= Not detected
NA= Not available

Table 8. Polynuclear aromatic hydrocarbon concentrations in sediment from station B-RW-055.

Analyte	Concentration (µg/kg dry wt)	Method Detection Limit	Reporting Limit	Effects Range Low Threshold
1-Methylnaphthalene	ND	1	5	NA
1-Methylphenanthrene	4.2	1	5	NA
2,3,5-Trimethylnaphthalene	ND	1	5	NA
2,6-Dimethylnaphthalene	ND	1	5	NA
2-Methylnaphthalene	ND	1	5	70
Acenaphthene	ND	1	5	16
Acenaphthylene	ND	1	5	44
Anthracene	ND	1	5	85.3
Benz[a]anthracene	ND	1	5	261
Benzo[a]pyrene	1.2	1	5	430
Benzo[b]fluoranthene	1.2	1	5	NA
Benzo[e]pyrene	1.2	1	5	NA
Benzo[g,h,i]perylene	ND	1	5	NA
Benzo[k]fluoranthene	1.4	1	5	NA
Biphenyl	ND	1	5	NA
Chrysene	2.1	1	5	384
Dibenz[a,h]anthracene	ND	1	5	63.4
Dibenzothiophene	ND	1	5	NA
Fluoranthene	6.2	1	5	600
Fluorene	1.4	1	5	19
Indeno[1,2,3-c,d]pyrene	ND	1	5	NA
Naphthalene	1	1	5	160
Perylene	ND	1	5	NA
Phenanthrene	6.2	1	5	240
Pyrene	7.8	1	5	665

ND= Not detected
NA= Not available

Table 9. Trace metal concentrations in sediment from station B-RW-055.

Analyte	Concentration (mg/kg dry wt)	Method Detection Limit	Reporting Limit	Effects Range Low Threshold
Arsenic (As)	6.204	0.025	0.05	8.2
Cadmium (Cd)	0.913	0.0025	0.005	1.2
Chromium (Cr)	43.083	0.0025	0.005	81
Copper (Cu)	33.519	0.0025	0.005	34
Lead (Pb)	11.928	0.0025	0.005	46.7
Nickel (Ni)	26.02	0.01	0.02	20.9
Selenium (Se)	0.372	0.025	0.05	NA
Silver (Ag)	0.32	0.01	0.02	1
Tin (Sn)	1.56	0.025	0.05	NA
Zinc (Zn)	84.826	0.025	0.05	150

ND= Not detected
NA= Not available

Table 10. Physical attributes of sediment from Ballona Wetlands and TIE samples.

#	Sample	Sand (%)	Silt (%)	Clay (%)	TOC (%)	Plasticity Index
3	B-RW-055	14.3	61.4	24.7	1.57	26
	A-HAS-016	21.4	59.1	19.3	1.83	20
1	Control Sediment	97.6	1.6	0.5	NA	NA
2	Fine Sediment Control	26.1	66.2	7.8	1.04	11
13	Texture Reference	25.2	62.1	12.4	NA	5
10	B-RW-055 Dilution with Control 20%	18.4	57.7	23.7	NA	NA
11	B-RW-055 Dilution with Control 40%	18.8	55.5	26.3	NA	NA
16	B-RW-055 Dilution with Texture Ref. 40%	15.7	60.6	23.2	NA	23

NA= Not analyzed

Table 11. TIE treatment interpretation summary. Treatment numbers refer to Tables 4 and 5. Definitions for stressor type indications: No = results indicate stressor type not likely to influence sample toxicity; Possible = toxicity result is plausible for stressor type but treatment is not specific for that stressor; Yes = results indicate stressor type has a major influence on sample toxicity; na = treatment not informative for this stressor type.

#	Treatment	Toxicity Change	Stressor Type Indicated	
			Chemical	Texture
4	Trace organics removal	No effect	No	Possible
6	Trace metals removal	No effect	No	Possible
8	Ammonia removal	No effect	No	Possible
10	Dilution with control sediment 20%	Decrease	Possible	Yes[1]
11	Dilution with control sediment 40%	Decrease		
15	Dilution with texture reference 20%	Slight decrease	No	Yes[1]
16	Dilution with texture reference 40%	No effect		
12	Dilution with fine sediment control 20%	No effect	No	Possible[1]
13	Texture reference	Increase	na	Yes
18	Pore water	Non toxic	No	Possible

[1] Conclusion based on comparison among results for all dilution treatment types.

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APPENDIX F6
Water Quality Technical Report

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Ballona Wetlands
Restoration Project

WATER AND SEDIMENT QUALITY TECHNICAL REPORT

Draft – Subject to Revision

September 28, 2015

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Ballona Wetlands Restoration Project
Water and Sediment Quality Technical Report

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1. Existing Water and Sediment Quality Conditions

The following discussion presents a summary of the existing water and sediment quality conditions as a basis to assess both potential impacts to the environment from the Ballona Wetlands Restoration Project (Figure 1 [Ballona Wetlands Restoration Project Site]) and potential impacts of the environment to the Project. Alternative 1, which is expected to have the greatest impacts, is assessed for simplicity. This summary of existing conditions is based on available water and sediment data. References to source documents are provided for further detail. The section is organized into two parts. Section 1.1 (Existing Conditions Summary for Impact Assessment from the Project) summarizes existing data applicable to the project site for analysis of potential impacts of the project on the environment during and following restoration construction. Section 1.2 (Existing Conditions Summary for Impact Assessment of the Environment on the Project) focuses on water and sediment quality results that are applicable to the assessment of potential impacts on the project from potential in-flows to the restored wetland areas.

1.1 Existing Conditions Summary for Impact Assessment from the Project

The water and sediment quality data summary presented in this subsection will be used to assess the following questions on potential impacts from the Project on the environment during and following construction of the restoration project:

During Construction

- What are the potential impacts of sediment migration from the Project site during grading activities due to wind borne emissions and construction equipment that can then be carried by stormwater runoff to adjacent water bodies that include Ballona Creek, existing tidal marsh, and Marina del Rey?
- What are the potential impacts of sediment migration from the Project site during construction from disturbed areas that can then be carried by stormwater runoff to adjacent water bodies that include Ballona Creek, existing tidal marsh, and Marina del Rey?
- What are the potential impacts from on-site sediments that are excavated and placed in a permitted marine placement site?

Post Construction

- What is the potential impact of site sediments on water quality and biological resources within the created and existing tidal wetlands and uplands?
- What is the potential impact of site sediments on groundwater below the site?
- What is the potential impact of site sediments on the public that may visit the site?
- Are the requirements of the Ballona Wetland TMDL achieved by the Project?



Ballona Wetlands Restoration Project

Figure 1
Ballona Wetlands Restoration Project Site

1.1.1 West Area B Existing Marsh

Sediment data collected by Weston (2006) and SMBRC (2011) indicate a potential impact from both flows from Ballona Creek and urban runoff on the sediments in West Area B. To assess the sediment samples for potential biological impact due to elevated constituents of concern, the Effects Range – Low (ER-L) and Effects Range-Median (ER-M) values can be used. The ER-Ls and ER-Ms were developed by Long et al. (1995) to evaluate dredged material for ocean disposal. In West Area B, arsenic, cadmium, copper, lead, mercury, nickel, silver, and zinc exceeded the more conservative ER-Ls in 2006 and 2011. In 2006, silver exceeded the ER-M in the most northeastern extent of the channel network. Copper, lead, and zinc exceeded the ER-Ms, as well, in the channel near Culver Boulevard, which indicates that runoff from adjacent residential communities and transportation corridors is likely impacting sediment quality in the marsh.

2006 samples near the SRT gate (Figure 1) show that the sediment is potentially impacted by pesticides, specifically chlordane and DDT, from Ballona Creek; however, 2010 and 2011 samples showed that pesticides were below limits. In 2006 and 2011, metal concentrations near the SRT gate were higher than those observed in Ballona Creek. West Area B may be acting as a sink for these metals due to the limited tidal circulation and flushing.

1.1.2 Proposed Uplands or Off-Site Disposal

The Project proposed to enhance and restore upland habitat around the site primarily using sediment excavated from Area A. Public access is also proposed in upland areas and human health criteria are discussed below in addition to ecological criteria. Sediment samples in Area A showed chemical concentrations below levels that would classify it as hazardous waste per the USEPA Title 40 Code of Federal Regulations Part 261 (USEPA 2006, Appendix A).

Human Health Criteria

Samples taken by Weston in 2008 and in 2012 indicate that all chemicals of concern, including PAHs, PCBs, pesticides, VOCs, TPHg, TPHd, BETX, and metals were below the California Human Health Screening Levels (CHHSL) or Preliminary Remediation Goal (PRG) soil criteria for potential residential land use, with the following exceptions (Weston 2009, Appendix A). Arsenic and iron were measured at ambient concentrations greater than residential CHHSLs and PRGs, but at concentrations consistent with natural marine sediments. Additionally, one sample showed elevated concentrations of PAHs just above the CHHSLs for residential land use, but well below soil criteria for potential commercial or industrial land use.

Ecological Criteria

The criteria (ER-Ls and ER-Ms) developed by Long et al. (1995) are helpful in assessing the potential biological impact of elevated constituents of concern. Another measure of potential ecological impacts is the Beneficial Reuse criteria for wetland restoration, developed by the San Francisco Regional Water Quality Control Board (2000) and refined for use outside of San Francisco Bay by Germano & Associates (2004). The Beneficial Reuse criteria have different values for material that will be used as wetland surface (more conservative) and wetland foundation material (less conservative). The use of these screening criteria for sediments in the Ballona Wetlands is appropriate when used as a tiered approach, including bioassays to determine actual toxic effects to the benthic community.

The 2008 and 2012 sediment samples were compared to the ER-Ls, ER-Ms, and Beneficial Reuse values to determine potential ecological impacts. The results showed that several metals slightly exceeded the ER-L values, including arsenic, cadmium, copper, lead, mercury, nickel, silver, zinc, total DDT, and total chlordane (Appendix A). However, no metals exceeded the corresponding ER-M or wetland surface Beneficial Reuse values, except silver, indicating relatively low concentrations. While silver exceeded the wetland surface Beneficial Reuse value, it was below the wetland foundation value and within the range of concentrations historically found in the existing Area B wetland.

1.1.3 Proposed Wetland Surface

Public access trails and paths would be located only in upland or transitional habitats, so the proposed wetland surface material is only compared to the ecological criteria and not the human health criteria.

In the 2012 investigation, the results of the analytical analysis of samples taken at approximately the proposed depth of the new marsh surface indicate that copper and total DDT in the proposed wetland surface exceeded the ER-L values, but were below the wetland surface criteria. Silver exceeded the ER-L and wetland surface Beneficial Reuse criteria, but was within the range of concentrations found historically in Area B (Appendix A).

A bioassay study was conducted on the samples collected within the anticipated depth of the new marsh surface. Results indicated low to moderate toxicity for one of the marine arthropods, *Eohaustorius estuarius*. These samples contained low concentrations of contaminants and a high percentage of fine sediments, leading to speculation that the toxicity was related to sediment grain size characteristics that were outside of the tolerance range of the toxicity test species. A toxicity identification evaluation (TIE) study, conducted in 2014, concluded that multiple lines of evidence indicated that nonchemical factors, possibly related to sediment texture, were the most likely cause of toxicity for the sediment (Greenstein and Bay 2014).

1.1.4 Proposed Wetland Foundation

Since the proposed wetland foundation material would be buried, it is only compared to the ecological criteria and not the human health criteria.

The 2012 investigation showed that the samples collected from depths that are anticipated to be below the proposed marsh surfaces and serve as wetland foundation material were all below the ER-Ls, with the exception of the silver concentration of one sample. However, the silver exceedance was still below the wetland foundation Beneficial Reuse value. These samples were also tested for toxicity and found to have low to moderate toxicity, but this is likely due to sediment texture as described above in Section 1.1.3 (Proposed Wetland Surface).

1.1.5 Proposed Material in Realigned Channel

Since the proposed material in the realigned channel would be below water, it is only compared to the ecological criteria and not the human health criteria.

The results of the analytical analysis of samples taken at the proposed depth of the realigned channel indicate that concentration of metals, pesticides, PAHs, and PCB are all below the most

stringent guidelines including the ER-L values and the wetland surface criteria. These samples were also tested for toxicity and found to have low to moderate toxicity, but this is likely due to sediment texture as described above in Section 1.1.3.

1.2 Existing Conditions Summary for Impact Assessment of the Environment on the Project

The water and sediment quality data summary presented in this subsection will be used to assess the potential impact from the following inflows to the restored areas:

- **Ballona Creek** –The Ballona Creek Watershed covers approximately 130 square miles located in the western portion of the Los Angeles Basin. The watershed drains predominantly urbanized areas with less than 21% open space concentrated in the upper portion of the watershed. The Ballona Creek is defined as the part of the creek upstream of the zone of tidal influence.
- **Ballona Estuary Creek Channel** – The Ballona estuary includes the downstream portion of the creek that is tidally influenced.
- **Marina Del Rey – Fiji Ditch** –As shown in Figure 1, the outfall of Ballona Creek to Santa Monica Bay is separated from the entrance channel to Marina Del Rey by a jetty. The Marina Del Rey entrance channel runs adjacent to Area A. Fiji Ditch is located on the northern border of Area A and extends to Area C as shown in Figure 1. Fiji Ditch is connected to Basin H in Marina del Rey.
- **Freshwater Marsh** – The Freshwater Marsh is located in the eastern portion of Southeast Area B as shown in Figure 1, and receives stormwater runoff flows from the central inlet, which drains the Playa Vista development, and the Jefferson Boulevard inlet. Water is added during the dry weather months to maintain the marsh. The marsh will also receive water from the riparian corridor restoration project that runs between Loyola Marymount University and the Playa Vista development. Water in the Freshwater Marsh flows to either a northern outlet structure, which discharges into Ballona Creek, or over a weir into South Area B during storm events.
- **Urban Runoff and Stormwater** – Urban runoff and stormwater discharge into the wetlands from various locations. Stormwater from the developed area east of Lincoln Boulevard discharges into the Freshwater Marsh. Urban runoff from the residential communities along the bluff to the south discharge into the channel that flows through south Area B under Culver Boulevard and into West Area B as shown in Figure 1. Stormwater along Culver Boulevard and from developed areas of Playa del Rey also flow into West and South Area B.
- **Groundwater** – Potential in-flow of groundwater into Area B is evident by the less salt water tolerant plant species (willows) along the base of the bluff slope along the southern portion of the site. The amount and characteristics of groundwater inflows to the project area has not been fully investigated to quantify or characterize at this time.

Based on the existing and applicable water and sediment quality data summarized in this subsection, the following potential impact questions will be assessed:

- **Ballona Creek Water Quality** – What are the potential impacts of water quality from dry and wet weather flows (including dissolved and solid fraction constituents and

sediment) in Ballona Creek on the restoration project, based on existing water and transported sediment quality data, anticipated pollutant reductions required under the TMDLs, and estimated project implementation schedule?

- **Ballona Estuary Creek Channel Sediment Quality** – What are the potential impacts of sediment quality from sediments within the Ballona Estuary Creek Channel on the restoration project based on existing sediment quality data?
- **Marina del Rey – Fiji Ditch** – What are the potential impacts of water quality from tidal flows (including dissolved and solid fraction constituents and sediment) from Marina del Rey on the restoration project based on existing water quality data, anticipated pollutant reductions required under the TMDLs, and estimated project implementation schedule?
- **Freshwater Marsh** – What are the potential impacts of water quality from dry and wet weather flows (including dissolved and solid fraction constituents and sediment) from the Freshwater Marsh on the restoration project based on existing water quality data?
- **Urban Runoff and Stormwater** – What are the potential impacts of water quality from urban runoff and stormwater flows from adjacent urbanized areas and roadways on the restoration project based on existing water quality data and anticipated pollutant reductions from proposed stormwater best management practices (BMPs)?
- **Groundwater** – What are the potential impacts to the restored habitat of the Project due to continued groundwater inputs?

1.2.1 Ballona Creek

Water Quality

Historical and current water quality data indicate that dry weather flows from Ballona Creek exceed water quality objectives for bacteria indicators, metals, and other constituents (Stein and Tiefenthaler 2004, Weston 2005, LARWQCB 2003, 2005, 2007, SMBRC 2011). Storm water flows frequently exceed water quality objectives for bacteria, metals, PAHs, and pesticides in the creek as well. In response to these exceedances, two TMDLs were put into place to address bacteria and metals in the water column. A third, discussed in the Sediment Quality Section below, addressed toxic pollutants in sediment and fish tissue. The 2007 Bacteria TMDL established water quality targets and waste load and load allocations for sources of bacteria within the watershed that are protective of the designated water contact recreation use. The 2008 Metals TMDL was developed to address impairments in the water column in Ballona Creek for copper, lead, selenium, and zinc. The TMDL set numeric targets based on the numeric water quality criteria contained in the California Toxics Rule (CTR). Table 1 presents the implementation schedule for both TMDLs in comparison with the construction schedule for the Ballona Wetlands Restoration. The reductions for all three TMDLs should be achieved by 2021, which corresponds with Phase 1 of Project construction (in Alternative 1).

In 2013, a reconsideration of the Toxics (discussed below) and Metals TMDLs used additional data to update the targets (LARWQCB 2013). Based on more recent selenium data, staff recommended removing selenium from the TMDL, but maintaining monitoring requirements. Additional data on flow rate, hardness, and conversion factors compelled revision of the dry and wet-weather targets, as well as WLAs for metals.

TABLE 1
TMDL IMPLEMENTATION AND PROJECT CONSTRUCTION SCHEDULE

Date	Bacteria TMDL	Toxics TMDL	Metals TMDL	Project Schedule
January 11, 2006		Effective Date		
April 27, 2007	Effective Date			
October 29, 2008			Effective Date	
January 11, 2011			Reconsideration	
January 11, 2012		Reconsideration		
January 11, 2013		25% reduction	25% reduction	
April 27, 2013	Compliance for dry weather achieved			
January 11, 2016		50% reduction	50% reduction	
January 11, 2017		75% reduction	75% reduction	
July 1, 2017 (earliest)				Start Phase 1 Construction
January 11, 2021		Compliance achieved	Compliance achieved	Area A breached (~3.5 yr after start)
April 27, 2021	Compliance for wet weather achieved			
March 2022				Finish Phase 1 Construction
May 2023 (earliest)				Start Phase 2 Construction
January 2025				Finish Phase 2 Construction

Sediment Quality

The Metals TMDL for Ballona Creek (2008 Metals TMDL) was approved by EPA on October 29, 2005, and revised by the LARWQCB on December 5, 2013. The revised TMDL combined this 2008 Metals TMDL for the water column in Ballona Creek (above the tidal prism or above Centinela Channel) with the Ballona Estuary Toxic Pollutant TMDL (2006 Toxics TMDL) for sediment in the channel (within the tidal prism). These were combined because constituents in the water column are carried with suspended sediment in storm flows from the watershed to the estuary, where sediments often settles out at the fresh water and salt water interface. Constituents that include PAHs and pesticides are hydrophobic and will adsorb to sediment particles carried by storm flows. Metals can also be present in the dissolved phase within the water column or adsorbed to sediment particles that may be carried during storm event down to the estuary. The water quality of storm flows from the watershed has direct impacts to the quality of sediments within the estuary. For this reason the two TMDLs have been combined to require both pollutant reductions from waste load allocation of metals (copper, lead, zinc and selenium) within the water column from the watershed, and attainment of protective categories based on the Sediment Quality Objectives. The reductions will reduce the potential for impacts to the Projects as this combined TMDL is implemented and scheduled for completion by 2021. Reductions in constituents in storm flows and dry weather flows from the watershed to meet WLAs and LAs will be monitored by the Permitees to track progress toward these goals. Further discussion of sediment quality within the Ballona Estuary Channel is presented in the following section.

1.2.2 Ballona Estuary Creek Channel

Water Quality

In general the oceanic water quality is better than in Ballona Creek or Marina Del Rey. In Ballona Creek the tidal influence extends up to Centinela Creek and water quality reduces further away from the ocean as a result of less mixing (a function of tide and fresh water flow). As described above, water quality data indicate that flows from Ballona Creek are impacted by bacteria, metals, and pesticides, but the 2007 Bacteria TMDL and the combined Ballona Creek Metals and Ballona Estuary Toxic Pollutant TMDL will require reductions of these constituents by 2021.

Sediment Quality

Historical sediment quality data indicate that sediments within the tidal prism of Ballona Creek are impacted by metals, pesticides, PAHs, and other organic compounds (Stein and Tiefenthaler 2004, LARWQCB 2005). Sediments within the tidal prism of Ballona Creek (identified as the Ballona Estuary in the State Water Board documents) were 303d listed for cadmium, copper, lead, silver, zinc, chlordane, DDT, PCBs, PAHs and toxicity. The Ballona Estuary Toxics Pollutant TMDL (2006 Toxics TMDL) was developed to address impairments to designated beneficial uses due to concentrations of these metals and toxic pollutants in sediment and fish tissue above guidelines within the tidal prism of Ballona Creek. Toxicity testing of sediments within the tidal prism also indicated toxic responses to marine benthic organism. The Ballona Estuary Toxic Pollutant TMDL set numeric sediment targets based on effects range-low (ER-Ls) values, which are sediment quality guidelines compiled by the National Oceanic and Atmospheric Administration.

Recent monitoring of the sediments in Ballona Channel within the tidal prism indicate toxicity of sediments to marine benthic organisms continues to be observed, but the contribution of DDT, PCBs and PAHs to the sediment toxicity was not significant. While DDT, PCBs and PAHs were not found to be contributors to toxicity, concentrations of these toxic pollutant and metals were detected above 2006 Toxics TMDL targets. Metals in sediments were responsible for some toxicity to sea urchins. The results of toxicity identification evaluation testing (TIE) indicated that synthetic pyrethroid pesticides were the major contributor to toxicity in estuary sediments.

As discussed above, the 2006 Toxics TMDL (Ballona Estuary) was revised and combined with the 2008 Metals TMDL for Ballona Creek in 2013. The LARWQCB staff recommended removing the DDT, PCBs, and chlordane targets, WLAs, and LAs from the TMDL based on this recent sediment quality monitoring. PAHs targets, WLAs, and LAs were also recommended for removal from the TMDL, but monitoring requirements for PAHs were maintained. The sediment targets, WLAs, and LAs for the 303d listed metals and DDT were updated based on the current sediment quality data.

Reductions in toxic pollutants in sediment within the tidal prism of the Ballona Creek will be monitored by the Permitees and will include chemical, toxicity and benthic assessments that will be used to compare with the Sediment Quality Objectives (SQO) required under the State's Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality (EB&E Plan Part 1) adopted in 2009. The EB&E Plan Part 1 requires this multiple line of evidence or "triad" approach to determining the protection of benthic communities. The revised 2005 Toxics TMDL requires that the results of the SQO analysis of sediments in the Ballona Estuary demonstrate the attainment of the protective SQO categories of "Unimpacted," or "Likely unimpacted." The

revised 2006 Toxics TMDLs also requires monitoring of fish tissue to protect human health beneficial uses as also required under the EB&E Plan Part 1. The revised TMDL requires attainment of target fish tissue concentrations for chlordane, total DDT, and total PCBs. The revised now combined Ballona Estuary Toxic Pollutant and Ballona Creek Metals TMDL (revised December 2103)requires attainment of protective SQOs and toxic pollutant concentration targets in the sediment within the tidal prism by 2021. Fish tissue targets for toxic pollutants are also to be attained by this date. WLAs for chlordane, DDT and PCBs in stormwater flows from the watershed have been revised and included in the combined 2006 Toxics and 2008 Metals TMDL. WLAs for metals in dry weather and stormwater from the watershed have also been established in the combined TMDL. Therefore, the combined TMDL addresses both metals and toxic pollutant loading reductions from the watershed in the water column of Ballona Creek (non-tidal) to reduce impacts to sediment within the tidal prism of Ballona Creek, and the attainment of protective targets for sediment and fish tissue in the Ballona Estuary.

1.2.3 Marina del Rey – Fiji Ditch

Water Quality

Like Ballona Creek, Marina del Rey also exceeds the water quality objectives for bacteria indicators, metals, and other constituents (ABC 2004). However, the magnitude and frequency of these exceedances are lower than in Ballona Creek. The main channel of Marina del Rey has better water quality than the back basins due to greater circulation, proximity to the ocean, and less direct input from urban runoff. During high discharges from Ballona Creek, flushing of the marina is inhibited, leading to an accumulation of chemicals in marina waters (Moffatt and Nichol 1994). Additionally, Ballona Creek is an important contributor of chemicals to the marina (Moffatt and Nichol 1994, Soule et al. 1996, ABC 2001).

Fiji Ditch is connected to Basin H in Marina del Rey, which has better water quality than the back basins due to its proximity to the ocean and tidal flushing. However, water samples collected by SMBRC (2011) indicate bacteria input from Marina del Rey to Fiji Ditch.

Sediment Quality

Marina del Rey has impacted sediments in the main channel, where vessels may be a major contributor of contaminants, and in several of the back basins, where water movement is low and fine sediments, which are more likely to have high levels of chemicals associated with them, settle (Moffatt and Nichol 1998, ABC 2001). The sources of the impacted sediments may include the Ballona estuary, resuspension of coastal sediments during storms, storm water discharges directly into Marina del Rey, and human activities within the Marina (Moffatt and Nichol 1998, ABC 2001).

1.2.4 The Freshwater Marsh

Water and sediment quality monitoring data collected by the Center for Natural Lands Management and Geosyntec indicate that the Freshwater Marsh is functioning as a biological system (2003, 2005). Nutrients, such as nitrates, are within ranges expected of natural wetlands and metals are low in concentration and below the Acute and Chronic Freshwater Toxicity Values in the California Toxics Rule. No pesticides have been detected. Across all parameters, water

quality and sediment quality data do not show any trends of accumulation or build-up that would signal the need for sediment removal, or pose a threat to aquatic life.

1.2.5 Urban Runoff and Stormwater

Water Quality

Results of the analysis of stormwater samples entering the Freshwater Marsh from Jefferson Boulevard indicate the presence of constituents common to urban runoff, including metals, bacteriological indicators, and nutrients (Center for Natural Lands Management and Geosyntec 2003, 2005). Similar characteristics can be expected from runoff entering the tidal marsh from surrounding urbanized areas.

Sediment Quality

Suspended sediment and organic matter in urban runoff attract and provide the mechanism to transport constituents such as heavy metals (copper, lead, zinc), bacteria, pesticides, PAHs, and other organic compounds to receiving waters. These sediments then settle out as velocity decreases when storm flows meet tidal waters or enter into the wetlands. Sediment data in the existing Area B Marsh (see Section 1.1.1 [West Area B Existing Marsh]) indicate that runoff from adjacent residential communities and transportation corridors (Culver Boulevard) is impacting sediment quality in the marsh (Weston 2006).

1.2.6 Groundwater

Although the historic level of groundwater at the Ballona Wetlands was high, today it is much lower. Straw (1987) described a confined aquifer with artesian pressure under Area B. The groundwater is strongly controlled by the adjacent uplands, which act as recharge areas for the confined aquifers, and by Ballona Creek and the coast which are discharge areas. The water table, therefore, slopes from the Del Rey Bluffs towards Ballona Creek. The inflow of groundwater into Area B is indicated by the presence of willows (generally salt water intolerant) along the base of the bluff slope. However, the amount and characteristics of groundwater inflows to the project area has not been fully investigated to quantify or characterize at this time.

2. Potential Impacts from the Project

The water and sediment quality data summary presented in Section 1 (Existing Water and Sediment Quality Conditions) provides the basis to assess the potential impacts from the Project on the environment during and following construction of the restoration project. The assessment of these potential impacts is presented as responses to the specific assessment questions first listed in Section 1 and presented below. The assessment questions related to Project construction are first discussed followed by the assessment of potential impacts following restoration completion. Assessment questions that are associated with similar sources and issues are addressed under a combined response. The discussion following these related assessment questions include both identification of potential impacts and proposed project measures that address them. Where additional measures are needed to address the potential impacts for post

construction operation and maintenance, the discussion references Section 4 (Adaptive Management and Monitoring).

During Construction

The following assessment discussion addresses the following related questions:

- ***Would the project violate any water quality standards or waste discharge requirements?***
- ***What are the potential impacts of sediment migration from the Project site during grading activities due to wind borne emissions and construction equipment that can then be carried by stormwater runoff to adjacent water bodies that include Ballona Creek, existing tidal marsh, and Marina del Rey?***
- ***What are the potential impacts of sediment migration from the Project site during construction from disturbed areas that can then be carried by stormwater runoff to adjacent water bodies that include Ballona Creek, existing tidal marsh, and Marina del Rey?***

There is a potential for violation of water quality standards or waste discharge requirements during construction from the migration of sediments and soils during excavation, grading and placement activities into receiving waters through dust emissions, construction equipment and stormwater runoff or direct discharge into receiving waters in the absence of required best management practices (BMPs). These measures include erosion and sediment controls, dust controls, off-site sediment migration from construction equipment controls, and stormwater pollution BMPs required under the 401 and General Construction Permits to prevent impacts to receiving waters from sediment migration and direct discharges.

During restoration activities management measures will be implemented to address potential violation of water quality standards or waste discharge requirements under the 401 Permit and General Construction Permit. Monitoring of the effectiveness of these measures to address these permit requirements will also be conducted. Both the protective measures and monitoring are defined in the Preliminary Stormwater Management Plan for the Ballona Restoration Project (SMP) (Psomas 2015).

Water quality standards will be protected with the implementation of erosion and sediment control, stormwater management BMPs, off-site sediment transport by vehicles, and dust control measures that will be implemented in accordance with the Final SMP prepared for the 401 Permit. The Final SMP will be prepared in accordance with the State-wide General Construction Permit that requires implementation of BMPs to control and manage on-site discharges that could impact receiving waters. The General Construction Permit has established water quality standards for discharges and receiving water that may be impacted by construction activities. The Final SMP will outline the type and performance requirements of the proposed BMPs that will be implemented during construction to meet the permit requirements.

The Final SMP will also require monitoring of receiving waters during construction to verify that grading activities and other construction activities are not resulting in the impact of the beneficial uses of adjacent receiving waters. This monitoring includes measurements of turbidity down-current (may vary due to tide cycles) of construction activities that disturb, excavate or place soils and sediments. BMPs for these activities in areas not subject to tidal waters include erosion control rolls, check dams, stabilized construction entrances, and stormwater capture and retention basins. Stabilization of disturbed areas to control erosion also includes temporary vegetative,

application of binder material or placement of mulch. These types of BMPs and disturbed soil stabilization will be defined in the Final SMP. Soil and sediment disturbance within direct contact with tidal waters will be avoided to the extent feasible through the construction sequencing of the work in the existing creek channel. Where this work occurs in direct contact with tidal waters, control measures such as sediment curtains, minimal disturbance and continuous construction monitoring will be implemented in accordance with the construction phase permits.

The following assessment discussion addresses the following related question:

- **What are the potential impacts from on-site sediments that are excavated and placed in a permitted marine placement site?**

Sediments excavated from Area A and Area B to establish final restoration grading will be used for beneficial use on-site to the extent feasible. On-site sediment that is not used for on-site beneficial use may be designated for alternative placement depending on final cut and fill balance quantities. Previous and recent investigations provide geotechnical, chemical and toxicity testing results for assessment as summarized above. The testing results to date do not preclude this placement option. A presentation of the sediment testing results from samples collected from Area A and Area B that may be placed in an approved marine placement site was given to the Southern California Dredge Material Management Team (DMMT) on January 28, 2015. The DMMT includes the USACE Los Angeles District and the Los Angeles Regional Water Quality Control Board. The presentation included the results of the Preliminary Geotechnical Investigation (Weston 2009) and the Sediment Quality Study (ESA 2014) that is detailed in the Sediment Investigation Report (ESA 2015, May). The results indicate no toxic response to three marine species due to any constituents detected in the sediment samples collected from both Area A and Area B. The DMMT recommended further testing of the sediments as part of the final permitting for off-site disposal in accordance with the USACE guidelines. These guidelines require additional sample testing that includes bioaccumulation studies. Based on the current set of results, potential impacts from placement of on-site sediment at a permitted site are not anticipated.

Post Construction

The following assessment discussion addresses the following related question:

- **What is the potential impact of site sediments on water quality and biological resources within the created and existing tidal wetlands and uplands?**

Previous and recent sediment quality investigations provide geotechnical, chemical, and toxicity testing results on the potential impact of the use of on-site sediments on water quality and biological resources. Results from the Preliminary Geotechnical Investigation (Weston 2009) and the Sediment Quality Study (ESA 2014) are summarized above and more detailed discussion presented in the Sediment Quality Investigation Report (ESA 2015, May). Samples were collected throughout Area A and Area B at various depths to represent materials that would be used for site grading for wetlands and upland habitats and sediments that would be re-exposed for channels, marsh and upland habitat. Geotechnical and chemical testing were performed on these representative samples. The results of the chemistry analysis indicated concentrations of several metals and legacy pesticides were above the most conservative effects range low (ERL), but none were above the effects range –medium (ERM). Comparison of these concentrations to Beneficial Reuse criteria for wetland restoration, developed by the San Francisco Regional Water Quality Control Board (2000) and refined for use outside of San Francisco Bay by Germano & Associates (2004) for use as wetland surface (more conservative) and wetland foundation material (less

conservative), indicate only silver concentrations in limited samples were above the criteria for wetland surfaces and none above for wetland foundation. In addition, toxicity and toxicity investigation evaluation (TIE) testing indicated no toxic response from three marine species due to constituents (metals or pesticides) detected in on-site sediment samples. These results indicate no anticipated impact from site sediments used for wetland surface or foundation on water quality and the biological resources.

The result of the sediment quality analysis summarized in the Sediment Quality Investigation Report (ESA 2015, May) of the analytical analysis of samples taken within the depths that will be excavated and used for predominantly upland placement, indicate the concentration of silver and total DDT are above the most stringent ER-L guidelines and similar TMDL goals in two of nine and three of nine samples, respectively. No bioassay testing was performed on this material. As material use for uplands, the biological resources will be terrestrial and not wetland/marine species that have a greater exposure risk from constituents that can migrate through interstitial water and the sediment/water interface. Based on the results of toxicity and TIE testing of on-site sediments with similar metals and pesticides concentrations for use in more restrictive tidal wetlands, potential impact on water quality and biological resources from these sediment used for upland habitat is not likely. Migration of these sediments to receiving water from stormwater runoff will be addressed through post-construction erosion and sediment controls. Upland areas will be stabilized with established native vegetation to minimize erosion during storm events and minimize migration of on-site soils/sediments that may impact adjacent receiving waters.

The following assessment discussion addresses the following related question:

- **What is the potential impact of site sediments on groundwater below the site?**

Although there were multiple detections of TPH as diesel, TPH as Heavy Hydrocarbons, and Total Recoverable Petroleum Hydrocarbons, none of the concentrations were above the residential soil screening criteria for surface or deep soils for the protection of groundwater (Screening Criteria for Environmental Concerns at Sites with Contaminated Soils and Groundwater – SFBRWQCB, 2007 and revised May 2008). Residual concentrations of petroleum products were anticipated in soils within Area A and Area B based on the historical uses of the property which was used for oil and gas extraction. Gas production wells remain active on the site. The soils in the areas around the existing gas wells were inspected and only minor surface staining was observed and did not extend below the surface of the soil (area less than 1 foot squared and only in three to four places). Shallow 10-foot boreholes were advanced around the existing well heads, but due to the lack of evidence of sediment impacts, no sampling was collected for analysis. Other constituents that were detected in on-site are less mobile metals and pesticides. All samples were screened in the field using an organic vapor head space analysis. Samples that indicated reading above background were selected for TPH analysis. These analyses reflect the historical and current industrial uses of the site and address potential contamination from these activities. Based on these results, impact to groundwater below the site from existing soils is not likely.

Furthermore, the groundwater elevations below the site correspond to the tidally influenced creek elevations and therefore are also likely tidally influenced. It is not likely the sites groundwater will be used for direct potable use due to the tidal connection and salt water intrusion.

The following assessment discussion addresses the following related question:

- **What is the potential impact of site sediments on the public that may visit the site?**

The results of the analytical analysis, compared to residential California Human Health Screening Levels (CHHSL) indicated arsenic concentrations are above these criteria in all samples that were collected and analyzed in the Sediment Quality Stud. Iron also exceeded the CHHSL in many samples. As reported in the Sediment Quality Investigation Report (ESA 2015, May), these concentrations are characteristic of marine sediments. One sample out of twenty samples from the Preliminary Sediment Investigation (2008) had concentrations of the PAH benzo(a)pyrene above the residential criteria. As residential criteria, these thresholds are more conservative to actual site usage. Potential impact to visitors at the site is only possible in areas of high public use and access where direct exposure to on-site sediments at the surface is possible. As most of the site will be restricted to public access as a wetland preserve, areas of potential impact are very limited. Measures to fully address potential impact due to direct exposure of site sediments in these limited areas of high public access may include covering on-site sediments in these higher public access areas with a 6- to 8-inch layer (loose thickness) of clean soil, top soil or mulch, and restrict activities that would disturbed this cover and expose these sediments.

The following assessment discussion addresses the following related question:

- **Are the requirements of the Ballona Wetland TMDL achieved by the Project?**

The TMDL for Sediment and Invasive Exotic Vegetation for the Ballona Creek Wetlands (US EPA, March 2012) establishing a load allocations for legacy sediment removal for Area A, Area B, and Area C. The Ballona Creek Wetlands TMDL also includes alternative load allocations for sediment based on the restoration of historical marsh habitats. Table 2 (
Ballona Creek Wetlands TMDL Waste Load Allocations and
Estimated Sediment Removal Quantities) presents the TMDL load allocations for sediment and anticipated sediment removal for the three alternatives for the Project. As summarized in Table 2, the proposed sediment removal quantities for the three alternatives do not reach the load allocations under the TMDL. However, the TMDL allows for the use of an alternative load allocation based on the acres of historical salt marsh habitats restored.

TABLE 2
BALLONA CREEK WETLANDS TMDL WASTE LOAD ALLOCATIONS AND ESTIMATED SEDIMENT REMOVAL QUANTITIES

	TMDL Load Allocation – Sediment Removal(cy)	Alt 1 – Estimated Sediment Removal (cy)	Alt 2 – Estimated Sediment Removal (cy)	Alt 3 – Estimated Sediment Removal (cy)
Area A	2,100,000	1,730,000	1,730,000	1,420,000
Area B	700,000	310,000	310,000	-
Area C	300,000	-	-	-

Table 3 (
Alternative Load Allocations for Ballona Wetland TMDL and
Estimated Project Habitat Acreage) provides a summary of the TMDL alternative load allocations based on attainment of beneficial uses for Ballona Creek Wetlands through habitat restoration. These alternative load allocations may supersede the sediment load allocations in Table 1, if the proposal to use these alternative allocations is submitted to USEPA and the Los Angeles Regional Water Quality Control Board, and approved by the Executive Officer of the Regional Board with no objections from USEPA. As summarized in Table 3, the alternative load allocations under the TMDL for acreage of specific habitat types based on the lesser of historical elevation ranges in Ballona Creek Wetlands and similar marsh-tidal flat dominant wetland systems in Southern

California are above and below the TMDL load allocation. As both sediment removal and tidal wetland habitats are achieved under the Project, but not in accordance with the TMDL load allocations, a proposal to use alternative load allocation for the Project is anticipated for submittal to EPA and the Regional Board.

TABLE 3
ALTERNATIVE LOAD ALLOCATIONS FOR BALLONA WETLAND TMDL AND ESTIMATED PROJECT HABITAT ACREAGE

Elevation Range (ft NAVD)	TMDL Load Allocation (ac)	Alt 1 habitats (ac)	Alt 2 habitats (ac)	Alt 3 habitats (ac)	Assumptions
-3 to -0.2 (subtidal)	22	62.97	63.14	62.53	Subtidal
-0.2 to 3.6 (intertidal)	87	19.96	13.74	2.81	Mudflat and low marsh
3.6 to 9.6 (vegetated wetland)	346	195.29	186.64	85.28	Mid and high marsh, transition zone, and muted-tidal
6.3 to 9.6 (salt flat)	5	26.25	26.69	22.81	Salt Pan

3. Potential Impacts on the Project

The following discussion focuses on the potential impacts from water and sediment quality originated not from the site, but from upstream Ballona Creek and other inputs to the Project as listed in Section 1. Based on the existing and applicable water and sediment quality data summarized in Section 1, a set of potential impact questions were developed for each of the following inputs to the Project that may impact the Project:

- Upstream Ballona Creek Water
- Existing Ballona Estuary Creek Channel Sediment
- Marina del Rey – Tidal Flow into Fiji Ditch
- Discharges from the Freshwater Marsh
- Urban Runoff and Stormwater from Adjacent Properties to the Project
- Groundwater Seepage from Adjacent Properties to the Project

The water and sediment quality data summary presented in Section 1 provides the basis to assess the potential impacts from Ballona Creek and adjacent properties on the Project. The assessment of these potential impacts is presented as responses to the specific assessment questions for the listed inputs presented below. The discussion following these related assessment questions include both identification of potential impacts to the Project and proposed Project design and implementation measures to minimize these impacts. Where additional measures are needed to address the potential impacts to the Project for post construction operation and maintenance, the discussion references Section 4.

3.1 Impacts from Ballona Creek

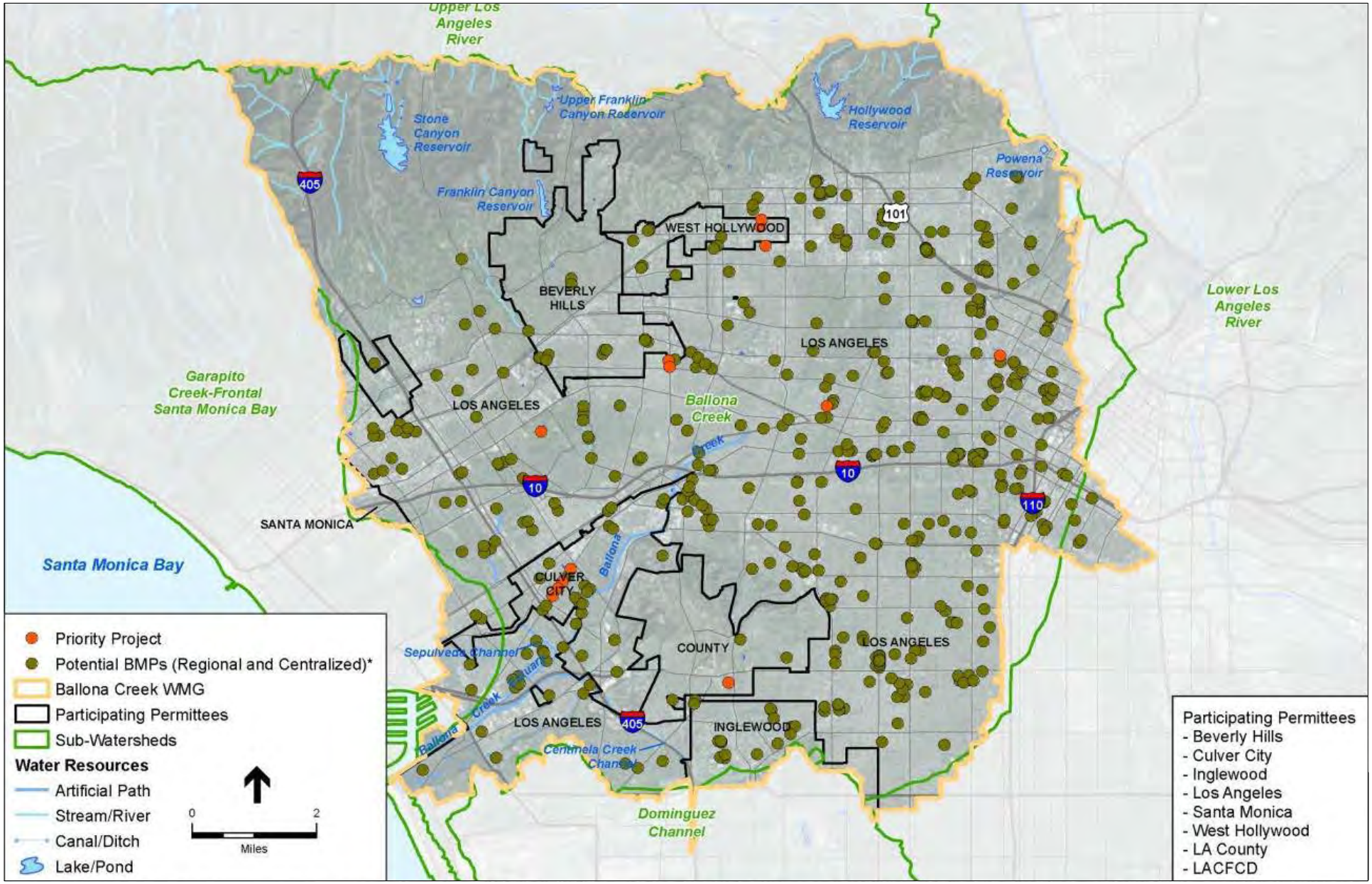
Based on the existing and applicable water and sediment quality data summarized in Section 1, the following potential impact questions will be assessed:

- **Ballona Creek Water Quality – What are the potential impacts of water quality from dry and wet weather flows (including dissolved and solid fraction constituents and sediment) in Ballona Creek on the restoration project, based on existing water and transported sediment quality data, anticipated pollutant reductions required under the TMDLs, and estimated project implementation schedule?**

As summarized in Section 1 under the water quality for Ballona Creek (Section 1.2.1 [Ballona Creek]), historical and current water quality data indicate that dry weather flows from Ballona Creek exceed water quality objectives for bacteria indicators, metals, and other constituents (Stein and Tiefenthaler 2004, Weston 2005, LARWQCB 2003, 2005, 2007). Storm water flows frequently exceed water quality objectives for bacteria, metals, PAHs, and pesticides in the creek as well. TMDLs for bacteria and metals in the water column and metals and toxics in sediment for Ballona Creek have been developed. Waste load allocations and implementation timelines to meet these goals are defined in these TMDLs. Waste load allocations are the allowable amount of constituents that may be discharged to receiving waters, such as Ballona Creek, that will not result in impairment of designated beneficial uses often based on water quality objectives and defined as receiving water limitations. The Los Angeles Regional Water Quality Control Board has incorporated these TMDL waste load allocations and timelines into the reissued municipal separate storm sewer system (MS4) permit. The MS4 Permit requires municipalities and agencies that discharge stormwater and non-storm runoff from an MS4 to Ballona Creek to reduce pollutant concentrations and loading to achieve these waste load allocations and meet the receiving water limitations to restore and protect the designated beneficial uses of Ballona Creek. Compliance with the MS4 permit is an enforceable action subject to fines under the Clean Water Act and California Porter Cologne legislation. The current reissued MS4 permit allows permittees to meet compliance with receiving water limitations through the implementation of the Enhanced Watershed Management Plan (EWMP).

EWMPs vary for each watershed, but generally provide the opportunity for Permittees to customize their stormwater programs to achieve compliance with applicable receiving water limitations (RWLs) and water-quality-based effluent limits (WQBELs) in accordance with the MS4 Permit through implementation of stormwater best management practices (BMPs) or watershed control measures. BMPs vary in function and type, with each BMP providing unique design characteristics and benefits from implementation. The overarching goal of BMPs in the EWMP is to reduce the impact of stormwater and non-stormwater on receiving water quality and address the water quality priorities as defined by the MS4 Permit. The development of each EWMP involves the evaluation and selection of multiple BMP types, including nonstructural (institutional) and distributed, centralized, and regional structural watershed control measures, that will be implemented to meet compliance goals and strategies under the 2012 MS4 Permit.

An EWMP has been developed for Ballona Creek with specific prioritized BMPs to be implemented within the timelines needed to achieve the RWLs and WQBELs. Figure 2 (Location of Priority and Planned BMPs for Ballona Creek Watershed) presents the preliminary location and type of BMPs that are planned throughout the Ballona Creek Watershed to meet the water quality goals. Figure 2 demonstrates the watershed-wide efforts that are proposed to reduce pollutant loading to Ballona Creek that will have benefits to the Restoration Project through improved water quality entering the wetland.



** Potential Distributed BMP not shown - predominantly located in urbanized areas*

Ballona Wetlands Restoration Project

Figure 2
Location of Priority and Planned BMPs for Ballona Creek Watershed

Priority and planned structural BMPs to reduce the impact of stormwater and non-stormwater on receiving water quality, include the following types:

- **Distributed Structural BMPs** – Treat runoff close to the source and typically implemented at a single- or few-parcel level (e.g., facilities typically serving a contributing area less than one acre). Because of their nature (intended to treat runoff at the parcel-scale), distributed BMPs are most likely to be implemented in high-density urban, commercial, industrial, and transportation areas, where they will either replace or improve upon existing stormwater infrastructure. These types of BMPs are generally "retrofit" type projects that replace existing impervious surfaces with pervious surfaces such as bioinfiltration cells, bioswales, porous pavement, and filter strips that tie into existing stormwater management systems as part of the MS4. These projects may also augment the existing MS4 with additional inlet screens, filter media systems, sediment removal systems, and diversions to sanitary sewer lines.
- **Centralized Structural BMPs** – Centralized structural BMPs use similar elements to the low impact development (LID), infiltration and biofiltration type BMP used in distributed structural BMPs, but collect, store, treat and filter stormwater from multiple parcels and much larger drainage areas. Centralized BMPs also include diversion and treatment type BMPs that use similar technologies for these types of BMPs under distributed BMPs, but can be implemented on a much larger scale collecting, diverting, and treating urban runoff (dry-weather flows) or limited stormwater flows from multiple parcels and large drainage areas. Therefore, centralized structural BMPs require greater footprints for construction and implementation, but provide a greater potential for water quality improvement through the filtering, treatment and/or infiltration of greater volume and rates of stormwater and urban runoff. Finally, centralized BMPs include two unique BMP types, treatment wetlands, and stream/creek restoration projects. Unlike the other structural BMP types described, these BMPs use natural systems to filter and clean the water. Treatment wetlands are typically off-line treatment systems that are not in the receiving waters, but may have habitat benefits through the establishment of more native plants and ecosystems. Creek, river, and estuary restoration projects provide a unique opportunity to restore natural cleansing processes, reestablish habitats, and address impacts from hydromodification and urban runoff.
- **Regional Structural BMPs** – Centralized BMPs that include storage and infiltration or storage and use have similar functions and construction methods to regional BMPs using the same stormwater management elements. However, regional BMPs have the distinct requirement per the Permit to retain on-site the 85th percentile 24-hour storm event for the drainage area served by the BMP (i.e., in the Los Angeles area, the 85th percentile storm is around 0.75 inch of rain in a 24-hour period), which are meant to retain the 85th percentile storm over 24 hours from a contributing area. Generally, the 85th percentile storm is approximately 0.75 inch over 24 hours

The implementation of distributed, centralized, and regional BMPs within the Ballona Creek Watershed will begin with the priority BMPs that have undergone a greater level of site evaluation, design, and permitting. The planned BMPs will be implemented based on further site assessment and planning. Compliance with the MS4 Permit requires implementation of the number and pollutant removal capacity of BMPs that is needed to meet the RWL and WQBELs within the required timelines of the current TMDLs. As presented in Section 1.2.1, the compliance data for meeting these water quality goals and objective under the metals and toxics TMDLs is 2021. The anticipated schedule for the Project includes breaching the levies to allow

Ballona Creek to enter Area A in 2021 – the same time as the TMDL timeline to meet the water quality goals. Phase 2 of the Project will not be completed until 2025.

Based on the historical water quality data for Ballona Creek, there is a potential for impact to the Project from metals, pesticides and PAH concentrations that are above the water quality objectives. However, the concentration and loading of these constituents from the watershed will be reduced to comply with the re-issued MS4 Permit and EWMP that includes the attainment of water quality goals that meet the RWL and WQBELs within a timeline that proceeds the completion of the Project. Progress toward meeting these water quality goals has been challenging in the past due to the resources needed to implement BMPs on the scale and magnitude needed as presented in the EWMP. As compliance is now directly linked to progress in implementing the EWMP, greater progress in meeting the pollutant reduction goals is anticipated over the next 5 to 10 years. The potential for impacts to the Project from Ballona Creek will therefore be significantly reduced with the implementation of the EWMP given that attainment of the goals are achieved with the current timelines that correspond to the construction of the initial phase of the Project. ***Implementation of Phase 1 of the Project (i.e., breaching and connecting restored wetland areas to Ballona Creek) is therefore recommended to be completed on the same schedule or after successful implementation of the EWMP.***

Recent water quality and sediment toxicity testing (SCCRWP, 2014) have indicated that synthetic pyrethroid pesticides were the cause of the toxicity to benthic macro-invertebrates in sediments in the Ballona Creek Channel at the base of the watershed adjacent to Area A, Area B, and Area C. Synthetic pyrethroids are new emerging water quality issue that has been identified throughout urban areas in California. Synthetic pyrethroid pesticides are now widely available and used to replace banned pesticides such as chlordane. These and other emerging water and sediment quality issues have the potential to impact the Project. The continued implementation of structural and non-structural BMPs in the watershed will address these emerging issues. For example, the implementation of infiltration and bio-filtration distributed, centralized and regional structural BMPs will also reduce the concentrations and loading of synthetic pyrethroids and other pesticides. Synthetic pesticides and many pesticides are hydro-phobic and are more prone to adsorbed to sediment particles in stormwater runoff than remain in the water column. Infiltration and bio-filtration type BMPs filter out sediments and the pollutant that are adsorbed to these sediments. Non-structural BMPs are also being implemented such as requirements for training of pesticide applications and certification of commercial pest control appliers to reduce over spraying and applying these pesticides before a rain event. Continue monitoring of receiving water and sediment quality remains a requirement of the MS4 permit. The identification of emerging pollutants s and potential impacts will continue through MS4 Permit monitoring by the permittees and other parties.

In addition to the significant reduction in the potential for impacts to the Project from Ballona Creek water and sediment through the implementation of the Ballona EWMP, the Project alternatives have considered these potential impacts in the design of the restoration. The Project alternatives allow for full tidal flows into the wetlands to the extent possible while protecting existing important habitat. Full tidal exchange creates more favorable water quality conditions by reducing retention times of potentially impacted stormwater and non-storm flows and increased flushing of the wetlands with much higher water quality of the ocean. Sediment carried from the watershed during storm flows that may contain pollutants such as metals, pesticides and PAHs may accumulate in portions of the restored channel and some areas of the wetland floodplain. These areas of sediment accumulation are identified in the Sediment Dynamics and Sediment Budget Analysis (ESA 2015) and will be open to full tidal flow and periodic flushing during high tide events.

To fully address the potential of impact of sediments carried by storm flows from the urbanized watershed to the Project, a monitoring and adaptive management program will be implemented after construction as discussed in Section 4.

Based on the existing and applicable water and sediment quality data summarized in Section 1, the following potential impact questions will be assessed:

- **Ballona Creek Channel Sediment Quality – What are the potential impacts of sediment quality from sediments within the Ballona Creek Channel on the restoration project based on existing sediment quality data?**

The results of historical and recent sediment quality sampling and testing within the tidally influence segment of Ballona Creek that will be within the Project boundaries, have indicated these sediment contain metals, PAHs, and pesticides that are above the ER-L and show a toxic response to marine species. Recent TIE studies (SCCWRP, 2014) have indicated that the toxicity is due to concentration of synthetic pyrethroid pesticides as discussed above. These sediments within the tidally-influenced segment of Ballona are likely impacted from sediment carried from the watershed during storm events that are deposited when fresh water storm flows are slowed by tidal flow and changes in geochemistry within this segment. As discussed in the previous assessment question on water quality of Ballona Creek, significant reduction of these impacted sediments and overall pollutant loading from the watershed is anticipated through the implementation of the Ballona EWMP in accordance with the MS4 Permit. The existing sediments, however, remain a potential source of impact to the Project.

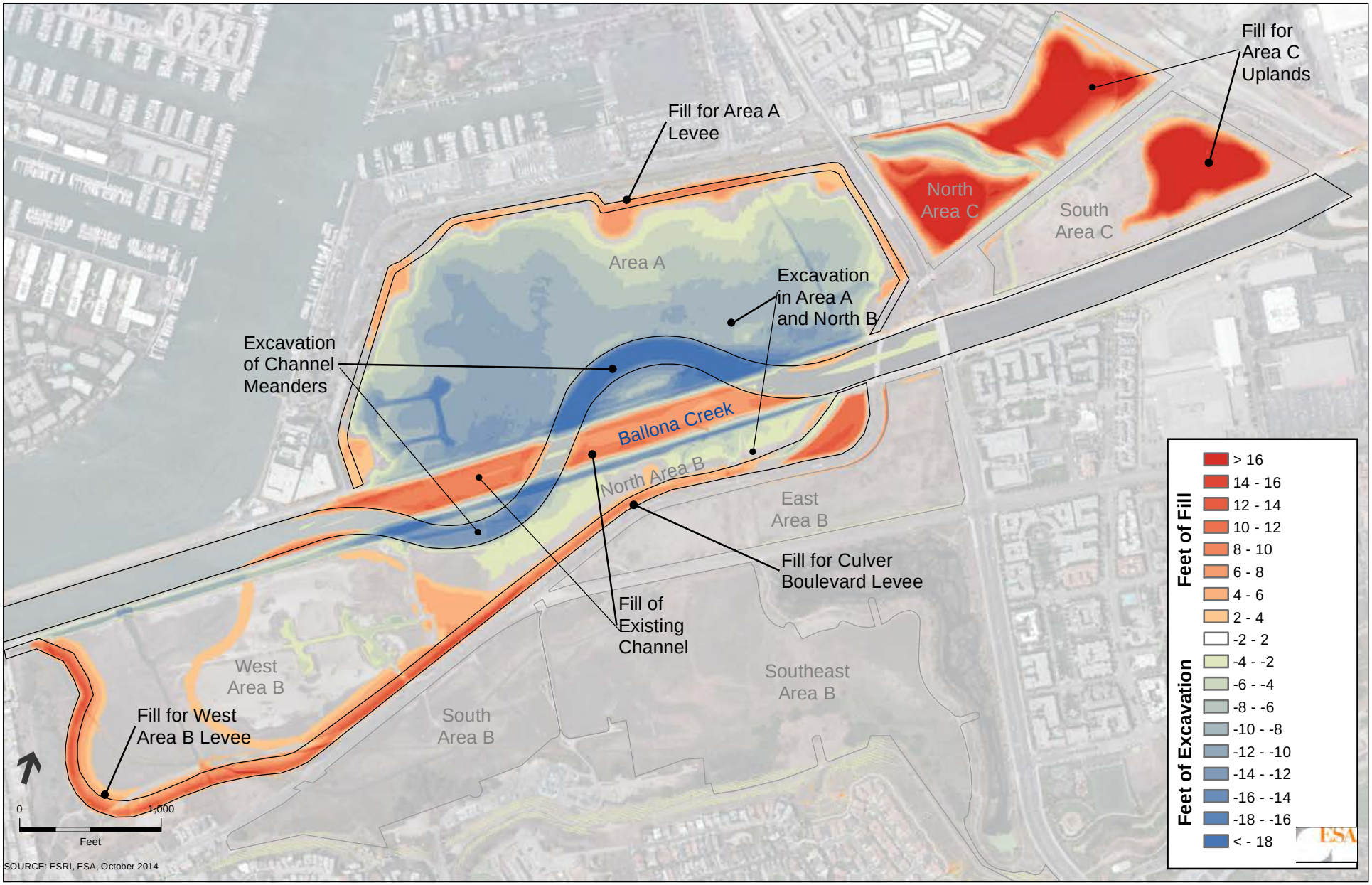
The proposed Project alternatives include the re-alignment of Ballona Creek within the tidally influenced segment (Figure 3 [Fill and Excavation in Alternative 1]). The Project would have the beneficial effect of covering impacted sediments within the existing channel per the restoration design. For the sections of the creek channel that will remain and contain the existing impacted sediment, the existing sediments have the potential to impact the Project and the environment in reaches of the channel that are erosional.

Consideration of sediment management measures to reduce the potential for increased mobilization of existing impacted sediment within the existing channel is recommended. For example, impacted sediments could be removed and replaced with clean material. Impacted sediment could be placed as wetland foundation in the sections of the existing channel to be filled at a depth that would not be subject to scour. Alternatively, impacted sediment could be undercut and buried with underlying clean sediment. The depth of excavation could be based on the constituents concentrations compared to the TMDL cleanup requirements (ER-L) or to a depth that is not subject to exposure due to scouring.

3.2 Impacts from Adjacent Properties

Based on the existing and applicable water and sediment quality data summarized in Section 1, the following potential impact questions will be assessed:

- **Marina del Rey – Fiji Ditch – What are the potential impacts of water quality from tidal flows (including dissolved and solid fraction constituents and sediment) from Marina del Rey on the restoration project based on existing water quality data, anticipated pollutant reductions required under the TMDLs, and estimated project implementation schedule?**



Ballona Wetlands Restoration Project

Figure 3
Fill and Excavation in Alternative 1

The results of water quality monitoring in Marina del Rey indicate the water quality is of much higher quality than Ballona Creek due to the greater tidal exchange and flux with the ocean, and not anticipated to impact the Project. Further the Project is not changing the tidal portion of Fiji Ditch, so the same flow and extent of tidal influence will remain the same.

Based on the existing and applicable water and sediment quality data summarized in Section 1, the following potential impact questions will be assessed:

- **Freshwater Marsh – What are the potential impacts of water quality from dry and wet weather flows (including dissolved and solid fraction constituents and sediment) from the Freshwater Marsh on the restoration project based on existing water quality data?**

The results of water quality monitoring of the Fresh Water Marsh indicate the water quality is good and not anticipated to impact the Project.

Based on the existing and applicable water and sediment quality data summarized in Section 1, the following potential impact questions will be assessed:

- **Urban Runoff and Stormwater – What are the potential impacts of water quality from urban runoff and stormwater flows from adjacent urbanized areas and roadways on the restoration project based on existing water quality data and anticipated pollutant reductions from the best management practices (BMPs) proposed in the Stormwater Management Plan (Psomas 2015)?**

Stormwater inputs to the Project were investigated during the Baseline Study for the Ballona Wetlands Restoration Feasibility Report (PWA 2008) and through continued monitoring by the The Bay Foundation. The results of these investigations indicated that stormwater runoff from adjacent roadways and urbanized area of Playa del Rey to the west of Area B has impacted sediments in existing marsh channels. Higher concentrations of metals were detected sediments closed to stormwater outfalls that discharge urban runoff into the marsh. Several metals concentrations were above the ER-L. Based on these results, there is a potential for stormwater from adjacent roadways and urbanized areas that include Playa del Rey to impact the water and sediment quality of the Project (as is currently the case under existing conditions), unless measures are implemented to reduce pollutant loading and concentrations of metals, pesticides and PAH form stormwater discharges to the Project.

The Preliminary Stormwater Management Plan (Psomas, 2015) provides a conceptual plan to address these impacts. The planned measures include the construction of bioswales along the existing roadways and stormwater retention facilities at the stormwater outfalls that discharge directly into the marsh. The BMPs will provide for the capture and reduction of sediment carried in stormwater flows that can also contain metals, PAH and pesticides. The Preliminary SMP will be further developed to provide more detail on the planned BMPs that balance the need to reduce impacts from these storm flows on the wetlands with the area needed to capture and treat these flows effectively. More detail on the specific capture and treatment BMPs that address the metals, PAH and pesticides that are known to be in urban stormwater flows will be provided in the Final SMP. With these details on the types of BMPs will also be the anticipated design storm and pollutant removal efficiencies of the BMPs for the constituents that are indicated to exceed the sediment quality guidelines in the previous sediment studies in Area B. BMPs will therefore be designed to remove pollutants in stormwater from adjacent properties to concentrations that will not impact the water and sediment quality of the Project.

4. Adaptive Management and Monitoring

As discussed in the assessment of potential impacts to the Project, there may be the potential for impact from the watershed during storm events depending on the effectiveness of the implementation of BMPs under the EWMP. As stated, the timeline for meeting TMDL waste load allocations for metals and toxics from the watershed is 2021, which corresponds with the implementation schedule for the initial phase of the Project. No potential impact is anticipated if these pollutant reductions are achieved in accordance with the MS4 Permit. A sediment and water quality monitoring and adaptive management plan is recommended to address the potential impact if these reductions are not made or potential new emerging water quality issues occurs that are not fully addressed by the BMPs implemented under the EWMP. The monitoring will focus on sediment quality in areas subject to the greatest deposited form storm events and that are also not subject to regular tidal flushing, for example the Area A meander bend. The sediment quality monitoring would be performed at a frequency that would capture the build-up of contaminants in the deposited sediment before concentration are reached that would impact benthic macro-invertebrates and other sensitive species. A Sediment and Water Quality Adaptive Management Plan is recommended in which sediment management measures would be specified and triggered if impacted sediment is identified. Protocols would be established in the Sediment and Water Quality Adaptive Management Plan for the detection of impacted accumulated sediments that may pose an impact to the biological resources of the Project. These measures may include additional sampling and analysis, additional testing to determine the risk of impact based on toxicity and where applicable bioaccumulation. Depending on the concentrations and results of follow-up testing, additional measures may be taken to partially remove impacted sediments. These measures will balance the potential impact from the constituents in the sediment with the impact of temporary disturbance of sediments and habitat. More detailed monitoring and adaptive management procedures will be developed subsequent to this Administrative Draft for use in the Project EIR/S.

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APPENDIX F7
Hydraulics and Hydrology Report

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Draft

BALLONA WETLANDS RESTORATION PROJECT

Preliminary Hydrology and Hydraulics Report

Prepared for
California State Coastal Conservancy

May 8, 2013

ESA PWA



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BALLONA WETLANDS RESTORATION PROJECT

Preliminary Hydrology and Hydraulics Report

Prepared for
California State Coastal Conservancy

May 8, 2013

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May 8, 2013

Mr. Richard Leifield
Chief of Engineering and Levee Safety Officer
U.S. Army Corps of Engineers, Los Angeles District
P.O. Box 532711
Los Angeles, CA 90053-2325

Subject: Ballona Wetlands Restoration Project Preliminary Hydrology and Hydraulics Report

Dear : Mr. Leifield

Please find enclosed the Ballona Wetlands Restoration Preliminary Hydrology and Hydraulics Report (H&H Report) as part of the Section 408 Initial Submittal A to the U.S. Army Corps of Engineers for the Ballona Wetlands Restoration Project.

This H&H Report documents preliminary hydrology and hydraulics technical analyses including the hydrology of Ballona Creek and local tributaries, a hydraulic analysis using the 1-D HEC-RAS model, a hydrodynamic analysis using the 2-D EFDC model, a preliminary sediment transport analysis, a geomorphology analysis, and tsunami and coastal sediment assessments.

The following additional analyses will be completed subsequent to Submittal A for CEQA/NEPA review and detailed analysis and design for Submittal B:

1. This H&H Report includes a preliminary analysis of sediment transport. Additional sediment transport analysis will be performed to further assess potential changes in sediment transport
2. A channel dynamics assessment will be conducted to further evaluate the dynamics and erosion potential of the realigned Ballona Creek, including a long-term sediment budget analysis.

The sediment transport, channel dynamics, and sediment budget analyses will be submitted as addenda to the H&H Report during Summer/Fall 2013.

Please note that this H&H Report assesses a prior iteration of the Project design that is similar to the current design presented in the Ballona Wetlands Restoration Project Preliminary Design Report (PDR) (ESA PWA 2013). Since the completion of analyses in the H&H Report, the preliminary design has been updated. The key

differences between the design in this H&H Report and the PDR are the treatment of the existing natural gas wells in west Area A and West Area B. Section 1.2 of the PDR describes these differences. Refinements to the hydraulic analyses will evaluate the current design in greater detail and will be included in Submittal B.

Sincerely,



Nicholas Garrity, P.E.
Southern California Manager / Project Manager
ESA PWA | Environmental Hydrology

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Appendix 2 Coastal Sediment Data Assessment
Appendix 3 Developing Design Dimensions for the Restored Ballona Creek Channel
Appendix 4 Preliminary HEC-RAS Model Results

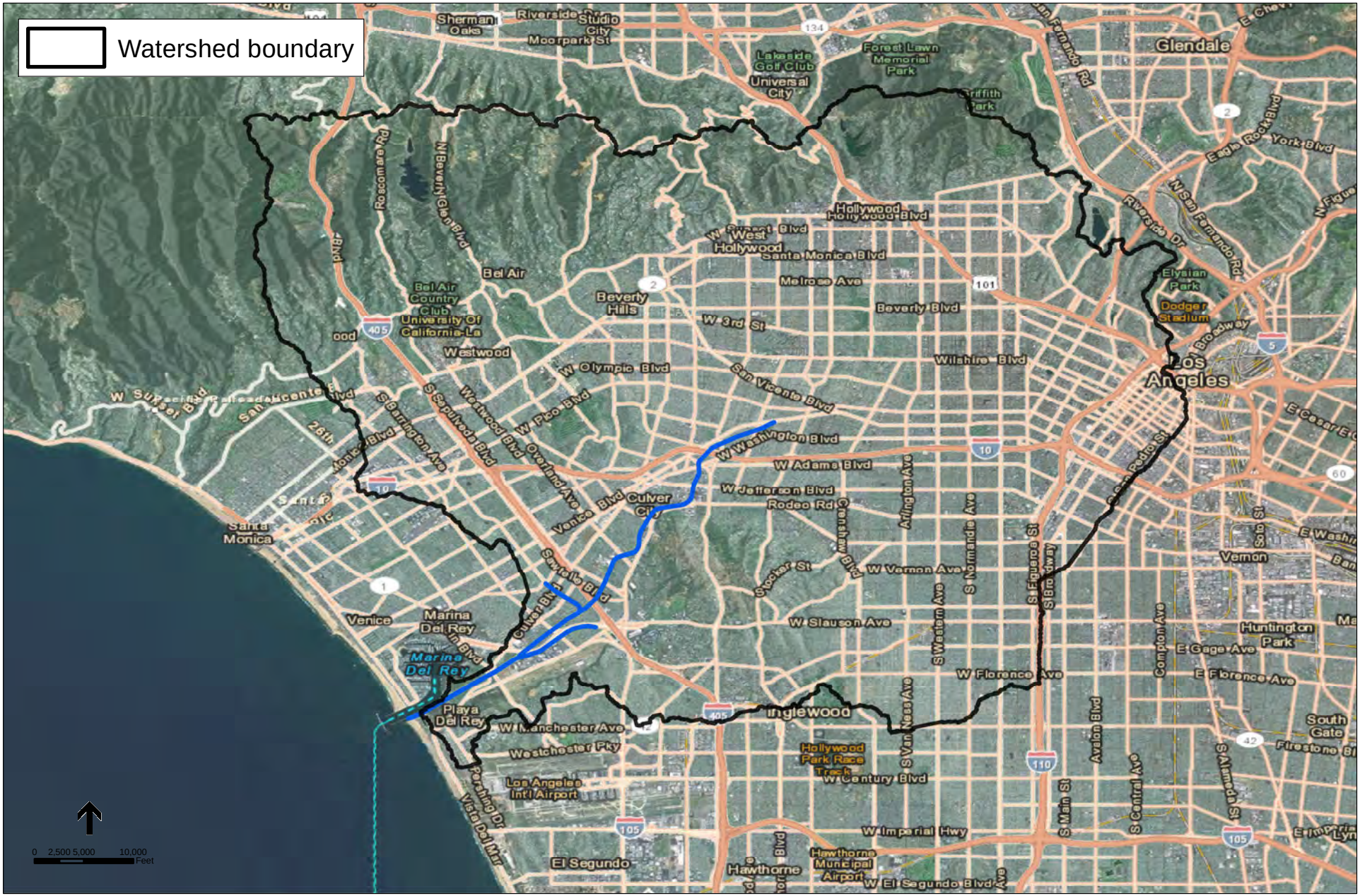
1. INTRODUCTION

ESA PWA has conducted analysis of the hydraulic behavior of flood discharges in Ballona Creek under existing conditions and a proposed project to create several hundred acres of tidal marsh along the lower reaches of the channel. Ballona Creek is currently a channelized trapezoidal flood control channel that collects surface runoff and concentrated storm drainage from canyons in the Santa Monica Mountains and the heavily urbanized areas of Beverly Hills, Culver City, Hollywood, and a western portion of the City of Los Angeles. The watershed drains approximately 130 square miles, of which 20% is undeveloped foothill and canyon area while the remaining 80% is highly urbanized coastal plain (USACE 2010a).The watershed location is shown in Figure 1.

This report summarizes the results of preliminary hydrologic, hydraulic, hydrodynamic, sediment transport, and geomorphic analyses that were used to inform the development of the preliminary restoration design for the Ballona Wetlands Ecological Reserve (Ballona Wetlands), including a reach of Ballona Creek. The Preliminary Design Report (PDR) describes the proposed project conditions that were analyzed for this report in more detail.

The purpose of the Preliminary Hydrology and Hydraulics study was to evaluate the preliminary project design relative to current flood management and sediment transport conditions, and inform design development to accommodate geomorphic processes and future sea level rise (SLR). ESA PWA reviewed prior studies to identify appropriate design flows for use in the hydraulic analysis. In addition, tidal conditions in Santa Monica Bay were assessed to develop representative starting water levels at the downstream end of Ballona Creek.

The primary hydraulic and sediment transport analyses were conducted using a one-dimensional (1-d), steady-state HEC RAS model. Because of the spatial complexity of the proposed project, a two-dimensional (2-d) hydrodynamic model was also developed to simulate both flood flows and tidal conditions on the site. Results from the 2-d model were used to inform the set up of the 1-d model to appropriately simulate 2-d processes and flow expansion and contraction and to verify 1-d model results. Preliminary sediment transport analyses were conducted to verify that sediment continuity will be maintained under the preliminary project design conditions without excessive sedimentation or erosion, and to inform preliminary design development.



SOURCE:ESRI ArcGIS Online (basemap)

Ballona Wetlands. D120367

Figure 1
Ballona Creek Watershed

ESA PWA

2. HYDROLOGY

The Ballona Creek watershed encompasses 130 square miles of western Los Angeles County. Mean annual precipitation in the watershed ranges from just over 13 inches in the southwest, to more than 19 inches in the higher portions of the Santa Monica Mountains. The headwaters of Ballona Creek originate on the southern slopes of the Santa Monica Mountains which are characterized by gently sloping terrain dissected by steep canyons. Approximately 20% of the drainage area is located in this environment, which is the least developed portion of the watershed. The remaining 80% of the watershed includes the densely developed communities of Beverly Hills, Culver City, Hollywood and a portion of the City of Los Angeles. The urbanized portions of the watershed drain to Ballona Creek and its tributaries via streets and storm drains. (USACE 2010b)

2.1 DESIGN FLOWS

USACE 2010a provides the following description of flow rates used in the design of the Ballona Creek flood protection channel:

> "(1) The design and construction history of Ballona Creek channel is somewhat obscure. The original set of design discharges for the channel was developed in the mid-1930's using a form of the rational method. At that time, the unit-hydrograph procedure was not used and the standard project flood had not yet been conceived. A modified rational method (ultimate Q) was adopted as the best method by which the runoff hydrographs could be computed that would compensate for (expected) ultimate development. Optimized 24-hour-50 year rainfall was used to develop these design discharges. Channel and possibly bridge construction based on these values followed.
>
> "(2) In 1949, the Los Angeles County Flood Control District (LAFCD) prepared a set of "Capitol Q's" (design discharges) for Ballona Creek. These discharges were also based on 24-hour-50 year rainfall. They are compared favorably with the previous design discharges. It is not certain if these Capitol Q's were used as a basis for any design.
>
> "(3) In 1954, the Los Angeles District (LAD) computed standard project flood [SPF] design discharges for expected future conditions on Ballona Creek. These discharges were significantly greater than the previous design discharges and 1949 Capitol Q's in the upper reach (drainage less than about 50 square miles). For the larger drainage areas, all three studies resulted in similar discharges. Additional channel construction followed in the 1960's to increase channel capacities. It is believed that 1954 SPF discharges are the design discharges used to upgrade the conveyance capabilities of the Ballona Creek channel."

After reviewing numerous documents provided by LA County and Corps staff, ESA PWA has identified flow rates believed to correspond to those described in items (1) and (3) above. The LA District Corps maintenance manual (USACE 1999) identifies a design flow rate of 46,000 cfs for lower Ballona Creek, which is believed to reflect the original Corps design flow (item (1) above). LA County FCD as-built

drawings for lower Ballona Creek channel and levee improvements constructed in 1959 show a design flow rate of 51,240 cfs for lower Ballona Creek, which may reflect the 1954 SPF discharge (item (3) above). Table 1 summarizes design flow estimates for Ballona Creek from these sources as well as USACE 2010b (Corps feasibility study Hydrology report).

Table 1 Summary of Ballona Creek Design Flow Rates (Project Reach)

	Q cfs	Source
Q100	44,270	USACE 2010b
Design Q (USACE)	46,000	LA District Corps 1999
Design Q (LA County FCD)	51,240	LA County FCD 1959

Based on preliminary direction from Corps staff, the preliminary hydraulic analysis described in this report is based on the design flow rate from USACE 1999 of 46,000 cfs (Renee Vermeeren, pers. comm. 8/22/12).

2.2 N-YEAR HYDROGRAPHS AND PEAK FLOWS

The USACE conducted a feasibility study for Ballona Creek ecosystem restoration in 2010. As part of this study, a HEC-HMS rainfall-runoff model was developed to estimate discharge hydrographs for multiple runoff events (2-, 5-, 10-, 25-, 50-, 100-, 150-, 100-, 200- and 500-year) (USACE 2010b). The USACE conducted a flood frequency analysis on data collected by the stream gage currently located approximately 500 feet upstream of Sawtelle Boulevard (LA County F38C-R Ballona Creek above Sawtelle) and used the results to calibrate the hydrologic model. The USACE conducted the frequency analysis using methods outlined in Bulletin 17B (IACW 1982) for 75 peak annual flows from 1928-2005. Gaged flows were adjusted for urbanization. The results of the flood frequency analysis were compared to peak discharges estimated in the HMS model for a given flood discharge and the model was adjusted to more closely match the flood frequency at the gage.

ESA PWA used the results of the calibrated HEC-HMS model as a source for n-year hydrographs and peak discharges for Ballona Creek. Model results for n-year peak flows at various model nodes in the Ballona Creek watershed are summarized in Table 2. The node that represents flows in the project area is at the confluence between Centinela Channel and Ballona Creek. Peak flow for the 100-year event at this location is 44,270 cfs, which is somewhat lower than the project reach design flow of 46,000 cfs described above.

Table 2 Flood Frequency on Ballona Creek Estimated by the USACE Using HEC-HMS

	Peak Discharge								
Location	**Q2**	**Q5**	**Q10**	**Q25**	**Q50**	**Q100**	**Q150**	**Q200**	**Q500**
0.14 mile South of Venice Blvd on the Pickford Street	3800	5390	6460	7620	8930	10050	10692	11089	12494
Ballona Creek Cross with I-10	8350	11930	14280	16710	19610	22020	23426	24297	27376
Ballona Creek Cross with Jacob Street	11830	16900	20220	23560	27610	30990	32967	34192	38524
0.09 Mile North of Higuera Street on the Ballona Creek	11970	17120	20470	23820	27930	31320	33316	34553	38932
Ballona Creek Cross with Sepulveda Blvd	12610	18070	21600	25040	29420	32900	35000	36300	40900
At confluence between Sepulveda Channel and Ballona Creek	15700	22690	27130	31160	36740	40960	43577	45195	50922
At confluence between Centinela Channel and Ballona Creek	16980	24530	29320	33690	39720	44270	43577	45195	50922
Ballona Creek at Pacific Ave	17170	24840	29690	34020	40150	44690	47097	48846	55036

2.3 COASTAL HYDROLOGY AND FLOODING

2.3.1 Tidal Datums

The tidal hydrology of Santa Monica Bay was used to inform the starting downstream water surface elevation for hydraulic, hydrodynamic and sediment transport analyses. Water surface elevations describing tidal conditions are measured relative to a fixed elevation datum, and several different datums have been used in prior studies. Table 3 lists tide levels relative to The North American Vertical Datum of 1988 (NAVD), the mean lower low water tidal datum (MLLW), and the National Geodetic Vertical Datum of 1929 (NGVD). MLLW is the average lower low tide elevation, and the MLLW datum is commonly used for marine projects. NAVD is the national datum, which replaced NGVD (also referred to as the Sea level Datum of 1929 or “Mean Sea Level”) in 1988. In Santa Monica Bay and at the Ballona Wetlands Restoration site, NAVD is similar to MLLW. Elevations in this report are presented in the NAVD.

Table 3 Tidal Datums at the Ballona Wetlands Restoration Site in MLLW, NAVD, and NGVD.

	MLLW (ft)	NAVD (ft)	NGVD (ft)
100-year tide (FEMA)	9.1	8.9	6.5
Max. observed (11/30/1982 7:54)	8.5	8.3	5.9
HAT (12/2/1990 16:12)	7.3	7.1	4.6
MHHW	5.4	5.2	2.8
MHW	4.7	4.5	2.1
MTL	2.8	2.6	0.2
MSL	2.8	2.6	0.2
NGVD	2.6	2.4	0.0
MLW	0.9	0.7	-1.7
NAVD	0.2	0.0	-2.4
MLLW	0.0	-0.2	-2.6
LAT (1/1/87 0:00)	-2.0	-2.2	-4.6
Min. observed (12/17/1933 15:42)	-2.8	-3.0	-5.5

Notes: Tidal datums from NOAA/NOS Santa Monica Tide Station 9410840, 1983-2001 Epoch
NAVD to NGVD conversion from NOAA/NGS
100-year tide from FEMA (2008) Flood Insurance Study for Los Angeles County (based on studies completed in 1984)
HAT = highest astronomical tide
MHHW = mean higher high water
MHW = mean high water
MTL = mean tide level
MSL = mean sea level
MLW = mean low water
MLLW = mean lower low water
LAT = lowest astronomical tide
NAVD = North American Vertical Datum of 1988
NGVD = National Geodetic Vertical Datum of 1929

2.3.2 Sea Level Rise

Estimates of SLR were used in the hydraulic analysis to evaluate potential future flooding conditions. In 2010, the Ocean Protection Council released a draft resolution which revised previous global sea-level rise projections. The resolution advises California state agencies to consider 10-17 inches of SLR by 2050 and 31-69 inches by 2100 (measured from a 2000 baseline) (OPC, 2010). The 2100 estimates reflect the range in greenhouse gas emission scenarios, with low emissions resulting in 31-50 inches of sea-level rise and high emissions resulting in 43-69 inches. To date, emissions have been tracking on the high scenario. Assuming continuation of the high emissions trajectory, the higher range of SLR projections would apply. The high estimate is similar to the Army Corp of Engineers' Modified NRC-III curve which predicts 59 inches by 2100 (from a 1992 baseline) (USACE, 2011). Therefore, 59 inches by 2100 was selected as the SLR scenario for this analysis.

As global water levels increase, land elevations may also be changing. Land subsidence in the project area has not been quantified for this planning effort, but is likely much less than projected sea-level rise rates.

2.3.3 Coastal Flooding

Coastal flood hazards result from extreme tides, with water levels further raised by storm surge and waves. Planning for coastal floods take into account existing flood hazards, as well as recognize evolving conditions including SLR and local subsidence. Tsunami are also considered a source of coastal flooding, but are treated as separate events (see next section).

The Federal Emergency Management Agency (FEMA) publishes flood maps that indicate the likely extent of the 100-year coastal flood. The minimum flood level is the 100-year high Pacific Ocean water level, often evaluated by extreme value analysis of tide gage records. The effects of waves are additive to the ocean water levels. Waves are incorporated in multiple ways:

- The erosion during the flood event, called "Event-based Erosion" to distinguish from long-term erosion which is not considered by FEMA;
- The elevation of the wave crests;
- The potential vertical extent of wave runup projected on and potentially above the highest coastal barrier, usually a dune or bluff; and,
- The depth, extent and volume of overtopping waters in the lee of coastal barriers.

At Ballona, the project site is well inland of the beach and remaining dunes (mostly developed) and is therefore not expected to be flooded by direct wave action under existing conditions. While waves can propagate up the Ballona Creek channel, the rock breakwater offshore of the creek mouth and the rock jetties along both creek banks limit wave exposure.

The most recent coastal flood analysis by FEMA was completed in the 1980s (Dames and Moore, 1984 as referenced in FEMA, 2008a), with updated mapping in the 2000s to account for existing topography and datums (FEMA, 2008b). Ballona Channel is mapped within the 100-year coastal flood plain, without velocity wave action (called an "A Zone") and without an elevation specified. The rest of the project site is characterized as being subject to flooding of less than one foot at the 100-year recurrence (called an "X Zone) with no specific elevations, depths or frequencies defined. The flood elevation within the adjacent Marina Del Rey is 9 feet NAVD. Higher flood risk is identified for the beaches and nearshore areas due to exposure to ocean waves, with flood elevations of 14 feet NAVD and high velocity wave action (called "V Zone").

FEMA will accomplish new studies (called "re-studies") and update maps of the area within the next decade. The new maps are likely to show increased flood elevations and inland extents owing to the statistical effect of storm events observed since the 1980s, as well as updates in methodology and SLR over the last 30 years. Based on a review the existing FEMA reports, we estimate that the 100-year coastal flood elevation for levee design is roughly equivalent to the 100-year ocean water level, plus an allowance for local wave action, and elevated slightly with distance upstream due to creek discharge likely to occur during the coastal flood. Wave effects are likely to be small due to the protection afforded by the jetties and breakwaters, and the limited fetches available for local wind wave generation.

The effect of creek flows on water levels during the 100-year coastal flood event are expected to be small given the flat gradient. The limited wave and fluvial effects indicate a condition similar to that in Marina Del Rey, for which FEMA has established an elevation of 9 feet NAVD. The preliminary coastal flood level in the Ballona Creek channel is therefore estimated by adding to the Marina Del Rey elevation as follows: two feet for wave action, one foot of sloping water surface profile (due to creek flow), and one foot of freeboard[1], for a total additive amount of four feet. The corresponding minimum levee crest elevation is therefore 9 feet NAVD plus 4 feet or 13 feet NAVD. SLR would add to this water level, resulting in a required crest elevation of 17.9 feet NAVD by year 2100 for the anticipated 59 inches of SLR. These estimated elevations are below the conceptual design levee crest elevations of 20.5 feet NAVD. The conceptual design levee elevations allows for approximately 4 ft of freeboard above the estimated total coastal water level above. The design levee elevations will be refined in future phases based on further consideration of coastal and fluvial flood levels.

2.3.4 Tsunami Risk

ESA PWA reviewed existing tsunami research in the project vicinity. These results are presented in Appendix **1**. Further assessment will be conducted in later analyses.

[1] One foot of freeboard is used in this discussion to approximate a minimum levee height elevation above the 100-year total coastal water level including waves and creek flow.

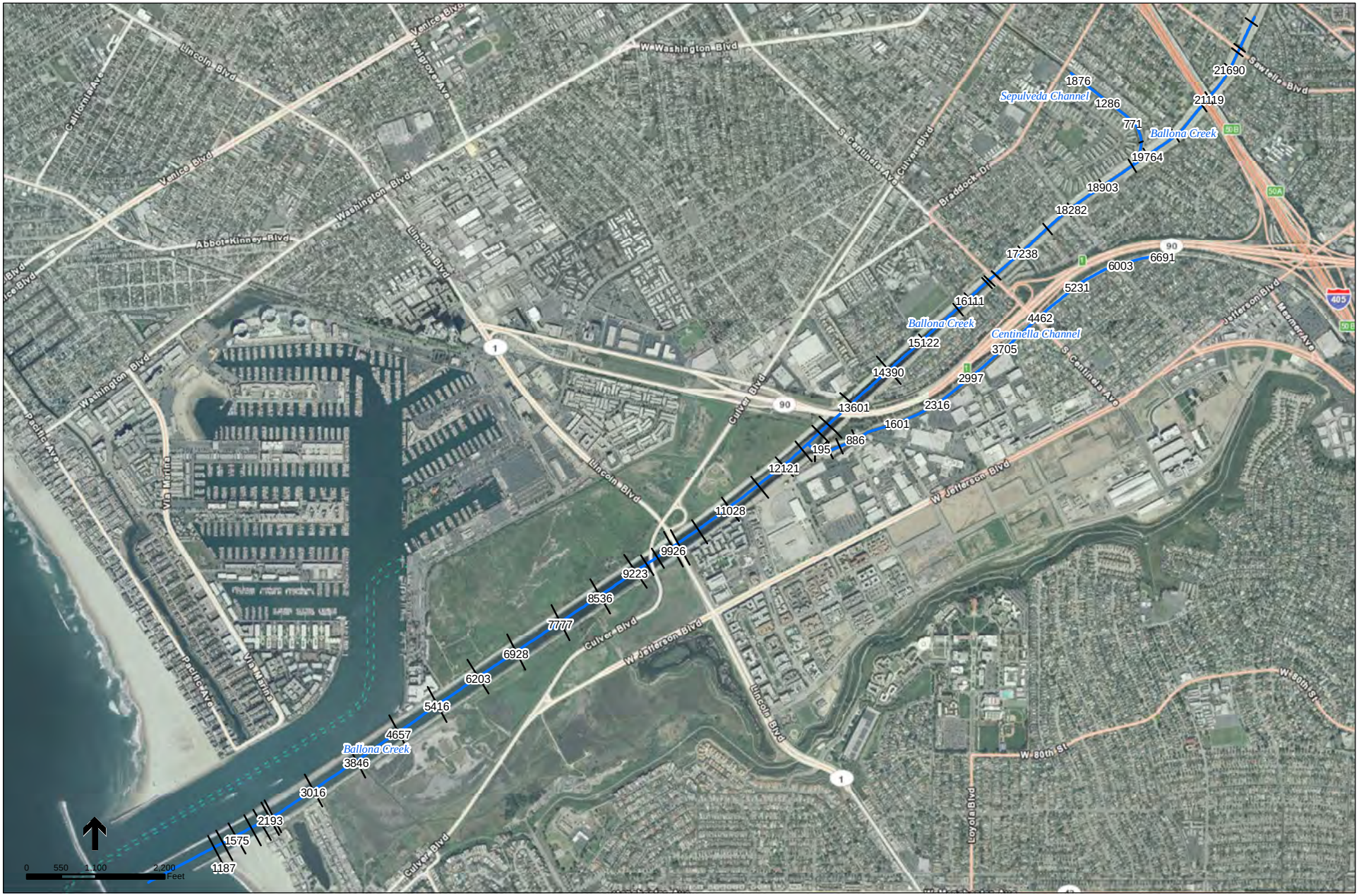
3. HYDRAULIC ANALYSIS

Ballona Creek is a nine mile long flood protection channel that drains the watershed described in Section 2. The major tributaries include Centinela Creek, Sepulveda Canyon Channel, Benedict Canyon Channel, and numerous storm drain outfalls. Figure 2 provides an overview of the Ballona Creek channel layout and location.

The Ballona Wetlands Restoration Project area includes about 600 acres between Marina Del Rey (to the north) and Playa Del Rey (to the south), and about 10,500 feet of the Ballona Creek channel between approximately Lincoln Boulevard and Pacific Avenue. Within the project site, the existing Ballona Creek flood control channel and levees, constructed in the 1930s by the USACE (USACE 1999), provide flood protection for surrounding areas. The existing channel is about 250 feet wide (width of the potential flow area between the levees), with a total corridor width (including the levees slopes) of about 320 feet. The channel and levees provide flood protection from the 100-year flood event (100-year discharge) in Ballona Creek according to the effective FEMA Flood Insurance Study (FEMA 2008).

The project entails expansion and enhancement of wetlands surrounding lower Ballona Creek and associated site modifications necessary to avoid increasing the flood risk to surrounding property and infrastructure. The project will include removing existing levees, reconfiguring the Ballona Creek channel within the project reach, and constructing new flood protection levees around the perimeter of the project area. Figure 3 shows the conceptual layout of the proposed project which is further described in the PDR.

ESA PWA constructed a hydraulic model of Ballona Creek using the HEC-RAS v4.1 software to evaluate existing and proposed project conditions. HEC-RAS is a one-dimensional step-backwater modeling program used extensively in flood and sediment transport analysis applications. The model was developed in a georeferenced framework using the GeoRAS toolbar in ArcGIS to enable geospatially oriented transfer of information between GIS and HEC-RAS. Based on preliminary direction from Corps staff, analyses of flood performance were based on the design flow rate of 46,000 cfs (Renee Vermeeren, pers. comm. 8/22/12).



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Ballona Wetlands. D120367

Figure 2

Ballona Creek Channel

Existing conditions model cross-sections

Existing conditions model channel alignment

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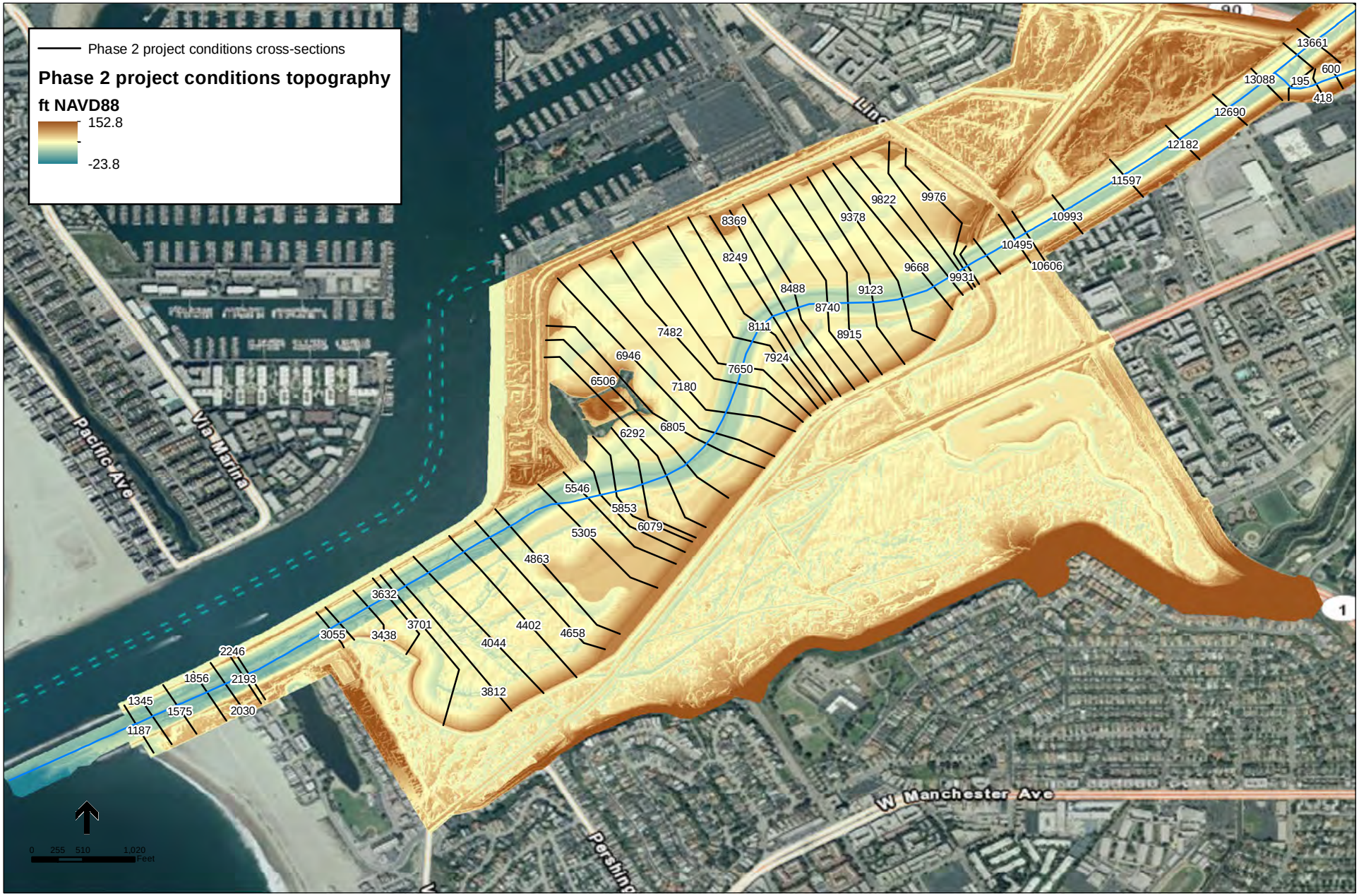

FILENAME

SOURCE:ESRI ArcGIS Online (aerial), PSOMAS (existing condition topography), ESA (conceptual topography)

NOTE: River station shown on cross-sections in feet upstream of pacific ocean

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Figure 3

Ballona Project Plan

3.1 PREVIOUS HYDRAULIC MODELING

The USACE constructed a HEC-RAS hydraulic model of the Ballona Creek drainage system (USACE 2010a). To characterize channel and bridge geometry, the USACE used a series of as-built plans from LACFCD. Overbank areas beyond the extents of the as-built plans were extracted from a 10-meter USGS DTM (digital terrain model). All input data and results from the USACE model are vertically referenced to NGVD29. Table 4 summarizes the model reaches and Manning's roughness values from this model.

Table 4 USACE 2010a Model Reaches and "n" Values

		Manning's Roughness		
Reach	**Extent**	**Left Overbank**	**Main Channel**	**Right Overbank**
Ballona Creek	- Approximately 850-feet upstream of Burnside Avenue to the Sepulveda Channel	0.05	0.013 - 0.017	0.05
	- Between the Sepulveda Channel and the Centinela Channel	0.05	0.017 - 0.018	0.05
	- From the Centinela Channel to the Pacific Ocean	0.05	0.019 - 0.02	0.05
Sepulveda Channel	Ballona Creek to W Washington Blvd	0.05	0.015	0.05
Centinela Channel	From Ballona Creek to Margaret Avenue	0.05	0.015	0.05

ESA PWA used elements of the Corps' model to build the existing conditions model for Ballona Creek; we updated or revised a number of the model COE model parameters based on the most recent available information. The revised parameters used in the ESA PWA model of Existing Conditions and the basis for the revision are documented below.

- **Horizontal projection of geometry data** – The horizontal coordinate system used in the HEC-GeoRAS analysis conducted by the corps was not identified however the x, and y coordinate values in the model indicate that the model was projected using NAD83/California State Plane Zone VI. Los Angeles County and Ballona Creek are located in NAD83/California State Plane Zone V.
- **Channel stationing** – The channel station for each cross-section represents the cumulative distance in feet from the downstream node of the channel centerline. As such, the main channel distance input for each cross section should correspond to the difference in the cross-section stations. Some discrepancies exist between the channel stationing and the defined channel lengths at the cross-sections.
- **Contraction and expansion coefficients –** The coefficients used to define the head loss incurred by velocity differences caused by expanding or contracting cross-sectional area are typically defined as 0.1 and 0.3 for contraction and expansion respectively. Effectively, these values define the fraction of velocity head difference between sections that is converted to head loss. The values in the corps model were set at 0.01 and 0.03—an order of magnitude below the default

values. This has a significant impact on the water surface profiles calculated by the model particularly in the vicinity of the multiple bridge crossings.

3.2 MODEL SETUP

3.2.1 Geometry

3.2.1.1 Existing Conditions

The existing conditions model extent includes the Ballona Creek channel from the Pacific Ocean to the streamflow gage approximately 500 feet upstream of Sawtelle Boulevard, the Centinela Channel from Ballona Creek to Margaret Avenue, and the Sepulveda Channel from Ballona Creek to Braddock Drive. The model structures include: Sawtelle Blvd, I-405, Inglewood Blvd, S Centinela Ave, CA-90, Lincoln Blvd, Culver Blvd, and Pacific Highway.

Topography

Topographic data obtained for modeling existing conditions for the Ballona Creek system is a combination of as-built structure data from the USACE model and a DTM constructed by PSOMAS engineering. All elevations are vertically referenced to NAVD88.

In 2012 PSOMAS constructed a DTM of the Ballona Creek channel and overbank areas from the following datasets:

1. Bathymetric surveys of the lower reaches of Ballona Creek
2. Cross-sectional surveys of Ballona Creek
3. Photogrammetric data
4. LiDAR data

A detailed description of the methods used to construct the topography is provided in the PDR.

Cross-sections for the hydraulic model were extracted from the DTM and imported into HEC-RAS using the GIS based HEC-GeoRAS tool. HEC-GeoRAS enables the transfer of data from GIS to HEC-RAS including cross-section topography, river stationing, downstream reach lengths, bank station locations, roughness limits, and ineffective flow areas, and allows for the transfer of HEC-RAS results to GIS for a quasi-two-dimensional depiction of modeled flow depth, velocity, and shear stress. Cross-section alignments were laid out in GIS, intersected with the DTM to extract the topographic profile, and imported into HEC-RAS for the existing and project conditions models.

Structures

Topographic data for the existing structures included in the model was obtained from structure information extracted from the USACE HEC-RAS model. Our understanding is that the original source for these data was as-build drawings of the bridge structures. The elevations for the structures, vertically referenced to NGVD29 in the USACE model, were converted to NAVD88 by adding a constant of 2.4-feet.

In HEC-RAS, two approaches are available for modeling high flows through bridges. The approaches are:

1. **Energy Flow** – This method balances the energy equation by assuming open channel flow with flow area limited to the bridge opening through the bridge. Friction losses are calculated using the manning's equation and bridge piers and abutments are subtracted from the available flow area. This approach is most appropriate when the bridge is either highly submerged or in cases where the bridge does not provide a substantial barrier to flow.
2. **Pressure and/or Weir Flow** – Bridge hydraulics computed using this method assumes that flow through the bridge opening can be represented using orifice flow equations while overtopping flows are computed separately using weir flow equations. This approach is most appropriate where a bridge crossing provides a substantial barrier to flow generating appreciable backwater and where flow through the bridge opening is expected to be similar to orifice flow.

In general, the bridges over the Ballona Creek channel have relatively large openings that would not be expected to reflect orifice conditions or introduce large backwater effects. The energy flow approach was therefore selected as the most appropriate method for modeling the bridges for this system.

As described above, the expansion and contraction coefficients used for typical cross sections are 0.1 and 0.3 respectively. Contraction and expansion losses at hydraulic structures are greater than typical channel sections and the HEC RAS Hydraulic Reference Manual recommends the use of 0.3 and 0.5 for "typical bridge sections" (USACE, 2010c). Therefore, contraction and expansion coefficients of 0.3 and 0.5 were applied to the nearest upstream and downstream sections.

Hydraulic Roughness

The hydraulic roughness values used in the USACE model were reviewed and verified relative to typical values for similar hydraulic channel features. The values were maintained for existing conditions in the modeled reaches.

3.2.1.2 Project Conditions

The project conditions model covers the same extents as the Existing Conditions model, but incorporates proposed changes to the project site reflecting the preliminary project design (Figure 3).

Topography

ESA PWA developed a surface representing the proposed project using AutoCAD, using the existing conditions DTM as a base. Cross-sections for the hydraulic model were extracted from AutoCAD and imported into HEC-RAS using the GIS based HEC-GeoRAS tool, similar to the method described for Existing Conditions above. Cross-section alignments were laid out in GIS, intersected with the DTM to extract the topographic profile, and imported into HEC-RAS for both existing and project conditions models. Details of the preliminary project design are provided in the PDR.

Structures

Existing bridge structures will not be affected by the proposed project reflected in the PDR. Therefore, bridge geometry, modeling approach and expansion and contraction coefficients were unchanged from Existing Conditions. Future runs may include a new bridge if included in the project design.

Hydraulic Roughness

The floodplain roughness for the overbank areas under project conditions was estimated using the methods outlined in the USGS Water-supply Paper 2339 (WSP2339) derived by Arcement *et al* (1989). A USACE document (EM 1110-2-1601) identifies this approach among a list of acceptable methods in Chapter 5 (USACE 1994, pg. 5-1). The method involves calculating a bare soil base roughness (n_b) which is then increased using adjustment factors for surface irregularities (n_1), floodplain obstructions (n_3), and floodplain vegetation (n_4)[2]. The composite roughness value is computed using the following equation:

$$n = n_b + n_1 + n_3 + n_4$$

A relationship between hydraulic radius (R_h), intermediate particle size (d_{84}), and roughness (n) developed by Limerinos (1970) was used to estimate the base roughness of the floodplain. This relationship is expressed in the following equation:

$$n_b = \frac{0.1129 {R_h}^{1/6}}{1.16 + 2.0 \log_{10}\left(\frac{R_h}{d_{84}}\right)}$$

Based on the HEC-RAS results the average hydraulic radius of cross-sections through the project reach is approximately 8 feet (2.44 meters). Sediment grain size distributions (GSD) for floodplain sediment were not available for this report thus it was assumed that the intermediate particle diameter was equal to the d_{84} of the composite GSD of from channel sediment samples collected by the USACE (USACE 2003). Based on floodplain core data presented in the preliminary geotechnical memo (GDC 2012), the floodplain surface sediment is composed primarily of sand and silt with some locations containing gravel sized sediment classes. This is consistent with the sediment composition in the channel which contains approximately 15% gravel, 60% sand, and 20% silt. Thus the d_{84} from the channel samples of approximately 2 mm (.002 meters) was used to estimate the base roughness. Using the values of R_h and d_{84} in meters, the Limerinos relationship yields a base roughness value of 0.018.

Typical roughness adjustment factors for floodplains are provided in Table 3 of WSP2339. For surface irregularities, the adjustment factor varies from 0.0 for the smoothest possible floodplain area, to 0.02 for a severe degree of irregularities including sloughs, rises, and dips in the floodplain. Based on the proposed floodplain contouring and natural evolution of tidal channels and seasonal wetlands in the floodplains, it was assumed that the surface irregularities could be characterized as moderate to severe,

[2] Note: the ordering of the correction factors comes from the equation for estimating channel roughness which contains factors not relevant for computing floodplain roughness

requiring a roughness adjustment of 0.01 for n_1. The adjustment factor for floodplain obstructions including debris, stumps, and isolated boulders varies from 0.0-0.004 for a negligible coverage, reflecting obstructions covering less than 5% of the cross-sectional area, to 0.02-0.03 for appreciable coverage described as 15-50% of the cross-sectional area obstructed. It was assumed that obstructions in the graded floodplains would be relatively negligible corresponding to a roughness adjustment factor of 0.004 for n_3. The adjustment factor for vegetation coverage varies from 0.001 to 0.2 depending on the degree of vegetation coverage and the type of vegetation present. For the project conditions it was assumed that the vegetation coverage in the salt marshes will contain primarily cord grass and pickleweed, with some larger stemmed vegetation along the upland transitions. An adjustment factor of 0.025 for n_4 was assumed for floodplain vegetation coverage corresponding to the high end of the medium coverage category. By adding the adjustment factors to the base roughness estimate, we derived a composite floodplain roughness of 0.057.

Other floodplain roughness references considered in this analysis include a USACE publication (ERDC/CHL TR-00-25) on the *Determination of Resistance Due to Shrubs and Woody Vegetation* (USACE, 2000), and the textbook *Sediment Transport Technology* (Simons and Senturk, 1992). The USACE publication from 2000 suggests that floodplain roughness values for Mulefat, a typical southern California riparian wetland plant that, of the categories considered in this publication, most closely resembles the type of vegetation expected in the salt marsh floodplains for project conditions, range from 0.051 to 0.059 for high velocity flow. Simons and Senturk suggest floodplain roughness values varying from 0.05 to 0.07 for medium brush vegetation. Based on the value derived through the methods outlined in WSP2339, and the supporting references described above, a floodplain roughness value of 0.06 was selected for the project conditions overbank areas.

Ineffective Flow Areas

Under project conditions, high flows will encounter an expansion in channel area at the upstream end of the project site where the existing trapezoidal channel section transitions to a reduced trapezoidal area with a large overbank floodplain. Similarly, flows will contract back into the existing channel shape at the downstream end of the restored floodplain. At abrupt transitions in channel area, the rate at which flow can expand and contract can be less than the rate at which the channel area expands or contracts. As a result, the portion of the wetted cross-section that is outside the expansion or contraction zone does not contribute to the overall conveyance of flow through that cross-section. To simulate this two-dimensional phenomenon within the one-dimensional framework of HEC-RAS, the channel areas where significant downstream flow does not occur are defined explicitly as “ineffective” flow area within the model geometry. Defining the ineffective flow area in HEC-RAS forces the model to route all conveyance through the effective area of the cross-section, more accurately simulating both velocity and water depths.

Ineffective flow area is frequently encountered at bridge constrictions and the length over which flow expands and contracts has been studied to aid in defining these regions in a one-dimensional model. In Technical Paper 151 (TP-151, USACE 1996) the USACE summarized research conducted by Hunt (1995) who utilized two-dimensional models of idealized bridge cross-sections for a total of 76 cases to estimate expansion and contraction reach lengths and coefficients. For flow expansion the mean and median of the ratio of distance in the direction of flow over distance perpendicular to flow was estimated

to be approximately 1.5:1. The ratio derived for flow contraction had a range of 0.7:1 to 2.3:1 with a mean and median of around 1.1 to 1.

As described in Chapter 4 of this report, a 2-d hydrodynamic model of Ballona Creek was developed to inform the hydraulic analysis and project design. As illustrated in Figure 4 velocity vectors from the 2-d model results for the 100-year flood were used to identify ineffective flow areas at the upstream and downstream project limits. Flow expanding onto the floodplain in Area A creates a vortex of slow-moving water in the northeast corner of the project site which does not contribute to downstream conveyance. Additionally, much of the water near the levees on West Area B is stagnant and does not contribute to the total flow conveyance. The ineffective flow areas suggested by these results represent a flow expansion ratio of 1.7:1 for flow expanding at the upstream entrance to the project site, and a flow contraction ratio of 2.0:1 for flow contracting from West Area B back to the existing flood control channel downstream. The transition lengths are consistent with the findings outlined in TP-151.

3.2.2 Hydrology

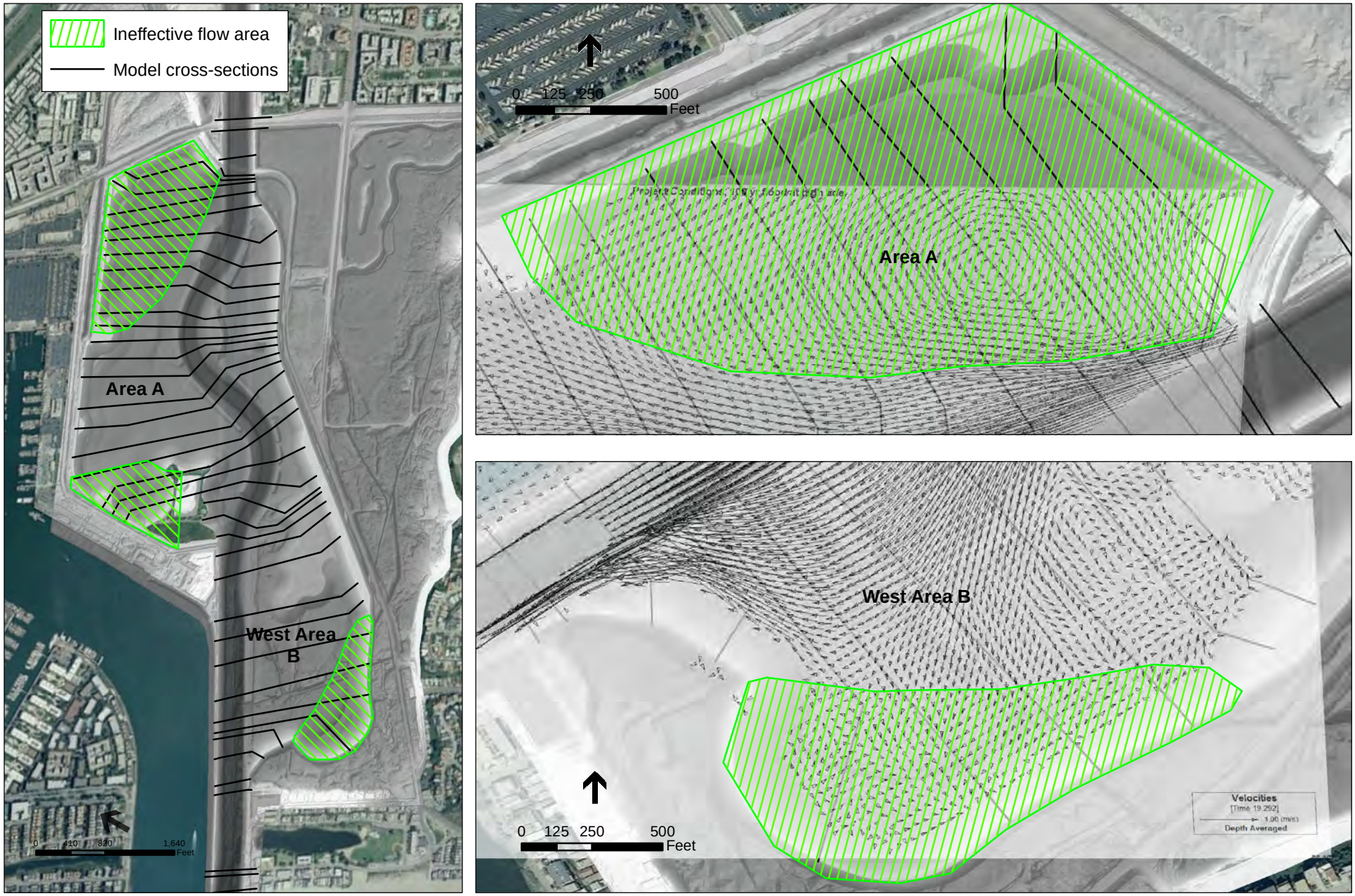
As described in Section 2, the design flood flow rate for the project reach used in this analysis is 46,000 cfs; the source for project reach n-year peak flows and hydrographs is USACE 2010b (model results for Ballona Creek at confluence between Centinela Channel and Ballona Creek).

3.2.3 Downstream Boundary Conditions

Under subcritical flow conditions, HEC RAS computes water surface elevations for each cross section working upstream from a known water surface elevation. The downstream boundary condition (water level) is therefore an important input to the model. For this study, the downstream boundary of the HEC RAS model is Santa Monica Bay where Ballona Creek discharges to the Pacific Ocean. Downstream boundary conditions representing a range of tidal conditions were therefore used in the hydraulic analysis of Ballona Creek.

3.2.3.1 Design Flood Boundary Condition

As described in Section 2.1, little information is available regarding the hydraulic assumptions used in the original channel design for Ballona Creek. LA County staff provided a sheet of hydraulic calculations dated 1/3/1940 which indicates a downstream water level of 5.23 ft NGVD (7.63 ft NAVD) was used in the channel design hydraulic analysis for Ballona Creek. This water level is referred to as the "highest tide of record." We were not able to verify the highest tide of record as of the date of the calculation sheet, and the source of the calculation sheet is unknown. Nonetheless, this water level represents best available information on the downstream water level used in the original channel design analysis and was therefore selected as the downstream boundary condition for design flood analyses. Further discussion of tidal boundary conditions is provided in Section 3.2.3.2 below.



SOURCE: ESRI Online (aerials), ESA PWA EFDC model (2D velocity vectors)

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Figure 4

Plan View of Modeled Velocity Vectors and Ineffective Flow Areas

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3.2.3.2 Tidal Boundary Conditions

In addition to the design event described above, other scenarios were modeled to reflect a range of flow and tide conditions. Water levels selected to represent tidal conditions were based on the NOAA/NOS Santa Monica Tide Station (9410840). MHHW, MTL and MLLW were used in sensitivity runs to test the sensitivity of water levels to the downstream boundary condition. In addition, MHHW was used to represent typical high tide conditions for n-year flood runs.

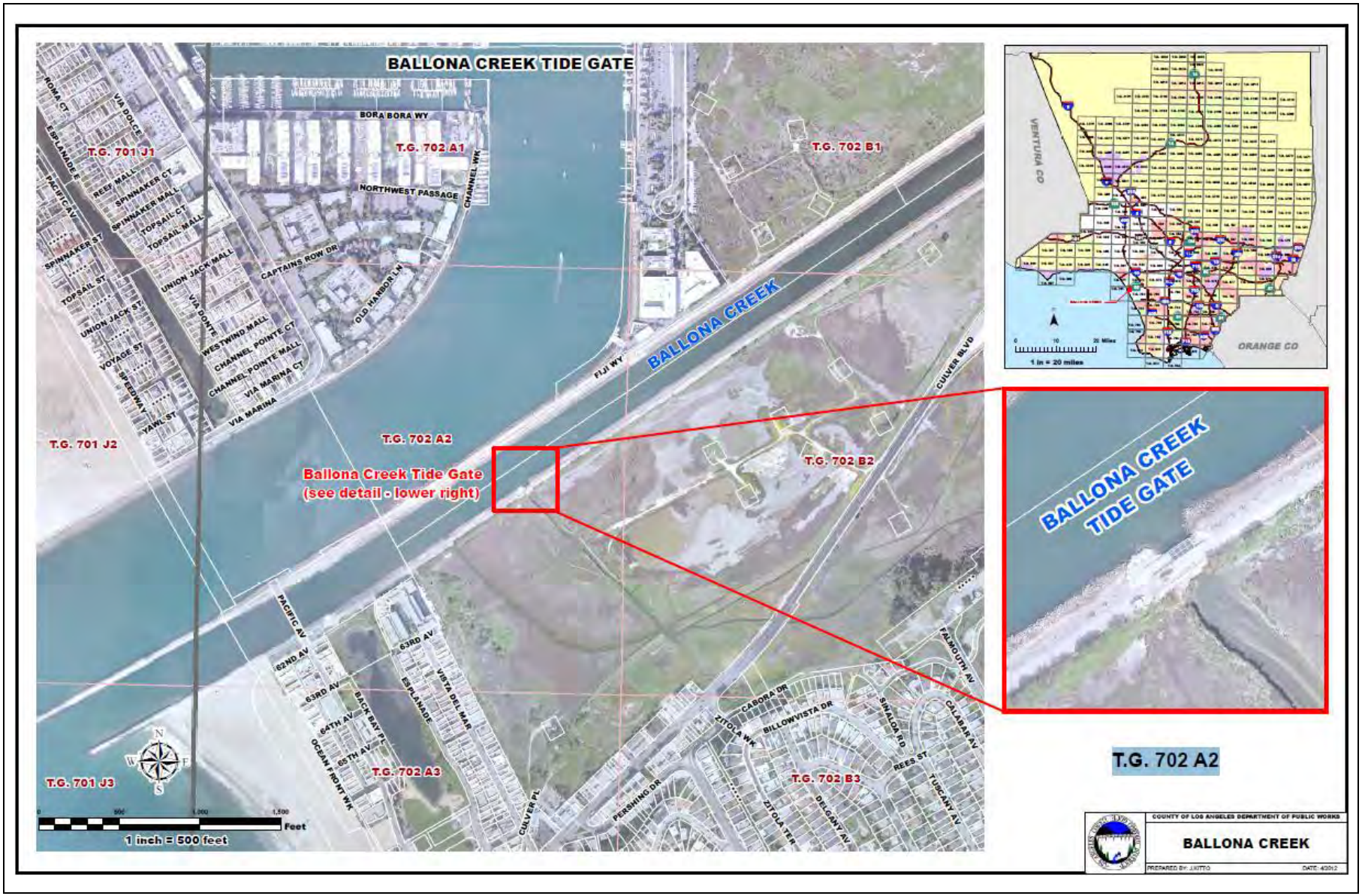
Table 5 summarizes the tidal conditions in Santa Monica Bay. In addition to the design flood boundary condition, MHHW, MTL and MLLW used in the hydraulic analysis (shown in **bold**), the Highest Astronomical (HAT) and Maximum Observed tides for the Santa Monica Tide Station and the FEMA 100-year tide level for this location are also shown for comparison. The design flood boundary condition of 7.63 ft NAVD represents an extreme high tide condition, approximately midway between the HAT and Maximum Observed tide for the Santa Monica Bay.

Table 5 Summary of Downstream Boundary Conditions

Description	Water level (ft NAVD)	Source
Design flood boundary condition	**7.6**	**1940 Hydraulic Calculation Sheet**
Mean Higher High Water (MHHW)	**5.2**	**NOAA/NOS Santa Monica Tide Sta**
Mean Tide Level (MTL)	**2.6**	**NOAA/NOS Santa Monica Tide Sta**
Mean Lower Low Water (MLLW)	**-0.2**	**NOAA/NOS Santa Monica Tide Sta**
FEMA 100-year tide	8.9	FEMA (2008)
Highest Astronomical Tide (HAT)	7.1	NOAA/NOS Santa Monica Tide Sta
Maximum Observed Tide (11/30/82)	8.3	NOAA/NOS Santa Monica Tide Sta

3.2.3.3 Tidal Time Series

To conduct unsteady flow analysis for model verification, ESA PWA used observed water level data provided by the Los Angeles County Department of Public Works (LACDPW; Tide Gate 702 A2) for a gage in Ballona Creek approximately 3,000 feet upstream of the mouth (Figure 5). Water level readings recorded at this gage extend from 2008 to the present during which time six events occurred with flows equal or greater than 7,000 cfs with the largest event having a peak flow of 14,000 cfs. A review of the tidal time series during these significant flow events indicates that the watershed flow input has little to no impact on the water levels this far downstream. This is described further in Section 3.3.1.



Source: LACDPW (2012)

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Figure 5

LACDPW Tide Gauge Location

3.2.3.4 Sea Level Rise

ESA PWA applied an adjustment of 59 inches to downstream water levels to reflect a conservative estimate of SLR by 2100 (Section 2.3.2). In addition to adjusting the downstream water levels, model runs were conducted incorporating an assumption for bed aggradation under a long period of rising sea levels. For these runs, it was assumed that the amount of bed aggradation would match SLR at the mouth of Ballona Creek (i.e. 59 inches of aggradation) and the aggradation would project linearly back to meet the existing channel bed elevation at approximately Lincoln Boulevard. It is not clear whether there is sufficient sediment supply to realize this amount of aggradation by 2100 but this condition was selected as a conservative assumption pending refinements in modeling and design.

3.3 RESULTS AND DISCUSSION

Table 6 provides a summary of hydraulic model runs used in the analyses described in this section.

Table 6 HEC RAS Model Run Catalog

	model name	geometry source	flow inputs (Q)	d/s boundary	sediment data	description
Without Project Conditions	HEC RAS Updated Existing	as-builts & new survey	46,000 cfs	7.63 ft NAVD, MHHW, MTL, MLLW		Corps (1930's) design capacity
	HEC RAS Updated Existing	as-builts & new survey	Q2, 5, 10, 25, 50, 100, 200, 500	MHHW		flood frequency (Qn)
	HEC RAS (or HEC 6T) Sediment Transport	HEC RAS Updated Existing	1993-2003 composite gage record (all flows >200cfs)	MTL (2.6 ft NAVD)	BC: suspended sed data + assumption for total load based on % SL / BL, Grain sizes: Corps average grain size, Transport function&Cohesive options: TBD	sediment transport
	HEC RAS model verification	HEC RAS Updated Existing	Unsteady flow record (adjusted from Sawtelle)	tidal time series (observed)		model verification
Future Without Project Conditions	HEC RAS Future Existing	HEC RAS updated existing plus bed aggradation	46,000 cfs	7.63 ft NAVD+SLR, MHHW+SLR		future no project
With Project Conditions	HEC RAS With Project	design plan as of 10/17/12	46,000 cfs	7.63 ft NAVD, MHHW, MTL, MLLW		future design capacity
		design plan as of 10/17/12 plus bed aggradation	46,000 cfs	7.63 ft NAVD+SLR, MHHW+SLR		future design with SLR
			Q2, 5, 10, 25, 50, 100, 200, 500	MHHW		future flood frequency (Qn)
	HEC RAS Interim Project	Phase I plan as of 10/17/12	46,000 cfs	7.63 ft NAVD		Interim design capacity
	HEC RAS Sediment Transport With Project	design plan as of 10/17/12 plus bed aggradation	Unsteady Q100 hydrograph	MTL + SLR (59")	BC: suspended sed data + assumption for total load based on % SL / BL, Grain sizes: Corps average grain size, Transport function&Cohesive options: TBD	future sediment transport

3.3.1 Model Verification

LA County has operated a water level recording station at a tide gate located on the south bank of Ballona Creek between the Culver Boulevard and Pacific Avenue bridges since 2008. ESA PWA reviewed flow records from the Sawtelle gage and identified the highest flow rates recorded during this time period. We then attempted to correlate peak flows at Sawtelle with corresponding peaks in the recorded water level. However, even the largest flow recorded during that time period (14,000 cfs) did not influence high water levels in the Ballona Creek channel, as recorded at the water level station, apparently due to the strong influence of the tides at this location.

We ran the recorded event through the unsteady HEC RAS model to verify that the model results represented the water level conditions recorded at the tide gate. To represent inflow from the Sepulveda and Centinela tributaries ESA PWA scaled the gage readings using relationships between discharge at the Sawtelle gage and discharge estimates for flow contributed by the tributaries from HEC HMS model results (USACE 2010a) (Table 7). HEC HMS model results showed a consistent ratio of approximately 0.25 for the Sepulveda tributary ($Q_{Sepulveda}/Q_{Sawtelle}$), and 0.10 for the Centinela tributary ($Q_{Centinela}/Q_{Sawtelle}$) across a range of design flood events. The downstream boundary for the model verification run was a tidal time series from the LACDPW tide gage.

Table 7 Model Verification Run

Date	Peak Q Sawtelle (recorded) cfs	Peak Q Sepulveda (scaled) cfs	Peak Q Centinela (scaled) cfs
1/18/10	14,000	3,500	1,400

As shown in Figure 6, the HEC-RAS model results are similar to recorded water surface elevations at the location of the tide gate. Both modeled and recorded water levels reflect the dominance of tidal water surface elevations at this location and flow rate.

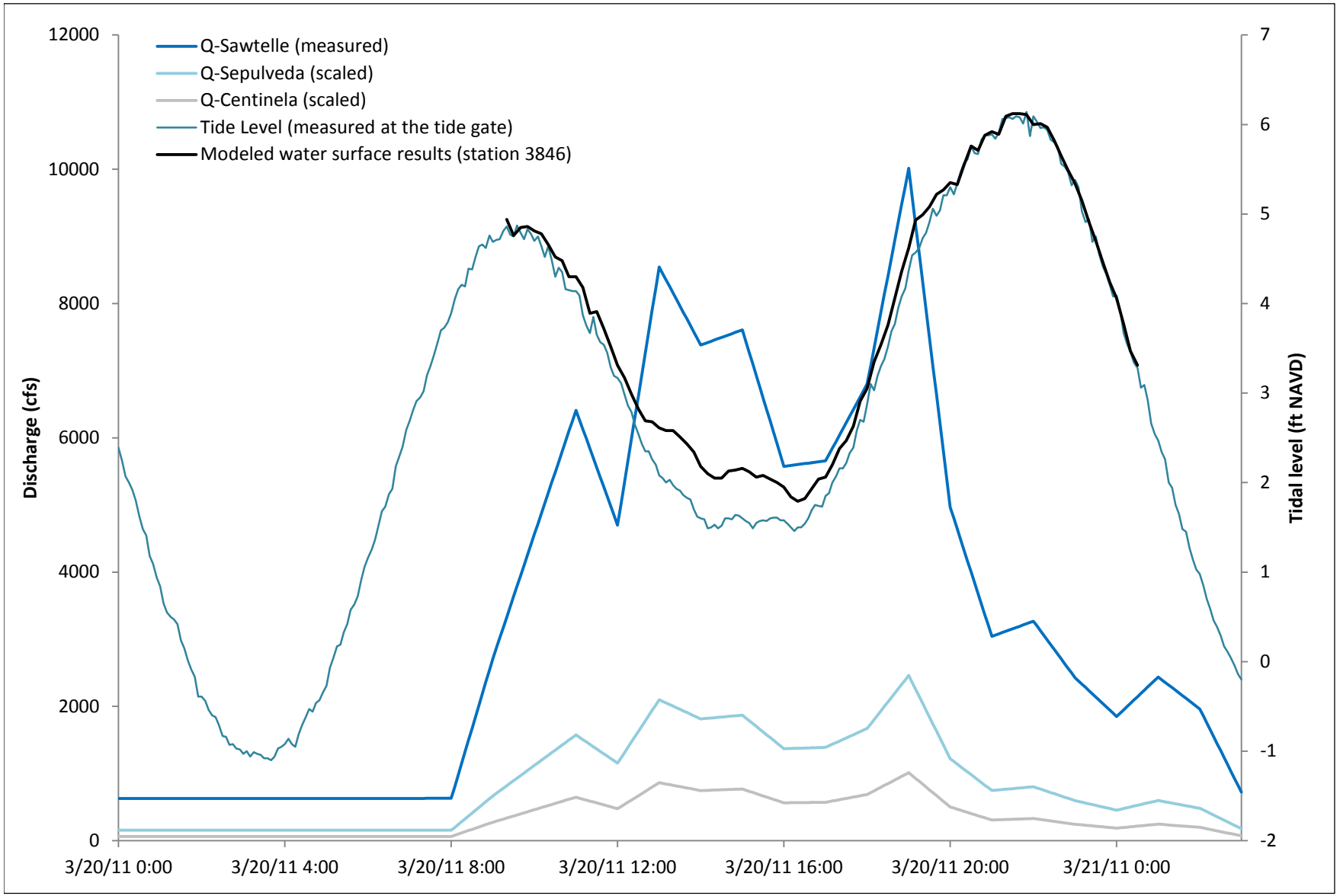

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Figure 6

Model Verification Results - Time Series

ESA PWA

3.3.2 Existing Conditions Model Results

A variety of discharge rates and boundary conditions were simulated for Existing Conditions to characterize the hydraulic behavior of Ballona Creek in the project reach under existing conditions.

Figure 7 shows HEC RAS water surface profile results for the design flow of 46,000 cfs with a downstream boundary of 7.6 ft NAVD along with the channel thalweg (the line following the lowest point of the channel). Under existing conditions, model results indicate that the design flow is contained in the channel throughout the project reach with approximately five to seven feet of freeboard below the existing levee crests. Modeled flow velocity is approximately ten feet per second within the project reach.

Figure 8 shows HEC RAS water surface profile results for the design flow of 46,000 cfs with a range of downstream boundary conditions. These results indicate that under existing conditions, flood levels are moderately sensitive to the downstream water level throughout the project reach. Upstream of Culver Blvd, the flood level is not sensitive to the downstream boundary condition for the simulated range of water levels (-0.2 to 7.6 feet NAVD).

Figure 9 shows HEC RAS water surface profile results for a range of peak flows representing n-year events (Q2,5,10,25,50,100,200,500), with a downstream boundary of MHHW. These results show the sensitivity of the water surface profile to discharge rate under existing conditions.

3.3.3 Future (without project) Conditions

The future (without project) condition was simulated using the Existing Conditions geometry in combination with a downstream boundary condition that reflects SLR (59-inches by 2100). In addition, the Existing Conditions channel geometry was modified to represent bed aggradation equal to SLR at the channel mouth and tapering off to zero at the upstream limit of tidal influence (approximately Culver Blvd). This scenario is considered a worst case condition for bed aggradation, since it could only occur if ample sediment supply were available to allow the channel to aggrade. See further discussion of the sediment budget in Chapter 5. Model results for the 100-year flood shown in Figure 10 indicate that, with the exception of the south jetty which would overtop onto the adjacent beach, flood flows would be contained within the existing channel under SLR conditions, but freeboard would be significantly reduced relative to existing conditions.

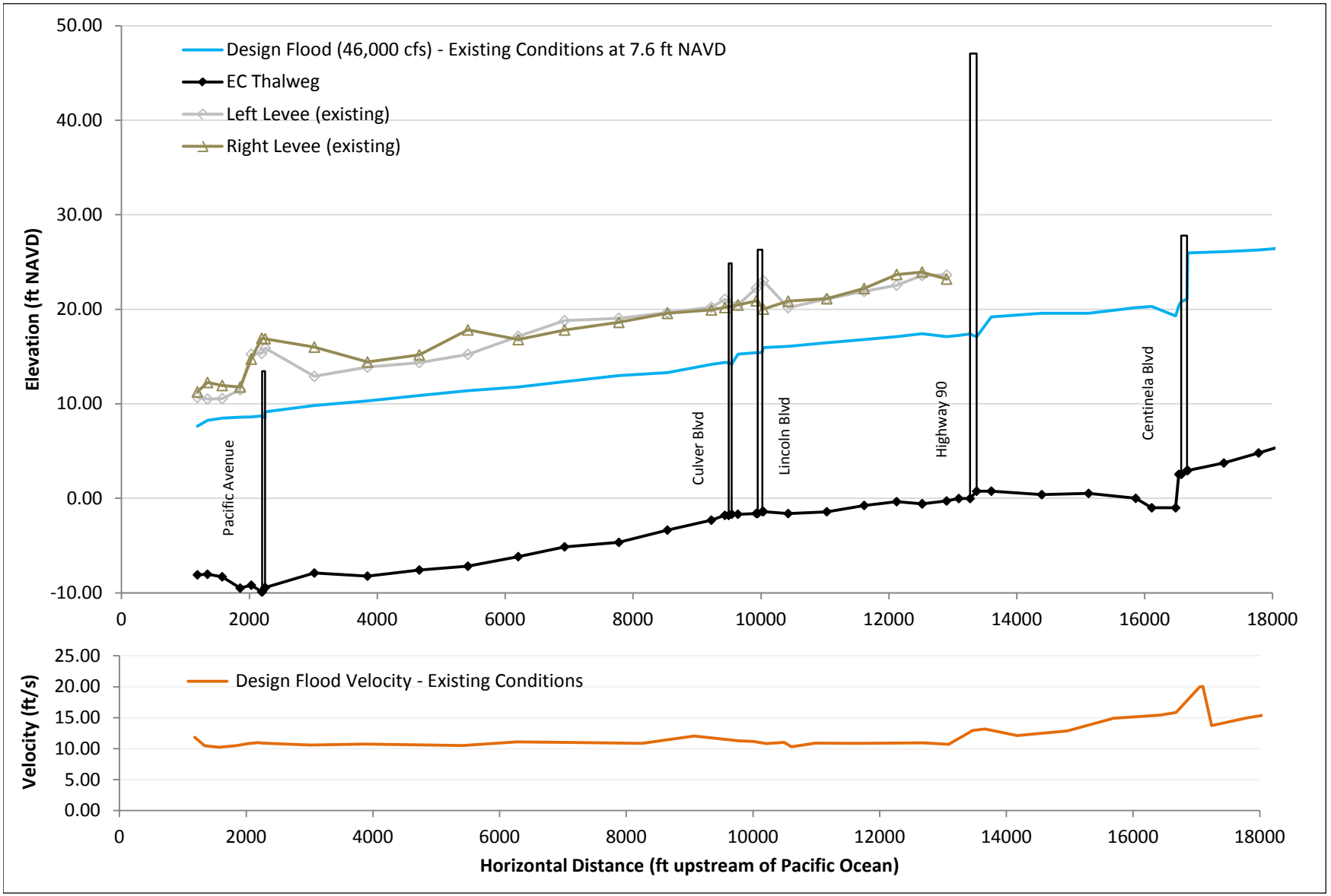

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Figure 7

Design Flood and Velocity Profiles
Existing Conditions

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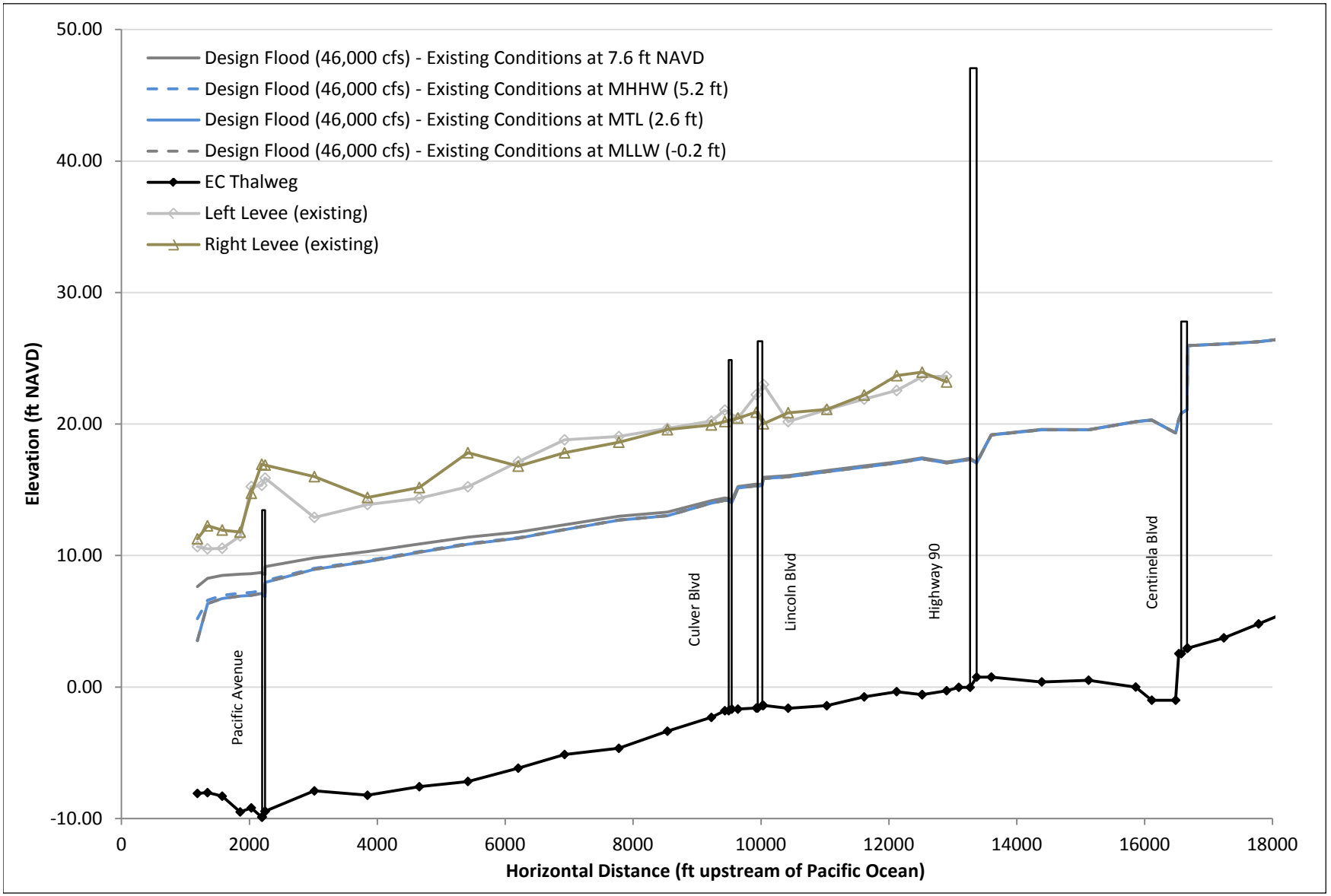

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Figure 8

Design Flood Profiles

Existing Conditions Downstream Boundary Sensitivity

ESA PWA

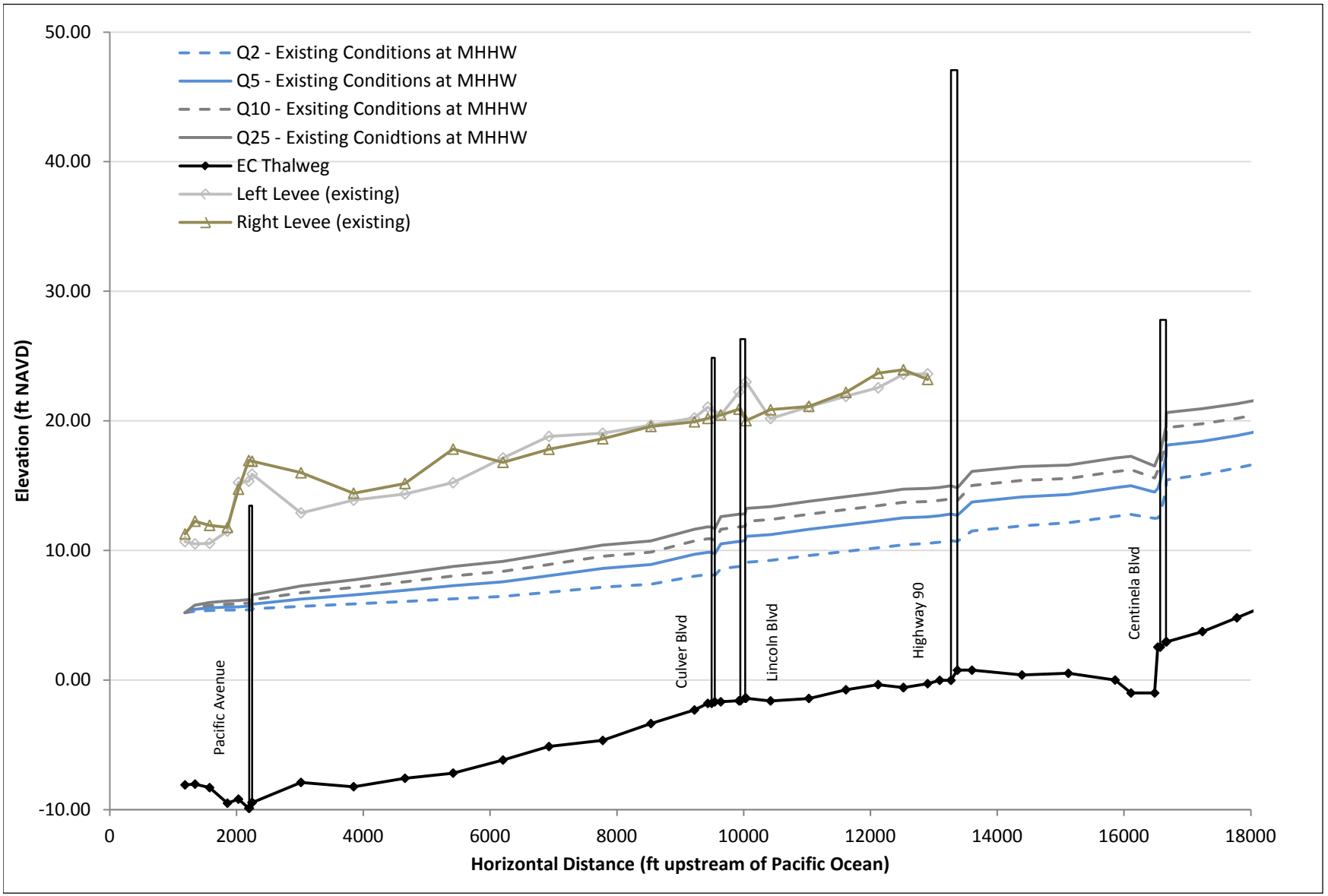

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Figure 9a

Q2 - Q25 Flood Profile
Existing Condtions

ESA PWA

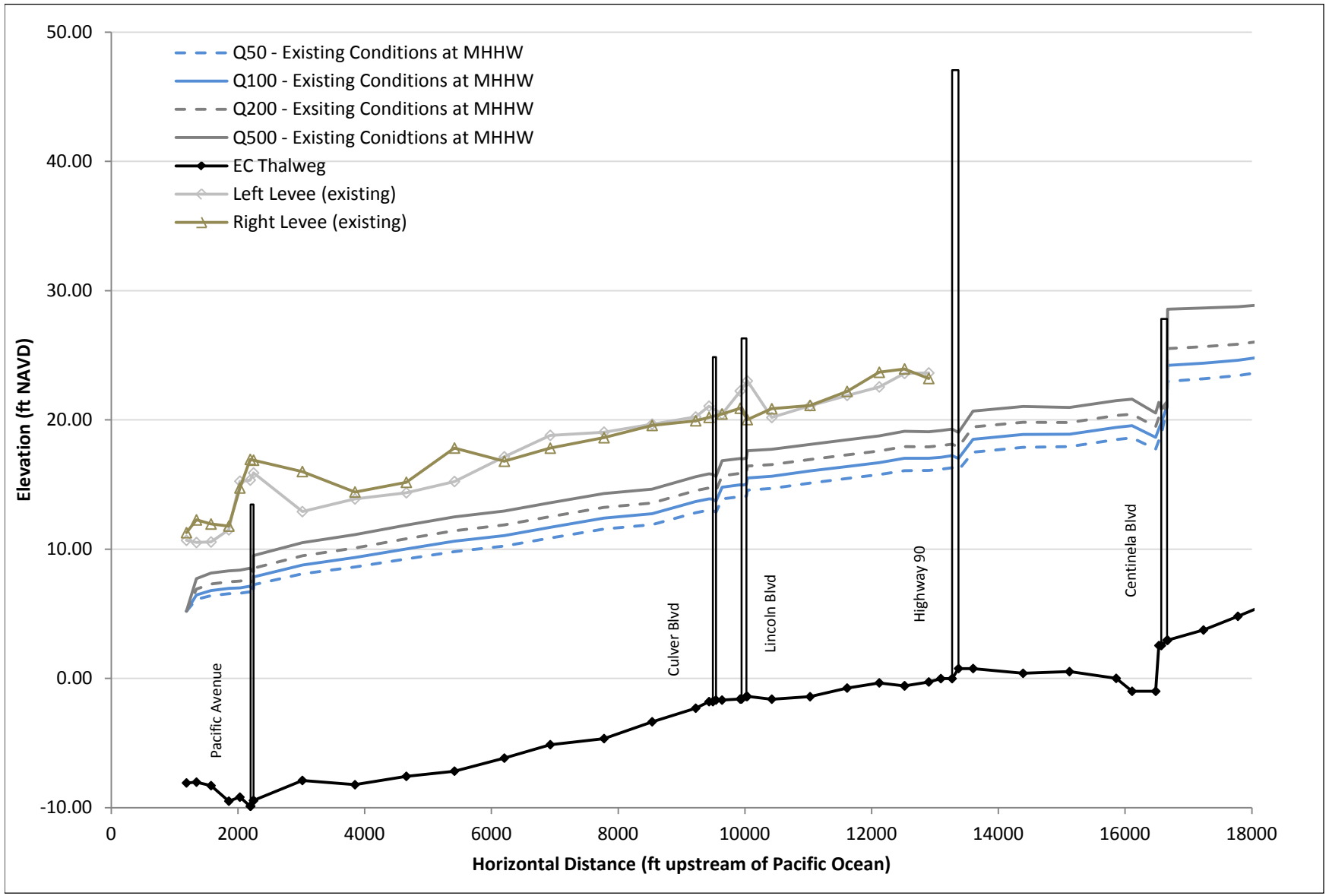

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Figure 9b

Q50 - Q500 Flood Profile
Existing Condtions

ESA PWA

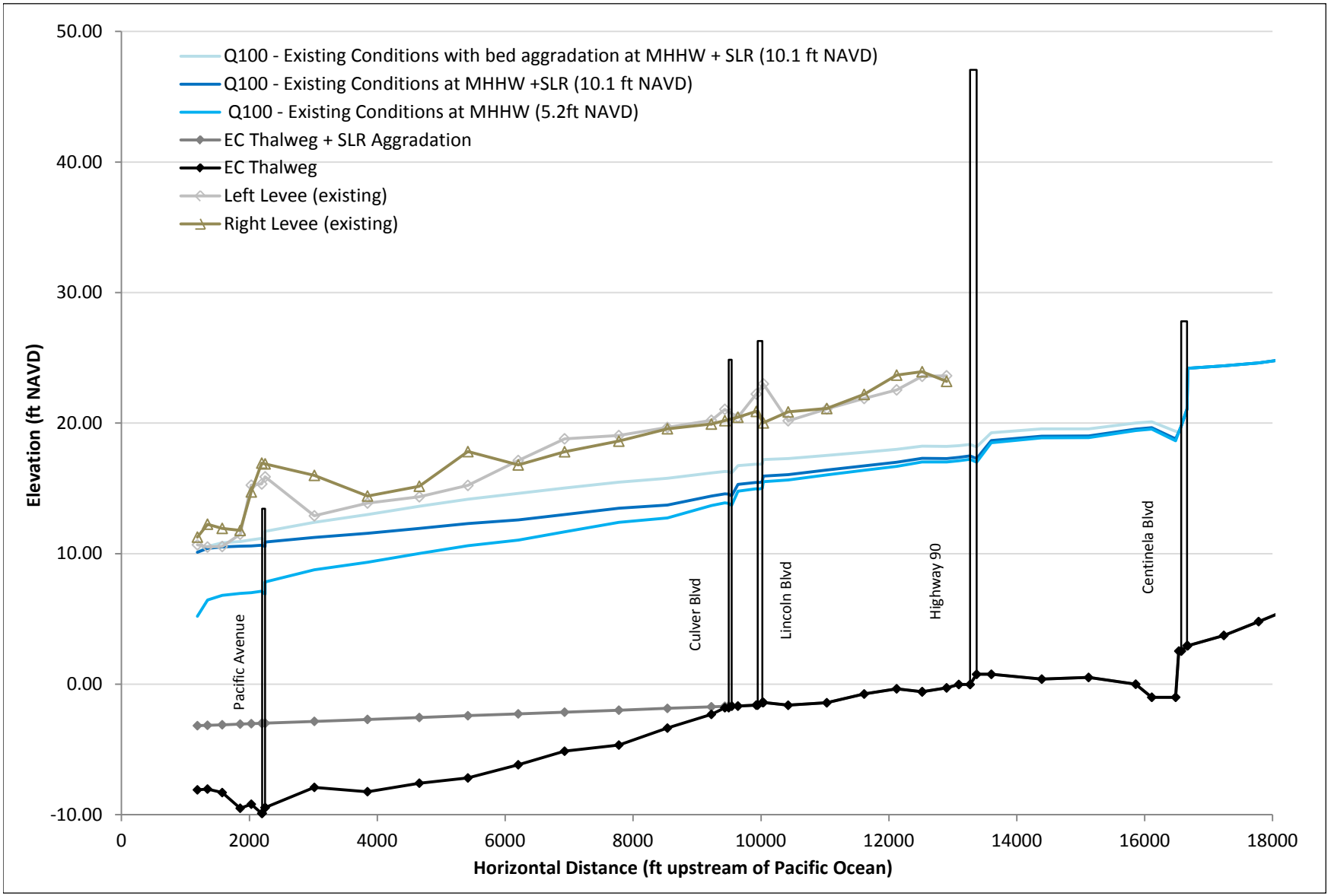

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Figure 10

Q100 Flood Profile

Existing vs. Future (without Project)

ESA PWA

3.3.4 Project Conditions

A variety of discharge rates and boundary conditions were simulated for Project Conditions to evaluate the potential hydraulic effects of the project on Ballona Creek relative to existing conditions, and to inform restoration design development. For Project Conditions scenarios, the post-project levee crest is assumed to be at 20.5 feet NAVD based on the current preliminary project design (Figure 3).

Water surface and velocity profiles for project conditions relative to existing conditions are shown in Figure 11. This figure shows significant reduction in flow velocities through the project reach for the design flow of 46,000 cfs with a downstream boundary of 7.6 ft NAVD. Under project conditions, floodplain areas on the left and right banks of the channel provide increased conveyance capacity while also increasing roughness and wetted perimeter, which reduces flow velocities. This leads to a generally flatter water surface profile relative to the constrained existing conditions, resulting in slightly higher water surfaces through the project reach. Because the levee heights are increased under project conditions, freeboard through the project reach is increased as summarized in Table 8 and Table 9. The flattened water surface profile extends through the bridges at Culver and Lincoln boulevards resulting in less head loss through these bridges and slight reductions in water surface elevation extending upstream to Highway 90. Upstream of highway 90 the existing and project conditions water surface profiles converge.

To evaluate the effects of SLR on the water surface elevations, model runs were conducted for project conditions with a downstream boundary of MHHW plus 59 inches of SLR with the current project thalweg. In addition, this tidal boundary was combined with a theoretical future geometry with the thalweg aggraded by 59 inches projecting linearly to Lincoln Boulevard. The results of these two runs compared to existing conditions for the 100-year flood are shown in Figure 12. As seen in these figures, the increase in the downstream water level under SLR scenarios increases water levels from the creek mouth to Centinela Boulevard. For the scenario including the aggraded channel bottom, the water surface is higher than without aggradation; however the change between these two profiles is mitigated by the fact that the bed aggradation represents a relatively small portion of the overall flow area in the cross-section.

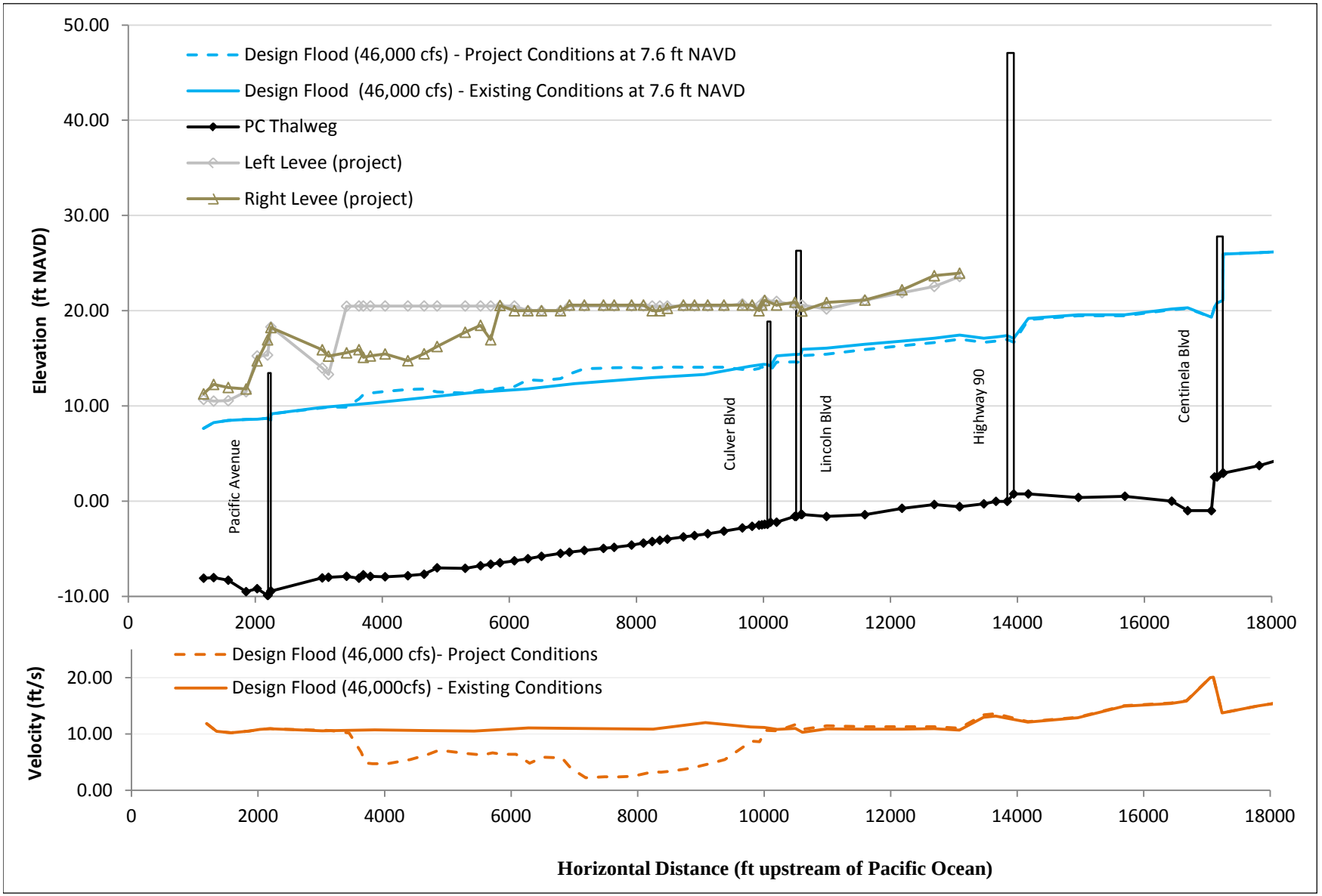
To evaluate the sensitivity of the project conditions model results to the downstream tide level, the design flood was run under a series of tidal boundary conditions. Water surface profiles for the design flood with a tidal boundary at the design condition (7.6-feet NAVD), and at MHHW, MTL, and MLLW (5.2, 2.6, and -0.2-feet NAVD respectively) are shown in Figure 13. As seen in this figure, the tidal boundary condition has a moderate influence on the water surface profile from the downstream boundary up to Lincoln Boulevard. This influence dissipates between Lincoln and Highway 90, upstream of which all the project conditions profiles converge. The design tidal boundary results in a water surface profile above the lower tidal boundary profiles by a maximum of 1.1 feet near Pacific Highway, and an average of 0.6 feet between Pacific and Lincoln. Reducing the tidal boundary below MHHW has no significant impact on the water surface profiles, which are dominated by the fluvial input for low tide levels.

Water surface profiles under project conditions for the suite of n-year floods are shown in Figure 14. These profiles, discharging against a tidal boundary at MHHW, show that the project's effect on the water

surface profile increases relative to existing conditions as discharge increases. The relative change in the flow hydraulics, including flow velocity and shear stress, between the existing channel and the project reach is more pronounced as an increasing portion of the flow overtops the banks and floods the floodplain areas created by the project.

3.3.4.1 Interim Project Conditions

Water surface and velocity profiles for project conditions under the interim construction phase (described in the PDR that accompanies this report) for the 46,000cfs design flow are shown in Figure 15. For this phase of the project, the existing levee separating West Area B is retained and flow is converged back into the existing channel approximately 1500 feet upstream of the convergence point for the full project. The velocity and water surface profiles for this scenario show similar patterns as for the full project through Area A and North Area B, and converge with existing conditions where the existing channel is retained. The average velocity through the interim project reach drops from 11.0 ft/s under existing conditions to 5.5 ft/s.

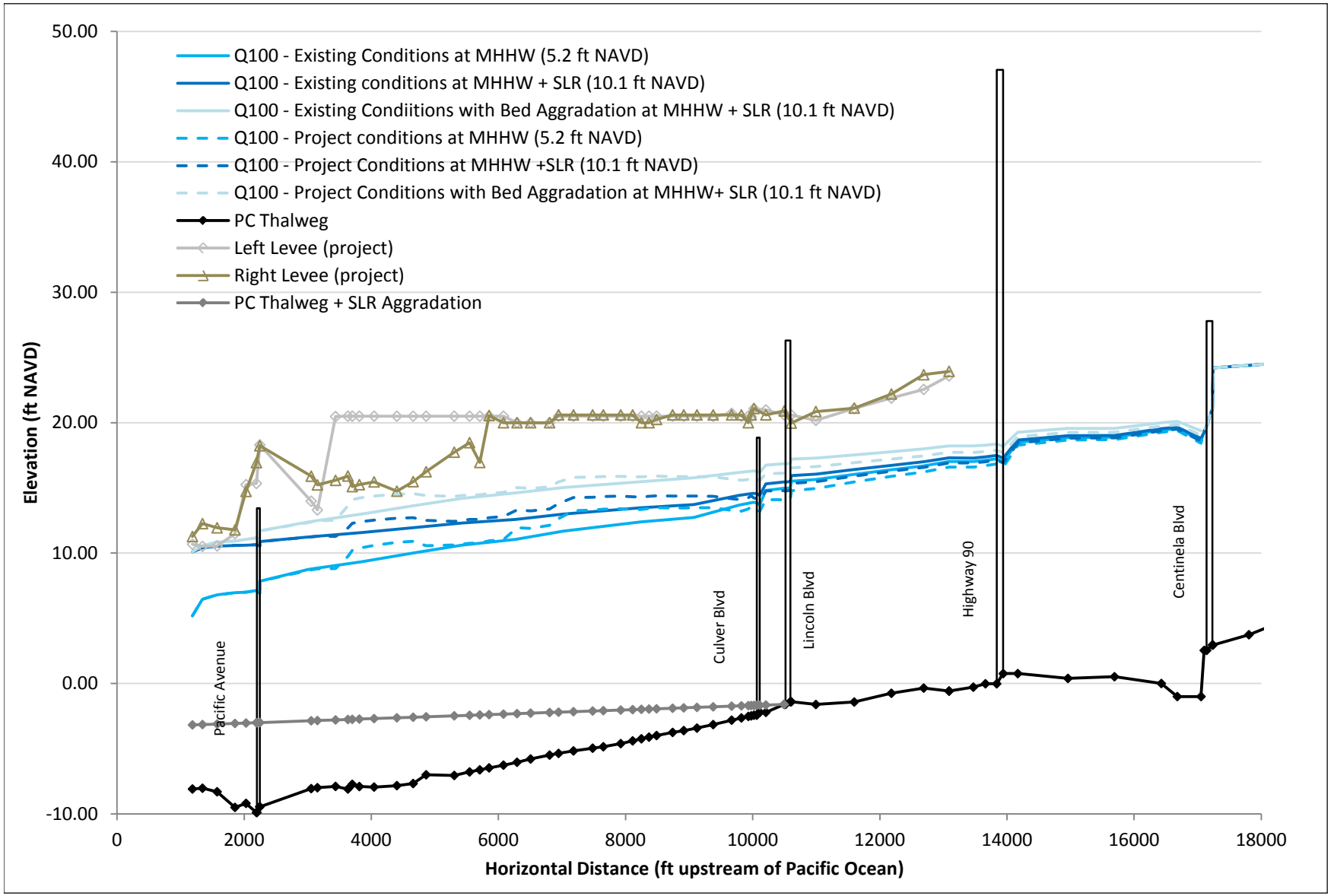


Ballona Wetland Restoration. D120367

Figure 11

Design Flood and Velocity Profiles
Existing vs. Project Conditions

ESA PWA



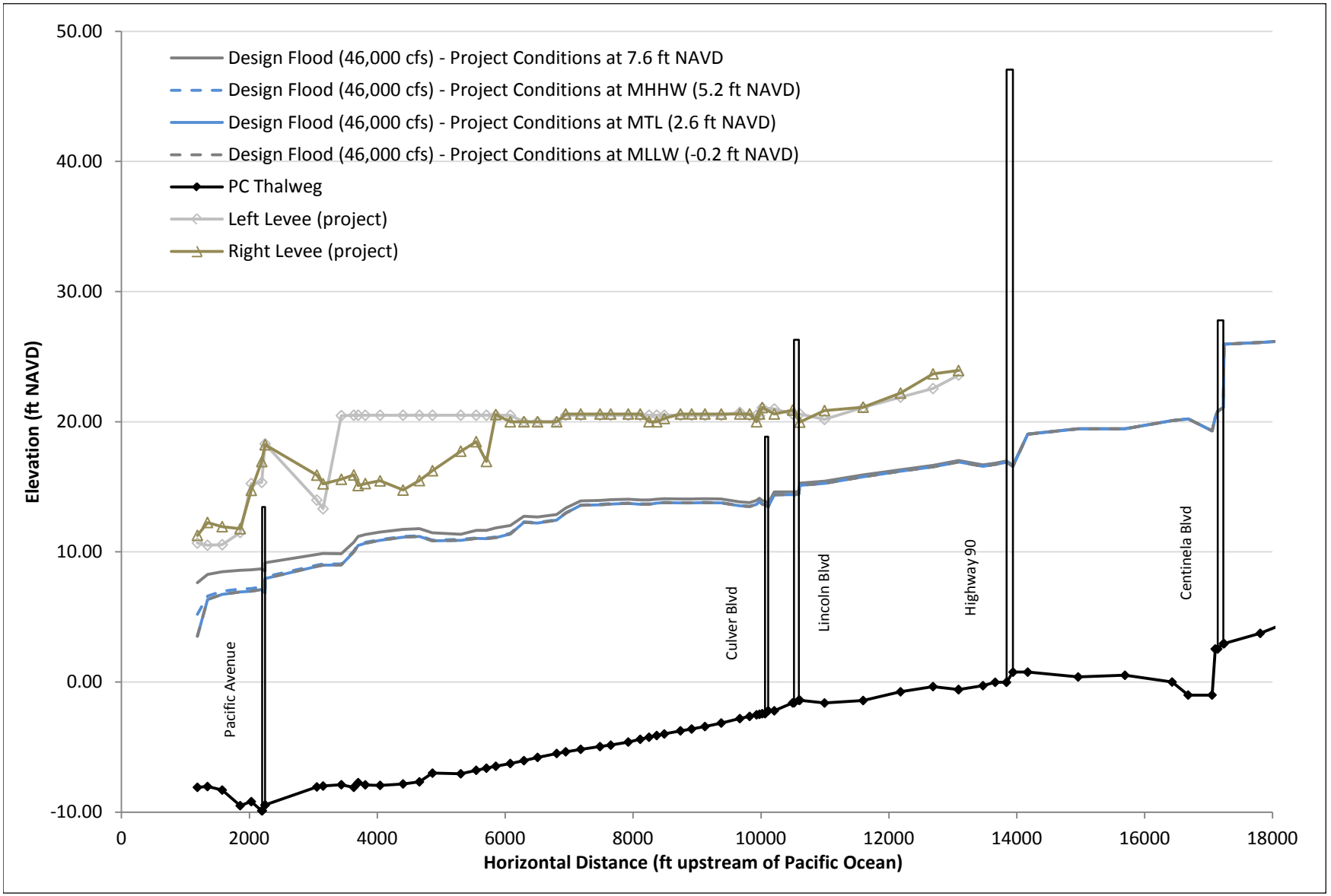
Ballona Wetland Restoration. D120367

Figure 12

Q100 Flood Profiles

Existing vs. Project with SLR Conditions

ESA PWA



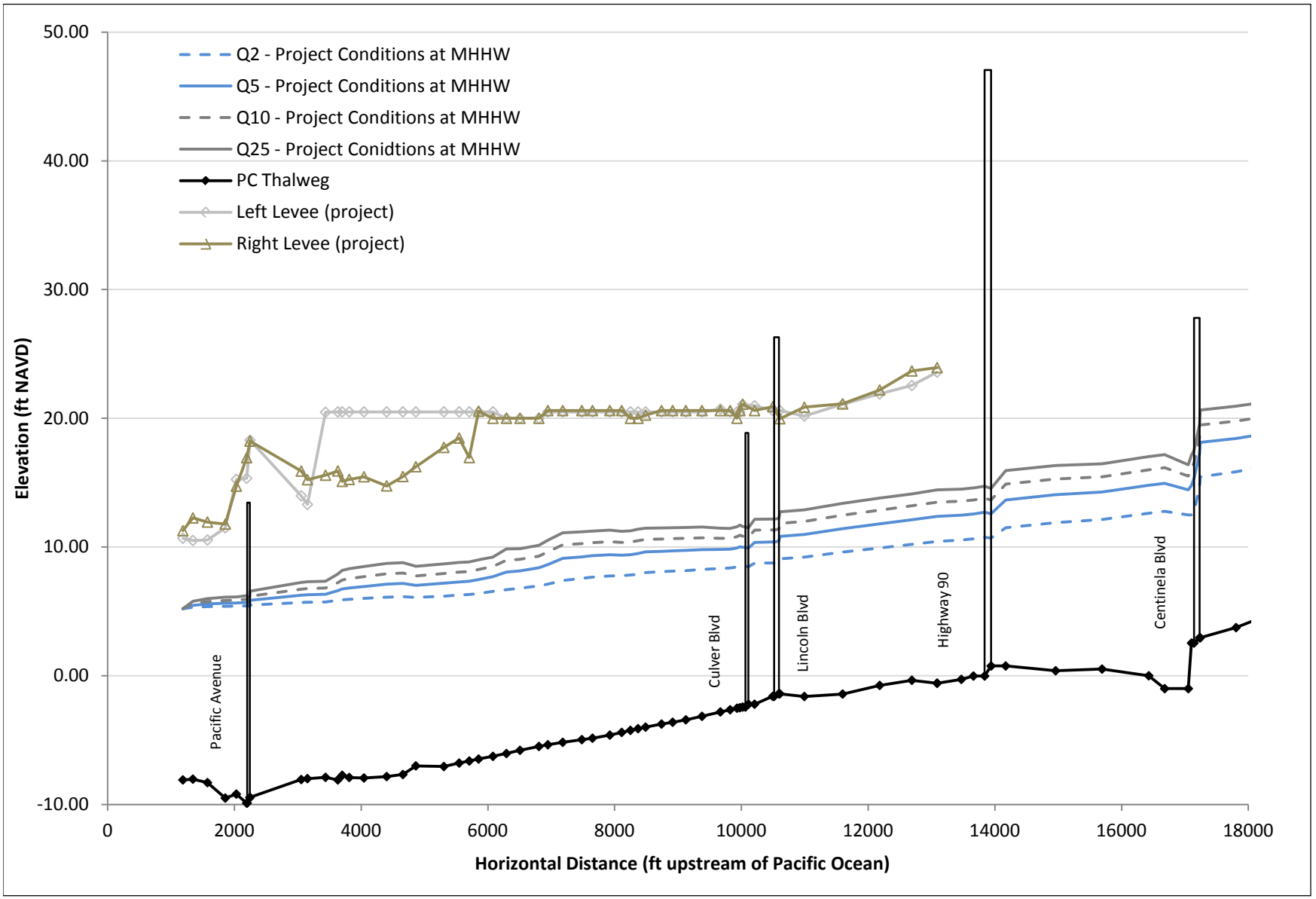
Ballona Wetland Restoration. D120367

Figure 13

Design Flood Profiles

Project Conditions Downstream Boundary Sensitivity

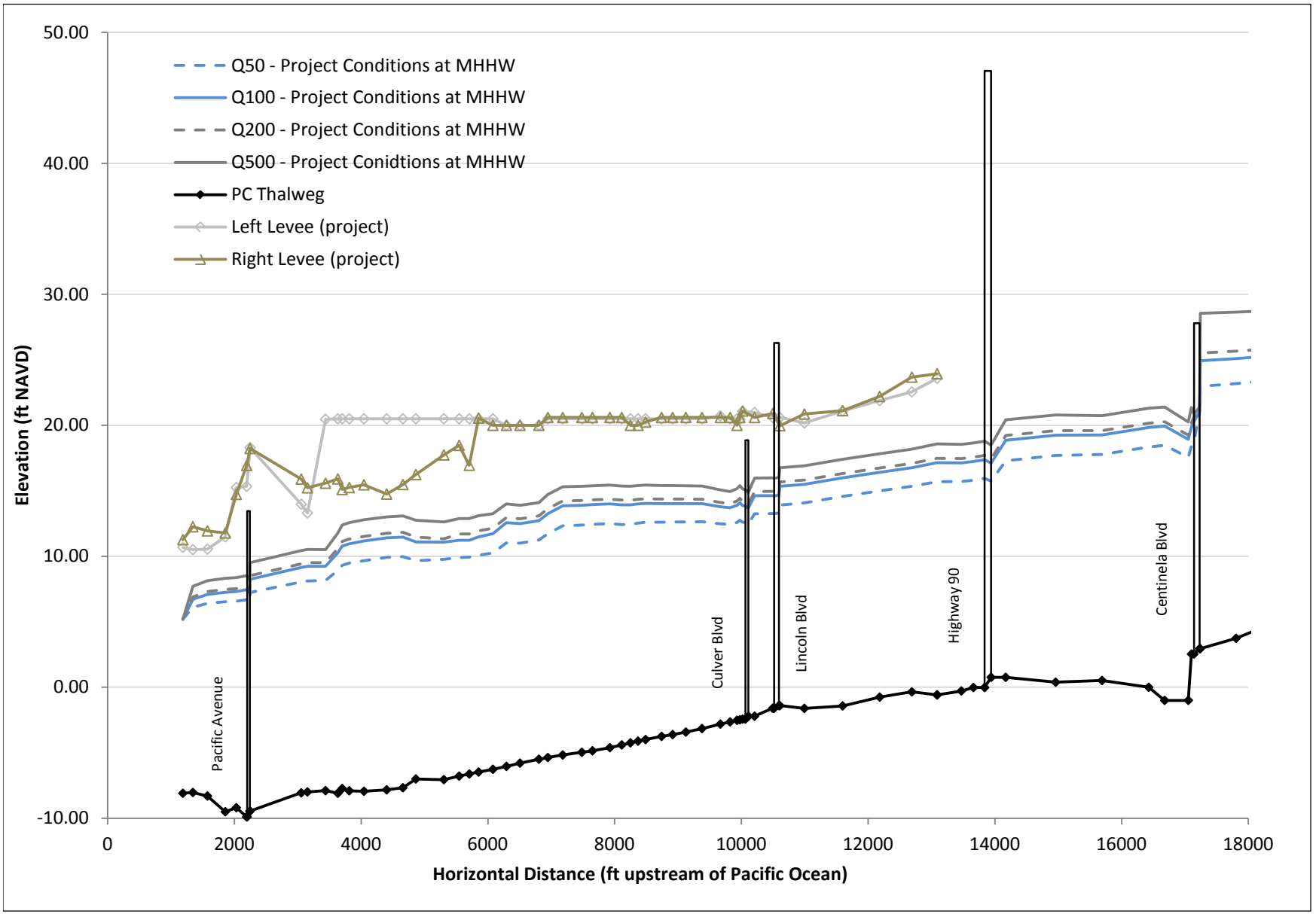
ESA PWA



Ballona Wetland Restoration. D120367

Figure 14a

Q2 - Q25 Flood Profile
Project Conditions

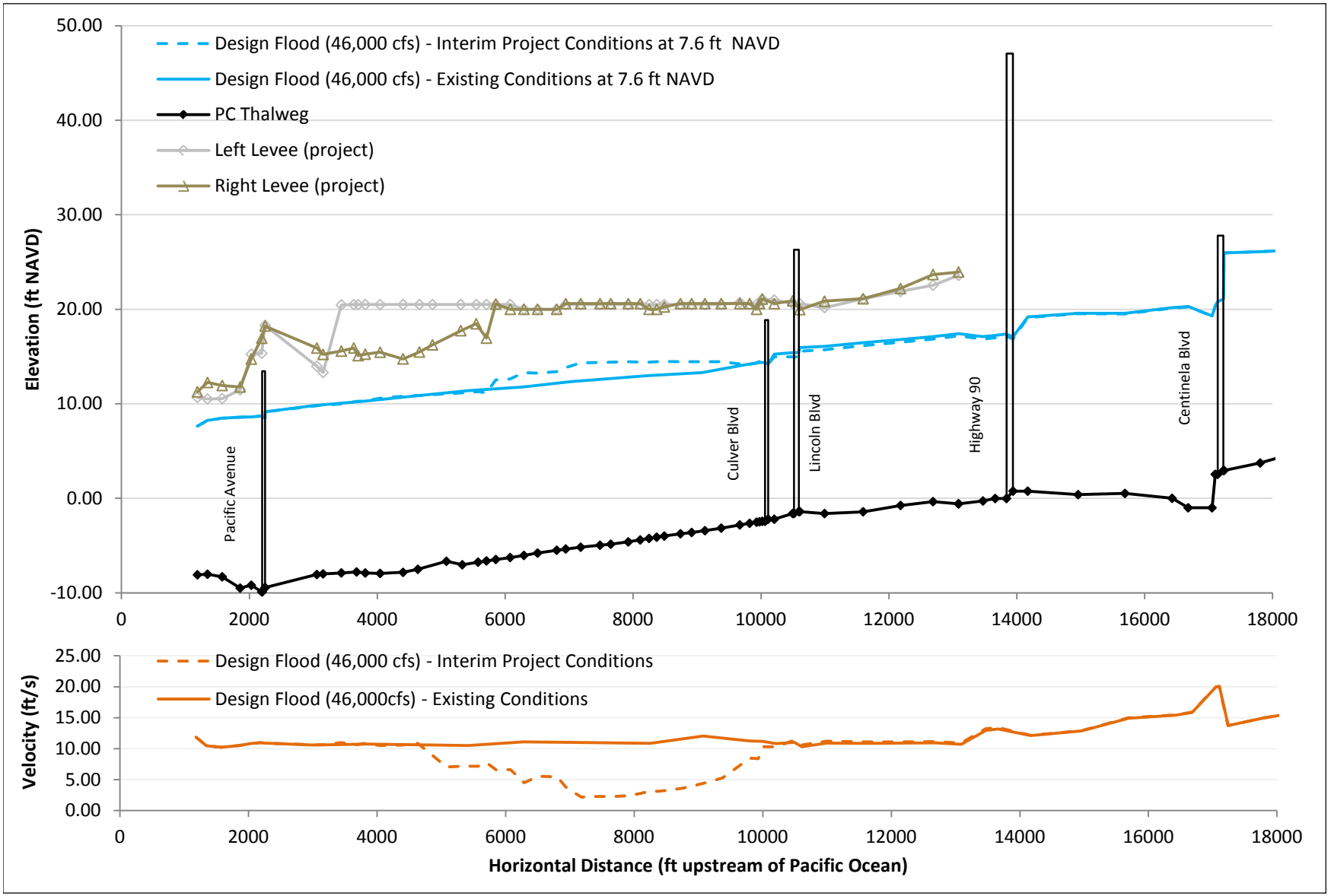


Ballona Wetland Restoration. D120367

Figure 14b

Q50 - Q500 Flood Profile
Project Conditions

ESA PWA



Ballona Wetland Restoration. D120367

Figure 15

Design Flood Velocity Profiles
Existing Conditions vs. Interim Project Conditions

ESA PWA

3.3.5 Discussion

Tables 8 and 9 summarize freeboard results from the HEC RAS model for the design flood of 46,000 cfs. Results for Area A and North Area B, shown in Table 8, indicate that the maximum, minimum and reach averaged freeboard are increased under both interim and full project conditions relative to existing conditions. Freeboard results for the Left (south) and Right (north) Bank levees are reported separately in the table.

Table 8 HEC RAS Results - Freeboard (Project Reach through Area A and North Area B)

	Freeboard (ft) Area A/North Area B (RS 6079 to 10019)					
	Left Bank			Right Bank		
Design Flood (46,000cfs)	Reach Average	Maximum	Minimum	Reach Average	Maximum	Minimum
Existing[1]	6.22	6.68	5.35	5.70	6.27	5.01
With interim project[2]	6.32	7.88	5.97	6.38	7.88	6.01
With project[2]	6.76	8.47	6.33	6.70	7.97	5.95

[1] Freeboard based on existing levee elevation

[2] Freeboard based on project levee elevation of 20.5 ft NAVD

Results for West Area B are shown separately in Table 9. Model results show significant increases in freeboard for the Left Bank under project conditions, reflecting the increased levee heights proposed for West Area B. Through most of this reach, however, the Right Bank consists of the existing levee/jetty that is not shown as being modified under the preliminary project design. Elevated water levels in the vicinity of Area B under project conditions reduce the amount of freeboard provided by the existing levee/jetty along the Right Bank by up to one foot. The majority of the Right Bank is formed by the jetty that separates Ballona Creek from the Marina Del Rey and a reduction in freeboard along the jetty may not represent a significant increase in flood risk. However, as discussed in the PDR, there is a section of the existing levee between the upstream end of the jetty and the downstream end of the new proposed North Area A levee that may need to be raised in order to maintain or improve the existing level of flood protection.

Table 10 shows velocity results from the HEC RAS model for the design flood of 46,000 cfs. Reach averaged and maximum velocities in the project reach are significantly reduced relative to existing conditions under both interim and project conditions.

Table 9 HEC-RAS Results – Freeboard (Project Reach through West Area B)

	Freeboard (ft) West Area B (RS 3055 to 5853)					
	Left Bank			Right Bank		
Design Flood (46,000cfs)	Reach Average	Maximum	Minimum	Reach Average	Maximum	Minimum
Existing[1]	3.63	3.84	3.48	4.94	6.43	4.11
With interim project[1]	3.63	3.84	3.48	5.99	9.35	3.91
With project[2]	9.15	10.60	8.65	5.11	8.70	3.01

[1] Freeboard based on existing levee elevation

[2] Freeboard based on project levee elevation of 20.5 ft NAVD

Table 10 HEC RAS Results - Velocity (Project Reach)

Velocity (feet/second)	Reach Average	Minimum	Maximum
Design Flood - 46,000 cfs			
Existing	11.0	10.51	12.02
With interim project	5.53	2.16	10.84
With project	5.83	2.27	10.66

4. HYDRODYNAMIC ANALYSIS

The two-dimensional (2D) hydrodynamic model results are used to provide insight into the 1-d hydraulic analysis, the preliminary restoration design (see PDR), and to more closely examine some of the 2D processes, such as flow area, velocity, and shear stress for Project Conditions.

4.1 PREVIOUS MODELING

ESA PWA previously constructed an EFDC hydrodynamic model for Ballona Wetlands to support the restoration planning process (PWA 2009). The EFDC model was selected for application by the Project Management Team, Science Advisory Committee, the USACE, and ESA PWA. The model was used to characterize the hydrodynamic response of various restoration alternatives.

4.2 MODEL DESCRIPTION

EFDC is a numerical model designed for simulating flows in open water systems. The model was originally developed at the Virginia Institute of Marine Science and receives continuing support from the U.S. EPA. A complete description of the model assumptions, governing equations and approximations, including the space discretization, time integration, and numerical solution methods, is presented in Hamrick (1992). Tetra Tech (2002) provides guidance in using the model as well as references to successful applications of EFDC for a variety of tidally-influenced systems.

EFDC solves the physical equations for fluid flow on a staggered, finite-difference grid. The modeling domain is defined by a curvilinear flexible mesh, enabling the grid to follow dominant terrain features. At present, the model has been configured to predict 2D depth-averaged flow. Although not implemented for this study, the model can be extended to simulate three-dimensional (3D) flows and the transport of salt, sediment, and/or contaminants.

4.3 GEOMETRY

4.3.1 Existing Conditions

The model domain extends from where Ballona Creek passes under Sawtelle Boulevard to Santa Monica Bay, as shown in Figure 16. The upstream boundary is beyond the range of tidal influence and coincides with a discharge monitoring station. Placing the downstream boundary within Santa Monica Bay provides ample distance and tidal volume between the specified tidal boundary condition and the region of interest. Between the upstream and downstream boundaries, the model domain includes:

- Lower Ballona Creek;
- Ballona Wetland Restoration Areas A, B, and C;
- Marina Del Rey, including Oxford Basin;
- Del Rey Lagoon;
- Ballona Lagoon, including the Grand Canal downstream of Washington Boulevard; and
- A portion of Santa Monica Bay roughly 1.3 km by 2.5 km.

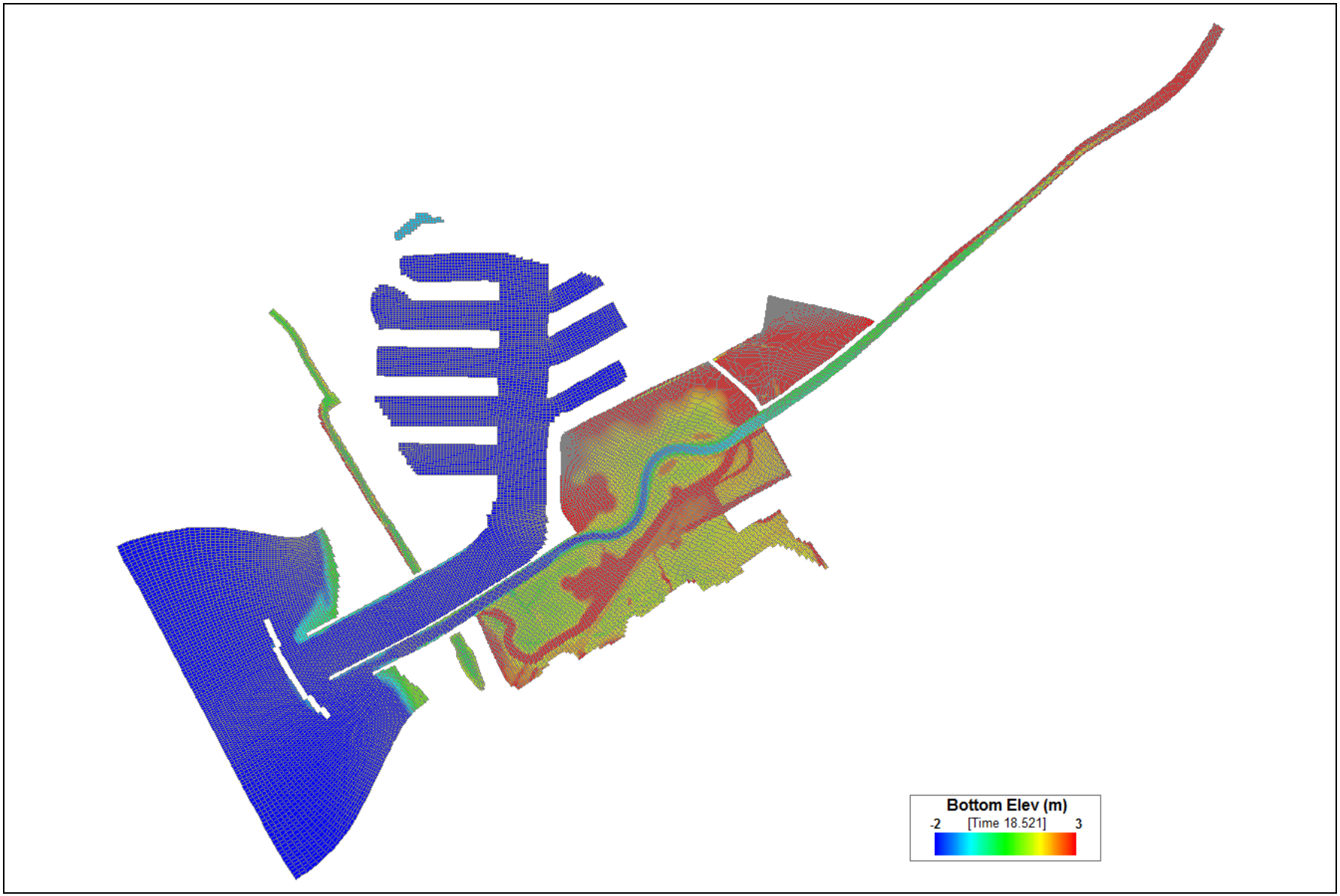


Figure 16
EFDC Project Conditions
Model Topography, Full Extent

4.3.1.1 Topography and Bathymetry

The EFDC model represented the actual bathymetry as a single elevation value at the center of each 10 m grid cell. Multiple sources of bathymetric data were compiled to cover the entire model domain. The sources of bathymetry data for each region are listed below:

- *Ballona Creek and Ballona Wetland Areas A, B, and C:* Topographic and bathymetric surface from PSOMAS (2012).
- *Santa Monica Bay*: Bathymetric survey data from the National Oceanic and Atmospheric Administration (1997).
- *Marina Del Rey*: Elevations in the main stem of the marina from unpublished USACE dredging surveys in March 2006 and elevations in the mooring basins extrapolated from the adjacent main channel elevations.
- *Del Rey Lagoon:* Spot elevations from bathymetric survey drawings (City of Los Angeles, 2003) interpolated across the lagoon.
- *Ballona Lagoon and the Grand Canal*: Elevations from cross section surveys (Coastal Frontiers Corporation, 1989) and Ballona Lagoon Enhancement Project design drawings (City of Los Angeles, 1997).

All elevation data were converted to the same horizontal datum (UTM Zone 10N) and vertical datum (NAVD88). The data sets were then imported into the DELFT3D bathymetry generation software (WL | Delft Hydraulics, 2006a), checked for consistency where data sets overlap or adjoin, and smoothly interpolated at the boundaries between data sets. The compiled bathymetric surface was converted into EFDC-specific input files using the EFDC_Explorer graphical user interface (Craig, 2004). The compiled bathymetry for the model extent is shown in Figure 16.

4.3.1.2 Structures

Under existing conditions, culverts and gates regulate flow into and out of the Area B wetland, Del Rey Lagoon, and Ballona Lagoon. Culvert flow is represented in the model as water-level-dependent discharge between a pair of grid cells. Discharges through the culverts are implemented in the EFDC model through an input file that specifies the discharge as a function of the difference in water levels at the ends of each culvert.

Since Area B is managed and the culvert connecting Area B and Ballona Creek would be closed during flood events, the culvert is not open during flood model runs.

4.3.1.3 Bed Roughness

EFDC parameterizes the bed friction's effect on flow through a roughness height, z_0, based on the assumption of a logarithmic velocity profile. A typical, constant z_0 value of 0.02 m was applied across the entire domain (Blumberg and Mellor, 1987).

4.3.2 Project Conditions

4.3.2.1 Topography and Bathymetry

Topography and bathymetry for the Project Conditions includes the following changes from the Existing Conditions model (Section 4.3.1.1):

- New proposed setback levees around the north perimeter of Area A and in Area B along Culver Blvd. and the perimeter of West Area B.
- Ballona Creek channel realignment, including removal of the existing levees (existing north levee along Area A and south levee along Area B), creation of two new proposed channel meander bends within the restored site, and open connection between the realigned channel and adjacent restored wetlands.
- Area A: removal of fill to restore wetlands from the channel bank to the perimeter.
- Area B: wetland restoration along the south side of the realigned channel and fill to create an upland peninsula in West Area B around the existing gas wells.

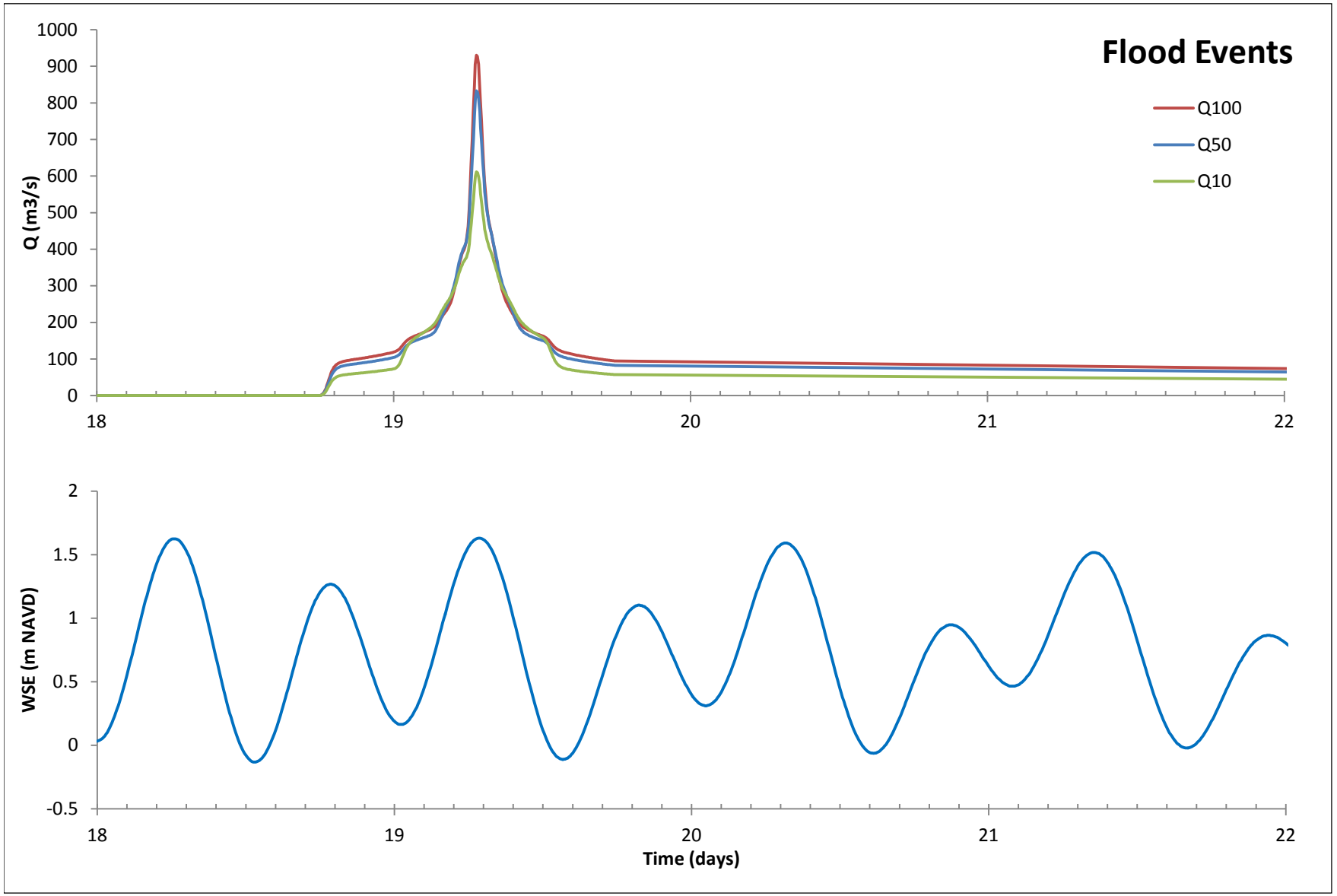
The project grading plan is presented in the PDR.

4.3.2.2 Structures

The existing levees and the West Area B tide gates are removed in the Project Conditions model. No changes from the Existing Conditions model were made to the other culverts for the Project Conditions model. The areas south of the new proposed Culver levee (South and East Area B) will be managed wetland, and the new proposed culvert connecting these areas to Ballona Creek would be designed to be closed during flood events. The new culverts are therefore not included in the Project Conditions model.

4.4 HYDROLOGY

As described in Section 2, the source for n-year peak flows and hydrographs is USACE 2010b (Table 2). The 10-, 50-, and 100-year hydrographs are shown in Figure 17 with the downstream tide boundary condition discussed below. These hydrographs are applied at the upstream boundary at Sawtelle Boulevard.



Source: Hydrograph data from USACE 2010b; Tide data from Santa Monica tide gage (Station ID 9410840) (NOAA 2012)

Ballona Wetlands. D120367

Figure 17

Hydrograph and Tide Boundary Conditions

4.5 TIDAL BOUNDARY CONDITIONS

Measured tide data at Santa Monica (Station ID 9410840) (Figure 17) was used as the downstream water level boundary condition in the model. The timing of the higher high tide and the hydrographs were adjusted so that the high tide and peak discharge are coincident within the restored site (Figure 17). The coincident high tide level is 5.4 ft NAVD (0.2 ft above MHHW).

4.6 RESULTS AND DISCUSSION

ESA PWA ran the 10-, 50-, and 100-year flood events through the EFDC existing conditions and project conditions models. Figure 18 shows the peak velocities across the site for the project condition. Figure 19 presents the direction of flow during the 100-year event under project conditions. The velocity vectors indicate that flow generally follows the realigned channel with some flow across the marsh. The velocity results show (from upstream to downstream):

- De-acceleration of flow as flow diverges onto the restored wetland floodplain downstream of Culver Blvd
- Low velocity flow and inundation in north Area A adjacent to the proposed Area A levee
- Low to medium velocity flow adjacent to the Culver levee on the south side of the realigned channel
- Flow acceleration as flow converges at the west end of Area A/Area B upland peninsula
- Medium velocity flow in West Area B adjacent to the channel
- Low velocity flow around the perimeter of West Area B and the proposed West Area B levee
- Flow acceleration at the downstream end of the project where flow re-converges into the channel downstream
- Downstream channel velocities comparable for existing and project conditions

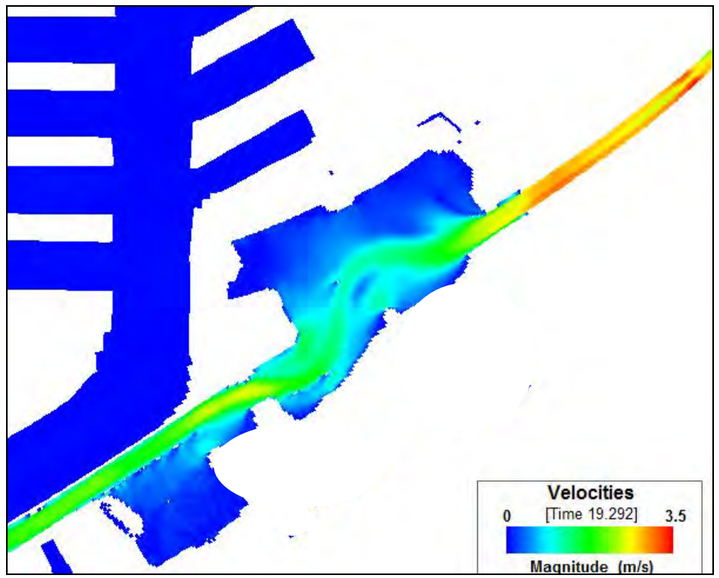
Figure 20 presents peak velocities and shear at key locations across the site for the 100-year event under project conditions. Figure 20 also includes a table listing the permissible shear stress (i.e., critical shear stress above which erosion occurs) for a range of vegetation, soil, and armoring from the literature (Fishenich 2001). Peak modeled shear stresses for the 100-year event are generally within the range of permissible shear stress for native vegetation. The results indicate that vegetated wetland along the channel banks will experience some erosion. Peak shear stress in the channel and at the toe of the channel bank is generally at or above the critical shear for erosion of alluvial silt (colloidal). Some channel bed and bank erosion are therefore expected during the 100-year event.

These results were used to develop the preliminary armoring plan included in the PDR. Soil samples and cores are being collected and analyzed for erosion properties. Further analysis of potential erosion rates and amounts will be performed in subsequent analyses based on soil erosion properties.

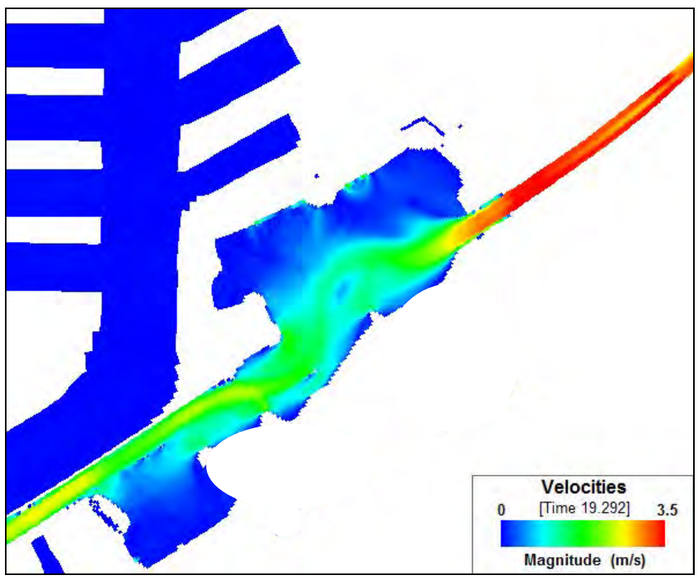
Figure 21 compares the peak water level profiles for the HEC-RAS and EFDC models for the 100-year event. The EFDC model does not include the bridges upstream of the site which are included in the HEC-RAS model, so the water levels do not agree upstream. Within the project reach, the water surface profiles generally agree.

Project Conditions

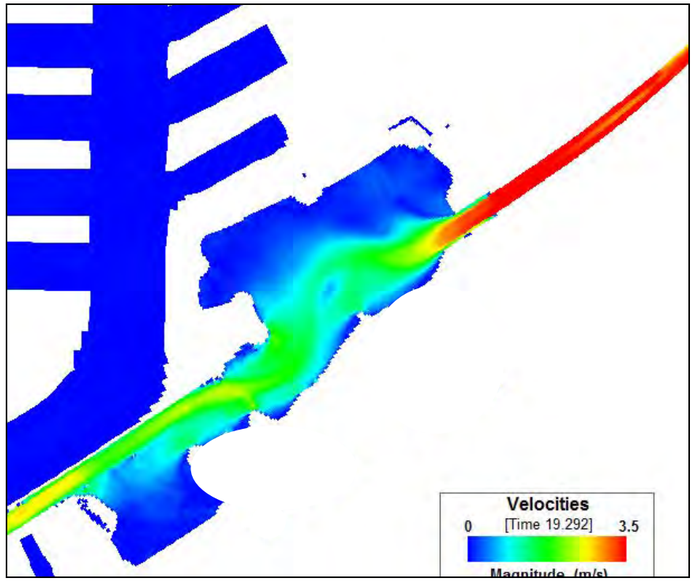
10-Yr Flood



50-Yr Flood



100-Yr Flood



SOURCE: EFDC model

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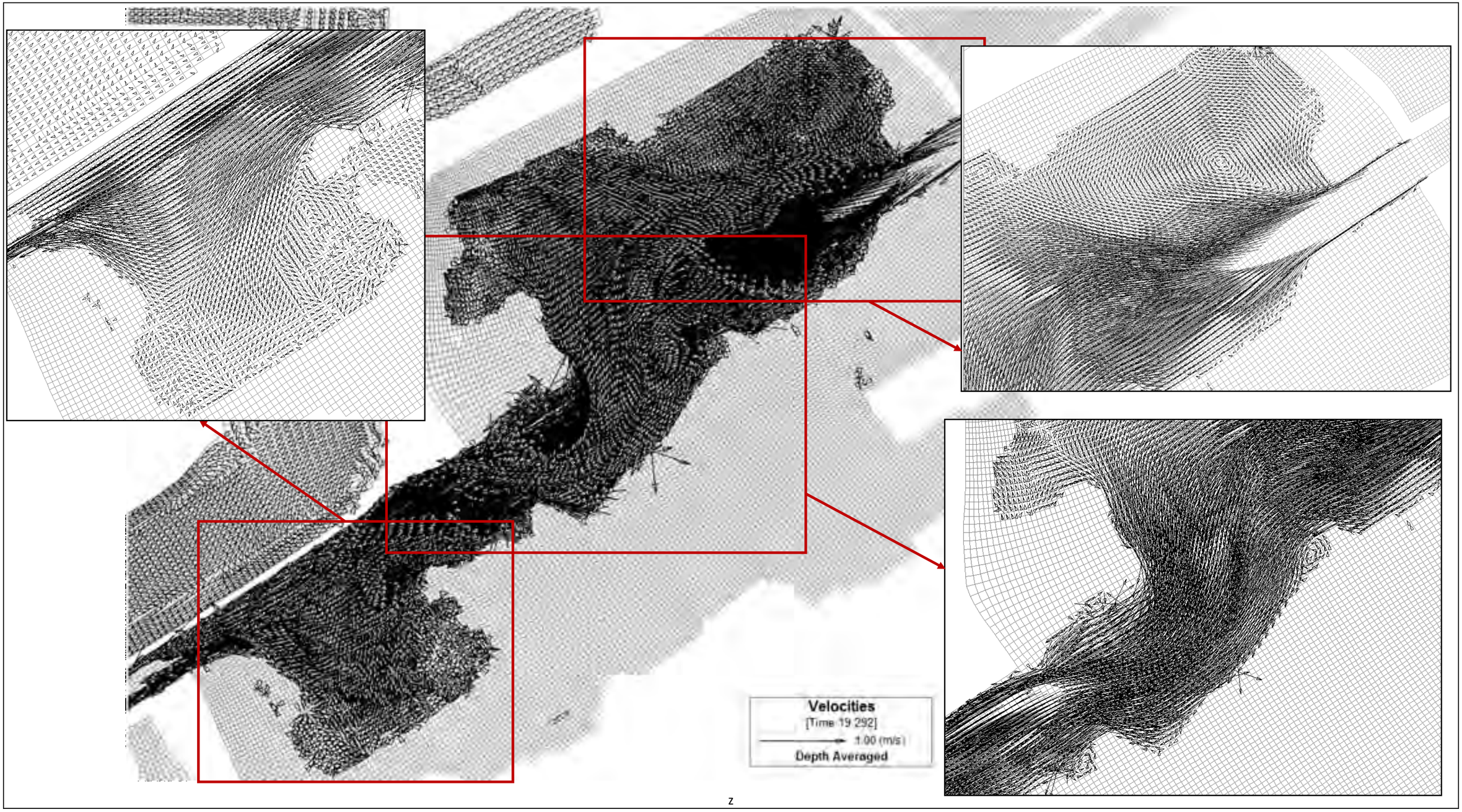
Ballona Wetlands . D120367

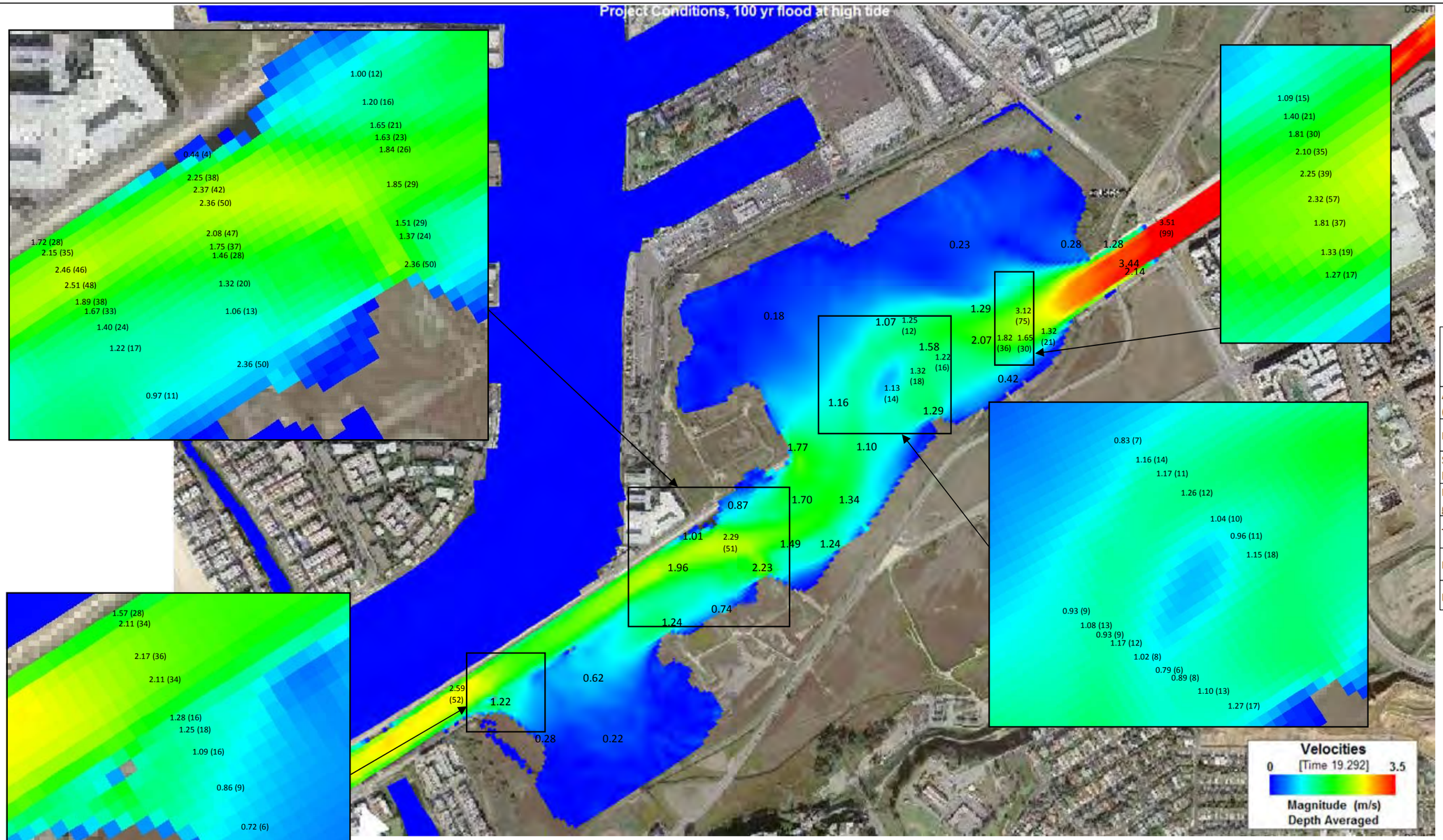
Figure 18
Project Conditions
Peak Velocities



SOURCE: EFDC model

Ballona Wetlands . D120367

Figure 19
Project Conditions, 100-Year Flood
Velocity Vectors at Peak Velocity



	Permissable Shear Stess in Pa (Fishenich 2001)
Alluvial silt (colloidal)	12
Reed plantings	5 - 29
Short native and bunch grasses	34 - 45
Long native grasses	57 - 81
Turf (Class A - C)	48 - 177
Rip rap - 6"	120
Rip rap - 24"	484

Velocity in m/s (Shear in Pa)

SOURCE: EFDC model

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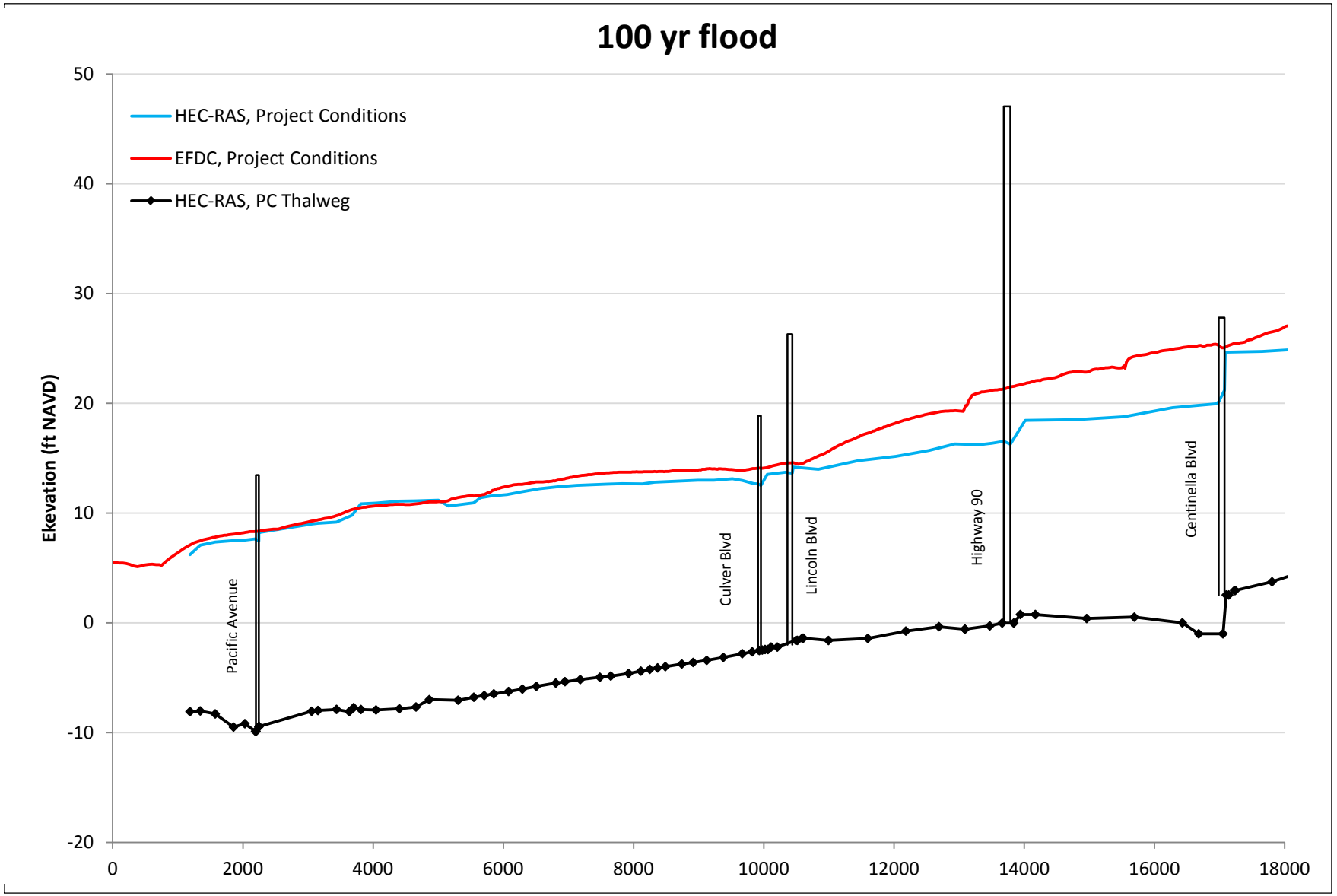
Figure 20

100-Yr Peak Velocity and Shear



Ballona Wetland Restoration. D120367

Figure 21

HEC-RAS and EFDC 100-Yr Peak Water Level Profiles

5. SEDIMENT TRANSPORT ANALYSIS

To evaluate sediment transport conditions in the project reach of Ballona Creek under existing and project conditions, we reviewed existing sediment data and studies for the channel and developed a sediment transport model based on the HEC RAS one-dimensional hydraulic model described above. For this preliminary evaluation, we ran the model for one representative flow event using available sediment data. Subsequent analyses will consider additional flow scenarios and incorporate additional sediment data based on recent sediment sampling from the project area.

Approximately 80% of the 130 square mile Ballona Creek watershed (Figure 1) is densely urbanized area with a high degree of impervious surfaces and low potential for sediment generation. The remaining 20% of the watershed is comprised of several steep headwater canyons on the southerly slopes of the Santa Monica Mountains with natural hillsides and urbanized valley bottoms. Many of the larger canyons contain debris and sediment collection basins which impound much of the sediment generated from the hillsides thus limiting the sediment supply to Ballona Creek as well as filtering out large diameter sediment. Samples collected by the USACE (2003) indicate that Ballona Creek sediments are primarily comprised of sand and silt (65% and 20% respectively) with small quantities of gravel (15%) based on a composite GSD. The size and quantity of sediment delivered to the Ballona Channel, along with the channel shape and profile slope, influences channel dynamics and flood performance for large, infrequent events, and governs the long term deposition and degradation regime in the channel.

Ballona Creek transitions from a concrete bottom channel to an earthen channel with concrete banks just downstream of Centinela Avenue. This location is also a major grade break in the channel profile, transitioning from a slope of 0.2% to a 0.09% slope. Based on a comparison of the channel profile between 1959 as-built plans from the Los Angeles County Flood Control District and topographic channel surveys conducted for this project (PSOMAS 2012), some sediment deposition has historically occurred in the channel downstream of this transition (Figure 22). This is likely due to the combination of the increase in channel roughness and the decrease in channel slope which decreases velocities in the channel thus reducing the channel's capacity to transport incoming and in-situ sediment. The proposed project is located downstream of this location in the low-energy, tidally-influenced zone of the Ballona Creek system.



J:\1793_Ballona\Accretion.mxd

Ballona Wetlands. D120367

Figure 22
Bed Accretion in Ballona Creek (1959 and 2012)

ESA PWA

5.1 SEDIMENT TRANSPORT MODEL

A preliminary sediment transport analysis was conducted using the sediment transport routines in HEC-RAS. The purpose of this analysis was to evaluate potential effects of the proposed Ballona Creek project on sediment transport within the project area and adjacent reaches of the channel based on a representative flow event. Potential impacts could include sediment deposition that could reduce flood conveyance capacity, or excessive scour that could cause channel and bank erosion. Subsequent analyses will evaluate these potential impacts in more detail for a broader range of flow conditions, including extreme flood events.

5.1.1 Sediment Data

Two primary forms of sediment play a large role in sediment transport processes in riverine systems: suspended sediment load, and bed sediment load or bedload. Respectively, these constituents represent the incoming sediment to a channel reach that remains in suspension (smaller particles), and the load of sediment that is mobilized along the channel bed by the incoming flow (larger particles). Together, these components comprise what is known as the total load of sediment being transported in the channel. Suspended sediment measurements are easy to obtain, and standard sampling methods have been widely applied in fluvial systems. However, bedload measurements are more difficult to obtain, and the techniques are generally less reliable than those used to sample suspended load. Therefore, bedload is often assumed to be a percentage, or range of percentages, of the total load. This percentage can be used to estimate total sediment load based on measured suspended sediment data (Turowski *et al* 2010). For this study, the fraction of bedload contributing to sediment transport was estimated to be about 10%, using documented values for California rivers as described in Section 5.1.1.3 below.

5.1.1.1 Grain size distribution

As part of the Ballona Creek Sediment Control Management Plan (USACE 2003a), the USACE collected a series of 20 sediment samples from Ballona Creek and its tributaries, and analyzed the samples for GSD. A composite GSD for the creek was derived for sediment transport analyses as summarized in Table 11.

Table 11 Representative Grain Size Distribution Curve for Sediment in Ballona Creek

Sediment Class	Grain size diameter range (mm)	Geometric mean diameter[1] (mm)	% Finer	% of Total
Silt	0.004 - 0.0625	0.02	20%	20%
Very fine sand	0.0625 - 0.125	0.09	25%	5%
Fine sand	0.125 - 0.25	0.18	40%	15%
Medium sand	0.25 - 0.5	0.35	56%	16%
Coarse sand	0.5 - 1	0.71	73%	17%
Very coarse sand	1 - 2	1.41	85%	13%
Very Fine Gravel	2 - 4	2.83	95%	10%
Fine Gravel	4 - 8	5.66	100%	5%

[1]Geometric mean represented by equation $\sqrt{(d_{max} * d_{min})}$

The composite GSD from the USACE data was used for the sediment transport analyses conducted in this study.

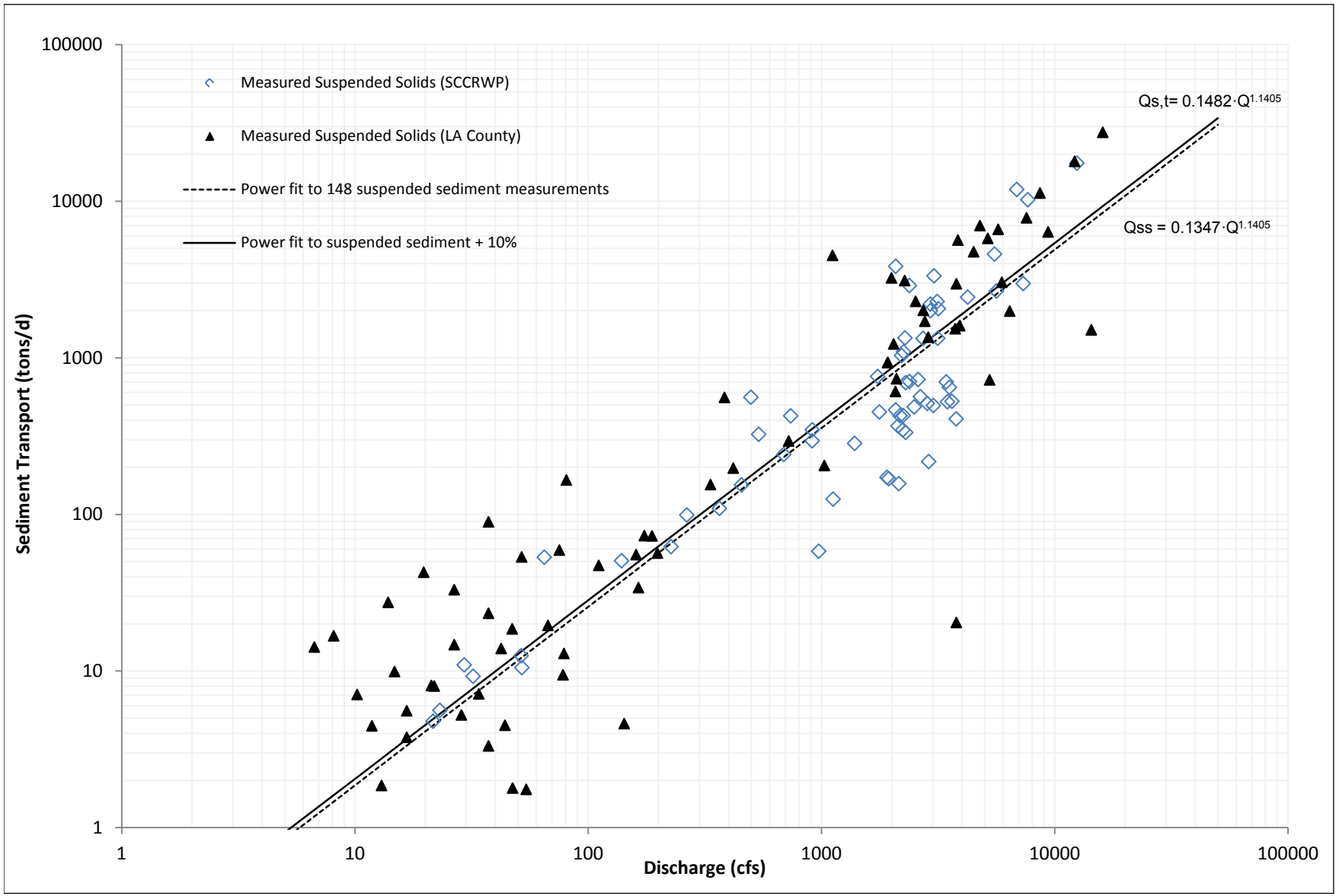
5.1.1.2 Suspended sediment data

Several water quality monitoring stations have been installed on Ballona Creek to evaluate total maximum daily loads (TMDLs) of various constituents affecting water quality in the Creek. The LACDPW has operated a monitoring station (S01) on Ballona Creek upstream of Sawtelle Boulevard since 1997 and the Southern California Coastal Water Research Project (SCCWRP) organization operated a mass emissions station (ME05) near the same location from 2001-2004. These monitoring stations were used to collect data for a number of water quality constituents including milligrams per liter (mg/L) of suspended sediment. Daily suspended sediment data in mg/L were provided by the LACDPW at S01 for 78 storm events from 1999-2011. These data did not include flow measurements at the time of the collected samples. For relating discharge to these suspended sediment data, it was assumed that the sample was collected near the peak daily flow measured at the LACDPW streamflow gage near Sawtelle (gage F38C-R). Additionally, data for 70 suspended sediment samples collected for 7 storm events at ME05 were provided along with measured flow data at the time of sampling. The total 148 samples were converted from a concentration (mg/L) to a loading rate (tons/day) by multiplying the discharge by the concentration and converting to the appropriate units. A suspended sediment rating curve relating suspended load (Q_{ss}) to discharge (Q) was created by fitting a power function to the measured data. The suspended sediment rating curve is shown in Figure 23

5.1.1.3 Bedload sediment fraction

In the absence of direct bedload measurements on Ballona Creek, the bedload fraction was estimated based on a review of typical values measured under similar hydrogeomorphic conditions. Several studies have been conducted to estimate the fraction of total load represented by bedload with estimates varying widely depending on characteristics of the river and sediment being analyzed. A commonly used ratio of bedload to suspended load of 10% has been assumed in several studies of coastal rivers in Central and Southern California (Willis and Griggs 2003, Warrick and Barnard 2012). Additional studies have been conducted using empirical and theoretical relationships as described in the following sections.

Based on previously collected data and existing studies for southern California rivers, it is apparent that for sand-bedded rivers with large watersheds, bedload fraction represents approximately 5-15% of suspended sediment load. For this analysis, it was assumed that the bedload fraction represents 10% of the suspended load and, therefore, that the total load supplied to the upper end of the channel is the suspended load yield plus 10%. The sediment rating curve representing the total load is presented in Figure 23.



SOURCE: LACDPW (S01 data), SCCWRP (ME05 data)
Note: Qss = suspended sediment load, Qs,t = total sediment load

Ballona Wetlands . D120367

Figure 23

Ballona Creek Sediment Rating Curves

Inman and Jenkins 1999

Inman and Jenkins (1999) estimated streamflow and sediment characteristics in a study of the 20 largest rivers draining to the Pacific Ocean along the central and southern California coast including Ballona Creek. The study suggested that the fraction of the bedload component of total load is approximately 10% for rivers with watershed areas exceeding 500 km^2 (~190 square-miles), and approximately 15% for smaller rivers[3].

Brownlie and Taylor 1981

Brownlie and Taylor (1981) estimated the bedload fraction at the river mouth of the Santa Clara and Ventura rivers at 5.26%, and 13.6% respectively. Given suspended load measurements and particle size distribution of the bed material, the study applied the "modified Einstein" procedure of Colby and Hembree to estimate bedload fraction for 47 years of data from the Ventura River, and 25 years of data from the Santa Clara River. In the absence of GSD measurements, it was assumed, based on experience with Northern California rivers, that the bedload fraction for other rivers included in the study was 10%.

Turowski and others 2010

In a wide review studying the partitioning of sediment load between suspended and bedload, Turowski and others generated empirical relationships between bedload and suspended load transport rates using measured data reported by Nanson (1974), Williams and Rosgen (1989), Métivier *et al* (2004), and Meunier *et al* (2006). The relationship between bedload (G) and suspended load (L) in mg/s was described using the following equation:

$$G = \begin{cases} aL^b, & L \leq (a/c)^{1/(d-b)} \\ cL^d, & otherwise \end{cases}$$

By fitting this relationship to the suspended sediment data collected by the LACDPW and SCCWRP, using the range of values for parameters a, b, c, and d from the 25th percentile fit from the Turowski study, the average bedload fraction is estimated to be 9%.

5.1.1.4 Boundary Conditions

The following sections describe boundary conditions used in the HEC-RAS sediment transport model.

Sediment

Sediment boundary conditions are required at the upstream end of each reach included in the model characterize sediment discharge entering the system. In this case, the three reaches modeled are Ballona Creek and two tributaries: the Sepulveda and Centinela channels. No measured sediment data are available for the two tributaries and since the Sawtelle gage represents the majority of the watershed, it was assumed that only Ballona Creek upstream of the Sawtelle Gage delivers sediment to the lower reaches.

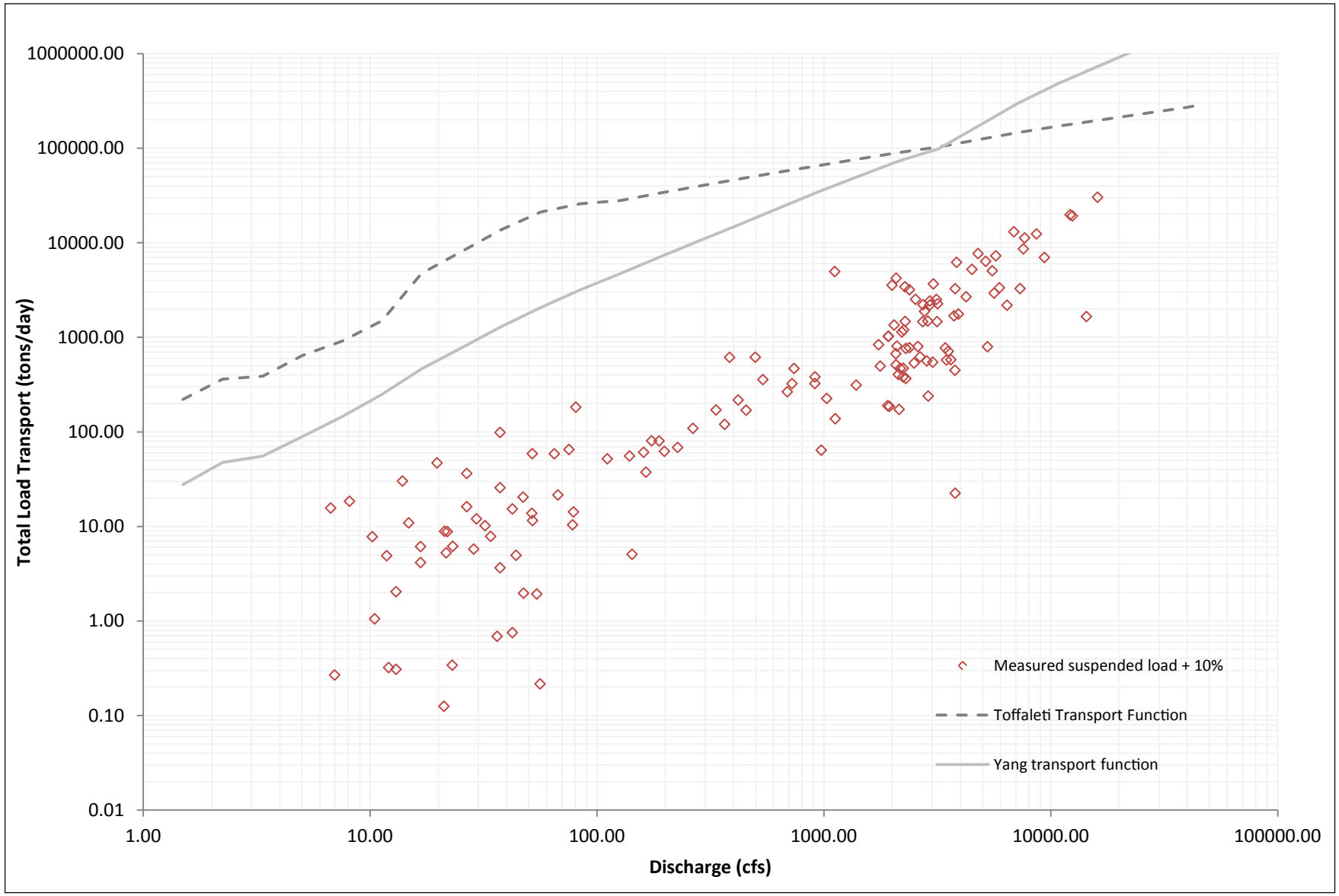
[3] The bedload fraction for smaller mountain streams has been seen to be considerably higher

For the sediment delivered by Ballona Creek, the sediment rating curve developed based on measured suspended sediment data at the Sawtelle gage was applied at the upstream end of the reach. The rating curve defines the total load in tons/day delivered for a given incoming flow rate. In addition to the total incoming load, each point on the rating curve requires an estimate of the GSD of the sediment load. To estimate the load composition, the sediment transport capacity tool in HEC-RAS was applied for the most upstream cross-section in the model. The transport capacity tool computes the hydraulics at a given cross section for a given flow rate or set of flow rates, then uses the hydraulic results to calculate sediment transport capacity and load composition for each flow rate profile in the model based on the GSD of the sediment at that cross section and a user-selected sediment transport function. The composite GSD from the USACE (2003a) was applied and two transport functions were selected to evaluate transport capacity: Yang, and Toffaleti. Of the transport functions available in HEC-RAS, these two methods were derived using sediment and hydraulic conditions that most closely resemble Ballona Creek. A comparison of the system parameters for the two transport functions used and corresponding features of Ballona Creek is summarized in Table 12.

Table 12 Ballona Creek Channel and Sediment Properties vs Those Used in Yang, Toffaleti

	Ballona Creek	Toffaleti (field)	Yang (field-sand)
Diameter range (mm)	0.004 - 8	0.062 - 4	0.15 - 1.7
D_{50} (mm)	0.5	0.095 - 0.76	N/A
Channel width (ft)	150 - 300	63 - 3640	0.44 - 1750
Channel Depth (ft)	22	N/A	0.04 - 50
Channel slope (ft)	.0009 - 0.002	0.000002 - 0.0011	0.000043 - 0.028
Velocity (ft/s)	5 - 20	0.7 - 7.8	0.8 - 6.4

As described above, the HEC-RAS transport capacity tool provides estimates of total transportable load at a given cross-section. This represents the total load that the reach would be capable of transmitting without any limitation on sediment delivery. A comparison of the total load capacity over a range of flows for the Yang and Toffaleti transport functions and the estimated total load transported near Sawtelle Boulevard (i.e. measured suspended load + 10% for bedload) is shown in Figure 24. This figure indicates that, based on the hydraulic conditions of Ballona Creek at Sawtelle including the channel shape and shear stresses and velocities incurred, the channel has substantially more transport capacity than the amount of incoming sediment. This condition is referred to as a “supply-limited” sediment regime. It is evident that the high degree of urbanization and the debris and sediment detention basins in the undeveloped segments of the watershed result in low sediment delivery rates in the Ballona Creek watershed.



SOURCE: LACDPW (S01 data), SCCWRP (ME05 data)

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Figure 24

Theoretical Sediment Transport Capacity (Yang, Toffaleti)
Compared to Measured Sediment Data

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Discharge, Stage, and Temperature

For the discharge boundaries, one flow event was modeled to estimate scour and deposition behavior under a representative geomorphically-significant flood event. For southern California streams, Q_5 typically represents a channel forming discharge as it represents the combination of flow magnitude and frequency that make it most significant in affecting the long-term channel geometry (Coleman et al, 2005). Therefore, a Q5 event was selected as the representative event for preliminary sediment transport modeling.

To construct the quasi-unsteady hydrograph required for the HEC-RAS sediment transport routine, flow hydrographs were extracted from the HEC-HMS model developed by the USACE (2010a). Hydrographs were assembled for flow at the upper end of the three modeled reaches. The time steps for the hydrographs were revised from the raw output, which had a time step of 1-minute, to a more computationally efficient 30-minute time increment. Basins in the HEC-HMS model that add flow to Ballona Creek at the tributary confluences were added to the upstream end of their respective tributary to simplify the number of boundary conditions required and remain consistent with the total flow generated by the watershed model. A summary of the HEC-HMS basins used to develop the quasi-unsteady hydrograph for the 5-year flood is included in Table 13.

Table 13 HEC-HMS Basins Used to Construct Q_{100} Hydrographs for Sediment Transport Analysis

HEC-RAS Boundary	HEC-HMS Basins used	Description
Ballona Creek at Sawtelle Boulevard	JR530	Junction upstream of Sepulveda tributary confluence
Sepulveda Channel	JR490	Junction upstream of Ballona confluence
	R490W490	Basin draining to Ballona/Sepulveda confluence from west side of Ballona channel
	R530W530	Basin draining to Ballona/Sepulveda confluence from east side of Ballona channel
Centinela Channel	JR590	Junction upstream of Ballona confluence
	R590W590	Basin draining to Ballona/Centinela confluence from east side of Ballona channel
	R580W580	Basin draining to Ballona/Centinela confluence from west side of Ballona channel

A tide level of 2.6 feet NAVD, which corresponds to mean tide level (MTL) at Ballona Creek, was selected as the downstream stage boundary for the model run. This is a relatively low tidal boundary and represents a conservative assumption with respect to scour potential which is larger under lower tides and a steeper hydraulic gradient. For the temperature boundary condition, a uniform temperature of 60 °F was assumed for the entire length of each hydrograph.

5.1.1.5 Initial Conditions

Three sets of data are needed to define the initial conditions of a sediment transport model. The first of these are the "bed stations" which delineate the width of the channel that is susceptible to scour. The bed

stations were set at the toe of the levees where the channel transitions from concrete bank to earthen bottom.

The second initial condition is the maximum scour depth at each cross section which defines the lowest elevation at which scour is expected. The underlying lithology of the site has not been examined at this time, and in lieu of additional information, 10 feet was used as a generic maximum depth of scour. Cross-sections were checked to compare simulated scour depths with the assumed maximum to identify locations where this assumption may need to be modified. For both existing and post-project conditions it was assumed that no scour could occur upstream of Centinela Avenue where the channel bottom is concrete.

The third initial condition of the model is sediment gradation. Sediment gradation for the site was characterized using the composite GSD from samples collected by the USACE (2003). This composite grain size was applied for the full length of the channel.

5.1.1.6 Sediment Transport Methods and Parameters

Due to the inherent uncertainty in sediment transport modeling, and the wide range of estimates furnished by the many transport functions, it is important to evaluate multiple transport functions to provide a range of plausible transport conditions. For this analysis, two sediment transport functions were utilized to evaluate the potential range of transport behavior. The two functions applied were the Yang (1973, 1984) total load function and the Toffaleti (1968) total load function. Both functions are appropriate for sand-bedded systems such as Ballona Creek. Initial review of the model results indicated that the Yang transport function produced more consistent results than the Toffaleti function with respect to likely scour and deposition behavior in Ballona Creek. All results presented with this report reflect HEC-RAS sediment transport modeling conducted using the Yang transport function. The Standard defaults were used for sorting and deposition: the Exner 5 three-layer bed mixing algorithm (Brunner, 2002), and the Rubey (1933) fall velocity equation, respectively.

5.2 RESULTS AND DISCUSSION

5.2.1 Existing Conditions

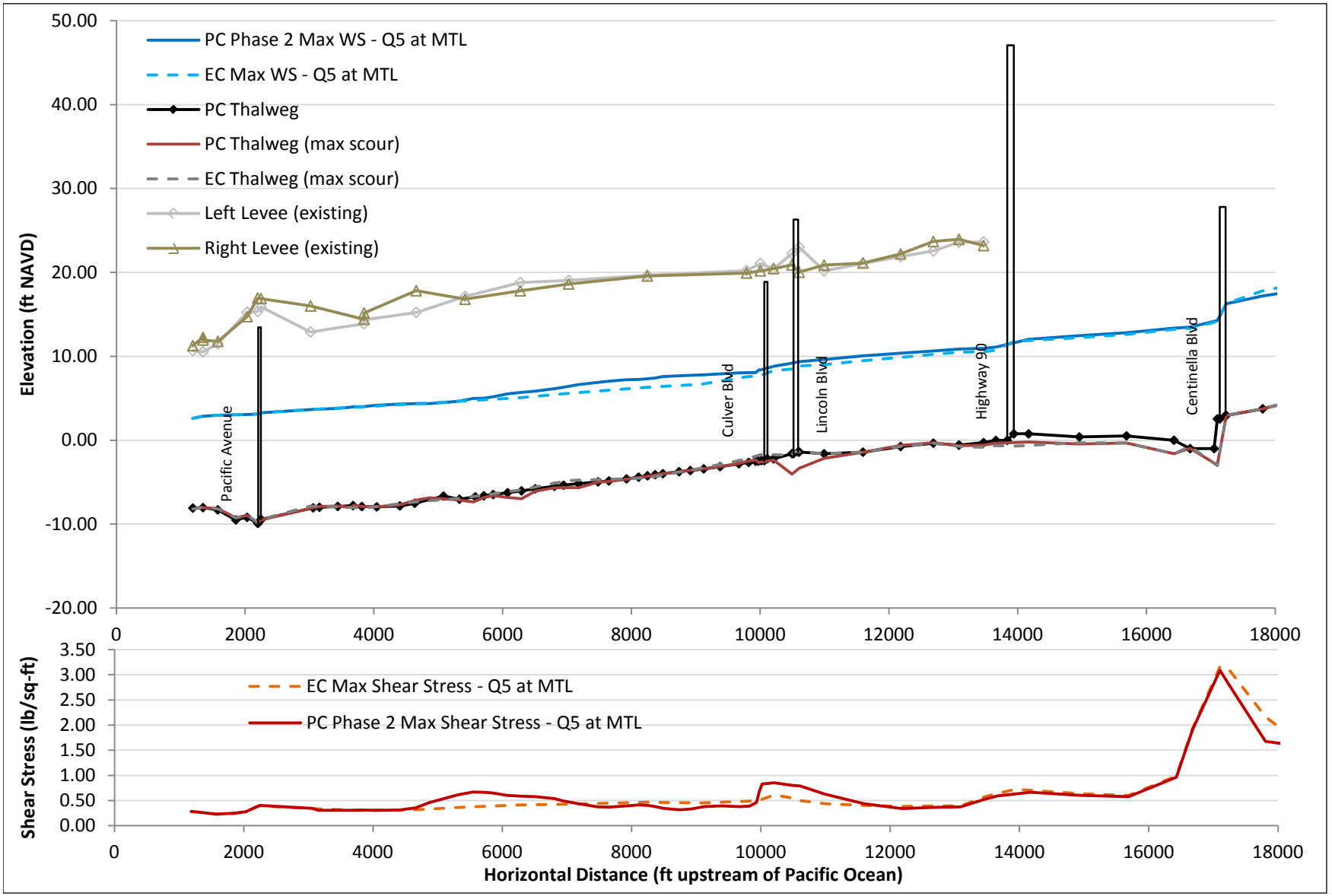
For the Q5 design event, the model results indicate that scour is likely to occur downstream of Centinela where the channel transitions from concrete to soft bottom. There is a significant grade break at this point in the channel which results in substantial energy dissipation focused at this location. This is evident in the thalweg of the channel through this transition which indicates that the channel has scoured up to 3.5 feet below the fixed concrete channel since the construction of the concrete channel. Model results indicate the channel is relatively stable downstream of this location, with slight aggradation occurring over the last mile of the reach where tidal levels dominate the hydraulic conditions. The initial and final thalweg profiles and maximum shear for existing and project conditions are shown in Figure 25.

The scour predicted by the model extends further downstream than indicated by the comparison between the design channel and the existing channel shown in Figure 22. This over-prediction of channel scour relative to the observed channel profile may be due to the over-representation of fine material contained

in the composite GSD used for the transport analysis. A higher proportion of fines would result in higher sediment transport, particularly on the falling limb of the hydrograph. To improve the accuracy of the sediment transport analysis, additional sediment samples will be collected over the length of the channel to improve our understanding and representation of grain sizes present in the channel for future analyses.

5.2.2 Project Conditions

For project conditions, the results for the 5-year flood run are similar to existing conditions, with some scour occurring at the break in the thalweg profile downstream of Centinela. Additional scour is also indicated in the vicinity of the Lincoln Boulevard Bridge, where shear stress is increased under project conditions as the flow transitions into the project area. This result is consistent with hydraulic modeling results that reflect increased flow velocity upstream of the project under project conditions, and will be examined further to evaluate the potential need for design modifications in response to increased shear stress at this location. The profile and shear stress results of the project conditions are shown compared to existing conditions in Figure 25.



NOTE: Results derived using Yang transport function in HEC-RAS

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Figure 25

Existing and project conditions bed change and shear stress for Q5

6. GEOMORPHOLOGY

ESA PWA performed preliminary geomorphic analysis to inform the Preliminary Restoration Design and to assess how the site will develop and evolve over time in response to the restoration and physical processes. The geomorphic analyses rely on available existing and historic site data, reference site information, and empirical relationships, supported by the preceding hydraulic and sediment transport modeling analyses.

6.1 HISTORIC GEOMORPHOLOGY

A brief discussion of the geomorphology of the historic Ballona Wetlands system is included for context. A more complete assessment of the site evolution over geologic time is included in the Ballona Wetlands Existing Conditions Report (PWA and others 2006). Historic conditions and ecology at the time of the 1884 historic map are described in detail by Dark and others (2011). The existing site conditions and physical processes differ significantly from historic conditions (e.g., fill placement, construction of the flood control channel, urbanization of the watershed). The restoration is designed to function in response to the current hydrology and physical conditions and constraints rather than historic conditions.

Figure 26 shows a conceptual model of the pre-historic evolution of the Ballona estuary over an extended geologic time frame (Altschul, 2003). This geologic evolution shows:

- The estuary formed through inundation of the coastal plain during rates of rapid sea-level rise (7000-5000 years before present or BP).
- The Los Angeles River intermittently drained to the Ballona estuary, delivering sediment to the estuary. There was frequent switching of its course between Long Beach and Ballona Creek.
- Longshore sediment transport built a sand bar across the estuary as sea-level rise stabilized (4000 BP).
- Sediment from the Los Angeles River progressively filled in the estuary and formed wetlands (4000-200 BP).

Figure 27 (Grossinger and others 2011) and Figure 28 (Dark and others 2011) show the historic ecology of the Ballona Creek wetlands and watershed in 1850. During the 1825 flood, the course of the Los Angeles River avulsed to its current location with its mouth at Long Beach, where it was channelized between 1884 and 1939. Storm flows and sediment delivery from the smaller Ballona Creek watershed were likely reduced after the avulsion of the Los Angeles River. The mouth of the Ballona wetlands at this point in history was constricted and seasonally closed due to longshore sediment transport, reduced tidal flows, and possibly reduced fluvial storm flows following the avulsion of the Los Angeles River (Dark and others 2011, Jacobs and others 2010). The historic wetlands included a salinity range from brackish to salt marsh, with large areas of high intertidal flats or salt pans. The wetlands were likely inundated by creek discharge during larger storm events. During the dry season, the wetlands likely experienced limited tidal inundation and circulation due to the restricted inlet and evaporative non-tidal conditions when the inlet was seasonally closed.

The Existing Conditions Report (PWA and others 2006) includes a detailed discussion of existing site conditions. The existing flood control channel and urbanized watershed have significantly modified the hydrology and sediment processes of the Ballona Wetlands.

Appendix 2 shows a timeline of anthropogenic modifications to the Ballona Wetlands, which include:

- **1939:** Ballona Creek flood control channel and levees were constructed, disconnecting the remaining wetlands in Areas A, B and C from tidal and fluvial inundation and sedimentation. The leveed wetlands in Area B may have subsided due to oil extraction.
- **1957:** Marina del Rey harbor was constructed by dredging wetlands to the north of Ballona Creek. Between 10 and 15 ft of dredge spoils were placed over the wetlands in Areas A and C. Jetties were constructed for the Marina del Rey entrance channel. Offshore of the mouth, a shore-parallel breakwater was constructed which reduced wave penetration into the marina. These activities had significant impacts on the littoral sediment transport pathways.

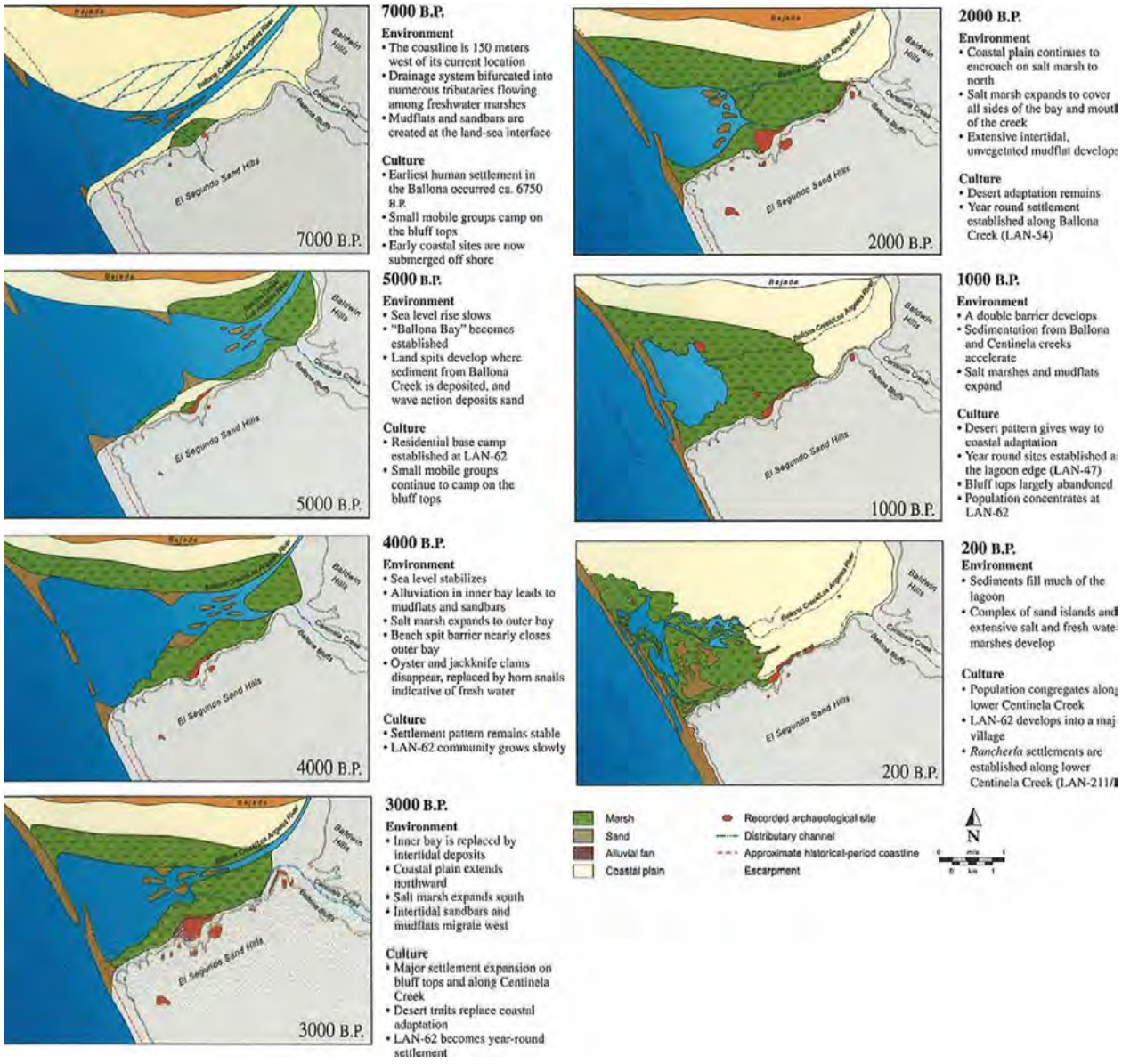
6.2 GEOMORPHIC ANALYSES

This section describes geomorphic analyses of Ballona Creek channel sizing (hydraulic geometry), deposition, wetland accretion, and coastal sediment transport. These analyses inform the projections of likely geomorphic evolution discussed in Section 6.3.

6.2.1 Hydraulic Geometry

Hydraulic geometry provides an estimate of the equilibrium channel size at various locations, in response to the tidal and fluvial hydraulic influences, as well as sediment availability. It allows prediction of the long term channel width, depth, and cross-sectional area. Empirical hydraulic geometry relationships between channel size (cross-section dimensions) and flows provide an estimate of the equilibrium channel dimensions that would form in sediment transport-limited conditions (i.e., with enough sediment in the system to deposit in the channel and reach equilibrium with tidal and fluvial flows). **Appendix 3** contains an analysis of the Ballona Creek channel hydraulic geometry, which is summarized below.

Figure 29 shows the existing Ballona Creek channel cross-section compared to predicted equilibrium dimensions for a natural unleveed creek channel from hydraulic geometry relationships. The existing Ballona Creek flood control channel is oversized compared to predicted equilibrium dimensions. This suggests that the existing channel is depositional during normal tidal conditions and more frequent channel-forming storm flows, but that deposition is limited by sediment supply.



Source: Statistical Research Institute (SRI)

Figure 26

Ballona Wetlands. D120367

Pre-historic Model of Ballona Estuary

ESA PWA

Figure 27
1850 Ballona Wetland Historic Ecology

Note: Coastal Features Digitized from T-1432b, Overlaid on Modern Aerial Photography (USDA 2005), at Same Scale as Facing T-sheet

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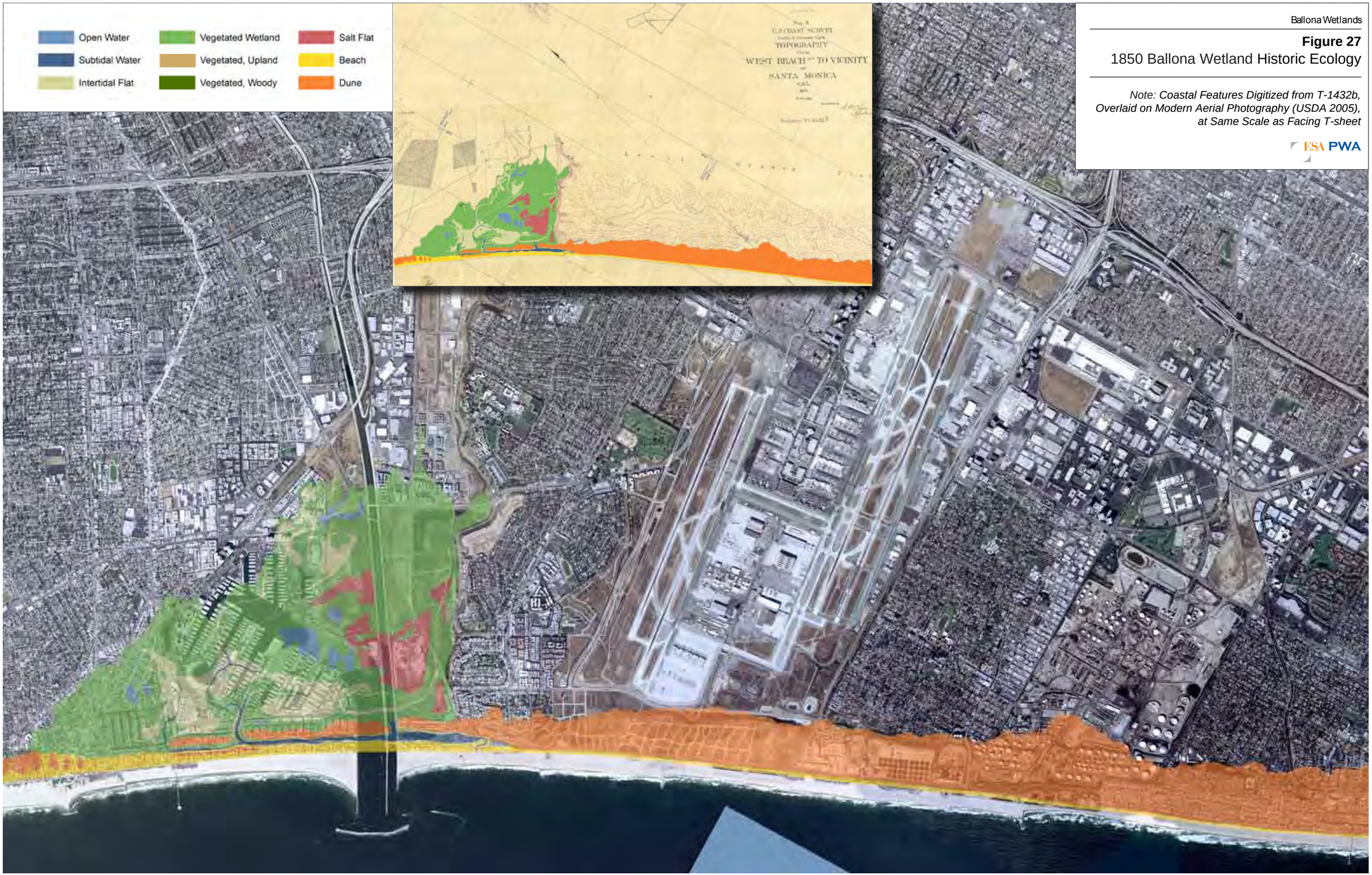
1:100,000



Ballona Wetlands

Figure 28

1850 Ballona Creek Watershed Historic Ecology

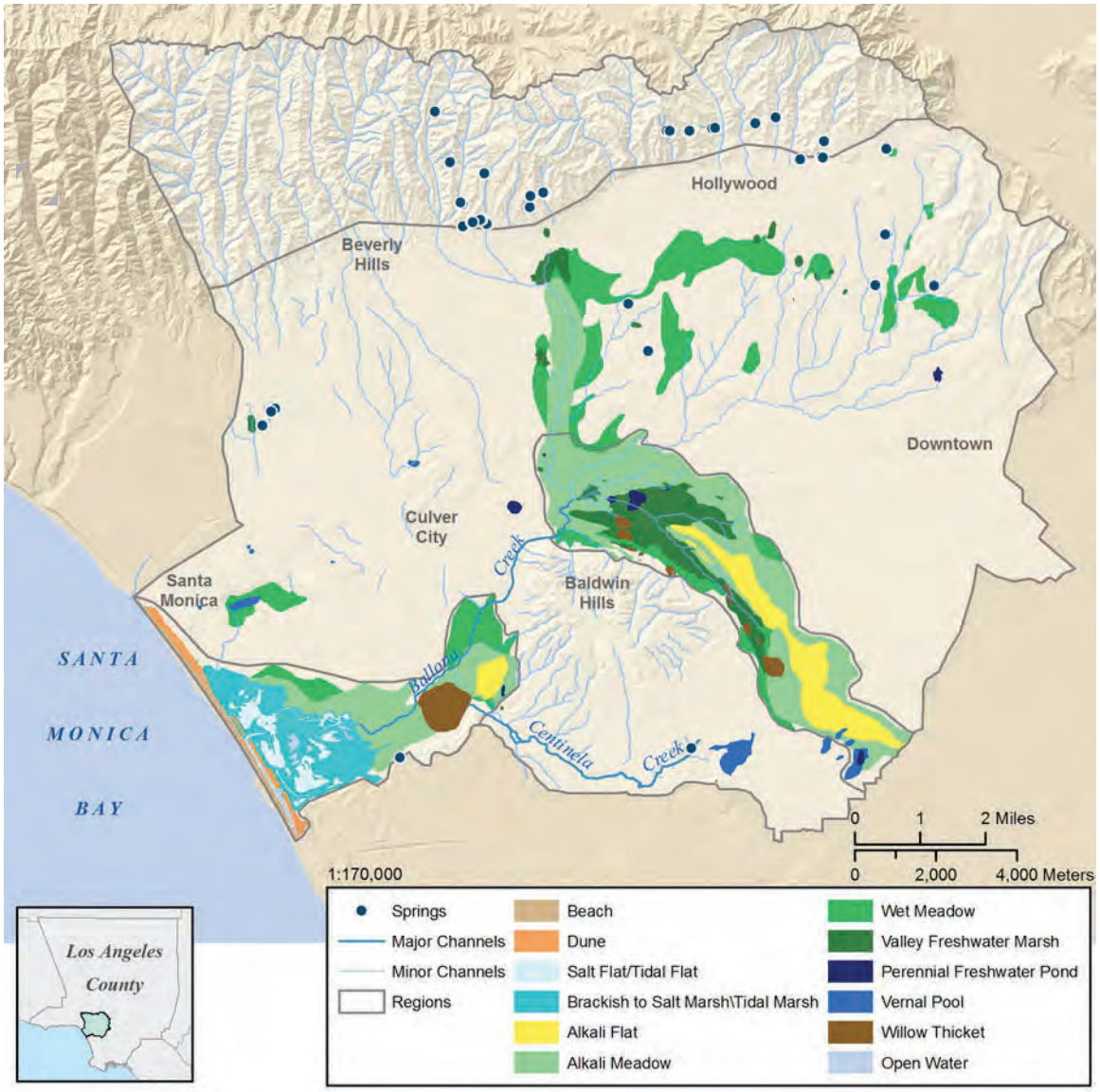
ESA PWA

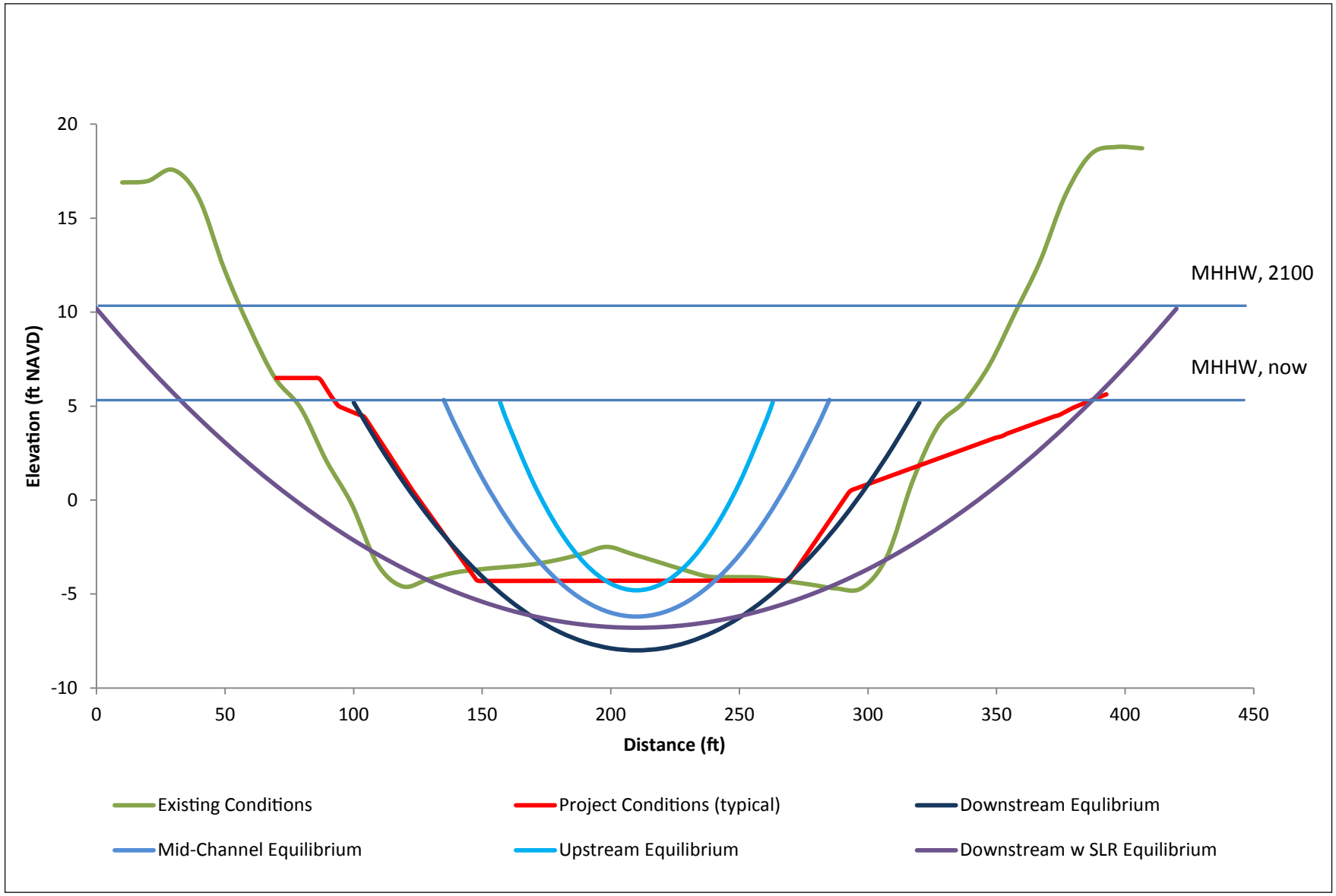
A total of 174 unique wetland polygons were mapped comprising 14,149 acres (5,470 ha; TABLE 3). The dominant wetland types across the entire study area included alkali meadow (35%), valley freshwater marsh (10%), brackish to salt marsh/tidal marsh (9%), and alkali flats (8%). The watershed contained a wide diversity of wetlands ranging from vernal pools and alkali flats to wetland meadows and willow thickets (excluding willow-dominant riparian corridors). It is likely that our habitat map did not capture the total complexity of this landscape, due to a lack of documentation in the historical record, or inability to display using a habitat map. For example, textual citations describing features at a finer scale cannot be incorporated into a two-dimensional map, but lend depth to our understanding of habitat diversity. We hope to provide a cautioned insight into the complexity of this ecological system in the following pages.

HABITAT CLASSIFICATION	UNIQUE WETLANDS	ACRES	HECTARES
ALKALI FLAT	5	1284	486
ALKALI MEADOW	21	5273	1915
BEACH	2	159	64
DUNE	8	187	76
OPEN WATER*	8	96	39
PERENNIAL FRESHWATER POND	8	110	45
SALT FLAT/TIDAL FLAT	15	423	171
SALT MARSH/TIDAL MARSH	20	1240	498
VALLEY FRESHWATER MARSH	35	1356	547
VERNAL POOL	15	260	105
WET MEADOW	24	3336	1351
WILLOW THICKET	13	425	173
TOTALS	174	14149	5470

*DOES NOT INCLUDE PACIFIC OCEAN

TABLE 3:
Summary of wetlands mapped on the Ballona Historical Ecology project.





SOURCE: ESA PWA (2012)

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Figure 29

Ballona Creek
Hydraulic Geometry

With adequate sediment supply, the channel could fill in to the equilibrium dimensions. The predicted equilibrium dimensions therefore represent an estimate of a potential reduced cross-section. In subsequent analyses and design refinement, the project may consider a smaller "equilibrium" channel cross-section for the realigned channel (e.g., to encourage sediment deposition in the wetlands and reduce channel deposition, and to show that the estimated reduced cross-section maintains flood performance).

Figure 29 also shows predicted equilibrium dimensions with 59 inches of sea-level rise in 2100 (high end estimate per USACE 2011 and NRC 2012; see Section 2.3.2). In this scenario, the wetland area and volume of tidal flows (tidal prism) are larger and the equilibrium channel dimensions are closer to the existing channel dimensions.

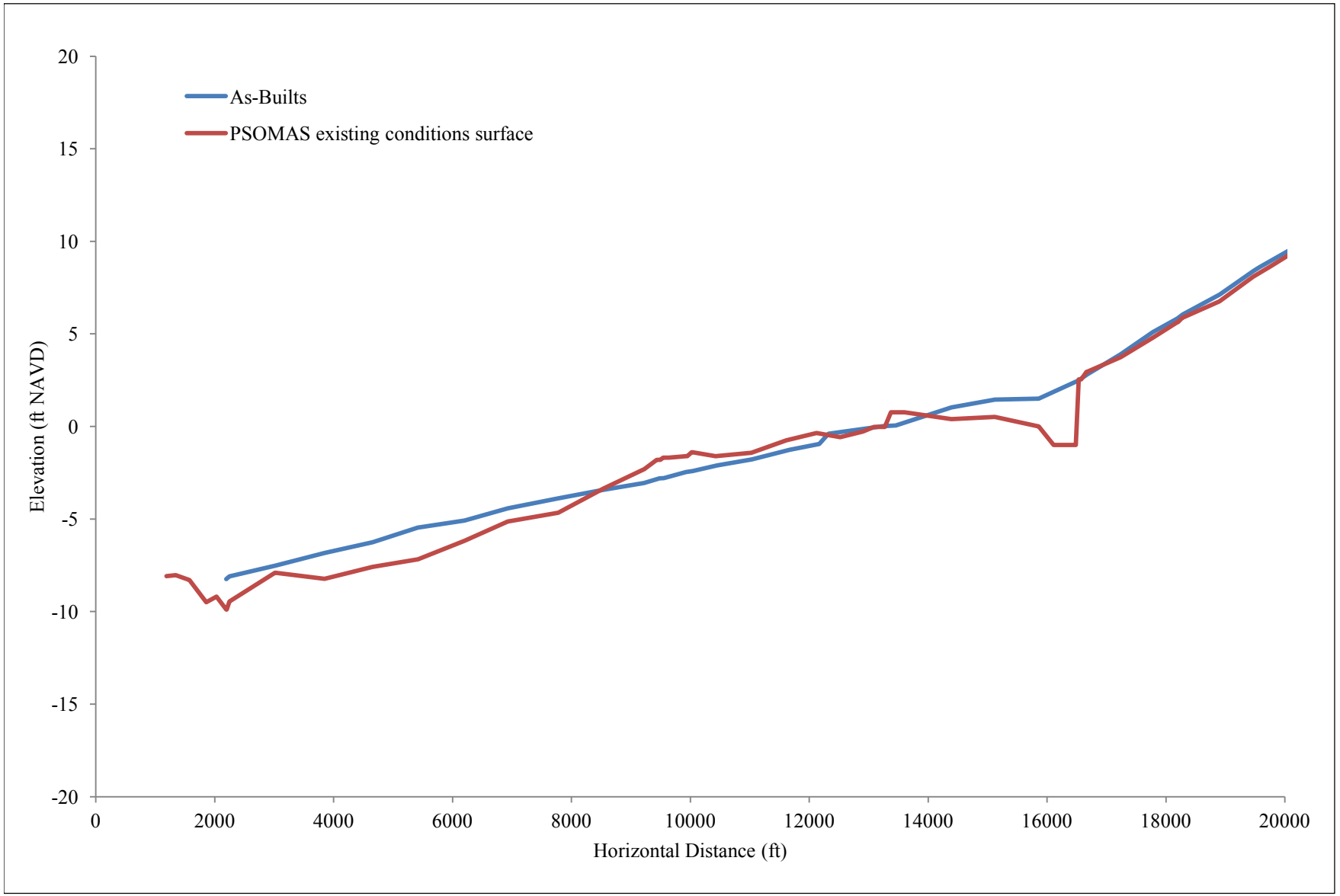
6.2.2 Channel Deposition

ESA PWA compared the 2012 channel bathymetry survey (Psomas 2012) to the 1959/1961 "as-built" channel survey to estimate net channel deposition (Figure 22). Table 14 shows the net amounts, volumes, and rates of deposition for the five reaches shown in Figure 22. The deposition rates are calculated from 1959 and also from the last major storm event, which was in 1994 (discharge greater than 10-year event), to capture the range of possible deposition sequences. The rate of deposition in the reach showing higher accretion (1,600 to 4,700 CY/yr) generally agrees with the estimated rate of watershed sediment supply (8,530 CY/yr, see Section 5.1.1). Figure 30 compares the thalweg profiles from the as-built survey and 2012 survey.

Table 14 Channel Deposition and Erosion Depths, Volumes, and Rates from 1959 to 2012

Reach	Depth (ft)	Volume (cubic yards)	Rate (ft/yr)	Rate (CY/yr)
Upstream fluvial scour reach (Centinella Blvd. to 2,300 ft downstream)	-4 to 0	-2,760	-0.2 to 0	-150 to -50
Downstream fluvial deposition reach (to 1,500 ft downstream of Culver Blvd)	0 to 3	85,330	0.1 to 0.2	1,600 to 4,700
Downstream tidal reach (to Pacific Ave.)	-2 to 2	17,570	-0.1 to 0.1	330 to 980
Creek mouth coastal reach (to end of south jetty)	3 to 9	43,700	0.2 to 0.5	820 to 2,400

Note Positive depths/volumes/rates indicate the depth/volume/rate of deposition; negative depths/volumes/rates indicate the depth/volume/rate of erosion. Rates are calculated between: 1) 1959 and 2012 and 2) 1994 (last major storm, discharge greater than 10-year event) to 2012 to give a range that accounts for the possible sequence of deposition. The accuracy of the volume and rate estimates is about +/-20% due to uncertain accuracy of the as-built survey.



SOURCE: USACE (2003); PSOMAS (2012)

Ballona Wetlands. D2110367

Figure 30

Thalweg Profiles
1960 and 2012

ESA PWA

The observed channel deposition patterns and other supporting analyses indicate the following sediment processes by reach for the soft-bottom channel (downstream of Centinella Blvd.):

1. Upstream concrete/soft-bottom channel transition scour reach: a scour hole has formed below the transition from concrete to soft-bottom channel.
2. Upstream depositional fluvial reach: sediment (primarily silty sand) from the watershed and upstream scour reach is deposited in the existing channel, presumably during more frequent storm flows (i.e., up to 10-year events).
3. Downstream "stable" tidal reach: net accretion is lower in this tidal-dominated reach due to lack of sediment supply. Watershed sediment supply is typically deposited upstream in the "fluvial reach." This pattern is supported by water level data and hydraulic modeling, which show that storm flows up to the 5-year event do not affect tidal water levels or velocities in this reach.
4. Creek mouth coastal depositional reach: deposition observed at the channel mouth is likely due to sand transport from the coast into the mouth (see Section 6.2.4 below).

Sediment samples will be collected from the reaches identified above and analyzed for grain size to provide additional data for this assessment. Additional assessment of the effects of the project on the observed patterns of sediment deposition will be completed in subsequent analyses.

6.2.3 Wetland Accretion

The restored wetlands are expected to accrete due to organic soil production (i.e., bioaccumulation in vegetated wetlands) and inorganic sediment deposition. Rates of organic accretion may range from 0.04 to 0.12 in/yr (1-3 mm/yr) (Stralberg 2011). A lower end rate of 0.04 in/yr (1 mm/yr) is expected for the tidal salt-marsh dominated habitat of the Ballona restoration. The rate of sediment deposition on the restored marshplain is limited by sediment supply and the frequency, period, and depth of inundation. ESA PWA modeled long-term sediment accretion assuming a constant low suspended sediment concentration of 50 mg/L, based on review of measured suspended sediment concentrations during storm events. Wetland accretion estimates and projected sea-level rise were applied to the preliminary grading plan (from the PDR) to model projected future wetland elevations and habitat zones (Figure 32).

Table 15 shows the volume and rates of modeled wetland sediment deposition. The modeled annual rate of wetland sediment deposition increases over time as the site becomes progressively lower in the tide frame.

The range of modeled wetland sediment deposition over time (160 cy/yr to 4,750 cy/yr per Table 15) is less than the watershed sediment supply rate (8,530 cy/yr or 6,520 m3/yr). Note that the watershed sediment supply rate includes both suspended sediment and bedload, whereas wetland deposition is expected to result primarily from suspended sediment deposition. Further assessment of deposition patterns in the wetland floodplain and channel will be performed in subsequent analyses considering suspended and bedload sediment transport. This preliminary comparison between the modeled wetland sedimentation rate and watershed sediment supply indicates that sediment supply may be adequate to support the modeled accretion shown in Figure 32 and higher rates of wetland deposition could possibly occur.

Table 15 Volume and Rate of Modeling Wetland Sediment Deposition

Sea-level rise scenario	Cumulative Volume (cy)	Incremental Volume (cy)	Sediment Volume (cy)	Organic Volume (cy)	Sediment Rate (cy/yr)	Organic Rate (cy/yr)
9 inches by 2030	12,500	12,500	2,980	9,520	160	530
19 inches by 2050	67,700	55,200	42,830	12,370	2,140	620
32 inches by 2070	141,700	74,000	59,860	14,150	2,990	710
59 inches by 2100	301,400	159,700	142,450	17,250	4,750	580

Note: All volumes are rounded

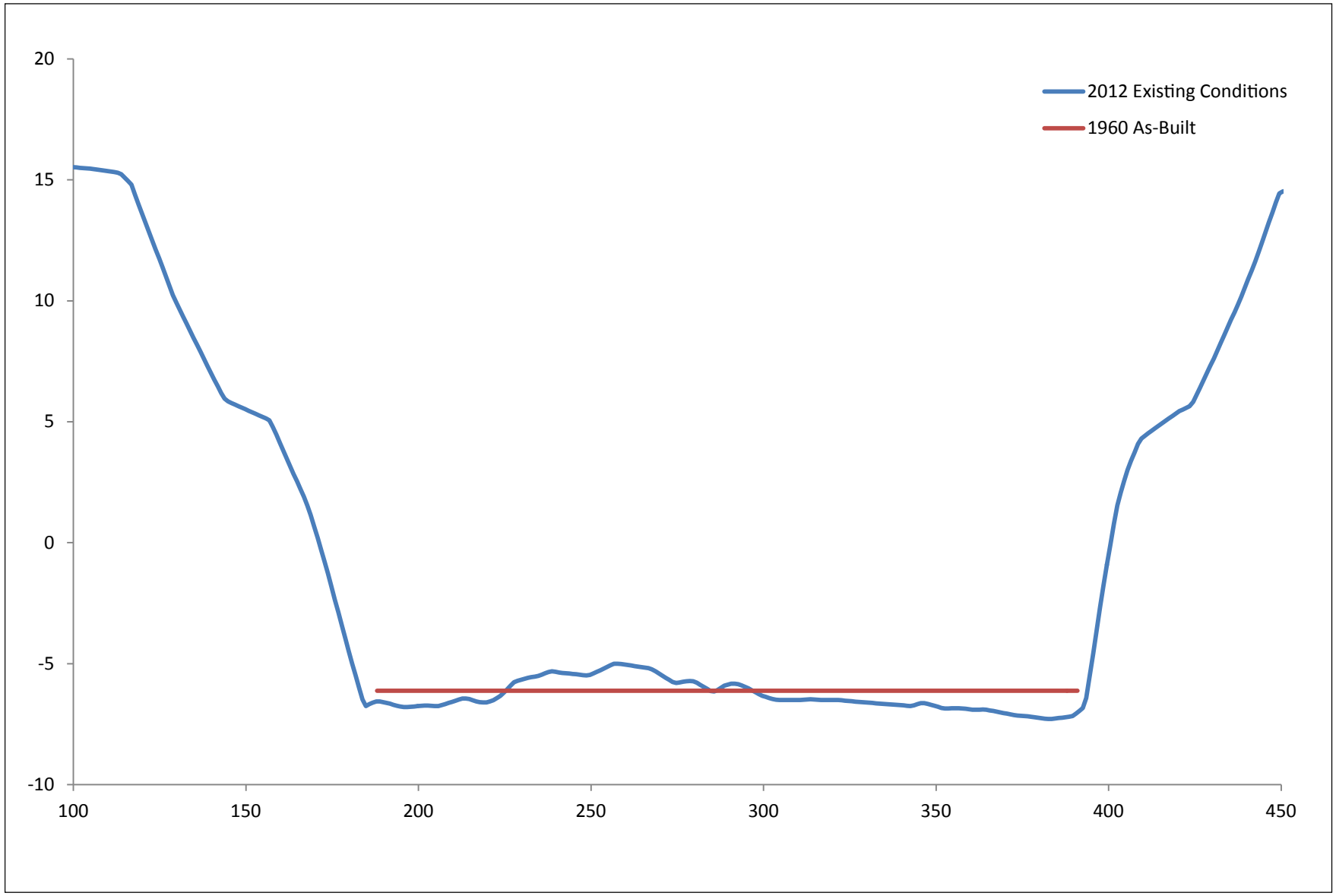
6.2.4 Coastal Sediment Transport

Available coastal sediment transport studies describe net longshore coastal sediment transport as being from north to south due to dominant north swells; however, south swells are also likely to cause transport from the south to north. Sediment transport is interrupted by the Marina del Rey harbor entrance channel and sand from the north is deposited in the harbor channel. A harbor channel maintenance dredging program for Marina Del Rey is in place, with the most recent channel dredging completed in 2012. The Ballona Creek channel mouth is not included in the harbor channel maintenance and has not been dredged since the 1959 county channel and levee improvements. A summary of available coastal sediment transport studies and analysis of recent dredging data are provided in **Appendix 2**.

Deposition in the dredged area downstream of the Ballona Creek channel mouth and south jetty is 7,650 CY/yr. This is substantially higher that the rate of deposition in the Ballona Creek channel mouth (820 to 2,400 CY/yr - see Section 6.2.2). The difference suggests that most of the sediment that accumulates at the mouth of the creek originates elsewhere and is deposited by longshore currents instead of being delivered by Ballona Creek. Mineralogical analysis could confirm this supposition.

ESA PWA observed waves from a small south swell propagating up the Ballona Creek channel on May 22, 2012. A shoal along the south jetty was also observed. The shoal extends approximately 600 ft downstream of the Pacific Ave. bridge (see Figure 22).This observation suggests that deposition in the Ballona Creek mouth could be associated with transport of sand from the coast into the mouth during south swells, forming a flood shoal at the creek mouth as is typical of coastal channels/lagoons. (Note that sediment samples will be collected and analyzed for grain size to confirm the shoal is sand.)

Figure 33 shows a cross-section at the Ballona Creek mouth/shoal with predicted equilibrium tidal channel dimensions (see Section 6.2.1). This indicates that the shoal has not reached equilibrium and sediment is likely to continue to deposit at the mouth under existing and project conditions. (Note that deposition would continue to decrease the cross-sectional area. However, the channel thalweg may be at equilibrium with the predicted tidal channel depth.)



SOURCE: USACE (2003) PSOMAS (2012)

ESA PWA

Ballona Wetlands. D120367

Figure 31
Tidal Reach Channel Cross-sections



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SOURCE: Managed wetlands inboard of Culver levee shown as being managed to maintain marsh habitat over time.

Ballona Wetlands. D120367

Figure 32a

Restored Habitat Zones

ESA PWA



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SOURCE: Managed wetlands inboard of Culver levee shown as being managed to maintain marsh habitat over time.

Ballona Wetlands. D120367

Figure 32b

Restored Habitat Zones

2030 Projection (9 in of sea-level rise)



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SOURCE: Managed wetlands inboard of Culver levee shown as being managed to maintain marsh habitat over time.

Ballona Wetlands. D120367

Figure 32c

Restored Habitat Zones
2050 Projection (19 in of sea-level rise)



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SOURCE: Managed wetlands inboard of Culver levee shown as being managed to maintain marsh habitat over time.

Ballona Wetlands. D120367

Figure 32d

Restored Habitat Zones
2070 Projection (32 in of sea-level rise)

ESA PWA



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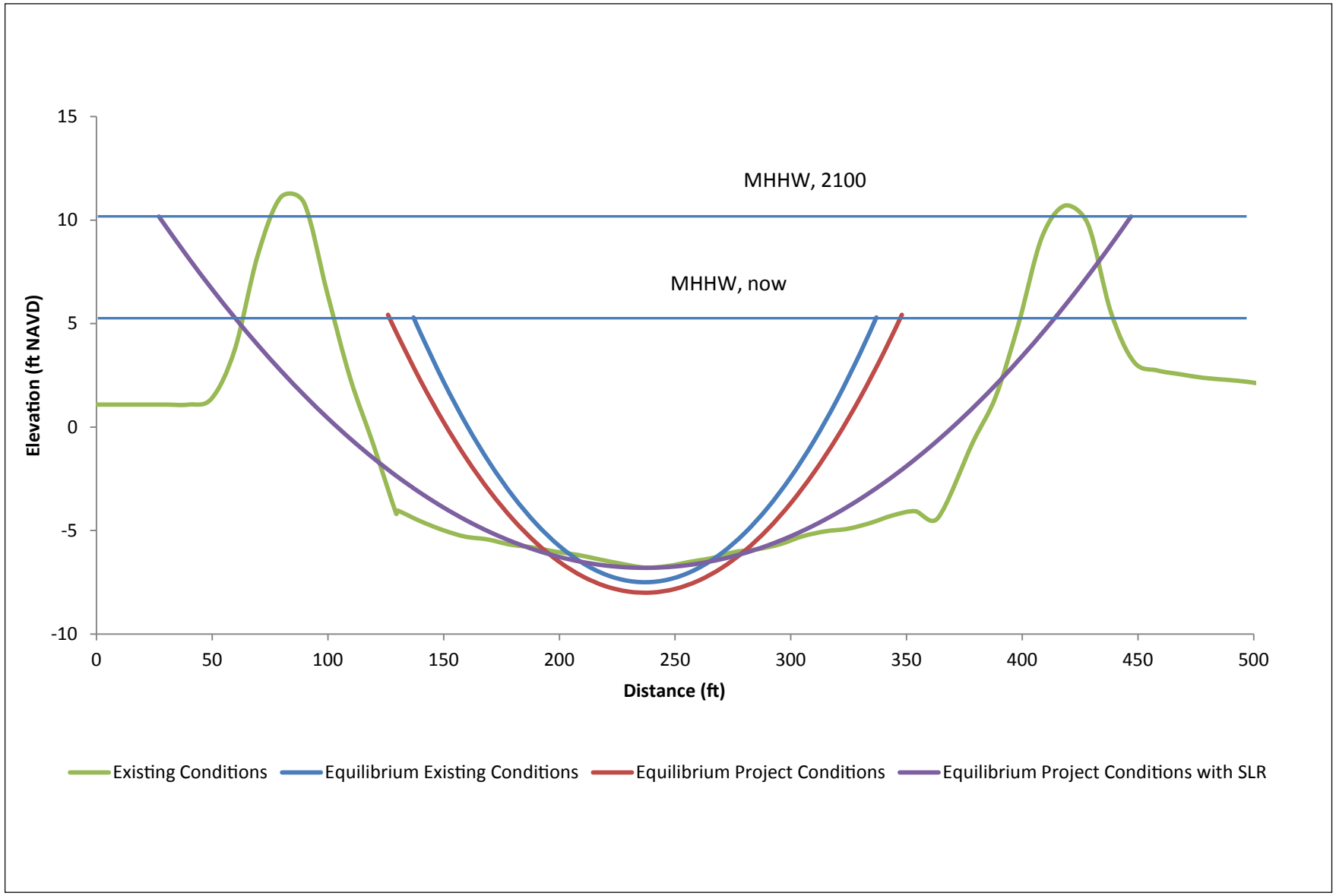
SOURCE: Managed wetlands inboard of Culver levee shown as being managed to maintain marsh habitat over time.

Ballona Wetlands. D120367

Figure 32e

Restored Habitat Zones
2100 Projection (59 in of sea-level rise)

ESA PWA



SOURCE: ESA PWA (2012)

ESA PWA

Ballona Wetlands. D120367

Figure 33

Ballona Creek Channel Cross Section
at the Downstream Shoal

6.3 DISCUSSION OF SITE GEOMORPHIC EVOLUTION

The above analyses provide some indications on how the site will likely evolve in response to the restoration project, as well as future sea-level rise. The anticipated geomorphic evolution or physical response of the restored wetlands and channel to near- and long-term physical process is discussed below. Understanding the geomorphic evolution of the site is important for understanding the response of the restored wetlands, channel, and habitats to physical processes. This preliminary discussion will be refined in subsequent analyses based on additional data collection.

The current Ballona Creek channel represents the trapezoidal flood control channel constructed in the 1930s and improved in the 1960s. The channel has undergone minor changes in response to the flow and sediment regime over the past 50 years. There is evidence of some (1 to 4 ft) of channel incision (deepening) upstream, with deposition (0 to 3 ft) in the project reach and formation of a moderate sand shoal (about 5 ft high) at the Creek mouth. The channel banks are hardened, preventing changes in width or any channel migration. The removal of the hardened banks through the project reach will allow the channel to respond both vertically and horizontally over time. These changes are an important component in supporting the types of habitats important to the vegetation and wildlife species that the project will support. However, it is important that these changes occur within the footprint of the project, and not adversely increase flood or erosion hazards to adjacent infrastructure. This geomorphic assessment provides guidance on what types of changes might occur in the restored channel and wetlands and provides the basis for designing the project to allow for these changes to occur without impacting adjacent infrastructure. The preliminary understanding of site evolution discussed below indicates that the preliminary restoration design will support the desired habitat and flood management functions.

6.3.1 Net-depositional and sediment supply-limited system.

Under normal tidal conditions and more frequently occurring storm flows, the site acts as a depositional environment and sediment sink; however, watershed sediment supply is low and the rate of sediment deposition is slow. Under existing conditions, sediment carried by frequent storm flows is deposited in the soft bottom channel (starting at Centinella Blvd.) to approximately 2,000 ft downstream of Lincoln Blvd. Deposition and channel dimensions have not reached an equilibrium with the sediment transport capacity of the channel forming flows (approximately 1-year event; see Appendix 3). With the low rate of sediment supply (approximately 8,530 cy/yr or 6,520 m3/yr), the channel is unlikely to reach its equilibrium dimensions before a larger infrequent storm flow scours out the deposited sediment.

For restored project conditions, a slow rate of sediment deposition is expected to continue in the restored channel and upstream, with the potential for suspended sediment deposition in the restored wetland marshplain/floodplain.

While the project may decrease the size of the future channel (due to expanded flow area and reduced velocities), the rate of deposition is limited by sediment supply. Additional analysis of the channel with projected future deposition and SLR will be evaluated to investigate how deposition may affect flood performance. The predicted smaller equilibrium channel cross-section may be considered as the potential

"minimum" cross-section to define a theoretical channel maintenance limit and/or as a design option for the realigned channel cross-section. Designing the realigned channel to have an equilibrium cross-section could possibly reduce channel deposition and encourage wetland deposition and accretion.

Note that previous estimates of watershed sediment supply range from 58,350 to 60,000 cy/yr (44,615 to 45,873 m3/yr) and appear to be based on the rate of sand deposition in the south entrance to the Marina del Rey harbor channel. Our analysis and estimates of watershed sediment supply and channel deposition indicate sand deposition at the creek mouth is due to coastal sand transport during south swells and that the watershed sediment supply is significantly lower (8,530 cy/yr or 6,520 m3/yr).

6.3.2 Channel dynamics during storm flow events.

During storm flow events, localized erosion of the restored vegetated channel bank is expected. Note that the channel bank will be armored in locations of high shear stress to reduce the potential for progressive erosion (e.g., at the first meander bend and flow convergence locations; see the PDR for more details). Some channel edge erosion will likely occur during flood events. However, erosion of the restored vegetated wetland marshplain/floodplain is expected to be limited because flow velocities across the marshplain are low (see Section 4.6).

Additional analyses of sediment erosion and deposition during larger storm flow events will be performed in subsequent analyses. Sediment samples are being collected from the site and Ballona Creek channel and the sediment erosion properties will be analyzed in a laboratory (Sedflume analysis of critical shear stress and rate of erosion). Additional hydrodynamic modeling of erosion and deposition during storm flow events will be performed using laboratory results. Model results will be incorporated into subsequent geomorphic assessments.

Based on this preliminary assessment, the amount of bank erosion during smaller more frequent storm flows (e.g., 10-year event and below) may not alter the site significantly. Localized bank erosion and channel/wetland deposition are expected to re-work sediment within the restored site as in natural river/wetland systems. A portion of eroded sediment may be deposited in the "over-sized" channel downstream.

Larger infrequent storm flows (e.g., greater than 20-year event) have the potential to cause a greater level of change to the restored channel and wetland system. (Note that armoring in key locations will be designed to reduce the potential for the channel to meander or avulse in locations near the perimeter levee systems; see the PDR for more details). Due to limited sediment supply, the restoration may only have limited potential for any areas of erosion during large storm events to "recover" through subsequent years of sediment deposition under tidal and small storm events. Subsequent modeling and analysis will be performed to assess the range of potential change during small and large storm events and the rate and degree of system "recovery."

Note that the frequency of larger storm events (i.e., 20 years or more on average) is similar in time-scale to wetland response and change to projected future sea-level rise (see Section 6.3.4 below).

6.3.3 Channel mouth and coastal sediment processes

Preliminary assessments indicate that observed deposition/shoal in the channel mouth is due to coastal sand transport by tidal flows and/or south swells (see Section 6.2.4). The channel mouth is oversized compared to tidal flows and sand is expected to continue to deposit in the shoal until equilibrium is reached with the scour potential of tidal flows. The restoration will increase tidal flows; however, the effect of the restoration on the shoal may not be significant. Subsequent analyses will be performed to complete this assessment.

6.3.4 Sea-level rise

The rate of sea-level rise is expected to be greater than the rate of wetland accretion. Restored wetland habitats are expected to convert to lower elevation habitats over time (e.g., vegetated wetland to mudflat and mudflat to subtidal). Figure 32 shows this habitat conversion assuming low sediment supply. The sediment supply from the watershed to the wetlands may support a somewhat higher rate of wetland accretion and a slower rate of wetland conversion.

The restored wetlands are expected to transgress into restored transition and upland habitat zones as shown in Figure 32.

7. LIST OF ACRONYMS

DTM	Digital Terrain Model
GSD	Grain Size Distribution
LACDPW	Los Angeles County Department of Public Works
LACFCD	Los Angeles County Flood Control District
MHHW	Mean Higher High Water
MTL	Mean Tide Level
MLLW	Mean Lower Low Water
NAVD	North American Vertical Datum of 1988
NGVD	National Geodetic Vertical Datum of 1929
PDR	Preliminary Design Report
RS	River Stationing
SCCWRP	Southern California Coastal Water Research Project
SLR	Sea Level Rise

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9. LIST OF PREPARERS

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APPENDICES

Appendix 1 Ballona Wetlands Tsunami Assessment

Ballona Wetlands Restoration Preliminary Hydrology and Hydraulics Report
February 1, 2013 Administrative Draft
ESA PWA

APPENDIX 1
BALLONA WETLANDS TSUNAMI ASSESSMENT

1. INTRODUCTION

This technical memo provides an initial assessment of the potential impacts of tsunamis for the Ballona Wetlands Restoration Project. The purpose of this assessment is to review recent research on tsunamis, examine historic impacts from tsunamis for this stretch of California coast, and to identify risks to the project and additional risks caused by the project.

2. BACKGROUND

Tsunamis (often referred to as "tidal waves" for the way they approach similar to the rising tide) are a series of potentially large waves which are caused by catastrophic events including: earthquakes, underwater landslides, volcanic eruptions, and infrequently, asteroids. Tsunamis are categorized based on the source of the generating event. Nearfield tsunamis occur in relative close proximity to the site while farfield tsunamis are generated at longer distances typically on the opposite side of ocean basins.

The formation mechanisms for a tsunami are illustrated in Figure 1. First, a catastrophic event vertically displaces a volume of water as illustrated in the first stage of Figure 1. The second stage shows how waves are split and sent outward across the ocean. In the open ocean, these waves have small heights (amplitudes), but long periods (10-20 minutes) and fast speeds (350-500 mph) (Komar, 1997). (Note that Figure 1 is exaggerated for illustrative purposes). For comparison, a typical swell wave one would see at the coast is called a surface gravity wave with periods of 13-20 seconds and speeds of 30-75 mph. Viewed at sea, a tsunami is barely noticeable; however, as the waves reach the coast, they shoal on the continental shelf with water piling up as the sea floor becomes shallower, and the height of the wave increases dramatically as shown in stage 3. The first sign of an impending tsunami is often an unusual lowering of the water below a typical negative low tide level. This is the trough between wave crests and is followed by a stage 4 where water levels rise onshore and can cause flooding.

Southern California is threatened by both near and farfield tsunamis. Sources of nearfield tsunamis could be a submarine (underwater) landslide and/or a large earthquake on any of the nearby faults. These faults include the Palos Verdes fault zone which trends northwest off the Long Beach and Santa Ana coast, the San Pedro Basin fault zone, and Santa Cruz-Santa Catalina Ridge fault zones. The Palos Verdes Slide (PVS), which is off the Palos Verdes Peninsula, has the potential to cause significant damage in the Long Beach area. The large amounts of debris in the area indicate that significant avalanches have occurred before. Borrero, et al (2002) show that a slide on the PVS could cause up to a 20 meter tsunami that would hit the Palos Verdes Peninsula 7 minutes after it occurs, causing velocities over 3 m/s in the Port of LA. However, their model also show that, around the peninsula in the Redondo Beach area, a tsunami from the PVS would only be up to 0.5 meters and occur approximately 15 min after the slide.

Farfield tsunamis that would threaten the Ballona project site could originate anywhere along the Pacific Rim, Alaska, or South America. A tsunami originating from Japan would take 10-15 hours to reach Los

Angeles while an event in South America could take up to 20 hours to reach the area. While such an incident would provide substantial time for evacuations, the effects could be as damaging as a nearfield event. One example is the Japan earthquake (M9.0) which occurred on March 11, 2011 and generated a ~0.5m tsunami at Los Angeles that caused over $50 million dollars in damages along the California coast (LA Times, 2011). Figure 2 shows data from the Santa Monica water level gauge during this event and illustrates the exaggerated heights of the waves overlying the longer period tidal oscillations.

3. HISTORY OF TSUNAMIS IN LOS ANGELES

Two notable tsunamis have affected the Los Angeles area in the twentieth century. On May 22, 1960, a farfield tsunami originating in Chile, South America from an 8.7 magnitude earthquake reached Los Angeles 14 hours later with a height of 2.6 feet (NOAA). At least one death was associated with the tsunami in Los Angeles and $1,000,000 in damage was recorded (Whitmore 2003).

An 8.9 magnitude earthquake in Anchorage Alaska occurred on March 3, 1964 and resulted in run-up heights of 2 feet in Los Angeles (NOAA). The tsunami caused $200,000 in boat damage and one death in the Los Angeles area (Whitmore, 2003).

4. TSUNAMI MAPPING

Knowing the probability of tsunami run-up occurrences is essential in evaluating risk. The California Emergency Management Agency, the California Geologic Survey, and the University of Southern California have partnered to create statewide tsunami inundation maps to help predict areas that are at risk. These maps were created by first examining tsunamis originating from the Pacific Rim or Cascadia subduction zones, underwater earthquake or landslide events, and past tsunamis and then running them through the MOST (Method of Splitting Tsunami) model using a coarse grid to determine which events would have the greatest impact on the California coast. Once identified, these events were run through the model again using nested grids down to 30 meter for three sea ports and 90 meter for the rest of the coast. The results of each modeled event were then combined to create a worst-case scenario wave and run-up estimate. Using USGS 10 meter and interferometric radar 3 meter high resolution digital elevation models (DEMs), the inundation line was refined and verified in the field. This mapping effort, which is ongoing, provides the best information on the tsunami risk at Ballona (Figure 3).

The City of Los Angeles in their Safety Plan (1996) also created a map of potential tsunami hazard areas (Figure 4). However, the map does not seem to be derived from modeling, and the plan notes only that flooding would occur in low-lying areas.

5. BALLONA TSUNAMI RISK

The city tsunami map shows that all of the Ballona site, except for a western portion of Area A, could potentially be impacted by a tsunami. However, according to the state tsunami map, only Ballona Creek will feel the effects of a tsunami while the rest of the site is not expected to be inundated. While the state

maps are not intended for planning purposes, they represent the best statewide tsunami mapping effort to date. Figure 5 shows a zoomed in image of the state inundation line near Ballona. The state mapping indicates that Del Rey Lagoon and the areas west of it could possibly flood. However, the existing Ballona Creek levees, which range in elevation from 13 to greater than 16 feet would prevent tsunami waters from entering the rest of the site.

The state maps do not include wave run-up velocities which would be important in predicting potential erosion impacts. Future sea level rise may increase flood risk as well. Tide level and sea level elevation at the time of arrival will affect the impact of tsunami run-up. These are independent factors that may reduce or exacerbate the impacts from such an event.

6. DESIGN CONSIDERATIONS

The proposed restoration design would maintain the same level of flood protection to surrounding areas as existing conditions. While more of the site itself would likely be inundated by a tsunami, the wetland vegetation and natural channel bottom would provide friction which would reduce the wave energy that would reach the levees. High water velocities could cause erosion along the levees and the tsunami could produce seiches within the site which would result in higher waves. However, Borrero et al (2002) modeled that a slide on the Palos Verdes fault would cause velocities of 3 m/s in the Port of LA, which is no faster than modeled velocities for a 50 year fluvial event.

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Figure 3. State Map of Tsunami Inundation
Figure 4. City Map of Tsunami Inundation
Figure 5. State Tsunami Inundation Line at Ballona

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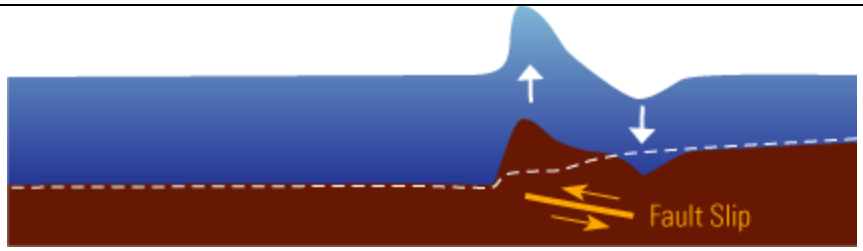
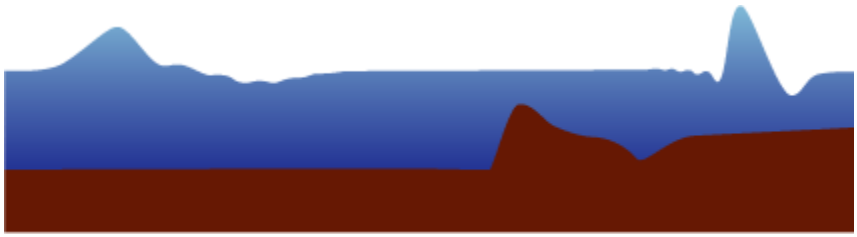


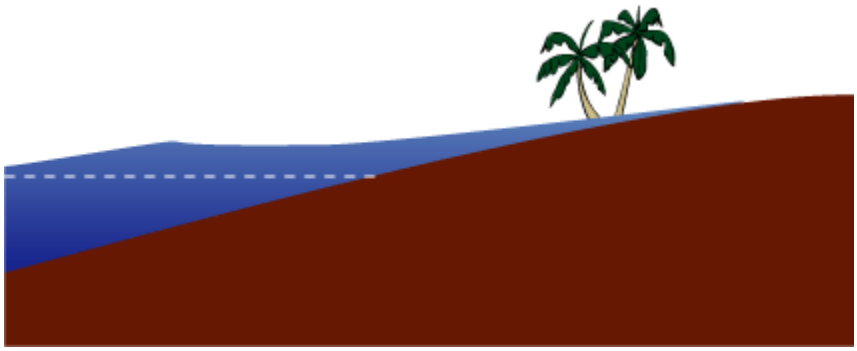
Stage 1- Initiation



Stage 2- Split



Stage 3- Amplification



Stage 4- Run-up

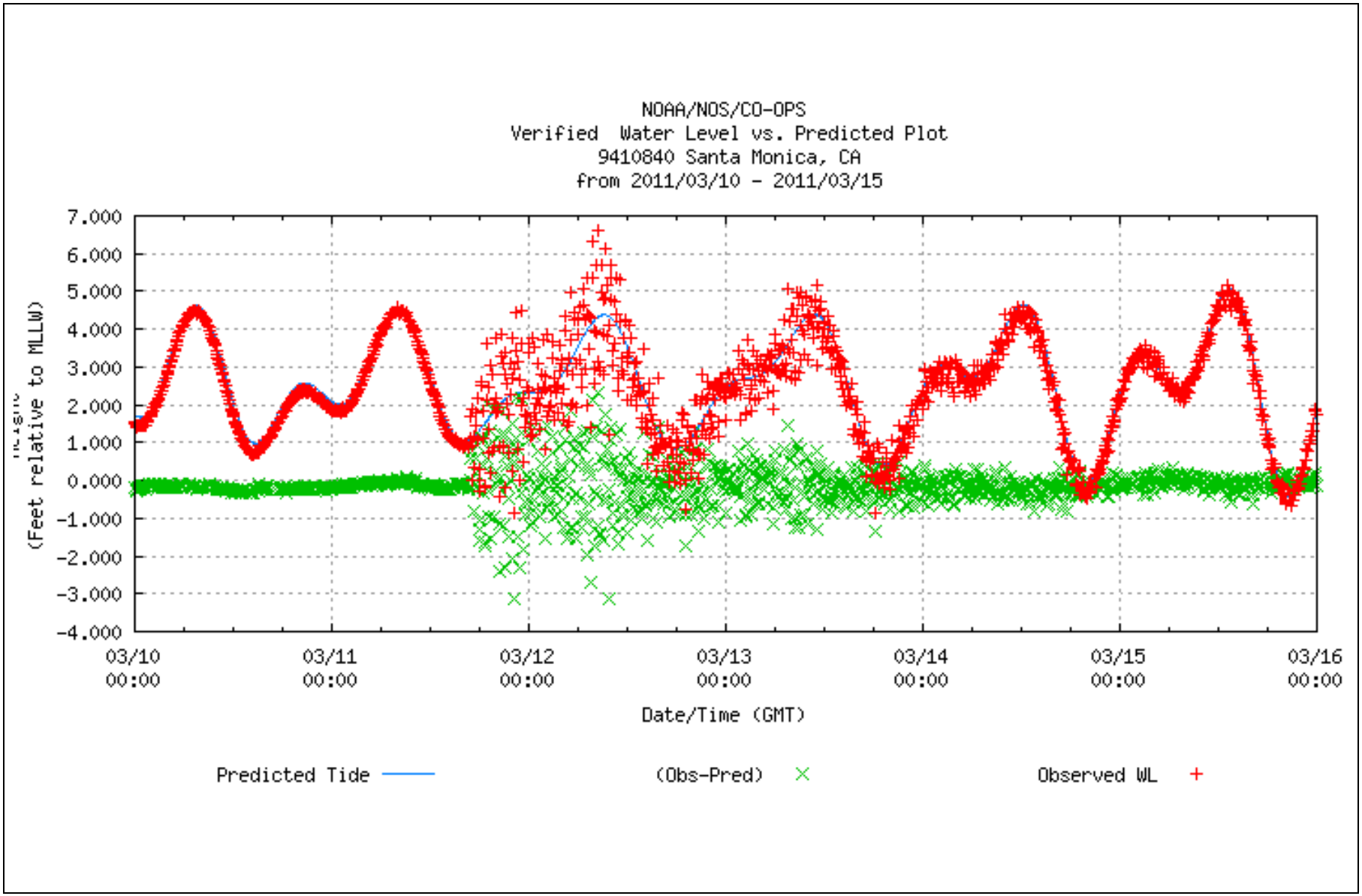
The height of the waves above are exaggerated for illustrative purposes.

Ballona Wetlands . D120367

SOURCE: USGS. Life of a Tsunami
http://walrus.wr.usgs.gov/tsunami/basics.html. 7/12/2010.

Figure 1
Typical Tsunami Formation

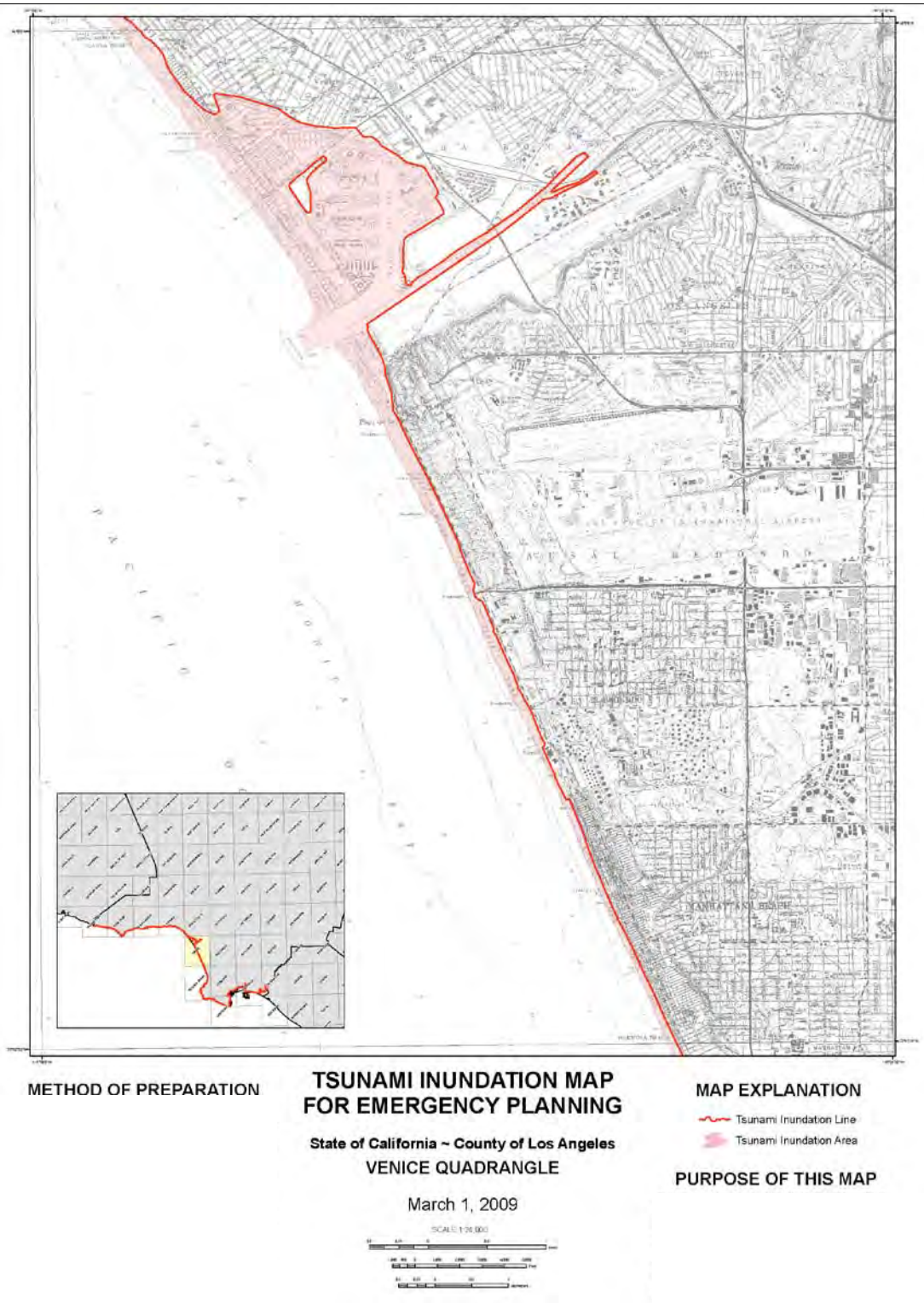
ESA PWA



SOURCE: NOAA Tides and Currents.
http://tidesandcurrents.noaa.gov/data_menu.shtml?type=Historic+Tide+Data&mstn=9410840. 8/2/2012

ESA PWA

Figure 2
Santa Monica Water Level Data
for the Tsunami on 3/12/11

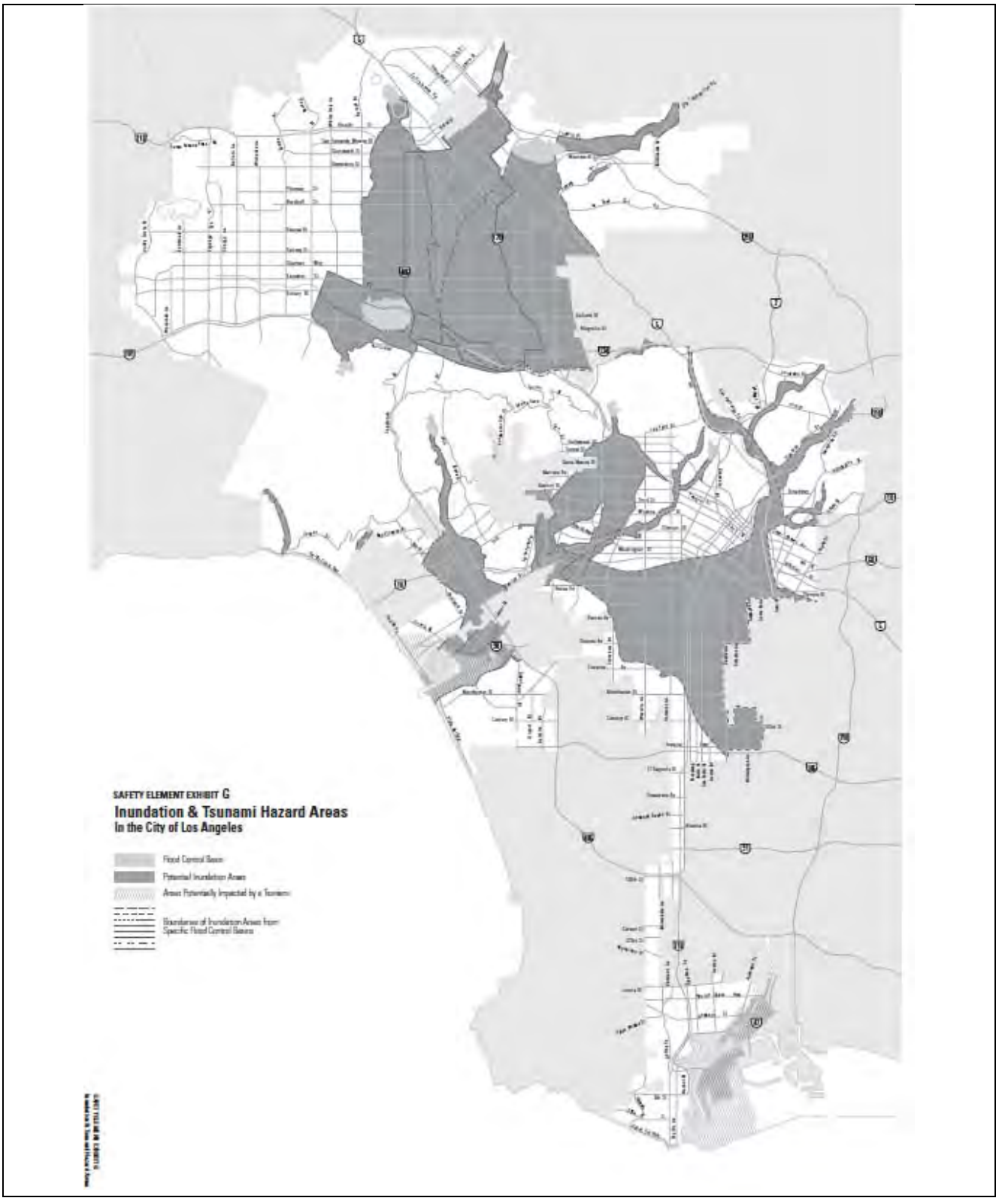


SOURCE: State of California (2009).

Ballona Wetlands . D120367

Figure 3

State Map of Tsunami Inundation



Ballona Wetlands . D120367

SOURCE: City of Los Angeles (1996).

Figure 4
City Map of Tsunami Inundation

ESA PWA



J:\1793_Ballona\Tsunami.mxd

SOURCE: State of California (2009).

ESA PWA

Ballona Wetlands. D120367

Figure 5

State Tsunami Inundation Line at Ballona

Appendix 2 Ballona Creek Sediment Budget

Ballona Wetlands Restoration Preliminary Hydrology and Hydraulics Report
February 1, 2013 Administrative Draft
ESA PWA

APPENDIX 2
BALLONA CREEK SEDIMENT BUDGET

1. SEDIMENT TRANSPORT PROCESSES

Marina del Rey, which was opened in 1965 (Attachment 1), is part of the Santa Monica Littoral Cell (Figure 1). Sediment from Ballona Creek and other water ways in the area, enters the cell and is transported south to the Redondo Submarine Canyon where it is lost from the system. In the vicinity of Marina del Rey, the alignment of the coastline and the associated prevailing waves create a predominant net sediment transport to the southeast (downcoast). This may be reversed periodically, especially when southern swells approach the coastline during the summer, and when Santa Ana winds (offshore) prevail for extended periods of time (days). However, northern transport into Marina del Rey is considered negligible (USACE 2009).

The marina entrance, jetties, and breakwater act as a nearly complete littoral transport barrier. The jetties and breakwater extend into the littoral zone and interrupt both downcoast and upcoast longshore transport during normal conditions. Major storm events, mostly in the winter, are responsible for major movements of sediments, both transport and deposition, in and around littoral barriers. These events cause sediment from Ballona Creek and littoral transport to build shoals in the entrances to the marina which inhibits safe navigation and requires dredging. The shoals in the entrance areas tend to remain flat during the spring and summer because the tides rework the sediment and deposit it farther offshore.

Marina del Rey has a northern and southern entrance (Figure 2). The sediment that accumulates in the north entrance comes primarily from littoral transport, and is generally clean enough for beach or ocean disposal (USACE 2003b). Sediment that accumulates in the south entrance comes primarily from Ballona Creek, and is generally too contaminated to put on the beach or discharged to the ocean (USACE 2003b). Historically, sediments have been disposed of in three main locations: the beach, the LA-2 Ocean Dredged Material Disposal Site, and various opportunistic sites for the placement of contaminated sediments.

While the general direction of transport seems to be agreed upon between reports, the amount of sediment moving in the system is unclear. In the Ballona Creek Sediment Control Management Plan EIR/S, it is noted that approximately 65% of the sediments deposited in the harbor entrance come from Ballona Creek (USACE 2003b). However, the EIR/S also includes a figure (Figure 3) that presents a sediment yield of 44,615 m^3/yr from Ballona Creek and 48,000 m^3/yr from littoral transport. This suggests Ballona Creek contributes less than 50% of the sediment in the marina.

In 2009, the US Army Corp of Engineers (USACE) produced the Ballona Creek Ecosystem Restoration Feasibility Study with a Coastal Engineering Appendix. The appendix references the 1998 USACE Marina del Rey Shoaling and Disposal Feasibility Study which presents north to south sediment transport of 0 to 25,200 m^3/yr and 45,873 m^3/yr of sediment coming from Ballona. This estimate of the Ballona Creek sediment yield is similar to a 2003 estimate (44,615 m^3/yr), but the littoral transport from the north is about half that of the 2003 estimate (48,000 m^3/yr).

Inman and Jenkins (1999) used a sedimentation curve from a similar watershed along with flow rates from Ballona Creek to estimate a sediment yield of 10,800 m^3/yr. Using a suspended sediment rating curve derived from suspended sediment measurements collected by LACDPW (1999 – 2011) and SCCWRP (2001 – 2004), a much lower estimate of 6,520 m^3/yr is calculated. Table 1 summarizes the different estimates.

2. DREDGE HISTORY AND SHOALING RATES

A history of dredging events for Marina del Rey from 1969-2009 is provided in Table 2. Surveys are conducted to evaluate conditions in the harbor before dredging (pre-dredge), after dredging (post-dredge), and in between dredging events (conditions). There are some differences between the numbers reported by different sources for the1999 dredging event. See table notes for more details.

In 2003(a), Moffat and Nichol (M&N) and USACE revised their previously calculated shoaling rates by adding more recent data. They used two methods to calculate shoaling rates at the Marina del Rey entrance with data from 1991 to 2001. Using conditions, pre-, and post-dredge surveys, they developed bathymetric difference maps. The first method subtracts the first bathy survey (1991) from the last bathy survey (2001) and adds the total reported dredge quantities in between, then divides by the years in between the two surveys. This method estimated shoaling of 71,600 cubic meters (93,600 cubic yards) per year. M&N and USACE also divided the marina entrance into four areas labeled A, B, G, and H and shown in Figure 4. The second method calculates shoaling rates between each survey for each area, divides by the years in between, and then averages all of the rates. This method estimated shoaling of 109,100 cubic meters (142,700 cubic yards) per year. Table 3 presents the rates for both methods. Figure 3 shows the shoaling rates for each area in the overall sediment budget. The rates in Areas A and G are consistent with those calculated by M&N and USACE in Table 3, but the rates in Areas B and H are not (the calculated rates are shown in parenthesis below those from the figure). It is unclear how the shoaling rates in Areas B and H from the figure are calculated.

3. ACCRETION RATES

A similar analysis to that used by M&N and USACE was repeated including all the most recent data. Figure 5 shows the difference plots from the dredge surveys. The maximum, minimum, and average accretion in inches in each of the four areas was calculated and is summarized in Table 4. Figure 6 presents the averages and standard deviations by area. The figure shows that sedimentation in the north entrance of Marina del Rey is greater than in the south entrance which is likely due to the downcoast sediment transport. However, the standard deviation of each calculation is greater than the mean itself, so there is large variability in the system. Figure 7 shows the trends over time. Significant accretion in all areas occurred after El Nino events in 2002-2003 and 2009-2010 likely due to large storm events. Other than in early 2008 after a dredge event, Areas B and H (the northern entrance areas) have higher accretion rates than Areas A and G in the southern entrance. This also suggests that littoral transport to the south is more significant than transport to the north.

Historically, no bathymetric surveys of Ballona Creek were conducted upstream of dredging activities. The only available channel data is the as-built survey from 1959/1961 and the recent survey by PSOMAS. The existing conditions bathymetric survey by PSOMAS was compared to the as-built thalweg elevations to look at accretion within Ballona Creek (Figure 8). Sedimentation is observed at the far downstream end of the channel near the

marina entrance and upstream of Lincoln Blvd. Within most of the site, accretion is minimal and located in the center of the channel.

Since 1988, there have only been one Q5 and one Q10 storm event in Ballona Creek. Hydraulic modeling shows that there is no fluvial influence of storms of Q5 or smaller within the site, so since the Q10 storm in 1994, sediment has likely not been flushed from the system. Assuming the current accretion in the channel has been building since 1994, it can be estimated that Ballona Creek provides 6,300 m^3/yr of sediment to the coastal system.

4. SEDIMENT SIZE

Based on past dredging event in the marina, sediments in the center of the main channel and near the bend of Marina del Rey were predominantly silt/clay. Sediments were coarser (sand-sized particles) along the sides of the entrance channel and at the mouth. The coarsest sediments were found at the mouth of Ballona Creek and at the entrance of Ballona Lagoon. The grain size of sediments at the harbor entrance is mostly between 0.1 and 0.25 mm. Sediments coming from Ballona Creek are 20% silt, 65% sand, and 15% gravel (USACE 2003b).

Leidersdorf, Hollar, and Woodell (1994) estimate that Ballona Creek inputs 46,000 cy/yr (35,000 m^3/yr) of fine sand to the littoral cell. USACE (2009) cites their 1998 Marina del Rey Shoaling and Disposal Feasibility Study to suggest that Ballona contributes 39,760 m^3/yr of sand, although the report later estimates that 45,873 m^3/yr of sediment moves through the system with 90% sand and 10% silt (or 41,300 m^3/yr of sand). Sediment sampling conducted in 2010 (Figure 9) showed that sediments in the north entrance of Marina del Rey tended to be sandier than those in the south entrance. This supports the idea that sand is moving south into the marina entrances with minimal sand moving north.

FIGURES

Figure 1. Santa Monica Littoral Cell
Figure 2. Ballona Creek Mouth and Marina del Rey Entrances
Figure 3. USACE, 2003, Marina del Rey Sediment Budget
Figure 4. Marina del Rey Entrance Areas
Figure 5. Marina del Rey Bathymetric Difference Maps
Figure 6. Marina del Rey Accretion Rates
Figure 7. Marina del Rey Accretion by Area Over Time
Figure 8. Ballona Creek Accretion
Figure 9. Marina del Rey Sediment Sizes

ATTACHMENT
Timeline for Ballona Creek and Marina del Rey Areas

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USACE (2009). Ballona Creek Ecosystem Restoration Feasibility Study, Coastal Engineering Appendix. Los Angeles, CA. June 2009.

Table 1. Ballona Creek Sediment Yield Estimates

Source	Average Volumetric loading rate (m^3/yr)	Note
ESA PWA	6,300	Based on sediment accumulated in Ballona Creek
ESA PWA	6,520	Based on suspended sediment rating curve derived from suspended sediment measurements collected by LACDPW (1999 - 2011) and SCCWRP (2001 - 2004)
Inmann & Jenkins (1999)	10,800	Based on suspended sediment rating curve of a similar watershed and gage data at USGS 11103500 (data from 1944-1995)
USACE 2003	44,615	Based on sediment accumulated at mouth
USACE 2009	45,873	Based on sediment accumulated at mouth

Table 2. Dredge History of Marina del Rey

Date[1]	Location	Material	Method	Destination	Quantity (yd^3)	Source[2]
1969	Ballona Creek mouth		no record	Del Rey Beach	389,800	3
1973	South side of north jetty		no record	Upcoast of north jetty	16,100	3
1981	Entrance channel; Ballona creek mouth		no record	South of Dockweiler Beach	217,400	3
1987	Jetty tips; Ballona creek mouth		no record	Dockweiler Beach	35,300	3
1992	Ballona creek mouth	chemically challenged	dragging to fill voids	in situ	21,500	2
1994	Entrance channel	chemically challenged	clamshell	Port of LA shallow water habitat	57,000	2
1996	Entrance channel	beach quality	hydraulic dredge	Dockweiler State Beach	238,000	2
1998	Entrance channel	chemically challenged	clamshell	LA-2 Disposal Site	52,000	3
		beach quality	clamshell	Dockweiler State Beach	73,800	3
1999	Entrance channel	chemically challenged	clamshell	Port of Long Beach	390,000	4**
		beach quality	clamshell	Redondo Beach	282,000	4**
2007			clamshell	Dockweiler State Beach	327,000	4
2009			hydraulic dredge	Dockweiler State Beach	4,700	4

[1] Indicates year project was started
[2] Quantities from Source 2 are pay volumes; quantities from source 3 and 4 are unspecified, although volumes agree (with rounding) for 1969-1998
**** There is a large discrepancy between source 2, 3 and 4 (see hidden columns G, H, and I). Source 4 was the middle value and the most recent report, so those values are included. K:\projects_2012\D12XXXX.00 - Ballona\06 Project Library\Sediment_Studies\MDR Dredge History.xls**

Sources: 1. USACE 2003, Draft EIR/EIS for the Ballona Creek Sediment Control Management Plan,
2. USACE 2003, Marina Del Rey and Ballona Creek Feasibility Study, Ballona Creek Sediment Control Management Plan, Dredging Analysis Appendix
3. USACE 2004, LA Regional Dredged Material Management Plan Feasibility Study, Baseline Conditions (F3) Report Technical Appendix
4. Kinnetic Laboratories, Inc, Halcrow Inc, 2011. Marina Del Rey Maintenance Dredging Project Follow-Up Sediment Tier II and III Investigation, Final Report

Table 3. Shoaling Rates Marina del Rey

SURVEYS	YEARS*	A		B		G		H		TOTAL (m^3)
		VOLUME (m^3)	RATE (m^3/yr)	VOLUME (m^3)	RATE (m^3/yr)	VOLUME (m^3)	RATE (m^3/yr)	VOLUME (m^3)	RATE (m^3/yr)	
7/91-2/01 (Condition-Condition)	9.6	-49,900		-50,065		-38,445		25,202		-113,208
Total Dredging (USACE Reported Values)										799,550
Total Shoal Volume										686,342
Method 1 - Average Annual Shoaling Rate										71,618 m^3/yr
7/91-5/92 (Condition-Condition)	0.86	20,483	23,734	11,031	12,782	50,548	58,571			
5/92-10/92 (Condition-Pre)	0.36	-3,391	-9,448	-1,967	-5,481	-1,751	-4,879			
12/92-12/93 (Post-Condition)	1.00	26,297	26,297	18,785	18,785	-13,748	-13,748			
12/93-6/94 (Condition-Condition)	0.56	1,005	1,807	1,504	2,704	4,353	7,827			
6/94-10/94 (Condition-Pre)	0.50	-9,943	-20,051	-3,629	-7,318	-12,132	-24,465			
12/94-1/95 (Post-Condition)	0.10	23,569	238,963	11,987	121,535	1,260	12,775	25,153	255,023	
1/95-6/95 (Condition-Condition)	0.36	19,291	53,750	17,490	48,732	7,102	19,788			
6/95-12/95 (Condition-Condition)	0.50	-8,103	-16,206	-4,983	-9,966	-6,440	-12,880	3,820	3,445	
12/95-3/96 (Condition-Pre)	0.25	14,071	56,284	18,405	73,620	1,862	7,448			
4/96-9/96 (Post-Condition)	0.47	4,909	10,540	4,851	10,415	-1,208	-2,594	5,580	11,981	
9/96-8/97 (Condition-Condition)	0.90	8,065	8,975	9,626	10,712	2,515	2,799	38,853	43,236	
8/97-2/98 (Condition-Condition)	0.50	18,554	37,210	25,750	51,641	1,591	3,191	51,732	96,338	
2/98-3/98 (Condition-Pre)	0.04	6,219	162,138	1,952	50,891	2,469	64,370			
4/98-6/98 (Post-Condition)	0.14	-1,316	-9,418	-48,269	-77,957	-2,111	-15,108	-36,634	-59,166	
6/98-11/98 (Condition-Condition)	0.48	4,204	8,768			336	701			
11/98-5/99 (Condition-Condition)	0.48	310	647	14,280	29,784	-879	-1,833	32,293	67,354	
5/99-10/99 (Condition-Pre) **	0.44	-3,171	-7,145	-357	-804	-3,344	-7,534	-7,100	-15,997	
3/00-2/01 (Post-Condition)	0.96	8,373	8,732	9,637	10,050	10,439	10,886	56,390	58,807	
Avg. Annual Shoal Rate by Area:			31,977		20,007		5,851		51,225	
Method 2 - Average Annual Shoaling Rate (Sum of Rates for Sub-areas A, B, G & H)										109,059 m^3/yr

* Years 1991 through April, 1998 from M&N, 1999a

** Based on the survey data, Sub-area A shows -41,021 m^3 change in shoaling. Corps record indicated that 37,850 m^3 was actually dredged because dredging started 10 days prior to pre-dredged survey.

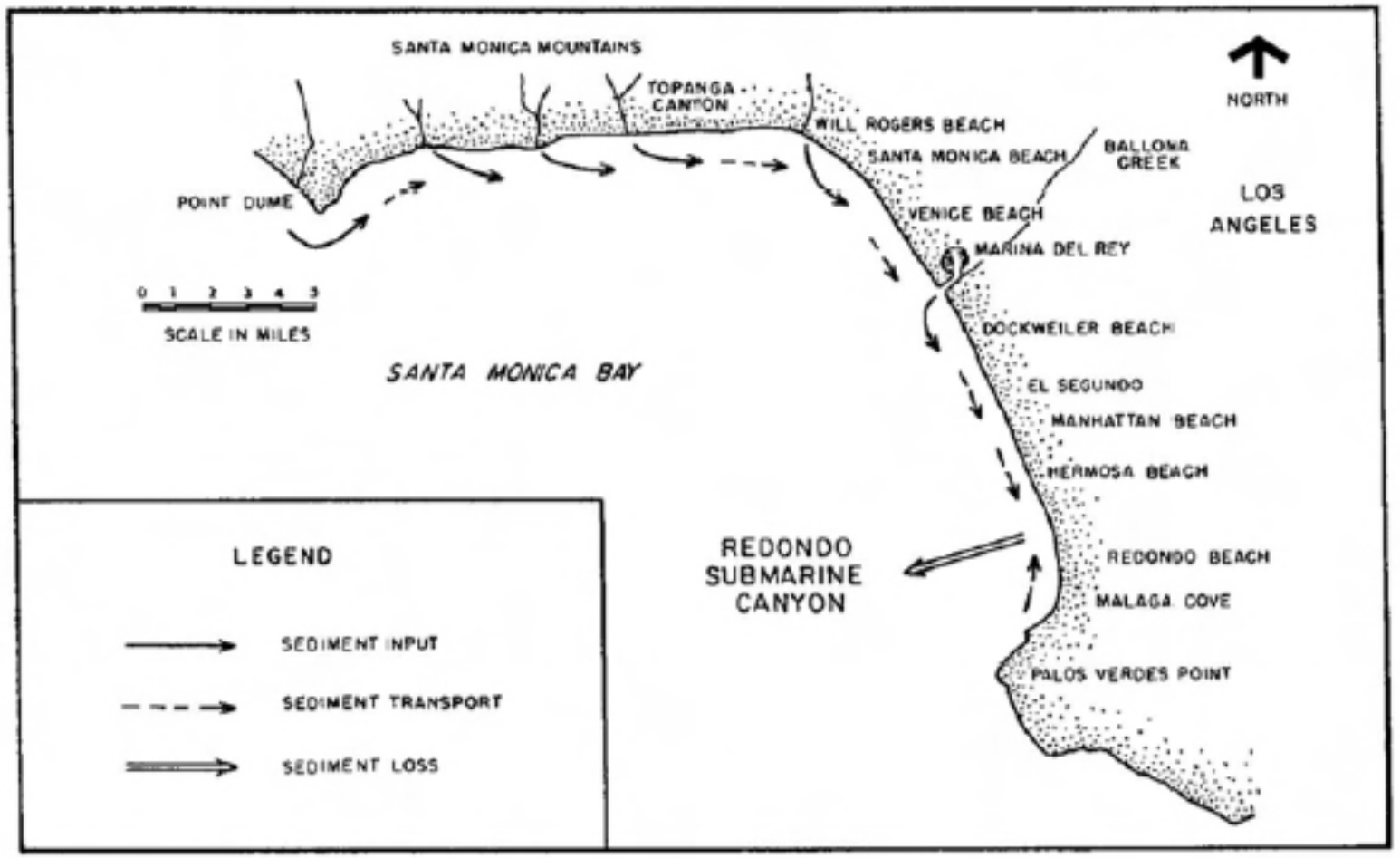
Source: Dredging Analysis Appendix of EIR/S

Table 4. Accretion Rates at Marina del Rey

Area A				
Years	**Minimum (in/yr)**	**Maximum (in/yr)**	**Mean (in/yr)**	**Std. Dev (in/yr)**
2000/2001	-29	67	9	8.9
2001/2002	-11	26	1	5.9
2002/2003	-90	189	20	10.7
2003/2005	-4	58	13	20.1
2005/2006	-28	24	3	8.1
2006/2007	-47	26	-3	7.9
2007/2008	-36	28	8	7.3
2008/2009	-31	10	0	7.1
2009/2011	-46	45	0	23.3
2011/2012	-41	77	3	8.1
Average[1]	**-36**	**58**	**5**	**6.9**

Area B				
Years	**Minimum (in/yr)**	**Maximum (in/yr)**	**Mean (in/yr)**	**Std. Dev (in/yr)**
2000/2001	-29	96	11	11.0
2001/2002	-25	73	6	15.5
2002/2003	-65	265	34	16.4
2003/2005	-9	75	12	23.9
2005/2006	-23	149	25	32.0
2006/2007	-35	29	0	7.3
2007/2008	-213	24	-54	73.7
2008/2009	-16	47	4	14.1
2009/2011	-45	98	16	39.7
2011/2012	-19	113	10	12.0
Average[1]	**-30**	**105**	**13**	**23.4**
Area G				
Years	**Minimum (in/yr)**	**Maximum (in/yr)**	**Mean (in/yr)**	**Std. Dev (in/yr)**
2000/2001	-100	121	10	22.7
2001/2002	-24	90	4	14.9
2002/2003	-71	159	17	12.9
2003/2005	-12	64	12	31.8
2005/2006	-30	38	-1	12.0
2006/2007	-36	11	-11	7.2
2007/2008	-7	22	5	6.0
2008/2009	-40	10	-5	12.2
2009/2011	-14	50	11	12.6
2011/2012	-37	25	-3	6.5
Average[1]	**-40**	**63**	**4**	**8.8**
Area H				
Years	**Minimum (in/yr)**	**Maximum (in/yr)**	**Mean (in/yr)**	**Std. Dev (in/yr)**
2000/2001	-13	284	79	79.0
2001/2002	-10	107	20	37.8
2002/2003	-39	453	88	42.4
2003/2005	-19	43	4	27.4
2005/2006	-26	129	36	29.2
2006/2007	-29	28	-4	7.4
2007/2008	-157	-2	-65	51.1
2008/2009	-12	58	7	18.5
2009/2011	8	101	38	28.9
2011/2012	-30	24	0	8.6
Average[1]	**-19**	**136**	**30**	**44.0**

[1] Averages do not include 2007/2008 since a dredge event occurred during this time



SOURCE: Figure 2, Leidersdorf, Hollar, and Woodell (1994).

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Ballona Wetlands . D120367

Figure 1
Santa Monica Littoral Cell



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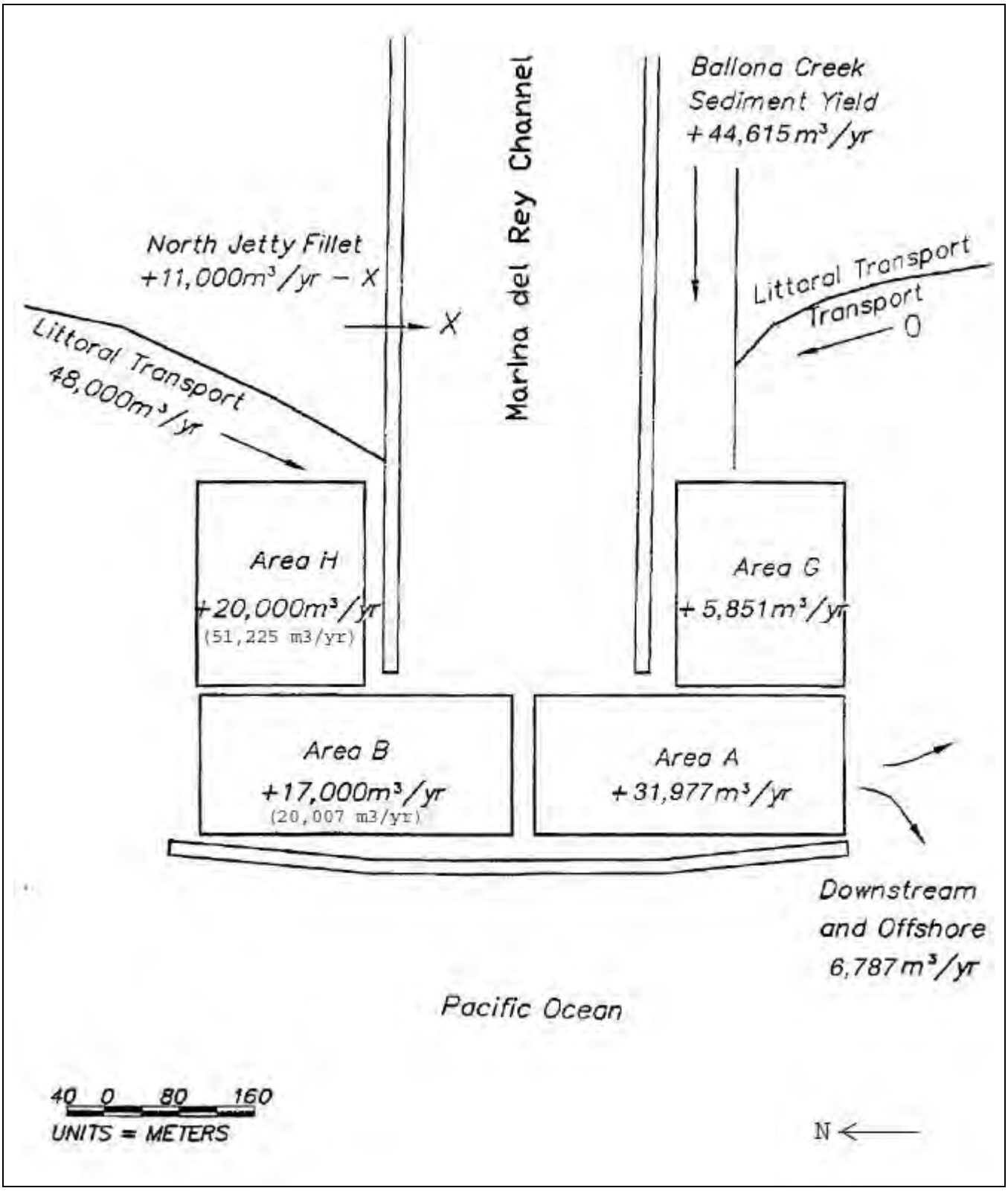
ESA PWA

Figure 2
Ballona Creek Mouth and
Marina del Rey Entrances



SOURCE: Reproduced from Figure 3.2-5 USACE (2003).

Ballona Wetlands . D120367

Figure 3
USACE, 2003, Marina del Rey
Sediment Budget



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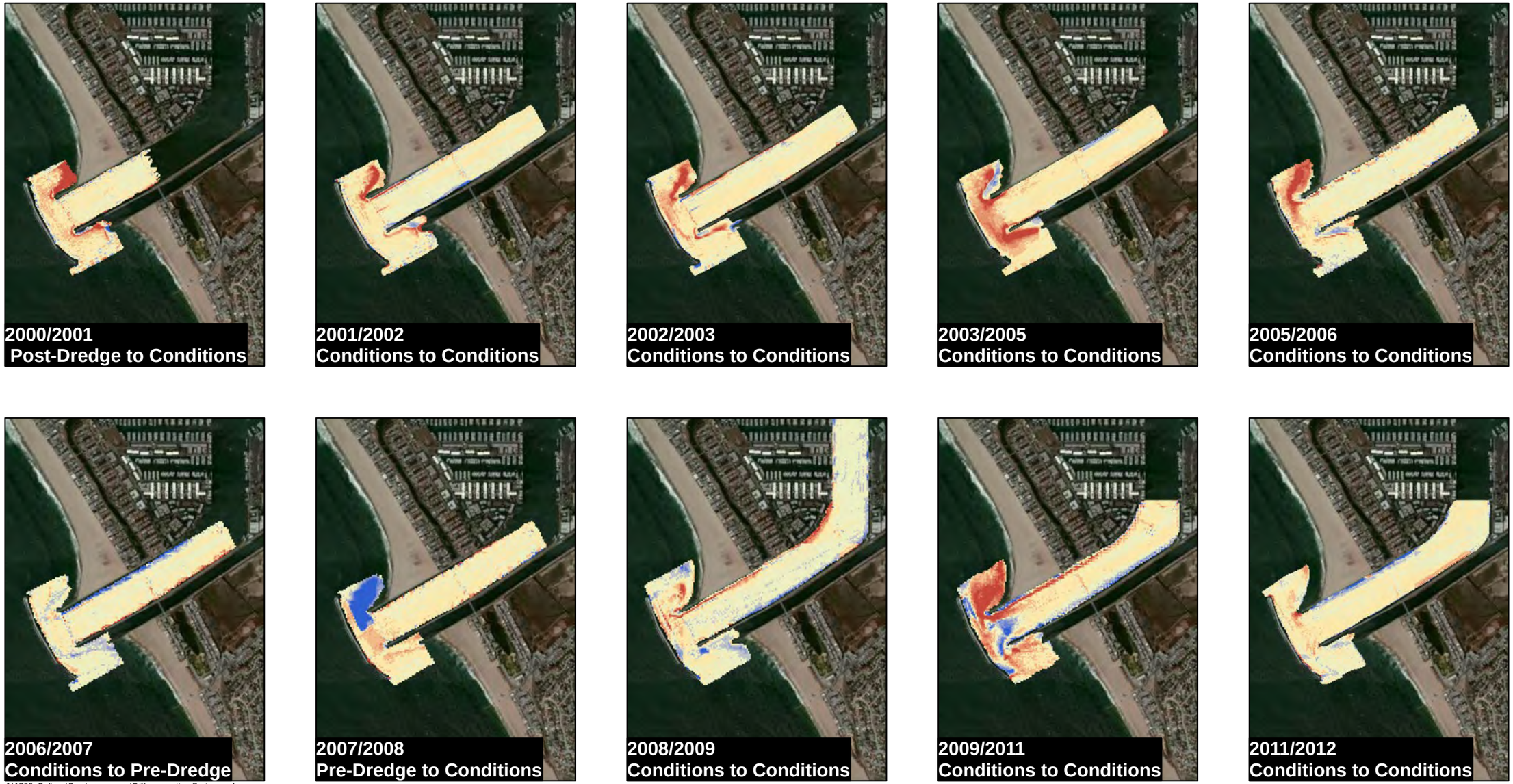
ESA PWA

Figure 4
Marina del Rey
Entrance Areas



J:\1793_BallonaDredge_surveys\Difference_timeSeries.mxd

0 500 1,000 2,000 Feet

Accretion (meters)

< -1 | -1 - -0.75 | -0.75 - -0.5 | -0.5 - -0.25 | -0.25 - 0 | 0 - 0.25 | 0.25 - .5 | 0.5 - .75 | 0.75 - 1 | > 1

SOURCE: Managed wetlands inboard of Culver levee shown as being managed to maintain marsh habittat over time.

ESA PWA

Figure 5
Marina del Rey
Bathymetric Difference Maps



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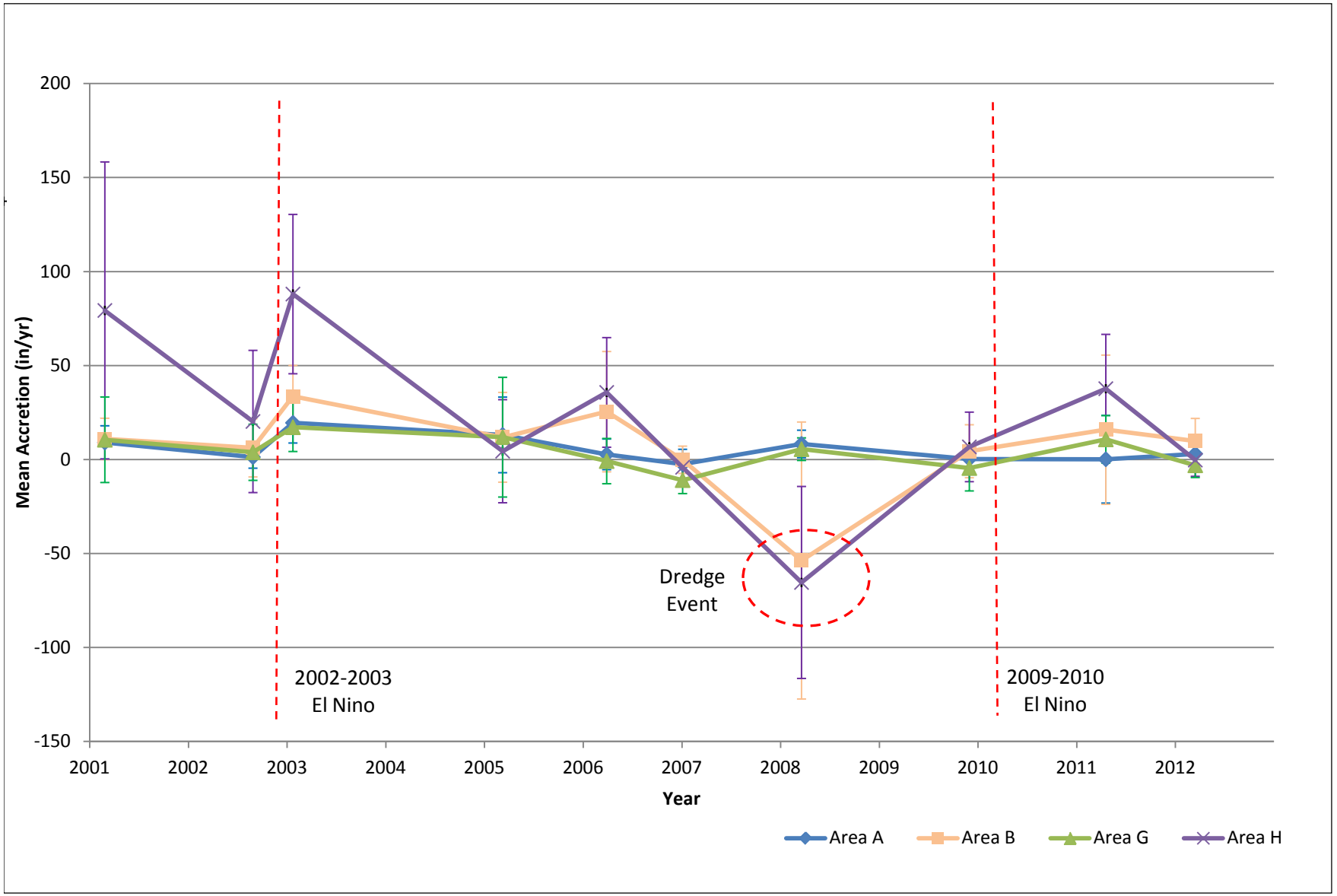
ESA PWA

Figure 6
Marina del Rey Accretion Rates



ESA PWA

Figure 7

Marina del Rey Accretion by Area Over Time



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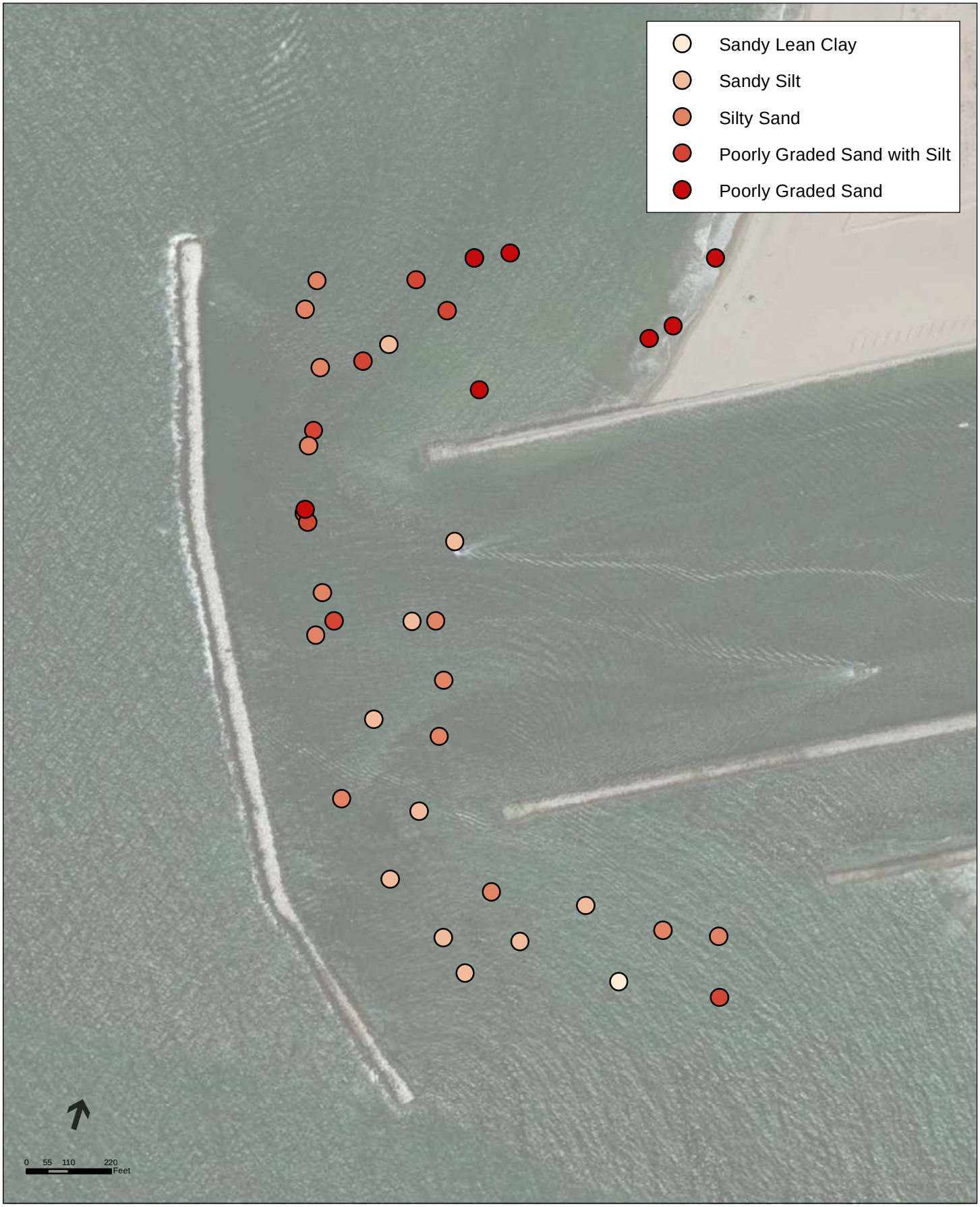
SOURCE: PSOMAS (2012)

ESA PWA

Ballona Wetlands. D120367

Figure 8
Ballona Creek Accretion
between 1959 and 2012



Ballona Wetlands. D120367

SOURCE: Kinnetic Laboratories (2010).

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Figure 9
Marina del Rey
Sediment Sizes

ATTACHMENT
TIMELINE FOR BALLONA CREEK AND MARINA DEL REY AREAS

Year	Item	Reference
1880 (earliest)	Rail lines constructed in wetlands	EPA, 2012
1900 (earliest)	Roadways constructed in wetlands	EPA, 2012
1904	Venice Pier & Breakwater (breakwater remains)	Shaw, 1980 and Tekmarine, 1985
1909	Old Ballona Creek Jetties (no longer exist)	Shaw, 1980 and Tekmarine, 1985
1909 & 1912	Santa Monica Pier	Shaw, 1980 and Tekmarine, 1985
1928 (earliest)	20 groins Sunset Blvd to Santa Monica Pier (4 remain)	Shaw, 1980 and Tekmarine, 1985
1930	Oil and gas exploration and production begins in wetlands	EPA, 2012
1934	Santa Monica Breakwater	Shaw, 1980 and Tekmarine, 1985
Pre-1935	Ocean Park Pier (no longer exists)	Shaw, 1980 and Tekmarine, 1985
1937 – 1988	21 bridge crossings constructed over creek throughout watershed	National Bridge Inventory, 2012
1938 (earliest)	3 groins Santa Monica Pier to Venice Breakwater (2 groins remain)	Shaw, 1980 and Tekmarine, 1985
1939	Ballona Creek flood control channels completed	USACE, 1995
1939	Redondo Beach Breakwater	Shaw, 1980 and Tekmarine, 1985
Pre-1946 (earliest)	4-8 groins Ballona Creek to Redondo Beach (4 remain	Shaw, 1980 and Tekmarine, 1985
1946	South Jetty, Marina del Rey	Shaw, 1980 and Tekmarine, 1985
Post-1946	Venice Beach groin	Shaw, 1980 and Tekmarine, 1985
1950-1960	Sawtelle-Westwood system channels completed	USACE, 1995
1957	Marina del Rey construction begins	LA County Department of Beaches and Harbors
1959	Middle and North Jetties, Marina del Rey	USACE, 1995
1962	Centinela Creek channel completed	USACE, 1995
1964	Benedict Canyon system channels completed	USACE, 1995
1965	Offshore breakwater, Marina del Rey completed; marina opened	USACE, 1995
1969	Dredging of Ballona Creek mouth	USACE, 2004
1973	Dredging of Marina del Rey entrance	USACE, 2004
1981	Dredging of Marina del Rey entrance and Ballona Creek mouth	USACE, 2004
1987	Dredging of Marina del Rey entrance and Ballona Creek mouth	USACE, 2004
1992	Dredging of Marina del Rey entrance	USACE, 2003
1994	Dredging of Marina del Rey entrance	USACE, 2003
1996	Dredging of Marina del Rey entrance	USACE, 2003
1998	Dredging of Marina del Rey entrance	USACE, 2004
1999	Dredging of Marina del Rey entrance	Kinnetic Laboratories, 2011
2004	State Coastal Conservancy funds Ballona Wetlands Restoration Project	State Coastal Conservancy
2007	Dredging of Marina del Rey entrance	Kinnetic Laboratories, 2011
2009	Dredging of Marina del Rey entrance	Kinnetic Laboratories, 2011
2012	Dredging of Marina del Rey entrance	Kinnetic Laboratories, 2011

The Ballona Creek watershed drains urban Los Angeles and is almost 90 percent developed (Dojiri *et al.*, 2003). The Ballona Creek watershed (338 km^2) contains seven subbasins (LACDPW, 1999) and is relatively flat, with a maximum average slope of 6 percent. ***Ballona Creek has no dams or treatment plant discharges.***

- From Ackerman, Drew, Kenneth C. Schiff, and Stephen B. Weisberg, 2005. Evaluation HSPF in an Arid, Urbanized Watershed. Journal of the American Water Resources Association (JAWRA) 41(2):477-486.

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Appendix 3 Developing Design Dimensions for the Restored Ballona Creek Channel

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APPENDIX 3
DEVELOPING DESIGN DIMENSIONS FOR THE RESTORED BALLONA CREEK CHANNEL

1. BACKGROUND

Within and around the restoration area, Ballona Creek has an artificial channel that was designed to contain flood flows. However, for the restoration project it is desirable to construct a channel that is in geomorphic equilibrium with its watershed, which typically means a channel that has a much smaller cross section than a flood control channel. In addition to being more stable (in balance between erosion and deposition), an appropriately-sized channel will provide better ecological function by overflowing onto its floodplain at frequencies that mimic the desired natural environments. This memo describes the analyses used to develop a preliminary channel size for the restoration area. The channel dimensions will be refined as additional data become available.

There are numerous ways of estimating natural channel dimensions, ranging from mimicking historic or nearby reference channels, using regional empirical relationships or employing sediment transport analyses. Complicating the issue, within the restoration area Ballona Creek is at the intersection of the fluvial and tidal regimes, and is likely shaped by both. Three approaches have been used to determine channel size: estimation of dominant discharge based on fluvial sediment transport analysis, the use of regional regressions to estimate bankfull channel width and depth for fluvial regimes, and the use of regression equations based on tidal flow.

- Dominant discharge is the flow range which cumulatively transports the most sediment over a period of several decades. Cumulative sediment transport capacity for any given flow range is the sum of flow frequency and sediment transport capacity per event within that range. It has been observed that for most environments dominant discharge corresponds to bankfull discharge (Q_{bf}), suggesting that this is the mechanism that shapes natural channels.

- The bankfull flow is defined as the maximum discharge that can be contained by the main channel before it overflows onto the floodplain under natural channel conditions. Bankfull geometry is the channel cross section shape that holds the bankfull flow. In fluvial systems bankfull dimensions within a region typically correlate with watershed area.

- Tidal channel dimensions can be related to tidal flow (the volume of water making up the tidal prism at MHHW) through the empirical relationships of Williams et al (2002). These relationships are based on data from tidal channels in mature natural marshes located throughout the San Francisco Bay.

Estimating the dominant discharge and associated fluvial and tidal channel geometry will help inform the channel design for the proposed realignment. We have also assumed that where one regime (e.g. tidal) produces much larger estimates of channel cross section than the other regime (e.g. fluvial), the former is likely dominant in that location. We would expect Ballona Creek to gradually transition from tidally-dominated in its lower reaches to fluvially-dominated in its upper reaches.

2. DOMINANT DISCHARGE ESTIMATE

Dominant discharge is calculated by estimating or measuring sediment transport at a range of flows, dividing the flows into bins, and identifying the range of flows that cumulatively transport the most sediment over a period of several decades. It is assumed that the channel will adjust through erosion and deposition to carry the dominant discharge. ESA PWA estimated the dominant discharge for the downstream reach of Ballona Creek using four steps: 1) Selection and summary of flow data, 2) preliminary estimate of bankfull channel dimensions, 3) development of a bed material sediment rating curve, and 4) integration of the flow data and the sediment rating curve to produce a sediment load histogram (sediment load as a function of discharge over the period of record). The histogram peak represents the bankfull discharge increment - i.e. the range of flows that transport the most sediment over time.

2.1.1 Flow Data

An hourly flow record from the Sawtelle Boulevard streamflow gage (F38-C) from October 1988 to December 2010 was used to evaluate the range of expected flows in the Ballona Creek channel. An hourly flow duration curve for this gage is shown in Figure 2. The data demonstrates that 99% of the hourly flow is less than 2,000 cfs. The maximum recorded flow over the 1988-2010 period occurred on 3/10/1995 and had a magnitude of 23,340 cfs.

2.1.2 Initial Assumed Bankfull Dimensions for Dominant Discharge Analysis

In order to estimate sediment transport capacity it is necessary to assume an initial channel cross section. The cross section was initially estimated based on the observed channel geometry at the Sawtelle Blvd gage. This was used to drive the sediment load histogram and bankfull discharge estimation method described in this section, the results of which were used to revise estimates for bankfull flow width. The sediment transport analysis was then repeated iteratively varying channel dimensions until the flow width derived from the regression equations converged with the bankfull flow estimated using the sediment load histogram approach.

2.1.3 Bed Material Sediment Rating Curve

Using the Bedload Assessment in Gravel-bedded Streams (BAGS) program developed for the U.S. Forest Service (USFS) (Pitlick et al., 2008, 2009), and the substrate-based Parker Klingerman Mclean (PKM) transport function (1982), a bed material sediment rating curve (SRC) was developed for the downstream reach of Ballona Creek. (Note that although the program is named for gravel streams, the sediment transport function selected was based on sand.) Inputs for the SRC development included bankfull flow width, an estimate of main channel roughness, a representative bed grain size distribution, a representative slope estimate, and a range of flows.

- Representative bankfull top width: As described above, the initial estimate of 300 feet was used based on the observed cross-section of the flood control channel. Through a series of iterations an average top width of 103 feet was derived. Little difference was observed between results for the top width estimates based on the two sediment transport functions used.
- Main channel roughness: A roughness of 0.03 was assumed for the main channel.

- Bed grain size distribution: The composite grain size distribution curve for Ballona Creek (USACE 2003) was used to represent sediment size present in the main channel. The 20 sediment samples collected by the USACE were taken at several locations over the length of Ballona Creek and its tributaries. Though the composite distribution was utilized for this analysis, results may be improved by using the data for samples collected within the analyzed reach. This data was not available at the time of this assessment.
- Representative slope: An average friction slope for the downstream reach was estimated using the Q100 profiles from the HEC-RAS model for Ballona Creek. The slope was estimated at 0.0009 ft/ft.
- Based upon the range of flows reported for the Sawtelle Boulevard gage, the sediment rating curve was calculated for up to 24,000 cfs.

One limitation of the BAGS program in this application is that it was originally designed for gravel-bedded streams. The transport functions available in BAGS are less appropriate for channels where the majority of the sediment falls in the sand and silt range which is the case for Ballona Creek. Evaluating the transport of the cohesive fraction of the bed sediment is even more problematic. Cohesion between sediment particles introduces large levels of uncertainty in sediment transport analysis. In-situ shear strength analysis is required to produce transport predictions within a reasonable degree of uncertainty. It is likely that that finer sediment would have a lower dominant discharge than coarser sediment, resulting in a smaller channel estimate.

2.1.4 Sediment Load Histogram

Using the flow data and the bed material SRC, an hourly sediment load was calculated for each average hourly discharge value (discharge values less than 5 cfs were excluded, as little-to-no bed material would be mobilized at such flows). The flow data, and associated total sediment loads, were summarized into a histogram of arithmetic class intervals (or bins), subsequently creating a sediment load histogram as well. The effective discharge was taken as the mid-point of the bin with the largest total sediment load (i.e., the peak of the sediment load histogram).

In previous studies, the number of arithmetic class intervals has ranged from 8 to 54, with 20 to 25 being the most common (Soar and Thorne, 2001). The selected class interval should be small enough to accurately represent the frequency distribution of flows, but large enough to produce a continuous distribution, with no classes having a flow frequency of zero (Shields et al., 2008, *Chapter 9*; Soar and Thorne, 2001). Using a range of several bin sizes, the average most effective sediment transporting flow was 2,100 cfs. This was assumed to be the dominant discharge at the Sawtelle Boulevard gage. The sediment load histogram for a class interval of 50 (corresponding to a bin size of 470 cfs) is shown in Figure 3.

2.2 Prorated Dominant Discharge and Channel Dimensions for the Restoration Site

The dominant flow estimate was conducted using streamflow recorded at the Sawtelle Boulevard gage which is approximately 3.8 miles upstream of the Ballona Creek outlet. This gage drains approximately 70% of the total Ballona Creek watershed, with an additional 36 square miles draining to the outlet. The

ratio of flows between the two locations from the USACE flood frequency analysis (2008) was used to scale the dominant discharge estimate from the gage to the channel outlet. As shown in Table 1, the ratio between predicted flows is generally consistent over several return periods.

Table 1. Flood frequency estimates and ratio for n-year floods on Ballona Creek at Sepulveda Avenue and the channel outlet

	Drainage Area	n-year discharge (cfs)					
Ballona Creek	(sq-mi)	Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}
At Sepulveda ave	87.12	12,610	18,070	21,600	25,040	29,420	32,900
At outlet	122.8	17,170	24,840	29,690	34,020	40,150	44,690
Ratio	1.41	1.36	1.37	1.37	1.36	1.36	1.36

The scaled dominant discharge estimate at the restoration site is approximately 2,900 cfs. We would thus expect the channel cross section that contains this flow to be the stable channel dimensions. Based on the analysis the channel would have a width of approximately 103 feet.

3. FLUVIAL METHODS OF ESTIMATING BANKFULL CHANNEL GEOMETRY

The inputs and methodologies employed to estimate bankfull discharge and channel geometry based on watershed area and other attributes are described in the following sections.

3.1 Dunne and Leopold Analysis

Dunne and Leopold (1972) collected data relating bankfull width, depth and cross-sectional area to drainage area for four regions within the United States. This included the San Francisco Bay region at locations with 30-inches of mean annual precipitation and encompassed watershed areas greater than 100 square miles. The mean annual precipitation for the Ballona Creek watershed is approximately 27 inches based on the 1971-2000 rainfall dataset compiled by the PRISM climate group at Oregon State University, and the watershed area is 122.8 square miles. It should be noted that regression relationships vary between regions based on rainfall, vegetation and geology, but the San Francisco curve is believed to be the closest regional curve with a large dataset. The San Francisco Bay regional relationships were used to estimate the bankfull channel dimensions for Ballona Creek.

The Dunne and Leopold regression predicts a bankfull channel cross section of 518.4 square feet, with a width of 105.3 feet and a depth of 5.1 feet (Table 2). Dunne and Leopold's equations can also be used to estimate bankfull discharge based on watershed size; for the watershed area and rainfall described above the estimated bankfull discharge would be 4,650 cfs.

3.2 Wilkerson and Parker Analysis

Wilkerson and Parker developed bankfull channel and discharge relationships using data collected on sand-bed rivers across the world. The relationships derived relate bankfull width, depth, and slope to bankfull discharge and median particle diameter. The dataset analyzed in this study contained sediment

with a median bed particle size (D_{50}) between 0.062 mm and 0.50 mm. Sediment data collected for the Ballona Creek Channel presented by the USACE (2003) showed a reach-averaged D_{50} of 0.4 mm. The grain size distribution for 20 samples collected on Ballona Creek and its tributaries along with a composite average is shown in Figure 1.

The bankfull geometry relationships presented in Wilkerson and Parker (2011) rely on an estimate of bankfull discharge which, circularly, requires information on bankfull channel dimensions. Thus this analysis was solved iteratively until the predicted channel dimensions agreed with the predicted bankfull discharge. Our analysis bracketed the range of potential bankfull discharges, with a dominant discharge analysis (described in Section 2.) providing the lower value of 2,900 cfs and the Leopold and Dunne equation the higher potential value of 4,650 cfs.

Assuming a bankfull discharge of 2,900 cfs, the channel width estimated using the Wilkerson and Parker equation is 123.5 feet, with a depth of 5.6 feet. If a bankfull discharge of 4,650 cfs was used, the width would be expected to be 170.6 feet and the depth 6.4 feet (Table 2).

3.3 Soar and Thorne Analysis

The Soar and Thorne report provided updated relationships between bankfull width and discharge for sand-bed streams in 58 U.S. locations. This study demonstrated improved correlation in variables when accounting for vegetation coverage in the channel. For this preliminary estimate, the average relationships, regardless of channel vegetation, were assumed.

Soar and Thorne's equation predicts a channel width of 121.4 feet assuming a lower bankfull discharge of 2,900 cfs, and 156 feet for a higher discharge of 4,650 cfs (Table 2).

Table 2. Bankfull channel dimensions for the Ballona Creek channel

Source	Q_{bf} = 2,900 cfs			Q_{bf} = 4,650 cfs		
	Area (ft^2)	Width (ft)	Depth (ft)	Area (ft^2)	Width (ft)	Depth (ft)
Wilkerson and Parker	-	123.5	5.6	-	170.6	6.4
Soar and Thorne	-	121.4	-	-	156	-
Dunne & Leopold	518.4	105.3	5.1	518.4	105.3	5.1

4. TIDAL HYDRAULIC GEOMETRY ESTIMATES

The hydraulic geometry relationships from Williams et al (2002) provide expected channel dimensions once a site has developed into a mature marsh, based on the volume of water flowing in and out of the site. Because the sediment load in Ballona Creek is low and sedimentation would be slow or non-existent, tidal prism may not decrease significantly with time (due to marsh accretion), so the relationship

between tidal prism at existing grade and channel dimensions is used. This approach is consistent with the Design Guidelines for Tidal Wetland Restoration in San Francisco Bay (PWA 2004).

Because tidal channels vary in size along their length, the channel dimensions of Ballona Creek were evaluated upstream of the site, at the transition into the site, mid-meander, at the transition out of the site, downstream of the site and at the end of the jetties (Figure 4). Tidal prism at each of these points was calculated as the volume above the conceptual grade between -0.2 ft NAVD (MLLW) and 5.2 ft NAVD (MHHW). This calculation was done for both existing and project conditions. To calculate channel dimensions with sea level rise, the tidal prism was calculated between 4.7 ft NAVD and 10.1 ft NAVD (59 in of sea level rise). Table 3 shows the channel dimensions for each scenario while Figure 5 and Figure 6 illustrate two channel cross-sections.

Table 3. Ballona Creek Tidal Hydraulic Geometry Channel Dimensions

Dimension	Scenario	All	Downstream	Downstream Transition	Mid-meander	Upstream Transition	Upstream
Depth (ft below MHHW)	Existing Conditions	12.7	12.3	11.8	11.2	10.5	10.0
	Project Conditions	13.2	12.8	12.0	11.4	10.5	10.0
	SLR Project Conditions	16.9	16.7	15.6	15.0	12.8	11.7
Top Width (ft at MHHW)	Existing Conditions	199	182	164	143	121	106
	Project Conditions	220	205	170	149	122	106
	SLR Project Conditions	419	408	340	307	202	160
Area (ft^2 below MHHW)	Existing Conditions	1472	1295	1124	925	734	607
	Project Conditions	1695	1532	1180	977	738	607
	SLR Project Conditions	4192	4035	3131	2710	1505	1082

5. DISCUSSION AND RECOMMENDATIONS

The set of fluvial-based methods produces a range of estimated channel cross sections from approximately 103 feet wide, based on dominant discharge, to 105 – 170 feet wide based on empirical regression equations. Channel depths range from 5-6 feet. Bankfull discharge vary from 2,100 cfs to 4,650 cfs, with an associated recurrence interval ranging from approximately 0.5 to 1.0 years (Table 3). By comparison, a regional regression based on tidal processes produces a range of channel widths from 162 at the upstream limit of the new channel to 221 feet at the downstream transition, with depths varying from 11.7 to 13.2 feet below MHHW (Table 5). It should be noted that all the methods used have considerable natural variability and uncertainty associated with them, and that the apparent differences between tidal and fluvial dimensions are not necessarily significant without additional supporting evidence. In general, the results of the channel geometry suggest that tidal processes are more significant in shaping the channel than fluvial processes. The downstream transition out of the site can be considered tidally dominated since it is so close to the ocean and because the tidal equations produce a larger cross section. At the upstream transition into the site, the results are not as clear, since the tidal prism is smaller and large fluvial events (greater than the one-year flow) are expected to exert a strong local influence on hydraulics and sediment transport processes. The analyses suggest that the restored channel should have a bankfull width at the marsh plain elevation of approximately 220 feet at the downstream transition and 160-170 feet at the upstream transition. The existing flood control channel is approximately 200 feet wide at the equivalent elevation, so it will be feasible to transition between artificial and restored channels without a sharp change in geometry. The details of this transition and the resulting channel morphology should be based on hydraulic modeling to develop a relatively smooth transition between flood channel and restoration site.

Table 4. Estimates for bankfull channel dimensions and discharge on Ballona Creek

	Cross-sectional Area (ft^2)	Width (ft)	Depth (ft)	Q_{bf} (cfs)
Existing Conditions	4500 - 5000	350 - 400	10 - 15	2,900- 4,650
Proposed Conditions	518.4	105 - 171	5.1- 6.4	

Table 5. Estimates for tidal channel dimensions on Ballona Creek

	Cross-sectional Area (ft^2 below MHHW)	Width (ft at MHHW)	Depth (ft below MHHW)
Existing Conditions	600 – 1500	110 – 200	10 – 12.7
Proposed Conditions	600 – 1700	110 – 220	10 – 13.2
Sea Level Rise Conditions	1100 – 4200	160 – 420	11.7 – 16.9

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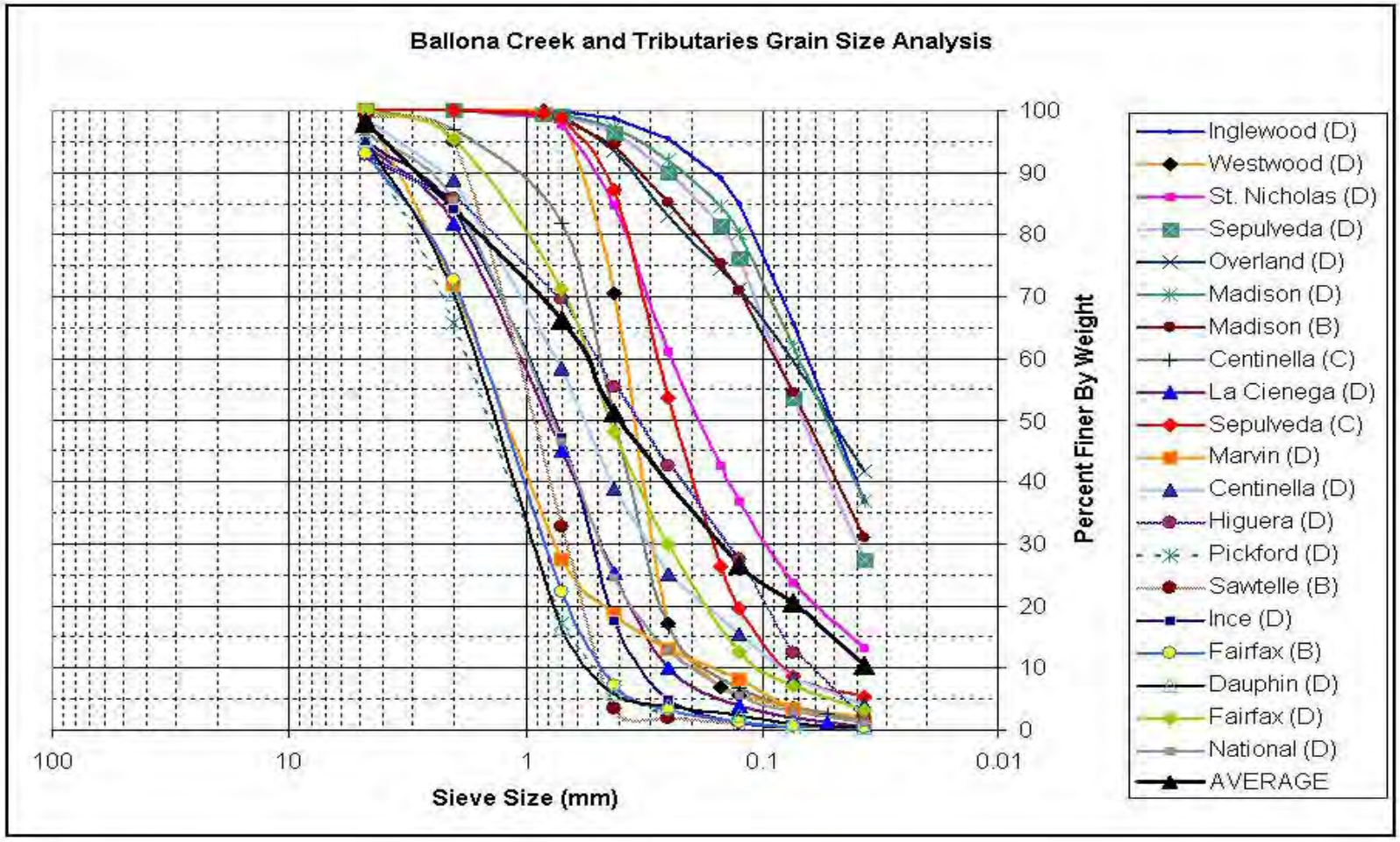

SOURCE: Reproduced from Figure 5 of USACE 2003

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Figure 1
Grain Size Distribution in
Ballona Creek and Its Tributaries

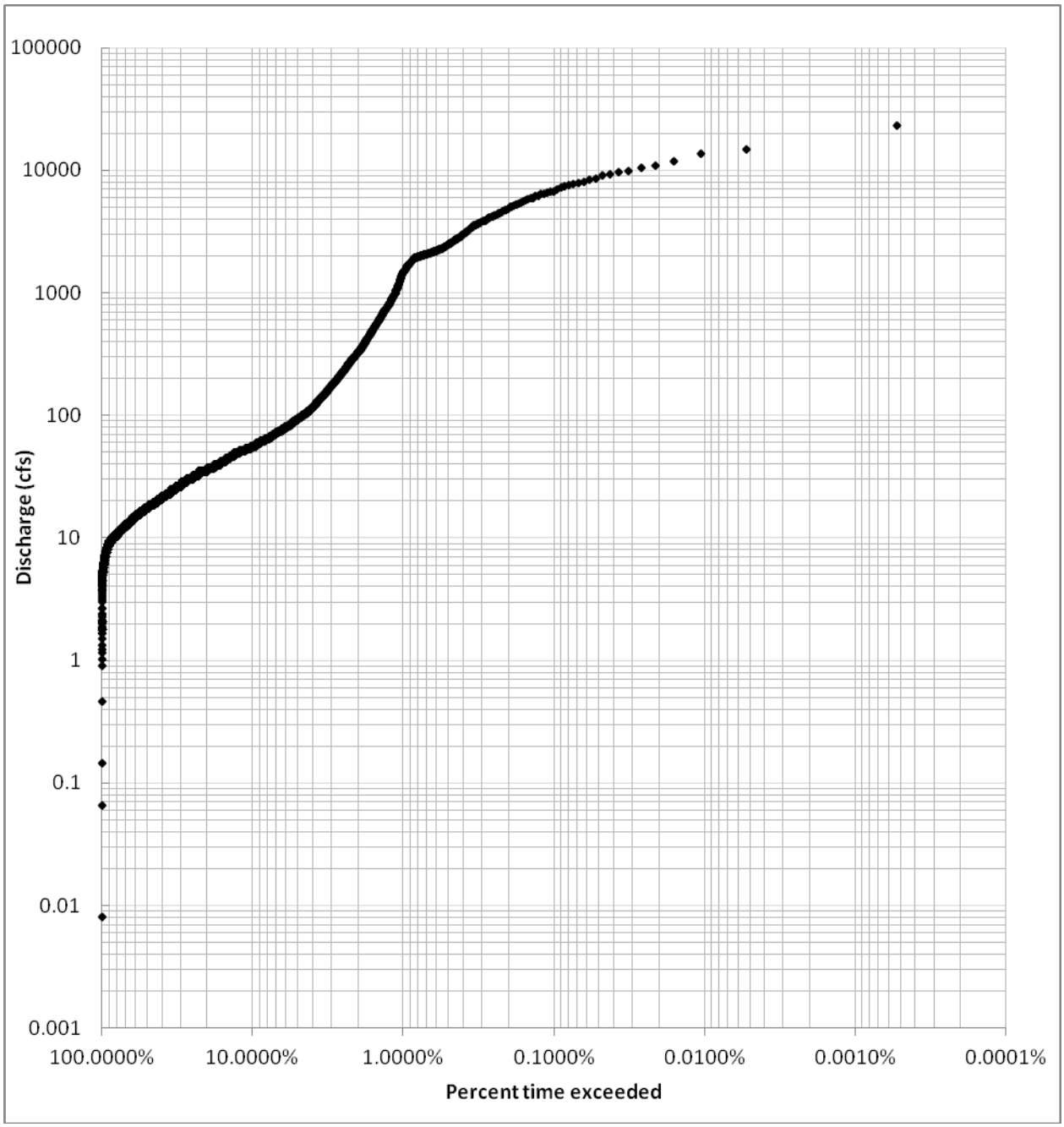

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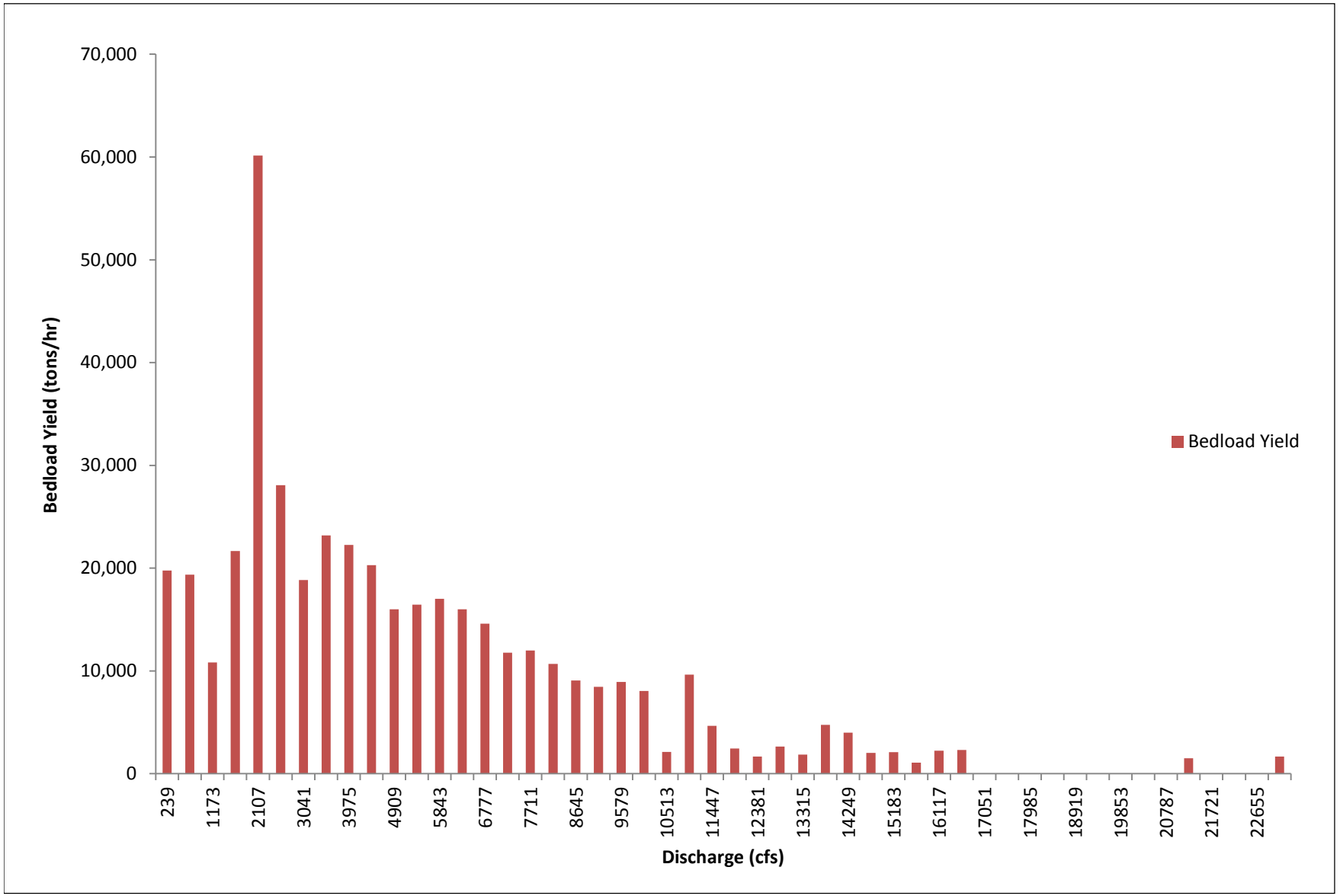
Figure 2
Flow Duration Curve for Sawtelle Blvd Gage F38-C on Ballona Creek



Note: Peak sediment transport at the Sawtelle Blvd gauge occurs at 2,100 cfs

Ballona Wetlands. 120367.00

Figure 3

Sediment Load Histogram for 50 Class Intervals



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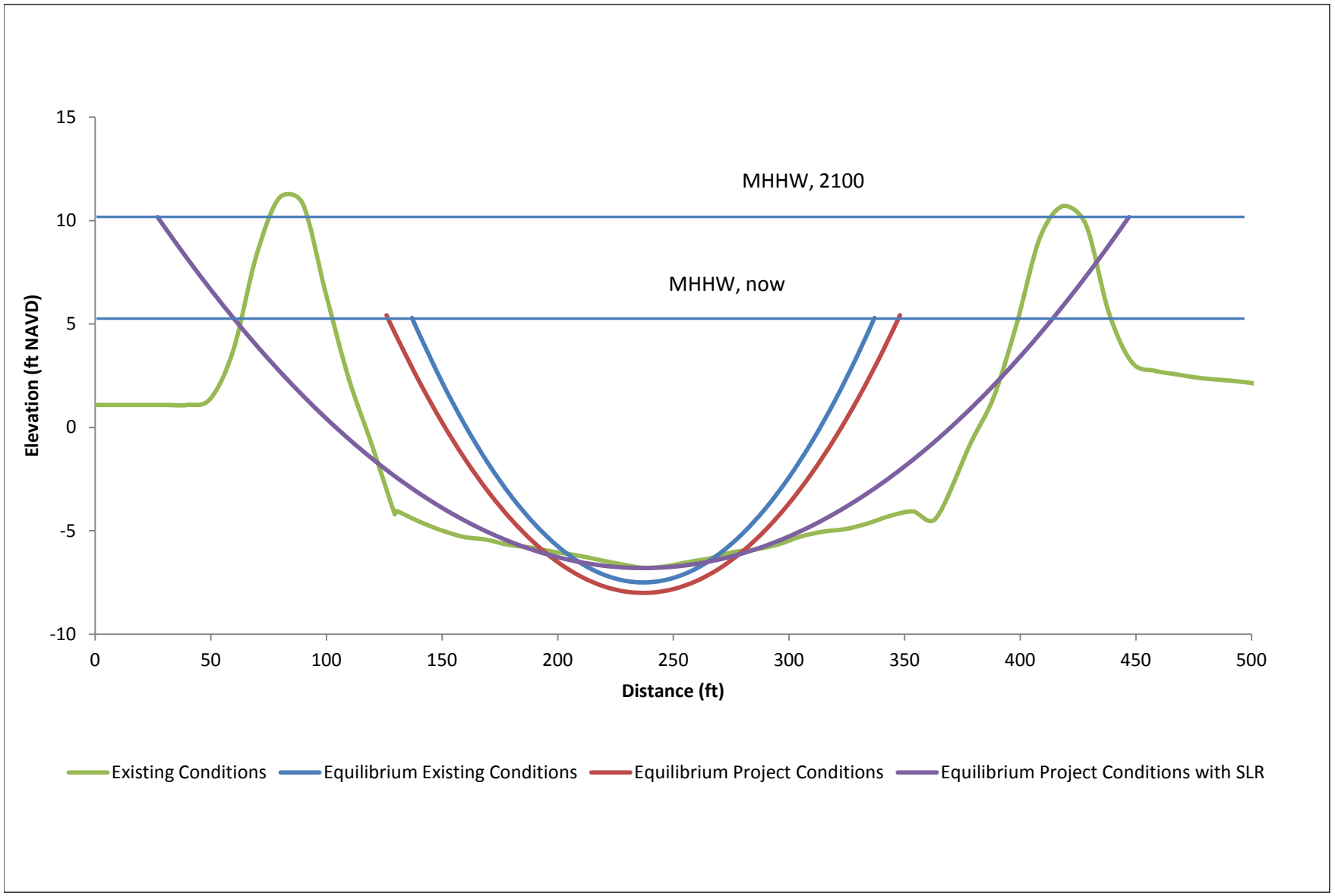
Figure 4
Tidak Hydraulic Geometry
Calculation Locations



SOURCE: ESA PWA (2012)

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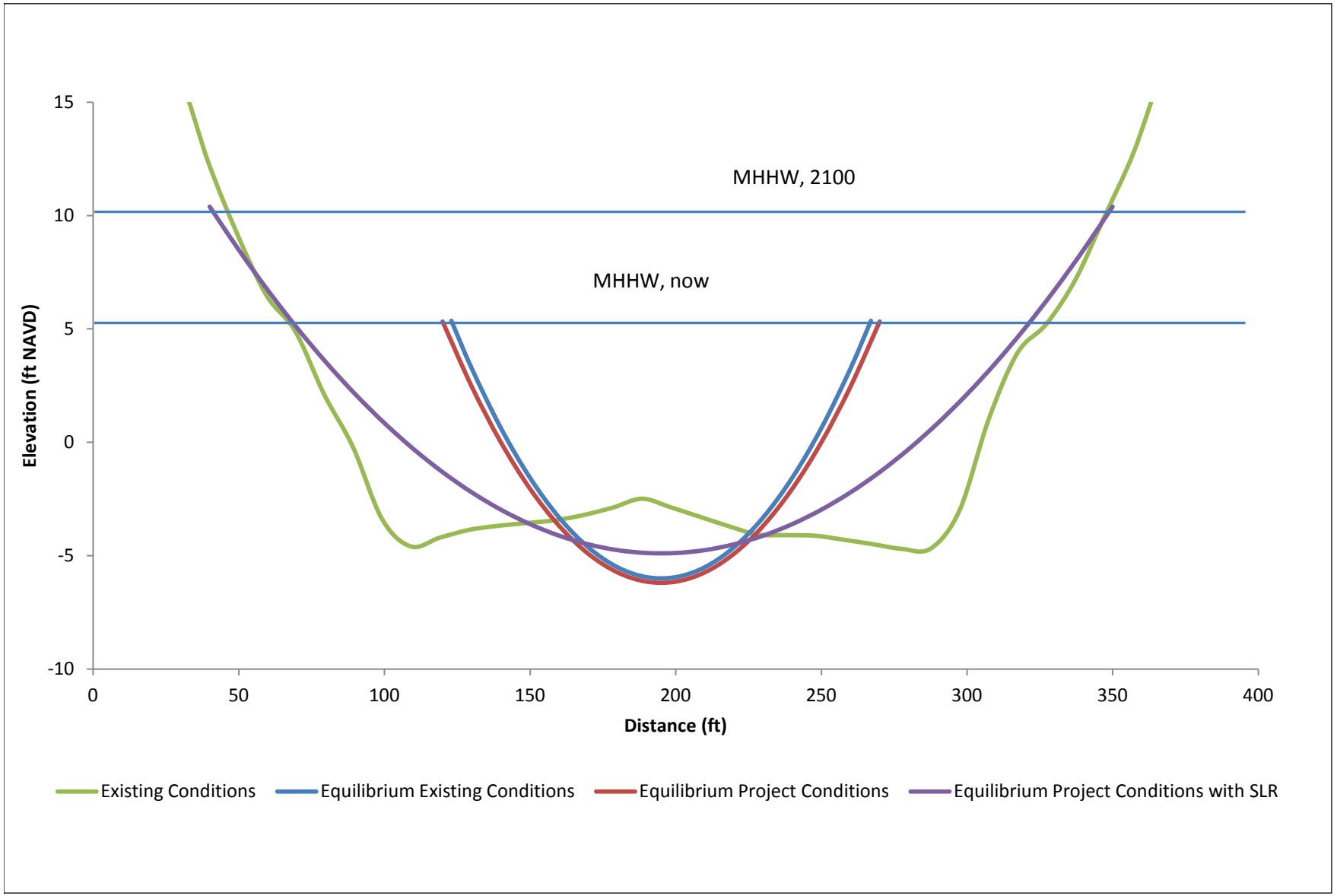
Figure 5

Ballona Creek Channel Cross Section
at the Downstream Shoal



SOURCE: ESA PWA (2012)

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Figure 6

Ballona Creek Channel Cross Section
Mid-Meander

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Appendix 4 Preliminary HEC-RAS Model Results

Ballona Wetlands Restoration Preliminary Hydrology and Hydraulics Report
February 1, 2013 Administrative Draft
ESA PWA

Appendix 4 - Preliminary HEC-RAS Model Results – Ballona Creek Submittal A (1/30/2013)

Existing conditions results:

Station		Thalweg (ft NAVD)	Q100 WSE (ft NAVD)			46,000 cfs design flow WSE (ft NAVD)	
Existing alignment	Project alignment		MHHW	MHHW + SLR	MHHW + SLR w/Aggraded bed	7.63 ft NAVD	7.63 ft + SLR w/Aggraded bed
1187	1187	-8.09	5.20	10.10	10.10	7.63	12.53
1345	1345	-8.03	6.45	10.41	10.56	8.26	12.45
1575	1575	-8.30	6.80	10.52	10.84	8.48	12.71
1856	1856	-9.50	6.96	10.58	10.92	8.58	12.71
2030	2030	-9.19	7.01	10.60	11.05	8.62	12.70
2193	2193	-9.89	7.13	10.65	11.17	8.71	12.78
2201	2201	-9.89	7.08	10.62	11.13	8.67	12.75
2245	2245	-9.45	6.90	10.55	11.05	8.54	12.69
2246	2246	-9.45	7.84	10.88	11.71	9.16	13.15
3016	3016	-7.90	8.77	11.25	12.40	9.82	13.67
3846	3846	-8.23	9.34	11.57	13.00	10.31	14.64
4657	4657	-7.58	10.01	11.94	13.63	10.88	14.83
5416	5415	-7.18	10.61	12.30	14.18	11.39	15.04
6204	6272	-6.17	11.05	12.59	14.62	11.79	15.43
6928	7024	-5.13	11.68	12.99	15.03	12.34	15.79
7777	8247	-4.66	12.40	13.48	15.48	12.98	16.19
8536	9072	-3.36	12.73	13.72	15.77	13.30	16.46
9224	9789	-2.31	13.68	14.42	16.18	14.18	16.85
9434	10002	-1.80	13.89	14.59	16.30	14.38	16.96
9495	10063	-1.80	13.86	14.56	16.28	14.35	16.93
9543	10111	-1.68	13.71	14.43	16.18	14.19	16.84
9639	10207	-1.68	14.80	15.31	16.75	15.25	17.38
9926	10495	-1.60	14.97	15.46	16.86	15.42	17.49

9947	10516	-1.60	14.95	15.44	16.84	15.39	17.47
10022	10591	-1.40	15.01	15.49	16.88	15.45	17.50
10037	10606	-1.40	15.51	15.94	17.20	15.95	17.82
10425	10993	-1.61	15.64	16.05	17.28	16.08	17.89
11028	11597	-1.42	16.04	16.40	17.54	16.47	18.13
11613	12182	-0.75	16.40	16.73	17.78	16.81	18.36
12121	12689	-0.35	16.70	17.00	17.99	17.11	18.56
12520	13088	-0.58	17.02	17.30	18.23	17.43	18.79
12520	13088	-0.58	17.02	17.30	18.23	17.43	18.79
12902	13470	-0.28	17.02	17.30	18.22	17.12	18.54
13093	13661	-0.02	17.11	17.38	18.28	17.23	18.62
13270	13838	-0.02	17.23	17.49	18.37	17.38	18.72
13372	13940	0.76	17.01	17.28	18.19	17.09	18.50
13602	14170	0.76	18.50	18.66	19.27	19.19	19.90
14390	14959	0.39	18.86	19.01	19.57	19.59	20.23
15122	15691	0.52	18.89	19.03	19.56	19.58	20.20
15859	16428	0.00	19.42	19.54	20.00	20.18	20.70
16110	16680	-1.00	19.54	19.65	20.10	20.31	20.80
16484	17053	-1.00	18.64	18.80	19.38	19.31	19.90
16534	17103	2.54	19.31	19.31	19.31	20.35	20.35
16572	17141	2.54	19.76	19.76	19.76	20.81	20.81
16662	17231	2.95	21.08	21.08	21.08	21.08	21.08
16672	17241	2.95	24.21	24.21	24.21	25.96	25.96
17237	17806	3.74	24.39	24.39	24.39	26.10	26.10
17781	18350	4.80	24.61	24.61	24.61	26.26	26.26
18195	18764	5.64	24.90	24.90	24.90	26.51	26.51
18201	18771	5.64	24.38	24.38	24.38	25.26	25.26
18276	18846	5.87	24.70	24.70	24.70	32.02	32.02
18281	18851	5.87	28.45	28.45	28.45	38.03	38.03

18902	19471	6.76	28.60	28.60	28.60	38.08	38.08
19467	20036	8.09	28.59	28.59	28.59	38.12	38.12
19467	20036	8.09	28.59	28.59	28.59	38.12	38.12
19762	20332	8.66	30.49	30.49	30.49	37.98	37.98
20304	20874	9.74	30.52	30.52	30.52	38.03	38.03
20951	21521	11.00	31.17	31.17	31.17	38.25	38.25
20951	21521	11.00	31.07	31.07	31.07	37.58	37.58
21116	21686	11.23	30.83	30.83	30.83	37.69	37.69
21117	21687	11.23	33.37	33.37	33.37	41.16	41.16
21688	22259	12.54	33.80	33.80	33.80	41.27	41.27
21974	22544	13.00	33.79	33.79	33.79	41.15	41.15
21975	22545	13.00	33.71	33.71	33.71	39.90	39.90
22041	22611	13.00	33.46	33.46	33.46	39.78	39.78
22051	22621	13.00	34.99	34.99	34.99	44.86	44.86
22501	23071	14.06	35.34	35.34	35.34	45.19	45.19

Existing Conditions						Freeboard (ft)									
						Q100						46,000 cfs			
Coverage (relative to full project)		Station		Levee El. (ft NAVD)		MHHW		MHHW + SLR		MHHW + SLR wAggraded Bed		7.63 ft		7.63+ SLR wAggraded bed	
Left	Right	EC	PC	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
DS of West Area B	Marina	1187	1187	10.7	11.3	5.5	6.1	0.6	1.2	0.6	1.2	3.1	3.6	-1.8	-1.3
		1345	1345	10.5	12.3	4.1	5.8	0.1	1.9	0.0	1.7	2.2	4.0	-1.9	-0.2
		1575	1575	10.6	11.9	3.7	5.1	0.0	1.4	-0.3	1.1	2.1	3.5	-2.2	-0.8
		1856	1856	11.5	11.8	4.5	4.8	0.9	1.2	0.6	0.9	2.9	3.2	-1.2	-0.9
		2030	2030	15.3	14.7	8.2	7.7	4.6	4.1	4.2	3.7	6.6	6.1	2.5	2.0
		2193	2193	15.3	16.9	8.2	9.8	4.7	6.3	4.2	5.8	6.6	8.2	2.6	4.2
		2201	2201	15.4	16.9	8.3	9.8	4.8	6.3	4.3	5.8	6.8	8.3	2.7	4.2
		2245	2245	15.9	16.9	9.0	10.0	5.3	6.3	4.8	5.8	7.3	8.3	3.2	4.2
		2246	2246	15.9	16.9	8.0	9.0	5.0	6.0	4.2	5.2	6.7	7.7	2.7	3.7
		3016	3016	12.9	16.0	4.1	7.2	1.7	4.8	0.5	3.6	3.1	6.2	-0.8	2.3
West Area B		3846	3846	13.9	14.4	4.5	5.1	2.3	2.9	0.9	1.4	3.6	4.1	-0.8	-0.2
		4657	4657	14.4	15.2	4.4	5.2	2.4	3.2	0.7	1.5	3.5	4.3	-0.5	0.3
		5416	5415	15.2	17.8	4.6	7.2	2.9	5.5	1.1	3.6	3.8	6.4	0.2	2.8
North Area B	Area A	6204	6272	17.1	16.8	6.1	5.8	4.6	4.2	2.5	2.2	5.4	5.0	1.7	1.4
		6928	7024	18.8	17.8	7.1	6.1	5.8	4.8	3.8	2.8	6.5	5.5	3.0	2.0
		7777	8247	19.1	18.6	6.7	6.2	5.6	5.1	3.6	3.1	6.1	5.6	2.9	2.4
		8536	9072	19.7	19.6	6.9	6.8	5.9	5.8	3.9	3.8	6.4	6.3	3.2	3.1
		9224	9789	20.2	19.9	6.5	6.3	5.8	5.5	4.0	3.7	6.0	5.8	3.4	3.1
		9434	10002	21.1	20.2	7.2	6.3	6.5	5.6	4.8	3.9	6.7	5.8	4.1	3.2
		9495	10063	20.9	20.3	7.0	6.4	6.3	5.7	4.6	4.0	6.5	5.9	3.9	3.3
Upstream of Project		9543	10111	20.7	20.3	7.0	6.6	6.3	5.9	4.6	4.1	6.5	6.1	3.9	3.5
		9639	10207	20.5	20.5	5.7	5.7	5.1	5.1	3.7	3.7	5.2	5.2	3.1	3.1
		9926	10495	22.2	20.9	7.3	5.9	6.8	5.4	5.4	4.0	6.8	5.5	4.7	3.4

	9947	10516	22.4	20.7	7.4	5.8	6.9	5.3	5.5	3.9	7.0	5.3	4.9	3.3
	10022	10591	22.9	20.1	7.9	5.1	7.4	4.6	6.0	3.3	7.5	4.7	5.4	2.6
	10037	10606	23.0	20.0	7.5	4.5	7.1	4.1	5.8	2.8	7.1	4.1	5.2	2.2
	10425	10993	20.2	20.9	4.5	5.2	4.1	4.8	2.9	3.6	4.1	4.8	2.3	3.0
	11028	11597	21.1	21.1	5.0	5.1	4.7	4.7	3.6	3.6	4.6	4.7	3.0	3.0
	11613	12182	21.9	22.2	5.5	5.8	5.2	5.5	4.1	4.4	5.1	5.4	3.5	3.8
	12121	12689	22.5	23.7	5.9	7.0	5.5	6.7	4.6	5.7	5.4	6.6	4.0	5.1
	12520	13088	23.6	23.9	6.6	6.9	6.3	6.6	5.4	5.7	6.2	6.5	4.8	5.1
Upstream of Project	12520	13088	23.6	23.9	6.6	6.9	6.3	6.6	5.4	5.7	6.2	6.5	4.8	5.1
	12902	13470	23.6	23.2	6.6	6.2	6.3	5.9	5.4	5.0	6.5	6.1	5.1	4.7
	13093	13661	26.0	25.4	8.9	8.3	8.6	8.0	7.7	7.1	8.7	8.1	7.3	6.7
	13270	13838	25.4	25.0	8.2	7.8	7.9	7.5	7.0	6.7	8.0	7.7	6.7	6.3
	13372	13940	25.1	24.8	8.1	7.8	7.8	7.6	6.9	6.7	8.0	7.8	6.6	6.3
	13602	14170	24.4	24.4	5.9	5.9	5.7	5.8	5.1	5.1	5.2	5.2	4.5	4.5
	14390	14959	24.4	24.6	5.6	5.7	5.4	5.6	4.9	5.0	4.9	5.0	4.2	4.4
	15122	15691	25.5	25.5	6.7	6.6	6.5	6.5	6.0	5.9	6.0	5.9	5.3	5.3
	15859	16428	26.3	26.0	6.9	6.5	6.7	6.4	6.3	6.0	6.1	5.8	5.6	5.3
	16110	16680	26.5	25.6	6.9	6.1	6.8	6.0	6.4	5.5	6.2	5.3	5.7	4.8
	16484	17053	26.2	27.7	7.5	9.1	7.4	8.9	6.8	8.3	6.9	8.4	6.3	7.8
	16534	17103	27.5	28.0	8.2	8.7	8.2	8.7	8.2	8.7	7.1	7.6	7.1	7.6

Interim project conditions results:

Station	Thalweg (ft NAVD)	Q100 WSE (ft NAVD)		46,000 cfs design flow WSE (ft NAVD)
Project alignment		MHHW	MHHW + SLR	7.63 ft NAVD
1187	-8.09	5.20	10.10	7.63
1345	-8.03	6.45	10.41	8.26
1575	-8.30	6.80	10.52	8.48
1856	-9.50	6.96	10.58	8.58
2030	-9.19	7.01	10.60	8.62
2193	-9.89	7.13	10.65	8.71
2201	-9.89	7.08	10.62	8.67
2245	-9.45	6.90	10.55	8.54
2246	-9.45	7.84	10.88	9.16
3055	-8.06	8.72	11.24	9.80
3152	-7.99	8.80	11.29	9.87
3438	-7.89	8.93	11.36	9.97
3676	-7.79	9.29	11.54	10.27
3812	-7.90	9.33	11.56	10.30
4044	-7.94	9.68	11.75	10.59
4403	-7.83	9.92	11.89	10.79
4634	-7.51	10.02	11.95	10.88
5081	-6.66	10.14	12.12	11.05
5329	-7.03	10.32	12.18	11.16
5576	-6.75	10.43	12.27	11.28
5707	-6.62	10.29	12.18	11.15
5853	-6.47	11.93	13.11	12.53
6077	-6.26	12.03	13.18	12.62
6293	-6.04	12.74	13.74	13.31

6506	-5.79	12.68	13.67	13.24
6805	-5.49	12.85	13.80	13.40
6946	-5.36	13.31	14.18	13.85
7180	-5.17	13.82	14.60	14.34
7482	-4.96	13.85	14.63	14.37
7650	-4.85	13.90	14.67	14.42
7924	-4.61	13.95	14.70	14.46
8111	-4.40	13.89	14.65	14.40
8249	-4.24	13.89	14.65	14.39
8369	-4.11	13.95	14.69	14.45
8488	-3.99	13.99	14.72	14.48
8740	-3.75	13.97	14.70	14.46
8915	-3.61	13.97	14.70	14.46
9123	-3.42	13.98	14.70	14.46
9378	-3.15	13.97	14.68	14.45
9669	-2.81	13.77	14.49	14.23
9822	-2.64	13.70	14.43	14.16
9931	-2.52	13.86	14.56	14.32
9976	-2.48	14.03	14.70	14.49
10019	-2.43	13.91	14.60	14.37
10063	-2.43	13.88	14.57	14.33
10111	-2.21	13.74	14.44	14.19
10207	-2.21	14.52	15.09	14.96
10495	-1.60	14.53	15.10	14.97
10516	-1.60	14.50	15.07	14.94
10591	-1.40	14.57	15.13	15.01
10606	-1.40	15.14	15.62	15.58
10993	-1.61	15.28	15.74	15.71
11597	-1.42	15.73	16.13	16.15
12182	-0.75	16.12	16.48	16.53

12690	-0.35	16.44	16.77	16.84
13088	-0.58	16.79	17.09	17.19
13088	-0.58	16.79	17.09	17.19
13470	-0.28	16.79	17.09	16.86
13661	-0.02	16.89	17.18	16.99
13838	-0.02	17.01	17.29	17.15
13940	0.76	16.79	17.08	16.85
14170	0.76	18.38	18.54	19.11
14959	0.39	18.75	18.90	19.52
15691	0.52	18.78	18.92	19.52
16428	0.00	19.34	19.45	20.13
16679	-1.00	19.46	19.57	20.26
17052	-1.00	18.52	18.68	19.31
17102	2.54	19.31	19.31	20.35
17141	2.54	19.76	19.76	20.81
17231	2.95	21.08	21.08	21.08
17241	2.95	24.21	24.21	25.96
17806	3.74	24.39	24.39	26.10
18349	4.80	24.61	24.61	26.26
18764	5.64	24.90	24.90	26.51
18770	5.64	24.38	24.38	25.26
18845	5.87	24.70	24.70	32.02
18850	5.87	28.45	28.45	38.03
19471	6.76	28.60	28.60	38.08
20036	8.09	28.59	28.59	38.12
	0.00	0.00	0.00	0.00
20036	8.09	28.59	28.59	38.12
20331	8.66	30.49	30.49	37.98
20873	9.74	30.52	30.52	38.03

21519	11.00	31.17	31.17	38.25
21520	11.00	31.07	31.07	37.58
21685	11.23	30.83	30.83	37.69
21686	11.23	33.37	33.37	41.16
22257	12.54	33.80	33.80	41.27
22543	13.00	33.79	33.79	41.15
22543	13.00	33.71	33.71	39.90
22609	13.00	33.46	33.46	39.78
22619	13.00	34.99	34.99	44.86
23070	14.06	35.34	35.34	45.19

Interim Project conditions					Freeboard (ft)					
					Q100 WSE (ft NAVD)				46,000 cfs WSE (ft NAVD)	
Coverage (relative to full project)		Station	Levee El. (ft NAVD)		MHHW		MHHW + SLR		7.63 ft	
Left	Right	PC	Left	Right	Left	Right	Left	Right	Left	Right
DS of West Area B	Marina	1187	10.7	11.3	5.5	6.1	0.6	1.2	3.1	3.6
		1345	10.5	12.3	4.1	5.8	0.1	1.9	2.2	4.0
		1575	10.6	11.9	3.7	5.1	0.0	1.4	2.1	3.5
		1856	11.5	11.8	4.5	4.8	0.9	1.2	2.9	3.2
		2030	15.3	14.7	8.2	7.7	4.6	4.1	6.6	6.1
		2193	15.3	16.9	8.2	9.8	4.7	6.3	6.6	8.2
		2201	15.8	17.1	8.7	10.0	5.2	6.5	7.1	8.5
		2245	15.9	16.9	9.0	10.0	5.3	6.3	7.4	8.4
		2246	15.9	16.9	8.0	9.0	5.0	6.0	6.7	7.7
		3055	14.0	15.9	5.3	7.2	2.7	4.7	4.2	6.1
		3152	13.3	15.2	4.5	6.4	2.0	3.9	3.4	5.4
West Area B		3438	13.8	15.6	4.9	6.7	2.4	4.2	3.8	5.6
		3676	14.8	15.5	5.5	6.2	3.3	3.9	4.5	5.2
		3812	14.0	15.4	4.6	6.0	2.4	3.8	3.7	5.1
		4044	13.9	15.5	4.2	5.8	2.1	3.7	3.3	4.9
		4403	14.6	14.7	4.7	4.8	2.7	2.8	3.8	3.9
		4634	18.5	15.5	8.4	5.5	6.5	3.6	7.6	4.6
		5081	20.5	17.6	10.4	7.5	8.4	5.5	9.5	6.6
		5329	20.5	17.6	10.2	7.3	8.3	5.5	9.3	6.5
		5576	20.5	17.5	10.1	7.1	8.2	5.2	9.2	6.2
		5707	20.5	20.0	10.2	9.7	8.3	7.8	9.3	8.8
		5853	20.5	20.4	8.6	8.4	7.4	7.3	8.0	7.8
North Area B	Area A	6077	20.5	20.0	8.5	8.0	7.3	6.8	7.9	7.4
		6293	20.0	20.0	7.3	7.3	6.3	6.3	6.7	6.7

		6506	20.0	20.0	7.3	7.3	6.3	6.3	6.8	6.8
		6805	20.0	20.0	7.1	7.1	6.2	6.2	6.6	6.6
		6946	20.5	20.6	7.2	7.3	6.3	6.4	6.7	6.8
		7180	20.5	20.6	6.7	6.8	5.9	6.0	6.2	6.3
		7482	20.5	20.6	6.6	6.7	5.9	6.0	6.1	6.2
		7650	20.5	20.6	6.6	6.7	5.8	5.9	6.1	6.2
		7924	20.5	20.6	6.6	6.7	5.8	5.9	6.0	6.1
		8111	20.5	23.0	6.6	9.1	5.8	8.3	6.1	8.6
		8249	20.5	20.0	6.6	6.1	5.9	5.4	6.1	5.6
		8369	20.5	20.0	6.6	6.1	5.8	5.3	6.0	5.5
		8488	20.5	20.3	6.5	6.3	5.8	5.5	6.0	5.8
		8740	20.5	20.6	6.5	6.6	5.8	5.9	6.0	6.1
		8915	20.5	20.6	6.5	6.6	5.8	5.9	6.0	6.1
		9123	20.5	20.6	6.5	6.6	5.8	5.9	6.0	6.1
		9378	20.5	20.6	6.5	6.6	5.8	5.9	6.1	6.2
		9669	20.7	20.6	7.0	6.8	6.2	6.1	6.5	6.4
		9822	20.5	20.6	6.8	6.9	6.1	6.2	6.3	6.4
		9931	20.5	20.0	6.6	6.1	5.9	5.4	6.2	5.7
		9976	20.5	20.6	6.4	6.6	5.8	5.9	6.0	6.1
		10019	21.1	21.1	7.2	7.2	6.5	6.5	6.7	6.7
Upstream of Project Site		10063	21.1	21.0	7.2	7.1	6.5	6.4	6.7	6.6
		10111	21.0	21.0	7.3	7.3	6.6	6.6	6.8	6.8
		10207	21.0	30.1	6.5	15.6	5.9	15.1	6.0	15.2
		10495	22.2	20.9	7.7	6.4	7.1	5.8	7.3	5.9
		10516	20.6	20.7	6.1	6.2	5.5	5.6	5.7	5.8
		10591	20.6	20.1	6.0	5.5	5.5	5.0	5.6	5.1
		10606	23.0	20.0	7.9	4.8	7.4	4.3	7.5	4.4
		10993	20.2	20.9	4.9	5.6	4.4	5.1	4.5	5.1
		11597	21.1	21.1	5.4	5.4	5.0	5.0	4.9	5.0
		12182	21.9	22.2	5.8	6.1	5.4	5.7	5.4	5.7

	12690	22.5	23.7	6.1	7.2	5.8	6.9	5.7	6.8
	13088	23.6	23.9	6.8	7.2	6.5	6.9	6.4	6.8
Upstream of Project Site	13088	23.6	23.9	6.8	7.2	6.5	6.9	6.4	6.8
	13470	23.6	23.2	6.8	6.4	6.5	6.1	6.8	6.3
	13661	26.0	25.6	9.1	8.7	8.8	8.4	9.0	8.6
	13838	25.4	25.2	8.4	8.2	8.1	7.9	8.3	8.0
	13940	25.1	24.9	8.3	8.2	8.1	7.9	8.3	8.1
	14170	24.5	24.4	6.1	6.0	5.9	5.9	5.3	5.3
	14959	24.4	24.6	5.7	5.8	5.5	5.7	4.9	5.1
	15691	25.5	25.5	6.8	6.7	6.6	6.6	6.0	6.0
	16428	26.3	26.0	7.0	6.6	6.8	6.5	6.2	5.8
	16679	26.5	25.6	7.0	6.2	6.9	6.0	6.2	5.4
	17052	26.2	27.7	7.6	9.2	7.5	9.0	6.9	8.4
	17102	27.5	28.0	8.2	8.7	8.2	8.7	7.1	7.6

Full project conditions results:

Station	Thalweg (ft NAVD)	Q100 WSE (ft NAVD)			46,000 cfs design flow WSE (ft NAVD)	
Project alignment		MHHW	MHHW + SLR	MHHW + SLR w/Aggraded bed	7.63 ft NAVD	7.63 ft + SLR w/Aggraded bed
1187	-8.09	5.20	10.10	10.10	7.63	12.53
1345	-8.03	6.45	10.56	10.41	8.26	12.45
1575	-8.30	6.80	10.85	10.52	8.48	12.71
1856	-9.50	6.96	10.92	10.58	8.58	12.71
2030	-9.19	7.01	11.06	10.60	8.62	12.70
2193	-9.89	7.13	11.17	10.65	8.71	12.78
2201	-9.89	7.08	11.13	10.62	8.67	12.75
2245	-9.45	6.90	11.05	10.55	8.54	12.69
2246	-9.45	7.84	11.71	10.88	9.16	13.15
3055	-8.06	8.72	12.38	11.24	9.80	13.63
3152	-7.99	8.80	12.47	11.29	9.87	13.71
3438	-7.89	8.82	12.53	11.27	9.87	13.74
3632	-8.09	9.75	13.63	11.93	10.75	14.72
3701	-7.73	10.21	14.10	12.28	11.19	15.14
3812	-7.90	10.38	14.22	12.39	11.34	15.26
4044	-7.94	10.59	14.37	12.53	11.52	15.38
4403	-7.83	10.84	14.52	12.68	11.74	15.51
4658	-7.67	10.90	14.56	12.72	11.79	15.55
4863	-7.00	10.57	14.41	12.51	11.47	15.43
5305	-7.05	10.63	14.35	12.43	11.36	15.38
5546	-6.78	10.76	14.46	12.58	11.65	15.45
5707	-6.62	10.78	14.46	12.57	11.65	15.45
5853	-6.47	10.94	14.58	12.70	11.85	15.55
6079	-6.26	11.04	14.65	12.80	12.03	15.60
6293	-6.04	11.95	15.03	13.31	12.75	15.91

6506	-5.79	11.90	14.95	13.24	12.68	15.83
6805	-5.49	12.13	15.08	13.39	12.87	15.94
6946	-5.36	12.65	15.46	13.80	13.37	16.30
7180	-5.17	13.25	15.82	14.26	13.91	16.62
7482	-4.96	13.30	15.84	14.29	13.95	16.64
7650	-4.85	13.36	15.87	14.33	14.00	16.67
7924	-4.61	13.41	15.89	14.37	14.05	16.69
8111	-4.40	13.34	15.86	14.32	13.99	16.66
8249	-4.24	13.34	15.85	14.31	13.98	16.64
8369	-4.11	13.43	15.88	14.36	14.05	16.67
8488	-3.99	13.48	15.90	14.40	14.09	16.68
8740	-3.75	13.46	15.87	14.37	14.07	16.66
8915	-3.61	13.47	15.87	14.37	14.07	16.65
9123	-3.42	13.48	15.87	14.38	14.08	16.65
9378	-3.15	13.48	15.85	14.37	14.07	16.63
9669	-2.81	13.27	15.67	14.17	13.85	16.44
9822	-2.64	13.21	15.60	14.10	13.78	16.36
9931	-2.52	13.38	15.65	14.24	13.95	16.42
9976	-2.48	13.57	15.85	14.40	14.13	16.61
10019	-2.43	13.37	15.68	14.22	13.93	16.45
10063	-2.43	13.33	15.66	14.19	13.89	16.42
10111	-2.21	13.19	15.54	14.06	13.74	16.30
10207	-2.21	14.09	16.09	14.77	14.61	16.82
10495	-1.60	14.10	16.14	14.78	14.62	16.86
10516	-1.60	14.07	16.11	14.75	14.58	16.84
10591	-1.40	14.15	16.16	14.82	14.66	16.88
10606	-1.40	14.79	16.54	15.35	15.28	17.24
10993	-1.61	14.95	16.64	15.48	15.43	17.33
11597	-1.42	15.45	16.94	15.91	15.91	17.60
12182	-0.75	15.88	17.22	16.27	16.32	17.86

12690	-0.35	16.23	17.46	16.58	16.65	18.09
13088	-0.58	16.59	17.73	16.92	17.02	18.34
13088	-0.58	16.59	17.73	16.92	17.02	18.34
13470	-0.28	16.60	17.72	16.92	16.68	18.07
13661	-0.02	16.70	17.79	17.01	16.82	18.16
13838	-0.02	16.83	17.89	17.13	16.98	18.28
13940	0.76	16.60	17.70	16.91	16.67	18.04
14170	0.76	18.28	18.93	18.44	19.07	19.63
14959	0.39	18.67	19.25	18.81	19.48	19.98
15691	0.52	18.70	19.26	18.84	19.48	19.96
16428	0.00	19.27	19.74	19.39	20.10	20.50
16679	-1.00	19.40	19.84	19.51	20.23	20.60
17052	-1.00	18.43	19.05	18.59	19.31	19.63
17102	2.54	19.31	19.31	19.31	20.35	20.35
17141	2.54	19.76	19.76	19.76	20.81	20.81
17231	2.95	21.08	21.08	21.08	21.08	21.08
17241	2.95	24.21	24.21	24.21	25.96	25.96
17806	3.74	24.39	24.39	24.39	26.10	26.10
18349	4.80	24.61	24.61	24.61	26.26	26.26
18764	5.64	24.90	24.90	24.90	26.51	26.51
18770	5.64	24.38	24.38	24.38	25.26	25.26
18845	5.87	24.70	24.70	24.70	32.02	32.02
18850	5.87	28.45	28.45	28.45	38.03	38.03
19471	6.76	28.60	28.60	28.60	38.08	38.08
20036	8.09	28.59	28.59	28.59	38.12	38.12
20036	8.09	28.59	28.59	28.59	38.12	38.12
20331	8.66	30.49	30.49	30.49	37.98	37.98
20873	9.74	30.52	30.52	30.52	38.03	38.03

21519	11.00	31.17	31.17	31.17	38.25	38.25
21520	11.00	31.07	31.07	31.07	37.58	37.58
21685	11.23	30.83	30.83	30.83	37.69	37.69
21686	11.23	33.37	33.37	33.37	41.16	41.16
22257	12.54	33.80	33.80	33.80	41.27	41.27
22543	13.00	33.79	33.79	33.79	41.15	41.15
22543	13.00	33.71	33.71	33.71	39.90	39.90
22609	13.00	33.46	33.46	33.46	39.78	39.78
22619	13.00	34.99	34.99	34.99	44.86	44.86
23070	14.06	35.34	35.34	35.34	45.19	45.19

Full project conditions					Freeboard (ft)									
					Q100						46,000 cfs			
Coverage		Station	Levee El. (ft NAVD)		MHHW		MHHW + SLR		MHHW + SLR w/Aggraded Bed		7.63 ft		7.63+ SLR w/Aggraded bed	
Left	Right	PC	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
DS of West Area B	Marina	1187	10.7	11.3	5.5	6.1	0.6	1.2	0.6	1.2	3.1	3.6	-1.8	-1.3
		1345	10.5	12.3	4.1	5.8	0.1	1.9	0.0	1.6	2.2	4.0	-1.9	-0.2
		1575	10.6	11.9	3.7	5.1	0.0	1.4	-0.3	1.0	2.1	3.5	-2.2	-0.8
		1856	11.5	11.8	4.5	4.8	0.9	1.2	0.6	0.7	2.9	3.2	-1.2	-0.9
		2030	15.3	14.7	8.2	7.7	4.6	4.1	4.2	3.5	6.6	6.1	2.5	2.0
		2193	15.3	16.9	8.2	9.8	4.7	6.3	4.2	5.6	6.6	8.2	2.6	4.2
		2201	15.8	17.1	8.7	10.0	5.2	6.5	4.6	5.8	7.1	8.5	3.0	4.4
		2245	15.9	16.9	9.0	10.0	5.3	6.3	4.8	5.7	7.3	8.3	3.2	4.2
		2246	15.9	16.9	8.0	9.0	5.0	6.0	4.2	4.9	6.7	7.7	2.7	3.7
		3055	14.0	15.9	5.3	7.2	2.7	4.7	1.6	3.2	4.2	6.1	0.3	2.3
		3152	13.3	15.2	4.5	6.4	2.0	3.9	0.8	2.4	3.4	5.4	-0.4	1.5
West Area B		3438	20.5	15.6	11.7	6.8	9.2	4.3	7.9	2.7	10.6	5.7	6.7	1.8
		3632	20.5	15.9	10.8	6.2	8.6	4.0	6.9	1.8	9.8	5.2	5.8	1.2
		3701	20.5	15.1	10.3	4.9	8.2	2.8	6.4	0.5	9.3	3.9	5.4	0.0
		3812	20.5	15.3	10.1	4.9	8.1	2.9	6.3	0.6	9.2	3.9	5.2	0.0
		4044	20.5	15.5	9.9	4.9	8.0	2.9	6.1	0.6	9.0	3.9	5.1	0.1
		4403	20.5	14.8	9.7	3.9	7.8	2.1	6.0	-0.2	8.8	3.0	5.0	-0.8
		4658	20.5	15.5	9.6	4.6	7.8	2.8	5.9	0.4	8.7	3.7	4.9	-0.1
		4863	20.5	16.2	9.9	5.7	8.0	3.7	6.1	1.3	9.0	4.8	5.1	0.8
		5305	20.5	17.7	9.9	7.1	8.1	5.3	6.1	2.9	9.1	6.4	5.1	2.4
		5546	20.5	18.5	9.7	7.7	7.9	5.9	6.0	3.5	8.9	6.8	5.1	3.0
		5707	20.5	17.0	9.7	6.2	7.9	4.4	6.0	2.0	8.8	5.3	5.1	1.5
		5853	20.5	20.5	9.6	9.6	7.8	7.8	5.9	5.5	8.7	8.7	5.0	5.0
North	Area A	6079	20.5	20.0	9.5	9.0	7.7	7.2	5.9	4.9	8.5	8.0	4.9	4.4

Area B		6293	20.0	20.0	8.0	8.0	6.7	6.7	5.0	4.5	7.3	7.3	4.1	4.1
		6506	20.0	20.0	8.1	8.1	6.8	6.8	5.0	4.6	7.3	7.3	4.2	4.2
		6805	20.0	20.0	7.9	7.9	6.6	6.6	4.9	4.5	7.1	7.1	4.1	4.1
		6946	20.5	20.6	7.9	8.0	6.7	6.8	5.0	4.7	7.1	7.2	4.2	4.3
		7180	20.5	20.6	7.2	7.3	6.2	6.3	4.7	4.3	6.6	6.7	3.9	4.0
		7482	20.5	20.6	7.2	7.3	6.2	6.3	4.7	4.3	6.5	6.6	3.9	4.0
		7650	20.5	20.6	7.1	7.2	6.2	6.3	4.6	4.2	6.5	6.6	3.8	3.9
		7924	20.5	20.6	7.1	7.2	6.1	6.2	4.6	4.2	6.5	6.6	3.8	3.9
		8111	20.5	20.6	7.2	7.3	6.2	6.3	4.6	4.2	6.5	6.6	3.8	3.9
		8249	20.5	20.0	7.2	6.7	6.2	5.7	4.7	3.7	6.5	6.0	3.9	3.4
		8369	20.5	20.0	7.1	6.6	6.1	5.6	4.6	3.6	6.4	5.9	3.8	3.3
		8488	20.5	20.3	7.0	6.8	6.1	5.9	4.6	3.9	6.4	6.2	3.8	3.6
		8740	20.5	20.6	7.0	7.1	6.1	6.2	4.6	4.2	6.4	6.5	3.8	3.9
		8915	20.5	20.6	7.0	7.1	6.1	6.2	4.6	4.2	6.4	6.5	3.8	3.9
		9123	20.5	20.6	7.0	7.1	6.1	6.2	4.6	4.3	6.4	6.5	3.9	4.0
		9378	20.5	20.6	7.0	7.1	6.1	6.2	4.6	4.3	6.4	6.5	3.9	4.0
		9669	20.7	20.6	7.5	7.3	6.6	6.4	5.1	4.5	6.9	6.8	4.3	4.2
		9822	20.5	20.6	7.3	7.4	6.4	6.5	4.9	4.6	6.7	6.8	4.1	4.2
		9931	20.5	20.0	7.1	6.6	6.3	5.8	4.8	3.9	6.6	6.1	4.1	3.6
		9976	20.5	20.6	6.9	7.0	6.1	6.2	4.6	4.3	6.3	6.5	3.8	4.0
		10019	21.1	21.1	7.7	7.7	6.9	6.9	5.4	5.0	7.2	7.2	4.6	4.6
Upstream of Project Site		10063	21.1	21.0	7.7	7.6	6.9	6.8	5.4	4.9	7.2	7.1	4.6	4.6
		10111	21.0	21.0	7.8	7.8	7.0	7.0	5.5	5.0	7.3	7.3	4.7	4.7
		10207	21.0	20.6	6.9	6.5	6.2	5.8	4.9	4.0	6.4	6.0	4.2	3.8
		10495	20.6	20.9	6.5	6.8	5.8	6.1	4.5	4.3	6.0	6.3	3.7	4.0
		10516	20.6	20.7	6.5	6.7	5.8	6.0	4.5	4.1	6.0	6.1	3.8	3.9
		10591	20.6	20.1	6.4	5.9	5.8	5.3	4.4	3.5	5.9	5.4	3.7	3.2
		10606	20.6	20.0	5.8	5.2	5.2	4.6	4.1	2.9	5.3	4.7	3.4	2.7
		10993	20.2	20.9	5.2	5.9	4.7	5.4	3.5	3.7	4.7	5.4	2.9	3.5
		11597	21.1	21.1	5.6	5.7	5.2	5.2	4.2	3.7	5.2	5.2	3.5	3.5

	12182	21.9	22.2	6.0	6.3	5.6	5.9	4.7	4.5	5.6	5.9	4.0	4.3
	12690	22.5	23.7	6.3	7.5	6.0	7.1	5.1	5.7	5.9	7.0	4.5	5.6
	13088	23.6	23.9	7.0	7.3	6.7	7.0	5.9	5.7	6.6	6.9	5.2	5.6
Upstream of Project Site	13088	23.6	23.9	7.0	7.3	6.7	7.0	5.9	5.7	6.6	6.9	5.2	5.6
	13470	23.6	23.2	7.0	6.6	6.7	6.3	5.9	5.0	6.9	6.5	5.6	5.1
	13661	26.0	25.6	9.3	8.9	8.9	8.6	8.2	7.3	9.1	8.8	7.8	7.4
	13838	25.4	25.2	8.6	8.3	8.3	8.0	7.5	6.8	8.5	8.2	7.2	6.9
	13940	25.1	24.9	8.5	8.3	8.2	8.0	7.4	6.7	8.5	8.3	7.1	6.9
	14170	24.5	24.4	6.2	6.1	6.0	6.0	5.5	4.9	5.4	5.3	4.8	4.8
	14959	24.4	24.6	5.8	5.9	5.6	5.8	5.2	4.8	5.0	5.1	4.5	4.6
	15691	25.5	25.5	6.8	6.8	6.7	6.6	6.3	5.7	6.1	6.0	5.6	5.5
	16428	26.3	26.0	7.0	6.7	6.9	6.6	6.6	5.7	6.2	5.9	5.8	5.5
	16679	26.5	25.6	7.1	6.2	7.0	6.1	6.6	5.2	6.2	5.4	5.9	5.0
	17052	26.2	27.7	7.7	9.3	7.6	9.1	7.1	8.2	6.9	8.4	6.5	8.1

APPENDIX F8
Hydraulic Modeling Addendum

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memorandum

date September 28, 2015 – *updated November 5, 2015*

to Ballona Wetlands Restoration Project Management Team

from James Gregory, PE, Christie Beeman, PE, and Nick Garrity, PE

subject Ballona Wetlands Restoration Project - Preliminary Hydrology and Hydraulics Report ADDENDUM

This memorandum was prepared as an addendum to the Draft Preliminary Hydrology and Hydraulics Report dated May 8, 2013. It describes additional hydraulic analyses performed to evaluate the Ballona Wetlands Restoration Project Alternatives and sediment deposition scenarios for the Ballona Creek channel to inform potential channel maintenance limits.

The hydraulic analyses described in this Addendum were performed to evaluate and compare potential flood impacts from the following project alternatives, relative to existing conditions:.

Alternative 1, Phase 1 – would restore connectivity of Ballona Creek with the floodplain by removing the existing levees, lowering the grade in Area A and North Area B, and creating a sinuous channel. New earthen levees would be built around the northern perimeter of Area A and along the north side of Culver Boulevard in North Area B to the junction of Culver Boulevard and Jefferson Boulevard, and then connect to the existing West Area B levee.

Alternative 1, Phase 2 – would remove the levee along the north side of West Area B and build a new levee to the south of West Area B and east of the dune habitat in the west.

Alternative 2 – would restore connectivity of Ballona Creek with the floodplain by removing the existing levees, lowering the grade in Area A and North Area B, and creating a sinuous channel. New earthen levees would be built around the northern perimeter of Area A and along the north side of Culver Boulevard in North Area B to the junction of Culver Boulevard and Jefferson Boulevard, and then connect to the existing West Area B levee. Alternative 2 is similar to Alternative 1, Phase 1; however, the levee geometry in North Area B is different.

Alternative 3 – would restore connectivity of Ballona Creek with the floodplain by lowering the grade in Area A and installing open culverts through the north Ballona Creek levee. A new earthen levee would be built around the northern perimeter of Area A.

Alternative 4 is the No Action Alternative and is therefore the same as existing conditions for this hydraulic analysis. These alternatives are described in detail in Chapter 2, Project Description, of the EIR/S.

Three sedimentation scenarios were applied to each Alternative to evaluate the potential effect of sedimentation on flood levels and channel maintenance needs. For the purposes of this evaluation, three sedimentation scenarios were modeled to evaluate the sedimentation threshold that would raise water levels enough to require channel maintenance. These sedimentation scenarios are:

Equilibrium Tidal Channel Hydraulic Geometry – represents the channel dimensions at which the tidal hydraulic influences are in balance with sedimentation. The method used to estimate these dimensions is presented in the Draft Preliminary Hydrology and Hydraulics Report (ESA 2013).

2 feet of deposition in the channel bottom – represents the channel dimensions with 2 feet of deposition over the channel bed.

4 feet of deposition in the channel bottom – represents the channel dimensions with 4 feet of deposition over the channel bed.

The first scenario assumes tidal sediment transport processes will dominate long term sedimentation in the channel and that sufficient sediment is available for the channel to aggrade to equilibrium hydraulic geometry dimensions. This is considered a conservative assumption because the channel is sediment supply limited (as described in ESA PWA 2013) and therefore not expected to aggrade to equilibrium hydraulic geometry dimensions.

The 2- and 4-foot deposition scenarios assume a uniform depth of sediment deposition throughout the entire channel. These deposition scenarios are considered conservative because fluvial sediment transport modeling results indicate the restored channel will experience both erosion and deposition during storm events, with a maximum of 0.7 ft of deposition at any given cross section for the modeled scenarios. While erosion and deposition patterns will vary with the magnitude of the modeled event and specific location along the channel, modeling results indicate that larger flood events are likely to produce net erosion under project conditions. (Sediment transport modeling results and discussion are presented in the Ballona Creek and Wetlands Sediment Dynamics and Sediment Budget Analysis, Appendix F1).

HEC-RAS Model

For the current analysis, ESA used the same hydraulic modeling inputs and parameters as described in the Draft Preliminary Hydrology and Hydraulics Report (ESA 2013). Channel geometry was modified to reflect the project alternatives and sedimentation scenarios as described above.

ESA modified cross section geometry in the existing HEC RAS model (described in ESA 2013) to reflect the Alternative 1 Phase 1, Alternative 1 Phase 2, Alternative 2, and Maintenance Limit scenarios. Channel geometry for Alternative 3 is identical to Existing Conditions except that it includes an open connection between Ballona Creek and Area A via culverts through the Ballona Creek levee. As a result of the culvert connection, the water level in Area A will be in equilibrium with the Ballona Creek water level under steady-state conditions. Therefore, steady-state hydraulic modeling results for Existing Conditions reflect the same conditions that will exist under Alternative 3.

Model geometry for the Equilibrium Tidal Channel Hydraulic Geometry scenario was developed based on tidal hydraulic geometry relationships (Section 6.2.1 of ESA 2013). For the 2-, and 4-foot deposition scenarios, these depths were added to the channel bottom uniformly between the left and right toe of the channel.

The model was run for each of the scenarios under a variety of boundary conditions. Table 1 provides a hydraulic modeling run catalog that summarizes the model scenarios applied to each of the alternatives.

Table 1. Hydraulic model run catalog

Scenario	Flow Rate (Q)	Downstream Boundary	Bed Aggradation
Design Flood	46,000 cfs	7.63 ft NAVD	-
Sea Level Rise (SLR)	46,000 cfs	7.63 ft NAVD + SLR	-
SLR + Aggradation	46,000 cfs	7.63 ft NAVD + SLR	SLR
Flood Frequency	Q2, 5, 10, 25, 50, 100, 200, 500	MHHW	-
Sedimentation Scenario	46,000 cfs	7.63 ft NAVD	Tidal Geometry, 2 feet, 4 feet deposition

Results

HEC RAS modeling results for the scenarios summarized in Table 1 are presented in Figures 1-4 listed below. In each of the figures, model results for Existing Conditions are also shown for comparison.

Figure 1 - Design flood EC, Alt 1 Ph1, Alt 1, Alt2
Figure 2a - Design Flood Profiles with Sea Level Rise and Bed Aggradation for EC and Alt1 Phase 1
Figure 2b - Design Flood Profiles with Sea Level Rise and Bed Aggradation for EC and Alt1
Figure 2c - Design Flood Profiles with Sea Level Rise and Bed Aggradation for EC and Alt2
Figure 3a – Flood Frequency Q2 for EC, Alt1 Phase 1, Alt 1, and Alt2
Figure 3b – Flood Frequency Q5 for EC, Alt1 Phase 1, Alt 1, and Alt2
Figure 3c – Flood Frequency Q10 for EC, Alt1 Phase 1, Alt 1, and Alt2
Figure 3d – Flood Frequency Q25 for EC, Alt1 Phase 1, Alt 1, and Alt2
Figure 3e – Flood Frequency Q50 for EC, Alt1 Phase 1, Alt 1, and Alt2
Figure 3f – Flood Frequency Q100 for EC, Alt1 Phase 1, Alt 1, and Alt2
Figure 3g – Flood Frequency Q200 for EC, Alt1 Phase 1, Alt 1, and Alt2
Figure 3h – Flood Frequency Q500 for EC, Alt1 Phase 1, Alt 1, and Alt2
Figure 4 – Design Flood Profiles for Project Alternatives with Tidal Geometry
Figure 5 – Design Flood Profiles for Project Alternatives with 2 feet of Deposition
Figure 6 – Design Flood Profiles for Project Alternatives with 4 feet of Deposition
Figure 7 – Cross-sections in Area A for existing and project conditions with sedimentation scenarios

Table 2 summarizes hydraulic modeling results for the Design Flood scenario for existing conditions and the Alternatives in terms of freeboard. Table 3 summarizes the freeboard results for the sedimentation scenarios. Freeboard is the difference between the water surface elevation (from hydraulic model results) and the elevation of the levee top. For existing conditions, freeboard is calculated relative to existing levee elevations. For all other scenarios it is calculated relative to the proposed levee elevations. Where model results show the water surface elevation higher than the levee top elevation, freeboard equal to zero is reported in the table. Because the model was not set up to recognize flow reductions that may result from levee overtopping, model results may somewhat overstate water surface elevations for scenarios where the water surface elevation exceeds the levee elevation.

Table 2 HEC RAS Results for Design Flood Scenario – Ballona Creek Freeboard (feet)

	Adjacent to Area A/North Area B (RS 6079 to 10019)			Adjacent to West Area B (RS 3055 to 5853)		
	Reach Average	Maximum	Minimum	Reach Average	Maximum	Minimum
Existing Conditions[1]	5.6	6.3	5.0	3.7	4.2	3.1
Alt 1, Phase 1[2]	5.7	6.9	5.4	5.1[1]	8.1[1]	3.2[1]
Alt 1, Phase 2[2]	4.7	5.8	4.4	5.0	7.4	3.1
Alternative 2[2]	3.8	4.6	3.6	4.9[1]	7.1[1]	3.2[1]
Alternative 3[1]	5.6	6.3	5.0	3.7	4.2	3.1

[1] Freeboard based on existing levee elevation
[2] Freeboard based on project levee elevation of 20.5 ft NAVD

Table 3 HEC RAS Results for Sedimentation Scenarios – Ballona Creek Freeboard (feet)

	Adjacent to Area A/North Area B (RS 6079 to 10019)			Adjacent to West Area B (RS 3055 to 5853)		
	Reach Average	Maximum	Minimum	Reach Average	Maximum	Minimum
Alt 1, Phase 1[2]	5.7	6.9	5.4	5.1[1]	8.1[1]	3.2[1]
Alt 1, Phase 1 tidal hydraulic geometry[2]	1.7	2.5	1.2	0	3.0	0
Alt 1, Phase 1 2 feet of deposition	4.7	5.7	4.4	4.0	6.8	2.3
Alt 1, Phase 1 4 feet of deposition	3.5	4.4	3.2	2.7	5.4	1.0
Alt 1, Phase 2[3]	4.7	5.8	4.4	5.0	7.4	3.1
Alt 1, Phase 2 tidal hydraulic geometry [3]	0.8	1.2	0.4	0.0	1.6	0.0
Alt 1, Phase 2 2 feet of deposition[3]	4.0	4.9	3.8	3.9	6.1	2.0
Alt 1, Phase 2 4 feet of deposition[3]	3.1	3.7	2.9	2.5	4.5	0.6
Alternative 2[2]	3.8	4.6	3.6	4.9	7.1	3.2
Alternative 2 tidal hydraulic geometry [2]	0	0.2	0	0	1.2	0
Alt 2, 2 feet of deposition	2.8	3.4	2.6	3.8	5.0	2.3
Alt 2, 4 feet of deposition	1.3	1.7	1.1	2.5	4.2	1.0

[1] Freeboard based on existing levee elevation
[2] Freeboard based on project levee elevation of 20.5 ft NAVD
[3] Freeboard based on project levee elevation varying from 18.5 feet to 16.5 feet

Discussion

The results show that freeboard is greater than three feet for all alternative conditions and phases. Additional hydraulic analysis to ensure that the design levee meets 90-percent non-exceedance criteria (e.g., risk and uncertainty analysis) will be performed for the U.S. Army Corps of Engineers (USACE) Section 408 Permit Submittal B.

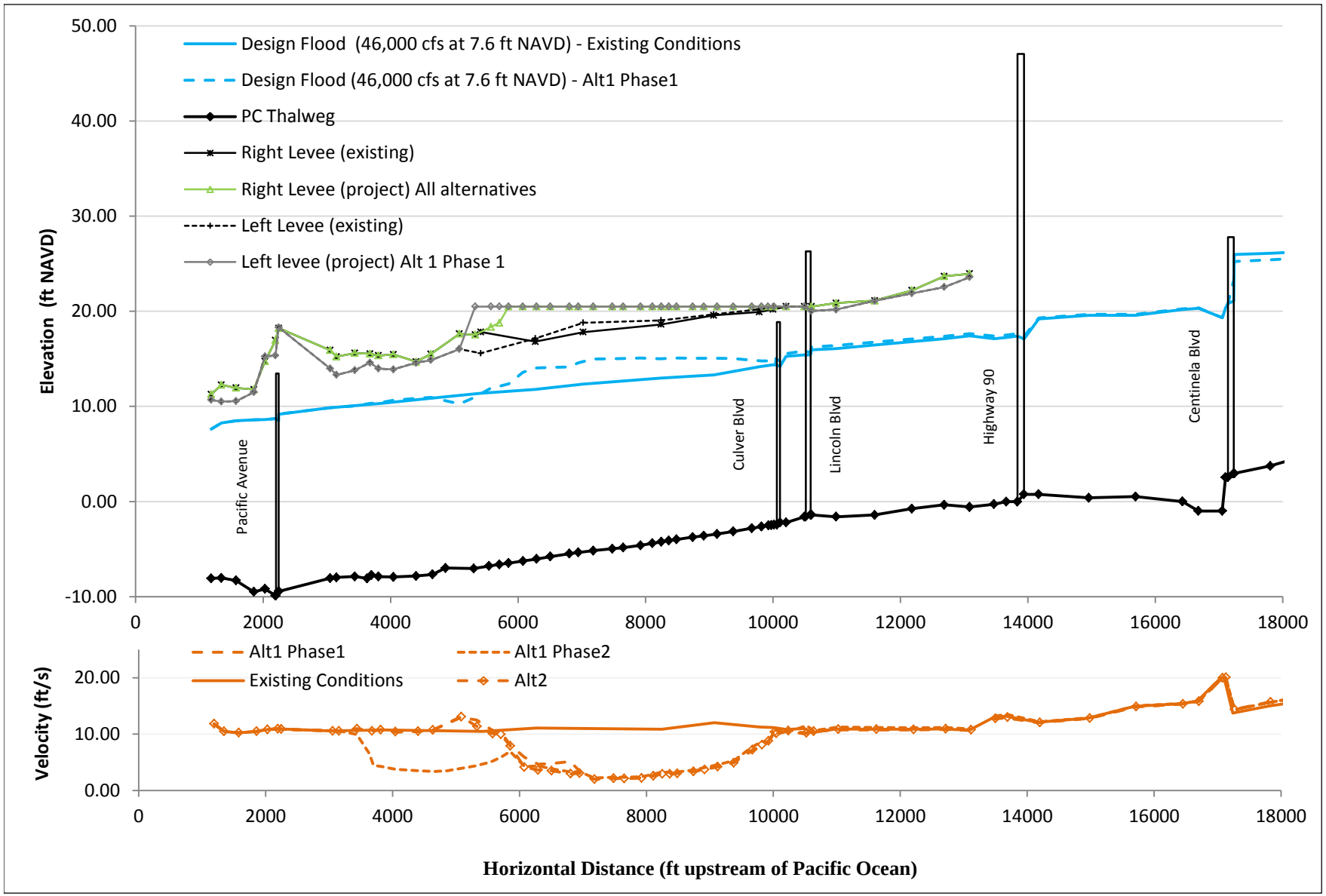
For the sedimentation scenarios, model results summarized in Table 3 show that all of the alternative scenarios maintain some level of positive freeboard in Area A and West Area B with 2 feet and 4 feet of sedimentation. Under the equilibrium tidal channel hydraulic geometry scenario, modeled water levels exceed the elevation of the existing West Area B levee and the jetty between Ballona Creek and Marina del Rey harbor during the design flood event. (Note that in Alternative 1 Phase 1 and Alternative 2, the levee along West Area B would be maintained at existing elevations.) Additionally, Alt 2 shows overtopping in Area A with the tidal hydraulic geometry condition. The results indicate that channel maintenance to remove sedimentation from the channel could potentially be required if deposition reaches the level represented by equilibrium tidal geometry; however, as described above, the tidal geometry scenario assumes conservatively high levels of channel deposition.

Further analysis will be performed in subsequent steps of the project, including risk and uncertainty analyses required for the USACE Section 408 approval process, to assess the potential for channel deposition to increase flood hazards under project conditions. These analyses could include modeling the equilibrium tidal geometry in only reaches that are expected to be depositional and evaluating erosion of deposited material during more frequent storm events.

These results were used to inform the sedimentation and erosion components of the Hydrology and Water Quality Monitoring and Adaptive Management Plan (MAMP) (Appendix F11), including the potential need for channel maintenance to maintain flood performance. Per the Hydrology and Water Quality MAMP, channel deposition will be monitored and, if significant deposition is observed, further analysis will be required. For Alternative 1, Phase 1 and Phase 2, and Alternative 2, any deposition greater than 4 ft would trigger an analysis of flood performance.

References

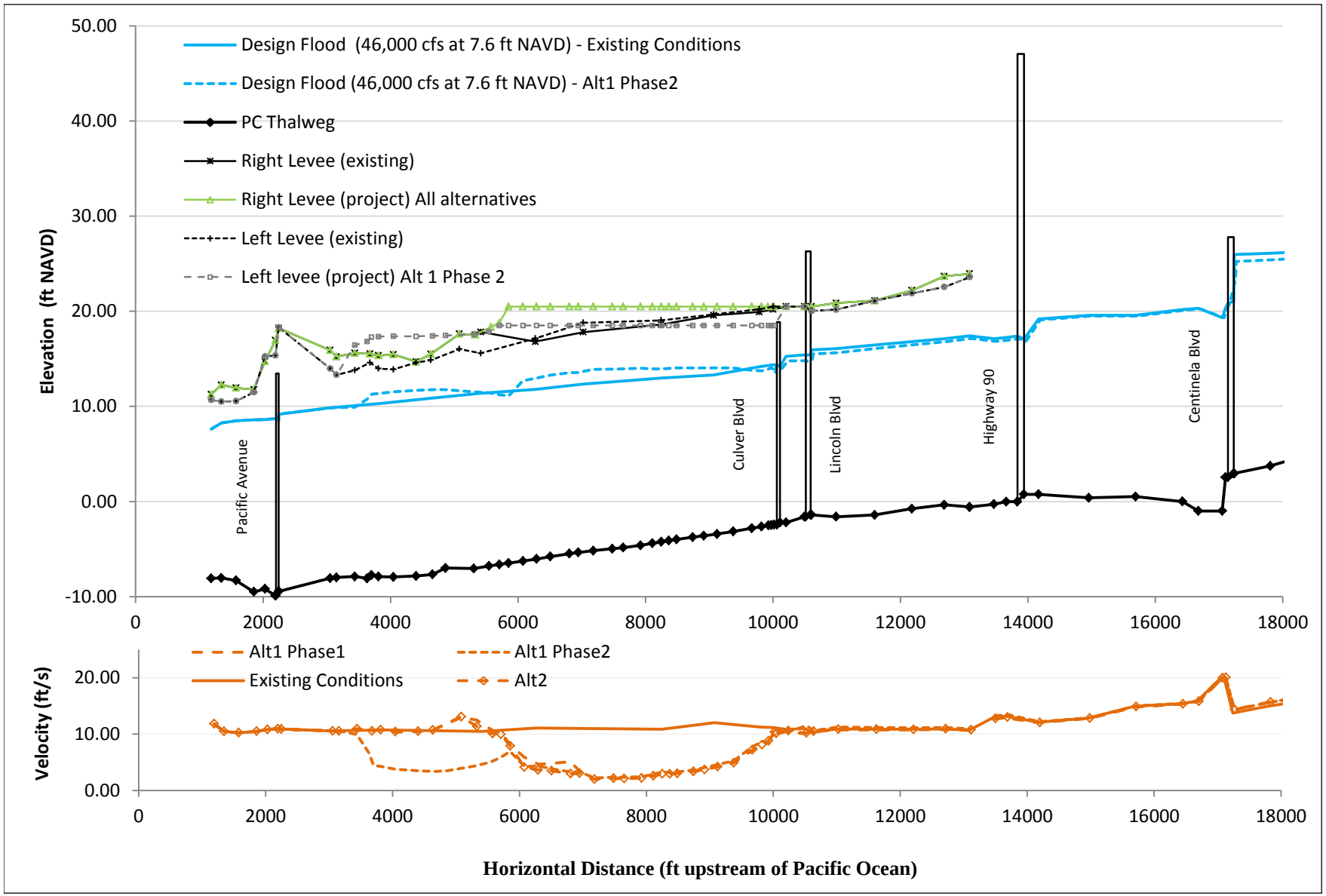
ESA PWA. 2013. Draft Ballona Wetlands Restoration Project, Preliminary Hydrology and Hydraulics Report. Prepared for the California State Coastal Conservancy. May 8, 2013



Ballona Wetland Restoration. D120367

Figure 1a

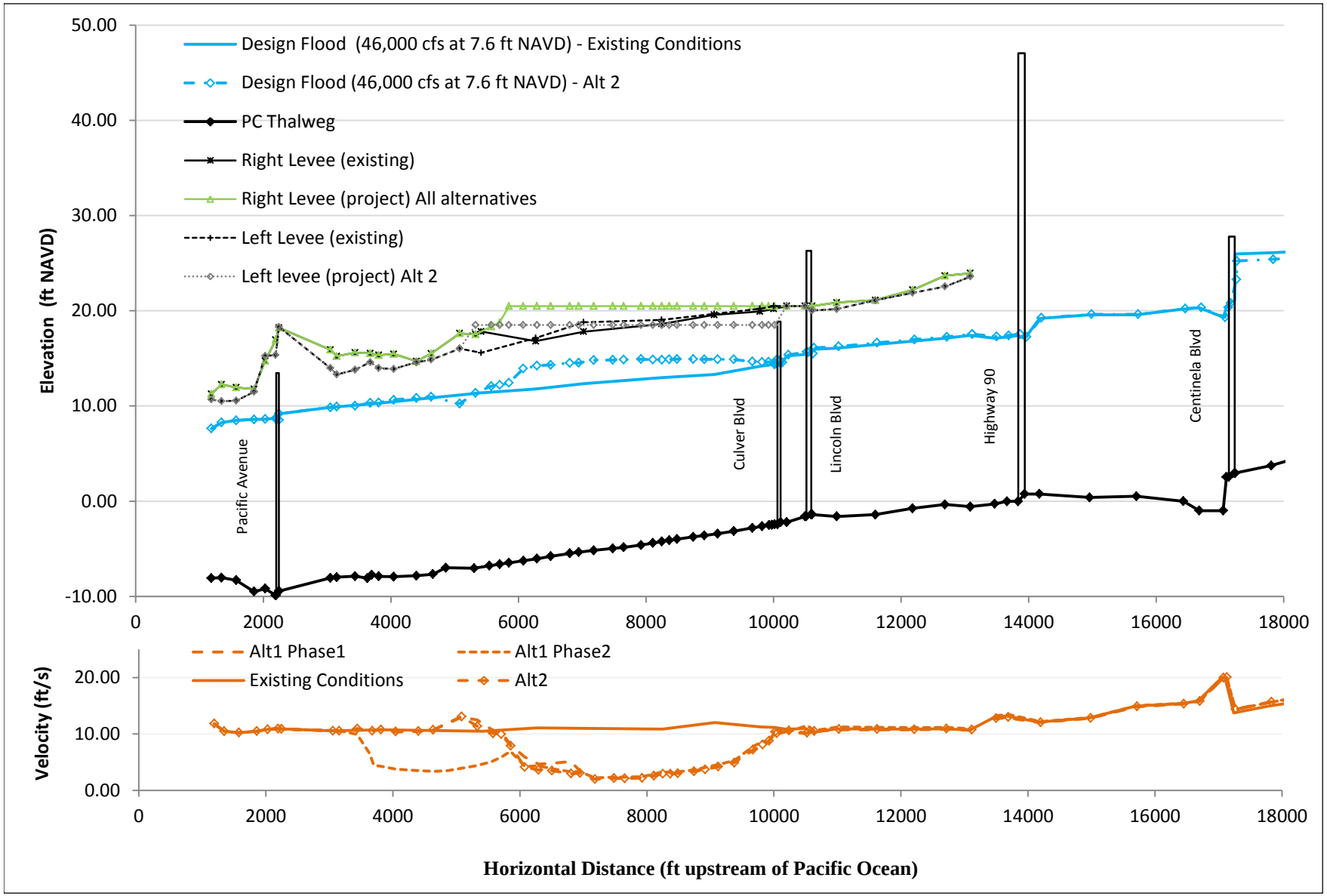
Design Flood and Velocity Profiles
Existing vs. Alt 1 Phase 1 Project Conditions



Ballona Wetland Restoration. D120367

Figure 1b

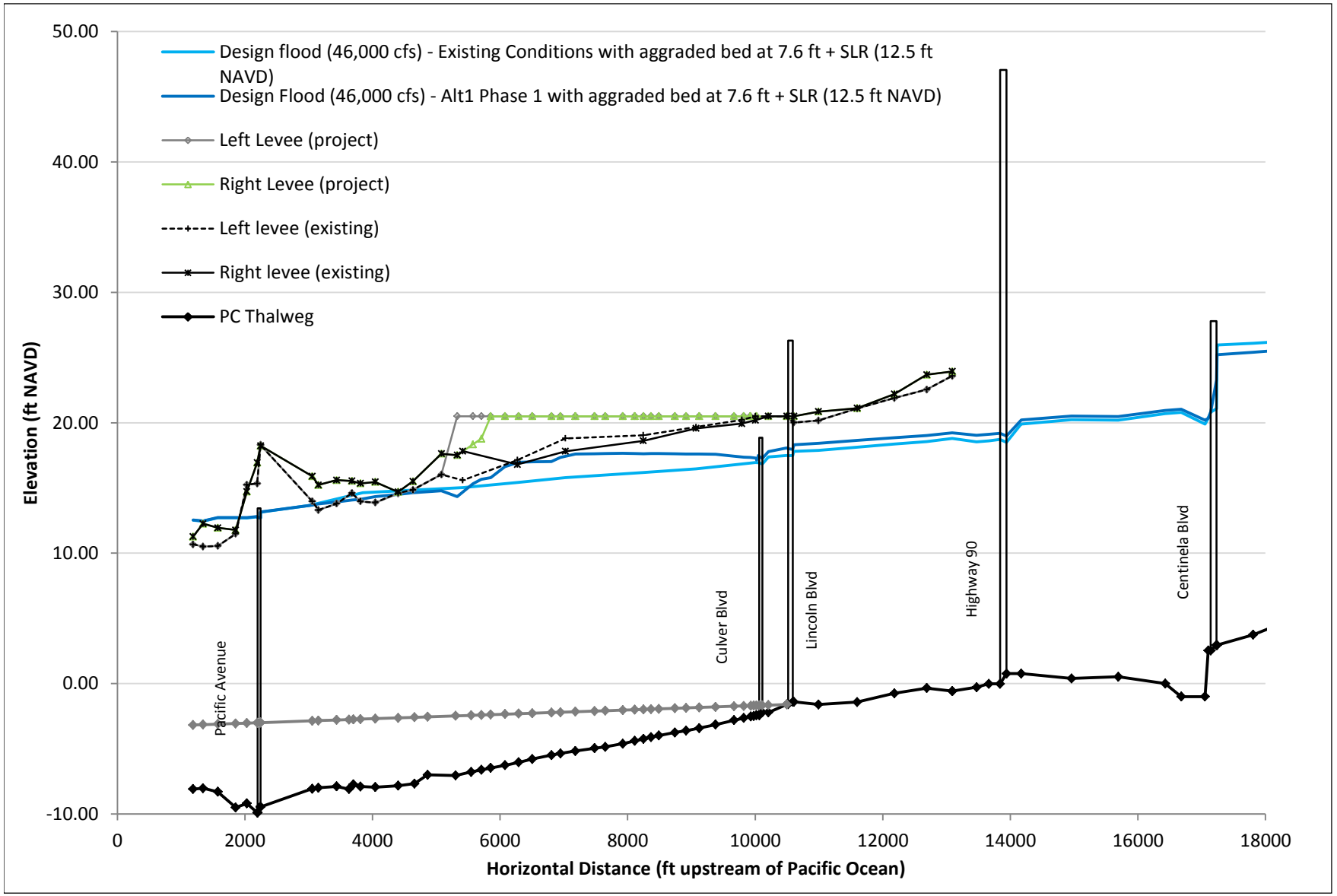
Design Flood and Velocity Profiles
Existing vs. Alt 1 Phase 2 Project Conditions



Ballona Wetland Restoration. D120367

Figure 1c

Design Flood and Velocity Profiles
Existing vs. Alt 2 Project Conditions

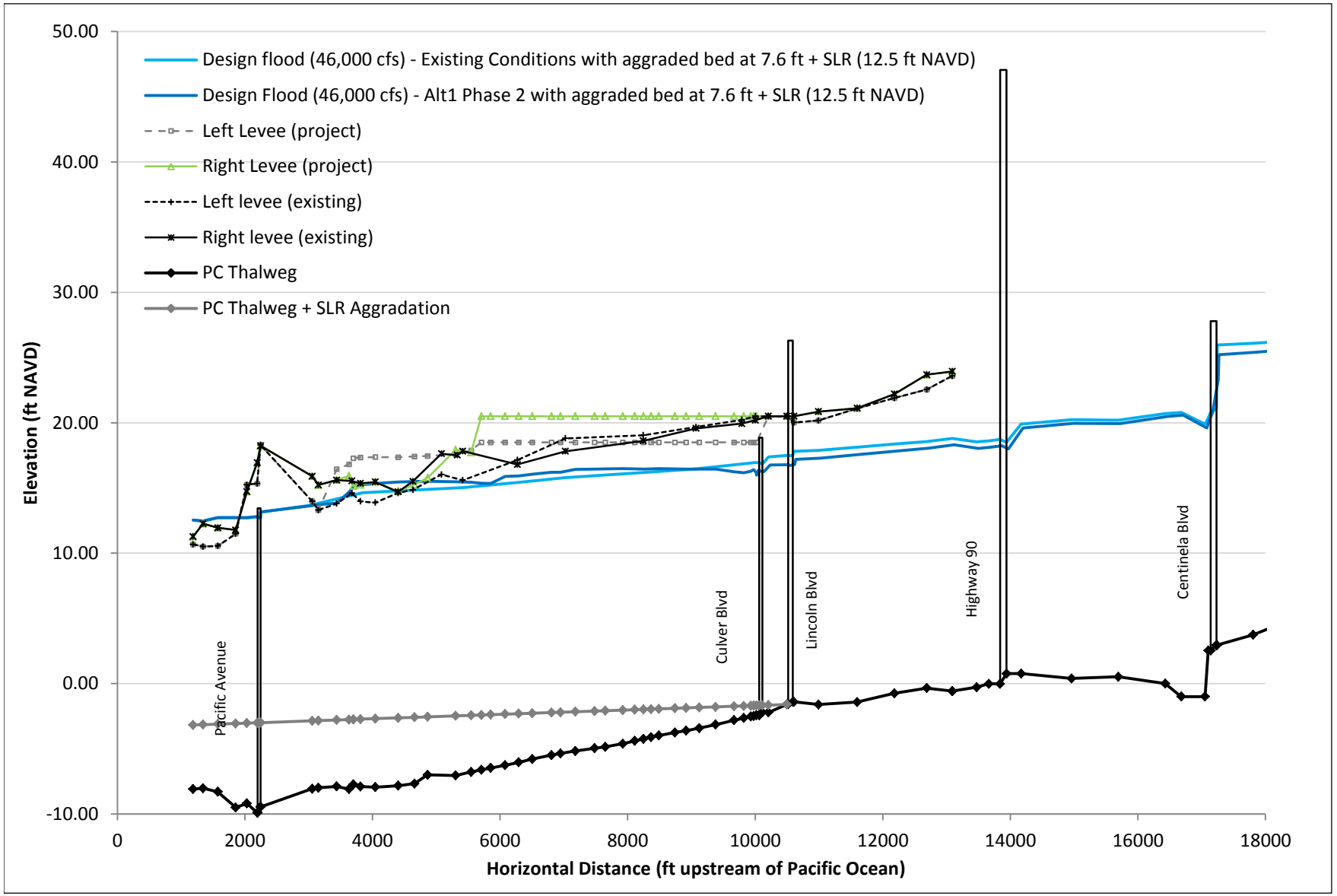


Ballona Wetland Restoration. D120367

Figure 2a

Design Flood Profiles with Sea Level Rise and Bed Aggradation for EC and Alt1 Phase 1

ESA PWA

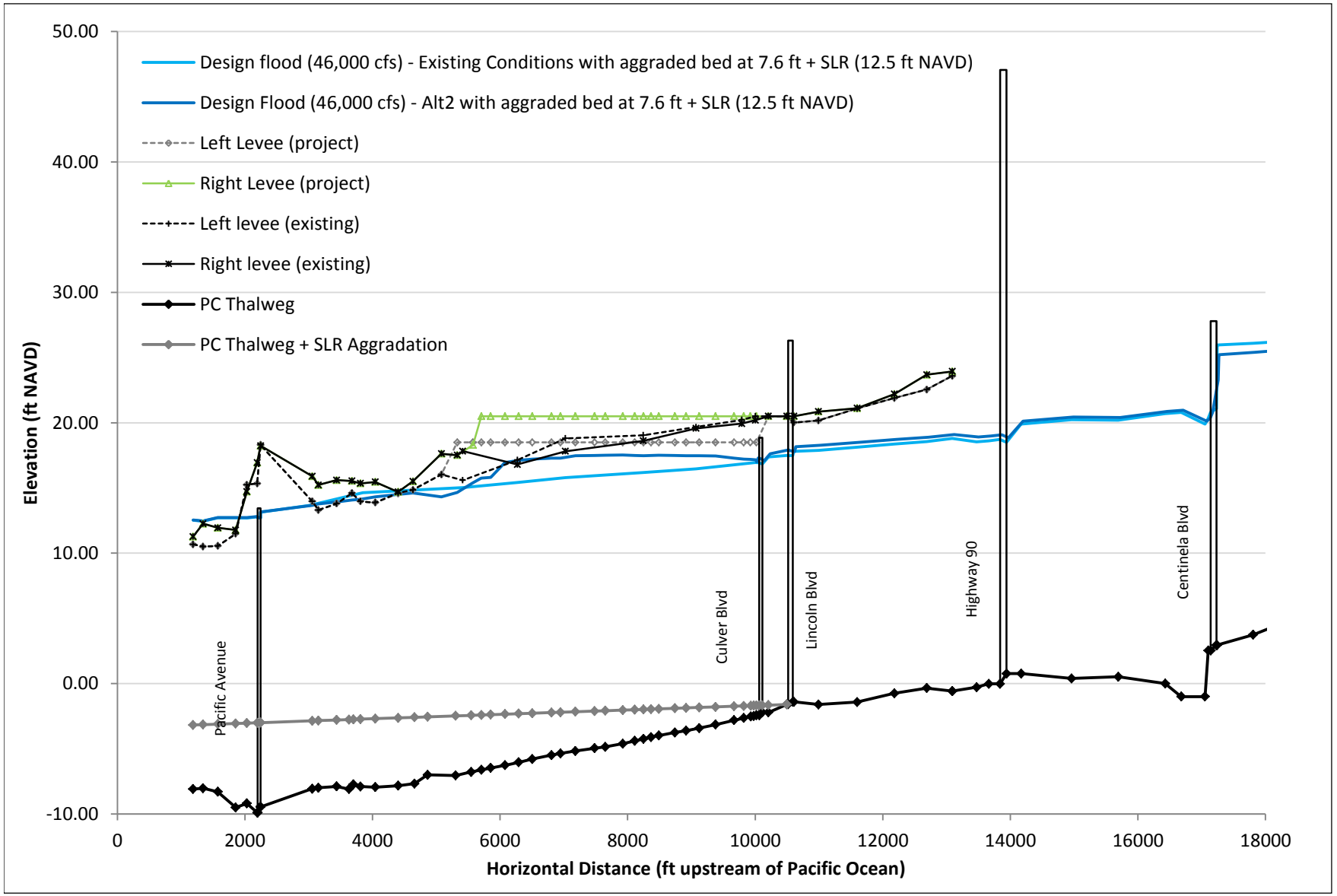


Ballona Wetland Restoration. D120367

Figure 2b

Design Flood Profiles with Sea Level Rise and Bed Aggradation for EC and Alt1 Phase 2

ESA PWA

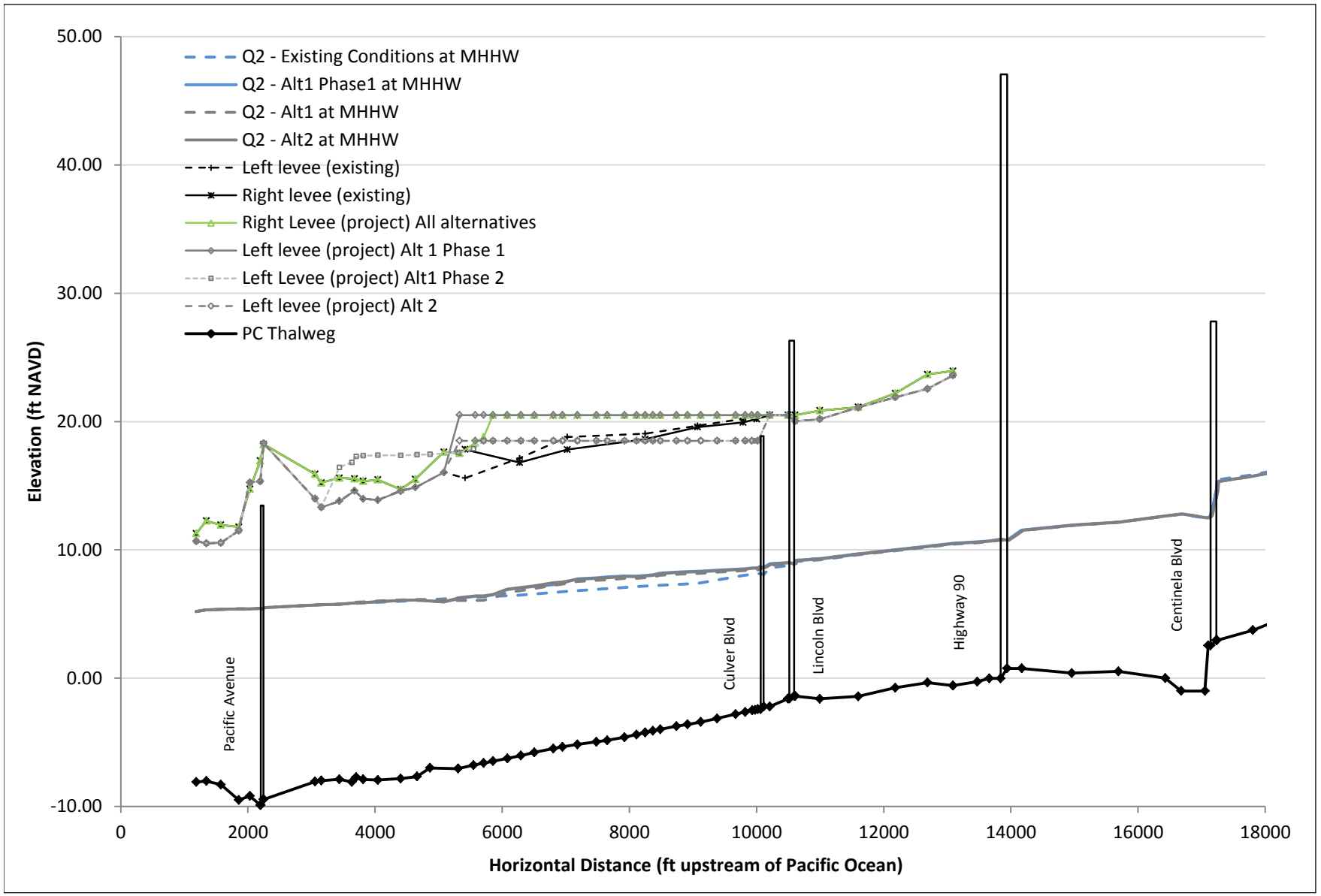


Ballona Wetland Restoration. D120367

Figure 2c

Design Flood Profiles with Sea Level Rise and Bed Aggradation for EC and Alt2

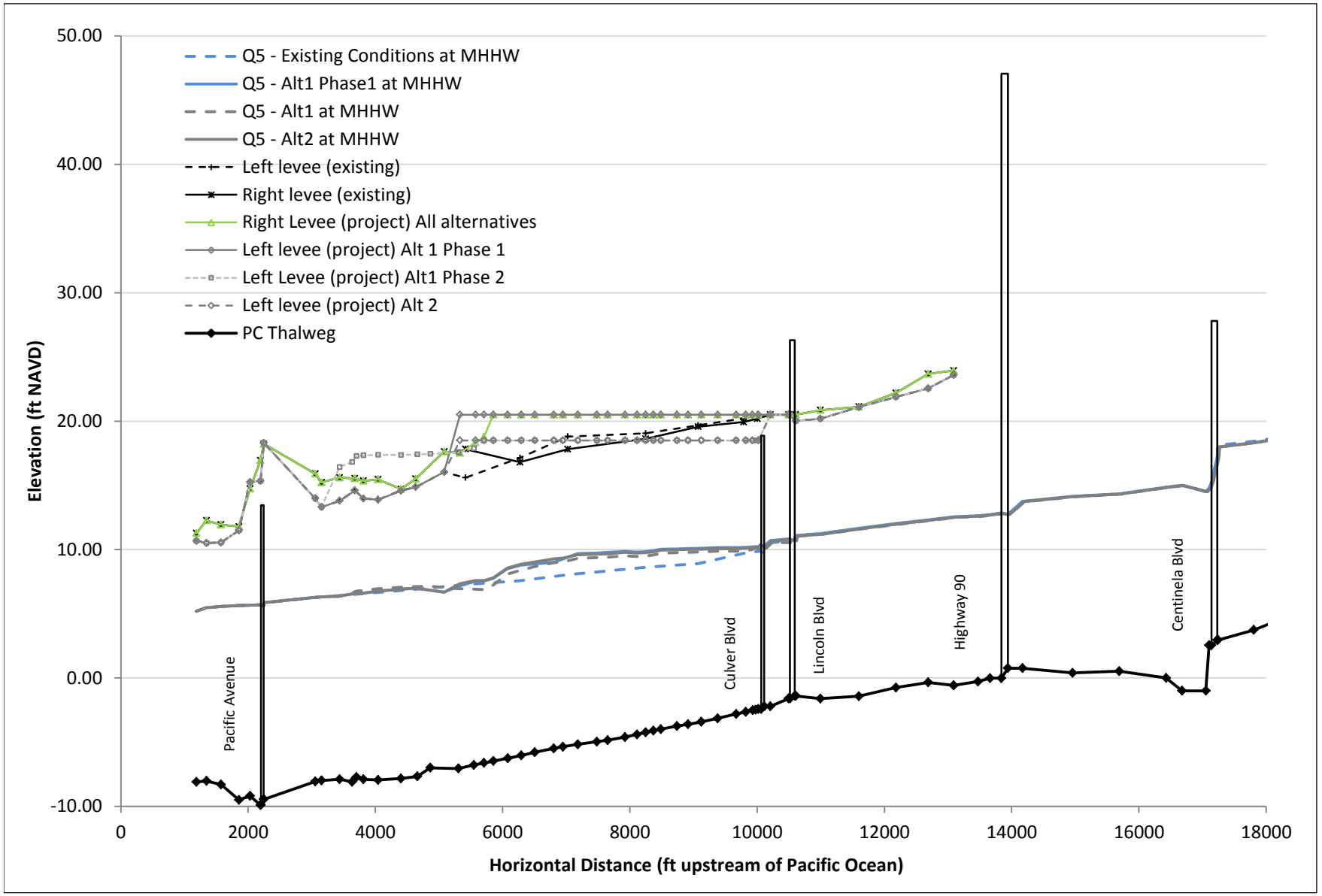
ESA PWA



Ballona Wetland Restoration. D120367

Figure 3a

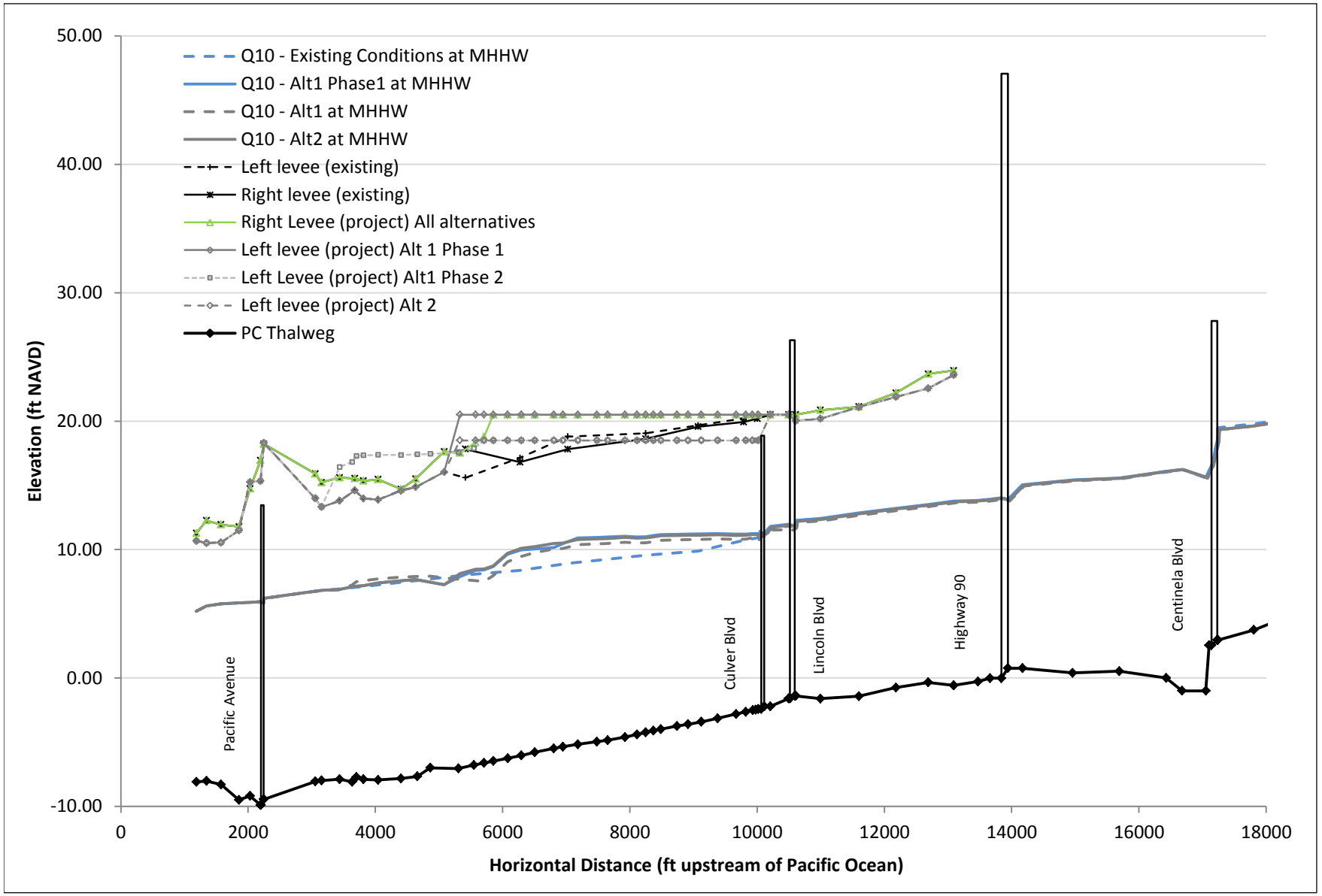
Flood Frequency Q2 for EC, Alt1 Phase 1, Alt 1, and Alt2



Ballona Wetland Restoration. D120367

Figure 3b

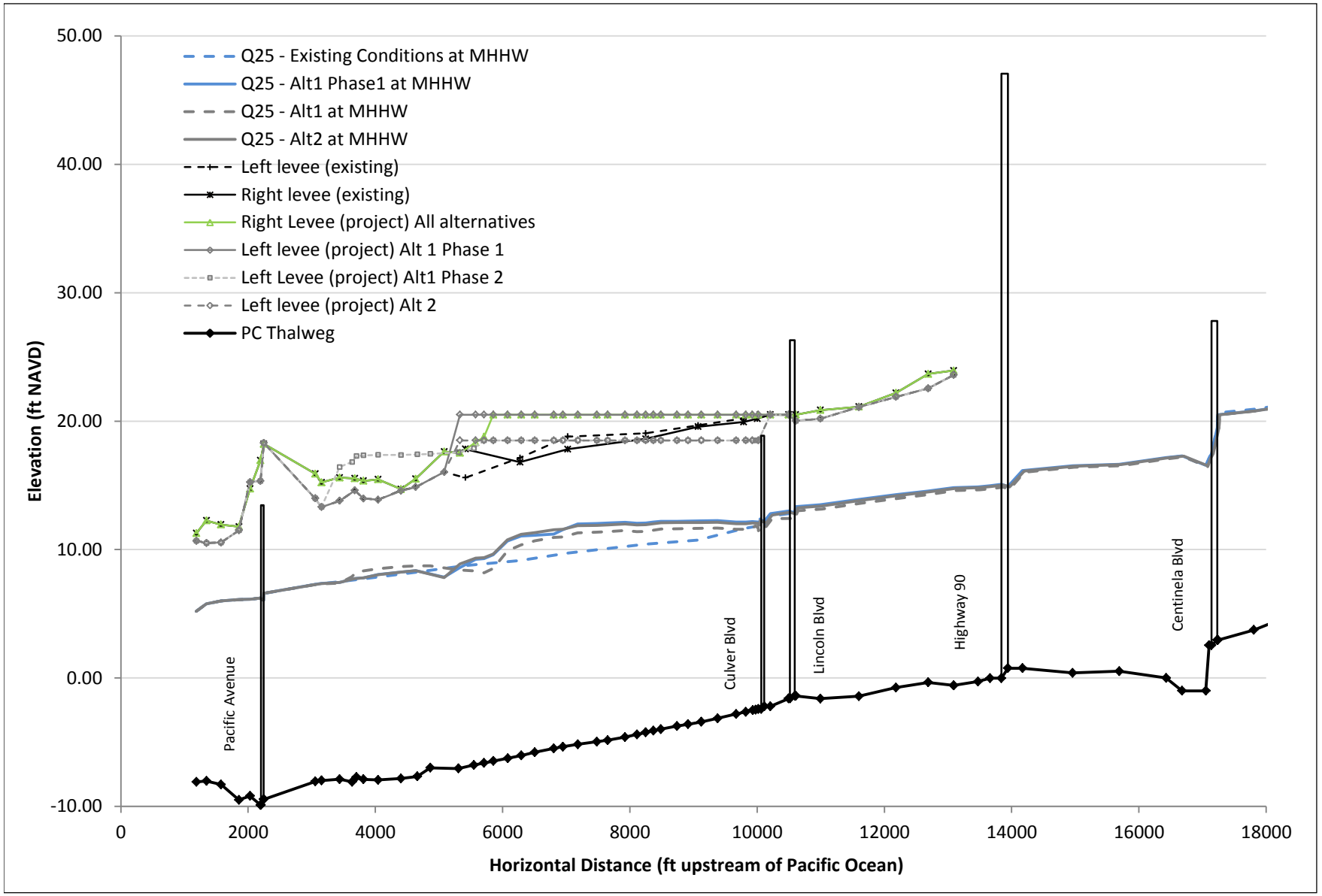
Flood Frequency Q5 for EC, Alt1 Phase 1, Alt 1, and Alt2



Ballona Wetland Restoration. D120367

Figure 3c

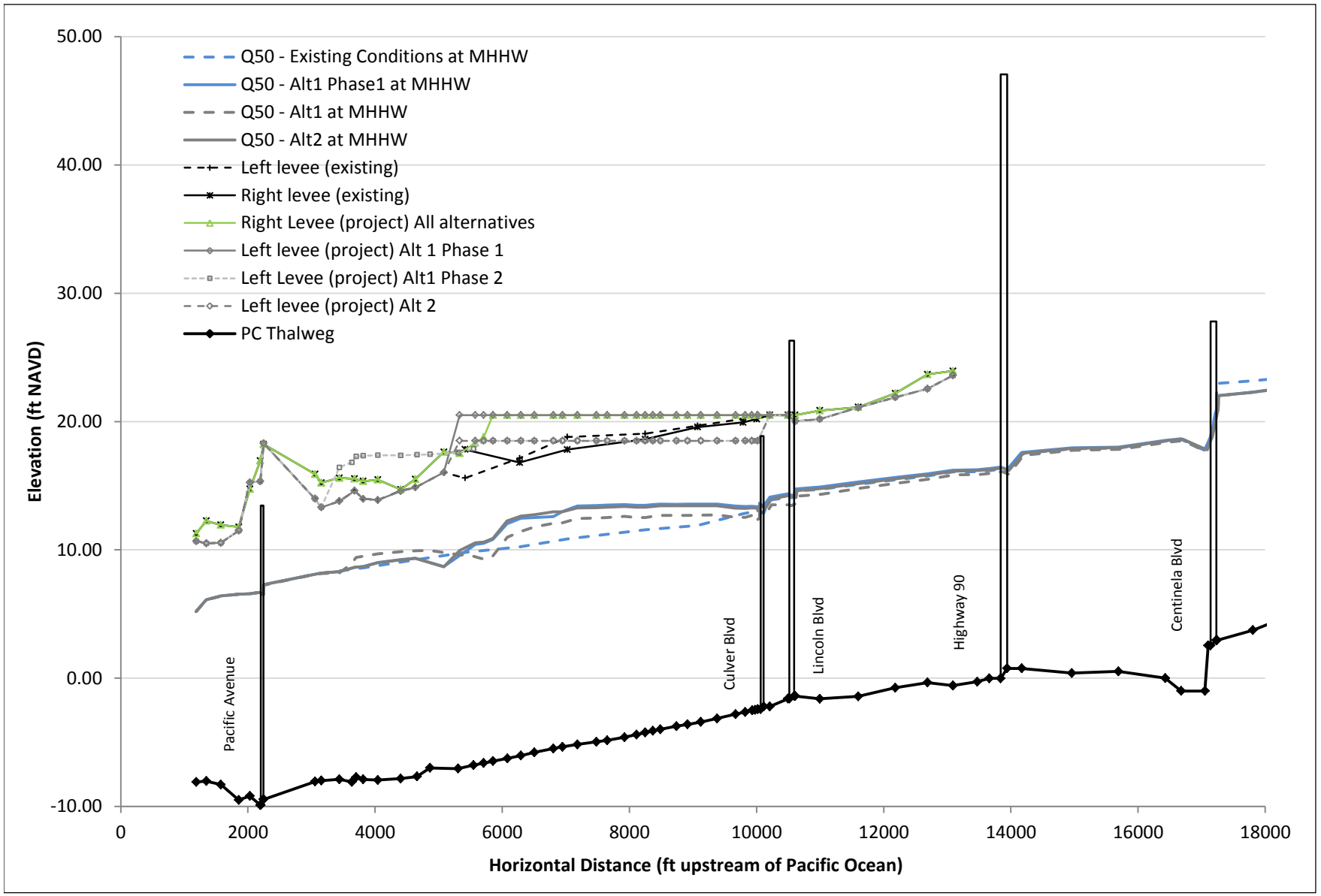
Flood Frequency Q10 for EC, Alt1 Phase 1, Alt 1, and Alt2



Ballona Wetland Restoration. D120367

Figure 3d

Flood Frequency Q25 for EC, Alt1 Phase 1, Alt 1, and Alt2



Ballona Wetland Restoration. D120367

Figure 3e

Flood Frequency Q50 for EC, Alt1 Phase 1, Alt 1, and Alt2

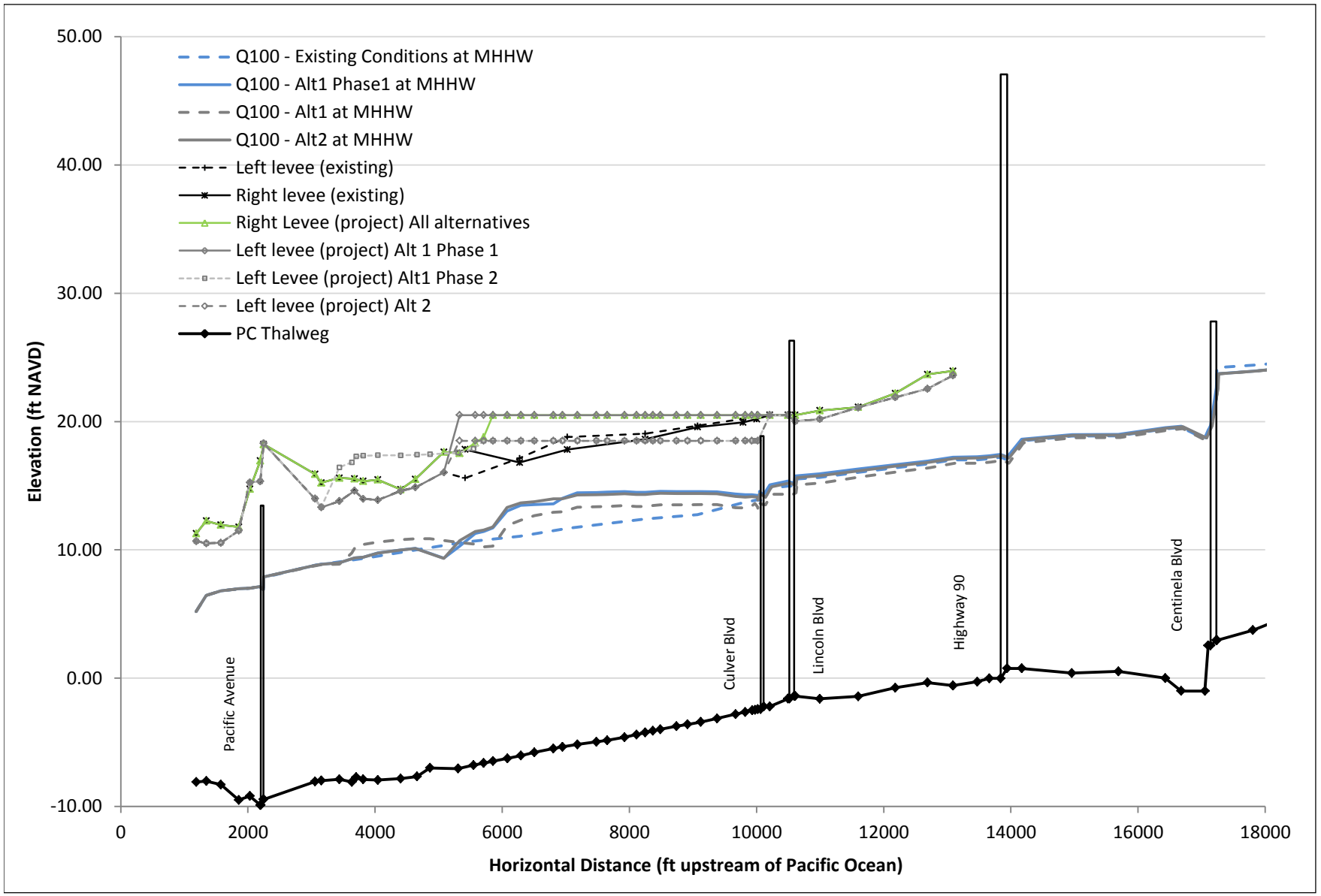
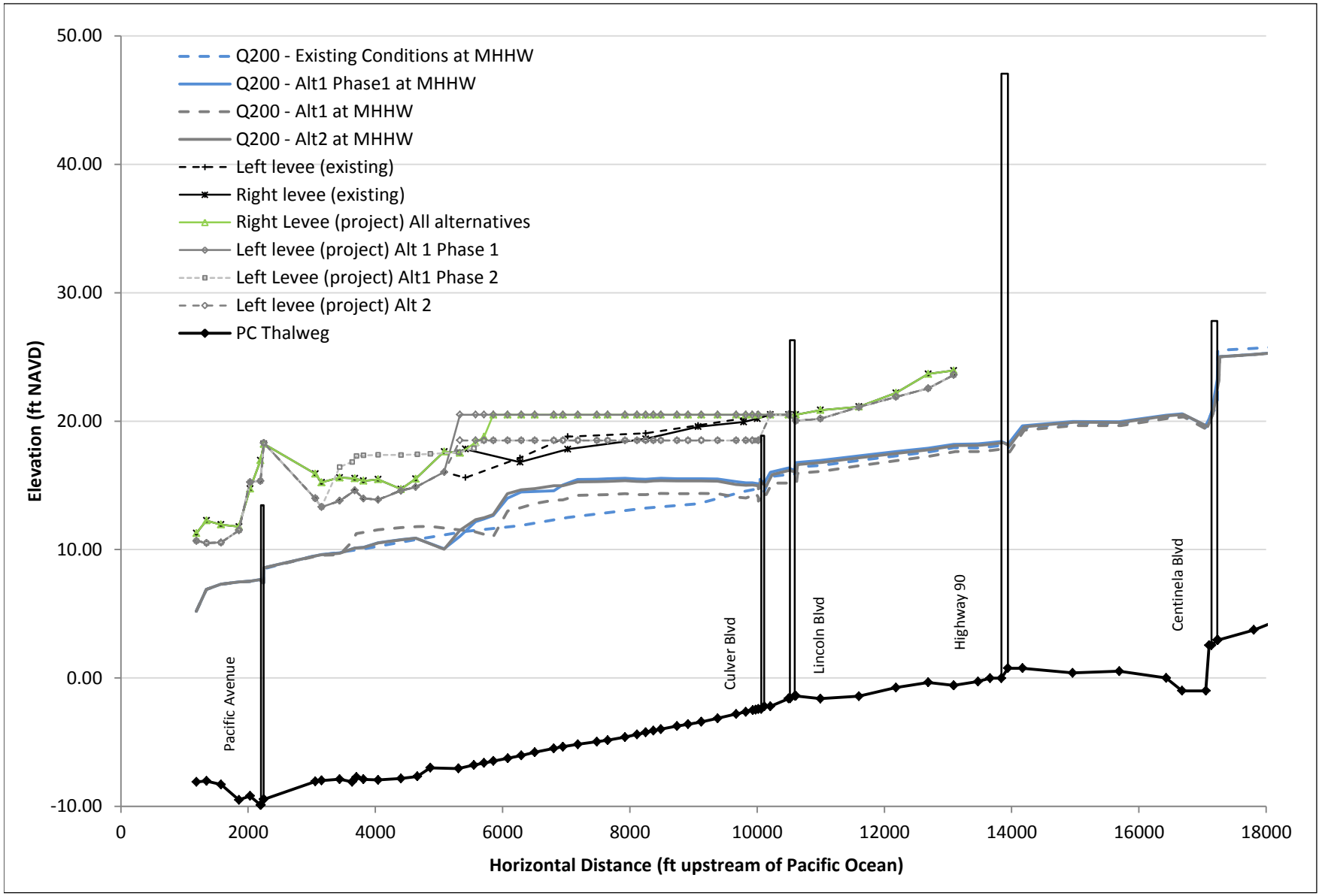


Figure 3f

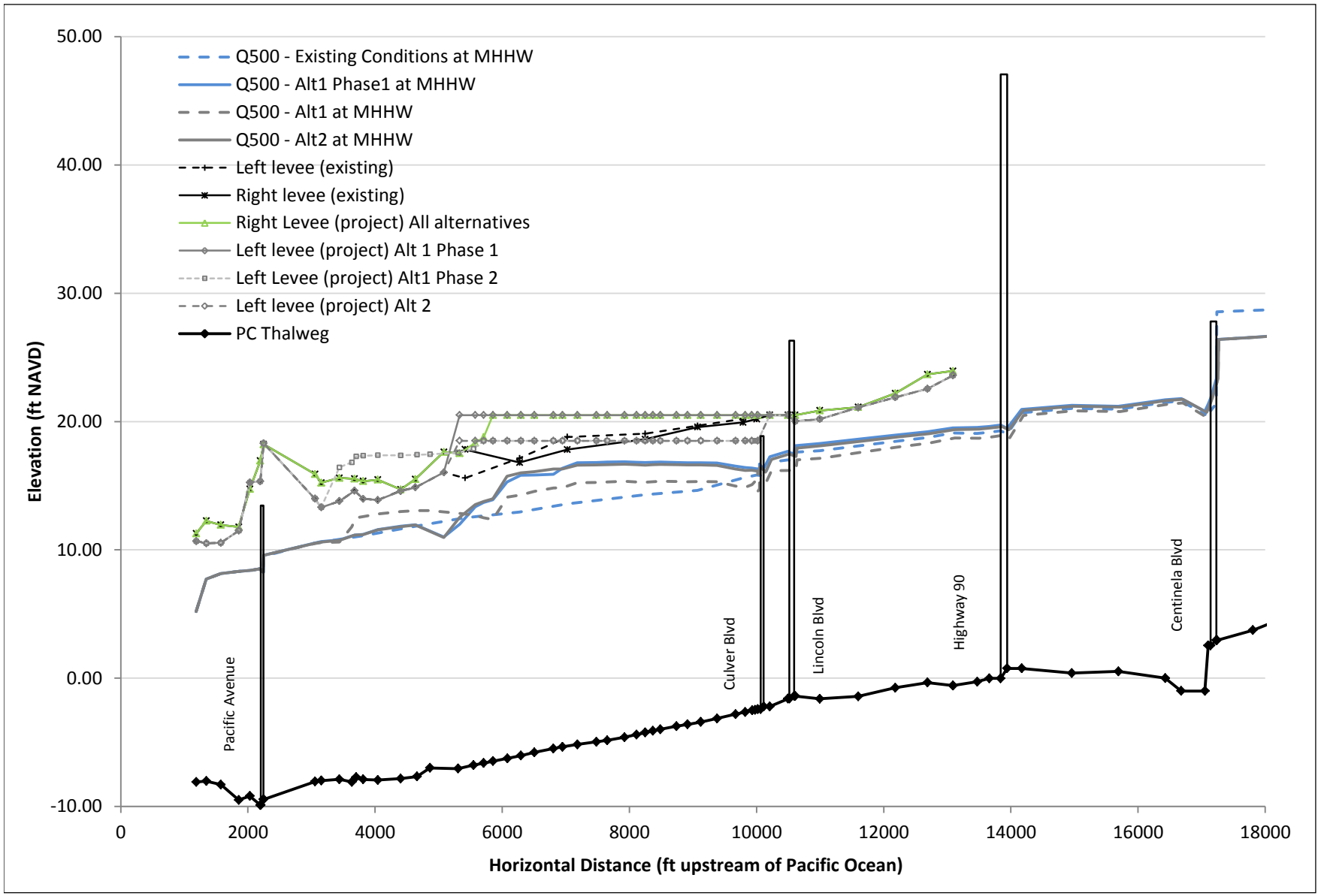
Flood Frequency Q100 for EC, Alt1 Phase 1, Alt 1, and Alt2



Ballona Wetland Restoration. D120367

Figure 3g

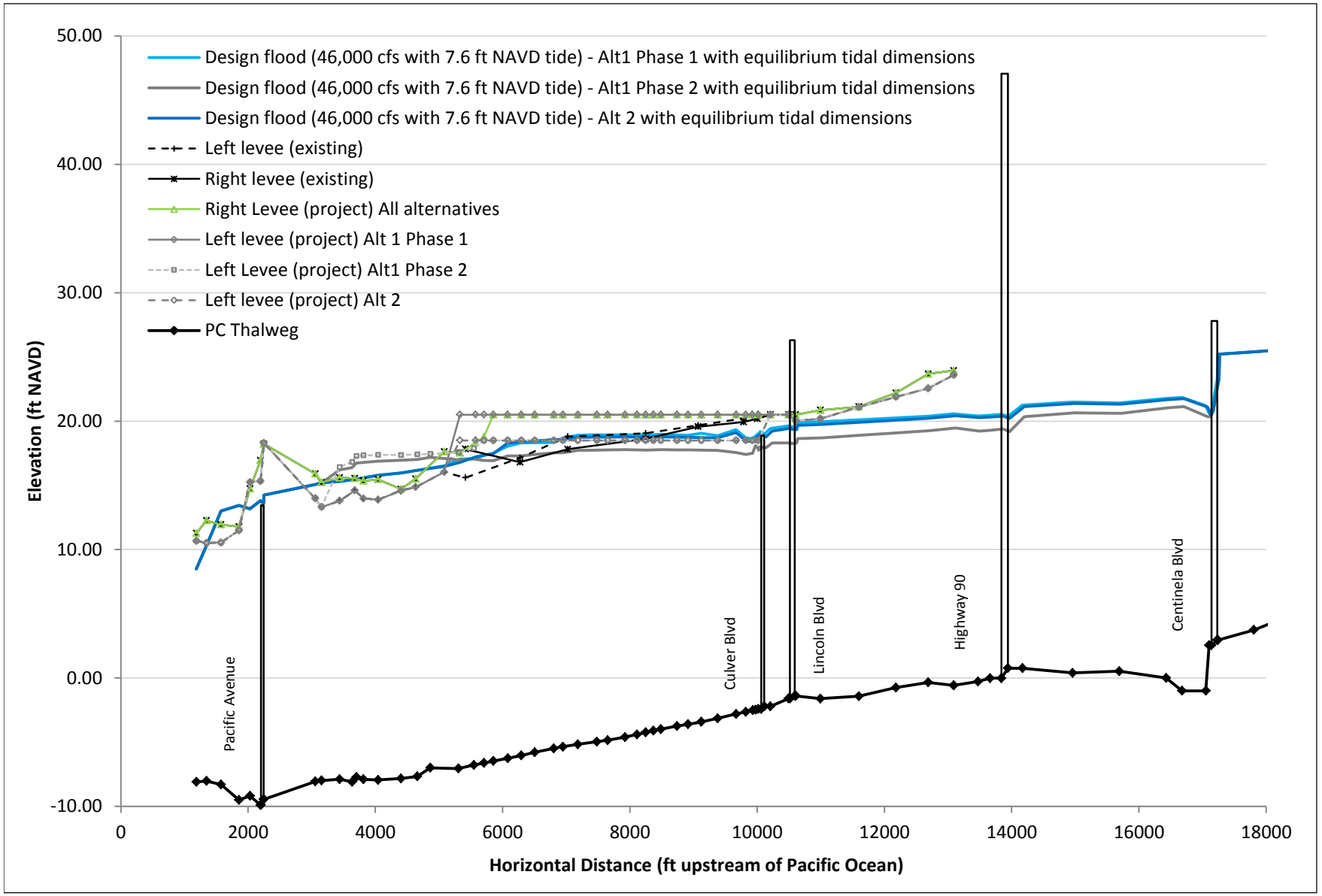
Flood Frequency Q200 for EC, Alt1 Phase 1, Alt 1, and Alt2



Ballona Wetland Restoration. D120367

Figure 3h

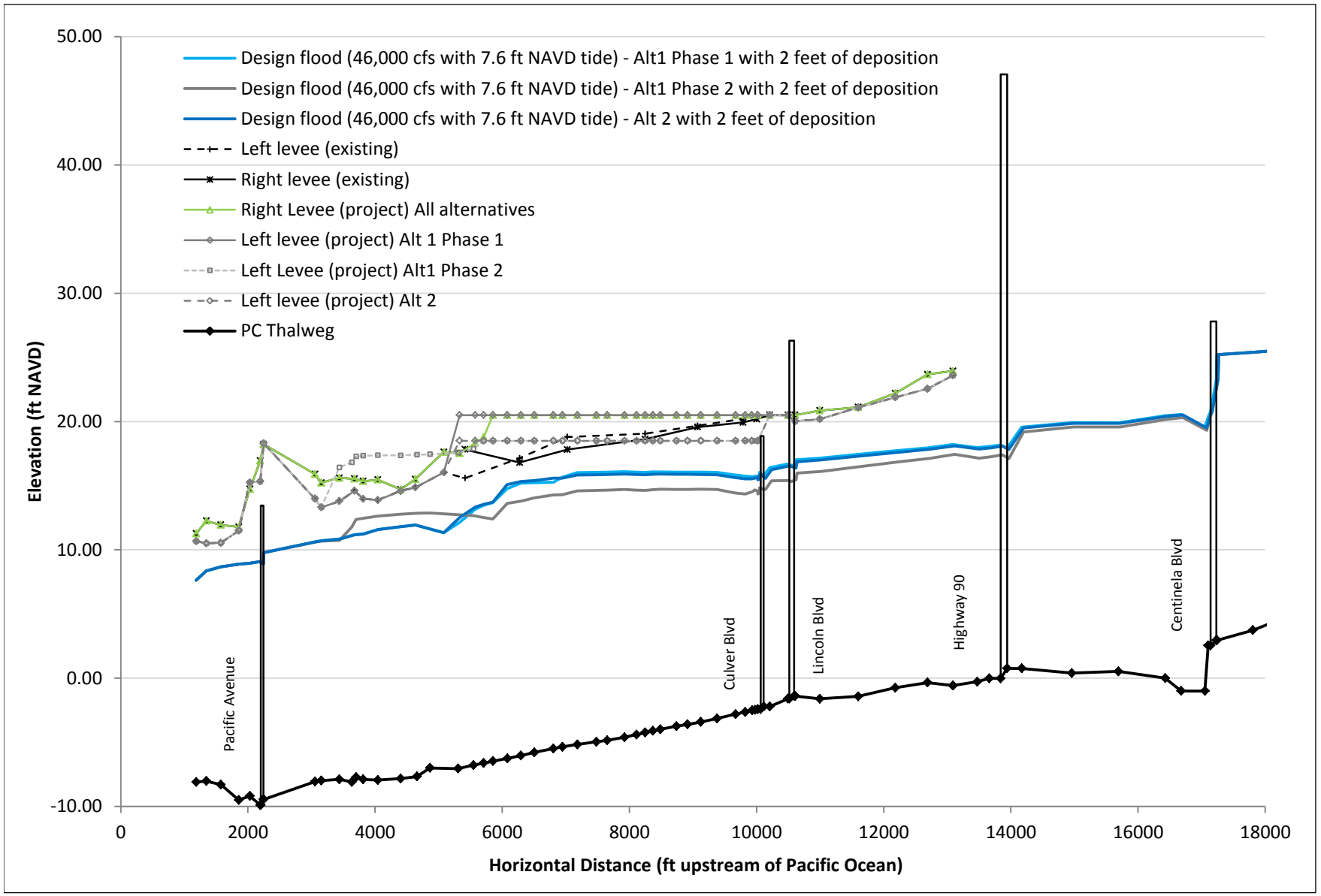
Flood Frequency Q500 for EC, Alt1 Phase 1, Alt 1, and Alt2



Ballona Wetland Restoration. D120367

Figure 4

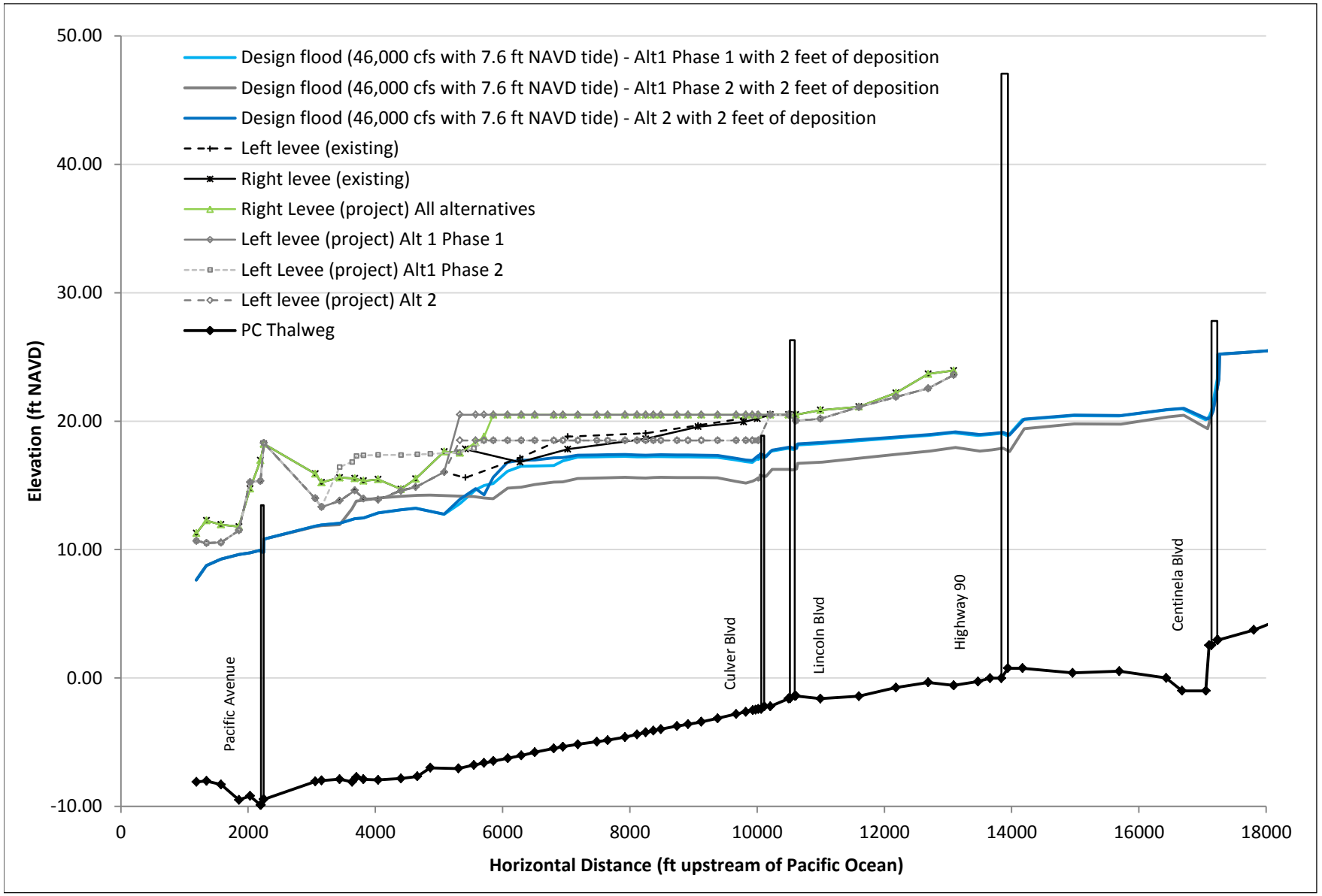
Design flood profiles for project alternatives with equilibrium tidal geometry



Ballona Wetland Restoration. D120367

Figure 5

Design flood profiles for project alternatives with 2 feet of deposition



Ballona Wetland Restoration. D120367

Figure 6

Design flood profiles for project alternatives with 4 feet of deposition

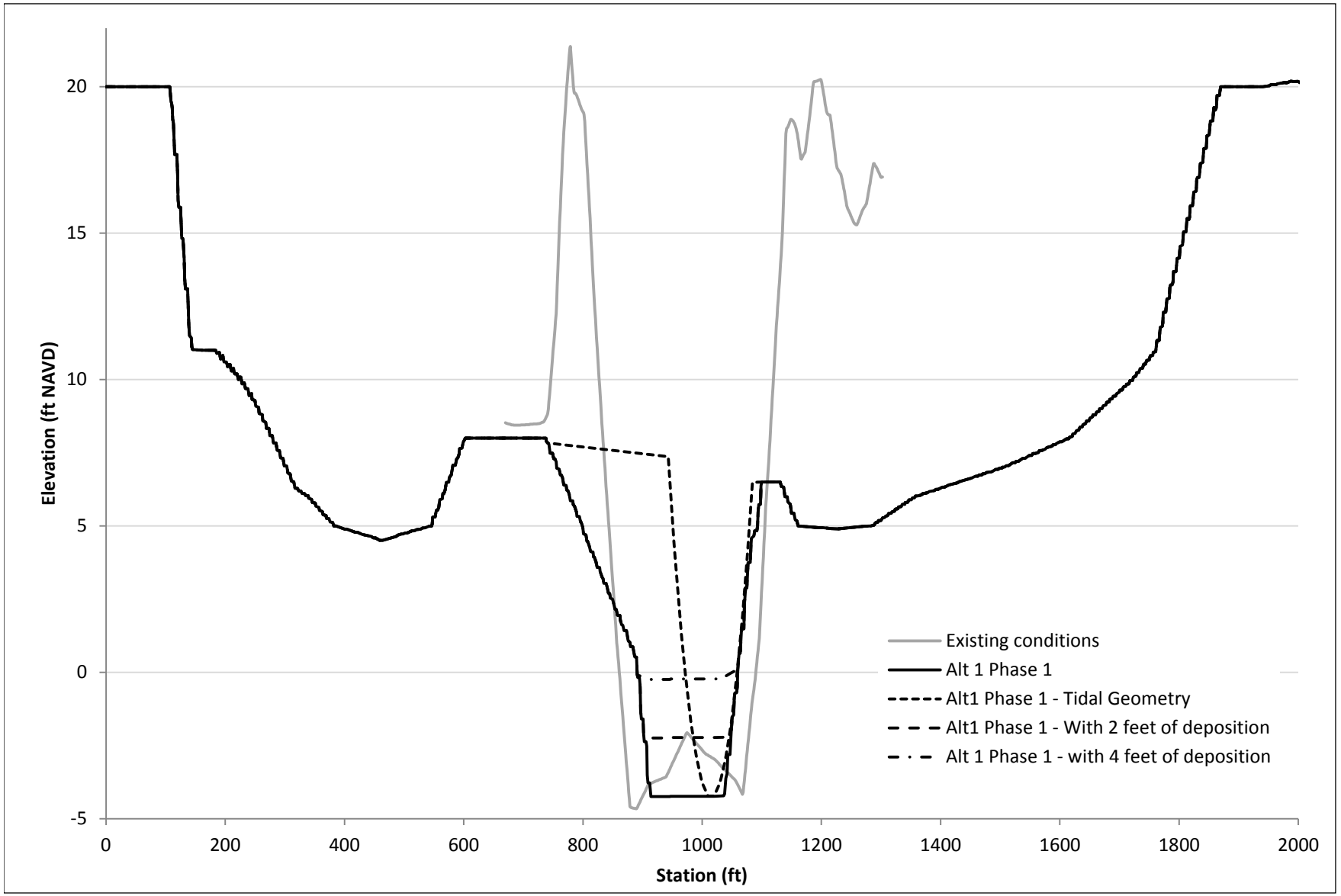


Figure 7

Cross-sections in Area A for existing and project conditions with sedimentation scenarios

APPENDIX F9
Draft Area B Managed Wetlands Preliminary Design

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memorandum

date August 3, 2015 – *updated November 6, 2015*

to Ballona Wetlands Restoration Project Management Team

from Lindsey Sheehan, P.E. and Nick Garrity, P.E.

subject Draft Area B Managed Wetlands Preliminary Design

This memorandum provides the detailed hydrology basis of design for the South and Southeast Area B managed wetlands enhancements, including design criteria for channels, berms, and water control structures as well as hydraulic modeling of existing and project conditions for typical operations and flood scenarios. This memo is an addendum to the September 2015 Preliminary Design Report and the May 2013 Hydraulics and Hydrology Report. This memo provides a discussion of the existing conditions in Section 1, the South and Southeast Area B design features in Section 2, and the model description and results in Section 3. Section 4 notes next steps.

1 Existing Conditions

A brief summary of existing conditions in West, South, and Southeast Area B is included below to provide context for this memo (Figure 1). Other project documents contain more detailed information on existing conditions (e.g., PWA 2006).

1.1 Tidal Connectivity

There are two channels in West Area B that connect to Ballona Creek via culverts through the levee under existing conditions (Figure 1). All of the culverts are equipped with control structures that are designed to limit inflows from Ballona Creek to West Area B. The west channel is connected to the creek with one 36-inch corrugated metal pipe (CMP) which has a one-way flap gate that keeps water from flowing into the marsh (Table 1) from Ballona Creek. The east channel has three 60-inch CMPs, two of which have self-regulating tide gates (SRT gates). The SRT gates are designed to close and prevent inflows when the water surface elevation of Ballona Creek reaches 3.4 ft NAVD, but in practice, they leak and allow water levels to increase in West Area B (LA County 2012). To keep the water levels in the marsh lower than

3.4 ft NAVD, the gates are currently operated to close at 1.4 ft NAVD (LA County 2012). The third CMP has a one-way flap gate intended to keep water from flowing into West Area B.

West Area B is connected to South Area B by three culverts that go under Culver Blvd. A 36-inch reinforced concrete pipe (RCP) connects West Area B to the northern South Area B channel and two 24-inch RCPs connect it to the southern channel (Table 1).

Southeast Area B and South Area B are divided by the Gas Company road, which has three culverts through it. The north channel has two 48-inch CMPs and the south channel has one 48-inch CMP (Table 1).

Southeast Area B also receives overflows from the Freshwater Marsh during storms greater than the mean annual event.

1.2 Existing Topography

The lowest elevations in the vicinity of South and Southeast Area B occur along Culver Blvd, and this is where flooding would occur first during a storm event. In South Area B where Culver Blvd crosses over the existing culvert and channel from West to South Area B, the road drops down and is about even with the surrounding marshplain. For about 300 ft, the middle of the road drops below 7 ft NAVD, with the edges of the road reaching down to below 6.3 ft NAVD. The remainder of Culver Blvd along South Area B is at elevations between 7 to 8 ft NAVD. Where Jefferson Blvd comes off from Culver Blvd, north of Southeast Area B, the road rises to 8 to 9 ft NAVD and then up to 12 ft NAVD when the lanes split. North of the Freshwater Marsh, Jefferson is above 14 ft NAVD. To the south of South and Southeast Area B, the Gas Company is above 7.5 ft NAVD west of the Gas Company Road and above 10 ft NAVD to the east.

The topography is South and Southeast Area B is on the higher end of the range for where salt marsh typically occurs. Generally, pickleweed grows from mean high water (MHW) to the highest high tide level (e.g., Highest Astronomical Tide or HAT). Elevations in South and Southeast Area B are generally conducive to pickleweed marsh (between mean tide level (MTL) and HAT within Ballona Creek), while most of West Area B is lower (between MTL and mean higher high water (MHHW) within Ballona Creek). However, the existing tides are muted by the SRT gates (Section 1.3), so most of the existing habitat does not receive regular tidal inundation. Figure 2 shows how the majority of the area in South and Southeast Area B, of which a portion supports pickleweed, is above the existing high water level, while most of West Area B is much closer to the high water elevation.

1.3 Hydrology and Inundation

West Area B experiences muted tides due to the SRT gates described above. West Area B habitat, which includes a range of marsh habitats, tidal channels, and salt pans, supports the Belding's savannah sparrow and other species. In particular, it has been noted that the current channel layout protects the Belding's savannah sparrow from predators, by limiting access to the marshplain. The muted tidal exchange supports pickleweed at lower elevations than would

be found if the area were fully tidal (Section 1.2). In West Area B, the pickleweed is able to grow down to 3.5 ft NAVD, due to the managed water levels. This is a foot below MHW in Ballona Creek (4.5 ft NAVD), so below the lower end of where pickleweed typically occurs (MHW). The muted tides also support a large salt pan at a lower elevation than would occur under full tidal conditions, due to less frequent flooding of the area.

Tides are further muted in South and Southeast Area B due to the culvert connections with West Area B. The muted tidal flow is limited to the existing ditches in these areas and does not inundate the marshplain. However, South and Southeast Area B do support areas of salt marsh vegetation (e.g. pickleweed). The pickleweed grows up to elevations of about 6.75 ft NAVD, which is approximately 2.9 ft higher than the highest managed tide level allowed by the existing culverts and 1.6 ft higher than mean higher high water (MHHW) in Ballona Creek (5.2 ft NAVD). The majority of pickleweed in South and Southeast Area B is considered non-tidal salt marsh, since it is at elevations above the managed tide range and not supported by tidal flows (The Bay Foundation and WRA 2014).

Although construction of the Freshwater Marsh has reduced storm flows to South and Southeast Area B, the pickleweed is likely still supported by residual soil salinity combined with infrequent inundation by stormwater runoff. Historically, storm drainage from the east flowed into the Centinella Ditch, which ran along the southern portion of South and Southeast Area B. Runoff inundated lower elevation areas in South Area B and the western portion of Southeast Area B during extreme rainfall runoff events (Straw 1987). Now, under existing conditions, the Freshwater Marsh intercepts runoff from the east and discharges low flows to Ballona Creek after providing water quality treatment. However, even with this removal of typical storm flows from the east, the flood modeling performed for this memo indicates that portions of South and Southeast Area B are inundated during extreme rainfall runoff events under existing conditions, which likely supports the pickleweed habitat (Section 3.2.2).

Additionally, groundwater elevation data shows that the pickleweed in South and Southeast Area B is likely not reliant on groundwater for survival. Groundwater data is available from July 1987 from a study by Straw, prior to construction of the Freshwater Marsh and installation of the SRT gates. These data indicate that groundwater levels were about 3 to 4 ft below the central portion of Southeast Area B and that the zone of soil saturation was likely about 2 ft below ground throughout the year over much of Southeast Area B except during years of extreme rainfall (Straw 1987). This information and data suggest that the existing salt marsh vegetation in South and Southeast Area B is likely supported by direct precipitation, limited and infrequent inundation by stormwater runoff, and residual soil salinity, but not groundwater.

2 Preliminary Design

The following section supplements PDR Section 3.6. The Preliminary Design for South and Southeast Area B is based on design objectives intended to achieve the goal of enhancing wetland habitat, while avoiding adverse effects to the surrounding properties. The design objectives for the South and Southeast Area B Managed Wetlands enhancements are as follows:

1. Restore and enhance pickleweed-dominant salt marsh habitat for Belding's savannah sparrow nesting habitat. Pickleweed habitat restoration and enhancement includes removal of invasive vegetation, establishment of pickleweed vegetation, and increased tidal inundation to support pickleweed marsh enhancement and function. Increasing tidal inundation involves installing new culverts under Culver Blvd. and enhancing tidal channels.

2. Restore and enhance tidal channels to convey tidal flows and promote marsh inundation. Enhanced tidal channels are also intended to create foraging habitat and to provide protection from predators for the Belding's savannah sparrow. Channel restoration and enhancement would involve excavating tidal channels in the Area B managed wetlands.

3. Maintain the existing level of flood protection for adjacent areas surrounding the Area B managed wetlands, including Culver and Jefferson Boulevards, the Gas Company, and the Freshwater Marsh storm detention and treatment wetland system for Playa Vista and adjacent areas.

4. Allow for management flexibility and adaptive management, including seasonally closed/non-tidal wetland habitat management to mimic certain wetland habitat conditions present at the site in the 1890s, if desirable.

5. Create a managed wetland system that will be resilient to sea level rise within the management constraints.

As part of the EIR/S process, four alternatives are being evaluated for the Ballona Wetlands Restoration. Chapter 2 of the EIR/S describes these alternatives in detail. This memo describes the preliminary design for Alternative 1 only, but is applicable to the other alternatives as well. For example, restoration under Alternative 2 involves a similar design, but without the final phase of restoration. Alternatives 3 and 4 do not involve significant grading south of Ballona Creek or alteration of the flood control features, so they are not included here.

Alternative 1 would use a phased approach to allow for successful evaluation of biologic (including special-status species), hydrologic, and geomorphic performance of early restoration stages prior to the commencement of further phases. Alternative 1 would involve two phases:

1. Phase 1: enhancement of the existing Area B managed wetlands, restoration of Area A and North Area B, new perimeter flood protection levees, and realignment of the Ballona Creek channel (Figure 3).
2. Phase 2: full tidal restoration of West Area B (Figure 4). Note, only the first phase would occur in Alternative 2.

Phase 1. New culverts with adjustable gates would be installed to connect a tidal channel in North Area B with the channels in Southeast Area B under the Culver Blvd levee (Figure 3, Section 2.1). An overflow weir would be installed in South Area B, before the culverts that go under Culver Blvd to West Area B, which would prevent flow from South Area B to West Area B

under normal tidal conditions. These connections would allow an increased tidal range south of Culver Blvd to improve pickleweed habitat, without affecting Belding's savannah sparrow existing nesting habitat in West Area B. Additionally, during extreme storm events, water from South Area B could flow over the weir to West Area B, which would provide additional storage area.

The SRT gates would allow for continued flexible management in West Area B. Tidal channels would be excavated in South and Southeast Area B to bring in more water, provide foraging habitat for birds, and offer nesting Belding's savannah sparrows protection from predators (Section 2.3). Berms would be constructed to protect the road to the north and the Gas Company to the south from the higher tide levels and storm flows (Section 2.4). An impoundment berm would be constructed to retain freshwater from the Freshwater Marsh in the southeast of Southeast Area B to encourage the development of brackish marsh habitat in this area and allow for brackish marsh management (Section 2.5).

Phase 2. When the Ballona Creek levee is breached and lowered and West Area B becomes fully tidal, the weir between South and West Area B would be removed and new, larger culverts with adjustable gates would be installed to increase flow between the two areas (Figure 4, Sections 2.1 and 2.2).

The project features and the basis for design are further described below.

2.1 Hydraulic Structures

Phase 1. New culverts with adjustable gates would be installed between Ballona Creek and Southeast Area B to allow an increase in water levels in South and Southeast Area B. Existing hydraulic structures under the Gas Company Rd would be replaced to increase flow capacity between South and Southeast Area B. In both locations, four 60-inch diameter pipe culverts or similar structures would be installed at an elevation of -1 ft NAVD. A new weir box would be added to the existing structure between South to West Area B to manage water levels. The weir would be installed in South Area B to prevent tidal waters from entering West Area B, but to allow stormwater to overflow. The weir would be set to an elevation of 7 ft NAVD.

Phase 2. The weir from South to West Area B would be removed, new, larger culverts (four 60-inch diameter culverts or similar) with adjustable tide gates would be installed. The gates would consist of combination slide/flap gates, SRT gates, or other similar gates or valves, however, tide gates are not required to maintain the existing level of flood protection. Hydraulic modeling results shows that flow through open culverts results in an acceptable range of water levels for typical conditions and the design storm event (Section 3.2); however, the addition of tide gates would provide added safety and design redundancy. The gates would also allow for management flexibility, including the option for managing for habitat seasonally closed to Ballona Creek. As sea level rises, the gates would be used to limit water levels in South and Southeast Area B.

2.2 Long-Term Operation of Hydraulic Structures

Because of the hydraulic connection to Ballona Creek, sea level rise will impact water levels south of Culver Boulevard over time. USACE (2011) estimates 59 inches of sea level rise will occur by 2100, under a high emissions scenario. Since there is substantial variability in the sea level rise estimates, water levels south of Culver Boulevard would be managed to adapt to changing water levels over time.

The hydraulic modeling in this memorandum assumes that there will be 59 inches of sea level rise by 2100. The project is designed so that management, including the addition of flap gates or other controls, can be altered easily in response to changing conditions. SRT gates could be used to limit maximum water levels, or flap gates and slide gates could be used to limit flow in and out of these areas. The project scenarios modeled for this memorandum assume that a flap gate would be added to one culvert at each bank of culverts (between South and West Area B and Southeast Area B and Ballona Creek) about every 25 years, so that by 2100 only one culvert would allow flow into South Area B from Ballona Creek and West Area B, while the other culverts would only provide outflow. This reduction in inflow capacity will limit water levels in the marsh in order to maintain flood protection.

2.3 Tidal Channels

Networks of branching, sinuous tidal channels would be excavated in South and Southeast Area B in Phase 1 and connected to Ballona Creek through a culvert through North Area B. The tidal channel network would extend from and drain to Ballona Creek during Phase 1 (Figure 3), with the flexibility to connect the channels through West Area B in Phase 2. The purpose of the tidal channels is to convey tidal flows and sediment to the restored wetlands, providing tidal circulation (inundation and drainage) to support wetland vegetation and functions. Tidal channels are also expected to provide foraging habitat and protection from predators for the Belding's savannah sparrow. See the PDR for further details on channel sizing and placement.

As described in Section 1.2, groundwater is not thought to be supporting the pickleweed habitat in South and Southeast Area B. This means that the existing channels can be deepened, and any flushing of groundwater should not impact the pickleweed habitat.

2.4 Perimeter Berms

Berms would be constructed along the lower portions of Culver Boulevard, Jefferson Boulevard, and the Gas Company to protect these areas from inundation due to the higher water levels in South and Southeast Area B (Figure 4). The berm crest elevation is set to 9 ft NAVD, in order to increase the existing freeboard during the design flood (see Section 3.2.2 for further discussion). The berm would be offset from the road by 30 ft, and have a top width of 8 ft. The berm would have a slope of 3:1 on the outboard side and a slope of 5:1 on the inboard side down to the marsh. With these dimensions, the berm would require approximately 11,300 cy of fill, which is slightly more than quantity cut from the tidal channels (9,400 cy).

2.5 Brackish Marsh Impoundment Berm

A new low berm would be constructed near the Freshwater Marsh to encourage brackish marsh habitat to establish in the eastern portion of Southeast Area B (Figure 4). This berm would include a weir with adjustable risers designed to allow tidal water into the area and delay drainage of the freshwater that flows into Southeast Area B from the Freshwater Marsh. Overtime, the freshwater impoundment is expected to leach salts from the soil and encourage brackish marsh vegetation to colonize. The berm would also provide transitional habitat and, with sea level rise, high tide refugia.

Adaptive management of the brackish marsh areas is expected to be required to encourage brackish marsh habitat development, and the brackish marsh design is therefore intended to provide management flexibility. Further development of the brackish marsh design will focus on designing water control structures that provide management flexibility rather than precise estimates of salinities.

At a height of 6.8 ft NAVD, the berm would impound freshwater and limit tidal inundation without causing backflow into the Freshwater Marsh with the Freshwater Marsh overflow weir set at the lowest weir elevation (6.9 ft NAVD). The berm would limit tidal inundation of the brackish marsh area until about 2050 (assuming 19 in of sea level rise), when it would be regularly overtopped, at which point the berm would no longer limit tidal inundation. The top width of the berm would be 5 ft and slope to the marsh at 10:1 on both sides. The berm would require approximately 350 cy of fill.

The Freshwater Marsh operation would be adjusted to allow more flow into the brackish marsh. Currently, the Freshwater Marsh can hold up to the annual storm (100% chance of recurrence in an average year or the 1 year storm) by lowering water levels during the summer (down to 4.4 ft NAVD) and allowing water to fill up to the lowest weir setting at 6.9 ft NAVD, before it overflows to Southeast Area B (PSOMAS, 2012). For the brackish marsh to receive freshwater every year, the Freshwater Marsh would need to be managed so that at least the 1 year storm (80 ac-ft) flows into Southeast Area B. A new culvert in the northwest of the Freshwater Marsh would be installed so that treated water would flow into Southeast Area B more frequently, rather than flowing out to Ballona Creek.

3 Hydraulic Modeling

Hydraulic modeling was conducted to evaluate water levels under existing and project conditions and to design the berm elevations and hydraulic structure dimensions. The goal of the modeling and design is to maintain or increase the level of flood protection along Culver Boulevard, Jefferson Boulevard, and the Gas Company property, while increasing tidal elevations to achieve the design objectives described in Section 2.

3.1 Model Setup

3.1.1 Model Geometry

Three HEC-RAS hydraulic model geometries were used to represent existing conditions, project conditions under Alternative 1, Phase 1 (which would be the same as Alternative 2), and project conditions under Alternative 1, Phase 2.

The model extent includes the Ballona Creek channel from the Pacific Ocean to just downstream of Centinella Creek (Figure 5). Additionally, the model includes West Area B, South Area B, and Southeast Area B, all modeled as storage areas. The model structures include: Lincoln Blvd, Culver Blvd, and the Pacific Highway bridges, as well as culverts between Ballona Creek and West Area B, between West Area B and South Area B, and between South Area B and Southeast Area B.

3.1.1.1 Topography

A combination of as-built structure data from the USACE model of the Ballona Creek drainage system (USACE 2010) and a digital terrain model (DTM) constructed for the PDR was used to develop existing conditions model geometry for the Ballona Creek system. All elevations are vertically referenced to NAVD88.

3.1.1.2 Storage Areas

West Area B, South Area B, and Southeast Area B were each modeled as individual storage areas for existing conditions, since water surface gradients across the areas are not significant. A stage-storage curve was developed for each area from the topography (Section 3.1.1.1). For Alternative 1, Phase 1 project conditions (Figure 6) model runs, the stage-storage curves that were used for existing conditions were adjusted to account for the tidal channel grading in South and Southeast Area B. For the Alternative 1, Phase 2 project conditions model runs, West Area B was included in the Ballona Creek channel cross-sections and eliminated as a storage area (Figure 7).

3.1.1.3 Structures

Ten culverts were modeled to represent connections between the storage areas and Ballona Creek under existing and project conditions. Table 1 summarizes how each connection was represented in the model geometry.

Under project conditions, the connections between West Area B and Ballona Creek are not modeled since West Area B is included in the channel cross-sections.

3.1.1.4 SRT Calibration

The SRT gates that connect West Area B to Ballona Creek allow water to leak into Area B when they are closed (LA County 2012; Section 1.1). To achieve modeled water levels similar to existing levels in the marsh, the model was run with the SRT gates closing down to a 0.2 ft opening at a rate of 0.2 ft/min when Ballona Creek water levels reach 2.2 ft NAVD. Once

channel water levels drop below 2.2 ft NAVD, the gates re-open. Water elevation data from the marsh and the channel, recorded in December 2011, were used to calibrate the SRT gates in the model. The calibration results are shown in Figure 8.

3.1.2 Hydrology

The flood flow rate modeled for the creek is the design flood of 46,000 cfs (USACE 1999) (see H&H report for additional details). A hydrograph based on model runs from the H&H Report was added just downstream of Centinella Creek and included the flows from Centinella, Sepulveda, and Ballona Creeks. This hydrograph is presented in Figure 9.

Stormwater inflow hydrographs were added to South and Southeast Area B to represent 100-year flows from the Freshwater Marsh (with the Ballona Creek outlet gate closed) and the Westchester Bluffs, respectively (PSOMAS 2012). The peak flow into Southeast Area B from the Freshwater Marsh is 174 cfs and the peak flow into South Area B from Westchester Bluffs is 160 cfs (PSOMAS 2012). Figure 9 presents these hydrographs. The 100-year flows result in a peak volume of 17 ac-ft in Southeast Area B and 34 ac-ft in South Area B (PSOMAS 2012).

3.1.3 Downstream Boundary Conditions

An unsteady tidal signal was used for the downstream boundary of the model. For the typical tides scenarios, a two week tide time series from December 2011 was used, in order to include a spring and neap cycle. For the storm runs, a one-day tide time series from February 2007 was used to represent a spring high tide cycle. The peak tidal water level of 6.22 ft NAVD was timed to occur just before the peak flow in Ballona Creek, when water levels in South and Southeast Area B would be at their highest due to the leaking SRT gates. Figure 9 shows these boundary conditions and the timing of the tides in relation to the flow hydrographs. Note that 7.6 ft NAVD, the downstream water level used to design the flood control channel, was not modeled, but may be in future efforts for the 408 Submittal B.

To represent conditions with sea-level rise for the years 2030, 2050, 2070, and 2100, the tidal signals were raised by 9, 19, 32, and 59 inches respectively per the USACE high emissions scenario (2011). To represent the worst-case storm scenario under sea-level rise conditions for the project, the peak flows were timed to coincide with the end of the neap cycle, when water levels in South and Southeast Area B would be at their highest.

Table 1. Model Culvert Data

		Ballona Creek to West Area B		West Area B to South Area B			South Area B to Southeast Area B			Ballona Creek to Southeast Area B
		West channel	East channel	North channel	South channel		North channel		South channel	
					North	South	North	South		
Existing Conditions	Number of culverts	1	3	1	1	1	1	1	1	
	Invert north (ft NAVD)	-1.28	-1.2							
	Invert south (ft NAVD)	-0.11	-1.2							
	Invert west (ft NAVD)			1.61	0.89	0.9	2.82	3.96	2.55	
	Invert east (ft NAVD)			2.56	0.94	1.08	3.2	3.74	2.23	
	Diameter (ft)	3	5 (FG)	3	2	2	4	4	4	
	Height x Width (ft)		5 x 3.93 (SRTs)							
	Length (ft)	58	50 (SRTs), 46 (FG)	77.3	87.5	89.8	30.8	30.1	41.5	
	Shape	Circular	Square (SRTs), Circular (FG)	Circular	Circular	Circular	Circular	Circular	Circular	
	Chart #	2 - CMP	2 - CMP	1 - RCP	1 - RCP	1 - RCP	2 - CMP	2 - CMP	2 - CMP	
	Scale #	1- Headwall	1- Headwall	1- Sq edge	1- Sq edge	1- Sq edge	1- Headwall	1- Headwall	1- Headwall	
	Entrance Loss Coefficient	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
	Exit Loss Coefficient	1	1	1	1	1	1	1	1	
	Manning's n	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	
	Gates	Flap gate	2 SRTs, 1 Flap gate							
	Gate closing elevation (ft NAVD)		3.4							
Alternative 1, Phase 1	Number of culverts	1	3		1	1	4			4
	Invert north (ft NAVD)	-1.28	-1.2							
	Invert south (ft NAVD)	-0.11	-1.2							
	Invert west (ft NAVD)				0.89	0.9	-1			-1
	Invert east (ft NAVD)				0.94	1.08	-1			-1
	Diameter (ft)	3	5 (FG)		2	2	5			5
	Height x Width (ft)		5 x 3.93 (SRTs)							
	Length (ft)	58	50 (SRTs), 46 (FG)		87.5	89.8	40			600
	Shape	Circular	Square (SRTs), Circular (FG)		Circular	Circular	Circular			Circular
	Chart #	2 - CMP	2 - CMP		1 - RCP	1 - RCP	2 - CMP			2 - CMP
	Scale #	1- Headwall	1- Headwall		1- Sq edge	1- Sq edge	1- Headwall			1- Headwall
	Entrance Loss Coefficient	0.5	0.5		0.5	0.5	0.5			0.5
	Exit Loss Coefficient	1	1		1	1	1			1
	Manning's n	0.024	0.024		0.024	0.024	0.024			0.024
	Gates	Flap gate	2 SRTs, 1 Flap gate		Weir structure					
	Gate closing elevation (ft NAVD)		3.4							
Alternative 1, Phase 2	Number of culverts			4			4			4
	Invert west (ft NAVD)			-1			-1			-1
	Invert east (ft NAVD)			-1			-1			-1
	Diameter (ft)			5			5			5
	Length (ft)			900			40			600
	Shape			Circular			Circular			Circular
	Chart #			2 - CMP			2 - CMP			2 - CMP
	Scale #			1- Headwall			1- Headwall			1- Headwall
	Entrance Loss Coefficient			0.5			0.5			0.5
	Exit Loss Coefficient			1			1			1
	Manning's n			0.024			0.024			0.024
	Gates			Flap gates with SLR over time (0 fg initially, 1 fg at 9”, 2 fg at 19”, 3 fg at 32”,3 fg and 1 slide gate at 59”)						Flap gates with SLR over time (0 fg initially, 1 fg at 9”, 2 fg at 19”, 3 fg at 32”,3 fg and 1 slide gate at 59”)

HEC-RAS can model SRT gates as rectangular culverts, but not circular, so dimensions were chosen to match the culvert area and culvert elevations.

3.1.4 Run Catalog

Sixteen scenarios were run. These included existing and project conditions (Alternative 1, Phase 1 and 2), typical tides and the design storm event, and sea-level rise. **Error! Reference source not found.** provides the run catalog.

Table 2. Model Run Catalog

	Run	Scenario	Hydrology	Downstream Boundary Conditions	Sea-Level Rise
Typical tides	Calibration	Existing	-	Two weeks typical tides	-
	1	Existing	-	Two weeks typical tides	-
	2	Alt 1, Phase 1	-	Two weeks typical tides	-
	3	Alt 1, Phase 2	-	Two weeks typical tides	-
Design Event	4	Existing	Design Event	Spring high tide	-
	5	Alt 1, Phase 1	Design Event	Spring high tide	-
	6	Alt 1, Phase 2	Design Event	Spring high tide	-
Sea Level Rise	7	Existing	-	Two weeks typical tides	9” (high)
	8	Existing	-	Two weeks typical tides	19” (high)
	9	Existing	-	Two weeks typical tides	32” (high)
	10	Existing	-	Two weeks typical tides	59” (high)
	11	Alt 1, Phase 2	-	Two weeks typical tides	9” (high)
	12	Alt 1, Phase 2	-	Two weeks typical tides	19” (high)
	13	Alt 1, Phase 2	-	Two weeks typical tides	32” (high)
	14	Alt 1, Phase 2	-	Two weeks typical tides	59” (high)
Design Event with SLR	15	Existing	Design Event	End of neap tides	59” (high)
	16	Alt 1, Phase 2	Design Event	End of neap tides	59” (high)

3.2 Results and Discussion

Model results are presented in Table 3 and Figures 10-16 and discussed in the following sections.

3.2.1 Typical Tides

Figure 10 shows model results for tidal inundation extent during a low tide and spring high tide in Ballona Creek for existing conditions and Alternative 1 (Phase 1 and Phase 2). Under existing conditions, only the remnant channels in South and Southeast Area B are inundated, due to the muted, managed water levels, which have damped high tide levels. Similarly, West Area B experiences a small extent of inundation as well. Under the proposed operations for Phase 1, the new culverts would allow higher water levels, which would increase inundation in South and Southeast Area B. In Phase 2, water levels would increase even more as the culverts to West Area B are expanded. The eucalyptus grove in South Area B near the Gas Company does not experience any inundation under existing conditions. With Alternative 1, the edge of the grove would be tidally inundated. A berm could be

added around the grove to protect it from tidal waters if the inundation is determined to be detrimental.
The elevation-area curves in Figure 11 show inundated acreage under existing, Phase 1, and Phase 2 project conditions. The model results indicate that Phase 1 would inundate an additional 64 acres of marsh in South and Southeast Area B (65 acres total), and Phase 2 would inundate 75 acres.

Figure 12 shows the model results for a typical tidal signal. Under existing conditions, the modeled water level in each area rises with the tide until the water level in Ballona Creek reaches the elevation at which the SRT gates close , and then slowly increases in proportion to the water level in the creek (due to leakage in the SRT gates) until the Creek water levels drops. As the Creek level drops, the areas drain out to the lowest ground surface elevation.

Phase 1 model results show water levels in West Area B would follow the same pattern because the area would be operated the same in Phase 1 as under existing conditions. In South and Southeast Area B model results show some high tide muting despite the increased culvert capacity. With the tidal channel grading, the tidal prism in South and Southeast Area B increases dramatically from 17 ac-ft to 84 ac-ft, and even with the additional and larger culverts, the flow cannot be conveyed quickly enough into the site to raise water levels to the Ballona Creek peak water level before the tide in the Creek starts to drop. This is reflected in the model results, which show peak water level in South and Southeast Area B somewhat lower than the Ballona Creek peak water level.

Under Phase 2, the culvert capacity effectively doubles from Phase 1 (with the removal of the weir from South to West Area B and the new, larger culverts), but model results show the high tide is still slightly muted. However, the muting is not substantial and increasing the culvert dimensions further would offer a decreasing return on investment.

3.2.2 Design Storm Event

During the design storm event under existing conditions, the maximum water level in South and Southeast Area B reaches 5.3 ft NAVD according to model results (Figure 13, **Error! Reference source not found.**). This results in 1.5 ft of freeboard to the low point in Culver Boulevard (6.8 ft NAVD).

In Alternative 1, Phase 1, model results show that the water levels in West Area B are initially lower than under existing conditions because the weir from South to West Area B limits flow. Once the water levels in South Area B overtop the weir (6 ft NAVD), the water levels in West Area B increase and peak to the same level as under existing conditions (4.5 ft NAVD). The weir also limits drainage from South and Southeast Area B. This is reflected in the model results, which show it takes longer (< 1 hour) to drain these areas under Alternative 1, Phase 1 than under existing conditions. Model results show peak water levels in South and Southeast Area B increase to 7.0 and 7.1 ft NAVD respectively under Alternative 1, Phase 1 conditions. However, with the new perimeter berm (9 ft NAVD), freeboard increases to 1.9 ft (Table 3).

In Alternative 1, Phase 2, West Area B would be reconnected to Ballona Creek and the water levels in South and Southeast Area B would increase slightly from Phase 1 according to model results (to 7.3 and 7.4 ft NAVD respectively). The second culvert connection through West Area B allows water to

move more quickly into the site, so modeled water levels are higher even before the storm peak passes. However, model results show that the new berm would provide 1.6 ft of freeboard at the peak water level of 7.3 ft NAVD (Table 3).

Since Ballona Creek flow expands and slows in West Area B under Phase 2 project conditions, model results show water levels at the creek side of the tide gates remain elevated for longer than under existing conditions (Figure 13). This would delay drainage in the areas south of Culver Blvd, but the increased culvert capacity allows water to flow out more quickly (2 hours faster than Phase 1, according to model results).

These results demonstrate that flood hazard is not increased under Alternative 1 relative to existing conditions. The modeled project design assumes open culverts without gates; SRT gates or similar types of automatic gates could be added to the culverts under Phase 2 project conditions if more freeboard and lower water levels are desired or for added safety and design redundancy.

3.2.3 Sea-Level Rise

With sea level rise, inundation is expected to increase over time. Without the project, low tide and high tide inundation will be similar, and habitats will convert to lower elevation habitat types (mid marsh to low marsh or low marsh to mudflat). With the project, the tidal signal can be maintained for a longer time. Figure 14 shows the low and high tide inundation with sea level rise over time.

With 59 inches of sea-level rise by 2100 (USACE 2011), MLLW will rise to 4.7 ft NAVD, which is more than two feet above the current SRT closing elevation. Under typical tidal conditions with sea-level rise (i.e., future without project conditions), this means that the water level in all of the managed areas would continually increase (due to the leakage in the SRT gates) except during spring low tides occurring every two weeks when the water can drain out, as shown in the model results in Figure 15. Under project conditions, modeled water levels still show a tidal signal (as opposed to under existing conditions), because the open culverts allow higher tides and are bigger than under existing conditions, so they provide better drainage. While pickleweed in South and Southeast Area B may not survive until 2100 due to the elevations and the increased duration of inundation in South and Southeast Area B, the vegetation would survive longer than it would without the project.

When the design storm event occurs under sea level rise conditions, water levels south of Culver Boulevard would depend largely on whether the event occurs during a spring or neap tide according to the model results. As shown in Figure 15, the modeled water elevations in South and Southeast Area B due to the tides alone can range from 3.6 to 8.2 ft NAVD under project conditions. The worst-case scenario for project conditions would be if the peak flow hit toward the end of the neap tides, when the water levels would already be at their highest south of Culver Boulevard. The model shows that this would result in water levels up to 8.7 ft NAVD (Figure 16, **Error! Reference source not found.**), with 0.3 ft of freeboard for the berm. Under existing conditions, West Area B provides additional storage, and the SRT gates are operated to close at a lower elevation, so the water levels are 2 feet lower (6.7 ft NAVD) than project conditions; however, the freeboard for Culver Blvd under existing conditions is only 0.1 ft. Model results show that the Project would, therefore, maintain or increase the level of flood protection in the future with up to 59 inches of sea level rise.

Table 3. Area B Water Level Results Summary

		Area B	Existing Conditions (EC)	Alternative 1, Phase 1	Change from EC	Alternative 1, Phase 2	Change from EC
Existing Hydrology	Highest Tide Level	All	3.9	5.7	1.8	6.1	2.2
	Design Storm Peak Water Level	West	4.5	4.5	0.0	-	-
		South	5.3	7.0	1.7	7.3	2.0
		Southeast	5.3	7.1	1.8	7.4	2.1
	Freeboard[1]		1.5	1.9	0.4	1.6	0.1
Sea-Level Rise	Highest Tide Level	All	6.3	-	-	8.2	1.9
	Design Storm Peak Water Level	South	6.7	-	-	8.7	2.0
		Southeast	6.7	-	-	8.7	2.0
	Freeboard[1]		0.1	-	-	0.3	0.2

1. Freeboard is to Culver Blvd low point (6.8 ft NAVD) for Existing Conditions and Phase 1, and to the new berm (9.0 ft NAVD) for Phase 2.

3.3 Summary and Conclusions

For the culvert configuration and operation modeled for this preliminary hydraulic design, high tide levels south of Culver Blvd would be increased by 1.8 ft to 5.7 ft NAVD in Phase 1, and increased by 2.2 ft to 6.1 ft NAVD in Phase 2 under typical tidal conditions (**Error! Reference source not found.**). The proposed new perimeter berm would maintain the existing freeboard above high tide for Culver Boulevard in Phase 2, which is approximately 2.9 ft.

With the proposed structure configuration for Phase 1 project conditions, the water levels in South and Southeast Area B during the design storm would increase by 1.8 ft due to the higher starting tidal water levels. In Phase 2, the modeled peak water levels increase further, due to the extra culverts, which allow more flow into the site before the storm peak. During the design storm, the modeled water levels south of Culver Blvd increase by 2.1 ft, but are still 1.6 ft below the proposed new perimeter berm and therefore maintain the existing freeboard (**Error! Reference source not found.**). Subsequent phases of the design will consider the addition of SRT or similar tide gates and hydraulic controls to limit peak water levels and provide added safety and design redundancy. Culvert sizes and designs will also be refined.

With 59 inches of sea-level rise projected in 2100, the project would increase water levels by 1.9 ft under tidal conditions, and 2 ft during the design storm, according to the model results. However, with the proposed new perimeter berm, freeboard is increased by 0.2 ft during the design storm.

Model results for typical tidal conditions demonstrate that Alternative 1 functions to increase the tide range in South and Southeast Area B, therefore enhancing pickleweed-dominant salt marsh, without increasing the tide range in West Area B under Phase 1, in order to protect existing Belding's savannah sparrow nesting habitat. Model results for design storm conditions demonstrate that flood hazard is not increased under Alternative 1 relative to existing conditions. The model results also demonstrate that the design will be more resilient to sea level rise than existing conditions. Additionally, the design

allows for management flexibility and adaptive management, thus achieving all of the design objectives.

4 Next Steps

The South Area B managed wetland enhancement design will be further developed in subsequent phases of the design, including:

- Develop gate configuration design. For the new water control structures in the Culver levee in Phase 2, combination slide and flap gates or SRT gates could be used.
- Develop water management design for the brackish marsh area, including the brackish marsh impoundment water control structure design and operation and modifications to the Freshwater Marsh structures.

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6 List of Preparers

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Figure 1. Site Overview

Figure 2. Existing Pickleweed Elevations

Figure 3. Alternative 1, Phase 1 Restoration

Figure 4. Alternative 1, Phase 2 Restoration

Figure 5. Existing Conditions Model

Figure 6. Alternative 1, Phase 1, Project Conditions Model

Figure 7. Alternative 1, Phase 2, Project Conditions Model

Figure 8. SRT Gates Calibration

Figure 9. Model Hydrographs and Tidal Signals

Figure 10. Increased Inundation Under Alternative 1, Plan View

Figure 11. Increased Inundation Under Alternative 1, by Elevation

Figure 12. Typical Tides Model Results

Figure 13. Design Flood Model Results

Figure 14. Inundation Under Alternative 1 with Sea Level Rise

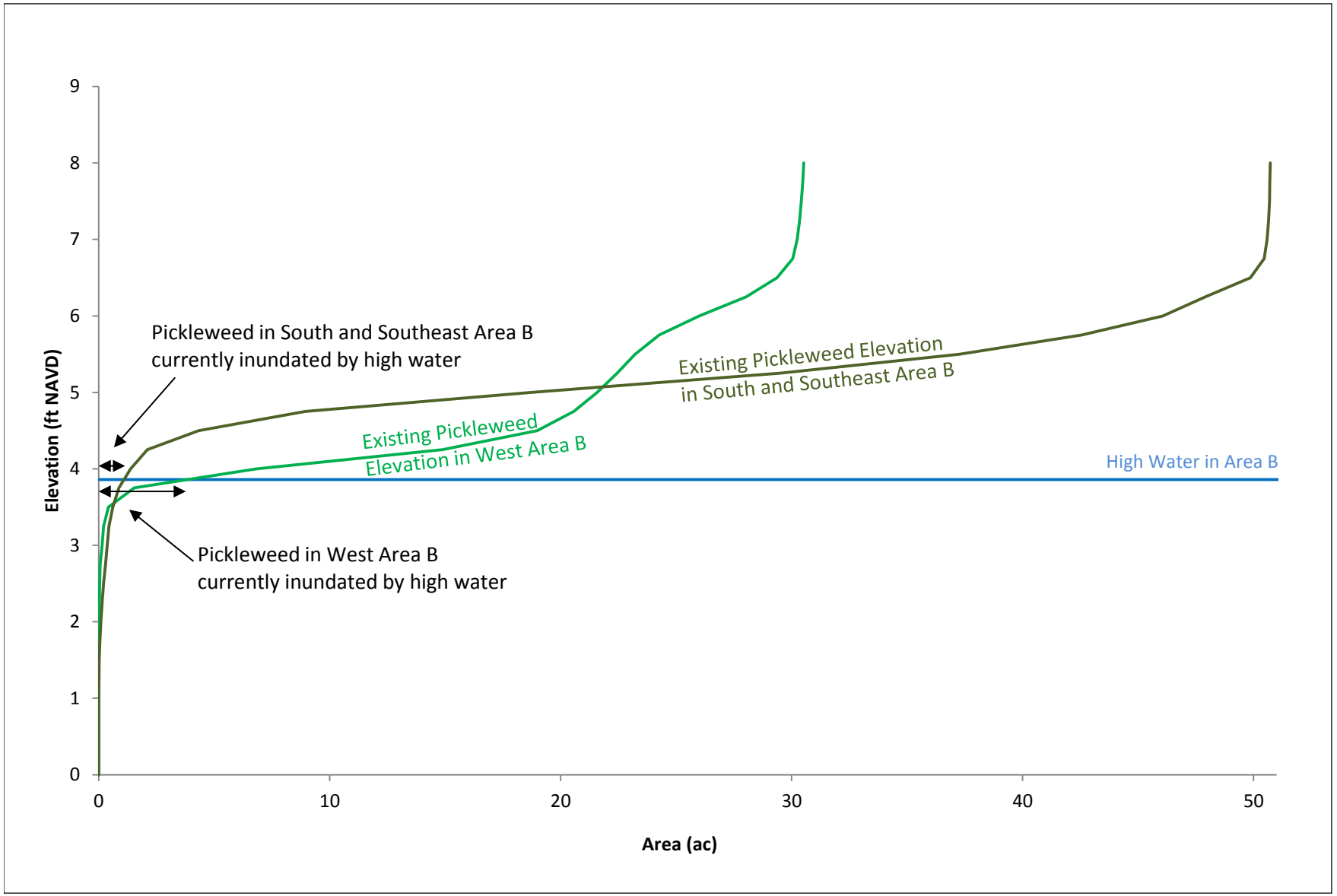
Figure 15. Typical Tides with Sea Level Rise Model Results

Figure 16. Design Flood with Sea Level Rise Model Results



Ballona Wetlands Restoration Project

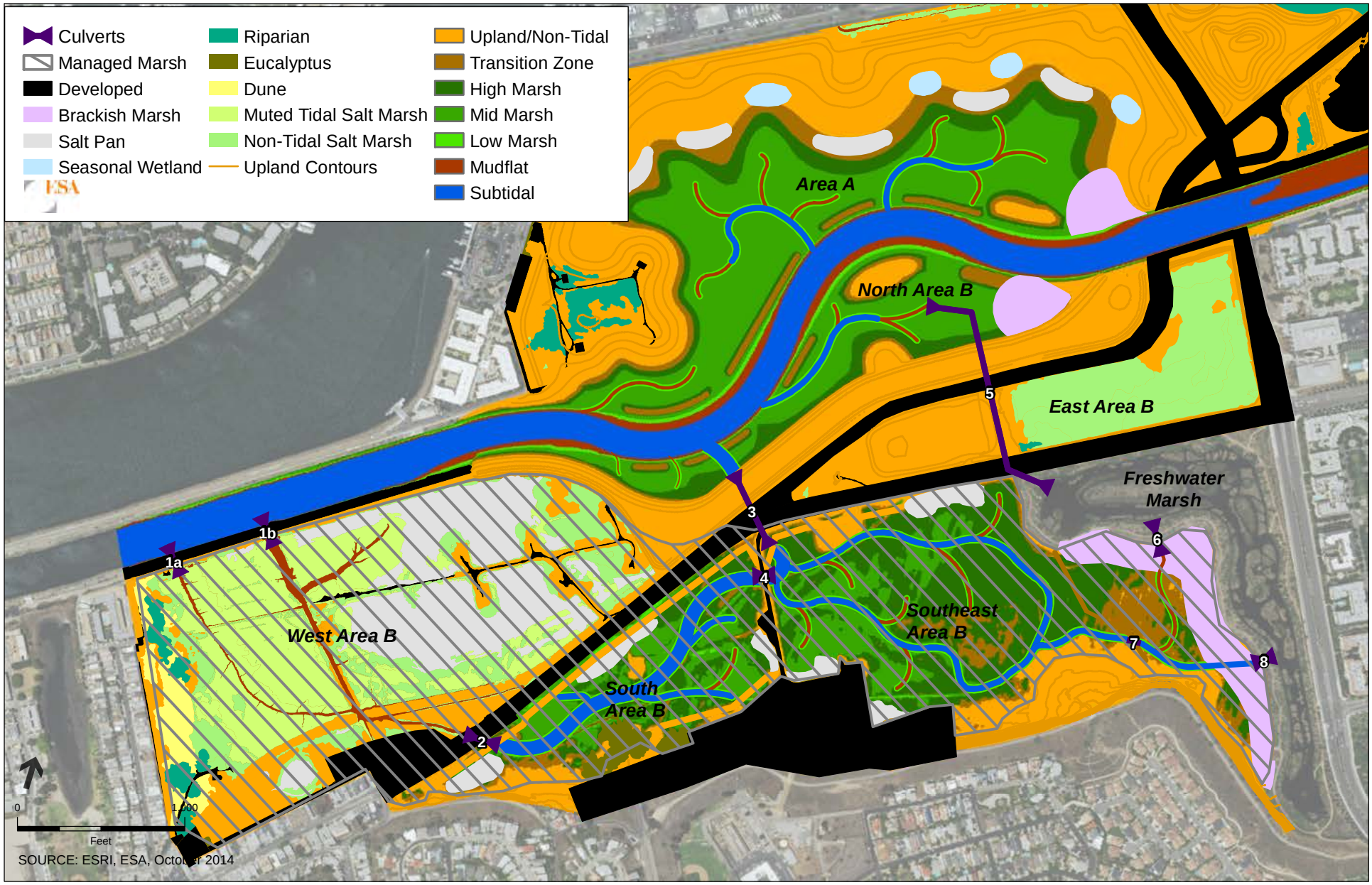
Figure 1
Site Overview



Note: Elevation data from PSOMAS 2013 for PDR. Habitat mapping from the California Department of Fish & Game's (2007) habitat and vegetation mapping.

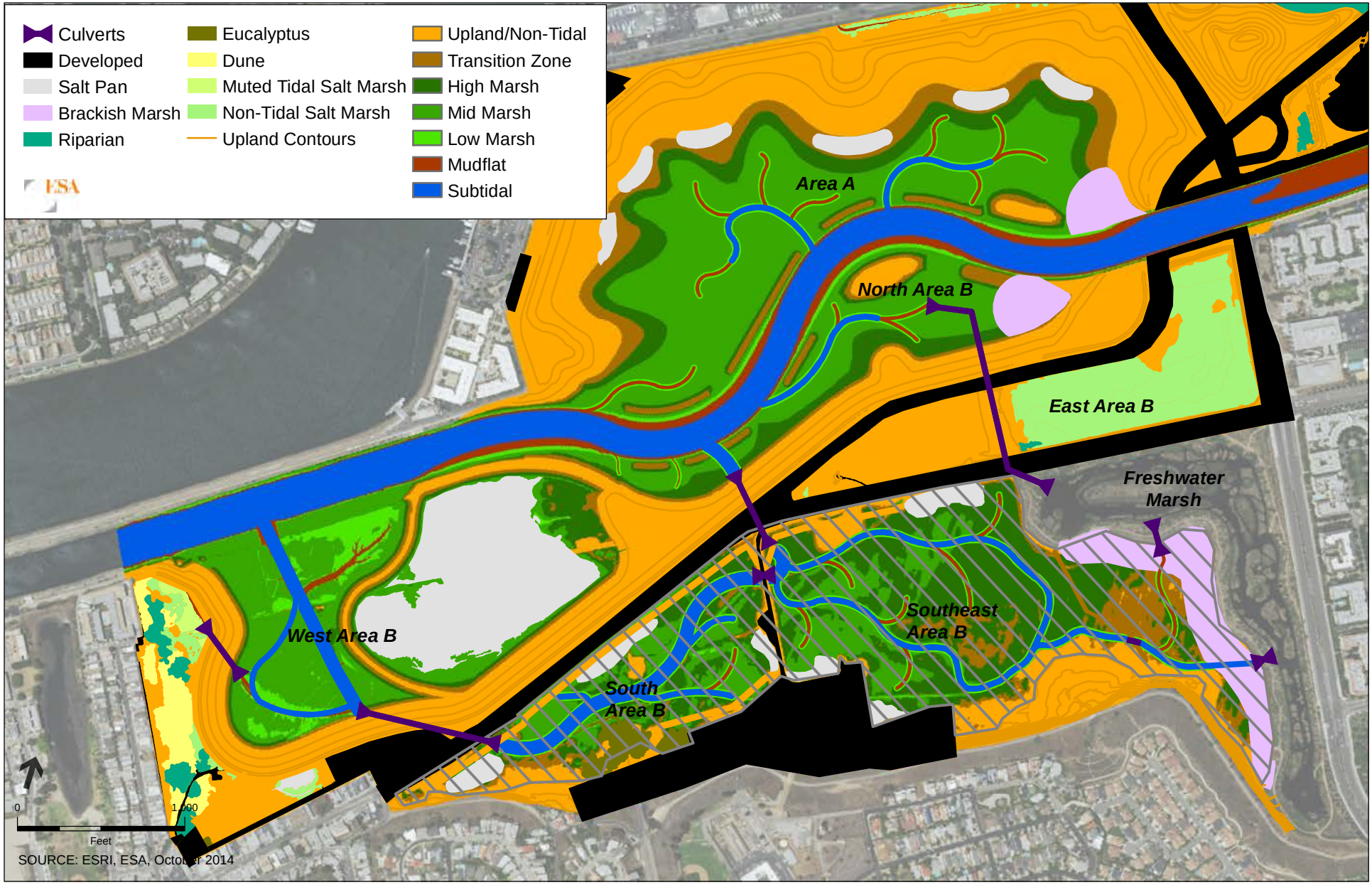
Ballona Wetlands. D120367

Figure 2
Area B
Existing Pickleweed Elevations



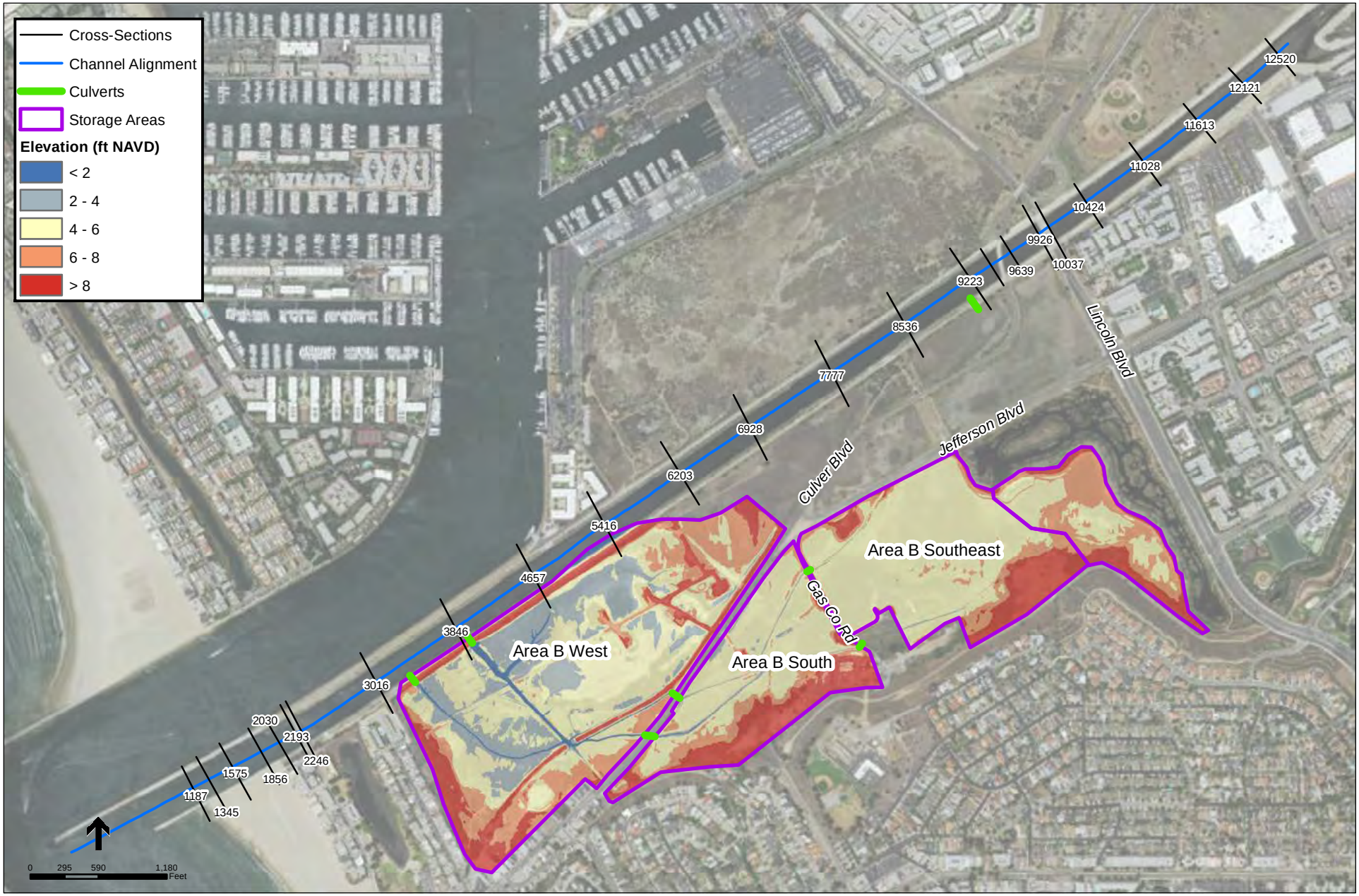
Ballona Wetlands Restoration Project

Figure 3
Alternative 1, Phase 1 Restoration



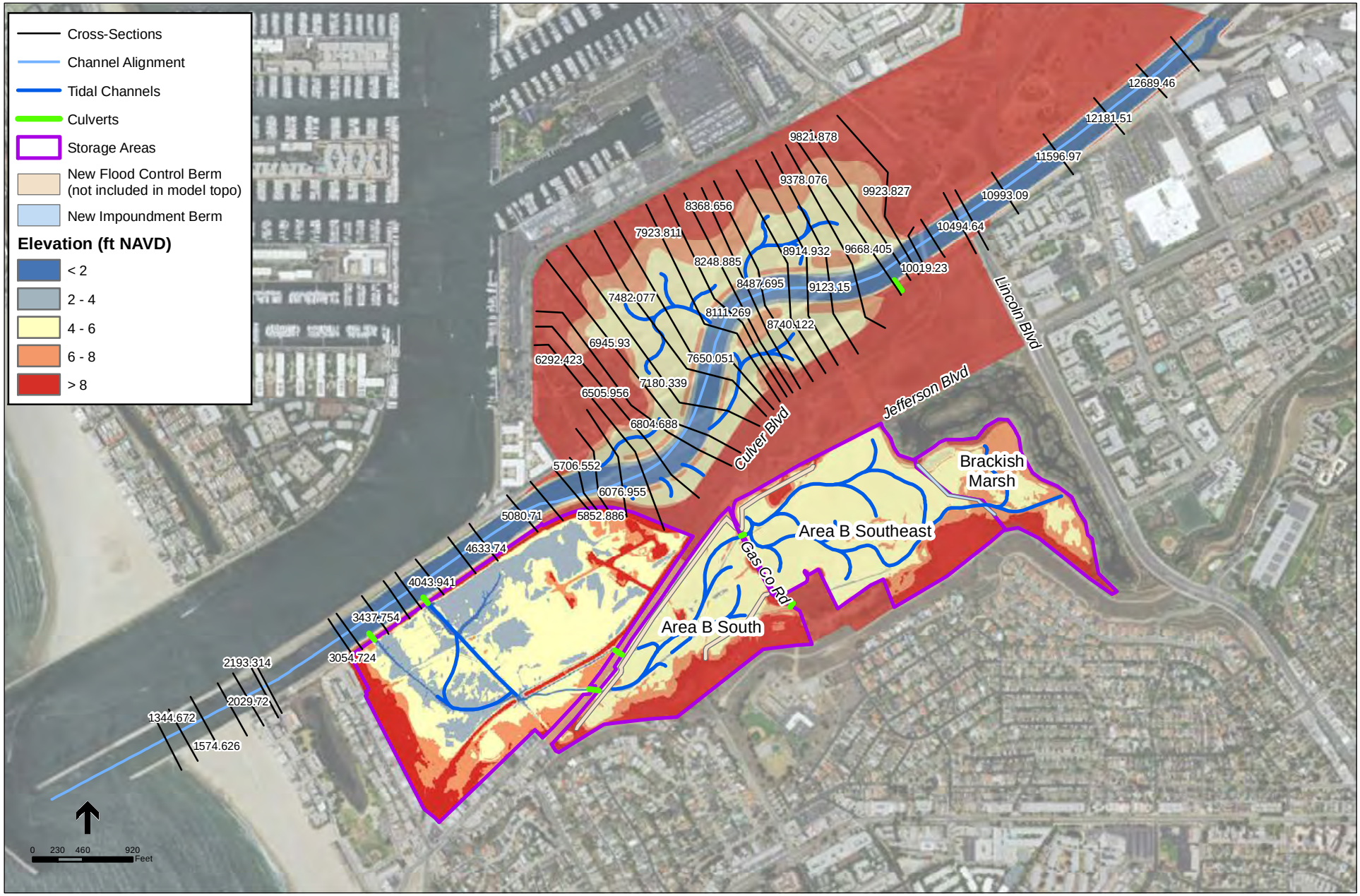
Ballona Wetlands Restoration Project

Figure 4
Alternative 1, Phase 2 Restoration



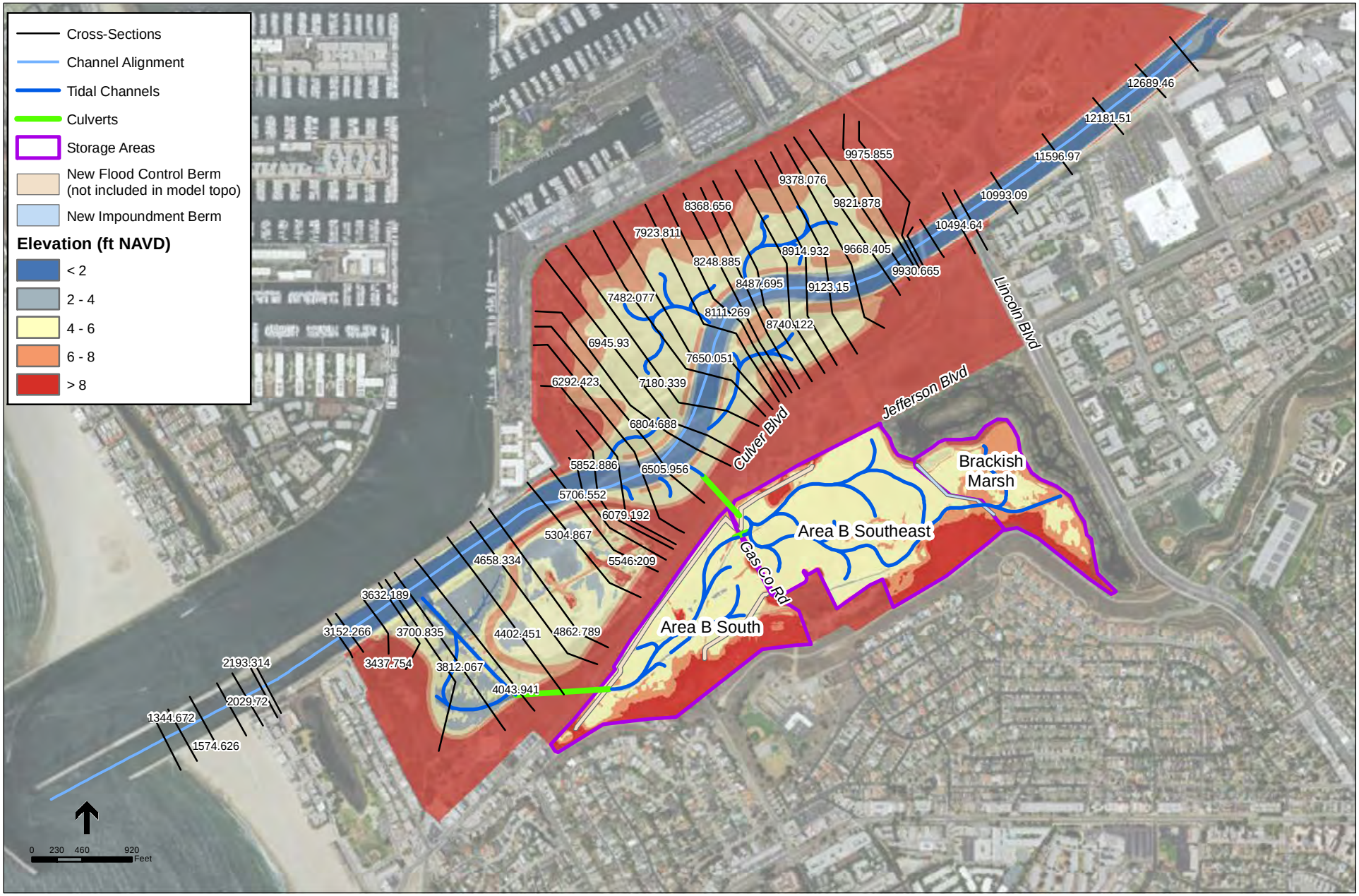
Ballona Wetlands Restoration Project

Figure 5
Existing Conditions Model



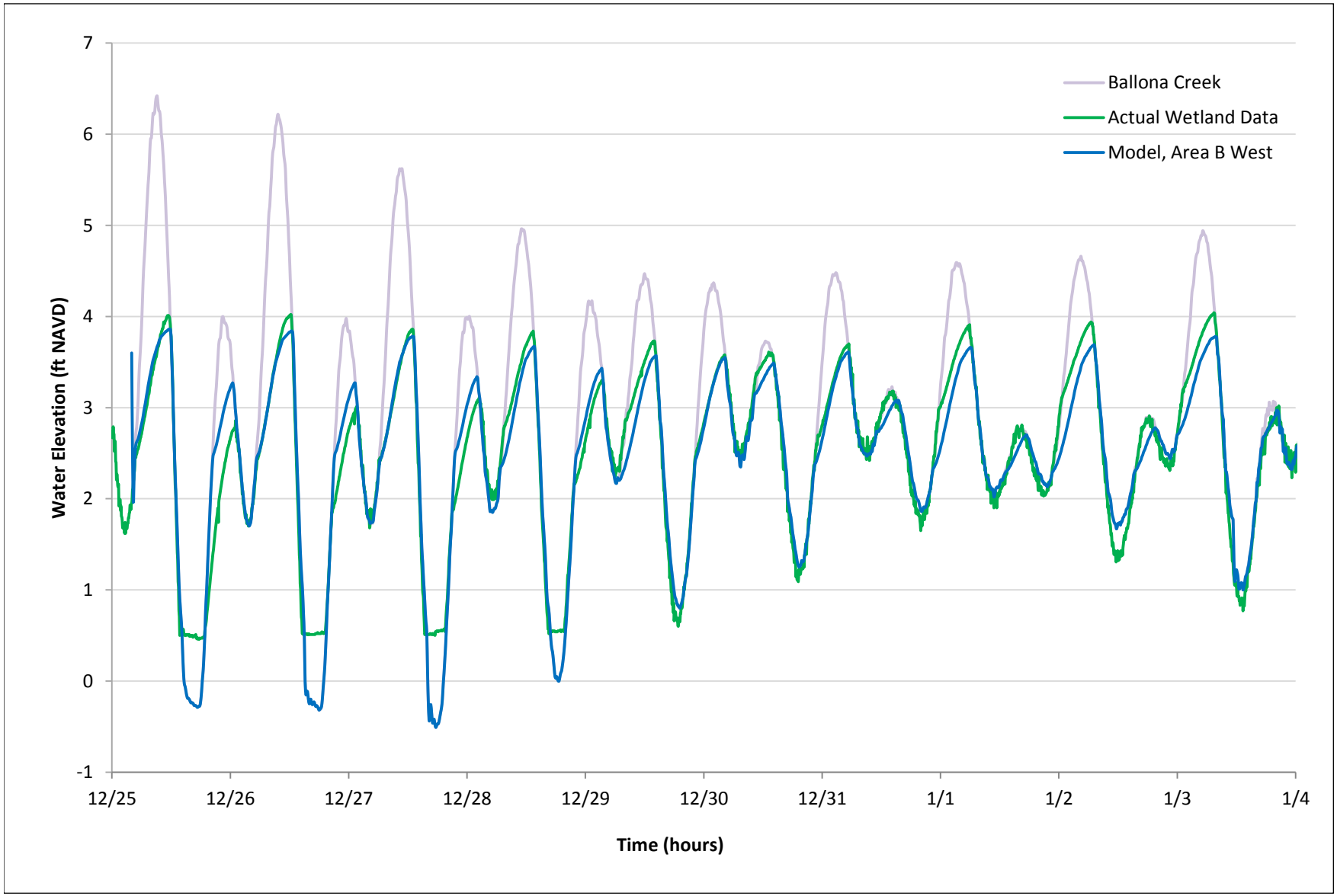
Ballona Wetlands Restoration Project

Figure 6
Alternative 1, Phase 1,
Project Conditions Model



Ballona Wetlands Restoration Project

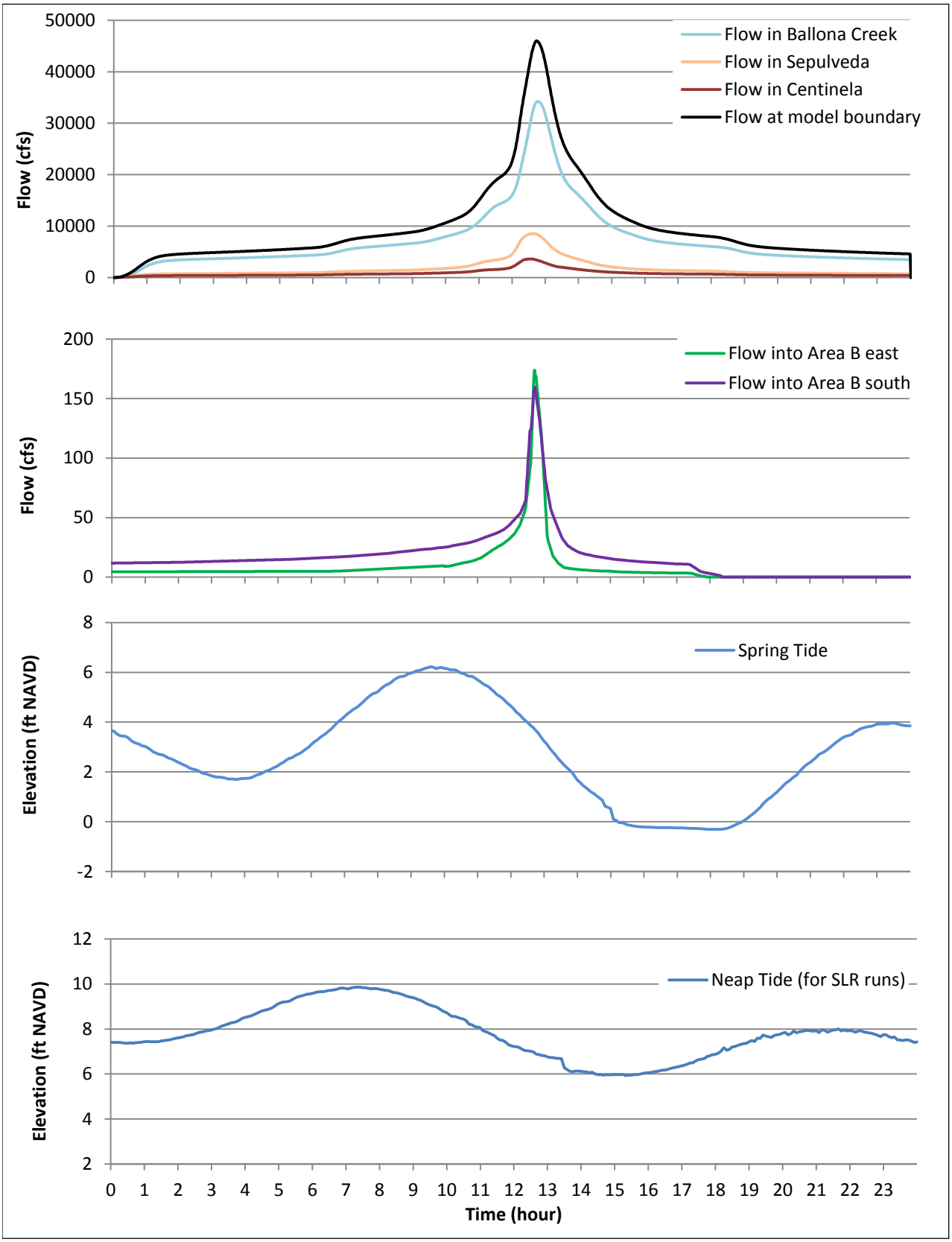
Figure 7
Alternative 1, Phase 2,
Project Conditions Model



Ballona Wetlands. D120367

Note: Ballona Creek water levels taken just outside Area B

Figure 8
Area B
SRT Gates Calibration



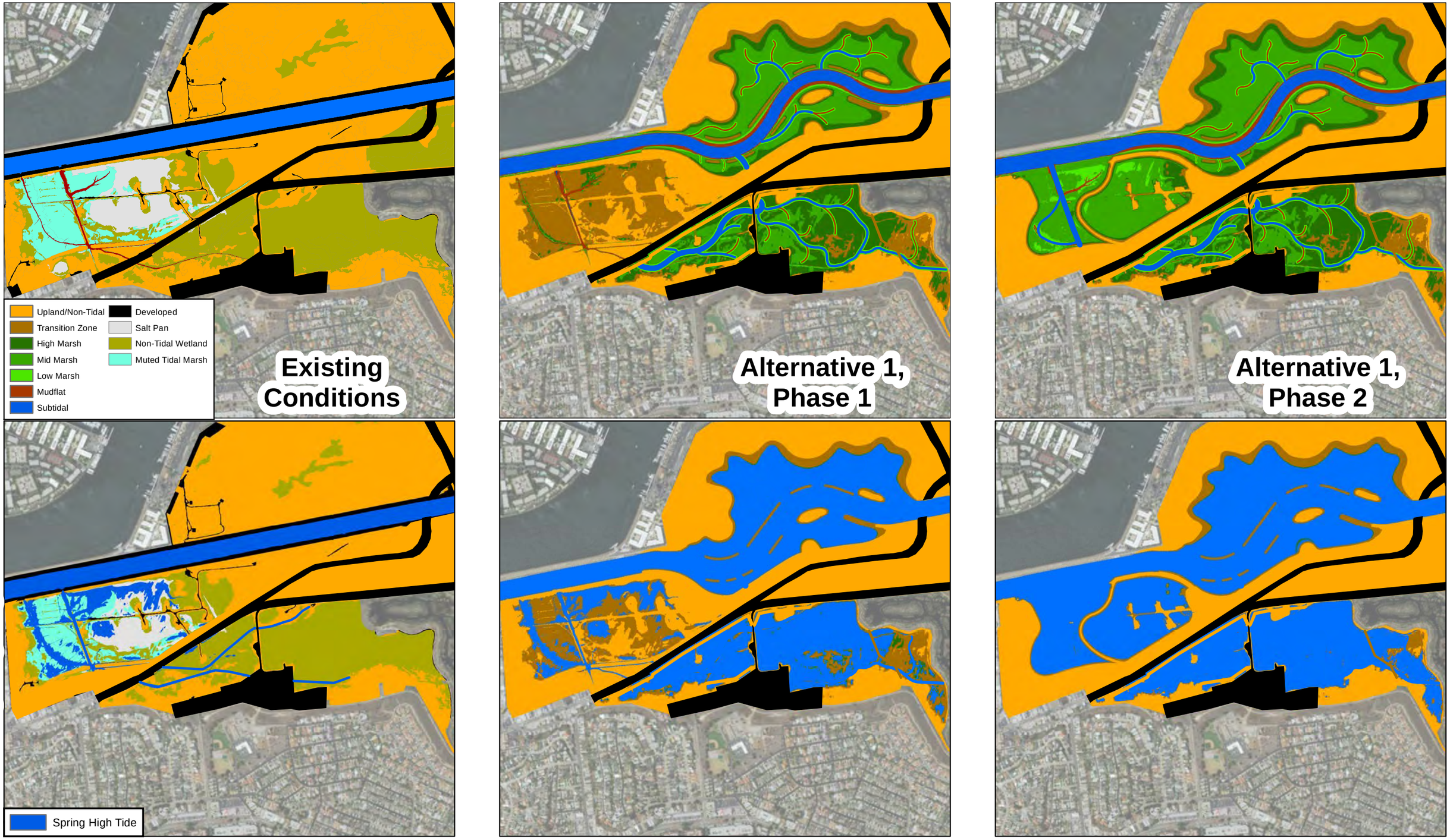
Ballona Wetlands Restoration Project

Figure 9
Model Hydrographs and Tidal Signals

SOURCE: Channel hydrographs from USACE HMS model; Area B hydrographs from PSOMAS 2012; Tide data from NOAA at the Santa Monica gage.
NOTES: Channel hydrographs represent the design flood event; Storage area hydrographs represent the Q100.

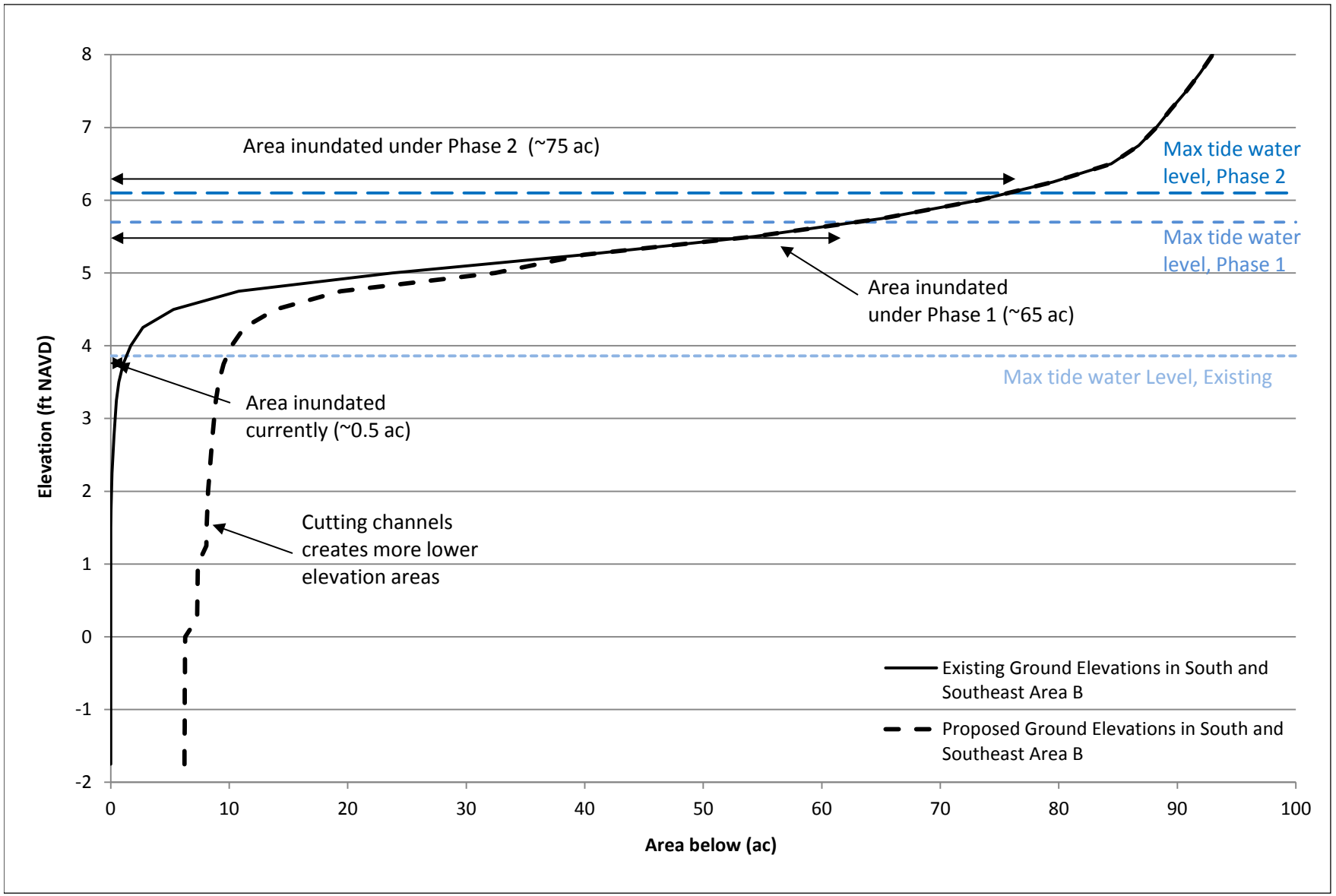
Low Tide

Spring High Tide



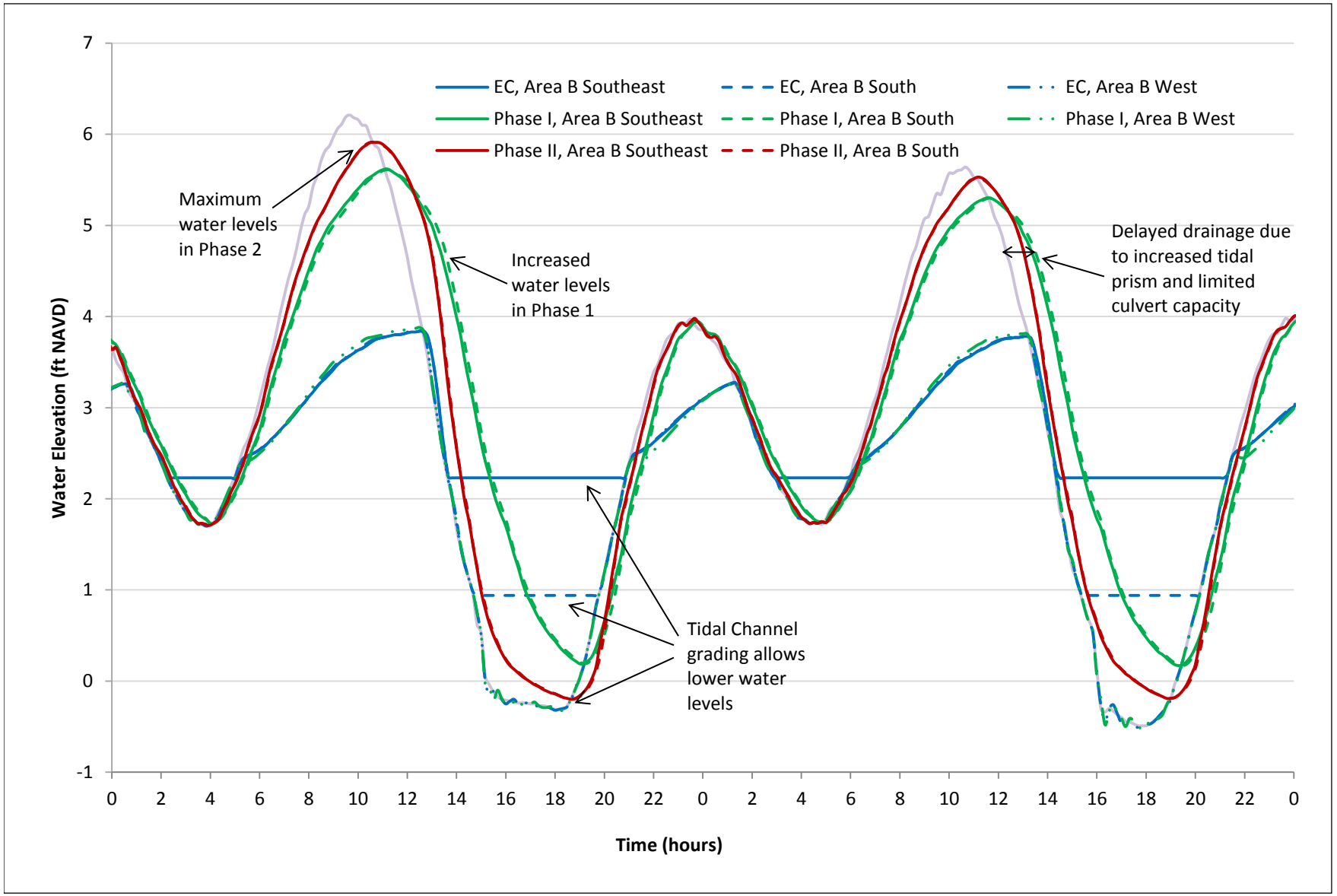
Ballona Wetlands Restoration Project

Figure 10
Increased Inundation Under Alternative 1, Plan View



Ballona Wetlands Restoration Project

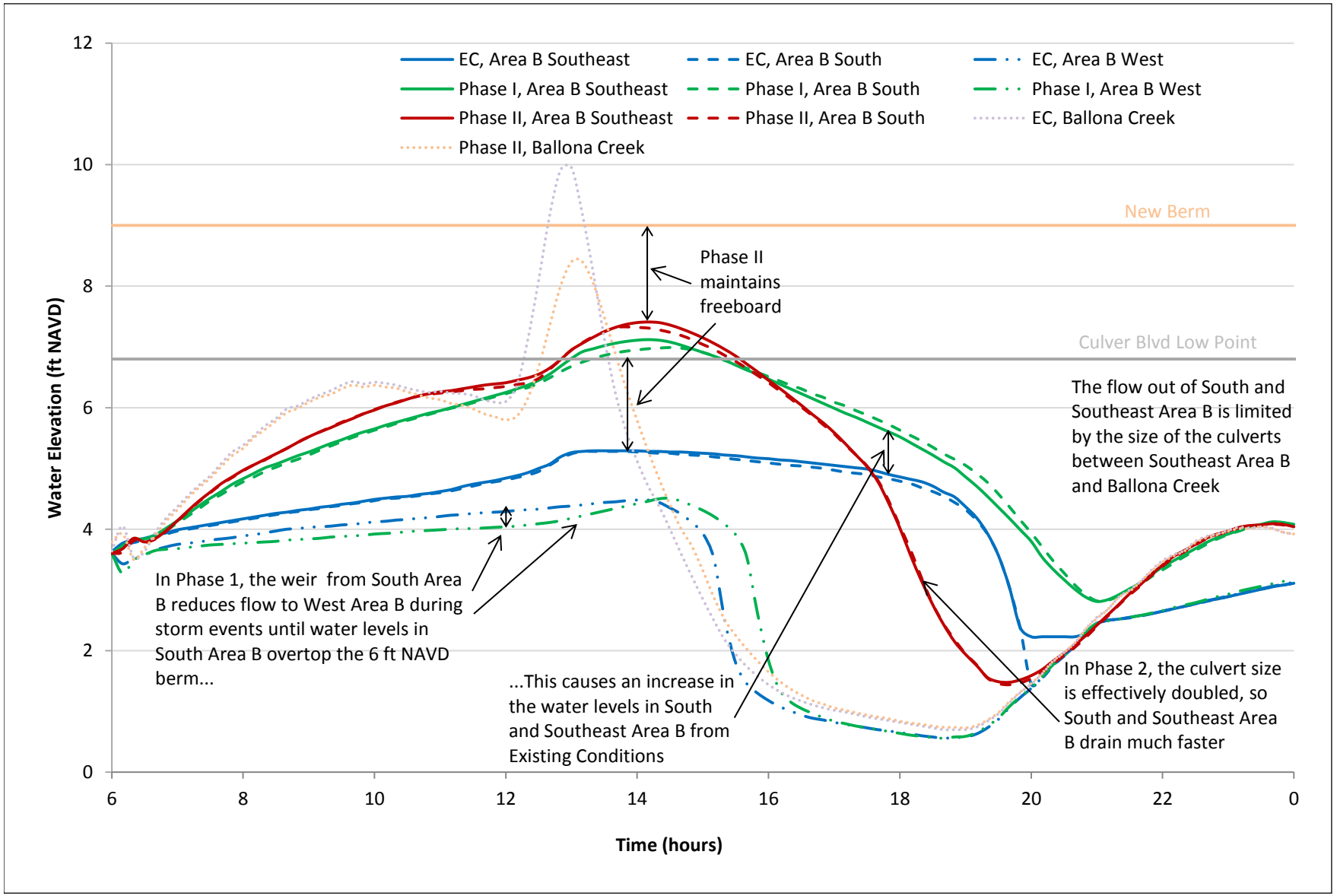
Figure 11
Increased Inundation Under Alternative 1, by Elevation



Ballona Wetlands Restoration Project

Figure 12
Typical Tides Model Results

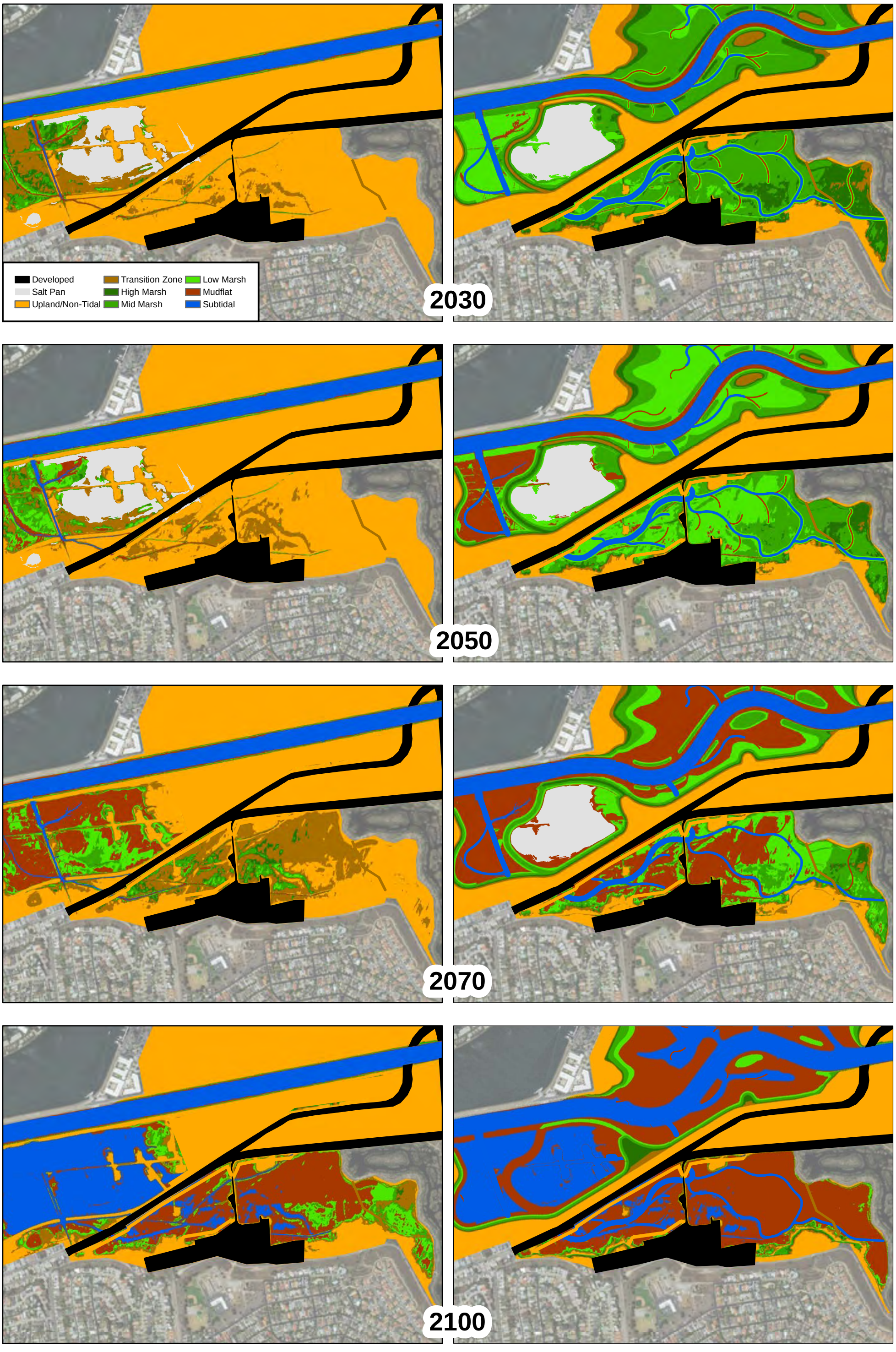
Note: Ballona Creek water levels taken just outside Area B



Ballona Wetlands Restoration Project

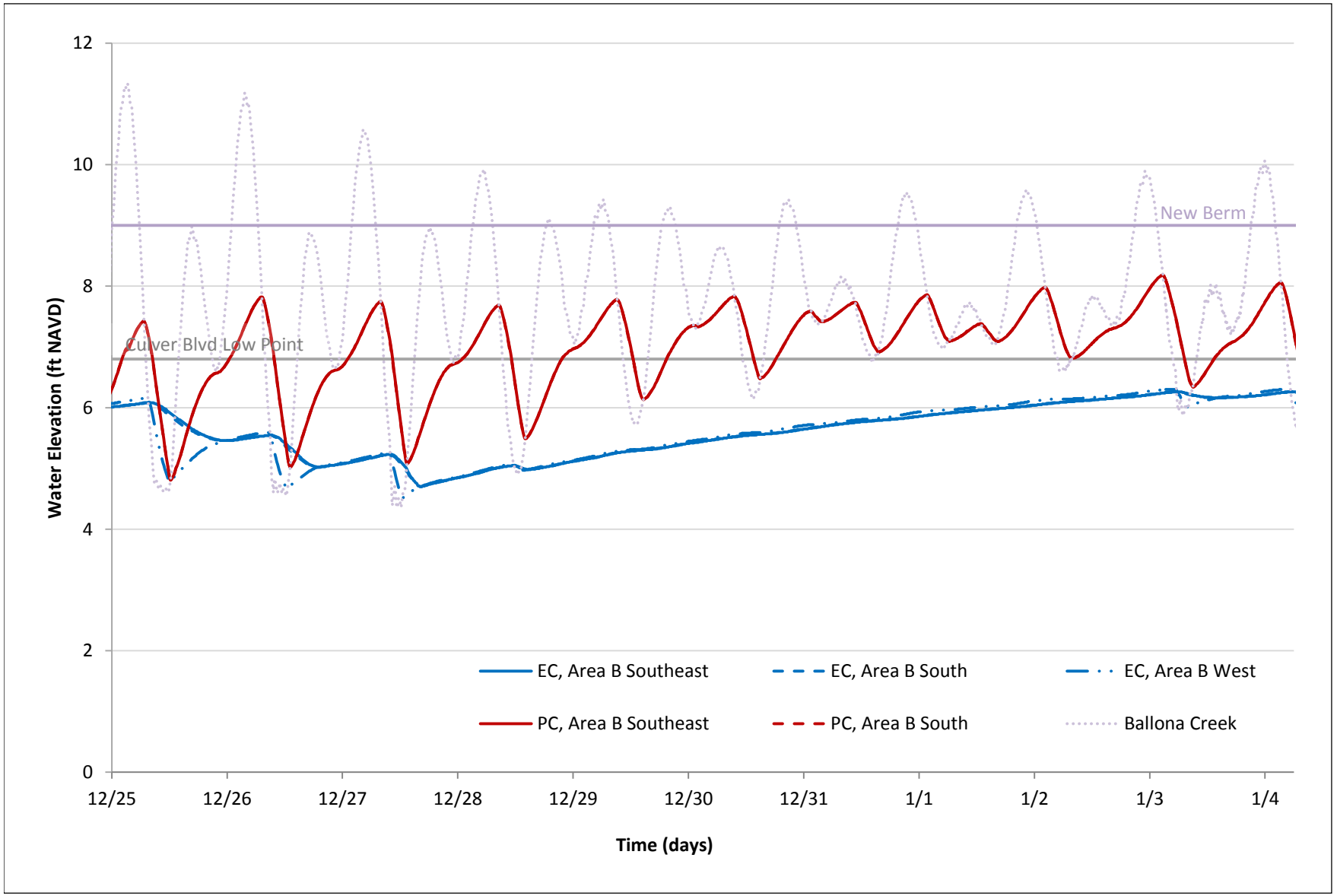
Figure 13
Design Flood Model Results

Note: Ballona Creek water levels taken just outside Area B



Ballona Wetlands Restoration Project

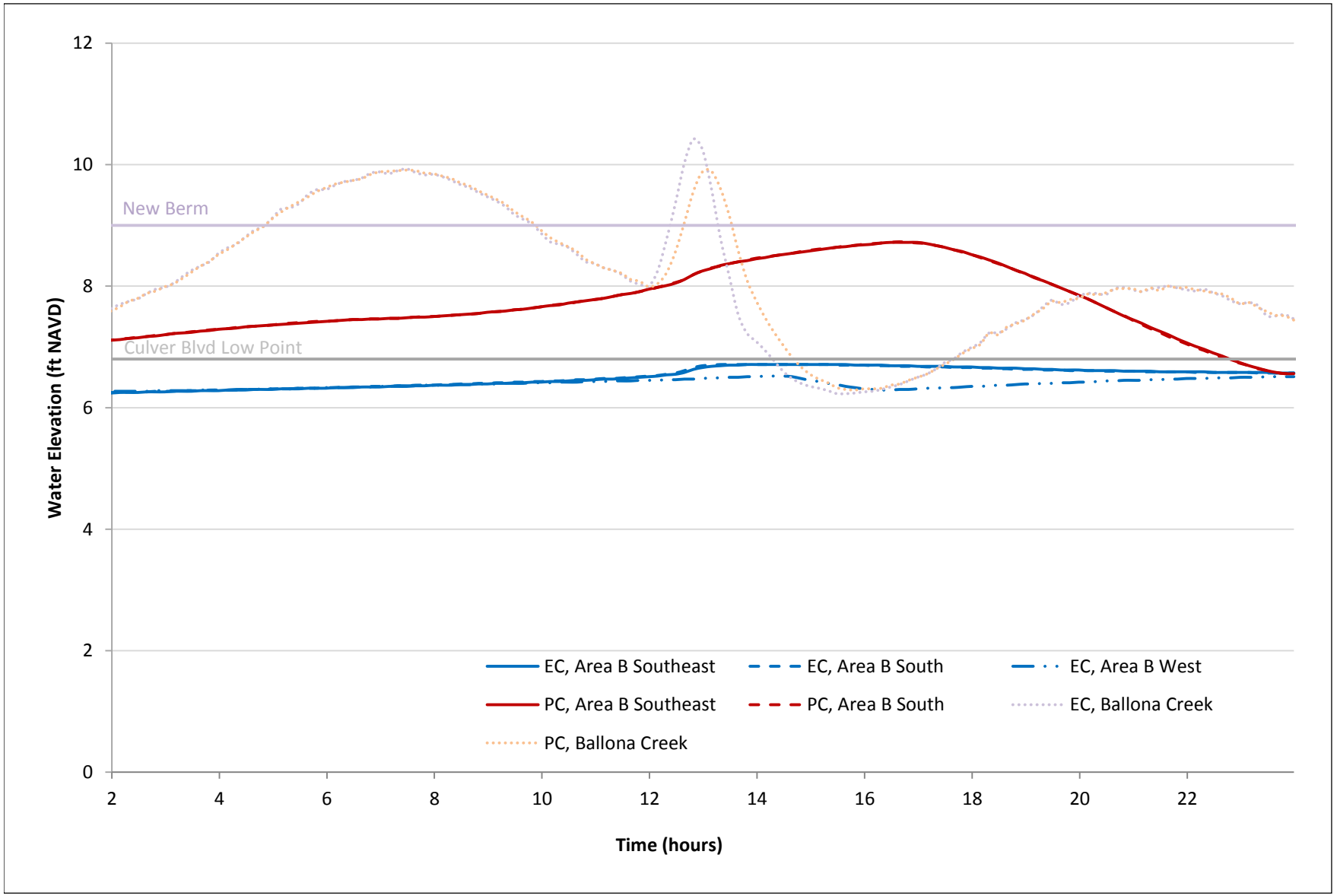
Figure 14
Inundation Under Existing Conditions and Alternative 1 with Sea Level Rise



Ballona Wetlands Restoration Project

Figure 15
Typical Tides with Sea Level Rise Model Results

Note: Ballona Creek water levels taken just outside Area B



Ballona Wetlands Restoration Project

Figure 16
Design Flood with Sea Level Rise
Model Results

Note: Ballona Creek water levels taken just outside Area B.

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APPENDIX F10
Addendum 1. Sediment Transport Analysis

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Memorandum

date December 6, 2013 Administrative Draft – *revised 2/18/2014, 4/21/2014*

to Mary Small, California State Coastal Conservancy

from Nick Garrity, P.E., James Gregory, P.E., and Christie Beeman, P.E.

subject *Draft Ballona Wetlands Restoration Project, Preliminary Hydrology and Hydraulics Report*
Addendum 1. Sediment Transport Analysis

EXECUTIVE SUMMARY

This document is Addendum 1, Sediment Transport Analysis, to the Ballona Wetlands Restoration Preliminary Hydrology and Hydraulics Report (H&H Report, ESA PWA 2013a) prepared for the U.S. Army Corps of Engineers (USACE) Section 408 Initial Submittal A. To refine the representative sediment transport model simulations conducted for Submittal A, ESA PWA conducted sensitivity analyses on several sediment transport parameters and modeling of design flood events. The model used is the USACE's Hydraulic Engineering Center's River Analysis System (HEC-RAS), version 4.1.0. The purpose of the sensitivity testing was to identify the relative influence of each parameter and to adjust the parameters to which the model is most sensitive in order to improve model agreement with the historic scour and deposition as reflected in the channel profile. The sensitivity results of the sensitivity analysis will also inform the Risk and Uncertainty (R&U) analysis required for Submittal B of the Corps 408 permit application. Preliminary results indicate that the sediment transport model is sensitive to variation in some sediment parameters such as grain size distribution; however, the flood levels simulated in HEC-RAS are not sensitive to the differences in the channel profile that result from varying grain size and sediment load parameters.

Sediment transport modeling of the 100-year discharge (Q100) and design flood event were performed to inform subsequent design refinement and assessment of long-term erosion and deposition patterns for the restored wetlands. Project conditions model results demonstrate local increases in shear and erosion may be caused by channel expansion and contraction at the upstream and downstream ends of the project reach. This result will be used to inform the next phase of project design development, including design refinement for scour protection features.

1. INTRODUCTION

This document is Addendum 1, Sediment Transport Analysis, to the Ballona Wetlands Restoration Preliminary Hydrology and Hydraulics Report (H&H Report, ESA PWA 2013a) prepared for the U.S. Army Corps of Engineers (USACE) Section 408 Initial Submittal A. This Sediment Transport Analysis Addendum includes additional fluvial sediment transport model sensitivity analyses and sediment transport model runs to support Submittal A and inform subsequent design refinement and preparation of Section 408 Submittal B. A complete discussion of data sources and the technical approach for sediment transport modeling is provided in the H&H Report (ESA PWA 2013a).

To refine the representative sediment transport model simulations included in the H&H Report, this Sediment Transport Analysis includes sensitivity analyses on several sediment transport parameters. The purpose of the sensitivity testing is to identify the relative influence of each parameter and to adjust the parameters to which the model is most sensitive in order to improve model agreement with the historic scour and deposition patterns as reflected in channel profile surveys over time. Results of the sensitivity analysis will also inform the Risk and Uncertainty (R&U) analysis required for Submittal B. The sensitivity analysis was structured to lead directly into the R&U analysis, using upper and lower bounds for key parameters per the guidelines laid out in EM 1110-2-1619 (USACE, 1996). Preliminary results indicate that the sediment transport model is sensitive to variation in some sediment parameters such as grain size distribution; however, the flood levels simulated in HEC-RAS are not sensitive to the differences in the channel profile that result from varying sediment transport parameters.

As described in Submittal A, results of the sediment transport analysis also inform design development for the wetland restoration project. For example, the design for scour protection features (discussed in the Ballona Wetlands Restoration Preliminary Design Report, ESA PWA 2013b) will be refined considering sediment transport model results. This Sediment Transport Analysis Addendum includes sediment transport model runs for the estimated effective discharge (Q_{eff}), 5-year discharge (Q5), 100-year discharge (Q100), and the channel design event (46,000 cubic feet per second (cfs) with a 7.63 ft NAVD tide boundary condition) to inform further design development and for consistency with hydraulic and sediment transport analyses included in the H&H Report. The Q_{eff} (the discharge responsible for transporting the majority of sediment in the channel, based on magnitude-frequency analysis) and Q5 runs were chosen to reflect channel-forming flow conditions, while Q100 and the design event were selected to evaluate the erosion and sedimentation risk of large flood events. The hydrographs for these events were adapted from the USACE's HEC-HMS hydrology (USACE, 2010) which included hydrographs for 2-, 5- , 10-, 25-, 50-, 100-, 150-, 100-, 200- and 500-year flood events. The Qeff hydrograph was scaled down from the 2-year HMS hydrographs, and the design event was scaled up from the 100-year HMS hydrographs.

Note that the results from this Sediment Transport Analysis will be incorporated into a sediment budget assessment to further characterize long-term erosion and deposition patterns and equilibrium conditions for the restored wetlands.

2. SEDIMENT TRANSPORT PARAMETERS

The following parameters were tested to evaluate the sensitivity of sediment transport modeling results to the values selected:

1. Bed material grain size distribution (GSD)
2. Tidal boundary condition
3. Incoming sediment load
    a. GSD
    b. Total load (rating curve)

The analyses conducted to evaluate the model sensitivity for these parameters are discussed in the following sections.

2.1 Bed material grain size distribution

The sediment gradation in the channel bed affects the amount of sediment that can be mobilized from the bed material. Coarse sediments require more energy to mobilize than fine sediments and thus a coarser bed material composition will be less susceptible to bed scour. Previous sediment transport analysis (H&H Report, ESA PWA 2013a) applied an "average" (composite) GSD developed by the U. S. Army Corps of Engineers' from data shown in Figure 1 (USACE 2003). To refine our understanding of GSD in the project reach, bed sediment samples were collected by ESA PWA at three discrete locations in the Ballona Creek channel downstream of Lincoln Boulevard. The three sample locations were:

1. Downstream of Lincoln Boulevard at approximately river station 9800
2. Within the project reach at approximately station 4400
3. Downstream of Pacific Ave on the shoal near the river mouth at approximately station 1800

Two samples were collected at location 3 to better characterize the sediment size gradation in the shoal at the mouth of the channel, for a total of 4 samples. The GSD of these collected samples was analyzed and provided to ESA PWA by Wallace Labs. Table 1 shows mean diameter (D_{50}) for the collected samples, reflecting the expected pattern of sediment fining in the downstream direction. Table 1 also shows D_{50} for the USACE composite GSD, which is similar to the downstream-most sample collected by ESA PWA. Visual inspection of the channel confirmed that the sediment composition at the upstream end of the study reach is coarser than that of the composite USACE curve.

Table 1. D_{50} for USACE sample composite and ESA PWA bed material samples

	ESA PWA Samples (approximate station)			USACE composite
	1. (9800)	2. (4400)	3. (1800)	
D50 (mm)	0.80	0.53	0.36	0.39

To identify an appropriate range of GSD curves for sensitivity testing, a subset of the 20 sediment samples collected by the USACE on Ballona Creek and its tributaries (USACE 2003) were used in combination with the sediment samples collected by ESA PWA to estimate a mean and standard deviation of percentages for each sediment class. Based on comparison to ESA PWA samples, visual observations and previous modeling results, five of the USACE samples were identified as outliers with

atypically high fine concentrations and excluded from the statistical analysis. The percent-finer value was estimated for each sediment class size from the USACE graph (Figure 1). The lowest sediment size was estimated by projecting the end of each curve onto the x-axis. The USACE samples and highlighted outliers are shown in Figure 2.

For each sediment class represented in the HEC-RAS sediment transport module (i.e. coarse sand, fine sand, etc) the percent of the bed material in that class was identified for the 15 USACE samples and the 4 ESA PWA samples. The average and standard deviation of the sediment class percentages were estimated for the 19 samples. The full set of sediment samples are presented with average and standard deviation curves in Figure 3. The standard deviation curves were computed by adding or subtracting the standard deviation estimate of percent to each sediment class for the average GSD resulting in a respectively finer or coarser GSD curve. The values for the average and standard deviation curves are summarized in Table 2.

Table 2. Average and standard deviation GSD curves for Ballona Creek sediment

	Particle Diameter (mm)	Average	Standard Deviation	1SD Coarser[1]	1SD Finer	2SD Coarser	2SD Finer
Clay	0.004	1%	1%	0%	2%	0.0%	3%
VFM	0.008	1%	2%	0%	3%	0.0%	5%
FM	0.016	2%	2%	0%	4%	0.0%	7%
MM	0.035	3%	4%	0%	7%	0.0%	11%
CM	0.0625	5%	6%	0%	11%	0.0%	16%
VFS	0.125	11%	10%	1%	21%	0.0%	30%
FS	0.25	22%	18%	4%	40%	0.0%	58%
MS	0.5	44%	27%	16%	71%	0.0%	99%
CS	1	67%	22%	45%	89%	22.5%	100%
VCS	2	86%	12%	74%	98%	61.6%	100%
VFG	4	95%	6%	89%	100%	82.3%	100%
FG	8	99%	3%	96%	100%	92.5%	100%
MG	16	100%	0%	100%	100%	100.0%	100%
CG	32	100%	0%	100%	100%	100.0%	100%
VCG	64	100%	0%	100%	100%	100.0%	100%

[1]Negative values were converted to zero and values exceeding 100% were fixed at 100% to create the standard deviation GSD curves

For sediment transport modeling, ESA PWA processed the sample data into the grain size classes utilized in HEC-RAS. The baseline bed sediment conditions were set up in the model using the GSD for each of the samples at the model cross section nearest the sample location. The model was set to interpolate the GSDs for cross-sections between sampling locations. The sediment sample collected at Lincoln was used for the GSD upstream of Lincoln Blvd to the concrete to earthen channel transition. Upstream of the transition, the channel is concrete lined and the bed was assumed to be immobile. To capture the model sensitivity to bed sediment grain size, model runs were also conducted with the average GSD shifted into the coarse range by 2 standard deviations and into the fine range by 2 standard deviations. A shift of two

standard deviations above and below the mean captures the 95% and 5% confidence interval on the available grain size data and was therefore used to calculate upper and lower bound parameter values for GSD.

2.2 Tidal Boundary Condition

The tide level has a substantial influence on flow velocities and, consequently, sediment transport capacity in the project reach of the existing Ballona Creek channel. Higher tides create backwater conditions that slow incoming floodwaters and reduce the sediment transport capacity in the channel. Inversely, lower tidal conditions provide less of a barrier to incoming flow which leads to more efficient transport conditions. Three tidal conditions were evaluated in the sensitivity analysis (1) mean tide level (MTL, 2.6-ft NAVD) representing average downstream boundary conditions, and (2) mean higher high water (MHHW, 5.2-ft NAVD) representing a high downstream boundary condition, and (3) mean lower low water (MLLW, -0.2-ft NAVD) representing a low downstream boundary condition. The MTL boundary condition represents the baseline parameter.

2.3 Incoming Sediment Load

In addition to the sediment composition of the channel bed discussed above, the sediment load carried by creek flows will affect sediment transport conditions in the channel. Higher sediment loading may lead to increased deposition in cases where the transport capacity of the channel is less than the sediment delivered to the system. In a sediment-limited environment, flows may cause a net sediment export leading to degradational conditions. In evaluating the incoming sediment load, we evaluated the model sensitivity to both GSD of the incoming sediment load as well as the magnitude of the load.

2.3.1 Sediment Load GSD

The GSD of the sediment load is not necessarily the same as the GSD of the bed material discussed above. No GSD data have been measured for the sediment load. Therefore the "hydraulic design" module in HEC-RAS was used to estimate the GSD for the load for each flow on the rating curve. The module computes the size fraction based on a user defined baseline GSD and a theoretical transport function. As described in the previous sediment transport modeling conducted for the H&H Report (ESA PWA 2013a), the Yang transport function was selected as the most representative function for the Ballona Creek sediment transport regime. A coarser grain size distribution will correspond to a coarser load composition. Baseline load composition was estimated based on the USACE sample average bed material GSD described above. To evaluate model sensitivity, the average bed material GSD was shifted toward the coarser end of the sediment size spectrum by two standard deviations and to the finer end of the spectrum by two standard deviations to represent the 95% and 5% confidence intervals (upper and lower bound). Because GSD data were not available for the sediment load, the standard deviation of each sediment class was assumed to be equal to the standard deviation derived from the bed material data. The upper and lower bound bed material curves and corresponding sediment load compositions are presented in Figure 4.

2.3.2 Sediment Load Rating Curve

The sediment supply rating curve was also varied to test the model sensitivity to assumptions about the total amount of sediment delivered to the project reach by creek flows. As described in Submittal A, the baseline sediment rating curve was developed using 148 suspended sediment measurements from the LACDPW and SCCWRP with an added factor of 10% to represent bed load (ESA PWA 2013a). We estimated the 5% and 95% confidence intervals to identify a range of rating curves for use in sensitivity testing. The 5% and 95% confidence intervals (CI) were calculated using the following statistical relationship between a predicted value for a given value of the independent variable x_i.

$$CI = \pm t(\alpha, df) S_{yx} \sqrt{1 + \frac{1}{n} + \frac{(x_i - \overline{x})^2}{\sum_{i-1}^{n} (x_i - \overline{x})^2}}$$

Where $\overline{x}$ is the sample average, n is the number of samples collected, S_{yx} is the standard error in the estimate, and *t* is the critical t statistic, a statistical function of α, the confidence interval desired (in this case the 0.05, and 0.95 interval), and the degrees of freedom in the sample set *df*. Note that in this case the relationship between discharge and sediment is linearized by taking the logarithm of both, thus *x* refers to the logarithm of the independent variable (in this case, discharge). This equation for estimating confidence intervals around a linear regression fitted to the logarithms of the independent variable has been applied in various applications for evaluating sediment load sensitivity (Lee and Bhowmik, 1979).

The confidence intervals around the sediment rating curve are shown in Figure 5. Model runs were conducted using the sediment rating curve representing the 5% and 95% confidence intervals to evaluate model sensitivity to sediment loading.

3. SENSITIVITY ANALYSIS

To evaluate the sensitivity of model results to each of the four identified sediment transport parameters, each parameter was varied individually using a Q_5 discharge event (24,500 cfs at the river mouth) in the HEC-RAS existing conditions sediment transport model. The Q_5 flood event was selected as a representative event likely to generate sediment mobilization yet frequent enough to reflect expected trends of deposition and scour. Channel profiles resulting from the model simulations were compared to historic sedimentation trends estimated by comparing contemporary topography (PSOMAS 2012) with Ballona Creek as-built channel drawings (LA County FCD 1959).

3.1 Baseline Conditions

We first ran the model using baseline parameter values for bed material GSD, sediment load magnitude and sediment load composition combined with MTL. This model run is identical to the existing conditions run included in the H&H Report (ESA PWA 2013a), with the exception that the bed material, previously characterized using the USACE composite GSD, was replaced with the sample data collected by ESA PWA. Relative to the results presented in Submittal A, this adjustment was found to have negligible effects on the overall model results.

As described in the H&H Report (ESA PWA 2013a), the study area can be divided into three reaches between the concrete to earthen channel bottom transition and the jetties at the river mouth based on historic changes in the channel bathymetry as follows and as shown in Figure 6a:

1. An erosional reach immediately downstream of the terminus of the concrete channel lining (Station 16,500 to 14,350), which includes a scour hole at the transition from the concrete to earthen channel bottom;
2. An aggradational reach (Station 14,350 to 7,850); and
3. A slightly net aggradational reach exhibiting both erosion and aggradation at the downstream end of the study reach (Station 7,850 to 1,200). Though this reach is net aggradational, the thalweg has lowered slightly over time.

The historic trend in sediment transport conditions can be summarized as exhibiting erosion for approximately 2000 ft downstream of the concrete to soft bottom transition, aggradation for another 7000 ft downstream, and slight net aggradation for another 5,000 ft downstream to the jetties at the river mouth. A shoal has developed at the river mouth, which appears to be influenced by coastal/tidal sediment sources. Besides baseline conditions, the sensitivity results were evaluated relative to this understanding of historic sediment transport trends for the fluvial sediment transport.

The baseline parameter simulations predicted significant channel scour relative to the existing channel profile in two locations:

1. Station 14,000 to 16,000, immediately downstream of the concrete-lined channel.
2. Near station 10,000 at the Lincoln and Culver Blvd. bridges.

The existing channel profile represents the thalweg from the 2012 topography developed by PSOMAS. Comparison between the 1959 as-built and 2012 surveyed channel profiles (Figure 6b) indicates that significant channel erosion has not occurred between station 13,000 and 14,000 or at the bridges since the channel was constructed. This suggests that the sediment transport model baseline parameters may over-represent scour potential at these locations under existing conditions. Note that the profile comparison in Figure 6b shows a lower elevation thalweg in 2012 compared to the 1959 as-builts for the downstream reach (station 7,850 to 1,200), but Figure 6a shows some net accretion when accounting for apparent change in the channel cross-section (i.e., channel scour adjacent to the levees and deposition in the channel center). This indicates that the thalweg has lowered over time but that deposition in other areas has led to net accretion in this reach. The topographic changes shown in Figure 6a and the thalweg profiles shown in Figure 6b were both developed using the USACE as-built drawings and the 2012 topography collected by PSOMAS. Profiles in Figure 6b represent the lowest point in the channel which is not necessarily at the center of the channel.

3.2 Sensitivity Runs

Adjustments to the model parameters were grouped according to whether they would tend to simulate more depositional or more erosional conditions relative to the baseline parameters. The "upper bound" (i.e. those that would tend to simulate more depositional conditions) and “lower bound” (i.e. those that

would tend to simulate more erosional conditions) parameter adjustments are listed below and summarized in Table 3. The upper bound parameter adjustments were:

1. Bed material GSD shifted 2 standard deviation towards coarser sediment, with baseline load and load composition conditions and a tidal boundary condition at MTL
2. Baseline sediment conditions with a tidal boundary condition at MHHW
3. Sediment load GSD 2 standard deviations above the baseline load GSD, with the baseline load and baseline bed material GSD conditions at MTL
4. Sediment rating curve loading conditions for the 95% confidence interval, with baseline GSD and load composition at MTL

Similarly the lower bound parameter adjustments were:

1. Bed material GSD shifted 2 standard deviation towards finer sediment, with baseline load and load composition conditions at MTL
2. Baseline sediment conditions with a tidal boundary condition at MLLW
3. Sediment load GSD 2 standard deviations below the baseline load GSD, with the baseline load and bed material GSD conditions at MTL
4. Sediment rating curve loading conditions for the 5% confidence interval, with baseline GSD and load composition at MTL

Table 3. Sediment transport model parameter groupings for sensitivity runs.

		Bed material GSD	Sediment load GSD	Sediment load	Tidal boundary condition	Short ID
Upper bound	1	+2 SD	baseline	baseline	MTL	Bed GSD + 2SD at MTL
	2	baseline	baseline	baseline	MHHW	Baseline parameters at MHHW
	3	baseline	+2 SD	baseline	MTL	Sediment load GSD + 2SD at MTL
	4	baseline	baseline	95% CI	MTL	95%CI Sediment load at MTL
Lower bound	1	-2 SD	baseline	baseline	MTL	Bed GSD - 2SD at MTL
	2	baseline	baseline	baseline	MLLW	Baseline parameters at MLLW
	3	baseline	-2 SD	baseline	MTL	Sediment load GSD - 2SD at MTL
	4	baseline	baseline	5% CI	MTL	5%CI Sediment load at MTL

Notes: 2 SD = two standard deviations, CI = confidence interval.

3.2.1 Upper Bound Sensitivity Runs

Channel profiles resulting from the upper bound sensitivity runs and the baseline run are shown in Figure 7. Historic trends for the three channel segments are shown at the top of the figure. The baseline run indicates scour potential at the profile break where the channel bottom transitions from concrete to earthen material. There is an existing scour hole at this transition (reflected in the existing channel profile from the 2012 PSOMAS topography data), but the baseline simulation over-predicted the extent of channel scour at this location. Adjusting the composition of the incoming sediment supply and raising the downstream boundary had little effect on this result; however, simulations using coarser bed material GSD and higher sediment load both resulted in less scour.

Results from all upper bound simulations indicate minor deposition from river station 4,000 to 8,000, a pattern which generally matches with the historic trend. None of the parameter adjustments have a significant impact on sediment transport conditions downstream of the Culver Boulevard bridge at station 10,000.

3.2.2 Lower Bound Sensitivity Runs

Channel profiles resulting from the lower bound sensitivity and baseline runs are shown in Figure 8. As noted above, the baseline run indicates scour potential at the profile break where the channel bottom transitions from concrete to earthen material. As expected, each of the lower bound sensitivity runs shows similar or higher scour potential extending from the channel bottom transition downstream to approximately station 13,000 ft. With MLLW conditions, this scour persists to approximately station 8000 ft. All of the lower bound runs show slight aggradation from river station 4000 ft to 8000 ft and generally over-predict scour potential relative to the historic changes to the channel profile.

3.3 Results

Figure 7 and Figure 8 show the average bed change for each of the model runs. As shown for the upper bound runs, increasing the sediment load has the largest impact on scour and deposition rates, followed by the coarser bed material. The model results indicate relatively little sensitivity to the coarser bed material and coarser sediment load. For the lower bound runs, lowering the downstream tidal boundary had the greatest impact on average bed change, largely as a result of the increased scour at the river mouth. The degree of scour shown at the concrete to soft bottom transition point is likely exaggerated in these runs as the model does not account for bed armoring and sediment consolidation which would limit scour depth at this location. On average, the bed change is within 0.5 feet for the lower bound sediment sensitivity runs. The average bed change as well as the bed change for each run is summarized in Table 4.

Table 4. Modeled bed change for sediment transport sensitivity analysis runs

Run		Bed Change for Q5 (ft)			
		Upper Reach (historically erosive)	Middle Reach (historically aggradational)	Lower Reach (historically net aggradational)	Average
Baseline parameters at MTL		-0.53	-0.42	-0.12	-0.36
Upper bound sediment parameter sensitivity runs	Sediment load GSD + 2SD at MTL	-0.57	-0.36	-0.05	-0.33
	Baseline parameters at MHHW	-0.51	-0.23	0.1	-0.21
	Bed GSD + 2SD at MTL	-0.19	-0.13	0.08	-0.08
	95%CI Sediment load at MTL	-0.19	-0.02	0.09	-0.04
Lower bound sediment parameter sensitivity runs	5%CI Sediment load at MTL	-0.60	-0.46	-0.13	-0.40
	Sediment load GSD - 2SD at MTL	-0.68	-0.48	-0.04	-0.40
	Bed GSD - 2SD at MTL	-1.15	-0.47	0.15	-0.49
	Baseline parameters at MLLW	-0.55	-0.68	-0.86	-0.70

The modeled bed change for each of the sediment transport sensitivity runs relative to the existing profile is shown by reach in Table 4. All runs show net scour in the upper reach and in the middle reach under a Q5 event. In the middle reach, a coarser grain size distribution and higher sediment load have the largest impact on reducing the predicted scour and bringing the transport behavior more in line with observed conditions. For the lower reach, model results vary within a relatively minor bed change of +/- 0.2-feet, with the exception of the lower boundary condition which results in a large potential for scour at the mouth of the channel.

All model runs over-predict scour potential at the profile inflection point where the channel bottom transitions from concrete to earthen material (upper reach) and at the existing bridge crossings (middle reach), relative to the observed channel profile. The over-prediction of scour may indicate that sediment load is higher than the estimated baseline rating curve, bed material GSD is coarser than the sample average, and/or sub-surface conditions limit the extent of scour. The ESA PWA bed samples were collected from a kayak with a petite Ponar grab sampler, which has the potential to lose material during sampling. Field observation of the bed material prior to laboratory testing suggested a higher content of coarse grains than was present in the ESA PWA samples. Therefore, we adjusted the bed material GSD to evaluate whether a coarser GSD would bring the model results in line with the current channel profile.

Results of model runs shifting the baseline bed material GSD by 2 standard deviations and raising sediment loading rates to the 95% confidence interval both produced deposition through the historically erosive reach downstream of the channel bottom transition. Therefore, an additional run with a 1 standard deviation shift on the GSD was performed. The results of this run show moderate scour downstream of the channel bottom transition attenuating at approximately station 13500. This result is more similar to the observed scour pattern than any of the other runs (Figure 9). This analysis indicates that either the

GSD at this location is coarser than the sample that was analyzed, or that factors not accounted for in the model such as an armor layer of coarse sediment, or rubble or riprap below the surface, may limit the depth of scour at this location. For future analyses, we will investigate options for evaluating vertical variation of the in-situ material to further refine the sediment transport model.

4. EFFECT ON WATER SURFACE ELEVATION

The impact of model parameter adjustments on the water surface elevations will inform the risk and uncertainty analysis which will be conducted in the next phase of this project. Two additional model runs were conducted using combinations of these parameter changes to get an initial sense of water level response to different parameter combinations. As identified in the Corps R&U guidance, sensitivity analysis can either be done for each parameter individually or for "reasonable likely combinations of upper and lower bound estimates of model parameter values" (Section 5-7, USACE, 1996). The first model run contains an upper bound combination of parameters which will tend to result in increased depositional conditions, and the second model run contains a lower bound combination of parameters which will all result in increased erosional conditions.

1. Bed GSD + 2SD, sediment load at the 95% CI, sediment load GSD + 2SD, tide level at MHHW.
2. Bed GSD - 2SD, sediment load at the 5% CI, sediment load GSD - 2SD, tide level at MLLW.

These two runs are intended to capture the range of reasonable likely combinations in sediment transport parameters. The resultant water surfaces for the upper and lower bound runs are shown for a 5-year flood event in Figure 10. These results are compared to a run with GSD + 1 standard deviation which was found to more closely reflect historic sediment dynamics as described in the previous section.

4.1 Results

The model results indicate a water surface change averaged over the downstream limit of the model and Centinella Ave (station 1,100 to 17,200) of -0.5 feet for the lower-bound run and +0.6 feet for the upper-bound run relative to the baseline parameter run. When these runs were repeated with a consistent tidal boundary of MTL, there was no difference in water surface results relative to baseline conditions (Figure 10). This indicates that, over a reasonable range of parameter combinations, the water surface profile is not sensitive to the selection of bed GSD, sediment load, and sediment load GSD parameters. The range of deposition and scour incurred under the parameter combinations does not affect the water surface profiles. The water surface is, however, inherently a function of the downstream boundary tide level and thus is sensitive to this parameter. Water surface sensitivity to the tide level, including the effects of sea level rise, will be explored further in the R&U analysis for Submittal B.

5. COMPARISON OF PROJECT AND EXISTING CONDITIONS

Both existing and project conditions runs were conducted for the effective discharge (Q_{eff}) estimated to be 4,650 cfs (ESA PWA H&H Report, Appendix 3), Q_5 (24,500 cfs), and Q_{100} (44,270 cfs), at MTL. Additionally, a model run was conducted for the design event (46,000 cfs discharging against a tailwater

of 7.6 ft NAVD). The set of model runs and sediment transport parameters used for each run are summarized in Table 5.

Table 5. Existing and project conditions sediment transport model runs and parameters

	Run	Discharge		Tidal boundary condition		Bed material GSD	Sediment load GSD	Sediment load
		Event	Discharge (cfs)	Tide level	El (ft NAVD)			
Existing conditions	1	Q_{eff}	4,500	MTL	2.6	GSD + 1SD	Baseline	Baseline
	2	Q_5	24,500	MTL	2.6			
	3	Design flow	46,000	Design water level	7.6			
	4	Q_{100}	44,270	MLLW	-0.2			
	5			MTL	2.6			
	6			MHHW	5.2			
	7			MHHW+SLR	10.1			
Project conditions	8	Q_{eff}	4,500	MTL	2.6	GSD + 1SD	Baseline	Baseline
	9	Q_5	24,500	MTL	2.6			
	10	Design flow	46,000	Design water level	7.6			
	11	Q_{100}	44,270	MLLW	-0.2			
	12			MTL	2.6			
	13			MHHW	5.2			
	14			MHHW+SLR	10.1			

For each of these runs, the sediment load and load GSD were kept at baseline conditions and the bed material GSD was raised by 1SD to better reflect observed sediment dynamics. The tide level was set at MTL for Q_{eff}, and Q_5, and at the design water level of 7.6ft for the design flow. Additionally, Q_{100} runs were conducted with tide levels at MLLW, MTL, MHHW, and MHHW with sea level rise (SLR).

The bed change and average cross-section shear stress for existing and project conditions for Q_{eff}, Q_5, and the design flow are shown in Figure 11. This figure indicates that shear stresses and sediment transport under project conditions are similar to existing conditions upstream of around station 12,000 (approximately 2,000 feet upstream of the entrance to the project site), with some regions of increased shear stress and scour relative to existing conditions for larger flood events. Downstream of station 12,000 model results indicate that changes in the channel shape at the entrance to and exit from the project site under proposed conditions lead to local flow accelerations, increased shear stresses, and increased potential for local erosion at expansion and contraction points. This result will be used to inform the next phase of design development, which will incorporate measures to address local erosion potential.

At the entrance to the project site, the flow area expansion leads to a local acceleration increasing shear stresses from around station 10,000 to 11,000. The flow acceleration occurs due to the steepening of the water surface at the channel expansion transition. Downstream of this transition, velocities are reduced due to the expanded flow area. Under existing conditions, model results for this channel reach reflected energy losses as a result of flow contact with the Culver and Lincoln bridge piers. With project conditions, the bridge losses and the acceleration due to changing channel shape may increase erosion potential under high flow conditions. Under these conditions, model results show some of the material scoured from the bridge vicinity being deposited just downstream; however the deposition is not extensive enough to impact channel capacity. Further analysis will be conducted for final project design to evaluate the potential for scour- and deposition-related impacts to bridge piers and the adjacent levees.

Model results for the downstream reach of the project near the point of reconvergence between the project area and existing channel reflect another occurrence of local acceleration leading to increased scour potential under high flows. Sediment transport model results for Q_{eff} suggest this reach is generally stable (i.e. minimal net change in bed elevation) to slightly aggradational, suggesting that under average conditions sediment deposition through this channel segment would likely balance out some of the scour that may be incurred under larger flood events. This result will be evaluated further during the next phase of design development.

Additional runs were conducted to evaluate the channel scour and deposition behavior under the 100-year discharge event (Q100) for tailwater conditions at MLLW, MTL, MHHW, and MHHW+SLR. These runs, the results of which are shown in Figure 12, exhibit similar sediment transport trends as the design event. Significant scour potential present under existing conditions continues for project conditions between river station 14,350 and 16,500 where the channel bed transitions from concrete-lined to earthen conditions. The historically aggradational reach from station 7,850 to 14,350 shows some scour and deposition of scoured material, as would be expected under a large flood event, but shows less scour than the upstream reach. The reach between station 1,200 and 7,850 shows net scour under project conditions, primarily as a result of increased shear stresses where flows reconverge with the existing confined channel. Some deposition occurs near the entrance to the project site at approximately station 10,000 ranging from 0.2 ft under MLLW, to 0.9 ft under MHHW+SLR. The potential impact of this deposition on water levels will be evaluated for the final design and R&U analysis in the next phase.

A quasi-two-dimensional depiction of shear stress and velocity model results for the 100-year discharge with project conditions is presented in Figure 13. This graphic was generated using the GeoRAS toolbar in ArcGIS which apportions overbank velocities and shear stresses over the depth along a coincident 2D surface. Model results reflect similar velocity and shear stress patterns for the other flow events discussed above. High velocity regions are found at the upstream and downstream boundaries of the project site as well as near the peninsula between Area A and Area B where flow reconvergence causes local acceleration and increased shear stress. Ineffective flow areas were used in HEC-RAS to account for areas where water is stored but not contributing to conveyance. Preliminary results from 2D modeling described in the Submittal A report (ESA PWA, 2013) indicate that the ineffective flow area in Area B may be larger than what is currently reflected in the HEC-RAS model. The ineffective flow area extents

will be revised for future model iterations to more closely reflect the velocity conditions suggested by the 2D modeling results.

As described in this report, the project consists of significantly expanding the channel and overbank conveyance area downstream of Culver Boulevard and then reconverging the flow back into the flood control channel approximately 1000-feet upstream of Pacific Avenue. This increase in conveyance area leads to significant reductions in flow velocities; however, as described in this section, model results indicate local increases in channel shear and bed change under project conditions. The locations of increased shear are a function of large changes in conveyance area over short distances required to expand the channel through the project reach and contract the channel back into the flood control channel before it reaches the Pacific Ocean. Figure 14 contains plots of water surface elevation, flow velocity, flow area, friction slope[1], shear stress, and bed change for the 100-year discharge. Model results indicate two primary locations where increased shear stress may lead to bed erosion under project conditions, as shown in Figure 14: (1) just upstream of the project area between station 10,000 and station 11,000, and (2) near the channel contraction from station 5,000 to 7,200. The increase in conveyance area at the upstream end of the project lowers and steepens the water surface profile just upstream of the project area. This steeper water surface profile increases shear stress which increases the potential for scour at this location. Between stations 5,000 and 7,000, the flow area is reduced from approximately 18,000 ft^2 to 5,600 ft^2 (30%) over a 1,200-foot reach. Though the velocity is lower through this constriction than under existing conditions, the flow area is larger and the shear stress is equivalent. Additionally, over the full hydrograph, shear stresses in this reach are generally higher under project conditions as shown in Figure 15. Model results indicate that the conditions in this reach have the potential to cause local scour under a large flood event. The design for the channel (cross-section) and scour protection will be refined based on these results.

6. SUMMARY AND CONCLUSIONS

To refine the representative sediment transport model simulations conducted for Submittal A, ESA PWA conducted sensitivity analyses on several sediment transport parameters. The purpose of the sensitivity testing was to identify the relative influence of each parameter and to adjust the parameters to which the model is most sensitive in order to improve model agreement with the historic scour and deposition as reflected in the channel profile. Results of the sensitivity analysis will also inform the Risk and Uncertainty (R&U) analysis required for Submittal B of the Corps 408 permit application. The key findings of this analysis are summarized as follows:

- As discussed in the H&H Report (ESA PWA 2013a), sediment supply to the study area is low relative to the sediment transport capacity and the site can be characterized as generally sediment supply-limited. Sediment transport model results support this conclusion, with all sensitivity runs

[1] Friction slope, also known as the energy grade line, is the energy (head) loss per unit length which is a measure of the rate of energy dissipated by flowing water. Shear stress is directly proportional to the friction slope thus a higher slope, or higher rate of head loss, corresponds to higher shear stress.

generally showing more potential for scour than for sediment deposition under existing conditions.

- Since the channel was constructed, the profile has been relatively stable, although some scour is observed immediately downstream of the terminus of the concrete channel lining.
- Baseline conditions model results over-predicted scour relative to the observed channel profile at the concrete to earthen channel bottom transition as well as in the vicinity of the existing bridges. This result suggests that either the GSD of bed sediments is higher than what was sampled, or that other factors such as channel armoring and/or buried coarse sediments have historically mitigated scour potential during flood events.
- Model results indicate that over a reasonable range of combinations, the water surface profile is not sensitive to bed material GSD, sediment load GSD, or total sediment load parameters. Of the four parameters analyzed, the water surface is only sensitive to the tidal boundary condition. This result will be explored further as part of the R&U analysis.
- Initial project conditions model results show that at the channel bottom transition from concrete to earthen the change in scour relative to existing conditions is within 0.1 ft for a 100-year event suggesting minimal changes in the historically scoured reach.
- Project conditions model results demonstrate local increases in shear and erosion may be caused by channel expansion and contraction at the upstream and downstream ends of the project reach. This result will be used to inform the next phase of project design development.

7. REFERENCES

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ESA PWA, 2013b. Ballona Wetlands Restoration Preliminary Design Report. May 8 Draft. Prepared for the California State Coastal Conservancy.

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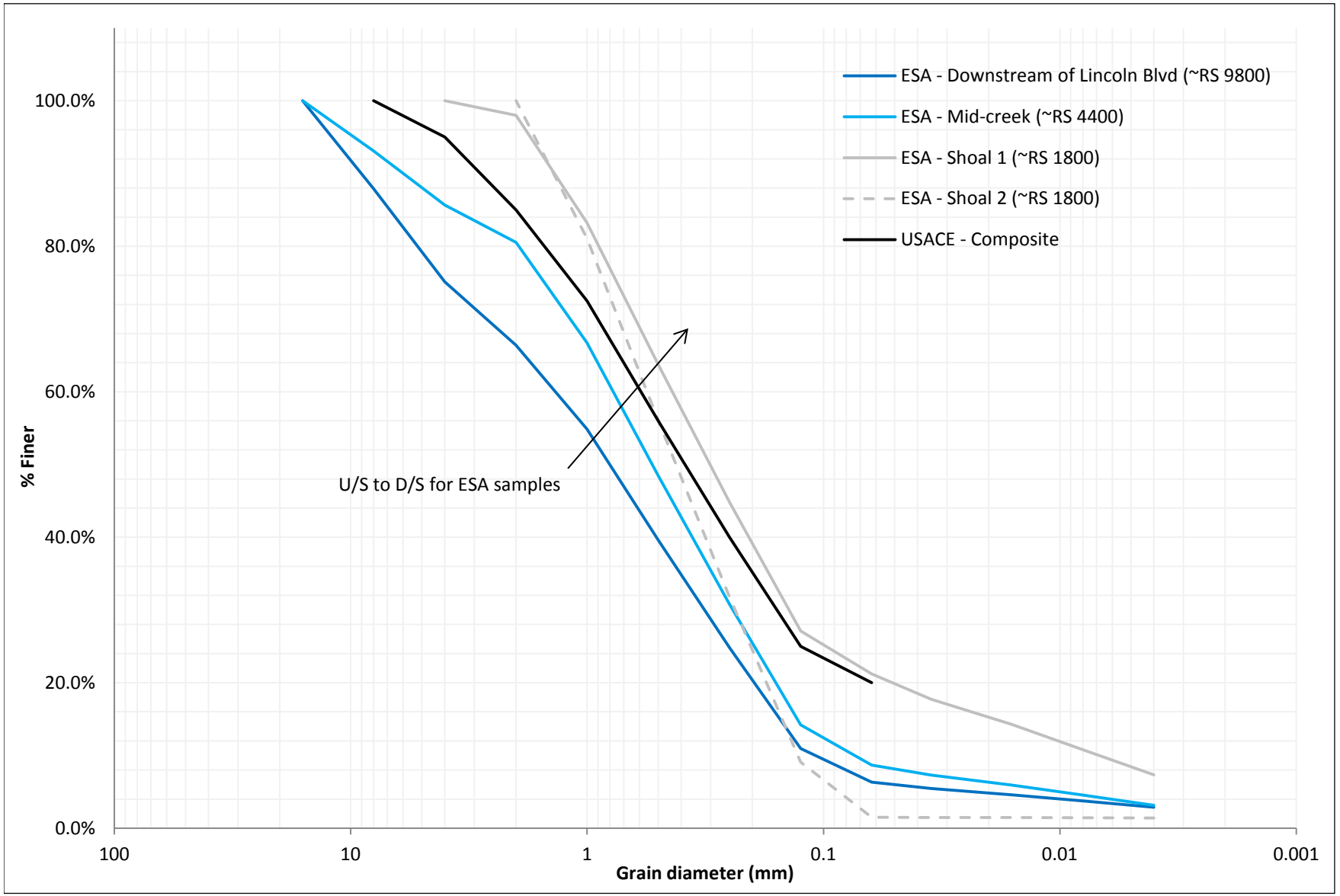
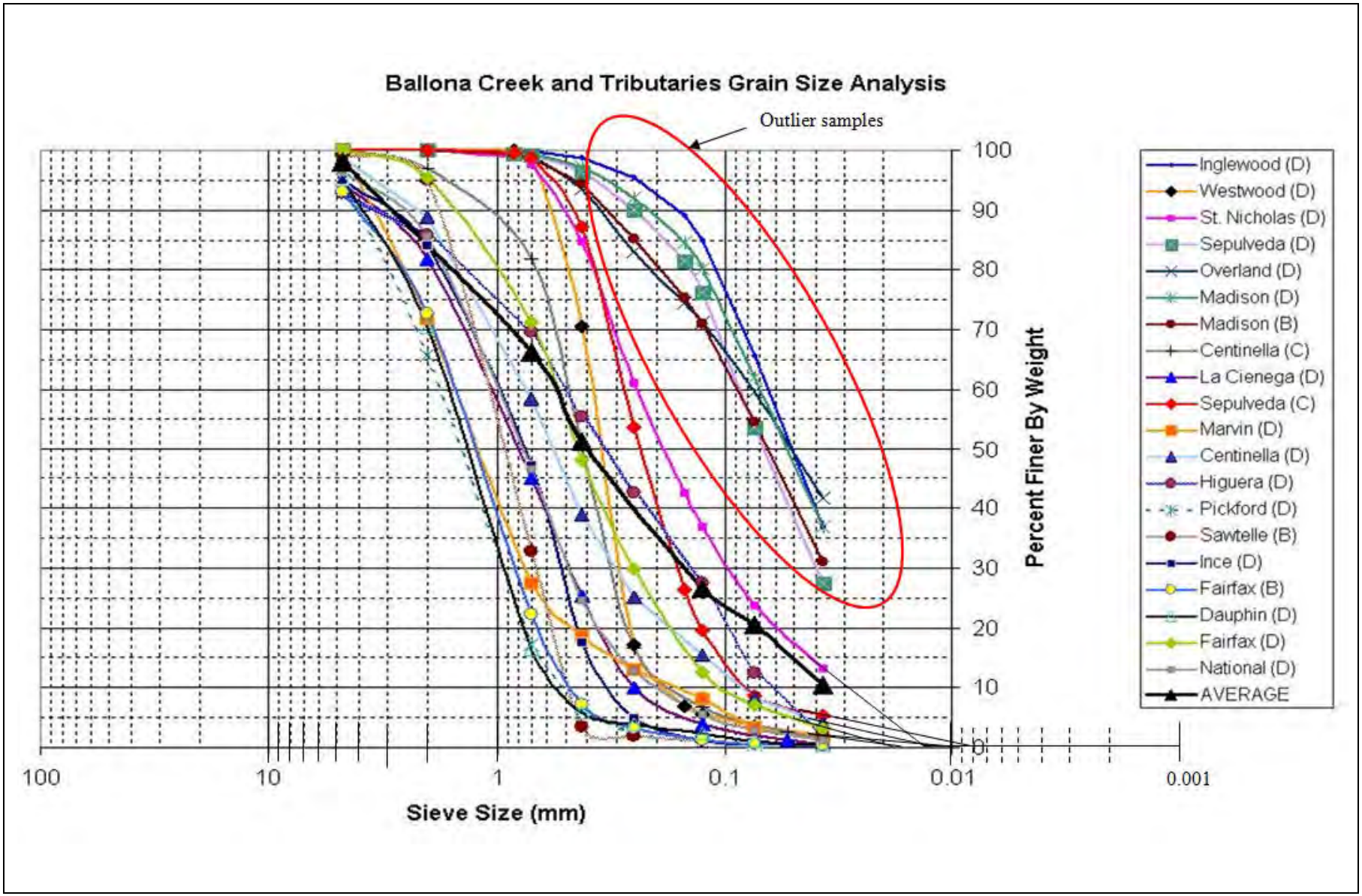


SOURCE: USACE (2003), Wallace Labs (2013)

Ballona Creek Wetlands . D120367

Figure 1

Ballona Creek Grain Size Distribution Curves

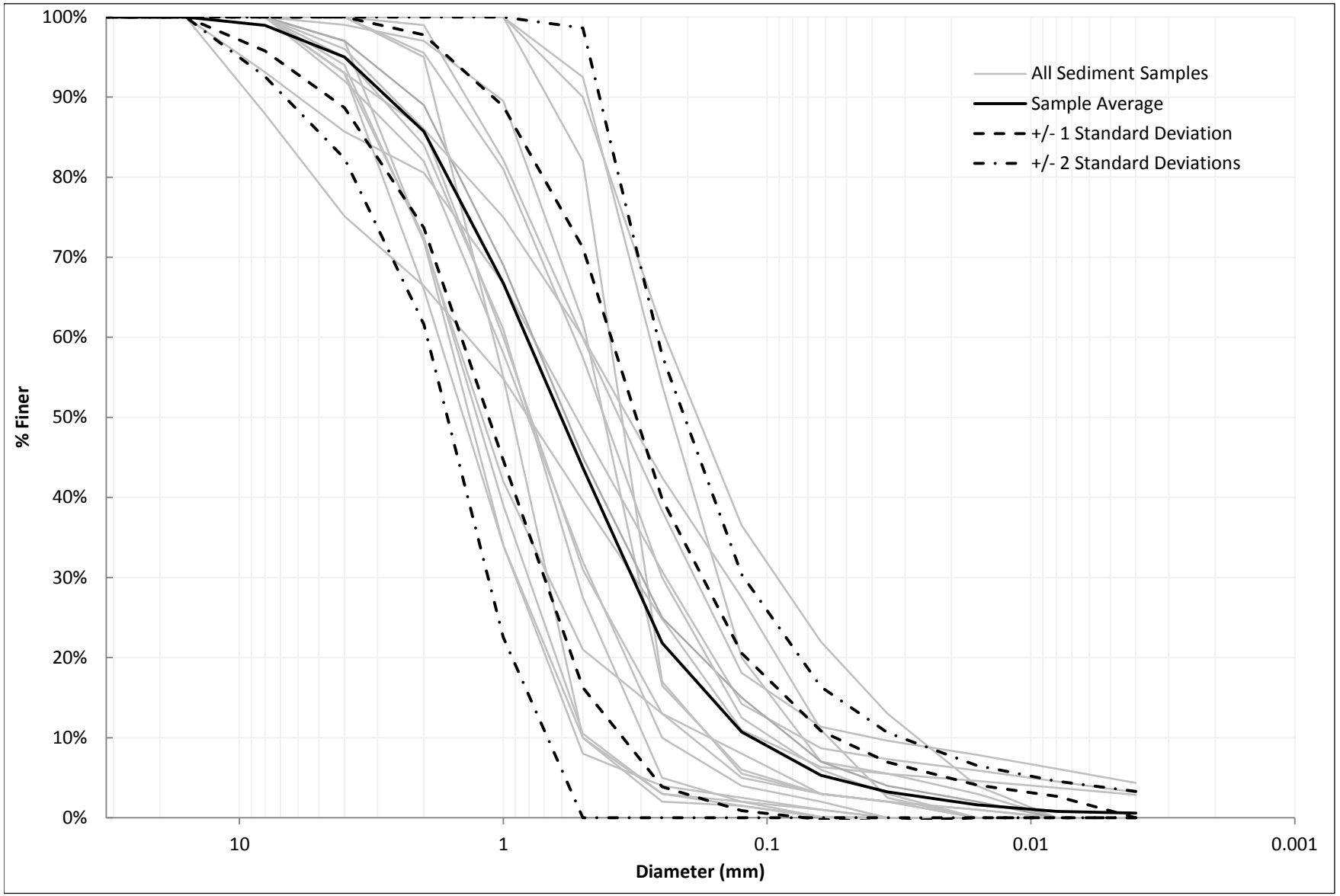


SOURCE: USACE 2003

Ballona Wetlands . 120367.00

Figure 2

Corps Grain Size Distribution Curves for Samples on Ballona Creek



SOURCE: USACE sediment samples F4 documentation (2003), ESA sediment samples (2012-2013)

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Figure 3

Grain Size Distribution Sensitivity

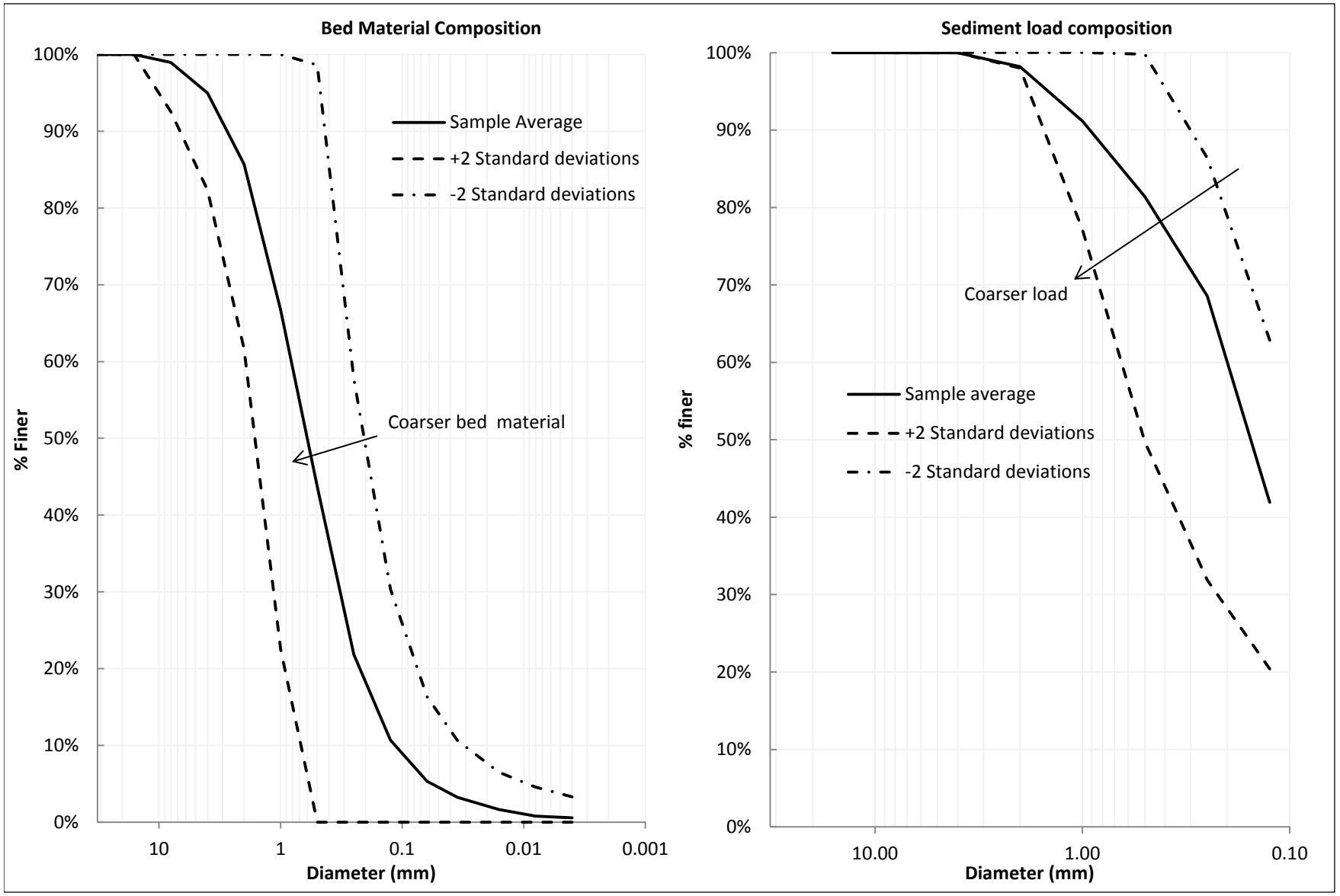

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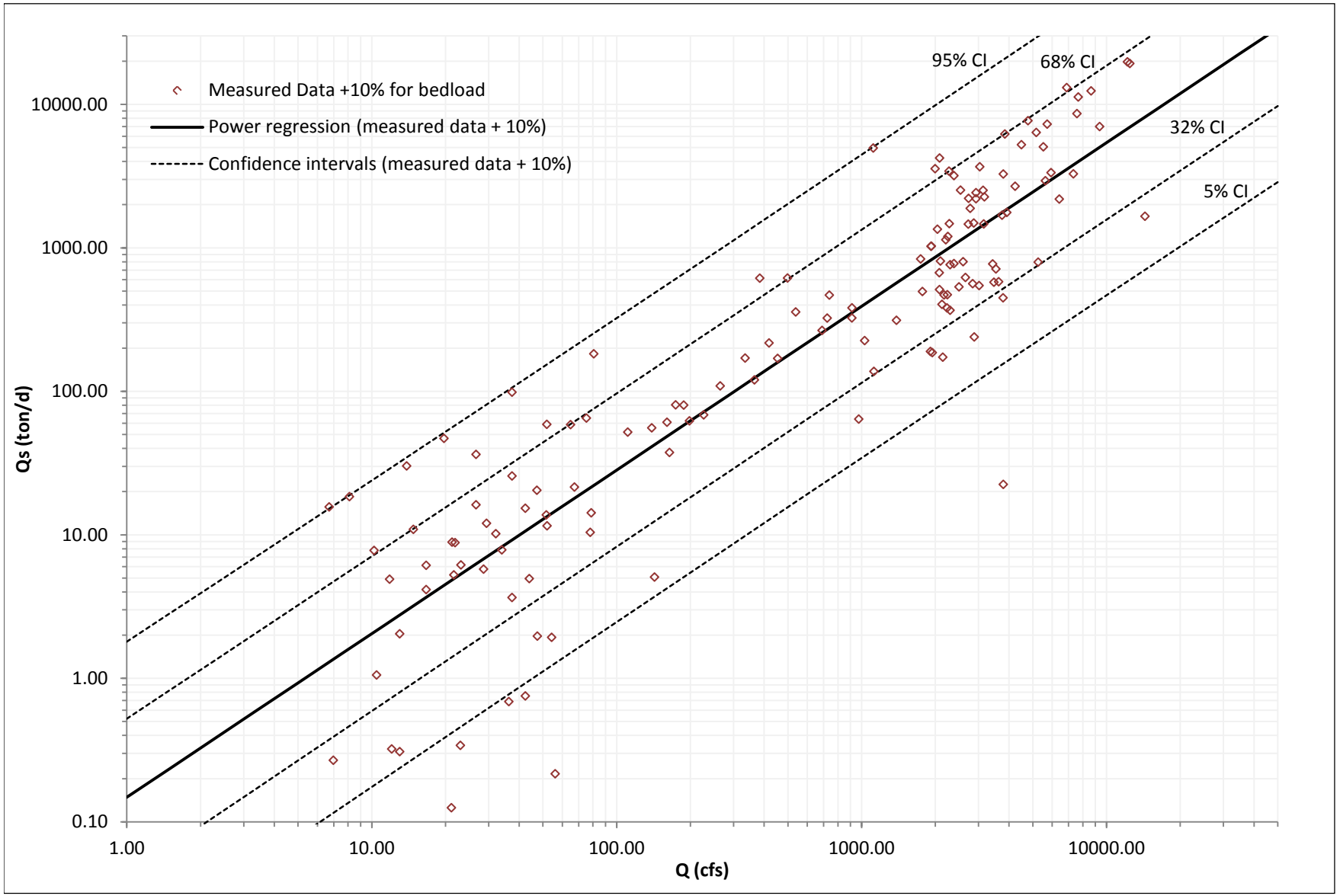
Figure 4

Sediment Load Composition Sensitivity



SOURCE: LACDPW, SCCWRP

Ballona Wetlands . D120367

Figure 5

Sediment Rating Curve Sensitivity



J:\1793_Ballona\Accretion.mxd

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community; USACE (2003), PSOMAS (2012)
Notes: Figure shows net change from 1961 to 2012.

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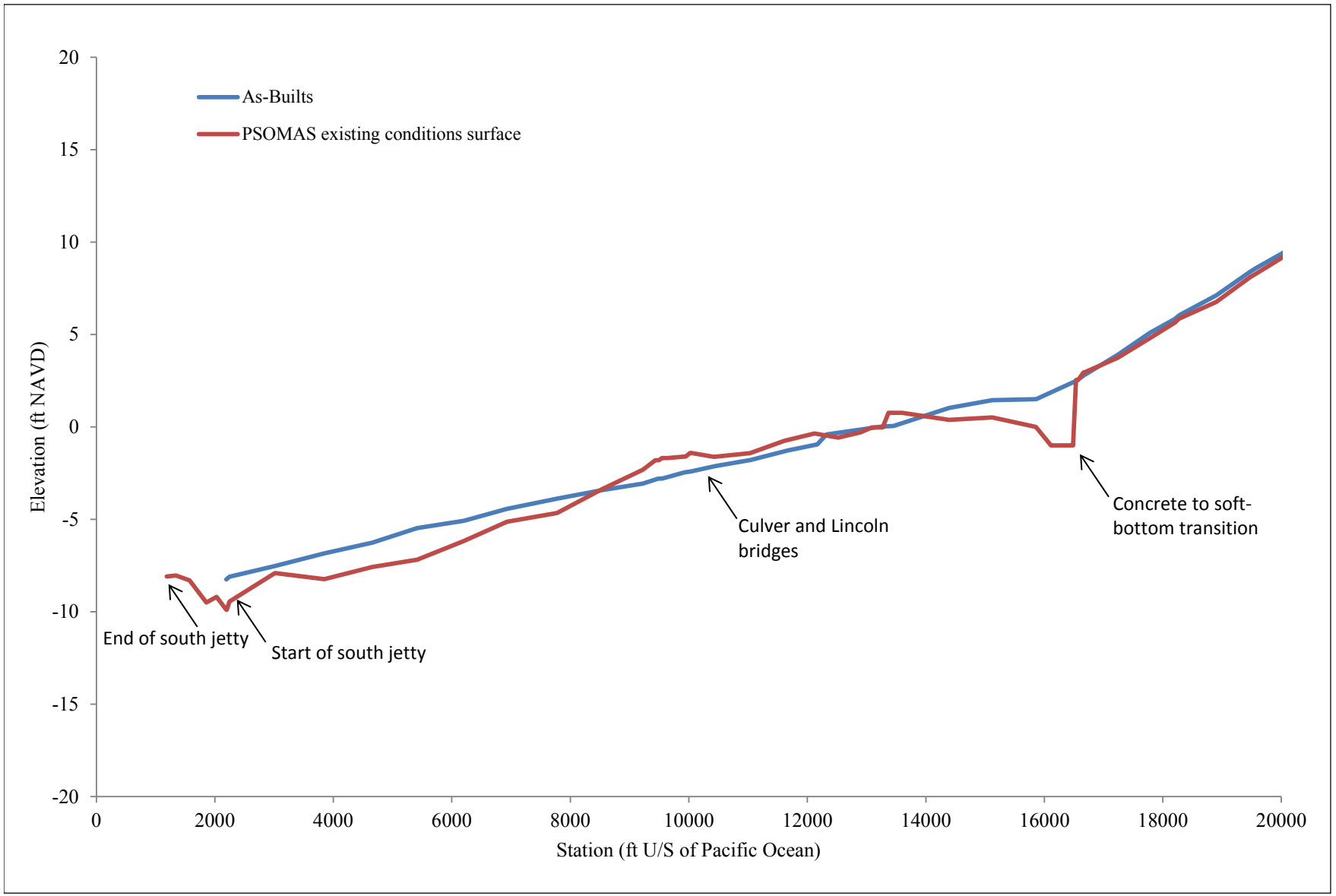
Figure 6a
Ballona Creek Accretion
between 1961 and 2012



SOURCE: USACE (2003); PSOMAS (2012)
NOTE: Figure shows net change from 1961 to 2012

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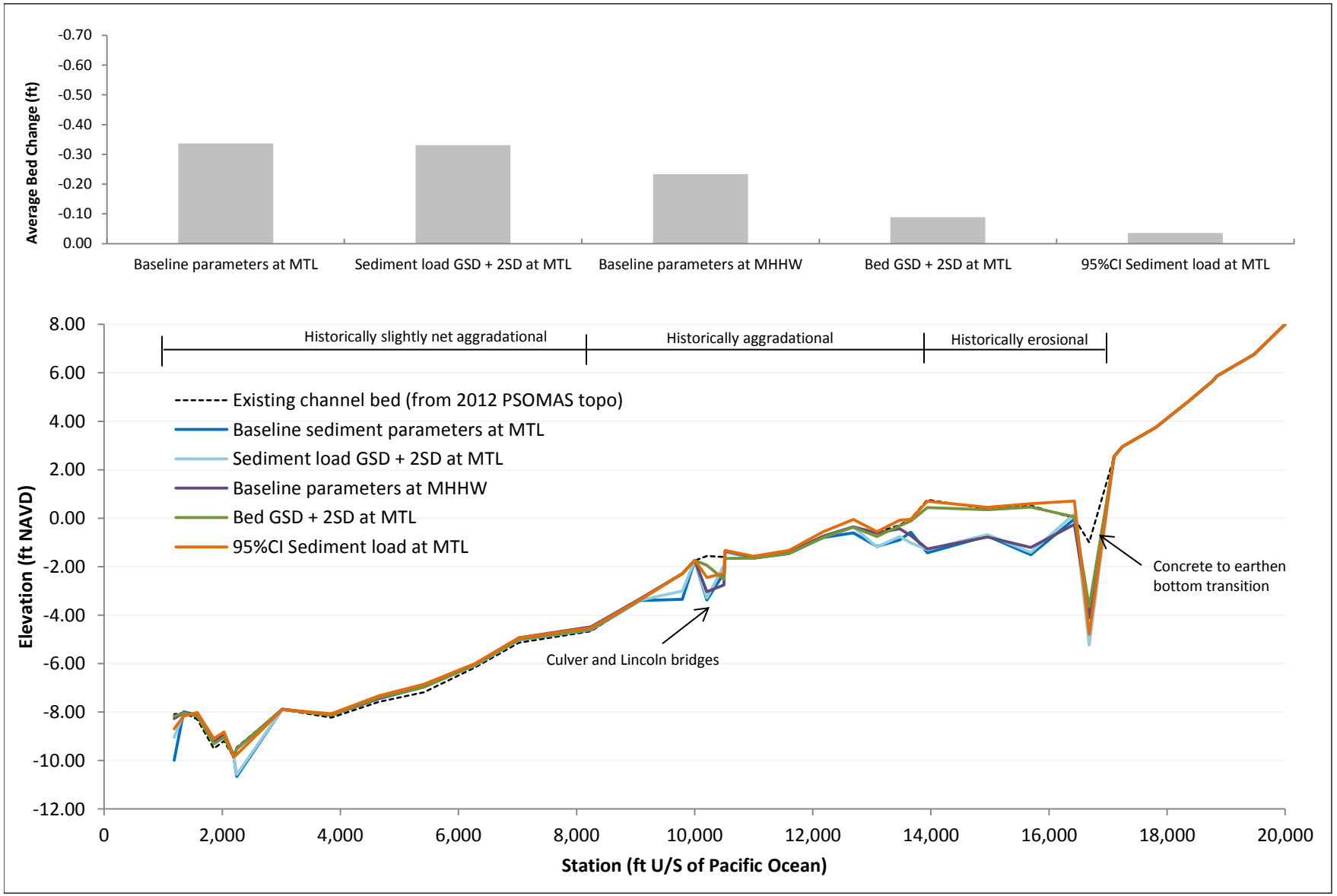
Figure 6b

Thalweg Profiles
1961 and 2012



NOTE: Results represent model runs conducted using Yang transport function for a Q5 event. Historic patterns (net aggradation and erosion between 1961 and 2012 from Figure 6a) are shown above for reference.

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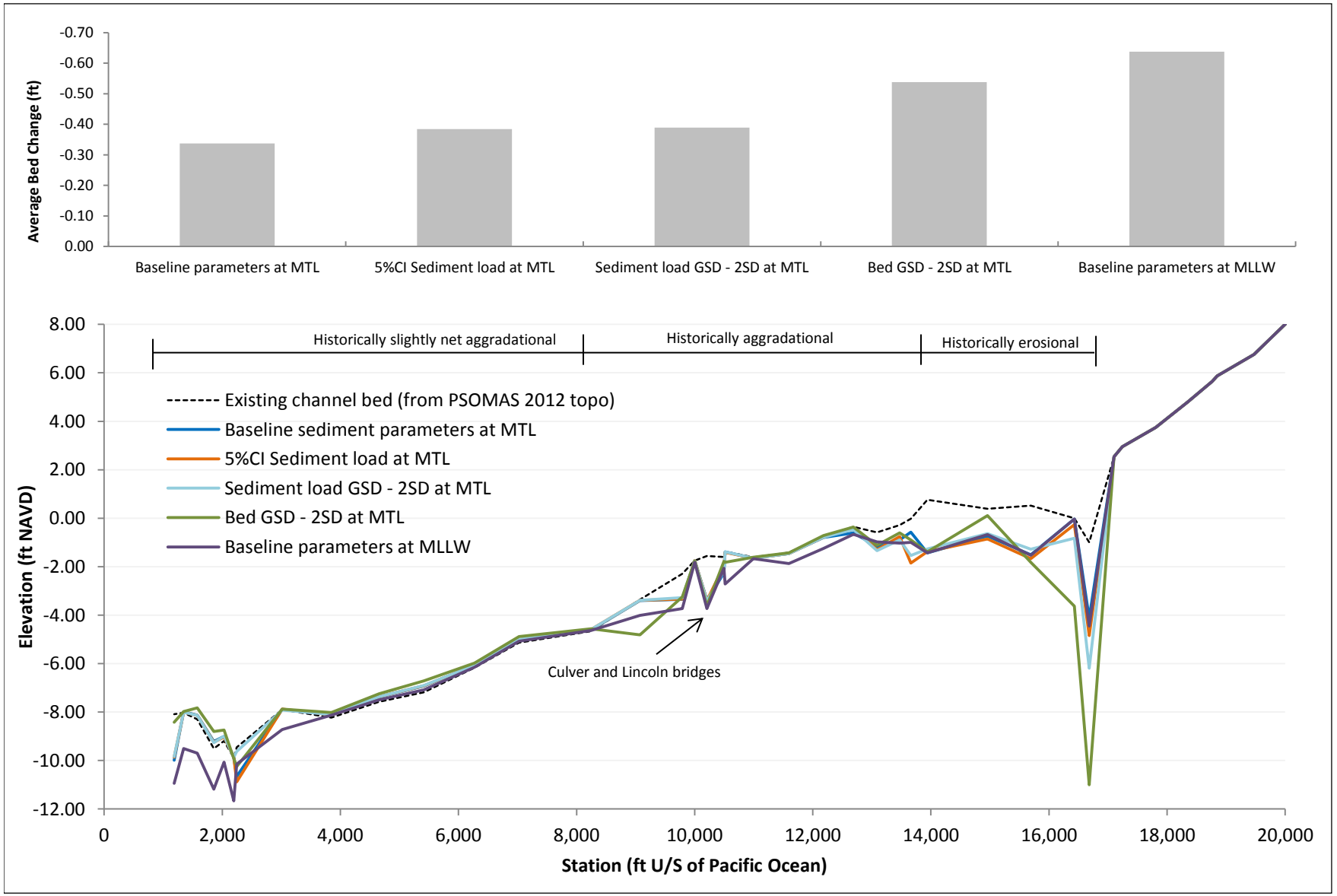
Figure 7

Q5 Channel Profiles for Upper Bound Sediment Transport Parameter Sensitivity Runs



NOTE: Results represent model runs conducted using Yang transport function for a Q5 event. Historic patterns (net aggradation and erosion between 1961 and 2012 from Figure 6a) are shown above for reference.

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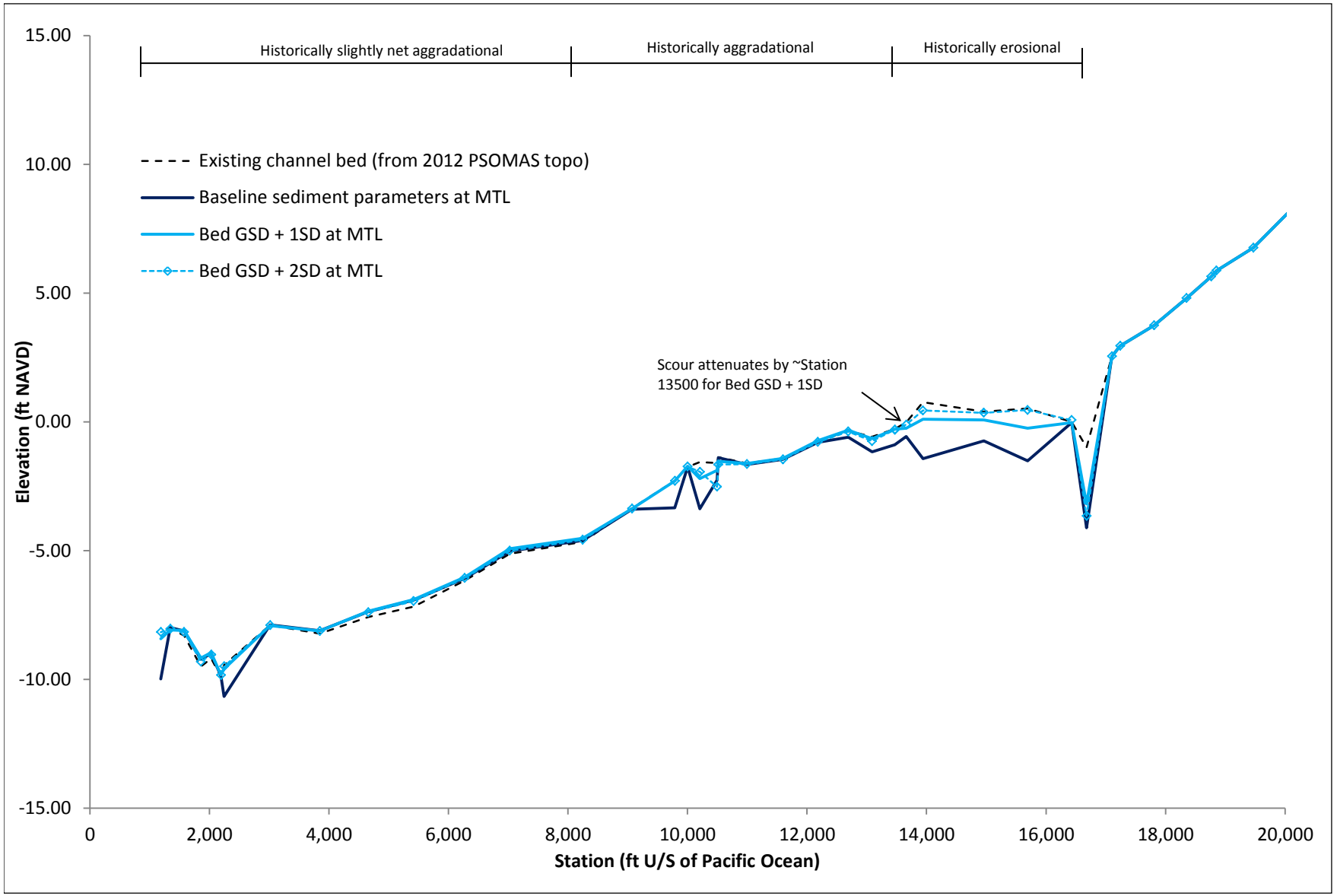
Figure 8

Q5 Channel Profiles for Lower Bound Sediment Transport Parameter Sensitivity Runs



NOTE: Results represent model runs conducted using Yang transport function for a Q5 event. Historic patterns (net aggradation and erosion between 1961 and 2012 from Figure 6a) are shown above for reference.

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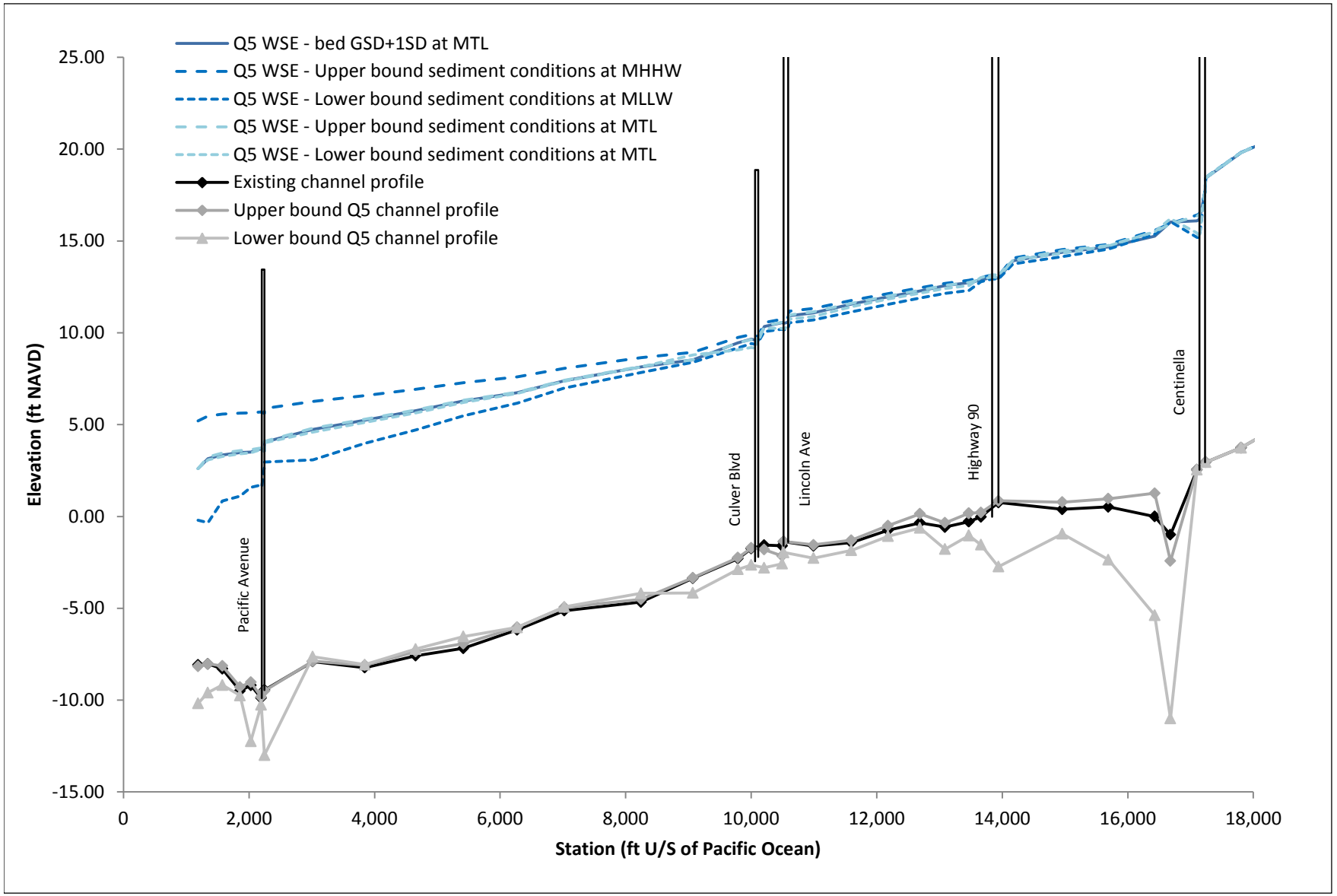
Figure 9

Q5 Channel Profiles with Initial and Modified Baseline Sediment Parameters



NOTE: Results represent model runs conducted using Yang transport function for a Q5 event.

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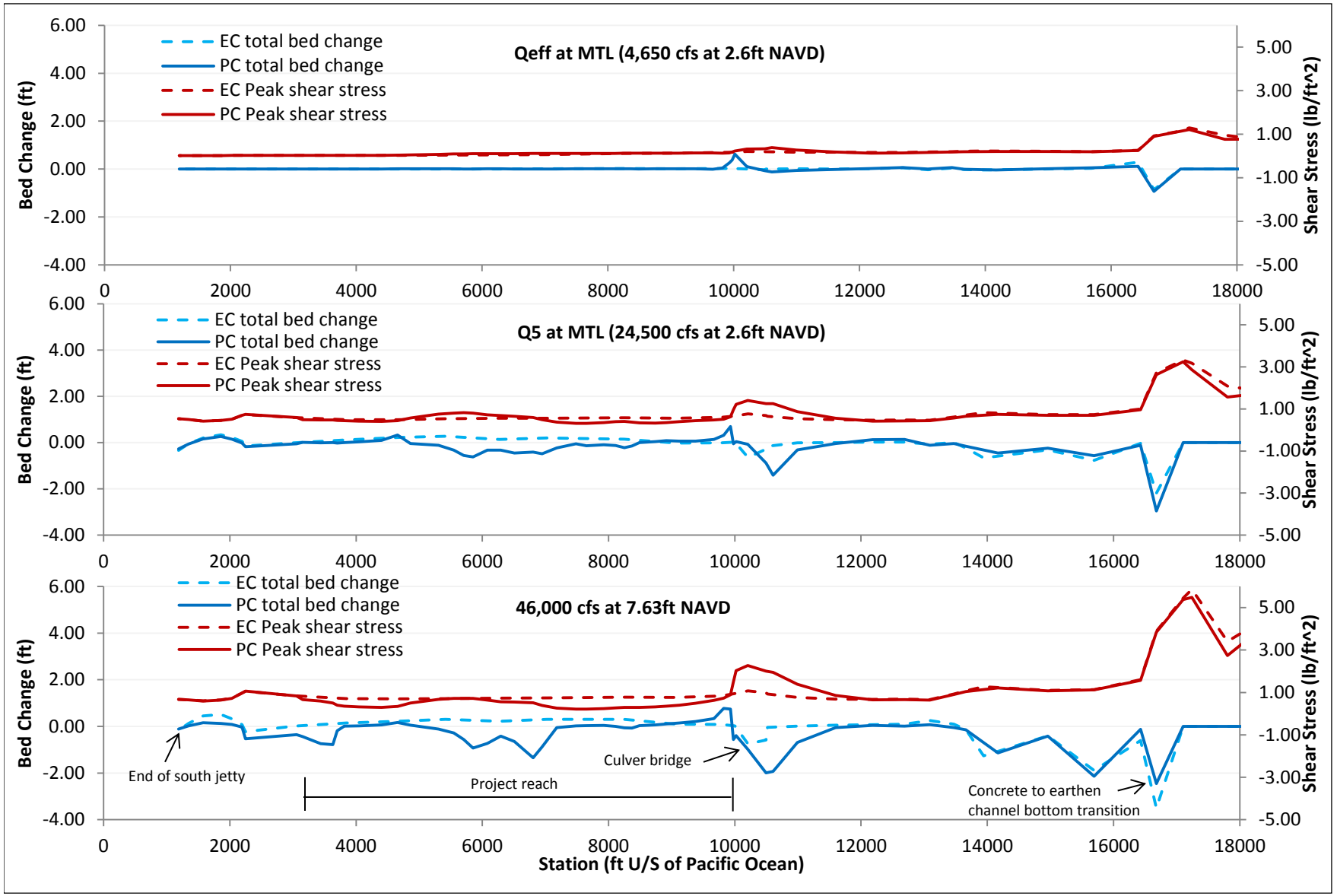
Figure 10

Existing Conditions Q5 Water Surface Profiles with Upper and Lower Bound Sediment Parameter Combinations

ESA PWA



NOTE: Bed change results for existing and project conditions are the same upstream of station 16,500

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Figure 11

Existing and project conditions sediment transport results

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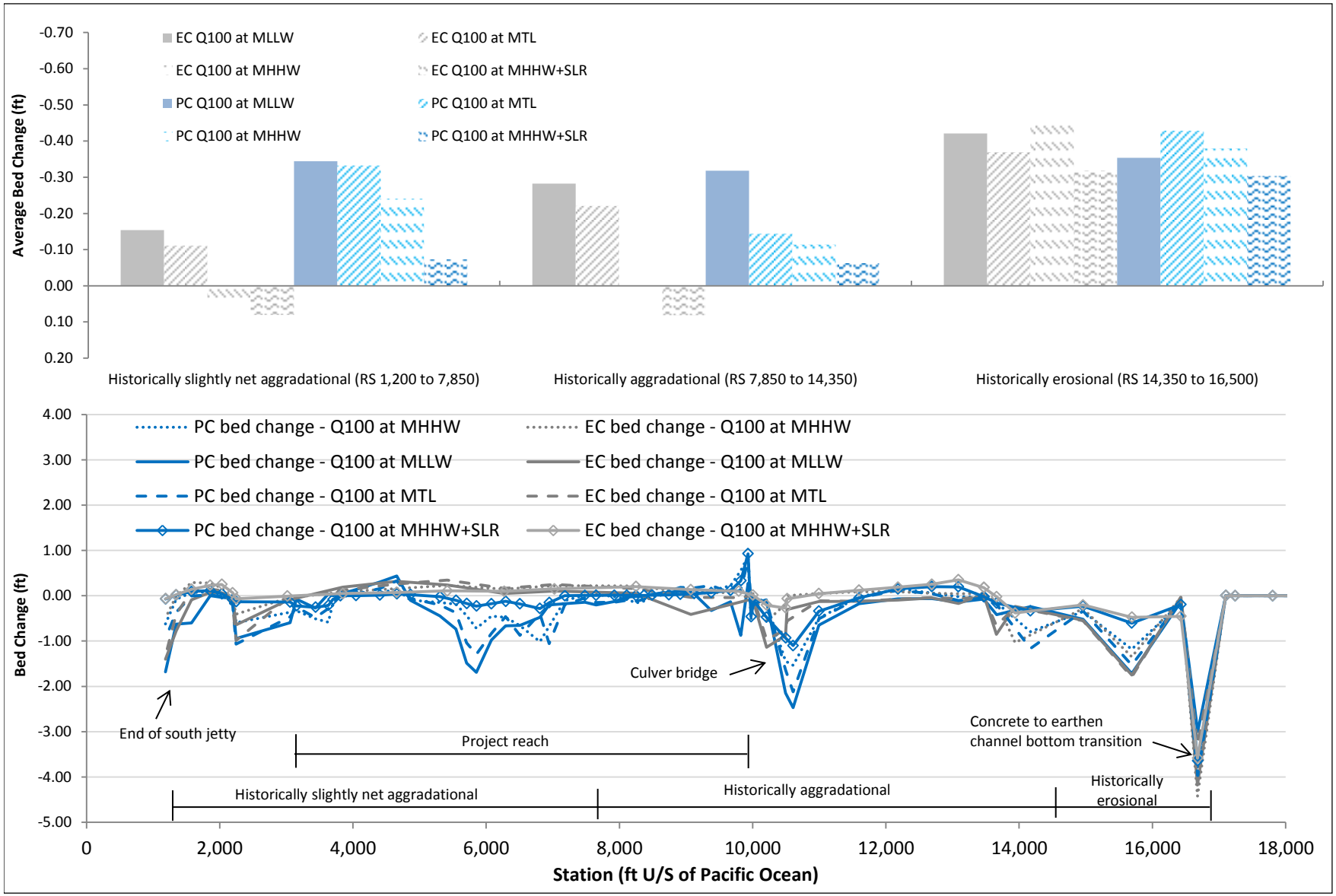

NOTE: Bed change results for existing and project conditions are the same upstream of station 16,500. Simulation results are for a Q100 event. Historic patterns (net aggradation and erosion between 1961 and 2012 from Figure 6a) are shown above for reference.

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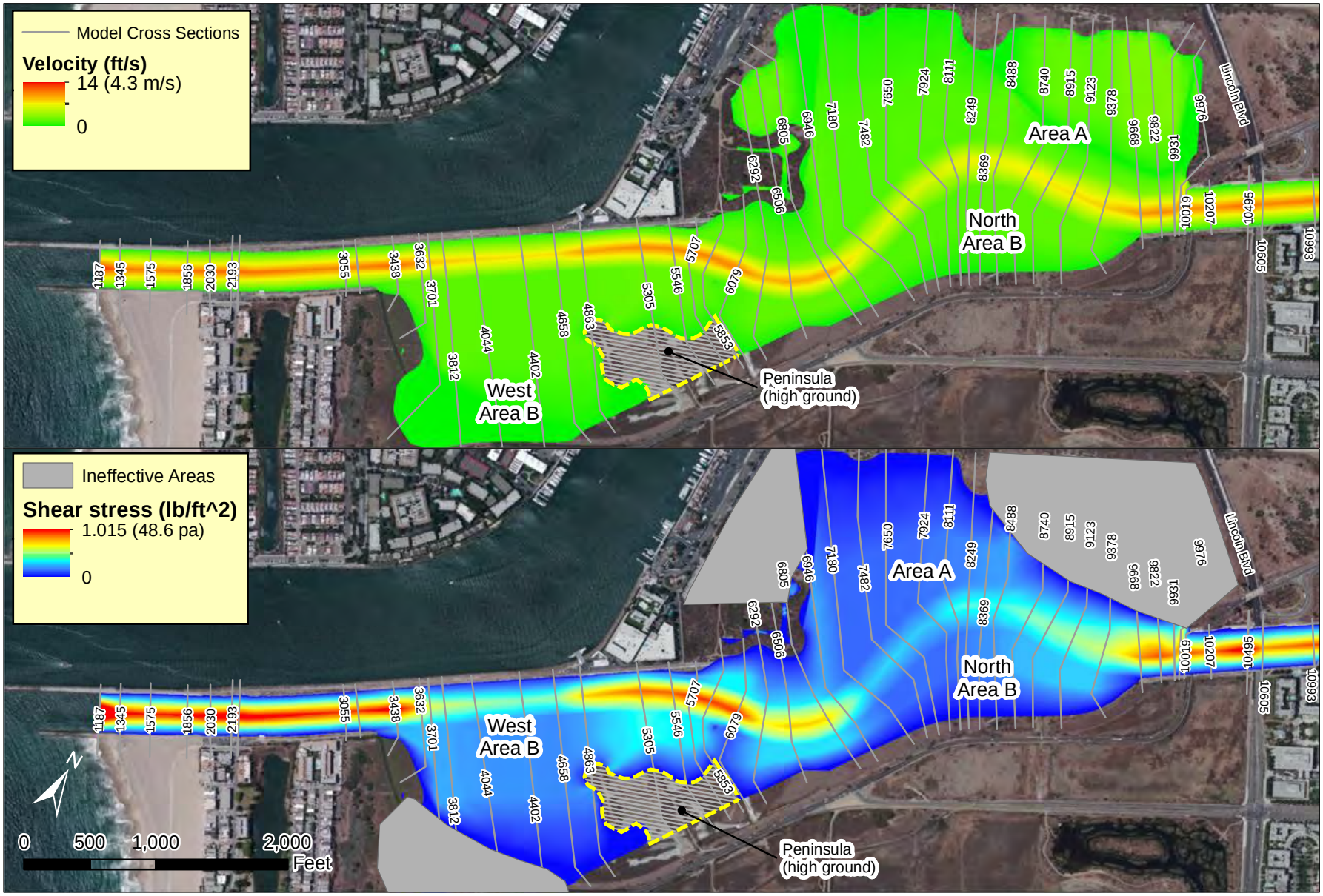
Figure 12

Bed change for Q100 event

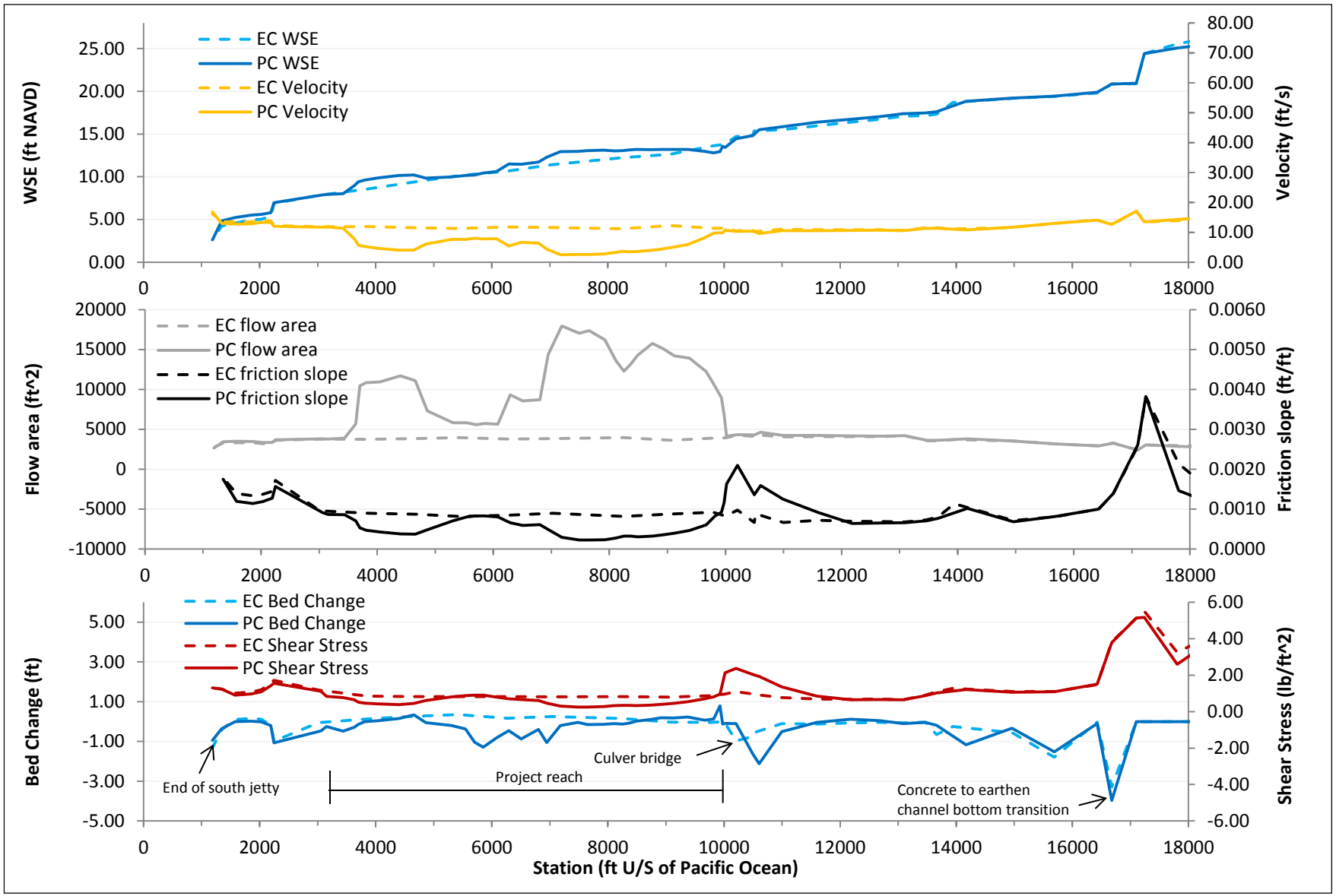
ESA PWA



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User

Ballona Wetlands. D120367.00

Figure 13
Q100 Shear Stress and Velocity Map



NOTE: Results for existing and project conditions are the same upstream of station 16,500

Ballona Wetlands. D120367

Figure 14

Q100 Existing and project conditions model results

ESA PWA

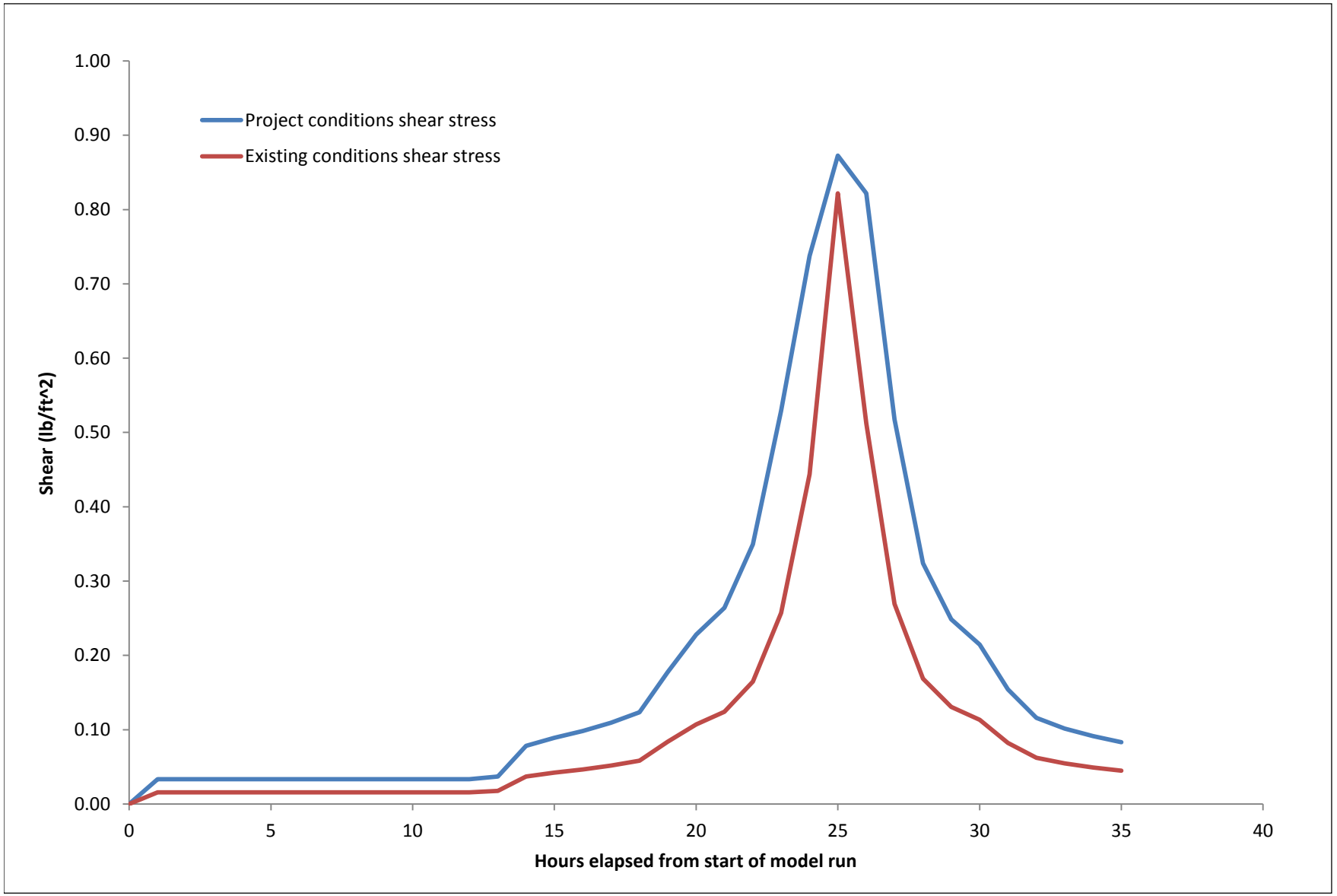


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Figure 15

Q100 Existing and Project Shear Stress Through Time at Station 5400

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APPENDIX F11
Monitoring and Adaptive Management Plan

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Introduction

The purpose of this Hydrodynamics and Water and Sediment Quality Monitoring and Adaptive Management Plan (H&WSQ-MAMP) is to provide a framework for the Ballona Wetlands Restoration Project (Project) for monitoring, assessing, and managing potential hydrodynamic and water and sediment quality impacts to biological resources and human health from and to the Project after construction. These potential impacts have been identified and discussed in the Sediment Dynamics and Budget Report (ESA 2015a), the Water Quality Technical Report (ESA 2015b), and the Environmental Impact Report/Statement (EIRS/S; ESA 2015c). This H&WSQ-MAMP will confirm the effectiveness of project features for potential post-construction impacts to hydrodynamics and water and sediment quality that have been identified in these documents. These potential impacts have been identified as less than significant in the EIR/S, due to planned Project features and regulatory driven actions in the Ballona Creek watershed and tidal prism as well as the mitigation measures. However, due to a number of unknown factors regarding the overall effectiveness of these features, post-construction monitoring and assessment will be needed to confirm that impacts remain less than significant. In the case where impacts are indicated based on comparisons to Project or regulatory thresholds, adaptive management measures will be needed. This framework provides a summary of the potential post-construction impacts, the Project features that are being taken to make them less than significant, and the monitoring program that will be the basis for continued assessment of these features. Adaptive management measures are also presented that would be taken if impacts are identified based on multiple lines of evidence. This framework meets the requirements of the CEQA process and provides the basis to develop a more detailed final MAMP.

Summary of Potential Impacts, Planned Mitigation Measures, and Effectiveness Monitoring

Potential hydrodynamic impacts may originate from the Project due to increased deposition or erosion caused by the reconnection of Ballona Creek to the floodplain. Water and sediment quality impacts may originate from the Project due to re-exposure of historical dredge sediments or marsh material from site grading that contain legacy constituents above thresholds. Legacy or recent constituents in sediment within the wetland channels can also be mobilized from channel scouring due to channel reconfiguration. Impacts to sediment and water quality within the Project may result from constituent loading from stormwater runoff from the watershed and surrounding urbanized areas adjacent the Project.

These and other potential impacts are summarized in Table 1 and categorized by “impacts from the Project” and “impacts to the Project.” Table 1 also summarizes the planned Project features to address potential impacts from the Project. The watershed and project measures to address the impacts to the Project are also summarized. Watershed measures are the responsibility of the Permittees and listed parties to the applicable total maximum daily loads (TMDL) enforced through the municipal separate storm sewer system (MS4) stormwater permit. In the final column of Table 1, the planned monitoring to confirm the effectiveness of these features is summarized.

Monitoring and Adaptive Management Framework

The framework for the H&SWQ-MAMP is based on the impacts identified from and to the Project, and the planned Project and watershed measures listed in Table 1. The framework is also based on the monitoring elements listed in Table 1 to confirm Project features are effective. Building on these elements, the Monitoring and Adaptive Management Framework has been developed and is presented in Figure 1.

The MAMP framework is based on answering the following key questions for impacts from and to the Project:

Monitoring Questions (impacts from the Project):

- Has the Project increased deposition in Ballona Creek to a point that could cause flooding?
- Has the Project increased deposition in the entrance to Marina del Rey to a point that could impact navigation?
- Is the site experiencing erosion that could threaten levee stability?
- Has increased scouring of Ballona Creek resulted in migration of sediment containing legacy and emerging constituents above thresholds that can impact biological resources or human health within the estuary?
- Have exposure and/or migration of legacy constituents above thresholds in marsh sediments resulted in potential impact to biological resources?

Monitoring Questions (Impacts to the Project):

- Have dry weather flows and stormwater from the watershed and adjacent lands resulted in accumulation of constituents in sediments within Ballona Creek and the connected wetland channels at concentrations that result in a significant impact to biological resources or human health?
- Has sea level rise increased managed water levels in South and Southeast Area B to levels that will flood Culver Blvd., Jefferson Blvd, and/or the Gas Company?

Current Monitoring

To address these key questions, Project monitoring will be coordinated with sediment monitoring in Marina del Rey. Los Angeles County and USACE conduct conditions surveys of the Marina del Rey harbor entrance as well as sediment sampling. Cooperation with regional monitoring programs is also important, as these programs provide developed standard protocols, baseline data, and the ability to compare to other estuaries in Southern California. The regional program includes the Bight program, which has a coastal wetland assessment component. Currently under development is a framework for a regional assessment of wetland conditions. This assessment framework can be used in combination with the framework presented in this MAMP to provide a multiple-line of evidence approach to assessing the health of the wetlands and informing management actions. Further development and implementation of these regional programs are dependent on funding priorities. Collaboration with these regional programs is fundamental to the development of the final MAMP, which will include reference to these programs and the methods, protocols, and baseline data developed under these programs.

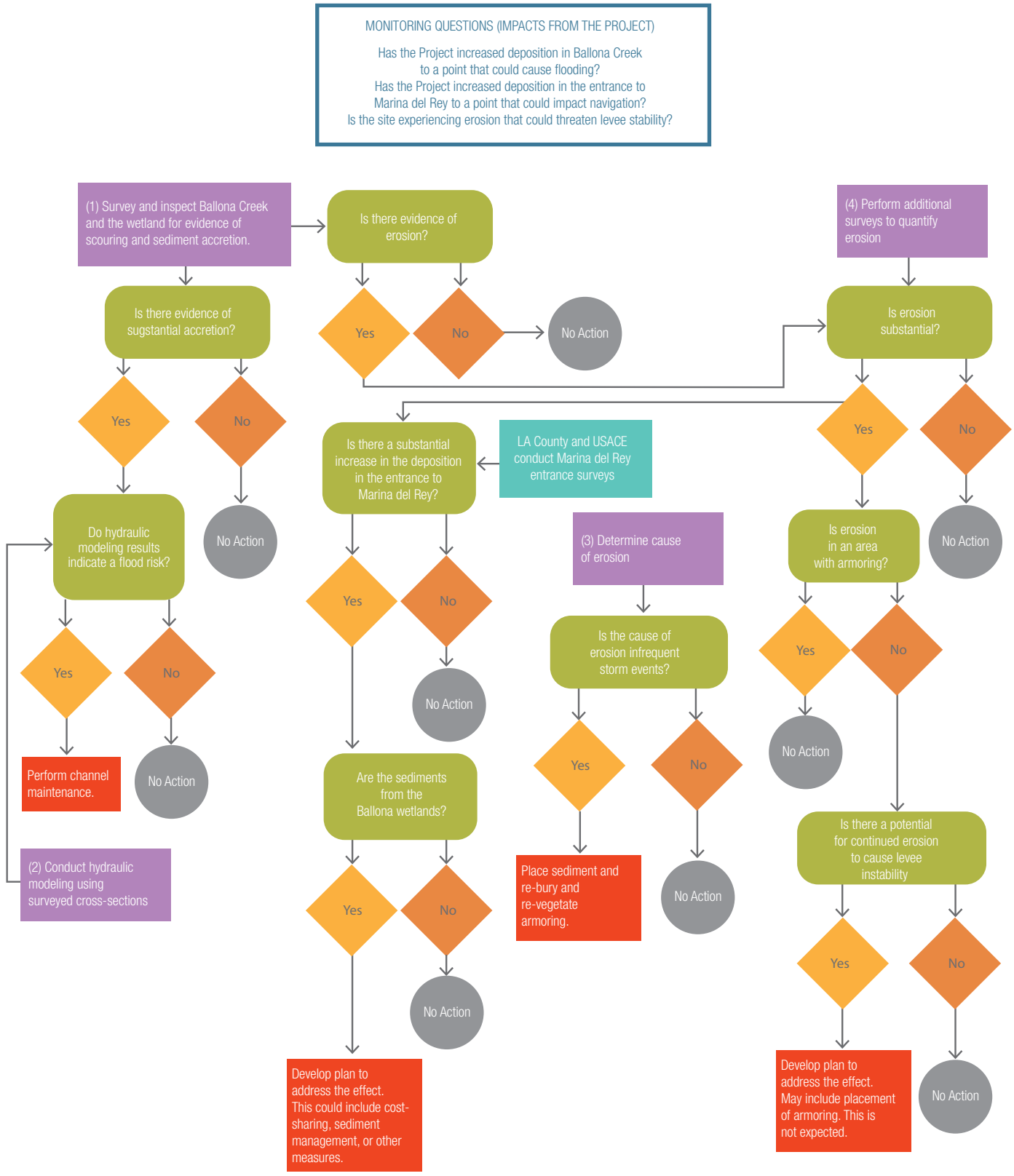
Table 1: Summary of Potential Impacts, Mitigation Measures, and Effectiveness Monitoring

Potential Impacts	Planned Project Features or Watershed Management Measures	Planned Post-Construction Monitoring to Assess Effectiveness of Mitigation Measures
"From the Project"		
Channel Deposition – Deposition in the channel or entrance to Marina del Rey could cause flooding or increase the amount of dredging for navigation	**New Levees** – The new Project levees are designed to accommodate some level of channel deposition and maintain flood protection. An assessment of maintenance limits was performed for the EIR/S in the Modeling Addendum (ESA 2015c). Under Alternative 1, the maintenance limit was modeled as a reduced equilibrium tidal channel hydraulic geometry cross-section. These reduced dimensions are conservative and are not expected to be reached due to limited sediment supply. The dimensions represent a minimum channel size limit, because even if adequate sediment supply was available, tidal flows would maintain this equilibrium cross-section. Modeling results showed that freeboard from the water surface to the levee would be maintained with these reduced dimensions, and the need for maintenance is therefore not expected. In the other alternatives, the existing Ballona Creek levee remains in either West Area B (Alternative 2) or the whole site (Alternative 3), so the flood protection is not as great as in Alternative 1. The maintenance limit that was modeled was 4 feet of deposition in the channel, and results showed positive freeboard under this scenario.	**Channel Cross-Section Monitoring** – Based on annual channel surveys, any locations with substantial channel deposition would be identified and channel cross-sections would be surveyed. The survey results would be compared to the maintenance limits established for the Project. If channel surveys show that channel dimensions are reduced below the established maintenance limit in any location along the channel, the potential effect of the deposition on flood levels would be assessed. This assessment would include updating the hydraulic model with the surveyed channel dimensions to test whether the deposition would negatively affect flood performance. This assessment would be overseen by a qualified licensed professional civil engineer. If flood performance was found to be impacted, channel maintenance would be performed. If no impact was found, surveys would continue to be performed with an adjusted focus on areas of deposition. **Marina del Rey Entrance Monitoring –** LA County and USACE perform regular monitoring of elevations in the Marina del Rey harbor entrance. If significant erosion is observed in the Reserve, surveys would be performed to quantify the amount of erosion. Monitoring data from the harbor entrance would be assessed in coordination with LA County and USACE to determine if a corresponding significant increase in deposition in the harbor entrance occurred. If such an assessment indicates that erosion from the wetlands could have potentially caused a significant increase in deposition, additional sampling of sediment deposits in the harbor entrance channel would be performed to assess sediment properties and compare them against sediment properties in the Reserve area of erosion. If the project partners determine that erosion due to the Project caused a significant increase in deposition in the entrance channel, then the partners would coordinate and agree to a plan to accommodate the increase in sediment deposition. This could include cost-sharing proportional to the increase in deposition, sediment management measures to re-use/replace deposited sediment within the Reserve, or other measures.
Channel Erosion – Erosion or migration of the channel could threaten levee stability	**Project Erosion Protection** – The Project would provide erosion protection by realigning the flood risk management levees to the perimeter of Area A around the restored wetlands and restoring a wide vegetated floodplain that gradually slopes from wetland to upland habitats along the new perimeter levees. These broad slopes are expected to reduce storm flow depths and velocities near the new levees, thereby reducing the potential for levee erosion. Flow in the restored Ballona Creek channel would be guided by the sloping floodplain and upland peninsulas. Some gradual channel migration and periodic localized bank erosion and sedimentation would be expected to occur as is typical for natural river and estuary systems. The restoration is designed so that (1) this level of change would be acceptable for the habitat restoration and flood risk management and (2) the channel would not require regular maintenance. Where higher flows do occur and scour potential is increased, levees and channel banks would be protected by rock armoring as described further in the Preliminary Design Report (ESA 2015d). The erosion protection features are intended to guide Ballona Creek flows back into the existing channel and to reduce the potential for the channel to meander too far north or south.	**Erosion Monitoring** – Levees and channel banks would be inspected for erosion. Any locations of significant erosion would by assessed for potential effects. Inspection and assessment should be performed by a qualified licensed professional civil engineer. In any locations where erosion exposes buried armor protection, it would be assessed whether the erosion was due to an infrequent event or more regular flows. If erosion is determined to be due to an infrequent event, sediment would be placed to re-bury and re-vegetate the armoring, and monitoring focused on this area would be continued. If erosion along unprotected levees, such as the perimeter of Area A and the southeast side of West Area B, is observed, it would be assessed to determine if the erosion is negatively affecting the levee integrity. If negative effects were determined, a plan would be developed, which could include actions such as placement of armoring or buried armoring. Note that this is not expected. If any locations of significant channel bank erosion are observed in sections of the channel bank without armoring, the areas would be assessed for potential continued erosion that could negatively affect habitat or adjacent levees/infrastructure. If negative effects were determined, a plan would be developed, which could include actions such as placement of armoring or buried armoring. This is not anticipated.
Erosion of marsh sediments with legacy constituents – Legacy constituents at concentrations above thresholds could become exposed and/or migrate through stormwater runoff or new channel scouring.	**Pre-Construction Sediment Sampling** – A pre-construction sampling analysis plan would identify sediments with high levels of constituents and designate those sediments for burial or use in less effected habitats. As part of the final permit and design process, pre-construction sampling and analysis of sediment for legacy constituents that will be exposed or used as foundation material for the wetlands and upland habitat will be performed. This pre-construction sampling will provide additional representative characterization to address any potential impacts from identified legacy constituents above threshold levels that pose a significant impact to biological resources and human health. The testing and analysis will also meet dredge material characterization requirements for marine placement. The results of this sampling and analysis will be used to develop the sediment management specifications for the Project.	**Monitoring of Marsh Sediment Quality** – Potential impact will be monitored in coordination with Permittees' TMDL monitoring of Ballona Channel. The TMDL monitoring of the channel will be supplemented by sampling of sediment in new wetland channels subject to erosion and accumulation of migrated sediment and analyzed for legacy constituents (metals, PCBs, DDT, PAHs) and compared to TMDL sediment criteria. If the results indicate concentrations of these legacy constituents exceed the criteria, toxicity and benthic surveys will be conducted and results compared to Sediment Quality Objectives (SQOs). Further testing to identify the source of these constituents will be performed to confirm these results and the source of the constituents. Management action will be taken based on results of the SQO analysis, confirmation sampling, and source identification studies.

Table 1: Summary of Potential Impacts, Mitigation Measures, and Effectiveness Monitoring (continued)

Potential Impacts	Planned Project Features or Watershed Management Measures	Planned Post-Construction Monitoring to Assess Effectiveness of Mitigation Measures
Erosion of Ballona Creek sediments with legacy constituents – Legacy constituents in sediments such as copper, zinc, and PCB may pose impacts to fish tissue and human health.	**TMDL/NPDES Permit Monitoring and Watershed Pollutant Reductions** – The TMDL sets a plan and schedule for addressing the existing impacted sediment in the channel. Permittees are required to conduct testing and analysis of creek sediment within the tidal prism that includes chemical, toxicity, and benthic assessment for comparisons to the SQOs, to determine if sediments are impaired. If a sample is determined to be impaired, then further action is required. These actions may include further monitoring, reductions of pollutant loading from the watershed, and/or removal of the impacted sediment. Permittees are also required to conduct tissue sampling and compare to TMDL targets. These actions are to be taken and targets met prior to the estimated construction of the Project. The presence of legacy constituents at concentrations that can impact biological resources and human health will, therefore, be addressed prior to construction. **Covering of Impacted Sediments from Project** – Additionally, portions of Ballona Creek with sediments that contain legacy and emerging constituents will be covered as part of the creek re-alignment. These buried impacted sediments will not be subject to exposure and impact to the biological community or human health.	**Monitoring of Channel Sediment Quality** – Monitoring of sediments within the Channel will be conducted by the Permittees in accordance with the required TMDL monitoring program. Monitoring of sediments at the Marina del Rey harbor entrance will be conducted by LA County and the USACE as part of the Marina del Rey harbor entrance navigation maintenance and dredging program. This monitoring will assess the sediment quality compared to the SQOs and other applicable criteria for dredging. If samples are identified as impaired, further reductions in pollutant loading from the watershed or other actions will be taken. If results indicate new emerging constituents such as synthetic pyrethroids, which have not been fully addressed through the TMDL, are resulting in impacts, further action will be required under the MS4 Permit (if these emerging issues are from MS4 discharges). Sediment sampling under this MAMP will be coordinated with the Permittees' monitoring, ongoing Regional Wetland Monitoring programs, and LA County and USACE's monitoring in the Marina del Rey entrance. MAMP monitoring will occur outside of the main channel in the connecting channels of the Project. Monitoring will be conducted if results of the main channel monitoring indicated sediments remain impacted and may be subject to additional scouring and possible migration of emerging constituents. If the results of sediment sampling in wetland channels (not main channel) indicate concentrations of these constituents exceed the TMDL sediment thresholds, toxicity and benthic surveys will be conducted and results compared to Sediment Quality Objectives (SQOs). Further testing to identify the source of these constituents will be performed and management action taken based on results of the SQO analysis. **Monitoring of Fish Tissue under TMDL**- Fish tissue sampling and testing as required by the TMDL will assess impacts to human health until targets are reached.
"To the Project"		
Deposition of sediments with high constituents in the marsh – Constituents that are hydrophobic such as many metals, pesticides, and PAH will adsorb to sediment that is carried by stormwater to the wetland and settle out, potentially impacting the existing and restored wetland biological resources.	**TMDL/NPDES Permit Monitoring and Watershed Pollutant Reductions** – The amended Toxic Pollutant TMDL (R13-010 December 5, 2013) sets a plan and schedule for reducing the current waste load allocations. Permittees have developed Enhanced Watershed Management Plans to meet TMDL load reductions by 2021; before the construction of the Project is finished. The permittees are required to monitoring for pesticides and if reductions are not obtained, the Regional Board will require further action. **Tidal Channel Design** – The Project has been designed to allow for natural flushing and circulation within wetland channels to improve water quality. **Stormwater Treatment Best Management Practices (BMPs) –** The Project plans to implement BMPs to collect and treat stormwater from outfalls that discharge directly to the wetlands. A retention treatment BMP is planned for the largest stormwater outfall from an urbanized area of Playa del Rey that was shown to impact sediments in the wetland channel of Area B. Bioswales are planned along Culvert Boulevard to remove sediment and constituents from runoff from this roadway that runs through Area B.	**Monitoring of Watershed Storm Flows and Dry Weather Flows** – The Permittees under the TMDL will continue to monitor water quality from the watershed above the tidal prism and sediment quality and fish tissue within the tidal prism of Ballona Creek to track progress toward and confirm attainment of load reductions and TMDL targets. **Monitoring of Wetland Channel Sediment Quality** – Long-term monitoring of existing and new wetland channels, which are subject to stormwater discharge, will be performed in accordance with approach outlined in this MAMP. The TMDL monitoring of the channel will be supplemented by sampling of sediment in existing and new wetland channels, which are subject to accumulation of migrated sediment from watershed and adjacent property, analyzed for legacy constituents (metals, PCBs, DDT, PAHs), and compared to TMDL sediment criteria. If the results indicate concentrations of these legacy constituents exceed the criteria, toxicity and benthic surveys will be conducted and results compared to Sediment Quality Objectives (SQOs). Further testing will be performed to confirm these results and determine the source of the constituents (Is the source from the watershed, site or adjacent properties?). Management action will be taken based on results of the SQO analysis, confirmation sampling and source identification studies. If stormwater is determined to be the source, additional BMPs may be implemented.
Sea level rise causing increased flood risk south of Culver Blvd	**Culvert Flap Gates- The Project has been designed to allow for the addition of flap gates to the culvert leading into South and Southeast Area B to manage water levels south of Culver Blvd.**	**Water Level Monitoring- The Project would conduct annual water level monitoring in South and/or Southeast Area B. Based on monitoring results, flap gates would be added to the culverts over time to limit the amount of watering entering the areas south of Culver Blvd as sea level rises. Initial modeling indicates that one flap gate will be added to the culverts every 25 years. Water level monitoring will determine when water levels need to be reduced by adding a flap gate.**

Figure 1: Accretion and Erosion Monitoring and Adaptive Management Flow Chart



Additional water and sediment quality monitoring is conducted through the amended Toxic Pollutant TMDL (R13-010 December 5, 2013), which requires the Permittees to conduct water quality monitoring in the non-tidal segment, including analysis of settable solids in storm flows for cadmium, copper, lead, silver, zinc, chlordane, dieldrin, total DDT, total PCBs, total PAHs, and total organic carbon. Sediment quality evaluations will be conducted every 5 years and include a full chemical suite, two toxicity tests, and four benthic indices, as specific in the SQO. Sediment chemistry and sediment toxicity samples will be collected annually (in addition to the SQO samples) to evaluate trends in general sediment quality constituents (e.g. TOC, grain size) and listed constituents (i.e. cadmium, copper, lead, silver, zinc, chlordane, total DDT, total PAHs, and total PCBs. The Permittees will also monitor chlordane, total DDTs, and PCBs in fish and mussel tissue within the estuary on an annual basis per the TMDL. The results of this Permittee monitoring will be coordinated with Project Monitoring to answer the key Monitoring questions as presented in Figure 1.

Additionally, as part of the Marina del Rey entrance dredging program, LA County and USACE conducts sediment sampling prior to dredging.

Accretion and Erosion Framework Steps

As presented in Figure 1, the MAMP framework provides steps that are to be taken in coordination with other monitoring efforts. The steps of the framework are highlighted in purple, which differ from the current monitoring elements, in teal. Each step includes decision points that determine if the next step is taken or if no further action is needed. The decision points are shown in Figure 1 as questions in green with yes or no responses.

Step 1: Erosion and Accretion Monitoring. The framework begins with Project monitoring of Ballona Creek and the wetland channels for evidence of scouring and sediment accretion. These site inspections and surveys are to be conducted on an annual basis.

Step 2: Hydraulic Modeling. If the surveys conducted in Step 1 show that Ballona Creek has experienced enough accretion to reach the maintenance limits of the channel, hydraulic modeling will be conducted to determine any potential impacts to flooding. This assessment would include updating the hydraulic model with the surveyed channel dimensions to test whether the deposition negatively affects flood performance. This assessment would be overseen by a qualified licensed professional civil engineer.

Management Actions. If hydraulic modeling shows the accretion in the channel could cause flooding, channel maintenance would be performed.

Step 3: Quantify Erosion. In areas where the inspection in Step 1 shows substantial erosion, the erosion would be quantified through additional surveys.

Step 4: Assess Cause of Erosion. In areas where the inspection in Step 1 shows substantial erosion (as determined by Step 3) the cause of the erosion would be evaluated. A licensed civil engineer would assess whether erosion is due to an infrequent event and whether placement of sediment to re-bury and re-vegetate the armoring is likely to be sustainable. This assessment may include continuing focused monitoring.

Management Actions. If the erosion is determine to be due to infrequent storm events, sediment may be placed to re-bury the armoring and re-vegetation could occur. If the erosion is occurring in an area without armoring, armoring could be placed to protect levee stability. This is not expected.

Step 5. Sediment Sampling. If surveys conducted by LA County and USACE show an increase in the deposition in Marina del Rey during the same period that substantial erosion from the marsh has been observed, sediment sampling will be conducted to determine sediment properties in the marsh. These properties will be compared to data from LA County and USACE in the marina entrance to determine if the increased sediment is a result of the Project.

Management Actions. If sediment sampling shows the increase in deposition or lowered sediment quality in the marina entrance is due to the Project, then the partners will coordinate and agree to a plan to accommodate the increase in sediment deposition. This could include cost-sharing proportional to the increase in deposition, sediment management measures to re-use/replace deposited sediment within BWER, or other measures.

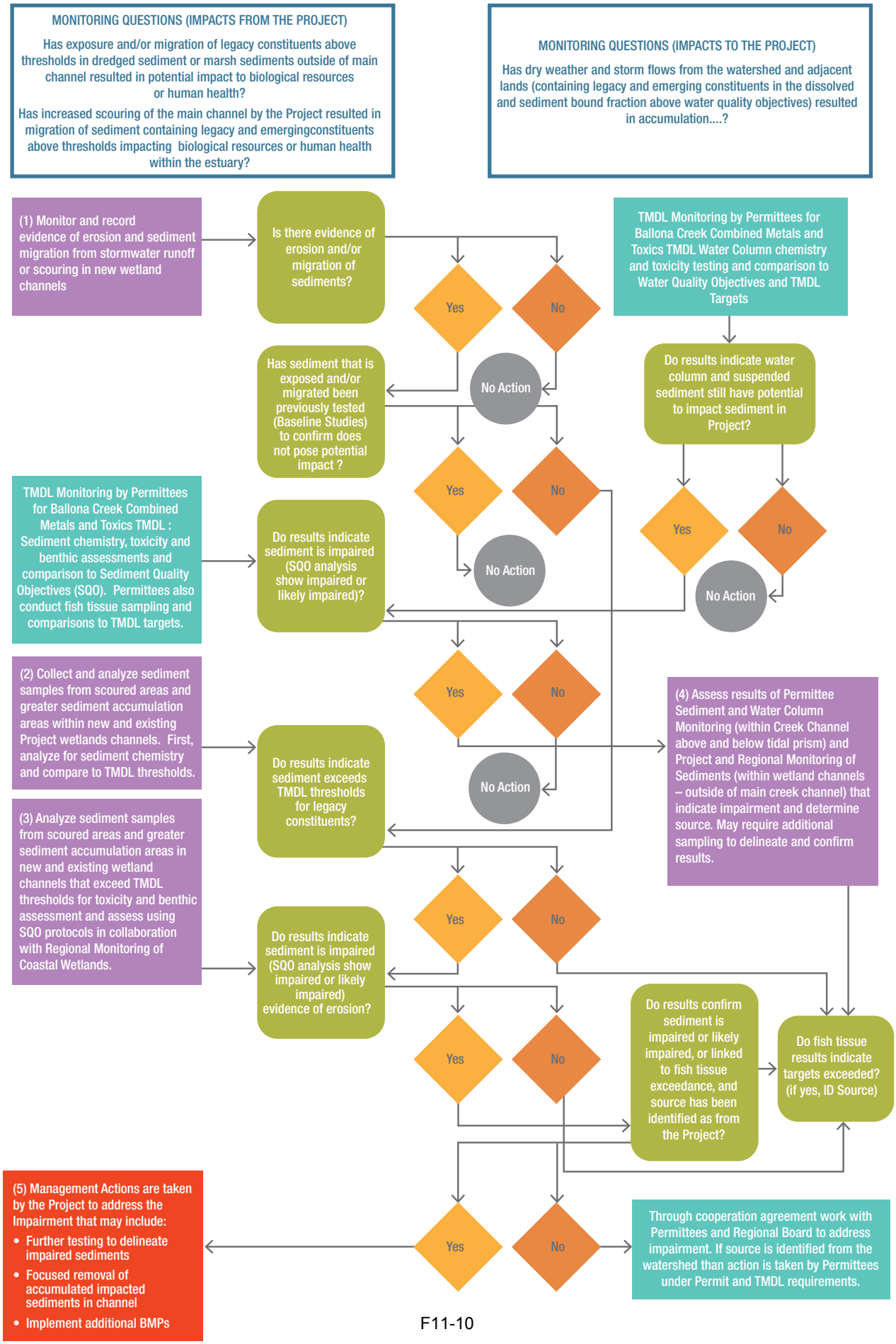
Water and Sediment Quality Framework Steps

Step 1: Erosion and Accretion Monitoring. The framework begins with Project monitoring of the wetland channels for evidence of scouring and sediment accretion (Figure 2). These site inspections are to be conducted on an annual basis. Evidence of scouring or accumulation of sediments in new channels will be identified and recorded. The observed or likely source of the sediment that has accumulated will be assessed and recorded. Potential observations of scouring and erosion and likely potential sources are listed in the table below:

Example Potential Observations	Potential Likely Sources
Accumulation of sediments in existing or new wetland channels near observed stormwater runoff outfall or erosion in upland area	-Stormwater runoff from adjacent land that may or may not be managed through Project BMPs -Stormwater from upland area that has channelized and eroded existing soils
Accumulation of sediments in wetland channels in areas that are predicted for higher sediment accretion from the watershed with no evidence of local channel scouring	-Watershed storm flows
Accumulation of sediments in wetland channels in areas that are predicted for higher sediment accretion from the watershed, but also show evidence of local channel scouring	-Watershed storm flows -Localized scouring of wetland channels
Scouring of Ballona Creek observed and accumulation of sediments in adjacent and downstream wetland channels	-Ballona Creek sediments
Accumulated sediment in new channels with multiple observations of Ballona Creek and wetland channel scouring and likely loading from the watershed	-Watershed storm flows -Localized scouring of wetland channels -Ballona Creek sediment

These observational data are to be used in combination with previous baseline and pre-construction testing of sediments to determine if additional action is needed. If previous testing indicated no potential impact from sediments in areas that have been exposed, or in accumulated sediments from a known site source, then no further action is needed. If exposure or accumulated sediment is from an on-site source that has not been characterized, then further Project monitoring is needed. This additional Project monitoring is to be coordinated with the results of the Permittees TMDL monitoring of

Figure 2: Water and Sediment Quality Monitoring and Adaptive Management Flow Chart



Ballona Creek water column above the tidal prism and sediments within the tidal prism. If the TMDL monitoring identifies through SQO assessment that the sediments within the tidal prism are impaired or likely impaired, than these results will inform further Project monitoring as outlined in the framework in Figure 2.

Step 2: Sediment Testing. If the erosion and accretion monitoring and review of existing sediment quality data indicate further monitoring is required, than the second step would include the sampling and analysis of targeted sediment within wetlands channels. This sampling and analysis should be coordinated with regional monitoring programs and the Permittee TMDL monitoring. For this step the analysis will be limited to chemical analysis of legacy and identified new constituents such as synthetic pyrethroid pesticides. The concentrations of these constituents will be compared to the TMDL sediment quality targets based on the effects range low (ER-Ls) or other applicable thresholds for the emerging pollutants.

Step 3: Toxicity and Bioassessment Testing. If the ER-L targets or thresholds are exceeded, further analysis of the sediment will be conducted to include toxicity and benthic bioassessment to assess the sediments using SQO methods.

Step 4. Determine Source. If the sediment is identified through the SQO process to be impaired or likely impaired, than the next step would be conducted. This step includes an assessment of all the data from the various monitoring programs and identification of the likely or known sources of the constituents that are predominant in resulting in the impaired condition. This may require additional monitoring and testing. For example, to determine the sources of sediment impairment in accumulated sediment in new wetland channels, evaluation of the chemistry data may indicate that the presence of synthetic pyrethroid pesticides above the L_{50} based threshold. Further testing of the sediments could indicate that the sediment results in a toxic response to marine arthropods. Toxicity identification evaluations (TIE) testing could then indicate that the toxicity is due to these pesticides. Since these pesticides have only recently been introduced and heavily use (last 10 years), the analysis could conclude that the source of sediment was not the dredge material from Marina del Rey placed in Area A, or historical marsh sediments in areas that have not been subject to recent watershed or adjacent urbanized land storm flows. The analysis would show that the sediment is likely from the watershed where these pesticides are used.

In addition to impairment of biological resources, impact to human health needs to also be monitored. Monitoring for fish tissue is part of the Permittee TMDL monitoring. In addition to conducting the sediment quality analysis under Step 4, results of any fish tissue testing and comparison to targets should be used to identify further actions as shown on Figure 2. If the fish tissue data indicated an exceedance of targets to protect human health, than the data shall be assessed to determine if there are linkages between the fish tissue results and observed exceedances of sediment or water quality from the watershed or with eroded or accumulated sediment in the Estuary. The collection and assessment of the monitoring data from all four steps is used to answer the key Monitoring questions highlighted above and listed in Figure 2 at the top of the page.

Management Actions. Management actions will be taken if the results of steps 1 through 4 confirm sediment is impaired or likely impaired, or linked to fish tissue exceedance, and the source has been identified as from the Project. Management actions that may be taken by the Project to address the impairment include:

- **Further testing to delineate impaired sediments** – further delineation of the sediment that contains constituents that are resulting in impairment may be needed to limit the extent and depth of sediment to be managed.
- **Focused removal of impacted sediments in channel –** following delineation of the sediments that contain concentrations above the thresholds and result in SQO identified impaired or likely impaired conditions, management actions may require focused removal of sediment. Sediment removal would be balanced with impacts to sensitive species and habitat within the wetlands channels. No sediment removal outside the channels is recommended due to the potential impact to habitat.
- **Implementation of Additional BMPs –** additional BMPs to treat stormwater from adjacent lands that discharge to the wetlands may be needed to remove constituents that continue to accumulate in sediments within the wetland channels.

Management actions will also be taken if the results indicate that the sources of impaired or likely impaired sediments or fish tissue exceedance are from constituents present in storm and/or dry flows from the watershed. For these management actions, the Project will work with Permittees and the Los Angeles Regional Water Quality Control Board through cooperation agreements to address the impairment. If the source of the impairment is identified directly due dry weather or storm flows from the Ballona watershed, and from constituents under an existing TMDL, than action will be taken by Permittees under Permit and TMDL requirements.

Summary

This framework outlines the monitoring and assessment elements needed to determine if Project features and watershed actions are effective in addressing potential impacts to biological resources or human health. This framework also uses monitoring to assess sources, if impacts are determined through comparison to established thresholds and compliance targets. As Project features address potential accretion, erosion, and water and sediment quality impacts, the monitoring outlined in the framework is to assess the effectiveness of these features. In addition, this framework addresses the potential unknowns that include the potential erosion and accretion of sediments, the exposure and migration of sediment that has not been previously characterized and contains constituents above the thresholds, and the accumulation of emerging pollutant from the watershed that are not addressed in the current TMDL, such as synthetic pyrethroid pesticides. This monitoring and adaptive management framework therefore provides an additional Project feature to mitigate for the uncertainties that are not fully addressed by the Project or through the existing monitoring for the watershed and marina.

APPENDIX G

Noise Measurement Data and Calculations

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Noise Measurement Data

Summary				
File Name	LxT_Data.019			
Serial Number	0004161			
Model	SoundTrack LxT®			
Firmware Version	2.301			
User				
Location				
Job Description				
Note				
Measurement Description	15 Minute Logging			
Start	2015-06-30 9:45:53			
Stop	2015-06-30 10:00:53			
Duration	0:15:00.0			
Run Time	0:15:00.0			
Pause	0:00:00.0			
Pre Calibration	2015-06-30 9:44:40			
Post Calibration	None			
Calibration Deviation	---			
Overall Settings				
RMS Weight	A Weighting			
Peak Weight	Z Weighting			
Detector	Slow			
Preamp	PRMLxT1			
Microphone Correction	Off			
Integration Method	Exponenital			
Overload	145.3 dB			
	A	**C**	**Z**	
Under Range Peak	101.5	98.5	**103.5**	dB
Under Range Limit	**37.7**	35.7	43.7	dB
Noise Floor	24.8	25.4	32.9	dB
Results				
LASeq	53.9 dB			
LASE	83.5 dB			
EAS	24.771 µPa²h			
EAS8	792.669 µPa²h			
EAS40	3.963 mPa²h			
LZSpeak (max)	2015-06-30 9:46:47	94.2 dB		
LASmax	2015-06-30 9:46:47	73.8 dB		
LASmin	2015-06-30 9:48:35	45.1 dB		
SEA	-99.9 dB			
LAS > 115.0 dB (Exceedance Counts / Duration)	0	0.0 s		
LAS > 120.0 dB (Exceedance Counts / Duration)	0	0.0 s		
LZSpeak > 135.0 dB (Exceedance Counts / Duration)	0	0.0 s		
LZSpeak > 137.0 dB (Exceedance Counts / Duration)	0	0.0 s		
LZSpeak > 140.0 dB (Exceedance Counts / Duration)	0	0.0 s		
LCSeq	69.0 dB			

LASeq	53.9	dB
LCSeq - LASeq	15.0	dB
LAIeq	56.1	dB
LAeq	53.9	dB
LAIeq - LAeq	2.2	dB
# Overloads	0	
Overload Duration	0.0	s

Dose Settings			
Dose Name	OSHA-1	OSHA-2	
Exchange Rate	3	3	dB
Threshold	90	80	dB
Criterion Level	90	90	dB
Criterion Duration	8	8	h

Results			
Dose	0.00	0.00	%
Projected Dose	0.02	0.02	%
TWA (Projected)	53.9	53.9	dB
TWA (t)	38.9	38.9	dB
Lep (t)	38.9	38.9	dB

Statistics		
LAS5.00	58.3	dB
LAS10.00	55.6	dB
LAS50.00	49.8	dB
LAS90.00	47.0	dB
LAS95.00	46.3	dB
LAS99.00	45.4	dB

Summary				
File Name	LxT_Data.045			
Serial Number	0004161			
Model	SoundTrack LxT®			
Firmware Version	2.301			
User				
Location				
Job Description				
Note				
Measurement Description	15 Minute Logging			
Start	2015-07-07 10:06:48			
Stop	2015-07-07 10:21:48			
Duration	0:15:00.0			
Run Time	0:15:00.0			
Pause	0:00:00.0			
Pre Calibration	2015-07-07 10:02:52			
Post Calibration	None			
Calibration Deviation	---			
Overall Settings				
RMS Weight	A Weighting			
Peak Weight	Z Weighting			
Detector	Slow			
Preamp	PRMLxT1			
Microphone Correction	Off			
Integration Method	Exponenital			
Overload	145.4 dB			
	A	**C**	**Z**	
Under Range Peak	101.6	98.6	**103.6**	dB
Under Range Limit	**37.8**	35.8	43.8	dB
Noise Floor	24.8	25.4	32.9	dB
Results				
LASeq	51.6 dB			
LASE	81.1 dB			
EAS	14.422 µPa²h			
EAS8	461.498 µPa²h			
EAS40	2.307 mPa²h			
LZSpeak (max)	2015-07-07 10:19:42	90.2 dB		
LASmax	2015-07-07 10:19:42	60.5 dB		
LASmin	2015-07-07 10:16:34	44.9 dB		
SEA	-99.9 dB			
LAS > 115.0 dB (Exceedance Counts / Duration)	0	0.0 s		
LAS > 120.0 dB (Exceedance Counts / Duration)	0	0.0 s		
LZSpeak > 135.0 dB (Exceedance Counts / Duration)	0	0.0 s		
LZSpeak > 137.0 dB (Exceedance Counts / Duration)	0	0.0 s		
LZSpeak > 140.0 dB (Exceedance Counts / Duration)	0	0.0 s		
LCSeq	68.9 dB			

LASeq	51.6	dB
LCSeq - LASeq	17.3	dB
LAIeq	53.8	dB
LAeq	51.6	dB
LAIeq - LAeq	2.2	dB
# Overloads	0	
Overload Duration	0.0	s

Dose Settings			
Dose Name	OSHA-1	OSHA-2	
Exchange Rate	3	3	dB
Threshold	90	80	dB
Criterion Level	90	90	dB
Criterion Duration	8	8	h

Results			
Dose	0.00	0.00	%
Projected Dose	0.01	0.01	%
TWA (Projected)	51.6	51.6	dB
TWA (t)	36.5	36.5	dB
Lep (t)	36.5	36.5	dB

Statistics		
LAS5.00	55.6	dB
LAS10.00	54.2	dB
LAS50.00	50.2	dB
LAS90.00	47.2	dB
LAS95.00	46.5	dB
LAS99.00	45.5	dB

Summary				
File Name	LxT_Data.046			
Serial Number	0004161			
Model	SoundTrack LxT®			
Firmware Version	2.301			
User				
Location				
Job Description				
Note				
Measurement Description	15 Minute Logging			
Start	2015-07-07 10:40:52			
Stop	2015-07-07 10:55:52			
Duration	0:15:00.0			
Run Time	0:15:00.0			
Pause	0:00:00.0			
Pre Calibration	2015-07-07 10:35:28			
Post Calibration	None			
Calibration Deviation	---			
Overall Settings				
RMS Weight	A Weighting			
Peak Weight	Z Weighting			
Detector	Slow			
Preamp	PRMLxT1			
Microphone Correction	Off			
Integration Method	Exponenital			
Overload	145.4 dB			
	A	**C**	**Z**	
Under Range Peak	101.6	98.6	**103.6**	dB
Under Range Limit	**37.8**	35.8	43.8	dB
Noise Floor	24.8	25.4	32.9	dB
Results				
LASeq	51.2 dB			
LASE	80.7 dB			
EAS	13.152 µPa²h			
EAS8	420.872 µPa²h			
EAS40	2.104 mPa²h			
LZSpeak (max)	2015-07-07 10:46:09	93.7 dB		
LASmax	2015-07-07 10:46:09	63.8 dB		
LASmin	2015-07-07 10:44:25	40.6 dB		
SEA	-99.9 dB			
LAS > 115.0 dB (Exceedance Counts / Duration)	0	0.0 s		
LAS > 120.0 dB (Exceedance Counts / Duration)	0	0.0 s		
LZSpeak > 135.0 dB (Exceedance Counts / Duration)	0	0.0 s		
LZSpeak > 137.0 dB (Exceedance Counts / Duration)	0	0.0 s		
LZSpeak > 140.0 dB (Exceedance Counts / Duration)	0	0.0 s		
LCSeq	65.4 dB			

LASeq	51.2	dB
LCSeq - LASeq	14.2	dB
LAIeq	54.4	dB
LAeq	51.2	dB
LAIeq - LAeq	3.2	dB
# Overloads	0	
Overload Duration	0.0	s

Dose Settings			
Dose Name	OSHA-1	OSHA-2	
Exchange Rate	3	3	dB
Threshold	90	80	dB
Criterion Level	90	90	dB
Criterion Duration	8	8	h

Results			
Dose	0.00	0.00	%
Projected Dose	0.01	0.01	%
TWA (Projected)	51.2	51.2	dB
TWA (t)	36.1	36.1	dB
Lep (t)	36.1	36.1	dB

Statistics		
LAS5.00	56.9	dB
LAS10.00	54.9	dB
LAS50.00	47.9	dB
LAS90.00	43.2	dB
LAS95.00	42.5	dB
LAS99.00	41.7	dB

Summary				
File Name	LxT_Data.047			
Serial Number	0004161			
Model	SoundTrack LxT®			
Firmware Version	2.301			
User				
Location				
Job Description				
Note				
Measurement Description	15 Minute Logging			
Start	2015-07-07 11:13:42			
Stop	2015-07-07 11:28:42			
Duration	0:15:00.0			
Run Time	0:15:00.0			
Pause	0:00:00.0			
Pre Calibration	2015-07-07 11:12:20			
Post Calibration	None			
Calibration Deviation	---			
Overall Settings				
RMS Weight	A Weighting			
Peak Weight	Z Weighting			
Detector	Slow			
Preamp	PRMLxT1			
Microphone Correction	Off			
Integration Method	Exponenital			
Overload	145.5 dB			
	A		**C**	**Z**
Under Range Peak	101.7		98.7	**103.7** dB
Under Range Limit	**37.8**		35.8	43.8 dB
Noise Floor	24.9		25.5	33.0 dB
Results				
LASeq	50.5 dB			
LASE	80.1 dB			
EAS	11.280 µPa²h			
EAS8	360.971 µPa²h			
EAS40	1.805 mPa²h			
LZSpeak (max)	2015-07-07 11:21:31		92.5 dB	
LASmax	2015-07-07 11:16:40		61.5 dB	
LASmin	2015-07-07 11:21:37		42.4 dB	
SEA	-99.9 dB			
LAS > 115.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LAS > 120.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LZSpeak > 135.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LZSpeak > 137.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LZSpeak > 140.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LCSeq	65.4 dB			

LASeq	50.5	dB
LCSeq - LASeq	14.9	dB
LAIeq	52.9	dB
LAeq	50.5	dB
LAIeq - LAeq	2.4	dB
# Overloads	0	
Overload Duration	0.0	s

Dose Settings			
Dose Name	OSHA-1	OSHA-2	
Exchange Rate	3	3	dB
Threshold	90	80	dB
Criterion Level	90	90	dB
Criterion Duration	8	8	h

Results			
Dose	0.00	0.00	%
Projected Dose	0.01	0.01	%
TWA (Projected)	50.5	50.5	dB
TWA (t)	35.5	35.5	dB
Lep (t)	35.5	35.5	dB

Statistics		
LAS5.00	56.4	dB
LAS10.00	54.1	dB
LAS50.00	47.2	dB
LAS90.00	44.3	dB
LAS95.00	43.8	dB
LAS99.00	43.2	dB

Summary				
File Name	LxT_Data.048			
Serial Number	0004161			
Model	SoundTrack LxT®			
Firmware Version	2.301			
User				
Location				
Job Description				
Note				
Measurement Description	15 Minute Logging			
Start	2015-07-07 11:40:08			
Stop	2015-07-07 11:55:08			
Duration	0:15:00.0			
Run Time	0:15:00.0			
Pause	0:00:00.0			
Pre Calibration	2015-07-07 11:37:08			
Post Calibration	None			
Calibration Deviation	---			
Overall Settings				
RMS Weight	A Weighting			
Peak Weight	Z Weighting			
Detector	Slow			
Preamp	PRMLxT1			
Microphone Correction	Off			
Integration Method	Exponenital			
Overload	145.5 dB			
	A		**C**	**Z**
Under Range Peak	101.7		98.7	**103.7** dB
Under Range Limit	**37.8**		35.8	43.8 dB
Noise Floor	24.9		25.5	33.0 dB
Results				
LASeq	54.7 dB			
LASE	84.2 dB			
EAS	29.532 µPa²h			
EAS8	945.016 µPa²h			
EAS40	4.725 mPa²h			
LZSpeak (max)	2015-07-07 11:44:49		91.7 dB	
LASmax	2015-07-07 11:52:01		60.7 dB	
LASmin	2015-07-07 11:46:43		43.4 dB	
SEA	-99.9 dB			
LAS > 115.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LAS > 120.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LZSpeak > 135.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LZSpeak > 137.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LZSpeak > 140.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LCSeq	66.4 dB			

LASeq	54.7	dB
LCSeq - LASeq	11.7	dB
LAIeq	55.6	dB
LAeq	54.7	dB
LAIeq - LAeq	0.9	dB
# Overloads	0	
Overload Duration	0.0	s

Dose Settings			
Dose Name	OSHA-1	OSHA-2	
Exchange Rate	3	3	dB
Threshold	90	80	dB
Criterion Level	90	90	dB
Criterion Duration	8	8	h

Results			
Dose	0.00	0.00	%
Projected Dose	0.03	0.03	%
TWA (Projected)	54.7	54.7	dB
TWA (t)	39.7	39.7	dB
Lep (t)	39.7	39.7	dB

Statistics		
LAS5.00	58.7	dB
LAS10.00	58.0	dB
LAS50.00	53.7	dB
LAS90.00	47.0	dB
LAS95.00	45.8	dB
LAS99.00	44.3	dB

Summary				
File Name	LxT_Data.048			
Serial Number	0004161			
Model	SoundTrack LxT®			
Firmware Version	2.301			
User				
Location				
Job Description				
Note				
Measurement Description	15 Minute Logging			
Start	2015-07-07 11:40:08			
Stop	2015-07-07 11:55:08			
Duration	0:15:00.0			
Run Time	0:15:00.0			
Pause	0:00:00.0			
Pre Calibration	2015-07-07 11:37:08			
Post Calibration	None			
Calibration Deviation	---			
Overall Settings				
RMS Weight	A Weighting			
Peak Weight	Z Weighting			
Detector	Slow			
Preamp	PRMLxT1			
Microphone Correction	Off			
Integration Method	Exponenital			
Overload	145.5 dB			
	A		**C**	**Z**
Under Range Peak	101.7		98.7	**103.7** dB
Under Range Limit	**37.8**		35.8	43.8 dB
Noise Floor	24.9		25.5	33.0 dB
Results				
LASeq	54.7 dB			
LASE	84.2 dB			
EAS	29.532 µPa²h			
EAS8	945.016 µPa²h			
EAS40	4.725 mPa²h			
LZSpeak (max)	2015-07-07 11:44:49		91.7 dB	
LASmax	2015-07-07 11:52:01		60.7 dB	
LASmin	2015-07-07 11:46:43		43.4 dB	
SEA	-99.9 dB			
LAS > 115.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LAS > 120.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LZSpeak > 135.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LZSpeak > 137.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LZSpeak > 140.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LCSeq	66.4 dB			

LASeq	54.7	dB
LCSeq - LASeq	11.7	dB
LAIeq	55.6	dB
LAeq	54.7	dB
LAIeq - LAeq	0.9	dB
# Overloads	0	
Overload Duration	0.0	s

Dose Settings			
Dose Name	OSHA-1	OSHA-2	
Exchange Rate	3	3	dB
Threshold	90	80	dB
Criterion Level	90	90	dB
Criterion Duration	8	8	h

Results			
Dose	0.00	0.00	%
Projected Dose	0.03	0.03	%
TWA (Projected)	54.7	54.7	dB
TWA (t)	39.7	39.7	dB
Lep (t)	39.7	39.7	dB

Statistics		
LAS5.00	58.7	dB
LAS10.00	58.0	dB
LAS50.00	53.7	dB
LAS90.00	47.0	dB
LAS95.00	45.8	dB
LAS99.00	44.3	dB

Summary				
File Name	LxT_Data.049			
Serial Number	0004161			
Model	SoundTrack LxT®			
Firmware Version	2.301			
User				
Location				
Job Description				
Note				
Measurement Description	15 Minute Logging			
Start	2015-07-07 12:14:23			
Stop	2015-07-07 12:29:23			
Duration	0:15:00.0			
Run Time	0:15:00.0			
Pause	0:00:00.0			
Pre Calibration	2015-07-07 12:11:04			
Post Calibration	None			
Calibration Deviation	---			
Overall Settings				
RMS Weight	A Weighting			
Peak Weight	Z Weighting			
Detector	Slow			
Preamp	PRMLxT1			
Microphone Correction	Off			
Integration Method	Exponenital			
Overload	145.4 dB			
	A		**C**	**Z**
Under Range Peak	101.6		98.6	**103.6** dB
Under Range Limit	**37.8**		35.8	43.8 dB
Noise Floor	24.8		25.4	32.9 dB
Results				
LASeq	54.4 dB			
LASE	83.9 dB			
EAS	27.564 µPa²h			
EAS8	882.056 µPa²h			
EAS40	4.410 mPa²h			
LZSpeak (max)	2015-07-07 12:27:03		99.1 dB	
LASmax	2015-07-07 12:26:20		68.6 dB	
LASmin	2015-07-07 12:21:08		44.6 dB	
SEA	-99.9 dB			
LAS > 115.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LAS > 120.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LZSpeak > 135.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LZSpeak > 137.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LZSpeak > 140.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LCSeq	63.5 dB			

LASeq	54.4	dB
LCSeq - LASeq	9.1	dB
LAIeq	56.2	dB
LAeq	54.4	dB
LAIeq - LAeq	1.8	dB
# Overloads	0	
Overload Duration	0.0	s

Dose Settings			
Dose Name	OSHA-1	OSHA-2	
Exchange Rate	3	3	dB
Threshold	90	80	dB
Criterion Level	90	90	dB
Criterion Duration	8	8	h

Results			
Dose	0.00	0.00	%
Projected Dose	0.03	0.03	%
TWA (Projected)	54.4	54.4	dB
TWA (t)	39.4	39.4	dB
Lep (t)	39.4	39.4	dB

Statistics		
LAS5.00	56.9	dB
LAS10.00	56.3	dB
LAS50.00	54.0	dB
LAS90.00	50.9	dB
LAS95.00	50.0	dB
LAS99.00	46.5	dB

Summary				
File Name	LxT_Data.020			
Serial Number	0004161			
Model	SoundTrack LxT®			
Firmware Version	2.301			
User				
Location				
Job Description				
Note				
Measurement Description	15 Minute Logging			
Start	2015-06-30 10:38:00			
Stop	2015-06-30 10:53:00			
Duration	0:15:00.0			
Run Time	0:15:00.0			
Pause	0:00:00.0			
Pre Calibration	2015-06-30 9:44:38			
Post Calibration	None			
Calibration Deviation	---			
Overall Settings				
RMS Weight	A Weighting			
Peak Weight	Z Weighting			
Detector	Slow			
Preamp	PRMLxT1			
Microphone Correction	Off			
Integration Method	Exponenital			
Overload	145.3 dB			
	A	**C**	**Z**	
Under Range Peak	101.5	98.5	**103.5**	dB
Under Range Limit	**37.7**	35.7	43.7	dB
Noise Floor	24.8	25.4	32.9	dB
Results				
LASeq	50.9 dB			
LASE	80.5 dB			
EAS	12.426 µPa²h			
EAS8	397.635 µPa²h			
EAS40	1.988 mPa²h			
LZSpeak (max)	2015-06-30 10:38:09	105.7 dB		
LASmax	2015-06-30 10:38:09	73.5 dB		
LASmin	2015-06-30 10:52:39	44.6 dB		
SEA	-99.9 dB			
LAS > 115.0 dB (Exceedance Counts / Duration)	0	0.0 s		
LAS > 120.0 dB (Exceedance Counts / Duration)	0	0.0 s		
LZSpeak > 135.0 dB (Exceedance Counts / Duration)	0	0.0 s		
LZSpeak > 137.0 dB (Exceedance Counts / Duration)	0	0.0 s		
LZSpeak > 140.0 dB (Exceedance Counts / Duration)	0	0.0 s		
LCSeq	66.8 dB			

LASeq	50.9	dB
LCSeq - LASeq	15.9	dB
LAIeq	60.0	dB
LAeq	50.9	dB
LAIeq - LAeq	9.1	dB
# Overloads	0	
Overload Duration	0.0	s

Dose Settings			
Dose Name	OSHA-1	OSHA-2	
Exchange Rate	3	3	dB
Threshold	90	80	dB
Criterion Level	90	90	dB
Criterion Duration	8	8	h

Results			
Dose	0.00	0.00	%
Projected Dose	0.01	0.01	%
TWA (Projected)	50.9	50.9	dB
TWA (t)	35.9	35.9	dB
Lep (t)	35.9	35.9	dB

Statistics		
LAS5.00	54.6	dB
LAS10.00	52.5	dB
LAS50.00	48.3	dB
LAS90.00	46.3	dB
LAS95.00	45.6	dB
LAS99.00	45.0	dB

Summary				
File Name	LxT_Data.021			
Serial Number	0004161			
Model	SoundTrack LxT®			
Firmware Version	2.301			
User				
Location				
Job Description				
Note				
Measurement Description	15 Minute Logging			
Start	2015-06-30 11:13:49			
Stop	2015-06-30 11:28:49			
Duration	0:15:00.0			
Run Time	0:15:00.0			
Pause	0:00:00.0			
Pre Calibration	2015-06-30 9:44:38			
Post Calibration	None			
Calibration Deviation	---			
Overall Settings				
RMS Weight	A Weighting			
Peak Weight	Z Weighting			
Detector	Slow			
Preamp	PRMLxT1			
Microphone Correction	Off			
Integration Method	Exponenital			
Overload	145.3 dB			
	A	**C**	**Z**	
Under Range Peak	101.5	98.5	**103.5**	dB
Under Range Limit	**37.7**	35.7	43.7	dB
Noise Floor	24.8	25.4	32.9	dB
Results				
LASeq	63.9 dB			
LASE	93.4 dB			
EAS	242.908 µPa²h			
EAS8	7.773 mPa²h			
EAS40	38.865 mPa²h			
LZSpeak (max)	2015-06-30 11:27:16	100.7 dB		
LASmax	2015-06-30 11:18:10	74.5 dB		
LASmin	2015-06-30 11:16:11	48.1 dB		
SEA	-99.9 dB			
LAS > 115.0 dB (Exceedance Counts / Duration)	0	0.0 s		
LAS > 120.0 dB (Exceedance Counts / Duration)	0	0.0 s		
LZSpeak > 135.0 dB (Exceedance Counts / Duration)	0	0.0 s		
LZSpeak > 137.0 dB (Exceedance Counts / Duration)	0	0.0 s		
LZSpeak > 140.0 dB (Exceedance Counts / Duration)	0	0.0 s		
LCSeq	73.9 dB			

LASeq	63.9	dB
LCSeq - LASeq	10.0	dB
LAIeq	64.6	dB
LAeq	63.9	dB
LAIeq - LAeq	0.7	dB
# Overloads	0	
Overload Duration	0.0	s

Dose Settings			
Dose Name	OSHA-1	OSHA-2	
Exchange Rate	3	3	dB
Threshold	90	80	dB
Criterion Level	90	90	dB
Criterion Duration	8	8	h

Results			
Dose	0.01	0.01	%
Projected Dose	0.24	0.24	%
TWA (Projected)	63.9	63.9	dB
TWA (t)	48.8	48.8	dB
Lep (t)	48.8	48.8	dB

Statistics		
LAS5.00	68.4	dB
LAS10.00	67.3	dB
LAS50.00	62.2	dB
LAS90.00	53.1	dB
LAS95.00	51.4	dB
LAS99.00	48.9	dB

Summary				
File Name	LxT_Data.022			
Serial Number	0004161			
Model	SoundTrack LxT®			
Firmware Version	2.301			
User				
Location				
Job Description				
Note				
Measurement Description	15 Minute Logging			
Start	2015-06-30 11:49:06			
Stop	2015-06-30 12:04:06			
Duration	0:15:00.0			
Run Time	0:15:00.0			
Pause	0:00:00.0			
Pre Calibration	2015-06-30 9:44:38			
Post Calibration	None			
Calibration Deviation	---			
Overall Settings				
RMS Weight	A Weighting			
Peak Weight	Z Weighting			
Detector	Slow			
Preamp	PRMLxT1			
Microphone Correction	Off			
Integration Method	Exponenital			
Overload	145.3 dB			
	A		**C**	**Z**
Under Range Peak	101.5		98.5	**103.5** dB
Under Range Limit	**37.7**		35.7	43.7 dB
Noise Floor	24.8		25.4	32.9 dB
Results				
LASeq	60.9 dB			
LASE	90.5 dB			
EAS	123.988 µPa²h			
EAS8	3.968 mPa²h			
EAS40	19.838 mPa²h			
LZSpeak (max)	2015-06-30 11:50:02		99.1 dB	
LASmax	2015-06-30 11:52:06		76.2 dB	
LASmin	2015-06-30 12:03:36		50.4 dB	
SEA	-99.9 dB			
LAS > 115.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LAS > 120.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LZSpeak > 135.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LZSpeak > 137.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LZSpeak > 140.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LCSeq	68.4 dB			

LASeq	60.9	dB
LCSeq - LASeq	7.4	dB
LAIeq	62.1	dB
LAeq	60.9	dB
LAIeq - LAeq	1.2	dB
# Overloads	0	
Overload Duration	0.0	s

Dose Settings			
Dose Name	OSHA-1	OSHA-2	
Exchange Rate	3	3	dB
Threshold	90	80	dB
Criterion Level	90	90	dB
Criterion Duration	8	8	h

Results			
Dose	0.00	0.00	%
Projected Dose	0.12	0.12	%
TWA (Projected)	60.9	60.9	dB
TWA (t)	45.9	45.9	dB
Lep (t)	45.9	45.9	dB

Statistics		
LAS5.00	67.5	dB
LAS10.00	65.9	dB
LAS50.00	54.4	dB
LAS90.00	52.6	dB
LAS95.00	52.2	dB
LAS99.00	51.2	dB

Summary				
File Name	LxT_Data.023			
Serial Number	0004161			
Model	SoundTrack LxT®			
Firmware Version	2.301			
User				
Location				
Job Description				
Note				
Measurement Description	15 Minute Logging			
Start	2015-06-30 12:19:41			
Stop	2015-06-30 12:34:41			
Duration	0:15:00.0			
Run Time	0:15:00.0			
Pause	0:00:00.0			
Pre Calibration	2015-06-30 9:44:38			
Post Calibration	None			
Calibration Deviation	---			
Overall Settings				
RMS Weight	A Weighting			
Peak Weight	Z Weighting			
Detector	Slow			
Preamp	PRMLxT1			
Microphone Correction	Off			
Integration Method	Exponenital			
Overload	145.3 dB			
	A		**C**	**Z**
Under Range Peak	101.5		98.5	**103.5** dB
Under Range Limit	**37.7**		35.7	43.7 dB
Noise Floor	24.8		25.4	32.9 dB
Results				
LASeq	66.6 dB			
LASE	96.1 dB			
EAS	454.692 µPa²h			
EAS8	14.550 mPa²h			
EAS40	72.751 mPa²h			
LZSpeak (max)	2015-06-30 12:28:29		99.8 dB	
LASmax	2015-06-30 12:33:11		72.2 dB	
LASmin	2015-06-30 12:28:45		58.5 dB	
SEA	-99.9 dB			
LAS > 115.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LAS > 120.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LZSpeak > 135.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LZSpeak > 137.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LZSpeak > 140.0 dB (Exceedance Counts / Duration)	0		0.0 s	
LCSeq	75.3 dB			

LASeq	66.6	dB
LCSeq - LASeq	8.7	dB
LAIeq	67.3	dB
LAeq	66.6	dB
LAIeq - LAeq	0.7	dB
# Overloads	0	
Overload Duration	0.0	s

Dose Settings			
Dose Name	OSHA-1	OSHA-2	
Exchange Rate	3	3	dB
Threshold	90	80	dB
Criterion Level	90	90	dB
Criterion Duration	8	8	h

Results			
Dose	0.01	0.01	%
Projected Dose	0.45	0.45	%
TWA (Projected)	66.6	66.6	dB
TWA (t)	51.5	51.5	dB
Lep (t)	51.5	51.5	dB

Statistics		
LAS5.00	69.2	dB
LAS10.00	68.6	dB
LAS50.00	66.5	dB
LAS90.00	62.7	dB
LAS95.00	61.9	dB
LAS99.00	59.4	dB

Address	Time	Measurme	LAeq	LAE	LAmax	LAmin	LA10	LA33	LA50	LA90	LA99	LCpeak	Over	Under	Pause
1	12/16/2013 6:40	0:10:00	95.8	123.6	113.9	33.4	83.1	57.8	44.8	35.4	34.3	134	Over	-	-
2	12/16/2013 6:50	0:10:00	68.7	96.5	79.9	37.5	73.3	69	62.7	43.1	41	121.8	Over	-	-
3	12/16/2013 7:00	0:10:00	71.4	99.2	80.4	65	73.6	71.8	70.7	68.3	66.1	122.4	-	-	-
4	12/16/2013 7:10	0:10:00	70.2	98	78.1	51.2	72.4	70.8	70	65.7	55.3	120.3	-	-	-
5	12/16/2013 7:20	0:10:00	67	94.8	78.4	48.4	69.6	67.2	66.1	62.5	49.6	123.4	-	-	-
6	12/16/2013 7:30	0:10:00	67.4	95.2	80.2	49.2	70.5	68	66.6	55.6	50.7	120.3	-	-	-
7	12/16/2013 7:40	0:10:00	65.1	92.9	78.4	48.6	67.9	65.8	64.6	54.2	50	120.3	-	-	-
8	12/16/2013 7:50	0:10:00	62.7	90.5	69.2	47.7	65.9	63.9	62.7	50.8	48.5	114.5	-	-	-
9	12/16/2013 8:00	0:10:00	71	98.8	81.5	44.8	75.9	70.1	67.3	52.4	45.2	121.3	-	-	-
10	12/16/2013 8:10	0:10:00	69.8	97.6	86.3	45	72.8	68.9	66.6	46.1	45.5	126	-	-	-
11	12/16/2013 8:20	0:10:00	59.7	87.5	75.7	29.8	65.9	47.9	45.8	31.6	30.6	118.1	-	-	-
12	12/16/2013 8:30	0:10:00	33.5	61.3	45.3	28.6	35.4	33.2	32.2	30.4	29.4	82.6	-	-	-
13	12/16/2013 8:40	0:10:00	66.4	94.2	89.1	29.3	65.8	36.1	33.7	30.9	29.8	128.1	Over	-	-
14	12/16/2013 8:50	0:10:00	62.7	90.5	78.8	29.4	67.6	59.4	42	31.8	30.2	119.1	-	-	-
15	12/16/2013 9:00	0:10:00	32.7	60.4	42.9	28.2	35.1	32.4	31.4	29.7	28.9	75.1	-	-	-
16	12/16/2013 9:10	0:10:00	34.1	61.9	50.1	28.3	35.5	32.8	31.8	29.8	28.8	100.3	-	-	-
17	12/16/2013 9:20	0:10:00	66	93.8	85.8	37.2	68	65.3	63.6	47.8	43.7	123.5	Over	-	-
18	12/16/2013 9:30	0:10:00	55	82.7	81	26	43.1	35.7	32.9	27.8	26.6	129.6	Over	Under	-
19	12/16/2013 9:40	0:10:00	33.6	61.3	43.3	25.9	36.4	33.3	32.1	28.3	26.9	73.9	-	Under	-
20	12/16/2013 9:50	0:10:00	62	89.8	82.3	22.3	65.2	51.6	37.1	31	23.1	129.4	Over	Under	-
21	12/16/2013 10:00	0:10:00	28.7	56.5	46.3	19.9	29.9	25.4	23.5	20.9	20.2	74.9	-	Under	-
22	12/16/2013 10:10	0:10:00	29.2	57	44.8	19.6	31.7	26.9	25.8	23.6	21.1	70.9	-	Under	-
23	12/16/2013 10:20	0:10:00	48.8	76.5	75.6	19.3	36.2	28.4	25.8	22	19.9	125.7	Over	Under	-
24	12/16/2013 10:30	0:10:00	57.6	85.3	80.9	19.2	52	36	31.2	23.6	20	127.9	Over	Under	-
25	12/16/2013 10:40	0:10:00	57.6	85.4	70.2	32.5	64.5	38.8	37.6	35.4	33.5	116.5	-	-	-
26	12/16/2013 10:50	0:10:00	60	87.8	75.3	33.2	66.2	46	41.4	35.5	33.9	118.4	-	-	-
27	12/16/2013 11:00	0:10:00	56.8	84.6	77.4	26.8	62.7	34.7	32.7	29.8	28.2	125.2	Over	Under	-
28	12/16/2013 11:10	0:10:00	33.3	61.1	41.5	29.4	34.8	33.4	32.8	31.1	30.2	78.1	-	-	-
29	12/16/2013 11:20	0:10:00	58	85.8	77.2	29.9	64	48.4	34.9	31.8	30.7	125.8	Over	-	-
30	12/16/2013 11:30	0:10:00	70.4	98.2	95.3	33.1	69.2	65.7	60.7	39.5	35.9	127.9	-	-	-
31	12/16/2013 11:40	0:10:00	62.6	90.4	76.5	29.8	67.1	58.4	43.6	41.6	31	123.2	Over	-	-
32	12/16/2013 11:50	0:10:00	82.6	110.3	100	28.5	87.2	70.8	52.8	33.4	29.8	134	Over	-	-
33	12/16/2013 12:00	0:10:00	76.4	104.2	102.6	15.7	73	61.1	57.1	51.9	17.1	134	Over	Under	-
34	12/16/2013 12:10	0:10:00	54.1	81.9	65.5	49.3	55.8	54.1	53.4	51	49.6	88.3	-	-	-
35	12/16/2013 12:20	0:10:00	54.3	82.1	63.9	50.1	56.6	54.4	53.4	51.1	50.4	86.9	-	-	-
36	12/16/2013 12:30	0:10:00	55.9	83.7	68.3	50.3	57.3	54.7	53.8	51.9	50.9	93.7	-	-	-
37	12/16/2013 12:40	0:10:00	56.9	84.7	66.2	51.6	59	56.9	55.9	53.5	52	89.8	-	-	-
38	12/16/2013 12:50	0:10:00	56.3	84.1	62.5	52.1	58.3	56.7	55.8	53.9	52.6	90	-	-	-
39	12/16/2013 13:00	0:10:00	55.8	83.6	64	51.8	57.9	56	55.3	53.1	52.2	86.9	-	-	-
40	12/16/2013 13:10	0:10:00	54.8	82.6	61.5	50.7	56.5	54.9	54.3	52.2	51.3	84.2	-	-	-
41	12/16/2013 13:20	0:10:00	53.3	81	59.6	49.1	55.1	53.8	53	50.6	49.4	88.3	-	-	-
42	12/16/2013 13:30	0:10:00	53.5	81.2	59.4	49.4	55.2	53.9	53.2	51	50.1	88.7	-	-	-

43	12/16/2013 13:40	0:10:00	54.6	82.4	62.8	49.8	56.2	54.8	54	51.8	50.5	88.5	-	-	-
44	12/16/2013 13:50	0:10:00	54.1	81.9	64.6	49.3	55.7	54.1	53.4	51	49.9	87	-	-	-
45	12/16/2013 14:00	0:10:00	53.5	81.3	63.8	48	55.3	53.6	52.9	50.6	48.6	86.3	-	-	-
46	12/16/2013 14:10	0:10:00	52	79.8	58.7	46.9	54.4	52	51.2	48.9	47.8	87.4	-	-	-
47	12/16/2013 14:20	0:10:00	51.4	79.2	57	46.8	53.6	51.8	50.9	48.5	47.4	86.2	-	-	-
48	12/16/2013 14:30	0:10:00	50.3	78.1	56.2	46.8	52.2	50.6	49.9	47.7	47.1	83.7	-	-	-
49	12/16/2013 14:40	0:10:00	51.8	79.6	56.9	48	53.6	52.1	51.5	49.3	48.3	83	-	-	-
50	12/16/2013 14:50	0:10:00	53.3	81.1	68.7	48.4	54	52.4	51.7	49.8	48.9	86	-	-	-
51	12/16/2013 15:00	0:10:00	52	79.8	58.4	48	53.3	52.2	51.8	50.5	48.5	84.7	-	-	-
52	12/16/2013 15:10	0:10:00	54.9	82.7	61.9	48.1	57.2	54.7	53.9	51.6	49.2	87.8	-	-	-
53	12/16/2013 15:20	0:10:00	53.1	80.8	61.4	49.3	54.6	53.2	52.6	50.3	49.5	85.8	-	-	-
54	12/16/2013 15:30	0:10:00	53.1	80.9	61.9	48.7	54.6	52.8	52.2	50.6	49.1	86.2	-	-	-
55	12/16/2013 15:40	0:10:00	54.8	82.6	62.1	49.1	58	54.5	53.6	51	49.5	85	-	-	-
56	12/16/2013 15:50	0:10:00	54.8	82.6	58.9	51.1	56.1	55.1	54.7	53.1	51.6	83.6	-	-	-
57	12/16/2013 16:00	0:10:00	55	82.8	61	50.7	57.1	55.2	54.4	52.7	51.1	86.1	-	-	-
58	12/16/2013 16:10	0:10:00	53.7	81.5	58.6	50.5	55.2	54	53.5	51.9	50.8	83.9	-	-	-
59	12/16/2013 16:20	0:10:00	54.2	82	60.4	50.4	56	54.6	53.8	52	50.7	85.1	-	-	-
60	12/16/2013 16:30	0:10:00	54.1	81.9	59.2	50	55.6	54.3	53.7	52.2	50.7	83.9	-	-	-
61	12/16/2013 16:40	0:10:00	59.2	87	76.8	51.6	58.2	56	55.1	53.1	51.9	98	-	-	-
62	12/16/2013 16:50	0:10:00	58.4	86.2	74.3	51.4	59.7	57.4	56.8	54.1	52.1	88.2	-	-	-
63	12/16/2013 17:00	0:10:00	57.9	85.7	72.4	53.6	58.1	56.9	56.4	54.9	54	86.1	-	-	-
64	12/16/2013 17:10	0:10:00	55.9	83.7	64	52.8	57.3	56.3	55.7	53.9	53.1	83.8	-	-	-
65	12/16/2013 17:20	0:10:00	56.1	83.9	62.7	52.2	57.4	56.4	55.8	53.9	52.4	85.8	-	-	-
66	12/16/2013 17:30	0:10:00	55.8	83.6	65.2	52.5	57.3	55.7	55.2	53.8	52.8	84.9	-	-	-
67	12/16/2013 17:40	0:10:00	55	82.8	58.4	51.2	56.6	55.4	54.7	53.4	51.8	84.7	-	-	-
68	12/16/2013 17:50	0:10:00	54.7	82.5	59.6	51.4	56.1	55	54.4	53	51.7	85.4	-	-	-
69	12/16/2013 18:00	0:10:00	55.9	83.7	60.8	52.7	57.6	56.1	55.5	54.1	53.2	87.2	-	-	-
70	12/16/2013 18:10	0:10:00	56	83.8	61.4	51.9	57.5	56.3	55.9	54.1	52.4	84	-	-	-
71	12/16/2013 18:20	0:10:00	57.1	84.9	63.5	53.1	59.3	57.1	56.3	54.6	53.6	87.4	-	-	-
72	12/16/2013 18:30	0:10:00	57.6	85.4	73.5	52.2	58.8	56.3	55.7	54.2	52.6	93.8	-	-	-
73	12/16/2013 18:40	0:10:00	56.4	84.2	60.9	52.7	57.5	56.8	56.3	54.8	53.4	86.4	-	-	-
74	12/16/2013 18:50	0:10:00	56.6	84.3	60	52.1	58	57	56.5	54.8	52.5	84.2	-	-	-
75	12/16/2013 19:00	0:10:00	56.8	84.6	60.4	54.2	58.1	57.1	56.6	55.3	54.6	86	-	-	-
76	12/16/2013 19:10	0:10:00	55.6	83.4	59.1	52.2	56.9	56.1	55.6	53.9	52.8	83.1	-	-	-
77	12/16/2013 19:20	0:10:00	55.5	83.3	58.1	52.6	56.6	55.9	55.6	53.7	52.8	89.6	-	-	-
78	12/16/2013 19:30	0:10:00	56.6	84.4	61.4	52.9	58.5	56.8	56.1	54.4	53.4	84.8	-	-	-
79	12/16/2013 19:40	0:10:00	56.9	84.6	69.6	51.6	58.2	56.7	56.2	53.8	51.8	87.5	-	-	-
80	12/16/2013 19:50	0:10:00	56	83.8	59.5	52.2	57.6	56.2	55.6	54.1	53.4	82.4	-	-	-
81	12/16/2013 20:00	0:10:00	57.7	85.5	63.5	52.5	59.5	58.1	57.5	55.2	53	84.7	-	-	-
82	12/16/2013 20:10	0:10:00	56.3	84.1	59.9	53.1	58.2	56.8	55.8	54.3	53.4	84.1	-	-	-
83	12/16/2013 20:20	0:10:00	56.7	84.4	70.9	52.3	57.4	55.6	55	53.5	52.8	89	-	-	-
84	12/16/2013 20:30	0:10:00	56	83.8	59	52.4	57.5	56.4	55.9	54	52.8	85.3	-	-	-
85	12/16/2013 20:40	0:10:00	56.4	84.2	62.5	52.3	57.9	56.9	56.2	54.1	52.8	83.7	-	-	-

86	12/16/2013 20:50	0:10:00	57	84.8	61.3	53.6	58.3	57.4	56.8	55.5	54	83.6	-	-	-
87	12/16/2013 21:00	0:10:00	58	85.7	67.8	53.7	58.6	57.6	57.1	55.7	54.3	88.9	-	-	-
88	12/16/2013 21:10	0:10:00	56.6	84.4	61.1	54.3	57.6	57	56.6	55.3	54.6	80.7	-	-	-
89	12/16/2013 21:20	0:10:00	56.8	84.6	61.2	53.8	57.9	57.2	56.7	55.2	54.3	86.7	-	-	-
90	12/16/2013 21:30	0:10:00	58.3	86.1	69	54.6	58.9	57.7	57.1	55.5	54.9	92.5	-	-	-
91	12/16/2013 21:40	0:10:00	57.4	85.2	65.6	53.9	58.7	57.5	57	55.5	54.6	87.5	-	-	-
92	12/16/2013 21:50	0:10:00	57	84.7	59.5	54.7	58.1	57.3	56.9	55.6	55	86.8	-	-	-
93	12/16/2013 22:00	0:10:00	56.9	84.7	60.3	53.9	58	57.3	56.9	55.6	54.6	80.5	-	-	-
94	12/16/2013 22:10	0:10:00	58.5	86.3	68.3	54.1	60	58.7	58.2	56.4	54.7	89.2	-	-	-
95	12/16/2013 22:20	0:10:00	59.1	86.8	63.5	55.2	60.9	59.5	58.8	56.6	55.8	85.3	-	-	-
96	12/16/2013 22:30	0:10:00	58.1	85.9	62.8	54.2	59.5	58.3	57.8	56.4	55.1	86.8	-	-	-
97	12/16/2013 22:40	0:10:00	57.5	85.3	64	54.3	59	57.9	57.2	55.3	54.6	84.1	-	-	-
98	12/16/2013 22:50	0:10:00	57.8	85.6	61.9	53.9	59.8	58.2	57.4	55.4	54.3	86.2	-	-	-
99	12/16/2013 23:00	0:10:00	57.2	85	65.8	53.3	58.6	57.4	56.6	55	54.1	84.1	-	-	-
100	12/16/2013 23:10	0:10:00	56.6	84.4	62.5	53.2	58	56.8	56.3	54.9	53.9	86	-	-	-
101	12/16/2013 23:20	0:10:00	55.6	83.4	60.1	51.6	57.3	56	55.4	53.1	52	85.5	-	-	-
102	12/16/2013 23:30	0:10:00	55.4	83.2	61.1	51.6	57	55.7	55.1	53.4	52.1	84	-	-	-
103	12/16/2013 23:40	0:10:00	54.2	82	59.9	48.5	56.3	54.5	53.7	51.4	49.4	81.3	-	-	-
104	12/16/2013 23:50	0:10:00	54.6	82.4	64.8	48.8	56.3	54.9	54.2	51.8	49.8	88.3	-	-	-
105	12/17/2013 0:00	0:10:00	54	81.8	59	48.2	56.2	54.5	53.6	50.8	48.9	83.2	-	-	-
106	12/17/2013 0:10	0:10:00	53.3	81.1	68	44.9	55.1	53.1	52.3	49.4	46.2	84	-	-	-
107	12/17/2013 0:20	0:10:00	52	79.8	58.3	45.2	54.1	52.3	51.5	48.9	46.1	84.3	-	-	-
108	12/17/2013 0:30	0:10:00	51.8	79.6	59.3	45.1	54.5	52	51	47.8	46.1	82.3	-	-	-
109	12/17/2013 0:40	0:10:00	53.8	81.6	64.3	45.3	56.9	53.8	52.2	47.9	46.3	86.2	-	-	-
110	12/17/2013 0:50	0:10:00	51	78.8	63	42.3	54.1	50.5	48.3	44.5	42.9	81.9	-	-	-
111	12/17/2013 1:00	0:10:00	56.3	84.1	73.6	41	56.4	50.6	47.5	44	41.9	92.1	-	-	-
112	12/17/2013 1:10	0:10:00	49.4	77.2	60.8	42.1	52.9	48	46.8	44.3	42.6	82.8	-	-	-
113	12/17/2013 1:20	0:10:00	49.9	77.7	58.4	41.6	53.1	50.1	48.2	43.6	42	83	-	-	-
114	12/17/2013 1:30	0:10:00	53.2	81	73.4	41.8	53.3	50.3	48.7	44.6	42.8	84.5	-	-	-
115	12/17/2013 1:40	0:10:00	49.6	77.4	62.5	41.8	51.7	49.7	48.6	44.4	42.4	82.8	-	-	-
116	12/17/2013 1:50	0:10:00	49.4	77.1	57.6	42	52.4	49.4	48	44.3	42.8	85.6	-	-	-
117	12/17/2013 2:00	0:10:00	50	77.8	56.5	42.9	52.8	50.4	49.1	45.7	43.7	78.1	-	-	-
118	12/17/2013 2:10	0:10:00	50.5	78.3	57.3	42.9	52.9	50.9	49.8	46.7	44	78.5	-	-	-
119	12/17/2013 2:20	0:10:00	48.8	76.6	56.5	41.5	51.5	48.7	47.5	45.1	41.9	75.5	-	-	-
120	12/17/2013 2:30	0:10:00	47.6	75.4	57.2	41	50.3	47.5	46.4	42.9	41.4	75.1	-	-	-
121	12/17/2013 2:40	0:10:00	47.7	75.5	56.4	40.7	50.5	47.8	46.5	43.3	41.3	77.1	-	-	-
122	12/17/2013 2:50	0:10:00	47	74.8	54.3	42.2	49.5	47.2	46.2	43.8	42.5	74.5	-	-	-
123	12/17/2013 3:00	0:10:00	50.6	78.4	66.9	42	52.4	49.2	47.7	44.9	42.5	89	-	-	-
124	12/17/2013 3:10	0:10:00	45.6	73.3	55.2	39.8	48	45.5	44.3	41.5	40.2	79.5	-	-	-
125	12/17/2013 3:20	0:10:00	44.5	72.3	51.8	39.3	46.9	44.5	43.5	41	39.9	73	-	-	-
126	12/17/2013 3:30	0:10:00	46.3	74.1	57	40.2	49.2	46.1	44.8	42	40.9	72.3	-	-	-
127	12/17/2013 3:40	0:10:00	47.7	75.5	58.9	39.2	51.4	47	44.6	40.9	39.7	74.4	-	-	-
128	12/17/2013 3:50	0:10:00	48.5	76.2	64.6	40.6	51.3	47.3	45.8	42.8	41.3	81.6	-	-	-

129	12/17/2013 4:00	0:10:00	48	75.8	58.1	39.5	52.1	46.6	44.6	41.5	40.1	76.1	-	-	-
130	12/17/2013 4:10	0:10:00	48.8	76.6	58.2	41.2	52.4	48.1	46.5	43.6	41.9	74.7	-	-	-
131	12/17/2013 4:20	0:10:00	55.5	83.3	72.9	44.9	55.3	51.2	49.7	46.8	45.5	93.8	-	-	-
132	12/17/2013 4:30	0:10:00	53	80.7	65.4	45.8	55	52	50.7	47.9	46.7	85.1	-	-	-
133	12/17/2013 4:40	0:10:00	52.8	80.5	59.4	46.2	55.3	52.8	51.8	49.2	47.1	83.8	-	-	-
134	12/17/2013 4:50	0:10:00	52.7	80.4	59.2	46.6	55	53.1	52	48.7	47	79.8	-	-	-
135	12/17/2013 5:00	0:10:00	53	80.8	57.8	48.5	55.4	53.4	52.5	50	48.9	83.6	-	-	-
136	12/17/2013 5:10	0:10:00	53.3	81.1	59.5	48.3	55.3	53.7	52.8	50.3	49.2	86.1	-	-	-
137	12/17/2013 5:20	0:10:00	53.7	81.5	58.5	48.6	55.8	54	53.2	51	49.5	82.2	-	-	-
138	12/17/2013 5:30	0:10:00	55.4	83.2	64.4	51.4	57.4	55.6	54.6	52.9	51.9	81.7	-	-	-
139	12/17/2013 5:40	0:10:00	56.6	84.3	61.7	51.6	58.4	56.9	56.1	54.2	53	85.9	-	-	-
140	12/17/2013 5:50	0:10:00	56.4	84.2	61.8	51.5	58.5	56.9	56	53.7	52.1	81.4	-	-	-
141	12/17/2013 6:00	0:10:00	57.2	85	65.2	52.8	59.4	57.3	56.5	54.8	53.2	82.8	-	-	-
142	12/17/2013 6:10	0:10:00	57.9	85.7	62	51.3	59.8	58.5	57.7	55.1	52.8	84.7	-	-	-
143	12/17/2013 6:20	0:10:00	57.4	85.2	62.1	52.3	59.4	58.1	57	54	52.6	81.1	-	-	-
144	12/17/2013 6:30	0:10:00	58.2	86	63.7	53.7	59.9	58.7	57.9	55.8	54.5	85.3	-	-	-
145	12/17/2013 6:40	0:10:00	59.6	87.4	68.6	54.6	61.5	60.1	59.2	56.6	55	85.8	-	-	-
146	12/17/2013 6:50	0:10:00	59.5	87.2	62.3	56	61	59.8	59.3	57.8	56.5	85	-	-	-
147	12/17/2013 7:00	0:10:00	58.9	86.7	62	55.7	60.1	59.3	58.8	57.5	56.7	85.6	-	-	-
148	12/17/2013 7:10	0:10:00	58.3	86.1	61.3	56	59.3	58.6	58.2	57	56.4	87.7	-	-	-
149	12/17/2013 7:20	0:10:00	59.4	87.2	62.8	56.6	60.4	59.7	59.3	58.2	57.3	85.5	-	-	-
150	12/17/2013 7:30	0:10:00	59.1	86.9	62.9	56.6	60.4	59.5	59	57.6	56.9	87.3	-	-	-
151	12/17/2013 7:40	0:10:00	59.5	87.3	62.6	56.1	60.6	59.9	59.5	58.3	56.5	88.8	-	-	-
152	12/17/2013 7:50	0:10:00	59.1	86.9	62.5	56.6	60.2	59.4	59	57.9	56.9	86.8	-	-	-
153	12/17/2013 8:00	0:10:00	59.2	87	62	56.8	60.2	59.5	59.1	58.1	57.4	85.4	-	-	-
154	12/17/2013 8:10	0:10:00	59	86.8	70.5	56.4	59.6	58.7	58.4	57.3	56.6	91.9	-	-	-
155	12/17/2013 8:20	0:10:00	57.6	85.4	63.9	55.7	58.7	58	57.5	56.3	55.9	88.4	-	-	-
156	12/17/2013 8:30	0:10:00	56.9	84.7	61.9	54.2	58.2	57.3	56.7	55.4	54.5	90.7	-	-	-
157	12/17/2013 8:40	0:10:00	56.5	84.3	68.2	53.4	58.3	56.2	55.7	54.5	53.8	90.2	-	-	-
158	12/17/2013 8:50	0:10:00	54.6	82.4	61	51.4	55.8	54.7	54.2	53.2	52.1	87.9	-	-	-
159	12/17/2013 9:00	0:10:00	53.2	80.9	58.4	49.2	54.4	53.2	52.8	51.9	50.5	85.3	-	-	-
160	12/17/2013 9:10	0:10:00	54	81.8	61.3	50.5	55.5	54.1	53.6	52.3	51.1	88.3	-	-	-
161	12/17/2013 9:20	0:10:00	54.8	82.6	59.3	50.7	56.7	55.4	54.4	52.1	51.2	83.6	-	-	-
162	12/17/2013 9:30	0:10:00	55.7	83.5	61.1	52.1	57.2	55.9	55.4	53.9	52.8	86.4	-	-	-
163	12/17/2013 9:40	0:10:00	56.8	84.6	63.3	53.3	58.5	57	56.5	54.6	53.7	88.3	-	-	-
164	12/17/2013 9:50	0:10:00	56.8	84.6	63.5	51.4	58.5	56.9	56.3	54.3	52.4	88.3	-	-	-
165	12/17/2013 10:00	0:10:00	55	82.8	61.2	51.8	56.8	55.3	54.6	52.7	52	86.9	-	-	-
166	12/17/2013 10:10	0:10:00	54.5	82.3	58.6	49.5	56.2	55	54.4	52.3	50.2	83.5	-	-	-
167	12/17/2013 10:20	0:10:00	54.2	82	67.1	48.9	55.6	53.8	53	51.1	49.7	90.8	-	-	-
168	12/17/2013 10:30	0:10:00	52.9	80.7	58.4	47.9	54.9	53.3	52.5	50.3	48.8	88	-	-	-
169	12/17/2013 10:40	0:10:00	52.4	80.2	59.7	47.2	54.4	52.4	51.7	49.5	48.4	86.5	-	-	-
170	12/17/2013 10:50	0:10:00	51.7	79.4	58.8	47.4	53.3	52	51.4	49.4	47.9	84.2	-	-	-
171	12/17/2013 11:00	0:10:00	51.8	79.5	56.4	48.2	53.5	51.9	51.4	49.8	48.6	85.9	-	-	-

172	12/17/2013 11:10	0:10:00	51.9	79.7	56.3	47.7	53.6	52.4	51.7	49.4	48.3	83	-	-	-
173	12/17/2013 11:20	0:10:00	52.6	80.4	68.2	48.5	53.4	51.9	51.4	49.4	48.8	88.7	-	-	-
174	12/17/2013 11:30	0:10:00	51.4	79.2	58.1	48.6	52.8	51.5	51	49.8	49	84.8	-	-	-
175	12/17/2013 11:40	0:10:00	51.7	79.5	57.5	48.5	53.3	51.7	51.3	49.9	49	83.8	-	-	-
176	12/17/2013 11:50	0:10:00	51.7	79.5	61.4	48.3	53.2	51.4	50.7	49.5	48.9	83.6	-	-	-
177	12/17/2013 12:00	0:10:00	52	79.8	59.7	48.4	54.4	51.7	51.1	49.5	48.7	82.6	-	-	-
178	12/17/2013 12:10	0:10:00	51.4	79.1	65	46.8	52.9	50.8	50.2	48.6	47.3	89.8	-	-	-
179	12/17/2013 12:20	0:10:00	52.6	80.4	59.7	46.8	54.7	52.6	51.7	49.6	47.7	83.3	-	-	-
180	12/17/2013 12:30	0:10:00	52.1	79.9	70.2	45.8	52.1	50.2	49.5	47.4	46.3	95	-	-	-
181	12/17/2013 12:40	0:10:00	50.6	78.4	57.1	46.9	52.4	50.7	50.1	48.2	47.3	81.7	-	-	-
182	12/17/2013 12:50	0:10:00	53.1	80.9	70.2	47.9	53.6	52.1	51.4	49.5	48.4	87	-	-	-
183	12/17/2013 13:00	0:10:00	54.3	82.1	60	49.9	56.2	54.5	53.8	51.7	50.3	82.6	-	-	-
184	12/17/2013 13:10	0:10:00	54.6	82.4	63.5	50	56.3	54.6	54	51.3	50.4	84.5	-	-	-
185	12/17/2013 13:20	0:10:00	53.8	81.6	59.2	50.1	55.5	54.1	53.6	51.9	50.8	85.1	-	-	-
186	12/17/2013 13:30	0:10:00	53.7	81.5	64.6	48.9	55.5	53.9	52.9	50.8	49.2	85.9	-	-	-
187	12/17/2013 13:40	0:10:00	82.1	109.8	107.1	15.8	72.6	56.8	53.3	43.4	25.7	134	Over	Under	-
188	12/17/2013 13:50	0:10:00	70.8	98.6	94.4	41.4	70.3	64.9	63	47.2	42.5	134	Over	-	-
189	12/17/2013 14:00	0:10:00	73	100.7	95.6	43	71.2	64.7	61.2	46.5	43.8	133.9	Over	-	-
190	12/17/2013 14:10	0:10:00	68.4	96.2	77.7	49.9	72.6	68.2	65.2	60.7	54.2	119.8	-	-	-
191	12/17/2013 14:20	0:10:00	65.6	93.4	75.5	51	68.9	65.9	64.1	60.2	53.4	119.9	-	-	-
192	12/17/2013 14:30	0:10:00	67.6	95.3	77.3	49.6	70.2	67.6	66.8	62.6	51.1	121	-	-	-
193	12/17/2013 14:40	0:10:00	68.8	96.6	73.9	62.7	71.2	69.2	67.9	65.9	64.5	120.3	-	-	-
194	12/17/2013 14:50	0:10:00	68.5	96.3	77.6	60.3	70.5	69.1	68	64.6	61.3	120	-	-	-
195	12/17/2013 15:00	0:10:00	66.6	94.4	76.1	18.7	70.5	67	65.7	47.1	19.4	120.6	-	Under	-
196	12/17/2013 15:10	0:10:00	20.5	48.3	34.4	17.9	21.1	19.3	19	18.2	18	71.3	-	Under	-
197	12/17/2013 15:20	0:10:00	40.4	68.2	67.6	17.9	22.4	19.6	18.9	18.2	18	119.9	Over	Under	-
198	12/17/2013 15:30	0:10:00	72.9	100.7	98.7	17.9	34.2	19.9	19.3	18.5	18	134	Over	Under	-
199	12/17/2013 15:40	0:10:00	58.8	86.5	69.5	18.4	64.4	53.6	36.1	19.3	18.5	123.4	Over	Under	-
200	12/17/2013 15:50	0:10:00	72.8	100.6	96.3	28.1	68.2	58.8	47.5	41.3	29.3	133.5	Over	-	-
201	12/17/2013 16:00	0:10:00	44.7	72.5	46.1	42.8	45.4	44.9	44.7	43.8	43.3	82.2	-	-	-
202	12/17/2013 16:10	0:10:00	45.9	73.7	47.7	44.8	46.4	46.1	45.8	45.3	45	79.1	-	-	-
203	12/17/2013 16:20	0:10:00	46.6	74.4	47.7	44.3	47.2	47	46.7	45.8	45.2	79.2	-	-	-
204	12/17/2013 16:30	0:10:00	47	74.8	48	46.2	47.3	47.1	47	46.7	46.4	80.4	-	-	-
205	12/17/2013 16:40	0:10:00	47.4	75.2	58.4	46.3	47.4	47.3	47.2	46.9	46.7	95.4	-	-	-
206	12/17/2013 16:50	0:10:00	47.1	74.9	59.3	46.1	47.2	47	46.9	46.5	46.3	99.7	-	-	-
207	12/17/2013 17:00	0:10:00	47	74.8	47.9	46.2	47.3	47.1	47	46.7	46.4	80.1	-	-	-
208	12/17/2013 17:10	0:10:00	47	74.8	47.9	46.1	47.4	47.2	47	46.7	46.3	81.4	-	-	-
209	12/17/2013 17:20	0:10:00	47.1	74.9	47.8	46.3	47.5	47.3	47.1	46.7	46.4	85.2	-	-	-
210	12/17/2013 17:30	0:10:00	47.3	75.1	48.1	46.4	47.6	47.4	47.3	47	46.7	80.1	-	-	-
211	12/17/2013 17:40	0:10:00	47.4	75.2	48.1	46.6	47.7	47.5	47.4	47.1	46.8	81.3	-	-	-
212	12/17/2013 17:50	0:10:00	47.6	75.4	48.3	46.7	47.9	47.7	47.6	47.2	46.9	79.4	-	-	-
213	12/17/2013 18:00	0:10:00	49.3	77	64.2	46.4	50.3	47.6	47.5	47	46.6	101.6	-	-	-
214	12/17/2013 18:10	0:10:00	49.2	77	64.3	46.1	50.6	47.9	47.5	46.7	46.4	101.1	-	-	-

215	12/17/2013 18:20	0:10:00	75.5	103.3	100.6	47	50.3	49.7	49.5	48.7	47.3	134	Over	-	-
216	12/17/2013 18:30	0:10:00	50.2	78	51.2	49.3	50.5	50.3	50.2	49.9	49.6	80.2	-	-	-
217	12/17/2013 18:40	0:10:00	50.2	78	51	49.3	50.6	50.4	50.2	49.9	49.6	81.1	-	-	-
218	12/17/2013 18:50	0:10:00	50	77.8	50.9	48.9	50.4	50.1	50	49.6	49.2	80.1	-	-	-
219	12/17/2013 19:00	0:10:00	50.1	77.9	50.9	49.4	50.4	50.2	50.1	49.8	49.6	80.5	-	-	-
220	12/17/2013 19:10	0:10:00	49.8	77.6	51	48.3	50.4	50.1	49.8	49.2	48.7	80.4	-	-	-
221	12/17/2013 19:20	0:10:00	50.1	77.8	51	49.1	50.5	50.2	50	49.7	49.4	80.5	-	-	-
222	12/17/2013 19:30	0:10:00	50.3	78	51.2	49.4	50.6	50.4	50.3	49.9	49.6	81.1	-	-	-
223	12/17/2013 19:40	0:10:00	50.1	77.8	51.3	48.8	50.6	50.3	50.1	49.5	49.1	80.4	-	-	-
224	12/17/2013 19:50	0:10:00	50.3	78.1	51.1	49.6	50.6	50.4	50.3	50	49.8	80.3	-	-	-
225	12/17/2013 20:00	0:10:00	50.1	77.8	51.1	48.6	50.6	50.3	50.1	49.5	49.1	80.9	-	-	-
226	12/17/2013 20:10	0:10:00	50.4	78.2	51.2	49.4	50.7	50.5	50.4	50.1	49.8	79.8	-	-	-
227	12/17/2013 20:20	0:10:00	50.4	78.2	51.1	49.6	50.7	50.5	50.4	50.1	49.9	80.7	-	-	-
228	12/17/2013 20:30	0:10:00	49.9	77.7	51	48.7	50.3	50	49.9	49.4	49.1	80.4	-	-	-
229	12/17/2013 20:40	0:10:00	50	77.8	50.8	49.1	50.3	50.1	50	49.7	49.4	80.5	-	-	-
230	12/17/2013 20:50	0:10:00	49.8	77.6	50.7	48.6	50.2	50	49.8	49.3	48.9	81	-	-	-
231	12/17/2013 21:00	0:10:00	49.9	77.7	50.7	49	50.2	50	49.9	49.5	49.3	80	-	-	-
232	12/17/2013 21:10	0:10:00	49.8	77.6	50.8	48.5	50.3	50	49.8	49.3	48.9	80.2	-	-	-
233	12/17/2013 21:20	0:10:00	49.7	77.5	50.9	48	50.3	50	49.8	48.9	48.5	80.1	-	-	-
234	12/17/2013 21:30	0:10:00	49.7	77.4	50.6	48.8	50	49.8	49.6	49.3	49.1	80.7	-	-	-
235	12/17/2013 21:40	0:10:00	49.4	77.2	50.4	48.2	49.8	49.5	49.4	48.9	48.6	80.1	-	-	-
236	12/17/2013 21:50	0:10:00	49.5	77.3	50.6	48.6	49.9	49.6	49.5	49.1	48.8	80.2	-	-	-
237	12/17/2013 22:00	0:10:00	49.5	77.3	50.3	48.6	49.8	49.6	49.5	49.2	48.9	80	-	-	-
238	12/17/2013 22:10	0:10:00	48.8	76.6	50.3	47.5	49.5	49.1	48.8	48.1	47.8	79.7	-	-	-
239	12/17/2013 22:20	0:10:00	49.1	76.9	50	48	49.5	49.2	49.1	48.7	48.4	79.9	-	-	-
240	12/17/2013 22:30	0:10:00	48.9	76.7	49.8	47.5	49.3	49.1	48.9	48.4	48	79.9	-	-	-
241	12/17/2013 22:40	0:10:00	48.9	76.7	49.9	47.6	49.3	49.1	48.9	48.3	47.9	80.2	-	-	-
242	12/17/2013 22:50	0:10:00	48.8	76.6	49.7	47.8	49.2	49	48.8	48.4	48.1	80	-	-	-
243	12/17/2013 23:00	0:10:00	48.5	76.3	49.6	47.3	49	48.6	48.5	48	47.7	80.3	-	-	-
244	12/17/2013 23:10	0:10:00	48.8	76.5	49.6	47.8	49.1	48.9	48.7	48.4	48.2	79.6	-	-	-
245	12/17/2013 23:20	0:10:00	48.5	76.3	49.6	47.2	49.1	48.7	48.6	48	47.6	80.1	-	-	-
246	12/17/2013 23:30	0:10:00	48.3	76	49.6	46.9	48.7	48.4	48.3	47.7	47.3	79.6	-	-	-
247	12/17/2013 23:40	0:10:00	48.6	76.3	49.5	47.6	48.9	48.7	48.6	48.1	47.8	79.9	-	-	-
248	12/17/2013 23:50	0:10:00	48.4	76.2	49.7	47	49	48.6	48.4	47.9	47.5	79.8	-	-	-
249	12/18/2013 0:00	0:10:00	48.7	76.5	49.7	47.6	49.1	48.8	48.7	48.2	47.9	80.3	-	-	-
250	12/18/2013 0:10	0:10:00	48.1	75.9	49.5	46.6	48.8	48.3	48.1	47.3	46.9	79.9	-	-	-
251	12/18/2013 0:20	0:10:00	48.3	76.1	49.5	46.5	48.9	48.5	48.3	47.6	46.9	79.8	-	-	-
252	12/18/2013 0:30	0:10:00	48	75.8	49.3	46.5	48.6	48.3	48.1	47.4	47	79.5	-	-	-
253	12/18/2013 0:40	0:10:00	47.8	75.5	48.9	46.4	48.3	47.9	47.7	47.2	46.8	79.5	-	-	-
254	12/18/2013 0:50	0:10:00	48.1	75.9	49.1	46.8	48.5	48.3	48.1	47.7	47.3	79.5	-	-	-
255	12/18/2013 1:00	0:10:00	47.7	75.5	49	46.3	48.2	47.9	47.7	47.2	46.8	79.2	-	-	-
256	12/18/2013 1:10	0:10:00	47.8	75.6	48.8	46.8	48.2	48	47.9	47.4	47.1	79.6	-	-	-
257	12/18/2013 1:20	0:10:00	47.7	75.5	48.8	46.4	48.2	47.9	47.7	47.2	46.8	79.3	-	-	-

258	12/18/2013 1:30	0:10:00	48.1	75.9	49.2	47	48.6	48.3	48.1	47.6	47.3	79.2	-	-	-
259	12/18/2013 1:40	0:10:00	47.7	75.5	49	46	48.4	48	47.8	46.9	46.4	79.4	-	-	-
260	12/18/2013 1:50	0:10:00	47.6	75.4	48.9	45.8	48.2	47.8	47.6	46.8	46.3	79.6	-	-	-
261	12/18/2013 2:00	0:10:00	48.1	75.9	49.1	46.7	48.6	48.3	48.1	47.7	47.2	79.8	-	-	-
262	12/18/2013 2:10	0:10:00	47.8	75.6	48.9	46.5	48.3	48	47.8	47.3	46.9	79.6	-	-	-
263	12/18/2013 2:20	0:10:00	48.3	76.1	49.3	47.3	48.7	48.4	48.3	47.9	47.6	79.6	-	-	-
264	12/18/2013 2:30	0:10:00	47.8	75.5	49	46.6	48.3	47.9	47.8	47.2	46.9	79.2	-	-	-
265	12/18/2013 2:40	0:10:00	48	75.8	49.2	47	48.5	48.2	48	47.6	47.3	79.7	-	-	-
266	12/18/2013 2:50	0:10:00	47.9	75.7	49.1	46.4	48.4	48.1	47.9	47.3	46.8	79.5	-	-	-
267	12/18/2013 3:00	0:10:00	47.9	75.7	48.9	46.6	48.4	48	47.9	47.4	47	79.2	-	-	-
268	12/18/2013 3:10	0:10:00	47.9	75.7	48.9	46.7	48.3	48.1	47.9	47.5	47	79.5	-	-	-
269	12/18/2013 3:20	0:10:00	47.6	75.3	48.6	46.4	48	47.7	47.6	47.1	46.7	79.2	-	-	-
270	12/18/2013 3:30	0:10:00	47.9	75.7	49	46.7	48.4	48.1	47.9	47.4	47	79.8	-	-	-
271	12/18/2013 3:40	0:10:00	47.6	75.4	48.9	46.2	48.1	47.8	47.6	47.1	46.7	79.2	-	-	-
272	12/18/2013 3:50	0:10:00	47.8	75.6	48.9	46.6	48.2	47.9	47.8	47.4	47.1	79.7	-	-	-
273	12/18/2013 4:00	0:10:00	47.8	75.6	48.7	46.5	48.2	48	47.8	47.3	46.8	79.7	-	-	-
274	12/18/2013 4:10	0:10:00	47.7	75.5	48.9	46.4	48.3	47.9	47.7	47.1	46.8	79.3	-	-	-
275	12/18/2013 4:20	0:10:00	47.9	75.7	48.9	47	48.3	48.1	47.9	47.5	47.2	79.9	-	-	-
276	12/18/2013 4:30	0:10:00	47.6	75.4	48.7	46.2	48.1	47.7	47.6	47.1	46.7	79.8	-	-	-
277	12/18/2013 4:40	0:10:00	47.4	75.2	48.4	46.3	47.8	47.6	47.4	47	46.7	79.3	-	-	-
278	12/18/2013 4:50	0:10:00	47.3	75.1	48.5	46.1	47.8	47.5	47.3	46.8	46.6	79.5	-	-	-
279	12/18/2013 5:00	0:10:00	47.4	75.1	48.5	46.1	47.8	47.5	47.4	46.9	46.5	79.4	-	-	-
280	12/18/2013 5:10	0:10:00	47.6	75.4	48.6	46.4	48.1	47.8	47.6	47.2	46.9	79.3	-	-	-
281	12/18/2013 5:20	0:10:00	47.1	74.9	48.7	45.7	47.8	47.3	47.1	46.5	46.1	79.2	-	-	-
282	12/18/2013 5:30	0:10:00	47.6	75.3	48.6	46.5	48	47.7	47.6	47.1	46.8	83.1	-	-	-
283	12/18/2013 5:40	0:10:00	47.8	75.6	48.9	46.8	48.2	48	47.8	47.3	47	83.9	-	-	-
284	12/18/2013 5:50	0:10:00	47.8	75.6	48.9	46.7	48.3	48	47.8	47.3	47	84.8	-	-	-
285	12/18/2013 6:00	0:10:00	47.5	75.3	48.8	46.3	48	47.7	47.5	47	46.6	83.6	-	-	-
286	12/18/2013 6:10	0:10:00	47.4	75.2	48.7	46	48	47.6	47.3	46.8	46.5	84.5	-	-	-
287	12/18/2013 6:20	0:10:00	48	75.8	49	47	48.4	48.2	48	47.6	47.3	83.5	-	-	-
288	12/18/2013 6:30	0:10:00	48.3	76.1	49.2	47.1	48.8	48.5	48.3	47.8	47.5	84.7	-	-	-
289	12/18/2013 6:40	0:10:00	48.4	76.2	49.6	47	48.9	48.6	48.4	47.8	47.4	84.2	-	-	-
290	12/18/2013 6:50	0:10:00	48.2	76	49.7	47.2	48.8	48.4	48.2	47.8	47.5	85	-	-	-
291	12/18/2013 7:00	0:10:00	48.4	76.2	49.5	47.4	48.8	48.5	48.4	48	47.7	84.4	-	-	-
292	12/18/2013 7:10	0:10:00	48	75.8	49.1	46.6	48.4	48.1	48	47.6	47.2	83.7	-	-	-
293	12/18/2013 7:20	0:10:00	47.9	75.6	48.9	46.6	48.3	48	47.9	47.4	47	85.7	-	-	-
294	12/18/2013 7:30	0:10:00	47.9	75.7	49.3	46.1	48.5	48.1	47.9	47.2	46.7	84.8	-	-	-
295	12/18/2013 7:40	0:10:00	47.9	75.7	49.2	46.7	48.4	48.1	47.9	47.4	47	84.4	-	-	-
296	12/18/2013 7:50	0:10:00	48.5	76.2	49.9	47.1	49	48.6	48.5	47.9	47.5	86	-	-	-
297	12/18/2013 8:00	0:10:00	48.7	76.5	49.8	47.4	49.2	48.9	48.7	48.2	47.8	84.8	-	-	-
298	12/18/2013 8:10	0:10:00	48.5	76.3	49.7	46.9	49	48.7	48.5	48	47.5	84.8	-	-	-
299	12/18/2013 8:20	0:10:00	48.8	76.5	49.8	47	49.2	48.9	48.8	48.3	47.5	84.6	-	-	-
300	12/18/2013 8:30	0:10:00	49.4	77.1	51.1	48	49.9	49.5	49.3	48.8	48.5	85.6	-	-	-

301	12/18/2013 8:40	0:10:00	49.4	77.2	50.8	48	49.9	49.6	49.4	48.9	48.5	86.3	-	-	-
302	12/18/2013 8:50	0:10:00	49.8	77.6	51.5	48.1	50.3	50	49.8	49.2	48.7	86	-	-	-
303	12/18/2013 9:00	0:06:03	68.9	94.5	91.2	48.2	54.6	49.9	49.7	49.2	48.7	131.1	Over	-	-

Address	Time	Measurme	LAeq	LAE	LAmax	LAmin	LA01	LA10	LA50	LA90	LA99	LCpeak	Over	Under	Pause
1	12/16/2013 6:40	0:10:00	92.6	120.4	113.9	29.1	98.8	70.3	42.3	33.5	31.2	134	Over	-	-
2	12/16/2013 6:50	0:10:00	68	95.8	86.5	40.2	76.2	71.6	64.6	44.4	41.5	120.6	-	-	-
3	12/16/2013 7:00	0:10:00	69.8	97.6	82.7	60.9	74.6	71.8	69.3	66.4	63.8	120	-	-	-
4	12/16/2013 7:10	0:10:00	69.1	96.8	82.7	47.9	75.3	71.3	68.5	63.1	51	117.9	-	-	-
5	12/16/2013 7:20	0:10:00	66.3	94	81.3	47.3	74.2	68.9	65	59.3	48.8	117.5	-	-	-
6	12/16/2013 7:30	0:10:00	66.9	94.7	80.5	46.7	75	69.7	65.6	53.6	49.3	119.8	-	-	-
7	12/16/2013 7:40	0:10:00	63.7	91.4	78.8	44.6	70	66.8	62.7	52.1	48.1	116.5	-	-	-
8	12/16/2013 7:50	0:10:00	61.8	89.6	75.7	45.2	67.8	64.9	61.4	50.3	47.8	113.5	-	-	-
9	12/16/2013 8:00	0:10:00	71	98.7	87.5	43.4	80.4	75.2	66.2	48.4	46.3	120.8	-	-	-
10	12/16/2013 8:10	0:10:00	67.6	95.4	83.2	43.2	76.8	71.5	64.5	48.5	46.3	119.9	-	-	-
11	12/16/2013 8:20	0:10:00	56.2	83.9	75.5	25.4	68.2	59.7	46.8	28.5	27.1	118.7	-	Under	-
12	12/16/2013 8:30	0:10:00	31.9	59.7	47.7	24.9	39.9	33.5	30.1	28.1	26.9	83.2	-	Under	-
13	12/16/2013 8:40	0:10:00	62.6	90.4	84.1	25.4	75	66.3	32	28.3	26.8	122	Over	Under	-
14	12/16/2013 8:50	0:10:00	58.9	86.7	82.6	25	69.2	63.3	32.8	28.3	26.5	119.8	-	Under	-
15	12/16/2013 9:00	0:10:00	30.7	58.5	45.6	24.3	37.3	33	29.4	27.1	25.8	75.3	-	Under	-
16	12/16/2013 9:10	0:10:00	49.4	77.2	75.7	23.3	63.5	37.8	29.2	26.4	24.7	121.3	Over	Under	-
17	12/16/2013 9:20	0:10:00	65	92.8	87	32.2	75.4	67.7	61.8	44	34.2	122.8	-	-	-
18	12/16/2013 9:30	0:10:00	61.1	88.9	96.7	21.8	55.9	40.3	29.5	25.1	23.3	133.3	Over	Under	-
19	12/16/2013 9:40	0:10:00	32.4	60.1	47.9	21.5	39.8	35.4	30.3	25.3	23.5	75.3	-	Under	-
20	12/16/2013 9:50	0:10:00	68.4	96.2	102.4	26	75.2	64	40.7	31.1	28.2	134	Over	Under	-
21	12/16/2013 10:00	0:10:00	76.5	104.3	110.3	14.4	82	64.2	52.3	41.7	15.5	131.9	Over	Under	-
22	12/16/2013 10:10	0:10:00	50.1	77.9	73.1	40.6	57.5	51.3	48.8	46.4	42.8	93.9	-	-	-
23	12/16/2013 10:20	0:10:00	48.2	76	65.6	40	54.2	50.9	47.1	42.4	41.1	92.2	-	-	-
24	12/16/2013 10:30	0:10:00	49.8	77.6	74.9	37.6	58.1	52.7	44.6	41.5	39.6	99.6	-	-	-
25	12/16/2013 10:40	0:10:00	45.4	73.2	59.1	37.9	51.5	47.7	44.5	41.9	40.5	78.7	-	-	-
26	12/16/2013 10:50	0:10:00	44.4	72.2	60.9	35.8	50.6	46.8	43.5	39.8	37	78.5	-	-	-
27	12/16/2013 11:00	0:10:00	46.3	74.1	57	38.1	55.1	48.4	45.1	41.5	39.1	78.3	-	-	-
28	12/16/2013 11:10	0:10:00	46.9	74.7	65.5	36	57.5	48.4	43.8	40.8	38.3	86.3	-	-	-
29	12/16/2013 11:20	0:10:00	45.6	73.4	55	34.8	52	48.3	44.8	40.4	37	80.8	-	-	-
30	12/16/2013 11:30	0:10:00	51.6	79.4	71.9	41.1	64.5	51.2	47.7	44.9	42.6	86.4	-	-	-
31	12/16/2013 11:40	0:10:00	49	76.8	66.7	43.7	54	50.4	47.8	45.9	44.5	83.8	-	-	-
32	12/16/2013 11:50	0:10:00	47.7	75.5	59.2	41.2	55.1	49.9	46.3	44.2	42.4	83.5	-	-	-
33	12/16/2013 12:00	0:10:00	50.8	78.5	67.4	41.6	59.2	52.1	48.8	46.3	43.1	86.3	-	-	-
34	12/16/2013 12:10	0:10:00	49.2	77	59.1	43.8	54.3	51.2	48.5	46.6	44.8	80.5	-	-	-
35	12/16/2013 12:20	0:10:00	52.4	80.2	71	44.8	62.5	52.9	49.8	47.6	46.3	86	-	-	-
36	12/16/2013 12:30	0:10:00	49.5	77.3	58.5	44.1	55.2	51.4	48.8	46.8	45.5	85.3	-	-	-
37	12/16/2013 12:40	0:10:00	49.9	77.6	60.5	44.4	55.4	51.9	49.1	47	45.5	80.3	-	-	-
38	12/16/2013 12:50	0:10:00	49.6	77.4	57.9	45.1	53.6	51.4	49.2	47.4	46	81.6	-	-	-
39	12/16/2013 13:00	0:10:00	49.7	77.5	58.3	44.6	54.8	52	48.9	46.9	45.4	80	-	-	-
40	12/16/2013 13:10	0:10:00	50.3	78.1	60.6	45.4	55.7	52.1	49.7	48.1	46.7	80.8	-	-	-
41	12/16/2013 13:20	0:10:00	49.1	76.9	58.6	45.1	54.4	50.8	48.5	46.9	45.7	79.7	-	-	-
42	12/16/2013 13:30	0:10:00	48.7	76.4	57.8	44.3	53.5	50.4	48	46.7	45.7	79.2	-	-	-

43	12/16/2013 13:40	0:10:00	50	77.7	58.7	44.5	55.5	52	49.2	47.3	46	85.1	-	-	-
44	12/16/2013 13:50	0:10:00	48.4	76.2	63.4	44.1	51.4	49.9	48	46.6	45.5	79.9	-	-	-
45	12/16/2013 14:00	0:10:00	48.9	76.7	60.9	43.4	53	50.4	48.4	47	44.5	81.1	-	-	-
46	12/16/2013 14:10	0:10:00	49.9	77.7	63.2	43.7	57.6	52.3	48.2	46.2	45.1	85.4	-	-	-
47	12/16/2013 14:20	0:10:00	48.3	76.1	60.5	43.7	54.5	50.5	47.3	45.6	44.7	79.8	-	-	-
48	12/16/2013 14:30	0:10:00	46.4	74.2	62.6	41.9	51.1	47.6	45.9	44.6	42.9	79.1	-	-	-
49	12/16/2013 14:40	0:10:00	48.8	76.5	59.2	44.2	54.7	50.6	47.9	46	44.8	79.7	-	-	-
50	12/16/2013 14:50	0:10:00	49.5	77.3	61.3	44.7	53.5	50.8	49.3	47.2	45.7	79.3	-	-	-
51	12/16/2013 15:00	0:10:00	48.3	76	56.6	44.3	53	49.9	47.8	46.2	45.3	80.1	-	-	-
52	12/16/2013 15:10	0:10:00	48.6	76.4	59.1	43.8	54.7	50.6	47.8	45.8	44.9	81.8	-	-	-
53	12/16/2013 15:20	0:10:00	48.3	76	56.9	43.3	52.1	50.3	47.7	45.3	44.2	81	-	-	-
54	12/16/2013 15:30	0:10:00	50.1	77.8	61	45.3	56.1	52.3	49.2	47.2	46	83.1	-	-	-
55	12/16/2013 15:40	0:10:00	49.5	77.3	54.8	44.8	52.7	51.1	49.3	47.4	45.8	79.1	-	-	-
56	12/16/2013 15:50	0:10:00	49.7	77.5	63.4	44.7	54	51.3	49.3	47.4	45.5	82.9	-	-	-
57	12/16/2013 16:00	0:10:00	50.7	78.5	57.3	46.9	54.4	52.5	50.3	48.7	47.7	81.4	-	-	-
58	12/16/2013 16:10	0:10:00	50.6	78.4	61.6	47	54.3	52.1	50.3	48.7	47.7	80.6	-	-	-
59	12/16/2013 16:20	0:10:00	51.2	79	57.2	46.5	54.7	52.9	50.9	49	47.7	80.6	-	-	-
60	12/16/2013 16:30	0:10:00	50	77.8	56.8	45.7	53.5	51.4	49.8	48.2	47.1	82.4	-	-	-
61	12/16/2013 16:40	0:10:00	51.3	79.1	63.3	45.8	57.8	53.6	50.2	48.5	47.3	83.5	-	-	-
62	12/16/2013 16:50	0:10:00	49.5	77.3	59.3	45.6	55.3	50.9	48.9	47.7	46.6	81.6	-	-	-
63	12/16/2013 17:00	0:10:00	49.4	77.2	60.3	46.2	53.8	50.6	48.9	47.9	47.1	78.1	-	-	-
64	12/16/2013 17:10	0:10:00	49.6	77.4	57.2	46.2	53.8	51.1	49.1	47.8	47	78.9	-	-	-
65	12/16/2013 17:20	0:10:00	50.8	78.6	60.8	46	55.5	52.3	50.4	48.4	47	81.2	-	-	-
66	12/16/2013 17:30	0:10:00	50	77.8	55.3	45.8	52.9	51.4	50	47.9	46.9	77.5	-	-	-
67	12/16/2013 17:40	0:10:00	50.5	78.3	61.4	46.2	55.5	52	50	48.7	47.5	84	-	-	-
68	12/16/2013 17:50	0:10:00	50.7	78.5	57.3	46.7	53	52	50.7	49	47.7	78.6	-	-	-
69	12/16/2013 18:00	0:10:00	50.7	78.5	57.2	47	54.2	52	50.5	49.1	47.9	81	-	-	-
70	12/16/2013 18:10	0:10:00	50.7	78.5	56	47.2	54	52.3	50.3	48.8	48	81.7	-	-	-
71	12/16/2013 18:20	0:10:00	52.8	80.6	73.1	45.8	63.1	52.5	49.7	48.4	47	81.9	-	-	-
72	12/16/2013 18:30	0:10:00	50.8	78.6	61.4	46.1	58.1	53.2	49.5	47.8	47	82.7	-	-	-
73	12/16/2013 18:40	0:10:00	51.8	79.6	67.7	47.2	61.2	52.9	50	48.8	48	79.6	-	-	-
74	12/16/2013 18:50	0:10:00	49.5	77.3	55.1	46	53.3	51.3	49.1	47.5	46.7	79.1	-	-	-
75	12/16/2013 19:00	0:10:00	50.8	78.5	59	46.5	54.2	52.5	50.4	48.7	47.7	81.4	-	-	-
76	12/16/2013 19:10	0:10:00	50.3	78	55.3	46.9	53.8	51.5	50.1	48.6	47.8	77.7	-	-	-
77	12/16/2013 19:20	0:10:00	50.3	78	54.9	46.4	52.7	51.5	50.1	48.6	47.3	77.3	-	-	-
78	12/16/2013 19:30	0:10:00	49.5	77.2	56.3	45.8	52.8	51	49.1	47.7	46.6	78.8	-	-	-
79	12/16/2013 19:40	0:10:00	48.9	76.6	57.5	45.2	54.3	50.4	48.2	47	46	82	-	-	-
80	12/16/2013 19:50	0:10:00	48.2	76	54.2	45.1	51.1	49.5	48	46.8	45.9	76.9	-	-	-
81	12/16/2013 20:00	0:10:00	49.6	77.4	62.2	44.4	54.8	51.4	48.9	47.2	45.7	82.1	-	-	-
82	12/16/2013 20:10	0:10:00	49.1	76.9	53.5	45.8	51.5	50.2	49	47.5	46.5	77.2	-	-	-
83	12/16/2013 20:20	0:10:00	49.5	77.3	58.5	43.6	55.1	51.2	49	47.1	44.7	77.9	-	-	-
84	12/16/2013 20:30	0:10:00	49.3	77.1	58.1	44.2	54.1	51.6	48.7	47	45.7	78.6	-	-	-
85	12/16/2013 20:40	0:10:00	49.8	77.5	55.1	45.6	53.4	51.5	49.4	47.6	46.6	76.7	-	-	-

86	12/16/2013 20:50	0:10:00	50.4	78.2	62.9	45.2	57.9	51.7	49.5	47.6	46.5	79.3	-	-	-
87	12/16/2013 21:00	0:10:00	50.5	78.3	64.9	46	58.7	51.5	49.7	48	46.8	80.5	-	-	-
88	12/16/2013 21:10	0:10:00	49.7	77.5	56.7	45.5	53.2	51.3	49.4	47.8	46.6	77.3	-	-	-
89	12/16/2013 21:20	0:10:00	49.3	77	55.1	44.2	52.9	51.1	49	46.5	45.5	78.2	-	-	-
90	12/16/2013 21:30	0:10:00	48.6	76.4	56.8	43.8	53.5	50.3	48	46.6	45.4	77.5	-	-	-
91	12/16/2013 21:40	0:10:00	48.4	76.2	56	44.3	52.3	49.8	48.1	46.5	45.3	75	-	-	-
92	12/16/2013 21:50	0:10:00	48.7	76.4	57.7	42.8	52.4	50.2	48.4	46.3	43.7	76.7	-	-	-
93	12/16/2013 22:00	0:10:00	48.5	76.3	54.1	42.8	52.3	50.6	48.1	45.9	44	75.3	-	-	-
94	12/16/2013 22:10	0:10:00	47.5	75.2	52.7	41.7	51.1	49.4	47.1	44.6	43.2	77	-	-	-
95	12/16/2013 22:20	0:10:00	48.2	76	57.3	42.3	54.5	49.8	47.6	45.5	43.6	79.2	-	-	-
96	12/16/2013 22:30	0:10:00	47.2	75	57.2	41.5	53.8	49.1	46.2	43.7	42.4	77.7	-	-	-
97	12/16/2013 22:40	0:10:00	47.4	75.2	61.5	40.5	55.2	49.2	46.2	43.4	41.7	81.9	-	-	-
98	12/16/2013 22:50	0:10:00	53.2	81	74.5	38.1	65.8	52.2	45.1	41.5	39.3	82.6	-	-	-
99	12/16/2013 23:00	0:10:00	51.1	78.9	73.1	37.6	63.6	49.8	44.7	42	39.6	80.9	-	-	-
100	12/16/2013 23:10	0:10:00	45.8	73.6	54.9	39.1	52.1	48	45.1	42.4	40.3	74.2	-	-	-
101	12/16/2013 23:20	0:10:00	43.8	71.6	50	38.1	47.9	45.9	43.3	41.2	39.5	75.6	-	-	-
102	12/16/2013 23:30	0:10:00	44.3	72.1	51.3	39.5	48.5	46.3	43.8	41.8	40.4	76	-	-	-
103	12/16/2013 23:40	0:10:00	43	70.8	53	36.6	48	45.3	42.3	38.9	37.5	74.6	-	-	-
104	12/16/2013 23:50	0:10:00	42.9	70.7	50.8	37.2	47.8	45.4	42	39.6	38.1	76.8	-	-	-
105	12/17/2013 0:00	0:10:00	42.6	70.4	53.6	35.5	48.5	45.3	41.6	38.4	36.6	77.7	-	-	-
106	12/17/2013 0:10	0:10:00	41.5	69.3	50.9	35.1	46.4	43.9	40.8	38.1	36.5	77.7	-	-	-
107	12/17/2013 0:20	0:10:00	42	69.8	51.7	34.1	47.5	44.6	41.2	38.5	36.2	78.3	-	-	-
108	12/17/2013 0:30	0:10:00	52.3	80	74.3	34.6	65.8	51.3	42.4	38.6	36.4	80.9	-	-	-
109	12/17/2013 0:40	0:10:00	44.4	72.2	53.3	35.5	50.9	47.3	43.3	39	36.8	78.1	-	-	-
110	12/17/2013 0:50	0:10:00	43.5	71.3	55.4	34.3	49.6	46.5	42.3	38.2	35.7	77.5	-	-	-
111	12/17/2013 1:00	0:10:00	41.7	69.5	52.1	35.1	48.4	44.6	40.1	37.2	36.1	75.1	-	-	-
112	12/17/2013 1:10	0:10:00	40.9	68.7	49.8	35.1	46.4	43.1	40.1	37.8	36.4	76.7	-	-	-
113	12/17/2013 1:20	0:10:00	40.8	68.6	49.1	35.4	46	43.2	40.1	37.3	36.3	74.5	-	-	-
114	12/17/2013 1:30	0:10:00	39.6	67.3	55.2	33.7	46.5	41.8	38.2	36.1	34.9	75.4	-	-	-
115	12/17/2013 1:40	0:10:00	39.7	67.5	47.7	34.2	44.7	41.6	39.1	36.9	35.6	77.3	-	-	-
116	12/17/2013 1:50	0:10:00	41.2	69	57.1	34.7	49.6	42.9	39.7	37.1	35.7	76.7	-	-	-
117	12/17/2013 2:00	0:10:00	41	68.8	50.7	34.2	46.9	43.9	40	37.2	35.7	73.2	-	-	-
118	12/17/2013 2:10	0:10:00	41.5	69.3	52.6	34	48.6	44.8	39.6	36.6	35.2	78.3	-	-	-
119	12/17/2013 2:20	0:10:00	40.5	68.3	54.1	35	46.1	42.8	39.7	36.9	35.8	76.7	-	-	-
120	12/17/2013 2:30	0:10:00	39.4	67.2	50	34.8	43.8	41.4	38.8	36.8	35.8	75.3	-	-	-
121	12/17/2013 2:40	0:10:00	38.8	66.5	47.8	34.2	43	40.6	38.2	36.6	35.7	74.3	-	-	-
122	12/17/2013 2:50	0:10:00	41.7	69.5	49.9	35.6	46.7	43.8	41.1	38.8	37.5	80.2	-	-	-
123	12/17/2013 3:00	0:10:00	41.9	69.7	61.4	35.8	50.1	43.6	40.3	37.5	36.5	77.1	-	-	-
124	12/17/2013 3:10	0:10:00	39.6	67.4	47.6	33.5	44.5	42.2	38.7	36.4	34.7	84.1	-	-	-
125	12/17/2013 3:20	0:10:00	38.6	66.3	47.4	33	43.8	41	37.7	35.8	34.2	77.3	-	-	-
126	12/17/2013 3:30	0:10:00	38	65.8	48.4	32.6	44.3	40.4	36.8	34.9	33.9	74.2	-	-	-
127	12/17/2013 3:40	0:10:00	37.2	65	47.4	32.2	44.2	40.1	35.7	34.2	33.2	72.3	-	-	-
128	12/17/2013 3:50	0:10:00	40	67.8	58	33.1	46.7	42.9	38.2	35.4	34.4	80.6	-	-	-

129	12/17/2013 4:00	0:10:00	40.6	68.3	55.1	34.1	46.1	42.9	39.7	37.3	35.8	80.1	-	-	-
130	12/17/2013 4:10	0:10:00	48.9	76.7	69.9	34.8	61.3	50.8	40.5	37.4	35.9	76.5	-	-	-
131	12/17/2013 4:20	0:10:00	54.7	82.5	74.1	34.8	69.7	46.6	39.6	36.9	35.7	92.4	-	-	-
132	12/17/2013 4:30	0:10:00	51.4	79.2	72.7	34.8	67.2	44.3	40.4	37.7	36.1	89.8	-	-	-
133	12/17/2013 4:40	0:10:00	42.6	70.4	53.8	35.3	49.7	45.2	41.3	37.8	36.3	76.5	-	-	-
134	12/17/2013 4:50	0:10:00	43	70.8	55.7	35.6	49.5	45.8	41.6	38.3	36.9	78.6	-	-	-
135	12/17/2013 5:00	0:10:00	42.8	70.6	51.9	35.7	48.5	45.6	41.7	38.5	37.1	75.7	-	-	-
136	12/17/2013 5:10	0:10:00	42	69.8	48.6	36.7	45.9	44.2	41.5	39.1	37.6	75.9	-	-	-
137	12/17/2013 5:20	0:10:00	42.6	70.4	48.6	37.8	46.7	44.7	42.1	39.7	38.7	76.8	-	-	-
138	12/17/2013 5:30	0:10:00	44.2	72	52.7	37.5	49.6	46.4	43.6	41.2	39.2	75.4	-	-	-
139	12/17/2013 5:40	0:10:00	44.7	72.5	51.4	38.3	48.9	46.9	44.1	41.9	40.1	74.1	-	-	-
140	12/17/2013 5:50	0:10:00	46.2	74	53.9	39.6	50.9	48.7	45.4	42.6	40.7	74	-	-	-
141	12/17/2013 6:00	0:10:00	45.7	73.5	50.9	39.7	49.2	47.7	45.4	42.6	40.9	75.6	-	-	-
142	12/17/2013 6:10	0:10:00	46.6	74.4	55.3	41.6	50.6	48.3	46.4	44.1	42.7	75.2	-	-	-
143	12/17/2013 6:20	0:10:00	50.2	78	58.3	41.8	55.3	52.8	49.5	45.7	43.2	76.5	-	-	-
144	12/17/2013 6:30	0:10:00	50.3	78	57.2	43.3	54.3	52.6	49.8	46.8	45	77.9	-	-	-
145	12/17/2013 6:40	0:10:00	51.6	79.4	66	45.6	58.6	53.3	50.5	48.2	46.7	79.5	-	-	-
146	12/17/2013 6:50	0:10:00	51.5	79.3	56.2	47.2	54.5	53.2	51.3	49	48	78.2	-	-	-
147	12/17/2013 7:00	0:10:00	51.9	79.7	58	46.1	55.5	53.6	51.6	49.5	47.8	78.6	-	-	-
148	12/17/2013 7:10	0:10:00	50.9	78.7	55	47.1	53.7	52.4	50.7	49.1	47.9	78.6	-	-	-
149	12/17/2013 7:20	0:10:00	50.1	77.9	58.4	46.1	54.2	51.8	49.7	48	47.1	78.8	-	-	-
150	12/17/2013 7:30	0:10:00	49.8	77.5	60.9	45.9	54.7	51.6	49	47.7	47	79.7	-	-	-
151	12/17/2013 7:40	0:10:00	48.8	76.6	60.9	45.4	52.9	50.3	48.3	47	46.3	79.2	-	-	-
152	12/17/2013 7:50	0:10:00	48.9	76.6	54.6	45.4	52.5	50.5	48.4	47.1	46.3	80	-	-	-
153	12/17/2013 8:00	0:10:00	50.6	78.4	68.7	46.6	61.4	50.3	48.8	47.9	47.3	81.6	-	-	-
154	12/17/2013 8:10	0:10:00	50.3	78.1	62.4	46.1	57.1	51.9	49.4	47.7	46.7	80.1	-	-	-
155	12/17/2013 8:20	0:10:00	50.9	78.7	56.7	47	54.8	52.7	50.4	48.9	48.1	81.2	-	-	-
156	12/17/2013 8:30	0:10:00	50.3	78.1	56.6	46	54.7	52	49.8	48.2	47.1	79.8	-	-	-
157	12/17/2013 8:40	0:10:00	53.9	81.7	70.8	45.5	63.6	57.1	50.4	48.7	47.4	82.2	-	-	-
158	12/17/2013 8:50	0:10:00	50.6	78.4	67.2	44.7	61.6	51.6	48	46.5	45.7	82.9	-	-	-
159	12/17/2013 9:00	0:10:00	48	75.8	59.4	43.2	53.9	50.3	47.1	45	44	82.8	-	-	-
160	12/17/2013 9:10	0:10:00	49.8	77.6	56.5	44.7	53.1	51.2	49.7	47.1	45.8	78	-	-	-
161	12/17/2013 9:20	0:10:00	50.4	78.2	63.1	45.6	55	52.4	49.8	47.6	46.4	81.2	-	-	-
162	12/17/2013 9:30	0:10:00	50.2	78	61.1	45.7	53.3	51.7	50	48.2	46.8	79.9	-	-	-
163	12/17/2013 9:40	0:10:00	50.8	78.5	56.7	46	53.8	52.5	50.5	48.6	47	81.4	-	-	-
164	12/17/2013 9:50	0:10:00	50.4	78.2	60.7	44.4	55.4	52.8	49.6	47.1	45.3	83.7	-	-	-
165	12/17/2013 10:00	0:10:00	49.1	76.8	57	44.1	52.8	50.9	48.7	46.5	45.2	79.9	-	-	-
166	12/17/2013 10:10	0:10:00	50	77.8	60	44.3	56	51.8	49.4	47	45.2	86.2	-	-	-
167	12/17/2013 10:20	0:10:00	48.4	76.1	58.7	44.1	53.1	50.3	47.8	46.1	45.1	78.9	-	-	-
168	12/17/2013 10:30	0:10:00	48.1	75.9	60.1	43.4	53.8	50.5	47.2	45	44.3	81.7	-	-	-
169	12/17/2013 10:40	0:10:00	48.3	76.1	62.8	43.9	53.5	50.2	47.4	45.8	44.6	78.5	-	-	-
170	12/17/2013 10:50	0:10:00	48	75.8	55.9	43.2	52.4	49.6	47.7	45.6	44.2	79.5	-	-	-
171	12/17/2013 11:00	0:10:00	49.1	76.9	59.2	43.9	54.9	51.6	48.1	46.2	45	78.7	-	-	-

172	12/17/2013 11:10	0:10:00	48.1	75.9	58.1	43.8	52.3	49.6	47.8	45.9	44.5	79.3	-	-	-
173	12/17/2013 11:20	0:10:00	48.4	76.2	61.3	42.7	55.1	50.2	47.2	45.2	44	78.3	-	-	-
174	12/17/2013 11:30	0:10:00	46.4	74.2	55.1	43	51.7	48.2	45.7	44.6	43.7	80.6	-	-	-
175	12/17/2013 11:40	0:10:00	48.7	76.5	65.6	43.3	59.1	50	46.2	44.6	44	84.2	-	-	-
176	12/17/2013 11:50	0:10:00	46.5	74.3	53.5	43	51.4	48.5	45.7	44.5	43.8	79	-	-	-
177	12/17/2013 12:00	0:10:00	46.6	74.4	54	42.2	52	49	45.6	44	43.1	77.2	-	-	-
178	12/17/2013 12:10	0:10:00	47.4	75.2	59	42.8	53.6	50.3	45.8	44.3	43.6	80.8	-	-	-
179	12/17/2013 12:20	0:10:00	48.1	75.9	56.6	41.9	54.2	51.3	46.5	44.2	43	78.8	-	-	-
180	12/17/2013 12:30	0:10:00	79.6	107.4	110.3	14.7	91	67.5	45.5	34.8	15.8	134	Over	Under	-
181	12/17/2013 12:40	0:10:00	59.9	87.6	82	38.1	68.6	63.9	50	44.4	41.6	121.9	-	-	-
182	12/17/2013 12:50	0:10:00	49.1	76.9	76.6	19.2	60.6	50.5	43.1	23.1	20.2	120.1	Over	Under	-
183	12/17/2013 13:00	0:10:00	62.8	90.6	81.3	21.1	70.7	66.3	60.2	45.1	40.9	123.6	Over	Under	-
184	12/17/2013 13:10	0:10:00	63.4	91.2	82.8	43.3	71.2	66.6	60.9	53.5	46.8	120.1	-	-	-
185	12/17/2013 13:20	0:10:00	62.2	90	93.7	40	68.4	63.3	54.9	43.7	42	123.7	Over	-	-
186	12/17/2013 13:30	0:10:00	63.8	91.5	88.6	26.2	73.1	66.7	60.6	31.6	28.6	125.1	Over	Under	-
187	12/17/2013 13:40	0:10:00	37.5	65.3	66.9	24.3	46.7	37.7	32.6	29	27.1	107.8	-	Under	-
188	12/17/2013 13:50	0:10:00	73.2	101	101	30.3	79.4	71.2	64	53.2	39.1	130.6	-	-	-
189	12/17/2013 14:00	0:10:00	71.8	99.6	98.1	37	82.6	71.6	61.9	47.7	41	134	Over	-	-
190	12/17/2013 14:10	0:10:00	69.6	97.4	89.9	46.1	78.7	73.7	65.3	59	50.8	118.7	-	-	-
191	12/17/2013 14:20	0:10:00	64.7	92.5	79.8	46.7	72.7	67.6	62.9	58.8	50	116.5	-	-	-
192	12/17/2013 14:30	0:10:00	67.3	95.1	82.3	51	75.4	69.6	65.6	62.8	56.8	120.1	-	-	-
193	12/17/2013 14:40	0:10:00	67.6	95.4	79.3	59.6	74.4	70.2	66.3	63.7	61.9	118.3	-	-	-
194	12/17/2013 14:50	0:10:00	67.2	95	84.9	57.2	74.2	68.9	66	63.4	61.3	118.3	-	-	-
195	12/17/2013 15:00	0:10:00	65.5	93.3	81	17.7	75.1	69	63	19.6	18.1	120.7	-	Under	-
196	12/17/2013 15:10	0:10:00	20.7	48.5	39.5	17.3	29.1	21.5	18.7	17.8	17.6	66.9	-	Under	-
197	12/17/2013 15:20	0:10:00	41.5	69.3	76.4	17.3	37.1	22.4	18.4	17.7	17.6	120.2	Over	Under	-
198	12/17/2013 15:30	0:10:00	72	99.7	104.7	17.5	58.4	28.6	19.6	18.5	17.9	134	Over	Under	-
199	12/17/2013 15:40	0:10:00	61.3	89.1	84.8	17.9	69.4	66.1	49.1	19.1	18.3	123.6	Over	Under	-
200	12/17/2013 15:50	0:10:00	73	100.8	104.9	22.4	79.7	61.1	36.8	26.8	24.7	134	Over	Under	-
201	12/17/2013 16:00	0:10:00	70	97.8	100.6	28.2	75.2	44.3	31.1	30.1	29.4	134	Over	-	-
202	12/17/2013 16:10	0:10:00	30.8	58.6	34.2	28	32.5	31.6	30.7	29.9	29.2	79.5	-	-	-
203	12/17/2013 16:20	0:10:00	31	58.8	34	28.4	32.5	31.8	31	30.1	29.4	80.3	-	-	-
204	12/17/2013 16:30	0:10:00	31.2	59	36.2	28.6	33.3	32.1	31.2	30.3	29.5	80.5	-	-	-
205	12/17/2013 16:40	0:10:00	33	60.8	57.9	28.8	38.4	32.2	31.2	30.4	29.8	94	-	-	-
206	12/17/2013 16:50	0:10:00	34	61.8	58.1	28.5	40.2	32.6	31.5	30.5	29.9	96.3	-	-	-
207	12/17/2013 17:00	0:10:00	31.3	59.1	47.2	28.1	34.1	32.1	31.2	30.2	29.7	80.4	-	-	-
208	12/17/2013 17:10	0:10:00	31.3	59.1	45	28.4	35.5	32.1	31	30.1	29.3	85.8	-	-	-
209	12/17/2013 17:20	0:10:00	31.1	58.8	37.8	28	32.8	31.9	31	30.1	29.4	79.9	-	-	-
210	12/17/2013 17:30	0:10:00	31	58.8	34.3	27.8	32.6	31.8	31	30.1	29.3	80	-	-	-
211	12/17/2013 17:40	0:10:00	31.1	58.9	34.1	28.4	32.7	31.9	31.1	30.1	29.5	79.3	-	-	-
212	12/17/2013 17:50	0:10:00	30.7	58.5	34.1	27.1	32.6	31.7	30.7	29.2	28.2	79	-	Under	-
213	12/17/2013 18:00	0:10:00	32.6	60.4	58.7	26.6	39.7	30.4	29.2	28.2	27.5	93.9	-	Under	-
214	12/17/2013 18:10	0:10:00	63.5	91.3	90.5	26.5	71.6	36.6	28.9	28	27.4	125.1	-	Under	-

215	12/17/2013 18:20	0:10:00	76.4	104.2	109.5	25.5	83	61.3	32.7	28.2	27.1	131.1	Over	Under	-
216	12/17/2013 18:30	0:10:00	54	81.7	83.7	26.6	59.2	56	50	40.8	29.4	125.7	Over	Under	-
217	12/17/2013 18:40	0:10:00	48.8	76.6	80.9	21.3	55.2	50.1	41.5	25.3	23.1	123.1	Over	Under	-
218	12/17/2013 18:50	0:10:00	28.8	56.5	42.2	20.9	38.6	30.5	26.9	24.3	22.6	86.3	-	Under	-
219	12/17/2013 19:00	0:10:00	26	53.7	36.2	20	31.5	28	25.3	23.2	21.6	81.3	-	Under	-
220	12/17/2013 19:10	0:10:00	27.3	55.1	46.1	20.4	33.7	29.7	26.2	23.9	22.4	89.1	-	Under	-
221	12/17/2013 19:20	0:10:00	29.2	57	49.8	20.7	37.8	31.1	26.9	24.1	22.4	80.3	-	Under	-
222	12/17/2013 19:30	0:10:00	27.3	55.1	40.1	20.7	34.4	29.7	26	23.8	22.3	83.4	-	Under	-
223	12/17/2013 19:40	0:10:00	50.5	78.2	83	20.4	57	52.5	33.6	24.7	22.6	125.2	Over	Under	-
224	12/17/2013 19:50	0:10:00	52.8	80.6	67.4	34.3	58.2	55.4	52.5	41.8	36.6	105.2	-	-	-
225	12/17/2013 20:00	0:10:00	51.3	79.1	81.1	17.4	58.8	53.1	20.4	18	17.7	122.7	Over	Under	-
226	12/17/2013 20:10	0:10:00	19.9	47.7	37.2	17.4	28.1	20	18.4	17.9	17.6	74	-	Under	-
227	12/17/2013 20:20	0:10:00	23.7	51.5	46.8	17.3	35	21.8	18.6	17.8	17.5	73.9	-	Under	-
228	12/17/2013 20:30	0:10:00	28.1	55.9	52	17.3	41.7	19.5	18.2	17.8	17.6	77.8	-	Under	-
229	12/17/2013 20:40	0:10:00	23.6	51.4	48.5	17.3	34.1	20.4	18.4	17.8	17.6	77.7	-	Under	-
230	12/17/2013 20:50	0:10:00	18.9	46.7	40.2	17.2	23.9	18.9	18	17.7	17.5	67.7	-	Under	-
231	12/17/2013 21:00	0:10:00	25.7	53.4	48.2	17.4	36.6	23.5	19	18	17.7	73.8	-	Under	-
232	12/17/2013 21:10	0:10:00	23.8	51.6	47.8	17.1	27.5	20	18	17.5	17.4	72.9	-	Under	-
233	12/17/2013 21:20	0:10:00	19.7	47.5	40	17.2	27.3	19	18	17.6	17.4	69.9	-	Under	-
234	12/17/2013 21:30	0:10:00	20.3	48.1	36.2	17.2	29.2	22.1	18	17.5	17.4	76.2	-	Under	-
235	12/17/2013 21:40	0:10:00	21.4	49.1	37.4	17.3	33.4	20	18	17.7	17.5	69.1	-	Under	-
236	12/17/2013 21:50	0:10:00	19	46.7	29.3	17.4	24.3	19.8	18.4	17.9	17.7	61.2	-	Under	-
237	12/17/2013 22:00	0:10:00	18.7	46.5	32.8	17.5	20.7	19.1	18.4	18.1	17.9	60.2	-	Under	-
238	12/17/2013 22:10	0:10:00	19.9	47.7	40.8	17.5	28.5	20	18.5	18.1	17.8	72	-	Under	-
239	12/17/2013 22:20	0:10:00	23.1	50.9	43.1	17.5	36.2	22.4	18.6	18.1	17.8	70.3	-	Under	-
240	12/17/2013 22:30	0:10:00	29.8	57.6	57	17.6	28.3	19.4	18.5	18.1	17.8	82.1	-	Under	-
241	12/17/2013 22:40	0:10:00	18.8	46.5	29.3	17.4	23.3	19.6	18.3	17.9	17.7	65.2	-	Under	-
242	12/17/2013 22:50	0:10:00	18.7	46.5	31.1	17.5	22.3	19.2	18.5	18.1	17.9	63	-	Under	-
243	12/17/2013 23:00	0:10:00	18.4	46.2	29.8	17.4	20	18.9	18.3	18	17.8	58.9	-	Under	-
244	12/17/2013 23:10	0:10:00	19.1	46.9	27.3	17.5	22.8	19.9	18.7	18.2	17.9	57.1	-	Under	-
245	12/17/2013 23:20	0:10:00	18.8	46.6	26.8	17.5	23.8	19.3	18.4	18.1	17.8	63.1	-	Under	-
246	12/17/2013 23:30	0:10:00	19.5	47.3	28.5	17.4	26.3	20.6	18.6	18.1	17.8	61.9	-	Under	-
247	12/17/2013 23:40	0:10:00	18.8	46.6	38.7	17.4	21.3	18.9	18.4	18	17.8	65.4	-	Under	-
248	12/17/2013 23:50	0:10:00	28.3	56.1	55.7	17.6	33.4	19.8	18.6	18.1	17.9	79.7	-	Under	-
249	12/18/2013 0:00	0:10:00	19	46.8	33	17.5	24.2	19.2	18.5	18.1	17.8	59	-	Under	-
250	12/18/2013 0:10	0:10:00	19.2	46.9	38.3	17.5	23.1	19.1	18.5	18.1	17.8	66.5	-	Under	-
251	12/18/2013 0:20	0:10:00	18.8	46.6	29.2	17.5	24.2	19.1	18.4	18.1	17.8	67.9	-	Under	-
252	12/18/2013 0:30	0:10:00	18.9	46.7	33.2	17.6	23.2	19.3	18.5	18.1	17.9	61.2	-	Under	-
253	12/18/2013 0:40	0:10:00	18.4	46.2	25.1	17.5	19.7	18.9	18.4	18.1	17.8	59	-	Under	-
254	12/18/2013 0:50	0:10:00	19.2	47	36.5	17.5	23.6	18.9	18.4	18	17.8	64.9	-	Under	-
255	12/18/2013 1:00	0:10:00	18.6	46.4	28.8	17.5	22.1	18.9	18.4	18	17.8	56.1	-	Under	-
256	12/18/2013 1:10	0:10:00	18.4	46.1	26.2	17.3	20.9	18.8	18.3	17.8	17.5	54.4	-	Under	-
257	12/18/2013 1:20	0:10:00	18.4	46.1	19.9	17.5	19.1	18.7	18.4	18	17.8	52.3	-	Under	-

258	12/18/2013 1:30	0:10:00	18.9	46.7	33.6	17.6	25.3	18.9	18.5	18.2	17.9	61.3	-	Under	-
259	12/18/2013 1:40	0:10:00	18.6	46.3	23.8	17.5	20.6	19.1	18.5	18.1	17.8	57.1	-	Under	-
260	12/18/2013 1:50	0:10:00	18.6	46.3	21.8	17.7	20	19	18.5	18.2	17.9	56.5	-	Under	-
261	12/18/2013 2:00	0:10:00	18.4	46.1	22.6	17.5	19.2	18.7	18.4	18.1	17.8	57.5	-	Under	-
262	12/18/2013 2:10	0:10:00	18.9	46.7	28.2	17.3	23.5	19.6	18.5	18	17.7	62.2	-	Under	-
263	12/18/2013 2:20	0:10:00	18.3	46.1	25.4	17.5	19.1	18.7	18.4	18	17.8	50.6	-	Under	-
264	12/18/2013 2:30	0:10:00	18.5	46.3	22.9	17.6	19.6	18.9	18.5	18.1	17.9	54.7	-	Under	-
265	12/18/2013 2:40	0:10:00	18.5	46.3	33.2	17.3	19.7	18.9	18.5	18.1	17.7	57.1	-	Under	-
266	12/18/2013 2:50	0:10:00	18.4	46.2	19.7	17.6	19.2	18.8	18.4	18.1	17.9	52.3	-	Under	-
267	12/18/2013 3:00	0:10:00	18.4	46.2	21.1	17.6	19.1	18.8	18.4	18.1	17.8	56.5	-	Under	-
268	12/18/2013 3:10	0:10:00	18.4	46.2	19.7	17.6	19.1	18.8	18.4	18.1	17.9	51.9	-	Under	-
269	12/18/2013 3:20	0:10:00	18.3	46.1	19.9	17.3	19.2	18.8	18.3	17.9	17.7	65.8	-	Under	-
270	12/18/2013 3:30	0:10:00	18.5	46.3	25.9	17.4	20.7	19.1	18.5	18	17.7	62.4	-	Under	-
271	12/18/2013 3:40	0:10:00	18.5	46.3	28.4	17.4	21.3	19	18.4	18	17.8	56.2	-	Under	-
272	12/18/2013 3:50	0:10:00	18.6	46.3	33.4	17.4	21.8	18.9	18.3	17.9	17.7	64.7	-	Under	-
273	12/18/2013 4:00	0:10:00	18.5	46.3	23.8	17.4	21.8	19.2	18.3	17.9	17.7	64.1	-	Under	-
274	12/18/2013 4:10	0:10:00	18.4	46.2	28.9	17.4	21.3	18.9	18.2	17.8	17.6	70.2	-	Under	-
275	12/18/2013 4:20	0:10:00	18.3	46	26	17.4	20	18.6	18.2	17.9	17.7	69.1	-	Under	-
276	12/18/2013 4:30	0:10:00	74.7	102.5	106.4	17.4	81.1	44.7	18.7	18	17.7	134	Over	Under	-
277	12/18/2013 4:40	0:10:00	54.4	82.2	75.8	35.4	61.8	56.7	53.4	43	38	107.4	-	-	-
278	12/18/2013 4:50	0:10:00	56	83.8	77.6	36.4	63.7	58.5	54.3	49.7	44.7	110.3	-	-	-
279	12/18/2013 5:00	0:10:00	56.9	84.7	70.6	40.8	62.7	59.1	56.1	53.7	48	108.2	-	-	-
280	12/18/2013 5:10	0:10:00	59.8	87.5	66.4	53.9	63.4	61.5	59.5	57.5	55.7	106.6	-	-	-
281	12/18/2013 5:20	0:10:00	60.1	87.9	81.2	34.1	66.3	62.7	58.9	53.9	49.6	122.9	Over	-	-
282	12/18/2013 5:30	0:09:56	82.3	110.1	114.5	14.3	86	62.5	55.5	42.5	14.8	134	Over	Under	-

LT 1 - Leq to CNEL Conversion

Start time (hour)	Leq dB(A)	Leq' dB(A)	5.1 * Leq	antilog to base 10	5.1 * Leq'	antilog to base 10
0:00	52.8	62.8	5.279	190107.828	6.279	1901078.28
1.00	52.2	62.2	5.221	166341.265	6.221	1663412.65
2.00	48.8	58.8	4.879	75683.2895	5.879	756832.895
3.00	47.7	57.7	4.768	58613.8165	5.768	586138.165
4.00	52.5	62.5	5.251	178237.877	6.251	1782378.77
5.00	55.0	65.0	5.498	314774.831	6.498	3147748.31
6.00	58.4	68.4	5.84	691830.971	6.84	6918309.71
7.00	68.2	68.2	6.823	6652731.56	6.823	6652731.56
8.00	66.9	66.9	6.689	4886523.59	6.689	4886523.59
9.00	59.9	59.9	5.992	981747.943	5.992	981747.943
10.00	55.7	55.7	5.57	371535.229	5.57	371535.229
11.00	75.1	75.1	7.514	32658783.2	7.514	32658783.2
12.00	68.8	68.8	6.88	7585775.75	6.88	7585775.75
13.00	54.4	54.4	5.443	277332.01	5.443	277332.01
14.00	52.2	52.2	5.219	165576.996	5.219	165576.996
15.00	53.9	53.9	5.392	246603.934	5.392	246603.934
16.00	56.4	56.4	5.636	432513.831	5.636	432513.831
17.00	56.0	56.0	5.603	400866.718	5.603	400866.718
18.00	56.6	56.6	5.664	461317.575	5.664	461317.575
19.00	56.3	61.3	5.627	423642.966	6.127	1339676.69
20.00	56.7	61.7	5.672	469894.109	6.172	1485935.64
21.00	57.4	62.4	5.74	549540.874	6.24	1737800.83
22.00	58.0	68.0	5.804	636795.521	6.804	6367955.21
23.00	55.7	65.7	5.573	374110.588	6.573	3741105.88
			Sum of all 24 values	59250882.3		86549681.4
Night Hrs			Ave. value for all 24 values	2468786.76		3606236.72
Evening Hrs			log to base 10 of all 24 values	6.39248358		6.55705423
Daytime Hrs			10 times log to base 10 of all 24 values	63.9		65.6
			24 hour cumulative value (Leq)	**63.9**		
			24 hour cumulative value (CNEL)			**65.6**

LT 2 - Leq to CNEL Conversion

Start time (hour)	Leq dB(A)	Leq' dB(A)	5.1 * Leq	antilog to base 10	5.1 * Leq'	antilog to base 10
0:00	46.5	56.5	4.65	44668.3592	5.65	446683.592
1.00	40.7	50.7	4.072	11803.2064	5.072	118032.064
2.00	40.6	50.6	4.061	11508.0039	5.061	115080.039
3.00	39.5	49.5	3.949	8892.01118	4.949	88920.1118
4.00	49.7	59.7	4.97	93325.4301	5.97	933254.301
5.00	44.0	54.0	4.4	25118.8643	5.4	251188.643
6.00	49.9	59.9	4.986	96827.7856	5.986	968277.856
7.00	67.1	67.1	6.709	5116818.36	6.709	5116818.36
8.00	65.5	65.5	6.551	3556313.19	6.551	3556313.19
9.00	62.8	62.8	6.281	1909853.26	6.281	1909853.26
10.00	68.8	68.8	6.875	7498942.09	6.875	7498942.09
11.00	48.4	48.4	4.835	68391.1647	4.835	68391.1647
12.00	50.4	50.4	5.038	109144.034	5.038	109144.034
13.00	49.4	49.4	4.942	87498.3775	4.942	87498.3775
14.00	48.8	48.8	4.877	75335.5564	4.877	75335.5564
15.00	49.1	49.1	4.914	82035.1544	4.914	82035.1544
16.00	50.6	50.6	5.06	114815.362	5.06	114815.362
17.00	50.2	50.2	5.02	104712.855	5.02	104712.855
18.00	51.2	51.2	5.117	130918.192	5.117	130918.192
19.00	49.8	54.8	4.976	94623.7161	5.476	299226.464
20.00	49.6	54.6	4.964	92044.9572	5.464	291071.712
21.00	49.3	54.3	4.926	84333.4758	5.426	266685.866
22.00	49.3	59.3	4.929	84918.0475	5.929	849180.475
23.00	46.3	56.3	4.632	42854.852	5.632	428548.52
			Sum of all 24 values	19545696.3		23910927.2
Night Hrs			Ave. value for all 24 values	814404.012		996288.635
Evening Hrs			log to base 10 of all 24 values	5.9108399		5.99838518
Daytime Hrs			10 times log to base 10 of all 24 values	59.1		60.0
			24 hour cumulative value (Leq)	**59.1**		
			24 hour cumulative value (CNEL)			**60.0**

Construction Noise Calculations

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 6/30/2015
Case Description: Ballona Wetlands Restoration Project - Equipment Reference #1A

		Baselines (dBA)			---- Receptor #1 ----			
Description	Land Use	Daytime	Evening	Night				
Reference #1A Mix	Residential	60	55	50				

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Grader	No	40	85		50	0
Grader	No	40	85		50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Generator	No	50		80.6	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Backhoe	No	40		77.6	50	0
Backhoe	No	40		77.6	50	0

	Results													
	Calculated (dBA)		Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	*Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Grader	85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator		80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader		79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader		79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader		79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader		79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe		77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe		77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Total	85	88.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 6/30/2015
Case Description: Ballona Wetlands Restoration Project - Equipment Reference #1B

		Baselines (dBA)			---- Receptor #1 ----
Description	Land Use	Daytime	Evening	Night	
Reference #1B Mix	Residential	60	55	50	

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Dump Truck	No	40		76.5	50	0

		Calculated (dBA)		Results Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
				Day		Evening		Night		Day		Evening		Night	
Equipment		*Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Total	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 6/30/2015
Case Description: Ballona Wetlands Restoration Project - Equipment Reference #2A

		Baselines (dBA)			---- Receptor #1 ----			
Description	Land Use	Daytime	Evening	Night				
Reference #2A Mix	Residential	60	55	50				

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Grader	No	40	85		50	0
Grader	No	40	85		50	0
Grader	No	40	85		50	0
Grader	No	40	85		50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Soil Mix Drill Rig	No	50	80		50	0
Generator	No	50		80.6	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Backhoe	No	40		77.6	50	0
Generator	No	50		80.6	50	0

	Calculated (dBA)		Results						Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night		Day		Evening		Night	
Equipment	*Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Grader	85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Soil Mix Drill Rig	80	77	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator	80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe	77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator	80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	85	89.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 6/30/2015
Case Description: Ballona Wetlands Restoration Project - Equipment Reference #2B

		---- Receptor #1 ----		
		Baselines (dBA)		
Description	Land Use	Daytime	Evening	Night
Reference #2B Mix	Residential	60	55	50

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0

		Results													
		Calculated (dBA)		Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
				Day		Evening		Night		Day		Evening		Night	
Equipment		*Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Total	76.5	75.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 6/30/2015
Case Description: Ballona Wetlands Restoration Project - Equipment Reference #3

		Baselines (dBA)			---- Receptor #1 ----
Description	Land Use	Daytime	Evening	Night	
Reference #3 Mix	Residential	60	55	50	

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Generator	No	50		80.6	50	0
Generator	No	50		80.6	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Backhoe	No	40		77.6	50	0
Crane	No	16		80.6	50	0

	Calculated (dBA)		Results						Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night		Day		Evening		Night	
Equipment	*Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator		80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator		80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader		79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader		79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader		79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader		79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe		77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Crane		80.6	72.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Total	80.6	87	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 6/30/2015
Case Description: Ballona Wetlands Restoration Project - Equipment Reference #4

		Baselines (dBA)			---- Receptor #1 ----					
Description	Land Use	Daytime	Evening	Night						
Reference #4 Mix	Residential	60	55	50						

			Equipment				
	Impact		Spec Lmax	Actual Lmax	Receptor Distance	Estimated Shielding	
Description	Device	Usage(%)	(dBA)	(dBA)	(feet)	(dBA)	
Grader	No	40	85		50	0	
Dump Truck	No	40		76.5	50	0	
Dump Truck	No	40		76.5	50	0	
Dump Truck	No	40		76.5	50	0	
Dump Truck	No	40		76.5	50	0	
Front End Loader	No	40		79.1	50	0	
Backhoe	No	40		77.6	50	0	

			Results											
	Calculated (dBA)		Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	*Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Grader	85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe	77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	85	84	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 6/30/2015
Case Description: Ballona Wetlands Restoration Project - Equipment Reference #5A

		Baselines (dBA)			---- Receptor #1 ----			
Description	Land Use	Daytime	Evening	Night				
Reference #5A Mix	Residential	60	55	50				

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Soil Mix Drill Rig	No	50	80		50	0
Crane	No	16		80.6	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Generator	No	50		80.6	50	0
Generator	No	50		80.6	50	0
Generator	No	50		80.6	50	0
Generator	No	50		80.6	50	0
Generator	No	50		80.6	50	0
Generator	No	50		80.6	50	0
Backhoe	No	40		77.6	50	0
Crane	No	16		80.6	50	0

	Results													
	Calculated (dBA)		Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	*Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Soil Mix Drill Rig	80	77	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Crane	80.6	72.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator		80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator		80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator		80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator		80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator		80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator		80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe		77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Crane		80.6	72.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Total	80.6	88	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 6/30/2015
Case Description: Ballona Wetlands Restoration Project - Equipment Reference #5B

		---- Receptor #1 ----		
		Baselines (dBA)		
Description	Land Use	Daytime	Evening	Night
Reference #5B Mix	Residential	60	55	50

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Man Lift	No	20		74.7	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0

		Results													
		Calculated (dBA)		Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
				Day		Evening		Night		Day		Evening		Night	
Equipment		*Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Man Lift		74.7	67.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Total	76.5	79.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 6/30/2015
Case Description: Ballona Wetlands Restoration Project - Equipment Reference #6

		Baselines (dBA)			---- Receptor #1 ----			
Description	Land Use	Daytime	Evening	Night				
Reference #6 Mix	Residential	60	55	50				

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Soil Mix Drill Rig	No	50	80		50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Generator	No	50		80.6	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0

	Results													
	Calculated (dBA)		Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	*Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Soil Mix Drill Rig	80	77	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator		80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Total	80.6	85.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 6/30/2015
Case Description: Ballona Wetlands Restoration Project - Equipment Reference #7

		Baselines (dBA)			---- Receptor #1 ----			
Description	Land Use	Daytime	Evening	Night				
Reference #7 Mix	Residential	60	55	50				

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Grader	No	40	85		50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Backhoe	No	40		77.6	50	0
Backhoe	No	40		77.6	50	0

	Results													
	Calculated (dBA)		Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	*Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Grader		85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader		79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader		79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader		79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader		79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe		77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe		77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Total	85	86.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 6/29/2015
Case Description: Ballona Wetlands Restoration Project - Equipment Reference #8A

		Baselines (dBA)			---- Receptor #1 ----			
Description	Land Use	Daytime	Evening	Night				
Reference #8A Mix	Residential	60	55	50				

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Soil Mix Drill Rig	No	50	80		50	0
Crane	No	16		80.6	50	0
Crane	No	16		80.6	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Man Lift	No	20		74.7	50	0
Man Lift	No	20		74.7	50	0
Dump Truck	No	40		76.5	50	0
Grader	No	40	85		50	0
Generator	No	50		80.6	50	0
Generator	No	50		80.6	50	0
Generator	No	50		80.6	50	0
Backhoe	No	40		77.6	50	0
Backhoe	No	40		77.6	50	0
Generator	No	50		80.6	50	0

	Calculated (dBA)		Results Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	*Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Soil Mix Drill Rig	80	77	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Crane	80.6	72.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Crane	80.6	72.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Man Lift		74.7	67.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Man Lift		74.7	67.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader		85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator		80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator		80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator		80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe		77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe		77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator		80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Total	85	88.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 6/29/2015
Case Description: Ballona Wetlands Restoration Project - Equipment Reference #8B

		Baselines (dBA)			---- Receptor #1 ----			
Description	Land Use	Daytime	Evening	Night				
Reference #8B Mix	Residential	60	55	50				

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0

		Calculated (dBA)		Results Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
				Day		Evening		Night		Day		Evening		Night	
Equipment		*Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Total	76.5	80.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 6/30/2015
Case Description: Ballona Wetlands Restoration Project - Equipment Reference #9A

		Baselines (dBA)			---- Receptor #1 ----
Description	Land Use	Daytime	Evening	Night	
Reference #9A Mix	Residential	60	55	50	

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Soil Mix Drill Rig	No	50	80		50	0
Crane	No	16		80.6	50	0
Crane	No	16		80.6	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Man Lift	No	20		74.7	50	0
Man Lift	No	20		74.7	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Generator	No	50		80.6	50	0
Generator	No	50		80.6	50	0
Generator	No	50		80.6	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0

			Results											
	Calculated (dBA)		Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	*Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Soil Mix Drill Rig	80	77	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Crane	80.6	72.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Crane	80.6	72.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Man Lift		74.7	67.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Man Lift		74.7	67.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator		80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator		80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator		80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Total	80.6	86.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 6/30/2015
Case Description: Ballona Wetlands Restoration Project - Equipment Reference #9B

		Baselines (dBA)			---- Receptor #1 ----
Description	Land Use	Daytime	Evening	Night	
Reference #9B Mix	Residential	60	55	50	

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0

		Calculated (dBA)		Results Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
				Day		Evening		Night		Day		Evening		Night	
Equipment		*Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Total	76.5	77.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 6/29/2015
Case Description: Ballona Wetlands Restoration Project - Equipment Reference #10A

		Baselines (dBA)			---- Receptor #1 ----			
Description	Land Use	Daytime	Evening	Night				
Reference #10A Mi	Residential	60	55	50				

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Grader	No	40	85		50	0
Grader	No	40	85		50	0
Grader	No	40	85		50	0
Grader	No	40	85		50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Backhoe	No	40		77.6	50	0
Backhoe	No	40		77.6	50	0
Generator	No	50		80.6	50	0

	Calculated (dBA)		Results						Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night		Day		Evening		Night	
Equipment	*Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Grader	85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader		79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader		79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader		79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader		79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader		79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader		79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader		79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe		77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe		77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator		80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Total	85	89.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 6/30/2015
Case Description: Ballona Wetlands Restoration Project - Equipment Reference #10B

		Baselines (dBA)			---- Receptor #1 ----
Description	Land Use	Daytime	Evening	Night	
Reference #10B Mi	Residential	60	55	50	

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0

			Results											
	Calculated (dBA)		Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	*Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	76.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 6/29/2015
Case Description: Ballona Wetlands Restoration Project - Equipment Reference #11A

		Baselines (dBA)			---- Receptor #1 ----
Description	Land Use	Daytime	Evening	Night	
Reference #11A Mi	Residential	60	55	50	

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Grader	No	40	85		50	0
Grader	No	40	85		50	0
Grader	No	40	85		50	0
Grader	No	40	85		50	0
Grader	No	40	85		50	0
Grader	No	40	85		50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Backhoe	No	40		77.6	50	0
Backhoe	No	40		77.6	50	0
Backhoe	No	40		77.6	50	0
Backhoe	No	40		77.6	50	0
Backhoe	No	40		77.6	50	0
Backhoe	No	40		77.6	50	0

			Results											
	Calculated (dBA)		Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	*Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Grader	85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe	77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe	77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe	77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe	77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe	77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe	77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	85	90.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 6/29/2015
Case Description: Ballona Wetlands Restoration Project - Equipment Reference #11B

		Baselines (dBA)			---- Receptor #1 ----
Description	Land Use	Daytime	Evening	Night	
Reference #11B Mi	Residential	60	55	50	

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0

		Calculated (dBA)		Results	Noise Limits (dBA)					Noise Limit Exceedance (dBA)					
				Day		Evening		Night		Day		Evening		Night	
Equipment		*Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Total	76.5	83.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 6/30/2015
Case Description: Ballona Wetlands Restoration Project - Equipment Reference #12A

		Baselines (dBA)			---- Receptor #1 ----
Description	Land Use	Daytime	Evening	Night	
Reference #12A Mi	Residential	60	55	50	

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Backhoe	No	40		77.6	50	0
Backhoe	No	40		77.6	50	0
Backhoe	No	40		77.6	50	0
Backhoe	No	40		77.6	50	0
Backhoe	No	40		77.6	50	0
Backhoe	No	40		77.6	50	0
Soil Mix Drill Rig	No	50	80		50	0
Generator	No	50		80.6	50	0
Generator	No	50		80.6	50	0
Grader	No	40	85		50	0
Grader	No	40	85		50	0
Grader	No	40	85		50	0
Grader	No	40	85		50	0
Grader	No	40	85		50	0

	Results													
	Calculated (dBA)		Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	*Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe	77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Backhoe		77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe		77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe		77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe		77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe		77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Soil Mix Drill Rig		80	77	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator		80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator		80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader		85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader		85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader		85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader		85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader		85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Total	85	90.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 6/30/2015
Case Description: Ballona Wetlands Restoration Project - Equipment Reference #12B

		Baselines (dBA)			---- Receptor #1 ----			
Description	Land Use	Daytime	Evening	Night				
Reference #12B Mi	Residential	60	55	50				

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Grader	No	40	85		50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0

	Calculated (dBA)		Results Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	*Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Grader	85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Total	85	85.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 6/29/2015
Case Description: Ballona Wetlands Restoration Project - Equipment Reference #13

					---- Receptor #1 ----			
		Baselines (dBA)						
Description	Land Use	Daytime	Evening	Night				
Reference #13 Mix	Residential	60	55	50				

			Equipment Spec	Actual	Receptor	Estimated
	Impact		Lmax	Lmax	Distance	Shielding
Description	Device	Usage(%)	(dBA)	(dBA)	(feet)	(dBA)
Grader	No	40	85		50	0
Grader	No	40	85		50	0
Grader	No	40	85		50	0
Grader	No	40	85		50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0

			Results											
	Calculated (dBA)		Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	*Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Grader	85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	85	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Total	85	88.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 6/29/2015
Case Description: Ballona Wetlands Restoration Project - Equipment Reference #14

		---- Receptor #1 ----		
		Baselines (dBA)		
Description	Land Use	Daytime	Evening	Night
Reference #14 Mix	Residential	60	55	50

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0

			Results											
		Calculated (dBA)		Noise Limits (dBA)						Noise Limit Exceedance (dBA)				
				Day		Evening		Night		Day		Evening		Night	
Equipment		*Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Total	76.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 6/29/2015
Case Description: Ballona Wetlands Restoration Project - Equipment Reference #15

		Baselines (dBA)			---- Receptor #1 ----			
Description	Land Use	Daytime	Evening	Night				
Reference #15 Mix	Residential	60	55	50				

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Front End Loader	No	40		79.1	50	0
Front End Loader	No	40		79.1	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0

	Results													
	Calculated (dBA)		Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	*Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck		76.5	72.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Total	79.1	85.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Calculated Lmax is the Loudest value.

Receptors

R1: Multi-family residential uses located north of North Area C of the Project site, east of Lincoln Boulevard
R2: Boat slips located north of Area A of the Project site, beyond Fiji Way
R3: Boat slips located west of Area A of the Project site, beyond Fiji way
R4: Multi-family residential uses located west of Area A of the Project site and north of Ballona Creek
R5: Multi-family residential uses located west of West Area B of the Project site, fronting Vista Del Mar
R6: Multi-family residential, park, and hotel uses located along Culver Boulevard and directly south of West Area B of the Project site
R7: Single-family residences located south of West Area B and South Area B of the Project site and south of Culver Boulevard
R8: Single-family residences located along Cabora Drive and south of South Area B and Southeast Area B of the Project site
R9: Multi-family residential uses located east of Southeast Area B, across Lincoln Boulevard and south of Jefferson Boulevard
R10: Multi-family residential uses located east of East Area B, across Lincoln Boulevard between Ballona Creek and Jefferson Blvd.

Project Equipment Mix Noise Levels

Equipment Reference	Composite Noise @ 50 ft.
1	88.4
2	90.0
3	87.0
4	84.0
5	88.6
6	85.7
7	86.8
8	88.9
9	87.3
10	90.5
11	91.3
12	91.8
13	88.9
14	82.5
15	85.2

Estimated Construction Noise Levels at Nearby Receptors - Alternative 1

Receptor	Jurisdictional Location	Phase	Sequence	Area	Actions	Equipment	Distance to Construction	Total Equipment Noise @ 50 ft (dBA Leq).	Noise from Loudest Equip. Mix (dBA Leq)
R1	City	1	5	A&C		9	985	87.3	61.4
		1	6	A		10	460	90.5	71.2
		1	7	A		11	460	91.3	72.0
		1	8	A		12	460	91.8	72.5
		1	15	C		10, 11	50	91.3	91.3
		1	16	A&C		11	50	91.3	91.3
		1	17	C		13, 14	1005	88.9	62.8
		1	23	A&B	23a	7	460	86.8	67.5
									Max: 91.3
R2	County	1	6	A		10	360	85.7	68.6
		1	7	A		11	360	91.3	74.2
		1	8	A		12	360	91.8	74.7
		1	16	A&C		11	360	91.3	74.2
		1	23	A&B	23a	7	360	86.8	69.7
					23b	2	360	90	72.9
					23c	3	360	87	69.9
		2	25	A&Prop. 1	25b	6	1105	85.7	58.8
					25c	4	1105	84	57.1
		2	26	A		1	1105	88.4	61.5
		2	27	A		11	1105	91.3	64.4
		2	28	A		1, 14	1105	88.4	61.5
									Max: 74.7
R3	County	1	6	A		10	425	90.5	71.9
		1	7	A		11	425	91.3	72.7
		1	8	A		12	425	91.8	73.2
		1	16	A&C		11	425	91.3	72.7
		1	23	A&B	23a	7	425	86.8	68.2
					23b	2	322	90	73.8
					23c	3	322	87	70.8
		2	25	A&Prop. 1	25b	6	230	85.7	72.4
					25c	4	230	84	70.7
		2	26	A		1	400	88.4	70.3
		2	27	A		11	400	91.3	73.2

		2	28	A		1,14	400	88.4		70.3
									Max:	**73.8**
R4	County	1	3	A		4	250	84		70.0
		1	6	A		10	55	90.5		89.7
		1	7	A		11	55	91.3		90.5
		1	8	A		12	55	91.8		91.0
		1	9	B&Prop. 1	9b	6	1314	85.7		57.3
					9c	4	265	84		69.5
		1	16	A&C		11	55	91.3		90.5
		1	23	A&B	23a	7	55	86.8		86.0
					23b	2	1330	90		61.5
					23c	3	1330	87		58.5
		2	25	A&Prop. 1	25a	5	395	88.6		70.6
					25b	6	106	85.7		79.2
					25c	4	106	84		77.5
		2	26	A		1	395	88.4		70.4
		2	27	A		11	395	91.3		73.3
		2	28	A		1, 14	395	88.4		70.4
		2	29	B	29b	6	882	85.7		60.8
					29c	4	1500	84		54.5
		2	30	B		1	882	88.4		63.5
		2	31	B		1, 14	882	88.4		63.5
		2	32	B		10	400	90.5		72.4
		2	34	B		11	40	91.3		93.2
									Max:	**93.2**
R5	City	1	22	B	22a	7	58	86.8		85.5
					22b	7	58	86.8		85.5
		2	29	B	29b	6	305	85.7		70.0
		2	30	B		1	305	88.4		72.7
		2	31	B		1, 14	305	88.4		72.7
		2	32	B		10	438	90.5		71.6
		2	33	B		12	438	91.8		72.9
		2	34	B		11	367	91.3		74.0
		2	35	B		7	438	86.8		67.9
									Max:	**85.5**
R6	City	1	22	B	22a	7	35	86.8		89.9
					22b	7	175	86.8		75.9
		2	29	B	29b	6	445	85.7		66.7

		2	30	B		4	445	84		65.0
		2	31	B		1, 14	445	88.4		69.4
		2	32	B		10	185	90.5		79.1
		2	33	B		12	308	91.8		76.0
		2	34	B		11	1535	91.3		61.6
		2	35	B		7	308	86.8		71.0
									Max:	**89.9**
R7	City	1	1	B		4	723	84		60.8
		2	29	B	29a	5	430	88.6		69.9
					29b	6	950	85.7		60.1
		2	30	B		1	950	88.4		62.8
		2	31	B		1, 14	950	88.4		62.8
		2	33	B		12	785	91.8		67.9
		2	34	B		11	2048	91.3		59.1
		2	35	B		7	785	86.8		62.9
									Max:	**69.9**
R8	City	1	2	B		1	656	88.4		66.0
R9	City	1	12	B		12	1092	91.8		65.0
		1	13	B		1, 10	475	90.5		70.9
		1	14	B		11	475	91.3		71.7
		1	18	B		1	435	88.4		69.6
		2	31	B		1, 14	1360	88.4		59.7
									Max:	**71.7**
R10	City	1	4	A&B		8	650	88.9		66.6
		1	5	A&C		9	650	87.3		65.0
		1	13	B		1, 10	200	90.5		78.5
		1	14	B		11	200	91.3		79.3
		1	15	C		10	380	90.5		72.9
		1	16	A&C		11	380	91.3		73.7
		1	17	C		13, 14	380	88.9		71.3
									Max:	**79.3**

Estimated Construction Noise Levels at Nearby Receptors - Alternative 2

Receptor	Jurisdictional Location	Sequence	Area	Actions	Equipment	Distance to Construction	Total Equipment Noise @ 50 ft (dBA Leq).	Noise from Loudest Equip. Mix (dBA Leq)
R1	City	5	A&C		9	985	87.3	61.4
		6	A		10	460	90.5	71.2
		7	A		11	460	91.3	72.0
		8	A		12	460	91.8	72.5
		15	C		10, 11	50	91.3	91.3
		16	A&C		11	50	91.3	91.3
		17	C		7, 14	1005	86.8	60.7
		23	A&B	23a	7	460	86.8	67.5
							Max:	**91.3**
R2	County	6	A		10	360	85.7	68.6
		7	A		11	360	91.3	74.2
		8	A		12	360	91.8	74.7
		16	A&C		11	360	91.3	74.2
		23	A&B	23a	7	360	86.8	69.7
				23b	2	360	90	72.9
				23c	3	360	87	69.9
		25	A&Prop. 1	25b	6	1105	85.7	58.8
				25c	4	1105	84	57.1
		26	A		1	1105	88.4	61.5
		27	A		11	1105	91.3	64.4
		28	A		1, 14	1105	88.4	61.5
							Max:	**74.7**
R3	County	6	A		10	425	90.5	71.9
		7	A		11	425	91.3	72.7
		8	A		12	425	91.8	73.2
		16	A&C		11	425	91.3	72.7
		23	A&B	23a	7	425	86.8	68.2
				23b	2	322	90	73.8
				23c	3	322	87	70.8
		25	A&Prop. 1	25b	6	230	85.7	72.4
				25c	4	230	84	70.7

		26	A		1	400	88.4		70.3
		27	A		11	400	91.3		73.2
		28	A		1,14	400	88.4		70.3
								Max:	**73.8**
R4	County	3	A		4	250	84		70.0
		6	A		10	55	90.5		89.7
		7	A		11	55	91.3		90.5
		8	A		12	55	91.8		91.0
		9	B&Prop. 1	9b	6	1314	85.7		57.3
				9c	4	265	84		69.5
		16	A&C		11	55	91.3		90.5
		23	A&B	23a	7	55	86.8		86.0
				23b	2	1330	90		61.5
				23c	3	1330	87		58.5
		25	A&Prop. 1	25a	5	395	88.6		70.6
				25b	6	106	85.7		79.2
				25c	4	106	84		77.5
		26	A		1	395	88.4		70.4
		27	A		11	395	91.3		73.3
		28	A		1, 14	395	88.4		70.4
		29	B	29b	6	882	85.7		60.8
				29c	4	1500	84		54.5
		30	B		1	882	88.4		63.5
		31	B		1, 14	882	88.4		63.5
								Max:	**91.0**
R5	City	22	B	22a	7	58	86.8		85.5
				22b	7	58	86.8		85.5
		29	B	29b	6	305	85.7		70.0
		30	B		1	305	88.4		72.7
		31	B		1, 14	305	88.4		72.7
								Max:	**85.5**
R6	City	22	B	22a	7	35	86.8		89.9
				22b	7	175	86.8		75.9
		29	B	29b	6	445	85.7		66.7
		30	B		4	445	84		65.0

		31	B		1, 14	445	88.4		69.4
								Max:	**89.9**
R7	City	1	B		4	723	84		60.8
		29	B	29a	5	430	88.6		69.9
				29b	6	950	85.7		60.1
		30	B		1	950	88.4		62.8
		31	B		1, 14	950	88.4		62.8
								Max:	**69.9**
R8	City	2	B		1	656	88.4		66.0
R9	City	12	B		12	1092	91.8		65.0
		13	B		1, 10	475	90.5		70.9
		14	B		11	475	91.3		71.7
		18	B		1	435	88.4		69.6
		31	B		1, 14	1360	88.4		59.7
								Max:	**71.7**
R10	City	4	A&B		8	650	88.9		66.6
		5	A&C		9	650	87.3		65.0
		13	B		1, 10	200	90.5		78.5
		14	B		11	200	91.3		79.3
		15	C		10	380	90.5		72.9
		16	A&C		11	380	91.3		73.7
		17	C		7, 14	380	86.8		69.2
								Max:	**79.3**

Estimated Construction Noise Levels at Nearby Receptors - Alternative 3

Receptor	Jurisdictional Location	Sequence	Area	Actions	Equipment	Distance to Construction	Total Equipment Noise @ 50 ft (dBA Leq).	Noise from Loudest Equip. Mix (dBA Leq)
R1	City	6	A		10	460	90.5	71.2
		7	A		11	460	91.3	72.0
		8	A		12	460	91.8	72.5
		16	A		11	460	91.3	72.0
		17	C		7, 14	1005	86.8	60.7
		23	A&B	23a	7	460	86.8	67.5
							Max:	**72.5**
R2	County	6	A		10	360	85.7	68.6
		7	A		11	360	91.3	74.2
		8	A		12	360	91.8	74.7
		16	A		11	360	91.3	74.2
		23	A&B	23a	7	360	86.8	69.7
				23b	2	360	90	72.9
				23c	3	360	87	69.9
		25	A&Prop. 1	25b	6	1105	85.7	58.8
				25c	4	1105	84	57.1
							Max:	**74.7**
R3	County	6	A		10	425	90.5	71.9
		7	A		11	425	91.3	72.7
		8	A		12	425	91.8	73.2
		16	A		11	425	91.3	72.7
		23	A&B	23a	7	425	86.8	68.2
				23b	2	322	90	73.8
				23c	3	322	87	70.8
		25	A&Prop. 1	25b	6	230	85.7	72.4
				25c	4	230	84	70.7
							Max:	**73.8**
R4	County	3	A		4	250	84	70.0
		6	A		10	55	90.5	89.7
		7	A		11	55	91.3	90.5

		8	A		12	55	91.8		91.0
		16	A		11	55	91.3		90.5
		23	A&B	23a	7	55	86.8		86.0
				23b	2	1330	90		61.5
				23c	3	1330	87		58.5
		25	A&Prop. 1	25a	5	395	88.6		70.6
				25b	6	106	85.7		79.2
				25c	4	106	84		77.5
		29	B	29b	6	882	85.7		60.8
				29c	4	1500	84		54.5
		30	B		1	882	88.4		63.5
		31	B		1, 14	882	88.4		63.5
								Max:	**91.0**
R5	City	29	B	29b	6	305	85.7		70.0
		30	B		1	305	88.4		72.7
		31	B		1, 14	305	88.4		72.7
								Max:	**72.7**
R6	City	29	B	29b	6	445	85.7		66.7
		30	B		4	445	84		65.0
		31	B		1, 14	445	88.4		69.4
								Max:	**69.4**
R7	City	1	B		4	723	84		60.8
		29	B	29a	5	430	88.6		69.9
				29b	6	950	85.7		60.1
		30	B		1	950	88.4		62.8
		31	B		1, 14	950	88.4		62.8
								Max:	**69.9**
R8	City	2	B		1	656	88.4		66.0
R9	City	6	A		10	1543	90.5		60.7
		7	A		11	1543	91.3		61.5
		16	A		11	1543	91.3		61.5
		23	A	23a	7	1225	86.8		59.0
								Max:	**61.5**

R10	City	16	A	11	620	91.3		69.4
		17	C	7, 14	380	86.8		69.2
							Max:	**69.4**

Traffic Noise Calculations

Existing (2015)

Calveno - Peak Hour

No.	ROAD SEGMENT	LOCATION	TOTAL # VEHICLES	VEHICLE TYPE %						VEHICLE SPEED						NOISE LEVEL (dBA)			CALCULATED NOISE LEVEL (15 meters from roadway center)	Receptor Dist. from Roadway Center (m.)	Adjusted Noise Level (dBA)	Distance from Roadway to 65 dBA (m)	Distance from Roadway to 65 dBA (ft)
				Auto		MT		HT															
				%	Auto	%	MT	%	HT	Auto	k/h	MT	k/h	HT	k/h	Auto	MT	HT					
1	Admiralty Way	North of Bali Way	2,989	97	2899.3	2	59.78	1	29.89	40	64	40	64	40	64	70.6	62.7	66.0	72.4	30.4	69.3	82.4	270.2
2	Admiralty Way	South of Bali Way	2,481	97	2406.6	2	49.62	1	24.81	40	64	40	64	40	64	69.8	61.9	65.2	71.6	30.4	68.5	68.4	224.3
3	Admiralty Way	North of Fiji Way	1,514	97	1468.6	2	30.28	1	15.14	40	64	40	64	40	64	67.6	59.7	63.1	69.4	30.4	66.4	41.7	136.9
4	Lincoln Boulevard	North of Washington Blvd.	3,432	97	3329	2	68.64	1	34.32	35	56	35	56	35	56	69.5	62.4	66.1	71.7	30.4	68.6	70.2	230.2
5	Lincoln Boulevard	North of SR 90 Ramp	4,707	97	4565.8	2	94.14	1	47.07	35	56	35	56	35	56	70.9	63.8	67.5	73.1	30.4	70.0	96.2	315.7
6	Lincoln Boulevard	North of Bali Way	3,417	97	3314.5	2	68.34	1	34.17	35	56	35	56	35	56	69.5	62.4	66.1	71.7	30.4	68.6	69.8	229.2
7	Lincoln Boulevard	North of Mindanao Way	3,044	97	2952.7	2	60.88	1	30.44	40	64	40	64	40	64	70.7	62.8	66.1	72.5	30.4	69.4	83.9	275.2
8	Lincoln Boulevard	North of Fiji Way	3,779	97	3665.6	2	75.58	1	37.79	40	64	40	64	40	64	71.6	63.7	67.1	73.4	30.4	70.3	104.1	341.6
9	Lincoln Boulevard	North of Culver Blvd.	4,778	97	4634.7	2	95.56	1	47.78	45	72	45	72	45	72	74.1	65.5	68.5	75.6	30.4	72.6	173.1	568.1
10	Lincoln Boulevard	North of Jefferson Blvd.	5,468	97	5304	2	109.4	1	54.68	45	72	45	72	45	72	74.7	66.1	69.1	76.2	30.4	73.1	198.2	650.1
11	Lincoln Boulevard	North of Bluff Creek Dr.	4,602	97	4463.9	2	92.04	1	46.02	45	72	45	72	45	72	73.9	65.4	68.4	75.5	30.4	72.4	166.8	547.2
12	Lincoln Boulevard	South of Bluff Creek Dr.	5,264	97	5106.1	2	105.3	1	52.64	45	72	45	72	45	72	74.5	66.0	69.0	76.0	30.4	73.0	190.8	625.9
13	Mindanao Way	West of Admiralty Way	135	97	130.95	2	2.7	1	1.35	30	48	30	48	30	48	53.6	47.3	51.4	56.2	30.4	53.2	2.0	6.5
14	Mindanao Way	West of Lincoln Blvd.	1,379	97	1337.6	2	27.58	1	13.79	30	48	30	48	30	48	63.6	57.4	61.5	66.3	30.4	63.3	20.3	66.7
15	Mindanao Way	West of SR 90 EB	2,271	97	2202.9	2	45.42	1	22.71	30	48	30	48	30	48	65.8	59.6	63.7	68.5	30.4	65.4	33.5	109.8
16	Mindanao Way	West of SR 90 WB	1,765	97	1712.1	2	35.3	1	17.65	30	48	30	48	30	48	64.7	58.5	62.6	67.4	30.4	64.3	26.0	85.3
17	Mindanao Way	East of SR 90 Ramp	1,817	97	1762.5	2	36.34	1	18.17	30	48	30	48	30	48	64.8	58.6	62.7	67.5	30.4	64.4	26.8	87.8
18	Bali Way	West of Admiralty Way	166	97	161.02	2	3.32	1	1.66	30	48	30	48	30	48	54.4	48.2	52.3	57.1	30.4	54.1	2.4	8.0
19	Bali Way	West of Lincoln Blvd.	854	97	828.38	2	17.08	1	8.54	30	48	30	48	30	48	61.6	55.3	59.4	64.2	30.4	61.2	12.6	41.3
20	Washington Boulevard	West of Lincoln Blvd.	2,768	97	2685	2	55.36	1	27.68	35	56	35	56	35	56	68.6	61.5	65.2	70.8	30.4	67.7	56.6	185.6
21	Washington Boulevard	East of Lincoln Blvd.	2,059	97	1997.2	2	41.18	1	20.59	35	56	35	56	35	56	67.3	60.2	63.9	69.5	30.4	66.4	42.1	138.1
22	Bluff Creek Drive	East of Lincoln Blvd.	816	97	791.52	2	16.32	1	8.16	35	56	35	56	35	56	63.3	56.2	59.9	65.5	30.4	62.4	16.7	54.7
23	Jefferson Boulevard	East of Lincoln Blvd.	2,355	97	2284.4	2	47.1	1	23.55	45	72	45	72	45	72	71.0	62.5	65.5	72.6	30.4	69.5	85.3	280.0
24	Culver Boulevard	West of Nicholson St.	2,025	97	1964.3	2	40.5	1	20.25	30	48	30	48	30	48	65.3	59.1	63.2	68.0	30.4	64.9	29.8	97.9
25	Culver Boulevard	West of Jefferson Blvd	3,115	97	3021.6	2	62.3	1	31.15	45	72	45	72	45	72	72.3	63.7	66.7	73.8	30.4	70.7	112.9	370.4
26	Culver Boulevard	West of SR 90 EB	3,359	97	3258.2	2	67.18	1	33.59	45	72	45	72	45	72	72.6	64.0	67.0	74.1	30.4	71.0	121.7	399.4
27	Culver Boulevard	East of SR 90 Ramp	2,234	97	2167	2	44.68	1	22.34	40	64	40	64	40	64	69.3	61.4	64.8	71.1	30.4	68.1	61.6	201.9
28	Culver Boulevard	East of Vista Del Mar	2,054	97	1992.4	2	41.08	1	20.54	35	56	35	56	35	56	67.3	60.2	63.9	69.5	30.4	66.4	42.0	137.7
29	Vista Del Mar	North of Culver Blvd.	121	97	117.37	2	2.42	1	1.21	25	40	25	40	25	40	50.8	45.6	50.2	54.2	30.4	51.1	1.2	4.1
30	SR 90 WB	North of Mindanao Way	1,416	97	1373.5	2	28.32	1	14.16	40	64	40	64	40	64	67.4	59.5	62.8	69.2	30.4	66.1	39.0	128.0
31	SR 90 WB	North of Culver Blvd.	150	97	145.5	2	3	1	1.5	40	64	40	64	40	64	57.6	49.7	53.0	59.4	30.4	56.3	4.1	13.6
32	SR 90 EB	North of Mindanao Way	1,084	97	1051.5	2	21.68	1	10.84	40	64	40	64	40	64	66.2	58.3	61.6	68.0	30.4	64.9	29.9	98.0
33	SR 90 EB	South of Mindanao Way	2,464	97	2390.1	2	49.28	1	24.64	40	64	40	64	40	64	69.8	61.9	65.2	71.6	30.4	68.5	67.9	222.7

Existing (2015), Plus Project - Post Restoration

Calveno - Peak Hour

No.	ROAD SEGMENT	LOCATION	TOTAL # VEHICLES	VEHICLE TYPE %						VEHICLE SPEED						NOISE LEVEL (dBA)			CALCULATED NOISE LEVEL (15 meters from roadway center)	Receptor Dist. from Roadway Center (m.)	Adjusted Noise Level (dBA)	Distance from Roadway to 65 dBA (m)	Distance from Roadway to 65 dBA (ft)
				Auto		MT		HT															
				%	Auto	%	MT	%	HT	Auto	k/h	MT	k/h	HT	k/h	Auto	MT	HT					
1	Admiralty Way	North of Bali Way	2,994	97	2904.2	2	59.88	1	29.94	40	64	40	64	40	64	70.6	62.7	66.0	72.4	30.4	69.3	82.5	270.6
2	Admiralty Way	South of Bali Way	2,486	97	2411.4	2	49.72	1	24.86	40	64	40	64	40	64	69.8	61.9	65.2	71.6	30.4	68.5	68.5	224.7
3	Admiralty Way	North of Fiji Way	1,532	97	1486	2	30.64	1	15.32	40	64	40	64	40	64	67.7	59.8	63.1	69.5	30.4	66.4	42.2	138.5
4	Lincoln Boulevard	North of Washington Blvd.	3,434	97	3331	2	68.68	1	34.34	35	56	35	56	35	56	69.5	62.4	66.1	71.7	30.4	68.6	70.2	230.3
5	Lincoln Boulevard	North of SR 90 Ramp	4,709	97	4567.7	2	94.18	1	47.09	35	56	35	56	35	56	70.9	63.8	67.5	73.1	30.4	70.0	96.3	315.8
6	Lincoln Boulevard	North of Bali Way	3,429	97	3326.1	2	68.58	1	34.29	35	56	35	56	35	56	69.5	62.4	66.1	71.7	30.4	68.6	70.1	230.0
7	Lincoln Boulevard	North of Mindanao Way	3,056	97	2964.3	2	61.12	1	30.56	40	64	40	64	40	64	70.7	62.8	66.1	72.5	30.4	69.4	84.2	276.3
8	Lincoln Boulevard	North of Fiji Way	3,791	97	3677.3	2	75.82	1	37.91	40	64	40	64	40	64	71.6	63.7	67.1	73.4	30.4	70.4	104.4	342.7
9	Lincoln Boulevard	North of Culver Blvd.	4,782	97	4638.5	2	95.64	1	47.82	45	72	45	72	45	72	74.1	65.5	68.5	75.6	30.4	72.6	173.3	568.6
10	Lincoln Boulevard	North of Jefferson Blvd.	5,472	97	5307.8	2	109.4	1	54.72	45	72	45	72	45	72	74.7	66.1	69.1	76.2	30.4	73.1	198.3	650.6
11	Lincoln Boulevard	North of Bluff Creek Dr.	4,606	97	4467.8	2	92.12	1	46.06	45	72	45	72	45	72	74.0	65.4	68.4	75.5	30.4	72.4	166.9	547.6
12	Lincoln Boulevard	South of Bluff Creek Dr.	5,266	97	5108	2	105.3	1	52.66	45	72	45	72	45	72	74.5	66.0	69.0	76.0	30.4	73.0	190.8	626.1
13	Mindanao Way	West of Admiralty Way	135	97	130.95	2	2.7	1	1.35	30	48	30	48	30	48	53.6	47.3	51.4	56.2	30.4	53.2	2.0	6.5
14	Mindanao Way	West of Lincoln Blvd.	1,392	97	1350.2	2	27.84	1	13.92	30	48	30	48	30	48	63.7	57.4	61.6	66.4	30.4	63.3	20.5	67.3
15	Mindanao Way	West of SR 90 EB	2,285	97	2216.5	2	45.7	1	22.85	30	48	30	48	30	48	65.8	59.6	63.7	68.5	30.4	65.4	33.7	110.5
16	Mindanao Way	West of SR 90 WB	1,767	97	1714	2	35.34	1	17.67	30	48	30	48	30	48	64.7	58.5	62.6	67.4	30.4	64.3	26.0	85.4
17	Mindanao Way	East of SR 90 Ramp	1,818	97	1763.5	2	36.36	1	18.18	30	48	30	48	30	48	64.8	58.6	62.7	67.5	30.4	64.5	26.8	87.9
18	Bali Way	West of Admiralty Way	166	97	161.02	2	3.32	1	1.66	30	48	30	48	30	48	54.4	48.2	52.3	57.1	30.4	54.1	2.4	8.0
19	Bali Way	West of Lincoln Blvd.	854	97	828.38	2	17.08	1	8.54	30	48	30	48	30	48	61.6	55.3	59.4	64.2	30.4	61.2	12.6	41.3
20	Washington Boulevard	West of Lincoln Blvd.	2,768	97	2685	2	55.36	1	27.68	35	56	35	56	35	56	68.6	61.5	65.2	70.8	30.4	67.7	56.6	185.6
21	Washington Boulevard	East of Lincoln Blvd.	2,061	97	1999.2	2	41.22	1	20.61	35	56	35	56	35	56	67.3	60.2	63.9	69.5	30.4	66.4	42.1	138.2
22	Bluff Creek Drive	East of Lincoln Blvd.	816	97	791.52	2	16.32	1	8.16	35	56	35	56	35	56	63.3	56.2	59.9	65.5	30.4	62.4	16.7	54.7
23	Jefferson Boulevard	East of Lincoln Blvd.	2,356	97	2285.3	2	47.12	1	23.56	45	72	45	72	45	72	71.0	62.5	65.5	72.6	30.4	69.5	85.4	280.1
24	Culver Boulevard	West of Nicholson St.	2,034	97	1973	2	40.68	1	20.34	30	48	30	48	30	48	65.3	59.1	63.2	68.0	30.4	64.9	30.0	98.3
25	Culver Boulevard	West of Jefferson Blvd	3,122	97	3028.3	2	62.44	1	31.22	45	72	45	72	45	72	72.3	63.7	66.7	73.8	30.4	70.7	113.1	371.2
26	Culver Boulevard	West of SR 90 EB	3,360	97	3259.2	2	67.2	1	33.6	45	72	45	72	45	72	72.6	64.0	67.0	74.1	30.4	71.0	121.8	399.5
27	Culver Boulevard	East of SR 90 Ramp	2,235	97	2168	2	44.7	1	22.35	40	64	40	64	40	64	69.3	61.4	64.8	71.1	30.4	68.1	61.6	202.0
28	Culver Boulevard	East of Vista Del Mar	2,055	97	1993.4	2	41.1	1	20.55	35	56	35	56	35	56	67.3	60.2	63.9	69.5	30.4	66.4	42.0	137.8
29	Vista Del Mar	North of Culver Blvd.	122	97	118.34	2	2.44	1	1.22	25	40	25	40	25	40	50.8	45.6	50.3	54.2	30.4	51.1	1.3	4.1
30	SR 90 WB	North of Mindanao Way	1,416	97	1373.5	2	28.32	1	14.16	40	64	40	64	40	64	67.4	59.5	62.8	69.2	30.4	66.1	39.0	128.0
31	SR 90 WB	North of Culver Blvd.	150	97	145.5	2	3	1	1.5	40	64	40	64	40	64	57.6	49.7	53.0	59.4	30.4	56.3	4.1	13.6
32	SR 90 EB	North of Mindanao Way	1,084	97	1051.5	2	21.68	1	10.84	40	64	40	64	40	64	66.2	58.3	61.6	68.0	30.4	64.9	29.9	98.0
33	SR 90 EB	South of Mindanao Way	2,469	97	2394.9	2	49.38	1	24.69	40	64	40	64	40	64	69.8	61.9	65.2	71.6	30.4	68.5	68.0	223.2

Assumptions: Peak hour traffic data from Raju Associates, Inc. 2015.

Change Between Existing (2015), and Existing Plus Project - Post Restoration

No.	ROAD SEGMENT	LOCATION	CALCULATED Existing NOISE LEVEL (15 meters from roadway center)	CALCULATED Existing Plus Project NOISE LEVEL (15 meters from roadway center)	dBA Change
1	Admiralty Way	North of Bali Way	72.4	72.4	0.0
2	Admiralty Way	South of Bali Way	71.6	71.6	0.0
3	Admiralty Way	North of Fiji Way	69.4	69.49	0.1
4	Lincoln Boulevard	North of Washington Blvd.	71.7	71.7	0.0
5	Lincoln Boulevard	North of SR 90 Ramp	73.1	73.07	0.0
6	Lincoln Boulevard	North of Bali Way	71.7	71.7	0.0
7	Lincoln Boulevard	North of Mindanao Way	72.5	72.49	0.0
8	Lincoln Boulevard	North of Fiji Way	73.4	73.43	0.0
9	Lincoln Boulevard	North of Culver Blvd.	75.6	75.63	0.0
10	Lincoln Boulevard	North of Jefferson Blvd.	76.2	76.21	0.0
11	Lincoln Boulevard	North of Bluff Creek Dr.	75.5	75.46	0.0
12	Lincoln Boulevard	South of Bluff Creek Dr.	76	76.05	0.0
13	Mindanao Way	West of Admiralty Way	56.2	56.23	0.0
14	Mindanao Way	West of Lincoln Blvd.	66.3	66.36	0.0
15	Mindanao Way	West of SR 90 EB	68.5	68.51	0.0
16	Mindanao Way	West of SR 90 WB	67.4	67.39	0.0
17	Mindanao Way	East of SR 90 Ramp	67.5	67.52	0.0
18	Bali Way	West of Admiralty Way	57.1	57.12	0.0
19	Bali Way	West of Lincoln Blvd.	64.2	64.24	0.0
20	Washington Boulevard	West of Lincoln Blvd.	70.8	70.77	0.0
21	Washington Boulevard	East of Lincoln Blvd.	69.5	69.48	0.0
22	Bluff Creek Drive	East of Lincoln Blvd.	65.5	65.46	0.0
23	Jefferson Boulevard	East of Lincoln Blvd.	72.6	72.55	0.0
24	Culver Boulevard	West of Nicholson St.	68	68.01	0.0
25	Culver Boulevard	West of Jefferson Blvd	73.8	73.78	0.0
26	Culver Boulevard	West of SR 90 EB	74.1	74.09	0.0
27	Culver Boulevard	East of SR 90 Ramp	71.1	71.13	0.0
28	Culver Boulevard	East of Vista Del Mar	70.8	70.77	0.0
29	Vista Del Mar	North of Culver Blvd.	54.2	54.21	0.0
30	SR 90 WB	North of Mindanao Way	69.2	69.15	0.0
31	SR 90 WB	North of Culver Blvd.	59.4	59.4	0.0
32	SR 90 EB	North of Mindanao Way	68	67.99	0.0
33	SR 90 EB	South of Mindanao Way	71.6	71.57	0.0

Existing a.m. peak hour (2015)

Calveno - Peak Hour

No.	ROAD SEGMENT	LOCATION	TOTAL # VEHICLES	VEHICLE TYPE % Auto %	Auto	MT %	MT	HT %	HT	VEHICLE SPEED Auto	k/h	MT	k/h	HT	k/h	NOISE LEVEL (dBA) Auto	MT	HT	CALCULATED NOISE LEVEL (15 meters from roadway center)	Receptor Dist. from Roadway Center (m.)	Adjusted Noise Level (dBA)	Distance from Roadway to 65 dBA (m)	Distance from Roadway to 65 dBA (ft)
1	Lincoln Boulevard	South of Mindanao Way	3,564	97	3457.1	2	71.28	1	35.64	40	64	40	64	40	64	71.4	63.5	66.8	73.2	30.4	70.1	98.2	322.2
2	Lincoln Boulevard	North of Fiji Way	3,515	97	3409.6	2	70.3	1	35.15	40	64	40	64	40	64	71.3	63.4	66.7	73.1	30.4	70.0	96.8	317.7
3	Lincoln Boulevard	South of Fiji Way	4,741	97	4598.8	2	94.82	1	47.41	30	48	30	48	30	48	69.0	62.8	66.9	71.7	30.4	68.6	69.9	229.2
4	Mindanao Way	East of Lincoln Boulevard	1,949	97	1890.5	2	38.98	1	19.49	30	48	30	48	30	48	65.1	58.9	63.0	67.8	30.4	64.8	28.7	94.2
5	Mindanao Way	East of SR 90 EB	1,852	97	1796.4	2	37.04	1	18.52	30	48	30	48	30	48	64.9	58.7	62.8	67.6	30.4	64.5	27.3	89.5
6	Mindanao Way	East of SR 90 WB	1,817	97	1762.5	2	36.34	1	18.17	30	48	30	48	30	48	64.8	58.6	62.7	67.5	30.4	64.4	26.8	87.8
7	SR 90 EB	North of Mindanao Way	1,122	97	1088.3	2	22.44	1	11.22	40	64	40	64	40	64	66.3	58.4	61.8	68.1	30.4	65.1	30.9	101.4
8	SR 90 EB	South of Mindanao Way	2,320	97	2250.4	2	46.4	1	23.2	40	64	40	64	40	64	69.5	61.6	64.9	71.3	30.4	68.2	63.9	209.7

Existing a.m. peak hour (2015) Plus Construction

Calveno - Peak Hour

No.	ROAD SEGMENT	LOCATION	TOTAL # VEHICLES	VEHICLE TYPE % Auto %	Auto	MT %	MT	HT %	HT	VEHICLE SPEED Auto	k/h	MT	k/h	HT	k/h	NOISE LEVEL (dBA) Auto	MT	HT	CALCULATED NOISE LEVEL (15 meters from roadway center)	Receptor Dist. from Roadway Center (m.)	Adjusted Noise Level (dBA)	Distance from Roadway to 65 dBA (m)	Distance from Roadway to 65 dBA (ft)
1	Lincoln Boulevard	South of Mindanao Way	3,640	97	3,473	2	71	1	96	40	64	40	64	40	64	71.4	63.5	71.1	74.6	30.4	71.5	136.7	448.5
2	Lincoln Boulevard	North of Fiji Way	3,592	97	3,427	2	70	1	95	40	64	40	64	40	64	71.3	63.4	71.1	74.6	30.4	71.5	135.4	444.1
3	Lincoln Boulevard	South of Fiji Way	4,826	97	4,624	2	95	1	107	30	48	30	48	30	48	69.0	62.8	70.4	73.2	30.4	70.1	99.4	326.0
4	Mindanao Way	East of Lincoln Boulevard	2,015	97	1,897	2	39	1	79	30	48	30	48	30	48	65.2	58.9	69.1	70.9	30.4	67.8	58.1	190.6
5	Mindanao Way	East of SR 90 EB	1,882	97	1,796	2	37	1	49	30	48	30	48	30	48	64.9	58.7	67.0	69.5	30.4	66.4	41.9	137.6
6	Mindanao Way	East of SR 90 WB	1,850	97	1,765	2	36	1	48	30	48	30	48	30	48	64.8	58.6	67.0	69.4	30.4	66.3	41.5	136.0
7	SR 90 EB	North of Mindanao Way	1,156	97	1,092	2	22	1	41	40	64	40	64	40	64	66.4	58.4	67.4	70.2	30.4	67.2	50.1	164.3
8	SR 90 EB	South of Mindanao Way	2,384	97	2,254	2	46	1	83	40	64	40	64	40	64	69.5	61.6	70.5	73.3	30.4	70.3	102.2	335.3

Change Between Existing (2015), and Existing (2015) Plus Construction

No.	ROAD SEGMENT	LOCATION	CALCULATED Existing NOISE LEVEL (15 meters from roadway center)	CALCULATED Ex. Plus Project NOISE LEVEL (15 meters from roadway center)	dBA Change
1	Lincoln Boulevard	South of Mindanao Way	73.2	74.6	1.4
2	Lincoln Boulevard	North of Fiji Way	73.1	74.6	1.5
3	Lincoln Boulevard	South of Fiji Way	71.7	73.2	1.5
4	Mindanao Way	East of Lincoln Boulevard	67.8	70.9	3.1
5	Mindanao Way	East of SR 90 EB	67.6	69.5	1.9
6	Mindanao Way	East of SR 90 WB	67.5	69.4	1.9
7	SR 90 EB	North of Mindanao Way	68.1	70.2	2.1
8	SR 90 EB	South of Mindanao Way	71.3	73.3	2.0

Existing (2015)

Calveno - Peak Hour

No.	ROAD SEGMENT	LOCATION	TOTAL # VEHICLES	VEHICLE TYPE % Auto %	Auto	MT %	MT	HT %	HT	VEHICLE SPEED Auto	k/h	MT	k/h	HT	k/h	NOISE LEVEL (dBA) Auto	MT	HT	CALCULATED NOISE LEVEL (15 meters from roadway center)	Receptor Dist. from Roadway Center (m.)	Adjusted Noise Level (dBA)	Distance from Roadway to 65 dBA (m)	Distance from Roadway to 65 dBA (ft)
1	Admiralty Way	North of Bali Way	2,989	97	2899.3	2	59.78	1	29.89	40	64	40	64	40	64	70.6	62.7	66.0	72.4	30.4	69.3	82.4	270.2
2	Admiralty Way	South of Bali Way	2,481	97	2406.6	2	49.62	1	24.81	40	64	40	64	40	64	69.8	61.9	65.2	71.6	30.4	68.5	68.4	224.3
3	Admiralty Way	North of Fiji Way	1,514	97	1468.6	2	30.28	1	15.14	40	64	40	64	40	64	67.6	59.7	63.1	69.4	30.4	66.4	41.7	136.9
4	Lincoln Boulevard	North of Washington Blvd.	3,432	97	3329	2	68.64	1	34.32	35	56	35	56	35	56	69.5	62.4	66.1	71.7	30.4	68.6	70.2	230.2
5	Lincoln Boulevard	North of SR 90 Ramp	4,707	97	4565.8	2	94.14	1	47.07	35	56	35	56	35	56	70.9	63.8	67.5	73.1	30.4	70.0	96.2	315.7
6	Lincoln Boulevard	North of Bali Way	3,417	97	3314.5	2	68.34	1	34.17	35	56	35	56	35	56	69.5	62.4	66.1	71.7	30.4	68.6	69.8	229.2
7	Lincoln Boulevard	North of Mindanao Way	3,044	97	2952.7	2	60.88	1	30.44	40	64	40	64	40	64	70.7	62.8	66.1	72.5	30.4	69.4	83.9	275.2
8	Lincoln Boulevard	North of Fiji Way	3,779	97	3665.6	2	75.58	1	37.79	40	64	40	64	40	64	71.6	63.7	67.1	73.4	30.4	70.3	104.1	341.6
9	Lincoln Boulevard	North of Culver Blvd.	4,778	97	4634.7	2	95.56	1	47.78	45	72	45	72	45	72	74.1	65.5	68.5	75.6	30.4	72.6	173.1	568.1
10	Lincoln Boulevard	North of Jefferson Blvd.	5,468	97	5304	2	109.4	1	54.68	45	72	45	72	45	72	74.7	66.1	69.1	76.2	30.4	73.1	198.2	650.1
11	Lincoln Boulevard	North of Bluff Creek Dr.	4,602	97	4463.9	2	92.04	1	46.02	45	72	45	72	45	72	73.9	65.4	68.4	75.5	30.4	72.4	166.8	547.2
12	Lincoln Boulevard	South of Bluff Creek Dr.	5,264	97	5106.1	2	105.3	1	52.64	45	72	45	72	45	72	74.5	66.0	69.0	76.0	30.4	73.0	190.8	625.9
13	Mindanao Way	West of Admiralty Way	135	97	130.95	2	2.7	1	1.35	30	48	30	48	30	48	53.6	47.3	51.4	56.2	30.4	53.2	2.0	6.5
14	Mindanao Way	West of Lincoln Blvd.	1,379	97	1337.6	2	27.58	1	13.79	30	48	30	48	30	48	63.6	57.4	61.5	66.3	30.4	63.3	20.3	66.7
15	Mindanao Way	West of SR 90 EB	2,271	97	2202.9	2	45.42	1	22.71	30	48	30	48	30	48	65.8	59.6	63.7	68.5	30.4	65.4	33.5	109.8
16	Mindanao Way	West of SR 90 WB	1,765	97	1712.1	2	35.3	1	17.65	30	48	30	48	30	48	64.7	58.5	62.6	67.4	30.4	64.3	26.0	85.3
17	Mindanao Way	East of SR 90 Ramp	1,817	97	1762.5	2	36.34	1	18.17	30	48	30	48	30	48	64.8	58.6	62.7	67.5	30.4	64.4	26.8	87.8
18	Bali Way	West of Admiralty Way	166	97	161.02	2	3.32	1	1.66	30	48	30	48	30	48	54.4	48.2	52.3	57.1	30.4	54.1	2.4	8.0
19	Bali Way	West of Lincoln Blvd.	854	97	828.38	2	17.08	1	8.54	30	48	30	48	30	48	61.6	55.3	59.4	64.2	30.4	61.2	12.6	41.3
20	Washington Boulevard	West of Lincoln Blvd.	2,768	97	2685	2	55.36	1	27.68	35	56	35	56	35	56	68.6	61.5	65.2	70.8	30.4	67.7	56.6	185.6
21	Washington Boulevard	East of Lincoln Blvd.	2,059	97	1997.2	2	41.18	1	20.59	35	56	35	56	35	56	67.3	60.2	63.9	69.5	30.4	66.4	42.1	138.1
22	Bluff Creek Drive	East of Lincoln Blvd.	816	97	791.52	2	16.32	1	8.16	35	56	35	56	35	56	63.3	56.2	59.9	65.5	30.4	62.4	16.7	54.7
23	Jefferson Boulevard	East of Lincoln Blvd.	2,355	97	2284.4	2	47.1	1	23.55	45	72	45	72	45	72	71.0	62.5	65.5	72.6	30.4	69.5	85.3	280.0
24	Culver Boulevard	West of Nicholson St.	2,025	97	1964.3	2	40.5	1	20.25	30	48	30	48	30	48	65.3	59.1	63.2	68.0	30.4	64.9	29.8	97.9
25	Culver Boulevard	West of Jefferson Blvd	3,115	97	3021.6	2	62.3	1	31.15	45	72	45	72	45	72	72.3	63.7	66.7	73.8	30.4	70.7	112.9	370.4
26	Culver Boulevard	West of SR 90 EB	3,359	97	3258.2	2	67.18	1	33.59	45	72	45	72	45	72	72.6	64.0	67.0	74.1	30.4	71.0	121.7	399.4
27	Culver Boulevard	East of SR 90 Ramp	2,234	97	2167	2	44.68	1	22.34	40	64	40	64	40	64	69.3	61.4	64.8	71.1	30.4	68.1	61.6	201.9
28	Culver Boulevard	East of Vista Del Mar	2,054	97	1992.4	2	41.08	1	20.54	35	56	35	56	35	56	67.3	60.2	63.9	69.5	30.4	66.4	42.0	137.7
29	Vista Del Mar	North of Culver Blvd.	121	97	117.37	2	2.42	1	1.21	25	40	25	40	25	40	50.8	45.6	50.2	54.2	30.4	51.1	1.2	4.1
30	SR 90 WB	North of Mindanao Way	1,416	97	1373.5	2	28.32	1	14.16	40	64	40	64	40	64	67.4	59.5	62.8	69.2	30.4	66.1	39.0	128.0
31	SR 90 WB	North of Culver Blvd.	150	97	145.5	2	3	1	1.5	40	64	40	64	40	64	57.6	49.7	53.0	59.4	30.4	56.3	4.1	13.6
32	SR 90 EB	North of Mindanao Way	1,084	97	1051.5	2	21.68	1	10.84	40	64	40	64	40	64	66.2	58.3	61.6	68.0	30.4	64.9	29.9	98.0
33	SR 90 EB	South of Mindanao Way	2,464	97	2390.1	2	49.28	1	24.64	40	64	40	64	40	64	69.8	61.9	65.2	71.6	30.4	68.5	67.9	222.7

Cummulative (2023)

Calveno - Peak Hour

No.	ROAD SEGMENT	LOCATION	TOTAL # VEHICLES	VEHICLE TYPE %						VEHICLE SPEED						NOISE LEVEL (dBA)			CALCULATED NOISE LEVEL (15 meters from roadway center)	Receptor Dist. from Roadway Center (m.)	Adjusted Noise Level (dBA)	Distance from Roadway to 65 dBA (m)	Distance from Roadway to 65 dBA (ft)
				Auto		MT		HT															
				%	Auto	%	MT	%	HT	Auto	k/h	MT	k/h	HT	k/h	Auto	MT	HT					
1	Admiralty Way	North of Bali Way	3,259	97	3161.2	2	65.18	1	32.59	40	64	40	64	40	64	71.0	63.1	66.4	72.8	30.4	69.7	89.8	294.6
2	Admiralty Way	South of Bali Way	2,725	97	2643.3	2	54.5	1	27.25	40	64	40	64	40	64	70.2	62.3	65.6	72.0	30.4	68.9	75.1	246.3
3	Admiralty Way	North of Fiji Way	1,698	97	1647.1	2	33.96	1	16.98	40	64	40	64	40	64	68.1	60.2	63.6	69.9	30.4	66.9	46.8	153.5
4	Lincoln Boulevard	North of Washington Blvd.	3,903	97	3785.9	2	78.06	1	39.03	35	56	35	56	35	56	70.1	63.0	66.7	72.3	30.4	69.2	79.8	261.7
5	Lincoln Boulevard	North of SR 90 Ramp	5,347	97	5186.6	2	106.9	1	53.47	35	56	35	56	35	56	71.5	64.3	68.0	73.6	30.4	70.6	109.3	358.6
6	Lincoln Boulevard	North of Bali Way	3,965	97	3846.1	2	79.3	1	39.65	35	56	35	56	35	56	70.2	63.0	66.7	72.3	30.4	69.3	81.0	265.9
7	Lincoln Boulevard	North of Mindanao Way	3,556	97	3449.3	2	71.12	1	35.56	40	64	40	64	40	64	71.4	63.5	66.8	73.2	30.4	70.1	98.0	321.5
8	Lincoln Boulevard	North of Fiji Way	4,344	97	4213.7	2	86.88	1	43.44	40	64	40	64	40	64	72.2	64.3	67.7	74.0	30.4	71.0	119.7	392.7
9	Lincoln Boulevard	North of Culver Blvd.	5,357	97	5196.3	2	107.1	1	53.57	45	72	45	72	45	72	74.6	66.0	69.0	76.1	30.4	73.1	194.1	636.9
10	Lincoln Boulevard	North of Jefferson Blvd.	6,102	97	5918.9	2	122	1	61.02	45	72	45	72	45	72	75.2	66.6	69.6	76.7	30.4	73.6	221.1	725.5
11	Lincoln Boulevard	North of Bluff Creek Dr.	5,203	97	5046.9	2	104.1	1	52.03	45	72	45	72	45	72	74.5	65.9	68.9	76.0	30.4	72.9	188.5	618.6
12	Lincoln Boulevard	South of Bluff Creek Dr.	6,157	97	5972.3	2	123.1	1	61.57	45	72	45	72	45	72	75.2	66.6	69.6	76.7	30.4	73.7	223.1	732.1
13	Mindanao Way	West of Admiralty Way	146	97	141.62	2	2.92	1	1.46	30	48	30	48	30	48	53.9	47.6	51.8	56.6	30.4	53.5	2.2	7.1
14	Mindanao Way	West of Lincoln Blvd.	1,464	97	1420.1	2	29.28	1	14.64	30	48	30	48	30	48	63.9	57.7	61.8	66.6	30.4	63.5	21.6	70.8
15	Mindanao Way	West of SR 90 EB	2,436	97	2362.9	2	48.72	1	24.36	30	48	30	48	30	48	66.1	59.9	64.0	68.8	30.4	65.7	35.9	117.8
16	Mindanao Way	West of SR 90 WB	1,882	97	1825.5	2	37.64	1	18.82	30	48	30	48	30	48	65.0	58.7	62.9	67.7	30.4	64.6	27.7	91.0
17	Mindanao Way	East of SR 90 Ramp	1,947	97	1888.6	2	38.94	1	19.47	30	48	30	48	30	48	65.1	58.9	63.0	67.8	30.4	64.7	28.7	94.1
18	Bali Way	West of Admiralty Way	183	97	177.51	2	3.66	1	1.83	30	48	30	48	30	48	54.9	48.6	52.8	57.5	30.4	54.5	2.7	8.8
19	Bali Way	West of Lincoln Blvd.	906	97	878.82	2	18.12	1	9.06	30	48	30	48	30	48	61.8	55.6	59.7	64.5	30.4	61.4	13.3	43.8
20	Washington Boulevard	West of Lincoln Blvd.	3,003	97	2912.9	2	60.06	1	30.03	35	56	35	56	35	56	69.0	61.8	65.5	71.1	30.4	68.1	61.4	201.4
21	Washington Boulevard	East of Lincoln Blvd.	2,256	97	2188.3	2	45.12	1	22.56	35	56	35	56	35	56	67.7	60.6	64.3	69.9	30.4	66.8	46.1	151.3
22	Bluff Creek Drive	East of Lincoln Blvd.	1,336	97	1295.9	2	26.72	1	13.36	35	56	35	56	35	56	65.4	58.3	62.0	67.6	30.4	64.5	27.3	89.6
23	Jefferson Boulevard	East of Lincoln Blvd.	2,997	97	2907.1	2	59.94	1	29.97	45	72	45	72	45	72	72.1	63.5	66.5	73.6	30.4	70.5	108.6	356.3
24	Culver Boulevard	West of Nicholson St.	2,316	97	2246.5	2	46.32	1	23.16	30	48	30	48	30	48	65.9	59.6	63.8	68.6	30.4	65.5	34.1	112.0
25	Culver Boulevard	West of Jefferson Blvd	3,477	97	3372.7	2	69.54	1	34.77	45	72	45	72	45	72	72.7	64.2	67.2	74.2	30.4	71.2	126.0	413.4
26	Culver Boulevard	West of SR 90 EB	3,565	97	3458.1	2	71.3	1	35.65	45	72	45	72	45	72	72.8	64.3	67.3	74.4	30.4	71.3	129.2	423.9
27	Culver Boulevard	East of SR 90 Ramp	2,386	97	2314.4	2	47.72	1	23.86	40	64	40	64	40	64	69.6	61.7	65.1	71.4	30.4	68.3	65.7	215.7
28	Culver Boulevard	East of Vista Del Mar	2,297	97	2228.1	2	45.94	1	22.97	35	56	35	56	35	56	67.8	60.7	64.4	70.0	30.4	66.9	47.0	154.0
29	Vista Del Mar	North of Culver Blvd.	126	97	122.22	2	2.52	1	1.26	25	40	25	40	25	40	51.0	45.8	50.4	54.4	30.4	51.3	1.3	4.2
30	SR 90 WB	North of Mindanao Way	1,522	97	1476.3	2	30.44	1	15.22	40	64	40	64	40	64	67.7	59.8	63.1	69.5	30.4	66.4	41.9	137.6
31	SR 90 WB	North of Culver Blvd.	166	97	161.02	2	3.32	1	1.66	40	64	40	64	40	64	58.0	50.1	53.5	59.8	30.4	56.8	4.6	15.0
32	SR 90 EB	North of Mindanao Way	1,165	97	1130.1	2	23.3	1	11.65	40	64	40	64	40	64	66.5	58.6	61.9	68.3	30.4	65.2	32.1	105.3
33	SR 90 EB	South of Mindanao Way	2,639	97	2559.8	2	52.78	1	26.39	40	64	40	64	40	64	70.1	62.2	65.5	71.9	30.4	68.8	72.7	238.6

Cummulative (2023) with Project

Calveno - Peak Hour

No.	ROAD SEGMENT	LOCATION	TOTAL # VEHICLES	VEHICLE TYPE %						VEHICLE SPEED						NOISE LEVEL (dBA)			CALCULATED NOISE LEVEL (15 meters from roadway center)	Receptor Dist. from Roadway Center (m.)	Adjusted Noise Level (dBA)	Distance from Roadway to 65 dBA (m)	Distance from Roadway to 65 dBA (ft)
				Auto		MT		HT															
				%	Auto	%	MT	%	HT	Auto	k/h	MT	k/h	HT	k/h	Auto	MT	HT					
1	Admiralty Way	North of Bali Way	3,264	97	3166.1	2	65.28	1	32.64	40	64	40	64	40	64	71.0	63.1	66.4	72.8	30.4	69.7	89.9	295.1
2	Admiralty Way	South of Bali Way	2,730	97	2648.1	2	54.6	1	27.3	40	64	40	64	40	64	70.2	62.3	65.6	72.0	30.4	68.9	75.2	246.8
3	Admiralty Way	North of Fiji Way	1,716	97	1664.5	2	34.32	1	17.16	40	64	40	64	40	64	68.2	60.3	63.6	70.0	30.4	66.9	47.3	155.1
4	Lincoln Boulevard	North of Washington Blvd.	3,905	97	3787.9	2	78.1	1	39.05	35	56	35	56	35	56	70.1	63.0	66.7	72.3	30.4	69.2	79.8	261.9
5	Lincoln Boulevard	North of SR 90 Ramp	5,349	97	5188.5	2	107	1	53.49	35	56	35	56	35	56	71.5	64.3	68.0	73.6	30.4	70.6	109.3	358.7
6	Lincoln Boulevard	North of Bali Way	3,977	97	3857.7	2	79.54	1	39.77	35	56	35	56	35	56	70.2	63.0	66.7	72.3	30.4	69.3	81.3	266.7
7	Lincoln Boulevard	North of Mindanao Way	3,568	97	3461	2	71.36	1	35.68	40	64	40	64	40	64	71.4	63.5	66.8	73.2	30.4	70.1	98.3	322.5
8	Lincoln Boulevard	North of Fiji Way	4,356	97	4225.3	2	87.12	1	43.56	40	64	40	64	40	64	72.2	64.3	67.7	74.0	30.4	71.0	120.0	393.8
9	Lincoln Boulevard	North of Culver Blvd.	5,361	97	5200.2	2	107.2	1	53.61	45	72	45	72	45	72	74.6	66.0	69.0	76.1	30.4	73.1	194.3	637.4
10	Lincoln Boulevard	North of Jefferson Blvd.	6,106	97	5922.8	2	122.1	1	61.06	45	72	45	72	45	72	75.2	66.6	69.6	76.7	30.4	73.6	221.3	726.0
11	Lincoln Boulevard	North of Bluff Creek Dr.	5,205	97	5048.9	2	104.1	1	52.05	45	72	45	72	45	72	74.5	65.9	68.9	76.0	30.4	72.9	188.6	618.9
12	Lincoln Boulevard	South of Bluff Creek Dr.	6,159	97	5974.2	2	123.2	1	61.59	45	72	45	72	45	72	75.2	66.6	69.6	76.7	30.4	73.7	223.2	732.3
13	Mindanao Way	West of Admiralty Way	146	97	141.62	2	2.92	1	1.46	30	48	30	48	30	48	53.9	47.6	51.8	56.6	30.4	53.5	2.2	7.1
14	Mindanao Way	West of Lincoln Blvd.	1,477	97	1432.7	2	29.54	1	14.77	30	48	30	48	30	48	63.9	57.7	61.8	66.6	30.4	63.5	21.8	71.4
15	Mindanao Way	West of SR 90 EB	2,450	97	2376.5	2	49	1	24.5	30	48	30	48	30	48	66.1	59.9	64.0	68.8	30.4	65.7	36.1	118.4
16	Mindanao Way	West of SR 90 WB	1,884	97	1827.5	2	37.68	1	18.84	30	48	30	48	30	48	65.0	58.7	62.9	67.7	30.4	64.6	27.8	91.1
17	Mindanao Way	East of SR 90 Ramp	1,948	97	1889.6	2	38.96	1	19.48	30	48	30	48	30	48	65.1	58.9	63.0	67.8	30.4	64.8	28.7	94.2
18	Bali Way	West of Admiralty Way	183	97	177.51	2	3.66	1	1.83	30	48	30	48	30	48	54.9	48.6	52.8	57.5	30.4	54.5	2.7	8.8
19	Bali Way	West of Lincoln Blvd.	906	97	878.82	2	18.12	1	9.06	30	48	30	48	30	48	61.8	55.6	59.7	64.5	30.4	61.4	13.3	43.8
20	Washington Boulevard	West of Lincoln Blvd.	3,003	97	2912.9	2	60.06	1	30.03	35	56	35	56	35	56	69.0	61.8	65.5	71.1	30.4	68.1	61.4	201.4
21	Washington Boulevard	East of Lincoln Blvd.	2,258	97	2190.3	2	45.16	1	22.58	35	56	35	56	35	56	67.7	60.6	64.3	69.9	30.4	66.8	46.2	151.4
22	Bluff Creek Drive	East of Lincoln Blvd.	1,336	97	1295.9	2	26.72	1	13.36	35	56	35	56	35	56	65.4	58.3	62.0	67.6	30.4	64.5	27.3	89.6
23	Jefferson Boulevard	East of Lincoln Blvd.	2,998	97	2908.1	2	59.96	1	29.98	45	72	45	72	45	72	72.1	63.5	66.5	73.6	30.4	70.5	108.6	356.5
24	Culver Boulevard	West of Nicholson St.	2,325	97	2255.3	2	46.5	1	23.25	30	48	30	48	30	48	65.9	59.7	63.8	68.6	30.4	65.5	34.3	112.4
25	Culver Boulevard	West of Jefferson Blvd	3,489	97	3384.3	2	69.78	1	34.89	45	72	45	72	45	72	72.7	64.2	67.2	74.3	30.4	71.2	126.4	414.8
26	Culver Boulevard	West of SR 90 EB	3,566	97	3459	2	71.32	1	35.66	45	72	45	72	45	72	72.8	64.3	67.3	74.4	30.4	71.3	129.2	424.0
27	Culver Boulevard	East of SR 90 Ramp	2,387	97	2315.4	2	47.74	1	23.87	40	64	40	64	40	64	69.6	61.7	65.1	71.4	30.4	68.4	65.8	215.8
28	Culver Boulevard	East of Vista Del Mar	2,298	97	2229.1	2	45.96	1	22.98	35	56	35	56	35	56	67.8	60.7	64.4	70.0	30.4	66.9	47.0	154.1
29	Vista Del Mar	North of Culver Blvd.	127	97	123.19	2	2.54	1	1.27	25	40	25	40	25	40	51.0	45.8	50.4	54.4	30.4	51.3	1.3	4.3
30	SR 90 WB	North of Mindanao Way	1,522	97	1476.3	2	30.44	1	15.22	40	64	40	64	40	64	67.7	59.8	63.1	69.5	30.4	66.4	41.9	137.6
31	SR 90 WB	North of Culver Blvd.	166	97	161.02	2	3.32	1	1.66	40	64	40	64	40	64	58.0	50.1	53.5	59.8	30.4	56.8	4.6	15.0
32	SR 90 EB	North of Mindanao Way	1,165	97	1130.1	2	23.3	1	11.65	40	64	40	64	40	64	66.5	58.6	61.9	68.3	30.4	65.2	32.1	105.3
33	SR 90 EB	South of Mindanao Way	2,633	97	2554	2	52.66	1	26.33	40	64	40	64	40	64	70.1	62.2	65.5	71.8	30.4	68.8	72.5	238.0

Assumptions: Peak hour traffic data from Raju Associates, Inc. 2015.

Change Between Existing and Cummulative (2023) with Project

No.	ROAD SEGMENT	LOCATION	CALCULATED Existing NOISE LEVEL (15 meters from roadway center)	CALCULATED Cumulative NOISE LEVEL (15 meters from roadway center)	CALCULATED Cumulative + Project NOISE LEVEL (15 meters from roadway center)	dBA Change	dBA Change
1	Admiralty Way	North of Bali Way	72.4	72.8	72.8	0.4	0.0
2	Admiralty Way	South of Bali Way	71.6	72.0	72.0	0.4	0.0
3	Admiralty Way	North of Fiji Way	69.4	69.9	70.0	0.5	0.0
4	Lincoln Boulevard	North of Washington Blvd.	71.7	72.3	72.3	0.6	0.0
5	Lincoln Boulevard	North of SR 90 Ramp	73.1	73.6	73.6	0.6	0.0
6	Lincoln Boulevard	North of Bali Way	71.7	72.3	72.3	0.7	0.0
7	Lincoln Boulevard	North of Mindanao Way	72.5	73.2	73.2	0.7	0.0
8	Lincoln Boulevard	North of Fiji Way	73.4	74.0	74.0	0.6	0.0
9	Lincoln Boulevard	North of Culver Blvd.	75.6	76.1	76.1	0.5	0.0
10	Lincoln Boulevard	North of Jefferson Blvd.	76.2	76.7	76.7	0.5	0.0
11	Lincoln Boulevard	North of Bluff Creek Dr.	75.5	76.0	76.0	0.5	0.0
12	Lincoln Boulevard	South of Bluff Creek Dr.	76.0	76.7	76.7	0.7	0.0
13	Mindanao Way	West of Admiralty Way	56.2	56.6	56.6	0.3	0.0
14	Mindanao Way	West of Lincoln Blvd.	66.3	66.6	66.6	0.3	0.0
15	Mindanao Way	West of SR 90 EB	68.5	68.8	68.8	0.3	0.0
16	Mindanao Way	West of SR 90 WB	67.4	67.7	67.7	0.3	0.0
17	Mindanao Way	East of SR 90 Ramp	67.5	67.8	67.8	0.3	0.0
18	Bali Way	West of Admiralty Way	57.1	57.5	57.5	0.4	0.0
19	Bali Way	West of Lincoln Blvd.	64.2	64.5	64.5	0.3	0.0
20	Washington Boulevard	West of Lincoln Blvd.	70.8	71.1	71.1	0.4	0.0
21	Washington Boulevard	East of Lincoln Blvd.	69.5	69.9	69.9	0.4	0.0
22	Bluff Creek Drive	East of Lincoln Blvd.	65.5	67.6	67.6	2.1	0.0
23	Jefferson Boulevard	East of Lincoln Blvd.	72.6	73.6	73.6	1.0	0.0
24	Culver Boulevard	West of Nicholson St.	68.0	68.6	68.6	0.6	0.0
25	Culver Boulevard	West of Jefferson Blvd	73.8	74.2	74.3	0.5	0.0
26	Culver Boulevard	West of SR 90 EB	74.1	74.4	74.4	0.3	0.0
27	Culver Boulevard	East of SR 90 Ramp	71.1	71.4	71.4	0.3	0.0
28	Culver Boulevard	East of Vista Del Mar	69.5	70.0	70.0	0.5	0.0
29	Vista Del Mar	North of Culver Blvd.	54.2	54.4	54.4	0.2	0.0
30	SR 90 WB	North of Mindanao Way	69.2	69.5	69.5	0.3	0.0
31	SR 90 WB	North of Culver Blvd.	59.4	59.8	59.8	0.4	0.0
32	SR 90 EB	North of Mindanao Way	68.0	68.3	68.3	0.3	0.0
33	SR 90 EB	South of Mindanao Way	71.6	71.9	71.8	0.3	0.0

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APPENDIX H
Traffic Study

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TRAFFIC STUDY
FOR THE
BALLONA WETLANDS ECOLOGICAL RESERVE
RESTORATION PROJECT

ENVIRONMENTAL IMPACT REPORT

SEPTEMBER 2015



Prepared for :

Environmental Science Associates

Submitted by :

RAJU Associates Inc

TRAFFIC STUDY
FOR THE
BALLONA WETLANDS ECOLOGICAL RESERVE RESTORATION PROJECT
DEIR

SEPTEMBER 2015

Prepared for:

ENVIRONMENTAL SCIENCE ASSOCIATES

Prepared by:

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EXECUTIVE SUMMARY

A detailed traffic study has been performed by Raju Associates, Inc. to assess the traffic impacts of the proposed Ballona Wetlands Ecological Reserve Restoration Project located both in the City of Los Angeles and County of Los Angeles, California.

The Proposed Project (also referred to as Alternative 1 – Proposed Action) consists of restoration of the Ballona Wetlands Ecological Reserve which includes enhancing and creating native coastal wetland and upland habitats in the approximately 581-acre Reserve. The Reserve comprises previously filled coastal wetland and upland habitat that would be restored by increasing tidal flow throughout the project area, removing invasive species, and planting native vegetation. The Proposed Project has been divided into three main areas, called Areas A, B, and C, with Areas B and C further divided for design and analyses purposes. Area A is located on the northern side of the Ballona Wetlands Ecological Reserve, north of Ballona Creek and west of Lincoln Boulevard. Fiji Way borders the north and west sides of Area A.

Area B is located on the southern side of the Ballona Wetlands Ecological Reserve, south of Ballona Creek and west of Lincoln Boulevard. Both Culver Boulevard and Jefferson Boulevard are located within Area B. Area B is divided into several subareas including North Area B, West Area B, South Area B, Southeast Area B and East Area B.

Area C is located on the eastern side of the Ballona Wetlands Ecological Reserve, north of Ballona Creek and east of Lincoln Boulevard. Culver Boulevard divides Area C into North Area C and South Area C. The Marina (SR-90) Freeway is located along the northeastern edge of Area C and the freeway and on-ramp embankment is not part of the Reserve. The southeastern half of South Area C is the home of the Culver Marina Little League, including four baseball fields along with associated parking and concessions/maintenance facilities.

The Proposed Project would be completed in two phases:

- Phase 1: Restoration of Area A and North Area B, enhancement of the existing managed wetlands in South/Southeast Area B, construction of new perimeter flood protection levees and an interim levee along West Area B, and realignment of the Ballona Creek channel. Phase 1 would only decommission the gas wells that are required for the Phase 1 restoration. Other wells, including the wells in Area A and West Area B, would be maintained until they are decommissioned in Phase 2. Phase 1 would be completed by the year 2020.
- Phase 2: Full tidal restoration of West Area B and new West Area B perimeter flood protection levee. Remaining gas wells would be decommissioned and the well removal areas restored during Phase 2. Phase 2 would be completed by the year 2023.

As proposed, the existing armored levees along the banks of the Ballona Creek channel within the Ballona Reserve would be removed. Ballona Creek would be realigned to flow in a natural meandering pattern, and the landscape grade in Area A would be lowered to create a connected floodplain. Native wetland and upland habitats would be established, restored, and enhanced throughout the site.

New earthen levees would be built around the northern perimeter of Area A, along the north side of Culver Boulevard in North and West Area B, and immediately east of the dune habitat in West Area B. The new levees would be set back from the existing Ballona Creek channel in order to connect the proposed realigned creek with its restored wetland floodplain, allowing a variety of coastal wetland habitats to form within the floodplain. The levees would be broad and gently sloped away from roadways and buildings, protecting development from the inundation of the restored Ballona Creek wetland floodplain and providing upland and transitional habitat zones within the restored Ballona Reserve. The new levees would be set back from the original Ballona Creek channel in order to connect the creek with its floodplain, allowing a variety of coastal wetland habitats to form within the floodplain. New trails and bike paths constructed on top of the levees would encourage safe use by visitors, and gateway entrances would be added to the Ballona Reserve with educational and art installations.

The existing Southern California Gas wells would be decommissioned within the Ballona Reserve and related pipelines would be abandoned or modified to accommodate the proposed restoration activities.

The Proposed Project would require minimal operation and maintenance (O&M) activities since the Proposed Project intends to restore wetlands and creek habitat, and create a flood risk management system that is sustained by natural processes. Necessary O&M activities would relate to: habitat and vegetation; trash removal; the newly modified channel and levees; water control structures; parking facilities; the ball fields if external funding results in their replacement; and other ongoing and routine maintenance (i.e. inspect and lock gates, fence and gate maintenance, trail, bike path and access road maintenance).

As part of the Project, a new three-level parking structure would be built on the site of the existing Los Angeles County Department of Beaches and Harbors (DBH)-operated parking lot located along Fiji Way (in Area A) and would reduce the existing parking area footprint in that location by approximately 0.68 acre. The parking structure would contain a total of 302 parking spaces included within the three levels of the parking structure, including standard, compact, and ADA-accessible spaces, along with an area for motorcycle parking. This is an increase of 39 parking spaces from the existing parking lot. A total of 20 spaces would be dedicated to DBH vehicles and nine spaces would be provided for California Department of Fish and Wildlife (CDFW) staff. The remaining parking spaces would be publically available paid parking spaces using pay stations. The top deck of the structure would include parking and an observation deck with signage, maps, and telescopes allowing views of the reconstructed wetlands in Area A and beyond. Hours of operation for public use of the parking structure would be from dawn to dusk. The parking structure would be closed and locked after hours. The structure would be accessed from a driveway off Fiji Way.

The Project also proposes upgrades to the existing West Culver Parking Lot located near the intersection of Vista del Mar and Culver Boulevard. It is currently a poorly drained gravel lot that currently can accommodate approximately 50 vehicles. As proposed, it would be paved and striped to accommodate approximately 43 parking spaces for daytime use, the drainage would be improved, and sidewalks would be installed. Two spaces would be dedicated to CDFW vehicles. A separate bus and emergency vehicle access would enter from Culver Boulevard just east of the intersection with Nicholson Street and there would be a dedicated drop-off/pickup area for buses. This entrance to the Ballona Wetlands Ecological Reserve would include interpretive signs, shade structures, seating, picnic tables, and restrooms. New gates and fences would be installed on the perimeter of the West Culver Parking Lot, and public parking would be available from dawn to dusk. Parking would be gated and locked after hours. A driveway located along Culver Boulevard

and another driveway located along Vista del Mar at Culver Place provides access to this parking lot.

The Project would develop and improve public access, recreation, and interpretative opportunities within the Project site and includes construction of three primary entrances, into the Ballona Wetlands Ecological Reserve with adjacent parking, new trails, and new interpretive features and amenities.

The three primary entrances would provide access to pedestrians and bicyclists with a series of several smaller secondary entrances leading to the walking and biking trail network around and within the site. One primary entrance serving pedestrians and bicyclists would be located in Area A along Culver Boulevard, west of Lincoln Boulevard. A second entrance would be located in Area A adjacent to the proposed parking structure in the Ballona Wetlands Ecological Reserve across from Fisherman's Village along Fiji Way. The remaining entrance would be located at the West Culver Parking Lot in the southwestern corner of West Area B in Playa del Rey.

Several secondary entrances would also be created to allow pedestrians and cyclists to access trails in the Ballona Wetlands Ecological Reserve from adjacent neighborhoods. Secondary entrances would consist of a small gate with informational and directional signage to help visitors position themselves on the site.

The Project would provide a new bicycle and pedestrian bridge over Ballona Creek adjacent to the Culver Boulevard vehicular bridge between Area A and North Area B/East Area B. The bridge would be 25 feet wide and would include a 11 feet wide pedestrian path, 10 feet wide bicycle path, and 2 feet wide shoulders. The bridge would connect the existing Ballona Creek Bike Path to the proposed Ballona Wetlands Ecological Reserve pedestrian and bicycle path system. An overlook would be provided, with information provided about the rerouting of Ballona Creek. The Project would also provide a new pedestrian bridge over Lincoln Boulevard connecting Area A with North Area C. The bridges would serve two purposes: 1. During construction, the bridges would allow movement of soil among Areas A, B, and C, reducing the need to use of surface streets such as Culver Boulevard and Lincoln Boulevard.; and 2. after construction is completed, the bridges would allow visitors to cross Ballona Creek and Lincoln Boulevard using paths and trails within Ballona Wetlands Ecological Reserve.

Current and future traffic analyses at 18 intersections within the City of Los Angeles and County of Los Angeles were conducted in this study. At these locations, traffic operations were studied prior to and after implementation of the Proposed Project, deficiencies and impacts identified, any necessary improvements and mitigation measures developed, their effectiveness determined and residual traffic impacts ascertained as part of this study. The following executive summary highlighting the key findings of this study is presented below.

- A total of 18 intersections were analyzed within the study area for this project. The study area is bounded by Washington Boulevard on the north, Bluff Creek Drive on the south, Vista del Mar and Admiralty Way on the west, and the Marina Expressway/Freeway on the east.

- Currently, all of the analyzed intersection locations are operating at levels of service (LOS) D or better during both the morning and evening peak hours.

- In the Cumulative (Future Year 2023) Base conditions, i.e., future conditions without the implementation of the Proposed Project, 16 of the 18 study intersections are projected to operate at LOS D or better during the morning peak hour. During the evening peak hour, 15 of the 18 study intersections are also projected to operate at LOS D or better. The remaining locations are projected to operate at LOS E and include:

  - Lincoln Boulevard/Washington Boulevard: AM peak hour – LOS E
  - Lincoln Boulevard/Jefferson Boulevard: AM peak hour – LOS E
  - Nicholson Street/Culver Boulevard: PM peak hour – LOS E
  - Jefferson Boulevard/Culver Boulevard: PM peak hour – LOS E
  - SR-90 Freeway Westbound Ramps/Culver Boulevard: PM peak hour – LOS E

- The Proposed Project includes restoration of the Ballona Wetlands Ecological Reserve. The Project is estimated to generate a total of 12 trips during the morning peak hour and 52 trips during the evening peak hour.

- In the Existing (2015) plus Project conditions, both AM and PM peak hour operating conditions would be similar to those for the Existing conditions (without the project). All of the study intersections are projected to continue to operate at LOS D or better during both the morning and evening peak hours. Traffic generated by the Project would not change the intersection levels of service from existing conditions.

- The Existing (2015) plus Project traffic conditions indicate that the Proposed Project would not cause significant traffic impacts at any of the analysis locations during the weekday morning and evening peak hours.

- In the Cumulative (Future Year 2023) plus Project conditions, both AM and PM peak hour operating conditions would be similar to those projected for the Cumulative Base conditions. Traffic generated by the Project would not change the intersection levels of service from cumulative base conditions.

- The Cumulative (Future Year 2023) plus Project traffic conditions indicate that the Proposed Project would not cause significant traffic impacts at any of the analysis locations during the weekday morning and evening peak hours.

- Construction impacts of the Proposed Project were assessed. The construction activity associated with the Proposed Project would not cause significant traffic impacts at any of the analysis locations during the weekday morning and evening peak hours.

- The Proposed Project would add less than 50 trips to the nearest Congestion Management Program (CMP) arterial monitoring locations and would add less than 150 trips in either direction to the nearest CMP mainline freeway monitoring locations during the weekday evening peak hour. Per CMP guidelines, no further CMP analysis is required.

- Project Alternatives – Four project alternatives including Alternative 1 – Proposed Action (also referred to as the Proposed Project and results summarized above), Alternative 2 – Partial Restoration, Alternative 3 – Levee Culverts and Oxbow and Alternative 4 – No Federal Action/No Project were evaluated. Detailed operational and construction activity traffic impact analyses at the study intersections were conducted.

- Alternative 2: Partial Restoration - Restore contiguous tidal wetlands in Area A and North Area B, maintain existing managed wetland in West Area B, and enhance managed wetlands in South Area B. Alternative 2 would adversely impact traffic to the same degree as that of the Proposed Project and would have similar construction related traffic effects. Similar to the Proposed Project (Alternative 1), Alternative 2 would not cause significant operational and/or constructed related traffic impacts at any of the analysis locations during the weekday morning and evening peak hours.

- Alternative 3: Levee Culverts and Oxbow - Restore tidal wetlands in Area A, maintain existing Area B managed wetlands, and restore wetlands in South Area C. Alternative 3 would adversely impact traffic to the same degree as that of the Proposed Project. The construction related traffic effects of Alternative 3 would adversely impact traffic to a lesser degree than the Proposed Project. Similar to the Proposed Project (Alternative 1), Alternative 3 would not cause significant operational and/or constructed related traffic impacts at any of the analysis locations during the weekday morning and evening peak hours.

Summarizing, the Proposed Project would not cause any significant impacts at any of the analyzed intersections. Therefore, no project-specific mitigation measures would be required.

I. INTRODUCTION

This report documents the assumptions, methodologies and findings of a study conducted by Raju Associates, Inc., to evaluate the potential traffic impacts of the proposed Ballona Wetlands Ecological Reserve Restoration Project located in the City of Los Angeles and County of Los Angeles, California.

PROJECT DESCRIPTION

The Proposed Project (also referred to as Alternative 1 – Proposed Action) consists of restoration of the Ballona Wetlands Ecological Reserve which includes enhancing and creating native coastal wetland and upland habitats in the approximately 581-acre Reserve. The Reserve comprises previously filled coastal wetland and upland habitat that would be restored by increasing tidal flow throughout the project area, removing invasive species, and planting native vegetation. The Proposed Project has been divided into three main areas, called Areas A, B, and C, with Areas B and C further divided for design and analyses purposes. Figure 1 illustrates the location of the Proposed Project in relation to the surrounding street system. The planning areas within the Ballona Wetlands Ecological Reserve and its operations and maintenance plan are shown in Figure 2.

As shown in Figure 2, Area A is located on the northern side of the Ballona Wetlands Ecological Reserve, north of Ballona Creek and west of Lincoln Boulevard. Fiji Way borders the north and west sides of Area A.

Area B is located on the southern side of the Ballona Wetlands Ecological Reserve, south of Ballona Creek and west of Lincoln Boulevard. Both Culver Boulevard and Jefferson Boulevard are located within Area B. Area B is divided into several subareas including North Area B, West Area B, South Area B, Southeast Area B and East Area B.

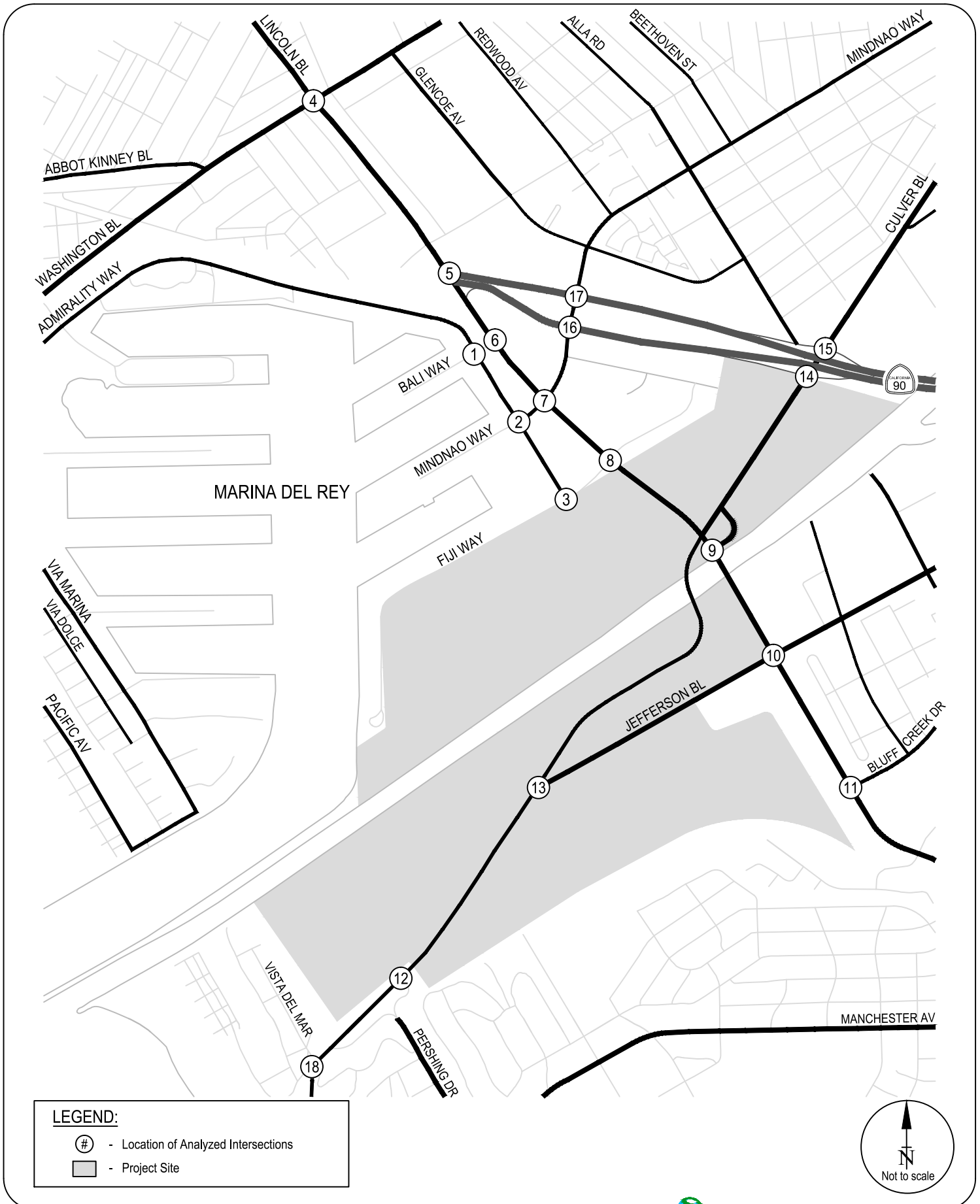

FIGURE 1
LOCATION OF PROJECT AND ANALYZED INTERSECTIONS

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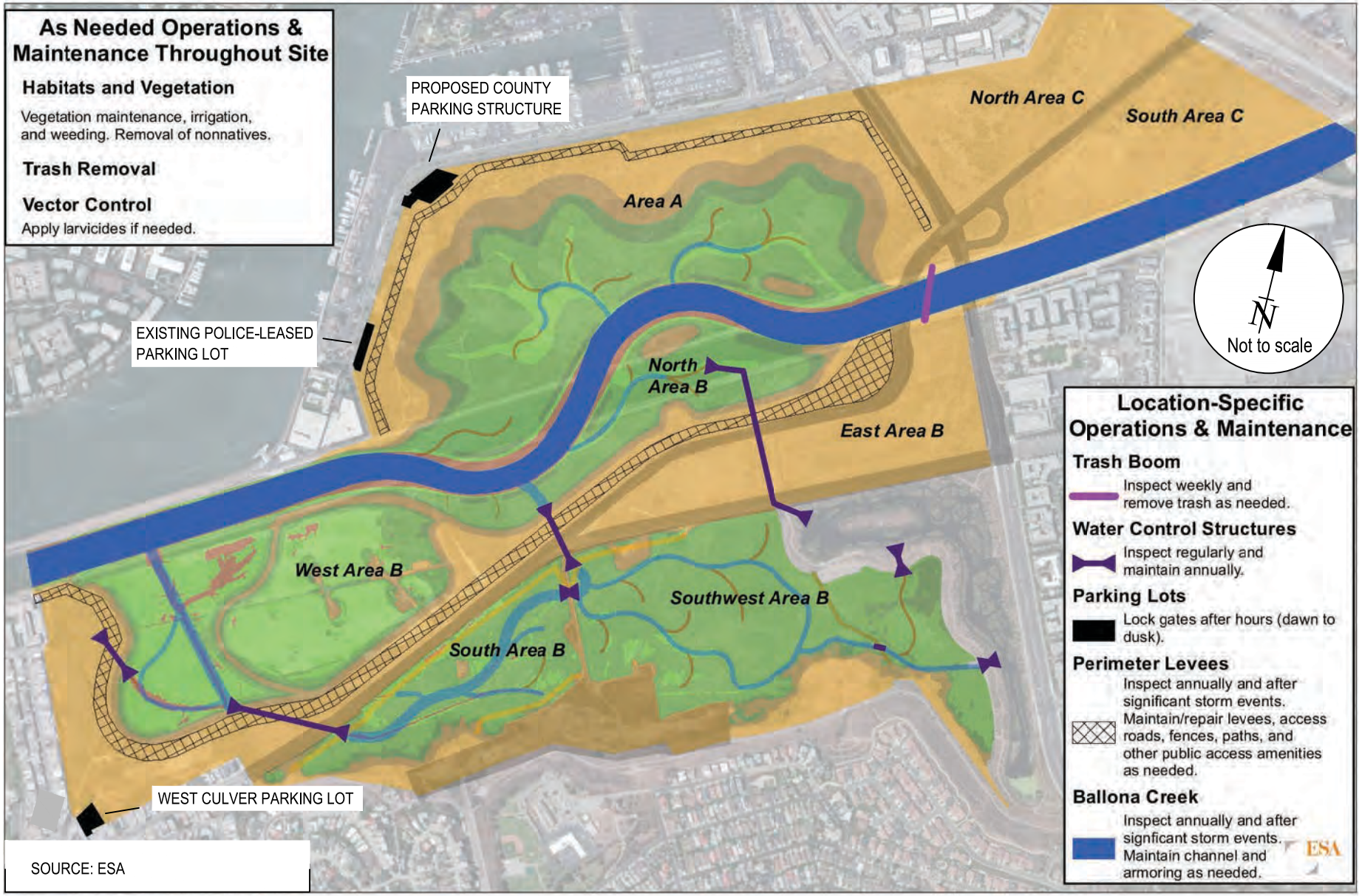


FIGURE 2
BALLONA WETLANDS ECOLOGICAL RESERVE OPERATIONS AND MAINTENANCE PLAN

RAJU Associates, Inc.

Area C is located on the eastern side of the Ballona Wetlands Ecological Reserve, north of Ballona Creek and east of Lincoln Boulevard. Culver Boulevard divides Area C into North Area C and South Area C. The Marina (SR-90) Freeway is located along the northeastern edge of Area C and the freeway and on-ramp embankment is not part of the Reserve. The southeastern half of South Area C is the home of the Culver Marina Little League, including four baseball fields along with associated parking and concessions/maintenance facilities.

The Proposed Project would be completed in two phases:

- Phase 1: Restoration of Area A and North Area B, enhancement of the existing managed wetlands in South/Southeast Area B, construction of new perimeter flood protection levees and an interim levee along West Area B, and realignment of the Ballona Creek channel. Phase 1 would only decommission the gas wells that are required for the Phase 1 restoration. Other wells, including the wells in Area A and West Area B, would be maintained until they are decommissioned in Phase 2. Phase 1 would be completed by the year 2020.
- Phase 2: Full tidal restoration of West Area B and new West Area B perimeter flood protection levee. Remaining gas wells would be decommissioned and the well removal areas restored during Phase 2. Phase 2 would be completed by the year 2023.

As proposed, the existing armored levees along the banks of the Ballona Creek channel within the Ballona Reserve would be removed. Ballona Creek would be realigned to flow in a natural meandering pattern, and the landscape grade in Area A would be lowered to create a connected floodplain. Native wetland and upland habitats would be established, restored, and enhanced throughout the site.

New earthen levees would be built around the northern perimeter of Area A, along the north side of Culver Boulevard in North and West Area B, and immediately east of the dune habitat in West Area B. The new levees would be set back from the existing Ballona Creek channel in order to connect the proposed realigned creek with its restored wetland floodplain, allowing a variety of coastal wetland habitats to form within the floodplain. The levees would be broad and gently sloped away from roadways and buildings, protecting development from the inundation of the restored Ballona Creek wetland floodplain and providing upland and transitional habitat zones within the restored Ballona Reserve. The new levees would be set back from the original Ballona Creek channel in order to connect the creek with its floodplain, allowing a variety of coastal wetland habitats to form within the floodplain. New trails and bike paths constructed on top of the

levees would encourage safe use by visitors, and gateway entrances would be added to the Ballona Reserve with educational and art installations.

The existing Southern California Gas wells would be decommissioned within the Ballona Reserve and related pipelines would be abandoned or modified to accommodate the proposed restoration activities.

OPERATION AND MAINTENANCE

The Proposed Project would require minimal operation and maintenance (O&M) activities since the Proposed Project intends to restore wetlands and creek habitat, and create a flood risk management system that is sustained by natural processes. Necessary O&M activities would relate to: habitat and vegetation; trash removal; the newly modified channel and levees; water control structures; parking facilities; the ball fields if external funding results in their replacement; and other ongoing and routine maintenance (i.e. inspect and lock gates, fence and gate maintenance, trail, bike path and access road maintenance). As indicated above, the operations and maintenance plan for the Ballona Wetlands Ecological Reserve is shown in Figure 2.

PROJECT PARKING

As part of the Project, a new three-level parking structure would be built on the site of the existing Los Angeles County Department of Beaches and Harbors (DBH)-operated parking lot located along Fiji Way (in Area A) and would reduce the existing parking area footprint in that location by approximately 0.68 acre. The parking structure would contain a total of 302 parking spaces included within the three levels of the parking structure, including standard, compact, and ADA-accessible spaces, along with an area for motorcycle parking. This is an increase of 39 parking spaces from the existing parking lot. A total of 20 spaces would be dedicated to DBH vehicles and nine spaces would be provided for California Department of Fish and Wildlife (CDFW) staff. The remaining parking spaces would be publically available paid parking spaces using pay stations. The top deck of the structure would include parking and an observation deck with signage, maps, and telescopes allowing views of the reconstructed wetlands in Area A and beyond. Hours of

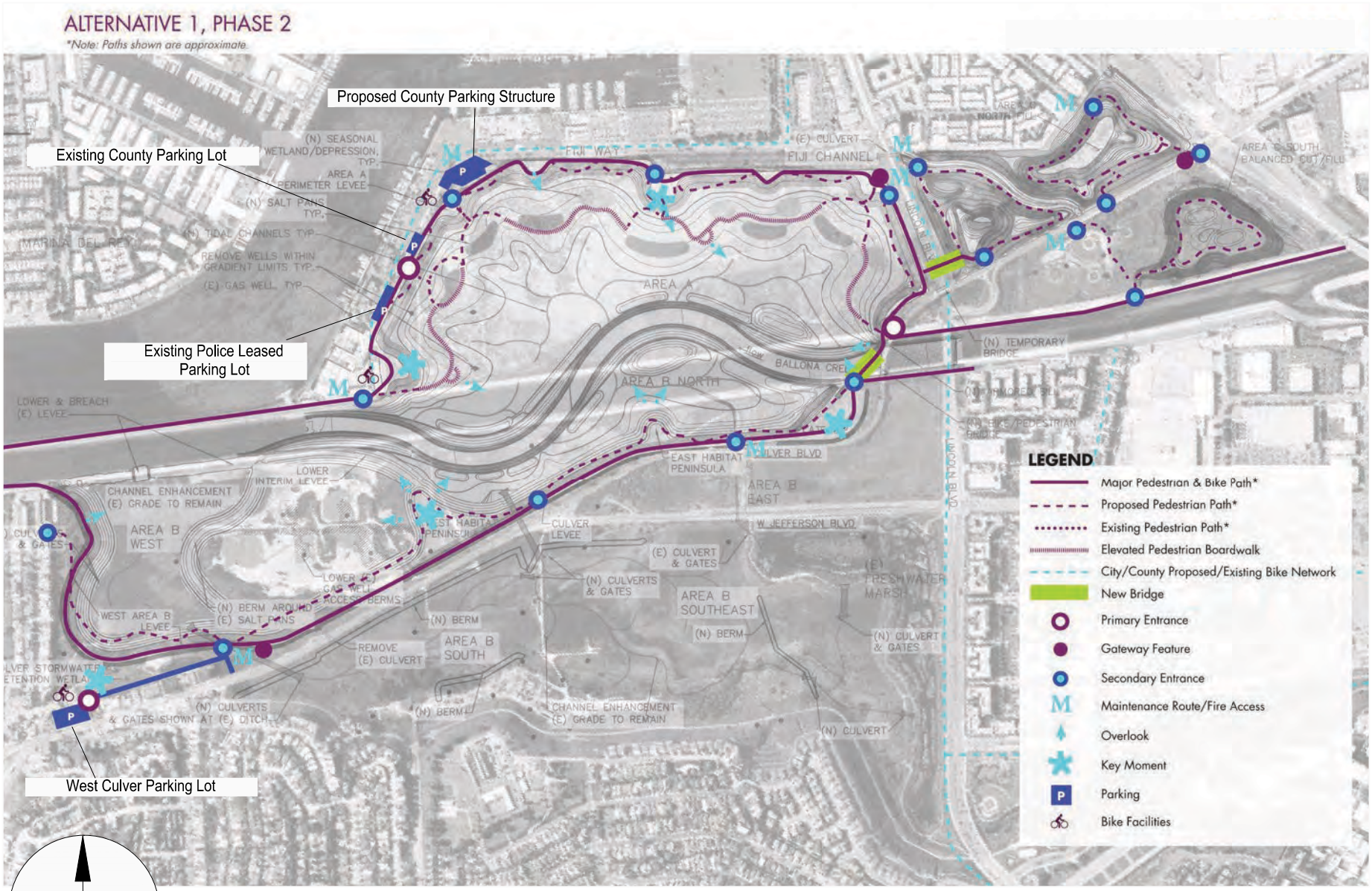
operation for public use of the parking structure would be from dawn to dusk. The parking structure would be closed and locked after hours. The structure would be accessed from a driveway off Fiji Way.

The Project also proposes upgrades to the existing West Culver Parking Lot located near the intersection of Pershing Drive and Culver Boulevard. It is currently a poorly drained gravel lot that currently can accommodate approximately 50 vehicles. As proposed, it would be paved and striped to accommodate approximately 43 parking spaces for daytime use, the drainage would be improved, and sidewalks would be installed. Two spaces would be dedicated to CDFW vehicles. A separate bus and emergency vehicle access would enter from Culver Boulevard just east of the intersection with Nicholson Street and there would be a dedicated drop-off/pickup area for buses. This entrance to the Ballona Wetlands Ecological Reserve would include interpretive signs, shade structures, seating, picnic tables, and restrooms. New gates and fences would be installed on the perimeter of the West Culver Parking Lot, and public parking would be available from dawn to dusk. Parking would be gated and locked after hours. A driveway located along Culver Boulevard and another driveway located along Vista del Mar at Culver Place provides access to this parking lot.

ACCESS AND CIRCULATION

The Project would develop and improve public access, recreation, and interpretative opportunities within the Project site and includes construction of three primary entrances into the Ballona Wetlands Ecological Reserve with adjacent parking, new trails, and new interpretive features and amenities. The public access plan is illustrated in Figure 3.

The three primary entrances would provide access to pedestrians and bicyclists with a series of several smaller secondary entrances leading to the walking and biking trail network around and within the site. One primary entrance serving pedestrians and bicyclists would be located in Area A along Culver Boulevard, west of Lincoln Boulevard. A second entrance would be located in Area A adjacent to the proposed parking structure in the Ballona Wetlands Ecological Reserve across from Fisherman’s Village along Fiji Way. The remaining entrance would be located at the West Culver Parking Lot in the southwestern corner of West Area B in Playa del Rey.



SOURCE: Melendrez

FIGURE 3
BALLONA WETLANDS ECOLOGICAL RESERVE - PUBLIC ACCESS PLAN
H-22

RAJU Associates, Inc.

Several secondary entrances would also be created to allow pedestrians and cyclists to access trails in the Ballona Wetlands Ecological Reserve from adjacent neighborhoods. Secondary entrances would consist of a small gate with informational and directional signage to help visitors position themselves on the site.

The Project would provide a new bicycle and pedestrian bridge over Ballona Creek adjacent to the Culver Boulevard vehicular bridge between Area A and North Area B/East Area B. The bridge would be 25 feet wide and would include a 11 feet wide pedestrian path, 10 feet wide bicycle path, and 2 feet wide shoulders. The bridge would connect the existing Ballona Creek Bike Path to the proposed Ballona Wetlands Ecological Reserve pedestrian and bicycle path system. An overlook would be provided, with information provided about the rerouting of Ballona Creek. The Project would also provide a new pedestrian bridge over Lincoln Boulevard connecting Area A with North Area C. The bridges would serve two purposes: 1. During construction, the bridges would allow movement of soil among Areas A, B, and C, reducing the need to use of surface streets such as Culver Boulevard and Lincoln Boulevard.; and 2. after construction is completed, the bridges would allow visitors to cross Ballona Creek and Lincoln Boulevard using paths and trails within Ballona Wetlands Ecological Reserve.

STUDY SCOPE

The base assumptions, technical methodologies and geographic coverage of the study were all identified as part of the study approach. The study is directed at the analysis of potential traffic impacts on the street system produced by the Proposed Project and includes an analysis of the following scenarios:

- Existing (2015) Conditions - The analysis of existing traffic conditions is intended to provide a basis for the remainder of the study. The existing conditions analysis includes an assessment of streets, traffic volumes, and operating conditions.

- Existing (2015) Plus Project Conditions – The net traffic expected to be generated by the Proposed Project is estimated and added to the Existing (2015) traffic volumes. The impacts of the Proposed Project on existing traffic operating conditions are then identified.

- Cumulative (2023) Base Conditions - Future traffic conditions in the year 2023 without the Proposed Project has been developed. The objective of this analysis is to project future traffic growth and operating conditions, which could be expected to result from regional growth and related projects in the vicinity of the study area by the year 2023, the year in which the project will be completed.

- Cumulative (2023) Plus Project Conditions – The net traffic expected to be generated by the Proposed Project is estimated and added to the Cumulative (2023) Base traffic forecasts. The impacts of the Proposed Project on future traffic operating conditions are then identified.

For this traffic study, 18 locations were defined as study intersections. All 18 study intersections are controlled by traffic signals (see Figure 1 for their location) and include the following:

1. Admiralty Way and Bali Way
2. Admiralty Way and Mindanao Way
3. Admiralty Way and Fiji Way
4. Lincoln Boulevard and Washington Boulevard
5. Lincoln Boulevard and Marina (SR-90) Expressway - Los Angeles County Congestion Management Program (CMP) monitoring location
6. Lincoln Boulevard and Bali Way
7. Lincoln Boulevard and Mindanao Way
8. Lincoln Boulevard and Fiji Way
9. Lincoln Boulevard and Culver Boulevard Ramps
10. Lincoln Boulevard and Jefferson Boulevard
11. Lincoln Boulevard and Bluff Creek Drive
12. Nicholson Street and Culver Boulevard
13. Culver Boulevard and Jefferson Boulevard
14. Culver Boulevard and Marina (SR-90) Freeway Eastbound Ramps
15. Culver Boulevard and Marina (SR-90) Freeway Westbound Ramps
16. Mindanao Way and Marina (SR-90) Expressway Eastbound
17. Mindanao Way and Marina (SR-90) Expressway Westbound
18. Vista del Mar/Vista del Mar Lane & Culver Boulevard

This traffic study has been prepared in accordance with the latest City of Los Angeles traffic study guidelines titled *Traffic Study Policies and Procedures*, August 2014.

ORGANIZATION OF REPORT

An executive summary presenting key details of the study is provided at the beginning of this report. The rest of the report is divided into seven chapters. Chapter I presents an introduction and provides details of the various elements of the study. Chapter II describes the existing circulation system, traffic volumes, and traffic conditions within the study area. Chapter III describes the development of the Proposed Project's traffic projections. The methodology to develop Future Year 2023 traffic volume forecasts without and with the Proposed Project is described and applied in Chapter IV. Chapter V presents assessment of traffic conditions with and without the project and the potential traffic impacts due to the Proposed Project. Project construction impacts evaluation is presented in Chapter VI. The results of the analysis of the Proposed Project's impacts on the CMP regional transportation system are provided in Chapter VII. Chapter VIII discusses the Project alternatives analyses. A summary of the analysis and study conclusions is included in Chapter IX. Appendices to this report include details of the technical analyses.

II. EXISTING CONDITIONS

A comprehensive data collection effort was undertaken to develop a detailed description of existing conditions within the study area. The assessment of conditions relevant to this study includes an inventory of the street system, traffic volumes on these facilities, and operating conditions at key intersections. A detailed description of these elements is presented in this chapter. The existing transit system serving the study area is also described in this chapter.

STUDY AREA

The Proposed Project is divided into three main areas, called Areas A, B, and C, with Areas B and C further divided for design and analyses purposes and is illustrated in Figure 2. Area A is located on the northern side of the Ballona Wetlands Ecological Reserve, north of Ballona Creek and west of Lincoln Boulevard. Fiji Way borders the north and west sides of Area A.

Area B is located on the southern side of the Ballona Wetlands Ecological Reserve, south of Ballona Creek and west of Lincoln Boulevard. Both Culver Boulevard and Jefferson Boulevard are located within Area B. Area B is divided into several subareas including North Area B, West Area B, South Area B, Southeast Area B and East Area B.

Area C is located on the eastern side of the Ballona Wetlands Ecological Reserve, north of Ballona Creek and east of Lincoln Boulevard. Culver Boulevard divides Area C into North Area C and South Area C. State Route 90 (the Marina Freeway) is located along the northeastern edge of Area C and the freeway and on-ramp embankment is not part of the Reserve. The southeastern half of South Area C is the home of the Culver Marina Little League, including four baseball fields along with associated parking and concessions/maintenance facilities.

The study area is bounded by Washington Boulevard on the north, the Marina Freeway on the east, Bluff Creek Drive on the south, and Nicholson Street on the west. The street system within study area is under the jurisdiction of the City of Los Angeles, County of Los Angeles, and Caltrans. The Marina (SR-90) Freeway is located adjacent to the eastern frontage of the Project site and the San Diego (I-405) Freeway is located approximately 2 miles east of the Project site.

EXISTING STREET SYSTEM

The existing street system within the study area consists of a regional highway system including major arterials and a local street system including secondary arterials, collectors and local streets. A description of the regional and local access and circulation offered by the various roadways follows.

The San Diego (I-405) Freeway and Marina (SR-90) Freeway provide the primary regional access to the study area. The major and other arterial streets used to access the study area include Washington Boulevard, Lincoln Boulevard, Jefferson Boulevard, Culver Boulevard, Bluff Creek Drive, Admiralty Way and Mindanao Way. Bali Way, Fiji Way and Nicholson Street provide local access and circulation. Brief descriptions of the arterial facilities serving the study area are included in the following section. The existing lane configurations of the analyzed intersections are included in Appendix A.

- Lincoln Boulevard – Lincoln Boulevard is a major arterial roadway that runs in a north-south direction across several jurisdictions. The posted speed limit is 40 or 45 miles per hour in the vicinity of the study area. Within the study area, the roadway generally offers six to eight travel lanes, three to four lanes in each direction with left-turn lanes at all intersections. Generally, no parking is allowed along many stretches of this roadway within the study area.

- Washington Boulevard – Washington Boulevard is a major arterial roadway that traverses in an east-west direction. This roadway offers four travel lanes, two lanes per direction, with a central left-turn median. Restricted parking is allowed along many stretches of this roadway, generally, except at major intersections where turn lanes are provided. The posted speed limit is 35 miles per hour.

- Jefferson Boulevard – Jefferson Boulevard is a major arterial roadway that traverses in an east-west direction across several jurisdictions. It generally provides six to seven travel lanes, three lanes in the westbound direction and three to four lanes in the eastbound

direction. This roadway provides connection to the I-405 northbound and southbound on-off ramps. Parking is allowed on the north side of the street between Grosvenor Boulevard and Centinela Avenue and restricted parking is available for a short stretch on either side of the street between Inglewood Boulevard and Mesmer Avenue. The posted speed limit is 45 miles per hour.

- Culver Boulevard – Culver Boulevard is a major arterial roadway that traverses in a north/east-south/west direction. This roadway offers four travel lanes, two lanes per direction. Restricted parking is allowed along many stretches of this roadway, generally, except at major intersections where turn lanes are provided. Within the study area, the posted speed limit is 40 miles per hour.

- Bluff Creek Drive – Bluff Creek Drive is classified as a secondary arterial roadway and transverses in an east-west direction. Currently, it runs from Lincoln Boulevard to Dawn Creek and from Westlawn Avenue to Centinela Avenue. The roadway generally provides four travel lanes, two lanes in each direction. Six travels lanes are provided east of Campus Center Drive to Centinela Avenue. Parking is generally not allowed along this roadway. The roadway section between Dawn Creek and Westlawn Avenue is anticipated to be completed by 2023 and would provide connectivity between Lincoln Boulevard to Centinela Avenue.

- Admiralty Way – Admiralty Way is a secondary highway that traverses generally in a north-south direction from Via Marina to Fiji Way. The posted speed limit is 40 miles per hour. This roadway generally offers four travel lanes, two lanes in each direction, with a raised median and left-turn lanes at key intersections. On-street parking is not allowed on either side of the street along this roadway.

- Mindanao Way – Mindanao Way is a secondary arterial roadway that traverses in an east-west direction. Mindanao Way provides access to Burton Chase Park, the Marina del Rey Basin G berths, the Marina Freeway and points east. The posted speed limit is 30 miles per hour. The roadway generally offers four travel lanes, two lanes in each direction, with a raised central median between Admiralty Way and Marina Freeway. Within the study area, on-street parking is generally not allowed on either side of the street.

- Bali Way – Bali Way is a short local roadway that traverses in an east-west direction. The posted speed limit is 30 miles per hour. Bali Way provides connectivity from Lincoln Boulevard to Admiralty Way and points west and provides access to the Marina del Rey Basin F and Basin G areas. This roadway offers two lanes in each direction between Lincoln Boulevard and Admiralty Way. On-street parking is not allowed on either side of the street within that stretch.

- Fiji Way – Fiji Way is a local roadway and traverses in an east-west direction. This roadway provides four travel lanes, two lanes in each direction, with a raised central median between Lincoln Boulevard and Admiralty Way. Within the study area, on-street parking is not allowed on either side of the street. The posted speed limit along this facility is 35 miles per hour.

- Nicholson Street – Nicholson Street is a local roadway that traverses in a north-south direction. This roadway offers one travel lanes per direction. Within the study area, on-street parking is not allowed on either side of the street.

- Pershing Drive – Pershing Drive is a major arterial that traverses in a north-south direction and provides connectivity from Culver Boulevard to Imperial Highway. Within the study area, Pershing Drive provides three to four travel lanes, two lanes in the southbound direction and one to two in the northbound direction. Parking is allowed along most stretches of this roadway. The posted speed limit is 35 miles per hour.

- Vista Del Mar – Vista Del Mar is a major arterial that traverses in a north-south direction and provides connectivity from Culver Boulevard to Imperial Highway. Within the study area, Vista Del Mar provides four travel lanes, two lanes per direction; with left-turn lanes at major intersections. Parking is not allowed along this roadway. The posted speed limit is 40 miles per hour.

EXISTING TRAFFIC VOLUMES AND LEVELS OF SERVICE

The following sections present the existing intersection peak hour traffic volumes, a description of the methodology utilized to analyze the intersection traffic conditions, and the resulting level of service conditions at each of the study intersections.

Existing Traffic Volumes

Weekday morning and evening peak hour traffic counts were compiled from data collected at the analyzed intersections in March and April 2015. These traffic volumes reflect typical weekday operations during current year 2015 conditions. The traffic volumes in Figure 4 represent, for the purposes of this analysis, the Existing 2015 AM and PM peak hour conditions. The raw data showing the raw traffic counts are attached in Appendix B.

Level of Service Methodology

Level of service (LOS) is a qualitative measure used to describe the condition of traffic flow, ranging from excellent conditions at LOS A to overloaded conditions at LOS F. LOS D is typically recognized as the minimum acceptable level of service in urban areas. The Level of service definitions for signalized intersections is provided in Table 1. All of the analyzed intersections are controlled by traffic signals.

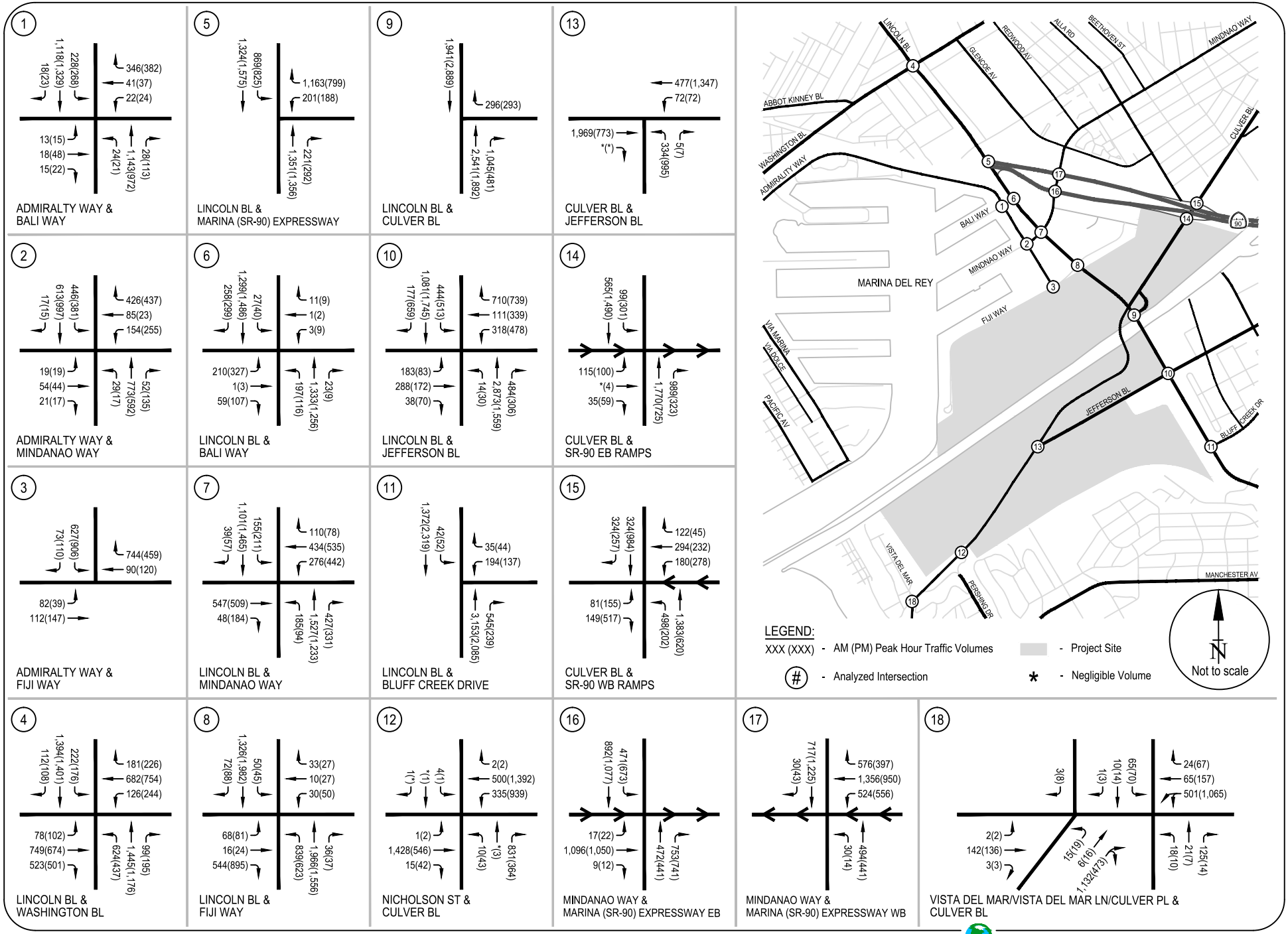


FIGURE 4
EXISTING (2015) CONDITIONS - PEAK HOUR TRAFFIC VOLUMES

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TABLE 1
LEVEL OF SERVICE DEFINITIONS FOR SIGNALIZED INTERSECTIONS

Level of Service	Volume/Capacity Ratio	Definition
A	0.000 - 0.600	EXCELLENT. No vehicle waits longer than one red light and no approach phase is fully used.
B	>0.600 - 0.700	VERY GOOD. An occasional approach phase is fully utilized; many drivers begin to feel somewhat restricted within groups of vehicles.
C	>0.700 - 0.800	GOOD. Occasionally drivers may have to wait through more than one red light; backups may develop behind turning vehicles.
D	>0.800 - 0.900	FAIR. Delays may be substantial during portions of the rush hours, but enough lower volume periods occur to permit clearing of developing lines, preventing excessive backups.
E	>0.900 - 1.000	POOR. Represents the most vehicles intersection approaches can accommodate; may be long lines of waiting vehicles through several signal cycles.
F	> 1.000	FAILURE. Backups from nearby locations or on cross streets may restrict or prevent movement of vehicles out of the intersection approaches. Tremendous delays with continuously increasing queue lengths.

Source: Transportation Research Board, *Transportation Research Circular No. 212, Interim Materials on Highway Capacity* , 1980.

The "Critical Movement Analysis-Planning", (Transportation Research Board, 1980) method of intersection capacity analysis was used to determine the intersection volume to capacity (V/C) ratio and corresponding level of service at the signalized study intersections within both the City of Los Angeles and County of Los Angeles. Level of service spreadsheets developed by LADOT were used to implement the CMA (Circular 212 Method) methodology. Table 1 defines the ranges of V/C ratios and corresponding levels of service for signalized intersections.

Fifteen of the 18 study intersections are located in the City of Los Angeles and are currently controlled by the City of Los Angeles' Automated Traffic Surveillance and Control (ATSAC) System and Adaptive Traffic Control System (ATCS). In accordance with LADOT procedures, a capacity increase of 10% (0.07 V/C adjustment for ATSAC and 0.03 V/C adjustment for ATCS) was applied to reflect the benefits of ATSAC/ATCS control at these intersections.

The remaining three intersections are located in the County of Los Angeles and include the following intersections: Admiralty Way and Bali Way, Admiralty Way and Mindanao Way and Admiralty Way and Fiji Way. ATSAC/ATCS credit was not taken at these locations.

Existing Levels of Service

The existing traffic volumes presented in Figure 4 for AM and PM peak hours were used in conjunction with the level of service methodologies described above, and the current intersection characteristics illustrated in Appendix A, to determine the existing operating conditions at the analyzed intersections.

Table 2 summarizes the results of the intersection capacity analysis for existing conditions at each of the study intersections in the study area. The table indicates the existing V/C ratio during the morning and evening peak hours and the corresponding LOS at the study intersections. As illustrated in the table, all 18 of the study intersections are currently operating at LOS D or better during both the morning and evening peak hours.

Capacity calculation worksheets for Existing (2015) conditions are provided in Appendix C of the report.

TABLE 2
EXISTING (2015) WEEKDAY INTERSECTION LEVEL OF SERVICE ANALYSIS

No.	Intersection	Existing (2015) Conditions			
		AM Peak Hour		PM Peak Hour	
		V/C	LOS	V/C	LOS
1.	Admiralty Way & Bali Way	0.616	B	0.627	B
2.	Admiralty Way & Mindanao Way	0.667	B	0.587	A
3.	Admiralty Way & Fiji Way	0.451	A	0.338	A
4.	Lincoln Boulevard & Washington Boulevard	0.837	D	0.783	C
5.	Lincoln Boulevard & Marina (SR-90) Expressway [1]	0.717	C	0.676	B
6.	Lincoln Boulevard & Bali Way	0.509	A	0.552	A
7.	Lincoln Boulevard & Mindanao Way	0.710	C	0.781	C
8.	Lincoln Boulevard & Fiji Way	0.628	B	0.720	C
9.	Lincoln Boulevard & Culver Loop	0.805	D	0.535	A
10.	Lincoln Boulevard & Jefferson Boulevard	0.840	D	0.639	B
11.	Lincoln Boulevard & Bluff Creek Drive	0.544	A	0.360	A
12.	Nicholson Street & Culver Boulevard	0.652	B	0.798	C
13.	Jefferson Boulevard & Culver Boulevard	0.727	C	0.810	D
14.	Culver Boulevard & SR-90 Eastbound Ramps	0.436	A	0.463	A
15.	Culver Boulevard & SR-90 Westbound Ramps	0.798	C	0.873	D
16.	Mindanao Way & Marina (SR-90) Expressway Eastbound	0.756	C	0.809	D
17.	Mindanao Way & Marina (SR-90) Expressway Westbound	0.572	A	0.559	A
18.	Vista del Mar/Vista del Mar Lane & Culver Boulevard	0.782	C	0.653	B

[1] Los Angeles County Congestion Management Program monitoring location.

The following section provides description of public transit operated by public agencies and municipalities.

EXISTING TRANSIT CONDITIONS

Nine bus lines currently serve the study area. Three bus lines are operated by the Los Angeles County Metropolitan Transportation Authority (LACMTA), three bus lines are operated by the Culver City Bus (CC), two bus lines, including one 'Rapid Bus' line, are operated by Santa Monica Big Blue Bus (SM) and one bus line is operated by the Los Angeles Department of Transportation (CE. These transit lines are described below:

- LACMTA 108 - Line 108 is a local east/west line that provides service from Marina Del Rey to Pico Rivera and travels primarily along Via Marina, Admiralty Way and Mindanao Way within the study area. This line runs every day, including holidays, at a peak frequency of approximately 20-30 minutes during peak commute hours. The western terminus is at the intersection of Palawan Way/Washington Boulevard in Marina Del Rey. The eastern terminus is at the intersection of Paramount Boulevard/Slauson Avenue in Pico Rivera.

- LACMTA 110 - Line 110 is a local east/west line that provides service from Playa Vista to Bell Gardens and travels primarily along Jefferson Boulevard within the study area. This line runs every day, including holidays, at a peak frequency of approximately 8-10 minutes during peak commute hours. The western terminus is at intersection of Playa Vista Drive/Jefferson Boulevard in Playa Vista. The eastern terminus is at the intersection of Granger Avenue/Florence Avenue in Bell Gardens.

- LACMTA 358 - Line 358 is a local, limited stop, east/west line that provides service from Marina Del Rey to Pico Rivera and travels primarily along Via Marina, Admiralty Way and Mindanao Way within the study area. This line runs Monday through Friday, at a frequency of 15-25 minutes during peak commute hours. The western terminus is at the intersection of Washington Boulevard and Palawan Way in Marina Del Rey. The eastern terminus is at the intersection of Paramount Boulevard/Slauson Avenue in the City of Pico Rivera.

- CC Line 1 – Line 1 is a local east/west line that provides service from Venice through Culver City to West Los Angeles and travels primarily along Washington Boulevard in the vicinity of the study area. This line runs every day, including holidays, at a peak frequency of approximately 12 minutes during peak commute hours. The western terminus is at the intersection of Main Street/Windward Circle in Venice. The eastern terminus is at the intersection of Fairfax Avenue/Washington Boulevard in West Los Angeles.

- CC Line 2 – Line 2 is a local east/west line that provides service from Culver City to Venice and travels primarily along Washington Boulevard and Lincoln Boulevard in the vicinity of the study area. This line runs Monday through Friday at a frequency of approximately 60 minutes. Service is not provided on weekends and holidays. The western terminus is at Venice High School in Venice. The eastern terminus is at the Culver City Transit Center near the intersection of Sepulveda Boulevard/Slauson Avenue in Culver City.

- CC Line 7 – Line 7 is a local east/west line that provides service from Marina Del Rey to Culver City and travels primarily along Admiralty Way, Fiji Way, Bali Way, Lincoln Boulevard and Culver Boulevard within the study area. This line runs Monday through Friday at a frequency of approximately 30 minutes. Service on weekends and holidays is not provided. The western terminus is at Fisherman's Village in Marina Del Rey. The eastern terminus is at the Metro Expo Line Robertson Station in Culver City.

- SM 3 – Santa Monica Big Blue Bus Line 3 is a local north/south line that provides service from Santa Monica to Inglewood and travels primarily along Lincoln Boulevard within the study area. This line runs every day, including holidays, at a peak frequency of 12-15 minutes during peak commute hours. The northern terminus is at the intersection of 5th Street/Arizona Avenue in Santa Monica. The southern terminus is at the Metro Green Line Aviation Station in Inglewood.

- SM Rapid 3 – Santa Monica Bus Blue Bus Line Rapid 3 is a north/south "rapid bus" line that provides service from Santa Monica to Inglewood and travels primarily along Lincoln Boulevard within the study area. This line runs Monday through Friday at a peak frequency of approximately 10 minutes during peak commute hours. Service is not provided on weekends and holidays. The northern terminus is at the intersection of 5th Street/Arizona Avenue in Santa Monica. The southern terminus is at the Metro Green Line Aviation Station in Inglewood.

- CE 437 – Line 437 is a LADOT Commuter Express line that provides service from Downtown Los Angeles to Marina Del Rey and travels primarily along Pacific Avenue, Via Marina, Admiralty Way and Mindanao Way within the study area. This line runs Monday through Friday and provides service only during peak commute hours. During the morning peak hours, it runs in the eastbound direction only, from Marina del Rey to Downtown Los Angeles, with a frequency of approximately 22-24 minutes. During the evening peak hours, it runs in the westbound direction only, from Downtown Los Angeles to Marina del Rey, with a frequency of approximately 30 minutes. Service is not provided during weekday off-peak hours and on weekends and holidays. The western terminus is at the intersection of Pacific Avenue/Washington Boulevard in Marina Del Rey. The eastern terminus is at the intersection of San Pedro Street/Temple Street in Downtown Los Angeles.

These public transit lines within the study area are illustrated in Figure 5. It can be observed from Figure 5 that there is a robust transit network serving the study area. Private tour operators also provide visitor tours in the study area.

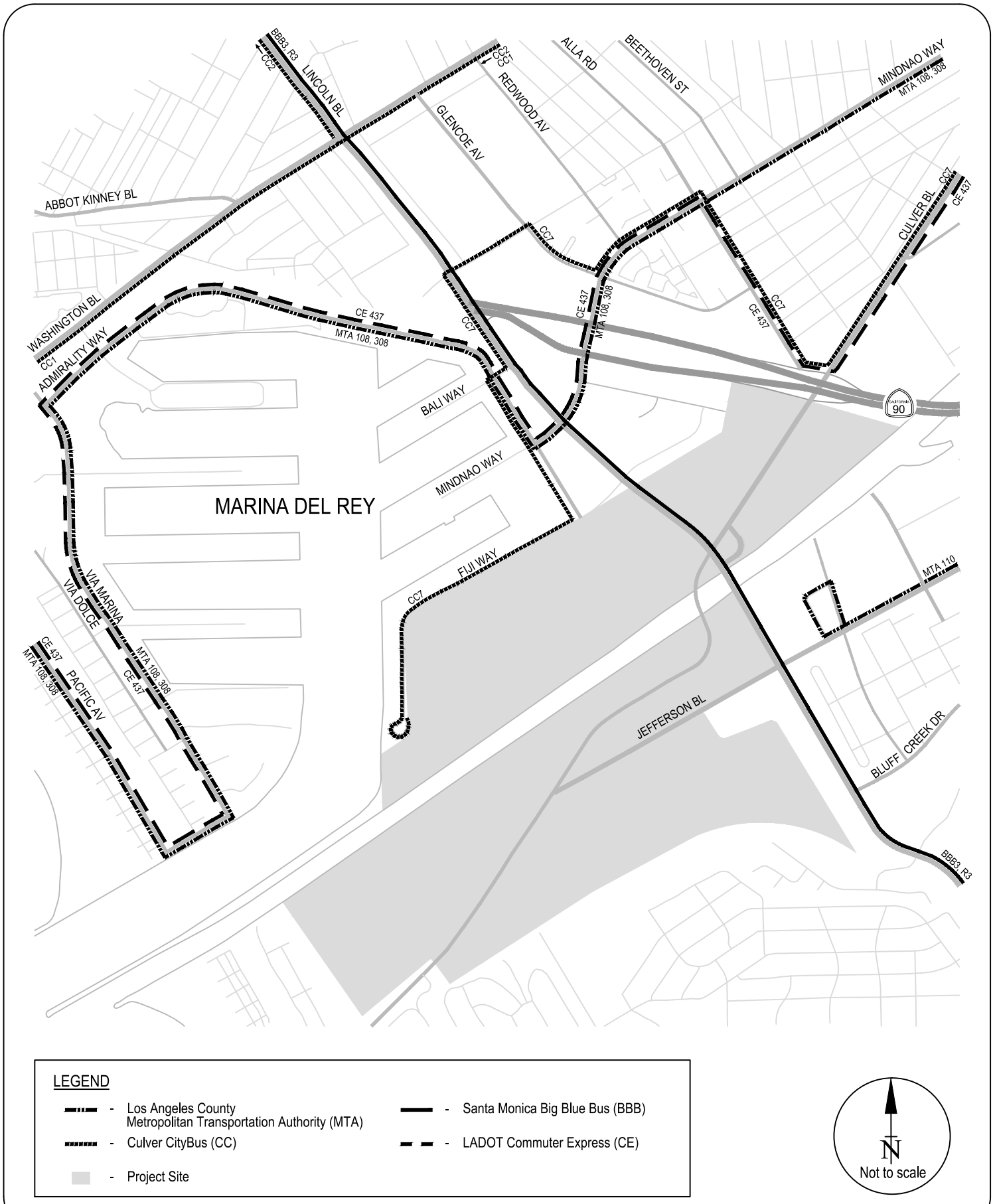

FIGURE 5
EXISTING TRANSIT LINES

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III. PROJECT TRAFFIC PROJECTIONS

In order to properly evaluate the potential impact of the Proposed Project on the local street system, estimates of the Project traffic volumes were developed. The traffic generated by the Proposed Project was estimated and assigned separately to the street system. The addition of Project traffic and existing traffic volumes represents the Existing (2015) plus Project scenario. Traffic projections for future scenarios are described in the next chapter.

PROJECT TRAFFIC VOLUMES

The development of traffic generation estimates for the Proposed Project involves the use of a three-step process: trip generation, trip distribution and traffic assignment.

Project Trip Generation

Implementation of the Proposed Project consists of restoration of the Ballona Wetlands Ecological Reserve which includes enhancing and creating native coastal wetland and upland habitats in the approximately 581-acre Reserve. The Project would develop and improve public access, recreation, and interpretative opportunities within the Project site with new parking, new trails, and new interpretive features and amenities. The Proposed Project would require minimal operation and maintenance (O&M) activities. The O&M activities include current and ongoing routines that do not occur on a daily basis and would not generate any new trips. Other future O&M activities also would not occur on a daily basis and any trips associated with those activities would be minimal.

Utilizing the ITE's Trip Generation *Manual*, 9th Edition trip rates, the Proposed Project's trip generation was determined. For the purpose of this analysis, ITE trip generation rates for Land Use Code 412 - County Park Land Use was used for estimating the project's peak hour trip generation. Table 3 presents details of the Proposed Project's trip generation including type of use, size, applicable rate and trip generation estimates.

TABLE 3
ESTIMATED PROJECT WEEKDAY TRIP GENERATION

	Size	Daily	AM Peak Hour			PM Peak Hour		
			IN	OUT	TOTAL	IN	OUT	TOTAL
Proposed Project Ballona Wetlands Ecological Reserve	581 acres	378	7	5	12	32	20	52
Trip Rates [1] State Park/County Park (ITE Land Use 413/412)	Trips per acre	0.65	61%	39%	0.02	61%	39%	0.09

[1] Trip generation of the Ballona Wetlands Ecological Reserve was estimated using county park and state park trip generation rates from ITE Trip Generation Manual, 9th Edition, 2012.

From Table 3, it can be observed that the Proposed Project's trip generation would result in a total of approximately 378 daily trips of which 12 trips would occur during the morning peak hour and 52 trips during the evening peak hour.

Project Trip Distribution

The Project's trip distribution was based on various factors such as project site location, points of access of the project driveways, availability of major and secondary arterials connecting to the regional freeway system as well as professional judgment and knowledge of local travel patterns within the study area. The geographic distribution for Project trips was assumed to be the following:

- To and From the North: 25%
- To and From the South: 25%
- To and From the East: 40%
- To and From the West: 10%

Intersection level trip distribution percentages are shown in Figures 6A and 6B. Based on these distribution assumptions, location and points of access of the project driveways (both to the Proposed County Parking Structure in Area A and the West Culver Parking Lot in Area B), and trip generation estimates from the Proposed Project, traffic estimates of project-only trips were developed. These project-only trips are presented in Figure 7.

EXISTING (2015) PLUS PROJECT TRAFFIC VOLUMES

Utilizing the project-only traffic estimates for both AM and PM peak hours, traffic forecasts for the Existing (2015) plus Project conditions were developed. The Existing (2015) traffic volumes were combined with the project-only traffic volumes to obtain the Existing with Project traffic volume forecasts. The Existing (2015) plus Project traffic volumes during both AM and PM peak hours are presented in Figure 8.

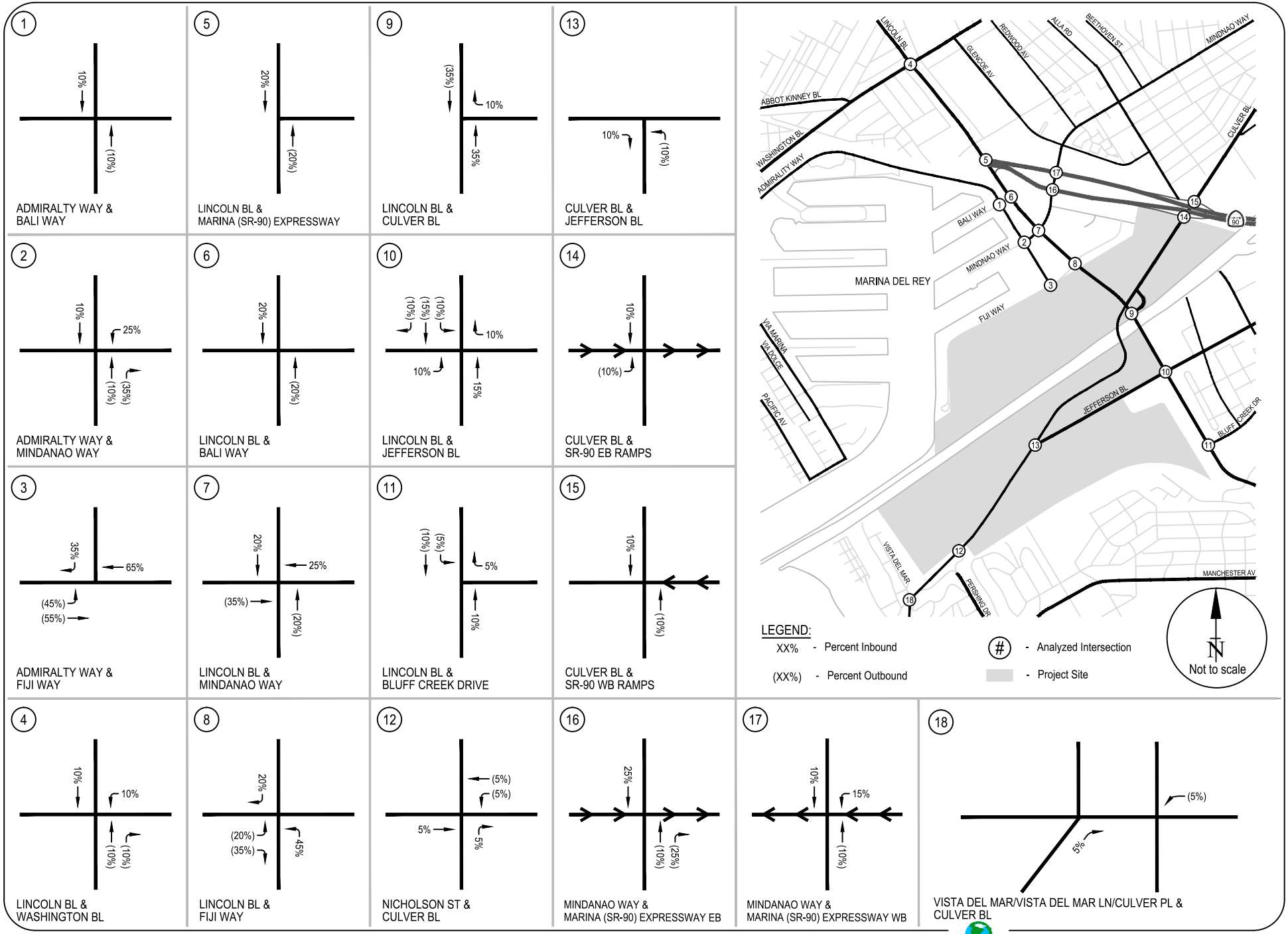

FIGURE 6A
PROJECT TRIP DISTRIBUTION
TO/FROM AREA A - PROPOSED COUNTY PARKING STRUCTURE

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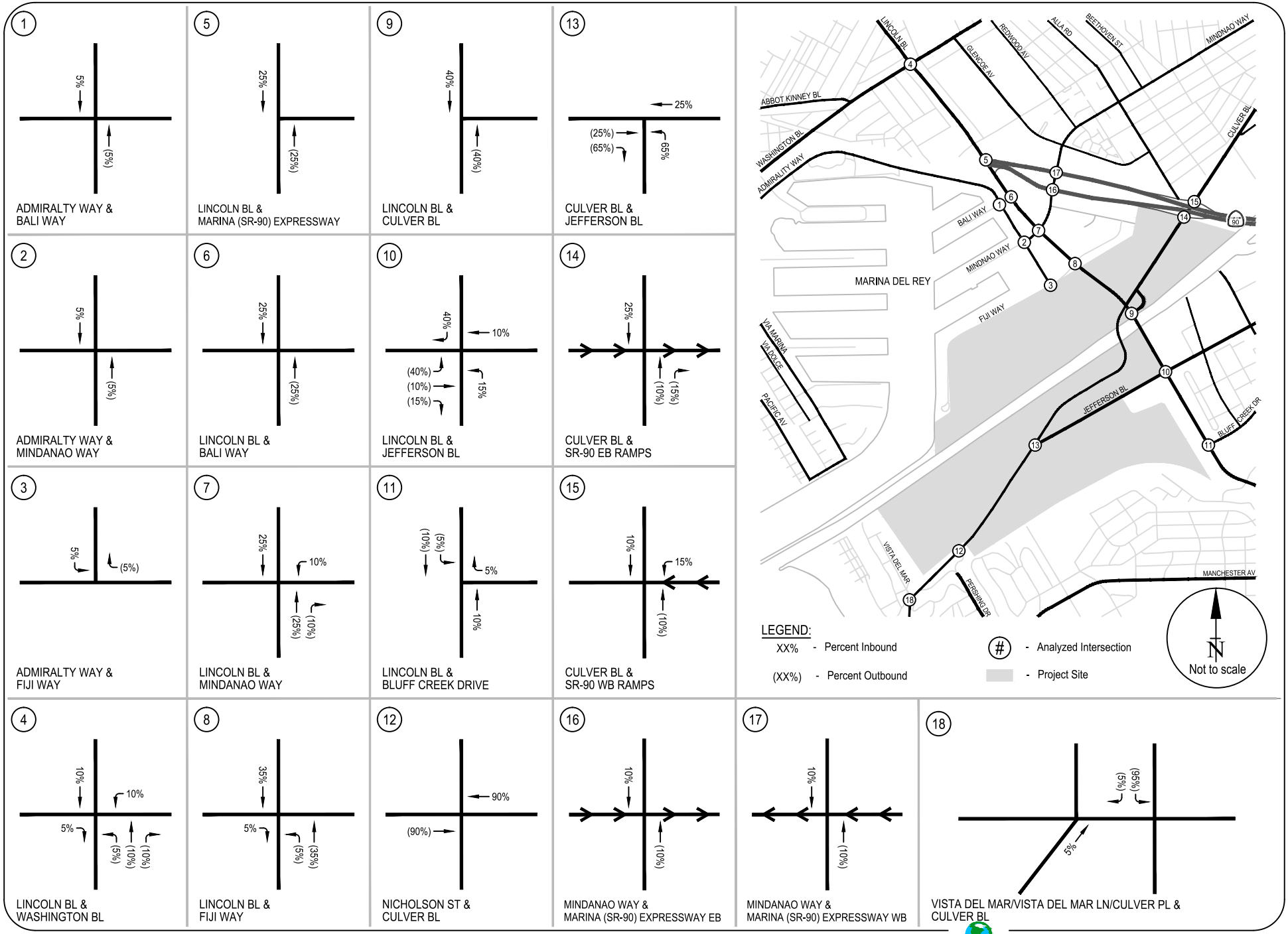

FIGURE 6B
PROJECT TRIP DISTRIBUTION
TO/FROM AREA B - WEST CULVER PARKING LOT

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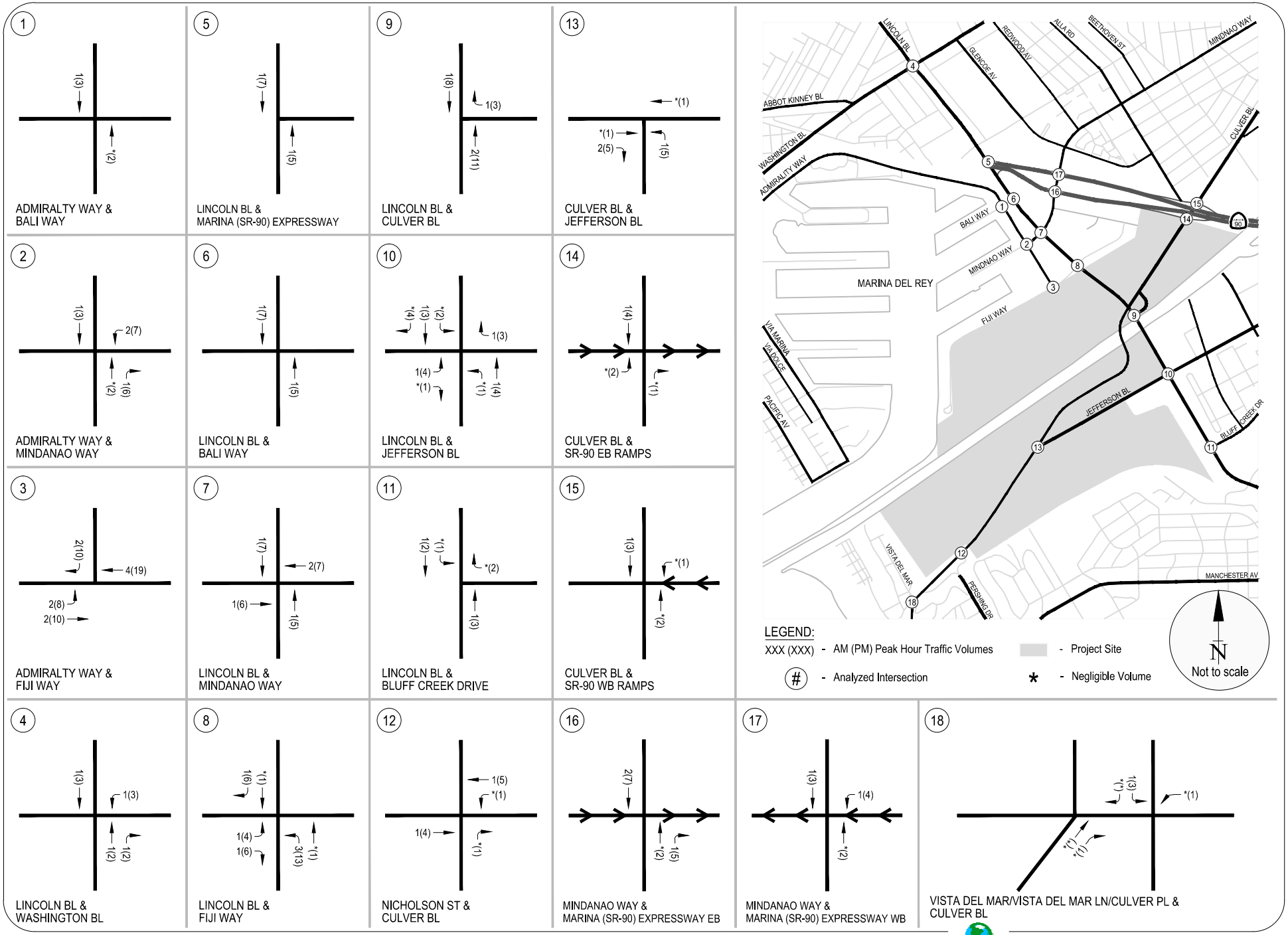

FIGURE 7
PROJECT ONLY - PEAK HOUR TRAFFIC VOLUMES

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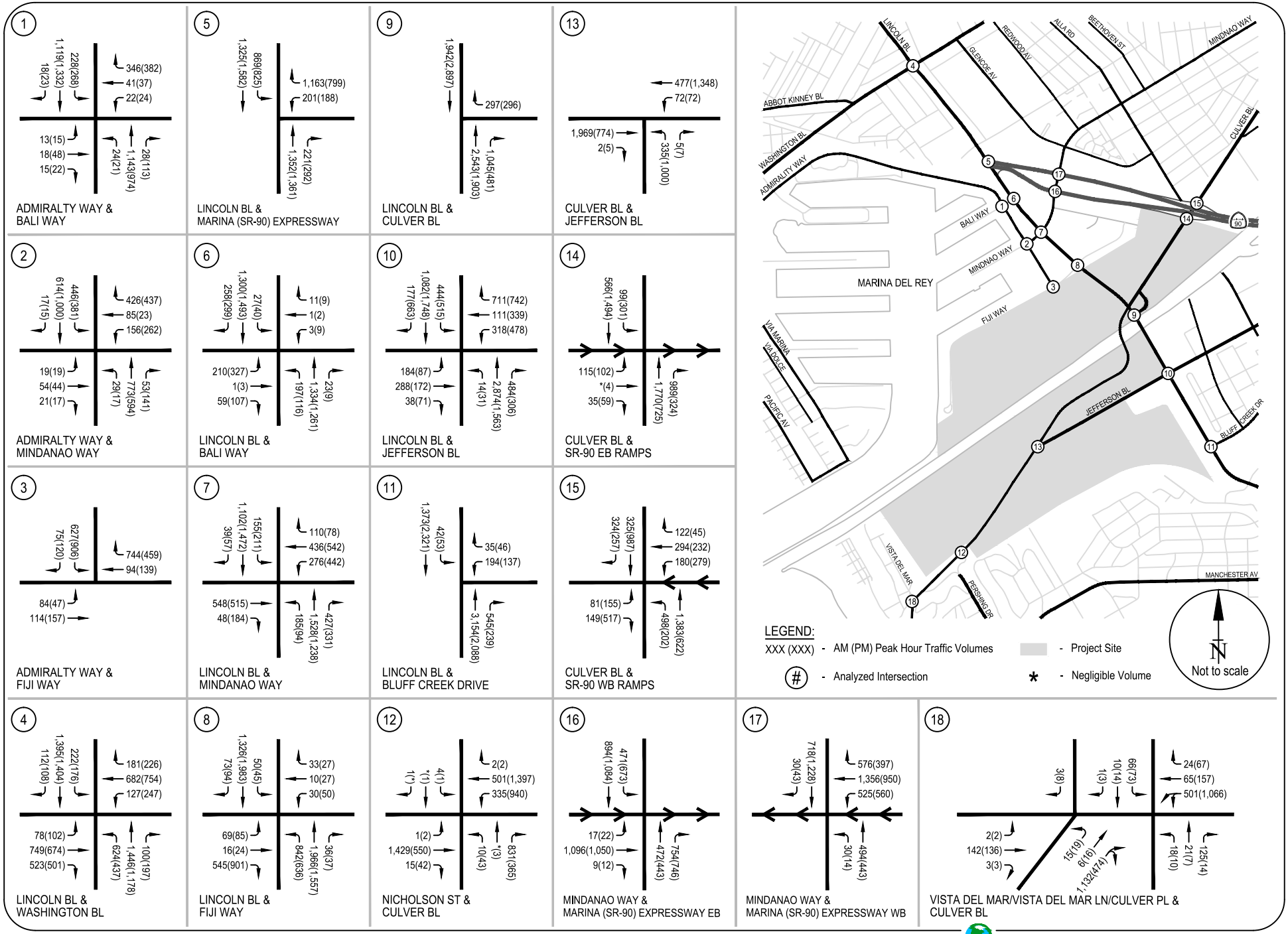

FIGURE 8
EXISTING (2015) PLUS PROJECT CONDITIONS - PEAK HOUR TRAFFIC VOLUMES

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IV. FUTURE YEAR 2023 TRAFFIC PROJECTIONS

The Proposed Project is expected to be completed by Year 2023. In order to properly evaluate the potential impact of the Proposed Project on the local street system, estimates of the Future Year 2023 traffic volumes both with and without the Project were developed. The Future Year 2023 without the Project was first developed including estimates for background growth in area-wide trip making and trips generated by future developments (related projects) in the vicinity of the study area. The Future (2023) without Project traffic represents the cumulative base conditions. Next, the traffic generated by the Proposed Project was estimated and assigned separately to the street system. The addition of Project traffic and the cumulative base traffic volumes provides traffic volume estimates for the Future Cumulative (2023) plus Project scenario. Each of these future traffic scenarios is described further in this chapter.

CUMULATIVE (2023) BASE TRAFFIC PROJECTIONS

The Cumulative (2023) Base traffic projections reflect growth in traffic from two primary sources: Firstly, the background or ambient growth to reflect the effects of overall area-wide regional growth both within and outside the study area; and secondly, from traffic generated by specific related (cumulative) projects located within, or in the vicinity of, the study area. Each of these components is described below.

Area-wide Ambient Traffic Growth

Utilizing the traffic growth observed in City of Los Angeles' Travel Demand Forecasting Model, the traffic in the vicinity of the study area was estimated to increase at a rate of about 0.57% per year during the morning peak hour and 0.64% per year during the evening peak hour. Future increases in background traffic volumes due to regional growth and development are expected to continue at this rate. With the assumed completion date of 2023, the Existing 2015 traffic volumes were adjusted upward by a factor of 4.56% during the morning peak hour and 5.12% during the evening peak hour to reflect this area-wide regional growth. The resulting Existing plus Ambient Growth (2023) traffic volumes are illustrated in Figure 9.

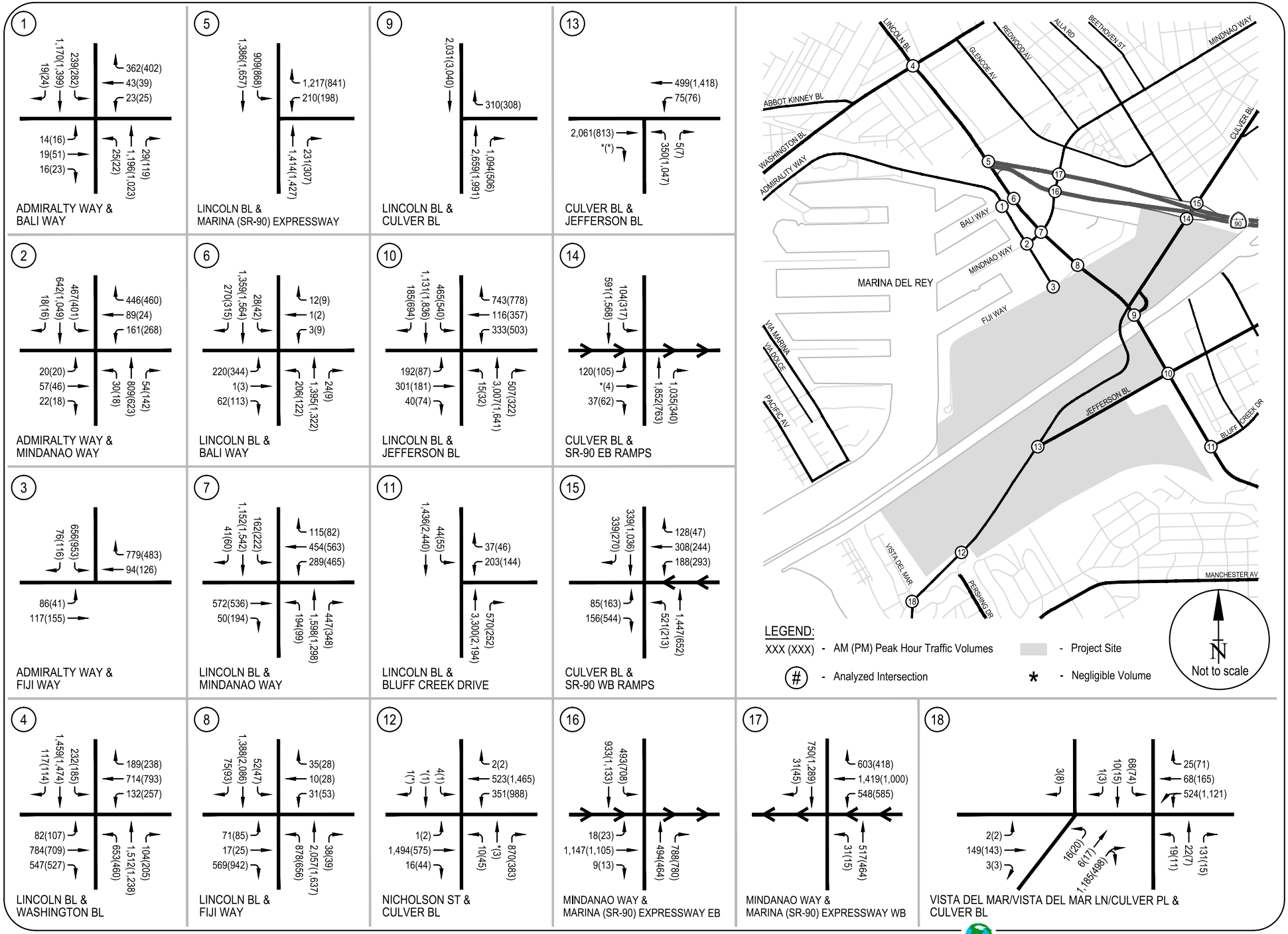

FIGURE 9
EXISTING WITH AMBIENT GROWTH (2023) CONDITIONS - PEAK HOUR TRAFFIC VOLUMES

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Related Projects Traffic Generation and Assignment

As indicated, the second potential source of traffic growth in the study area is that expected from other future development projects in the vicinity. These related or "cumulative" projects are those developments that are planned and expected to be in place within the same timeframe as the Proposed Project. Data describing related projects in the area was compiled from the City of Los Angeles, County of Los Angeles and Culver City. Thirty-one (31) related projects were identified within the study area and are listed in Table 4. The locations of these projects are shown in Figure 10.

The trip generation estimates for the related projects were based on different sources including trip generation rates contained in ITE's *Trip Generation Manual*, 9th Edition and trip generation estimates provided by the recently completed traffic studies for projects in the City of Los Angeles and is included in Table 4. As summarized in Table 4, the related projects are expected to generate approximately 13,772 trips during the morning peak hour and 16,737 trips during the evening peak hour. The geographic distribution and the traffic assignment of the related projects were performed and the results are shown in Figure 11.

Cumulative (2023) Base Traffic Volumes

The related projects' traffic estimates were added to the Existing plus Ambient Growth traffic to obtain the Cumulative (2023) Base traffic volumes. Figure 12 provides the Cumulative (2023) Base traffic volumes at each of the analysis intersections during both AM and PM peak hours. These volumes represent Future (2023) Cumulative Base (without project) conditions.

CUMULATIVE (2023) PLUS PROJECT TRAFFIC VOLUMES

Utilizing the project-only traffic estimates developed for both AM and PM peak hours, traffic forecasts for the Future Year 2023 plus Project conditions were developed. The Cumulative (2023) Base traffic forecasts were combined with the project-only traffic volumes to obtain the Future with Project traffic volume forecasts. The Future Year 2023 Cumulative plus Project traffic volumes during both AM and PM peak hours are presented in Figure 13.

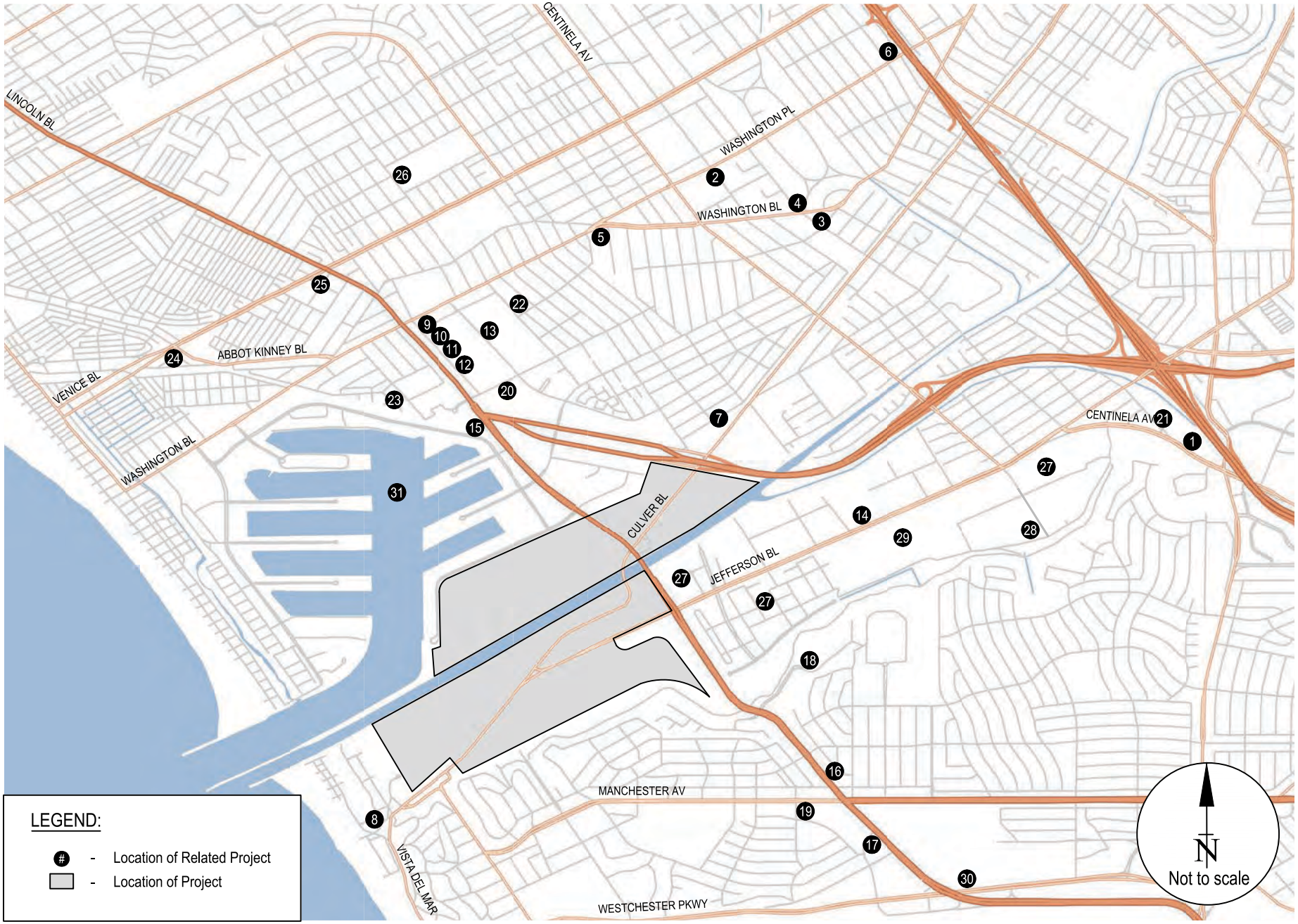

FIGURE 10
LOCATION OF RELATED PROJECTS

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TABLE 4
ESTIMATED WEEKDAY TRIP GENERATION OF RELATED PROJECTS

Map No.	Project Name	Location	Description	Daily	AM Peak Hour			PM Peak Hour		
					IN	OUT	TOTAL	IN	OUT	TOTAL
City of Culver City [1]										
1	Entrada Office Project	6161 W. Centinela Avenue	342,409 s.f. of commercial office use	3,442	442	60	502	79	383	462
2	Residential	4025 Grand View Boulevard	36 Townhome rental units	209	3	13	16	13	6	19
3	Commercial/Residential	11924-11960 Washington Boulevard	Mixed Use with 13,000 s.f. Commercial, 48 dwelling units in Culver City and 49 dwelling units in L.A. City, tandem parking.	2,514	38	58	96	119	105	224
4	Mixed-Use Project	11957 Washington Boulevard	Mixed-Use Project with 30 d.u. and 8,682 s.f. Retail	1,587	25	25	50	68	68	136
5	Residential/Commercial	12712-12718 Washington Boulevard	New 4-story mixed-use building with 5 units (11,516 s.f. Residential), 3,414 s.f. retail, plus subterranean parking	785	12	10	22	32	33	65
6	Commercial	11281 Washington Place	New Retail with 6,294 s.f. and 25 parking spaces.	1,125	18	11	29	45	49	94
City of Los Angeles [2]										
7	Marina Island Mixed-Use: Apartment & Office	5000 S. Beethoven Street	Mixed-Use: 156-Unit Apartment and 33,484 s.f. Office.	1,406	62	70	132	102	101	203
8	Mixed-use condominium and retail	138 Culver Boulevard	Mixed-use with 72-unit condominium, 13,000 s.f. retail space & 1,500 s.f. restaurant.	984	26	34	60	60	55	115
9	Mixed-Use: Apartment, Mini-Warehouse & Office	4040 S. Del Rey Avenue	New 195-Unit Apartment; 15,000 sf Office & 80,000 s.f. Mini-Warehouse (Option 1) or 235-Unit Apartment & 15,000 s.f. Office (Option 2 Preferred).	931	16	31	47	36	26	62
10	Apartment	4090 S. Del Rey Avenue	51 d.u. apartments	339	5	21	26	23	13	36
11	Apartment	4100 S. Del Rey Avenue	77 d.u. apartments	512	8	31	39	35	19	54
12	Mixed-Use: Condominium & Office	4210 S. Del Rey Avenue	Proposed 136 Condominium Units & 20,000 s.f. Commercial Office.	627	29	42	71	44	41	85
13	Mixed-Use: Apartment & Office	4140 S. Glencoe Avenue	67 d.u. apartments & 3,211 s.f. of office use	481	11	28	39	33	23	56
14	Office	12777 W. Jefferson Boulevard	Commercial Office Expansion (49,950 s.f.).	550	68	9	77	17	83	100
15	Mixed-Use: Condominium & Retail	4363 S. Lincoln Boulevard	Consultation: proposed 10-Story, 80 Condominium Units & 15,100 s.f. Supermarket.	695	11	28	39	42	26	68
16	Coffee Shop without Drive Through	8400 S. Lincoln Boulevard	Starbucks Coffee Shop (without Drive Through) within Shopping Center (1,522 s.f. In + 150 s.f. Out).	1,354	99	95	194	31	30	61
17	OTIS College of Arts & Design	9045 S. Lincoln Boulevard	Relocation & Consolidation of existing OTIS College Campus students, faculty & staff.	48	4	1	5	3	3	6
18	LMU Master Plan	1 LMU Drive	Increase enrollment capacity to 7,800 students.	2,540	146	30	176	129	128	257
19	Apartment	7280 W Manchester Avenue	126-unit apartment in-lieu of 24,000 s.f. retail space of the previously approved/entitled Decron mixed-use development.	887	13	52	65	57	31	88
20	Mixed-Use: residential & retail	13488 W. Maxella Avenue	The Villa Marina Mixed-Use: 244 Condominium Units and 9,000 s.f. Retail.	896	11	84	95	73	10	83
21	Mixed-Use: Apartment & Automotive Dealership	5748 S. Mesmer Avenue	New 400-Unit Apartment & 250,000 s.f. Automotive Dealership (West LA Hooman) - 5 Auto Dealers.	8,866	350	243	593	475	581	1056
22	Mixed-Use: Condominium & Office	4091 S. Redwood Avenue	67 d.u. condominium & 7,525 s.f. commercial office building with 141 parking spaces	391	4	21	25	29	22	51
23	LADPW Maintenance Yard	3233 Thatcher Avenue	Improve/expansion of the existing LADPW maintenance yard plus addition of 30 new employees to site.	100	12	2	14	2	12	14
24	Residential & Retail	580 Venice Boulevard	(Preliminary) 5-unit residential plus 5,700 s.f. retail space.	1,084	17	12	29	45	47	92
25	Restaurant	1020 W. Venice Boulevard	Proposed House of Pies Sit-Down Restaurant land use (3,895 s.f.).	396	17	16	33	20	13	33
26	LAUSD Elementary School	2224 S. Walgrove Avenue	New 567-Student Elementary School (K-5) Immersive Mandarin Language program.	n/a	286	224	510	153	187	340
27	Playa Vista Phase I [3]	Jefferson Boulevard b/t Lincoln Boulevard and Centinela Avenue	Includes 3,246 d.u., 1,570,000 s.f. of office use, 25,000 s.f. of retail use and 65,000 s.f. of community serving use.	28,257	2,464	1,328	3,792	1,541	2,462	4,003
28	Playa Vista Plant Site (Spruce Goose) [3]	Campus Center Drive/Bluff Creek Drive	Includes 1,129,900 s.f of production and staging support and 572,050 s.f. of office use.	n/a	1,456	198	1,654	259	1,267	1,526
29	The Village at Playa Vista (Phase II) [4]	s/o Jefferson Boulevard/Westlawn Avenue	include 2,600 d.u., 175,000 s.f. of office use,150,000 s.f. of retail use, and 40,000 s.f. of community serving uses.	24,220	577	1,049	1,626	1,275	1,027	2,302
30	LAX Northside Project [5]	Westchester Parkway b/t Pershing Drive and Sepulveda Boulevard	2.32 million s.f. of development including office, research & development, community/civic uses, recreation and open space.	23,635	1,584	425	2,009	758	1,785	2,543
County of Los Angeles										
31	Marina Del Rey Local Coastal Plan [6]	Marina del Rey	Development contained within Local Coastal Plan	34,098	622	1,085	1,707	1378	1,125	2,503
			RELATED PROJECTS TRIP GENERATION TOTAL	142,959	8,436	5,336	13,772	6,976	9,761	16,737

[1] Source: Related projects obtained *Culver City Planning Division - Active Projects List April 2015*. Trip generation estimates based on *Trip Generation Manual*, 9th Edition, ITE 2012.
[2] Source: Los Angeles Department of Transportation, June 2015. List of related projects and their trip generation totals provided by LADOT, unless noted otherwise. Trip directionality (in%/out%) based on *Trip Generation Manual, 9th Edition, ITE 2012*.
[3] Trip generation from *Playa Vista Traffic Impact Assessment Culver City Agreement-Third Amendment, Kaku Associates, May 2002.*
[4] Trip generation from *the Village at Playa Vista Transportation Plan, Raju Associates, Inc. and Kaku Associates, July 2003*.
[5] Trip generation from *Transportation Study for the LAX Northside Plan Update, Gibson Transportation Consulting, Inc., May 2014*.
[6] Trip generation from *Traffic Study for the Marina del Rey Local Coastal Program Amendment, Raju Associates, Inc., April 2010*.

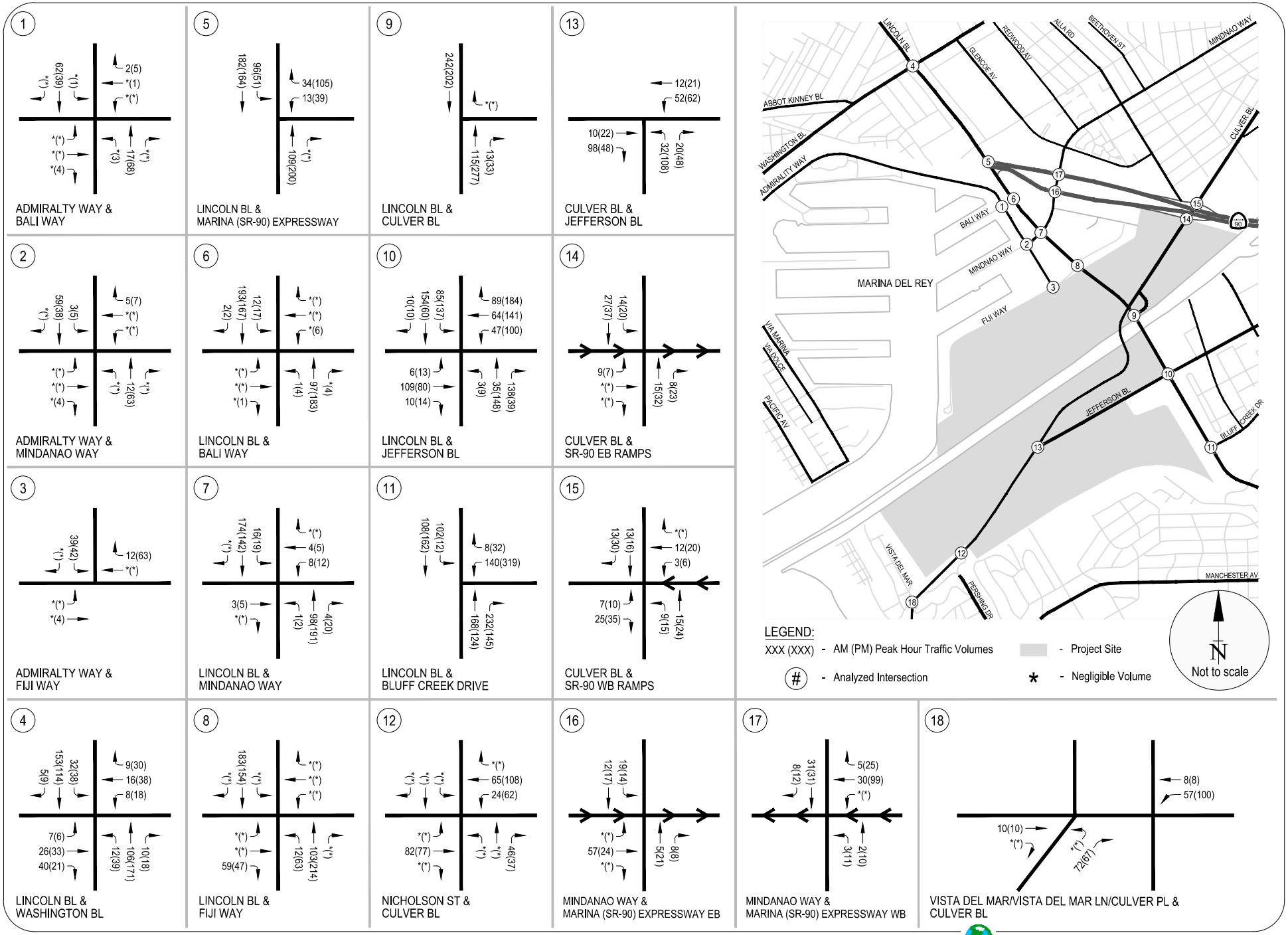

FIGURE 11
RELATED PROJECTS ONLY - PEAK HOUR TRAFFIC VOLUMES

RAJU Associates, Inc.

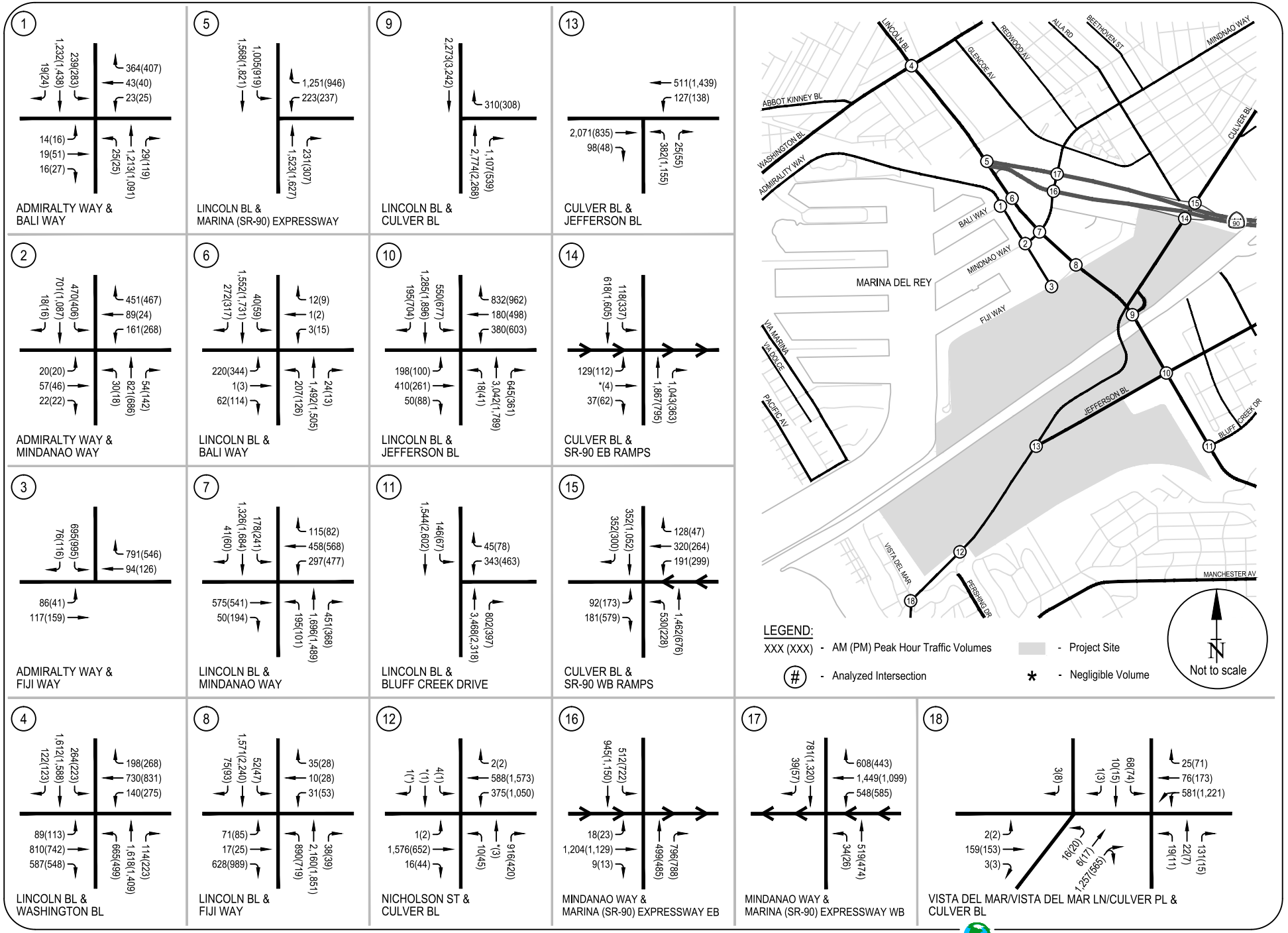

FIGURE 12
CUMULATIVE (2023) BASE CONDITIONS - PEAK HOUR TRAFFIC VOLUMES

RAJU Associates, Inc.

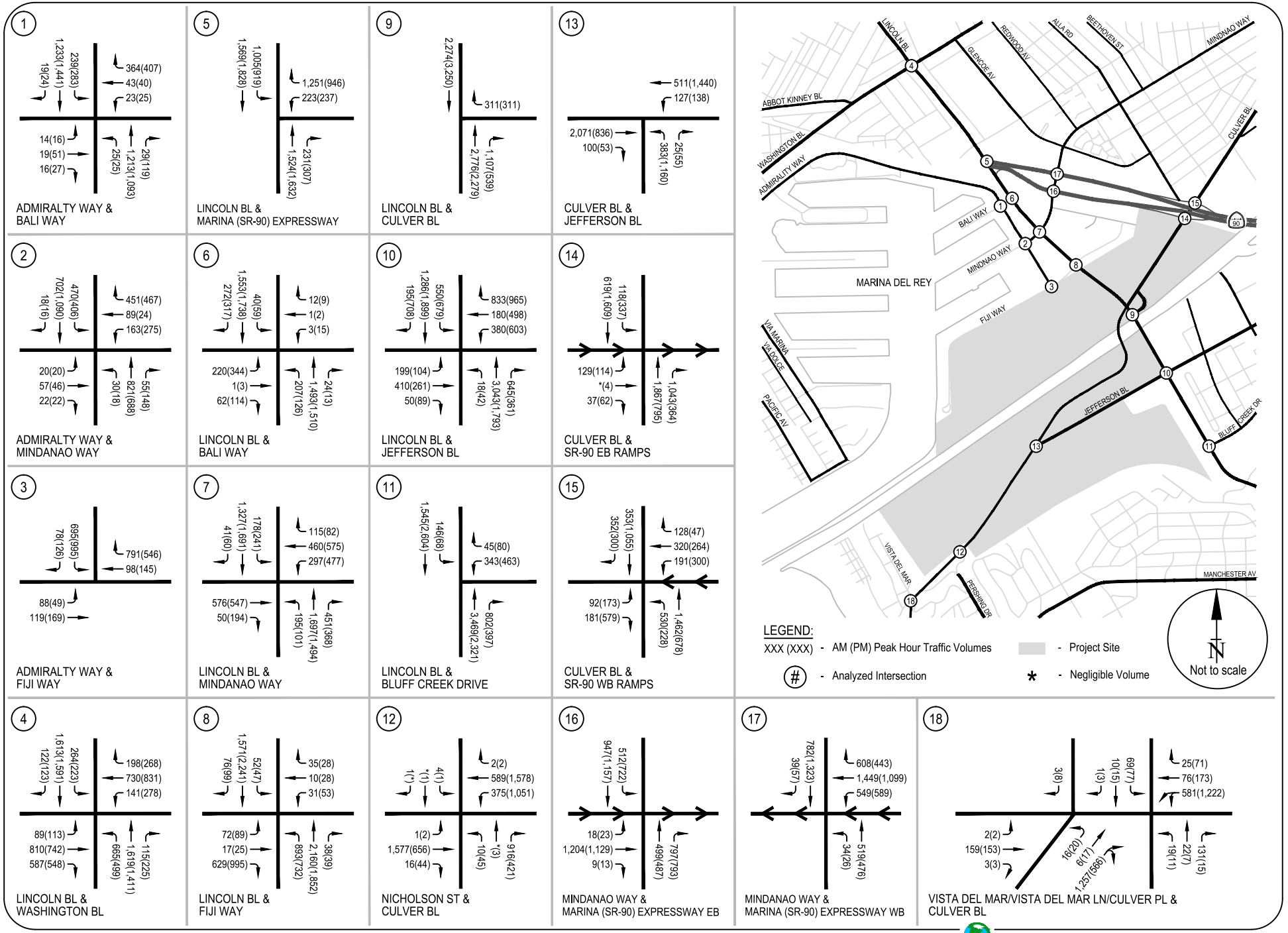

FIGURE 13
CUMULATIVE (2023) PLUS PROJECT CONDITIONS - PEAK HOUR TRAFFIC VOLUMES

RAJU Associates, Inc.

V. TRAFFIC CONDITIONS & IMPACT ANALYSIS

The Existing (2015) and Future Year (2023) Cumulative conditions without and with the Project were analyzed utilizing the methodologies and assumptions per the City of Los Angeles traffic study guidelines. The results were then used to assess the potential impact of the proposed project on the local street system.

The traffic impact analysis compares the volume to capacity (V/C) ratios at each study location under the existing and existing plus project; and cumulative base and cumulative plus project conditions to determine the incremental difference in V/C ratios caused by the proposed project. These values provide the information needed to assess the potential impact of the project using significance criteria established by the City of Los Angeles.

SIGNIFICANT TRAFFIC IMPACT CRITERIA

The City of Los Angeles Department of Transportation has established threshold criteria that determine if a project has a significant traffic impact at a specific signalized intersection. According to the criteria provided by the City of Los Angeles, a project impact is considered significant if the following conditions are met:

Intersection Condition With Project Traffic		Project-Related Increase in V/C Ratio
LOS	V/C Ratio	
C	0.701 – 0.800	equal to or greater than 0.040
D	0.801 – 0.900	equal to or greater than 0.020
E, F	> 0.900	equal to or greater than 0.010

Using these criteria, for example, a project would not have a significant impact at a signalized intersection if it is operating at LOS C after the addition of project traffic and the incremental change in the V/C ratio is less than 0.040. However, if the intersection is operating at a LOS E or

F after the addition of project traffic and the incremental change in V/C ratio is 0.010 or greater, the project would be considered to have a significant impact.

EXISTING (2015) PLUS PROJECT TRAFFIC CONDITIONS

The Existing (2015) plus Project peak hour traffic volumes were analyzed at each of the study intersections to determine the V/C ratio and corresponding level of service. Table 5 presents the results of the Existing (2015) plus Project traffic analysis. As indicated in the table, all 18 of the study intersections are projected to continue to operate at LOS D or better during both the morning and evening peak hours. Traffic generated by the Project would not change the intersection levels of service from existing conditions.

Capacity calculation worksheets for Existing (2015) plus Project conditions are attached in Appendix D of the report.

CUMULATIVE (2023) BASE TRAFFIC CONDITIONS

The Cumulative (2023) Base without proposed project peak hour traffic volumes were analyzed at each of the study intersections to determine the V/C ratio and corresponding level of service. Table 5 presents the results of the Year 2023 Cumulative Base (without project) traffic analysis. As indicated in the table, 16 of the 18 study intersections are projected to operate at LOS D or better during the morning peak hour. During the evening peak hour, 15 of the 18 study intersections are also projected to operate at LOS D or better. The remaining locations are projected to operate at LOS E and include:

- Lincoln Boulevard/Washington Boulevard: AM peak hour – LOS E
- Lincoln Boulevard/Jefferson Boulevard: AM peak hour – LOS E
- Nicholson Street/Culver Boulevard: PM peak hour – LOS E
- Jefferson Boulevard/Culver Boulevard: PM peak hour – LOS E
- SR-90 Freeway Westbound Ramps/Culver Boulevard: PM peak hour – LOS E

Capacity calculation worksheets for Cumulative (2023) Base conditions are attached in Appendix E of the report.

TABLE 5
SUMMARY OF INTERSECTION LEVEL OF SERVICE ANALYSIS

No.	Intersection	Peak Hour	Existing (2015) Conditions V/C	Existing (2015) Conditions LOS	Existing (2015) plus Project Conditions V/C	Existing (2015) plus Project Conditions LOS	Project Increase in V/C	Significant Project Impact	Cumulative (2023) Base Conditions V/C	Cumulative (2023) Base Conditions LOS	Cumulative (2023) plus Project Conditions V/C	Cumulative (2023) plus Project Conditions LOS	Project Increase in V/C	Significant Project Impact
1.	Admiralty Way & Bali Way	AM	0.616	B	0.616	B	0.000	No	0.656	B	0.656	B	0.000	No
		PM	0.627	B	0.628	B	0.001	No	0.692	B	0.692	B	0.001	No
2.	Admiralty Way & Mindanao Way	AM	0.667	B	0.667	B	0.001	No	0.709	C	0.709	C	0.001	No
		PM	0.587	A	0.593	A	0.006	No	0.652	B	0.658	B	0.006	No
3.	Admiralty Way & Fiji Way	AM	0.451	A	0.452	A	0.001	No	0.485	A	0.486	A	0.001	No
		PM	0.338	A	0.356	A	0.018	No	0.376	A	0.394	A	0.018	No
4.	Lincoln Boulevard & Washington Boulevard	AM	0.837	D	0.838	D	0.001	No	0.937	E	0.938	E	0.001	No
		PM	0.783	C	0.785	C	0.002	No	0.893	D	0.896	D	0.002	No
5.	Lincoln Boulevard & Marina (SR-90) Expressway [1]	AM	0.717	C	0.717	C	0.000	No	0.793	C	0.793	C	0.000	No
		PM	0.676	B	0.678	B	0.001	No	0.798	C	0.799	C	0.001	No
6.	Lincoln Boulevard & Bali Way	AM	0.509	A	0.509	A	0.000	No	0.585	A	0.585	A	0.000	No
		PM	0.552	A	0.553	A	0.001	No	0.634	B	0.635	B	0.001	No
7.	Lincoln Boulevard & Mindanao Way	AM	0.710	C	0.710	C	0.000	No	0.787	C	0.787	C	0.001	No
		PM	0.781	C	0.785	C	0.004	No	0.894	D	0.898	D	0.004	No
8.	Lincoln Boulevard & Fiji Way	AM	0.628	B	0.631	B	0.002	No	0.711	C	0.712	C	0.001	No
		PM	0.720	C	0.729	C	0.009	No	0.822	D	0.832	D	0.010	No
9.	Lincoln Boulevard & Culver Loop	AM	0.805	D	0.806	D	0.001	No	0.877	D	0.877	D	0.000	No
		PM	0.535	A	0.539	A	0.004	No	0.637	B	0.640	B	0.003	No
10.	Lincoln Boulevard & Jefferson Boulevard	AM	0.840	D	0.841	D	0.001	No	0.937	E	0.937	E	0.000	No
		PM	0.639	B	0.640	B	0.001	No	0.821	D	0.824	D	0.003	No
11.	Lincoln Boulevard & Bluff Creek Drive	AM	0.544	A	0.545	A	0.001	No	0.697	B	0.697	B	0.000	No
		PM	0.360	A	0.360	A	0.000	No	0.536	A	0.536	A	0.000	No
12.	Nicholson Street & Culver Boulevard	AM	0.652	B	0.652	B	0.000	No	0.732	C	0.733	C	0.001	No
		PM	0.798	C	0.800	D	0.002	No	0.915	E	0.918	E	0.002	No
13.	Jefferson Boulevard & Culver Boulevard	AM	0.727	C	0.727	C	0.000	No	0.815	D	0.816	D	0.000	No
		PM	0.810	D	0.812	D	0.002	No	0.987	E	0.989	E	0.001	No
14.	Culver Boulevard & SR-90 Eastbound Ramps	AM	0.436	A	0.436	A	0.000	No	0.479	A	0.479	A	0.000	No
		PM	0.463	A	0.466	A	0.003	No	0.510	A	0.513	A	0.003	No
15.	Culver Boulevard & SR-90 Westbound Ramps	AM	0.798	C	0.798	C	0.000	No	0.866	D	0.866	D	0.000	No
		PM	0.873	D	0.875	D	0.001	No	0.974	E	0.975	E	0.001	No
16.	Mindanao Way & Marina (SR-90) Expressway Eastbound	AM	0.756	C	0.757	C	0.001	No	0.827	D	0.827	D	0.000	No
		PM	0.809	D	0.810	D	0.001	No	0.877	D	0.879	D	0.002	No
17.	Mindanao Way & Marina (SR-90) Expressway Westbound	AM	0.572	A	0.572	A	0.000	No	0.624	B	0.625	B	0.001	No
		PM	0.559	A	0.560	A	0.001	No	0.634	B	0.636	B	0.002	No
18.	Vista del Mar/Vista del Mar Lane & Culver Boulevard	AM	0.782	C	0.783	C	0.001	No	0.878	D	0.879	D	0.001	No
		PM	0.653	B	0.657	B	0.004	No	0.765	C	0.768	C	0.003	No

[1] Los Angeles County Congestion Management Program monitoring location.

V/C - Volume to Capacity Ratio

LOS - Level of Service

CUMULATIVE (2023) PLUS PROJECT TRAFFIC CONDITIONS

The Cumulative (2023) Plus Project peak hour traffic volumes were analyzed to determine the V/C ratio and corresponding level of service at each of the analyzed intersections. The results of this analysis are also summarized on Table 5. Table 5 indicates that traffic generated by the Project would not change the intersection levels of service from cumulative base conditions at the study intersections during both the morning and evening peak hours.

Capacity calculation worksheets for Cumulative (2023) plus Project conditions are attached in Appendix F of the report.

PROJECT IMPACTS

Using the specified significant impact criteria, the traffic impacts at the 18 analysis locations were determined. Table 5 identifies the individual impacts during both AM and PM peak hours at each of the analysis locations. It can be observed that the Proposed Project does not cause significant impacts at any of the analyzed intersections under both existing and future conditions. Therefore, no project-specific mitigation measures would be required.

VI. CONSTRUCTION IMPACT ANALYSIS

This chapter presents the analysis and evaluation of the effects of the construction-related activities associated with the various components of the Proposed Project on the vehicular, parking, and pedestrian access/circulation system in the vicinity of the Project. The construction traffic analysis for this study uses a methodology that is consistent with the City of Los Angeles *Traffic Study Guidelines*. The scope and geographic coverage as well as the key assumptions and parameters for this study are consistent with projects of this nature.

Analysis of construction traffic impacts has been performed as part of this study. This analysis includes identification of changes to operations on-site, period of construction, estimation of construction traffic volumes, assessment of traffic conditions during construction resulting from construction related traffic and identification of adverse potential construction traffic impacts. These construction impacts would be temporary in nature and would not occur after completion of construction.

Construction activity related traffic includes construction trucks and construction worker trips. The magnitude of construction traffic depends upon the various construction elements, their duration, potential overlap and potential intensity of activity. A brief discussion of each of these follows.

CONSTRUCTION ACTIVITIES

Construction of the Proposed Project would be accomplished over an approximately six-year period, scheduled to commence in 2017 and completed in 2023. During this period, it is anticipated that all construction activity would occur on-site with the exception of the construction of the bridge across Lincoln Boulevard, construction of water control structures (storm drains) across Culver Boulevard and Jefferson Boulevard, construction activities associated with gas line relocation across Culver Boulevard, construction worker trips and off-site trucks. The Proposed Project (Alternative 1) would be implemented in two phases. The overall construction schedule is shown in Table 6. Within each phase, restoration construction activities would be sequenced as shown in Table 6.

TABLE 6
CONSTRUCTION SCHEDULE AND SEQUENCES

Sequence	Area	Title	Actions	Start Date	Working Days	Number of Workers
		PHASE 1				
1	B	Area "B" Southeast Gas Lines	1a. Remove and relocate existing gas line	1/2/2017	20	8
2	B	Area "B" South Enhancement	2a. Create swale (10,000 CY wet cut)	1/2/2017	40	26
3	A	Area "A' Gas Line Removal	3a. Remove existing inactive gas line	1/2/2017	10	8
			3b. Cut and cap gas line at Fiji Way	1/2/2017	1	8
4	A & B	Pedestrian/Bike Bridge	4a. Construct temporary & portion of final re-routed trail to existing trail	4/17/2017	40	15
			4b. Construct new pedestrian/bike bridge over Ballona Creek	1/2/2017	130	50
			4c. Reroute Ballona Creek Bike Trail under Culver Blvd Bridge	7/4/2017	5	15
5	A & C	Lincoln Bridge	5a. Build Lincoln Bridge next to Culver Bridge to connect Area A to Area C North	7/4/2017	65	30
6	A	Clear, Grub, and Stockpile Area "A"	6a. Remove vegetation from Area A (54,400 CY dry cut)	7/4/2017	10	35
			6b. Remove trash	7/4/2017	20	35
			6c. Stockpile	7/4/2017	20	35
7	A	Excavate Area "A"	7a. Remove 36" concrete pipe near center of Area A	7/4/2017	5	8
			7b. Excavate old fill from Area A (1,134,200 CY wet cut and 54,400 dry cut)	7/4/2017	555	80
			7c. Dig below (over excavate) future levees (25,200 CY dry cut)	7/4/2017	5	80
8	A	Area "A' Construct North Levee	8a. Grade and construct new levee around Area A (125,300 CY fill)	7/4/2017	35	90
			8b. Protect Del Ray 13, 14, 15, 17, and 19	1/2/2017	n/a	-
9	B & Property 1	Area "B" North Gas Line Relocation & Well Abandonment	9a. Drill new well at SoCal Gas Plant to replace Del Ray 12	1/2/2017	50	70
			9b. Abandon and plug Del Ray 12	4/3/2017	90	17
			9c. Remove/relocate existing pipelines	7/4/2017	10	8
10	B	Area "B" North Clear & Grub	10a. Remove vegetation from Area B North and interim levee (25,000 CY wet cut)	7/4/2017	10	35
			10b. Remove trash	7/4/2017	50	35
11	B	Area "B" North Over-Excavate and Stockpile	11a. Excavate Area B North (56,700 CY wet cut)	7/4/2017	25	80
			11b. Dig below (over excavate) future levees (11,400k CY wet cut)	7/4/2017	5	80
12	B	Construct Area "B" Levee	12a. Construct Area B levees (452,800 CY fill = total import from Area A = 566,000 CY)	8/14/2017	165	90
13	B	Clear, Grub, and Stockpile Area "B" East	13a. Remove vegetation in Area B East (4,600 CY wet cut)	2/5/2018	5	26
			13b. Stockpile and prepare for fill	2/5/2018	5	35
14	B	Area "B" East Stockpile Grading	14a. Grade Area B east and import from Area A (80,000 CY import from Area A)	2/12/2018	25	80
15	C	Clear & Grub Area "C" North & South	15a. Protect baseball fields and structures.	1/2/2017	n/a	-
			15b. Clear vegetation from Area C North (56,000 CY dry cut) & South (15,000 CY dry cut)	4/2/2018	10	35
			15c. Re-align and replace Marina ditch (45,000 CY wet cut)	4/23/2018	15	80
16	A & C	Area "A" Grading and Export to Area "C" North & South	16a. Excavate Area A and export to C South (300,000 CY total)	5/21/2018	75	80
			16b. Excavate Area A and export to C North (720,000 CY ultimate total; 420,000 CY to C North)	9/3/2018	110	80
17	C	Finish Grading for Uplands Area "C" South	17a. Finish grading Area C South	6/3/2019	15	10
			17b. Re-establish upland vegetation	6/24/2019	5	16
18	B	Area "B" New and Reconstructed Culverts	18a. Install culverts under Culver/Jefferson Blvd, Gas Co Rd, and FWM berm; modify existing culvert under west end of Culver Blvd.	1/7/2019	130	26
			18b. Remove existing FWM pipes and outlets	7/8/2019	15	26
			18c. Construct new FWM outlet and spillway	7/29/2019	40	26
19	A & B	Area "A" and Area "B" North Excavate and Breach Existing Levees	19a. Excavate Ballona Creek Channel in Areas A and B North (277,800 CY cut)	4/15/2019	130	80
20	A & B	Area "A" and Area "B" North Block and Fill Existing Channels	20a. Install temporary pipe	4/15/2019	10	8
			20b. Temporary block then fill existing Ballona Creek (269,100 CY fill from Seq 19)	4/15/2019	60	80
21	A & B	Area "A" and Area "B" North Remove Existing Levees	21a. Remove old Ballona Creek levee (424,400CY) and excavate new channel meanders - Export to Area C North, quantities included in Sequence 16, ultimate.	7/8/2019	120	80
22	B	Area "B" West Fire Access Road	22a. Construct maintenance and fire road in Area B West	10/14/2019	20	15
			22b. Reconstruct Area B parking lot	10/14/2019	20	15
23	A & B	Bike Path, Pedestrian Walkway and Amenities	23a. Construct bike and ped trails on levees	10/14/2019	65	15
			23b. Construct County Parking Structure Foundation	10/14/2019	60	24
			23c. Construct County Parking Structure	10/14/2019	120	40
24	A	Export	24a. Export final excess dirt quantity (Assume up to 110,000 CY)	10/14/2019	35	2
		PHASE 2				
		Area A Gas Well Removal and Restoration				
25	A & Property 1	Gas Well Abandonment	25a. Drill new well at SoCal Gas Plant to replace Del Ray 19	1/2/2017	50	70
			25b. Abandon and plug Del Ray 13, 14, 15, 17, 18, and 19	3/13/2017	225	17
			25c. Remove existing gas lines serving removed wells	1/22/2018	10	8
26	A	Area A around Wells Clear & Grub	26a. Remove vegetation around wells (2,000 CY)	1/22/2018	5	26
27	A	Area A around Wells Grading and Export to West Area B	27a. Excavate Area A and Export to West Area B (208,000 CY)	1/22/2018	5	80
28	A	Finish Grading For Uplands	28a. Finish grading around wells	2/12/2018	10	26
			28b. Re-establish upland vegetation	2/26/2018	5	16
		Area B wells				
29	B	Area B Abandon Wells	29a. Drill new well at SoCal Gas Plant to replace Del Rey 9 and Vidor 18	1/2/2017	50	70
			29b. Abandon and plug Vidor 1, 2, 3, 5, 14, 18 and Del Rey 4, 5, 9, 11	3/13/2017	225	17
			29c. Remove existing pipelines	11/13/2017	10	8
30	B	Area B around Wells Clear & Grub	30a. Remove vegetation around wells (2,000 CY)	11/27/2017	5	26
31	B	Finish Grading For Uplands	31a. Finish grading around wells	12/4/2017	10	26
			31b. Re-establish upland vegetation	12/18/2017	5	16
		Area B West				
32	B	Area "B" West Clear & Grub	32a. Remove vegetation in Area B West (76,000 CY)	4/17/2023	10	35
33	B	Area "B" West Grading and Levee Extention	33a. Install temporary flexible storm drain	5/1/2023	10	26
			33b. Dig below (over excavate) levees (10,800k CY wet cut)	5/1/2023	10	90
			33c. Grade Area B West channels, construct salt pan berm, and construct levee with import from stockpile from Area B North and East at 248,000 CY (31,200 + 216,800 CY (291,800 less 49,000 and 26,000))	5/15/2023	75	90
34	B	Area "B" West Excavate and Breach Existing Levees	34a. Breach existing levee in Area B West and place in Stability berms (75,000 CY wet = 26,000 + 49,000)	4/15/2023	130	80
35	B	Finish Bike Path, Pedestrian Walkway and Amenities	35a. Construct maintenance and fire access road and bike path on new levee.	8/14/2023	20	15
36	B	Finish Grading For Uplands	36a. Finish grading Area B East	9/4/2023	10	10
			36b. Re-establish upland vegetation	9/18/2023	5	16

Sources: Psomas, June 2015

In Phase 1, Area A site preparation would occur, including utility relocation, construction of bridges across Ballona Creek and Lincoln Boulevard for soil transport, and clearing and grubbing. Then soil would be excavated and used to build the Area A perimeter levee. Site preparation of North Area B would occur, including utility relocation, clearing and grubbing, and over-excavation along the levee alignment. Soil excavated from Area A would be transported to Area B and used to construct the Culver Boulevard levee and the interim levee. North Area C and South Area C would be cleared and grubbed and additional soil excavated from Area A would be transported to these areas and placed and graded to form new upland areas. Soil for levee construction in Phase 2 would be stockpiled within the Culver and interim levees and East Area B.

For the South/Southeast Area B wetland enhancement, water control structures would be installed and modified, and wetland enhancements, including channel excavation, berm construction, and invasive plant removal, would be completed.

Once the new levees are in place, the channel meanders would be constructed. The new channel meanders would be excavated behind the existing levees, the existing levees would be breached to connect the new meanders to the existing Ballona Creek channel, and the existing Ballona Creek channel segments between the meander bends then would be blocked and filled. This sequence would maintain an open Ballona Creek channel throughout the construction process. The existing levee then would be removed.

Finally, the public access features, including new bicycle and pedestrian paths and the West Area B fire access road and storm water drainage improvements would be completed. The proposed parking structure across from Fisherman's Village along Fiji Way and parking improvements in the West Culver Parking Lot are included in Phase 1, although the availability of funding may affect the actual timing of construction.

In Phase 2, clearing and grubbing would occur along the alignment of the new West Area B levee and salt pan berm. The West Area B levee and salt pan berm would be constructed using the fill stockpiled in the Culver and interim levees and East Area B. A water control structure would be installed to connect the existing channel from West Area B to behind the dunes. A new water control structure would be installed in the levee, and Culver Boulevard would be extended to reach under the West Area B levee. Tidal channels would be excavated in West Area B. The

interim and south Ballona Creek levees would be lowered, re-graded into the upland peninsula and salt pan berm, and breached. Re-vegetation would occur on the levees, berm, peninsula, and East Area B.

From a traffic perspective, based on the construction schedule shown in Table 6, it is anticipated that the greatest amount of construction-related peak hour trips would be generated during Phase 1 in Year 2019 and includes the following overlapping construction sequences:

- Excavate Area "A"
    - Excavate old fill from Area A (1,134,200 cubic yards wet cut and 54,400 cubic yards dry cut)

- Area A and Area B North Excavate and Breach Existing Levees
    - Excavate Ballona Creek Channel in Areas A and B North (277,800 cubic yards cut)

- Area A and Area B North Block and Fill Existing Channels
    - Install temporary pipe
    - Temporary block then fill existing Ballona Creek (269,100 cubic yards fill)

- Area A and Area B North Remove Existing Levees
    - Remove old Ballona Creek levee (424,400 cubic yards) and excavate new channel meanders - Export to Area C North.

- Area B West Fire Access Road
    - Construct maintenance and fire road in Area B West
    - Reconstruct Area B parking lot

- Bike Path, Pedestrian Walkway and Amenities
    - Construct bike and ped trails on levees
    - Construct County Parking Structure Foundation
    - Construct County Parking Structure

- Off-Site Export
    - Export final excess dirt quantity (up to 110,000 cubic yards)

A brief general description of the earthwork and soil transport is included below. The associated construction related peak hour trips and their effects are discussed further in the next section of this study.

Earthwork and Soil Transport

Much of the Project's earthwork would be accomplished by traditional land-based equipment (e.g., scrapers). Wetland restoration construction also would require some special equipment and construction methods, as high groundwater and weak soils can preclude use of traditional land equipment. Specialized equipment and construction methods may be needed.

The Proposed Project would install permanent bridge crossings across Ballona Creek and across Lincoln Boulevard for pedestrian and bicycle trail crossings. These bridges would be used for transporting soil from Area A to Area B and North Area C during construction. Additional methods for transporting soil between Areas A, B, and C could be used to cross Ballona Creek, including a temporary floating crossing or a ford (e.g., temporary fill in the Ballona Creek channels with buried culverts to maintain conveyance). An additional option for transporting soil from Area A to North Area C could include a conveyor system through the existing drainage culvert under Lincoln Boulevard at Fiji Ditch. To transport soil to/from East Area B (i.e., to East Area B in Phase 1 to North Area B in Phase 2), a temporary bridge would be installed over Culver Boulevard between North and East Area B, or trucks/scrapers would travel on existing roads with traffic controls (e.g., directly crossing Culver Boulevard between North and East Area B, or traveling on Lincoln Boulevard from Area A to East Area B, returning on Jefferson Boulevard, Lincoln Boulevard, and Fiji Way).

Off-Site Soil Export

Up to approximately 110,000 cubic yards of excavated soil could be exported from the site. There are three options for off-site soil export and disposal:

1. Export via trucks with disposal at local landfills, the most likely of which could include Scholl Canyon Landfill in the City of Glendale, Calabasas Sanitary Landfill in the City of Agoura, and/or the Lancaster Landfill and Recycling Center in Lancaster;

2. Export via barge to the Port of Los Angeles or Port of Long Beach, transfer to trucks for upland disposal at local landfills; or

3. Export via barge to an off-shore disposal location, potentially including the Los Angeles ocean disposal site approximately 30 miles (26 nautical miles) away from the Project Site off the coast from San Pedro (LA-2) or the Newport Bay ocean disposal site approximately

55 miles (48 nautical miles) away from the Project Site off the coast from Newport Beach (LA-3), each of which is managed by the U.S. EPA.

Of these three options, Option 1 would generate the most construction related trips on the street system. Therefore, Option 1 was assumed for construction analysis to determine construction related traffic impacts.

As indicated above, it is anticipated that most construction activities would occur on-site with the exception of the construction of the bridge across Lincoln Boulevard, construction of water control structures (storm drains) across Culver Boulevard and Jefferson Boulevard, construction activities associated with gas line relocation across Culver Boulevard, construction worker trips and off-site trucks.

The construction of the bridge across Lincoln Boulevard which requires off-site construction would occur for approximately three to four weeks in 2017. The gas line relocation and associated construction activities are anticipated to occur in 2017 and early 2018. The storm drain installation would occur for approximately three to four weeks per location in 2019.

Lincoln Boulevard Bridge Construction Impacts

The bridge across Lincoln Boulevard would be constructed during night-time hours (11:00 PM to 5:00 AM) for a period of three to four weeks. This would require intermittent closure of Lincoln Boulevard during night-time hours over a four-week period in 2017. It is anticipated that cranes will be used to place the bridge segments and secured over the existing abutments or new abutments adjacent to and north of the Culver Boulevard bridge structure. The intermittent night-time closures of Lincoln Boulevard would allow the cranes to swing the bridge segments (structural members) over the travel lanes to place them over the existing or new abutments and secure them. Once the members are in place and secured, the roadway would be opened. Emergency access will be maintained at all times. The current number of lanes along Lincoln Boulevard would not be affected during daytime (when there is no construction activity); and after the construction is complete, there would be no change to the number of lanes along Lincoln Boulevard.

Detailed 24-hour traffic counts were conducted along Lincoln Boulevard in the vicinity of the proposed bridge during September 2015. These traffic counts are included in Appendix B. It can be observed from the counts that traffic volumes along Lincoln Boulevard between the hours of 11:00 PM and 5:00 AM ranged from 48 vehicles to 380 vehicles in each direction in any one hour. Detailed construction traffic management plan would be prepared at the time of final design and would include specific details relative to detour routes, signage, temporary traffic control and hours of construction to the satisfaction of Caltrans and LADOT.

The potential detour route during construction (night-times for approximately three to four weeks) would include re-routing northbound Lincoln Boulevard traffic through the Culver Loop ramp to Marina Freeway back to Lincoln Boulevard, as well as through Jefferson Boulevard to Centinela Avenue to Marina Freeway and then back to Lincoln Boulevard. The southbound Lincoln Boulevard traffic could also be re-routed through Marina Freeway to Culver Boulevard or Centinela Avenue and then back to Lincoln Boulevard. With the implementation of the detour routes and other construction traffic management plan elements along with restriction of construction activities to night-times (11:00 PM to 5:00 AM) only, there would be no residual construction traffic impacts due to the Lincoln Boulevard bridge construction.

Both the bridges across Ballona Creek and Lincoln Boulevard would be constructed in 2017. After construction, the movement of soil between Project Areas A, B and C would commence and occur on these bridges, reducing the need to use surface streets such as Lincoln Boulevard, Culver Boulevard and Jefferson Boulevard. After construction activities associated with the Ballona Wetlands Restoration Project are complete, these bridges would become an integral part of the bicycle and pedestrian circulation system allowing visitors to cross Ballona Creek and Lincoln Boulevard as part of the recreational trails within the Ballona Reserve.

Construction Traffic Impacts of Gas Line Relocation and Stormwater Drain Installation

Removal and relocation of existing gas lines in Area B as well as storm drain installation in Area B would require partial closure of lanes along Culver Boulevard. Removal and relocation of existing gas lines in Area B would occur in 2017 and would require closure of half of Culver Boulevard over a four week period. The storm drain installation in Area B would occur in 2019 and would require closure of half of Culver Boulevard over a three week period per location.

Detailed 24-hour traffic counts were conducted along Culver Boulevard west of Lincoln Boulevard during June 2015. These counts have been included in Appendix B. Based on these counts, it is recommended that the partial closure of Culver Boulevard for construction activity be between the hours of 11:00 PM to 5:00 AM when traffic along Culver Boulevard is minimal, ranging from approximately 30 vehicles to 206 vehicles in either direction during this time period. A detailed construction traffic management plan including detour routes, signage, traffic control and hours of construction would be prepared at the times of final design to the satisfaction of LADOT.

The potential detour route during construction activities associated with gas line relocation and stormwater drain installation across Culver Boulevard (night-time periods for three weeks per location) would involve re-routing eastbound/northbound Culver Boulevard to Jefferson Boulevard to Lincoln Boulevard back to Culver Boulevard. The westbound/southbound Culver Boulevard would continue to use the partially open (half-roadway) Culver Boulevard during night-times.

With the implementation of the construction traffic management plan including detour routes and night-time hours of construction, there would be no residual significant traffic impacts due to the gas line relocation and stormwater drain installation components of the Project.

It has been estimated that the greatest amount of construction-related trips including off-site trucks and construction worker trips would occur during the Phase 1 construction period in 2019. An evaluation of detailed construction traffic analysis follows:

CONSTRUCTION ANALYSIS STUDY SCOPE

The scope of work for this study was developed in accordance with the City of Los Angeles *Traffic Study Guidelines*. The base assumptions, technical methodologies and geographic coverage of the study were all identified as part of the study approach. The construction impact evaluation is directed at the analysis of potential traffic impacts produced by the construction of the Proposed Project on the street system and includes an analysis of the following scenarios:

- Cumulative (2019) Base (without Project – Pre-Construction) Conditions – Future traffic conditions without the Proposed Project (pre-construction) has been developed for the year 2019. The objective of this analysis is to project future traffic growth and operating

conditions, which could be expected to result from regional growth as well as cumulative related projects, if any, in the vicinity of the study area by the year 2019. The effects of other construction projects in the area are included in this baseline scenario.

- Cumulative (2019) with Construction Activity Conditions – The traffic expected to be generated by the construction activity associated with the Proposed Project is estimated and added to the Future Year 2019 without Project traffic forecasts. The traffic impacts of the construction of the Proposed Project on future traffic operating conditions are then identified. Mitigation measures, if required, are then identified.

For this construction traffic evaluation, the same 18 study intersections identified for analysis in the traffic study were also evaluated for construction impacts on the street system and include the following locations:

1. Admiralty Way and Bali Way
2. Admiralty Way and Mindanao Way
3. Admiralty Way and Fiji Way
4. Lincoln Boulevard and Washington Boulevard
5. Lincoln Boulevard and Marina (SR-90) Expressway
6. Lincoln Boulevard and Bali Way
7. Lincoln Boulevard and Mindanao Way
8. Lincoln Boulevard and Fiji Way
9. Lincoln Boulevard and Culver Boulevard Ramps
10. Lincoln Boulevard and Jefferson Boulevard
11. Lincoln Boulevard and Bluff Creek Drive
12. Nicholson Street and Culver Boulevard
13. Culver Boulevard and Jefferson Boulevard
14. Culver Boulevard and Marina (SR-90) Freeway Eastbound Ramps
15. Culver Boulevard and Marina (SR-90) Freeway Westbound Ramps
16. Mindanao Way and Marina (SR-90) Expressway Eastbound
17. Mindanao Way and Marina (SR-90) Expressway Westbound
18. Vista del Mar/Vista del Mar Lane & Culver Boulevard

CUMULATIVE (2019) BASE (PRE-CONSTRUCTION) TRAFFIC VOLUMES

The Future Cumulative Base (Year 2019 without project – pre-construction) traffic projections were developed in a similar manner as described for the Cumulative (2023) Base traffic projections in Chapter III.

Utilizing the traffic growth observed in City of Los Angeles' Travel Demand Forecasting Model, the traffic in the vicinity of the study area was estimated to increase at a rate of about 0.57% per year during the morning peak hour and 0.64% per year during the evening peak hour. Future increases in background traffic volumes due to regional growth and development are expected to continue at this rate. With the assumed date of 2019, the Existing 2015 traffic volumes were adjusted upward by a factor of 2.28% during the morning peak hour and 2.56% during the evening peak hour to reflect this area-wide regional growth. The resulting Existing plus Ambient Growth (2019) traffic volumes are illustrated in Figure 14.

These related projects' traffic estimates, developed in Chapter III and shown in Figure 11, were added to the Existing plus Ambient Growth (2019) traffic volumes to obtain the Cumulative Base (Year 2019 pre-construction) traffic volumes during both AM and PM peak hours. The traffic volumes presented in Figure 15 represent the Future Cumulative Base (Year 2019 pre-construction) conditions.

PROJECT CONSTRUCTION TRIPS

Construction of the Proposed Project would be accomplished over a six-year period scheduled to commence in 2017 and completed in 2023. Based on the construction schedule shown in Table 6, the heaviest or most intense construction phase for the Proposed Project would occur during Phase 1 in Year 2019. During this period, multiple construction activities would overlap with one another including off-site soil export. Table 7 summarizes the construction sequence/activity and the number of workers of each sequence for this peak construction period. As indicated in the table, a total of approximately 351 workers would be on-site. This does not include the workers for off-site soil export, which would arrive in their dirt-hauler truck from an outside yard to the site on a daily basis.

As part of the grading process, soil would be balanced on-site to the extent possible. Up to 110,000 cubic yards of soil could be removed/exported, which would require approximately 7,334 haul trips over a seven-week period. Conservatively assuming an average of 2 minute headway between trucks leaving the site to account for operations and traffic flow impacts, 240 truck trips would be generated during an eight hour day (Source: *Technical Memo - Ballona Landfill Disposal Site Review*, Psomas, May 4, 2015). This would result in approximately 480 truck trips per day.

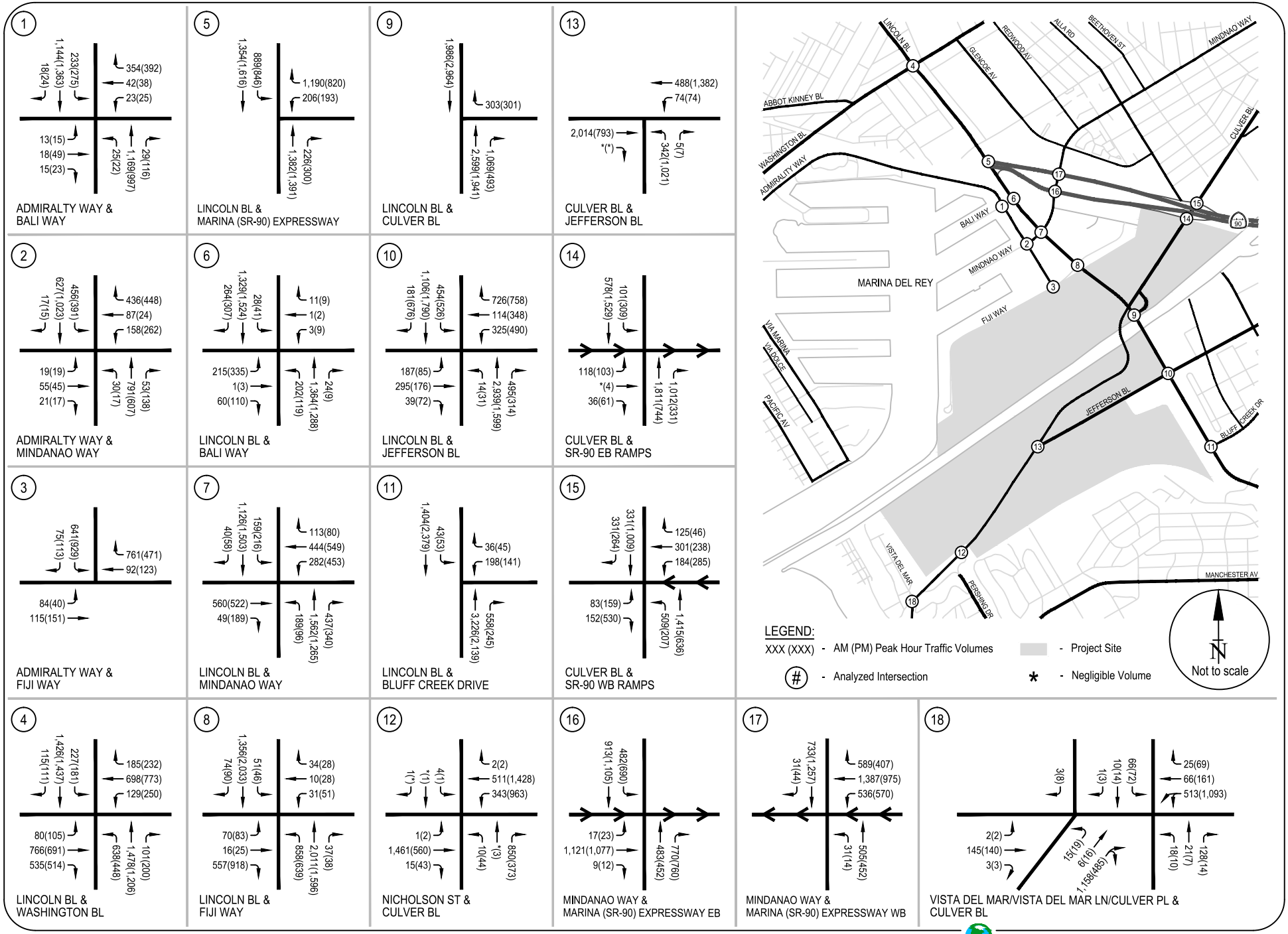

FIGURE 14
EXISTING PLUS AMBIENT GROWTH (2019) CONDITIONS - PEAK HOUR TRAFFIC VOLUMES

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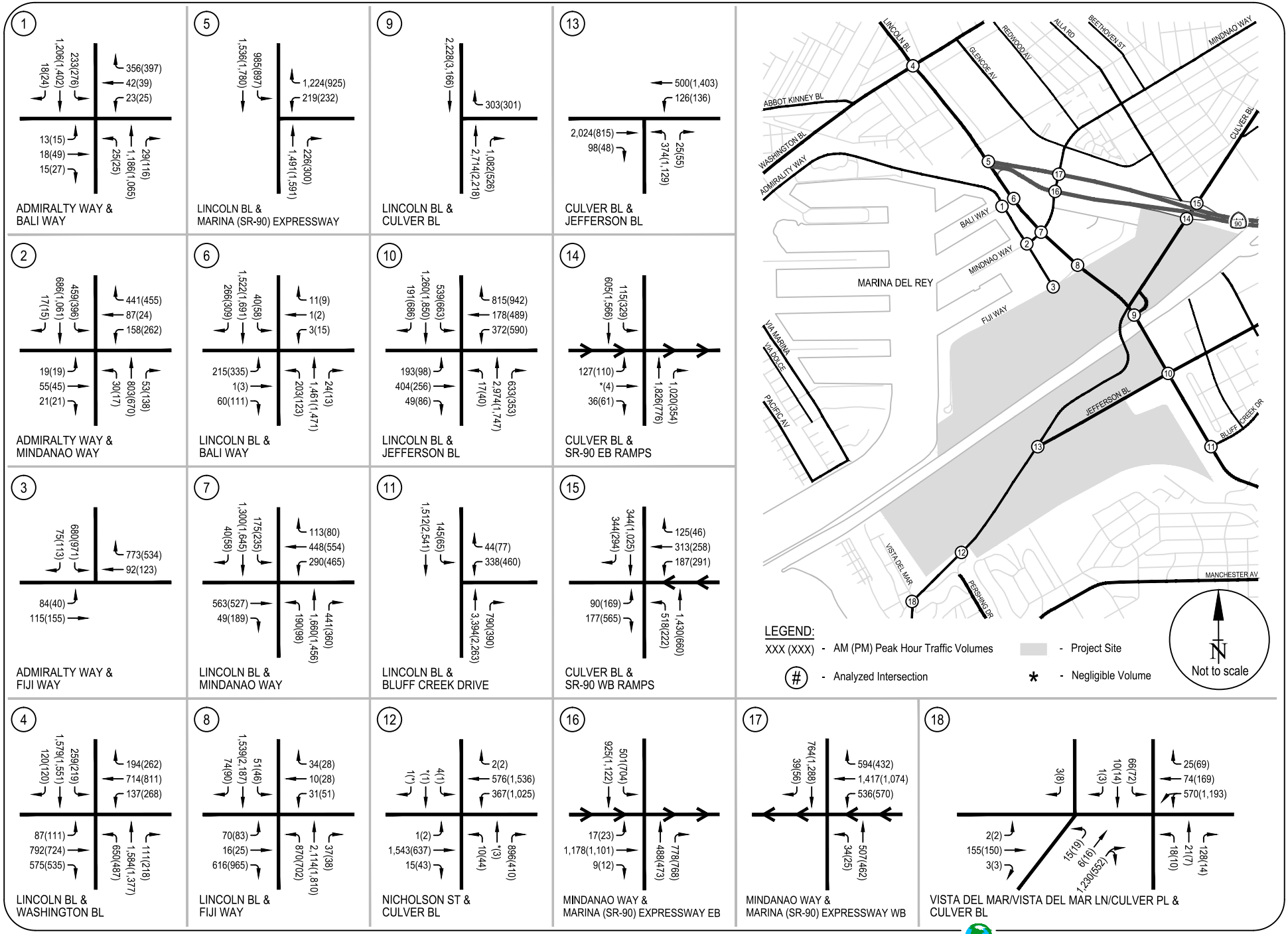

FIGURE 15
CUMULATIVE (2019) BASE CONDITIONS - PEAK HOUR TRAFFIC VOLUMES

RAJU Associates, Inc.

TABLE 7
PEAK CONSTRUCTION ACTIVITY/SEQUENCES

Sequence	Area	Title	Actions	Start Date	Working Days	Number of Workers
		PHASE 1				
7	A	Excavate Area "A"	7b. Excavate old fill from Area A (1,134,200 CY wet cut and 54,400 dry cut)	7/4/2017	555	80
19	A & B	Area "A" and Area "B" North Excavate and Breach Existing Levees	19a. Excavate Ballona Creek Channel in Areas A and B North (277,800 CY cut)	4/15/2019	130	80
21	A & B	Area "A" and Area "B" North Remove Existing Levees	21a. Remove old Ballona Creek levee (424,400CY) and excavate new channel meanders - Export to Area C North, quantities included in Sequence 16, ultimate.	7/8/2019	120	80
22	B	Area "B" West Fire Access Road	22a. Construct maintenance and fire road in Area B West	10/14/2019	20	15
			22b. Reconstruct Area B parking lot	10/14/2019	20	15
23	A & B	Bike Path, Pedestrian Walkway and Amenities	23a. Construct bike and ped trails on levees	10/14/2019	65	15
			23b. Construct County Parking Structure Foundation	10/14/2019	60	24
			23c. Construct County Parking Structure	10/14/2019	120	40
24	A	Export	24a. Export final excess dirt quantity (Assume up to 110,000 CY)	10/14/2019	35	2
					TOTAL NUMBER OF WORKERS	351

Sources: Psomas, June 2015
Note: Construction activities would only occur during weekdays and in particular seasons of the year.

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Utilizing the anticipated number of workers in the peak construction period, the construction workers' trip generation was determined. Table 8 summarizes the estimated trip generation of construction activity. From Table 8, it can be observed that the workers' trip generation would result in a total of approximately 809 daily trips of which 35 trips would occur during the morning peak hour and 34 trips during the evening peak hour.

The soil export activity would result in approximately 480 daily trips. As shown in Table 8, this level of truck travel would be equivalent to 1,200 passenger car equivalent daily trips (passenger car equivalent or PCE: assumes 1 truck trip = 2.5 passenger cars). On an average hourly basis, assuming a uniform distribution of trips over an 8-hour work day, these daily trip totals would translate to approximately 150 trips during the morning peak hour. Soil export operations would end before evening peak hour traffic. Therefore, no truck trips would occur during the evening peak hour.

The construction activity would result in a maximum trip generation of approximately 2,009 daily trips of which 185 trips would occur during the morning peak hour and 34 trips during the evening peak hour.

Construction Workers Trip Distribution

The regional geographic trip distribution for construction worker trips was computed based on a number of factors including existing traffic patterns and general distribution of expected construction worker trips. They were estimated and assumed to be the following:

- To and From the North: 25%
- To and From the South: 25%
- To and From the West: 40%
- To and From the East: 10%

The majority of construction workers would park in a temporary lot located in Area A on the west side of Lincoln Boulevard. The workers would be directed to access this lot from southbound Lincoln Boulevard and exit the lot southbound on Lincoln Boulevard (i.e. right-turn in and right-turn out).

TABLE 8
ESTIMATED TRIP GENERATION - CONSTRUCTION ACTIVITY

	Daily	AM Peak Hour			PM Peak Hour		
		IN	OUT	TOTAL	IN	OUT	TOTAL
Construction Workers [1]	809	31	4	35	6	28	34
Soil Export [2,3] (Dump Truck Trips)	1,200	75	75	150	0	0	0
Total Trips	2,009	106	79	185	6	28	34

[1] For the purpose of this analysis, ITE 9th Edition trip generation rates for workers at an office use was utilized. Per project construction description, maximum construction workers anticipated during peak construction period equivalent to 351 with a SCAg-model based AVR of 1.44 was used in this analysis. Additionally, most of this construction worker traffic would occur before the peak hours on weekdays. However, it was conservatively assumed that 30% of the construction worker peak hour traffic would occur during the AM and PM peak hours.

[2] Assumes an average of 15 cubic yards (c.y.) of soil per truck haul with an average headway of 2 minutes between trucks leaving the site. Soil export operations would end before evening peak hour traffic. Therefore, no truck trips would occur during the PM peak hour.

[3] Construction truck trips have been converted to Passenger Car Equivalents (PCEs) using a factor of 2.5.

Workers constructing the County Parking Structure along Fiji Way would park on-site. A minimal amount of workers would park in Area B.

Based on the distribution assumptions, location of the project and construction worker parking locations on-site, the intersection level trip distribution was developed. The resulting Intersection level trip distribution percentages are shown in Figures 16A and 16B.

Truck Haul Routes

The truck haul route is shown in Figure 17. As shown in this figure, a haul route from the site would require traveling from Area A into North Area C via the Lincoln Boulevard temporary construction bridge and merging onto northbound Lincoln Boulevard, to Mindanao Way onto the Marina (SR-90) Freeway. This outgoing route is chosen to eliminate left turns onto Lincoln Boulevard. For the return trips, the empty trucks would enter Area A from Lincoln Boulevard from the south, again to avoid left turns and provide a one-way operation on-site for efficiency.

Based on the worker trip distribution assumptions, truck haul routes, and construction activity trip generation estimates, traffic estimates of construction activity trips were developed. These construction activity trips are presented in Figure 18.

CUMULATIVE YEAR 2019 WITH PROJECT CONSTRUCTION ACTIVITY TRAFFIC VOLUMES

Utilizing the construction activity traffic estimates developed for both peak hours, traffic forecasts for the Future Cumulative Year 2019 with Project Construction Activity conditions were developed. The Future Cumulative Base (Year 2019 pre-construction) traffic forecasts were combined with the Excavation/Earthwork Phase construction activity traffic volumes to obtain the Future Cumulative (2019) with Project Construction Activity traffic volume forecasts. The Future Cumulative (2019) with Project Construction Activity traffic volumes during both the morning and evening peak hours are presented in Figure 19.

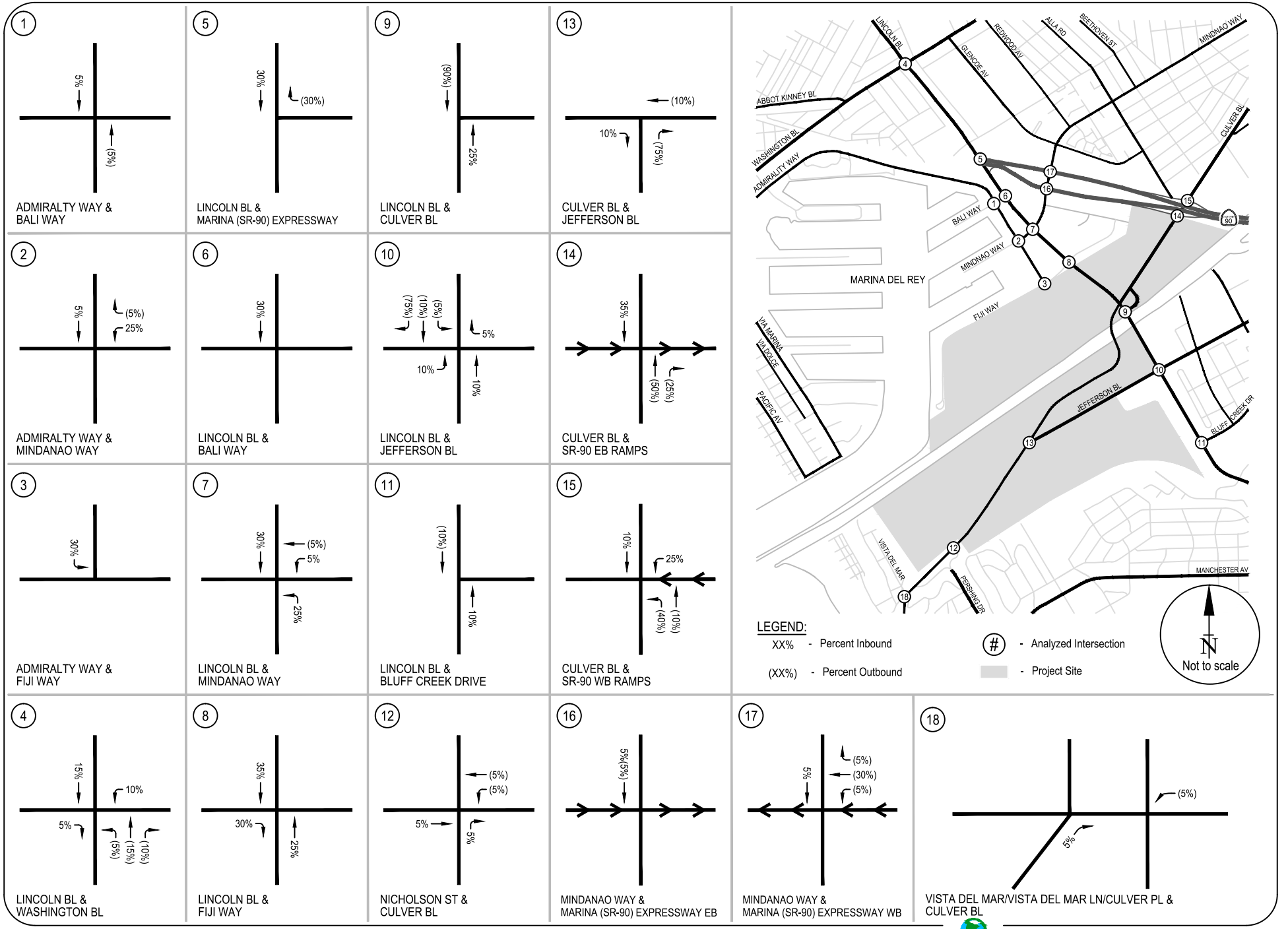

FIGURE 16A
CONSTRUCTION WORKERS TRIP DISTRIBUTION
TO/FROM AREA A TEMPORARY PARKING LOT

RAJU Associates, Inc.

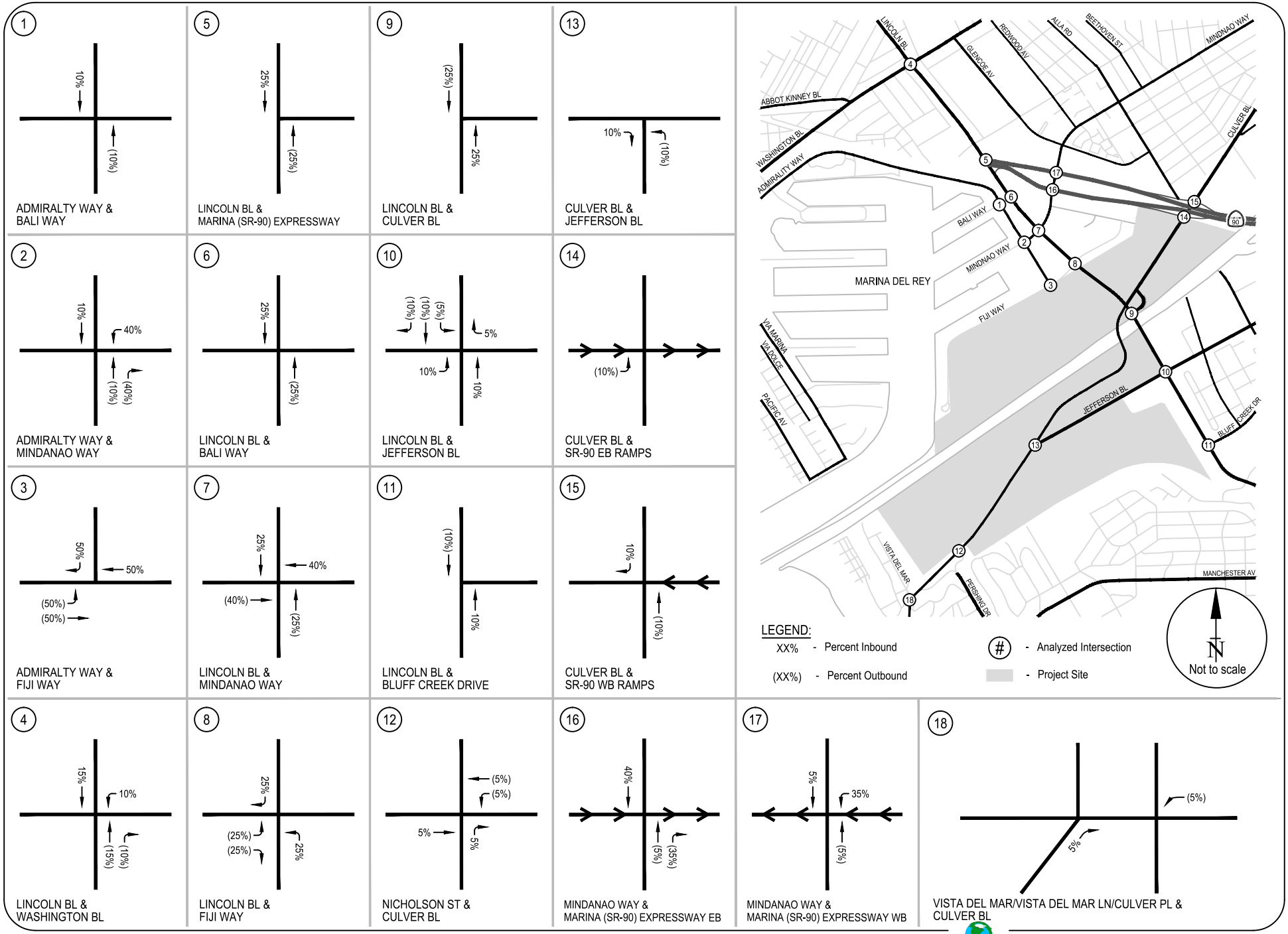

FIGURE 16B
CONSTRUCTION WORKERS TRIP DISTRIBUTION
TO/FROM AREA A PROPOSED COUNTY PARKING STRUCTURE

RAJU Associates, Inc.

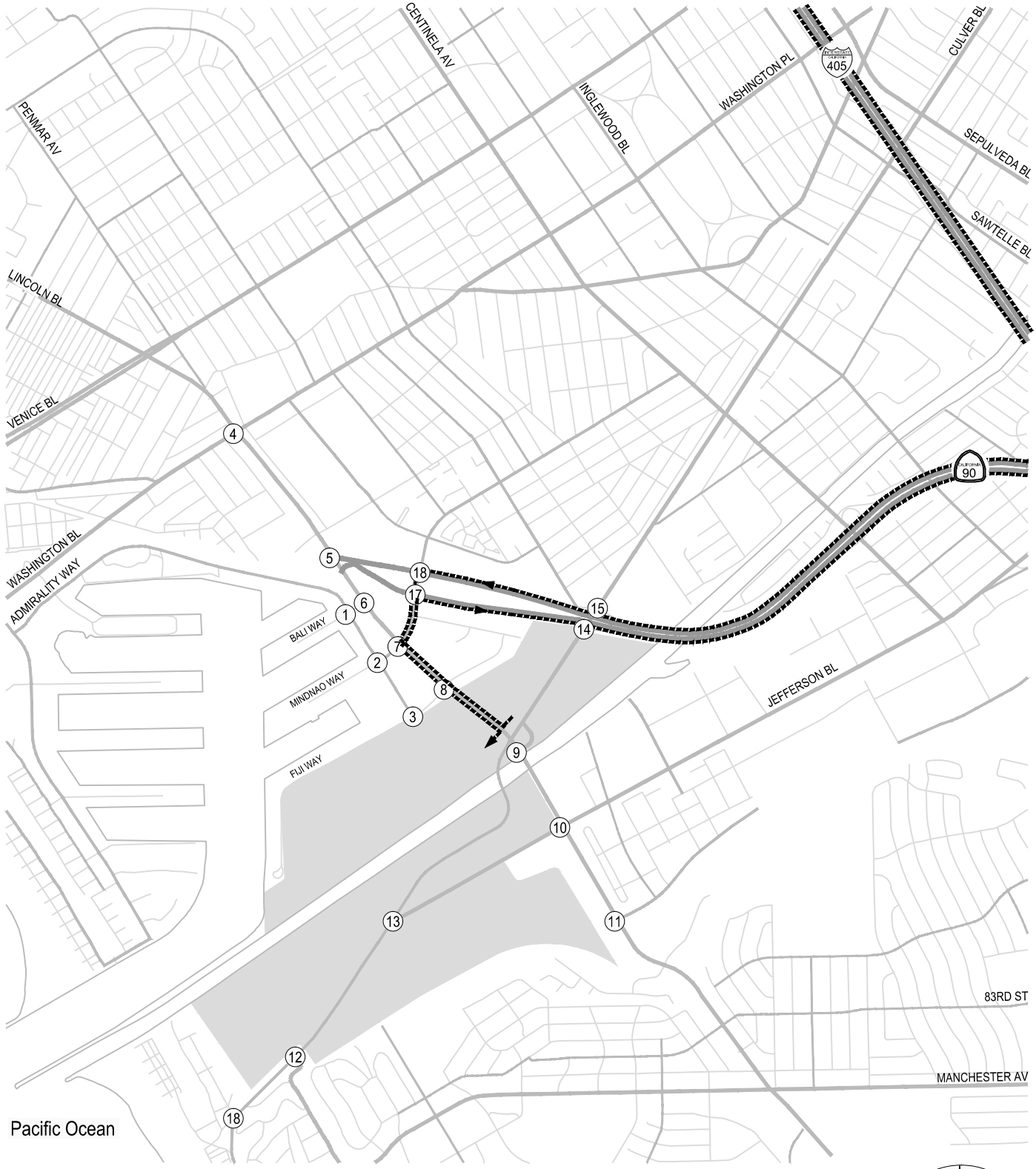

FIGURE 17
TRUCK HAUL ROUTE

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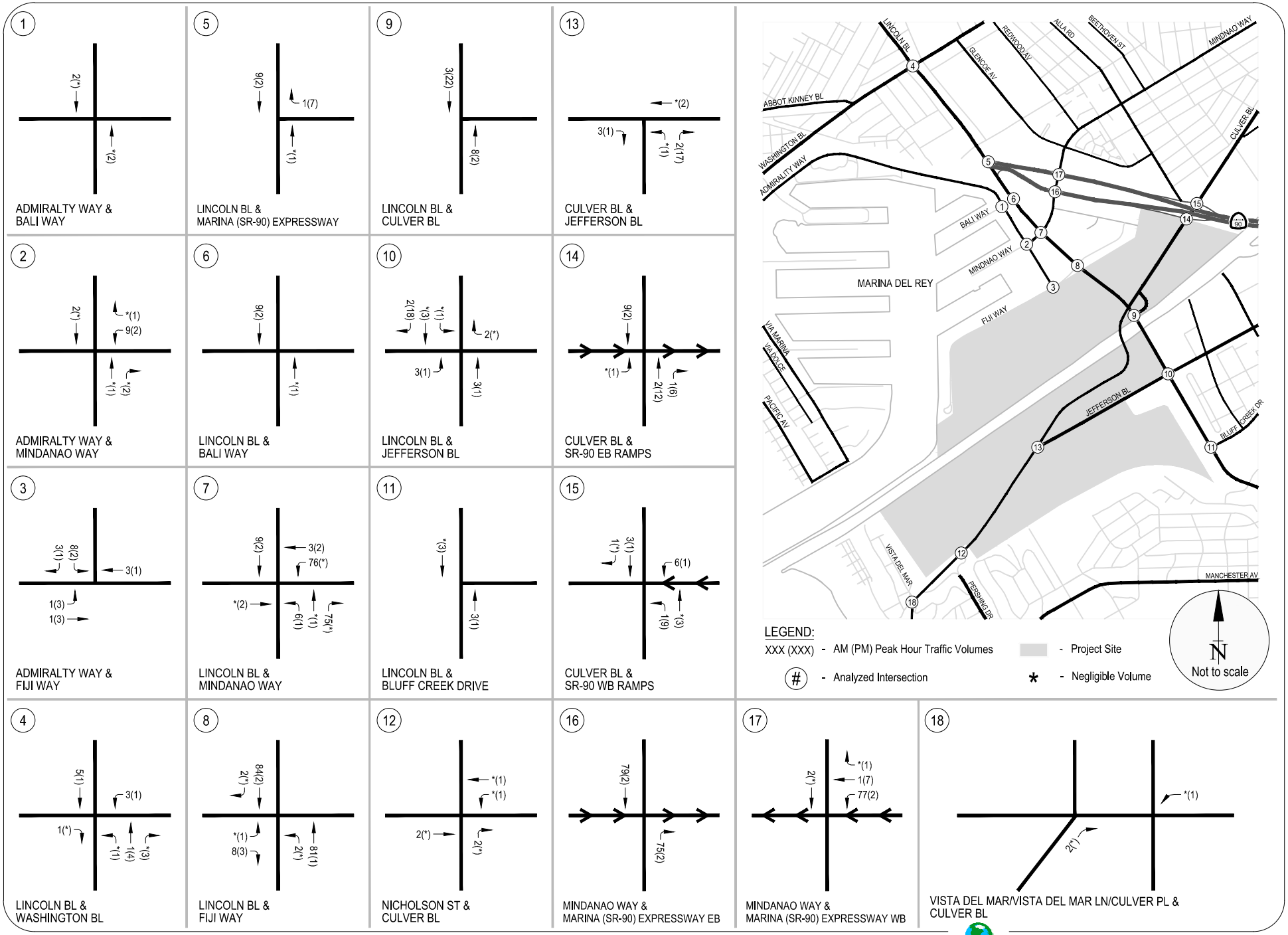


FIGURE 18
CONSTRUCTION ACTIVITY TRIPS - PEAK HOUR TRAFFIC VOLUMES

RAJU Associates, Inc.

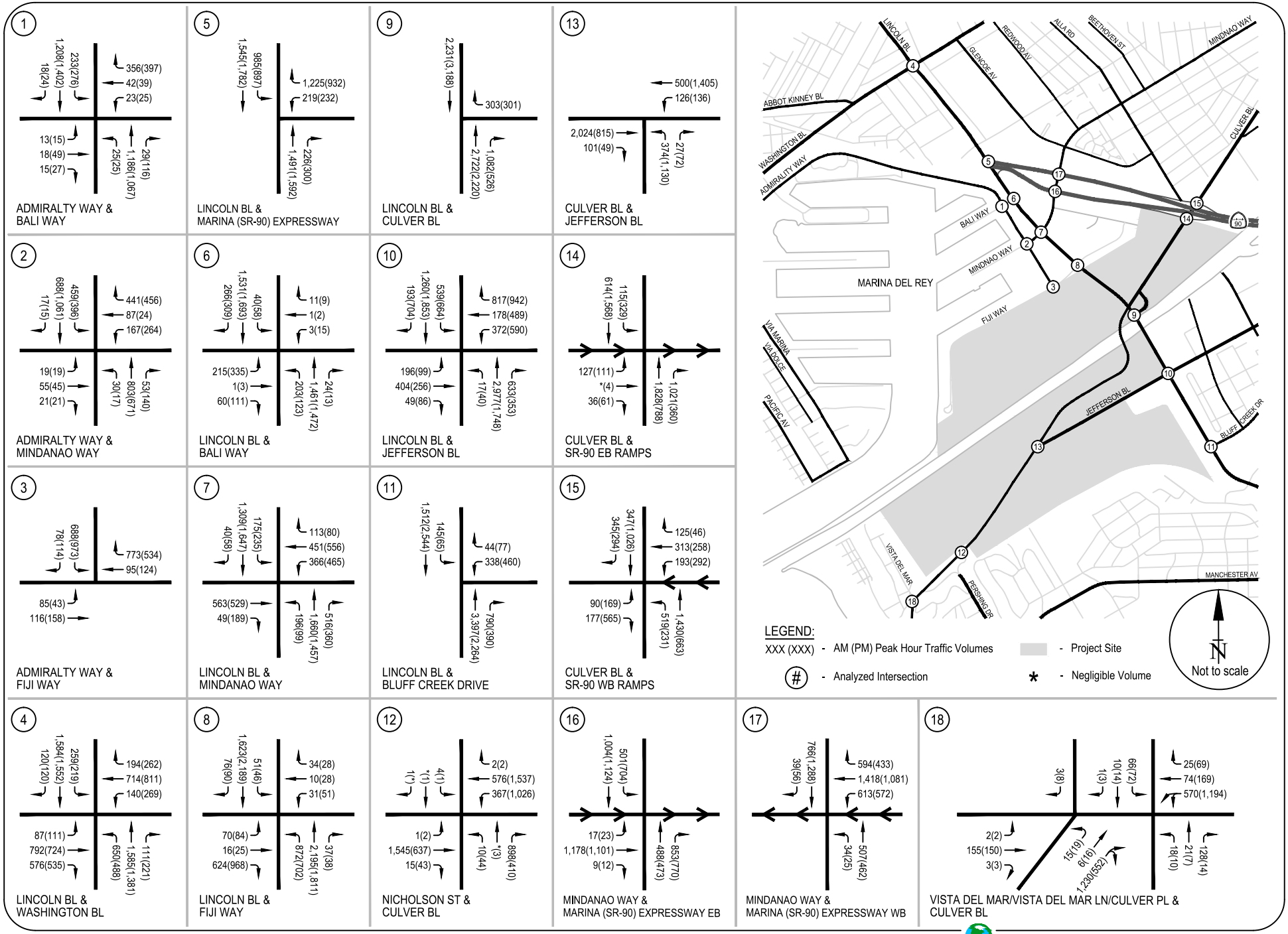


FIGURE 19
CUMULATIVE (2019) WITH PROJECT CONSTRUCTION ACTIVITY - PEAK HOUR TRAFFIC VOLUMES

RAJU Associates, Inc.

CUMULATIVE BASE (YEAR 2019 PRE-CONSTRUCTION) TRAFFIC CONDITIONS

The Future Cumulative Base (Year 2019 pre-construction) peak hour traffic volumes were analyzed at each of the study intersection and street segment to determine the V/C ratio and corresponding level of service. Table 9 presents the results of the Cumulative Base (Year 2019 without project – pre-construction) traffic analysis. As indicated in the table, 16 of the 18 study intersections are projected to operate at LOS D or better during both the morning and evening peak hours.

The remaining locations are projected to operate at LOS E and include:

- Lincoln Boulevard/Washington Boulevard: AM peak hour – LOS E
- Lincoln Boulevard/Jefferson Boulevard: AM peak hour – LOS E
- Jefferson Boulevard/Culver Boulevard: PM peak hour – LOS E
- SR-90 Freeway Westbound Ramps/Culver Boulevard: PM peak hour – LOS E

The capacity calculation worksheets for Cumulative (2019) Base conditions are provided in Appendix G.

CUMULATIVE (2019) WITH PROJECT CONSTRUCTION ACTIVITY TRAFFIC CONDITIONS

The Future Cumulative (2019) with Project Construction Activity peak hour traffic volumes were analyzed to determine the V/C ratio and LOS at each of the study locations. The results of this analysis are also summarized on Table 9. Table 9 indicates that construction related traffic would not change the intersection levels of service from cumulative base conditions at the study intersections during both the morning and evening peak hours with the exception of the intersection of Lincoln Boulevard/Fiji Way which would operate at LOS C during the morning peak hour compared to LOS B under cumulative base conditions.

The capacity calculation worksheets for Cumulative (2019) with Project Construction Activity conditions are provided in Appendix H.

TABLE 9
SUMMARY OF INTERSECTION LEVEL OF SERVICE ANALYSIS - CONSTRUCTION ANALYSIS

No.	Intersection	Peak Hour	Cumulative (2019) Base Conditions V/C	Cumulative (2019) Base Conditions LOS	Cumulative (2019) with Construction Activity V/C	Cumulative (2019) with Construction Activity LOS	Project Increase in V/C	Significant Project Impact
1.	Admiralty Way & Bali Way	AM	0.639	B	0.639	B	0.000	No
		PM	0.672	B	0.673	B	0.001	No
2.	Admiralty Way & Mindanao Way	AM	0.690	B	0.693	B	0.003	No
		PM	0.634	B	0.636	B	0.002	No
3.	Admiralty Way & Fiji Way	AM	0.471	A	0.472	A	0.001	No
		PM	0.365	A	0.368	A	0.003	No
4.	Lincoln Boulevard & Washington Boulevard	AM	0.915	E	0.917	E	0.003	No
		PM	0.870	D	0.871	D	0.001	No
5.	Lincoln Boulevard & Marina (SR-90) Expressway [1]	AM	0.774	C	0.774	C	0.001	No
		PM	0.778	C	0.779	C	0.001	No
6.	Lincoln Boulevard & Bali Way	AM	0.571	A	0.573	A	0.002	No
		PM	0.616	B	0.616	B	0.000	No
7.	Lincoln Boulevard & Mindanao Way	AM	0.768	C	0.798	C	0.030	No
		PM	0.870	D	0.872	D	0.001	No
8.	Lincoln Boulevard & Fiji Way	AM	0.694	B	0.714	C	0.020	No
		PM	0.801	D	0.802	D	0.001	No
9.	Lincoln Boulevard & Culver Loop	AM	0.855	D	0.857	D	0.002	No
		PM	0.621	B	0.621	B	0.000	No
10.	Lincoln Boulevard & Jefferson Boulevard	AM	0.915	E	0.915	E	0.000	No
		PM	0.803	D	0.803	D	0.000	No
11.	Lincoln Boulevard & Bluff Creek Drive	AM	0.682	B	0.682	B	0.000	No
		PM	0.523	A	0.524	A	0.001	No
12.	Nicholson Street & Culver Boulevard	AM	0.715	C	0.715	C	0.001	No
		PM	0.892	D	0.892	D	0.001	No
13.	Jefferson Boulevard & Culver Boulevard	AM	0.796	C	0.796	C	0.000	No
		PM	0.963	E	0.965	E	0.001	No
14.	Culver Boulevard & SR-90 Eastbound Ramps	AM	0.467	A	0.467	A	0.000	No
		PM	0.495	A	0.497	A	0.001	No
15.	Culver Boulevard & SR-90 Westbound Ramps	AM	0.844	D	0.845	D	0.001	No
		PM	0.948	E	0.951	E	0.004	No
16.	Mindanao Way & Marina (SR-90) Expressway Eastbound	AM	0.807	D	0.824	D	0.018	No
		PM	0.853	D	0.853	D	0.000	No
17.	Mindanao Way & Marina (SR-90) Expressway Westbound	AM	0.609	B	0.609	B	0.000	No
		PM	0.616	B	0.619	B	0.002	No
18.	Vista del Mar/Vista del Mar Lane & Culver Boulevard	AM	0.856	D	0.856	D	0.000	No
		PM	0.744	C	0.744	C	0.000	No

[1] Los Angeles County Congestion Management Program monitoring location.

V/C - Volume to Capacity Ratio

LOS - Level of Service

CONSTRUCTION TRAFFIC IMPACTS

Using the specified significant impact criteria, the traffic impacts at the analysis locations were determined. Table 9 identifies the individual impacts during both the morning and evening peak hours at all analyses locations. It can be observed none of the analyzed locations would be significantly impacted by the traffic associated with the construction activity of the Proposed Project. Therefore, no traffic-related mitigation measures would be required for the Proposed Project.

Additionally, during the construction phase of the Proposed Project, there would be no temporary street closures or reduction in travel lanes; therefore, the adjacent streets would not be affected.

CONSTRUCTION PARKING IMPACTS

All construction activity will occur on-site and will not impact on-street parking on any of the adjacent streets. It is anticipated that construction workers will park on-site.

CONSTRUCTION ACCESS IMPACTS

No driveways or sidewalks would need to be removed during construction. Therefore, there would be no loss of vehicular or pedestrian access to any uses in the vicinity of Project site during the phases of construction.

TRANSIT CONDITIONS DURING CONSTRUCTION

No temporary loss of bus stops would occur or rerouting of bus lines required, during the construction activities associated with the construction or operation of the Proposed Project.

CONSTRUCTION TRAFFIC MANAGEMENT PLAN

Although the Proposed Project would not result in temporary construction impacts, it is recommended that a final construction traffic management plan be prepared for each phase of the Project. This Plan would address details related to haul routes, dust control, noise control and City and County regulations. The construction management plan ensures that the construction activities and workers follow the City regulations and provides details of activities planned on-site. This Construction Traffic Management Plan will be prepared at the time of final design, prior to commencement of construction.

The Construction Traffic Management Plan will address various issues and details such as those noted above – access and parking associates with construction trips, haul routes and delivery management and other site-specific changes during construction.

VII. REGIONAL/CONGESTION MANAGEMENT PLAN ANALYSIS

This section presents the Congestion Management Program (CMP) transportation impact analysis. This analysis was conducted in accordance with the procedures outlined in the *2010 Congestion Management Program for Los Angeles County* (Los Angeles County Metropolitan Transportation Authority, 2010). The CMP requires that when a traffic impact report is prepared for a project, traffic impact analyses be conducted for select regional facilities based on the quantity of project traffic expected to use these facilities.

CMP TRAFFIC IMPACT ANALYSIS

The CMP guidelines for determining the study area for analysis of CMP arterial monitoring intersections and for freeway monitoring locations are as follows:

- All CMP arterial monitoring intersections where the proposed project will add 50 or more trips during either the AM or PM weekday peak hours of adjacent street traffic.
- All CMP mainline freeway monitoring locations where the proposed project will add 150 or more trips, in either direction, during either the AM or PM weekday peak hours.

The nearest CMP arterial monitoring intersection to the project site is the intersection of Lincoln Boulevard/Marina Expressway. Based on the incremental Project trip generation estimates presented in Chapter III, the Proposed Project will not add 50 or more new trips per hour to this location. Therefore, no further analysis of CMP arterial monitoring locations is required. However, this location was analyzed in the traffic study and the results of the analysis are presented in Chapter V. No significant traffic impacts are projected to occur at this location.

The nearest mainline freeway monitoring location to the project site is the San Diego Freeway (I-405) north of La Tijera Boulevard. Based on the incremental Project trip generation estimates, the Proposed Project will not add 150 or more new trips per hour to this location in either direction. Therefore, no further analysis of CMP freeway monitoring stations is required.

VIII. ALTERNATIVES ANALYSIS

This chapter presents the results of the traffic impact analysis of project alternatives for the Ballona Wetlands Ecological Reserve Restoration Project. These alternatives are required per CEQA as part of the Draft Environmental Impact Report (EIR) for the Project. A brief description of the alternatives including their proposed project description and corresponding trip generation estimates, and comparison to the Proposed Project's trip generation is provided in the following sections. Future Cumulative 2023 conditions with and without the alternatives, as well as traffic impacts of the alternatives in relation to those of the Proposed Project are presented in this chapter.

Four project alternatives have been analyzed in this study. They include the following:

- Alternative 1: Proposed Action (also referred to as the Proposed Project) - Restore contiguous tidal wetlands north of Culver Boulevard and enhance managed wetlands south of Culver Boulevard (South Area B).
- Alternative 2: Partial Restoration - Restore contiguous tidal wetlands in Area A and North Area B, maintain existing managed wetland in West Area B, and enhance managed wetlands in South Area B.
- Alternative 3: Levee Culverts and Oxbow - Restore tidal wetlands in Area A, maintain existing Area B managed wetlands, and restore wetlands in South Area C.
- Alternative 4: No Federal Action/No Project - No actions requiring federal, state, or local discretionary approval would be allowed.

Table 10 provides a summary of the alternatives. Descriptions of each of the alternatives, corresponding trip generation estimates, and comparison to those of the Proposed Project have been provided in the following sections. The same trip generation, distribution, traffic assignment, and traffic impact analysis parameters and assumptions as those used for the Proposed Project have been utilized in the analysis and evaluation of these alternatives. A comparative discussion of traffic impacts of each of the alternatives in relation to those of the Proposed Project is also provided in the subsequent sections of this Chapter.

TABEL 10
SUMMARY OF PROJECT ALTERNATIVES

Alternative Summary	Ecosystem Restoration	Flood Risk and Stormwater Management	Public Access & Visitor Amenities	Infrastructure & Utility Modifications	Implementation & Construction Process
Alternative 1: Proposed Action					
Restore contiguous tidal wetlands north of Culver Boulevard and enhance managed wetlands south of Culver Boulevard (South Area B)	Phased Restoration: • Phase 1 (Interim Restoration): – Area A and North Area B tidal wetland restoration and Ballona Creek realignment – South Area B managed wetland enhancement – East Area B (western portion), North Area C, and South Area C (eastern portion) upland habitat restoration • Phase 2 (Final Restoration): West Area B tidal restoration	• Remove existing armored levees along Area A and North and West Area B • Install new earthen perimeter levees in Area A, along the North side of Culver Boulevard, and in North and West Area B • Install new water control structures in South Area B • Construct Culver Boulevard stormwater detention wetland	• Construct levee trail and bike paths • Add gateway entrances with art/education installations • Construct new 3-story parking structure, improve existing West Culver Parking Lot • Install two new bridges for public access	• Gas well abandonment and replacement with phasing • Gas pipeline relocation (Phase 1) • Removal of abandoned sewer pipe	• Large-scale grading: – Up to approximately 2,440,000 cubic yards (cy) of on-site soil excavation, transport, and placement (fill for levees and uplands) – Fill stockpiled in East Area B and the Culver levee (Phase 1) – 10,000 cy of off-site soil export • Install two new bridges for soil transport/public access • Remove existing levees and realign Ballona Creek • Revegetation
Alternative 2: Restored Partial Sinuous Creek					
Restore contiguous tidal wetlands in Area A and North Area B, maintain existing managed wetland in West Area B, and enhance managed wetlands in South Area B	Restoration: • Area A and North Area B tidal wetland restoration and Ballona Creek realignment • South Area B managed wetland enhancement • East Area B, North Area C, and South Area C upland habitat restoration	• Remove existing levees along Area A and North Area B • Install new Area A and Culver Boulevard perimeter levees • Install new South Area B water control structure • Construct Culver Boulevard stormwater detention wetland	• Construct levee trail and bike paths • Add gateway entrances with art/education installations • Construct new 3-story parking structure, improve existing West Culver Parking Lot • Install two new bridges for public access	• Gas well abandonment and replacement • Gas pipeline relocation • Removal of abandoned sewer pipe	• Large-scale grading: – 2,130,000 cy of on-site soil excavation, transport, and placement (fill for levees and uplands) – 10,000 cy of off-site soil export • Install two new bridges for soil transport/public access • Remove existing levees, except in West Area B, realign Ballona Creek • Revegetation
Alternative 3: Levee Culverts and Oxbow					
Restore tidal wetlands in Area A and maintain existing Area B managed wetlands, restore wetlands in South Area C	Restoration: • Area A tidal wetland restoration with new Ballona Creek water control structures	• Install new Area A perimeter levee • Install new Area A water control structures (i.e., tide gates) along area A • Construct Culver Boulevard stormwater detention wetland	• Construct levee trail and bike paths • Add gateway entrances with art/education installations • Construct new 3-story parking structure, improve existing West Culver Parking Lot • Install one new bridge for public access	• Gas well abandonment and replacement • Removal of abandoned sewer pipe	• Large-scale grading: – 1,500,000 cy of on-site soil excavation, transport, and placement (fill for levees and uplands) – 1,230,000 cy of off-site soil export • Install one new bridge for soil transport/public access • Install new water control structures in existing Area A levee (i.e., north Ballona Creek levee) • Revegetation
Alternative 4: No Federal Action/No Project					
No actions requiring federal, state, or local discretionary approval would be allowed.	• No change. • Existing management and community volunteer restoration efforts would continue using exclusively hand-tools (no mechanized equipment currently is, or would be allowed under Alternative 4). • Ongoing influence of sea level rise would substantially affect tidal wetlands and related habitats over time	• No change to existing levees or other infrastructure would occur. • No culverts would be created, and no new levee armoring would occur. • Ongoing influence of sea level rise would eventually would render existing tide gates useless.	• No change • No new visitor or recreational amenities would be provided • Existing public access restrictions would continue • No parking structure would be built, and no improvements to existing parking areas would be made.	• No change. • SoCalGas would continue to manage wells and pipelines within the Ballona Reserve and independently would pursue well and pipeline abandonment and/or relocation based on the utility's priorities.	• No implementation or construction would occur • CDFW would continue to remove trash and debris, remove homeless encampments, and monitor and enforce other unauthorized or illegal activities. • Management of existing tide gates would continue until their permanent closure is necessitated, e.g., by the effects of sea level rise.

Source: ESA

Table 11 summarizes the trip generation estimates of the project alternatives including a comparison to the Proposed Project. Given that the size of the Ballona Wetlands Ecological Reserve (581 acres), the amount of parking provided and amenities provided are the same for Alternatives 1-3 (although the restoration footprint of the reserve are different for the three alternatives), the trip generation estimates for all three alternatives are similar.

ALTERNATIVE 1 – PROPOSED ACTION (PROPOSED PROJECT)

The description and analyses associated with this alterative have been discussed in detail in previous chapters (Chapters 3, 4, 5, 6, and 7).

ALTERNATIVE 2 – PARTIAL RESTORATION

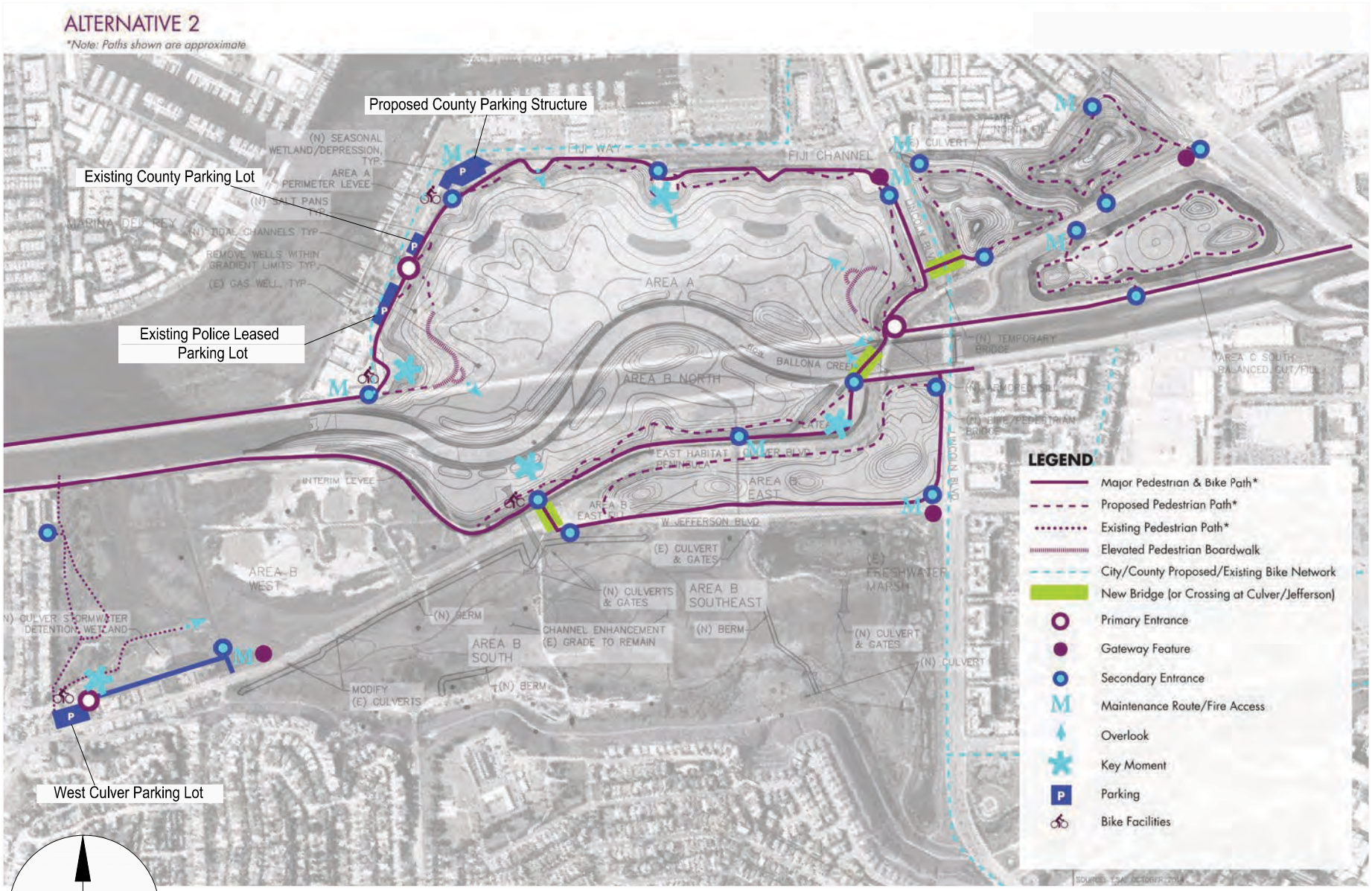
Alternative 2 is similar to the Proposed Project (Alternative 1), but with a slightly smaller project footprint. The extents of Alternative 2 and its public access plan are shown in Figure 20.

In Alternative 2, existing armored levees on the Ballona Creek channel adjacent to the Ballona Reserve would be removed and Ballona Creek would be realigned to flow in a natural meandering pattern as described for the Proposed Project; however, the southern levee of the Ballona Creek channel adjacent to West Area B would not be breached, and the existing water control structures would remain. As a result, this alternative restores a mix of fully tidal wetlands and managed wetlands in the Ballona Reserve while retaining existing habitats in West Area B. Alternative 2 would include the first restoration phase described for the Proposed Project, but not the second and final restoration phase and without the stockpiled fill along the Culver Boulevard levee and East Area B in the first phase of the Proposed Project.

New earthen levees would be built around the northern perimeter of Area A and along the north side of Culver Boulevard in North Area B. The interim levee identified in the Proposed Project would become the new location for the final North/West Area B levee in Alternative 2. The levees would be broad and gently sloped away from roadways and buildings, protecting development from potential flooding of Ballona Creek, and providing upland and transitional habitat zones. The new levees would be set back from Ballona Creek in order to connect the creek with its floodplain, allowing wetland habitat to form within the floodplain.

TABLE 11
ALTERNATIVE ANALYSIS - SUMMARY AND COMPARISON OF TRIP GENERATION ESTIMATES

Scenario	DAILY TOTAL	AM PEAK HOUR			PM PEAK HOUR		
		IN	OUT	TOTAL	IN	OUT	TOTAL
Operational Analysis							
Alternative 1-Proposed Action	378	7	5	12	32	20	52
Alternative 2: Partial Restoration	378	7	5	12	32	20	52
Difference from Alternative 1	0	0	0	0	0	0	0
Alternative 3: Levee Culverts and Oxbow	378	7	5	12	32	20	52
Difference from Alternative 1	0	0	0	0	0	0	0
Alternative 4: No Federal Action/No Project	0	0	0	0	0	0	0
Difference from Alternative 1	(378)	(7)	(5)	(12)	(32)	(20)	(52)
Construction Analysis							
Alternative 1-Proposed Action	2,009	106	79	185	6	28	34
Alternative 2: Partial Restoration	2,009	106	79	185	6	28	34
Difference from Alternative 1	0	0	0	0	0	0	0
Alternative 3: Levee Culverts and Oxbow	1,571	89	77	166	3	12	15
Difference from Alternative 1	(438)	(17)	(2)	(19)	(3)	(16)	(19)
% Difference	*-22%*	*-16%*	*-3%*	*-10%*	*-50%*	*-57%*	*-56%*
Alternative 4: No Federal Action/No Project	0	0	0	0	0	0	0
Difference from Alternative 1	(2,009)	(106)	(79)	(185)	(6)	(28)	(34)



SOURCE: Melendrez

FIGURE 20
BALLONA WETLANDS ECOLOGICAL RESERVE ALTERNATIVE 2 - PUBLIC ACCESS PLAN

RAJU Associates, Inc.

As with the Proposed Project, Alternative 2 would provide new trails and bicycle paths that would encourage safe use by visitors, and gateway entrances with educational and art installations. However, Alternative 2 would differ from the Proposed Project in that the trail would go along the North/West Area B levee (as in Phase 1 of Proposed Project) instead of going around the perimeter of West Area B and the baseball fields in Area C would be replaced (if external funding becomes available for this purpose) at a higher elevation following the placement of fill in that location.

Alternative 2 balances functioning tidal habitat creation with interim impacts to sensitive species habitats. While implementation of Alternative 2 would restore less full tidal wetlands in the Ballona Reserve as compared to the Proposed Project, it would eliminate the need to re-establish State-listed endangered Belding's Savannah Sparrow Habitat prior to potential losses of such habitat during implementation of the second phase. Alternative 2 would maintain West Area B in its present managed tidal state.

In addition, the existing SoCalGas wells would be decommissioned within the Ballona Reserve and pipelines would be abandoned or modified, as needed, to accommodate the proposed restoration activities.

Alternative 2 Trip Generation

Under Alternative 2, Ballona Wetlands Ecological Reserve would contain approximately 581 acres, same as the Proposed Project. The points of vehicular access, parking locations, amount of parking provided and amenities provided will be the same as the Proposed Project. Utilizing the ITE's Trip Generation Manual, 9th Edition trip rates, the Alternative 2 trip generation was determined and is summarized in Table 12. From Table 12, it can be observed that the Alternative 2 trip generation would result in a total of approximately 378 daily trips of which 12 trips would occur during the morning peak hour and 52 trips during the evening peak hour. From Table 11, it can be observed that this alternative generates the same amount of trips as the Proposed Project.

TABLE 12
ESTIMATED ALTERNATIVE 2 WEEKDAY TRIP GENERATION

	Size	Daily	AM Peak Hour			PM Peak Hour		
			IN	OUT	TOTAL	IN	OUT	TOTAL
Proposed Project Ballona Wetlands Ecological Reserve	581 acres	378	7	5	12	32	20	52
Trip Rates [1] State Park/County Park (ITE Land Use 413/412)	Trips per acre	0.65	61%	39%	0.02	61%	39%	0.09

[1] Trip generation of the Ballona Wetlands Ecological Reserve was estimated using county park and state park trip generation rates from ITE Trip Generation Manual, 9th Edition, 2012.

Alternative 2 Traffic Conditions

Table 13 summarizes the intersection morning and evening peak hour traffic conditions analysis associated with this alternative. It can be observed from this table that the Cumulative (2023) plus Project – Alternative 2 would result in similar traffic condition as the Proposed Project. As indicated in the table, 16 of the 18 study intersections are projected to operate at LOS D or better during the morning peak hour.

During the evening peak hour, 15 of the 18 study intersections are also projected to operate at LOS D or better. The remaining locations are projected to operate at LOS E and include:

- Lincoln Boulevard/Washington Boulevard: AM peak hour – LOS E
- Lincoln Boulevard/Jefferson Boulevard: AM peak hour – LOS E
- Nicholson Street/Culver Boulevard: PM peak hour – LOS E
- Jefferson Boulevard/Culver Boulevard: PM peak hour – LOS E
- SR-90 Freeway Westbound Ramps/Culver Boulevard: PM peak hour – LOS E

As indicated in Table 13, similar to the Proposed Project, Alternative 2 Project does not cause significant impacts at any of the analyzed intersections under both existing and future conditions. Therefore, no project-specific mitigation measures would be required.

It is important to note that if external funding does not become available for replacement of the baseball fields in Area C, this alternative would result in diversion of the traffic associated with the ball fields during the evening peak hours during the Little League season to Culver City, Del Rey and North Venice locations and consequently would have lesser traffic around the Project site compared to the Proposed Project. Based on the current traffic counts associated with the ball fields, the evening peak hour traffic diversion would be approximately 60 trips (48 inbound, 12 outbound) during the little league baseball season (March to June).

The associated intersection peak hour traffic volumes and capacity calculation worksheets for the Cumulative (2023) plus Project - Alternative 2 conditions are attached in Appendix I.

TABLE 13
SUMMARY OF INTERSECTION LEVEL OF SERVICE ANALYSIS - ALTERNATIVE 2 PROJECT

No.	Intersection	Peak Hour	Existing (2015) Conditions V/C	Existing (2015) Conditions LOS	Existing (2015) plus Project - Alt. 2 V/C	Existing (2015) plus Project - Alt. 2 LOS	Project Increase in V/C	Significant Project Impact	Cumulative (2023) Base Conditions V/C	Cumulative (2023) Base Conditions LOS	Cumulative (2023) plus Project - Alt. 2 V/C	Cumulative (2023) plus Project - Alt. 2 LOS	Project Increase in V/C	Significant Project Impact
1.	Admiralty Way & Bali Way	AM	0.616	B	0.616	B	0.000	No	0.656	B	0.656	B	0.000	No
		PM	0.627	B	0.628	B	0.001	No	0.692	B	0.692	B	0.001	No
2.	Admiralty Way & Mindanao Way	AM	0.667	B	0.667	B	0.001	No	0.709	C	0.709	C	0.001	No
		PM	0.587	A	0.593	A	0.006	No	0.652	B	0.658	B	0.006	No
3.	Admiralty Way & Fiji Way	AM	0.451	A	0.452	A	0.001	No	0.485	A	0.486	A	0.001	No
		PM	0.338	A	0.356	A	0.018	No	0.376	A	0.394	A	0.018	No
4.	Lincoln Boulevard & Washington Boulevard	AM	0.837	D	0.838	D	0.001	No	0.937	E	0.938	E	0.001	No
		PM	0.783	C	0.785	C	0.002	No	0.893	D	0.896	D	0.002	No
5.	Lincoln Boulevard & Marina (SR-90) Expressway [1]	AM	0.717	C	0.717	C	0.000	No	0.793	C	0.793	C	0.000	No
		PM	0.676	B	0.678	B	0.001	No	0.798	C	0.799	C	0.001	No
6.	Lincoln Boulevard & Bali Way	AM	0.509	A	0.509	A	0.000	No	0.585	A	0.585	A	0.000	No
		PM	0.552	A	0.553	A	0.001	No	0.634	B	0.635	B	0.001	No
7.	Lincoln Boulevard & Mindanao Way	AM	0.710	C	0.710	C	0.000	No	0.787	C	0.787	C	0.001	No
		PM	0.781	C	0.785	C	0.004	No	0.894	D	0.898	D	0.004	No
8.	Lincoln Boulevard & Fiji Way	AM	0.628	B	0.631	B	0.002	No	0.711	C	0.712	C	0.001	No
		PM	0.720	C	0.729	C	0.009	No	0.822	D	0.832	D	0.010	No
9.	Lincoln Boulevard & Culver Loop	AM	0.805	D	0.806	D	0.001	No	0.877	D	0.877	D	0.000	No
		PM	0.535	A	0.539	A	0.004	No	0.637	B	0.640	B	0.003	No
10.	Lincoln Boulevard & Jefferson Boulevard	AM	0.840	D	0.841	D	0.001	No	0.937	E	0.937	E	0.000	No
		PM	0.639	B	0.640	B	0.001	No	0.821	D	0.824	D	0.003	No
11.	Lincoln Boulevard & Bluff Creek Drive	AM	0.544	A	0.545	A	0.001	No	0.697	B	0.697	B	0.000	No
		PM	0.360	A	0.360	A	0.000	No	0.536	A	0.536	A	0.000	No
12.	Nicholson Street & Culver Boulevard	AM	0.652	B	0.652	B	0.000	No	0.732	C	0.733	C	0.001	No
		PM	0.798	C	0.800	D	0.002	No	0.915	E	0.918	E	0.002	No
13.	Jefferson Boulevard & Culver Boulevard	AM	0.727	C	0.727	C	0.000	No	0.815	D	0.816	D	0.000	No
		PM	0.810	D	0.812	D	0.002	No	0.987	E	0.989	E	0.001	No
14.	Culver Boulevard & SR-90 Eastbound Ramps	AM	0.436	A	0.436	A	0.000	No	0.479	A	0.479	A	0.000	No
		PM	0.463	A	0.466	A	0.003	No	0.510	A	0.513	A	0.003	No
15.	Culver Boulevard & SR-90 Westbound Ramps	AM	0.798	C	0.798	C	0.000	No	0.866	D	0.866	D	0.000	No
		PM	0.873	D	0.875	D	0.001	No	0.974	E	0.975	E	0.001	No
16.	Mindanao Way & Marina (SR-90) Expressway Eastbound	AM	0.756	C	0.757	C	0.001	No	0.827	D	0.827	D	0.000	No
		PM	0.809	D	0.810	D	0.001	No	0.877	D	0.879	D	0.002	No
17.	Mindanao Way & Marina (SR-90) Expressway Westbound	AM	0.572	A	0.572	A	0.000	No	0.624	B	0.625	B	0.001	No
		PM	0.559	A	0.560	A	0.001	No	0.634	B	0.636	B	0.002	No
18.	Vista del Mar/Vista del Mar Lane & Culver Boulevard	AM	0.782	C	0.783	C	0.001	No	0.878	D	0.879	D	0.001	No
		PM	0.653	B	0.657	B	0.004	No	0.765	C	0.768	C	0.003	No

[1] Los Angeles County Congestion Management Program monitoring location.

V/C - Volume to Capacity Ratio

LOS - Level of Service

Alternative 2 Construction Impact Analysis

Construction phasing would be the same as described for the Phase 1 of the Proposed Project. Construction of the Alternative 2 Project would be accomplished over an approximately three-year period, scheduled to commence in 2017 and completed in 2020 (compared to 2023 for the Proposed Project). During this period, it is anticipated that all construction activity would occur on-site with the exception of the construction of the bridge across Lincoln Boulevard, construction of water control structures (storm drains) across Culver Boulevard and Jefferson Boulevard, construction activities associated with gas line relocation across Culver Boulevard, construction worker trips and off-site trucks. Alternative 2 would be implemented in one phase. The overall construction schedule for Alternative 2 is shown in Table 14. The restoration construction activities would be sequenced as shown in Table 14.

In Alternative 2, utilities would be relocated within the Ballona Reserve, Area A and North Area B would be graded, and new levees would be constructed. Soil excavated from Area A would be transported to Area B and used to construct the Culver Boulevard levee. Water control structures would be installed/modified, and the wetland enhancements in South Area B, including channel excavation and berm construction, would be completed. Area A site preparation, grading, and re-vegetation also would occur. Site preparation of North and South Area B would occur, including utility relocation, clearing and grubbing, and over-excavation along the levee alignment. Area C and East Area B would be graded to upland habitat. Once the new levees are in place, the channel meanders would be constructed and existing levee segments removed. An open Ballona Creek channel would be maintained throughout the construction process. Finally, the public access features, including new bicycle and pedestrian paths and the West Area B fire access road and storm water drainage improvements, would be completed.

Similar to the Proposed Project, it is anticipated that the greatest amount of construction-related peak hour trips would be generated in Year 2019 and includes the following overlapping construction sequences:

- Excavate Area A
    - Excavate old fill from Area A (1,384,000 cubic yards wet cut)

- Area A and Area B North Excavate and Breach Existing Levees
    - Excavate Ballona Creek Channel in Areas A and B North (277,800 cubic yards cut)

TABLE 14
CONSTRUCTION SCHEDULE AND SEQUENCES - ALTERNATIVE 2

Sequence	Area	Title	Actions	Start Date	Working Days	Number of Workers
1	B	Area "B" Southeast Gas Lines	1a. Remove and relocate existing gas line	1/2/2017	20	8
2	B	Area "B" South Enhancement	2a. Create swale (10,000 CY wet cut)	1/2/2017	40	26
3	A	Area "A' Gas Line Removal	3a. Remove existing inactive gas line	1/2/2017	10	8
			3b. Cut and cap gas line at Fiji Way	1/2/2017	1	8
25	A & Property 1	Gas Well Abandonment	25a. Drill new well at SoCal Gas Plant to replace Del Ray 19	1/2/2017	50	70
			25b. Abandon and plug Del Ray 13, 14, 15, 17, 18, and 19	3/13/2017	225	17
			25c. Remove existing gas lines serving removed wells	1/22/2018	10	8
26	A	Area A around Wells Clear & Grub	26a. Remove vegetation around wells (2,000 CY)	1/22/2018	5	26
27	A	Area A around Wells Grading and Export to West Area B	27a. Excavate Area A and Export to West Area B (208,000 CY)	1/22/2018	5	80
28	A	Finish Grading For Uplands	28a. Finish grading around wells	2/12/2018	10	26
			28b. Re-establish upland vegetation	2/26/2018	5	16
29	B	Area B Abandon Wells	29a. Drill new well at SoCal Gas Plant to replace Del Rey 9 and Vidor 18	1/2/2017	50	70
			29b. Abandon and plug Vidor 1, 2, 3, 5, 14, 18 and Del Rey 4, 5, 9, 11	3/13/2017	225	17
			29c. Remove existing pipelines	11/13/2017	10	8
30	B	Area B around Wells Clear & Grub	30a. Remove vegetation around wells (2,000 CY)	11/27/2017	5	26
31	B	Finish Grading For Uplands	31a. Finish grading around wells	12/4/2017	10	26
			31b. Re-establish upland vegetation	12/18/2017	5	16
4	A & B	Pedestrian/Bike Bridge	4a. Construct temporary & portion of final re-routed trail to existing trail	4/17/2017	40	15
			4b. Construct new pedestrian/bike bridge over Ballona Creek	1/2/2017	130	50
			4c. Reroute Ballona Creek Bike Trail under Culver Blvd Bridge	7/4/2017	5	15
5	A & C	Lincoln Bridge	5a. Build Lincoln Bridge next to Culver Bridge to connect Area A to Area C North	7/4/2017	65	30
6	A	Clear, Grub, and Stockpile Area "A"	6a. Remove vegetation from Area A (54,400 CY dry cut)	7/4/2017	10	35
			6b. Remove trash	7/4/2017	20	35
			6c. Stockpile	7/4/2017	20	35
7	A	Excavate Area "A"	7a. Remove 36" concrete pipe near center of Area A	7/4/2017	5	8
			7b. Excavate old fill from Area A (1,384,000 CY wet cut, see note)	7/4/2017	555	80
			7c. Dig below (over excavate) future levees (30,000 CY dry cut)	7/4/2017	5	80
8	A	Area "A' Construct North Levee	8a. Grade and construct new levee around Area A (125,300 CY fill)	7/4/2017	35	90
9	B & Property 1	Area "B" North Gas Line Relocation & Well Abandonment	9a. Drill new well at SoCal Gas Plant to replace Del Ray 12	1/2/2017	50	70
			9b. Abandon and plug Del Rey 12	4/3/2017	90	17
			9c. Remove/relocate existing pipelines	7/4/2017	10	8
10	B	Area "B" North Clear & Grub	10a. Remove vegetation from Area B North and Area B West (25,000 CY wet cut)	7/4/2017	10	35
			10b. Remove trash	7/4/2017	50	35
11	B	Area "B" North Over-Excavate and Stockpile	11a. Excavate Area B North (56,700 CY wet cut)	7/4/2017	25	80
			11b. Dig below (over excavate) future levees (3,000 CY wet cut)	7/4/2017	5	80
12	B	Construct Area "B" Levee	12a. Construct Area B levees (266,200 CY)	8/14/2017	165	90
13	B	Clear, Grub, and Stockpile Area "B" East	13a. Remove vegetation in Area B East stockpile area (4,600 CY wet cut)	2/5/2018	5	26
			13b. Stockpile and prepare for fill	2/5/2018	5	35
14	B	Area "B" East Grading	14a. Grade Area B east and import from Area A (324,000 CY import from Area A)	2/12/2018	85	80
15	C	Clear & Grub Area "C" North & South	15a. Demo baseball fields and structures.	1/2/2017	15	-
			15b. Clear vegetation from Area C North (56,000 CY dry cut) & South (51,000 CY dry cut)	4/2/2018	25	35
			15c. Re-align and replace Marina ditch (45,000 CY wet cut)	4/23/2018	15	80
16	A & C	Area "A" Grading and Export to Area "C" North & South	16a. Excavate Area A and export to C South (540,000 CY total)	5/21/2018	135	80
			16b. Excavate Area A and export to C North (500,000 CY ultimate total; 183,000 CY at this sequence until levee is breached)	9/3/2018	50	80
17	C	Finish Grading for Uplands Area "C" South	17a. Reconstruct ballfields and structures and detailed grading in Area C South	6/3/2019	65	15
			17b. Re-establish upland vegetation	6/24/2019	5	16
18	B	Area "B" New and Reconstructed Culverts	18a. Install culverts under Culver/Jefferson Blvd, Gas Co Rd., and FWM berm; modify existing culvert under west end of Culver Blvd.	1/7/2019	130	26
			18b. Remove existing FWM pipes and outlets	7/8/2019	15	26
			18c. Construct new FWM outlet and spillway	7/29/2019	40	26
19	A & B	Area "A" and Area "B" North Excavate and Breach Existing Levees	19a. Excavate Ballona Creek Channel in Areas A and B North (277,800 CY cut)	4/15/2019	130	80
20	A & B	Area "A" and Area "B" North Block and Fill Existing Levees	20a. Install temporary pipe	4/15/2019	10	8
			20b. Temporary block then fill existing Ballona Creek (269,100 CY fill from Seq 19)	4/15/2019	60	80
21	A & B	Area "A" and Area "B" North Remove Existing Levees	21a. Remove old Ballona Creek levee (424,400CY) and excavate new channel meanders - Export to Area C North, quantities included in Sequence 16, ultimate.	7/8/2019	120	80
22	B	Area "B" West Fire Access Road	22a. Construct maintenance and fire road in Area B West	10/14/2019	20	15
			22b. Reconstruct Area B parking lot	10/14/2019	20	15
23	A & B	Bike Path, Pedestrian Walkway and Amenities	23a. Construct bike and ped trails on levees	10/14/2019	65	15
			23b. Construct County Parking Structure Foundation	10/14/2019	60	24
			23c. Construct County Parking Structure	10/14/2019	120	40
24	A	Export	24a. Export final excess dirt quantity (Assume 530,000 CY)	10/14/2019	150	2

Sources: Psomas, June 2015

- Area A and Area B North Block and Fill Existing Channels
    - Install temporary pipe
    - Temporary block then fill existing Ballona Creek (269,100 cubic yards fill)

- Area A and Area B North Remove Existing Levees
    - Remove old Ballona Creek levee (424,400 cubic yards) and excavate new channel meanders - Export to Area C North.

- Area B West Fire Access Road
    - Construct maintenance and fire road in Area B West
    - Reconstruct Area B parking lot

- Bike Path, Pedestrian Walkway and Amenities
    - Construct bike and ped trails on levees
    - Construct County Parking Structure Foundation
    - Construct County Parking Structure

- Off-Site Export
    - Export final excess dirt quantity (up to 530,000 cubic yards)

As indicated above, it is anticipated that most construction activities would occur on-site with the exception of the construction of the bridge across Lincoln Boulevard, construction of water control structures (storm drains) across Culver Boulevard and Jefferson Boulevard, construction activities associated with gas line relocation across Culver Boulevard, construction worker trips and off-site trucks.

The construction of the bridge across Lincoln Boulevard which requires off-site construction would occur for approximately three to four weeks in 2017. The gas line relocation and associated construction activities are anticipated to occur in 2017 and early 2018. The storm drain installation would occur for approximately three to four weeks per location in 2019.

Alternative 2: Lincoln Boulevard Bridge Construction Impacts - The bridge across Lincoln Boulevard would be constructed during night-time hours (11:00 PM to 5:00 AM) for a period of three to four weeks. This would require intermittent closure of Lincoln Boulevard during night-time hours over a four-week period in 2017. It is anticipated that cranes will be used to place the bridge segments and secured over the existing abutments or new abutments adjacent to and north of the Culver Boulevard bridge structure. The intermittent night-time closures of Lincoln Boulevard would allow the cranes to swing the bridge segments (structural members) over the travel lanes to place them over the existing or new abutments and secure them. Once the

members are in place and secured, the roadway would be opened. Emergency access will be maintained at all times. The current number of lanes along Lincoln Boulevard would not be affected during daytime (when there is no construction activity); and after the construction is complete, there would be no change to the number of lanes along Lincoln Boulevard.

Detailed 24-hour traffic counts were conducted along Lincoln Boulevard in the vicinity of the proposed bridge during September 2015. These traffic counts are included in Appendix B. It can be observed from the counts that traffic volumes along Lincoln Boulevard between the hours of 11:00 PM and 5:00 AM ranged from 48 vehicles to 380 vehicles in each direction in any one hour. Detailed construction traffic management plan would be prepared at the time of final design and would include specific details relative to detour routes, signage, temporary traffic control and hours of construction to the satisfaction of Caltrans and LADOT.

The potential detour route during construction (night-times for approximately three to four weeks) would include re-routing northbound Lincoln Boulevard traffic through the Culver Loop ramp to Marina Freeway back to Lincoln Boulevard, as well as through Jefferson Boulevard to Centinela Avenue to Marina Freeway and then back to Lincoln Boulevard. The southbound Lincoln Boulevard traffic could also be re-routed through Marina Freeway to Culver Boulevard or Centinela Avenue and then back to Lincoln Boulevard. With the implementation of the detour routes and other construction traffic management plan elements along with restriction of construction activities to night-times (11:00 PM to 5:00 AM) only, there would be no residual construction traffic impacts due to the Lincoln Boulevard bridge construction.

Both the bridges across Ballona Creek and Lincoln Boulevard would be constructed in 2017. After construction, the movement of soil between Project Areas A, B and C would commence and occur on these bridges, reducing the need to use surface streets such as Lincoln Boulevard, Culver Boulevard and Jefferson Boulevard. After construction activities associated with the Ballona Wetlands Restoration Project are complete, these bridges would become an integral part of the bicycle and pedestrian circulation system allowing visitors to cross Ballona Creek and Lincoln Boulevard as part of the recreational trails within the Ballona Reserve.

Alternative 2: Construction Traffic Impacts of Gas Line Relocation and Stormwater Drain Installation - Removal and relocation of existing gas lines in Area B as well as storm drain

installation in Area B would require partial closure of lanes along Culver Boulevard. Removal and relocation of existing gas lines in Area B would occur in 2017 and would require closure of half of Culver Boulevard over a four week period. The storm drain installation in Area B would occur in 2019 and would require closure of half of Culver Boulevard over a three week period per location.

Detailed 24-hour traffic counts were conducted along Culver Boulevard west of Lincoln Boulevard during June 2015. These counts have been included in Appendix B. Based on these counts, it is recommended that the partial closure of Culver Boulevard for construction activity be between the hours of 11:00 PM to 5:00 AM when traffic along Culver Boulevard is minimal, ranging from approximately 30 vehicles to 206 vehicles in either direction during this time period. A detailed construction traffic management plan including detour routes, signage, traffic control and hours of construction would be prepared at the times of final design to the satisfaction of LADOT.

The potential detour route during construction activities associated with gas line relocation and stormwater drain installation across Culver Boulevard (night-time periods for three weeks per location) would involve re-routing eastbound/northbound Culver Boulevard to Jefferson Boulevard to Lincoln Boulevard back to Culver Boulevard. The westbound/southbound Culver Boulevard would continue to use the partially open (half-roadway) Culver Boulevard during night-times.

With the implementation of the construction traffic management plan including detour routes and night-time hours of construction, there would be no residual significant traffic impacts due to the gas line relocation and stormwater drain installation components of the Alternative 2 Project.

An evaluation of detailed construction traffic analysis for Alternative 2 follows:

Based on the construction schedule shown in Table 14, the heaviest or most intense construction phase for the Alternative 2 Project would occur in the year 2019. During this period, multiple construction activities would overlap with one another including off-site soil export. Table 15 summarizes the construction activity and the number of workers of each sequence for this peak construction period. As indicated in the table, a total of approximately 351 workers would be on-site, similar to the Proposed Project. This does not include the workers for off-site soil export, which would arrive in their dirt-hauler truck from an outside yard to the site on a daily basis.

TABLE 15
PEAK CONSTRUCTION ACTIVITY/SEQUENCES - ALTERNATIVE 2

Sequence	Area	Title	Actions	Start Date	Working Days	Number of Workers
7	A	Excavate Area "A"	7b. Excavate old fill from Area A (1,384,000 CY wet cut)	7/4/2017	555	80
19	A & B	Area "A" and Area "B" North Excavate and Breach Existing Levees	19a. Excavate Ballona Creek Channel in Areas A and B North (277,800 CY cut)	4/15/2019	130	80
21	A & B	Area "A" and Area "B" North Remove Existing Levees	21a. Remove old Ballona Creek levee (424,400CY) and excavate new channel meanders - Export to Area C North, quantities included in Sequence 16, ultimate.	7/8/2019	120	80
22	B	Area "B" West Fire Access Road	22a. Construct maintenance and fire road in Area B West	10/14/2019	20	15
			22b. Reconstruct Area B parking lot	10/14/2019	20	15
23	A & B	Bike Path, Pedestrian Walkway and Amenities	23a. Construct bike and ped trails on levees	10/14/2019	65	15
			23b. Construct County Parking Structure Foundation	10/14/2019	60	24
			23c. Construct County Parking Structure	10/14/2019	120	40
24	A	Export	24a. Export final excess dirt quantity (Assume 530,000 CY)	10/14/2019	150	2
				TOTAL NUMBER OF WORKERS		351

Sources: Psomas, June 2015
Note: Construction activities would only occur during weekdays and in particular seasons of the year.

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As part of the grading process, up to 530,000 cubic yards of soil could be removed/exported in Alternative 2 compared to 110,000 cubic yards of soil for the Proposed Project. This would require approximately 35,334 haul trips over a 30-week period. This results in more truck haul trips overall, over a longer period of time compared to the Proposed Project. However, based on 240 truck trips per day estimated to occur at the site, Alternative 2 would result in approximately 480 truck trips per day, same as the Proposed Project.

Table 16 summarizes the estimated trip generation of construction activity for Alternative 2. From Table 16, it can be observed that the workers' trip generation would result in a total of approximately 809 daily trips of which 35 trips would occur during the morning peak hour and 34 trips during the evening peak hour, same as the Proposed Project.

The construction activity would result in a maximum trip generation of approximately 2,009 daily trips of which 185 trips would occur during the morning peak hour and 34 trips during the evening peak hour. This is the same construction activity trip generation as that of the Proposed Project.

The results of the Cumulative (2019) with Construction Activity – Alternative 2 traffic analysis are summarized on Table 17. It can be observed from this table that the Cumulative (2019) with Construction Activity – Alternative 2 would result in similar traffic condition as the Proposed Project. As indicated in the table, 16 of the 18 study intersections are projected to operate at LOS D or better during both the morning and evening peak hours. The remaining locations are projected to operate at LOS E and include:

- Lincoln Boulevard/Washington Boulevard: AM peak hour – LOS E
- Lincoln Boulevard/Jefferson Boulevard: AM peak hour – LOS E
- Jefferson Boulevard/Culver Boulevard: PM peak hour – LOS E
- SR-90 Freeway Westbound Ramps/Culver Boulevard: PM peak hour – LOS E

As indicated in Table 17, similar to the Proposed Project, none of the analyzed locations would be significantly impacted by the traffic associated with the construction activity of the Alternative 2 Project. Therefore, no traffic-related mitigation measures would be required for the Proposed Project.

TABLE 16
ESTIMATED TRIP GENERATION - CONSTRUCTION ACTIVITY: ALTERNATIVE 2

	Daily	AM Peak Hour			PM Peak Hour		
		IN	OUT	TOTAL	IN	OUT	TOTAL
Construction Workers [1]	809	31	4	35	6	28	34
Soil Export [2,3] (Dump Truck Trips)	1,200	75	75	150	0	0	0
Total Trips	2,009	106	79	185	6	28	34

[1] For the purpose of this analysis, ITE 9th Edition trip generation rates for workers at an office use was utilized. Per project construction description, maximum construction workers anticipated during peak construction period equivalent to 351 with a SCAg-model based AVR of 1.44 was used in this analysis. Additionally, most of this construction worker traffic would occur before the peak hours on weekdays. However, it was conservatively assumed that 30% of the construction worker peak hour traffic would occur during the AM and PM peak hours.

[2] Assumes an average of 15 cubic yards (c.y.) of soil per truck haul with an average headway of 2 minutes between trucks leaving the site. Soil export operations would end before evening peak hour traffic. Therefore, no truck trips would occur during the PM peak hour.

[3] Construction truck trips have been converted to Passenger Car Equivalents (PCEs) using a factor of 2.5.

TABLE 17
SUMMARY OF INTERSECTION LEVEL OF SERVICE ANALYSIS - CONSTRUCTION ANALYSIS: ALTERNATIVE 2

No.	Intersection	Peak Hour	Cumulative (2019) Base Conditions V/C	Cumulative (2019) Base Conditions LOS	Cumulative (2019) with Construction Activity V/C	Cumulative (2019) with Construction Activity LOS	Project Increase in V/C	Significant Project Impact
1.	Admiralty Way & Bali Way	AM	0.639	B	0.639	B	0.000	No
		PM	0.672	B	0.673	B	0.001	No
2.	Admiralty Way & Mindanao Way	AM	0.690	B	0.693	B	0.003	No
		PM	0.634	B	0.636	B	0.002	No
3.	Admiralty Way & Fiji Way	AM	0.471	A	0.472	A	0.001	No
		PM	0.365	A	0.368	A	0.003	No
4.	Lincoln Boulevard & Washington Boulevard	AM	0.915	E	0.917	E	0.003	No
		PM	0.870	D	0.871	D	0.001	No
5.	Lincoln Boulevard & Marina (SR-90) Expressway [1]	AM	0.774	C	0.774	C	0.001	No
		PM	0.778	C	0.779	C	0.001	No
6.	Lincoln Boulevard & Bali Way	AM	0.571	A	0.573	A	0.002	No
		PM	0.616	B	0.616	B	0.000	No
7.	Lincoln Boulevard & Mindanao Way	AM	0.768	C	0.798	C	0.030	No
		PM	0.870	D	0.872	D	0.001	No
8.	Lincoln Boulevard & Fiji Way	AM	0.694	B	0.714	C	0.020	No
		PM	0.801	D	0.802	D	0.001	No
9.	Lincoln Boulevard & Culver Loop	AM	0.855	D	0.857	D	0.002	No
		PM	0.621	B	0.621	B	0.000	No
10.	Lincoln Boulevard & Jefferson Boulevard	AM	0.915	E	0.915	E	0.000	No
		PM	0.803	D	0.803	D	0.000	No
11.	Lincoln Boulevard & Bluff Creek Drive	AM	0.682	B	0.682	B	0.000	No
		PM	0.523	A	0.524	A	0.001	No
12.	Nicholson Street & Culver Boulevard	AM	0.715	C	0.715	C	0.001	No
		PM	0.892	D	0.892	D	0.001	No
13.	Jefferson Boulevard & Culver Boulevard	AM	0.796	C	0.796	C	0.000	No
		PM	0.963	E	0.965	E	0.001	No
14.	Culver Boulevard & SR-90 Eastbound Ramps	AM	0.467	A	0.467	A	0.000	No
		PM	0.495	A	0.497	A	0.001	No
15.	Culver Boulevard & SR-90 Westbound Ramps	AM	0.844	D	0.845	D	0.001	No
		PM	0.948	E	0.951	E	0.004	No
16.	Mindanao Way & Marina (SR-90) Expressway Eastbound	AM	0.807	D	0.824	D	0.018	No
		PM	0.853	D	0.853	D	0.000	No
17.	Mindanao Way & Marina (SR-90) Expressway Westbound	AM	0.609	B	0.609	B	0.000	No
		PM	0.616	B	0.619	B	0.002	No
18.	Vista del Mar/Vista del Mar Lane & Culver Boulevard	AM	0.856	D	0.856	D	0.000	No
		PM	0.744	C	0.744	C	0.000	No

[1] Los Angeles County Congestion Management Program monitoring location.

V/C - Volume to Capacity Ratio

LOS - Level of Service

The associated intersection peak hour traffic volumes and capacity calculation worksheets for Cumulative (2019) with Project Construction Activity - Alternative 2 conditions are attached in Appendix J.

Replacement of Area C Baseball Fields – As part of Alternative 2, the baseball fields in Area C, home of the Culver Marina Little League, would be replaced (if external funding becomes available for this purpose) at a higher elevation following the placement of fill in that location. This would occur over a 1-year period, from April 2018 to April 2019. During this period, the Culver Marina Little League would have their games at interim nearby locations including: Culver City Little League at 9800 Jefferson Boulevard in Culver City, Del Rey Little League at two locations - 6705 West 77th Street, Los Angeles and 100 Convoy Street, Los Angeles, and North Venice Little League at 3321 Grand View Boulevard, Los Angeles. It is anticipated that games/ball fields will be shared with the other leagues (source: ESA). Given that games are currently being played at the proposed interim locations by other Little Leagues, the relocation of the Culver Marina Little League would not result in more games being played during the peak hours of traffic and any additional games would be played during the off-peak hours of traffic. Also, traffic studies are generally not required for baseball little leagues, since their traffic effects are typically captured in the traffic associated with those parks and ball fields. Therefore, no additional traffic analysis would be required for the temporary relocation of the little league. If external funding does not become available to reestablish the ball fields, the Culver Marina Little League would either be absorbed into the nearby Little Leagues or construct ball fields at another undetermined location.

Summary

On an overall basis, this alternative would adversely impact traffic to the same degree as that of the Proposed Project and would have similar construction related traffic effects. However, the effects of Alternative 2 construction related traffic (i.e. export of soil to off-site facilities) would last for a longer period of time than the Proposed Project, 30 weeks compared to 7 weeks. No significant differences in travel patterns outside the project area are anticipated between this alternative and the Proposed Project.

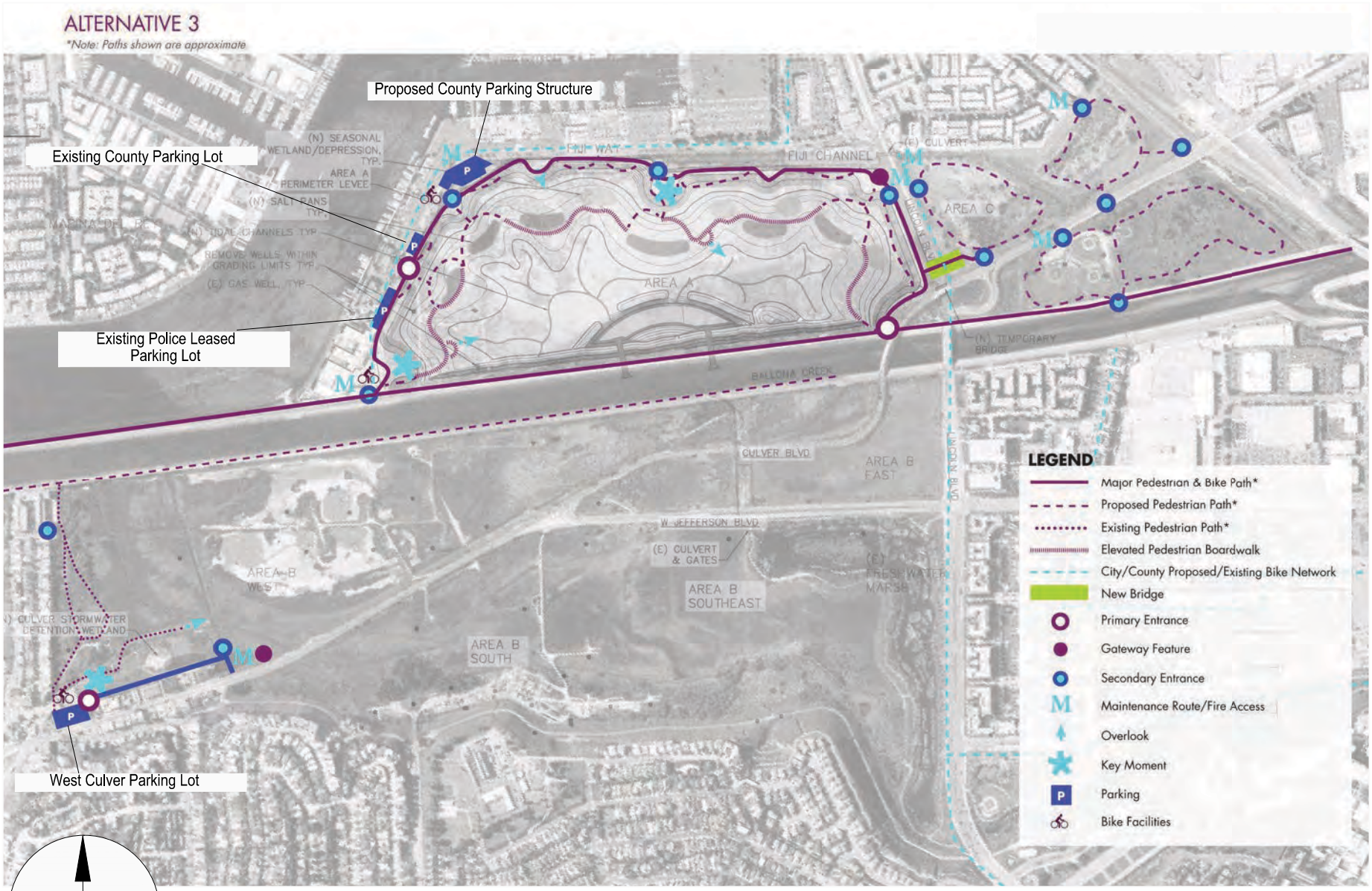
ALTERNATIVE 3 – LEVEE CULVERTS AND OXBOW

Alternative 3 would have a substantially smaller project footprint than the Proposed Project (Alternative 1) and Alternative 2. The extents of Alternative 3 and its public access plan are shown in Figure 21.

Restoration under Alternative 3 would be focused in Area A and Area C only. Area B would not be actively restored and habitats would remain in their current condition (e.g., muted tidal in West and South/Southeast Area B, non-tidal in the remainder of Area B). In Alternative 3, existing armored levees on the Ballona Creek channel adjacent to the Ballona Reserve would remain intact. No levee breaching would occur. Instead, two new culvert water control structures would be installed within the northern Ballona Creek channel levee to support full tidal restoration in Area A similar to the Proposed Project, with an oxbow channel. The southern Ballona Creek channel levee would remain unchanged from its current condition. Alternative 3 would include restoration of Area A and a new perimeter flood risk management levee.

A new earthen levee would be built around the northern perimeter of Area A as described in the Proposed Project. The levee would be broad and gently sloped toward the restored wetlands, protecting development from potential flooding of Ballona Creek and providing upland and transitional habitat zones within the restored Ballona Reserve. Between the new perimeter levee and the existing Ballona Creek channel levee a variety of coastal wetland habitats would be restored within the created marsh plain similar to those proposed in the Proposed Project.

As in the Proposed Project, Alternative 3 would provide new trails and bicycle paths in Area A, which would encourage safe use by visitors, and gateway entrances with educational and art installations. There would be no new trails in Area B or in Area C. A new parking structure along Fiji Way for use by DBH, CDFW staff, and the public would reduce the existing parking area footprint within this portion of the Ballona Reserve by approximately 0.68 acre. Alternative 3 would include improvements to the existing West Culver Parking Lot in West Area B to make access safer and more appealing to visitors.



SOURCE: Melendrez

FIGURE 21
BALLONA WETLANDS ECOLOGICAL RESERVE ALTERNATIVE 3 - PUBLIC ACCESS PLAN

RAJU Associates, Inc.

Alternative 3 is intended to reduce temporary and permanent impacts to Federal and state jurisdictional wetlands, and eliminate the potential need to reestablish state-listed endangered Belding's Savannah Sparrow nesting habitat prior to implementation of a project phase that could impact the habitat, as under the Proposed Project. However, Alternative 3 would result in restoring less tidal wetland and other habitats in the Ballona Reserve than proposed under the Project.

Alternative 3 Trip Generation

Under Alternative 3, Ballona Wetlands Ecological Reserve would contain approximately 581 acres, same as the Proposed Project. The points of vehicular access, parking locations, amount of parking provided and amenities provided will be the same as the Proposed Project. Utilizing the ITE's Trip Generation Manual, 9th Edition trip rates, the Alternative 3 trip generation was determined and is summarized in Table 18. From Table 18, it can be observed that the Alternative 3 trip generation would result in a total of approximately 378 daily trips of which 12 trips would occur during the morning peak hour and 52 trips during the evening peak hour. From Table 11, it can be observed that this alternative generates the same amount of trips as the Proposed Project.

Alternative 3 Traffic Conditions

Table 19 summarizes the intersection morning and evening peak hour traffic conditions analysis associated with this alternative. It can be observed from this table that the Cumulative (2023) plus Project – Alternative 3 would result in similar traffic condition as the Proposed Project. As indicated in the table, 16 of the 18 study intersections are projected to operate at LOS D or better during the morning peak hour. During the evening peak hour, 15 of the 18 study intersections are also projected to operate at LOS D or better. The remaining locations are projected to operate at LOS E and include:

- Lincoln Boulevard/Washington Boulevard: AM peak hour – LOS E
- Lincoln Boulevard/Jefferson Boulevard: AM peak hour – LOS E
- Nicholson Street/Culver Boulevard: PM peak hour – LOS E
- Jefferson Boulevard/Culver Boulevard: PM peak hour – LOS E
- SR-90 Freeway Westbound Ramps/Culver Boulevard: PM peak hour – LOS E

TABLE 18
ESTIMATED ALTERNATIVE 3 WEEKDAY TRIP GENERATION

	Size	Daily	AM Peak Hour			PM Peak Hour		
			IN	OUT	TOTAL	IN	OUT	TOTAL
Proposed Project Ballona Wetlands Ecological Reserve	581 acres	378	7	5	12	32	20	52
Trip Rates [1] State Park/County Park (ITE Land Use 413/412)	Trips per acre	0.65	61%	39%	0.02	61%	39%	0.09

[1] Trip generation of the Ballona Wetlands Ecological Reserve was estimated using county park and state park trip generation rates from ITE Trip Generation Manual, 9th Edition, 2012.

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TABLE 19
SUMMARY OF INTERSECTION LEVEL OF SERVICE ANALYSIS - ALTERNATIVE 3

No.	Intersection	Peak Hour	Existing (2015) Conditions V/C	Existing (2015) Conditions LOS	Existing (2015) plus Project - Alt. 3 V/C	Existing (2015) plus Project - Alt. 3 LOS	Project Increase in V/C	Significant Project Impact	Cumulative (2023) Base Conditions V/C	Cumulative (2023) Base Conditions LOS	Cumulative (2023) plus Project - Alt. 3 V/C	Cumulative (2023) plus Project - Alt. 3 LOS	Project Increase in V/C	Significant Project Impact
1.	Admiralty Way & Bali Way	AM	0.616	B	0.616	B	0.000	No	0.656	B	0.656	B	0.000	No
		PM	0.627	B	0.628	B	0.001	No	0.692	B	0.692	B	0.001	No
2.	Admiralty Way & Mindanao Way	AM	0.667	B	0.667	B	0.001	No	0.709	C	0.709	C	0.001	No
		PM	0.587	A	0.593	A	0.006	No	0.652	B	0.658	B	0.006	No
3.	Admiralty Way & Fiji Way	AM	0.451	A	0.452	A	0.001	No	0.485	A	0.486	A	0.001	No
		PM	0.338	A	0.356	A	0.018	No	0.376	A	0.394	A	0.018	No
4.	Lincoln Boulevard & Washington Boulevard	AM	0.837	D	0.838	D	0.001	No	0.937	E	0.938	E	0.001	No
		PM	0.783	C	0.785	C	0.002	No	0.893	D	0.896	D	0.002	No
5.	Lincoln Boulevard & Marina (SR-90) Expressway [1]	AM	0.717	C	0.717	C	0.000	No	0.793	C	0.793	C	0.000	No
		PM	0.676	B	0.678	B	0.001	No	0.798	C	0.799	C	0.001	No
6.	Lincoln Boulevard & Bali Way	AM	0.509	A	0.509	A	0.000	No	0.585	A	0.585	A	0.000	No
		PM	0.552	A	0.553	A	0.001	No	0.634	B	0.635	B	0.001	No
7.	Lincoln Boulevard & Mindanao Way	AM	0.710	C	0.710	C	0.000	No	0.787	C	0.787	C	0.001	No
		PM	0.781	C	0.785	C	0.004	No	0.894	D	0.898	D	0.004	No
8.	Lincoln Boulevard & Fiji Way	AM	0.628	B	0.631	B	0.002	No	0.711	C	0.712	C	0.001	No
		PM	0.720	C	0.729	C	0.009	No	0.822	D	0.832	D	0.010	No
9.	Lincoln Boulevard & Culver Loop	AM	0.805	D	0.806	D	0.001	No	0.877	D	0.877	D	0.000	No
		PM	0.535	A	0.539	A	0.004	No	0.637	B	0.640	B	0.003	No
10.	Lincoln Boulevard & Jefferson Boulevard	AM	0.840	D	0.841	D	0.001	No	0.937	E	0.937	E	0.000	No
		PM	0.639	B	0.640	B	0.001	No	0.821	D	0.824	D	0.003	No
11.	Lincoln Boulevard & Bluff Creek Drive	AM	0.544	A	0.545	A	0.001	No	0.697	B	0.697	B	0.000	No
		PM	0.360	A	0.360	A	0.000	No	0.536	A	0.536	A	0.000	No
12.	Nicholson Street & Culver Boulevard	AM	0.652	B	0.652	B	0.000	No	0.732	C	0.733	C	0.001	No
		PM	0.798	C	0.800	D	0.002	No	0.915	E	0.918	E	0.002	No
13.	Jefferson Boulevard & Culver Boulevard	AM	0.727	C	0.727	C	0.000	No	0.815	D	0.816	D	0.000	No
		PM	0.810	D	0.812	D	0.002	No	0.987	E	0.989	E	0.001	No
14.	Culver Boulevard & SR-90 Eastbound Ramps	AM	0.436	A	0.436	A	0.000	No	0.479	A	0.479	A	0.000	No
		PM	0.463	A	0.466	A	0.003	No	0.510	A	0.513	A	0.003	No
15.	Culver Boulevard & SR-90 Westbound Ramps	AM	0.798	C	0.798	C	0.000	No	0.866	D	0.866	D	0.000	No
		PM	0.873	D	0.875	D	0.001	No	0.974	E	0.975	E	0.001	No
16.	Mindanao Way & Marina (SR-90) Expressway Eastbound	AM	0.756	C	0.757	C	0.001	No	0.827	D	0.827	D	0.000	No
		PM	0.809	D	0.810	D	0.001	No	0.877	D	0.879	D	0.002	No
17.	Mindanao Way & Marina (SR-90) Expressway Westbound	AM	0.572	A	0.572	A	0.000	No	0.624	B	0.625	B	0.001	No
		PM	0.559	A	0.560	A	0.001	No	0.634	B	0.636	B	0.002	No
18.	Vista del Mar/Vista del Mar Lane & Culver Boulevard	AM	0.782	C	0.783	C	0.001	No	0.878	D	0.879	D	0.001	No
		PM	0.653	B	0.657	B	0.004	No	0.765	C	0.768	C	0.003	No

[1] Los Angeles County Congestion Management Program monitoring location.

V/C - Volume to Capacity Ratio

LOS - Level of Service

As indicated in Table 19, similar to the Proposed Project, Alternative 3 Project does not cause significant impacts at any of the analyzed intersections under both existing and future conditions. Therefore, no project-specific mitigation measures would be required.

The associated intersection peak hour traffic volumes and capacity calculation worksheets for Cumulative (2023) plus Project - Alternative 3 conditions are attached in Appendix K.

Alternative 3 Construction Impact Analysis

Construction of the Alternative 3 Project would be accomplished over an approximately four-year period, scheduled to commence in 2017 and completed in 2021. During this period, it is anticipated that all construction activity would occur on-site with the exception of the construction of the bridge across Lincoln Boulevard, construction activities associated with gas line relocation across Culver Boulevard, construction worker trips and off-site trucks. Alternative 3 would be implemented in one phase. The overall construction schedule for Alternative 3 is shown in Table 20. The restoration construction activities of Alternative 3 would be sequenced as shown in Table 20.

In Alternative 3, utilities would be relocated within the Ballona Reserve, Area A would be graded, and new levees would be constructed. Soil excavated from Area A would be transported off-site. Tide gates would be installed in the northern Ballona Creek channel levee and Area A would be re-vegetated.

Similar to the Proposed Project, it is anticipated that the greatest amount of construction-related peak hour trips would be generated in Year 2019 and includes the following overlapping construction sequences:

- Area A Grading and Export to Area C North & South Off-Site
    - Excavate Area A and export to C South (300,000 cubic yards total)

- Bike Path, Pedestrian Walkway and Amenities
    - Construct bike and ped trails on levees
    - Construct County Parking Structure Foundation
    - Construct County Parking Structure

- Off-Site Export
    - Export final excess dirt quantity (up to 1,230,000 cubic yards)

TABLE 20
CONSTRUCTION SCHEDULE AND SEQUENCES - ALTERNATIVE 3

Sequence	Area	Title	Actions	Start Date	Working Days	Number of Workers
1	B	Area "B" Southeast Gas Lines	1a. Remove and relocate existing gas line	1/2/2017	20	8
2	B	Area "B" South Enhancement	2a. Create stormwater detention/treatment swale/wetland (10,000 CY wet cut)	1/2/2017	40	26
3	A	Area "A' Gas Line Removal	3a. Remove existing inactive gas line	1/2/2017	10	8
			3b. Cut and cap gas line at Fiji Way	1/2/2017	1	8
25	A & Property 1	Gas Well Abandonment	32a. Drill new well at SoCal Gas Plant to replace Del Rey 17 and 19	1/2/2017	50	70
			32b. Abandon and plug Del Rey 13, 14, 15, 17, 18 and 19	3/13/2017	225	17
			32c. Remove existing gas lines serving removed wells	1/22/2018	10	8
9	B & Property 1	Area "B" North Gas Line Relocation & Well Abandonment	31a. Finish grading around wells	12/4/2017	10	26
			31b. Re-establish upland vegetation	12/18/2017	5	16
			9c. Remove existing pipelines	7/4/2017	10	8
29	B	Area B Abandon Wells	29b. Abandon and plug Vidor 1, 2, 3, 5, 14, 18 and Del Rey 4, 5, 9, 11	3/13/2017	225	17
			29b. Remove existing pipelines	11/13/2017	10	8
30	B	Area B around Wells Clear & Grub	30a. Remove vegetation around wells (2,000 CY)	11/27/2017	5	26
31	B	Finish Grading and Habitat Establishment	31a. Finish grading around wells	12/4/2017	10	26
			31b. Establish vegetation	12/18/2017	5	16
5	A & C	Lincoln Bridge	5a. Build Lincoln Bridge next to Culver Bridge to connect Area A to Area C North	7/4/2017	65	30
6	A	Clear, Grub, and Stockpile Area "A"	6a. Remove vegetation from Area A (54,400 CY dry cut)	7/4/2017	10	35
			6b. Remove trash	7/4/2017	20	35
			6c. Stockpile	7/4/2017	20	35
7	A	Excavate Area "A"	7a. Remove 36" concrete pipe near center of Area A	7/4/2017	5	8
			7b. Excavate old fill from Area A (999,700CY wet cut, see note)	7/4/2017	400	80
			7c. Dig below (over excavate) future levees (30,000 CY dry cut)	7/4/2017	5	80
8	A	Area "A' Construct North Levee	8a. Grade and construct new levee around Area A (125,300 CY fill)	7/4/2017	35	90
19	A	Area "A" Excavate New Channel	19a. Excavate Ballona Creek Channel in Area A (190,900 CY cut)	4/15/2019	55	80
			Install culverts in existing north Ballona Creek levee	4/15/2019	20	26
16	A & C	Area "A" Grading and Export Off-Site	16a. Excavate Area A and export Off-Site (1,230,000 CY Total; Split into Seq 's 16 (859k), 19/20 (195k), 21 (166k), and 24 (10k))	5/21/2018	340	80
17	C	Remove invasives for Uplands Area "C" North & South	17a. Remove invasives Area C North & South	6/3/2019	45	16
			17b. Re-establish upland vegetation	6/24/2019	5	16
23	A & B	Bike Path, Pedestrian Walkway and Amenities	23a. Construct bike and ped trails on levees	10/14/2019	65	15
			23b. Construct County Parking Structure Foundation	10/14/2019	60	24
			23c. Construct County Parking Structure	10/14/2019	120	40
24	A	Export	24a. Export final excess dirt quantity (Assume 1,230,000 CY, per line 16a.)	10/14/2019	340	2

Sources: Psomas, June 2015

As indicated above, it is anticipated that most construction activities would occur on-site with the exception of the construction of the bridge across Lincoln Boulevard, construction activities associated with gas line relocation across Culver Boulevard, construction worker trips and off-site trucks.

The construction of the bridge across Lincoln Boulevard which requires off-site construction would occur for approximately three to four weeks in 2017. The gas line relocation and associated construction activities are anticipated to occur in 2017 and early 2018.

Alternative 3: Lincoln Boulevard Bridge Construction Impacts - The bridge across Lincoln Boulevard would be constructed during night-time hours (11:00 PM to 5:00 AM) for a period of three to four weeks. This would require intermittent closure of Lincoln Boulevard during night-time hours over a four-week period in 2017. It is anticipated that cranes will be used to place the bridge segments and secured over the existing abutments or new abutments adjacent to and north of the Culver Boulevard bridge structure. The intermittent night-time closures of Lincoln Boulevard would allow the cranes to swing the bridge segments (structural members) over the travel lanes to place them over the existing or new abutments and secure them. Once the members are in place and secured, the roadway would be opened. Emergency access will be maintained at all times. The current number of lanes along Lincoln Boulevard would not be affected during daytime (when there is no construction activity); and after the construction is complete, there would be no change to the number of lanes along Lincoln Boulevard.

Detailed 24-hour traffic counts were conducted along Lincoln Boulevard in the vicinity of the proposed bridge during September 2015. These traffic counts are included in Appendix B. It can be observed from the counts that traffic volumes along Lincoln Boulevard between the hours of 11:00 PM and 5:00 AM ranged from 48 vehicles to 380 vehicles in each direction in any one hour. Detailed construction traffic management plan would be prepared at the time of final design and would include specific details relative to detour routes, signage, temporary traffic control and hours of construction to the satisfaction of Caltrans and LADOT.

The potential detour route during construction (night-times for approximately three to four weeks) would include re-routing northbound Lincoln Boulevard traffic through the Culver Loop ramp to Marina Freeway back to Lincoln Boulevard, as well as through Jefferson Boulevard to Centinela

Avenue to Marina Freeway and then back to Lincoln Boulevard. The southbound Lincoln Boulevard traffic could also be re-routed through Marina Freeway to Culver Boulevard or Centinela Avenue and then back to Lincoln Boulevard. With the implementation of the detour routes and other construction traffic management plan elements along with restriction of construction activities to night-times (11:00 PM to 5:00 AM) only, there would be no residual construction traffic impacts due to the Lincoln Boulevard bridge construction.

The bridge across Lincoln Boulevard would be constructed in 2017. After construction, the movement of soil between Project Areas A and C would commence and occur on this bridge, reducing the need to use surface streets such as Lincoln Boulevard and Culver Boulevard. After construction activities associated with the Ballona Wetlands Restoration Project are complete, this bridge would become an integral part of the bicycle and pedestrian circulation system allowing visitors to cross Lincoln Boulevard as part of the recreational trails within the Ballona Reserve.

Alternative 3: Construction Traffic Impacts of Gas Line Relocation - Removal and relocation of existing gas lines in Area B would require partial closure of lanes along Culver Boulevard. Removal and relocation of existing gas lines in Area B would occur in 2017 and would require closure of half of Culver Boulevard over a four week period.

Detailed 24-hour traffic counts were conducted along Culver Boulevard west of Lincoln Boulevard during June 2015. These counts have been included in Appendix B. Based on these counts, it is recommended that the partial closure of Culver Boulevard for construction activity be between the hours of 11:00 PM to 5:00 AM when traffic along Culver Boulevard is minimal, ranging from approximately 30 vehicles to 206 vehicles in either direction during this time period. A detailed construction traffic management plan including detour routes, signage, traffic control and hours of construction would be prepared at the times of final design to the satisfaction of LADOT.

The potential detour route during construction activities associated with gas line relocation across Culver Boulevard (night-time periods for three weeks per location) would involve re-routing eastbound/northbound Culver Boulevard to Jefferson Boulevard to Lincoln Boulevard back to Culver Boulevard. The westbound/southbound Culver Boulevard would continue to use the partially open (half-roadway) Culver Boulevard during night-times.

With the implementation of the construction traffic management plan including detour routes and night-time hours of construction, there would be no residual significant traffic impacts due to the gas line relocation component of the Alternative 3 Project.

An evaluation of detailed construction traffic analysis for Alternative 3 follows:

Based on the construction schedule shown in Table 20, the heaviest or most intense construction phase for the Alternative 3 Project would occur in the year 2019. During this period, multiple construction activities would overlap with one another including off-site soil export. Table 21 summarizes the construction sequence/activity and the number of workers of each sequence for this peak construction period. As indicated in the table, a total of approximately 161 workers would be on-site, less than the Proposed Project. This does not include the workers for off-site soil export, which would arrive in their dirt-hauler truck from an outside yard to the site on a daily basis.

As part of the grading process, up to 1,230,000 cubic yards of soil could be removed/exported in Alternative 3 compared to 110,000 cubic yards of soil for the Proposed Project. This would require approximately 82,000 haul trips over a 70-week period. This results in more truck haul trips overall, over a longer period of time compared to the Proposed Project. However, based on 240 truck trips per day, Alternative 3 would result in approximately 480 truck trips per day, same as the Proposed Project during a typical peak construction day.

Table 22 summarizes the estimated trip generation of construction activity for Alternative 3. From Table 19, it can be observed that the workers' trip generation would result in a total of approximately 371 daily trips of which 16 trips would occur during the morning peak hour and 15 trips during the evening peak hour.

The construction activity would result in a maximum trip generation of approximately 1,571 daily trips of which 77 trips would occur during the morning peak hour and 15 trips during the evening peak hour. As indicated in Table 11, this alternative generates 10% less construction activity trips in the morning peak hour and 56% less construction activity trips in the evening peak hour than the Proposed Project.

TABLE 21
PEAK CONSTRUCTION ACTIVITY/SEQUENCES - ALTERNATIVE 3

Sequence	Area	Title	Actions	Start Date	Working Days	Number of Workers
16	A & C	Area "A" Grading and Export Off-Site	16a. Excavate Area A and export Off-Site (1,230,000 CY Total; Split into Seq 's 16 (859k), 19/20 (195k), 21 (166k), and 24 (10k))	5/21/2018	340	80
23	A & B	Bike Path, Pedestrian Walkway and Amenities	23a. Construct bike and ped trails on levees	10/14/2019	65	15
			23b. Construct County Parking Structure Foundation	10/14/2019	60	24
			23c. Construct County Parking Structure	10/14/2019	120	40
24	A	Export	24a. Export final excess dirt quantity (Assume 1,230,000 CY, per line 16a.)	10/14/2019	340	2
					TOTAL NUMBER OF WORKERS	161

Sources: Psomas, June 2015
Note: Construction activities would only occur during weekdays and in particular seasons of the year.

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TABLE 22
ESTIMATED TRIP GENERATION - CONSTRUCTION ACTIVITY: ALTERNATIVE 3

	Daily	AM Peak Hour			PM Peak Hour		
		IN	OUT	TOTAL	IN	OUT	TOTAL
Construction Workers [1]	371	14	2	16	3	12	15
Soil Export [2,3] (Dump Truck Trips)	1,200	75	75	150	0	0	0
Total Trips	1,571	89	77	166	3	12	15

[1] For the purpose of this analysis, ITE 9th Edition trip generation rates for workers at an office use was utilized. Per project construction description, maximum construction workers anticipated during peak construction period equivalent to 161 with a SCAg-model based AVR of 1.44 was used in this analysis. Additionally, most of this construction worker traffic would occur before the peak hours on weekdays. However, it was conservatively assumed that 30% of the construction worker peak hour traffic would occur during the AM and PM peak hours.

[2] Assumes an average of 15 cubic yards (c.y.) of soil per truck haul with an average headway of 2 minutes between trucks leaving the site. Soil export operations would end before evening peak hour traffic. Therefore, no truck trips would occur during the PM peak hour.

[3] Construction truck trips have been converted to Passenger Car Equivalents (PCEs) using a factor of 2.5.

The results of the Cumulative (2019) with Construction Activity – Alternative 3 traffic analysis are summarized on Table 23. It can be observed from this table that the Cumulative (2019) with Construction Activity – Alternative 3 would result in similar traffic conditions as the Proposed Project. As indicated in the table, 16 of the 18 study intersections are projected to operate at LOS D or better during both the morning and evening peak hours. The remaining locations are projected to operate at LOS E and include:

- Lincoln Boulevard/Washington Boulevard: AM peak hour – LOS E
- Lincoln Boulevard/Jefferson Boulevard: AM peak hour – LOS E
- Jefferson Boulevard/Culver Boulevard: PM peak hour – LOS E
- SR-90 Freeway Westbound Ramps/Culver Boulevard: PM peak hour – LOS E

As indicated in Table 23, similar to the Proposed Project, none of the analyzed locations would be significantly impacted by the traffic associated with the construction activity of the Alternative 3 Project. Therefore, no traffic-related mitigation measures would be required for the Proposed Project.

The associated intersection peak hour traffic volumes and capacity calculation worksheets for Cumulative (2019) with Project Construction Activity - Alternative 3 conditions are attached in Appendix L.

Summary

On an overall basis, this alternative would adversely impact traffic to the same degree as that of the Proposed Project. The construction related traffic effects of Alternative 3 would adversely impact traffic to a lesser degree than the Proposed Project. However, the effects of Alternative 3 construction related traffic (i.e. export of soil to off-site facilities) would last for a longer period of time than the Proposed Project, 70 weeks compared to 7 weeks. No significant differences in travel patterns outside the project area would be expected between this alternative and the Proposed Project.

TABLE 23
SUMMARY OF INTERSECTION LEVEL OF SERVICE ANALYSIS - CONSTRUCTION ANALYSIS: ALTERNATIVE 3

No.	Intersection	Peak Hour	Cumulative (2019) Base Conditions V/C	Cumulative (2019) Base Conditions LOS	Cumulative (2019) with Construction Activity V/C	Cumulative (2019) with Construction Activity LOS	Project Increase in V/C	Significant Project Impact
1.	Admiralty Way & Bali Way	AM	0.639	B	0.639	B	0.000	No
		PM	0.672	B	0.672	B	0.000	No
2.	Admiralty Way & Mindanao Way	AM	0.690	B	0.691	B	0.001	No
		PM	0.634	B	0.636	B	0.002	No
3.	Admiralty Way & Fiji Way	AM	0.471	A	0.472	A	0.001	No
		PM	0.365	A	0.368	A	0.003	No
4.	Lincoln Boulevard & Washington Boulevard	AM	0.915	E	0.916	E	0.001	No
		PM	0.870	D	0.870	D	0.000	No
5.	Lincoln Boulevard & Marina (SR-90) Expressway [1]	AM	0.774	C	0.774	C	0.000	No
		PM	0.778	C	0.779	C	0.001	No
6.	Lincoln Boulevard & Bali Way	AM	0.571	A	0.571	A	0.001	No
		PM	0.616	B	0.616	B	0.000	No
7.	Lincoln Boulevard & Mindanao Way	AM	0.768	C	0.798	C	0.030	No
		PM	0.870	D	0.872	D	0.001	No
8.	Lincoln Boulevard & Fiji Way	AM	0.694	B	0.713	C	0.019	No
		PM	0.801	D	0.802	D	0.001	No
9.	Lincoln Boulevard & Culver Loop	AM	0.855	D	0.856	D	0.001	No
		PM	0.621	B	0.621	B	0.000	No
10.	Lincoln Boulevard & Jefferson Boulevard	AM	0.915	E	0.915	E	0.000	No
		PM	0.803	D	0.803	D	0.000	No
11.	Lincoln Boulevard & Bluff Creek Drive	AM	0.682	B	0.682	B	0.000	No
		PM	0.523	A	0.524	A	0.001	No
12.	Nicholson Street & Culver Boulevard	AM	0.715	C	0.715	C	0.001	No
		PM	0.892	D	0.892	D	0.001	No
13.	Jefferson Boulevard & Culver Boulevard	AM	0.796	C	0.796	C	0.000	No
		PM	0.963	E	0.964	E	0.001	No
14.	Culver Boulevard & SR-90 Eastbound Ramps	AM	0.467	A	0.467	A	0.000	No
		PM	0.495	A	0.497	A	0.001	No
15.	Culver Boulevard & SR-90 Westbound Ramps	AM	0.844	D	0.845	D	0.001	No
		PM	0.948	E	0.949	E	0.001	No
16.	Mindanao Way & Marina (SR-90) Expressway Eastbound	AM	0.807	D	0.824	D	0.018	No
		PM	0.853	D	0.853	D	0.000	No
17.	Mindanao Way & Marina (SR-90) Expressway Westbound	AM	0.609	B	0.609	B	0.000	No
		PM	0.616	B	0.617	B	0.001	No
18.	Vista del Mar/Vista del Mar Lane & Culver Boulevard	AM	0.856	D	0.856	D	0.000	No
		PM	0.744	C	0.744	C	0.000	No

[1] Los Angeles County Congestion Management Program monitoring location.

V/C - Volume to Capacity Ratio

LOS - Level of Service

ALTERNATIVE 4 – NO PROJECT

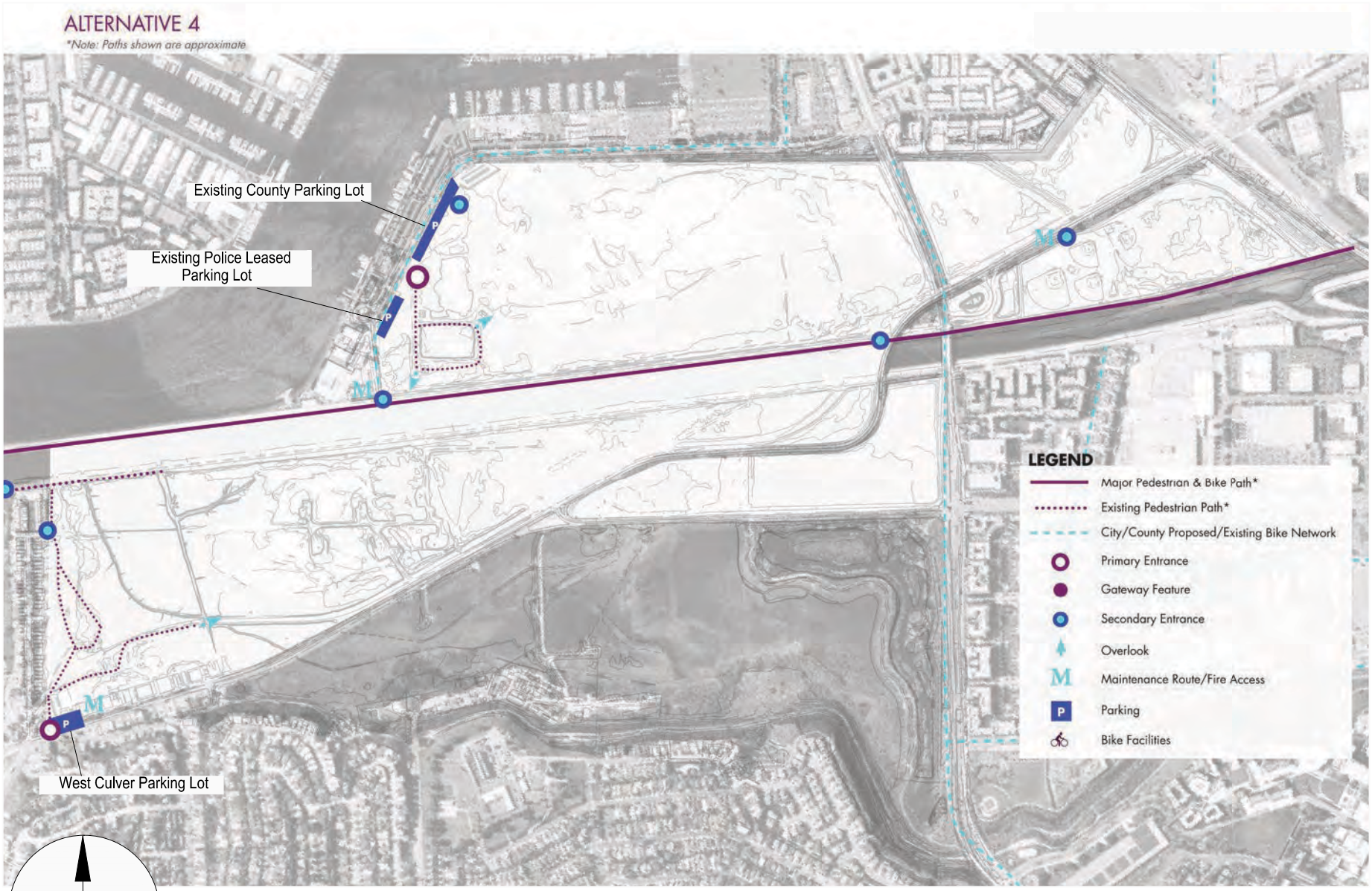
Under Alternative 4, the No Federal Action/No Project Alternative, the proposed federal action would be denied, and state and local permits and other authorizations necessary for the Project also would be denied. The extents of Alternative 4 and its public access plan are shown in Figure 22.

No substantial changes would be made to the physical or human environment within the Ballona Reserve and no new wetlands restoration would take place, although the continuation of previously-permitted restoration activities would be allowed, such as the small-scale control of invasive plant species by hand-tools only and the planting and seeding of native species. SoCalGas Company activities on the portion of its property within the Project site would continue in accordance with existing permits and approvals.

CDFW would continue to remove trash and debris, remove homeless encampments, and monitor and enforce other unauthorized or illegal activities. Management of the existing tide gates to provide some acclimation to sea level rise would be possible temporarily, but the tide gates eventually would have to be closed permanently and the tidal wetland habitats cut off from the estuary due to sea level rise. No changes would be made to existing elevations within the Ballona Reserve, existing armored levees channelizing Ballona Creek would remain in place, and Ballona Creek would not reconnect with the wetland floodplain. Additionally, no new culverts would be created.

Existing restricted access to the Ballona Reserve would continue, remaining closed to the public except for managed access where authorized by CDFW for such uses as educational tours and wildlife viewing trips, scientific research and monitoring, bicycling (only on the existing Area A levee bicycle path), fishing and boating (only in the Ballona Creek channel), habitat restoration, and baseball (in South Area C). No new visitor or recreational improvements or amenities would be provided, no parking structure would be constructed or operated, and no improvements to existing parking areas would be made.

SoCalGas would continue to manage wells and pipelines within the Ballona Reserve and would independently pursue well and pipeline abandonment and/or relocation based on facilities priorities.



SOURCE: Melendrez

FIGURE 22
BALLONA WETLANDS ECOLOGICAL RESERVE ALTERNATIVE 4 - PUBLIC ACCESS PLAN

RAJU Associates, Inc.

The no project alternative assumes there would be no change to the existing conditions and use of the Project site. The volumes and traffic conditions for this alternative are equivalent to the Future Cumulative 2023 Base (without Project) conditions scenario. Roadway network assumptions would also be similar to those in Future Cumulative (2023) Base conditions. Therefore, this alternative will result in traffic conditions similar to Cumulative (2023) Base conditions as detailed in Chapter IV. This alternative will result in no significant traffic impacts and would have lesser adverse impacts than those of the Proposed Project.

IX. SUMMARY OF CONCLUSIONS

This study was undertaken to assess existing traffic conditions with and without the Proposed Project, estimate future conditions with and without the Proposed Project, analyze potential traffic impacts of the Proposed Project, assess required improvements and identify/recommend project mitigation to alleviate the significant traffic impacts on the transportation system, if needed. Raju Associates, Inc. performed this detailed study and the following summarizes the results of the analysis:

- A total of 18 intersections were analyzed within the study area for this project. The study area is bounded by Washington Boulevard on the north, Bluff Creek Drive on the south, Vista del Mar and Admiralty Way on the west, and the Marina Expressway/Freeway on the east.

- Currently, all of the analyzed intersection locations are operating at levels of service (LOS) D or better during both the morning and evening peak hours.

- In the Cumulative (Future Year 2023) Base conditions, i.e., future conditions without the implementation of the Proposed Project, 16 of the 18 study intersections are projected to operate at LOS D or better during the morning peak hour. During the evening peak hour, 15 of the 18 study intersections are also projected to operate at LOS D or better. The remaining locations are projected to operate at LOS E and include:

  - Lincoln Boulevard/Washington Boulevard: AM peak hour – LOS E
  - Lincoln Boulevard/Jefferson Boulevard: AM peak hour – LOS E
  - Nicholson Street/Culver Boulevard: PM peak hour – LOS E
  - Jefferson Boulevard/Culver Boulevard: PM peak hour – LOS E
  - SR-90 Freeway Westbound Ramps/Culver Boulevard: PM peak hour – LOS E

- The Proposed Project includes restoration of the Ballona Wetlands Ecological Reserve. The Project is estimated to generate a total of 12 trips during the morning peak hour and 52 trips during the evening peak hour.

- In the Existing (2015) plus Project conditions, both AM and PM peak hour operating conditions would be similar to those for the Existing conditions (without the project). All of the study intersections are projected to continue to operate at LOS D or better during both the morning and evening peak hours. Traffic generated by the Project would not change the intersection levels of service from existing conditions.

- The Existing (2015) plus Project traffic conditions indicate that the Proposed Project would not cause significant traffic impacts at any of the analysis locations during the weekday morning and evening peak hours.

- In the Cumulative (Future Year 2023) plus Project conditions, both AM and PM peak hour operating conditions would be similar to those projected for the Cumulative Base conditions. Traffic generated by the Project would not change the intersection levels of service from cumulative base conditions.

- The Cumulative (Future Year 2023) plus Project traffic conditions indicate that the Proposed Project would not cause significant traffic impacts at any of the analysis locations during the weekday morning and evening peak hours.

- Construction impacts of the Proposed Project were assessed. The construction activity associated with the Proposed Project would not cause significant traffic impacts at any of the analysis locations during the weekday morning and evening peak hours.

- The Proposed Project would add less than 50 trips to the nearest Congestion Management Program (CMP) arterial monitoring locations and would add less than 150 trips in either direction to the nearest CMP mainline freeway monitoring locations during the weekday evening peak hour. Per CMP guidelines, no further CMP analysis is required.

- Project Alternatives – Four project alternatives including Alternative 1 – Proposed Action (also referred to as the Proposed Project and results summarized above), Alternative 2 – Partial Restoration, Alternative 3 – Levee Culverts and Oxbow and Alternative 4 – No Federal Action/No Project were evaluated. Detailed operational and construction activity traffic impact analyses at the study intersections were conducted.

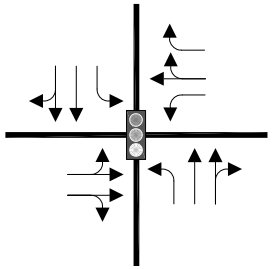
- Alternative 2: Partial Restoration - Restore contiguous tidal wetlands in Area A and North Area B, maintain existing managed wetland in West Area B, and enhance managed wetlands in South Area B. Alternative 2 would adversely impact traffic to the same degree as that of the Proposed Project and would have similar construction related traffic effects. Similar to the Proposed Project (Alternative 1), Alternative 2 would not cause significant operational and/or constructed related traffic impacts at any of the analysis locations during the weekday morning and evening peak hours.

- Alternative 3: Levee Culverts and Oxbow - Restore tidal wetlands in Area A, maintain existing Area B managed wetlands, and restore wetlands in South Area C. Alternative 3 would adversely impact traffic to the same degree as that of the Proposed Project. The construction related traffic effects of Alternative 3 would adversely impact traffic to a lesser degree than the Proposed Project. Similar to the Proposed Project (Alternative 1), Alternative 3 would not cause significant operational and/or constructed related traffic impacts at any of the analysis locations during the weekday morning and evening peak hours.

APPENDIX A

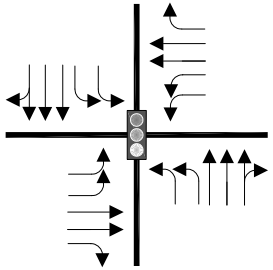
Intersection Lane Configurations

1



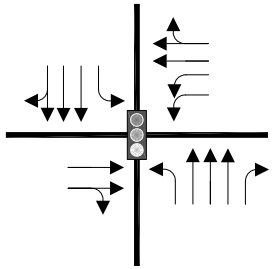
ADMIRALITY WAY &
BALI WAY

4



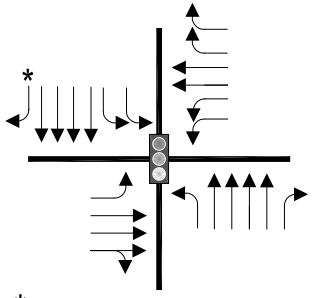
LINCOLN BOULEVARD &
WASHINGTON BOULEVARD

7



LINCOLN BOULEVARD &
MINDANAO WAY

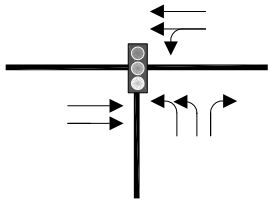
10



*De facto right-turn lane.

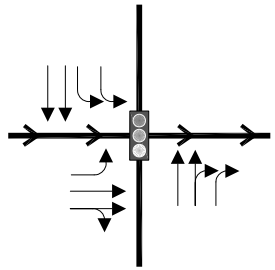
LINCOLN BOULEVARD &
JEFFERSON BOULEVARD

13



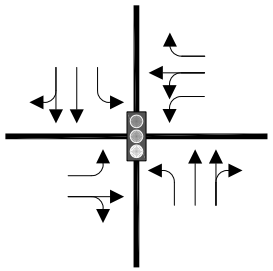
JEFFERSON BOULEVARD &
CULVER BOULEVARD

16



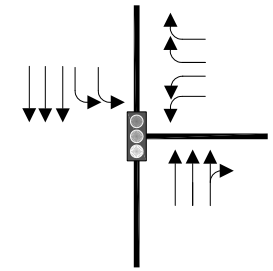
MINDANAO WAY &
MARINA EXPRESSWAY EB RAMPS

2



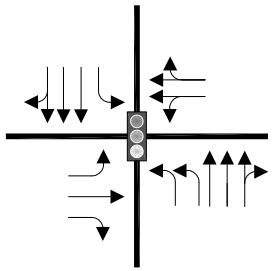
ADMIRALITY WAY &
MINDANAO WAY

5



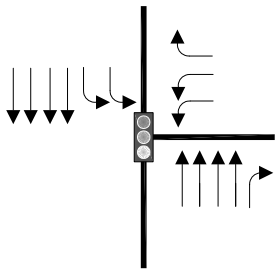
LINCOLN BOULEVARD &
MARINA (SR-90) EXPRESSWAY

8



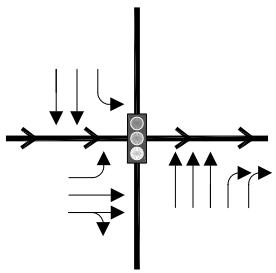
LINCOLN BOULEVARD &
FIJI WAY

11



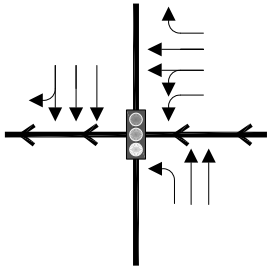
LINCOLN BOULEVARD &
BLUFF CREEK DRIVE

14



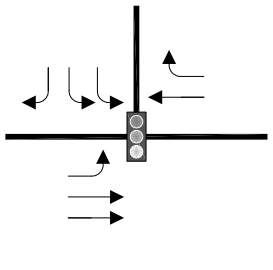
CULVER BOULEVARD &
SR-90 EASTBOUND RAMPS

17



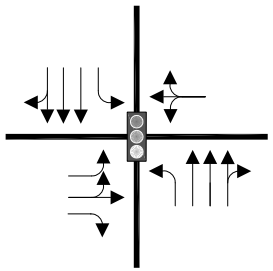
MINDANAO WAY &
MARINA EXPRESSWAY WB RAMPS

3



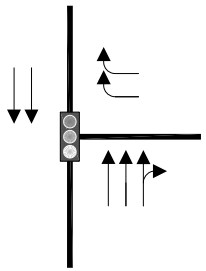
ADMIRALITY WAY &
FIJI WAY

6



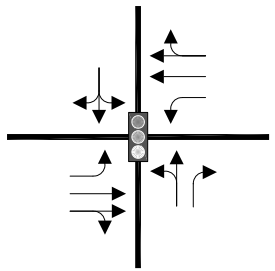
LINCOLN BOULEVARD &
BALI WAY

9



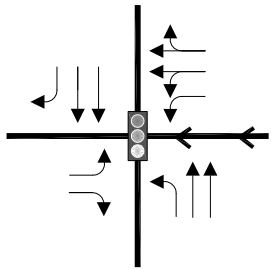
LINCOLN BOULEVARD &
CULVER LOOP

12



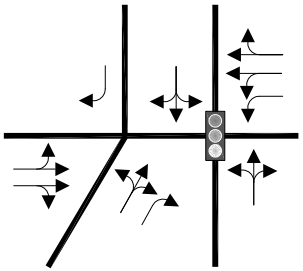
NICHOLSON STREET &
CULVER BOULEVARD

15



CULVER BOULEVARD &
SR-90 WESTBOUND RAMPS

18



VISTA DEL MAR/VISTA DEL MAR LN &
CULVER BOULEVARD

APPENDIX A
INTERSECTION LANE CONFIGURATIONS - EXISTING CONDITIONS

RAJU Associates, Inc.

APPENDIX B

Existing Traffic Counts

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5241-012 **Day:** Wednesday

City: Los Angeles **Date:** 4/22/2015

AM

NS/EW Streets:	Admiralty Wy			Admiralty Wy			Bali Wy			Bali Wy			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	2	0	2	2	0	0.5	1	0.5	1	0.5	1.5	
7:00 AM	2	219	7	35	159	3	2	3	3	1	7	30	471
7:15 AM	2	251	2	36	161	2	0	3	1	9	5	56	528
7:30 AM	4	285	7	44	207	1	3	2	1	3	4	73	634
7:45 AM	5	286	9	43	277	0	4	5	3	5	10	76	723
8:00 AM	5	298	2	52	263	5	5	2	3	6	12	91	744
8:15 AM	7	230	7	54	252	2	2	6	6	8	10	83	667
8:30 AM	6	284	12	64	263	6	1	6	5	3	9	76	735
8:45 AM	6	331	7	58	340	5	5	4	1	5	10	96	868
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	37	2184	53	386	1922	24	22	31	23	40	67	581	5370
APPROACH %'s :	1.63%	96.04%	2.33%	16.55%	82.42%	1.03%	28.95%	40.79%	30.26%	5.81%	9.74%	84.45%	
PEAK HR START TIME :	800 AM												TOTAL
PEAK HR VOL :	24	1143	28	228	1118	18	13	18	15	22	41	346	3014
PEAK HR FACTOR :		0.868			0.846			0.821			0.921		0.868

CONTROL : Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5241-012 **Day:** Wednesday

City: Los Angeles **Date:** 4/22/2015

PM

NS/EW Streets:	Admiralty Wy			Admiralty Wy			Bali Wy			Bali Wy			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	2	0	2	2	0	0.5	1	0.5	1	0.5	1.5	
4:00 PM	7	221	21	76	326	4	7	11	7	12	10	82	784
4:15 PM	10	233	15	79	303	8	6	11	4	5	11	103	788
4:30 PM	7	227	30	73	323	7	8	6	6	3	10	95	795
4:45 PM	9	240	11	65	302	10	2	4	7	11	10	95	766
5:00 PM	6	230	43	68	305	5	2	18	7	7	9	91	791
5:15 PM	8	226	20	75	350	5	2	7	7	4	11	94	809
5:30 PM	3	238	31	62	338	6	4	11	3	9	9	103	817
5:45 PM	4	278	19	63	336	7	7	12	5	4	8	94	837
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	54	1893	190	561	2583	52	38	80	46	55	78	757	6387
APPROACH %'s :	2.53%	88.58%	8.89%	17.55%	80.82%	1.63%	23.17%	48.78%	28.05%	6.18%	8.76%	85.06%	
PEAK HR START TIME :	500 PM												TOTAL
PEAK HR VOL :	21	972	113	268	1329	23	15	48	22	24	37	382	3254
PEAK HR FACTOR :		0.919			0.942			0.787			0.915		0.972

CONTROL : Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5241-013 **Day:** Wednesday

City: Los Angeles **Date:** 4/22/2015

AM

NS/EW Streets:	Admiralty Wy			Admiralty Wy			Mindanao Wy			Mindanao Wy			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	2	0	2	2	0	1	0.5	0.5	1.5	0.5	1	
7:00 AM	4	136	9	65	87	2	2	4	3	29	5	80	426
7:15 AM	2	170	7	69	94	0	1	2	0	20	16	100	481
7:30 AM	7	212	8	109	110	3	4	2	3	19	8	92	577
7:45 AM	11	205	7	115	154	6	16	10	1	28	18	120	691
8:00 AM	5	194	8	123	127	1	3	8	4	39	15	119	646
8:15 AM	12	141	24	73	144	4	5	35	2	51	41	87	619
8:30 AM	6	209	8	119	133	8	6	5	6	34	13	102	649
8:45 AM	6	229	12	131	209	4	5	6	9	30	16	118	775
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	53	1496	83	804	1058	28	42	72	28	250	132	818	4864
APPROACH %'s :	3.25%	91.67%	5.09%	42.54%	55.98%	1.48%	29.58%	50.70%	19.72%	20.83%	11.00%	68.17%	
PEAK HR START TIME :	800 AM												TOTAL
PEAK HR VOL :	29	773	52	446	613	17	19	54	21	154	85	426	2689
PEAK HR FACTOR :		0.864			0.782			0.560			0.929		0.867

CONTROL : Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5241-013 **Day:** Wednesday

City: Los Angeles **Date:** 4/22/2015

PM

NS/EW Streets:	Admiralty Wy			Admiralty Wy			Mindanao Wy			Mindanao Wy			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	2	0	2	2	0	1	0.5	0.5	1.5	0.5	1	
4:00 PM	7	137	24	114	228	5	12	10	8	62	7	94	708
4:15 PM	4	138	30	93	223	7	9	12	8	62	15	104	705
4:30 PM	6	156	27	109	225	5	8	15	5	54	12	99	721
4:45 PM	7	116	35	79	237	6	9	9	6	66	13	128	711
5:00 PM	6	140	31	95	209	2	5	18	4	67	9	112	698
5:15 PM	6	148	34	104	276	5	4	10	8	64	6	98	763
5:30 PM	3	155	40	81	270	5	3	9	1	67	4	95	733
5:45 PM	2	149	30	101	242	3	7	7	4	57	4	132	738
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	41	1139	251	776	1910	38	57	90	44	499	70	862	5777
APPROACH %'s :	2.87%	79.59%	17.54%	28.49%	70.12%	1.40%	29.84%	47.12%	23.04%	34.87%	4.89%	60.24%	
PEAK HR START TIME :	500 PM												TOTAL
PEAK HR VOL :	17	592	135	381	997	15	19	44	17	255	23	437	2932
PEAK HR FACTOR :		0.939			0.905			0.741			0.926		0.961

CONTROL : Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5241-014 **Day:** Wednesday

City: Los Angeles **Date:** 4/22/2015

AM

NS/EW Streets:	Admiralty Wy			Admiralty Wy			Fiji Wy			Fiji Wy			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	0	0	2	0	1	1	2	0	0	1	1	
7:00 AM	0	0	0	79	0	18	10	18	0	0	33	131	289
7:15 AM	0	0	0	77	0	13	16	7	0	0	36	159	308
7:30 AM	0	0	0	99	0	13	10	17	0	0	18	202	359
7:45 AM	0	0	0	135	0	16	21	21	0	0	27	185	405
8:00 AM	0	0	0	136	0	10	15	24	0	0	23	181	389
8:15 AM	0	0	0	165	0	20	20	33	0	1	15	159	413
8:30 AM	0	0	0	130	0	21	17	26	0	0	31	188	413
8:45 AM	0	0	0	196	0	22	30	29	0	0	20	216	513
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	0	0	0	1017	0	133	139	175	0	1	203	1421	3089
APPROACH %'s :	#DIV/0!	#DIV/0!	#DIV/0!	88.43%	0.00%	11.57%	44.27%	55.73%	0.00%	0.06%	12.49%	87.45%	
PEAK HR START TIME :	800 AM												TOTAL
PEAK HR VOL :	0	0	0	627	0	73	82	112	0	1	89	744	1728
PEAK HR FACTOR :		0.000			0.803			0.822			0.883		0.842

CONTROL : Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5241-014 **Day:** Wednesday

City: Los Angeles **Date:** 4/22/2015

PM

NS/EW Streets:	Admiralty Wy			Admiralty Wy			Fiji Wy			Fiji Wy			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	0	0	2	0	1	1	2	0	0	1	1	
4:00 PM	0	0	0	201	0	26	14	58	0	0	27	105	431
4:15 PM	0	0	0	188	0	39	20	41	0	0	25	100	413
4:30 PM	0	0	0	198	0	14	11	33	0	2	32	107	397
4:45 PM	0	0	0	212	0	18	4	39	0	0	28	98	399
5:00 PM	0	0	0	194	0	27	12	46	0	0	23	112	414
5:15 PM	0	0	0	242	0	33	10	36	0	2	37	103	463
5:30 PM	0	0	0	239	0	24	8	24	0	3	23	109	430
5:45 PM	0	0	0	231	0	26	9	41	0	1	31	135	474
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	0	0	0	1705	0	207	88	318	0	8	226	869	3421
APPROACH %'s :	#DIV/0!	#DIV/0!	#DIV/0!	89.17%	0.00%	10.83%	21.67%	78.33%	0.00%	0.73%	20.49%	78.79%	
PEAK HR START TIME :	500 PM												TOTAL
PEAK HR VOL :	0	0	0	906	0	110	39	147	0	6	114	459	1781
PEAK HR FACTOR :		0.000			0.924			0.802			0.867		0.939

CONTROL : Signalized

City Of Los Angeles

Department Of Transportation

MANUAL TRAFFIC COUNT SUMMARY

STREET:

North/South Lincoln Blvd

East/West Washington Blvd

Day: Tuesday Date: April 21, 2015 Weather: SUNNY

Hours: 7-10 & 3-6 Chekrs: NDS

School Day: YES District: I/S CODE

	N/B	S/B	E/B	W/B
DUAL-WHEELED	183	137	92	73
BIKES	63	84	107	108
BUSES	66	60	41	43

	N/B	TIME	S/B	TIME	E/B	TIME	W/B	TIME
AM PK 15 MIN	591	7.45	459	8.15	355	8.45	282	8.00
PM PK 15 MIN	479	17.45	438	16.45	327	16.00	318	15.15
AM PK HOUR	2266	9.00	1736	8.15	1372	8.00	989	7.45
PM PK HOUR	1808	17.00	1707	16.45	1277	17.00	1224	17.00

NORTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	570	1514	98	2182
8-9	628	1408	104	2140
9-10	672	1406	188	2266
15-16	410	1085	206	1701
16-17	458	1158	174	1790
17-18	437	1176	195	1808
TOTAL	3175	7747	965	11887

SOUTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	157	1016	75	1248
8-9	209	1397	106	1712
9-10	259	1220	107	1586
15-16	234	1310	79	1623
16-17	217	1364	98	1679
17-18	176	1401	108	1685
TOTAL	1252	7708	573	9533

TOTAL	**XING S/L**		**XING N/L**	
N-S	Ped	Sch	Ped	Sch
3430	52	2	39	1
3852	64	1	35	2
3852	42	2	50	0
3324	79	7	59	0
3469	73	5	40	0
3493	0	0	0	0
21420	396	25	270	3

EASTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	66	621	445	1132
8-9	90	763	519	1372
9-10	103	665	500	1268
15-16	92	649	497	1238
16-17	109	641	492	1242
17-18	102	674	501	1277
TOTAL	562	4013	2954	7529

WESTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	87	563	139	789
8-9	137	659	181	977
9-10	138	566	200	904
15-16	266	607	311	1184
16-17	268	659	243	1170
17-18	244	754	226	1224
TOTAL	1140	3808	1300	6248

TOTAL	**XING W/L**		**XING E/L**	
E-W	Ped	Sch	Ped	Sch
1921	39	1	57	2
2349	41	0	52	1
2172	38	1	42	2
2422	61	2	82	1
2412	40	2	56	1
2501	0	0	0	0
13777	314	14	365	8

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5237-011 **Day:** Tuesday

TOTALS

City: Los Angeles **Date:** 4/21/2015

AM

NS/EW Streets:	Lincoln Blvd			Lincoln Blvd			Washington Blvd			Washington Blvd			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	2	3	0	2	3	0	2	2	1	2	2	1	
7:00 AM	110	356	33	18	165	16	15	120	97	19	96	25	1070
7:15 AM	135	410	21	26	242	23	19	151	100	25	122	36	1310
7:30 AM	138	365	23	54	289	10	20	161	116	21	163	37	1397
7:45 AM	187	383	21	59	320	26	12	189	132	22	182	41	1574
8:00 AM	160	355	23	60	339	22	17	195	128	43	184	55	1581
8:15 AM	137	358	30	55	370	34	20	185	139	23	164	42	1557
8:30 AM	140	349	25	48	365	30	29	180	124	38	152	43	1523
8:45 AM	191	346	26	46	323	20	24	203	128	33	159	41	1540
9:00 AM	149	357	37	69	350	26	20	164	115	34	155	50	1526
9:15 AM	181	367	29	57	284	24	20	180	141	40	145	53	1521
9:30 AM	172	348	53	68	280	28	32	175	124	31	130	56	1497
9:45 AM	170	334	69	65	306	29	31	146	120	33	136	41	1480
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	1870	4328	390	625	3633	288	259	2049	1464	362	1788	520	17576
APPROACH %'s :	28.38%	65.70%	5.92%	13.75%	79.92%	6.34%	6.87%	54.32%	38.81%	13.56%	66.97%	19.48%	
PEAK HR START TIME :	745 AM												TOTAL
PEAK HR VOL :	624	1445	99	222	1394	112	78	749	523	126	682	181	6235
PEAK HR FACTOR :		0.917			0.941			0.981			0.877		0.986

CONTROL : Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5237-011 **Day:** Tuesday

City: Los Angeles **Date:** 4/21/2015

TOTALS

PM

NS/EW Streets:	Lincoln Blvd			Lincoln Blvd			Washington Blvd			Washington Blvd			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	2	3	0	2	3	0	2	2	1	2	2	1	
3:00 PM	101	284	62	55	339	23	27	168	129	66	133	78	1465
3:15 PM	106	272	37	58	304	16	27	153	118	72	163	83	1409
3:30 PM	107	268	52	71	322	22	15	161	130	75	150	66	1439
3:45 PM	96	261	55	50	345	18	23	167	120	53	161	84	1433
4:00 PM	117	284	50	61	325	26	27	168	132	49	162	69	1470
4:15 PM	109	273	42	58	330	23	32	166	126	72	168	49	1448
4:30 PM	116	299	34	49	350	19	25	146	117	73	166	62	1456
4:45 PM	116	302	48	49	359	30	25	161	117	74	163	63	1507
5:00 PM	98	259	54	52	353	25	33	171	118	61	182	52	1458
5:15 PM	113	296	52	34	350	24	24	166	130	81	181	55	1506
5:30 PM	108	306	43	46	353	32	25	169	121	48	196	54	1501
5:45 PM	118	315	46	44	345	27	20	168	132	54	195	65	1529
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	1305	3419	575	627	4075	285	303	1964	1490	778	2020	780	17621
APPROACH %'s :	24.63%	64.52%	10.85%	12.57%	81.71%	5.71%	8.06%	52.28%	39.66%	21.74%	56.46%	21.80%	
PEAK HR START TIME :	500 PM												TOTAL
PEAK HR VOL :	437	1176	195	176	1401	108	102	674	501	244	754	226	5994
PEAK HR FACTOR :		0.944			0.977			0.991			0.965		0.980

CONTROL : Signalized

City Of Los Angeles

Department Of Transportation

MANUAL TRAFFIC COUNT SUMMARY

STREET:

North/South Lincoln Blvd

East/West SR-90 Ramps

Day: Tuesday Date: April 21, 2015 Weather: SUNNY

Hours: 7-10 & 3-6 Chekrs: NDS

School Day: YES District: I/S CODE

	N/B	S/B	E/B	W/B
DUAL-WHEELED	107	168	0	113
BIKES	40	30	0	0
BUSES	69	84	0	9

	N/B	TIME	S/B	TIME	E/B	TIME	W/B	TIME
AM PK 15 MIN	458	7.00	602	8.15	0	0.00	378	9.00
PM PK 15 MIN	456	17.30	625	17.30	0	0.00	264	17.45
AM PK HOUR	1665	7.00	2278	8.00	0	0.00	1372	8.45
PM PK HOUR	1648	17.00	2431	16.45	0	0.00	987	17.00

NORTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	0	1517	148	1665
8-9	0	1309	209	1518
9-10	0	1334	201	1535
15-16	1	1155	166	1322
16-17	2	1316	246	1564
17-18	1	1355	292	1648
TOTAL	4	7986	1262	9252

SOUTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	737	972	0	1709
8-9	922	1356	0	2278
9-10	827	1188	0	2015
15-16	799	1417	0	2216
16-17	783	1551	0	2334
17-18	825	1575	0	2400
TOTAL	4893	8059	0	12952

TOTAL	**XING S/L**		**XING N/L**	
N-S	Ped	Sch	Ped	Sch
3374	0	0	1	0
3796	2	0	1	0
3550	0	0	0	0
3538	1	0	0	0
3898	0	0	1	0
4048	0	0	1	0
22204	3	0	4	0

EASTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	0	0	0	0
8-9	0	0	0	0
9-10	0	0	0	0
15-16	0	0	0	0
16-17	0	0	0	0
17-18	0	0	0	0
TOTAL	0	0	0	0

WESTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	135	0	969	1104
8-9	210	0	999	1209
9-10	180	0	1186	1366
15-16	207	0	703	910
16-17	222	0	749	971
17-18	188	0	799	987
TOTAL	1142	0	5405	6547

TOTAL	**XING W/L**		**XING E/L**	
E-W	Ped	Sch	Ped	Sch
1104	0	0	4	0
1209	0	0	10	0
1366	0	0	5	0
910	0	0	12	0
971	0	0	5	0
987	0	0	13	0
6547	0	0	49	0

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5237-003

Day: Tuesday

TOTALS

City: Los Angeles

Date: 4/21/2015

AM

NS/EW Streets:	Lincoln Blvd			Lincoln Blvd			SR-90 Ramps			SR-90 Ramps			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	3	1	2	3	0	0	0	0	2	0	2	
7:00 AM	0	415	43	152	165	0	0	0	0	27	0	215	1017
7:15 AM	0	404	24	148	239	0	0	0	0	25	0	244	1084
7:30 AM	0	299	37	209	252	0	0	0	0	37	0	263	1097
7:45 AM	0	399	44	228	316	0	0	0	0	46	0	247	1280
8:00 AM	0	296	45	241	315	0	0	0	0	48	0	245	1190
8:15 AM	0	327	39	250	352	0	0	0	0	59	0	213	1240
8:30 AM	0	352	57	223	347	0	0	0	0	57	0	249	1285
8:45 AM	0	334	68	208	342	0	0	0	0	46	0	292	1290
9:00 AM	0	327	45	227	310	0	0	0	0	53	0	325	1287
9:15 AM	0	338	51	211	325	0	0	0	0	45	0	297	1267
9:30 AM	0	328	58	208	286	0	0	0	0	37	0	277	1194
9:45 AM	0	341	47	181	267	0	0	0	0	45	0	287	1168
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	0	4160	558	2486	3516	0	0	0	0	525	0	3154	14399
APPROACH %'s :	0.00%	88.17%	11.83%	41.42%	58.58%	0.00%	#DIV/0!	#DIV/0!	#DIV/0!	14.27%	0.00%	85.73%	
PEAK HR START TIME :	830 AM												TOTAL
PEAK HR VOL :	0	1351	221	869	1324	0	0	0	0	201	0	1163	5129
PEAK HR FACTOR :		0.961			0.962			0.000			0.902		0.994

CONTROL : Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5237-003

Day: Tuesday

TOTALS

City: Los Angeles

Date: 4/21/2015

PM

NS/EW Streets:	Lincoln Blvd			Lincoln Blvd			SR-90 Ramps			SR-90 Ramps			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	3	1	2	3	0	0	0	0	2	0	2	
3:00 PM	0	286	36	200	349	0	0	0	0	47	0	183	1101
3:15 PM	0	260	39	198	344	0	0	0	0	49	0	190	1080
3:30 PM	1	295	44	212	350	0	0	0	0	54	0	149	1105
3:45 PM	0	314	47	189	374	0	0	0	0	57	0	181	1162
4:00 PM	0	352	57	177	398	0	0	0	0	41	0	191	1216
4:15 PM	0	307	62	193	364	0	0	0	0	63	0	173	1162
4:30 PM	1	324	58	196	391	0	0	0	0	63	0	189	1222
4:45 PM	1	333	69	217	398	0	0	0	0	55	0	196	1269
5:00 PM	0	287	80	201	386	0	0	0	0	37	0	180	1171
5:15 PM	1	327	74	225	379	0	0	0	0	51	0	211	1268
5:30 PM	0	379	77	201	424	0	0	0	0	40	0	204	1325
5:45 PM	0	362	61	198	386	0	0	0	0	60	0	204	1271
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	4	3826	704	2407	4543	0	0	0	0	617	0	2251	14352
APPROACH %'s :	0.09%	84.38%	15.53%	34.63%	65.37%	0.00%	#DIV/0!	#DIV/0!	#DIV/0!	21.51%	0.00%	78.49%	
PEAK HR START TIME :	500 PM												TOTAL
PEAK HR VOL :	1	1355	292	825	1575	0	0	0	0	188	0	799	5035
PEAK HR FACTOR :		0.904			0.960			0.000			0.935		0.950

CONTROL : Signalized

City Of Los Angeles
Department Of Transportation

MANUAL TRAFFIC COUNT SUMMARY

STREET:
North/South Lincoln Blvd

East/West Bali Wy

Day: Tuesday Date: April 21, 2015 Weather: SUNNY

Hours: 7-10 & 3-6 Chekrs: NDS

School Day: YES District: I/S CODE

	N/B	S/B	E/B	W/B
DUAL-WHEELED	98	98	20	4
BIKES	37	38	11	2
BUSES	69	74	1	0

	N/B	TIME	S/B	TIME	E/B	TIME	W/B	TIME
AM PK 15 MIN	466	7.00	418	8.30	78	9.30	7	9.45
PM PK 15 MIN	389	17.45	476	17.45	119	17.30	13	16.00
AM PK HOUR	1702	7.00	1593	8.00	285	8.45	22	9.00
PM PK HOUR	1381	17.00	1825	17.00	451	16.45	39	15.15

NORTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	141	1533	28	1702
8-9	193	1294	27	1514
9-10	156	1294	21	1471
15-16	101	1025	20	1146
16-17	90	1212	14	1316
17-18	116	1256	9	1381
TOTAL	797	7614	119	8530

SOUTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	18	914	164	1096
8-9	34	1306	253	1593
9-10	24	1138	232	1394
15-16	42	1309	294	1645
16-17	38	1466	319	1823
17-18	40	1486	299	1825
TOTAL	196	7619	1561	9376

TOTAL	**XING S/L**		**XING N/L**	
N-S	Ped	Sch	Ped	Sch
2798	4	0	0	0
3107	5	0	0	0
2865	17	1	0	0
2791	5	1	0	0
3139	9	0	0	0
3206	10	0	0	0
17906	50	2	0	0

EASTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	119	0	39	158
8-9	204	2	55	261
9-10	203	4	51	258
15-16	299	1	72	372
16-17	306	1	80	387
17-18	327	3	107	437
TOTAL	1458	11	404	1873

WESTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	0	1	6	7
8-9	2	3	10	15
9-10	4	1	17	22
15-16	9	1	24	34
16-17	5	2	25	32
17-18	9	2	9	20
TOTAL	29	10	91	130

TOTAL	**XING W/L**		**XING E/L**	
E-W	Ped	Sch	Ped	Sch
165	4	0	5	0
276	6	0	3	0
280	11	1	9	0
406	11	0	11	0
419	9	0	7	0
457	17	0	7	0
2003	58	1	42	0

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5237-004 **Day:** Tuesday

TOTALS

City: Los Angeles **Date:** 4/21/2015

AM

NS/EW Streets:	Lincoln Blvd			Lincoln Blvd			Bali Wy			Bali Wy			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	3	0	1	3	0	1.5	0.5	1	0	1	0	
7:00 AM	18	441	7	2	149	30	38	0	9	0	0	1	695
7:15 AM	34	410	8	5	240	29	33	0	12	0	0	1	772
7:30 AM	42	339	4	3	228	49	20	0	10	0	0	1	696
7:45 AM	47	343	9	8	297	56	28	0	8	0	1	3	800
8:00 AM	43	293	7	11	307	55	55	2	11	1	2	1	788
8:15 AM	46	336	10	2	326	80	48	0	12	1	1	2	864
8:30 AM	47	322	0	10	349	59	45	0	16	0	0	3	851
8:45 AM	57	343	10	11	324	59	56	0	16	0	0	4	880
9:00 AM	47	332	3	4	300	60	61	1	15	2	0	2	827
9:15 AM	51	329	7	6	314	60	45	1	12	2	0	3	830
9:30 AM	31	296	5	6	274	46	60	2	16	0	0	6	742
9:45 AM	27	337	6	8	250	66	37	0	8	0	1	6	746
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	490	4121	76	76	3358	649	526	6	145	6	5	33	9491
APPROACH %'s :	10.45%	87.92%	1.62%	1.86%	82.24%	15.90%	77.70%	0.89%	21.42%	13.64%	11.36%	75.00%	
PEAK HR START TIME :	815 AM												TOTAL
PEAK HR VOL :	197	1333	23	27	1299	258	210	1	59	3	1	11	3422
PEAK HR FACTOR :		0.947			0.947			0.877			0.938		0.972

CONTROL : Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5237-004

Day: Tuesday

TOTALS

City: Los Angeles

Date: 4/21/2015

PM

NS/EW Streets:	Lincoln Blvd			Lincoln Blvd			Bali Wy			Bali Wy			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	3	0	1	3	0	1.5	0.5	1	0	1	0	
3:00 PM	20	247	9	12	327	81	70	0	17	2	1	5	791
3:15 PM	19	231	3	8	314	75	82	0	17	4	0	5	758
3:30 PM	34	277	4	11	340	63	77	1	19	0	0	6	832
3:45 PM	28	270	4	11	328	75	70	0	19	3	0	8	816
4:00 PM	20	319	3	16	390	68	64	0	24	1	0	12	917
4:15 PM	18	297	3	10	336	90	73	1	17	2	2	4	853
4:30 PM	30	305	2	9	366	79	81	0	20	1	0	3	896
4:45 PM	22	291	6	3	374	82	88	0	19	1	0	6	892
5:00 PM	28	265	1	7	373	76	89	1	26	3	0	0	869
5:15 PM	34	296	2	11	369	58	76	0	33	3	0	7	889
5:30 PM	25	339	2	17	360	78	96	1	22	1	1	0	942
5:45 PM	29	356	4	5	384	87	66	1	26	2	1	2	963
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	307	3493	43	120	4261	912	932	5	259	23	5	58	10418
APPROACH %'s :	7.99%	90.89%	1.12%	2.27%	80.50%	17.23%	77.93%	0.42%	21.66%	26.74%	5.81%	67.44%	
PEAK HR START TIME :	500 PM												TOTAL
PEAK HR VOL :	116	1256	9	40	1486	299	327	3	107	9	2	9	3663
PEAK HR FACTOR :		0.888			0.959			0.918			0.500		0.951

CONTROL : Signalized

City Of Los Angeles

Department Of Transportation

MANUAL TRAFFIC COUNT SUMMARY

STREET:

North/South Lincoln Blvd

East/West Mindanao Wy

Day: Tuesday Date: April 21, 2015 Weather: SUNNY

Hours: 7-10 & 3-6 Chekrs: NDS

School Day: YES District: I/S CODE

	N/B	S/B	E/B	W/B
DUAL-WHEELED	115	76	19	46
BIKES	32	32	25	21
BUSES	69	59	16	15

	N/B	TIME	S/B	TIME	E/B	TIME	W/B	TIME
AM PK 15 MIN	555	7.00	337	8.45	172	8.45	223	8.45
PM PK 15 MIN	465	17.30	450	17.45	196	15.15	305	17.15
AM PK HOUR	2139	8.15	1299	8.00	605	8.00	829	8.00
PM PK HOUR	1658	17.00	1733	17.00	699	15.00	1074	16.30

NORTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	139	1591	365	2095
8-9	194	1477	416	2087
9-10	152	1401	388	1941
15-16	88	1023	310	1421
16-17	93	1152	310	1555
17-18	94	1233	331	1658
TOTAL	760	7877	2120	10757

SOUTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	75	791	34	900
8-9	151	1107	41	1299
9-10	107	1012	44	1163
15-16	145	1206	77	1428
16-17	131	1412	57	1600
17-18	211	1465	57	1733
TOTAL	820	6993	310	8123

TOTAL	**XING S/L**		**XING N/L**	
N-S	Ped	Sch	Ped	Sch
2995	26	0	18	0
3386	43	0	26	0
3104	43	0	22	0
2849	46	1	24	0
3155	83	1	30	0
3391	55	0	19	0
18880	296	2	139	0

EASTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	0	419	29	448
8-9	0	558	47	605
9-10	0	472	66	538
15-16	0	535	164	699
16-17	0	506	153	659
17-18	0	509	184	693
TOTAL	0	2999	643	3642

WESTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	250	378	75	703
8-9	270	460	99	829
9-10	292	389	104	785
15-16	380	469	99	948
16-17	401	503	84	988
17-18	442	535	78	1055
TOTAL	2035	2734	539	5308

TOTAL	**XING W/L**		**XING E/L**	
E-W	Ped	Sch	Ped	Sch
1151	10	0	35	0
1434	16	0	32	0
1323	11	0	26	0
1647	27	0	37	0
1647	49	0	44	0
1748	25	0	30	0
8950	138	0	204	0

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5237-005 **Day:** Tuesday

TOTALS

City: Los Angeles **Date:** 4/21/2015

AM

NS/EW Streets:	Lincoln Blvd			Lincoln Blvd			Mindanao Wy			Mindanao Wy			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	3	1	1	3	0	0	2	0	2	2	0	
7:00 AM	14	460	81	18	131	2	0	79	5	53	94	21	958
7:15 AM	28	425	83	15	195	11	0	91	5	43	88	16	1000
7:30 AM	39	364	88	21	217	5	0	130	9	60	91	21	1045
7:45 AM	58	342	113	21	248	16	0	119	10	94	105	17	1143
8:00 AM	61	335	107	31	263	12	0	120	11	76	117	17	1150
8:15 AM	43	398	98	39	273	10	0	122	18	59	120	22	1202
8:30 AM	42	339	117	41	283	10	0	155	7	69	103	23	1189
8:45 AM	48	405	94	40	288	9	0	161	11	66	120	37	1279
9:00 AM	52	385	118	35	257	10	0	109	12	82	91	28	1179
9:15 AM	31	375	106	29	274	15	0	128	18	69	101	24	1170
9:30 AM	31	290	78	21	244	9	0	121	17	62	102	24	999
9:45 AM	38	351	86	22	237	10	0	114	19	79	95	28	1079
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	485	4469	1169	333	2910	119	0	1449	142	812	1227	278	13393
APPROACH %'s :	7.92%	72.99%	19.09%	9.90%	86.56%	3.54%	0.00%	91.07%	8.93%	35.05%	52.96%	12.00%	
PEAK HR START TIME :	815 AM												TOTAL
PEAK HR VOL :	185	1527	427	155	1101	39	0	547	48	276	434	110	4849
PEAK HR FACTOR :		0.964			0.961			0.865			0.919		0.948

CONTROL : Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5237-005 **Day:** Tuesday

City: Los Angeles **Date:** 4/21/2015

TOTALS

PM

NS/EW Streets:	Lincoln Blvd			Lincoln Blvd			Mindanao Wy			Mindanao Wy			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	3	1	1	3	0	0	2	0	2	2	0	
3:00 PM	16	240	78	44	302	14	0	126	31	98	111	20	1080
3:15 PM	24	225	92	24	269	20	0	143	53	80	99	31	1060
3:30 PM	23	281	63	40	321	18	0	140	41	112	133	24	1196
3:45 PM	25	277	77	37	314	25	0	126	39	90	126	24	1160
4:00 PM	26	285	91	24	358	17	0	125	27	106	137	28	1224
4:15 PM	14	286	72	48	332	18	0	125	39	79	104	14	1131
4:30 PM	28	292	80	28	360	13	0	132	39	113	136	27	1248
4:45 PM	25	289	67	31	362	9	0	124	48	103	126	15	1199
5:00 PM	24	277	77	50	368	13	0	116	48	105	118	26	1222
5:15 PM	18	275	60	46	345	17	0	137	46	132	157	16	1249
5:30 PM	25	339	101	54	376	14	0	126	36	100	132	19	1322
5:45 PM	27	342	93	61	376	13	0	130	54	105	128	17	1346
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	275	3408	951	487	4083	191	0	1550	501	1223	1507	261	14437
APPROACH %'s :	5.93%	73.54%	20.52%	10.23%	85.76%	4.01%	0.00%	75.57%	24.43%	40.89%	50.38%	8.73%	
PEAK HR START TIME :	500 PM												TOTAL
PEAK HR VOL :	94	1233	331	211	1465	57	0	509	184	442	535	78	5139
PEAK HR FACTOR :		0.891			0.963			0.942			0.865		0.954

CONTROL : Signalized

City Of Los Angeles

Department Of Transportation

MANUAL TRAFFIC COUNT SUMMARY

STREET:

North/South Lincoln Blvd

East/West Fiji Wy

Day: Tuesday Date: April 21, 2015 Weather: SUNNY

Hours: 7-10 & 3-6 Chekrs: NDS

School Day: YES District: I/S CODE

	N/B	S/B	E/B	W/B
DUAL-WHEELED	129	87	33	8
BIKES	62	36	40	22
BUSES	69	57	18	0

	N/B	TIME	S/B	TIME	E/B	TIME	W/B	TIME
AM PK 15 MIN	731	8.15	374	8.30	185	8.45	22	9.45
PM PK 15 MIN	631	17.45	537	17.15	273	16.30	38	16.30
AM PK HOUR	2841	8.15	1457	8.00	634	8.00	75	9.00
PM PK HOUR	2216	17.00	2115	17.00	1018	16.30	118	16.30

NORTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	811	1989	28	2828
8-9	837	1935	41	2813
9-10	731	1756	38	2525
15-16	446	1268	27	1741
16-17	494	1394	35	1923
17-18	623	1556	37	2216
TOTAL	3942	9898	206	14046

SOUTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	23	982	63	1068
8-9	45	1336	76	1457
9-10	43	1269	65	1377
15-16	61	1611	73	1745
16-17	46	1839	80	1965
17-18	45	1982	88	2115
TOTAL	263	9019	445	9727

TOTAL	**XING S/L**		**XING N/L**	
N-S	Ped	Sch	Ped	Sch
3896	0	0	23	0
4270	0	0	18	0
3902	0	0	18	0
3486	0	0	21	0
3888	0	0	23	0
4331	0	0	0	0
23773	0	0	122	0

EASTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	53	14	362	429
8-9	64	22	548	634
9-10	76	11	442	529
15-16	95	16	693	804
16-17	101	15	885	1001
17-18	81	24	895	1000
TOTAL	470	102	3825	4397

WESTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	19	15	24	58
8-9	26	9	28	63
9-10	22	16	37	75
15-16	21	20	37	78
16-17	32	19	33	84
17-18	50	27	27	104
TOTAL	170	106	186	462

TOTAL	**XING W/L**		**XING E/L**	
E-W	Ped	Sch	Ped	Sch
487	1	0	3	0
697	2	0	3	0
604	1	0	5	0
882	0	0	8	0
1085	3	0	3	0
1104	0	0	0	0
4859	7	0	25	0

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5237-006 **Day:** Tuesday

TOTALS

City: Los Angeles **Date:** 4/21/2015

AM

NS/EW Streets:	Lincoln Blvd			Lincoln Blvd			Fiji Wy			Fiji Wy			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	2	3	0	1	3	0	1	1	1	0	2	0	
7:00 AM	155	519	7	1	186	12	9	1	69	4	1	6	970
7:15 AM	201	512	8	2	225	15	19	3	77	0	7	7	1076
7:30 AM	220	483	8	6	274	14	19	4	85	3	4	6	1126
7:45 AM	235	475	5	14	297	22	6	6	131	12	3	5	1211
8:00 AM	205	465	12	8	334	18	16	7	122	3	2	6	1198
8:15 AM	224	493	14	11	319	27	18	3	136	9	2	8	1264
8:30 AM	199	471	8	14	341	19	16	5	126	6	3	8	1216
8:45 AM	209	506	7	12	342	12	14	7	164	8	2	6	1289
9:00 AM	207	496	7	13	324	14	20	1	118	7	3	11	1221
9:15 AM	180	460	9	7	339	14	20	4	108	5	4	7	1157
9:30 AM	147	360	15	15	305	17	18	3	116	5	4	7	1012
9:45 AM	197	440	7	8	301	20	18	3	100	5	5	12	1116
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	2379	5680	107	111	3587	204	193	47	1352	67	40	89	13856
APPROACH %'s :	29.13%	69.56%	1.31%	2.84%	91.93%	5.23%	12.12%	2.95%	84.92%	34.18%	20.41%	45.41%	
PEAK HR START TIME :	815 AM												TOTAL
PEAK HR VOL :	839	1966	36	50	1326	72	68	16	544	30	10	33	4990
PEAK HR FACTOR :		0.972			0.968			0.849			0.869		0.968

CONTROL : Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5237-006 **Day:** Tuesday

City: Los Angeles **Date:** 4/21/2015

TOTALS

PM

NS/EW Streets:	Lincoln Blvd			Lincoln Blvd			Fiji Wy			Fiji Wy			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	2	3	0	1	3	0	1	1	1	0	2	0	
3:00 PM	110	307	10	9	411	13	26	5	144	2	8	6	1051
3:15 PM	119	333	5	16	364	19	25	4	170	3	5	8	1071
3:30 PM	109	333	4	16	441	20	20	4	175	9	3	14	1148
3:45 PM	108	295	8	20	395	21	24	3	204	7	4	9	1098
4:00 PM	108	357	6	7	482	21	32	3	213	6	5	3	1243
4:15 PM	133	339	10	15	419	13	29	6	195	5	4	8	1176
4:30 PM	129	367	10	12	457	24	25	3	245	13	7	18	1310
4:45 PM	124	331	9	12	481	22	15	3	232	8	3	4	1244
5:00 PM	145	346	8	10	481	21	24	3	217	17	9	7	1288
5:15 PM	165	352	5	15	499	23	18	11	222	21	5	6	1342
5:30 PM	126	427	11	12	497	20	23	5	213	7	2	5	1348
5:45 PM	187	431	13	8	505	24	16	5	243	5	11	9	1457
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	1563	4218	99	152	5432	241	277	55	2473	103	66	97	14776
APPROACH %'s :	26.58%	71.73%	1.68%	2.61%	93.25%	4.14%	9.88%	1.96%	88.16%	38.72%	24.81%	36.47%	
PEAK HR START TIME :	500 PM												TOTAL
PEAK HR VOL :	623	1556	37	45	1982	88	81	24	895	50	27	27	5435
PEAK HR FACTOR :		0.878			0.985			0.947			0.788		0.933

CONTROL : Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5241-015 **Day:** Wednesday

City: Los Angeles **Date:** 4/22/2015

AM

NS/EW Streets:	Lincoln Blvd			Lincoln Blvd			Culver Blvd			Culver Blvd			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	3	1	0	2	0	0	0	0	0	0	2	
7:00 AM	0	611	138	0	243	0	0	0	0	0	0	44	1036
7:15 AM	0	677	235	0	312	0	0	0	0	0	0	53	1277
7:30 AM	0	680	321	0	353	0	0	0	0	0	0	50	1404
7:45 AM	0	627	291	0	456	0	0	0	0	0	0	60	1434
8:00 AM	0	627	270	0	454	0	0	0	0	0	0	79	1430
8:15 AM	0	608	248	0	486	0	0	0	0	0	0	65	1407
8:30 AM	0	662	276	0	467	0	0	0	0	0	0	75	1480
8:45 AM	0	644	251	0	534	0	0	0	0	0	0	77	1506
9:00 AM	0	597	245	0	469	0	0	0	0	0	0	80	1391
9:15 AM	0	579	198	0	467	0	0	0	0	0	0	95	1339
9:30 AM	0	508	185	0	448	0	0	0	0	0	0	98	1239
9:45 AM	0	511	141	0	425	0	0	0	0	0	0	79	1156
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	0	7331	2799	0	5114	0	0	0	0	0	0	855	16099
APPROACH %'s :	0.00%	72.37%	27.63%	0.00%	100.00%	0.00%	#DIV/0!	#DIV/0!	#DIV/0!	0.00%	0.00%	100.00%	
PEAK HR START TIME :	800 AM												TOTAL
PEAK HR VOL :	0	2541	1045	0	1941	0	0	0	0	0	0	296	5823
PEAK HR FACTOR :		0.956			0.909			0.000			0.937		0.967

CONTROL : Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5241-015 **Day:** Wednesday

City: Los Angeles **Date:** 4/22/2015

PM

NS/EW Streets:	Lincoln Blvd			Lincoln Blvd			Culver Blvd			Culver Blvd			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	3	1	0	2	0	0	0	0	0	0	2	
3:00 PM	0	359	110	0	538	0	0	0	0	0	0	52	1059
3:15 PM	0	426	105	0	552	0	0	0	0	0	0	66	1149
3:30 PM	0	404	85	0	619	0	0	0	0	0	0	70	1178
3:45 PM	0	361	95	0	628	0	0	0	0	0	0	77	1161
4:00 PM	0	392	78	0	680	0	0	0	0	0	0	72	1222
4:15 PM	0	413	106	0	599	0	0	0	0	0	0	56	1174
4:30 PM	0	461	86	0	686	0	0	0	0	0	0	46	1279
4:45 PM	0	418	99	0	688	0	0	0	0	0	0	64	1269
5:00 PM	0	427	113	0	673	0	0	0	0	0	0	77	1290
5:15 PM	0	445	133	0	741	0	0	0	0	0	0	75	1394
5:30 PM	0	476	131	0	745	0	0	0	0	0	0	70	1422
5:45 PM	0	544	104	0	730	0	0	0	0	0	0	71	1449
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	0	5126	1245	0	7879	0	0	0	0	0	0	796	15046
APPROACH %'s :	0.00%	80.46%	19.54%	0.00%	100.00%	0.00%	#DIV/0!	#DIV/0!	#DIV/0!	0.00%	0.00%	100.00%	
PEAK HR START TIME :	500 PM												TOTAL
PEAK HR VOL :	0	1892	481	0	2889	0	0	0	0	0	0	293	5555
PEAK HR FACTOR :		0.916			0.969			0.000			0.951		0.958

CONTROL : Signalized

City Of Los Angeles

Department Of Transportation

MANUAL TRAFFIC COUNT SUMMARY

STREET:

North/South Lincoln Blvd

East/West Jefferson Blvd

Day: Tuesday Date: April 21, 2015 Weather: SUNNY

Hours: 7-10 & 3-6 Chekrs: NDS

School Day: YES District: I/S CODE

	N/B	S/B	E/B	W/B
DUAL-WHEELED	146	99	15	65
BIKES	36	44	22	12
BUSES	70	63	2	3

	N/B	TIME	S/B	TIME	E/B	TIME	W/B	TIME
AM PK 15 MIN	941	7.30	510	8.45	173	9.15	359	8.45
PM PK 15 MIN	528	17.30	785	17.15	100	17.15	430	17.45
AM PK HOUR	3371	7.30	1938	8.15	643	8.45	1233	8.00
PM PK HOUR	1895	17.00	2917	17.00	335	15.45	1556	17.00

NORTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	8	2761	462	3231
8-9	13	2568	394	2975
9-10	21	2007	416	2444
15-16	34	1285	325	1644
16-17	36	1398	286	1720
17-18	30	1559	306	1895
TOTAL	142	11578	2189	13909

SOUTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	295	898	134	1327
8-9	589	1061	212	1862
9-10	668	914	178	1760
15-16	484	1405	403	2292
16-17	440	1784	545	2769
17-18	513	1745	659	2917
TOTAL	2989	7807	2131	12927

TOTAL	**XING S/L**		**XING N/L**	
N-S	Ped	Sch	Ped	Sch
4558	15	0	5	0
4837	19	0	3	0
4204	4	0	12	0
3936	28	0	8	0
4489	29	0	3	0
4812	0	0	0	0
26836	114	0	36	0

EASTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	177	252	31	460
8-9	201	327	43	571
9-10	150	359	61	570
15-16	71	180	64	315
16-17	77	156	89	322
17-18	83	172	70	325
TOTAL	759	1446	358	2563

WESTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	259	85	612	956
8-9	295	130	808	1233
9-10	269	89	710	1068
15-16	396	179	580	1155
16-17	381	211	578	1170
17-18	478	339	739	1556
TOTAL	2078	1033	4027	7138

TOTAL	**XING W/L**		**XING E/L**	
E-W	Ped	Sch	Ped	Sch
1416	5	0	11	0
1804	3	0	17	0
1638	9	0	4	0
1470	9	0	32	0
1492	3	0	23	0
1881	0	0	0	0
9701	33	0	100	0

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5237-007 **Day:** Tuesday

TOTALS

City: Los Angeles **Date:** 4/21/2015

AM

NS/EW Streets:	Lincoln Blvd			Lincoln Blvd			Jefferson Blvd			Jefferson Blvd			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	4	1	2	4	0	1	3	0	2	2	2	
7:00 AM	0	552	90	48	178	25	47	48	4	47	26	121	1186
7:15 AM	4	699	108	61	191	31	44	65	5	46	16	157	1427
7:30 AM	4	805	132	87	249	31	33	47	5	72	19	160	1644
7:45 AM	0	705	132	99	280	47	53	92	17	94	24	174	1717
8:00 AM	8	638	103	116	255	41	50	89	10	78	36	193	1617
8:15 AM	2	725	117	142	297	58	47	60	6	74	32	183	1743
8:30 AM	0	664	79	137	251	55	48	76	13	65	31	182	1601
8:45 AM	3	541	95	194	258	58	56	102	14	78	31	250	1680
9:00 AM	3	611	108	181	263	44	42	99	11	78	20	204	1664
9:15 AM	9	515	122	140	217	46	51	102	20	75	26	185	1508
9:30 AM	3	386	98	194	202	45	45	88	13	61	22	164	1321
9:45 AM	6	495	88	153	232	43	12	70	17	55	21	157	1349
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	42	7336	1272	1552	2873	524	528	938	135	823	304	2130	18457
APPROACH %'s :	0.49%	84.81%	14.71%	31.36%	58.05%	10.59%	32.98%	58.59%	8.43%	25.27%	9.33%	65.40%	
PEAK HR START TIME :	730 AM												TOTAL
PEAK HR VOL :	14	2873	484	444	1081	177	183	288	38	318	111	710	6721
PEAK HR FACTOR :		0.896			0.856			0.785			0.928		0.964

CONTROL : Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5237-007 **Day:** Tuesday

TOTALS

City: Los Angeles **Date:** 4/21/2015

PM

NS/EW Streets:	Lincoln Blvd			Lincoln Blvd			Jefferson Blvd			Jefferson Blvd			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	4	1	2	4	0	1	3	0	2	2	2	
3:00 PM	11	314	80	144	332	86	11	44	10	95	27	155	1309
3:15 PM	7	363	94	105	357	97	20	49	14	106	47	128	1387
3:30 PM	11	299	70	118	358	113	17	42	20	100	51	151	1350
3:45 PM	5	309	81	117	358	107	23	45	20	95	54	146	1360
4:00 PM	9	337	68	108	499	102	10	40	22	91	50	146	1482
4:15 PM	8	353	84	107	414	122	30	29	26	95	54	157	1479
4:30 PM	13	361	74	103	447	165	21	49	20	101	50	154	1558
4:45 PM	6	347	60	122	424	156	16	38	21	94	57	121	1462
5:00 PM	9	359	79	122	429	144	15	32	20	109	82	161	1561
5:15 PM	4	356	74	152	461	172	29	59	12	118	83	191	1711
5:30 PM	9	436	83	101	428	169	19	38	20	116	82	184	1685
5:45 PM	8	408	70	138	427	174	20	43	18	135	92	203	1736
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	100	4242	917	1437	4934	1607	231	508	223	1255	729	1897	18080
APPROACH %'s :	1.90%	80.66%	17.44%	18.01%	61.85%	20.14%	24.01%	52.81%	23.18%	32.34%	18.78%	48.88%	
PEAK HR START TIME :	500 PM												TOTAL
PEAK HR VOL :	30	1559	306	513	1745	659	83	172	70	478	339	739	6693
PEAK HR FACTOR :		0.897			0.929			0.813			0.905		0.964

CONTROL : Signalized

City Of Los Angeles

Department Of Transportation

MANUAL TRAFFIC COUNT SUMMARY

STREET:

North/South Lincoln Blvd

East/West Bluff Creek Dr

Day: Wednesday Date: March 25, 2015 Weather: SUNNY

Hours: 7-10 & 3-6 Chekrs: NDS

School Day: YES District: I/S CODE

	N/B	S/B	E/B	W/B
DUAL-WHEELED	187	126	0	14
BIKES	47	32	2	8
BUSES	82	70	0	1

	N/B	TIME	S/B	TIME	E/B	TIME	W/B	TIME
AM PK 15 MIN	992	8.00	402	7.45	0	0.00	70	8.15
PM PK 15 MIN	631	17.30	634	17.45	0	0.00	53	16.00
AM PK HOUR	3762	7.15	1448	7.45	0	0.00	229	7.30
PM PK HOUR	2324	17.00	2371	17.00	0	0.00	181	16.45

NORTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	0	3213	291	3504
8-9	3	2844	768	3615
9-10	0	2272	360	2632
15-16	1	1693	160	1854
16-17	0	1875	195	2070
17-18	0	2085	239	2324
TOTAL	4	13982	2013	15999

SOUTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	24	1117	0	1141
8-9	37	1349	0	1386
9-10	29	1210	0	1239
15-16	43	1985	0	2028
16-17	41	2234	0	2275
17-18	52	2319	0	2371
TOTAL	226	10214	0	10440

TOTAL	**XING S/L**		**XING N/L**	
N-S	Ped	Sch	Ped	Sch
4645	0	0	0	0
5001	0	0	4	0
3871	0	0	8	0
3882	0	0	10	0
4345	0	0	5	0
4695	0	0	3	0
26439	0	0	30	0

EASTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	0	0	0	0
8-9	0	0	0	0
9-10	0	0	0	0
15-16	0	0	0	0
16-17	0	0	0	0
17-18	0	0	0	0
TOTAL	0	0	0	0

WESTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	136	0	24	160
8-9	176	0	41	217
9-10	89	0	37	126
15-16	113	0	37	150
16-17	138	0	36	174
17-18	137	0	44	181
TOTAL	789	0	219	1008

TOTAL	**XING W/L**		**XING E/L**	
E-W	Ped	Sch	Ped	Sch
160	0	0	4	0
217	4	0	5	0
126	2	0	6	0
150	2	0	4	0
174	4	0	6	0
181	3	0	10	0
1008	15	0	35	0

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5172-001 **Day:** Wednesday

TOTALS

City: Los Angeles **Date:** 3/25/2015

AM

NS/EW Streets:	Lincoln Blvd			Lincoln Blvd			Bluff Creek Dr			Bluff Creek Dr			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	4	1	2	4	0	0	0	0	2	0	1	
7:00 AM	0	710	24	1	202	0	0	0	0	21	0	9	967
7:15 AM	0	868	46	5	238	0	0	0	0	29	0	6	1192
7:30 AM	0	854	77	11	282	0	0	0	0	39	0	5	1268
7:45 AM	0	781	144	7	395	0	0	0	0	47	0	4	1378
8:00 AM	1	828	163	14	356	0	0	0	0	52	0	12	1426
8:15 AM	1	688	161	10	339	0	0	0	0	56	0	14	1269
8:30 AM	0	671	207	3	324	0	0	0	0	36	0	6	1247
8:45 AM	1	657	237	10	330	0	0	0	0	32	0	9	1276
9:00 AM	0	625	207	13	316	0	0	0	0	22	0	9	1192
9:15 AM	0	517	79	7	278	0	0	0	0	20	0	10	911
9:30 AM	0	589	48	2	328	0	0	0	0	23	0	7	997
9:45 AM	0	541	26	7	288	0	0	0	0	24	0	11	897
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	3	8329	1419	90	3676	0	0	0	0	401	0	102	14020
APPROACH %'s :	0.03%	85.42%	14.55%	2.39%	97.61%	0.00%	#DIV/0!	#DIV/0!	#DIV/0!	79.72%	0.00%	20.28%	
PEAK HR START TIME :	730 AM												TOTAL
PEAK HR VOL :	2	3151	545	42	1372	0	0	0	0	194	0	35	5341
PEAK HR FACTOR :		0.932			0.879			0.000			0.818		0.936

CONTROL : Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5172-001 **Day:** Wednesday

TOTALS

City: Los Angeles **Date:** 3/25/2015

PM

NS/EW Streets:	Lincoln Blvd			Lincoln Blvd			Bluff Creek Dr			Bluff Creek Dr			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	4	1	2	4	0	0	0	0	2	0	1	
3:00 PM	0	436	31	10	445	0	0	0	0	29	0	13	964
3:15 PM	1	434	44	11	446	0	0	0	0	23	0	5	964
3:30 PM	0	425	33	9	502	0	0	0	0	33	0	9	1011
3:45 PM	0	398	52	13	592	0	0	0	0	28	0	10	1093
4:00 PM	0	473	33	10	548	0	0	0	0	41	0	12	1117
4:15 PM	0	463	64	12	531	0	0	0	0	31	0	10	1111
4:30 PM	0	481	43	12	591	0	0	0	0	26	0	10	1163
4:45 PM	0	458	55	7	564	0	0	0	0	40	0	4	1128
5:00 PM	0	469	52	11	573	0	0	0	0	27	0	11	1143
5:15 PM	0	509	52	20	573	0	0	0	0	33	0	13	1200
5:30 PM	0	561	70	7	553	0	0	0	0	41	0	12	1244
5:45 PM	0	546	65	14	620	0	0	0	0	36	0	8	1289
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	1	5653	594	136	6538	0	0	0	0	388	0	117	13427
APPROACH %'s :	0.02%	90.48%	9.51%	2.04%	97.96%	0.00%	#DIV/0!	#DIV/0!	#DIV/0!	76.83%	0.00%	23.17%	
PEAK HR START TIME :	500 PM												TOTAL
PEAK HR VOL :	0	2085	239	52	2319	0	0	0	0	137	0	44	4876
PEAK HR FACTOR :		0.921			0.935			0.000			0.854		0.946

CONTROL : Signalized

City Of Los Angeles

Department Of Transportation

MANUAL TRAFFIC COUNT SUMMARY

STREET:

North/South Nicholson St

East/West Culver Blvd

Day: Tuesday Date: April 21, 2015 Weather: SUNNY

Hours: 7-10 & 3-6 Chekrs: NDS

School Day: YES District: I/S CODE

	N/B	S/B	E/B	W/B
DUAL-WHEELED	30	0	26	49
BIKES	9	0	10	13
BUSES	0	0	2	1

	N/B	TIME	S/B	TIME	E/B	TIME	W/B	TIME
AM PK 15 MIN	332	7.00	3	9.30	377	7.15	269	8.00
PM PK 15 MIN	121	15.15	3	15.30	162	17.15	599	17.30
AM PK HOUR	987	9.00	5	7.45	1467	7.15	852	8.00
PM PK HOUR	436	15.00	6	15.00	590	17.00	2333	17.00

NORTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	8	3	835	846
8-9	12	0	845	857
9-10	21	2	964	987
15-16	43	1	392	436
16-17	46	0	352	398
17-18	43	3	364	410
TOTAL	173	9	3752	3934

SOUTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	1	1	1	3
8-9	4	0	0	4
9-10	2	2	1	5
15-16	1	4	1	6
16-17	3	0	1	4
17-18	1	1	0	2
TOTAL	12	8	4	24

TOTAL	**XING S/L**		**XING N/L**	
N-S	Ped	Sch	Ped	Sch
849	3	0	0	0
861	2	0	0	0
992	4	0	0	0
442	3	0	0	0
402	1	0	0	0
412	3	0	0	0
3958	16	0	0	0

EASTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	1	1404	7	1412
8-9	1	1389	12	1402
9-10	0	1054	19	1073
15-16	0	471	22	493
16-17	1	511	27	539
17-18	2	546	42	590
TOTAL	5	5375	129	5509

WESTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	257	305	1	563
8-9	325	525	2	852
9-10	232	383	2	617
15-16	678	810	3	1491
16-17	843	1139	3	1985
17-18	939	1392	2	2333
TOTAL	3274	4554	13	7841

TOTAL	**XING W/L**		**XING E/L**	
E-W	Ped	Sch	Ped	Sch
1975	2	0	0	0
2254	7	0	0	0
1690	3	0	0	0
1984	4	0	0	0
2524	1	0	0	0
2923	0	0	0	0
13350	17	0	0	0

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5237-001

Day: Tuesday

TOTALS

City: Los Angeles

Date: 4/21/2015

AM

NS/EW Streets:	Nicholson St			Nicholson St			Culver Blvd			Culver Blvd			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	1	1	0	1	0	1	2	0	1	2	0	
7:00 AM	2	1	329	0	0	0	0	297	0	57	52	0	738
7:15 AM	2	2	174	0	1	0	1	374	2	53	79	1	689
7:30 AM	2	0	138	0	0	0	0	369	1	69	77	0	656
7:45 AM	2	0	194	1	0	1	0	364	4	78	97	0	741
8:00 AM	2	0	228	1	0	0	1	346	5	103	166	0	852
8:15 AM	4	0	206	1	0	0	0	360	6	79	106	0	762
8:30 AM	2	0	203	1	0	0	0	358	0	75	131	2	772
8:45 AM	4	0	208	1	0	0	0	325	1	68	122	0	729
9:00 AM	1	0	258	1	0	0	0	310	5	56	88	0	719
9:15 AM	3	0	225	0	0	0	0	256	8	70	102	2	666
9:30 AM	6	1	256	1	1	1	0	251	3	48	104	0	672
9:45 AM	11	1	225	0	1	0	0	237	3	58	89	0	625
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	41	5	2644	7	3	2	2	3847	38	814	1213	5	8621
APPROACH %'s :	1.52%	0.19%	98.29%	58.33%	25.00%	16.67%	0.05%	98.97%	0.98%	40.06%	59.69%	0.25%	
PEAK HR START TIME :	745 AM												TOTAL
PEAK HR VOL :	10	0	831	4	0	1	1	1428	15	335	500	2	3127
PEAK HR FACTOR :		0.914			0.625			0.981			0.778		0.918

CONTROL : Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5237-001 **Day:** Tuesday

TOTALS

City: Los Angeles **Date:** 4/21/2015

PM

NS/EW Streets:	Nicholson St			Nicholson St			Culver Blvd			Culver Blvd			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	1	1	0	1	0	1	2	0	1	2	0	
3:00 PM	11	1	106	0	1	1	0	116	6	169	172	1	584
3:15 PM	10	0	111	0	1	0	0	127	2	152	197	0	600
3:30 PM	9	0	88	1	2	0	0	122	9	180	216	1	628
3:45 PM	13	0	87	0	0	0	0	106	5	177	225	1	614
4:00 PM	13	0	73	1	0	1	1	122	5	184	237	1	638
4:15 PM	10	0	89	1	0	0	0	136	7	201	258	1	703
4:30 PM	14	0	93	0	0	0	0	134	6	217	322	0	786
4:45 PM	9	0	97	1	0	0	0	119	9	241	322	1	799
5:00 PM	9	0	89	0	0	0	0	132	3	251	342	0	826
5:15 PM	12	1	93	0	0	0	1	148	13	222	339	0	829
5:30 PM	11	1	89	0	1	0	0	120	13	245	353	1	834
5:45 PM	11	1	93	1	0	0	1	146	13	221	358	1	846
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	132	4	1108	5	5	2	3	1528	91	2460	3341	8	8687
APPROACH %'s :	10.61%	0.32%	89.07%	41.67%	41.67%	16.67%	0.18%	94.20%	5.61%	42.35%	57.51%	0.14%	
PEAK HR START TIME :	500 PM												TOTAL
PEAK HR VOL :	43	3	364	1	1	0	2	546	42	939	1392	2	3335
PEAK HR FACTOR :		0.967			0.500			0.910			0.974		0.986

CONTROL : Signalized

City Of Los Angeles

Department Of Transportation

MANUAL TRAFFIC COUNT SUMMARY

STREET:

North/South Jefferson Blvd

East/West Culver Blvd

Day: Tuesday Date: April 21, 2015 Weather: SUNNY

Hours: 7-10 & 3-6 Chekrs: NDS

School Day: YES District: I/S CODE

	N/B	S/B	E/B	W/B
DUAL-WHEELED	26	0	38	26
BIKES	9	0	4	4
BUSES	0	0	0	1

	N/B	TIME	S/B	TIME	E/B	TIME	W/B	TIME
AM PK 15 MIN	101	8.45	0	0.00	498	7.45	190	8.00
PM PK 15 MIN	267	17.45	0	0.00	200	17.15	375	16.30
AM PK HOUR	374	8.00	0	0.00	1969	7.45	549	7.45
PM PK HOUR	1002	17.00	0	0.00	774	16.45	1438	16.30

NORTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	216	0	8	224
8-9	370	0	4	374
9-10	294	0	5	299
15-16	586	0	6	592
16-17	784	0	9	793
17-18	995	0	7	1002
TOTAL	3245	0	39	3284

SOUTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	0	0	0	0
8-9	0	0	0	0
9-10	0	0	0	0
15-16	0	0	0	0
16-17	0	0	0	0
17-18	0	0	0	0
TOTAL	0	0	0	0

TOTAL	**XING S/L**		**XING N/L**	
N-S	Ped	Sch	Ped	Sch
224	0	0	0	0
374	0	0	0	0
299	0	0	0	0
592	0	0	0	0
793	0	0	0	0
1002	1	0	0	0
3284	1	0	0	0

EASTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	0	1946	1	1947
8-9	0	1949	0	1949
9-10	0	1791	1	1792
15-16	0	733	0	733
16-17	0	732	0	732
17-18	0	773	0	773
TOTAL	0	7924	2	7926

WESTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	50	355	0	405
8-9	64	456	0	520
9-10	65	316	0	381
15-16	70	918	0	988
16-17	98	1210	0	1308
17-18	72	1347	0	1419
TOTAL	419	4602	0	5021

TOTAL	**XING W/L**		**XING E/L**	
E-W	Ped	Sch	Ped	Sch
2352	0	0	0	0
2469	0	0	0	0
2173	0	0	0	0
1721	0	0	0	0
2040	0	0	0	0
2192	0	0	0	0
12947	0	0	0	0

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5237-002 **Day:** Tuesday

TOTALS

City: Los Angeles **Date:** 4/21/2015

AM

NS/EW Streets:	Jefferson Blvd			Jefferson Blvd			Culver Blvd			Culver Blvd			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	2	0	1	0	0	0	0	2	0	0	2	0	
7:00 AM	40	0	1	0	0	0	0	492	0	5	64	0	602
7:15 AM	52	0	3	0	0	0	0	473	0	8	84	0	620
7:30 AM	59	0	3	0	0	0	0	483	1	11	98	0	655
7:45 AM	65	0	1	0	0	0	0	498	0	26	109	0	699
8:00 AM	88	0	1	0	0	0	0	496	0	17	173	0	775
8:15 AM	87	0	2	0	0	0	0	482	0	10	94	0	675
8:30 AM	94	0	1	0	0	0	0	493	0	19	101	0	708
8:45 AM	101	0	0	0	0	0	0	478	0	18	88	0	685
9:00 AM	56	0	2	0	0	0	0	469	0	25	87	0	639
9:15 AM	96	0	0	0	0	0	0	480	0	12	79	0	667
9:30 AM	67	0	3	0	0	0	0	450	1	13	78	0	612
9:45 AM	75	0	0	0	0	0	0	392	0	15	72	0	554
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	880	0	17	0	0	0	0	5686	2	179	1127	0	7891
APPROACH %'s :	98.10%	0.00%	1.90%	#DIV/0!	#DIV/0!	#DIV/0!	0.00%	99.96%	0.04%	13.71%	86.29%	0.00%	
PEAK HR START TIME :	745 AM												TOTAL
PEAK HR VOL :	334	0	5	0	0	0	0	1969	0	72	477	0	2857
PEAK HR FACTOR :	0.892			0.000			0.988			0.722			0.922

CONTROL : Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5237-002 **Day:** Tuesday

TOTALS

City: Los Angeles **Date:** 4/21/2015

PM

NS/EW Streets:	Jefferson Blvd			Jefferson Blvd			Culver Blvd			Culver Blvd			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	2	0	1	0	0	0	0	2	0	0	2	0	
3:00 PM	108	0	2	0	0	0	0	183	0	11	237	0	541
3:15 PM	138	0	1	0	0	0	0	190	0	20	220	0	569
3:30 PM	172	0	2	0	0	0	0	198	0	21	226	0	619
3:45 PM	168	0	1	0	0	0	0	162	0	18	235	0	584
4:00 PM	155	0	5	0	0	0	0	173	0	23	277	0	633
4:15 PM	188	0	1	0	0	0	0	177	0	23	259	0	648
4:30 PM	213	0	2	0	0	0	0	186	0	31	344	0	776
4:45 PM	228	0	1	0	0	0	0	196	0	21	330	0	776
5:00 PM	230	0	2	0	0	0	0	190	0	20	344	0	786
5:15 PM	242	0	1	0	0	0	0	200	0	14	334	0	791
5:30 PM	259	0	1	0	0	0	0	188	0	24	335	0	807
5:45 PM	264	0	3	0	0	0	0	195	0	14	334	0	810
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	2365	0	22	0	0	0	0	2238	0	240	3475	0	8340
APPROACH %'s :	99.08%	0.00%	0.92%	#DIV/0!	#DIV/0!	#DIV/0!	0.00%	100.00%	0.00%	6.46%	93.54%	0.00%	
PEAK HR START TIME :	500 PM												TOTAL
PEAK HR VOL :	995	0	7	0	0	0	0	773	0	72	1347	0	3194
PEAK HR FACTOR :	0.938			0.000			0.966			0.975			0.986

CONTROL : Signalized

City Of Los Angeles

Department Of Transportation

MANUAL TRAFFIC COUNT SUMMARY

STREET:

North/South SR-90 EB Ramps

East/West Culver Blvd

Day: Wednesday Date: April 22, 2015 Weather: SUNNY

Hours: 7-10 & 3-6 Chekrs: NDS

School Day: YES District: I/S CODE

	N/B	S/B	E/B	W/B
DUAL-WHEELED	0	15	76	43
BIKES	0	0	5	2
BUSES	0	1	2	3

	N/B	TIME	S/B	TIME	E/B	TIME	W/B	TIME
AM PK 15 MIN	0	0.00	59	7.45	737	7.45	194	8.00
PM PK 15 MIN	0	0.00	46	17.30	281	17.15	496	17.00
AM PK HOUR	0	0.00	150	7.45	2765	7.15	664	7.45
PM PK HOUR	0	0.00	163	17.00	1051	16.45	1791	17.00

NORTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	0	0	0	0
8-9	0	0	0	0
9-10	0	0	0	0
15-16	0	0	0	0
16-17	0	0	0	0
17-18	0	0	0	0
TOTAL	0	0	0	0

SOUTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	87	0	16	103
8-9	84	1	34	119
9-10	73	1	32	106
15-16	66	5	63	134
16-17	70	4	70	144
17-18	100	4	59	163
TOTAL	480	15	274	769

TOTAL	**XING S/L**		**XING N/L**	
N-S	Ped	Sch	Ped	Sch
103	0	0	0	0
119	0	0	0	0
106	0	0	0	0
134	2	0	2	0
144	0	0	3	0
163	0	0	0	0
769	2	0	5	0

EASTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	0	1717	921	2638
8-9	0	1751	943	2694
9-10	0	1483	663	2146
15-16	0	558	328	886
16-17	0	578	328	906
17-18	0	725	323	1048
TOTAL	0	6812	3506	10318

WESTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	83	411	0	494
8-9	96	542	0	638
9-10	97	379	0	476
15-16	221	980	0	1201
16-17	259	1334	0	1593
17-18	301	1490	0	1791
TOTAL	1057	5136	0	6193

TOTAL	**XING W/L**		**XING E/L**	
E-W	Ped	Sch	Ped	Sch
3132	0	0	0	0
3332	0	0	0	0
2622	0	0	0	0
2087	0	0	0	0
2499	0	0	0	0
2839	0	0	0	0
16511	0	0	0	0

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5241-017 **Day:** Wednesday

TOTALS

City: Los Angeles **Date:** 4/22/2015

AM

NS/EW Streets:	SR-90 EB Ramps			SR-90 EB Ramps			Culver Blvd			Culver Blvd			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	0	0	1	1.5	0.5	0	3	2	1	2	0	
7:00 AM	0	0	0	15	0	0	0	367	188	15	79	0	664
7:15 AM	0	0	0	7	0	8	0	408	227	16	73	0	739
7:30 AM	0	0	0	13	0	1	0	467	244	22	110	0	857
7:45 AM	0	0	0	52	0	7	0	475	262	30	149	0	975
8:00 AM	0	0	0	19	0	6	0	404	278	20	174	0	901
8:15 AM	0	0	0	29	0	9	0	406	222	22	115	0	803
8:30 AM	0	0	0	15	0	13	0	485	227	27	127	0	894
8:45 AM	0	0	0	21	1	6	0	456	216	27	126	0	853
9:00 AM	0	0	0	12	0	9	0	446	194	21	112	0	794
9:15 AM	0	0	0	24	1	8	0	362	175	26	87	0	683
9:30 AM	0	0	0	19	0	7	0	380	151	19	88	0	664
9:45 AM	0	0	0	18	0	8	0	295	143	31	92	0	587
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	0	0	0	244	2	82	0	4951	2527	276	1332	0	9414
APPROACH %'s :	#DIV/0!	#DIV/0!	#DIV/0!	74.39%	0.61%	25.00%	0.00%	66.21%	33.79%	17.16%	82.84%	0.00%	
PEAK HR START TIME :	745 AM												TOTAL
PEAK HR VOL :	0	0	0	115	0	35	0	1770	989	99	565	0	3573
PEAK HR FACTOR :	0.000			0.636			0.936			0.856			0.916

CONTROL : Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5241-017 **Day:** Wednesday

TOTALS

City: Los Angeles **Date:** 4/22/2015

PM

NS/EW Streets:	SR-90 EB Ramps			SR-90 EB Ramps			Culver Blvd			Culver Blvd			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	0	0	1	1.5	0.5	0	3	2	1	2	0	
3:00 PM	0	0	0	17	0	19	0	125	98	53	202	0	514
3:15 PM	0	0	0	21	1	17	0	158	78	56	236	0	567
3:30 PM	0	0	0	16	1	16	0	144	83	57	275	0	592
3:45 PM	0	0	0	12	3	11	0	131	69	55	267	0	548
4:00 PM	0	0	0	19	1	20	0	135	84	79	321	0	659
4:15 PM	0	0	0	16	2	16	0	148	101	51	308	0	642
4:30 PM	0	0	0	19	1	18	0	132	62	66	343	0	641
4:45 PM	0	0	0	16	0	16	0	163	81	63	362	0	701
5:00 PM	0	0	0	26	0	12	0	171	75	97	399	0	780
5:15 PM	0	0	0	23	0	15	0	189	92	65	358	0	742
5:30 PM	0	0	0	26	0	20	0	212	68	61	352	0	739
5:45 PM	0	0	0	25	4	12	0	153	88	78	381	0	741
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	0	0	0	236	13	192	0	1861	979	781	3804	0	7866
APPROACH %'s :	#DIV/0!	#DIV/0!	#DIV/0!	53.51%	2.95%	43.54%	0.00%	65.53%	34.47%	17.03%	82.97%	0.00%	
PEAK HR START TIME :	500 PM												TOTAL
PEAK HR VOL :	0	0	0	100	4	59	0	725	323	301	1490	0	3002
PEAK HR FACTOR :	0.000			0.886			0.932			0.903			0.962

CONTROL : Signalized

City Of Los Angeles

Department Of Transportation

MANUAL TRAFFIC COUNT SUMMARY

STREET:

North/South SR-90 WB Ramps

East/West Culver Blvd

Day: Wednesday Date: April 22, 2015 Weather: SUNNY

Hours: 7-10 & 3-6 Chekrs: NDS

School Day: YES District: I/S CODE

	N/B	S/B	E/B	W/B
DUAL-WHEELED	33	30	50	40
BIKES	3	6	5	6
BUSES	0	17	0	19

	N/B	TIME	S/B	TIME	E/B	TIME	W/B	TIME
AM PK 15 MIN	193	7.45	70	7.45	518	7.45	209	8.00
PM PK 15 MIN	147	17.30	184	17.00	229	17.30	328	17.00
AM PK HOUR	627	7.30	236	7.30	1881	7.45	648	7.45
PM PK HOUR	555	17.00	672	17.00	822	17.00	1260	16.30

NORTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	169	285	75	529
8-9	172	260	95	527
9-10	141	235	99	475
15-16	243	161	37	441
16-17	266	204	43	513
17-18	278	232	45	555
TOTAL	1269	1377	394	3040

SOUTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	81	0	99	180
8-9	72	0	153	225
9-10	83	0	109	192
15-16	97	0	313	410
16-17	95	0	385	480
17-18	155	0	517	672
TOTAL	583	0	1576	2159

TOTAL	**XING S/L**		**XING N/L**	
N-S	Ped	Sch	Ped	Sch
709	0	0	0	0
752	0	0	0	0
667	1	0	0	0
851	2	0	2	0
993	0	0	1	0
1227	0	0	0	0
5199	3	0	3	0

EASTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	431	1356	0	1787
8-9	551	1291	0	1842
9-10	539	1009	0	1548
15-16	178	446	0	624
16-17	187	462	0	649
17-18	202	620	0	822
TOTAL	2088	5184	0	7272

WESTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	0	223	227	450
8-9	0	310	312	622
9-10	0	224	229	453
15-16	0	644	245	889
16-17	0	942	260	1202
17-18	0	984	257	1241
TOTAL	0	3327	1530	4857

TOTAL	**XING W/L**		**XING E/L**	
E-W	Ped	Sch	Ped	Sch
2237	0	0	1	0
2464	0	0	1	0
2001	0	0	1	0
1513	0	0	1	0
1851	0	0	0	0
2063	0	0	0	0
12129	0	0	4	0

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5241-018 **Day:** Wednesday

TOTALS

City: Los Angeles **Date:** 4/22/2015

AM

NS/EW Streets:	SR-90 WB Ramps			SR-90 WB Ramps			Culver Blvd			Culver Blvd			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1.5	1	1.5	1	0	1	1	2	0	0	2	1	
7:00 AM	40	34	7	9	0	9	88	299	0	0	41	37	564
7:15 AM	32	54	11	16	0	24	98	319	0	0	29	48	631
7:30 AM	48	91	19	19	0	33	129	336	0	0	61	58	794
7:45 AM	49	106	38	37	0	33	116	402	0	0	92	84	957
8:00 AM	45	67	25	13	0	40	110	331	0	0	102	107	840
8:15 AM	41	66	32	19	0	42	108	320	0	0	63	68	759
8:30 AM	45	55	27	12	0	34	164	330	0	0	67	65	799
8:45 AM	41	72	11	28	0	37	169	310	0	0	78	72	818
9:00 AM	44	66	18	28	0	22	150	299	0	0	66	73	766
9:15 AM	28	57	28	20	0	34	139	256	0	0	48	63	673
9:30 AM	32	59	26	15	0	21	136	250	0	0	57	44	640
9:45 AM	37	53	27	20	0	32	114	204	0	0	53	49	589
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	482	780	269	236	0	361	1521	3656	0	0	757	768	8830
APPROACH %'s :	31.48%	50.95%	17.57%	39.53%	0.00%	60.47%	29.38%	70.62%	0.00%	0.00%	49.64%	50.36%	
PEAK HR START TIME :	745 AM												TOTAL
PEAK HR VOL :	180	294	122	81	0	149	498	1383	0	0	324	324	3355
PEAK HR FACTOR :		0.772			0.821			0.908			0.775		0.876

CONTROL : Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5241-018 **Day:** Wednesday

TOTALS

City: Los Angeles **Date:** 4/22/2015

PM

NS/EW Streets:	SR-90 WB Ramps			SR-90 WB Ramps			Culver Blvd			Culver Blvd			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1.5	1	1.5	1	0	1	1	2	0	0	2	1	
3:00 PM	54	39	15	20	0	74	39	97	0	0	134	55	527
3:15 PM	65	35	9	24	0	74	55	130	0	0	146	67	605
3:30 PM	57	39	6	25	0	84	42	117	0	0	197	59	626
3:45 PM	67	48	7	28	0	81	42	102	0	0	167	64	606
4:00 PM	69	45	14	22	0	99	35	123	0	0	234	63	704
4:15 PM	66	49	12	13	0	74	48	112	0	0	217	66	657
4:30 PM	68	56	9	31	0	99	49	105	0	0	248	60	725
4:45 PM	63	54	8	29	0	113	55	122	0	0	243	71	758
5:00 PM	84	51	11	47	0	137	44	157	0	0	263	65	859
5:15 PM	57	54	9	29	0	132	46	162	0	0	242	68	799
5:30 PM	73	60	14	44	0	118	64	165	0	0	226	59	823
5:45 PM	64	67	11	35	0	130	48	136	0	0	253	65	809
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	787	597	125	347	0	1215	567	1528	0	0	2570	762	8498
APPROACH %'s :	52.15%	39.56%	8.28%	22.22%	0.00%	77.78%	27.06%	72.94%	0.00%	0.00%	77.13%	22.87%	
PEAK HR START TIME :	500 PM												TOTAL
PEAK HR VOL :	278	232	45	155	0	517	202	620	0	0	984	257	3290
PEAK HR FACTOR :		0.944			0.913			0.897			0.946		0.958

CONTROL : Signalized

City Of Los Angeles

Department Of Transportation

MANUAL TRAFFIC COUNT SUMMARY

STREET:

North/South Mindanao Wy

East/West SR-90 EB Ramps

Day: Wednesday Date: April 22, 2015 Weather: SUNNY

Hours: 7-10 & 3-6 Chekrs: NDS

School Day: YES District: I/S CODE

	N/B	S/B	E/B	W/B
DUAL-WHEELED	53	101	111	0
BIKES	22	31	0	0
BUSES	24	18	14	0

	N/B	TIME	S/B	TIME	E/B	TIME	W/B	TIME
AM PK 15 MIN	326	8.15	363	8.15	295	8.30	0	0.00
PM PK 15 MIN	314	17.00	450	17.45	297	17.30	0	0.00
AM PK HOUR	1225	8.00	1363	8.00	1125	8.15	0	0.00
PM PK HOUR	1182	17.00	1750	17.00	1084	17.00	0	0.00

NORTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	0	379	532	911
8-9	0	472	753	1225
9-10	0	470	644	1114
15-16	0	396	653	1049
16-17	0	451	693	1144
17-18	0	441	741	1182
TOTAL	0	2609	4016	6625

SOUTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	365	697	0	1062
8-9	471	892	0	1363
9-10	423	802	0	1225
15-16	583	997	0	1580
16-17	635	1038	0	1673
17-18	673	1077	0	1750
TOTAL	3150	5503	0	8653

TOTAL	**XING S/L**		**XING N/L**	
N-S	Ped	Sch	Ped	Sch
1973	0	0	0	0
2588	0	0	0	0
2339	0	0	0	0
2629	0	0	0	0
2817	0	0	0	0
2932	0	0	0	0
15278	0	0	0	0

EASTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	11	908	7	926
8-9	17	1096	9	1122
9-10	35	913	6	954
15-16	22	964	10	996
16-17	19	957	16	992
17-18	22	1050	12	1084
TOTAL	126	5888	60	6074

WESTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	0	0	0	0
8-9	0	0	0	0
9-10	0	0	0	0
15-16	0	0	0	0
16-17	0	0	0	0
17-18	0	0	0	0
TOTAL	0	0	0	0

TOTAL	**XING W/L**		**XING E/L**	
E-W	Ped	Sch	Ped	Sch
926	7	0	9	0
1122	21	0	3	0
954	18	0	8	0
996	22	0	13	0
992	19	0	12	0
1084	22	0	13	0
6074	109	0	58	0

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5241-019 **Day:** Wednesday

TOTALS

City: Los Angeles **Date:** 4/22/2015

AM

NS/EW Streets:	Mindanao Wy			Mindanao Wy			SR-90 EB Ramps			SR-90 EB Ramps			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	1.5	1.5	2	2	0	0	3	0	0	0	0	
7:00 AM	0	78	107	78	160	0	3	186	0	0	0	0	612
7:15 AM	0	102	122	77	170	0	0	199	1	0	0	0	671
7:30 AM	0	99	137	103	167	0	3	251	2	0	0	0	762
7:45 AM	0	100	166	107	200	0	5	272	4	0	0	0	854
8:00 AM	0	110	179	118	219	0	1	259	2	0	0	0	888
8:15 AM	0	127	199	129	234	0	7	275	2	0	0	0	973
8:30 AM	0	104	184	109	212	0	2	290	3	0	0	0	904
8:45 AM	0	131	191	115	227	0	7	272	2	0	0	0	945
9:00 AM	0	118	155	106	200	0	9	256	0	0	0	0	844
9:15 AM	0	127	192	123	192	0	8	223	2	0	0	0	867
9:30 AM	0	112	148	93	192	0	8	229	4	0	0	0	786
9:45 AM	0	113	149	101	218	0	10	205	0	0	0	0	796
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	0	1321	1929	1259	2391	0	63	2917	22	0	0	0	9902
APPROACH %'s :	0.00%	40.65%	59.35%	34.49%	65.51%	0.00%	2.10%	97.17%	0.73%	#DIV/0!	#DIV/0!	#DIV/0!	
PEAK HR START TIME :	800 AM												TOTAL
PEAK HR VOL :	0	472	753	471	892	0	17	1096	9	0	0	0	3710
PEAK HR FACTOR :		0.939			0.939			0.951			0.000		0.953

CONTROL : Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5241-019

Day: Wednesday

TOTALS

City: Los Angeles

Date: 4/22/2015

PM

NS/EW Streets:	Mindanao Wy			Mindanao Wy			SR-90 EB Ramps			SR-90 EB Ramps			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	1.5	1.5	2	2	0	0	3	0	0	0	0	
3:00 PM	0	110	181	151	235	0	8	248	3	0	0	0	936
3:15 PM	0	95	177	160	253	0	5	241	0	0	0	0	931
3:30 PM	0	91	155	164	252	0	3	254	3	0	0	0	922
3:45 PM	0	100	140	108	257	0	6	221	4	0	0	0	836
4:00 PM	0	105	185	174	244	0	4	233	4	0	0	0	949
4:15 PM	0	110	185	160	238	0	3	239	2	0	0	0	937
4:30 PM	0	119	174	159	264	0	7	242	5	0	0	0	970
4:45 PM	0	117	149	142	292	0	5	243	5	0	0	0	953
5:00 PM	0	106	208	174	259	0	2	249	4	0	0	0	1002
5:15 PM	0	109	190	168	254	0	5	265	3	0	0	0	994
5:30 PM	0	111	173	168	277	0	10	286	1	0	0	0	1026
5:45 PM	0	115	170	163	287	0	5	250	4	0	0	0	994
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	0	1288	2087	1891	3112	0	63	2971	38	0	0	0	11450
APPROACH %'s :	0.00%	38.16%	61.84%	37.80%	62.20%	0.00%	2.05%	96.71%	1.24%	#DIV/0!	#DIV/0!	#DIV/0!	
PEAK HR START TIME :	500 PM												TOTAL
PEAK HR VOL :	0	441	741	673	1077	0	22	1050	12	0	0	0	4016
PEAK HR FACTOR :		0.941			0.972			0.912			0.000		0.979

CONTROL : Signalized

City Of Los Angeles

Department Of Transportation

MANUAL TRAFFIC COUNT SUMMARY

STREET:

North/South Mindanao Wy

East/West SR-90 WB Ramps

Day: Wednesday Date: April 22, 2015 Weather: SUNNY

Hours: 7-10 & 3-6 Chekrs: NDS

School Day: YES District: I/S CODE

	N/B	S/B	E/B	W/B
DUAL-WHEELED	28	78	0	174
BIKES	22	31	0	5
BUSES	15	16	0	15

	N/B	TIME	S/B	TIME	E/B	TIME	W/B	TIME
AM PK 15 MIN	135	9.00	206	8.15	0	0.00	634	8.45
PM PK 15 MIN	125	16.30	335	17.00	0	0.00	522	17.45
AM PK HOUR	524	8.45	785	8.00	0	0.00	2456	8.45
PM PK HOUR	469	16.30	1268	17.00	0	0.00	1903	17.00

NORTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	5	394	0	399
8-9	19	467	0	486
9-10	25	486	0	511
15-16	17	395	0	412
16-17	20	447	0	467
17-18	14	441	0	455
TOTAL	100	2630	0	2730

SOUTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	0	598	5	603
8-9	0	769	16	785
9-10	0	694	30	724
15-16	0	1037	37	1074
16-17	0	1156	42	1198
17-18	0	1225	43	1268
TOTAL	0	5479	173	5652

TOTAL	**XING S/L**		**XING N/L**	
N-S	Ped	Sch	Ped	Sch
1002	0	0	6	0
1271	0	0	10	0
1235	0	0	9	0
1486	0	0	23	0
1665	0	0	10	0
1723	0	0	8	0
8382	0	0	66	0

EASTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	0	0	0	0
8-9	0	0	0	0
9-10	0	0	0	0
15-16	0	0	0	0
16-17	0	0	0	0
17-18	0	0	0	0
TOTAL	0	0	0	0

WESTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	474	1091	609	2174
8-9	594	1239	538	2371
9-10	528	1312	579	2419
15-16	521	883	358	1762
16-17	518	932	387	1837
17-18	556	950	397	1903
TOTAL	3191	6407	2868	12466

TOTAL	**XING W/L**		**XING E/L**	
E-W	Ped	Sch	Ped	Sch
2174	14	0	12	0
2371	31	0	10	0
2419	21	0	9	0
1762	28	0	18	0
1837	21	0	13	0
1903	27	0	16	1
12466	142	0	78	1

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5241-020 **Day:** Wednesday

TOTALS

City: Los Angeles **Date:** 4/22/2015

AM

NS/EW Streets:	Mindanao Wy			Mindanao Wy			SR-90 WB Ramps			SR-90 WB Ramps			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	2	0	0	3	0	0	0	0	1.5	1.5	1	
7:00 AM	1	83	0	0	124	0	0	0	0	107	223	98	636
7:15 AM	0	98	0	0	141	2	0	0	0	115	283	151	790
7:30 AM	2	104	0	0	151	2	0	0	0	118	289	178	844
7:45 AM	2	109	0	0	182	1	0	0	0	134	296	182	906
8:00 AM	1	113	0	0	188	3	0	0	0	142	265	150	862
8:15 AM	5	125	0	0	203	3	0	0	0	168	294	132	930
8:30 AM	1	108	0	0	180	4	0	0	0	138	319	129	879
8:45 AM	12	121	0	0	198	6	0	0	0	146	361	127	971
9:00 AM	10	125	0	0	174	7	0	0	0	130	330	159	935
9:15 AM	7	124	0	0	192	10	0	0	0	124	306	153	916
9:30 AM	1	124	0	0	153	7	0	0	0	124	359	137	905
9:45 AM	7	113	0	0	175	6	0	0	0	150	317	130	898
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	49	1347	0	0	2061	51	0	0	0	1596	3642	1726	10472
APPROACH %'s :	3.51%	96.49%	0.00%	0.00%	97.59%	2.41%	#DIV/0!	#DIV/0!	#DIV/0!	22.92%	52.30%	24.78%	
PEAK HR START TIME :	845 AM												TOTAL
PEAK HR VOL :	30	494	0	0	717	30	0	0	0	524	1356	576	3727
PEAK HR FACTOR :		0.970			0.915			0.000			0.968		0.960

CONTROL : Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5241-020 **Day:** Wednesday

TOTALS

City: Los Angeles **Date:** 4/22/2015

PM

NS/EW Streets:	Mindanao Wy			Mindanao Wy			SR-90 WB Ramps			SR-90 WB Ramps			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	2	0	0	3	0	0	0	0	1.5	1.5	1	
3:00 PM	4	107	0	0	265	11	0	0	0	110	210	90	797
3:15 PM	5	96	0	0	266	8	0	0	0	138	236	88	837
3:30 PM	4	90	0	0	289	6	0	0	0	129	192	87	797
3:45 PM	4	102	0	0	217	12	0	0	0	144	245	93	817
4:00 PM	7	96	0	0	307	11	0	0	0	116	197	81	815
4:15 PM	4	111	0	0	271	11	0	0	0	120	242	102	861
4:30 PM	3	122	0	0	283	12	0	0	0	148	230	104	902
4:45 PM	6	118	0	0	295	8	0	0	0	134	263	100	924
5:00 PM	7	97	0	0	317	18	0	0	0	125	205	96	865
5:15 PM	2	114	0	0	288	10	0	0	0	139	246	95	894
5:30 PM	4	117	0	0	318	3	0	0	0	142	232	101	917
5:45 PM	1	113	0	0	302	12	0	0	0	150	267	105	950
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	51	1283	0	0	3418	122	0	0	0	1595	2765	1142	10376
APPROACH %'s :	3.82%	96.18%	0.00%	0.00%	96.55%	3.45%	#DIV/0!	#DIV/0!	#DIV/0!	28.99%	50.25%	20.76%	
PEAK HR START TIME :	500 PM												TOTAL
PEAK HR VOL :	14	441	0	0	1225	43	0	0	0	556	950	397	3626
PEAK HR FACTOR :		0.940			0.946			0.000			0.911		0.954

CONTROL : Signalized

City Of Los Angeles

Department Of Transportation

MANUAL TRAFFIC COUNT SUMMARY

STREET:

North/South Vista Del Mar

East/West Culver Blvd

Day: Wednesday Date: March 25, 2015 Weather: SUNNY

Hours: 7-10 & 3-6 Chekrs: NDS

School Day: YES District: I/S CODE

	N/B	S/B	E/B	W/B
DUAL-WHEELED	20	9	4	31
BIKES	1	9	60	57
BUSES	4	0	5	8

	N/B	TIME	S/B	TIME	E/B	TIME	W/B	TIME
AM PK 15 MIN	317	7.15	27	8.45	53	9.00	170	8.30
PM PK 15 MIN	139	17.00	27	17.30	47	15.30	340	16.15
AM PK HOUR	1227	7.15	88	8.45	172	8.15	585	8.30
PM PK HOUR	508	16.45	90	15.15	162	15.00	1274	16.45

NORTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	8	2	1202	1212
8-9	15	6	1132	1153
9-10	4	6	969	979
15-16	15	12	433	460
16-17	12	17	411	440
17-18	22	15	471	508
TOTAL	76	58	4618	4752

SOUTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	53	6	0	59
8-9	65	8	1	74
9-10	71	13	1	85
15-16	72	14	2	88
16-17	78	10	0	88
17-18	64	9	3	76
TOTAL	403	60	7	470

TOTAL	**XING S/L**		**XING N/L**	
N-S	Ped	Sch	Ped	Sch
1271	0	0	11	0
1227	0	0	20	0
1064	0	0	28	0
548	1	0	15	0
528	3	0	22	1
584	2	0	38	2
5222	6	0	134	3

EASTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	0	117	3	120
8-9	2	140	3	145
9-10	2	153	4	159
15-16	2	152	8	162
16-17	0	135	1	136
17-18	1	136	6	143
TOTAL	7	833	25	865

WESTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	307	41	8	356
8-9	489	65	24	578
9-10	324	100	38	462
15-16	698	140	41	879
16-17	971	188	66	1225
17-18	1041	157	69	1267
TOTAL	3830	691	246	4767

TOTAL	**XING W/L**		**XING E/L**	
E-W	Ped	Sch	Ped	Sch
476	15	0	5	0
723	14	0	10	0
621	15	0	18	0
1041	21	0	11	0
1361	27	1	19	0
1410	42	1	16	0
5632	134	2	79	0

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5172-014 **Day:** Wednesday

TOTALS

City: Los Angeles **Date:** 3/25/2015

AM

NS/EW Streets:	Vista Del Mar			Vista Del Mar			Culver Blvd			Culver Blvd			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0.3	0.3	1.3	0	1	0	0	2	0	1.5	1.5	0	
7:00 AM	2	0	295	10	1	0	0	38	2	47	10	1	406
7:15 AM	3	1	313	13	1	0	0	26	0	66	11	1	435
7:30 AM	2	1	312	11	4	0	0	19	0	89	8	4	450
7:45 AM	1	0	282	19	0	0	0	34	1	105	12	2	456
8:00 AM	3	0	309	15	1	0	0	26	0	103	19	5	481
8:15 AM	6	2	306	15	1	0	0	39	2	98	13	9	491
8:30 AM	2	3	268	13	2	0	1	29	1	154	11	5	489
8:45 AM	4	1	249	22	4	1	1	46	0	134	22	5	489
9:00 AM	0	1	257	12	2	0	1	50	2	101	23	5	454
9:15 AM	2	4	273	19	4	1	0	37	1	88	25	12	466
9:30 AM	1	1	212	22	1	0	1	29	0	70	22	10	369
9:45 AM	1	0	227	18	6	0	0	37	1	65	30	11	396
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	27	14	3303	189	27	2	4	410	10	1120	206	70	5382
APPROACH %'s :	0.81%	0.42%	98.77%	86.70%	12.39%	0.92%	0.94%	96.70%	2.36%	80.23%	14.76%	5.01%	
PEAK HR START TIME :	800 AM												TOTAL
PEAK HR VOL :	15	6	1132	65	8	1	2	140	3	489	65	24	1950
PEAK HR FACTOR :		0.918			0.685			0.771			0.850		0.993

CONTROL : Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5172-014 **Day:** Wednesday

TOTALS

City: Los Angeles **Date:** 3/25/2015

PM

NS/EW Streets:	Vista Del Mar			Vista Del Mar			Culver Blvd			Culver Blvd			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0.3	0.3	1.3	0	1	0	0	2	0	1.5	1.5	0	
3:00 PM	7	2	110	18	2	1	0	42	0	139	37	8	366
3:15 PM	2	3	120	16	4	0	1	44	1	157	35	8	391
3:30 PM	3	2	87	21	3	1	0	44	3	199	35	4	402
3:45 PM	3	5	116	17	5	0	1	22	4	203	33	21	430
4:00 PM	4	3	95	23	0	0	0	35	0	208	43	15	426
4:15 PM	2	3	92	14	2	0	0	35	1	263	62	15	489
4:30 PM	4	7	104	17	6	0	0	33	0	256	37	20	484
4:45 PM	2	4	120	24	2	0	0	32	0	244	46	16	490
5:00 PM	6	2	131	8	3	1	0	36	1	254	34	16	492
5:15 PM	5	5	114	15	3	1	0	27	1	288	26	19	504
5:30 PM	6	5	108	23	3	1	1	35	1	264	51	16	514
5:45 PM	5	3	118	18	0	0	0	38	3	235	46	18	484
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	49	44	1315	214	33	5	3	423	15	2710	485	176	5472
APPROACH %'s :	3.48%	3.13%	93.39%	84.92%	13.10%	1.98%	0.68%	95.92%	3.40%	80.39%	14.39%	5.22%	
PEAK HR START TIME :	445 PM												TOTAL
PEAK HR VOL :	19	16	473	70	11	3	1	130	3	1050	157	67	2000
PEAK HR FACTOR :		0.914			0.778			0.905			0.956		0.973

CONTROL : Signalized

City Of Los Angeles

Department Of Transportation

MANUAL TRAFFIC COUNT SUMMARY

STREET:

North/South Culver Pl

East/West Culver Blvd

Day: Wednesday Date: March 25, 2015 Weather: SUNNY

Hours: 7-10 & 3-6 Chekrs: NDS

School Day: YES District: I/S CODE

	N/B	S/B	E/B	W/B
DUAL-WHEELED	0	0	0	0
BIKES	7	24	39	1
BUSES	0	0	0	0

	N/B	TIME	S/B	TIME	E/B	TIME	W/B	TIME
AM PK 15 MIN	0	0.00	3	9.15	1	9.00	0	0.00
PM PK 15 MIN	0	0.00	3	16.30	0	0.00	0	0.00
AM PK HOUR	0	0.00	7	8.30	1	9.00	0	0.00
PM PK HOUR	0	0.00	11	16.30	0	0.00	0	0.00

NORTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	0	0	0	0
8-9	0	0	0	0
9-10	0	0	0	0
15-16	0	0	0	0
16-17	0	0	0	0
17-18	0	0	0	0
TOTAL	0	0	0	0

SOUTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	0	0	2	2
8-9	0	0	3	3
9-10	0	0	6	6
15-16	0	0	7	7
16-17	0	0	6	6
17-18	0	0	7	7
TOTAL	0	0	31	31

TOTAL	**XING S/L**		**XING N/L**	
N-S	Ped	Sch	Ped	Sch
2	5	0	16	0
3	9	0	13	0
6	14	0	10	0
7	9	0	23	0
6	9	0	12	0
7	11	0	23	0
31	57	0	97	0

EASTBOUND Approach

Hours	Lt	Th	Rt	Total
9-10	1	0	0	1
TOTAL	1	0	0	1

WESTBOUND Approach

Hours	Lt	Th	Rt	Total
9-10	0	0	0	0
TOTAL	0	0	0	0

TOTAL	**XING W/L**		**XING E/L**	
E-W	Ped	Sch	Ped	Sch
1	2	0	0	0
1	10	0	0	0

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5172-114 **Day:** Wednesday

TOTALS

City: Los Angeles **Date:** 3/25/2015

AM

NS/EW Streets:	Culver Pl			Culver Pl			Culver Blvd			Culver Blvd			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	0	0	0	0	1	0	2	0	1.5	1.5	0	
7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15 AM	0	0	0	0	0	1	0	0	0	0	0	0	1
7:30 AM	0	0	0	0	0	1	0	0	0	0	0	0	1
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30 AM	0	0	0	0	0	1	0	0	0	0	0	0	1
8:45 AM	0	0	0	0	0	2	0	0	0	0	0	0	2
9:00 AM	0	0	0	0	0	1	1	0	0	0	0	0	2
9:15 AM	0	0	0	0	0	3	0	0	0	0	0	0	3
9:30 AM	0	0	0	0	0	1	0	0	0	0	0	0	1
9:45 AM	0	0	0	0	0	1	0	0	0	0	0	0	1
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	0	0	0	0	0	11	1	0	0	0	0	0	12
APPROACH %'s :	#DIV/0!	#DIV/0!	#DIV/0!	0.00%	0.00%	100.00%	100.00%	0.00%	0.00%	#DIV/0!	#DIV/0!	#DIV/0!	
PEAK HR START TIME :	845 AM												TOTAL
PEAK HR VOL :	0	0	0	0	0	7	1	0	0	0	0	0	8
PEAK HR FACTOR :	0.000			0.583			0.250			0.000			0.667

CONTROL : Signalized

0 0 0 0 0 3 0 0 0 0 0 0

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5172-114

Day: Wednesday

TOTALS

City: Los Angeles

Date: 3/25/2015

PM

NS/EW Streets:	Culver Pl			Culver Pl			Culver Blvd			Culver Blvd			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	0	0	0	0	1	0	2	0	1.5	1.5	0	
3:00 PM	0	0	0	0	0	1	0	0	0	0	0	0	1
3:15 PM	0	0	0	0	0	2	0	0	0	0	0	0	2
3:30 PM	0	0	0	0	0	2	0	0	0	0	0	0	2
3:45 PM	0	0	0	0	0	2	0	0	0	0	0	0	2
4:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
4:15 PM	0	0	0	0	0	1	0	0	0	0	0	0	1
4:30 PM	0	0	0	0	0	3	0	0	0	0	0	0	3
4:45 PM	0	0	0	0	0	2	0	0	0	0	0	0	2
5:00 PM	0	0	0	0	0	3	0	0	0	0	0	0	3
5:15 PM	0	0	0	0	0	3	0	0	0	0	0	0	3
5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
5:45 PM	0	0	0	0	0	1	0	0	0	0	0	0	1
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	0	0	0	0	0	20	0	0	0	0	0	0	20
APPROACH %'s :	#DIV/0!	#DIV/0!	#DIV/0!	0.00%	0.00%	100.00%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
PEAK HR START TIME :	430 PM												TOTAL
PEAK HR VOL :	0	0	0	0	0	11	0	0	0	0	0	0	11
PEAK HR FACTOR :	0.000			0.917			0.000			0.000			0.917

CONTROL : Signalized

0 0 0 0 0 8 0 0 0 0 0 0

City Of Los Angeles

Department Of Transportation

MANUAL TRAFFIC COUNT SUMMARY

STREET:

North/South Vista Del Mar Ln

East/West Culver Blvd

Day: Wednesday Date: March 25, 2015 Weather: SUNNY

Hours: 7-10 & 3-6 Chekrs: NDS

School Day: YES District: I/S CODE

	N/B	S/B	E/B	W/B
DUAL-WHEELED	3	1	0	3
BIKES	6	1	9	1
BUSES	0	0	0	0

	N/B	TIME	S/B	TIME	E/B	TIME	W/B	TIME
AM PK 15 MIN	47	8.15	4	9.00	2	8.15	6	8.00
PM PK 15 MIN	13	16.15	4	15.00	2	16.30	7	17.30
AM PK HOUR	164	8.00	6	9.00	4	9.15	12	7.30
PM PK HOUR	36	16.00	8	15.00	8	16.30	16	17.00

NORTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	7	9	38	54
8-9	18	21	125	164
9-10	13	15	37	65
15-16	9	5	11	25
16-17	11	10	15	36
17-18	8	7	12	27
TOTAL	66	67	238	371

SOUTHBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	0	1	0	1
8-9	0	2	0	2
9-10	0	6	0	6
15-16	0	8	0	8
16-17	0	2	0	2
17-18	0	3	0	3
TOTAL	0	22	0	22

TOTAL	**XING S/L**		**XING N/L**	
N-S	Ped	Sch	Ped	Sch
55	5	0	15	0
166	6	0	14	0
71	13	0	15	0
33	8	0	25	0
38	20	4	29	1
30	24	0	46	2
393	76	4	144	3

EASTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	0	0	0	0
8-9	0	0	2	2
9-10	0	0	4	4
15-16	0	0	1	1
16-17	0	0	5	5
17-18	0	0	4	4
TOTAL	0	0	16	16

WESTBOUND Approach

Hours	Lt	Th	Rt	Total
7-8	5	0	0	5
8-9	12	0	0	12
9-10	5	0	0	5
15-16	12	0	0	12
16-17	11	0	0	11
17-18	16	0	0	16
TOTAL	61	0	0	61

TOTAL	**XING W/L**		**XING E/L**	
E-W	Ped	Sch	Ped	Sch
5	0	0	11	0
14	0	0	20	0
9	0	0	28	0
13	0	0	15	0
16	0	0	21	0
20	0	0	38	1
77	0	0	133	1

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5172-214

Day: Wednesday

TOTALS

City: Los Angeles

Date: 3/25/2015

AM

NS/EW Streets:	Vista Del Mar Ln			Vista Del Mar Ln			Culver Blvd			Culver Blvd			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	1	0	0	1	0	0	2	0	1.5	1.5	0	
7:00 AM	1	1	3	0	0	0	0	0	0	0	0	0	5
7:15 AM	0	1	10	0	0	0	0	0	0	2	0	0	13
7:30 AM	3	2	11	0	1	0	0	0	0	1	0	0	18
7:45 AM	3	5	14	0	0	0	0	0	0	2	0	0	24
8:00 AM	4	3	21	0	1	0	0	0	0	6	0	0	35
8:15 AM	5	6	36	0	1	0	0	0	2	3	0	0	53
8:30 AM	5	7	35	0	0	0	0	0	0	1	0	0	48
8:45 AM	4	5	33	0	0	0	0	0	0	2	0	0	44
9:00 AM	4	6	15	0	4	0	0	0	0	1	0	0	30
9:15 AM	5	5	10	0	0	0	0	0	2	0	0	0	22
9:30 AM	2	3	6	0	2	0	0	0	1	2	0	0	16
9:45 AM	2	1	6	0	0	0	0	0	1	2	0	0	12
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	38	45	200	0	9	0	0	0	6	22	0	0	320
APPROACH %'s :	13.43%	15.90%	70.67%	0.00%	100.00%	0.00%	0.00%	0.00%	100.00%	100.00%	0.00%	0.00%	
PEAK HR START TIME :	800 AM												TOTAL
PEAK HR VOL :	18	21	125	0	2	0	0	0	2	12	0	0	180
PEAK HR FACTOR :		0.872			0.500			0.250			0.500		0.849

CONTROL : Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: 15-5172-214 **Day:** Wednesday

City: Los Angeles **Date:** 3/25/2015

TOTALS

PM

NS/EW Streets:	Vista Del Mar Ln			Vista Del Mar Ln			Culver Blvd			Culver Blvd			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	1	0	0	1	0	0	2	0	1.5	1.5	0	
3:00 PM	1	1	2	0	4	0	0	0	0	2	0	0	10
3:15 PM	2	0	5	0	0	0	0	0	0	5	0	0	12
3:30 PM	2	2	2	0	2	0	0	0	0	2	0	0	10
3:45 PM	4	2	2	0	2	0	0	0	1	3	0	0	14
4:00 PM	0	2	4	0	1	0	0	0	0	0	0	0	7
4:15 PM	7	3	3	0	1	0	0	0	1	2	0	0	17
4:30 PM	1	2	3	0	0	0	0	0	2	6	0	0	14
4:45 PM	3	3	5	0	0	0	0	0	2	3	0	0	16
5:00 PM	2	0	2	0	3	0	0	0	2	3	0	0	12
5:15 PM	2	3	3	0	0	0	0	0	2	2	0	0	12
5:30 PM	3	1	4	0	0	0	0	0	0	7	0	0	15
5:45 PM	1	3	3	0	0	0	0	0	0	4	0	0	11
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	28	22	38	0	13	0	0	0	10	39	0	0	150
APPROACH %'s :	31.82%	25.00%	43.18%	0.00%	100.00%	0.00%	0.00%	0.00%	100.00%	100.00%	0.00%	0.00%	
PEAK HR START TIME :	415 PM												TOTAL
PEAK HR VOL :	13	8	13	0	4	0	0	0	7	14	0	0	59
PEAK HR FACTOR :		0.654			0.333			0.875			0.583		0.868

CONTROL : Signalized

Tuesday, September 01, 2015 Location: City of Los Angeles PROJECT: SC0712

ADT Lincoln Boulevard south of Fiji Way. **Prepared by AimTD tel. 714 753 7888**

AM Period	NB		SB		EB	WB		PM Period	NB		SB		EB	WB	
00:00	69		65					12:00	499		424				
00:15	57		58					12:15	475		403				
00:30	43		45					12:30	473		437				
00:45	40	209	28	196			405	12:45	501	1948	408	1672			3620
01:00	40		28					13:00	449		428				
01:15	22		31					13:15	441		431				
01:30	24		18					13:30	423		480				
01:45	19	105	17	94			199	13:45	407	1720	412	1751			3471
02:00	11		15					14:00	397		494				
02:15	10		12					14:15	415		443				
02:30	15		17					14:30	456		481				
02:45	12	48	12	56			104	14:45	442	1710	470	1888			3598
03:00	12		8					15:00	400		530				
03:15	13		9					15:15	466		570				
03:30	10		13					15:30	455		576				
03:45	16	51	18	48			99	15:45	443	1764	613	2289			4053
04:00	18		16					16:00	402		628				
04:15	22		36					16:15	505		640				
04:30	23		55					16:30	474		573				
04:45	64	127	55	162			289	16:45	466	1847	667	2508			4355
05:00	48		59					17:00	432		650				
05:15	100		79					17:15	488		669				
05:30	112		108					17:30	549		710				
05:45	145	405	107	353			758	17:45	512	1981	693	2722			4703
06:00	187		116					18:00	523		664				
06:15	288		173					18:15	543		641				
06:30	374		186					18:30	483		663				
06:45	578	1427	219	694			2121	18:45	455	2004	604	2572			4576
07:00	638		250					19:00	449		583				
07:15	663		293					19:15	422		532				
07:30	629		356					19:30	408		532				
07:45	685	2615	411	1310			3925	19:45	402	1681	475	2122			3803
08:00	633		454					20:00	302		441				
08:15	598		440					20:15	307		342				
08:30	696		465					20:30	270		352				
08:45	674	2601	443	1802			4403	20:45	266	1145	303	1438			2583
09:00	632		442					21:00	240		325				
09:15	595		501					21:15	261		285				
09:30	631		430					21:30	220		257				
09:45	573	2431	364	1737			4168	21:45	228	949	206	1073			2022
10:00	555		354					22:00	203		188				
10:15	469		312					22:15	190		194				
10:30	452		374					22:30	169		166				
10:45	469	1945	399	1439			3384	22:45	123	685	135	683			1368
11:00	444		342					23:00	105		123				
11:15	506		386					23:15	94		98				
11:30	451		214					23:30	77		89				
11:45	353	1754	415	1357			3111	23:45	71	347	70	380			727
Total Vol.	13718		9248				**22966**		17781		21098				**38879**

Daily Totals

NB	SB	EB	WB	Combined
31499	30346			**61845**

	AM			PM		
Split %	59.7%	40.3%	**37.1%**	45.7%	54.3%	**62.9%**
Peak Hour	07:00	08:30	**08:30**	17:30	17:15	**17:30**
Volume	2615	1851	**4448**	2127	2736	**4835**
P.H.F.	0.95	0.92	**0.96**	0.96	0.96	**0.96**

pacific@aimtd.com Tell. 714 753 7888

Wednesday, June 10, 2015 CITY: Los Angeles PROJECT: sc0642

Culver Boulevard w/o Lincoln Boulevard **Prepared by AimTD tel. 951 249 3226**

AM Period	NB	SB	EB		WB			PM Period	NB	SB	EB		WB		
00:30			26		35			12:00			229		153		
00:15			26		22			12:15			198		143		
00:30			20		24			12:30			173		171		
00:45			15	87	20	101	188	12:45			201	801	162	629	1430
01:00			11		18			13:00			206		154		
01:15			13		5			13:15			192		155		
01:30			14		8			13:30			201		146		
01:45			9	47	11	42	89	13:45			187	786	158	613	1399
02:00			15		12			14:00			185		142		
02:15			8		9			14:15			180		165		
02:30			5		6			14:30			210		186		
02:45			2	30	3	30	60	14:45			179	754	211	704	1458
03:00			8		7			15:00			166		233		
03:15			6		6			15:15			220		220		
03:30			14		16			15:30			183		235		
03:45			4	32	6	35	67	15:45			179	748	294	982	1730
04:00			4		8			16:00			189		286		
04:15			10		22			16:15			185		356		
04:30			20		27			16:30			179		371		
04:45			24	58	26	83	141	16:45			171	724	346	1359	2083
05:00			23		33			17:00			151		364		
05:15			37		35			17:15			196		361		
05:30			68		47			17:30			199		372		
05:45			97	225	66	181	406	17:45			178	724	358	1455	2179
06:00			126		60			18:00			167		338		
06:15			215		58			18:15			181		338		
06:30			244		68			18:30			192		326		
06:45			348	933	52	238	1171	18:45			155	695	355	1357	2052
07:00			413		61			19:00			144		365		
07:15			405		72			19:15			127		342		
07:30			426		99			19:30			124		254		
07:45			434	1678	121	353	2031	19:45			122	517	259	1220	1737
08:00			410		139			20:00			108		192		
08:15			454		111			20:15			122		179		
08:30			456		135			20:30			121		145		
08:45			447	1767	132	517	2284	20:45			133	484	126	642	1126
09:00			438		101			21:00			88		122		
09:15			433		109			21:15			100		122		
09:30			418		128			21:30			82		135		
09:45			385	1674	104	442	2116	21:45			68	338	99	478	816
10:00			336		103			22:00			90		94		
10:15			310		96			22:15			75		106		
10:30			289		98			22:30			71		88		
10:45			293	1228	95	392	1620	22:45			51	287	70	358	645
11:00			268		84			23:00			54		62		
11:15			264		95			23:15			34		43		
11:30			221		113			23:30			31		49		
11:45			241	994	113	405	1399	23:45			35	154	52	206	360
Total Vol.				8753		2819	**11572**					7012		10003	**17015**

Daily Totals

NB	SB	EB	WB	Combined
		15765	12822	**28587**

			AM			PM		
Split %			75.6%	24.4%	**40.5%**	41.2%	58.8%	**59.5%**
Peak Hour	00:30	00:30	08:15	11:45	**08:00**	12:00	17:00	**17:00**
Volume			1795	580	**2284**	801	1455	**2179**
P.H.F.			0.98	0.85	**0.97**	0.87	0.98	**0.95**

pacific@aimtd.com Tell. 951 249 3226

APPENDIX C

Level of Service Worksheets

Existing (2015) Conditions

Level of Service Worksheet
(Circular 212 Method)

I/S #:	PROJECT TITLE:	Ballona Wetlands Restortation Project			
1	North-South Street:	Admiralty Way	East-West Street:	Bali Way	
	Scenario:	Existing (2015) Conditions			
	Count Date:		Analyst:	RA	Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?		NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	24	1	24	21	1	21
	Left-Through		0			0	
	Through	1143	1	**586**	972	1	**543**
	Through-Right		1			1	
	Right	28	0	28	113	0	113
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	228	1	**228**	268	1	**268**
	Left-Through		0			0	
	Through	1118	1	568	1329	1	676
	Through-Right		1			1	
	Right	18	0	18	23	0	23
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	13	0	**13**	15	0	**15**
	Left-Through		1			1	
	Through	18	0	30	48	0	50
	Through-Right		1			1	
	Right	15	0	30	22	0	50
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	22	1	22	24	1	24
	Left-Through		0			0	
	Through	41	0	**194**	37	0	**210**
	Through-Right		1			1	
	Right	346	1	0	382	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	814		*North-South:*	811
			East-West:	207		*East-West:*	225
			SUM:	1021		*SUM:*	1036
VOLUME/CAPACITY *(V/C)* RATIO:				0.716			0.727
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.616**			**0.627**
LEVEL OF SERVICE (LOS):				**B**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 2

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Admiralty Way East-West Street: Mindanao Way
Scenario: Existing (2015) Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				2			2
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	29	1	29	17	1	17
	Left-Through		0			0	
	Through	773	1	**413**	592	1	**364**
	Through-Right		1			1	
	Right	52	0	52	135	0	135
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	446	1	**446**	381	1	**381**
	Left-Through		0			0	
	Through	613	1	315	997	1	506
	Through-Right		1			1	
	Right	17	0	17	15	0	15
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	19	1	19	19	1	19
	Left-Through		0			0	
	Through	54	0	**75**	44	0	**61**
	Through-Right		1			1	
	Right	21	0	0	17	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	154	1	**120**	255	1	**139**
	Left-Through		1			1	
	Through	85	0	120	23	0	139
	Through-Right		0			0	
	Right	426	1	0	437	1	56
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	859		*North-South:*	745
			East-West:	195		*East-West:*	200
			SUM:	1054		*SUM:*	945
VOLUME/CAPACITY *(V/C)* RATIO:				0.767			0.687
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.667**			**0.587**
LEVEL OF SERVICE (LOS):				**B**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 3

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Admiralty Way East-West Street: Fiji Way
Scenario: Existing (2015) Conditions'
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	627	2	**345**	906	2	**498**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	73	1	32	110	1	91
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	82	1	**82**	39	1	**39**
	Left-Through		0			0	
	Through	112	2	56	147	2	74
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	90	1	90	120	1	**120**
	Through-Right		0			0	
	Right	744	1	**399**	459	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	345		*North-South:*	498
			East-West:	481		*East-West:*	159
			SUM:	826		*SUM:*	657
VOLUME/CAPACITY *(V/C)* RATIO:				0.551			0.438
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.451**			**0.338**
LEVEL OF SERVICE (LOS):				**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 4

PROJECT TITLE: Ballona Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Washington Boulevard
Scenario: Existing (2015) Conditions
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 3	WB --	3	EB -- 3	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	624	2	**343**	437	2	**240**
	Left-Through		0			0	
	Through	1445	2	515	1176	2	457
	Through-Right		1			1	
	Right	99	0	99	195	0	195
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	222	2	122	176	2	97
	Left-Through		0			0	
	Through	1394	2	**502**	1401	2	**503**
	Through-Right		1			1	
	Right	112	0	112	108	0	108
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	78	2	43	102	2	56
	Left-Through		0			0	
	Through	749	2	**375**	674	2	**337**
	Through-Right		0			0	
	Right	523	1	180	501	1	261
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	126	2	**69**	244	2	**134**
	Left-Through		0			0	
	Through	682	2	341	754	2	377
	Through-Right		0			0	
	Right	181	1	59	226	1	129
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	845		*North-South:*	743
			East-West:	444		*East-West:*	471
			SUM:	1289		*SUM:*	1214
VOLUME/CAPACITY *(V/C)* RATIO:				0.937			0.883
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.837**			**0.783**
LEVEL OF SERVICE (LOS):				**D**			**C**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #:	PROJECT TITLE:	Ballona Wetlands Restoration Project				
5	North-South Street:	Lincoln Boulevard	East-West Street:	Marina Expressway (SR-90)		
	Scenario:	Existing (2015) Conditions				
	Count Date:		Analyst:	RA	Date:	6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	3	EB -- 0	WB --	3
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	1351	2	**524**	1356	2	**549**
	Through-Right		1			1	
	Right	221	0	221	292	0	292
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	869	2	**478**	825	2	**454**
	Left-Through		0			0	
	Through	1324	3	441	1575	3	525
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	**0**	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	201	2	111	188	2	**103**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	1163	2	**162**	799	2	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	1002		*North-South:*	1003
			East-West:	162		*East-West:*	103
			SUM:	1164		*SUM:*	1106
	VOLUME/CAPACITY *(V/C)* RATIO:			0.817			0.776
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.717**			**0.676**
	LEVEL OF SERVICE (LOS):			**C**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 6

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Bali Way
Scenario: Existing (2015) Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			4			4
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			2			2
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	197	1	**197**	116	1	**116**
	Left-Through		0			0	
	Through	1333	2	452	1256	2	422
	Through-Right		1			1	
	Right	23	0	23	9	0	9
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	27	1	27	40	1	40
	Left-Through		0			0	
	Through	1299	2	**519**	1486	2	**595**
	Through-Right		1			1	
	Right	258	0	258	299	0	299
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	210	1	**106**	327	1	**165**
	Left-Through		1			1	
	Through	1	0	106	3	0	165
	Through-Right		0			0	
	Right	59	1	0	107	1	49
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	3	0	3	9	0	9
	Left-Through		0			0	
	Through	1	0	**15**	2	0	**20**
	Through-Right		0			0	
	Right	11	0	0	9	0	0
	Left-Through-Right		1			1	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	716		*North-South:*	711
			East-West:	121		*East-West:*	185
			SUM:	837		*SUM:*	896
	VOLUME/CAPACITY *(V/C)* RATIO:			0.609			0.652
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.509**			**0.552**
	LEVEL OF SERVICE (LOS):			**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 7

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Mindanao Way
Scenario: Existing (2015) Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --		0	NB -- 3	SB --	0
	EB -- 0	WB --		0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	185	1	185	94	1	94
	Left-Through		0			0	
	Through	1527	3	**509**	1233	3	**411**
	Through-Right		0			0	
	Right	427	1	275	331	1	88
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	155	1	**155**	211	1	**211**
	Left-Through		0			0	
	Through	1101	2	380	1465	2	507
	Through-Right		1			1	
	Right	39	0	39	57	0	57
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	547	1	**298**	509	1	**347**
	Through-Right		1			1	
	Right	48	0	48	184	0	184
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	276	2	**152**	442	2	**243**
	Left-Through		0			0	
	Through	434	1	272	535	1	307
	Through-Right		1			1	
	Right	110	0	110	78	0	78
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	664		*North-South:*	622
			East-West:	450		*East-West:*	590
			SUM:	1114		*SUM:*	1212
VOLUME/CAPACITY *(V/C)* RATIO:				0.810			0.881
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.710**			**0.781**
LEVEL OF SERVICE (LOS):				**C**			**C**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 8

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Fiji Way
Scenario: Existing (2015) Conditions
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 1	WB --	0	EB -- 1	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	839	2	**461**	623	2	**343**
	Left-Through		0			0	
	Through	1966	2	667	1556	2	531
	Through-Right		1			1	
	Right	36	0	36	37	0	37
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	50	1	50	45	1	45
	Left-Through		0			0	
	Through	1326	2	**466**	1982	2	**690**
	Through-Right		1			1	
	Right	72	0	72	88	0	88
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	68	1	**68**	81	1	**81**
	Left-Through		0			0	
	Through	16	1	16	24	1	24
	Through-Right		0			0	
	Right	544	1	0	895	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	30	0	30	50	0	50
	Left-Through		1			1	
	Through	10	0	**43**	27	0	**54**
	Through-Right		1			1	
	Right	33	0	0	27	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	927		*North-South:*	1033
			East-West:	111		*East-West:*	135
			SUM:	1038		*SUM:*	1168
VOLUME/CAPACITY *(V/C)* RATIO:				0.728			0.820
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.628**			**0.720**
LEVEL OF SERVICE (LOS):				**B**			**C**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 9

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Culver Loop
Scenario: Existing (2015) Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 0	WB --		0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	2541	2	**1195**	1892	2	**791**
	Through-Right		1			1	
	Right	1045	0	1045	481	0	481
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	1941	2	971	2889	2	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	296	2	**163**	293	2	**161**
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1195		*North-South:*	791
			East-West:	163		*East-West:*	161
			SUM:	1358		*SUM:*	952
VOLUME/CAPACITY *(V/C)* RATIO:				0.905			0.635
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.805**			**0.535**
LEVEL OF SERVICE (LOS):				**D**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 10

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Jefferson Boulevard
Scenario: Existing (2015) Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	3		NB -- 3	SB --	3
	EB -- 0	WB --	3		EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	14	1	14	30	1	30
	Left-Through		0			0	
	Through	2873	4	**718**	1559	4	**390**
	Through-Right		0			0	
	Right	484	1	309	306	1	43
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	444	2	**244**	513	2	**282**
	Left-Through		0			0	
	Through	1081	4	270	1745	4	436
	Through-Right		0			0	
	Right	177	1	0	659	1	576
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	183	1	**183**	83	1	83
	Left-Through		0			0	
	Through	288	2	109	172	2	**81**
	Through-Right		1			1	
	Right	38	0	38	70	0	70
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	318	2	175	478	2	**263**
	Left-Through		0			0	
	Through	111	2	56	339	2	170
	Through-Right		0			0	
	Right	710	2	**147**	739	2	124
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	962		*North-South:*	672
			East-West:	330		*East-West:*	344
			SUM:	1292		*SUM:*	1016
VOLUME/CAPACITY *(V/C)* RATIO:				0.940			0.739
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.840**			**0.639**
LEVEL OF SERVICE (LOS):				**D**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 11

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Bluff Creek Drive
Scenario: Existing (2015) Conditions
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	0	NB -- 3	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	3153	4	**788**	2085	4	521
	Through-Right		0			0	
	Right	545	1	438	239	1	164
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	42	2	**23**	52	2	29
	Left-Through		0			0	
	Through	1372	4	343	2319	4	**580**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	194	2	**107**	137	2	**75**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	35	1	12	44	1	15
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	811		*North-South:*	580
			East-West:	107		*East-West:*	75
			SUM:	918		*SUM:*	655
VOLUME/CAPACITY *(V/C)* RATIO:				0.644			0.460
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.544**			**0.360**
LEVEL OF SERVICE (LOS):				**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 12

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Nicholson Street East-West Street: Culver Boulevard
Scenario: Existing (2015) Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 1	SB --		0	NB -- 1	SB --	0
	EB -- 0	WB --		0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	10	0	**10**	43	0	43
	Left-Through		1			1	
	Through	0	0	10	3	0	**46**
	Through-Right		0			0	
	Right	831	1	0	364	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	4	0	4	1	0	**1**
	Left-Through		0			0	
	Through	0	0	**5**	1	0	2
	Through-Right		0			0	
	Right	1	0	0	0	0	0
	Left-Through-Right		1			1	
	Left-Right		0			0	
EASTBOUND	Left	1	1	1	2	1	2
	Left-Through		0			0	
	Through	1428	1	**722**	546	1	**294**
	Through-Right		1			1	
	Right	15	0	15	42	0	42
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	335	1	**335**	939	1	**939**
	Left-Through		0			0	
	Through	500	1	251	1392	1	697
	Through-Right		1			1	
	Right	2	0	2	2	0	2
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	15		*North-South:*	47
			East-West:	1057		*East-West:*	1233
			SUM:	1072		*SUM:*	1280
VOLUME/CAPACITY *(V/C)* RATIO:				0.752			0.898
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.652**			**0.798**
LEVEL OF SERVICE (LOS):				**B**			**C**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 13

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Jefferson Boulevard East-West Street: Culver Boulevard
Scenario: Existing (2015) Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			2			2
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	334	2	**184**	995	2	**547**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	5	1	5	7	1	7
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	1969	2	**985**	773	2	387
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	72	0	**72**	72	0	72
	Left-Through		1			1	
	Through	477	1	455	1347	1	**818**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	184		*North-South:*	547
			East-West:	1057		*East-West:*	818
			SUM:	1241		*SUM:*	1365
	VOLUME/CAPACITY *(V/C)* RATIO:			0.827			0.910
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.727**			**0.810**
	LEVEL OF SERVICE (LOS):			**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 14

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 EB Ramps East-West Street: Culver Boulevard
Scenario: Existing (2015) Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0		NB -- 0	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	115	1	**115**	100	1	**100**
	Left-Through		0			0	
	Through	0	1	0	4	1	4
	Through-Right		1			1	
	Right	35	0	35	59	0	59
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	1770	3	**590**	725	3	242
	Through-Right		0			0	
	Right	989	2	544	323	2	178
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	99	1	**99**	301	1	301
	Left-Through		0			0	
	Through	565	2	283	1490	2	**745**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	115		*North-South:*	100
			East-West:	689		*East-West:*	745
			SUM:	804		*SUM:*	845
VOLUME/CAPACITY *(V/C)* RATIO:				0.536			0.563
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.436**			**0.463**
LEVEL OF SERVICE (LOS):				**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 15

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 WB Ramps East-West Street: Culver Boulevard
Scenario: Existing (2015) Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				1			1
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	180	1	99	278	1	153
	Left-Through		1			1	
	Through	294	0	**416**	232	0	**277**
	Through-Right		1			1	
	Right	122	0	122	45	0	45
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	81	1	**81**	155	1	155
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	149	1	0	517	1	**416**
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	498	1	**498**	202	1	**202**
	Left-Through		0			0	
	Through	1383	2	692	620	2	310
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	324	2	162	984	2	**492**
	Through-Right		0			0	
	Right	324	1	**284**	257	1	180
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	497		*North-South:*	693
			East-West:	782		*East-West:*	694
			SUM:	1279		*SUM:*	1387
VOLUME/CAPACITY *(V/C)* RATIO:				0.898			0.973
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.798**			**0.873**
LEVEL OF SERVICE (LOS):				**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 16

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 EB Ramps East-West Street: Mindanao Way
Scenario: Existing (2015) Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 2	WB --		0	EB -- 2	WB --	0
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	17	1	17	22	1	22
	Left-Through		0			0	
	Through	1096	1	**553**	1050	1	**531**
	Through-Right		1			1	
	Right	9	0	9	12	0	12
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	472	1	**408**	441	1	**394**
	Through-Right		1			1	
	Right	753	1	0	741	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	471	2	**259**	673	2	**370**
	Left-Through		0			0	
	Through	892	2	446	1077	2	539
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	553		*North-South:*	531
			East-West:	667		*East-West:*	764
			SUM:	1220		*SUM:*	1295
VOLUME/CAPACITY *(V/C)* RATIO:				0.856			0.909
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.756**			**0.809**
LEVEL OF SERVICE (LOS):				**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 17

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 WB Ramps East-West Street: Mindanao Way
Scenario: Existing (2015) Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0		NB -- 0	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

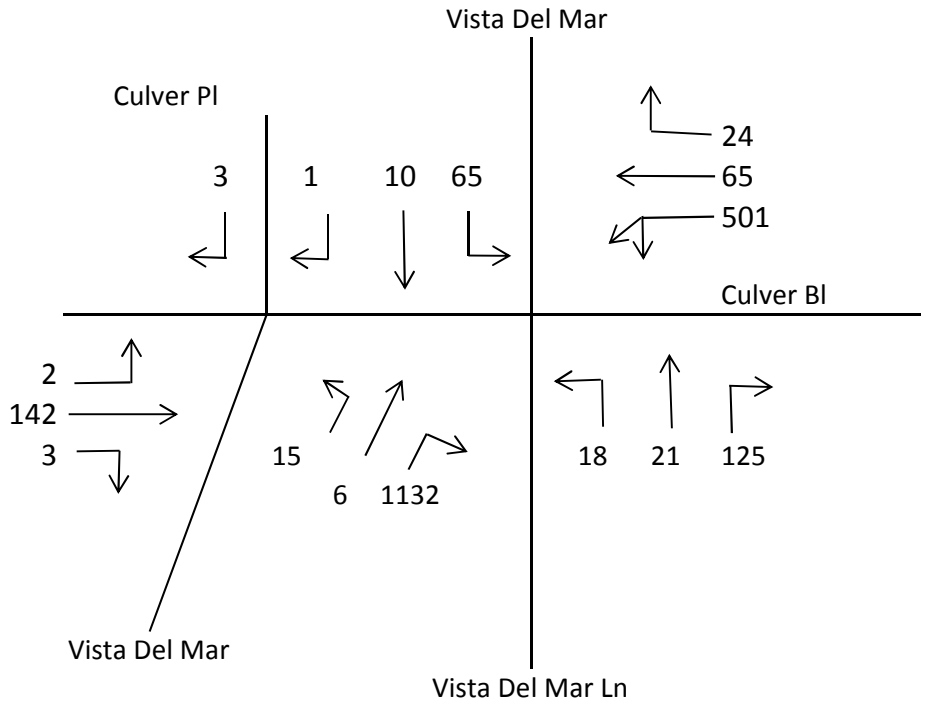
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	524	1	524	556	1	**502**
	Left-Through		1			1	
	Through	1356	1	**678**	950	1	502
	Through-Right		0			0	
	Right	576	1	576	397	1	397
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	**0**	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	30	1	**30**	14	1	**14**
	Left-Through		0			0	
	Through	494	2	247	441	2	221
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	717	2	**249**	1225	2	**423**
	Through-Right		1			1	
	Right	30	0	30	43	0	43
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	678		*North-South:*	502
			East-West:	279		*East-West:*	437
			SUM:	957		*SUM:*	939
VOLUME/CAPACITY *(V/C)* RATIO:				0.672			0.659
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.572**			**0.559**
LEVEL OF SERVICE (LOS):				**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

CMA METHODOLOGY
EXISTING (2015) CONDITIONS
AM PEAK HOUR

Int#18 - Vista Del Mar/Vista Del Mar Lane & Culver Boulevard



1. 501 x 0.55 or (65 + 24)

2. (15 + 6 + 1132) x 0.55

3. $\frac{(2 + 142 + 3)}{2}$

4. 65 + (18 + 21 + 125) or 18 + (65 + 10 + 1)

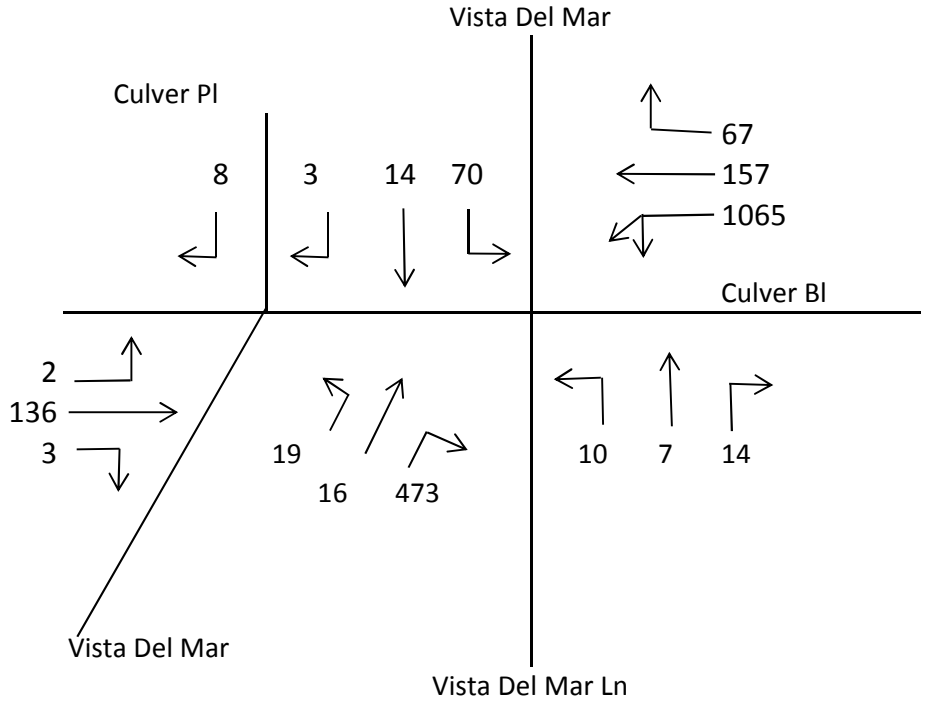
Critical Volumes = 276 + 634 + 74 + 229 = 1213

V/C = $\frac{1213}{1375}$ =

= 0.882 - 0.10 = 0.782 LOS C
ATSAC/ATCS

CMA METHODOLOGY
EXISTING (2015) CONDITIONS
PM PEAK HOUR

Int#18 - Vista Del Mar/Vista Del Mar Lane & Culver Boulevard



1. 1065 x 0.55 or (157 + 67)

2. (19 + 16 + 473) x 0.55

3. $\frac{(1 + 136 + 3)}{2}$

4. 70 + (10 + 7 + 14) or 10 + (70 + 14 + 3)

Critical Volumes = 586 + 279 + 70 + 101 = 1036

V/C = $\frac{1036}{1375}$ =

= 0.753 - 0.10 = 0.653 LOS B
ATSAC/ATCS

APPENDIX D

Level of Service Worksheets

Existing (2015) plus Project Conditions

Level of Service Worksheet
(Circular 212 Method)

I/S #:	PROJECT TITLE:	Ballona Wetlands Restortation Project			
1	North-South Street:	Admiralty Way	East-West Street:	Bali Way	
	Scenario:	Existing (2015) Plus Project Conditions			
	Count Date:		Analyst:	RA	Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?		NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	24	1	24	21	1	21
	Left-Through		0			0	
	Through	1143	1	**586**	974	1	**544**
	Through-Right		1			1	
	Right	28	0	28	113	0	113
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	228	1	**228**	268	1	**268**
	Left-Through		0			0	
	Through	1119	1	569	1332	1	678
	Through-Right		1			1	
	Right	18	0	18	23	0	23
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	13	0	**13**	15	0	**15**
	Left-Through		1			1	
	Through	18	0	30	48	0	50
	Through-Right		1			1	
	Right	15	0	30	22	0	50
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	22	1	22	24	1	24
	Left-Through		0			0	
	Through	41	0	**194**	37	0	**210**
	Through-Right		1			1	
	Right	346	1	0	382	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	814		*North-South:*	812
			East-West:	207		*East-West:*	225
			SUM:	1021		*SUM:*	1037
VOLUME/CAPACITY *(V/C)* RATIO:				0.716			0.728
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.616**			**0.628**
LEVEL OF SERVICE (LOS):				**B**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 2

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Admiralty Way East-West Street: Mindanao Way
Scenario: Existing (2015) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				2			2
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	29	1	29	17	1	17
	Left-Through		0			0	
	Through	773	1	**413**	594	1	**368**
	Through-Right		1			1	
	Right	53	0	53	141	0	141
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	446	1	**446**	381	1	**381**
	Left-Through		0			0	
	Through	614	1	316	1000	1	508
	Through-Right		1			1	
	Right	17	0	17	15	0	15
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	19	1	19	19	1	19
	Left-Through		0			0	
	Through	54	0	**75**	44	0	**61**
	Through-Right		1			1	
	Right	21	0	0	17	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	156	1	**121**	262	1	**143**
	Left-Through		1			1	
	Through	85	0	121	23	0	143
	Through-Right		0			0	
	Right	426	1	0	437	1	56
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	859		*North-South:*	749
			East-West:	196		*East-West:*	204
			SUM:	1055		*SUM:*	953
VOLUME/CAPACITY *(V/C)* RATIO:				0.767			0.693
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.667**			**0.593**
LEVEL OF SERVICE (LOS):				**B**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 3

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Admiralty Way East-West Street: Fiji Way
Scenario: Existing (2015) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	627	2	**345**	906	2	**498**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	75	1	33	120	1	97
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	84	1	**84**	47	1	**47**
	Left-Through		0			0	
	Through	114	2	57	157	2	79
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	94	1	94	139	1	**139**
	Through-Right		0			0	
	Right	744	1	**399**	459	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	345		*North-South:*	498
			East-West:	483		*East-West:*	186
			SUM:	828		*SUM:*	684
VOLUME/CAPACITY *(V/C)* RATIO:				0.552			0.456
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.452**			**0.356**
LEVEL OF SERVICE (LOS):				**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 4

PROJECT TITLE: Ballona Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Washington Boulevard
Scenario: Existing (2015) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			4			4
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 3	WB --	3	EB -- 3	WB --	3
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	624	2	**343**	437	2	**240**
	Left-Through		0			0	
	Through	1446	2	515	1178	2	458
	Through-Right		1			1	
	Right	100	0	100	197	0	197
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	222	2	122	176	2	97
	Left-Through		0			0	
	Through	1395	2	**502**	1404	2	**504**
	Through-Right		1			1	
	Right	112	0	112	108	0	108
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	78	2	43	102	2	56
	Left-Through		0			0	
	Through	749	2	**375**	674	2	**337**
	Through-Right		0			0	
	Right	523	1	180	501	1	261
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	127	2	**70**	247	2	**136**
	Left-Through		0			0	
	Through	682	2	341	754	2	377
	Through-Right		0			0	
	Right	181	1	59	226	1	129
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	845		*North-South:*	744
			East-West:	445		*East-West:*	473
			SUM:	1290		*SUM:*	1217
	VOLUME/CAPACITY *(V/C)* RATIO:			0.938			0.885
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.838**			**0.785**
	LEVEL OF SERVICE (LOS):			**D**			**C**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 5

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Marina Expressway (SR-90)
Scenario: Existing (2015) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 0	WB --		3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	1352	2	**524**	1361	2	**551**
	Through-Right		1			1	
	Right	221	0	221	292	0	292
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	869	2	**478**	825	2	**454**
	Left-Through		0			0	
	Through	1325	3	442	1582	3	527
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	**0**	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	201	2	111	188	2	**103**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	1163	2	**162**	799	2	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1002		*North-South:*	1005
			East-West:	162		*East-West:*	103
			SUM:	1164		*SUM:*	1108
VOLUME/CAPACITY *(V/C)* RATIO:				0.817			0.778
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.717**			**0.678**
LEVEL OF SERVICE (LOS):				**C**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 6

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Bali Way
Scenario: Existing (2015) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/205

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			2			2
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	197	1	**197**	116	1	**116**
	Left-Through		0			0	
	Through	1334	2	452	1261	2	423
	Through-Right		1			1	
	Right	23	0	23	9	0	9
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	27	1	27	40	1	40
	Left-Through		0			0	
	Through	1300	2	**519**	1493	2	**597**
	Through-Right		1			1	
	Right	258	0	258	299	0	299
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	210	1	**106**	327	1	**165**
	Left-Through		1			1	
	Through	1	0	106	3	0	165
	Through-Right		0			0	
	Right	59	1	0	107	1	49
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	3	0	3	9	0	9
	Left-Through		0			0	
	Through	1	0	**15**	2	0	**20**
	Through-Right		0			0	
	Right	11	0	0	9	0	0
	Left-Through-Right		1			1	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	716		*North-South:*	713
			East-West:	121		*East-West:*	185
			SUM:	837		*SUM:*	898
VOLUME/CAPACITY *(V/C)* RATIO:				0.609			0.653
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.509**			**0.553**
LEVEL OF SERVICE (LOS):				**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 7

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Mindanao Way
Scenario: Existing (2015) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	0		NB -- 3	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	185	1	185	94	1	94
	Left-Through		0			0	
	Through	1528	3	**509**	1238	3	**413**
	Through-Right		0			0	
	Right	427	1	275	331	1	88
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	155	1	**155**	211	1	**211**
	Left-Through		0			0	
	Through	1102	2	380	1472	2	510
	Through-Right		1			1	
	Right	39	0	39	57	0	57
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	548	1	**298**	515	1	**350**
	Through-Right		1			1	
	Right	48	0	48	184	0	184
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	276	2	**152**	442	2	**243**
	Left-Through		0			0	
	Through	436	1	273	542	1	310
	Through-Right		1			1	
	Right	110	0	110	78	0	78
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	664		*North-South:*	624
			East-West:	450		*East-West:*	593
			SUM:	1114		*SUM:*	1217
VOLUME/CAPACITY *(V/C)* RATIO:				0.810			0.885
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.710**			**0.785**
LEVEL OF SERVICE (LOS):				**C**			**C**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 8

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Fiji Way
Scenario: Existing (2015) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0		NB -- 0	SB --	0
	EB -- 1	WB --	0		EB -- 1	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	842	2	**463**	636	2	**350**
	Left-Through		0			0	
	Through	1966	2	667	1557	2	531
	Through-Right		1			1	
	Right	36	0	36	37	0	37
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	50	1	50	45	1	45
	Left-Through		0			0	
	Through	1326	2	**466**	1983	2	**692**
	Through-Right		1			1	
	Right	73	0	73	94	0	94
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	69	1	**69**	85	1	**85**
	Left-Through		0			0	
	Through	16	1	16	24	1	24
	Through-Right		0			0	
	Right	545	1	0	901	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	30	0	30	50	0	50
	Left-Through		1			1	
	Through	10	0	**43**	27	0	**54**
	Through-Right		1			1	
	Right	33	0	0	27	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	929		*North-South:*	1042
			East-West:	112		*East-West:*	139
			SUM:	1041		*SUM:*	1181
VOLUME/CAPACITY *(V/C)* RATIO:				0.731			0.829
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.631**			**0.729**
LEVEL OF SERVICE (LOS):				**B**			**C**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 9

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Culver Loop
Scenario: Existing (2015) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			2			2
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	2543	2	**1196**	1903	2	**795**
	Through-Right		1			1	
	Right	1045	0	1045	481	0	481
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	1942	2	971	2897	2	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	297	2	**163**	296	2	**163**
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	1196		*North-South:*	795
			East-West:	163		*East-West:*	163
			SUM:	1359		*SUM:*	958
	VOLUME/CAPACITY *(V/C)* RATIO:			0.906			0.639
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.806**			**0.539**
	LEVEL OF SERVICE (LOS):			**D**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 10

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Jefferson Boulevard
Scenario: Existing (2015) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	3	NB -- 3	SB --	3
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	14	1	14	31	1	31
	Left-Through		0			0	
	Through	2874	4	**719**	1563	4	**391**
	Through-Right		0			0	
	Right	484	1	309	306	1	43
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	444	2	**244**	515	2	**283**
	Left-Through		0			0	
	Through	1082	4	271	1748	4	437
	Through-Right		0			0	
	Right	177	1	0	663	1	576
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	184	1	**184**	87	1	87
	Left-Through		0			0	
	Through	288	2	109	172	2	**81**
	Through-Right		1			1	
	Right	38	0	38	71	0	71
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	318	2	175	478	2	**263**
	Left-Through		0			0	
	Through	111	2	56	339	2	170
	Through-Right		0			0	
	Right	711	2	**147**	742	2	125
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	963		*North-South:*	674
			East-West:	331		*East-West:*	344
			SUM:	1294		*SUM:*	1018
VOLUME/CAPACITY *(V/C)* RATIO:				0.941			0.740
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.841**			**0.640**
LEVEL OF SERVICE (LOS):				**D**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 11

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Bluff Creek Drive
Scenario: Existing (2015) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	0	NB -- 3	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	3154	4	**789**	2088	4	522
	Through-Right		0			0	
	Right	545	1	438	239	1	164
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	42	2	**23**	53	2	29
	Left-Through		0			0	
	Through	1373	4	343	2321	4	**580**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	194	2	**107**	137	2	**75**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	35	1	12	46	1	17
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	812		*North-South:*	580
			East-West:	107		*East-West:*	75
			SUM:	919		*SUM:*	655
VOLUME/CAPACITY *(V/C)* RATIO:				0.645			0.460
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.545**			**0.360**
LEVEL OF SERVICE (LOS):				**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 12

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Nicholson Street East-West Street: Culver Boulevard
Scenario: Existing (2015) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 1	SB --	0	NB -- 1	SB --	0
	EB -- 0	WB --	0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	10	0	**10**	43	0	43
	Left-Through		1			1	
	Through	0	0	10	3	0	**46**
	Through-Right		0			0	
	Right	831	1	0	365	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	4	0	4	1	0	**1**
	Left-Through		0			0	
	Through	0	0	**5**	1	0	2
	Through-Right		0			0	
	Right	1	0	0	0	0	0
	Left-Through-Right		1			1	
	Left-Right		0			0	
EASTBOUND	Left	1	1	1	2	1	2
	Left-Through		0			0	
	Through	1429	1	**722**	550	1	**296**
	Through-Right		1			1	
	Right	15	0	15	42	0	42
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	335	1	**335**	940	1	**940**
	Left-Through		0			0	
	Through	501	1	252	1397	1	700
	Through-Right		1			1	
	Right	2	0	2	2	0	2
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	15		*North-South:*	47
			East-West:	1057		*East-West:*	1236
			SUM:	1072		*SUM:*	1283
VOLUME/CAPACITY *(V/C)* RATIO:				0.752			0.900
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.652**			**0.800**
LEVEL OF SERVICE (LOS):				**B**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 13

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Jefferson Boulevard East-West Street: Culver Boulevard
Scenario: Existing (2015) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	335	2	**184**	1000	2	**550**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	5	1	5	7	1	7
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	1969	2	**985**	774	2	387
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	72	0	**72**	72	0	72
	Left-Through		1			1	
	Through	477	1	455	1348	1	**818**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	184		*North-South:*	550
			East-West:	1057		*East-West:*	818
			SUM:	1241		*SUM:*	1368
VOLUME/CAPACITY *(V/C)* RATIO:				0.827			0.912
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.727**			**0.812**
LEVEL OF SERVICE (LOS):				**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 14

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 EB Ramps East-West Street: Culver Boulevard
Scenario: Existing (2015) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/205

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	115	1	**115**	102	1	**102**
	Left-Through		0			0	
	Through	0	1	0	4	1	4
	Through-Right		1			1	
	Right	35	0	35	59	0	59
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	1770	3	**590**	725	3	242
	Through-Right		0			0	
	Right	989	2	544	324	2	178
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	99	1	**99**	301	1	301
	Left-Through		0			0	
	Through	566	2	283	1494	2	**747**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	115		*North-South:*	102
			East-West:	689		*East-West:*	747
			SUM:	804		*SUM:*	849
VOLUME/CAPACITY *(V/C)* RATIO:				0.536			0.566
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.436**			**0.466**
LEVEL OF SERVICE (LOS):				**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 15

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 WB Ramps East-West Street: Culver Boulevard
Scenario: Existing (2015) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			1			1
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	180	1	99	279	1	153
	Left-Through		1			1	
	Through	294	0	**416**	232	0	**277**
	Through-Right		1			1	
	Right	122	0	122	45	0	45
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	81	1	**81**	155	1	155
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	149	1	0	517	1	**416**
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	498	1	**498**	202	1	**202**
	Left-Through		0			0	
	Through	1383	2	692	622	2	311
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	325	2	163	987	2	**494**
	Through-Right		0			0	
	Right	324	1	**284**	257	1	180
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	497		*North-South:*	693
			East-West:	782		*East-West:*	696
			SUM:	1279		*SUM:*	1389
	VOLUME/CAPACITY *(V/C)* RATIO:			0.898			0.975
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.798**			**0.875**
	LEVEL OF SERVICE (LOS):			**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 16

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 EB Ramps East-West Street: Mindanao Way
Scenario: Existing (2015) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 2	WB --		0	EB -- 2	WB --	0
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	17	1	17	22	1	22
	Left-Through		0			0	
	Through	1096	1	**553**	1050	1	**531**
	Through-Right		1			1	
	Right	9	0	9	12	0	12
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	472	1	**409**	443	1	**396**
	Through-Right		1			1	
	Right	754	1	0	746	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	471	2	**259**	673	2	**370**
	Left-Through		0			0	
	Through	894	2	447	1084	2	542
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	553		*North-South:*	531
			East-West:	668		*East-West:*	766
			SUM:	1221		*SUM:*	1297
VOLUME/CAPACITY *(V/C)* RATIO:				0.857			0.910
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.757**			**0.810**
LEVEL OF SERVICE (LOS):				**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 17

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 WB Ramps East-West Street: Mindanao Way
Scenario: Existing (2015) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0		NB -- 0	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

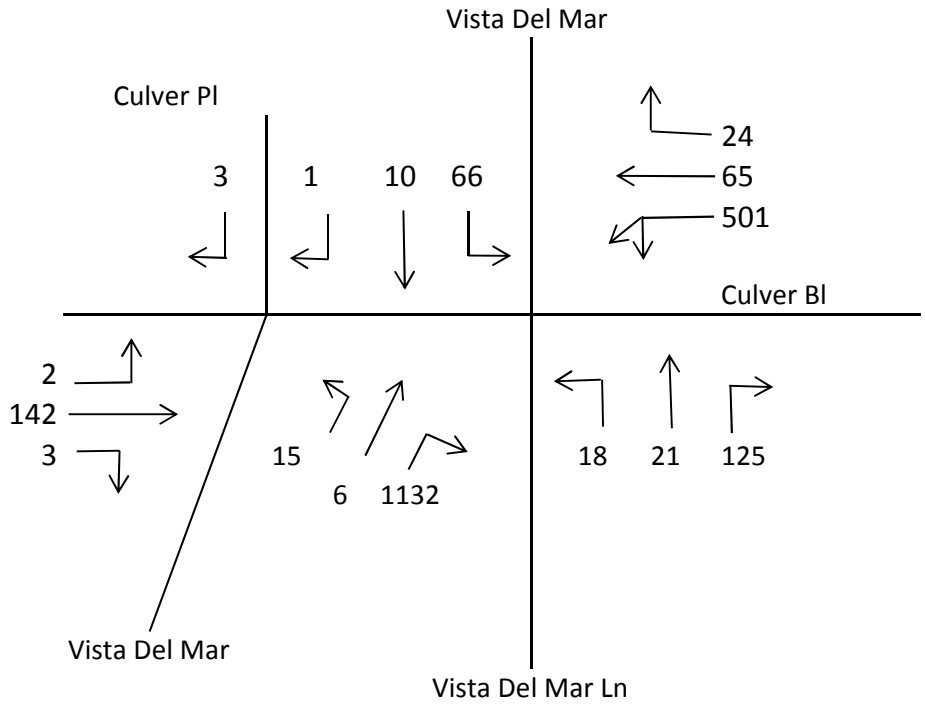
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	525	1	525	560	1	**503**
	Left-Through		1			1	
	Through	1356	1	**678**	950	1	503
	Through-Right		0			0	
	Right	576	1	576	397	1	397
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	**0**	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	30	1	**30**	14	1	**14**
	Left-Through		0			0	
	Through	494	2	247	443	2	222
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	718	2	**249**	1228	2	**424**
	Through-Right		1			1	
	Right	30	0	30	43	0	43
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	678		*North-South:*	503
			East-West:	279		*East-West:*	438
			SUM:	957		*SUM:*	941
VOLUME/CAPACITY *(V/C)* RATIO:				0.672			0.660
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.572**			**0.560**
LEVEL OF SERVICE (LOS):				**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

CMA METHODOLOGY
EXISTING (2015) PLUS PROJECT CONDITIONS
AM PEAK HOUR

Int#18 - Vista Del Mar/Vista Del Mar Lane & Culver Boulevard



1. 501 x 0.55 or (65 + 24)

2. (15 + 6 + 1132) x 0.55

3. $\frac{(2 + 142 + 3)}{2}$

4. 66 + (18 + 21 + 125) or 18 + (66 + 10 + 1)

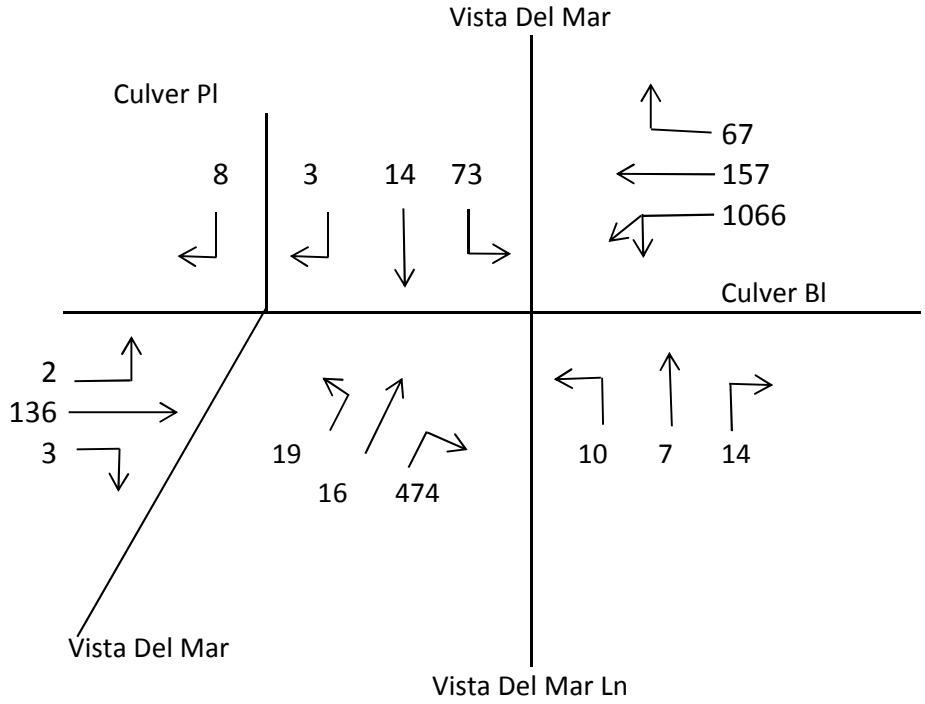
Critical Volumes = 276 + 634 + 74 + 230 = 1214

V/C = $\frac{1214}{1375}$ =

= 0.883 - 0.10 = 0.783 LOS C
ATSAC/ATCS

CMA METHODOLOGY
EXISTING (2015) PLUS PROJECT CONDITIONS
PM PEAK HOUR

Int#18 - Vista Del Mar/Vista Del Mar Lane & Culver Boulevard



1. 1066 x 0.55 or (157 + 67)

2. (19 + 16 + 474) x 0.55

3. $\frac{(2 + 136 + 3)}{2}$

4. 73 + (10 + 7 + 14) or 10 + (73 + 14 + 3)

Critical Volumes = 586 + 280 + 71 + 104 = 1041

V/C = $\frac{1041}{1375}$ =

= 0.757 - 0.10 = 0.657 LOS B
ATSAC/ATCS

APPENDIX E

Level of Service Worksheets

Cumulative (2023) Base Conditions

Level of Service Worksheet
(Circular 212 Method)

I/S #:	PROJECT TITLE:	Ballona Wetlands Restortation Project			
1	North-South Street:	Admiralty Way	East-West Street:	Bali Way	
	Scenario:	Cumulative (2023) Base Conditions			
	Count Date:		Analyst:	RA	Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	3	EB -- 0	WB --	3
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	25	1	25	25	1	25
	Left-Through		0			0	
	Through	1213	1	**621**	1091	1	**605**
	Through-Right		1			1	
	Right	29	0	29	119	0	119
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	239	1	**239**	283	1	**283**
	Left-Through		0			0	
	Through	1232	1	626	1438	1	731
	Through-Right		1			1	
	Right	19	0	19	24	0	24
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	14	0	**14**	16	0	**16**
	Left-Through		1			1	
	Through	19	0	32	51	0	55
	Through-Right		1			1	
	Right	16	0	32	27	0	55
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	23	1	23	25	1	25
	Left-Through		0			0	
	Through	43	0	**204**	40	0	**224**
	Through-Right		1			1	
	Right	364	1	0	407	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	860		*North-South:*	888
			East-West:	218		*East-West:*	240
			SUM:	1078		*SUM:*	1128
	VOLUME/CAPACITY *(V/C)* RATIO:			0.756			0.792
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.656**			**0.692**
	LEVEL OF SERVICE (LOS):			**B**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 2

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Admiralty Way East-West Street: Mindanao Way
Scenario: Cumulative (2023) Base Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				2			2
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	30	1	30	18	1	18
	Left-Through		0			0	
	Through	821	1	**438**	686	1	**414**
	Through-Right		1			1	
	Right	54	0	54	142	0	142
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	470	1	**470**	406	1	**406**
	Left-Through		0			0	
	Through	701	1	360	1087	1	552
	Through-Right		1			1	
	Right	18	0	18	16	0	16
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	20	1	20	20	1	20
	Left-Through		0			0	
	Through	57	0	**79**	46	0	**68**
	Through-Right		1			1	
	Right	22	0	0	22	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	161	1	**125**	268	1	**146**
	Left-Through		1			1	
	Through	89	0	125	24	0	146
	Through-Right		0			0	
	Right	451	1	0	467	1	61
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	908		*North-South:*	820
			East-West:	204		*East-West:*	214
			SUM:	1112		*SUM:*	1034
VOLUME/CAPACITY *(V/C)* RATIO:				0.809			0.752
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.709**			**0.652**
LEVEL OF SERVICE (LOS):				**C**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 3

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Admiralty Way East-West Street: Fiji Way
Scenario: Cumulative (2023) Base Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			2			2
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	3	EB -- 0	WB --	3
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	695	2	**382**	995	2	**547**
	Left-Through		0			0	
	Through	20	0	0	0	0	0
	Through-Right		0			0	
	Right	76	1	33	116	1	96
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	86	1	**86**	41	1	**41**
	Left-Through		0			0	
	Through	117	2	59	159	2	80
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	94	1	94	126	1	**126**
	Through-Right		0			0	
	Right	791	1	**409**	546	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	382		*North-South:*	547
			East-West:	495		*East-West:*	167
			SUM:	877		*SUM:*	714
	VOLUME/CAPACITY *(V/C)* RATIO:			0.585			0.476
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.485**			**0.376**
	LEVEL OF SERVICE (LOS):			**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 4

PROJECT TITLE: Ballona Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Washington Boulevard
Scenario: Cumulative (2023) Base Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			4			4
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 3	WB --	3	EB -- 3	WB --	3
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	665	2	**366**	499	2	**274**
	Left-Through		0			0	
	Through	1618	2	577	1409	2	544
	Through-Right		1			1	
	Right	114	0	114	223	0	223
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	264	2	145	223	2	123
	Left-Through		0			0	
	Through	1612	2	**578**	1588	2	**570**
	Through-Right		1			1	
	Right	122	0	122	123	0	123
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	89	2	49	113	2	62
	Left-Through		0			0	
	Through	810	2	**405**	742	2	**371**
	Through-Right		0			0	
	Right	587	1	221	548	1	274
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	140	2	**77**	275	2	**151**
	Left-Through		0			0	
	Through	730	2	365	831	2	416
	Through-Right		0			0	
	Right	198	1	53	268	1	145
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	944		*North-South:*	844
			East-West:	482		*East-West:*	522
			SUM:	1426		*SUM:*	1366
	VOLUME/CAPACITY *(V/C)* RATIO:			1.037			0.993
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.937**			**0.893**
	LEVEL OF SERVICE (LOS):			**E**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 5

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Marina Expressway (SR-90)
Scenario: Cumulative (2023) Base Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	1523	2	**585**	1627	2	**645**
	Through-Right		1			1	
	Right	231	0	231	307	0	307
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	1005	2	**553**	919	2	**505**
	Left-Through		0			0	
	Through	1568	3	523	1821	3	607
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	**0**	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	223	2	123	237	2	**130**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	1251	2	**135**	946	2	15
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1138		*North-South:*	1150
			East-West:	135		*East-West:*	130
			SUM:	1273		*SUM:*	1280
VOLUME/CAPACITY *(V/C)* RATIO:				0.893			0.898
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.793**			**0.798**
LEVEL OF SERVICE (LOS):				**C**			**C**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 6

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Bali Way
Scenario: Cumulative (2023) Base Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			4			4
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			2			2
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	207	1	**207**	126	1	**126**
	Left-Through		0			0	
	Through	1492	2	505	1505	2	506
	Through-Right		1			1	
	Right	24	0	24	13	0	13
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	40	1	40	59	1	59
	Left-Through		0			0	
	Through	1552	2	**608**	1731	2	**683**
	Through-Right		1			1	
	Right	272	0	272	317	0	317
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	220	1	**111**	344	1	**174**
	Left-Through		1			1	
	Through	1	0	111	3	0	174
	Through-Right		0			0	
	Right	62	1	0	114	1	51
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	3	0	3	15	0	15
	Left-Through		0			0	
	Through	1	0	**16**	2	0	**26**
	Through-Right		0			0	
	Right	12	0	0	9	0	0
	Left-Through-Right		1			1	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	815		*North-South:*	809
			East-West:	127		*East-West:*	200
			SUM:	942		*SUM:*	1009
	VOLUME/CAPACITY *(V/C)* RATIO:			0.685			0.734
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.585**			**0.634**
	LEVEL OF SERVICE (LOS):			**A**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 7

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Mindanao Way
Scenario: Cumulative (2023) Base Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	0		NB -- 3	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	195	1	195	101	1	101
	Left-Through		0			0	
	Through	1696	3	**565**	1489	3	**496**
	Through-Right		0			0	
	Right	451	1	288	368	1	106
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	178	1	**178**	241	1	**241**
	Left-Through		0			0	
	Through	1326	2	456	1684	2	581
	Through-Right		1			1	
	Right	41	0	41	60	0	60
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	575	1	**313**	541	1	**368**
	Through-Right		1			1	
	Right	50	0	50	194	0	194
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	297	2	**163**	477	2	**262**
	Left-Through		0			0	
	Through	458	1	287	568	1	325
	Through-Right		1			1	
	Right	115	0	115	82	0	82
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	743		*North-South:*	737
			East-West:	476		*East-West:*	630
			SUM:	1219		*SUM:*	1367
VOLUME/CAPACITY *(V/C)* RATIO:				0.887			0.994
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.787**			**0.894**
LEVEL OF SERVICE (LOS):				**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 8

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Fiji Way
Scenario: Cumulative (2023) Base Conditions
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 1	WB --	0	EB -- 1	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	890	2	**490**	719	2	**395**
	Left-Through		0			0	
	Through	2160	2	733	1851	2	630
	Through-Right		1			1	
	Right	38	0	38	39	0	39
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	52	1	52	47	1	47
	Left-Through		0			0	
	Through	1571	2	**549**	2240	2	**778**
	Through-Right		1			1	
	Right	75	0	75	93	0	93
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	71	1	**71**	85	1	**85**
	Left-Through		0			0	
	Through	17	1	17	25	1	25
	Through-Right		0			0	
	Right	628	1	0	989	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	31	0	31	53	0	53
	Left-Through		1			1	
	Through	10	0	**45**	28	0	**56**
	Through-Right		1			1	
	Right	35	0	0	28	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1039		*North-South:*	1173
			East-West:	116		*East-West:*	141
			SUM:	1155		*SUM:*	1314
VOLUME/CAPACITY *(V/C)* RATIO:				0.811			0.922
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.711**			**0.822**
LEVEL OF SERVICE (LOS):				**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 9

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Culver Loop
Scenario: Cumulative (2023) Base Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0		NB -- 0	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	2774	2	**1294**	2268	2	**936**
	Through-Right		1			1	
	Right	1107	0	1107	539	0	539
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	2273	2	1137	3242	2	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	310	2	**171**	308	2	**169**
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1294		*North-South:*	936
			East-West:	171		*East-West:*	169
			SUM:	1465		*SUM:*	1105
VOLUME/CAPACITY *(V/C)* RATIO:				0.977			0.737
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.877**			**0.637**
LEVEL OF SERVICE (LOS):				**D**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 10

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Jefferson Boulevard
Scenario: Cumulative (2023) Base Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	3		NB -- 3	SB --	3
	EB -- 0	WB --	3		EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	18	1	18	41	1	41
	Left-Through		0			0	
	Through	3042	4	**761**	1789	4	**447**
	Through-Right		0			0	
	Right	645	1	436	361	1	29
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	550	2	**303**	677	2	**372**
	Left-Through		0			0	
	Through	1285	4	321	1896	4	474
	Through-Right		0			0	
	Right	195	1	0	704	1	604
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	198	1	198	100	1	100
	Left-Through		0			0	
	Through	410	2	**153**	261	2	**116**
	Through-Right		1			1	
	Right	50	0	50	88	0	88
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	380	2	**209**	603	2	**332**
	Left-Through		0			0	
	Through	180	2	90	498	2	249
	Through-Right		0			0	
	Right	832	2	155	962	2	157
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1064		*North-South:*	819
			East-West:	362		*East-West:*	448
			SUM:	1426		*SUM:*	1267
VOLUME/CAPACITY *(V/C)* RATIO:				1.037			0.921
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.937**			**0.821**
LEVEL OF SERVICE (LOS):				**E**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 11

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Bluff Creek Drive
Scenario: Cumulative (2023) Base Conditions
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	0	NB -- 3	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	3468	4	**867**	2318	4	580
	Through-Right		0			0	
	Right	802	1	613	397	1	142
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	146	2	**80**	67	2	37
	Left-Through		0			0	
	Through	1544	4	386	2602	4	**651**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	343	2	**189**	463	2	**255**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	45	1	0	78	1	41
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	947		*North-South:*	651
			East-West:	189		*East-West:*	255
			SUM:	1136		*SUM:*	906
VOLUME/CAPACITY *(V/C)* RATIO:				0.797			0.636
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.697**			**0.536**
LEVEL OF SERVICE (LOS):				B			A

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 12

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Nicholson Street East-West Street: Culver Boulevard
Scenario: Cumulative (2023) Base Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 1	SB --	0	NB -- 1	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	10	0	**10**	45	0	45
	Left-Through		1			1	
	Through	0	0	10	3	0	**48**
	Through-Right		0			0	
	Right	916	1	0	420	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	4	0	4	1	0	**1**
	Left-Through		0			0	
	Through	0	0	**5**	1	0	2
	Through-Right		0			0	
	Right	1	0	0	0	0	0
	Left-Through-Right		1			1	
	Left-Right		0			0	
EASTBOUND	Left	1	1	1	2	1	2
	Left-Through		0			0	
	Through	1576	1	**796**	652	1	**348**
	Through-Right		1			1	
	Right	16	0	16	44	0	44
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	375	1	**375**	1050	1	**1050**
	Left-Through		0			0	
	Through	588	1	295	1573	1	788
	Through-Right		1			1	
	Right	2	0	2	2	0	2
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	15		*North-South:*	49
			East-West:	1171		*East-West:*	1398
			SUM:	1186		*SUM:*	1447
	VOLUME/CAPACITY *(V/C)* RATIO:			0.832			1.015
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.732**			**0.915**
	LEVEL OF SERVICE (LOS):			**C**			**E**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 13

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Jefferson Boulevard East-West Street: Culver Boulevard
Scenario: Cumulative (2023) Base Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0		NB -- 0	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	382	2	**210**	1155	2	**635**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	25	1	0	55	1	55
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	2071	2	**1036**	835	2	418
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	127	0	**127**	138	0	138
	Left-Through		1			1	
	Through	511	1	511	1439	1	**996**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	210		*North-South:*	635
			East-West:	1163		*East-West:*	996
			SUM:	1373		*SUM:*	1631
VOLUME/CAPACITY *(V/C)* RATIO:				0.915			1.087
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.815**			**0.987**
LEVEL OF SERVICE (LOS):				**D**			**E**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 14

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 EB Ramps East-West Street: Culver Boulevard
Scenario: Cumulative (2023) Base Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0		NB -- 0	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	129	1	**129**	112	1	**112**
	Left-Through		0			0	
	Through	0	1	0	4	1	4
	Through-Right		1			1	
	Right	37	0	37	62	0	62
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	1867	3	**622**	795	3	265
	Through-Right		0			0	
	Right	1043	2	574	363	2	200
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	118	1	**118**	337	1	337
	Left-Through		0			0	
	Through	618	2	309	1605	2	**803**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	129		*North-South:*	112
			East-West:	740		*East-West:*	803
			SUM:	869		*SUM:*	915
VOLUME/CAPACITY *(V/C)* RATIO:				0.579			0.610
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.479**			**0.510**
LEVEL OF SERVICE (LOS):				**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 15

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 WB Ramps East-West Street: Culver Boulevard
Scenario: Cumulative (2023) Base Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				1			1
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0		NB -- 0	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	191	1	105	299	1	164
	Left-Through		1			1	
	Through	320	0	**448**	264	0	**311**
	Through-Right		1			1	
	Right	128	0	128	47	0	47
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	92	1	**92**	173	1	173
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	181	1	0	579	1	**465**
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	530	1	**530**	228	1	**228**
	Left-Through		0			0	
	Through	1462	2	731	676	2	338
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	352	2	176	1052	2	**526**
	Through-Right		0			0	
	Right	352	1	**306**	300	1	214
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	540		*North-South:*	776
			East-West:	836		*East-West:*	754
			SUM:	1376		*SUM:*	1530
VOLUME/CAPACITY *(V/C)* RATIO:				0.966			1.074
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.866**			**0.974**
LEVEL OF SERVICE (LOS):				D			E

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 16

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 EB Ramps East-West Street: Mindanao Way
Scenario: Cumulative (2023) Base Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 2	WB --	0	EB -- 2	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	18	1	18	23	1	23
	Left-Through		0			0	
	Through	1204	1	**607**	1129	1	**571**
	Through-Right		1			1	
	Right	9	0	9	13	0	13
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	499	1	**432**	485	1	**424**
	Through-Right		1			1	
	Right	796	1	0	788	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	512	2	**282**	722	2	**397**
	Left-Through		0			0	
	Through	945	2	473	1150	2	575
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	607		*North-South:*	571
			East-West:	714		*East-West:*	821
			SUM:	1321		*SUM:*	1392
	VOLUME/CAPACITY *(V/C)* RATIO:			0.927			0.977
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.827**			**0.877**
	LEVEL OF SERVICE (LOS):			**D**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 17

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 WB Ramps East-West Street: Mindanao Way
Scenario: Cumulative (2023) Base Conditions
Count Date: Analyst: RA Date: 6/17/205

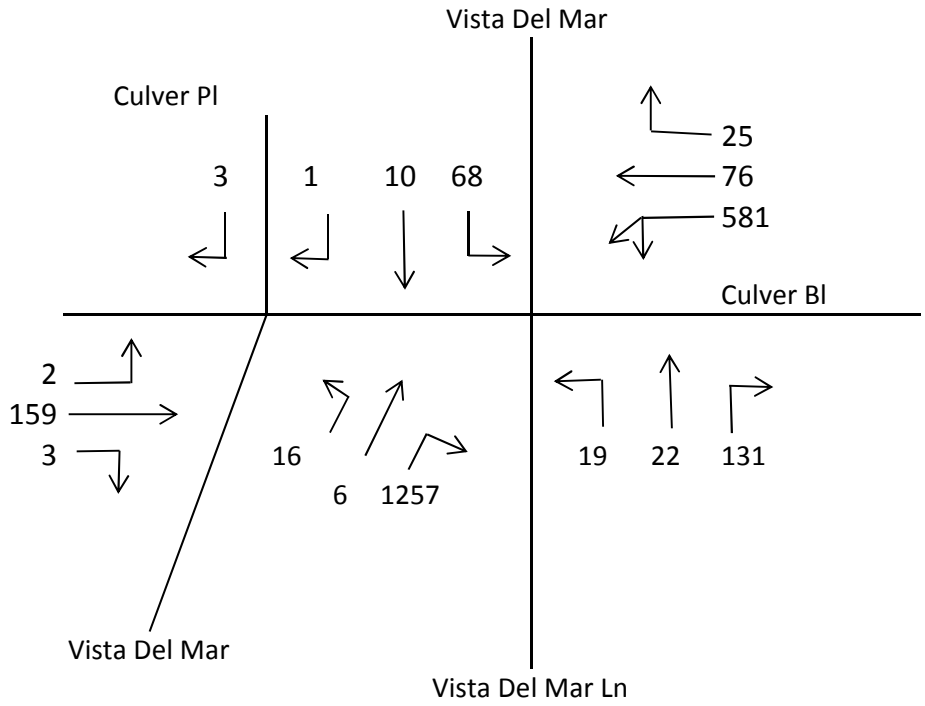
		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	548	1	548	585	1	**561**
	Left-Through		1			1	
	Through	1449	1	**725**	1099	1	561
	Through-Right		0			0	
	Right	608	1	608	443	1	443
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	**0**	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	34	1	**34**	26	1	**26**
	Left-Through		0			0	
	Through	519	2	260	474	2	237
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	781	2	**273**	1320	2	**459**
	Through-Right		1			1	
	Right	39	0	39	57	0	57
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	725		*North-South:*	561
			East-West:	307		*East-West:*	485
			SUM:	1032		*SUM:*	1046
	VOLUME/CAPACITY *(V/C)* RATIO:			0.724			0.734
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.624**			**0.634**
	LEVEL OF SERVICE (LOS):			**B**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

CMA METHODOLOGY
CUMULATIVE (2023) BASE CONDITIONS
AM PEAK HOUR

Int#18 - Vista Del Mar/Vista Del Mar Lane & Culver Boulevard



1. 581 x 0.55 or (76 + 25)

2. (16 + 6 + 1257) x 0.55

3. $\frac{(2 + 159 + 3)}{2}$

4. 68 + (19 + 22 + 131) or 19 + (68 + 10 + 1)

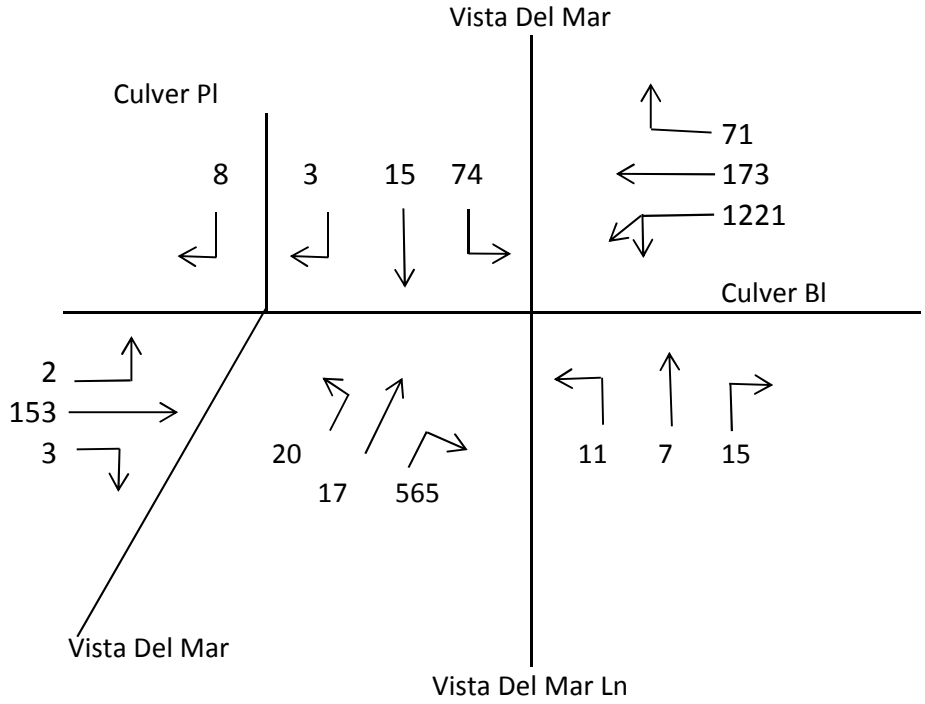
Critical Volumes = 320 + 703 + 82 + 240 = 1345

V/C = $\frac{1345}{1375}$ =

= 0.978 - 0.10 = 0.878 LOS D
ATSAC/ATCS

CMA METHODOLOGY
CUMULATIVE (2023) BASE CONDITIONS
PM PEAK HOUR

Int#18 - Vista Del Mar/Vista Del Mar Lane & Culver Boulevard



1. 1221 x 0.55 or (173 + 71)

2. (20 + 17 + 565) x 0.55

3. $\frac{(2 + 153 + 3)}{2}$

4. 74 + (11 + 7 + 15) or 11 + (74 + 15 + 3)

Critical Volumes = 672 + 331 + 79 + 107 = 1189

V/C = $\frac{1189}{1375}$ =

= 0.865 - 0.10 = 0.765 LOS C
ATSAC/ATCS

APPENDIX F

Level of Service Worksheets

Cumulative (2023) plus Project Conditions

Level of Service Worksheet
(Circular 212 Method)

I/S #:	PROJECT TITLE:	Ballona Wetlands Restortation Project			
1	North-South Street:	Admiralty Way	East-West Street:	Bali Way	
	Scenario:	Cumulative (2023) Plus Project Conditions			
	Count Date:		Analyst:	RA	Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	3	EB -- 0	WB --	3
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	25	1	25	25	1	25
	Left-Through		0			0	
	Through	1213	1	**621**	1093	1	**606**
	Through-Right		1			1	
	Right	29	0	29	119	0	119
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	239	1	**239**	283	1	**283**
	Left-Through		0			0	
	Through	1233	1	626	1441	1	733
	Through-Right		1			1	
	Right	19	0	19	24	0	24
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	14	0	**14**	16	0	**16**
	Left-Through		1			1	
	Through	19	0	32	51	0	55
	Through-Right		1			1	
	Right	16	0	32	27	0	55
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	23	1	23	25	1	25
	Left-Through		0			0	
	Through	43	0	**204**	40	0	**224**
	Through-Right		1			1	
	Right	364	1	0	407	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	860		*North-South:*	889
			East-West:	218		*East-West:*	240
			SUM:	1078		*SUM:*	1129
	VOLUME/CAPACITY *(V/C)* RATIO:			0.756			0.792
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.656**			**0.692**
	LEVEL OF SERVICE (LOS):			**B**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 2

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Admiralty Way East-West Street: Mindanao Way
Scenario: Cumulative (2023) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				2			2
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	30	1	30	18	1	18
	Left-Through		0			0	
	Through	821	1	**438**	688	1	**418**
	Through-Right		1			1	
	Right	55	0	55	148	0	148
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	470	1	**470**	406	1	**406**
	Left-Through		0			0	
	Through	702	1	360	1090	1	553
	Through-Right		1			1	
	Right	18	0	18	16	0	16
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	20	1	20	20	1	20
	Left-Through		0			0	
	Through	57	0	**79**	46	0	**68**
	Through-Right		1			1	
	Right	22	0	0	22	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	163	1	**126**	275	1	**150**
	Left-Through		1			1	
	Through	89	0	126	24	0	150
	Through-Right		0			0	
	Right	451	1	0	467	1	61
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	908		*North-South:*	824
			East-West:	205		*East-West:*	218
			SUM:	1113		*SUM:*	1042
VOLUME/CAPACITY *(V/C)* RATIO:				0.809			0.758
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.709**			**0.658**
LEVEL OF SERVICE (LOS):				**C**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 3

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Admiralty Way East-West Street: Fiji Way
Scenario: Cumulative (2023) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			2			2
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	3	EB -- 0	WB --	3
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	695	2	**382**	995	2	**547**
	Left-Through		0			0	
	Through	20	0	0	0	0	0
	Through-Right		0			0	
	Right	78	1	34	126	1	102
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	88	1	**88**	49	1	**49**
	Left-Through		0			0	
	Through	119	2	60	169	2	85
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	98	1	98	145	1	**145**
	Through-Right		0			0	
	Right	791	1	**409**	546	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	382		*North-South:*	547
			East-West:	497		*East-West:*	194
			SUM:	879		*SUM:*	741
	VOLUME/CAPACITY *(V/C)* RATIO:			0.586			0.494
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.486**			**0.394**
	LEVEL OF SERVICE (LOS):			**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 4

PROJECT TITLE: Ballona Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Washington Boulevard
Scenario: Cumulative (2023) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 3	WB --		3	EB -- 3	WB --	3
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	665	2	**366**	499	2	**274**
	Left-Through		0			0	
	Through	1619	2	578	1411	2	545
	Through-Right		1			1	
	Right	115	0	115	225	0	225
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	264	2	145	223	2	123
	Left-Through		0			0	
	Through	1613	2	**578**	1591	2	**571**
	Through-Right		1			1	
	Right	122	0	122	123	0	123
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	89	2	49	113	2	62
	Left-Through		0			0	
	Through	810	2	**405**	742	2	**371**
	Through-Right		0			0	
	Right	587	1	221	548	1	274
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	141	2	**78**	278	2	**153**
	Left-Through		0			0	
	Through	730	2	365	831	2	416
	Through-Right		0			0	
	Right	198	1	53	268	1	145
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	944		*North-South:*	845
			East-West:	483		*East-West:*	524
			SUM:	1427		*SUM:*	1369
VOLUME/CAPACITY *(V/C)* RATIO:				1.038			0.996
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.938**			**0.896**
LEVEL OF SERVICE (LOS):				**E**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 5

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Marina Expressway (SR-90)
Scenario: Cumulative (2023) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	1524	2	**585**	1632	2	**646**
	Through-Right		1			1	
	Right	231	0	231	307	0	307
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	1005	2	**553**	919	2	**505**
	Left-Through		0			0	
	Through	1569	3	523	1828	3	609
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	**0**	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	223	2	123	237	2	**130**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	1251	2	**135**	946	2	15
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1138		*North-South:*	1151
			East-West:	135		*East-West:*	130
			SUM:	1273		*SUM:*	1281
VOLUME/CAPACITY *(V/C)* RATIO:				0.893			0.899
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.793**			**0.799**
LEVEL OF SERVICE (LOS):				**C**			**C**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 6

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Bali Way
Scenario: Cumulative (2023) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				2			2
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	207	1	**207**	126	1	**126**
	Left-Through		0			0	
	Through	1493	2	506	1510	2	508
	Through-Right		1			1	
	Right	24	0	24	13	0	13
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	40	1	40	59	1	59
	Left-Through		0			0	
	Through	1553	2	**608**	1738	2	**685**
	Through-Right		1			1	
	Right	272	0	272	317	0	317
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	220	1	**111**	344	1	**174**
	Left-Through		1			1	
	Through	1	0	111	3	0	174
	Through-Right		0			0	
	Right	62	1	0	114	1	51
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	3	0	3	15	0	15
	Left-Through		0			0	
	Through	1	0	**16**	2	0	**26**
	Through-Right		0			0	
	Right	12	0	0	9	0	0
	Left-Through-Right		1			1	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	815		*North-South:*	811
			East-West:	127		*East-West:*	200
			SUM:	942		*SUM:*	1011
VOLUME/CAPACITY *(V/C)* RATIO:				0.685			0.735
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.585**			**0.635**
LEVEL OF SERVICE (LOS):				**A**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 7

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Mindanao Way
Scenario: Cumulative (2023) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			4			4
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	0	NB -- 3	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	195	1	195	101	1	101
	Left-Through		0			0	
	Through	1697	3	**566**	1494	3	**498**
	Through-Right		0			0	
	Right	451	1	288	368	1	106
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	178	1	**178**	241	1	**241**
	Left-Through		0			0	
	Through	1327	2	456	1691	2	584
	Through-Right		1			1	
	Right	41	0	41	60	0	60
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	576	1	**313**	547	1	**371**
	Through-Right		1			1	
	Right	50	0	50	194	0	194
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	297	2	**163**	477	2	**262**
	Left-Through		0			0	
	Through	460	1	288	575	1	329
	Through-Right		1			1	
	Right	115	0	115	82	0	82
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	744		*North-South:*	739
			East-West:	476		*East-West:*	633
			SUM:	1220		*SUM:*	1372
	VOLUME/CAPACITY *(V/C)* RATIO:			0.887			0.998
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.787**			**0.898**
	LEVEL OF SERVICE (LOS):			**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 8

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Fiji Way
Scenario: Cumulative (2023) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 1	WB --	0	EB -- 1	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	893	2	**491**	732	2	**403**
	Left-Through		0			0	
	Through	2160	2	733	1852	2	630
	Through-Right		1			1	
	Right	38	0	38	39	0	39
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	52	1	52	47	1	47
	Left-Through		0			0	
	Through	1571	2	**549**	2241	2	**780**
	Through-Right		1			1	
	Right	76	0	76	99	0	99
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	72	1	**72**	89	1	**89**
	Left-Through		0			0	
	Through	17	1	17	25	1	25
	Through-Right		0			0	
	Right	629	1	0	995	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	31	0	31	53	0	53
	Left-Through		1			1	
	Through	10	0	**45**	28	0	**56**
	Through-Right		1			1	
	Right	35	0	0	28	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1040		*North-South:*	1183
			East-West:	117		*East-West:*	145
			SUM:	1157		*SUM:*	1328
VOLUME/CAPACITY *(V/C)* RATIO:				0.812			0.932
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.712**			**0.832**
LEVEL OF SERVICE (LOS):				**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 9

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Culver Loop
Scenario: Cumulative (2023) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0		NB -- 0	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	2776	2	**1294**	2279	2	**939**
	Through-Right		1			1	
	Right	1107	0	1107	539	0	539
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	2274	2	1137	3250	2	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	311	2	**171**	311	2	**171**
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1294		*North-South:*	939
			East-West:	171		*East-West:*	171
			SUM:	1465		*SUM:*	1110
VOLUME/CAPACITY *(V/C)* RATIO:				0.977			0.740
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.877**			**0.640**
LEVEL OF SERVICE (LOS):				**D**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 10

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Jefferson Boulevard
Scenario: Cumulative (2023) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	3	NB -- 3	SB --	3
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	18	1	18	42	1	42
	Left-Through		0			0	
	Through	3043	4	**761**	1793	4	**448**
	Through-Right		0			0	
	Right	645	1	436	361	1	29
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	550	2	**303**	679	2	**373**
	Left-Through		0			0	
	Through	1286	4	322	1899	4	475
	Through-Right		0			0	
	Right	195	1	0	708	1	604
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	199	1	199	104	1	104
	Left-Through		0			0	
	Through	410	2	**153**	261	2	**117**
	Through-Right		1			1	
	Right	50	0	50	89	0	89
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	380	2	**209**	603	2	**332**
	Left-Through		0			0	
	Through	180	2	90	498	2	249
	Through-Right		0			0	
	Right	833	2	155	965	2	158
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1064		*North-South:*	821
			East-West:	362		*East-West:*	449
			SUM:	1426		*SUM:*	1270
VOLUME/CAPACITY *(V/C)* RATIO:				1.037			0.924
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.937**			**0.824**
LEVEL OF SERVICE (LOS):				**E**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 11

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Bluff Creek Drive
Scenario: Cumulative (2023) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	0	NB -- 3	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	3469	4	**867**	2321	4	580
	Through-Right		0			0	
	Right	802	1	613	397	1	142
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	146	2	**80**	68	2	37
	Left-Through		0			0	
	Through	1545	4	386	2604	4	**651**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	343	2	**189**	463	2	**255**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	45	1	0	80	1	43
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	947		*North-South:*	651
			East-West:	189		*East-West:*	255
			SUM:	1136		*SUM:*	906
VOLUME/CAPACITY *(V/C)* RATIO:				0.797			0.636
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.697**			**0.536**
LEVEL OF SERVICE (LOS):				**B**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 12

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Nicholson Street East-West Street: Culver Boulevard
Scenario: Cumulative (2023) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 1	SB --	0	NB -- 1	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	10	0	**10**	45	0	45
	Left-Through		1			1	
	Through	0	0	10	3	0	**48**
	Through-Right		0			0	
	Right	916	1	0	421	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	4	0	4	1	0	**1**
	Left-Through		0			0	
	Through	0	0	**5**	1	0	2
	Through-Right		0			0	
	Right	1	0	0	0	0	0
	Left-Through-Right		1			1	
	Left-Right		0			0	
EASTBOUND	Left	1	1	1	2	1	2
	Left-Through		0			0	
	Through	1577	1	**797**	656	1	**350**
	Through-Right		1			1	
	Right	16	0	16	44	0	44
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	375	1	**375**	1051	1	**1051**
	Left-Through		0			0	
	Through	589	1	296	1578	1	790
	Through-Right		1			1	
	Right	2	0	2	2	0	2
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	15		*North-South:*	49
			East-West:	1172		*East-West:*	1401
			SUM:	1187		*SUM:*	1450
	VOLUME/CAPACITY *(V/C)* RATIO:			0.833			1.018
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.733**			**0.918**
	LEVEL OF SERVICE (LOS):			**C**			**E**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 13

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Jefferson Boulevard East-West Street: Culver Boulevard
Scenario: Cumulative (2023) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			2			2
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	383	2	**211**	1160	2	**638**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	25	1	0	55	1	55
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	2071	2	**1036**	836	2	418
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	127	0	**127**	138	0	138
	Left-Through		1			1	
	Through	511	1	511	1440	1	**996**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	211		*North-South:*	638
			East-West:	1163		*East-West:*	996
			SUM:	1374		*SUM:*	1634
	VOLUME/CAPACITY *(V/C)* RATIO:			0.916			1.089
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.816**			**0.989**
	LEVEL OF SERVICE (LOS):			**D**			**E**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 14

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 EB Ramps East-West Street: Culver Boulevard
Scenario: Cumulative (2023) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			2			2
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	129	1	**129**	114	1	**114**
	Left-Through		0			0	
	Through	0	1	0	4	1	4
	Through-Right		1			1	
	Right	37	0	37	62	0	62
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	1867	3	**622**	795	3	265
	Through-Right		0			0	
	Right	1043	2	574	364	2	200
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	118	1	**118**	337	1	337
	Left-Through		0			0	
	Through	619	2	310	1609	2	**805**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	129		*North-South:*	114
			East-West:	740		*East-West:*	805
			SUM:	869		*SUM:*	919
	VOLUME/CAPACITY *(V/C)* RATIO:			0.579			0.613
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.479**			**0.513**
	LEVEL OF SERVICE (LOS):			**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 15

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 WB Ramps East-West Street: Culver Boulevard
Scenario: Cumulative (2023) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			1			1
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	191	1	105	300	1	165
	Left-Through		1			1	
	Through	320	0	**448**	264	0	**311**
	Through-Right		1			1	
	Right	128	0	128	47	0	47
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	92	1	**92**	173	1	173
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	181	1	0	579	1	**465**
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	530	1	**530**	228	1	**228**
	Left-Through		0			0	
	Through	1462	2	731	678	2	339
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	353	2	177	1055	2	**528**
	Through-Right		0			0	
	Right	352	1	**306**	300	1	214
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	540		*North-South:*	776
			East-West:	836		*East-West:*	756
			SUM:	1376		*SUM:*	1532
	VOLUME/CAPACITY *(V/C)* RATIO:			0.966			1.075
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.866**			**0.975**
	LEVEL OF SERVICE (LOS):			D			E

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 16

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 EB Ramps East-West Street: Mindanao Way
Scenario: Cumulative (2023) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 2	WB --		0	EB -- 2	WB --	0
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	18	1	18	23	1	23
	Left-Through		0			0	
	Through	1204	1	**607**	1129	1	**571**
	Through-Right		1			1	
	Right	9	0	9	13	0	13
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	499	1	**432**	487	1	**427**
	Through-Right		1			1	
	Right	797	1	0	793	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	512	2	**282**	722	2	**397**
	Left-Through		0			0	
	Through	947	2	474	1157	2	579
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	607		*North-South:*	571
			East-West:	714		*East-West:*	824
			SUM:	1321		*SUM:*	1395
VOLUME/CAPACITY *(V/C)* RATIO:				0.927			0.979
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.827**			**0.879**
LEVEL OF SERVICE (LOS):				**D**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 17

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 WB Ramps East-West Street: Mindanao Way
Scenario: Cumulative (2023) Plus Project Conditions
Count Date: Analyst: RA Date: 6/17/205

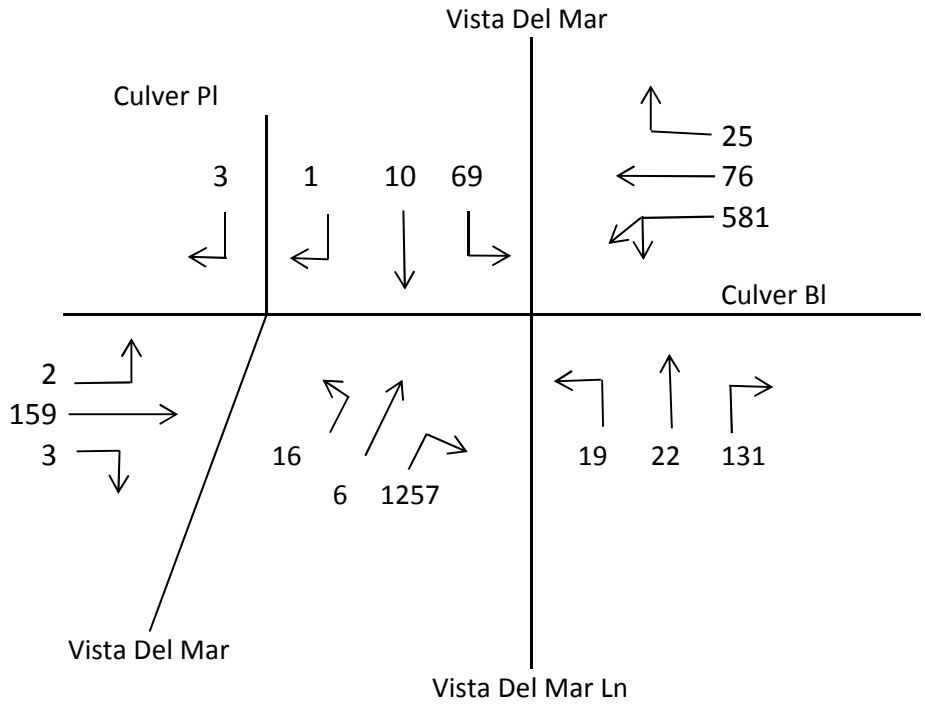
		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	549	1	549	589	1	**563**
	Left-Through		1			1	
	Through	1449	1	**725**	1099	1	563
	Through-Right		0			0	
	Right	608	1	608	443	1	443
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	**0**	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	34	1	**34**	26	1	**26**
	Left-Through		0			0	
	Through	519	2	260	476	2	238
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	782	2	**274**	1323	2	**460**
	Through-Right		1			1	
	Right	39	0	39	57	0	57
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	725		*North-South:*	563
			East-West:	308		*East-West:*	486
			SUM:	1033		*SUM:*	1049
	VOLUME/CAPACITY *(V/C)* RATIO:			0.725			0.736
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.625**			**0.636**
	LEVEL OF SERVICE (LOS):			**B**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

CMA METHODOLOGY
CUMULATIVE (2023) PLUS PROJECT CONDITIONS
AM PEAK HOUR

Int#18 - Vista Del Mar/Vista Del Mar Lane & Culver Boulevard



1. 581 x 0.55 or (76 + 25)

2. (16 + 6 + 1257) x 0.55

3. $\frac{(2 + 159 + 3)}{2}$

4. 69 + (19 + 22 + 131) or 19 + (69 + 10 + 1)

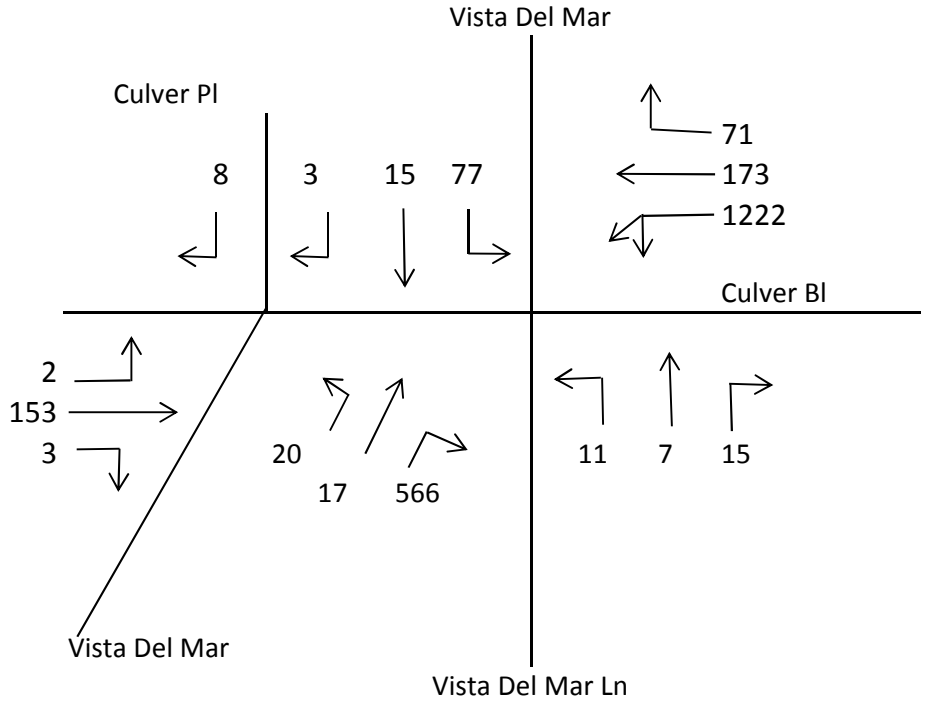
Critical Volumes = 320 + 703 + 82 + 241 = 1346

V/C = $\frac{1346}{1375}$ =

= 0.979 - 0.10 = 0.879 LOS D
ATSAC/ATCS

CMA METHODOLOGY
CUMULATIVE (2023) PLUS PROJECT CONDITIONS
PM PEAK HOUR

Int#18 - Vista Del Mar/Vista Del Mar Lane & Culver Boulevard



1. 1222 x 0.55 or (173 + 71)

2. (20 + 17 + 566) x 0.55

3. $\frac{(2 + 153 + 3)}{2}$

4. 77 + (11 + 7 + 15) or 11 + (77 + 15 + 3)

Critical Volumes = 672 + 332 + 79 + 110 = 1193

V/C = $\frac{1193}{1375}$ =

= 0.868 - 0.10 = 0.768 LOS C
ATSAC/ATCS

APPENDIX G

Level of Service Worksheets

Cumulative (2019) Pre-Construction Conditions

Level of Service Worksheet
(Circular 212 Method)

I/S #:	PROJECT TITLE:	Ballona Wetlands Restortation Project			
1	North-South Street:	Admiralty Way	East-West Street:	Bali Way	
	Scenario:	Cumulative (2019) Pre-Construction Conditions			
	Count Date:		Analyst:	RA	Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	3	EB -- 0	WB --	3
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	25	1	25	25	1	25
	Left-Through		0			0	
	Through	1186	1	**608**	1065	1	**591**
	Through-Right		1			1	
	Right	29	0	29	116	0	116
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	233	1	**233**	276	1	**276**
	Left-Through		0			0	
	Through	1206	1	612	1402	1	713
	Through-Right		1			1	
	Right	18	0	18	24	0	24
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	13	0	**13**	15	0	**15**
	Left-Through		1			1	
	Through	18	0	30	49	0	53
	Through-Right		1			1	
	Right	15	0	30	27	0	53
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	23	1	23	25	1	25
	Left-Through		0			0	
	Through	42	0	**199**	39	0	**218**
	Through-Right		1			1	
	Right	356	1	0	397	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	841		*North-South:*	867
			East-West:	212		*East-West:*	233
			SUM:	1053		*SUM:*	1100
	VOLUME/CAPACITY *(V/C)* RATIO:			0.739			0.772
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.639**			**0.672**
	LEVEL OF SERVICE (LOS):			**B**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 2

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Admiralty Way East-West Street: Mindanao Way
Scenario: Cumulative (2019) Pre-Construction Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				2			2
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	30	1	30	17	1	17
	Left-Through		0			0	
	Through	803	1	**428**	670	1	**404**
	Through-Right		1			1	
	Right	53	0	53	138	0	138
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	459	1	**459**	396	1	**396**
	Left-Through		0			0	
	Through	686	1	352	1061	1	538
	Through-Right		1			1	
	Right	17	0	17	15	0	15
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	19	1	19	19	1	19
	Left-Through		0			0	
	Through	55	0	**76**	45	0	**66**
	Through-Right		1			1	
	Right	21	0	0	21	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	158	1	**123**	262	1	**143**
	Left-Through		1			1	
	Through	87	0	123	24	0	143
	Through-Right		0			0	
	Right	441	1	0	455	1	59
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	887		*North-South:*	800
			East-West:	199		*East-West:*	209
			SUM:	1086		*SUM:*	1009
VOLUME/CAPACITY *(V/C)* RATIO:				0.790			0.734
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.690**			**0.634**
LEVEL OF SERVICE (LOS):				**B**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 3

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Admiralty Way East-West Street: Fiji Way
Scenario: Cumulative (2019) Pre-Construction Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			2			2
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	3	EB -- 0	WB --	3
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	680	2	**374**	971	2	**534**
	Left-Through		0			0	
	Through	20	0	0	0	0	0
	Through-Right		0			0	
	Right	75	1	33	113	1	93
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	84	1	**84**	40	1	**40**
	Left-Through		0			0	
	Through	115	2	58	155	2	78
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	92	1	92	123	1	**123**
	Through-Right		0			0	
	Right	773	1	**399**	534	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	374		*North-South:*	534
			East-West:	483		*East-West:*	163
			SUM:	857		*SUM:*	697
	VOLUME/CAPACITY *(V/C)* RATIO:			0.571			0.465
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.471**			**0.365**
	LEVEL OF SERVICE (LOS):			**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 4

PROJECT TITLE: Ballona Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Washington Boulevard
Scenario: Cumulative (2019) Pre-Construction Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			4			4
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 3	WB --	3	EB -- 3	WB --	3
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	650	2	**358**	487	2	**268**
	Left-Through		0			0	
	Through	1584	2	565	1377	2	532
	Through-Right		1			1	
	Right	111	0	111	218	0	218
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	259	2	142	219	2	120
	Left-Through		0			0	
	Through	1579	2	**566**	1551	2	**557**
	Through-Right		1			1	
	Right	120	0	120	120	0	120
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	87	2	48	111	2	61
	Left-Through		0			0	
	Through	792	2	**396**	724	2	**362**
	Through-Right		0			0	
	Right	575	1	217	535	1	267
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	137	2	**75**	268	2	**147**
	Left-Through		0			0	
	Through	714	2	357	811	2	406
	Through-Right		0			0	
	Right	194	1	52	262	1	142
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	924		*North-South:*	825
			East-West:	471		*East-West:*	509
			SUM:	1395		*SUM:*	1334
	VOLUME/CAPACITY *(V/C)* RATIO:			1.015			0.970
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.915**			**0.870**
	LEVEL OF SERVICE (LOS):			**E**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 5

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Marina Expressway (SR-90)
Scenario: Cumulative (2019) Pre-Construction Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 0	WB --		3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	1491	2	**572**	1591	2	**630**
	Through-Right		1			1	
	Right	226	0	226	300	0	300
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	985	2	**542**	897	2	**493**
	Left-Through		0			0	
	Through	1536	3	512	1780	3	593
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	**0**	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	219	2	120	232	2	**128**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	1224	2	**131**	925	2	16
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1114		*North-South:*	1123
			East-West:	131		*East-West:*	128
			SUM:	1245		*SUM:*	1251
VOLUME/CAPACITY *(V/C)* RATIO:				0.874			0.878
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.774**			**0.778**
LEVEL OF SERVICE (LOS):				**C**			**C**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 6

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Bali Way
Scenario: Cumulative (2019) Pre-Construction Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				2			2
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 0	WB --		0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	203	1	**203**	123	1	**123**
	Left-Through		0			0	
	Through	1461	2	495	1471	2	495
	Through-Right		1			1	
	Right	24	0	24	13	0	13
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	40	1	40	58	1	58
	Left-Through		0			0	
	Through	1522	2	**596**	1691	2	**667**
	Through-Right		1			1	
	Right	266	0	266	309	0	309
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	215	1	**108**	335	1	**169**
	Left-Through		1			1	
	Through	1	0	108	3	0	169
	Through-Right		0			0	
	Right	60	1	0	111	1	50
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	3	0	3	15	0	15
	Left-Through		0			0	
	Through	1	0	**15**	2	0	**26**
	Through-Right		0			0	
	Right	11	0	0	9	0	0
	Left-Through-Right		1			1	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	799		*North-South:*	790
			East-West:	123		*East-West:*	195
			SUM:	922		*SUM:*	985
VOLUME/CAPACITY *(V/C)* RATIO:				0.671			0.716
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.571**			**0.616**
LEVEL OF SERVICE (LOS):				**A**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 7

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Mindanao Way
Scenario: Cumulative (2019) Pre-Construction Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	0		NB -- 3	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	190	1	190	98	1	98
	Left-Through		0			0	
	Through	1660	3	**553**	1456	3	**485**
	Through-Right		0			0	
	Right	441	1	281	360	1	104
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	175	1	**175**	235	1	**235**
	Left-Through		0			0	
	Through	1300	2	447	1645	2	568
	Through-Right		1			1	
	Right	40	0	40	58	0	58
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	563	1	**306**	527	1	**358**
	Through-Right		1			1	
	Right	49	0	49	189	0	189
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	290	2	**160**	465	2	**256**
	Left-Through		0			0	
	Through	448	1	281	554	1	317
	Through-Right		1			1	
	Right	113	0	113	80	0	80
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	728		*North-South:*	720
			East-West:	466		*East-West:*	614
			SUM:	1194		*SUM:*	1334
VOLUME/CAPACITY *(V/C)* RATIO:				0.868			0.970
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.768**			**0.870**
LEVEL OF SERVICE (LOS):				**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 8

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Fiji Way
Scenario: Cumulative (2019) Pre-Construction Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 1	WB --		0	EB -- 1	WB --	0
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	870	2	**479**	702	2	**386**
	Left-Through		0			0	
	Through	2114	2	717	1810	2	616
	Through-Right		1			1	
	Right	37	0	37	38	0	38
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	51	1	51	46	1	46
	Left-Through		0			0	
	Through	1539	2	**538**	2187	2	**759**
	Through-Right		1			1	
	Right	74	0	74	90	0	90
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	70	1	**70**	83	1	**83**
	Left-Through		0			0	
	Through	16	1	16	25	1	25
	Through-Right		0			0	
	Right	616	1	0	965	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	31	0	31	51	0	51
	Left-Through		1			1	
	Through	10	0	**44**	28	0	**56**
	Through-Right		1			1	
	Right	34	0	0	28	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1017		*North-South:*	1145
			East-West:	114		*East-West:*	139
			SUM:	1131		*SUM:*	1284
VOLUME/CAPACITY *(V/C)* RATIO:				0.794			0.901
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.694**			**0.801**
LEVEL OF SERVICE (LOS):				**B**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 9

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Culver Loop
Scenario: Cumulative (2019) Pre-Construction Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			2			2
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	2714	2	**1265**	2218	2	**915**
	Through-Right		1			1	
	Right	1082	0	1082	526	0	526
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	2228	2	1114	3166	2	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	303	2	**167**	301	2	**166**
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	1265		*North-South:*	915
			East-West:	167		*East-West:*	166
			SUM:	1432		*SUM:*	1081
	VOLUME/CAPACITY *(V/C)* RATIO:			0.955			0.721
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.855**			**0.621**
	LEVEL OF SERVICE (LOS):			**D**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 10

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Jefferson Boulevard
Scenario: Cumulative (2019) Pre-Construction Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	3		NB -- 3	SB --	3
	EB -- 0	WB --	3		EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	17	1	17	40	1	40
	Left-Through		0			0	
	Through	2974	4	**744**	1747	4	**437**
	Through-Right		0			0	
	Right	633	1	428	353	1	28
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	539	2	**296**	663	2	**365**
	Left-Through		0			0	
	Through	1260	4	315	1850	4	463
	Through-Right		0			0	
	Right	191	1	0	686	1	588
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	193	1	193	98	1	98
	Left-Through		0			0	
	Through	404	2	**151**	256	2	**114**
	Through-Right		1			1	
	Right	49	0	49	86	0	86
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	372	2	**205**	590	2	**325**
	Left-Through		0			0	
	Through	178	2	89	489	2	245
	Through-Right		0			0	
	Right	815	2	152	942	2	153
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1040		*North-South:*	802
			East-West:	356		*East-West:*	439
			SUM:	1396		*SUM:*	1241
VOLUME/CAPACITY *(V/C)* RATIO:				1.015			0.903
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.915**			**0.803**
LEVEL OF SERVICE (LOS):				**E**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 11

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Bluff Creek Drive
Scenario: Cumulative (2019) Pre-Construction Conditions
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	0	NB -- 3	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	3394	4	**849**	2263	4	566
	Through-Right		0			0	
	Right	790	1	604	390	1	137
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	145	2	**80**	65	2	36
	Left-Through		0			0	
	Through	1512	4	378	2541	4	**635**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	338	2	**186**	460	2	**253**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	44	1	0	77	1	41
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	929		*North-South:*	635
			East-West:	186		*East-West:*	253
			SUM:	1115		*SUM:*	888
VOLUME/CAPACITY *(V/C)* RATIO:				0.782			0.623
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.682**			**0.523**
LEVEL OF SERVICE (LOS):				**B**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 12

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Nicholson Street East-West Street: Culver Boulevard
Scenario: Cumulative (2019) Pre-Construction Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 1	SB --	0		NB -- 1	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	10	0	**10**	44	0	44
	Left-Through		1			1	
	Through	0	0	10	3	0	**47**
	Through-Right		0			0	
	Right	896	1	0	410	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	4	0	4	1	0	**1**
	Left-Through		0			0	
	Through	0	0	**5**	1	0	2
	Through-Right		0			0	
	Right	1	0	0	0	0	0
	Left-Through-Right		1			1	
	Left-Right		0			0	
EASTBOUND	Left	1	1	1	2	1	2
	Left-Through		0			0	
	Through	1543	1	**779**	637	1	**340**
	Through-Right		1			1	
	Right	15	0	15	43	0	43
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	367	1	**367**	1025	1	**1025**
	Left-Through		0			0	
	Through	576	1	289	1536	1	769
	Through-Right		1			1	
	Right	2	0	2	2	0	2
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	15		*North-South:*	48
			East-West:	1146		*East-West:*	1365
			SUM:	1161		*SUM:*	1413
VOLUME/CAPACITY *(V/C)* RATIO:				0.815			0.992
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.715**			**0.892**
LEVEL OF SERVICE (LOS):				**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 13

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Jefferson Boulevard East-West Street: Culver Boulevard
Scenario: Cumulative (2019) Pre-Construction Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			2			2
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	374	2	**206**	1129	2	**621**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	25	1	0	55	1	55
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	2024	2	**1012**	815	2	408
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	126	0	**126**	136	0	136
	Left-Through		1			1	
	Through	500	1	500	1403	1	**974**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	206		*North-South:*	621
			East-West:	1138		*East-West:*	974
			SUM:	1344		*SUM:*	1595
	VOLUME/CAPACITY *(V/C)* RATIO:			0.896			1.063
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.796**			**0.963**
	LEVEL OF SERVICE (LOS):			**C**			**E**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 14

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 EB Ramps East-West Street: Culver Boulevard
Scenario: Cumulative (2019) Pre-Construction Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 0	WB --		0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	127	1	**127**	110	1	**110**
	Left-Through		0			0	
	Through	0	1	0	4	1	4
	Through-Right		1			1	
	Right	36	0	36	61	0	61
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	1826	3	**609**	776	3	259
	Through-Right		0			0	
	Right	1020	2	561	354	2	195
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	115	1	**115**	329	1	329
	Left-Through		0			0	
	Through	605	2	303	1566	2	**783**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	127		*North-South:*	110
			East-West:	724		*East-West:*	783
			SUM:	851		*SUM:*	893
VOLUME/CAPACITY *(V/C)* RATIO:				0.567			0.595
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.467**			**0.495**
LEVEL OF SERVICE (LOS):				**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 15

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 WB Ramps East-West Street: Culver Boulevard
Scenario: Cumulative (2019) Pre-Construction Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			1			1
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	187	1	103	291	1	160
	Left-Through		1			1	
	Through	313	0	**438**	258	0	**304**
	Through-Right		1			1	
	Right	125	0	125	46	0	46
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	90	1	**90**	169	1	169
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	177	1	0	565	1	**454**
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	518	1	**518**	222	1	**222**
	Left-Through		0			0	
	Through	1430	2	715	660	2	330
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	344	2	172	1025	2	**513**
	Through-Right		0			0	
	Right	344	1	**299**	294	1	210
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	528		*North-South:*	758
			East-West:	817		*East-West:*	735
			SUM:	1345		*SUM:*	1493
	VOLUME/CAPACITY *(V/C)* RATIO:			0.944			1.048
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.844**			**0.948**
	LEVEL OF SERVICE (LOS):			**D**			**E**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 16

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 EB Ramps East-West Street: Mindanao Way
Scenario: Cumulative (2019) Pre-Construction Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 2	WB --		0	EB -- 2	WB --	0
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	17	1	17	23	1	23
	Left-Through		0			0	
	Through	1178	1	**594**	1101	1	**557**
	Through-Right		1			1	
	Right	9	0	9	12	0	12
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	488	1	**422**	473	1	**414**
	Through-Right		1			1	
	Right	778	1	0	768	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	501	2	**276**	704	2	**387**
	Left-Through		0			0	
	Through	925	2	463	1122	2	561
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	594		*North-South:*	557
			East-West:	698		*East-West:*	801
			SUM:	1292		*SUM:*	1358
VOLUME/CAPACITY *(V/C)* RATIO:				0.907			0.953
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.807**			**0.853**
LEVEL OF SERVICE (LOS):				**D**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 17

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 WB Ramps East-West Street: Mindanao Way
Scenario: Cumulative (2019) Pre-Construction Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 0	WB --		0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

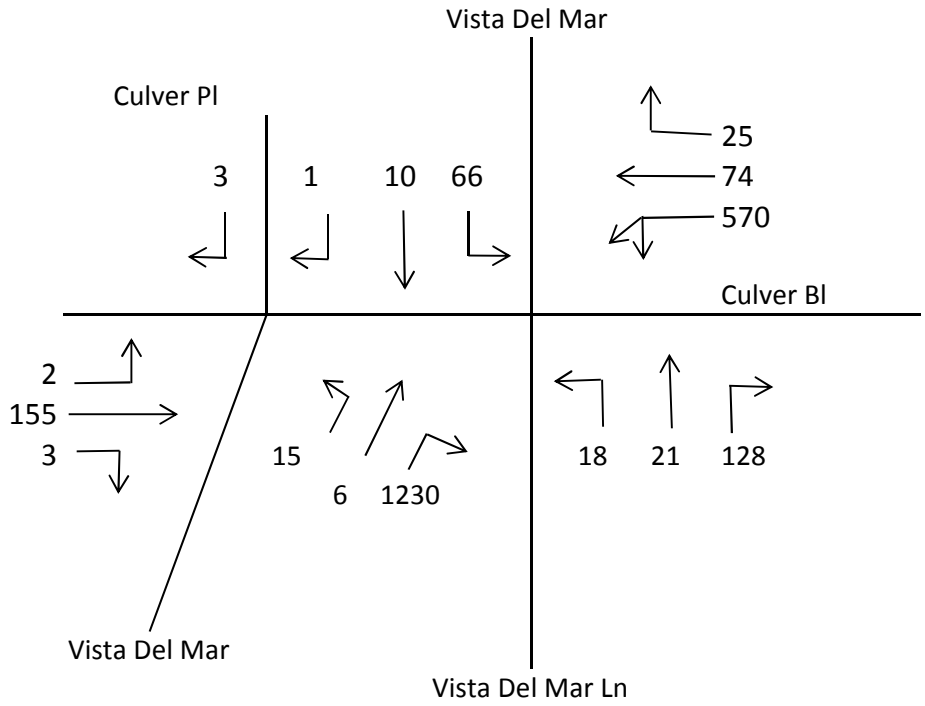
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	536	1	536	570	1	**548**
	Left-Through		1			1	
	Through	1417	1	**709**	1074	1	548
	Through-Right		0			0	
	Right	594	1	594	432	1	432
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	**0**	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	34	1	**34**	25	1	**25**
	Left-Through		0			0	
	Through	507	2	254	462	2	231
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	764	2	**268**	1288	2	**448**
	Through-Right		1			1	
	Right	39	0	39	56	0	56
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	709		*North-South:*	548
			East-West:	302		*East-West:*	473
			SUM:	1011		*SUM:*	1021
VOLUME/CAPACITY *(V/C)* RATIO:				0.709			0.716
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.609**			**0.616**
LEVEL OF SERVICE (LOS):				**B**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

CMA METHODOLOGY
CUMULATIVE (2019) PRE-CONSTRUCTION CONDITIONS
AM PEAK HOUR

Int#18 - Vista Del Mar/Vista Del Mar Lane & Culver Boulevard



1. 570 x 0.55 or (74 + 25)

2. (15 + 6 + 1230) x 0.55

3. $\frac{(2 + 155 + 3)}{2}$

4. 66 + (18 + 21 + 128) or 18 + (66 + 10 + 1)

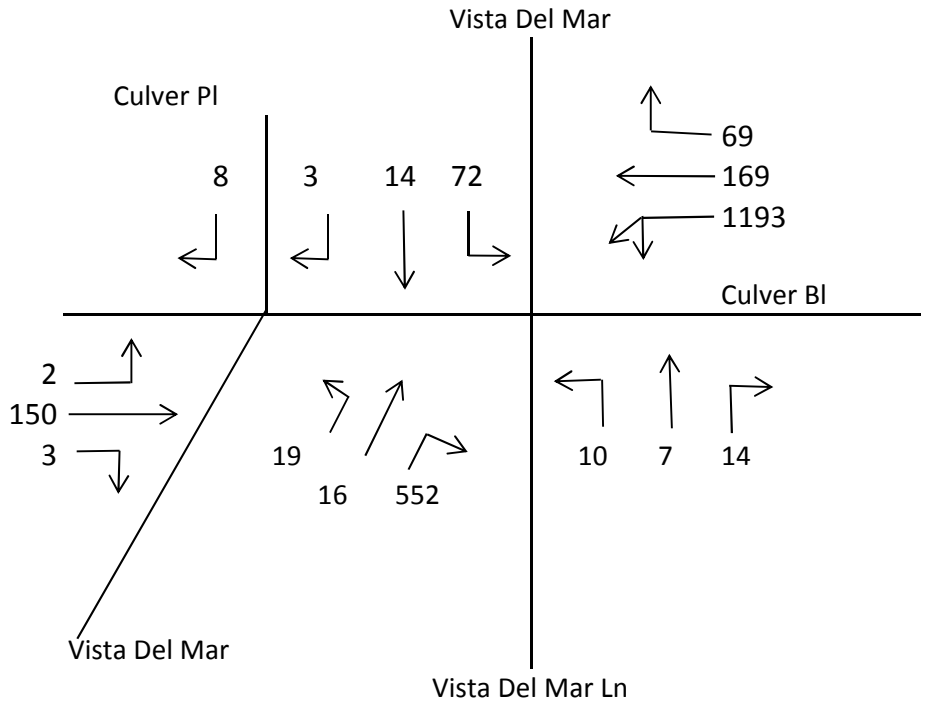
Critical Volumes = 314 + 688 + 80 + 233 = 1315

V/C = $\frac{1315}{1375}$ =

= 0.956 - 0.10 = 0.856 LOS D
ATSAC/ATCS

CMA METHODOLOGY
CUMULATIVE (2019) PRE-CONSTRUCTION CONDITIONS
PM PEAK HOUR

Int#18 - Vista Del Mar/Vista Del Mar Lane & Culver Boulevard



1. 1193 x 0.55 or (169 + 69)

2. (19 + 16 + 552) x 0.55

3. $\frac{(2 + 150 + 3)}{2}$

4. 72 + (10 + 7 + 14) or 10 + (72 + 14 + 3)

Critical Volumes = 656 + 323 + 78 + 103 = 1160

V/C = $\frac{1160}{1375}$ =

= 0.844 - 0.10 = 0.744 LOS C
ATSAC/ATCS

APPENDIX H

Level of Service Worksheets

Cumulative (2019) with Project Construction Activity Conditions

Level of Service Worksheet
(Circular 212 Method)

I/S #:	PROJECT TITLE:	Ballona Wetlands Restortation Project			
1	North-South Street:	Admiralty Way	East-West Street:	Bali Way	
	Scenario:	Cumulative (2019) with Construction Activity			
	Count Date:		Analyst:	RA	Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	3	EB -- 0	WB --	3
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	25	1	25	25	1	25
	Left-Through		0			0	
	Through	1186	1	**608**	1067	1	**592**
	Through-Right		1			1	
	Right	29	0	29	116	0	116
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	233	1	**233**	276	1	**276**
	Left-Through		0			0	
	Through	1208	1	613	1402	1	713
	Through-Right		1			1	
	Right	18	0	18	24	0	24
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	13	0	**13**	15	0	**15**
	Left-Through		1			1	
	Through	18	0	30	49	0	53
	Through-Right		1			1	
	Right	15	0	30	27	0	53
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	23	1	23	25	1	25
	Left-Through		0			0	
	Through	42	0	**199**	39	0	**218**
	Through-Right		1			1	
	Right	356	1	0	397	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	841		*North-South:*	868
			East-West:	212		*East-West:*	233
			SUM:	1053		*SUM:*	1101
	VOLUME/CAPACITY *(V/C)* RATIO:			0.739			0.773
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.639**			**0.673**
	LEVEL OF SERVICE (LOS):			**B**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 2

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Admiralty Way East-West Street: Mindanao Way
Scenario: Cumulative (2019) with Construction Activity
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				2			2
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	30	1	30	17	1	17
	Left-Through		0			0	
	Through	803	1	**428**	671	1	**406**
	Through-Right		1			1	
	Right	53	0	53	140	0	140
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	459	1	**459**	396	1	**396**
	Left-Through		0			0	
	Through	688	1	353	1061	1	538
	Through-Right		1			1	
	Right	17	0	17	15	0	15
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	19	1	19	19	1	19
	Left-Through		0			0	
	Through	55	0	**76**	45	0	**66**
	Through-Right		1			1	
	Right	21	0	0	21	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	167	1	**127**	264	1	**144**
	Left-Through		1			1	
	Through	87	0	127	24	0	144
	Through-Right		0			0	
	Right	441	1	0	456	1	60
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	887		*North-South:*	802
			East-West:	203		*East-West:*	210
			SUM:	1090		*SUM:*	1012
VOLUME/CAPACITY *(V/C)* RATIO:				0.793			0.736
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.693**			**0.636**
LEVEL OF SERVICE (LOS):				**B**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 3

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Admiralty Way East-West Street: Fiji Way
Scenario: Cumulative (2019) with Construction Activity
Count Date: Analyst: RA Date: 6/17/205

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	688	2	**378**	973	2	**535**
	Left-Through		0			0	
	Through	20	0	0	0	0	0
	Through-Right		0			0	
	Right	78	1	36	114	1	93
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	85	1	**85**	43	1	**43**
	Left-Through		0			0	
	Through	116	2	58	158	2	79
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	95	1	95	124	1	**124**
	Through-Right		0			0	
	Right	773	1	**395**	534	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	378		*North-South:*	535
			East-West:	480		*East-West:*	167
			SUM:	858		*SUM:*	702
VOLUME/CAPACITY *(V/C)* RATIO:				0.572			0.468
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.472**			**0.368**
LEVEL OF SERVICE (LOS):				**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 4

PROJECT TITLE: Ballona Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Washington Boulevard
Scenario: Cumulative (2019) with Construction Activity
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB -- 0		NB -- 0	SB -- 0	
	EB -- 3	WB -- 3		EB -- 3	WB -- 3	
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	650	2	**358**	488	2	**268**
	Left-Through		0			0	
	Through	1585	2	565	1381	2	534
	Through-Right		1			1	
	Right	111	0	111	221	0	221
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	259	2	142	219	2	120
	Left-Through		0			0	
	Through	1584	2	**568**	1552	2	**557**
	Through-Right		1			1	
	Right	120	0	120	120	0	120
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	87	2	48	111	2	61
	Left-Through		0			0	
	Through	792	2	**396**	724	2	**362**
	Through-Right		0			0	
	Right	576	1	218	535	1	267
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	140	2	**77**	269	2	**148**
	Left-Through		0			0	
	Through	714	2	357	811	2	406
	Through-Right		0			0	
	Right	194	1	52	262	1	142
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	926		*North-South:*	825
			East-West:	473		*East-West:*	510
			SUM:	1399		*SUM:*	1335
VOLUME/CAPACITY *(V/C)* RATIO:				1.017			0.971
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.917**			**0.871**
LEVEL OF SERVICE (LOS):				**E**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 5

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Marina Expressway (SR-90)
Scenario: Cumulative (2019) with Construction Activity
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	1491	2	**572**	1592	2	**631**
	Through-Right		1			1	
	Right	226	0	226	300	0	300
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	985	2	**542**	897	2	**493**
	Left-Through		0			0	
	Through	1545	3	515	1782	3	594
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	**0**	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	219	2	120	232	2	**128**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	1225	2	**132**	932	2	20
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1114		*North-South:*	1124
			East-West:	132		*East-West:*	128
			SUM:	1246		*SUM:*	1252
VOLUME/CAPACITY *(V/C)* RATIO:				0.874			0.879
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.774**			**0.779**
LEVEL OF SERVICE (LOS):				**C**			**C**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 6

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Bali Way
Scenario: Cumulative (2019) with Construction Activity
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			4			4
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			2			2
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	203	1	**203**	123	1	**123**
	Left-Through		0			0	
	Through	1461	2	495	1472	2	495
	Through-Right		1			1	
	Right	24	0	24	13	0	13
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	40	1	40	58	1	58
	Left-Through		0			0	
	Through	1531	2	**599**	1693	2	**667**
	Through-Right		1			1	
	Right	266	0	266	309	0	309
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	215	1	**108**	335	1	**169**
	Left-Through		1			1	
	Through	1	0	108	3	0	169
	Through-Right		0			0	
	Right	60	1	0	111	1	50
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	3	0	3	15	0	15
	Left-Through		0			0	
	Through	1	0	**15**	2	0	**26**
	Through-Right		0			0	
	Right	11	0	0	9	0	0
	Left-Through-Right		1			1	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	802		*North-South:*	790
			East-West:	123		*East-West:*	195
			SUM:	925		*SUM:*	985
	VOLUME/CAPACITY *(V/C)* RATIO:			0.673			0.716
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.573**			**0.616**
	LEVEL OF SERVICE (LOS):			**A**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 7

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Mindanao Way
Scenario: Cumulative (2019) with Construction Activity
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	0	NB -- 3	SB --	0
	EB -- 0	WB --	0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	196	1	196	99	1	99
	Left-Through		0			0	
	Through	1660	3	**553**	1457	3	**486**
	Through-Right		0			0	
	Right	516	1	315	360	1	104
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	175	1	**175**	235	1	**235**
	Left-Through		0			0	
	Through	1309	2	450	1647	2	568
	Through-Right		1			1	
	Right	40	0	40	58	0	58
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	563	1	**306**	529	1	**359**
	Through-Right		1			1	
	Right	49	0	49	189	0	189
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	366	2	**201**	465	2	**256**
	Left-Through		0			0	
	Through	451	1	282	556	1	318
	Through-Right		1			1	
	Right	113	0	113	80	0	80
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	728		*North-South:*	721
			East-West:	507		*East-West:*	615
			SUM:	1235		*SUM:*	1336
VOLUME/CAPACITY *(V/C)* RATIO:				0.898			0.972
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.798**			**0.872**
LEVEL OF SERVICE (LOS):				**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 8

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Fiji Way
Scenario: Cumulative (2019) with Construction Activity
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 1	WB --	0	EB -- 1	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	872	2	**480**	702	2	**386**
	Left-Through		0			0	
	Through	2195	2	744	1811	2	616
	Through-Right		1			1	
	Right	37	0	37	38	0	38
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	51	1	51	46	1	46
	Left-Through		0			0	
	Through	1623	2	**566**	2189	2	**760**
	Through-Right		1			1	
	Right	76	0	76	90	0	90
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	70	1	**70**	84	1	**84**
	Left-Through		0			0	
	Through	16	1	16	25	1	25
	Through-Right		0			0	
	Right	624	1	0	968	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	31	0	31	51	0	51
	Left-Through		1			1	
	Through	10	0	**44**	28	0	**56**
	Through-Right		1			1	
	Right	34	0	0	28	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1046		*North-South:*	1146
			East-West:	114		*East-West:*	140
			SUM:	1160		*SUM:*	1286
VOLUME/CAPACITY *(V/C)* RATIO:				0.814			0.902
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.714**			**0.802**
LEVEL OF SERVICE (LOS):				**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 9

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Culver Loop
Scenario: Cumulative (2019) with Construction Activity
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	2722	2	**1268**	2220	2	**915**
	Through-Right		1			1	
	Right	1082	0	1082	526	0	526
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	2231	2	1116	3188	2	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	303	2	**167**	301	2	**166**
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1268		*North-South:*	915
			East-West:	167		*East-West:*	166
			SUM:	1435		*SUM:*	1081
VOLUME/CAPACITY *(V/C)* RATIO:				0.957			0.721
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.857**			**0.621**
LEVEL OF SERVICE (LOS):				**D**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 10

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Jefferson Boulevard
Scenario: Cumulative (2019) with Construction Activity
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB -- 3		NB -- 3	SB -- 3	
	EB -- 0	WB -- 3		EB -- 0	WB -- 3	
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	17	1	17	40	1	40
	Left-Through		0			0	
	Through	2977	4	**744**	1748	4	**437**
	Through-Right		0			0	
	Right	633	1	428	353	1	28
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	539	2	**296**	664	2	**365**
	Left-Through		0			0	
	Through	1260	4	315	1853	4	463
	Through-Right		0			0	
	Right	193	1	0	704	1	605
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	196	1	196	99	1	99
	Left-Through		0			0	
	Through	404	2	**151**	256	2	**114**
	Through-Right		1			1	
	Right	49	0	49	86	0	86
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	372	2	**205**	590	2	**325**
	Left-Through		0			0	
	Through	178	2	89	489	2	245
	Through-Right		0			0	
	Right	817	2	153	942	2	153
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1040		*North-South:*	802
			East-West:	356		*East-West:*	439
			SUM:	1396		*SUM:*	1241
VOLUME/CAPACITY *(V/C)* RATIO:				1.015			0.903
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.915**			**0.803**
LEVEL OF SERVICE (LOS):				**E**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 11

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Bluff Creek Drive
Scenario: Cumulative (2019) with Construction Activity
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	0	NB -- 3	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	3397	4	**849**	2264	4	566
	Through-Right		0			0	
	Right	790	1	604	390	1	137
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	145	2	**80**	65	2	36
	Left-Through		0			0	
	Through	1512	4	378	2544	4	**636**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	338	2	**186**	460	2	**253**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	44	1	0	77	1	41
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	929		*North-South:*	636
			East-West:	186		*East-West:*	253
			SUM:	1115		*SUM:*	889
VOLUME/CAPACITY *(V/C)* RATIO:				0.782			0.624
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.682**			**0.524**
LEVEL OF SERVICE (LOS):				**B**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 12

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Nicholson Street East-West Street: Culver Boulevard
Scenario: Cumulative (2019) with Construction Activity
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 1	SB --	0	NB -- 1	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	10	0	**10**	44	0	44
	Left-Through		1			1	
	Through	0	0	10	3	0	**47**
	Through-Right		0			0	
	Right	898	1	0	410	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	4	0	4	1	0	**1**
	Left-Through		0			0	
	Through	0	0	**5**	1	0	2
	Through-Right		0			0	
	Right	1	0	0	0	0	0
	Left-Through-Right		1			1	
	Left-Right		0			0	
EASTBOUND	Left	1	1	1	2	1	2
	Left-Through		0			0	
	Through	1545	1	**780**	637	1	**340**
	Through-Right		1			1	
	Right	15	0	15	43	0	43
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	367	1	**367**	1026	1	**1026**
	Left-Through		0			0	
	Through	576	1	289	1537	1	770
	Through-Right		1			1	
	Right	2	0	2	2	0	2
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	15		*North-South:*	48
			East-West:	1147		*East-West:*	1366
			SUM:	1162		*SUM:*	1414
	VOLUME/CAPACITY *(V/C)* RATIO:			0.815			0.992
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.715**			**0.892**
	LEVEL OF SERVICE (LOS):			**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 13

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Jefferson Boulevard East-West Street: Culver Boulevard
Scenario: Cumulative (2019) with Construction Activity
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			2			2
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	374	2	**206**	1130	2	**622**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	27	1	0	72	1	72
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	2024	2	**1012**	815	2	408
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	126	0	**126**	136	0	136
	Left-Through		1			1	
	Through	500	1	500	1405	1	**975**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	206		*North-South:*	622
			East-West:	1138		*East-West:*	975
			SUM:	1344		*SUM:*	1597
	VOLUME/CAPACITY *(V/C)* RATIO:			0.896			1.065
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.796**			**0.965**
	LEVEL OF SERVICE (LOS):			**C**			**E**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 14

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 EB Ramps East-West Street: Culver Boulevard
Scenario: Cumulative (2019) with Construction Activity
Count Date: Analyst: RA Date: 6/17/205

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	127	1	**127**	111	1	**111**
	Left-Through		0			0	
	Through	0	1	0	4	1	4
	Through-Right		1			1	
	Right	36	0	36	61	0	61
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	1828	3	**609**	788	3	263
	Through-Right		0			0	
	Right	1021	2	562	360	2	198
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	115	1	**115**	329	1	329
	Left-Through		0			0	
	Through	614	2	307	1568	2	**784**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	127		*North-South:*	111
			East-West:	724		*East-West:*	784
			SUM:	851		*SUM:*	895
VOLUME/CAPACITY *(V/C)* RATIO:				0.567			0.597
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.467**			**0.497**
LEVEL OF SERVICE (LOS):				**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 15

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 WB Ramps East-West Street: Culver Boulevard
Scenario: Cumulative (2019) with Construction Activity
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			1			1
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	193	1	106	292	1	161
	Left-Through		1			1	
	Through	313	0	**438**	258	0	**304**
	Through-Right		1			1	
	Right	125	0	125	46	0	46
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	90	1	**90**	169	1	169
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	177	1	0	565	1	**450**
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	519	1	**519**	231	1	**231**
	Left-Through		0			0	
	Through	1430	2	715	663	2	332
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	347	2	174	1026	2	**513**
	Through-Right		0			0	
	Right	345	1	**300**	294	1	210
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	528		*North-South:*	754
			East-West:	819		*East-West:*	744
			SUM:	1347		*SUM:*	1498
	VOLUME/CAPACITY *(V/C)* RATIO:			0.945			1.051
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.845**			**0.951**
	LEVEL OF SERVICE (LOS):			D			E

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 16

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 EB Ramps East-West Street: Mindanao Way
Scenario: Cumulative (2019) with Construction Activity
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 2	WB --		0	EB -- 2	WB --	0
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	17	1	17	23	1	23
	Left-Through		0			0	
	Through	1178	1	**594**	1101	1	**557**
	Through-Right		1			1	
	Right	9	0	9	12	0	12
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	488	1	**447**	473	1	**414**
	Through-Right		1			1	
	Right	853	1	0	770	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	501	2	**276**	704	2	**387**
	Left-Through		0			0	
	Through	1004	2	502	1124	2	562
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	594		*North-South:*	557
			East-West:	723		*East-West:*	801
			SUM:	1317		*SUM:*	1358
VOLUME/CAPACITY *(V/C)* RATIO:				0.924			0.953
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.824**			**0.853**
LEVEL OF SERVICE (LOS):				**D**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 17

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 WB Ramps East-West Street: Mindanao Way
Scenario: Cumulative (2019) with Construction Activity
Count Date: Analyst: RA Date: 6/17/205

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

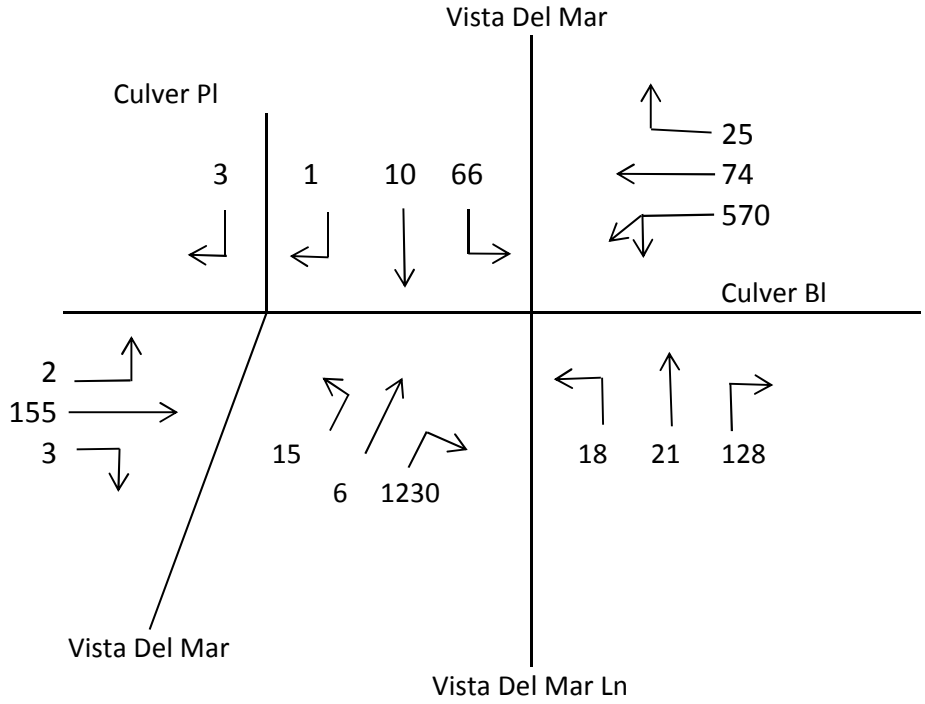
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	613	1	613	572	1	**551**
	Left-Through		1			1	
	Through	1418	1	**709**	1081	1	551
	Through-Right		0			0	
	Right	594	1	594	433	1	433
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	**0**	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	34	1	**34**	25	1	**25**
	Left-Through		0			0	
	Through	507	2	254	462	2	231
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	766	2	**268**	1288	2	**448**
	Through-Right		1			1	
	Right	39	0	39	56	0	56
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	709		*North-South:*	551
			East-West:	302		*East-West:*	473
			SUM:	1011		*SUM:*	1024
VOLUME/CAPACITY *(V/C)* RATIO:				0.709			0.719
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.609**			**0.619**
LEVEL OF SERVICE (LOS):				**B**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

CMA METHODOLOGY
CUMULATIVE (2019) WITH CONSTRUCTION ACTIVITY (ALT1 - PROPOSED PROJECT)
AM PEAK HOUR

Int#18 - Vista Del Mar/Vista Del Mar Lane & Culver Boulevard



1. 570 x 0.55 or (74 + 25)

2. (15 + 6 + 1230) x 0.55

3. $\frac{(2 + 155 + 3)}{2}$

4. 66 + (18 + 21 + 128) or 18 + (66 + 10 + 1)

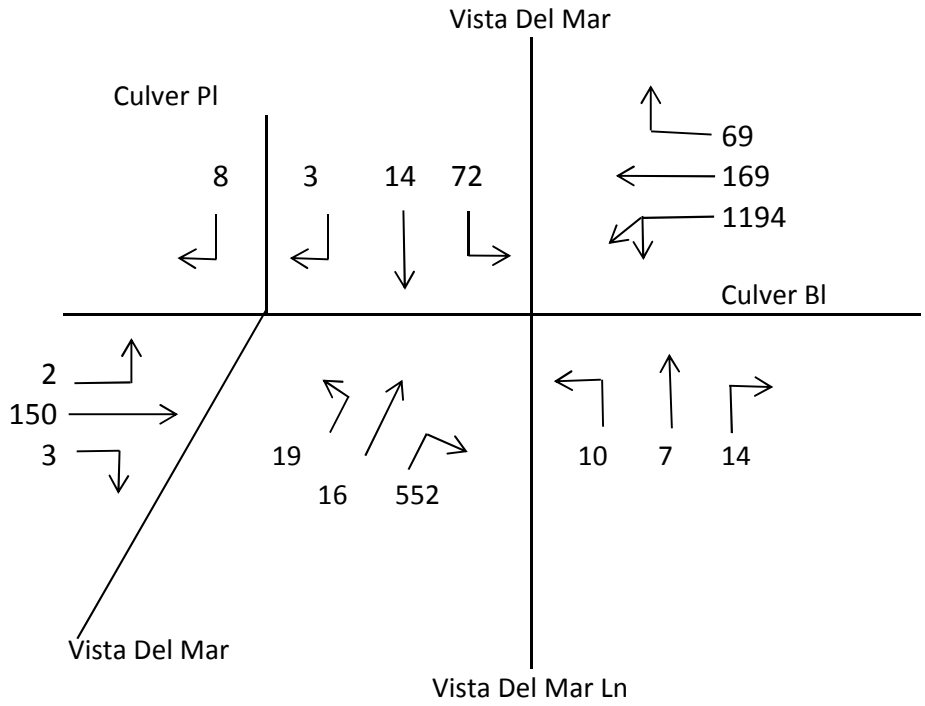
Critical Volumes = 314 + 688 + 80 + 233 = 1315

V/C = $\frac{1315}{1375}$ =

= 0.956 - 0.10 = 0.856 LOS D
ATSAC/ATCS

CMA METHODOLOGY
CUMULATIVE (2019) WITH CONSTRUCTION ACTIVITY (ALT1 - PROPOSED PROJECT)
PM PEAK HOUR

Int#18 - Vista Del Mar/Vista Del Mar Lane & Culver Boulevard



1. 1194 x 0.55 or (169 + 69)

2. (19 + 16 + 552) x 0.55

3. $\frac{(2 + 150 + 3)}{2}$

4. 72 + (10 + 7 + 14) or 10 + (72 + 14 + 3)

Critical Volumes = 657 + 323 + 78 + 103 = 1161

V/C = $\frac{1161}{1375}$ =

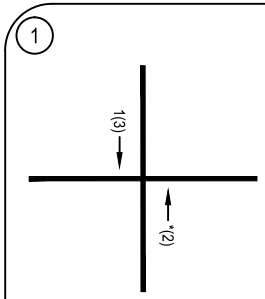
= 0.844 - 0.10 = 0.744 LOS C
ATSAC/ATCS

APPENDIX I

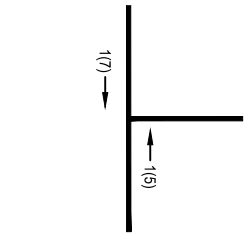
Level of Service Worksheets

Existing (2015) plus Project – Alternative 2 Conditions

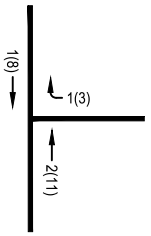
Cumulative (2023) plus Project – Alternative 2 Conditions



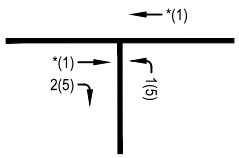
1 ADMIRALTY WAY & BALI WAY



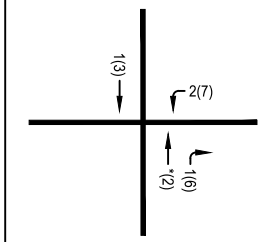
5 LINCOLN BL & MARINA (SR-90) EXPRESSWAY



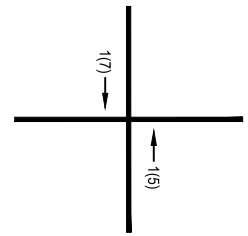
9 LINCOLN BL & CULVER BL



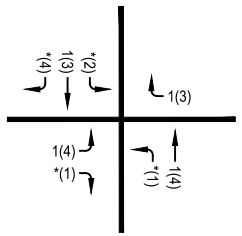
13 CULVER BL & JEFFERSON BL



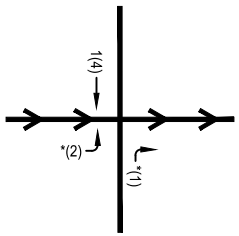
2 ADMIRALTY WAY & MINDANAO WAY



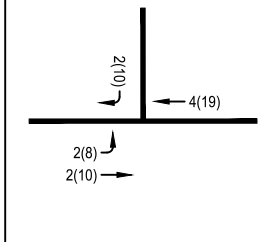
6 LINCOLN BL & BALI WAY



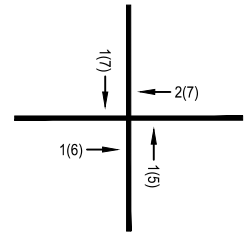
10 LINCOLN BL & JEFFERSON BL



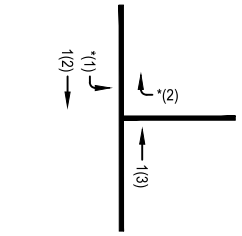
14 CULVER BL & SR-90 EB RAMPS



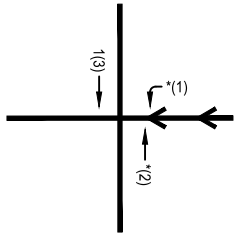
3 ADMIRALTY WAY & FIJI WAY



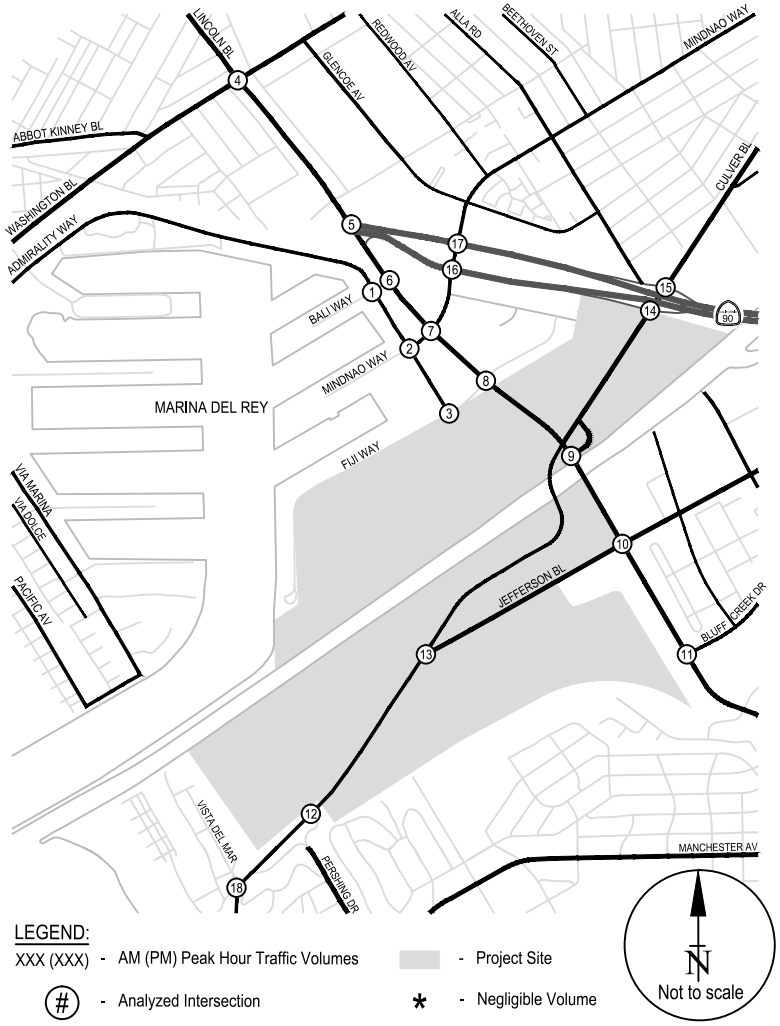
7 LINCOLN BL & MINDANAO WAY



11 LINCOLN BL & BLUFF CREEK DRIVE



15 CULVER BL & SR-90 WB RAMPS



LEGEND:

XXX (XXX) - AM (PM) Peak Hour Traffic Volumes

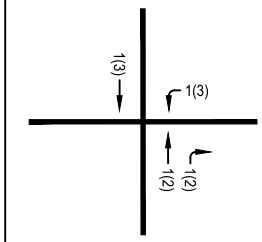
(#) - Analyzed Intersection

- Project Site

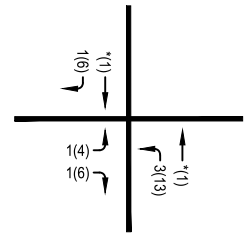
* - Negligible Volume

N

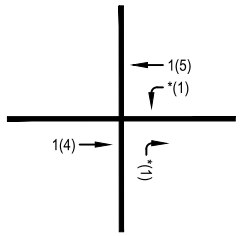
Not to scale



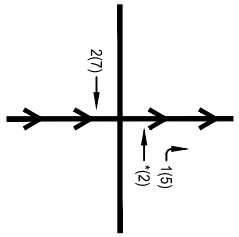
4 LINCOLN BL & WASHINGTON BL



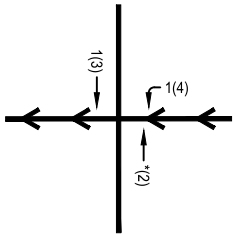
8 LINCOLN BL & FIJI WAY



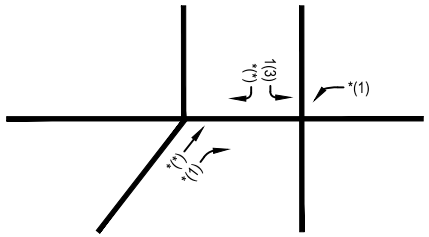
12 NICHOLSON ST & CULVER BL



16 MINDANAO WAY & MARINA (SR-90) EXPRESSWAY EB



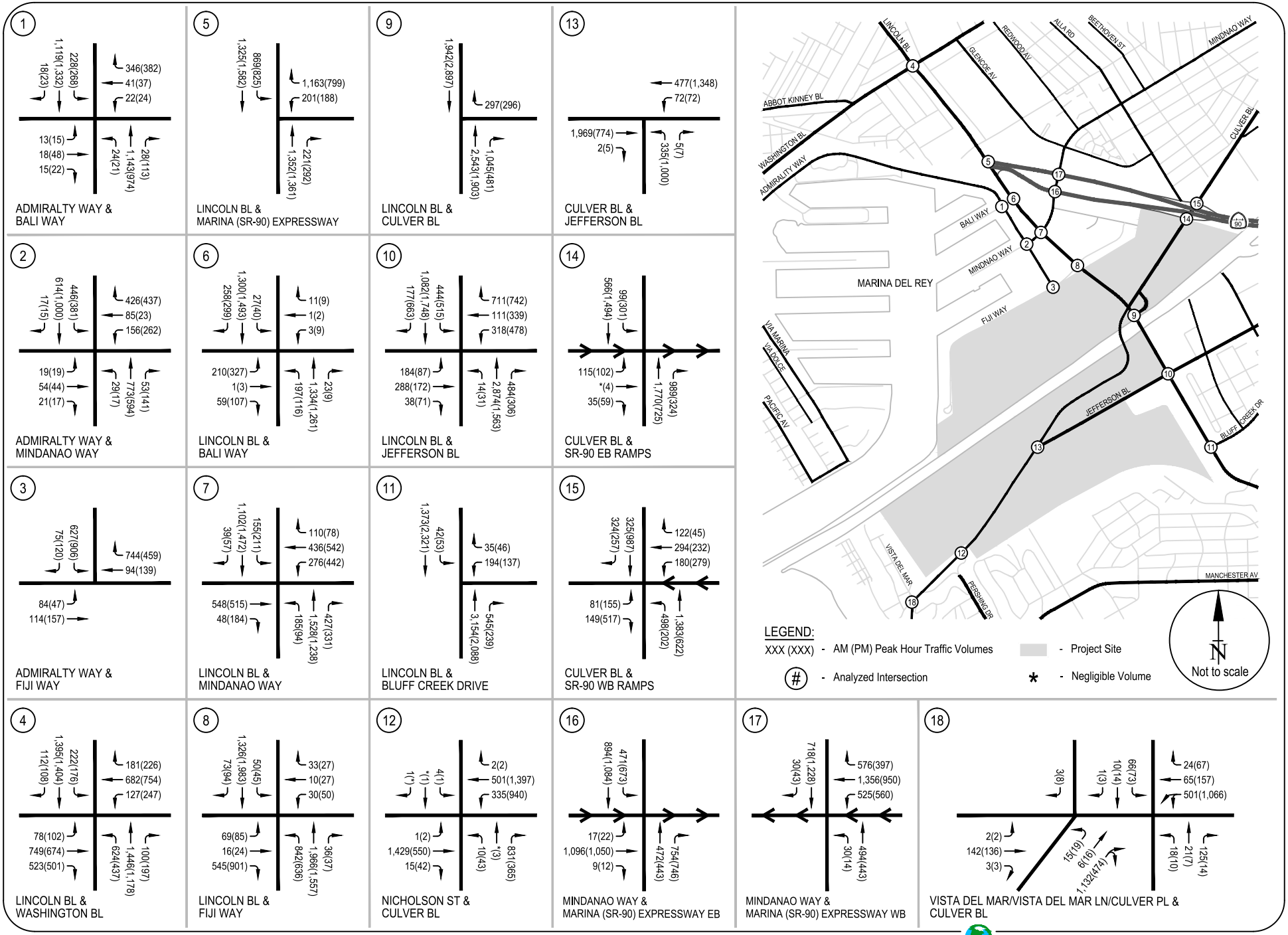
17 MINDANAO WAY & MARINA (SR-90) EXPRESSWAY WB



18 VISTA DEL MAR/VISTA DEL MAR LN/CULVER PL & CULVER BL

APPENDIX I1
ALTERNATIVE 2 PROJECT ONLY - PEAK HOUR TRAFFIC VOLUMES

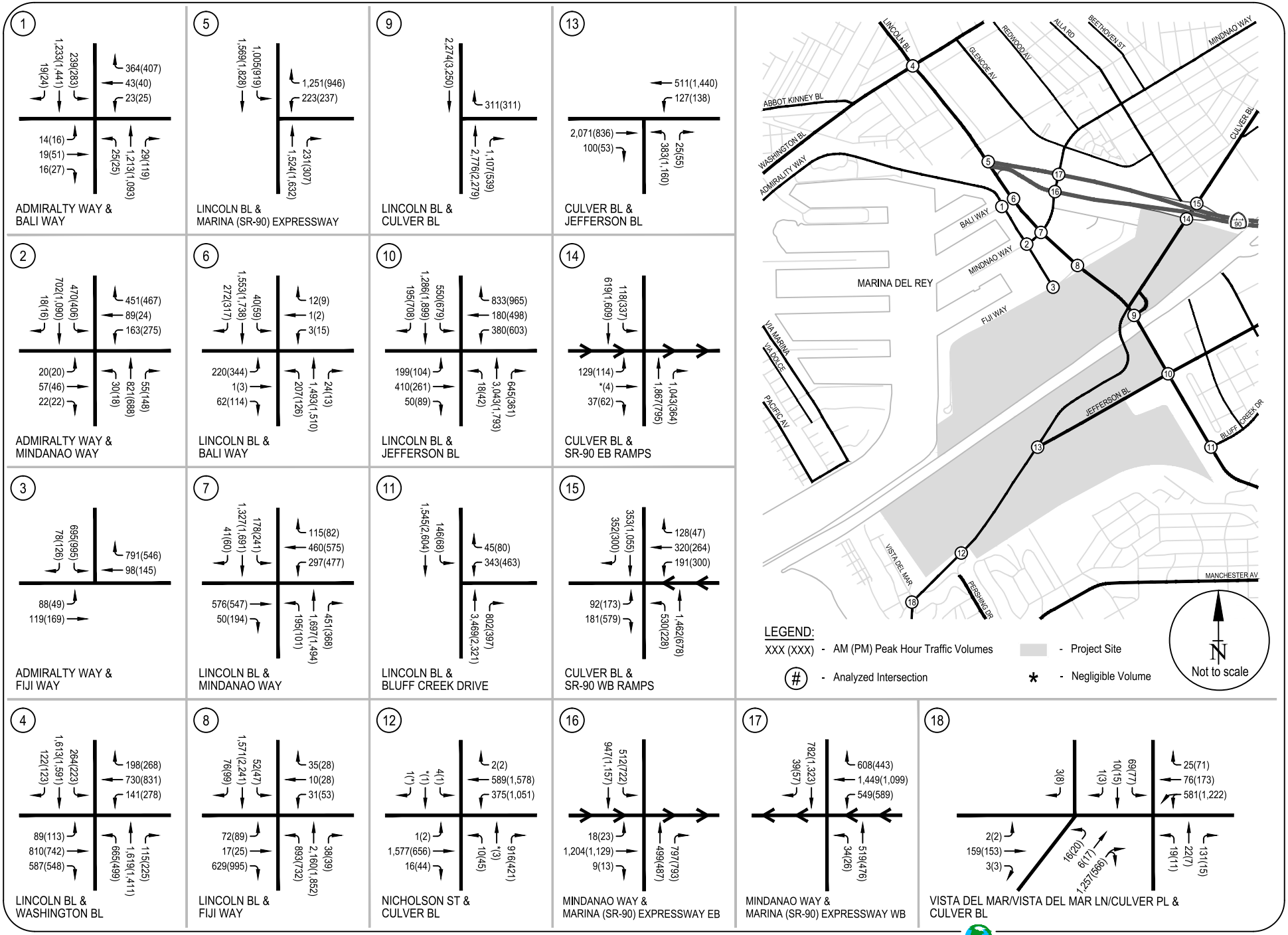
RAJU Associates, Inc.



APPENDIX I2

EXISTING (2015) PLUS PROJECT - ALTERNATIVE 2 CONDITIONS - PEAK HOUR TRAFFIC VOLUMES

RAJU Associates, Inc.



APPENDIX I3

CUMULATIVE (2023) PLUS PROJECT - ALTERNATIVE 2 CONDITIONS - PEAK HOUR TRAFFIC VOLUMES

RAJU Associates, Inc.

Level of Service Worksheet
(Circular 212 Method)

I/S #:	PROJECT TITLE:	Ballona Wetlands Restortation Project			
1	North-South Street:	Admiralty Way	East-West Street:	Bali Way	
	Scenario:	Existing (2015) Plus Project - Alternative 2 Conditions			
	Count Date:		Analyst:	RA	Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	3	EB -- 0	WB --	3
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	**Volume**	**No. of Lanes**	**Lane Volume**	**Volume**	**No. of Lanes**	**Lane Volume**
NORTHBOUND	Left	24	1	24	21	1	21
	Left-Through		0			0	
	Through	1143	1	**586**	974	1	**544**
	Through-Right		1			1	
	Right	28	0	28	113	0	113
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	228	1	**228**	268	1	**268**
	Left-Through		0			0	
	Through	1119	1	569	1332	1	678
	Through-Right		1			1	
	Right	18	0	18	23	0	23
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	13	0	**13**	15	0	**15**
	Left-Through		1			1	
	Through	18	0	30	48	0	50
	Through-Right		1			1	
	Right	15	0	30	22	0	50
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	22	1	22	24	1	24
	Left-Through		0			0	
	Through	41	0	**194**	37	0	**210**
	Through-Right		1			1	
	Right	346	1	0	382	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	814		*North-South:*	812
			East-West:	207		*East-West:*	225
			SUM:	1021		*SUM:*	1037
	VOLUME/CAPACITY *(V/C)* RATIO:			0.716			0.728
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.616**			**0.628**
	LEVEL OF SERVICE (LOS):			**B**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 2

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Admiralty Way East-West Street: Mindanao Way
Scenario: Existing (2015) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			4			4
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			2			2
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	3	EB -- 0	WB --	3
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	29	1	29	17	1	17
	Left-Through		0			0	
	Through	773	1	**413**	594	1	**368**
	Through-Right		1			1	
	Right	53	0	53	141	0	141
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	446	1	**446**	381	1	**381**
	Left-Through		0			0	
	Through	614	1	316	1000	1	508
	Through-Right		1			1	
	Right	17	0	17	15	0	15
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	19	1	19	19	1	19
	Left-Through		0			0	
	Through	54	0	**75**	44	0	**61**
	Through-Right		1			1	
	Right	21	0	0	17	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	156	1	**121**	262	1	**143**
	Left-Through		1			1	
	Through	85	0	121	23	0	143
	Through-Right		0			0	
	Right	426	1	0	437	1	56
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	859		*North-South:*	749
			East-West:	196		*East-West:*	204
			SUM:	1055		*SUM:*	953
	VOLUME/CAPACITY *(V/C)* RATIO:			0.767			0.693
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.667**			**0.593**
	LEVEL OF SERVICE (LOS):			**B**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 3

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Admiralty Way East-West Street: Fiji Way
Scenario: Existing (2015) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			2			2
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	3	EB -- 0	WB --	3
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	627	2	**345**	906	2	**498**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	75	1	33	120	1	97
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	84	1	**84**	47	1	**47**
	Left-Through		0			0	
	Through	114	2	57	157	2	79
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	94	1	94	139	1	**139**
	Through-Right		0			0	
	Right	744	1	**399**	459	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	345		*North-South:*	498
			East-West:	483		*East-West:*	186
			SUM:	828		*SUM:*	684
	VOLUME/CAPACITY *(V/C)* RATIO:			0.552			0.456
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.452**			**0.356**
	LEVEL OF SERVICE (LOS):			**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 4

PROJECT TITLE: Ballona Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Washington Boulevard
Scenario: Existing (2015) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			4			4
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 3	WB --	3	EB -- 3	WB --	3
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	624	2	**343**	437	2	**240**
	Left-Through		0			0	
	Through	1446	2	515	1178	2	458
	Through-Right		1			1	
	Right	100	0	100	197	0	197
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	222	2	122	176	2	97
	Left-Through		0			0	
	Through	1395	2	**502**	1404	2	**504**
	Through-Right		1			1	
	Right	112	0	112	108	0	108
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	78	2	43	102	2	56
	Left-Through		0			0	
	Through	749	2	**375**	674	2	**337**
	Through-Right		0			0	
	Right	523	1	180	501	1	261
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	127	2	**70**	247	2	**136**
	Left-Through		0			0	
	Through	682	2	341	754	2	377
	Through-Right		0			0	
	Right	181	1	59	226	1	129
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	845		*North-South:*	744
			East-West:	445		*East-West:*	473
			SUM:	1290		*SUM:*	1217
	VOLUME/CAPACITY *(V/C)* RATIO:			0.938			0.885
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.838**			**0.785**
	LEVEL OF SERVICE (LOS):			**D**			**C**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 5

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Marina Expressway (SR-90)
Scenario: Existing (2015) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 0	WB --		3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	1352	2	**524**	1361	2	**551**
	Through-Right		1			1	
	Right	221	0	221	292	0	292
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	869	2	**478**	825	2	**454**
	Left-Through		0			0	
	Through	1325	3	442	1582	3	527
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	**0**	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	201	2	111	188	2	**103**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	1163	2	**162**	799	2	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1002		*North-South:*	1005
			East-West:	162		*East-West:*	103
			SUM:	1164		*SUM:*	1108
VOLUME/CAPACITY *(V/C)* RATIO:				0.817			0.778
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.717**			**0.678**
LEVEL OF SERVICE (LOS):				**C**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 6

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Bali Way
Scenario: Existing (2015) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			4			4
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			2			2
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	197	1	**197**	116	1	**116**
	Left-Through		0			0	
	Through	1334	2	452	1261	2	423
	Through-Right		1			1	
	Right	23	0	23	9	0	9
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	27	1	27	40	1	40
	Left-Through		0			0	
	Through	1300	2	**519**	1493	2	**597**
	Through-Right		1			1	
	Right	258	0	258	299	0	299
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	210	1	**106**	327	1	**165**
	Left-Through		1			1	
	Through	1	0	106	3	0	165
	Through-Right		0			0	
	Right	59	1	0	107	1	49
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	3	0	3	9	0	9
	Left-Through		0			0	
	Through	1	0	**15**	2	0	**20**
	Through-Right		0			0	
	Right	11	0	0	9	0	0
	Left-Through-Right		1			1	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	716		*North-South:*	713
			East-West:	121		*East-West:*	185
			SUM:	837		*SUM:*	898
	VOLUME/CAPACITY *(V/C)* RATIO:			0.609			0.653
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.509**			**0.553**
	LEVEL OF SERVICE (LOS):			**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 7

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Mindanao Way
Scenario: Existing (2015) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	0		NB -- 3	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	185	1	185	94	1	94
	Left-Through		0			0	
	Through	1528	3	**509**	1238	3	**413**
	Through-Right		0			0	
	Right	427	1	275	331	1	88
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	155	1	**155**	211	1	**211**
	Left-Through		0			0	
	Through	1102	2	380	1472	2	510
	Through-Right		1			1	
	Right	39	0	39	57	0	57
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	548	1	**298**	515	1	**350**
	Through-Right		1			1	
	Right	48	0	48	184	0	184
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	276	2	**152**	442	2	**243**
	Left-Through		0			0	
	Through	436	1	273	542	1	310
	Through-Right		1			1	
	Right	110	0	110	78	0	78
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	664		*North-South:*	624
			East-West:	450		*East-West:*	593
			SUM:	1114		*SUM:*	1217
VOLUME/CAPACITY *(V/C)* RATIO:				0.810			0.885
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.710**			**0.785**
LEVEL OF SERVICE (LOS):				**C**			**C**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 8

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Fiji Way
Scenario: Existing (2015) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 1	WB --		0	EB -- 1	WB --	0
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	842	2	**463**	636	2	**350**
	Left-Through		0			0	
	Through	1966	2	667	1557	2	531
	Through-Right		1			1	
	Right	36	0	36	37	0	37
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	50	1	50	45	1	45
	Left-Through		0			0	
	Through	1326	2	**466**	1983	2	**692**
	Through-Right		1			1	
	Right	73	0	73	94	0	94
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	69	1	**69**	85	1	**85**
	Left-Through		0			0	
	Through	16	1	16	24	1	24
	Through-Right		0			0	
	Right	545	1	0	901	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	30	0	30	50	0	50
	Left-Through		1			1	
	Through	10	0	**43**	27	0	**54**
	Through-Right		1			1	
	Right	33	0	0	27	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	929		*North-South:*	1042
			East-West:	112		*East-West:*	139
			SUM:	1041		*SUM:*	1181
VOLUME/CAPACITY *(V/C)* RATIO:				0.731			0.829
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.631**			**0.729**
LEVEL OF SERVICE (LOS):				**B**			**C**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 9

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Culver Loop
Scenario: Existing (2015) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			2			2
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	2543	2	**1196**	1903	2	**795**
	Through-Right		1			1	
	Right	1045	0	1045	481	0	481
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	1942	2	971	2897	2	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	297	2	**163**	296	2	**163**
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	1196		*North-South:*	795
			East-West:	163		*East-West:*	163
			SUM:	1359		*SUM:*	958
	VOLUME/CAPACITY *(V/C)* RATIO:			0.906			0.639
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.806**			**0.539**
	LEVEL OF SERVICE (LOS):			**D**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 10

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Jefferson Boulevard
Scenario: Existing (2015) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	3		NB -- 3	SB --	3
	EB -- 0	WB --	3		EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	14	1	14	31	1	31
	Left-Through		0			0	
	Through	2874	4	**719**	1563	4	**391**
	Through-Right		0			0	
	Right	484	1	309	306	1	43
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	444	2	**244**	515	2	**283**
	Left-Through		0			0	
	Through	1082	4	271	1748	4	437
	Through-Right		0			0	
	Right	177	1	0	663	1	576
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	184	1	**184**	87	1	87
	Left-Through		0			0	
	Through	288	2	109	172	2	**81**
	Through-Right		1			1	
	Right	38	0	38	71	0	71
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	318	2	175	478	2	**263**
	Left-Through		0			0	
	Through	111	2	56	339	2	170
	Through-Right		0			0	
	Right	711	2	**147**	742	2	125
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	963		*North-South:*	674
			East-West:	331		*East-West:*	344
			SUM:	1294		*SUM:*	1018
VOLUME/CAPACITY *(V/C)* RATIO:				0.941			0.740
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.841**			**0.640**
LEVEL OF SERVICE (LOS):				**D**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 11

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Bluff Creek Drive
Scenario: Existing (2015) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	0		NB -- 3	SB --	0
	EB -- 0	WB --	3		EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	3154	4	**789**	2088	4	522
	Through-Right		0			0	
	Right	545	1	438	239	1	164
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	42	2	**23**	53	2	29
	Left-Through		0			0	
	Through	1373	4	343	2321	4	**580**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	194	2	**107**	137	2	**75**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	35	1	12	46	1	17
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	812		*North-South:*	580
			East-West:	107		*East-West:*	75
			SUM:	919		*SUM:*	655
VOLUME/CAPACITY *(V/C)* RATIO:				0.645			0.460
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.545**			**0.360**
LEVEL OF SERVICE (LOS):				**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 12

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Nicholson Street East-West Street: Culver Boulevard
Scenario: Existing (2015) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 1	SB --	0	NB -- 1	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	10	0	**10**	43	0	43
	Left-Through		1			1	
	Through	0	0	10	3	0	**46**
	Through-Right		0			0	
	Right	831	1	0	365	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	4	0	4	1	0	**1**
	Left-Through		0			0	
	Through	0	0	**5**	1	0	2
	Through-Right		0			0	
	Right	1	0	0	0	0	0
	Left-Through-Right		1			1	
	Left-Right		0			0	
EASTBOUND	Left	1	1	1	2	1	2
	Left-Through		0			0	
	Through	1429	1	**722**	550	1	**296**
	Through-Right		1			1	
	Right	15	0	15	42	0	42
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	335	1	**335**	940	1	**940**
	Left-Through		0			0	
	Through	501	1	252	1397	1	700
	Through-Right		1			1	
	Right	2	0	2	2	0	2
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	15		*North-South:*	47
			East-West:	1057		*East-West:*	1236
			SUM:	1072		*SUM:*	1283
	VOLUME/CAPACITY *(V/C)* RATIO:			0.752			0.900
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.652**			**0.800**
	LEVEL OF SERVICE (LOS):			**B**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 13

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Jefferson Boulevard East-West Street: Culver Boulevard
Scenario: Existing (2015) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	335	2	**184**	1000	2	**550**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	5	1	5	7	1	7
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	1969	2	**985**	774	2	387
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	72	0	**72**	72	0	72
	Left-Through		1			1	
	Through	477	1	455	1348	1	**818**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	184		*North-South:*	550
			East-West:	1057		*East-West:*	818
			SUM:	1241		*SUM:*	1368
VOLUME/CAPACITY *(V/C)* RATIO:				0.827			0.912
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.727**			**0.812**
LEVEL OF SERVICE (LOS):				**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 14

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 EB Ramps East-West Street: Culver Boulevard
Scenario: Existing (2015) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			2			2
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	115	1	**115**	102	1	**102**
	Left-Through		0			0	
	Through	0	1	0	4	1	4
	Through-Right		1			1	
	Right	35	0	35	59	0	59
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	1770	3	**590**	725	3	242
	Through-Right		0			0	
	Right	989	2	544	324	2	178
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	99	1	**99**	301	1	301
	Left-Through		0			0	
	Through	566	2	283	1494	2	**747**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	115		*North-South:*	102
			East-West:	689		*East-West:*	747
			SUM:	804		*SUM:*	849
	VOLUME/CAPACITY *(V/C)* RATIO:			0.536			0.566
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.436**			**0.466**
	LEVEL OF SERVICE (LOS):			A			A

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 15

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 WB Ramps East-West Street: Culver Boulevard
Scenario: Existing (2015) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				1			1
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0		NB -- 0	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	180	1	99	279	1	153
	Left-Through		1			1	
	Through	294	0	**416**	232	0	**277**
	Through-Right		1			1	
	Right	122	0	122	45	0	45
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	81	1	**81**	155	1	155
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	149	1	0	517	1	**416**
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	498	1	**498**	202	1	**202**
	Left-Through		0			0	
	Through	1383	2	692	622	2	311
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	325	2	163	987	2	**494**
	Through-Right		0			0	
	Right	324	1	**284**	257	1	180
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	497		*North-South:*	693
			East-West:	782		*East-West:*	696
			SUM:	1279		*SUM:*	1389
VOLUME/CAPACITY *(V/C)* RATIO:				0.898			0.975
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.798**			**0.875**
LEVEL OF SERVICE (LOS):				**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 16

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 EB Ramps East-West Street: Mindanao Way
Scenario: Existing (2015) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0		NB -- 0	SB --	0
	EB -- 2	WB --	0		EB -- 2	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	17	1	17	22	1	22
	Left-Through		0			0	
	Through	1096	1	**553**	1050	1	**531**
	Through-Right		1			1	
	Right	9	0	9	12	0	12
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	472	1	**409**	443	1	**396**
	Through-Right		1			1	
	Right	754	1	0	746	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	471	2	**259**	673	2	**370**
	Left-Through		0			0	
	Through	894	2	447	1084	2	542
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	553		*North-South:*	531
			East-West:	668		*East-West:*	766
			SUM:	1221		*SUM:*	1297
VOLUME/CAPACITY *(V/C)* RATIO:				0.857			0.910
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.757**			**0.810**
LEVEL OF SERVICE (LOS):				**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 17

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 WB Ramps East-West Street: Mindanao Way
Scenario: Existing (2015) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0		NB -- 0	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

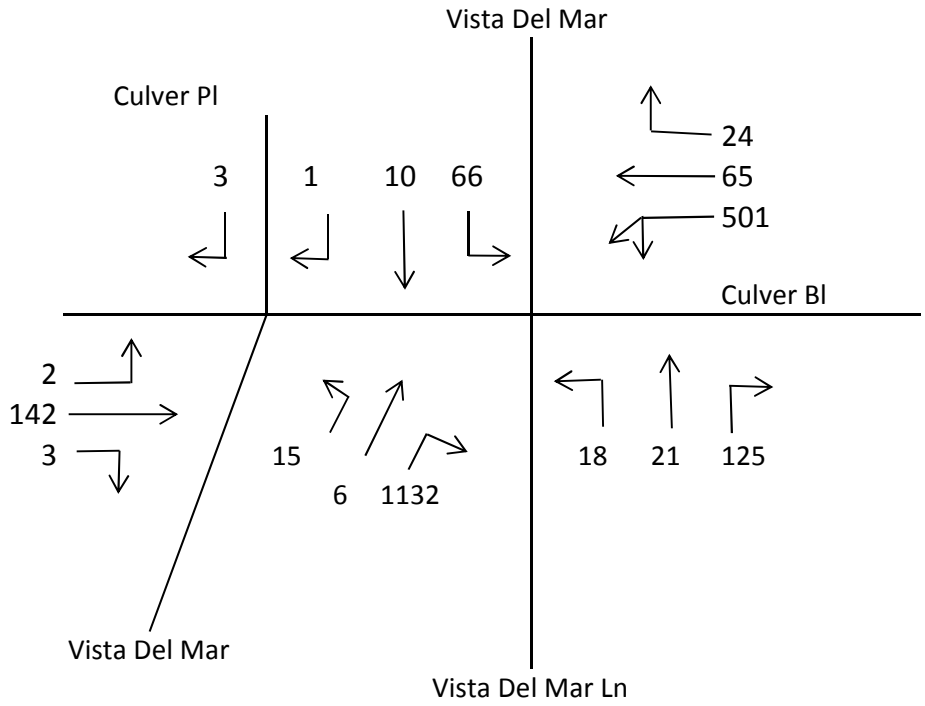
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	525	1	525	560	1	**503**
	Left-Through		1			1	
	Through	1356	1	**678**	950	1	503
	Through-Right		0			0	
	Right	576	1	576	397	1	397
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	**0**	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	30	1	**30**	14	1	**14**
	Left-Through		0			0	
	Through	494	2	247	443	2	222
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	718	2	**249**	1228	2	**424**
	Through-Right		1			1	
	Right	30	0	30	43	0	43
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	678		*North-South:*	503
			East-West:	279		*East-West:*	438
			SUM:	957		*SUM:*	941
VOLUME/CAPACITY *(V/C)* RATIO:				0.672			0.660
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.572**			**0.560**
LEVEL OF SERVICE (LOS):				**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

CMA METHODOLOGY
EXISTING (2015) PLUS PROJECT - ALT 2 CONDITIONS
AM PEAK HOUR

Int#18 - Vista Del Mar/Vista Del Mar Lane & Culver Boulevard



1. 501 x 0.55 or (65 + 24)

2. (15 + 6 + 1132) x 0.55

3. $\frac{(2 + 142 + 3)}{2}$

4. 66 + (18 + 21 + 125) or 18 + (66 + 10 + 1)

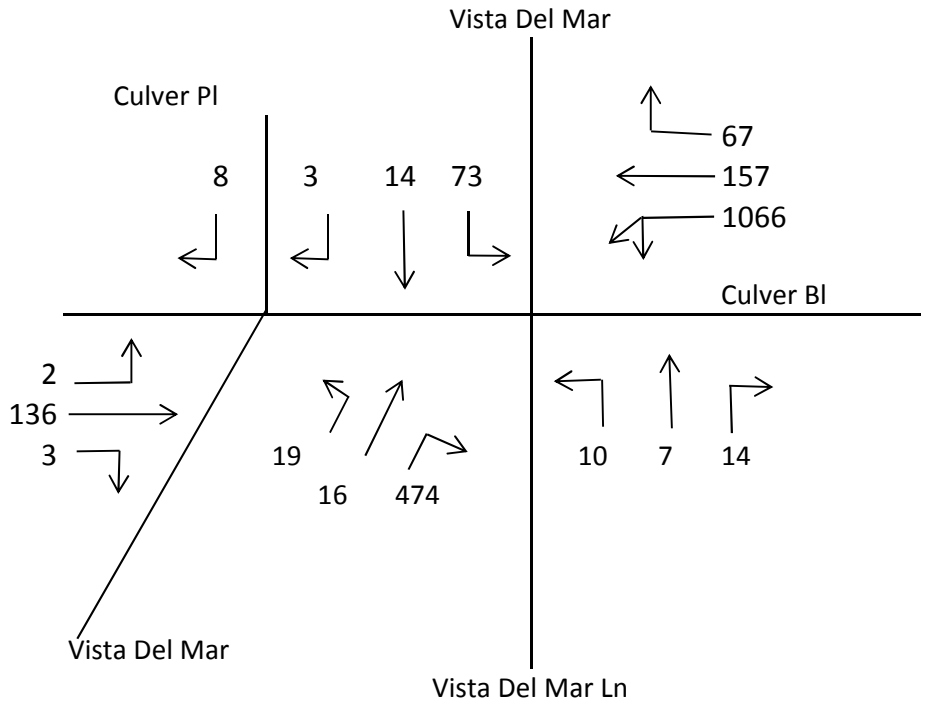
Critical Volumes = 276 + 634 + 74 + 230 = 1214

V/C = $\frac{1214}{1375}$ =

= 0.883 - 0.10 = 0.783 LOS C
ATSAC/ATCS

CMA METHODOLOGY
EXISTING (2015) PLUS PROJECT - ALT 2 CONDITIONS
PM PEAK HOUR

Int#18 - Vista Del Mar/Vista Del Mar Lane & Culver Boulevard



1. 1066 x 0.55 or (157 + 67)

2. (19 + 16 + 474) x 0.55

3. $\frac{(2 + 136 + 3)}{2}$

4. 73 + (10 + 7 + 14) or 10 + (73 + 14 + 3)

Critical Volumes = 586 + 280 + 71 + 104 = 1041

V/C = $\frac{1041}{1375}$ =

= 0.757 - 0.10 = 0.657 LOS B
ATSAC/ATCS

Level of Service Worksheet
(Circular 212 Method)

I/S #:	PROJECT TITLE:	Ballona Wetlands Restortation Project			
1	North-South Street:	Admiralty Way	East-West Street:	Bali Way	
	Scenario:	Cumulative (2023) Plus Project - Alternative 2 Conditions			
	Count Date:		Analyst:	RA	Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	3	EB -- 0	WB --	3
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	25	1	25	25	1	25
	Left-Through		0			0	
	Through	1213	1	**621**	1093	1	**606**
	Through-Right		1			1	
	Right	29	0	29	119	0	119
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	239	1	**239**	283	1	**283**
	Left-Through		0			0	
	Through	1233	1	626	1441	1	733
	Through-Right		1			1	
	Right	19	0	19	24	0	24
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	14	0	**14**	16	0	**16**
	Left-Through		1			1	
	Through	19	0	32	51	0	55
	Through-Right		1			1	
	Right	16	0	32	27	0	55
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	23	1	23	25	1	25
	Left-Through		0			0	
	Through	43	0	**204**	40	0	**224**
	Through-Right		1			1	
	Right	364	1	0	407	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	860		*North-South:*	889
			East-West:	218		*East-West:*	240
			SUM:	1078		*SUM:*	1129
	VOLUME/CAPACITY *(V/C)* RATIO:			0.756			0.792
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.656**			**0.692**
	LEVEL OF SERVICE (LOS):			**B**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 2

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Admiralty Way East-West Street: Mindanao Way
Scenario: Cumulative (2023) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			4			4
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			2			2
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	3	EB -- 0	WB --	3
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	30	1	30	18	1	18
	Left-Through		0			0	
	Through	821	1	**438**	688	1	**418**
	Through-Right		1			1	
	Right	55	0	55	148	0	148
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	470	1	**470**	406	1	**406**
	Left-Through		0			0	
	Through	702	1	360	1090	1	553
	Through-Right		1			1	
	Right	18	0	18	16	0	16
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	20	1	20	20	1	20
	Left-Through		0			0	
	Through	57	0	**79**	46	0	**68**
	Through-Right		1			1	
	Right	22	0	0	22	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	163	1	**126**	275	1	**150**
	Left-Through		1			1	
	Through	89	0	126	24	0	150
	Through-Right		0			0	
	Right	451	1	0	467	1	61
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	908		*North-South:*	824
			East-West:	205		*East-West:*	218
			SUM:	1113		*SUM:*	1042
	VOLUME/CAPACITY *(V/C)* RATIO:			0.809			0.758
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.709**			**0.658**
	LEVEL OF SERVICE (LOS):			**C**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 3

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Admiralty Way East-West Street: Fiji Way
Scenario: Cumulative (2023) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			2			2
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	3	EB -- 0	WB --	3
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	695	2	**382**	995	2	**547**
	Left-Through		0			0	
	Through	20	0	0	0	0	0
	Through-Right		0			0	
	Right	78	1	34	126	1	102
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	88	1	**88**	49	1	**49**
	Left-Through		0			0	
	Through	119	2	60	169	2	85
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	98	1	98	145	1	**145**
	Through-Right		0			0	
	Right	791	1	**409**	546	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	382		*North-South:*	547
			East-West:	497		*East-West:*	194
			SUM:	879		*SUM:*	741
	VOLUME/CAPACITY *(V/C)* RATIO:			0.586			0.494
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.486**			**0.394**
	LEVEL OF SERVICE (LOS):			**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 4

PROJECT TITLE: Ballona Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Washington Boulevard
Scenario: Cumulative (2023) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?		NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 3	WB --	3	EB -- 3	WB --	3
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0
MOVEMENT		Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	665	2	**366**	499	2	**274**
	Left-Through		0			0	
	Through	1619	2	578	1411	2	545
	Through-Right		1			1	
	Right	115	0	115	225	0	225
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	264	2	145	223	2	123
	Left-Through		0			0	
	Through	1613	2	**578**	1591	2	**571**
	Through-Right		1			1	
	Right	122	0	122	123	0	123
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	89	2	49	113	2	62
	Left-Through		0			0	
	Through	810	2	**405**	742	2	**371**
	Through-Right		0			0	
	Right	587	1	221	548	1	274
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	141	2	**78**	278	2	**153**
	Left-Through		0			0	
	Through	730	2	365	831	2	416
	Through-Right		0			0	
	Right	198	1	53	268	1	145
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	944		*North-South:*	845
			East-West:	483		*East-West:*	524
			SUM:	1427		*SUM:*	1369
VOLUME/CAPACITY *(V/C)* RATIO:				1.038			0.996
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.938**			**0.896**
LEVEL OF SERVICE (LOS):				**E**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 5

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Marina Expressway (SR-90)
Scenario: Cumulative (2023) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	1524	2	**585**	1632	2	**646**
	Through-Right		1			1	
	Right	231	0	231	307	0	307
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	1005	2	**553**	919	2	**505**
	Left-Through		0			0	
	Through	1569	3	523	1828	3	609
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	**0**	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	223	2	123	237	2	**130**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	1251	2	**135**	946	2	15
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1138		*North-South:*	1151
			East-West:	135		*East-West:*	130
			SUM:	1273		*SUM:*	1281
VOLUME/CAPACITY *(V/C)* RATIO:				0.893			0.899
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.793**			**0.799**
LEVEL OF SERVICE (LOS):				**C**			**C**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 6

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Bali Way
Scenario: Cumulative (2023) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			4			4
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			2			2
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	207	1	**207**	126	1	**126**
	Left-Through		0			0	
	Through	1493	2	506	1510	2	508
	Through-Right		1			1	
	Right	24	0	24	13	0	13
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	40	1	40	59	1	59
	Left-Through		0			0	
	Through	1553	2	**608**	1738	2	**685**
	Through-Right		1			1	
	Right	272	0	272	317	0	317
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	220	1	**111**	344	1	**174**
	Left-Through		1			1	
	Through	1	0	111	3	0	174
	Through-Right		0			0	
	Right	62	1	0	114	1	51
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	3	0	3	15	0	15
	Left-Through		0			0	
	Through	1	0	**16**	2	0	**26**
	Through-Right		0			0	
	Right	12	0	0	9	0	0
	Left-Through-Right		1			1	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	815		*North-South:*	811
			East-West:	127		*East-West:*	200
			SUM:	942		*SUM:*	1011
	VOLUME/CAPACITY *(V/C)* RATIO:			0.685			0.735
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.585**			**0.635**
	LEVEL OF SERVICE (LOS):			**A**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 7

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Mindanao Way
Scenario: Cumulative (2023) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	0		NB -- 3	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	195	1	195	101	1	101
	Left-Through		0			0	
	Through	1697	3	**566**	1494	3	**498**
	Through-Right		0			0	
	Right	451	1	288	368	1	106
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	178	1	**178**	241	1	**241**
	Left-Through		0			0	
	Through	1327	2	456	1691	2	584
	Through-Right		1			1	
	Right	41	0	41	60	0	60
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	576	1	**313**	547	1	**371**
	Through-Right		1			1	
	Right	50	0	50	194	0	194
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	297	2	**163**	477	2	**262**
	Left-Through		0			0	
	Through	460	1	288	575	1	329
	Through-Right		1			1	
	Right	115	0	115	82	0	82
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	744		*North-South:*	739
			East-West:	476		*East-West:*	633
			SUM:	1220		*SUM:*	1372
VOLUME/CAPACITY *(V/C)* RATIO:				0.887			0.998
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.787**			**0.898**
LEVEL OF SERVICE (LOS):				**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 8

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Fiji Way
Scenario: Cumulative (2023) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 1	WB --	0	EB -- 1	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	893	2	**491**	732	2	**403**
	Left-Through		0			0	
	Through	2160	2	733	1852	2	630
	Through-Right		1			1	
	Right	38	0	38	39	0	39
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	52	1	52	47	1	47
	Left-Through		0			0	
	Through	1571	2	**549**	2241	2	**780**
	Through-Right		1			1	
	Right	76	0	76	99	0	99
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	72	1	**72**	89	1	**89**
	Left-Through		0			0	
	Through	17	1	17	25	1	25
	Through-Right		0			0	
	Right	629	1	0	995	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	31	0	31	53	0	53
	Left-Through		1			1	
	Through	10	0	**45**	28	0	**56**
	Through-Right		1			1	
	Right	35	0	0	28	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	1040		*North-South:*	1183
			East-West:	117		*East-West:*	145
			SUM:	1157		*SUM:*	1328
	VOLUME/CAPACITY *(V/C)* RATIO:			0.812			0.932
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.712**			**0.832**
	LEVEL OF SERVICE (LOS):			**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 9

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Culver Loop
Scenario: Cumulative (2023) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0		NB -- 0	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	2776	2	**1294**	2279	2	**939**
	Through-Right		1			1	
	Right	1107	0	1107	539	0	539
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	2274	2	1137	3250	2	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	311	2	**171**	311	2	**171**
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1294		*North-South:*	939
			East-West:	171		*East-West:*	171
			SUM:	1465		*SUM:*	1110
VOLUME/CAPACITY *(V/C)* RATIO:				0.977			0.740
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.877**			**0.640**
LEVEL OF SERVICE (LOS):				**D**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 10

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Jefferson Boulevard
Scenario: Cumulative (2023) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	3		NB -- 3	SB --	3
	EB -- 0	WB --	3		EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	18	1	18	42	1	42
	Left-Through		0			0	
	Through	3043	4	**761**	1793	4	**448**
	Through-Right		0			0	
	Right	645	1	436	361	1	29
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	550	2	**303**	679	2	**373**
	Left-Through		0			0	
	Through	1286	4	322	1899	4	475
	Through-Right		0			0	
	Right	195	1	0	708	1	604
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	199	1	199	104	1	104
	Left-Through		0			0	
	Through	410	2	**153**	261	2	**117**
	Through-Right		1			1	
	Right	50	0	50	89	0	89
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	380	2	**209**	603	2	**332**
	Left-Through		0			0	
	Through	180	2	90	498	2	249
	Through-Right		0			0	
	Right	833	2	155	965	2	158
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1064		*North-South:*	821
			East-West:	362		*East-West:*	449
			SUM:	1426		*SUM:*	1270
VOLUME/CAPACITY *(V/C)* RATIO:				1.037			0.924
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.937**			**0.824**
LEVEL OF SERVICE (LOS):				**E**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 11

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Bluff Creek Drive
Scenario: Cumulative (2023) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	0	NB -- 3	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	3469	4	**867**	2321	4	580
	Through-Right		0			0	
	Right	802	1	613	397	1	142
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	146	2	**80**	68	2	37
	Left-Through		0			0	
	Through	1545	4	386	2604	4	**651**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	343	2	**189**	463	2	**255**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	45	1	0	80	1	43
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	947		*North-South:*	651
			East-West:	189		*East-West:*	255
			SUM:	1136		*SUM:*	906
VOLUME/CAPACITY *(V/C)* RATIO:				0.797			0.636
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.697**			**0.536**
LEVEL OF SERVICE (LOS):				**B**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 12

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Nicholson Street East-West Street: Culver Boulevard
Scenario: Cumulative (2023) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 1	SB --	0		NB -- 1	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	10	0	**10**	45	0	45
	Left-Through		1			1	
	Through	0	0	10	3	0	**48**
	Through-Right		0			0	
	Right	916	1	0	421	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	4	0	4	1	0	**1**
	Left-Through		0			0	
	Through	0	0	**5**	1	0	2
	Through-Right		0			0	
	Right	1	0	0	0	0	0
	Left-Through-Right		1			1	
	Left-Right		0			0	
EASTBOUND	Left	1	1	1	2	1	2
	Left-Through		0			0	
	Through	1577	1	**797**	656	1	**350**
	Through-Right		1			1	
	Right	16	0	16	44	0	44
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	375	1	**375**	1051	1	**1051**
	Left-Through		0			0	
	Through	589	1	296	1578	1	790
	Through-Right		1			1	
	Right	2	0	2	2	0	2
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	15		*North-South:*	49
			East-West:	1172		*East-West:*	1401
			SUM:	1187		*SUM:*	1450
VOLUME/CAPACITY *(V/C)* RATIO:				0.833			1.018
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.733**			**0.918**
LEVEL OF SERVICE (LOS):				**C**			**E**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 13

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Jefferson Boulevard East-West Street: Culver Boulevard
Scenario: Cumulative (2023) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			2			2
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	383	2	**211**	1160	2	**638**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	25	1	0	55	1	55
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	2071	2	**1036**	836	2	418
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	127	0	**127**	138	0	138
	Left-Through		1			1	
	Through	511	1	511	1440	1	**996**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	211		*North-South:*	638
			East-West:	1163		*East-West:*	996
			SUM:	1374		*SUM:*	1634
	VOLUME/CAPACITY *(V/C)* RATIO:			0.916			1.089
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.816**			**0.989**
	LEVEL OF SERVICE (LOS):			**D**			**E**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 14

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 EB Ramps East-West Street: Culver Boulevard
Scenario: Cumulative (2023) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0		NB -- 0	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	129	1	**129**	114	1	**114**
	Left-Through		0			0	
	Through	0	1	0	4	1	4
	Through-Right		1			1	
	Right	37	0	37	62	0	62
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	1867	3	**622**	795	3	265
	Through-Right		0			0	
	Right	1043	2	574	364	2	200
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	118	1	**118**	337	1	337
	Left-Through		0			0	
	Through	619	2	310	1609	2	**805**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	129		*North-South:*	114
			East-West:	740		*East-West:*	805
			SUM:	869		*SUM:*	919
VOLUME/CAPACITY *(V/C)* RATIO:				0.579			0.613
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.479**			**0.513**
LEVEL OF SERVICE (LOS):				**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 15

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 WB Ramps East-West Street: Culver Boulevard
Scenario: Cumulative (2023) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				1			1
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	191	1	105	300	1	165
	Left-Through		1			1	
	Through	320	0	**448**	264	0	**311**
	Through-Right		1			1	
	Right	128	0	128	47	0	47
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	92	1	**92**	173	1	173
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	181	1	0	579	1	**465**
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	530	1	**530**	228	1	**228**
	Left-Through		0			0	
	Through	1462	2	731	678	2	339
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	353	2	177	1055	2	**528**
	Through-Right		0			0	
	Right	352	1	**306**	300	1	214
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	540		*North-South:*	776
			East-West:	836		*East-West:*	756
			SUM:	1376		*SUM:*	1532
VOLUME/CAPACITY *(V/C)* RATIO:				0.966			1.075
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.866**			**0.975**
LEVEL OF SERVICE (LOS):				D			E

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 16

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 EB Ramps East-West Street: Mindanao Way
Scenario: Cumulative (2023) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 2	WB --	0	EB -- 2	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	18	1	18	23	1	23
	Left-Through		0			0	
	Through	1204	1	**607**	1129	1	**571**
	Through-Right		1			1	
	Right	9	0	9	13	0	13
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	499	1	**432**	487	1	**427**
	Through-Right		1			1	
	Right	797	1	0	793	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	512	2	**282**	722	2	**397**
	Left-Through		0			0	
	Through	947	2	474	1157	2	579
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	607		*North-South:*	571
			East-West:	714		*East-West:*	824
			SUM:	1321		*SUM:*	1395
	VOLUME/CAPACITY *(V/C)* RATIO:			0.927			0.979
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.827**			**0.879**
	LEVEL OF SERVICE (LOS):			**D**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 17

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 WB Ramps East-West Street: Mindanao Way
Scenario: Cumulative (2023) Plus Project - Alternative 2 Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0		NB -- 0	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

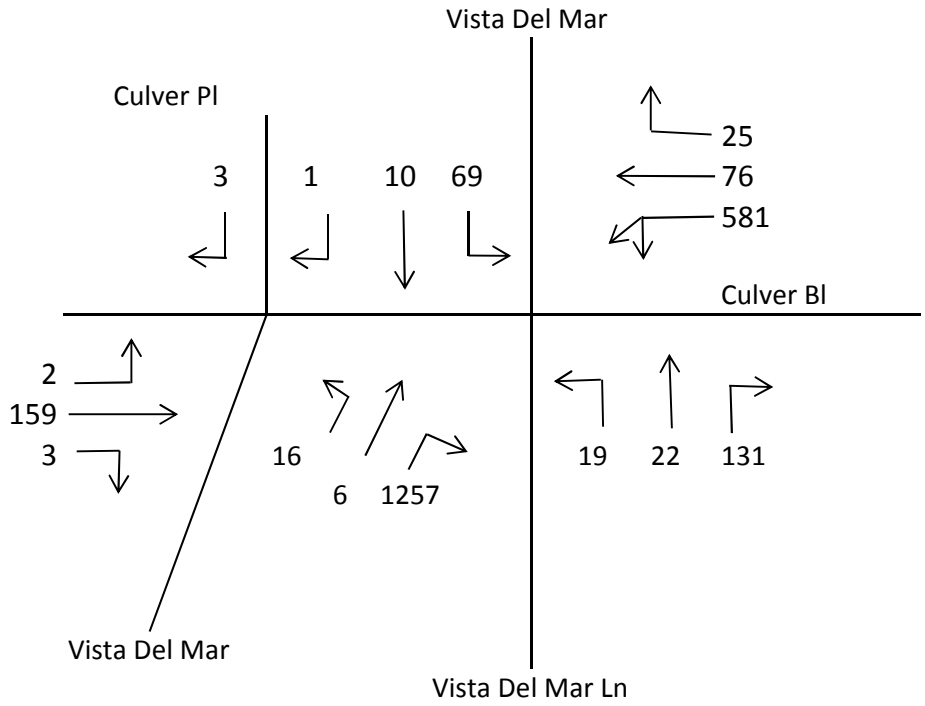
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	549	1	549	589	1	**563**
	Left-Through		1			1	
	Through	1449	1	**725**	1099	1	563
	Through-Right		0			0	
	Right	608	1	608	443	1	443
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	**0**	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	34	1	**34**	26	1	**26**
	Left-Through		0			0	
	Through	519	2	260	476	2	238
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	782	2	**274**	1323	2	**460**
	Through-Right		1			1	
	Right	39	0	39	57	0	57
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	725		*North-South:*	563
			East-West:	308		*East-West:*	486
			SUM:	1033		*SUM:*	1049
VOLUME/CAPACITY *(V/C)* RATIO:				0.725			0.736
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.625**			**0.636**
LEVEL OF SERVICE (LOS):				**B**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

CMA METHODOLOGY
CUMULATIVE (2023) PLUS PROJECT - ALT 2 CONDITIONS
AM PEAK HOUR

Int#18 - Vista Del Mar/Vista Del Mar Lane & Culver Boulevard



1. 581 x 0.55 or (76 + 25)

2. (16 + 6 + 1257) x 0.55

3. $\frac{(2 + 159 + 3)}{2}$

4. 69 + (19 + 22 + 131) or 19 + (69 + 10 + 1)

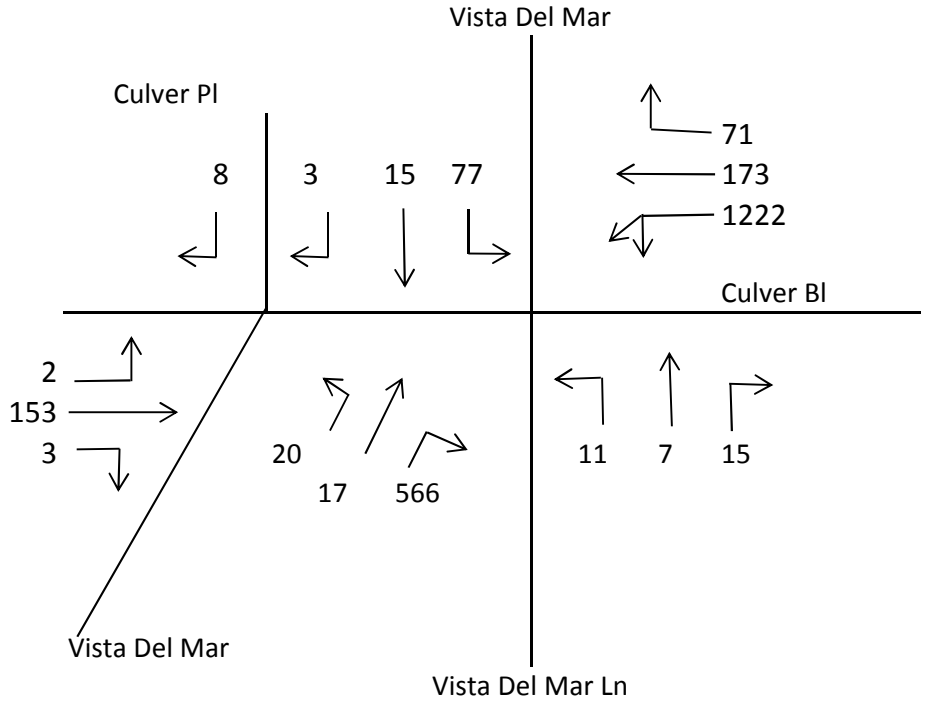
Critical Volumes = 320 + 703 + 82 + 241 = 1346

V/C = $\frac{1346}{1375}$ =

= 0.979 - 0.10 = 0.879 LOS D
ATSAC/ATCS

CMA METHODOLOGY
CUMULATIVE (2023) PLUS PROJECT - ALT 2 CONDITIONS
PM PEAK HOUR

Int#18 - Vista Del Mar/Vista Del Mar Lane & Culver Boulevard



1. 1222 x 0.55 or (173 + 71)

2. (20 + 17 + 566) x 0.55

3. $\frac{(2 + 153 + 3)}{2}$

4. 77 + (11 + 7 + 15) or 11 + (77 + 15 + 3)

Critical Volumes = 672 + 332 + 79 + 110 = 1193

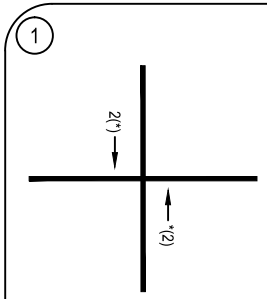
V/C = $\frac{1193}{1375}$ =

= 0.868 - 0.10 = 0.768 LOS C
ATSAC/ATCS

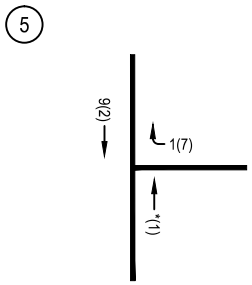
APPENDIX J

Level of Service Worksheets

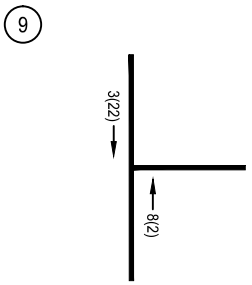
Cumulative (2019) with Project Construction Activity – Alternative 2 Conditions



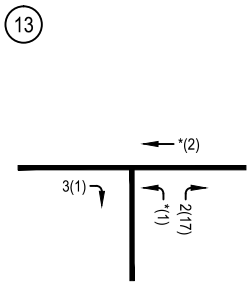
1 ADMIRALTY WAY & BALI WAY



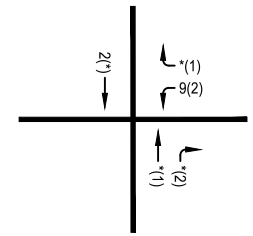
5 LINCOLN BL & MARINA (SR-90) EXPRESSWAY



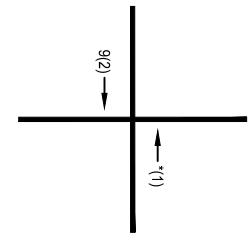
9 LINCOLN BL & CULVER BL



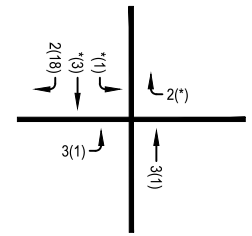
13 CULVER BL & JEFFERSON BL



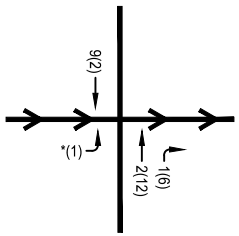
2 ADMIRALTY WAY & MINDANAO WAY



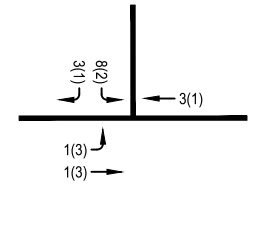
6 LINCOLN BL & BALI WAY



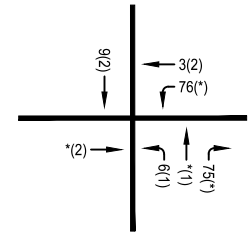
10 LINCOLN BL & JEFFERSON BL



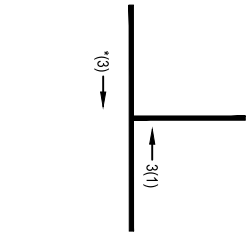
14 CULVER BL & SR-90 EB RAMPS



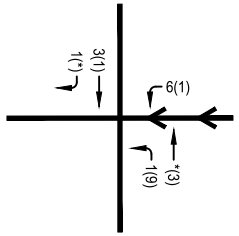
3 ADMIRALTY WAY & FIJI WAY



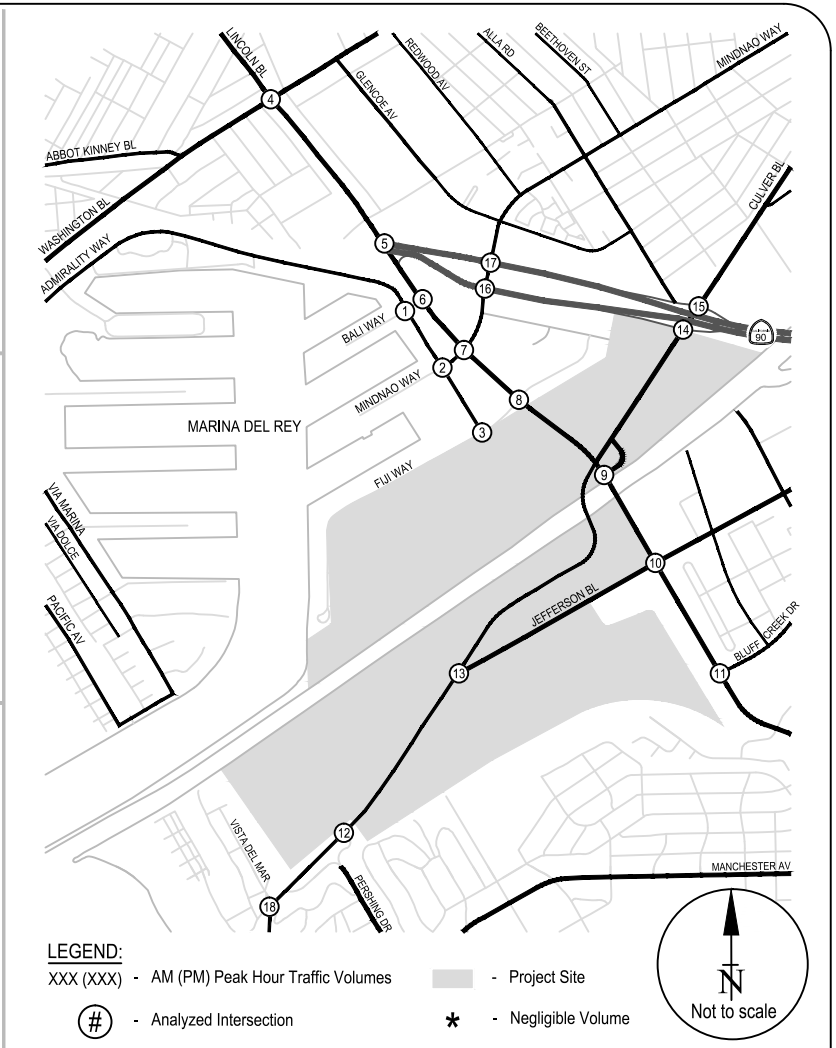
7 LINCOLN BL & MINDANAO WAY

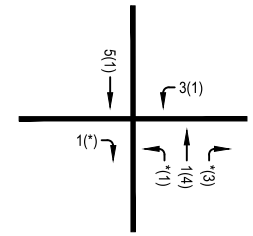


11 LINCOLN BL & BLUFF CREEK DRIVE

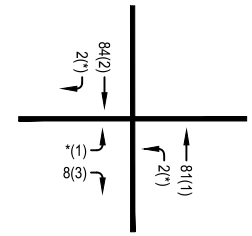


15 CULVER BL & SR-90 WB RAMPS

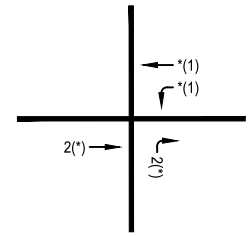




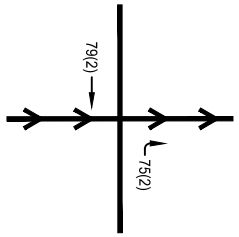
4 LINCOLN BL & WASHINGTON BL



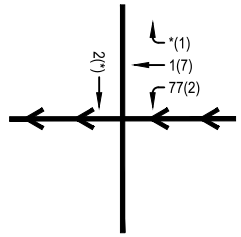
8 LINCOLN BL & FIJI WAY



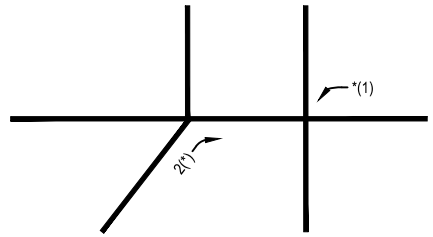
12 NICHOLSON ST & CULVER BL



16 MINDANAO WAY & MARINA (SR-90) EXPRESSWAY EB



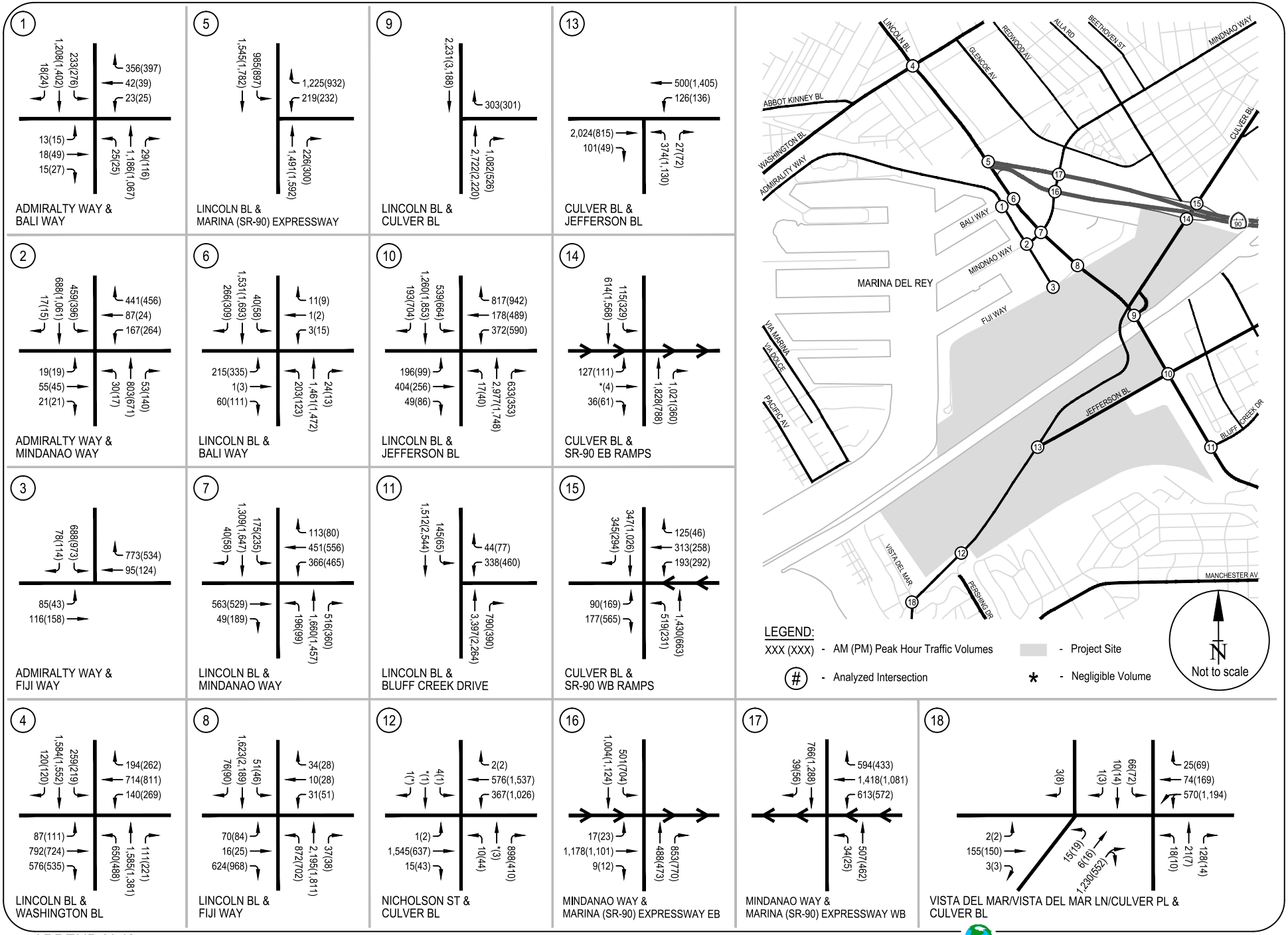
17 MINDANAO WAY & MARINA (SR-90) EXPRESSWAY WB



18 VISTA DEL MAR/VISTA DEL MAR LN/CULVER PL & CULVER BL

APPENDIX J1
ALTERNATIVE 2 CONSTRUCTION ACTIVITY TRIPS - PEAK HOUR TRAFFIC VOLUMES

RAJU Associates, Inc.



APPENDIX J2
CUMULATIVE (2019) WITH PROJECT CONSTRUCTION ACTIVITY - ALTERNATIVE 2
PEAK HOUR TRAFFIC VOLUMES

RAJU Associates, Inc.

Level of Service Worksheet
(Circular 212 Method)

I/S #:	PROJECT TITLE:	Ballona Wetlands Restortation Project			
1	North-South Street:	Admiralty Way	East-West Street:	Bali Way	
	Scenario:	Cumulative (2019) with Construction Activity - Alternative 2			
	Count Date:		Analyst:	RA	Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	3	EB -- 0	WB --	3
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	25	1	25	25	1	25
	Left-Through		0			0	
	Through	1186	1	**608**	1067	1	**592**
	Through-Right		1			1	
	Right	29	0	29	116	0	116
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	233	1	**233**	276	1	**276**
	Left-Through		0			0	
	Through	1208	1	613	1402	1	713
	Through-Right		1			1	
	Right	18	0	18	24	0	24
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	13	0	**13**	15	0	**15**
	Left-Through		1			1	
	Through	18	0	30	49	0	53
	Through-Right		1			1	
	Right	15	0	30	27	0	53
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	23	1	23	25	1	25
	Left-Through		0			0	
	Through	42	0	**199**	39	0	**218**
	Through-Right		1			1	
	Right	356	1	0	397	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	841		*North-South:*	868
			East-West:	212		*East-West:*	233
			SUM:	1053		*SUM:*	1101
	VOLUME/CAPACITY *(V/C)* RATIO:			0.739			0.773
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.639**			**0.673**
	LEVEL OF SERVICE (LOS):			**B**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 2

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Admiralty Way East-West Street: Mindanao Way
Scenario: Cumulative (2019) with Construction Activity - Alternative 2
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				2			2
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	30	1	30	17	1	17
	Left-Through		0			0	
	Through	803	1	**428**	671	1	**406**
	Through-Right		1			1	
	Right	53	0	53	140	0	140
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	459	1	**459**	396	1	**396**
	Left-Through		0			0	
	Through	688	1	353	1061	1	538
	Through-Right		1			1	
	Right	17	0	17	15	0	15
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	19	1	19	19	1	19
	Left-Through		0			0	
	Through	55	0	**76**	45	0	**66**
	Through-Right		1			1	
	Right	21	0	0	21	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	167	1	**127**	264	1	**144**
	Left-Through		1			1	
	Through	87	0	127	24	0	144
	Through-Right		0			0	
	Right	441	1	0	456	1	60
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	887		*North-South:*	802
			East-West:	203		*East-West:*	210
			SUM:	1090		*SUM:*	1012
VOLUME/CAPACITY *(V/C)* RATIO:				0.793			0.736
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.693**			**0.636**
LEVEL OF SERVICE (LOS):				**B**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 3

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Admiralty Way East-West Street: Fiji Way
Scenario: Cumulative (2019) with Construction Activity - Alternative 2
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	688	2	**378**	973	2	**535**
	Left-Through		0			0	
	Through	20	0	0	0	0	0
	Through-Right		0			0	
	Right	78	1	36	114	1	93
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	85	1	**85**	43	1	**43**
	Left-Through		0			0	
	Through	116	2	58	158	2	79
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	95	1	95	124	1	**124**
	Through-Right		0			0	
	Right	773	1	**395**	534	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	378		*North-South:*	535
			East-West:	480		*East-West:*	167
			SUM:	858		*SUM:*	702
VOLUME/CAPACITY *(V/C)* RATIO:				0.572			0.468
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.472**			**0.368**
LEVEL OF SERVICE (LOS):				**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 4

PROJECT TITLE: Ballona Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Washington Boulevard
Scenario: Cumulative (2019) with Construction Activity - Alternative 2
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			4			4
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 3	WB --	3	EB -- 3	WB --	3
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	650	2	**358**	488	2	**268**
	Left-Through		0			0	
	Through	1585	2	565	1381	2	534
	Through-Right		1			1	
	Right	111	0	111	221	0	221
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	259	2	142	219	2	120
	Left-Through		0			0	
	Through	1584	2	**568**	1552	2	**557**
	Through-Right		1			1	
	Right	120	0	120	120	0	120
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	87	2	48	111	2	61
	Left-Through		0			0	
	Through	792	2	**396**	724	2	**362**
	Through-Right		0			0	
	Right	576	1	218	535	1	267
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	140	2	**77**	269	2	**148**
	Left-Through		0			0	
	Through	714	2	357	811	2	406
	Through-Right		0			0	
	Right	194	1	52	262	1	142
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	926		*North-South:*	825
			East-West:	473		*East-West:*	510
			SUM:	1399		*SUM:*	1335
	VOLUME/CAPACITY *(V/C)* RATIO:			1.017			0.971
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.917**			**0.871**
	LEVEL OF SERVICE (LOS):			**E**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 5

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Marina Expressway (SR-90)
Scenario: Cumulative (2019) with Construction Activity - Alternative 2
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	1491	2	**572**	1592	2	**631**
	Through-Right		1			1	
	Right	226	0	226	300	0	300
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	985	2	**542**	897	2	**493**
	Left-Through		0			0	
	Through	1545	3	515	1782	3	594
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	**0**	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	219	2	120	232	2	**128**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	1225	2	**132**	932	2	20
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1114		*North-South:*	1124
			East-West:	132		*East-West:*	128
			SUM:	1246		*SUM:*	1252
VOLUME/CAPACITY *(V/C)* RATIO:				0.874			0.879
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.774**			**0.779**
LEVEL OF SERVICE (LOS):				**C**			**C**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 6

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Bali Way
Scenario: Cumulative (2019) with Construction Activity - Alternative 2
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			4			4
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			2			2
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	203	1	**203**	123	1	**123**
	Left-Through		0			0	
	Through	1461	2	495	1472	2	495
	Through-Right		1			1	
	Right	24	0	24	13	0	13
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	40	1	40	58	1	58
	Left-Through		0			0	
	Through	1531	2	**599**	1693	2	**667**
	Through-Right		1			1	
	Right	266	0	266	309	0	309
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	215	1	**108**	335	1	**169**
	Left-Through		1			1	
	Through	1	0	108	3	0	169
	Through-Right		0			0	
	Right	60	1	0	111	1	50
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	3	0	3	15	0	15
	Left-Through		0			0	
	Through	1	0	**15**	2	0	**26**
	Through-Right		0			0	
	Right	11	0	0	9	0	0
	Left-Through-Right		1			1	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	802		*North-South:*	790
			East-West:	123		*East-West:*	195
			SUM:	925		*SUM:*	985
	VOLUME/CAPACITY *(V/C)* RATIO:			0.673			0.716
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.573**			**0.616**
	LEVEL OF SERVICE (LOS):			**A**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 7

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Mindanao Way
Scenario: Cumulative (2019) with Construction Activity - Alternative 2
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			4			4
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	0	NB -- 3	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	196	1	196	99	1	99
	Left-Through		0			0	
	Through	1660	3	**553**	1457	3	**486**
	Through-Right		0			0	
	Right	516	1	315	360	1	104
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	175	1	**175**	235	1	**235**
	Left-Through		0			0	
	Through	1309	2	450	1647	2	568
	Through-Right		1			1	
	Right	40	0	40	58	0	58
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	563	1	**306**	529	1	**359**
	Through-Right		1			1	
	Right	49	0	49	189	0	189
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	366	2	**201**	465	2	**256**
	Left-Through		0			0	
	Through	451	1	282	556	1	318
	Through-Right		1			1	
	Right	113	0	113	80	0	80
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	728		*North-South:*	721
			East-West:	507		*East-West:*	615
			SUM:	1235		*SUM:*	1336
	VOLUME/CAPACITY *(V/C)* RATIO:			0.898			0.972
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.798**			**0.872**
	LEVEL OF SERVICE (LOS):			**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 8

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Fiji Way
Scenario: Cumulative (2019) with Construction Activity - Alternative 2
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 1	WB --		0	EB -- 1	WB --	0
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	872	2	**480**	702	2	**386**
	Left-Through		0			0	
	Through	2195	2	744	1811	2	616
	Through-Right		1			1	
	Right	37	0	37	38	0	38
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	51	1	51	46	1	46
	Left-Through		0			0	
	Through	1623	2	**566**	2189	2	**760**
	Through-Right		1			1	
	Right	76	0	76	90	0	90
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	70	1	**70**	84	1	**84**
	Left-Through		0			0	
	Through	16	1	16	25	1	25
	Through-Right		0			0	
	Right	624	1	0	968	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	31	0	31	51	0	51
	Left-Through		1			1	
	Through	10	0	**44**	28	0	**56**
	Through-Right		1			1	
	Right	34	0	0	28	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1046		*North-South:*	1146
			East-West:	114		*East-West:*	140
			SUM:	1160		*SUM:*	1286
VOLUME/CAPACITY *(V/C)* RATIO:				0.814			0.902
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.714**			**0.802**
LEVEL OF SERVICE (LOS):				**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 9

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Culver Loop
Scenario: Cumulative (2019) with Construction Activity - Alternative 2
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 0	WB --		0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	2722	2	**1268**	2220	2	**915**
	Through-Right		1			1	
	Right	1082	0	1082	526	0	526
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	2231	2	1116	3188	2	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	303	2	**167**	301	2	**166**
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1268		*North-South:*	915
			East-West:	167		*East-West:*	166
			SUM:	1435		*SUM:*	1081
VOLUME/CAPACITY *(V/C)* RATIO:				0.957			0.721
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.857**			**0.621**
LEVEL OF SERVICE (LOS):				**D**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 10

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Jefferson Boulevard
Scenario: Cumulative (2019) with Construction Activity - Alternative 2
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	3	NB -- 3	SB --	3
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	17	1	17	40	1	40
	Left-Through		0			0	
	Through	2977	4	**744**	1748	4	**437**
	Through-Right		0			0	
	Right	633	1	428	353	1	28
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	539	2	**296**	664	2	**365**
	Left-Through		0			0	
	Through	1260	4	315	1853	4	463
	Through-Right		0			0	
	Right	193	1	0	704	1	605
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	196	1	196	99	1	99
	Left-Through		0			0	
	Through	404	2	**151**	256	2	**114**
	Through-Right		1			1	
	Right	49	0	49	86	0	86
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	372	2	**205**	590	2	**325**
	Left-Through		0			0	
	Through	178	2	89	489	2	245
	Through-Right		0			0	
	Right	817	2	153	942	2	153
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1040		*North-South:*	802
			East-West:	356		*East-West:*	439
			SUM:	1396		*SUM:*	1241
VOLUME/CAPACITY *(V/C)* RATIO:				1.015			0.903
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.915**			**0.803**
LEVEL OF SERVICE (LOS):				**E**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 11

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Bluff Creek Drive
Scenario: Cumulative (2019) with Construction Activity - Alternative 2
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	0	NB -- 3	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	3397	4	**849**	2264	4	566
	Through-Right		0			0	
	Right	790	1	604	390	1	137
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	145	2	**80**	65	2	36
	Left-Through		0			0	
	Through	1512	4	378	2544	4	**636**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	338	2	**186**	460	2	**253**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	44	1	0	77	1	41
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	929		*North-South:*	636
			East-West:	186		*East-West:*	253
			SUM:	1115		*SUM:*	889
VOLUME/CAPACITY *(V/C)* RATIO:				0.782			0.624
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.682**			**0.524**
LEVEL OF SERVICE (LOS):				**B**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 12

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Nicholson Street East-West Street: Culver Boulevard
Scenario: Cumulative (2019) with Construction Activity - Alternative 2
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 1	SB --		0	NB -- 1	SB --	0
	EB -- 0	WB --		0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	10	0	**10**	44	0	44
	Left-Through		1			1	
	Through	0	0	10	3	0	**47**
	Through-Right		0			0	
	Right	898	1	0	410	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	4	0	4	1	0	**1**
	Left-Through		0			0	
	Through	0	0	**5**	1	0	2
	Through-Right		0			0	
	Right	1	0	0	0	0	0
	Left-Through-Right		1			1	
	Left-Right		0			0	
EASTBOUND	Left	1	1	1	2	1	2
	Left-Through		0			0	
	Through	1545	1	**780**	637	1	**340**
	Through-Right		1			1	
	Right	15	0	15	43	0	43
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	367	1	**367**	1026	1	**1026**
	Left-Through		0			0	
	Through	576	1	289	1537	1	770
	Through-Right		1			1	
	Right	2	0	2	2	0	2
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	15		*North-South:*	48
			East-West:	1147		*East-West:*	1366
			SUM:	1162		*SUM:*	1414
VOLUME/CAPACITY *(V/C)* RATIO:				0.815			0.992
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.715**			**0.892**
LEVEL OF SERVICE (LOS):				**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 13

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Jefferson Boulevard East-West Street: Culver Boulevard
Scenario: Cumulative (2019) with Construction Activity - Alternative 2
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 0	WB --		0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	374	2	**206**	1130	2	**622**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	27	1	0	72	1	72
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	2024	2	**1012**	815	2	408
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	126	0	**126**	136	0	136
	Left-Through		1			1	
	Through	500	1	500	1405	1	**975**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	206		*North-South:*	622
			East-West:	1138		*East-West:*	975
			SUM:	1344		*SUM:*	1597
VOLUME/CAPACITY *(V/C)* RATIO:				0.896			1.065
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.796**			**0.965**
LEVEL OF SERVICE (LOS):				**C**			**E**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 14

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 EB Ramps East-West Street: Culver Boulevard
Scenario: Cumulative (2019) with Construction Activity - Alternative 2
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 0	WB --		0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	127	1	**127**	111	1	**111**
	Left-Through		0			0	
	Through	0	1	0	4	1	4
	Through-Right		1			1	
	Right	36	0	36	61	0	61
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	1828	3	**609**	788	3	263
	Through-Right		0			0	
	Right	1021	2	562	360	2	198
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	115	1	**115**	329	1	329
	Left-Through		0			0	
	Through	614	2	307	1568	2	**784**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	127		*North-South:*	111
			East-West:	724		*East-West:*	784
			SUM:	851		*SUM:*	895
VOLUME/CAPACITY *(V/C)* RATIO:				0.567			0.597
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.467**			**0.497**
LEVEL OF SERVICE (LOS):				**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 15

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 WB Ramps East-West Street: Culver Boulevard
Scenario: Cumulative (2019) with Construction Activity - Alternative 2
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				1			1
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 0	WB --		0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	193	1	106	292	1	161
	Left-Through		1			1	
	Through	313	0	**438**	258	0	**304**
	Through-Right		1			1	
	Right	125	0	125	46	0	46
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	90	1	**90**	169	1	169
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	177	1	0	565	1	**450**
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	519	1	**519**	231	1	**231**
	Left-Through		0			0	
	Through	1430	2	715	663	2	332
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	347	2	174	1026	2	**513**
	Through-Right		0			0	
	Right	345	1	**300**	294	1	210
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	528		*North-South:*	754
			East-West:	819		*East-West:*	744
			SUM:	1347		*SUM:*	1498
VOLUME/CAPACITY *(V/C)* RATIO:				0.945			1.051
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.845**			**0.951**
LEVEL OF SERVICE (LOS):				**D**			**E**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 16

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 EB Ramps East-West Street: Mindanao Way
Scenario: Cumulative (2019) with Construction Activity - Alternative 2
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 2	WB --		0	EB -- 2	WB --	0
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	17	1	17	23	1	23
	Left-Through		0			0	
	Through	1178	1	**594**	1101	1	**557**
	Through-Right		1			1	
	Right	9	0	9	12	0	12
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	488	1	**447**	473	1	**414**
	Through-Right		1			1	
	Right	853	1	0	770	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	501	2	**276**	704	2	**387**
	Left-Through		0			0	
	Through	1004	2	502	1124	2	562
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	594		*North-South:*	557
			East-West:	723		*East-West:*	801
			SUM:	1317		*SUM:*	1358
VOLUME/CAPACITY *(V/C)* RATIO:				0.924			0.953
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.824**			**0.853**
LEVEL OF SERVICE (LOS):				**D**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 17

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 WB Ramps East-West Street: Mindanao Way
Scenario: Cumulative (2019) with Construction Activity - Alternative 2
Count Date: Analyst: RA Date: 6/17/205

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

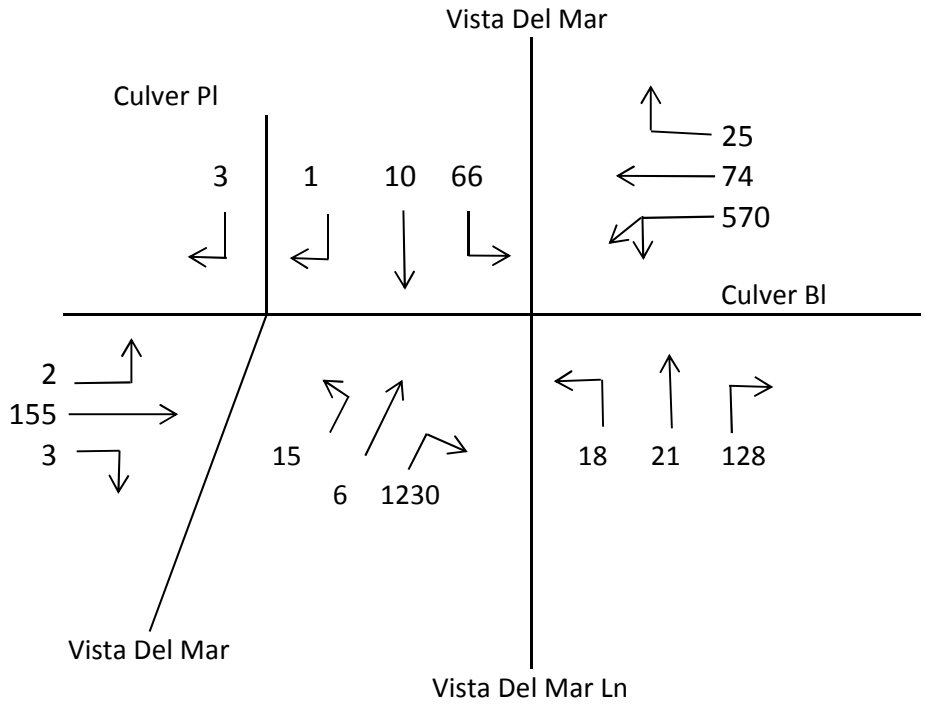
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	613	1	613	572	1	**551**
	Left-Through		1			1	
	Through	1418	1	**709**	1081	1	551
	Through-Right		0			0	
	Right	594	1	594	433	1	433
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	**0**	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	34	1	**34**	25	1	**25**
	Left-Through		0			0	
	Through	507	2	254	462	2	231
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	766	2	**268**	1288	2	**448**
	Through-Right		1			1	
	Right	39	0	39	56	0	56
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	709		*North-South:*	551
			East-West:	302		*East-West:*	473
			SUM:	1011		*SUM:*	1024
VOLUME/CAPACITY *(V/C)* RATIO:				0.709			0.719
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.609**			**0.619**
LEVEL OF SERVICE (LOS):				**B**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

CMA METHODOLOGY
CUMULATIVE (2019) WITH CONSTRUCTION ACTIVITY - ALTERNATIVE 2
AM PEAK HOUR

Int#18 - Vista Del Mar/Vista Del Mar Lane & Culver Boulevard



1. 570 x 0.55 or (74 + 25)

2. (15 + 6 + 1230) x 0.55

3. $\frac{(2 + 155 + 3)}{2}$

4. 66 + (18 + 21 + 128) or 18 + (66 + 10 + 1)

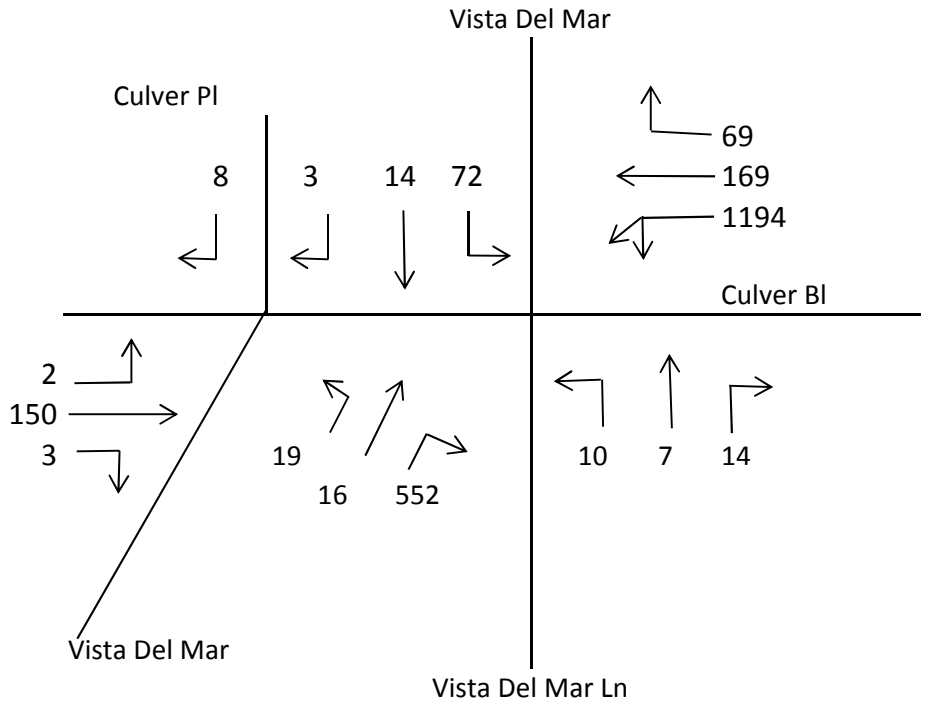
Critical Volumes = 314 + 688 + 80 + 233 = 1315

V/C = $\frac{1315}{1375}$ =

= 0.956 - 0.10 = 0.856 LOS D
ATSAC/ATCS

CMA METHODOLOGY
CUMULATIVE (2019) WITH CONSTRUCTION ACTIVITY - ALTERNATIVE 2
PM PEAK HOUR

Int#18 - Vista Del Mar/Vista Del Mar Lane & Culver Boulevard



1. 1194 x 0.55 or (169 + 69)

2. (19 + 16 + 552) x 0.55

3. $\frac{(2 + 150 + 3)}{2}$

4. 72 + (10 + 7 + 14) or 10 + (72 + 14 + 3)

Critical Volumes = 657 + 323 + 78 + 103 = 1161

V/C = $\frac{1161}{1375}$ =

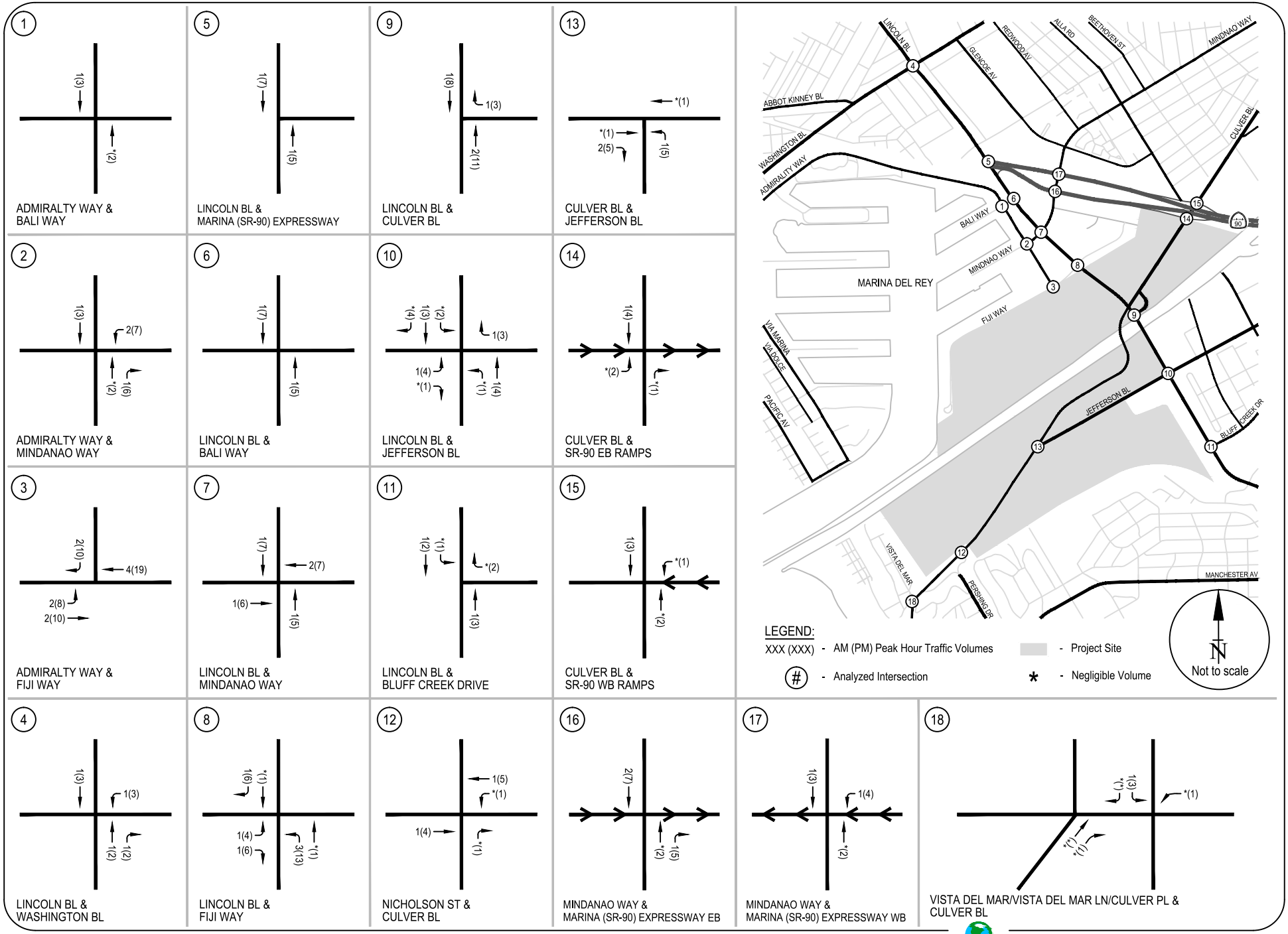
= 0.844 - 0.10 = 0.744 LOS C
ATSAC/ATCS

APPENDIX K

Level of Service Worksheets

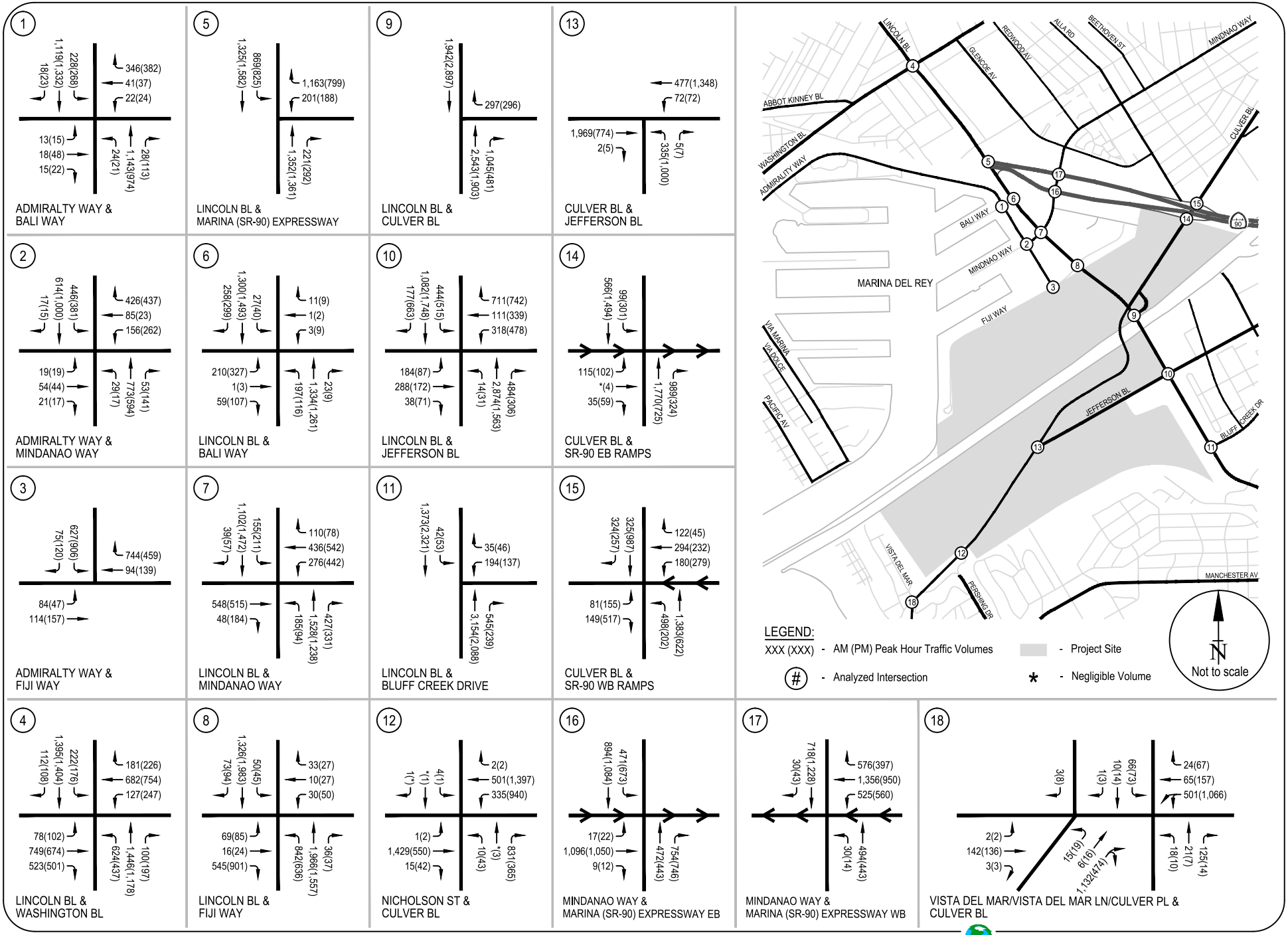
Existing (2015) plus Project – Alternative 3 Conditions

Cumulative (2023) plus Project – Alternative 3 Conditions



APPENDIX K1
ALTERNATIVE 3 PROJECT ONLY - PEAK HOUR TRAFFIC VOLUMES

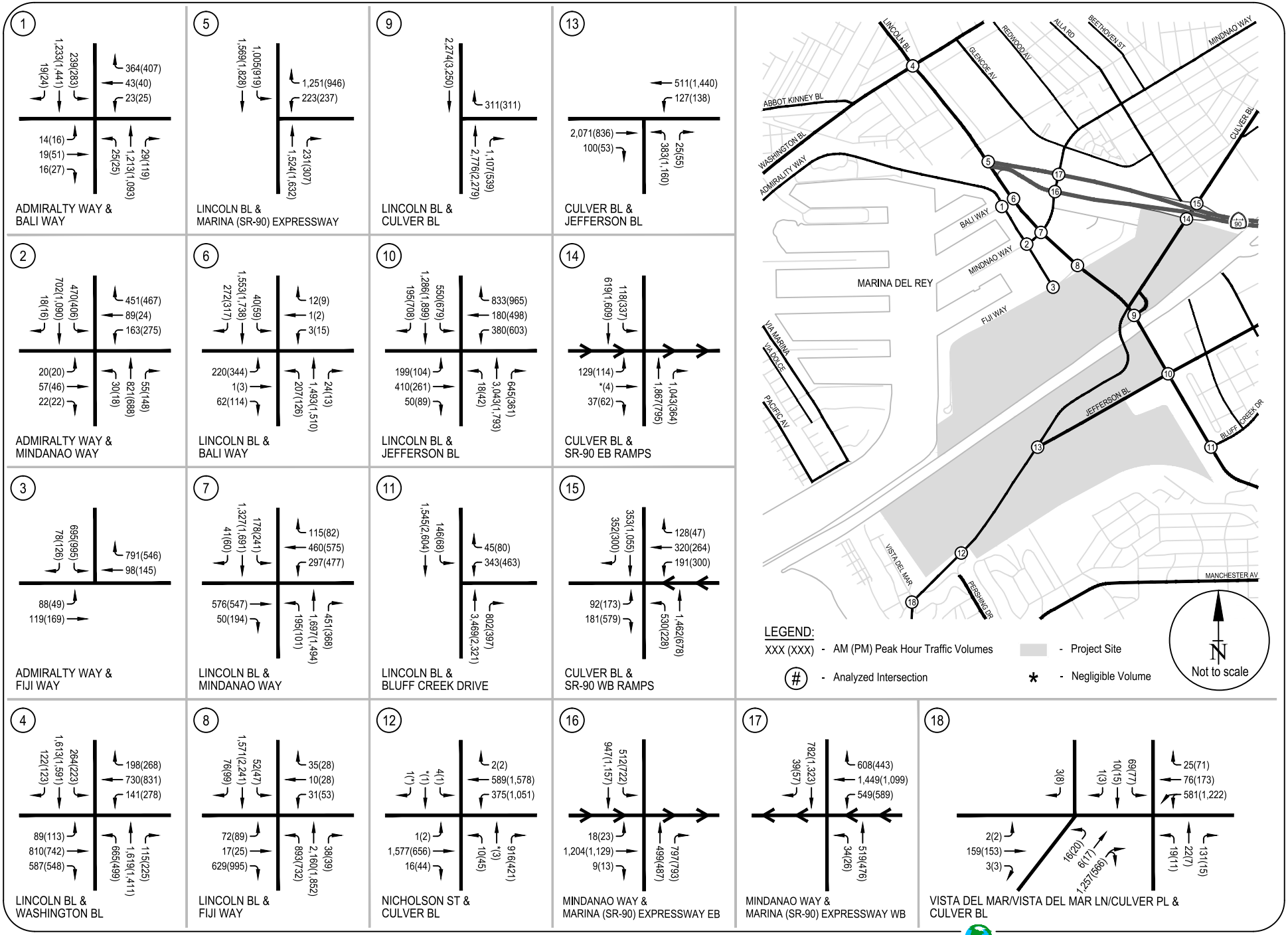
RAJU Associates, Inc.



APPENDIX K2

EXISTING (2015) PLUS PROJECT - ALTERNATIVE 3 CONDITIONS - PEAK HOUR TRAFFIC VOLUMES

RAJU Associates, Inc.



APPENDIX K3

CUMULATIVE (2023) PLUS PROJECT - ALTERNATIVE 3 CONDITIONS - PEAK HOUR TRAFFIC VOLUMES

RAJU Associates, Inc.

Level of Service Worksheet
(Circular 212 Method)

I/S #:	PROJECT TITLE:	Ballona Wetlands Restortation Project			
1	North-South Street:	Admiralty Way	East-West Street:	Bali Way	
	Scenario:	Existing (2015) Plus Project - Alternative 3 Conditions			
	Count Date:		Analyst:	RA	Date: 6/17/205

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	24	1	24	21	1	21
	Left-Through		0			0	
	Through	1143	1	**586**	974	1	**544**
	Through-Right		1			1	
	Right	28	0	28	113	0	113
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	228	1	**228**	268	1	**268**
	Left-Through		0			0	
	Through	1119	1	569	1332	1	678
	Through-Right		1			1	
	Right	18	0	18	23	0	23
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	13	0	**13**	15	0	**15**
	Left-Through		1			1	
	Through	18	0	30	48	0	50
	Through-Right		1			1	
	Right	15	0	30	22	0	50
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	22	1	22	24	1	24
	Left-Through		0			0	
	Through	41	0	**194**	37	0	**210**
	Through-Right		1			1	
	Right	346	1	0	382	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	814		*North-South:*	812
			East-West:	207		*East-West:*	225
			SUM:	1021		*SUM:*	1037
VOLUME/CAPACITY *(V/C)* RATIO:				0.716			0.728
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.616**			**0.628**
LEVEL OF SERVICE (LOS):				**B**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 2

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Admiralty Way East-West Street: Mindanao Way
Scenario: Existing (2015) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			4			4
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			2			2
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	3	EB -- 0	WB --	3
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	29	1	29	17	1	17
	Left-Through		0			0	
	Through	773	1	**413**	594	1	**368**
	Through-Right		1			1	
	Right	53	0	53	141	0	141
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	446	1	**446**	381	1	**381**
	Left-Through		0			0	
	Through	614	1	316	1000	1	508
	Through-Right		1			1	
	Right	17	0	17	15	0	15
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	19	1	19	19	1	19
	Left-Through		0			0	
	Through	54	0	**75**	44	0	**61**
	Through-Right		1			1	
	Right	21	0	0	17	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	156	1	**121**	262	1	**143**
	Left-Through		1			1	
	Through	85	0	121	23	0	143
	Through-Right		0			0	
	Right	426	1	0	437	1	56
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	859		*North-South:*	749
			East-West:	196		*East-West:*	204
			SUM:	1055		*SUM:*	953
	VOLUME/CAPACITY *(V/C)* RATIO:			0.767			0.693
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.667**			**0.593**
	LEVEL OF SERVICE (LOS):			**B**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 3

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Admiralty Way East-West Street: Fiji Way
Scenario: Existing (2015) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			2			2
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	3	EB -- 0	WB --	3
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	627	2	**345**	906	2	**498**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	75	1	33	120	1	97
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	84	1	**84**	47	1	**47**
	Left-Through		0			0	
	Through	114	2	57	157	2	79
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	94	1	94	139	1	**139**
	Through-Right		0			0	
	Right	744	1	**399**	459	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	345		*North-South:*	498
			East-West:	483		*East-West:*	186
			SUM:	828		*SUM:*	684
	VOLUME/CAPACITY *(V/C)* RATIO:			0.552			0.456
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.452**			**0.356**
	LEVEL OF SERVICE (LOS):			**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 4

PROJECT TITLE: Ballona Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Washington Boulevard
Scenario: Existing (2015) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			4			4
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 3	WB --	3	EB -- 3	WB --	3
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	624	2	**343**	437	2	**240**
	Left-Through		0			0	
	Through	1446	2	515	1178	2	458
	Through-Right		1			1	
	Right	100	0	100	197	0	197
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	222	2	122	176	2	97
	Left-Through		0			0	
	Through	1395	2	**502**	1404	2	**504**
	Through-Right		1			1	
	Right	112	0	112	108	0	108
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	78	2	43	102	2	56
	Left-Through		0			0	
	Through	749	2	**375**	674	2	**337**
	Through-Right		0			0	
	Right	523	1	180	501	1	261
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	127	2	**70**	247	2	**136**
	Left-Through		0			0	
	Through	682	2	341	754	2	377
	Through-Right		0			0	
	Right	181	1	59	226	1	129
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	845		*North-South:*	744
			East-West:	445		*East-West:*	473
			SUM:	1290		*SUM:*	1217
	VOLUME/CAPACITY *(V/C)* RATIO:			0.938			0.885
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.838**			**0.785**
	LEVEL OF SERVICE (LOS):			**D**			**C**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 5

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Marina Expressway (SR-90)
Scenario: Existing (2015) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 0	WB --		3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	1352	2	**524**	1361	2	**551**
	Through-Right		1			1	
	Right	221	0	221	292	0	292
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	869	2	**478**	825	2	**454**
	Left-Through		0			0	
	Through	1325	3	442	1582	3	527
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	**0**	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	201	2	111	188	2	**103**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	1163	2	**162**	799	2	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1002		*North-South:*	1005
			East-West:	162		*East-West:*	103
			SUM:	1164		*SUM:*	1108
VOLUME/CAPACITY *(V/C)* RATIO:				0.817			0.778
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.717**			**0.678**
LEVEL OF SERVICE (LOS):				**C**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 6

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Bali Way
Scenario: Existing (2015) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			4			4
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			2			2
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	197	1	**197**	116	1	**116**
	Left-Through		0			0	
	Through	1334	2	452	1261	2	423
	Through-Right		1			1	
	Right	23	0	23	9	0	9
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	27	1	27	40	1	40
	Left-Through		0			0	
	Through	1300	2	**519**	1493	2	**597**
	Through-Right		1			1	
	Right	258	0	258	299	0	299
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	210	1	**106**	327	1	**165**
	Left-Through		1			1	
	Through	1	0	106	3	0	165
	Through-Right		0			0	
	Right	59	1	0	107	1	49
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	3	0	3	9	0	9
	Left-Through		0			0	
	Through	1	0	**15**	2	0	**20**
	Through-Right		0			0	
	Right	11	0	0	9	0	0
	Left-Through-Right		1			1	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	716		*North-South:*	713
			East-West:	121		*East-West:*	185
			SUM:	837		*SUM:*	898
	VOLUME/CAPACITY *(V/C)* RATIO:			0.609			0.653
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.509**			**0.553**
	LEVEL OF SERVICE (LOS):			**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 7

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Mindanao Way
Scenario: Existing (2015) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			4			4
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	0	NB -- 3	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	185	1	185	94	1	94
	Left-Through		0			0	
	Through	1528	3	**509**	1238	3	**413**
	Through-Right		0			0	
	Right	427	1	275	331	1	88
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	155	1	**155**	211	1	**211**
	Left-Through		0			0	
	Through	1102	2	380	1472	2	510
	Through-Right		1			1	
	Right	39	0	39	57	0	57
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	548	1	**298**	515	1	**350**
	Through-Right		1			1	
	Right	48	0	48	184	0	184
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	276	2	**152**	442	2	**243**
	Left-Through		0			0	
	Through	436	1	273	542	1	310
	Through-Right		1			1	
	Right	110	0	110	78	0	78
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	664		*North-South:*	624
			East-West:	450		*East-West:*	593
			SUM:	1114		*SUM:*	1217
	VOLUME/CAPACITY *(V/C)* RATIO:			0.810			0.885
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.710**			**0.785**
	LEVEL OF SERVICE (LOS):			**C**			**C**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 8

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Fiji Way
Scenario: Existing (2015) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0		NB -- 0	SB --	0
	EB -- 1	WB --	0		EB -- 1	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	842	2	**463**	636	2	**350**
	Left-Through		0			0	
	Through	1966	2	667	1557	2	531
	Through-Right		1			1	
	Right	36	0	36	37	0	37
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	50	1	50	45	1	45
	Left-Through		0			0	
	Through	1326	2	**466**	1983	2	**692**
	Through-Right		1			1	
	Right	73	0	73	94	0	94
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	69	1	**69**	85	1	**85**
	Left-Through		0			0	
	Through	16	1	16	24	1	24
	Through-Right		0			0	
	Right	545	1	0	901	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	30	0	30	50	0	50
	Left-Through		1			1	
	Through	10	0	**43**	27	0	**54**
	Through-Right		1			1	
	Right	33	0	0	27	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	929		*North-South:*	1042
			East-West:	112		*East-West:*	139
			SUM:	1041		*SUM:*	1181
VOLUME/CAPACITY *(V/C)* RATIO:				0.731			0.829
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.631**			**0.729**
LEVEL OF SERVICE (LOS):				**B**			**C**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 9

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Culver Loop
Scenario: Existing (2015) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0		NB -- 0	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	2543	2	**1196**	1903	2	**795**
	Through-Right		1			1	
	Right	1045	0	1045	481	0	481
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	1942	2	971	2897	2	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	297	2	**163**	296	2	**163**
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1196		*North-South:*	795
			East-West:	163		*East-West:*	163
			SUM:	1359		*SUM:*	958
VOLUME/CAPACITY *(V/C)* RATIO:				0.906			0.639
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.806**			**0.539**
LEVEL OF SERVICE (LOS):				**D**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 10

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Jefferson Boulevard
Scenario: Existing (2015) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	3		NB -- 3	SB --	3
	EB -- 0	WB --	3		EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	14	1	14	31	1	31
	Left-Through		0			0	
	Through	2874	4	**719**	1563	4	**391**
	Through-Right		0			0	
	Right	484	1	309	306	1	43
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	444	2	**244**	515	2	**283**
	Left-Through		0			0	
	Through	1082	4	271	1748	4	437
	Through-Right		0			0	
	Right	177	1	0	663	1	576
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	184	1	**184**	87	1	87
	Left-Through		0			0	
	Through	288	2	109	172	2	**81**
	Through-Right		1			1	
	Right	38	0	38	71	0	71
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	318	2	175	478	2	**263**
	Left-Through		0			0	
	Through	111	2	56	339	2	170
	Through-Right		0			0	
	Right	711	2	**147**	742	2	125
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	963		*North-South:*	674
			East-West:	331		*East-West:*	344
			SUM:	1294		*SUM:*	1018
VOLUME/CAPACITY *(V/C)* RATIO:				0.941			0.740
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.841**			**0.640**
LEVEL OF SERVICE (LOS):				**D**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 11

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Bluff Creek Drive
Scenario: Existing (2015) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	0		NB -- 3	SB --	0
	EB -- 0	WB --	3		EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	3154	4	**789**	2088	4	522
	Through-Right		0			0	
	Right	545	1	438	239	1	164
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	42	2	**23**	53	2	29
	Left-Through		0			0	
	Through	1373	4	343	2321	4	**580**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	194	2	**107**	137	2	**75**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	35	1	12	46	1	17
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	812		*North-South:*	580
			East-West:	107		*East-West:*	75
			SUM:	919		*SUM:*	655
VOLUME/CAPACITY *(V/C)* RATIO:				0.645			0.460
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.545**			**0.360**
LEVEL OF SERVICE (LOS):				**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 12

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Nicholson Street East-West Street: Culver Boulevard
Scenario: Existing (2015) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 1	SB --	0	NB -- 1	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	10	0	**10**	43	0	43
	Left-Through		1			1	
	Through	0	0	10	3	0	**46**
	Through-Right		0			0	
	Right	831	1	0	365	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	4	0	4	1	0	**1**
	Left-Through		0			0	
	Through	0	0	**5**	1	0	2
	Through-Right		0			0	
	Right	1	0	0	0	0	0
	Left-Through-Right		1			1	
	Left-Right		0			0	
EASTBOUND	Left	1	1	1	2	1	2
	Left-Through		0			0	
	Through	1429	1	**722**	550	1	**296**
	Through-Right		1			1	
	Right	15	0	15	42	0	42
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	335	1	**335**	940	1	**940**
	Left-Through		0			0	
	Through	501	1	252	1397	1	700
	Through-Right		1			1	
	Right	2	0	2	2	0	2
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	15		*North-South:*	47
			East-West:	1057		*East-West:*	1236
			SUM:	1072		*SUM:*	1283
	VOLUME/CAPACITY *(V/C)* RATIO:			0.752			0.900
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.652**			**0.800**
	LEVEL OF SERVICE (LOS):			**B**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 13

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Jefferson Boulevard East-West Street: Culver Boulevard
Scenario: Existing (2015) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0		NB -- 0	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	335	2	**184**	1000	2	**550**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	5	1	5	7	1	7
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	1969	2	**985**	774	2	387
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	72	0	**72**	72	0	72
	Left-Through		1			1	
	Through	477	1	455	1348	1	**818**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	184		*North-South:*	550
			East-West:	1057		*East-West:*	818
			SUM:	1241		*SUM:*	1368
VOLUME/CAPACITY *(V/C)* RATIO:				0.827			0.912
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.727**			**0.812**
LEVEL OF SERVICE (LOS):				**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 14

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 EB Ramps East-West Street: Culver Boulevard
Scenario: Existing (2015) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			2			2
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	115	1	**115**	102	1	**102**
	Left-Through		0			0	
	Through	0	1	0	4	1	4
	Through-Right		1			1	
	Right	35	0	35	59	0	59
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	1770	3	**590**	725	3	242
	Through-Right		0			0	
	Right	989	2	544	324	2	178
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	99	1	**99**	301	1	301
	Left-Through		0			0	
	Through	566	2	283	1494	2	**747**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	115		*North-South:*	102
			East-West:	689		*East-West:*	747
			SUM:	804		*SUM:*	849
	VOLUME/CAPACITY *(V/C)* RATIO:			0.536			0.566
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.436**			**0.466**
	LEVEL OF SERVICE (LOS):			A			A

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 15

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 WB Ramps East-West Street: Culver Boulevard
Scenario: Existing (2015) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				1			1
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0		NB -- 0	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	180	1	99	279	1	153
	Left-Through		1			1	
	Through	294	0	**416**	232	0	**277**
	Through-Right		1			1	
	Right	122	0	122	45	0	45
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	81	1	**81**	155	1	155
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	149	1	0	517	1	**416**
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	498	1	**498**	202	1	**202**
	Left-Through		0			0	
	Through	1383	2	692	622	2	311
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	325	2	163	987	2	**494**
	Through-Right		0			0	
	Right	324	1	**284**	257	1	180
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	497		*North-South:*	693
			East-West:	782		*East-West:*	696
			SUM:	1279		*SUM:*	1389
VOLUME/CAPACITY *(V/C)* RATIO:				0.898			0.975
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.798**			**0.875**
LEVEL OF SERVICE (LOS):				**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 16

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 EB Ramps East-West Street: Mindanao Way
Scenario: Existing (2015) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0		NB -- 0	SB --	0
	EB -- 2	WB --	0		EB -- 2	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	17	1	17	22	1	22
	Left-Through		0			0	
	Through	1096	1	**553**	1050	1	**531**
	Through-Right		1			1	
	Right	9	0	9	12	0	12
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	472	1	**409**	443	1	**396**
	Through-Right		1			1	
	Right	754	1	0	746	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	471	2	**259**	673	2	**370**
	Left-Through		0			0	
	Through	894	2	447	1084	2	542
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	553		*North-South:*	531
			East-West:	668		*East-West:*	766
			SUM:	1221		*SUM:*	1297
VOLUME/CAPACITY *(V/C)* RATIO:				0.857			0.910
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.757**			**0.810**
LEVEL OF SERVICE (LOS):				**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 17

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 WB Ramps East-West Street: Mindanao Way
Scenario: Existing (2015) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0		NB -- 0	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

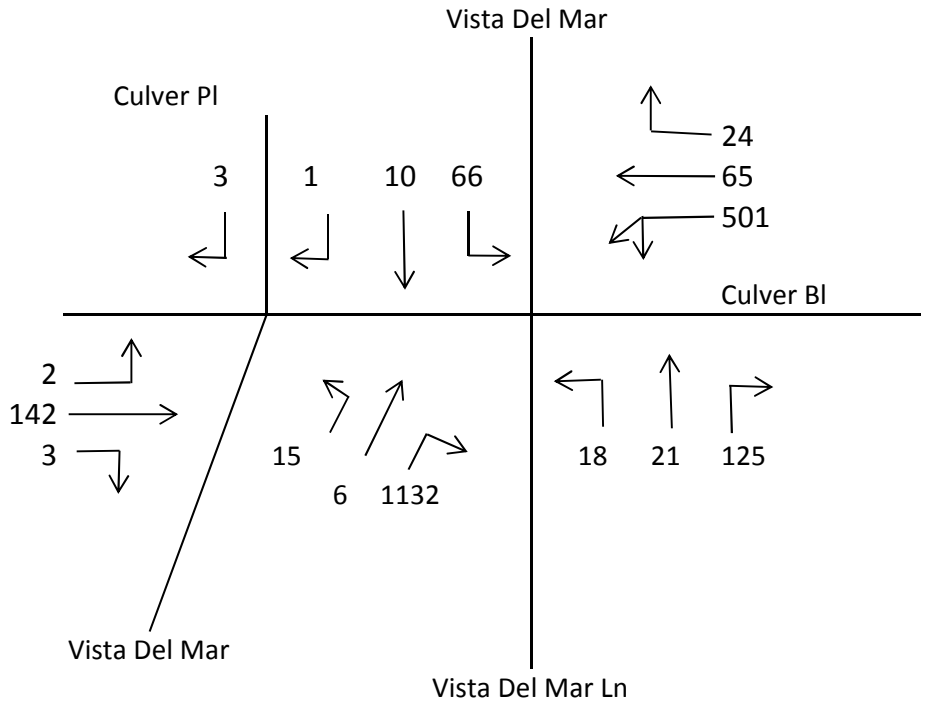
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	525	1	525	560	1	**503**
	Left-Through		1			1	
	Through	1356	1	**678**	950	1	503
	Through-Right		0			0	
	Right	576	1	576	397	1	397
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	**0**	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	30	1	**30**	14	1	**14**
	Left-Through		0			0	
	Through	494	2	247	443	2	222
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	718	2	**249**	1228	2	**424**
	Through-Right		1			1	
	Right	30	0	30	43	0	43
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	678		*North-South:*	503
			East-West:	279		*East-West:*	438
			SUM:	957		*SUM:*	941
VOLUME/CAPACITY *(V/C)* RATIO:				0.672			0.660
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.572**			**0.560**
LEVEL OF SERVICE (LOS):				**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

CMA METHODOLOGY
EXISTING (2015) PLUS PROJECT - ALT 3 CONDITIONS
AM PEAK HOUR

Int#18 - Vista Del Mar/Vista Del Mar Lane & Culver Boulevard



1. 501 x 0.55 or (65 + 24)

2. (15 + 6 + 1132) x 0.55

3. $\frac{(2 + 142 + 3)}{2}$

4. 66 + (18 + 21 + 125) or 18 + (66 + 10 + 1)

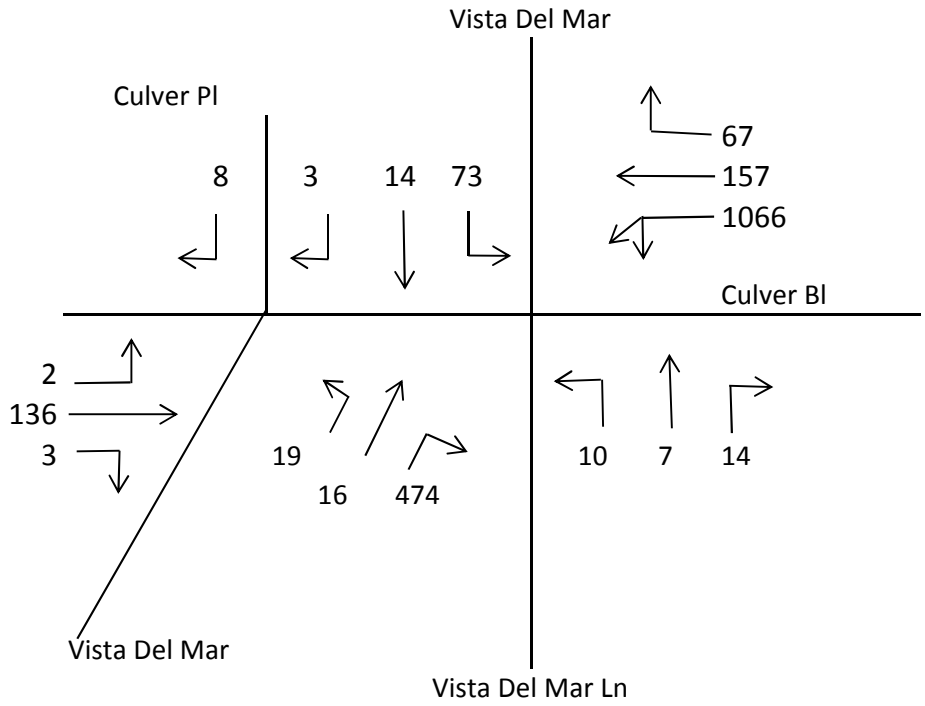
Critical Volumes = 276 + 634 + 74 + 230 = 1214

V/C = $\frac{1214}{1375}$ =

= 0.883 - 0.10 = 0.783 LOS C
ATSAC/ATCS

CMA METHODOLOGY
EXISTING (2015) PLUS PROJECT - ALT 3 CONDITIONS
PM PEAK HOUR

Int#18 - Vista Del Mar/Vista Del Mar Lane & Culver Boulevard



1. 1066 x 0.55 or (157 + 67)

2. (19 + 16 + 474) x 0.55

3. $\frac{(2 + 136 + 3)}{2}$

4. 73 + (10 + 7 + 14) or 10 + (73 + 14 + 3)

Critical Volumes = 586 + 280 + 71 + 104 = 1041

V/C = $\frac{1041}{1375}$ =

= 0.757 - 0.10 = 0.657 LOS B
ATSAC/ATCS

Level of Service Worksheet
(Circular 212 Method)

I/S #:	PROJECT TITLE:	Ballona Wetlands Restortation Project			
1	North-South Street:	Admiralty Way	East-West Street:	Bali Way	
	Scenario:	Cumulative (2023) Plus Project - Alternative 3 Conditions			
	Count Date:		Analyst:	RA	Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	3	EB -- 0	WB --	3
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	25	1	25	25	1	25
	Left-Through		0			0	
	Through	1213	1	**621**	1093	1	**606**
	Through-Right		1			1	
	Right	29	0	29	119	0	119
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	239	1	**239**	283	1	**283**
	Left-Through		0			0	
	Through	1233	1	626	1441	1	733
	Through-Right		1			1	
	Right	19	0	19	24	0	24
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	14	0	**14**	16	0	**16**
	Left-Through		1			1	
	Through	19	0	32	51	0	55
	Through-Right		1			1	
	Right	16	0	32	27	0	55
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	23	1	23	25	1	25
	Left-Through		0			0	
	Through	43	0	**204**	40	0	**224**
	Through-Right		1			1	
	Right	364	1	0	407	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	860		*North-South:*	889
			East-West:	218		*East-West:*	240
			SUM:	1078		*SUM:*	1129
	VOLUME/CAPACITY *(V/C)* RATIO:			0.756			0.792
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.656**			**0.692**
	LEVEL OF SERVICE (LOS):			**B**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 2

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Admiralty Way East-West Street: Mindanao Way
Scenario: Cumulative (2023) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				2			2
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 0	WB --		3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	30	1	30	18	1	18
	Left-Through		0			0	
	Through	821	1	**438**	688	1	**418**
	Through-Right		1			1	
	Right	55	0	55	148	0	148
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	470	1	**470**	406	1	**406**
	Left-Through		0			0	
	Through	702	1	360	1090	1	553
	Through-Right		1			1	
	Right	18	0	18	16	0	16
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	20	1	20	20	1	20
	Left-Through		0			0	
	Through	57	0	**79**	46	0	**68**
	Through-Right		1			1	
	Right	22	0	0	22	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	163	1	**126**	275	1	**150**
	Left-Through		1			1	
	Through	89	0	126	24	0	150
	Through-Right		0			0	
	Right	451	1	0	467	1	61
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	908		*North-South:*	824
			East-West:	205		*East-West:*	218
			SUM:	1113		*SUM:*	1042
VOLUME/CAPACITY *(V/C)* RATIO:				0.809			0.758
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.709**			**0.658**
LEVEL OF SERVICE (LOS):				**C**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 3

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Admiralty Way East-West Street: Fiji Way
Scenario: Cumulative (2023) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	695	2	**382**	995	2	**547**
	Left-Through		0			0	
	Through	20	0	0	0	0	0
	Through-Right		0			0	
	Right	78	1	34	126	1	102
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	88	1	**88**	49	1	**49**
	Left-Through		0			0	
	Through	119	2	60	169	2	85
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	98	1	98	145	1	**145**
	Through-Right		0			0	
	Right	791	1	**409**	546	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	382		*North-South:*	547
			East-West:	497		*East-West:*	194
			SUM:	879		*SUM:*	741
VOLUME/CAPACITY *(V/C)* RATIO:				0.586			0.494
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.486**			**0.394**
LEVEL OF SERVICE (LOS):				**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 4

PROJECT TITLE: Ballona Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Washington Boulevard
Scenario: Cumulative (2023) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 3	WB --		3	EB -- 3	WB --	3
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	665	2	**366**	499	2	**274**
	Left-Through		0			0	
	Through	1619	2	578	1411	2	545
	Through-Right		1			1	
	Right	115	0	115	225	0	225
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	264	2	145	223	2	123
	Left-Through		0			0	
	Through	1613	2	**578**	1591	2	**571**
	Through-Right		1			1	
	Right	122	0	122	123	0	123
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	89	2	49	113	2	62
	Left-Through		0			0	
	Through	810	2	**405**	742	2	**371**
	Through-Right		0			0	
	Right	587	1	221	548	1	274
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	141	2	**78**	278	2	**153**
	Left-Through		0			0	
	Through	730	2	365	831	2	416
	Through-Right		0			0	
	Right	198	1	53	268	1	145
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	944		*North-South:*	845
			East-West:	483		*East-West:*	524
			SUM:	1427		*SUM:*	1369
VOLUME/CAPACITY *(V/C)* RATIO:				1.038			0.996
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.938**			**0.896**
LEVEL OF SERVICE (LOS):				**E**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 5

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Marina Expressway (SR-90)
Scenario: Cumulative (2023) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	1524	2	**585**	1632	2	**646**
	Through-Right		1			1	
	Right	231	0	231	307	0	307
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	1005	2	**553**	919	2	**505**
	Left-Through		0			0	
	Through	1569	3	523	1828	3	609
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	**0**	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	223	2	123	237	2	**130**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	1251	2	**135**	946	2	15
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1138		*North-South:*	1151
			East-West:	135		*East-West:*	130
			SUM:	1273		*SUM:*	1281
VOLUME/CAPACITY *(V/C)* RATIO:				0.893			0.899
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.793**			**0.799**
LEVEL OF SERVICE (LOS):				**C**			**C**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 6

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Bali Way
Scenario: Cumulative (2023) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				2			2
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	207	1	**207**	126	1	**126**
	Left-Through		0			0	
	Through	1493	2	506	1510	2	508
	Through-Right		1			1	
	Right	24	0	24	13	0	13
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	40	1	40	59	1	59
	Left-Through		0			0	
	Through	1553	2	**608**	1738	2	**685**
	Through-Right		1			1	
	Right	272	0	272	317	0	317
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	220	1	**111**	344	1	**174**
	Left-Through		1			1	
	Through	1	0	111	3	0	174
	Through-Right		0			0	
	Right	62	1	0	114	1	51
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	3	0	3	15	0	15
	Left-Through		0			0	
	Through	1	0	**16**	2	0	**26**
	Through-Right		0			0	
	Right	12	0	0	9	0	0
	Left-Through-Right		1			1	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	815		*North-South:*	811
			East-West:	127		*East-West:*	200
			SUM:	942		*SUM:*	1011
VOLUME/CAPACITY *(V/C)* RATIO:				0.685			0.735
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.585**			**0.635**
LEVEL OF SERVICE (LOS):				**A**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 7

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Mindanao Way
Scenario: Cumulative (2023) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	0		NB -- 3	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	195	1	195	101	1	101
	Left-Through		0			0	
	Through	1697	3	**566**	1494	3	**498**
	Through-Right		0			0	
	Right	451	1	288	368	1	106
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	178	1	**178**	241	1	**241**
	Left-Through		0			0	
	Through	1327	2	456	1691	2	584
	Through-Right		1			1	
	Right	41	0	41	60	0	60
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	576	1	**313**	547	1	**371**
	Through-Right		1			1	
	Right	50	0	50	194	0	194
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	297	2	**163**	477	2	**262**
	Left-Through		0			0	
	Through	460	1	288	575	1	329
	Through-Right		1			1	
	Right	115	0	115	82	0	82
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	744		*North-South:*	739
			East-West:	476		*East-West:*	633
			SUM:	1220		*SUM:*	1372
VOLUME/CAPACITY *(V/C)* RATIO:				0.887			0.998
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.787**			**0.898**
LEVEL OF SERVICE (LOS):				**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 8

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Fiji Way
Scenario: Cumulative (2023) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 1	WB --	0	EB -- 1	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	893	2	**491**	732	2	**403**
	Left-Through		0			0	
	Through	2160	2	733	1852	2	630
	Through-Right		1			1	
	Right	38	0	38	39	0	39
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	52	1	52	47	1	47
	Left-Through		0			0	
	Through	1571	2	**549**	2241	2	**780**
	Through-Right		1			1	
	Right	76	0	76	99	0	99
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	72	1	**72**	89	1	**89**
	Left-Through		0			0	
	Through	17	1	17	25	1	25
	Through-Right		0			0	
	Right	629	1	0	995	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	31	0	31	53	0	53
	Left-Through		1			1	
	Through	10	0	**45**	28	0	**56**
	Through-Right		1			1	
	Right	35	0	0	28	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1040		*North-South:*	1183
			East-West:	117		*East-West:*	145
			SUM:	1157		*SUM:*	1328
VOLUME/CAPACITY *(V/C)* RATIO:				0.812			0.932
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.712**			**0.832**
LEVEL OF SERVICE (LOS):				**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 9

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Culver Loop
Scenario: Cumulative (2023) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0		NB -- 0	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	2776	2	**1294**	2279	2	**939**
	Through-Right		1			1	
	Right	1107	0	1107	539	0	539
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	2274	2	1137	3250	2	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	311	2	**171**	311	2	**171**
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1294		*North-South:*	939
			East-West:	171		*East-West:*	171
			SUM:	1465		*SUM:*	1110
VOLUME/CAPACITY *(V/C)* RATIO:				0.977			0.740
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.877**			**0.640**
LEVEL OF SERVICE (LOS):				**D**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 10

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Jefferson Boulevard
Scenario: Cumulative (2023) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	3		NB -- 3	SB --	3
	EB -- 0	WB --	3		EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	18	1	18	42	1	42
	Left-Through		0			0	
	Through	3043	4	**761**	1793	4	**448**
	Through-Right		0			0	
	Right	645	1	436	361	1	29
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	550	2	**303**	679	2	**373**
	Left-Through		0			0	
	Through	1286	4	322	1899	4	475
	Through-Right		0			0	
	Right	195	1	0	708	1	604
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	199	1	199	104	1	104
	Left-Through		0			0	
	Through	410	2	**153**	261	2	**117**
	Through-Right		1			1	
	Right	50	0	50	89	0	89
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	380	2	**209**	603	2	**332**
	Left-Through		0			0	
	Through	180	2	90	498	2	249
	Through-Right		0			0	
	Right	833	2	155	965	2	158
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1064		*North-South:*	821
			East-West:	362		*East-West:*	449
			SUM:	1426		*SUM:*	1270
VOLUME/CAPACITY *(V/C)* RATIO:				1.037			0.924
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.937**			**0.824**
LEVEL OF SERVICE (LOS):				**E**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 11

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Bluff Creek Drive
Scenario: Cumulative (2023) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	0	NB -- 3	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	3469	4	**867**	2321	4	580
	Through-Right		0			0	
	Right	802	1	613	397	1	142
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	146	2	**80**	68	2	37
	Left-Through		0			0	
	Through	1545	4	386	2604	4	**651**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	343	2	**189**	463	2	**255**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	45	1	0	80	1	43
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	947		*North-South:*	651
			East-West:	189		*East-West:*	255
			SUM:	1136		*SUM:*	906
VOLUME/CAPACITY *(V/C)* RATIO:				0.797			0.636
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.697**			**0.536**
LEVEL OF SERVICE (LOS):				**B**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 12

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Nicholson Street East-West Street: Culver Boulevard
Scenario: Cumulative (2023) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 1	SB --	0	NB -- 1	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	10	0	**10**	45	0	45
	Left-Through		1			1	
	Through	0	0	10	3	0	**48**
	Through-Right		0			0	
	Right	916	1	0	421	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	4	0	4	1	0	**1**
	Left-Through		0			0	
	Through	0	0	**5**	1	0	2
	Through-Right		0			0	
	Right	1	0	0	0	0	0
	Left-Through-Right		1			1	
	Left-Right		0			0	
EASTBOUND	Left	1	1	1	2	1	2
	Left-Through		0			0	
	Through	1577	1	**797**	656	1	**350**
	Through-Right		1			1	
	Right	16	0	16	44	0	44
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	375	1	**375**	1051	1	**1051**
	Left-Through		0			0	
	Through	589	1	296	1578	1	790
	Through-Right		1			1	
	Right	2	0	2	2	0	2
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	15		*North-South:*	49
			East-West:	1172		*East-West:*	1401
			SUM:	1187		*SUM:*	1450
	VOLUME/CAPACITY *(V/C)* RATIO:			0.833			1.018
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.733**			**0.918**
	LEVEL OF SERVICE (LOS):			**C**			**E**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 13

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Jefferson Boulevard East-West Street: Culver Boulevard
Scenario: Cumulative (2023) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			2			2
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	383	2	**211**	1160	2	**638**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	25	1	0	55	1	55
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	2071	2	**1036**	836	2	418
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	127	0	**127**	138	0	138
	Left-Through		1			1	
	Through	511	1	511	1440	1	**996**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	211		*North-South:*	638
			East-West:	1163		*East-West:*	996
			SUM:	1374		*SUM:*	1634
	VOLUME/CAPACITY *(V/C)* RATIO:			0.916			1.089
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.816**			**0.989**
	LEVEL OF SERVICE (LOS):			**D**			**E**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 14

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 EB Ramps East-West Street: Culver Boulevard
Scenario: Cumulative (2023) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			2			2
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	129	1	**129**	114	1	**114**
	Left-Through		0			0	
	Through	0	1	0	4	1	4
	Through-Right		1			1	
	Right	37	0	37	62	0	62
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	1867	3	**622**	795	3	265
	Through-Right		0			0	
	Right	1043	2	574	364	2	200
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	118	1	**118**	337	1	337
	Left-Through		0			0	
	Through	619	2	310	1609	2	**805**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	129		*North-South:*	114
			East-West:	740		*East-West:*	805
			SUM:	869		*SUM:*	919
	VOLUME/CAPACITY *(V/C)* RATIO:			0.579			0.613
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.479**			**0.513**
	LEVEL OF SERVICE (LOS):			**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 15

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 WB Ramps East-West Street: Culver Boulevard
Scenario: Cumulative (2023) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			1			1
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	191	1	105	300	1	165
	Left-Through		1			1	
	Through	320	0	**448**	264	0	**311**
	Through-Right		1			1	
	Right	128	0	128	47	0	47
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	92	1	**92**	173	1	173
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	181	1	0	579	1	**465**
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	530	1	**530**	228	1	**228**
	Left-Through		0			0	
	Through	1462	2	731	678	2	339
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	353	2	177	1055	2	**528**
	Through-Right		0			0	
	Right	352	1	**306**	300	1	214
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	540		*North-South:*	776
			East-West:	836		*East-West:*	756
			SUM:	1376		*SUM:*	1532
	VOLUME/CAPACITY *(V/C)* RATIO:			0.966			1.075
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.866**			**0.975**
	LEVEL OF SERVICE (LOS):			D			E

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 16

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 EB Ramps East-West Street: Mindanao Way
Scenario: Cumulative (2023) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0		NB -- 0	SB --	0
	EB -- 2	WB --	0		EB -- 2	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	18	1	18	23	1	23
	Left-Through		0			0	
	Through	1204	1	**607**	1129	1	**571**
	Through-Right		1			1	
	Right	9	0	9	13	0	13
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	499	1	**432**	487	1	**427**
	Through-Right		1			1	
	Right	797	1	0	793	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	512	2	**282**	722	2	**397**
	Left-Through		0			0	
	Through	947	2	474	1157	2	579
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	607		*North-South:*	571
			East-West:	714		*East-West:*	824
			SUM:	1321		*SUM:*	1395
VOLUME/CAPACITY *(V/C)* RATIO:				0.927			0.979
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.827**			**0.879**
LEVEL OF SERVICE (LOS):				**D**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 17

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 WB Ramps East-West Street: Mindanao Way
Scenario: Cumulative (2023) Plus Project - Alternative 3 Conditions
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0 EB -- 0		SB -- WB --	0 0	NB -- 0 EB -- 0		SB -- WB --	0 0
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

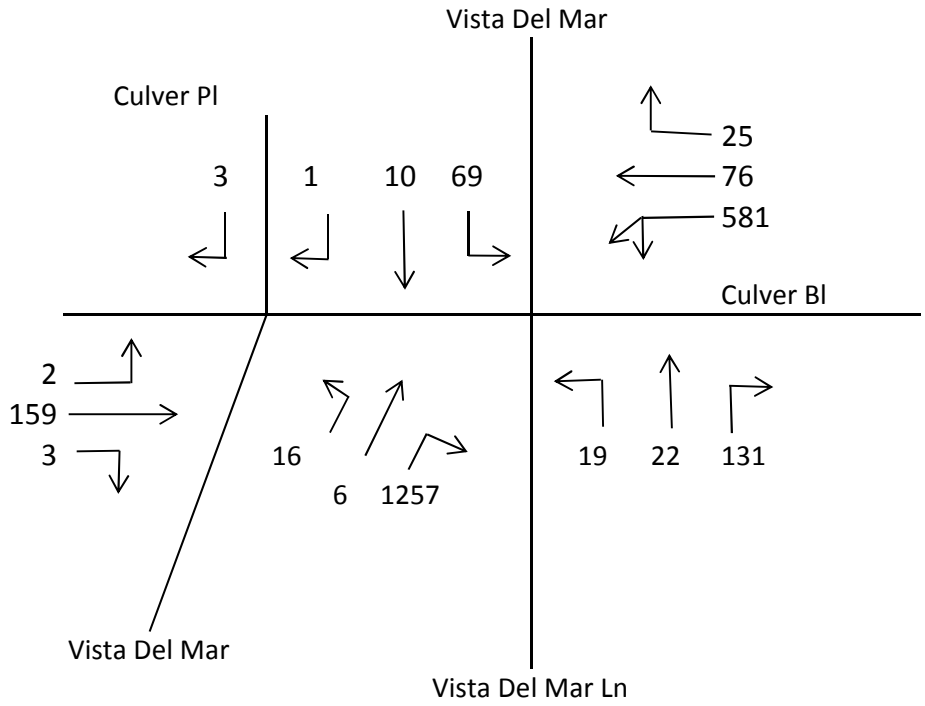
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	549	1	549	589	1	**563**
	Left-Through		1			1	
	Through	1449	1	**725**	1099	1	563
	Through-Right		0			0	
	Right	608	1	608	443	1	443
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	**0**	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	34	1	**34**	26	1	**26**
	Left-Through		0			0	
	Through	519	2	260	476	2	238
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	782	2	**274**	1323	2	**460**
	Through-Right		1			1	
	Right	39	0	39	57	0	57
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	725		*North-South:*	563
			East-West:	308		*East-West:*	486
			SUM:	1033		*SUM:*	1049
VOLUME/CAPACITY *(V/C)* RATIO:				0.725			0.736
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.625**			**0.636**
LEVEL OF SERVICE (LOS):				**B**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

CMA METHODOLOGY
CUMULATIVE (2023) PLUS PROJECT - ALT 3 CONDITIONS
AM PEAK HOUR

Int#18 - Vista Del Mar/Vista Del Mar Lane & Culver Boulevard



1. 581 x 0.55 or (76 + 25)

2. (16 + 6 + 1257) x 0.55

3. $\frac{(2 + 159 + 3)}{2}$

4. 69 + (19 + 22 + 131) or 19 + (69 + 10 + 1)

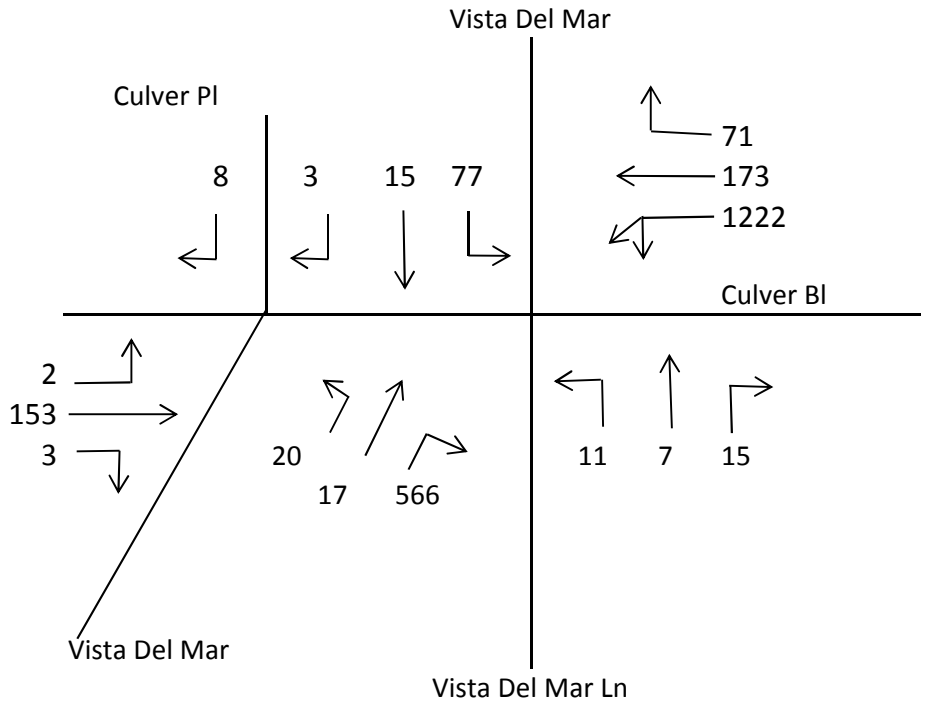
Critical Volumes = 320 + 703 + 82 + 241 = 1346

V/C = $\frac{1346}{1375}$ =

= 0.979 - 0.10 = 0.879 LOS D
ATSAC/ATCS

CMA METHODOLOGY
CUMULATIVE (2023) PLUS PROJECT - ALT 3 CONDITIONS
PM PEAK HOUR

Int#18 - Vista Del Mar/Vista Del Mar Lane & Culver Boulevard



1. 1222 x 0.55 or (173 + 71)

2. (20 + 17 + 566) x 0.55

3. $\frac{(2 + 153 + 3)}{2}$

4. 77 + (11 + 7 + 15) or 11 + (77 + 15 + 3)

Critical Volumes = 672 + 332 + 79 + 110 = 1193

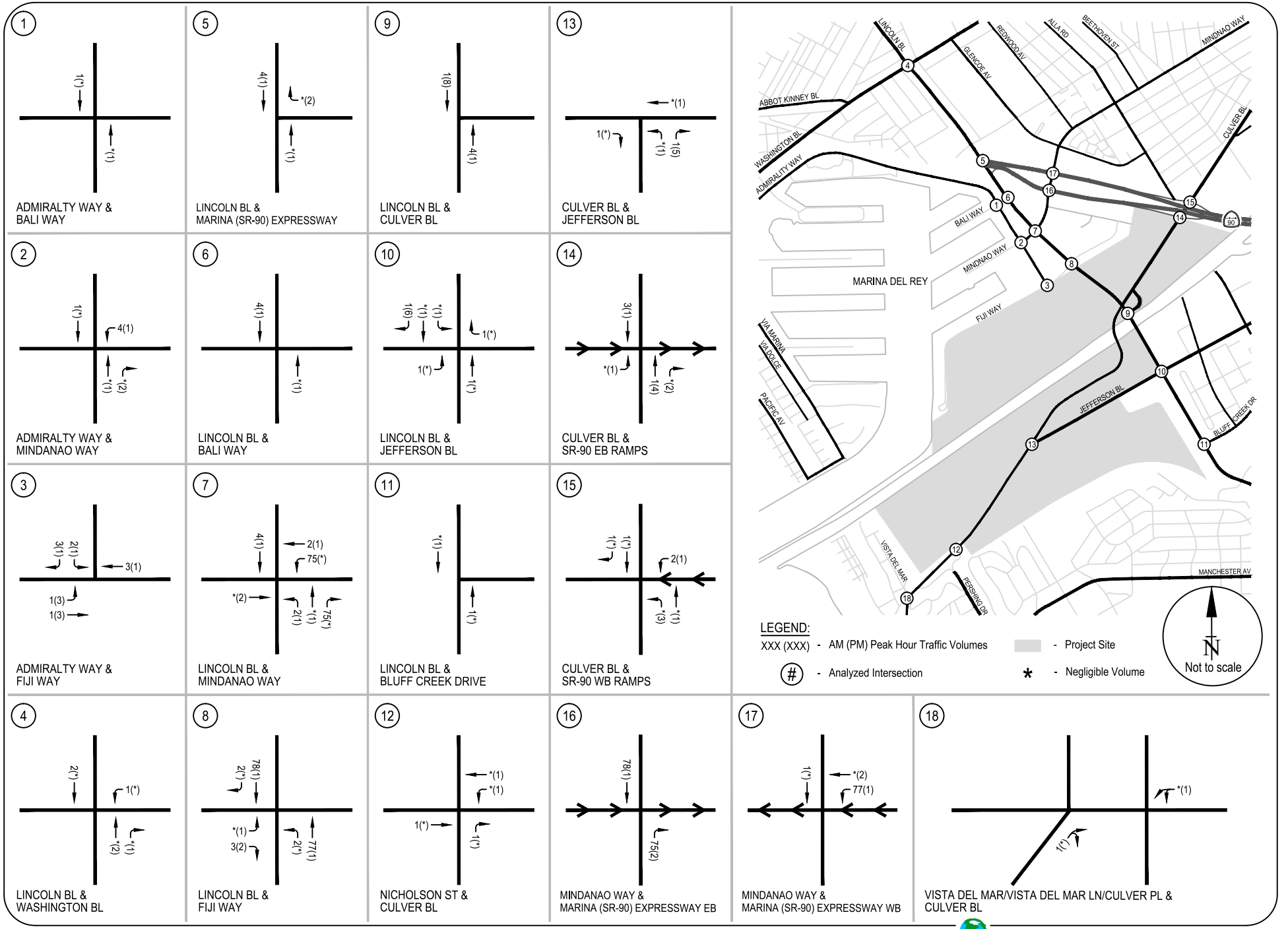
V/C = $\frac{1193}{1375}$ =

= 0.868 - 0.10 = 0.768 LOS C
ATSAC/ATCS

APPENDIX L

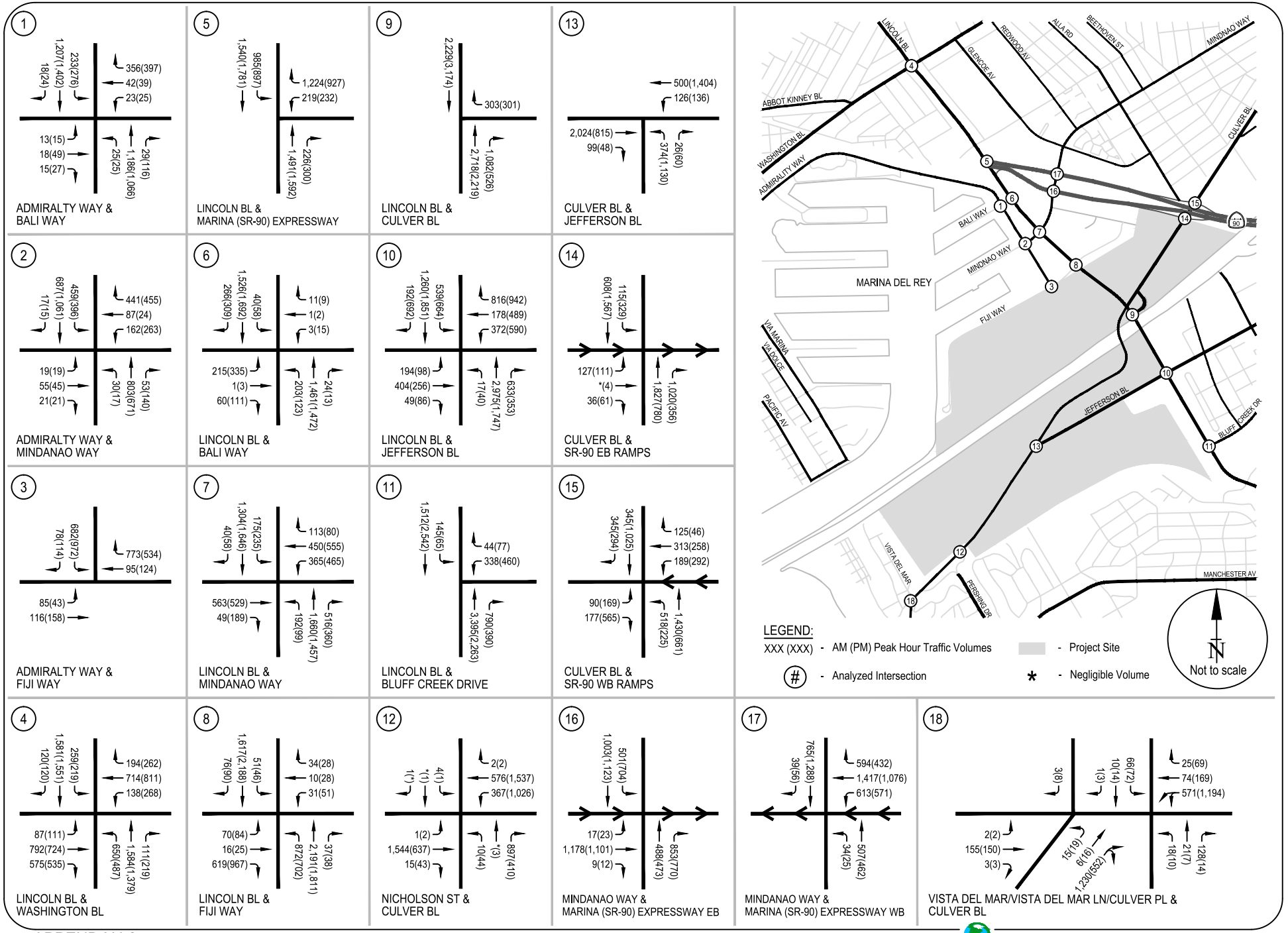
Level of Service Worksheets

Cumulative (2019) with Project Construction Activity – Alternative 3 Conditions



APPENDIX L1
ALTERNATIVE 3 CONSTRUCTION ACTIVITY TRIPS - PEAK HOUR TRAFFIC VOLUMES

RAJU Associates, Inc.



APPENDIX L2
CUMULATIVE (2019) WITH PROJECT CONSTRUCTION ACTIVITY - ALTERNATIVE 3
PEAK HOUR TRAFFIC VOLUMES

RAJU Associates, Inc.

Level of Service Worksheet
(Circular 212 Method)

I/S #:	PROJECT TITLE:	Ballona Wetlands Restortation Project			
1	North-South Street:	Admiralty Way	East-West Street:	Bali Way	
	Scenario:	Cumulative (2019) with Construction Activity - Alternative 3			
	Count Date:		Analyst:	RA	Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	3	EB -- 0	WB --	3
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	25	1	25	25	1	25
	Left-Through		0			0	
	Through	1186	1	**608**	1066	1	**591**
	Through-Right		1			1	
	Right	29	0	29	116	0	116
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	233	1	**233**	276	1	**276**
	Left-Through		0			0	
	Through	1207	1	613	1402	1	713
	Through-Right		1			1	
	Right	18	0	18	24	0	24
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	13	0	**13**	15	0	**15**
	Left-Through		1			1	
	Through	18	0	30	49	0	53
	Through-Right		1			1	
	Right	15	0	30	27	0	53
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	23	1	23	25	1	25
	Left-Through		0			0	
	Through	42	0	**199**	39	0	**218**
	Through-Right		1			1	
	Right	356	1	0	397	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	841		*North-South:*	867
			East-West:	212		*East-West:*	233
			SUM:	1053		*SUM:*	1100
	VOLUME/CAPACITY *(V/C)* RATIO:			0.739			0.772
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.639**			**0.672**
	LEVEL OF SERVICE (LOS):			**B**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 2

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Admiralty Way East-West Street: Mindanao Way
Scenario: Cumulative (2019) with Construction Activity - Alternative 3
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				2			2
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 0	WB --		3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	30	1	30	17	1	17
	Left-Through		0			0	
	Through	803	1	**428**	671	1	**406**
	Through-Right		1			1	
	Right	53	0	53	140	0	140
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	459	1	**459**	396	1	**396**
	Left-Through		0			0	
	Through	687	1	352	1061	1	538
	Through-Right		1			1	
	Right	17	0	17	15	0	15
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	19	1	19	19	1	19
	Left-Through		0			0	
	Through	55	0	**76**	45	0	**66**
	Through-Right		1			1	
	Right	21	0	0	21	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	162	1	**125**	263	1	**144**
	Left-Through		1			1	
	Through	87	0	125	24	0	144
	Through-Right		0			0	
	Right	441	1	0	455	1	59
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	887		*North-South:*	802
			East-West:	201		*East-West:*	210
			SUM:	1088		*SUM:*	1012
VOLUME/CAPACITY *(V/C)* RATIO:				0.791			0.736
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.691**			**0.636**
LEVEL OF SERVICE (LOS):				**B**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 3

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Admiralty Way East-West Street: Fiji Way
Scenario: Cumulative (2019) with Construction Activity - Alternative 3
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	682	2	**375**	972	2	**535**
	Left-Through		0			0	
	Through	20	0	0	0	0	0
	Through-Right		0			0	
	Right	78	1	36	114	1	93
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	85	1	**85**	43	1	**43**
	Left-Through		0			0	
	Through	116	2	58	158	2	79
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	95	1	95	124	1	**124**
	Through-Right		0			0	
	Right	773	1	**398**	534	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	375		*North-South:*	535
			East-West:	483		*East-West:*	167
			SUM:	858		*SUM:*	702
VOLUME/CAPACITY *(V/C)* RATIO:				0.572			0.468
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.472**			**0.368**
LEVEL OF SERVICE (LOS):				**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 4

PROJECT TITLE: Ballona Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Washington Boulevard
Scenario: Cumulative (2019) with Construction Activity - Alternative 3
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			4			4
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB -- 0		NB -- 0	SB -- 0	
	EB -- 3	WB -- 3		EB -- 3	WB -- 3	
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	650	2	**358**	487	2	**268**
	Left-Through		0			0	
	Through	1584	2	565	1379	2	533
	Through-Right		1			1	
	Right	111	0	111	219	0	219
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	259	2	142	219	2	120
	Left-Through		0			0	
	Through	1581	2	**567**	1551	2	**557**
	Through-Right		1			1	
	Right	120	0	120	120	0	120
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	87	2	48	111	2	61
	Left-Through		0			0	
	Through	792	2	**396**	724	2	**362**
	Through-Right		0			0	
	Right	575	1	217	535	1	267
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	138	2	**76**	268	2	**147**
	Left-Through		0			0	
	Through	714	2	357	811	2	406
	Through-Right		0			0	
	Right	194	1	52	262	1	142
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	925		*North-South:*	825
			East-West:	472		*East-West:*	509
			SUM:	1397		*SUM:*	1334
VOLUME/CAPACITY *(V/C)* RATIO:				1.016			0.970
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.916**			**0.870**
LEVEL OF SERVICE (LOS):				**E**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 5

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Marina Expressway (SR-90)
Scenario: Cumulative (2019) with Construction Activity - Alternative 3
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	3	EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	1491	2	**572**	1592	2	**631**
	Through-Right		1			1	
	Right	226	0	226	300	0	300
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	985	2	**542**	897	2	**493**
	Left-Through		0			0	
	Through	1540	3	513	1781	3	594
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	**0**	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	219	2	120	232	2	**128**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	1224	2	**131**	927	2	17
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1114		*North-South:*	1124
			East-West:	131		*East-West:*	128
			SUM:	1245		*SUM:*	1252
VOLUME/CAPACITY *(V/C)* RATIO:				0.874			0.879
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.774**			**0.779**
LEVEL OF SERVICE (LOS):				**C**			**C**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 6

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Bali Way
Scenario: Cumulative (2019) with Construction Activity - Alternative 3
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			4			4
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			2			2
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	203	1	**203**	123	1	**123**
	Left-Through		0			0	
	Through	1461	2	495	1472	2	495
	Through-Right		1			1	
	Right	24	0	24	13	0	13
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	40	1	40	58	1	58
	Left-Through		0			0	
	Through	1526	2	**597**	1692	2	**667**
	Through-Right		1			1	
	Right	266	0	266	309	0	309
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	215	1	**108**	335	1	**169**
	Left-Through		1			1	
	Through	1	0	108	3	0	169
	Through-Right		0			0	
	Right	60	1	0	111	1	50
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	3	0	3	15	0	15
	Left-Through		0			0	
	Through	1	0	**15**	2	0	**26**
	Through-Right		0			0	
	Right	11	0	0	9	0	0
	Left-Through-Right		1			1	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	800		*North-South:*	790
			East-West:	123		*East-West:*	195
			SUM:	923		*SUM:*	985
	VOLUME/CAPACITY *(V/C)* RATIO:			0.671			0.716
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.571**			**0.616**
	LEVEL OF SERVICE (LOS):			**A**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 7

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Mindanao Way
Scenario: Cumulative (2019) with Construction Activity - Alternative 3
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			4			4
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	0	NB -- 3	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	192	1	192	99	1	99
	Left-Through		0			0	
	Through	1660	3	**553**	1457	3	**486**
	Through-Right		0			0	
	Right	516	1	315	360	1	104
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	175	1	**175**	235	1	**235**
	Left-Through		0			0	
	Through	1304	2	448	1646	2	568
	Through-Right		1			1	
	Right	40	0	40	58	0	58
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	563	1	**306**	529	1	**359**
	Through-Right		1			1	
	Right	49	0	49	189	0	189
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	365	2	**201**	465	2	**256**
	Left-Through		0			0	
	Through	450	1	282	555	1	318
	Through-Right		1			1	
	Right	113	0	113	80	0	80
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	728		*North-South:*	721
			East-West:	507		*East-West:*	615
			SUM:	1235		*SUM:*	1336
	VOLUME/CAPACITY *(V/C)* RATIO:			0.898			0.972
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.798**			**0.872**
	LEVEL OF SERVICE (LOS):			**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 8

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Fiji Way
Scenario: Cumulative (2019) with Construction Activity - Alternative 3
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 1	WB --	0	EB -- 1	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	872	2	**480**	702	2	**386**
	Left-Through		0			0	
	Through	2191	2	743	1811	2	616
	Through-Right		1			1	
	Right	37	0	37	38	0	38
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	51	1	51	46	1	46
	Left-Through		0			0	
	Through	1617	2	**564**	2188	2	**759**
	Through-Right		1			1	
	Right	76	0	76	90	0	90
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	70	1	**70**	84	1	**84**
	Left-Through		0			0	
	Through	16	1	16	25	1	25
	Through-Right		0			0	
	Right	619	1	0	967	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	31	0	31	51	0	51
	Left-Through		1			1	
	Through	10	0	**44**	28	0	**56**
	Through-Right		1			1	
	Right	34	0	0	28	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1044		*North-South:*	1145
			East-West:	114		*East-West:*	140
			SUM:	1158		*SUM:*	1285
VOLUME/CAPACITY *(V/C)* RATIO:				0.813			0.902
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.713**			**0.802**
LEVEL OF SERVICE (LOS):				**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 9

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Culver Loop
Scenario: Cumulative (2019) with Construction Activity - Alternative 3
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0		NB -- 0	SB --	0
	EB -- 0	WB --	0		EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	2718	2	**1267**	2219	2	**915**
	Through-Right		1			1	
	Right	1082	0	1082	526	0	526
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	2229	2	1115	3174	2	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	303	2	**167**	301	2	**166**
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	1267		*North-South:*	915
			East-West:	167		*East-West:*	166
			SUM:	1434		*SUM:*	1081
VOLUME/CAPACITY *(V/C)* RATIO:				0.956			0.721
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.856**			**0.621**
LEVEL OF SERVICE (LOS):				**D**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 10

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Jefferson Boulevard
Scenario: Cumulative (2019) with Construction Activity - Alternative 3
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			4			4
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	3	NB -- 3	SB --	3
		EB -- 0	WB --	3	EB -- 0	WB --	3
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	17	1	17	40	1	40
	Left-Through		0			0	
	Through	2975	4	**744**	1747	4	**437**
	Through-Right		0			0	
	Right	633	1	428	353	1	28
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	539	2	**296**	664	2	**365**
	Left-Through		0			0	
	Through	1260	4	315	1851	4	463
	Through-Right		0			0	
	Right	192	1	0	692	1	594
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	194	1	194	98	1	98
	Left-Through		0			0	
	Through	404	2	**151**	256	2	**114**
	Through-Right		1			1	
	Right	49	0	49	86	0	86
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	372	2	**205**	590	2	**325**
	Left-Through		0			0	
	Through	178	2	89	489	2	245
	Through-Right		0			0	
	Right	816	2	153	942	2	153
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	1040		*North-South:*	802
			East-West:	356		*East-West:*	439
			SUM:	1396		*SUM:*	1241
	VOLUME/CAPACITY *(V/C)* RATIO:			1.015			0.903
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.915**			**0.803**
	LEVEL OF SERVICE (LOS):			**E**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 11

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Lincoln Boulevard East-West Street: Bluff Creek Drive
Scenario: Cumulative (2019) with Construction Activity - Alternative 3
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 3	SB --	0		NB -- 3	SB --	0
	EB -- 0	WB --	3		EB -- 0	WB --	3
ATSAC-1 or ATSAC+ATCS-2?			2				2
Override Capacity			0				0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	3395	4	**849**	2263	4	566
	Through-Right		0			0	
	Right	790	1	604	390	1	137
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	145	2	**80**	65	2	36
	Left-Through		0			0	
	Through	1512	4	378	2542	4	**636**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	338	2	**186**	460	2	**253**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	44	1	0	77	1	41
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	929		*North-South:*	636
			East-West:	186		*East-West:*	253
			SUM:	1115		*SUM:*	889
VOLUME/CAPACITY *(V/C)* RATIO:				0.782			0.624
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.682**			**0.524**
LEVEL OF SERVICE (LOS):				**B**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 12

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Nicholson Street East-West Street: Culver Boulevard
Scenario: Cumulative (2019) with Construction Activity - Alternative 3
Count Date: Analyst: RA Date: 6/17/2015

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 1	SB --	0	NB -- 1	SB --	0
	EB -- 0	WB --	0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	10	0	**10**	44	0	44
	Left-Through		1			1	
	Through	0	0	10	3	0	**47**
	Through-Right		0			0	
	Right	897	1	0	410	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	4	0	4	1	0	**1**
	Left-Through		0			0	
	Through	0	0	**5**	1	0	2
	Through-Right		0			0	
	Right	1	0	0	0	0	0
	Left-Through-Right		1			1	
	Left-Right		0			0	
EASTBOUND	Left	1	1	1	2	1	2
	Left-Through		0			0	
	Through	1544	1	**780**	637	1	**340**
	Through-Right		1			1	
	Right	15	0	15	43	0	43
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	367	1	**367**	1026	1	**1026**
	Left-Through		0			0	
	Through	576	1	289	1537	1	770
	Through-Right		1			1	
	Right	2	0	2	2	0	2
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	15		*North-South:*	48
			East-West:	1147		*East-West:*	1366
			SUM:	1162		*SUM:*	1414
VOLUME/CAPACITY *(V/C)* RATIO:				0.815			0.992
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.715**			**0.892**
LEVEL OF SERVICE (LOS):				**C**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 13

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: Jefferson Boulevard East-West Street: Culver Boulevard
Scenario: Cumulative (2019) with Construction Activity - Alternative 3
Count Date: Analyst: RA Date: 6/17/2015

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 0	WB --		0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	374	2	**206**	1130	2	**622**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	26	1	0	60	1	60
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	2024	2	**1012**	815	2	408
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	126	0	**126**	136	0	136
	Left-Through		1			1	
	Through	500	1	500	1404	1	**974**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	206		*North-South:*	622
			East-West:	1138		*East-West:*	974
			SUM:	1344		*SUM:*	1596
VOLUME/CAPACITY *(V/C)* RATIO:				0.896			1.064
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.796**			**0.964**
LEVEL OF SERVICE (LOS):				**C**			**E**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 14

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 EB Ramps East-West Street: Culver Boulevard
Scenario: Cumulative (2019) with Construction Activity - Alternative 3
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				2			2
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 0	WB --		0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	0	0	**0**	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	127	1	**127**	111	1	**111**
	Left-Through		0			0	
	Through	0	1	0	4	1	4
	Through-Right		1			1	
	Right	36	0	36	61	0	61
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	**0**
	Left-Through		0			0	
	Through	1827	3	**609**	780	3	260
	Through-Right		0			0	
	Right	1020	2	561	356	2	196
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	115	1	**115**	329	1	329
	Left-Through		0			0	
	Through	608	2	304	1567	2	**784**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	127		*North-South:*	111
			East-West:	724		*East-West:*	784
			SUM:	851		*SUM:*	895
VOLUME/CAPACITY *(V/C)* RATIO:				0.567			0.597
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.467**			**0.497**
LEVEL OF SERVICE (LOS):				**A**			**A**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 15

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 WB Ramps East-West Street: Culver Boulevard
Scenario: Cumulative (2019) with Construction Activity - Alternative 3
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
	No. of Phases			3			3
	Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			1			1
	Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
		EB -- 0	WB --	0	EB -- 0	WB --	0
	ATSAC-1 or ATSAC+ATCS-2?			2			2
	Override Capacity			0			0
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	189	1	104	292	1	161
	Left-Through		1			1	
	Through	313	0	**438**	258	0	**304**
	Through-Right		1			1	
	Right	125	0	125	46	0	46
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	90	1	**90**	169	1	169
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	177	1	0	565	1	**453**
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	518	1	**518**	225	1	**225**
	Left-Through		0			0	
	Through	1430	2	715	661	2	331
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	345	2	173	1025	2	**513**
	Through-Right		0			0	
	Right	345	1	**300**	294	1	210
	Left-Through-Right		0			0	
	Left-Right		0			0	
	CRITICAL VOLUMES		*North-South:*	528		*North-South:*	757
			East-West:	818		*East-West:*	738
			SUM:	1346		*SUM:*	1495
	VOLUME/CAPACITY *(V/C)* RATIO:			0.945			1.049
	V/C LESS ATSAC/ATCS ADJUSTMENT:			**0.845**			**0.949**
	LEVEL OF SERVICE (LOS):			**D**			**E**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 16

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 EB Ramps East-West Street: Mindanao Way
Scenario: Cumulative (2019) with Construction Activity - Alternative 3
Count Date: Analyst: RA Date: 6/17/205

		AM PEAK HOUR			PM PEAK HOUR		
No. of Phases				3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?				0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --		0	NB -- 0	SB --	0
	EB -- 2	WB --		0	EB -- 2	WB --	0
ATSAC-1 or ATSAC+ATCS-2?				2			2
Override Capacity				0			0

	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	0	0	**0**	0	0	**0**
	Left-Through		0			0	
	Through	0	0	0	0	0	0
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	17	1	17	23	1	23
	Left-Through		0			0	
	Through	1178	1	**594**	1101	1	**557**
	Through-Right		1			1	
	Right	9	0	9	12	0	12
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	488	1	**447**	473	1	**414**
	Through-Right		1			1	
	Right	853	1	0	770	1	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	501	2	**276**	704	2	**387**
	Left-Through		0			0	
	Through	1003	2	502	1123	2	562
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	594		*North-South:*	557
			East-West:	723		*East-West:*	801
			SUM:	1317		*SUM:*	1358
VOLUME/CAPACITY *(V/C)* RATIO:				0.924			0.953
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.824**			**0.853**
LEVEL OF SERVICE (LOS):				**D**			**D**

REMARKS:

Version: 1i Beta; 8/4/2011

Level of Service Worksheet
(Circular 212 Method)

I/S #: 17

PROJECT TITLE: Ballona Wetlands Restoration Project
North-South Street: SR-90 WB Ramps East-West Street: Mindanao Way
Scenario: Cumulative (2019) with Construction Activity - Alternative 3
Count Date: Analyst: RA Date: 6/17/205

	AM PEAK HOUR			PM PEAK HOUR		
No. of Phases			3			3
Opposed Ø'ing: N/S-1, E/W-2 or Both-3?			0			0
Right Turns: FREE-1, NRTOR-2 or OLA-3?	NB -- 0	SB --	0	NB -- 0	SB --	0
	EB -- 0	WB --	0	EB -- 0	WB --	0
ATSAC-1 or ATSAC+ATCS-2?			2			2
Override Capacity			0			0

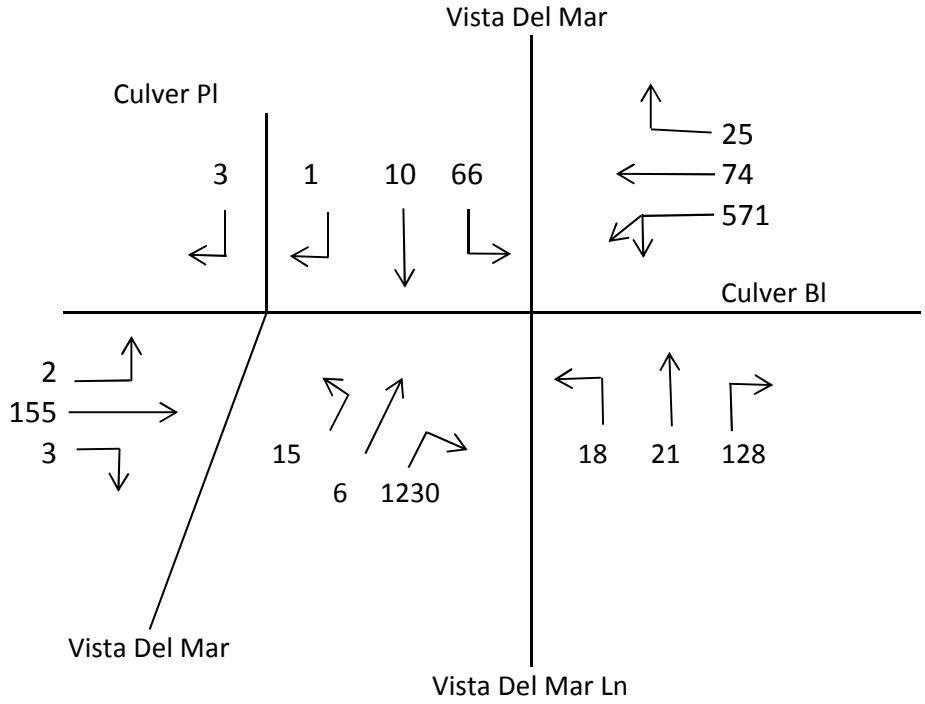
	MOVEMENT	Volume	No. of Lanes	Lane Volume	Volume	No. of Lanes	Lane Volume
NORTHBOUND	Left	613	1	613	571	1	**549**
	Left-Through		1			1	
	Through	1417	1	**709**	1076	1	549
	Through-Right		0			0	
	Right	594	1	594	432	1	432
	Left-Through-Right		0			0	
	Left-Right		0			0	
SOUTHBOUND	Left	0	0	**0**	0	0	0
	Left-Through		0			0	
	Through	0	0	0	0	0	**0**
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
EASTBOUND	Left	34	1	**34**	25	1	**25**
	Left-Through		0			0	
	Through	507	2	254	462	2	231
	Through-Right		0			0	
	Right	0	0	0	0	0	0
	Left-Through-Right		0			0	
	Left-Right		0			0	
WESTBOUND	Left	0	0	0	0	0	0
	Left-Through		0			0	
	Through	765	2	**268**	1288	2	**448**
	Through-Right		1			1	
	Right	39	0	39	56	0	56
	Left-Through-Right		0			0	
	Left-Right		0			0	
CRITICAL VOLUMES			*North-South:*	709		*North-South:*	549
			East-West:	302		*East-West:*	473
			SUM:	1011		*SUM:*	1022
VOLUME/CAPACITY *(V/C)* RATIO:				0.709			0.717
V/C LESS ATSAC/ATCS ADJUSTMENT:				**0.609**			**0.617**
LEVEL OF SERVICE (LOS):				**B**			**B**

REMARKS:

Version: 1i Beta; 8/4/2011

CMA METHODOLOGY
CUMULATIVE (2019) WITH CONSTRUCTION ACTIVITY (ALTERNATIVE 3)
AM PEAK HOUR

Int#18 - Vista Del Mar/Vista Del Mar Lane & Culver Boulevard



1. 571 x 0.55 or (74 + 25)

2. (15 + 6 + 1230) x 0.55

3. $\frac{(2 + 155 + 3)}{2}$

4. 66 + (18 + 21 + 128) or 18 + (66 + 10 + 1)

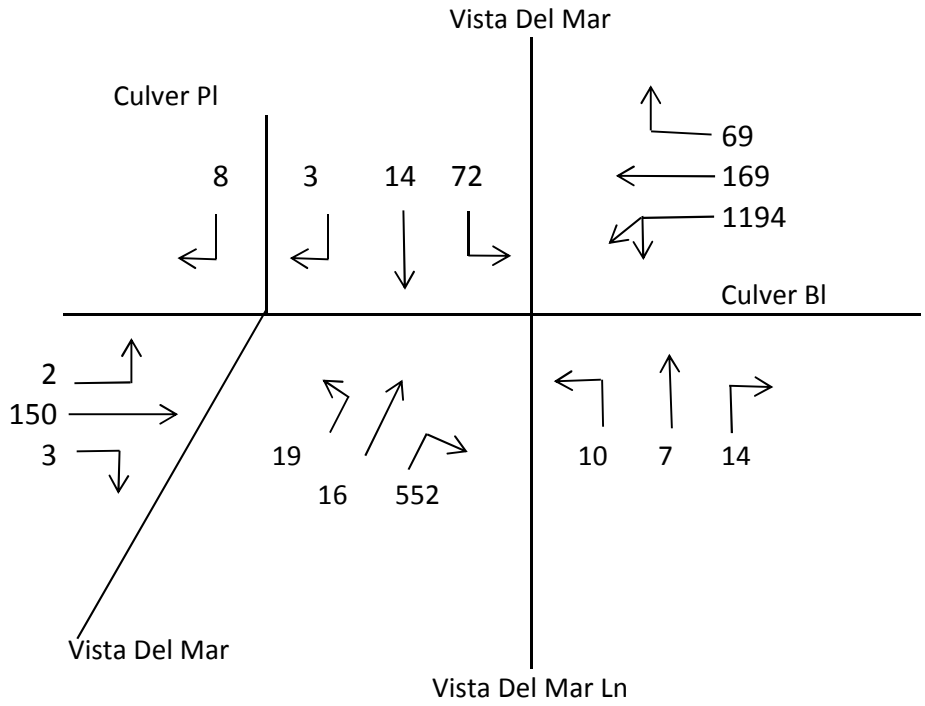
Critical Volumes = 314 + 688 + 80 + 233 = 1315

V/C = $\frac{1315}{1375}$ =

= 0.956 - 0.10 = 0.856 LOS D
ATSAC/ATCS

CMA METHODOLOGY
CUMULATIVE (2019) WITH CONSTRUCTION ACTIVITY (ALTERNATIVE 3)
PM PEAK HOUR

Int#18 - Vista Del Mar/Vista Del Mar Lane & Culver Boulevard



1. 1194 x 0.55 or (169 + 69)

2. (19 + 16 + 552) x 0.55

3. $\frac{(2 + 150 + 3)}{2}$

4. 72 + (10 + 7 + 14) or 10 + (72 + 14 + 3)

Critical Volumes = 657 + 323 + 78 + 103 = 1161

V/C = $\frac{1161}{1375}$ =

= 0.844 - 0.10 = 0.744 LOS C
ATSAC/ATCS

APPENDIX I

Local Study Area Census and Survey Data

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Appendix I – Local Study Area Census and Survey Data

		LA County	City of LA	Total Local Study Area	Playa del Rey				
1	**Census Unit**	**County**	**City**		**2766.01**	**2766.03**	**2766.04**	**2781.02**	**All**
2	Historical/Existing population								
3	2000 (2000 Census)	**9,519,338**	**3,694,820**	**na**	-	-	-	-	**-**
4	2010 (2010 Census)	**9,818,605**	**3,792,621**	**211,754**	3,838	5,252	3,983	3,158	**16,231**
5	Racial Characteristics (2010 Census)								
6		**4,687,889**	**1,838,822**	**48,988**	450	558	591	282	**1,881**
7	Hispanic/Latino (of any race)	**47.7%**	**48.5%**	**23.1%**	11.7%	10.6%	14.8%	8.9%	**11.6%**
8		**2,728,321**	**1,086,908**	**113,536**	2,522	3,471	2,251	2,465	**10,709**
9	Not Hispanic or Latino, White Alone	**27.8%**	**28.7%**	**53.6%**	65.7%	66.1%	56.5%	78.1%	**66.0%**
10	Not Hispanic or Latino, Black or African American	**815,086**	**347,380**	**15,578**	187	314	374	137	**1,012**
11	alone	**8.3%**	**9.2%**	**7.4%**	4.9%	6.0%	9.4%	4.3%	**6.2%**
12	Race, alone or in combination with one or more races (2010 Census)								
13		**5,292,966**	**2,031,586**	**147,759**	2,999	4,065	2,825	2,788	**12,677**
14	White	**53.9%**	**53.6%**	**69.8%**	78.1%	77.4%	70.9%	88.3%	**78.1%**
15		**948,337**	**402,448**	**19,582**	237	432	473	167	**1,309**
16	Black or African American	**9.7%**	**10.6%**	**9.2%**	6.2%	8.2%	11.9%	5.3%	**8.1%**
17		**140,764**	**54,236**	**3,358**	40	51	57	29	**177**
18	American Indian and Alaskan Native	**1.4%**	**1.4%**	**1.6%**	1.0%	1.0%	1.4%	0.9%	**1.1%**
19		**1,497,960**	**483,585**	**31,412**	647	792	664	224	**2,327**
20	Asian	**15.3%**	**12.8%**	**14.8%**	16.9%	15.1%	16.7%	7.1%	**14.3%**
21		**54,169**	**15,031**	**1,252**	27	43	33	13	**116**
22	Native Hawaiian and Other Pacific Islander	**0.6%**	**0.4%**	**0.6%**	7.0%	80.0%	0.8%	0.4%	**0.7%**
23		**2,356,448**	**994,308**	**21,535**	129	209	204	84	**626**
24	Some other race	**24.0%**	**26.2%**	**10.2%**	3.4%	4.0%	5.1%	2.7%	**3.9%**
25	***Percent Total Minority (Other than Non-Hispanic White)***	***72.2%***	***71.3%***	***46.4%***	***34.3%***	***33.9%***	***43.5%***	***21.9%***	***34.0%***
26	Housing (2010 Census)								
27	Total Housing Units	**3,445,076**	**1,413,995**	**103,779**	1,754	3,280	2,287	1,752	**9,073**
28	Occupied Housing Units	**3,241,204**	**1,318,168**	**95,609**	1,683	3,128	2,071	1,595	**8,477**
29	Percent owner occupied	**47.7%**	**38.2%**	**43.1%**	60.0%	44.3%	35.9%	42.6%	**45.0%**
30	Percent renter occupied	**52.3%**	**61.8%**	**56.9%**	40.0%	55.7%	64.1%	57.4%	**55.0%**
31	Percent vacant	**5.9%**	**6.8%**	**7.9%**	4.0%	4.6%	9.4%	9.0%	**6.6%**
32	Vacant units for rent	**104,960**	**53,309**	**3,350**	31	87	172	70	**360**
33	% Vacant for rent	**3.0%**	**3.8%**	**3.2%**	**1.8%**	**2.7%**	**7.5%**	**4.0%**	**4.0%**
34	Vacant units for sale	**26,808**	**10,930**	**560**	12	12	5	13	**42**
35	Vacant units for seasonal, recreational, or occasional use	**19,099**	**7,540**	**1,443**	6	32	18	44	**100**
36	% Vacant (2013 ACS 5-year)	**6.4%**	**7.1%**	**7.6%**	**8.2%**	**2.4%**	**7.5%**	**9.0%**	**6.1%**
37	Employment and Income (2013 ACS 5-Year DP03)								
38	Total civilian labor force	**5,070,505**	**2,032,832**	**132,379**	2,243	4,548	2,732	2,119	**11,642**
39	Percent unemployed	**7.4%**	**8.0%**	**6.6%**	7.9%	6.3%	3.3%	6.3%	**5.9%**
40	Total Households			**96,122**	1,627	3,212	2,409	1,499	**8,747**
41	Median household income	**55,909**	**$ 49,497**	**$ 80,373**	$ 95,568	$ 80,510	$ 73,985	$121,875	**$ 88,603**
42	Households with Food Stamp/SNAP benefits in the past 12 months	**7.8%**	**8.3%**	**2.4%**	2.3%	0.0%	0.0%	2.5%	**0.9%**
43	Percent of people whose income in the past 12 months is below the poverty level	**17.8%**	**22.0%**	**10.5%**	7.9%	8.5%	17.4%	5.7%	**10.0%**
44	Children (2013 ACS 5-year)								
45	Population	**9,893,481**	**3,827,261**	**211,710**	3,726	5,645	4,160	2,998	16,529
46	Percentage of population 18 and above	**76.0%**	**77.4%**	**85.8%**	83.7%	95.0%	94.9%	89.8%	91.5%
47	Percentage below 18 (Children)	**24.0%**	**22.6%**	**16.8%**	16.3%	5.0%	5.1%	10.2%	8.5%
48	Percentage below 5 (young children)	**6.5%**	**6.6%**	**6.0%**	4.3%	3.1%	1.8%	2.8%	3.0%
49	Employment by Industry (2013 ACS 5-Year)								
50	Civilian employed population 16 years and over	**4,489,974**	1,787,083	**120,269**	1,994	4,207	2,600	1,946	**10,747**
51	Agriculture, forestry, fishing and hunting, and mining	**22,433**	8,273	**413**	0	0	0	0	**0**
52	Construction	**255,359**	107,969	**3,418**	43	47	52	86	**228**
53	Manufacturing	**483,592**	163,336	**7,292**	109	206	373	228	**916**
54	Wholesale trade	**162,995**	51,433	**2,568**	75	62	17	42	**196**
55	Retail trade	**478,076**	184,895	**9,784**	154	489	107	52	**802**
56	Transportation and warehousing, and utilities	**235,944**	73,396	**3,932**	128	229	193	101	**651**
57	Information	**195,741**	103,400	**12,352**	191	435	181	311	**1,118**
58	Finance and insurance, and real estate and rental and leasing	**286,163**	114,028	**8,500**	107	177	125	182	**591**
59	Professional, scientific, and management, and administrative and waste management services	**551,858**	243,804	**22,042**	397	633	383	378	**1,791**
60	Educational services, and health care and social assistance	**930,098**	352,970	**27,373**	520	1,191	648	293	**2,652**
61	Arts, entertainment, and recreation, and accommodation and food services	**457,287**	211,740	**13,388**	114	486	455	144	**1,199**
62	Other services, except public administration	**278,039**	128,454	**5,657**	65	109	54	38	**266**
63	Public administration	**152,389**	43,385	**3,550**	91	143	12	91	**337**

	Playa Vista			Del Rey							
1	**2756.02**	**2756.03**	**All**	**2751.01**	**2751.02**	**2752**	**2753.02**	**2753.11**	**2754**	**2755**	**All**
2											
3	-	-	**-**	-	-	-	-	-	-	-	**-**
4	6,470	2,711	**9,181**	1,177	4,226	3,887	4,775	4,993	3,349	5,207	**27,614**
5											
6	737	945	**1,682**	331	2,835	1,922	671	1,398	672	3,698	**11,527**
7	11.4%	34.9%	**18.3%**	28.1%	67.1%	49.4%	14.1%	28.0%	20.1%	71.0%	**41.7%**
8	3,211	946	**4,157**	490	837	1,201	3,061	2,172	1,941	676	**10,378**
9	49.6%	34.9%	**45.3%**	41.6%	19.8%	30.9%	64.1%	43.5%	58.0%	13.0%	**37.6%**
10	709	102	**811**	86	96	196	219	162	113	322	**1,194**
11	11.0%	3.8%	**8.8%**	7.3%	2.3%	5.0%	4.6%	3.2%	3.4%	6.2%	**4.3%**
12											
13	3,942	1,534	**5,476**	692	2,387	2,345	3,647	3,051	2,431	2,331	**16,884**
14	60.9%	56.6%	**59.6%**	58.8%	56.5%	60.3%	76.4%	61.1%	72.6%	44.8%	**61.1%**
15	903	141	**1,044**	108	152	257	309	231	176	383	**1,616**
16	14.0%	5.2%	**11.4%**	9.2%	3.6%	6.6%	6.5%	4.6%	5.3%	7.4%	**5.9%**
17	82	23	**105**	209	74	76	41	60	51	95	**606**
18	1.3%	0.8%	**1.1%**	2.5%	1.8%	2.0%	0.9%	1.2%	1.5%	1.8%	**2.2%**
19	1,674	680	**2,354**	230	416	505	747	1,191	544	460	**4,093**
20	25.9%	25.1%	**25.6%**	19.5%	9.8%	13.0%	15.6%	23.9%	16.2%	8.8%	**14.8%**
21	41	17	**58**	20	33	22	22	44	18	47	**206**
22	0.6%	0.6%	**0.6%**	1.7%	0.8%	0.6%	0.5%	0.9%	0.5%	0.9%	**0.7%**
23	292	475	**767**	175	1,389	923	259	720	304	2,134	**5,904**
24	4.5%	17.5%	**8.4%**	14.9%	32.9%	23.7%	5.4%	14.4%	9.1%	41.0%	**21.4%**
25	***50.4%***	***65.1%***	***54.7%***	***58.4%***	***80.2%***	***69.1%***	***35.9%***	***56.5%***	***42.0%***	***87.0%***	***62.4%***
26											
27	3,739	1,179	**4,918**	506	1,395	1,669	2,659	2,316	1,944	1,688	**12,177**
28	3,490	1,132	**4,622**	482	1,326	1,583	2,522	2,202	1,663	1,643	**11,421**
29	40.8%	61.5%	**45.9%**	40.0%	33.5%	21.2%	62.6%	48.8%	51.1%	28.5%	**43.3%**
30	59.2%	38.5%	**54.1%**	60.0%	66.5%	78.8%	37.4%	51.2%	48.9%	71.5%	**56.7%**
31	6.7%	4.0%	**6.0%**	4.7%	4.9%	5.2%	5.2%	4.9%	14.5%	2.7%	**6.2%**
32	114	20	**134**	12	34	38	57	74	94	30	**339**
33	**3.0%**	**1.7%**	**2.7%**	**2.4%**	**2.4%**	**2.3%**	**2.1%**	**3.2%**	**4.8%**	**1.8%**	**2.8%**
34	43	3	**46**	4	11	5	6	5	79	2	**112**
35	43	7	**50**	2	3	6	44	9	15	4	**83**
36	**8.2%**	**2.4%**	**7.5%**	**3.1%**	**5.0%**	**5.3%**	**4.3%**	**3.1%**	**8.4%**	**2.4%**	**4.6%**
37											
38	4,932	1,609	**6,541**	796	2,493	2,573	2,754	3,591	2,212	2,639	**17,058**
39	9.7%	9.2%	**9.6%**	7.4%	5.2%	8.5%	5.2%	4.7%	4.8%	12.8%	**6.8%**
40	3,662	1,186	**4,848**	503	1,296	1,603	2,544	2,284	1,661	1,634	**11,525**
41	$ 72,335	$ 59,091	**$ 69,095**	$ 67,386	$ 55,458	$ 55,884	$ 93,973	$ 67,955	$ 106,336	$ 35,970	**$ 71,586**
42	0.0%	5.0%	**1.2%**	5.8%	4.7%	2.3%	0.0%	11.1%	1.7%	16.8%	**5.9%**
43	9.5%	12.1%	**10.3%**	1.5%	7.3%	22.0%	13.0%	5.4%	7.4%	28.0%	**13.7%**
44											
45	7,393	2,893	10,286	1,301	4,225	4,518	4,978	5,933	3,240	5,296	29,491
46	86.1%	83.5%	85.4%	82.0%	75.8%	75.9%	90.7%	82.8%	84.3%	73.5%	80.5%
47	13.9%	16.5%	14.6%	18.0%	24.2%	24.1%	9.3%	17.2%	15.7%	26.5%	19.5%
48	10.1%	4.5%	8.5%	6.4%	9.1%	8.5%	5.4%	8.0%	11.3%	8.3%	8.1%
49											
50	4,311	1,380	**5,691**	715	2322	2274	2518	3356	2080	2115	**15380**
51	15	34	**49**	0	0	0	15	0	0	9	**24**
52	50	16	**66**	23	100	108	22	153	26	101	**533**
53	365	107	**472**	13	46	142	234	114	100	139	**788**
54	105	19	**124**	40	30	30	103	78	18	31	**330**
55	546	103	**649**	59	146	161	122	206	139	313	**1146**
56	183	76	**259**	25	90	84	75	29	46	186	**535**
57	394	142	**536**	5	112	168	358	382	334	90	**1449**
58	329	163	**492**	66	48	102	170	180	104	52	**722**
59	954	146	**1,100**	198	905	421	440	391	548	140	**3043**
60	987	356	**1,343**	148	386	351	404	1060	446	353	**3148**
61	265	98	**363**	66	195	440	405	423	205	351	**2085**
62	32	58	**90**	60	197	244	79	296	37	243	**1156**
63	86	62	**148**	12	67	23	91	44	77	107	**421**

	Mar Vista											
1	2713	2714	2715	2716	2719.01	2719.02	2721	2722.01	2722.02	2723.01	2723.02	**Total**
2												
3	-	-	-	-	-	-	-	-	-	-	-	**-**
4	4,506	3,391	2,397	4,475	3,087	3,877	4,354	2,411	3,378	2,941	4,074	**38,891**
5												
6	863	446	328	450	870	926	1,061	917	1,466	911	2,041	**10,279**
7	19.2%	13.2%	11.2%	10.1%	28.2%	23.9%	24.4%	38.0%	43.4%	31.0%	50.1%	**26.4%**
8	2,383	2,365	1,971	2,184	1,363	2,173	2,646	1,060	1,324	1,422	1,380	**20,271**
9	52.9%	69.7%	67.1%	48.8%	44.2%	56.0%	60.8%	44.0%	39.2%	48.4%	33.9%	**52.1%**
10	113	29	54	95	220	124	76	107	131	145	186	**1,280**
11	2.5%	0.9%	1.8%	2.1%	7.1%	3.2%	1.7%	4.4%	3.9%	4.9%	4.6%	**3.3%**
12												
13	3,120	2,819	2,317	2,655	1,905	2,837	3,415	1,554	2,021	2,020	2,424	**27,087**
14	69.2%	83.1%	78.9%	59.3%	61.7%	73.2%	78.4%	64.5%	59.8%	68.7%	59.5%	**69.6%**
15	182	63	80	155	268	186	123	152	183	177	238	**1,807**
16	4.0%	1.9%	2.7%	3.5%	8.7%	4.8%	2.8%	6.3%	5.4%	6.0%	5.8%	**4.6%**
17	43	32	24	49	68	66	72	57	100	53	101	**665**
18	1.0%	0.9%	0.8%	1.1%	2.2%	1.7%	1.7%	2.4%	3.0%	1.8%	2.5%	**1.7%**
19	1,084	507	550	1,689	587	586	500	281	389	417	423	**7,013**
20	24.1%	15.0%	18.7%	37.7%	19.0%	15.1%	11.5%	11.7%	11.5%	14.2%	10.4%	**18.0%**
21	31	15	11	12	20	13	27	2	20	19	10	**180**
22	0.7%	0.4%	0.4%	0.3%	0.6%	0.3%	0.6%	0.1%	0.6%	0.6%	0.2%	**0.5%**
23	333	143	120	153	424	427	449	485	850	437	1,082	**4,903**
24	7.4%	4.2%	4.1%	3.4%	13.7%	11.0%	10.3%	20.1%	25.2%	14.9%	26.6%	**12.6%**
25	***47.1%***	***30.3%***	***32.9%***	***51.2%***	***55.8%***	***44.0%***	***39.2%***	***56.0%***	***60.8%***	***51.6%***	***66.1%***	***47.9%***
26												
27	2,105	1,381	1,388	2,020	1,354	1,888	1,836	1,145	1,585	1,351	1,988	**18,041**
28	2,002	1,344	1,331	1,914	1,286	1,796	1,775	1,095	1,519	1,277	1,880	**17,219**
29	57.4%	86.6%	56.6%	30.5%	32.3%	36.2%	60.2%	20.8%	20.8%	37.6%	13.7%	**41.0%**
30	42.6%	13.4%	43.4%	69.5%	67.7%	63.8%	39.8%	79.2%	79.2%	62.4%	86.3%	**59.0%**
31	4.9%	2.7%	4.1%	5.2%	5.0%	4.9%	3.3%	4.4%	4.2%	5.5%	5.4%	**4.6%**
32	55	5	30	71	43	63	26	36	53	48	88	**518**
33	**2.6%**	**0.4%**	**2.2%**	**3.5%**	**3.2%**	**3.3%**	**1.4%**	**3.1%**	**3.3%**	**3.6%**	**4.4%**	**2.9%**
34	17	6	6	3	13	5	2	2	3	2	3	**62**
35	6	3	5	9	2	6	11	4	2	4	8	**60**
36	**7.3%**	**2.3%**	**6.3%**	**2.8%**	**6.0%**	**3.0%**	**7.1%**	**0.0%**	**4.2%**	**5.1%**	**3.8%**	**4.5%**
37	0	0	0									
38	2,769	1,857	1,628	2,449	1,858	2,594	2,178	1,493	2,417	1,960	2,482	**23,685**
39	5.6%	6.0%	3.0%	4.2%	7.7%	8.6%	5.4%	7.0%	10.3%	5.7%	3.4%	**6.1%**
40	1,942	1,356	1,322	1,955	1,278	1,779	1,743	1,141	1,543	1,323	1,977	**17,359**
41	$ 78,782	$ 104,091	$ 86,875	$ 76,181	$ 66,050	$ 62,596	$ 85,236	$ 54,952	$ 57,768	$ 83,850	$ 47,722	**$ 72,549**
42	2.7%	2.0%	0.5%	2.7%	0.0%	4.1%	1.9%	0.7%	5.6%	2.7%	2.1%	**2.4%**
43	10.0%	9.3%	6.2%	14.7%	11.3%	7.4%	9.6%	12.7%	12.8%	10.2%	14.7%	**11.0%**
44												
45	4,645	3,636	3,064	4,655	3,487	4,184	4,240	2,288	3,683	3,159	4,141	41,182
46	85.7%	79.3%	80.1%	78.6%	78.4%	83.9%	74.1%	83.9%	85.5%	86.1%	82.8%	81.5%
47	14.3%	20.7%	19.9%	21.4%	21.6%	16.1%	25.9%	16.1%	14.5%	13.9%	17.2%	18.5%
48	3.4%	3.6%	6.1%	11.0%	8.0%	7.2%	13.8%	6.6%	3.1%	4.5%	4.7%	6.7%
49												
50	2,540	1,680	1,553	2,292	1,644	2,285	2,005	1,355	2,088	1,804	2,362	**21,608**
51	31	0	0	0	0	0	0	0	54	0	0	**85**
52	76	26	39	43	54	79	101	155	101	37	58	**769**
53	133	98	162	190	31	52	212	77	105	131	63	**1,254**
54	32	19	22	33	0	23	30	44	0	107	53	**363**
55	294	55	155	111	88	158	54	45	261	98	224	**1,543**
56	14	10	18	86	12	16	24	36	182	64	77	**539**
57	161	234	251	81	129	282	355	130	110	131	256	**2,120**
58	153	205	85	96	152	139	167	103	118	152	69	**1,439**
59	559	256	363	566	351	318	426	116	141	282	290	**3,668**
60	620	313	313	879	452	564	352	253	373	227	415	**4,761**
61	283	285	65	104	297	407	137	266	514	414	600	**3,372**
62	77	97	68	34	64	179	114	88	99	108	212	**1,140**
63	107	82	12	69	14	68	33	42	30	53	45	**555**

	Venice											
1	2731	2732	2733	2734.02	2735.02	2736	2737	2738	2739.02	2741	2742.02	**All**
2												
3	-	-	-	-	-	-	-	-	-	-	-	**-**
4	2,197	3,711	3,695	3,172	2,884	2,413	2,801	3,107	4,227	4,418	4,337	**36,962**
5												
6	488	1,281	1,213	312	273	413	661	602	383	430	274	**6,330**
7	22.2%	64.5%	32.8%	9.8%	9.5%	17.1%	23.6%	19.4%	9.1%	9.7%	6.3%	**17.1%**
8	1,460	1,769	1,830	2,463	2,249	1,727	1,845	2,081	3,376	2,965	3,560	**25,325**
9	66.5%	47.7%	49.5%	77.6%	78.0%	71.6%	65.9%	67.0%	79.9%	67.1%	82.1%	**68.5%**
10	47	441	380	110	93	82	49	86	128	216	152	**1,784**
11	2.1%	11.9%	10.3%	3.5%	3.2%	3.4%	1.7%	2.8%	3.0%	4.9%	3.5%	**4.8%**
12												
13	1,869	2,450	2,527	2,784	2,538	2,038	2,330	2,553	3,757	3,419	3,880	**30,145**
14	85.1%	66.0%	68.4%	87.8%	88.0%	84.5%	83.2%	82.2%	88.9%	77.4%	89.5%	**81.6%**
15	76	504	471	163	153	115	100	144	163	285	221	**2,395**
16	3.5%	13.6%	12.7%	5.1%	5.3%	4.8%	3.6%	4.6%	3.9%	6.5%	5.1%	**6.5%**
17	23	70	86	63	63	45	65	62	51	57	48	**633**
18	1.0%	1.9%	2.3%	2.0%	2.2%	1.9%	2.3%	2.0%	1.2%	1.3%	1.1%	**1.7%**
19	182	146	180	204	189	142	189	265	273	712	278	**2,760**
20	8.3%	3.9%	4.9%	6.4%	6.6%	5.9%	6.7%	8.5%	6.5%	16.1%	6.4%	**7.5%**
21	4	10	22	12	12	9	11	12	17	20	5	**134**
22	0.2%	0.3%	0.6%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.5%	0.1%	**0.4%**
23	143	709	650	113	97	169	276	205	137	161	1	**2,661**
24	6.5%	19.1%	17.6%	3.6%	3.4%	7.0%	9.9%	6.6%	3.2%	3.6%	1.7%	**7.2%**
25	***33.5%***	***52.3%***	***50.5%***	***22.4%***	***22.0%***	***28.4%***	***34.1%***	***33.0%***	***20.1%***	***32.9%***	***17.9%***	***31.5%***
26												
27	1,630	1,710	1,775	2,387	1,954	1,242	1,304	1,651	2,537	2,563	2,815	**21,568**
28	873	1,586	1,639	2,095	1,765	1,149	1,245	1,569	2,306	2,333	2,438	**18,998**
29	69.4%	26.9%	19.3%	15.8%	15.9%	49.0%	50.8%	30.8%	39.3%	36.1%	49.3%	**34.7%**
30	30.6%	73.1%	80.7%	84.2%	84.1%	51.0%	49.2%	69.2%	60.7%	63.9%	50.7%	**65.3%**
31	46.4%	7.3%	7.7%	12.2%	9.7%	7.5%	4.5%	5.0%	9.1%	9.0%	13.4%	**11.9%**
32	9	47	53	117	98	25	27	43	74	82	95	**670**
33	**0.6%**	**2.7%**	**3.0%**	**4.9%**	**5.0%**	**2.0%**	**2.1%**	**2.6%**	**2.9%**	**3.2%**	**3.4%**	**3.1%**
34	3	9	14	20	6	2	6	3	11	20	84	**178**
35	8	19	38	89	57	29	7	17	92	83	147	**586**
36	**41.2%**	**9.0%**	**9.2%**	**15.9%**	**5.8%**	**6.5%**	**5.8%**	**3.4%**	**13.8%**	**14.9%**	**20.2%**	**13.9%**
37												
38	1,274	2,407	2,432	2,220	2,437	1,554	1,718	2,176	3,012	3,030	2,308	**24,568**
39	3.3%	9.9%	8.1%	12.2%	11.2%	8.1%	8.1%	7.0%	9.2%	2.4%	5.1%	**7.8%**
40	898	1,559	1,604	1,987	1,834	1,140	1,241	1,608	2,167	2,276	2,173	**18,487**
41	$ 101,250	$ 80,223	$ 76,649	$ 66,008	$ 60,714	$ 98,108	$ 81,473	$ 82,549	$ 90,379	$ 110,139	$ 111,675	**$ 87,431**
42	0.0%	6.9%	6.9%	0.8%	1.0%	1.0%	2.1%	0.0%	0.5%	0.0%	2.7%	**1.9%**
43	9.0%	16.4%	15.5%	10.1%	13.2%	16.4%	12.6%	11.9%	11.4%	12.8%	6.7%	**12.3%**
44												
45	2,047	3,625	3,779	2,774	2,860	2,318	2,799	3,234	3,852	4,507	3,847	35,642
46	88.5%	83.0%	79.4%	97.0%	94.6%	82.7%	82.4%	84.7%	91.1%	86.2%	91.4%	87.2%
47	11.5%	17.0%	20.6%	3.0%	5.4%	17.3%	17.6%	15.3%	8.9%	13.8%	8.6%	12.8%
48	4.3%	7.1%	8.5%	1.6%	1.8%	2.5%	5.3%	8.2%	4.7%	7.9%	2.6%	5.2%
49												
50	1,212	2,106	2,183	1,891	2,128	1,393	1,523	1,984	2,681	2,934	2,129	22,164
51	0	8	0	14	0	0	14	0	0	11	0	47
52	45	81	95	39	54	19	58	12	83	77	12	575
53	33	111	173	51	71	133	37	102	109	235	34	1,089
54	16	10	52	39	35	19	26	27	134	213	69	640
55	45	231	120	102	202	121	214	298	231	235	94	1,893
56	6	71	83	15	41	22	20	0	12	59	45	374
57	131	392	281	327	402	161	209	352	730	314	161	3,460
58	63	87	85	27	120	77	66	94	181	474	228	1,502
59	351	354	397	711	475	273	282	497	459	405	620	4,824
60	351	300	400	266	235	272	216	282	455	450	554	3,781
61	87	287	382	172	331	200	269	136	190	365	218	2,637
62	52	135	81	76	123	41	34	74	92	54	76	838
63	32	39	34	52	39	55	78	110	5	42	18	504

	Westchester										
1	2760	2761	2764	2765	2770	2771	2772	2774	2780.01	9800.28	**Total**
2											
3	-	-	-	-	-	-	-	-	-	-	**-**
4	5,578	5,592	4,009	5,063	5,395	3,004	2,490	1,533	2,458	4	**35,126**
5											
6	945	808	464	933	753	724	766	351	1,832	2	**7,578**
7	17.5%	14.1%	11.6%	18.4%	14.0%	24.1%	30.8%	22.9%	74.5%	50.0%	**21.6%**
8	3,430	1,123	2,839	3,061	3,569	1,553	511	125	1,212	0	**17,423**
9	63.6%	20.1%	70.8%	60.5%	66.2%	51.7%	20.5%	8.2%	49.3%	0.0%	**49.6%**
10	191	2,761	104	238	178	145	803	827	208	2	**5,457**
11	3.5%	49.4%	2.6%	4.7%	3.3%	4.8%	32.2%	53.9%	8.5%	50.0%	**15.5%**
12											
13	4,291	1,637	3,330	3,964	4,354	2,172	903	290	1,732	1	**22,674**
14	79.5%	29.3%	83.1%	78.3%	80.7%	72.3%	36.3%	18.9%	70.5%	25.0%	**64.6%**
15	297	3,020	160	351	271	206	927	898	256	2	**6,388**
16	5.5%	54.0%	4.0%	6.9%	5.0%	6.9%	37.2%	58.6%	10.4%	50.0%	**18.2%**
17	59	89	44	73	66	39	56	26	33	0	**485**
18	1.1%	1.6%	1.1%	1.4%	1.2%	1.3%	2.2%	1.7%	1.3%	0.0%	**1.4%**
19	760	726	546	768	825	533	313	177	376	0	**5,024**
20	14.1%	13.0%	13.6%	15.2%	15.3%	17.7%	12.6%	11.5%	15.3%	0.0%	**14.3%**
21	22	36	26	50	35	18	33	13	45	0	**278**
22	0.4%	0.6%	0.6%	1.0%	0.6%	0.6%	1.3%	0.8%	1.8%	0.0%	**0.8%**
23	319	437	129	291	212	255	462	214	178	1	**2,498**
24	5.9%	7.8%	3.2%	5.7%	3.9%	8.5%	18.6%	14.0%	7.2%	25.0%	**7.1%**
25	***36.4%***	***79.9%***	***29.2%***	***39.5%***	***33.8%***	***48.3%***	***79.5%***	***91.8%***	***50.7%***	***100.0%***	***50.4%***
26											
27	2,267	2,962	1,586	759	2,196	1,124	1,134	728	1,012	1	**13,769**
28	2,184	2,797	1,539	138	2,148	1,091	1,051	581	963	1	**12,493**
29	79.5%	17.9%	84.3%	66.9%	79.7%	82.3%	12.7%	3.8%	54.5%	0.0%	**55.4%**
30	20.5%	82.1%	15.7%	33.1%	20.3%	17.7%	87.0%	96.2%	45.5%	100.0%	**44.6%**
31	3.7%	5.6%	3.0%	2.8%	2.2%	2.9%	87.3%	20.2%	4.8%	0.0%	**9.3%**
32	32	121	5	1	11	6	57	106	19	0	**358**
33	**1.4%**	**4.1%**	**0.3%**	**0.1%**	**0.5%**	**0.5%**	**5.0%**	**14.6%**	**1.9%**	**0.0%**	**2.6%**
34	11	8	10	1	9	5	4	0	4	0	**52**
35	17	15	5	5	3	7	4	0	14	0	**70**
36	**3.9%**	**4.3%**	**1.6%**	**1.6%**	**6.1%**	**3.8%**	**8.7%**	**16.1%**	**10.0%**	**0.0%**	**5.4%**
37											
38	3,021	4,104	2,376	2,446	2,718	1,786	1,522	935	1,249	0	**20,157**
39	4.6%	9.4%	7.5%	4.9%	4.0%	5.6%	7.5%	7.3%	4.3%	na	**6.3%**
40	2,221	2,866	1,565	717	2,110	1,094	1,011	624	922	na	**13,130**
41	$ 105,664	$ 60,568	$ 97,875	$ 86,825	$ 117,120	$ 85,263	$ 58,491	$ 43,526	$ 69,457	na	**$ 84,877**
42	0.5%	4.2%	0.9%	1.3%	0.6%	1.5%	4.3%	16.7%	3.8%	na	**2.8%**
43	3.6%	19.4%	12.9%	5.5%	4.9%	11.3%	9.7%	22.1%	11.0%	na	**10.1%**
44											
45	5,620	6,013	4,325	5,084	5,526	3,067	2,453	1,578	2,311	na	35,977
46	80.6%	82.9%	82.2%	93.6%	77.5%	79.7%	77.7%	78.5%	77.7%	na	82.0%
47	19.4%	17.1%	17.8%	6.4%	22.5%	20.3%	22.3%	21.5%	22.3%	na	18.0%
48	4.9%	6.5%	5.8%	2.4%	6.7%	7.6%	4.7%	7.2%	7.8%	na	5.7%
49											
50	2,811	3,631	2,104	2,209	2,540	1,645	1,374	841	1,171	na	18,326
51	0	13	0	0	23	0	0	0	0	na	36
52	99	49	41	3	29	40	23	15	32	na	331
53	147	316	128	96	164	146	136	26	40	na	1,199
54	55	24	65	0	147	24	50	0	15	na	380
55	239	379	148	117	248	171	104	90	71	na	1,567
56	57	431	73	0	124	59	85	162	81	na	1,072
57	254	172	107	169	309	61	57	28	128	na	1,285
58	207	215	173	88	259	136	42	45	133	na	1,298
59	684	276	297	260	293	258	189	72	142	na	2,471
60	645	1,201	615	1,207	575	384	362	191	332	na	5,512
61	230	161	242	159	174	171	53	100	67	na	1,357
62	114	205	137	84	128	122	141	33	41	na	1,005
63	80	189	78	26	67	73	132	79	89	na	813

(na = not available)

	Culver City										Marina Del Rey
1	7024	7025.01	7025.02	7026	7027	7028.01	7028.02	7028.03	7030.01	All	All
2											
3										38,816	8,176
4	4,541	4,625	4,048	6,069	3,440	5,205	2,282	2,963	5,889	38,883	8,866
5											
6	1,456	758	497	1,082	719	1,618	923	1,293	708	9,025	686
7	32.1%	16.4%	12.3%	17.8%	20.9%	31.1%	40.4%	43.6%	12.0%	23.2%	7.7%
8	2,108	2,934	1,864	3,225	1,987	2,147	955	1,243	2,264	18,649	6,624
9	46.4%	63.4%	46.0%	53.1%	57.8%	41.2%	41.8%	42.0%	38.4%	48.0%	74.7%
10	219	144	818	304	79	248	62	94	1,652	3,587	453
11	4.8%	3.1%	20.2%	5.0%	2.3%	4.8%	2.7%	3.2%	28.1%	9.2%	5.1%
12											
13	3,096	3,642	2,352	4,198	2,589	3,154	1,553	2,014	2,916	25,408	7,408
14	68.2%	78.7%	58.1%	69.2%	75.3%	60.6%	68.1%	68.0%	49.5%	65.3%	83.6%
15	303	212	957	438	127	326	99	128	1,877	4,431	592
16	6.7%	4.6%	23.6%	7.2%	3.7%	6.3%	4.3%	4.3%	31.9%	11.4%	6.7%
17	66	46	65	80	37	69	39	64	104	570	117
18	1.5%	1.0%	1.6%	1.3%	1.1%	1.3%	1.7%	2.2%	1.8%	1.5%	1.3%
19	654	725	775	1,351	607	1,143	307	301	1,076	6,906	935
20	14.4%	15.7%	19.1%	22.3%	17.6%	22.0%	13.5%	10.2%	18.3%	17.8%	10.5%
21	53	24	29	45	19	21	13	27	25	255	25
22	1.2%	0.5%	0.7%	0.7%	0.6%	0.4%	0.6%	0.9%	0.4%	0.7%	0.3%
23	751	245	181	404	277	818	402	594	309	3,966	210
24	16.5%	5.3%	4.5%	6.7%	8.1%	15.7%	17.6%	20.0%	5.2%	10.2%	2.4%
25	*53.6%*	*36.6%*	*54.0%*	*46.9%*	*42.2%*	*58.8%*	*58.2%*	*58.0%*	*61.6%*	*52.0%*	*25.3%*
26											
27	0	0	0	0	0	0	914	1,210	0	17,491	6,742
28	0	0	0	0	0	0	885	1,146	0	16,779	5,600
29	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	45.0%	37.4%	0.0%	54.3%	11.5%
30	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	55.0%	62.6%	0.0%	45.7%	88.5%
31	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.2%	5.3%	0.0%	4.1%	16.9%
32	0	0	0	0	0	0	14	33	0	333	638
33	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.9%	9.5%
34	0	0	0	0	0	0	0	2	0	65	3
35	0	0	0	0	0	0	5	4	0	62	432
36	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.7%	16.0%
37											
38	0	0	0	0	0	0	1,346	1,714	0	22,636	6,092
39	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	8.6%	8.0%	0.0%	6.0%	5.5%
40	0	0	0	0	0	0	824	1,180	0	16,605	5,421
41	$ 84,482	$ 80,698	$ 95,342	$ 102,816	$ 128,370	$ 62,326	$ 78,750	$ 54,128	$ 70,295	$ 77,333	$ 95,248
42	0.8%	0.8%	0.0%	1.9%	0.0%	3.9%	4.2%	4.5%	0.9%	1.4%	2.6%
43	5.5%	7.2%	4.5%	3.1%	2.8%	11.5%	7.9%	16.5%	9.5%	7.1%	9.9%
44											
45	3,875	5,106	4,453	6,130	3,501	5,324	2,223	3,125	5,534	33,737	8,866
46	86.2%	78.4%	86.1%	78.5%	74.4%	79.3%	80.4%	80.9%	83.7%	94.2%	90.9%
47	13.8%	21.6%	13.9%	21.5%	25.6%	20.7%	19.6%	19.1%	16.3%	22.3%	9.1%
48	5.2%	5.6%	5.5%	3.1%	7.4%	5.1%	4.3%	6.2%	4.6%	5.9%	2.8%
49											
50	-*	-	-	-	-	-	-	-	-	20,705	5,648
51	-	-	-	-	-	-	-	-	-	131	41
52	-	-	-	-	-	-	-	-	-	701	215
53	-	-	-	-	-	-	-	-	-	1,316	258
54	-	-	-	-	-	-	-	-	-	322	213
55	-	-	-	-	-	-	-	-	-	1,654	530
56	-	-	-	-	-	-	-	-	-	386	116
57	-	-	-	-	-	-	-	-	-	1,911	473
58	-	-	-	-	-	-	-	-	-	1,547	909
59	-	-	-	-	-	-	-	-	-	3,993	1,152
60	-	-	-	-	-	-	-	-	-	5,213	963
61	-	-	-	-	-	-	-	-	-	1,975	400
62	-	-	-	-	-	-	-	-	-	965	197
63	-	-	-	-	-	-	-	-	-	591	181

* Only City-level employment by industry data gathered for Culver City.

APPENDIX J
Acronyms and Glossary

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Abbreviation/Acronym	Definition
ACHP	Advisory Council on Historic Preservation
ADA	Americans with Disabilities Act of 1990, as amended
AHPA	Archaeological and Historic Preservation Act
APE	area of potential effect
Ballona Reserve	Ballona Wetlands Ecological Reserve
BMP	best management practice
CAA	Clean Air Act, as amended
CAAQS	California Ambient Air Quality Standards
Cal-IPC	California Invasive Plant Council
Cal/OSHA	California Occupational Safety and Health Administration
CDFW	California Department of Fish and Wildlife
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
Conceptual Plan	Ballona Wetlands Conceptual Habitat Restoration and Adaptive Management Plan
Corps	U.S. Army Corps of Engineers
CSLC	California State Lands Commission
CWA	Clean Water Act
dB	decibel
dBA	A-weighted decibel
DBH	Los Angeles County Department of Beaches and Harbors
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ESA	Endangered Species Act
I-405	Interstate 405; San Diego Freeway
IPM	Integrated Pest Management
LACDPW	Los Angeles County Department of Public Works
LACFCD	Los Angeles County Department of Public Works-Los Angeles County Flood Control District
LACVCD	Los Angeles County Vector Control District
LACWD	Los Angeles County Waterworks District
LADWP	City of Los Angeles Department of Water and Power
LAPD	City of Los Angeles Police Department
LARWQCB	Los Angeles Regional Water Quality Control Board
LEDPA	Least Environmentally Damaging Practicable Alternative
LEED	Leadership in Energy and Environmental Design
MLLW	Mean Lower Low Water
MSL	mean sea level
NAHC	Native American Heritage Commission
NAVD	National American Vertical Datum of 1988

Abbreviation/Acronym	Definition
NEP	National Estuary Program
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOA	notice of availability
NOAA	National Oceanic and Atmospheric Administration
NOC	Notice of Completion
NOI	notice of intent
NOP	notice of preparation
NPDES	National Pollution Discharge Elimination System
O&M	operations and maintenance
PDR	Preliminary Design Report
PMT	project management team
Regional Strategy	Regional Restoration Strategy
Reserve	Ballona Wetlands Ecological Reserve
RHA	Rivers and Harbors Act
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
SAC	Science Advisory Committee
SCAQMD	South Coast Air Quality Management District
SCC	State Coastal Conservancy
SHPO	State Historic Preservation Officer
SMBRC	Santa Monica Bay Restoration Commission
SoCalGas	Southern California Gas Company
SR	State Route
SR-90	State Route 90; the Marina Freeway
State	State of California
TMDL	total maximum daily load
U.S.	United States
USC	U.S. Code
USDA	U. S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
WRP	Southern California Wetlands Recovery Project
ZNE	zero net energy

Glossary

100-year flood
A stream flow caused by a discharge that is exceeded, on the average, only once in 100 years. A 100-year flood has a 1% chance of occurrence in any given year.

500-year flood
A flood that has a 0.2% change of occurring in any given year.

Acre foot
The amount of water necessary to cover an acre (43,560 sq. feet) to a depth of one foot, or 43,560 cubic feet, which is equivalent to 325,828 gallons.

Aggradation (of a stream channel bed)
When sediment supply is in excess of sediment-transport capacity, the stream bed elevation rises.

Air quality standard
The specified average concentration of an air pollutant in ambient air during a specified time period, at or above which level the public health may be at risk; equivalent to AAQS.

Alkalinity
The capability of a base element to neutralize acids. An example is lime added to lakes to decrease acidity.

Alluvial
Sediments deposited by flowing water.

Alluvium
Soil, sand, gravel, and other materials that have been transported and deposited by flowing water. An alluvial feature is formed by material that has been deposited by water.

Ambient air
Any unconfined portion of the atmosphere; the outside air.

Ambient noise level
Noise from sources, near and far. ANL constitutes the normal or existing level of environmental noise at a given location.

Aquifer
A permeable geologic unit, sand or gavel containing water and transmits it readily.

Attainment area
An area having air quality as good as or better than the national ambient air quality standards as defined in the Clean Air Act. An area may be an attainment area for one pollutant and a non-attainment area for others.

Average
As a measure, the sum of the measurements (over a specified period) divided by the number of measurements.

Average discharge
The average of all complete water years of record, whether or not they are consecutive. Average discharge is not published for less than 5 years of record. The term "average" is generally reserved for average of record and "mean" is used for averages of shorter periods, namely, daily mean discharge.

Backfill
Earth that is replaced after excavation.

Background level
The concentration of a substance in an environmental media (air, water, or soil) that occurs naturally or is not the result of human activities. In exposure assessment the concentration of a substance in a defined control area, during a fixed period of time before, during, or after a data-gathering operation.

Base flow
The fair-weather or sustained flow of streams; that part of stream discharge not attributable to direct runoff from precipitation, snowmelt, or a spring. Discharge entering streams channels as effluent from the groundwater reservoir. Also referred to as groundwater flow.

Baseline
A set of existing conditions against which change is to be described and measured.

Beach
The zone of unconsolidated material that extends landward from the low water line to the place where there is marked change in material or physiographic form, or to the line of permanent vegetation (usually the effective limit of storm waves). The seaward limit of a beach-- unless otherwise indicated-- is the mean low water line.

Bed forms
Local topographical interruptions to the uniformity of a channel bed occurring during the passage of a stream flow. Antidunes are an example of bed forms.

Bed load
Sediment particles resting on or near the channel bottom that are pushed or rolled along by the flow of water.

Berm
A narrow shelf, path, or ledge typically at the top or bottom of a slope; also, an earthen, mounded wall.

Best available control technology (BACT)
For any specific source, the currently available technology producing the greatest reduction of air pollutant emissions, taking into account energy, environmental, economic, and other costs.

Best management practice (BMP)
Methods that have been determined to be the most effective, practical means of preventing or reducing pollution from non-point sources.

Biodegradable
Capable of decomposing under natural conditions.

Biodiversity
Refers to the variety and variability among living organisms and the ecological complexes in which they occur. Diversity can be defined as the number of different items and their relative frequencies. For biological diversity, these items are organized at many levels, ranging from complete ecosystems to the biochemical structures that are the molecular basis of heredity. Thus, the term encompasses different ecosystems, species, and genes.

Biomass
All of the living material in a given area; often refers to vegetation.

Biota
Living organisms.

Brackish
Pertaining to water, generally estuarine, in which the salinity ranges from 0.5 to 17 parts per thousand by weight.

Channel lining
Artificial hardening of the sides and/or bed of a stream channel to prevent erosion. Concrete, soil cement and rock riprap are typical channel linings.

Clay soil
Soil material containing more than 40 percent clay, less than 45 percent sand, and less than 40 percent silt.

Cleared Strip
Vegetation area that is cleared or mowed annually.

Coastal block
Geologic term describing area adjacent to the coast, which may be faulted or fractured.

Coastal zone
Lands and waters adjacent to the coast that exert an influence on the uses of the sea and its ecology, or whose uses and ecology are affected by the sea. Also, coastal land under the jurisdiction of the California Coastal Act.

Colluvium
Rock detritus and soil accumulated at the foot of a slope.

Community
In ecology, an assemblage of populations of different species within a specified location in space and time. Sometimes, a particular sub-grouping may be specified, such as the fish community in a lake or the soil arthropod community in a forest.

Concentration
The relative amount of a substance mixed with another substance. An example is 5 ppm of carbon monoxide in air or 1 mg/l of iron in water.

Concentration point
A downstream convergence point for storm runoff in a drainage area. See Concentration Time.

Concentration time
The period of time required for storm runoff to flow from the most remote point of a drainage area to the outlet or point under consideration. Concentration time varies with depth of flow and channel condition.

Confined aquifer
An aquifer in which ground water is confined under pressure which is significantly greater than atmospheric pressure.

Conglomerate
Consolidated (sedimentary) stone composed primarily of large, gravel-sized particles.

Contaminant
Any physical, chemical, biological, or radiological substance or matter that has an adverse effect on air, water, or soil.

Contamination
Introduction into water, air, and soil of microorganisms, chemicals, toxic substances, wastes, or wastewater in a concentration that makes the medium unfit for its next intended use.

Corrosion
The dissolution and wearing away of metal caused by a chemical reaction such as between water and the pipes, chemicals touching a metal surface, or contact between two metals.

Corrosive
A chemical agent that reacts with the surface of a material causing it to deteriorate or wear away.

Criteria pollutants
The 1970 amendments to the Clean Air Act required EPA to set National Ambient Air Quality Standards for certain pollutants known to be hazardous to human health. EPA has identified and set standards to protect human health and welfare for six pollutants: ozone, carbon monoxide,

total suspended particulates, sulfur dioxide, lead, and nitrogen oxide. The term, “criteria pollutants” derives from the requirement that EPA must describe the characteristics and potential health and welfare effects of these pollutants. It is on the basis of these criteria that standards are set or revised.

Decibel (dB)
A logarithmic unit that describes the wide range of sound intensities to which the human ear is sensitive.

Decibel A-weighted (dBA)
Decibel unit scale that is modified to better represent the relative insensitivity of the human ear to low-pitched sounds.

Degradation (of a stream channel bed)
Lowering of streambed elevation, caused by sediment-transport capacity in excess of the sediment supply. Degradation can be long-term (after the passage of many stream flows) or short-term (caused by a single stream flow).

Diffusion
The movement of suspended or dissolved particles (or molecules) from a more concentrated to a less concentrated area. The process tends to distribute the particles or molecules more uniformly.

Diffusion model
A model, calculated by formula, graphs, or computer, that estimates the dilution of an air pollutant as it is carried downwind. The models are based on physical principles with various simplifications to aid solvability.

Discharge
Flow of surface water in a stream or canal or the outflow of ground water from a flowing artesian well, ditch, or spring. Can also apply to discharge of liquid effluent from a facility or to chemical emissions into the air through designated venting mechanisms.

Dredging
Removal of soils from the bottom of water bodies. Dredging activities may be subject to regulation under Section 404 of the Clean Water Act.

Ecology
The relationship of living things to one another and their environment, or the study of such relationships.

Ecosystem
The interacting system of a biological community and its non-living environmental surroundings.

Effluent
Wastewater--treated or untreated--that flows out of a treatment plant, sewer, or industrial outfall. Generally refers to wastes discharged into surface waters.

Emission
Unwanted substances released by human activity into air or water.

Emission inventory
A listing, by source, of the amount of air pollutants discharged into the atmosphere of a community; used to establish emission standards.

Emission, primary
An emission that is treated as inert (non-reactive).

Emission, secondary
Unwanted substances that are chemical byproducts of reactive primary emissions.

Endangered species
Animals, birds, fish, plants, or other living organisms threatened with extinction by anthropogenic (man-caused) or other natural changes in their environment. Requirements for declaring a species endangered are contained in the Endangered Species Act.

Environmental Assessment (EA)
An environmental analysis prepared pursuant to the National Environmental Policy Act to determine whether a federal action would significantly affect the environment and thus require a more detailed environmental impact statement.

Environmental Impact Report (EIR)
A document required of state and local agencies by the California Environmental Quality Act for public or private projects that have the potential to significantly affect the physical environment.

Environmental Impact Statement (EIS)
A document required of federal agencies by the National Environmental Policy Act for major projects or legislative proposals significantly affecting the environment. A tool for decision making, it describes the positive and negative effects of the undertaking and cites alternative actions.

Environmentally superior alternative
Alternative selected by the CEQA lead agency that provides an overall environmental advantage over the other alternatives.

Erosion
The wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep.

Estuary
Widening area at seaward end of river where its current is met and influenced by ocean tides.

Ethnohistoric
Ethnological information collected during historic times, for instance, that from the Spanish mission registers.

Eutrophication
The slow aging process during which a lake, estuary, or bay evolves into a bog or marsh and eventually disappears. During the later stages of eutrophication the water body is choked by abundant plant life due to higher levels of nutritive compounds such as nitrogen and phosphorus. Human activities can accelerate the process.

Exotic species
A species that is not indigenous to a region.

Fault
A fracture or zone of fractures in rock strata which have undergone movement that displaces the sides relative to each other, usually in a direction parallel to the fracture. Abrupt movement on faults is a cause of most earthquakes.

Fauna
Animals or animal life.

Fill
Man-made deposits of natural soils or rock products and waste materials.

Flood capacity
The flow carried by a stream or floodway at bankfull water level. Also, the storage capacity of the flood pool at a reservoir.

Flood frequency
A statistical expression or measure of how often a hydrologic event of a given size or magnitude should, on an average, be equaled or exceeded. For example, a 50-year frequency flood (2 percent change of occurrence) should be equaled or exceeded, on the average, once in 50 years.

Floodplain
A strip of relatively smooth land bordering a stream, built of sediment carried by the stream and dropped in the slack water beyond the influence of the swiftest current. The lowland that borders a stream or river, usually dry but subject to flooding.

Flora
Plants or plant life.

Freeboard
Vertical distance from the normal water surface to the top of a confining wall.

Fugitive dust
Airborne pulverized soil particles.

Geomorphology
The geographical study of the form of the earth. Geomorphic means of or pertaining to the shape of the earth or its topographic features.

Ground water
The supply of fresh water found beneath the Earth's surface, usually in aquifers, which supply wells and springs.

Habitat
The place where a population (e.g., human, animal, plant, microorganism) lives and its surroundings, both living and non-living.

Hazardous substance
Any material that poses a threat to human health and/or the environment. Typical hazardous substances are toxic, corrosive, ignitable, explosive, or chemically reactive. Also, any substance designated by EPA to be reported if a designated quantity of the substance is spilled in the waters of the U.S. or is otherwise released into the environment.

Hazardous waste
By-products of society that can pose a substantial or potential hazard to human health or the environment when improperly managed. Possesses at least one of four characteristics (ignitability, corrosivity, reactivity, or toxicity), or appears on special EPA lists.

Herbicide
A chemical pesticide designed to control or destroy plants, weeds, or grasses.

Herbivore
An animal that feeds on plants.

Hydraulic analysis
A mathematical evaluation of the capacity of a flood control channel or river to convey flow. The evaluation is typically prepared by applying the laws of physics to compute the flow depth along the channel or river for a given rate of flow. The calculations account for the size and shape of the channel cross section, the slope of the channel or river, and the flow resistance caused by the material comprising the channel boundary, as well as by obstructions such as bridges and vegetation. The computed flow depths are compared to the depth of channel or the height of a levee along the river to determine the peak rate of flow, in cubic feet per second, that the channel or river can convey without overflowing.

Hydrocarbons
Compounds composed principally of carbon and hydrogen; they occur in petroleum, natural gas, coal, and bitumens.

Hydrocarbons, nonmethane
Mixture or concentration of hydrocarbons with the methane fraction ignored. One of many formulations for reactive hydrocarbons.

Hydrocarbons, reactive
Mixture or concentration of hydrocarbons with fraction assumed to be nonreactive removed from consideration. See VOC.

Hydrogeological cycle
The natural process recycling water from the atmosphere down to (and through) the earth and back to the atmosphere again.

Hydrogeology
The geology of ground water, with particular emphasis on the chemistry and movement of water.

Hydrologic cycle
Movement or exchange of water between the atmosphere and earth.

Hydrology
The science dealing with the properties, distribution, and circulation of water.

Igneous
Igneous refers to a type of rock that is formed from the cooling and solidification of molten rock. Molten rock (magma) is produced due to the high internal core temperature of the earth. Upon cooling, magma becomes igneous rock. Granite and basalt are two common forms of igneous rock.

Infiltration
The penetration of water through the ground surface into sub-surface soil or the penetration of water from the soil into sewer or other pipes through defective joints, connections, or manhole walls.

Infiltration rate
The quantity of water that can enter the soil in a specified time interval.

Inventory, emission
A list of daily or annual emissions, listed by pollution source category (e.g., trains, refineries, agriculture, etc.).

Invertebrate
Animals that lack a spinal column.

Leachate
Water that collects contaminants as it trickles through wastes, pesticides or fertilizers. Leaching may occur in farming areas, feedlots, and landfills, and may result in hazardous substances entering surface water, ground water, or soil.

Leaching
The process by which soluble constituents are dissolved and filtered through the soil by a percolating fluid.

Limnology
The study of the physical, chemical, hydrological, and biological aspects of fresh water bodies.

Liquefaction
The process of making or becoming liquid (soils).

Lithology
Mineralogy, grain size, texture, and other physical properties of granular soil, sediment, or rock.

Local scour
Lowering of a channel bed as a result of a local disturbance to flow, such as bridge piers, a sudden drop or a sharp channel bend.

Low flow
Low rate of water flow due to scant rainfall and low runoff.

Low-flow channel
Formation of a local, small channel inside a larger stream channel as a result of low-discharge flows.

Macroinvertebrate
Pertaining to invertebrates that are visible to the naked eye.

Maintained Vegetation.
Vegetation group comprised of wetland (bulrush, sedges, and cattails), and riparian (willows, mulefat, cottonwood, and sycamore trees) vegetation allowed to mature undisturbed within the flow conveyance zone, but would be managed as indicated in the plan for annual and rotational clearing. Sediment may need to be cleared periodically.

Marsh
A type of wetland that does not accumulate appreciable peat deposits and is dominated by herbaceous vegetation. Marshes may be either fresh or saltwater, tidal or non-tidal.

Maximum probable flood
The largest flood for which there is any reasonable expectancy.

Median
The mid-value is a series of values, with half having greater value and half lower value. To be distinguished from “average.”

Metamorphic
Metamorphic refers to rocks that have been altered from their original form by heat and pressure.

Methane
A colorless, nonpoisonous, flammable gas created by anaerobic decomposition of organic compounds. A major component of natural gas used in the home.

Microclimate
Distinctive climate within a small geographic area.

Micron
One millionth of a meter.

Mobile source
Any non-stationary source of air pollution such as cars, trucks, motorcycles, buses, airplanes, and locomotives.

Monitoring station
A mobile or fixed site equipped to measure instantaneous or average ambient air pollutant concentrations.

National Ambient Air Quality Standards (NAAQS)
Standards established by EPA that apply for outdoor air throughout the country.

National Pollutant Discharge Elimination System (NPDES)
A provision of the Clean Water Act which prohibits discharge of pollutants into waters of the United States unless a special permit is issued by EPA, a state, or, where delegated, a tribal government on an Indian reservation.

National Priorities List (NPL)
EPA's list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action under Superfund. The list is based primarily on the score a site receives from the Hazard Ranking System. EPA is required to update the NPL at least once a year. A site must be on the NPL to receive money from the Trust Fund for remedial action.

Navigable waters of the United States
Navigable waters of the United States generally include those waters of the United States that are subject to the ebb and flow of the tide shoreward to the mean high water mark, and/or are presently used, or have been used in the past, or may be susceptible to use to transport interstate or foreign commerce (33 CFR 322.2).

New Source Review (NSR)
A Clean Air Act requirement that State Implementation Plans must include a permit review that applies to the construction and operation of new and modified stationary sources in nonattainment areas to ensure attainment of national ambient air quality standards.

Nitrate
A compound containing nitrogen that can exist in the atmosphere or as a dissolved gas in water and which can have harmful effects on humans and animals. Nitrates in water can cause severe illness in infants and domestic animals. A plant nutrient and inorganic fertilizer, nitrate is found in septic systems, animal feed lots, agricultural fertilizers, manure, industrial waste waters, sanitary landfills, and garbage dumps.

Nitrogen oxides
A gaseous mixture of nitric oxide (NO) and nitrogen dioxide (NO2) and symbolically represented as NO3.

Noise level, median
The level of noise exceeded 50 percent of the time. Usually specified as either the daytime or the nighttime median noise level. Also given the designation L50.

Non-attainment area
Area that does not meet one or more of the National Ambient Air Quality Standards for the criteria pollutants designated in the Clean Air Act.

Non-point sources
Diffuse pollution sources (i.e., without a single point of origin or not introduced into a receiving stream from a specific outlet). The pollutants are generally carried off the land by storm water. Common non-point sources are agriculture, forestry, urban, mining, construction, dams, channels, land disposal, saltwater intrusion, and city streets.

Nourishment
The process of replenishing a beach. It may be brought about naturally by longshore transport, or artificially by the deposition of dredged materials.

Nutrient
Any substance assimilated by living things that promotes growth. The term is generally applied to nitrogen and phosphorus in wastewater, but is also applied to other essential and trace elements.

Organic
Referring to or derived from living organisms. In chemistry, any compound containing carbon.

Organic chemicals/compounds
Naturally occurring (animal or plant-produced or synthetic) substances containing mainly carbon, hydrogen, nitrogen, and oxygen.

Organic matter
Carbonaceous waste contained in plant or animal matter and originating from domestic or industrial sources.

Organism
Any form of animal or plant life.

Outfall
The place where effluent is discharged into receiving waters.

Oxidant
A mixture of chemically oxidizing compounds formed from ultraviolet stimulated reactions in the atmosphere, with ozone a principal fraction.

Ozone
A molecule of three oxygen atoms -- O3. A principal component of “oxidant” in photochemically polluted atmospheres.

Particulate matter (particulates)
Very fine sized solid matter or droplets, typically averaging one micron or smaller in diameter. Also called “aerosol.”

Peak flow
The maximum instantaneous discharge of a stream or river at a given location. It usually occurs at or near the time of maximum stage.

Perched water
Zone of unpressurized water held above the water table by impermeable rock or sediment.

Percolation
The movement of water downward and radially through subsurface soil layers, usually continuing downward to ground water. Can also involve upward movement of water.

Photochemical pollutant
Reactive organic compounds (ROC) and nitrogen oxides (NOx), photochemical pollutants that absorb energy from the sun and react chemically to form ozone (O3).

Point source
A stationary location or fixed facility from which pollutants are discharged; any single identifiable source of pollution; e.g., a pipe, ditch, ship, ore pit, factory smokestack.

Pollutant
Generally, any substance introduced into the environment that adversely affects the usefulness of a resource or the health of humans, animals, or ecosystems.

Preferred alternative
Alternative selected by the NEPA lead agency considering all environmental and economic information associated with the project and alternatives.

Proposed Action
Plan that contains sufficient details about the intended actions to be taken, or that will result, to allow alternatives to be developed and its environmental impacts analyzed (40 CFR §1508.23). This EIS/EIR refers to Alternative 1 as the “Proposed Action” because it is the proposal described in CDFW’s and LACDPW’s permit applications to the Corps. However, use of this term does not in any way indicate the Lead Agencies’ preference for Alternative 1. Rather, the term is used to facilitate the discussion and comparison of Alternatives 1 through 4 as presented

in this EIR/EIS. As an informational document, an EIS/EIR does not recommend approval or denial of any specific alternative.

Recharge
The process by which water is added to a zone of saturation, usually by percolation from the soil surface; e.g., the recharge of an aquifer.

Reservoir
Any natural or artificial holding area used to store, regulate, or control water.

Return frequency
A measure of the how often a given event, such as a flood, is expected to occur. The term refers to the period of time during which the magnitude of a flood is expected to be equaled or exceeded only once, on the average. For example, the 100-year flood is expected to be equaled or exceeded only once every hundred years, on the average. Also known as flood frequency, recurrence frequency, or return interval. The same measure can also be expressed in terms of either probability or percent chance of occurrence. For example, the 100-year flood has a probability of 0.01, or a 1 percent chance, of being equaled or exceeded in any given year. Mathematically, the probability of occurrence is equal to one divided by the return frequency; for example, the probability of the 100-year flood is 1 divided by 100, or 0.01.

Riparian
Area along the banks of a river or lake supporting specialized plant and animal species.

Rip rap
A protective layer or facing of quarry-stone, usually well graded within wide size limit, randomly placed to prevent erosion, scour, or sloughing of an embankment of bluff; also the stone so used. The quarry-stone is paced in a layer at least twice the thickness of the 50 percent size, or 1.25 times the thickness of the largest size stone in the gradation.

River basin
The land area drained by a river and its tributaries.

Salinity
The percentage of salt in water.

Sediment yield
The quantity of sediment arriving at a specific location.

Sedimentation
Letting solids settle out of wastewater by gravity during treatment.

Sediment
Soil, sand, and minerals washed from land into water, usually after rain. They pile up in reservoirs, rivers and harbors, destroying fish and wildlife habitat, and clouding the water so that

sunlight cannot reach aquatic plants. Careless farming, mining, and building activities will expose sediment materials, allowing them to wash off the land after rainfall.

Sedimentary
Sedimentary refers to a type of rock that is formed by the consolidation of rock particles. These particles are usually transported from their source by forces of erosion, such as wind, water, and glaciers. Over time, the particles become cemented or consolidated into rock. Shale and sandstone are two forms of sedimentary rock.

Seedbank
The layer of topsoil containing native plant seed material, which is frequently used as a "seed bank" for revegetation of native plants.

Seismicity
The relative frequency and distribution of earthquakes.

Senescence
The aging process. Sometimes used to describe lakes or other bodies of water in advanced stages of eutrophication. Also used to describe plants and animals.

Sensitive receptor
That segment of the population that because of age or weak health is more susceptible to the effects of air pollution, noise, oil spill, etc., than the population at large.

Shrink-swell potential
The expansion or contraction of primarily clay-rich soils during alternating wetting and drying cycles.

Silt
Sedimentary materials composed of fine or intermediate-sized mineral particles.

Slough
A place of deep mud or mire; bog. A stagnant swamp, backwater, bayou inlet, or pond in which water backs up.

Standard project flood (SPF)
The flood that may be expected from the most severe combination of meteorological and hydrological conditions considered reasonably characteristic of the geographical area in which the drainage basin is located, excluding extremely rare combinations.

Stationary source
A fixed-site producer of pollution, mainly power plants and other facilities using industrial combustion processes.

Stream scour
Lowering of a streambed during the passage of a single stream flow. Stream scour can be local in nature or more widespread.

Substrate
Geologic term describing soil or geologic layers underlying a project site or construction area.

Sulfates
Compounds in air or water that contain four oxygen atoms for each sulfur atom. See SOx.

Sulfur oxides
A gaseous mixture of sulfur dioxide (SO2) and sulfur trioxide (SO3) and symbolically represented as SOx. Can include particulate species such as sulfate compounds (-SO4).

Surface water
All water naturally open to the atmosphere (rivers, lakes, reservoirs, ponds, streams, impoundments, seas, estuaries, etc.).

Terrestrial
Related to or living on land. Terrestrial biology deals with upland areas as opposed to shorelines or coastal habitats.

Thalweg
The lowest thread along the axial part of a valley or stream channel.

Topography
The physical features of a surface area including relative elevations and the position of natural and man-made (anthropogenic) features.

Toxic substance
A chemical or mixture that may present an unreasonable risk of injury to human or animal health or the environment.

Transpiration
The process by which water vapor is lost to the atmosphere from living plants. The term can also be applied to the quantity of water thus dissipated.

Turbidity
Cloudiness or muddiness of water or ocean, resulting from suspended or stirred up particles.

Vector
An organism, often an insect or rodent, that carries disease.

Vehicle miles traveled (VMT)
A measure of the extent of motor vehicle operation; the total number of vehicle miles traveled within a specific geographic area over a given period of time.

Wastewater
The spent or used water from a home, community, farm, or industry that contains dissolved or suspended matter.

Water table
The sub-surface elevation of groundwater.

Watershed
The land area that drains into a stream; the watershed for a major river may encompass a number of smaller watersheds that ultimately combine at a common point.

Weir
A wall or plate placed in an open channel to measure the flow of water.

Wetland
Lands transitional between upland and aquatic environments. Wetlands are generally highly productive environments with abundant fish, wildlife, aesthetic, and natural resource values. For this reason, coupled with the alarming rate of their destruction, they are considered valuable resources, and several regulations and laws have been implemented to protect them.

Wetland Vegetation
Vegetation group consisting of flexible vegetation, bulrush, sedges, cattails, mulefat, and other species, that would easily bend over with water flow, usually less than ½ inch diameter.

Zooplankton
Microscopic marine/aquatic animals generally carried within a water mass.

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